



Grade Level: 3-12

Essential Skills: 5, 8

NGSS: 5-LS2-1, 4-ESS2-2, MS-ESS2-1, HS-ESS2-1

CCSS: RI.3.7

Math: NF.3.1

Time: 15 minutes

Materials:

One apple, knife, *Earth as Apple* worksheet (optional: world map)

Soil Facts:

- Life on Earth depends on soil: plants get food from soil, and animals get food from plants or animals that eat plants.
- Soils form very slowly - about one inch per 100 years.
- Soil are the largest water filter on the planet and can produce clean water through physical, chemical, and biological services.
- From 2002-07, 4+ million acres of agricultural land were paved over; an area the size of Massachusetts.

AITC Library Resources:

Check out these materials online at AITC's [Lending Library](#):

Books:

Cycling Back to Nature - Soils Alive!

The Soul of Soil

Caretakers All

More Lessons:

From Rocks to Soil

Water Filtering and Soil

Lesson to Grow

Part I: Earth as an Apple & Soil Conservation

Description:

Students learn about the small fraction of the planet available for growing food and ways this important land can be protected. This two-part lesson is an excellent way to introduce students to the importance of preserving soil and soil's role in feeding 7+ billion people.

Directions:

Set the stage: Display a map of the world so all the students can see it. Ask students if they know what amount of the Earth is water and what is land. Then, show students an apple and ask them to imagine it is the Earth they see on the map.

1) Begin the demonstration by first cutting the apple in half lengthwise, then half again. Ask students as you go what the fractions are as you progress through the activity. Once the apple is cut into fourths, set three of the four pieces to the side (3/4th) and explain they represent the bodies of water on the planet. This includes oceans, seas, lakes, and rivers. The remaining 1/4th represents the land area on the planet.

2) Have students fill in the worksheet (attached) as you explain the land resources of the Earth.

3) Cut the 1/4 land piece in half so you have two 1/8th sections. One of these pieces represent land on the planet that is not suitable for producing food or for human habitation. This includes deserts, swamps, high mountainous regions, the Arctic and the Antarctic. The other 1/8 piece represents land suitable for humans to live.

4) Next, slice the 1/8 piece lengthwise into four equal parts. This should give you four 1/32 sections of apple. The first 1/32 section represents areas of the world where the soil is too rocky or poor quality for any type of food production. The second 1/32 piece represents the areas of the world too wet for food production. The third section represents land that has been developed by humans into cities, roads, parking lots, etc.

5) Carefully cut the peel off the last 1/32nd section of apple. This thin sliver represents (about 3% of the Earth's landmass) all the topsoil of the planet where food can be grown.

6) Pause and let this sink in with your students. Discuss with students the soil facts in the side bar. The human population is growing at a rate of 1.1% annually and each year agricultural land is being lost to development. What does this mean for them?



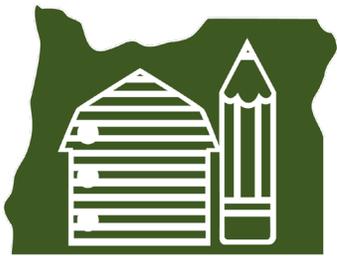
Step 1: 3/4 of earth's surface is water, 1/4 is land.



Steps 3-4: 1/8 of earth's land is unsuitable for human habitation/farming, 1/32 soil too rocky to farm, 1/32 too wet to farm, 1/32 is cities and roads, 1/32 (3%) is farmable.



Step 5: The skin of a 1/32 piece represents the Earth's **topsoil** available for farming.



Part II: Earth as an Apple & Soil Conservation

Description: In this two-part lesson, students first view historical images of the Dust Bowl and read a diary entry representative of the time. Students learn how human actions can effect soil, and in turn, the landscape and people. In the second part of the lesson, students look at what was learned from the Dust Bowl, and changes it made in farming methods and soil conservation practices.



Grade Level: 3-12

Essential Skills: 2, 3, 5

CCSS: RI.3-4.3, RI.3-6.7, RI.3.8, SL.3.3

Social Sciences: 3.13, 3.18, 3.20, 4.19, 5.10, 5.11, 6.15, 8.6

NGSS: 3-ESS3-1, 3-LS4-4, 4-ESS2-1, 5-LS2-1, 7-LS2-4, 7-ESS3-4

Time: 1 class period

Materials:

Worksheets, historic images of the Dust Bowl

AITC Library Resources:

Check out these materials online at AITC's [Lending Library](#):

Books:

Manual for Judging Oregon Soils

Instructional Units:

Cycling Back to Nature - Soils Alive! - Grades 6-11
Caretakers All - Grades 3-9

Video:

Dirt: Secrets of Soil

Could it happen today?

