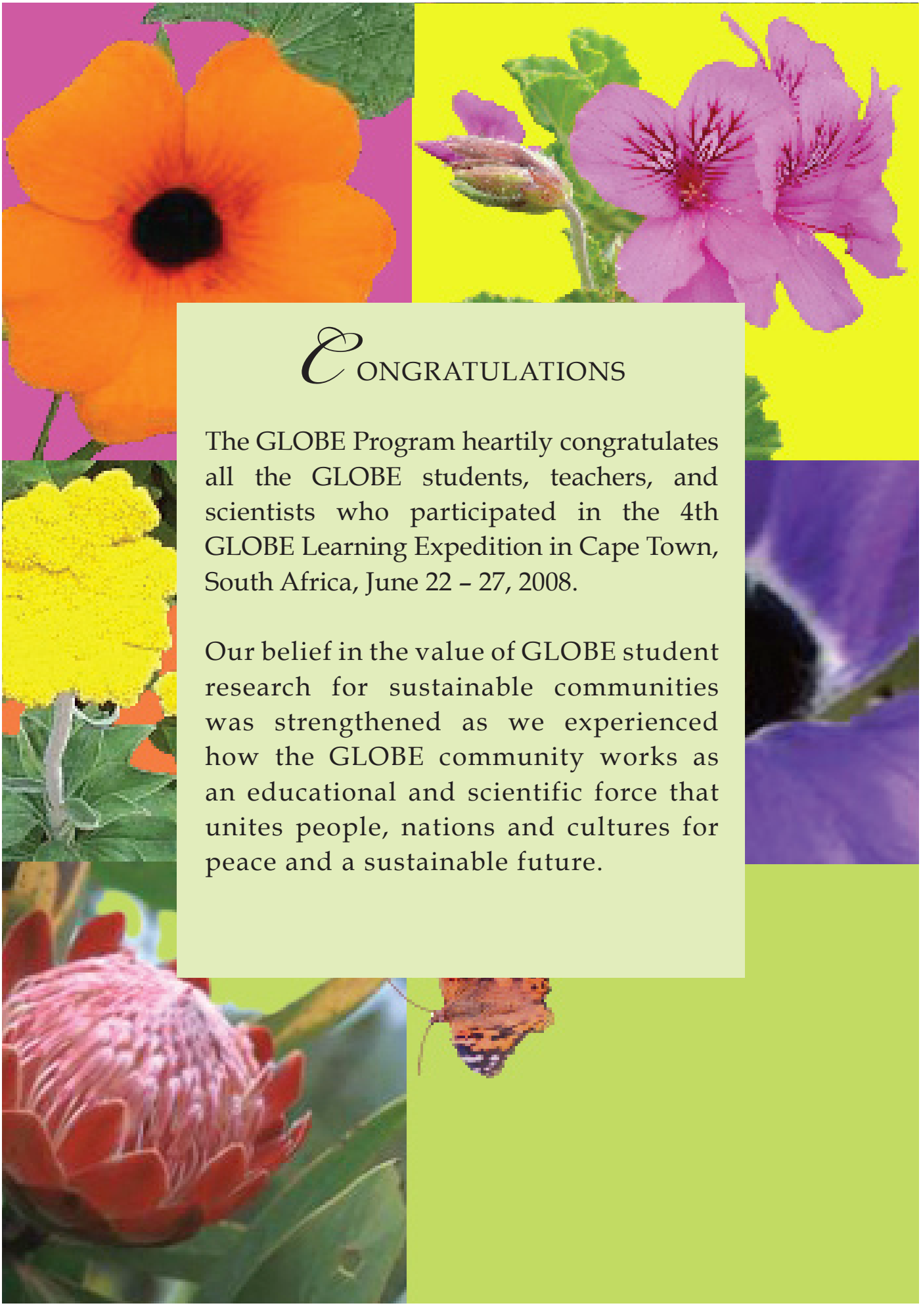
GLOBE Learning Expedition

22 - 27 June 2008

GLOBE Student Research for Sustainable Communities

Cape Town, South Africa

Proceedings

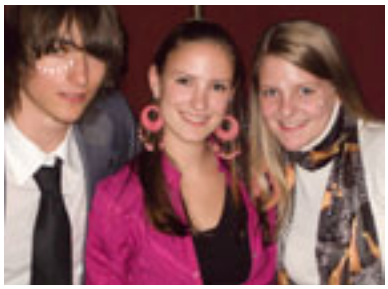


CONGRATULATIONS

The GLOBE Program heartily congratulates all the GLOBE students, teachers, and scientists who participated in the 4th GLOBE Learning Expedition in Cape Town, South Africa, June 22 – 27, 2008.

Our belief in the value of GLOBE student research for sustainable communities was strengthened as we experienced how the GLOBE community works as an educational and scientific force that unites people, nations and cultures for peace and a sustainable future.

Table of Contents



Globe Program Overview 2

Acknowledgments..... 3

Conference Overview 4

GLE 2008 Delegation Sponsors..... 5

Conference Agenda..... 6

GLE 2008 Sponsors 8

Student Speakers..... 9

Student Research by Country..... 13

Conference Participants 233

The GLOBE Program Overview

Announced in 1994, GLOBE (Global Learning and Observations to Benefit the Environment) began operations on Earth Day 1995. GLOBE is a worldwide, hands-on, inquiry-based primary and secondary school science and education program. GLOBE observations and measurements include atmosphere and clime, hydrology, land cover and phenology, and soils. GLOBE students, teachers and scientists collaborate on inquiry-based investigations of the environment and the Earth system, working in close partnership with NASA and NSF Earth System Science Projects (ESSPs), on research topics related to the carbon cycle, watersheds, seasons and biomes and extreme environments. Understanding the Earth as an interconnected system is at the core of the GLOBE Program.

"GLOBE is the quintessentially ideal program for involving kids in science."

-Nobel Laureate Dr. Leon Lederman

The GLOBE Program is implemented through a worldwide network of primary and secondary schools. GLOBE students:

- Take environmental measurements at or near their schools using GLOBE measurement protocols and appropriate, calibrated measurement equipment.
- Report their observations to the GLOBE database via the GLOBE Web site or email.
- Use tools on the GLOBE Web site to create maps and graphs from their own data, to analyze GLOBE data sets, and to share their data with other schools around the world.
- Conduct real research in collaboration with scientists and other GLOBE students worldwide.

Over a million GLOBE students in more than 20,000 schools located in over 110 countries have reported over 18 million measurements in the areas of Atmosphere/Climate, Hydrology, Soils, Land Cover/Biology and Phenology. GLOBE improves student understanding by involving students in conducting real science – taking measurements, analyzing data, and participating in research collaborations with other students, as well as with scientists engaged in cutting-edge Earth Systems Science research.

Broad international participation is an integral part of the GLOBE Program. Bilateral agreements establish partnerships between the United States and its international partner countries, which are then responsible for designing program implementation in their own countries. Implementation in the United States depends upon the efforts of more than 100 state and local partner organizations. GLOBE is funded by the National Aeronautics and Space Administration (NASA) and the National Science Foundation (NSF), and supported by the U.S. Department of State, and implemented through a cooperative agreement between NASA and the University Corporation for Atmospheric Research (UCAR) in Boulder, Colorado. Colorado State University (CSU) in Fort Collins, Colorado, is a key partner in GLOBE, leading technical and Help Desk functions.

Visit the GLOBE Program at www.globe.gov

Acknowledgements

Dr. Emmett Wright — GLOBE Program Office, Co-Chair
Mrs. Margaret Besong — GLOBE Africa GIAC Representative, Co-Chair
Mr. Mark Brettenny — South Africa GLOBE, Co-Chair
Dr. Sheila Yule — GLE Coordinator
Dr. Peggy LeMone — GLOBE Chief Scientist

Mrs. Rogeline Brettenny — South Africa GLOBE
Ms. Alidjennatou Aliou Emmanuel — GLOBE Benin Country Coordinator
Ms. Diana Garasic — GLOBE Croatia Country Coordinator GLE Host 2003
Ms. Lynne Hehr — University of Arkansas - GLE Hostess, June 2000
Ms. Dana Votapkova — GLOBE Czech Republic Country Coordinator
Dr. Diola Bagayoko — Southern University and Texas A&M, USA
Dr. Raifu Durodye — North Lake College in Texas, USA
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Conference Overview

The 2008 GLOBE Learning Expedition was held in Cape Town, South Africa, 22 June through 27 June, 2008. The Learning Expedition is a GLOBE signature event which presents an opportunity for teams of GLOBE students from around the world to meet one another, learn together, present the results of their GLOBE student scientific research projects, and form collaborations for future research. Representatives from the following countries attended:

Argentina
Bahamas
Bahrain
Botswana
Cameroon
Canada
Chile
Congo
Croatia
Czech Republic
Denmark
Dominican Republic
Estonia
Ethiopia
Finland
France
Germany
Greenland
Guinea
Hungary
Iceland
India
Japan
Kazakhstan
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Lebanon
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Mali
Namibia
Netherlands
New Zealand
Niger
Nigeria
Poland
Puerto Rico
Qatar
Rwanda
Saudi Arabia
Senegal
South Africa
South Korea
Spain
Sri Lanka
Swaziland
Switzerland
Tanzania
Thailand
Trinidad and Tobago
Uganda
United States of America

The conference featured plenary and parallel sessions within a two-day research seminar entitled "Students Making a Difference through GLOBE Student Scientific Research." GLOBE students presented scientific projects within the following research strands:

- Health and the Environment
- Water Quality and Availability
- Regional Impacts of Climate Change
- Earth System Science Projects

In addition to the Student Research Seminar, activities included two days of field exploration and study/ Students enjoyed a Student Alumni Dinner, cultural presentations, and a final banquet at "MOYO", the place for an African continental feast and entertainment.

GLOBE Learning Expedition Delegations

Many thanks to the sponsors of our GLOBE Learning Expedition Delegations!

Country	School	Sponsors
Argentina	CEI "San Ignacio" - Fundacion Cruzada Patagonica	Capsa-Capex AES Argentina
Estonia	Tallinn Science Secondary School	Estonian Ministry of Education - Imbi Henno, Ülle Kikas Paide's City Council - Kersti Sarapuu, Edith Tänavots Paide Gymnasium - Vello Talviste Tallinn Secondary Science School - Gunnar Polma
Germany	IGS Franzsches Feld	SE-BS: BS-Energy Volkswagen
Greenland	GU Nuuk School	Nunafonden
Hungary	Bibó István High School	Oktatási és Kultúrális Minisztérium Arany Kapu Rt Pirtó-Vill Kft
United States	Motor City Model UN Club	D2 Abatement UAW Region 1A

Conference Agenda

Saturday, 21 June **PARTICIPANTS ARRIVE**	Sunday, 22 June **OPENING DAY**	Monday, 23 June **STUDENT RESEARCH SEMINAR**	Tuesday, 24 June **STUDENT RESEARCH SEMINAR**
6:30 – 8:30 Breakfast (dormitory residents)	7:00 – 9:00 Breakfast (dormitory residents) 7:30 – 12:30 Shuttles run between Dormitory and Upper Campus	6:30 – 8:00 Breakfast (dormitory residents) 7:30 – 8:00 Shuttles to Plenary	6:30 – 8:00 Breakfast (dormitory residents) 7:30 – 8:00 Shuttles to Plenary
8:00 – 18:00 Registration , travel & tours information desk open *Molly Blackburn Hall*	8:00 – 18:00 Registration , travel & tours information desk open *Molly Blackburn Hall* 8:00 – 12:00 Exhibit set-up *Leslie Hall*	8:30 – 10:00 Plenary Session *Jameson Hall* 10:30 – 12:00 Breakout Session 1 *Leslie Hall*	8:30 – 10:00 Plenary Session *Jameson Hall* 10:30 – 12:00 Breakout Session 3 *Leslie Hall*
	11:00 – 12:15 Lunch *Graça Machel Dining Hall*	12:00 – 13:15 Lunch and Exhibits *Leslie Hall*	12:00 – 13:15 Lunch and Exhibits *Leslie Hall*
	13:00 – 14:00 Logistics & safety briefing, all students and participants *Leslie Hall* 14:00 – 15:00 Students line up for procession *Outside Leslie Hall* 14:00 – 14:30 Logistics & safety briefing for chaperones, group leaders *Leslie Hall* 15:00 – 17:30 Opening Ceremony Parade of Students *Jameson Hall*	13:30 – 15:00 Breakout Session 2 *Leslie Hall* 15:15 – 16:30 Cultural Presentations *Jameson Hall* 16:30 – 17:00 Shuttles to dinner	13:30 – 15:00 Breakout Session 4 *Leslie Hall* 15:15 – 15:45 Field Day Preparation for Students *Jameson Hall* 15:15 – 17:00 Take down exhibits and posters 15:45 – 17:00 Shuttles to dinner
18:00 – 20:00 Dinner *Graca Machel Dining Hall*	17:30 – 18:30 Dignitary and Press Exhibit Viewing 17:30 – 18:30 Shuttles to Student Dinner 18:00 – 19:30 Student Dinner *Graça Machel Dining Hall* 18:30 -21:00 Dignitary Dinner (by invitation) *transport provided* 18:45 – 19:30 Shuttles to Student Icebreaker 20:00 – 22:00 Pre-Conference Student Icebreaker *Jameson Hall* 22:00 – 22:30 Shuttles to dormitory	17:00 – 18:30 Dinner *Graca Machel Dining Hall* 18:15 – 18:45 Shuttles to Cultural Presentations 19:00 – 22:00 Cultural Presentations *Jameson Hall* 22:00 – 22:30 Shuttles to Dormitory/Hotel	16:30 – 18:00 Dinner *Graca Machel Dining Hall* 18:00 – 18:30 Shuttles to Cultural Presentations 19:00 – 22:00 Cultural Presentations *Jameson Hall* 22:00 – 22:30 Shuttles to Dormitory/Hotel
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Student Speakers

Name: Achu Sandrine Ajei
School: Government Bilingual Practicing High School, Yaounde, Cameroon

Speech Excerpt: "Everyday my teacher, friends and I move to the meteorological site around noon and collect data on several environmental factors and at the end of every week we go to the GLOBE Regional resource centre to enter our data into the web site. Before joining the club I had no idea about how the computer functions or even how to use it, but today I know how it works, I can use it and comfortably send the data we have been collecting and also communicate with other GLOBE students around the world. I have gathered a lot of information about our local and global environment, climate change and other sciences from the internet. I am greatly encouraged to study even more because I have had practical lessons with GLOBE that have motivated me. … Today I stand here to encourage all students to be part of GLOBE because it will help them, to do science with fun and improve on their understanding of the Earth as a system. At home I try to teach my parents and my younger brother who is in primary school about GLOBE. My GLOBE teacher is already teaching us how to write projects on environmental issues around us, and I know that I will still learn more as we work together in GLOBE. I look forward to being a leader in the society of tomorrow."

Name: Samuel Naylor
School: ACS Beirut, Lebanon

Speech Excerpt:" Enter the GLOBE initiative! This body of students and teachers, leaders and scientists, has for over a decade been dedicated to providing the opportunity for people to grow through analysis and appreciation of the natural world. The purpose of this group as I see it is two fold: To be a vision for a new model of living, and secondly to be a voice for change! I would not be here were it not for the GLOBE program's indefatigable energy in drawing attention to the problems in our wasteful, ignorant lifestyles and providing an attractive example of how to live with greater awareness of the world around us. By providing a model of how to live an aware lifestyle, as well as making sustainability a point of focus, the GLOBE initiative has brought the program out of the classroom and into an economic reality. The message of change that GLOBE inspires in our individual lifestyles through involvement in the projects it supports are now being brought to the international scene by students and GLOBE participants, exercising the programs purpose: to be a vision and voice for reform. … Sustainability, I believe, is not a passing craze, nor a misguided attempt to save an irrevocably fallen world, but is the term that will define the twenty-first century. The paradigm shift from wasteful consumerism to sustainable development will be the change that characterizes the generation and will be amongst the greatest turning points in human history."

Name: Kanchanpreet Sohal
School: Kingsburg High School, California, USA

Speech Excerpt:"All of you in this room took part in an extensive science project following GLOBE protocols. You are the best of the best. You are dedicated students who are willing to go above and beyond if the opportunity presents itself. In front of me is the future. You will all play a role as leaders, either as leaders in your family, leaders in your community or leaders on a state and national level. It is up to us to become stewards of the planet, to build sustainable communities, and to continue our research efforts for the betterment of education and science. Through our collective efforts we can help keep the planet lush, fertile, beautiful and green for generations to come. I leave with this quote that seems somehow quite appropriate for this conference: "You are capable of more than you know. Choose a goal that seems right for you and strive to be the best, however hard the path. Aim high. Behave honorably. Prepare to be alone at times, and to endure failure. Persist! The world needs all you can give." (Edward O. Wilson)."

Name: Ashley Nicole Boardwine
School: St. Paul High School, Virginia, USA

Speech Excerpt:" GLOBE research has become a major part of my life. I was introduced to the process last summer, and my passion for improving the environment has greatly increased. I now take pride in recycling, conserving water, and even telling my family and friends about the GLOBE project. … I have graduated from St. Paul High School, but I have left a legacy for other students, demonstrating how GLOBE has impacted my life in so many ways. I have had the opportunity to present my local watershed, Wetlands Estonoa, at the Virginia School Board Association conference in Williamsburg, Virginia. I have attended and participated in the North American Association for Environmental Education Conference held in Virginia Beach. I have also learned to monitor my local watershed by testing turbidity, electrical conductivity, temperature, dissolved oxygen, pH balance, alkalinity, and nitrates. However, my greatest achievement is the privilege of standing before you today in South Africa representing GLOBE students all over the world. Never would I have thought that a young woman from deep southwestern Virginia would have such an honor. … GLOBE research is directly related to the creation of safe, healthy, livable communities."

Name: Nicolas Racedo
School: CEI San Ignacio, Argentina

Speech Excerpt:" In my school there are carried out activities of different natures, among the most outstanding: I work to field, covered low cultivation, intensive vegetable garden, raising of farm animals, elaboration of sweets and preserves, as well as we carry out works of scientific and environmental interest as analysis of floors, of waters, atmosphere measurements and recently phenology. … This way to continue carrying out these measurements that so much benefit us in daily situations linked to the agricultural activity that we carry out in the school and the generation of conscience on the care and preservation of the environment."

Name: Ada Abessolo Charlene Ryana
School: Government High School, Mvomeka'a, Cameroon

Speech Excerpt: "The studies were related to the observation and the protection of the Environment. Our work was mainly based on the Atmosphere and the Hydrology of our school neighbourhood. Let me confess that scientific material that we use makes the studies and the observations really practical. My Geography and Science teachers contributed to my motivation when I realised that some of their lessons had something to do with the GLOBE Program. As a matter of fact, these practical activities not only consolidated my knowledge in the related topics (Geography, Science) but also satisfied my requirements. So that I found myself involved in the fight for the preservation of our environment and humanitarian issues."

Name: Natasha Cerese Hope
School: Ramey Unit School, Puerto Rico, USA

Speech Excerpt: "Our GLOBE team concluded that the use of yard mulch on garden beds in the tropics does have a noticeable effect on both the soil moisture and the soil temperatures of the garden beds. The mulch not only lowered the temperatures of the soil and helped maintain high soil moisture levels but also helped lower the weed count. The experiment turned out to be highly beneficial for gardens in the tropics. From the previous conclusions using mulch for garden beds had several major advantages besides the obvious ones. In order to obtain mulch, we removed organic material and leaves that were destined for the landfill and put it to good use, which would inevitably decrease the percentage of waste being dumped in the over-filling landfills. The sustainable temperatures the leaf mulch provided would allow the growing season to be extended, which would ultimately cut down the importation of food from elsewhere. Furthermore, the amounts of fuel and energy that would normally be used to import would be conserved. Naturally this would be a small-scale solution to many issues with water shortages and such. Thinking on a world scale, the conservation and preservation would be astounding. "

Name: Lucsame Gruneck
School: Dara Academy, Thailand

Speech Excerpt:" People who do research will learn things they never knew before and therefore gain an advantage in life and help the world be a better place. So organizations like GLOBE will be in great demand for research for sustainable communities within counties around the world. … My GLOBE experiences over the last 7 years have helped me to develop a positive approach to research in many ways. First they have taught me how to be a team leader and work with my fellow students on various projects. GLOBE has helped me to better understand and appreciate the various aspects of nature. Research helps to solve problems that will benefit the environment."

Name: Papa Ibrahima Ndiaye
School: High School Seydina Limamoulaye, Senegal

Speech Excerpt:" Students use the computer to compile and process the data collected. This produces databases available to researchers and the entire education system. The GLOBE program should be integrated into the teaching of science for: Quality education; Sustainable development; ICTS in the teaching of science; the civilization of the third millennium! Dear GLOBE students around the word, let us combine our efforts and continue our research projects. Our successful results are being used as: Support materials for awareness campaigns on environment issues; Teaching aids in classroom; And materials to celebrate the World Environment Day! Let us mobilize behind the GLOBE program for sustainable development!"

Name: Ibrahim Ismael Al-Amro
School: Al-Thawra AL-Arabia School for Boys, Jordan

Speech Excerpt:" The GLOBE Program aims at spreading the environmental awareness between all people by means of its different programs, depending on gathering scientific information about all the environmental elements in all areas of this world. This information will be a main source on which we can depend to establish our scientific research and projects. By these projects, we can understand the state of our planet which is our first and last shelter. And we – the youth – are the future generation who will build the future and make the decisions about it. … It is our responsibility to fortify our efforts and arm ourselves with science and knowledge in order to build peaceful, effective as well as sustainable communities that participate in establishing healthy and clean environment for us and for the next generations."


Building Capacity
Through GLOBE Alumni

The effects of climatic change in the flows of the rivers Chimehuín, Malleo and Quilquihue and their relationship with the humidity of the steppe and "mallín" (wetland) land

Students: Ancalao, J. G.; Barria, R.C.; Fuentes, A. B.; Lagos, B. C.; Racedo, L. N. and Torres N. S.
School: 3º Polimodal, Argentina
Teachers: Prieto, A. B.; Bertossi, M. E.; Krumpholz, E. and Bubenick, L.

ABSTRACT
Water is a scarce resource in the Patagonian steppe, the use of which has increased due to population growth and this will continue with future urbanizations.

Taking into account the impacts of climatic change and the anthropic effects, the following questions arise: Is climatic change causing a decrease in the flow of the rivers Chimehuín, Quilquihue and Malleo? How is this global change affecting us to regional scale? Where does land humidity come from?

Hypothesis 1: The temperatures, thermal width, humidity, rains and subsiquent days without rains in the last years in Junín de los Andes do not coincide with the hottest years at a global scale.

Hypothesis 2: The flows of the rivers Chimehuín, Quilquihue and Malleo have been the same in the last years and they have not been affected by the hottest years at a global scale.

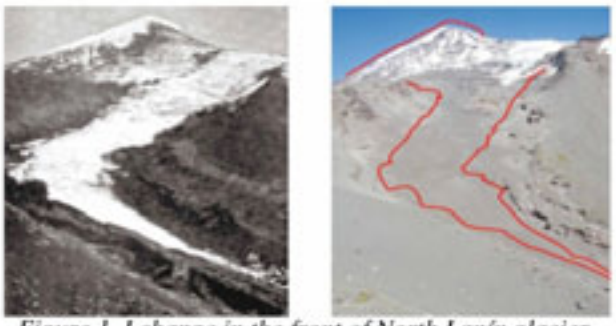

Figure 1. I change in the front of North Lanín glacier during the last 104 years. Pictures of: F. Moreno in 1896 (left) and Delgado, et.al.,2001 (right).

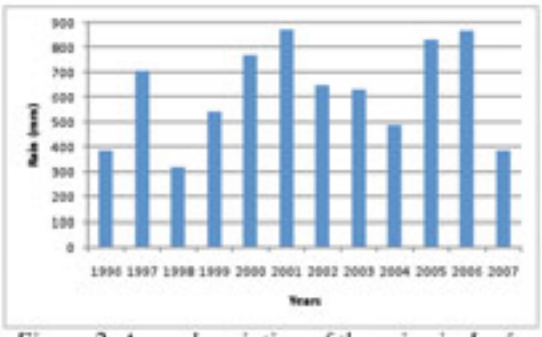

Figure 2. Annual variation of the rains in Junín de los Andes. (Coordination Office for Fire Management).

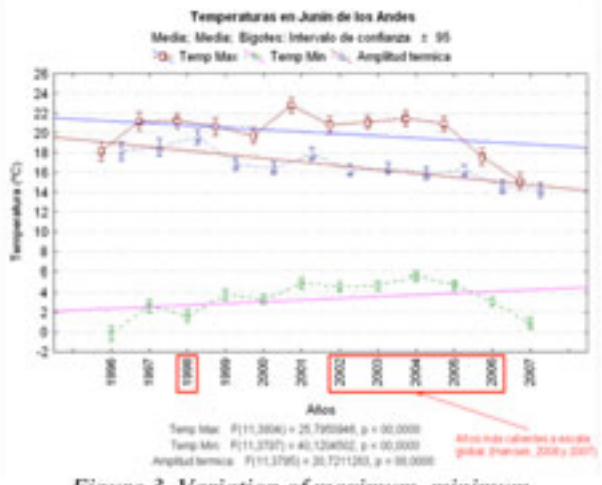

Figure 3. Variation of maximum, minimum temperatures and thermal width in Junín de los Andes.

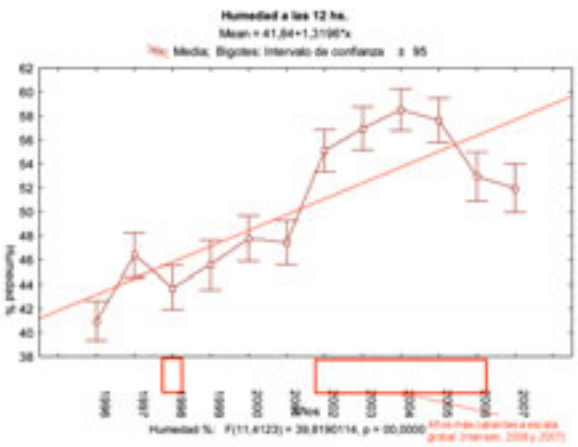

Figure 4. Humidity variation at 12.00 hs. in Junín de los Andes.

Hypothesis 3: The humidity of the steppe and "mallín" soil does not change with the rains, subsequent days without rains, the temperature, or the flow fluctuations of the river Chimehuín.

Seasonal measurements of land humidity were carried out, using GLOBE protocols, sampling: a) steppe, b) mallín. To detect evidences of climatic change meteorological data was used and data of the flows of the rivers Chimehuín, Quilquihue and Malleo (provided by government organisms) relating them with NOAA and NASA data about global changes.

Significant differences were detected in meteorological variables and in the flows coinciding with the hottest years at global level. Humidity of the steppe soil is related to local meteorological variables, while humidity of "mallines" is related to the river flow. If precipitations and flows diminish land erosion will increase.

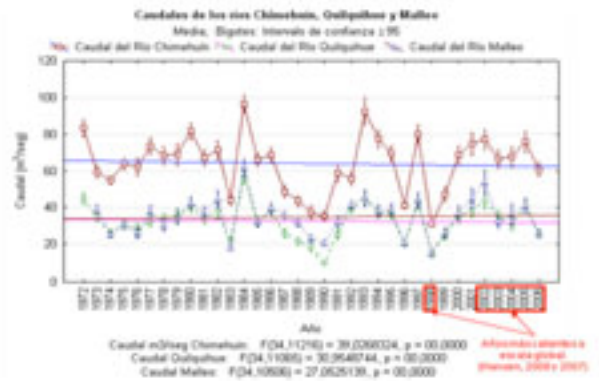

Figure 5. Flow variation of the rivers Chimehuín, Quilquihue and Malleo.

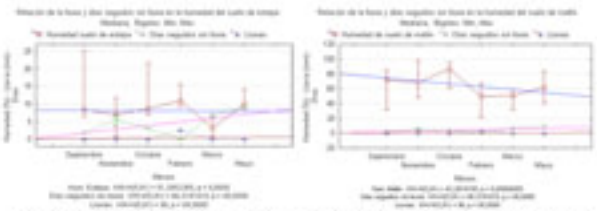

Figure 6. The relationship between soil moisture and steppe mallín with rain and days in a row without rain.

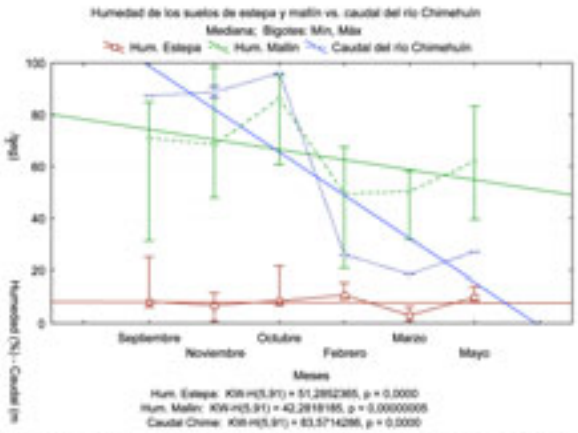

Figure 20. Relationship between humidity of steppe and "mallín" soils with the flow of the river Chimehuín.

Effects of the climatic change in the frequency and duration of the fires in the North of the Patagonia

Students: Castillo, E.; Huichaqueo, E. C.; Izaza, J. P.; Lefín, G. L.; Painemilla, L. M. and Reinao, S. D.
School: 3º Polimodal, Argentina
Teachers: Prieto, A. B.; Bertossi, M. E.; Krumpholz, E. and Davies, C.

ABSTRACT
The water is a scarce resource especially in summer in the steppe Patagonian when most of the fires occur. Its use is increased by the population's increase and it will continue with future urbanizations.

Considering the impacts of the climatic change added to the anthropic effects we ask ourselves: How are we being affected at a regional scale by global changes respecting the frequency of fires? Has the frequency and duration of the fires changed? How do the changes of the meteorological variables influence the meteorological index of danger of fires (FWI)?

Hypothesis 1: The temperatures, thermal amplitude, humidity, rains and followed days without rains in the last years in Junín of the Andes, don't coincide with the hottest years to global scale, neither with the events of the "El Niño" and "La Niña."

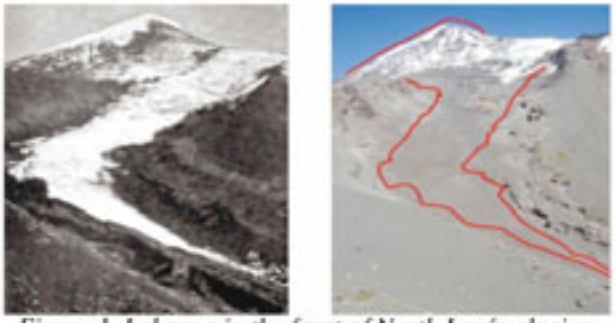

Figure 1. I change in the front of North Lanín glacier during the last 104 years. Pictures of: F. Moreno in 1896 (left) and Delgado, et.al.,2001 (right).

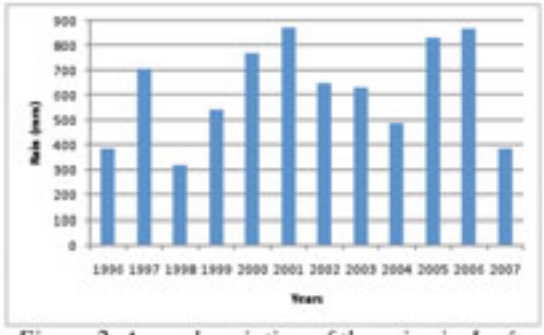

Figure 2. Annual variation of the rains in Junín de los Andes. (Coordination Office for Fire Management).

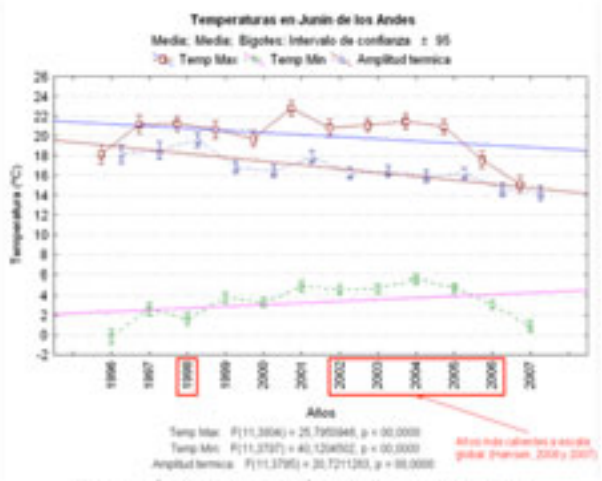

Figure 3. Variation of maximum, minimum temperatures and thermal width in Junín de los Andes.

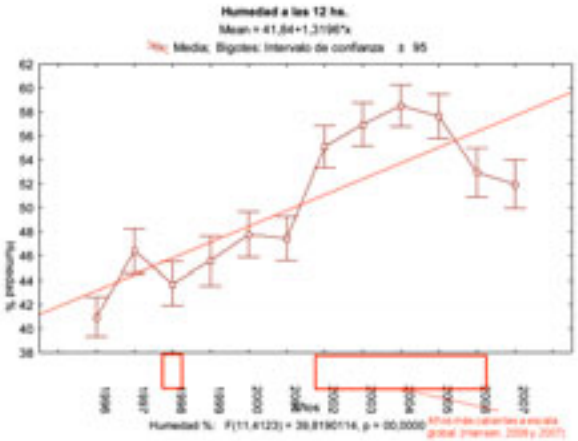

Figure 4. Humidity variation at 12.00 hs. in Junín de los Andes.

Hypothesis 2: The frequency and the duration of the fires have not changed in the last years.

Hypothesis 3: The FWI indicates the changes in the meteorological variables that can cause a fire.

Hypothesis 4: The fire season of has not changed in the last years.

Atmosphere measurements were carried out using the GLOBE protocol. So as to detect evidences of climatic change, meteorological data (provided by governmental organisms) were used relating them with NOAA and NASA data on global changes. Significant differences were detected in the meteorological variables and in the frequency of fires during the season which expanded until April inclusive, coinciding with the hottest years at global level. The month of October of 1998 has very significant differences with all the other ones, coinciding with the events "El Niño" and "La Niña" in the same year; as well as being one of the hottest years to global level.

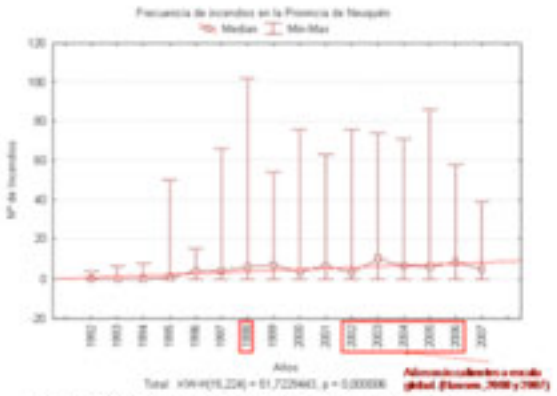

Figure 5. Changes in the frequency of fires in the Province of Neuquén

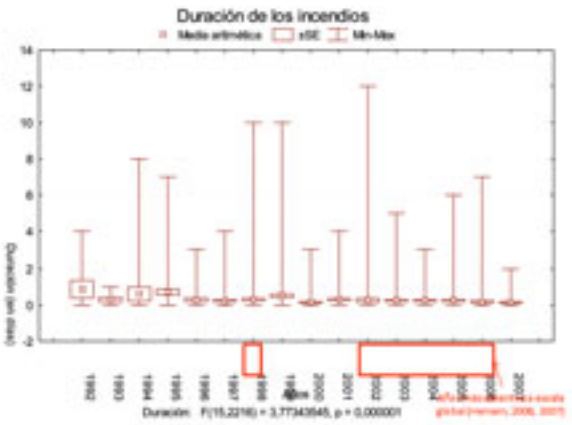

Figure 6. Duration of the fires.

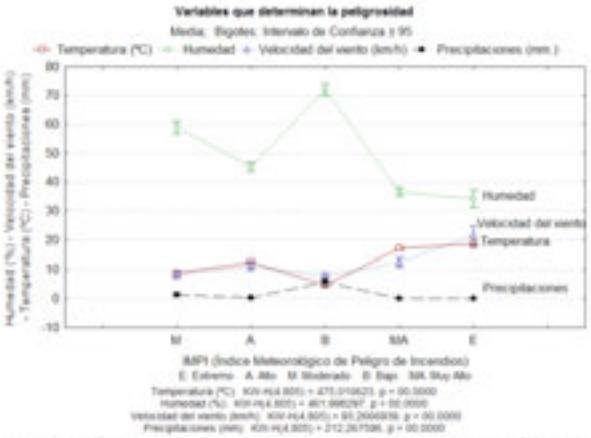

Figure 7. Incidence of the meteorological variables in the FWI of Junín of the Andes (Department Huiliches)

Figure 8. Fire Seasons in the region in different years.

Effects of climate change on water quality Chimehuín River. Junín de los Andes, Patagonia, Argentina

Students: Bergara, J.G.; Millain, R. A.; Painemilla, V.A.; Reinao, P. R. and Rojas, H. L.
School: 3º Polimodal, Argentina
Teachers: Prieto, A. B.; Bertossi, M. E.; Krumpholz E. and Matias, L. A.

ABSTRACT
The water of the river Chimehuín is used by people for human consumption, watering, recreation and sport fishing. Its use is increased by the population's rising and it will increase with the future urbanizations on its coasts.

Considering the impacts of the climatic change added to the anthropic effects we wonder about: where do we go to with the quality and quantity of water in our area? How is it affecting us at regional scale the changes at global level?

Hypothesis 1: The temperatures, thermal amplitude, humidity, rains and followed days without rains in the last years in Junín of the Andes don't coincide with the hottest years to global scale.

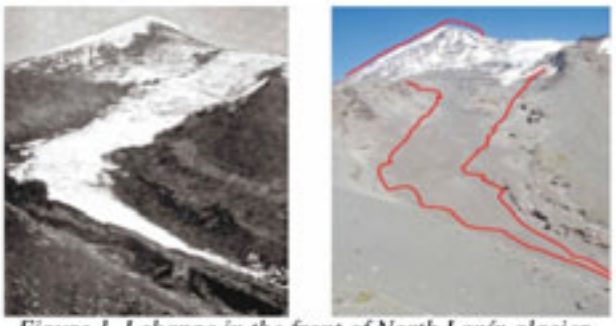

Figure 1. I change in the front of North Lanín glacier during the last 104 years. Pictures of: F. Moreno in 1896 (left) and Delgado, et.al.,2001 (right).

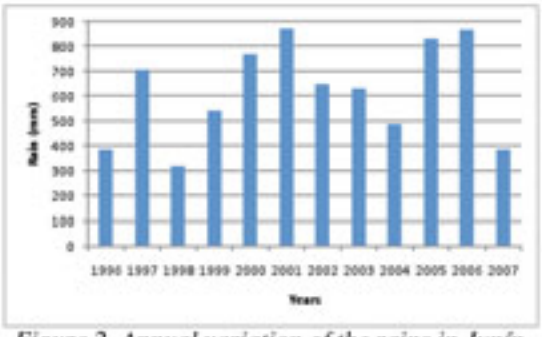

Figure 2. Annual variation of the rains in Junín de los Andes. (Coordination Office for Fire Management).

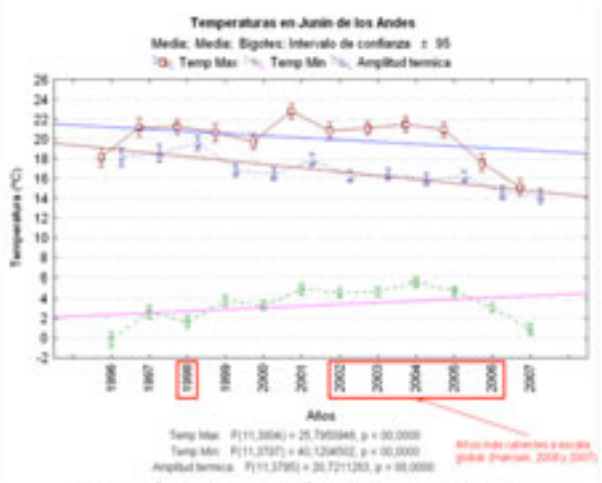

Figure 3. Variation of maximum, minimum temperatures and thermal width in Junín de los Andes.

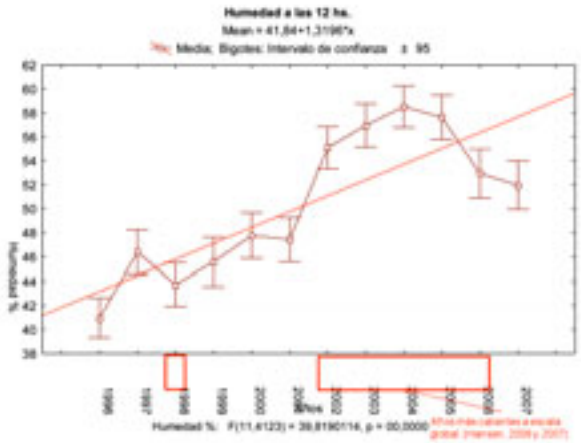

Figure 4. Humidity variation at 12.00 hs. in Junín de los Andes.

Hypothesis 2: The flows of the river Chimehuín are the same in the last years and they are not affected by the hottest years to global scale.

Hypothesis 3: The quality of the water doesn't change with the fluctuations of the flow of the river Chimehuín and in the watering channel.

Hypothesis 4: The quality of the water of the river Chimehuín has not changed in the last years.

Weekly measurements of quality of water were carried out from 2001 to 2007, using protocols GLOBE, showing: a) river b) a watering channel. To detect evidences of climatic change, meteorological data and flow of the river Chimehuín data (provided by government organisms) were used relating them with the NOAA data of the phenomenon ENSO and those of NASA of the hottest years at global level.

Significant differences were detected by means of the test Tukey(HDS) in the meteorological variables, in the flow and in the quality of the water coinciding with the hottest years at global level. If the flow of the river continued its tendency to get lower, the quality of the water would get lower resembling of the watering channel.

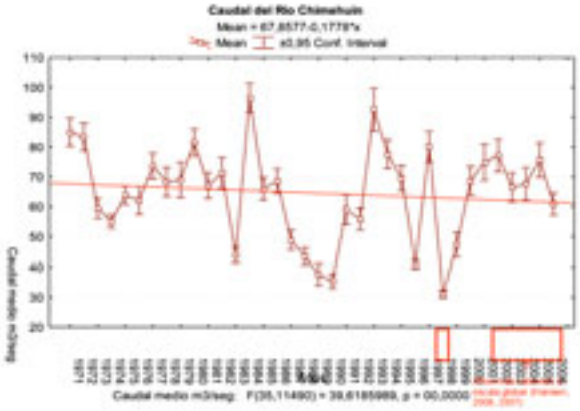

Figure 5. Variation of the flow of the river Chimehuín.

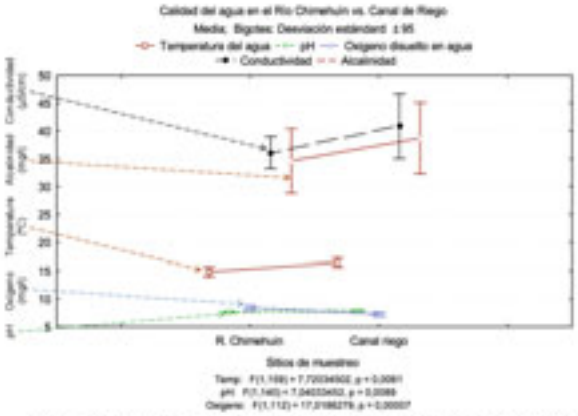

Figure 6. Comparison of the temperature, pH, dissolved oxygen, conductivity and alkalinity of the river Chimehuín and a watering channel.

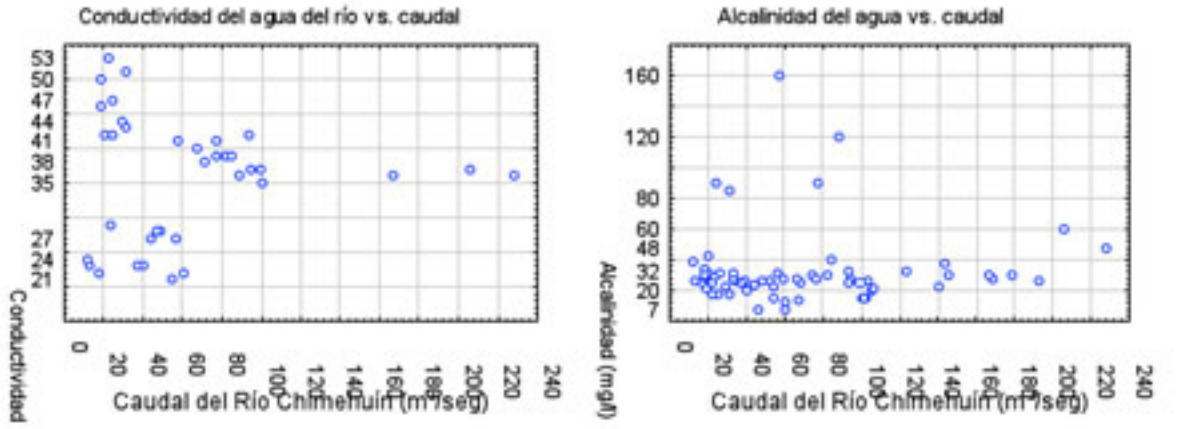

Figure 14. Variation of the conductivity and the alkalinity of the water of the river Chimehuín according to the fluctuations of their flow.

New green in PUJATO

School: Escuela Primaria Particular Incorporada Nº 1345 “Nuestra Señora del Carmen” de Pujato, provincia de Santa Fe, Argentina

ABSTRACT
This work was carried out from the Science Club Nº. 076 “Julio Maiztegui” (School No. 1345) of Pujato - Santa Fe.

This project seeks to respond to a local need: the reforestation of the town to benefit the local environment.

Most people are engaged in activities related to agriculture (cultivation, collection and transportation of grain). As a result of these activities, a variety of herbicides and pesticides are applied in plots located a few meters from the urban area; also felling of forests that formerly existed, to take place to cultivate soya (monoculture soya) or to increase urban fabric.

Moreover the low wooded public as well as their pruning indiscriminate could produce that Pujato turn in the near future, in a “heat island”.

All these aspects affect the local environment and quality of life for its inhabitants.

The aims from this project are study different species of trees, woody species and existent species with the phenology protocols.

To prevent the effect of island of heat the students intend to reforest areas of Pujato with the local government’s collaboration and the Association “Friends of the Tree”.

“Water that you haven’t to drink…” Quality of the water of a stream in Pujato’s rural zone

School: Escuela de Enseñanza Media N° 241 – Club de Ciencias “Dr. Bernardo Alberto Houssay” de Pujato, provincia de Santa Fe, Argentina

ABSTRACT
Students of the Club of Sciences N ° 136 “Houssay” (School N°241) of Pujato, of 9 ° year have determined, in May and June 2007, the quality of the waters of a stream that born in the locality, it is tributary of the Ludueña stream which flows into the Parana river, in Rosario.

The students work in field.

- observed of stream and area that surrounds it.
- examined flora and crops
- collected samples of flora and identified species.
- [a] drew sketches of the stream and its insertion in the Basin Ludueña.
- determined position with GPS.
- measured width, depth and water temperature.
- noted transparency, smell and appearance of water.
- collected sampled of water several days to determine pH, dissolved oxygen, presence of nitrate and presence of dissolved salts by conductivity.

Students observed, from the first sampled of water, a significant decrease in dissolved oxygen and the last sampled of water registered a high level of alkalinity, indicating that are altered environmental conditions. They determined that the salt content is very low and they did not find presence of nitrates.

An analysis showed that the bacteriological results are within the limits required for the provision of drinking water standards in the province of SantaFe.

In conclusion they can comment about the physical and chemical conditions, in moments studied, show a slight impact, temporary and recoverable of human action.

This study in the headwaters of a tributary of Ludueña stream stands as an important point of a preventive nature aimed at preventing future environmental conflicts.

The Economical Importance of the Safi Fish

School:
Shaikh Abdul Aziz Bin Mohammed Al Khalifa Boys Secondary School, Adleya 336 - Manama, Bahrain

In this research, we are to give some of the basic in information about a specific kind of fish, inhibiting our territorial waters.

The information, demonstrated in this paper work, was gathered from numerous resources such as internet websites, general meetings with either executives of the public commission for the protection marine resources, environment and wild life and, in contrary, some of the real life fishermen.

In addition, we made use of GLOBE protocols in our natural marine life in order for us to define it's characteristics and study the similarities between the local and the species in different countries around the world such as India, Thailand, Malaysia, Korea and Japan.

"Singus canaliculatus" is the scientific name of the fish usually known as "The White-Spotted Rabbitfish". It is basically found in shallow warm waters located between 30N. 20S, where the temperature ranges from 25 degrees C to 30 degrees C. The main source of nutrition for this kind of fish is basically the vegetation found in its respective habitats.

When it comes to the general outer look of the fish, you easily can notice that the fish has is grey and slightly big in size, compared to the other species in different parts of the world. Thus, the full-grown fish can weigh up to 250 grams and it could grow up to 18.5 cm in length. On the other hand, it is a member of the Bony Fish class, which is characterized with the broad, long, dorsal and anal spines.

These Spines are slightly poisonous but usually they cause no harm.

Apart from all that, The White Spotted-Rabbitfish is unisexual which means that there are two separated sexes "male and female" and it cannot reproduce intuitively without sexual activity with the opposite sex. However, the period of reproduction for this specific kind of fish is usually between March and June. The egg yielding from the sexual intercourse is distinctive in terms of adhesiveness; it can nearly stick on any nearby object or substance.

There are many disease inflict this species but mainly parasitic and bacterial threats are the most dangerous of which are the "Streptococcus sp" bacteria which deposit the chemical element mercury (hydrargymrum "Hg") in their bodies so it can be dangerous for humans to eat them because that element causes to sterility. Although, the fishing revenues don't contribute more than 0.3 % of the country's financial income which is a low portion compared with the world's fishing income, Fishing still has its huge importance for some families depending on it as a livelihood. Further more, Fish in general and the Rabbitfish specially have huge nutritional values, which make them a healthy affordable meal. However, the prices differ yearly due to the changing numbers of fish in the natural habitats and that could be emerged from either the illegal marine activities, that some of the fishing companies may use, or pollution.

After some scrutinizing local observations, we found that this kind of fish inhabits three geographical section of which the northern and eastern ones are the most important in terms of fishing because of the huge numbers of fish there. Local fishermen have their own techniques such as the Gill net, the hook and line, Haddrah and Gragoor. However, Haddrah is the best one of their techniques because it doesn't harm the caught fish and environment respectively.

FISH FARMING:
In Bahrain, the fish farming project was founded in 1998. The foremost aim of the program is deduced in experimenting on both the open free waters and the restricted waters such as in cultivating farms and cells, also it is related to the nutritional experiments on fish in order to increase the productivity for exporting.

The project was successful in cultivating and reproducing nearly half a ton of fish in 2001. Some of which were released in 2003 as small fish embryos in the water to make it up for the loss and lack of fish in the region.

There were many of setbacks that the project has encountered such as:

1. The Rabbitfish embryos are produced with their mouths shut and later on the open them so they need some food to live off which is not available in the gulf waters.
2. The emergence of some of the bacterial threats.

WATER PROTOCOLS:
Water protocols are used to specify the features of the territorial waters of Bahrain.

We have taken some specimens from different coastal parts of Bahrain which were Al hid, Sitra, Budaiya, Askar, Joe and Al nabeeh salah 's village, also, we have located their coordinates utilizing a GPS device. We, then, took the transparency and PH level. Finally we analyzed the specimens to determine their Oxygen capacity.

The table below shows the results we have got:

Budaiya	Al hid	Al Nabeeh Salah	Sitra	Askar	Jaw	Area
12	11.7	12.48	10.23	0.32	2.46	Timming
27.21155	26.22577	26.17155	26.17082	26.05430	25.99746	N
20031212	20051208	20061206	20031127	19971206	20001126	التاريخ
19,0822	6,4495	7,4597	35,1581	36,3500	14,5780	LAT
73,7459	79,6512	99,0127	136,0603	127,3400	120,9757	LON
788,3	118,9	44,9	48,7	120	45,2	ELV
EA6eAkM	tmZ8jSc	y4lFf9A	KsW1BMa	CSIPUAU	SkCJFP2	SCODE
SWS-01	SWS-01		SWS-01	SWS-01	SWS-03	SITE
212			126			wcon
	332		41			Walk
0,93 TC disk	92	104	98		Greater than 120	Transparency
22,3	28	28	15,3	10	29	Temp
	6,5	5,7	12,3		7,4	O2 capacity
9	7,1	7,7	8,2	7,8	8,2	PH

RESULTS ANALYSIS:

1. Bahrain is a small and populous country so that the prefect environmental habitats are so scarce.
2. The nature of the costs differs from one to the other.
3. The temperatures taken are different due to the difference in the taking time.
4. We can notice the difference in transparency, basically because of the stormy winds which usually agitate the sand on the seabed.
5. The oxygen levels are nearly similar everywhere except for Al hod Al Jaf where the oxygen level is low because of the heated water returned to the sea.
6. The Ph levels are entitled to the place taken from, they change as the place changes.

The following table demonstrates some of other countries GLOBE water protocols results with date of taken:

050.44568	050.66698	050.58049	050.627086	050.62040	050.62041	E
4m	4m	3 m	5 m	6m	5m	ALT
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	TRIP
india	srilanka	Thailand	JAPAN	Korea, South	Philippines	Area
9	8.7	9.48	7.23	0.32	11.46	GMT
Urban and populous	Urban and industrial	Urban and populous	Urban and populous	Urban and populous	urban and agricultural	Env
sand	rocky	rocky	muddy	sand	muddy	Beaches
Greater than 120	Greater than 120	67	85	Greater than 120	Greater than 120	transparency
24	25	20	21	22	22.3	Temp
1.37	1.35	1.31	1.35	1.33	1.35	Hydro meter
8	6.6	7	10	10	10	O2 capacity
7.8	7.1	6.7	7.8	8.1	8.2	PH

We inferred from the table above:

1. We have quite similar temperature to some of the above countries such as Philippines, Thailand, Sirlanka and India.
2. Due to the pollution in India, their Ph results show that their water has a low PH level.
3. In most countries the transparency is greater than 90.
4. The Oxygen capacity level in Japan is very great which substantiates the huge existence of vegetation under the water.

RECOMMENDATIONS:

1. It is important for the natural marine life to be using the cutting-edge technologies to solve the problems it encounters.
2. Supporting the fish numbers by putting embryos into water.
3. Enacting laws in order to increase the reproduction rates within the same species such can be helpful such as to refrain people from fishing in certain periods of time in which the fish usually reproduce.
4. Inspecting factories and companies for any law-breaking actions can be a troubleshooting contributor.
5. Setting some regulations to control the amount of waste dumped in the sea can be an essential elemeny.
6. Establishing Water reserves is a substantial techniques to increase the numbers of fish.

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3. ftp://ftp,fao,org/docrep/fao/009/ad468e/AD468eLY,pdf
4. http://www,alaswaq,net/articles/2007/07/13/9363,html
5. http://mekshat,com/vb/showthread,php?s=&threadid=17246
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7. http://www,globe,gov/r?lang=en&nav=1

The Influence of Atmospheric Conditions on the Prevalence of Endemic Malaria in Bamunka-Ndop Central Subdivision of the North West Province of Cameroon

Presented by: Atiomela Tsinda Yula Mitterand & Felix Njoghonyi of G.B.H.S NDOP, Cameroon
Supervised by: Afong George Nsoh (GLOBE Teacher)

ABSTRACT:
The project investigates the relationship that exists between the prevalence of malaria and rainfall, temperature & humidity variations in Bamunka. GLOBE Student atmospheric data for GBHS Ndop, (Located in Bamunka) from January to December 2005 was downloaded from the GLOBE website. The excel spreadsheet was then used to calculate the averages for each month, for current Temperature in degrees Celsius, Relative humidity in percentage, and Rainfall in millimeters. These averages for each atmospheric parameter per month were then correlated with hospital data from the Ndop district hospital, for the same period, on graphs.

From the results obtained, it can be concluded that, malaria is endemic in Bamunnka, and that temperature, rainfall and humidity, greatly influence its prevalence. The months of March, May and October provide the most optimum conditions for the transmission of malaria while April, June and September, provide the most unfavourable conditions for transmission. This information can be used in the planning and implementation of malaria control activities in the Ndop health District.

BACKGROUND:
Malaria is a major public health problem in Cameroon. Over 900,000 clinical cases occur yearly and are responsible for 40–45% hospital consultations, 20% hospital admissions and 35–40% deaths. Children less than five years old are the most affected. Despite efforts made by the National Malaria Control Programme to curb the disease burden, the prevalence is seemingly on the increase. Previous studies have attributed this to the increasing spread of drug resistance in the parasite, insecticide resistance in the vectors, inadequate and inconsistent allocation of resources for control and the presence of very efficient mosquito vectors of *Plasmodium falciparum*.

Malaria vector control activities in Cameroon focus mainly on the use of insecticide-treated bed nets. However, the implementation of effective malaria control strategies requires requisite information on the atmospheric conditions that enhance the life cycle of the vector. Previous studies in Cameroon have shown that the intensity and duration of transmission, as well as the vector species, vary greatly between different eco-zones of the country, from perennial transmission in the southern-forested regions to seasonal and unstable transmission in the northern Sudano-savannah and Sahelian savannah regions. At least 14 out of the 45 species of *Anopheles* described in Cameroon are capable of transmitting malaria.

In Bamunka, malaria is known to be more rampant during some specific periods of the year than at others. Caused by the parasitic protozoan called Plasmodium sp, the disease is spread by infected female anopheles mosquitoes when they bite humans to suck blood. The mosquito breeds in water in the presence of favorable atmospheric conditions such as temperature, humidity and rainfall. This gives us reason to appreciate the influence of atmospheric conditions on the prevalence of malaria in Bamunka.

Bamunka is the chief town of Ngoketunjia Division located at Latitude 06.1008 N and Longitude 10.270 E, at an elevation of 1172 metres (etrex-GPS Receiver). The population is approximately-----and the town is about 43kms from Bamenda. With a lot of swamps, Bamunka provides ideal breeding grounds for mosquitoes and hence a favourable area for malaria.

RESEARCH QUESTION:
Can atmospheric conditions such as temperature, humidity and rainfall, be integrated into active malaria surveillance in Bamunka? (i.e. can atmospheric conditions be used to develop a model for determining and controlling the spread of malaria in Bamunka ?)

HYPOTHESIS:
Atmospheric conditions such as temperature, humidity and rainfall can be used to determine the prevalence and spread of malaria in Bamunka.

MATERIALS AND METHOD:
The GLOBE program Website was used to download GLOBE Student atmospheric data for GBHS Ndop, from January to December 2005. The excel spreadsheet was then used to calculate the averages for each month, for current temperature in degrees Celsius, Relative Humidity in percentage, and Rainfall in millimeters. These averages for each atmospheric parameter per month were then correlated with hospital data from the Ndop district hospital, for the same period, on graphs. The hospital data consisted of the totals of hospitalizations for men, women and children, due to malaria, plus outpatients diagnosed for malaria. The Internet and some books were also used for literature review.

DATA SUMMARY:
TABLE 1: 2005 Malaria cases from Ndop District Hospital.

Months	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.
In-patients (male, Female & Children)	49	40	40	20	20	10	20	31	25	30	33	30
Out-patients (Male, Female & Children)	51	44	58	20	40	26	26	27	29	34	33	38
TOTALS	100	84	98	40	60	36	46	58	54	64	66	68

TABLE 2: 2005 Monthly Average Current temperatures, Rainfall and Relative Humidity.

MONTHS	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.
Average Current Temp.(°C)	27.9	29.8	29.2	29.8	28.2	27.2	26.5	25.7	26.9	27.4	30.3	29.8
Average Rainfall (mm).	0.12	1.2	4.6	5.5	5.8	5.9	5.7	7.7	6.1	4.1	0.4	0.0
Average Relative Humidity (%)	40.3	44.9	55.5	57.4	65.5	69.7	66.8	68.9	67.2	62.5	41.9	39.7

Figure 1. 2005 Relationship between temperature and malaria prevalence

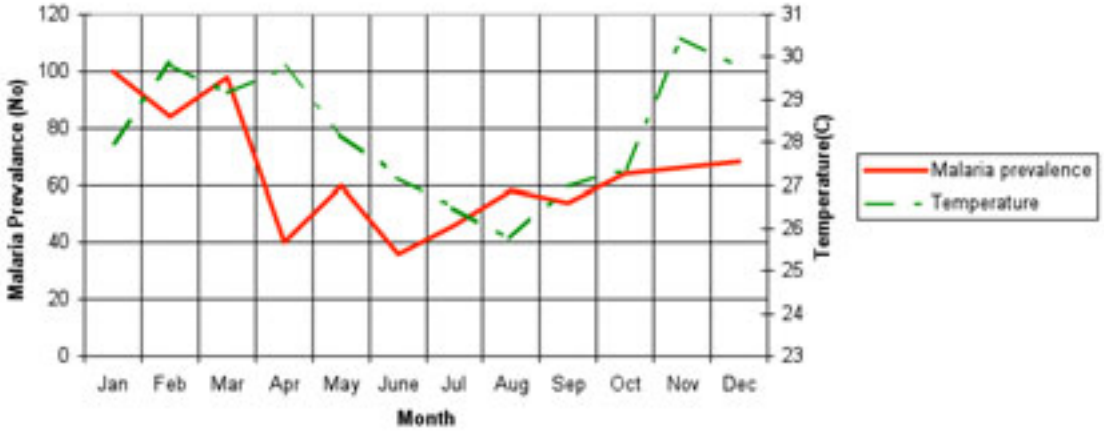


Figure 2. 2005 Relationship between rainfall and malaria prevalence

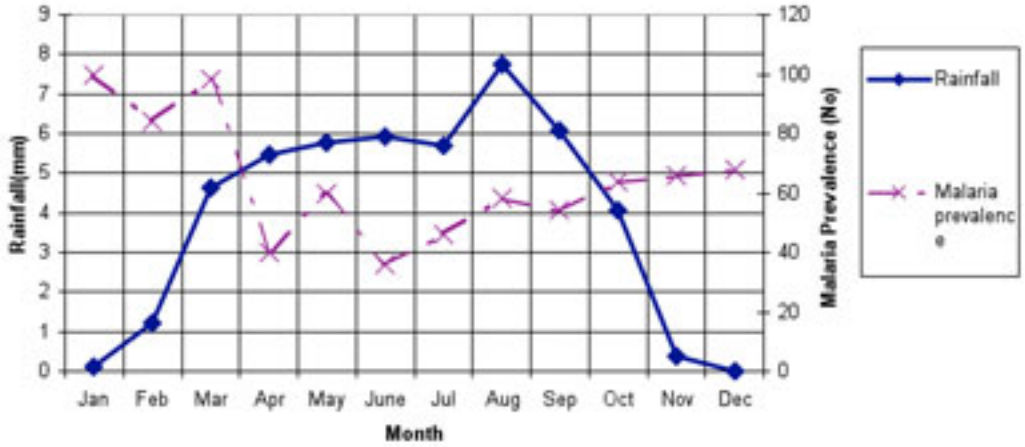
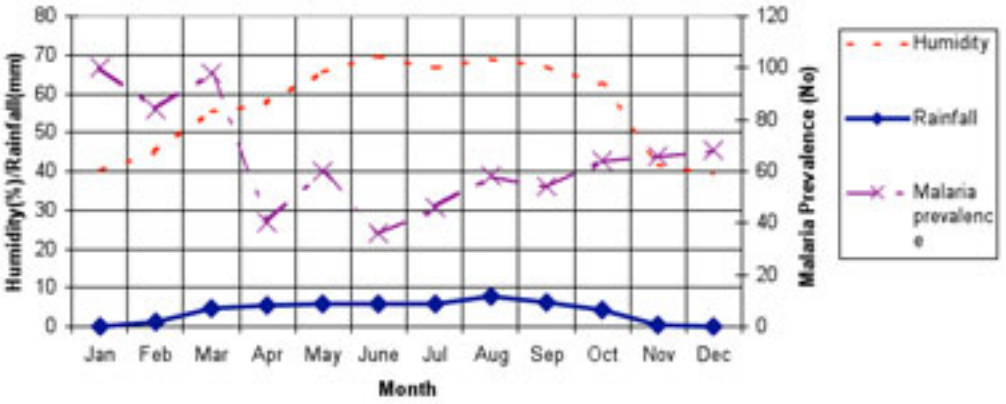


Figure 3. 2005 Relationship between rainfall/humidity and malaria prevalence



DISCUSSIONS AND CONCLUSIONS:
From Table 1 above, the first observation is that malaria cases are recorded in all the months throughout the year. This confirms the fact that malaria is endemic in Bamunka. Secondly, it can be observed in Figures 1, 2 & 3 that the prevalence of malaria is highest in March and October (98 and 64 cases respectively) and lowest in June with 36 cases. June with the lowest prevalence of malaria interestingly registers one of the highest average monthly rainfall, a low average monthly current temperature and the highest Relative Humidity. Willem J. M Martens and al 1997 writes ''rising temperatures decrease longevity of the mosquitoes and this increase with increase humidity but very high rainfall is harmful as it flushes out mosquito larva and hence lowers the population''. This accounts for the low prevalence of malaria in April, June, and September, as can be shown by Figure 2, with higher rainfall patterns. Willem J. M Martens and al 1997 equally notes that the optimum temperature for the survival of mosquitoes falls between 20 – 310 and it is lowest below 160c or above 350c. March and October, with highest prevalence of malaria, registers average monthly Current temperatures of 29.2 and 27.40 C and an average monthly rainfall of 4.6 and 4.1millimetres respectively. All these temperatures and rainfall ranges fall within the optimum for the development of both the larva and the adults. To support this (Bayoh MN 1 and al 2003) writes that the immature stages of mosquitoes develop rapidly at about 280C, greatest adult development at about 280 – 320C and lowest adult development at above 340C. Prof, Rodolfo Carvallo (1996) also writes that a temperature of 220C accelerates the mosquito's metabolic activities and at the same time accelerates the developmental stages of the malaria parasites. Lower than 15.60C or higher than 37.80C the parasites are disturbed and less than 200C activity related to flying and feeding by the mosquitoes reduces drastically.

Rainfall on its part does not affect the transmission of malaria just through its monthly average but on its frequency per day and per week. If it rains too often, the run off will destroy mosquito larvae and hence reduce the prevalence of Malaria.

Temperature and rainfall therefore greatly influence the prevalence of malaria, which varies through the years in Bamunka with March, May and October providing the most optimum conditions for the transmission of malaria while April, June and September, provide the most unfavourable conditions for this. This information can be used in the planning and implementation of malaria control activities in the Ndop health District.

Considering the rapid changes in global climate, we recommend that for a better understanding, this project should be carried out for a period of about five years before a final conclusion can be drawn.

ACKNOWLEDGEMENTS: We wishes to thank the GLOBE Program Country Coordinator for Cameroon (Mrs. Margaret Besong) for her constant material support and encouragements; The GLOBE Program Office for making GLOBE student data available to us through the GLOBE website, and Dr. Esene Ignatius of Ndop District Hospital, for Making Hospital Data available to us. We also wish to thank the other members of the GLOBE team of GBHS Ndop for collecting viable atmospheric data, which has formed the backbone of this work.

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The relationship between soil water storage, and altitude

(The case of Ndop – Cameroon (Latitude: 6.1008 N; Altitude 1302m) and Adjohoun – Benin (Latitude: 6.4180 N; Altitude 37m)

Teachers: George Nditafon (GLOBE Program Hydrology Master Trainer)
Mercy Tayim (GLOBE Teacher, LBA, Yaounde)

ABSTRACT
Ndop – Cameroon is located on latitude: 6.1008 N and altitude 1302m, while Adjohoun – Benin is located on latitude: 6.4180 N and altitude 37m (GLOBE Program student GPS readings). Found on almost the same latitude, these two GLOBE study sites are expected to have similar climate regimes. Despite the vast difference in elevation, literature review shows that the two sites have a similar soil type – loamy sand. This project sets out to investigate the relationship between soil water storage, and altitude by making use of daily precipitations (rainfall) and temperature figures collect over a given period of time. With these values, monthly Potential Evapotranspiration values were calculated and the water balance tables for the two sites completed. Graphs of total monthly precipitations, water storage and actual evapotranspiration were drawn using the Excel Program for visualisation and the identification of trends and patterns, needed for comparison of the soil water retaining capacities of the two sites. From the results obtained, it was found that altitude influences soil water storage capacity probably indirectly through its moderating effect on temperature and rainfall. The work further illustrated the classroom and the real life importance of modelling the water budget of an area, especially for poor and developing countries such as Cameroon and Benin.

Keywords: Altitude, Potential Evapotranspiration, Temperature, Precipitation, Soil Water Budget, Field Capacity, Soil Water Storage, Runoff

INTRODUCTION: RESEARCH QUESTION, HYPOTHESIS AND VARIABLES
Soil Water Budget is an accounting of all water on a local scale, i.e. the local hydrologic cycle. The sum of all the local hydrologic cycles gives the global hydrologic cycle.

Moisture stored in the soil has several important roles amongst which are:
- Contribution to atmospheric humidity,
- Contribution to weathering
- Use by plants in photosynthesis
- Nutrient uptake by plants, and
- Flooding

The project finds several applications in agriculture whose importance cannot be overemphasized especially in developing countries like Cameroon and Benin where agriculture is the mainstay of the economy. The importance of this project therefore lies in the facts that by:
- estimating soil water storage, agricultural water needs such as for irrigation can be calculated and local farmers advised accordingly,
- calculating evapotranspiration, potential vegetation types, and crop yields can be estimated,
- modeling the water budget of a place, local environments can be evaluated for water resource potential (sinking of wells and boreholes), and
- modeling the water budget of a place, climatic classification can be made, and climate change over the years can be monitored.

From literature review, precipitation is localized and specialized and as a result, soil moisture varies from month to month, place to place thus resulting in a variable amount of water available for plant use.

RESEARCH QUESTION
Can places on widely different altitudes, but closely similar latitudes have different soil water budget models? In other words, do differences in altitude affect the amount of water stored in the soil in a particular place?

HYPOTHESIS
The amount of water stored in the soil over a year in Ndop – Cameroon (Altitude: 1302 m; Latitude: 6.1008 N) is greater than that for Adjohoun – Benin (Altitude: 37m: Latitude: 6.4180 N).

VARIABLES
The variables that affect soil water storage include among others:
1. temperature,
2. duration of sunshine,
3. amount of precipitation,
4. amount of ground cover,
5. soil properties, and
6. field capacity.

MATERIALS AND METHOD
The materials used in this research included:
- Pens, pencils, rulers, papers,
- The Excel Spreadsheet,
- The GLOBE Program Teacher's Guide,
- The GLOBE Program Website,
- The Internet – for research and online calculation of evapotranspiration using the Thornthwaite formula
- Books for literature review

The methodology consisted of:

Data Collection

1. From the GLOBE Website (www.globe.gov), the students downloaded the following data sets:
   a. Daily precipitation (rainfall) data for GBHS Ndop, Bamenda, NW, CM, and EPP FANVI/A, Adjohoun, OUEME, BJ for the year 2004.
   b. Daily maximum and minimum temperatures in °C for the two sites for the same year.
   c. GPS location of the two sites (Latitudes, longitudes and altitudes)
2. Data analysis using the Thornwaite formula, online calculations and the Excel Spreadsheet.

DATA ANALYSIS AND RESULTS

Data Analysis

1. The total monthly precipitations (P) - rainfall in mm for the 12 months of year 2004 for the two sites were calculated.
2. From the temperature data, the daily average temperatures for the two sites were calculated, and from the daily averages, the monthly averages (Tm) were also calculated as follows:

$$T_m = \frac{T_{d1} + T_{d2} + T_{d3} + \ldots T_{dn}}{n} \ ^\circ C$$

Where n = number of days in the month

3. Using the monthly average temperatures, latitudes and specification of the hemisphere in which the sites are located, an online calculation method that takes into consideration the daylight correction factors was used to compute the monthly potential evapotranspiration

$$I_i = (T_i/5)^{1.514}$$

$$J = \sum_{i=1}^{12}(I_i)$$

$$c = 0.000000675J^3 - 0.0000771J^2 + 0.01792J + 0.49239$$

$$PET_i(0) = 1.6(10T_i/J)^c$$

$$PET_i(L) = K\ PET_i(0)$$

directly as follows:

Where: I_i = Monthly heat index; J = Annual heat index; T_i = Average monthly temperatures; K = Daylight correction factor; and c = exponent that depends on I. See details of a sample calculation in the annex to this report.
(See details at: http://ponce.sdsu.edu/onlinethornthwaite.php and the annex to this project report).

Field capacity examples were obtained from ASCE, 1990:

Sand	12*	Silt	32
Loamy Sand	14	Silty Clay Loam	34
Sandy Loam	23	Silty Clay	36
Loam	26	Clay	36
Silt Loam	30		

*Cm/Meter of Soil
Source: ASCE, 1990, Table 2.6 p.21

4. With the Evapotranspiration values and the field capacities obtained, the Water Budget Tables for the two sites were completed using the following calculations:

P: Total precipitation (rainfall) in mm for each month.

PET: Potential Evapotranspiration = The total amount of water that would be lost through evaporation and transpiration if water were always available.

EW: Extra Water = Precipitation in excess of what is needed to meet monthly demands for plants
EW = P – PET (When the difference is positive), i.e. P > PET.

EWN: Extra Water Needed = P – PET, when the difference is negative (when P < PET).

WS: Water Storage = Water stored in the soil. Storage is never less than 0 or greater than field capacity.
- WS for Month 1 = EW
- WS = WS (Previous Month) + EW; when P – PET = Positive.
- WS = WS (Previous Month) – EWN; when P – PET = Negative.
- If EW from previous month and WS from current month is greater than field capacity, then WS =Field Capacity. The rest is runoff.
- If EW from current month is 0, then WS for that month = WS from previous month - EWN

S↓: Water shortage = Water needed in excess of precipitation and storage to meet plant demands.
S↓ = EWN (Current Month) – WS (Previous Month); when P – PET is negative.

RO: Runoff = Water lost when P > PET, and WS is at field capacity.
RO = EW (Current Month) + WS (Previous Month); when this sum is > field capacity.

AET: Actual Evapotranspiration = The amount of water that is actually lost through evaporation and transpiration.
AET = PET - S↓.
AET = PET; When EW = 0

Note: Field capacity is defined in this research as the water saturation point of any given soil type. Above the field capacity, the soil type can no longer hold water and additional water is considered as runoff.

5. Graphs of total monthly precipitations, water storage and actual evapotranspiration were drawn to determine areas of water surpluses, shortages, and runoff. Results were then interpreted and discussed with respect to soil water retention and altitude.

Data Summary for Ndop and Ajohoun

Location	Month	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Ndop	Total P (mm)	2.5	20.4	29.7	54.2	157.2	177.2	219.5	233.9	206	142.3	121	0
Lat: 6.1008N	Av Mtly T (degrees C)	23.7	23.6	25.7	24.6	24.7	23.8	22.5	22.7	22.9	23.5	23.6	22.6
Alt: 1302 m	PET (mm)	96.6	96	124.3	111.6	114.2	103.2	87.3	89	90.2	95.4	95.4	83.7
Ajohoun	**Month**	**Jan**	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**	**Oct**	**Nov**	**Dec**
Lat: 6.4180 N	Total P (mm)	30.2	10.2	51.4	103.8	197.1	76.6	132.6	22.8	118.8	165.8	6	0
Alt:37m	Av Mtly T (degrees C)	28.9	28.7	29.3	28.1	27.6	26.3	25.6	25.9	25.7	26.6	27.6	28.7
	PET (mm)	182.3	180.7	196.5	169	159.1	131.6	117.3	122.2	116.9	131.9	151.2	176

Water Budget Tables for Ndop and Ajohoun

Location	Month	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Ndop	**P**	2.5	20.4	29.7	54.2	157.2	177.2	219.5	233.9	206	142.3	121	0
	PET	96.6	96	124.3	111.6	114.2	103.2	87.3	89	90.2	95.4	95.4	83.7
Lat: 6.1008N	**EW**					43	74	132.2	144.9	115.8	46.9	25.6	
	EWN	94.1	75.6	94.6	57.4								83.7
Alt: 1302 m	**WS**	0	0	0	0	43	117	140	140	140	140	140	0
	S↓	94.1	75.6	94.6	57.4								83.7
	RO							109.2	144.9	115.8	46.9	25.6	
	AET	2.5	20.4	29.7	54.2	71.2	103.2	87.3	89	90.2	95.	95.4	83.7
Location	**Month**	**Jan**	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**	**Oct**	**Nov**	**Dec**
Ajohoun	**P**	30.2	10.2	51.4	103.8	197.1	76.6	132.6	22.8	118.8	165.8	6	0
	PET	182.3	180.7	196.5	169	159.1	131.6	117.3	122.2	116.9	131.9	151.2	176
Lat: 6.4180 N	**EW**					38		15.3		1.9	33.9		
	EWN	152.1	170.5	145.1	65.2		55		99.4			154.2	176
Alt:37m	**WS**	0	0	0	0	38	0	15.3	0	1.9	35.8	0	0
	S↓	152.1	170.5	145.1	65.2		17		84.1			118.4	176
	RO												
	AET	30.2	10.2	51.4	103.8	159.1	114.6	117.3	122.2	116.9	131.9	32.8	0

Note: In this research, both soil types are loamy sand, with field capacity of 140mm

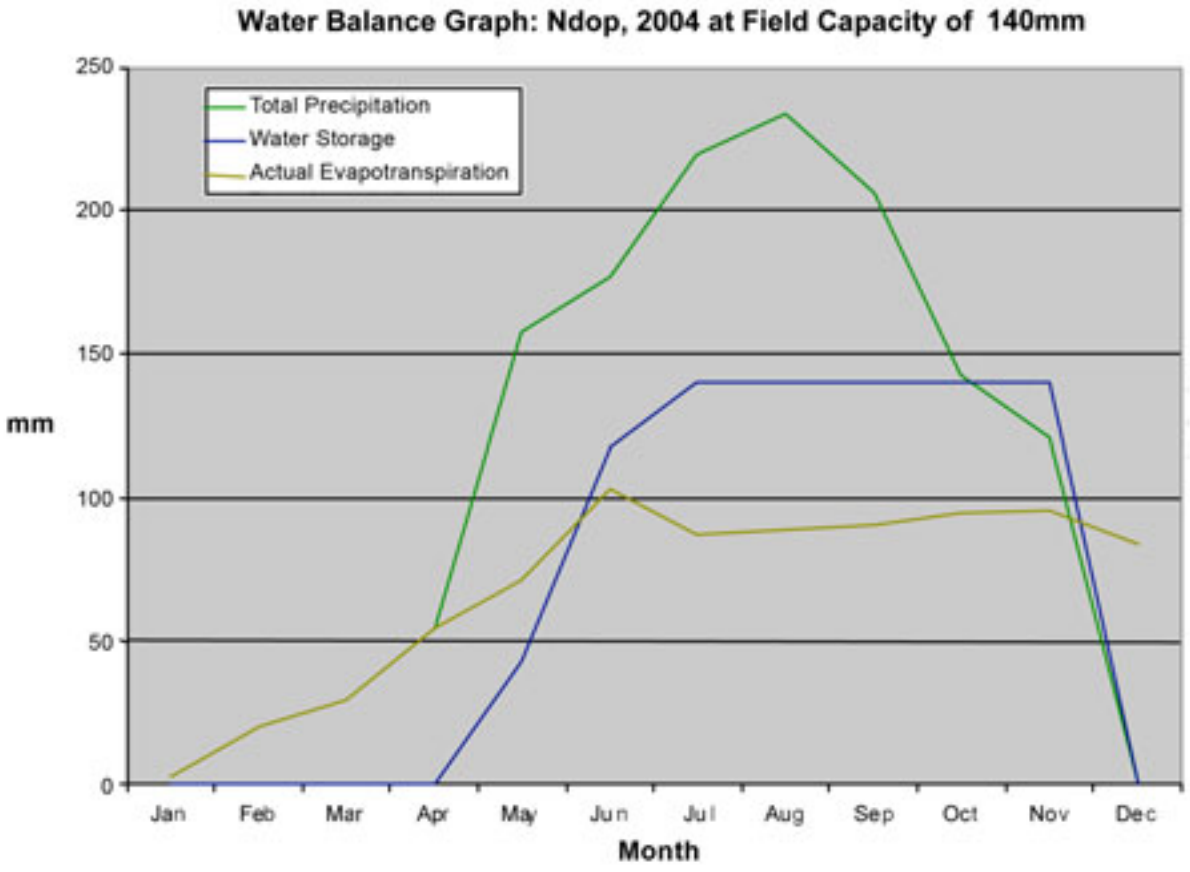
SUMMARY OF RESULTS

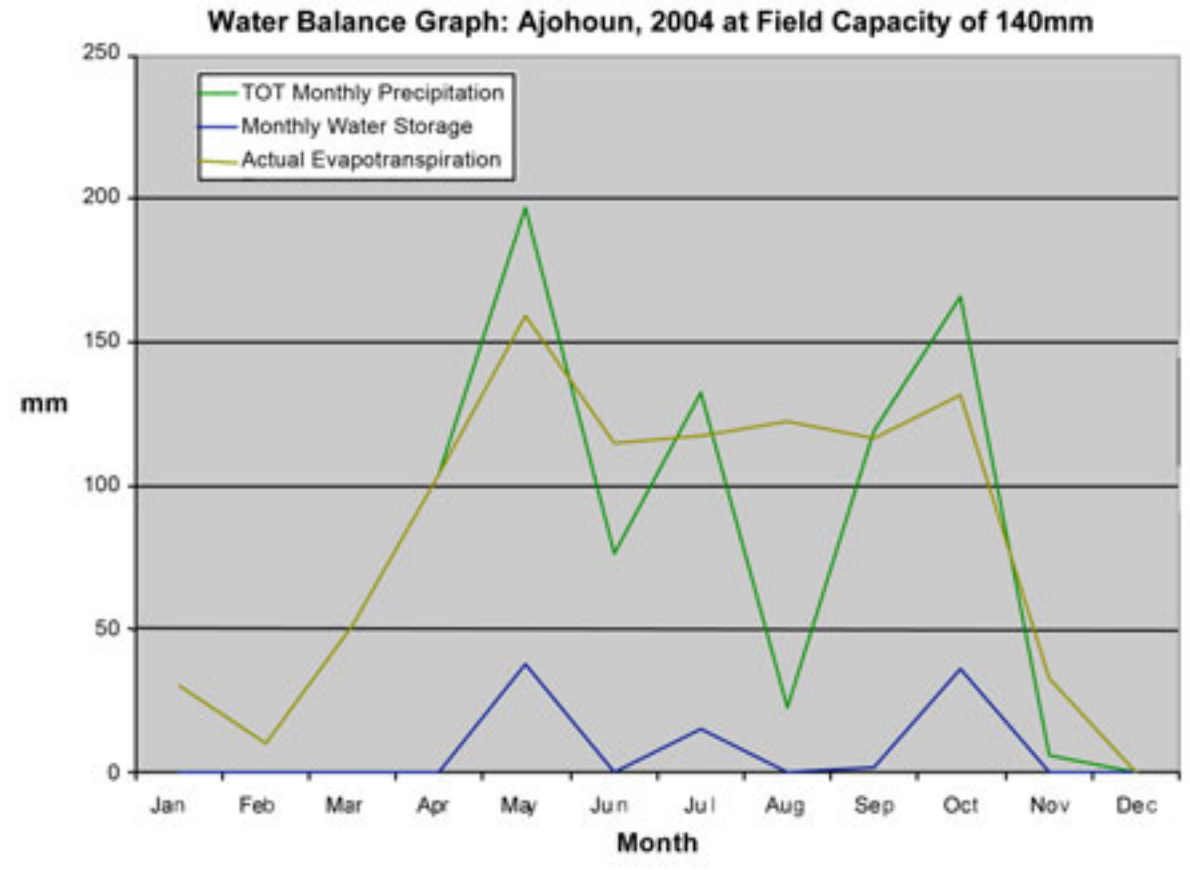
CONCLUSIONS

Differences in altitudes affect the soil water budget model of different places at closely similar latitudes. This may be indirectly through a moderating effect on temperature: ‘’the higher you go the colder it becomes’’. From the graphs, water storage in Ndop is higher, reaching field capacity from July through November, while in Ajohoun, this is extremely low reaching only 25% of the field capacity in October. Hence the amount of water stored in the soil over a year in Ndop – Cameroon (Altitude: 1302 m; Latitude: 6.1008 N) is more than that for Adjohoun – Benin (Altitude: 37m: Latitude: 6.4180 N)). The soil water budget model can therefore be used to show soil water content in the soil where such data is not available.

DISCUSSION

The difference between the water storage capacity of the same type of soil as in Ndop and Ajohoun could have been caused by the moderating effect of altitude on temperature and therefore the amount of evapotranspiration that takes place. For the year 2004, Ndop has an annual average temperature of 23.6°C and a total annual precipitation of 1300mm, while Ajohoun has an annual mean temperature of 25.1°C, with an annual total precipitation of 900mm. Ajohoun therefore is hotter and drier than Ndop – a factor that may explain the difference in the water storage capacity of the soil in these two sites.


Water Balance Graph: Ndop, 2004 at Field Capacity of 140mm
Total Precipitation
Water Storage
Actual Evapotranspiration
mm
250
200
150
100
50
0
Jan
Feb
Mar
Apr
May
Jun
Jul
Aug
Sep
Oct
Nov
Dec
Month


Water Balance Graph: Ajohoun, 2004 at Field Capacity of 140mm
TOT Monthly Precipitation
Monthly Water Storage
Actual Evapotranspiration
mm
250
200
150
100
50
0
Jan
Feb
Mar
Apr
May
Jun
Jul
Aug
Sep
Oct
Nov
Dec
Month

This work illustrates the classroom importance of modelling the water budget of an area, such as:

- the learning of Mathematics including graphing;
- acquiring ICT and online research skills:
- learning and acquiring Spreadsheet skills (Excel Program); and
- improving critical thinking skills

Similar research aimed at determining soil water budget models do not exist at least for Ndop in Cameroon which this team is familiar with.

Possible improvements to this work include among others:

- The need for statistical analysis for the degree of significance of the differences in results;
- Obtaining, analysing and comparing soil moisture data for both sites;
- Expanding the spatial sampling (by analysing data over many more years);

Suggestions for further studies could include among others the:

- determination of the Permanent Wilting Point of plants so as to determine irrigation needs; and
- determination of the thickness of the soil horizons for field capacity; in order to estimate the depth to which plant roots would penetrate to obtain water, etc.

Out of the classroom, this research has a direct implication in food production and therefore the alleviation of hunger and poverty, especially in developing countries where hunger, starvation and poverty are major livelihood challenges. Through modeling the water budget of a place, local environments can be evaluated for water resource potential (sinking of wells and boreholes).

Difficulties faced included among others:

- The lack of consistent data over a consecutive period of years.
- The inability to compare soil moisture data due to the lack of such data for Ndop in Cameroon.
- Irregular and wrong data collection due to poor reading and manipulation of scientific equipment by students could lead to faulty analysis and therefore wrong conclusions.
- Improper instrument care and lack of a quality control and quality assurance plan could result in wrong data and therefore faulty analysis and conclusions.
- The difficulty of obtaining information on similar research in the countries selected which led to the inability to compare the results obtained in this research with similar results.

ACKNOWLEDGEMENTS
We wishes to thank the Ministry of Secondary Education, Cameroon for sponsoring our team to South Africa; the GLOBE Program Country Coordinator for Cameroon (Mrs. Margaret Besong) for her constant material support and encouragements; The GLOBE Program Office for making GLOBE student data available to us through the GLOBE website, and The GLOBE Africa Consortium for co-organizing this learning expedition. We also wish to thank the GLOBE teachers and students of GBHS Ndop in Cameroon and EPP FANVI/A, Adjohoun, OUEME in Benin for their atmosphere data which forms the basis of this work. The GLOBE Country Coordinator for Benin (Mrs. Emmanuelle Alijenatou) for her stewardship of GLOBE Benin resulting in the collection of viable scientific GLOBE data

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ANNEX

Sample Online calculation: Potential evapotranspiration by Thornthwaite method for Ajohoun, January 2004

Formulas

$I_i = (T_i/5)^{1.514}$

$J = \sum_{i=1}^{12}(I_i)$

$c=0.000000675J^3 - 0.0000771J^2 + 0.01792J + 0.49239$

$PET_i(0) = 1.6(10T_i/J)^c$

$PET_i(L) = K\ PET_i(0)$

INPUT DATA: [Description] [Sample input]

Month:	Latitude L (degrees):	Hemisphere:
January	6.418	North

Twelve (12) values of mean monthly temperature (T_i °C), for January to December (separate each value with a comma; maximum string length is 200 characters).

ECHO OF INPUT:
Month: January
Hemisphere: North
T_1 = 28.9; T_2 = 28.7; T_3 = 29.3; T_4 = 28.1;
T_5 = 27.6; T_6 = 26.3; T_7 = 25.6; T_8 = 25.9;
T_9 = 25.7; T_{10} = 26.6; T_{11} = 27.6; T_{12} = 28.7.

OUTPUT:
♦ Monthly PET = 18.23 cm.

The Supply and Quality of Drinkable Water in Mvomrka'a

School: Government Bilingual Practicing High School, Yaounde, Centre, Cameroon

SUMMARY:
The study aimed at investigating the quality of water consumed by the Mvomeka'a Population. Simple hydrology GLOBE protocols (the temperature, turbidity, and pH) were used. We took the data for six weeks from four sites (water from a modern well, a river, pipe-borne supplied by the National Water Corporation (Societé Nationale des Eaux du Cameroun (SNEC)) and water from a traditional well). These sites are the most used sources of consumable water in Mvomeka'a. From our analyses, from the modern well is of better for a direct consumption in Mvomeka'a than all the other sources. The PH is neutral on the average and the turbidity is high (up to 110 cm) for the six weeks of studies. Since water from SNEC is directly consumed we have suggested that it should be properly treated before use. We have also suggested that many more modern wells be constructed since those that exist are not sufficient to meet the needs of the entire population of Mvomeka'a.

ABSTRACT:
The study aimed at investigating the quality of water consumed by the Mvomeka'a Population. Simple hydrology GLOBE protocols (the temperature, turbidity, and pH) were used. We took the data for six weeks from four sites (water from a modern well, a river, pipe-borne supplied by the National Water Corporation (Societé Nationale des Eaux du Cameroun (SNEC)) and water from a traditional well). These sites are the most used sources of consumable water in Mvomeka'a. From our analyses, from the modern well is of better for a direct consumption in Mvomeka'a than all the other sources. The PH is neutral on the average and the turbidity is high (up to 110 cm) for the six weeks of studies. Since water from SNEC is directly consumed we have suggested that it should be properly treated before use. We have also suggested that many more modern wells be constructed since those that exist are not sufficient to meet the needs of the entire population of Mvomeka'a.

HYPOTHESIS:
The problem in this study is to relate the quality of consumable water in Mvomeka'a with the various sources from which the water is obtained using simple hydrological parameters (turbidity, PH mainly).

The hypothesis: Consumable water in Mvomeka'a from the four principal sources is clear and has a neutral pH.

From our GLOBE Pedagogic Guide and according to the 2008 GLOBE competition, this study has been carried out as a means of raising awareness on the importance and necessity of good quality drinking water in the Mvomeka'a community.

RESEARCH METHOD:
This study was carried out using the Hydrology GLOBE protocols and equipment. These are the turbidity tube, the pH paper, and a thermometer. During six week, from the 6th of October 2007 to the 17th of November 2007, we took data using these instruments on four sites listed earlier I this report. The data collected were represented in tables and graphs. From the graphs we could observe patterns and our interpretation were based on the fact that drinkable water should be colourless and with a pH close to or neutral.

DATA SUMMARY:

Table n°1 Site n°1: Tap Water

Weeks	Date	T° water	Turbidity	PH
1	6/10/2007	25°C	110,5 cm	4
2	13/10/2007	24°C	110 cm	5
3	20/10/2007	24°C	110 cm	5
4	3/11/2007	24°C	110 cm	5
5	10/11/2007	25°C	110 cm	4,5
6	17/11/2007	25°C	110 cm	4

Table n°2 Site n°2: Water from a traditional well

Weeks	Date	T° water	Turbidity	PH
1	6/10/2007	25°C	110 cm	4
2	13/10/2007	25°C	110 cm	7
3	20/10/2007	24°C	110 cm	6,5
4	3/11/2007	26°C	110 cm	6
5	10/11/2007	26°C	30 cm	7
6	17/11/2007	25°C	110 cm	6

Table n°3 Site n°3: Water from a modern well

Weeks	Date	T° water	Turbidity	PH
1	6/10/2007	24° C	110 cm	5
2	13/10/2007	24° C	110 cm	7,5
3	20/10/2007	24° C	110 cm	7
4	3/11/2007	24° C	110 cm	7,5
5	10/11/2007	24° C	110 cm	7
6	17/11/2007	24° C	110 cm	7,5

Table n°4 Site n°4: Water from a river

Weeks	Date	T° water	Turbidity	PH
1	6/10/2007	21° C	110 cm	5
2	13/10/2007	22° C	110 cm	4,5
3	20/10/2007	20° C	110 cm	4
4	3/11/2007	23° C	50 cm	3
5	10/11/2007	23,5° C	80 cm	4
6	17/11/2007	23° C	110 cm	4

ANALYSIS:
A comparison of the pH of water from the four sites show that water from the modern well is of better quality for direct consumption than all the other sources. Tap water which is treated at the water treatment centre nevertheless is also useable, but what astonishes us is the very low pH values registered for all the samples investigated over the six weeks of study World Health Organisation (WHO) standards states that good drinkable water should have a pH range of between 6 and 8.

