Subject/Target Grade
Science and Social Studies/
Middle School (6-8)

Duration
One or two 50-minute periods –
Classroom & outdoor setting

Materials
per class
- 3 100-ml graduated cylinders
- container of water (10-ml/student)
- *Water Cycle* with no labels (transparency master)
- *Water Cycle* with arrows and locations correctly labeled (transparency master)
- cup of salt water (optional, for one student to taste)
- map of the United States
- 1 green and 1 blue paper plate (optional)
- 1-2 inflatable globes
- blue food coloring
- 1 clear plastic 2-L (2000 ml) bottle filled with (blue) water
- 5 clear plastic 9 oz. or 12 oz. cups
- permanent marker
- 1 water dropper
- paper towels
- scissors
- *Where Is Water on Earth?* (transparency master/answer key)
- *How Much of Earth's Water Is Available for Human Use?* (transparency master)
- *Great Lakes Physical Features and Population* (transparency master)

per small group
- 1 clear plastic 2-L (2000ml) bottle
- 100-ml graduated cylinder
- 5 clear plastic 9 oz. or 12 oz. cups
- 1 water dropper
- calculator
- 1 green and 1 blue paper plate (optional)
- scissors (optional)
- *Water Cycle* with no arrows or labels (student activity)
- *Where Is Water on Earth?* (student activity)
- map of the United States or Great Lakes watershed map
- sidewalk chalk
- *Water Cycle Scavenger Hunt* (outdoor activity)

Where Is All the Water in the World?

Lesson Overview

This lesson focuses on the availability of freshwater on Earth. Students review the basic terms and processes associated with the water cycle, play a game to determine the percentage of the Earth's surface covered by water, work together in groups to estimate the distribution of water in the various locations on Earth where it is found, and discover how much fresh water is available on Earth for human use.

Focus Questions

Students answer these essential questions: Where is water found on Earth? How does water move on Earth? Is there enough water on Earth for everyone? Why are the Great Lakes unique?

Objectives

Students will be able to:

1. Define basic terms and processes associated with the hydrologic cycle.
2. Describe the distribution and availability of freshwater and saltwater on Earth.
3. Discuss the importance and responsibility of living next to the Great Lakes.

Michigan Grade Level Content Expectations

Grades 6-7 Science:

- Demonstrate scientific concepts through illustrations, performances, models, exhibits, and activities. **S.RS.M15**
- Describe the effect humans and other organisms have on the balance of the natural world. **S.RS.M17**
- Demonstrate, using a model or drawing, the relationship between warming by the sun and of the Earth and the water cycle as it applies to the atmosphere. **E.ES.07.11**
- Explain the water cycle and describe how evaporation, transpiration, condensation, cloud formation, precipitation, infiltration, surface runoff, ground water, and absorption occur within the cycle. **E.ES.07.81**
- Analyze the flow of water between components of a watershed, including surface features and groundwater. **E.ES.07.82**

Grades 6-7 Math:

- Calculate part of a number given the percentage and the number. **N.FL.06.12**
- Solve word problems involving percentages. **N.FL.06.13**
- Express probabilities as fractions, decimals, or percentages between 0 and 1; know that "0" probability means that an event will not occur, and probability "1" means an event will occur. **D.PR.06.01**
- Compute probabilities of events from simple experiments with equally likely outcomes, e.g. tossing dice, flipping coins, etc. by listing all possibilities and finding the fraction that meets given conditions. **D.PR.06.02**

Grade 6-7 Social Studies:

- Use historical perspective to analyze global issues faced by humans long ago and today. **6 - H1.4.3**
- Describe the environmental effects of human action on the atmosphere, biosphere, lithosphere and hydrosphere. **6 - G5.1.1**
- Explain that communities are affected positively or negatively by changes in technology. **7 - G2.2.2**
- Identify and explain factors (e.g. natural resources) that contribute to conflict and cooperation between and among cultural groups **7 - G4.4.1**
- Describe the effects that a change in the physical environment could have on human activities and the choices people would have to make in adjusting to the change. **7 - G5.2.1**

HS Earth Science:

- Describe that the water cycle includes evaporation, transpiration, condensation, precipitation, infiltration, surface runoff, groundwater, and absorption. **E4.p1A**
- Compare and contrast surface water systems and groundwater in regard to their relative sizes as Earth's freshwater reservoirs and the dynamics of water movement (inputs, outputs, residence times, sustainability). **E4.1A**
- Scientific Reflection and Social Implications (See HSCEs listed for Earth Science). **BI.2**

Advance Preparation

1. Cut one green and one blue paper plate from edge to center, and fit together, to show students how to assemble these pie graphs (optional).

2. Label one 2-L bottle '*Oceans'* on two opposite sides, and label the five cups: *Icecaps & Glaciers, Lakes, Rivers, Atmosphere, Groundwater.* Repeat for each set of cups and 2-L bottles, or have students label them. Save the labeled cups for future repetitions of the activity. Fill the 2-L bottle with blue water for the teacher demonstration. Fill one 2-L bottle with water per student group.

3. Inflate 1-2 globes, depending upon the size of the class.

4. Prepare a cup of salt water for one student to taste.

5. Set out three 100-ml graduated cylinders. Place a label next to each one: *ocean*, *lake*, and *snow/ice*. Fill a container with enough water for 10 ml per student. Post the question: *Where would you most like to take a family vacation?*

Background Information

Water is the most common substance on the planet and covers 70% of the Earth's surface. Most of the Earth's water (97.25%) is **salt water** found in the oceans, while 2.75% is **freshwater** found in the icecaps, glaciers, groundwater, lakes, rivers, and atmosphere. Water is also present in plants, animals, and soil. Less than 1% of the Earth's water is considered to be available **freshwater**. While saltwater in the ocean is useful for shipping, recreation, and food, and supports a wide variety of plants and animals, freshwater is far more usable by humans.

Some of the Earth's water is located underground as **groundwater** (i.e., water that fills all of the spaces between earth particles), as water vapor in the **atmosphere**; or is frozen in the icecaps and glaciers. However, most of the Earth's water is **surface water** because it is found on the surface of the Earth in oceans, lakes, and rivers.