Yes, there are places in the U.S. and around the world that experience Dust Bowl-like conditions due to prolonged droughts.

Part A: The Dust Bowl - Cause & Effect

Teachers - Prepare for this lesson by reading the *Background Material* included in this lesson. It provides general information on soil, the Dust Bowl and new farming practices to help conserve soil.

- 1) Distribute copies of *The Dust Bowl - A Turning Point* and the *Dust Bowl Diary* worksheets. The two worksheets are designed to be used together. Have students read the diary entry and look at the photos on the sheet.
- 2) Students work in small groups to complete the *Turning Point* worksheet. The teacher copy of this worksheet includes text to read to students as they review the images and consider the causes and effects of the Dust Bowl.
- 3) Facilitate the process by asking students the following questions.

Ask: What problems do you see in these pictures and in the diary entry?

Blowing soil is covering land in drifts. The soil looks very dry. There are no plants to hold the soil. Huge ominous clouds of dust fill the sky, fields look like dunes and have no vegetation.



Ask: Where and when do you think these photos were taken?

While students may have seen sand drifts near the coast or by large lakes, point out this photo was taken far from any ocean. These images were taken in South Dakota and other plains states in the United States during the 1930s.

Ask: What clues from the diary help explain why this region was called the "Dust Bowl"? *Windstorms, lack of rain, everything was covered with dirt, etc.*

Ask: What do you think might have caused the problem? What are the effects? *Encourage students to speculate and fill in the worksheet. Refer to teacher copy for answers.*

Extension Activity:

A picture is worth a thousand words. Share with your class Oregon AITC's **You Tube** Dust Bowl playlist. There are historic clips like Discovery Channel's, *The Making of a Continent*. Plus, clips of modern dust bowls.

Lesson to Grow

Part II B: Lessons Learned in Soil Conservation

Description: In this part of the lesson students learn about soil conservation methods that came about as a result of the Dust Bowl. They will complete a worksheet that poses problems they might face as a farmer. Teachers lead students in a question and answer exchange on farming and soils. A class field trip around the neighborhood to find signs of erosion (human, weather, or animal caused) is an ideal way to wrap up the lesson.

1) Lead students in a Q/A discussion before handing out worksheets.

Teachers - prepare for the activity by reading the *Teacher Background* section to provide you with general soils information and the Oregon conservation picture. Possible questions:

Ask: What is soil erosion? What caused soil erosion in the Dust Bowl?

Erosion is the wearing away of soil by wind and water. It is caused by wind, drought, and plowing away the plant cover.

Ask: What else could erode the soil? Have you seen erosion? Where, and was it caused by man, animals or weather?

Water or gravity (if land is on a slope, etc.); Vacant lot, lawn, river banks, beach, hillside, etc.

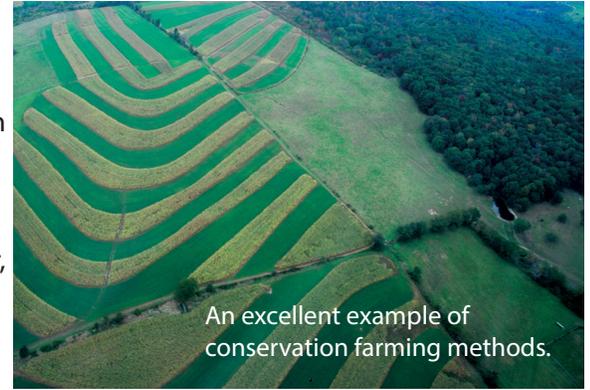
2) Project aerial farm images for students to see and find any signs of erosion or conservation. Ask students questions like: Why are there paths through some of the crops? Why doesn't the farmer cut down the trees so he can plant more crops? What evidence is there that the farmer is a good planner?

On these farms there are no barren areas of cracked, parched earth like the images from the Dust Bowl. Vegetation is lush and green. Both photos show extensive farmsteads with windbreaks, terraces, and grassed waterways. Grassy waterways have been planted to slow down water and to repair or prevent the formation of gullies.

Ask: How can farmers survive bad weather like the drought of the Dust Bowl? Why does the farmer plant the crops in curved rows? Why does the farmer plant strips of different crops?

