Module 8 • Water

Brief Overview

This module provides an introduction to water within the context of urban ecosystems. Students will look closely at the locations of water in their city and begin to understand the sources from which their water comes. In addition, students will study the water cycle as it relates to the urban environment. They will identify a variety of uses for water in order to understand the importance of water in Baltimore's ecosystem. Finally, students will be able to explain ways in which water pollution impacts the urban ecosystem as well as provide solutions for preventing the pollution of our water resources.

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Time

12 - 14 sessions

Desired Outcomes

At the end of this module, students will:

- Demonstrate basic map interpreting skills.
- Locate their school on a map in relation to Baltimore's natural water systems (i.e. Gwynns Falls, Patapsco River, Chesapeake Bay, and Atlantic Ocean).
- Identify the variety of locations where water is found in their local surroundings by observing the environment around them.
- Label water as a solid, liquid, or gas.

- Explain the water cycle.
- Identify ways in which Baltimore's water cycle differs from the natural water cycle.
- Identify sources of water pollution as a result of human activities.
- Identify solutions for reducing water pollution in their neighborhood.

What You'll Need

For Each Student

- ☐ Land/Water map worksheet
- ☐ Crayons
- ☐ Markers
- ☐ Pencils
- ☐ Colored pencils

For Each Group

- ☐ Butcher paper

For Whole Class

- ☐ A physical globe of Earth – or a physical map
- ☐ A physical map of North America/U.S. (Maryland should be delineated)
- ☐ A terrain map of Baltimore (showing street signs and water)
- ☐ Satellite/Bird's eye view images of Baltimore (showing neighborhoods, trees, water, etc.)
- ☐ (Optional) Disposable camera for taking pictures of water in the neighborhood
- ☐ Ice cubes
- ☐ Styrofoam cups
- ☐ Closed jar with a lid
- ☐ Masking Tape
- ☐ Drawing Paper
- ☐ Sponge
- ☐ Plastic plate
- ☐ Chart paper
- ☐ 1000 mL beaker
- ☐ A smaller beaker
- ☐ 100 mL graduated cylinder
- ☐ Eyedropper
- ☐ Metal sewing thimble or small medicine cup
- ☐ Blue food coloring
- ☐ Table salt
- ☐ Maple syrup
- ☐ Red pepper flakes
- ☐ Sidewalk chalk
- ☐ Post-it notes (squares, various colored packs) or squares of construction paper with tape
- ☐ Baking flour
- ☐ Plastic kiddie pool or large plastic container
- ☐ Plastic aquatic plants

- Plastic aquatic animals
- rock salt
- green yarn or plastic Easter grass

Worksheets and Handouts

- *Where is Our Water?*
- *Land and Water Map*
- *A Closer Look at Water – Slides*
- *3 States of Water Flow Chart*
- *Water Cycle Diagram - Slides*
- *Water Cycle Review*
- *Storm Drain Study*

Journals

- Lesson 2: Where Can We Find Water?
- Lesson 3: Is the earth covered mostly by land or by water?
- Lesson 4: A Closer Look at Water
- Lesson 5: The Water Cycle
- Lesson 6: My Drop of Water
- Lesson 7: What is Pollution?
- Lesson 8: A Day in the Life of Water!

New Vocabulary

Accumulation
The gathering of something in large amounts.

Catchment
An area of land that collects water, such as a reservoir or a basin.

Cause
Anything that happens to bring about an effect. (Ex: Humans dump trash in a stream.)

Condensation
The process when water vapor comes in contact with colder air and changes into something more dense or solid, like rain, sleet or snow.

Dam
A barrier designed to obstruct the flow of water.

Effect
The result of something that happens. (Ex: A stream becomes polluted.)

Evaporation
The process by which a liquid is heated to become a gas.

Filtration
The process of sending a substance through a filter to collect unwanted materials, leaving a cleaner and more pure product.

Gas
The state of water in which individual molecules are highly energized and move about freely. A gas moves freely in whatever space it occupies (container, air, etc.)

Hydrologic cycle
Another name for the water cycle.

Impervious surface
A surface, such as asphalt, that does not allow the passage of water or other materials through it.

Liquid
The state of water in which molecules move freely among themselves but do not separate like those in a gaseous state. A liquid takes the shape of whatever container is holding it.

Molecule
The smallest unit of an element or compound, consisting of one or more like atoms in an element and two or more different atoms in a compound.

Pervious surface
A surface, such as soil, that allows the passage of water or other materials through it.

Pollutant
Anything, such as certain chemicals or waste products, that renders the air, soil, water, or other natural resource harmful or unsuitable for a specific purpose.

Pollution
The introduction of harmful substances or products into the environment

Precipitation
The end product (rain, snow, or sleet) when water vapor changes into a more solid form.

Purification
To make pure and free from anything that pollutes or contaminates.

Reservoir
A natural or artificial place where water is collected and stored for use in a community.

Run-off
Water that drains or flows off the surface of the land.

Scale
A certain proportionate size or extent. *When presenting each map, students start at a larger scale (the earth) and move to a smaller scale (the neighborhood).*

Solid
The state of water in which molecules have limited movement. A solid has a definite shape.

Storm water
An abnormal amount of surface water due to a heavy rain or snowstorm.

Transpiration
The evaporation of water from tree stems and leaves.

Wastewater
Water that has been used in washing, flushing, or manufacturing (i.e. sewage).

Water cycle
The endless movement of water from the atmosphere to earth to groundwater to rivers to oceans and back to the atmosphere.

Careers

Students will learn about different occupations in ecology-related fields.

- Ecologist
- Hydrologist
- Chemist

Preparing the Lessons

Leaders will:

- REVIEW ALL NEEDED MATERIALS IN ADVANCE TO PLANNING THE LESSON!
- Review the lesson sequences and the lesson preparation directions.
- Review the "Background for Teachers" and useful websites prior to facilitating the lessons.
- Prepare areas in the classroom and hallways for hanging student work (a bulletin board will be needed for Lesson 5).
- Clean/remove "unsafe objects from outdoor areas where students will investigate.

- YOU WILL NEED TO MAKE A MAP/DRAWING OF THE SCHOOLYARD AREA AND ITS STORM DRAINS FOR THE STUDENTS. Place the school building in the center of the map and indicate front and back. Label all streets adjacent to the school. Label all gutters/storm drains along the perimeter of the school and in the school grounds.
- Identify potential parent or school adult volunteers.
- Identify possibilities for a culminating activity and arrange for any field trips or classroom visitors.

Module 8 Pre-Assessment – Grades 2/3
2009 – 2010

Before we start Module 8, we want to see what you may already know about **water**. Do the best you can, even if you are not sure of an answer. IF YOU WOULD LIKE TO DRAW YOUR ANSWER, DO IT ON THE BACK OF YOUR PAPER.

.

Name: _____ Date: _____

Class: _____ Teacher: _____

Grade: _____

---

1. Read each sentence. Circle true if the sentence is true and false if it is not right. THEN explain why you chose your answer.

The Earth is covered mostly with water. true false

Explain: _____

You can use a map of Baltimore to find your school. true false

Explain: _____

The Inner Harbor is part of the Chesapeake Bay. true false

Explain: _____

The Chesapeake Bay empties into the Atlantic Ocean. true false

Explain: _____

2. Water exists as a <u>solid</u>, a <u>liquid</u>, and a <u>gas</u>. Water can be found in some places and not in others. For each of the things below, circle whether or not you think there's water in it. If there is water in it, put an X to show what form it is in.

Thing	**Is there water in it?**	**What form is the water in?** 		
		Solid	**Liquid**	**Gas**
Air in a room	Yes No			
Bubbles in boiling water	Yes No			
Cloud	Yes No			
Ice	Yes No			
Orange juice	Yes No			
Paper clip	Yes No			
Tree	Yes No			
Now, add to the table with two of your own examples.				
	Yes No			
	Yes No			

3. How does water help you live? List all the ways that you can think of.

_____

_____

_____

_____

4. What is the <u>water cycle</u>?

_____

_____

5. Write a story about a water molecule. LABEL your drawing using the words below.

Rain Clouds River Ground Air Storm drain Run-off

6. Answer each question in the space below.

After it rains you see puddles on the sidewalk at your school. After a few days the puddles are gone. Where did the water go?

_____

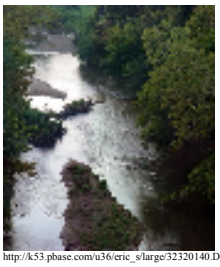
Can any of the water end up in your bathtub? (Circle one) **Yes** **No**

If you said yes, HOW can water end up there?

_____

(Source: Michigan State University Environmental Literacy Project)

7. Complete the chart to describe water in different places.

Water in:	**Where does it come from?**	**Where is it going?**
A river:  http://k53.pbase.com/u36/eric_s/large/32320140.DSC04501pano03final.jpg		
Water mains and pipes: 		
Water treatment plants: 		

	Where does it come from?	**Where is it going?**
Storm drains: 		
A water fountain:  http://a.abcnews.go.com/images/GMA/cb_water_fountain_070619_main.jpg		

8. Draw pictures that show the difference between clean water and polluted water. Label important things in your pictures.

Drawing of clean water	Drawing of polluted water

(Source: Michigan State University Environmental Literacy Project)

9. How does water get polluted?

_____

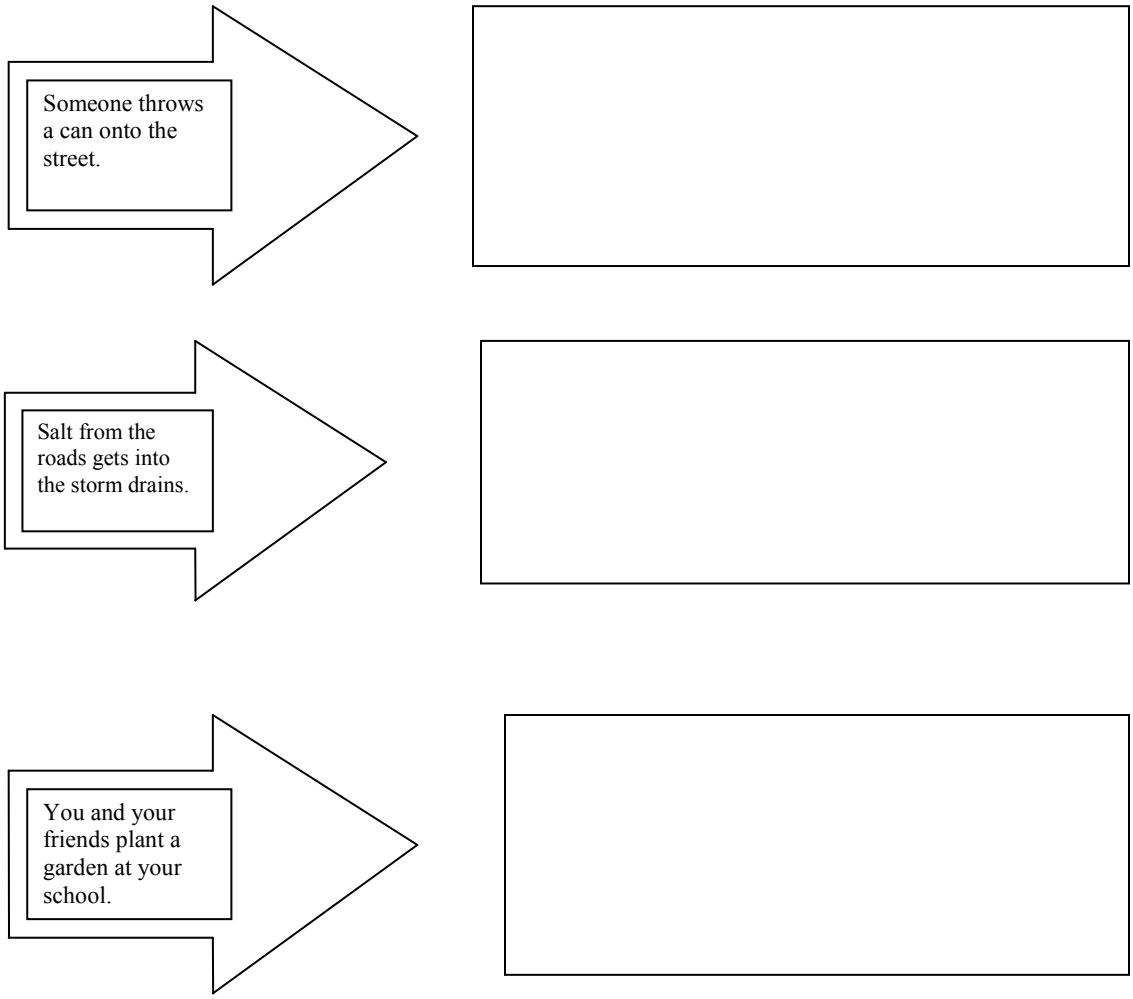
_____

_____

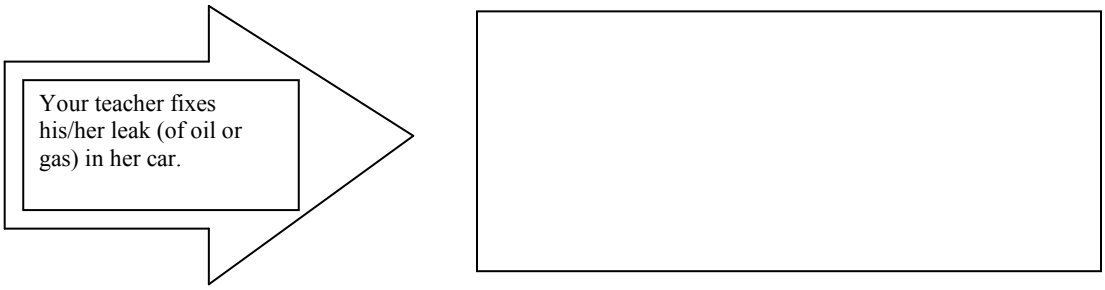
10. How do our choices affect the ecosystem?