CONCLUSION:
A better source of drinkable water in Mvomeka'a is the modern wells. The pH, the temperature and the turbidity are ideal for this purpose. Water from the other sources should be treated 9boil and filter) to prevent the risk of contamination through water-borne diseases. Furthermore, and according to WHO recommendation for this area, more modern wells be constructed to meet the needs of everyone.

DISCUSSION:
This project should have been better if a bacteriological study was also carried out in all the four sites.

BIBLIOGRAPHY:
This study has carried out thanks to the GLOBE students of Government High School Mvomeka'a with the assistance of their GLOBE teacher and the school authority. We also express our gratitude to a SNEC employee, who gave us useful information the transportation of water from the treatment centre to the taps in Mvomeka'a town.

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The GLOBE Program Teacher's Guide: 1997 edition

Death-rate of fish in the river Kupa

School: OS Banija, Karlovac, Croatia

SUMMARY:
We have researched why some of the fish were dying during the summer(year 2003, 2006) in the river Kupa in city of Karlovac, republic of Croatia .We measured water temperature, dissolved oxygen level, nitrates and nitrites and studied macro invertebrates. We have concluded that death of the fish was caused by extremely high water temperature, low level of dissolute oxygen (4mg/l), low water level (80cm under normal),while the existence of macro invertebrates were indicators that water in Kupa is middle quality (biotic index is 5.0 and 4.8)

ABSTRACT:
The aim of our research is : «Why do fish die during summer in the river Kupa in Karlovac?»

Our hypothesis is : Dying of fish is due to high temperature, little oxygen, low water level and industrial pollution. We also suppose that some sort of invertebrate animals indicating pollution could be found in the river. We took the samples of macro invertebrate from the bottom of the river, examined by the microscope, classified them according to their tolerance to pollution and calculated their biotic index.

The analysis of the results show that the temperature of the water of the river Kupa was rising in August 2003 and August 2006 up to 27°C. The quantity of dissolved oxygen was low :4 mg/l. During the period of dying of fish we noticed nitrates and nitrites that could be the result of industrial pollution. Level of the water was low: 80cm below the normal level.

We classified invertebrate into three categories: those indicating pollution, those indicating clean water and those tolerant to both and living in all waters.

We calculated the biotic index that was 5.0 (on 24th Sept. 2006) and 4.8 (on 9th May 2007) and both are the characteristic of medium clean waters.

We concluded that dying of fish was the result of high water temperature, little oxygen, low water level and industrial pollution.

The quality of the water in Kupa and the degree of pollution should be regularly monitored because of its importance for the health of the population.

HYPOTHESIS:
The aim of our resarch is : «Why do fish die during summer in the river Kupa in Karlovac?»

Our hypothesis is : Dying of fish is due to high temperature, little oxygen, low water level and industrial pollution. We also suppose that some sort of invertebrate animals indicating pollution could be found in the river.

RESEARCH METHOD:
We used OŠ Banija Globe data base for the Kupa river for the period from 2003 to 2006. We compared the data from our school with those from OŠ Dubovac taken from the same river.

We used the data from DHMZ (the State Hydrometeorological Institute) about the water level of the Kupa river. We took the samples of macro invertebrate animals (species) from the bottom of the river, determinated them, photographed, examined by the microscope, classified them according to their tolerance to pollution and calculated their biotic index. We determinated the coordinates of the location by GPS.

ANALYSIS:
The analysis of the results show that the temperature of the water of the river Kupa was rising (getting higher) in August 2003 and August 2006 up to 27°C. The quantity of dissolved oxygen was low :4 mg/l. During the period of dying of fish we noticed nitrates and nitrites that could be the result of industrial pollution. Comparing the data from both OŠ Banija & OŠ Dubovac we found out some minor discrepancies in measuring due to the fact that Oš Dubovac is up the river and out of the centre and Oš Banija down the river Kupa. The diagram shows that the level of the water was low: 80cm below the normal level both in August 2003 and in August 2006.

We found some invertebrate species at the bottom of the river and classified them into three categories: those indicating pollution, those indicating clean water and those tolerant to both and living in all waters.

We calculated the biotic index that was 5.0 (on 24th Sept. 2006) and 4.8 (on 9th May 2007) and both are the characteristic of medium clean waters.

CONCLUSIONS:
We concluded that dying of fish in the Kupa river was the result of high water temperature, little oxygen, low water level and industrial pollution.

The quality of the water in the Kupa river and the degree of pollution should be regularly monitored because of its importance for the health of the population.

DISCUSSION:
1. Could something else influence at dying of fish?
2. Is it big ecological problem?
3. Can't we stop it?
4. Research should be continued!
5. Use better water analysis!

The influence of the water on the physical – chemical features of the river Sava

School: OS Hugo Badalic, Slavonski Brod, Croatia

SUMMARY:
We checked the physical – chemical features of the river Sava (tenperature, pH, transparency, alkali, nitrate, nitrite, melted oxygen) by GLOBE protocols once a week for 6 years. We asked ourselves if the water level had an influence on physical.- chemical features of the river Sava. Namely, the water level of the river Sava changes during the whole year so the difference between the lowest and the highest water level is up to 10 meters. We assumed that water levle had an influence on some physical – chemical features of the river Sava.

ABSTRACT:
Slavonski Brod is situated on the north bank of the river Sava, on the south edge of the Pannonian plain, between Brodsko Brdo (the shapes of mountain Dilj) and the river Sava. The river Sava is one of three longest rivers in Croatia (the lenght is 940 km) and the surface of its basin is 95729 km2.

HYPOTHESIS:
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RESEARCH METHOD:
For the research we needed date, water temperature, pH, transparency, quality of melted oxygen, nitrate, nitrite, alkali and water level. Besides the results of our measurements of those physical – chemical features of the river Sava by GLOBE protocols in the period from 2003. to 2007. ,we asked the water level date for the same period of time from The State Meteorological and hydrological service.

DATA SUMMARY:
We represented the date by graphs showing the relation between the water level and the physical – chemical features of the river Sava (temperature, pH, transparency, alkali, melted oxygen, nitrite, nitrate.)

What water do we drink?

School: Elementary School Konjscina, Croatia

SUMMARY
The idea for the project has crossed our minds while making preparations for the Project Day of our school pertaining to the World Day of Water. Our plan has been to examine the sanitary quality of water having been drunk by the inhabitants of our municipality. We have assumed that the water from the Public Waterworks System is sanitary clean, and that the inhabitants drinking water from the public wells is sanitary unclean. We have selected seven exploratory spots for making our tests. Five of these research spots have been the public and private wells not being linked to the Public Waterworks System. We have also picked two research spots at the wellspring of the Public Waterworks System itself and the water from the faucet in our school.

Utilizing the Globe protocols we have examined the physical and chemical properties of the tested water. We have compared our results with the results made by the Health Department of Ecology. We have worked closely together with that Department during the whole project. The results of our examinations have not showed considerable flections from the maximum allowable concentration except in the case of public wells in the Jertovec community. We have also used the results of the Health Department of Ecology because their microbiology results and our physical and chemical water property results have made the right confirmation of sanitary cleanness of water. We have come to these conclusions:

- The analysis of the water samples from public and private wells have proven that water from these locations is unclean for drinking. Though, the water could be used for cooking, except in the case of the public wells in the Jertovec community, where the analysis have showed that water from that wells need not to be used neither for drinking nor for cooking.
- The analysis of the water samples originating from both the spot at the wellspring of the Public Waterworks System itself and the water from the faucet in out school has proven that water is sanitary clean thus confirming our assumptions to be true.

We have notified the Municipality of Konjscina and the users of water from the tested wells about our test results in written form and the public in general through the means of mass communication. Utilizing the GLOBE protocols just confirmed the usefulness of the GLOBE program for both the students themselves and the local community. The students have managed to link and apply the acquired knowledge from various school subjects as well.

WHAT WE HAVE EXAMINED
We have examined the sanitary quality of water coming from the Public Waterworks System, public wells and waterworks utilized for the personal requirements of the inhabitants. We have also learned that there are some parts of our municipality (some villages and smaller villages) not having been linked to the Public Waterworks System.

The aim of the project has been to investigate what water concerning its sanitary cleanness the inhabitants of our municipality drink. We have also wanted to develop and improve the critical way of students' thinking, and link and apply their established knowledge from different educational realms into the GLOBE program. We wanted them to discover the usefulness of the GLOBE program knowledge and its application into the every day life of our local community as well.

TASKS OF THE EXAMINATIONS:

- To learn what villages and smaller villages of our municipality have not been linked to the Public Waterworks Network, and how they are supplied with the sanitary clean water.
- To establish the cooperation with the Zagorje Public Waterworks System, with the Bureau of the National Health Service and its Department of Ecology.
- To find out, on one hand, the quality parameters of the tested water being important for its sanitary cleanness, and, on the other, to utilize the GLOBE protocols during the examinations.
- To select the research water sample spots not originating from the Public Waterworks System.
- To compare our test results with the test results of the Department of Ecology.
- To inform the inhabitants, the ruling bodies and representatives of our municipality about our test results.
- To provide and prepare the students of ours for the research approach and critical understanding of educational and scientific facts.

EXAMINING HYPOTHESIS:

- Water from the Zagorje Public Waterworks Network is sanitary clean for drinking.
- The inhabitants drinking water from the public and private wells is sanitary unclean.
- The majority of our inhabitants from our municipality drink sanitary clean water.

The test sample has been preplanned. Table 1 depicts all of the names of Municipality of Konjscina and where they are supplied with water from. We have selected the public wells and waterworks utilized for private requirements at places not having been linked to the Public Waterworks Network, the wellsprings where the water has been distributed from,

using the Public Waterworks System and water from the faucet in our school. The sample could be considered representative although it has been made on purpose. It also encircles all the areas of the Konjscina municipality not being enfolded by the Public Waterworks Network and water from the Public Waterworks System.

Table 1: The wellsprings of drinking water in the communities of Konjscina Municipality

Name of the community	Waterworks	Public/Private Wells
Bocadir	+	
Bocaki	+	
Brlekovo	+	
Donja Konjscina	+	
Donja Batina	+	
Galovec	+	
Gornja Konjscina		+
Jelovec	+	
Jertovec		+
Klimen	+	
Konjscina	+	
Kosovecko	+	
Krapina Selo	+	
Pesceno		+
Susobreg	+	
Turnisce	+	
SUM	13	3

THE METHODS OF EXAMINATIONS

During the examinations, we have executed the chemical method of analyzing of water sample utilizing the GLOBE protocols. We have compared the GLOBE test results of our school with the results obtained by the Department of Ecology. We have also used the method of enquiring in the first stage of investigating, the analyzing and synthesizing method, proving, the method of graphical representation, and the presentation method of the gained results.

THE SEQUENCE OF EXAMINATIONS

Having processed the questionnaire having been filled in by the students of our school (410), we have learned what communities have not been supplied with water from the Zagorje Waterworks System. We have also learned what water they have been supplied with. We have established the excellent relations with the Zagorje Waterworks System being located in Zabok. Having informed the responsible bodies with our municipality we have been provided with the indispensable data. We have analyzed the regional waterworks system map. We have used the provided data for making of the waterworks system of our municipality. We have made the necessary arrangements with the Bureau of the National Health Service, that is, its Department of Ecology referring the issue of examining of water samples and insight into the data concerning the sanitary cleanness of water in the Public Waterworks System. We have selected the homes and provided their approval for examining the water in them. We have taken the water samples and measured the temperature and pH according to the Bureau of the National Health Service regulations in the field directly. We have made the water temperature measurements and entered them into the Department of Ecology official lab results. We have taken the water sample measurements into both our school and the Department of Ecology data reports. We have made other physical and chemical measuring parameters (nitrate and electrical conductivity) utilizing Merck measurement sets.

We have scaled the sanitary cleanness of water in the selected homes based on the comparison of acquired results according to the maximum allowable quantities ruled by the book of regulations. We have provided the consumers and the local community with the analytical report in the written form. We have also informed the public about the results of ours through the means of mass communication.

Table 2 depicts the measured physical and chemical values of some samples having been provided with the GLOBE protocols and value analysis of the Department of Ecology.

Table 2: The physical and chemical GLOBE group water analysis (G) and the Bureau of the National Health Service (Z)

The well	Temperature		Oxidizing Value O_2mg/l		Transparency NTU		pH		Nitrate mg/l		El. Conductivity µS/cm	
	G	Z	G	Z	G	Z	G	Z	G	Z	G	Z
Public well-Jertovec	10.3			2.18		**4.63**	7.5	7.17	**65**	**63.5**	900	747
Private well-Jertovec	10.1			1.16		0.59	8	7.12	2.5	3.22	780	678
Public well–Pešćeno	12.6			1.22		2.79	8	7.49	0.02	0.02	510	476
Private well-Pešćeno	10.5			1.36		2.74	7	6.69	15.15	16.13	570	514
Private well-G. Konjščina	11.6			1.31		1.81	7	6.93	1.5	1.67	660	590
Public Waterworks System-Konjščina	7.2			1.24		1.12	8	7.85	3.6	4.34	450	410
Public Waterworks System-Selnica	11.8			0.64		0.19	8	7.51	3.0	3.51	465	459
Maximum allowable quantities	**25**		**3.0**		**4**		**6.5-9.5**		**50**		**2500**	

There are some given values of sanitary clean water according to the Book of regulations enacted by the Croatian Ministry of Health having been provided in the last row. According to the Book it supposed to be made the microbiology analysis of water beside the physical and chemical analysis, so that the sanitary cleanness of water could be ascertained. The microbiologist of the Department of Ecology has conducted these tests because such examinations could not be possible to execute utilizing the GLOBE protocols. The results have been depicted in Table 3.

THE ANALYSIS

The water sample analysis from private and public wells has shown that water is not sanitary clean for drinking. There has been some Escherichia Coli bacteria, that is, their increased colony number could be found on 37°C/48h and 22°C/72h. Among them there has been found some concentration of Enterococcus above its maximum allowable concentration onto three testing locations (public well Jertovec, private well Pesceno and private well Gornja Konjscina), hence reboiling of water could remedy the problem of contamination envoked by the microorganisms. Concerning the fact that water is clean chemically it could be used for cooking but not for drinking. There have been found two chemical increased indexes beside the bacteria above the maximum allowable quantities in water tested samples from the public well in Jertovec community: too high value of water transparency (4.63 NTU), and too high concentration of nitrate (68.58 mg/l). Referring this case the method of reboiling could not remedy the problem as well. That water is neither for drinking nor for cooking, but could be utilized for some other purposes. Thus, it could be hypothesized that the analysis of water from other wells in the vicinity of Pesceno, Jertovec, and Gornja Konjscina area could provide us with the alike results, because they have not been linked to the Zagorje Public Waterworks System. However, the analysis of water taken from the wellsprings near the Public Waterworks System and faucet in our school has shown that the physical, chemical, and microbiological values are below the maximum allowable quantities, proving that it is sanitary clean water.

CONCLUSIONS

We have come to these conclusions from our examining results proving the hypothesis of ours:

- All the water tested sample parameters having been taken from the Public Waterworks System are below the maximum allowable quantities thus proving the inhabitants consuming the sanitary clean water.
- The water analysis taken from the public and private wells has proven the increased presence of bacteria, making water from these sources sanitary unclean. It has also proven the assumption of ours that the inhabitants consuming water from these sources are using water which is unclean for drinking and dangerous for the health of people themselves.
- Concerning the municipality of Konjscina counting 4.074 inhabitants, and the villages G. Konjscina, Jertovec and Pesceno living 1.117 inhabitants, the majority of them are consuming sanitary clean water.

THE DISCUSSION

Comparing the Globe group chemical and physical results of water analysis (its pH, nitrate, and electrical conductivity) with the results having been executed by the Bureau of the National Health Service we have encountered differing values. Discussing them we have come to these conclusions referring two reasons for these flections:

- The results differ because of utilizing different testing methods and testing instruments. The Bureau of the

Table 3: The microbiological test results of water conducted by the Bureau of the National Health Service.

The well	Enterobacteriaceae n/100mL	Escherichia Coli n/100mL	Enterococcus n/100mL	Number of colonies (37°C/48h) n/1 mL	Number of colonies (22°C/72h) n/1 mL
Public well-Jertovec	**1100**	**900**	**780**	**560**	**1200**
Private well-Jertovec	**860**	**80**	0	**360**	**420**
Public well –Pešćeno	**110**	**6**	0	**25**	78
Private well-Pešćeno	**480**	**120**	**140**	**160**	**560**
Private well-G. Konjščina	**660**	**360**	**50**	**850**	**680**
Public Waterworks System-Konjščina	0	0	0	8	7
Public Waterworks System-Selnica	0	0	0	2	1
Maximum allowable quantites	**0**	**0**	**0**	**20**	**100**

National Health Service uses methods having been in conjunction with the ISO standards. The students have not used these standardized methods, but the Globe protocols which are customized according to their age and knowledge level.

- The water samples have not been the same. Two bottles of water have been taken from every well. The Globe students have analyzed one bottle and the second one has been analyzed at the Bureau. The measurements supposed to be done from the same bottle so that the testing results could be accurately comparable.

Both of these examinations have proven some flections from the maximum allowable quantities concerning water samples from the same wells, thus, having the influence on differences of measured values having been conducted by the Globe group and the Bureau. We have proven that Globe measurements, although not being standardized, are excellent indicator of chemical and physical characteristics of drinking water. We could presume that the analysis of testing water from wells in vicinity of G. Konjscina, Jertovec and Pesceno area could show the alike results. Then we have asked ourselves why is that. Based on our observations we have come to the conclusion that the wells are situated at lower level pertaining to barns, septic pit, or fields referencing the sea level, and they have been treated with various chemicals, fertilized with artificial and natural manure. In most cases the wells are not properly protected from entering of water from the land surface (the rain), then there are no well covers, and there is a possibility of falling of branches, dust, leaves, animals and so forth. Sometimes the wells are not deep enough. The chlorination of wells is also not suitable, because it could cause to the danger of hyper-chlorination. Chlorine in great quantities is very dangerous for the health of people. Besides, there is a pretty short effect of chlorination, because the fresh water pours into the well bringing numerous bacteria The Public Waterworks System water comes from the Earth's depths and is of a good quality. There are some dissolved minerals providing the water with perceptible taste. The wellsprings are well-protected, the waterworks network is under strict control, and enacted law acts. This is not the case with private and public wells. They are not liable to any control, and there is a huge danger for the health of people. As a matter of fact it could be the topic of our next examining "Water and health". We have also learned that the management of our municipality possesses the elaborated planned documentation for building of public waterworks network in places which we have examined. The representative municipality bodies have not started to realize the project. There is a resistance among the inhabitants, because they should participate in financing of building the waterworks network. We wanted to warn both the local community and inhabitants of these places not linked to the Public Waterworks System jet to take all the possible safety measures and to do everything in their power to link to the Waterworks network as early as possible ensuring themselves access to the sanitary clean water.

The Globe students and Globe mentors of hydrology group of Elementary School Konjscina have realized the project.

Save Our Ponds

GLOBE Mentors: Mira Hrvatin, Ceda Perko
Secondary School: MATE BLAZINA L A B I N, Croatia
Students: Leona Stemberger, Tamara Malic, Valentino Blasina
Teachers: Mira Hrvatin, Anka Dundara, Mirjana Cvijin, Karmen Diminic-Milevoj

ABSTRACT

EIGHT YEARS AGO, 43 GLOBE STUDENTS HAD DEFINED THE COORDINATE FOR 41 PONDS USING GPS METHOD AND HAD DROWN THEM INTO THE MAP OF LABIN AREA.
THIS YEAR OUR GLOBE GROUPINPROJECT «SAVE OUR PONDS» TRIED TO FIND ANSWER ON THE RESEARCH QUESTION:

ARE THE KARSTIC PONDS OF LABIN ENDANGERED ECOSYSTEMS?

ACTIVITIES:
- to list the ponds
- to estimate the level and the reasons of endangerment
- to determine the diversity of the living world
- to initiate the protection and preservation of the ponds

RESOULTS
- ►41 ponds has been found on the Labin area
- ►All ponds are extremely small water ecosystems.
  - animal species: numerous insects, crabs, amphibians, reptiles, fish and birds
  - plant groups: water and swamp plants.
  - countryside is very diverse MUC-codes:91- urbanized, residential, 121 deciduous forest of the arid zone, 221- bushes, mixed deciduous and conifer (ever-green), 322- undersized bushes mainly deciduous
- ► Water in all the ponds satisfies the criteria of closed water habitat which was set up in natural, half-natural or artificial way.
- ► Ponds have lost their original purpose, and are mostly carelessed

CONCLUSION
Working on this project, we have realized the importance of this water reserves in our karstic and surface water poor area and we wish to encourage wider social community to join the recovery of still existing ponds not only on the Labin area, but also the whole Istria.
We have presented the results of this work to the local government hoping that joined actions could encourage the conscience of the importance of preserving ponds.

2. RESEARCH QUESTION

EIGHT YEARS AGO, 43 GLOBE STUDENTS HAD DEFINED THE COORDINATE FOR 41 PONDS USING GPS METHOD AND HAD DROWN THEM INTO THE MAP OF LABIN AREA.
THIS YEAR OUR GLOBE GROUPINPROJECT «SAVE OUR PONDS» TRIED TO FIND ANSWER ON THE RESEARCH QUESTION:

ARE THE KARSTIC PONDS OF LABIN ENDANGERED ECOSYSTEMS?

3. RESEARCH ACTIVITIES AND MODE

ACTIVITIES:

- to list the ponds of Labin so that their number and condition could be determined
- to estimate the level and the reasons of endangerment so that their authenticity – the primary function and living world richness – could be approached in time
- to determine the diversity of the living world around and within ponds so that their role and importance in circulation of matter and energy processes could be understood
- to initiate the protection and preservation of the ponds as an aquest of nature evolution, human history and tradition

MODE:

GLOBE GROUP	ACTIVITIES
11 - 1st grade students	• listing the ponds • determining pond coordinates
10 - 2nd grade students	• determining pond size and condition • determining the purpose of the ponds
17 - 3rd grade students	• determining living world diversity • analyzing water quality
10 - 4th grade students, leaders	• analyzing results • preparing the • presentation

4. RESEARCH MATERIAL AND METHODS

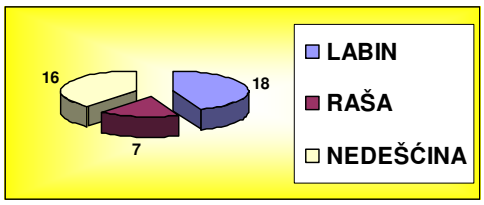
EQUIPMENT AND ACCESSORIES	METHODS
• GPS • CAMERA • EQUIPMENT for taking samples on the sludgy habitat, measuring bars and tapes • Water analysis kit	• GLOBE PROTOCOLS: GPS, HYDROLOGICAL, MUC • REPUBLIC OF CROATIA REGULATION CONCERNING THE CLASSIFICATION OF WATERS • LIST FORM

LIST FORM
I. LOCATION OF THE POND
VILLAGE: NAME OF THE POND:
LOCATION: in the village: □ on the border of the village : □ outside the village :□
COORDINATES E : N: ALTITUDE: m MUC CODE:
II. POND DESCRIPTION
SIZE: length:____ m width:____m depth:____ m measurement date:_____
WATER PRESENCE: all year □ main part of the year □ only in rainfall □
WATER SOURCE: rain □ stream □ spring □ other□
BOTTOM: argillaceous/sludgy □ stony □ concreted □
WALL IN: whole □ material_____ partly □ material_____ no wall □
VEGETATION: coastal □ ____ % swamp □ ____ % water □ ____ %
ANIMALS: water insects□ crustaceans□ fishes□ amphibians □ reptiles □ birds □ mammals □
ENDANGERMENT: waste waters □ solid garbage □ squalor □ other □
PURPOSE: livestock watering: in the past □ today □ soil watering: in the past □ today □ fireman water: in the past □ today □ other: in the past □ today □
III. SKETCH AND POND PHOTO
Pond location sketch - wider area
IV. COLLECTOR'S DATA
Name and surname: Grade: Observation date:

5. RESEARCH RESULTS

5.1. POND DESCRIPTION

5.1.1. NUMBER OF LISTED PONDS: 41 TOTAL



5.1.2. POND DESCRIPTION

Table 1. LABIN

	NAME	LOCATION	LATITUDE	LONGITUDE	ALT. m	AREA m2	MAX DEPTH m	MUC CODE
1.	MARCILNICA	LABIN	N 45006'26"	E 14006'83"	277	429	0,2	91
2.	GONDULIĆI 1	LABIN	N 450 04'34"	E 14007'40"	361	234	0,6	91
3.	GONDULIĆI 2	LABIN	N 45004'31"	E 14007'41"	324	150	1,5	91
4.	GONDULIĆI 3	LABIN	N 45004'14"	E 14008'06"	269	220	0,8	91
5.	KOL BERGAT	LABIN	N 45005'92"	E 14009'66"	351	20	1	322
6.	KOL NA TIKAČKI	LABIN	N 45005'88"	E 14009'99"	355	150	2,5	221
7.	MIKULJANSKI KOL	LABIN	N 45006'13"	E 14010'23"	305	48	0,5	221
8.	KOL NA BRŠTOVICE	LABIN	N 45006'13"	E 14010'23"	353	48	0,5	221
9.	RIPENDA-KOSI	LABIN	N 45006'32"	E 14010'99"	251	160	2	91
10.	KOL NA ŠUŠLJE	LABIN	N 45007'30"	E 14007'51"	298	104	1	322
11.	DRAGULINOV KOL	LABIN	N 45007'31"	E 14007'55"	298	28	0,4	322
12.	DUBROVA	LABIN	N 45006'72"	E 14006'07"	294	240	1	322
13.	KATURI	LABIN	N 45006'48"	E 14007'64"	277	7	0,8	91
14.	KOL VIDASI	LABIN	N 45004'15"	E 14006'37"	253	28	0,3	322
15.	MIDAS	LABIN	N 45005'96"	E 14007'35"	277	20	0,9	322
16.	KOL NA BENECI	LABIN	N 45007'15"	E 14004'03"	276	204	1	121
17.	KOL ŽUGOJ	LABIN	N 45003'34"	E 14006'34"	200	248	0,7	121
18.	SOLINA	LABIN	N 45004'09"	E 14006'44"	261	189	1	91

Table 2. RAŠA

	NAME	LOCATION	LATITUDE	LONGITUDE	ALT. m	AREA m2	MAX DEPTH m	MUC CODE
1.	DRENJE 1	RAŠA	N 45000'50"	E 14009'03"	151	64	1	221
2.	DRENJE 3	RAŠA	N 45000'50"	E 14009'03"	151	20	0,4	221
3.	DRENJE 2	RAŠA	N 45000'50"	E 14009'03"	151	30	0,5	221
4.	DRENJE 4	RAŠA	N 45001'05"	E 14008'46"	113	42	0,8	221
5.	LOVAČKA	RAŠA	N 45001'29"	E 14009'28"	48	9	0,5	221
6.	CEROVICA	RAŠA	N 44059'29"	E 14009'08"	361	500	2,5	112
7.	SKITAČA	RAŠA	N 44059'29"	E 14010'08"	372	900	3,5	221

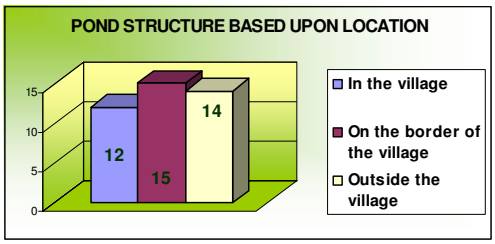
The largest and the deepest pond

Table 3. NEDEŠĆINA

	NAME	LOCATION	LATITUDE	LONGITUDE	ALT. m	AREA m2	MAX DEPTH m	MUC CODE
1.	KOL PULI MAURIĆI	NEDEŠĆINA	N 45 007'41"	E 14002'26"	326	104	1,5	121
2.	RUPICA	NEDEŠĆINA	N 45009'07"	E 14007'11"	367	3	0,4	91
3.	BALAVONE	NEDEŠĆINA	N 45009'38"	E 14007'10"	178	43	2	91
4.	ERŽIŠĆE	NEDEŠĆINA	N 45009'30"	E 14007'19"	271	40	2	221
5.	LAŠĆEVICA	NEDEŠĆINA	N 45009'19"	E 14008'06"	230	48	1,4	221
6.	PUĆ	NEDEŠĆINA	N 45009'05"	E 14007'15"	266	50	0,5	91
7.	MRGUDA	NEDEŠĆINA	N 45009'13"	E 14006'57"	358	510	1,5	221
8.	SNAŠICA	NEDEŠĆINA	N 45009'24"	E 14007'09"	180	128	2	91
9.	BARONOV KOL	NEDEŠĆINA	N 45003'12"	E 14007'04"	270	374	0,7	221
10.	PJERIČOV KOL	NEDEŠĆINA	N 45008'16"	E 14005'05"	276	700	1,5	221
11.	REŠKI	NEDEŠĆINA	N 45008'12"	E 14003'50"	235	218	2,5	221
12.	VIŠKOVICA	NEDEŠĆINA	N 45006'02"	E 14002'40"	194	187	3	121
13.	FORTICA	NEDEŠĆINA	N 45009'13"	E 14003'49"	234	100	1,5	121
14.	ŠUMBER 1	NEDEŠĆINA	N 45009'25"	E 14005'08"	235	54	0,2	121
15.	ŠUMBER 2	NEDEŠĆINA	N 45010'17"	E 14005'37"	210	117	1,5	121
16.	ŠUMBER 3	NEDEŠĆINA	N 45009'42"	E 14005'52"	189	420	0,5	91

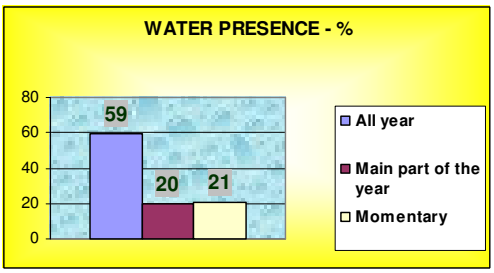
The smallest pond

5.1.3. POND STRUCTURE BASED UPON LOCATION

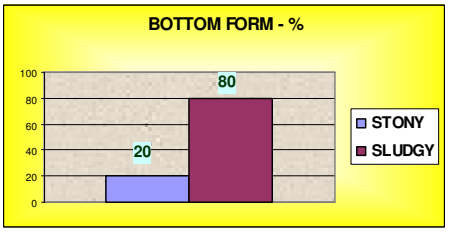


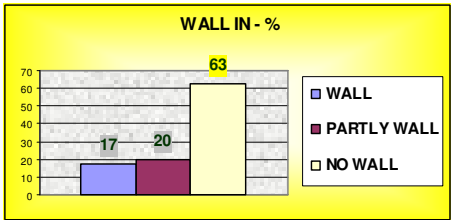
5.1.4. WATER PRESANCE

WATER SOURCE FOR ALL THE PONDS IS RAIN, AND A SPRING WAS FOUND IN ONE OF THEM.



5.1.5. BOTTOM FORM & WALL IN

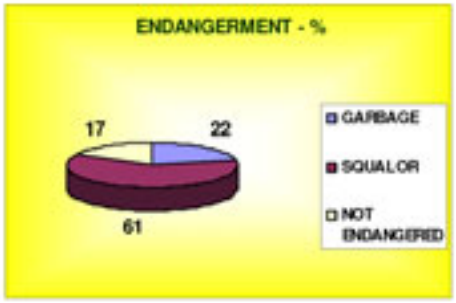




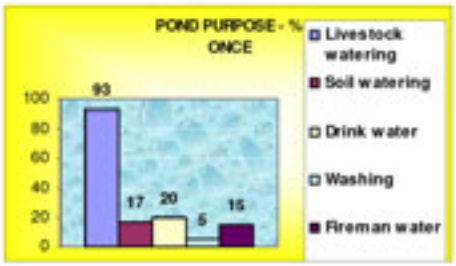
5.1.6. NUMEROUS PLANT AND ANIMAL WORLD

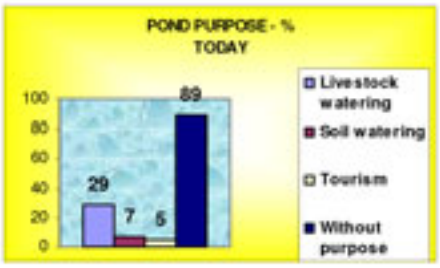
- *VARIETY OF SPECIES IS LARGE*
- *EIGHT PONDS ARE INHABITED BY FISH*

5.1.7. ENDANGERMENT



5.1.8. POND PURPOSE





5.1.9. DISCUSSION

►41 ponds has been found on the Labin area
►The biggest and deepest pond is on the Raša area, pond SKITAĆA
►The smallest pond is on the Nedešćina area, pond RUPICA
►All ponds are extremely small water ecosystems.

- Regarding animal species, we found numerous insects, crabs, amphibians, reptiles and birds which are present all the time or are just hibernating.
- Eight ponds are also inhabited by fish, and we discovered gold fishes in three ponds which were probably forced to find their habitat there after some "admirer" of pets had thrown them away.
- Regarding plant groups, ponds enable survival of water and swamp plants.
- Countryside around the pond is very diverse as we can see from different MUC-codes:

91- urbanized, residential
121 deciduous forest of the arid zone
221- bushes, mixed deciduous and conifer (ever-green)
322- undersized bushes mainly deciduous

► People today loose interest for maintaining the ponds because we have built water supply systems – waterworks, and the number of people who deal with crop husbandry and animal husbandry is decreasing. Beside that, people who live in the village are fewer so this also causes squalor and degradation of numerous water habitats, such as ponds.

5. 2. WATER QUALITY IN THE PONDS

►For analyzing water quality in the ponds, we have chosen seven ponds which have a purpose today, and which in our opinion could have educational and tourist impact.

►We have compared the results of our work with Croatian Regulation for the classification of waters (since 2nd June 1998 Official Gazette No.77) in order to determine the category of water because this regulation classifies natural waters in 5 classes namely:

I. CLASS – waters which can be used for drink in natural position.
II. CLASS – waters which can be used for drink and cultivation of precious fish sorts with minimal treatment.
III. CLASS – waters which can be used in natural position for sport and recreation, for fishing and with better treatment for drink and in food industry.
IV. CLASS – waters which can be used for watering and in industry with antecedent treatment.
V. CLASS – waters which have to be threatened for certain purpose

►In order to analyze, we took three samples of the water from each pond in average water-level, and as result we demonstrated mean of those samples

Table 4. 5.2.1.LABIN – MARCILNICA

LOCATION OF THE POND CHARACTERISTIC	LEGAL STANDARD	IN THE VILLAGE
COLOUR	no - colour	lihgt yellow
SMELL (FLAVOUR)	no - with	without
TRANSPARENCY	see-through – muddy	see-through
DENSITY g/cm3 SALINITY ppt		0,999 0,1
pH	8.5 6.5 <5.3 >9.5	6,5
TOTAL RIGIDITY ONJ		14
NO^{3-} mg/l N NO^{2-} mg/l N	< 0,05 - <10 < 0,01 - <0.2	0
Cl^- mg/l	200	0
PO_4^{3-} mg/l P	< 0.01 - <0.15	0
SO_4^{2-} mg/l	< 200	< 200
NH_3 mg/l N	<0,1->1,5	0.05
O_2 mg/l	<7- <3	8,5
BOD 5 mg/l	<2->15	0,2
HEAVY METALS Hg, Pb mg/l	< 0,01	0
CLASS	I -V	II

Table 5. 5.2.2. LABIN – DUBROVA

LOCATION OF THE POND CHARACTERISTIC	LEGAL STANDARD	ON THE BORDER OF THE VILLAGE
COLOUR	no - colour	lihgt yellow
SMELL (FLAVOUR)	no - with	without
TRANSPARENCY	see-through – muddy	see-through
DENSITY g/cm3 SALINITY ppt		0,999 0,5
pH	8.5 6.5 <5.3 >9.5	6,5
TOTAL RIGIDITY ONJ		16
NO^{3-} mg/l N NO^{2-} mg/l N	< 0,05 - <10 < 0,01 - <0.2	0
Cl^- mg/l	200	0
PO_4^{3-} mg/l P	< 0.01 - <0.15	0
SO_4^{2-} mg/l	< 200	< 200
NH_3 mg/l N	<0,1->1,5	0.05
O_2 mg/l	<7- <3	7,5
BOD 5 mg/l	<2->15	1,8
HEAVY METALS Hg, Pb mg/l	< 0,01	0
CLASS	I -V	II

Table 6. 5.2.3. LABIN – RIPENDA KOSI

LOCATION OF THE POND CHARACTERISTIC	LEGAL STANDARD	OUTSIDE THE VILLAGE
COLOUR	no - colour	lihgt yellow
SMELL (FLAVOUR)	no - with	without
TRANSPARENCY	see-through – muddy	see-through
DENSITY g/cm3 SALINITY ppt		0,999 0,2
pH	8.5 6.5 <5.3 >9.5	6,5
TOTAL RIGIDITY ONJ		14
NO^{3-} mg/l N NO^{2-} mg/l N	< 0,05 - <10 < 0,01 - <0.2	0
Cl^- mg/l	200	0
PO_4^{3-} mg/l P	< 0.01 - <0.15	<0,05
SO_4^{2-} mg/l	< 200	< 200
NH_3 mg/l N	<0,1->1,5	0.05
O_2 mg/l	<7- <3	7,2
BOD 5 mg/l	<2->15	2,2
HEAVY METALS Hg, Pb mg/l	< 0,01	0
CLASS	I -V	III

Table 7. 5.2.4. RAŠA – SKITAČA

LOCATION OF THE POND CHARACTERISTIC	LEGAL STANDARD	OUTSIDE THE VILLAGE
COLOUR	no - colour	lihgt yellow
SMELL (FLAVOUR)	no - with	without
TRANSPARENCY	see-through – muddy	see-through
DENSITY g/cm3 SALINITY ppt		0,999 0,5
pH	8.5 6.5 <5.3 >9.5	6,5
TOTAL RIGIDITY ONJ		14
NO^{3-} mg/l N NO^{2-} mg/l N	< 0,05 - <10 < 0,01 - <0.2	0
Cl^- mg/l	200	0
PO_4^{3-} mg/l P	< 0.01 - <0.15	0
SO_4^{2-} mg/l	< 200	< 200
NH_3 mg/l N	<0,1->1,5	0.05
O_2 mg/l	<7- <3	7,5
BOD 5 mg/l	<2->15	1,8
HEAVY METALS Hg, Pb mg/l	< 0,01	0
CLASS	I -V	II

Table 8. **5.2.5. NEDEŠĆINA – PUĆ**

LOCATION OF THE POND CHARACTERISTIC	LEGAL STANDARD	IN THE VILLAGE
COLOUR	no - colour	light yellow
SMELL (FLAVOUR)	no - with	low
TRANSPARENCY	see-through – muddy	muddy
DENSITY g/cm3 SALINITY ppt		1.001 5.0
pH	8.5 6.5 <5.3 >9.5	6,0
TOTAL RIGIDITY ONJ		10
NO^{3-} mg/l N NO^{2-} mg/l N	< 0,05 - <10 < 0,01 - <0.2	0
Cl^- mg/l	200	0
PO_4^{3-} mg/l P	< 0.01 - <0.15	<0,05
SO_4^{2-} mg/l	< 200	< 200
NH_3 mg/l N	<0,1->1,5	0.1
O_2 mg/l	<7- <3	4,2
BOD 5 mg/l	<2->15	2,8
HEAVY METALS Hg, Pb mg/l	< 0,01	0
CLASS	I -V	III

Table 9. **5.2.5. NEDEŠĆINA – REŠKI**

LOCATION OF THE POND CHARACTERISTIC	LEGAL STANDARD	ON THE BORDER OF THE VILLAGE
COLOUR	no - colour	light yellow
SMELL (FLAVOUR)	no - with	low
TRANSPARENCY	see-through – muddy	muddy
DENSITY g/cm3 SALINITY ppt		1.001 5.0
pH	8.5 6.5 <5.3 >9.5	6,0
TOTAL RIGIDITY ONJ		10
NO^{3-} mg/l N NO^{2-} mg/l N	< 0,05 - <10 < 0,01 - <0.2	0
Cl^- mg/l	200	0
PO_4^{3-} mg/l P	< 0.01 - <0.15	<0,05
SO_4^{2-} mg/l	< 200	< 200
NH_3 mg/l N	<0,1->1,5	0.6
O_2 mg/l	<7- <3	4.0
BOD 5 mg/l	<2->15	2,8
HEAVY METALS Hg, Pb mg/l	< 0,01	0
CLASS	I -V	III

Table 10. **5.2.6. NEDEŠĆINA – VIŠKOVICA**

LOCATION OF THE POND CHARACTERISTIC	LEGAL STANDARD	OUTSIDE THE VILLAGE
COLOUR	no - colour	yellow
SMELL (FLAVOUR)	no - with	low
TRANSPARENCY	see-through – muddy	see-through
DENSITY g/cm3 SALINITY ppt		1..000 1.6
pH	8.5 6.5 <5.3 >9.5	6.0
TOTAL RIGIDITY ONJ		7
NO^{3-} mg/l N NO^{2-} mg/l N	< 0,05 - <10 < 0,01 - <0.2	0
Cl^- mg/l	200	0
PO_4^{3-} mg/l P	< 0.01 - <0.15	<0,1
SO_4^{2-} mg/l	< 200	< 200
NH_3 mg/l N	<0,1->1,5	0.5
O_2 mg/l	<7- <3	7,1
BOD 5 mg/l	<2->15	3,1
HEAVY METALS Hg, Pb mg/l	< 0,01	0
CLASS	I -V	III

5.2.7. DISCUSSION

► According to the regulation of the water quality in three ponds (MARCINLNICA, DUBROVA and SKITAĆA) water is 2nd sort, and in the remaining four ponds (RIPENDA KOSI, PUĆ, REŠKI and VIŠKOVICA) water is 3rd sort.

► A little worse water quality in four plashes we could explain with the position of those pond in the rural part of Labin where a crop husbandry and thereby a possibility of polluting the water with chemical fertilizers and organic matter are rather present. (presence of ammonium and phosphates, increased BOD 5)

► Water in all the ponds satisfies the criteria of closed water habitat which was set up in natural, half-natural or artificial way.

► In biological terms pond is a habitat of a wide spectrum of different plant and animal species on a very narrow and specific area (different MUC-codes) and as such it is very important for preservation of biodiversity.

► Ponds have lost their original purpose, and are mostly carelessed, but with their improvement we could gain a new purpose, beside the natural biological function, like educational, recreational, tourist and similar.

6. CONCLUSION

Working on this project, we have realized the importance of this water reserves in our karstic and surface water poor area and we wish to encourage wider social community to join the recovery of still existing ponds not only on the Labin area, but also the whole Istria.

We have presented the results of this work to the local government hoping that joined actions could encourage the conscience of the importance of preserving ponds.

In order to be sure that our initiative will be always ˝on mind˝ to our authorities and in order to be sure that our wish for common action for the pond recovery will be realized, our group gave a gold fish from the pond SKITAĆA to our MAYOR.

We believe that the gold fish will comply our wish...

LOCAL SONG:

«KOL»

"Kol je stori šlovek da bi moga napojit blogo,
da bi ime kade oprat budonti i kanotijeri (ko hi je ime),
a dugo vremena je to vodo anke pi.

Kada je šlovek već skopo kol,
natura je zajno storila beštije i pjante.

Voda z kola nikamor ne gre ,
pa so koli jedine vodi poli nas ke stoje."

«POND»

"Pond was made by man for livestock watering,
washing pants and undershirts (if he had any)
and for a long time he even drank that water.

Once man had dug the pond,
animals and plants were created by nature immediately.

Water from the pond does not flow
so it is the only stagnant water in our surrounding."

PARTICIPANTS IN THIS PROJECT:

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e-mail: ekoblazina@yahoo.com

GLOBE GROUP: 38 different age students from different classes 10 students (leaders) STUDENTS: 20 2nd class students as an elective subject 30 students of the 3rd class in grammar school and commercial school as their elective subject or as a part of school subjects such as: biology, chemistry or ecology

TEACHERS: ANKA DUNDARA, English teacher MIRJANA CVIJIN, Croatian teacher KARMEN DIMINIC-MILEVOJ, Geography teacher

COLLABORATORS ON THIS PROJECT:
1. INSTITUTE FOR HEALTH PROTECTION, PULA
2. TE PLOMIN, Environment protection department
3. LABIN MUNICIPALITY – Regional planning department
4. Project «LABIN – HEALTHY CITY»
5. TOURIST ASSOCIATION OF LABIN

7. BIBLIOGRAPHY

• GLOBE GUIDE AND PROTOCOLS: GPS, HYDROLOGICAL , MUC
• REPUBLIC OF CROATIA REGULATION CONCERNING, THE CLASSIFICATION OF WATERS

The Springs

Students: Jiří Vinklář and Jan Pospíšil
School: Gymnázium Dr. A. Hrdličky
Humpolec, the Czech Republic
Teacher: Mgr. Jana Blehová

RESEARCH QUESTION AND HYPOTHESIS
Humpolec is a small town with a population of about 10,000 inhabitants. It is situated in the Czech –Moravian Highland in the centre of the Czech Republic. The subsoil of this region consists of gneiss and granite.

The town Humpolec is nowadays supplied with water from two sources. The first source is the water reservoir Švihov on the river Želivka; the second source is the water from springs in the surroundings of Humpolec. In fact, 30 % of the drinkable water is gathered from the forest subsurface water sources. This water is firstly collected in water tanks where it is treated. Afterwards it is drained into water pipelines. The whole system of the water supply is controlled by VODAK Ltd. Company.

There are many tiny water sources in Humpolec surroundings. There are a lot of small swamps in forests, brooks, springs, and wet ground. There are also about six bigger sources near Humpolec. Water from some of these sources is of better quality than packed or bottled water, so it was necessary to localize each of water sources in town surroundings and find out its usage.

Our project continues the work of students from 2002 – 2005, when about 150 water sources were observed and set in maps. Information about each source was introduced into tables. Four of these sources were investigated within two years, analyzed chemically and its water yield was compared with rainfall data from GLOBE measuring. It was found that the quality and yield in two of these sources were just as good as other sources. So there is a big probability of their usage in the future.

Nowadays, in years 2007 – 2008, all the found water sources were observed again and the changes were documented. The new final table with all the changes and some new information has been made. The work on completing map of springs also started in electronic form.

The electronic map is being made in program GIS (Geographic Information System), which application was made by experts from regional office of Highland region. This form of the map has many advantages compared to the physical, paper map, for example the possibility of the correction, changing, or adding of more data or information. The work with it is much more comfortable, it can be accessed by the public (on the internet, a small specialized publication or CD Rom) and in addition it is not physically damageable.

At every water source, which is plotted in electronic map, the available table, in which are written information about this source,(its type, size, water yield, sediments, colour of the water, position, vegetation, ordination and current using). This table can be amplified and complemented in the future. The results of our project will be used by the town of Humpolec. Region Vysočina is interested in our project, too. In the framework of this cooperation our project could be further amplified. There is the possibility of finding other water sources in the surroundings of our town, which have not been mapped yet and improving the map and tables which have been done.

MATERIALS AND METHOD
4.1 Work in Terrain
The first part of our work consists of repeated localisation and check-ups of all water sources which have been found. We were equipped with maps (scale 1:10 000), in which were plotted water sources found between 2002 – 2005, GPS navigator, a note book, and writing material.

Work in the terrain itself proceeded in this way: We firstly had to find every water source according to the map and with the help of GPS point out its ordinate and altitude. After that we wrote down into the notebook mapping number of source and its characteristic, including the type of source, position, vegetation, etc.

4.2 Creation of Tables
The base of creation of water sources tables was created from terrain observations. Data, which we noted (see subchapter Work in Terrain), were compared with data from previous measurements from 2002 – 2005. There were recorded eventual changes and the table was created in a Microsoft Excel programme. There these criteria were written: the name of water source, the type of source, size, estimated water yield, description of water, sediments, description of surroundings, vegetation, ordinate, current usage and notes.

The name of the water source is a group of three digits. The first digit in the title shows the area where the source appears (Humpolec surroundings were divided into three areas); the other two digits say in which sequence the source in its area was found. The type of source marks in which form water

occurs in given place (for example: spring, swamp, lake…). The size conveys dimensions of the water source (extent by lakes, the size of basin by springs). The estimation of water yield records the rate of flow of water source in time when it was found. The description of water is visual (or also olfactory) valuation of the water, which means clarity, colour, cleanness and sometimes the smell of water. The column Sediments indicates what kind of sediments are there on the bottom of water source (sand, mud, stones needles…). The description of surroundings denotes in which environment water source is located (in forest, field, meadow…). Vegetation is describing of the plants which are found around the water source or also in the source. Ordinates are numbered in degrees, minutes and seconds of north latitude and east longitude. The current usage introduces if the water source is used by public or supplies ponds, etc. The last column is Notes where the specific characteristic, except already mentioned criteria, are introduced.

4.3 The Creating of Electronic Map

The most important part of our work was the creating of an electronic map. This map was created in flexible program GIS. In November 2007, there was organized training in our school, in which students learned basis of work in this program. In April 2008 application of GIS program for our purposes was created by specialists from region office of region Vysočina.

For possibility of exact record of point to map we have at our disposal a black and white and coloured orthophoto map (usable even with big scale, for example 1:300), farther map of ordinate, cadastral map, map of address points and normal map with scales 1:10 000.

How is the map of springs created? The area with the water sources is chosen and zoomed, so some significant orientation point can bee seen.

Comparing the ordinate, contour lines, and with the help of the paper map, the sources are mapped.

We can plot the water source in the map in three ways.

The first way is a point. The point is used when we want to enroll a small water source (small spring).

The next way is a line, which can be plotted for a watercourse.

And the last one is the polygon, which is used for the mapping of bigger water area (swamp, lake).

When the water source is mapped, the table is added (see the chapter The Creating of the Tables)

Compared to a classical paper map, there is a big advantage in correction of mistakes.

There is a possibility of sliding or erasing of every water source, we can change or add the data in the tables. We have our password for the access to the map, so for the time being the map is not opened to the public. After finishing this project we are going to make this map accessible.

DATA SUMMARY

Here are the tables with data, which are taken into the table in electronic map.

Table 1

The Name of the Source	The Type of Source	The Size	The Estimation of Water Yield
003	ameliorative arch formwork		1 tenth l/s
004	spring	small	more then 1 tenth l/s
005	waterlogging-march		-
006	spring area, marches	area 20*10m	1 tenth l/s
007	Basin	average basin 9m	-
008	several springs	basin o 1m	in total more then 1 tenth l/s

009	spring	featureless basin 10*10m	less then 1 tenth l/s
010	waterlogging	area 10*20m	
011	spring	featureless basin, average 2m	
012	place when is effluent of sewerage		-
013	spring, further down the current is lake and other affluents	basin with average 1m	0,5 l/s, but further down the current is lake and lot of affluents
014	spring	small basin 0,5*0,5m	2 tenth l/s
015	effluent water to man-made channel, but part maybe spring above		0,4 l/s
016	effluent channel to brooklet		1 tenth l/s
017	fountain	imperceptible, but channel is there – clearly it is flow under ground	
018	mouth of amelioration		1l/s
019	fountain	basin 2*1m	2-3 tenth l/s
020	march	area 30*20m	small affluent to fountain
021	waterlogging	average about 30m	less then 0,5 tenth l/s,
022	waterlogging	10*30m	-
The Name of the Source	**The Type of Source**	**The Size**	**The Estimation of Water Yield**
023	small pond; direct in this place is small pound, but water is feed by a pipe - its source is not visible on the ground	6*3m	0,3 tenth l/s
024	Waterlogging	1*1m	-
025	Well	1m in average	difficult to estimate, I don't know that it is not feed by brook
026	Spring	circle 10m in average	there small, but 50 m down the current 0,5 tenth l/s
027	fencing well		-
028	well, flow-off by dint of overflow, pipe	4m in average	2-3 tenth l/s
029	right affluent to ditch		0,5 l/s
030	spring	area 3*3m	0,3 l/s
031	waterlogging	3*4m	-
032	well, with cover		-
033	spring		2 tenth l/s
034	spring-fountain		less then 0,5 l/s
035	waterlogging	area 400*50m	3l/s
036	spring area		there very small, but 100m down the current about 5 tenth l/s
037	flow	channel with water	rate of flow 3l/s
038	flow	channel with water	rate of flow less then 5 tenth l/s
039	waterlogging	area 50*20m	-
040	waterlogging	area 10*10 m	less then 0,5 l/s
041	waterlogging	area 50*10 m	-
042			-
043	march	80x100 m	-
044	pond	15x15 m	effluent 0.5 l/s
045	flow	channel with water	2 l/s

046	flow	channel with water	2l/s
047	flow	channel with water	-
048	waterlogging spring area	area 10x10m	0.5 l/s
049	waterlogging meadow	50x50m	-
050	waterlogging area	10*10m	-
051	spring		-
052	flow		3-4 l/s
053	flow	channel	-
054	small pond	20*35m	-
055	waterlogging	area 2*5m	-
056	well	1,5m in average	-
057		-	-
058	well	-	-
059	waterlogging	area 2*2m	-
060		-	-
061	spring in channel	-	-
062	spring area	about 100 m2	1,5l
063	waterlogging	about 500m2	-
064	well	-	-
The Name of the Source	**The Type of Source**	**The Size**	**The Estimation of Water Yield**
065	spring area	500m2	-
066	spring area	about 500m2	-
067	spring area	about 500m2	-
068	fountain	1m2	0,5 tenth l/s
069	amelioration		-
070	spring		1 tenth l/s
071	spring		2 tenth l/s
072	waterlogging	about 500m2	2 tenth l/s
073	waterlogging on left shore	about 500m2	1 l/s
074	dried up fountain	2 m2	-
075	waterlogging area	about 500m2	-
076	spring		-
077	source of water supply		-
078	well	2m in average	-
079	march	area 10m2	-
101	mouth of amelioration	-	less then 05 l/s
102	ameliorative arch formwork	-	less then 05 l/s
103	mouth of pipe	-	less then 05 l/s
104	well	-	-
105	waterlogging	10*10m	-
106	Spring area, bog	30*15	less then 0,1 l/s
107	waterlogging	30*10	-
108	several marches	30*30	0,1 l/s
109	march	20*20	less then 0,5 l/s
110	waterlogging	2*10	-
111	fountain	-	less then 0,1 l/s
112	march	20*30	less then 0,1 l/s
113	several springs	to 2 m	in all less then 0,5
114	waterlogging	100*10	-

115	waterlogging, ameliorative arch formwork		-
116	waterlogging	10*2	-
117	spring	-	temporary nothing
118	effluent	-	-
119	spring	-	0,1 l/s
120	gully	-	-
121	percolation	10*2m	1cl/s
122	spring	channel 1m wide	water disappear
123	pipe with cover	-	-
124	waterlogging	10*10m	-
125	waterlogging	100*30m around well	-
126	reservoir-pond	20*10m	tenth l/s
127	spring	-	water disappear
128	effluent	-	tenth l/s
129	spring	-	water disappear
130	waterlogging	several m2 near path	-
201	spring	2 * 4m	0
202	channel	80m long	0
203	spring	-	hundredths l/s
The Name of the Source	**The Type of Source**	**The Size**	**The Estimation of Water Yield**
204	spring	-	0
205	spring	-	0
206	spring	5m in average	0,2 l/s
207	pipe	-	0,2 l/s
208	waterlogging	20*20m	0
209	waterlogging	-	0
210	waterlogging	2*10m	0
211	"fountain"	-	0,5 l/s
212	waterlogging	50*50m	flow-off 0,2 l/s
213	well	-	-
214	effluent - spring	-	hundredths l/s
215	spring	40*20m	0
216	spring	10*10m	tenth l/s
217	march	60*20m	-
218	spring	-	tenth l/s
219	spring area	triangle; side 40 m	flow-off is not visible well
220	spring	triangle; side 10 m	-
221	spring	1m2	hundredths l/s
222	spring	20*6m	flow-off disappear
223	spring	2*1m	-
224	pipe	hundredths l/s	-
225	fountain		tenth l/s
226	spring	triangle; side10m	tenth l/s
227	spring	several cm	small
228	waterlogging	4*4m	tenth l/s
229	pond	11*13,5m	-
230	from arch formwork	-	2 tenth l/s
231	pond	40*40m	-
232	march	5*14,5m	small
233	march	-	small
234	well	2*2m	-

235	pond	30*40m	-
236	march	-	-
237	march	6*2m	tenth l/s
238	march	25*10	tenth l/s
239	march	50*100	5tenth l/s
240	effluent	-	-
241	spring	-	hundredths l/s
242	spring area	20*10m	-
243	spring area	30*10m	tenth l/s

Table 2

The Name of the Source	The Description of Water	Sediments	The Description of Surroundings
003	clear	brown	meadow
004	clear	brown	border field
005	-	-	between fields
006	clear	brown	tall forest
007	-	-	forest
008	clear	sand	forest-seed plot
The Name of the Source	**The Description of Water**	**Sediments**	**The Description of Surroundings**
009	clear	sand	forest
010	-	-	forest
011	-	black	forest
012	-	-	grown over area
013	clear	-	grown over area
014	clear	-	ploughed field
015	clear	sand	-
016	clear	-	forest
017	-	-	forest
018	dim	mire	field
019	clear	gravel	tall spruce forest
020	-	-	forest
021	-	-	garden
022	-	-	field
023	water aggressively smells, on the level are oil smears		border of the forest
024	-	-	field
025	relatively clear	-	enclosure
026	clear	-	under break
027	-	-	-
028	clear	-	meadow, 100 m from graveyard
029	clear	mire	grown over area
030	clear	sand	in grown over area; between stones
031	-	-	meadow
032	-	-	-
033	clear	-	border of the field, 10 m near road
034	clear	mire	field
035	clear	brown-orange	area of valley
036	-	-	grown over area
037	clear	-	meadow near enclosure

038	little dim	-	meadow near enclosure
039	-	-	field
040	clear	sand, gravel	waterlogged meadow between fields
041	-	-	waterlogged meadow
042	-	-	industrial area
043	clear (chemically polluted from factory)	-	industrial area
044	dim	mire, rubbish	industrial area
045	dim	from a field	meadow (marshy)
046	dim	from a field	meadow (marshy)
047	dim	from a field	meadow
048	dirty, dim	from a field	meadow
049	-	-	meadow
050	dirty	mire	forest
051	clear	-	meadow
052	clear	sand	bush
053	clear	sand	meadow
054	dirty	-	between trees
055	clear	-	meadow
The Name of the Source	**The Description of Water**	**Sediments**	**The Description of Surroundings**
056	-	-	meadow
057	-	-	-
058	-	-	meadow
059	-	-	small grass area in a field
060	-	-	-
061	dim	mire	between trees
062	clear	sand	between fields
063	-	-	border of a forest
064	-	-	young spruce forest
065	-	-	forest
066	-	-	under break
067	-	-	around path in tall forest
068	clear (pot for drinking)	sand	tall forest near lake and path
069	-	-	field
070	clear	sand	under road
071	clear	sand	forest
072	clear	-	forest
073	clear	-	forest
074	-	-	spruce forest
075	-	-	between grass and trees
076	-	-	between fields
077	-	-	border of the forest
078	-	-	meadow
079	brown	-	small forest
101	clear	red-brown	meadow
102	clear	red-brown	meadow
103	clear	red-brown	forest
104	-	-	forest
105	-	-	forest path
106	clear	mica, sand	tall forest
107	-	-	border meadow
108	clear	mire, needles	forest
109	-	gravel, sand	forest
110	-	-	

111	clear	mire	forest
112	clear	-	forest
113	clear	-	young spruces
114	-	-	meadow
115	-	-	field
116	-	-	meadow
117	-	-	forest
118	-	-	border of the forest
119	pure	-	forest
120	-	-	meadow
121	clear	foliage	forest
122	clear	needles	forest
123	-	-	forest
124	-	-	forest
125	-	-	forest
126	clear	hardly overgrown	forest, near motorway
127	-	-	forest, near motorway
128	clear	-	forest, near motorway
The Name of the Source	**The Description of Water**	**Sediments**	**The Description of Surroundings**
129	-	needles	forest
130	-	-	near path
201	clear	mire	border of the field
202	clear	red foliage	meadow
203	clear	-	ploughed field
204	no	-	forest-spruce
205	dark	foliage	forest-spruce
206	clear	-	forest-alder
207	clear	-	border of meadow and forest
208	-	-	field without crop
209	-	-	meadow
210	-	-	meadow
211	clear	-	meadow
212	clear	-	meadow
213	-	-	grass area in field
214	clear	mire	grass area in field
215	clear	-	forest - seed plot
216	-	-	meadow
217	-	-	small forest of alders
218	clear	-	young spruce forest
219	clear	mire	area without trees in the forest
220	-	-	tall spruce forest
221	-	-	tall spruce forest
222	clear	-	tall spruce forest
223	-	-	tall spruce forest
224	clear	-	tall spruce forest
225	clear	mire	tall spruce forest
226	clear	-	forest – pop ashes
227	clear	sand, foliage	meadow
228	clear	mire, sand	meadow
229	dark	algae	meadow
230	clear	algae, sand	meadow
231	dark	mire	meadow
232	clear	mire, grass	meadow

233	dark	mire, grass	meadow
234	clear	-	meadow
235	dark	-	meadow
236	clear	-	meadow
237	clear	mire	meadow
238	dark	mire, foliage	forest, clearance
239	clear	mire, foliage	meadow, forest, clearance
240	clear	-	-
241	clear	-	meadow, forest
242	-	-	forest-spruce
243	clear	sand	forest, under path

Table 3

The Name of the Source	Vegetation	Ordinates north latitude	Ordinates east longitude
003	-	49°33´15,8´´	15°20´07,8´´
004	nettles	49°33´89,5´´	15°22´16,7´´
005	reed, rush, cotton grass	49°33´16,6´´	15°22´21,8´´
The Name of the Source	**Vegetation**	**Ordinates north latitude**	**Ordinates east longitude**
006	horsetail, fern	49°33´08,0´´	15°22´52,2´´
007	wood sorrel	49°33´08,7´´	15°22´54,7´´
008	fern	49°33´05,2´´	15°22´55,9´´
009	fern, horsetail	49°33´03,0´´	15°23´00,8´´
010	horsetail	49°33´02,2´´	15°22´57,8´´
011	-	49°32´59,4´´	15°23´01,4´´
012	dark green grass	49°32´25,4´´	15°23´34,8´´
013	-	49°32´25,2´´	15°23´33,9´´
014	-	49°32´25,2´´	15°23´31,9´´
015	several alder trees	49°32´24,3´´	15°23´33,9´´
016	-		
017	algae	49°32´14,9´´	15°23´32,1´´
018	-	49°32´24,9´´	15°23´21,3´´
019	-	49°32´20,1´´	15°23´30,8´´
020	fern	49°32´20,0	´15°23´32,8´´
021	sedge etc.		
022	grasses		
023	willow on the shore		
024	-		
025	-		
026	-		
027	-		
028	-	49°32´35,9´´	15°22´13,2´´
029	grass, sedge	49°32´25,6´´	15°22´08,8´´
030	sorrel	49°32´25,3´´	15°22´11,5´´
031	green grass		
032	-		
033	-	49°32´12,4´´	15°22´15,5´´
034	grasses	49°32´59,0´´	15°21´20,6´´
035	reed, bulrush	49°33´06,3´´	15°21´06,5´´
036	sedge	49°33´24,7´´	15°21´05,4´´
037	grasses	49°33´22,3´´	15°21´31,7´´
038	grasses	49°33´21,7´´	15°21´34,0´´
039	reed	49°33´22,4´´	15°20´39,6´´
040	reed	49°33´27,4´´	15°20´40,2´´

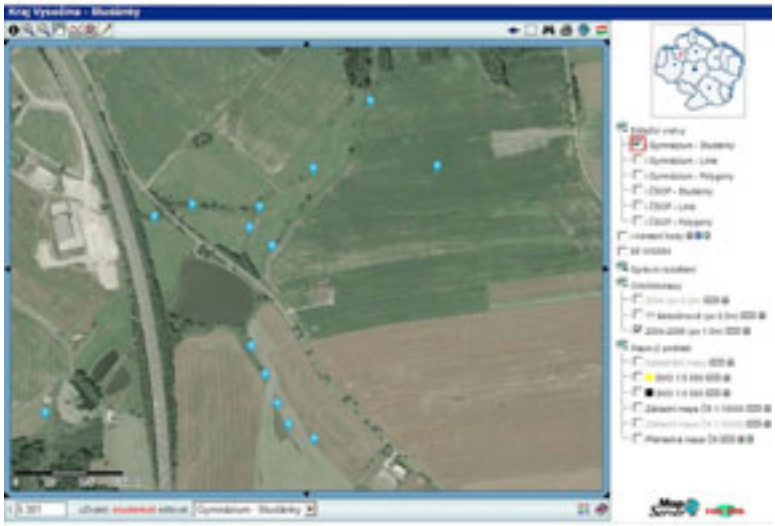
041	different vegetation – sorrel, etc.	49°33´31,0´´	15°20´40,2´´
042			
043	reed, ruderal plants		
044	-		
045	wet grasses		
046	wet grasses	49°32´53,3´´	15°19´59,1´´
047	grasses	49°32´48,9´´	15°20´2,6´´
048	more green grasses	49°32´47,2´´	15°20´04,4´´
049	more green grasses		
050	-	49°32´55,6´´	15°19´47,5´´
051	grasses	49°33´06,6´´	15°19´47,8´´
052	small bushy trees	49°33´4,2´´	15°19´41,5´´
053	grasses	49°33´04,6´´	15°19´54,8´´
054		49°33´10,7´´	15°19´47,4´´
055	grasses	49°33´08,7´´	15°79´54,7´´
056	grasses	49°33´06,1´´	15°19´54,8´´
057	-		
The Name of the Source	**Vegetation**	**Ordinates** north latitude	**Ordinates** east longitude
058	grasses	49°33´09,1´´	15°20´01,1´´
059	grasses	49°33´15,8´´	15°20´0,7,8´´
060			
061	grasses, nettles	49°33´38,1´´	15°19´54,1´´
062	sedge	49°33´25,6´´	15°23´07,7´´
063	young alder forest	49°33´17,8´´	15°23´25,1´´
064	-		
065	moss, fern	49°33´15,6´´	15°23´25,7´´
066	moss, alder trees	49°33´10,4´´	15°23´30,1´´
067	moss, fern	49°33´06,9´´	15°23´32,0´´
068	-	49°32´54,5´´	15°23´31,2´´
069	-	49°32´43,2´´	15°23´32,1´´
070	-	49°32´47,7´´	15°23´37,0´´
071	-		
072	fern, moss		
073	alder trees, sedge, bog moss	49°33´21,1´´	15°23´28,2´´
074	-	49°33´21,4´´	15°23´41,5´´
075	sedge	49°33´49,4´´	15°23´27,5´´
076	reed	49°33´44,7´´	15°23´29,2´´
077	-	49°33´48,0´´	15°23´39,0´´
078	-	49°33´36,5´´	15°20´27,6´´
079	mossy	49°32´56,1´´	15°19´47,1´´
101	grass	49°31´39,7´´	15°23´17,9´´
102	grass	49°31´40,4´´	15°23´14,2´´
103	rush	49°31´36,8´´	15°22´57,3´´
104		49°31´40,0´´	15°22´51,3´´
105	rush	49°31´37,4´´	15°22´ 48,5´´
106	bog moss	49°31´37,1´´	15°22´57,2´´
107	rush	49°31´37,7´´	15°23´04,5´´
108	bog moss, alder trees	49°31´37,4´´	15°23´08,9´´
109	fern, moss	49°31´37,6´´	15°23´16,6´´
110	rush	49°31´36,3´´	15°23´21,0´´
111		49°31´33,2´´	15°23´18,5´´
112	bog moss		
113	-	49°31´32,0´´	15°23´25,3´´
114	rush, sedge	49°31´33,3´´	15°23´33,7´´

115	-	49°32´05,6´´	15°22´21,2´´
116	-	49°31´58,3´´	15°21´47,4´´
117	-	49°31´49,6´´	15; 22´02,0´´
118	iris	49°31´52,1´´	15°21´31,3´´
119	-	49°31´50,4´´	15°21´24,8´´
120	willow	49°32´00,6´´	15°21´44,1´´
121	-	49°31´02,6´´	15°22´34,8´´
122	moss	49°31´06,1´´	15°22´33,1´´
123	-	49°31´14,3´´	15°22´36,2´´
124	bog moss	49°31´14,6´´	15°22´35,8´´
125	rush	49°31´14,5´´	15°22´33,8´´
126	algae	49°31´26,4´´	15°31´27,5´´
127	-	49°31´27,5´´	15°22´17,6
128	algae	49°31´26,4´´	15°22´24,5´´
129	-		
130	rush	49°31´16,5´´	15°22´38,5´´
The Name of the Source	**Vegetation**	**Ordinates** north latitude	**Ordinates** east longitude
201	sedge	49°32´40,4´´	15°18´45,2´´
202	willow	49°32´38,7´´	15°18´59,5´´
203	-	49°32´39,8´´	15°18´55,6´´
204	alder trees	49°32´15,4´´	15°18´41,8´´
205	-		
206	-	49°32´18,5´´	15°18´49,1´´
207	-	49; 32´25,6´´	15°22´08,8´´
208	old grass	49°32´36,4´´	15°18´42,9´´
209	sedge a butterbur	49°32´32,3´´	15°18´55,0´´
210	butterbur	49°32´26,7´´	15°18´43,8´´
211	-	49°32´22,0´´	15°18´43,7´´
212	sedge, rush	49°32´19,7´´	15°18´44,5´´
213	-	49°32´21,1´´	15°19´31,7´´
214	sorrel	49°32´22,0´´	15°19´31,4´´
215	golden saxifrage		
216	marsh marigold rush	49°32´44,0´´	15°19´27,1´´
217	marsh marigold , alder trees	49°32´47,1´´	15°19´32,8´´
218	-		
219	rush		
220	moss		
221	-		
222	horsetail, moss		
223	-	49°32´36,7´´	15°19´30,49´´
224	-	49°32´36,3´´	15°19´31,8´´
225	-		
226	-	49°32´27,1´´	15°19´32,0´´
227	grasses		
228	grasses		
229	grasses		
230	grasses		
231	grasses		
232	grasses	49°32´52,5´´	15°18´39,6´´
233	birches, grasses	49°33´29,2´´	15°18´49,8´´
234	-	49°33´29,0´´	15°18´53,4´´
235	birches, grasses	49°33´31,6´´	15°18´55,7´´
236	grasses	49°33´29,7´´	15°18´56,1´´
237	grasses, marsh marigold	49°33´29,4´´	15°18´58,3´´

238	grasses, trees	49°33´43,1´´	15°19´07,9´´
239	grasses, bulrush, bushes	49°30´43,7´´	15°19´11,9´´
240	-	49°33´41,3´´	15°19´24,9´´
241	grasses	49°33´49,9´´	15°19´02,5´´
242	horsetail	49°32´38,4´´	15°19´34,0´´
243	rush	49°32´10,6´´	15°18´51,5´´

ANALYSIS AND RESULTS
In cooperation with the regional office all data were transferred into a system GIS, where other work with them is possible. In our work the mistakes could appear because of possibility of bad orientation in terrain, the inaccuracy of the maps and locations systems, or wrong recording into a computer. There is a possibility to correct these mistakes, and therefore a large area for improvement.

Here is the example of the map with water sources plotted in. Every source has reference on its own table.
You can find the whole map on 1st September on the Internet.



CONCLUSIONS
In 2002 – 2005 all water sources were found within 2km of Humpolec. On four chosen sources necessary measurements to their usage were performed. Two of these sources could be used, but the town of Humpolec have not done it yet. Between 2007 – 2008 the water sources were remapped. Eventual changes were noted. From this, a uniform table describing characteristics of water sources, prepared to give to the map was created. It was created with the electronic map of the sources, which is possible to enhance. The results of our work will be handed to the town of Humpolec. Work of our predecessors is available on: http://www.globe.gov/fsl/worddocs/CZ_03_humpolec.doc

DISCUSSION
Our project could be further improved. There are a lot of possibilities for improvement, for example enlarging the tables with more facts, taking photos of plotted water source in the map, etc. Next, it is possible to observe found sources and research their behaviour during the year (or more years). And finally, there is the possibility of finding new water sources.

The main aim in the future is creating the map of subsurface water. We will be able to create it on the basis of our knowledge about altitude, gained in our research. The project can be used by the town Humpolec, region Vysočina, our school (students and teachers) and public.

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BIBLIOGRAPHY
We used the results of previous works – tables, maps and lists. The report of previous work from 2003 can be seen: http://www.globe.gov/fsl/worddocs/CZ_03_humpolec.doc

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Magic Dust

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Our project is about the corelation between dust storms and hurricanes. We think that dust particles are reducing the tropical storm risk for Dominican Republic and Puerto Rico, preventing the formation of hurricanes, and lowering the number of them formed in this area. As we know hurricanes are formed under specific conditions like water of at least 26.5 C, high humidity, low amounts of wind shear, and 5 of latitude away from the equator, but it is obvious that without warm surface water a storm cannot survive.

The dust storms that occur in Africa are caused by strong winds that remove the smallest particle of sand to saltate or leap, and this stays suspended in the air, where wind currents to the Atlantic Ocean transport it.

These particles are classified as aerosols, just like sea spray, burning fossil fuels, volcano ashes, etc. All these aerosols affect the temperature in certain areas because they block the sunlight. This means that the aerosols are cooling PUERTO RICO AND DOMINICAN REPUBLIC. Certain tests have proven that aerosols reflect the sunlight back into the space by reducing the solar radiation that reaches the surface. All of this varies depending on the size of the aerosol particles.

"The net effect of aerosols is to cool the climate system by reflecting sunlight. Depending on their composition, aerosols can also absorb sunlight in the atmosphere, further cooling the surface but warming the atmosphere in the process. These effects of aerosols on the temperature profile, along with the role of aerosols as cloud condensation nuclei, impact the hydrologic cycle, through changes in cloud cover, cloud properties and precipitation." *Nature* 419, 215-223 (12 September 2002) | doi:10.1038/nature01091;Yoram J. Kaufman, Didier Tanré, Olivier Boucher.

We believe that the aerosols are reducing hurricane activities because aerosols alter the condition in which the storms are formed like cooling the surface water. This study is just the beginning of a greater research we will conduct in the years to come.

Forest-fire danger in forest areas of Tallinn

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School: Tallinna Science Secondary School, Estonia
Supervisor: Imbi Henno, National Examination and Qualification Center

Earth's climate is changing its influence is noticeable also in Estonia. Drought periods are getting common in summers, so the forest fire danger is getting higher at times. While soils are quite sandy and air pollution is a problem in Tallinn, the capital of Estonia, it is important to protect forests and woodlands against fire in Tallinn city area.

Research author decided to verify the forest fire danger using the GLOBE program's fire fuel protocol and added his own complementary method. These methods were similar.

For research the author chose 10 locations of study sites which all are in forested areas in Tallinn City or near Tallinn. Study sites were in suburbs. Author's hypothesis before research told that the highest forest-fire danger is in Männiku and Raku forests and lowest danger in Nõmme and Merimetsa forests. To compare forest-fire danger, author made measurements (including tree height, grown height, sprig existence, presence of other factors), compared all factors and compiled score-system.

With the help of research the author got to know other interesting information about common pine's canopy and verified locations with lower or higher forest fire danger. The result showed that fire danger in different areas was quite similar.

Phenology research - Trees green up in Iisalmi

Students: Roosa Krogerus and Noora Rantanen
Teacher: Jukka Väre
School: Juhani Aho`s school, Iisalmi, Finland

We are doing the research on green up of Finnish trees on this spring.

We are observing five different branches (3 birches, aspen and alder) three South warded buds. Trees are situated in different places of the town Iisalmi (63°33` N 27°13`E and 63°35` N 27°11`E).

We measure the length of the leaves from the opening of the bud till the growth finished. We also keep observing the lowest and the highest temperatures during the night times. We compare our results to the results of other studies done before.

HYPOTHESES:
We think that the growth of the leaves starts when the days average temperature reaches 5ºC degrees.
That the leaves grow till the middle of June.
The more South the leaves are the faster they grow.

The role of CO_2 in global warming

School: College Cantelande, Cestas, France

OBJECTIVE
Make experiences to determine if CO_2 plays a role in the global increase of temperature.

EXPERIENCE
We fill clear tubes with variable quantities of CO_2, enlighten them for 5 minutes and measure the increase of temperature inside the tubes.

EXPERIMENTAL PROTOCOL
- Fill the tube if the CO_2 quantity wanted.
- Note the temperature at the beginning of the experience
- Enlighten for 5 minutes
- Note the temperature at the end of the experience
- Repeat the experience several times with different CO_2 quantities

RESULTS
Note the measured values in a table
Construct a chart indicating the value of temperature variation depending on CO_2 quantity

RESULTS ANALYSIS
We must be able to demonstrate that the variation of temperature difference increase with the quantity of CO_2 in the tube.

CONCLUSION
It is an experience, not a modeling of what's happening in the atmosphere. The results found out are a mere indication of the influence of CO_2 quantities on warming, but cannot allow us to conclude on the global level because there are a lot more factors that can intervene.

SAT – HYDRO
Study of a watershed using satellite data in the Champagne-Ardenne Region, northeast of FRANCE

Students: Clémence CHARLIGNY and Sam VELICITAT
School: Lycée Roosevelt – Reims – France
Teacher: Nicole HERMAN – Applied Physics teacher

The study of a watershed began 3 years ago by a study of an example of what can be done to diminish nitrogen pollution of the water in our region. Then that led to the study of our local river and then, very quickly, the facts that river pollution cannot be attributed only to people living and working along the river, that it could be attributed to activities implemented a long distance from the river, led the students to discover the existence of a watershed zone.

The whole study was implemented by different students according the different school years.

SCHOOL YEAR 2005/2006
PRELIMINARY STUDY

INTRODUCTION
In 2005/2006, students worked on a project called "Satellite location applications". Two systems were studied : either a satellite is receiving messages sent by an emitter and the emitter location is calculated using Doppler Effect laws (ARGOS system and location of buoys, animals…), either satellites are emitting messages and a receiver calculates the location using the different messages (GPS system and location of vehicles, people, special places…).

One particular GPS application could clearly be linked with our region : Precision Farming used GPS location associated with yield measurements inside a cultivated field to obtain a yield map of the field. Then that yield map is used to put fertilizers only where they are needed in the field : the right amount at the right place…

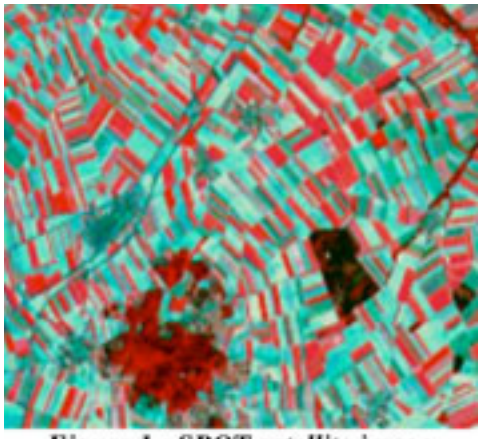


Figure 1 : SPOT satellite image

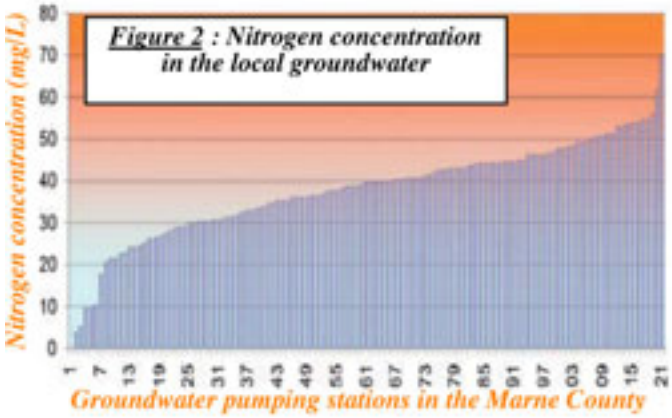
A satellite SPOT image gives an idea of the agricultural activity of our region : arable farming producing mainly wheat, barley and sugar beets. The predominance of cereals and sugar beets can be seen in the agricultural statistics : 34% of the Marne county land is occupied by these products while non-agricultural zones occupy 39% of the county area.

CONCLUSION
Even if the main objective was the GPS application, students wanted to know why research is implemented to use less fertilizers in our region ?

The answer was very quickly found : a lot of fertilizers in all the cultivated areas gives a lot of nitrate pollution in our rivers and groundwaters !

A first step was to found the amount of nitrogen that could be found in miscellaneous waters : using either GLOBE nitrates protocol or data collected from official bodies, some answers were found for the river flowing in our city or in the groundwater from which the domestic water is pumped for the town inhabitants.

Knowing that a European Community directive limits to 50 mg/L the NO_{3-} concentration in drinkable water, the high values found either in the regional groundwater or in the local river led the students to implement a vast study of the causes of the observed situation.



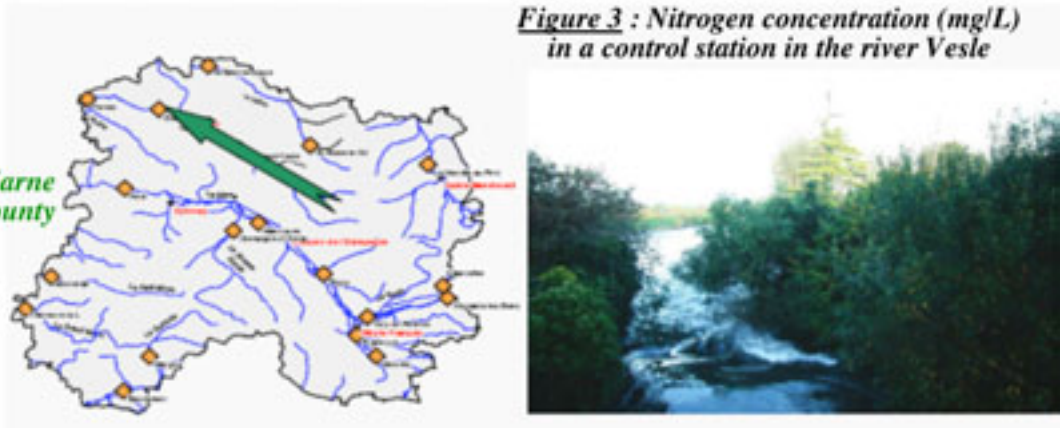


Figure 3 : Nitrogen concentration (mg/L) in a control station in the river Vesle

Date in 2005	11/01	08/02	08/03	12/04	10/05	07/06	19/07	09/08	16/09	12/10	16/11	13/12
mg/L of NO_3^-	35.2	38.7	35.9	33.5	30.7	29.9	41.6	44.4	31.8	35.2	32.8	46.1

SCHOOL YEAR 2006/2007
THE STUDY OF A LOCAL RIVER : THE VESLE RIVER

RESEARCH QUESTIONS

During the 2006/2007 school year, some research activities were implemented concerning the Vesle river study associated to facts concerning other rivers to eventually be able to compare data from other rivers in order to acquire general knowledge.

- Geography
- Hydrology
- Biology and Chemistry

MATERIALS AND METHODS

Different means and resources were used :

- The data of a SPOT satellite image (acquired in 2004) were used (after some physics experiments on light sensors and light filters) to get a general idea of the geography of the region.
- GPS protocol for the longitudinal profile of the river and precipitations protocols associated to flow data were the supports of the hydrology study.
- Hydrology protocols (Water Transparency, Water Temperature, Dissolved Oxygen, pH, Nitrate) were implemented for biology and chemistry studies.

Figure 4 : Location of our region in France and it's geological structure

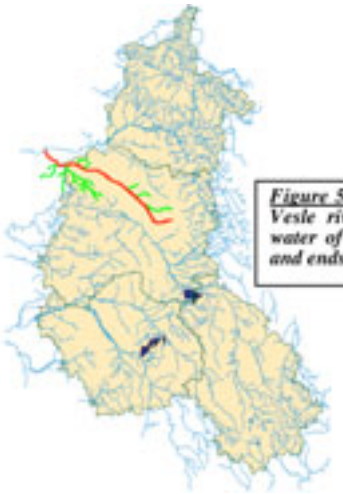
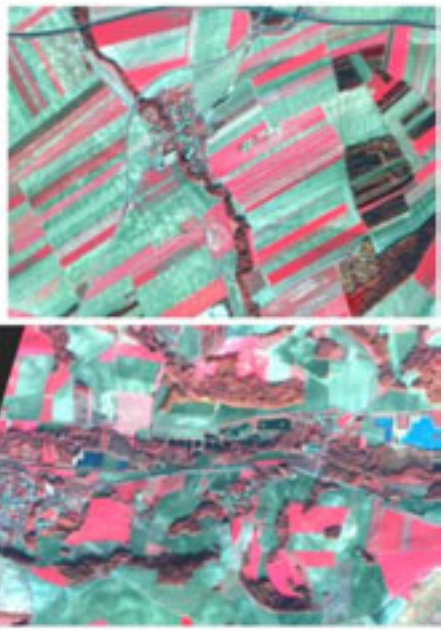


Figure 5 : The regional hydrographic network (in red the Vesle river and in green its principal tributaries.) The water of the Vesle river arrives finally in the Seine river and ends in the North Sea.

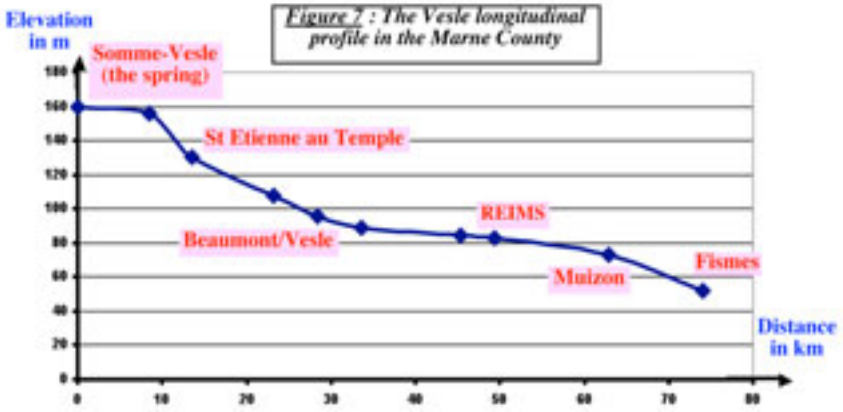
DATA SUMMARY

Figure 6 : Two extracts of the SPOT satellite image (the top one, near the spring, the below, just before flowing in another river).



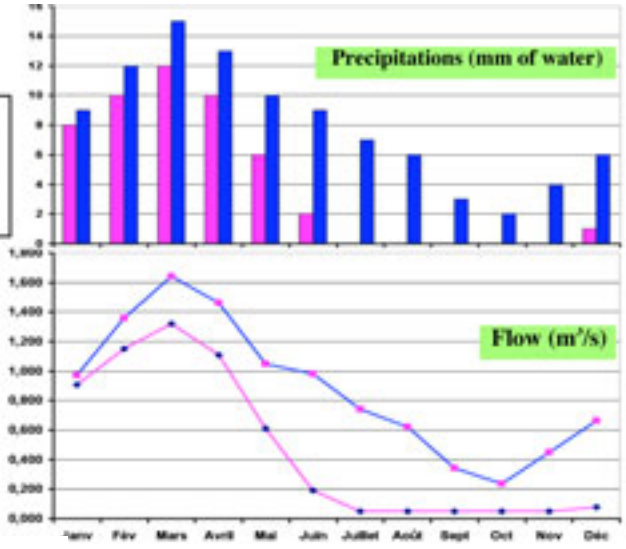
After going on a field trip to find the elevation in different points along the river Vesle (using a GPS), the students realised the graph below.

Figure 7 : The Vesle longitudinal profile in the Marne County



Then information about flow data was asked from the local Water Management Institute and meteorological data came from Meteo France, the meteorology organisation in France.

Figure 8 : Comparison of flow and precipitation for two specific years : 1976, a very dry year 2006, a "normal" year



Compared to nitrogen data in the surface water, the nitrogen data in the groundwater given by the Water Management Institute brought a big surprise !

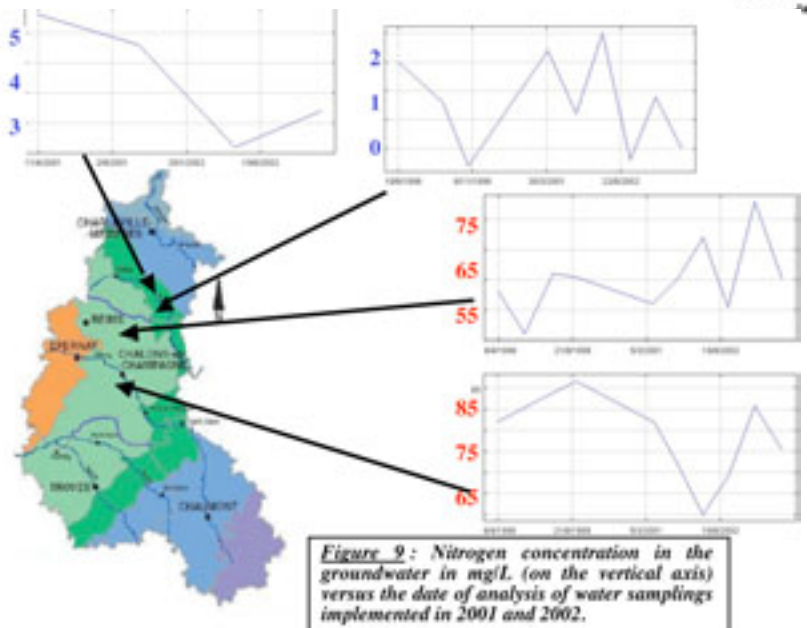


Figure 9 : Nitrogen concentration in the groundwater in mg/L (on the vertical axis) versus the date of analysis of water samplings implemented in 2001 and 2002.

ANALYSIS AND RESULTS

First, the November 2004 satellite image gave a good idea of how much arable farming is important in our region. Using a photoreceiver study and studying the 3 sets of satellite data, a "chart" was build to "read" that image : light blue for naked soils, bright red for fields with active vegetation, reddish brown for forest, dark blue or even black for water.

The hydrological data were typical of a not very big river flowing mostly in a plain.

On each side of the river were cultivated fields and arable farming is a process known to use a lot of fertilizers, so the bad nitrogen results measured the previous year in the river Vesle could

be explained as a consequence of that type of farming (and it explains the Precision Farming experiments in our region).

But to explain the big difference between the groundwater nitrogen measurements, some land use research had to be organised.

Most of the Marne county is occupied by arable farming and the groundwater underneath that zone is heavily polluted. Where there are meadows and forests, the groundwater is quite nitrogen free…

But on the east part of the county, where the river Vesle is flowing towards its outlet, the land use map told us that it's a forest region, so why the bad nitrogen results ?

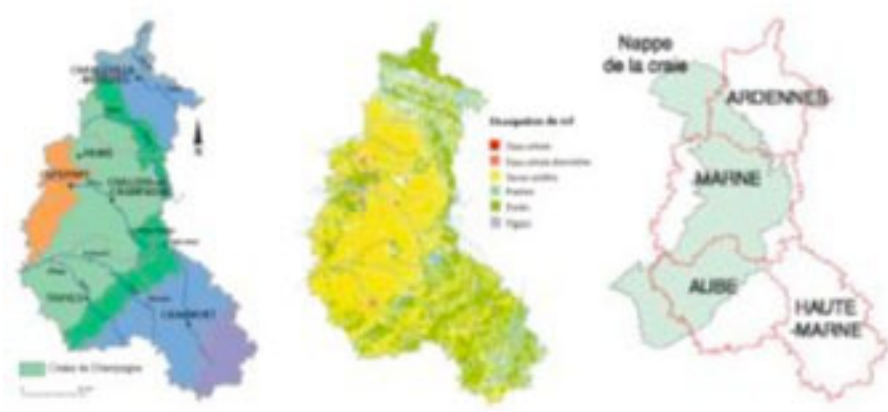


***Figure 10** : Study of 3 maps of the region*

Map 1 : the geological map
Map 2 : the land use map (in yellow, wheat and sugar beets, in blue, meadows and cattle, in green, forests)
Map 3 : the local groundwater reservoir.

