Water in your community: Where does it come from? Where does it go? **Lesson: 1**

National Science Education Standards for Grades 9-12

Content Standard C: Life Science: The Interdependence of Organisms

- *Human beings live within the world's ecosystems. Increasingly, humans modify ecosystems as a result of population growth, technology and consumption.*

Content Standard D: Earth and Space Science: Geochemical Cycles

- *Each element on earth moves among reservoirs in the solid earth, oceans, atmosphere and organisms as part of geochemical cycles.*

Content Standard F: Science in Personal and Social Perspectives: Natural Resources

- *Human populations use resources in the environment in order to maintain and improve their existence. Natural resources have been and will continue to be used to maintain human populations.*

- *The earth does not have infinite resources; increasing human consumption places severe stress on the natural processes that renew some resources, and it depletes those resources that cannot be renewed.*

Student Learning Objectives

1.1 Describe the water cycle from a local perspective.

1.2 Define and diagram their local watershed.

1.3 Describe the term "agricultural area" as it might be applied locally, in other areas of their state, and nationally (e.g., cropland, dairy farms, cattle ranches, apple orchards, tree farms, etc.).

Teacher Info Table Time

Instruction time for this lesson: 65 minutes if no remedial activities used, longer as needed.

Resources, Tools, Equipment and Supplies

1.1. Remedial Water Cycle Activity

Resources

- PRE-TEST: SW.1.1.ASSESS—The Water Cycle
- Remedial activity for water cycle background: FFA Middle School Food and Agricultural Literacy Curriculum MS.NR.3.2: *My Water's Been Where? Understanding the Water Cycle* http://ffa.learn.com/files/pdf/MS.NR.3.2.pdf
- *Summary of the Water Cycle – USGS Water Science for Schools:* http://ga.water.usgs.gov/edu/watercyclesummary.html
- Groundwater and the Water Cycle, The Groundwater Foundation: www.groundwater.org/kc/gwwatercycle.html
- Water Cycle Diagram – Animated from *Earthguide* http://earthguide.ucsd.edu/earthguide/diagrams/watercycle/

Equipment

Overhead projector or LCD projector

Supplies

Glass of drinking water

1.2.a. Map Your Watershed Activity

Resources

- SW.1.2.TM.A: Powerpoint Slides – Watersheds
- SW.1.2.AS.A: Activity Worksheet – Mapping Your Watershed

Equipment

Overhead projector or LCD projector

Supplies

Topographic map or maps, which include your site and any other maps you have collected of the area.

Copies of topographic map for each student

Pencils

Resources, Tools, Equipment and Supplies

1.2.b. Build Your Own Watershed Activity

Resources

- SW.1.2.AS.B: Activity Worksheet– Build Your Own Watershed

Supplies

1 large plastic container (about 1.5'W x 3'L x 1'H)

2 lbs. of modeling clay

3 lbs. of sand (any type of sand will do)

2 lbs. of aquarium gravel

1 roll of wax paper (or any other impervious, water repellant surface, tin foil, plastic wrap, etc.)

1/4 cup of cocoa mix, iced tea mix or other flavored drink mix (to represent chemicals)

1 spray bottle or bucket full of water

Key Terms

Aquifer

Condensation

Discharge

Evaporation

Evapotranspiration

Groundwater flow

Infiltration

Percolation

Precipitation

Recharge

Runoff

Topographic

Transpiration

Watershed

SUMMARY OF CONTENT AND TEACHING STRATEGIES:

WATER CYCLE[1]

Water is a natural resource that is found throughout the earth. It is a resource that is constantly recycled throughout the earth in a process called the water cycle. The water you drink, use to wash a car, or give to your animals at home has gone through this recycling process. The water cycle is important because it helps filter and refresh that water for future use. There is, however, a finite amount of clean, fresh water on earth. If we don't take proper care of our water, especially our very limited amount of fresh water, it can become contaminated and unsafe for use by people and animals.

A. What is the water cycle?

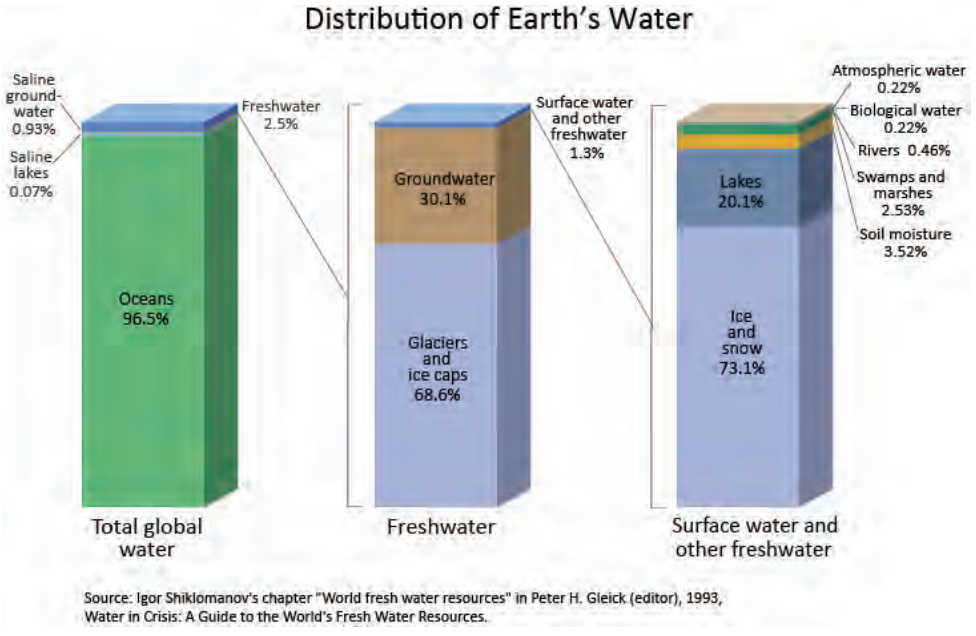
1. Water continually moves throughout the earth and is always changing states (liquid, vapor, ice).
2. The water cycle has been working for billions of years and all life on Earth depends on it continuing to work.
3. Water is filtered, recycled and refreshed by moving through the Earth's environment and the water cycle.