Write or draw your answers in the boxes after each arrow.

What if…? Then…



What if…? Then…



Great job!

Module 8 • Lesson 2 • Where is Our Water?

Background for Teachers:

Water exists all around us at every second of the day. About 70% of the Earth is covered by water, though most of it is found in the ocean. As we move from a large scale map of the earth, to a map of North America at a smaller scale, to a map of Maryland, and ultimately to a map of Baltimore city, it becomes clear that water can be found in many locations.

Maps can be used for many purposes. They can provide directions from one place to another. Maps can also show the user the locations of specific landforms such as mountains and rivers. Using a map is an important skill as it allows students to interpret visual information in order to make predictions, ask questions, and relate information.

Useful websites:

Baltimore City iMap (Allows the user to zoom in/out of various views of the city, including aerial photographs):
http://maps.baltimorecity.gov/imap/Default.aspx

HRW World Atlas (World view, Continental view):
http://go.hrw.com/atlas/norm_htm/world.htm

Action Synopsis

Students will use maps of various scales and types to identify locations where water is found on earth and in their local ecosystem. They will apply scientific reasoning skills to recognize that the surface of the earth is mostly (more than ½) covered with water. Finally, through observation and hands-on exploration, students will conclude that water can be found in both large and small spaces all around them.

Time

1 – 2 sessions

Desired Outcomes

Students will:

- Demonstrate basic map interpreting skills by locating their school on a map in relation to Baltimore's natural water systems (i.e. Gwynns Falls, Patapsco River, Chesapeake Bay, Atlantic Ocean).
- Identify the variety of locations where water is found in their local surroundings by observing the environment around them.

What You'll Need

For Each Student

- ☐ Land/Water map worksheet
- ☐ 1 Blue Crayon or Marker
- ☐ 1 Brown Crayon or Marker

For Each Group

- ☐ Student Observation Sheet** –

***As a modification to the observation sheet, students can use a disposable camera to take pictures of the locations of water around them. The pictures can be combined as a single class collage.*

For Whole Class

- ☐ A physical globe of Earth – or a physical map
- ☐ A physical map of North America/U.S. (Maryland should be delineated)
- ☐ A terrain map of Baltimore (showing street signs and water)
- ☐ Satellite/Bird's eye view images of Baltimore (showing neighborhoods, trees, water, etc.)
- ☐ (Optional) Disposable camera for taking pictures of water in the neighborhood

Preparing for the Lesson

Leaders will:

- Copy "Land and Water" Map (worksheet)
- Copy "Where is Our Water?" observation sheet (worksheet) – *IF USED*
- Gather globe, maps
- Gather camera(s) – *IF USED*

New Vocabulary

Scale

A certain proportionate size or extent. *When presenting each map, students start at a larger scale (the earth) and move to a smaller scale (the neighborhood).*

Assessments

Journal: "Where Can We Find Water?"

Lesson Sequence

1. Journal: In their journals, have the students write or draw and label places on earth and around them where water can be found. Allow 5 – 10 minutes for this activity.

Once students have finished their journal activity, introduce the subject of water. Explain to the students that they will be investigating the places where water is found. Pass around a globe and inquire if the students know what a globe is used for. Explain/review the use of a globe if necessary. Ask the children to study the globe and name one place where water can be found on the earth. Allow each student to share different answers. Write their answers on the board or chart paper. (5 minutes)

2. Ask the students if they think there is more land than water on earth or more water than land? Allow the students to raise their hands or answer aloud for one or the other. Ask the students "How could you find out?" and allow for answers.
Introduce the "Land and Water" map activity sheet to the students and explain that they will be coloring the map to determine the answer. Pass out the "Land and Water Map" activity sheet and review the directions. Allow the students time to color their maps. (approx. 10-15 minutes)

3. When everyone has finished, repeat the question: "Is there more land than water, or is their more water than land?" Students should be able to use their maps to see that the Earth is covered by MORE WATER than land (over ½) and answer accordingly. Ask the students "How did you get that answer?" "What did you look at to get that information?" Students should be able to explain that their answers were based on the globe and/or their land and water map. (5 minutes)

4. Present the map of North America/U.S. Explain that this map is a *large scale* picture of our continent. Explain what the word "scale" means. Ask students: "Would this map be a good way to study where water is found in our neighborhood?" *(Answer: No, as this map shows less detail because it is at a larger scale.)*

Have the students:
- Answer the question
- Discuss their answers
- Locate Maryland on the map
- Encourage the students to point out all of the places they see water on the map.

(3 minutes)

5. Present the map of Maryland. Explain that this map is at a *smaller scale* than the previous one because it is showing less land/water but in more detail. Ask the same question as before: "Would this map be a good way to study where water is found in our neighborhood?" *(Answer: No, as this map shows less detail because it is at a larger scale.)*

Have the students:
- Answer the question
- Discuss their answers
- Locate Baltimore on the map
- Encourage the students to point out all of the places they see water on the maps.

(3 minutes)

6. Present the political/terrain map of Baltimore and repeat the process from above. Ask "Is this map at a larger scale or smaller scale than the one before?" Allow students to answer and explain. Ask "Would this map be a good way to study where water is found in our neighborhood?" *(Answer: Yes. This map shows detail of Baltimore city and its water resources.)*

Have the students:
- Answer the question
- Discuss their answers
- Locate their neighborhood on the map
- Locate the sources of water that are close to their neighborhood (i.e. Gwynn's Falls, Inner Harbor, etc.)

Students should have more ease with this map in finding water resources.
(3 minutes)

7. Present an aerial map/photograph of the student's neighborhood. Ask "Is this a larger scale or smaller scale than the map before?" "How do you know?"

Explain to the students what this particular map is used for (locating parks, schools, streams, etc.). Ask the question: "Would this map be a good way to study where water is found in the neighborhood?"

Have the students:
- Answer the question
- Discuss their answers
- Locate their neighborhood on the map
- Determine if there are locations where water is found and where they are located using the map resources and what they already know (community pool, park fountain, etc.)

(5-10 minutes)

8. Based on the activity and discussion, students should conclude that different maps are useful for different things, and that maps that are smaller in scale are most useful when studying things close up.

9. Explain that the students are going to answer the question "Where is water found in our neighborhood," by getting as close as possible. Explain to the students that they will be going on an exploration around their environment (either school grounds or neighborhood) in search of water. Explain to the students that their job is to find water and:

- Write the location,
- Mark the water resource on a neighborhood map, or
- Draw a picture of what water looks like in that location or photograph and label the location

(see variations at the end of lesson sequence)

(Allow at least 20 minutes to 1 hour for this activity, depending on the variation.)

10. After the exploration, gather the students together. Allow the students to discuss their findings, either independently or as student groups. Depending on how students recorded their findings, create a collage/mural titled "Water's All Around Us!" and either write, draw, or arrange labeled photographs of the students' findings. Student work should be displayed within the school building to encourage other students to recognize the sources of water around them.

VARIATION (see above):

a. Use a student observation sheet and list the location and source of water found (ex: "puddle on W. Lexington Street next to school")
b. Use a neighborhood map worksheet and key to label locations of water in the area (ex: fire hydrant on corner as indicated by hydrant icon)
c. Use a digital camera or Polaroid, take pictures, label images, and arrange them onto a collage
d. Create a large-scale neighborhood map and arrange images to display.

Maryland SC Standards (2nd and 3rd Grade): *Standards are presented in the following format:* *(Grade)Standard.Topic.Indicator.Objective – Objective Statement*	
Science	
Standard 1.0 Skills and Processes: Students will demonstrate the thinking and acting inherent in the practice of science.	Constructing Knowledge: (2)1.A.1.b – Seek information through reading, observation, exploration, and investigations. Applying Evidence and Reasoning: (2)B.1.a – Provide reasons for accepting or rejecting ideas examined. (2)B.1.b – Develop reasonable explanations for observations made, investigations completed, and information gained by sharing ideas and listening to others' ideas. (3)B.1.a – Develop explanations using knowledge possessed and evidence from observations, reliable print resources, and investigations. Communicating Scientific Information: (2)C.1.a – Describe things as accurately as possible and compare observations with those of others. (2)C.1.b – Describe and compare things in terms of number, shape, texture, size, weight, color, and motion. (3)C.1.a – Make use of and analyze models, such as table and graphs to summarize and interpret data. (3)C.1.d – Construct and share reasonable explanations for questions asked.
Standard 2.0 Earth/Space Science: Students will use scientific skills and processes to explain the chemical and physical interactions (i.e., natural forces and cycles, transfer of energy) of the environment, Earth, and the universe that occur over time.	Interactions of Hydrosphere and Atmosphere: (2)E.1.a – Identify the many locations where water is found.
Social Studies	
Standard 3.0 Geography: Students will use geographic concepts and processes to understand location and its relationship to human activities.	Using Geographic Tools: (2)A.1.a – identify the purpose and use of a globe and a variety of maps and atlases, such as school maps, neighborhood maps and simple atlases (2)A.1.d - Describe a place using bird's eye view, and satellite images, photographs, and pictures (3)A.1.a – Describe the purposes of a variety of maps and atlases, such as transportation maps, physical maps, and political maps (3)A.1.c – Identify the location of communities, major cities in Maryland, United States and the world using a globe, maps, and atlases Geographic Characteristics of Places and Regions 2.B.1.a – Identify natural/physical features and human-made features using maps and photographs (3)B.1.a – Compare places and regions using geographic features
Standard 6.0 Social Studies Skills and Processes: Students shall use reading, writing, and thinking processes and skills to gain knowledge and understanding of political, historical, and current events using chronological and spatial thinking, economic reasoning, and historical interpretation, by framing and evaluating questions from primary and secondary sources.	(2)D.1.c – Locate and gather data and information from appropriate non-print sources, such as music, maps, graphs, photographs, and illustrations (2)D.2.b – Make and record observations (2)E.2.c – Display information on various types of graphic organizers, maps, and charts (2)F.1.a – Compare information from a variety of sources (3)D.1.c – Locate and gather data and information from appropriate non-print sources, such as music, artifacts, charts, maps, graphs, photographs, video clips, illustrations, paintings, political cartoons, interviews, and oral histories (3)D.2.a – Gather data (3)D.2.b – Make and record observations (3)E.1.d – Construct various types of graphic organizers, maps, and charts to display information (3)F.1.a – Interpret information in maps, charts and graphs

Module 8 • Lesson 3 • The States of Water

Background for Teachers:

Water is an important molecule that is essential for all life to exist. Water is a molecule that consists of one oxygen atom and two hydrogen atoms (H_2O). This structure gives water some unique qualities. First, it is considered the universal solvent, which means that it can dissolve more substances than any other liquid. However, it's most important physical quality is that it can exist in three states: a solid, a liquid, and a gas.

A solid has a definite shape. When water is in a solid state, the molecules are fixed in place and have limited movement. Water becomes a solid when energy in the form of heat is removed and water therefore freezes.

When heat energy is added to solid water, the molecules begin to speed up. This melting process causes ice to become a liquid. A liquid takes the shape of whatever container is holding it. Water molecules in a liquid state have more energy and therefore move more freely than those in a solid state.

When heat energy is added to liquid water, the molecules increase in speed greatly. A gas moves freely in whatever space it occupies (container, air, etc.). The process of a liquid becoming a gas is called ***evaporation****. The water molecules in a gaseous state are called water vapor, and they are highly energized. The process of heat energy being removed and gas cooling back into a liquid state is called* ***condensation****. See the figure below showing a solid, a liquid, and a gas.*

Image from: http://www.btinternet.com/~n.j.f/Y7science/matterweb/particles.htm

The processes of evaporation and condensation are an important aspect of water, and will continue to be as students learn about the water cycle in later activities.

Useful websites:

Water Properties:
http://ww2010.atmos.uiuc.edu/(Gh)/guides/mtr/cld/dvlp/wtr.rxml

States of Water:
http://ww2010.atmos.uiuc.edu/(Gh)/guides/mtr/cld/dvlp/wtr.rxml

Chem4Kids States of Matter:
http://www.chem4kids.com/files/matter_states.html

Action Synopsis

Students will demonstrate an understanding of the physical states of water (solid, liquid, or gas) through hands-on investigation and physical reenactment. They will identify various states of water in their local ecosystem.

Time

1 session

Desired Outcomes

Students will:

- Identify water as a solid, liquid, or gas
- Explain each state of water as it relates to heat energy
- Identify various states of water in their local ecosystem

What You'll Need

For Each Student

 Pencil

For Whole Class

 A plate with an ice cube
 A cup of water
 A cup of boiling water (steam should be visible for activity)
 A closed jar of ice and water (jar should be completely sealed off from outside)
 Visual Aids:
  1) Cartoon figures of Solid, Liquid, and Gas, and
  2) Flow Chart of Heat Energy
 Chart Paper (folded into 3 Columns: Solid, Liquid, Gas)
 Markers and/or Crayons
 Flow Chart pictures/symbols
 1 Red tee shirt
 1 Blue tee shirt

Preparing for the Lesson

Leaders will:

- Review the Background for Teachers information on the states of water
- Review the Flow Chart for the activity
- Review rules for Water Tag

- Set up an observation area (desk, table, floor mat) with 1) an ice cube on a tray, 2) a glass of water, 3) a cup or jar with boiling water (steam should be visible)

New Vocabulary

Condensation
The process by which a gas is cooled to become a liquid.

