NATURAL RESOURCES

-Soil

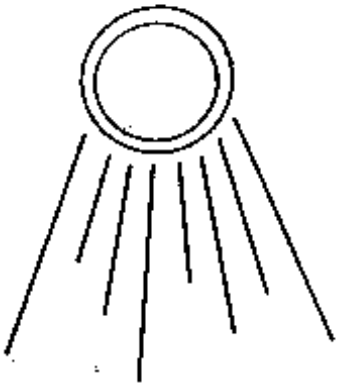
-Water

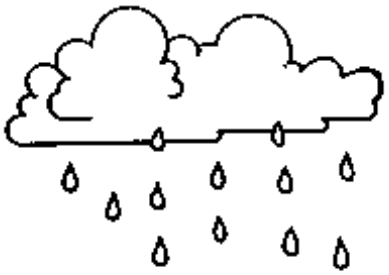
-Weather

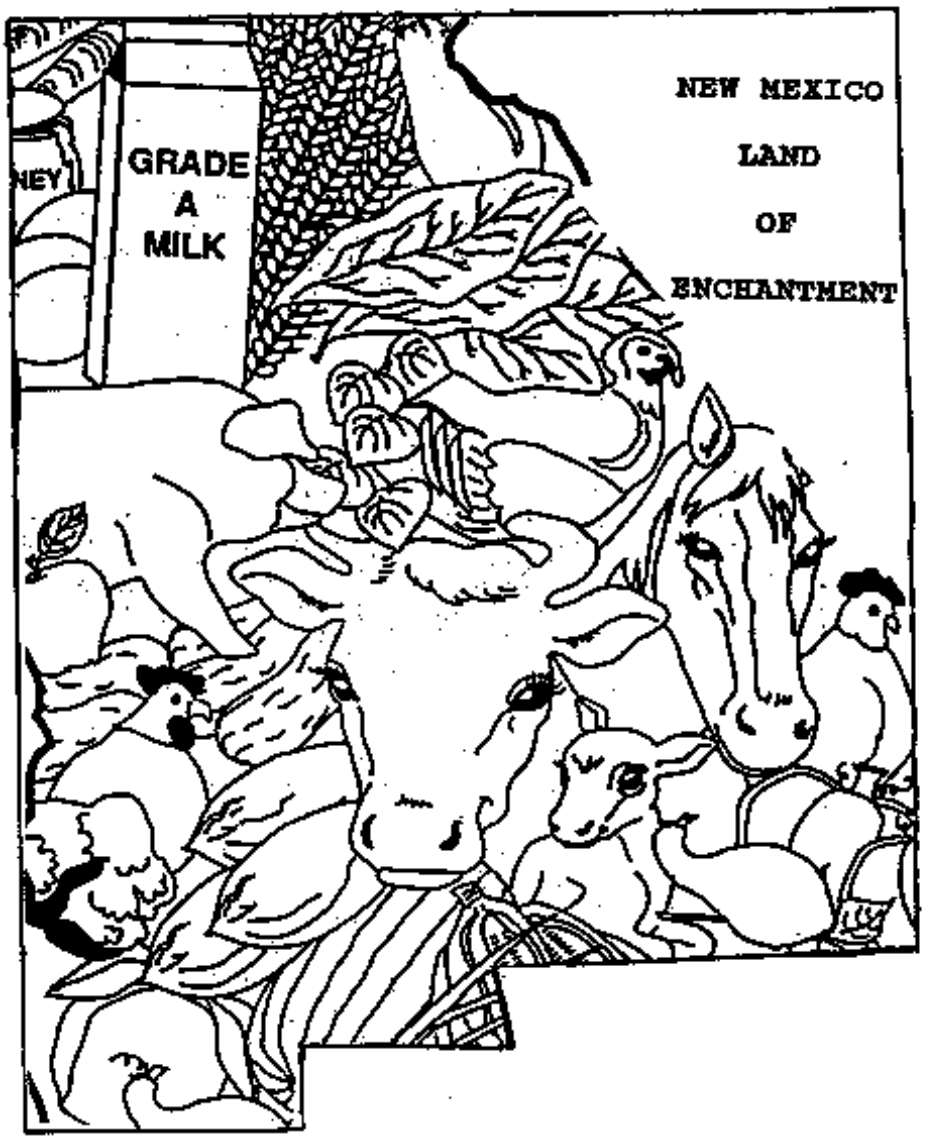
-Plants

-Rangeland

Name _____







Name _____

NEW MEXICO AGRICULTURE

What are natural resources?

Natural resources include water, soil, sunlight, air, minerals and natural vegetation such as range grasses and forest supplies. This means we must all learn to conserve these precious resources. We must all work together to protect and enhance our environment. Discover 3 ways you can help keep our planet green and growing!

*To Discover Natural Resources, unscramble the following words:

taerw _ _ _ _ _ olis _ _ _ _ ria _ _ _

hilusngt _ _ _ _ _ _ _ _ lnmeasir _ _ _ _ _ _ _ _

tsrfoe _ _ _ _ _ _ garne gasrses _ _ _ _ _ _ _ _ _ _

*Look up the word Conserve in the dictionary. Write the definition below:

Conserve:

_____

_____

_____

How I can Help Protect and ENHANCE THE ENVIRONMENT

List the 3 ways you discovered below:

1. _____

2. _____

3. _____

Name _____

New Mexico Agriculture

PROTECT OUR NATURAL RESOURCES

Use the code to discover what Natural Resources include.

A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y	Z
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26

23 1 20 5 18 19 15 9 12 1 9 18

19 21 14 13 9 14 5 18 1 12 19

6 15 18 5 19 20

18 1 14 7 5 7 18 1 19 19 5 19

WORD SCRAMBLE

Unscramble these words used in the Natural Resource section.

rieonso _____

stocopm _____

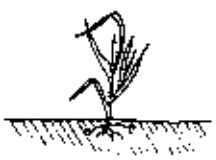
rete _____

eramfr _____

sercontionva _____

NATURAL RESOURCES . . .

Handle with care!



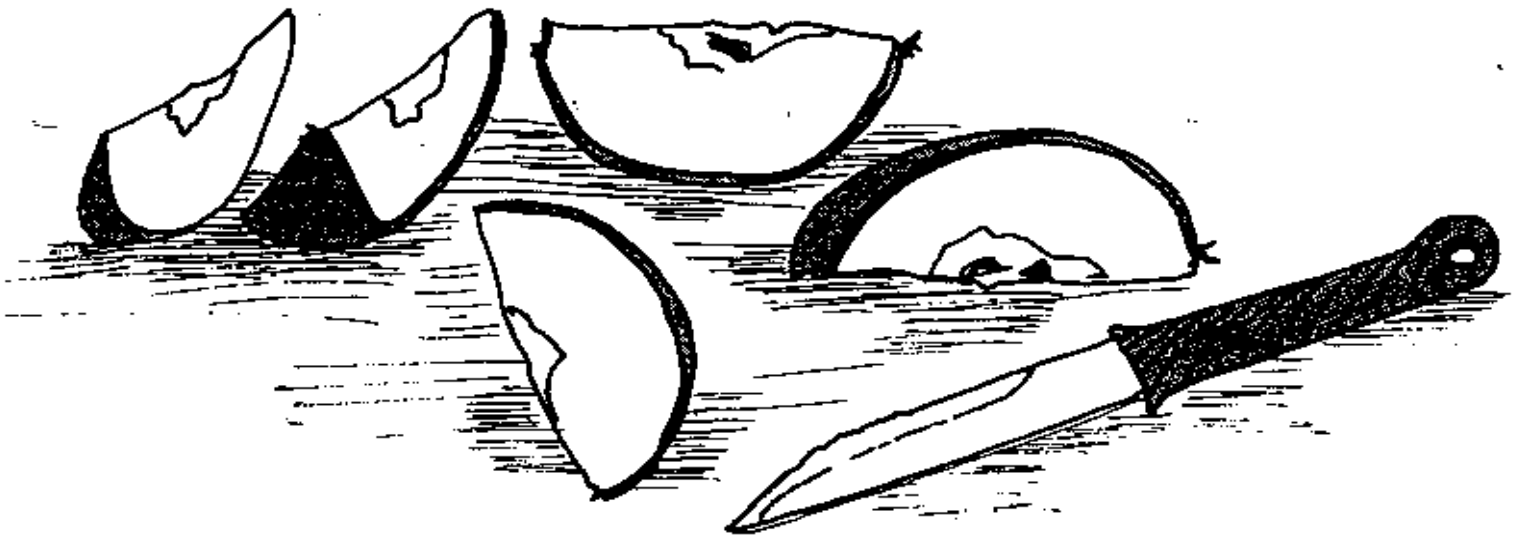
Name _____

S O I L

SOIL CAN BE REGENERATED, BUT IT TAKES ABOUT 500 YEARS TO FORM ONE INCH OF TOPSOIL. AN INCH OF TOPSOIL CAN WASH AWAY IN JUST ONE AFTERNOON IF IT ISN'T PROTECTED AGAINST STRONG RAIN AND WIND STORMS.

A SLICE OF SOIL

(Demonstration)



Name_____

A Slice of Soil -- Getting to the Core

How much of the earth's surface is soil capable of producing food? How much cannot grow food but will graze livestock? How much of the earth's surface is ocean, deserts, mountains, etc.? The following demonstration helps students understand what makes up our earth's surface.

* **Materials needed:** Large apple and paring knife

Consider the earth as an apple.

Procedure:

1. Slice an apple into quarters.
   * Three quarters represent the earth covered by oceans. What food do we get from the oceans?

   * The 4th quarter roughly represents the total land area left.

2. Slice the 4th quarter representing land in half lengthwise, giving you two 1/8th land pieces.

   * One of these pieces represent land inhospitable to people-- polar areas, desert, swamps, antarctic, arctic, and very high, rocky, mountainous areas.

   * The other 1/8th piece represents land where people live, but not necessarily grow foods needed for life.

3. Slice this 1/8th piece into four sections, giving you four 1/32nd pieces.

   * 1/32nd piece = land too rocky, wet, cold, steep, or hot for food production.

   * 1/32nd piece = land covered with cities, highways, suburban developments, shopping centers and other structures people have built.

   * 1/32nd piece = this section has poor soil, gets very little rain or is too hilly to be used for farm crops. Some people feel this land should be used to produce food. They do not understand that this land will not grow crops but is land capable of growing grasses which livestock can utilize--people cannot. By allowing livestock (cattle, sheep, goats, etc.) to graze this natural resource we efficiently keep it from being wasted and utilize it to

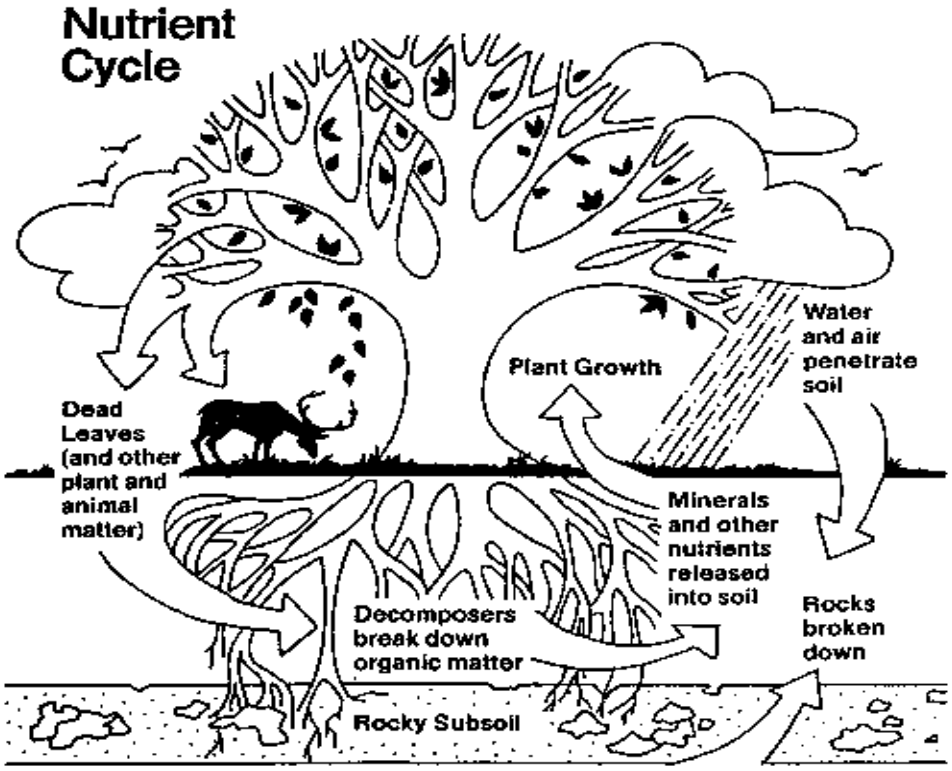
Name_____

produce meat, clothing and many other by-products for people.

* 1/32nd piece = this leaves us with a 1/32nd slice of the earth. Carefully peel this slice. This tiny bit of peeling represents the top layer of soil upon which all people depend for food. Less than 5 feet deep, it is quite a fixed amount of food-producing land.
On this small area farmers must produce enough food and fiber to feed, clothe and shelter the world. Now you realize that protecting our land resources is important. Advanced agricultural technology has enabled the world to feed many
people. One American farmer/rancher can feed 128 people (94 in USA and 34 abroad). With a fixed land resource base and an increasing number of people feeding from the base each persons portion becomes smaller and more important to the individual. We must all protect our natural resources and the environmental quality of our air, water and land!

— Make a circle graph depicting the portion of the earth's surface used to grow crops, graze livestock, cities and homes, mountains, oceans, ect.

SOIL ECOSYSTEM



Name_____

SOIL FACTS

Soil makes up the outermost layer of our planet.

Topsoil is the most productive soil layer. It has varying amounts of organic matter
(living and dead organisms), minerals, and nutrients.

Five tons of topsoil spread over an acre is as thick as a dime.

Natural processes can take 500 years to form one inch of top soil.

Soil scientists have identified over 70,000 kinds of soil in the United States.

Soil is formed from rocks and decaying plants and animals.

An average soil sample is 45% minerals, 25% water, 25% air, and 5% organic matter.

Different sized mineral particles, such as sand, silt, and clay give soil texture

Lichens help to break apart rocks to form soil.

Fungi and bacteria help break down organic matter in the soil.

Plant roots break up rocks, which becomes part of new soil.

Roots hold soil together and help prevent erosion.

Five to ten tons of animal life can live in an acre of soil.

Soil is not dirt

Soil is the loose top layer of the earth's surface which is suitable for the growth of plant life.

Soil first begins as parent material. It is broken down to soil particle sizes by climate conditions such as wind, rain, plants and living organisms. The speed at which this breaking down takes place is determined by what kind of topography or climate it is in. For instance, a parent material on a hillside is more likely to be broken down by wind, rain and temperature changes faster than rocks on level ground. This breaking down is called erosion.

Erosion can be good or bad. Soil forming erosion is good. Erosion that blows soil or washes good soil away from where it is needed is bad.

Living organisms help to decompose leaves, wood, and roots which will become the organic parts of the soil. Plants die, decay, and add nutrients or soil vitamins to the soil. These nutrients are necessary for healthy plant and crop growth. Organic matter from decayed plants is responsible for the black color usually seen in the top few inches of soil. If the soil does not have enough nutrients, farmers may add them to the soil by fertilizing.

Name_____

This can be very expensive to do.

Small burrowing animals, worms, and insects continually churn and mix the organic soil matter with the parent soil particles. This is the natural or organic way of adding nutrients to the soil. In just one acre of land, there may be fourteen million insects and one million earth worms!

Soil Layers

Soil is formed in layers. Each layer has a name.

The very top layer of soil is called the organic layer. This is the darkest layer and consists of leaves and other organic matter. Organic matter is the decaying plants and insects that were once living. Organic farmers rely only on this process to fertilize their crops.

The next layer down is called the topsoil. It is also a dark layer. The already decayed organic matter is found here. This is the layer the farmer plows under and cultivates when preparing a field for planting. The top soil is the most productive layer of soil and is where planted seeds begin their growth. Most nutrients are derived from this soil layer.

The third layer down is called the sub-soil. Here all the nutrients from the topsoil accumulate as they are washed down into the subsoil from the topsoil. As plants grow, roots reach down to this layer for water and nutrients to grow healthy.

The fourth layer comes just before the parent rock layer. Partly broken down and disintegrated parent materials may be found here.

The amount of sand, silt, and clay a soil has in it determines how much water and how many nutrients it will hold. This is called soil texture.

Silt is the very finest particle found in soil. It feels like powder. Sand is a coarser particle and allows air to enter the soil. Clay is sticky and helps to keep water in the soil.

Farmers and ranchers can have the texture and the nutrients in their soil checked by soil scientists. A wise farmer knows what kinds of soils make up his fields, so he can plant crops that grow best in each kind of soil. This will also allow him to care for the land in the best possible way so that it will continue to be productive.

Name _____

STUDY QUESTIONS

1. Soil is formed by the interaction of _____, _____, _____, _____ and _____.

2. The top layers of soil are called _____, _____, and _____.

3. Soil texture is determined by the amount of _____, _____, and _____ it has in it.

4. Soil nutrients necessary for healthy plant growth accumulate in the _____ layer.

5. Seeds begin their plant growth in the _____ layer of soil.

6. _____ in the soil allows air to enter the soil.

7. _____ helps to retain water in the soil.

8. What kind of soil is in your area? Humid, arid, semi arid?

Soil	Soil Use
A - Arid to Semi arid plains	Rangeland and dryland farm
B - Arid to sub humid plains	Mostly rangeland, some dryland farming
C - Arid to sub humid mountains	Mostly rangeland - some dryland farming
D - Sub humid - humid mountains	Timber - recreation - water runoff
E - Semi-arid - humid	Rangeland, fruit orchards and farmland. If it is a dry summer irrigation will be necessary.

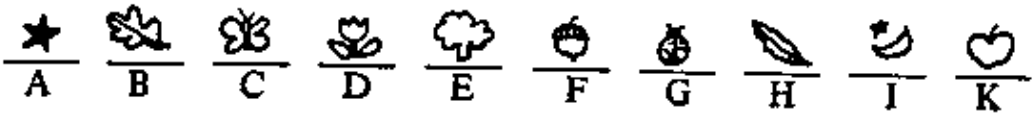
Arid: Soil that is dry over half the time it is warm enough to plant.

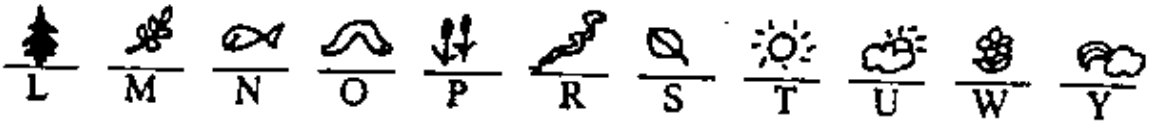
Sub humid: Soil that is dry less than half the time it is warm enough to plant.

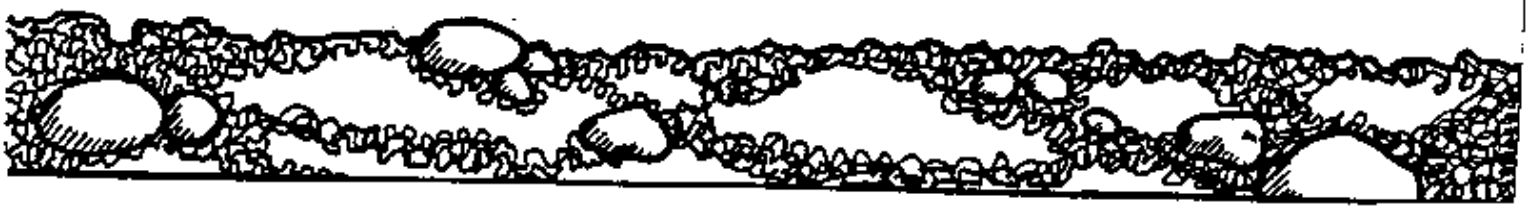
Humid: Always moist.

Weathering Away

In the coded message below, find out what helps make soil. Write the letter of each picture clue over the same picture in the puzzle.







Name _____

Soil Layers Activity

Objectives
To learn the percentages of each type of particle in collected soil samples by calculations and observations. Time: 50 minutes

Materials
Soil samples from four different areas
Quart jar with lid
Calculator
Ruler

Procedure
Collect soil samples from at least four differing soil areas. You might collect from pine forest, river bank, swampy area, grassy meadow, or farm field. Place part of each of your samples in a jar and fill each jar 3/4 full of water. Cap the jars and shake them vigorously. Set the jars on a table to settle. Where do the sand particles settle? The silt particles? The clay particles?

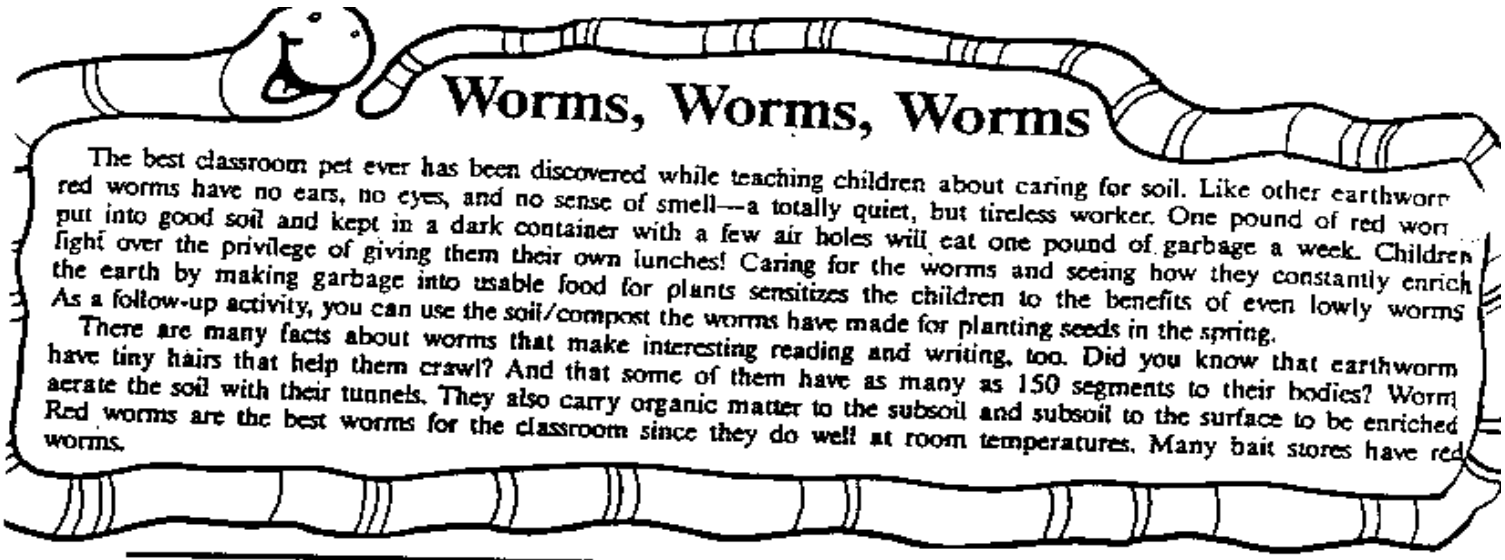
When layers appear in the jars, measure the layers and calculate the percentage of each type of particle using the following formula:

$$\frac{\text{depth of each layer}}{\text{total depth of soil}} \times 100 = \_\_\_\_\_\%$$

Extended Projects:

- English - Students write letters requesting soil samples from other counties or states.
- Science - Students determine soil texture, water penetration and "critter" counts (students run experiments and log data.
- Math - Students calculate averages and standard deviations.
- History - Students write Chamber of Commerce in each area requesting info on local history and types of farming common to the region.
- Exhibit - Students demonstrate hard work at science fair or Earth Day Celebration.
- Students learn -
  - Agriculture's important role in history
  - To match soil texture with crop suitability
  - The interdependence of soil and agriculture as well as soil conservation.

Alex Lehman, science teacher, Madera's Thomas Jefferson Junior High, Madera Unified School District.
Cream of the Crop Vol. 7, No. 2 Winter 1993-94



Worms, Worms, Worms

The best classroom pet ever has been discovered while teaching children about caring for soil. Like other earthworm red worms have no ears, no eyes, and no sense of smell—a totally quiet, but tireless worker. One pound of red worm put into good soil and kept in a dark container with a few air holes will eat one pound of garbage a week. Children fight over the privilege of giving them their own lunches! Caring for the worms and seeing how they constantly enrich the earth by making garbage into usable food for plants sensitizes the children to the benefits of even lowly worms. As a follow-up activity, you can use the soil/compost the worms have made for planting seeds in the spring.

There are many facts about worms that make interesting reading and writing, too. Did you know that earthworm have tiny hairs that help them crawl? And that some of them have as many as 150 segments to their bodies? Worm aerate the soil with their tunnels. They also carry organic matter to the subsoil and subsoil to the surface to be enriched. Red worms are the best worms for the classroom since they do well at room temperatures. Many bait stores have red worms.

THE "SOIL-DOCTOR" IS IN

Today's farmer uses high-tech equipment to grow food and help protect the environment. One environmentally friendly machine used by farmers is the SOIL DOCTOR. Here's how it works: To apply the correct amount of plant foods, farmers first take a soil sample to a lab to be analyzed. After they find out exactly what nutrients are lacking in their soil, they use the SOIL DOCTOR to apply just what is needed to grow healthy crops.

The SOIL DOCTOR, mounted on a tractor, has sensors that glide through the soil sending information back to an onboard computer. The computer controls the amount of plant food being applied so that only what is needed is added to the soil.

By carefully applying nutrients to soil, farmers can protect the soil and water, and keep food costs down.

CLASS "SOIL FACTS" BOOK

Have students choose one fact below to copy and illustrate. Put them together to make a class book.

1) Soil is formed from rocks and decaying plants and animals.
2) It takes 500 years to make one inch of topsoil.
3) Plants and trees grow best in topsoil.
4) Roots from grasses and trees hold soil together and help prevent erosion.
5) Plants, leaves, left-over food, and manure help enrich the soil.
6) Five to ten tons of animal life can live in an acre of soil.
7) Earthworms are good for the soil. They eat it and the leaves and other vegetable material in it. That breaks the nutrients down and enriches the soil so that plants grow better.

NEW MEXICO

A Slice of Soil
The importance of soil conservation

Level: Grades 3-5
Subjects: Science, Mathematics
Purpose: Students will learn about soil, its properties, how it is created and why it should be conserved.
Vocabulary: silt, sand, clay, texture, topsoil, subsoil, bedrock, soil profile
Time: three sessions, 45 minutes each
Materials: clear cups, spoons, vanilla and chocolate pudding cups, gummy worms, Oreo cookies, apple, knife

Mineral Particles

Background Information
Soil is important to support life. Plants need it for sustenance, and we use it for growing our food and fiber and to raise the animals we depend upon for meat. Soil is made up of mineral particles, organic matter (once living plants and animals), and pore spaces (holes filled with air, water, or living organisms.). Mineral particles, classified according to size include:

- sand: soil particle between .05 and 2.0 mm in diameter
- silt: soil particles between .002 and .05 mm in diameter
- clay: soil particles less than .002 in diameter

Sand is the largest mineral particle and it has more pore space between its particles than silt or clay. Silt particles are smaller than sand, but larger than clay particles. Likewise, these is less pore space between silt particles than between sand particles, but more than between clay particles. Clay, the smallest particle has the least amount of pore space.

Since these particle sizes are difficult to visualize, an analogy helps clarify their relative sizes. If a sand particle is the size of a basketball, a silt particle would be the size of a golf ball, and a clay particle the size of a dot made by chalk. These particles also have different textures. Clay has a sticky feel and holds a lot of water. Silt feels like flour and is very smooth. Sand has a gritty feel and does not hold water well.

Rarely made up of only one type of particle, soils consist of varying combinations of the three. The percentage of sand, silt, and clay in a particular soil determines its capacity to hold water. Water moves quickly through a sandy soil because of the large pores, or empty spaces between the particles. A clay-type soil, however, will actually attract water and absorb it like a sponge. Clay particles, as a clump, swell as they get wet and shrink as they dry.

Activity
Explain that students are going to pretend to be soil particles. They will simulate different particle sizes and pore spaces between the particles. Designate three or four students as “water droplets.” The rest of the students will all simulate the “particles”: sand, silt and clay. Explain that they will use arm actions to represent each soil particle.

1. Have all the "particle" students represent sand particles by having them stand in a straight line and holding their arms and legs outstretched so that students do not touch each other. Have the "water droplet" students pass through the line. This should be relatively easy considering the available space that outstretched arms and legs create. The empty space between sand particles represents pore space. These "living" spaces in nature are filled with air, water or living organisms.

2. Now have the "particle" students represent silt particles by placing their hands on their hips with arms bent at the elbow and have them stand elbow to elbow with their legs outstretched. Instruct the "water droplet" students to again pass through the line. Discuss the differences in water movement between the sand and the silt. Which was easiest to move through?

3. Finally have all the "particle" students represent clay particles by standing side by side with their arms at their sides and their legs together. The particles will be bunched together and the "water droplet" students will have a hard time passing by them and will pool together.

Explain that most soils are a combination of the three particles. Ask what might be the advantage of having a very sandy soil? A heavy clay soil? What are the disadvantages? Sandy soil holds less water for plants and dries out more rapidly. Water moves through the clay soils very slowly and may cause plants to suffocate by drowning their roots. What kind of soil would farmers prefer? Play areas in sandy soils would drain away quickly and not be muddy. Play areas on clay soils would be wet for a long time after a rain and would be muddy.

State Standards and Benchmarks:
Science Strand II Standard I Benchmark I
Stand II Standard II Benchmark I

Soil Profiles

Background Information
Soil is a mixture of four main ingredients: weathered rock, organic matter, air and water. The weathered rock can be in the form of sand, silt, clay pebbles or other size rocks. Organic matter can by anything from old leaves, dead animals and plants, or tiny living things. If you were to take an elevator ride from the surface of the earth to the bedrock, you would pass several distinct layers or horizons of soil as you descended. These three distinctive layers form a soil profile.