3) Activity sheet - **Soil Conservation Solutions**. The Dust Bowl taught people the importance of being good caretakers of soil. This worksheet covers five important farming techniques that save soil. (**Worksheet answers: C, A, E, D, B**) Students work through the worksheet in pairs and review as a class. There may be more than one answer, ask students to justify answers that differ.

4) Erosion is not just a problem for farmers. Take an erosion walk around your school. Have students be on the lookout for signs of erosion from rain, snow, wind, animals, or people. Look for areas that need to be cared for in order to preserve and improve the environment. Make a list of problem areas. Try to identify what is causing the erosion of these areas and develop creative solutions and ways students can help.



An excellent example of conservation farming methods.



Urban water erosion



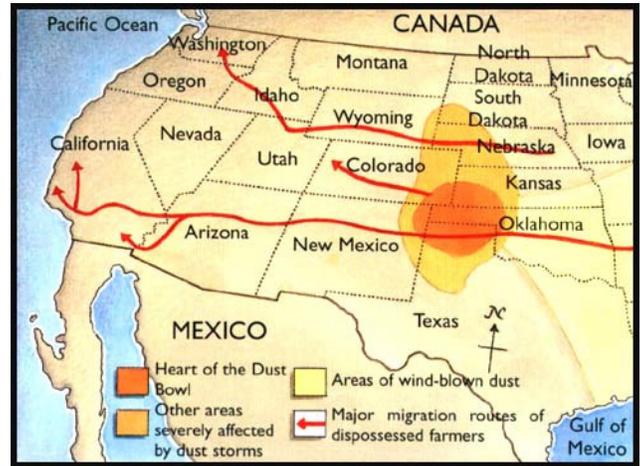
Urban erosion from construction

Teacher Background Info: Dust Bowl & Soil Conservation Today

Soil's Vital Role in Life on Earth

Soil is the storehouse of water and food (nutrient) for living plants and microorganisms. Minerals in the soil are absorbed by plants and provide nutrients to living things.

Humans depend on soil to produce food and fiber they need to survive. Plant roots help hold soil in place, absorb water and protect soil from the direct force of wind and rain. **Soil erosion** is the wearing away, or loss, of soil (from a given area) through the action of wind, water, or other forces. Plant roots help hold soil in place, absorb water and protect soil from the direct force of wind and rain. Human activity increases the opportunity for erosion when people remove plant life for construction, harvesting, mining or farming.



Dust Bowl and Farming Today

During the 1930s, in the Plains states, plowing of sturdy native grasses, mixed with a seven-year drought and winds, stripped topsoil from the land and farmers could not grow crops. During this period great clouds of soil were blown hundreds of miles. This region became known as the Dust Bowl.

Conservation Methods: Farmers learned from this experience and today implement soil conservation practices to reduce erosion and allow the land to recover. Farmers leave the roots and stubble of crops on the field (**conservation tillage**) and plow as little as possible. They create grass channels (**waterways**) to deter water erosion during rainy times. They plant strips of shrubs and trees (**windbreaks**) along the sides of fields buffeted by prevailing winds (**windward**) to protect the soil from wind erosion. They plant crops in strips (**strip cropping**), with grassy cover like hay or clover planted between row crops like corn. This protects soil that might otherwise be blown or washed away from row crops. Farmers plant crops across the contours of hills (**contour farming**) rather than straight up and down the hills. On steeper slopes, they build terraces in addition to contour rows. Farmers who raise cattle plant grass, which holds the soil in place better than crops. This slows water runoff and prevents water from racing down the hills carrying away valuable topsoil.

Farmers improve the soil by rotating the crops they plant, since different plants use various nutrients from the soil. This is called **crop rotation**. Farmers replenish the soil by leaving crop stubble in the field and by planting legumes, such as alfalfa, clover, peas, soybeans, and peanuts. These plants give nitrogen back to the soil.

According to the U.S. Department of Agriculture's Natural Resource Conservation Service, farmers reduced erosion caused by water by 43% from 1982 to 2003, and they continue to find new ways to protect the soil. **In Oregon cropland erosion declined by 54% from 1982-2007** as growers changed tillage practices, added buffers, etc.

Oregon's Land Conservation Picture

The United States is the most productive agricultural country in the world. In fact, U.S. farmers and ranchers produce about 16% of the world's food on just 7% of the world's agricultural land.

In Oregon, about 28% of the state's land (17.1 million acres) is in agricultural production. This figure includes farms with over \$10,000 in annual sales.