Evaporation
The process by which a liquid is heated to become a gas.

Gas
The state of water in which individual molecules are highly energized and move about freely. A gas moves freely in whatever space it occupies (container, air, etc.)

Liquid
The state of water in which molecules move freely among themselves but do not separate like those in a gaseous state. A liquid takes the shape of whatever container is holding it.

Molecule
The smallest unit of an element or compound, consisting of one or more like atoms in an element and two or more different atoms in a compound.

Solid
The state of water in which molecules have limited movement. A solid has a definite shape.

Assessments

Journal: Is the earth covered mostly by land or water?

Lesson Sequence

1. Journal activity – Have students answer the question, using what they learned from the previous activity to explain their answer. Allow approximately 5 minutes for this activity.

   Once students have finished in their journals, invite the students to observe the ice cube, glass of water, and cup of steaming water – be sure to remind students not to touch the hot water. Encourage the students to share some observations about what they see. Allow all students to answer. Ask the students: "Which one of these is a GAS?" Explain the definition of gas as needed. Students should conclude that the steam is a gas. Ask the students: "Which one of these is a solid?" Explain the definition of solid as needed. Students should conclude that the ice cube is a solid. Ask the students: "Which one of

these is a liquid?" Explain the definition of liquid as needed. Students should conclude that the glass of water is a liquid. (5 minutes)

2. Explain to the students, that although the ice cube, glass of water, and steam look different, they are all made of the same thing: WATER. Explain that water exists on earth as a solid, a liquid, or a gas. Using chart paper, brainstorm with the students ideas/meanings/examples for the terms SOLID, LIQUID, and GAS. Encourage students to use observations from the previous activity to find examples of the different states of water in their own environment. (10 minutes)

Image from: http://thegreatwaterodyssey.com/third.html

3. Have the students return to the table with the ice cube, glass of water, and cup of boiling water (steam). Ask the students: "How does ice (solid) become liquid water?" Student answers may vary, but should involve the idea of melting. Explain to the students that melting occurs when you add heat energy to something. When heat energy is added to an ice cube (from your hands, the sun, etc.) that solid ice melts into a liquid. Then ask the students: "If ice turns to liquid water because of heat energy, how do you think liquid water becomes steam?" Allow students to answer. Explain that heat energy also turns liquid water into water vapor (steam), and we call this process *evaporation*.

Image from: http://student.britannica.com/elementary/art/print?id=88425&articleTypeId=0

4. Ask the students: "What would happen to the liquid water if we took the heat energy away?" Allow students to answer, while hinting that it would be the OPPOSITE of melting. Students may/should predict that the liquid water would turn into ice. Similarly, taking heat energy from water vapor would turn steam into liquid water. Present the jar of ice water to the students. Explain that when gas, such as our air, is cooled it cannot hold as much moisture as when the air is warm. The water is released as water droplets. The water droplets on the outside of the jar are not coming from the water, but from the air around the jar. (5 minutes)

Image from: http://community.seas.columbia.edu/weatherstation/fuse.php?id=15

5. Post the Flow Chart showing the states of water on the board to explain how water changes states when heat energy is either added  or taken away  . (5 minutes)

*(Once the students get an understanding of the states of water, take them **outside** or to an open area inside.)*

6. Explain to the students that they will play a game of **tag** to show how water is always changing states. (15 – 20 minutes)

   Briefly explain the rules listed in the Leader Tools.

7. Wrap – up: Gather the students together and allow them to share their thoughts about the tag game. Ask the students: "Were you ever the same thing (ice, water, water vapor) for too long?" "Why?" Allow for student answers.

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Standard 1.0 Skills and Processes: Students will demonstrate the thinking and acting inherent in the practice of science.	Constructing Knowledge: (2)1.A.1.b – Seek information through reading, observation, exploration, and investigations. Applying Evidence and Reasoning: (2)B.1.b – Develop reasonable explanations for observations made, investigations completed, and information gained by sharing ideas and listening to others' ideas. (3)B.1.a – Develop explanations using knowledge possessed and evidence from observations, reliable print resources, and investigations. Communicating Scientific Information: (2)C.1.a – Describe things as accurately as possible and compare observations with those of others. (2)C.1.b – Describe and compare things in terms of number, shape, texture, size, weight, color, and motion. (3)C.1.a – Make use of and analyze models, such as table and graphs to summarize and interpret data. (3)C.1.d – Construct and share reasonable explanations for questions asked.
Standard 2.0 Earth/Space Science: Students will use scientific skills and processes to explain the chemical and physical interactions (i.e., natural forces and cycles, transfer of energy) of the environment, Earth, and the universe that occur over time.	Interactions of Hydrosphere and Atmosphere: (2)E.1.a – Identify the many locations where water is found. (2)E.1.b – Describe the changes that occur to water found anywhere (3)E.1.b – Observe and explain what happens when liquid water disappears • Turns into vapor (gas) in the air • Can reappear as a liquid or solid when cooled, such as clouds, fog, rain, snow, etc.
Standard 5.0 Physics: Students will use scientific skills and processes to explain the interactions of matter and energy and the energy transformations that occur.	Thermodynamics: (3)B.1.a – Recognize and describe that the temperature of an object increases when heat is added and decreases when heat is removed.

Module 8 • Lesson 4 • Water Water Everywhere: An Introduction to the Water Cycle

Background for Teachers:

The Water Cycle: The Cool Way the System Works!

(Text from the US Geological Survey: http://ga.water.usgs.gov/edu/watercycle.html)

Earth's water is always in movement, and the water cycle, also known as the hydrologic cycle, describes the continuous movement of water on, above, and below the surface of the Earth. Since the water cycle is truly a "cycle," there is no beginning or end. Water can change states among liquid, vapor, and ice at various places in the water cycle, with these processes happening in the blink of an eye and over millions of years.

Although the balance of water on Earth remains fairly constant over time, individual water molecules can come and go in a hurry. The water in the apple you ate yesterday may have fallen as rain half-way around the world last year or could have been used 100 million years ago by Mama Dinosaur to give her baby a bath.

Water

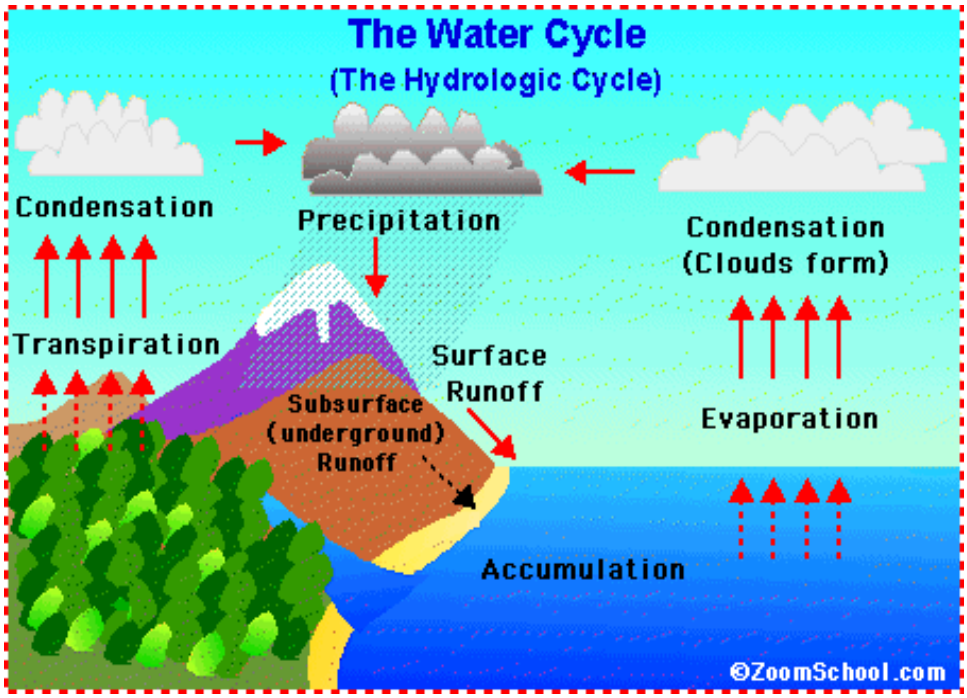
We all know about water, right? We know about the joy of a cold glass of water on a hot summer day. We love to splash in a swimming pool or the ocean. In Baltimore, we experience rain, snow, ice, fog and dew; all forms of water.

But what do we really know about water?

- *How does water get into the clouds?*
- *What happens to water when it reaches the earth (think about rain, snow)?*
- *Why is there sometimes too much water (flooding)?*
- *Why is there sometimes too little water (drought)?*
- *Is there enough water for the world's plants, animals and people?*

First, we are going to learn about the Water Cycle

The water cycle (also known as the hydrologic cycle) is the journey water takes as it circulates from the land to the sky and back again.



Here's how the water cycle works! Since we're talking about a cycle we can start at any point in the cycle.

Evaporation

Oceans:
Did you know that water covers 75% of the earth? Most of the earth's water is sea water which is salty. This water is harmful to land animals and plants. But, this is the source of most of the earth's precipitation (rain, snow, sleet).

How does the water move from the ocean and become precipitation. The first step in this process is evaporation, the process when ocean water changes into vapor. Evaporation takes place when the sun's heat provides energy to evaporate water from the Earth's surface (oceans, lakes, etc.).

Plants:
Plants also contribute moisture to the air through a process called transpiration, which we'll learn more about later. Here are the basics about how it works: Plants pull water from the soil through their roots into their stems and leaves. Then the water evaporates from tree stems and leaves and is released into the air as water vapor (form of gas). This is called transpiration.

We can see some forms of vapor as fog, mist or clouds.

Condensation

Next, the water vapor condenses, forming tiny droplets in clouds. This happens when water vapor comes in contact with colder air, which changes it from vapor into a denser or solid form, like rain, sleet, or snow. Rain, sleet and snow are examples of precipitation. This is how water returns to the land and bodies of water (ocean, lakes, streams).

Some of the precipitation soaks into the ground. Some of the underground water is trapped between rock or clay layers. This accumulation of water is called groundwater. But most of the water flows downhill as runoff eventually returning to the seas as slightly salty water. There are two kinds of runoff: surface runoff that moves on land surfaces and subsurface or underground runoff that seeps into the ground.

Useful websites:

Baltimore Ecosystem Study Hydroecology Education -

http://www.beslter.org/perspective/perspective.aspx?action=get-attachment&page=education:SchoolyardHydroEcologyHandbook&name=Hydro-Ecology+Handbook+-+draft+2+-+Lesson+1.pdf

Action Synopsis

Students will illustrate the water cycle and use scientific reasoning skills to explain why the water that is found on earth today is the same water that was on earth millions of years ago.

Time

1 session

Desired Outcomes

Students will:

- Explain the water cycle.
- Use scientific reasoning to explain that the water on Earth today is the same as the water that existed millions of years ago.

What You'll Need

For Each Student

☐ Journal

For Each Group

- Butcher paper (large sheets of paper) – Students may work individually or in pairs.
- Colored pencils, markers , crayons

For Whole Class

- Background information for teacher with water cycle illustration
- Laminated Water Cycle Diagram illustrations and matching description cards
- Masking tape

Preparing for the Lesson

Leaders will:

- Review the "Background for Teachers" information.
- Review the "Water Cycle Diagram" illustration slides and descriptions.
- Cut sheets of butcher paper for each student/student pairs

New Vocabulary

Accumulation
The gathering of something in large amounts.

Condensation
The process when water vapor comes in contact with colder air and changes into something more dense or solid, like rain, sleet or snow.

Evaporation
The process when water changes into vapor.

Hydrologic cycle
Another name for the water cycle.

Precipitation
The end product (rain, snow, or sleet) when water vapor changes into a more solid form.

Water cycle
The endless movement of water from the atmosphere to earth to groundwater to rivers to oceans and back to the atmosphere.

Run-off
Water that drains or flows off the surface of the land.

Transpiration
The evaporation of water from tree stems and leaves.

Assessments

Journal: "A Closer Look at Water" follow-up sheet: (Post-assessment from previous day's activity.)

Lesson Sequence

1. Journal Activity: "A Closer Look at Water" follow-up sheet. Allow at least 10 minutes for this activity.

   Once students have completed their follow-up sheets, explain to the students that they will be learning about the water cycle. Ask the students: "What do you think of when you hear the word 'cycle'?" Allow for student answers. Explain that the word "cycle" means that it is something that never ends. Remind the students that we have been learning about water and how it exists on earth as a solid, a liquid, or a gas. Then ask the students: "What do you think the water cycle is?" Allow students to answer.

Use the *Background Information for Teacher* to lead a discussion of the water cycle.

2. After you have read and discussed information on the water cycle, pass out the illustration cards showing parts of the water cycle to student volunteers. Recreate the water cycle by reading aloud different description cards and having the students match their illustration card to each description. Tape the illustration cards onto the chalkboard as the activity progresses, drawing arrows to connect each illustration into a cycle. The end result will be a completed illustration of the water cycle. Encourage all students to participate, helping others as needed. Once completed, review each part of the water cycle with the students.

   Ask the students:

   "How do we know that the water on earth today is the same water that was on earth when the dinosaurs lived here?"
   "Why doesn't water disappear?"

   Allow students to explain their answers. Students should conclude that water never goes away, it just changes form (solid, liquid, or gas).