Topsoil	The top layer of soil, which contains the highest concentration of organic matter and is dark in color. Topsoil is formed when decaying plants and animals mix with the soil, creating a new layer, high in nutrients and organic matter. Plant roots are found primarily in this layer. Topsoil is not always present in a soil profile.
Subsoil	The soil found between the topsoil and the underlying bedrock. It is formed from the weathering of bedrock and often consists of many layers. Deep-reaching plant roots, such as tree roots, are found in this region.
Bedrock	The solid rock that underlies soil.

No two soil profiles are the same as top soils erode and bedrock is pushed closer to the surface by earthquakes. The bedrock layer is much closer to the surface on the top of a mountain as water and wind have carried off the top soil, whereas the top soil is much thicker in a river valley where flooding has brought richer soils downstream.

Activity
Have students create their own soil profiles using cookies, pudding and gummy worms. Have students wash their hands before beginning the activity. Divide students into pairs and give them two clear plastic cups, two spoons, two Oreo cookies, one cup vanilla pudding, one cup chocolate pudding and two gummy worms. Have students place an Oreo in the bottom of their cup to represent the bedrock. Next have the students split the vanilla pudding evenly into their cups, followed by the chocolate pudding. Then place a gummy worm on top. These layers represent a soil profile and demonstrate that not all layers are even.

State Standards and Benchmarks:
Science Strand II Standard I Benchmark I
Stand II Standard II Benchmark I

Soil Conservation

Background Information
Ask students what some of the most important natural resources in the world are. Lead students toward soil as a very important resource (people need food to live and need soil directly or indirectly to produce food). Explain that our food producing land is finite, yet the world population continues to grow.

Activity
Using an apple to represent the world, you can demonstrate how much of the world's arable land surface is available for food production.

1. Cut an apple in half and then into quarters. Three parts represent the oceans of the world. The fourth part represents the land area.

2. Put aside the water pieces and cut the land section in half lengthwise. Tell them that one section represents land such as deserts, swamps, Antarctic, Arctic and mountain regions and the other represents land where people can live.

3. Slice one of the 1/8 pieces lengthwise into four equal parts. Three of these 1/32 parts represent areas of land that are too rocky, too wet, too hot, or where soils are too poor for production, as well as areas developed by people.

4. Peel the last section. This small bit of peel represents the topsoil of the earth on which people depend on for food production.

State Standards and Benchmarks:
Mathematics Strand: Number and Operations
Standard: Students will understand numerical concepts and mathematical operations.
Benchmark: Demonstrate an understanding of fractions as parts of unit wholes.

Name_____

COMPOST

Our soil is made up of bits of rock and organic materials from decaying plants and animals. Molds and microscopic animals called bacteria that live in our soil "recycle" dead plants and animals.

We can watch this process in action when we compost grass clippings, food and animal wastes, and leaves. Your parents may have a compost bin in your backyard. If so, ask your parents to show you how it works!

Composting is important because it breaks the animal and plant wastes down into nutrients that living plants can use. The substance produced is called humus (pronounced HEW?MUSS). Humus is rich in minerals and nutrients needed by living plants.

Since humus is used up by living plants, New Mexico farmers replace the nutrients taken out of the soil by growing food crops. If farmers didn't replace soil nutrients, the soil would not grow healthy plants and less food would be produced.

One way to replace the nutrients is to compost manure or animal waste. This helps prevent the use of more expensive fertilizers.

MAKE YOUR OWN MINI-COMPOSTER FROM AN OLD MILK JUG. HERE'S HOW:

1. Leave the cap on the milk jug. Turn it on its side.
2. Cut a flap in the side so you can reach inside with a spoon.
3. Collect food scraps like fruit and fresh vegetable peelings, greens, and coffee grounds and grind them in a blender for a moment. If there is any liquid, drain it off.

CAUTION: Don't use any cooked foods, meats, fats, or dairy products.

4. Spread your mixture inside the milk jug. Cover the mixture with a layer of soil. Put your compost container in the garage or outside on your patio since it will smell a little.
5. Each day, add another layer of recycled food. You can even add a few crumbled, dried leaves or grass clippings. Stir the mixture every day. Add a little water if it looks dry.
6. The bacteria and molds will make your compost into brown soil in about three weeks. Then it's ready to spread around your garden plants.
7. Recycle the plastic milk jug when you are finished.

Compost Column

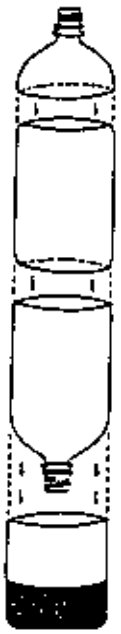
Introduction

Composting, which is based on the biological process of decomposition, is a fascinating educational activity. When people make composting piles and bins of organic material, they encourage the natural process of rotting, and the result – compost – is a dark, earthy smelling, crumbly material that is the best natural fertilizer in the world. Composting returns organic wastes to the earth, recycling them for use by other forms of life.

What turns dead plants and animals into compost? Microscopic bacteria and fungi, which feed on dead tissue, are the chief agents. These organisms are everywhere – in the air, on the leaves of plants, and in the soil. Different kinds specialize in breaking down particular types of tissue, and certain varieties thrive early in the rotting process while others come along at the end to finish the job. Their activity releases a variety of nutrients, as well as water, gases and heat. How many different kinds and colors of fungi and bacteria can you see – and when do they appear – in your column?

What affects the composting process? The amount of moisture and air, temperature, light, source of bacteria and fungi, and the nature of the decomposing material are all critical. Soft banana peels and lettuce, for example, will rot and make compost many times faster than a piece of wood, under ordinary conditions. Old banana peels kept in the freezer, on the other hand, will decompose much more slowly than a piece of wood in a warm, moist place. How can you vary the conditions which affect your column?

The presence or absence of air (oxygen) is one of the most important factors in composting. Modern landfills seal garbage deep in the earth, excluding air and moisture, preventing microorganisms from doing their work. It is said that the newspapers we bury today in a landfill will still be readable 75 years from now. A paper bag may be more biodegradable than a plastic bag, but in a sealed landfill, neither will decompose fully for hundreds of years. The practice of composting, in contrast, allows air and moisture to speed the natural process of biodegradation. Making a composting column lets you see this process, and witness nature's world of recycling.



Making Your Own

The basic column design requires making a hollow cylinder that will hold the materials to be composted. It can be made from one or more empty soda bottles. An additional bottle is needed to hold the column upright, and to catch drippings. These instructions show how to make a two-bottle column.

Materials:

- Three 2-liter plastic beverage bottles
- Bottle Basics tools: marking pen, knife or razor blade, scissors, hot water, sharp needles for poking holes, clear tape, plastic electrical tape
- Netting or mesh fabric, rubber band
- Organic material for composting, such as kitchen scraps, leaves, newspapers, and grass clippings. Why might it be best to avoid materials of animal origin?

1630 Linden Dr., Madison, WI 53706, (608) 263-5645
University of Wisconsin-Madison

Remove the bottle bases from two bottles, and the labels from all three. Cut them as illustrated, and assemble. Most columns will require air holes for ventilation, and these can be poked into the plastic with a sharp cold needle or with a needle heated in a candle flame. Alternatively, a larger hole can be cut into the sides with a knife and covered with a fine fabric mesh, held in place with tape. See page three for illustrations.

Explorations

The possibilities for compost column discoveries are endless. There is no limit to what can be put inside, or the conditions under which the column can be kept. In addition to simply observing changes, you can design experiments which explore the effects of variables on your column. Here are two ideas.

• Make two identical columns, and fill each with a known quantity of shredded newspaper. Use a bottle balance to determine the weight of the paper. On top of one column, add a handful of garden soil -- which is naturally loaded with microorganisms. Pour equal amounts of rainwater into each column, and wait several hours for it to percolate through. If none comes out the bottom, add more in equal amounts until about a half cup drips into the base. Schedule a rain storm to occur in the column every few days. Which column decomposes faster and why?

• Compost columns can be used to produce a liquid fertilizer, called "Compost Tea". You might try making several columns with different contents, whose drippings are likely to differ in color and chemistry. Use this liquid to water and fertilize identical sets of seedlings to see which brand of "tea" induces the fastest growth. How much water should be poured through the column, how often will you recycle the drippings , and how often (if at all) should the column get new ingredients? Can you be sure that the "tea" and not some other factor was responsible for the plant growth you observe?

Notes from the Field

• At the beginning of each school year, Ann Croal's first grade class makes a compost column which is continuously filled throughout the year. This year her kids named it "Mother Nature's Stew". Though she asks for contributions that would make good compost, both organic and inorganic ingredients get added. During the last week of school they spread out a plastic sheet and dump the remains, and the students root around with tongue depressors to see what's left. Lots of discussion occurs, of course, which Ann guides toward concepts of nature and human nature. She finds that this activity is especially intriguing in autumn, when the newly fallen leaves are beginning to decay. "What you see happening in nature", she says, "is what you're doing in the compost column."

(From Ann Croal, who teaches 1st grade in Madison, Wisconsin)

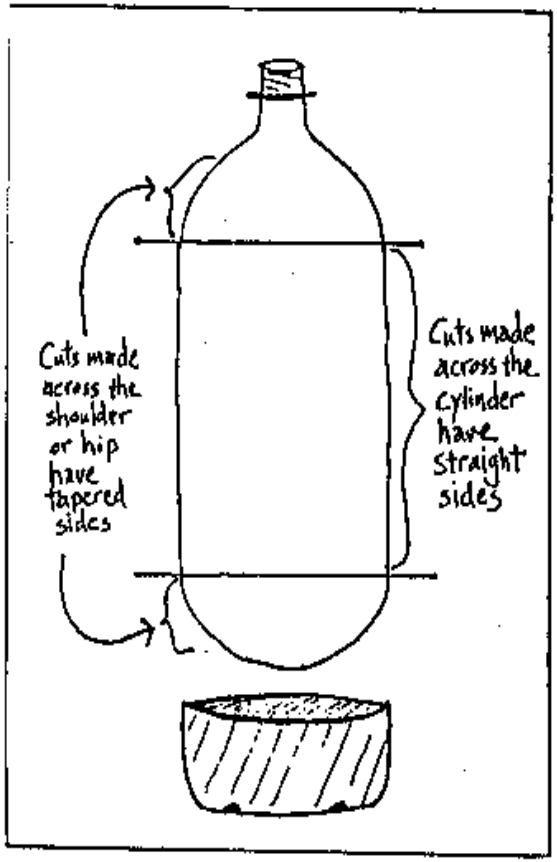
• In a science methods class at a university, 90 future elementary teachers each make a column which they take home to observe. Teams of four students each construct group columns as well, and these are left in the classroom for study. Throughout the semester, they make many discoveries -- that overly large vent holes let the water leak out the sides, that the strong smells of the first few weeks *do* disappear, and that columns with non-biodegradable contents are boring to watch. Weekly observations are logged into a notebook in the classroom, to be read by all.

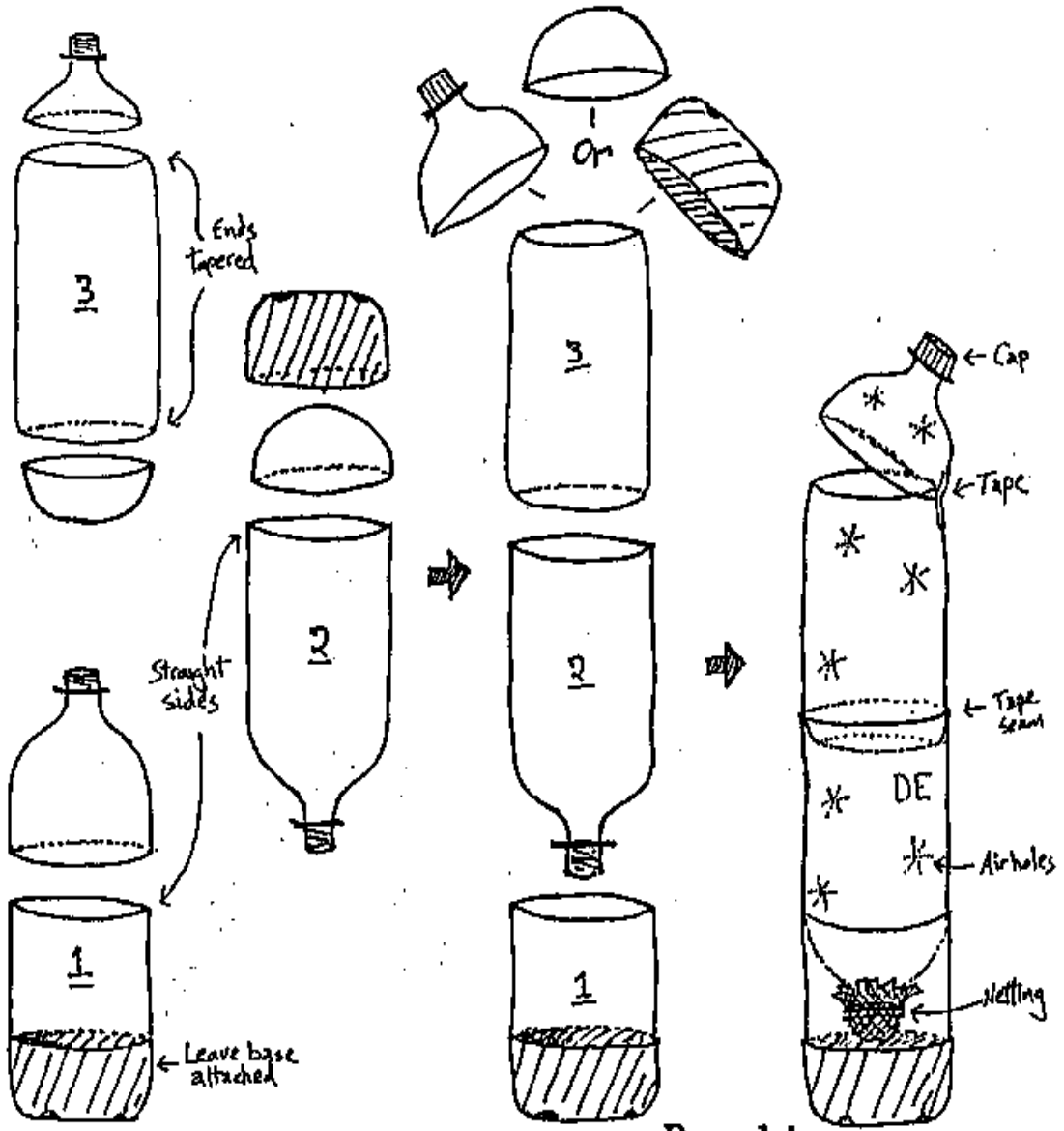
(This activity was developed by Betty Downs at the University of Wisconsin-Madison)

References:

Minnich, Jerry and Marjorie Hunt (1979). The Rodale Guide to Composting. Emmaus., PA: Rodale Press.
Catton, C. and J. Gray (1984). The Incredible Heap. New York: St. Martin's Press.
Kreutar, M. (1985). The Macmillan Book of Organic Gardening. New York: Macmillan.

Compost Column (2-Bottle version)





Bottle Biology Resources Network

University of Wisconsin-Madison • 1630 Linden Dr., Madison, WI 53706 • (608) 263-5645

Recycle!

All column components and unused parts are recyclable.

Name_____

CONSERVATION AND FARMING

Conservation, which is careful use and management of the soil and water to preserve its usefulness, is important to all of us because of our dependence on plants and the plants dependence on the soil and water. Soil and water are two of New Mexico's and farmer's most valuable natural resources. We must use it wisely and learn to conserve it.

The concept of conservation has developed over many years as man became aware of the consequences of misusing our soil and water. In the early stages of misuse, the amount of plants that can be grown on the soil is reduced. Eventually the soil will blow or wash away (erode) if it is not cared for properly, and water can become so contaminated it cannot be used for anything.

Each year an average of almost one ton of soil for every rangeland acre is destroyed by erosion. Each year an average of ten tons of soil on a cropland acre is destroyed by wind and rain erosion. Each year in forests, an average of one ton of soil for each forest land acre is destroyed by erosion.

There are several factors that can cause the soil to decline in usefulness. Irrigation is the use of water pumped onto the soils to increase crop growth. Too much irrigation can sometimes cause the minerals in the soil to breakdown and wash away.

The most common soil problem is erosion. When soil erodes it is broken down and carried away by the wind or water runoff after a rain. This not only is harmful to the soil, but it helps prevent erosion because the plant roots hold the soil together so it doesn't wash of blow away.

Farming methods that prevent soil from being blown away and washed away must be practiced by good farmers and ranchers. Here are some of the ways farmers and ranchers work to conserve soil.

Contour Farming: Farmers work in their field around the hills rather than up and down. This makes little ridges of soil around the hillside that will help stop water from washing away the soil downhill.

Strip Cropping: Farmers plant strips of grasslike crops between fallowed or cultivated fields. The strips of crop keep exposed soil from being blown or washed away.

Conservation Tillage: Instead of plowing or cultivating a field after it has been harvested, the grain stems are left to stand. This keeps soil from being blown or washed away. The stems can also add organic particles to the soil.

Name_____

Crop Rotation:
Instead of planting the same crop year after year in a field, farmers rotate their crops. One year they may plant a hay crop, the next year a grain crop. Some of the crops will add nutrients to the soil that others take out. The soil will remain healthy without excessive use of fertilizers.

Shelter Belts: Rows of trees or tall grasses are planted in windy areas to slow wind speed and reduce the amount of soil that could be blown away.

Grasses: Can be placed where water runs during a very wet time. This prevents the water from cutting into the soil and carrying good soil downstream.

Sod Busting: Is a practice of plowing up ground that has never been used for cropland before. This may not be a good farming practice if the soil is not suited to grow crops. A farmer should have a soil specialist help him determine if the soil will make good cropland before he plows it up. Some land should be used only for grassland because its fragile soil and climate condition can only support minimum plant life. When this minimum plant life is plowed under, the soil is exposed and can easily be blown away.

The most useful soil could not support plants without water. Conservation of water is becoming increasingly important as the amount of water available declines.

Surface water has been polluted by man for many years. Chemicals, trash, and other wastes are dumped into the water. Many people are concerned about the possible contamination of groundwater by chemicals that work their way through the soil down into the water. However, the use of chemicals is not all bad. When used correctly, they are beneficial.

New Mexico farmers and ranchers care about their soil and water and know that if they are to continue farming or ranching, soil and water conservation must be practiced.

Study Questions

1. Conservation means _____ _____.

2._____ and_____ are 2 of New Mexico's and farmers and ranchers most valuable natural resources.

3. Farming around hillsides, rather than up and down them is called _____ _____.

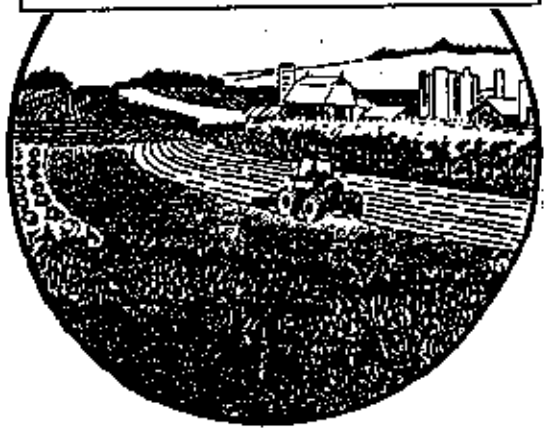
4. Leaving grain stems and other vegetation of the soil's surface rather than plowing it under after harvest is called _____.

5. Plowing up fragile soil in dry climate regions is called_____.

Modern Agriculture Conserves Resources In Many Ways

Plants protect soil from erosion — thereby reducing water pollution.

Contour farming (going across the hill instead of up and down) is used on steep hillsides to keep soil from washing away. Almost 26 million acres in the United States are managed by contour farming.



Forested areas are important to all of us. Thinning the forests properly helps to keep them healthy, provides lumber for our use, and improves wildlife habitat. It is important to keep steep hillsides in trees rather than using them for cropland. Do you know why?

List five products we get from wood: _____

_____ _____

_____ _____

Windbreaks are rows of trees and hedges which protect fields from wind which can blow soil away! American farmers have planted over 170,000 miles of windbreaks and plant thousands more each year.

Grazing pastures and rangeland is beneficial. Keeping and improving good native grass cover is an important conservation practice, and keeps livestock and wildlife well fed. Cattle and sheep are good at converting grasses and other forages into food and nonfood products for us to use.

Three food products we get from cattle and sheep:

_____

_____

_____

Three non-food products we get from cattle and sheep: _____

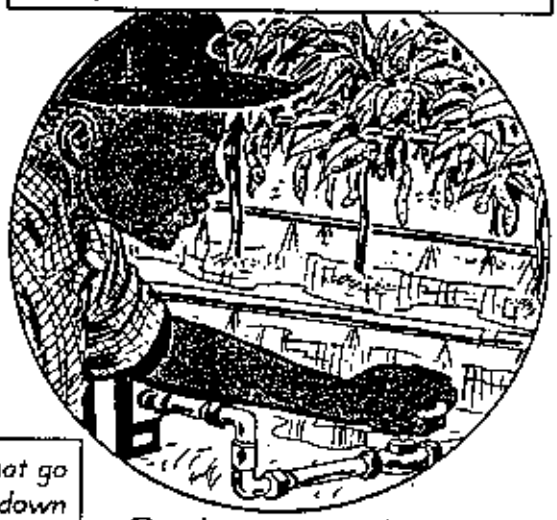
_____ _____

...More ways to keep our planet green and growing

Riparian areas are the lands along streams and other water areas. A good riparian area has grasses, shrubs, trees and other vegetation. This vegetation provides food and shelter for wild life and livestock. It also filters the water and helps to keep soil from washing away.

Crop rotation is used by farmers to conserve the quality of soil resources. Planting different crops and letting the land rest keeps the soil healthy for growing plants.

Drip irrigation puts water directly on a plant's roots. Less water is used to grow more plants!



Drip Irrigation works great in gardens!

Terracing is done by making wide ridges that go around a hill to prevent water from rushing down the hill too fast.

Country to Classroom, Wyoming

How can we all help to protect our water and soil and keep our environment safe?
Here are a few examples. List three more.

- Plant grass and shrubs on bare soil to keep it from washing away.
- Plant trees to shade homes and clean the air.

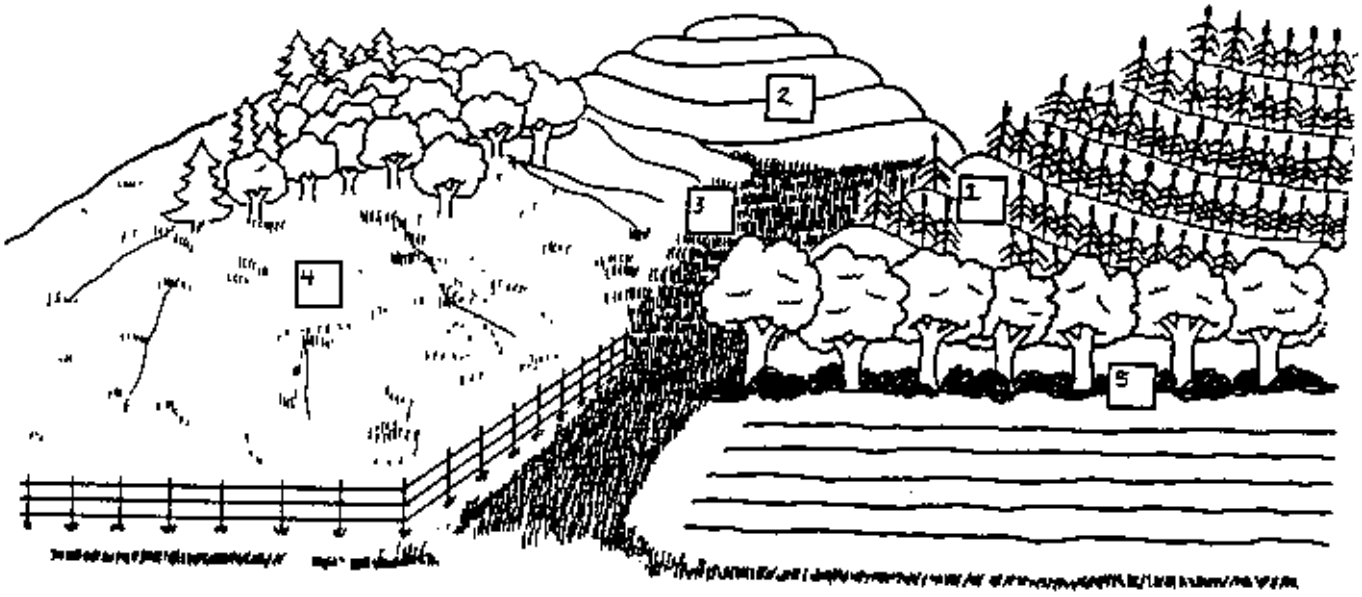
_____

_____

_____

Name _____

Soil Conservation Practices



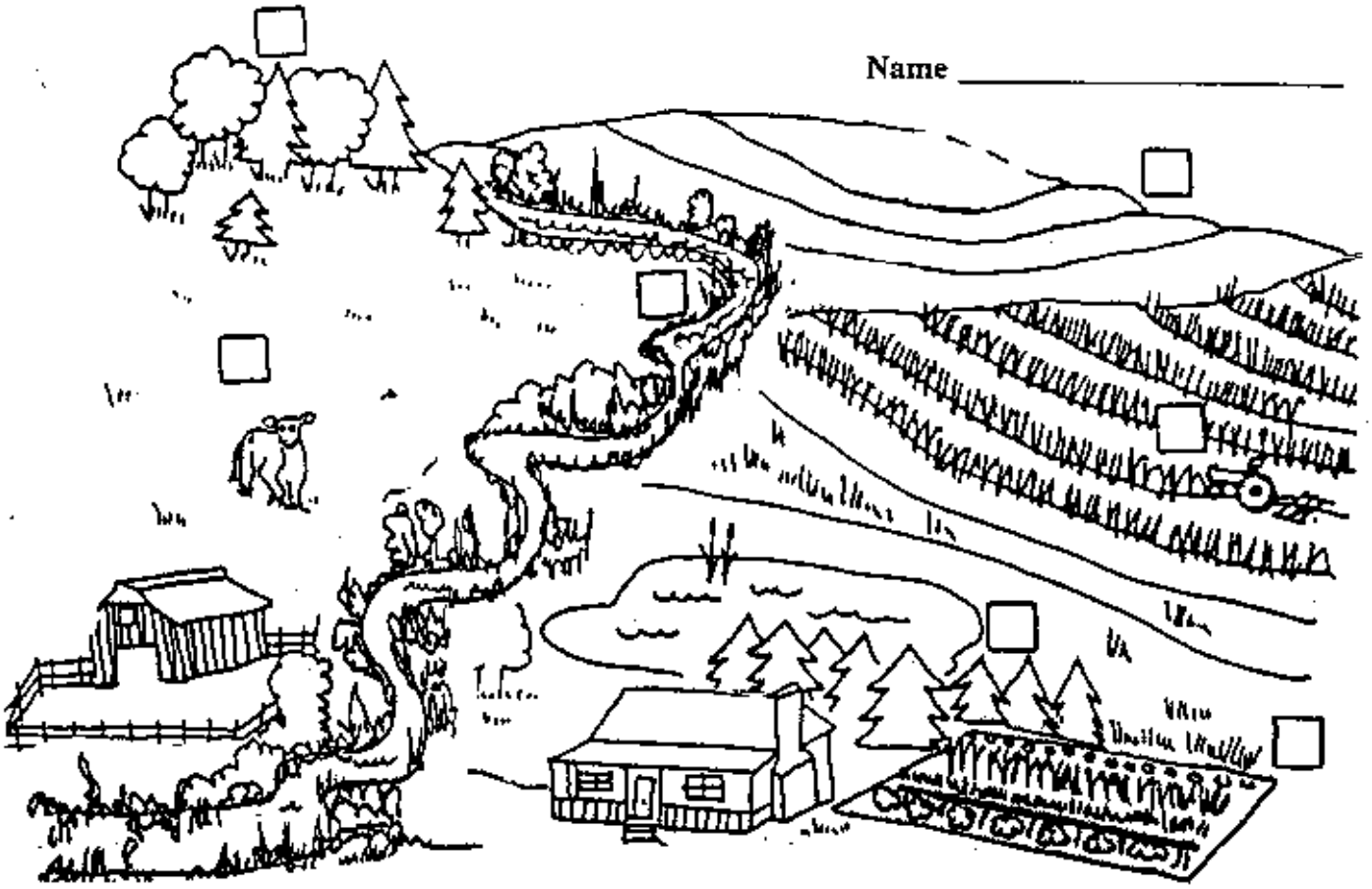
Farmers use several different methods to conserve soil. Match the number of the practice to the correct box in the picture.

- ☐ **forest and grass areas** - keep steep hillsides in trees or grass rather than clear for cropland
- ☐ **terraces** - make wide ridges that go around a hill to prevent water from rushing down the hill too fast
- ☐ **grassed waterways** - plant grass and don't plow low areas in a field where water usually runs down the hill
- ☐ **contour planting** - plant crops around the curve of a hill rather than up and down the hill
- ☐ **windbreak** - rows of trees planted to slow down the wind and prevent soil loss from blowing wind

Adapted from Food For America, a program of the National FFA Organization sponsored by Mobay Corporation, Agricultural Chemicals Division.

LAND FOR LIFE

Name _____



How well farmers and ranchers use their land will determine their income in the future. They can reduce soil loss by doing several things. Place the number of the soil practice below in the correct box in the picture above.

1. Contour Farming
2. Terracing
3. Forested Areas
4. Grazing
5. Wind break
6. Drip Irrigation
7. Riparian Area

Nature itself sometimes destroys good land and even causes water pollution. Geologic erosion is one way this happens. Geologic erosion is a natural process that moves soil from one location to another by wind, water and other natural forces such as hailstorms, floods, glaciers and mudslides. The Grand Canyon was formed by natural erosion.

Draw a picture of your neighborhood showing the different land uses.

Courtesy of "Country to Classroom", Wyoming Ag Magazine

Name _____

Match the following words to their correct definition.

1.	erosion	•	plant used for food, shelter, beauty, air purification, shade, buildings, paper, etc.
2.	compost	•	planned management of natural resources to prevent destruction or neglect; such as topsoil, forests and waterways.
3.	tree	•	to wear away soil by the action of water, wind or ice and maybe caused by man, animals or naturally.
4.	farmer	•	mixture of decayed organic matter used for fertilizing.
5.	conservation	•	a person who takes care of natural resources as a career providing food, clothing and many other products for you.

