

Earth: The Apple of Our Eye

Concept: A visual demonstration of the limited sources of food available from land and water.

Materials: An apple, a knife, and a paper towel

Procedure: Slice the apple according to the instructions, narrating as you go. Use the Discussion Questions to encourage critical thinking in discussion of these facts.

Part I: Farmland

Apple	Planet Earth	Narrative
Whole Apple	Planet Earth	1. Hold the apple out so the class can see it. <i>"This apple represents our planet."</i>
3/4	Water	2. Cut the apple into quarters. Hold out 3/4 in one hand. Ask the class: <i>"What do these 3/4 represent?" (Water.)</i>
1/4	Land	3. Set the three "water" sections aside and hold out the remaining quarter. Ask the class: <i>"What fraction of the apple remains?" (1/4.) This 1/4 represents the total land surface."</i>
1/8	Uninhabitable & Non-Arable Land	4. Slice the land (the remaining 1/4) in half, lengthwise. Hold out one of the pieces. Ask the class: <i>"What fraction of the apple is this?" (1/8.) This 1/8 represents the half of the Earth's surface that is inhospitable to people and to crops: the polar regions, deserts, swamps, and high or rocky mountains."</i>
1/8	Habitable Land	5. Set that 1/8 aside and hold out the other. <i>"This 1/8 represents the other half of the Earth's surface. These are the areas on which people can live, but cannot necessarily grow food."</i>
3/32	Habitable Land, but Non-Arable Land	6. Slice this 1/8 crosswise into four equal pieces. Hold out 3/32 in one hand. <i>"These 3/32 represent land on which people can live, but cannot grow food. Some of it was never arable because it's too rocky, wet, cold, steep or has soil too poor to produce food. Some of it used to be arable but isn't any longer because it's been developed—turned into cities, suburbs, highways, etc., so it can no longer be farmed. Governments have earmarked other areas, such as parks, nature preserves and other public lands to remain undeveloped forever."</i>
1/32	Arable Land	7. Set 3/32 aside and hold out 1/32. <i>"So, only 1/32 of the Earth's surface has the potential to grow the food needed to feed all of the people on Earth."</i>
1/32 Peel	Topsoil	8. Carefully peel the 1/32 slice of Earth. 9. Hold up the peel. <i>"This tiny bit of peel represents the topsoil, the dark, nutrient-rich soil that holds moisture and feeds us by feeding our crops. Currently, 90% of U.S. croplands lose soil above the sustainable rate.¹"</i>

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Some Facts About Farmland:

Erosion by wind and water is the most serious cause of soil loss and degradation. Although it is a natural process, erosion is accelerated greatly by things like construction, deforestation, and unsustainable practices in farming and animal grazing.

- In the U.S., soil is now eroding at 17 times the rate at which it forms. The soil erosion rate is estimated to be double in Asia, Africa, and South America.²
- In order to feed the nearly 80 million humans added to the population annually, 12 million acres of new land must be put into production.³
- More than 25 million acres of productive arable land are severely degraded and abandoned worldwide every year—that's an area the size of the states of Ohio, Indiana, Illinois, Michigan, Wisconsin, and Minnesota put together.⁴

Discussion Questions:

1. What are the things humans do to arable land that make it more vulnerable to erosion?

- **Deforestation:** When trees are cut down, the soil loses the shelter of branches and leaves that protect it from the force of rain and wind that otherwise blow and wash it away. The root systems that hold the soil in place from underneath are also destroyed.
- **Over-farming:** Each kind of crop takes certain elements from the soil. Over-farming occurs when the same crop is grown in the same place for too many years in a row, and the soil can't renew itself. Eventually all of that particular element is gone, and that soil is unable to grow anything. One way to avoid this is crop rotation. Farmers divide their land into sections, and every year, they change the kind of crop grown in each section. One section might be left unplanted, or fallow, for a growing season, giving the soil microbes time to break down dead plant and/or animal matter into soil nutrients.
- **Over-grazing:** When cattle eat grass, they pull it out of the ground by the roots, taking some soil with it. Each bite leaves a patch of ground uncovered, exposed to the wind and the rain. These animals' sharp hooves also tear up the surface a little with each step.

2. How many people can the Earth feed with its existing croplands?

- Although much of the hunger problem stems from uneven food distribution, rising affluence also plays a role in the number of humans that the world's food supply can sustain. Per capita consumption of grain in a low-income nation, such as India, whose people's diets consist of primarily a single starchy staple, like rice, is 440 lb/year. However, a typical American consumes almost 2,000 pounds of grains each year, the bulk of which is indirectly consumed from eating animal products such as beef, pork, poultry, eggs, milk, and other dairy products.⁵
- The current world grain harvest is 1.85 billion tons. Even if this harvest were expanded to 2 billion tons in the future, it could support 10 billion people who eat like a typical Indian, or 2.2 billion people with the average diet of a person living in the United States.⁶

3. What conclusions can we draw about the relationship between a growing population and a shrinking amount of land capable of growing food for those people?

- With a limited amount of land and a growing number of people to feed from that land, each person's part becomes smaller and smaller. Protecting our land resources is therefore of great importance.