3. Explain to the children that they will be making a water cycle diagram (including drawing and labeling). Teachers can choose to have students work individually or in pairs. Ask them to begin the activity without looking at the diagram on the wall/board. (Have extra paper on hand for mistakes.) However, if students struggle, encourage them to refer to the diagram on the wall/board.

Extension: Encourage students to add additional things to their diagram, such as people, houses, cars, animals, etc. *(This will allow the students to start thinking about the connections between themselves and the water cycle.)*

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Standard 2.0 Earth/Space Science: Students will use scientific skills and processes to explain the chemical and physical interactions (i.e., natural forces and cycles, transfer of energy) of the environment, Earth, and the universe that occur over time.	Interactions of Hydrosphere and Atmosphere: (2)E.1.a – Identify the many locations where water is found. (2)E.1.b – Describe the changes that occur to water found anywhere (3)E.1.b – Observe and explain what happens when liquid water disappears • Turns into vapor (gas) in the air • Can reappear as a liquid or solid when cooled, such as clouds, fog, rain, snow, etc.

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Module 8 • Lesson 5 • Where Does *My* Water Come From? (Understanding the Urban Water Cycle)

Background for Teachers:

Although the water cycle is a never ending process that recycles water back into the atmosphere, Baltimore is an urban area that has been developed or "urbanized" by people. Therefore, the natural cycle of water has been changed due to the changes made to the environment by human beings.

The "engineered" water cycle functions in a similar way to a natural water cycle, but contains separate processes that allow us to clean the water before recycling it back into the natural water cycle. Water collected from the environment (lakes, reservoirs) is treated for bacteria and disease before it is released into the public water supply. Baltimore has three Water Filtration Plants:

- *Montebello I*
- *Montebello II*
- *Ashburton*

After treatment and release into the water supply, people use water for many different things (i.e. drinking, washing, bathing, etc.)

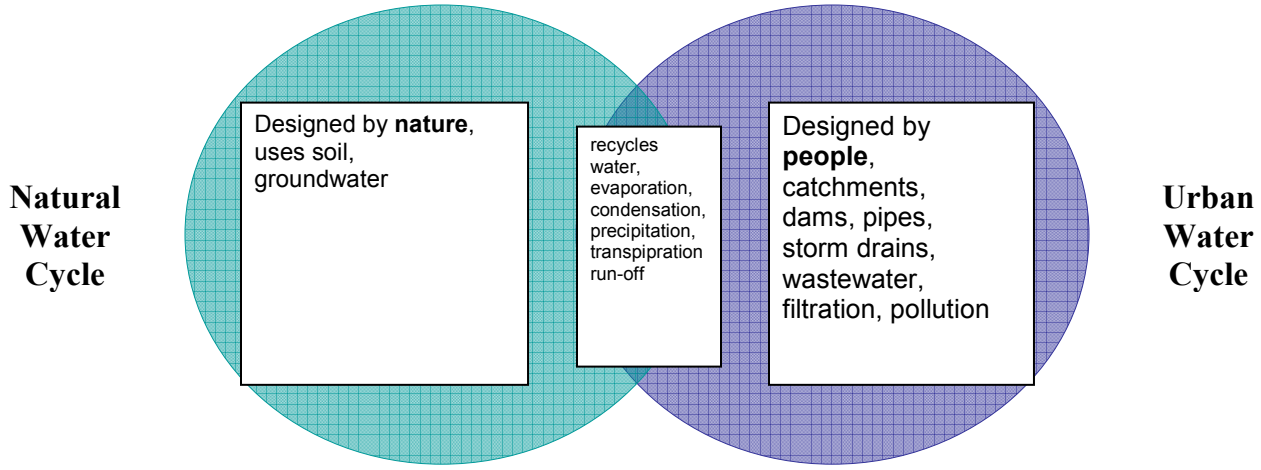
Once the water is used, where does it go? Water that is used for various purposes is dumped into drains as wastewater and is released into our underground sewage system. Similarly, storm water runoff from roads and sidewalks is channeled into storm drains, carrying with it any litter and debris found on the city's surfaces. In order for clean water to be put back into the natural water cycle, it must be treated and cleaned at a wastewater treatment facility. Baltimore's facilities are the Back River Wastewater Treatment Plant and the Patapsco Wastewater Treatment Plant. Due to the high amount of impervious surfaces in cities such as Baltimore (surface that does not allow water to soak into it), a great amount of storm water ends up in the wastewater supply, carrying with it a great deal of debris. Removing asphalt surfaces and replacing them with pervious surfaces such as grass would reduce the great amount of storm water released into the system, and ultimately the Chesapeake Bay.

Useful Websites:

Baltimore's Department of Public Works:
http://www.ci.baltimore.md.us/government/dpw/water/

Baltimore's Watershed 263 Project (Baltimore Ecosystem Study, Parks and People Foundation):
http://www.homedepotfoundation.org/pdfs/parks_people_3.pdf

The Natural Water Cycle vs. The Urban Water Cycle
Comparisons include, but are not limited to, the following:



Action Synopsis

Students will visualize/learn the journey of a drop of water as it goes through the water cycle in Baltimore. They will identify factors in their city and neighborhood that makes the engineered water cycle in Baltimore different from the water cycle in a natural ecosystem.

Time

1 session

Desired Outcomes

Students will:

- Explain the urban water cycle
- Identify ways in which Baltimore's water cycle differs from the natural water cycle

What You'll Need

For Each Student

- ☐ A copy of "The Water Cycle" sheet
- ☐ A pencil

For Whole Class

- ☐ Story/Slide Show "How Did I Get Here? A Journey Through Baltimore's Water Cycle" (a detailed story explaining the journey of water from a catchment to the groundwater after water treatment.)
- ☐ Drawing Paper
- ☐ Crayons/Markers
- ☐ Steps of the urban water cycle on strips of paper
- ☐ A sponge
- ☐ A plastic plate
- ☐ A cup with water

Preparing for the Lesson

Leaders will:

- Review the "Background for Teachers" section at the beginning of Lesson 5.
- Review the Story/Slide Show "How Did I Get Here? A Journey Through Baltimore's Water Cycle"
- Set up the demonstration of a pervious vs. impervious surface using a sponge (pervious), a plastic plate (impervious), and a glass of water. See "Demonstration" description in Lesson Sequence.
- Draw a Venn Diagram outline on chart paper or the chalkboard

- Prepare individual strips of paper with one step of the urban water cycle on each. (Students will choose a strip and draw a picture of the step to create a bulletin board of the Urban Water Cycle)

Steps of the urban water cycle:
- *catchment*
- *dams and reservoirs*
- *water main pipes (carry large amounts of water from reservoir down to the city), smaller pipes*
- *taps (fire hydrants, sink faucets, hoses, etc.)*
- *drains (sink drains, toilets, showers/bathtubs)*
- *storm drains*
- *water treatment facility*
- *natural water cycle*

- Arrange words on a class bulletin board titled: "Baltimore's Urban Water Cycle"

New Vocabulary

Catchment
An area of land that collects water, such as a reservoir or a basin.

Dam
A barrier designed to obstruct the flow of water.

Impervious surface
A surface, such as asphalt, that does not allow the passage of water or other materials through it.

Pervious surface
A surface, such as soil, that allows the passage of water or other materials through it.

Purification
To make pure and free from anything that pollutes or contaminates.

Reservoir
A natural or artificial place where water is collected and stored for use in a community.

Storm water
An abnormal amount of surface water due to a heavy rain or snowstorm.

Wastewater
Water that has been used in washing, flushing, or manufacturing (i.e. sewage).

Assessments

"The Water Cycle" Worksheet – Students draw and label the water cycle.

Lesson Sequence

1. Pass out the worksheet, "The Water Cycle" and explain to the students that they will be labeling the natural water cycle that was discussed in the previous lesson. Encourage the students to try to use their memory to label each part, but ensure them that they can look at a Water Cycle Diagram for help. (10 minutes)

2. Once the students have completed the sheet, review the parts of the water cycle with the students. (5 minutes)

3. Explain to the students that while the last lesson was on the water cycle, today's lesson will be on the special water cycle that Baltimore has. Ask the students: "Where do you think our water comes from?" Allow for student answers and discuss them. (10 minutes)

4. Present or read the PowerPoint presentation/story: "How Did I Get Here? A Journey Through Baltimore's Water Cycle."

Important: After PAGE 5, ***demonstrate*** the difference between a pervious and impervious surface. (see below)

Demonstration:

a. Using a glass of water and a sponge, POUR some water onto the sponge so that it can be absorbed.
b. Ask the students: "What happens to the water?" Allow for student responses. Then ask: "If this was soil, where would the water go?" Allow for student responses.
c. Using the glass of water, pour some water onto the plastic plate. Ask the students: "What happens to the water?" Allow for student responses. Then ask: "If this was asphalt, where would the water go?" Allow for student responses.

d. Continue reading the story.

Once the presentation/story has ended, follow-up with a brief discussion.

Ask the students:

"Now that you know where our water comes from, how would you explain it to someone else?" Allow for student answers. (15 – 20 minutes)

5. As a group, complete the Venn Diagram on the chart paper/board to compare/contrast the natural water cycle to Baltimore's water cycle. (A sample Venn Diagram is presented in the "Background for Teachers" section of the lesson.)
(10 minutes)

6. Have the students choose a strip of paper with one step of the urban water cycle on it. Explain to the students that they will **create a bulletin board** showing Baltimore's water cycle and all of its elements (i.e. catchments, dams, reservoirs, water system, storm drain system, water treatment facility, natural water cycle). Pass out drawing paper, pencils, and crayons/markers. Allow the students time to draw and label each element of the water cycle. They may work as individuals or in pairs. When they are done, the students should present their drawings to the group.

   Once all students have shared, assemble each drawing onto the bulletin board. To make the assembly more challenging, rearrange the drawings to that they are out of order and have the students place them in the correct order.
(30-40 minutes)

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Standard 6.0 Environmental Science: Students will use scientific skills and processes to explain the interactions of environmental factors (living and non-living) and analyze their impact from a local to a global perspective.	Natural Resources and Human Needs: (2)A.1.a – Describe natural resources as something from the natural environment that is used to meet one's needs. (2)A.1.b – Identify water, air, soil, minerals, animals, and plants as basic natural resources.
Social Studies	
Standard 3.0 Geography	Geographic Characteristics of Places and Regions: (2)B.1.c – Classify places as rural and urban Modifying and Adapting to the Environment: (2)D.1.a – Describe ways, such as clearing trees and farming land, that people modify their environment and the impact of those modifications

Module 8 • Lesson 6 • Where Does *My* Water Go? (Investigating Baltimore's Water Use and Storm Drain System)

Background for Teachers:

Storm drains function in the urban water cycle as a means for collecting storm water and surface runoff coming from the asphalt surfaces of streets, sidewalks, parking lots, and buildings. In Baltimore's ecosystem, the surface consists mainly of these impervious surfaces, restricting water from getting absorbed into the ground. As a result, water released onto the surfaces (i.e. spilling, runoff, storm water) is channeled into the city's storm drains and underground storm drain system. In addition to water, pollution and debris from the streets and sidewalks collect in these storm drains as well.

Due to the fact that Baltimore has a great amount of impervious surface, rainstorms and other precipitation causes water to move into our storm drains and urban streams too quickly to manage. This fast movement of water causes flooding. While much of our wastewater in the sewer system (from sinks, toilets, etc.) gets filtered before its release into the environment, run-off from storm drains is not treated at all. As a result, a great deal of trash and debris from our storm drains are not filtered out of the system before it reaches the Chesapeake Bay.

Students need to understand that humans have altered the natural environment and as a result, the natural water cycle must be altered as well. With that in mind, simple choices such as throwing trash in a trash can or planting native trees and shrubs in your yard helps keep our storm drains clean, and ultimately helps improve the water quality for Baltimore City.

Useful Websites:

Baltimore's Department of Public Works:
http://www.ci.baltimore.md.us/government/dpw/water/

Baltimore's Watershed 263 Project (Baltimore Ecosystem Study, Parks and People Foundation):
http://www.homedepotfoundation.org/pdfs/parks_people_3.pdf

Action Synopsis

Students will evaluate the storm drains in their local environment to determine their effectiveness as it relates to human activities and the urban water cycle.

Time

1 session

Desired Outcomes

Students will:

- Explain the use of city storm drains in an urban water cycle.
- Identify causes for effectiveness/ineffectiveness of a storm drain as it relates to human activities.

What You'll Need

For Each Student

 Journal
 Pencil

For Each Group

 Copy of the "Storm Drain Study" sheet

For Whole Class

 A map outline of the school grounds and its nearby streets

Preparing for the Lesson

Leaders will:

- Review the "Background for Teachers" section at the beginning of Lesson 5.
- Review the Story/Slide Show "How Did I Get Here? A Journey Through Baltimore's Water Cycle"
- Create a large map outline on butcher paper or poster board showing the school grounds and the streets surrounding it.

Assessments

Journal Activity: "My Drop of Water!"

Lesson Sequence

1. Journal Activity: "My Drop of Water!" Students will write about the journey a water drop takes to get into the sink faucet in their house, and where that drop is going once it enters the drain. Allow at least 10 minutes for this activity.

   Once students have finished their journals, review Baltimore's water cycle using the student – created bulletin board from the previous activity. (5 minutes)

2. Explain to the students that today's activity will be a storm drain investigation. Ask the students: "Who can explain what a storm drain is and what it does?" Allow for student answers. (5 minutes)

3. Pass out clipboards, pencils, and investigation sheets. Review the "Storm Drain Study" worksheet with the students, explaining the directions and answering questions. Remind the students that they are not to TOUCH anything, as it may be dangerous (broken glass, metal, dirty materials, etc.). (5 minutes)

4. Bring the students outside to complete their storm drain study. (30 minutes)

5. After students have completed their storm drain study, gather them (inside or outside) and discuss their findings as a group.