Name_____

CONSERVATION

The preservation of natural resources such as topsoil, forests, and waterways

Modern farming methods have allowed farmers all over the world to feed more people. Farmers practice soil and water conservation in order to preserve the natural resources necessary for future food production.

- Before farmers irrigate, they must know if their farmland is suitable for irrigation. Intensive irrigation can allow salts to build up when the irrigated water evaporated. Salty soils cannot support plant life.
- Farm chemicals increase farm productivity, but can be a serious problem if they are used improperly.
- When grasslands are plowed up to become cropland, fragile soil may be exposed to wind. Unnecessary soil erosion may occur. Some land is not suitable for cropland and should be left as grassland so its usefulness is not destroyed.
- Today's farmers and ranchers are more knowledgeable and educated than ever before. Chemical companies offer courses that teach about safety and the proper use of chemicals. Soil conservation specialists offer services, and agricultural extension agents help farmers decide what kinds of farming methods are best suited for their land.

Its possible to lose ten tons per acre of cropland topsoil to wind and rain erosion. What can farmers and ranchers do about this problem?

_____

_____

_____

Name_____

Each year almost one ton per acre of soil is lost to erosion in forests. How can this happen?

_____
_____
_____
_____

Why is forest erosion less than a cropland erosion?

_____
_____
_____
_____

Name_____

SOIL EROSION

KEEP IT DOWN ON THE FARM

Have you ever noticed how rain can wash away soil around a new home and create little valleys? Sometimes the soil ends up in the street or in the storm drains and sewers. This process is called erosion (pronounced EE - ROE - SZUHN). It happens because grass, trees, and plants haven't been planted in the yard yet and there is nothing to hold the soil and keep it from washing away. Unprotected soil in backyards and vacant lots, on farms, at construction sites, home sites, and other places washes away if water from rainstorms or snowmelt runs over the surface. Plants of many kinds, grasses, shrubs and trees help hold the soil in place. This, runoff water will not carry silt and sediment to the reservoirs from which people get their water for home and industry.

New Mexico farmers are concerned that the same thing could happen to their farmland. If our soil resources were lost, then farmers could not produce the abundance of healthy, wholesome food we need and expect.

To prevent erosion, farmers use special techniques such as conservation tillage. Two examples are reduced and no-till cultivation where plant residues from last year's crop are left on top of the soil to hold it down instead of plowing them under. Farmers understand the kinds of erosion problems that are present on their farm. They use the right combination of conservation tillage practices to keep the soil in their fields, where it belongs.

Try some of these demonstrations on soil erosion
Sometimes it <u>does</u> come out in the wash

Try this simple demonstration of soil erosion in your garden or where there is a supply of loose soil. You will also need a garden sprinkler can or water hose.

1. Mound up a hill of soil in the garden.

2. Gently pour a steady stream of water over the top of the mound.

Describe what happens to the mound.

_____
_____
_____
_____
_____

Can you think of some ways to prevent erosion?

_____
_____
_____
_____
_____

Name _____

Soil Mountains

An Erosion Experiment

Materials

Sand
Large shallow metal pan
Book
Water and watering can
Leaves, grass, twigs, rocks
Popsicle sticks with evenly spaced (pen marked) bands

Instructions

Make a "mountain" with damp sand on the metal tray
Put a book under the pan-
  tilt it so the water will flow away from the mountain
Put marker sticks into mountain on different sides-
  only the top band should be showing
Sprinkle the mountain gently simulating rainfall

Discussion topics

Do all marker sticks look the same?
How many marks show on each stick?
Where is erosion occurring more rapidly (top, sides, bottom)?
Where do the eroded parts go?
Are there miniature streams, canyons or landslides?

Experiment variations

Add leaves and grass to one side of mountain and note results
Add twigs and rocks to mountain and note results

Discussion topics

What effect do trees and rocks have on erosion?
What effect do leaves and grass have on erosion?
What types of plants would stop erosion?
How can farmers keep soil from eroding?

Teaches the relationship between crops and soil and how farmers prevent erosion.

KarenBeth Troyer, Science Resource Teacher (grades 2-5), Graystone Elementary School, San Jose Unified School District. KarenBeth says, "Many educators are looking for a way to bridge biological, physical and social sciences. Agriculture does just that."
Cream of the Crop, Vol.7, No.2, Winter 1993-94

How Does Crop Cover Affect Soil Loss?

On land that must be cultivated and cannot be kept in grass all the time, farmers can keep the land covered as much of the time as possible by using crop rotations. By growing a cultivated crop like corn followed by a small grain crop and one or more years of grass-legume meadow, the land can be covered much of the time. Mulches can help gardens.

You will need two small boxes about 16 inches long, 12 inches wide and 4 inches deep. (These boxes can be used for several activities so they are worth making and keeping on hand.) Make them watertight by lining them with plastic material, tin or tar paper.

At one end of each box cut a V-notch 1- to 1½-inches deep and fit with a tin spout to draw runoff water into a container (see drawing).

You will also need two flower sprinklers, at least a quart in size (half gallon or better), two half-gallon wide mouth fruit jars and two sticks of wood about 1 inch thick.

Cut a piece of sod from a pasture, lawn, fence row, or the like, to fit one of the boxes. Trim the grass with scissors so that it is not more than an inch high. This makes it easier to handle.

Fill the other box with soil from the same place — no grass, just soil, but don't try to pick a very poor soil. The idea is to have the same kind of soil in the boxes — one with grass, the other bare.

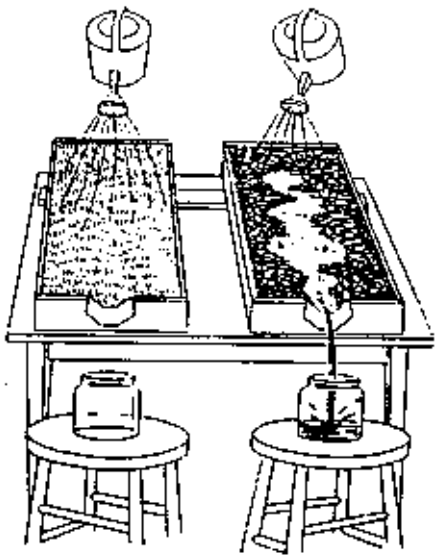
Set the boxes on a table so that the spouts extend over the edge. Place the sticks under the other end to give them slope.

Put the empty fruit jars on stools placed beneath the spouts.

Fill the two sprinklers with water and pour the water on both boxes at the same time. Pour steadily and at the same rate for both boxes. Hold the sprinklers the same height from the boxes. About a foot will be satisfactory, although you can get various results from different heights.

Interpretation

You will find that water will rush off the bare soil into the fruit jar, taking soil with it. The flow will stop soon, but the jar will contain muddy water.



The water that flows from the sod will be reasonably clear. It will take longer for the flow to start and it will continue longer. Also, not as much water will reach the jar. The amount of water in the two samples before the experiment will affect the results somewhat. Unless the soils are waterlogged, however, the activity will be successful. The samples need not be completely dry.

This activity illustrates one of the most fundamental principles of soil and water conservation — the protection grass gives sloped soil against the pounding of raindrops and the movement of running water.

The grass breaks the force of the raindrops so that the soil is not pounded and broken apart by this impact. The grass roots open up channels to let water get into the soil. Organic matter furnished by decayed grass crops also lets water enter more readily, as we learn in "Compare How Much Water Different Soils Hold." And as the water runs off, the stems of grass slow it down so that it does not have enough speed to disturb the soil.

Experiments show this is true. For example, on one plot at La Crosse, Wis., where corn had been grown every year for 6 years, the annual soil loss was 89 tons per acre. On a plot in bluegrass sod, however, the annual soil loss was only 0.2 ton per acre.

Reprinted with permission from "Teaching Soil and Water Conservation," a Camping and Field Guide, U.S. Department of Agriculture, PA-341.

How Does Mulch Prevent Soil Loss?

Use the same boxes you made for "How Does Crop Cover Affect Soil Loss?" This time fill them both with the same kind of soil.

Set them on the table as before, placing the sticks under one end to make a slope.

Cover one box of soil with a thin layer of straw, grass, wood shavings or sawdust; leave the other bare. Sprinkle water on both boxes, using the same amount of water and pouring at the same rate from an equal height.

Note how much and how fast water runs off into each fruit jar.

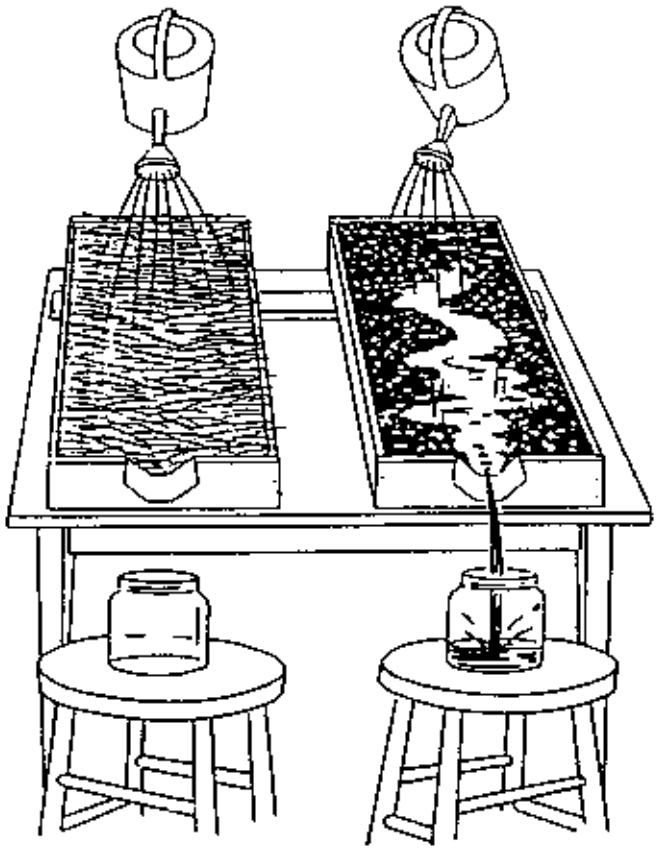
Another way to study the protection of mulches on the soil is to drop water from a short height on soil that is not protected and on soil that is protected with mulch.

For this you will need two small tin cans. With an 8-penny nail, punch a hole in the bottom of each can and fill the hole loosely with cotton.

Put one-half inch of soil in two small fruit jars or water glasses. Put a light layer of dry grass clippings on one of the soil samples. Leave the other one bare.

Arrange the tin cans so that they are about 4 feet above the jars of soil. Put about one-half inch of water in the cans. Large drops of water will form through the holes in the cans and drop on the soil in the jars. Note the amount of soil that is splashed on the sides of the glass.

The third activity shows the effect of mulch on water intake of soil as well as the value of mulch in conserving soil and water.



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SPLASH EROSION

The first step in the erosion process is the wearing away of soil particles or detachment by raindrops. The force exerted by falling rain is so great that soil granules are not only loosened and detached, but may also be beaten to pieces. This is called splash erosion and is very damaging to the productivity of soils.

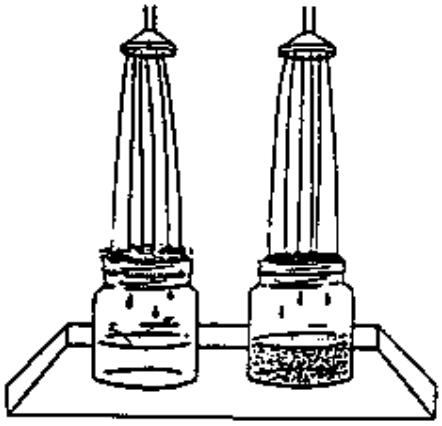
For the following activities you will need:

- white paper (approximately 3 ft. square)
- 2 fruit jar lids with an equal number of small holes punched in them
- 2 fruit jars
- dry soil (approximately 1 pint)
- grass clippings or straw mulch
- sprinkler can and water
- 12-inch ruler

Place a fruit jar lid topside down on top of a fruit jar. Fill the lid full of soil and level off with a ruler. Place the lid and jar in the center of the white paper and hold the sprinkler over it, letting the water fall about 3 feet. Observe what happens to the water and bare soil. Measure how far the soil splashes onto the white paper with the ruler and record in a notebook.

Now place the white paper and repeat the experiment but make sure to cover the bare soil with grass clippings. After sprinkling with water, measure how far the soil splashes and record the value.

- From which jar lid does the soil splash the furthest?
- Which jar collected the most water and why?
- What is the value of covering the soil in preventing soil erosion?



HOW FARMERS SAVE THE SOIL

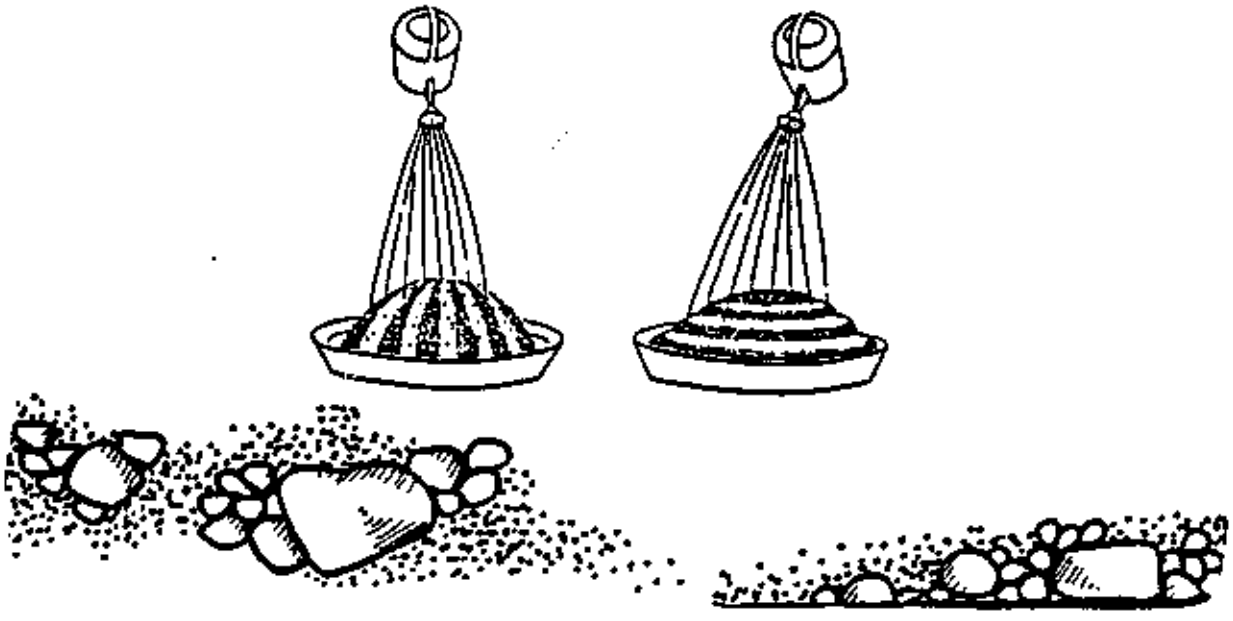
When farmers use their implements across the slope of the land as an effort to control erosion, this is referred to as **contour farming.** Contour farming is one of the easiest and most widely accepted conservation practices. When a farmer farms on the contour, he or she disregards the usual straight filed boundaries and straight rows and follows curved lines whenever necessary to stay on the contour.

Contour farming will be demonstrated in the following activity. For the activity you will need:

- 2 round pans approximately 2" deep and 12" in diameter
- enough soil to make mounds in the middle of both pans
- sprinkler can and water

Form mounds of soil in the middle of both pans. Try to make the mounds equal in size and similar in shape. With a pencil or your finger, make furrows up and down one of the mounds and circles around the other mound (on the contour). Sprinkle an equal amount of water on each mound and observe the water.

- In which pan does the water reach the bottom first?
- In which pan would the greatest amount of erosion take place and why?
- Will contour farming control soil erosion?



CARETAKERS ALL

STUDY PRINT 3

CARETAKERS OF THE SOIL

OBJECTIVES

Students will be able to:

I. Define and describe soil and erosion.

2. Explore the effects of soil erosion.

3. Identify examples of erosion in their own environment.

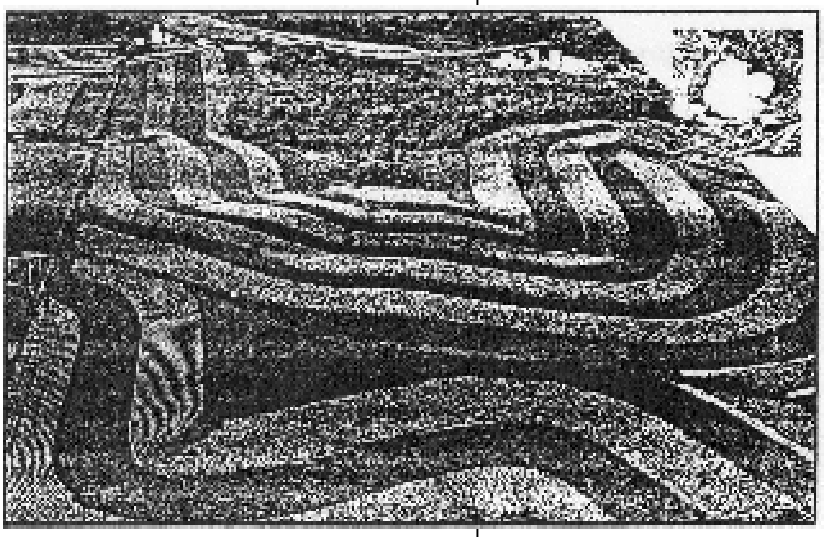
4. Demonstrate ways to preserve/improve their immediate environment.

KEY TERMS FOR STUDENTS

conservation tillage, contour farming, crop rotation, drought, Dust Bowl, erosion, gullies, nitrogen, nutrients, replenish, soil, stripcropping, topsoil, waterways, windbreak, windward

TIME

The following lesson will require three to four 30-minute class periods, depending upon the depth of coverage. Teachers are encouraged to select and adapt the following plan to best meet the needs of their students. Extension activities listed at the end of the lesson take the concept across the curriculum.



MATERIALS NEEDED/DAY I

ACTIVITY SHEET 3A/SOIL SAMPLE less than a handful of sand or salt; a soil sample, approximately 1 foot square and six inches deep, or a spade if class will be taking their own sample from the school grounds; magnifying glasses, knife for separating samples, covered jar(s) and warm water.

MATERIALS NEEDED/DAY 2

ACTIVITY SHEET 3B/THE DUST BOWL—A TURNING POINT and a map of the U.S.

MATERIALS NEEDED/DAY 3

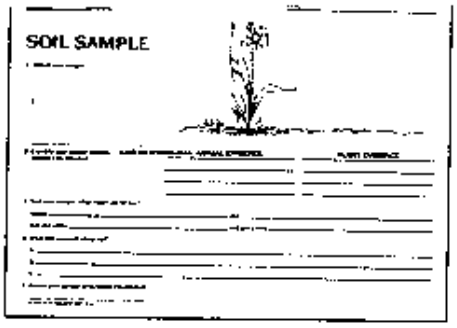
STUDY PRINT 3
ACTIVITY SHEET 3C/SOIL CONSERVATION SOLUTIONS.

BACKGROUND INFORMATION FOR TEACHERS

Soil is the storehouse of water and food (nutrients) for living plants and microorganisms. Minerals from the soil are absorbed by crops and provide nutrients for all living things. People depend upon soil to produce the food and fiber they need to survive. The condition of the soil is dependent on people.

Soil erosion is the wearing away, or loss of soil (from a given site or location) through the actions 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. People increase the opportunity for erosion when they remove plant life for construction projects, harvesting and mining operations or farming.

During the 1930s, farmers on the Great Plains learned the hard way that careless plowing of sturdy native grasses, coupled with devastating drought and winds will strip land of valuable topsoil necessary for producing crops. During this period, great clouds of soil were blown hundreds of miles away. This region became known as



SOIL SAMPLE

the Dust Bowl. Today farmers implement soil conservation practices to reduce erosion, and to allow the land to recover.

After harvesting, farmers leave the roots and stubble of harvested 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. The grass, or close growing crops, stop 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 planting different crops at different times since different crops use different nutrients from the soil. This is called crop rotation. Farmers also replenish the soil by leaving crop stubble in the field and by planting leguminous plants. Legumes, such as alfalfa, clover, peas, soybeans and peanuts give nitrogen back to the soil in exchange for water and other nutrients.

George Washington Carver was a scientist who encouraged crop rotation at a time when farmers knew little about soil nutrients. Students may be encouraged to research this man and his contribution to agriculture either at this time or during Black History Month.

BEFORE THE LESSON/DAY 1

1. If you plan to use cooperative groups, have students arranged in groups and aware of the rules and their roles. (See page 31 for information on cooperative groups.)

2. Duplicate ACTIVITY SHEET 3A/ SOIL SAMPLE.

3. Prepare for sand/salt demonstration.

4. Locate an area where you may dig up a 1 square foot soil sample about 6 inches deep. It might be from a flower bed or playground area. The "wilder" the area, the better. Have a spade ready so that the sample will include roots of grasses or plants. Secure the necessary permission. Anticipate replacing soil after the experiment. If this is not feasible in your school setting, bring in a sample from another area.

5. If possible conduct the following activities outdoors. Students will need to bring: ACTIVITY SHEET 3A/SOIL SAMPLE, a pencil and something hard and flat (notebook, book, etc.) on which to write.

GETTING STARTED/DAY 1

1. Sprinkle a fine layer of sand or salt over a flat surface. Have students predict what will happen if someone blows across the surface. Gently, then more vigorously, blow as students observe. Be careful not to blow sand or salt toward students.

2. Ask:

■ *Have you ever been to a sandy beach on a windy day? What was it like?*

■ *Where else have you experienced soil being carried by the wind?*
Sprinkle a fine layer of sand or salt over the soil sample which was previously collected. Blow over the sample and ask students to comment on the movement of the sand or salt on the sample as compared to that on the flat surface.

■ *In which place would the most soil be carried by the wind? The least? Why?*
Point out that soil is blown when it is dry and left exposed, without plants to hold it in place. Explain that in these lessons students will learn about soil and ways that people can help protect the soil and their environment.

DOING THE LESSON/DAY 1

1. Distribute and review the directions for ACTIVITY SHEET 3A/SOIL SAMPLE.

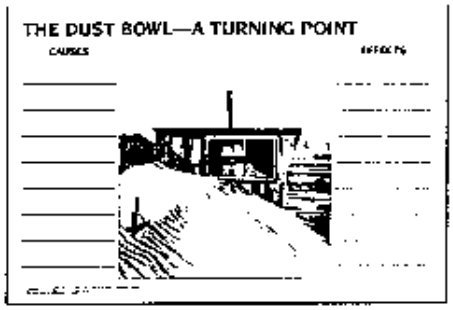
2. Divide the soil sample so that each cooperative group has at least a 3"x 3"x 6" section. Encourage students to use a magnifying glass to examine plant roots and how they hold the soil. Challenge them to look for insect tunnels and any living, or formerly-living things in the soil. Allow students time to complete the investigation as outlined in ACTIVITY SHEET 3A/SOIL SAMPLE. Direct students to return living insects and worms to their home, the earth, and return soil sample to its former location.

3. Perform the following experiment as a demonstration, or allow the students to work in cooperative groups to do a group experiment. In a covered jar, shake a small quantity of various components of the soil sample. Add about twice the amount of warm water and shake well until it is completely mixed and return to your classroom if you have been working outdoors. Examine this mixture immediately after mixing. Note the muddied water and observe how water carries soil. Record your observations. Watch how the heaviest parts of the sample (sand or stones) immediately settle to the bottom of the jar and how the pieces of formerly living things float.

WRAPPING IT UP/DAY 1

1. Allow groups to share what they learned about soil today.

2. Have each group report on how they worked together.



BEFORE THE LESSON/DAY 2

1. If you plan to use cooperative groups, have students arranged in groups and aware of the rules and their roles.

2. Duplicate ACTIVITY SHEET 3B/THE DUST BOWL—A TURNING POINT.

GETTING STARTED/DAY 2

1. Observe the soil from yesterday's experiment in the covered jars. Have students record their observations.

2. Compare their observations to yesterday's observations.

3. Note that the water has rearranged the soil sample in such a way that the soil best for growing crops is not necessarily on top anymore.

DOING THE LESSON/DAY 2

1. Distribute ACTIVITY SHEET 3B/THE DUST BOWL—A TURNING POINT. Point out and discuss the center photo.

■ *What appears to be the problem in this picture?*
Soil has covered the window and door of this shed. That soil must be very dry. There are no plants to hold the soil.

■ *Where do you think the photo was taken?*
While students may have seen sand drifts near large lakes and oceans, point out that this photo was taken far from any oceans —in Cimarron County, Oklahoma. Point out Oklahoma on a United States map.

■ *Is this a rural, urban or suburban area?*
Field in background is evidence that this is a rural area. Lack of buildings and houses in background indicate that this is not an urban or suburban area.

■ *Do you think this photo was taken recently?*
It was taken during the 1930s

■ *What do you think might have caused the problem?*
Encourage students to make predictions.

2. Read the following "Dust Bowl Diary" while students check their predictions. Explain that this simulated letter could have been written by a teenager that lived in the 1930s. Have them listen to find out what caused the problem.

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 and stuff, 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.

3. Ask:

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

Tell students that this diary entry was written about the time when farmers learned the hard way not to take the land for granted and that's why farmers and ranchers now have soil science, range science and other information available to them. The Great Plains (indicate the general area between the Rocky Mountains and the Mississippi River on a map of the U.S.) have strong winds. Before the first settlers came, these plains were covered with thick, tall grass and had never been plowed. The grasses sometimes grew so high that a rider on horseback could barely be seen over them. Because the grasses were always moving with the wind, the area was nicknamed the waving prairie.

4. Have students listen for causes and effects of the Dust Bowl as you read the following:

Settlers removed more and more grasses and plowed more and more land. Remind students of the inset picture of the sod house on STUDY PRINT 1. In the 1930s there were seven continuous years of hot sun and drought (a prolonged lack of rain). The ground dried up, crumbling into small pieces. Crops withered and died. The grassless soil became dirt and then dry dust. Strong winds blew continuously and swept the soil from states like Kansas eastward to Chicago, New York and Washington, D.C. (indicate on U.S. map) and finally more than 100 miles out across the ocean where it settled on ships at sea.

On the Great Plains, visibility during dust storms was low and many people had trouble breathing. Fields lost from two to twelve inches of rich topsoil. It was at this time that people realized that soil needs protection. Farmers could have saved their topsoil by implementing soil conservation practices. Because they didn't know how to do that back then, exposed soil was lost to wind and rain.

5. Allow students to work in cooperative groups to complete ACTIVITY SHEET 3B/THE DUST BOWL—A TURNING POINT. Encourage them to do it as a "roundtable" so that all participate. (See page 31 if this strategy is new to you.)

WRAPPING IT UP/DAY 2

1. Allow each group to share their work on ACTIVITY SHEET 3B/THE DUST BOWL—A TURNING POINT. Answers may include:

CAUSES	EFFECTS
wind	difficulty breathing for people and animals
wind	soil carried to other locations
lack of rain (drought)	loss of topsoil
plowing left the soil exposed	no pastures for livestock
few plants to hold soil	poor visibility
drying heat	unsuccessful farms

BEFORE THE LESSON/DAY 3

1. Duplicate ACTIVITY SHEET 3C/SOIL CONSERVATION SOLUTIONS.

GETTING STARTED/DAY 3

1. Tell students that one positive effect of the Dust Bowl was that people learned the importance of being good caretakers of the soil. In this lesson they will learn about some good soil conservation methods and also check their own environment for erosion.

DOING THE LESSON/DAY 3

1. Ask:

■ *What is soil erosion?*
Wearing away of topsoil.

■ *What caused soil erosion in the Dust Bowl?*
Wind, drought, and plowing away the plant cover

■ *What else could erode the soil?*
Water, gravity, people, animals, etc.

■ *Where have you seen soil erosion?*
Vacant lot, lawn, river bank, beach, hillside, etc.

■ *Was this erosion caused by man, animals or weather?*
Answers will vary.

2. Display STUDY PRINT 3. Tell students that this picture was taken in Pennsylvania (have students locate Pennsylvania on a map). Ask:

■ *Do you see any sign of soil erosion in this picture?*
No. There are no barren areas of cracked, parched earth. Vegetation is lush and green.

■ *Can farmers control weather?*
No, but they can plan ahead to lessen the damage of weather. Have students examine the photograph on the study print to see if they can detect what the farmers have done to plan ahead and protect the soil from weather.

■ *Why does the farmer plant the crops in curved rows?*
The farmer plans ahead to prevent soil erosion by planting crops along the shape (contour) or slope of the land rather than in straight lines up and down the hills. Each curved row acts like a step and slows soil movement caused by water or wind.

3. Reinforce the meaning of coutour by having a few students trace the curved contours on the study print. Write CONTOUR FARMING on the board. Sketch a rolling horizon line beneath it. Draw in chalk contours. It might look like this:

CONTOUR FARMING

Draw in straight lines with your finger from the top of the hills downward to illustrate poor planting. Encourage students to look for lines on the land that illustrate good soil caretaking practices in books, when traveling or in other photographs.

4. Ask:

■ *Why does the farmer plant strips of different crops?*
Some plants that are bushy and have many roots protect the soil from wind and water erosion. Other plants are more stalky and leave the ground uncovered. By planting these two types of crops in alternating strips, farmers can grow the stalky plants and also prevent erosion. Stripcropping and year-to-year crop rotation also maintain the nutrients in the soil.

Point out to students that soil is a bit like their refrigerator. In order to grow, plants take nutrients, their own special food, from the soil as we take food from the refrigerator. Different types of plants take different nutrients. One of the main nutrients found in the soil is nitrogen. Some crops, such as corn, remove nitrogen from the soil. When we go grocery shopping we replenish, or put food back in, the refrigerator. Farmers have learned that other crops, like alfalfa, clover, peas, soybeans and peanuts, put nitrogen back into the soil.