B. How does water move through the water cycle? The six following steps illustrate how water cycles through the Earth's environment. Water does not, however, always cycle in this order. For instance, surface water may move through the ground to replenish or recharge groundwater resources. Groundwater can replenish surface water sources such as lakes or rivers. This is particularly important under drought conditions.

1. Water travels from the Earth's surface to the atmosphere through evaporation. Evaporation is the conversion of water from liquid to gas form by the exposure to heat.
2. Water is released as water vapor by plants into the atmosphere through transpiration. Transpiration is the process of plants releasing water from their leaves.
3. As water vapor rises in the atmosphere, it begins to cool and turn back into water. This process is called condensation. (Water may still need treatment before use as drinking water.)
4. As water vapor condenses, clouds are formed. As the vapor droplets become large, rain is formed and falls to the earth's surface as precipitation.

1 Adapted from http://ffa.learn.com/files/pdf/MS.NR.3.2.pdf

5. When water reaches the ground, it enters waterways such as rivers, lakes and oceans or it percolates through the ground and becomes part of groundwater.
6. Water is then brought to the Earth's surface, and the process is started again through evaporation or transpiration.



WATERSHEDS

1. Definition
   a. Land area from which surface runoff drains into a stream, channel, lake, reservoir, or other body of water, or recharges groundwater
   b. Includes everything (plants, animals, structures) within the land area
   c. May also be called a drainage basin or a catchment

2. Basic components

a. Headwater of the body of water
b. Watershed divide (boundary; hills, mountains, etc.)
c. Tributaries (smaller bodies of water)
d. Low point (stream, lake, river, etc.)
e. All shapes and sizes; cross county, state and national boundaries

f. A smaller part of a watershed may be a source of drinking water from surface water or groundwater

3. Basic functions of a watershed for humans
    a. Supply drinking water
    b. Provide recreation and respite
    c. Sustain life

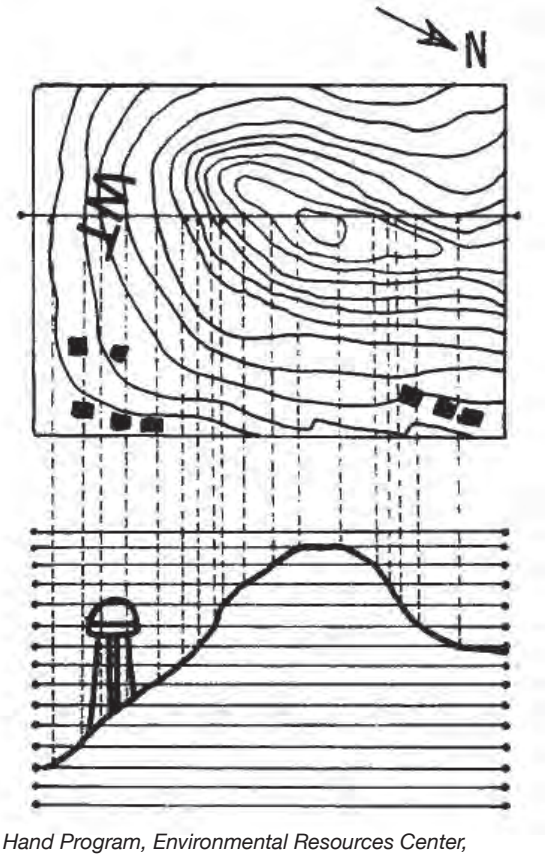
4. Aquifer
    a. A geological formation or structure that is water bearing
    b. Stores and/or transmits water, such as to wells and springs
    c. Use of the term is usually restricted to those water-bearing formations capable of yielding water in sufficient quantity to constitute a usable supply for people's uses

5. Groundwater recharge area
    a. A land area where permeable soil or rock allows water to seep into the ground to replenish an aquifer
    b. Part of a watershed; found below ground level

USING TOPOGRAPHIC MAPS[2]

Topographic maps depict an aerial view of land. They use contour lines to show the elevation of land areas. These lines are sometimes called level lines because they show points that are at the same level or altitude. The **top** drawing below is a contour map showing the same hills which are illustrated in profile in the **bottom** drawing. On this particular map, the vertical distance between each contour line is 10 feet.

Lines that are close together show steeper slopes. Lines that are far apart show flatter terrain. Rivers and streams on topographic maps are often found within the broader spaces between lines, which indicate the flat, floodplain areas created by moving waters. Hilltops are where contour lines connect to form circles or ovals. They are illustrated as the smallest center circle.