   Ask the students:
   "Do you think your storm drains do a good job bringing water to the treatment facility? Why/Why not?"
   "Did some storm drains work better than others? Why? How?"

6. Inside the classroom, lay out the outline of the school and it's nearby streets, explaining the outline to the students. With the students, label the storm drains around the school environment. Be sure to draw a key explaining the symbol for the storm drain. The completed map can be displayed near the bulletin board from the previous activity. (20-30 minutes)

Extension Activity:
Go on a field trip to a water treatment facility in your area.

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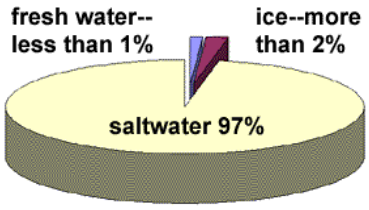
Standard 6.0 Environmental Science: Students will use scientific skills and processes to explain the interactions of environmental factors (living and non-living) and analyze their impact from a local to a global perspective.	Natural Resources and Human Needs: (2)A.1.a – Describe natural resources as something from the natural environment that is used to meet one's needs. (2)A.1.b – Identify water, air, soil, minerals, animals, and plants as basic natural resources. Environmental Issues: (2)B.1.b – Identify and describe that individual and group actions, such as leaving lights on, wasting water, or throwing away recyclables, can limit the natural resources of the environment.
Social Studies	
Standard 3.0 Geography	Geographic Characteristics of Places and Regions: (2)B.1.c – Classify places as rural and urban Modifying and Adapting to the Environment: (2)D.1.a – Describe ways, such as clearing trees and farming land, that people modify their environment and the impact of those modifications
Standard 6.0 Social Studies Skills and Processes	Acquire Social Studies Information (2)D.2.a, (3)D.2.a – Gather data (2)D.2.b, (3)D.2.b – Make and record observations

Module 8 • Lesson 7 • Where Does it All Go? (Storm Drain Systems and Pollution)

Background for Teachers:

Although water is a natural resource that is constantly being recycled (i.e. water cycle), it is still a limited resource that must be protected. The majority of the surface of the earth is covered with water. Of that water, 97% of it is saltwater, which contains too many minerals (salt) for humans to use untreated. That leaves only 3 % of Earth's water as freshwater. However, because 2% of that water is locked up as ice in our glaciers, only 1% of the Earth's water is fresh water. That means that of ALL the water on Earth, only 1% is usable freshwater!

(See figure below taken from: http://www.nationalgeographic.com/kidsnetwork/water/session_01.html)



In addition to drinking, we use water for many things, including bathing, washing clothes, cleaning cars, watering lawns, and fighting fires. When wastewater hits the surfaces of our streets and sidewalks (impervious surfaces), it travels through storm drains and eventually into our larger underground storm drain system. The pollutants on the surface of our community streets and sidewalks also get washed into the storm drains and contaminate the wastewater even more. Although most of our wastewater goes through a filtration process, it is not likely that all wastewater gets to this process, or that all contaminants are removed before release into our natural water bodies.

It is important for individuals to learn about the effect of surface pollution on the city's wastewater and the effects of that pollution on living things. Ultimately, all wastewater is introduced back into the ecosystem, regardless of how clean it is.

A Few Examples of Human Activities that Cause Water Contamination:

- *Littering*
- *Washing cars at home*
- *Not picking up dog poop*
- *Road salting during ice/snow*
- *Over-fertilizing yards*
- *Not keeping cars in good shape (leaking oil and/or other chemicals)*

Useful Websites:

Baltimore's Department of Public Works:
http://www.ci.baltimore.md.us/government/dpw/water/

Baltimore's Watershed 263 Project (Baltimore Ecosystem Study, Parks and People Foundation):
http://www.homedepotfoundation.org/pdfs/parks_people_3.pdf

Action Synopsis

As a group, students will brainstorm the various ways water is used in their families and community. They will identify the human activities that cause water pollution in their neighborhood. Students will demonstrate how pollutants are transported through the city's storm drain system, and how water is cleaned before release into the natural environment.

Time

2 sessions

Desired Outcomes

Students will:

- Identify common uses for water in their community
- Identify sources of water pollution as a result of human activities
- Explain how pollutants are transported through the storm drain systems
- Explain how in spite of wastewater treatment, not all pollution can be removed from the city's wastewater

What You'll Need

For Whole Class

For discussions:
 2 sheets of chart paper with the following titles:
- *"Uses for Water"*
- *"How Water Gets Polluted"*

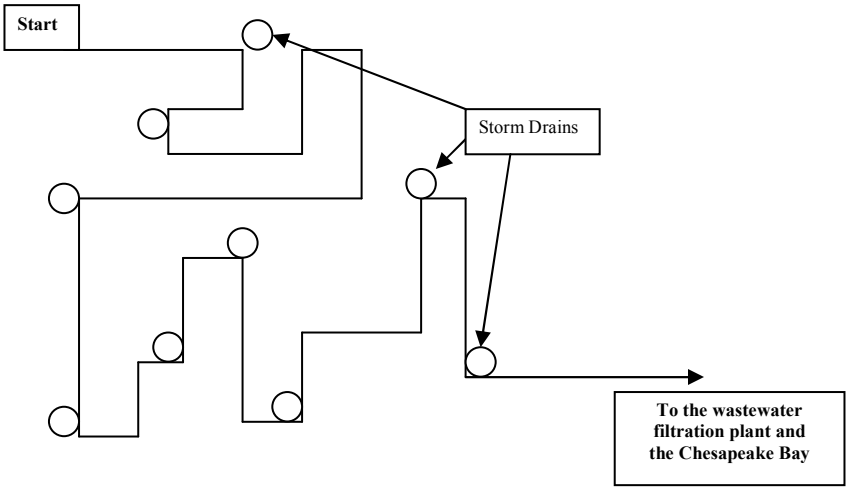
For demonstration:
 1000 mL beaker full of water
 Blue food coloring (add this to color the 1000 mL of water)
 100 mL graduated cylinder
 A smaller beaker
 An eyedropper

- Metal sewing thimble or small medicine cup
- Table salt
- Maple syrup (represents motor oil pollutant), Red pepper flakes (represents litter)
- A sponge

For activity (maze):

- Sidewalk chalk for drawing maze (Indoor modification: Use masking tape instead and outline a maze on the classroom floor)
- Post-it notes (squares, various colored packs) - *If Post-it notes are unavailable you may cut construction paper in squares and attach tape to each piece.*
- Flour (not necessary for use if indoors)
- Class-constructed storm drain map (use as a resource for drawing maze/storm drains)

Ex: Storm Drain Maze with Storm Drains



Preparing for the Lesson

Leaders will:

- Gather chart paper for both brainstorming/discussion activities. If possible, write titles (see *Materials* section) on both sheets to set-up for future activity.
- Set up the demonstration by adding water to the beaker and coloring it blue. Arrange additional materials in an area where students can sit/stand to participate and observe.

- Set up the Storm Drain Maze either inside or outside, depending on the weather. See below:

  Set-up (Adapted from Project WET's "A-maze-ing water"):

  Outdoors: Sidewalk Chalk *Indoors: Masking Tape*

  3-1.1. Using the class-made map showing neighborhood streets and storm drains, construct a maze/grid of the neighborhood streets. (See example in "What You'll Need" section of the lesson.)
  *3-1.2. At each point in the maze where a storm drain is located, place several Post-it notes (or paper with tape) labeled as different pollutants (ex: road salt, trash, dog poop) on each. Incorporate findings from the Storm Drain Investigation sheets (previous activity), student brainstorm, and the "Background for Teachers" section. **Be sure to write "road salt" on several Post-its/paper with tape***
  3-1.3. Choose 2-3 points to place containers of flour that represent metals/other pollutants. (Students will walk through the maze and stick Post-its/flour on themselves.)

- Review the "Background for Teachers" section at the beginning of Lesson 7.

New Vocabulary

Filtration
The process of sending a substance through a filter to collect unwanted materials, leaving a cleaner and more pure product.

Pollutant
Anything, such as certain chemicals or waste products, that renders the air, soil, water, or other natural resource harmful or unsuitable for a specific purpose.

Pollution
The introduction of harmful substances or products into the environment

Assessments

Session 1 Journal Activity: "What is Pollution?"

Lesson Sequence

<u>Session 1:</u>

1. Journal: "What is Pollution?" Students can use their experiences to describe examples of pollution by either writing about them or drawing and labeling them. Allow the students

to work as independently as possible, limiting teacher input. Allow at least 10 minutes for this activity.

2. Introduce the subject of water pollution. Inform the students that they will be investigating how pollution gets into Baltimore's water, but first they will brainstorm ways in which water is used in the neighborhood. Ask the students: "How do we use water in our lives?" Allow for several student answers. Brainstorm answers by writing them on a sheet of chart paper. Tape the chart titled *"Uses for Water"* to the wall or chalkboard.
(5 – 10 minutes)

3. After the brainstorm/discussion, explain to the students that we only have a certain amount of water that humans can use. Use the directions in the Leader Tools to complete a demonstration showing the amount of drinkable/useable water on earth (taken from Project WET's "A Drop in the Bucket." (10 – 15 minutes):

4. Ask the students: "What are some things that people do that causes our water to get polluted?" Remind students of the storm drain investigation from the previous lesson, and what items were found in the storm drain that didn't belong there (i.e. trash). Tape the second chart titled "How Water Gets Polluted" to the board or wall and record student ideas.

   Once ideas have been recorded, ask the students: "What happens to all of the stuff that pollutes our neighborhoods?" "How does it get into our water?" Allow for student answers, keeping in mind that the storm drains in our communities carries a lot of pollutants from human activities on the surface.

<u>Session 2</u>

Activity:

1. Have students use their journals and review with the students the ways in which people use water and the ways water gets polluted. Ask the students:

   "What happens to this water?" Allow for student answers.

2. Inform the students that they will be going outside to become water! Bring the students outside to the black top where the maze is located. Explain to the students that pollution that happens at the surface of our environment (on our streets, yards, side walks) eventually goes into our storm drains because of the run-off from ***impervious surfaces*** (recall from previous activity).

3. Explain the maze to the students and tell them that the maze represents the storm drain system in our neighborhood. Show them the location of storm drains throughout the maze, explaining the different pollutants (Post-its, flour) that have collected at each drain.

5. Tell the students that they are no longer kids, but they are drops of wastewater traveling through the storm drain system in the neighborhood. Demonstrate how each student will travel through the maze and collect a pollutant at each point. **Where flour (metal pollutant) is located, students may pick up flour with their fingers and sprinkle it onto their hair or clothes.**

6. Allow the students (one at a time or single file) to travel through the maze as a drop of water and collect some of the materials from the drawings (post-it notes, flour, etc.) to see how much pollution gets added into the water from storm run-off.

7. Allow the students to travel through the maze several times, each time collecting more pollutants. Once they've completed the maze, gather the students and ask them: "Do you think people should drink you?" "Do you think they should swim in you?" "Do you think animals like fish should live in you?" Student answers should vary, but students should get the idea that the water leaving a storm drain contains many pollutants, and these pollutants are harmful to living things in the ecosystem.

8. Ask for a student volunteer (or two) to become a wastewater treatment plant (suggest one of Baltimore's facilities, either Back River or Patuxent Wastewater Treatment Plants. Arrange remaining students (water) in a single-file line.

9. One-by-one, have each student walk through the wastewater treatment facility (they should slowly walk past the student volunteer). As the water moves past the volunteer cleaner, the volunteer attempts to "clean" water off by pulling off Post-its and brushing off flour. Not all pollutants should be removed in this process.

10. Once students have been "treated" as the filtration plant, gather the students. Ask the students: "What are some of the pollutants you collected as you traveled through our storm drains?" Allow for student responses. Ask: "Although you went through the wastewater treatment plant, are you as clean as you were when you started the journey through the maze?" Allow for student answers. (Students should recognize that it is difficult to remove all of the pollution before dumping into streams/bay.) (20-30 minutes)

(Extension: Students can start the maze with some pollutants already on them. This would simulate the concept that water becomes contaminated upstream from the city.)

11. Wrap-up the lesson by having the students write/draw in their journal "A Day in the Life of Water" to have them include the journey through the storm drain system and ultimately their release into the environment. (This can be completed on the following day if time is limited.)

