

Earth: The Apple of Our Eye

Student Activity

Method:

A visual demonstration of the limited sources of food available from Earth's land, followed by discussion of how to feed a growing population.

Introduction:

Only about three percent of the Earth's surface is capable of growing food. Over the past century, farming technology has made it possible to produce more food from the world's limited cropland to feed the growing world population. However, much of this arable (farmable) land has been taken out of production for urban/suburban development and livestock grazing, or has been mismanaged leading to irreparable soil erosion. By 2030, we will need to produce 30 percent more grain to feed the expected population of 8.5 billion. Protecting our arable land resources is becoming more important than ever.

Procedure:

Slice the apple according to the instructions, narrating as you go. Use the Q & A to encourage critical thinking in discussion of these facts.

Farmland		
Apple	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) "So, 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, length wise. 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 can't necessarily grow food."</i>
3/32	Habitable, 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>



Concept:

Farmland is an essentially non-renewable resource that we depend upon for our food. As the population grows, food needs increase, but farmland is often diminished.

Objectives:

Students will be able to:

- Describe Earth's geography as it pertains to habitable/uninhabitable land, developed land, and farmland.
- Discuss threats to farmland and ways it can be preserved.

Subjects:

Geography, environmental science, mathematics

Skills:

Understanding cause-and-effect, deductive reasoning, group discussion, research

Materials:

An apple
A knife
Paper towel

Key Terms: arable, crop rotation, fallow, topsoil

Apple	Earth	Narrative
1/32	Arable Land	7. Set 3/32 aside and hold out 1/32. “So, <i>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. 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 percent of U.S. croplands lose topsoil above the sustainable rate.</i> ” ¹

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, unsustainable farming practices, and animal grazing.

- In the U.S., soil is now eroding at 10 times the rate at which it forms. The soil erosion rate in China and India is estimated to be 30-40 times faster than the replenishment rate.²
- In order to feed the nine billion people expected in 2050, food production must increase by 70 percent.³
- Land degradation is intensifying in many parts of the world, with more than 20 percent of cultivated areas undergoing degradation, affecting one-fourth of the world’s population.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 2000 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 2 billion tons. At the U.S. level of consumption (800 kg of grain per person for food and feed), the world’s grain harvest would support 2.5 billion people. At the Italian level of consumption (400 kg), we could support 5 billion people. At the level (200kg) consumed by the average Indian, it would support a population of 10 billion.*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 portion 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 percent 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 feedlot 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 inaccessible 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.*

Assessment Idea:

Have the students imagine that they are citizens of a town that is rapidly growing, and the city council is considering expanding the urban area onto some nearby farmland. Have each student write a letter to the editor or an op-ed for a fictitious newspaper in this town explaining the consequences of doing so.

Sources:

^{1,2} U.S. Global Change Research Information Office. 18 May 2004 www.gcrio.org/geo/soil.html.

³ Food and Agriculture Organization (FAO), "How to Feed the World in 2050," 2009, www.fao.org

⁴ Food and Agriculture Organization, "Land Degradation on the Rise," FAO Newsroom, July 2, 2008, www.fao.org

^{5,6} Brown, Lester. *Plan B 4.0: Mobilizing to Save Civilization*. Earth Policy Institute. New York: W.W. Norton & Company, Inc., 2009.

⁷ U.S. Department of Agriculture, 18 May 2004 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, *World on the Edge*. (New York: W.W. Norton & Company, Inc.), 2011, p. 173.