Unit 7: How Our Water Becomes Polluted

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Unit 7: How Our Water Becomes Polluted

Objectives: Each student will be able to:

- List causes of water pollution
- Discuss how people contribute to water pollution
- Explain the concept of a **watershed**

Words to Remember:

- **acid**
- **acid rain**
- **agriculture**
- **algae**
- **aquatic**
- **Blackbelt**
- **contaminants**
- **crop rotation**
- **DDT**
- **diversity**
- **erosion**
- **fertilizer**
- **habitat**
- **invertebrate**
- **landfill**
- **lagoon**
- **leach**
- **nonpoint source**
- **nutrients**
- **PCBs**
- **pesticides**
- **pH**
- **point source**
- **pollutants**
- **radium**
- **radon**
- **runoff**
- **sediment**
- **solvent**
- **Tennessee Valley**
- **toxic**
- **universal solvent**
- **watershed**
- **wetlands**
- **Wiregrass**

Background Information

Water has many properties. One of its properties is its ability to dissolve many substances. Because of this property, water is known as the **universal solvent** and is seldom found pure in nature. In fact, natural waters may contain hundreds or even thousands of chemicals, and in some cases, an equal number of biological life forms (such as microorganisms).

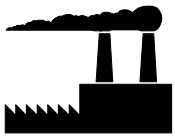
All forms of life depend on water. Water helps to dissolve chemicals in foods, then it transports these chemicals to cells in our bodies. However, sometimes harmful substances can dissolve in water. Substances that harm the quality of water are known as **pollutants** or **contaminants**. Most contaminants in water do not cause problems because they are not toxic and are at such low amounts. However, some substances which dissolve in water, even at very low levels, can be harmful.

Causes of Water Pollution. There are two primary causes of water pollution: nature and people. Actually, although **pollutants** and **contaminants** are generally used to mean the same thing, **pollutants** are usually thought of as contaminants or impurities in water due to the activities of *people*. **Contaminants** are usually thought of as impurities in water caused by *natural processes*.

Naturally occurring events such as volcanic eruptions, landslides, floods and wild animal wastes, can produce polluting materials. These pollutants can wash into lakes, rivers and other streams and damage water quality.

Groundwater can become contaminated by the minerals it comes in contact with. A natural source of groundwater pollution is a gas called **radon**. **Radon** comes from certain types of rock which contain the element **radium**. Scientists believe radon is dangerous to people, so groundwater from wells where minerals contain radium

should be tested for radon. Special filters on faucets can remove radon from water.



However, *people* cause most water pollution. People cause water pollution through carelessness or lack of knowledge. Farms, factories, automobiles and even our homes are potential sources of pollutants.

Farmers, gardeners and homeowners use **fertilizers** and **pesticides** on their crops, gardens and lawns. Although **fertilizers** supply **nutrients** which are essential for healthy plant growth, the use of too much fertilizer can cause nutrients to wash into streams and creeks. Surface waters contaminated by too many nutrients may contain large amounts of **algae**. Algae is necessary for **aquatic** life, but too much algae can cause the water to turn green and have a bad smell or taste. It may even kill fish when it dies and rots in the water. Bacteria that grow and eat the dead algae use up all the oxygen. If this happens, the fish die from a lack of oxygen.

Pesticides sprayed on crops help protect the plants from diseases and bugs. Diseases and insects are especially a problem in the humid climate of Alabama. If pesticides weren't used, farmers, gardeners and others would have a hard time growing successful crops. But many pesticides are **toxic**, or poisonous. They may wash into streams or soak too far into the ground. They may harm **aquatic** life and pollute our drinking water.

Sometimes contaminated water from factories is dumped or washed into nearby waterways. Poisonous chemicals may also be spilled, poured on the ground, or buried in **landfills** or other places. These chemicals can **leach**, or soak, into the groundwater, contaminating our water supplies.

Automobiles are very useful in our society but they cause air and water pollution. Internal combustion engines from cars release dangerous gases into the air. Some of these gases react with water vapor to form **acid**. When this water vapor condenses it produces **acid rain**. This acidic water harms aquatic life in lakes and can damage trees and buildings.

People contribute to water pollution in their homes. In fact, homeowners apply more fertilizers and pesticides, per square foot, on their lawns and gardens than farmers apply to entire crop fields. Homeowners don't always properly dispose of poisonous wastes, either. Some wastes may be thrown into ditches or the woods, or flushed down the drain. Even some of the wastes that end up in **landfills** may leach into water supplies. Septic systems that are not functioning properly also can contaminate groundwater. All of these things can contribute to water pollution.

***Types of Water Pollution*.** There are two main types of water pollution: **point source** and **nonpoint source**. **Point source** pollution is any pollution that comes from a particular spot or source. For example, when a factory dumps contaminated water into a river, it is **point source** pollution.

Nonpoint source pollution comes from widespread areas, not just a particular point. It is not always easy to identify the specific source of **nonpoint** pollution. It may come from many individual places. Stormwater can cause **runoff** (precipitation that flows off the land) from urban areas and farm fields. This runoff can carry **sediment**, nutrients, pesticides and other chemicals from farms and cities. It can travel a long way before entering a stream or river. Acid rain is another example of nonpoint sources of pollution. The causes

of acid rain and the areas affected may be extensive.

Nonpoint sources of pollution are harder to clean up because they come from a variety of sources over a large area. See Figure 7.1 for examples of nonpoint sources pollution.

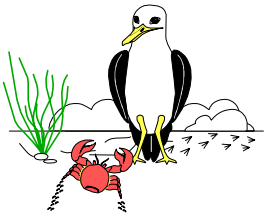
The Watershed. A **watershed** is the land area that drains into a water system such as a river, stream or lake. This land area may contain many smaller rivers, streams and creeks. An example of a watershed in Alabama is the Flint Creek Watershed in northern Alabama (Figure 7.2). In this watershed, Flint Creek joins West Fork Creek; they both eventually flow into the Tennessee River. Smaller watersheds make up larger watersheds. An example of a large watershed is the Mississippi River Watershed. This very large watershed stretches from the Rockies to the Appalachian Mountains. It contains many rivers; these include the Missouri, Ohio, Arkansas and Tennessee Rivers.

Any land activity within a watershed can affect the water quality of its rivers and streams. Most precipitation eventually either seeps into the groundwater or drains into surface waters before it evaporates or is transpired back into the atmosphere. The **runoff** into surface water can carry polluting materials. These materials could be from farmland, woodland, urban areas, marinas, waste dump sites and landfills, construction sites or other land-disturbed areas, or where oil on and other chemicals have been spilled or used on streets and roadways. To find a nonpoint source of pollution, we often must examine the entire watershed. Therefore, the understanding of a watershed is very important.

Wetlands. **Wetlands** are areas of land that are often covered by water. They may contain either salt water or fresh water. Swamps and marshes are examples of wetlands.

We used to think that wetlands were worthless areas. These lands are difficult to use for buildings or for planting crops. Now we realize that wetlands are very valuable. They help to control possible pollution problems. Wetlands act as a natural filter for water soaking into the ground. They function as a transition between an area of land and a body of water. In this transition zone, wetlands can trap sediment and pollutants, and help to break them down before they run into surface waters.

Wetlands act as storage areas for storm water. They provide **habitats** for many fish and other wildlife. Shrimp, fish, crabs, shorebirds and alligators are very dependent upon coastal wetlands for survival. Wetland areas are common in southern Alabama. In Alabama, there are 3 million acres of wetlands and marshes, including 118,000 acres of coastal wetlands.



Water Pollution in Alabama. Water quality in Alabama is generally good, especially when compared to some other states. However, the state does have pollution problems. **Sediment** (solid particles, such as soil, carried by water), is the major source of water pollution problems in Alabama. Large amounts of soil can wash into streams. This sediment can cause many problems. It fills up streams and causes flooding, it covers **habitat** (an animal's home--including its food, water and shelter). It hurts aquatic life by blocking necessary sunlight. Also, sediment can carry other polluting materials with it. When the land is disturbed by construction, farming, or timber harvesting, it is more susceptible to erosion. When it rains, particularly in heavy storms, bare soil

is eroded and runoff carries the sediment to lakes and waterways. Because land areas devoted to agriculture are generally quite large, these areas contribute the most erosion and sediment to water sources. Nutrients from animal wastes and fertilizers, and pesticides or other chemicals can be attached to sediment that is eroded from farmland and other areas. Wherever the sediment goes, these materials also go.

There are certain areas in Alabama where water quality has been affected by excess nutrients. These areas are generally those that have a high concentration of animals or agricultural crops. The **Tennessee Valley** in northern Alabama and the **Wiregrass** in the coastal plain of southeast Alabama have the greatest amounts of cropland. Cropland areas also have the most frequent pesticide pollution problems. Because of Alabama's large poultry industry, animal wastes pose problems for water quality in certain areas.

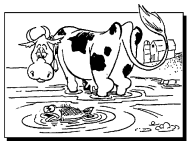
Another unique area in Alabama is the **Black Belt** region. This area in the west-central part of the state is named for its unusual black-colored soils. Sometimes the water quality in this region is not very good, but it is because there is often a high mineral content in the water. This is a naturally occurring contaminant due to the nature of the soil and is not caused by any polluting activities of people.

In Alabama, the most frequent causes of *lake* pollution are **point** sources from industry and city wastewater. According to the Alabama Department of Environmental Management, agricultural runoff causes more **nonpoint** pollution in *rivers* and *streams* in our state than any other activity.