4. How can we preserve farmland?

- **By not building on arable land:** Land covered up by buildings, highways, and other forms of development can't be used for growing crops. In the U.S., nearly 2.2 million acres of land are converted to urban and other uses each year. About 25% of that land is former cropland.⁷
- **By eating lower on the food chain:** While over a billion people suffer from malnutrition or starvation, meat production requires a disproportionate amount of grain input.⁸ Producing a pound of beef in a feed lot requires seven pounds of grain, a pound of pork requires four, and a pound of poultry requires two pounds of grain.⁹ The land that is used to produce grain for consumption by animals is unavailable for growing grain for human consumption.
- **By reducing pollution:** Pollution impairs the ability of the land and the seas to provide food that's both sufficient in quantity and free of contaminants.
- **By stabilizing human population growth:** Food supply is an excellent example of the relationship between any resource and the size and consumption patterns of the population that depends on it. Simply put, the more people there are to feed, the less food there is to go around.

Part II: Seafood

Apple	Planet Earth	Narrative
3/4	Water	<p>1. Return to the 3/4 of the original apple that represents water.</p> <p><i>"Some of our food comes from the sea. Nearly one billion people, mostly in Asia, rely on fish as their primary source of protein.¹⁰ Yet, despite their vastness and seeming uniformity, many regions of the world's oceans are unproductive due to a lack of life-supporting nutrients."</i></p>
1/8	Food-productive Areas	<p>2. Set aside two of the three quarters.</p> <p>Cut the remaining 1/4 in half.</p> <p>Set 1/8 aside and hold out the other 1/8.</p> <p><i>"This 1/8 represents the productive zones of the ocean along the equator and the western margins of continents. Currents in these areas cause upwelling, which brings nutrients to the surface. These nutrients support large numbers of marine plants and animals."</i></p>
1/8 peel	Photic Zone	<p>3. Carefully peel the 1/8 slice of Earth.</p> <p>Hold out the peel.</p> <p><i>"This peel represents the photic zone, the top 100 meters (330 feet) of the ocean which light can penetrate, supporting photosynthesis. Since the marine food chain depends on algae and photosynthesizing plants, especially phytoplankton, almost all ocean life depends on this narrow photic zone. At 100 meters below the surface, the amount of light is only 1% of what it is at the surface."¹¹</i></p>

Discussion Questions:

1. What jeopardizes the oceans' health and capacity to produce food for us?

The two major factors are water pollution and over-fishing. Rapid human population growth is at the root of both problems.

- **Water Pollution:** Fish and shellfish use estuaries (water passages where rivers and tidal currents merge, usually in shallow waters near shores) as spawning grounds. But rising levels of water pollution and destruction of coastal ecosystems make it increasingly difficult for sealife to find healthy spaces in which they can successfully reproduce. Approximately 44% of the estuaries in the United States currently suffer from pollution and habitat degradation.¹²

About 40% of the world's and 43% of the United States' populations live within 100 km, or 62 miles of a coastline (about 2.3 billion, and 126.5 million people, respectively).¹³ Much of the sewage, trash, industrial pollution, and agricultural run-off produced by these populations finds its way into nearby coastal waters. Inland communities also contribute to ocean contamination, as rivers carry the same pollutants from landlocked population centers out to sea.

- **Over-fishing:** When we take too many fish from the oceans, there are too few left to reproduce and restore their population. Between 1950 and 1995, the world's human population more than doubled and, in turn, the monitored annual world fish catch almost quadrupled. The Food and Agriculture Organization of the United Nations estimates that 11 of the world's 15 major fishing grounds and 70% of major fish species are overexploited.¹⁴

2. How can we preserve the oceans' health and food-producing capability?

- By voluntarily restricting our seafood consumption, so the fish stocks will have a chance to regenerate.
- By reducing pollution in all its forms: We each encounter many opportunities to do this in our daily lives. Placing trash in the proper receptacles keeps it from finding its way into waterways. Taking hazardous substances (such as used motor oil, antifreeze, and other household toxins) to disposal centers rather than emptying them into the sink, toilet or storm drain keeps them out of the water supply and natural bodies of water. Maintaining our cars properly can prevent their leaking oil and other substances onto the roads, which would otherwise "run off" the pavement whenever it rained, into lakes, streams, rivers and eventually, the ocean.
- By stabilizing population growth: Again, more people will consume more resources and produce more garbage and other forms of pollution.

This activity is based on one that originally appeared in KUITATK, a Native American Science Education Association Issue Publication. The water section based on "Apple Ocean," from: Project O.C.E.A.N. Habitat Curriculum Guide (Draft) by the Oceanic Society/San Francisco Bay Chapter, Building E, Fort Mason, San Francisco, CA 94123.

Sources:

^{1,2} The U.S. Global change Research Information Office: www.gcrio.org/geo/soil.html. ^{3,4} David Pimental, et. al "Will Limits of the Earth's Resources Control Human Numbers?" *Environment, Development, and Sustainability*, 1999, p. 22-23. ^{5,6} Brown, Lester, Gary Gardner and Brian Halweil. *Beyond Malthus*. New York: W.W. Norton & Company, 1999. pp. 35-6. ⁷ U.S. Department of Agriculture website: www.nrcs.usda.gov/technical/land/mapgif.asp?mapid=4390. ⁸ The World Bank. *2003 World Development Indicators*. Washington, DC: International Bank for Reconstruction and Development, 2003, p. 106. ⁹ Brown, Lester, et al. *Beyond Malthus*, p.103. ^{10,14} Brown, Lester R., et al. *State of the World 2000*. New York: W.W. Norton & Company, 2000. p.187-8. ¹¹ "Apple Ocean." Project O.C.E.A.N., 1988. ¹² American Oceans Campaign. *Splash*. Vol. 12, No. 1, Spring 2001. ¹³ World Resources Institute website, http://earthtrends.wri.org/searchable_db/index.cfm.