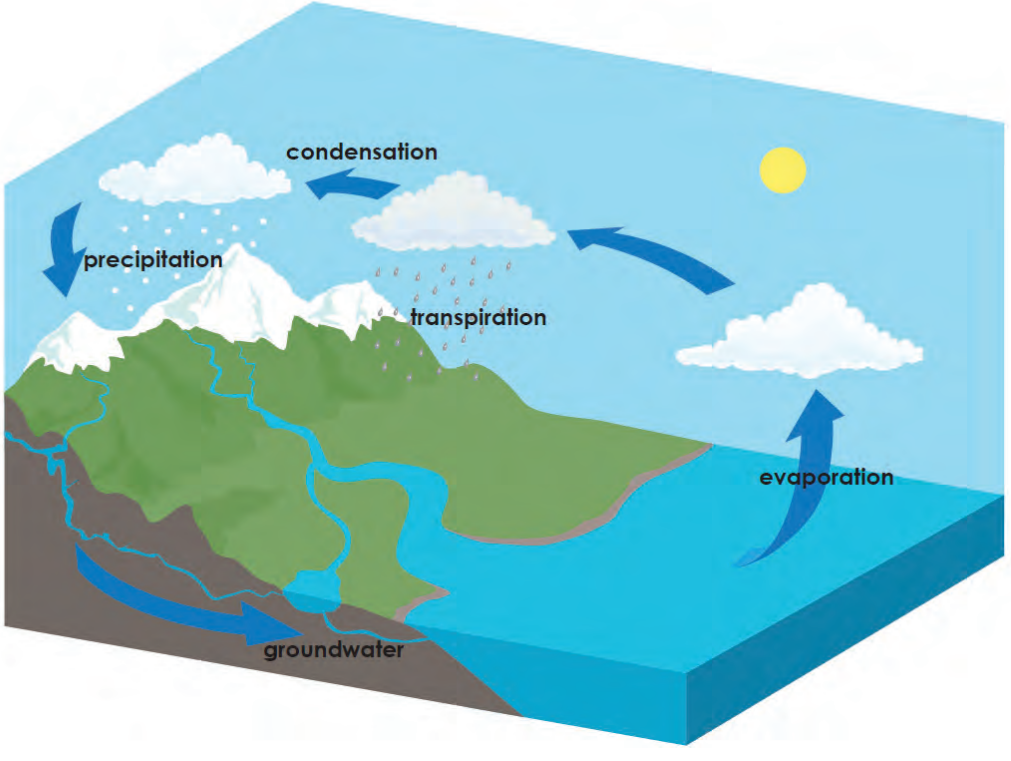
With Credit To: The Give Water a Hand Program, Environmental Resources Center, University of Wisconsin, www.uwex.edu/erc/gwah

U.S. Geological Survey (USGS) maps use brown ink for topographic lines. Every fifth line is an index line which is bolder and gives a number indicating its altitude above sea level. Water bodies are in blue. Buildings and other human-made structures are in black. Green shading indicates wooded areas. Important roads and survey system marks are in red. Purple features were added from aerial photographs during map revision and have not yet been field checked.

2 Map Your Watershed [from GWAH http://www.uwex.edu/erc/gwah/pdf-files/leadguide/9-18.pdf]

Each map has a scale, which is the relationship between distance on a map and the corresponding distance on the ground. The scale is expressed as a ratio, such as 1:24,000. The smaller the second number, the more detail the map has. You need to make sure you have a topographic map with a small enough scale so that you will be able to find specific streams, buildings and hills on your site. A good choice for local watershed mapping using USGS map scales is 1:24,000 (also known as 7.5 minute quadrangle maps). Your site may be on the edge of a map, or your watershed may cross two map sheets, in which case you may need two or more maps.

Check the date on your topographic map to see how recently it was made. A current, detailed street map can help you fill in new construction and other changes as you map your watershed. You will also need a street map to fill in details that are off the edge of your map. USGS also sells aerial photographs of most areas, and they may be helpful in locating landmarks (such as your school, a patch of woods, or a road). Find and order USGS maps at http://topomaps.usgs.gov/ordering_maps.html



INTEREST APPROACH:

Students apply content to learn about local source and ground water resources. They participate in hands-on activities to build curiosity and science skills.

Here are some ideas for introducing this lesson:

Hold up clear glass of water.

This looks pretty good, doesn't it? I want to drink it, but is it safe to drink?

How do we know our water, whether it's from a tap or bottle, is safe to drink? We are taking for granted that because it comes from a tap or bottle that it's safe to drink, right?

Why is it safe to assume our water in the U.S. is safe for consumption? Is it reasonable to assume that when you turn on the tap for a glass of water the glass will fill quickly and completely?

One of our basic resources necessary for life is water. We have a number of uses for water in our lives and every time we turn on the faucet, we take this resource for granted. We assume this water is plentiful and safe to drink, but is it?

Where does our water come from? Where has it been? What is in our water and what is taken out of it? Water is such an important part of our lives and an important part of our society. As citizens and agriculturalists, it is critical we understand where our water comes from, how we use it, and how available it will be in the future.

The water cycle is the foundation on which our knowledge of drinking water sources and availability is built. The water cycle filters and refreshes water. (Water may still need treatment before use as drinking water.) The Earth's water cycle, and the water cycle in the context of our local topography or our watershed, are the topics for today's lesson.

OBJECTIVE BY OBJECTIVE:

Activity Outline and Teacher Support Information:

Water in your community: Where does it come from? Where does it go? – This lesson reviews basic watershed concepts and engages student interest by involving them in applying the knowledge to their local watersheds. Students' science backgrounds may vary, so the lesson offers remedial activities to build a core conceptual framework for achieving the objectives. You will have to add an additional class period if you choose to have your class participate in a remedial activity.

1.1. Describe the water cycle from a local perspective.

Pretest: Assess your students' knowledge of watersheds with a quick pretest, "The Water Cycle." (See PRETEST: SW.1.1.ASSESS, p. 13.) If students can answer three of the four questions in Part I correctly and can give a reasonable short answer in Part II, they are ready for a quick review of this material in part a. below. If you feel your students would benefit from more review, see the activity in part 1.1.b.

