

Earth's Water as an Apple

Area of Study: Watersheds

Grades: 4 - 8, adaptations for older students included

Subjects: Geography, fractions, percentages, critical thinking

Time: 30 - 45 minutes

Objectives:

- Students will be able to examine the earth's water systems from a global perspective.
- Students will understand how land and water are connected on the planet.
- Students will be better prepared to examine the interconnections between humans and the environment during their time at the Headlands Institute.

Background

The earth's surface is mostly water. Most of that water is stored in the earth's oceans. Very little of the earth's water freshwater, and an even smaller percentage of that freshwater is available for human consumption.

In ocean areas with the most life tend to be along coastlines where continental slopes drop off. The open ocean has vast areas with little productivity. In these areas, few plants can grow, so even fewer animals are capable of living there over long periods of time.

The greatest productivity in the ocean is within the top 100 meters of the surface. This is the depth to which sunlight penetrates, known as the photic zone. All marine life depends on photosynthesizing plants, particularly phytoplankton. Plants in this zone use sunlight to create food through photosynthesis. Even within the zone, the amount of light drops off dramatically. Only 1 % of the surface light penetrates down 100 meters.

Where currents meet along the equator, waters are very high in nutrients. Higher nutrient content means greater productivity, and therefore there are many species of marine plants and animals. Along the western margins of continents, there are areas of upwelling, where deep cold water rich with nutrients rises to the surface due to earth's rotation and wind. The nutrients in this water serve as food for plankton, the organisms that serve as the base of most ocean food webs. Upwelling areas are critical for plankton populations which affect migrating seabirds, marine mammals, and for fishing industries throughout the world.

Materials:

- A large world map
- Smaller world maps for each group (optional)
- A piece of paper with a large circle drawn on it for a pie chart (optional)
- One apple for each pair of students and one for the teacher, or just one apple for you to demonstrate for your students
- Plastic knives, or one knife if you are demonstrating for younger children
- 20 completed labels, prepared in advance

- 25 blank labels the students will complete during the activity
- Paper plates or recycled cardboard, one for each pair of students, to catch apple juice

Introducing the activity

- In advance, prepare 20 labels with the following terms: oceans, land, mountains, swamps, lakes, deserts, rivers, land that grows food, river basin, ice, drinkable water, productive zones, non-productive zones, habitable, uninhabitable, too wet, too hot, too dry, and too cold.
- Give each pair of students an apple and tell them it represents the earth.
- Distribute to each pair a knife and the pre-cut paper for labels.
- Ask the students to observe and follow your demonstration.

Procedure

Part I - The earth

- Show students the world map. Explain to them that the apple they have represents the surface of the earth.
- Ask students to describe the surface of the earth.

Part II - Dry land

- Cut the apple in half (from top to bottom).
- Cut each of the two pieces of apple in half (top to bottom).
- Set aside three pieces of the apple and label them "**oceans**." If you are making a pie chart either begin labeling it now or do so after the exercise to assess students understanding.
- Set out the one piece left and label it "**land**." The land quarter also represents areas of the earth not covered by water such as lakes, rivers, ice.

Discussion: We've just divided the earth's surface into four parts. Each part represents one-quarter of the earth's surface. How many quarters of the earth's surface are oceans? How many quarters of the earth's surface are land?

- Take the one quarter that represents the land and cut it in half.
- Label one of the halves you just cut (1/8 piece) "Uninhabitable."

Discussion: This piece is one-eighth of the earth's surface and represents all the land that is too dry, too wet, too cold, or too hot for people to live. It is uninhabitable, defined as a place that cannot support the life and growth of an organism.

- Write labels that describe uninhabitable land and place them next to the uninhabitable label, e.g., mountains, deserts, swamps, and ice.
- Write labels that describe the conditions of uninhabitable land, e.g. "**too cold**," "**too wet**," "**too hot**," and "**too dry**."
- Take the other one-eighth piece and cut it into four pieces. Set 3 of the pieces you just cut with the land section and set the fourth (1/32) piece aside. Label this 1/32 piece: "**land that grows food**."

Discussion: This represents the amount of land that grows the food for the whole world's population.

- Take this $\frac{1}{32}$ nd piece and cut off a thin slice. Label this "drinkable water."

Discussion: This tiny slice represents 3 hundredths of 1% (0.0003 or .03%) of the earth's surface, which includes all of the drinkable water for the human population.

Part III - The ocean

- Set aside the land slices you've been working with, and return to the $\frac{3}{4}$ th of the apple that is labeled "oceans."
- Take one of these quarters and cut it in half.
- Place one half back with the other ocean parts. Leaving $\frac{1}{8}$ th of the apple in front of you.

Discussion: Many regions of the world's ocean have very little life. These areas are called non-productive zones, they do not produce/make anything.

- Label the $\frac{5}{8}$ ths group "**non-productive zones.**"
- Label the $\frac{1}{8}$ th piece "**productive/photic zones.**"

DISCUSSION: Of the oceans productive, or photic zones, $\frac{1}{4}$ are along North America's Pacific Coast. The average depth of the ocean is 2 $\frac{1}{2}$ miles. This sliver represents the top 100 meters or 330 feet of our oceans through which light can penetrate and support photosynthesis. Almost all of the ocean's life is concentrated in this narrow region.

Adaptations for older students

Write out all the labels (e.g. usable fresh, water, uninhabitable, oceans) with definitions and ask students match those categories with the corresponding fractions.

To increase the mathematical component of this lesson, have students convert fractions into percentages.

Extended activities

Have the students discuss and answer these research questions:

- How much of the land on each continent is agricultural land?
- In what ways do cultures protect and provide drinkable water?
- What are the effects of pollution on drinkable water?
- What is photosynthesis?
- Why don't many animals and plants live below the photic zone?
- What are some ways we depend on the narrow photic zone of the sea?
- What are the effects of pollution on the photic zone?
- Are we able to build communities in areas previously thought to be inhabitable?

- What other zones of the ocean are productive besides the photic zone? Can animals live at the bottom of the ocean floor? How?