5. Draw a rectangle on a chalkboard to represent a farmer's field. Ask them to use this information to decide what to plant to keep the soil in their fields healthy and full of nutrients. Allow students to suggest ways to be good caretakers. Introduce the term crop rotation when students suggest reversing crops which are nitrogen users with nitrogen builders.

6. Ask:

■ *Why are there paths through some of the crops?*
Grassed waterways have been planted to slow down water and to repair or prevent the formation of gullies.

■ *Why doesn't the farmer cut down the trees so he can plant more crops?*
Trees are left in place and deliberately planted to serve as a windbreak. The windbreak also serves as a home to many forms of wildlife and reduces energy costs to his/her home

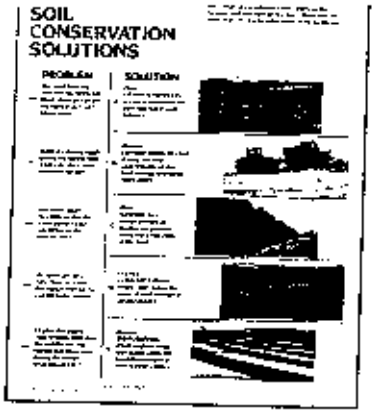
■ *What evidence is there that the farmer is a good planner?*
Trees planted as windbreaks, grassed waterways, contour stripcropping and healthy crops all point to good planning.

■ *What evidence is there that the farmer cares for animals?*
Windbreaks, crop areas and grassed waterways are home to many different animals. These are good places for wildlife and livestock to live, find food, raise their young and hide from danger.

7. Point out the inset picture. Explain that after harvest, instead of "plowing under" the crop stubble, this farmer left the remains of the plants on the field to protect the topsoil so that wind and water wouldn't carry it away as they did during the Dust Bowl days. The crop's roots and stubble protect the soil from harsh winds, hold it in place during heavy rainfall and provide cover during hot dry periods. A mother bird is also glad the farmer left the stubble because it provides a place for nesting. Continue discussing this picture by asking:

■ *Why is this a good spot for a nest?*
Bits of grain and insects provide food for nesting birds and other wildlife. Crop-remains are easily formed into a nest which provides cover and protective camouflage. The colors and irregular surfaces of crop remnants match the coloration of many adult birds. The field provides food and protection until planting time. Birds and animals will return after the harvest.

■ *What forms the nest?*
The mother bird has fashioned this nest from the remains of the crop and her own down feathers.



■ *What kind of bird do you think will hatch from these eggs?*
Answers will vary.

8. Distribute ACTIVITY SHEET 3C/SOIL CONSERVATION SOLUTIONS. (This activity is best suited for advanced students.) Observe and discuss the six methods that are illustrated and defined on the handout. Challenge students in cooperative groups to match each farmer's problem with a good caretaking solution. Point out that there may be more than one way to solve some of the problems. Allow groups to share their results and justify their answers if they disagree. Have students identify methods defined on ACTIVITY SHEET 3C/SOIL CONSERVATION SOLUTIONS which are depicted on STUDY PRINT 3.

WRAPPING IT UP/DAY 3

1. Point out that erosion is not just a problem for farmers.

2. Take an erosion walk around your school if weather permits. Have students be on the lookout for signs of erosion from rain, snow, wind or people. Look for areas that need to be cared for in order to preserve and improve the environment (worn paint, cracked sidewalks, graffiti scratched on objects, faded curtains,crumbling pavement, damaged statues, hills with gullies, missing parts of playground equipment, etc.)

3. Make a list of problem areas. Try to identify what is causing the erosion of these areas and develop some creative solutions.

CURRICULUM EXTENSIONS

READING
Allow students to take a closer look at soil by sharing *Beneath Your Feet* by Seymour Simon (published by Walker Publishing Co., Inc., 1977).

SOCIAL STUDIES
Research George Washington Carver and his role to encourage crop rotation.

WRITING
Do an acrostic poem. Have students write words/phrases that describe a word they write vertically on their paper.

ANSWERS TO QUESTIONS ON ACTIVITY SHEETS

ACTIVITY SHEET 3A/SOIL SAMPLE
1. Does sketch include root, plant life and an indication that student has observed sample carefully?

2. Animal evidence may include: bird feather, piece of bone, worm, etc.

Plant evidence may include: roots, flowers, stems, leaves, moss, etc.

3. Answers will depend upon soil composition in your area. Students should see at least 4 components: clay, sand, small stones, rich black topsoil, etc.

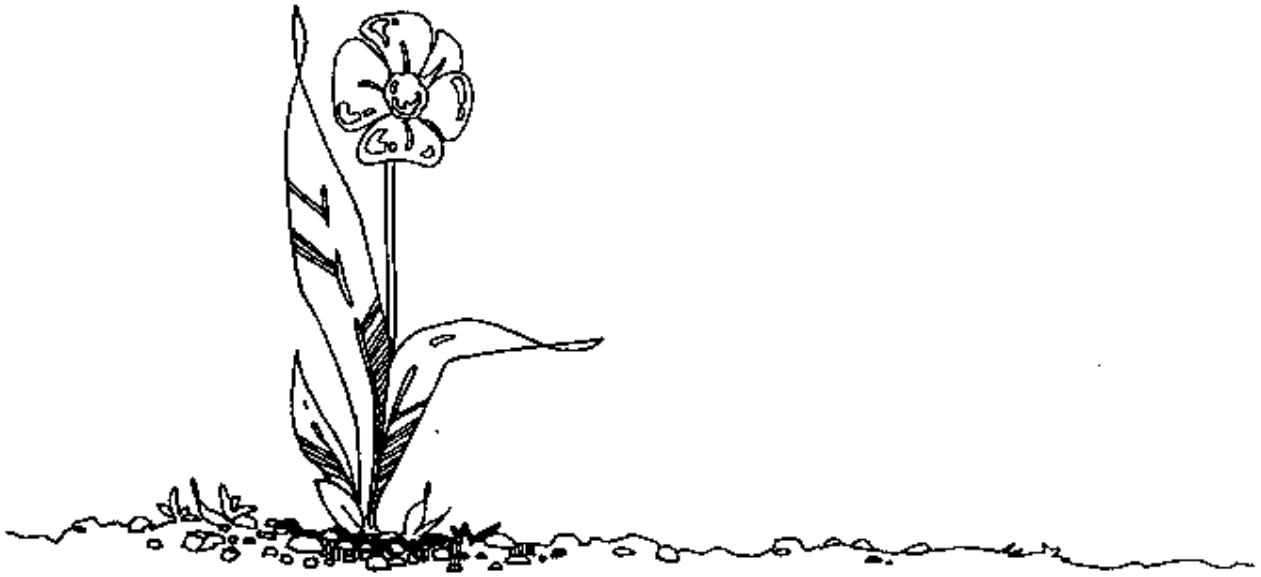
4. Encourage a variety of answers. They may include: it's a home for worms; roots travel deep and wide; there's lots of action beneath our feet; etc.

ACTIVITY SHEET 3B/THE DUST BOWL—A TURNING POINT
See WRAPPING IT UP/DAY 2 on page 16.

ACTIVITY SHEET 3C/SOIL CONSERVATION SOLUTIONS
There may be more than one way to solve some of the problems. If students' answers differ from these, they must be able to justify their answer: C, A, E, D, B

NAME _____

SOIL SAMPLE



1 Sketch your sample.

2 Crumble your sample carefully. Record it on this chart.

Look for →

ANIMAL EVIDENCE	PLANT EVIDENCE

3 Sort your sample. What makes up the soil?

Mostly _____ and _____

but also some _____ and just a little _____

4 What did you learn about soil?

A _____

B _____

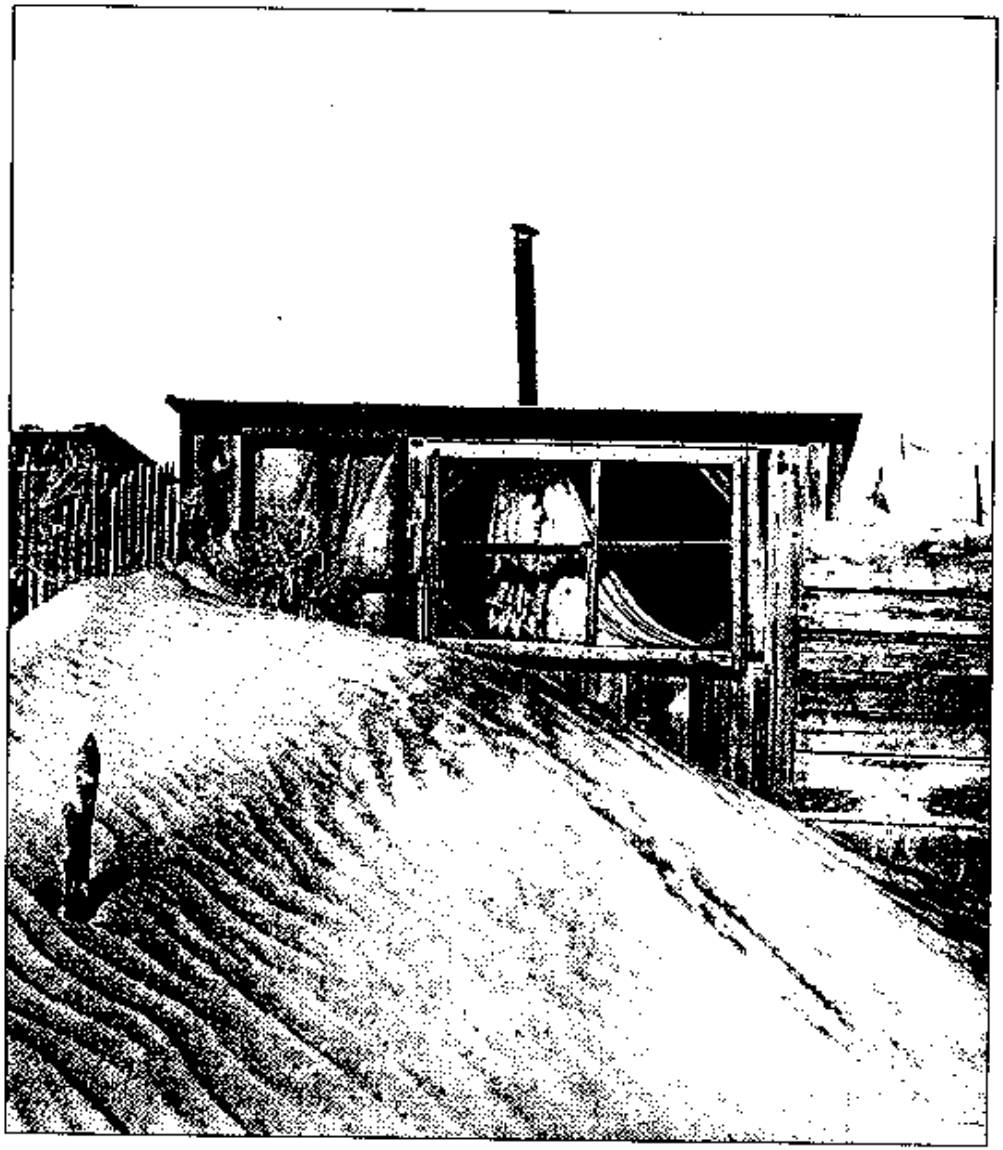
C _____

5 Return your sample to its former environment.

NAME _____

THE DUST BOWL—A TURNING POINT

CAUSES



EFFECTS

SOIL CONSERVATION SOLUTIONS

DIRECTIONS: Match each problem with a soil conservation solution. Look closely at the pictures and descriptions for clues. There may be more than one way to solve some of the problems.

PROBLEM

___ The wind from the west hits my fields full blast. How can I protect the topsoil so it isn't blown away?

___ Water is creating a gully during the spring rains. What can I do to slow down the run off?

___ How shall I plant my crops so that the water doesn't wash ruts between the rows of corn?

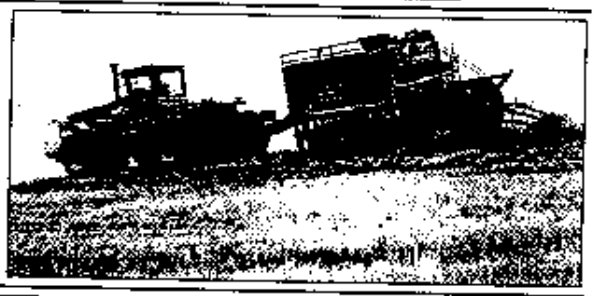
___ My fields are very hilly. How can I stop the topsoil from being carried to the bottom?

___ If I plow this year's crop-remains back into the soil this fall, the topsoil may blow away during the winter. What should I do?

SOLUTION

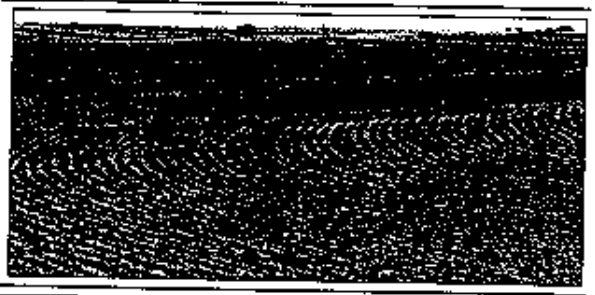
A Plant GRASSY WATERWAYS. (Grass is planted in the path that runoff water follows.)

B Practice CONSERVATION TILLAGE. (Leave last year's crop-remains on the field instead of plowing them under.)



C Plant WINDBREAKS. (Strips of trees or bushes are planted along the windy edge of the field.)

D Practice CONTOUR FARMING. (Plant crops across the slope of a hill instead of up and down.)



E Practice STRIPCROPPING. (Plant crops in strips with grassy crops like hay between rows of corn or other crops.)

OBJECTIVE: To help students become aware of soil and its importance to plants and animals.

16 Picture Poster Activities (LA, S, A, M)

★ **Who Needs Soil?** Ask your students to think of ways that animals and plants use the soil. If they need help, here are some ideas:
- to live in (termites and worms)
- to sleep in (moles, snakes)
- to store food in (squirrels, chipmunks)
- to get food from (birds, people, worms)
- to hibernate in (turtles, frogs, insects)
- to grow in (plants)

Observing: Look at the 16-picture poster together. Can your students find animals that use the soil in the ways you've just discussed? The prairie dog, for example, makes its home by burrowing into the soil. See the back of the poster for examples of how other animals use the soil.

Drawing: Have each child draw a picture of a favorite plant or animal, and explain why it needs soil. Older students can write a sentence on their pictures about why soil is important to plants and animals.

Comparing: Ask students to compare the four **habitats,** identifying how they are alike (they all have soil, plants, animals, etc.) and how they are different (the desert is dry, the marsh is wet, the forest is shady, the prairie is sunny, etc.). You may also want to talk about similarities and differences between plants and animals.

★ **Soil Flash Cards** Laminate the 16-picture poster or cover it with clear contact paper. Cut the poster into sixteen individual pictures and use them in the following activities.

Classification: Ask students to sort the pictures in different ways. Which animals have fur? Feathers? Scales? A hard covering? Which animals dig? Swim? Fly? Hop? Crawl? Walk? Find the animals and plants with the color orange, black, green, etc. in them. Which animal names begin with the letter P? M? and so on.

Counting: How many birds are there? Furry animals? Insects? (NOTE: Remind your students that spiders and worms are not insects. Insects have six legs and three body sections.) How many legs does the tarantula have? How many legs do the other animals have? How many do people have? How many legs are there in the class? How many plants are there in the poster?

Movement: Choose several different animals from the 16-picture poster. Call out the name of an animal, such as "grasshopper," and let the children act out the animal. Encourage your students to mimic things that these animals do, such as eating, sleeping, playing, and looking for food. Turn this into a game of charades by letting one child or a small group of children mimic the animal, while the rest of the class tries to guess what the animal is.

★ **Food Chains** You can make a **food chain** bulletin board using the 16-picture poster photos and other pictures. Using construction paper, make a sun for the top of the bulletin board and a strip of soil for the bottom. Put the picture of the cattails and the prairie flowers above the soil. Here you can talk about how plants make food from sunlight and get minerals from the soil. Next put the muskrat above the cattails and the grasshopper above the prairie plant to show that these animals eat the plants. Connect the plants and animals with yarn or string. Now you can talk about the muskrat eating cattails and the grasshopper eating prairie plants. Put the snapping turtle above the muskrat and the burrowing owl above the grasshopper. Snapping turtles eat muskrats and burrowing owls eat grasshoppers. Connect these animals. Talk with your children about how a food chain works.

★ **Food Chain Game** Choose two children to start the food chain game, and have the rest of the class form a circle around them. Blindfold both students. One of them will be the burrowing owl and the other will be the grasshopper. The rest of the children will be prairie plants. The burrowing owl must try to catch the grasshopper in the "prairie" formed by the circle of children. When the burrowing owl says "who," the grasshopper must answer "chirp, chirp." The children in the circle should help the owl and the grasshopper stay inside the prairie.

To make the game more difficult, have the children in the circle make the sounds of wind, coyotes, swishing grasses, and other prairie noises. Adjust the size of the circle to change the difficulty of the game. Choose a new owl and grasshopper to start each round.

Soil Walk (S, LA)

Materials: a magnifying glass for each child

Children enjoy exploring the out-of-doors, so here are some suggestions for planning a "soil walk." Save time for a pre-walk discussion when you can ask the children what they

Grades K-2

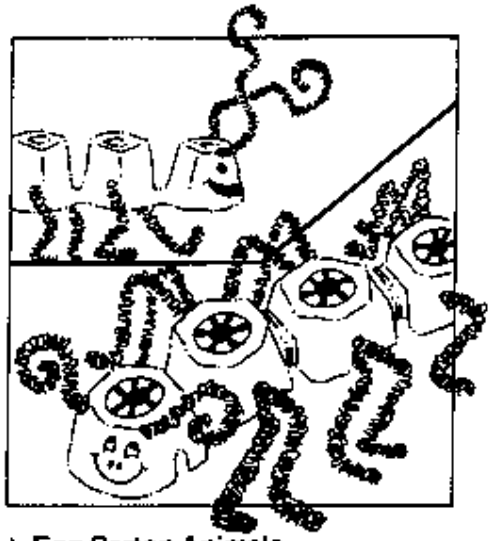
think soil is made of, what it feels like, what colors it might be, and how soils might differ. Show them how to use a hand lens or magnifier.

For your soil walk, visit several places where different kinds of soil can be found. Try such areas as a pitcher's mound, the bottom of a slide, under a tree, the edge of a field, or under a rotten log. At each spot, have the children look closely at the soil with the magnifying glass. They might find bits of plants and animals, clay, rocks, and sand. Look for leaves, sticks, roots, and remains of animals such as insects and worms. Students can pick up, feel, and smell each kind of soil and look for different colored soils. Make sure that your students return the soil to the place where they found it to prevent erosion.

Down-to-Earth Art (A)

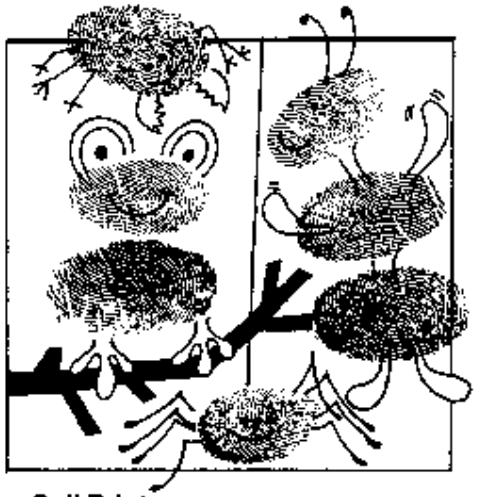
★ **Soil Collage**
Materials: soil, glue, markers, and heavy paper or cardboard

Let your children use real soil to make their own pictures. Begin by talking about soil's importance to plants. Name some plants you see every day (trees in the school yard, house plants, wildflowers, grass, and plants that give us food). How is soil important to these plants? Let each child sketch a plant showing the roots beneath the ground's surface. Trace over the roots with a brightly colored marker. Spread glue over the soil area (omitting the roots) and sprinkle soil over the glue. Wait for the glue to dry and shake off the excess.



★ **Egg Carton Animals**
Materials: egg cartons (broken apart in lengths of two to six cups), pipe cleaners, markers, seeds, glue, and scrap paper

After your children have studied the animals on the 16-picture poster and the soil ecosystem transparency, let them make their own soil creatures using the materials suggested above. Earthworms, millipedes, and ants are easy to make with egg cartons.



★ **Soil Prints**
Materials: clay, scrap paper, felt tipped pens, paper, and thumbs

Your children can make soil prints by pressing the tips, sides, and pads of their thumbs in moist clay soil, then onto paper. Add a few straight lines, curves, dots, and triangles of scrap paper to turn their thumbprints into amazing soil animals.

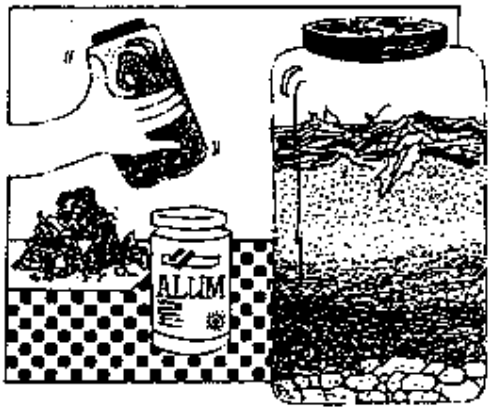
Grades 3-5

OBJECTIVE: To help students understand how soils are formed and the characteristics of different types of soil.

Shake-a-Jar (S)

Materials: quart jars, newspapers, soil, water, and alum (purchase in drugstore)

Soil is composed of a variety of materials. To compare the relative amount of these materials in different soil types, have your students take soil samples from a garden, field, empty lot, woods, and other places. Keeping samples separate, spread the soil on a newspaper, crush any lumps, and remove large rocks, sticks, or trash.



For each soil type, fill a quart jar one-quarter full with soil, label, and add water until the jar is three-quarters full. Add one tablespoon of alum, close the lid, and shake hard. Let the jar stand for several minutes.

Students will see that the mixture separates into layers. The larger particles—coarse sand or rocks—settle to bottom of the jar. The finer particles of silt and clay will form the next layer. The material left floating on top of the water is called organic matter. Organic matter is made up of dead leaves, twigs, stems, and parts of animals and plants. The more organic matter in soil, the richer it is.

Ask your students such questions as: How long did it take for all the particles to settle? Did some soil samples take longer to separate than others? If so, what do you think caused

this to happen? Compare the different soil samples. Which has the most organic matter? In which soil do you think plants would grow best? What could be done to improve soil with little organic matter?

Watching Roots Grow (S)

Materials: soil, gravel, seeds (bean, pea, squash, corn, or radish), clear plastic cups, and masking tape

As plants grow, their roots spread into the soil. Roots break up rocks by pushing into cracks and crevices and splitting them apart. This helps add minerals to the soil. Roots also loosen the soil, allowing air to seep under the ground. Air stimulates plant growth and speeds up decomposition of organic materials within the soil.

Give each student a cup, gravel, soil, three to four seeds, and a piece of masking tape for a label. Have them put gravel in their cups for drainage, then fill three-quarters full with soil. Poke holes in the soil with a pencil and drop in the seeds. Place one seed along the outside wall of the cup so that the root growth can be easily seen. Cover the seeds with soil, pat down lightly, and water. Students should label the cups with their name, the kind of seed, and the date.

Depending on the seed, you should see growth within a few days. Ask the students such questions as: What do the seeds need to grow? (soil, sunlight, water) What happens as the seed begins to grow? What part of the plant grows first? (roots) How long before shoots or leaves come up? Do big seeds sprout first? Do different kinds of seeds have differently shaped roots? Are the roots long or short? Which grows faster – the roots or the leaves? How do the roots affect the soil?

Water the plants every other day with just enough water to darken the soil. To record the seed growth, students can make drawings of their plants every few days. The plants can be transferred to milk cartons to take home.

Glacier Glide (S, SS)

Materials: a half-gallon cardboard milk carton, masking tape, small rocks, gravel, sand, fine sediment, water, and wood panel

Approximately 15,000 years ago, glacial ice several kilometers thick (one km = 0.62 miles) stretched across large sections of North America. As the glaciers moved across the surface of the earth, they acted like giant bulldozers picking up large rocks and scouring everything in their paths. When the giant ice

masses receded, they left behind rocks, gravel, and sand. Water from melting ice carried large quantities of this **sediment** far beyond the boundaries of the glaciers. This sediment is known as glacial drift. Many areas of soil in the midwest and northeast were formed from glacial drift.

Using a model of a receding glacier, demonstrate to your students how glaciers left large deposits of rock and soil on the earth. At least two days in advance make the model glacier as follows: Wash out a half-gallon wax-coated milk or juice container, and place it on its side. Cut out the top side panel and tape the spout opening closed so that water cannot escape. Put a layer of small rocks, gravel, sand, and fine sediment in the bottom of the carton. Fill the container one-third full with water and place it in a freezer. After the water has frozen, repeat the layering process two more times or until the ice reaches the top.

On a warm day (above 55° F) take your model glacier out on the school grounds and remove the carton. Place the block on a twelve foot panel that is set at a 20° angle. As the ice melts, the glacier model will slowly slide down the board and leave deposits.

After you try this activity, you may want to have your students do research to find out if glaciers affected the landscape and soil in your area.

Volcanic Panic (S, SS)

Materials: clay or papier-mâché, small juice can, vinegar or lemon juice, baking soda, water, and red food coloring

A volcano is an opening in the earth's surface from which molten rock (magma), rock fragments, hot ashes, and gases escape—often forming a cone-shaped mountain. The heat and pressure deep inside the earth are extreme and sometimes cause tremendous explosions when the volcano erupts. Since the formation of the earth, volcanos have brought molten rock and ash from the center of earth to its surface, and this material has contributed significantly to the making of soil.

Students can make a model of a volcanic cone from clay or papier-mâché with a shallow crater (about six inches deep). In the crater of the volcano, place an empty orange juice can. To simulate lava (flowing magma), fill three-fourths of the container with water and add several drops of food coloring plus a tablespoon of lemon juice or vinegar. Then add two tablespoons of baking soda. The combination of water, baking soda, and an acidic substance such as vinegar and or lemon juice releases carbon dioxide gas causing the water to foam and flow down the sides of the model.

After demonstrating the explosive force of a volcano, your students may want to research the effects of the 1980 eruption of Mount St. Helens on the northwest area of the United States. You may also want to do research on how volcanoes may have affected the area in which you live, or other parts of the country.

Worm Watch (s)

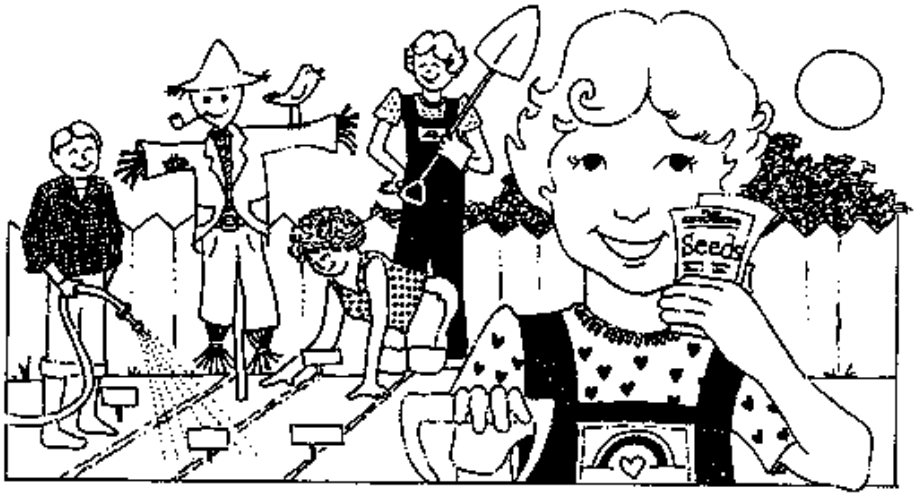
Materials: earthworms, hand lens, and paper towels

Earthworms are familiar to almost all children and make great classroom animals. You can buy earthworms at a bait shop or dig them up yourself. Just after a rain is a good time to find worms. Look for them in moist soil. Put the worms in a box filled with moist soil or lined with damp paper towels, and keep covered.

Give each child a moist paper towel and place a worm on it. See if the children can identify these parts of an earthworm: the rings, the head (the pointed end), the tail (the slightly flattened end), the light-colored band around the worm (two worms join here during mating), the top side, and the belly (a little lighter in color than the top and lined with tiny bristles). With a hand lens, children may also be able to see beneath the skin's surface to the long intestinal tube and the five ring-shaped hearts near the earthworm's head. Some questions you can ask the children are: What does the skin feel like? How does the worm move? What are its bristles for? Can you see eyes, ears. or a mouth? What happens when you turn the earthworm over? What happens when you gently touch the worm? What do worms eat? (Bits of decaying plants and animals in the soil). Why are worms good for plants? (As earthworms tunnel underground, they loosen the soil, allowing air and water to reach plant roots. Their tunneling also helps mix organic matter rich in nutrients, into the soil. Earthworms help break down organic matter making these nutrients available for plants to use.)

Digging For Words

Forty-one soil-related words are hidden in this puzzle. The shortest word contains three letters; the longest contains thirteen. The words may be read forward, backward, up, or down. All words for solving this puzzle can be found on the back of the Wildlife Week posters and throughout the Educator's Guide.



W E A T H E R I N G C R O P S C
I R E S O U R C E L X A Z R I O
N O C O R N Z C Y A M I R E L N
D S C I H Z V O L C A N O C T S
T I L L A G E M D I R T D I Y E
O O A A B R M P S E S G E P T R
P N Y N I O I O O R G A N I C V
S A N D T U N S U M U H V T O A
O W L G A N E T R E E S I A N T
I X C P T D R S K U N K R T T I
L A N D S C A P E L O R O I O O
S U B S O I L L I R S M N O U N
H C L U M W O R M S I E M N R M
E B K C P U L V E R I Z E D O O
E S T R I P C R O P P I N G M L
T W I N D B R E A K S L T R M E

Answers: Ant, clay, compost, conservation, conifer, corn, crops, dirt, environment, erosion, glacier, ground, habitat, humus, land, landscape, mineral, mole, mulch, organic, owl, precipitation, pulverized, rain, resource, rill, sand, sheet, silt, skunk, soil, subsoil, stripcropping, tillage, trees, topsoil, volcano, weathering, wind, windbreaks, and worms.