1.1.a. Even if your class has a good basic understanding of the water cycle, do a short overview with one of these quick primers:

Summary of the Water Cycle – USGS Water Science for Schools: http://ga.water.usgs.gov/edu/watercyclesummary.html

or

Groundwater and the Water Cycle, The Groundwater Foundation (5 mins) http://www.groundwater.org/kc/gwwatercycle.html

or

Water Cycle Diagram – Animated from *Earthguide* (5 mins) http://earthguide.ucsd.edu/earthguide/diagrams/watercycle/

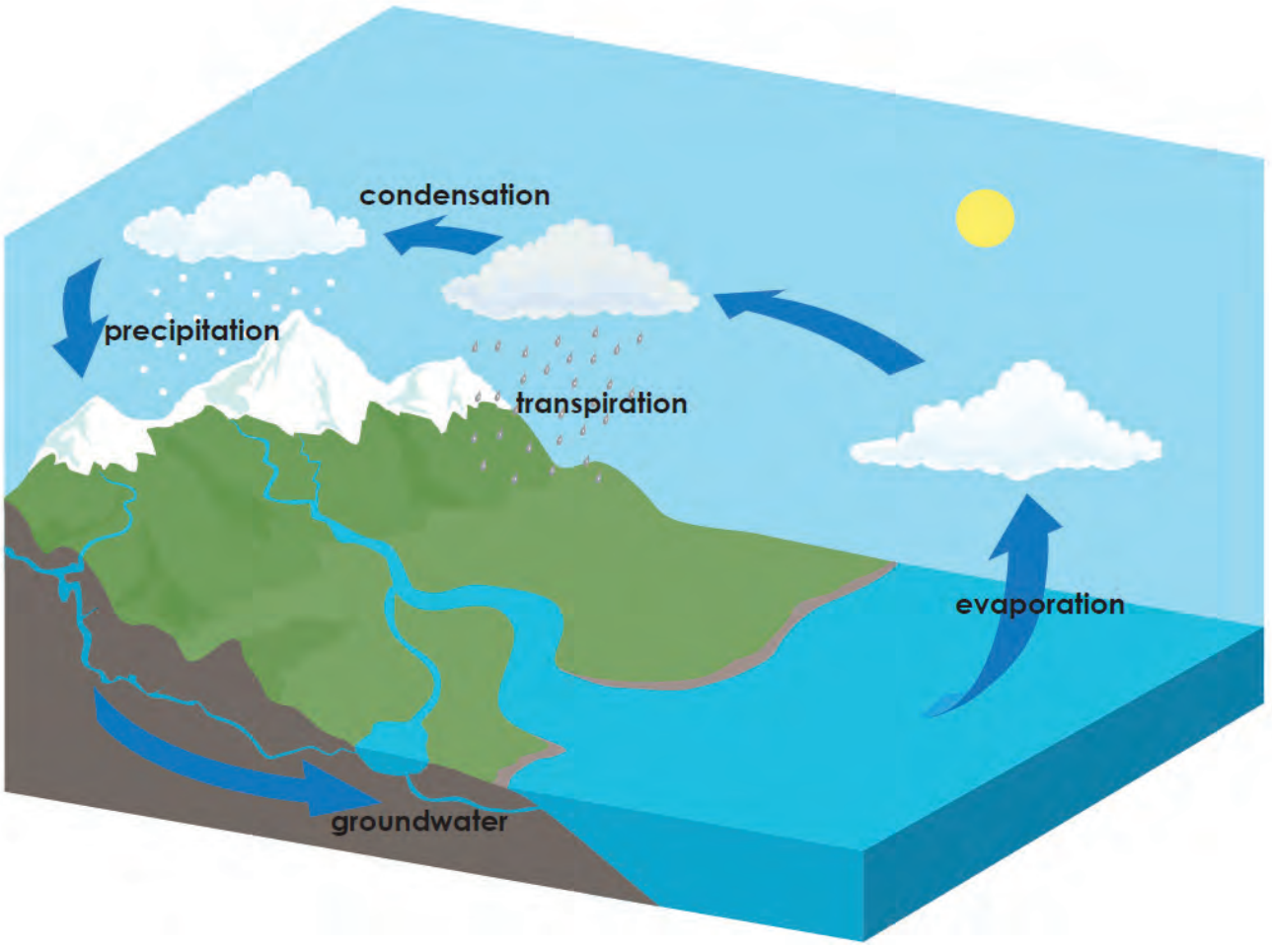
or

Earth's Water Distribution—USGS Water Resources of Georgia—http://ga.water.usgs.gov/edu/waterdistribution.html

1.1.b. Students needing more background information will benefit from completing the activities in SW.1.1B.TM.A, the FFA Middle School Food and Agricultural Literacy Curriculum MS.NR.3.2: *My Water's Been Where? Understanding the Water Cycle*. (http://ffa.learn.com/files/pdf/MS.NR.3.2.pdf)

The Water Cycle Rap
http://mbc.sandi.net/library/items/the-water-cycle-rap-with-lyrics---1663024v22dd3760-4715-012f-5166-569eeb3c0b2d

Ask students to describe the topography in the water cycle diagram



What are the main land features (mountains, streams, lake, ocean)? Does this diagram remind you of the lands and bodies of water in your community? Why or why not? If this diagram depicted human influences on the local community, how would we need to change it?

1.2. Define and diagram their local watershed.

Review water cycle and watershed definitions using SW.1.2.TM.A, "Water Cycles and Watersheds."

