Where is all the freshwater on Earth?

Lesson Overview: Students will learn where sources of both salt and freshwater are located on Earth. Students will use an inquiry activity to learn how freshwater is distributed on Earth and how this supply is very limited. They will also learn how these freshwater reservoirs are related by the use of the global water cycle (discussed in previous lesson).

Lesson Core

The Guiding Question: How much drinking water is available on Earth?

Safety precautions: None.

Advanced Preparation: Prepare all worksheet packages for each student. Prepare materials as listed in ‘Materials and Equipment Needed’.

Background Information for Teachers: None required aside from Pre-teaching below.

Important Terms:  
- salt water  
- freshwater  
- groundwater  
- atmosphere  
- surface water

Engage: How much drinking water is available on Earth?

Building on prior knowledge:  
- Which is there more of on Earth: salt water or fresh water?  
- Where can we find the most drinking water?
• Is there enough water on Earth for everyone?
• How do these sources of water contribute to the global water cycle?

Pre-teaching: (Taken in Part from MEEC Water Quality Lesson 1)

Previously we learned about the global water cycle on Earth. Today we are going to take a look at where freshwater is located on Earth.

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.

Why is freshwater a valuable resource? What organisms use it?
• Every living thing uses water.
• Humans (60% body mass)
  • 2/3 in Cells (intracellular)
  • 1/3 in Blood plasma (extracellular)
  • Essential for good health
• Animals
• Plants
• Important for agriculture, industry, and recreation

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.]

How much of this water is usable to humans? < 1%

The Great Lakes are the largest body of fresh surface water in the world with 18% of the world’s available surface freshwater and 95% of the fresh surface water in the U.S.

Hand out the ‘Where is Water on Earth?’ worksheet to each student.

Explore:
Water Distribution Activity:
1. Distribute supplies to groups of two or three.
   a. 1000 mL blue tinted water in ocean bottle
   b. 5 labeled plastic cups
   c. Marker
   d. Graduated cylinder
e. Dropper
2. Rank how much water they think is in each of the six locations.
3. Under ‘Prediction’, list the percentage of the Earth’s water is found in each location. Compile on board.
a. Multiply the percentage by 1000 mL to determine the amount of water in each location.

b. Put the amount of water in each of the six cups.

4. Teacher fills in the table to include the actual amounts. Teacher demonstrates the actual amounts of water in each cup using graduated cylinders and droppers.
   a. Great Lakes: 1 drop = 0.2 mL = .002% all water and .20% total freshwater
   b. Lake Superior: 0.5 drop = .02 mL = .001% all water and .10% of total freshwater

5. Discuss the differences between your predictions and actual values.

**Explain:** Discuss the differences between your predictions and actual values. Share your results with the class.

**Elaboration:** Hand out copies of the ‘Where is Water on Earth Pie Chart Instructions’ and ‘Where is Water on Earth Pie Chart Grading Rubric’ to each student. Explain that the students will be using MS Excel to create two pie charts. Review the pie chart instructions with the students. Be sure to explain the example of the pie chart at the end of the instruction sheet.

Review the pie chart grading rubric with the students. Have them complete a pie chart according to your instructions by the end of the period.

**Evaluate:** Students will each hand in their completed worksheets and pie charts. The pie charts will be graded based on the attached rubric.

**Lesson Closure:**
- Is there a lot of freshwater available on Earth?
- How might water shortages in the United States or the world affect the Great Lakes?
- Should any person, city, state, or country be able to use (unlimited amounts of) Great Lakes water?
- How do you feel about the western states diverting water from Lake Superior?
- Should people live in deserts with lush green lawns?
- As citizens of a Great Lakes state, what is our role in protecting the Great Lakes for our use and use by future generations?