Ways to Prevent Water Pollution. It is everyone's responsibility to care for our environment and to help prevent water pollution. In our homes, we can use less harmful chemicals for cleaning products. Remember, much of these products go down the drain and end up in a septic tank or at a wastewater treatment plant. We should properly dispose of hazardous, or poisonous wastes. We need to be careful when we apply fertilizer and pesticides to our lawns. They may wash off during a rain storm.

Factories are required to treat wastewater before dumping it back into rivers. (However, there is still some illegal dumping). Emission control devices are required on cars. These devices help reduce pollutants caused by exhaust which contribute to acid rain pollution.

Today, there are less **toxic** materials in our waters than in the past. This decline is due partly to the banned use of chemicals such as **DDT** and **PCBs**, and the decreasing amount of coal mining in our state. Chemicals such as **DDT** and **PCBs** are **toxic** chemicals that were once used by agriculture and industry. These chemicals, particularly PCBs, have sometimes been found in rivers and streams and in the fish found there. DDT and PCBs worked well for each of their purposes, but they last a very long time in the environment, so it is hard to clean them up. They have been linked to the decline in bald eagle populations (although this has not been proven). However, industries in Alabama which once used PCBs have spent large amounts of money to help clean up the environment. Bald eagle populations are increasing in Alabama, partly due to a eagle sanctuary in Lake Guntersville State Park.



Farmers can help reduce **erosion** and runoff. There are many management practices called best management practices or BMPs, that farmers can use to

reduce sediment, nutrient and pesticide pollution. One method which helps protect the land is the practice of **crop rotation**. Less erosion occurs when types of crops grown on farmlands are changed (or rotated) periodically. This helps preserve nutrients and reduces the need for certain pesticides. It decreases the chance of fertilizer and pesticides getting into water supplies. Farm animals should be kept out of nearby streams. This helps to keep animal wastes out of our waterways. Animal manures from confined animal operations should be stored, handled and used so that they do not get into water sources.

One example in Alabama of everyone working together to improve water quality is the Bear Creek Floatway Water Quality Improvement Project. This waterway is near the Tennessee River in northwest Alabama. It was once closed to recreation because of pollution problems. Agricultural pollutants from farm animals were the main sources. People worked together to identify and solve these pollution problems. Federal, state and local agencies all contributed money to the efforts. Farmers moved livestock away from streams and built fences to keep them out of the water. They built **lagoons** to store waste and capture runoff from animal waste products. A special area was built to filter wastewater from a local school system.

Today, the Bear Creek Floatway is open again to recreation. This cooperation between people and all levels of government shows, when we really try, we can protect a very valuable natural resource--Alabama's water.

Questions For Review

1. Why is water known as the **universal solvent**?
2. What causes most water pollution--natural events and processes or people?
3. Name a way in which water can become polluted in nature.
4. List some ways in which people contribute towards water pollution.
5. What are the two main types of water pollution?
6. Why is it harder to clean up pollution from nonpoint sources?
7. Why is it important to consider the entire watershed when looking for sources of pollution?
8. What is a wetland? Why are wetlands important?
9. What is a major pollutant in Alabama's water? Is this from a point or nonpoint source?
10. What are some ways in which we can prevent water pollution?

Questions For Thought

1. Do you think that it is always possible to recognize polluted water by its appearance?
2. If you found a polluted stream or creek in your neighborhood, how do you think it could get cleaned up? Who would you let know?[1]
3. Many wetlands in our country were destroyed because people thought they had no value. What would be the results if we continue to destroy our wetlands?[2]
4. If you were a farmer in Alabama, what could you do on your farm to help prevent water supplies from getting contaminated?[3]

Service Learning Idea:
"Trash Patrol"

Form a clean-up crew of school friends. Adopt an area within your community where litter is often dropped, such

as a playground, city park, or an area by a stream. Once a week patrol the adopted area and pick up trash. Litter can wash into waterways during rain storms and become a cause of pollution.[4]

Teacher Notes:

[1] You could contact your local Health Department if you think that the water is seriously contaminated.

[2] The play "Willa in Wetlands" is available free of charge from the E.P.A. This play could be performed for a younger group of children at your school. See resource list at the end of curriculum.

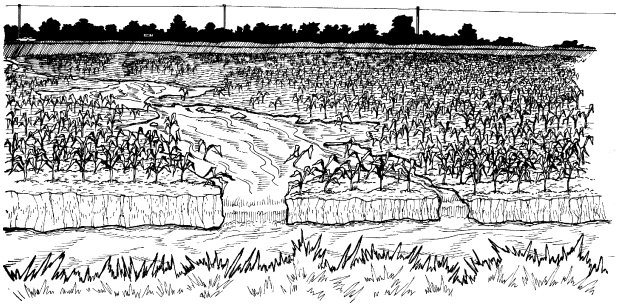
[3] Have a local farmer come to speak to your class about procedures he uses on his farm and what he does to help prevent water pollution.

[4] Two programs in Alabama help to clean up litter. These are Alabama PALS and Adopt-A-Stream. For information on how your club can join, contact (334) 263-7737.

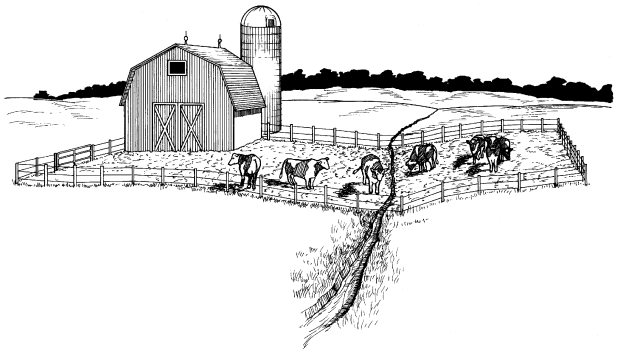
Note: There are two models available for loan which help demonstrate pollution: the **Enviroscape** and the plexiglass **Groundwater Model**. See **Equipment and Supplies** in the Bibliography and Resource Materials section for more information.

FIGURE 7.1: Nonpoint Sources Of Pollution

Urban runoff from garbage dumped in streams



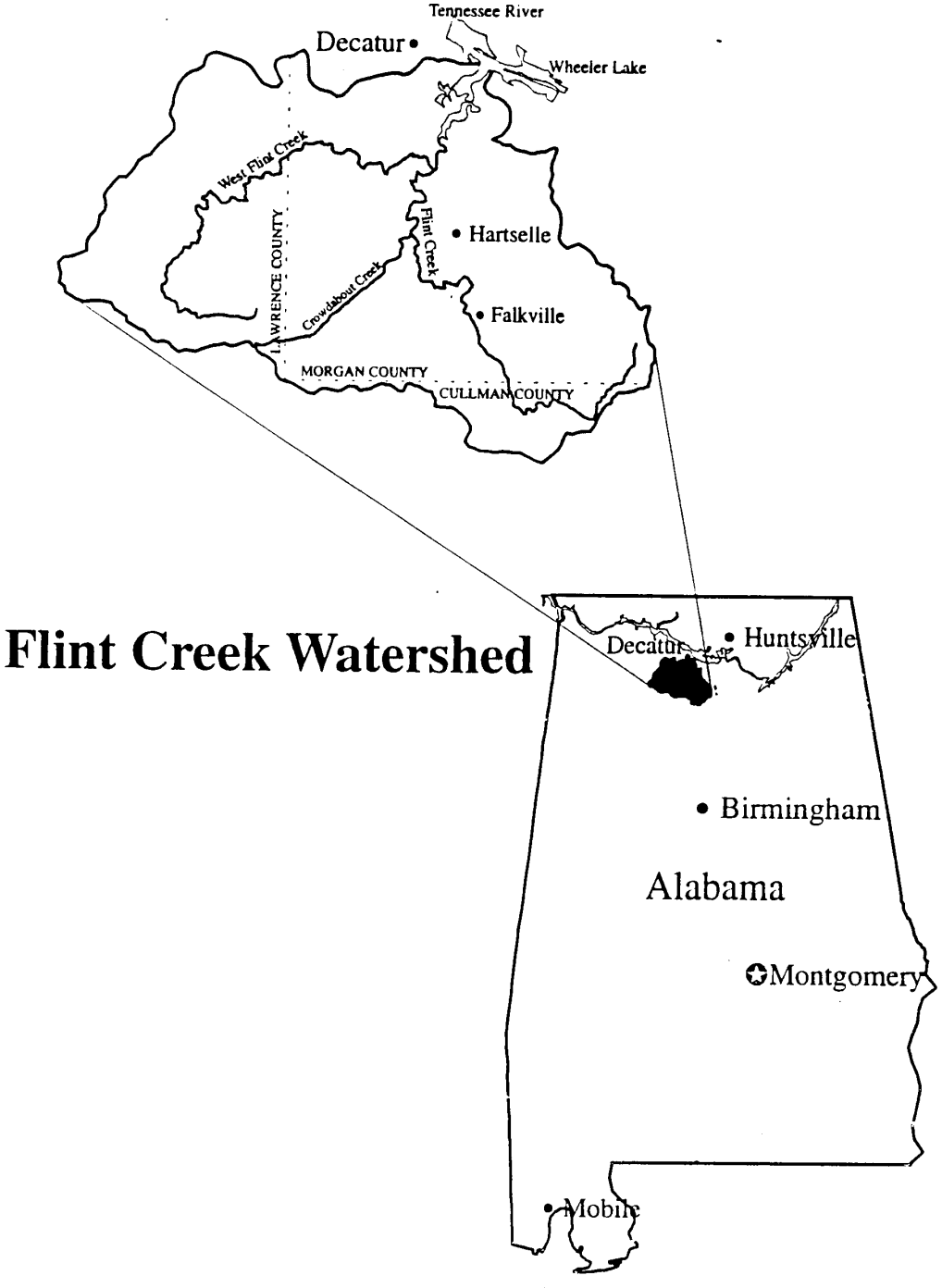
Runoff from croplands



Animal waste runoff

Stormwater runoff from pavement

FIGURE 7.2: The Flint Creek Watershed



FACT SHEET: How Our Water Becomes Polluted

Interesting facts to remember about how water becomes polluted:

1. Many substances can dissolve in water; this is why it is known as the universal **solvent**.

2. When harmful substances mix with water, this causes water pollution.

3. Natural events, such as volcanic eruptions, floods, landslides and even **radon** gas from the ground, sometimes cause water pollution.