Select one of the following local watershed activities which best suits the skill and background of your students:

1.2.a. **Map Your Watershed Activity**, SW.1.2.AS.A, in which students work with a topographic map to plot their watershed. If your class has no experience working with topography maps you might find this information helpful.

Explain that USGS maps are made from aerial photographs. Imagine what it would be like to fly in a plane over your site. What would you see?

One way to explain different elevations shown on a topographic map is to pretend to walk along a road on a map (or a trail if there is one). Look at your topographic map and determine where on the road the slope would be steepest. Figure out how high a particular hill is. Relate that height to something familiar such as a tall building, which is ten feet per floor. Are there any cliffs on along the road? Which part of the road would you find the most interesting scenery? Which part of the walk would be the hardest? If your group needs help reading contour lines, see "Using Topographic Maps" on p. 6.

1.2.b. **EPA's Build Your Own Watershed**, SW.1.2.AS.B , for students who would benefit from the three-dimensional model in which they can physically experience their watershed.

1.3. Describe the term "agricultural area" as it might be applied locally, in other areas of their state, and nationally (i.e., cropland, dairy farms, cattle ranches, apple orchards, tree farms, etc.).

When we think of the term agriculture, we often picture a dairy farm, beef or pork operation, or fields of corn, soybeans and alfalfa. Students might not be aware of the variety of agricultural-related businesses there are in their county or state. Have students work in small groups to create a list of different types of local, state and national agricultural producers.

Students should locate and label agricultural areas on the topographic watershed map or watershed model that they produced in activity 1.2. Labels should include entries such as: dairy farms, vineyards, orchards, hog farms or maple sugaring operations.

REVIEW / SUMMARY:

Ask students to create a journal entry that diagrams their yards at home from the perspective of someone standing on the street. They should include all man-made structures and all the trees and large shrubs. Have them include elevation differences in their diagrams as well: Is the entire yard flat? Does the land slope downhill from the right side of the lawn to the left? Does the land slope away from the driveway or toward the driveway? Ask them to put an H at the highpoints, and L at the low points. They should use arrows to describe how water moves over, under, and through their yards to help them reflect on the water cycle and watershed concepts covered in this lesson. Stress that you're more concerned with the latter objective than with the details or artistry of their diagrams.

EVALUATION AND ANSWERS:

PRE-TEST: SW.1.1.ASSESS

The Water Cycle

Name _____

Part I: Fill in the Blank

Directions: Complete the following statements.

1. The conversion of water from liquid to gas formed by the exposure to heat is known as _____.

2. The process of plants releasing water from their leaves is known as _____.

3. During _____, water vapor rises in the atmosphere, and as it begins to cool it turns back into water.

4. _____ occurs when vapor droplets become large, rain forms and falls to the earth's surface.

5. Make a diagram of the water cycle on the back of this paper. Make sure you label the components of your water cycle diagram to include terms used in #1-4 above.

Part II: Short Answer

5. Explain the importance of the water cycle.

_____

_____

_____

PRE-TEST: SW.1.1.ASSESS Answers

Part I: Fill in the Blank

1. Evaporation
2. Transpiration
3. Condensation
4. Precipitation
5. Diagram of water cycle should have components 1-4 above illustrated and labeled correctly.

Part II: Short Answer

5. The water cycle is important because it helps filter the water to refresh and renew it for future use. (Water may still need treatment before use as drinking water.) (Answers may vary.)

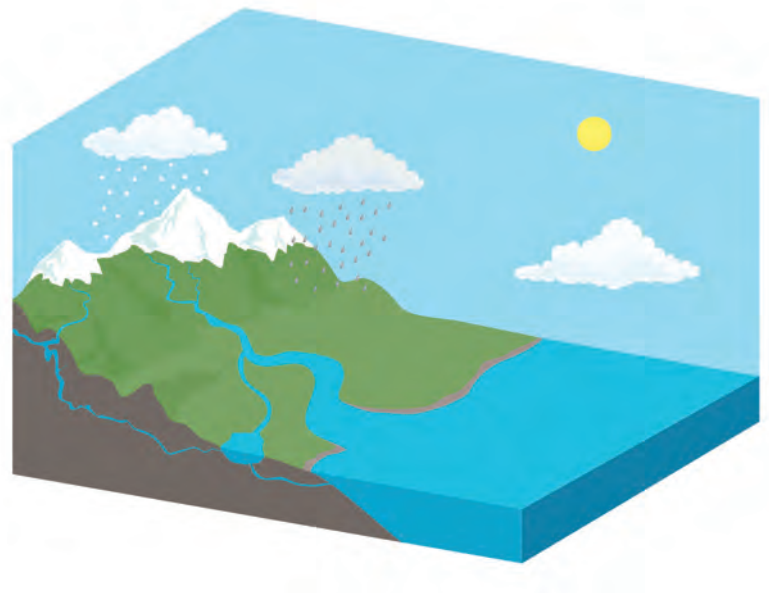
ACTIVITY WORKSHEET(S) – AS NEEDED:

SW.1.1.B.TM.A

A REVIEW OF THE WATER CYCLE

Part I: Label the Water Cycle

Directions: Look at the following illustration. Determine where the following terms belong: precipitation, transpiration, groundwater, evaporation, lakes and streams, and clouds (or water vapor). Once you have placed all the words in the correct places, place arrows showing in which direction water travels through the water cycle.