Maryland SC Standards (2nd and 3rd Grade):

Standards are presented in the following format:
(Grade)Standard.Topic.Indicator.Objective – Objective Statement

Science	
Standard 1.0 Skills and Processes: Students will demonstrate the thinking and acting inherent in the practice of science.	Constructing Knowledge: (2)1.A.1.b – Seek information through reading, observation, exploration, and investigations. Applying Evidence and Reasoning: (2)B.1.a – Provide reasons for accepting or rejecting ideas examined. (2)B.1.b – Develop reasonable explanations for observations made, investigations completed, and information gained by sharing ideas and listening to others' ideas. (3)B.1.a – Develop explanations using knowledge possessed and evidence from observations, reliable print resources, and investigations. Communicating Scientific Information: (2)C.1.a – Describe things as accurately as possible and compare observations with those of others. (2)C.1.b – Describe and compare things in terms of number, shape, texture, size, weight, color, and motion. (3)C.1.a – Make use of and analyze models, such as table and graphs to summarize and interpret data. (3)C.1.d – Construct and share reasonable explanations for questions asked.
Standard 2.0 Earth/Space Science: Students will use scientific skills and processes to explain the chemical and physical interactions (i.e., natural forces and cycles, transfer of energy) of the environment, Earth, and the universe that occur over time.	Interactions of Hydrosphere and Atmosphere: (2)E.1.a – Identify the many locations where water is found. (2)E.1.b – Describe the changes that occur to water found anywhere.
Standard 6.0 Environmental Science: Students will use scientific skills and processes to explain the interactions of environmental factors (living and non-living) and analyze their impact from a local to global perspective.	Natural Resources and Human Needs: (2)A.1.d – Identify ways that humans use Earth's natural resources to meet their needs. (2)A.1.e – Explain that some natural resources are limited and need to be used wisely. Environmental Issues: (2)B.1.b – Identify and describe that individual and group actions, such as leaving lights on, wasting water, or throwing away recyclables, can limit the natural resources of the environment.
Social Studies	
Standard 6.0 Social Studies Skills and Processes: Students shall use reading, writing, and thinking processes and skills to gain knowledge and understanding of political, historical, and current events using chronological and spatial thinking, economic reasoning, and historical interpretation, by framing and evaluating questions from primary and secondary sources.	(2)D.1.c – Locate and gather data and information from appropriate non-print sources, such as music, maps, graphs, photographs, and illustrations (3)D.1.c – Locate and gather data and information from appropriate non-print sources, such as music, artifacts, charts, maps, graphs, photographs, video clips, illustrations, paintings, political cartoons, interviews, and oral histories (3)D.2.a – Gather data (3)F.1.a – Interpret information in maps, charts and graphs

Module 8 • Lesson 8 • Design an Ecosystem!

Background for Teachers:

For every human action in an ecosystem, there is a reaction by the natural habitats in the ecosystem. Currently, the Baltimore Ecosystem Study is studying the effects of human activities such as road paving, construction, and deforestation on the water quality of the local streams. As the development of impervious surfaces increases, the amount of pollutants entering local streams also increases. For example, research has shown that road salting activities have significantly increased the amount of salinization (adding salts) in the freshwater streams in Baltimore. Due to the fact that these streams are part of a larger watershed, the contamination of these streams becomes a critical factor in the declining health of our water resources in Baltimore.

Other research activities are being done in the Baltimore area that support the argument that ***human activities are changing the water system in Baltimore****. Understanding the cause/effect relationships between human actions and our water resources is an important step in preventing water contamination and promoting better water quality in the city.*

Useful Websites:

Baltimore's Department of Public Works:
http://www.ci.baltimore.md.us/government/dpw/water/

Baltimore's Watershed 263 Project (Baltimore Ecosystem Study, Parks and People Foundation):
http://www.homedepotfoundation.org/pdfs/parks_people_3.pdf

"To Salt or Not to Salt?" (An Institute of Ecosystem Studies Highlighting BES Research):
http://www.ecostudies.org/images/newsletter/winter_2005.pdf

Action Synopsis

Students will create a model of an aquatic ecosystem to explain some of the effects of water pollution on living things. Students will identify practical solutions for preventing water pollution in their city.

Time

2 sessions

Desired Outcomes

Students will:

- Explain the effects of water pollution on living things in the ecosystem

- Given a cause (i.e. human activity that causes pollution), predict the possible effect on the local ecosystem.
- Identify solutions for reducing water pollution in their neighborhood.

What You'll Need

For Each Student

☐ Journal

For Whole Class

☐ Crayons/markers
☐ Plastic kiddie pool (OR a large container such as a plastic storage crate)
☐ Plastic aquatic plants (Ex: grasses)
☐ Plastic aquatic animals: (Ex: small fish, large fish, blue crabs)
☐ Pollutant materials: trash (from classroom trashcan), rock salt, maple syrup, cut strings of green yarn or plastic Easter grass
☐ Photographs of BES research sites and activities being conducted

Preparing for the Lesson

Leaders will:

- Review the "Background for Teachers" section at the beginning of Lesson 8.
- Prepare "What if?" charts for student groups including one topic of BES research on each:
  - Salt from roads washing into the stream
  - Chemicals from roads and yards washing into the stream
  - Litter from roads and sidewalks washing into the stream
- Arrange materials for making a model of a stream ecosystem including the pool, plants, animals, and pollutants.

New Vocabulary

Cause

Anything that happens to bring about an effect. (Ex: Humans dump trash in a stream.)

Effect

The result of something that happens. (Ex: A stream becomes polluted.)

Assessments

Journal: "How does pollution get into our water?" Students may write or draw their answers to explain this question.

Lesson Sequence

Session 1:

1. Journal: "How does pollution get into our water?" Students may write or draw their answers. Allow 5 -10 minutes for students to complete their journal entries.

2. When journals have been completed, explain to the students that they will be learning about the types of pollution in Baltimore's streams. Ask the students: "What are some things that people do that can cause water pollution?" Using chart paper or the chalkboard, brainstorm/review human activities that cause water pollution. Encourage all students to share their ideas. (10 minutes)

3. Inform the students that they will be making a model of a healthy stream ecosystem in Baltimore. Present the plastic swimming pool to the group.

   Ask the students: "What do you think the water looks like in a healthy stream?" Allow for student answers.

   Ask: "Are there plants in a healthy stream?" Once students have answered, explain that plants are necessary to give oxygen to the living things in the water for them to breathe. Add the plastic aquatic plants.

   Ask: "What kinds of animals do you think live in a healthy stream?" Allow for student answers. Introduce the plastic animal models to the pool/ecosystem. Allow the students to place the animals where they see fit.

4. Review the healthy stream habitat with the students. Remind the students that the water is clean, there are many plants to bring oxygen to the water, and there are MANY different types of animals.

5. With the pollutants close by, review the brainstorm from the beginning of the activity explaining human actions that cause pollution.

   Ask the students: "What do you think would happen if trash entered the ecosystem?" Allow for student answers. **Select one or two students to take a trash can from the classroom and dump it into the ecosystem**. Ask: "Would this be a healthy habitat?" "Why or why not?" Allow for answers.

   Ask the students: "What do you think would happen if a rainstorm washed oil from the road into the ecosystem. Allow for student answers. **Select a student to pour the syrup into the ecosystem.** Ask: "Would this be a healthy habitat?" "Why or why not?" Allow for answers.

   (Optional) Ask the students: "What do you think would happen if a rainstorm washed chemicals from people's yards into the ecosystem?" Allow for student answers. Explain

to the students that these chemicals cause algae to grow which blocks sunlight for the good plants that are needed in the stream. **Select one or two students to spread the green yarn/grass into the stream ecosystem.**
Ask: "Would this be a healthy habitat?" "Why or why not?" Allow for answers.

Ask the students: "What do you think would happen if a melting snow washed salt from the roads down into the ecosystem. **Select one or two student s to sprinkle rock salt into the ecosystem.** Ask: "Would this be a healthy habitat?" "Why or why not?" Allow for answers.

Then ask: "Would you DRINK this water?" Allow for student answers.

6. Discuss this activity with the students. Have the students reflect on:
   a. The health of the stream before/after the activity
   b. What it would be like to be one of the living things in that stream
   c. What we would be drinking or eating if the unhealthy water was in our food and water.
   d. Whether or not people can make the stream healthy again and how.

   (20-25 minutes)

<u>Session 2:</u>

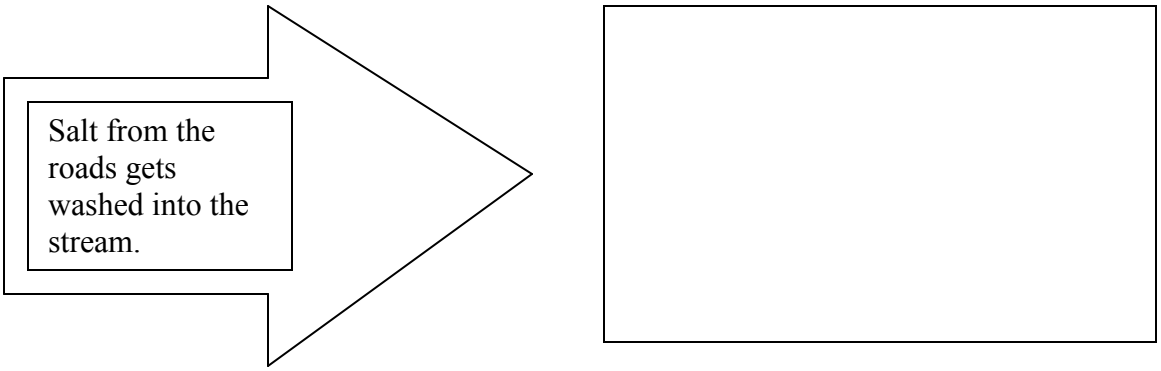
1. Explain to the students that scientists are working in Baltimore to find ways to make our streams healthy. Introduce the Baltimore Ecosystem Study research that is being conducted on local streams (i.e. road salting, pesticide use). Show students pictures of scientists doing their research. Ask the students: Why do you think it is important for scientists to do this work?" Allow for student answers. (10 minutes)

2. Inform the students that they are going to use what they've learned to make a prediction. Allow students to work in groups or in pairs. Pass out a sheet of chart or butcher paper with a "What if?" chart already drawn, including one of the BES research topics. *It is important to allow the students to share their answers freely without concern for what is a right/wrong answer.*

See examples on the following page:

"What if?" Chart:

What if? (Cause) ***Possible Effects***



3. Using BES identified "causes," have students create drawings to predict the effects of this pollution on living things in the ecosystem based on what they've learned. Encourage students to not only think about the living things IN the stream, but also the animals and people living NEAR the stream. Once student groups have completed their drawings, have each group share their work. (30 minutes)

4. Once students have shared, discuss ways in which water pollution can be prevented. This can be a brainstorming activity completed on the chalkboard, or a general discussion. (5 – 10 minutes)

Maryland SC Standards (2nd and 3rd Grade): *Standards are presented in the following format:* *(Grade)Standard.Topic.Indicator.Objective – Objective Statement*	
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Module 8 Post-Assessment – Grades 2/3
2009 – 2010

Now that we have finished Module 8, we want to see what you have learned about **water**. Do the best you can, even if you are not sure of an answer. If you have the same answer as you did on the pre-test, see if you can ADD to it with what you have learned in our lessons. IF YOU WOULD LIKE TO DRAW YOUR ANSWER, DO IT ON THE BACK OF YOUR PAPER.

Name: _____ Date: _____

Class: _____ Teacher: _____

Grade: _____

---

1. Read each sentence. Circle true if the sentence is true and false if it is not right. THEN explain why you chose your answer.

The Earth is covered mostly with water. true false

Explain: _____

You can use a map of Baltimore to find your school. true false

Explain: _____

The Inner Harbor is part of the Chesapeake Bay. true false

Explain: _____

The Chesapeake Bay empties into the Atlantic Ocean. true false

Explain: _____

2. Water exists as a <u>solid</u>, a <u>liquid</u>, and a <u>gas</u>. Water can be found in some places and not in others. For each of the things below, circle whether or not you think there's water in it. If there is water in it, put an X to show what form it is in.

Thing	**Is there water in it?**	**What form is the water in?** 		
		Solid	**Liquid**	**Gas**
Air in a room	Yes No			
Bubbles in boiling water	Yes No			
Cloud	Yes No			
Ice	Yes No			
Orange juice	Yes No			
Paper clip	Yes No			
Tree	Yes No			
Now, add to the table with two of your own examples.				
	Yes No			
	Yes No			

3. How does water help you live? List all the ways that you can think of.

_____

_____

_____

_____

4. What is the water cycle?

_____

_____

5. Write a story about a water molecule. LABEL your drawing using the words below.

Rain Clouds River Ground Air Storm drain Run-off

6. Answer each question in the space below.

After it rains you see puddles on the sidewalk at your school. After a few days the puddles are gone. Where did the water go?

_____

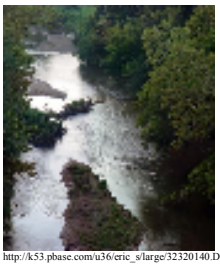
Can any of the water end up in your bathtub? (Circle one) **Yes** **No**

If you said yes, HOW can water end up there?

_____

(Source: Michigan State University Environmental Literacy Project)

7. Complete the chart to describe water in different places.

Water in:	**Where does it come from?**	**Where is it going?**
A river:  http://k53.pbase.com/u36/eric_s/large/32320140.DSC04501pano03final.jpg		
Water mains and pipes: 		
Water treatment plants: 		

	Where does it come from?	**Where is it going?**
Storm drains: 		
A water fountain:  http://a.abcnews.go.com/images/GMA/cb_water_fountain_070619_main.jpg		

8. Draw pictures that show the difference between clean water and polluted water. Label important things in your pictures.

Drawing of clean water	Drawing of polluted water

(Source: Michigan State University Environmental Literacy Project)

9. How does water get polluted?

_____

_____

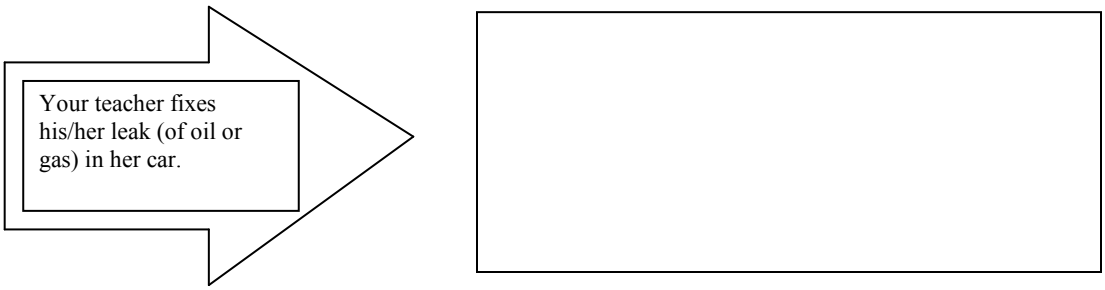
_____

10. How do our choices affect the ecosystem?

Write or draw your answers in the boxes after each arrow.

