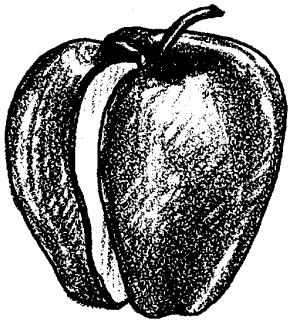
Ocean Apple

Key Concept

1. Earth is a water planet covered by one interconnected world ocean which circulates around all the continents.



Background

Our world is a water planet with nearly three quarters of the earth's surface covered with ocean. Looking at a globe from the perspective of the vast Pacific Ocean, it appears obvious that our Planet Earth should more appropriately be named Planet Ocean. The Southern Hemisphere, with only one third of the land area on earth, could more realistically be called the Oceanic Hemisphere. Looking at a globe from a South Polar perspective, the marine environment can easily be seen as one interconnected ocean system. The Antarctic continent can be viewed as being surrounded by an "Antarctic Ocean" with three large "extensions," the Atlantic, Pacific and Indian oceans. Other smaller oceans and seas, such as the Arctic and Mediterranean Sea, can be considered to be tributaries of these larger oceans. This ocean is the one feature which distinguishes our planet from all others in the solar system; it allows life as we know it to exist, makes our climate habitable, provides much of our oxygen and food, and transports nutrients, cultures and pollution around the globe.

Sailing the seven seas is a statement often used throughout maritime history and literature. While this is a poetic statement, today it is important to recognize that there is essentially only one ocean and that the consequences of our actions with regard to the ocean are often global in nature. What is put into one "sea" may very well end up on the beach of another halfway around the world. Trash from all over the west coast of North America washes up on the remote South Pacific island of Laysan.

Although we may think of the ocean as separating continents, it really connects and links them by surface and bottom currents. Acting in many respects like the circulatory system of our human bodies, the ocean currents carry seawater and marine organisms throughout the globe. The currents insure that the proportions of the major constituents in seawater (salts) remain constant throughout the world ocean, even though their total abundance may differ from place to place. Not only is the composition of sea water similar in all parts of the world ocean, there is also a vital similarity between the chemical composition of seawater and that of the body fluids of all organisms. Ocean currents are often vast in scale; cold, salty, nutrient super-rich water from Antarctica sinks and is pushed along the ocean floor all the way to

Newfoundland, Canada. There it finally wells up around the steep sides of the Grand Banks, creating one of the largest localized fishing areas in the world.

The vast ocean may appear to be a limitless resource, but there are huge areas of open ocean that support very little life and are considered to be "deserts". Only a small proportion of the entire ocean is actually considered to be highly productive. About 10% of the ocean, the area over the continental shelves, supports large concentrations of drifting, microscopic plants (phytoplankton) which forms the base of the ocean food web. Worldwide, over 90% of human fishing effort is concentrated in these coastal zones along the margins of the continents. Even within the coastal zones, productivity can vary greatly from place to place. For example, within the coastal zone are a small handful of intensely productive areas, where deep, cold, nutrient-rich waters are brought up to the surface (upwelled). Once at the surface, these nutrients act as fertilizer, stimulating the rapid growth and division (bloom) of phytoplankton living in the sunlit surface waters. The depth to which sunlight penetrates varies from less than one meter in turbid estuaries to over 100 meters in clear open ocean waters. It is within this thin surface layer, called the photic zone, that photosynthesis occurs.

The major upwelling areas supporting these intense, seasonal blooms of phytoplankton occur off the west coasts of North America, Peru, Africa and Australia. The blooms have a great effect because phytoplankton form the base of the food pyramid and are grazed upon by zooplankton. The zooplankton are eaten by fish and other animals that, in turn, are eaten by larger predators such as seabirds, seals, whales, and sharks. It is no surprise, then, that these areas of upwelling are the productive zones where the greatest fisheries in the world are located. It is also very sobering to realize that these rich upwelling areas represent only about 1/1000 of the ocean.

Materials

Part I - Small Group Brainstorming

For each group of 4 students:

- ocean related pictures and visuals, small and large
- overhead projector transparency
- erasable transparency marker

Part II - One World Ocean

For the class:

- blow-up globe or large wall map of the world

(Materials cont.)

Part III - Planet "Apple"

For each pair of students:

- one apple
- dull knife (plastic or butter)
- paper plate, full size, sturdy
- colored markers, three or four colors
- paper towels

Optional:

- Ocean sounds audiotape or videotape (e.g. "Gentle Ocean" from Nature Co. or other ocean related tapes without narration. Check your local library.)

Teaching Hints

In "Ocean Apple", pairs of students cut and re-cut an apple and make a pie chart as they explore proportions of land and water on Earth. The activity takes two class periods: one for setting the mood, "Small Group Brainstorming", and "One World Ocean", and the next period for "Planet Apple".