The total amount of water on Earth is estimated to be 370,000 quadrillion (370,000 + 18 zeros) gallons or 1.4 billion cubic kilometers. Of this total, approximately 0.01% is found in lakes. **The Great Lakes are the largest body of fresh surface water on Earth!** They contain about 84 percent of North America's surface fresh water and about 21 percent of the world's supply. Only the polar ice caps contain more fresh water. (For additional information, see *Great Lakes Physical Features and Population* transparency master.) Michigan has the longest freshwater coastline of any political subdivision in the world, being bounded by four of the five Great Lakes, plus Lake Saint Clair Michigan has 64,980 inland lakes and ponds. A person in Michigan is never more than six miles (10 km) from a natural water source or more than 85 miles (137 km) from a Great Lakes shoreline.

The **hydrologic cycle**, or **water cycle**, is the continuous movement of water above, below, and on the surface of the Earth.

> **Note:** Students should know that the water cycle and the hydrologic cycle are interchangeable terms for the same process.

The hydrologic cycle moves water from one location on Earth to another. Along the way, water may change state from liquid to gas (water vapor) or solid (snow and ice). For example, water evaporates from the ocean into the atmosphere and forms clouds, which may be blown to the Great Lakes, where they will condense into rain or snow and precipitate onto Michigan's land. Next, the rain and melted snow will run off into wetlands or inland lakes, which then empty into rivers that flow to the Great Lakes. The water in the Great Lakes may again evaporate into clouds, continuing the water cycle. As water moves through the water cycle, it passes through all terrestrial and aquatic ecosystems; passing through all plants, animals, and humans; and is used in some way in all economic activities. The transfer processes for water as it moves from one part of the water cycle to another include: **condensation, precipitation, infiltration, runoff, evaporation, sublimation,** and **transpiration.**

Water comprises about 70% of a person's body mass. There is no more important nutrient than water—clean water is essential for human health! Water makes up a part of every living plant and animal. The health of the American people and the economic growth of Michigan and the nation depend on the availability of clean freshwater. Water is fundamental to life and is a basic requirement for all of our agricultural, industrial, and recreational activities, as well as for the health of the natural environment.

Procedure

1. **Hook Your Students:** ***Where would you most like to take a family vacation?***

   As students enter the room, tell them to answer the question, "*Where would you most like to take a family vacation?*" by placing 10 ml of water into a 100ml graduated cylinder representing their destination choice for a vacation: ocean, lake, or snow/ice. Discuss students' responses after doing the activity *Where Is Water On Earth?* Compare where students would like to go on vacation to the percentage of water found in that location on the Earth.
2. **Review the water cycle—how water moves and is stored on Earth.**

   List the locations where water is found on Earth. [Water is stored on Earth in the oceans, icecaps and glaciers, groundwater, lakes, rivers, atmosphere, plants, animals, and soil.]

   In what phases (forms) is water stored on Earth? Give some examples. [Water is found in the liquid, solid, and vapor (gas) phases. Examples are: water vapor in the atmosphere, ice and snow (solid) in the polar ice caps and continental glaciers, liquid water in lakes and rivers, liquid water in the oceans, liquid water in groundwater aquifers, and liquid water in plants, animals, and soil.]

   How does water move from one location on Earth to another?
   Show the overhead transparency of the *Water Cycle* that does not have any arrows or labels on it. Ask students to describe the **transfer process** as water moves from one location to another, in response to the following prompts:

   How does water get from the atmosphere to the land surface, glaciers, polar ice caps, lakes, and oceans? [By **condensation** and then **precipitation**, the process by which water vapor in the atmosphere condenses to form liquid rain or solid snow and then falls (precipitates) by gravity to the Earth.]

   How does water get from the land surface to the groundwater? [By **infiltration** through the soil into the groundwater.]

   How does water get from the land surface to rivers, streams, lakes, and oceans? [**Surface runoff** directly into rivers, streams, lakes, and oceans, or **infiltration** into the groundwater that moves and eventually seeps into rivers, streams, lakes, and oceans.]

   How does water get from groundwater to rivers, streams, lakes, and oceans? [Groundwater seeps into rivers, streams, lakes, and oceans.]

   How does water get from the land surface, animals, rivers, streams, lakes, and oceans to the atmosphere? [**Evaporation**, the process by which water goes from a liquid to water vapor.]

   How does water get from snow to clouds? [By **sublimation**, through which water goes from a solid (snow and ice) directly to water vapor.]

   How does water get from plants to the atmosphere? [By **transpiration**, the process by which water is taken up from the soil by plant roots, transported through the plant where it is used in respiration and photosynthesis, and evaporated into the air through tiny openings (stomates) in the leaves to become water vapor.]

   Distribute a copy of the *Water Cycle* diagram student activity page to each student to complete. Review the following concepts with students:
   - Water is found on Earth as a solid, liquid, and gas.
   - Water is found on the Earth as surface water and below the Earth as groundwater.

- Water can be freshwater or salt water. Salt water is primarily used for shipping, recreation, fishing, and as a habitat for marine plants and animals. Freshwater is far more usable by humans. (*Optional:* Offer one student a sip of salt water, prepared by the teacher.) *Can salt water be used by humans for drinking, household uses, livestock, crop irrigation, or industrial processes?* [No.]
- The sun (solar energy) is the source of energy for water evaporation, air movement (moves clouds), cooling, and condensation.
- Gravity drives "falling" water (rain and snow), runoff, and stream flow from high to low elevations.
- Water is neither created nor destroyed, but changes location, and possibly form (phase) and quality, as it moves through the water cycle.
- At any one time, most water is "stored," rather than "moving" in the water cycle. The oceans are the storehouses for the vast majority (97.2%) of all water on Earth. Most (90%) of the water that is evaporated as part of the water cycle comes from the oceans.

