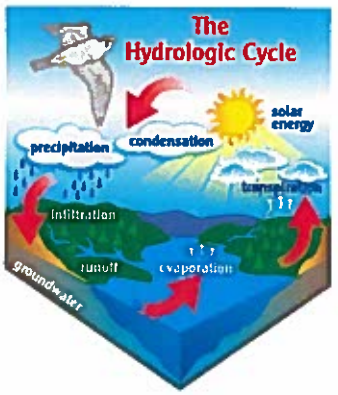
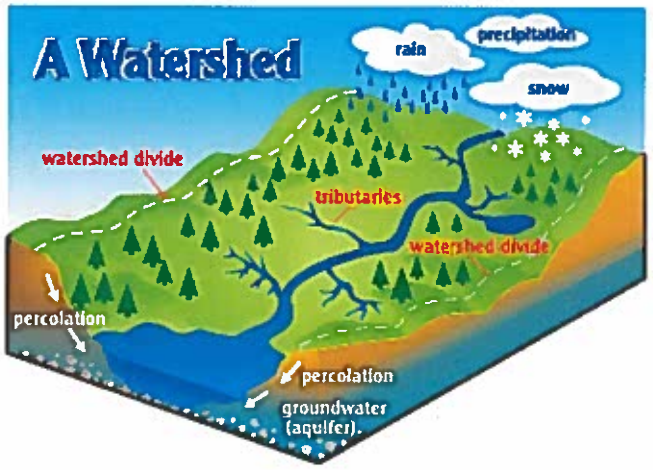
WATERSHED AWARENESS

EDUCATOR'S GUIDE





Pennsylvania Resources Council, Inc.

"Working to protect the environment since 1939

Funding provided by:

The Dominion Foundation

Watershed Awareness Program

The Pennsylvania Resources Council
and
Allegheny County Conservation District

The Pennsylvania Resources Council (PRC), in partnership with the Allegheny County Conservation District, is pleased to offer a watershed education program, designed to inspire and inform middle school students about watershed protection, to teachers in Allegheny County. PRC, founded in 1939, is committed to the preservation of our natural resources, protection of the environment and to the promotion of sound conservation practices.

PRC's Environmental Education Programs have engaged, inspired and educated local students in fourth through ninth grades on pertinent and timely topics for ten years.

The Watershed Awareness Program

Water is life and nowhere is the wonder and awe inspiring vitality of water more abundant than in the Three Rivers bioregion.

This two-session, hands-on, in-classroom program will familiarize students with their watershed, watershed basics and human impact on the watershed.

Students will learn watershed basics including the effects of human behavior and activities upon the watershed, sources of contamination, and ways to become good watershed stewards. Students and their families will be encouraged to work together to improve the health of their local watershed.

PA Academic Standards are addressed in the curriculum.

Funded by a Department of Environmental Protection Environmental Education Grant

Watershed Awareness

Water issues abound nationally and globally but before these can be addressed effectively it is imperative that citizens understand not only what it means to live in a watershed but also local watershed issues and how their local watershed is impacted by human behavior.

Local and regional watershed problems addressed in the curriculum include:

- Polluted urban runoff
- Abandoned mine drainage
- Combined sewer overflow
- Flooding
- Impervious surface
- Residential contaminants
  - Lawn and garden products and practices
  - Household cleaners/products
  - Car care
- Transportation
- Agriculture (pesticides, fertilizer, silt, manure)
- Construction
- Storm drains
- Industry
- Landfills
- Conservation

Watershed education can prepare and empower the citizens of the Commonwealth to make wise decisions and to take positive action. An environmentally literate public will understand watershed basics, point and nonpoint sources of pollution and will possess the knowledge and tools needed for promoting watershed protection.

The watershed education curriculum draws the connection between how people live on the land and the impacts of that behavior on the watershed. We seek to affect change by influencing the way that people think and feel about the land, the watershed and their relationship with the natural environment. When attitudes change behavior changes. An awareness of the watershed, water cycle and the inter-connectedness of the natural world will lead students to examine solutions aimed at reducing non-point source pollution.

Through education and understanding, a new relationship with the environment is possible.

Program Overview:

Water is a precious natural resource that we all must conserve and protect. There are many ways that we impact the watershed. Students, families, schools and businesses are all responsible for creating non-point source pollution. Understanding the water cycle, the watershed and local water issues is critical to preserving this vital resource. It is important that students, and by extension, their families, understand how human behavior affects the quality of our water.

Content Objective:

Students will understand that clean water is a precious resource, essential for healthy bodies and healthy ecosystems. They will be able to identify the parts of the hydrologic cycle, identify the locations and sources of Earth's water, define "watershed" and explain the role of a watershed. They will be able to list the various uses of water, how these uses can affect the watershed and where water goes after use. Students will have an awareness of how human behavior impacts the quality and quantity of water. Students will be able to identify sources of contamination, explain point and non-point source pollution and effective ways to protect and conserve water. Students will have a basic understanding of their local watershed and will understand their roles as environmental stewards.

Students who complete the program will:

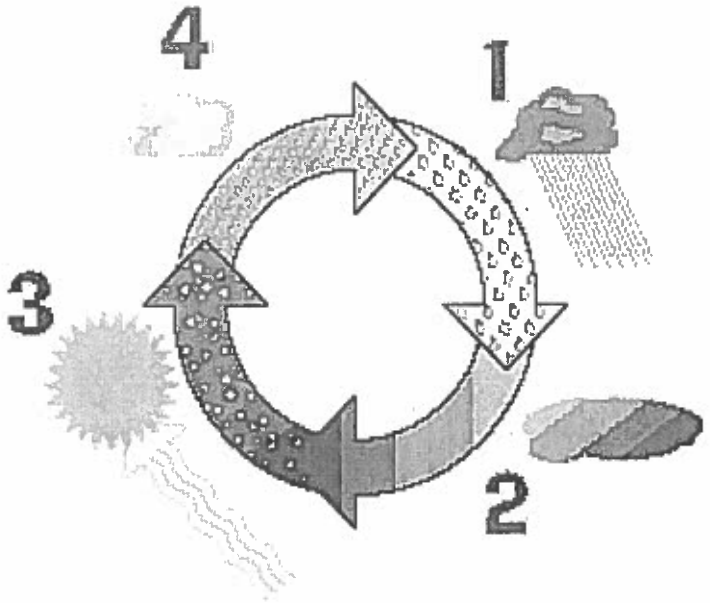
- Understand that clean water is a precious resource, essential for healthy bodies and healthy ecosystems.
- Be able to identify the parts of the hydrologic cycle
- Identify the locations and sources of Earth's water
- Define "watershed" and explain the role of a watershed
- Be able to list the various uses of water, how these uses can affect the watershed and where water goes after use
- Have an awareness of how human behavior impacts the quality and quantity of water
- Be able to identify sources of contamination
- Explain point and non-point source pollution and effective ways to protect and conserve water
- Have a basic understanding of their local watershed
- Understand their roles as environmental stewards
- Possess empowerment, problem-solving and practical application skills
- Understand that not only can we identify environmental problems; we can find solutions and take action in our own lives to reduce human impact on the watershed.

