# Water, water almost everywhere?

## Module Overview

The presence of water in solid, liquid, and gaseous forms is one of the primary factors that distinguishes Earth from its neighbors in the solar system. In this module, students compare the amount of land and water on Earth; consider craters as evidence of a lack of water on other planets; define and locate water bodies found on Earth; and identify changes that occur in these water bodies.

***Investigation 1:* Why is Earth called the "water planet"?**
Students use NASA photographs and hands-on activities to compare the amounts of land and water on our planet.

***Investigation 2:* How can we tell if other planets have water?**
Students learn that the presence of craters is an indication of a dry planet. They demonstrate how craters are formed and how craters are concealed or obliterated in wet climates. Students also use satellite images to assess the presence of water on two other planets.

***Investigation 3:* Water bodies, where are they?**
This investigation introduces and defines different kinds of water bodies and examines their locations. The activity focuses on oceans, seas, gulfs, bays, straits, lakes, and rivers. Students use NASA satellite images and maps to study these water bodies, and they compare their state's water bodies to those of other states.

***Investigation 4:* How do water bodies change over time?**
Students explore how water bodies change in response to changes in weather and climate. They do experiments to demonstrate the effect of rising sea level on coastlines. They also use NASA images to examine dramatic changes in water levels in a river system in the United States and a lake in Africa.

## Geography Standards

*The World in Spatial Terms*
- **Standard 1:** How to use maps and other geographic representations, tools, and technologies to acquire, process, and report information from a spatial perspective
- **Standard 2:** How to use mental maps to organize information about people, places, and environments in a spatial context
- **Standard 3:** How to analyze the spatial organization of people, places, and environments on Earth's surface

*Places and Regions*
- **Standard 4:** The physical and human characteristics of places

*Physical Systems*
- **Standard 7:** The physical processes that shape the patterns of Earth's surface

*The Uses of Geography*
- **Standard 18:** How to apply geography to interpret the present and plan for the future

## Science Standards

*Unifying Concepts and Processes*
- Evidence, models, and explanation
- Constancy, change, and measurement

*Science as Inquiry*
- Abilities necessary to do scientific inquiry

*Earth and Space Science*
- Properties of Earth materials
- Structure of the Earth system

## Technological Literacy Standards

*Technology and Society*
- **Standard 5:** The effects of technology on the environment

## Connections to the Curriculum

This module can be used in geography, social studies, and science classes in the study of Earth's physical characteristics and relations with the solar system. In addition, it provides a good case study to examine human impact on the environment. The world's oceans are an excellent focus for interdisciplinary units. The investigations strengthen science and social studies skills of observation, prediction, inference, and classification. Students are given many opportunities to practice measurement and estimation skills. The ratio of land to water on Earth is a topic. Students practice language arts skills by reading to be informed, by reading to learn to perform a task, and by expanding their vocabulary and interpretation skills.

## Time

Investigation 1: One or two 45-minute sessions
Investigation 2: Two 45-minute sessions
Investigation 3: Two 45-minute sessions
Investigation 4: Three 45-minute sessions

## Mathematics Standards

*Number and Operations*

- Compute fluently and make reasonable estimates

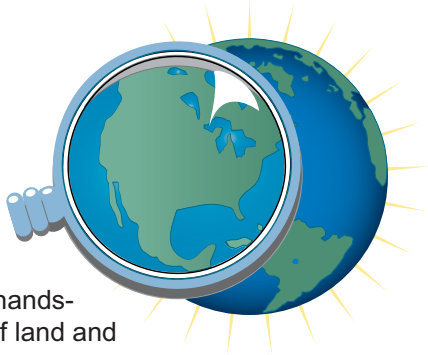
*Geometry*

- Use visualization, spatial reasoning, and geometric modeling to solve problems

*Measurement*

- Understand measurable attributes of objects and the units, systems, and processes of measurement
- Apply appropriate techniques, tools, and formulas to determine measurements

# Why is Earth called the "water planet"?



## Investigation Overview

Students use NASA photographs and hands-on activities to compare the amounts of land and water on our planet.

Time required: One or two 45-minute sessions

## Materials/Resources

NASA Images: (Show on large monitor or project as transparencies)
- Figure 1: Earthrise
- Figure 2: The "blue planet" from space
- Figure 3: Earth without shadows or clouds

Blue and brown crayons (one set per pair of students)
Inflatable or otherwise soft-sided globe
Outline world maps (one per pair of students)
Log: Our watery planet
Clay
Chart paper or transparency of Globe Toss Game, page 6

## Content Preview

NASA monitors Earth from space to investigate human impact on the environment (erosion, deforestation, water pollution, biomass burning), to monitor natural hazards (volcanoes, hurricanes, floods), and to be able to make predictions related to natural phenomena (weather, ENSO, climate, Antarctic ice melt). They also monitor the world ocean, 70 percent of Earth's surface, because it affects the entire Earth system. The world's water mass is divided into four oceans: the Pacific, the Atlantic, the Indian, and the Arctic. Beneath the ocean lie landforms like those above the surface.