3. Trace the path of a drop of water from your school to the Atlantic Ocean.

Show the map of the United States. Ask students to identify where their school is located. *How does a drop of rain falling on the school parking lot reach the Atlantic Ocean?* [The raindrop will run off the parking lot and travel overland as runoff into a stream, river, or lake; seep down into the groundwater; or go down a storm drain and empty into a river or lake. From there, the drop would eventually reach the Great Lakes (be sure students can describe exactly how this will happen). Trace the movement of the drop of water through the Great Lakes, the St. Lawrence Seaway, to the Atlantic Ocean.] *How can that same drop of water return to Michigan?* [Through evaporation or sublimation, and then precipitation.]

Outdoor Connection

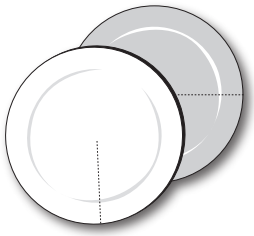
Follow a Drop of Water

Place the students in groups and have each group draw a map of the Great Lakes basin in the parking lot using sidewalk chalk. Label each of the Great Lakes, the states and provinces, and the St. Lawrence Seaway. Have the students trace the path of water on their map using arrows starting at the school parking lot and ending in the Atlantic Ocean. Provide the U.S. map or Great Lakes Watershed map to check their work.

Water Cycle Scavenger Hunt

Take students outside to look for evidence of the water cycle, such as: evaporation, runoff, infiltration, transpiration, etc. Give each pair of students a list of items to look for (see student page). Ask students to share what they found.

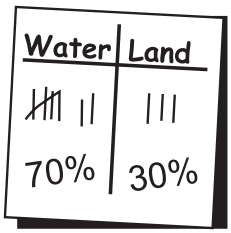
4. What percentage of Earth is covered with water?



Paper plate activity - Part 1 (Optional): Distribute one blue and one green paper plate to each group or each student. Tell students to make one cut on each paper plate from the edge to the center. Fit the two plates together so that rotating them exposes more or less of the blue "pie fraction." Tell students to adjust their plates in order to show how much of the Earth is covered with water. Ask students to hold up their pie plate fraction to compare with other students' estimates.

Play a game of Globe Toss with students. Assign one student to count tosses and another student to record the number of "water" and "land" responses on the board or overhead

projector. Tell students to stand in a circle and take turns throwing the inflatable globe a total of 100 times. When a student catches the globe, he/she must call out "water" or "land" depending on which their right thumb is touching when the globe is caught. Calculate the percentage of times the students' thumbs touched land or water.



Because approximately 70% of the Earth is covered with water, thumbs usually touch water an average of 70 times out of 100 throws. When fewer than 50 throws are used, results are less reliable. Once the activity is done, have a student taste the salt water. Discuss the taste—would they want to use this water for drinking and cooking? Having 70% of the Earth's surface covered in mostly salt water is great for transportation and recreation, but not for direct human use.

5. **Where is all the Water on Earth activity: How is water distributed on Earth and how much water is available for human use?**

Paper plate activity - Part 2 (Optional):
This time, tell students the blue "pie fraction" indicates the amount of freshwater on Earth. Ask students to adjust their plates accordingly and hold up their chart to compare with other students' estimates.

Distribute one copy of the student page *Where Is Water on Earth?* to student groups, along with five clear plastic 9-oz. cups, a 100-ml graduated cylinder, and a 2-L bottle filled with water representing all of the water on Earth. Have students label the 2-L bottle *oceans* and label the five cups: *lakes, icecaps and glaciers, rivers, groundwater,* and *atmosphere* using a permanent marker.

In the first column of the table, ask students to rank how much water they think is found in each of the six locations, from 1 (most) to 6 (least). In the left side of the second column, labeled "Prediction," ask the students to list the percentage of the Earth's water they estimate is found in each location. Multiple that percentage by 2000 to determine how many milliliters that equals.

Next, tell students to distribute the water in their 2-L bottle among the five labeled cups, keeping the "ocean" water in the 2-L bottle, according to their predictions in their table.

The teacher may ask student groups to report on their predicted distributions of water on Earth, or have each group record their predictions on the board or on an overhead transparency. Discuss the similarities and differences between the groups' predictions.

Next, the teacher will demonstrate the *actual* distribution of water on Earth using the answer key *Where Is Water On Earth?* Be sure to make the room very quiet when you drop the water into the last three cups using the eyedropper. Draw attention to the fact that of the five drops allocated to the lakes of the world, *one drop equals all of the water in the Great Lakes* (of which 50% is in Lake Superior), one-half drop equals atmosphere, and 1/20 drop equals rivers.

Display the overhead transparency of the student activity page *Where Is Water on Earth?* with the correct percentages and quantities. Have the class compare the actual percentages with their predictions. While the correct quantities are displayed, ask students to answer the questions at the bottom of the student activity page. Discuss their responses.

Teacher Tip: If there is not enough time to set up the full activity for students to do in small groups, the teacher can demonstrate the activity for the whole class. Have two sets of cups prepared. Ask the students to predict the amount of water on Earth found in each location. As the student says their prediction, pour that amount into the labeled cup. Next, pour the actual amount into the second set of labeled cups and have the class compare the amounts. Discuss the results as a group.

6. Tying it all together.

Revisit the three 100-ml graduated cylinders labeled *ocean, lake, snow/ice*, showing where students would most like to take a family vacation. Compare where they would like to go to the amount of water found in that form on the Earth's surface.

Ask the class whether they would like using salt water to make drink mixes or orange juice, or for taking a shower?

While the Earth has an abundance of water, we have learned that much of the Earth's water is not available for human use because it is either not freshwater (i.e., salt water in the oceans), it is frozen (i.e., ice caps and glaciers), or it is not easily accessible (i.e., very deep groundwater and polar ice caps). To further illustrate this, display the overhead transparency *How Much of Earth's Water Is Available for Human Use?* In addition, not all of the available freshwater is drinkable…some has been polluted. While the world will never run out of water, having a supply of clean, affordable, available freshwater in adequate quantities to meet human needs is already a challenge in some parts of the world, and even in some parts of the United States. The Great Lakes are the largest body of fresh surface water in the world, with 18% of the world's supply (only the polar ice caps contain more fresh surface water) and 95% of the United States' fresh surface water!