PA State Standards for Environment and Ecology addressed in the curriculum include:

- 4.1 Watersheds and Wetlands
- 4.2 Renewable and Nonrenewable Resources
- 4.3 Environmental Health
- 4.6 Ecosystems and Their Interactions
- 4.8 Humans and the Environment

Lesson 1

THE HYDROLOGIC CYCLE



Between earth and earth's atmosphere, the amount of water remains constant; there is never a drop more, never a drop less. This is a story of circular infinity, of a planet birthing itself.

LINDA HOGAN, Northern Lights, Autumn 1990

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Of all our planet's activities--geological movements, the reproduction and decay of biota, and even the disruptive propensities of certain species (elephants and humans come to mind)--no force is greater than the hydrologic cycle.

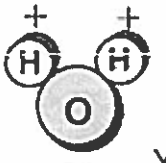
RICHARD BANGS and CHRISTIAN KALLEN, Rivergods, 1985

Background

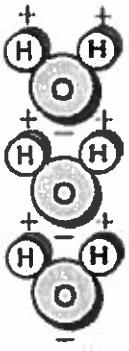
Water Properties

What are the physical and chemical properties of water that make it so unique and necessary for living things? When you look at water, taste and smell it - well, what could be more boring? Pure water is virtually colorless and has no taste or smell. But the hidden qualities of water make it a most interesting subject.

Water's Chemical Properties



You probably know water's chemical description is H_2O. As the diagram to the left shows, that is one atom of oxygen bound to two atoms of hydrogen. The hydrogen atoms are "attached" to one side of the oxygen atom, resulting in a water molecule having a positive charge on the side where the hydrogen atoms are and a negative charge on the other side, where the oxygen atom is. Since opposite electrical charges attract, water molecules tend to attract each other, making water kind of "sticky." As the right-side diagram shows, the side with the hydrogen atoms (positive charge) attracts the oxygen side (negative charge) of a different water molecule. (If the water molecule here looks familiar, remember that everyone's favorite mouse is mostly water, too).



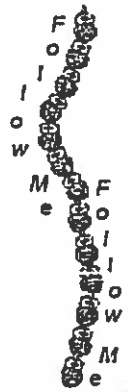
All these water molecules attracting each other mean they tend to clump together. This is why water drops are, in fact, drops! If it wasn't for some of Earth's forces, such as gravity, a drop of water would be ball shaped -- a perfect sphere. Even if it doesn't form a perfect sphere on Earth, we should be happy water is sticky.

- Water is called the "universal solvent" because it dissolves more substances than any other liquid. This means that wherever water goes, either through the ground or through our bodies, it takes along valuable chemicals, minerals, and nutrients.

Pure water has a neutral pH of 7, which is neither acidic nor basic.

Water's Physical Properties

- Water is unique in that it is the only natural substance that is found in all three states -- liquid, solid (ice), and gas (steam) -- at the temperatures normally found on Earth. Earth's water is constantly interacting, changing, and in movement.
- Water freezes at 32° Fahrenheit (F) and boils at 212° F (at sea level, but 186.4° at 14,000 feet). In fact, water's freezing and boiling points are the baseline with which temperature is measured: 0° on the Celsius scale is water's freezing point, and 100° is water's boiling point. Water is unusual in that the solid form, ice, is less dense than the liquid form, which is why ice floats.
- Water has a high specific heat index. This means that water can absorb a lot of heat before it begins to get hot. This is why water is valuable to industries and in your car's radiator as a coolant. The high specific heat index of water also helps regulate the rate at which air changes temperature, which is why the temperature change between seasons is gradual rather than sudden, especially near the oceans.
- Water has a very high surface tension. In other words, water is sticky and elastic, and tends to clump together in drops rather than spread out in a thin film. Surface tension is responsible for capillary action, which allows water (and its dissolved substances) to move through the roots of plants and through the tiny blood vessels in our bodies.



Even if you've never heard of capillary action, it is still important in your life. Capillary action is important for moving water (and all of the things that are dissolved in it) around. It **is defined as the movement of water within the spaces of a porous material due to the forces of adhesion, cohesion, and surface tension.**

Capillary action occurs because water is sticky -- water molecules stick to each other and to other substances, such as glass, cloth, organic tissues, and soil. Dip a paper towel into a glass of water and the water will "climb" onto the paper

towel. In fact, it will keep going up the towel until the pull of gravity is too much for it to overcome.

This is more important than you think. Consider:

- When you spill your glass of BubblyBerryPowerGo (which is, of course, mostly water) on the kitchen table you rush to get a paper towel to wipe it up before your parents see it. First, you can thank surface tension, which keeps the liquid in a nice puddle on the table, instead of a thin film of sugary goo that spreads out onto the floor. When you put the paper towel onto your mess the liquid attaches itself to the paper fibers.
- Plants and trees couldn't thrive without capillary action. Plants put down roots into the soil which are capable of carrying water from the soil up into the plant. Water, which contains dissolved nutrients, gets inside the roots and starts climbing up the plant tissue. As water molecule #1 starts climbing, it pulls along water molecule #2, which, of course, is dragging water molecule #3, and so on.

 One common experiment to demonstrate capillary action is to place a stalk of celery in a glass of water that has been colored with food coloring (you might want to use a piece of celery that has begun to whither, as it is in need of a quick drink). This effect happens because, in plants, water molecules move through narrow tubes that are called capillaries.