SCHOOL YEAR 2007/2008
THE VESLE RIVER WATERSHED

RESEARCH QUESTIONS AND HYPOTHESIS
The previous year work gave us some research questions :

- We noticed that what happens in a river is not always linked with the riparian activities, so on which particular zone, activities endangering the water quality can be implemented ?
  Hypothesis: Water is flowing according to gravity so by making research on Digital Elevation Models of the region, we could find from where and to where the water is running, any water, river water of course but also rain water, runoff water… The watershed concept could be the answer to that first question.
  As it seems impossible to stop altogether the farming activities, what can be done to protect the water quality ?
- We've already study the Precision Farming experiment but not every farmer is going to choose that farming method (because, it's expensive to get the necessary materials and one needs to be a computer addict to organise the follow-up of that kind of farming that is still in a test phase in our region).
  Hypothesis: So we have to find something else, maybe by analysing more precisely the satellite image… On that image, the "reading chart" gave us a way to locate fields (light blue or bright red), forests (reddish brown), water (dark blue or black) but what does represent a area that is dark red ?

MATERIALS AND METHODS
It was too expensive to buy a digital model (in fact we wanted to study a small region and so we didn't need a whole big set of data) but we found a software (GEORANDO distributed by IGN – Institut Géographique National) realised for outdoors activities (cycling, riding, hiking…) and in order to give practical information to the user on the difficulties of the hike chosen, the software gives an elevation profile of that particular hike.

On an area on the map, one chooses straight line hikes and obtained a profile for each hike.

To be able to get the whole river, 12 similar areas are chosen (with a given number built according to the line-column principle, from 11 to 43).

A model will be built by using Styrofoam sheets cut along the profile lines and assembled vertically side by side: the model will represent an rectangular area 70 km long and 36 km wide.

As the software gives the opportunity to mark roads, motorways, rivers, cities…, the model will be easily linked with the real thing (we hope !) and will be used to find the Vesle watershed divides.

Researches are being implemented to find where are located some of the plants that could present environmental hazards (fertilizers packaging plants for instance) using the Ecology and Sustainable Development Ministry Internet site.

During field trip along the river, a helium balloon equipped with a camera driven by a remote control system has been used.

Figure 11 : On the left, map of the studied zone, on the right, the different hikes drawn on the map (from number 00 on the left to number 23 on the right).

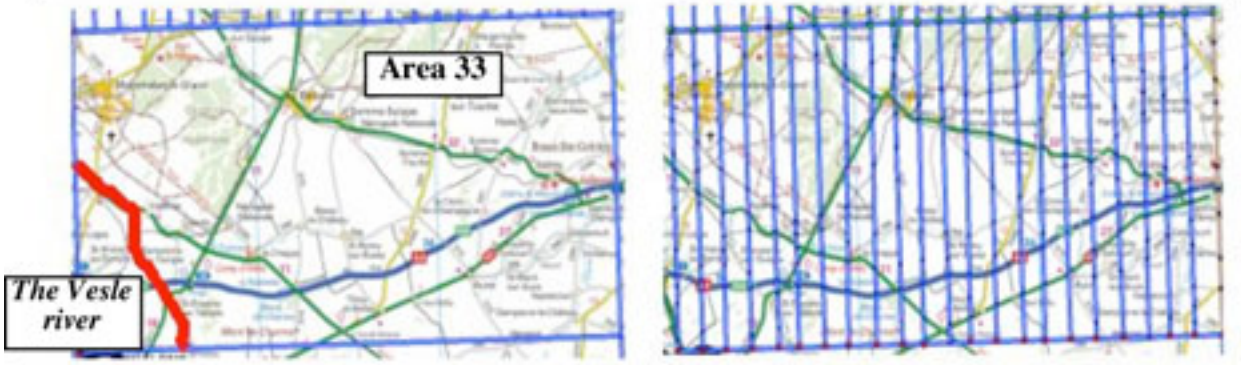
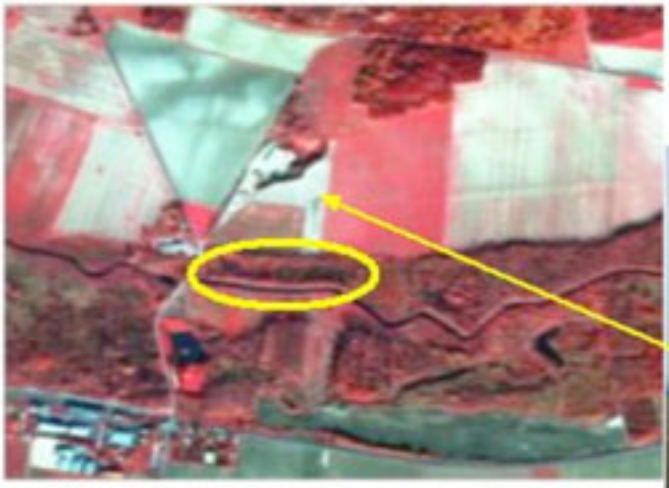


Figure 12 : The profiles of two hikes (number 22 and number 23).

ANALYSIS AND RESULTS

The study of the satellite image and a field trip gave us the answer : the dark red areas are wetlands.



This is a photograph of the light blue field marked with an arrow.

One can imagine, seeing the slope, that every time it rains, some runoff water is bound to go towards the river . But because of the wetlands zone, that runoff which might contains fertilizers, is trapped and is filtered by the wetland : part of it, purified by the water plants (reeds for instance) will arrive later in the river and part of it is going to recharge the groundwater after an infiltration period.

While doing field trips, we discovered that the purification properties of the wetlands are used in what is called “waste water station with reeds purification”. The students were surprised to realise that even if a lot of projects are organised to protect our wetlands, riparian and others, the total surface of these wetlands are diminishing (nearly by half in a century) and some people are “building” artificial wetlands to purify used water…

***Figure 14** : The same field seen from the balloon (the little dots are students !).*

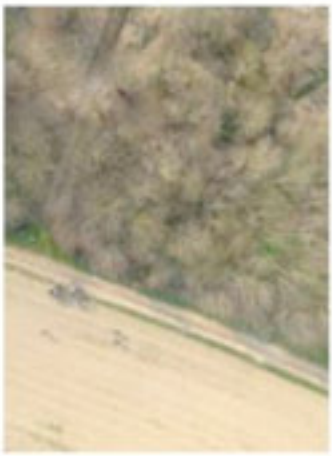


***Figure 15** : On that part of the image, one can see that runoff from the light blue field marked by a cross is bound to arrive directly in the river…*

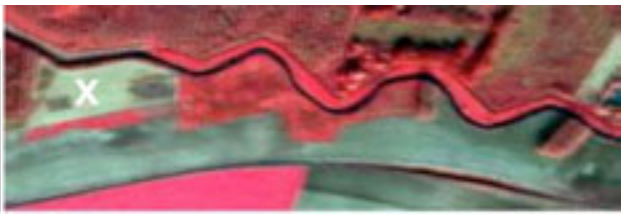


***Figure 16** : Visit of a reed waste water « plant »*

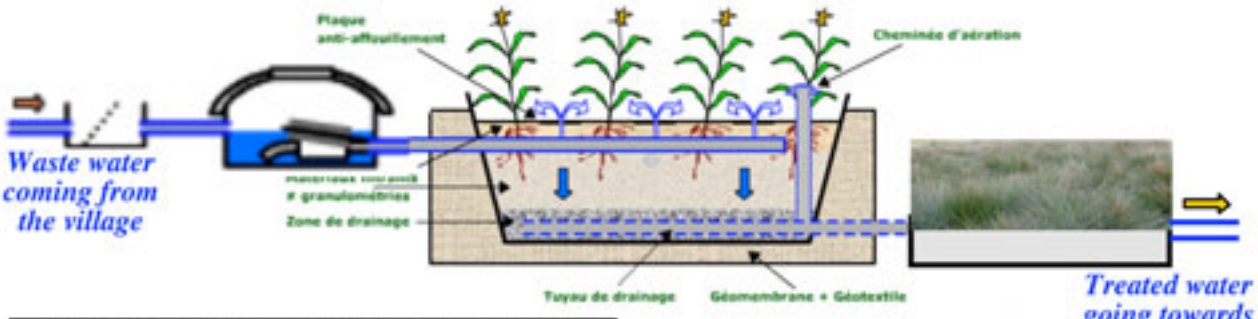


Figure 17 : Waste water treatment principle

CONCLUSIONS

Students were very interested when they discovered the watershed concept : they seemed pleased by the idea "Everybody living in a watershed is in charge of the local water". For them, it is a way to have people feeling they are part of a community, it gives the opportunity to exchange ideas, to find together solutions to environmental issues…

As we have still more than two months to prepare our model, it can be hoped that the Vesle watershed will become a reality for them.

ACKNOWLEDGEMENTS

Credit to those who gave assistance in our research :

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- Renée Deglaire, Chargée de mission, Direction de Secteur Vallées de Marne à Chalons en Champagne

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- Amélie Priou, animatrice du SAGE Aisne-Vesle-Suippe
- Sandrine Armenante, responsable technique S.I.A.BA. VE

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- Michel Voisin, Maire de Cormontreuil

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Sylvie Thirmont, Assainissement des eaux usées

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- Raphaël Mikaëlian, Responsable d'exploitation

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- Danielle De Staerke, responsable du projet GLOBE-CALISPH'AIR et coordonnatrice GLOBE-France

Calisph'air project at Collège « La Chênaie » at Mouans Sartoux

SUMMARY:
We set up our project in June 2006. We picked 13 year-old third form pupils, who had special interest in science.

Our project can be split into two parts, during two years:

- During the fourth class, the students have worked about atmospheric pollution and the influence on greenhouse effect. They learnt how to use the solar photometer to know the quantity of aerosols in our atmosphere. Also, they learnt to explain the graphics recorded by Calipso.

- For the year followed, during the third class, the pupils studied the impact of atmospheric pollution on Mediterranean Sea: they wondered about the effect of atmospheric pollution and the greenhouse effect on the ocean movement and on plankton.

Our headmistress supported us and gave us an extra hour a week when we could work in better conditions with smaller groups. During these hours, as we were taught in Toulouse in May 2006, at the "globe" meeting, we implemented Paul Adams' training so that the pupils could master the required theoretical notions.

We used and applied the investigation method: our pupils had to prepare, and then later, carry out their own experiments. They learnt notions such as the parasol and the greenhouse effect, the aerosols, the types of clouds, the ozone pollution, the earth atmosphere and the other planets atmosphere. They were able to build their own sensors.

After all this work, the students made some observations about our environment:

- First, for 2 years, we have noticed an increase in temperature. In summer, we have scorching heat.
- We realized an inventory of asthma attacks in our school, with the help of our lady doctor. It showed that we had, during 2006, 1.5 more attacks in our school in comparison with all the school of the department.

So, the students wondered: why are the temperatures so high in our district and why are there a lot of person who suffer about asthma attacks?

With the help of our lady doctor, we have established that all the schools, where there are several people who suffer about asthma attacks, are all situated near a motorway or a big road.

Moreover, the students saw a prevention film about the irritant properties of troposphere ozone.

So, they have formulated some hypothesis:
We live in Mouans Sartoux, a very little town between Cannes (where the famous worldwide movies festival takes place) and Grasse (the capital of the perfume).

Our school is located near a motorway, appreciatively 2 miles far, so our students wondered about the effect of ozone's pollution and aerosols' pollution on our health.

They use the sensor ZICUA and GLOBE protocol for ozone, the solar photometer and GLOBE protocol for aerosols. In the same time, they collected some meteorological data and used a qualitative method with some tobacco plants sensitive to ozone. With some reference tables, they compared the necroses of the plants and they could determinate the percentage of necroses of where they live.

They also analysed the graphics recorded by Calipso to see if there was a link between ozone's degree and aerosols' quantity.

The observations:
The data we have collected permit us to say that:

- There is a link between the temperature, ozone's degree and asthma attack.
- There is a link between the frequency of the motorway's cars and the temperature, and, so, with the ozone's degree.
- We can't say that there is a link between ozone's and aerosols' quantity.

The conclusion:
The motorway has a very high influence on our health. The cars deliver some pollutant gas like CO2 which develop temperature and so, greenhouse effect. With higher temperature, the troposphere ozone can be produced and with his irritant effect has a real impact on our health and our lungs.

Our Project, Collège «La Chênaie» Mouans Sartoux

We set up our project in June 2006. We picked third form pupils who had special interest in science. This class was made up of pupils of very different standards. Some of them were even disruptive.

Our pupils measured aerosols and ozone from the 5th of May, to the 15th of June (at the same period "Sand Voyager" did the same). They learnt how to use a solar photometer for the aerosols and the ZICUA device for ozone. We live in Mouans Sartoux, a very little town between Cannes (where the famous worldwide movies festival takes place) and Grasse (the capital of the perfume).

Our school is situated near a motorway, so our students wondered about the effect of pollution on our health.

They used a qualitative method with some tobacco plants sensitive to ozone. With some reference tables, they compared the necroses of the plants and they could determinate the percentage of necroses of where they live.

Our headmistress supported us and gave us an extra hour a week when we could work in better conditions with smaller groups. During these hours, as we were taught in Toulouse in May 2006, at the globe meeting, we implemented Paul Adams' training so that the pupils could master the required theoretical notions.

We used and applied the investigation method: our pupils had to prepare, and then later, carry out their own experiments. Our pupils learnt notions such as the parasol and the greenhouse effect, the aerosols, the types of clouds, the ozone pollution, the earth atmosphere and the other planets atmosphere.

The observations:
We have noticed a correlation between some temperatures, ozone's degree and pupils who have some asthma attacks. In fact, we can look that there are some days when the temperature is high (10/05/07, 16/05/07, 23/05/07, 25/05/07), the ozone's degree near our school increase: 100 ppm the 16/05/07 and the 23/05/07, 120 ppm the 10/06/07, and most of all 200 ppm the 08/06/07.

In the same time, there was the increase of the number of asthma attacks at school: 2 the 16/05/07, 2 the 09/06/07 and 3 the 08/06/07 (see annex 2).

This data shows that lung problems of the children are linked with ozone's degree. Also, this ozone's degree increases with the temperature and the frequency of cars on the motorway.

In conclusion: car pollution has an impact on the health and this impact gets worse with temperature increase.

Finally, the necroses of the tobacco plants show very well the irritant effect of ozone on organism.

The visits:
On the 10th of February 2007, thanks to Parsec association, we visited the Alénia Space Alcatel Plant where Calipso was built and we met an engineer who took part in its development. The pupils asked many questions.

The last week of March 2007, we organised a scientific trip to the Ariane plant in Mondonville. It was composed of workshops about weather, clouds, rainfall, cycle of water, greenhouse effect, wind, the making and launching of a rocket, demonstration of the principle of action and reaction. We visited, too, the space city at Toulouse: Visit of the planetarium, the Imax, the Mir station…

Our main partner from the CNES, Danielle DeStaerke and Paul Adams organised a Visio conference with American partners in Kansas. Our pupils could see their American counterparts, asked and answered some questions about the Calisph'air project and our everyday life.

In May 2007, to start studying atmospheric pollution impact on our marine environment and on plankton, we visited the zoology department of the oceanographic observatory in "Villefranche sur mer". This class will keep on studying and observing these effects. We met a student specialized in the influence of carbon dioxide on corals and sea weeds in the Mediterranean Sea.

The marine trek
In order to gather water and specimen samples, on the 27th of June 2007, we set up a « marine trek » funded by Mr Bernard Gauthier, chairman of CODEP (comity of water and underwater sports). With the parents' approval, we took the pupils fitted with diving suits, masks, scubas and flippers, to sea, one instructor taking care of four pupils.

After the marine trek, the pupils had to fill in charts to identify and compare the different species they watched.

This year:
At the parents' and pupils' request, we made up a new Calisph'air class composed of 27 pupils of very different standards, all of them motivated by science. We hope to get the same funding from the local authorities.

The fourth form has 29 pupils. We'll keep on measuring and observing the consequence of pollution particularly on the marine environment.

We want the pupils to make an experimental aquarium using a scientific approach, studying the different parameters: the physic-chemical parameters and the different species of the Mediterranean sea.

We're in touch with researchers specialized in the marine environment, who will give lectures and advise us about the making of the aquarium.

The trip to England:
English is very important in this project, that's why we decided to organize a trip to England to Portsmouth. The pupils will have English lessons, they'll visit places related to their school programmes (the marine world, pollution…)

For the new class:
We hope the pupils will be able to have the same training as the former class.

We organised the same scientific trip to Toulouse as last year and we thank Danielle and Paul for the organisation of the new Visio conference with the Kansas.

Our students have exchanged some information with the students of Kathy Rome, we hope that it would be the start of an e-mail exchange and, if possible, an exchange between Mouans Sartoux and Kansas…

The pupils will visit the Alenia Space Alcatel Society on the 15th of May 2008.

A marine trek will be organised at the end of June 2008.

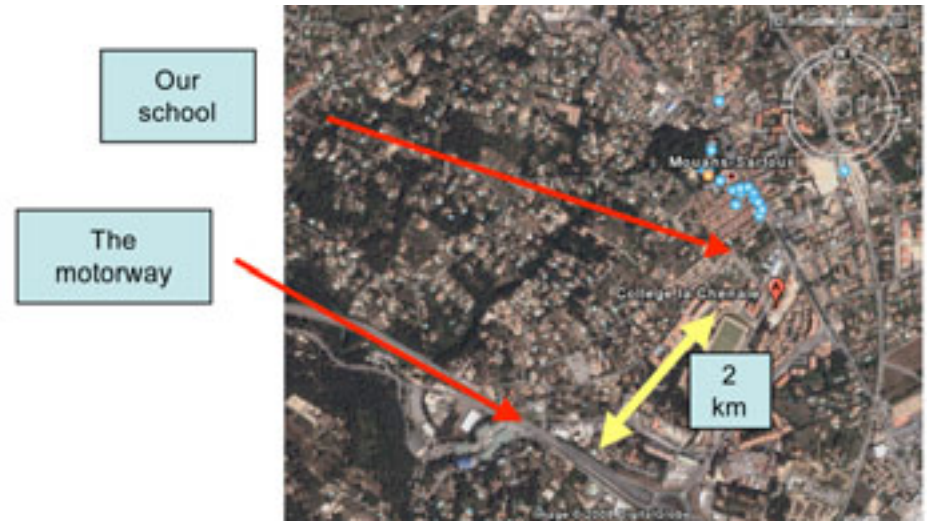
The difficulties of this year:
Last year, the local authorities gave us a funding to organise all the visits.

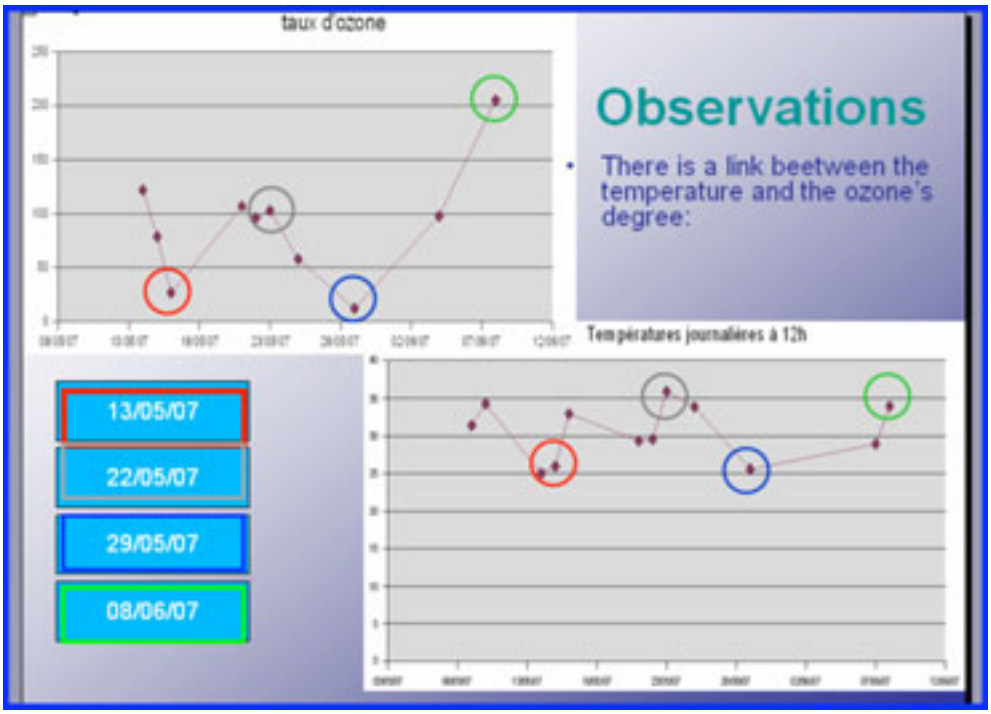
This year, we obviously depend on the different funding we're lucky to get, particularly as far as the school outings are concerned…the local authorities haven't given us a positive answer yet.

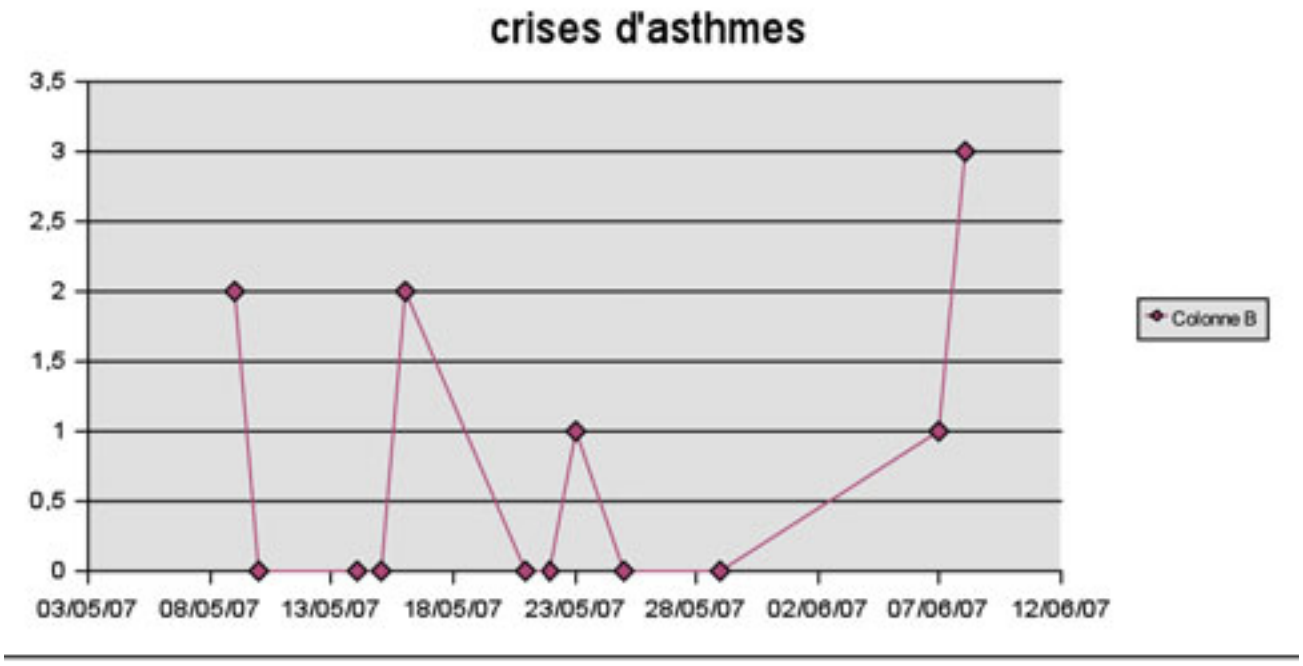
Conclusion:
This project is very interesting and fulfilling for the pupils and the teachers who keep exchanging and putting forward new ideas. The teachers of Biology, English, Physics Chemistry and Physical education are working together.

We'd like these pupils to have a good scientific culture, but most of all we'd like them to become citizens who respect their environment. This is the reason why we took them to the cinema to watch the movie « Earth ». After a debate and different works, we realized the pupils feel a real concern for global warming. We really think it's through education that behaviours and ways of life will change.

Annex 1
The localisation of our school:







Tobacco plants sensitive to ozone:

The marine trek:

Structural changes in our local stream to improve its biodiversity

School: IGS Franzsches Feld – Braunschweig, Germany

PROJECT:
Year 12 students have been asked to examine the local stream Mittelriede, which runs nearby school, according to the European water quality parameter guidelines. This is planned as a long-time project and will involve several groups of students in following years as part of their environmental studies in biology. 2007 has been the pilot year and cooperations with local water and environment authorities have been set up.

Our research is based on the hypothesis that the biodiversity of macroinvertebrates not only depends on the chemical quality of the water, but also on the stream‘s structure. By changing its structure to a more natural way and therefore offering a greater diversity of currents within the stream the biodiversity will increase noticeable, too.

Students used hydrology protocols for collecting data taken at different spots along the stream to gain an overview of its present status and determine quality parameters according to the guidelines, compared data and considered impacts on the water quality along the stream, presented their results to each other and decided on a hands-on activity.

To sum up, there are linkages between the structure of a stream, the chemical water quality and its biodiversity. In order to increase its biodiversity the stream’s structure must be improved as well.

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The Ozone Exposure in and around our school as well as its Effect on Airway Diseases

Participating students: Marie-Dominique Baum, Jan-Philipp Berndt, Bianca Laura Bräuning, Martin Hofmann, Ella Lange, Johnathan Maginness, Jan Peilstöcker, Alexander Sacher, Jan Simon Schneider, Niklas Frederik Wagner
School: Goetheschule Wetzlar, Germany
Mentoring Teacher: Dr. Diesendorf

1. INTRODUCTION
The Project has been initiated cooperatively by the students of the Goetheschule and Kingsburg High School in USA in the beginning of 2007; it has also been discussed per E-mail. We focused on the phrasing of questions and the procedural method at data collection.

The places where the tests were supposed to be conducted and its emphases were decided on. Because of the globally rising temperatures and the interconnected increase of the ozone concentration we posed the question, whether there was an increased sensitivity concerning airway diseases in our school or in its environment.

The central subject matter of our project arose from the crucial question:

Which effects does ground-level ozone has on the human organism?

Out of this we developed the following questions:
- Which factors influence the formation of ozone?
- Which effects does ozone on ground level have on lichens?
- Can we use the lichens as bio indicators?
- Has the air quality in Wetzlar changed over the last years?
- Will our twinned school in the US receive similar results?

2. HYPOTHESES
Out of this context we developed the following hypotheses:
1. The concentration of ozone at ground-level is proportional to the air temperature and disproportional to the cloud coverage as well as the relative air humidity
2. The ozone-concentration correlates with the airway diseases and worsen the local climate and thereby the health in the school and its surroundings.

3. Thunderstorms, SO_2, NO_2, and CO_2 are ozone-producing factors.
4. The quality of air in Wetzlar has improved in the last years.
5. The varying ozone exposure can be verified through lichens as bio-indicators. The data comparison and evaluation of Kingsburg High school's results as well as the Goetheschule results lead to different results.

3. BASIC INFORMATION ABOUT OZONE

3.1 Chemical Data

Ozone is a gas with the chemical formula O_3, a strong oxidant, very reactive and water-soluble with difficulty.

Ozone has a characteristic smell and can even be smelled in small amounts (20 µg/m^3 and above).

The gas has an intense blue color in high concentrations.

Ozone is mainly used as a disinfectant because it kills bacteria.

3.2 Development of Ozone in the Troposphere

The Troposphere is the air film that covers 100 above the earth's surface.

Ozone is a natural air component (background concentration) and a main component of photochemical smog with up to 90 %.

In the troposphere ozone forms in the following way: Intensive sunlight initiates a photochemical reaction of progenitor-substances (nitrogen oxides and hydrocarbons). Nitrogen dioxide breaks photolytically into nitrogen monoxide as well as atomic oxygen (radicals). This oxygen-atom further reacts with molecular oxygen of the air to ozone.

Photolysis with wavelengths of the visible spectrum:
(1) $\bullet NO_2 \rightarrow \bullet NO + \bullet O\bullet$

Formation of ground-level-ozone:
(2) $\bullet O\bullet + O_2 \rightarrow O_3$

The nitrogen monoxide reacts slowly with the air (3) or directly with the ozone (4) to nitrogen dioxide. The radicals in the air react catalytically.

They accelerate the reaction of nitrogen monoxide to nitrogen dioxide.
(3) $\bullet NO + HO_2 \bullet \rightarrow \bullet NO_2 + \bullet OH$
(4) $\bullet NO + O_3 \rightarrow \bullet NO_2 + O_2$

The generated nitrogen dioxide disintegrates under exposure to sunlight. This way a cycle of ozone-generation comes into existence.

There's only a constricted exchange of ozone between troposphere and stratosphere.

3.3 Geography (Germany)

The distribution of the ozone-concentration varies regionally. At the border of the Alps photo-oxidants are accumulating.

Because of this there's an extraordinary high concentration of ozone. Maximum values are also detected in basins and wide river-plains.

The highest concentrations of primary substances are found in big cities with high traffic volume. Yet the ozone-concentration isn't as big as expected in these areas. This phenomenon can be traced back to the fact that nitrogen monoxide and unsaturated hydrocarbons can act as „ozone catchers ", whereby the degradation of ozone is accelerated.

In areas of fresh air the moderate concentrations of ozone are relatively higher than those in congested urban areas, fort he described fact does not take place.

3.4 Course of the Day (Germany)

The ozone concentrations increase notably in summer months at nice weather mostly. That is as the ozone concentrations are intraday dependent on the intensity of sunlight, however with a temporal delay fort the ozone-generation must start first.

In the morning hours one can record a fast rise, at early afternoon it reaches a so-called concentration-plateau. This means that high ozone concentrations can linger for a long period of time.

In the evening hours ozone concentrations fall because the intensiveness of sunlight decreases and thus no ozone is built.

3.5 Ozone in the Stratosphere

The Stratosphere is the air film, which starts 10 km above the earth's surface.

This is where 90%-95% of all naturally produced ozone is found.

This ozone shields Earth from 95-97 % of UVA- und UVB-radiation, which is responsible for the creation of several forms of cancer.

3.6 Ozone Hole

The term „ozone hole" describes a considerable decrease of the ozone concentration at a certain place, but not the total absence of ozone.

The ozone hole is caused by the decrease of ozone in the stratosphere. Partially this takes place through reactions with CFKW (Chlorfluorkohlenwasserstoffe).

The responsibility for this is the human ones.

4. EFFECTS ON THE HUMAN

4.1 Ozone Hole

The ozone hole has effects on human health. Through the ozone hole UVB-rays can pass (the stratosphere), which can result in stronger skin browning, stronger sunburns, preterm skin aging, damage of the genotype and skin cancer as well as immunosuppression. Moreover damage of eyes and diseases like cataract and blindness have increased especially on the southern hemisphere due to the intensified UVB-radiation.

A positive effect on the human being is the generation of vitamin D3 in the human body.

4.2 How does the tropospherical Ozone take Effect?

Ozone takes effect on eyes, nose and bronchia.
In the bronchia it increases the bronchial over sensitivity, derogates respiration up to breathlessness (dyspnea) and dry cough.

For Ozone is water-insoluble it is not kept off by the upper airways, which are lined with mucous membrane, but invades deeply into the lungs.

In the lung ozone is adsorbed to unsaturated hydrocarbons, breaking double bonds and producing aggressive radicals, which lead to the further oxidation

The higher the concentration of ozone, the less pressure the lung may build up (linear relation). This means, that breathing becomes more difficult.

That way cell membrane is damaged which causes phlogistic processes. Substances which are generated by inflammation, get into the organism this way, so that the ozone does indirectly take effect on also inaccessible spots in the body.

Ozone-sensitive humans (approx. 10-30 % of the population) an ozone concentration of 100 µg/m³ may amount to mucosa irritations, nosebleed, headache, difficulties of breathing, stimulation of tears and cough.

Ozone can destroy DNA, but there was no evidence found of a cancer-supporting effect so far.

Between ozone concentration and cases of death there was no relation found as well.

4.3 Are their certain Risk Groups?

Risk factors in view of possible risk groups are the length of the ozone influence the ozone concentration as well as the volume, which is inhaled in a minute.

Only physical activity outside will have a too high ozone concentration which is dangerous for humans.

People who're working hard in the summer months outside are exposed to especially high ozone concentrations.

Usually asthmatics do not react more sensitively on increased ozone concentration than non-asthmatics. Yet Ozone effects that asthmatics react more strongly on Allergens.

Asthmatics are likely hyper-reactive, however they do not stay outside for several hours meanwhile they are training their physical fitness.

The sensitiveness of the human towards Ozone is relatively constant. It is affected by the period of daily Ozone exposure as well as time and intensity of the physical activity.

Further substances of the summer smog do even intensify the effects.

Presumably kids belong to this risk group, for their lungs are not entirely developed.

Seniors are not risk group, as they do generally stay outside on "ozone-days" because of the high temperatures more seldom.

Sportsmen are "more lung-healthy" and active than other humans on average. Subjectively they do even feel better on ozone days than others.

Humans, who do stay inside of closed rooms (Bureau-employees f.ex.) predominantly, are the least affected by the increased ozone stress.

There's also humans who're having symptoms when high ozone-concentration is detected, which are said to be connected with ozone. These concentrations are yet too small, to cause the according symptoms.

4.4 Chronic Effects

During residence of many years in areas with an extreme exposition ratio there's a rise in lung-affection (chronically obstructive bronchitis, bronchial asthma) statistically verifiable. Ozone is however only to a minor degree responsible fort his, main factors are other substances.

4.5 Effect on Plants

Increased ozone concentrations over long periods of time amount to tissue-destruction, tissue discoloration, yellowing of individual leaves and needles, lost of yield, leave deformation and accelerated aging.

This causes changes in metabolism which result in drought and insect attacks. IN addition to this it leads to a change of the consistence of botanical societies and ecosystems.

Thus membranes and photosynthesis are altered and biologically wrong intermediate metabolism-products are produced.

Ozone and following radicals alter enzymes, proteins and photosynthesis-pigments. Stress elements/factors like heat, dryness, freeze, infestation by pests, heavy metal stress and other gases reduce the defense of radicals of plants.

4.6 Limits/Boundary values
Ozone can be sensed from a concentration of 40-50 µg/m3 in the air on, if there are no further foreign substances in it.

5. MATERIAL UND METHODOLOGY
5.1 Ozone
In order to measure the ozone we used digital thermometers, digital hygrometers as well as the ozone measurement device ZIKUA from the Vistanomics Company including the related measuring tapes/stripes

The values are read from the displays of thermo- and hygrometer.

An ozone measurement required placing a testing stripe for an hour, after the measurement device has been calibrated. Subsequently the discolouring of the test stripe is evaluated and displayed as a value in ppb.

We did not measure the location ATM07-Stadtwerke. The data of this area was provided by the Hessische Landesanstalt für Umwelt, (HLUG) in the unit µg/m^3 via the Internet.

The used measuring device was built by the API (API 400) Company and the data is obtained through UV-absorption. Simultaneously conducted comparison measurements show only small differences. In order to convert the values we assumed the following comparing-value: 1ppb - 2 µg/m^3

Measuring Sites:
Goetheschule:
ATM03 weather station (temperature, precipitation, air humidity, air pressure, cloud kinds, cloud coverage, wind direction, ozone, lichen- research)
ATM06 park lot in front of the swimming hall (temperature, ozone, cloud kind, cloud coverage, wind direction)
Different rooms in school (ozone)

Traffic and industrial site of Wetzlar:
ATM07 municipal utility (temperature, precipitation, air humidity, air pressure, cloud kind, cloud coverage, wind direction, solar radiation, ozone, lichen-research, SO_2, NO, NO_2)
Leitzplatz (lichen measuring)
The biggest part of the received data was additionally saved in the GLOBE-server for further examination/analysis.

5.2 Lichens
In Wetzlar around the Goetheschule and in the Kirschenwäldchen we have searched for lichens and mapped these.

The Kirschenwäldchen is a bigger, connected woodland which begins approx. 2 kilometers from the school and represents an important recreation area close to the town.

Furthermore we took very well preserved lichens of individual kinds of this place to deploy them at the measuring sites ATM07 (Stadtwerke), ATM03 (Goetheschule) and in the town (Leitzplatz).

Fig.1: Site ATM-07

The lichens were examined with a stereo magnifier and photographed with a digital camera, mapped and specified. This way we were able to develop more precise conclusions on their condition. Moreover we were able to compare the mapping/cartography of lichens with an older examination..
We were able to form a statement about the air quality through the condition of the respective lichens.

5.3 Airway diseases
At first we started to collect information on the effects of ozone on the human body and the environment with help from existing research. We also had a meeting with Dr. Morr from the asthma-clinic in Elgershausen.

We then contacted the clinic in Wetzlar and received the statistics on the number of asthma attacks in the last two years (2006-2007).

Simultaneously, we compiled a questionnaire about the physical discomfort of the students that go to our school, which they were tasked to fill out within the period of 3 months. We then compared these results with the ozone measurements of each particular day.

5.4 Comparison with ozone data of Kingsburg Highschool
The results of each school will be compared and discussed during the attendance of the international conference (GLOBE Learning Expedition) in Cape Town (South Africa) from the 22nd -28th of June 2008 as both schools have been invited to this event. During this task we will familiarize ourselves with the results.

6 . ANALYSES, RESULTS AND CONCLUSIONS

Ozone and factors of correlation
Due to our observations in 2006, we assume that the ozone concentration in 2007 will be high again. The series of

measurements at our school and the surrounding area were started in a period of time in with a heat period changed into a rainy phase. These unfavourable conditions explain the generally low concentration in comparison with the year 2006.

As already assumed in our hypothesis, we could prove the correlations between temperature and Ozone concentration on the test point ATM-03 in a short period of time as well as on the test point ATM-07 in a time period of nearly 2 years with the following diagrams.

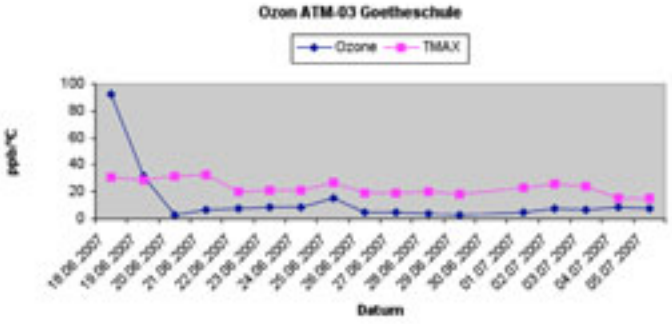


Fig.2: Ozone ATM-03 Goetheschule

They illustrate the close correlation between the measured ozone concentration and the temperature.

In the first diagram (Fig. 2) you can see how the ozone concentration increases when the temperature becomes greater. In most cases there is a strong correlation between both curves.

We hypothesize that the comparatively high ozone concentration that we measured on the 18.06.2007 can be explained with the hot weather conditions from that time. Before measurements where taken there was a period (beginning on 07.06.08) where the temperature reached 35°C , as a result of which the ozone concentration did not decrease at night as usual. Even the solar radiation reached a high-value of 850-880 W/m^2 in the previous week and the readings the city also were approximately 45 ppb.

Another reason could be that the nearby road, that is normally very busy, was not as frequently used on the previous day as it was a Sunday. As a result not as much nitrogen oxide was produced, meaning the ozone could accumulate more than usual. Additionally, the wind came from that northeastern direction.

The following illustration shows the previously mentioned correlation between the Temperature and the ozone concentration.

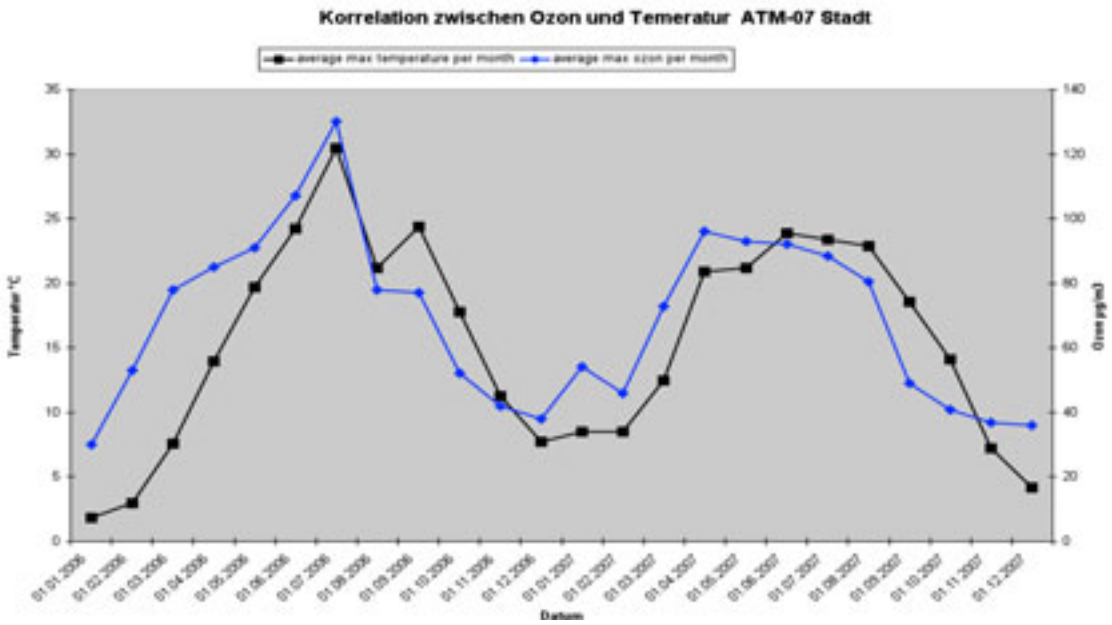
In figure 4 the correlation between ozone concentration and temperature is clarified on a statistic basis.

For this purpose half-hourly measuring values were taken over 15 days in June and averaged to two-hourly values and subtracted from an average month-value. The values of this difference are applied to the axes. It is obvious that the abnormalities correlate very likely fort he differences in high-points and low-points at these points are the same. Also one sees, that there must be other factors, which have an effect on this.

The anti-proportionality of the ozone values with the relative air humidity and the cloud coverage, as mentioned in our hypothesis, could only be verified with reference on the cloud coverage.

The air humidity doesn't show any clear anti-proportionality, as we had assumed. We will examine this however at the conduction location ATM-07 with more average-data.

Fig. 3: Correlation between Ozone und temperature ATM-07 Stadtwerke



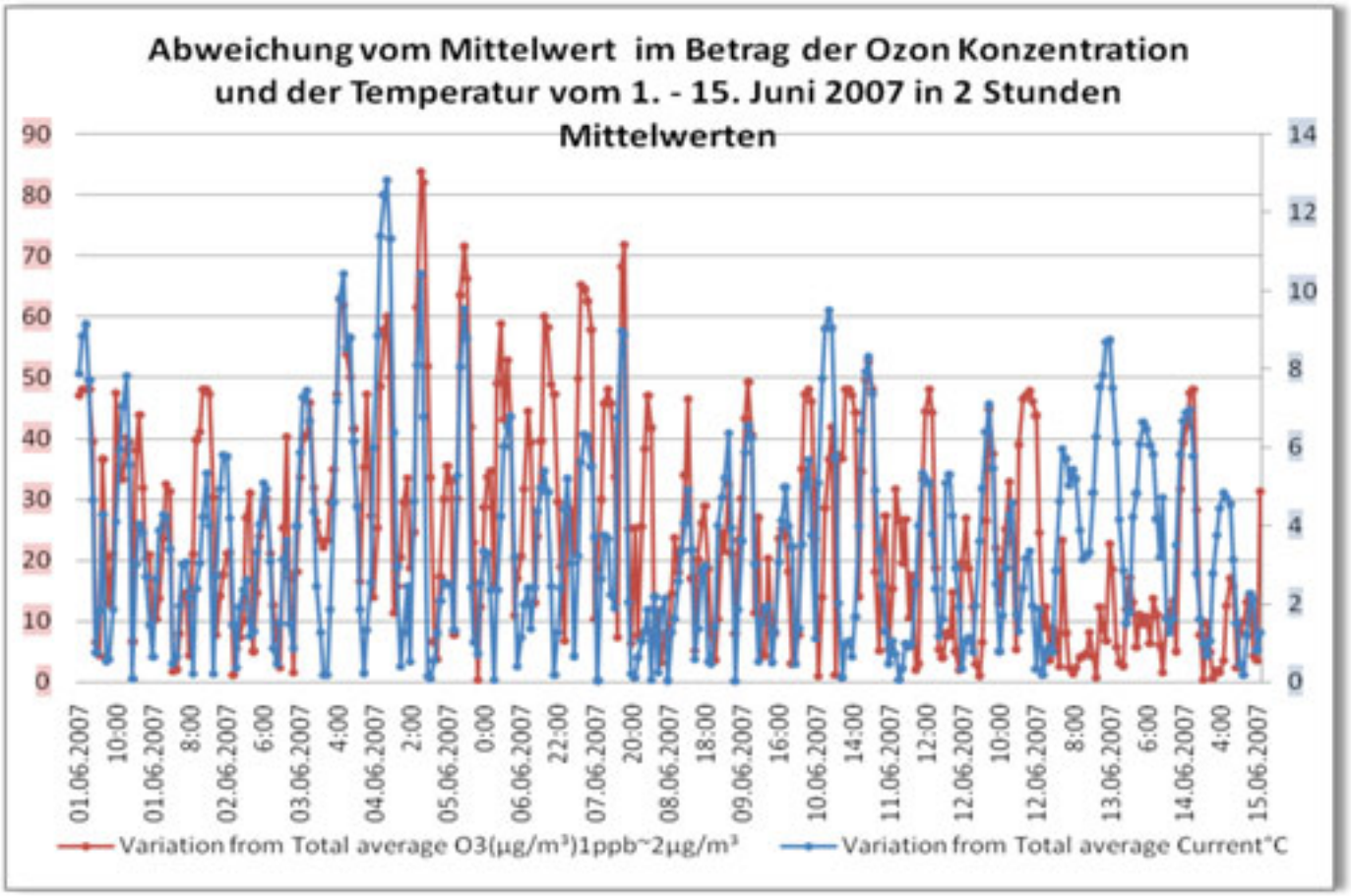
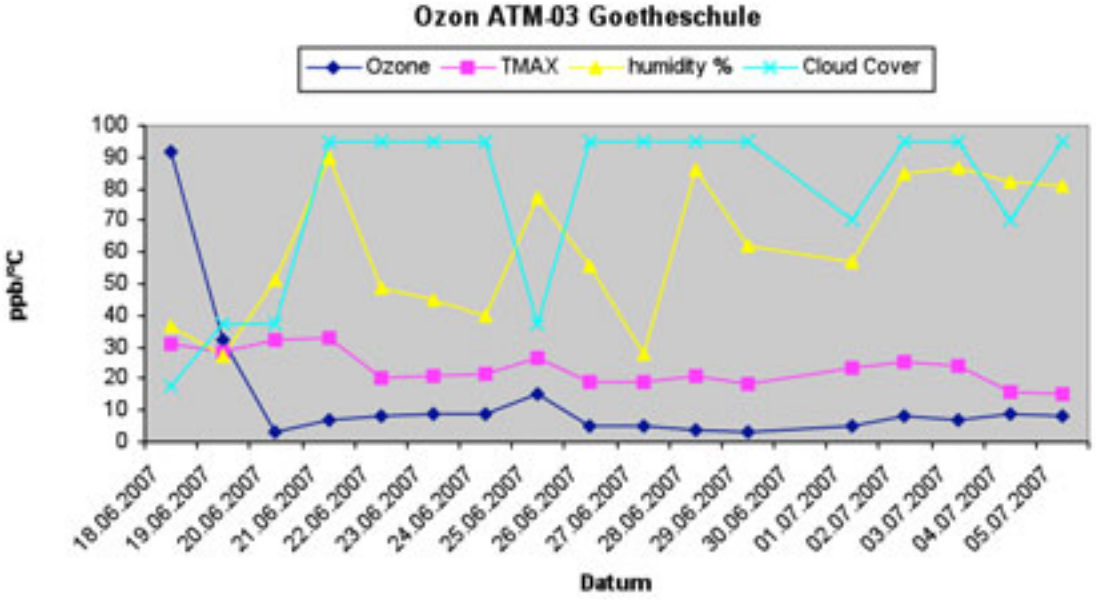


Fig.4 Variation of average O_3, temperature June 2007 01.st -15.th

Fig.5: Ozone, maximum temperature, humidity and cloud coverage.



6.2 The Ozone Exposure of the Car Park
The location of research ATM-06 is a parking site, which is directly located next to our school, holding ca. 40 individual parking lots. During the week it is completely occupied until afternoon. School begins at 8:05 a.m. and ends at different times at midday.

Out of this reason we decided to conduct the measurements at 7:45 a.m. right before school begins and at 12:20 p.m. The amount of traffic (arriving and departing vehicles) is relatively constant in this time, regarding our observations.

We compared these data to the data on weekends, when there is no school.

The following diagram depicts the amount of ozone shown in ppb in dependence to the daytime. The values were measured in the time from 18.June 2007 to 18.September 2007.

Generally one notices that the measured ozone values in the mornings are smaller than those in the mid of day.

This leads back to 2 individual factors. First, the air temperature and the UV-radiation, which is normally higher in the midday than in the mornings and secondly the expulsion of off-gas (nitrogen dioxide) which increase in the course of day and are responsible for the formation of ground-level-ozone (see 3.2 „Formation of Ozone in the Troposphere“).

Solely the values of Monday, 18th June 2007 with 60 not 50 ppb, and Friday, the 6th September 2007 with 3 not 1 ppb were an exception because at noon we measured less ground-level ozone than at the morning of the same day.

At noon of the same day (Monday) we measured a very high value of 92 ppb at ATM-03. Both measurements can't be explained right now, which is why we will keep track of this observation and examine eventual causations.

Friday can be explained more easily. Since we didn't observe the traffic volume specifically on this day an, the reason might be that fewer vehicles had left the parking site at this time on this specific day, as it was Friday and more students had left school earlier by car than they did the previous days.

A decrease of solar radiation through an increase of cloud coverage might play a similar role so that there's less nitrogen monoxide resp. atomic oxygen formed which advances the formation of ozone.

If we're now comparing the two measuring sites near our school in reference to the average ozone values, we're receiving a midpoint for ATM-03 (Goetheschule) of 8,5 ppb at 12:20 A.M, for ATM-06 (parking site) at 7:45 A.M. ca. 8 ppb, at 12:20 A.M. 13,3 ppb. If we're opposing these with the midpoints of ozone concentrations of the measuring sites ATM-07 (Stadtwerke) in the same period of time, we discover an almost twice as high value for 8:00 A.M. of 19,2 ppb as well as for 12:20 A.M. of 26,2 ppb.

The ozone exposure that we had measured at the parking site was at an average far away from the critical value of 90 ppb resp. 50 ppb for a beginning mucosa irritation but there were some isolated maximal values of 80 resp. 92 ppb, too, which is thoroughly alarming in the long run.

For this we want to perform further measurements during a period of very high temperatures in order to receive a clearer result.

6.3 Ozone and bronchial asthma
Another of our hypotheses was that there wasn't just a correlation between temperature and ozone but also proportionality with the airway affections. First we tried to in sections quarter-yearly the individual curves and developments to compare with each other for the two years 2006/2007. As an example we have here the diagram of the months January to June, which we tried to interpret.

Fig.6: Ozone ATM-06 Parking site

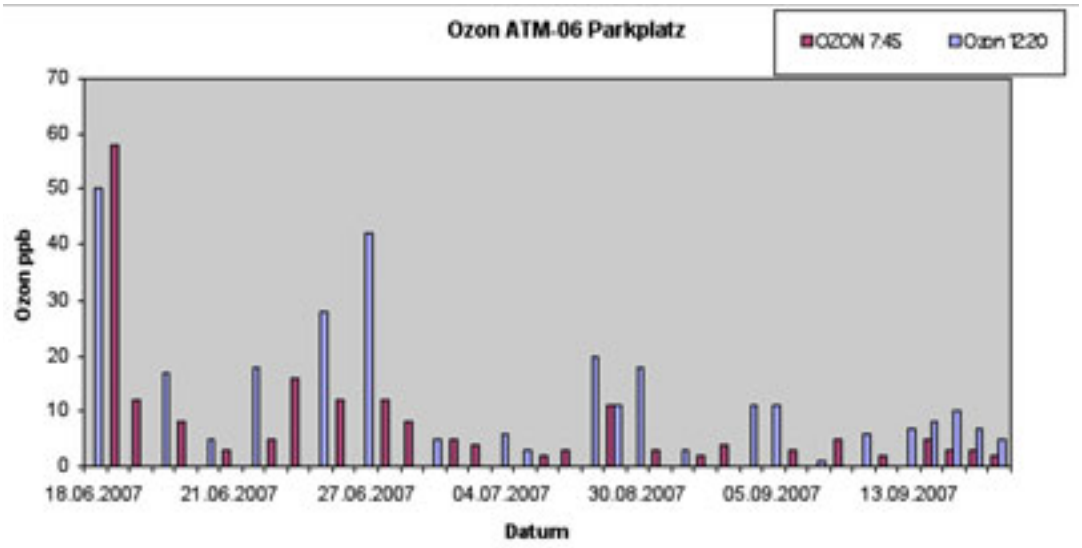


Fig.7: Ozone and airway attacks, January – March 2006

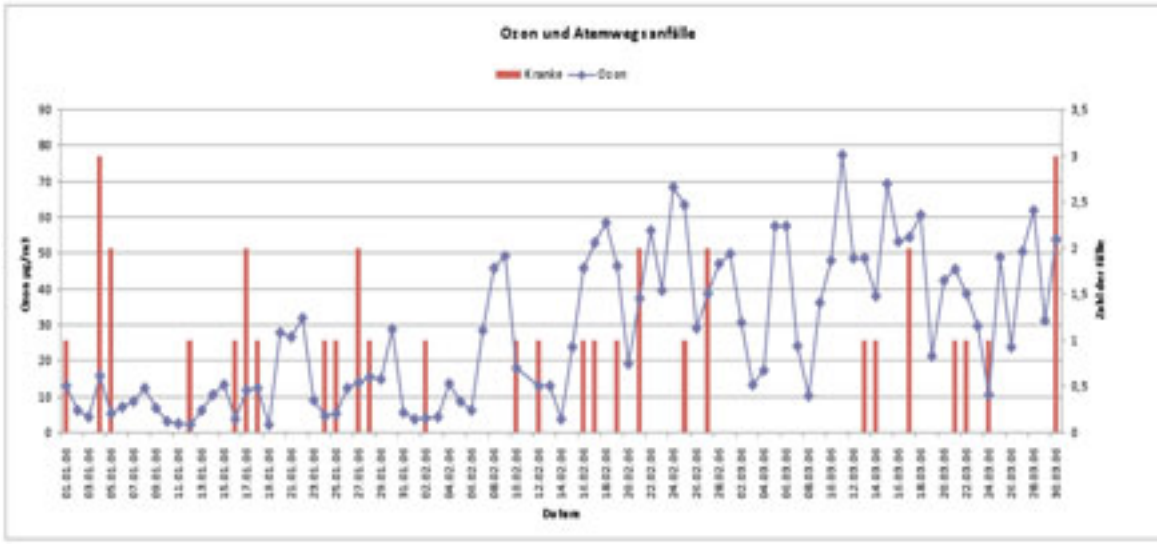
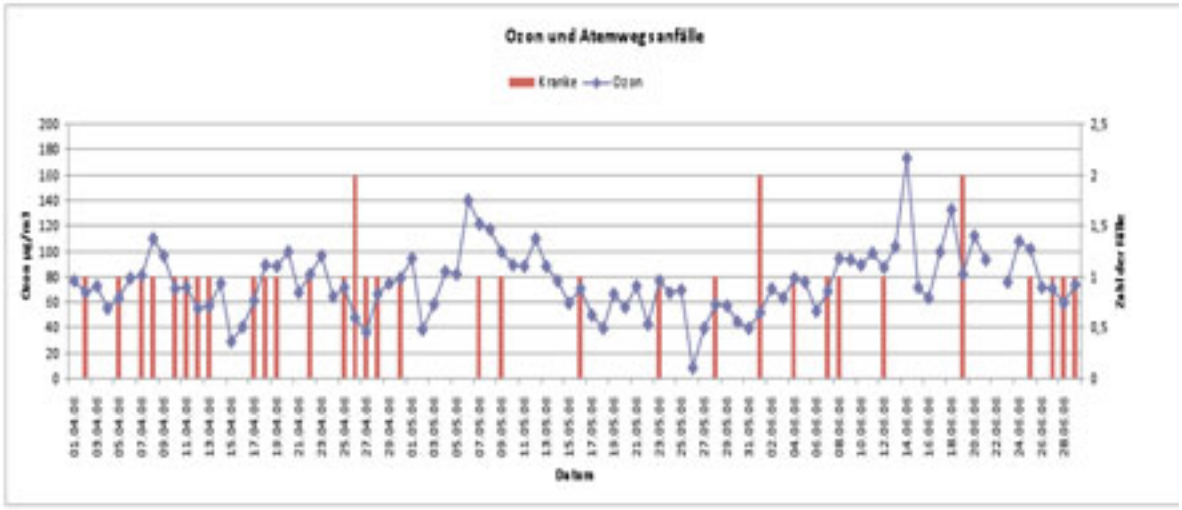


Fig.8: Ozone and airway attacks, April – June 2006



A correlation between the ozone exposure and the bronchial asthma attacks could not be detected at first. The fact is that the number of attacks increased (with delay) after a period of high ozone concentration. Patients presumably do not seek out a doctor as soon as they start having the first irritations but only when there condition worsens.

This Diagram shows the high number of asthma in April, which rapidly decreases in May, which is quite peculiar. In order to interpret other results we decided to compare the average maximum ozone concentration and the average maximum temperature of each month with the total number of attacks. The following Diagrams show these results:

In principle, the ozone concentration correlated with the Temperature (as shown on Diagram 2 and 3) and the connected solar radiation.

Following tendencies resulted while observing all the airway diseases of a month during a period of two years:

The number of attacks concerning airway diseases slightly increase in average from 2006 to 2007.

Looking at the ozone data from ATM-07 (Stadtwerke), there is only a slight change of 3 ppb between 2006 (36ppb) and 2007 (33ppb).

Through these significant findings we can now say that there is a direct correlation between the ozone concentration and the airway diseases, where there is a slight increase in the number of airway diseases and a slight decrease in ozone concentration.

Fig..9: Average maximum temperature and asthma attacks January 2006 – December 2007

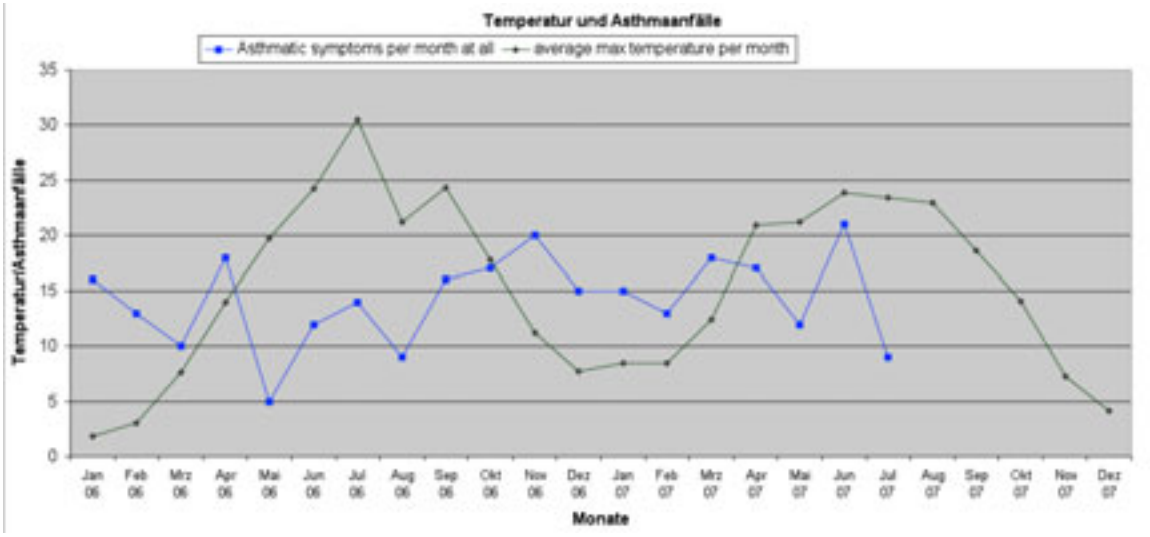
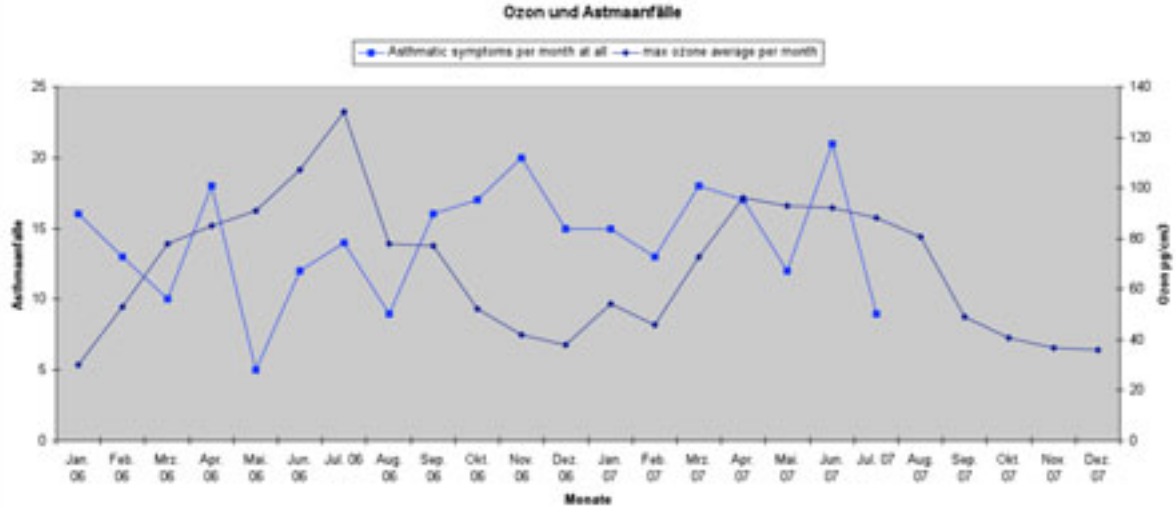


Fig.10: Monthly average maximum ozone concentration airway attacks January 2006 – December 2007



The Diagram takes on an entirely new form when the monthly averages of temperature, ozone concentration and the decline of airway diseases are compared with each other.

First of all, it is interesting how the airway diseases decrease with the increasing temperature of the months from January to the beginning of April, then how they increase during the wet and cold weather of late April and then how decrease again and adjust the pattern of temperature.

This phenomenon repeats itself in autumn 2006 and then again in spring 2007 on the exact same position, namely at approximately at a temperature of 17°C. The same kind of adaptation occurs again in summer 2007.

How can this be interpreted?

This is our theory: there are two effects that play a role. First of all, the human body appears to show some sign of adaptation and secondly this adaptation is interfered with through climatic stress (Temperature changes, Periods of rain, change of season).

In winter we normally adapt to the climate though our behaviour and by wearing clothes and keeping warm. This applies for people with airway diseases as well as all of us. In spring we tend to wear lighter clothing so that the risk of infection and the number of airway diseases increase, as we can see in the diagram of 2006.

It is remarkable that there is an exact correlation between the number of airway diseases and the monthly average temperature until the weather changes in October.

Now we react by looking after ourselves again and as a result the number of airway diseases and asthma attacks decrease. After this the adaptation follows with some delay and the number of asthma attacks correlates with the temperature and the ozone concentration, especially when the temperature grows above 20°C.

The phenomenon from spring 2006 repeats itself in autumn 2006, except with decreasing temperatures. The same kind of adaptation occurs with the same delay so that there is a correlation between ozone concentration/temperature once again. First, the number of attacks increase while the temperature decreases and then it adjusts the pattern of temperature and ozone concentration.

This is not only caused by the ozone concentration and temperature but also by the climatic stress that occurs every time the seasons change.

Additionally the number of infections is higher and the immune system is weaker in these times of year so that the number of airway diseases is automatically higher.

The high pollen count in spring causes allergies. This effect can be ignored in autumn because the pollen count is not as high.

We would like to test this theory by talking to people who have asthma as we heard that people prefer to travel to warm countries, especially in spring and autumn, to try avoiding these climate changes.

6.4 Ozone exposure and airway discomfort in our classrooms
Another question was how high the ozone concentration is in our classrooms and how it possibly could effect the students concerning breathing problems.

Through conversations with Professor Morr from the asthma clinic in Wetzlar, it became clear to us how hard it would be to connect these two factors.

We also discussed about synchronizing the ozone measurements with the results of our questionnaires, but organizing this proved to be difficult.

Due to a lack of measuring strips we decided to concentrate our research on the more critical rooms, like the IT rooms and the rooms that seemed the least problematic.

More intensive research would take place after we had the results of our questionnaire.

Our results show that the ozone concentration (especially in our science rooms) is higher when the windows are open, even when the temperature is the same.

This means that because of the solar radiation there is a higher ozone concentration outside that accumulates in the classrooms and creates critical situation for students who are sensitive to high ozone concentrations.

The ozone concentration in our chemistry room was 11 ppb but it was 21 ppb in our physics room. Our assumption that the computers in the IT rooms would increase the ozone concentration could not be proven because it was only 1-3 ppb, even though the computers were running.

In order to interpret these results we need more data from as many rooms as possible from the same time and with the same circumstances. We would need a large number of measuring devices in order to do this. Unfortunately, we only had two available.

In order to compare the ozone concentration with the number of airway diseases we needed enough data to allow us to evaluate the health conditions of each student and how he/she feels in each room.

We then developed a questionnaire and hoped to find students who would voluntarily take part in our survey for several weeks. The structure of a questionnaire is described in the attachment. At first, we could motivate about 60 students to take part.

The feedback (the number of completed questionnaires that we got back) was rather disappointing: we have the data of approximately 20 students at our disposal.

This poor result has several reasons, one of which is that the design of the survey was confusing and partly unusable, as a result of which the subjects had difficulties filling it out. Offering support to the subjects was also rather problematic as they came from different and even different year groups and we had no personal contact to them. We also didn't have any contact point for questions or problems, as a result the motivation to take part in the project suffered.

We have to make sure that the organization (internal and external) of future surveys are coordinated better, maybe by having fixed hand in dates and announcing people as contacts. Unfortunately we did not have this knowledge beforehand.

Despite this negative experience we went through great lengths to evaluate the little data we had at out disposal. A differentiated evaluation of the symptoms failed because of this lack of data and we were also not able to assign the data to specific rooms.

The diagram shows the frequency of the symptoms depending on the date and time (measurements were taken daily at 13:00 at ATM-07 "Stadtwerke"). We had to look for alternative data sources because had so little data from our school and looked if there was any connection between the two values.

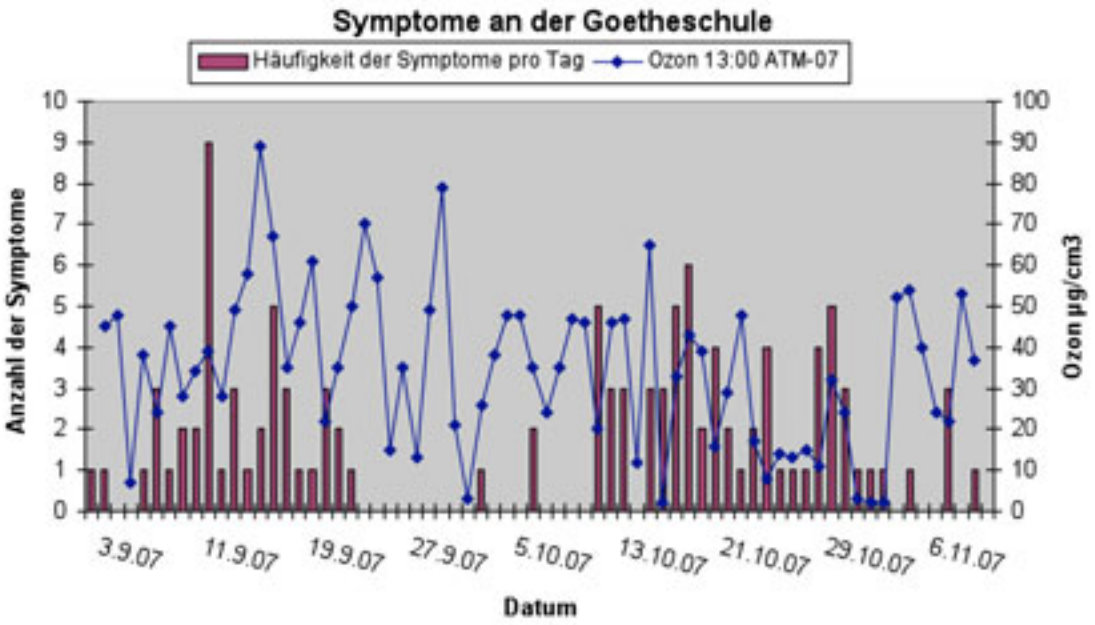
The measured Ozone data did not correlate with the results of the questionnaires/with the appearing symptoms.

We have a few explanations for this:

First of all, it hast to be clear that the measured ozone concentration did not even reach the lowest threshold mentioned in literature.

Secondly, the measurements were taken outside but the survey was taken inside the school building. The ozone

Fig.11: Symptoms at Goetheschule and ozone concentration at 13:00 p.m. of ATM-07



concentration is higher outdoors than inside, as previously explained. Thus the measurements that were taken outside cannot explain the symptoms from inside the building. Besides that, the mentioned symptoms could have miscellaneous reason, not only ozone. The SO_2 –concentration in the air could have also been a catalyst for the airway diseases that was ignored out of time problems. We concentrated on the number of problems and not what kind of airway problem.

We could not find any connection between the ozone concentration and the symptoms only with the questionnaire. The diagram also does not show any kind of connection, which is not really astonishing.

6.5 Ozone and Lichens as Bio Indicators
We were able to create the following diagram by defining and mapping different kinds of lichens the surrounding area of our school.

Essentially, we have to note that the researched lichens are bio indicators for the sensitivity to SO_2 and are used to determine the air quality. We found it interesting if different ozone concentrations reflected on different occurrences of the lichen types. We read that this is possible with plants in BERGMANN, E. (1996). We couldn't find any literature like this about lichens.

It is also our opinion that Sulphur dioxide could interfere with results, especially because Lichens are so sensitive to it and to photo-oxidants as well.

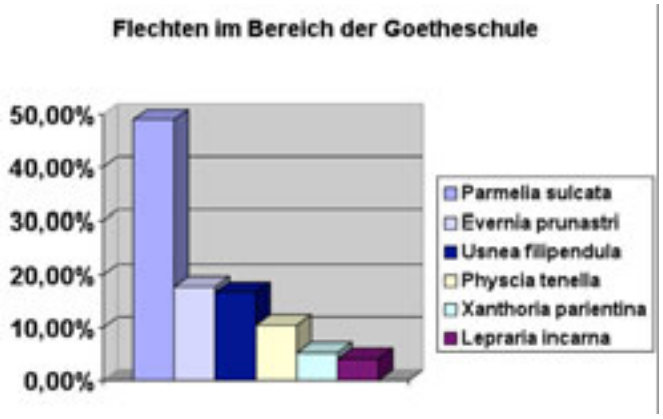
Lichens are periodically wet organisms, that have an increased metabolic activity during periods of wet weather so that they are more sensitive to ozone. However, the ozone concentration is generally low during the wet seasons. In summer lichens go into a state of "dry-rigour" to make themselves more resistant against solar radiation and the increased ozone concentration. This could be a problem when using lichens as bio-indicators for ozone.

It is noticeably how often the species Pamelia sulcata appears. This is not remarkable as it is one of the most common and widely spread foliose lichen in settlement areas and because the air is classed as "moderately polluted" (it tolerates 0.06 – 0.07 mg SO_2/m^3 in the air). The lichens Xanthoria parietina and Physcia tenella belong to the same category and support this evaluation.

The species Usnea filipendula is a sign for "very good" air because it only tolerates air with concentrations till 0.05 mg SO_2/m^3

Evernia prunastri fills the gap between "moderately polluted" air and "very good" air and is therefore an indicator of "marginally polluted" air.

Fig 12: Lichens in the sphere of Goetheschule



SO_2 mg/cm^3	> 0,15	0,1 - 0,15	0,07 - 0,1	till 0,06	till 0,05	< 0,05
Air quality	**heavily polluted**	**polluted**	**moderately polluted**	**marginally polluted**	**good**	**very good**
		Lepraria incarna	Parmelia solcata	Evernia prunastri		Usnea filipendula
			Physcia tenella			
			Xanthoria parietina			

Due to the appearance of certain lichen species, we have come to the conclusion that area around our school has a "moderately" to "marginally "polluted air quality. This does not contradict the measured ozone concentration or the assumed influence on the appearance of lichens.

We can only make a conclusion about the change in air quality in Wetzlar regarding our school and not the whole area of Wetzlar through comparison with an existent lichen mapping from 1996 (by MARX, A).

It was assumed in 1996 that in comparison to earlier studies the general air quality, especially around the border areas, has improved.

In this report the appearance of Physcia tenella was indicated to be 60-100%. Today our investigations show it to be only about 10%. The species Usnea filipendula did not even seem to exist in 1996 in the area of our school but today is its appearance is about 17%.

The spreading of Usnea filipendula from the higher situated "cherry woods" (Kirschenwäldchen) suggests that the air quality around our school has improved since 1996 as this species is a bio indicator for very good air.

We would like to discuss this with Professor Kirschbaum, an expert of lichen studies, who operates in the college of higher education in Gießen, in the near future as well.

Some preliminary investigations through determinations of species in the city centre show that on the one hand there are local lichen-deserts. On the other hand there are places where lichens grow scarcely and even places where they grow vigorously. We are also planning some research in this field, as we cannot tell whether or not the air quality has improved in this area.

This raised the following questions, which we plan to explain in future projects:

- How will the lichen species Evernia prunastri, which we placed in the city center at our measuring point ATM-07 (Stadtwerke) and Leitzplatz in August 2007, change (They don't usually grow in this area!) The necessary macro photograph on the condition was made in August 2007. (See attachment)
- How does this lichen react to the different pollutant complexes?
- Do sulphur dioxide and ozone interact?
- How do both concentrations act during the day/ during the different season?
- How will a constant ozone concentration (artificially produced by an ozone-generator) effect the growth of the different lichen species over a long time period?

The Ozone, sulphur dioxide and nitrogen dioxide concentrations have to be measured simultaneously and continuously in order for us to carry on our work and are necessary for an eventual conclusion.

DISCUSSION AND SUMMARY

1. Just like we hypothesized, we could prove that the ozone concentration is proportional to the air temperature and disproportional the cloud cover both at the measuring point at the Goetheschule and at the measuring point in the city center (Stadtwerke). Due to the data we had from the measuring point "Stadtwerke", we could statistically analyze and proved this.

2. Our hypothesis that the ozone concentration is disproportional to the air humidity could not be confirmed.

3. Due to the lack of time we had available we could not investigate if the ozone concentration is dependant on the sulphur, nitrogen and carbon dioxide concentration or on electrical storms, which is why our statements are only based on technical literature. According to this the concentration does, as a matter of fact, depend on the factors mentioned above, even if in different levels.

4. A correlation between ozone concentration and the number of asthma attacks or airway diseases in the clinic in Wetzlar could only be partly proved, however we discovered another connected close interaction through this.

   This effect intervenes with the correlation in spring as well as autumn of the testing years 2006/2007 and causes a temporary rise of airway affections through the weather change in spring respectively autumn, followed by a delayed adaptation after which both curves correlate until next climate stress.

The phenomenon appeared 3 times in both test-years and we're curious whether our interpretations will be confirmed, as we receive the requested data of autumn and spring 2007/2008.

Should this be the case, we can prove that the situation of the weather change and thereby the changing ozone concentrations have very likely a rise of airway affection as a consequence.

5. The ozone concentration measurements in Wetzlar didn't reach the critical values most of the time. In the few cases, they did, there were peak values, which could only be verified over a short time and had thus no sustainable effect on its environment. Therefore it was no manipulation of the local climate and health through ozone to be detected.

   The average ozone values are two times as high at the measuring site ATM-07 (Stadtwerke) as the surrounding environment of our school ATM-03 (Goetheschule). This is a concrete need for action to our mind, but it would be desirable to aspire a reduction of the emissions in order to reach the same air quality in the city's center as it is in the surrounding area of our school.

6. The special function of lichens' as bio-indicators for ozone could not be verified, which does in turn lead back to the low ozone concentrations, the complexity of these organisms (sensitivity against sulphur dioxide and other air components) as well as the fact that plants react on changes of their environment in the long run. Through a comparison with lichen mapping of the year 1996 we were able to show that the different species has changed in the direct environment of our school positively in reference to the air quality, because a further species, which is an indicator for very good air quality, was specified.

7. We could not compare results with the Kingsburg Highschool and thus we also could not confirm or disprove our sixth hypothesis, as we do not have any data from them yet. This will take place during the GLOBE Learning Expedition.

Conclusively, we can say that examining ozone and its effects on the environment proved to be quite difficult, as most of the results could not be distinctively assigned to the ozone factor. There are a lot of substances in the air that could also have an effect on the environment and on our health. It is hard to tell which substance is responsible for which effect. In order to make accurate statements about the effects of ozone we would need to experiment with pure ozone. The natural ozone concentration at ground level was not suitable for this.

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Anhang
Die zusätzlichen Daten, Tabellen, Grafiken und Bilder wurden wegen des großen Umfangs auf CD beigelegt.

Atmosphere

School: Apeejay Public School, Delhi, India

SUMMARY:
The project was awesome, we increased our knowledge by this endeavor.

ABSTRACT:
This is a project about clouds, clouds and just clouds. It is a detailed study of clouds. Cloud is a subject which people study rarely but with this project we get to know every tit bit of clouds.

HYPOTHESIS:
This was truely a nice experience I have ever had. I came to know everything about the clouds, its types, colour etc. The things which I did not judge earlier I know look very often.

The purpose of this is to help the Indian Department of Science to check the effect of pollution on the atmosphere and help reduce it.

RESEARCH METHOD:
For this project we used to check the cloud type daily at 12:30 and with the help of a mirror we used to check the temperature daily at the same time.

Also we took the PH of rain with the help of PH paper.

ANALYSIS:
With this study we come to know about the various types of clouds.

This project helped me think more about clouds, its types and cover.

CONCLUSION:
It can be concluded that clouds of our area (Pitampura) are generally cirrostratus.

BIBLIOGRAPHY:
I would like to thank our teacher Ms Sakshi Gupta for giving us such a brilliant opportunity.

Also I thank the organiser of this project. I would like to thank my team members Sonalika and Anisha.

I hope we will be given such assignments in future also.

DATA SUMMARY:

CLOUD TYPE	MONDAY	TUESDAY	WEDNESDAY	THURSDAY	FRIDAY	SATURDAY	SUNDAY
CIRRUS	No	No	YES	No	NO	No	NO
CIRROCUMULUS	No	No	No	No	No	No	NO
CIRROSTRATUS	NO	Yes	No	Yes	No	No	NO
ALTOSTRATUS	No	No	No	No	No	No	YES
ALTOCUMULUS	No	No	No	No	No	No	NO
CUMULUS	No	No	Yes	No	No	No	NO
NIMBOSTRATUS	No	No	No	No	No	No	NO
STRATUS	No	YES	No	No	No	No	NO
STRATOCUMULUS	No	No	No	No	No	No	NO
CUMULONIMBUS	No	No	No	No	No	Yes	NO

The Health Effects of Mineral Concentrations in Potable Water

School: Zelyonoborskaya School Gymnasium Shchuchinsky Rayon, Akmolinsky Oblast Zelyony Bor, Kazakhstan
Students: Veremeenko Kristina, Pak Julia, Bortaev Olzhaz, Tyan Andrey, Konkabaeva Asiya
Teacher – GLOBE: Tamara Lyssachyova

ABSTRACT
The purpose of the scientific project is identification of the quality of drinkable water of Zeleniy Bor and of Schuchinsk, and the investigation into the influence of high consistent fluorine, calcium and magnesium salts on people's health.

Tasks of the study:
- The collection of water samples from the waterhole of Zeleniy Bor
- The chemical water analysis
- Discovering of the diseases passed through water
- The preventing of possible diseases due to the high salts consistent in the water

Hypothesis:
If we determine the quality of drinkable water in Zeleniy Bor and establish the possibility of diseases being caused by poor quality of drinkable water, we can propose methods of prophylaxis towards preservation of people's health.

Methods of research:
- The chemical analysis of drinkable water,
- The statistical research into kidney stone disease and caries of tooth enamel,
- Literature search on the subject of investigation.

Practical results:
The salt content of the drinking-water of Zeleniy Bor and Schuchinsk exceeds the norm. The common water hardness of Zeleniy Bor makes 17 micro equiv. /dm^3, which exceeds the norm by more than 4 times. The drinking-water of Schuchinsk contains fluorine 3,96 mgs/l, compared to the norm of 1,5 mgs/dm^3 [1]. This causes distribution of kidney stone illness, caries of dental enamel and fluorosis.

From a study of the records of medical establishments, 10% of the population of Zeleniy Bor appealed for medical help to combat diseases which are caused by the use of drinking water with high hardness levels. More than 30% of the children in Schuchinsk city suffer from tooth enamel decay.

Such information gives rise to alarm, and a determination to find the methods of reducing the concentration of salts in water.

The known methods of reducing concentration of salts in water are boiling and freezing. We tested both methods and got the following results:

- The concentration of fluorine is reduced by boiling by 10%, and by freezing by 15%.
- Hardness in water is reduced by boiling by 30 %, and by freezing by 75 %.

Conclusions:
High retention of salts of calcium and magnesium causes high inflexibility of drinking-water, which is instrumental in the appearance of kidney stone illness for habitants in the area of the Zeleniy Bor, and the high retention of salts of fluorine in water causes fluorosis of dental enamel for the children of Schuchinsk town.
The drinking-water of these settlements needs cleaning.

INTRODUCTION
Water! You haven't a taste, a color, or a smell. We enjoy you although we don't know what you are. One can't say that you are necessary for life, for you are life yourself.
-Antoine de Saint Exupéry

The need, compelling us to investigate drinking-water, was due to the fact that, for many children of Schuchinsk town, their teeth have yellow and quite often staggered spots. It was determined to be the fluorosis – a result of high content of fluorine in the drinking water. The wide spread of fluorosis in the mentioned locality led us to investigate of the high levels of fluorine in the drinking water coming to the town from an open source, which is lake Shuchye.

In addition, many habitants of our village Zeleniy Bor had applied for medical treatment in connection with caries of dental enamel and kidney stone illness. These diseases also led us to the investigation of the high retention levels of salts of calcium and magnesium in the drinking water of Zeleniy Bor. High levels of hardness in water is detrimental to health. It also does damage in economic life, because such water incapacitates mechanisms utilizing water: washing machines, heating radiators, water boilers being some examples.

The problem of achieving reduction in high levels of salts in water is important and current for our region. We use untreated water for personal hygiene and for preparation of food. Every habitant of the village is aware of the high levels of scum which accumulates on the internal walls of cooking vessels, and appears when water is boiled (for example, on the sides of tea pot or pan). Salts which are contained in drinking-water also enters our bodies. What effect do these salts have on a healthy person?

We set up the following hypothesis:
If we determine the quality of drinkable water in Zeleniy Bor and establish the possibility of diseases being caused by poor quality of drinkable water, we can propose methods of prophylaxis towards preservation of people's health.

Water is life. Does a person think about the meaning of this phrase to himself? We are surrounded by water. It is not only under us and above us, but it is also in us. A person can live without it for only a few days. Water is the most widespread matter yet it remains the most unstudied.

The water which we use must certainly be clean. Diseases which are spread through contaminated water can cause health problems, disablement, and fatal illnesses, especially in children.

Infectious hepatitis, brucellosis, poliomyelitis, tularemia can be spread through water. At times water becomes a source of man's infection by worms, which are parasitic animals. The quality of water is also defined by the presence of chemical combinations, which are distinguished first by one's sense of smell and eyesight. Micro particles of copper give some opaqueness to water. Micro particles of iron give some red color to water.

Water is crucial to a person's health. Practically all its sources are exposed to man-made pollution of various intensities. The sanitary conditions of a majority of our open water reservoirs were improved last year because of a decrease in industrial waste and pollution, but the quality of the water is still a concern.

The concentration of calcium and magnesium combinations in drinkable water has a major influence on man's health. Certain compounds cause common water hardness. Calcium and magnesium form insoluble salts with organic and mineral acids. Those salts gather in kidneys or liver and cause various diseases. Analysis showed that drinkable water of our town contains a high level of calcium and magnesium salts. Furthermore, calcium is deposited in the organs and causes the progress of oncology diseases and the upset of the nervous system.

Fluorosis is an infringement of the enamel structure during the period of the development of teeth. It is evidenced by yellowish and white spots, sometimes erosions on teeth.

There are four degrees of tooth decay due to fluorosis:

The first degree is a very weak level of decay. There are separate surface marks, shallow and similar to porcelain, and chalk spots or strips, which occupy about 1/3 of affected teeth surface (sketch 1).

The second degree is weak decay. There are separate or multiple, opaque marks, similar to porcelain, and chalk spots or strips, which occupy just about half of the tooth's surface (sketch 2).

The third degree is moderate decay. There are big spots, which occupy more than half of the tooth's surface. These spots alternate with dark yellow or brown parts of intensive pigmentation (sketch 3).

The fourth degree is intensive decay. In addition to signs of third degree, there is evidence of significant decay of tooth enamel, which shows as colourless or marked brown pigmentation, which give a "pocked" colour effect to the most seriously affected teeth (sketch 4).

The nature of fluorine was established exactly. It is known that the cause of fluorosis is due to ingestion of high concentrations of fluorine ions during the period of tooth formation. The principal source of these fluorine ions is drinking water.

Materials and Methods:
We used the following materials and methods.

Materials
- Standards of drinking water of Zeleniy Bor and Schuchinsk city,
- Chemical reagents,
- Device for determination of conductivity,
- Secchi discs,
- Thermometer,
- Burettes,
- Chemical laboratory equipment
- Calorimeter.

Research methods:
- Globe procedures for determination of transparency of water,
- Measurement of content of salts,
- Measurement of conductivity,
- Use of pH-meter,
- Use of chemical analysis,
- Calorimetric determination of content of fluorine,
- Measurement of temporal and permanent hardness of water by titrometric method.

The quality of drinking water was determined using the GLOBE protocols.

Determination of presence of sulfates:
- Prepared a clean test tube
- Filled the test tube with the water sample
- Added barium chloride to the water sample
- Looked for the presence of white sediment that testifies to the presence of sulfates in the water.

$CaSO_4 + BaCl_2 = BaSO_4 \downarrow + CaCl_2$

Determination of presence of chlorides:
- Prepared a clean test tube
- Filled the test tube with the water sample
- Added silver nitrate to the water sample
- Looked for the presence of white sediment that testifies to the presence of chlorides in the water.

$CaCl_2 + 2AgNO_3 = 2AgCl \downarrow + Ca(NO_3)_2$

Determination of presence of carbonates:
- Prepared a clean test tube
- Filled the test tube with the water sample
- Added calcium hydroxide to the water sample
- Looked for allocation of gas that testifies to the presence of carbonates in the water.

$MgCO_3 + 2HCl = MgCl_2 + CO_2 \uparrow + H_2O$

Determination of presence of phosphates:
- Prepared a clean test tube
- Filled the test tube with the water sample
- Added silver nitrate to the water sample
- We looked for the presence of yellow sediment that testifies to the presence of phosphates in the water.

$Ca_3(PO_4)_2 + 6AgNO_3 = 2Ag_3PO_4 \downarrow + 3Ca(NO_3)_2$

Determination of presence of sulfides:
– Prepared a clean test tube
– Filled the test tube with the water sample
- Added lead nitrate to the water sample
- We looked for the presence of black sediment that testifies to the presence of sulfides in the water.

$MgS + Pb(NO_3)_2 = PbS \downarrow + Mg(NO_3)_2$

HOW TO MEASURE PH
Intermediate and Advanced Levers
In order to measure the pH of our water sample using the pH meter we did: (1) prepared buffer solutions, (2) calibrated the instruments, (3) rechecked our instrument by measuring the buffers in the field, and (4) measured the pH of our sample in the field.

Step 1: Prepare the Buffer Solutions
For each pH buffer (4, 7 and 10)
1. We wrote the buffer pH and date on two pieces of masking tape, place one on a clean, dry 100 mL beaker and the other on a 50 ml bottle.
2. Using a graduated cylinder, we measured 50 mL of distilled water and poured it into the beaker.
3. Over the beaker, we completely cut open one end of a pillow of buffer powder, then we squeezed and hake the pillow to release the powder into the water. We made sure all the powder is released into the water. We stirred with stirring rod until all the powder dissolves.
4. We poured the powder solution into the labeled bottle. We caped the bottle tightly then discarded after a month.
5. We continue preparing the other buffers, repeating steps 1-4 for each.

Step 2: Calibrate the pH pen or meter
Calibration of the pH meter
1. We conditioned the electrode (probe) as described in the manufacturer's instructions.
2. We rinsed the electrode and area around it twice with distilled water using a squeeze bottle and blot dry with a soft tissue after each rinse. We rinsed into a discard beaker or sink,
3. We turned the meter on (by pressing the ON/OFF button). We pushed the CAL button to indicate that we will be calibrating the instrument.
4. We immersed the electrode in the pH 7.0 buffer solution, making sure that the electrode is entirely immersed. We did not immerse the instrument further than is necessary. See Figure HYD-P-3.
5. Gently stir the buffer solution with the electrode and wait for the display value to stabilize. Once the reading has the HOLD/CON button to accept the value and complete the calibration. If the electrode is still immersed in the buffer, the display will read the same value as the pH of the buffer (i.e. 4, 7, or 10).
6. Remove the pH tester from the pH solution, rinse the electrode with distilled water, and blot dry with soft tissue.
7. Repeat steps 3 tough 6 using the pH 4 buffer and then using the pH 10 buffers.
8. Set the tester aside on a paper towel; turn the meter off by pushing the ON/OFF button.
9. Pour the buffer solution into their labeled bottles and cap then tightly.

pH Measurement Procedure
1. Rinse the electrode and the surrounding area with distilled water using the squeeze bottle. Blot he area dry with a soft tissue.
2. Fill a clean, dry 100 mL beaker to the 50 mL line with the water to be tested.
3. Immerse the electrode in the water. Be sure that the entire electrode is immersed, but avoid immersing it any further than necessary.
4. Stir once and then le the display value stabilize.
5. Once the display value is stable, read the pH value and record it in the Hydrology Investigation Data Work Sheet.
6. Repeat steps I through 5 for another sample as a quaintly control check. The two pH value should agree to within 0.2 which is the accuracy of this technique.

7. Rinse the probe with distilled water, blot it dry with soft tissue, replace the cap on the probe, and turn the instrument off.
8. Take the average of pH values measured by the student groups. If the recorded values are all within 0.2 of the average, report the average to the GLOBE Student Data Server. If there is one outlier (a value far different from the rest) discard that value and calculate the average of the other values. If they are all now within 0.2 of this new average it can report this new average to the GLOBE Student Data Server

ELECTRICAL CONDUCTIVITY PROTOCOL
How to Measure Conductivity
1. Remove cap from the meter ad press the ON/OFF button to turn the tester on.
2. Rinse the electrode with distilled water and blot it dry.
3. Fill a clean, dry, 100 mL beaker with water to be tested.
4. Immerse the electrode in the water sample. See Figure HYD-P-4.
5. Gently stir the sample for a few seconds, and then allow the display value to stabilize.
6. Read the display value and record its value on the Hydrology Investigation Data Work Sheet.
7. Take the average of electrical conductivity values measured by the student groups. If the recorded values are all within 40 micro Siemens/cm of the average, report the average value to the GLOBE Student Data Server. If you have more than three groups and there is one outlier (a value far different from the rest), discard that value and calculate the average of the other values. If they are now all within 40 micro Siemens/cm of this new average, report this new average to the GLOBE Student Data Server. If there is a wide scatter in results, discuss the procedure and the potential sources of error with the student, but do not report a value to the GLOBE Student Data Server. Repeat the protocol if possible to produce a reportable measurement.

CALIBRATION AND QUALITY CONTROL
Salinity Standards
Salinity Standards do not come with the Hydrometer, and need to be prepared as follows:
1. Add water to table salt to make 35 ppt salinity standard. Use this salinity standard and a blank to test the accuracy of the hydrometer.