Oregon land use laws enacted in the 1960s and 70s established exclusive farm use zones with the intent of protecting farm operations from urban pressures. At the time, it was considered revolutionary to create "urban growth boundaries" that required planned expansion, and exclusive farm use zones (EFU), forest zones, and rural residential zones. Oregon was a national leader in this type of planning.



Activity Page

Dust Bowl Diary - Read and Reflect

Read the diary entry below that could have been written by a teenager in the 1930s living through the Dust Bowl. How do you think the writer is feeling? What emotions would you feel living surrounded by dirt and dust storms? Would you want to move or stay and save your family's farm?

Dear Diary,

Last night I placed my head on my white pillow case. When I woke up this morning my silhouette was the only white on my pillow.

Last night there was another storm, but no rain. I heard the wind howling and shaking the windows. Even though my windows were closed tight, the wind pushed the dust in through invisible cracks.

The dust must have been so tired of the wind chasing it that it decided to lay itself down to rest on my bed and on me.

Outside, drifts reach almost to the window of the shed. No, it didn't snow; it was soil piling up outside the window. Good topsoil! Usually good for growing corn and wheat and beans, but no good when the wind has it on the run.

If only it would rain. We keep putting seeds in the ground but the ground doesn't stay put! Yesterday morning there was so much soil in the air that it blocked the sun. Everything seems upside down.

Morning is like evening. The sky is filled with soil instead of rain. Seeds are floating in the air instead of taking root in the earth.

If only it would rain. Rain would make soil and seeds lie down. If the seeds could just lie still long enough to sprout, their roots would hug the soil. All of us would be happy then. Tomorrow we will try again even though Pa says the seeds will most likely blow right on down the road with the soil. If these seeds don't stay, Pa says neither will we.



The Dust Bowl - A Turning Point



Directions: Examine these images and reflect on the Dust Bowl Diary reading. Record what you think were the causes of the Dust Bowl and the effects it had on the land and people. Could this happen again?

CAUSES	EFFECTS
1)	1)
2)	2)
3)	3)
4)	4)
5)	5)
6)	6)



The Dust Bowl - A Turning Point



Directions: Examine these images and reflect on the Dust Bowl Diary reading. Record what you think were the causes of the Dust Bowl and the effects it had on the land and people. Could this happen again?

CAUSES

- 1) Wind
- 2) Wind
- 3) Lack of rain/drought
- 4) Plowing left the soil exposed and it dried out
- 5) There were too few plants left to hold the soil
- 6) Drying heat, hot weather

EFFECTS

- 1) Difficulty breathing for people and animals
- 2) Good soil carried to other locations, away from the farms
- 3) Loss of top soil
- 4) There were no pasture areas for livestock
- 5) Soil filled the air, hard to see, day seemed like night
- 6) Farms failed, couldn't raise crops

Teachers: As students reflect on the images read the following passage. Also, links to YouTube video clips of the Dust Bowl are available from AITC to share with students.

Settlers removed more and more grasses and plowed more and more land. In the 1930s there were seven continuous years of intense drought. The ground dried up, crumbling into small pieces. Crops withered and died. The grass-less soil became dirt and then dry dust. Strong winds blew continuously and swept the soil from states like Kansas east towards Chicago, New York and Washington D.C. and finally over 100 miles out in the ocean where it settled on ships.

On the Great Plains visibility during dust storms was low and many people had trouble breathing. Fields lost from 2-12 inches of topsoil. It was at this time that people realized that soil needs protection. The Dust Bowl was a series of combined natural and man-made disasters that could have been lessened with soil conservation practices.