- Here's a quick rundown of some of water's properties:
  - Weight: 62.416 pounds per cubic foot at 32°F
  - Weight: 61.998 pounds per cubic foot at 100°F
  - Weight: 8.33 pounds/gallon, 0.036 pounds/cubic inch
  - Density: 1 gram per cubic centimeter (cc) at 39.2°F, 0.95865 gram per cc at 212°F

http://ga.water.usgs.gov/edu/waterproperties.html

Lesson One
Hydrologic Cycle
Water Properties, Locations and Uses

Content Objective:
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Materials:
1 liter measuring cup
1 cup measuring cup
Drinking glass
Measuring spoons
Eyedropper
Inflatable Earth ball
EnviroScape
Stream of Knowledge trifold
Student Guides
Take-home Water Wisdom handouts

Procedure:
Prior Knowledge:
Ask students questions to assess prior water knowledge.

Vocabulary:
The instructor can review vocabulary quickly; however the vocabulary will be covered in the lesson.

Water Cycle Vocabulary

aquifer: underground spaces where water is stored and through which it moves slowly under the influence of gravity

condensation: the process by which a vapor becomes a liquid

contaminant: any substance that when added to water (or another substance) makes it impure

ecosystem: a biological community (community of organisms) and its environment functioning as an ecological unit

environmental stewards: caretakers of the earth

evaporation: the process by which liquid turns into vapor (usually as a result of the application of heat energy)

groundwater: water that is found underground in cracks and spaces in the soil, sand and rocks and that moves under the influence of gravity

habitat: the place where an animal or human lives

impervious (surface): Impermeable: unable to penetrate. Impervious surface: a material, such as asphalt, covers the soil and does not allow water to penetrate into soil layers below. Prevents infiltration.

infiltration: the downward movement of water into the soil

natural resource: a substance that exists in nature that we can use for food, building, manufacturing, etc

precipitation: water falling to Earth in the form of rain, snow, sleet or hail

recharge: to replenish or refill groundwater supplies with rain or snowmelt

runoff: Rainfall or snowmelt that flows over the land surface without soaking into the soil, or over impervious surfaces (like parking lots) to lower elevations

surface water: water on the surface of the land, including lakes, streams, rivers, ponds, and runoff

transpiration: the process by which the surface of a plant gives off internal fluids as a vapor, usually from the leaves

water cycle: the paths water takes through its various states (liquid, vapor, solid) as it moves throughout the ocean, atmosphere, ground, rivers, etc.

Lesson 1:

- Hold up the Earth ball
  - Ask students what they notice about the Earth at first glance
    - (Answer: Mostly water)
- Discuss uses of water –using Earth ball as a "talking stick"
  - Toss Earth ball to students as they name some of the many uses of water (Ans: bathing, cooking, drinking, cleaning, manufacturing, agriculture, aquaculture, energy production, transportation, recreation, etc)
    - 75% of the water used in the home is used in the bathroom.
    - Explain that water also provides habitat to many aquatic species and supports wildlife and wildlife habitats.
      - Stress the importance of water to all life. Life cannot exist without it.
- Identify the locations and sources of Earth's water
  - Surface water

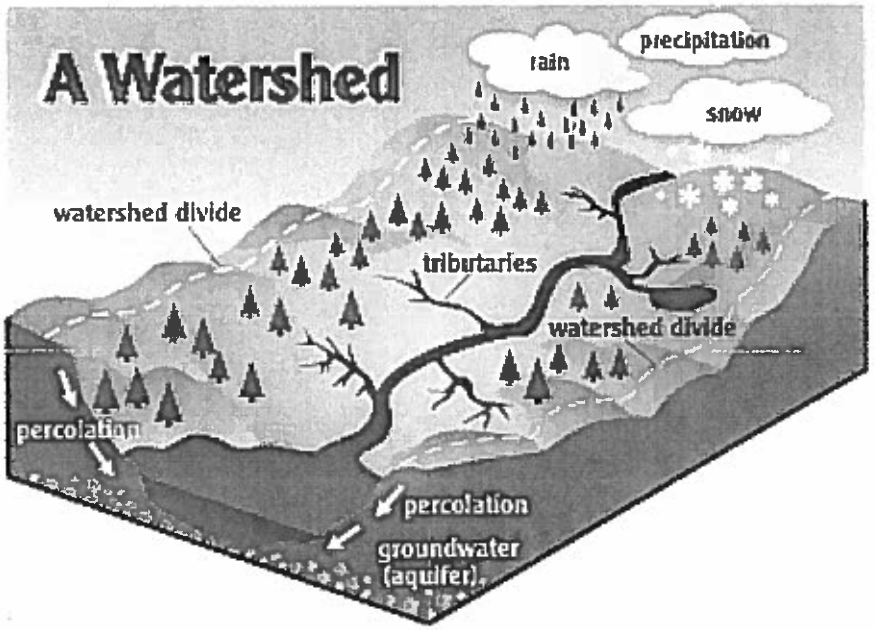
        - Fresh water
            - Rivers, lakes, streams, wetlands
            - Frozen water: polar ice caps, glaciers, mountain tops,
        - Salt water
            - Oceans
    - Groundwater
        - Soil water
        - Aquifers
        - Springs
    - Water vapor
- Usable water demonstration
    - Demonstrate using a one-liter container, two smaller clear containers, an eyedropper and a bowl the relatively small percentage of Earth's water that is easily accessible, surface water
        1. Show the class a liter of water and tell them that it represents all of the water on Earth.
        2. Ask where most of the water on Earth is located. Pour 30 ml of the water into a smaller clear container. This represents Earth's fresh water-about 3% of the total. Put salt into the remaining 970 ml to simulate water found in oceans, unsuitable for human consumption.
        3. Ask students what is located at the Earth's poles. Almost 80% of Earth's fresh water is frozen in ice caps and glaciers. Pour 6 ml of fresh water into a smaller clear container. Tell them that the water remaining in the larger fresh water vessel represents frozen water. The water in the smaller vessel (about 0.6 percent of the total) represents non-frozen fresh water. Only about 1.5 ml of this water is surface water, the rest is underground.
        4. Use an eyedropper to remove a single drop of water. Release this one drop into a bowl or saucer. This represents clean, fresh water that is not polluted or otherwise unavailable for use, about 0.00003 percent of the total.
        5. Discuss the results of the activity. Explain that this small percentage represents a large volume of water; however we do need to conserve and protect it
- Water's unique properties and behavior
    - Water as the universal solvent
        - Water is the liquid most capable of dissolving other substances
        - For this reason it can carry nutrients to plants(a good thing) or dissolve and carry pollutants form streets, parking lots, etc. into our waterways(a bad thing)
    - Occurs in three forms (liquid, solid, gas)
    - Surface tension
        - Water is sticky and elastic, and tends to clump together in drops rather than spread out in a thin film.
        - Surface tension is responsible for capillary action, which allows water (and its dissolved substances) to move through the roots of plants and through the tiny blood vessels in our bodies.
    - Water freezes at 32° Fahrenheit (F) and boils at 212° F (at sea level, but 186.4° at 14,000 feet). In fact, water's freezing and boiling points are the baseline with which temperature is measured:

        - 0° on the Celsius scale is water's freezing point
        - 100° is water's boiling point.
    - Water is unusual in that the solid form, ice, is less dense than the liquid form, which is why ice floats.
- Introduce Stream of Knowledge - a tri-fold interactive model depicting a woodland stream ecosystem and the water cycle

- Ask the students where they think that water comes from.
    - Explain that the same water that was here millions of years ago is still being recycled. In fact, long ago dinosaurs may have drunk the water that they will drink today.
    - As you discuss the **water cycle** use the Stream of Knowledge as a tool and ask the students to complete their blank water cycle worksheet.
    - Explain that water circulates continuously and that as it does it changes form from water to vapor to solid.
    - Using the tri-fold, point out that the three main parts of the water cycle are **precipitation, condensation** and **evaporation.** Explain that heat energy (Sun) causes the surface water to evaporate.
    - Explain how water also re-enters the atmosphere through the process of **transpiration** from plants.
    - Explain the process of precipitation recharging the groundwater by **infiltration** and that aquifers recharge the rivers and streams. Explain that precipitation also flows into streams and rivers as surface **runoff.**

Lesson 2

THE WATERSHED



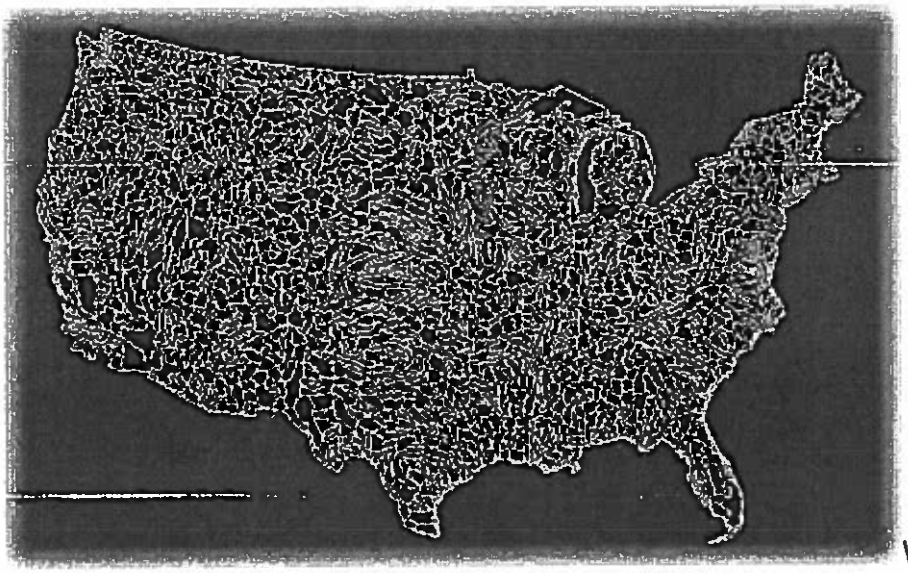
Watershed: Water what ?

The area of land that drains into streams, lakes, estuaries or other bodies of water are known as watersheds. They are also known as drainage basins or catchments. As precipitation falls to the ground, the water is pulled downhill by gravity, which causes it to flow over the landscape or infiltrate through the soil into the groundwater. Topography - the hills, valleys, and other features that define the landscape - determine the boundaries of watersheds.

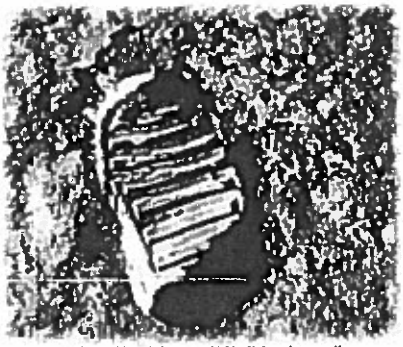
Every stream, regardless of its size, has a watershed. Smaller watersheds are contained within larger watersheds. For example, The Streets Run Watershed in southwestern Pennsylvania is part of the Monongahela River Watershed, which in turn is part of the Ohio River Watershed, which is part of the Mississippi River Watershed. **No matter where you live, you live within a watershed. Just as you have a home and school address, you also have a watershed address.**

Background:

What is a watershed?



When looking at the location of rivers and the amount of streamflow in rivers, the key concept is the river's "watershed". What is a watershed? Easy, if you are standing on ground right now, just look down. You're standing, and everyone is standing, in a watershed. A watershed is the area of land where all of the water that falls in it and drains off of it goes into the same place. Watersheds can be as small as a footprint or large enough to encompass all the land that drains water into rivers that drain into Chesapeake Bay, where it enters the Atlantic Ocean. This map shows one set of watersheds in the continental United States; these are known as National 8-digit hydrologic units (watersheds).

