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

Duration
One or two 50-minute periods –
Classroom 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 12 oz. cups
- permanent marker
- 1 water dropper
- paper towels
- 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 filled
  with blue water
- 100-ml graduated cylinder
- 5 clear plastic 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)

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 between the various locations on Earth where it
is found, and discover how much fresh water is available
on Earth for human use.

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.
Lesson 1

Where Is All the Water in the World?

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 in the world, with 18% of the world’s available (not frozen) surface freshwater and 95% of the United States’ fresh surface water.

Michigan Curriculum Framework Content Standards and Benchmarks

- Generate scientific questions about the world based on observation (SCI.I.1.MS.1).
- Use maps of the Earth to locate water in its various forms and describe conditions under which they exist (SCI.V.2.MS.1).
- Describe how surface water in Michigan reaches the ocean and returns (SCI.V.2.MS.2).
- Explain how water exists below the Earth’s surface and how it is replenished (SCI.V.2.MS.3).
- Explain the behavior of water in the atmosphere (SCI.V.3.MS.3).
- Locate, describe, and compare the ecosystems, resources, and human environment interactions of major regions (SS.II.2.MS.1).
- Explain how elements of the physical geography (water scarcity), culture, and history of a region may be influencing current events (conflicts over a limited essential resource) (SS.II.5.MS.3).

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.

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

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

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?
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 pass 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 an average of 60% of a man’s body mass and 55% of a woman’s body mass (due to a higher proportion of body fat). Water is abundant in most parts of the body, except in fat tissue. Two-thirds of this water is in the cells (intracellular water) and the other one-third is extracellular water, which includes blood plasma and interstitial fluids. There is no more important nutrient than water—clean water is essential for health! In addition, water makes up a portion 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 virtually all of our agricultural, industrial, and recreational activities, as well as for the sustained health of the natural environment.

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**Procedure**

1. **Anticipatory set.**

   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 100-ml graduated cylinder representing their destination choice of 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 hydrologic (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.]
Lesson 1

Where Is All the Water in the World?

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 movement 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, and to the Atlantic Ocean.] How can that same drop of water return to Michigan? [Through evaporation or sublimation, and then precipitation.]

4. Estimate the percentage of Earth covered with water with a game of Globe Toss.

*Paper plate activity (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.

*What percentage of the Earth is covered with water?* Play a game of Globe Toss with students to answer this question. 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.

5. How is water distributed on Earth and how much water is available for human use?

*Paper plate activity (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 12-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.

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


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.

<table>
<thead>
<tr>
<th>Lake</th>
<th>Volume (ml)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lake Superior</td>
<td>290 ml</td>
</tr>
<tr>
<td>Lake Michigan</td>
<td>118 ml</td>
</tr>
<tr>
<td>Lake Huron</td>
<td>85 ml</td>
</tr>
<tr>
<td>Lake Erie</td>
<td>11.6 ml</td>
</tr>
<tr>
<td>Lake Ontario</td>
<td>393 ml</td>
</tr>
<tr>
<td>Total (all Great Lakes)</td>
<td>543 ml</td>
</tr>
</tbody>
</table>

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.

<table>
<thead>
<tr>
<th>Lake</th>
<th>Time (hours)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lake Superior</td>
<td>54.5 hours</td>
</tr>
<tr>
<td>Lake Michigan</td>
<td>32.7 hours</td>
</tr>
<tr>
<td>Lake Huron</td>
<td>76.5 hours</td>
</tr>
<tr>
<td>Lake Erie</td>
<td>17.4 hours</td>
</tr>
<tr>
<td>Lake Ontario</td>
<td>14.24 hours</td>
</tr>
</tbody>
</table>

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-ROM.
Additional Resources

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.

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.


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 upon Earth. Relf, Pat. (1996). New York: Scholastic Paperback.


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 Is All the Water in the World?

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 June 30, 2005, from http://science.hq.nasa.gov/earth-sun/science/water.html.


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 paintings magnificently portray the changing landscape at different times of the day and in different kinds of weather. Locker, Thomas. (1993). London, England: Pied Piper.
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. __________________________
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
Where Is Water on Earth?

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.

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

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 water 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? ______________________

Name______________________________
Where Is Water on Earth?

<table>
<thead>
<tr>
<th>Source</th>
<th>% Total Water on Earth</th>
<th>Amount (2-liters = 2000 ml)</th>
<th>% Total Freshwater on Earth</th>
</tr>
</thead>
<tbody>
<tr>
<td>Oceans</td>
<td>97.25 %</td>
<td>1945 ml</td>
<td>----</td>
</tr>
<tr>
<td>Icecaps &amp; Glaciers</td>
<td>2.14 %</td>
<td>42.8 ml</td>
<td>68.7 %</td>
</tr>
<tr>
<td>Groundwater</td>
<td>0.61 %</td>
<td>12.2 ml</td>
<td>30.1 %</td>
</tr>
</tbody>
</table>
| 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 %                    |


[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 water is in all of the lakes of the world? 0.01%

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.
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:

National Geographic http://www.nationalgeographic.com/kidsnetwork/water/session_01.html
Great Lakes Physical Features and Population  
(http://www.epa.gov/cgi-bin/epaprintonly.cgi)

