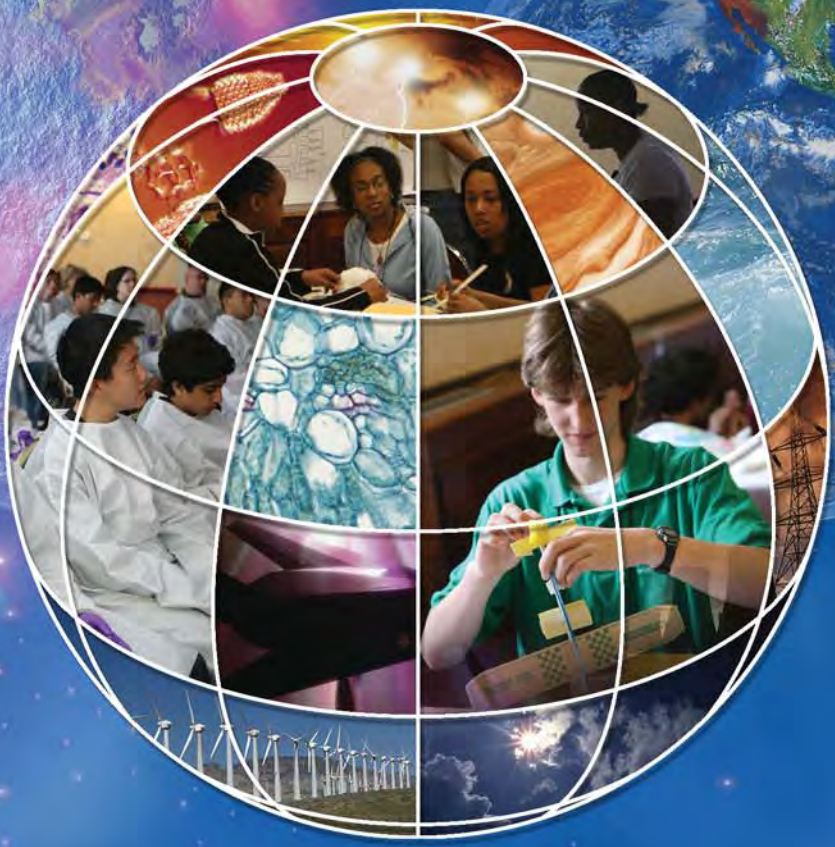
U.S. Department of Energy

National Science Bowl®

for High School Students

SCIENCE DAY PROGRAM



May 3, 2008

U.S. Department of Energy

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U.S. DEPARTMENT OF ENERGY

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National 4-H Conference Center

Sprinkled throughout the 2008 National Science Bowl® Science Day Program are many of the scientific discoveries highlighted in **The Science Channel's** series ***100 Greatest Discoveries*** hosted by Bill Nye. The Science Channel presented the big 100 in 9 episodes — Astronomy, Biology, Chemistry, Earth Science, Evolution, Genetics, Medicine, Physics — and ended with a wrap-up episode featuring the top 10 scientific discoveries. The show first aired December 2004. To find out more, go to http://science.discovery.com/. The Science Channel is part of the Discovery Communication, LLC network.

Seminars by Times and Locations

Room	Seminar	Page
Seminar I: 9:00–10:15 a.m.		
Aiton Auditorium	*How Many Scientists Does It Take to Change a Lightbulb?* – Dr. Paul Burrows	6
Seminar II: 10:30–11:45 a.m.		
Ohio Room	*Having Fun With Astronomy* – Wayne Bird	7
Iowa Room	*Fishing the Fermi Sea: The Search for Novel Materials* – Dr. Paul Canfield	8
Clover Room	*Science and Storytelling in Forensic Pathology* – Dr. Wendy Gunther	9
America Room	*Exploring Extinction and Invasion in Ecosystems with Network Science* – Dr. Neo Martinez	10
Missouri Room	*Enhancement Activities: Electromagnetics, Drop Zone, Laser Range*	12
Seminar III: 1:15–2:30 p.m.		
Ohio Room	*Having Fun With Astronomy* – Wayne Bird	7
Iowa Room	*Fishing the Fermi Sea: The Search for Novel Materials* – Dr. Paul Canfield	8
Clover Room	*Science and Storytelling in Forensic Pathology* – Dr. Wendy Gunther	9
America Room	*Exploring Extinction and Invasion in Ecosystems with Network Science* – Dr. Neo Martinez	10
Minnesota Room	*Theoretical Physics in the 21st Century* – Dr. Robert McNees	11
Missouri Room	*Enhancement Activities: Electromagnetics, Drop Zone, Laser Range*	12