Part II: Match the Term

Directions: Choose which definition best suits the vocabulary term learned today.

a. Condensation b. Evaporation c. Precipitation d. Transpiration

1. _____ The conversion of water from liquid to gas form by the exposure to heat
2. _____ The process of plants releasing water from their leaves.
3. _____ During this process, water vapor rises in the atmosphere, and as it begins to cool it turns back into water.
4. _____ This process occurs when vapor droplets become large, rain forms and falls to the earth's surface.

ACTIVITY WORKSHEET(S) – AS NEEDED:

SW.1.1.B.TM.A

Name _____

Part I: Fill in the Blank

Directions: Complete the following statements.

1. The conversion of water from liquid to gas formed by the exposure to heat is known as _____.

2. The process of plants releasing water from their leaves is known as _____.

3. During _____, water vapor rises in the atmosphere, and as it begins to cool it turns back into water.

4. _____ occurs when vapor droplets become large, rain forms and falls to the earth's surface.

Part II: Short Answer

5. Explain the importance of the water cycle.

_____

_____

_____

_____

_____

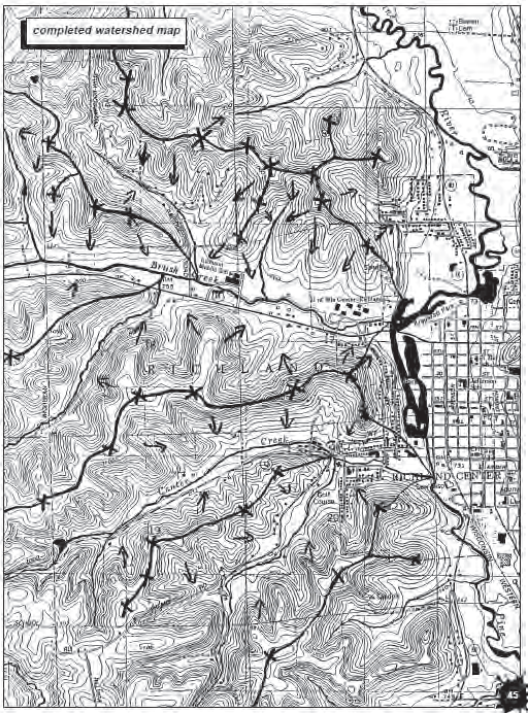
_____

ACTIVITY WORKSHEET SW.1.2.AS.A

Mapping Your Watershed

INTRODUCTION: USING TOPOGRAPHIC MAPS[3]

Topographic maps depict an aerial view of land. They use contour lines to show the elevation of land areas. These lines are sometimes called level lines because they show points that are at the same level or altitude. The **top** drawing below is a contour map showing the same hills which are illustrated in profile in the **bottom** drawing. On this particular map, the vertical distance between each contour line is 10 feet.



With Credit To: The Give Water a Hand Program, Environmental Resources Center, University of Wisconsin, www.uwex.edu/erc/gwah

Lines that are close together show steeper slopes. Lines that are far apart show flatter terrain. When crossing a valley or gully, a contour line makes a “v” or “u” pointing uphill. When crossing a spur or a ridge running down the side of a hill, a contour line makes a “v” or “u” pointing downhill. Hilltops are where contour lines connect to form circles or ovals. They are illustrated as the smallest center circle.

U.S. Geological Survey (USGS) maps use brown ink for topographic lines. Every fifth line is an index line which is bolder and gives a number indicating its altitude above sea level. Bodies of water are in blue. Buildings and other human-made structures are in black. Green shading indicates wooded areas. Important roads and survey system marks are in red. Purple features were added from aerial photographs during map revision and have not yet been field checked.

3 Map Your Watershed [from GWAH http://www.uwex.edu/erc/gwah/pdf-files/leadguide/9-18.pdf]

ACTIVITY WORKSHEET SW.1.2.AS.A *(continued)*

Each map has a scale, which is the relationship between distance on a map and the corresponding distance on the ground. The scale is expressed as a ratio, such as 1:24,000. The smaller the second number, the more detail the map has. You need to make sure you have a topographic map with a small enough scale so that you will be able to find specific streams, buildings and hills on your site. A good choice for local watershed mapping using USGS map scales is 1:24,000 (also known as 7.5 minute quadrangle maps). Your site may be on the edge of a map, or your watershed may cross two map sheets, in which case you may need two or more maps.

Check the date on your topographic map to see how recently it was made. A current, detailed street map can help you fill in new construction and other changes as you map your watershed. You will also need a street map to fill in details that are off the edge of your map.

GETTING STARTED:

A. Collect the following materials:

- Topographic map or maps which include your site and any other maps you have collected of the area (provided by your teacher)
- A clear sheet of plastic as big as your topographic map (this plastic is called mylar or acetate and is available at art supply stores or office supply stores for a few dollars)
- A piece of cardboard as big as your map
- Thumb tacks
- Dry erase markers
- Tissues

B. Your teacher will provide a copy of a topographic map of your county. You will outline a watershed on your map using the directions provided below.

C. Map your watershed:

1. On the topographic map, find and mark familiar landmarks such as your school, a hospital, the mall. A road map can help you find things.

2. Find the streams, ditches, marshes, lakes, oceans or rivers closest to your site and mark them in blue on the map.

3. Use the contour lines and numbers on the topographic map to find the highest and lowest points around your site. Lines that are close together show steeper slopes. Lines that are far apart show flatter terrain. Mark all the hilltops with an “X.”