4. Most water pollution is caused by people.

5. People cause water pollution by the way they use land and water resources and how they manage waste products. If **fertilizers** and **pesticides** are not used with care on farms, gardens, and yards, they can **leach** into groundwater or wash into waterways.

6. **Acid rain** is caused when **acidic** gases (such as are produced by the internal combustion engines of automobiles) mix with rain; it can harm **aquatic** life and trees in forests. Smoke stacks from factories can also put acid-forming gases into the air.

7. There are two main types of water pollution: **point sources** and **nonpoint sources**.

8. **Nonpoint source** pollution is harder to clean up because it is transported in storm water from a variety of locations.

9. Sometimes we must look at the entire **watershed** to find the source of water pollution.

10. **Wetlands** help protect water quality by filtering out pollutants.

11. **Sediment** from agricultural areas is a major water pollutant in Alabama.

12. **Runoff** of excessive **sediment** into surface water can damage lakes, rivers and other streams.

13. It is everyone's responsibility to help prevent water pollution.

GLOSSARY: How Our Water Becomes Polluted

acid	A chemical compound that has a pH less than 7; lemon juice and vinegar are weak acids.
acid rain	Rainwater made acidic when certain gases from automobile exhausts or the burning of coal dissolve in water vapor.
agriculture	The science of cultivating the soil, growing crops and raising livestock; farming.
algae	Types of plants which lack roots and leaves and grow in water; they may be green, red, or brown, and are in the animal food chain.
aquatic	Growing or living in water.
Black Belt	The area in west-central Alabama called this because of its black-colored soils.
contaminants	Impurities or pollutants; usually associated with naturally occurring events (when people cause pollution, we usually call these impurities pollutants).
crop rotation	The procedure of rotating types of crops grown on land; e.g., grasses are grown for two years and peanuts the next year; it helps to minimize erosion and reduces fertilizer and pesticide needs.
DDT	An abbreviation for "dichloro-diphenyl-trichloroethane," a synthetic chemical formerly used as a pesticide, but now banned from use. It was used to control mosquitoes, flies, boll weevils and many other insects.
diversity	Variety, many different kinds of things.
erosion	The process of soil being moved away by water or wind.
fertilizer	A material that can be used to supply essential nutrients needed for plant growth.
habitat	The place where a plant or animal naturally lives.
invertebrate	An organism which lacks a spinal column or backbone, such as an insect.
landfill	A disposal site beneath the land surface for solid waste products generated by people; the wastes are packed and covered with earth.
lagoon	An artificial pond or pool which is built to store and sometimes treat raw sewage or animal wastes.
leach	To wash materials deeper into the earth.
nonpoint source	Pollution which comes from a widespread area, not just a particular point. An example is when sediment (often from a large area) is carried by stormwater into waterways.

nutrients	Chemical elements which are necessary for plant growth. They can become pollutants if large quantities reach water and speed up **algae** growth.
PCBs	An abbreviation for "polychlorinated biphenyls," a chemical group formerly used to insulate electrical transformers and in the manufacturing of newsprint ink and other products; they were banned from use in 1979 because they were linked to causing cancer.
pesticides	Chemicals used to kill undesirable plant and animal pests. Some are **toxic** and can harm **aquatic** life when they wash into waterways.
pH	A scale which measures the acidity (low number or less than 7) or alkalinity (basic--high number or greater than 7) of a substance on a scale from 0 to 14. A pH of 7 is neutral.
point source	Pollution traced to a single source, such as a factory discharge of contaminated water into a river.
pollutants	Substances that have a harmful effect when introduced into the environment; this term is usually linked to people's actions.
radium	A radioactive element that produces radon. It is found in certain rocks and can pollute air and water.
radon	A radioactive gas, produced naturally from the decay of **radium** which is found in some rocks. It can pollute our air and water.
runoff	The part of precipitation that naturally flows off the land; sometimes it forms streams. The quantity of rainfall, the slope of the land and type of soil influences the amount of runoff.
sediment	Particles of soil which, when eroded from their natural position, can clog up waterways and cause other problems; it may carry nutrients, pesticides and other chemicals from other sources.
solvent	A substance, usually a liquid, which is capable of dissolving another substance.
Tennessee Valley	The valley which surrounds the Tennessee River, part of which can be found in northern Alabama.
toxic	Poisonous.
universal solvent	Water.
watershed	The area of land which drains into rivers and lakes; it may contain many smaller streams and creeks.
wetlands	Areas which have soils that are often covered with water. Examples are marshes and swamps.
Wiregrass	The area of southeast Alabama which is located in the coastal plain; it is known for the type of grass found there.

WORKSHEET 7.1: Definitions

Directions: In the left column are definitions to the *Words to Remember* and in the right column are the words. Match the words with the correct definitions. Place the letter of the correct definition in the blank to the left of the word.

_____1. The area of southeast Alabama which is located in the coastal plain, known for the type of grass found there.

_____2. A chemical compound that has a pH less than 7.

_____3. Substances that have a harmful effect when introduced into the environment; this term is usually linked to people's actions.

_____4. The science of cultivating the soil, growing crops and raising livestock; farming.

_____5. A material that can be used to supply essential nutrients needed for plant growth.

_____6. The area in west-central Alabama called this because of its black-colored soils.

_____7. The place where a plant or animal naturally lives.

_____8. To wash materials deeper into the earth.

_____9. An abbreviation for "dichloro-diphenyl-trichloro-ethane," a synthetic chemical formerly used as a pesticide, but now banned from use.

____10. A disposal site beneath the land surface for solid waste products generated by people; the wastes are packed and covered with earth.

____11. Impurities or pollutants; usually associated with naturally occurring events.

____12. Pollution which comes from a widespread area, not just a particular point. An example is sediment runoff from a large area.

____13. Chemical elements which are necessary for plant growth. They can become pollutants if large quantities reach water and speed up **algae** growth.

____14. Chemicals used to kill undesirable plant and animal pests. Some are **toxic** and can harm **aquatic** life when they wash into waterways.

____15. Pollution which can be traced to a single source, such as a factory discharge of contaminated water into a river.

A. acid
B. acid rain
C. agriculture
D. algae
E. aquatic
F. Black Belt
G. contaminants
H. crop rotation
I. DDT
J. erosion
K. fertilizer
L. habitat
M. landfill
N. lagoon
O. leach
P. nonpoint source
Q. nutrients
R. PCBs
S. pesticides
T. point source
U. pollutants
V. radium
W. radon
X. runoff
Y. sediment
Z. solvent
AA. Tennessee Valley
BB. toxic
CC. universal solvent
DD. watershed
EE. wetlands
FF. Wiregrass

____16. The area of land which drains into rivers and lakes; it may contain many smaller streams and creeks.

____17. Rainwater made acidic when certain gases from automobile exhausts or the burning of coal dissolve in water vapor.

____18. Types of plants which lack roots and leaves and grow in water; they may be green, red, or brown.

____19. An abbreviation for "polychlorinated biphenyls," a chemical group formerly used to insulate electrical transformers and in the manufacturing of newsprint ink and other products; they are now banned from use.

____20. A radioactive gas, produced naturally from the decay of **radium** which is found in some rocks. It can pollute our air and water.

____21. The procedure of rotating types of crops grown on land; it helps to minimize erosion and reduces fertilizer and pesticide needs.

____22. The part of precipitation that naturally flows off the land; sometimes it forms streams.

____23. A substance, usually a liquid, which is capable of dissolving another substance.

____24. The valley which surrounds the Tennessee River, part of which can be found in northern Alabama.

____25. Poisonous.

____26. Water.

____27. A radioactive element that produces **radon**. It is found in certain rocks and can pollute air and water.

____28. Particles of soil which, when eroded from their natural position, can clog up waterways and cause other problems; it may carry nutrients, pesticides and other chemicals from other sources.

____29. Areas which have soils that are often covered with water; examples are marshes and swamps.

____30. Growing or living in water.

____31. The process of soil being moved away by water or wind.

____32. An artificial pond or pool which is built to store and sometimes treat raw sewage or animal wastes.

WORKSHEET 7.2: Vocabulary (Puzzle)

Directions: Below are three word puzzles. Write the word for each definition in the blanks to the left. Place only one letter in each blank.

For each puzzle there is a **Mystery Word** that is made up of the letters that are in the boxes. Write the letters that are in the boxes in the boxes at the bottom of each puzzle. Unscramble the letters to reveal the **Mystery Word**.

Puzzle A

1. _ _ _ _ _ _ _ _ ☐ _ _ _
2. _ _ _ ☐ _ _ _ _
3. _ _ _ _ _ _ ☐ _ _
4. _ ☐ _ _ _ _ _
5. _ ☐ _ _ _ _ _ _

1. Pollution which can be traced to a single source, such as a factory discharge of contaminated water into a river.
2. Rainwater made acidic when certain gases from automobile exhausts or the burning of coal dissolve in water vapor.
3. Chemical elements which are necessary for plant growth.
4. The place where a plant or animal naturally lives.
5. The name of the source of pollution which comes from a widespread area and cannot be traced to a single source.