Discuss these difficult questions that have yet to be answered:

How might water shortages in the United States or the world affect the Great Lakes? [Many people, businesses, states, and countries will want to divert some of the Great Lakes freshwater.]

Should any person, city, state, or country be able to use (unlimited amounts of) Great Lakes water? [Responses will vary.]

How might global warming affect the amount of water in the Great Lakes? [Great Lakes water levels are predicted to decrease due to warmer temperatures and greater evaporation.]

As citizens of a Great Lakes state, what is our role in protecting the Great Lakes for our use and use by future generations [Responses will vary, but could include being informed about important Great Lakes water issues and understanding consequences of our decisions; practicing water conservation/using water wisely; preventing or cleaning up water pollution; supporting funding for water research and data collection on Michigan streams, lakes, groundwater, and weather; getting involved in helping to make informed water management decisions by voting, attending public meetings, citizen monitoring, etc.]

Assessment Option

Ask students to respond to these questions in their science journals: *Is there enough freshwater on Earth to meet everyone's needs? How has your view of the world's water supply changed after today's lesson?*

Extensions

1. To teach about the water cycle in more depth, have students play the "Incredible Journey" water cycle game from *Project WET Curriculum and Activity Guide: Water Education for Teachers*. (1999). Bozeman, MT: The Watercourse. Retrieved July 8, 2011, from www.projectwetusa.org/pdfs/incrediblejourney.pdf.

2. Ask students to research Lake Baikal, which has 20% of the Earth's available fresh surface water, equal to all the water in the Great Lakes. Where is Lake Baikal located and what are some of the environmental issues facing this lake? Visit *Baikal Web World,* which has comprehensive data about Lake Baikal in Siberia. Retrieved July 11, 2011, from http://www.bww.irk.ru.

3. Encourage students to explore the *World Lake Database* hosted by the International Lake Environment Committee and the United Nations Environment Program. On the site, they can locate information about physical characteristics and water quality for more than 500 lakes in the world. Retrieved July 11, 2011, from http://www.ilec.or.jp/database/database.html.

4. Use the following demonstration to compare the relative volume of water and surface area of each of the Great Lakes. Label five 2-L clear plastic bottles with the names of the Great Lakes. If 100 cubic miles of water is equal to 100 ml of water, how much water would be poured into each bottle? Use blue food coloring to make the water easier to see and use a graduated cylinder to measure the water.

Lake Superior	290 ml
Lake Michigan	118 ml
Lake Huron	850 ml
Lake Erie	11.6 ml
Lake Ontario	393 ml
Total (all Great Lakes)	5439 ml

Compare the surface area of each Great Lake by measuring the length and width of each lake in miles on a U.S. map. Compare how long it would take to drive the perimeter of each Great Lake in a car traveling at 50 miles per hour. *Hint:* divide shoreline length (miles) by 50 mile/hour to get the total hours of travel.

Lake Superior	54.5 hours
Lake Michigan	32.7 hours
Lake Huron	76.5 hours
Lake Erie	17.4 hours
Lake Ontario	14.24 hours

Display the overhead transparency *Great Lakes Physical Features and Population* for additional comparisons of the five Great Lakes.

5. Have students explore the physical and chemical characteristics of water by doing the activity *Is There Water on Zork*? from Project WET Curriculum and Activity Guide on the MEECS Water Quality CD.

Additional Resources

The Project WET Curriculum and Activity Guide 2.0 contains 64 water education activities for K-12 students described on 590 pages. Activities are organized into seven broad categories about water including its unique physical and chemical characteristics, how it is how it integrates all earth systems, its limited availability, water resources management, and social and cultural values. Helpful cross reference and planning charts help educators to quickly find the "right" activity for an age group, setting, concept, etc. In addition, WET educators may access a new companion Portal that contains searchable databases, discussion groups, state education correlations, and so much more. The Guide can only be obtained by attending a workshop (contact the Michigan Project essential for all life, WET coordinator for information). Project WET Foundation (2011) Bozeman, MT. www.projectwet.org

Project Learning Tree (PLT) Environmental Education Activity Guide (2010) provides many hands on, interdisciplinary activities. In the Water Wonders Activity students will describe the various components of the water cycle and the path a water molecule might take on its way through the cycle. www.plt.org.

The Great Lakes: An Environmental Atlas and Resource Book (1995) is packed full of information about the Great Lakes basin. Topics include natural and human history, ecology, physical characteristics of each Great Lake, and today's challenges supported by fact sheets, photographs, and many colorful maps. The book is available in print (Ottawa: Canadian Government Publishing), on CD, or online. Retrieved July 8, 2011, from http://www.epa.gov/glnpo/atlas/intro.html.

Great Lakes Information Network (GLIN) displays a wide variety of photographs of the Great Lakes Region, including photos taken from space by the National Aeronautics and Space Administration. Retrieved July 8, 2011, from http://www.great-lakes.net/infocenter/images/photogallery.html.

National Geographic Society Kids Network is a website with lessons, resources, children's books, and more to help teachers integrate teaching about many aspects of water into their curriculum. Retrieved July 8, 2011, from http://www.nationalgeographic.com/kidsnetwork/water/.

Water and Energy Cycle Focus Area is the part of the National Aeronautics and Space Administration (NASA) that studies the distribution, transport, and transformation of water and energy within the Earth system. NASA's long-term goal is to improve predictions of consequences of global change. Retrieved July 8, 2011, from http://science.hq.nasa.gov/earth-sun/science/water.html.

Water Science for Schools website describes the distribution and movement of water on, in, and above the Earth. This U.S. Geological Survey website has a wealth of information about water resources in the United States. Retrieved July 8, 2011, from http://ga.water.usgs.gov/edu/watercyclesummary.html.