**Lesson Extension**

**Assessment Options:** Hand out the ‘Scientific Word Search’ for extra credit points.

**Additional Resources:**
- Michigan Environmental Education Curriculum (MEEC) Water Quality Unit Lesson 1 (http://techalive.mtu.edu/meec_index.htm)
- Play the “Incredible Journey” water cycle game from Project WET Curriculum and Activity Guide: Water Education for Teachers. (www.projectwetusa.org/pdfs/incrediblejourney.pdf)
- Water Science for Schools web site describes the distribution and movement of water on, in, and above the Earth. This U.S. Geological Survey web site has a wealth of information
Where is Water on Earth?

Directions:
- 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 water).
- Under ‘Prediction’, list the percentage (%) of the Earth’s water you think is found in each place.
- Record the ‘Actual’ amounts provided by your teacher.
- Answer the questions below.

<table>
<thead>
<tr>
<th>Source</th>
<th>Rank #1 (most) to #6 (least)</th>
<th>Prediction</th>
<th>Actual</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>% Total Water on Earth</td>
<td>% Total Freshwater on Earth</td>
</tr>
<tr>
<td>Groundwater</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Oceans</td>
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<td></td>
<td></td>
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<tr>
<td>All Freshwater Lakes</td>
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<td>Rivers</td>
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<td>Icecaps &amp; Glaciers</td>
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<tr>
<td>Atmosphere</td>
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</table>

Name: ___________________________
Where is Water on Earth?: How to Make a Pie Chart in MS Excel

1. Enter the data that you want your pie graphs to represent into a spreadsheet in Microsoft Excel. We will make 2 pie charts:
   ♦ one for the % total water on Earth.
   ♦ one for the % total freshwater on Earth.

   **Be sure to distinguish between each data set when entering data onto your spreadsheet.**

2. Make sure to include column and row headings that explain what the data represents. We will use the following column headings for our data:

   ♦ **Column Headings:**
     - Source
     - % Total Water on Earth
     - % Total Freshwater on Earth

   ♦ **Row Headings:**
     - Groundwater
     - Oceans
     - Freshwater Lakes
     - Rivers
     - Icecaps & Glaciers
     - Atmosphere

3. Once the data is entered, highlight the data you would like to include in the pie chart. Then, from the ‘Insert’ menu, click on the word ‘Chart’.

4. In step 1 of the graph wizard, choose the simple pie graph, the first available option. Click ‘Next’.

5. In step 2 of the graph wizard, click the ‘Series’ tab and check that there is only one series included under your graph in the ‘Series’ box. Click ‘Next’.

6. In step 3 of the graph wizard, click the ‘Titles’ tab and check that the correct title is at the top of your graph. Click the ‘Legend’ tab and be sure that ‘Show Legend’ is selected and that the legend is aligned to the right. Under the ‘Data Labels’ tab, select ‘Category Name’, ‘Value’ and ‘Show Leader Lines’. Click ‘Next’.

7. In step 4 of the graph wizard, click ‘Place chart as New Sheet as Chart 1’. Click ‘Finish’.

8. Save your Excel file so that you do not lose your work.

9. To change the colors or patterns in your pie chart, right click on the slice of the pie and select ‘Format Data Point’.
Example: The pie chart below shows the ingredients used to make a sausage and mushroom pizza. The fraction of each ingredient by weight shown in the pie chart below is now given as a percent. Again, we see that half of the pizza's weight, 50%, comes from the crust. Note that the sum of the percent sizes of each slice is equal to 100%.
Where is Water on Earth?: Pie Chart Grading Rubric

<table>
<thead>
<tr>
<th></th>
<th>5</th>
<th>4</th>
<th>3</th>
<th>2</th>
<th>1</th>
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</thead>
<tbody>
<tr>
<td>Pie charts are distinguished from one another using descriptive titles.</td>
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<td>Data in pie chart is clearly labeled and unique.</td>
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<td>A legend is on the right side of the graph and explains the data points.</td>
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<td>Writing is clear and chart is colorful.</td>
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<td>All words are spelled correctly with proper punctuation and capitalization.</td>
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Total score: ________/ 25