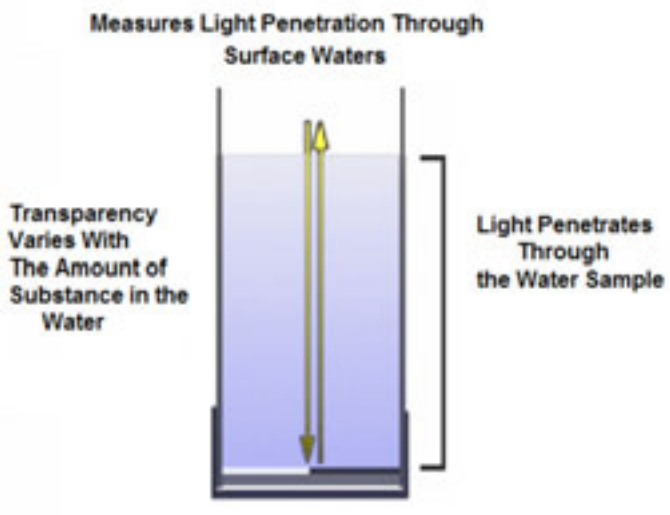
35 ppt standard:
1.1 Measure out 17.5g NaCl (table salt) using an analytical balance. Pour this into a 500 mL graduated cylinder.
1.2 Fill the cylinder to the 500 mL line with distilled water.
1.3 Carefully swirl the solution until all the salt has dissolved.
1.4 Pour the solution into a l-liter practice bottle and label with masking tape (include the date)

HOW TO MEASURE SALINITY
Note: before using the thermometer in this protocol, test it for accuracy following the instructions in *Maximum, Minimum, and Current Temperature Protocol* of the *Atmosphere Investigation.*
1. Rinse the 500 ml clear plastic graduated cylinder at least twice with sample water.
2. Fill the cylinder with sample water until the water level is 2 to 3cm from the top of the cylinder.
3. Determine the temperature.
4. Place the hydrometer in the cylinder and allow it to settle. Follow the manufacturer's instructions that came with the hydrometer. The hydrometer should not touch the cylinder walls, and be sure to take the reading from the *button* of the meniscus. Read the specific gravity from the hydrometer scale. Reading to three decimal places is acceptable.
5. Using the temperature and specific gravity values, read the salinity of the sample from Table HYD-P-3. To find the salinity value for your water sample:
5.1 Look up the temperature and specific gravity of the sample in Table HYD-P-3.
5.2 Look at the corresponding salinity (ppt) and record and record in on the Hydrology Investigation Data Work Sheet. For example, a water sample temperature of 22^0 C and specific gravity of 1.0070 has a salinity of 10.6 ppt.
6. Repeat steps 2-5 for at least two additional samples. Different student groups can make these additional measurements.
7. Take the average of the salinity values measured for the different samples. If the recorded values are all within 2 ppt of the average, proceed to step 8. If they are not within 2 ppt of the average, students should repeat the measurement using new samples, then record and average the new values. If there is still one outlier (a value far different from the rest) discard that value, average the remaining values, and if they are now within 2 ppt of this new average, proceed to step 8. If there is still a wide spread in values, discuss the procedures with the students and repeat the measurement if possible.

TRANSPARENCY
- Suspended solids scatter light passing through the water and cause the water to become "cloudy".
- The transparency of water determines the depth to which aquatic plants can grow.
- Transparency is measured by using a Secchi disk or a transparency tube.
- The Secchi disk is used in deep, still waters
- The transparency tube is used in shallow or flowing waters

Transparency Tube Reading
- Pour the sample water into the tube until the image at the bottom of the tube is no longer visible when looking directly through the water column to the image.
- Rotate the tube while looking down through it to see if the black and white areas of the decal are distinguishable.

- Record this depth of water on the Hydrology Investigation Data Sheet to the nearest 1 cm.
- If the tube is filled to the top and you can still see the image, simply record the length of the Tube and put a greater than (>) symbol in front of it.
- The tube reading should be made by three different student groups and each measurement must be reported separately.



WATER TEMPERATURE PROTOCOL

How to Measure Salinity

1. Tie one end of a piece of string securely to the end of the thermometer and the other end to a rubber band. Slip the rubber band around the wrist so that the thermometer is not lost if it is accidentally dropped in the water.
2. Hold the end of the thermometer (opposite the bulb) and shake it several times to remove any air in the enclosed liquid. Note the temperature reading.
3. Immerse the thermometer to a depth of 10cm in the sample water for three to five minutes.
4. Raise the thermometer only as much as is necessary to read the temperature. Quickly note the temperature reading. If the air temperature is significantly different from the water temperature or it is a windy day, the thermometer reading may change rapidly after it is removed from the water; try to take the reading while the bulb of the thermometer is still in the water. Lower the thermometer for another minute or until it stabilizes. Read it again. If the temperature is unchanged, proceed to Step 5.
5. Record this temperature along with the date and time on the Hydrology Investigation Data Work Sheet.
6. Take the average of the temperatures measured by the student groups. If all measured values are within 1.0o C of the average, submit the average value to the GLOBE Student Data Server. Otherwise, repeat the measurement.

THE METHOD OF FLUORINE CONSISTENCE' EXPOSITION IN WATER BY COLORIMETER

1. Preparation of reactive

a. Work standard solution with 0, 1 mg/l fluoride consistence: 0, 28 mg of fluorine natrium, which was dried until constant mass with 100^{o} C, is diluted in measurement retort on 1000 ml.
b. Work standard solution with 0, 05 mg/l of fluoride is prepared by dilution of standard solution in 20 times. It means that 5 ml of this solution is placed to measurement retort on 100 ml and is reduce by distillate water to mark.
c. Preparation of 0, 0005 normal alizarin complex solution: 0, 1927 g of alizarin complex is placed to measurement retort on 1000 sm^{3}; 5 – 6 drops of 4% natrium hydroxide and 500 ml of distillate water are poured for better dissolubility; 0, 25 g of natrium acetate is added and solution is mixed awaiting reagent dissolubility. Then 0, 1 normal solution of salt acid is poured by drops until color passage from red-orange to yellow (it corresponds to pH=5) and solution volume is reduced by distillate water to mark.
d. Preparation of acetate buffer solution (pH = 4, 5 ±0, 2). 105 g of three water natrium acetate is placed to glass on 500 ml, 300 ml of water is poured, salt is dissolved, solution is transferred to measurement retort on 1000 ml, 100 ml of ice vinegarish acid is added, solution is mixed and volume is reduced to mark.
e. Preparation of 0, 0005 normal nitrate lanthanum solution: 21, 66 g of six water nitrate lanthanum is placed to measurement retort on 1000 ml, 200 – 300 ml of water and 1 ml of 1 normal nitrogenous acid solution are added, salt is dissolved with mixing, and solution volume is reduced to mark.

2. Analysis course.

10 ml of analysis water is placed to measurement retort on 500 ml, 5 ml of alizarin complex solution and 1, 5 ml of buffer solution and 5 ml of lanthanum nitrate is added to there. Solution is been mixed and stayed stand in dark place for one hour. Then optical density is measured on photo electro colorimeter in ditch, 30 mm of thickness, with 610 – 620 nm of wave length concerning blank solution.

MEASURE OF LEVEL OF GENERAL HARDNESS OF WATER

We prepared a volumetric flask with 100 ml of the sampled water, and transferred it to a conical retort. We added 5 ml of ammonia buffer mixture to the water sample, followed by 8 drops of a spirit solution of dark blue chrome indicator. This solution is a red colour. We titrated the mixture by 0, 05 n solution of versene, adding it to the sample in droplets, shaking the mixture after the adding of every drop. Titration can be considered complete if, after adding one drop of solution the versene coloring of the solution changes from violet into dark blue with a greenish tint and, with the addition of further droplets of versene, does not change.

We calculated the total hardness of water using the formula:

$THW = N_k V_k \times 1000 / V_{H2O}$ (mg-equiv/dm^3),
Where Nk is normality of solution of versene;
Vk is a volume of solution (ml) of versene, expended on titration;
V H_2O is the volume of water (ml), taken for the analysis;

Reagents:
Versene is ethylene diamine of tetraacetic acid - $Na_2H_2C_{10}H_{12}O_8N_2 \times 2H_2O$
Buffer mixture is a mixture of matters, providing the permanent limit of acidity of solution, ammonia buffer mixture maintains pH=9.

THE METHOD OF MEASURING OF CONTENT OF FLUORINE **IN WATER BY COLORIMETER**

1. Preparation of reactive
a. Prepared standard solution with 0,1 mg/l fluoride concentration: 0,28 mg of sodium fluoride, which was dried at 100o C until it achieved a constant mass, and diluted in a volumetric flask of 1000 ml.
b. The working standard solution of 0,05 mg/l of fluoride is prepared by dilution of standard solution by 20 times. It means that 5 ml of this solution is placed to volumetric flask of 100 ml and is added with distilled water to the mark.
c. Preparation of 0, 0005 normal alizarine complexon solution: 0, 1927 g of alizarine complexon is placed to a volumetric flask of 1000 ml; 5 – 6 drops of 4% natrium hydroxide and 500 ml of distillate water are poured for better dissolubility; 0, 25 g of sodium acetate is added and the solution is mixed until the dissolution of the reagent. Then 0, 1 normal solution of salt acid is poured by drops until the color changes from red-orange to yellow (it corresponds to pH=5) then the solution is added with distilled water to the mark.
d. Preparation of acetate buffer solution (pH = 4, 5 ±0, 2). 105 g of three water sodium acetate is placed to a glass of 500 ml, 300 ml of water is poured, salt is dissolved, solution is transferred to of 1000 ml, 100 ml of glacial acetic acid is added, the solution is mixed and the volume is brought to the mark.
e. Preparation of 0, 0005 normal lanthanum nitrate solution: 21, 66 g of six water lanthanum nitrate is placed to a volumetric flask of 1000 ml, 200 – 300 ml of water and 1 ml of 1 normal nitric acid solution are added, salt is dissolved by mixing, and the solution volume is brought to the mark.

2. Analysis course.
10 ml of analysis water is placed to a volumetric flask of 500 ml, 5 ml of alizarin complexon solution, and 1, 5 ml of buffer solution and 5 ml of lanthanum nitrate are added. The solution is mixed and let stand in a dark place for one hour. Then optical density is measured with a photoelectric colorimeter in a bath, 30 mm of thickness, with the wave length of 610 – 620 nm concerning blank solution.

DATA SUMMARY

Table 1. The data of water analysis

Exponents	Unit	Limit norms	Zeleniy Bor	Shuchinsk
Electroconductivity	µS/cm		18.2	-
Hydrogen ion exponent	pH	6-9	6.9	6.5
Total hardness of water	micro equiv. /dm^3	7	17.0	3.5
Temperature	Degrees Celsius	-	22	21
Density	g/cm^3	1	1,002	
Salt content	mg/dm^3		0,004	-
Taste	Points	2	0	0
Turbidity	Units	2.6	2.37	1.41
Iron	mg/dm^3	0.3	0.3	0.07
Sulphates	mg/dm^3	500	73	-
Flourides	mg/dm^3	1.5	1.24	3.96
Chlorides	mg/dm^3	350	390	28.5
Nitrates	mg/dm^3	45	15.94	-
Ammonia	mg/dm^3	0.5	0.36	0.024
Nitrites	mg/dm^3	3.0	0.03	-



Table 2. The presence of salts and total water hardness in Zeleniy Bor

Water hole №	1	3	4	8
pH-level	6,16	6,16	6,7	6,5
Water hardness	16,8	17,2	17,1	
Cl^-	+	+	+	+
SO_4^-	+	-	-	+
CO_3^{2-}	+	+	+	+
PO_4^{3-}	+	+	+	+
NO_3^-	-	-	-	-
S^{2-}	+	+	-	+
F^-	+	+	+	+
Ca^{2+}	+	+	+	+
Mg^{2+}	+	+	+	+
Cu^{2+}	-	-	-	-
Al^{3+}	-	-	-	-
Fe^{3+}	-	+	+	-

Table 3. Disease incidence in Zeleniy Bor .

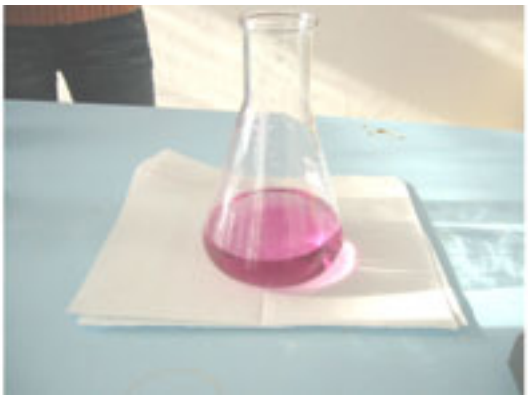
Diseases	**The number of people on the follow-up observation in 2007**	**The total number of diseased people**
Urolithiasis	30	230
Osteochondrosis	54	270
Urinary tracts infections	5	23

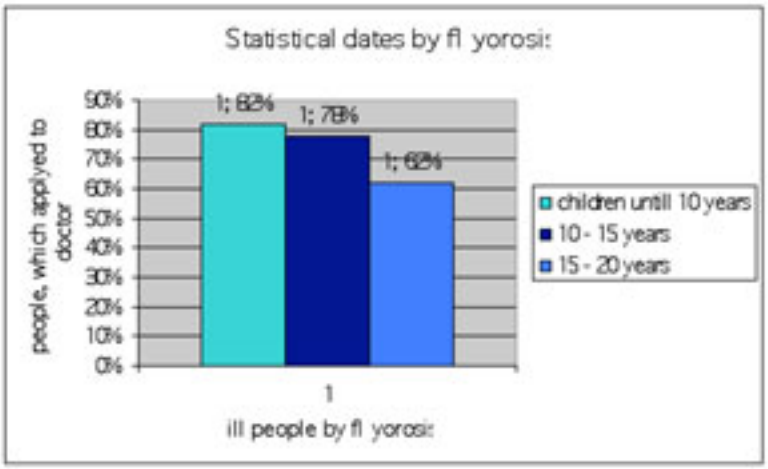
Table 4. The concentration of fluorine in water.

Water sources	The concentration of fluorine in water (mg/dm^3)
Shuchinsk, Well №1	4,10
Shuchinsk, Well №2	2,90
Shuchinsk, Well №3	3,40
Shuchinsk, Well №4	3,80
Zeleniy Bor, average	1,24

Table 5. Methods of water hardness decrease

Method	Sample 1 Hardness (mg-equiv/dm^3)	Sample 2 Hardness (mg-equiv/dm^3)	Sample 3 Hardness (mg-equiv/dm^3)	Initial hardness (mg-equiv/dm^3)	% of decrease
Boil	11.0	10.9	11.1	17	35,29
Froze	5.5	5.3	5.7	17	67,65





CONCLUSION

Water is crucial to a person's health. Practically all its sources are exposed to man-made influence of various intensities.

The presence of chemical elements in drinkable water in concentration, higher than the limit norms, leads to various diseases.

The analysis of drinkable water and facts of chemical structure from sanitary-hygienic laboratory of drinkable water of Zeleniy Bor showed that drinkable water of our town contains a lot of calcium and magnesium salts which causes its high hardness. The concentration of fluoride combinations is on average 3-4 times higher than the permissible norms. There is a sufficient quantity of Fe^{2+}, Fe^{3+} anions and Cl^-, SO_4^{2-} cations in our drinkable water, which makes it fall into the category of water with a high salt concentration.

The use of such water leads to salts deposits in the organism and, in consequence, to a series of illnesses. The people of Zeleniy Bor apply to the local medical ambulance station for medical help. The number of the diseased and being on the follow-up observation put together make of the 35% population.

Children below 15 years old suffer from caries. Adult populations suffer from urolithiasis and osteochondrosis, because the deposit of salts and formation of stones arise due to a metabolic disorder. This metabolic disorder was possibly caused by a permanent consumption of hard water.

In present time a water pipe-line from Sergeevskiy water reservoir, which is 300 km from Zeleniy Bor, is being built. Provided that the necessary purification is done, its water is expected to fit the sanitary norms of potable water.

DISCUSSION

When we had made the water analysis we drew up the tables of our data. Then we analyzed the finite data. And we came to the following conclusion. The chemical structure of water in Zeleniy Bor and Schuchinsk town is the cause of the spread of the stated illnesses. It has been revealed that a high consistence of fluorine causes fluorosis.

The drinking water enters Zeleniy Bor from artesian wells. That is why it contains a high consistence of calcium and magnesium salts. And the total hardness of water in our town is on average 17 miroequir/dm^3. It is approximately 2,5 times more than the limit permissible norms. Such water causes various diseases. When we studied literature on the causes of the diseases, we found out that 70% of kidney stone diseases arise from a high concentration of calcium salts.

A lot of people in Zeleniy Bor suffer from caries, urolithiasis, kidney stone disease, and others.

Our work has been interesting for us and it is also important for our people. We have studied new literature and have learnt new methods of chemical analysis. We can apply them in practice. We have become a little better educated.

People of our town wondered about the causes of their illnesses for a long time. They didn't know that it is because our drinkable water contains a lot of calcium and magnesium salts.

ACKNOWLEDGEMENTS

We would like to thank Allan Mournement, Roman Golub, Rodney Young and Bradley Parrish for their help in translating the text from Russian into English.

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The climate changes in Rujiena

School: Rujiena Secondary School, Latvia
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Teacher: Anda Deksne

ABSTRACT
Of late year's community increasingly shows interest in climate changes. In Rujiena Secondary School we have been exploring atmosphere and climate.

The target of our research work is to find out an effect of climate changes in our city Rujiena .

Hypothesis is, abnormal natural phenomenons and temperature rising, are big problem in all world and in Rujiena too. We have been collecting temperature measurements from 2004 till 2008. We calculated mean temperatures for every month from 2005 till 2008. From results we can see, that there is no very big temperature differences in this period. For research we use TAYLOR digital thermometer, which measures maximum and minimum air temperature °C. Now we can see, how the temperature had grown and fallen during these years.

Our conclusions are, that there are many opinions about global warming. Many people question whether or not global warming exists. Some people think that the global warming is just a myth. In Rujiena there are seen the temperature anomalies and it rises, so we think that it prows the global warming.

Our research time is too short to make deep and considerable analysis.

INTRODUCTION
In the world there are laws of nature, which can make big problems, if they are ignored. Of late year's community increasingly shows interest in climate changes and global warming. The main opinion in the world is, that people's inconsiderate action creates global warming, what is dangerous for civilization. Seconders of this opinion urge people to understand, that we are witnesses of unseen changes and if we won't do anything, the process will be irreversible. Opponents of this opinion express, that global warming is just a myth and propaganda.

The target of our research work is to find out an effect of global climate changes in our city Rujiena (latitude: 57.8992 N, longitude: 25.3378 E, elevation: 58 m) because, before we can start to fight with problem, we must get to know it and understand the reasons.
We have set tasks, which helps make research:
1. get information about global warming;
2. make and analyze graphs about temperature changes in Rujiena;

Hypothesis is, abnormal natural phenomenon, which cause is global warming, are big problem in all world and in Rujiena too.

MATERIALS AND METHOD
In Rujiena Secondary School we have been exploring atmosphere and climate. We have been collecting temperature measurements from 2004 to 2008. To do that precisely we use a digital thermometer, which is putted into a specially made instrument shelter. The instrument shelter is mounted so that the maximum – minimum thermometer mounted inside is 1,5 meters above the ground. It protects the thermometer form radiation form the sun, sky, ground, and surrounding objects, but allows air to flow through so the air temperature inside the shelter is the same as the air temperature outside the shelter. The instrument shelter is placed on the north – facing side of the post in the Northern Hemisphere, and on the south – facing side of the post in the Southern Hemisphere. This placement helps protect the thermometer from direct sunlight when the shelter door is opened to take reading. The shelter is located in private house yard to protect from vandalism.

For research we use TAYLOR digital thermometer. The digital thermometer measures maximum and minimum air and soil temperature degrees C. Every six days we collect the data, which are kept into a memory of the digital thermometer. After that we visit www.globe.gov and put in the data. Now we can see, how the temperature had grown and fallen during these years.

Picture 1.
The instrument shelter.

Picture 2.
The digital thermometer.

DATA SUMMARY AND ANALYSIS

When we see over the figure, it is seen, that temperature from December, 2004 to April, 2008 have trend to rise both in winter, and in summer.

The biggest temperature range has been in 2006 (the lowest temperature was – 33.2 °C and the highest was 42.9 °C).

This winter was the warmest in Latvia since 1925. The average temperature was + 0,8 degrees. It's 5 degrees more than usual (from Agency of Meteorology of Latvia).

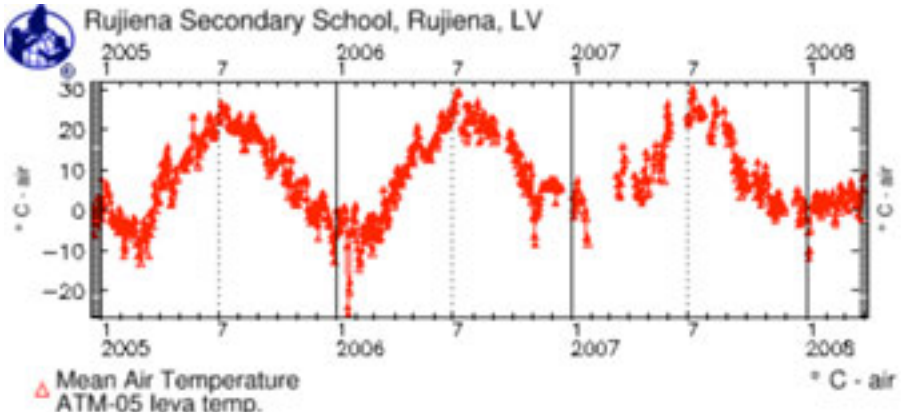

Figure 1. Mean air temperature from 17.12.2004. till 05.04.2008.

In 2007 there are radical mean temperature changes in the few months, for example in March mean temperature was +11°C, but in 2005 it was –3,3°C, and in 2006 it was –0,7°C. In July mean temperature was +28,4°C, but in 2005it was +22,7°C, and in 2006 it was +23,7°C.

We calculated mean temperature for these years (1. Table) and we can see a tendency of temperature rising: in 2005 it was +8,2°C, in 2006 it was +9,6°C and in 2007 it was +11,3°C.

	2005	**2006**	**2007**	**2008**
January	0,28	-5,37	0,99	-0,149
February	-5,7	-6,98	-	1,82
March	-3,3	-0,732	11,025	3,31
April	8,3	9,11	6,327	-
May	14,3	15,41	14,03	-
June	18,8	20,8167	20,5	-
July	22,7	23,7	28,44	-
August	19,7	21,796	21,55	-
September	14,6	18,7	12,05	-
October	8	9,87	7,025	-
November	2,7	3,276	1,5	-
December	-2,3	5,813	1,04	-
mean year temperature	**8,17**	**9,62**	**11,32**	-

Table. Mean temperature from 2005 till 2008.

CONCLUSION
The air temperature is one of the main climate points and the most important point for the global warming.

Our conclusions are:
There are many opinions about global warming. Many people question whether or not global warming exists. Some people think that the global warming is just a myth.

In Rujiena there are seen the temperature anomalies and it rises, so we think that it prows the global warming.

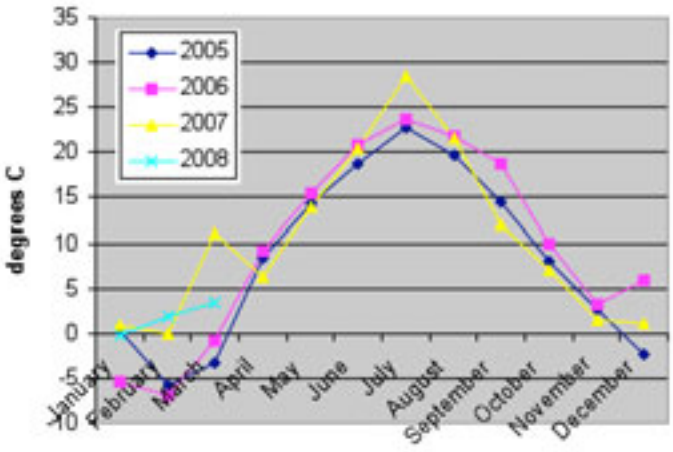

Figure 2. Mean temperature in each month.

DISCUSSION
We are going to continue this research in after years, but we have some faults. We miss some information about few days in these years, and this time is too short to make deep and considerable analysis. It may be very useful and interesting, if we could compare our results with our neighbour schools, but there aren't any school, which have made research like this from 2004 to 2008.

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Climate parameters influence on mosquito larvae development

School: Lycee Laurent Botokeky, Toliara I, Madagascar

PURPOSES OF THE EXPERIMENT
- To identify the development conditions of anopheles larvae: climate factors and water quality
- To imagine a fight against larvae by using Neem extract

HYPOTHESIS
Anopheles larvae may develop sequel to global warming. Their proliferation reduced by changing water quality in the breeding sites

PROCEDURES
Study on permanent and temporary breeding sites following 4 protocols:
- capturing larvae
- identifying anopheles larvae and other ones
- evaluating larvae rate,
- studying water quality and local climate

In classroom
- identifying and isolating larvae
- separating larvae according to their evolution steps and breeding sites
- putting them into test tubes for incubation

Study on the influence of Neem extract over anopheles larvae development
Neem extract : leaves pounded then filtered so as to get juice

Experimental protocol:
- control tube
- larvae + 3 ml of Neem extract from its leaves
- larvae + 8 ml of the same solution
- Local temperature : 30°C
- pH : 8 on the control
- pH : 10 in both test tubes
- Observation of larvae development after 12 hours

PRINCIPAL RESULTS
- Larvae density has correspondingly raised with the raise of temperature
- Development slowed down in both test tubes compared with the control
- Larvae develop fast during rainy season

CONCLUSIONS
We can stop mosquito larvae development by adding Neem extract into breeding sites.
Global warming make anopheles more numerous

Influence of traffic on the air quality

Students: Vincent Delvigne, Jordi Langen, Tom Ouwehand, Daan van Put, Jan Pieter Snoeij, Bas Wilbers
Teacher : Ms Wooning and Mr Van Asseldonk
School: College De Heemlanden, Houten, the Netherlands

ABSTRACT
We have studied the quality of the air around Houten, a village in the Netherlands. We have decided to focus our research on the influence of traffic on the air quality. We have used the concentration of particulate matter (PM10), NO_2 and SO_2 in the air as indicators of the pollution. We have also examined the effects of these exhaust gasses on the human health. Our hypothesis was that during rush hour there is a higher concentration of particulate matter.

Furthermore, we had an interview with the chairman of the Dutch cyclist federation. This organization has tested the levels of pollution in Houten. They measured the concentration of particulate matter in the air on different cycling paths throughout Houten.

Furthermore we held a survey about the means of transportation of teachers at our school.?

The purpose of our experiments was to comprehend the influence of traffic on the air quality, how much our teachers contribute to the pollution, to what amount of dirty air cyclists are exposed and what the effects of the pollution are on our health.

RESEARCH QUESTION AND HYPOTHESIS
The air quality is an important issue everywhere on Earth. Especially in densely populated areas the air quality is a great problem. Our school, College de Heemlanden, is in Houten, a small town in The Netherlands near a crossing of two highways. There is much traffic and we are exposed to the gasses they produce on a daily basis.

We live in a place where the air pollution is very bad. Since most of the students are going to school by bicycle during rush hour of the highways, we are curious about the concentrations of these gasses we inhale.

So our research question was : What is the influence of traffic on the air quality?

We also wanted to know what the effects are on our health. Secondly we assumed our teachers contribute to the pollution and we wanted to know how much they do so.

MATERIALS AND METHOD

For the research about the air quality we used data of the Dutch institute for health and the environment, the RIVM.. Because the weather influences the concentrations of gasses and PM10 in the air we used data of days on which there was no strong wind nor no wind at all and when it did not rain. For the weather we used data of the Dutch meteorological institute, the KNMI.

From the site of the RIVM you can retrieve data from 1991. They measure different gasses like NO_2, SO_2 and particulate matter (PM10) every hour. We used measurements from 2006 because this was the closest year with all data available. We also had to choose what data we were going to use, from which measure point.. We chose Eindhoven because it is a big city relatively close to Houten, and the air quality data from the RIVM was measured there, as well as the weather.

To investigate the contribution of our teachers to the air pollution we surveyed our teachers. We had them answer the following questions:

- How many times a week do you go to school?
- How far away from school do you live?
- What kind of transport do you use to go to school?

With this data we have calculated the amount of particulate matter and NO_2 the teachers produce while travelling to work.

The Dutch cyclists federation crosses the whole country to study the air quality that cyclists are exposed to. The cyclists federation also came to Houten to measure the air quality on different paths in the city.

There methodology is as follows. One cyclist rides through the city with a measurement device on his back and one car, equipped with the same device, drives different routes. After the measurements the results can be compared to each other to see what the difference is between a cyclist and someone in a car.

To study the effects on the human health we used multiple sources with data of the effects of NO_2, SO_2, Particulate matter and Ozone (O_3).

DATA SUMMARY

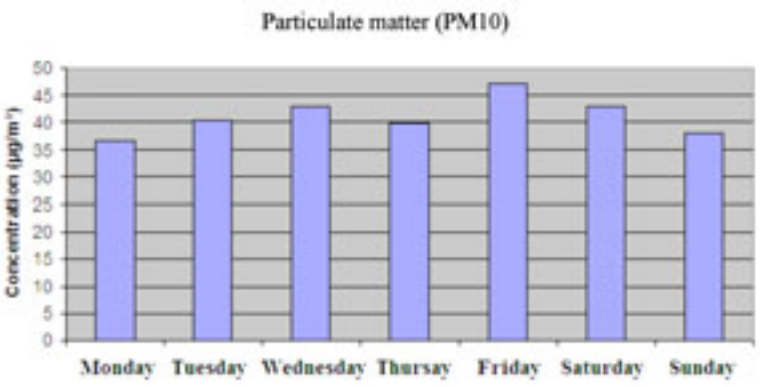


Diagram 1

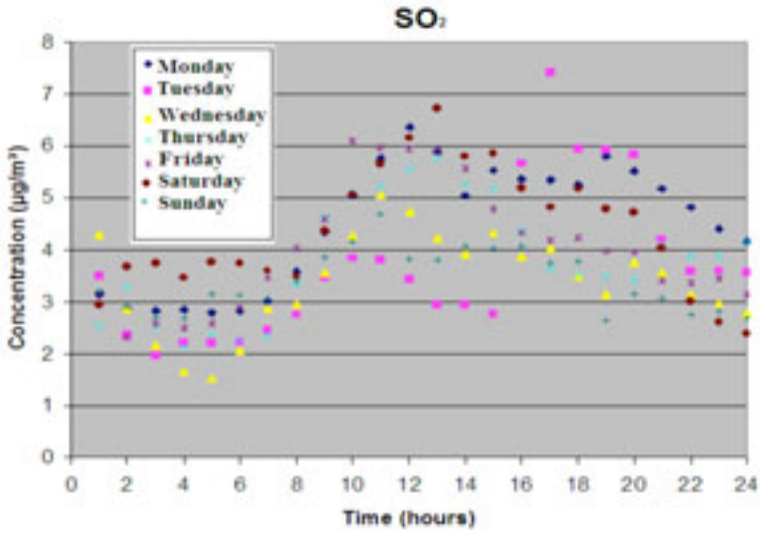


Diagram 2

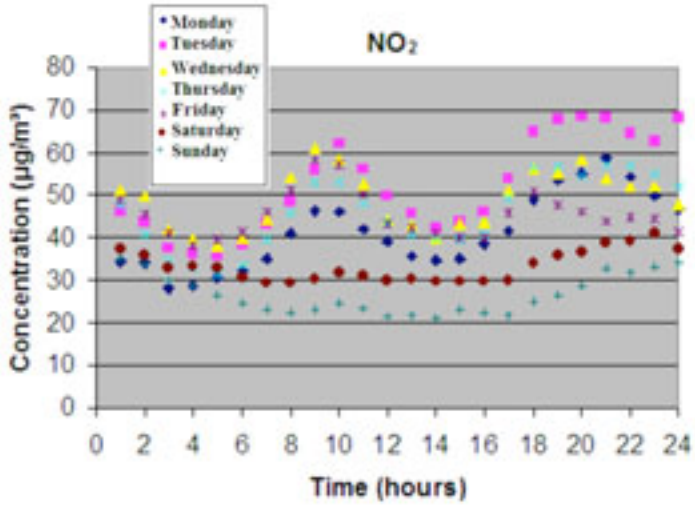


Diagram 3

ANALYSIS AND RESULTS
Influence of traffic on the air quality:

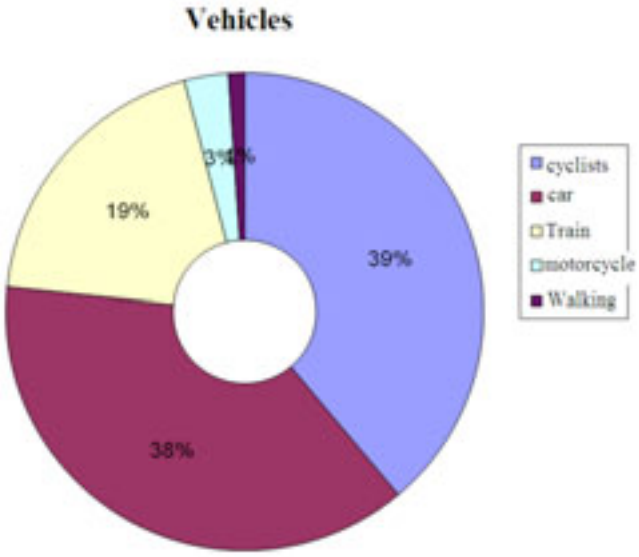
- A great part of the air pollution is caused by traffic.
- The traffic mainly exhausts NO_2, SO_2 and particulate matter (PM10).
- With this study we want to determine what the effect of these three substances is on the air quality. We did this by checking if there is a higher concentration of NO_2, SO_2 and PM10 at the moments that there is a lot of traffic on the road.

The concentration of PM10 is shown in diagram 1. From PM10 we could only obtain measurements of a whole day, not of single hours. Therefore we had data of the average exhaust of PM10 per day. In the diagram you can clearly see that the concentration of particulate matter at the end of the week is much higher than it is at the begin of the week. The weekday traffic exhausts the particulate matter and that causes the increasing concentration of particulate matter during the weekdays. In the weekend there is much less traffic so the exhaust of particulate matter is lower than on a weekday and the concentration of particulate matter is decreasing.

From Monday to Friday the concentration increases, excluding Thursday. We think that is because Wednesday is a day many people do not work or work shorter. That is why there is less traffic on the roads resulting in less traffic jams. So on this day there is less exhaust of particulate matter which causes the lower concentration on Thursday. Particular matter is a substance that does not disappear immediately when there is no traffic. It always stays for some time. It is clearly shown that the weekday work traffic has a great influence on the concentration of particulate matter.

The concentration of NO_2 is shown in diagram 3. The measurements are performed hourly. On the X-axis the time is shown and the Y-axis shows the concentration of NO_2. Each day of the week is shown with a different line type. In this graph you can clearly see that there is a huge different between the exhaust of NO_2 during rush hours and when there is no rush hour. In the Netherlands rush hour is around nine o'clock in the morning. A lot of people go to their work by car. You can see that the concentration of NO_2 increases enormously around that time. As soon as everyone has arrived at work the concentration immediately starts to decrease. Between six o'clock and eight o'clock there is another period of extensive traffic. At this time the concentration also peaks. In the weekend less people work, so the lines in the graphs of Saturday and Sunday are the only two lines where there hardly are any peaks.

The concentration of SO_2 is shown in diagram 2. The measurements we have used are obtained every hour. On the X-axis the time is shown and the Y-axis shows the concentration of SO_2. Each day of the week is shown with a different line type. In this graph the peaks are less clear around



Substance	Total emission each week	Average concentration	Amount of produced polluted air
PM10	3,8·108 µg	41 µg /m^3	9,2·106 m^3
NO_2	5,5·108 µg	40 µg /m^3	1,4·107 m^3

9 o'clock in the morning and 6 in the evening. Still, there is a clear difference between day and night. The average concentration SO_2 between 10 am and 10 pm is a lot higher than between 10 pm and 10 am. It also becomes clear in this graph that the concentration is higher when there is more traffic on the roads.

The data of the cyclists federation is not yet processed so we could not use it in this report.

The Studie among our teachers:
41% of the teachers travel to work by car or motorcycle,
15% of them travel less then ten kilometers to get to school.

Relatively many teachers use a bicycle as a means of transportation to get to school.

With the data of the distances the teachers travel by car to school and back home, we have calculated the amount of NO_2 and particulate matter caused by this traffic.

Each week our teachers drive 7500 km to school and back home. From an average amount of particulate matter and NO_2 that is exhausted each kilometre by traffic, we can calculate the amount of particulate matter and NO_2 that is exhausted by the commuter traffic. By combining this to the average concentrations, we have calculated that our teachers pollute weekly 9.2 million m³ air.

We want to show that travelling to work by car, especially little distances, is bad for the environment and our health.
Effects of the pollution on the human health:

- Not all exhaust gasses are harmful. The three most dangerous are particulate matter, NO_x and SO_2.
- O_3 (ozone) is not a direct exhaust gas, but is being formed from exhaust gasses and is also a result of the motorised traffic.

Effects of particulate matter:

- Breathing large amounts of particulate matter causes irritation of the lungs. For people who suffer lungs- or heart disease it can lead to death. The amount of deaths a year because of acute exposure to particulate matter, for example when bicycling behind a car, is 1700.
- Besides that there are 18.100 deaths a year because of long exposure to particulate matter.

Effects of NO_2:
Nitrogen dioxide itself is not very harmful, but it can cause hyperventilating. Nitrogen dioxide reacts with other substances and forms Ozone, which is very harmful. Nitrogen dioxide in the air can be converted to other substances which dissolve in rain and so cause acid rain.

Effects of SO_2:
Sulphur dioxide is a less dangerous exhaust gas. The gas starts to begin harmful at concentrations above 250 µg/m³. It mostly causes breathing problems at people with asthma during acute exposure to SO_2.

Effects of Ozone (O_3):
Ozone is like the other substances only harmful at high concentrations. Ozone starts being harmful above 150 µg/m³. Ozone can cause migraine. Yearly in the Netherlands 1800 people die due to the effects of acute exposure to ozone.

CONCLUSIONS
On weekdays the PM10 concentration increases due to traffic. (Particulate matter accumulates as the working week proceeds. In the weekends PM10 concentrations decreases because there is less traffic.

The NO_2 concentrations peaks at the rush hours, which is most likely caused by the increase in traffic during these hours.

During the day SO_2 reaches higher concentration than at night, when there are hardly cars on the road.

We have clearly shown that concentrations of car emission products are higher during the rush hours. We can safely conclude that traffic causes a large part of the pollution.

DISCUSSION
Our investigation turned out quite well. We found some quite shocking results, but they were as expected so that is good.

The investigation could be improved by using measurement data from different locations in stead of doing this investigation on a specific measure spot but that would have taken to long.

ACKNOWLEDGEMENTS
We want to thank everyone who helped with our project and investigations and who provided and / or shared data.

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- KNMI
- EPA (Environmental Protection Agency)
- ESA (OMI-satellite)
- Nehab(National platform of Environment and Health)
- Leefmilieu Brussel
- Milieu centraal
- GGD (Investigation of Fred Woudenberg)
- TNO delft

Environment and health in and around Maastricht, the Netherlands

Students: A project of class G3B
School: Sint- Maartenscollege, Maastricht, the Netherlands
Mentor: Drs. Ir. V.E.J.W. Boumans

ABSTRACT
Our home town Maastricht, the Netherlands is localized in the heart of one of the most industrialized regions in the world. The purpose of our project is to investigate the influence of air pollution on the health of the inhabitants of Maastricht, in particular the youth. We hypothesize that there is a correlation between the degree of air pollution and heath parameters such as pulmonary function. We measured the aerosol optical density near our school which is located within 250 meters of a major highway crossing in Maastricht. Furthermore we studied the data obtained in a recent study by the Maastricht University on the relationship between ambient particulate matter and pulmonary function in children.

Our analysis shows (1) that there are different methods to analyze our pollution with particulate matter and (2) that PM composition, specifically oxygen radical formation by PM is influencing the lung function of children.

INTRODUCTION
Our home town Maastricht is localized in one of the most industrialized regions of the world. To the East and South there are the German Ruhr and the Belgian Wallonia regions with heavy traditional chemical industries. To the North SABIC and DSM are two chemical industries. Furthermore, the city of Maastricht is crossed by the A2, one of the most busy highways in Western Europe. Maastricht lies in the valley of the river Maas which is another factor potentially contributing to a high degree of air pollution.

The purpose of our project is to investigate the influence of air pollution in the health of the inhabitants of Maastricht, in particular the youth. We hypothesize that there is a correlation between the degree of air pollution and health parameters such as pulmonary function. Previous studies in other parts of the world have focused on the association of particulate air pollution and diseases of the heart and lungs (Dochery et al., 1993, Samet et al., 2000). These studies showed an association of adverse health effects and degree of air pollution. Furthermore there are several groups at an increased risk of adverse heath effects from particulate air pollution among which are children (Ulrich et al., 2002). Our approach in this project consists of the following elements: (1) we collect data provided by the industries on their air pollution; (2) we measured aerosol optical density near our school which is located within 250 meters of the A2 highway and (3) we studied the data obtained in a recent investigation by the Maastricht University on the relationship between ambient particulate matter and pulmonary function in children (Hogervorst et al., 2006). At this stage of the project we can report on elements (2) and (3).

MATERIALS AND METHODS
1. Aerosol optical density (AOD) measurement
In the periods March/April 2007 and October/December 2007 we measured the AOD near our school using the GLOBE sun photometer method. Briefly the photometer measures the absorption and scatter of light with a certain wavelength by the aerosols.

The optical density (atot) is the sum of the Rayleigh scatter (arayleigh) the ozon absorption (aozon) and the absorption and scatter by aerosols (aaerosol). The a aerosol is determined with a photometer that measured the voltage of a light sensitive photo cell according to the Lambert-Beer law. For a detailed description see www.knmi.nl/globe.

2. Selection of study locations
Six primary schools in the city of Maastricht (the Netherlands) were selected as ambient PM sampling locations. These schools were selected on the basis of traffic intensity in the immediate surroundings of the school. In order to obtain a considerable range in traffic intensity, 2 schools were chosen near the A2 highway, which traverses the city and along which 45,000 vehicles pass per 24 h, of which 13.1% are heavy load traffic. Further, two schools with moderate traffic intensity in or near the center of the city and two schools in the outskirts of the city with low traffic intensity were selected. Traffic intensity within 250 m of the sampling location thus ranged from 3400 to 45,000 vehicles per 24 h. The relative contribution of heavy load traffic ranged from 2 to 14.5%.

Table 1 shows the traffic density for the 6 locations.

3. Measurement of particulate matter
PM Sampling
TSP and PM10 were sampled with a high volume sampler G1200 (Sierra-Andersen, Atlanta, GA), respectively with and without a 10-µm inlet, at a flow of 800 L/min. PM2.5 was sampled with a Digitel DHA 80 pump (Digitel Elektronik AG, Hegnau, Switzerland) at 500 L/min. At the playgrounds of each school, TSP, PM10, and PM2.5 were sampled on 4 days from 8.00 a.m. till 4.00 p.m. The samples were taken on days without precipitation and when the wind direction was westerly, which is the prevailing wind direction in the

TABLE 1. Description of Traffic Intensity at the Six Sampling Locations in Maastricht (the Netherlands)

Location	Traffic intensity within 250 m (*n*of motorized vehicles/24 h)	Traffic intensity at 250–500 m (*n*of motorized vehicles/24 h)	Heavy load traffic within 250 m (% of *n*of motorized vehicles/24 h)	Heavy load traffic at 250–500 m (% of *n*of motorized vehicles/24 h)
1	45,000	[a]	13.1	[a]
2	9500	45,000	10.0	13.1
3	5700	[a]	14.5	[a]
4	[a]	37,800	[a]	6.5
5	6100	[a]	9.0	[a]
6	3400	[a]	2.0	[a]

[a]Not applicable.

region. Before sampling, the filters (glass fiber for TSP and PM10, quartz fiber for PM2.5 from Whatman, Maidstone, UK) were weighed on a microbalance. After sampling, the filters were dried at 37°C for 24 h. Presampling mass was subtracted from postsampling mass to obtain mass concentration values for TSP, PM10 and PM2.5.

The filters were used to determine the generation of reactive oxygen species (ROS) by means of electron spin resonance. For technical details see Hogervorst et al., 2006.

4. Lung function measurements

The medical ethics committee of the Maastricht University hospital approved the study design. All 651 children in the age of 8 to 13 y (all students in the top 4 school grades) attending the 6 participating schools were invited to undergo spirometry with Vitalograph 2120 hand-held pneumotachographs (Vandeputte Medical B.V., Nieuwegein, the Netherlands). The reason for choosing this group of children is that these children are at least 8 y of age, which is a prerequisite for producing reliable spirometric test results (de Hartog et al., 1997). The parents of 429 children gave written informed consent for their children's participation. In their classrooms, children were plenary instructed to perform the spirometric test and again individually immediately before the test. They were instructed and stimulated to perform maximal expiration maneuvers after maximal inhalation while seated. The actual measurements did not take place in the classroom, but in a quiet other room. Forced expiratory volume in second 1 (FEV1), forced vital capacity (FVC), and forced expiratory flow at 50% of FVC (FEF50%) were recorded from three maneuvers

RESULTS

1. AOD measurements

Figure 1 gives the AOD for green and red light on the various days of measurement in 2007. Figure 2 gives the differences between the green and the red light for these measurements. The data show a larger AOD for the measurement in the March/April 2007 period than in the October/December period. Furthermore, the scatter in the data in the March/April period is much larger than in the October/December period. These data may imply that the data in the October/December period were more accurate al-

Figure 1

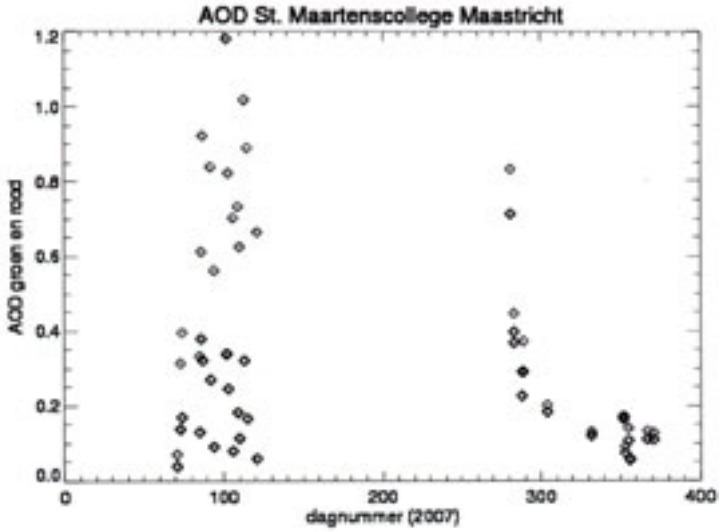

Figure 2

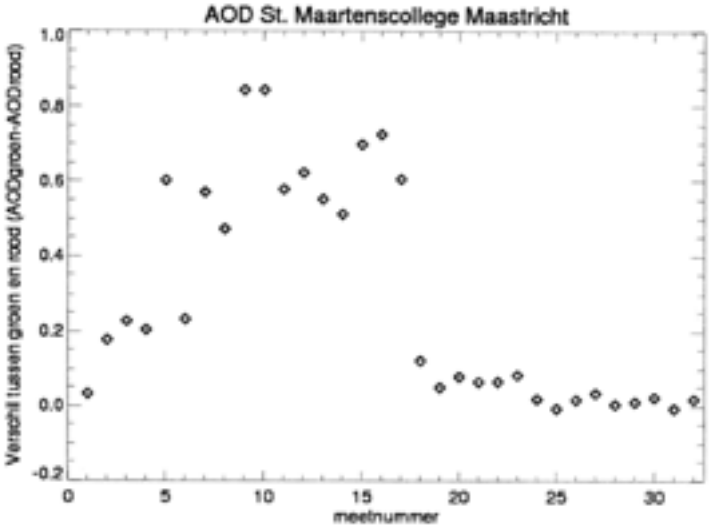

TABLE 2. PM Mass Concentration and Radical-Generating Capacity of PM on Average and at the Six Schools in Maastricht (the Netherlands) Individually, 2002

	Average	Location 1	Location 2	Location 3	Location 4	Location 5	Location 6
TSP							
Mass concentration in $\mu g/m^3$ (SD)	77.5 (20.6)	55.9 (23.9)	101.1 (39.4)	[b]	94.7 (30.1)	77.9 (47.5)	57.9 (34.0)
Radical-generating capacity in 10^6 peak area U/m^3 (SD)	14.3 (8.7)	7.5 [a]	14.0 [a]	[b]	6.9 [a]	14.7 [a]	28.5 [a]
Radical-generating capacity in 10^5 peak area U/µg PM (SD)	2.1 (1.5)	1.3 [a]	1.4 [a]	[b]	1.4 [a]	1.7 [a]	4.8 [a]
PM10							
Mass concentration in $\mu g/m^3$ (SD)	48.0 (11.0)	46.1 (23.9)	59.5 (7.2)	27.9 (12.8)	50.1 (14.6)	55.9 (27.0)	48.7 (30.0)
Radical-generating capacity in 10^6 peak area U/m^3 (SD)	10.0 (5.5)	5.8 [a]	7.9 [a]	11.0 [a]	8.0 [a]	6.7 [a]	20.6 [a]
Radical-generating capacity in 10^5 peak area U/µg PM (SD)	2.9 (2.4)	1.0 [a]	1.3 [a]	7.3 [a]	3.1 [a]	1.2 [a]	3.7 [a]
PM2.5							
Mass concentration in $\mu g/m^3$ (SD)	19.0 (3.2)	18.9 (6.4)	16.9 (6.9)	14.7 (3.2)	24.2 (5.7)	19.7 (5.8)	19.3 (11.7)
Radical-generating capacity in 10^6 peak area U/m^3 (SD)	3.3 (3.9)	3.1 [a]	2.9 [a]	4.6 [a]	2.7 [a]	2.1 [a]	4.3 [a]
Radical-generating capacity in 10^5 peak area U/µg PM (SD)	2.7 (2.7)	1.7 [a]	1.6 [a]	8.2 [a]	2.2 [a]	1.1 [a]	1.6 [a]

Note. Locations in order of decreasing traffic intensity.
[a]SD not applicable, because the four PM filters per location were pooled prior to the analysis.
[b]Not determined, because long-lasting unfavorable weather conditions (eastern winds) prohibited sampling.

TABLE 3. Average Predicted Values and Absolute Values (in Parentheses)of FEV1, FVC, and FEF50% for the Total Study Population (n = 342) and per School in Maastricht (the Netherlands), 2002

	Average	Location 1	Location 2	Location 3	Location 4	Location 5	Location 6
FEV1% (L)	86.5 (2.10)	86.8 (1.94)	89.1 (2.18)	84.5 (2.07)	88.0 (2.16)	86.2 (2.15)	85.5 (2.06)
SD	10.3 (0.43)	11.5 (0.39)	9.4 (0.42)	10.5 (0.41)	9.6 (0.39)	10.7 (0.46)	9.9 (0.51)
FVC% (L)	93.4 (2.45)	92.1 (2.23)	98.3 (2.66)	91.6 (2.43)	94.7 (2.51)	91.8 (2.46)	93.2 (2.42)
SD	11.1 (0.51)	14.0 (0.46)	10.6 (0.55)	10.5 (0.47)	10.8 (0.46)	10.9 (0.55)	8.9 (0.52)
FEF50%% (L/s)	95.4 (2.71)	92.6 (2.54)	94.1 (2.79)	94.2 (2.66)	99.9 (2.84)	99.0 (2.80)	91.2 (2.60)
SD	24.3 (0.75)	22.7 (0.65)	22.5 (0.77)	24.2 (0.71)	24.8 (0.73)	25.8 (0.78)	24.6 (0.87)

Note. Locations in order of decreasing traffic intensity.

though we can not exclude that the weather conditions (wind, clouds) were more variable in the March/April period.

2. PM mass concentration and radical-generating capacity
Table 2 shows the PM mass concentration and the radical generating capacity of OM at the six schools in the order of decreasing traffic intensity.

In table 3 the average lung function indices are shown per school. There were no significant differences in lung function indices between the locations. No trend of decreasing long function from the most traffic intense location to the least traffic intense location could be established. However, the radical generating capacity of PM2,5 per cubic meter of air correlated negatively and significantly with FEV.

DISCUSSION
Our analysis allows the following conclusions: (1) there are different methods to analyze air pollution with particulate matter and (2) PM composition, specifically oxygen radical generation by PM is influencing lung function of children. The first conclusion was based on our own measurement of aerosol density of the air near our school. As part of the GLOBE program we made photometer analysis of the aerosol optical density. The data show that particularly the October/December 2007 results were constant. Probably we were more experienced with the measurements during this second period. The other method for the determining PM values in the Maastricht region was used by Hogervorst et al. (2006). The 2 methods cannot be directly compared since they measure different aspects of particulate matter pollution. The second conclusion is based upon the study by Hogervorst et al. (2006). These investigations were the first to show that in a population an association could be shown between radical-generating capacity of PM and human lung function. Another important finding from that study is that particularly the finer size fractions (PM2,5) were negatively associated with lung function in relation to radical generating capacity. Other epidemiological studies have shown PM2,5 to be more harmful than more coarse particles (Diociaiuti

et al., 2001, Huang et al., 2003, Li et al., 2003). This can be explained by the fact that fine particles penetrate deeper into the lungs and also by differences in the chemical composition of different size factions.

ACKNOWLEDGEMENTS
We wish to thank Joris de Vroom of the KNMI for analyzing the AOD measurements.

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The future of Coastal Cod (Gadus morhua) in the region of Salten in northern Norway under influence of global warming and persistent organic pollution

Students: Kristine Iversen, Astrid Landstad, Ingrid Anthonsen, Marianne Holsmo and Mathias Thorshaug
School: Bodø videregående skole Norway

This study is our consideration of the future of Coastal Cod in our region. This report was motivated by the competition announced by the Norwegian Centre for Science Education. In order to reach the defined learning skills for the Science of Nature in our scool, we have chosen to examine the future of Coastal Cod in Salten under influence by environmental poison and global warming. Through this task we have been able to learn and understand more about global warming, pollution and how it may influence the local food supply from the sea.

In the text below we ask the important question: How is the future for Coastal Cod? We have examined and measured six different individuals of this species in Salten. The length and weight of each fish was measured, and used to calculate the condition factor. This factor is an indicator of the health of the individuals. We sent filet from five of the six codfish to the Norwegian Institute for Air Research. They measured the level of environmental toxins. The results are not ready yet, but will be used in the project Global POP.

Our individuals of fish seem to be in good condition, but will this state continue for the local population of Coastal Cod?

We and other scientists have to make further measurements and studies. Some years from now, the arctic fish species may have a lower condition factor and begin to seek colder territories because of warmer temperature of the sea. Atlantic Cod and Coastal Cod are among of the most abundant and important fish populations in the world. Maybe, we will end up losing these populations that have given food to our nation for ages.

Water never runs astray

Students: Ingrid Andersen Eidsvaag and Liv Sofie Hallaråker Utvær
School: Bergen katedralskole Norway

In this project we've tried to answer whether the freshwater availability in Africa will be affected by climate changes. In addition to this, we also wanted to find out if there were any simple measures that could prevent the negative outcomes if there should be any.

Since we had difficulties finding reports and data on the subject at the library etc., most of our data comes from online reports and other internet sources.

We also included an experiment of our own in this project, where the goal was to create a device that made it possible to extract freshwater from saltwater manually. From this experiment, we learned that it is possible to extract freshwater this way, but it requires too much energy to be used on a large scale.

From the project as a whole, we can say that the predicted climate changes are going to affect the freshwater availability on the continent, but that at least some of the negative changes can be prevented by goal-oriented planning by the governments to secure sufficient amounts of freshwater, viable use of freshwater resources, and focusing on farming methods better suited for a new climate.

Is it possible to observe local climate change at Vang in Norway?

Students: Lene Rogn and Camilla Søndrol
School: Vang barne- og ungdomsskule, 2975 Vang i Valdres, Norway

We have heard about climate change for years and we have tried to see if it is possible to observe the change here in Vang, far from the sea.

We have tried in three different ways to find possible changes, and discuss why it has changed and whether it is because of climate change or not.

1. We have compared old photos with new ones, taken at the same spot, looking for changes in the amount of trees and bushes.

2. We have compared the temperatures during the last 4 years with temperatures in Vang in the period 1961 – 1990.

3. We have compared phenological observations from the last years with observations taken by a local doctor in Vestre Slidre 130 years ago. Vestre Slidre is 25 km from Vang, but we have collaborated with the school in Vestre Slidre, so we know the difference from Vang to Vestre Slidre. The observations should show whether the spring comes earlier today than 130 years ago.

Assessment of the purity class of the Wislok River

School: Gimnazjum no. 9, sw. Krolowej Jadwigii – Rzeszow, Poland
Edited by: The project was edited by Biology teacher Adrianna Chmiel

1. INTRODUCTION

The aim of the above project was to assess the purity class of the Wislok River. The research was carried out from November 2006 to March 2007.

The quality of both surface waters and groundwaters turned out to be unsatisfactory. According to the data of the Provincial Inspectorate of Environmental Protection in Rzeszow, the analysis of the quality factors proved that there was a lack of good quality waters among the monitored rivers. Good quality of the waters was defined in 4 different control and measurement spots, which constituted 5.1 % of all the monitoring spots. 46.8 % of the control and measurement spots of the examined rivers was classified as the III class which illustrated satisfactory quality of the waters. Bad quality of the waters was affirmed in 3.8 % of the control and measurement spots, and it concerned rivers which had been exposed to the interaction with considerable amount of industrial waste or municipal sewage.

In order to asses the condition of water in the Wislok River we set ourselves a few tasks, that is to say, we put ourselves in the role of scientists and decided to find the answer among the people and surrounding nature. We commenced the project with preparing a survey for the local people. Thanks to the survey we found out what the people of Rzeszow think about the contamination of the Wislok River. Afterwards, for 4 consecutive months (from November to late March) we carried out physicochemical examination of water once a week. Moreover we conducted biological research of the river, applying Baur's method, as we are aware that the organisms living in the river can tell us a lot about the purity level of the water under discussion. On the basis of our research, observations and interviews with the local people we found out the most common reason for the contamination of the Wislok River. Furthermore, we familiarised ourselves with the ordinance of the Ministry of Environment, 27th November 2002, regarding the requirements for the surface water deposits which are used to provide people with the water meant for consumption.

2. OBJECT CHARACTERISATION

The research territory included the Wislok River which flows through our city.

The Wislok River is a mountain river characterised by impetuous course, rocky substratum and numerous gorges. The river flows out at the altitude of 823 m. above sea level, in the Lower Beskids. The average depth varies to 2 metres. The Wislok River is the longest tributary of the San. Its

pure source flows out in the Lower Beskids. Because of the fact that the above area is heavily afforested and sparsely populated, the source region of the river is crystal-clean. Contamination occurs when the Morawa, the first tributary which is highly contaminated by sewage from neighbouring Rymanów Zdrój, flows into the Wislok River. The river is also polluted by some toxic substances drained from some towns the river flows through. The towns are: Krosno, Frysztak, Wiśniowa, Strzyżów, Lubienia, Boguchwała, Błażowa, Rzeszów, Łańcut, Młynówka.

Recreational qualities

If only one of the main rivers in Subcarpathian Voivodeship was purified, it would become even more attractive as a beauty spot, a place where one can relax and have a nice time. The upper course of the river is a wild, marvellous canyon, characterised by nearly vertical slopes which, at some places, reach almost 200 meters above river level. The average depth varies to 2 metres, which would conduce to the development of water tourism and numerous baths. In its upper segment the Wislok River is a mountain river, therefore, the level of water is usually high in spring time. Hence, the banks of the river are washed away and the coastal shape changes annually which makes the river really attractive.

Because of the fact that the river forms countless gorges, many canoeing rallies are frequently held. A lot of species of fish can be found in the Wislok River, which is yet another advantage. Undoubtedly the number of animal species would grow along with the improvement of the water's condition. Accordingly, it can be stated that if it was not for the contamination, 204.9 kilometres of the river would become truly attractive. It is worth mentioning that Subcarpathian Voivodeship is one of the least polluted regions in Poland.

The amount of sewage drained to surface waters from punctual sources of contamination in the area of Subcarpathian Voivodeship in 2001 amounted to 174.3 hm^3. The sewage accounted for 1.9 % of the total amount of sewage drained in the whole country. In this respect Subcarpathian Voivodeship is ranked the eleventh place among all the voivodeships. However, as the years pass by, the industry has been constantly developing, all of which affects the natural environment negatively. Worse still, preventive measures are used rarely and provisionally.

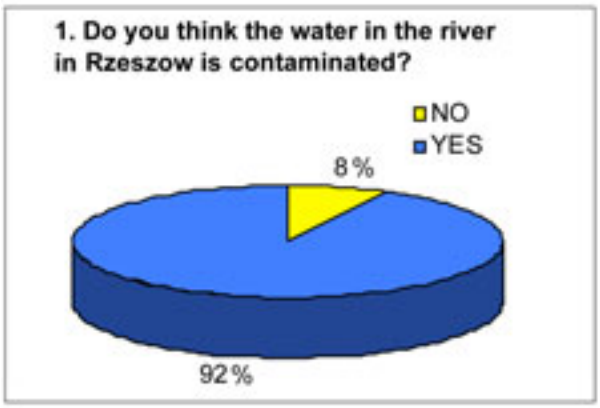
The purity classes in Poland:

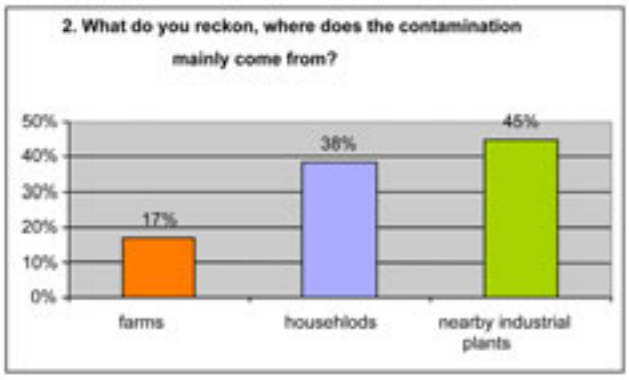
- I purity class - waters characterised by the highest purity level and sufficient quality to serve as drinking water (potable water, suitable for salmon farming.
- II purity class - fairly pure waters, suitable for fish farming of other species, farm animals breeding as well as organising baths, recreational purposes and water sports.
- III purity class – medium polluted waters, suitable for supplying industry, irrigation of agricultural area, horticultural production and production in greenhouses.

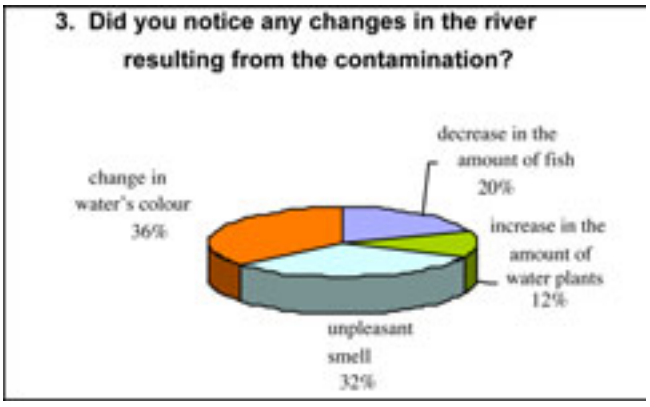
Waters characterised by qualities that go beyond the limits of class III are referred to as unclassified waters.

3. SOURCES AND RESEARCH METHODS

We prepared a survey about the contamination of the Wislok River. The survey was carried out among the people of Rzeszow and the students in our school. The results showed what local people think about the contamination of the examined river.
The results of the survey are as follows:







4. WHAT DO YOU THINK SHOULD BE DONE TO LESSEN THE CONTAMINATION OF THE RIVER?

Building a wastewater treatment plant

Sewerage schemes for the villages around Rzeszow

Fines or community free service for people who contaminate the river

Educating the young about environmental pollution and protection

Installation of filtering appliances

Discontinuation of contaminating the Wislok River

Purifying the area around the river, e.g. renovating the gravel pit

Purifying the river of water plants

Municipal police guarding the neighbourhoods of the city

By means of GPS we read out the location of our research area:

Latitude: 50.0382N
Longitude: 22.0078E
Elevation: 201.8 m

We carried out physicochemical examination of water from the Wislok River. We took into consideration the results in the space of five months – from November to March.

We investigated:

- dissolved oxygen
- alkalinity
- nitrite and nitrate
- translucency
- leadership
- temperature
- pH

5. THE RESULTS OF THE EXAMINATION.
The results from particular months are presented in the charts below.

NOVEMBER

Date	Dissolved oxygen	Alkalinity	Nitrite	Nitrate	Translucency	Leadership	Temperature	pH
	[mg/dm^3]	[mval/dm^3]	[mg/dm^3]	[mg/dm^3]	[cm]	[mS]	[^{o}C]	
7.11.06.	11,8	197	0,05	0,97	70	0,92	5,0	6,2
14.11.06.	12,1	180	0,05	1,1	75	1,19	5,5	6,3
21.11.06.	12,3	213	0,05	0,88	75	1,22	4,5	6,3
28.11.06.	12	220	0,05	0,79	80	1,32	4,5	6,4

DECEMBER

Date	Dissolved oxygen	Alkalinity	Nitrite	Nitrate	Translucency	Leadership	Temperature	pH
	[mg/dm^3]	[mval/dm^3]	[mg/dm^3]	[mg/dm^3]	[cm]	[mS]	[^{o}C]	
5.12.06.	12,2	230	0,1	0,81	82	1,11	4	7,2
12.12.06	11,9	183	0,05	0,92	89	0,95	4	6,5
19.12.06	12,4	150	0,05	0,84	90	1,28	3	6,3

JANUARY

Date	Dissolved oxygen	Alkalinity	Nitrite	Nitrate	Translucency	Leadership	Temperature	pH
	[mg/dm^3]	[mval/dm^3]	[mg/dm^3]	[mg/dm^3]	[cm]	[mS]	[^{o}C]	
2.01.07.	12,8	231	0,05	0,95	82	1,12	2,5	6,7
9.01.07.	12,3	183	0,05	0,90	80	0,95	2	6,3
16.01.07.	11,9	238	0,1	0,95	85	0,98	1,7	6,9
23.01.07.	12,4	210	0,05	1,32	82	0,93	1,5	6,8
30.01.07.	11,9	205	0,05	0,78	85	0,89	1,5	6,6

FEBRUARY

Date	Dissolved oxygen	Alkalinity	Nitrite	Nitrate	Translucency	Leadership	Temperature	pH
	[mg/dm^3]	[mval/dm^3]	[mg/dm^3]	[mg/dm^3]	[cm]	[mS]	[^{o}C]	
6.02.07.	12,3	230	0,05	0,60	100	0,91	1,5	
13.02.07.	11,3	265	0,05	1,25	110	0,58	1,0	7,0
20.02.07.	12,1	283	0,05	0,82	110	0,88	0,5	7,0
27.02.07.	12,9	215	0,05	0,53	108	0,42	0,5	6,8

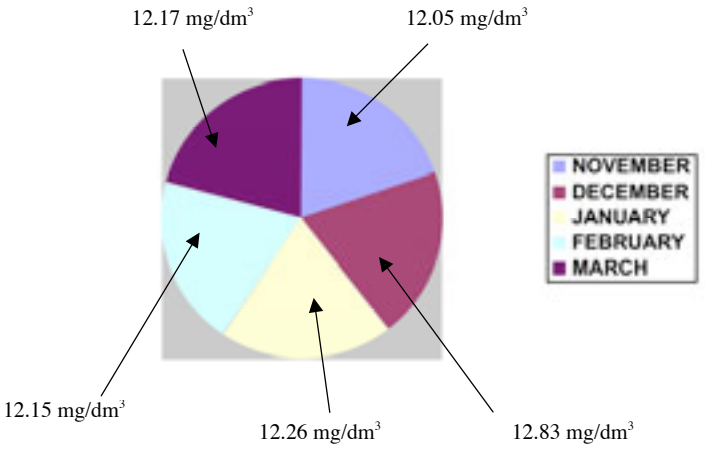
MARCH

Date	Dissolved oxygen	Alkalinity	Nitrite	Nitrate	Translucency	Leadership	Temperature	pH
	[mg/dm^3]	[mval/dm^3]	[mg/dm^3]	[mg/dm^3]	[cm]	[mS]	[^{o}C]	
6.03.07.	13,1	205	0,05	0,44	90	0,41	0,2	7,0
13.03.07.	13,1	200	0,05	0,28	110	0,38	0,1	7,5
20.03.07.	12,3	190	0,1	2,2	115	0,72	0,5	7,5
27.03.07.	12,8	205	0,1	2,2	115	0,63	0,3	6,8

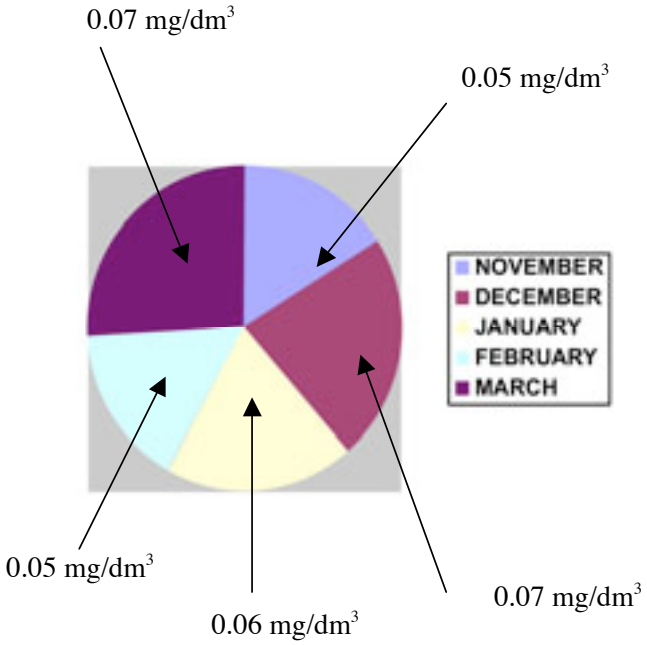
The results were compiled in the form of pie charts.

The charts present the average measurement results from particular months.

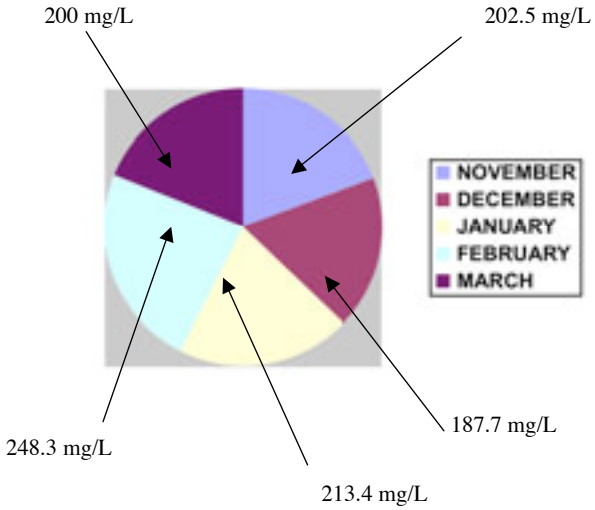
Dissolved oxygen – NOVEMBER 2006 – MARCH 2007



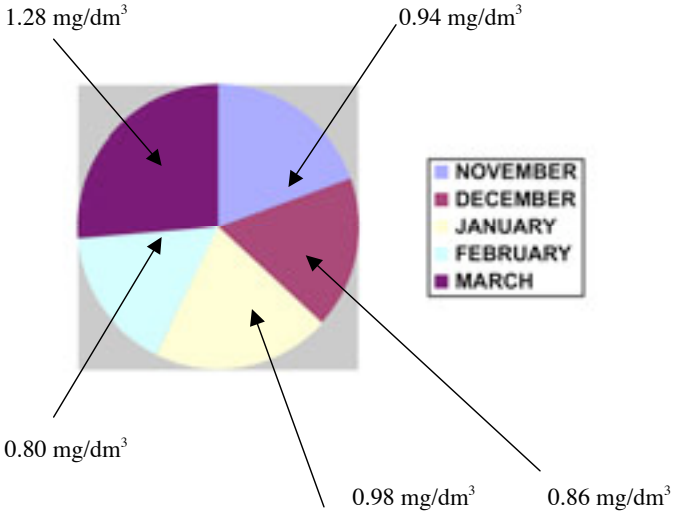
Nitrite – NOVEMBER 2006 – MARCH 2007



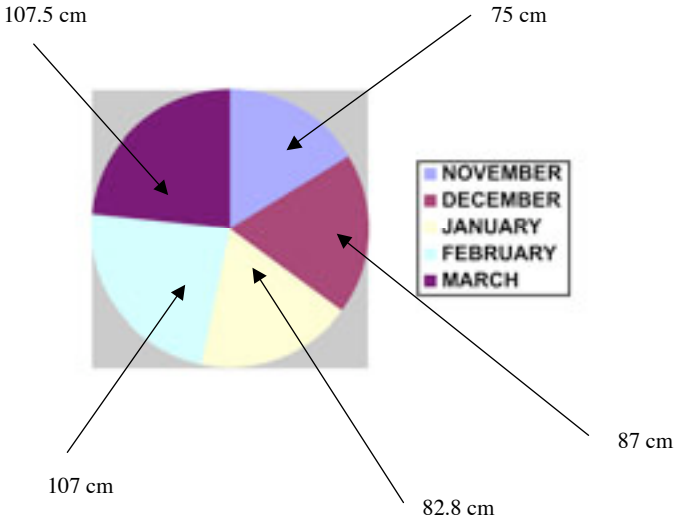
Alkalinity – NOVEMBER 2006 – MARCH 2007



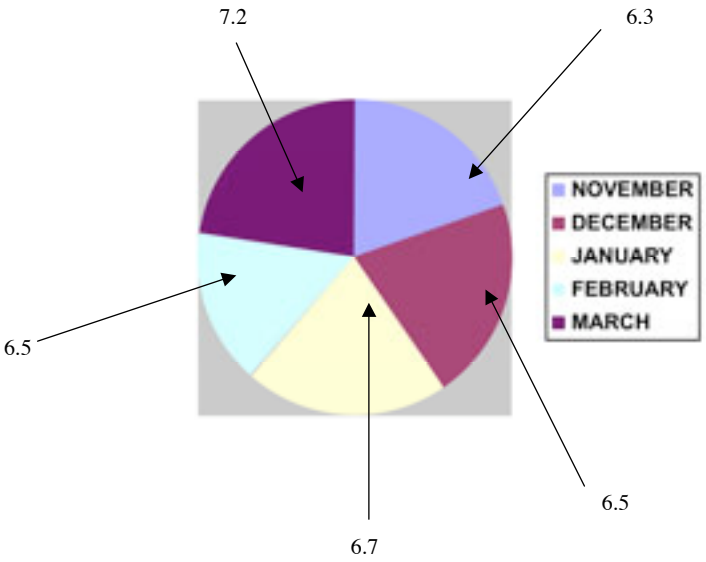
Nitrate – NOVEMBER 2006 – MARCH 2007



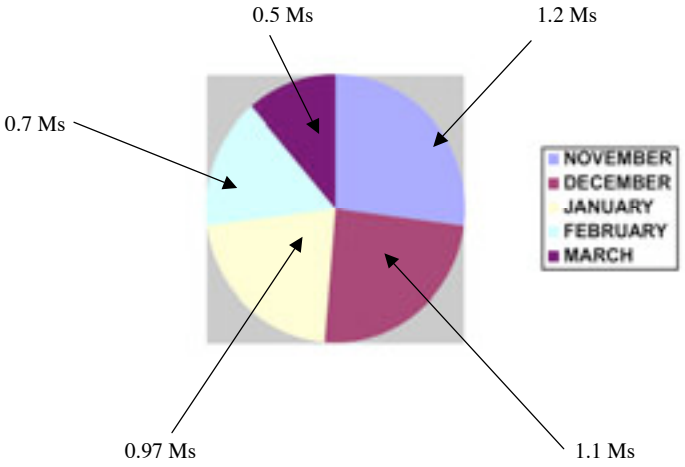
Translucency – NOVEMBER 2006 – MARCH 2007



pH – NOVEMBER 2006 – MARCH 2007

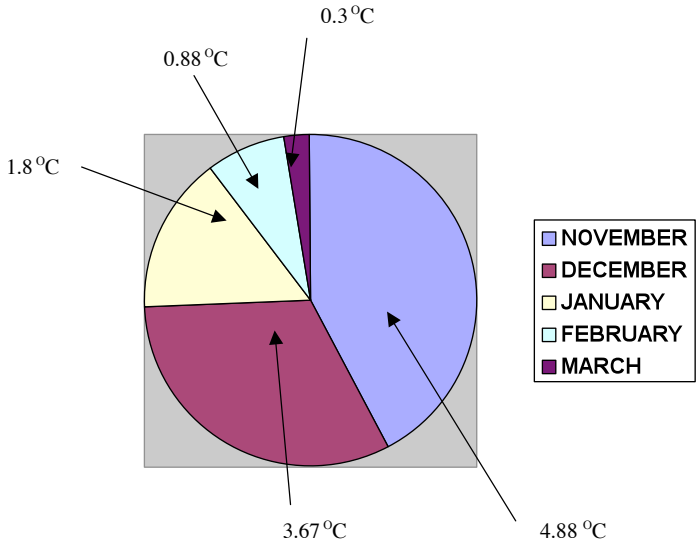


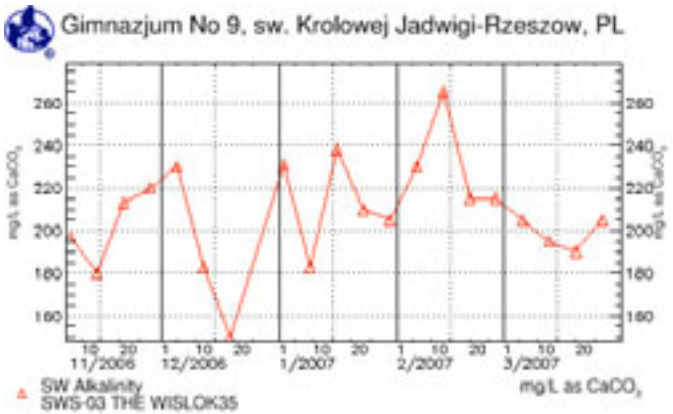
Leadership – NOVEMBER 2006 – MARCH 2007

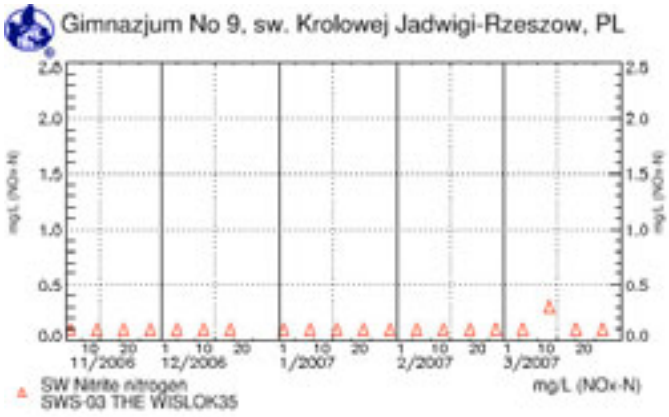


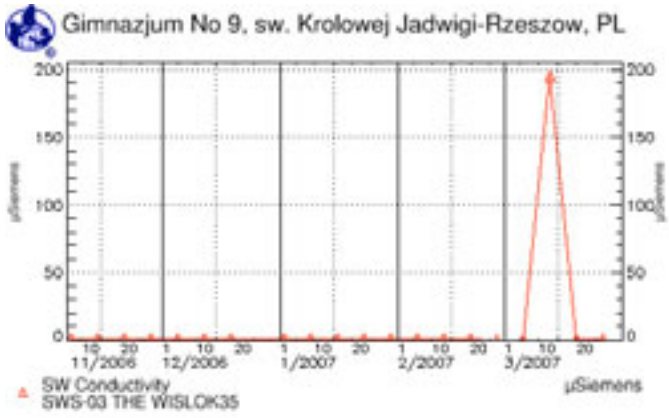
While working out the data we also used GLOBE database. These are the results:

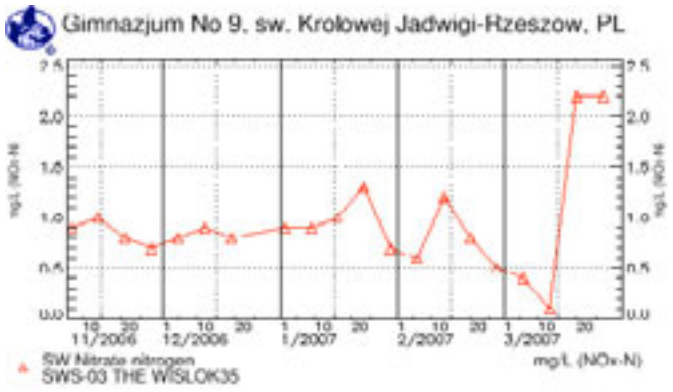
Temperature – NOVEMBER 2006- MARCH 2007

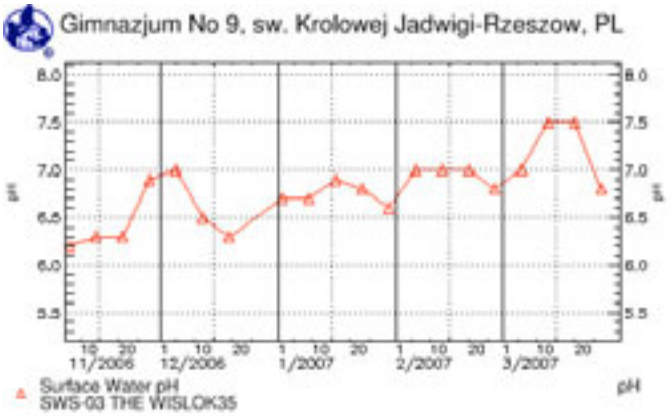


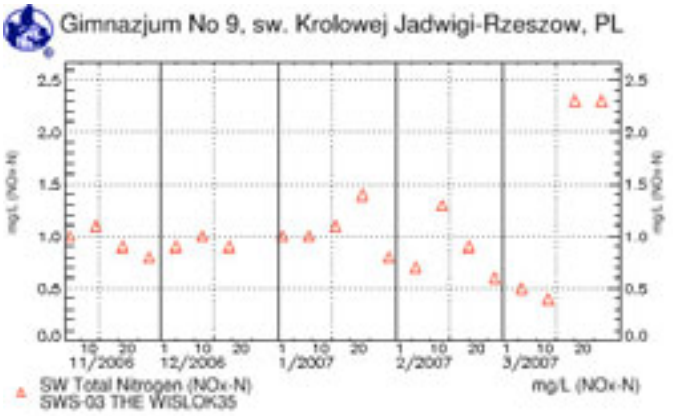


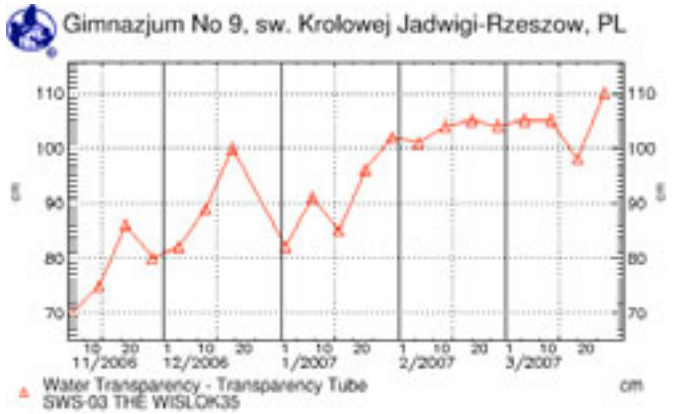












5. A DISCUSSION ON THE PHYSICOCHEMICAL FINDINGS OF WATER

OXYGEN

The amount of oxygen hesitates slightly depending on a month, which results from temperature changes, since with the temperature rise, the oxygen solubility in water decreases.

Water oxygen content is one of the most important indicators of water quality. Oceans, lakes, rivers and other reservoirs contain oxygen, which is necessary for plants' and water animals' lives. The lack of oxygen in a particular reservoir suggests that it is heavily polluted.

The oxygen in water comes from the atmosphere or gives off as an effect of plants' and algae's photosynthesis. As far as the latter source is concerned, one must bear in mind that there are natural, circadian fluctuations of oxygen content absorbed by a reservoir under discussion. Moreover, water temperatures, as well as ambient temperature which influences the former, decide on the amount of oxygen dissolved in water. In addition to this, the amount is dependant on precipitation, since then it is easier for the oxygen to get from air to water.

The lack of oxygen causes anaerobic processes to take place, the result of which is the emergence of toxic substances which destroy life in water. Drinking water should contain at least 2 mg/l of oxygen. The water that is used in district heating systems should not contain more than 10 mg of oxygen in one litre.

ALKALINITY
Nowadays, the alkalinity of water boils down to quantitative measurement of those ions in water test. Furthermore, it is a well-known fact today that some other ions, such as zinc or magnesium also take part in the complete water hardness. Thus, it is essential to measure and control the water hardness in order to prevent the formation of scale and blocking up of pipes.

The alkalinity of the research in question oscillates between 187.7 mg/L and 248.3 mg/L.

NITRATES
The nitrates' ions are present in trace amounts in surface waters as well as higher levels of subsoil waters. In household sewers the nitrates can be found merely in small amounts, yet their concentration can be higher (up to 30 mg/l as nitrogen) in fields run-off that were exposed to the biological process of nitrification.

A large dose of nitrates may contribute to methemoglobinemia: children's deaths and falling ill by adults. To avoid such situations there are limits agreed to, which decide about the content of nitrates in drinking water (e.g. 10 mg/l as nitrogen).

According to the research, the content of nitrates in water has risen in March. In our opinion, it is caused by the flow of waters from neighbouring farms and allotments.

TRANSPARENCY
The transparency of water in the river under discussion is considered to be good. The transparency is dependant; to a great extend, on weather conditions. Atmospheric precipitation contributes to the decrease of the degree of transparency of water.

CONDUCTIVITY
Electrolytic conductivity of water is feasible owing to the presence of ions that come from the dissociated molecules of salt, alkalines and acids, because the water itself dissociates to the minimal degree. In conductivity, the leading role belongs to both positive ions (cations) of lime, magnesium, sodium and potassium, and negative ions (anions) of chloride, sulphate, bicarbonate and nitrate.

The conductivity of water oscillates between 0.5 Ms and 1.2 Ms.

TEMPERATURE
The temperature has an influence on the basic physical, biological and chemical properties of water:
- the amount of oxygen that can be dissolved in water: the higher the temperature, the lesser the solubility of oxygen;
- the photosynthesis rate of algae and other water plants: the higher the temperature, the greater the rate of photosynthesis;
- the metabolism (energy conversion) rate of water organisms: the higher the temperature, the greater the rate of metabolism;
- the sensitivity of water organisms to toxic compounds, parasites and diseases: the higher the temperature, the greater the sensitivity.

REACTION
In our country, most unpolluted waters have the reaction related to the neutral one which oscillates between 6.5 and 8.5. Nevertheless, acid waters in forest areas and moors are an exception, because their reaction may come to about three. Moreover, when the process of photosynthesis is intensive, waters of temporarily high reaction can be found. Then, the pH value can be equal to ten. The majority of water organisms is adjusted to living in particular conditions, in which water reaction is very important. Most water organisms die when water reaction goes either below 4.5 or above 9.6. However, many of them may die even if the change of water reaction is insignificant. The typical example of fish that is very susceptible to the change of reaction is the brown trout which dies when the water reaction drops below 6.5.

In addition to this, the larvae of mayflies die in water whose reaction is < 6.5.

Water reaction of the Wislok River keeps average values from 6.3 to 7.2.

The research results have been compared with the value of indicators for particular water classes

The value of indicators for particular water classes.

After a thorough analysis and the comparison of the aforementioned research results with the value of indicators it can be firmly stated that water in the Wislok River belongs to I class of purity with regard to water oxygen content,

Name of indicator	Unit	I class of water purity	II class of water purity	III class of water purity
Conductivity	S/cm	800 and below	900 and below	1200 and below
Reaction	pH	6.5 - 8.5	6.5- 9.0	6.0- 9.0
Hardness	Mg $CaCO_3$/ dm^3	350 and below	550 and below	700 and below
Nitrates	Mg NO_3^-/dm^3	0,5 and below	0.5-1.5	1.5 – 4.0
Oxygen		7 and more	6-7	4-6

alkalinity and its pH value. Nonetheless, it has been also found out that there is nitrates pollution in the water, hence with this respect it belongs to II class of purity.

Waters of II class of purity are suitable for fish farm, animal husbandry, recreational purposes as well as for practicing water sports.

6. BIOLOGICAL RESEARCH APPLYING BAUR'S METHOD

a) sources and equipment:

- a ground map
- tables with water animals used to mark the species
- a kitchen sieve, a magnifying glass, a few empty jars, a plastic bucket, a white plastic bowl, tweezers

While establishing the quality of water it is important to remember, that the reliability of the results increases along with the number of samples taken. Therefore we should take many samples both from the bottom of the water basin and the plants. Having the data from the research we can easily determine the quality of water by applying a simple calculation. It is enough to multiply the number of the animals of one species by a quality factor and we will obtain the result (of the species). Then the number of inhabitants (everybody) is divided by the result (of the species) thus obtaining the average class of water quality. However, it is not the final result. The presence of many species of animals in the water is the sign of small yet truly existing burden of it. At the same time, among the marked species, only some can indicate water contamination. Therefore it is necessary to introduce corrective factor. With small number of animal species found, we add the corrective factor to the calculation results; whereas with great number of species we subtract. Having finished the examination we set the animals free, back to water. The examination shows that the observation of water organisms is a significant indication while establishing the quality of water.

The key to mark some water invertebrates

1 purity class	
	PLECOPTERA (larva) - ✓ about 1 cm long ✓ the abdomen tipped with two bristles
	HEMIPTERA – ✓ about 6 mm long ✓ found under the stones
	EPHEMEROPTERA (larva) – ✓ about 13 mm long ✓ the abdomen tipped with three bristles ✓ changeable pigmentation
	DIPTERA (larva) – ✓ about 5 – 12 mm long
1,5 purity class	
	TRICHOPTERA (larva) – ✓ a characteristic "house" made of various materials (sand, pebbles, sticks, etc.) ✓ up to 3 cm long
	PLANARIA – ✓ up to 12 mm long ✓ dark brown or black in colour ✓ flat body
2 purity class	
	PLANORBIS - ✓ a spirally twisted shell ✓ dark brown in colour ✓ shell's width - up to 20 mm; height – up to 5 mm
	PISIDIUM AMNICUM - ✓ up to 10 mm long ✓ the top of the shell situated asymmetrically
	RIVER LIMPET - ✓ shell in the shape of a "hat" ✓ 5 – 8 mm long ✓ 4 – 6 mm wide ✓ 3 – 4 mm high
	EPHEMEROPTERA (larva) – ✓ about 13 mm long ✓ the abdomen tipped with three bristles ✓ changeable pigmentation
	DENDROCOELLUM LACTEUM ✓ up to 25 mm long ✓ whitish in colour
	TRICHOPTERA (larva without a "house") - ✓ up to 15 mm long ✓ whitish in colour
	GLOSSIPHONIA COMPLANTA - ✓ up to 27 mm long ✓ changeable pigmentation
	OLIGOCHAETA - ✓ up to 20 mm long ✓ a good swimmer, very brisk
	GALBA PALUSTRIS - ✓ egg-shaped shell ✓ shell's height - about 24 mm
	GAMMARUS PULEX - ✓ body flattened on one side ✓ up to 12 mm long
3 purity class	
	DIPTERA (larva) - ✓ up to 15 mm long

	COMMON LEECH - ✓ up to 60 mm long ✓ dark brown in colour
	THE EUROPEAN FINGERNAIL CLAM - ✓ shell's length up to 12 – 17 mm ✓ slightly streaky ✓ found mainly at the bottom
	AQUATIC SOWBUG - ✓ body's length up to 17 mm ✓ dun in colour
3,5 purity class	
	RED WORM (larva) - ✓ up to 10 mm long ✓ deeply red in colour
	SEWAGE BACTERIA
4 purity class (unclassified)	
	TUBIFEX - ✓ up to 70 mm long ✓ bright red in colour

	DIPTERA - ✓ up to 30 mm long

How to calculate the class of water purity?

$$\frac{\text{Sum of products}}{\text{Sum of specimen}} = \text{unadjusted class of water purity}$$

73.5÷32..=2.3.....
2.3−0.2=2.1.... the second class of purity

7. A DISCUSSION ON BIOLOGICAL FINDINGS OF WATER

On the basis of the aforementioned findings and calculations it is clear that in our research centre, water in the Wislok River belongs to the II class of purity.