What if…?	Then…
Someone throws a can onto the street.	
Salt from the roads gets into the storm drains.	
You and your friends plant a garden at your school.	

What if…? Then…



Great job!

Module 8:

Water

Worksheets and Handouts

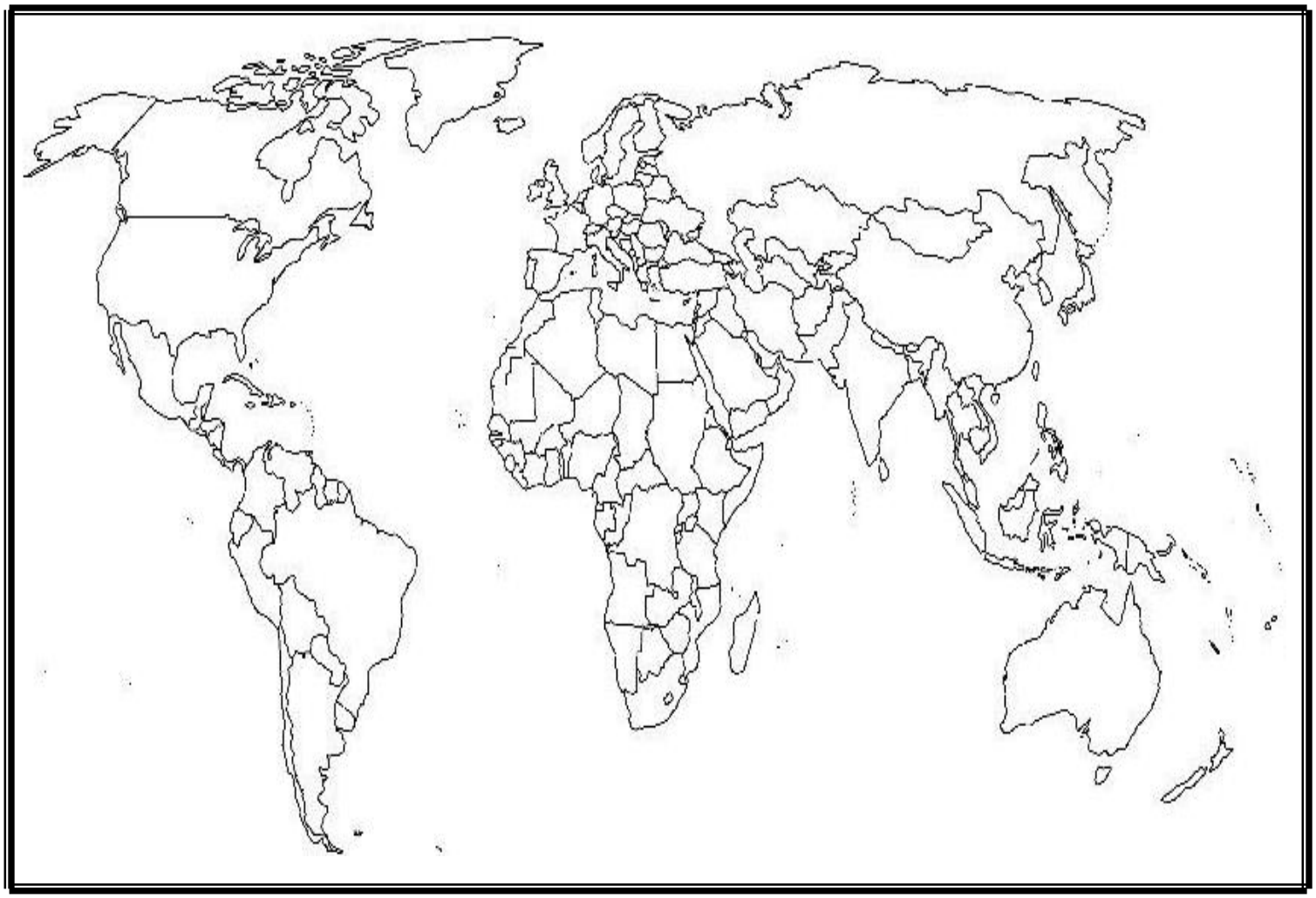
Grades 2 and 3

Land and Water Map

Your Name: _____

Directions: 1. Color all of the **LAND** on the map **BROWN**.

2. Color all of the **WATER** on the map **BLUE**.



Is the earth covered mostly with land or with water? _____

How do you know?

_____

Where is Our Water?

Your Name: _____

Please fill out the chart below as you find water in your neighborhood. Remember to look in LARGE and SMALL spaces!

Water in My Neighborhood

Type (puddle, fountain, sewer?)	**Location**	**Drawing**

Storm Drain Study

Name(s): _____

Today you will be investigating the storm drains around you!

Image from: http://commons.bcit.ca/watershed/newsltr/newsimg/dyknow.gif

Directions:
1. With your group, choose a storm drain around your school environment.
2. Describe where you found your storm drain.
3. Pour water into the storm drain to observe how water moves in it.
4. Use your eyes and ears to make observations about that storm drain and what is happening around it.
5. Draw your storm drain, including an arrow (←or →) to show how the water flows.

My Storm Drain!

Location: _____

_____

What I see: _____

_____

What I hear: _____

_____

My storm drain looks like this:

Module 8:

Water

Journals

Grades 2 and 3

Lesson 2 Journal:

Where can we find water?

Name: _____

Directions: Think about where water exists on Earth. Think about water around you. Write or draw as many places you can think of where you could find water.

_____

_____

_____

_____

_____

_____

Drawing:

Lesson 3 Journal:

Name: _____

Is the earth covered mostly by land or water? How do you know?

_____

_____

_____

_____

_____

_____

Drawing:

Lesson 4 Journal: **A Closer Look at Water**

Name: _____

Directions: Imagine you are making a cartoon about water. Fill in the chart below by drawing and writing what water would look like.

	Solid	**Liquid**	**Gas**
What water molecules look like as a…			
Examples that I see around me…			

Directions: Complete the sentences below by circling the correct words.

1. When you want to melt an ice cube, you have to

give heat **take away heat**

2. When water freezes into ice, heat has been

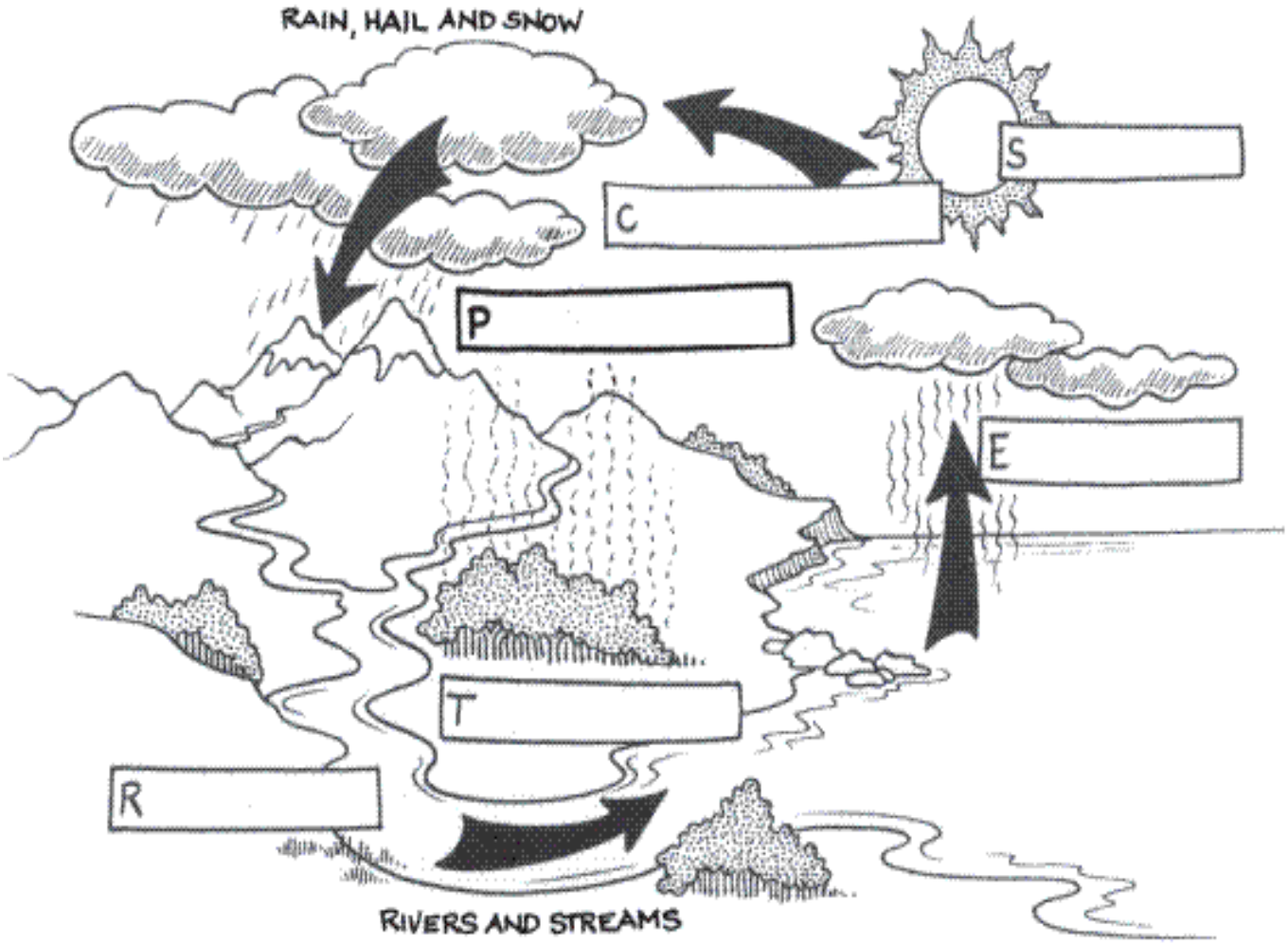
given **taken away**

Lesson 5 Journal:
The Water Cycle

Name: _____

(Image from http://www.ecomentors.ca/pub/assets/pdfs/water_cycle_worksheet.pdf)

Directions: Fill in the blanks to label the drawing of the water cycle. The first letters for each word have been done for you already.



Does water <u>disappear</u>? Explain your answer.

_____

_____

Where do you think YOUR water comes from?

_____

_____

Lesson 6 Journal: My Drop of Water

Name: _____

You see drops of water dripping from your faucet at home. Write a story describing where one drop of water came from.

_____

_____

_____

_____

_____

_____

Your water drop rushes drown the sink drain! Where is it going NOW?

_____

_____

_____

Drawing:

Lesson 7 Journal:

Name: _____

What is pollution?

_____

_____

What is WATER pollution?

_____

_____

Draw what polluted water looks like. Label everything in your picture

Lesson 7 Journal 2:

Name: _____

A Day in the Life of Water!

Imagine that you are a drop of rain that has just landed in front of the school. What would your journey be like in Baltimore's storm drains? Where would you go? Where would you end up? Tell a story of your journey!

_____

_____

_____

_____

_____

_____

What do you look like now? Draw and describe your before and after picture:

Before: After:

Module 8:

Water

Leader Tools

Grades 2 and 3

Module 8 Pre-/Post-Assessment Answers – Grades 2/3

2009 – 2010

Before we start Module 8, we want to see what you may already know about **water**. Do the best you can, even if you are not sure of an answer. IF YOU WOULD LIKE TO DRAW YOUR ANSWER, DO IT ON THE BACK OF YOUR PAPER.

.

Name: _____ Date: _____

Class: _____ Teacher: _____

Grade: _____

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1. Read each sentence. Circle true if the sentence is true and false if it is not right. THEN explain why you chose your answer. Explanations may vary.

The Earth is covered mostly with water. true false

Explain: You can tell by looking at a map or a globe. You can also find out through researching in books or on the internet that the surface of earth is covered almost 75% with water.

You can use a map of Baltimore to find your school. true false

Explain: A street map of Baltimore will show you where schools are.

The Inner Harbor is part of the Chesapeake Bay. true false

Explain: You can tell this is true by looking at a map and seeing that the Inner Harbour is part of the Chesapeake Bay.

The Chesapeake Bay empties into the Atlantic Ocean. true false

Explain: You can tell this is true by looking at a map or globe and seeing that the Chesapeake Bay flows into the Atlantic Ocean.

2. Water exists as a <u>solid</u>, a <u>liquid</u>, and a <u>gas</u>. Water can be found in some places and not in others. For each of the things below, circle whether or not you think there's water in it. If there is water in it, put an X to show what form it is in.

Thing	**Is there water in it?**	**What form is the water in?** 		
		Solid	**Liquid**	**Gas**
Air in a room	Yes No			X
*Bubbles in boiling water	Yes No			
Cloud	Yes No			X
Ice	Yes No	X		
Orange juice	Yes No		X	
Paper clip	Yes No			
Tree	Yes No		X	
Now, add to the table with two of your own examples. (Answers will vary.)				
People	Yes No		X	
Popsicle	Yes No	X		

* There are gases (like carbon dioxide, oxygen, etc) that have dissolved in water. When water is heated, these gases are released.