Name _____

NEW MEXICO'S WONDERFUL WATER!

Water! It is everywhere: in the air, on the earth's surface, and in the ground. Living organisms depend on water for life. Water is an essential part of our lives.

Odorless, tasteless and colorless, water is an amazing substance. We use it in many ways...ways we often take for granted. People use water for drinking, cooking, washing, and landscaping. It is used for agriculture, industry, transportation and recreation. Hydroelectric power provides us with electricity. One day water may be used to power space shuttles and space stations!

Our bodies are made up of up to 80 percent water! Water is in liquid form when it is found in streams or lakes. It is a gas-water vapor-when it condenses it makes clouds. It is solid when frozen as an icicle or ice cubes.

A WATER FACT

What is an acre-foot of water?

An acre-foot is the basic measurement of standing water. An acre-foot would be the amount of water a foot high on an acre. This would be similar to 10 inches standing on a football field. An acre foot is equal to 325,851 gallons.

MATH

CONVERSION FACTORS:

VOLUME: 1 acre-foot (AF) = 325,851 gallons of water
1 cubic foot + 7.48 gallons of water

RATE: 1 cubic foot/second (CFS) = 646,317 gallons per day
or 1.98 AF per day

AN ACRE FOOT OF WATER IS SUFFICIENT TO MEET THE NEEDS OF A FAMILY OF FIVE FOR ONE YEAR.

QUESTION: If a community has as its water supply a reservoir storing 5,000 AF of water, how many gallons do they have?

QUESTION: If that community has 1,800 families, how many years of reserve water supply does it have?

The Water Cycle . . .

A CYCLE THAT GOES **ON and ON and ON and ON and ON and ON and ON and ON and ON and ON!**

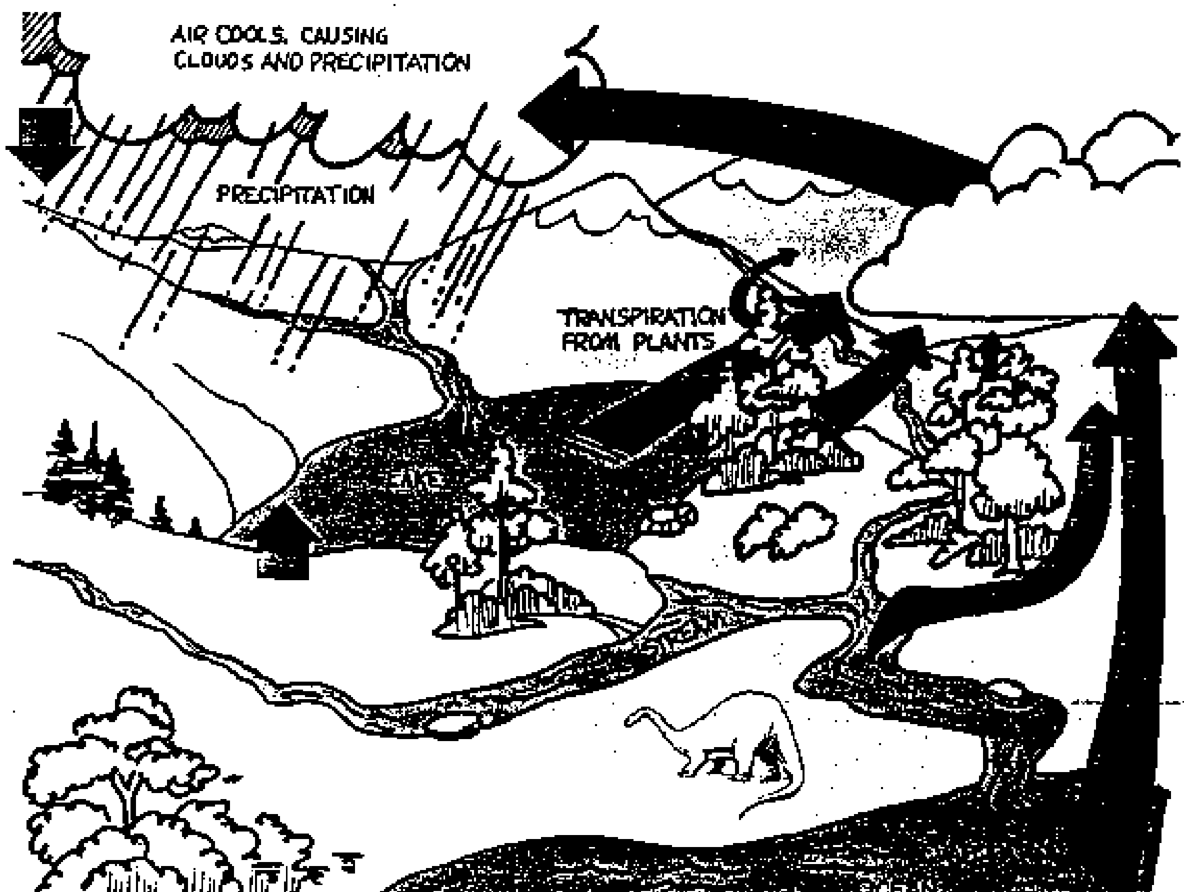
and ON and ON

The water you drink today could be the same water a dinosaur drank millions of years ago.

All water on earth is used and reused in an endless process called the **hydrologic cycle** or **water cycle.**

The amount of water in clouds, on land, in ice caps and in oceans is the same today as it was years and years ago. It will remain the same in the future.

Water from land and oceans is warmed by the sun and **evaporates** into the air as a gas – or **water vapor.** The water vapor in air **condenses** to form clouds then **precipitation** such as rain, snow and hail. The water falls to the earth. Some of it falls in oceans, some may run off land into lakes, rivers and streams, and some water filters into the soil to become **ground water** (water found below the surface of the earth). Ground water is the source of well water and springs. Some of the water in the soil is used by plants. **Moisture** is returned to the air when plants **transpire** or "breathe" and when water evaporates.



WHAT ARE THE THREE FORMS OF WATER?

1. ______________ 2. ______________ 3. ______________

Name _____

GROUND WATER Surface water is water found on the top of the ground, often in the form of lakes, rivers or wetlands. Ground water is water that has traveled down into aquifers and is another important source of water in New Mexico. Aquifers were formed millions of years ago. They are underground layers of rock, sand and gravel that hold water. Water travels around and through this material. Aquifers may be thin or thick; they may be very small or they may stretch for hundreds of miles. The refilling or replacement of water in aquifers is called recharging. You may be refilling an aquifer when you are watering your lawn.

Water is very important to New Mexico agriculture. Most of our state is very dry. Total precipitation is only seven inches a year in most parts of New Mexico. No crops could be grown in these areas if water was not available through irrigation. Farmers use this water to produce the food you eat. The water is used by the plants or evaporates into the air. Some of the unused water goes back into the water supply. Someone else can then use the water.

The re-entry of water into the ground water system is part of the water cycle or hydrologic cycle. There is a finite amount of water available on earth. Water is always in one form or another, in one place or another. The cycle has no fixed speed or distribution...the only constant is the amount of water that exists. The last time you took a shower, you were using the same water the dinosaurs drank!

WATER IS NECESSARY TO OUR LIVES. IT IS IMPORTANT EACH OF US LEARN TO USE IT WISELY AND KEEP IT CLEAN!

New Mexico is Chihuahuan desert. We get an average of 7 inches of rain per year. Do you think 7 inches is a lot of rain?

- ★ Research how much rain your county gets.
- ★ Research how much rain other areas of the country gets.

HOW WATER WISE ARE YOU??

- ★ **A quick shower uses less water than a bath.**
- ★ **Wash your hair while showering to save water.**
- ★ **Don't let water run while brushing your teeth or washing your face.**
- ★ **Keep a container of drinking water in the refrigerator.**
- ★ **Rinse dishes in a sink full of water, not under running water.**
- ★ **Don't water the streets, sidewalks and driveways. They won't grow a thing.**

Name_____

WATER CONSERVATION

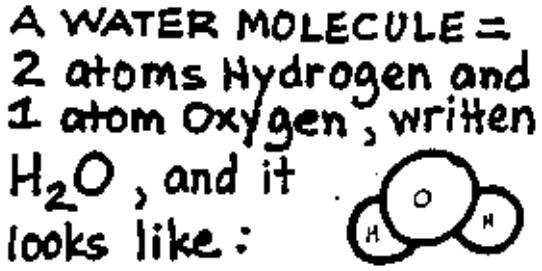
The water cycle shows water is used over and over again. Our water supply is variable, meaning sometimes we have a lot, other times less. Sometimes people pollute water faster than nature can clean it up. Water conservation is reducing the amount of water used or consumed. It is the wise use of water.

Water is not always where we want it exactly when we want it-especially in New Mexico. There are times when we have barely enough rain or snow to make the pastures green. Other times, the rain falls all at once and causes floods. Because our water supply is critical, it is important to conserve it and keep it clean. It is also important to store water for future use.

An average home uses 500 gallons of water every day. Most of this water is used for landscaping. Water is also used indoors for showers, baths, toilets, dishwashers, clothes washers, brushing teeth, cooking, watering plants and some is lost due to leaks. Water goes down the drain every day!

POLLUTION

From outer space our planet looks to be blue because three-quarters of its surface is covered by water. In the Earth's formation, a large amount of hydrogen and oxygen was formed. When these elements combine they make water. There are two hydrogen atoms and one oxygen atom in every molecule of water. The molecules are held together in such a way they "pull" other substances in to fill the spaces. This makes water very easy to pollute. In fact, there is no "pure" water in nature. All water contains natural pollutants no matter where it is or how clean it looks.



USE OF WATER

There is a difference between consumptive and nonconsumptive use of water. Consumptive use is when water is consumed or used, such as taking a drink of water.

Water not consumed generally returns to the water cycle to be used by others. When you_ wash your hands, the water goes down the drain. It will be cleaned and used by others. This is nonconsumptive use of water.

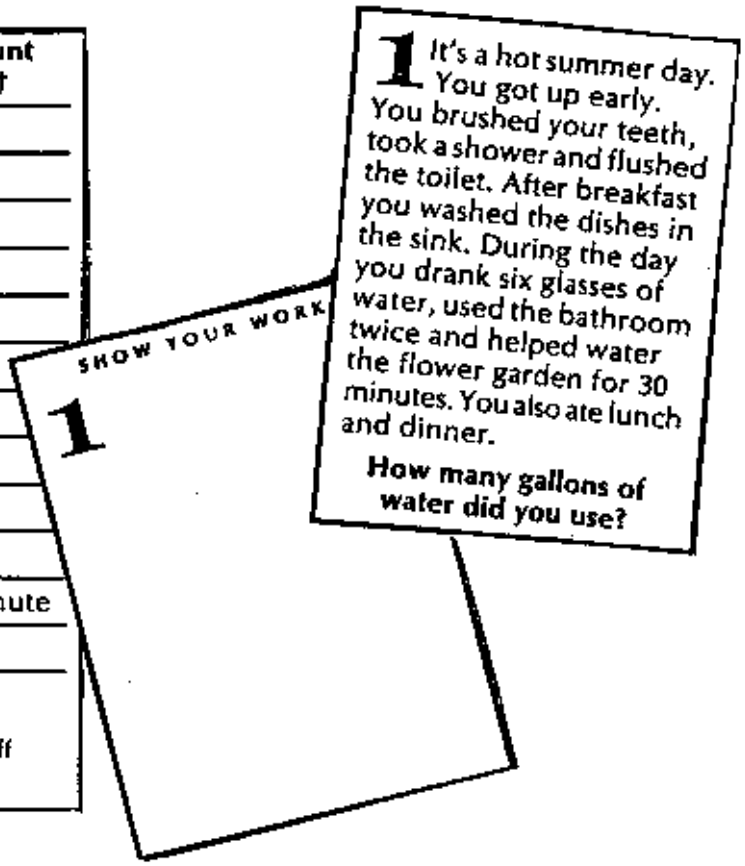
Name _____

MATH CHALLENGE

These are average numbers for how much water is used for an activity. Some of them may seem high but let's assume you let the water run to get it hot or cold. You wouldn't drink a quarter of a gallon of water each time you get a drink, but that's how much water would run from the faucet.

How you use water	Average amount of water used†
Taking a bath	50 gallons
Taking a shower	35 gallons*
Brushing teeth	1 gallon**
Washing hands/face	1 gallon
Flushing toilet	5 gallons
Getting a drink	1/4 gallon
Cooking a meal	3 gallons
Washing dishes in a sink	25 gallons
Washing dishes in dishwasher	10 gallons
Washing clothes	45 gallons
Watering outside	10 gallons/minute
Other	You estimate

† Figures are from Project WET.
* 20 gallons if shower has low-flow head.
** If water runs while brushing. 1/2 gallon if you turn off the water while brushing.



Water Conservation - What Have You Learned?

1. Where does water come from? _____

2. How is water formed? _____

3. Is water a renewable or non-renewable resource? Explain why.

_____

_____

4. Explain the formation of a rain cloud (you may illustrate).

5. Explain where the clouds come from that bring rain to New Mexico.

6. List four uses of water.

7. Describe two sources of community water in your area.

8. Identify four ill effects of a drought.

9. Explain what a watershed is and where it is located.

10. Explain what an aquifer is and explain its importance to the people of New Mexico.

Name _____

WATER CONSERVATION

1. Water comes from rain. The rain in clouds comes from many sources (transpiration, rivers, streams, respiration, ocean, soil, etc.
2. The sun's energy transfers water from the sources mentioned in no. 1 to the atmosphere in the form of water vapor. Air masses carry water vapor across the earth and it condenses into rain.
3. Renewable - the water we use stays in the water cycle and is never lost. Little water has ever been lost or added through the ages.
4. Cloud formation (condensation). Water vapor (evaporation from precipitation, combustion, rivers, animals, plants, ocean).
5. The clouds come primarily from the south-west (Pacific Ocean) and occasionally from the Gulf Coast.
6. Uses of water (variable answers):
   a. animals drink it
   b. plants use it
   c. fills our oceans, ponds, rivers and streams
   d. irrigation
   e. recreation
   f. transportation
   g. bathing
7. Community water in your area: (a) underground well, (b) rain.
8. Ill effects of drought:
   a. loss of yield from crops
   b. fires
   c. starvation/thirsting
   d. loss of wild life
9. An area drained by a river system, found in mountains in New Mexico, source of irrigation water.
10. An underground river, supplies well water for drinking, etc.

Everyday Classroom & Home Uses of Water

HOW MUCH WATER DO WE USE?

Americans are fortunate. We can turn on the faucet and get all the clean, fresh water we need. Many of us take water for granted. Have you ever wondered how much water you use each day?

The chart on page 2 lists average amounts of water required for certain activities. Look again to see how many gallons are needed for washing dishes by hand or for flushing a toilet.

Water is the most abundant of our natural resources. About 75% of the earth's surface is covered with water. However, most of the water is in saltwater oceans or in frozen polar ice caps. Only one percent of the earth's water is available for humans to use. We use fresh water for more than drinking.

How many ways can you think of that we use water?

_____

_____

_____

_____

_____

As demand for water increases, we need to be aware of ways to conserve it. But first we need to know how much water is used.

Monitor your class's use of water. Record on the chart each time a drink is taken or hands are washed. Record the number of times the restroom is used.

2 Your dishwasher is broken. This is the 5th day you've had to wash the dishes by hand in the sink. You wash the dishes once a day.

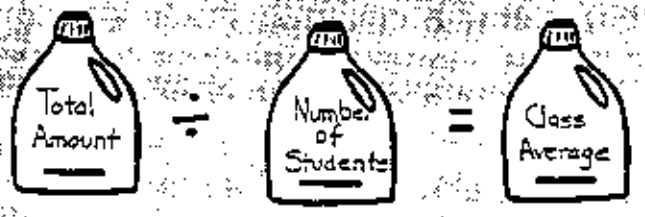
How many gallons of water have you used to do the dishes?

How many gallons of water does your dishwasher use for 5 days?

How much more water have you used?

A Personal School Survey

	Estimate	Actual # of Times	Time in Seconds	Amount of H_2O Used
Drinks				
Washing Hands				
Toilet			Multiply by 5 gallons	
Total				



To calculate the amount of water used, run water from the drinking fountain into a container for 10 seconds. Use this amount to determine how much water is used for each drink recorded in seconds. Multiply the number of trips to the restroom by five gallons (the amount of water consumed by the average toilet flush).

Compare the amount of water you use with the class average.
Are you above or below the class average?

How can you reduce your use of water at school?

_____

_____

SHOW YOUR WORK

2

Water — The Essential Nutrient

Water is the most important element in life. Some organisms can live without air, but no form of life has ever been found that can survive without water. From the world's earliest known history, people have always lived near rivers and lakes, where they had access to fresh water.

Nearly 60 percent of our body weight consists of water. Considering that adult bodies are nearly two-thirds water, this means that for a 150-pound person, 90 pounds, or 45 quarts, is water. We need to replace about 3 or 4 percent of ourselves each day. A loss of 1 percent of our necessary water level results in thirst, and possibly pain. A loss of 5 percent can lead to hallucinations, while a 10 percent loss in children — 15 percent in adults — will lead to death.

Water plays many essential roles in the body:

- ▲ It carries nutrients and oxygen to all parts of the body hrough blood and lymph.
- ▲ It helps regulate body temperature by allowing heat to escape through perspiration.
- ▲ It acts as a lubricant around joints and as a shock absorber inside the eyes and in the spinal cord.
- ▲ It maintains physical work performance. Just a 4 or 5 percent decrease in body water will result in a 20 to 30 percent decline in efficiency.
- ▲ It helps food to be digested and converted to energy.

Health authorities recommend that for our bodies to function

(more)

properly, we need about 2 quarts (6 to 8 cups) of water daily. Most of us drink little more than half this amount.

Besides water from the tap, all the beverages we drink contain water: coffee, tea, milk, soft drinks, and juices. Other water sources include soups and gelatins. Solid foods contain various amounts of water. Tomatoes are 95 percent water, and potatoes are 80 potatoes water. Meats are between 50 and 70 percent water, while bread is approximately 35 percent water.

The quality and quantity of this essential nutrient can affect our lives many times every day. From our morning cup of coffee to washing our hands; from making soup for dinner to doing the laundry, we depend on water. Most of us take our water for granted, but we shouldn't — water is too important to our existence to not be protected.

CARETAKERS ALL

STUDY PRINT 2

CARETAKERS OF WATER

OBJECTIVES

Students will be able to:

1. List ways people and animals depend upon water.

2. Describe the water cycle.

3. Give examples of ways to conserve water.

KEY TERMS FOR STUDENTS

condensation, evaporation, ground water, irrigation, precipitation, rural, suburban, urban, water cycle, water vapor

TIME

The following lesson will require two to three 30-minute class periods, depending upon the depth of coverage. Teachers are encouraged to select and adapt the following plan to best meet the needs of their students. Extension activities listed at the end of the lesson take the concept across the curriculum.

MATERIALS NEEDED/DAY I

STUDY PRINT 2
ACTIVITY SHEET 2A/WATER WISE
a potato, spoon, knife, paper towels, salt, water, chart paper, a variety of color markers, 3 drinking glasses, 3 labels and cutting board

MATERIALS NEEDED/DAY 2

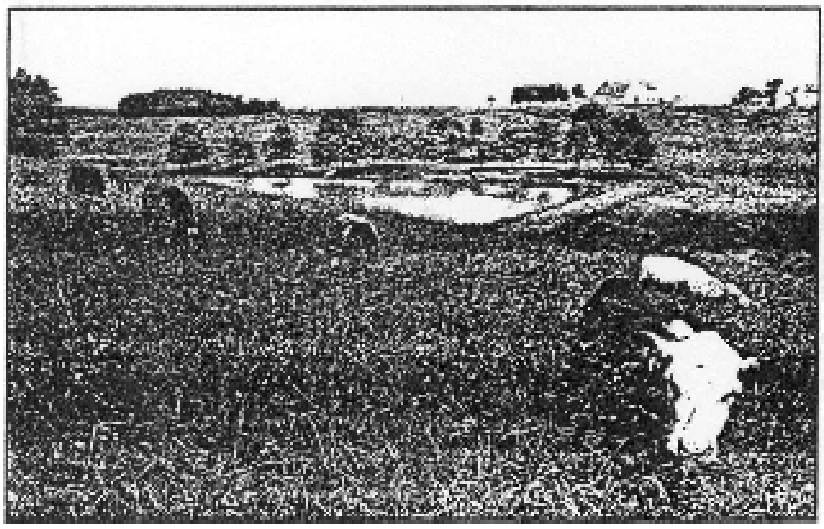
STUDY PRINT 2
ACTIVITY SHEET 2B/THE WATER CYCLE
salt, water, cup, spoon, pan, heat source, mirror or glass slide and dark piece of construction paper

BACKGROUND INFORMATION FOR TEACHERS

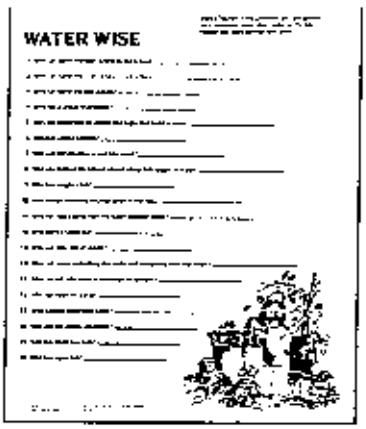
Water, the most abundant of all chemical compounds, is a necessity for all living things. It is an essential ingredient of all living organisms and a major component of our environment. Water and ice cover about 75% of the earth's surface and water vapor is an important constituent of the atmosphere.

Because of the water cycle. there is as much water on earth today as there ever was--or ever will be. The water you bathed in last night may be the same water a Native American used to irrigate crops before Columbus ever set sail from Spain. The amount of water on earth remains constant but its availability and usability changes. The liquid state of water is most important to life, but the sun's heat causes water to evaporate and become water vapor. About 65% of water vapor comes from the oceans. When air becomes saturated with water vapor, condensation occurs. Warm air is capable of holding more water vapor than cool air. Cooling of warm, moisture-laden air causes precipitation of water as rain, sleet or snow.

Salt water found in oceans and seas accounts for 94% of all the water on earth. It cannot be used for agriculture, drinking or by industry unless it is desalinated or



For a complete packet of "Caretakers All" contact
New Mexico Ag in Classroom at www.nmfb.org



until it evaporates. As salt water evaporates, the salt is left behind and the precipitation that falls to earth is fresh water. The waters of the planet Earth move continuously from the oceans, lakes, ponds, rivers and streams through an unending evaporation and precipitation cycle.

Although water does cycle, certain reservoirs (such as groundwater) are not as quickly replenished as they are used. Ideally, water returning to the earth as precipitation would percolate through the soil and replenish the groundwater supply uniformly. Unfortunately, this is not the case. Hypothetically, the Midwest could be experiencing a drought while Texas was experiencing floods.

The demand for water is constantly increasing. An average American uses from 70 to 100 gallons of water a day at home for bathing, laundry, drinking, cooking, etc. However Americans also are consuming water when they flip a light switch, start their car, or bite into a sandwich. Thermo-electric power is the single biggest user of water in North America. Approximately 42% of all the water used on the continent of North America is needed to supply power to run factories, businesses, and our homes. Much of this power is used for cooling and air conditioning.

Irrigation accounts for 37% of the water used on our continent. Irrigation is the practice of making available to crops, pasture and lawns a greater quantity of water than that attained from natural rainfall. It may include flooding or ditching techniques, overhead sprinkling, diking of fields or maintaining a constant drip. Agriculture depends on water for crops and livestock. Some water used for feeding livestock or growing plants isn't available to humans and is converted into food for people and animals while the remaining part of water used in agriculture is recycled through the groundwater system.

Industry accounts for 14% of the water used on our continent. Water is required for many goods we enjoy. For example, seven gallons of water are required to refine a single gallon of gasoline. Eighty gallons of water are required to produce each Sunday newspaper.

Water quality is a vitally important issue for everyone. Society has made great strides in addressing water pollution problems. Many factories, sewage disposal plants and others treat contaminated water before discharging it into sewers or streams.

Purity can also be affected as water moves through the water cycle. Pollutants in the air can dissolve in rainwater (acid rain, etc.). Water allowed to run off unstopped can pick up chemicals, soil, manure, fertilizers, pesticides, used oil, toxic substances and street debris. This pollution comes from cities, forests, mining operations, construction sites, suburban streets, parking lots and farms. If left unchecked, it may carry contaminants into nearby surface waters or groundwaters beneath the surface.

Because farmers and ranchers are concerned about water quality, they continually improve their practices. Farmers are developing better ways to test their soil so they don't over fertilize their fields which means they purchase less fertilizer and reduce the potential for runoff into streams and ponds. It is in their best interest to keep streams clean and unpolluted. Livestock producers are designing feedlots so that animal wastes do not contaminate groundwater. Farmers are protecting water quality by using integrated pest management techniques, keeping chemicals away from wells and using good soil conservation techniques.

This lesson will focus on becoming wise borrowers of water from the water cycle.

BEFORE THE LESSON/DAY 1

1. If you plan to use cooperative groups, have students arranged and aware of the rules and their roles.

2. Duplicate ACTIVITY SHEET 2A/ WATER WISE.

3. Prepare demonstration by having the following materials at hand: paper towel, salt, water, cups, potato, knife, labels, spoon and cutting board.

4. Have chart paper and markers ready for word web so that your finished web may be displayed in the classroom.

GETTING STARTED/DAY 1

1. The purpose of this activity is to focus on key terms and concepts that are basic to this study. Allow 5-7 minutes.

2. Distribute ACTIVITY SHEET 2A/ WATER WISE to all students.

3. Have students circulate in order to locate classmates described in this "People Search."

DOING THE LESSON/DAY 1

1. Discuss the previous activity by asking students why they think it was called *Water Wise*.

2. Discuss the importance of water. Explain that water is a necessity for all living things. It makes up 65% of the weight of our bodies. We can go without food for over a week, but without water we would die in just a few days. We get water from all the things we drink and eat. You can demonstrate this by pressing a very thin slice of potato between two pieces of paper toweling. Have students observe and feel the moisture absorbed by the towels.

3. Ask:

■ *Where do you think the potato got that moisture?*
The plant absorbed water from the moisture in the soil.

■ *How did the moisture get into the soil?*
Rainfall or deliberate watering by a person. Introduce the word *irrigation*.

4. Display STUDY PRINT 2. Ask:

■ *Do we live in a rural, urban or suburban community?*
Answers will vary.

■ *What kind of things do we expect to see in a rural community?*
Silos, barns, fields, open land and woods, farm animals and crops.

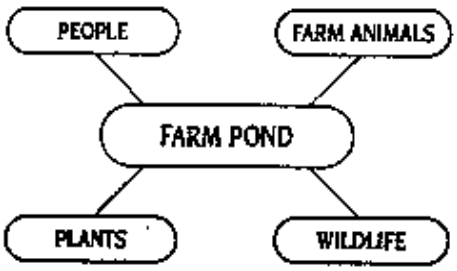
■ *An urban community?*
Many buildings, concrete, lots of people, lots of cars and very little yard area.

■ *A suburban community?*
Many residential areas, more yard space and malls.

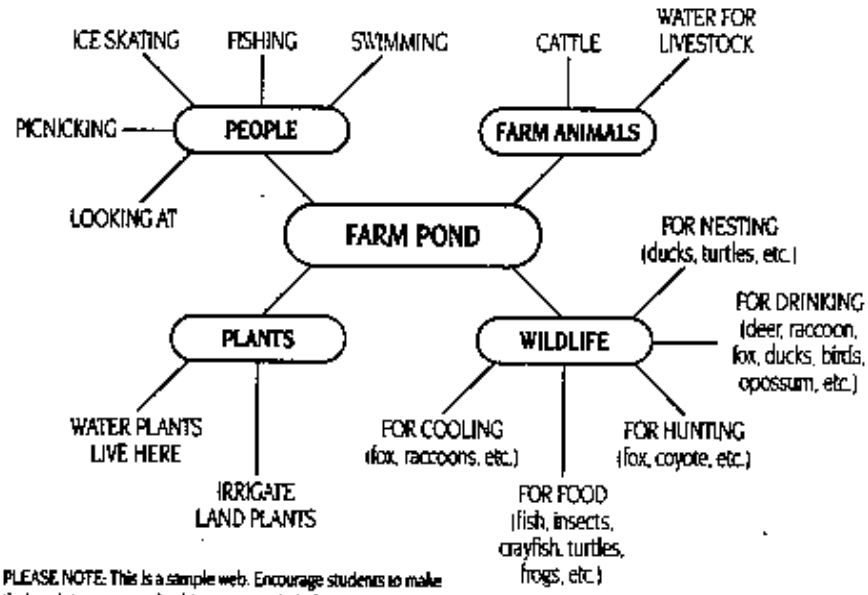
■ *Was this picture taken in a rural, urban or suburban community?*
Rural.

■ *How can you tell?*
Presence of livestock, only one house in sight, no roads, silo and barn in background.

■ *Who, or what, might use the water in this pond?*
Record students' answers on chart paper to form the outline of a word web. (See page 31 for an explanation of webbing if this technique is new to you.) It might look like this:



5. Allow students to work in small groups to complete this web by thinking of the ways water is used. After about 5 minutes, have groups report back as you record their answers on chart paper. It might look like this:



PLEASE NOTE: This is a simple web. Encourage students to make their web in a manner that best captures their discussion.

WRAPPING IT UP/DAY 1

1. Explain that most of the world's water (94%) is salt water in the oceans. Tell students that you are going to do an experiment to find out if salt water is as useful as the water in the farm pond.

2. Mix one tablespoon salt with one cup of water to make a salt solution in the first glass. Fill a second glass with fresh water. Leave a third glass empty. Place a slice of the potato in each glass. Label the glasses: SALT WATER, FRESH WATER, NO WATER. Place the glasses in the sun if possible. Make every effort to control variables in this experiment to model good scientific method. Keep type of glass, amount of water and size of potato slice constant.

3. Encourage students to observe and record their observations (i.e. potato slice in fresh water sinks quickly in glass; potato slice in salt water is suspended).

Have them observe the glasses again before they leave school at the end of the day. Record their observations.