It means that waters of this particular class can be classified as good/satisfactory: they meet most requirements pertaining to the quality of surface waters which are used for the delivery of drinking water to people when their purification is done using the method proper to the category of A2.

The experiments that have been conducted show that the observation of water organisms is one of important hints that helps to stipulate water quality. Moreover, it is an easy way of learning the difficulties of water environment in our neighbourhood.

8. SUMMARY

The results are equivocal since by using the Baur's method we are informed that the water belongs to the lower class of purity. In our opinion, this method gives better and clearer results since it focuses on marking the organisms that live in water. To the contrary, on the basis of physicochemical findings of water the data we get is not exhaustive.

The systematic analysis of water helped us to learn more about the local environment and the work on this project gave us the opportunity to gain profound knowledge of the Wislok River.

While we were conducting the research, we had a chance of working as scientists, since we were formulating hypotheses, analyzing the data and drawing conclusions.

Corrective factors used while calculating purity classes of waters:

The number of species of water organisms found	Corrective factor
1 – 2	0,5 point (the factor is added)
3 – 4	0,2 point (the factor is added)
5 – 10	0 point
11 – 13	0,2 point (the factor is subtracted)
14 and more	0,5 point (the factor is subtracted)

Biological examination of water

The inhabitants of water	**Number of specimen**	**Quality factor**	**Product = number of inhabitants**
Plecoptera larvae		1	
Mosquito larvae		1	
Ephemeroptera larvae	7	1	7
Planaria		1,5	
Trichoptera larvae (with a 'house')	1	1,5	1.5
Planorbis		2	
Gammarus pulex	2	2	4
River limpet	1	2	2
Dendrocoellum lacteum	2	2	4
Glossiphonia complanta		2	
Black flies larvae		2	
Caddice fly larvae		2	
Oligochaeta	3	2	6
Galba palustris	4	2	8
Pisidium amnicum	1	2	2
Aquatic sowbug		3	
Common leech	1	3	3
Diptera larvae	1	3	3
The European fingernail clam		3	
Sewage bacteria		3,5	
Red worm larvae	6	3,5	21
Tubifex	3	4	12
Drone fly larvae		4	
	32		73.5
	Sum of specimen		**Sum of products**

Tendencies of Changes of Temperature in Przysucha

Based on the measurements of the current temperature

School: John Paul II, Przysucha, Poland

The members of the Globe program in secondary school of John Paul II in Przysucha make systematic meteorological measurements.

Przysucha is a small county town located in the central Poland.

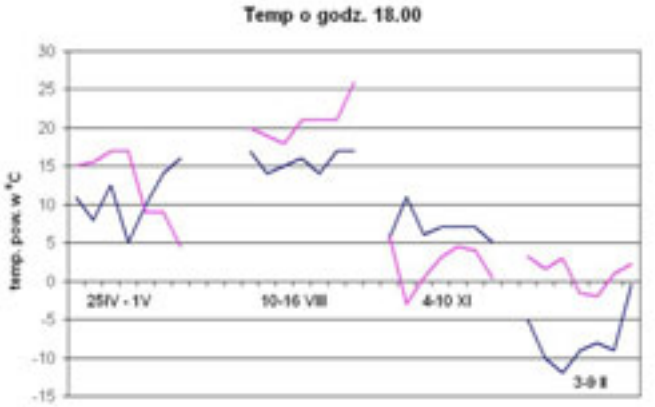
Measurements of the current temperature were taken in the so called "weather station" situated by our school; geographical location: 51,3667 N, 20,6333 E: altitude 205 meters above the sea level.

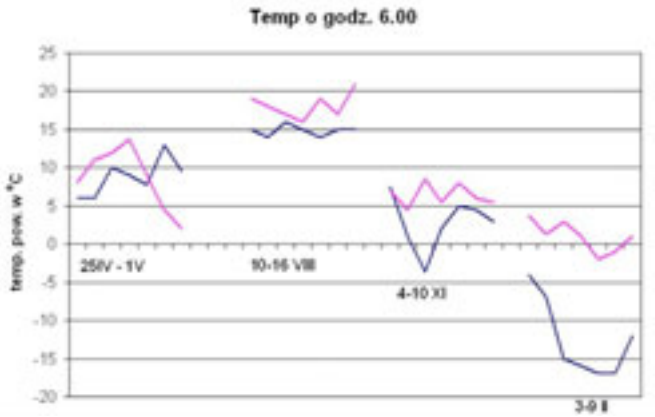
Students chose to make the measurements during one week of each season of the year 2005 and 2007 (spring. summer, autumn, winter). The measurements were taken at 6 a.m, at noon, and at 6 p.m according to UT time.

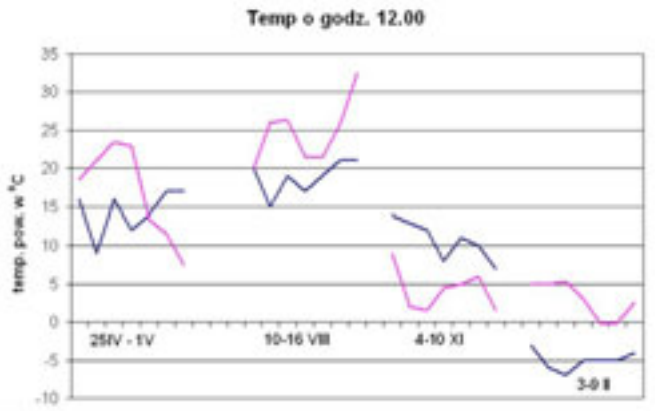
The charts clearly show the growth of temperature in Przysucha. This diversity depends on the different air mass flowing to Poland, shape of the area surface, the amount of sunlight, the type of the surface, plants, the neighbouring area of the town as well as on the type of weather, cloudiness and wind. While comparing the meteorological data from 2005 and 2007 we can see that the temperature diversity reaches even a few degrees centigrades e.g in summer 2005 and 2007. In 2005 from the 10th to the 16th of August the temperature was from 15°C to 21°C, whereas during the same season in 2007 the temperature was from 20°C to 32,5°C. Only the week of autumn was warmer in 2005 than 2007 at 1200 and 1800. The least temperature diversity appeared in spring and in autumn. Some values were even similar e.g on the 29th of April and on the 10th and 14th of August.

Written by the member of the Globe Program Michal Rybinski and the supervising teacher D. Maj.

Violet shows temperature in 2007
blue - in 2005







GLOBE Integration Program in Environment Education and in Science Education for Sustainable Development

School: Seydina Limoulaye Senior High School, Dakar, Senegal

ABSTRACT
If environmental education and scientific research disciplines are essential for sustainable community development, they have not yet imposed in education systems. Through the implementation of its technological capabilities; the GLOBE program is an additional asset to the educational, scientific, technological and environmental policy.

- How can we integrate this program into the teaching of sciences?
- How can this integration promote sustainable development for communities?
- The setting up of a weather station inside the school equipped with a thermometer, rain gauge and a cloud map help our students to record climate data.
- Then our students use the computer to compile and process the data collected. Thus they realise monthly charts as well as a yearly table of climatic data. Those data banks produced will be available to the whole educational system and environmentalists.
- The data will be used in class furthermore in awareness raising campaigns on environmental issues.

The GLOBE program should be integrated at all levels of studies. It can lead to the creation of a national and international system for students, teachers and environment specialists who collect and exchange data. Thus they will contribute to better the teaching, the learning of sciences and the protection of environment.

INTRODUCTION
If environmental education and scientific research disciplines are essential for sustainable community development, they have not yet imposed in education systems. Through the implementation of its technological capabilities; the GLOBE program is an additional asset to the educational, scientific, technological and environmental policy.

- How can we integrate the GLOBE program into the teaching of sciences?
- How can this integration promote sustainable development for communities?

With this research we want to improve:

- students' level in sciences and ICTS;
- the way sciences are taught by providing data banks available to teachers and the entire educational system;
- People's awareness about environmental issues.

This article presents the results of a year a year study by scientific 5th form Seydina Limamoulaye High school. After the description of the equipment and methods used, this article will show the analysis of the outcomes, their interpretation and conclusions which will be followed by a debate.

MATERIALS AND METHOD

The equipment

We conducted our research in atmosphere protocols. We installed within limamoulaye high school a weather station fitted out with a thermometer max/min, a rain gauge and a cloud chart.

The thermometer enable (helps) students to take the current temperature, the highest temperature and the lowest temperature within the 24 hours.

The rain gauge helps to determine the amount of rain that has fallen in the 24 hours.

The GLOBE cloud chart includes the main ten types of clouds and the students refer to them to identify the types they have observed and the cloud cover.

The population or target

The research was conducted by science students at limamoulaye high school. To specify: students from two fifth-form classes of about 50 each with the participation of CRPSE (a club which seeks to promote scientific and environmental research).

While the first group students are the same level, the CPRSE group is formed of about 50 sixth-form students and sometimes upper, that is to say the former GLOBE students.

Those assist the teacher in training the fifth-form students in ICT.

In the group formation the parity criterion is taken into account so that they are as many girls as boys.

REPUBLIQUE DU SENEGAL
MINISTERE DE LiENVIRONNEMENT

ET DE LA PROTECTION DE LA NATURE
MINISTERE DE LiEDUCATION

PROGRAMME GLOBE

Data collection

Air temperature

Cloud

Cloud cover

Each solar noon, a group of students (2 to 5) goes to the shelter and collect:

- the current, maximum and minimum air temperature;
- the rainfall;
- the types of cloud and cloud cover

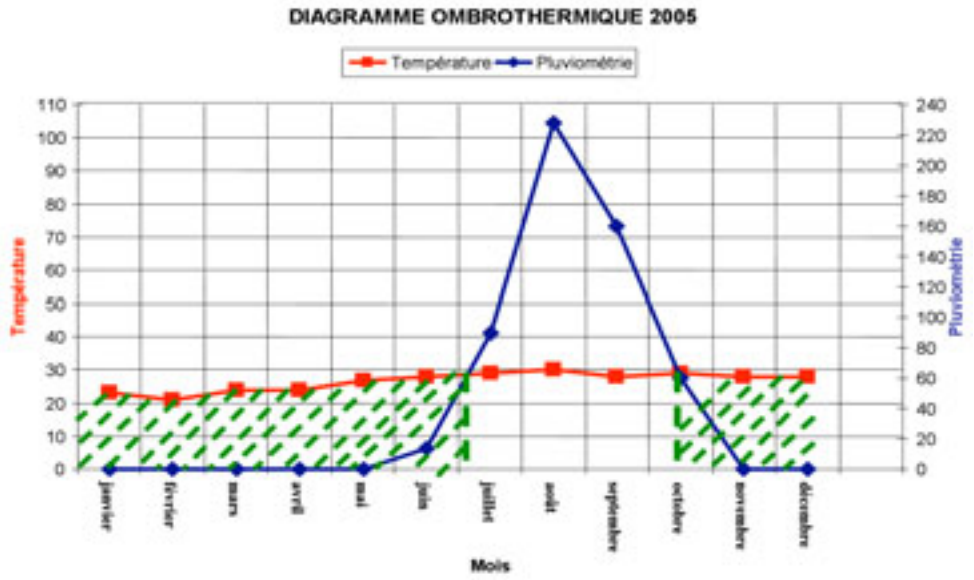
The data is recorded on sheets designed for that purpose. The average time for data collection is 10 to 15 minutes.
Students use computer to compile data

DATA SUMMARY

Mois/**2005**	Janvier	Février	Mars	Avril	Mai	Juin	Juillet	Août	Septembre	Octobre	Novembre	Décembre
Température Actuelle en °C au midi Solaire	24.60	22.30	25.25	25.10	29.01	29.50	29.91	30.15	30.13	30.98	29.12	29.10
Température Maximale en °C : M	26.30	23.30	25.84	25.60	29.83	30.13	30.98	30.97	31.16	31.70	30.05	29.98
Température Minimale En °C : m	20.30	19.93	22.60	22.11	25.45	27.00	27.50	27.86	26.54	27.82	26.72	26.14
Température Moyenne en°C (M+m)/2	23.30	21.61	24.22	23.85	27.64	28.56	29.24	29.41	28.85	29.76	28.38	28.06
Pluviométrie totale en mm : **554.9**	0	0	0	0	0	14.4	91.8	227.6	155.1	66	0	0

Document 1: 2005 yearly climatology table: site 01 Limamoulaye
Coordonnées GPS : N 14.7769°, W 017.37885°, Altitude : + 34m

Document 2 : temperature – rainfall curve



Document 3 : aridity index Ia

$$Ia = \frac{P}{T+10}$$

Ia:indice d'aridité
P:pluviometrie totale annuelle en mm
T:température moyenne annuelle °C
10:constante pour ajuster la température

Application numerique:
T= 26.9°C P=554.9 mm

$$Ia = \frac{554.9}{26.9+10} \Longrightarrow Ia=15.04$$

Document 4 : curves of variation of average monthly temperatures of 2005

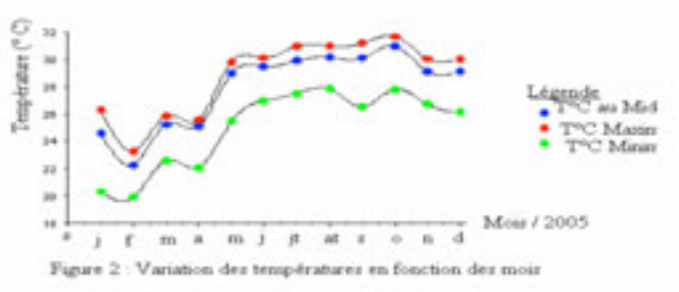
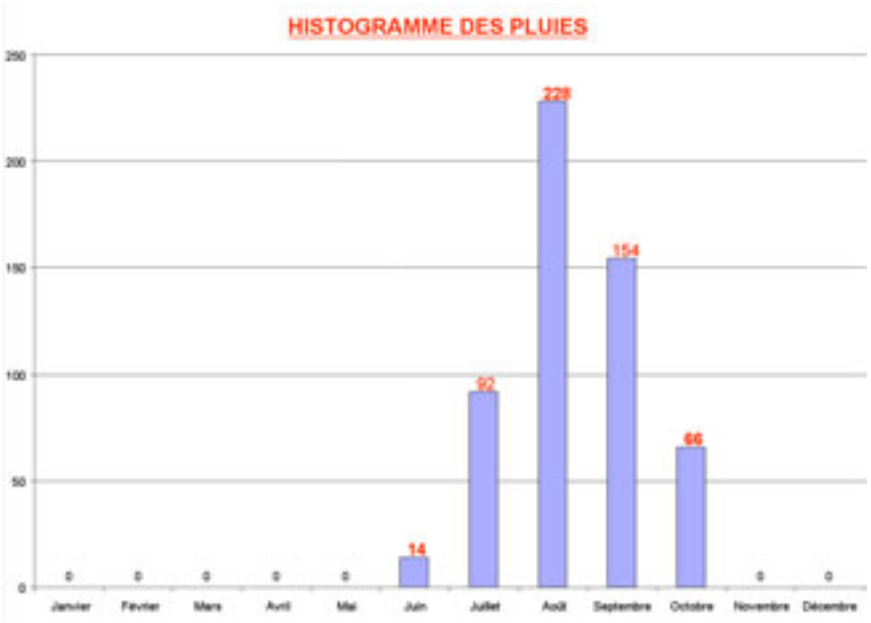
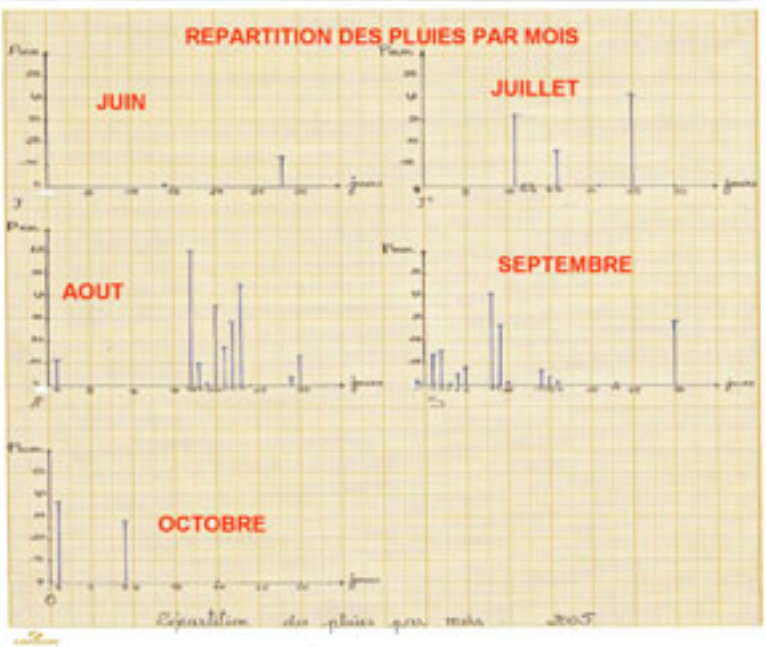


Figure 2 : Variation des températures en fonction des mois

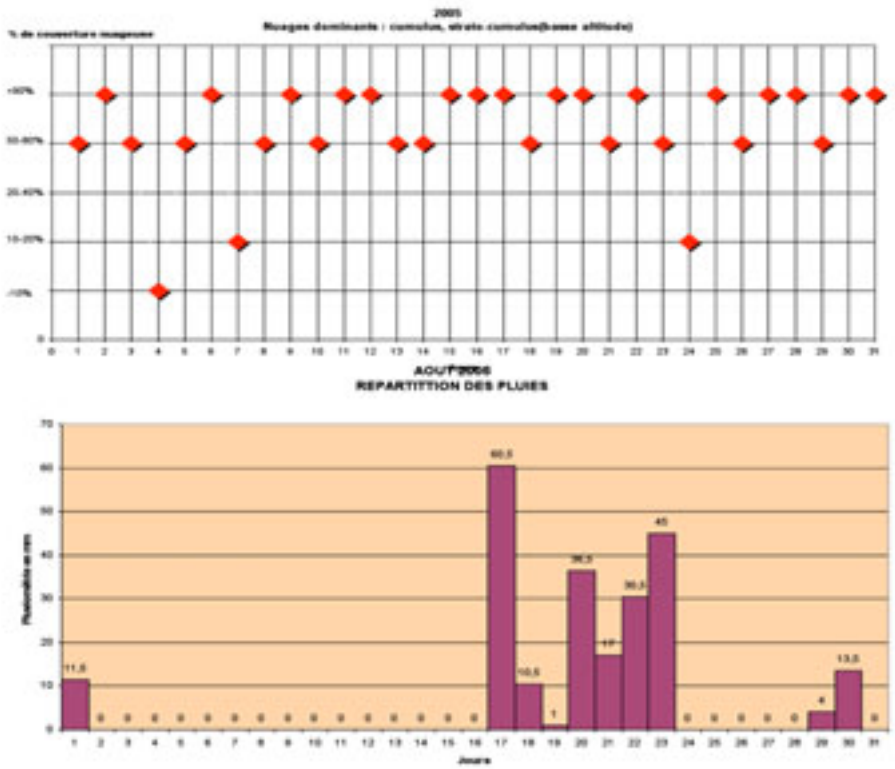
Document 5 : Histogram of the rains for 2005



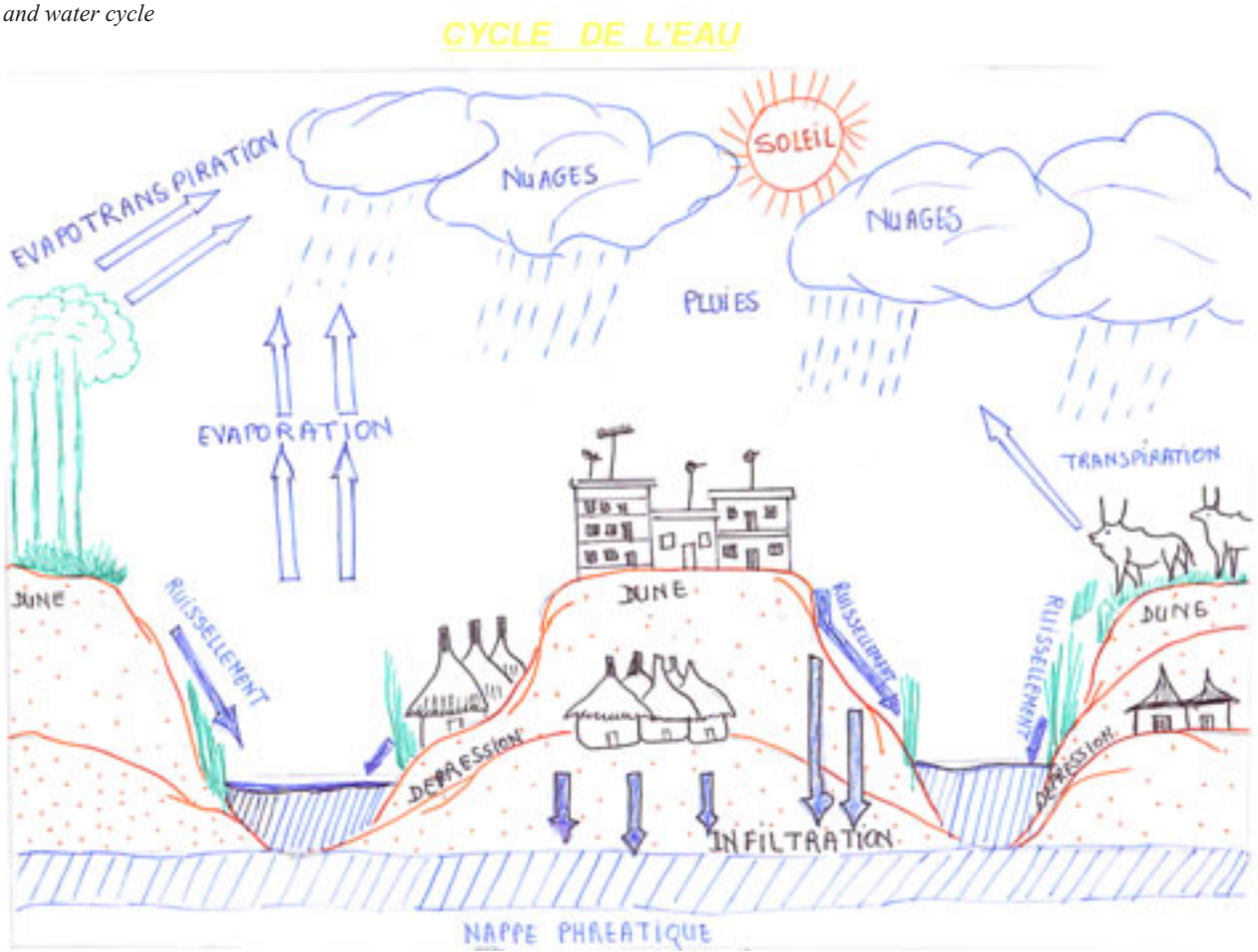
Document 6- diagram of daily rains



Document 7- relationship between clouds, cloud cover and rains



Document 8 : topography of the suburban area and water cycle



OUTCOMES OF THE ANALYSIS
Document 1: yearly climatic table of site-01 limamoulaye: 2005

Every month the averages in °Celsius of current, maximum and minimum are indicated at solar noon as well as the total rainfall in mm. The table shows the average and rainfall of the year 2005.

Document 1 will be used to calculate digital expression of the climate and to draw the following graphs.

Document 2: ombrothermic diagram = diagram rainfall and temperature

We put in « abscissa » the 12 months of the year and in « ordinates », on the left the temperature and on the right the rainfall. The red curve is that of the temperature (T) and the blue one that of the rainfall (P).

If P<2T the month is dry or arid and of P>2T the month is humid or rainy. The part of the graph corresponds to the dry season hachured and the non hachured part represent the rainy season. So in 2005 the dray season lasted 8 months (from October to June) and the rainy season 3 months (from July to September). The graph shows a sahelian climate characterised by a long dry season and a short rainy season.

Document 3: Calculate the aridity index of our study site
If Ia >40 the climate is humid and if Ia<40 the climate is arid. The mark found is 15. 04 and it is inferior to 40. Consequently the area studied is arid, the climate is sahelian arid.

Document 4: curves of variation of average monthly temperatures of 2005

The curves show 2 seasons: a hot season that last 7 months (from May to November) and a quite cold season of 5 months (from December to April). The hottest months correspond to the rainy season.

Document 5: Histogram of the rains for 2005

The whole rainfall in 2005 was 554.9 mm; so we had in June 14.4 mm, July 91.8 mm, August 227.6 mm, September 155.5 mm and October 66 mm. Therefore August and September are the rainiest months.

Document 6: diagram of daily rains

As a whole 30 rains varying from 5 to 60 mm were recorded including 22 rains between mid-July and mid-September. This breaking down of the rains shows two weeks of heavy rains in August and September as well as long rainless intervals.

Document 7: relationship between clouds, cloud cover and rains

During the 2 rainy weeks, there more cumuli and stratocumuli which are low altitude clouds. The sky was broken to overcast.

Document 8: topography of the suburban area and water cycle

To relate the data obtained in climatology through the GLOBE program and environment issues, the students have realised a drawing of the topography of the area. We have dunes and depressions or inter dunes and the texture of the soil is sandy. Trough topography and water cycle, we have shown that the inter dune areas are liable to flooding but not the dune areas. So the buildings represent the areas fit for housing whereas the huts represent the unfavourable areas.

Document 9: map of the Cap Vert Peninsula

This document shows the place of our study site in Guediawaye compared to the Cap Vert Peninsula

The photographs n° 1 to n° 14 are from the suburban area; they show the problems of the spatial planning

The students' data will be used for awareness Campaign in those areas. The pictures n° 1 to n° 5 show the abnormal occupancy of the low lands. From pictures n°6 to n° 13 show irrigation network and market gardening recommended on the low lands. The picture n° 14 shows a water pump located on the groundwater. Indeed the groundwater is near and overcharged (overloaded).

INTERPRETATION / CONCLUSION
Students' outcome are used has didactic materials.
Our studies helped to understand better the experimental process that consists and observing, experimenting, analysing and drawing conclusions.

The learners' research provides up- to-day data banks to teachers that can be used in class to teach science in an active way and to give concrete exercises. Teachers have recent data on their own environment instead of old data or data on not locate sites.

With the data, we can draw the diagram or the histogram of rain in their own environment. We can compare the climatic conditions of several years and calculate the aridity index of a few sites.

The GLOBE program helps students to be familiar with information and communication technologies including the computer.

Support for raising awareness in environment issues
Our research deals with the year 2005 because their were important floods, a serious environmental problem in Dakar, the capital of Senegal.

After working on document 1 to 4 a significant question was asked. How can and arid zone with a long dry season, with a short raining season with Ia<40 and a yearly rainfall of 554.9 can cause floods?

In fact the documents 5 and 6 show and irregular distribution of rains and a bad distribution of rains particulary in August and September, the rainiest months. The topography of our study site shows dunes, inter dunes and the soil is sandy; this means that it has a high infiltration speed. After repeated rains, the water reaches the groundwater as well as the one streaming down the slopes of sites.

When the groundwater is over-fed, the water emerges and occupies the inter dunes depressions, fact which entails the flooding of houses built on those areas.

Our conclusion is those floods are not caused only by heavy rains but by a bad planning of the suburban space. Before 2005 the rainfall was low and the groundwater decreases a lot; the inter dune depressions were filled in and houses were built. Climatic change being cyclic, when the rainfall increases such as 2005, the water will occupy its natural bed.

Our students are now very most aware of the importance suburban planning.

On the health, water from pumps is for domestic use (linens, dishes, watering…). At the inter dune area studied, the groundwater is near the garbage dumps and it is likely to be polluted.

Support materiel for the celebration of the world environment day

When we celebrate the Wold Environment day students convey information and raise people's awareness including their parents' and the Authorities. Students recommend people to avoid or stop building in the filled inter-dunes which should be transformed in to market-gardening zones for a sustainable development of the neighbouring communities.

DISCUSSION

The research done by the students of limamoulaye high school is a good example of the integration of the GLOBE program and the ICT in the teaching of sciences for a sustainable development of communities. From theoretical teaching we move to a practical approach to science while taking into account the environmental facts. The work achieved by the students has a very positive impact outside the classroom. It helps to make students, parents and the whole population aware of issues linked to climate factors. For our future research projects we intend to make a qualitative study of water from pumps located on the groundwater and its possible pollution

This research should be better taken into account by increasing the number of GLOBE schools in order to spread widely the environmental awareness campaigns.

These results compared to those of other GLOBE program students in the world may lead to the creation of an international network of students, teachers and partners who collect and exchange data; thus they contribute to a better teaching of sciences, to an understanding of our environment and a better protection of our planet earth.

ACKNOWLEDGEMENT

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Mr. Mamadou Diouf coordinator for the CEFE
Ms. Ngossé Fall Bousso professor SVT, master trainer and coordinator GLOBE Senegal
Mr. Souleymane Diop former headmaster of the school Seydina Limamoulaye
Mr. M'baye Sarr headmaster of the school Seydina Limamoulaye
Mr. Mamadou Ba professor of physics and chemistry, teacher GLOBE
Mr. Baye Sadiara Fall professor of PC and computer trainer
Mr. Diaraf fall professor
Ms. Marème Guèye professor of PC
Ms. Tall Faniang Guèye professor of PC
Ms. Adiaratou Senghor English teacher
Ms. Aminata Ndiaye English teacher
Teachers
Students

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Mansour Dieng. Protéger l'environnement pour un Sénégal encore plus beau. Direction de l'environnement du Sénégal. Pages 21 – 29.

Document 9 : The Cap Vert Peninsula map

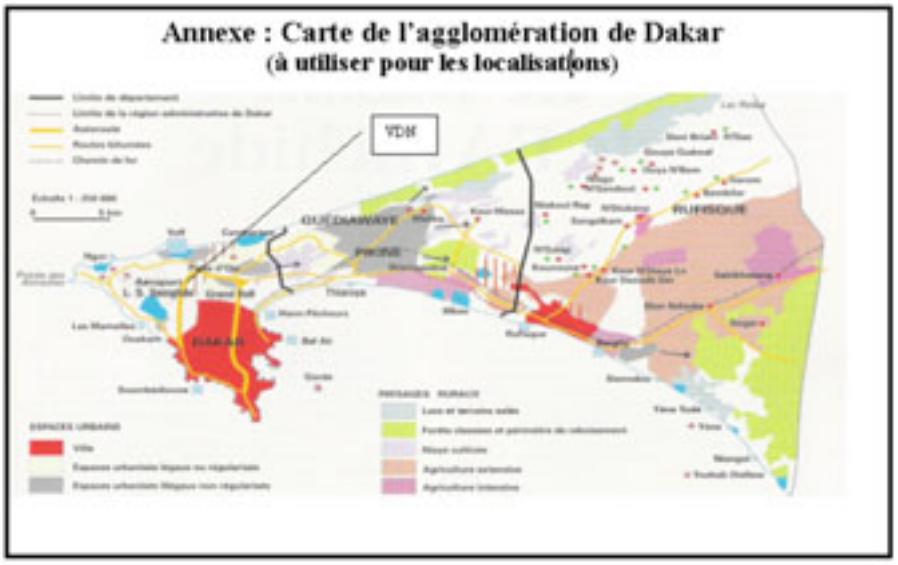


Photo 1 : Downtown Dakar

Photo 4 : domestic waste affecting interdunary depressions

Photo 5 : abnormal building on depression areas

Photo 8 : irrigation water drainage

Photo 9 : irrigation canal

Photo 12 : flat cultivation on the slopes of sandy dunes

For Sustainable Communities

NO! YES!

Adopt a River Project: A combined effort of the schools in the George Region in collaboration with the Eden District Municipality

Schools: Hibernia Primêr, Heidedal Primêr, Delville Park Primêr, Rosemoor Primêr, South Africa

BACKGROUND:

- Population increased dramatically-25% increase between 1996 and 2001.
- Southern Capeís Garden Route currently experiencing a tremendous increase in development (housing, industry, golf courses etc).
- Most rivers in Southern Cape originate from the Outeniqua Mountains which is largely conserved by Cape Nature within the Outeniqua Nature Reserve.
- Nature Reserve plays vital role in protecting water resources on which the booming Southern Cape depends.

PROBLEM STATEMENT

Today in South Africa people settle themselves anywhere, even along riverbanks. Poor management of water catchment areas has resulted in death of aquatic organisms. This is because nothing is being done about what is happening upstream. Problems resulting from this include:

- The Gwaing river system illustrates the seriously negative impacts of urbanisation on a river that originates within a near pristine environment above the town of George and emerges at its estuary as an impacted, polluted notorious river.

PRESENTERS

Grant Lottering	Hibernia Primêr
Zolani Mbanga	Heidedal Primêr
Candice Julius	Delville Park Primêr
Haylee Anne Prin	Rosemoor Primêr

The Guadarrama River in Central Spain: Environmental research on water quality

Students: Blanca Alarcón, Elena Alcalde, Irene Anula, Laura Barrado, Jaime Castillo, José Centeno, Sergio de Diego, Paloma Domínguez, Selma Gerrits, Omar Gómez, Eva González, Raquel Jiménez, Antonio Jiménez, Carlos Mora, María Quero, Marta Rodríguez, Jorge Rísquez, Roberto Solís, Santiago Uyana, Santiago A. Villegas.
Teachers: Rosario Corriendo, Begoña Maté, Rosana Quesada, Covadonga Segovia, Ana Suárez y María Concepción López Ramos (The GLOBE Program in IES Federico García Lorca Coordinator)
School: IES Federico García Lorca. C/ Gimnasio 1 y 3. 28290 Las Rozas de Madrid (Madrid), Spain

ABSTRACT
The purpose of this research is to prove the fact that the Guadarrama water loses quality between the upper and the medium courses due to human influence, especially urban development. This study focuses on the analysis of the pollution levels in both the upper and the medium courses of the Guadarrama River. Measurements have been taken in towns such as Collado Villalba (upper course), La Navata and Las Rozas de Madrid (medium course), where our high school is located.

In order to verify this hypothesis we used The GLOBE protocols (Hydrology) obtaining the following results:

In the Guadarrama River several differences between the upper and the medium courses were noticed, especially in the turbidity, dissolved oxygen, electrical conductivity, total nitrogen (NO_x-N) and alkalinity levels of the water. The main conclusion of the research is the fact that, as the river flows approaching the medium course, all these values become detrimental to the fluvial and riverside ecosystems.

The Guadarrama River headwaters are located in the Guadarrama Range. From here, it flows by a number of towns and residential estates, namely Guadarrama, Collado Villalba (upper course), La Navata, Parquelagos, Los Jarales and Molino de la Hoz, then reaching Las Rozas de Madrid (medium course).

This research has helped us to realize the importance of human influence on water quality and to become aware of the fact that the towns located on the Guadarrama riverside must have a sustainable development in order to avoid further environmental damage. This has also led to the conclusion that water depuration systems are needed in order for the water to be reused, not only by humans but also by the different living organisms in those ecosystems.

HYPOTHESIS
The Guadarrama River is a primary tributary of the Tajo River in Central Spain. The headwaters of the Guadarrama River are located in the west area of Comunidad Autónoma de Madrid (Fig. 2, 3 y 4). This river rises in the Guadarrama Range, which belongs to the Spanish Central Mountain Range

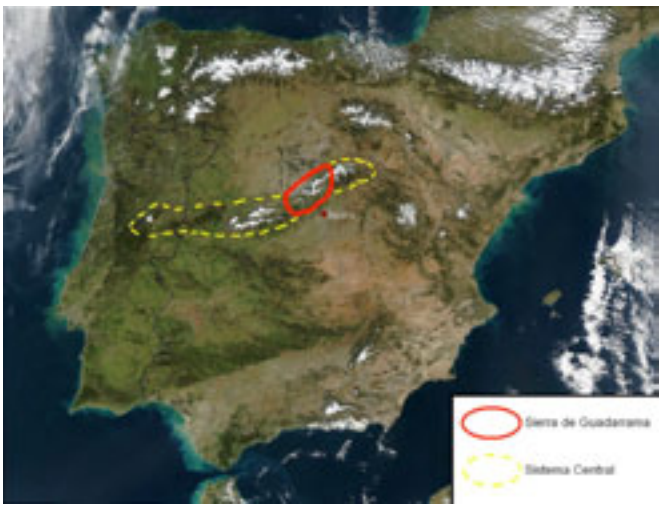


Fig. 1 Location of the Guadarrama Range within the Spanish Central Mountain Range.

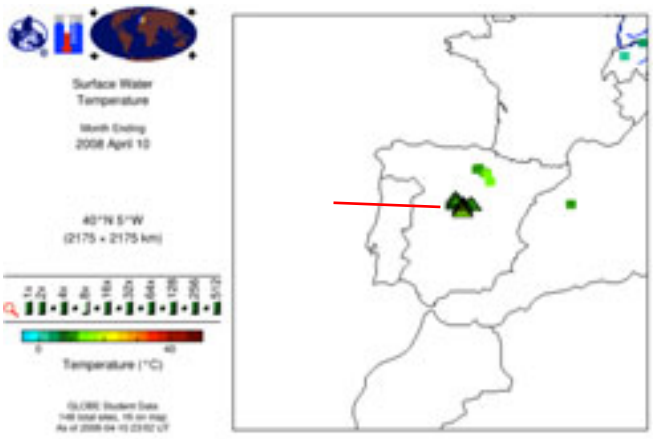


Fig. 2 Location of IES Federico García Lorca, in Las Rozas de Madrid.

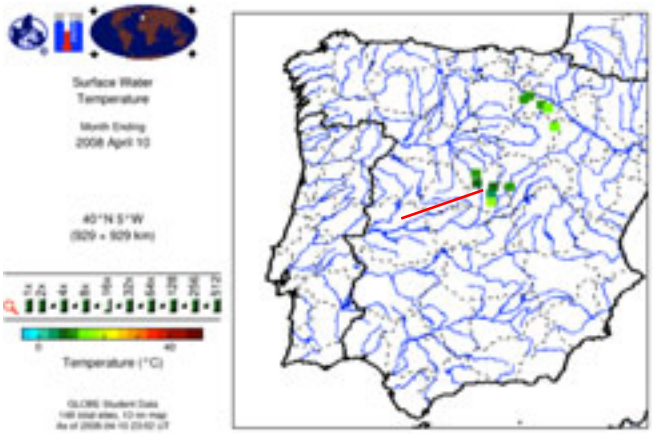


Fig. 3 The Guadarrama River (Central Spain).

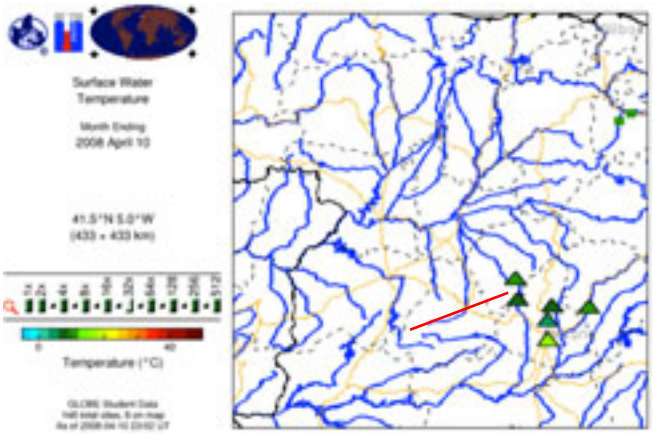


Fig. 4 The Guadarrama River (West Madrid).

Fig. 5 The medium course of the Guadarrama River.

Fig. 6 The upper course of the Guadarrama River.

In the medium course the river has both slow water and rapids. It is a small river (Fig. 5), approximately 6 meters wide.

There are more rapids in the upper course (Fig. 6).

The primary purpose of this research is to prove the influence that human activity has on the water quality of the river. Our project focused upon the analysis of the pollution in the upper and medium Guadarrama. Measurements have been taken in different towns near the river: Collado Villalba (upper Guadarrama), La Navata and Las Rozas (medium Guadarrama).

MATERIALS AND METHOD

Measurements have been taken once a week using instruments such as a turbidity tube, a pH meter, a water alkalinity kit, a dissolved oxygen kit, a water nitrate kit, an electrical conductivity meter, a thermometer, a cloud chart, a compass, a GPS, a clinometer, a 5L bucket, latex gloves, distilled water in a bottle,...

DATA SUMMARY
Most measurements were obtained by different students and teachers of the GLOBE teams of our school. They were subsequently uploaded to the GLOBE web obtaining the respective graphs.

Measurements were taken in the following sites:

Site SWS-04 upper Guadarrama (Fig. 10)

Site SWS-05 La Navata, near medium course.

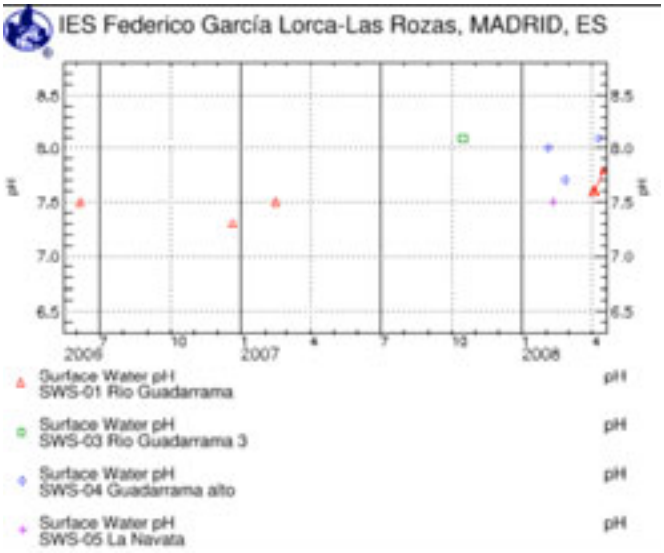
Sites SWS-01 Guadarrama River and SW-03 Guadarrama River are located on the medium course. These sites are the closest to the school.

Fig. 8 Location of the measurement sites.

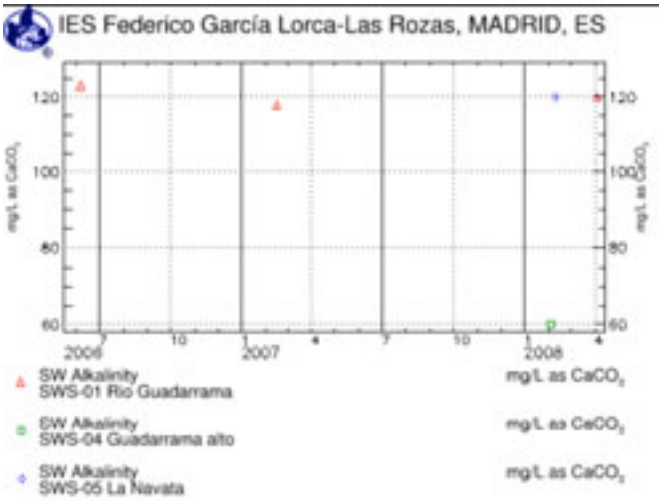
Fig. 9 Measurement site in the medium course of the Guadarrama River and location of IES Federico García Lorca in Las Rozas de Madrid.

Fig. 10 Measurement site in the upper course of the Guadarrama River in Collado Villalba.

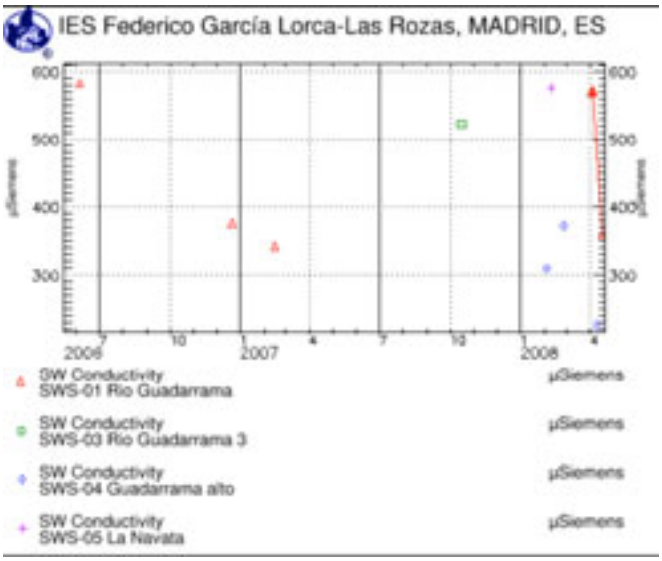
We can observe that during the summer months, the temperature of the water in the medium course reaches almost 25°C but it decreases in winter reaching 70°C. It has also been observed that there are some differences between the temperature of the medium course (around 12°C) and the temperature of the upper course (10°C) in April.



The pH levels ranged between 7,3 and 8. There are no significant differences between the medium course (SWS-01 and SWS-03) and the upper course (SWS-04). These values could be classified as basic.

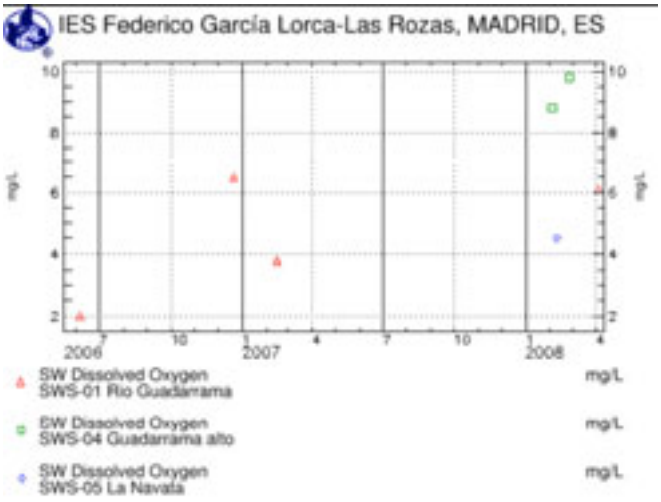


This graph shows how the alkalinity level in the upper course is lower than in the medium course. Generally alkalinity increases as rocks dissolve and it consequently increases as the river reaches the medium course. The decrease in alkalinity levels in the upper course could be a result of a snowmelt in the Guadarrama Range.

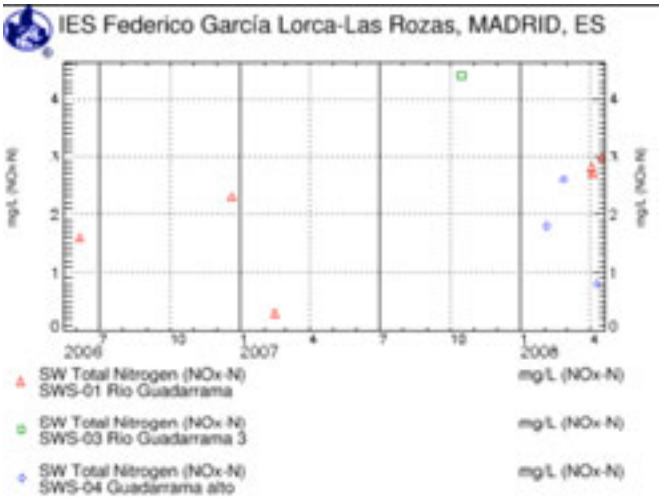


As electrical conductivity becomes higher, so does the amount of water impurities.

Analyzing this graph we can conclude that the electrical conductivity of the water in the Guadarrama upper course is lower as a consequence of the high purity of the water and therefore conductivity increases in the medium course, especially in the summer, because of the higher pollution in this area.

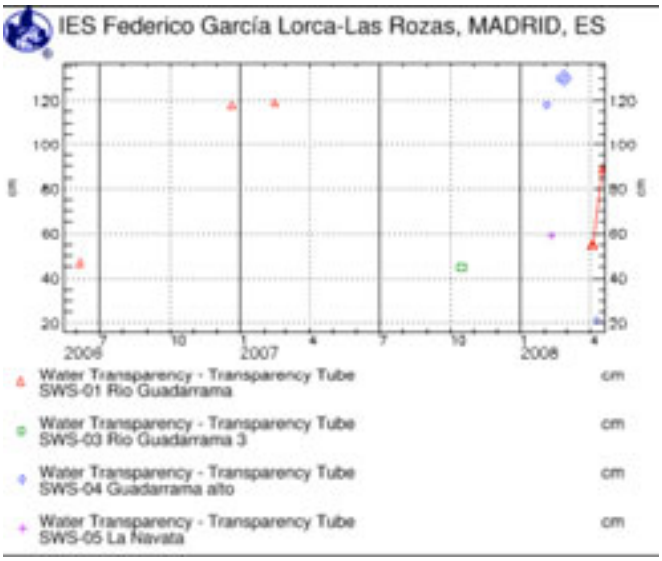


As regards to dissolved Oxygen, the only obvious fact in the graph is that the lowest amount of dissolved Oxygen occurred during the month of June, 2006. Levels below 3mg/L have a negative effect on the majority of aquatic organisms. The graph shows that Oxygen levels increase during the winter, and it can be clearly seen that the amount of dissolved Oxygen in the upper Guadarrama is higher than that in the medium Guadarrama.



It can be seen that the amount of Nitrates is generally lower in the upper course than in the medium course. In the medium course there was a big increase in October 2007 and a big decrease in February 2007. The increase could be due to waste dumped in the river from the numerous housing estates situated on the riverside. Big decreases are probably related to rainy days.

The presence of Nitrates may be due to multiple reasons; an excessive amount of these compounds in the river means that the water is enriched with nutrients and so it can become murky and be clogged with algal blooms. This process is called eutrophication and if its levels reach very high values, the ecological balance of the river can be seriously disturbed.



Water transparency is generally higher in the upper course than in the medium course. Water transparency in the medium course only increases in the winter months, but in the summer it dramatically decreases.

A lower transparency of water is due to the presence of sediments, bacteria, phytoplankton, other organisms, chemical waste or decomposing vegetation. We think that the main reason for lower transparency in the medium course is the presence of chemical waste from the various urban areas that the river flows by.This conclusion is based on the observation of foam and the presence of a strong smell from undetermined chemicals.

In the upper course there is a strong decrease in transparency levels in April because of a big presence of sediments after a rainy day.

ANALYSIS AND RESULTS

Firstly, water surface measurements from different sites have been introduced in the GLOBE website and then the tables and graphs of this web have been used to analyse the results.

CONCLUSIONS

The Guadarrama River flows mostly between human infrastructures (houses, roads, industrial areas), that produce an enormous amount of pollution. This study shows that this river has clear differences in terms of water quality between the upper and the medium courses. It may be observed that as the river flows approaching the medium course the quality of its water decreases: less transparency, less dissolved Oxygen, higher amount of ions in solution and Nitrates. This produces an important environmental degradation of its fluvial and riverside ecosystems.

In recent times, the quick increase of population in Comunidad de Madrid has put water resources under great pressure.

Table 1. *Measurements in the medium course of the Guadarrama River.*

	6/06/06 Las Rozas de Madrid	10/02/08 La Navata	2/04/08 Las Rozas de Madrid
Hour	15:25	13:05	10:00
Lat	N. 40,52002º	N. 40,59717º	N. 40,52002º
Long	W. 3,03961º	W. 3,97654º	W. 3,09361º
Alt	567 m	780,4 m	567m
Site	SWS-01	SWS-05	SWS-01
Clouds	Cirrus, cirrostratus	Clear	Clear
Transparency	47,53 cm	59 cm	55 cm
Temperature	25º		12º
Dissolved Oxygen	2 mg/L	4,5 mg/L	6,2 mg/L
Conductivity	583,3 mS/cm	576,67 mS/cm	570 mS/cm
pH	7,46	7,5	7,55
Alkalinity	123 mg/L	120 mg/L	120 mg/L
Total Nitrogen (NOx_N)	2,4 mg/L		2,86 mg/L

Table 2. *Measurements in the upper course of the Guadarrama River.*

	4/02/08 Collado Villalba	26/02/08 Collado Villalba	10/4/08 Collado Villalba
Hour	15:23	15:23	15:23
Lat	N. 40,63087	N. 40,63087	N. 40,63087
Long	W. 4,021	W. 4,021	W. 4,021
Alt	825,2 m	825,2 m	825,2 m
Site	SWS- 04	SWS-04	SWS- 04
Clouds	-	-	-
Transparency	118 cm	129.7cm	21 cm
Temperature	8º	10º	10º
Dissolved Oxygen	8,8 mg/L	9,8 mg/L	6,4 mg/L
Conductivity	310 mS/cm	373,3 mS/cm	225 mS/cm
pH	7,8	7,7	8,1
Alkalinity	60 mg/L		60 mg/L
Total Nitrogen (NOx_N)	1,8 mg/L	2,6 mg/L	0,8 mg/L

In conclusion, the growth and economic development of the riverside towns (Collado Villalba, La Navata, Torrelodones and Las Rozas de Madrid) has a big influence on water quality and on the Guadarrama River ecosystems. Because of that, this development should be balanced and sustainable and wastewater treatment plants and potabilization systems should be increased in the riverside housing estates and towns.

DISCUSSION

The results are valid but not enough. Future research wil be made in the area and in another river, the Manzanares River. The aim of this research will be the same, to prove our hypothesis that urban development has a negative effect on water quality, and as a result of this, on the environmental quality of its fluvial and riverside ecosystems.

In order to improve the research we will not only take more data from the upper and medium courses, but also from the lower course of the Guadarrama and Manzanares rivers.

This research has helped us to become aware of how human activity influences the quality of the river water and to become convinced that the towns located on its riverside should have sustainable development in order to avoid riverside and fluvial ecosystems environmental damage. We have also concluded that water depuration and potabilization systems are needed in all the riverside towns (Collado Villalba, Torrelodones, Las Rozas de Madrid) and housing estates (La Navata, Los Jarales, Molino de la Hoz) along the Guadarrama River in order for the water to be reused, not only by humans but also by the different living organisms that live in those ecosystems.

ACKNOWLEDGEMENTS

In the first place we would like to thank the GLOBE Program and all the people involved in it for allowing us to learn about the different measurement methodologies and resources in their webpage.

We would also like to thank Comunidad de Madrid (Spain) coordinator, Clemencia de Andrés, for her constant advice and support.

Our most sincere thanks also to the teachers Rosana Quesada and Begoña Maté for their help during sampling and chemical analysis of water and especially to all the teams of students who have participated for nearly three years in the GLOBE Program.

Last but not least, we would like to warmly thank our teacher and also friend Concha (Mª Concepción López Ramos), who has constantly given us encouragement and support to carry out this research for the GLOBE Program. Thank you very much.

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Web page: www. globe.gov

Web page: www. Google Earth

Effects of Mercury Contaminated Food on Growth of Mice

School: Kibaha Secondary School, Tanzania
Students: Mwasapi Kihongosi, Edward Moshi and Joseph Magehema
Teachers: Jeremiah Kashindye, Kaspar K Mmuya and Elizabeth Mbilinyi

1.0 ABSTRACT
This small research was carried out by students from the school's environmental club. In this study the effects of mercury contaminated diet on growth of mice, Mus musculus, were investigated. Mice were exposed to mercury for 5 days, and then fed on mercury free food for another 5 days. From day 10 to day 15 they were fed on mercury contaminated food, as well as from day 20 to day 25. As days of exposure to mercury increased, the rate of growing of mice was observed to be slow as compared to uncontrolled mice. Also the rate of feeding decreased for the mice exposed to mercury.

2.0 INTRODUCTION
Mercury is a naturally occurring heavy metal in the Earth's crust and is a highly toxic element. Exposure to and uptake of mercury has increased due to anthropogenic activities.

Both occupational and environmental exposures to mercury remain a serious problem in many developing as well as in some developed countries.

In most developed countries introduction of mercury into the human environment has decreased in recent years, largely due to public health campaigns and a decline in its commercial usage.

In developing countries, awareness of the impact of exposure of mercury to the public health is growing but relatively few of these countries have introduced policies and regulations for significant combating of the problem.

In Tanzania the problem of toxic effects of heavy metals in the environment is mainly caused by man activities such as mining activities and discharge of untreated industrial effluent to the environment and application of cosmetics. According to WHO the concentration levels of total mercury in water should not exceed the tolerable limit of 0.001 mg/l for drinking water.

Mercury can progressively concentrate through trophic transfers along the food chain, consequently forming an important source of mercury contaminants in fish and animals. Eating mercury contaminated fish and wild animals at the top of food chain expose people to mercury effects. The population at highest risk is the offspring of women who consume large amounts of contaminated food. For example, Minamata disease in Japan was caused by the consumption of mercury contaminated fish and shellfish obtained from mercury polluted water, contaminated by industrial effluents containing methyl mercury.

However, organic mercury compounds are more readily absorbed via digestion than inorganic mercury compounds. In mammals symptoms of high exposures to inorganic mercury include: skin rashes and dermatitis; mood swings; memory loss; mental disturbances; and muscle weakness and growth retadation

2.1 Significance of the study
In recent years Tanzania's mining industry has been growing very fast. This has been caused by forces of the so called modern world economy (globalization). Foreign investors have come to invest in mining and the trend is on the increase. Local miners are also more attracted to the business and are increasing in various areas of the country.

However, this growth in mining industry has not been accompanied by enough education and awareness on impacts of mining on the environment. The local people are not well informed or aware of ill-effects of effluents from the mining areas to the environment that will then be taken into their bodies through contaminated food and water. Local miners used mercury for collection of other minerals especially Gold.

This study will help to provide awareness to people around the mining areas on environmental and health impacts of effluents from the mines, including mercury.

Researchers also expect that this study will stimulate conduction of detailed studies on impacts of mining industry on the environment and health. We also intend to conduct field studies in the mining areas of the Lake Regions and Northern Tanzania.

2.2 Objectives of the research
The main objective of the study was to determine the effects of mercury-contaminated food on growth of mice.

2.3 Hypotheses
This study was guided by the following hypotheses, that:-
When ingested mercury is absorbed into the tissues which interferes the growth processes of the mice.

Mercuric chloride has corrosive actions and, when ingested, precipitates the mucous membrane proteins causing pain and vomiting conditions therefore decreasing the mice's feeding rate.

3.0 MATERIALS AND METHODS
Laboratory male mice Mus musculus was used in the research. The mice were housed in wooden cages with solid floors, walls and wire-meshed lids.

Figure 1: Diets preparations

Figure 2: Dried mice diet

3.1 Experimental diets
Food pellets was prepared as a mixture of broilers mash, Rastrineobola argentea "dagaa" and groundnut powder in a ratio of 3.1.1. Agar (3%) was dissolved in warm distilled water and added to the mixture to bind the food items into dough. 2mg of Mercury (II) chloride was incorporated into the 1Kg (1000g) experimental food. The dough was passed through a palletizes and the pellets dried in sun light for 2 days.

3.2 Experimental procedure
Mice of mean weights 21 ± 4g aged 3 weeks was obtained from the Botany department Kibaha secondary school and acclimatized to experimental cages. Five mice were kept in each of the four cages. Mice in one cage fed on mercury free diet, which served as the control experiment. Mice in other cages were fed diet containing mercury.

The mice were fed food weighing 15 % of their body weights daily. Daily rations were calculated on the basis of total weight of mice in the cage calculated from the mean weight. Feaces and uneaten food was removed from the bottom of the cages every day and dried

4.0 RESULTS AND DISCUSSION
Table 1 and 2 show trend in weight changes of the mice feeding on mercury contaminated food and mercury free diet respectively for 30 days.

The results show that generally the mice exposed to mercury grows slowly as compared to those which fed on mercury free diet. This was shown by less average weight in mice exposed to mercury.

On day 5 mice exposed to free diet mercury showed as slight increase in weight when compared to the mice with mark at the head and tail while mice with no mark showed decrease in weight. However, the controlled mice showed progressive increase in growth over the whole period of 30 days. The decreased growth in mice exposed to mercury may has been due to mercury intoxication which may interfere with body physiological processes.

5.0 CONCLUSION AND RECOMMENDATIONS
The study have established that prolonged exposure of organisms to mercury is very toxic and affects physiological processes like growth and can alter the feeding habit as was shown by the experimental mice.

Mercury intoxication have caused decrease in growth rates of the mice; and the observed decrease in feeding rate of the mice might have been caused by the corrosive actions of mercuric chloride which cause pains and sometimes vomiting.

Figure 3: Mice in uncontrolled cage

Figure 4: Mice in control cage

Recommendations

As there is still little awareness among people on toxic effects of mercury, use of mercury containing substances is continuing. Many users do not even know whether the item they have used contain mercury. Some know but do not know its ill-effects. Local miners and people around the miners become intoxicated unknowingly.

Therefore the following are recommendations to rescue the situation:

- Provide sufficient education to the community on mercury and its effects on the environment and health.
- Discourage people on using products which contain mercury as one of its ingredients such as insecticides, cosmetics, paints, batteries, computers and other products.
- Avoid consuming suspected mercury contaminated food such as fish and vegetables that are found near mines or industrial areas.

The results of this study have been one month research basis. However the school is continuing with the study in order to investigate the effects of mercury in animals/human beings. Therefore the findings of this study will also be used in areas where gold mining is done in small and large scale. Also the school is planning to use these findings to educate communities where mining and use of mercury is on process.

Figure 5: Weighing of Mice

Figure 6: Mice in the weighing machine

Acknowledgements

Special thanks to the Ministry of Education, Kibaha Secondary School (K.S.S) and Kibaha Education Centre (KEC) management by helping in data collections, experiment setup and report writing.

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Table 1: The weights of mice after 30 days of exposure to Mercury

Mice mark on	WEIGHTS (gm)						
	0days	5days	10days	15days	20days	25days	30days
Head	22.5	22.1	20.4	20.38	22.23	22.7	24.7
Tail	12.0	12.4	12.21	12.2	12.4	13.1	13.5
Back	13.0	13.7	14.92	15.42	15.78	16.3	16.7
Legs	15.5	15.1	13.84	14.92	14.7	15.6	16.5
No mark	17.5	16.78	17.69	18.1	19.3	20.01	21.3
Total	80.5	80.08	79.06	81.02	84.6	87.71	92.4
Average weight	16.1	16.016	15.81	16.20	16.9	17.54	18.54

Table 2: The weights of mice after 30 days of Mercury free diets

Mice mark on	WEIGHTS (gm)						
	0days	5days	10days	15days	20days	25days	30days
Head	16.5	17.36	18.02	21.1	21.38	21.3	22.3
Tail	16.8	18.2	18.8	21.6	22.68	23	24
Back	17.0	18.48	18.95	19.9	20.8	Died	Died
Legs	18.7	18.7	17.64	19.2	18.5	19.8	20.1
No mark	20.8	22.2	21.78	23.6	24.4	25.8	26.8
Total	89.8	94.94	95.19	105.4	107.76	89.9	93.2
Average weight	17.96	18.988	19.04	21.08	21.55	22.47	18.64

Domestic Water Quality Status at Kibaha Town

Students Names: Mwasapi Kihongosi, Edward Moshi and Joseph Magehema
Teachers: Jeremiah Kashindye, Kaspar K Mmuya and Elizabeth Mbilinyi
Study Site: River Ruvu, Picha ya Ndege, Mailimoja and Kibaha Sec. School, Coast Region - Tanzania
Ministry of Education and Vocational Training (MoEVT)

1.0 ABSTRACT
The water quality from the river Ruvu, which is the source of domestic water supplies for Kibaha town and Dar es Salaam, was measured based on the GLOBE hydrology protocols. Water sample were analyzed from untreated reserve water at water treatment plant. Then treated water at the treatment plant and at the other four locations were analysed for temperature, pH, turbidity and conductivity.

- Results have shown that the water treatment plant is very effective in removing water turbidity.
- The pH of treated water at various locations is more or less the same as that of treated water at the water treatment plant.
- The turbidity at various locations is more or less the same but less turbid than treated at the treatment plant.
- Conductivity at various locations increased slightly when compared to treated water at the treatment plant.
- The temperature was more or less the same at all sampling locations.

2.0 BACKGROUND OF THE RESEARCH PROBLEM
The importance of water for sustaining life is apparent to every person. In short no water no life. On average more than two third of human body and other living organisms including plants is comprised of water. It follows that there is a need to have enough water in order to sustain life.

However just having enough water does not solve or eliminate the water related life threatening problems. This water should be safe for human and animal consumptions. Contaminated water with either chemicals or disease causing microorganism may turn out to be even more dangerous. It follows that efforts should be made to make sure that the water available is safe for human consumptions. At this juncture comes the necessity of having water treatment plants which treat water from the natural sources e.g. rivers and lakes before they are supplied for domestic consumption.

Since the water treatment plant may cater for a very big community, the treated water has to be transported through pipes to various locations where they are to be used. In this case the treated water may be transported several thousand meters away and hence facing the risk of re-contamination on the way before it reaches the final water consumer. Hence there is a need to check the status of water quality at various end-points.

Kibaha town receives water from the water treatment plant, which is located at Mlandizi, more than twenty kilometers away. The water treatment plant at Mlandizi is supplied with water from river Ruvu. In this study, water temperature, pH, turbidity and conductivity were measured at these locations and at the treatment plant. The results from this work is expected to give light on the efficiency of treatment plants as well as on the reliability of the transporting system through pipes whether it affects the status of the water quality or not on their way to the final consumer. This will enable to give the positive re- commendations to the related authorities.

3.0 RESEARCH HYPOTHESIS
On this research we put forward a hypothesis that, the treated water are not significantly affected on their way through the transporting pipes to the final domestic water consumers, hence;

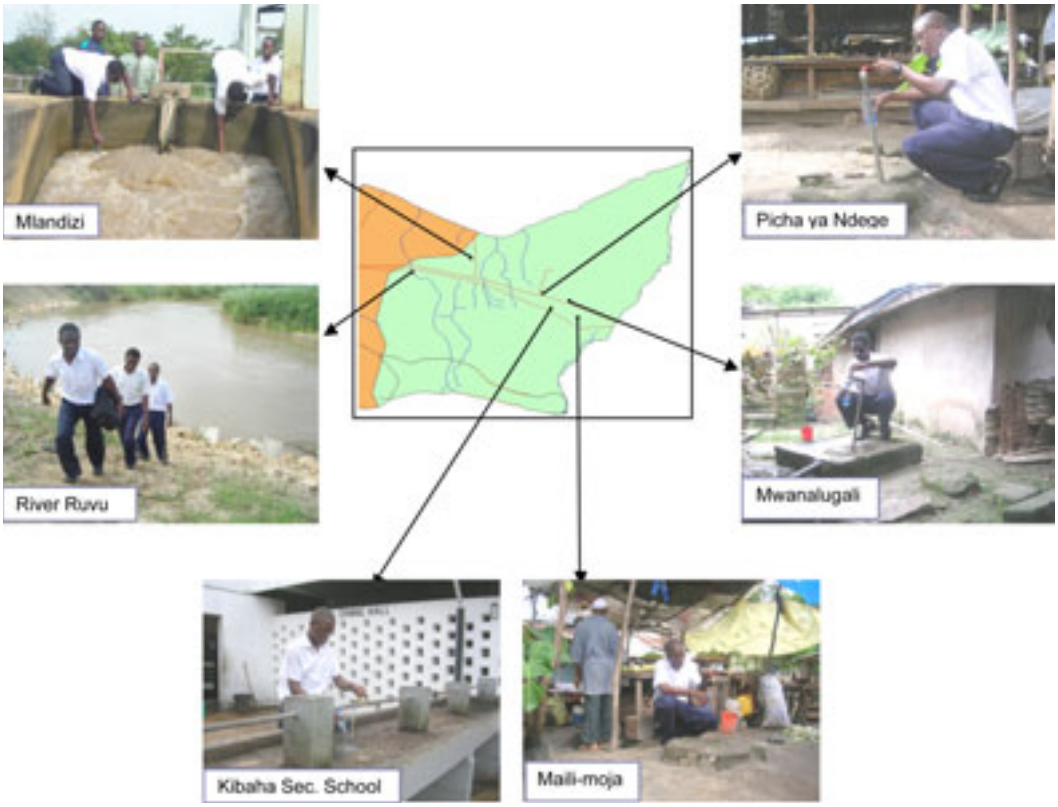
- There is no significant difference in pH, turbidity, temperature and conductivity of treated water at various locations around Kibaha town.
- There is no significant difference for the measured parameters between treated water at the water treatment plant and at various locations.
- There is significant difference between untreated river Ruvu water and treated water at the treatment plant.

4.0 RESEARCH METHODS
GLOBE Hydrological protocol was followed in obtaining the measurements for water temperature, pH, conductivity and turbidity. The measurements were carried out on 17th October 2007, 11th November 2007, 15th December 2007 and 17th February 2008.

4.1 Description of Sample Collecting Points
Water samples from the following locations were taken;

- River Ruvu
- the Treatment Plant (untreated water)
- the Treatment Plant (treated water)
- Picha ya Ndege
- Mailimoja
- Mwanalugali
- Kibaha Secondary School

4.2 Location
The maps below show the locations where the samples were taken.



4.3 Materials and Tools
- Packing bag
- 500ml plastic bottles
- Marker pens, ruler, notebook
- Masking tapes
- Thermometer
- Turbidity meter
- Conductivity meter
- pH meter
- Digital camera

4.4 Methodology Pictures

5.0 RESULTS
5.1 Data
The tables below present the data collected in monthly bases.
Table 5.1.1
October 17, 2007

No.	PARAMETERS	RAW WATER		TREATED WATER				
		Point A	Point B	Point C	Point D	Point E	Point F	Point G
1.	Temperature (°C)	27.2	26.6	27.0	27.2	26.7	26.5	26.8
2.	PH	6.8	7.2	7.0	6.6	7.05	6.63	6.5
3.	Turbidity (NTU)	215	49	3.2	1.7	1.5	1.3	1.9
4.	Conductivity (µS/cm)	161	159.7	154	167	155.7	169	171

Table 5.1.2 November 11, 2007

No.	PARAMETERS	RAW WATER		TREATED WATER				
		Point A	Point B	Point C	Point D	Point E	Point F	Point G
1.	Temperature (ºC)	25.9	26.3	27.1	26.7	26.6	26.3	26.5
2.	PH	6.24	6.65	6.63	6.4	6.9	6.7	6.3
3.	Turbidity (NTU)	765	552	3.8	2.1	1.8	1.2	2.6
4.	Conductivity (µS/cm)	88.0	87.8	103.6	112	104	129	123

Table 5.1.3 December 15, 2007

No.	PARAMETERS	RAW WATER		TREATED WATER				
		Point A	Point B	Point C	Point D	Point E	Point F	Point G
1.	Temperature (ºC)	27.5	27.0	27.6	27.5	27.3	27.6	27.1
2.	PH	6.65	7.60	7.56	6.6	7.25	6.86	6.5
3.	Turbidity (NTU)	322	105	3.1	1.7	1.5	1.12	2.22
4.	Conductivity (µS/cm)	123	123.7	124	142	125.3	147	145.2

Table 5.1.4 February 17, 2008

No.	PARAMETERS	RAW WATER		TREATED WATER				
		Point A	Point B	Point C	Point D	Point E	Point F	Point G
1.	Temperature (ºC)	28.6	29.1	28.5	28.7	28.8	28.9	29.0
2.	PH	6.91	7.66	7.64	6.70	7.02	6.95	6.65
3.	Turbidity (NTU)	756	310	3.2	1.6	1.30	0.88	2.34
4.	Conductivity (µS/cm)	114.2	112.3	102.0	91.5	137.0	137.7	132.5

5.2 Data summary

Table 5.2.1 Monthly Average

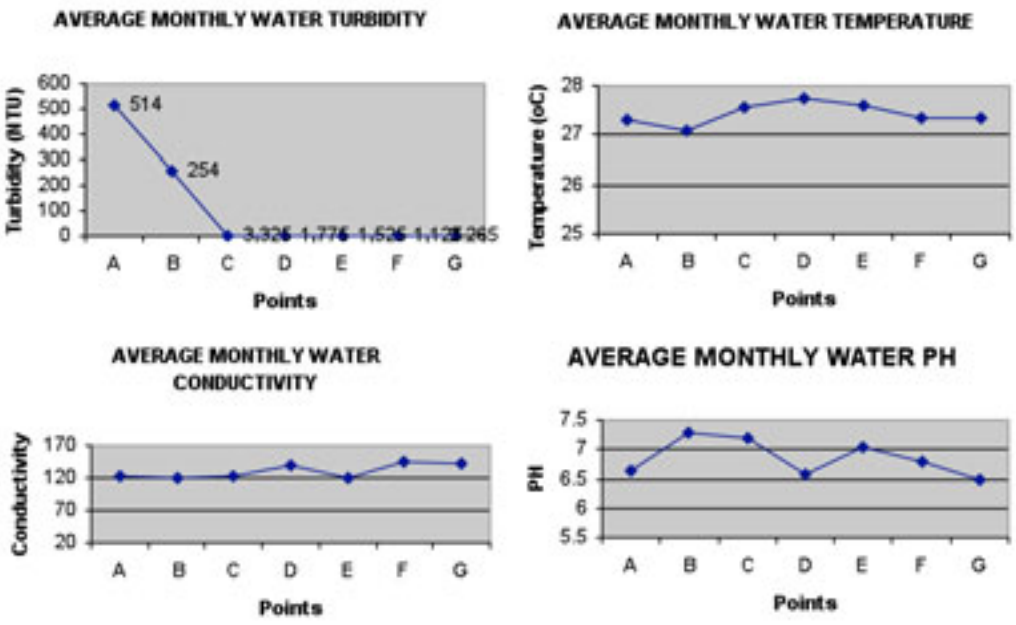
No.	PARAMETERS	RAW WATER		TREATED WATER				
		Point A	Point B	Point C	Point D	Point E	Point F	Point G
1.	Temperature (ºC)	27.3	27.1	27.55	27.75	27.58	27.33	27.35
2.	PH	6.65	7.3	7.2	6.58	7.05	6.79	6.49
3.	Turbidity (NTU)	514	254	3.325	1.775	1.525	1.125	2.265
4.	Conductivity (µS/cm)	121.5	120.8	123.4	139.5	120.9	145.7	142.9

5.3 Graphs

The following graphs are obtained from table 5 that describes the average of 4 monthly data.

Descriptions

Point A: the Ruvu River
Point B: the Treatment Plant (untreated water)
Point C: the Treatment Plant (treated water)
Point D: Picha ya Ndege
Point E: Mailimoja
Point F: Mwanalugali
Point G: Kibaha Secondary School



6.0 DATA ANALYSIS
This section describes the analytic methods used in our physical and chemical examination of the water found in different points selected. Our physical examination included temperature, turbidity and conductivity also chemical examination based on the PH.

6.1 Turbidity
Table 5.2.1 shows that the monthly average turbidity for the four months was 514 NTU (Normal Turbidity Unit) for untreated water from river Ruvu, while the turbidity decreases to 310 NTU for the reserve water just before water treatment. This is due to gravitational sedimentation, which takes place in a reserve tanks just before water enters the treatment plant. The turbidity decreases from 254NTU to 3.25NTU on the treated water at the plant. This shows a good efficiency of the water treatment plant.

6.2 pH
The PH of water at various locations on average ranges between 6.5 and 7.3 which is within the acceptable range of domestic fresh water for consumption. This shows that there is no re-contamination during transportation of treated water to consumers, which could have changed the pH outside the acceptable range. Contamination if any is not that much big to threaten life for water users.

6.3 Conductivity
As for conductivity which is the measure of dissolved minerals and ions in water, the average value for this parameter shows that there is some slight increases in conductivity at some locations compared to treated water at the treatment plant (Table 5.2.1). This may be attributed either to water pipe leakage which may lead to leakage of ions and minerals from the soil to the water especially during rain seasons, or to slight dissolution of iron pipes and releasing iron ions Fe^{2+} to water hence tending to increase the water conductivity. This factor may increase if the water becomes more acidic the case which we did not encounter in our study. However, although the conductivity values increased slightly at various locations the values are still within the acceptable range for fresh water for domestic water i.e. 100µS/cm - 500µS/cm.

6.4 Temperature
This is hydrological master variable which influences other factors such as PH, and conductivity hence determine amount of diversity of aquatic life. The temperature was more or less the same at various locations. Hence transportation did not change water temperature.

7.0 CONCLUSIONS AND RECOMMENDATIONS
This study has led us to the conclusion that there is no significant difference as far as domestic water quality is concerned at various locations for the treated water. This is because the main indicators for the water quality i.e PH, Conductivity and turbidity show no such difference at various locations. Hence our hypothesis has been accepted. It shows that there is minimum or rather negligible re-contamination of water on their way through the water pipes to the ultimate water consumers.

However there are indications that conductivity slightly increases as one moves away from the water treatment plant to the ultimate consumers. This leads us to recommend that there should be a regular monitoring of water quality at various locations in order to detect the extent of this increase in conductivity with time and it may be a good indicator for the need to change the water pipes due to excessive leakage. If leakage increases, more ions and minerals may leak from the soil to water especially during the raining seasons. This leakage is what detected as increase in conductivity.

Since our study focused only on the physical and chemical aspects of water quality, we recommend that further research should be done on the biological aspects of water quality e.g. presence of disease causing micro-organisms such as bacteria, amoeba etc. Through such a study it may be revealed whether or not water related diseases facing Kibaha originates from domestic water supply.

Acknowledgements
Special thanks to the Ministry of Education and Vocational Training, Kibaha Secondary School (K.S.S) and Kibaha Education Centre (KEC) management by helping in data collections, experiment setup and report writing.

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Rainfall pH in Different of Land Uses at Bangkok of Thailand

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Abstract

In 2005, the Pollution Control Department reported that the average annual rainfall pH of the Bangkok Metropolis was 4.89. This regarded as acid rain. Thus, we interested to investigate the rainfall pH in different of land uses in Bangkok. Our study sites were a thinly populated area, a densely populated area, a heavy traffic area, an agricultural area, and an industrial area. We followed the GLOBE Protocols for measuring the rainfall pH. We collected the rainfall everyday from June 21 to September 10, 2007. The pH meter was used. Our project results showed that in different land uses, the rainfall pH were different. The rainfall pH at the industrial area and heavy traffic area were lower (higher acidity) than the residential area and agricultural area. During our study period, no acid rain found. In addition, when rain occasionally fell, the rainfall pH on the first day after the pause was lower (higher acidity) than that of before the pause. While rain continuously fell for several days, the rainfall pH on the last day was slightly higher (lower acidity) than the first day.

Keywords: Acid rain, Rainfall pH, Land uses, Bangkok Metropolis

Introduction

Normally, rainfall is slightly acidic because carbon dioxide (CO_2) and nitrogen (N_2) in the atmosphere dissolves into it forming weak acid, a pH of about 5.6 at typical atmospheric concentrations of CO_2. If the pH of rainfall is below 5.6, it is regarded as *acid rain* (GLOBE, 2003a; PCD, 2007; US EPA, 2007). The Bangkok Metropolis has been faced with the acid rain problem. In 2005, the average annual rainfall pH was 4.89 which is lower than the rainfall pH in an unpolluted environment (PCD, 2005).

Acid rain is a phenomenon caused primarily by sulfur dioxide (SO_2) and oxide of nitrogen (NO_x) resulting from fossil fuel combustion. These gases react with rain drops and form solution of sulfuric acid and nitric acid. Over a long period of time, acid rain affects the natural resources and environment such as soil, water, plants, animals, buildings, and human health (GLOBE, 2003a; PCD, 2007; US EPA, 2007).

Thus, we interested to investigate the rainfall pH in different of land uses in Bangkok.

Research Question

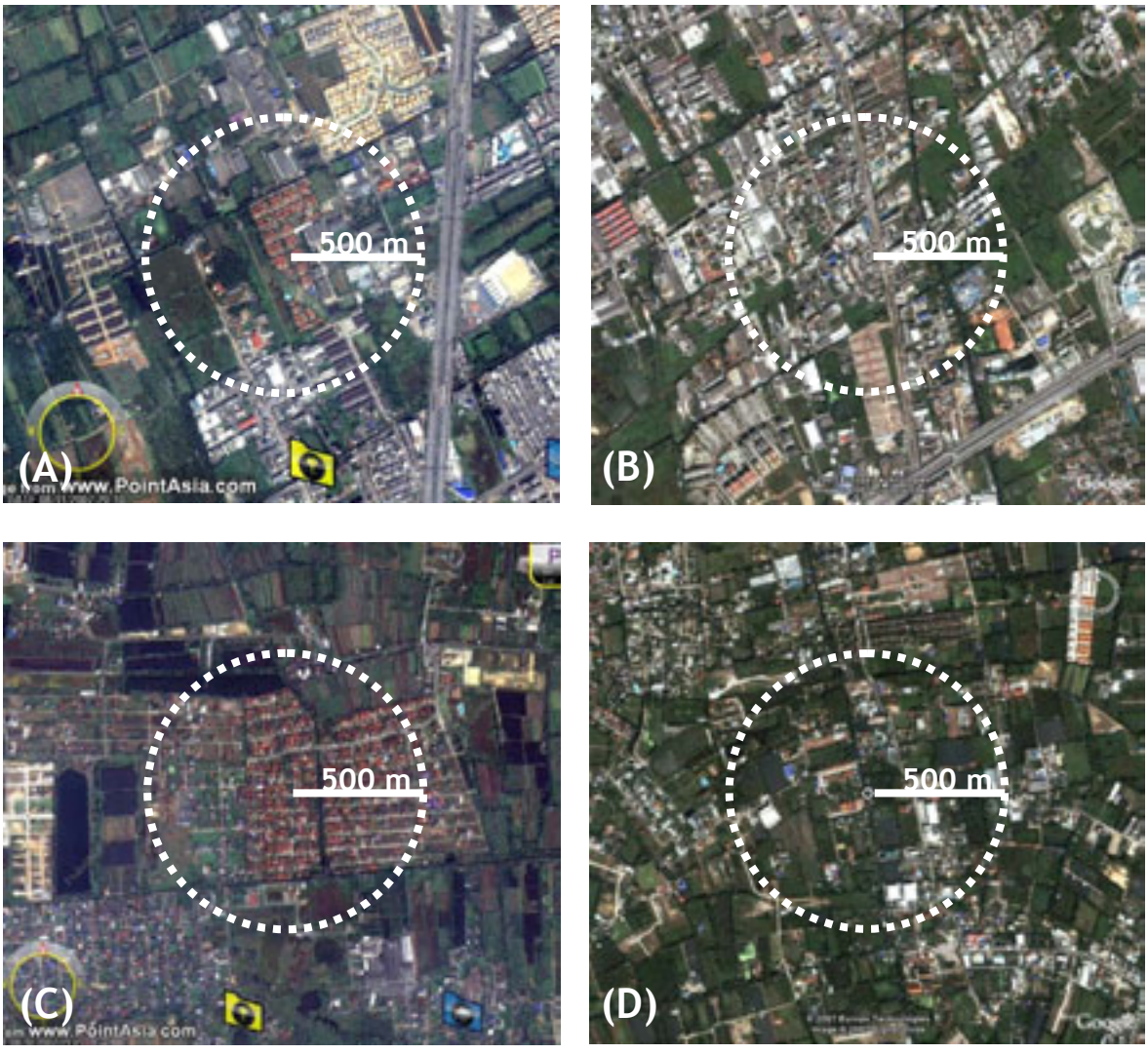
1. Among the different of land uses, are the rainfall pH different?
2. Within the same land use but different of time, are the rainfall pH different?

Hypothesis

1. In different land uses, the rainfall pH will be different.
2. When rain occasionally falls, the rainfall pH on the first day after the pause will be lower (higher acidity) than that of before the pause.
3. When rain continuously falls for several days, the rainfall pH on the last day will be higher (lower acidity) than the first day.

Study Area

We selected the 5 study sites by considering the land uses within a radius of 500 m. These were a thinly populated area, densely populated area, heavy traffic area, agricultural area, and industrial area (Figure 1).



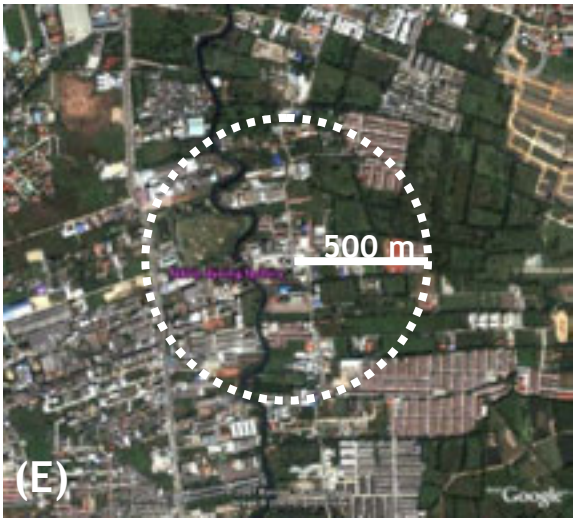


Figure 1: Land uses of the study site – thinly populated area (A), densely populated area (B), heavy traffic area (C), agricultural area (D), and industrial area (E) (Sources: mapping on Google Earth® and Point Asia®).

Materials and Method

To carry out our project, we followed the GLOBE Atmosphere Protocols (GLOBE, 2003a). There were 3 main steps of work as follows:

Literature Reviews and Site Selection

First, we started our project by the literature reviews. Then, a GPS Protocols (GLOBE, 2003b), Google Earth® and Point Asia® Programs were used with the ground observation to identify the study sites. Rain gauge was set up at an open area of each study site.

Data Collection and pH Measurement

We collected the 1-day rainfall from each study site from June 21 to September 10, 2007. We rinsed the sample container by rainwater, then collected it and brought to school. We measured the pH of each sample for 3 times by pH Meter. Then, we calculated the average of the 3 pH measurements. Importantly, we calibrated pH Meter everyday by using pH buffers of 4, 7, and 10.

Data Analysis and Conclusion

We drew the graphs of average 1-day rainfall pH of each study site. After that, we looked for any trend in pH values and compared our data among 5 study sites. The land use types were also considered. Finally, we made the conclusions and discussion.

Data Summary and Analysis

Thinly Populated Area

10 raining days were recorded in this site. The minimum (Min) and maximum (Max) rainfall pH were 5.73 and 8.10, respectively. The average of rainfall pH was 7.00 ± 0.96.

During the study period, we found no acid rain. When rain occasionally fell, we found that the rainfall pH on the first day after the pause was lower (higher acidity) than that of before the pause. These events were shown on August 2, 23, and 31, 2007 which the rainfall pH were 7.57, 6.54, and 5.73, respectively. However, on July 7, 2007, the rainfall pH after a pause was higher (lower acidity) than that of before the pause, pH of 8.10 (Figure 2).

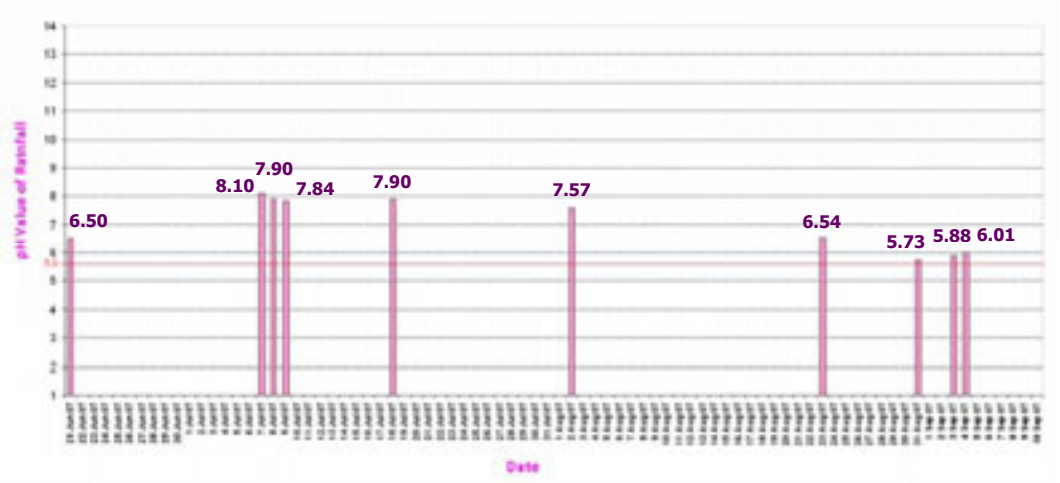


Figure 2: The rainfall pH at the thinly populated area.

Densely Populated Area

At this site, there were only 5 raining days. The Min and Max rainfall pH were 6.57 and 7.33, respectively. The average of rainfall pH was 6.99 ± 0.28.

We found no acid rain. In addition, when rain continuously fell for several days, we found that the rainfall pH on the last day were slightly higher (lower acidity) than the first day (Figure 3).

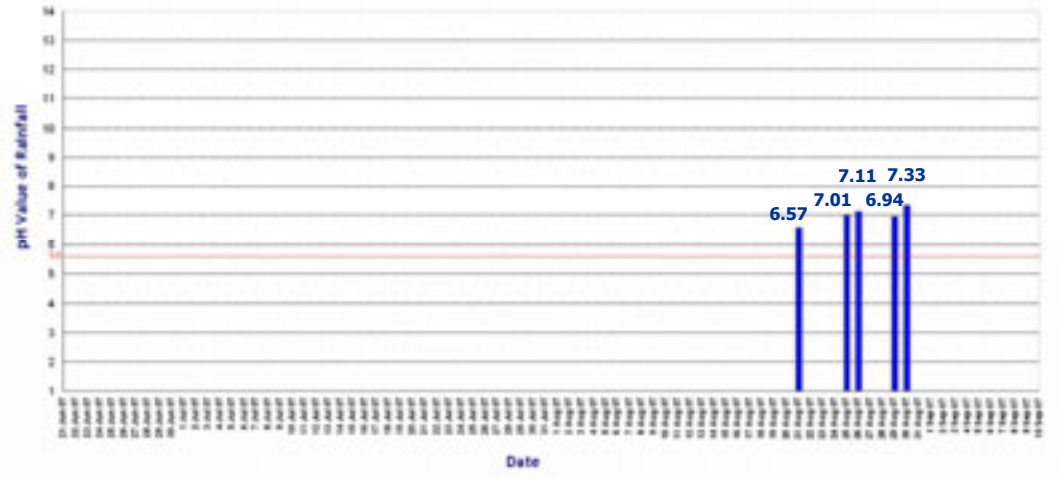


Figure 3: The rainfall pH at the densely populated area.

Heavy Traffic Area

For this site, there were 9 raining days. The Min and Max rainfall pH were 5.29 and 7.80, respectively. The average of rainfall pH was 6.88 ± 0.96.

We found that the rainfall pH on August 31 and September 2, 2007 were 5.36 and 5.29, respectively. These were regarded as acid rain (pH values were lower than the pink line, pH of 5.6). Obviously, August 31, 2007 was the first raining day after 30-day pause. In addition, when rain continuously fell for several days, the higher of pH values still found (Figure 4).

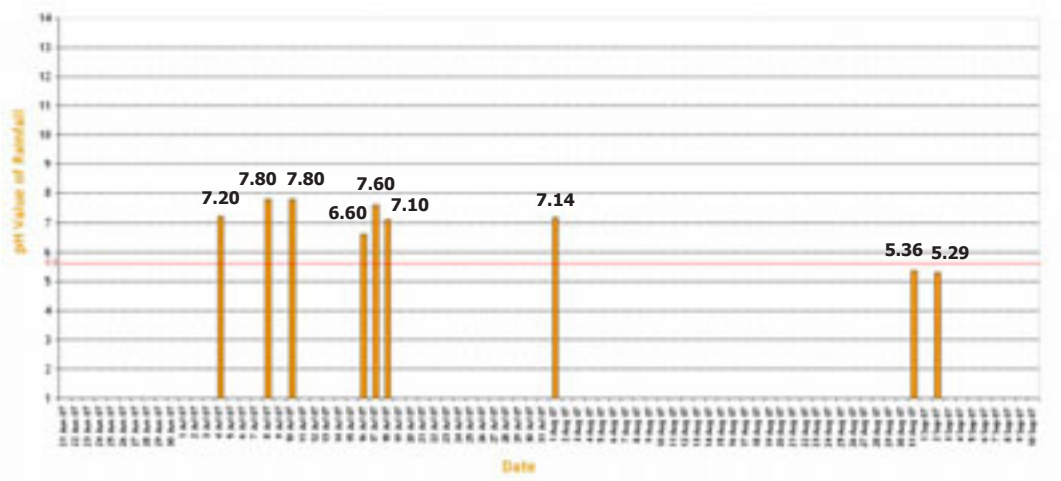


Figure 4: The rainfall pH at the heavy traffic area**.**

Agricultural Area

At this site, 9 raining days were recorded. The Min and Max rainfall pH were 7.40 and 8.50, respectively. The average of rainfall pH was 7.78 ± 0.33.

During our study period, we found no acid rain. In opposite, most of rainfall samples were slightly basic.

Interestingly, we found unclearly trend of pH. When rain occasionally fell, the pH on the first day after the pause were sometimes lower than that of before the pause but sometimes they were not. For example, on August 1, 2007, after 13-day pause, the rainfall pH increased to 8.50 (Figure 5).