3. How does water help you live? List all the ways that you can think of.
Answers will vary.

Water keeps you hydrated and cool. Water keeps the earth cool. Water allows you to stay clean by using it to bathe with. You use water for cooking and doing laundry, etc…

4. What is the <u>water cycle</u>?

The endless movement of water from the atmosphere to earth to groundwater to rivers to oceans and back to the atmosphere.

5. Write a story about a water molecule. LABEL your drawing using the words below.

Rain Clouds River Ground Air Storm drain Run-off

Drawings will vary but should show some/all of the following:

- Water falling to the ground as rain
- Water gathering as run-off
- Water traveling into a storm drain
- Water evaporating into the air
- Water vapor forming clouds
- Water being collected in a river either by flowing down a hill/mountain or by being released into a river from a storm drain
- Some students may suggest that water is released into a river through the ground

6. Answer each question in the space below.

After it rains you see puddles on the sidewalk at your school. After a few days the puddles are gone. Where did the water go?

The water evaporated into the air as water vapor.

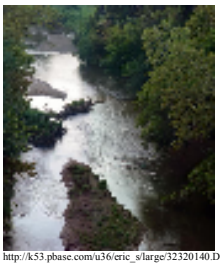
Can any of the water end up in your bathtub? (Circle one) **Yes** **No**

If you said yes, HOW can water end up there?

The water vapor condenses and forms clouds. The clouds release water as rain. Rain is collected in lakes and reservoirs and then channeled into a water treatment plant through large pipes. Once the water is cleaned, pipes deliver the clean water into our houses which can then be used to eat and clean with.

(Source: Michigan State University Environmental Literacy Project)

7. Complete the chart to describe water in different places.

Water in:	**Where does it come from?**	**Where is it going?**
A river:  http://k53.pbase.com/u36/eric_s/large/32320140.DSC04501pano03final.jpg	Higher elevations such as mountains.	Downstream to gather into a catchment or to be released into a bay or ocean.
Water mains and pipes: 	Water comes from catchments or reservoirs.	Water treatment plant.

Water treatment plants: 	Water mains bring the water from a reservoir to the water treatment plant.	Water will travel to homes and businesses after it is treated.
	Where does it come from?	**Where is it going?**
Storm drains: 	Rain	In Baltimore, it goes into the Chesapeake Bay.
A water fountain:  http://a.abcnews.go.com/images/GMA/cb_water_fountain_070619_main.jpg	Water treatment plant.	Wastewater goes to the wastewater treatment plant where it is cleaned and released into the environment.

8. Draw pictures that show the difference between clean water and polluted water. Label important things in your pictures.

Drawing of clean water	Drawing of polluted water
Answers will vary but will likely include clear water with bubbles, but little else in it.	Answers will vary but will likely include trash and litter in the water. Some students may indicate less visible pollutants such as chemicals in the water.

(Source: Michigan State University Environmental Literacy Project)

9. How does water get polluted? (Answers will vary)

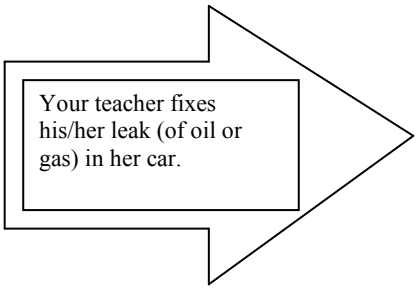
Water gets polluted when things that do not belong in water such as trash or chemicals are released into the water. Humans pollute the water when they do not use trash cans, allow their cars to leak oil and chemicals onto the streets, and do not pick up after their dog.

10. How do our choices affect the ecosystem?

Write or draw your answers in the boxes after each arrow. (Answers will vary in length and detail.)

What if…?	Then…
Someone throws a can onto the street.	The can travels into a storm drain during a rainstorm and gets released into the Chesapeake Bay. The can pollutes the water in the Chesapeake Bay and therefore pollutes the Atlantic Ocean.
Salt from the roads gets into the storm drains.	The salt gets released into the Chesapeake Bay and makes the water salty. Animals that need fresh water to survive become sick, and the ecosystem is damaged.
You and your friends plant a garden at your school.	Plants filter pollution from the air and release oxygen into the environment. Gardens bring more insects and other small animals to the schoolyard. Gardens provide food for you and your friends while making the schoolyard more beautiful

What if…? Then…



Less chemicals will be carried into the Chesapeake Bay. There will not be as much water pollution and the city and bay ecosystem will be healthier.

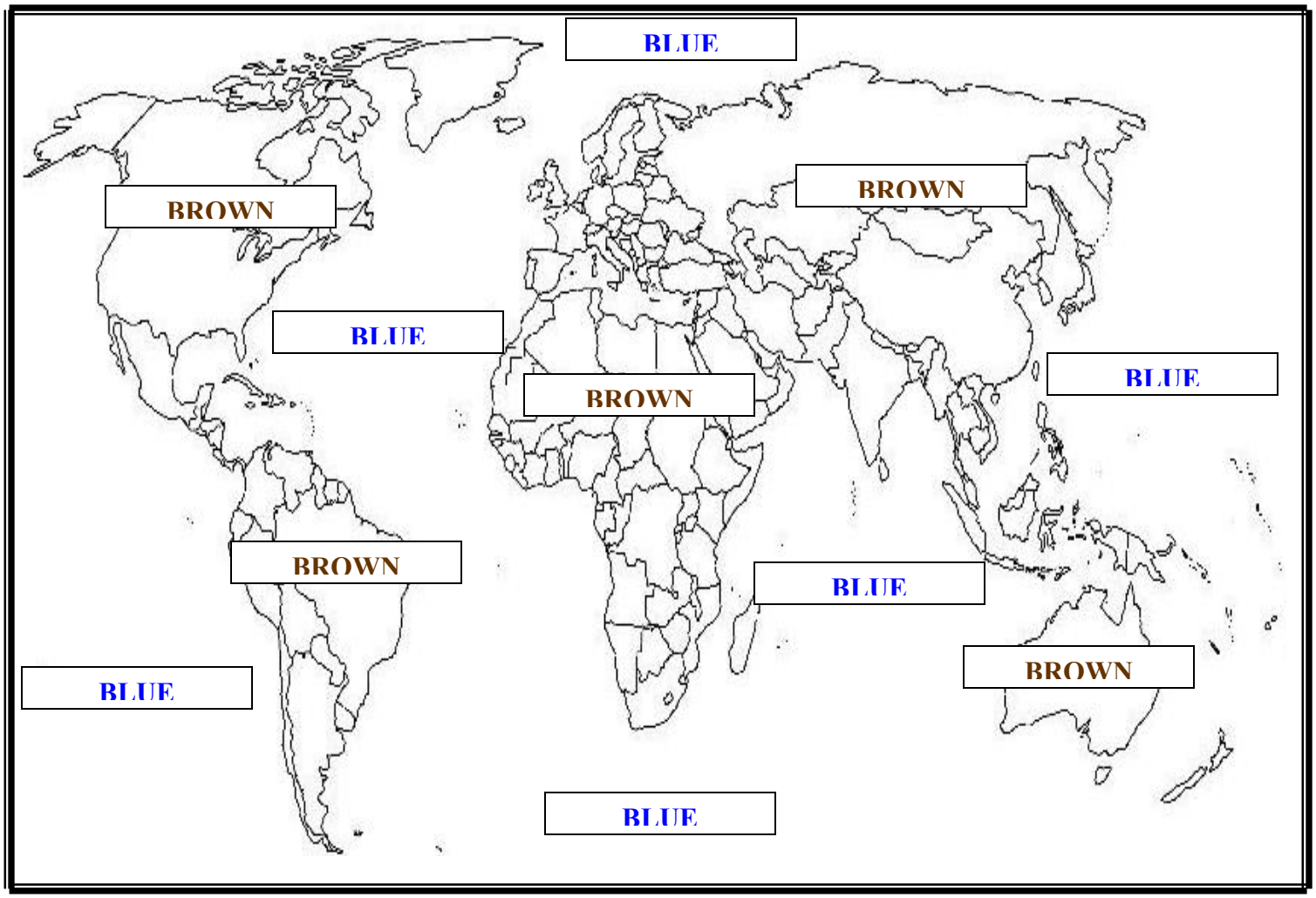
Great job!

Land and Water Map

Your Name: _____

Directions: 1. Color all of the **LAND** on the map **BROWN**.

2. Color all of the **WATER** on the map **BLUE**.



Is the earth covered mostly with land or with water? **The earth is covered mostly with water.**

How do you know?

I know this because the map and globe both show that water is on most of the surface of earth.

Where is Our Water? (Answers will vary)

Your Name: _____

Please fill out the chart below as you find water in your neighborhood. Remember to look in LARGE and SMALL spaces!

Water in My Neighborhood

Type (puddle, fountain, sewer?)	**Location**	**Drawing**
Puddle	On the blacktop in the playground	
Storm drain	In the schoolyard	
Storm drain	In front of school	

Insert Water Cycle Diagram Slides and Definition Slides (cards)

Module 8 Lesson 3 –

Water Tag

In this game, students reenact water molecules as they change between the states of solid (ice), liquid (water), and gas (steam/water vapor).

Minimum: 4 players (one "red shirt," one "blue shirt," and water molecules)

Red Shirt (HEAT - added)
One person wears a red shirt and represents HEAT energy being given. They move around the group and gently tag water molecules. When a water molecule is tagged, heat energy has been added and they change state.

Blue Shirt (COLD – heat taken away)
One person wears a blue shirt and represents HEAT energy being removed. They move around the group and gently tag water molecules. When a water molecule is tagged, heat energy has been taken away and they change state.

Water Molecules
The rest of the students are water molecules, and they move around according to the state they are in. Water molecules may choose what state they want to begin in (i.e. solid, liquid, gas).

Solid ice – Students stand still (frozen) until they are tagged by the student in the red shirt (HEAT).

Liquid water – Students move around slowly (walking) until they are tagged. If tagged by HEAT, students move faster as a gas. If tagged by COLD, students must freeze.

Gas (water vapor) – Students move around quickly (running) until they are tagged. When tagged by COLD, students move slowly as a liquid.

Each time a student is tagged, they change state and either move faster or slower (depending on who tags them – COLD or HEAT).

Students should be changing states throughout the game, never to stay in one state for too long. There is no winner, but you may allow for "rounds" to let other students play the HOT/COLD players.

Storm Drain Study

Name(s): _____

Today you will be investigating the storm drains around you!

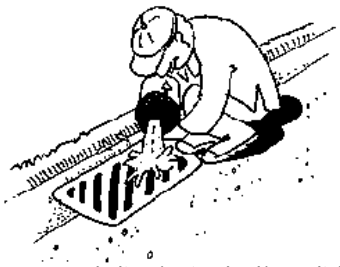


Image from: http://commons.bcit.ca/watershed/newsltr/newsimg/dyknow.gif

Directions:
1. With your group, choose a storm drain around your school environment.
2. Describe where you found your storm drain.
3. Pour water into the storm drain to observe how water moves in it.
4. Use your eyes and ears to make observations about that storm drain and what is happening around it.
5. Draw your storm drain, including an arrow (←or →) to show how the water flows.

My Storm Drain! (Answers will vary)

Location: In the schoolyard_____

_____

What I see: Grass, wrappers, rocks _____

_____

What I hear: echoes of water running _____

_____

My storm drain looks like this:

Lesson 7 Demonstration

(Adapted from Project WET's "A Drop in the Bucket")

Suggestion: Depending on the group, facilitate the demonstration by having the students pour the water/materials.

1. Show the class a liter (1000 mL in a beaker) of water and say*: "This water represents all the water on earth."* Have a globe or map handy to review that the majority of Earth's surface is covered with water (about 75%). (Image from: www.sciencestuff.com)

A 1000 mL beaker

2. Ask the students: *"Where is most of the water on Earth located?"* (Refer to the globe or map.) Allow for student answers.

Pour 30 mL of the water into a 100 mL graduated cylinder. Say: "*This represents Earth's fresh water, about 3 % of the total.*

Pour salt into the beaker containing the remaining 970 mL and say: *"This water in the beaker represents water found in oceans. This water is unusable for humans to drink because it is so salty."* (Image from: www.krackeler.com)

A graduated cylinder

3. Ask students: *"What is at the Earth's poles?"* Allow for student answers, then explain that almost 80% of Earth's fresh water is frozen in ice caps and glaciers (water in the graduated cylinder). Pour 6mL of fresh water from the graduated cylinder into a smaller beaker. Put the graduated cylinder containing the remaining 24 mL of water in the freezer. The 6mL of water in the small container represents non-frozen fresh water. However, only about 1.5 mL of this water is surface water; the rest is underground. Pour out 1.5 mL of the water onto the ground (if outside) or into a sponge (if inside) and say: *"Some of this freshwater is underground."*

4. Use an eyedropper to remove a single drop of water (0.003 mL). Release this one drop into a small container (metal thimble). Add pollutants (i.e. syrup, pepper flakes, etc.) to the remaining water in the small beaker and explain that pollutants in the water such as motor oil and litter make the water unusable. *Explain that the water in the thimble represents clean, fresh water that is not polluted and that is usable by humans.* (Image from: www.hearlihy.com)

An eyedropper 

Once the demonstration has concluded, host a discussion with the group. Ask the students: *"Do we have a lot of water available to use?" "What could happen if this water became polluted and we couldn't use it anymore?"* Allow for students to answer and discuss. Explain the fact that we only have a small amount of water to use, and that we must keep it clean.

~ End Demonstration ~

Insert:

A Closer Look at Water – Slides
3 States of Water Flow Chart
Water Cycle Diagram - Slides