You may wish to "Set the Mood" for ocean studies by playing tapes such as those mentioned above. Students can "mingle" around posters, pictures and other props related to the sea silently while the tape is playing. They are thinking about what they already know about the ocean, and what these items bring to mind.

Day 1

Part I - Small Group Brainstorming:

1. After the mood has been set with music and visuals, divide the students into groups of four. Provide each group with a variety of the ocean-related pictures, an overhead projector transparency and an erasable transparency marker. Have them use the visuals as prompts to brainstorm and record some of the things they already know about the ocean. Possible categories to think about: animals, plants, geography, physical features, human uses.

2. Have groups then share their ideas using the overhead projector with their own transparency. This is a good time for you to note any inaccurate ideas students may have about the ocean. As the students share, ask them to support their ideas: "WHY do you think that about whales?".

Part II - One World Ocean:

1. Use an extra large, plastic blow-up globe, regular globe or large wall map to show the relationship between the planet's land masses and ocean from different perspectives; e.g., show the world from the Pacific Ocean and then from the South Pole.

2. Begin to talk about **Planet Ocean** rather than **Planet Earth.** Ask:

   "How many oceans are there? Can you name some of them?"

   Ask a volunteer to come to the map and show where one ocean ends (whichever one he or she named) and another begins. Point out there is really just one huge ocean, and that ocean does not separate the continents, it really connects and links them. Ask:

   "How does it link them?"

3. Begin to draw a comparison between the planet and our own human bodies. Record on the board or on a poster the corresponding information about the planet and human body as each is discussed as follows:

   - approximately 3/4 of the planet is covered by water
   - approximately 3/4 of the human body is water (in our blood AND cells)
   - approximately 1/4 of the planet is covered by land
   - approximately 1/4 of the human body is muscle, bone and hard tissue
   - the ocean can be compared to our circulatory system: just as our blood circulates throughout our body, carrying whatever we put into it, so does the ocean circulate throughout the planet, carrying whatever we put into it.
   - our blood and all our body fluids are close to the same salinity as ocean water.

Day 2

Part III - Planet "Apple":

1. Have students sit side by side with a partner. Have them clear all materials off their table except an apple, a knife, a paper plate, a paper towel and a number of colored markers.

2. Tell the students that the apple represents all the land and water on Earth, and they will be learning some very interesting facts about our ocean planet. Point out that the plate will be a chart to record those facts. Draw a pie chart (plate) on the board. Demonstrate how to fill it in with each step as you proceed.

3. Tell the students that one of the partners will be the LAND and the other partner will be the OCEAN. The LAND will cut the apple first while the OCEAN will draw and label the plate first. Partners will switch jobs in the second part of the activity.

Looking at the Land

1a. Have each LAND partner cut the apple into four equal pieces from top to bottom. (Be sure the apple is standing up, and the cuts are through the core.) Ask the students:

"How many of these pieces should be set aside as "ocean" and how many should be "land" on our Earth?"

(Three of these pieces represent the 3/4 of the Earth that is covered by ocean.)

Have the partner set these three pieces aside for use later in the ocean part of the activity. Say:

"This remaining quarter represents the land, or area not covered by ocean."

b. Next, have the OCEAN partner follow your demonstration regarding how to divide the paper plate into four equal quarters. (Use a colored marker to draw a cross through the center of the plate.) Shop how to label three of the quarters "Ocean" and one "Land".

2a. Now, have each LAND partner cut the one quarter of the apple representing the land into two equal pieces. Hold up one piece (1/8 of the "apple world"). Say:

"This piece represents the land that is too dry, too wet, too cold, or too hot for people to live there. This is uninhabitable land (mountain tops, river basins, deserts, etc.)."

Have each LAND partner set this piece aside, and hold up the other piece that represents the habitable land.

b. Have the OCEAN partner draw a line on the paper plate which divides the 1/4 piece representing the land in half. Have the OCEAN partner draw a picture of a person in one of the resulting 1/8 pieces and a person with an X through it in the other or label one of the pieces "1/8 - Uninhabitable" and the other "1/8 - Habitable".

3a. Have the LAND partner cut the 1/8 apple representing the habitable land into four equal pieces. Have the LAND partner set aside three of these pieces and hold up the remaining piece. Say:

"This piece represents the portion of the habitable land on which we are able to grow food."

b. Have the OCEAN partner draw a line on the paper plate which divides the 1/8 piece representing the habitable portion into four slices. Have the OCEAN partner color one of the resulting 1/32 pieces to represent the habitable land on which we can grow food. The partner should also draw an arrow pointing to the colored-in slice and label the arrow "1/32 - All Our Farm Land".