ACTIVITY WORKSHEET SW.1.2.AS.A *(continued)*

4. From these "Xs", draw arrows on your map to show the flow of runoff. Which direction will rain or snow flow when it falls on your school? Where does runoff flow into bodies of water? Look at the completed watershed map on page 18. It has the outlines of watersheds already drawn. Look at the arrows showing where water flows. The outline of each watershed is between bodies of water, mostly along the tops of ridges or hills.
5. On your own map, find the highest ground (the hills and ridges) between two bodies of water. Draw a line along the highest points (connecting the "Xs" on hill tops) completely around your stream, including its mouth — the bottom end where it drains into another body of water. You have now outlined your watershed. In what watershed is your site? The name usually comes from the main stream or river in the watershed. Two small streams can be part of a larger watershed. Write the name on your map.

Build Your Own Watershed [From EPA 810-F-98-003 June 1998: http://water.epa.gov/learn/kids/drinkingwater/activity_grades_9-12_buildyourownwatershed.cfm]

BACKGROUND:

The land we live on is divided into watersheds. A watershed is a land area whose runoff drains into any river, stream, lake or ocean. It can also seep down through the soil and recharge groundwater. Small watersheds, such as the watershed for the creek behind your house, or the watershed for the pond down the road, drain into small bodies of water and cover small land areas. The runoff from small watersheds join together, and their combined areas become a new, larger watershed. Large watersheds, such as the Mississippi Basin and the Chesapeake Bay watershed, drain into large bodies of water, and cover immense land areas. Despite their differences in sizes, all watersheds share common properties. They all perform the same function of transporting water over the Earth's surface. The watersheds encompass agricultural fields, suburban lawns, parking lots and city streets. Water runs off these surfaces into rivers, lakes and streams. It also seeps down through the soil to aquifers, which are underground formations in rock and soil that contain ground water to supply wells and springs.

Many human activities have an effect on watersheds. Construction projects like dams can limit the flow of water; construction of roads and buildings can divert and even increase the flow of water. Agricultural fertilizers can run off of crop fields and inadvertently contaminate drinking water sources and promote the growth of algae in rivers and lakes, having an adverse effect on water quality, human health,

ACTIVITY WORKSHEET SW.1.2.AS.B *(continued)*

and marine life. The irresponsible disposal of agricultural, household, and industrial chemicals can be harmful because these chemicals travel through the watershed, poisoning life and damaging natural ecosystems.

Watersheds can also have an effect on humans. Communities use rivers, streams and aquifers as their sources of drinking water. Water treatment prepares this water for human consumption, but if the water is laden with chemicals, fertilizers and microorganisms, it can be difficult and expensive to treat effectively. Floods are one of the major events in a watershed. Homes built on flood plains, low lying areas adjacent to rivers, are susceptible to flooding conditions when heavy precipitation exceeds the watershed's capacity to absorb water. Rivers, streams and lakes overflow, threaten human lives, and damage or destroy roads, buildings, and flood control measures. Watersheds can also become dry, causing water shortages for those who depend on their lakes and rivers for drinking water.

It is clear that humans have a close relationship with watersheds. The responsible planning of watershed use and development is important to ensure that the ecosystems sustained by the watersheds are not destroyed and to protect the health and safety of our communities. Communities can help protect water quality by protecting wetlands and requiring riparian buffers of native plants and trees along rivers, lakes and streams. Wetlands and buffers help filter pollution and slow runoff.

NOTE: Prior to the demonstration, the teacher should engage the students in activities involving identification of a local watershed. Maps can be used to facilitate this activity, and a field trip to a local river or pond can serve to demonstrate the concept of a watershed. Ask students to identify where the water is coming from. How far does the watershed extend? For a small stream, the answer may be several hundred feet; but for a lake or river, the watershed may be much larger. Visit EPA's "Surf Your Watershed" for local watershed information (http://cfpub.epa.gov/surf/locate/index.cfm).

OBJECTIVES:

This experiment illustrates the basic properties of a watershed: How water flows from higher elevations to lower elevations, and how watersheds are interconnected. The students will understand how the placement of buildings, roads, and parking lots can be important to watershed runoff, and how careless use and disposal of harmful contaminants can have a serious effect on downstream watershed residents.

ACTIVITY WORKSHEET SW.1.2.AS.B *(continued)*

MATERIALS NEEDED:

- 1 large plastic container (about 1.5'W x 3'L x 1'H)
- 2 lbs. of modeling clay
- 3 lbs. of sand (any type of sand will do)
- 2 lbs. of aquarium gravel
- 1 roll of wax paper (or any other impervious, water repellant surface, tin foil, plastic wrap, etc.)
- 1/4 cup of cocoa mix, iced tea mix, or other flavored drink mix (to represent chemicals)
- 1 spray bottle or bucket full of water

PROCEDURE:
(Note: Prepare steps 1 to 4 before students are present

1. Wash the aquarium gravel carefully to remove any powdery residue that may add cloudiness to the water. Fill the container to about 2 inches from the bottom with the gravel. Slope the gravel slightly so, that at one end (downslope), the gravel is only about an inch deep and, at the other end (upslope), the gravel is about 3 inches deep. This gravel layer will represent the aquifer.

2. Mix the clay and the sand. The consistency of this mix should be gritty, with slightly more clay than sand. This mixture should allow water to run freely over it, but if left standing, the water should slowly permeate the surface. Add this mixture to the container carefully, so as not to disturb the slope of the aquifer already placed. The slopes should be similar, with about 2 inches of sand/clay mix overlying the gravel already placed, and on the downhill end there should be about 3 inches of gravel left exposed.

3. Carve a channel in the middle of the clay/sand layer, about 1/2 inch deep and about 1 inch wide. This channel will represent the main river of the watershed. Near the top of the slope, split the channel into two or three separate channels to represent tributaries. You may wish to add other tributaries along the main branch of the "river" to further illustrate other watersheds.