Division Team Challenge Competition Schedule

Room	Division
Session I: 2:45–3:45 p.m.	
Missouri Room	Arrhenius Division
Ohio Room	Bromery Division
Oklahoma Room	Einstein Division
Colorado Room	Galileo Division
Session II: 4:00–5:00 p.m.	
Ohio Room	Curie Division
Colorado Room	Darwin Division
Missouri Room	Fermi Division
Oklahoma Room	Hypatia Division

Round Robin Division	DTC Category
Arrhenius	Chemistry
Bromery	Geophysics
Curie	Earth Science
Darwin	Biology
Einstein	Physics
Fermi	General Science
Galileo	Astronomy
Hypatia	Math

1924 – 1929: The Universe Is Expanding — Edwin Hubble determines the distance to many nearby galaxies and discovers that the farther they are from us, the faster they are flying away from us. His calculations prove that the universe is expanding.

Discovering Science with Science Day Seminars!

Seminars –

All participants will enjoy the plenary session in the Aiton Auditorium for Seminar I. For Seminars II and III, students can choose to attend the session that interests them the most. Make sure to get to the sessions on time as the seats fill up fast! Most of the speakers are presenting during both sessions, so once all of the seats are filled in a room, participants will be asked to attend a different presentation for that seminar block.

Enhancement Activities –

Only students can participate in the Enhancement Activities in the Missouri Room for Seminars II and III. An entire team does not have to partake in the activities and students from different teams are invited to work collaboratively.

Division Team Challenges –

During the Division Team Challenge (DTC), each team in the same division will be given an identical hands-on problem that they must work collaboratively to solve. The nature of the problem is related to a scientific field studied by the scientist for which the division was named. Session I of the DTCs will be from 2:45–3:45 p.m. During this time, half of the divisions will compete. There will be four rooms running different divisions' DTCs concurrently. Session II will be from 4:00–5:00 p.m. and will involve the other four divisions. Only the students participating in the challenge will be allowed to enter the competition room.

The teams within each division will be ranked according to their performance on the assigned problem. At the end of the round robin tournament, the rankings will be used to break division ties, if necessary, to determine which teams will move on to the double elimination rounds.

★ **The sky really is falling on page 7.**

★ **Out with the old; in with the new . . . compounds on page 8.**

★ **Unlock the secrets with CSI Science Bowl on page 9.**

★ **Hungry to learn about complex ecological networks? Connect on page 10.**

★ **Turn your world upside down on page 11.**

★ **Opposites Attract, Hit the Bulls Eye and Don't Shoot with the Enhancement Activities on page 12.**

How Many Scientists Does it Take to Change a Lightbulb?

(The Challenge and Promise of Solid State Lighting)

Dr. Paul Burrows

Plenary Session

Aiton Auditorium

9:00–10:15 a.m.

Facilitator: Sue Ellen Walbridge

The rising cost and diminishing supply of energy have been making headlines this year. Finding the new sources of energy that growing populations in both developing and industrialized countries will need is an enormous challenge, with each choice likely to impact the environment. Appliances that do the same job using less energy, however, can help no matter what the source of that energy. Artificial lighting in homes, offices, schools, and stores devours over a fifth of the electricity generated in the United States, but current lighting technology is at best 20% efficient and the traditional incandescent lightbulb is only 5% efficient. When you switch on the light, therefore, between 80% and 95% of the energy used is actually converted to heat. The story of artificial lighting begins at the dawn of civilization but the final chapters have yet to be written. This lecture will explain why it is so hard to make an efficient lightbulb and how you might light the energy-efficient home of the future, from glowing semiconductors to light emitting plastic.