4a. Have the LAND partner cut off the thinnest slice possible from the 1/32 piece of apple and hold it up. Say:

"This tiny slice (which is still too big) represents 3/100 of 1% (3/10,000) of the earth's surface. This area supplies all of our drinkable water."

b. Have the OCEAN partner make a dot in the section of the plate that is colored in to represent the area on which we can grow food. The dot represents the drinkable water. Have the OCEAN partner label this dot "3/100 of 1% Drinkable Water." Say:

"All life on land, including human life, depends on fresh water for survival, and look how little of it there is."

Discuss conservation issues such as drought, pollution, water diversions, water use and waste, etc.

Looking at the Ocean

1. Have students set aside the land and return to the three quarters of the apple representing the ocean. Have the partners switch jobs so that the ocean partner is now cutting the apple and the land partner is drawing on the paper plate.

2a. Have the OCEAN partner cut one of the three pieces representing the ocean in half. Next have the OCEAN partner take one of the halves and cut it in half again. Hold up one of these small pieces. Say:

"This piece, 1/16 of the world's surface (or 9.9% of the ocean), approximately represents the productive coastal zones of the ocean. Over 90% of the world's fisheries occur in this slice.

Though we think of the ocean as a vast, infinite resource, most regions of the world's ocean are not very productive. This small slice represents the area of concentrated ocean productivity found over the shallow continental shelves along continental coasts."

b. Have the LAND partner draw a line on the plate which divides one of the quarters marked "ocean" in half. Then have that partner draw another line dividing one of these 1/8 sections in half. Have the LAND partner color in and draw a fish in one of the pieces, and label the piece "1/16 - Productive Coastal Zone".

3a. Have the OCEAN partner take one of these 1/16 pieces and cut off a thin slice. Hold up a thin slice. Say:

"This tiny slice represents the 1/1000 of the ocean that is the most productive. Here is where the upwelling occurs within a coastal zone."

Explain that upwelling is a process that brings nutrient-rich water from deep in the ocean, up to the surface during some seasons on the west coasts of four continents. The highest concentrations of plants and animals are found in upwelling areas. These areas are by far the richest areas of the world ocean and are often destinations for migrating birds, seals and whales. One of these upwelling areas is found along the Pacific Coast of North America, one of the richest regions in the ocean.

b. Have the LAND partner make a dot on the paper plate **within the coastal zone**. This dot represents the rich upwelling zone. Have the LAND partner label it with an arrow. Note that about 1/4 of the upwelling areas are along the west coast of North America.

4a. Have the OCEAN partner peel off and hold up a piece of the apple skin from one of the larger slices of apple still representing part of the ocean. Say:

"This piece of skin: though it is too thick to be truly accurate, represents the photic zone. The photic zone is the part of the ocean through which light can penetrate and support photosynthesis. This zone is only the top 100 meters or 330 feet. All seaweed and the tiny, drifting plants called phytoplankton live and grow in the photic zone. Since these plants form the base of the ocean food pyramid, almost all life in the ocean depends on the photic zone. This also means that almost all of the life in the ocean is concentrated in this narrow region below the surface of the sea. While there is

photosynthesis going on across the entire ocean, it is occurring at a much higher rate in the coastal zone.

b. Have the LAND partner make a dot on the paper plate in each of the sections of the ocean. The dot represents the photic zone. Have the LAND partner label these dots "Photic Zone".

Discussion and Summary:

Say:

"Now look at your tiny slices in relation to the rest of your apple. Which one represents our drinkable water, the resource necessary for all life on land?

Which one represents all of the upwelling zones, the most productive places on Earth?

Which one represents the all important photic zone, where all of the ocean's food producing green plants are found?

These three minute and fragile pieces of our planet support most of its life."

Have the student partners join another pair and discuss what they learned from this apple exercise. They should be prepared to share their thoughts with the class, and answer the following question:

"Which parts of this model, "Planet Apple", do you think humans impact the most? Why do you think so?"

The activities which follow are designed to introduce students to the global ocean environment, and to the concept of one world ocean. The seawater itself, the creatures that live in the water, and the human effects on this global system are examined through active participation by the students. It is our hope that you will approach the activities in the spirit of the late oceanographer, Roger Revelle (1909-1991) who noted

"Man is challenged by the voice within him, the voice out of the whirlwind of consciousness, to seek and to know all he can. Knowledge of the air and the sea and the solid Earth, and of our fellow creatures who share this planet, increases our ability to use the Earth wisely and well."

Key Words

continental shelf - that part of the continent that is submerged in relatively shallow water

photic zone - that part of the ocean through which light penetrates, usually thought of as the top 100 meters of the ocean

photosynthesis - the process by which green plants make food (carbohydrates) by combining carbon dioxide and water in the presence of chlorophyll and light, and release oxygen as a by-product

productivity - the rate at which producers (usually green plants) store chemical energy in the substances that make up their bodies

upwelling - a process, common along some continental coastlines, in which nutrient-laden waters from the ocean depths rise to the surface

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