Literature Connections

Cloud Dance takes readers on a journey through the world of clouds—from storm clouds to moonlit clouds to a blanket of gray clouds is explained in lyrical text and illustrated by glorious oil paintings that reveal the wonder and beauty of the sky in different seasons and under various meteorological conditions. Locker, Thomas. (2000). New York: Harcourt, Inc.

Come On, Rain captures the magnificence of a sudden rainstorm on a sweltering hot day. This book also portrays the tenderness of mother-daughter relations, the rhythms of urban society, and the power of nature to transform and reinvigorate all life forms. Hesse, Karen. (1999). New York: Scholastic Inc.

The Day the Great Lakes Drained Away explains what would happen if the Great Lakes drained away. This unique children's book shows the interesting landscape that would be revealed if all the water in the Great Lakes was to suddenly disappear. This book educates children and adults about the geologic features under the Great Lakes, and reminds us never to take the Great Lakes for granted. Barker, Charles Ferguson. (2005). Mackinac Island Press.

A Drop Around the World creatively combines language arts and science as it follows a drop of water through the water cycle, pairing an action and sound effect with each water property. McKinney, Barbara Shaw. (1998). Nevada City, CA: Dawn Publications.

Drop in My Drink: The Story of Water on Our Planet tells the history of water on Earth told with reference to its importance to the formation and continuation of life. Hooper, Meredith (1998). Viking Press.

A Drop of Water explains evaporation, condensation, capillary attraction, and surface tension through simple text and photos that reveal water in its many awesome transformations. Walter, Wick. (1997). New York: Scholastic Press.

The Magic School Bus Wet All Over: A Book about the Water Cycle allows readers to experience the Earth's water cycle firsthand as Ms. Frizzle's class rises into the air, forms a rain cloud, and drizzles down to Earth. Relf, Pat. (1996). New York: Scholastic Paperback.

One Well looks at all the water on Earth as a single global well upon which all life depends. Children learn of the growing demands on a finite supply. Strauss, Rochelle. (2007). New York: Kids Can Press.

The Snowflake: A Water Cycle Story tells the story of a single water droplet. The story begins with a snowflake falling to the jagged peak of a mountain to a rocky pond bottom. The water cycle becomes a perfectly logical and understandable, yet fascinating and beautiful part of the physical world. Waldman, Neil. (2003). Millbrook Press.

There Goes the Water: A Song about the Water Cycle will provide a kid-friendly approach to science comprehension. Original lyrics to familiar tunes combine with lively illustrations to reinforce fundamental science facts. Salas, Laurie (2010). New York: Picture Window Books.

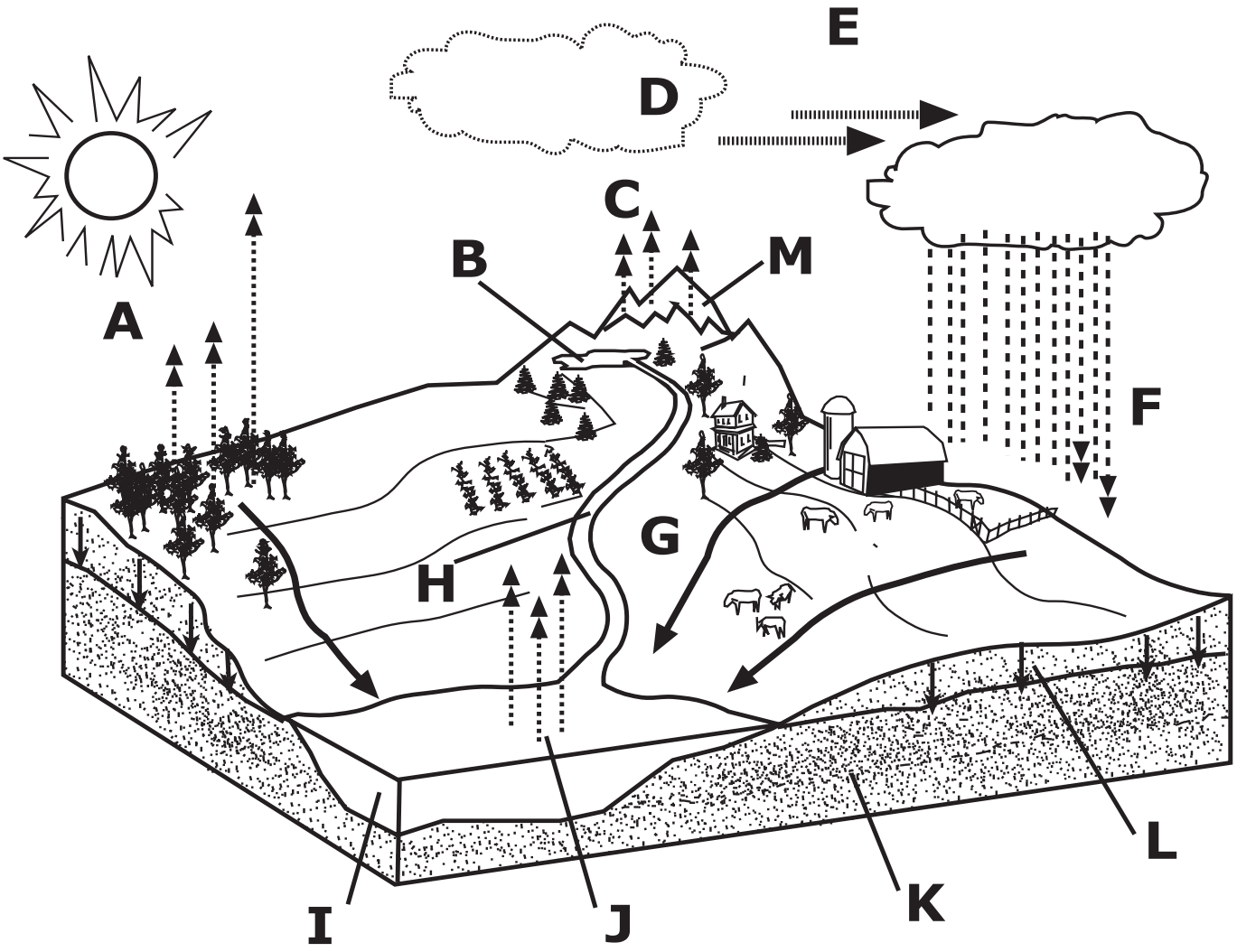
Water Dance allows readers to travel with water as it dances through the water cycle from rain, to river, to lake, to sea, to cloud. Each step is dramatized with one of Locker's paintings depicting changes in season, atmosphere, time of day, or weather. The haiku-like text sparks reader interaction. The book includes a scientist's brief explanation of the water cycle stages. Locker, Thomas. (2002). New York: Harcourt Brace & Company.