MYSTERY WORD:

☐ ☐ ☐ ☐ ☐

_____

Puzzle B

1. _ _ _ □ _ — 1. Types of plants which lack roots and leaves and grow in water; they may be green, red, or brown.

2. _ _ □ _ _ — 2. To wash materials deeper into the earth.

3. □ _ _ _ _ _ _ _ _ _ _ _ _ — 3. Impurities or pollutants; usually associated with naturally occurring events.

4. _ _ _ _ _ _ □ _ — 4. Areas which have soils that are often covered with water.

5. _ _ _ □ _ — 5. Poisonous.

6. _ _ _ _ _ _ □ _ _ _ — 6. Chemicals used to kill undesirable plant and animal pests.

7. _ _ □ _ _ _ — 7. The part of precipitation that naturally flows off the land; sometimes it forms streams.

8. _ _ _ _ _ □ _ _ _ — 8. The area of southern Alabama which is located in the coastal plain, it is known for the type of grass found there.

MYSTERY WORD:

□ □ □ □ □ □ □ □ _____

Puzzle C

1. _ ☐ _ _ _ _ _ _ _

1. A disposal site beneath the land surface for solid waste products generated by people; the wastes are packed and covered with earth.

2. _ _ _ _ ☐ _ _ _ _ _

2. A material that can be used to supply essential nutrients needed for plant growth.

3. _ _ _ _ _ _ _ _ _ ☐ _

3. The science of cultivating the soil, growing crops and raising livestock; farming.

4. _ _ _ _ _ _ _ _ ☐

4. The area of land which drains into rivers and lakes; it may contain many smaller streams and creeks.

5. _ _ _ _ ☐ _ _ _ _ _

5. Substances that have a harmful effect when introduced to the environment; this term is usually linked to people's actions.

6. _ _ _ _ ☐ _ _ _

6. Particles of soil which, when eroded from their natural position, can clog up waterways and cause other problems.

MYSTERY WORD:

☐ ☐ ☐ ☐ ☐ ☐ ☐

_____

WORKSHEET 7.3: Facts About How Our Water Becomes Polluted

Directions: Below are sentences with words left out. Write the best word in the blank. You may use the **Background Information** to help you.

1. Because of water's ability to dissolve many substances, it is called the _____ _____
2. The two primary causes of water pollution are _____ and _____.
3. Examples of naturally occurring processes which can pollute our water include _____, _____, and _____.
4. Two characteristics of water that has algae growth in it are a _____color and a _____ smell.
5. If too much pesticides and fertilizers are used on crops, gardens and lawns, the excess may wash into _____.
6. If poisonous chemicals are spilled, poured on the ground or buried in landfills, they may _____ into groundwater.
7. The two types of water pollution are_____ source and _____source.
8. A _____ is a land area that drains into a water system such as a river, stream or lake.
9. Wetlands serve as a natural _____ for water soaking into the ground.
10. _____, carried by runoff, causes the greatest damage to water quality in Alabama.

Directions: Below are review questions. Write the answer in the space below each question. Again, you may use the **Background Information** to help you.

11. Explain the relationship between runoff, excessive use of fertilizers and pesticides, and water pollution.

12. What is the difference in point source and nonpoint source water pollution?

13. What purpose do wetlands serve in preventing water pollution?

14. List some ways that you can help to prevent water pollution.

Activity 7.1: Monitoring A Neighborhood Stream

Goal:

To gain an awareness of the **diversity** of the **aquatic** environment.

Objectives:

- To collect information about the physical/chemical characteristics of a stream.
- To collect biological information about a stream through the identification of aquatic **macro-invertebrate** organisms.
- To estimate the water quality of the stream based on knowledge gained through information collected.

Materials:

- clipboard or hard-backed notebook with paper
- pen or pencil
- rubber boots (knee-high or hip waders, preferably) or old pair of tennis shoes
- white trays (plastic or styrofoam) and buckets
- nets or large strainer or colander (fine mesh)
- magnifying glasses
- **pH** paper or pH indicator solution
- thermometer
- ruler or tape measure
- identification sheet for invertebrate organisms[1]
- guide books for identifying insects or plants (optional)
- LaMotte Water Test Kit (optional)[2]

Background Information:

The measurement of certain physical characteristics of a stream can indicate the water quality of the stream. There are several tests (such as **pH**, dissolved oxygen, temperature, etc.) that can be performed. Also, types of organisms living in the stream (such as plants and insects) can be indicators of the water quality of the stream. Certain organisms will only survive in high-quality water while others can tolerate poor-quality conditions.

There is a classification system for **macro-invertebrates** (animals without backbones--such as insects--but large enough to be seen without a microscope) that classifies these organisms into 3 different groups. Organisms found in Group I indicate GOOD WATER QUALITY, those in Group II indicate MODERATE WATER QUALITY, and those in Group III indicate POOR WATER QUALITY.

In this exercise, we will measure the temperature and pH along a selected area of a waterway. We will try to identify organisms found in the water. We can write down any other observations we make (such as color, muddiness or odor of the stream). These measurements can give us an indication of the overall water quality of this stream. If the water is not of good quality, perhaps we can make some guesses about potential pollutants. We should remember that we must sometimes consider the surrounding watershed when trying to figure out the causes of pollution.

Teacher Notes:
[1] If possible, copy and laminate the identification sheets in this activity.
[2] This is a more elaborate testing kit for water, and is available through the Alabama Water Watch Program (see end of activity for description of program). This kit contains supplies to test for temperature, pH, dissolved oxygen, turbidity, hardness of water, etc.

Procedure:*

1. Select a local source of water, such as a stream, lake, pond, creek, river, etc.
2. Make arrangements to take students to the local water source.[3,4]
3. Take the students on field trip to a local water source.[5]
4. Ask students to identify as many things as they can, that are dependent on this water source (plants, wild animals, birds, insects, people, farm animals, factories, etc.).
5. Collect some organisms from the water with the nets, strainers or buckets.
6. Place the organisms collected on the white trays for better observation. Make sure an adequate supply of water is available for these organisms.
7. Try to identify the organisms found with the identification guides and mark the type, Group number and amount of each on the Report Form. Use the magnifying glasses to aid in identification.
8. If possible, measure the depth of the water with the tape measure.
9. Measure the temperature and pH of the water. (The water test kit also contains items for measuring these parameters).
10. Note any observations of water conditions, such as color, odor, muddiness, etc.
11. Be sure to write all observations on the Report Form.

***Alternative Procedure:**

1. Follow items 1-4 in procedure.
2. Skip the identification of organisms in steps 5-7, (the insects on the identification sheets are often hard to identify), but instead do the water testing in steps 8-10.[6] Of course, the more tests that can be performed, the more accurate the assessment.

Discussion:

Water that contains a wide **diversity** (many kinds) of organisms is generally a good indicator of high water quality. If only a few kinds of life are found, even if these are in large numbers, it may mean that the water conditions are of poorer quality (polluted). Polluted water will not support many different kinds of life. Pollution could be due to excess sediment, chemicals, heat from industrial plants, etc.

Discussion Questions:

1. Describe the water source in detail. What do you see? What types of plants are growing along the edges of the water?
2. Do you see any animal life? What types of animals may live in or near this supply of water? What types of animals may depend on this water source for drinking water?
3. If the area leading to the source of water and the edges of the water is not clean, describe what you see and why you think that it should not be there.
4. What can happen to a water source that is not kept clean?
5. Do you see any relationship between the types and amounts of aquatic insects found and the water quality of the stream?

Teacher Notes:

[3] Secure permission of parents before taking students on field trip.

[4] If a field trip to a stream is not feasible, perhaps the teacher or leader could obtain some water and/or some organisms from a local stream in advance of the class. The organisms should be placed in jars with plenty of water. Students could try to identify them with the identification sheets in class.

[5] Educate students about rules regarding behavior and safety while on the field trip. Rules should also include caution against disturbing the area surrounding the water sources so that nature will not be interrupted.

[6] **Reminder:** More water tests are available in the LaMotte test kit--they may be too difficult for the students, but perhaps the instructor could demonstrate.

Desired Outcome:

Students should accurately record data of the physical characteristics of water and proper identification of aquatic insects, if present. Based on these observations, draw conclusions about the quality of the water.

Evaluation:

1. To accurately record observations of water conditions of a nearby stream.
2. To accurately examine and report organisms in water samples.
3. To use observations and examinations to interpret the quality of the water.

Service Idea:

If pollution problems are found with the monitored stream, students may wish to notify local authorities about the problem. Writing letters about their concerns is a good way to get involved with their community. Look at the Resource section at the end of this manual for addresses of different government agencies.

Extending the Idea:

Students may wish to join an organization which monitors streams:

1. **Alabama Water Watch**

This organization promotes a stream monitoring program for the state of Alabama. Scientists from the Auburn University Fisheries Department have helped to train volunteers to monitor the quality of Alabama's waterways. Water test kits, an educational manual and report forms are available. Certified Water Quality monitors have undergone training sessions to learn to use the water quality test kits. Students may participate in the program under the guidance of a certified water quality monitor. The aim of Alabama Water Watch is to train citizen volunteers to perform certain tests on different waterways to help determine water quality. By routinely collecting this data, the conditions of a certain waterway can be observed and monitored. Possible threats to water quality, such as pollution, may be detected. It also will increase people's awareness of activities in their watersheds that could cause water pollution.

In addition, Alabama Water Watch offers a game called **Bio-Assess**. This environmental game has decks of cards with pictures of invertebrates and a hypothetical stream map. Students try to assess the water quality of the "stream" based on types of "bugs" found there.

For information contact the Alabama Water Watch Association toll free (888) 844-4785.