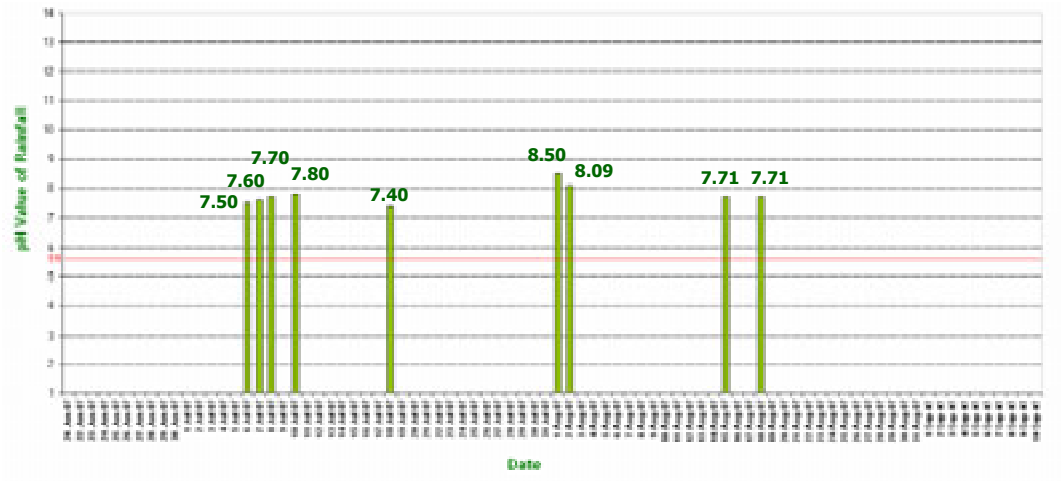


Figure 5: The rainfall pH at the agricultural area**.**

Industrial Area

For this site, there were only 4 rainfall samples. It was because the uncooperative in rainfall sampling. The Min and Max rainfall pH were 6.28 and 6.57, respectively. The average of rainfall pH was 6.42 ± 0.16

Among 4 samples, we found no acid rain. We also found that, when rain continuously fell, the rainfall pH on the next day were slightly higher (lower acidity) than the first day (Figure 6).

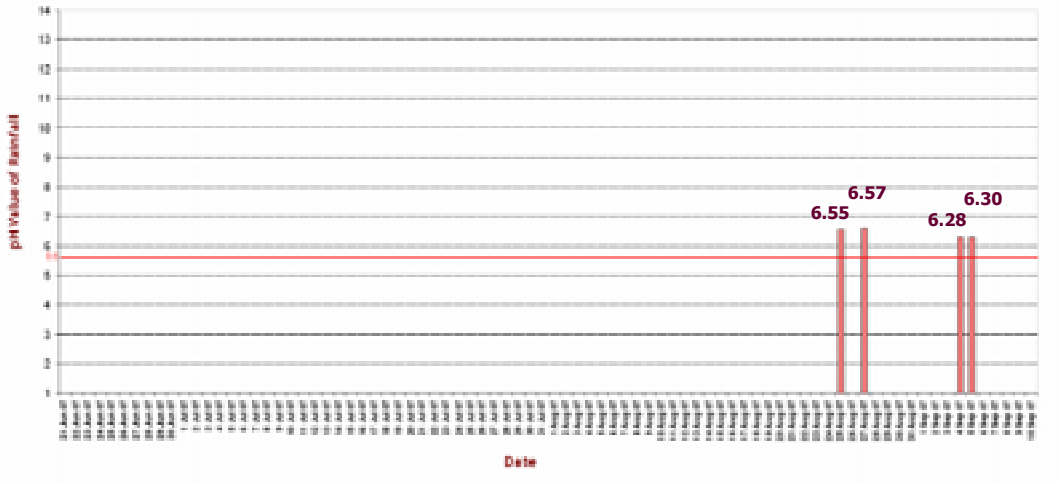


Figure 6: The rainfall pH at the industrial area.

For the whole study area, the average of rainfall pH with Min and Max values of each site was calculated as shown in Figure 7. We found no any average of pH value lower than the pH of 5.6.

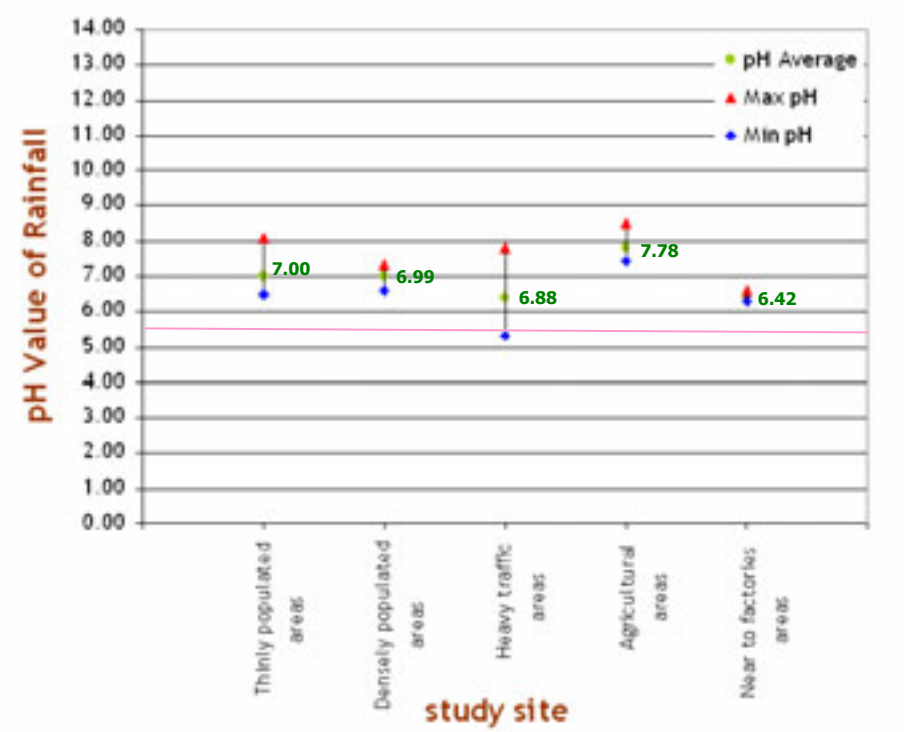


Figure 7: The average of rainfall pH at the study area.

Conclusions

Our project results revealed that in the different land uses, the rainfall pH were different. The rainfall pH at the industrial area and heavy traffic area were lower (higher acidity) than the residential area and agricultural area. From our ground observation, these maybe result from the factories and automobiles that emit CO_2, SO_2 and NO_x to the atmosphere.

The acidity of rainfall from maximum to minimum were the industrial area, heavy traffic area, densely populated area, thinly populated area, and agricultural area (average pH of 6.42 ± 0.16, 6.88 ± 0.96, 6.99 ± 0.28, 7.00 ± 0.96, and 7.78 ± 0.33, respectively). The acid rain was not found because no any average of rainfall pH lowers than 5.6. This is different to the report of PCD, 2005. It is possibly that the different of study period and sampling sites.

We also found that when rain occasionally fell, the rainfall pH on the first day after the pause was lower (higher acidity) than that of before the pause. This maybe because of the rain washed the acid chemicals in the atmosphere down.

When rain continuously fell for several days, the rainfall pH on the last day was slightly higher than the first day. It can be explained that the acid chemicals were washed down on the first raining day. So, the atmosphere was cleaner in the next raining day, and caused the pH of rainfall was slightly higher (lower acidity).

At the agricultural area, the rainfall pH were slightly basic. We think, it is possibly that the wind blew some basic chemicals from other areas to the study site.

Discussion

We strongly recommend that the area where should be monitored is the heavy traffic area. Because of there were 2 times that the pH of rainfall at this area were lower than 5.6. The other area is the industrial area because there are a fabric dyeing factory which operates everyday and a crematorium at this site.

To reduce the emissions, the cleaner fuels (e.g. gasohol, bio-diesel, and natural gas, etc.) should be used. Car pools and public transports also are the nice ways that we can do.

For the further study, (1) the direction and speed of wind should be measured. The wind can blow the acid and/or basic chemicals from one place to other places. (2) The study period should be extended to cover a rainy season, and numbers of study site with various types of land use should be added to the study.

Acknowledgements

This project is supported by the grant from the Institute for the Promotion of Teaching Science and Technology (IPST). We would like to give our thanks to the National Electronics and Computer Technology Center (NECTEC) for the pH Meter. Our special thanks are also to our teachers, scientists, parents, and friends.

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The Effects of Soil Erosion to Water Quality of Three Differential Study Site: Woodland, The Land Development Department, and Community Agricultural of Maerim District, Chiang Mai, Thailand

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Abstract

This study's purpose was to determine the effects of soil erosion on the water quality of three different study sites: the woodland site, the Land Development Department site and the Community Agricultural site. All three sites are located in the Maerim district of Chiang Mai, Thailand. GLOBE (Global Learning and Observations to Benefit the Environment) tools were used to study soil types and water quality. The Universal Soil Loss Equation (A= RKLSCP) was used to equate the amount of soil loss. The results of the research were as follows: (1)In the moderate level, as soil erosion increased, the water quality decreased. (2) Depending on the land use, the water quality either related in a negative or positive way. The cleanest water was found in the Community Agricultural site, the next cleanest was in the woodland site, and the most contaminated was in the Land Development Department site. (3)The highest amount of soil erosion, which was at the moderate level, was in the Land Development Department site. The least amounts of soil erosion, at a level of low, were in the woodland site and the Community Agricultural site.

Key words: Basin of a river, Soil erosion and Water quality

Introduction

By mapping of flood prone areas in the city of Chiang Mai, which the research team studied in 2005, and from comparative graphs of rainfall amounts in the years 2001 – 2005, the team discovered that in 2001, 13.22 cm of rain fell and in that year there was flooding. Conversely, in 2005, only 6.25 cm of rain fell but flooding still occurred (Lucsame Gruneck, Pawinee Kanthiya and Kritporn Reuangsutta, 2005).This information shows that the amount of rainfall might not be the actual cause of flooding. The cause is, rather, a law of nature. When rainfall causes erosion, the runoff flows to a water source and the sediment settles. The sediment load of the Ping River collects in the riverbed and this may be an additional cause of the flooding which periodically damages the communities along the banks of the river.The research team wants to study soil erosion and the sediment load of the Sa River which is a tributary valley of the Ping River valley. By studying three different sites : the woodland site, the Land Development Department site and the Community Agricultural site, the results of our research can be disseminated locally and be of benefit. Our intention is to have all stakeholders have a part in the administration of water resources using the principles of sustainable development.

Research Question

1. Among the different of soil erosion of three study sites, which are the woodland site, the land development department site and the community agricultural site, are the water quality in each study sites which are transparency, pH, DO, conductivity different?

2. Is the water quality of the community agricultural site is different from water quality of the land development department site?

Hypothesis

1. Different of soil erosion of three study sites cause different water quality.

2. Apply from basin of a river of three study sites cause different water quality.

Study Area

The woodland site

The Land Development Department site

The Community Agricultural site

Materials

- Measure soil types equipment of GLOBE
- Measure water quality equipment of GLOBE
- Rainfall data, Dept. of Meteorology, Year1990-2007
- Soil data, Dept. of Land Development year 2002
- Land use map, Dept. of Land Development year 2002
- Boundary map , Dept. of Land Development year 2002
- Arc View GIS3
- Din Thai program

Methods

- Consult with the head of information group for the Land Development Department, Section 6, to choose a differential study site at the basin of the Maesa River in Pongyaeng Maerim.
- Divide the one study site into three different study sites: the woodland site, the Land Development Department site and the Community Agricultural site.
- Study soil types and water quality following GLOBE (Global Learning and Observation to Benefit the Environment) guidelines.
- Study soil erosion with the use of USLE (Universal Soil Loss Equation) to analyze the amount of soil loss.
- Summarize the relationship between soil erosion and water quality within each study site.
- Use the Pearson product Moment Correlation to show the ratio of water quality in relation to soil erosion at each study site.
  According to the relation level standard

0.08	is	high/very high
0.60-0.79	is	moderately high
0.40-0.59	is	moderate
0.20-0.39	is	moderately low
<0.2	is	low

Data summary

Water: Table 1: compared the water quality data of three study sites

Study site	Do(m/L)	pH	Conductivity (µS)	Temperature (°C)	Transparency (cm)
Woodland	8.3	7.47	40.67	23.83	49.03
The Land Development Department	9.6	7.68	130.5	25	27.83
Community Agricultural	7	7.48	170.6	20.8	99.33

Soil:Table 2: shows soil texture of woodland on 18 August 2007

18-Aug-07	
TOP DEPTH(cm)	TEXTURE
0	Sandy clay loam
20	Sandy clay loam
33	Sandy clay loam
69	Sandy clay loam

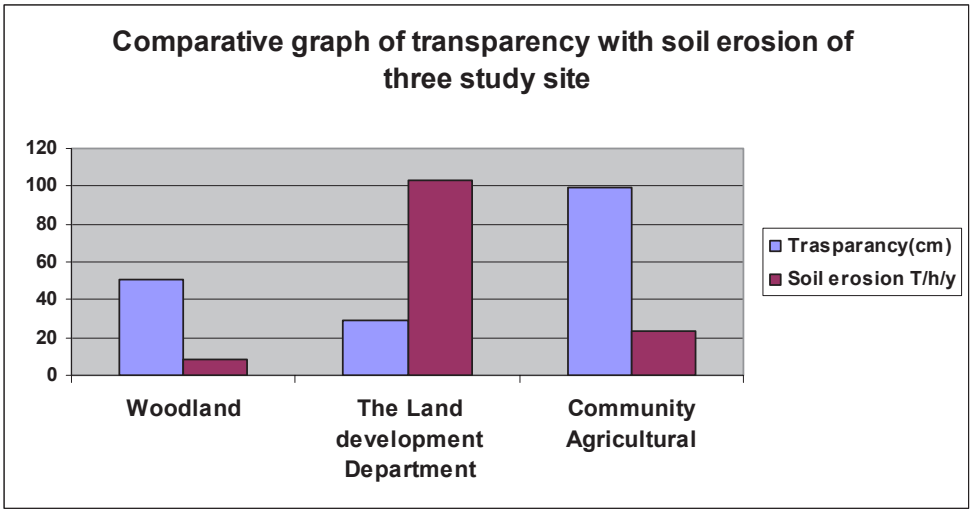
Table 3: shows soil texture of The Land Development Department on 18 August 2007

18-Aug-07	
TOP DEPTH(cm)	TEXTURE
0	Loamy sand
30	Loamy sand
52	Sandy clay loam

Table 8: shows soil texture of community agricultural on 18 August 2007

18-Aug-07	
TOP DEPTH(cm)	TEXTURE
0	Loamy sand
30	Loamy sand
52	Sandy clay loam

<u>Relation:</u> Figure 1: shows the relationship between soil erosion and water quality within each study site.



Analysis and Results

<u>Specify and compare position of study site:</u>

From the soil erosion values we can specify the position of the study site The soil erosion value of the Land Development Department is 103.47 T h-1 y-1 which is a moderate value of soil erosion.

The Soil erosion value of the Community Agricultural is 23.43 T h-1 y-1 which is a moderately low of soil erosion. The Soil erosion value of woodland is 8.55 T h-1 y-1 which is a low value of soil erosion

Conclusion

1. In the moderate level, as soil erosion increased, the water quality decreased.
2. Depending on the land use, the water quality either related in a negative or positive way. The cleanest water was found in the Community Agricultural site, the next cleanest was in the woodland site, and the most contaminated was in the Land Development Department site.
3. The highest amount of soil erosion, which was at the moderate level, was in the Land Development Department site. The least amounts of soil erosion, at a level of low, were in the woodland site and the Community Agricultural site.

Discussion

The soil erosion level of each study site shows that the Land Development Department site has a moderate level of soil erosion, higher than that of either the woodland site or the agricultural site. The moderate level of erosion in the Land Development Department site is due to higher water and soil erosion, meaning that there is a higher sediment load. The woodland and Agricultural sites have moderately low and low erosion levels.

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The Simple Flood Hazard Mapping Model for Downtown, Chiang Mai. October 2006.

Study of Thermal Spring Waters at Ankara Administrative Province

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ABSTRACT:
This study is about research of thermal spring waters within Ankara administrative province borders, by the help of applications in GLOBE Hydrology Protocol and additional activities. During the measurements, samples were collected from total of 8 districts of 4 towns of Ankara; Ayas, Beypazari, Kizilcahamam and Haymana, which are famous and rich with thermal sources. In order to reach high accuracy with data, some measurements were performed near springs and rest were carried out at the school laboratory. As a result it is observed that, mineral kinds and mineral amounts which thermal waters contain vary, and depending on several factors, mineral values of thermal waters even vary in very short time intervals.

INTRODUCTION:
What is thermal water?
It is kind of water which has higher temperature than average temperature in its brought out area. As a result of our search, there are different ideas about form of mineral-ion loaded thermal water that was known helpful for different illness treatment. One of the ideas is the water that leak out from cracks reach to the deep and warm layers by melting minerals on its path and is the shape of returning to the earth surface with the effect of temperature by evaporating and intensifying. Another approach is that some thermal water leak out by tectonic events evaporating and intensifying which melt some minerals that are layers near to magma. There is thermal water in Turkey's many cities because of Turkey's geological and geographic position. In this study we examine thermal water in Ankara due to our school being in Ankara. We think about this study as a pre-study. In following years we want to detail the study and examine other cities' thermal spring waters and species of dissolved minerals.

This study's aim is searching thermal spring waters by enriching water analyses with other analyses in hydrology protocol in GLOBE program. By this way we can more internalize water analyses in hydrology protocol and we can learn how our inputs can be used by different aspects.

The usage of thermal water: It is known that thermal spring waters have been used for health. We find ruins that show Anatolian different region's thermal spring waters have been used since old civilizations. A kind of thermal water physical

and chemical features may not match with other thermal water even the water that brought out near. We also figured out different results from different thermal spring waters very close each other. For this reason it is essential to be careful when choosing thermal spring waters for medical treatment. Moreover there is no any detailed and definite scientific explanation about water that is commonly used for medical treatment in our country.

The analyzed thermal spring waters among the towns of Ankara

1-KİZİLCAHAMAM:
Kizilcahamam is one of the most touristic towns of Ankara. As it can be understood from the ruins, caves and historical signs, it had been the base of many different civilizations like the Hittites, Phrygians, Lydian and Greek. Hot springs and National Park designate characteristics of the town. Due to their healing effect, hot springs of this area deserve the name "The Land of Hot Springs". Kizilcahamam is famous for its forests, mud baths, historical artifacts, mineral springs and spring waters. Hot springs of the town is well-known all over the world.

For vacations and healing issues, people both from Turkey and abroad prefer Kizilcahamam for its being close to Ankara. As being one of the most important contributions to town's economy, hot springs have proved effects on healing rheumatism, dermatological, orthopedics, neurotical and allergic diseases.

Buyuk Hot Spring:
It's in the centre and has a modern aspect. Instead of drinking, hot spring here is used for healing. It's volcanic water, deep layer origined. It has sodium bicarbonate and light chloride inside. It has an healing effect on diseases related to rheumatism, eczema, pains of bones, gynecology ,infantile. The temperature of the water is 50° C.

Kucuk Hot Spring:
It is located on the highest areas of Büyük hot spring. The rock of the spring was carved and afterwards it was formed like a voult bath. The water temperature in here is 51oC.In the base bath, the water temperature decreases to 43°C. From the point of view of healing,it has the same value as Buyuk Kaplıca.

2-HAYMANA
This town is in the south-east of Ankara.Thermal springs in here include sodium bicarbonate and carbon dioxide. It's limestone formed hill origined. It is thought that spring point reaches the resistant rocks via cracks that can't be seen on the debris area. 44° C of Haymana hot spring includes abundant water. It is recommended to be bottled as drinkable water due to its positive effects on digestive system. As being used as a bath, it is believed that it improves the circular and respiratory system. There is a physiotherapy centre which was founded during the Roman and Sejcuk period at Haymana Hot Spring.

3-AYAS
Ayas which is one of the richest thermal spring resources, is 80 km far from Ankara.

AYAS SPA-Mineral Springs:
It is located on the plateau of Ilıca Valley which is 23 km far from Ayas. Since the ancient times up to now, its healing effects were accepted and it has been used since then. The temperature, radioactivity and the minerals inside are the same level as Kardlspat Hot Spring which is world-wide famous. There is no other third mineral spring having those qualities. In Turkey it is also one of the major hot springs. The temperature in here is 51°C and flow rate is 15 lt /sec. Total mineral rate is 410 mg/lt and radioactivity rate is 38s/Avp.

Mineral and hot springs heal the stomach, intestine and liver problems and make them active. Gall bladder, kidney stone, urinary tract problems can be cured. It cleans worms, tenias and enterobius vermicularis in the stomach and intestine.

AYAS Başkent University Hot Springs:
It's in the centre of the town. It is used for physiotherapy and rehabilitation.In order to heal the patients, water taken from one of the springs is heated. The diseases which can be healed are rheumatism,apoplexy,muscular,skeleton ,nervous system and other neurologic infantile ailments.

4)-BEYPAZARİ:
Hot springs in here are 90 km to Ankara and 20 km to Beypazari and it is located on both sides of a valley.Not only rheumatism ,lumbago, joint system diseases but also after apoplexy matters,stress disorders, infectious diseases can be healed when it is used as an auxiliary treatment.

MATERIALS AND METHOD:
For the analysis of water, these districts were gone in sequence: Ayas, Beypazari, Kizilcahamam, Haymana. Choosing of the district and the fixation of the places where the sample of the water was taken were made by researching in the internet and by asking the people living nearby. The places where the sample of the water was taken is given in a table in sequence.

During taking the sample in order not to take up the concerned people's time, water temperature, pH, EC, TDS and dissolved oxygen measurements were done in the relevant places. Calcium, nitrate, nitrite, phosphate, ammonium, iron, and copper tests were done in our school's laboratory by taking samples. All the electronic devices were calibrated before testing every different water samples. All the measurements were repeated 3 times and average values were determined. The devices and test kits used during the tests are listed below:

TABLE 1: The places where the samples were taken

	The district where the sample was taken	The place where the sample was taken
1	AYAS	The thermal spring of Ayas
2	AYAS	Başkent University Ayas Physical Therapy and Rehabilitation Centre
3	AYAS	Inside of the neighborhood
4	BEYPAZARİ	Beyter thermal facilities
5	KİZİLCAHAMAM	Municipality thermal facilities
6	KİZİLCAHAMAM	Inside of the neighborhood
7	HAYMANA	Hayme Ana thermal facilities
8	HAYMANA	Municipality thermal facilities

TABLE 2: Devices and kits used during the research.

Measured property	**Devices/ test kits**
Water temperature	TT T-ECHNI-C
pH	MILWAUKEE pH 600
EC	MARTINI EC 59
TDS	MARTINI EC 59
Dissolved oxygen	SERA O_2 test kit
Iron	SERA Fe test kit
Phosphate	SERA PO_4 test kit
Copper	SERA Cu test kit
Calcium	SERA Ca test kit
Nitrite	SERA NO_2 test kit
Nitrate	SERA NO_3 test kit
Ammonia	SERA NH_3/ NH_4

PICTURE 1: Kizilcahamam buyuk hot spring's water analysis.

The following table shows the range of SERA test kits which measured the mineral ions levels of the samples by the color scale.

TABLE 3: The range of test kits

Cu (mg/L)	0,0	0,1	0,2	0,3	0,6	1,0	1,2	2,0			
Fe (mg/L)	0,0	0,1	0,25	0,5	1,0						
NH_4 (mg/L)	0	0,5	1	5	10						
PO_4 (mg/L)	0,1	0,2	0,25	0,50	1,0	1,25	2,0	2,5	4,0	5,0	10,0
Ca (mg/L)	0	20	40	60	80	100	120	140			
NO_2 (mg/L)	<0,3	<0,9	1,6	3,3	16,5						
NO_3 (mg/L)	0	5	10	20	50	80	100	160			

DATA SUMMARY:

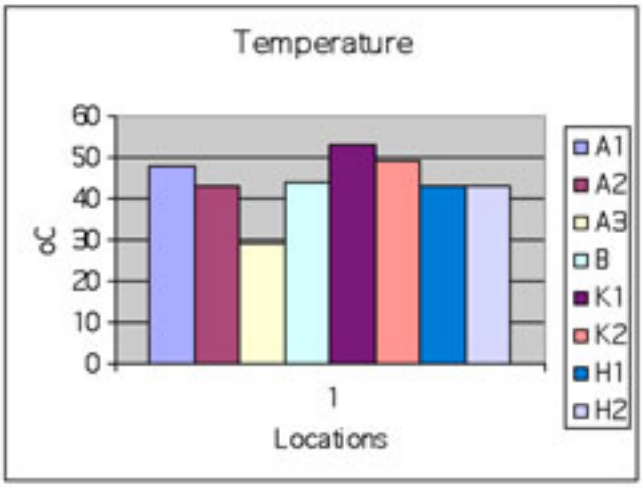
Measured property	AYAS Ayas SPA	AYAS Başkent Üniversity	AYAS Centrum	BEYPAZARİ Beyter thermal spring	KİZİLCAHAMAM Buyuk hot spring	KİZİLCAHAMAM Kucuk hot spring	HAYMANA Hayme Ana thermal spring	HAYMANA Municipality
Temperature (C^o)	48	43	29	44	53	49	43	43
pH	5.4	6,2	6.2	5.7	5.7	7.3	6.5	7.2
EC0 (µS)	>2000	320	333	114	1159	1452	425	406
TDS (ppm)	>3999	647	666	247	2220	2910	851	813
O_2: (mg/L)	0.5	4	0.5	4	0.5	0.5	0.5	0.5
Ca (mg/L)	620	45	45	460	30	45	90	75
Fe (mg/L)	1	0.5	0.5	1	0.5	0.25	0.25	0
Cu (mg/L)	0	0	0	0	0	0	0	0
NO_2 (mg/L)	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
NO_3 (mg/L)	0	0	0	0	0	0	0	0
NH_4 (mg/L)	0.5	0	0	0	0.5	0.5	0	0
PO_4 (mg/L)	4	1	0.5	2	2	2	1	1

TABLE 4: The results of the measurements.

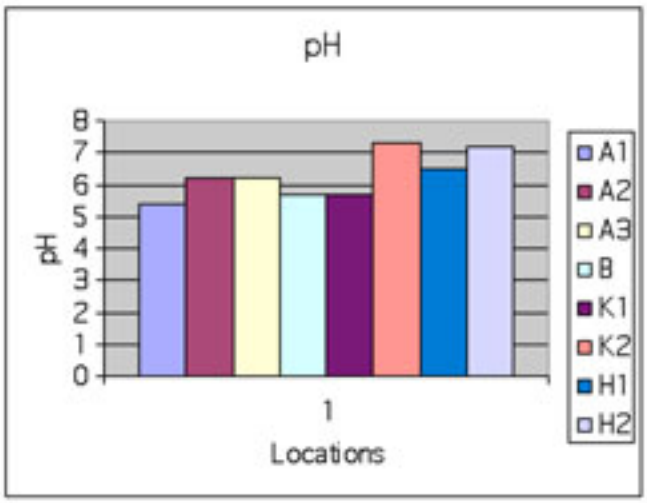
The places where the water samples were taken in codes in the below graphs. According to it, the meaning of the codes are:

A1: Ayas SPA
A2: Ayas Başkent University
A3: Ayas Centrum
B1: Beypazari Beyter Thermal Facilities
K1: Kizilcahamam Buyuk Hot Spring
K2: Kizilcahamam kucuk Hot Spring
H1: Haymana Hayme Ana Thermal Facilities
H2: Haymana Municipality Thermal Facilities

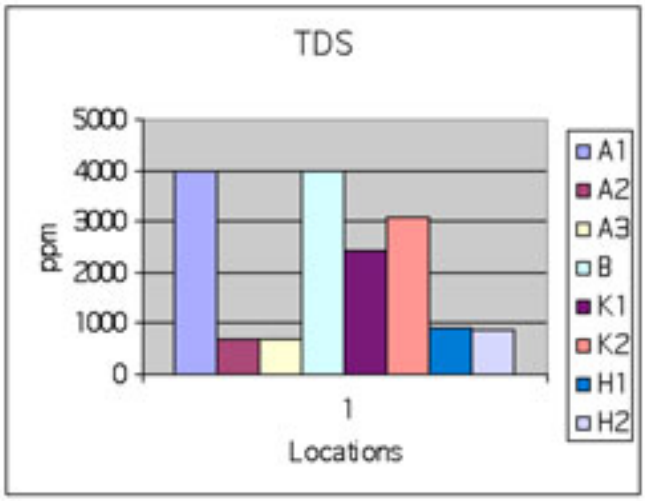
GRAPH 1: Comparison of measured thermal spring waters' temperatures



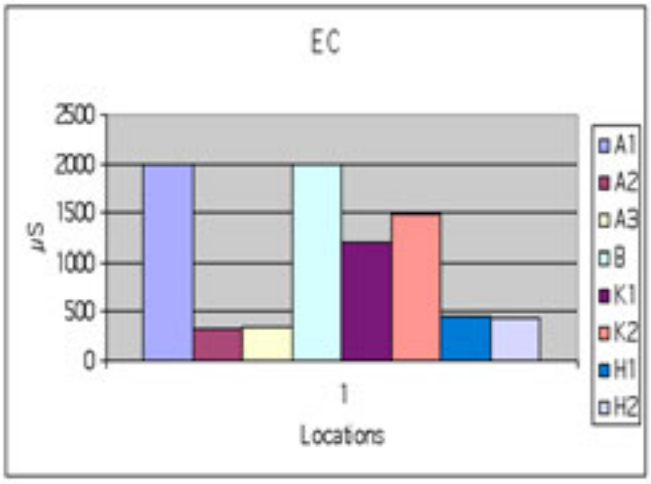
GRAPH 2: Comparison of measured thermal spring waters' pH values.



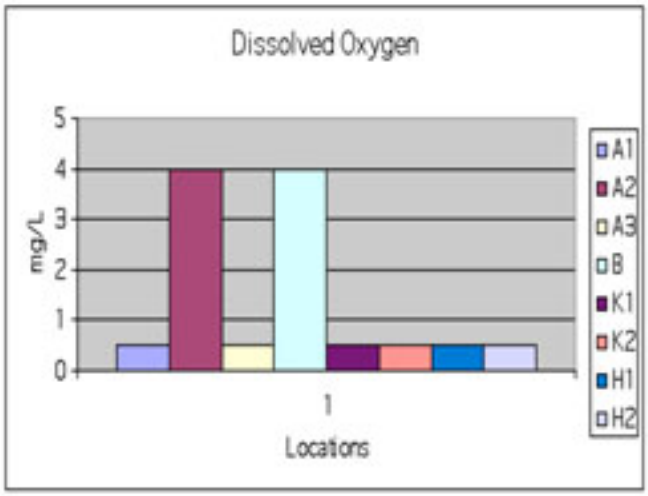
GRAPH 3: Comparison of measured thermal spring waters' total dissolved solid values.



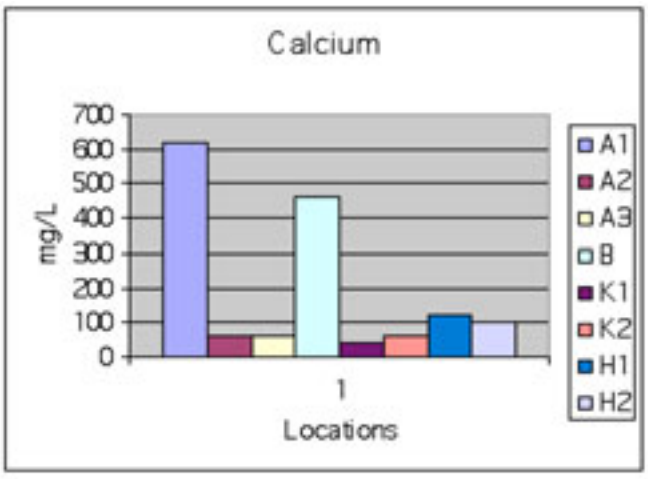
GRAPH 4: Comparison of measured thermal spring waters' electrical conductivity values



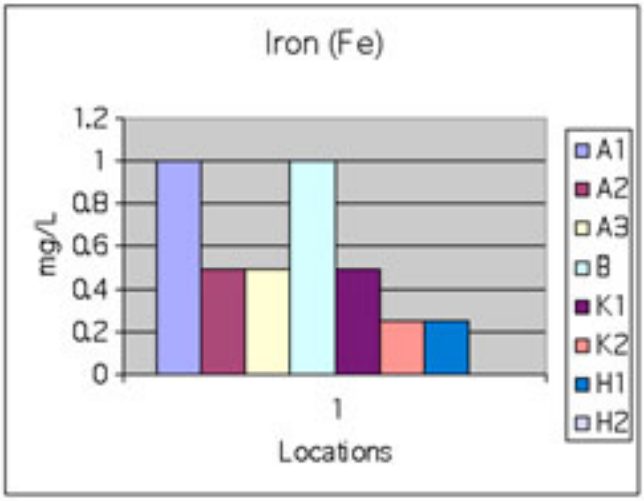
GRAPH 5: Comparison of measured thermal spring waters' dissolved oxygen values.



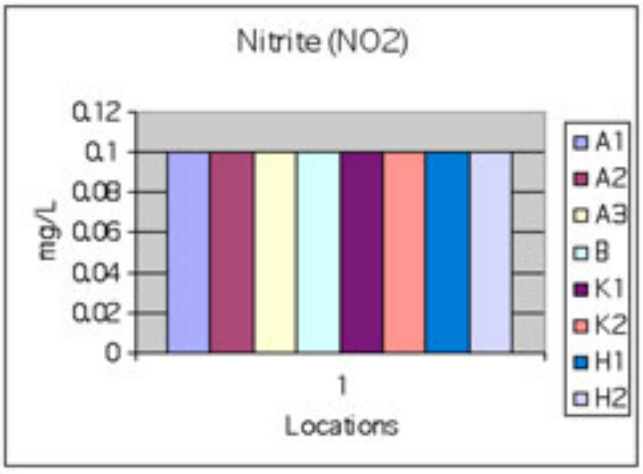
GRAPH 6: Comparison of measured thermal spring waters' calcium ion values.



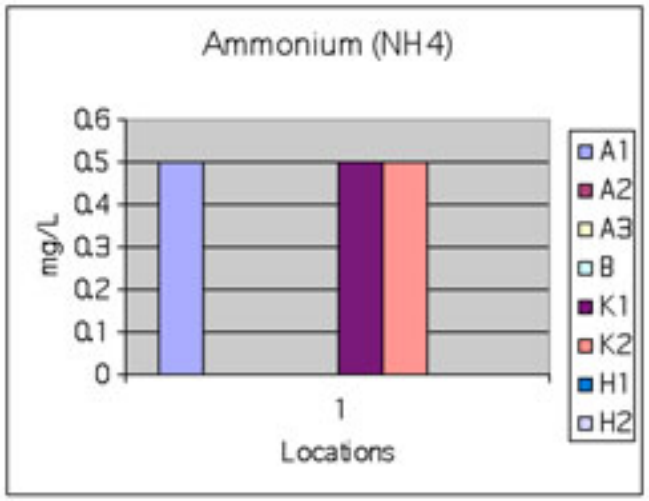
GRAPH 7: Comparison of measured thermal spring waters' iron ion values



GRAPH 8: Comparison of measured thermal spring waters' nitrite ion values.



GRAPH 9: Comparison of measured thermal spring waters' ammonium ion values.



GRAPH 10: Comparison of measured thermal spring waters' phosphate ion values.

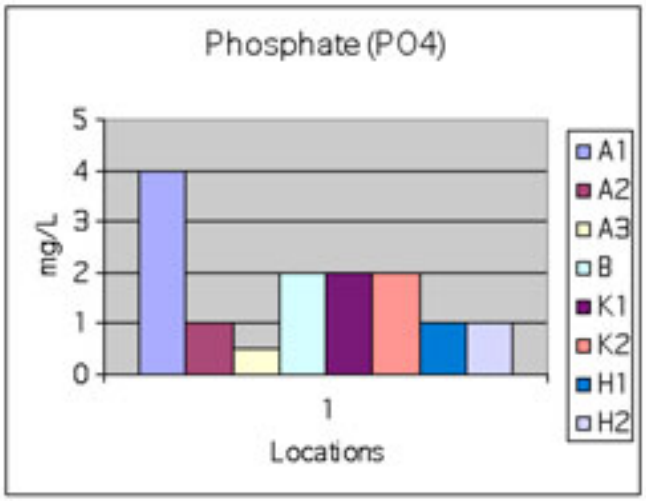


TABLE 5: Comparion of the measured values and the official values taken from the internet.

	A1	A2	A3	**Ayas**	B1	**Beypazari**	K1	K2	**Kizilcahamam**	H1	H2	**Haymana**
Temperature	48	43	29	**51**	44	**45**	53	49	**47**	43	43	**44**
pH	5.4	6.2	6.2	**6.4**	5.7	**6.48**	5.7	7.3	**7.8**	6.5	7.2	**4.96**
EC	>2000	334	342	**2465**	>2000	-----	1190	1478	**724**	457	440	**1837**
TDS	>3999	675	686	**No data**	>3999	**No data**	2440	3075	**No data**	903	878	**Veri yok**
O_2	0.5	4	0.5	**No data**	4	**No data**	0.5	0.5	**No data**	0.5	0.5	**Veri yok**
Ca	620	60	60	**687**	460	**535**	40	60	**18**	120	100	**96**
Fe	1	0.5	0.5	**3**	1	**2.5**	0.5	0.25	**0.05**	0.25	0.0	**0**
Cu	0	0	0	**0**	0	**0**	0	0	**0**	0	0	**0**
NO_2	<0.1	<0.1	<0.1	**No data**	<0.1	**No data**	<0.1	<0.1	**0**	<0.1	<0.1	**Veri yok**
NO_3	0	0	0	**No data**	0	**No data**	0	0	**No data**	0	0	**Veri yok**
NH_4	0.5	0	0	**0.8**	0	**0.08**	0.5	0.5	**0.9**	0	0	**---**
PO_4	4	1	0.5	**No data**	2	**No data**	2	2	**No data**	1	1	**Veri yok**

ANALYSIS AND RESULTS:

In order to compare measurement data, official data was searched. However facilities didn't want to give the official data. As it is seen in the pictures official data was taken whose origins are in some facilities, but the data analysis date was old. Internet searching was done. Although those data dates which were found in internet were old as well they were compared with the samples' measurement results. Since the mineral ion quantity of the thermal spring waters may change due to the seasonal factors such as rain, temperature, moisture it is hard to think that the comparison is accurate. Maybe in the next step it will be more suitable to make new measurements according to seasons and compare the measurements.

Temperature:

Three samples were taken from Ayas. The closest temperature value (51°C) which was read in official report is the temperature of water in Ayas SPA (A1) (48°C). In Baskent University facility (A2) employee said water which is coming is heated and this heated water is coming from 100 meters away. That is why in this facility 43°C doesn't have any meaning. The measurement was done at the point of A2 water (A3) and the temperature was 23°C. Also this water isn't a thermal facility water, it's district spring water. Although in official reports the water which is 51°C wasn't mentioned from which spring it was taken in Ayas. It's thought that the temperature belongs to A1 because Ayas SPA is the oldest and the most well known thermal facility.

In Beypazari Beyter thermal facility (B1) the temperature of the water was measured as 44°C. This result is almost same with the official data 45°C. In Beypazari water after comes out from the spring isn't heated or cooled.

In Kizilcihamam two different measurements which are taken from different springs are 53°C (K1) and 49°C (K2). Results are above the official data (47°C). That's why we think our measurement places are different from the official measurement places.

In Haymana according to the measurements water temperature are same in both facilities. These values are almost same with the official values (44°C) Due to the same values; we think water samples were taken from the same place.

pH:
It's seen that measurements which are taken from Ayas A2 and A3 are very close to the official data but A1 has a clear difference with the official data.

We see that official data in Beypazari is different from B1.

As we mentioned before the data are old. We think our measurements are accurate.

The official data in Kizilcahamam doesn't give the same data with K1 K2 water.

According to the official data in Haymana there's a difference between official data in Haymana and the measurement which was done in Haymana.

Ca:
In Ayas we did calcium research in three different springs. A1 spring 620mg/L, A2 and A3 springs 60mg/L results were reached. A1 measurement matches with the official data. A2 and A3 springs are different that's why measurements are different from A1. A1 spring almost 20 km. far away from A2 and A3. So we can talk about two close springs existence.

The measurements which we did in Beypazari are coherent with the official data.

The two measurements we did in Kizilcahamam matches with each other however official data doesn't match.

The two measurements we did in Haymana not only match with official data but also match with each other.

Fe:
The iron kit we used can measure at most 1 mg/L, that's why there's high possibility to make mistake.

The kit we used to measure A1 in Ayas can measure at most 1mg/L. However official data shows 3. A2 and A3 measurements are measured as 0,5 mg/L.

In Beypazari, since the test kit's upper measurement range is 1mg/L we could not compare our measauement data with the official data (2,5mg/L)

Due to the limits of test kit it is hard to compare our data with the official ones. Although K1 and K2 measurements which are taken from Kizilcahamam looks very different from official data.0,25 value is meaningful due to the limited test kit.

The measurements in Haymana are matching with the official data.

NH4 :

A1 spring in Ayas matches with official data. In A2 and A3 which are same springs, ammonium wasn't found.

Official data which belongs to Beypazari matches with the measurement.

Official data which belongs to Kizilcahamam matches with the measurement.

Official data which belongs to Haymana matches with the measurement.

Others:
Since we couldn't reach the thermal spring waters' official data of TDS, O_2, NO_2, and PO_4 that's why we couldn't compare our data with them. Since every test was done three times and our measurements' results are consistent we think that they are accurate. However due to our TDS equipment we couldn't get the accurate result for A1 and B1.

CONCLUSIONS AND DISCUSSION:
Hydrology protocol and mineral-ion analysis were studied with the samples taken from the thermals sources in eight districts of Ankara. First goal was to see how to use the thermal protocol in real life and to raise awareness. As a result of the measurements the input data attained and the official data are compared and it was noted that date of the measurements, seasonal changes and the points the samples were taken changed the results of the analysis considerably. Another significant point is the suitability of the measurement tools and the measurement range of the test kits for the sample. We concluded that test kits for the test weren't appropri ate for the study of the thermal water in terms of measurement range. As the test tools measure according to the color change, it isn't possible to observe the little changes in the color. Our main aim in this study was to apply the hydrology protocol so it turned out a success. However, it is suggested to the ones who will repeat this study that they work with more sensitive kits and equipments with higher measurement ranges. We are thinking of extending the study as a year long project and doing test on the soil too as the next step. In addition to that using GPS has been considered to determine the location of thermal hot springs exactly. Thus, hydrology protocol, soil protocol and using GPS will be internalized. To the ones who will conduct such study, we recommend that they work like this. At first it was planned students' not feeling tired and we aimed their getting their enthusiasm on this project. In the end they really enjoyed it. During the research they took pictures and prepared a poster study.

ACKNOWLEDGEMENTS:
We are grateful to TURKISH EDUCATION ASSOCIATION for supporting us supplying the equipments, to Murat Yilmaz, our security guard, as he was always with us when taking the samples, and to officers working in the thermal hot springs.

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Integrating Indigenous Athabaskan Deg Hitan Knowledge and GLOBE Measurements in an Alaskan Boreal Forest Study

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ABSTRACT
Our cultural traditions depend upon the environment we live in. Hundreds of our ancestral generations have adapted to the land and survived as climates have changed over centuries. Our culture is a subsistence-based culture, i.e. our day-to-day existence is built solely on animals and plants that have adapted to this environment as well. We have co-existed with the plants, animals, rivers and lakes in a natural balance of respect. Our traditional Deg Hitan dances and songs, customs and ceremonies reflect the stability of the environment we live in. Our observations of the living things around us and the changes we have observed/measured comprise this study.

After a fire occurred near our village in 2005, we set up a study site in the newly burned area, a control site (never been burned) and a 30-year old burn site to study vegetation types as well as plant and site characteristics. We used GLOBE protocols to measure air and soil temperature, tree height and circumference, budburst, green-down and soil characteristics. We wanted to find out about forest succession, what grows after a fire, what animals use burned areas, changes in an old burn and unburned site, and how they all compared to each other. We also used the new protocols in the Seasons and Biomes Earth System Science Project to observe freeze-up and break-up in the Innoko River and Shageluk Lake close to our study sites, school and town of Shageluk.

In the newly burned site horsetails (Equisetopsida) first appeared a year after the burn, then willows and now birch (Betula papyrifera). There is a general trend of earlier Innoko River break-up and birch budburst as well as a later freeze-up and green-down, with budburst trailing break-up in the spring and the reverse in the fall. Our data also indicate that the river ice is much thinner than it was in the past. Rivers and sloughs are used to access different parts of the land for subsistence hunting of ducks and geese. After break-up, rivers are fished for pike and white fish immediately for the large runs right after break-up. In the fall, freeze-up on the Innoko River has been coming later and freezing much thinner which later affects subsistence fishing.

For the 5th year in a row and during the fall of 2007, because the Innoko River did not freeze well due to warm temperatures and rain, it prevented the set-up and use of the fish fence, a traditional Shageluk Deg Hitan cultural community tradition and event. None of our high school students have had the opportunity to participate in this ancient fishing tradition that may become a lost art and practice. The trend toward warmer temperatures and less precipitation indicate that fires are likely to increase over time and will change the way we, the plants and animals of our land will live. Long-term data that includes long-term community knowledge is essential to any future cultural and subsistence planning for us.

1. RESEARCH QUESTION AND HYPOTHESIS

Our research project started in early August of 2003 when lightening struck 800m from our village. 6 hectares of land was totally burned trees and vegetation, right down to the soil. Emergency firefighting crews were sent out immediately to save our village from the fire. One week before school started that fall, the firefighters put the fire out. The students at the Innoko River School were curious: What grows and when does it start to grow on a total burn? Can animals use the burn area after a fire?

Understanding what our MUC classification was and determining what a "normal" boreal environment was in our area was information we needed first in order to be able to compare and analyze forest and vegetation succession and animal use in our burn site area. Recent climate change

Figure 1. Picture of a horsetail (Equisetum) 7 days after a complete burn in Shageluk, Alaska, USA, on August 16, 2005

Figure 2. Picture of GLOBE students gathering data on the Burn Site in Shageluk, Alaska, USA, on August 20-25, 2005

studies are focusing on the increase of fires in Alaska (2005 Wildland Fire Season Summary). Many changes in the local flora, fauna, soil and atmosphere occur as a result of forest fires that cause changes to the carbon cycle in that environment. As greater areas of a boreal forest are destroyed by fire in Alaska, succession, we assumed would be determined by rising temperature factors, precipitation, growing season change, snow depth and what spores or seeds were left behind after the burn. We really had no idea what would grow first, second, third, etc. and in what quantities and sizes. Basically, this research was a study in discovery of forest succession with so many variables to consider.

After several years of gathering new growth, atmospheric and precipitation data and conditions in the burn area and comparing it to a control/undisturbed site, we can show early patterns of growth.

This research will attempt to show how climate change is affected by an increase in forest fires and its overall adverse affect on the cultural traditions of indigenous populations of Athabaskans in Interior Alaska.

2. MATERIALS AND METHODS

Our data collection was fairly easy the first 2-weeks following the fire. There was very little growth! It was the end of the growing season and all vegetation had been completely consumed by the fire in that area. We gathered the data using the GLOBE Land Cover protocol and tools, and, as we already had a control study site set up adjacent to the burn area, we made some interesting observations, documenting them with cameras and our land cover data sheets, comparing the burn with the control site. We knew, based on basic tree ring study of the control site that it was about 100 years old; at least the TREES were that old. We had no idea how to determine the age of the layers of moss and organic matter that covered the soil/permafrost layer below it. We knew what was growing on the control site but we don't know what grew FIRST after a complete disturbance.

In our first data gathering 2-weeks following the fire, we determined that a trace smattering of horsetails had begun growing and very slight willow (salix) growth occurred around burned willow stumps. It took us just two days to gather this data and green-down on our control site was occurring and vegetation was already actively losing color and leaves.

After gathering our data, we decided that we needed to understand how lightening and fire works. We learned that:

1. At 4.7 million acres, the fire season of 2005 is ranked third in the Alaskan record books.
2. In 2005, The Bureau of Land Management pinpointed about 135,000 cloud-to-ground lightning strikes in Alaska, more than three times the average number.
3. As a result, lightning triggered at least 328 fires of the over 600 fires in 2005.
4. Forest fires release dangerous levels of carbons into the atmosphere that lead to climate change.

Figure 3. Screen snapshot of Department of Forestry website showing lightening strikes in and around Shageluk, Alaska, USA, on August 03, 2005

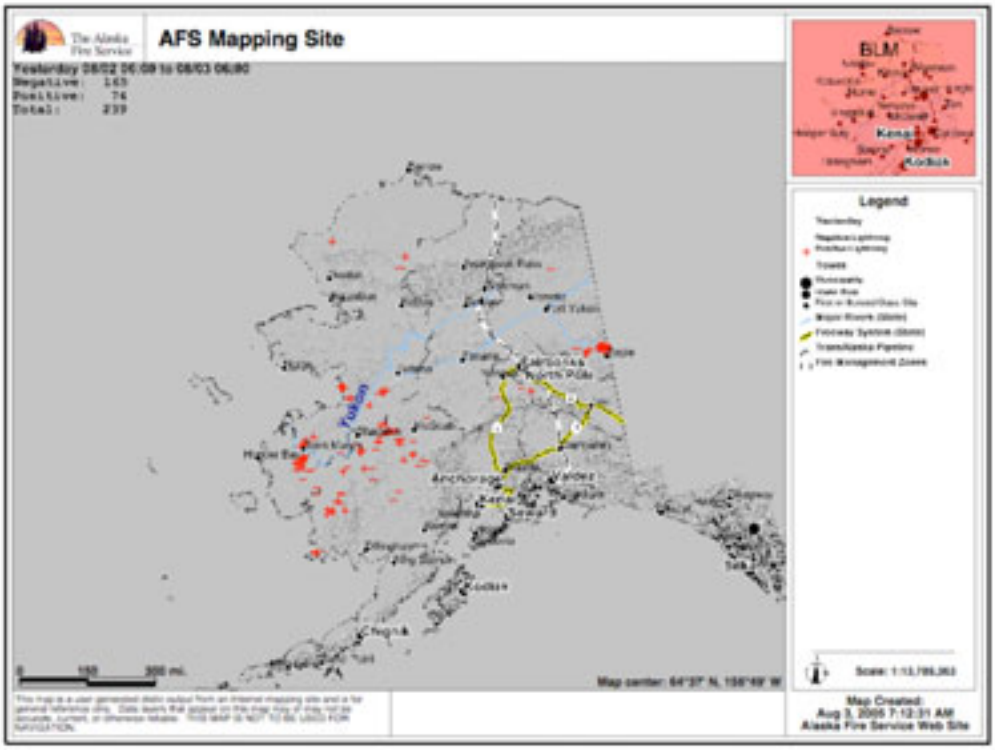

Figure 4. Students at the Innoko River School studying slope fires in Shageluk, Alaska, USA, on August 16, 2005

Then, we studied how fire works through a curriculum provided by the Alaska Department of Forestry.

3. DATA SUMMARY AND ANALYSIS

1. August 2005: What was growing 2-weeks after the fire: Horsetail (Equisetum)—locally we call this "goose grass" Willows (Salix)

Figure 5. Department of Forestry website screenshot showing current fires in Alaska, USA, on August 03, 2005

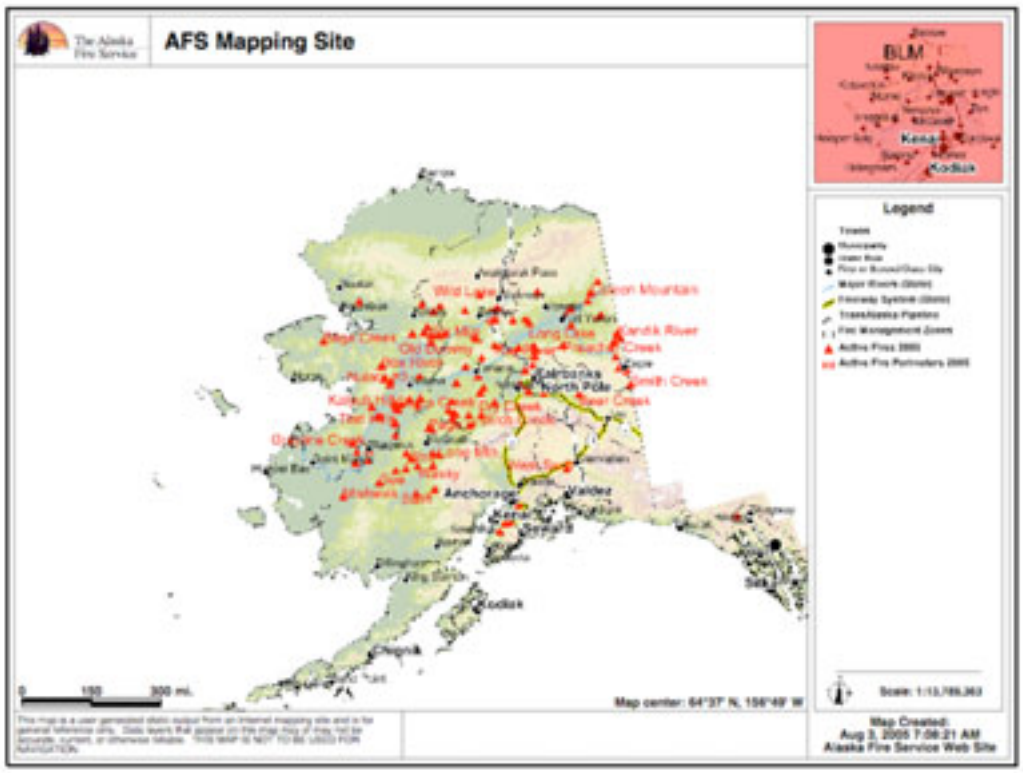

Figure 6. Student photo of salix at Shageluk Burn Site, Shageluk Alaska, USA, on August 18, 2005

2. August 2006: What was growing exactly one year following the fire:
- Epilobium angustifolium
- Salix alaxensis
- Calliergon giganteum
- Equisetum sylvaticum
- Alnus tenufolia

3. August 2007: What was growing exactly two years following the fire:
(All of the same and more of them!)
- Epilobium angustifolium
- Salix alaxensis

- Calliergon giganteum
- Equisetum sylvaticum
- Alnus tenufolia

4. Spring 2008: What was growing in the spring of 2008 during Spring Green-up:

- Goose Grass (Equisetum sylvaticum)
- Tundra Moss (Calliergon giganteum)
- Birch (Betula Papyrifera)
- Willows (Salix alaxensis)
- Fireweed (Epilobium angustifolium)
- Red Berries (Vaccinium vitis-idaea)
- Blueberry (Vaccinium alaskaense)
- Salmonberry (Rubus spectabilis)
- Sedges of various types

Note: During these years we also kept atmospheric temperature and cloud data using the GLOBE protocols.

Figure 7: Horsetails (Equisetum sylvaticum)

Figure 8: Fireweed (Epilobium angustifolium)

Figure 9: Horsetails (Equisetum sylvaticum)

Figure 10: Sedges and Salix of various kinds

Figure 11: Salmonberry (Rubus spectabilis)

Figure 12: Birch (Betula Papyrifera)

4. RESULTS, CONCLUSIONS, AND DISCUSSION

Why is our Research Important?

A. Forest Succession: Our student research using GLOBE protocols for soils, biology and mapping, provides long-term data on forest recovery and succession in a Boreal Forest.

B. Carbon Cycle

Forest Fires in a Boreal Forest also affect the Carbon Cycle in the environment. Our research documents quantitative data and recovery of vegetation in our Burn site year by year.

C. Our Deg Hitan Athabaskan Cultural Traditions and Lifestyle are direct Reflections and Expressions of our Local Environment and change when environmental and climates fluctuate or are disturbed. To us this is one of the most significant changes that result from disturbances in climate and environment. We are the last indigenous tribe on the Innoko River in the interior of Alaska. Historically there were many, many large Athabaskan ancestral villages along the 695 k of river; we are the last remaining people of the Deg Hitan tribe.

- We know that cultural traditions change and evolve over time. We also know that our traditions are a reflection of the resources and environment.
- We know that there are many other variables that have changed and impacted our cultural traditions over time.
- We know that our local resources are changing in types, species and numbers due to many other variables including disturbances brought on by fire (e.g. creating more habitat for moose).
- By interviewing older generations of people we have been able to gather biographies that tell us that our weather was much colder, the snow was much deeper and the summers were much wetter.
- We also know, based on old picture collections from our relatives from the 1930s-1990s that THERE WERE NO TREES OF ANY KIND GROWING ALONG THE RIVER BANKS AND SLOUGHS IN THE INNOKO AREA.

Other Unanswered Questions for Future Study

- Why didn't the Burn site get sloppy and wet after the burn from melted permafrost?
- Why is there Continuous permafrost in the Control site and why is there Discontinuous permafrost in the Burn site?
- Are lightning strikes increasing and if so, are they increasing because of global warming?

We are going to continue gathering growth data on our burn site throughout the many years ahead, as long as we can, using GLOBE protocols.

We enjoy this research and it has been interesting to see what grows. We noticed that birch, alder and willow height is a meter or more already.

ACKNOWLEDGMENTS

We wish to acknowledge and give credit to Uncle Rudy Hamilton, our cultural advisor for this project and many other projects that we do at the school. Dr. Elena Sparrow, who provided a great deal of help and support with writing, data gathering and GLOBE protocols, also helping with funding.

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Troposphere Ozone Levels and Respiratory Health of Students at Kingsburg High School

School: Kingsburg High School, Kingsburg, California, USA

ABSTRACT
Although stratospheric ozone protects us from harmful ultraviolet radiation, ozone is a threat to human health in the troposphere and has been linked to asthma and other respiratory ailments. More than one in five children in the San Joaquin Valley, California, has asthma, the highest rate in the United States (Fighting For Air 2007).

The geography, climate, and conditions in our valley provide a perfect formula for ozone production: industrial air pollutants, high traffic flow, trapped air due to mountains surrounding the valley, an inversion layer that traps the air from above, and long hot summers with little rainfall allowing photochemical interactions among the pollutants producing ozone. The San Joaquin Valley has recorded high levels of tropsopheric ozone for many years. Kingsburg High School's (KHS) campus is located near a major freeway and bordered by busy roads.

The goals of this project were to measure the amounts of ozone to which students are exposed at school, and to survey KHS students to find out the incidence of asthma and related factors that might correlate to higher or lower rates of asthma.

We hypothesized that ozone levels on campus would be highest outdoors and in parking lot areas. Outdoor ozone levels were much higher than indoor levels, but parking lots did not have higher levels than the interior of campus. Survey results revealed a weak correlation between how long students were diagnosed with asthma compared to how long they had been living in Kingsburg (in hindsight we should have asked how long they lived in the Valley). A slight positive relationship was found between the number of sports a student participated in and whether they had asthma, up to two sports, but there was not enough data to make a statement about the effect of three or more sports. There was a stronger positive relationship between number of students with asthma who had a family history of asthma.

A preliminary study to explore ozone's affect on our local agriculture was carried out to measure leaf deterioration and ozone levels in grape vines near high-traffic roadways compared to grape vines far from roadways. This study will be completed during the summer.

The final goal was to compare school ozone levels and respiratory health of KHS students with the same variables from a GLOBE school in Wetzlar, Germany. We will compare our findings at the conference.

BACKGROUND
KHS is located in Kingsburg, California, U.S.A. (Figure 1). Kingsburg is a small town with Swedish heritage in California's very large Central San Joaquin Valley. Kingsburg is 32 km south of Fresno, California (36.5197° N; +119.5465° W; Elevation: 92 meters) (Figure 2). Agriculture is the economic base of the region. Major crops include grapes, peaches, plums, nectarines, and pluots. Dairies are also important to our agricultural base and can create respiratory issues but we will not address those issues in this project. Our city is home to about 11,237 residents. KHS is the only high school in town, with 1,074 attending students.

Figure 1:

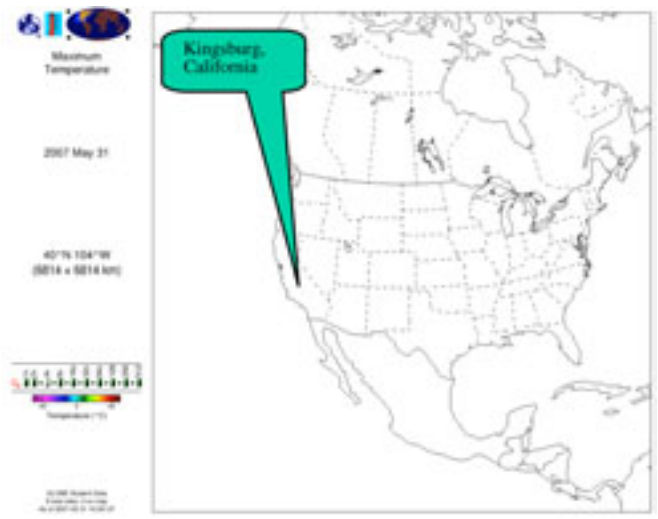
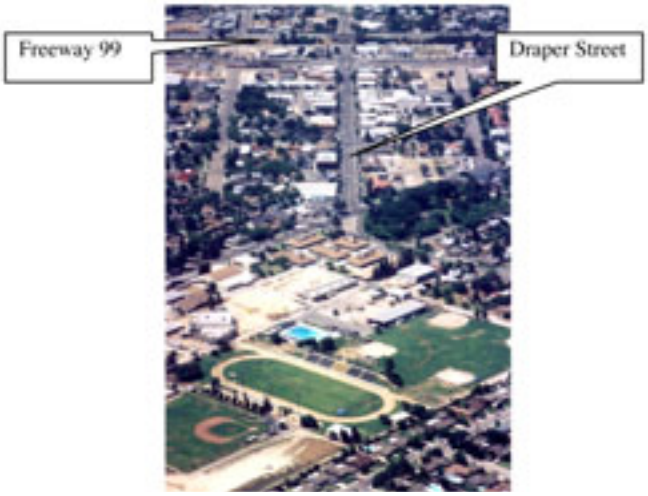


Figure 2:

Figure 3:



KHS in the foreground at the intersection of two major roads, with the main street, Draper, leading away towards a major freeway, Freeway 99.

In 2003, KHS had a Global Learning Expedition (GLE) team present at the Croatia GLE. That team read a special issue from the newspaper *The Fresno Bee*, called "Last Gasp," which focused on the issue of air pollution in our valley. The students learned that there are three air pollution seasons in our valley: summer, when ozone is affected by auto emissions interacting with sunlight; autumn, when particulates from agricultural harvesting stir up pesticides and dust particles; and winter, when particulates result from agricultural and fireplace burning. The 2003 team investigated air pollution in the winter, so we decided to investigate air quality during the summer, when ozone is the major issue. This team's focus was ozone and asthma.

Figure 4a shows a GLOBE graph that represents current KHS air temperature during 1999, a typical year in which data was collected by KHS students. The Central Valley is characterized by a Mediterranean climate, arid and hot in the summers and has limited rainfall in the winter along with heavy fog. Our project addresses whether or not there is a correlation between air temperature and the amount of ozone. Note the high summer temperatures. The Central San Joaquin Valley is surrounded by mountains, the Sierra Nevada range on the east side and the Coast Range on the west and south. These mountains trap the air and keep pollutants from escaping.

Figure 4b presents the maximum 8-hour ozone concentrations in Fresno each year from 1990 until 2006. Each year's maximum was above the acceptable national standard indicated by the dotted line.

The Fresno region is nationally ranked sixth highest in ozone concentration (American Lung Association, 2007) and ranks first in the 8-hour ozone average category (CVAQ, 2006). Ozone in the stratosphere is beneficial to human health because it blocks out harmful UV radiation, which can cause

Figure 4a:

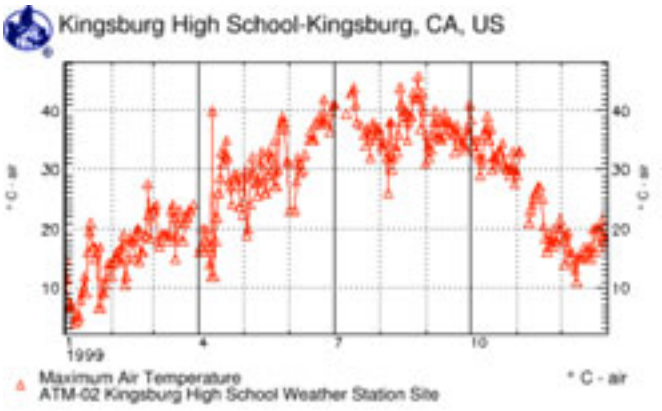


Figure 4b:

cancer and skin disease. However, ground level ozone in the troposphere has adverse effects on respiratory health in humans and damages vegetation. It can lead to chest pain, coughing, throat irritation, congestion, aggravating bronchitis, emphysema, and asthma. Tropospheric ozone can also reduce lung function and cause inflammation of the lungs. Repeated exposure may permanently scar lung tissue (Air Now, 2003).

Sports may also increase the chances of developing asthma. Rob McConnell, MD, Associate Professor of Preventive Medicine at the University of Southern California in Los Angeles, found that children living in an area with high ozone level with a mean maximum concentration of 75.4 ppb that play three or more sports are 3.3 times more likely to develop asthma than children in the same area that don't play sports.

Tropospheric ozone is formed by photochemical reactions, where nitrogen oxides (NO_x) and volatile organic compounds (VOCs) combine with sunlight energy. According

to the Environmental Protection Agency, motor vehicles account for 56% of all NO_x and 45% of VOCs in the atmosphere. Industry and chemical solvents also produces NO_x. The chemical lifetime of ozone varies depending on the altitude and the amount of NO_x in the atmosphere. Generally, the higher up in the troposphere, the longer the average residence time of ozone due to the absence of NO_x at these altitudes. However, the ozone near the surface lasts until the sun sets and then begins to decrease since both light and NO_x are present near the ground. The NO_x reaction that produces ozone is reversible. At night, in the absence of sunlight, the NO_x actually removes ozone from the air.

It is estimated that 19% of the children living in the Central San Joaquin Valley have asthma. Valley schools lose about $26 million each year to asthma-related absences (Central valley air quality coalition, 2006). 8,011 children were admitted at Valley Children's Hospital for asthma treatment last year.

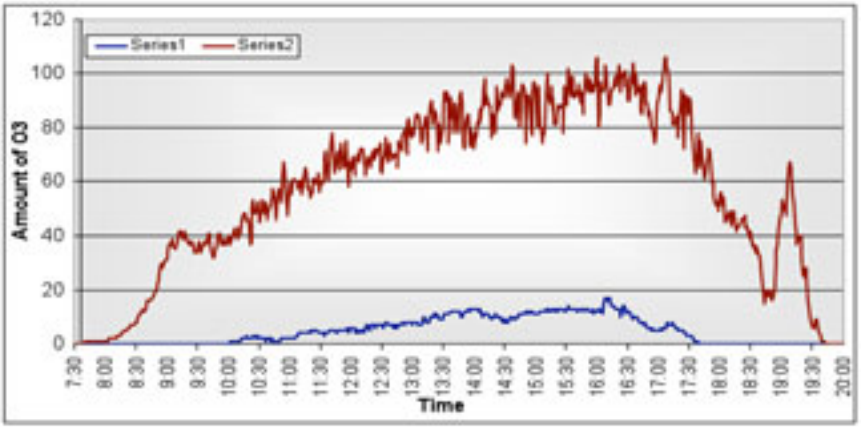
RESEARCH QUESTION(S)/HYPOTHESES

We took this information on ozone and investigated how it could be affecting our community. We sought to answer this question: What areas on our high school campus have high levels of ozone to which students are exposed? We decided to test the ozone levels at both indoor and outdoor campus sites.

We reviewed data collected by Andy Olson, a 2004-2005 KHS Advanced Placement Environmental Science (APES) student, a (Olson, 2005). Andy used an ACCESS air quality monitor borrowed from GLOBE in the city at UCLA to collect this information (Figures 5 & 6). Olson's findings helped us develop our hypothesis that outdoor ozone levels would be highest at the hottest times of the day and indoor ozone levels would be lower than outdoor levels. Figure 5 indicates that indoor ozone is much lower than outdoor ozone levels.

Series 1 represents indoor ozone levels in ppb and Series 2 represents outdoor ozone levels in ug/m^3 March 5, 2005

Figure 5:



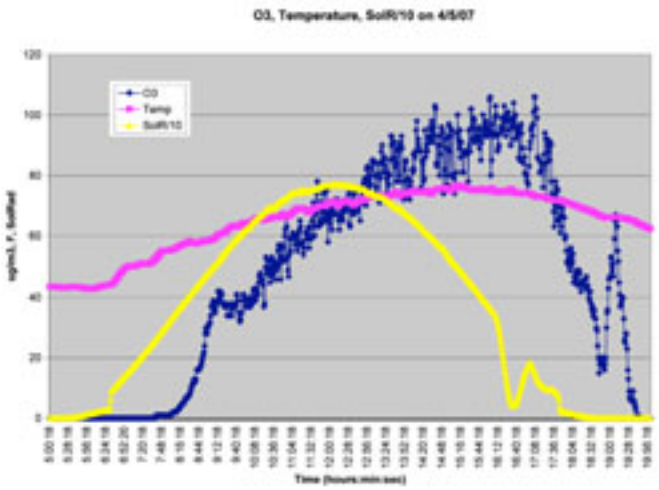


Figure 6:

This graph shows the solar radiation for the same day as the graph above it. It is being compared to the amount of solar radiation and temperature during the time period.

Our next two questions were: How many students at KHS have asthma? Does 1) residence location, 2) having a family history of asthma, or 3) the number of sports students participate in, correlate with having asthma? Our hypothesis for the first question was that at least 19% of KHS students would have asthma because that is the average for our region. Our hypotheses for the second question were: 1) that students living in town would have a higher incidence of asthma compared to those that live in the country because of the higher concentration of cars in town, 2) families of students with asthma would more often have family members with asthma than families of students without asthma 3) the more sports that students participate in, the more likely they are to have asthma.

Our team was curious about the influence of ozone on agriculture in the community. We wondered if grape vines near roadways are affected more by the high ozone levels than those not near roadways? It was expected that leaves in close proximity to roadways would show damage due to the higher amounts of ozone enhanced by auto emissions. We wondered if ozone was affecting crop yield, as farming is our region's major industry.

We have partnered with an international GLOBE school, Goethe Schule from Wetzlar, Germany. They are also investigating asthma, ozone, and community health. Our question regarding the comparison between the two GLOBE school locations was: How do Kingsburg, California, U.S.A.'s ozone levels and respiratory health compare to those in Wetzlar, Germany? Wexler is at higher latitude and has a much cooler climate. We expected Wexler would have lower levels of ozone and a lower incidence of asthma.

MATERIALS AND METHODS

The Survey Method:

Six teachers administered our survey to their classes. Three hundred and two 9th-12th grade students were surveyed. A copy of the survey is included in the appendix.

The Ozone Collection method:

We followed the GLOBE protocols when collecting ozone data. We placed EcoBadge ozone sample papers at different sites, both indoors and outdoors, around our school campus. The indoor sites were three classrooms, the library, the girls' restroom, and the photocopy room (see Figures 7-13). The outdoor sites were: outside the school theater adjacent to the student parking lot, outside the gym near the student parking lot, the Ag farm, the pool parking lot, the office parking lot, Tom's Donut Shop across from the campus, and the quad, a grassy area in the middle of campus (Figures 14-21). On the testing days, ozone was tested at three different time periods for an hour each starting at approximately 08:00, 11:00, and 14:00 hours. Each ozone sample paper was placed in a "Zip Lock" baggie and taken to the site that was labeled on the plastic baggie. Once removed from the baggies, papers were clipped into place by a binder clip. The papers were removed from the clips an hour after placement. After removing the papers from the clips, they were placed into the same plastic baggies and carried to room 74, where the Zikua ozone meter was kept. We did not touch or remove the papers from the baggies until it was time to take the readings. We calibrated the ozone meter before every set of readings was taken. We reused the same plastic baggies after wiping them out with tissues. When setting the EcoBadge papers out and picking them up, observations were taken of weather conditions, which were recorded according to GLOBE protocols. We also recorded the date, the time period, the exact time, and the name of recorder when setting out and picking up the papers. We recorded any observations about the areas where papers were placed. After the papers were collected, the ozone levels were read using the Zikua meter.

Figure 7: Aerial view of indoor sites.

Description of indoor sites:

Figure 8: Room 74 (Point A on Figure 7): Mrs. Foletta's classroom, which contains two televisions, a video projector, five computers, and a fume hood.

Figure 9, left: Room 60 (Point B on Figure 7): A science classroom located in an older building with a small computer server, one computer monitor, two printers, a television, and a chalkboard. Figure 10, right: Room 45 (Point D on Figure 7: The computer lab; an average-sized room with a large cooling unit, and twenty seven computers.

Figure 11: Library (Point F on Figure 7): Large room with an attached computer lab. The main section of the library contains seven computers.

Figure 12: Girls Restroom (Point C on Figure 7): A confined area with six stalls and sinks.

Figure 13: Photocopy room (Point E on Figure 7): A small room with an open door leading to a large office. There is another door leading outside. The room contains two photocopy machines that are used frequently.

Figure 14: An aerial view of all outdoor sites.

Description of outdoor sites:

Figure 15: Little Theater (Point A on Figure 14): The Eco-Badge paper was placed behind the Little Theater on the fence. The fence surrounds the air conditioning unit for the theater and is adjacent to the student parking lot.

Figure 16: Gym Parking Lot (Point B on Figure 14): The paper is on a "Wrong Way" sign. The sign is next to the football field and adjacent to the student parking lot.

Figure 17: The Ag Farm (Point C on Figure 14): A dusty school farm with few small trees, shrubs and livestock. During our ozone project, cows, lambs, sheep, and pigs were present.

Car Counting Method:
On May 29, 2007, students went out to four locations that were at or near the three parking lots or by the road that separates Tom's from our campus. Each person took a Hand Tally Counter to keep count of the passing cars. The results at each location were averaged. Cars were counted at only the 8:00 hours and 11:00 hours.

Figure 18: Pool Parking Lot (Point D on Figure 14): The paper is on a fence which separates the parking lot from the bus barn. Buses are parked and refueled within the fenced area. The parking lot is adjacent to the pool and softball field.

Figure 19: Office Parking Lot (Point F on Figure 14): The paper is on a sign by the trees on the left side that reads "Do Not Loiter." A major road passes by this parking lot.

Figure 20: Tom's Donut Shop (Point G on Figure 14): It is located across the street from our campus. The paper is placed in the parking lot beneath a newspaper stand. Tom's is at the intersection of two busy streets.

Figure 21: The Quad (Point E on Figure 14): It's an area in the center of our campus that is busy during break (approximately 10:15-10:35 am), lunch (approximately 12:25-1:10 pm), and after school (approximately 3:00-3:30 pm).

DATA SUMMARY
On the graphs below, the time period 800 represents the average ozone level between 8-9 am, 1100 represents average ozone level between 11 am to noon and 1400 represents average ozone levels between 2 pm and 3 pm. An individual point represents the average ozone level over a period of one hour.

Wind direction readings were taken when we set out and picked up ozone papers. The wind direction was fairly consistent during a particular month. The wind was light or absent throughout the measurement period. In May, wind usually blew in from the south or west. In July, the trend was usually from the west and northwest. In August, the general wind direction was from the east and northeast. We have individual data sheets for all of our collected ozone data, car counting, and survey results at school.

ANALYSIS AND RESULTS

Outdoor Ozone Data
Figure 22. On May 11, 2007 the ozone levels at Tom's and the office parking lot peaked in early morning and decreased by the 1100 and 1400 hour readings. The office parking lot gets a lot of traffic in the morning because parents drop students off for school and teachers are parking. Tom's is at a major intersection nearby where many people drive by on their way to school or work. At the 1400 hour, ozone levels were lowest at Tom's and the office parking lot where traffic was minimal because school got out early this day and few students were around. Levels at the Little Theater, Ag farm, pool parking, and quad peaked at the 1100 hour during which the temperature rose. Also, during the 1100 testing period students were dismissed and cars were moving in and out of parking lots. Students were all around campus, particularly in the quad. The 1400 hour readings were the lowest.

School was vacant by this time due to early release for prom schedule. The ozone paper at the gym parking lot was missing at the 1100 hour reading.

Figure 23. On May 15, 2007 ozone levels for all the sites except Tom's and the quad peaked at 1100 hours. Tom's and the quad started the day at the lowest readings, but increased at both 1100 and 1400 hours. All other sites had slightly decreased ozone levels at 1400 hours. Students were arriving to school at the 800 hour. At the 1100 hour, students were in class. Only Tom's and the quad supported our hypothesis that ozone levels would increase with temperature. There was no wind at the 1100 hour, so ozone probably didn't blow in from another part of campus. Ozone levels did not decrease on this day as much as other days at 1400 hours. This could be due to the higher temperature.

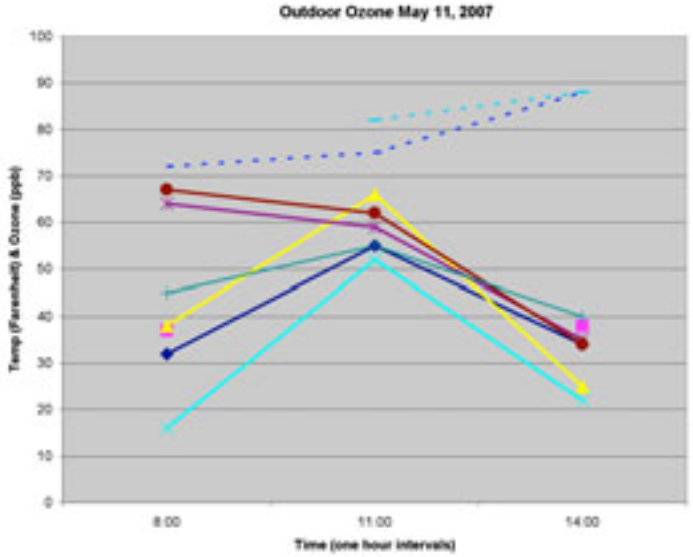
At this point in the project the team thought it would be interesting to keep track of the number of vehicles that were traveling by various regions of campus since car emissions form ozone. Cars were counted passing through and near parking areas on one day.

Figure 24. On May 18, 2007, the ozone levels peaked in the morning at the gym and at the pool parking lot. At the gym parking lot, at 800 hours, one hundred twenty three cars had just arrived, with more coming. At 1100 hours, the cars were parked and only seven were moving, accounting for the lower levels. The little theatre readings dropped the most at the 1100 hour and it is near the gym which didn't drop as much. At the pool parking lot, at 800 hours, forty five cars came and parked, while numerous others drove through. Around noon, only seven cars were moving and forty five were parked. Adding car data to each outdoor reading would be helpful if someone repeats our project. It would give more evidence about auto emissions affecting ozone levels in our parking lots.

Office parking was the highest both at 800 and 1100 hours but dropped at the 1400 hour. Tom's had the lowest levels all day. There were only seventy five cars that passed by the office parking lot, yet its levels were higher than Tom's where one hundred and eighty cars passed by. Wind from the south could have carried ozone to the office parking lot from Tom's. Neither ozone correlation to temperature or number of cars supported our hypotheses for these two sites.

Levels peaked at the 1400 hour reading for the Little Theater, Ag farm and quad but these were not much different than the 1100 readings. The temperature increased by 10 degrees Fahrenheit from the 1100 hour reading, providing some support to our hypothesis that temperature and ozone levels correlate for those sites but since other sites had decreased ozone levels the support is weak.

Figure 22:



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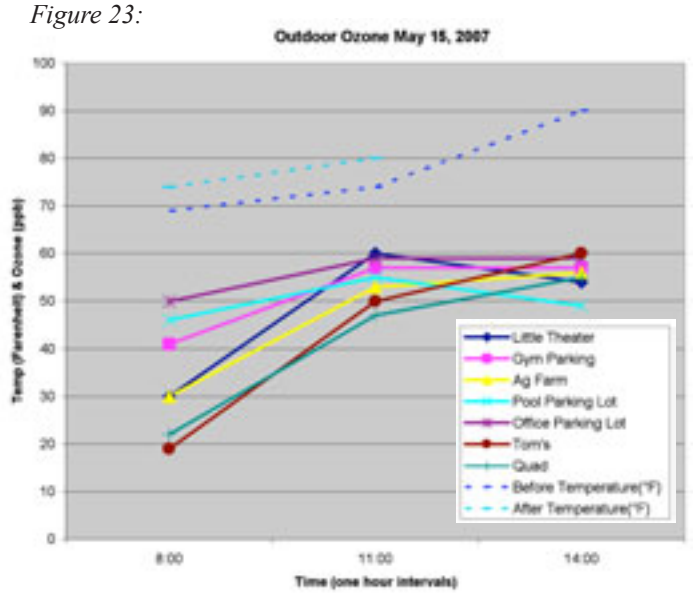

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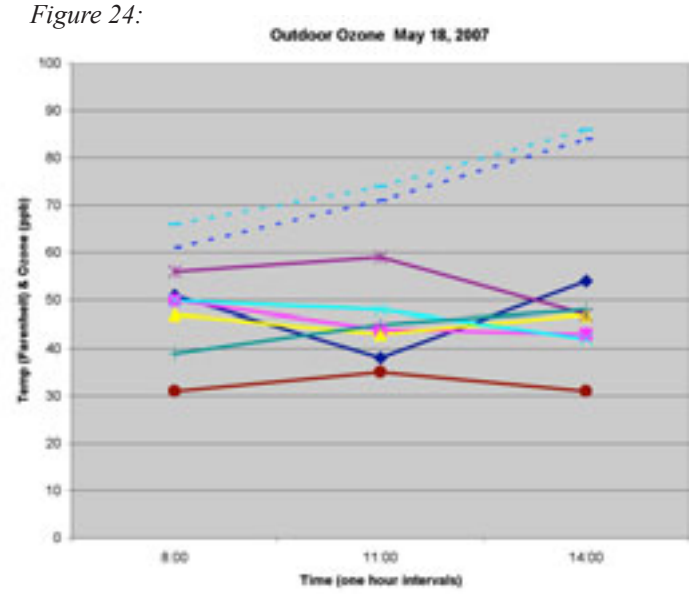


Figure 25. On May 22, 2007, the ozone levels in the quad were high, at 76 ppb in the middle of the day. In the morning there were two assemblies so students were walking to and from the theatre which correlated with a high quad and little theatre readings at 1100. Students don't produce ozone but did move ground level air, but we are really not sure how that would make the quad and theatre readings so high. The quad level dropped to the lowest of the day by the 1400 reading.

At the 800 hour, levels were higher than normal at the Ag farm, but the level there dropped significantly by the end of the day.

Ozone levels dropped by 10 ppb in some places and 59 ppb in others by the end of the day at the 1400 hour. This contradicts our hypothesis because the temperature was highest at the 1400 hour and ozone was lowest. There was not any wind at this time either. Possibly the majority of the ozone on our campus is not produced here but travels in from other parts of town.

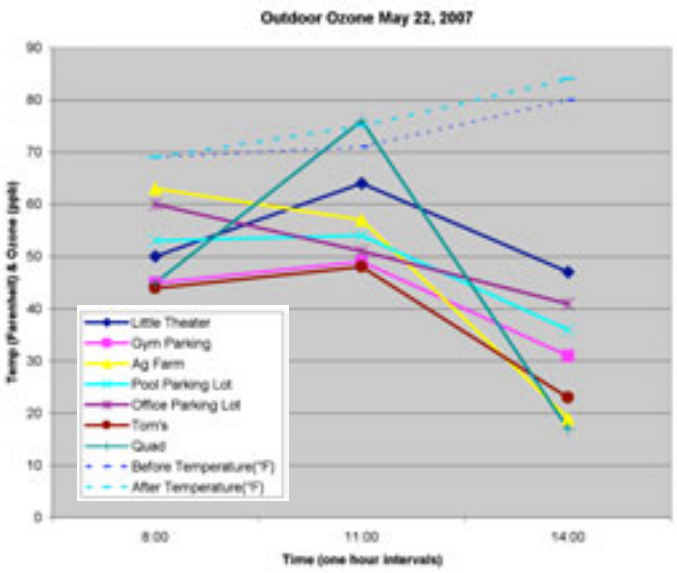
Figure 26. On May 24, 2007 ozone levels peaked in the middle of the day for all locations, whereas the temperature continued to increase into the afternoon. This data does not support our hypothesis in the afternoon that higher temperatures lead to higher ozone levels, but it does support the idea that ozone levels reach their highest point at mid-day when the sun angle is most direct. The front and center of campus, Tom's, office parking, and the quad ozone levels dropped below the ozone levels of the locations in the back of the campus, the little theatre, gym parking, and pool parking. Maybe there was more traffic in the front contributing to ozone concentrations, but since we did not count cars this day, we cannot draw that conclusion.

Figure 27. On May 29, 2007, ozone levels were high, above 70 ppb, at the Ag farm and the quad at 800 and gradually decreased through the day which is not the typical trend of ozone starting low, increasing, then dropping. The office parking lot changed little throughout the day as well, but started out lower than Ag and the quad, 54 ppb. The little theatre, gym, and Tom's started lower at 30 ppb, rose significantly at the 1100 hour (up to 78 ppb for the theatre), then dropped to around 50 ppb at the 1400 hour which is more of the typical trend.

This day had the highest temperatures and highest ozone levels recorded during this investigation. This supports the hypothesis that temperature and ozone levels are related. That trend, however, does not fit the daily pattern of ozone levels dropping in the afternoon when temperatures are the highest.

We came to school during the summer to see if the ozone levels were different from when we tested in May. July is generally a hotter month. In July, the ozone levels tended

Figure 25:



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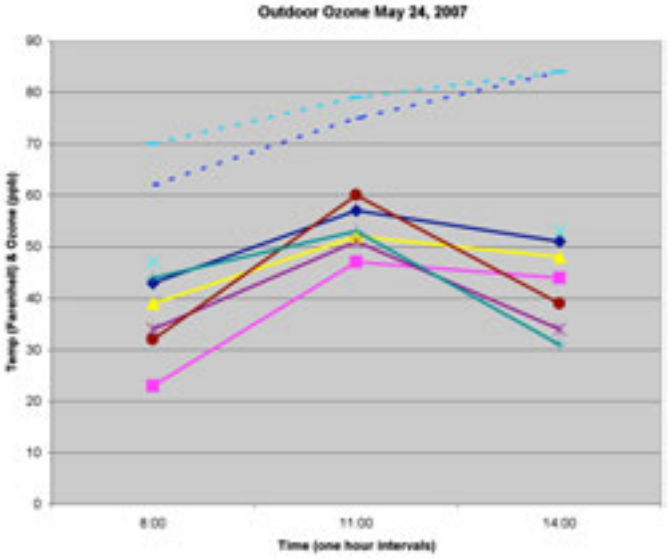

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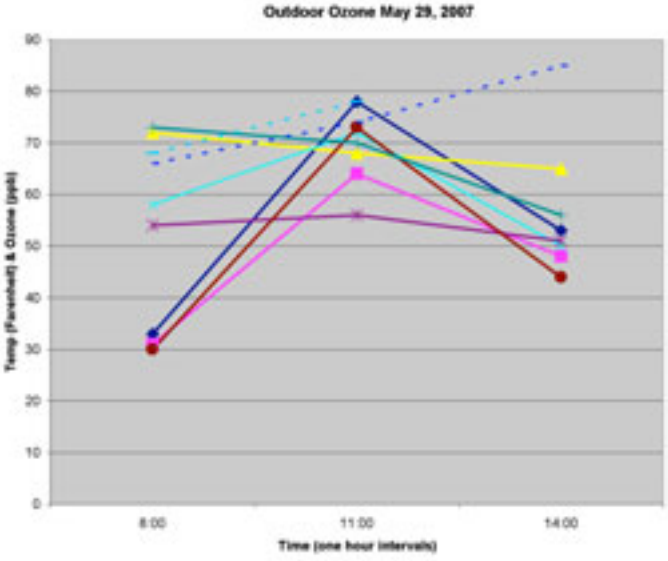

to increase more dramatically, with ozone levels lower in the morning, but much higher at the 1400 hour. Rather than a decrease at the end of the day, levels steadily rose, as did temperatures. Perhaps it would have been revealing to do correlation graphs by month.

Figure 28. On July 13, 2007, ozone levels rose very quickly, about 50 ppb, from the 800 hour to the 1100 hour. However temperature only increased 10 degrees Fahrenheit in that time period. The ozone levels at the little theatre and the Ag farm recorded a consistent ozone level from the 1100 hour to the 1400 hour, whereas, pool parking and quad increased. Tom's was only recorded at 800 and 1400 hours; it rose from 0 to 65, but we don't know about the 1100 level. Students were in the quad when data was collected at the 800 hours. Summer school hours were 7:30 through 11:30 am.

Figure 29. On July 16, 2007 ozone levels were not tested at the 1400 hour. Of the three July days tested this day the 800 readings were higher than the other two days, especially at the little theatre which had a reading of 50 ppb. We are not sure why, possibly because temperatures were slightly higher at the beginning of the day. Temperature was not recorded when the ozone papers were gathered. If we had a temperature reading at the 900 pick-up time it may have been higher than the other July days which would help explain the higher then usual readings at the 800 hour. All of the ozone levels went up at the 1100 hour which would be expected due to the increase in temperature. Pool parking levels increased the most. This is likely because the pool is open to the community during the summer and is busy with car traffic delivering and picking up children most of the day. Summer school was in session and students were in the quad at 1100 hours.

Figure 30. On July 17, 2007, at the 800 hour the temperature was 68.5 degrees Farenheit and the ozone levels remained relatively low, about 10 ppb for all the sites. As temperature increased at the 1100 hour, ozone levels steadily increased in all areas by 1400 hours. This supports our hypothesis that temperature and ozone levels correlate.

The school year began August 20th. We thought we would take readings to see how late August ozone levels compared to our July and May readings. This is the time of year when sports schedules are sometimes delayed because of high ozone levels. The days we took our readings turned out to be unusually humid and it rained on the 31st. The rainy season usually does not begin until October. The levels of ozone did not increase dramatically like they did in July, but we only took measurements on these two unusually wet August days, unfortunately.

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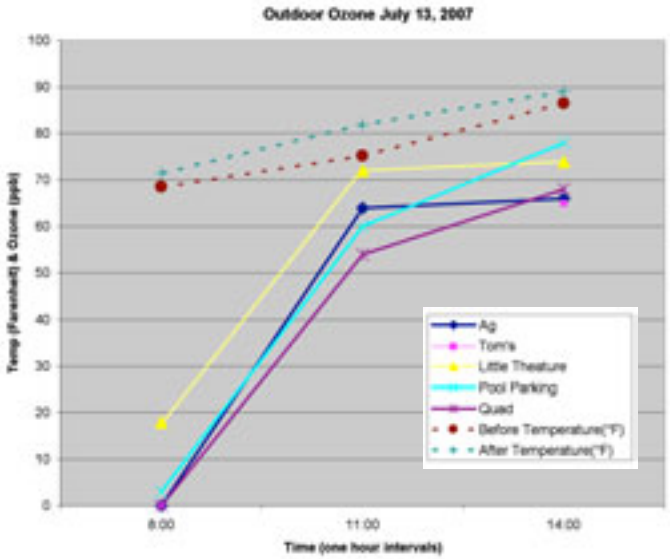

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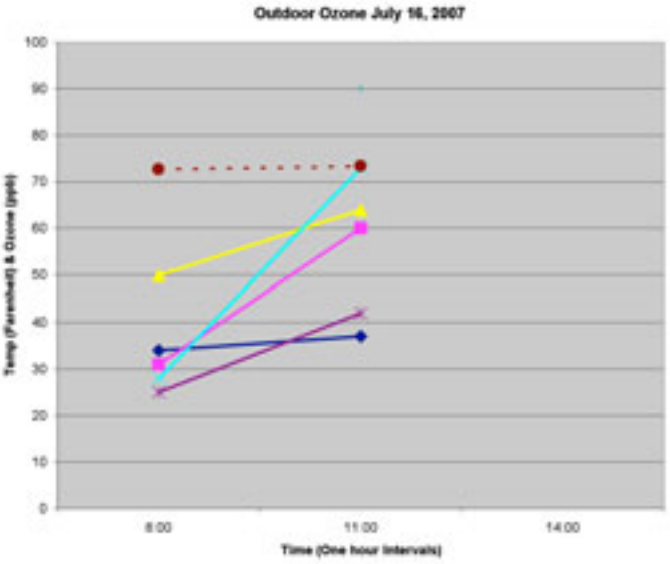

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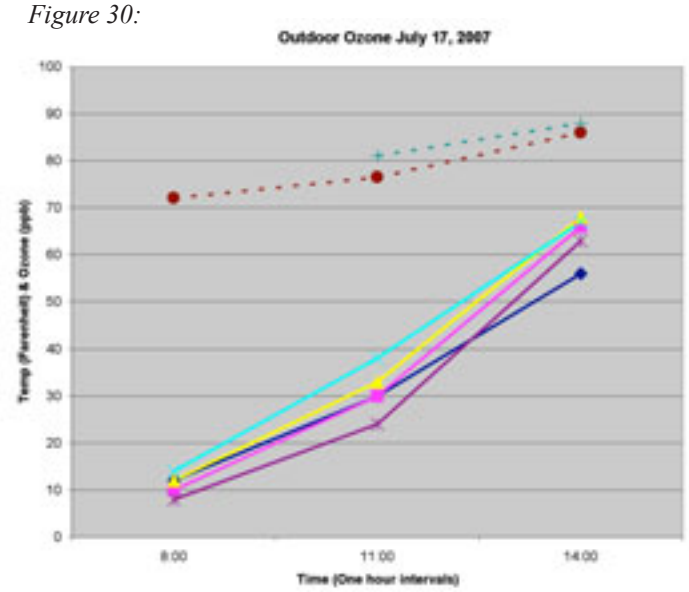


Figure 31. On August 30, 2007, ozone levels did not change very much between the 1100 and 1400 hours. Ozone levels in all locations stayed within a narrow range all day. The temperature at 800 was much higher than they had been in July and the ozone levels started out much higher as well, lending support to the temperature and ozone level correlating. Both the pool parking lot level and the level at Tom's decreased between the 800 and 1100 hours even though the temperature rose slightly, which was a new trend. This particular day the humidity was quite high, 50%. Usually our humidity in August is around 20%, so this was not a typical day. Activities and traffic were normal on this day.