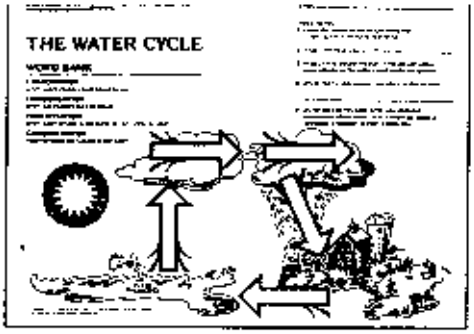
4. Have each group report on how they worked together today.

BEFORE THE LESSON/DAY 2

1. Duplicate ACTIVITY SHEET 2B/ THE WATER CYCLE

GETTING STARTED/DAY 2

1. Observe the potato pieces from yesterday's saltwater experiment. Have students summarize the results (potato in salt water is discolored and slimy, potato in fresh water has not changed in appearance, potato in no water is shriveled and dried out, etc.). Students should be aware that very salty water, like ocean water, is not useful for many plants—only those that have adapted to salt water.



2. Ask:

■ *Have you ever gone swimming in the ocean or a salt lake? What was it like? Did you get any water in your mouth?*
If students have not had this experience, tell them that drinking salt water will make them sick.

3. Point out that since most of the earth's water is either salt water or ice, it is very important that we wisely use the water that people, plants and animals need.

DOING THE LESSON/DAY 2

1. Make another cup of salt water. Place a drop or two on a dark sheet of construction paper. After discussing safe experimentation, have a student volunteer to taste a drop and report to the class. Place the salt water in a pan on a heat source (hot plate, stove, bunsen burner, etc.). While the water is heating ask:

■ *How is the water changing?*
Bubbles are forming.

■ *If I were to leave the pan on the stove until school was out, what would happen?*
Water would boil away.

■ *What is happening to the liquid that we placed in the pan?*
It is evaporating, becoming a gas (water vapor).

2. Capture some of the vapor on a clean mirror or glass slide. Allow students to watch the condensation form on the glass surface as the water vapor cools. Have the same student taste the condensation and report to the group. Ask:

■ *Has the taste changed? How?*
Yes, it is not salty.

■ *Why do you suppose the water from the gas is not salty?*
As water changes to gas, the salt remains behind.

3. Take a look at the dark construction paper. Have students observe the salt particles that are visible as white specks on the paper. Ask:

■ *What happened to the liquid?*
It was absorbed and evaporated.

4. Look for salt residue on the pan. Ask:

■ *How might this information be useful to us?*
It means that ocean water can become useful to plants and animals if it is evaporated and then condensed as it is in the water cycle.

5. Distribute ACTIVITY SHEET 2B/THE WATER CYCLE. Write the following on the chalkboard: SALT WATER, HEAT SOURCE, MIRROR, DROPLETS. Have students study the diagram and have them relate each of the items from the previous experiment to the water cycle. Ask:

■ *What in this picture would be like the _____ in our experiment?*
Record their remarks on the chalboard. It might look like this:

salt water ——— ocean water
heat source ——— sun
mirror ——— cool air
droplets ——— rain or snow

6. Introduce the following words and have students label the appropriate arrows on their handout:
evaporation—when water changes from liquid to gas
condensation—when gas changes back to liquid
precipitation—when water returns to the earth as rain, snow or sleet
groundwater—water beneath the surface of the earth

NOTE: On the activity sheet, the groundwater arrow is identified by a dotted line.

7. Explain that since plants and animals need water (and water is a limited resource), farmers need to manage water wisely so that we can have the food and clothing that plants and animals pro-

Refer again to STUDY PRINT 2. Ask:

■ *What do you think the farmer who lives on this farm might do if there is too little precipitation?*
Use water in the pond to irrigate the fields, pipe water to stock tanks for animals.

■ *What has the farmer done to protect the water quality of the farm pond?*
The farmer has planted close-growing grass and lush pasture to slow water runoff.

8. Point out that when we use water, we temporarily borrow it. While we borrow it, we need to be wise users. The amount of water on earth remains the same, but there are more people and more uses for water than ever before.

9. Have cooperative groups brainstorm ways they can borrow less water. Help them get started by suggesting that they think of water conservation methods they and their families could use in their homes and at school.

KITCHEN
- turn off water while rinsing dishes
- run FULL dishwasher only
- chill water in refrigerator rather than letting the tap run
- collect water while waiting for hot water and use it for watering plants

BATHROOM
- turn off water while brushing teeth
- take short showers
- turn off shower while washing body and hair
- put a brick or other water displacement device in toilet tank
- fix dripping faucets

AT SCHOOL
- don't leave water fountains and restroom faucets running

OUTSIDE
- water grass and gardens wisely
- use bucket, instead of hose, to wash car, bike, lawn furniture, etc.
- sweep, don't hose, driveway

■ landscape with plants native to the area or that require less water

WRAPPING IT UP/DAY 2

1. Allow students to share their lists as you record their responses on chart paper.

2. Display the chart and refer to it later in the week.

3. Encourage students to tell of ways they are trying to be wise borrowers from the water cycle.

4. Have groups report on how they functioned today.

CURRICULUM EXTENSIONS

ART

Make dioramas depicting ways to be a wise water borrower. Make a class collage of ways we all can be wise water borrowers. Make posters about saving water.

MATH

Chart and compare individual water usage. A two-minute shower takes approximately 12 gallons of water. A bath takes about
30 gallons of water. Have students time themselves as they bathe or shower. Have them create a chart of their own, like this:

INDIVIDUAL WATER USAGE

NAME	ACTIVITY	TIME	WATER USED
Jean	Bath	10 min.	30 gallons
Julie	Shower	6 min.	36 gallons
John	Shower	2 min.	12 gallons

Talk about who is using the best method. Point out that a short shower uses the least water, but if you enjoy a long shower like Julie, a bath is the best method.

The following chart may be helpful:

GALLONS PER USE

ACTIVITY	WATER USED
shower	6 gallons a minute
faucet	6 gallons a minute
toilet	5 gallons a flush
washing machine	50 gallons a load

Create and solve story problems about ways they are being wise borrowers of water from the water cycle.

READING

Two books that will allow your students to learn more about water and the water cycle are WATER—*What it is, What it Does* by Judith Seixas (published by Greenwillow Books, 1987) and *The Trip of a Drip* by Vicki Cobb (published by Little, Brown, & Co., 1986).

SCIENCE

Conduct this demonstration in order to impress on your students the need to preserve water quality. Display an empty covered jar and a pitcher of tap water. Tell students that this jar represents a sewer and the pitcher represents a faucet. Ask them what kinds of things might be found in a sewer: a handful of soil and pebbles, a few twigs, some leaves, a kleenex, etc.

Ask students their procedure for brushing their teeth. Have water and a toothbrush and a pitcher of water on hand to follow their process (wetting the toothbrush or leaving the tap run). Point out that the amount of water actually needed to brush teeth is less than one cup, but if they let the faucet run, they are using approximately six gallons for every minute it takes to brush their teeth. Empty the pitcher of water into the jar that represents the sewer to demonstrate the waste of letting the faucet run. Shake the jar and ask the
students if they would still be willing to drink this water. Tell them when we waste water by allowing the faucet to run unnecessarily, the water must be treated in order to make it safe to drink again.

Allow the jar to settle for a half hour. Carefully pour the liquid on top into the pitcher being careful not to disturb the sediment in the bottom. Ask if they think it is safe to drink now. Pour it through a coffee filter. Observe the filter to see the particles that were trapped. Ask if they think it is safe to drink now. Tell students that cities use huge plants that process what goes through our sewers. They treat waste by allowing heavy particles to settle and by passing it through filters, but still it is not safe to drink. They have to make sure invisible germs are also removed, so they add chemicals. Ask how we can reduce the amount of water we send down sewers. Add new ideas to the chart developed at the end of this lesson.

WRITING

Challenge students, working in cooperative groups, to use all the key terms in a story. Have the main character in their story be a water droplet. Have them tell the story from the droplet's viewpoint and draw a picture to accompany it.

Write a story about ways they can be wise borrowers of water from the water cycle.

ANSWERS TO QUESTIONS ON ACTIVITY SHEETS

ACTIVITY SHEET 2A/WATER WISE

Students should write the name of one of their classmates on each of the lines of this "people search" as they interview each other to find someone who can respond positively to each of the 20 questions.

ACTIVITY SHEET 2B/THE WATER CYCLE

1. Label arrows pointing up—EVAPORATION, label arrow pointing down—PRECIPITATION, label arrows in the clouds—CONDENSATION, label arrow at bottom of the page—GROUNDWATER
2. The sun
3. Draw circle around pipe with water returning to sea
4. In the clouds
5. Answers will vary

NAME _____

DIRECTIONS: Find someone who will answer each question. Write their name on the line. **Please use each person only once!**

WATER WISE

1 Who can name the lake closest to our school?_____

2 Who can name the river closest to our school?_____

3 Who can name the four oceans?_____

4 Who has a yellow toothbrush?_____

5 Who ate something for dinner last night that lived in water?_____

6 Who has seen a rainbow?_____

7 Who can tell you how to use less water?_____

8 Who can think of the title of a book about fish, boats, or water?_____

9 Who has caught a fish?_____

10 Who knows someone who has been in the Navy?_____

11 Who has had a drink from the water fountain today?_____

12 Who owns a squirt gun?_____

13 Who can describe irrigation?_____

14 Who can name something that sinks and something else that floats?_____

15 Who can tell why water is important to farmers?_____

16 Who has been on a boat?_____

17 Who washed something today?_____

18 Who did the dishes yesterday?_____

19 Who has been to a farm?_____

20 Who has a pet fish?_____

NAME _____

THE WATER CYCLE

WORD BANK

EVAPORATION
When water changes from liquid to gas.

CONDENSATION
When gas changes back to liquid.

PRECIPITATION
When water returns to the earth as rain, snow or sleet.

GROUND WATER
Water beneath the surface of the earth.

DIRECTIONS:

1 Label the arrows in the picture using the correct words from the WORD BANK.

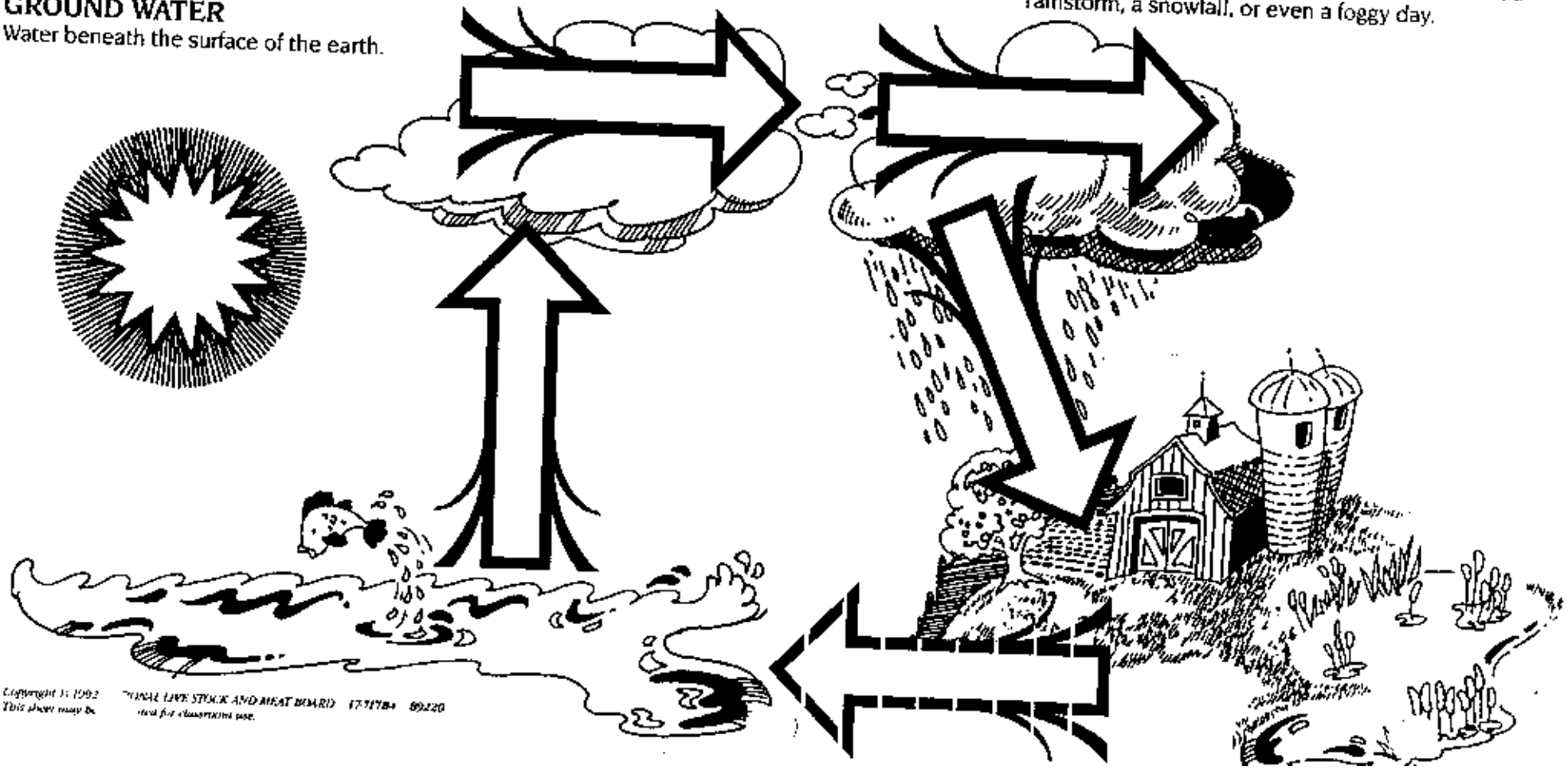
2 What is the heat source in this picture? _____

3 Draw a circle around the part of the picture where water returns to the surface from under the ground.

4 Where does condensation take place in this picture?

_____

5 On the back of this page, write your personal observation of the water cycle. It might be about a rainstorm, a snowfall, or even a foggy day.



Name _____

WATER

Purpose

- To understand the importance of water in agriculture
- To understand how water moves into, through, and out of plants

Background Information

Water covers over 70% of the earth's surface. It fills our lakes, rivers, and oceans. It is found in our soil and air.

Water is essential to all life on earth.

Plants use water to carry nutrients throughout their systems. They absorb the water through their roots and release it through their leaves and stems. Plants must always maintain a normal balance of water or they will die.

Animals must also maintain a normal balance of water. They must have constant access to water for survival.

Throughout history, water has played an important part in agriculture. The supply of water has determined where irrigation and grazing are possible to sustain agriculture, and civilizations developed. When agriculture was able to flourish so did farms, cities, and civilizations.

ACTIVITY B - Wilted Plant Observation

Materials Needed:

1 slightly wilted plant
1 bowl
Water

Advance Preparation

Obtain all necessary materials. A week to ten days before the meeting withhold water from the plant and allow it to begin to wilt. Caution: Do not allow the plant to dry out so much that it dies.

Suggested Grouping

Large group

Action (Observing, Inferring, and Communicating)

1. Show the participants the wilted plant. Explain that it has not been watered for a week to ten days and that you will water it now so that they can observe what will happen to it. Ask them to predict what will happen.

2. Place the plant in the bowl and water it heavily.

3. Place it in a location where participants can observe it during the meeting.

Sciencing

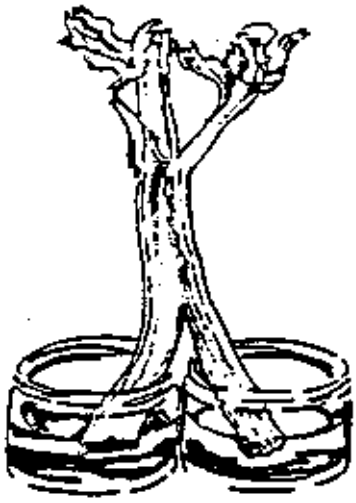
Communicating and Observing: Describe what happened to the plant during the meeting. (It absorbed the water and was no longer wilted.)

Inferring: What do you think happens to food crops during a drought? (They can wilt and die.) What do farmers have to do if it does not rain for a long time? (Irrigate their fields or the crops will die.)

ACTIVITY C - Uphill Water

Materials Needed:

1 stalk celery
blue or red food coloring
2 jars
Water



Advance Preparation

One day before the meeting:

1. Cut the celery stalk lengthwise from the bottom, 1/2 way up the stalk.

Name _____

2. Place 1 split end of the celery in one jar and the other split end in the other jar.

3. Add water to both jars.

4. To 1 jar add 10 drops of food coloring.

5. Place the celery and the jars in a safe location. Allow them to sit undisturbed overnight.

Suggestion Grouping

Large group

Action (Observing, Inferring, and Communicating)

1. Display the celery and jars for all participants to see.

2. Ask Participants to observe.

Sciencing

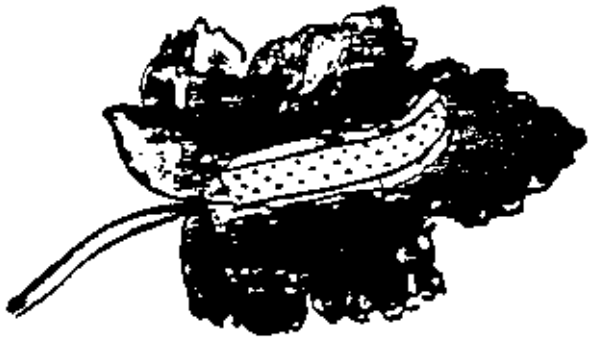
Observing and Communicating: Describe the differences between the two sides of the celery. (Half of the celery has food coloring in it and the other half does not.)

Inferring: How do you think the food coloring got inside the celery? (Inside the celery plant are tubes that carry water, minerals, and food through the plant. The food coloring can be seen inside the tubes of the celery.)

ACTIVITY D - Transpiration

Materials Needed:

Cobalt chloride test strips - 4 or more per group
Transparent tape - 1 or more rolls



Action (Observing, Communicating, Comparing, Inferring)

Explain to participants that plants release water from the surface of their leaves through a process called transpiration. They will be using special test paper to observe the release of water from leaves. The paper they will be using has been treated with a chemical called cobalt chloride, which turns pink when it comes in contact with moisture.

Demonstrate the color change by dipping a test strip into water. It will turn from blue to pink.

Participants will:

1. Gather 4 cobalt chloride test strip papers and 4 pieces of tape. Do not get the strips wet or moist.

2. Press each of the strips onto the sticky side of the tape. Fold one end of the tape over as shown. This will allow you to handle it without getting the strip wet or moist.

3. Press the sticky side of each of the strips onto a different leaf. Place one on the top side of a leaf and another on the bottom. Try different types of leaves.

4. Wait 5 - 15 minutes. Then observe the color change on the test strips.

Sciencing

Comparing, Observing and Communicating: Describe you observations about the color changes. (The test strips changed from blue to pink.) Were there any differences in color changes between the top and the bottom part of the leaf or leaf types? (Some leaves have no openings to release moisture on the top of their leaves. Depending on the location and weather conditions some leaves may release more moisture than others.)

Name _____

Inferring: Do you think a plant transpires more in the summer or in the winter? Why? (Summer, because of the sun.)

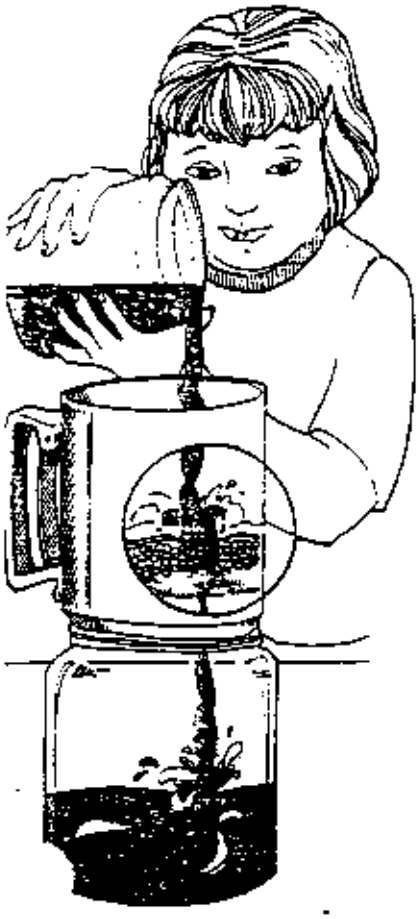
Do you think plants in the desert or along a creek transpire more? Why? (Plants in the desert have adaptations that allow them to retain more of their moisture.)

Inferring: If a farmer were looking for a piece of land to grow his crops on, what would he need to look for? (Availability of water and good soil.)

Opportunities for Applications through Inquiry & Challenge

1. At home tie a plastic bag over the end of a tree branch. Leave it there for a day. Observe the water that collects in the bag.

2. Make a terrarium. Use a quart jar, some soil, and birdseed. Add a little water. Seal the jar. Place in a sunny location. Observe what happens to the water in the terrarium.



Experiment

Learn more about how water is treated by cleaning it yourself.

You will need:

A flour sifter, or homemade container with a screen bottom

Absorbent cotton

Coarse, clean sand

Clean gravel

A large glass jar

Muddy water

Cover the screen at the bottom of the sifter or container with a layer of cotton, next a one-inch layer of the coarse sand, then a one-inch layer of the gravel. Set the sifter over the jar. Slowly pour muddy water into the sifter. Look at the water when it comes out the bottom of the sifter into the jar. Is it still muddy? (Note: Don't drink the water. It may look clean, but it still has germs.) Compare what you did with what wastewater treatment plants do, as shown on page 3.

Other Activities

- Do you waste water in your home? Wasted water flows into sewers and must be cleaned all over again. Make a list of ways you and your family can save water.
- Make an exhibit for your school or library showing how drinking water is distributed and wastewater is treated in your community.
- Visit a water treatment plant in your community.
- Visit a construction site or a gas station after a heavy rain. Look at the ground to see if the rain has washed dirt away from the site, or oil away from the gas station, into the street. Find out where the runoff of dirt or oil goes, and if anything can be done to stop the runoff.
- Draw a map of your community showing sources of water pollution.

Answers to questions at beginning of chapter:

1. If yours is like the average American family, you use about 160 gallons of water a day. You drink some of this water. But you also use gallons and gallons for bathing, cooking, washing the dishes and the laundry, brushing your teeth, watering the plants, flushing the toilet, and filling your squirt gun.

2. It takes about 60,000 gallons of water to make one ton of steel.

Compare How Much Water Different Soils Hold

You will need 2 cans of equal size (coffee cans will do); two 18-inch squares of cloth; some heavy string; a package or similar scale that weighs up to 64 ounces or 2,000 grams; and a container of water, such as a 2- or 3-gallon bucket or a 5-quart oilcan with the top cut out.

Put equal volumes of soil in the two cans. Take the soil for one from a field or garden that has been cultivated for several years and that shows lack of organic matter. This sample should be hard and cloddy. Get the other from a well-managed field where grasses and legumes have been grown, or from a good pasture or similar location. This sample should be crumbly and free from clods.

First allow the soils to dry.

Empty the two soil samples on the cloth squares, pull the corners together, and tie with a heavy string. Weigh each sample and record the weight.

Saturate each bag of soil by holding it in the water long enough to soak thoroughly. Remove the soil samples from the water and allow them to drain off the free water for a few minutes. Then weigh again and record the weights.

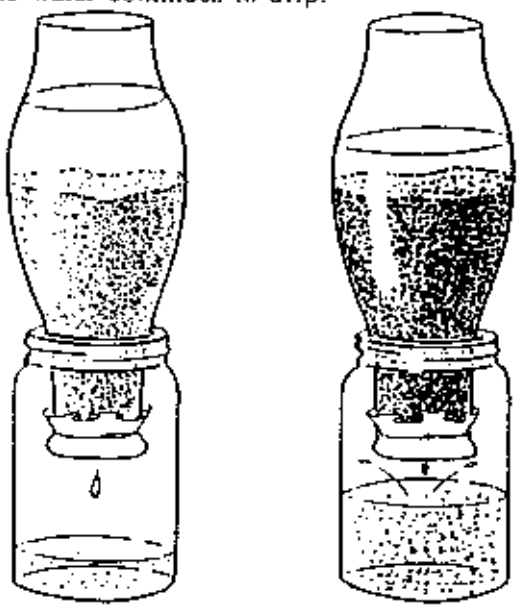
Calculate the difference in weight.

Another way to measure the water-holding capacity of soils is to use two old-fashioned lamp chimneys or cylinders as in the previous activity. Tie a cloth over the top, turn them upside down, and fill them about two-thirds full with the same two soils.

Be sure the soils are equally dry.

Place the chimneys in small-mouth fruit jars, as shown in the drawing.

Pour a pint of water into each chimney. Then note how long it takes the water to begin to drip into the jars, how much water comes from each soil and how long the water continues to drip.



Interpretation

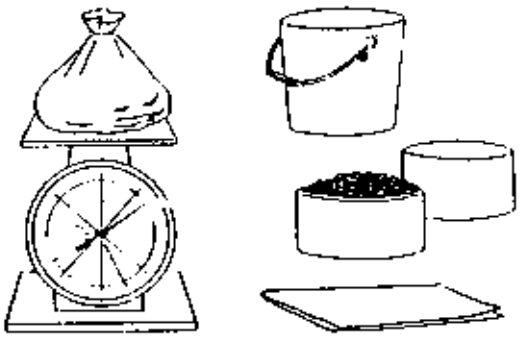
When organic matter is used up, soil packs together. Thus, a cloddy soil has fewer air spaces so particles do not cling together in granules, and the lack of organic matter means that it weighs more than an equal amount of crumbly soil from a well-managed plot.

Not only does a crumbly soil take in water faster than a cloddy one, it holds more. The thoroughly decomposed organic matter (humus) in a crumbly soil can absorb lots of water. On a dry-weight basis, this humus has a water-holding capacity of several hundred percent and may act like a sponge. In addition to the water held by the organic matter itself is the water held in the pores between the soil particles and between the soil granules. Hundreds of very fine soil particles are glued together by the organic matter into soil granules.

This increased water-holding capacity of soils high in organic matter under natural conditions makes a big difference in the intake of water. These well-managed soils can absorb most of the rain and snowmelt (if the soil is not frozen). This means there will be less erosion. Streams will run clear. Of course, when the soil is saturated by a long period of rainfall, any additional water then runs off. But until the soil is saturated it will store up water and let it go gradually. The result is that floods are less severe, water seeps to streams slowly and over a longer period of time, and water is stored in the soil for plants to use.

Crops use lots of water. Vegetables use an average of 2 acre-feet, or 650,000 gallons an acre. Cotton takes 800,000 gallons per acre. An acre of alfalfa needs over a million gallons. To produce one ear of corn takes over a barrel of water. Organic matter helps soil store more water and thus helps prevent erosion and produce better crops.

Many field tests have shown the improved water-holding capacity of well-managed soils that have enough organic matter to keep them crumbly and granulated. One deep soil in Texas that was high in organic mattter held 25 percent or 1 inch more water in the 1-foot surface layer, after the free water had drained off, than the same depth and type of soil in another field where the soil was low in organic matter. This made a difference of 27,000 gallons of water per acre in the first foot of soil.



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Water, Water Everywhere?

Do you ever think about the fact that our water is the same water that the dinosaurs drank? Our ecosystem has had the same water in its system since time began and will continue to have the same water forever. That's a good reason to keep our waters clean!

Three-quarters of the world is covered with water but an amazingly small amount of water is actually available for us to drink—less than 1 percent. Here are some statistics to analyze.

Water on Earth

Oceans	97.2%
All ice caps/glaciers	2.0%
Groundwater	0.62%
Freshwater lakes	0.009%
Inland seas/salt lakes	0.008%
Atmosphere	0.001%
All rivers	0.0001%
Total	99.8381%

To figure out how much fresh water is available for drinking, add the percentages shown for groundwater, freshwater lakes, and rivers. It adds up to only .06% of all the water on earth—a good reason to teach conservation of water!

To make it easier for students to understand, measure out 2 cups plus 4 teaspoons of water. You now have 100 teaspoons of water. To demonstrate how much of the world's water is available for drinking, take out ½ teaspoon. That symbolizes the amount of water on earth we have to get our drinking water from. It is such a small amount, yet it is the most polluted of all the water on earth. We shouldn't think of it as plentiful.

Use the "Water Puzzle" crossword puzzle and the work sheet "A Lot of Wet Words" provided by the USDA Soil and Conservation Service.

Place a rain gauge made from an olive jar outside your window and keep a chart of rainfall by the day and the month.

Using the following facts, have students compute how much water they use in one day, month, year.

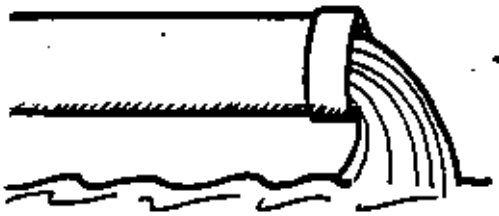
Gallons of Water Used

Shower	5 gallons/minute
Flushing toilets	3 gallons
Hand-washing dishes	5
Electric dishwasher	35
Brushing teeth	1
Washing hands	½
Washing face	½

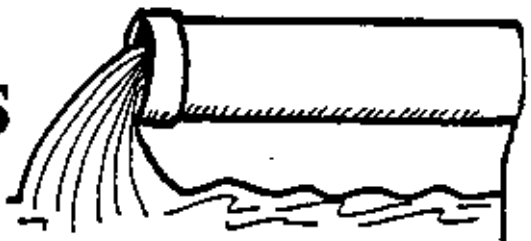
Use the Water Facts work sheet to explore interesting facts about water.

Have students draw illustrations to demonstrate at least four of the following practices that help conserve water.

- Don't let the water run when you are brushing your teeth or doing the dishes.
- Fix leaks right away.
- Water your yard slowly in the evening and only when necessary.
- Save water by putting a brick or similarly-sized object in the tank of the toilet.
- Dispose of wastes and hazardous wastes appropriately.
- Don't let oil or gas spill on the ground.
- Don't use creak banks as dumping grounds.
- Don't litter near water.
- Prevent erosion by planting in bare spots.
- Use boiling water or mechanical snakes to clean clogged drains.



Water Facts



Match the appropriate facts about water.