2. **Adopt-A-Stream**

Alabama PALS
340 North Hull Street
Montgomery, AL 36104
(334) 263-7737

This is an organization in Alabama in which volunteers clean up an area of a stream. It is similar to the Adopt-A-Mile program in which litter is picked up along roads. The sponsor's name is placed on a sign which is visible from a roadway. Vests, bags and other tools are provided to the workers. Its main purpose is to keep streams free of litter.

Activity adapted from "Alabama Water Watch" materials.

STREAM QUALITY REPORT FORM

Stream _____ **Location** _____
County _____ **Town/City**_____
Date _____ **Time** _____
Water Conditions:

Temperature of Water _____
Temperature of Air _____
pH _____
Water Depth _____
Color of Water _____
Is water <u>flowing</u> (as in a stream)
or <u>still</u> (as in a lake)? _____
Is water clear or cloudy?
_____
Note any other observations

<u>Optional Tests</u>:
(with LaMotte Test Kit)

Water Hardness
_____
Dissolved Oxygen
_____
Alkalinity
_____
Turbidity
_____

Aquatic Organism Inventory

GROUP 1 (Good Water Quality)	#	GROUP 2 (Moderate Water Quality)	#	GROUP 3 (Poor Water Quality)	#
Mayfly		Dragonfly Nymphs		Blackfly Larvae	
Stonefly		Crane Fly Larvae		Aquatic Worms	
Dobsonfly Larvae		Crayfish		Midge Larvae	
Caddisfly Larvae		Scud		Pouch Snails	
Riffle Beetle		Sow Bug			
TOTAL		TOTAL		TOTAL	

Adapted from: Alabama Water Watch materials

STREAM QUALITY REPORT FORM

Write your evaluation of the water quality of this stream

_____

_____

_____

_____

_____

Describe any conditions around the stream which may affect its water quality (good or bad)

_____

_____

_____

_____

_____

****Optional Test: Stream Velocity**

Note: This test will measure the **velocity** (the speed at which something moves) of a stream. If you are testing a relatively still body of water, such as a pond, there is no need to do this test.

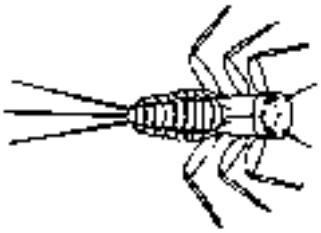
Materials needed: tape measure, stopwatch, light object for floating (such as a ping pong ball)

With the tape measure, measure out a certain distance along the stream (for example, 10 feet), and mark the beginning and end of this area. Have at least one person at each marker. Drop the object in the stream, start the stopwatch and note the time it takes for the object to travel the distance. Measure the velocity as feet/second. You might want to repeat this a couple of times--sometimes the object may get stuck, and an average value is more reliable.

What is the velocity of this stream? _____

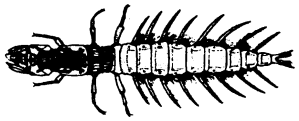
GROUP 1 ORGANISMS

(These species indicate GOOD WATER QUALITY)

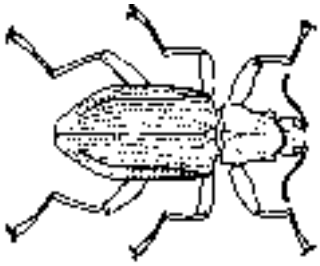


MAYFLY

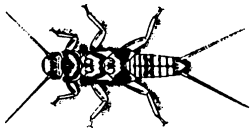
CADDISFLY



DOBSONFLY LARVA



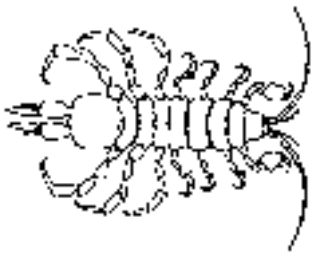
RIFFLE BEETLE



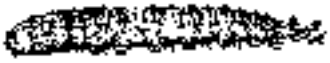
STONEFLY

GROUP 2 ORGANISMS

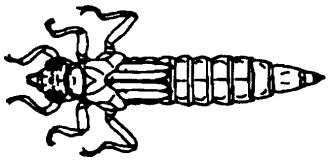
(These species indicate MODERATE WATER QUALITY)



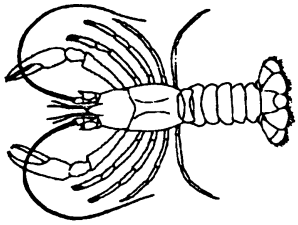
SOW BUG



CRANE FLY LARVAE



DRAGONFLY NYMPH

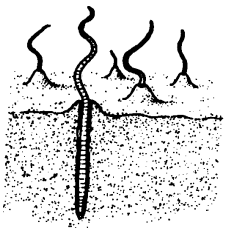


CRAYFISH

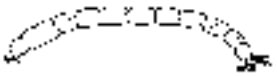
SCUD

GROUP 3 ORGANISMS

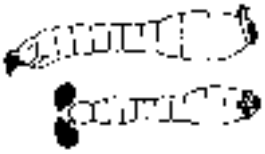
(These species indicate POOR WATER QUALITY)



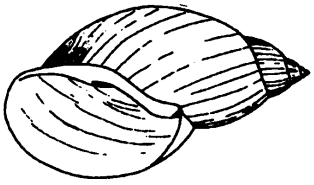
AQUATIC WORMS



MIDGE LARVAE



BLACK FLY



POUCH SNAIL

ACTIVITY 7.2: How Acidic Is It?

Goal:

To demonstrate the actions of acid rain in our environment.

Objectives:

- To determine the acidity of various liquid substances.
- To list the properties of alkaline and base substances.

Materials:

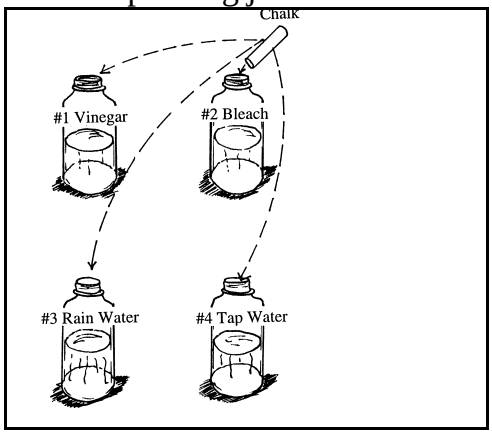
- pH testing kit (available at aquarium stores) or pH paper with color indicator chart (see background information for explanation of pH)
- assorted liquid substances such as: vinegar, ammonia, tap water, rain water, pond or stream water, soft drink, lemon juice, dissolved baking soda, bleach[1]
- small glass jars (such as baby food jars)
- small pieces of chalk (not the "dustless" variety)
- safety goggles
- rubber or latex gloves
- student sheet of pH scale[2]

Background Information:

The pH scale is a scale from 0 to 14 which measures the acidity or alkalinity of a substance. A substance which is acidic is called an **acid** and has a value less than 7. A substance which is **alkaline** is called a **base** and has a value greater than 7. A value of exactly 7 is neutral (neither a base nor an acid). The term pH means power of hydrogen. Acids contain the element **hydrogen (H)**. Bases contain a **hydroxide** group **(OH)**. An indicator such as pH paper will react differently with acids and bases and will turn different colors. Acids turn the indicator red and bases will turn it blue or yellow.

Procedure:

1. Label each of the glass jars with the name of the liquid to be tested.
2. Pour each liquid substance into corresponding jar.



3. Follow the directions on the pH testing kit or the pH paper and test the pH of each substance. (Usually, place a drop of the liquid on the paper and notice the color change).
4. On the left side of the pH scale report sheet, write the name of the liquid next to the appropriate number.
5. Place a piece of chalk in each jar of liquid and let sit for 15 minutes.
6. Test the pH of each substance again and record results on the right side of the pH scale sheet.

Teacher Notes:

[1] Some of these materials, such as ammonia and bleach, are very caustic. Safety goggles and rubber or latex gloves should be worn when handling these liquids. To insure the safety of the students, the instructor may choose to prepare these in advance.
(continued next page)

Discussion:

Acid rain is a source of pollutants which are a threat to water quality. An **acidic** substance has a low number on the pH scale. A low number is any number under 7. When something is very acidic it can cause harm to the environment. Plants cannot survive if the water they depend on is too acidic. Acidic water also harms fish and other aquatic life. Acid rain even damages the stone in buildings and statues. By testing the pH of various materials, we can get an idea of the range of pH values in liquids. The effect of an acidic substance on chalk demonstrates the action of acid rain on stone. The chalk contains calcium, which is found in many types of stone.

Discussion Questions:

1. Which liquid tested was the most acidic? Which was the most basic (number higher than 7)?
2. Which of the different types of water tested, such as tap water or stream water, had the lowest pH? Why do you think there was a difference?
3. What happened to the chalk when it was added to the liquid substances?
4. Which substance was the most affected by the chalk?
5. After adding the chalk, did the pH of the liquid get higher or lower? What does this mean about the pH of chalk?

Desired Outcome:

A list of various substances and their corresponding pH values.

Evaluation:

1. To accurately test and record the pH of various liquid substances.
2. To verbally identify the relationship between acidity in the environment and acid rain.

Extending the Idea:

1. Have students conduct library research about acid rain and write a report.
2. Collect rain water the next time it rains and test its pH.

References:

Groundwater: A Vital Resource. Student Activities. Knoxville,TN: Tennessee Valley Authority.

The Water Sourcebook: Grades 3-5. Tennessee Valley Authority, 1993.

My World, My Water and Me! Mercerville, NJ: Association of Environmental Authorities, New Jersey.