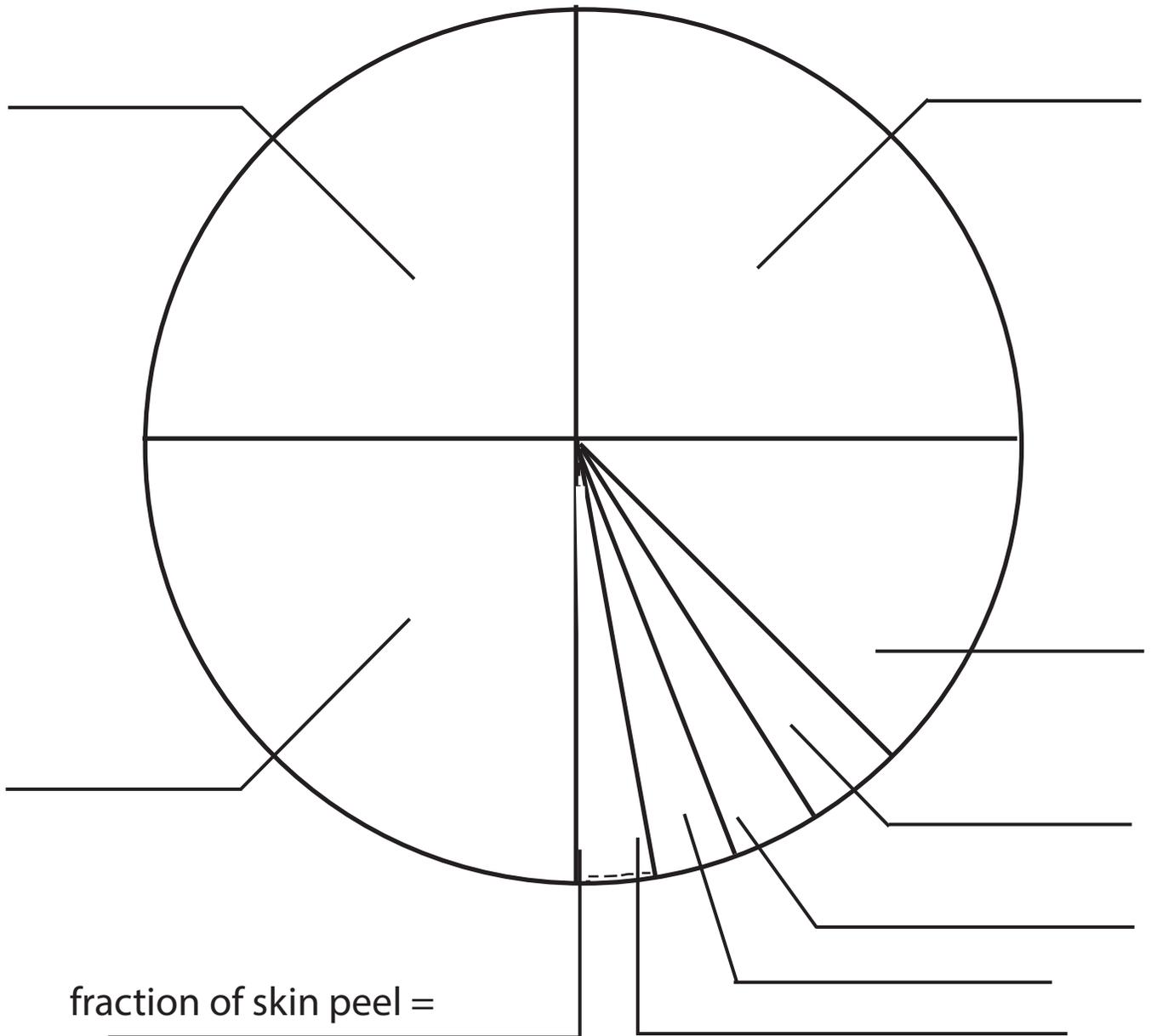
This lesson was adapted from materials in [Caretakers All](#).