____	1. Water is the only substance found on earth naturally	a.	but for approximately a week without water.
____	2. A person must consume from all sources (food, water, etc.)	b.	70 gallons of water a day in evaporation.
____	3. A person can live for more than a month without food	c.	in three forms, solid, liquid, and gas.
____	4. An average birch tree gives off	d.	66% water.
____	5. The average person uses	e.	70% water.
____	6. The human body is	f.	2½ quarts of water a day to maintain health.
____	7. An elephant is	g.	90% water.
____	8. A tomato is	h.	70 gallons of water a day.
____	9. It takes 28,100 gallons of water to process	i.	one ton of cane sugar into processed sugar.

FUN with WORDS

WORD SEARCH

Find all the words that relate to either wasting water or using water wisely. The words may be read across, down or diagonally. *How will you use water wisely this week?*

C K O T S H O W E R I N S E O T H
S O A P S P R I N K L E R D B I A
A I N A R B A T H T U B E R S G B
P S I S A V E L O F A U C E T A I
L L P W E H S E A L A W N S U L T
A V U I A R E S O U R C E C O L D
N A S M I S V S W S N D I N T O I
T L W M B O T A E H O D R A I N S
S U A I P I P E T A N K R O L T H
M A T N E W N A O I C H T Y P E W
O B E G D R I G I H O S E T O S A
S L R P R S U S P Y O N I S U U S
G E S O I L C L E A K R U N R D H
S L E O N T L A T O I L E T K S E
O I N L K Y E O P O N D R I P S R
D E T E R G E N T E G P U D D L E

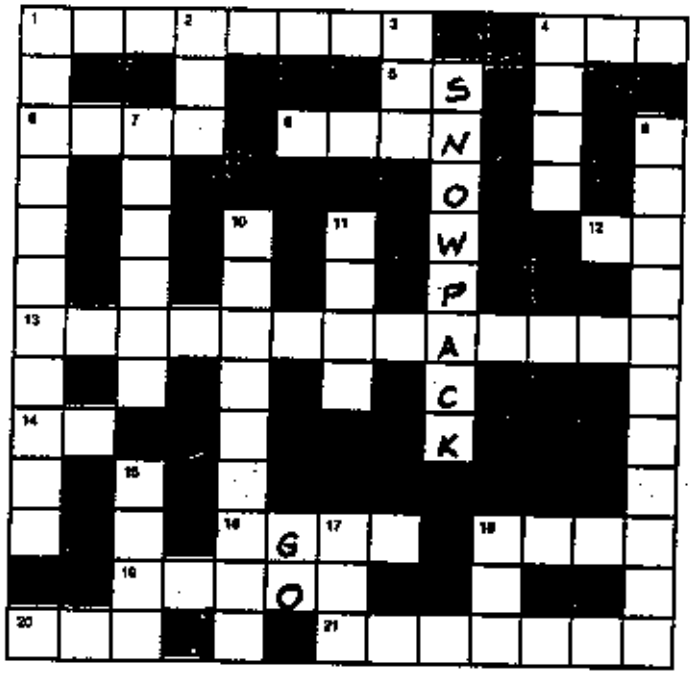
landscape
lawn
sprinkler
drops
leak
cooking
habit
gallon
sink
pour
pond

faucet
plumbing
pipe
laundry
soil
conservation
rinse
toilet
suds
wet
drains

dishwasher
drips
plants
shower
pool
resource
bathtub
tank
soap
sod
rain

water
swimming
save
wise
drinks
hose
detergent
cold
puddle
valuable
wash

CROSSWORD PUZZLE



CLUES

ACROSS

1. To save; to use wisely
4. Rover, Spot could be a name
5. Like
6. Como se llama; what is your ____?
8. Big building for horses and cattle
12. ____ and fro
13. Rain or snow or sleet
14. Pronoun that is not he or she
16. Over many, many years; over the ____
18. Snow fall is measured in inches, when it's really deep it's measured in ____
19. A mistake
20. Water vapor is water in what form?
21. Underground water area; Ogallala is one

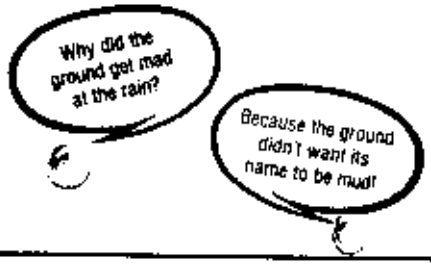
DOWN

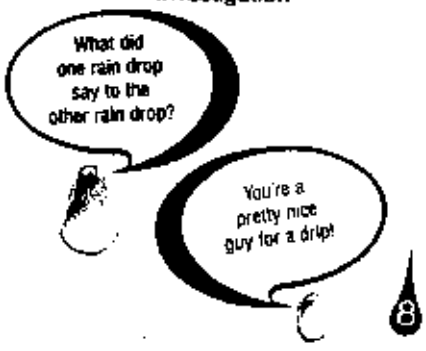
1. Type of water use when you drink a glass of water
2. Look
3. Listen with these
4. A leaky faucet does this
7. Grocery store is a super ____
9. Water found under the ground
10. A branch of a river
11. Dry, desert-like
15. Consumptive and non-consumptive are ____ of water
17. A long time frame
18. Federal Bureau of Investigation

RESEARCH ACTIVITY

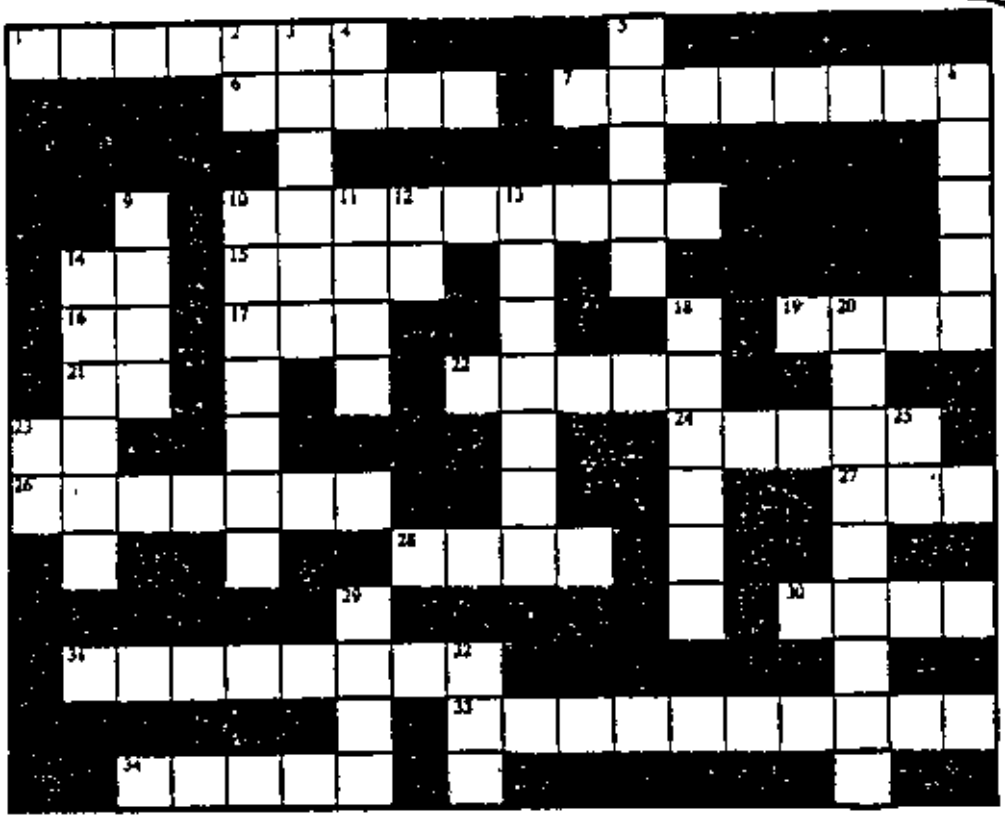
Use a dictionary to define these words. Use each in a sentence to show you understand what the word means:

acre foot
aquifer
precipitation
irrigation
transpiration
conservation
evaporation
condensation
pollution
reservoir
arid
weather





Water Puzzle



ACROSS

1. immature frog
6. most important liquid
7. tall plants at water's edge
10. Contamination of nature
14. abbreviation for Michigan
15. well traveled path
16. who is responsible for pollution
17. writing fluid
19. part of the pond where water meets land
21. slang for "be quiet"
22. Missouri is one
23. lives, exists
24. not dirty
26. national government
27. long-nosed armored fish
28. largemouth or smallmouth game fish
30. winter precipitation
31. microscopic decomposers
33. fruit that is 97% water
34. single-celled water plants

DOWN

2. Ouch!
3. a small pond or waste-water lake
4. extra terrestrial (abbr.)
5. short for "alligator"
8. reptile with no arms or legs
9. finned animal in water
10. the first three grades
11. large body of fresh water ___.
12. abbreviation for learning disability
13. reptiles with hard shells
14. clam-like invertebrate
18. runner-up, _____ place
20. large insect found near water
23. supposing that
25. North America (abbr.)
29. one of the Great Lakes
32. feeling inspired by a waterfall

Evaluation

(Participation in experiments and projects can be used as the evaluation. This is included if formal evaluation is desired.)

True or False

_____ 1. All erosion is bad.
_____ 2. Earthworms harm the soil.
_____ 3. The topsoil is the most productive layer of the soil.
_____ 4. Sand is as rich in nutrients as soil.
_____ 5. Good soils will grow plants regardless of the amount of water received or the quality of the water.
_____ 6. Water is the only substance found on earth naturally in all three forms- solid, liquid and gas.
_____ 7. A person needs 70 gallons of water a day.
_____ 8. The average person uses 70 gallons of water a day

9. List three types of soil conservation practices and briefly explain what they are:

_____

_____

_____

10. What are two ways you can help to conserve water each day?

11. Essay: Is soil our most valuable resource? If your answer is yes, tell three ways it affects your life. Give two examples of things you can do to help conserve our soil. Use complete sentences and capital letters with correct punctuation.

Evaluation

(Participation in experiments and projects can be used as the evaluation. This is included if formal evaluation is desired.)

True or False

FALSE 1. All erosion is bad.
FALSE 2. Earthworms harm the soil.
TRUE 3. The top soil is the most productive layer of the soil.
FALSE 4. Sand is as rich in nutrients as soil.
FALSE 5. Good soils will grow plants regardless of the amount of water received or the quality of the water.

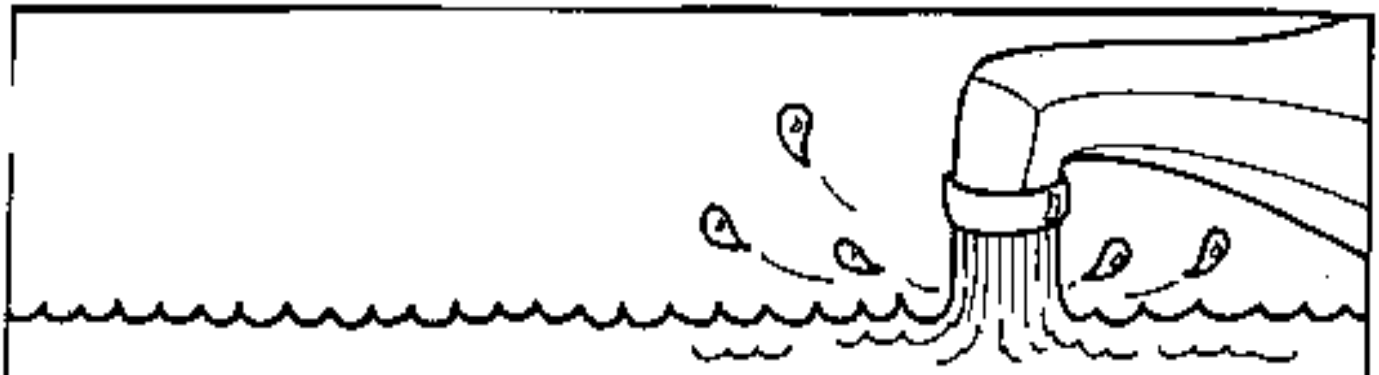
TRUE 6. Water is the only substance found on earth naturally in all three forms- solid, liquid and gas.
FALSE 7. A person needs 70 gallons of water a day.
TRUE 8. The average person uses 70 gallons of water a day

9. List three types of soil conservation practices and briefly explain what they are:
Terraces-wide ridges around a hill. (Forest and grass areas).
Contour planting – around the hill rather than up and down.
Windbreak – rows of trees to slowdown wind and present soil from blowing.
Grussed waterways – don't plow areas where water runs downhill.

10. What are two ways you can help to conserve water each day?

Not flushing toilets as much and don't leave water running while brushing teeth, etc.

11. Essay: Is soil our most valuable resource? If your answer is yes, tell three ways it affects your life. Give two examples of things you can do to help conserve our soil. Use complete sentences and capital letters with correct punctuation.



A Lot of Wet Words

For each letter in the word WATER, list one thing whose name begins with that letter or includes the letter in the number under the different categories.

	W	A	T	E	R
Ways people use water					recreation
Ways people waste water					
Ways water can be polluted					
Ways water is managed properly	sewage treatment				
Factors that increase or decrease the water supply					
Plants and animals found in water					

Write a paragraph about the importance of water.

WEATHER AND AGRICULTURE

All foods cannot be grown in the same areas. Climate and natural factors of the land determine which food products are grown in a particular area. Agriculture must adapt to factors in the environment. This makes communities around the world interdependent.

Soil and weather determine which crops can be grown in which area of the nation. For example, citrus fruits require a long, warm growing season. They are grown in Florida, Texas, Arizona, and California. In northern climates, the trees would freeze before producing oranges or grapefruit.

People in the North can grow fresh vegetables only during the summer. In some warm southern states, vegetables can be grown year round. Modern processing and transportation make them available to people in the north.

Most of the nation's wheat is grown in the Great Plains states. They have a short, frost-free growing season.

The Corn-Belt states have the largest area of fertile soil of any crop-producing area in the world. Corn, the main crop, is eaten by most Americans. Is also fed to meat-producing animals and is included in the feed of dairy cows – in addition to grass and hay.

The land is dry in parts of the West and Southwest. Grass is eaten by cattle and sheep in this less fertile area. The fertility of the soil and amount of rain are not enough to produce many crops.

In the Northeast, Northwest, and around the Wisconsin area, the growing season is short. Grass and hay grow well on the fertile and hilly land. Here there are many dairy farmers.

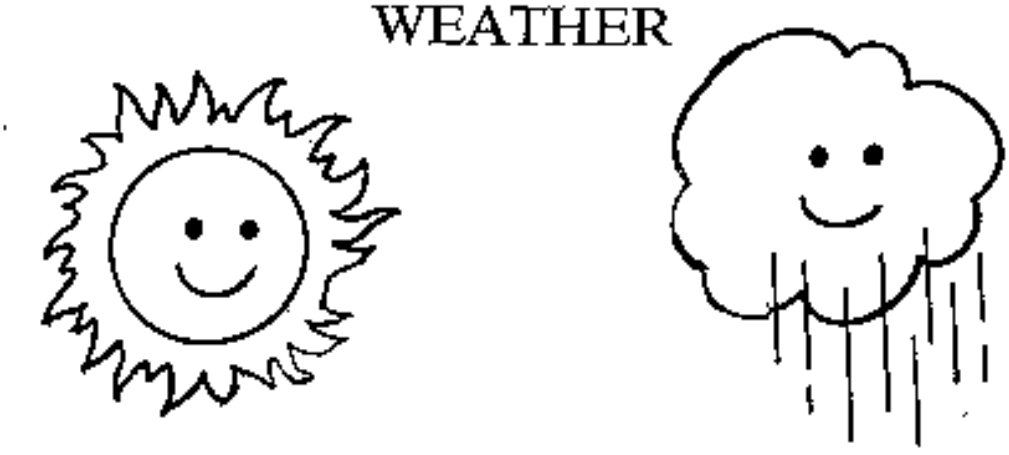
The United States has good food-producing abilities because of good soil and climate. Skilled farmers use modern farming equipment. There are many forms of transportation to take foods to market.

Thought questions:

How is weather relevant to your food, shelter and clothing supply?

What is drought? How does it affect the cost and availability of certain food products?

How can we compensate for the lack of an abundance of rain or sunshine?



1) Low water supply can cut crop yields or cause a total crop failure. A severe drought could cause a low water table, affect levels in wells and affect drinking water for livestock and humans.

2) Floods can drown crops and livestock. Too much water for too long can also affect a farmer controlling weeds in the crop fields and also cause loss of crop plants.

3) A blizzard can cause death of unsheltered livestock by suffocating or freezing them and covering their food supply.

4) Hail can cause damage to crops, livestock, equipment and buildings.

5) High temperatures can cause crops to wither and place heavy demands on water for crops and livestock. It can cause heat stroke in livestock and humans.

6) Strong winds can cause plants to bend over or break off. Also winds can damage buildings and equipment.

7) Frost can kill crops in early stages of growth or before they are mature. If not killed the crops are damaged thereby reducing yields. Frost is especially critical in states where it is not expected, i.e. orange groves in Florida. Potatoes and fruit trees are frequently affected in Idaho.

8) Low snowfall places a tremendous strain on the water supply for irrigation. The snowfall in the mountains is extremely important for summer water supplies.

9) Extremely cold temperatures can affect winter crops. If there is not a snow cover, cold temperatures combined with winds can kill small, tender plants.

DOES WEATHER AFFECT FARMERS?

Grade Level: Primary

Economic Concepts: Natural Resources, Productive Resources

Skills: Experimentation, Scientific Observation, Predicting Outcomes, Creative Movement

Time Frame: Four class sessions

The students will demonstrate their understanding that agriculture production is affected more by the forces of nature than all other major businesses by:

A. Keeping a weather chart.
B. Identifying productive resources.
C. Naming various weather conditions and how these affect farmers.
D. Performing experiments to determine how various weather conditions affect crops.

Vocabulary:

Natural resources, soil, climate, rainfall.

Materials:

Weather chart handout, worksheet, bean seeds, sand, soil, water, large containers for planting seeds, a high intensity lamp, tags labeled “Hot-Dry Climate” and “Warm-Wet Climate.”

Procedures:

A. Discuss the weather each day and record the high and low temperature on a weather chart. Have the students illustrate the weather each day. Older children may have their own individual worksheet to chart.

B. Review the terms human, natural, and capital resources. Give the students practice in naming examples of each resource. When discussing natural resources be certain to include weather conditions. Discuss whether we always have the right proportion of sun and rain Ask the students to tell what happens to plants and animals when we have too much rain or when we have too little rain. The students may want to demonstrate with body movement what happens to the plant.

C. 1. Ask the students if any workers are ever affected by weather conditions such as droughts, floods, dust storms, freezing temperatures, hail, and wind. A worksheet is included which can be completed by the students individually or worked as a group. After completing the worksheet, it should be obvious that all people are inconvenienced by the weather but that the farmers are affected by the weather, more than most other workers.

2. Discuss how the farmer is affected by the weather. You might want to invite a resource person (farmer, agricultural extension office employee, or a member of the Farm Bureau) to help the students learn how weather affects the animals or crops grown in your state. For example, cows do not eat as much when it is hot, which affects milk production; cold damp weather right after cotton is planted causes a fungus to grow and kill the seed; damp weather at soybean harvest time causes seeds to germinate in the pod; and heavy snow in the spring kills lots of animals. Once these resources are destroyed they cannot be used again.

D. 1. Begin the class discussion by introducing the words soil, climate, and rainfall. Explain that these three natural resources are very important to a farmer in deciding what agricultural product he will produce. Lead class in a brainstorming activity of why these are very important to a farmer and what decisions they might arrive at concerning these three factors.

2. Divide the class into two groups. Group one will be farmers in a hot, dry climate. Group two will be farmers in a warm, wet climate.

3. Group one will be given bean seeds to plant in a tub of sand. Discuss with them that their plants will not be given water everyday, but only twice in the growing period. They will also give their plants very intense heat.

4. Group two will be given a tub of soil to plant their bean seed in. Their plants will be watered every other day. The tub will be placed where it will receive a normal amount of sunlight.

5. Students will be given charts to fill out during the growing period (copy of charts follows lesson).

6. After the assigned growing period (2weeks), students will compare their charts and decide which three resources were the appropriate ones for what specific plant.

Does The Weather Affect The Workers?

	Yes	No	Sometimes
Heavy rain			
Farmers			
Letter carriers			
Teachers			
Doctors			
Snow in the spring			
Farmers			
Letter carriers			
Teachers			
Doctors			
Drought			
Farmers			
Letter carriers			
Doctors			
Teachers			
Dust Storm			
Farmers			
Letter carriers			
Teachers			
Doctors			
Freezing temperatures			
Farmers			
Letter carriers			
Teachers			
Doctors			
High winds			
Farmers			
Letter carriers			
Teachers			
Doctors			

Sunday	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday
High____Low____	High____Low____	High____Low____	High____Low____	High____Low____	High____Low____	High____Low____
High____Low____	High____Low____	High____Low____	High____Low____	High____Low____	High____Low____	High____Low____
High____Low____	High____Low____	High____Low____	High____Low____	High____Low____	High____Low____	High____Low____
High____Low____	High____Low____	High____Low____	High____Low____	High____Low____	High____Low____	High____Low____
High____Low____	High____Low____	High____Low____	High____Low____	High____Low____	High____Low____	High____Low____

Name _____

Weather and Agriculture
— What Have You Learned?

Describe how the following weather conditions affects the farmer.

1. Drought: _____

2. Flood: _____

3. Blizzard: _____

4. Hail: _____

5. High temperatures: _____

6. Strong winds: _____

7. Frost: _____

8. Low snowfall: _____

9. Low temperatures: _____

WEATHER - JUST A NATURAL THING

1. Discuss with your class their basic needs of food, shelter, and clothing. Discuss where goods and services to meet these needs originate. How do natural resources affect the price and availability of these needs?

2. Collect weather maps (U.S. Today is wonderful) and chart the highs and lows on a chart. This can be a bulletin board chart or kept individually for older students.

3. Brainstorm for list of examples for human, natural, and capital resources. What happens to plants and animals (people, too) when it is very dry or rains a great deal? How much is enough? When these resources are destroyed, can they be replaced?

4. Plant various seeds in different types of soil and with varying amounts of water. Let students chart their progress. Determine best growing conditions for the plants.

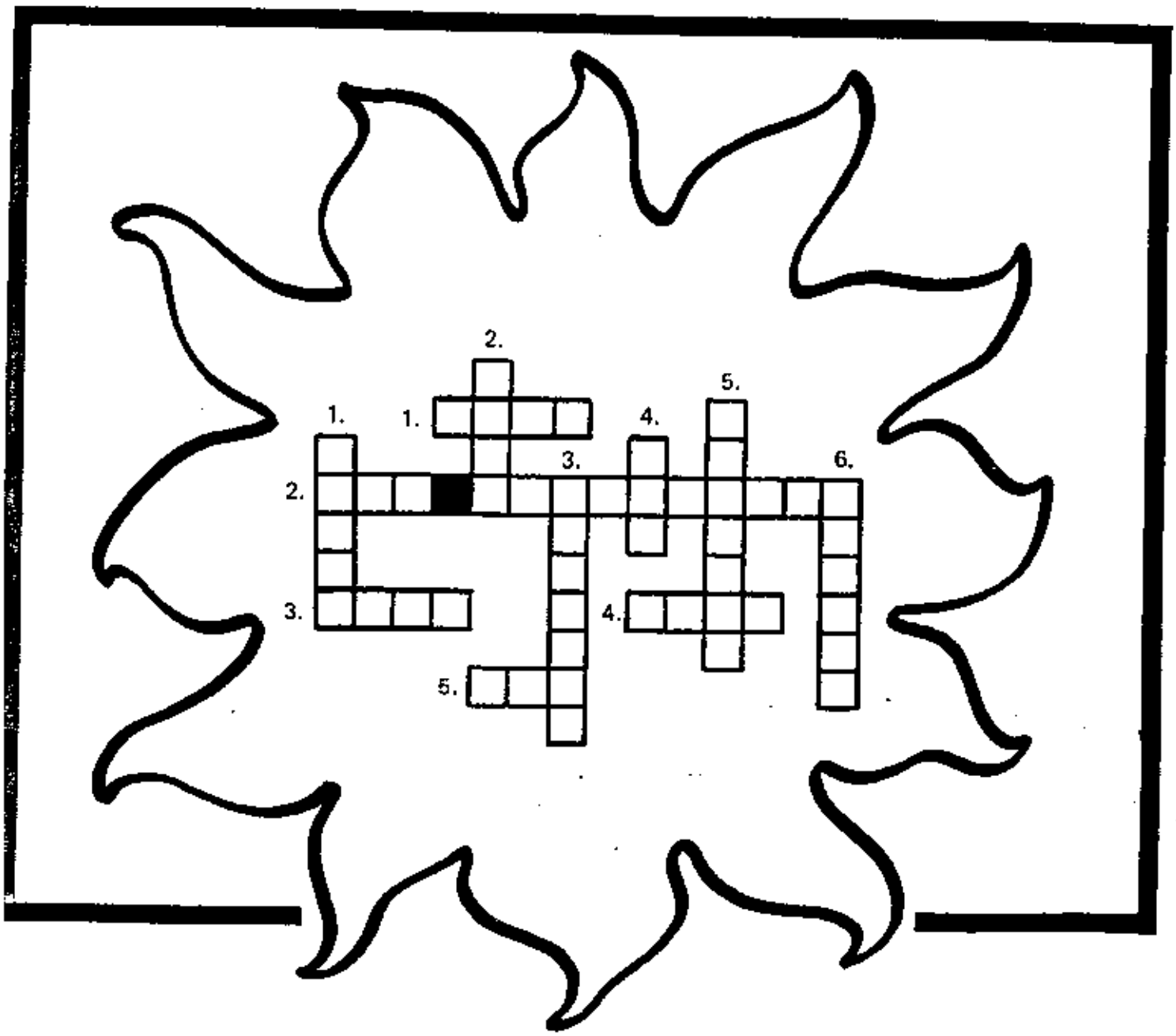
5. More mature students might like to choose a plant and log the effects of the environment on the plant. Many school campuses are large enough for class members to select a plant on site to observe.

Name _____

Worldly Weather

Locate the weather words in the hidden puzzle.

The SUN is one thing that has not changed on OLD MACDONALD'S farm.



TODAY farming still depends on the SUN. Solar energy is free and renewable. Without it there would be no food. Farming uses less than 3% of the fossil fuel consumed in the United States.

ACROSS	DOWN
1. can destroy a crop in minutes	1. energy from the sun
2. old fashioned farm	2. where your food comes from
3. water that falls from the sky	3. harvests wheat
4. energy to make you grow	4. gives milk
5. makes the earth warm	5. pulls a plow
	6. medicines for plants

ACROSS: 1. hail 2. Old Macdonalds 3. rain 4. food 5. sun DOWN: 1. solar 2. farm 3. combine 4. cow 5. tractor 6. sprays

SCIENCE

Weather – Recording Weather Information

Have you noticed that the wind direction or speed may change during the day? Have you noticed that the outside temperature may change a few degrees during the day? Are slight changes in the weather important to you? Your job, as a student, is probably not dependant on weather. Aerial applicators are dependant on the weather and changes in the wind and temperature affect their working day. Wind and temperature have an affect on the way an airplane flies and where the material being applied will land. In order to do a good job when applying materials, agricultural aviation pilots must be aware of the weather conditions. They are unable to control the weather so they learn what to expect when certain weather conditions exist. If the weather conditions are not right for spraying an ag pilot has to wait until they are.

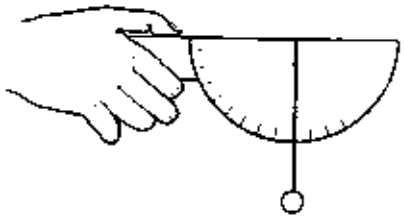
The following experiment will help you realize that: weather conditions often change during the day; weather is an important, uncontrollable factor in the production of food and fiber; and weather causes stress for agricultural aviation pilots.

Materials needed: Outdoor thermometer, wind speed indicator made from the following – protractor, ruler, clear tape, 25 cm of red thread, ping-pong ball.

Procedure:

1. Set up the thermometer in a place where it is easy to monitor the reading several times a day. Try not to place it in the direct sunlight.
2. Construct the wind speed indicator as shown in the illustration. Tape the protractor to the ruler. Tape one end of the thread to the ball, and the other end of the thread to the center of the protractor. When held parallel to the ground, the thread should indicate a reading of 90.
3. Take the wind speed indicator outside. Hold it still and level, using the ruler as a handle. Point the indicator into the wind. When the wind blows the ball it will move the thread on the protractor giving you a reading which can be converted to wind speed using the chart below. The number on the protractor corresponds with the speed in knots shown directly below.

Number on Protractor	90	95	100	105	110	115	120	125	130	135	140	145
Knots	0	5	7	8.6	10	11.3	13	14	15.7	16.7	18.4	20



4. Record your speed and temperature observations three times a day for one week and then with your teachers assistance make a graph showing the variations (changes). You may also want to record the wind direction each time.