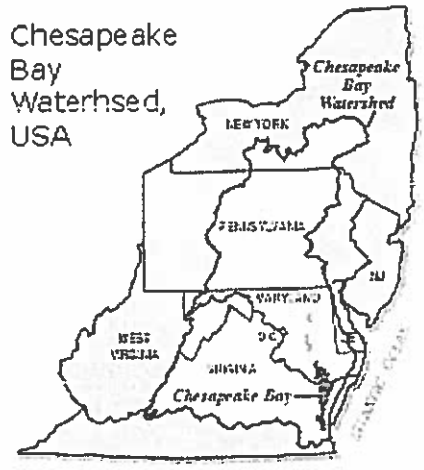


Footprint on the Moon - if it did rain on the Moon, then this footprint would be a watershed. (Credit: NASA)

A watershed is an area of land that drains all the streams and rainfall to a common outlet such as the outflow of a reservoir, mouth of a bay, or any point along a stream channel. The word watershed is sometimes used interchangeably with drainage basin or catchment. Ridges and hills that separate two watersheds are called the drainage divide. The watershed consists

of surface water--lakes, streams, reservoirs, and wetlands--and all the underlying ground water. Larger watersheds contain many smaller watersheds. It all depends on the outflow point; all of the land that drains water to the outflow point is the watershed for that outflow location. Watersheds are important because the streamflow and the water quality of a river are affected by things, human-induced or not, happening in the land area "above" the river-outflow point

A watershed is a precipitation collector



Most of the precipitation that falls within the drainage area of a stream's monitoring site collects in the stream and eventually flows by the monitoring site. Many factors, some listed below, determine how much of the streamflow will flow by the monitoring site. Imagine that the whole basin is covered with a big (and strong) plastic sheet. Then if it rained one inch, all of that rain would fall on the plastic, run downslope into gulleys and small creeks and then drain into main stream. Ignoring evaporation and any other losses, and using a 1-square mile example watershed, then all of the approximately 17,378,560 gallons of water that fell (you can use our interactive rainfall calculator to find out how many gallons of water fall during a storm) as rainfall would eventually flow by the watershed-outflow point.

Not all precipitation that falls in a watershed flows out

To picture a watershed as a plastic-covered area of land that collects precipitation is overly simplistic and not at all like a real-world watershed. A career could be built on trying to model a watershed water budget (correlating water coming into a watershed to water leaving a watershed). There are many factors that determine how much water flows in a stream (these factors are universal in nature and not particular to a single stream):

- Precipitation: The greatest factor controlling streamflow, by far, is the amount of precipitiation that falls in the watershed as rain or snow. However, not all precipitation that falls in a watershed flows out, and a

stream will often continue to flow where there is no direct runoff from recent precipitation.

- Infiltration: When rain falls on dry ground, some of the water soaks in, or infiltrates the soil. Some water that infiltrates will remain in the shallow soil layer, where it will gradually move downhill, through the soil, and eventually enters the stream by seepage into the stream bank. Some of the water may infiltrate much deeper, recharging ground-water aquifers. Water may travel long distances or remain in storage for long periods before returning to the surface. The amount of water that will soak in over time depends on several characteristics of the watershed:
    -
    - Soil characteristics: In Georgia, clayey and rockey soils of the northern areas absorb less water at a slower rate than sandy soils, such as in Georgia's Coastal Plain. Soils absorbing less water results in more runoff overland into streams.
    - Soil saturation: Like a wet sponge, soil already saturated from previous rainfall can't absorb much more ... thus more rainfall will become surface runoff.
    - Land cover: Some land covers have a great impact on infiltration and rainfall runoff. Impervious surfaces, such as parking lots, roads, and developments, act as a "fast lane" for rainfall - right into storm drains that drain directly into streams. Flooding becomes more prevalent as the area of impervious surfaces increase.
    - Slope of the land: Water falling on steeply-sloped land runs off more quickly than water falling on flat land.
- Evaporation: Water from rainfall returns to the atmosphere largely through evaporation. The amount of evaporation depends on temperature, solar radiation, wind, atmospheric pressure, and other factors.
- Transpiration: The root systems of plants absorb water from the surrounding soil in various amounts. Most of this water moves through the plant and escapes into the atmosphere through the leaves. Transpiration is controlled by the same factors as evaporation, and by the characteristics and density of the vegetation. Vegetation slows runoff and allows water to seep into the ground.
- Storage: Reservoirs store water and increase the amount of water that evaporates and infiltrates. The storage and release of water in reservoirs can have a significant effect on the streamflow patterns of the river below the dam.
- Water use by people: Uses of a stream might range from a few homeowners and businesses pumping small amounts of water to irrigate their lawns to large amounts of water withdrawals for irrigation, industries, mining, and to supply populations with drinking water.

http://ga.water.usgs.gov/edu/watershed.html

Q: How important is ground water?

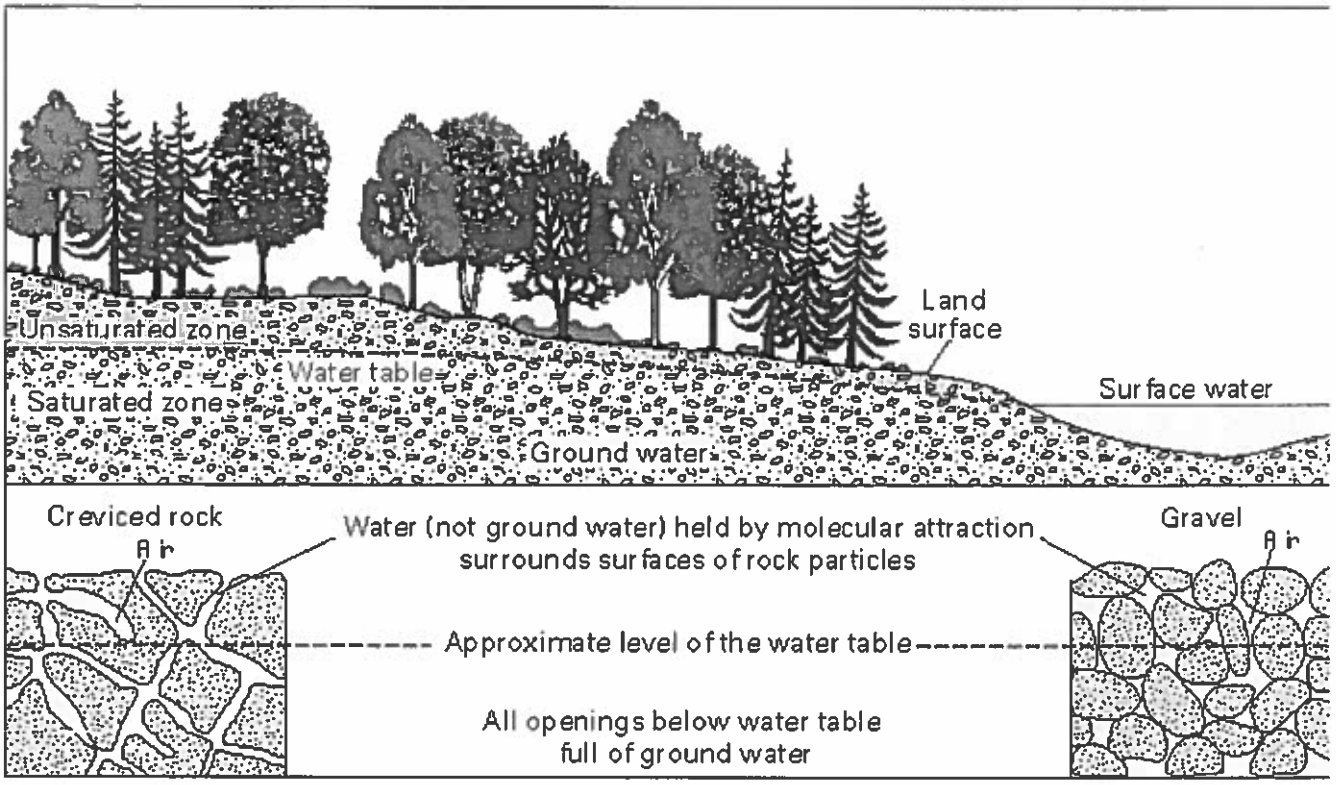
A: Ground water, which is in aquifers below the surface of the Earth, is one of the Nation's most important natural resources. Ground water is the source of about 37 percent of the water that county and city water departments supply to households and businesses (public supply). It provides drinking water for more than 90 percent of the rural population who do not get their water delivered to them from a county/city water department or private water company. Even some major cities, such as San Antonio, Texas, rely solely on ground water for all their needs. About 42 percent of the water used for irrigation comes from ground water. Withdrawals of ground water are expected to rise as the population increases and available sites for surface reservoirs become more limited.