Teacher Notes:

(continued from previous page)

[2] If colored markers are available, students may wish to color the pH scale on the sheet to match the indicator chart.

REPORT FORM

THE pH SCALE

ACIDIC

Liquid tested		**Liquid tested + chalk**
	1	
	2	
	3	
	4	
	5	
	6	
	7	
	8	
	9	
	10	
	11	
	12	
	13	
	14	

BASIC

1. On the left side of the scale, write the name of each substance tested next to its corresponding pH number.
2. On the right side of the scale, write the name of the substances tested after the chalk had been added, next to its appropriate number. (Use a different color pencil or pen to highlight any differences).

NOTE: If you have indicator paper with your pH kit, you may wish to color the chart above to match the colors of your indicator paper.

ACTIVITY 7.3: Effects of Pollution on Aquatic Plants

Goal:

To determine the effects of pollutants in water on the growth of aquatic plants.

Objective:

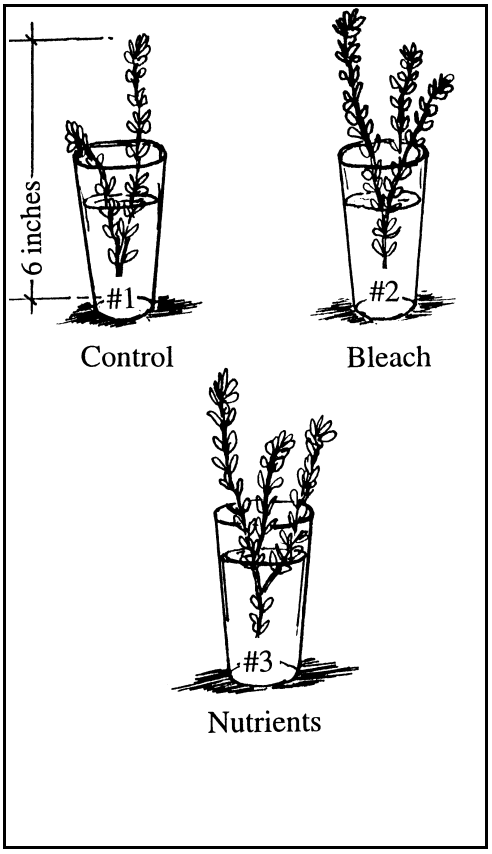
- To demonstrate the effects of two common pollutants on plant growth.

Materials:

- 9 eight ounce glass or plastic containers
- one gallon container (such as empty milk container)
- waterproof marking pen
- commercial plant food
- ruler
- household bleach
- measuring spoons
- eye dropper
- plastic wrap
- 9 sprigs of a submerged aquatic plant[1]

Procedure:

1. Arrange the eight ounce containers in three groups of three. Use the waterproof marking pen to mark each container in Group 1 with the number 1, each in Group 2 with the number 2, and each Group 3 with the number 3.
2. Fill the gallon container with tap water. Add the water to the eight ounce containers in Groups 1, 2 and 3.
3. Let the containers sit for 24 hours.[2]
4. Do not add anything else to Group 1.
5. With eye dropper, add 2 drops of household bleach to water of containers in Group 2.
6. Using the measuring spoon, add twice the amount of plant food as recommended on the label to the containers in Group 3. (Some plant food comes in



Teacher Notes:

[1] Plants can be purchased at aquarium shops (many large discount stores carry aquarium supplies). Elodea is an inexpensive plant.

[2] It is necessary to let the water stand uncovered for approximately 24 hours so that any chlorine in tap water can evaporate. Teacher or leader may wish to do this a day ahead if time is limited.

bottles with droppers. In this case, add twice as many drops as needed). Group 3 will represent plants with too many nutrients added.

7. Using the ruler, measure 9 six inch lengths of aquatic plants.
8. Place one sprig of each plant in each of the 9 containers and cover with plastic wrap.
9. Place containers with plants in a sunny location and let sit for two weeks.
10. At this point, make predictions about the differences in growth and appearance that may occur between the groups of plants. Write your predictions on the top of the report form.
11. Examine plants on days 1, 3, 8 and 15 and write your observations on the chart. Be sure to record the differences in color of water and color of the plants. Measure the length of the plants and record.
12. At the end of 15 days, compare the results on the charts.

Discussion:

Pollutants in water can harm plant life. Chemicals like pesticides used on farms and excess chemicals used to treat wastewater can wash into water supplies. Overuse of fertilizers contributes to water pollution when runoff carries these nutrients into nearby waterways. Pollutants cause plants to grow more slowly and to have a unhealthy appearance.

In scientific experiments, groups that do not have any kind of treatment are known as control groups. In this experiment, there were no pollutants added to Group 1; therefore, Group 1 became the control group. In scientific experiments, groups that have some type of treatment are known as experimental groups. Group 2 and Group 3 were experimental groups. Chlorine was added to Group 2 as the pollutant and excess fertilizer was added to Group 3 as the pollutant. These three groups were watched to observe how these pollutants affected plant growth.

Desired Outcome:

Plants in Group 1 should be the healthiest at the end of 2 weeks.

Evaluation:

To conduct the experiment accurately, record the observations, and draw logical conclusions about the effects of pollutants on plant growth.

Activity adapted from "Underwater Plants: A Resource In Trouble," The Story of Submerged Aquatic Vegetation In The Chesapeake Bay, used with permission of the Virginia Cooperative Extension Service.

REPORT FORM
ACTIVITY 7.3: Effects of Pollution on Aquatic Plants

My predictions: _____

_____

_____

	DAY 1	DAY 3	DAY 8	DAY 15
GROUP 1 control water only length	_____	_____	_____	_____
GROUP 2 chlorine bleach length	_____	_____	_____	_____
GROUP 3 nutrients length	_____	_____	_____	_____

Questions:

1. Which plants looked the most healthy (good color and growth)?

2. Which plants looked the least healthy?

3. What effect did chlorine have on the plants in Group 2?

4. What effect did overuse of plant food have on the plants in Group 3?

5. What was the biggest difference in the lengths of the plants over 15 days?

6. List possible ways an excess of nutrients could enter our water supplies.

7. What are ways in which chlorine could enter our water supplies?

Activity 7.4: Alternative Household Products

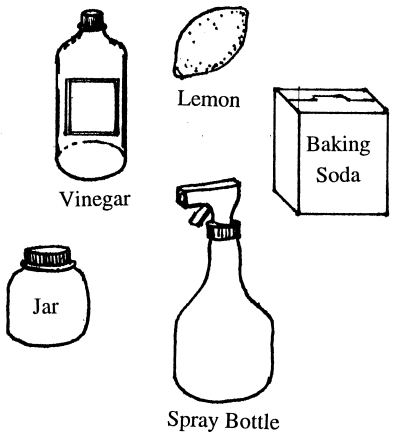
Goal:

To increase awareness of less toxic alternatives to common household cleaning products.

Objectives:

- To make alternative common household cleaners from products already in the home.

Materials:



- baking soda
- chalk
- vinegar
- garlic cloves
- clean, empty glass jars (with lids)
- lemons and juicer
- pan (large enough to hold pieces of silverware)
- salt
- club soda
- hotplate
- aluminum foil
- clean old towels (used for rags) or paper towels
- vegetable oil
- waterproof markers and labeling tape
- clean empty spray bottle (such as window cleaner bottle)
- measuring spoons and cups
- several herbs and spices such as: rosemary, fennel, cayenne pepper
- cedar chips
- tarnished silverware (small pieces, not antique knives which may contain solder)
- liquid soap (liquid dishwashing detergent)

Teacher Demonstration: Demonstrate in the classroom a nontoxic way to clean silver.

silver polish

Fill pan with 2-3 inches of water.
Add: 1 teaspoon salt
1 teaspoon baking soda
1 sheet aluminum foil
Put tarnished silver in pan and place on hot plate.
Bring water to boil and let boil 2-3 minutes.
Carefully remove silver and wipe away tarnish with cloth[1]

[1] During this procedure, the tarnish will move from the silver to the piece of aluminum foil because of a chemical reaction.

ACTIVITY 7.4: Alternative Household Products

Procedure:

Mix and try out the following substances. Make sure to properly label each mixture. Take the list home and post it for other family members.

air freshener	Sprinkle various herbs into a open bowl and let sit out in rooms. Also, try setting out a dish of hot vinegar to remove room odors.
bug repellent	Crumble up chalk and cayenne pepper and sprinkle in crevices to repel insects. Try sprinkling some cedar chips around pet bedding.
furniture polish	Mix 1 teaspoon of lemon juice in 1 pint of vegetable oil in an empty spray bottle or glass jar. Spray on furniture and or dip rag in mixture and wipe furniture. Wipe clean with cloth.
glass cleaner	Mix 1 tablespoon of **either** vinegar **or** lemon juice with 1 pint of water in an empty spray bottle or glass jar. Spray on glass or dip with rag and wipe on glass. Wipe clean with cloth.
insecticide	Into 1 quart of water (in an empty spray bottle), mix 2 tablespoons cayenne pepper, 2 garlic cloves and 1 tablespoon of liquid soap. Spray on plants to repel insects such as aphids or spider mites.
oven cleaner	Wipe out oven after using to clean up any spills. Make a solution of baking soda dissolved in water. Apply to oven, wait a few minutes and wipe with a damp cloth.
refrigerator deodorizer	Place baking soda in open container and place the container in back of refrigerator.
rug deodorizer	Sprinkle baking soda on dry carpet. Let sit 15 minutes, then vacuum.
spot remover	Try club soda on spot as soon as possible after spill. Also, mix some lemon juice in hot water and apply to spot.