4. With some extra clay/sand mix, build little hills between the tributaries. These hills separate the smaller watersheds, but when looked at as a whole, the entire "river" system is one watershed. You may also wish to add some small model trees or green felt to represent forests or fields. Buildings can be represented with small blocks of wood.

ACTIVITY WORKSHEET SW.1.2.AS.B *(continued)*

5. Along the main river, flatten out an area that is about 8 inches by 3 inches. Cut out a piece of wax paper to be about 4 inches by 3 inches in size. Stick this down onto the clay sand mix, sloping it slightly towards the river. If necessary, use some clay to hold the edges down. Explain to students that this wax paper represents the impervious surface of a parking lot.

6. Fill the bottom of the aquarium up to about 2 inches from the bottom with water. The water should fill all of the aquarium gravel "aquifer" area, and should just reach up to the lowest extent of the clay/sand mixture. Explain to students that the aquifer captures and transports water that seeps down through the soil.

7. Using the spray bottle, simulate rain over the flattened soil area and the parking lot. Ask the students to note that the "rain" soaks through the soil, but runs off the parking lot to the river. Ask them what the effect would be if the entire watershed was "paved".

8. Sprinkle some cocoa mix over the sides of one of the smaller watersheds. Tell the students that the cocoa represents pollution. Over one of the unpolluted "watersheds," create some rain with the spray bottle (*it may be necessary to create more rain by pouring water). Note that the runoff from the rain is clean. Now, make it rain over the polluted area. Ask the students to note how the pollution travels down through the watershed, contaminating all downstream areas. Discuss with the students why the pollution is a problem, and what can be done to fix the problem.

9. What are some possible sources of watershed pollution in your community?

10. What practices or techniques might help prevent water pollution in the first place? Here are two Web sites with some ideas: http://www.epa.gov/owow_keep/NPS/whatudo.html and http://water.epa.gov/infrastructure/drinkingwater/sourcewater/protection/whatyoucando.cfm

POWERPOINT SLIDES – AS NEEDED:

SW.1.2.TM.A

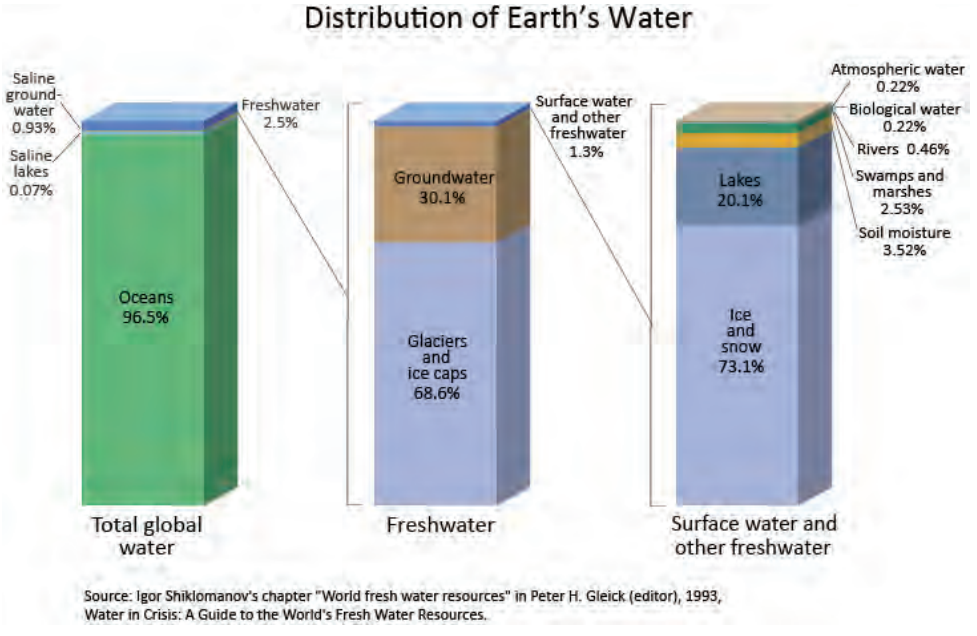
WATER CYCLES AND WATERSHEDS

What is the *water cycle*?

- Water continually moves throughout the earth and is always changing states (liquid, vapor, ice).
- The water cycle has been working for billions of years and all life on Earth depends on it continuing to work.

Why is the water cycle important?

- Water is filtered, recycled and refreshed by moving through the Earth's environment and the water cycle. (Water may still need treatment before use as drinking water.)



SW.1.2.TM.A *(continued)*

Definition of *watershed*

- Land area from which surface runoff drains into a stream, channel, lake, reservoir, or other body of water, or runs down through the soil and recharges ground water.
- Includes everything (plants, animals, structures) within the land area.
- May also be called a drainage basin.

Basic components

- Headwater of the body of water
- *Watershed* divide (boundary; hills, mountains, etc.)
- Tributaries (smaller bodies of water)
- Low point (stream, lake, river, etc.)
- All shapes and sizes; cross county, state and national boundaries

Functions of a *watershed*

- Supply drinking water
- Provide recreation and respite
- Sustain life

SW.1.2.TM.A *(continued)*

Definition of *aquifer*

- A geological formation or structure that is water bearing.
- Stores and/or transmits water, such as to wells and springs.
- Use of the term is usually restricted to those water-bearing formations capable of yielding water in sufficient quantity to constitute a usable supply for people's uses.

Definition of *groundwater recharge area*

- A land area where permeable soil or rock allows water to seep into the ground to replenish an aquifer.
- Part of a *watershed*; found below ground level