Ground-water aquifers

One of our most valuable resources is the water beneath our feet - something you can't see and may not even know is there! As you may have read, most of the void spaces in the rocks below the water table are filled with water. But rocks have different porosity and permeability characteristics, which means that water does not move around the same way in all rocks.

When a water-bearing rock readily transmits water to wells and springs, it is called an aquifer. Wells can be drilled into the aquifers and water can be pumped out. Precipitation eventually adds water (recharge) into the porous rock of the aquifer. The rate of recharge is not the same for all aquifers, though, and that must be considered when pumping water from a well. Pumping too much water too fast draws down the water in the aquifer and eventually causes a well to yield less and less water and even run dry. In fact, pumping your well too fast can even cause your neighbor's well to run dry if you both are pumping from the same aquifer.

In the diagram below, you can see how the ground below the water table (the blue area) is saturated with water. The "unsaturated zone" above the water table (the greenish area) still contains water (after all, plants' roots live in this area), but it is not totally saturated with water. You can see this in the two drawings at the bottom of the diagram, which show a close-up of how water is stored in between underground rock particles.



Sometimes the porous rock layers become tilted in the earth. There might be a confining layer of less porous rock both above and below the porous layer. This is an example of a confined aquifer. In this case, the rocks surrounding the aquifer confines the pressure in the porous rock and its water. If a well is drilled into this "pressurized" aquifer, the internal pressure might (depending on the ability of the rock to transport water) be enough to push the water up the well and up to the surface without the aid of a pump, sometimes completely out of the well. This type of well is called artesian. The pressure of water from an artesian well can be quite dramatic.

Here's a little experiment to show you how artesian pressure works. Fill a plastic baggie with water, put a straw in through the opening, tape the opening around the straw closed, DON'T point the straw towards your teacher, and then squeeze the baggie. Artesian water is pushed out through the straw.

Some information on this page is from *Waller, Roger M., Ground Water and the Rural Homeowner, Pamphlet, U.S. Geolgoical Survey, 1982*

Lesson 2
The Watershed

Content Objective:
Students will be able to define "watershed" and explain the role of a watershed. They will be able to list the various uses of water, how these uses can affect the watershed and where water goes after use. Students will have an awareness of how human behavior impacts the quality and quantity of water. Students will be able to identify sources of contamination, explain point and non-point source pollution and effective ways to protect and conserve water. Students will have a basic understanding of their local watershed and will understand their roles as environmental stewards.

Materials:
EnviroScape 3-D watershed model

Procedure:
Prior Knowledge:
Ask students questions to assess prior watershed knowledge.

Watershed Vocabulary:

Aquifer: underground spaces where water is stored and through which it moves slowly under the influence of gravity

Collection site: a stream, lake, reservoir, or other body of water fed by water drained from a watershed

Combined Sewer Overflow (CSO): in urban and suburban areas, runoff from roads, parking lots, and rooftops is often channeled into storm sewer pipes that combine with human sewage. During storms, human waste and storm water can overload the system, resulting in an overflow of water and untreated sewage into creeks and rivers. This is called Combined Sewage Overflow (CSO). It occurs most often in townships and municipalities with aging sewage systems.

Conservation: the use of water-saving methods to reduce the amount of water that we use

Contaminant: any substance that when added to water (or another substance) makes it impure

Ecosystem: a biological community and its environment functioning as a unit

Environmental stewards: caretakers of the earth

Groundwater: water that is found underground in cracks and spaces in the soil, sand and rocks and that moves under the influence of gravity

Habitat: the place where an animal or human lives

Headwaters, headwater stream: A small creek or stream that begins in the highest elevations of a watershed.

Impervious (surface): prevents water from entering soil directly

Infiltration: the downward movement of water into the soil

Non-point source pollution: pollution that originates over a widespread region from a variety of sources rather than a single point or location

Point source pollution: pollution that originates at a specific point or location, such as a factory or sewage plant (end-of-pipe sources)

Recharge: to replenish or refill groundwater supplies with rain or snowmelt

Runoff: rainfall or snowmelt that flows over the land surface without soaking into the soil or that flows over impervious surfaces (like parking lots)

Surface water: water on the surface of the land, including lakes, streams, rivers, ponds and runoff

Sewage treatment facility: facility that treats water to remove contaminants so that it can be safely used

Tributary: a smaller channel of water that drains into a larger body of running water: a creek that empties into a stream; a stream that empties into a river.