Dr. Paul Burrows is a Technology Consultant working in Kennewick, Washington. He recently spent seven years as a Laboratory Fellow at Pacific Northwest National Laboratory (PNNL) leading the Nanoscience and Nanotechnology Initiative and developing a research program in organic solid state lighting, using carbon-based materials to efficiently generate light. He has authored over 110 publications and is a co-inventor of 78 issued U.S. patents. From 1992 – 2000, Dr. Burrows was a Research Scholar at Princeton University in the Department of Electrical Engineering. He has also held positions at the University of Southern California and the Riken Institute in Saitama, Japan. His work has been instrumental in the creation of two new companies; Universal Display Corporation, which is developing a portfolio of intellectual property based on work performed at the Princeton University laboratories and Vitex Systems, a company spun off from Battelle to develop flexible encapsulation technology for large area electronic devices. He was awarded a Ph.D. in physics from the University of London in 1989.

Having Fun With Astronomy

Wayne Bird

Ohio Room

10:30–11:45 a.m.

Facilitator: Barbara Billington

1:15–2:30 p.m.

Facilitator: Steve Woodruff

Find out how, by using the most powerful word known to mankind — the "I" word (if you do not know what the "I" word is, come and find out), to find a way through the maze of planets (12 at last count — but who is counting), to explore the life and death of a star (make your very own white dwarf), and black holes work (watch as we warp the fabric of space). We will find out who is smarter than a fifth grader with Cosmic Survey Cards (start studying now, otherwise you will not have a chance), with Wayne Bird of the American Astronomical Society and Observatory Director of the Westminster Astronomical Society. Learn fun and unique ways to leave the planet, journey to the stars, and still be back in time for lunch. Highlights of the program: Chicken Little was Right; How **Big is Big**, How **F a r is F a r** and How **Small We Really Are**; Time Travel Made Easy; and if time, Fusion Magic Tricks.

Wayne "Skip" Bird is presently the Treasurer/Observatory Director (building it now)/Night Sky Network Guru for the Westminster Astronomical Society, and outreach fanatic (definition of fanatic: someone who will not change his mind AND will not change the subject). He is also an Education Assistant for the American Astronomical Society and a teacher for astronomy and physics with the 21st Century Community Learning Center and South Carroll Covenant Keepers Home School Association. He is the world renowned author of "Night Flying Astronomy Bird" articles (OK, maybe world renowned is being a little modest), and the World's Greatest Dad — he has the button to prove it.

1978: Laetoli Footprints — A team led by Mary Leakey discovers fossilized Australopithecus footprints in Laetoli, Tanzania. The footprints, dated to 3.5 million years ago, were formed when two individuals walked over wet volcanic ash that had hardened like cement. These human ancestors had perfect, two-footed strides, indicating that the hominids walked upright.

Fishing the Fermi Sea:

The Search for Novel Materials

Dr. Paul C. Canfield

Iowa Room
10:30–11:45 a.m.
Facilitator: Steve Karsjen
1:15–2:30 p.m.
Facilitator: Garvin Wattuhewa

The design, discovery, growth, characterization, and use of novel materials is the greatest achievement of modern society. Ultimately our ability to design and/or discover new materials will also determine our fate as a species: many of the problems that face us today will have to be addressed by radically different materials than are currently available. In this presentation, I will try to outline how the physicist interested in novel materials goes about trying to discover and understand several classes of compounds. An emphasis will be placed on aesthetics and excitement of the process. Specifics of the physics and detailed mathematics will be avoided at all costs.

Dr. Paul C. Canfield is a distinguished professor of physics at Iowa State University and a senior physicist at Ames Laboratory. He received his undergraduate degree in physics from the University of Virginia in 1983 and his Ph.D. in physics from UCLA in 1990. After a three-year Post-Doctoral stint at Los Alamos National Laboratory, Dr. Canfield started his career as staff scientist and then faculty at Ames Laboratory and Iowa State University. The unique combination of a DOE laboratory located directly onsite of a large research university has provided a rich, interdisciplinary environment for a research program focused on the design, discovery, growth, and characterization of novel materials. Dr. Canfield's group's web page can be found at http://cmp.ameslab.gov/personnel/canfield/ and provides updates to ongoing research, review articles, and pictures of current and former staff, as well as samples.