Activity Page

The Earth as an Apple

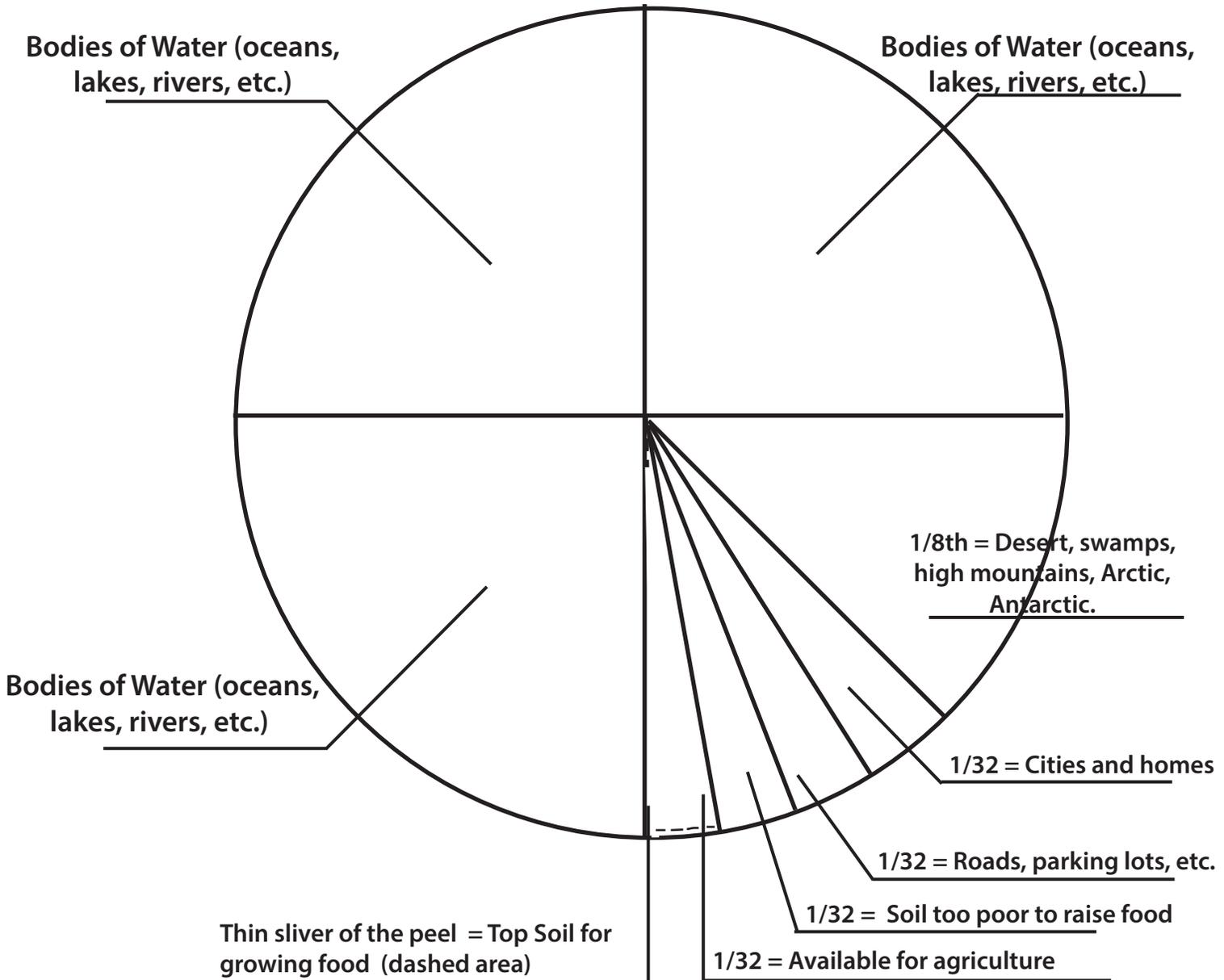
Directions: Label the segments of the graph, using the information from the teacher's demonstration. When you are finished, color the graph, using a different color for each segment.





The Earth as an Apple

Directions: Label the segments of the graph, using the information from the teacher's demonstration. When you are finished, color the graph, using a different color for each segment.





Activity Page

Soil Conservation Solutions

Directions: You are a farmer who needs to protect your soil. Below are series problems your farm has with its soil. Using information on conservation from the attached page, write the a short description of how to best solve your problem. Read carefully and look closely at the pictures for clues. There may be more than one way to solve some of the problems.

- 1) The wind from the west hits your fields full blast. How can you protect the topsoil so it won't blow away?
- 2) Water is creating a gully during the spring rains. What can you do to slow down the runoff?
- 3) How should you plant your crops so the water doesn't wash ruts between the row of plants?
- 4) Your fields are very hilly. How can you stop the topsoil from being carried to the bottom?
- 5) Winter is coming, should you plow this year's crop remains back into the soil? Why or why not?

Images to show extensive farmsteads with windbreaks, terraces, and grassed waterways.





Activity Page

Conservation Solutions

Before



After



GRASSY WATERWAYS: Grass is planted in the path runoff water follows. To the right is an example from a farm in Linn County. On this farm a grassed waterway was added to this field to prevent erosion. There was an 80% improvement after installation. It continued to improve as the grass waterway became more established.



NO-TILL or CONSERVATION TILLAGE: This involves leaving last year's crop-remains on the field instead of plowing them under. Crop remains are materials left in the field after the crop has been harvested. They include stalks and stubble (stems), leaves and seed pods. No-till can be used for almost any crop in almost any soil and can also save growers labor costs and fuel. It's a sound investment for the environment and farm.

WINDBREAKS: Planting strips of trees or bushes along the windy edge of the field slows down the wind and protects the soil. Photo shows line of spruce trees as a windbreak on an Oregon farm.



CONTOUR FARMING: Planting crops across the slope of a hill instead of up and down the hillside reduces water runoff.

STRIP CROPPING: Planting crops in strips with grassy crops like hay between rows of corn or other crops. This Oregon farm uses strips of row crops planted on the contour and alternates with strips of grasses or small grains.