Where the River Begins is the story of two boys and their grandfather who go on a camping trip to find the source of the river that flows by their home. Locker's painting magnificently portray the changing landscape at different times of the day and in different kinds of weather. Locker, Thomas. (1993). London, England: Pied Piper.

Name_____

The Water Cycle

Directions: Identify the locations where water is found on Earth and the transfer process for how water moves in the water cycle.



A. _____

B. _____

C. _____

D. _____

E. _____

F. _____

G. _____

H. _____

I. *Ocean*

J. _____

K. _____

L. _____

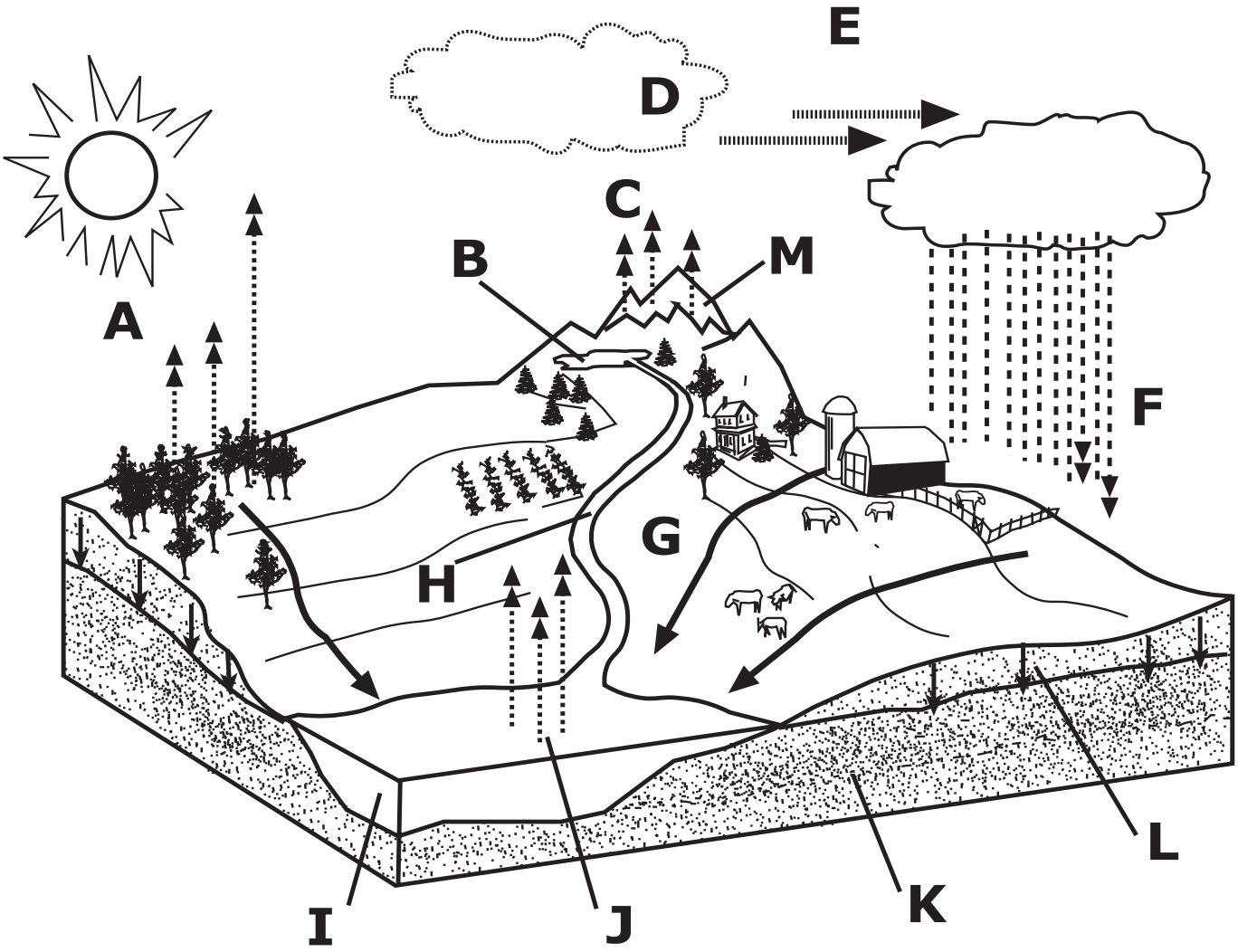
M. _____

Answer Key

TRANSPARENCY MASTER

The Water Cycle

Directions: Identify the locations where water is found on Earth and the transfer process for how water moves in the water cycle.



A. *Transpiration*

B. *Lake*

C. *Sublimation*

D. *Atmosphere/Clouds*

E. *Condensation*

F. *Precipitation*

G. *Runoff*

H. *River/Stream*

I. *Ocean*

J. *Evaporation*

K. *Groundwater*

L. *Infiltration*

M. *Icecaps/Glaciers*

Name_____

Where Is Water on Earth?

For this activity, let's assume that all of the water in the world is contained in this 2-L (2000 ml) bottle of water. Your job is to distribute the water amongst the various locations on Earth where water is found. All water that remains in the bottle will be "Ocean" water.