Science and Storytelling in Forensic Pathology:

A Medical Examiner Talks about Tough Cases

Dr. Wendy Gunther

Clover Room
10:30–11:45 a.m.
Facilitator: Kari Skalicky
1:15–2:30 p.m.
Facilitator: Debra Halliday

As a medical examiner for the state of Virginia, my job is to do an autopsy on a dead body that the police have sent to me to see if I can find out what the person died from, and whether it was murder. This means I need to use science in combination with the stories that police and other people tell me, to sift suicides, accidents, and natural deaths from homicides. In this presentation I tell you about real cases, and explain the combination of science and stories that allowed me to determine the manner of death for each of them. I teach you about the manners of death with examples from easy and then difficult cases, and ask you to vote on how you would have decided my toughest cases. I also touch on other uses of science in forensics, including the uses and drawbacks of DNA, the help we get from ballistics and other forensic sciences, and the ways we identify people who no longer look anything like the way they did when they were alive.

Dr. Wendy Gunther took an aptitude test in high school that asked, "Do you like to work with your hands?" She said, yes, very much. Then it said, "Do you like to read books, and do you like science?" She said, yes, very much. It said, "Error. There is no job for you." It was wrong. She has a job where she works with her hands, reads, teaches, and uses science. It is called forensic pathology. You have to be a doctor to do this. She became a doctor back in 1986. She thought she was going to be a family doctor and spend her life taking care of people, but instead she found herself in love with surgery, where you get to use your hands, and then switched over to forensic pathology, a specialty she had never even heard of before she went to medical school. She spent 4 years in high school, 5 years in college, 4 years in medical school, and 9 years in residency, which if you count high school, makes 22 years of education before she got her first real job! She has worked for medical examiners' offices in New York City where she trained; in Memphis, TN; Washington, DC; and now in Norfolk/Virginia Beach, VA. She is 49 years old, is married, and has a dog, but no kids. She is really happy with her life in forensic pathology. She has not been near a high school in 15 years.

Exploring Extinction and Invasion in Ecosystems with Network Science

Dr. Neo Martinez

America Room
10:30–11:45 a.m.
Facilitator: Cindy White
1:15–2:30 p.m.
Facilitator: Maddy McNaughton

These are not your grade school food chains. Instead, they are complex ecological networks, known as food webs, where the abundance of many interacting species rise and fall as food availability and predator activity change over time. What do these networks look like? How do they stay together without blowing up and crashing? What happens when species are lost? This presentation provides the most recent and still evolving answers to these questions. Many of the answers come from 3D network visualizations and massive computational experiments that make species within networks go extinct or invade the networks with alien species and see what happens. A major goal of this work is to provide models to help people manage ecosystems such as fisheries or forests. For a sneak preview, see our award-winning video at foodwebs.org.

Neo Martinez explores interdependence in complex systems, most specifically that of feeding relationships within ecosystems. His work on the structure and dynamics of these relationships has helped move ecology from a focus on species and their pair-wise interactions to a focus on large systems of species comprising complex ecological networks. This work also addresses network science in general and has developed new technologies for informatics and computational biology, including widely used network visualization software. Major findings of his research include discoveries of a very simple and highly general "niche model" of the network structure of ecosystems and constraints on the nonlinear dynamics of these networks needed to enable the great biodiversity of ecosystems to persist. Current research includes studying evolution of species within networks, the structure of ancient food webs in paleoecosystems, and the ecology and economy of human-natural networks. Neo holds a B.S. in biology from Cornell University, an M.S. in limnology and oceanography from the University of Wisconsin, and an interdisciplinary M.S. and Ph.D. in energy and resources from the University of California at Berkeley, where he co-founded and currently directs the Pacific Ecoinformatics and Computational Ecology Lab.

Theoretical Physics in the 21st Century:

Big Bangs, Superstrings, and Everything In-Between

Dr. Robert McNees

Minnesota Room
1:15–2:30 p.m.
Facilitator: Kari Skalicky

Physicists have developed intricate theories that describe the behavior of matter and energy over a dizzying range of scales. These theories let us trace the history of the universe all the way back to a fraction of a second after the big bang, or fast-forward to what it will look like billions of years from now. We can zoom in on a sub-atomic world governed by the weird laws of quantum mechanics, or predict how gravity will affect the evolution of vast, filamentary networks of galaxies that thread the cosmic void. This talk begins with a review of two important theories developed during the 20th century: General Relativity and the Standard Model of Particle Physics. What do these theories tell us about nature? Why do scientists agree that they are correct? And, most importantly, what are their limitations? Trying to answer this last question leads us on a tour of some of the major problems faced by theoretical physics in the 21st century. We will encounter black holes that glow, supernovae that are suspiciously dim, little loops of string that vibrate in 10 dimensions, and a whole host of radical ideas that promise to change the way we understand the world around us.