Discussion:

Less toxic cleaners can be made at home with products that are probably already in the kitchen. These cleaners may be substituted for those that are that are commercially prepared and used around the home. When flushed down drains, less toxic wastes contribute to less pollution.

Discussion Questions:

1. Which of the homemade products work the best?
2. How can hazardous waste products get into our water supplies?
3. What are some materials used around the home which are toxic to the environment?
4. Name some popular brands of household products for which you can make substitutes. You may try the name brand products and your home-made ones to compare results.

Desired Outcome:

The various less toxic substitutes for common household cleaners will:

air freshener:	Remove room odors.
bug repellent:	Discourage insect infestations.
furniture polish:	Shine furniture and/or floors and remove dust.
glass cleaner:	Clean spots from glass.
insecticide:	Repel and kill insect pests.
oven cleaner:	Remove food stains in oven.
refrigerator deodorizer:	Help eliminate bad odors from refrigerator.
rug deodorizer:	Remove bad odors from rugs or carpeting.
spot remover:	Take out spots from clothing or other material.

Students will introduce these less-toxic products to their homes.

Evaluation:

Students are able to:

1. Make cleaning products from common household ingredients.
2. Take information (chart) home to share with family members.
3. Get feedback from parents.

References:

The Consumer's Handbook for Reducing Solid Waste. U.S. EPA.

Indoor Air Pollution Fact Sheet: Household Products. American Lung Association, 1990.

ACTIVITY 7.5: Making a Model of a Watershed

Goal:

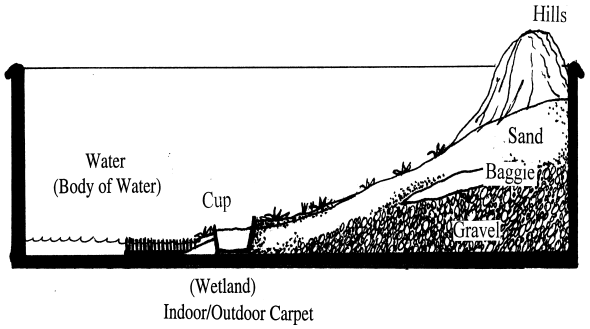
To demonstrate the complexity of a watershed

Objectives:

- To build a model of a watershed[1]
- To illustrate how nonpoint source pollution can affect different areas of the watershed

Materials:

- several sheets of newspaper
- spray bottle filled with water
- plastic box (such as a sweater box)
- strip of indoor/outdoor carpeting
- plastic wrap
- sand
- gravel or small rock
- baggie filled with water (resealable type)
- small bowl of water
- soil
- small clumps of grass
- small plastic farm animals
- food coloring



Procedure:

1. Pour some gravel in one half of the box and make it form a slope towards the other end.
2. Insert a baggie filled with water into the gravel.
3. Cover the gravel with a layer of sand. You may use wet sand so it is easier to shape into a slope.
4. Place a paper cup in the sand at the bottom of the slope.
5. Place some crumpled sheets of newspaper on top of the gravel and sand at end of box.
6. Cover the newspaper with a sheet of plastic wrap, forming hills.
7. Place some soil around the paper cup on top of the sand. Moisten the soil to make it stay in place.
8. Spray some water on top of the hills made by the crumpled newspaper. The water should flow down the hills, into the valley and collect on the far side of the box. The place where the water collects will represent a lake.
9. When water is sprayed onto the model, soil should rinse into the lake.
10. Place a strip of indoor/outdoor carpeting at the junction between the soil and the lake.

Teacher Notes:

[1] Teacher or leader may wish to make a watershed model before class to show the desired result.
Note: The **Enviroscape** and the plexiglass **Groundwater Model** are good visual demonstrations of pollution. See **Equipment and Supplies** under Bibliography and Resource Materials to borrow these models.

Pour water again on the hilly section and observe the amount of soil washing into the lake.

11. Plant a few clumps of grass on top of the soil just before the strip of carpeting and repeat the spraying of water on the hills. Note any differences.
12. Put some water in the paper cup. Poke a few small holes in the bottom of the cup and put a few drops of food coloring in the water. Notice what happens to the watershed model when the colored water leaks out of the cup.
13. Add some food coloring to the spray bottle. You may place some small toy farm animals on the land areas or some small buttons in rows to represent crops. Spray with the colored water around the simulated farms and notice where the water goes.

Discussion:

This watershed model demonstrates how waterways can become contaminated from different sources. It shows the usefulness of a wetland (represented by the carpeting) in slowing down sediment rinsing into surface water. Also, adding plant material should help keep more soil in place and prevent it from washing away. The cup of water represents pollution from a point source problem. One such example would be a landfill. The colored water sprayed on the farm region shows how contaminants, such as animal wastes or excess pesticides and fertilizers sprayed on crops, can end up in waterways. The colored water also represents how contaminants can travel a distance from the original source.

Discussion Questions:

1. What is the function of the wetland in this model?
2. How do you think animal wastes could be prevented from flowing into the lake?
3. What does the baggie of water represent?
4. What could be done to the landfill to prevent it from leaking into the water?
5. Name some other ways water could be polluted from either point source or nonpoint sources.

Desired Outcome:

1. When water is added in step 7, soil should wash into "lake," representing erosion.
2. The carpeting and the clumps of grass in steps 10 and 11 should help stop the soil from entering the "lake," representing wetlands and plant cover.
3. In step 12, the colored water will soak through the paper cup into the sand, representing point source pollution.
4. In step 13, the colored water will visibly spread over entire "watershed" representing nonpoint source pollution.

Evaluation:

Students will be able to:

1. Explain how watersheds work.
2. Discuss the value of wetlands in filtering contaminants before they reach water supplies.
3. Demonstrate the differences in point and non-point sources of water pollution.

References:

Groundwater: A Vital Resource. Student Activities. Knoxville, TN: Tennessee Valley Authority.

The Water Sourcebook: Grades 3-5. Tennessee Valley Authority, 1993.

Water Watchers. Boston, MA: Massachusetts Water Research Authority, 1987.

Lucas, E. Water: A Resource in Crisis. Chicago: Childrens Press, 1991.

ACTIVITY 7.6: Wetlands Outdoor Game[1]

Goal:

To demonstrate the roles of plants in wetlands

Objective:

O To explain the value, or role, of plant life in wetland areas.

Materials:

F string
F colored paper
F hole punch
F scissors

Procedure:[2]

1. Make nutrient tag markers by cutting squares of colored paper. Punch one hole in one side. Cut a piece of string about four feet long and put both cut ends of the string through the hole. Tie both ends of the string in a knot.
2. Divide group of students into two equal teams. Team 1 will be plants and Team 2 will be soil particles. Team 2 will wear the nutrient tag markers around their necks.[3]
3. Team 1 will form an uneven line on one side of the field. The "plants" should be spaced far enough apart that they can't reach one another. The space behind the plants will represent a waterway.
4. Team 2 will line up on the other side of the field.
5. On *Start* command, Team 2 will try to run between Team 1 to get to the other side of the plants. Members of Team 2 must drag one leg behind them while they run so as not to run too quickly. They must go between the "plants" and not around the outside or the ends.
6. "Plants" will try to touch a soil particle as it moves past them. The legs of the "plants" will act as roots and cannot be moved, but "plants" may bend and stretch.
7. If a "soil particle" is tagged, he or she must give up their tag to the "plant" and take their place in the plant line.
8. Any "soil particle" that reaches the waterway after passing through the plant line will return to the beginning. At the next *Start* command they will try to pass through the line again.
9. Continue game until all "soil particles" are caught.

Discussion:

In this exercise, the line of plants demonstrate vegetation in a wetland. A useful role of a wetland is to help improve water quality. A wetland can store nutrients and remove sediment from soil erosion. Runoff from agricultural erosion can carry excess nutrients which can end up in waterways. When enough nutrients build up in water, it can cause excessive **algae**

Teacher Notes:

[1] This activity will not work well with a class that does not follow directions. It needs to be an orderly exercise.

[2] An outdoor area is best for this game.

[3] Variation: Try starting game with either many plants or very few plants to increase or decrease the number of soil particles caught.

growth. However, these excess nutrients can be taken up by plants in a wetland. This helps to preserve good water quality in the waterway adjacent to the wetlands.

When the game is played with fewer plants and more soil particles, this shows how nutrients can run off into the waterway. When there is a lot of plant growth, it catches these nutrients before they can enter the waterway.

Discussion Questions:

1. Why are wetland plants important?
2. What would be the effect on the waterway if there were more plants than soil particles? What would happen if there were fewer plants?
3. Name some ways nutrients or other pollutants could get into the soil.

Desired Outcome:

Students will follow game directions until all "soil particles" are caught. They will apply the function of the game "plants" and "soil particles" to real plants and soil in wetlands.

Evaluation:

Can students explain the role of plant life in wetlands?

Extending the Idea:

1. Have the students do a report on an animal or plant in Alabama which is dependent on wetlands for survival. Some of the animals in Alabama include the alligator, the Alabama red-bellied turtle (a species on the Endangered List), and shrimp and oysters in the coastal wetlands. Many shore birds depend on these wetlands, too. The Everglades is a very large wetland in Florida which has been drastically altered by man; someone may wish to report on this area.
2. A play called Willa in Wetlands is available free of charge from the Wetlands Division of the U.S. E.P.A. It is a story of a wetlands community. The class may wish to present it (it would probably be appropriate for an audience of younger children). Copies are available by calling the EPA Wetlands Hotline (800) 832-7828.
3. The Wetlands Division of the EPA also has a list of a number of books about wetland subjects. The list specifies the grade level for each. Children may wish to read some of these books and make a report to the class about what they say about wetlands. This list is also provided free of charge by calling the number above.