Watershed: the land area from which surface runoff drains into a stream, channel, lake, reservoir or other body of water (collection site)

<u>Lesson 2:</u>

- Explain what a watershed is
    - the land area from which surface runoff drains into a common stream, channel, lake, reservoir or other body of water (collection site)
    - Defined by elevation
- Discuss the local watershed
    - Streets Run? Plum Creek? Yough? Mon? Allegheny? Ohio? Etc
        - Where does it originate?
        - Where does it go?
        - Local watershed issues
            - Impermeable surfaces
            - Flooding
            - AMD
            - Nonpoint Source Pollution (NPS)
            - Point Source Pollution
            - Combined Sewer Overflow (CSO)
            - Aquatic life

- Introduce the EnviroScape 3-D watershed model
- Review the various uses of water and how these uses can affect the watershed
    - Contamination
    - Aquatic life
- Identify sources of contamination
    - Residential
        - Lawn and garden
        - Household cleaners
        - Pharmaceuticals
        - Car care
        - Sewage
    - Timber harvesting
    - Transportation
    - Agriculture
        - Pesticides
        - Fertilizer
        - Silt
        - Manure
    - Construction/Urban runoff
    - Storm drains
    - Industry
    - Abandoned Mine Drainage- (resource extraction)
    - Landfills
- List best management practices to protect and conserve water.
- Introduce the rain barrel model
    - Rain barrels help to alleviate flooding
    - Method of water conservation

Distribute Take-Home materials.

- **Parent/Guardian will sign and return signed portion to the classroom teacher**

Administer Post -test

Extension Activity

Water Purification by Evaporation and Condensation

http://www.epa.gov/safewater/kids/activity_grades_4-8_waterpurification.html

GRADE LEVEL: 4 – 7

BACKGROUND:

The following demonstration illustrates how the water cycle helps to purify water. The key terms are evaporation and condensation. Evaporation is defined as the process through which a liquid becomes a vapor. Condensation is the process through which a vapor becomes a liquid, and is the opposite of evaporation. In the case of water, the main mechanisms for evaporation and condensation are heating and cooling, respectively.

MATERIALS NEEDED:

- 4 cups of dirt or sand a dozen stones,
- 2 quarts of water a large glass bowl with tall sides (mixing bowl),
- a short glass,
- clear plastic wrap, and
- a sunny day.

PROCEDURE:

Mix the dirt (or sand) and water in a large bowl. Stand a clean and empty short glass in the center of the bowl. Place the bowl outside in the sun. Cover the bowl with the plastic wrap and weigh down the edges with the remaining rocks. Place one rock on the plastic wrap directly over the cup. Allow the bowl to remain in the sun for several hours. Look in the cup (it should contain some relatively clean water free of mud). Look in the bowl (it should contain the dried dirt).

FOLLOW-UP QUESTIONS:

1. What are the two processes responsible for purifying the water? (Evaporation and Condensation)
2. Where else do you see condensation? (Cold drink outside on a hot day)
3. How does this process work on Earth?
4. What is the plastic wrap? (Our atmosphere)
5. What is the condensation? (Clouds and rain)
6. What would happen if the plastic wrap was dirty? (Air pollution)

VARIATIONS:

Add food coloring to water to demonstrate that this process does not remove all pollutants. This may be done simultaneously with the procedure above.

Extension Activity

Non-point Source Pollution

http://www.epa.gov/safewater/kids/activity_grades_4-8_nonpoint_pollution.htm

GRADE LEVEL: 4 – 7

BACKGROUND:

This activity is designed to demonstrate to students what an average storm drain collects during a rainfall event and how the water from storm drains can impact the water quality and aquatic environments of local streams, rivers, and bays.

MATERIALS NEEDED:

- "Waterway"
- Aquarium
- Rectangular Water Box
- Watering Can
- Spray Bottle
- "Pollutants"
- Green Food Coloring (pesticides/fertilizer)
- Vegetable Oil (motor oil)
- Soil/Sand/Pebbles (erosion)
- Grass Clippings (or Shredded Paper) and Twigs
- Cafeteria Waste and Trash

PREPARATION:

Fill the aquarium half-way with water and place it on an accessible area where it can be easily viewed by the students. Cut a hole in the bottom of the box and place the box on top of the aquarium. The box represents the storm drain and the aquarium represents the waterway that the storm water mixes into after entering the storm drain. Leave the sides of the aquarium uncovered so that the students can view its contents.

PROCEDURE:

1. Introduce this activity with a discussion of storm drains and storm drain systems and their purposes. Discuss where the water and objects that float down into a storm drain go. Have students list all of the things that they can think of that might enter a storm drain during a rain storm.
2. Assign a group of students to each pollutant. Discuss each pollutant,

including its use or origin and how it could enter the storm drain.

3. Have each group of students place their pollutant into the storm drain. Use the watering can to create rain to wash the pollutant into the waterway. While washing each pollutant into the waterway, review the pollutant and its use or origin. Discuss the following questions: How does the pollutant damage the environment? Do the people who are responsible for the pollutant want to damage the environment? Why did they do what they did? How can this type of pollution be stopped?
4. After adding all of the pollutants, examine the contents of the waterway. Discuss how the waterway has changed and how viewing this change makes the students feel.

FOLLOW-UP QUESTIONS:

1. What types of the pollution are natural?
2. What types of pollution are added by people living in the local communities?
3. How can we remove the pollution from the water?
4. What could be done to stop pollutants from entering storm drains?

VARIATIONS:

Have the groups of students responsible for the pollution think of ways to remove the pollution from the aquarium. Try some of the removal methods. Which pollutants were easy to remove? Which were difficult to remove?

Extension Activity

Role of Plants in Water Filtration

http://www.epa.gov/safewater/kids/activity_grades_4-8_plantsinwaterfiltration.html

GRADE LEVEL: 4 – 7

BACKGROUND:

Experiments can be done to show how a plume of dissolved materials can move through soil and enter a groundwater aquifer. But soil and plants have something of a dual role in this process. Depending on whether materials are dissolved or suspended in the water, soils and plant roots can remove some or all of this material as the water moves down through soil. Most suspended materials will adhere to the soil. These may then be broken down and used as food by the plants. Dissolved nutrients, such as nitrogen or phosphorus, chemically bond with some types of soil particles. They are then taken up by plants, thus removing them from the soil before they can enter an aquifer. For the plants, these elements are food, for an aquifer, they are pollution. Not all materials are absorbed by plants and not all water pollutants are food for plants. However, sediments from eroding soil, nutrients in human and animal wastes, and some components of household wastewater ("graywater") are excellent plant nutrients. Plants also use different nutrients at different rates, so that the amount of material they take up will depend on how much is dissolved in the water and how fast the water moves through. This experiment is a very simplified way to show whether plants will take up certain kinds of materials from water moving relatively quickly through their root systems.