Figure 32. On August 31, 2007, ozone levels increased between the 800 and 1100 hours. It rained that morning just before the 800 papers were set out. Ozone levels continued to increase at the 1400 hour, which does not follow the trend we found in May when the ozone increased at the 1100 hour and decreased by the 1400 hour. The temperature did reach 100 degrees Farenheit, so this was a hot afternoon. This does support our hypothesis as ozone levels rose as the temperature rose. The rain which lead to high humidity made this a very atypical August day.

May ozone levels tended to rise mid-day and decrease at the end of the day. Temperatures were highest at the 1400 hour, yet ozone levels still decreased. This did not support our hypothesis that there is a correlation between temperature and ozone levels. In July, ozone levels tended to increase more dramatically with ozone levels lower only in the morning and much higher by the 1400 hour. Rather than a decrease at the end of the day, levels steadily rose throughout the day, just as temperatures steadily rose. This did support our hypothesis. It could be that our hypothesis applies only when temperatures are very high. Levels seemed lower in August, but the two days we tested had unusual weather, humidity and rain. So these days were not representative of that time of the year. There was really no trend in the two days we tested in August except that levels were all low. Air quality was so bad the following week that some sports schedules were cancelled or postponed, however.

Figure 33 is a graph showing correlation between temperature and ozone levels at the quad. We hypothesized that there would be a direct correlation between the temperature and level of ozone. The data showed us that there was no direct correlation between ozone and temperature. You can see from Figures 22- 26 that ozone increases with temperature until noon

Figure 31:

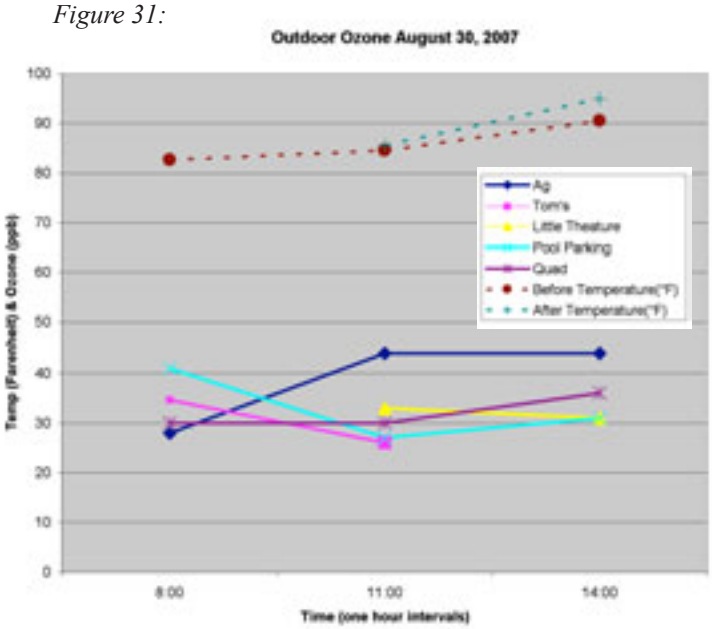


Figure 32:

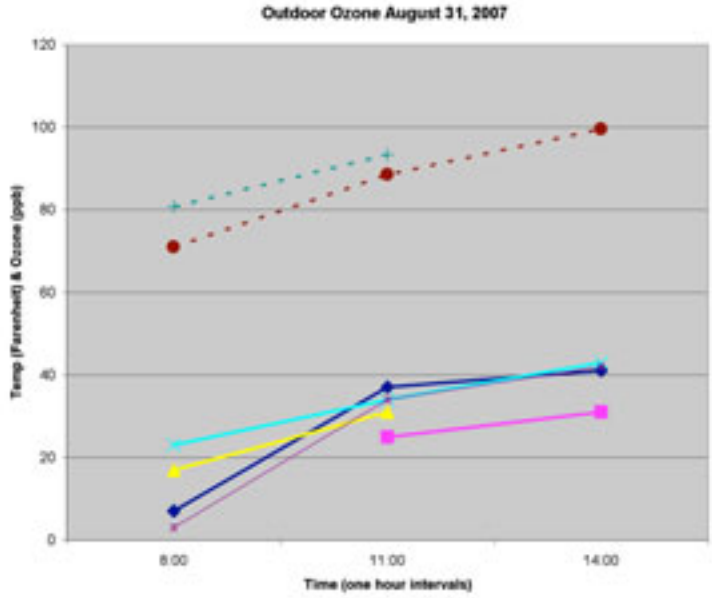
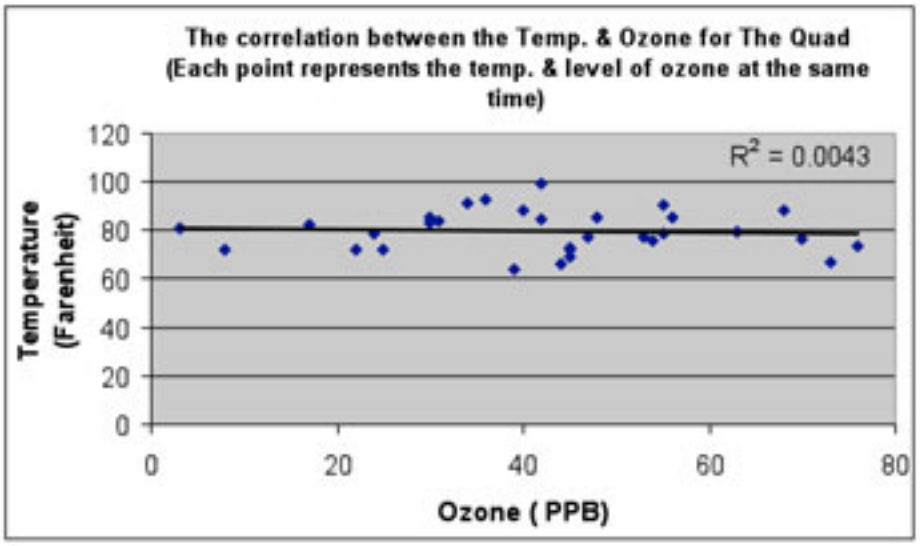


Figure 33:



and then ozone usually decreases as temperature rises in the afternoon. There did seem to be a direct correlation in the July graphs but we included data from all the days we tested on our correlation graph, not a correlation of each month separately. We will not include the data table with the rest of the correlation graphs because we think the graphs give enough information. R^2 (written on graphs) represents the correlation coefficient which is 0.0043 on this graph. The correlation coefficient converted into a percentage, 0.43% in this case, shows how well the variance in ozone can be explained by the variance in temperature. Variance is the measure of the distribution spread. The stronger the correlation, the more variance between the two can be explained. Since the variance is 0.43% there is almost no correlation between temperature and ozone at the quad. The next two graphs below show similar results that do not support our hypothesis.

Figure 35 shows an r^2 of 0.0007 or no correlation at all between the temperature and ozone readings at the little theatre. Figure 36 below shows an r^2 of 0.0385 between the temperature and ozone at the office parking lot for all readings. Again, this shows no correlation between the two. Our hypothesis regarding temperature correlating with ozone level was not supported by the data in this project.

Figure 35:

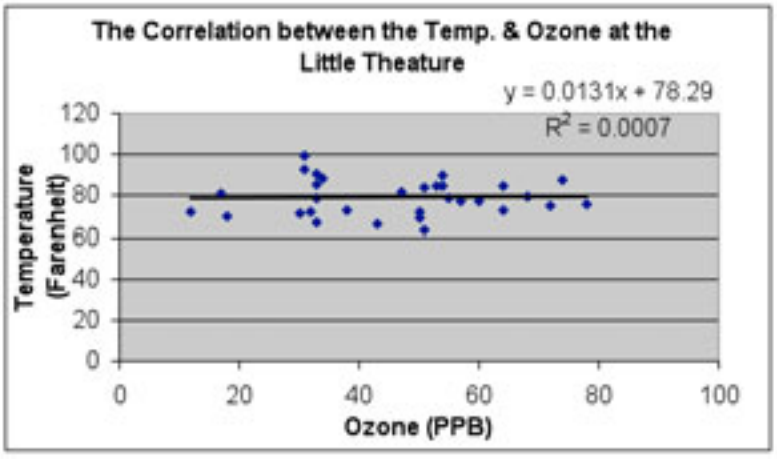


Figure 36:

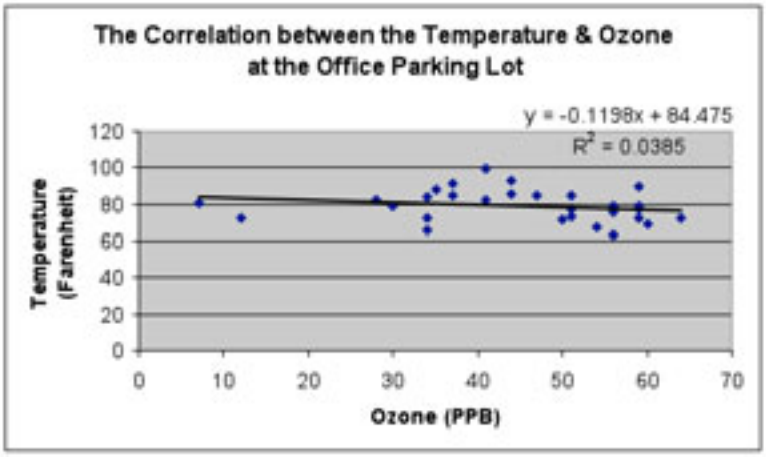


Figure 34:

Date	Time	Ozone in Quad	Temp
5/11/2007	800	45	72
5/11/2007	1100	55	78.5
5/11/2007	1400	40	88
5/15/2007	800	22	71.5
5/15/2007	1100	47	77
5/15/2007	1400	55	90
5/18/2007	800	39	63.5
5/18/2007	1100	45	72.5
5/18/2007	1400	48	85
5/22/2007	800	45	69
5/22/2007	1100	76	73
5/22/2007	1400	17	82
5/24/2007	800	44	66
5/24/2007	1100	53	77
5/24/2007	1400	31	84
5/29/2007	800	73	67
5/29/2007	1100	70	76
5/29/2007	1400	56	85
7/13/2007	800		70
7/13/2007	1100	54	75.2
7/13/2007	1400	68	87.8
7/16/2007	800	25	72.2
7/16/2007	1100	42	84.8
7/16/2007	1400		
7/17/2007	800	8	72
7/17/2007	1100	24	78.5
7/17/2007	1400	63	79.25
8/30/2007	800	30	82.6
8/30/2007	1100	30	85.1
8/30/2007	1400	36	92.6
8/31/2007	800	3	80.8
8/31/2007	1100	34	90.9
8/31/2007	1400	42	99.5

Indoor Ozone Data

Temperatures are not listed on the graphs of indoor ozone levels because all the rooms have thermostats and the temperatures were stable around 72 degrees Farenheit throughout the experimentation period. Since ozone requires sunlight to develop, we expected lower levels of ozone inside buildings and that ozone gets in when the doors are open. Our school does not have windows that open except in the girls' restroom.

Figure 37. On May 11, 2007, the sites started off with ozone levels at zero most likely because there were no students in the classrooms at that time in the morning so the doors had not been opened to let ozone in. The highest levels were at around 1100 hours and students were in the classrooms at this time. The 1400 hour readings were all zero, and no one was at school due to early dismissal that day. The girls' restroom had the highest ozone level, most likely because the door is kept open. Room 45 is the computer room and we think the computers might generate ozone separately from the ozone produced outside and entering through the door. We expected that the photocopy machines might also produce ozone, but there are only two copiers in that room compared to the large number of computers in the computer lab.

Figure 38. Ozone levels peaked at the 1100 hour except in the library. We don't know about the girls' restroom because we don't have an 1100 reading. The library level went up at the 1400 hour; there was an assembly there and people were opening and closing the doors, probably letting outdoor ozone in. Outdoor readings on this day remained about the same between the 1100 and 1400 readings. These indoor readings went down more than the outdoor readings, but class is in session at the 1400 hour and the doors should remain closed at that time.

Figure 39. Overall readings started low, rose at 1100 and decreased again at 1400. The copy room and room 74 were highest at 1100 hours. All the copy machines were running in the copy room. Class was in session in room 74 with the door closed. We couldn't find a reason for the ozone being high in room 74; however, students may have entered the room when we were not present. The girls' restroom levels increased from 800 through 1400 hours. The door to the girls rest room was open at the beginning of the 1400 hour but closed at the end. At the 1400 hour the copy room was inactive but room 74 had a class and the door was open which made us wonder why the reading was so low.

Figure 37:

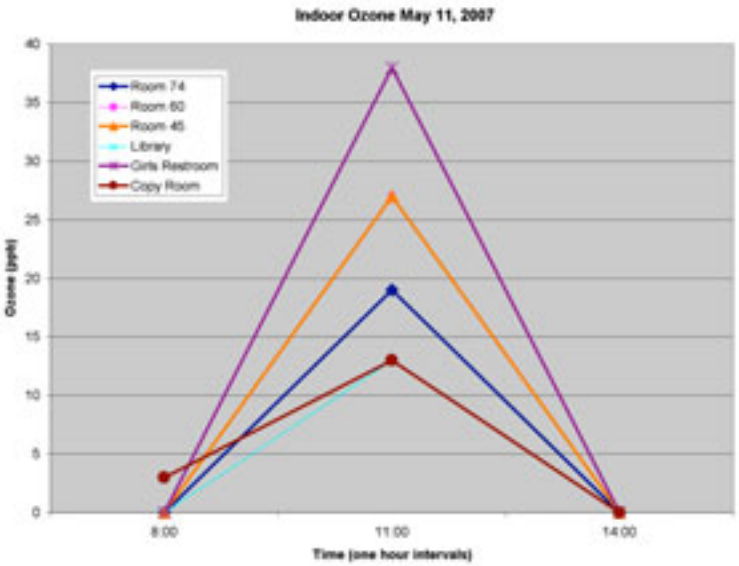


Figure 38:

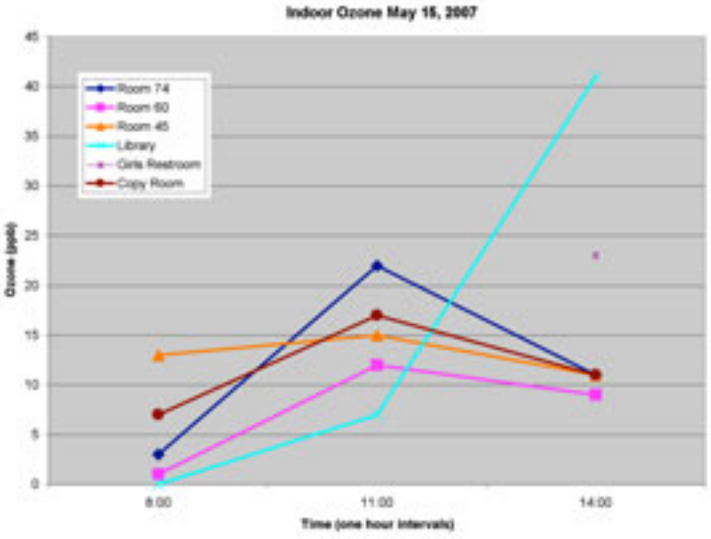


Figure 39:

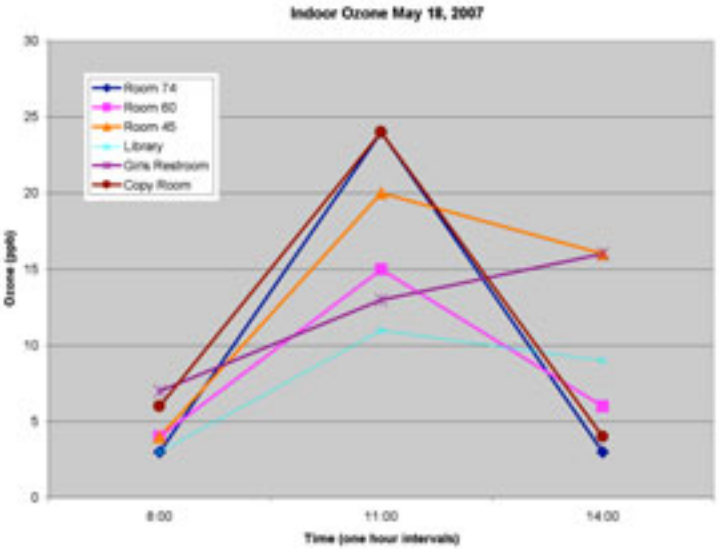


Figure 40. The ozone papers in room 45 and the girls' restroom were missing at the 800 hour, when we went to collect them. Room 45 was highest at 36 ppb at 1100 hours which is not expected because no one was in the room. Girls' restroom was second highest, again probably because the door was open. Room 60 was vacant with the door closed, so the reading seemed a bit high. Room 74 had a class and the door was closed except for students entering and leaving the room. The temperatures were kept stable by the automatic thermostat.

Figure 41. On May 24, 2007 ozone levels at 800 hours were all below 5 ppm and 1100 hours showed an increase for all locations with the girls' restroom being the highest at 24 ppm and room 74 18 ppm with the others lower. At 1400 hours, the copy room levels were unusually high. The door was kept shut and the machines were not used as much as usual which surprised us. Library ozone levels were high at the 1400 hour; there was a large class working in the library. The girls' restroom was slightly higher and at the end of the 1400 reading the doors were shut, but not the windows.

Figure 42. On May 29, 2007 the 1100 hour levels were lower than the 800 hour readings, except for the girls' restroom, likely because the door was open. Levels were unusually high at 1400 hours. Room 45 was the highest, which could be because all of the computers were in use. Levels in the library were higher likely because a large meeting was being held there. The copy room had high levels possibly due to the fact that all the copy machines were running and outside ozone levels were higher that day than others so ozone was probably brought in when doors were open and closed by students going in and out.

Figure 43. We reduced the number of locations we tested. This was mid summer. Room 70 was used for summer school which ends at 11:30 am. This accounts for the decrease in ozone after dismissal. Room 75 was a control room as no activity was taking place there all day. It started

Figure 40:

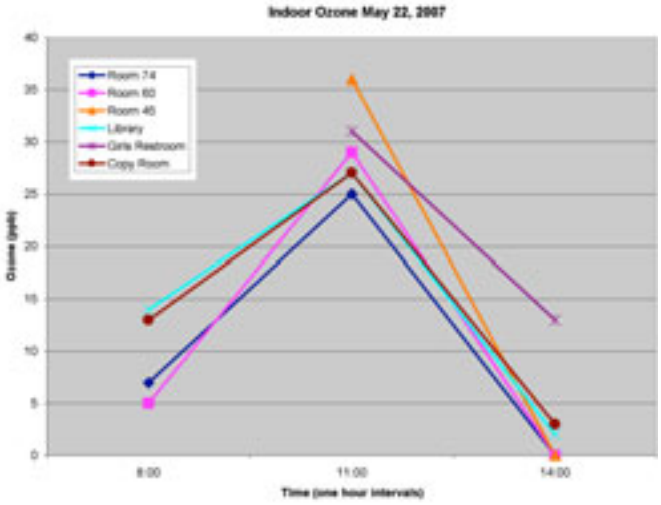


Figure 41:

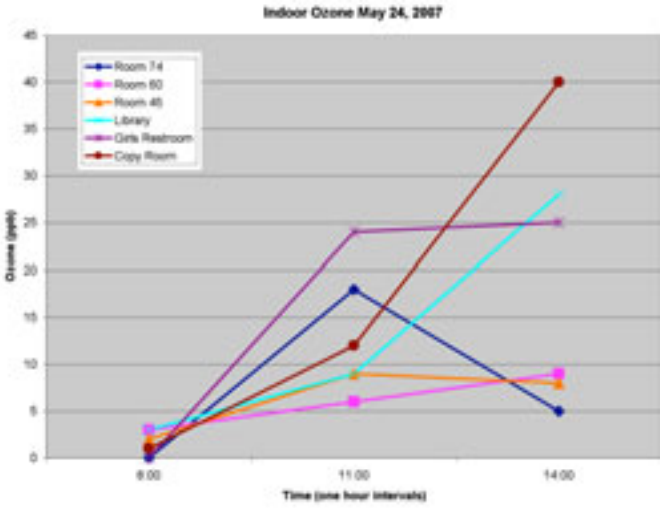


Figure 42:

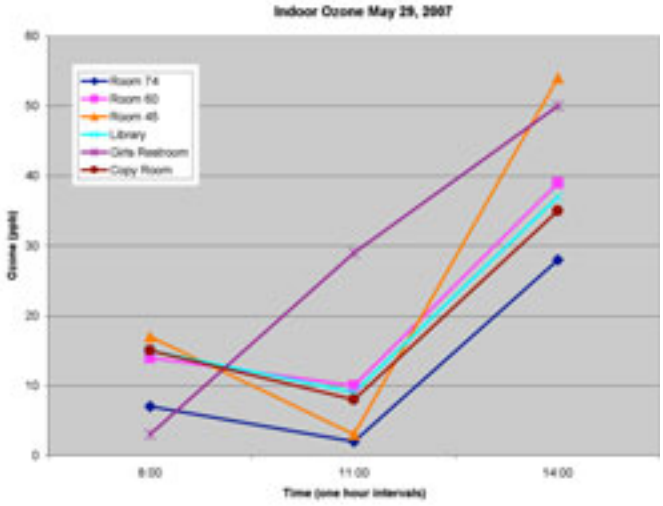
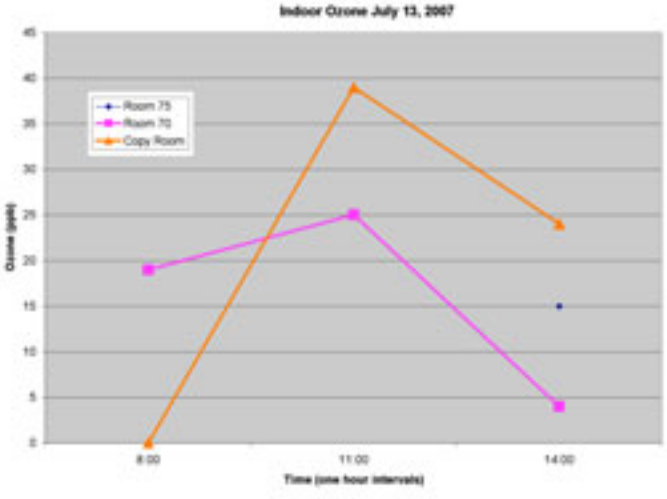


Figure 43:



out at 0 ppm, but no reading was taken at 1100, and the 1400 reading was 15 ppm, At the 1400 hour its readings were higher than those in the summer school classroom, room 70. The copy machine was running at the 800 hour however ozone levels were at 0 ppb. At the 1100 hour no one was in the copy room and no machines were running. We did not expect the high level of ozone we recorded there. Temperatures again were kept constant throughout the day by the automatic thermostat.

Figure 44. On July 16, 2007, we did not test at the 1400 hour. Ozone levels were low (see y-axis scale). Levels decreased in the copy room and Room 75 between the 800 and 1100 hours. The outdoor readings that day were also higher than normal at the 800 hour and we suspected it was due to outdoor temperatures being higher than usual at the beginning of the day. Outdoor ozone was likely brought inside from opening and closing the doors. The zero readings at the 1100 hour we cannot explain. Temperature was kept constant by thermostat.

Figure 45. On July 17, 2007 results were different than the general trend found in the May, when ozone peaked mid-day. Ozone levels on this day were low at mid-day, except room 75 which continually increased. During the 2nd time period, ozone levels were low in the copy room and room 70, even though students were around. At the 1400 hour, levels were higher, even though students had left. Temperature was kept constant by automatic thermostat.

Figure 46. On August 30, 2007 ozone levels were low; note the y-axis scale only goes up to 12 ppm. The ozone level in unused Room 75 dropped from 800 to 1100 hours and went up at the 1400 hour. Room 75 went up the most, which is unusual because there was no activity in this room. Room 70 decreased as the day went on. This is logical because students left the room shortly after the 1100 hour and the door stayed shut after that, so no outside air was let in. The copy room ozone went from 9 ppm to 11 ppm to 3 ppm through the day. Four students were running the machines at 800,

Figure 44:

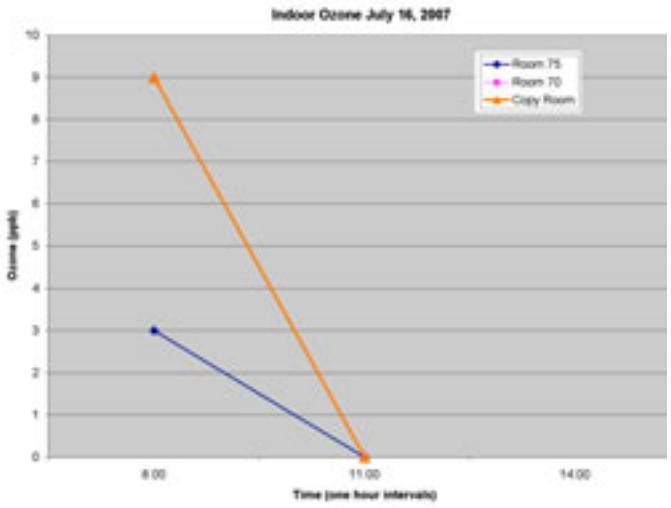
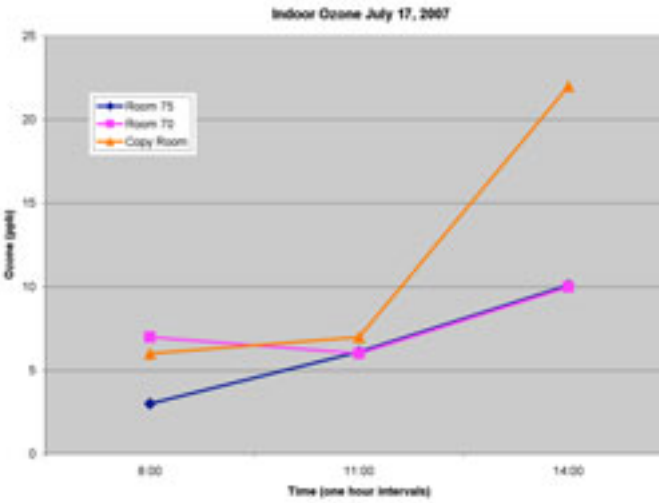


Figure 45:



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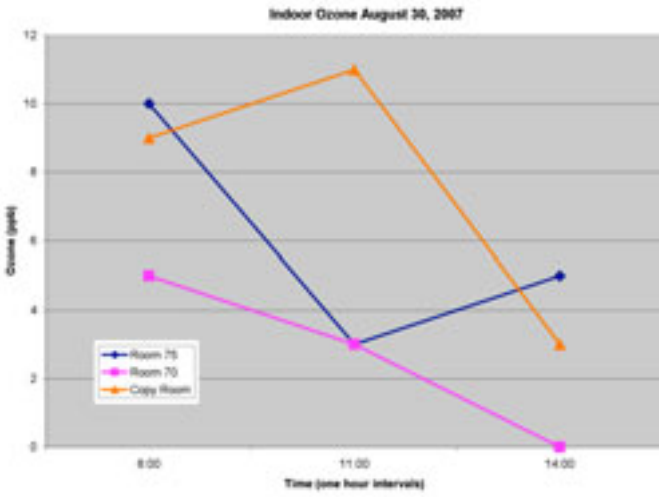
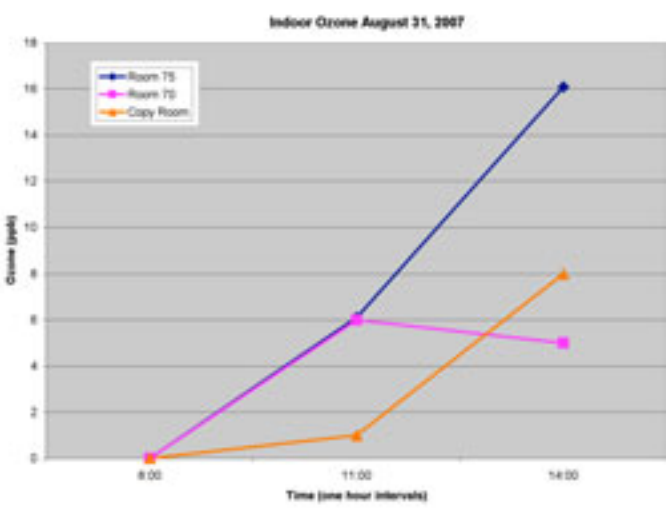


Figure 47:



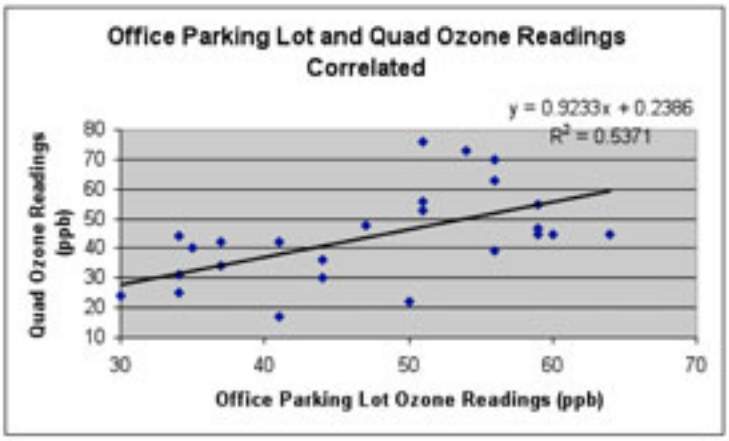
two people were running the machines at 1100, and one person ran one machine at 1400 hours. Nothing earth-shattering here.

Figure 47. On August 31, 2007, all areas started out at zero. The copy room ozone levels peaked at the 1100 hour instead of the 1400 hour even though there were more students in there at the 1400 hours. Room 70 O_3 levels decreased throughout the day while temperature increased. Room 75, the control room, had a high increase in ozone levels considering the fact that nothing was happening in there.

For more days than any other room, the copy room had the highest ozone levels, especially in July and August. These levels did not soar, but they were, on average, slightly higher than the other levels. This supported our hypothesis that copy room levels would be highest of any other indoor site. After looking at the data we realized that the copy room door is open and closed regularly with people entering and leaving the office; whereas, in the classrooms, the door is usually only opened during breaks. We had originally thought the copy machines would create ozone, and maybe they did, but the higher readings may have been more from the door being opened often.

In May, levels generally peaked at the 1100 hour. In July, levels actually dipped at the middle of the day, rather than peaking. This is hard to explain, however, temperatures were higher at the beginning of the day during July and that supports our hypothesis of there being a correlation between temperature and ozone. It does not explain the mid-day dip in ozone. In August, levels continued the pattern of dipping mid-day, except for the copy room.

The figure above shows the correlation between two outside locations, the office parking lot and the quad. These two locations have a positive correlation, which means that the ozone level trends of both were similar. The R2 when changed into a percent is around 53.71%. One of our hypotheses stated that parking lot ozone levels would be higher than interior locations. This correlation contradicts our hypothesis. The quad is a part of the interior of the campus away from the parking areas, so the fact that the quad correlates to the parking areas surprised us.



DATE	TIME	OFFICE PARKING	QUAD
11-May-2007	8	64	45
	11	59	55
	14	35	40
15-May-2007	8	50	22
	11	59	47
	14	59	55
18-May-2007	8	56	39
	11	59	45
	14	47	48
22-May-2007	8	60	45
	11	51	76
	14	41	17
24-May-2007	8	34	44
	11	51	53
	14	34	31
29-May-2007	8	54	73
	11	56	70
	14	51	56
16-Jul-2007	8	34	25
	11	37	42
	14		
17-Jul-2007	8	12	8
	11	30	24
	14	56	63
30-Aug-2007	8	28	30
	11	44	30
	14	44	36
31-Aug-2007	8	7	3
	11	37	34
	14	41	42

Figure 50. This graph correlates an indoor site to an outdoor site, room 74 to the office parking lot. Our hypothesis stated that we expected lower ozone levels indoors than outdoors. The correlation of .06 or 6% which indicates close to no correlation, so it does support our hypothesis (indoor does not correlate with outdoor).

Figure 51. This graph is similar to Figure 49 in that they both show a correlation between an area near a parking lot area (the little theatre) and an interior area (the quad). As with graph 49, this correlation contradicts our hypothesis which stated that interior areas would have lower ozone levels than parking lots.

Figure 52. This graph shows the correlation between locations on opposite sides of the campus: the office parking lot in the front of campus and the little theater at the back of campus. The R2 value is about .56, which is considered a moderate correlation. Our hypothesis was that parking lot ozone would be higher than interior areas of our campus. What we have found is that there is a higher correlation between the interior of campus (quad) and each parking lot than the parking lots to each other. Quad air mixes somewhat due to proximity with each parking area.

DATA SUMMARY: GLOBE SURVEYS

Figure 53. The graph in Figure 53 shows that 56 students have asthma and 236 do not have asthma. This shows that 19.2% of the two hundred ninety-two students surveyed had asthma. This number is approximately the average for our region (19%). This data supports our hypothesis.

Figure 54. Of the students with asthma, 63% of their families have members with asthma. Of the students without asthma, 74% of their families do not have members with asthma. The data supports our hypothesis which stated: families of students with asthma would more often have family members with asthma than families of students without asthma.

Figure 50:

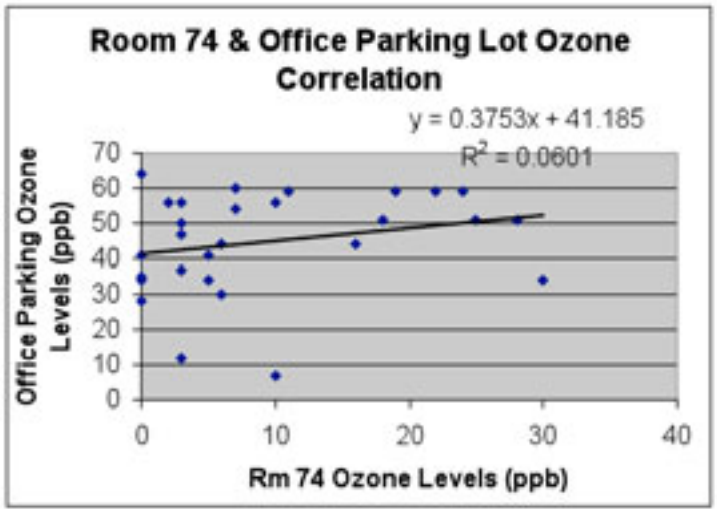


Figure 51:

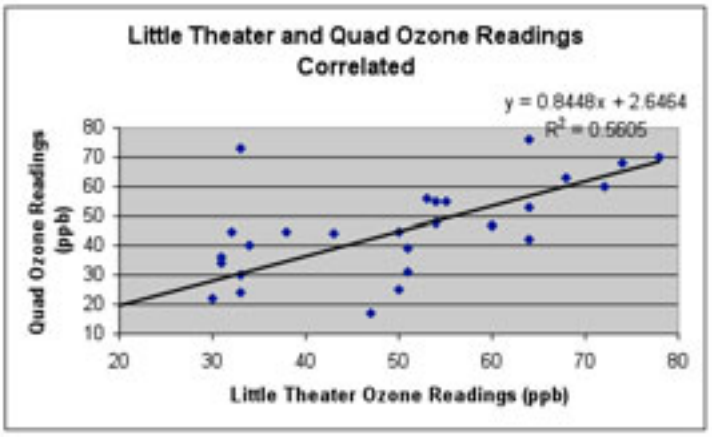


Figure 52:

Figure 55. The graph in Figure 55 illustrates that out of the one hundred eighty-three students that live in town, forty three, or 23.5 %, of them have asthma. Out of the eighty-one students who live in the country, twelve of them have asthma, or 14.8%. Our thinking was that there is more vehicle traffic in town than in the country, therefore, more ozone would be created there, causing more people to have asthma. This graph supports our hypothesis that a higher percentage of students surveyed who live in town have asthma than those students living in the country.

Figure 53:

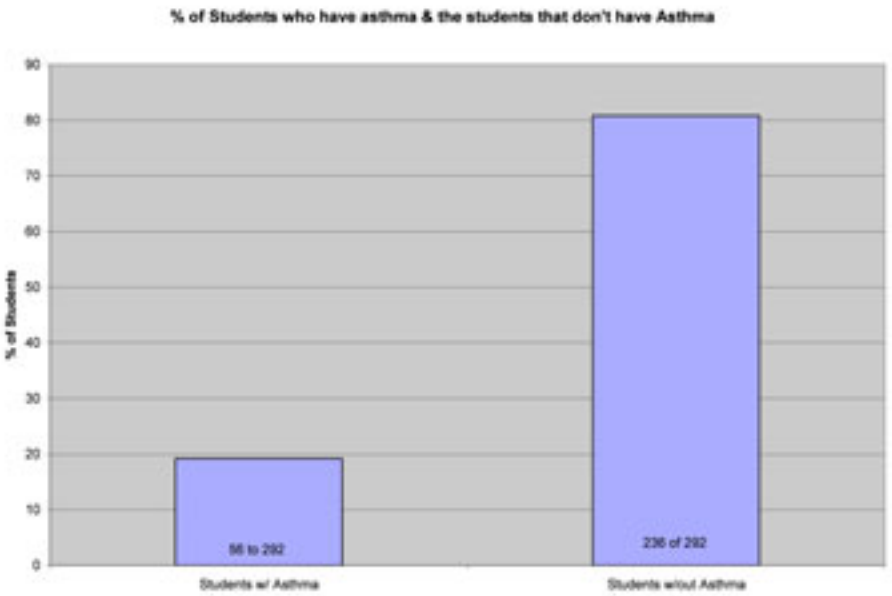


Figure 54:

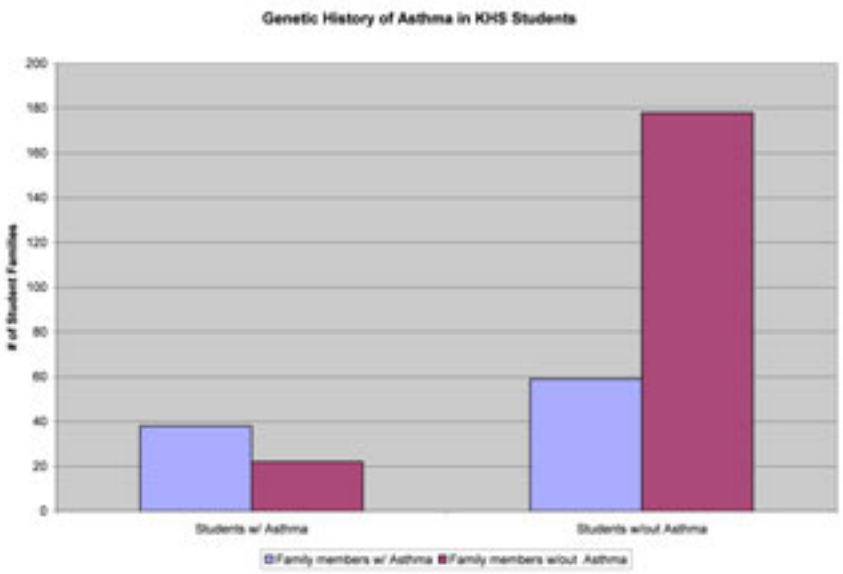


Figure 55:

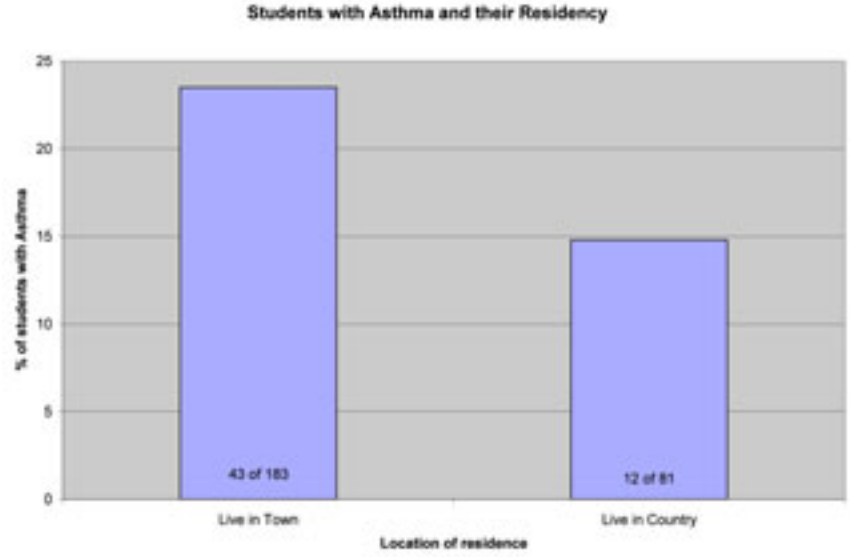


Figure 56. This graph illustrates that with an increase in the number of sports played by a student (with a maximum of two), the higher the occurrence of asthma. The data shows that students who play three sports have a lower incidence of asthma, but this may be because there are only 11 students surveyed who do play three sports. So the trend supports our hypothesis but not significantly. We need to survey more students to have significant results.

Figure 56:

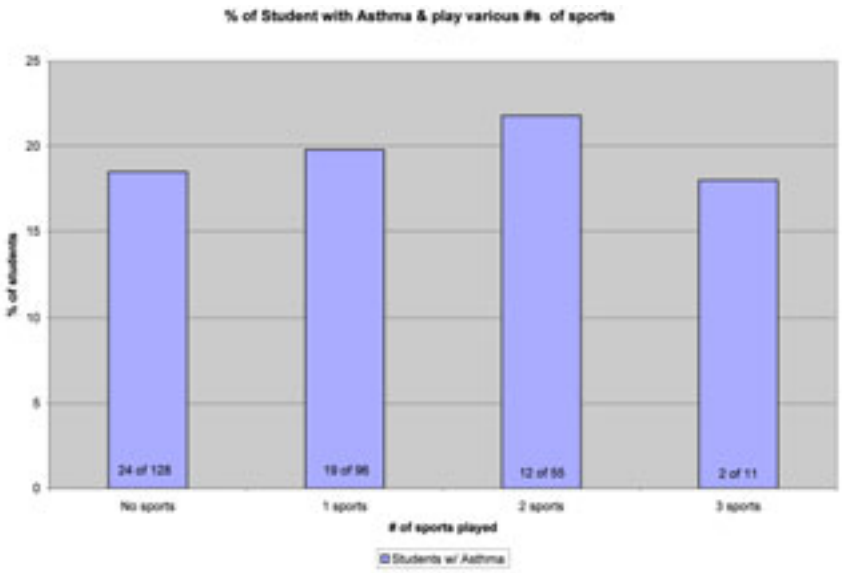
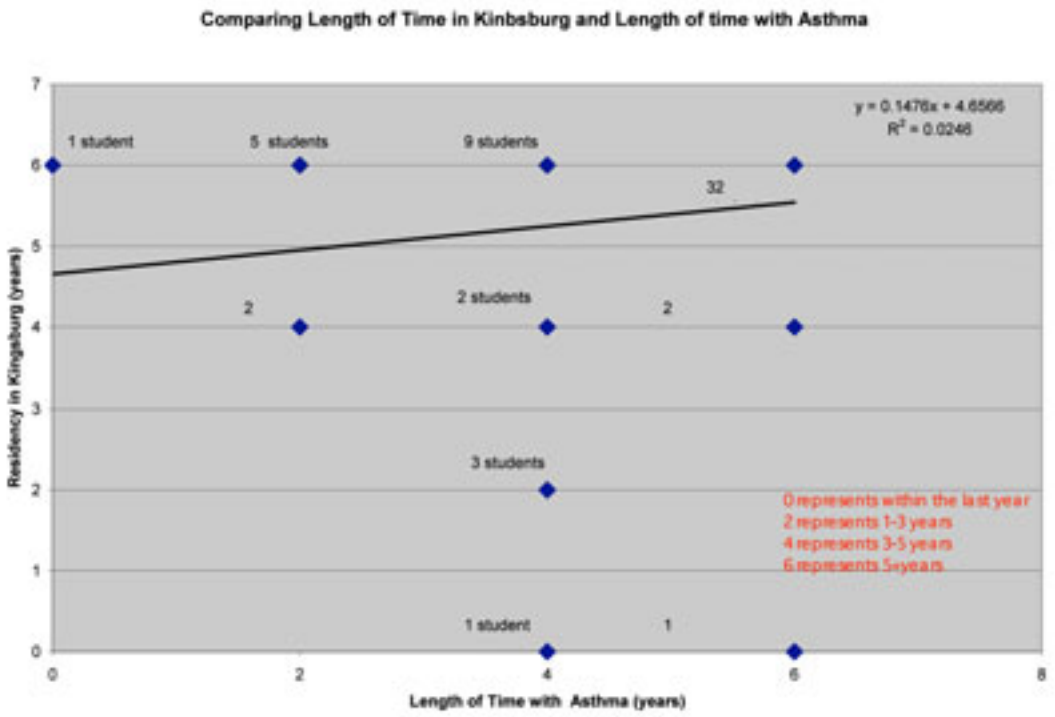


Figure 57. This graph is an attempt to make a correlation graph of data regarding how long students have had asthma versus how long they have lived in Kingsburg that was grouped (0-1 year, 1-3 years, 3-5 years, etc.). Each point on this graph represents the number of students indicated having asthma for a certain length of time and living in Kingsburg for a certain length of time. For example, one student lived in Kingsburg for less than a year (0 years is plotted on the graph), but had had asthma for 3-5 years (4 years is plotted on the graph). R2 = 0.0246, indicating there is a very weak to no relationship between the number of years a student has lived in Kingsburg and had asthma. Our hypothesis was that there would be a much stronger correlation than the one shown. We have data from the survey indicating where students lived before moving to Kingsburg. If we were to further analyze this data we would group students according to those living in the San Joaquin Valley rather than those living in just Kingsburg. We understand this graph is not a true correlation graph, but it was the only way that we could think of to display this data. If we rewrote our survey we would have asked exactly how many years that they had lived in the valley and had asthma. However, we would like to point out that thirty-two students both lived in Kingsburg for five or more years and have had asthma for 5 or more years. This seems significant to us.

Figure 57:



CONCLUSION

In answer to our first question of what areas on campus have highest levels of ozone to which students are exposed, we found that outdoor sites were consistently much higher than indoor sites. The girls restroom bridged the gap between indoor and outdoor, because the door was always open allowing outside air in. It was consistently the highest of the indoor levels, but lower than outdoor levels. We would expect this because ozone is created by a photochemical reaction which only occurs in the presence of sunlight. This also supports Andy Olson's findings that outdoor ozone levels are higher than indoor levels because of solar radiation, (Olson, 2005). Ozone levels varied on each day depending on: the school schedule, school activities, and meetings in various rooms. In the outdoor locations we expected to find higher ozone levels in the parking areas, however this was not the case. The center of campus often had as much ozone as parking areas. Indoor areas are relatively low in ozone levels, as long as the doors are kept closed as much as possible.

The second question asked how many students on our campus had asthma. Of the nearly three hundred surveyed, fifty-nine had asthma, which is roughly 20%, and is higher than our hypothesis, which was the 19% of students with asthma in the Central Valley (CVAQ, 2006).

Our third question asked if location, family history of asthma, or sports activity correlates with the number of students with asthma. We found that our hypotheses, for the most part, were supported. As we predicted, there is a higher percentage of students who live in town with asthma than students who live in the countryside with asthma. The second part of our hypothesis, relating to family members, also was supported. Both students with and without asthma have family members with asthma, though there is a higher occurrence of asthma in families as a whole if the student has asthma. The more sports a student plays also seems to have a weak positive correlation with the occurrence of asthma. Our data does not fully support our hypothesis on this, but it doesn't disprove our hypothesis either.

DISCUSSION

The data was discussed above in the results section. Here we will discuss the parts of the project that the students will be working on this year.

In a preliminary study, we sampled leaves from one row of grapevines from a local vineyard located near a highway. Our initial objective was to examine the health of the leaves' surfaces using an ALTA spectrometer and a digital dissecting microscope and correlate the deterioration with ozone levels detected by the EcoBadge ozone strips we used. We discovered that the ozone levels in the vines closest to the road were higher than ozone levels in the vines farthest from the road (that data is not included). Since cars emit NO_x it is logical that there would be a higher concentration of NO_x near the road. Our preliminary results supported this as the amount of ozone tended to be lower near the vines furthest from the road. However, we did not analyze the deterioration of the leaves.

We plan to compare our data with Goethe Schule's data at the conference, because they had not completed their project when we wrote our report. Germany has a cooler climate compared to our Mediterranean climate and we will be able to compare and contrast ozone levels from the different biome types. We hope compare our experiment on agricultural crops to their experiment on lichen growth. Together we can compare plant based studies and our surveys regarding health effects on our two communities.

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APPENDIX

This survey was given to 302 students at Kingsburg High School.

Age:

Sex: Male or Female

Do you have asthma?

How long have you had asthma?

Do you have any allergies? If yes, what are you allergic to?

How long have you had allergies?

Where did you grow up?

Does anyone in your family have asthma? If yes, what is their age and relation to you and where did they grow up?

Does anyone in your family have allergies? If yes what is their age and relation to you and where did they grow up?

Does your asthma or allergies prevent you from doing every day activities? If yes, what?

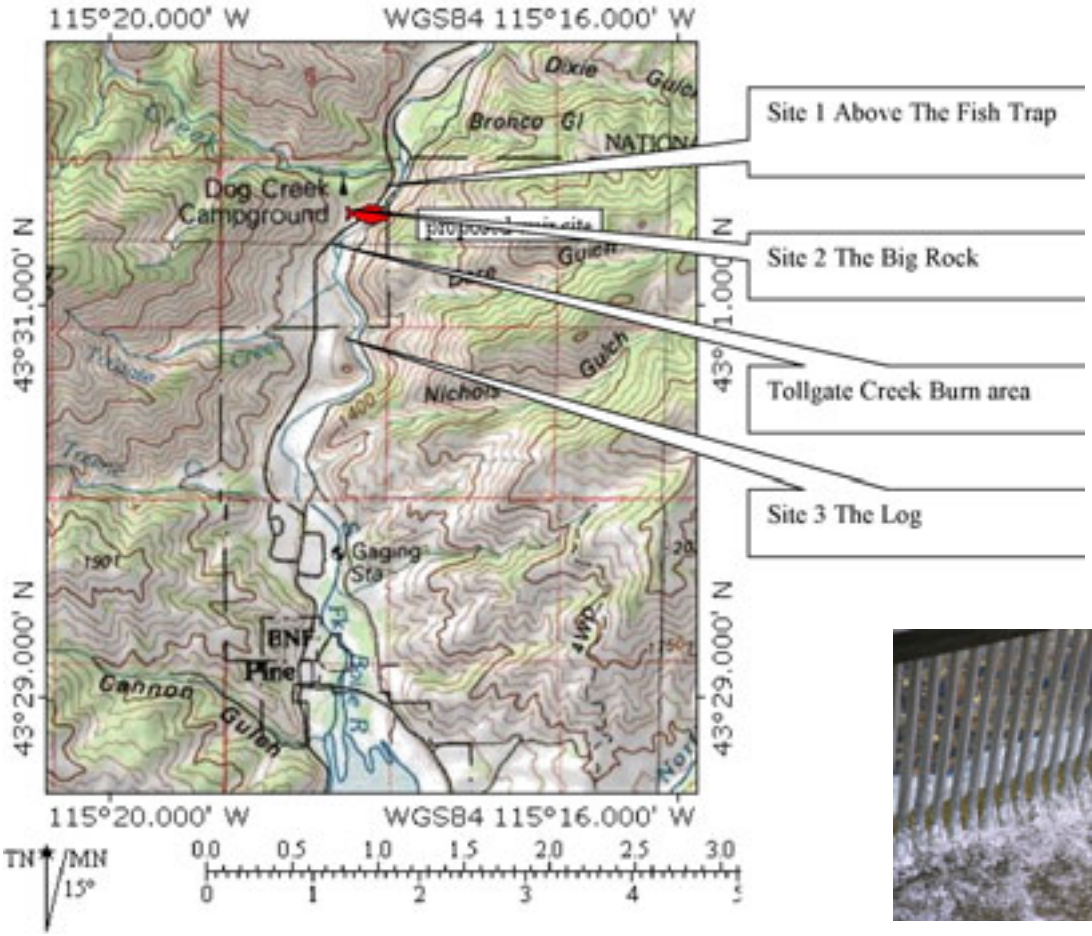
Did Either the Fish Weir or the Controlled Burn Affect the Health of Our River?

School: Pine School, Idaho, USA
Teachers: Pennie Hufford and Sue Fish
Students:

INTRODUCTION

Pine School is located in Pine Idaho {43.4777° N, 115.3098°W}. The Sawtooth Mountains surround us with the South Fork of the Boise River winding through our little town. Pine is a recreation center that includes hunting, fishing, snowmobiling, boating, and other out door sporting events. Pine School is one of the few remaining public one-room schoolhouses. We currently have 11 students. Our school consists of grades K-8th and all children, except the five kindergarteners, participate in GLOBE activities. Our research team consists of two 7th graders and one 6th grader: Malcolm, Kasey, and Emily.

Figure 1. Sample sites for the current hydrology project of the students of Pine School, Pine, Idaho. The sites included a sampling location starting just before the fish weir {43.31279°N, 115.18121°W}, proceeding downstream in an Easterly direction 119 meters just after the fish weir, and then proceeding in a southerly direction 462 meters to the log downstream from the controlled burn.



Fish Weir

ABSTRACT
Two major events occurred within a very short distance of each other on the South Fork of the Boise River this past year: A fish weir was installed on a concrete sill in the riverbed and a controlled burn was conducted alongside the river. These two events led us to ask the following question. Did either the controlled burn along the river or the construction of the fish weir affect the health of our river? We have been conducting a comparison study among three sites along the South Fork Boise River. We have taken samples above the fish weir, below the fish weir, and after the controlled burn area. (Figure 1) We looked for changes in the water that might have been caused by the construction of the fish weir and the controlled burn. We collected and documented GLOBE data between March and May 2007. Although we found slight differences in conductivity and turbidity, we concluded that neither the construction of the fish weir or the controlled burn affected the river in a negative way.

RESEARCH QUESTION/HYPOTHESIS
Did the construction of the fish weir or the controlled burn affect the health of our river? Our school has been studying the quality of the water in the South Fork of the Boise River using GLOBE data for almost six years. During the last nine months two major activities occurred on the river within the area that we have been testing: Idaho Department of Fish and Game built a fish weir in the river and Boise National Forest Ranger District implemented a "prescribed burn" on the edge of the river. Both projects were controversial. Our group decided to investigate the projects**. Did either the construction of the fish weir or the controlled burn affect the health of our river?** Our group believed that the fish weir would cause dirt and minerals to be brought up and carried down the river. We also believed that the run off from the snow and rain would carry ash and dirt from the burn to the river, therefore causing a change when we tested the water.

MATERIALS AND METHODS
We have been collecting water samples from the South Fork of the Boise River at three sites from March 24 to May 1, 2007. On average we have taken samples once a week. We have been following GLOBE protocols for Hydrology Investigations.

We followed the GLOBE protocols to collect the water samples by using a bucket attached to a rope. We used a dissolved oxygen kit, pH indicator paper and probe, conductivity meter, alcohol thermometer and a probe thermometer, and a turbidity tube.

DATA SUMMARY

Temperature Averages:	
Above the Fish Weir	8.16°C
The Big Rock	7.3°C
The Log	7.6°C
Conductivity Averages:	
Above the Fish Weir	86 µS/cm
The Big Rock	88 µS/cm
The Log	93 µS/cm
Dissolved Oxygen Avg:	
Above the Fish Weir	10.4 mg/L
The Log	11 mg/L
pH Averages:	
Above the Fish Weir	4.75
The Big Rock	4.79
The Log	4.7

Figure 2. Temperature measurements in degrees Celsius of three sites along the South Fork of the Boise River. Measurements were taken from March 24, 2007 to May 1, 2007.

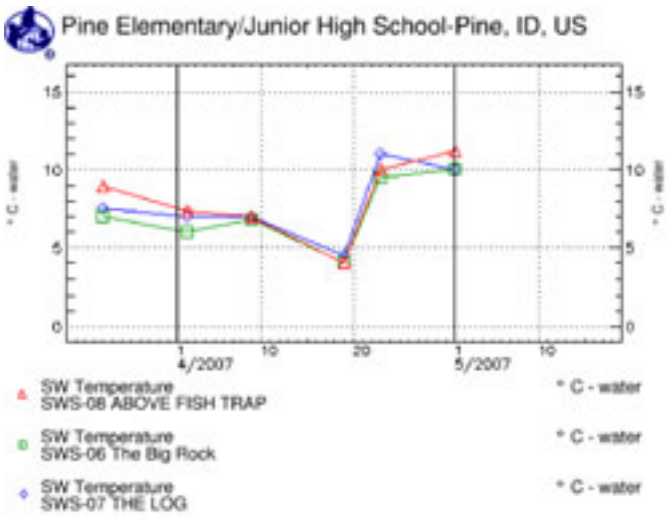
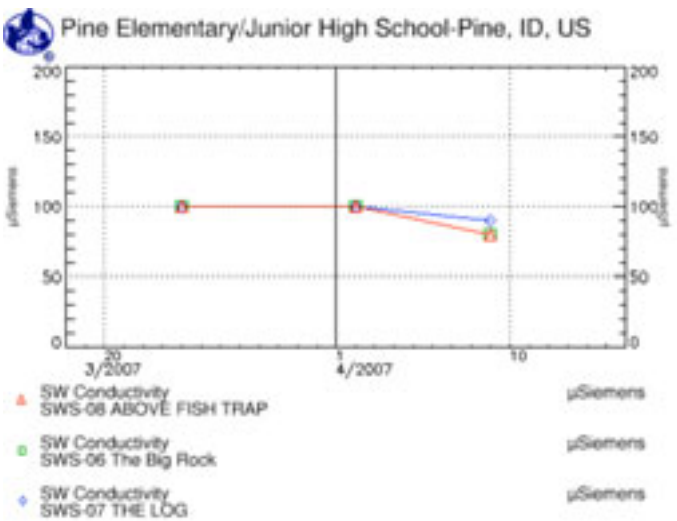


Figure 3. Conductivity measurements in micro Siemens of three sites along the South Fork of the Boise River. Measurements were taken from March 24, 2007 to May 1, 2007.



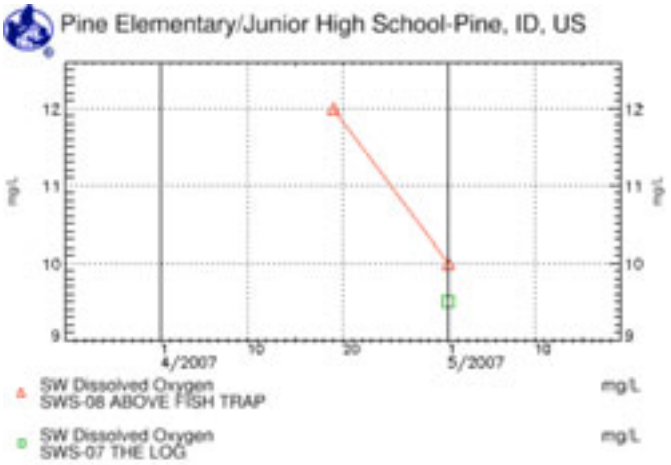


Figure 4. Dissolved Oxygen measurements in Milligrams/Liter of three sites along the South Fork of the Boise River. Measurements were taken from March 24, 2007 to May 1, 2007.

DATA ANALYSIS AND REPORTS

The data we have collected consistently shows a minor difference down stream of the fish weir and the controlled burn area. We took the average of each data set from each site from March 4, 2007 through May 1, 2007. Figures 2-5 show our data.

We used the dissolved oxygen kit and followed the instructions. The accuracy of the dissolved oxygen would be limited to how closely the participant followed the directions. The dissolved oxygen (average March-May) of the water taken Above the Fish Weir was 11 mg/L and by the Log was 10.4 mg/L.

For pH we used indicator paper and a probe. The pH indicator paper is limited in accuracy compared to other ways of reading pH. The pH (average March-May) for Above the Fish Weir was 4.75; the Big Rock was 4.79; and the Log was 4.7.

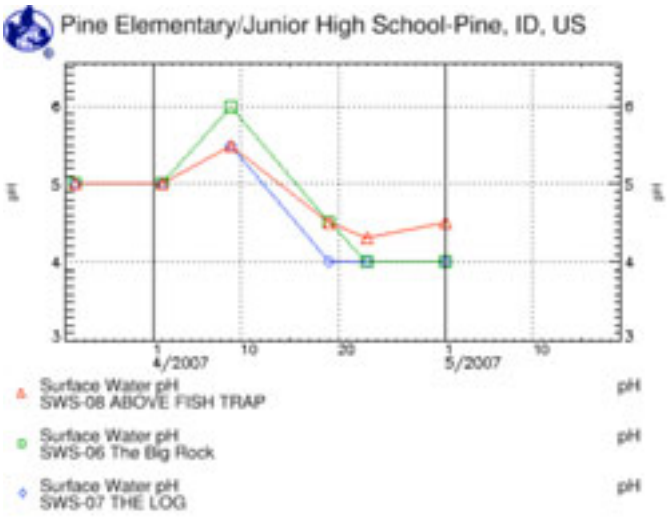


Figure 5. pH measurements of three sites along the South Fork of the Boise River. Measurements were taken from March 24, 2007 to May 1, 2007.

Site 1 – Above the Fish Weir

Site 2 – The Big Rock

Site 3 - The Log

Electrical conductivity was measured using a conductivity meter. The conductivity was (average March-May) for Above the Fish Weir 86 µS/cm; the Big Rock was 88 µS/cm; and the Log was 93 µS/cm.

Temperature was measured with an alcohol filled thermometer and probe. The accuracy of the thermometer would be +-.5 degrees Celsius. The temperature average for the water taken Above the Fish Weir was 8.16 °C; the Big Rock was 7.3°C; and at the Log was 7.6°C.

Turbidity was greater than 120 cm at each site except on May 1st when the river was higher due to spring runoff. On May 1, 2007, the turbidity tube reading was 90.7 cm Above the Fish Weir; 95.5 cm at the Big Rock; and 111.5 cm at the Log.

CONCLUSION

At the end of our investigation there was not a significant change in the data collected. It would seem that there was not significant impact on the river from either the construction of the fish weir or the controlled burn. The conductivity was slightly higher at the last site, indicating that perhaps the controlled burn area did introduce more dissolved solids in the water.

The Fish and Game Environmental Impact Statement (EIS) concluded there would not be any significant impact from the construction of the fish weir. The Forest Service did not file an EIS, but in their Discussion Memo they concluded that the controlled burn project would not adversely affect the environment. Our investigation results would support both the EIS from the Fish and Game and the Forest Service Discussion Memo that there was not any significant impact on the river.

DISCUSSION

Although there wasn't any significant impact to the health of the river shown from our investigation, we believe that a low snow pack in the higher mountains aided these findings. Had there been the snow pack that we had in 2006, we think there would have been dramatic differences caused by the fish weir and the controlled burn. We have not had the typical run off from the snow pack melting this spring, nor have we had much rain. The SNOTEL site for Trinity Mountain showed a huge difference in the snow pack between 2006 and 2007. See Figure 6.

Our investigation would have been helped if we could have started the research earlier. Accesses to the river in our investigative sites were inaccessible earlier in the spring due to snow.

Water plays a vital part in our community's economic needs. We are a recreational area that depends on good, clean water for fishing and boating. If there isn't enough water or the water is environmentally dirty, it definitely affects the businesses in the valley. That in turn affects who can live in the valley, and ultimately, if we even have enough students to keep our school open.

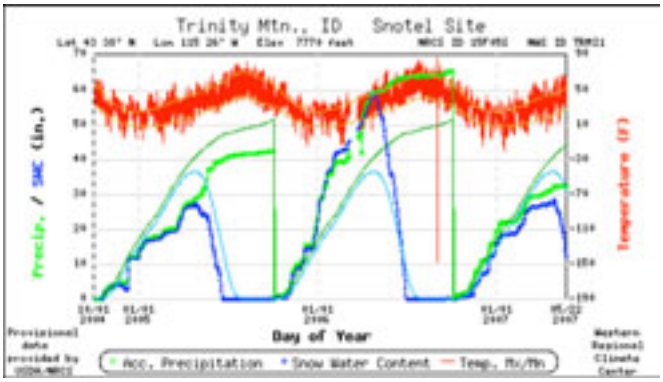


Figure 6. Snotel Graph for Trinity Mountain

A local area scientist, Jeremy Aulbach, also has encouraged us to investigate the dissolved oxygen levels in the ponds behind our school using a Winogradsky Column. We had noticed a marked difference in the color of the water and algae in these ponds and had asked Mr. Aulbach about them. We hope to be able to complete this investigation in the coming school year.

ACKNOWLEDGEMENTS

We would like to acknowledge the following people for their help in our investigations:

Robert E. Beckwith, F.I.R.E. (Field Inquiry Research Experience) Up for Summer. Mr. Beckwith encouraged us to investigate the impact the controlled burn would have on the quality of the water.

Jeremy Aulbach, Scientist from Boise State University. Mr. Aulbach helped us by getting the EIS from the Fish and Game and also gave us ideas in our research.

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A Comparison of Green Up in Two Locations at Similar Latitudes: Indiana and Washington, DC

Students: Lateefah Patterson and Kelsey Wessman Model
Secondary School for the Deaf, Washington, DC, USA

Joshua Self and Tyler Crace
Indiana School for the Deaf, Indianapolis, Indiana, USA

Advisor: Dr. H. David Snyder Chemistry and Physics Department, Gallaudet University

Abstract

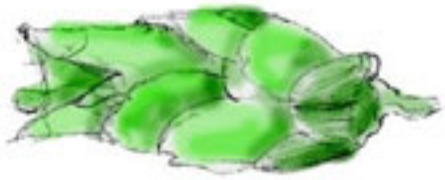
This report is a collaborative research project conducted during the spring of 2007. We are a team of four students representing the students in Earth System Science classes at the Model Secondary School for the Deaf in Washington, DC and Earth Science classes at the Indiana School for the Deaf in Indianapolis, Indiana.

Our project focused on answering the following questions:

1) Is there a difference in tree phenology with regard to spring budding in our two schools?
2) What environmental factor is (or factors are) controlling the timing of budburst in our areas?

We collected data using GLOBE's Green Up protocol. In Indiana, we used the GLOBE protocols for recording precipitation, minimum temperatures, and maximum temperatures at a GLOBE weather station. In Washington, DC, we obtained temperature, humidity, and precipitation data from a Davis Advantage Pro automatic weather station. At both schools, we studied Silver Maple (*Acer saccharinum*) and Crab Apple (*Pyrus coronaria)* trees. To complete our research project, we used the Internet and videoconferencing to discuss data, compare results, determine conclusions, and write a final report.

Before we started collecting data at each school, we looked for information about budburst. Much of the information we found, said that both temperature and moisture could influence budburst. We compared the geographic locations of our two schools. Our hypothesis was that the tree buds in Washington, DC would burst before Indiana's because there would be more water in the air closer to the ocean, and that the water would control the timing of budburst more than temperature. At the end of our project, we noted differences in precipitation and temperature in our two different geographic locations. We found patterns in the data as spring season progressed which indicated that temperature may have been more important than moisture in the budburst of our trees. We noted the biological responses of the trees to changes in the environment. We agree that the trees' responses are important to understand in order to predict what will happen to trees if our climate changes.



Bud of a Crab Apple tree

Bud of a Silver Maple tree

Problem/Purpose

We are a team of four students, Joshua and Tyler from the Indiana School for the Deaf, in Indianapolis, Indiana and Kelsey and Lateefah from the Model Secondary School for the Deaf in Washington, DC. We studied the timing of budburst on Silver Maple and Crab Apple to see if there were differences in budburst between the locations of our two schools.

The Indiana School for the Deaf (ISD) is located in Indianapolis, Indiana at Latitude 39.7251 north and Longitude -86.0841 west. The Model Secondary School for the Deaf (MSSD) is located in Washington, DC at Latitude 38.910258 north and Longitude -76.9990639 west. Our schools are about 500 miles apart east and west, but are close to the same latitude north.

The goal for this project was to study phenology to see how our trees might be affected by climate changes with the current problem of global warming. We studied phenology to learn about the cycle of plant growth and understand the effect of environmental factors on budburst. Phenology is the study of the response of living organisms to seasonal and climatic changes to the environment in which they live. [*What is Phenology?* 2006]. From our reading, we know that weather influences budburst. We know that changes in phenology can affect society such as in species distribution, spread of disease, food production, natural resources, and changing ecosystems. We examined how our two locations are different in order to learn what controls budburst.

At each school, we studied two different kinds of trees, one was Silver Maple and the other was Crab Apple. Our research question was: "Is there a difference in tree phenology with regard to spring budding in our two schools and what environmental factor is (or factors are) controlling the timing of budburst in our areas?"

Hypothesis

We predicted that we would see a difference in leaf budburst in the two trees at our two schools because of the geographical differences in our two locations. Indianapolis is a landlocked city far from any large body of water. It is about 600 miles west from the Atlantic Ocean, and 150 miles south of Lake Michigan. Washington, DC is about 30 miles west from Chesapeake Bay and only about 100 miles west from the Atlantic Ocean.

At ISD, we discussed the differences in our locations. We thought Washington, DC being near large bodies of water would influence the weather at MSSD, possibly providing more precipitation and humidity, along with warmer temperatures. Since Washington, DC is closer to an ocean we thought budburst would happen in Washington, DC before budburst in Indianapolis.

During our videoconference discussions, students from both of our schools could not agree about whether temperature or precipitation controls budburst more. We decided to investigate both factors. We assumed that the buds would burst in the same week each year if temperature and precipitation patterns were similar for the four months before budburst.

Our hypothesis was that the tree buds in Washington, DC would burst before Indiana's because there would be more precipitation due to the nearness of the ocean, and that the spring temperatures would be higher in Washington since it is nearer to the ocean.

Background Information

Before our team started the budburst observations outdoors, we needed to know something about the buds themselves. At each school, we studied the buds under a microscope and learned the names of the structures. We also used colored pencils to make drawings of the buds, flowers, and tiny leaves.

Buds – Leaves

Inside the bud are neatly folded immature leaves. Both the immature leaves and stem are in a protective case of the bud scale. When the leaves are ready to open, the bud scale swells. The axil is where the leaf joins the stem. A node is where the leaf is an appendage of the stem. The axil guides the stem to grow upward. The bud scales protect the leaf from the environment while the tiny leaves are still tender.

Buds – Flowers

The flower has reproductive organs for female and male. The female organ is called the carpel (or pistil), while the male organ is called the stamen. The stamen has a filament that supports the anther. The anther produces pollen. The carpel has an ovary which will become the fruit. Ovules are inside the ovary which will become seeds. The style is an extension from the ovary. The stigma is on top of the style and its purpose is to become receptive and slightly sticky when the ovules are ready to fertilize. Fertilization happens when pollen falls on the stigma, and moves down through the style to the ovaries. The sepals form the calyx. The petals attract insects to fertilize the flowers. The calyx protects the flower during the bud time period, before the bud starts to grow and mature.

Our team, at both ISD and MSSD, learned a lot about the biology of the two species of trees. We were surprised to learn that one of our Silver Maple trees was female and the other one was male. In Washington DC, we noticed that there were no seeds on the Silver Maple, while photos of the Silver Maple tree at ISD showed it had seeds. Our teacher at MSSD found information on the Internet that explained some trees can be both female and male, while other trees have just one gender on each tree [*Discover Life* 2007]. After reading the information about Silver Maple trees our team talked together and we realized that the Silver Maple in Washington, DC is a ***male*** tree and that the Silver Maple in Indiana is a ***female*** tree. Another thing we observed was that the Acer male flowers did not last very long and the anthers drooped after two days, while the Crab Apple flowers lasted about a month. At ISD, the Crab Apple flowers were damaged by below freezing temperatures about a week and a half after they opened, so it was not possible to compare how long the flowers would have lasted.

Procedure

Materials

red tape and magic marker
calendar
metric ruler
calculator
digital camera
pencils and paper for drawing
snow board
rain gauge
bud observation data sheets
atmosphere data sheets
Internet
microscopes
Davis Advantage Pro automated weather station (MSSD)
GLOBE weather station with digital thermometer (ISD)

Species of Trees

At each school we studied two different kinds of trees. One was a Silver Maple, *Acer saccharinum* and the other was a Crab Apple, *Pyrus coronaria*.

Silver Maple *Acer saccharinum***:** The Silver Maple is part of the Maple family. The Silver Maple grows from the Midwest to the eastern United States, except Florida and some parts of Maine. They have palm-shaped, simple and opposite leaves. The height of the tree tends to be around 80 to 100 feet. The leaves are green above and whitish below, but they will eventually become dull yellow in the fall. The bark of the Silver Maple is grayish and is smooth. Birds, squirrels, and other small animals eat winged fruit from the Silver Maple. [Zim 1956]

Crab Apple *Pyrus coronaria***:** The Crab Apple is part of the Rosaceae family and is a deciduous tree. The Crab Apple grows in the temperate region of Northern Hemisphere. The height of the tree tends to be around 8 to 50 feet. The leaves have an oval shape and are colored green above and lighter on the bottom. The leaves can become reddish in the fall. The color of the flowers ranges from white to purplish-red. The apples have a red or yellow color, but are tiny. Crab Apple trees require fertile, moist soil, full sun, and protection from late frost. [Simon and Schuster 1978]

In general, trees at both of our schools seemed to be in good health. A few small branches and the leaves on both trees at MSSD were dead and fell off. We think it was because of drought and insects. Lateefah and Kelsey at MSSD, talked with Trudy Haselhuhn, a horticultural expert from our campus, and she said last year, 2006, was a very dry year in Washington, DC and many trees on campus were showing stress. Mrs. Haselhuhn also told us that the trees we studied are not watered or fertilized except by nature. She also showed us many rows of small holes in the trunk and branches of our Crab Apple that were made by a woodpecker looking for insects to eat.

In Indiana, the Crab Apple tree was in pretty good health, but had been attacked by Japanese beetles in past summers, according to our teacher. The trunk of our Silver Maple tree was split and had a hole that had been used as a home by Northern Flickers. We also noticed woodpecker damage on the trunk and branches of our trees. We investigated and found that just like the trees at MSSD, our trees were not watered or fertilized during the year. This was important because we needed to know if our trees were responding to the natural environment and not to man-made conditions.

Site Descriptions - Views in four compass directions from the trees

Model Secondary School for the Deaf, Spring 2007

^
North
< East
West >
South
v

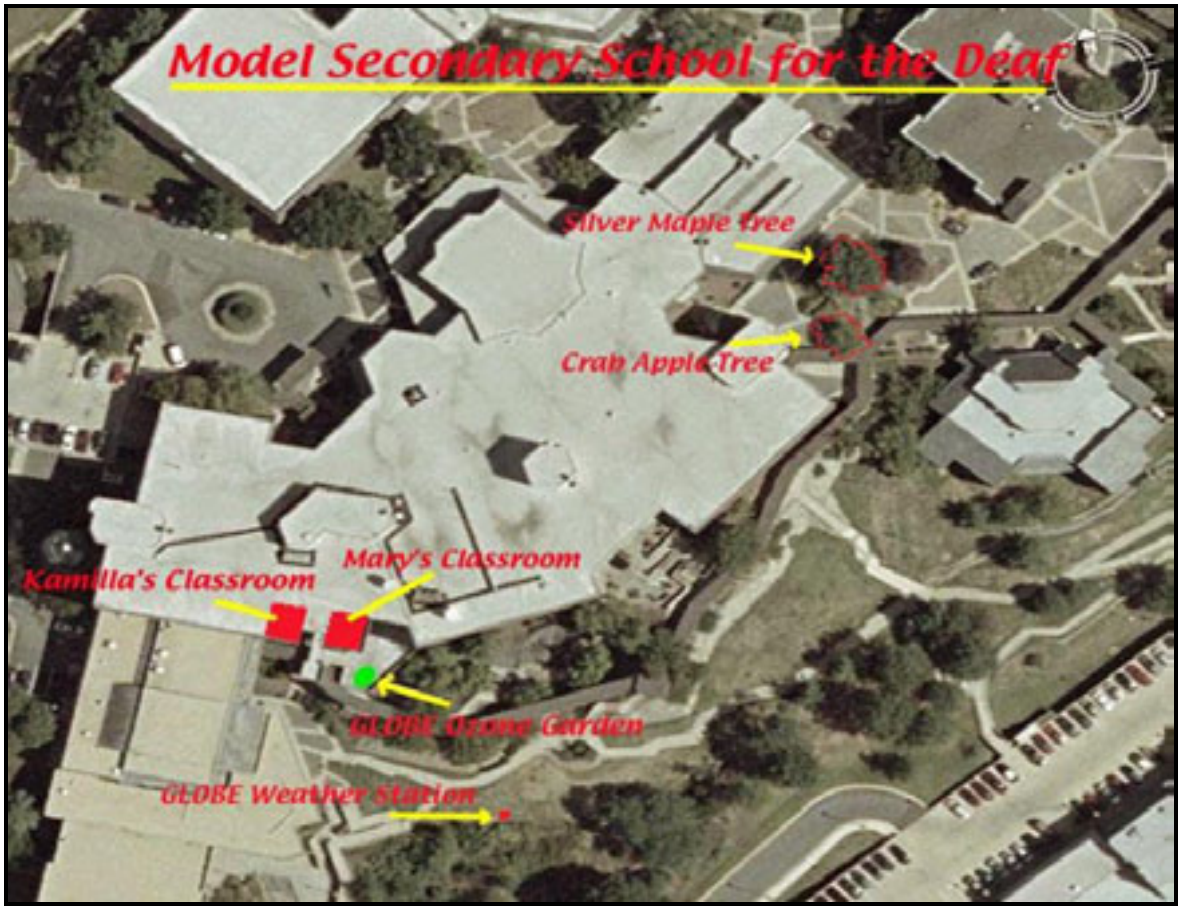
Note: At MSSD, our Silver Maple and Crab Apple trees are close to the school building. We know that is not the best place for phenology research, but it made it possible for us to check these trees every day.

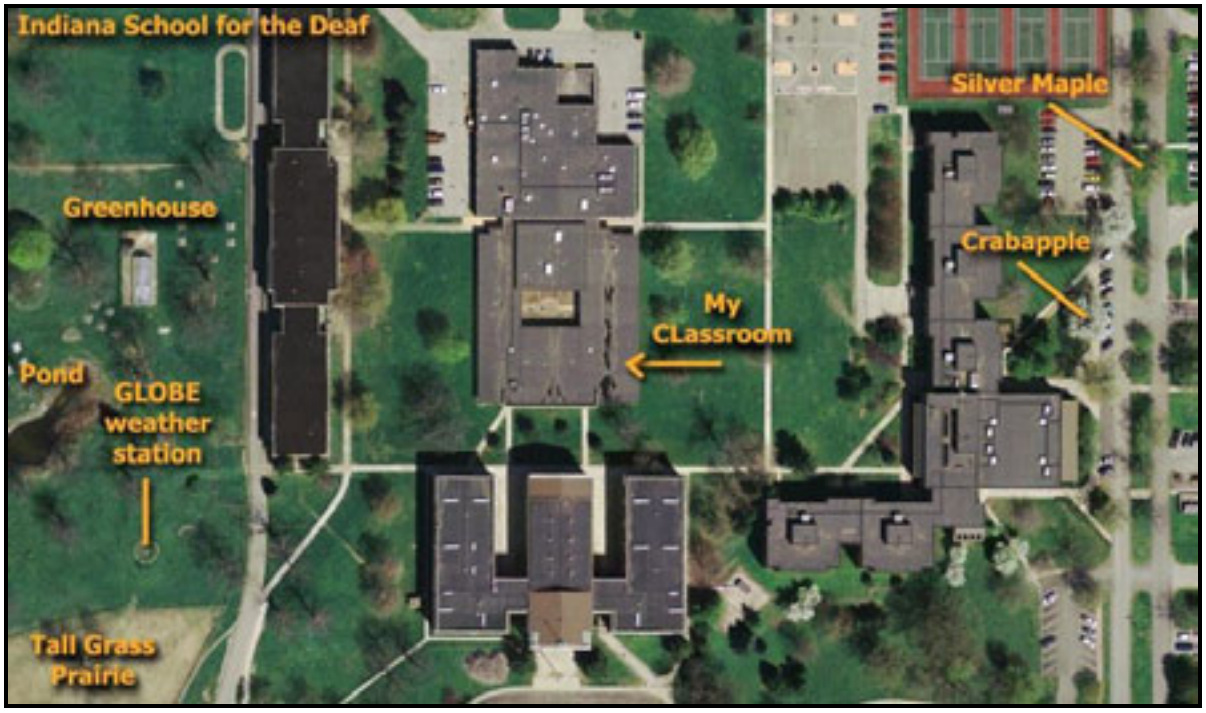
Indiana School for the Deaf, Spring, 2007

North
West East
South

Note: Our trees at ISD are also close to buildings. We selected these trees because they were in a similar location to the trees at the Model Secondary School for the Deaf.

School Site Locations from Google Maps, showing tree locations
(Our study trees are labeled in the right side of both photos.)





Geographical locations: Indiana School for the Deaf, Indianapolis, Indiana
Model Secondary School for the Deaf, Washington, DC

Google Earth Map showing the location of our two schools

Procedure and Observations

The authors of this report were involved with the design of the project and the collection of data. We also had help with making daily observations and measurements from the students in the Earth System Science classes at both ISD and MSSD, and we followed the GLOBE Program Budburst protocol. We used four months from January to April to check the initial dates of budburst in order to compare our two locations for the spring of 2007. At MSSD, we looked at the records of precipitation and temperature from the automatic weather station at the Gallaudet University Hall Memorial Building. At ISD, we collected temperature and precipitation data from our GLOBE weather station.

HMB Weather Station

Lateefah and Kelsey at MSSD, visited the Hall Memorial Building to learn about the automated weather station. The weather station is on the roof of the Hall Memorial Building. Dr. David Snyder explained to us that every five minutes the weather station collects eleven different measurements. The weather station is connected to a special page on the Internet. We wanted to collect the temperature and precipitation measurements, so Dr. Snyder taught us how to get that data from the Internet. We checked the Google Maps website and found out the weather station is 120 yards from the MSSD Silver Maple tree

At MSSD, we recorded how much snow fell each time we had a snow storm. We put a snowboard outside on a patio and checked the snow board after every snow. At ISD, our snowboard was outside near our GLOBE weather station. The pictures below show how we took a sample of the snow at MSSD on the snowboard using a rain gauge (10 cm diameter). We let the snow melt indoors and recorded the water equivalent in mm.

A sample from outside at MSSD

Melted snow at MSSD

At MSSD, we put red tape on our trees in the winter to mark which buds we wanted to watch. At ISD, we used twine to mark the branches and buds. We marked four buds on each of two kinds of trees, eight buds total. At MSSD, we marked the buds on February 20, 2007 and at ISD we marked the buds on February 26, 2007. We checked the buds throughout the winter and early spring months, January through April.

Marking the buds at ISD: 02-26-2007

Marking the buds At MSSD: 02-20-2007

At MSSD, on a sunny day, March 11th, we checked on the Silver Maple tree. We observed that the buds had pollen on tiny anthers.

At MSSD we looked at the Silver Maple to see if the buds had burst.

We saw the buds had pollen falling from the anthers like this.

At ISD, we compared our Silver Maple tree with MSSD's Silver Maple tree. Our tree was very different from MSSD's Silver Maple tree. Our tree did not have pollen, and grew seeds before the leaves appeared. We looked at the flowers with a microscope and made drawings. We discovered that MSSD's tree was a male tree and ours was a female tree. [*Trees of Wisconsin 2007*]

The female flowers and seeds from ISD's Silver Maple tree

At MSSD, our crab apple buds finally burst on March 17, 2007. The blooms were pink flowers, with green leaves. The Silver Maple's leaf buds had not burst yet. At ISD, our crab apple buds burst on March 24, 2007, but ours bloomed with white flowers.

MSSD

ISD
(Photo by Ian Britton)

On March 28, at MSSD, all of the Silver Maple flower buds that had burst a few days earlier, were now dead and had fallen to the ground.

Early in April, at both of our schools, we had snow and freezing temperatures. On April 7, at MSSD, it was snowing outside and our trees were covered by snow. The buds on our Crab Apple survived through the cold, snowy days. At ISD, we had freezing temperatures. The cold weather damaged the leaves on our crab apple tree.

Snow on our Crab Apple at MSSD

Damaged leaves and blossoms at ISD

At both schools, we continued checking the buds on our trees. At MSSD, we decided to measure the leaves to see how fast they grew. In the picture below, the leaf measures about 4 centimeters. As we observed the leaves on the Silver Maples each week, they grew greener and bigger. We found that they grew about 1 centimeter per day, which was faster than we expected. At ISD, our silver maple leaves grew to an average length of 140 mm and our crab apple leaves had an average length of 72 mm.

Measuring the length of the new Maple leaves

Silver Maple leaves are almost full grown

Calculations

At each school, we did the calculations of Growth Degree Summary, Potential Evapotranspiration, (PET) and Water Difference for the Silver Maple trees and Crab Apple trees. We learned how to do these calculations from the GLOBE Program budburst learning activity. [GLOBE 2007] We calculated Growth Degree Summary, Evapotranspiration, and Water Difference so that we could see how the timing of budburst is related to climate factors.

Growth Degree Summary

Growth Degree Summary is the sum of the average positive temperatures before budburst. Growth Degree Summary tells you how much the plant was able to grow based on the average temperature 30 days before budburst. To calculate Growth Degree Summary, we added up the days of average temperature which were above 0° C, not below 0° C. This is the standard procedure used by GLOBE to find the estimation of the plant's Growth Degree Summary. Each plant has a different temperature which is a limit for growth. Since we did not actually know the exact temperature that the Crab Apple or the Silver Maple stops growing, we just used zero degrees Celsius.

Starting with January 1, we added the numbers of degrees each day to get the total. We didn't need to add the zero or below zero temperatures, so we ignored it each day that the average temperature was below zero. The reason why the T_{avg} below 0°C is not added is because the trees are not able to grow in below zero temperatures. We stopped adding on the day the buds burst.

Potential Evapotranspiration and Water Difference

Potential Evapotranspiration and Water Difference will tell you how much the water was lost or evaporated. For the inputs, we totaled the daily precipitation 29 days prior to budburst. Precipitation

included rainfall and the snow that had melted into water. For the outputs, we had calculated an average temperature 30 days prior to budburst. After we calculated the daily average temperature, we used the table to get the Potential Evapotranspiration in mm per day, and then we totaled the Potential Evapotranspiration for 30 days. We found the Water Differences by using the following equation, input - output = water difference. This means we subtracted the PET from the precipitation to find the water difference. The Water Difference tells you how much water was available to the trees. If the water difference is negative the plants are in a dry condition, while if the water difference is positive the plants are in a wet condition.

Collaborations

At the end of our measurements, we had videoconferences with our two schools. We compared the locations of our two schools and pictures of our trees. We talked about how we did our measurements for bud burst. We shared our graphs and discussed the data. It was fun talking about what we learned, what our data showed, whether our hypothesis was right or wrong, and how we could improve our research. Our teachers helped us make a plan for writing our report as a team.

Data/Results

1. **Tables showing Silver Maple and Crab Apple budburst picture record of changes during Spring 2007 for MSSD & ISD:**

Table #1 Silver Maple – MSSD, Washington, DC

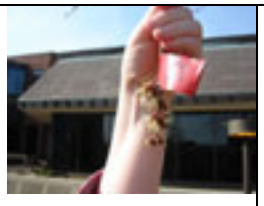
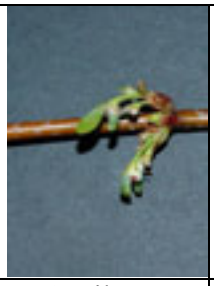
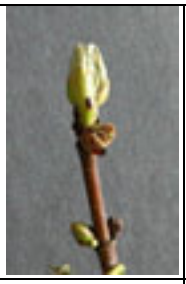
				
Feb 20, 2007	March 13, 2007	April 7, 2007	April 19, 2007	April 24, 2007

Table #2 Silver Maple, ISD, Indianapolis, IN

					
Feb 26, 2007	March 8, 2007	April 11, 2007	April 13, 2007	April 23, 2007	May 22, 2007

In Table 1 and 2 budburst pictures show how the **Silver Maple's** buds grew for four months as we checked them everyday at each school. The Silver Maple continued to grow longer leaves as well as new leaves each day. At MSSD on March 13, we noticed the buds had pollen that fell from the anthers. Three days later, most of the buds were dead. Leaf buds started to swell on March 24 and finally burst on April 11. New leaves grew an average of 1 centimeter each day. By April 24, 2007 at MSSD, the leaves were visible all over the Silver Maple tree and were visible at ISD by May 22, 2007. MSSD's leaves were bigger than ISD's leaves since MSSD's budburst was earlier than ISD's. The leaves continued to grow until the first of May, when they measured about 180 mm. The pictures show how MSSD's male flowers grew and developed, but did not produce any seeds. For ISD, the pictures show how different the female flowers were from MSSD's male flowers and how the female flowers grew seeds.

Table #3 Crab Apple – ISD, Indianapolis, IN

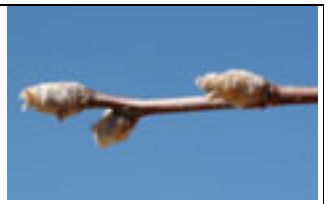
			
Feb. 26, 2007	March 8, 2007	March 28, 2006	April 11, 2007

Table #4 Crab Apple- MSSD, Washington, DC

			
Feb 20, 2007	March 13, 2007	March 29, 2007	April 7, 2007

In Table 3 and 4 budburst pictures show how the **Crab Apple's** buds grew faster than the Silver Maple. They grew beautiful flowers and the leaves and flowers burst at the same time, all by March 17. At MSSD, we missed the exact days for that due to a closed weekend at our school. The leaves didn't stop growing until mid April, but we did not measure them. MSSD's flowers were pink while ISD's flowers were white. During the early April freezes, the flowers and leaves on ISD's tree were not able to survive the below freezing temperatures, but MSSD's leaves and flowers were still healthy even though the leaves and flowers were covered in snow.