Dr. Robert McNees is a visiting scientist at the Perimeter Institute for Theoretical Physics, where he works on problems in String Theory, Cosmology, General Relativity, and Particle Physics. Robert received his Ph.D. in physics from the University of Texas and his B.S. in physics from the University of North Carolina. In 1991, as a senior at Oak Ridge High School, he competed in the first National Science Bowl®. While he was an undergraduate he had the opportunity to conduct research on a wide variety of topics: cryptography at Oak Ridge National Laboratory, acoustics at Penn State, and plasma physics at UNC. After a year abroad as a Rotary Ambassadorial Scholar, he began graduate studies at UT-Austin, where he worked in Professor Steven Weinberg's research group. Following his graduation, he held Post-Doctoral research fellowships at the University of Michigan and at Brown University. He currently lives in Ontario with his wife Kelly and two cats that pounce on his important physics papers if he turns his back for even a second.

Enhancement Activities (Students Only)

Missouri Room
10:30–11:45 a.m.
1:15–2:30 p.m.

Facilitators: Jan Tyler, Vince Schielack, Ben Walbridge, Annette Hoff, Yamunna Wattuhewa, Cathy Osiecki

Electromagnets –

Design, build, and calibrate an electromagnet with the materials provided to pick up a specific number of paper clips.

Drop Zone –

Design, build, and calibrate a ramp with the materials provided that will allow your team to roll a ball off of a table and onto a target on the floor.

Laser Range –

Position mirrors so that a laser beam is directed around an obstacle and onto a target located across the room.

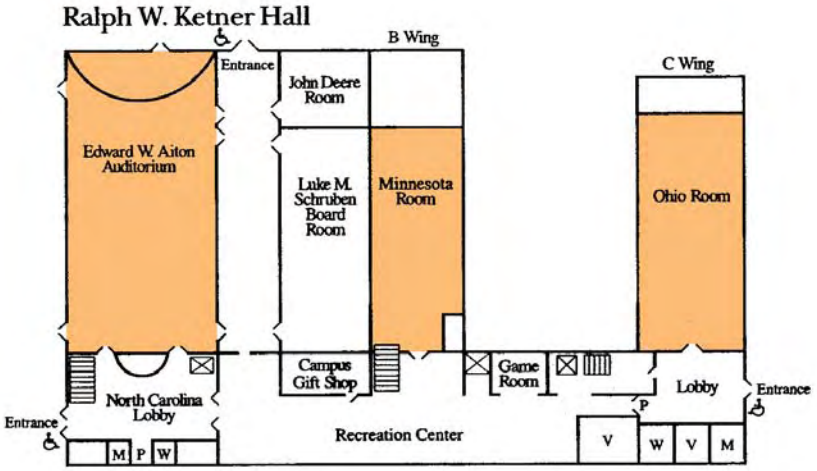
Division Team Challenge Competition

The Division Team Challenges (DTCs) are designed to test a team's ability to practically "do" science in the way that scientists and engineers do. The tasks have several possible ways to proceed and teams will have to apply scientific reasoning, measurement, and analytic skills to be successful.

All teams in the same division will have an identical problem to solve at the same time. Each team will receive a score and will be ranked within their division. Division ties at the end of the round robin matches will be decided by the DTC rankings.