OBJECTIVE:

To understand the role of plants in filtering the water moving through a watershed.

MATERIALS NEEDED:

- Six potted plants, with pots roughly six to eight inches in diameter, and holes in the bottom. These plants need to be moderately dry, as if they had not been watered for a couple days. Plants with saturated soil will not absorb water, and very dry plants will absorb it all.
- Six clear containers, such as cups, which will support the plants and allow drainage to be viewed. You will need separate plants and cups for each of the materials in the water.
- Soil from outside (anywhere). The best soil is loamy, with smaller particles than sand.
- Unsweetened powdered drink mix, preferably grape or cherry for color.

- Vegetable oil.
- One or two different household cleaners (such as Comet/Ajax and Dish or Laundry soap). One should be liquid and the other powder.

PREPARATION:

Set up the potted plants, each in its own cup. Slowly pour six to eight ounces of clean water through the pot, and check the percolation rate through the pot. Loosen or tighten the soil so that water percolates at about one ounce per minute. The rate should be fast enough to prevent long waiting periods, but slow enough not to carry very much soil through the pot.

PROCEDURE:

1. Place the potted plants into the top of their cups. Pour clean water slowly through one of the pots and watch it percolate through the bottom of the pot. The water should look as clean as what was poured.
2. Add a gram or so of soil to 6-8 ounces of water and stir so that the soil is well suspended and distributed in the water. Pour slowly into another flower pot. The water percolating through should look *much* cleaner than the dirty water poured.
3. Add about one ounce of vegetable oil to 6-8 ounces of water, stir (they won't mix completely) and pour into a third pot. See if the vegetable oil percolates through or is caught up by the plant roots.
4. Add some powdered drink mix to 6-8 oz. of water and pour through a fourth pot. See if the water percolating through retains the color.
5. Add some powdered cleanser to 6-8 oz. of water and pour through a fifth pot. Is the cleanser retained in the soil?
6. Add some liquid soap to the water (an ounce or so in 6-8 oz. water). Does the soap percolate through the soil?
7. Using the "contaminated" plants, pour some clean water at the same rate through each one (simulating a rain shower). Is more of the "pollutant" rinsed away from the soil by the clean water?

FOLLOW-UP QUESTIONS:

1. In what ways can plants and soil benefit drinking water quality?
2. We saw plants and soil remove some types of impurities from water. How might the plants remove larger quantities?
3. Can plants and soil remove any type of impurity from water?
4. What other organisms in the soil-plant system might aid the uptake of water pollutants?
5. What is the role of rainwater moving through contaminated soil?

Post-Test
Watershed Awareness Program

Directions: Read each question carefully and then answer to the best of your ability.
Note: You will not be graded on this exercise.

1) What percentage (%) of the Earth is covered with water?

_____

2) A watershed is always named (Circle one)
   a. After the body of water that the watershed drains into
   b. After the person who discovered it
   c. For the state that most of the watershed's land is in

3) Groundwater is: (circle one)

   a. water that lies on top of the ground
   b. water that has become polluted with soil
   c. water that is found underground in cracks and spaces in the soil, sand and rock

4) An area of land from which water drains into a common (the same) stream, lake, river or other body of water is known as: (circle one)

   a. a watershed
   b. the water cycle
   c. a riparian buffer zone

5) The water that the majority of southwestern Pennsylvanians use in their homes comes from where? (circle one)

   a. cisterns
   b. lakes
   c. rivers
   d. wells

6) The biggest water pollution problem facing North America today is:(circle one)

a. Point Source Pollution
b. Pet waste
c. Nonpoint Source Pollution
d. Litter

7) Name two ways that we can be environmental stewards and protect the quality of our water.

1._____

2._____

8) Name two sources of pollution that come from our homes and/or yards.

1._____
2._____

9) Name two things that you can do to conserve (save) water?

1._____
2._____

10) Name five ways that humans use water.

1._____
2._____
3._____
4._____
5._____

11) What watershed do you live in?

_____

Name of school: _____ Grade_____

Thank you!

Post-Test Answer Key
Watershed Awareness Program

Directions: Read each question carefully and then answer to the best of your ability.
Note: You will not be graded on this exercise.

1) What percentage (%) of the Earth is covered with water?

_____**75%**_____

2) A watershed is always named (Circle one)
   a. **After the body of water that the watershed drains into**
   b. After the person who discovered it
   c. For the state that most of the watershed's land is in

3) Groundwater is: (circle one)

   a. water that lies on top of the ground
   b. water that has become polluted with soil
   c. **water that is found underground in cracks and spaces in the soil, sand and rock**

4) An area of land from which water drains into a common (the same)stream, lake, river or other body of water is known as: (circle one)

   a. **a watershed**
   b. the water cycle
   c. a riparian buffer zone

5) The water that the majority of southwestern Pennsylvanians use in their homes comes from where? (circle one)

   a. cisterns
   b. lakes
   c. **rivers**
   d. wells

(Over)

6) The biggest water pollution problem facing North America today is:(circle one)

a. Point Source Pollution
b. Pet waste
c. **Nonpoint Source Pollution**
d. Litter

7) Name two ways that we can be environmental stewards and protect the quality of our water.

1. **Do not litter**
2. **Do not put anything in the storm drain**

8) Name two sources of pollution that come from our homes and/or yards.

1. **Pet Waste**
2. **Pesticides**

9) Name two things that you can do to conserve (save) warter..

1. **Take shorter showers**
2. **Don't let the water run when not in use**

10) Name five ways that humans use water.

1. **Bathing**
2. **Swimming**
3. **Energy production**
4. **Cooking**
5. **Putting out fires**

11) What watershed do you live in?

_____

Name of school: _____ Grade_____

Thank you!