Phenology Data Summaries

Spring 2007 ISD Phenology Data Summary - Table #5

Tree	Bud #	Budburst Flowers	Budburst Leaves	GDS (ºC)	**OUTPUT** P.E.T. (mm) A	**INPUT** Precipitation (mm) B	Water Difference (mm) WD=B-A
Pyrus	1	March 24, 2007	March 24, 2007	322.95	41.03	118.0	76.97
	2	March 24, 2007	March 24, 2007	322.95	41.03	118.0	76.97
	3	March 24, 2007	March 24, 2007	322.95	41.03	118.0	76.97
	4	March 24, 2007	March 24, 2007	322.95	41.03	118.0	76.97
Average:				**322.95**			**76.97**
Acer	1	March 15, 2007	April 22, 2007	634.70	57.14	101.6	44.46
	2	March 15, 2007	April 20, 2007	604.05	58.14	117.6	59.46
	3	March 14, 2007	April 21, 2007	617.95	57.14	101.6	44.46
	4	March 16, 2007	April 21, 2007	617.95	57.14	101.6	44.46
Average:				**618.66**			**48.21**

Spring 2007 MSSD Phenology Data Summary - Table #6

Tree	Bud #	Budburst Flowers	Budburst Leaves	GDS (ºC)	**OUTPUT** P.E.T. (mm) A	**INPUT** Precipitation (mm) B	Water Difference (mm) WD=B-A
Pyrus	1	March 17, 2007	March 17, 2007	425.49	35.85	107.48	71.63
	2	March 17, 2007	March 17, 2007	425.49	35.85	107.48	71.63
	3	March 17, 2007	March 17, 2007	425.49	35.85	107.48	71.63
	4	March 17, 2007	March 17, 2007	425.49	35.85	107.48	71.63
Average:				**425.49**			**71.63**
Acer	1	March 11, 2007	April 19, 2007	790.16	38.20	116.11	77.91
	2	March 11, 2007	April 14, 2007	741.61	50.40	75.13	24.73
	3	March 11, 2007	April 11, 2007	709.81	52.10	67.25	15.15
	4	March 11, 2007	April 12, 2007	721.01	55.70	81.41	25.71
Average:				**740.65**			**35.87**

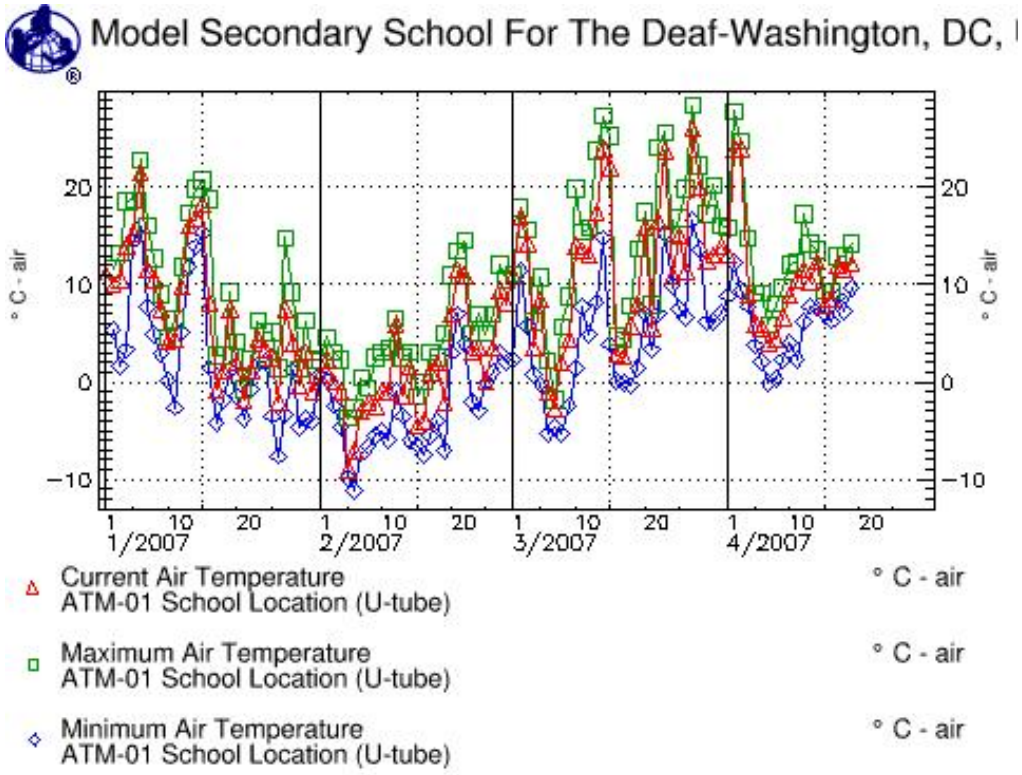
Budburst Data Summary Tables #5 and #6

Comparing MSSD and ISD, for the Crab Apple, we found that at ISD the buds burst a week later (March 24) than at MSSD (March 17). At MSSD, the Crab Apple required more Growth Degrees (GDS) (425.49) than at ISD (322.95). For the Water Difference, ISD's 76.97 mm of water was similar to MSSD's 71.63 mm for the Crab Apple.

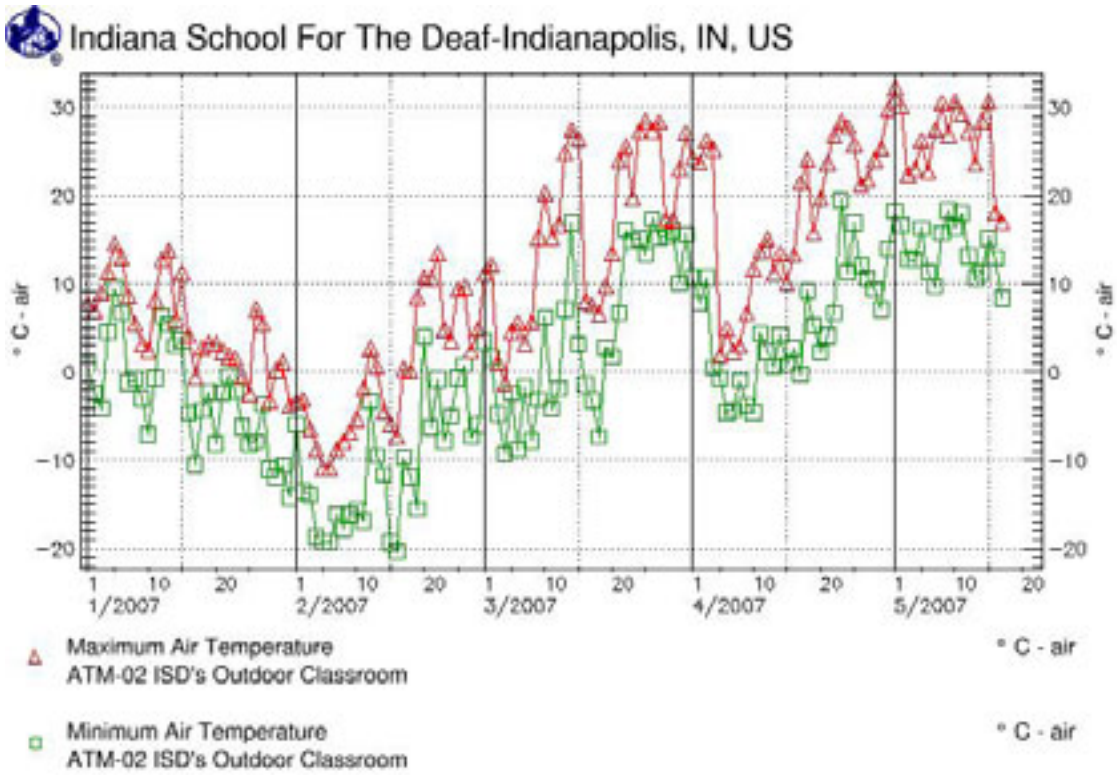
For the Silver Maple, we found that the leaf buds burst on almost the exact same days at ISD (April 20-22), and at MSSD (April 11-19). MSSD's leaf burst was just 2 or 3 days earlier than ISD's. The Silver Maple at MSSD had more Growth Degrees (740.65) than at ISD (618.66). For the Water Difference, Indiana's Silver Maple had a slightly larger water difference of 48 mm compared to MSSD's 35.87 mm.

3. Temperature and Precipitation Data Graphs

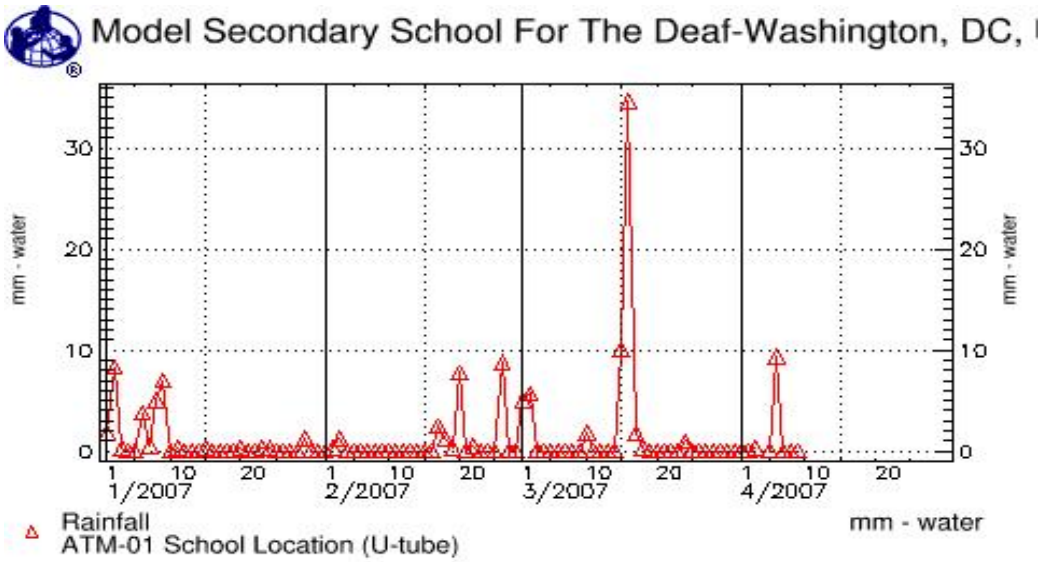
Graph # 1 Min/Max/Current Temperature Data (GLOBE) MSSD 2007



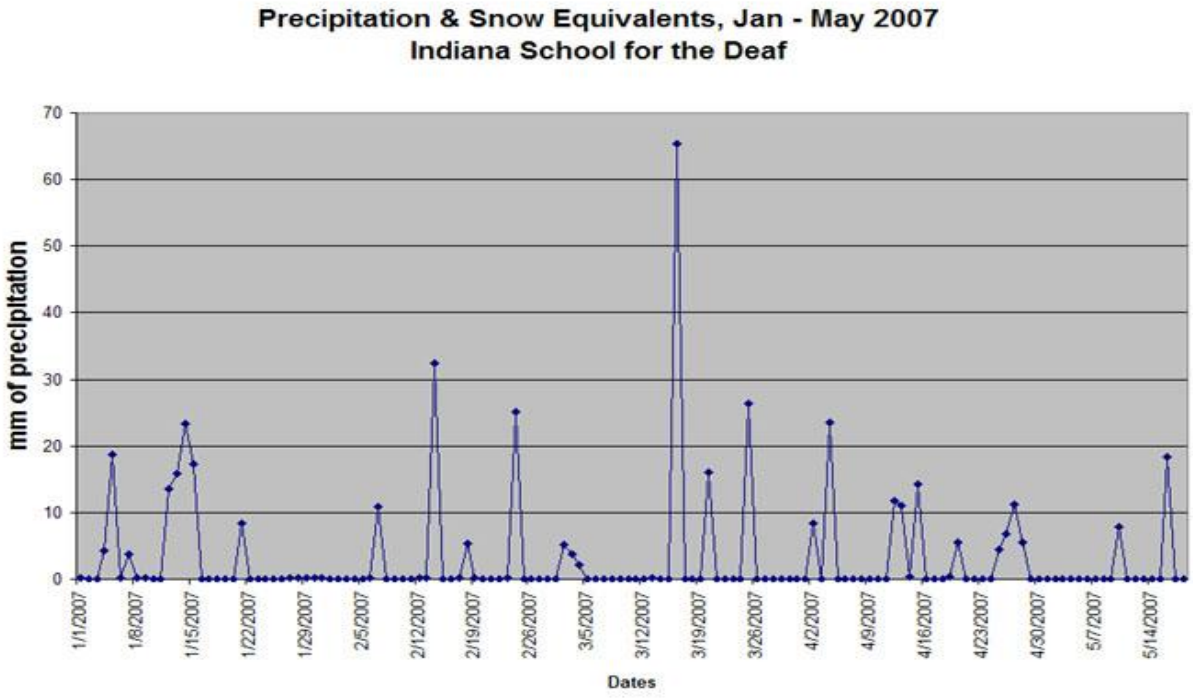
Graph # 2 Min/Max/Current Temperature Data (GLOBE) ISD 2007



Graph # 3 Precipitation Data (GLOBE) MSSD 2007



Graph # 4 Precipitation Data (GLOBE) ISD 2007

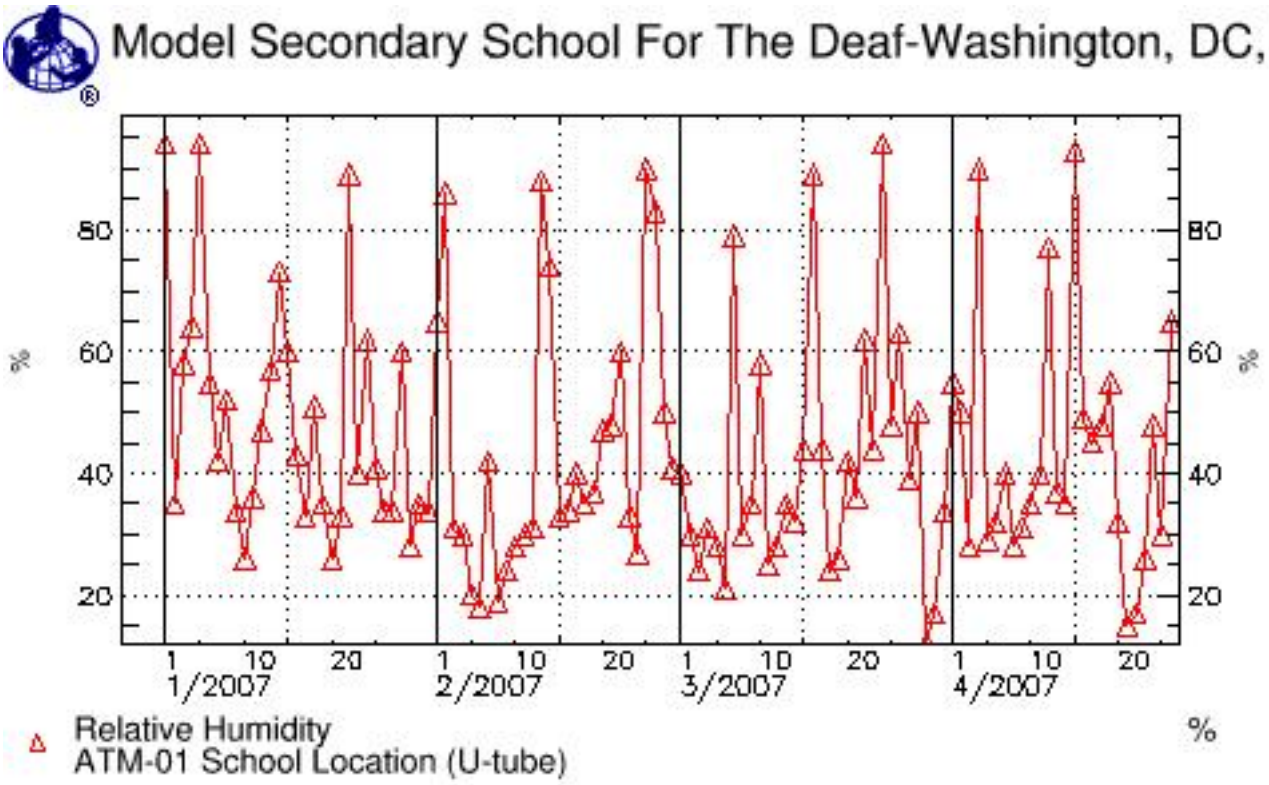


Graphs #1-4

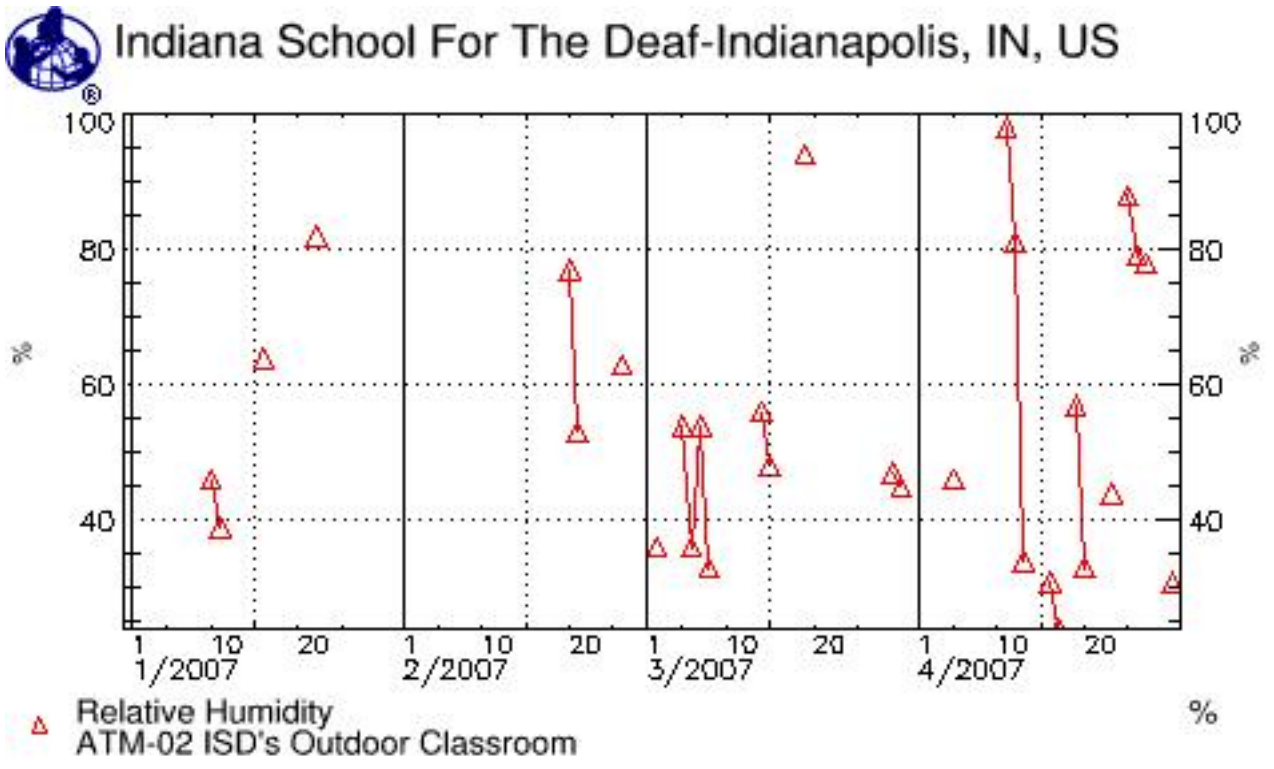
The graphs show temperature and precipitation for each school, MSSD and ISD. We compared and contrasted the two schools. In temperatures, there were a lot of differences between MSSD and ISD in January. In ISD's graphs, it was cold in January, then warmer later at the end of February. In MSSD's graphs, it was warm at the beginning of January, in the 20's ^{o} C. It was colder in February but not as many below-zero days as in Indiana. Both locations got warmer in March and April. Both of our schools were a little similar in March, and both had a cold spell the first week of April. At ISD, it was a lot colder than at MSSD. There was a late snow at both of our schools early in April.

In the rainfall graphs, there were a lot of differences in precipitation, but we were surprised to see a similar rainfall in the middle of March at both ISD and at MSSD, which were about 35 mm in Washington, DC and 65 mm in Indianapolis. Overall, at ISD, there was more rainfall than at MSSD.

Graph # 5 Humidity Data (GLOBE) MSSD 2007



Graph #6 Humidity Data (GLOBE) ISD 2007



Graph #5-6

These graphs show the relative humidity in our states. ISD's graph (range 50-100%) seems to show an overall tendency toward slightly higher humidity than in Washington, D.C. (30-95%).

Analysis

We learned many things during our experimentation and study of budburst. For the Silver Maple, we learned that the leaf buds burst at different times all over the tree, over a time span of about five or six days. For the Crab Apple, the buds for both leaves and flowers burst all at the same time over a time span of about two days. The Silver Maple flowers burst earlier than the Crab Apple, but eventually fell off the tree few days later. The Silver Maple's flowers burst in mid March while the leaves did not burst until April. We learned that different kinds of trees have different ways of producing flowers and leaves.

We found that the Silver Maple had budburst dates were 4 to 5 days later in Indiana than in Washington, DC. For the Crab Apple, budburst happened a full week later in Indiana (7 days). This data seemed to support our hypothesis that Washington DC trees would have an earlier budburst because they are near large bodies of water.

During one of our videoconferences, two of the students on our team thought that being near the ocean would impact the climate, making more moisture available in Washington, DC. We decided to compare our humidity data from both schools. There was not a lot of humidity data from ISD, but the two graphs show that the humidity may not be that much different. In fact Washington, DC graph shows slightly less humidity than in Indiana. We concluded humidity probably does not control budburst in our locations.

We decided to look at the precipitation data. On the precipitation graphs for Washington, DC and Indiana, they have similar precipitation patterns, including a very large rainfall on almost the same day in March. We concluded that, overall, there was more rainfall at ISD than at MSSD.

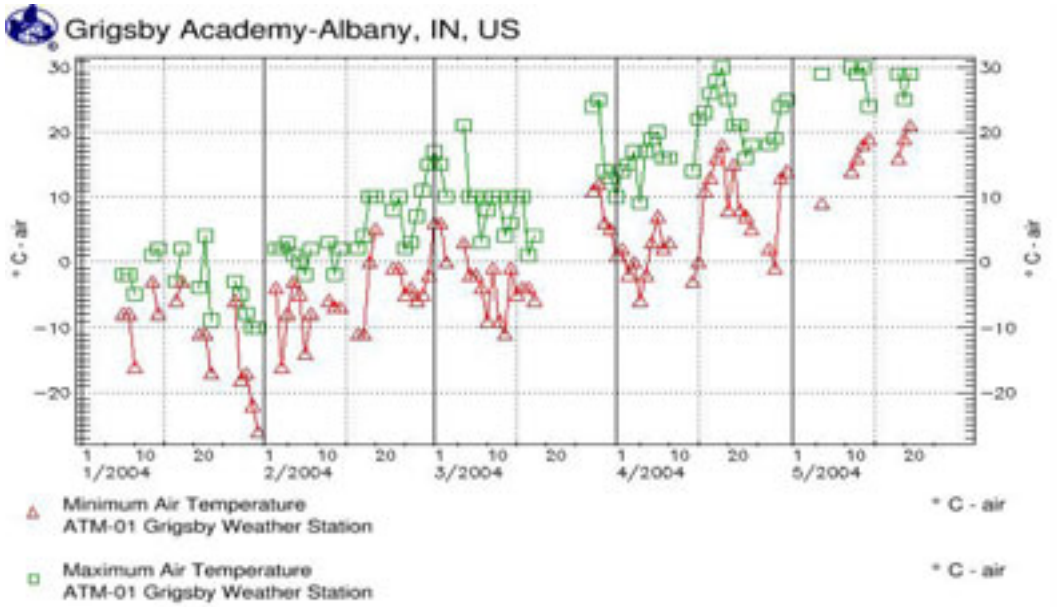
We wondered if maybe the rain evaporated faster in Indiana. When we calculated Water Difference, we realized that the Crab Apple had almost the same amount of water available at both MSSD –WD = 72 mm and ISD – WD = 77 mm. The water differences of the Silver Maple meant slightly more water was available before the budburst at ISD – WD = 48 mm than at MSSD – WD = 36 mm. In both cases, it was a wet year and not a drought. We suspect that the warm January in Washington, DC evaporated more water than at ISD. At ISD, it was too cold to evaporate until March, but we do not think water was controlling budburst at either school because there was not much difference at our two schools.

One student on our team believed that temperature controlled budburst. On the temperature graphs for Indiana and DC, the graphs show similar patterns for 2007, but Indiana had colder weather patterns than Washington DC. In Washington, DC there were only 7 days when the temperature did not get above zero degrees Celsius, while in Indiana there were about 25 days that the temperature was not above zero degrees Celsius. We suspected the cold temperatures in Indiana at the end of January and early February might have caused a delay in budburst for the trees.

We decided to compare the Growth Degree Summary for our two schools and see if that would help us to understand the temperature's influence. We noticed that the Maple had a higher Growth Degrees summary (GDS) in Washington, DC (average of 740 deg) than in Indiana (average of 619 deg). The result in Crab Apple shows more GDS days in Washington, DC (average of 425 deg) than in Indiana

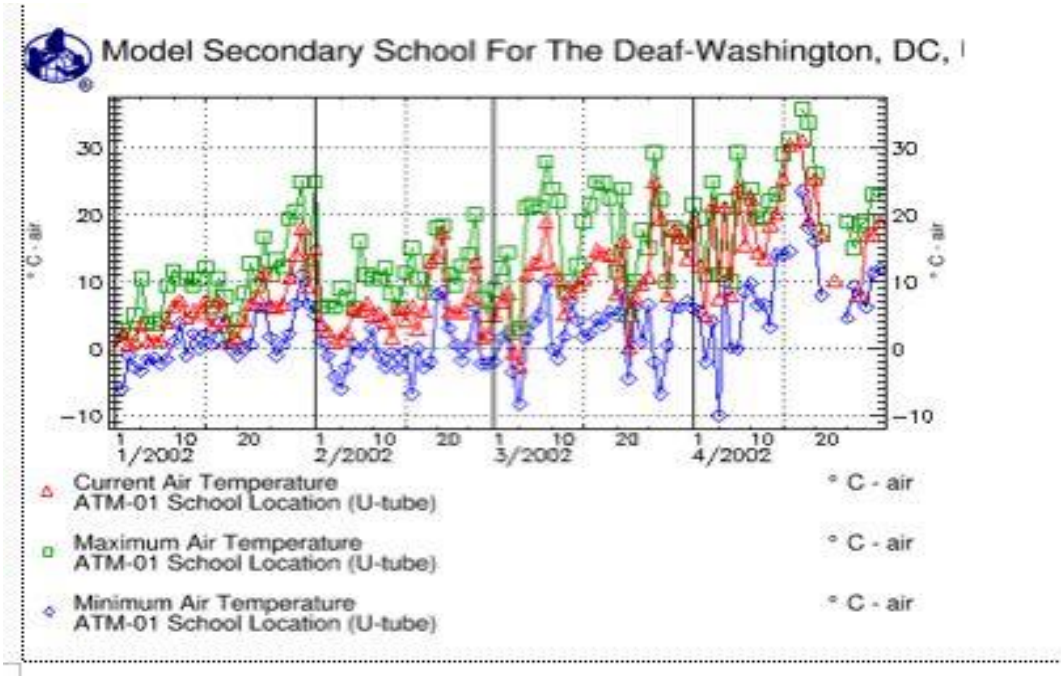
(average of 322 deg). The comparison of GDS of the two trees shows that the Acer budburst tends to require a higher GDS (740 and 619 deg) than the Crab Apple (425 and 323 deg). We concluded that different kinds of trees need different amounts of warming to start growth. Maybe that strategy helps some plants avoid being damaged by frost. We are still curious about the influence of the cold period in early February and wondered if it had delayed the budburst of our trees.

We decided to look for more data from our locations. We found that a school named Grigsby Academy in Albany, Indiana did a budburst study in 2004 and they studied 'Acer sacc'. We don't know if that means a Sugar Maple or a Silver Maple. That school is about 78 miles northeast of our school at ISD. Their budburst for the Acer leaves was on April 15 in 2005, which was 5-7 days earlier than our budburst in 2007.



The temperature data for Grigsby shows very cold temperatures in January 2004. The temperature became warmer in February, March and April. January 2004 temperatures were much colder for the first 2 weeks than for 2007. They did not have cold temperatures the first week of April and all of April seems warmer in 2004, so maybe that's why the Acer budburst was almost a week earlier at Grigsby than at ISD in 2007.

At MSSD, we had student data from our own school in 2002. When we compared the years, we learned that the Silver Maple had almost the same budburst dates in 2002 and 2007. However, the budburst for the Crab Apple in 2007 was about two weeks later (16 days) compared to the budburst in 2002, so we looked at the graph for the Washington DC temperatures for that year. (See below)



In the 2002 MSSD temperatures graph, it seemed like it was cold in January then warmer later at the end of January. In 2007, it was warm at the beginning of January then it was colder in February. It got warmer in March and April. The temperature graphs for 2007 and 2002 have opposite weather patterns in January. In 2007, the temperature had 7 days when it did not get above zero degrees Celsius, while in 2002 the temperature was above zero degrees Celsius everyday. We think the strong cold at the end of January and early February was the cause of the late budburst for the Crab Apple, this year in 2007. The budburst date for the Silver Maple was not much different, so the January cold did not seem to influence the Silver Maple. This year's February temperatures were colder than in 2002 at MSSD, and in April 2002 it was a little colder, with more days below freezing. Because the budburst for the Maple was almost the same for 2002 and 2007, we wonder if something else might be influencing the budburst of the Silver Maple.

From the observations of the trees, we noticed that the trees benefit from the rainfall, but we think budburst is controlled mostly by the temperature in the Crab Apple, but maybe not for the Silver Maple. We think the very cold temperatures in late January and February affected the Crab Apple and made delayed budburst.

Our group discussed the possible sources of error in our data and calculations. We are confident the measurements for the rainfall and air temperature are accurate and that we have good enough results for comparing ISD and MSSD data. At MSSD we were disappointed about our final record of observations of the budburst. Budburst for the Crab Apple happened during a long weekend when school was closed for four days, so we had to estimate the date of the budburst for the Crab Apple. But we are sure the date is accurate to within two days. This could skew the result of the budburst, but we felt comfortable with our estimate. When we did calculations there may have been mathematical errors, for example, for potential evapotranspiration (P.E.T), and/or water difference. We wanted to avoid that so we checked each other's work.

At MSSD we had some problems with students bothering out study sites. When we used the snowboard to measure the depth of the snow, there were some students who messed up our snowboard and we had to get a new one. Also at MSSD, there was a time when some students destroyed some of the Silver Maple tags

that we had marked for our observations. We had to remark the buds on that branch of the tree, and we may not have used the exact same buds for our observation, so that might have influenced our results

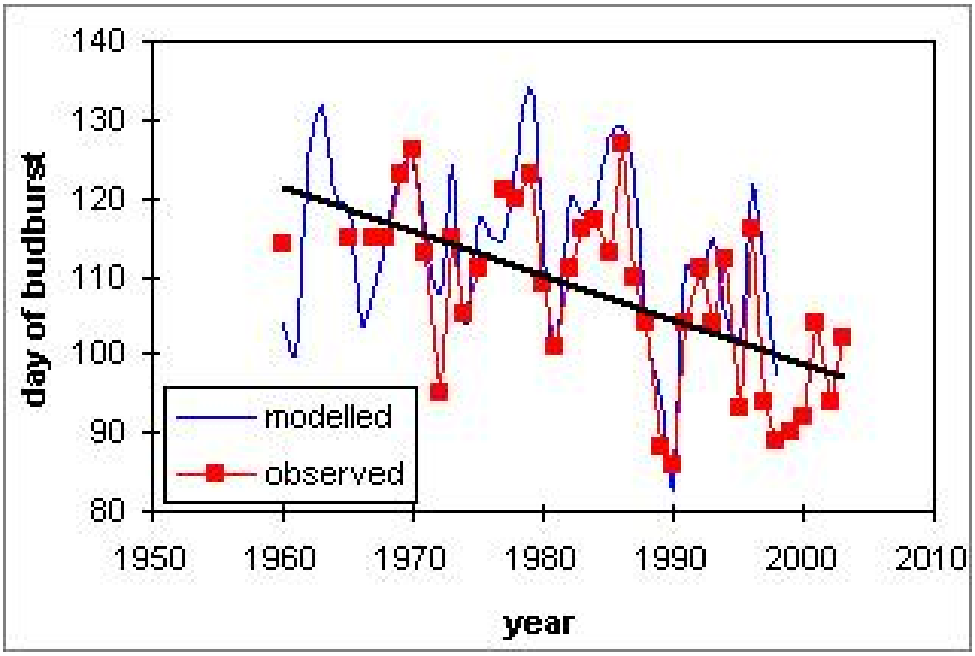
Students at both schools are concerned about our tree locations. Finding good trees for observation is sometimes difficult. To make it possible to get daily observations we picked trees that were not in the best location for the trees to respond naturally to their environment. At ISD the trees were not in a good position since there are nearby the roads on both sides of the trees. It's possible that ISD's trees may not have had the same amount of water as MSSD as their roots are under the road. Also, the ISD students observed their trees had been hit by lightening, which made the students wonder if the tree had normal water absorption from the roots. As for MSSD, both the Crab Apple and Maple trees are very near a building and we think the building could influence the air temperature around the trees.

Conclusions

Our purpose was to study phenology to see the cycle of plant growth and understand the effects of environmental factors on the timing of budburst. We also wanted to see if it was different from the past, and if it was more affected by moisture or temperature. Our hypothesis was that the tree buds in Washington, DC would burst before Indiana's because there would be more precipitation and humidity in the air due to the nearness of the ocean, and that water would control the timing of budburst in our two locations. Our data suggests that there was actually a little more humidity and also more precipitation in Indiana than in Washington, DC, so that does not support our hypothesis. Both trees showed budburst a little earlier in Washington, DC than in Indiana, but probably not because of moisture difference.

We have learned that large bodies of water affect the climate of an area by making temperatures change less. We think this is important, because if the climate changes then it might affect different trees in different ways. We now think our research shows that temperature is the most important factor controlling budburst. We think the Crab Apple trees in both Indiana and in Washington, DC were delayed by the cold temperatures in late January, 2007, but maybe the Silver Maple was not. In Indiana, the additional data from Grigsby seems to show that temperature delayed the Maple's budburst this year as compared to 2004, but in Washington, DC it did not have that influence. Some members of our team also suspect that the number of hours of sunlight could also be influencing the trees.

We wanted to see if our data would show any connection to global climate change but now we know we do not have enough data. We learned a lot from reading about a study in Headley, England, [*Oak budburst* 2007] where the scientists studied budburst in Oak trees for 14 years (1967-1981). In 14 years, their data shows a lot of variation in the date of budburst, but overall there is a trend towards earlier budburst. This data shows that it is not possible to see a trend in just two years of data. We realize we need more data for more years. We think our schools should keep monitoring budburst for many years and maybe we will see a trend toward earlier or later budburst dates, which could mean climate changes are happening.



Here is the Headley data, showing 14 years of budburst.
The black line shows that the buds tend to burst earlier now that they used to.

We have learned many things, but we still have questions. We are curious about the Silver Maple and what controls its growth. We also wonder if light is an influential factor in budburst. We would like to study more about photoperiod and the Silver Maple tree. We also wonder how deep the roots are underground and how much water they take in daily. We would also like to know if different plants have warning signs or indicators that show the impact of environmental factors that can be similar to environmental problems that affect people.

Our team talked about how we could improve our research study. Here are the suggestions we came up with for future investigations:

- We need to add data for sunlight (photoperiod) for both the Crab Apple and Silver Maple.
- We need well-organized data for the observations of the bud burst. Our first data and measurements that we observed and collected from the trees were confusing.
- We have already observed one Crab Apple and one Silver Maple at each school. We will need to find others of those same species to compare with the trees that we observed this past year. We would also like to add other species of trees to our experiment.
- We need to continue our research for at least 3-5 more years of comparison. The more data we collect, the better our research will be.
- We need a better snowboard for measuring the snowfall, so that students will not bother it.
- We would like to include measurements of air pressure with an aneroid barometer to see if air pressure may affect the trees.
- We would like to measure how much CO_2 the plants received and determine if it is enough or too much.
- We need a way to protect the trees so no one disturbs our marked buds. We need to think of a better way to mark the exact buds so we can find them, but other people will not notice them.

Acknowledgements

Our team, Lateefah, Kelsey, Joshua, and Tyler would like to thank the people who helped us with our research project.

To Dr. Snyder, thank you so much for helping us with our research project. We are very glad that you decided to help us as you are busy with college. Thank you also for providing all the data from your weather station so we will be able to gather information for our phenology research.

To Trudy Haselhuhn, Gallaudet Horticulture Specialist, thank you for explaining about our trees species in 2006 and comparing them in this year, 2007. You helped us understand how different these trees can be from year to years.

To all the ESS students at both schools, thank you for helping us to progress with our work. You helped us to get ready to work as we learned about the buds on our trees and you collected so much data.

To Mrs. Huckleberry, thank you for helping us to understand about the trees growing at both schools and how they can be similar or different. We learned a lot from you! We thank you for helping us write our report.

To Ms. Ellsworth, thank you for helping us to learn about our trees at MSSD. You showed us a lot about trees growing from under the influence of each factor: light, water, or temperature. Thank you for helping us write our report, too.

To the GLOBE Program, thank you for all the data graphs and teaching us how to observe trees. Thank you for letting us participate in the GLOBE Program!

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Climate and its Effect on West Nile Virus Distribution and Prevention

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School: Center School District #58, Kansas City, Missouri, USA
Teachers: Melinda Merrill, Debbie Sisk, Jason Steliga

ABSTRACT
Using GLOBE data, the student researchers investigated the relationship between precipitation, humidity, temperature and the frequency of West Nile virus. Only cities within certain latitudinal parameters were examined. The temperature was a key factor in the development of West Nile virus while precipitation appeared to be an indirect factor.

RESEARCH QUESTION/ HYPOTHESIS
Research Question: Based on environmental and climatic conditions when would these global cities most likely expect an outbreak of West Nile virus?

Hypothesis: If precipitation, humidity and temperature are elevated in a given area, then the instances of West Nile virus outbreaks will be increased because these factors are ideal for mosquito growth and development and mosquitoes transmit West Nile virus.

All students in our class last year had to create projects based on a specific scientist's field of study. One student designed their project on the spread of West Nile virus across the United States. We believed that the data this student collected and the research this student gathered was sufficient to support another more extensive project. This subsequent project has led to an investigative measure to examine how climatic factors would affect the spread of West Nile virus.

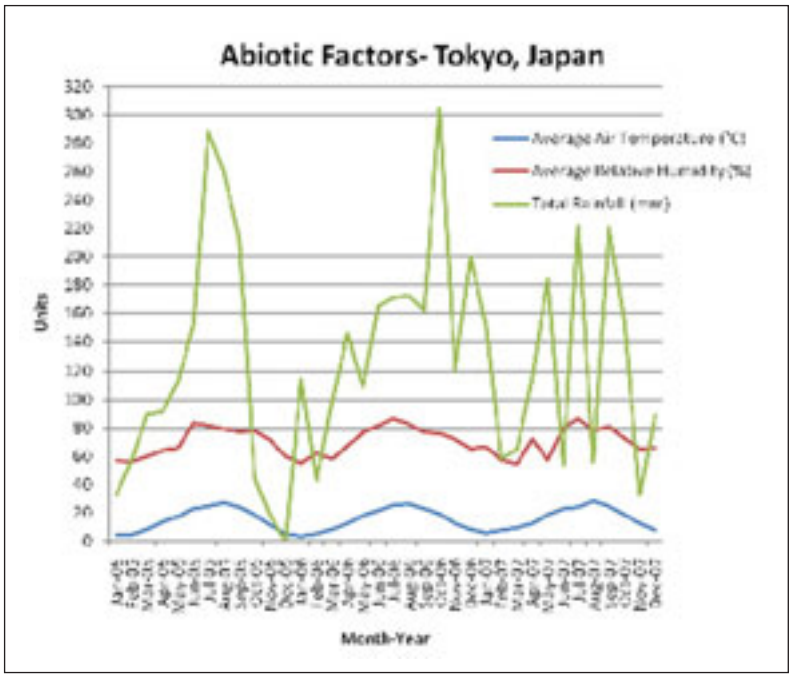
METHODS AND MATERIALS
We obtained our data from the GLOBE websites. We used a compilation of data from various schools throughout the world using GLOBE protocol. The following GLOBE protocols were used: relative humidity, average temperature, and total rainfall.

1. Go to http://www.globe.gov
2. Go into find data, advanced school search
3. Type in a city or school name in the school search bar
4. Click a school of your choice
5. Click the data link
6. Scroll down and click "Get Data Now"
7. Now click on the protocols you want
8. Go to the bottom of the page and select "Download tab-delimited results to disk"
9. Save it to where you would like it
10. Open it in Microsoft Excel
11. Find the averages that you want by using the average formula
12. Use the graph wizard to design a line graph

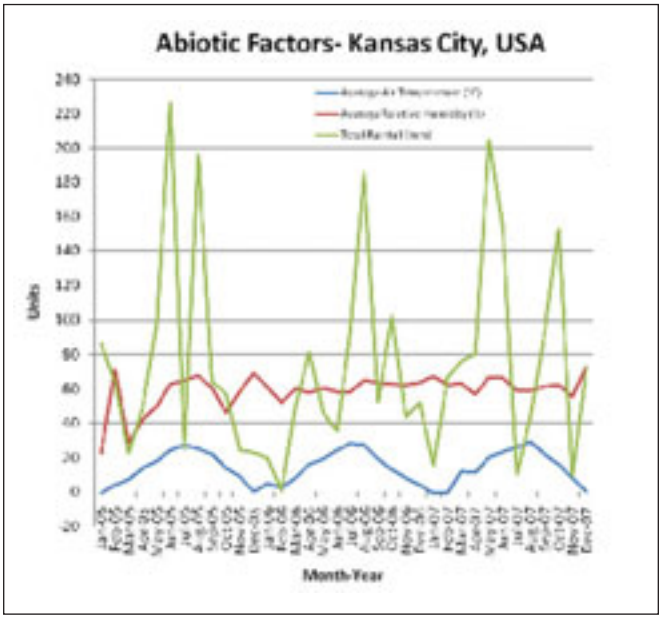
We also inputted data onto the GLOBE website using the Surface Temperature protocol. We used an IRT (Infra Red Thermometer) to measure the temperature. We used a GPS (Global Positioning System) to plot our points on a thirty meter by thirty meter grid.

DATA SUMMARY

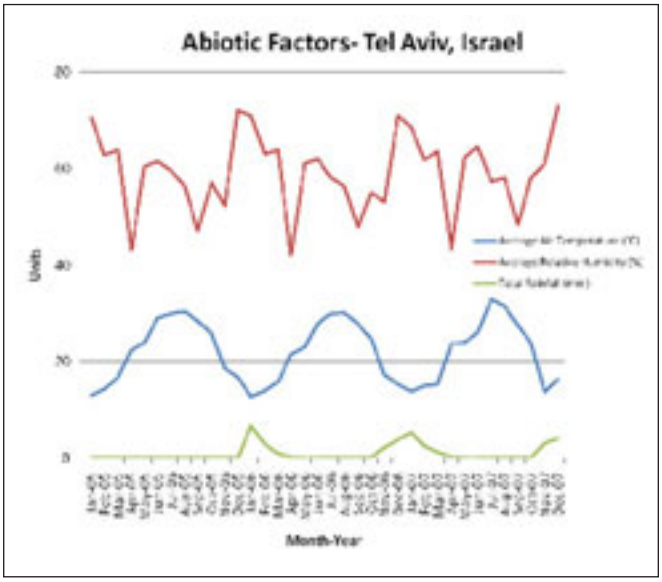
1. Total rainfall, average air temperature and average relative humidity in Tokyo, Japan from January 2005 to December 2007.



2. Total rainfall, average air temperature and average relative humidity in Kansas City, USA from January 2005 to December 2007. 3. Total rainfall, average air temperature and average relative humidity in Tel Aviv, Israel from January 2005 to December 2007.

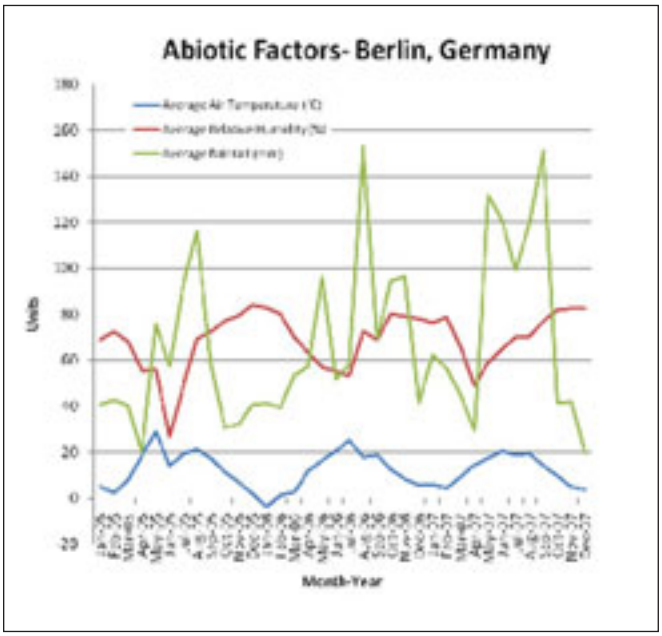


3. Total rainfall, average air temperature and average relative humidity in Tel Aviv, Israel from January 2005 to December 2007.



4. Total rainfall, average air temperature and average relative humidity in Zagreb, Croatia from January 2005 to December 2007.

5. Total rainfall, average air temperature and average relative humidity in Berlin, Germany from January 2005 to December 2007.



ANALYSIS AND RESULTS

In Zagreb we found that according to the data we collected July has the highest average temperature of about 27.6°C, since this is also the month with the highest precipitation, it is clear that there would be an increase in mosquito population resulting in an increased threat of WNV outbreaks from our research we found that a seven week lag period is noticed from ideal conditions to the outbreak itself. Therefore, about mid-August there is likely to be a surge in the number of people who are diagnosed with WNV. In Berlin, the temperature peaks in late may to early June, with consideration of the previously mentioned lag time, we can assume that the most likely time for a West Nile outbreak would be mid July. Although an epidemic in Berlin is not likely because the temperature never reaches the ideal 26°C and humidity is lower when the temperature rises. In Tel Aviv, the temperatures are highest in July but very low rainfall, although this wouldn't stop an outbreak because Tel Aviv is situated on the coast of the Mediterranean Sea and the moisture produced by it would be sufficient for mosquito growth. Therefore, the most likely time for West Nile Virus to occur in humans is during late August to early September, due to the seven week lag time. In Tokyo, temperature peaks around August, and there is consistently a fair amount of rain in this month. With the seven week lag, the most likely time for an outbreak in Tokyo would be in late September, to late October. In Kansas City, all measures peak in June therefore, after the 7 week lag period would lead to an expected WNV outbreak in late August, to early September.

CONCLUSION

Temperature is a key factor in the propagation of WNV in areas based upon the information collected throughout the research analysis. According to the research presented, a mean temperature around 27 degrees Celsius during a stretch of time greatly influenced the breakout of mosquito populations in these areas. Precipitation, necessary for the embryonic development of the mosquito, was not a direct factor in the outbreak of West Nile Virus. Humidity has no direct correlation to the incidence of West Nile Virus.

The conclusions were derived through the research process. The data collected using GLOBE protocol was established from hours of research determining the appropriate cities and schools that could provide the information and fit within the parameters set out at the beginning of the project. These parameters were to stay within a 30 degree latitude range of Kansas City, USA. The conclusions reached and discussed throughout the analysis section was done through peer-reviewed articles specifically examining the climatic factors associated with the spread of West Nile Virus. Data analysis was completed once the necessary information was gathered from the GLOBE database. The information was graphed and the trends were noted throughout the 3 year analysis performed throughout the experiment. It was noted that the trends found in each city corresponded to the data collected throughout the peer-reviewed information. Prevention techniques were discussed, especially in terms of physical and chemical techniques necessary to prevent the contraction of WNV for each country.

DISCUSSION

If our project were to be repeated, we would be able to make many improvements. We could have looked at more possibilities of preventative actions. We also could have found if other abiotic factors affected the development of the West Nile virus (WNV). The information that we assimilated will affect countries by explaining to them the preventative measures needed to be taken so that their citizens will not obtain the virus. Further studies that could be made include: finding out when other cities might have outbreaks. Find preventative measures on other encephalitis flavaviruses. Our findings were the same as in "The West Nile Virus in Israel", by Paz, there was a 3-9 week lag of the time when WNV was prevalent in mosquitoes to when humans had obtained it with some people with symptoms. Also most of the outbreaks in our findings would happen in September as in the findings in, "The West Nile Virus in Israel".

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This is Why I'm Hot

Students: Ashley Falls, Katelyn Jefferys, Julia Moyer, Elizabeth Price
Teacher/Advisor: Steven L. Frantz
School: Roswell Kent Middle School, Akron, Ohio, USA

ABSTRACT
Our project is about surface temperature and how the amount and albedo (reflectivity) of asphalt in an area affects the temperature of surrounding short-grass areas. We did this because our teacher was complaining that in the rural area in which he lives, there tends to be more snow days than the urban area where we live. We wanted to know why this is. We contacted other schools and took short-grass temperature data and recorded them on the GLOBE website for five consecutive days. Next, we graphed the data for the five days' temperatures taken. Finally, we compared the difference in the surface temperatures of short-grass sites in rural areas with the urban sites. We found the data we received supported our hypothesis, in part, the last two of the five days. Urban areas retained heat longer than rural areas. Our research results suggest an extended study is needed.

RESEARCH QUESTION AND HYPOTHESIS
Our teacher, Mr. Frantz was complaining there are more snow days in the rural area in which he lives, but here in the city, there are rarely any snow days. Since the sun's energy is better absorbed by darker colors because of low albedo (reflectivity), we believe urban areas are warmer than rural areas because of the greater surface area covered by asphalt. This absorbed heat energy will affect surrounding short-grass areas.

Our research question is: Will the percent of asphalt surface area coverage affect surrounding short-grass surface temperature areas?

Our hypothesis is: Short-grass surface temperature will be affected by the percent of asphalt covering the greater surrounding area.

MATERIALS AND METHODS
1) Heat Island Effect and albedo were studied to give us background information on which to base our research results. We learned black asphalt has very little to no albedo and as such absorbs almost all of the heat energy reaching it, causing its surface temperature to rise higher and faster than areas such as short-grass, which has a higher albedo.
2) We decided to contact Globe schools (as shown in Figure 1) relatively close to us (about a 30 mile radius except the Patalaska site) in an attempt to minimize weather front conditions and asked them to collect surface temperature data for us for five days at the same time (2:00 pm local time) on a short-grass surface. We also trained professors from Wayne College, Orrville, Ohio and the Ohio Agricultural Research and Development Center, Wooster, Ohio on Globe surface temperature protocol using the Fluke 63IR temperature probe (borrowed from Terri Benko, University of Toledo).
3) A grid overlay was made by taking a 10X10 piece of graph paper and copying it onto a clear plastic overhead projector sheet. The overlay was placed on the image and used to calculate the percent of surface area covered by a) natural cover (the corresponding squares colored green), b) asphalt (colored red), and c) man made structures (colored blue) then counting the individual squares (shown in Figure 2). Images were gathered using Google Earth and Digital Orthophotos from the Wayne County Ohio Auditor's Office for our seven sites. Images from Google Earth of the rural sites in Wayne County, Ohio were too low in resolution to be of any use.
4) Surface Temperature (Figure 3) and Surface Coverage (Figure 2) were graphed using Turbo CAD Pro and Excel Graphing.
5) Results were determined using both sets of data.
6) Coordinates were found using a GARMIN eTREX Venture Personal Navigator global positioning system.

DATA SUMMARY

Figure 1. Map of Ohio showing data collection sites.

ANALYSIS AND RESULTS

In general, for our five-day study, our temperatures were mild for the first three days then dropped dramatically (Figure 3). On day four and five a cold front brought much lower temperatures. The Orrville High School site was confusing because of the erratic data presented to us. After much debate, we contacted the advisor who informed us that his students had taken their short-grass temperature readings on an asphalt surface because it was too muddy to get to their short-grass site, and thus skewing their data. We chose to include this data for comparison.

DAY 1: Short grass surface temperatures ranged from 8ºC to 12ºC. Two out of the three lowest short grass surface temperatures were from the three urban sites, proving our hypothesis incorrect.

DAY 2: As ambient air temperature rose, two of the rural sites (O.A.R.D.C. and Patalaska) rose the most (5ºC difference), while the three urban sites stayed the within 3ºC of each other. This data is in conflict with our hypothesis.

DAY 3: All six sites had temperatures within 2°C of each other.

DAY 4: A cold front went through our area, dropping ambient air temperatures. The three urban sites' short-grass surface temperatures decreased significantly less. The South High School site remained 8°C warmer than the next warmest rural site. This data supports our hypothesis.

DAY 5: The cold front persisted. The three urban sites short grass surface temperatures remained higher than the two remaining rural sites (Wayne College did not record data for day five). The two rural sites each dropped 1°C, while two of the three urban sites dropped in temperature about 4°C each and one school (Roswell Kent Middle School) even rose about 4ºC from Day 4. This data supports our hypothesis.

We learned that because of the increased surface area covered by asphalt in our urban areas, heat is retained longer, even on surrounding short grass areas.

Other observations of our data we observed were, that at around 20°C, asphalt became warmer than short grass. At around 17°C, surface temperature tended to cluster, regardless whether urban or rural.

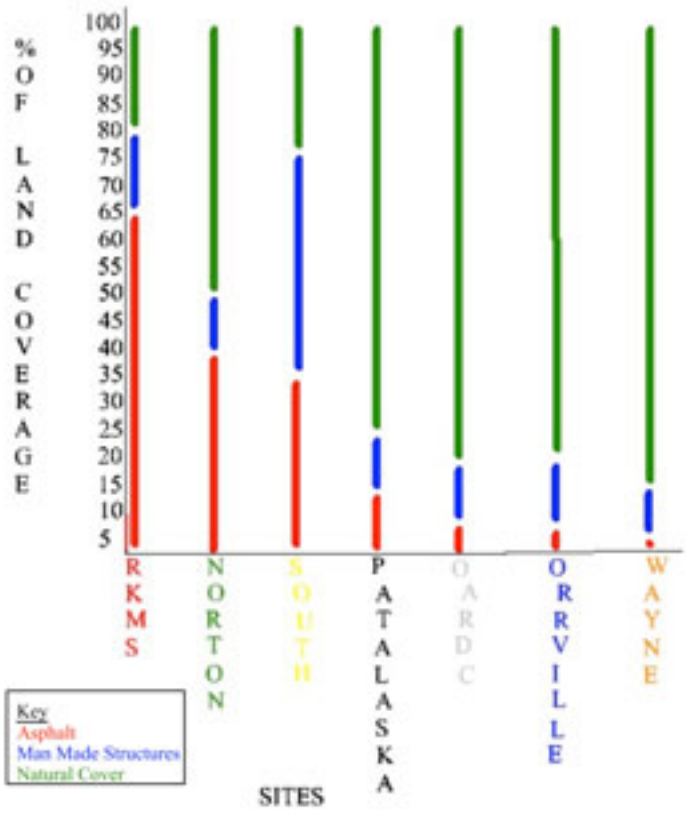

Figure 2.

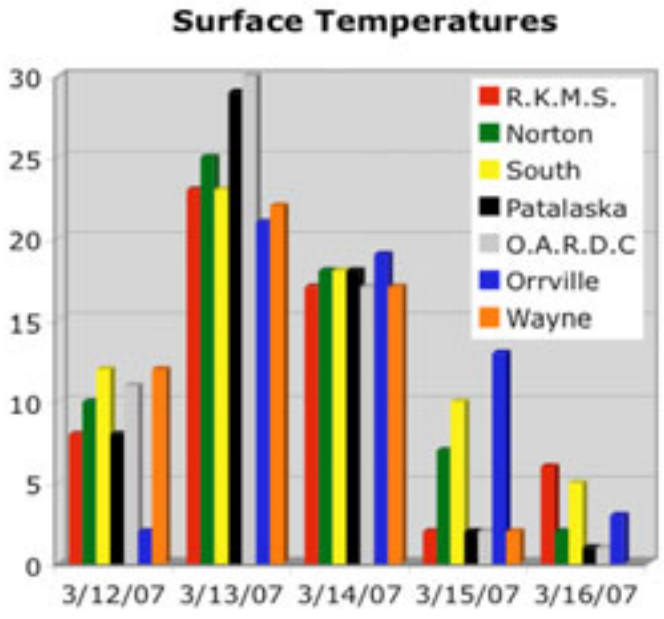

Figure 3.

CONCLUSION

Our hypothesis was supported in part, by our results during the last two of the five days. The urban areas did have warmer short grass surface temperatures during that time. Because the results are mixed, more data and a larger study are suggested. There seems to be an endless supply of relevant research that can be done in the future, such as including water surface temperature as a fourth surface type, cities retaining heat longer into the evening during summer months, or even growing crops between strips of asphalt to extend the growing season.

DISCUSSION

During our research we came across a problem. Our Orrville data was taken on asphalt (we did not know this initially) after we asked them to take it on short-grass. This altered our averages and data by having an outlier in the data. While frustrating, this mistake provided us with valuable comparative data and would make for a good study between grass and asphalt sites.

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Wayne County, Ohio Auditor's Office. (2004). *Wayne County southern half digital orthophotos.* Wooster, OH

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Mrs. Goddard, Math Teacher, Roswell Kent Middle School, Akron, OH

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Mr. and Mrs. Falls, Parents of Ashley Falls

Mrs. Carpenter, Mother of Katelyn Jefferys

Mrs. Moyer, Mother of Julia Moyer

The Effect of Leaf Mulch on Soil Moisture and Soil Temperature in the Tropics

Students: Xavier Martinez, Emmanuel Herrera, Richard (Kiki) Roettger, Natasha Hope
School: Ramey School, Ramey, Puerto Rico, USA
GLOBE Teacher: Mr. Richard Roettger

Abstract

The research topic was how leaf mulch affects the soil temperature and the soil moisture in the gardens in the tropics. Our research team designed an experiment that consisted of three gardens beds of one by three meters, one with no mulch, one with three inches of mulch and one with six inches of mulch. We followed the GLOBE soil moisture and temperature protocols. For three months the team gathered the soil temperature and five to ten centimeter soil moisture samples, the amount of rainfall, the soil moisture content as well as records of plant environment and growth conditions of the beds with the different levels of mulch. With the data collected to make suitable graphs, the team was able to infer that the garden beds with mulch allowed the conservation of water, lower soil temperatures and the depletion of weeds, despite the elements. Mulch decreases the soil moisture lost to the environment which conserves water and maintains a lower range of temperature variation in which plants can be grown.

Question/ Hypothesis

Over recent years, Puerto Rico, with the rest of the United States, has faced a problem concerning the overfilling of waste dumps. As landfills become filled up at an exponential rate, new ones continue to spring up. The problem is: where will it stop? Will we continue to use up our precious land resources, or will we devise solutions for a problem that affects us all?

Our experiment will test how the use of some of this "trash", this organic waste, specifically yard waste (leaves and cut grass) may actually benefit the environment. How does the use of leaf mulch affect the soil moisture and soil temperatures of gardens in the tropics? These are two key factors that have an effect on plants growing in your own backyard.

We believe that the use of mulch will actually lower soil temperatures and will help to maintain the soil moisture content. In addition, we predict that the bed with no mulch will have a higher range of temperature measurements and will have the lowest soil moisture content. The bed with six inches of mulch will likely have the lowest temperature measurements, as well as the highest moisture content, with the lowest range of moisture measurements. We further hypothesized that the bed with three inches of mulch will have the measurements for both moisture and temperature somewhere between the beds with no mulch and the bed with the six inches of mulch.

One may wonder how this experiment will help the environment. In truth, the alternate use of yard waste in gardening is beneficial in more than one way. Foremost is the issue of the landfills. In Puerto Rico, landfills in the north coast are being shut down by the EPA. Waste from these landfills is seeping into the earth, polluting our aquifers and groundwater systems in the north coast karsts formation. Encouraging people to

recycle yard waste, helps to reduce the amount of solid waste reaching the landfills. In the United States, more than 18% of the overall waste stored in city dumps is yard waste. That is 29.7 million pounds, or 225 pounds of yard waste per person, per year. Most of this yard waste is produced during the growing season. Puerto Rico has a substantially longer growing season than most of the United States. Therefore, more organic yard waste is produced in Puerto Rico than most cities in the United States. Most of this organic waste can be composted, or used as mulch for gardening. This compost is beneficial in that it returns nutrients taken from the earth back to the earth.

If indeed the mulch does help preserve soil moisture, it can also help gardeners cut back on water usage. It is estimated that gardeners use twice as much water in their gardens than is necessary. Puerto Rico is known to have extended dry seasons, sometimes lasting for months. In fact, across the island, the government has rationed water usage during periods of drought. By cutting back on water usage in gardens, there is more freshwater available for other uses.

We hope, perhaps, that our data may provide insight on the benefits that come of using organic yard mulch in gardening and may help encourage people to find better use for their own yard waste.

Materials and Method

To begin to answer our research question, "How does the use of leaf mulch affect the soil moisture and soil temperatures of gardens in the tropics?" members of the team located a suitable research site 14.4 meters away from our GLOBE atmospheric site on March 12th, 2007. The team measured out the three beds with the dimension of one by three meters, with a separation of one meter each. Once the beds were measured the team began digging and weeding, which took about two days. On March 14th, 2007 members of the team spread a fifty gallon container of manure collected from a local riding stable

on each bed. On March 15th, 2007 the team began preparing each bed using a double dig method. The double dig method involves removing the top 12 inches of soil and manure. Then the hardpan layer under the removed soil is loosened approximately six to eight inches deep. The adjacent top 12 inches soil and manure was used to fill in the loosened hardpan. This process continued until each bed was thoroughly mixed before mulching.

Nine large bags of leaf mulch collected by students serving after school detention and destined for the landfill were removed from the dumpster. This leaf mulch was distributed to two of the beds. Three bags were spread on one bed and the remaining six bags spread on another, leaving one bed as our control. Our three garden beds were identical except one had no mulch, the second had three inches of mulch and the third bed had six inches of mulch.

We began our first data collection of soil temperature at five and ten centimeter depths using a dial soil thermometer following the GLOBE soil temperature protocol on March 17th, 2007. At solar noon, approximately five times per week, the team went up to the site to gather the soil temperatures of each bed, as well as the local air temperature. The temperature from the beds covered in mulch was taken by removing the mulch until reaching soil level for the five and ten centimeter measurements. The team also collected our first soil moisture measurements from surface level to five centimeter depth and ten centimeter depth using the GLOBE gravimetric soil moisture protocols. The samples were collected from each bed using a modified star pattern moisture protocol. We used a rectangular pattern starting from one edge of the bed, moving left to right and then back and forth, so we would not collect from the same area. Approximately three times per week at solar noon, members of the team went up to the site and took soil samples from each bed. After these soil samples were gathered, they were weighed, recorded, and then placed in a seventy-five to ninety-five degree Celsius oven for roughly twenty-four hours.

reaching soil level for the five and ten centimeter measurements. The team also collected our first soil moisture measurements from surface level to five centimeter depth and ten centimeter depth using the GLOBE gravimetric soil moisture protocols. The samples were collected from each bed using a modified star pattern moisture protocol. We used a rectangular pattern starting from one edge of the bed, moving left to right and then back and forth, so we would not collect from the same area. Approximately three times per week at solar noon, members of the team went up to the site and took soil samples from each bed. After these soil samples were gathered, they were weighed, recorded, and then placed in a seventy-five to ninety-five degree Celsius oven for roughly twenty-four hours. The following day, they were removed from the oven and weighed and recorded once more in order to examine how much water each sample retained. Once the soil was measured for the second time, it was dumped into a bucket and redistributed evenly amongst the soil beds. Our measurements were used to calculate the soil water content in each bed, using the equation (A-B)/(B-C), where A is the mass of wet soil and container, B is the mass of the dried soil and container, and C is equal to the mass of the empty container.

The team leader also went up to the site during solar noon to the weather box located 14.4 meters north of the experiment site. He recorded the minimum, maximum, and current air temperature; the rain gauge and data logger on the automatic soil temperature reader was also checked at five and ten centimeter depths, and was then recorded onto the computer, which was later submitted to the GLOBE program website.

On April 12th, 2007, the team transplanted an equal number and variety of vegetable plants directly into the soil in three rows per bed. In the beds with mulch, the mulch was separated so that the plants could be transplanted directly into the soil. As the plants grew, the leaf mulch was replaced around the plants.

mulch was separated so that the plants could be transplanted directly into the soil. As the plants grew, the leaf mulch was replaced around the plants.

Due to a dry spell lasting from April 1st until April 22nd, the beds were watered by hand from the time the plants were planted until the first rainfall in order to preserve the life of our plants.

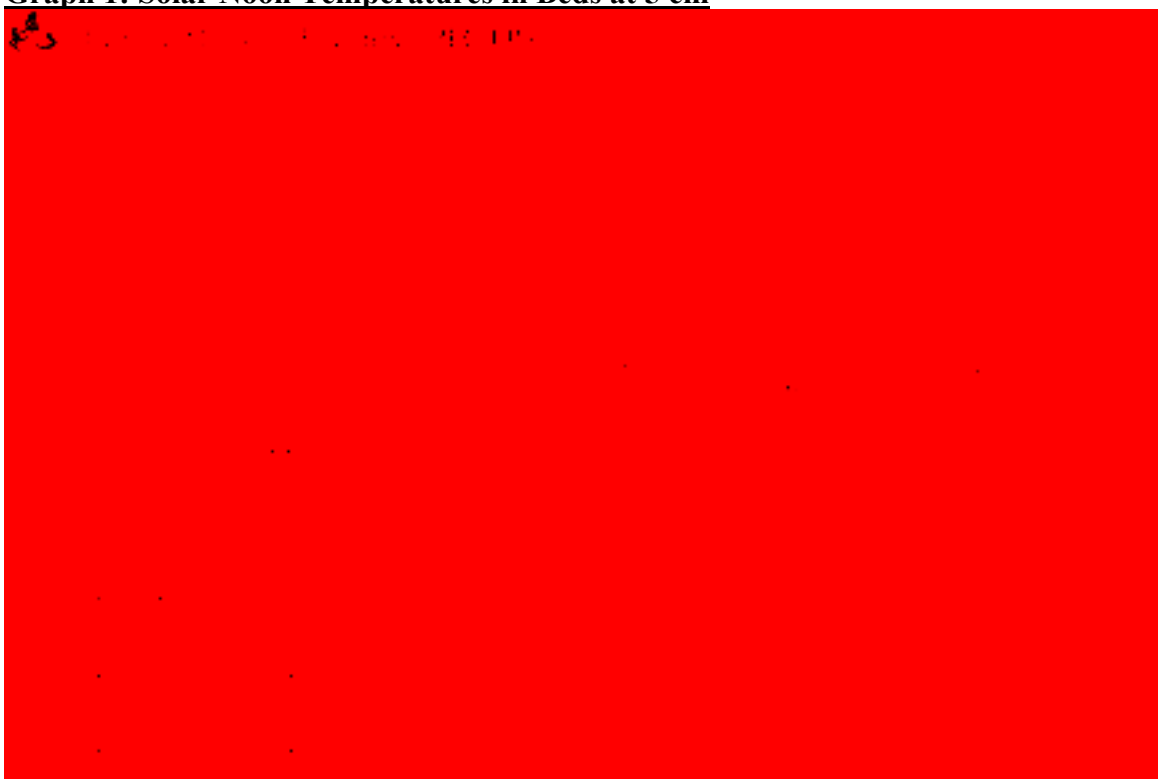
The soil Characterization Profile was also completed by utilizing the GLOBE Soil Characterization protocol at a site one meter north of our garden beds.

The team noted that the leaf mulch in the beds had to be replaced in order to maintain three- and six-inch depths of mulch in the garden beds. Two additional bags of mulch were added to the six inch bed, and one bag was added to the three inch bed.

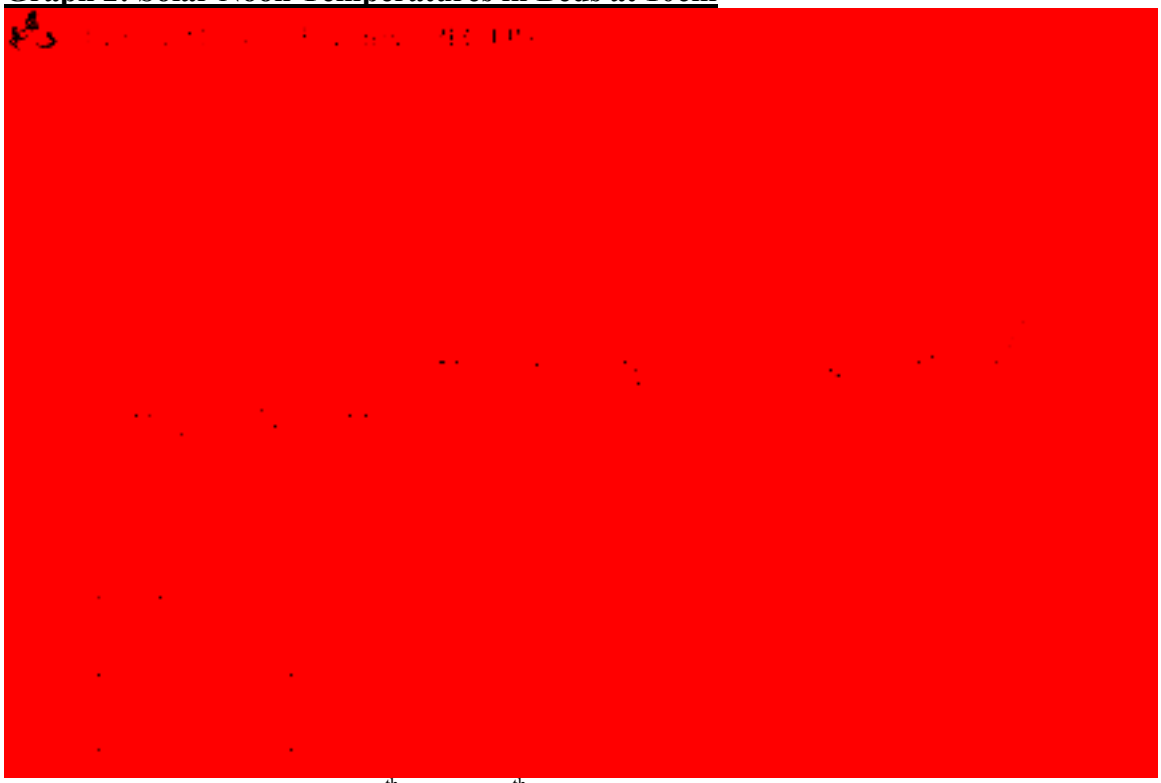
As time passed, we continued to observe the status of the garden beds and noted factors such as the amount of weeds in each bed, as well as how many lettuce plants "bolted" each day after the first plants began to bolt. As the lettuce plants showed the first signs of bolting, the team began to harvest.

Data Summary

Graph 1: Solar Noon Temperatures in Beds at 5 cm



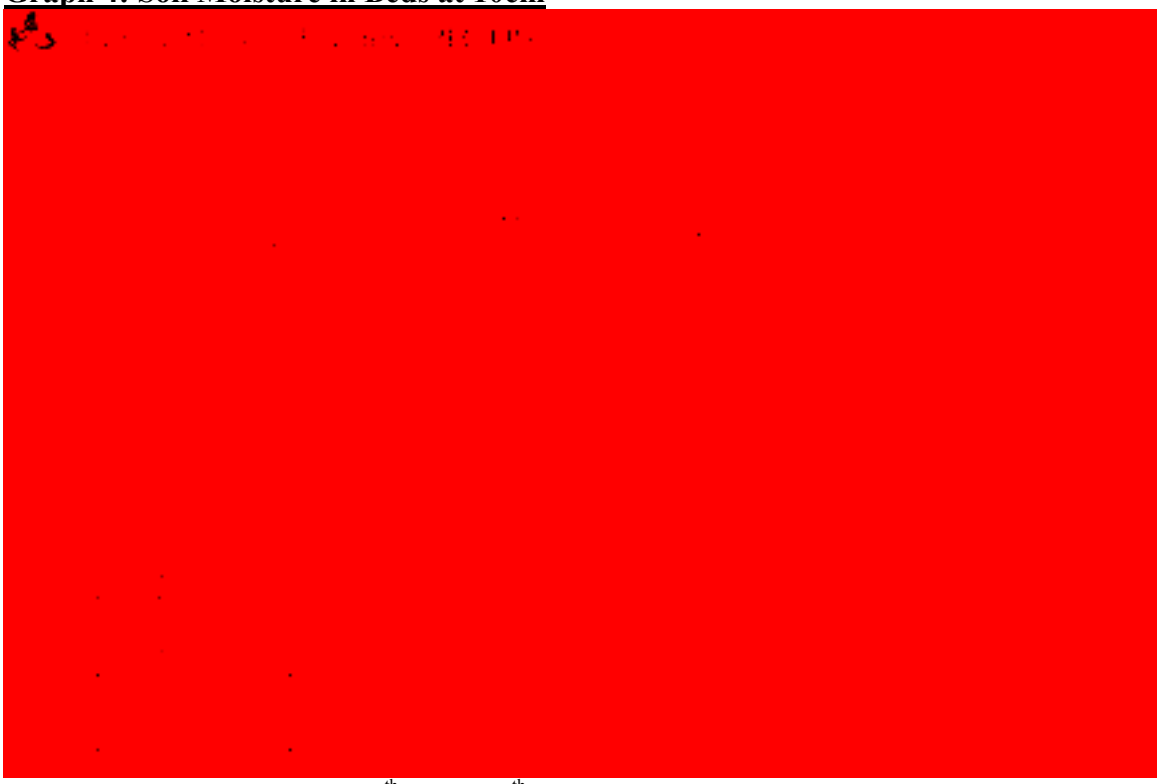
Graph 2: Solar Noon Temperatures in Beds at 10cm



*Note during the period of April 12th though 20th water was added to the garden beds. Refer to Graph 9 for details.

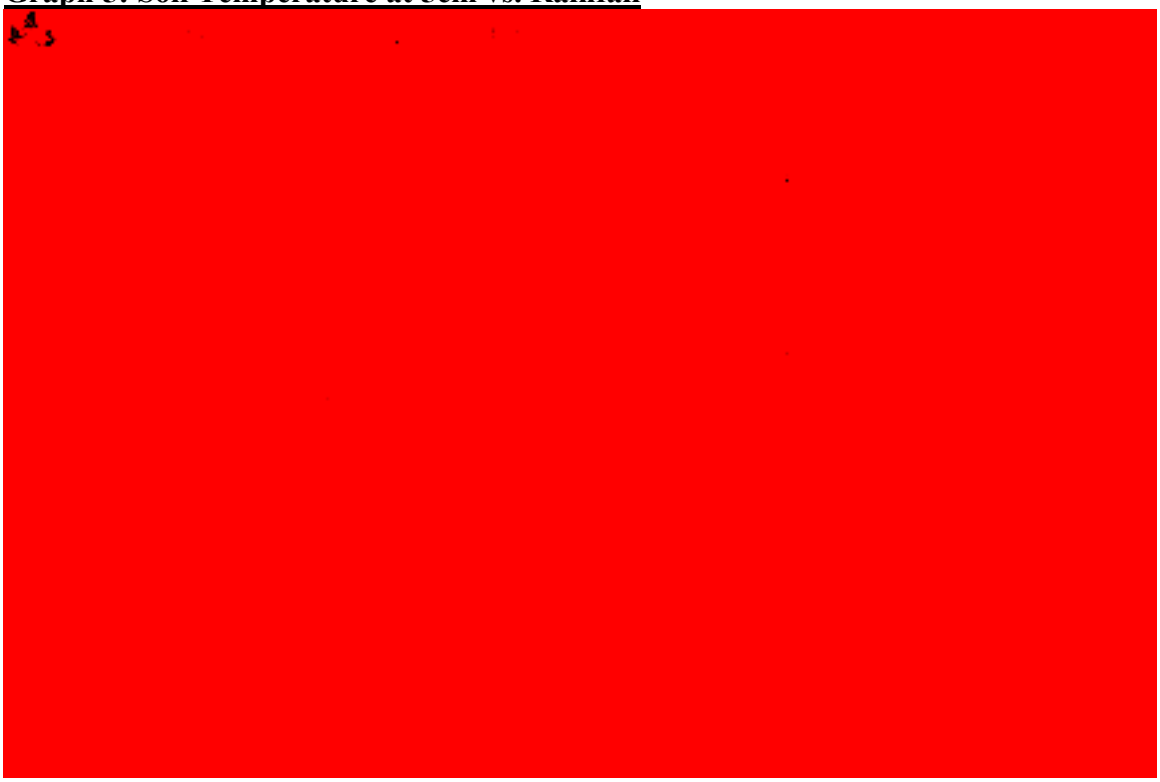
Graph 3: Soil Moisture in Beds at Surface

Graph 4: Soil Moisture in Beds at 10cm



*Note during the period of April 12th though 20th water was added to the garden beds. Refer to Graph 9 for details.

Graph 5: Soil Temperature at 5cm vs. Rainfall



Graph 6: Soil Temperature at 10 cm vs. Rainfall

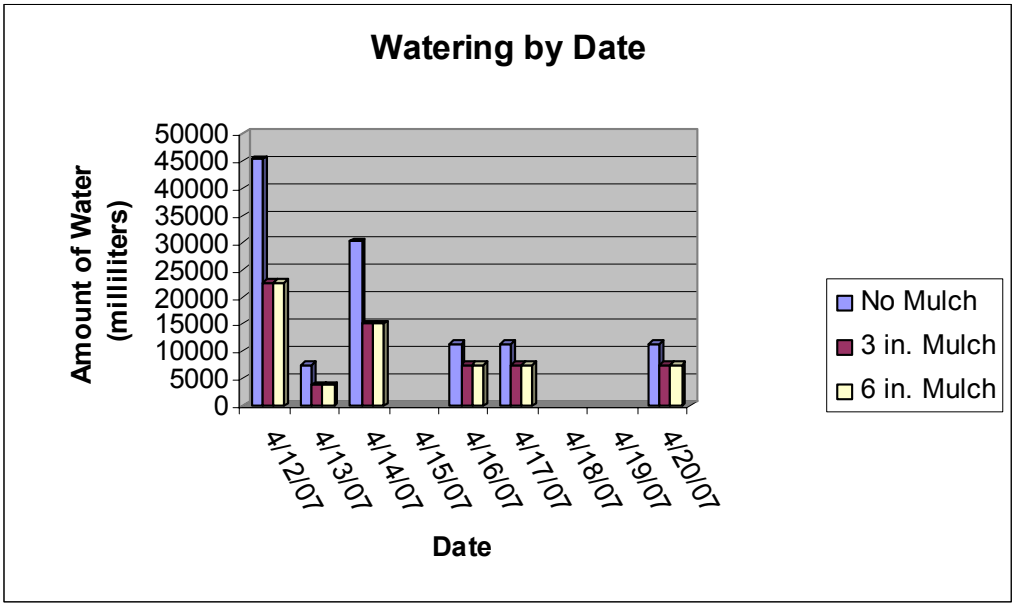
*Note during the period of April 12th though 20th water was added to the garden beds. Refer to Graph 9 for details.

Graph 7: Soil Moisture at Surface vs. Rainfall

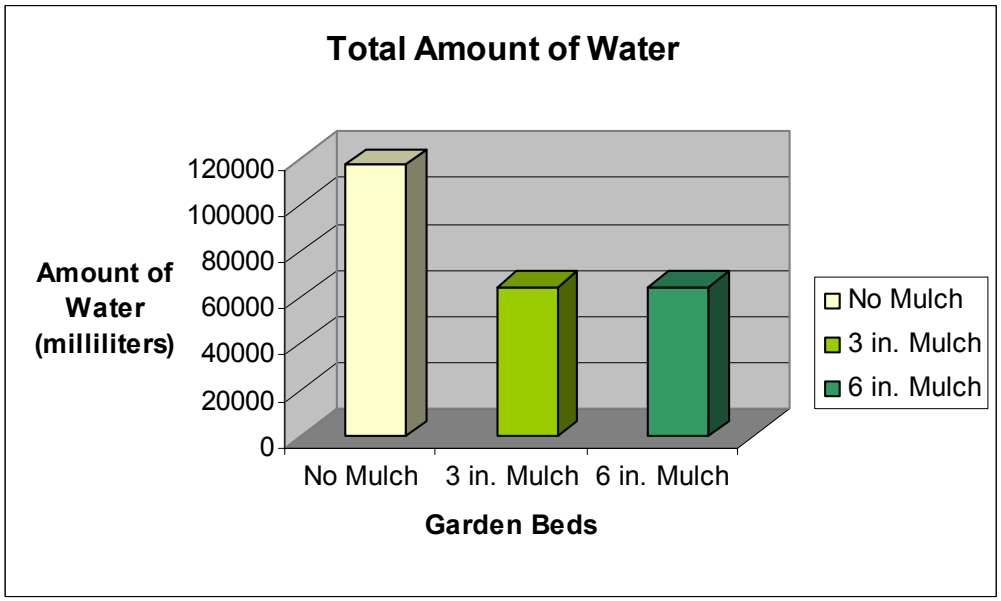
Graph 8: Soil Moisture at 10 cm vs. Rainfall

*Note during the period of April 12th though 20th water was added to the garden beds. Refer to Graph 9 for details.

Graph 9:



Graph 10:



Graph 11:

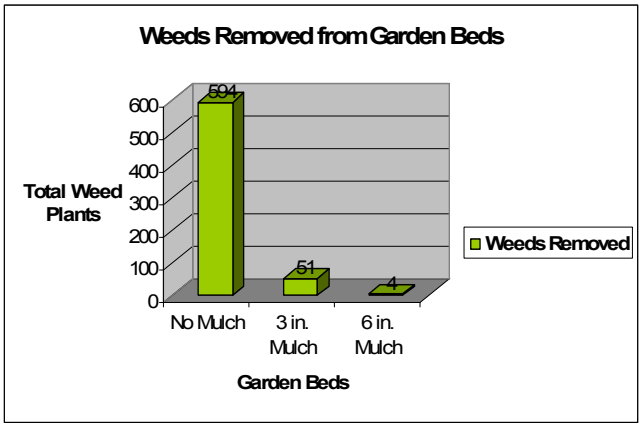


Photo 1:
No mulch bed before weeding

Photo 2:
3 inch mulch bed before weeding

Photo 3:
6 inch mulch bed before weeding

Photo 4:
Weeds in no mulch bed (594)

Photo 5:
Weeds in 3 inch mulch bed (54)

Photo 6:
Weeds in 6 inch mulch bed (4)

Table 1:

Accumulative Bolting Romaine Lettuce

Date	No Mulch	3 in. Mulch	6 in. Mulch
5/10/2007	1	1	2
5/11/2007	1	1	1
5/14/2007	2	2	2
5/15/2007	0	0	1
5/16/2007	1	0	0
5/18/2007	0	0	0
5/20/2007	0	0	0
5/25/2007	0	0	0
Total	5	4	6

Table 2:

Accumulative Bolting Anuenue Lettuce

Date	No Mulch	3 in. Mulch	6 in. Mulch
5/10/2007	0	0	0
5/11/2007	3	0	1
5/14/2007	1	2	0
5/15/2007	2	6	2
5/16/2007	1	0	4
5/18/2007	4	2	0
5/20/2007	0	0	1
5/25/2007	0	2	4
Total	11	12	12

Analysis

After reviewing the data from graphs 1 and 2, we can see that the temperatures in the bed with no mulch were consistently higher for both the 5 and 10 centimeter depth measurements than the temperatures in both the 3 inch mulch and the 6 inch mulch beds. We also calculated the range of temperatures by subtracting the minimum temperature from the maximum temperatures. The range of temperatures in the bed with no mulch was substantially higher (16°C at 5cm, 11°C at 10cm), and more extreme than the range of temperatures in the 3 inch mulch bed (7.5°C at 5cm, 5.5°C at 10cm) and the six inch mulch bed (7°C at 5cm, 5°C at 10cm).

Graphs 3 and 4 show the differences in the soil moisture for all three beds at surface and 10 centimeter depths. Generally, the soil moisture measurements for the three inch and six inch mulch beds were higher than that of the bed with no mulch. It was also found in these graphs that the range of soil moisture measurements for the bed with no mulch was much higher than the range of measurements for the three and six inch mulch beds. In our graph for soil moisture in the beds at surface (graph 3), there were two data points (dates 4/ 18/ 2007 and 5/ 03/ 2007) that did not fit the trend for the three inch

points (dates 4/ 18/ 2007 and 5/ 03/ 2007) that did not fit the trend for the three inch mulch bed. These anomalies were most like due to error in the measurements or the recording of the measurements

Graphs 5 and 6 compare the soil temperature with the amount of rainfall over the course of the experiment. The temperatures for the bed with no mulch were affected much more by precipitation than the temperatures of the other two beds. When there was rain, the soil temperatures for the bed with no mulch dropped dramatically, only to rise again during the periods of no rain. The temperatures in the three and six inch mulch beds maintained a smaller range of temperatures than the bed with no mulch.

Graphs 7 and 8 compare the soil moisture in the garden beds with the rainfall. These are two of the most important graphs because they show mainly how the mulch in the garden beds helped maintain soil moisture, even without the presence of precipitation. In the graphs, there is evidence of a period of drought, lasting from 3/31/2007 until the first substantial rain on 4/21/2007. During this period, the soil moisture levels for the bed with no mulch dropped dramatically, while the soil moisture levels for the beds with mulch maintained high moisture levels. (Note that during the period of April 12-20, water was added to the beds.)

After our team planted the lettuce plants, we were forced to water the lettuce due to this period of drought, lest the plants should die. The team watered each bed six times during the period of April 12 to April 20. Graphs 9 and 10 show how much water was added to each bed throughout a period of eight days.

Though it was an unforeseen factor in our experiment, graph 11, as well as photos 1-6 show that the use of mulch in the beds also helped cut back on the amount of weeds in each bed. When we weeded the gardens, we found that there were almost 600 weeds in

the garden bed with no mulch, in comparison to 54 weeds in the bed with three inches of mulch, and merely 4 weeds in the bed with six inches of mulch.

Lastly, tables 1 and 2 show the amount of lettuce plants that bolted in each bed over time. In general we found that all of the Romaine lettuce bolted at approximately the same time. With the Anuenue Lettuce, it appeared that the lettuce in the beds with mulch bolted later than the lettuce in the bed with no mulch. However, we do not have enough data to make conclusive assumptions about these results.

To help validate our temperature measurements, the GLE team compared the data logger measurements from our nearby atmospheric site with the dial thermometer temperatures, the group noticed that the data logger measurements were generally lower than the temperatures in the no mulch bed and were above or equal to the beds with both 5 and 10 centimeters of mulch.

We also compared the data logger solar noon temperatures with the maximum temperatures from the data logger and found that generally, the maximum temperatures were about 1 to 3 degrees Celsius higher than the temperatures for solar noon. However, there were a few instances where the maximum temperatures were up to 8 degrees higher than the temperatures at solar noon.

The team also took notice of areas of possible uncertainty in our measurements. Though we were careful to follow the soil moisture protocols, we were aware that we did not always have the same amount of soil in the sample cans. However, this should have had little or no effect on our soil moisture percentage, as we recorded the ratio of the mass of dry soil to the mass of the wet soil. It is also important to mention that the dial thermometer that was used to record the soil temperature had increments of 2 degrees Celsius, and our measurements were estimated to the nearest half of a degree.

Conclusions

The GLOBE team concluded that the use of yard mulch on garden beds in the tropics does have a noticeable effect on both the soil moisture and the soil temperatures of the garden beds. The addition of leaf mulch lowered soil temperatures and maintained higher soil moisture measurements than the bed without mulch. The beds with mulch also had a much lower range of temperatures than the bed containing no mulch. Likewise, the range for the soil moisture content in the beds with mulch was less than that of the bed without mulch.

The three- and six-inch mulch beds were similar in their soil temperature and soil moisture content; although the six-inch bed generally had lower temperatures and higher soil moisture contents than the three-inch mulch bed.

The data for the soil moisture vs. rainfall was especially important in the short periods of drought that occurred during the course of the experiment. The GLOBE 2007 team was able to infer that the use of mulch could help sustain higher soil moisture content levels considerably longer than without the use of mulch.

Similarly, during these periods of no rain or water, temperature levels in the no-mulch bed rose significantly. The beds with mulch, however, maintained low temperatures, as well as a constant range of soil temperatures in the beds.

During a period of no rain that occurred between the dates of March 31st and April 22nd, after the lettuce was planted, the team was forced to water the plants to prevent them from drying. We found that more water was necessary in the bed with no mulch in comparison with the amount necessary in the beds with mulch.

The team also concluded that adding mulch in the garden beds helped to greatly reduce the amount of weeds found in the garden.

In summary, the GLOBE 2008 team concluded that the use of mulch was highly beneficial for gardens in the tropics, as it helped to maintain higher soil moisture content and helped to minimize temperature variations in the soil.

Discussion

After implementing our research project, we feel the use of mulch was highly beneficial to garden beds in the tropics. From our conclusions, we found several ways the usage of mulch helps conserve soil moisture, decreases the soil temperature and reduces weeds, which can certainly benefit any local gardeners in the tropics.

This use of mulch in our garden bed is highly advantageous to sustainable communities. We removed leaf mulch that was destined for the landfill and put it to good use. Instead of over-filling the landfills with organic leaf mulch, we spread it upon our garden. With more usage of organic mulch used on local gardens, the amount of organic waste would be inevitably reduced, along with the usage of water used to maintain the gardens. The more percentage of yard mulch being recycled, rather than being dumped in landfills, the better Puerto Rico's environment will be. The sustainable lower temperatures of the soil and high soil moisture levels could allow growth of gardens in the communities to be extended through various dry seasons, and ultimately cut down the importation of food from elsewhere. Not only would the transportation be cut down, but also the amounts of fuel and energy used to conserve these imports would dissipate.

This would mean that the potential gardener in the tropics, with the use of mulch, would have to water his/her garden much less often, thereby cutting back on water usage. Our findings, when implemented, may prove a small-scale solution to a water shortage problem in Puerto Rico and other sustainable communities.

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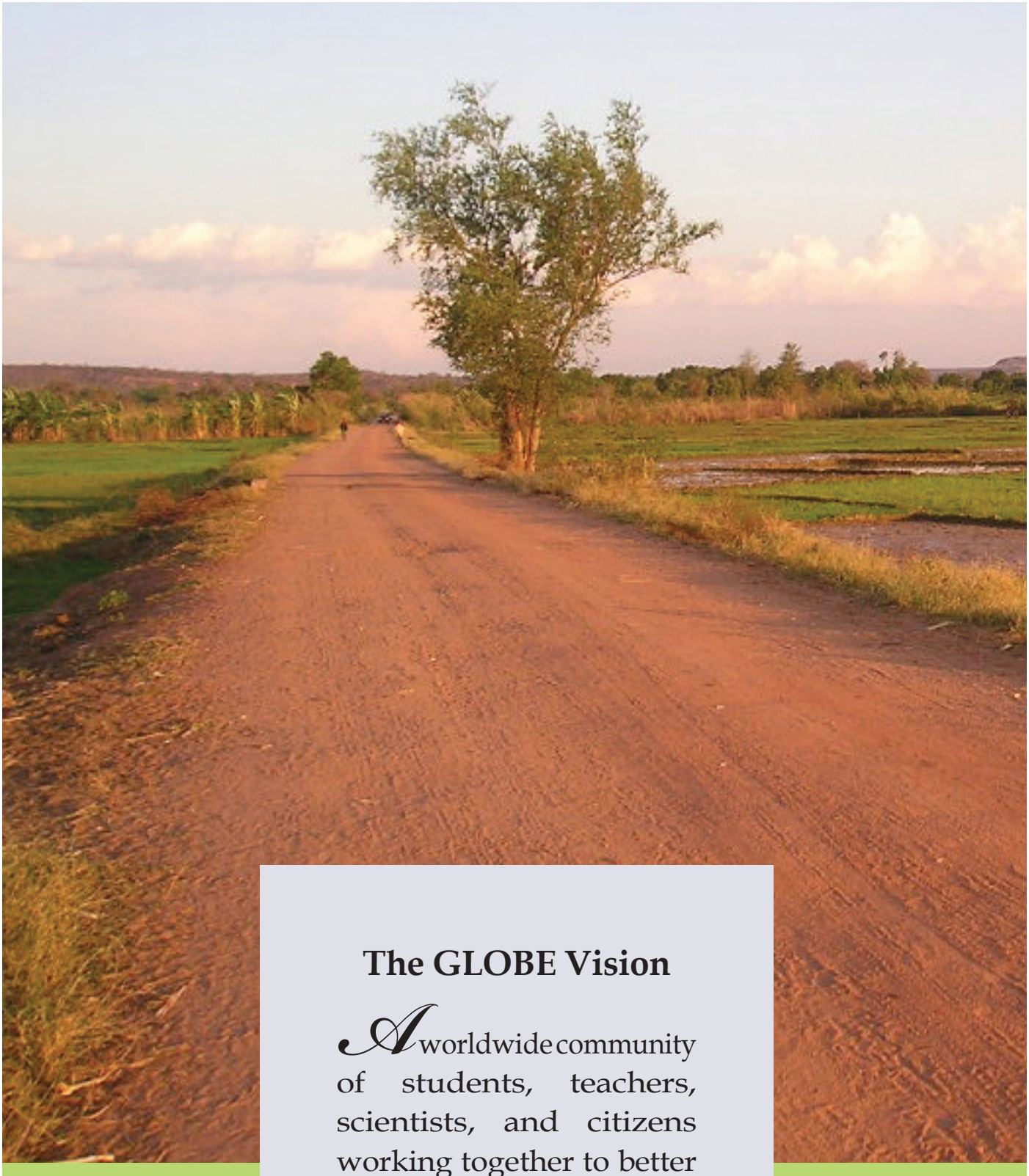

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A worldwide community of students, teachers, scientists, and citizens working together to better understand, sustain, and improve Earth's environment at local, regional, and global scales.

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