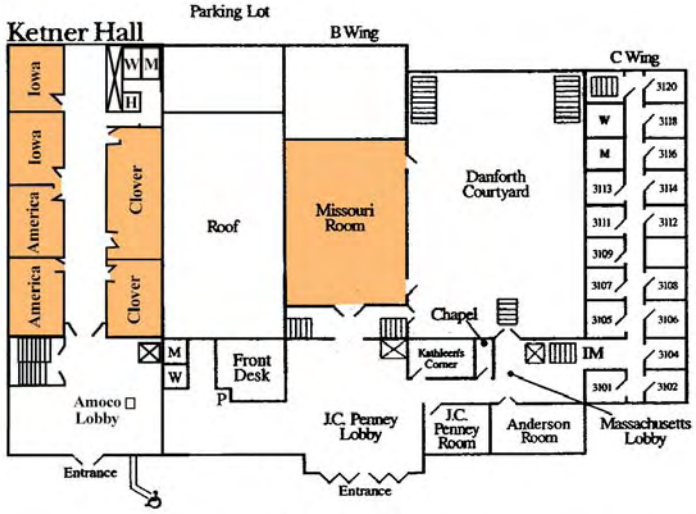
1770s: Photosynthesis — Jan Ingenhousz discovers that plants react to sunlight differently than shade. The underpinnings of the understanding of photosynthesis are born. Photosynthesis is a process in which plants, algae, and certain bacteria convert the energy of light into chemical energy. In plants, leaves take in carbon dioxide and roots absorb water. Sunlight runs a reaction that yields glucose (food for the plant) and oxygen (a waste product released into the environment). Nearly all living things on Earth are ultimately dependent on this process.

Interior Campus Map



Lower Level

J.C. PENNEY HALL

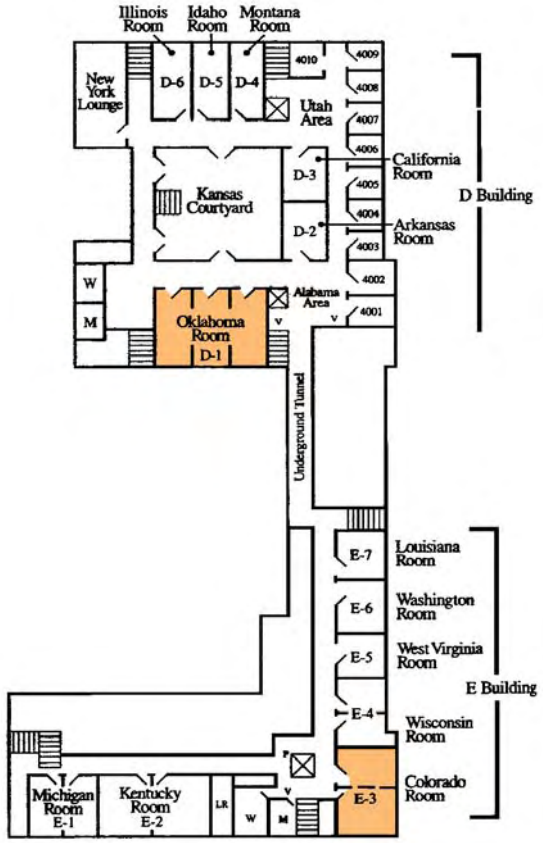


Ground Floor

FIRESTONE HALL

MCCORMICK HALL

W.K. KELLOGG HALL



Lower Level

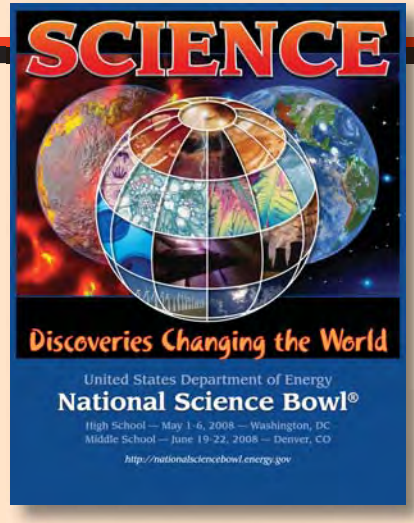
KEY

- ELEVATORS
- STAIRS
- M W REST ROOMS
- LR LAUNDRY ROOM
- IM ICE MACHINES
- V VENDING MACHINES
- P PHONE
- ♿ ACCESSIBLE ENTRANCE

Early 1900s: Vitamins — Frederick Hopkins and others discover that some diseases are caused by deficiencies of certain nutrients, later called vitamins. Through feeding experiments with laboratory animals, Hopkins concludes that these "accessory food factors" are essential to health.

THANK YOU

to all our
Seminar Speakers
and the Division Team
Challenge volunteers
for sharing their time
and energy with the
participants of the 2008
National Science Bowl®.



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