## Classroom Procedures

### *Beginning the Investigation*

1. Read the following description to the class.

   "Suddenly from behind the rim of the Moon . . . there emerges a sparkling blue and white jewel, a light, delicate blue sphere laced with slowly swirling veils of white, rising like a small pearl in a thick sea of black mystery. It takes more than a moment a fully realize this is Earth . . . home."

## Geography Standards

### *Standard 1: The World in Spatial Terms*

***How to use maps and other geographic representations, tools, and technologies to acquire, process, and report information from a spatial perspective***

- Show spatial information on geographic representations.

### *Standard 3: The World in Spatial Terms*

***How to analyze the spatial organization of people, places, and environments on Earth's surface***

- Analyze and explain distributions of physical and human phenomena with respect to spatial patterns, arrangements, and associations.

### *Standard 7: Physical Systems*

***The physical processes that shape the patterns of Earth's surface***

- Explain how physical processes help to shape features and patterns on Earth's surface.

### *Geography Skills*

***Skill Set 2: Acquire Geographic Information***

- Make and record observations about the physical and human characteristics of places.

***Skill Set 4: Analyze Geographic Information***

- Use tables and graphs to observe and interpret geographic trends and relationships.

***Skill Set 5: Answer Geographic Questions***

- Use methods of geographic inquiry to acquire geographic information, draw conclusions, and make generalizations.

2. Ask students to try to identify who might have described Earth in these words. (*They are the comments of an astronaut, Edgar Mitchell, who saw Earth from the Moon in 1971.*) Project **Figure 1** and ask the following questions.

   - What is Astronaut Mitchell seeing that is a "delicate blue"? (*Earth's oceans.*)
   - What are the "swirling veils of white"? (*Cloud cover.*)
   - What is the "thick sea of black mystery"? (*Space appears black because it cannot reflect any light from the Sun.*)
   - Why can't we see the lower half of Earth? (*It is the nighttime side of Earth.*)

3. Have students draw a picture of Earth as Mitchell saw it.

4. Have students look at the photo again and ask how many have heard Earth called the "blue planet?" Why is Earth sometimes called this? (*From space, Earth looks blue because so much of its surface is water. Oceans cover about 2/3 of Earth's surface, and more still is covered by large seas and lakes.*)

5. Have the students use a globe to identify the four oceans. Discuss where they are located in relation to the continents. Then, project **Figures 2** and **3** and ask students to identify the oceans they can see in each photograph. Explain that **Figure 3** was created from many different images. Clouds are always present in the atmosphere, and it would be impossible to get one photo that showed no clouds. Compare the amount of land and water visible in each image. Note the Arctic and Antarctic ice caps and explain that they contain so much ice that if it were to melt, the level of the oceans would rise and flood the present coastlines.

## *Developing the Investigation*

6. Explain the directions for a globe toss game and ask students to predict whether the final tally of the game will have more points for the land or water. *(For older students, have them predict which ocean will receive more points.)*

   - Students sit or stand in a circle.
   - An inflatable (or other soft-sided) globe is tossed or rolled to a student across the circle. The student receiving the globe will look at his/her right thumb to see where it has landed, either on water or land, and give the information to the tally person.
   - The student tallying the results will record the thumb landings on water or land on a tally sheet (sample above). Students in grades 2–4 can also give the names of the oceans and continents on which their thumbs land, to be recorded on the tally sheet. Make the tally sheet on large chart paper or on the chalkboard or make a transparency of the table on page 6 of this Educator's Guide.
   - Discuss the findings with the students. Were the results what they expected?

**Globe Toss Game, Grades K-1**

| Water | Land |
|---|---|
| | |

**Globe Toss Game, Grades 2-4**

| Water | | Land | |
|---|---|---|---|
| Atlantic Ocean | | Africa | |
| Arctic Ocean | | Antarctica | |
| Indian Ocean | | Asia | |
| Pacific Ocean | | Australia | |
| Other | | Europe | |
| | | North America | |
| | | South America | |

## *Concluding the Investigation*

7. For a more visual comparison of land and water, have the students make a bar graph of the tally sheet and complete the **Log**. Read the directions together. For K–2 students, the bottom section of the **Log** may be eliminated. Discuss their answers and guide them to understand that they have demonstrated that about 1/3 of Earth's surface is covered with land and about 2/3 with water.

8. Form groups of two or three students. Distribute outline world maps and clay. Ask the students to locate and label the oceans on the map. Then have them roll the clay into a "snake" long enough to contain the Pacific Ocean and place the "snake" around its borders. Use more clay to outline the other oceans. Describe the shapes made by the clay. Compare the sizes of the oceans.