Directions:

1. Rank how much water you think is found in each of the places on Earth listed in the table below, from 1 (the most water) to 6 (the least amount of water).
2. Under "Prediction," list the percentage (%) of Earth's water YOU THINK is found in each place.
3. Use a permanent marker to label the five cups: lakes, icecaps & glaciers, rivers, groundwater, and atmosphere. Label the 2-L bottle oceans.
4. Based on your predicted percentages, use your calculator to calculate the amount of water in milliliters that you should pour into each cup (total water = 2000 ml = 2 L).
5. Pour the water into the labeled cups according to your predictions using the 100-ml graduated cylinder (or metric measuring cup). The water remaining in the 2-L bottle is ocean water.
6. Record the "Actual" amounts provided by your teacher.
7. Answer the questions below.

Table 1. Water Distribution on Earth: Student Predictions and Results.

Source	Rank #1 (most) to #6 (least)	Prediction		Actual	
		% of Total Water on Earth	Milliliters (ml)	% of Total Water on Earth	Amount (ml)
Groundwater					
Oceans					
All of the Earth's Freshwater Lakes					
Rivers					
Icecaps & Glaciers					
Atmosphere					

1. What percentage of the Earth's water is freshwater? _____ Salt water? _____

2. What percentage of the Earth's water is available for human use? _____

3. Where is freshwater found on Earth? _____, _____, _____, _____, _____

4. What percent of the Earth's freshwater is in all of the lakes of the world? _____

5. What percent of the water found in all the Earth's freshwater lakes is in the Great Lakes? _____

   In Lake Superior? _____

6. How do your predictions compare to actual amounts?_____

   _____

Where Is Water on Earth?

Source	% Total Water on Earth	Amount (2-liters = 2000 ml)	% Total Freshwater on Earth
Oceans	97.25 %	1945 ml	----
Icecaps & Glaciers	2.14 %	42.8 ml	68.7 %
Groundwater	0.61 %	12.2 ml	30.1 %
All of the Earth's Freshwater Lakes	0.01 %	.2 ml (5 drops total; 1 drop = Great Lakes and ½ drop = L. Superior)	0.26 %
Atmosphere	0.001 %	.02 ml (1/2 drop)	0.04 %
Rivers	0.0001 %	.002 ml (1/20 drop)	0.006 %

Source: U.S. Geological Survey, (2005). *Earth's Water Distribution*. Washington, DC: USGS. Retrieved January 18, 2006 from http://ga.water.usgs.gov/edu/waterdistribution.html.

[Note: 0.005% (0.1 ml or drop) is found in soil moisture; and 0.00001% is found in plants and animals.]

1. What percentage of the Earth's water is freshwater? ***Less than 3%*** Salt water? ***More than 97%***

2. What percentage of the Earth's water is available for human use? ***Less than 1% is not frozen freshwater that is accessible (not too deep in the ground).***

3. Where is freshwater found on Earth? ***Icecaps & glaciers***, ***lakes***, ***rivers***, ***atmosphere***, ***groundwater***

4. What percentage of the Earth's freshwater is in all of the lakes of the world? ***0.26%***

5. What percentage of the water found in all the Earth's freshwater lakes is in the Great Lakes? ***20%*** *In Lake Superior?* ***10%***

6. How do your predictions compare to actual amounts? ***Responses will vary.***

Name_____

Where Is Water on Earth?

For this activity, let's assume that all of the water in the world is contained in this 2-L (2000 ml) bottle of water. Your job is to distribute the water amongst the various locations on Earth where water is found. All water that remains in the bottle will be "Ocean" water.

Directions:

1. Rank how much water you think is found in each of the places on Earth listed in the table below, with #1 (most) and #6 (least).
2. Under "Prediction," list the percentage (%) of Earth's water that YOU THINK is found in each place.
3. Label the five cups: lakes, icecaps & glaciers, rivers, groundwater, and atmosphere with a permanent marker, and label the empty 2-L bottle: oceans.
4. Based on your predictions in #2, pour the water into the labeled cups according to your predictions using a measuring cup. The water remaining in the 2-L bottle is ocean water.
5. Record the "Actual" amounts provided by your teacher.
6. Answer the questions below.

Table 1. Water Distribution on Earth: Student Predictions and Results.

Source	Rank #1 (most) to #6 (least)	Prediction	Actual
		% of Total Water on Earth	% of Total Water on Earth
Groundwater			
Oceans			
All of the Earth's Freshwater Lakes			
Rivers			
Icecaps & Glaciers			
Atmosphere			

1. What percentage of the Earth's water is freshwater? _____ Salt water? _____

2. What percentage of the Earth's water is available for human use? _____

3. Where is freshwater found on Earth? _____, _____, _____, _____, _____

4. What percent of the Earth's freshwater is in all of the lakes of the world? _____

5. What percent of the water found in all the Earth's freshwater lakes is in the Great Lakes? _____

   In Lake Superior? _____

6. How do your predictions compare to actual amounts?_____

   _____

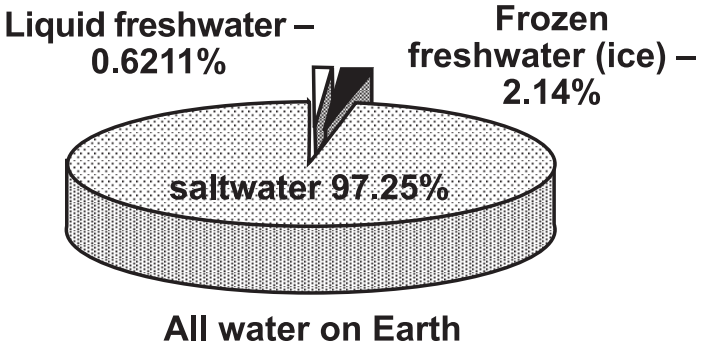
TRANSPARENCY MASTER

Q: How Much of Earth's Water Is "Available" for Human Use?