Activity adapted from material originally published in Virginia's State Parks...Your Backyard Classrooms and reproduced in the activity "Wetlands--The Nutrient Trap" in WOW!: The Wonders of Wetlands, used by permission of the Department of Conservation and Recreation, Richmond, VA and Environmental Concern Inc., St. Michaels, MD.

Additional References:

1. Wallace, R.K. Coastal Wetlands of Alabama. Circular ANR-831. MASGP-93-012. Auburn University Marine Extension and Research Center.

2. Wetlands Division, United States Environmental Protection Agency. Washington, D.C. (800) 832-7828.

ANSWER KEY
WORKSHEET 7.1: Definitions

Directions: In the left column are definitions to the *Words to Remember* and in the right column are the words. Match the words with the correct definitions. Place the letter of the correct definition in the blank to the left of the word.

FF 1. The area of southeast Alabama which is located in the coastal plain, known for the type of grass found there.

A 2. A chemical compound that has a pH less than 7.

U 3. Substances that have a harmful effect when introduced into the environment; this term is usually linked to people's actions.

C 4. The science of cultivating the soil, growing crops and raising livestock; farming.

K 5. A material that can be used to supply essential nutrients needed for plant growth.

F 6. The area in west-central Alabama called this because of its black-colored soils.

L 7. The place where a plant or animal naturally lives.

O 8. To wash materials deeper into the earth.

I 9. An abbreviation for "dichloro-diphenyl-trichloro-ethane," a synthetic chemical formerly used as a pesticide, but now banned from use.

M 10. A disposal site beneath the land surface for solid waste products generated by people; the wastes are packed and covered with earth.

G 11. Impurities or pollutants; usually associated with naturally occurring events.

P 12. Pollution which comes from a widespread area, not just a particular point. An example is sediment runoff from a large area.

Q 13. Chemical elements which are necessary for plant growth. They can become pollutants if large quantities reach water and speed up **algae** growth.

S 14. Chemicals used to kill undesirable plant and animal pests. Some are **toxic** and can harm **aquatic** life when they wash into waterways.

T 15. Pollution which can be traced to a single source, such as a factory discharge of contaminated water into a river.

A. acid
B. acid rain
C. agriculture
D. algae
E. aquatic
F. Black Belt
G. contaminants
H. crop rotation
I. DDT
J. erosion
K. fertilizer
L. habitat
M. landfill
N. lagoon
O. leach
P. nonpoint source
Q. nutrients
R. PCBs
S. pesticides
T. point source
U. pollutants
V. radium
W. radon
X. runoff
Y. sediment
Z. solvent
AA. Tennessee Valley
BB. toxic
CC. universal solvent
DD. watershed
EE. wetlands
FF. Wiregrass

DD 16. The area of land which drains into rivers and lakes; it may contain many smaller streams and creeks.

B 17. Rainwater made acidic when certain gases from automobile exhausts or the burning of coal dissolve in water vapor.

D 18. Types of plants which lack roots and leaves and grow in water; they may be green, red, or brown.

R 19. An abbreviation for "polychlorinated biphenyls," a chemical group formerly used to insulate electrical transformers and in the manufacturing of newsprint ink and other products; they are now banned from use.

W 20. A radioactive gas, produced naturally from the decay of **radium** which is found in some rocks. It can pollute our air and water.

H 21. The procedure of rotating types of crops grown on land; it helps to minimize erosion and reduces fertilizer and pesticide needs.

X 22. The part of precipitation that naturally flows off the land; sometimes it forms streams.

Z 23. A substance, usually a liquid, which is capable of dissolving another substance.

AA 24. The valley which surrounds the Tennessee River, part of which can be found in northern Alabama.

BB 25. Poisonous.

CC 26. Water.

V 27. A radioactive element that produces **radon**. It is found in certain rocks and can pollute air and water.

Y 28. Particles of soil which, when eroded from their natural position, can clog up waterways and cause other problems; it may carry nutrients, pesticides and other chemicals from other sources.

EE 29. Areas which have soils that are often covered with water; examples are marshes and swamps.

E 30. Growing or living in water.

J 31. The process of soil being moved away by water or wind.

N 32. An artificial pond or pool which is built to store and sometimes treat raw sewage or animal wastes.

ANSWER KEY
WORKSHEET 7.2: Vocabulary (Puzzle)

For each puzzle there is a **Mystery Word** that is made up of the letters that are in the boxes. Write the letters that are in the boxes in the boxes at the bottom of each puzzle. Unscramble the letters to reveal the **Mystery Word**.

Puzzle A

1. **P O I N T S O U [R] C E**	1. Pollution which can be traced to a single source, such as a factory discharge of contaminated water into a river.
2. **A C I [D] R A I N**	2. Rainwater made acidic when certain gases from automobile exhausts or the burning of coal dissolve in water vapor.
3. **N U T R I E [N] T S**	3. Chemical elements which are necessary for plant growth.
4. **H [A] B I T A T**	4. The place where a plant or animal naturally lives.
5. **N [O] N P O I N T**	5. The name of the source of pollution that comes from a widespread area and cannot be traced to a single source.

MYSTERY WORD:

[R] [D] [N] [A] [O]

R A D O N

Puzzle B

1. **A L G** [**A**] **E**	1. Types of plants which lack roots and leaves and grow in water; they may be green, red, or brown.
2. **L E** [**A**] **C H**	2. To wash materials deeper into the earth.
3. [**C**] **O N T A M I N A N T S**	3. Impurities or pollutants; usually associated with naturally occurring events.
4. **W E T L A N** [**D**] **S**	4. Areas which have soils that are often covered with water.
5. **T O X** [**I**] **C**	5. Poisonous
6. **P E S T I C** [**I**] **D E S**	6. Chemicals used to kill undesirable plant and animal pests.
7. **R U** [**N**] **O F F**	7. The part of precipitation that naturally flows off the land; sometimes it forms streams.
8. **W I R E G** [**R**] **A S S**	8. The area of southern Alabama which is located in the coastal plain, known for the type of grass found there.

MYSTERY WORD:

A	**A**	**C**	**D**	**I**	**I**	**N**	**R**

ACID RAIN

Puzzle C

1. **L A N D F I L L**

1. A disposal site beneath the land surface for solid waste products generated by people; the wastes are packed and covered with earth.

2. **F E R T I L I Z E R**

2. A material that can be used to supply essential nutrients needed for plant growth.

3. **A G R I C U L T U R E**

3. The science of cultivating the soil, growing crops and raising livestock; farming.

4. **W A T E R S H E D**

4. The area of land which drains into rivers and lakes; it may contain many smaller streams and creeks.

5. **P O L L U T A N T S**

5. Substances that have a harmful effect when introduced to the environment; this term is usually linked to people's actions.

6. **S E D I M E N T**

6. Particles of soil which, when eroded from their natural position, can clog up waterways and cause other problems.

MYSTERY WORD:

A I R D U M

RADIUM

ANSWER KEY
WORKSHEET 7.3: Facts About How Our Water Becomes Polluted

Directions: Below are sentences with words left out. Write the best word in the blank. You may use the **Background Information** to help you.

1. Because of water's ability to dissolve many substances, it is called the **UNIVERSAL SOLVENT**.
2. The two primary causes of water pollution are **PEOPLE** and **NATURE**.
3. Examples of naturally occurring processes which can pollute our water include **VOLCANIC ERUPTIONS**, **LANDSLIDES**, and **WILD ANIMAL WASTES, RADON, FLOODS**.
4. Two characteristics of water that has algae growth in it are a **GREEN** color and a **BAD** smell.
5. If too much pesticides and fertilizers are used on crops, gardens and lawns, the excess may wash into **STREAMS (OR WATERWAYS)**.
6. If poisonous chemicals are spilled, poured on the ground or buried in landfills, they may **LEACH** into groundwater.
7. The two types of water pollution are **POINT** source and **NONPOINT** source.
8. A **WATERSHED** is a land area that drains into a water system such as a river, stream or lake.
9. Wetlands serve as a natural **FILTER** for water soaking into the ground.
10. **SEDIMENT**, carried by runoff, causes the greatest damage to water quality in Alabama.

Directions: Below are review questions. Write the answer in the space below each question. Again, you may use the **Background Information** to help you.

11. Explain the relationship between runoff, excessive use of fertilizers and pesticides, and water pollution.

    Runoff is the part of precipitation that flows off the land into waterways. If fertilizers and pesticides mix with this runoff, these waters could become polluted.

12. What is the difference in point source and nonpoint source water pollution?

    Point source pollution comes from a particular spot or source. Nonpoint source pollution comes from a widespread area.

13. What purpose do wetlands serve in preventing water pollution?

    Wetlands function as a filter for water soaking into the ground. They can trap sediments or pollutants before they run into surface waters.

14. List some ways that you can help to prevent water pollution.

    1. Don't dump poisonous chemicals down the drain or into waterways.

    2. Be careful not to use too much fertilizers and pesticides in our yards.

    3. Don't drive cars too much because they contribute to acid rain.

HOW AM I DOING?

Page		Yes	No	Date
7-3	Practice reading and saying **Words to Remember**			
7-7	Answer **Questions for Review**			
7-7	Answer **Questions for Thought**			
7-11	Read **Fact Sheet**			
7-12	Review **Glossary**			

		Possible Score	My Score	Date
7-14	**Worksheet 7.1: Definitions**	32		
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		Complete	In-Complete	Date
7-21	**Activity 7.1: Monitoring A Neighborhood Stream**			
7-29	**Activity 7.2: How Acidic Is It?**			
7-32	**Activity 7.3: Effects of Pollution on Plants**			
7-36	**Activity 7.4: Alternative Household Products**			
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