## Background

The Pacific Ocean is by far the largest and deepest of the four oceans. It covers nearly 1/3 of the globe, an area approximately 165,760,000 square kilometers. This area can contain all the world's continents with room to spare. The average depth of the Pacific Ocean is 3,962 meters.

The Atlantic Ocean has an hourglass shape and covers more than 20 percent of Earth's surface. It is the second largest ocean. It covers 1/5 of Earth's surface. It reaches from the North Pole to the continent of Antarctica. The average depth is 3,657 meters. The Atlantic is less salty than other oceans because many rivers carry fresh water into it.

The Indian Ocean has a triangular shape and is bordered by Africa, Asia, Antarctica, and Australia. It is smaller than the Atlantic Ocean and less than half the size of the Pacific Ocean. It contains almost 1/5 of Earth's water surface, and many island nations are found within its boundaries.

The Arctic Ocean is centered approximately on the North Pole. It is the world's smallest and shallowest ocean. Its average depth is 1,205 meters. It is surrounded by North America, Eurasia, and Greenland. It is covered by ice year-round.

Draining the oceans would reveal that Earth's solid surface is divided into highlands and lowlands. The highlands are the landmasses that form the continents, and the lowlands form the ocean basins. The ocean floor contains mountain chains, isolated peaks, and deep valleys.

## Evaluation

***Log**

1. Earth has much more water than land.
2. 2/3 water, 1/3 land
3. Oceans: Atlantic, Pacific, Indian, Arctic
   Continents: Africa, Antarctica, Asia, Australia, Europe, North America, South America

## Resources

Image Sources:
Figure 1: http://images.jsc.nasa.gov/images/pao/AS8/10074963.jpg
Figure 2: http://pds.jpl.nasa.gov/planets/gif/ear/earthspn.gif
Figure 3: http://www.fourmilab.ch/cgi-bin/uncgi/Earth

http://www.ess.ucla.edu/hypermap/Vmap/top.html
http://seawifs.gsfc.nasa.gov/SEAWIFS.html *Life in the Oceans: Studying Global Ocean Color from Space*
http://earthrise.sdsc.edu Earthrise, large database of photos of the Earth from space
http://www.seaspace.com
http://www.sierraclub.org/books/598.html *Water, Water Everywhere*
*Ladybird First Facts about the Earth,* Caroline Arnold, Ladybird Books, Auburn, ME 04210
*The Earth's Surface,* Colin Walker, Modern Curriculum Press, Inc., 13900 Prospect Road, Cleveland, OH 44136

| Globe Toss Game | | | |
|---|---|---|---|
| **Water** | | **Land** | |
| Atlantic Ocean | | Africa | |
| Arctic Ocean | | Antarctica | |
| Indian Ocean | | Asia | |
| Pacific Ocean | | Australia | |
| Other | | Europe | |
| | | North America | |
| | | South America | |

# Module 2, Investigation 1: Log

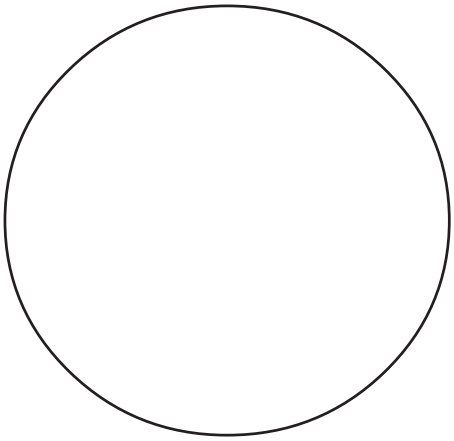
## Our watery planet

1. You have looked closely at Earth and compared the amount of land and water on its surface. What did you discover?

_____

_____

2. If all the land was moved together, to the top of the globe, how much of Earth's surface would be left to be covered by water? Your job now is to color with your blue crayon how much of Earth is covered by water.



3. Write the names of the oceans and continents on the lines below. Your teacher will help you.

**Water**

Oceans

1. _____
2. _____
3. _____
4. _____

**Land**

Continents

1. _____
2. _____
3. _____
4. _____
5. _____
6. _____
7. _____

# Module 2, Investigation 1: Figure 1

## Earthrise

Source: http://images.jsc.nasa.gov/images/pao/AS8/10074963.jpg

# Module 2, Investigation 1: Figure 2

## The "blue planet" from space

Source: http://pds.jpl.nasa.gov/planets/gif/ear/earthspn.gif

# Module 2, Investigation 1: Figure 3

## Earth without shadows or clouds

Source: http://www.fourmilab.ch/cgi-bin/uncgi/Earth