<table>
<thead>
<tr>
<th></th>
<th>Superior (feet)</th>
<th>Michigan (feet)</th>
<th>Huron (feet)</th>
<th>Erie (feet)</th>
<th>Ontario (feet)</th>
<th>Totals (feet)</th>
</tr>
</thead>
<tbody>
<tr>
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<td>577</td>
<td>577</td>
<td>569</td>
<td>243</td>
<td></td>
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<tr>
<td>(meters)</td>
<td>183</td>
<td>176</td>
<td>176</td>
<td>173</td>
<td>74</td>
<td></td>
</tr>
<tr>
<td><strong>Length</strong></td>
<td>350</td>
<td>307</td>
<td>206</td>
<td>241</td>
<td>193</td>
<td></td>
</tr>
<tr>
<td>(miles)</td>
<td>563</td>
<td>494</td>
<td>332</td>
<td>388</td>
<td>311</td>
<td></td>
</tr>
<tr>
<td>(kilometers)</td>
<td>160</td>
<td>118</td>
<td>183</td>
<td>57</td>
<td>53</td>
<td></td>
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<tr>
<td><strong>Breadth</strong></td>
<td>257</td>
<td>190</td>
<td>245</td>
<td>92</td>
<td>85</td>
<td></td>
</tr>
<tr>
<td>(miles)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(kilometers)</td>
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<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Average Depth</strong></td>
<td>483</td>
<td>279</td>
<td>195</td>
<td>62</td>
<td>283</td>
<td></td>
</tr>
<tr>
<td>(feet)</td>
<td>147</td>
<td>85</td>
<td>59</td>
<td>19</td>
<td>86</td>
<td></td>
</tr>
<tr>
<td>(meters)</td>
<td>1332</td>
<td>925</td>
<td>570</td>
<td>210</td>
<td>802</td>
<td></td>
</tr>
<tr>
<td><strong>Maximum Depth</strong></td>
<td>406</td>
<td>282</td>
<td>229</td>
<td>64</td>
<td>244</td>
<td></td>
</tr>
<tr>
<td>(feet)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(meters)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Volume</strong></td>
<td>2,900</td>
<td>1,180</td>
<td>850</td>
<td>116</td>
<td>393</td>
<td>5,439</td>
</tr>
<tr>
<td>(cu. miles)</td>
<td>12,100</td>
<td>4,920</td>
<td>3,540</td>
<td>484</td>
<td>1,640</td>
<td>22,684</td>
</tr>
<tr>
<td>(km³)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Water Surface Area</strong></td>
<td>31,700</td>
<td>22,300</td>
<td>23,000</td>
<td>9,910</td>
<td>7,340</td>
<td>94,250</td>
</tr>
<tr>
<td>(sq. miles)</td>
<td>82,100</td>
<td>57,800</td>
<td>59,600</td>
<td>25,700</td>
<td>18,960</td>
<td>244,160</td>
</tr>
<tr>
<td>(km²)</td>
<td></td>
<td></td>
<td></td>
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</tr>
<tr>
<td><strong>Land Drainage Area</strong></td>
<td>49,300</td>
<td>45,600</td>
<td>51,700</td>
<td>30,140</td>
<td>24,720</td>
<td>201,460</td>
</tr>
<tr>
<td>(sq. miles)</td>
<td>127,700</td>
<td>118,000</td>
<td>134,100</td>
<td>78,000</td>
<td>64,030</td>
<td>521,830</td>
</tr>
<tr>
<td>(km²)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Total Area (land+water)</strong></td>
<td>81,000</td>
<td>67,900</td>
<td>74,700</td>
<td>40,050</td>
<td>32,060</td>
<td>295,710</td>
</tr>
<tr>
<td>(sq. miles)</td>
<td>209,800</td>
<td>175,800</td>
<td>193,700</td>
<td>103,700</td>
<td>82,990</td>
<td>765,990</td>
</tr>
<tr>
<td>(km²)</td>
<td></td>
<td></td>
<td></td>
<td></td>
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<td></td>
</tr>
<tr>
<td><strong>Shoreline Length</strong></td>
<td>2,726</td>
<td>1,638</td>
<td>3,827</td>
<td>871</td>
<td>712</td>
<td>10,210</td>
</tr>
<tr>
<td>(miles)</td>
<td>4,385</td>
<td>2,633</td>
<td>6,157</td>
<td>1,402</td>
<td>1,146</td>
<td>17,017</td>
</tr>
<tr>
<td>(kilometers)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Retention Time</strong></td>
<td>191</td>
<td>99</td>
<td>22</td>
<td>2.6</td>
<td>6</td>
<td></td>
</tr>
<tr>
<td>(years)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Population</strong></td>
<td>519,728</td>
<td>9,820,620</td>
<td>1,664,639</td>
<td>8,133,932</td>
<td>1,191,467</td>
<td>24,033,244</td>
</tr>
<tr>
<td>U.S. (2000)</td>
<td>181,573</td>
<td>1,191,467</td>
<td>1,664,639</td>
<td>8,133,932</td>
<td>1,191,467</td>
<td>24,033,244</td>
</tr>
<tr>
<td>Canada (1991)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>TOTALS</strong></td>
<td>701,301</td>
<td>9,820,620</td>
<td>3,842,512</td>
<td>9,798,571</td>
<td>8,354,530</td>
<td>34,033,244</td>
</tr>
<tr>
<td><strong>Outlet</strong></td>
<td>St. Mary’s River</td>
<td>Straits of Mackinac</td>
<td>St. Clair River</td>
<td>Niagara R./ Welland Canal</td>
<td>St. Lawrence River</td>
<td></td>
</tr>
</tbody>
</table>


*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).