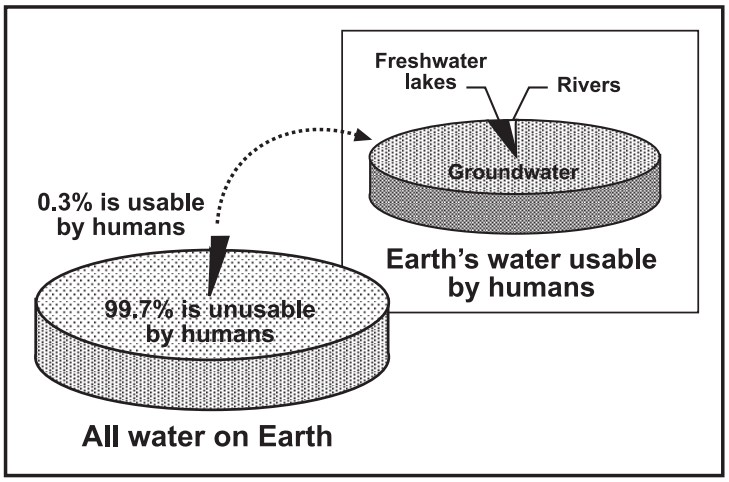
To be considered "available," water must be:

1) ***Freshwater*, not salt water.** Freshwater is only 2.75 % of the total water on Earth.

2) ***Liquid water*—not frozen in glaciers and ice caps.** Most freshwater is frozen. Only 0.62% of the Earth's water is not frozen.



3) ***Accessible water*, not too deep underground or frozen in the ice caps far away.** Much of our groundwater supplies are very deep and difficult-to-reach. In addition to being frozen, ice caps are far away. Thus, only 0.3% of Earth's water is considered usable by humans.



A: Less than 1% of the water on Earth is not frozen freshwater that is accessible (not too deep in the ground or far-away) and therefore is "Available" water for human use.

Sources:
U.S. Geological Survey. *Water Science for Schools* Department of the Interior. Washington DC. Retrieved November 6, 2011, from http://ga.water.usgs.gov/edu/earthwherewater.html and http://ga.water.usgs.gov/edu/earthhowmuch.html

National Geographic http://www.nationalgeographic.com/kidsnetwork/water/session_01.html

Great Lakes Physical Features and Population

		Superior	Michigan	Huron	Erie	Ontario	Totals
Elevation[a]	(feet)	600	577	577	569	243	
	(meters)	183	176	176	173	74	
Length	(miles	350	307	206	241	193	
	(kilometers)	563	494	332	388	311	
Breadth	(miles	160	118	183	57	53	
	(kilometers)	257	190	245	92	85	
Average Depth[a]	(feet)	483	279	195	62	283	
	(meters)	147	85	59	19	86	
Maximum Depth[a]	(feet)	1332	925	570	210	802	
	(meters)	406	282	229	64	244	
Volume[a]	(cu. miles)	2,900	1,180	850	116	393	5,439
	(km^3)	12,100	4,920	3,540	484	1,640	22,684
Water Surface Area	(sq. miles)	31,700	22,300	23,000	9,910	7,340	94,250
	(km^2)	82,100	57,800	59,600	25,700	18,960	244,160
Land Drainage Area[b] **(watershed)**	(sq. miles)	49,300	45,600	51,700	30,140	24,720	201,460
	(km^2)	127,700	118,000	134,100	78,000	64,030	521,830
Total Area (land+water)	(sq. miles)	81,000	67,900	74,700	40,050	32,060	295,710
	(km^2)	209,800	175,800	193,700	103,700	82,990	765,990
Shoreline Length[c]	(miles)	2,726	1,638	3,827	871	712	10,210[d]
	(kilometers)	4,385	2,633	6,157	1,402	1,146	17,017[d]
Retention Time	(years)	191	99	22	2.6	6	
Population	U.S. (2000)	519,728	9,820,6200	2,651,045	8,133,932	2,907,919	24,033,244*
	Canada (1991)	181,573	0	1,191,467	1,664,639	5,446,611	10,000,000**
TOTALS		701,301	9,820,6200	3,842,512	9,798,571	8,354,530	34,033,244
Outlet		St. Mary's River	Straits of Mackinac	St. Clair River	Niagara R./ Welland Canal	St. Lawrence River	

Source: Environment Canada Staff. (1995). *The Great Lakes: An Environmental Atlas and Resource Book (2nd ed)*. Ottawa: Canadian Government Publishing. Retrieved July 11, 2011 from: http://www.epa.gov/glnpo/atlas/

*U.S. totals are based on 2000 census data.
**Canada's total is from the *Life of the Lakes: Great Lakes Basin* poster published in 2003

[a] Measured at Low Water Datum.
[b] Land Drainage Area for Lake Huron includes St. Marys River. Lake Erie includes the St. Clair-Detroit system. Lake Ontario includes the Niagara River.
[c] Including islands.
[d] These totals are greater than the sum of the shoreline length for the lakes because they include the connecting channels (excluding the St. Lawrence River).

Name_____

Water Cycle Scavenger Hunt

Look for evidence of the water cycle.

Can you find:

- ☐ Condensation _____
- ☐ Something water has changed _____
- ☐ The part of the plant that loses water _____
- ☐ Water in the soil _____
- ☐ A place water is stored _____
- ☐ Water in a very high place _____
- ☐ Frozen water _____
- ☐ Water you can drink _____
- ☐ Moving water _____
- ☐ Water made of droplets _____
- ☐ Water you can hear _____

Share your most interesting example._____

_____

_____

_____

Name_____

Answer Key

Water Cycle Scavenger Hunt

Look for evidence of the water cycle.

Can you find:

- ☐ Condensation *dew on a plant*
- ☐ Something water has changed *ruts in a road, erosion*
- ☐ The part of the plant that loses water *leaves (stomates)*
- ☐ Water in the soil *squeeze a handful of soil to see if water holds it together*
- ☐ A place water is stored *any living plant or animal*
- ☐ Water in a very high place *cloud*
- ☐ Frozen water *snow, sleet, ice*
- ☐ Water you can drink *groundwater or lake water from a faucet; spring or artesian well*
- ☐ Moving water *river or stream; raining, snowing*
- ☐ Water made of droplets *pond, river, lake,*
- ☐ Water you can hear *rainfall, waterfall, babbling brook*

Share your most interesting example. *Answers will vary.*

_____

_____

_____