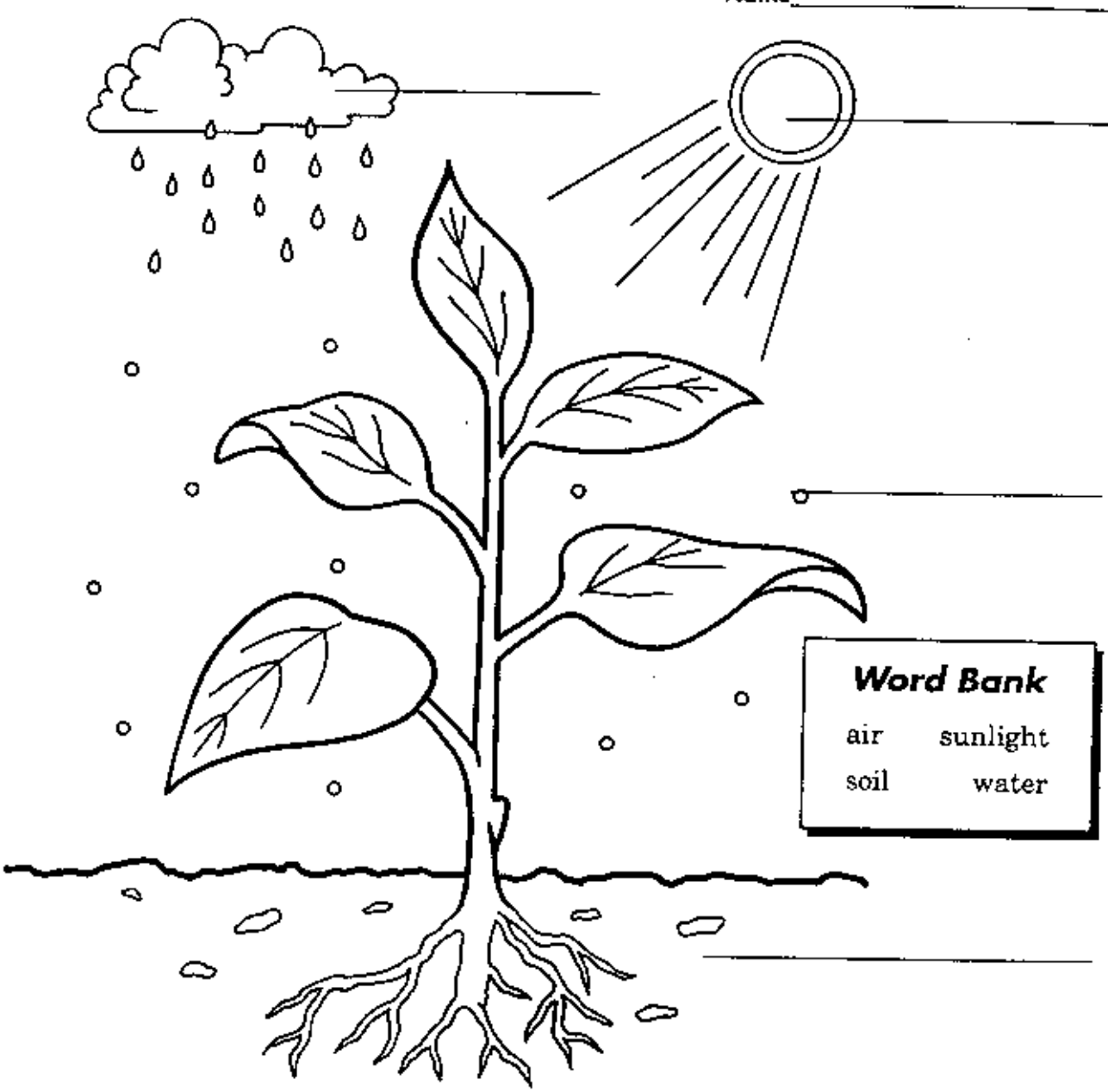
Answer the following:

1. What was the highest wind speed measured during the week?
2. What were the highest and lowest temperatures?
3. An Ag Pilot had a field to spray where the wind had to be blowing from the northeast at a speed between 2 and 8 knots and the temperature needed to be between 60°F and 80°F. Would the pilot have been able to complete the job?
4. How could the weather conditions cause stress for an ag pilot?

1005 E. Street, S.E., Washington, D.C. 20003

FOOD FOR AMERICA

Name_____



Word Bank

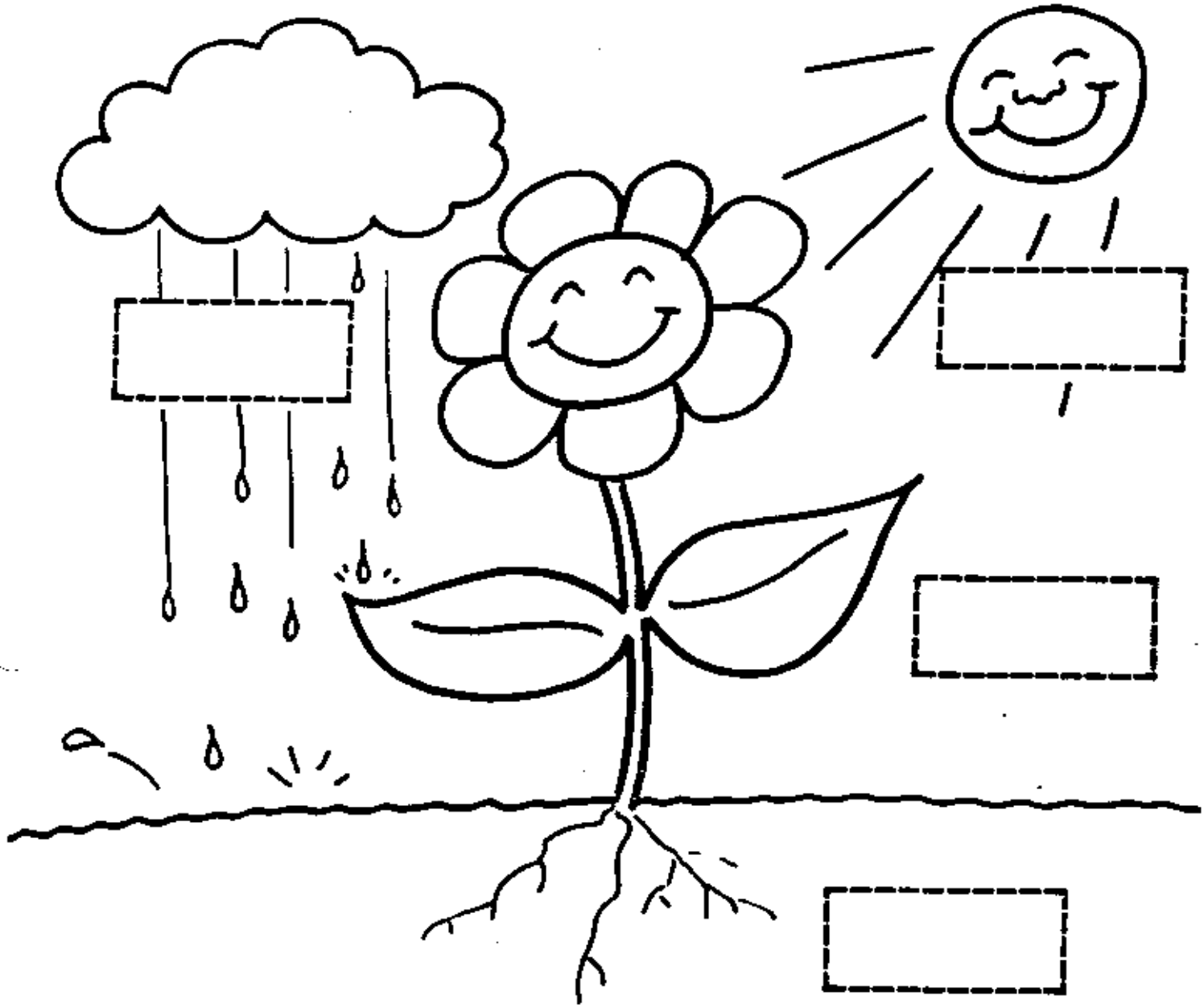
air sunlight
soil water

Natural Resources for Plants

Use the words from the word bank to label the natural resources necessary for plant growth.

Food For America is a program of the National FFA Organization sponsored by Moboy Corporation, Agricultural Chemicals Division.

Name _____ Color. Cut and paste the labels in the correct boxes.

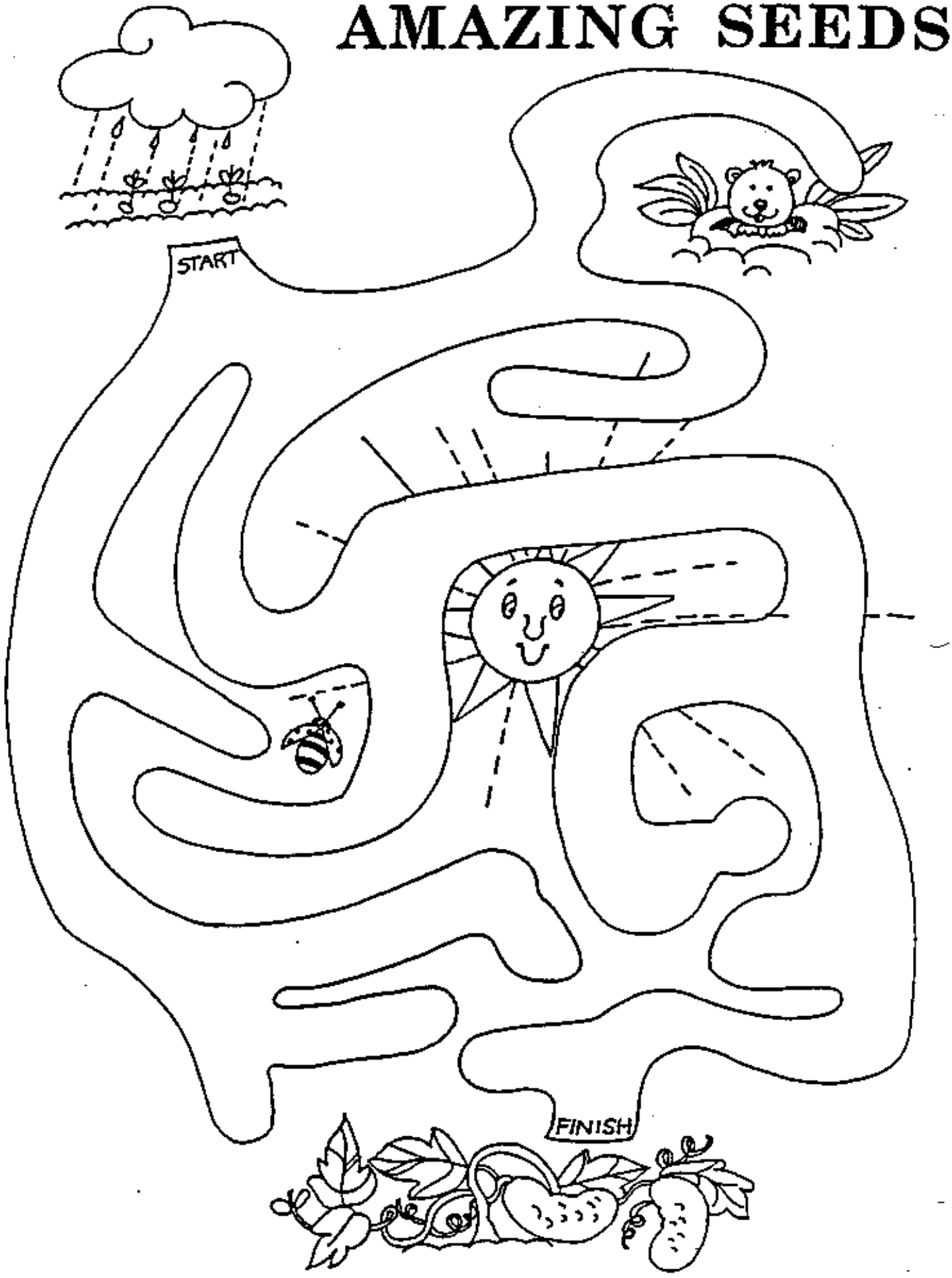


PLANT NEEDS

soil	air	water	sun

NAME_____

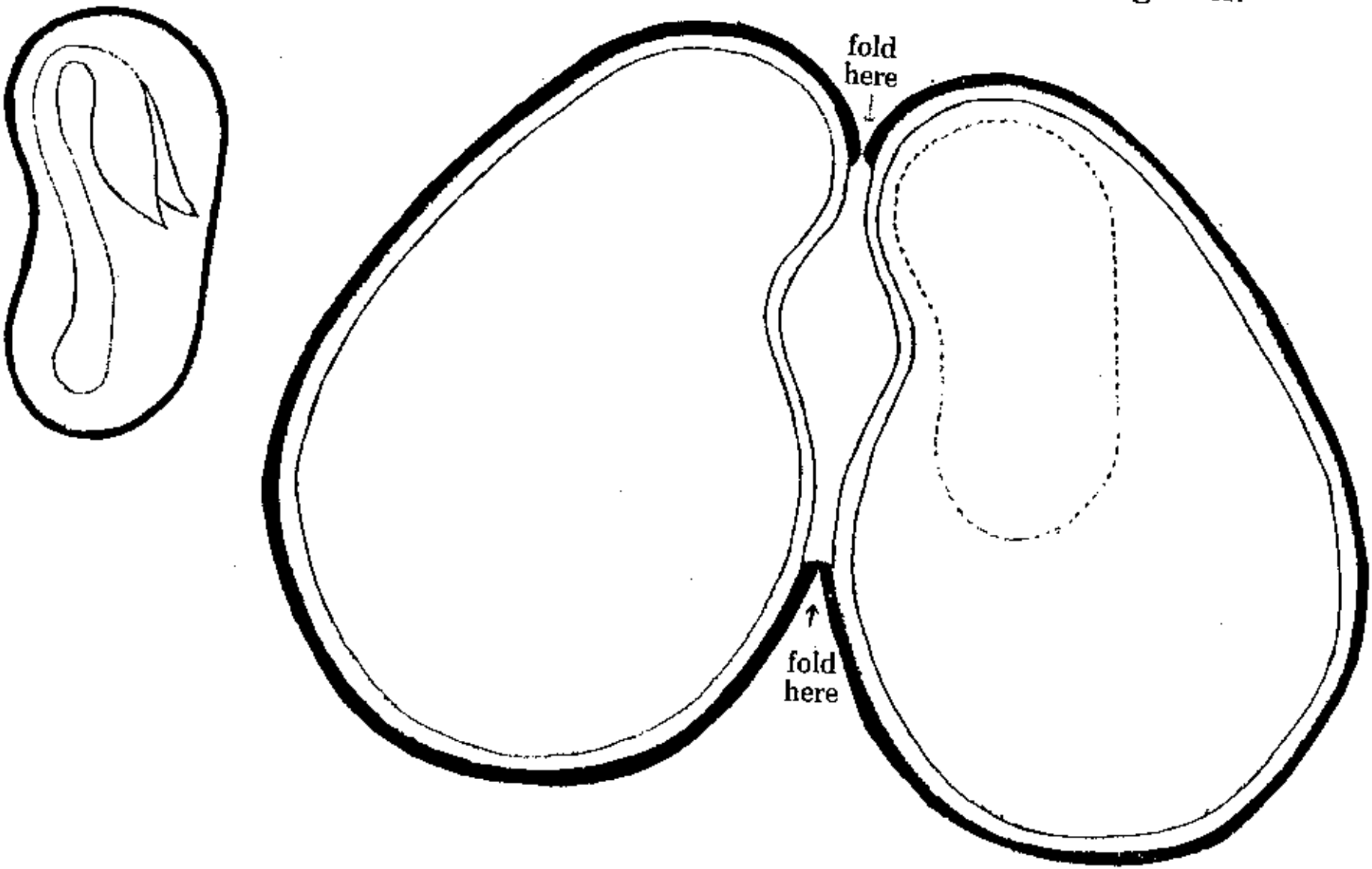
AMAZING SEEDS



Name: _____

Make a Seed

1. Color the seed and the baby plant.
2. Cut out the seed and the baby plant. Be sure to cut on the dark lines.
3. Paste the baby plant on the dotted lines in the seed.
4. Fold the seed together.

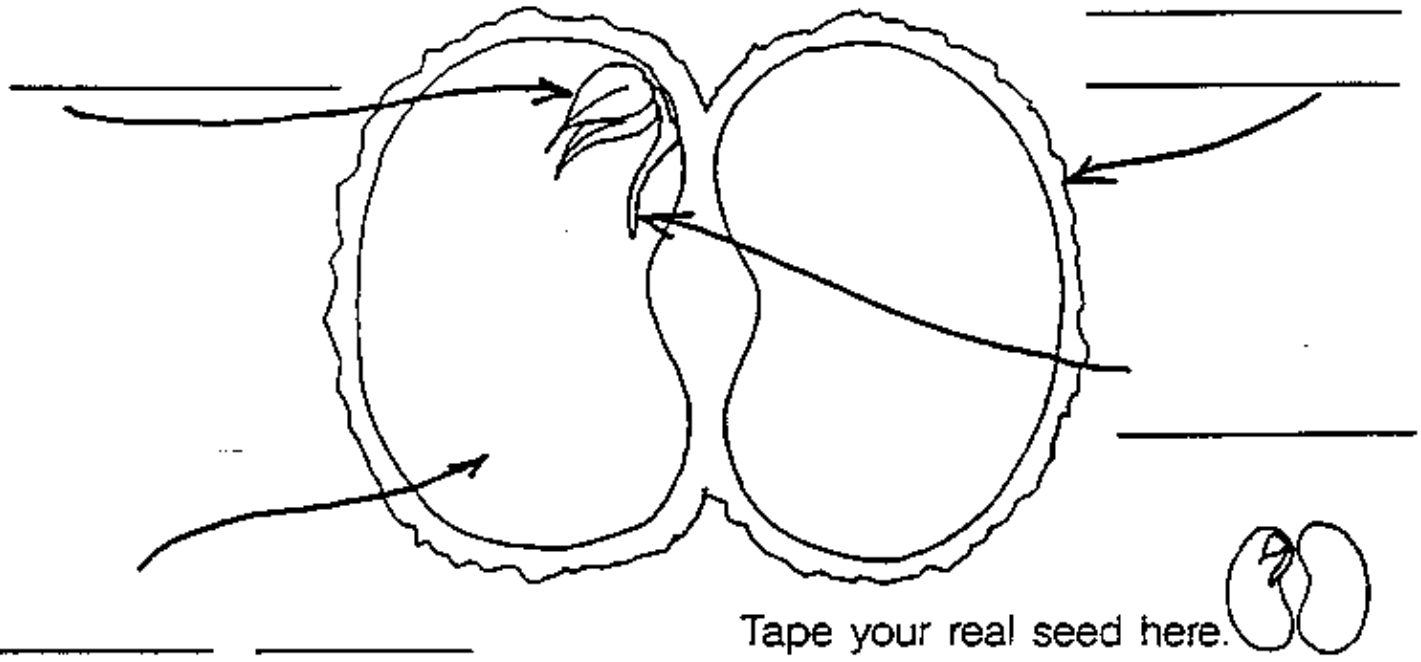


TO THE TEACHER:

1. Soak some lima bean seeds for about two hours, or until they begin to come apart.
2. Give each child two seeds to open carefully. Have them look for the parts you discussed on the giant lima bean seed on page 151.
3. When the children can find and name the parts of their seeds, have them fill in the blank spaces on this work sheet, using the word list.

Hi! Would you like to plant a lima bean seed like me? If you do, make sure you plant at least 3 seeds. This experiment will help you find out why.

Name _____



Tape your real seed here.

Look at your seed. Does it have a little plant inside? If not, it will not grow.

leaves	seed food	seed coat	root

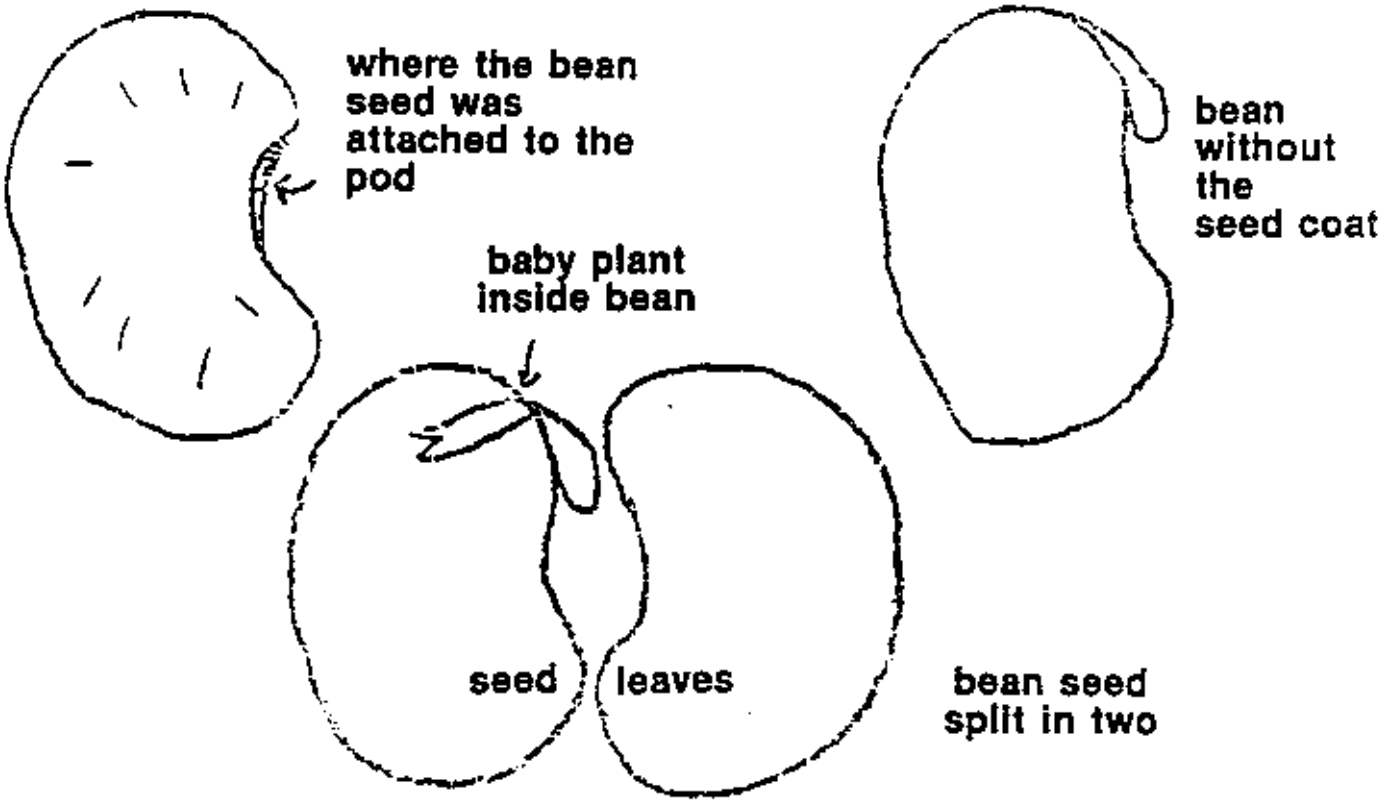
What's Inside A Seed?

Seeds look dry and dead. When you give them water and warmth they come to life. Every seed has the beginnings of a new plant inside it.

The seeds in the jar have been soaked overnight. They are now full of water and look swollen.

The thin outer covering of the seed is called the **seed coat.** This coat protects the seed until the weather is right for it to grow.

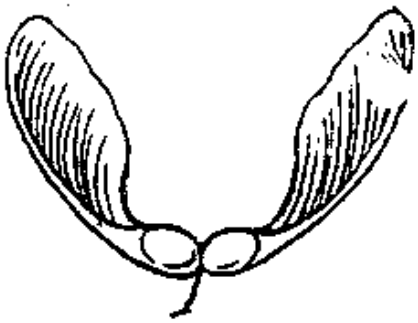
1. Take a seed out of the jar. Carefully peel off the seed coat.
2. Now split what you have left into two parts. These two parts are called **seed leaves.** They are stored food.
3. Find the tiny baby plant attached to the seed leaves. Roots, stems, and leaves will grow from this little plant. The baby plant will use the stored food found in the seed leaves to grow. When the plant is larger it will be able to make its own food by photosynthesis.
4. Now open three more different seeds. Can you find the baby plant in each?



KINDS OF SEEDS

Lima Bean

Corn



Maple

Dandelion

Cocklebur

Sunflower

Grass

Coconut

Acorn

PUPIL ACTIVITIES

1. Name two kinds of seeds we eat _____, _____.
2. Name two kinds of seeds that come from trees _____, _____.
3. Circle the seed that is covered with sharp, little hooks.
4. Color the seeds you have seen.

Name _____

SEED COLLECTION

1. Read each sentence.
2. Glue the correct seed in each box.
3. Tell what kind it is.
4. Draw a picture of what the full grown plant looks like.

This seed grows into a tree.	
This seed grows into a flower.	
This seed grows into a weed.	
This seed grows into a fruit or vegetable.	

SEEDS, SEEDS, AND MORE SEEDS

Background Information

Seeds are one of the most important parts of agriculture. They grow into the plants that we will consume, wear, or use. Some seeds grow into the grass that cows eat to give us meat and dairy products. Beans and peas are seeds that we eat in salads and soups. A tiny redwood seed will one day be a 200' redwood tree that can be turned into lumber, while cotton seeds will produce the cotton we use to make tee shirts, cotton balls, and bed sheets.

Germination is the beginning of growth in a seed. In a bean when the seed begins to germinate the seed swells and the embryo(young leaves, root, and stem) plant starts to grow. As the young plant grows the leaves, stem, and roots break through the seed but remain attached, using the seed as a source of food. The young plant continues to grow sending the stem and leaves upward and the roots down into the soil. Eventually the young plant appears above ground, exhausting its (seed) food source and continues to grow in to a mature plant.

Each plant has its own requirements for germination, which include availability of water and specific temperatures. For some it is warm rains or a Spring thaw, while others require the intense heat of a forest fire or a flash flood in a river bed.

Advance Preparation

Choose a corn product to make. Obtain all necessary ingredients and supplies (bowls, pots, oven,...) called for in the recipe(s). Be sure that you will be making enough food for everyone to help in the cooking as well as the eating of the product.

Suggested Grouping

Small or large group

Action (Communicating, Observing, Inferring)

1. Follow the directions in the recipe.
2. Cook and eat.

Sciencing

Communicating and Observing: Using your five senses describe what you observed as you mixed, cooked, and ate the food product in this activity. (Descriptions should include observations in sight, taste, smell, touch, and hearing.)

Inferring: How is cooking related to science? (Answers might include measuring, following directions, temperature causing reactions, mixing chemicals causing reactions, study of plants (botany),...)

ACTIVITY Germinating Ears of Corn

Materials You Will Need
Fresh, frozen, dry ornamental ears of corn - 1 each type
3 shallow cake or pie pans
Pitcher of water

Advance Preparation
Obtain all necessary materials.

Suggested Grouping
Large groups

Action (Communicating and Relating)
Show the participants the 3 different ears of corn. Explain that they are going to experiment to determine which type ear of corn will germinate first and grow the best.

1. Remove the husks from the corn.
2. Lay each ear of corn on its side in a pan.
3. Add enough water to cover 1/2 the ear of corn.
4. Ask 3 participants to take home and care for the corn.
5. Instruct them to place their pan in a warm sunny location (a windowsill will do).
6. Instruct them to bring them back to the next meeting.

Experimenting with Soils

Materials Needed:

Potato seeds and/or sprouting potatoes
4 Different types of soil:
potting soil
sand
garden soil
"My Choice Soil" - to be obtained by participant
Planting containers (10-16 oz. cans will do) - 4 per participant

Action (Communicating, Observing, and Relating)

Experiment with growing potatoes in a variety of soils, to determine which soil is best for growing.

Planting Seeds

Participants will:

1. Label the 4 pots:
   #1 - Sand
   #2 - Potting Soil
   #3 - Garden Soil
   #4 - My Choice
2. Fill pots #1- #3 with the appropriate soil.
3. Fill pot #4 with your own choice of soil, by either making a mixture of soils #1, 2, and/or 3, or getting soil from another source (backyard, field,...)
4. Plant seeds by placing 8-12 seed on top of the soil.
   Lightly sprinkle more soil on top of the seed.
   Gently press the soil down.
   Water.
5. Take pots home and care for the seed as described in the handout.
6. You will need to bring home the following:
   Pots with seeds
   Soil's Handout
   Pot #4 and some seeds to plant at home

Planting Sprouting Potatoes

Participants will:

Repeat Steps #1-3 above.

4. Cut the sprouting potato into 4 sections.
   Be sure that each section has a sprout.
5. Dig a hole in each container 1 1/2" deep.
   Plant a potato section in each hole.
   Cover with soil.
6. Take containers home and care for the potatoes as described on the handout.

Experimenting With Soils
At-Home Care For Growing Potatoes

1. Plant the remaining sprouting potato in your choice of soil.
2. Place all 4 containers in the same warm sunny location.
3. Water the containers as needed to keep the soil moist but not too wet.
4. Record your observations below.

Date started _____

I am trying to grow _____

My 4 soils are: #1 _____

#2 _____

#3 _____

#4 _____

Date sprouts started to appear

#1 _____

#2 _____

#3 _____

#4 _____

Prediction: I think the potatoes will grow best in soil # ____

because:_____

Results: My potatoes grew best in soil # _____.

Why?_____

Experimenting With Potato Types, Soils, and Hydroponics

Hydroponics is the growing of plants in water that contains the dissolved nutrients.

Experimenting with Hydroponics

Materials Needed:

Sweet potatoes - 4 per participant
Wide-mouth 16 oz. jars - 4 per participant
Quart jar with lid - 1 per participant
Small bottle with dropper - 1 per participant
Toothpicks - 1 box
Miracle Grow or other liquid plant food - 1 bottle
Gelatin - 1 envelope per group
Masking tape - 1 roll
Permanent marking pen - 1 or more
Hydroponic Worksheet - 1 per participant

Action (Communicating, Comparing, and Relating)

Experiment with growing sweet potatoes in a variety of hydroponic solutions, to determine which solution is best for growing sweet potatoes.

Participants will:

1. Label the jars:
   - #1 - Tap water
   - #2 - Water and Plant Food
   - #3 - Water and Gelatin
   - #4 - My choice
2. Insert 3-4 toothpicks into each sweet potato as shown.
3. Place 1 potato in each jar.
4. Fill the quart jar with water.
   - Add the envelope of gelating and shake.
   - You will use this at home.
5. Care for your potatoes as described in the handout.
6. You will need to bring home the following:
   - Sweet potatoes and jars
   - Jars of gelatin and water
   - Small bottle of liquid plant food
   - Hydroponic's Worksheet

Hydroponic Experiment - At-Home Care For Sweet Potatoes

1. Fill jar #1 with tap water until 1/2 the sweet potato is covered.
2. Fill jar #2 in the same manner, but add 5 drops of liquid plant food.
3. Fill jar #3 in the same manner, but use the water and gelatin mixture.
4. Decide what you will use for the jar labeled #4 - My Choice.
   Make the solution and fill jar #4 in the same manner.
5. Place all of the jars in the same sunny location.
6. Every 3-4 days replace the solutions in each jar.
7. Record your observations below.

Date started_____

My 4 solutions are: #1 _____

#2 _____

#3 _____

#4 _____

Date the roots appeared _____Date shoots first appeared

#1_____#1 _____

#2_____#2 _____

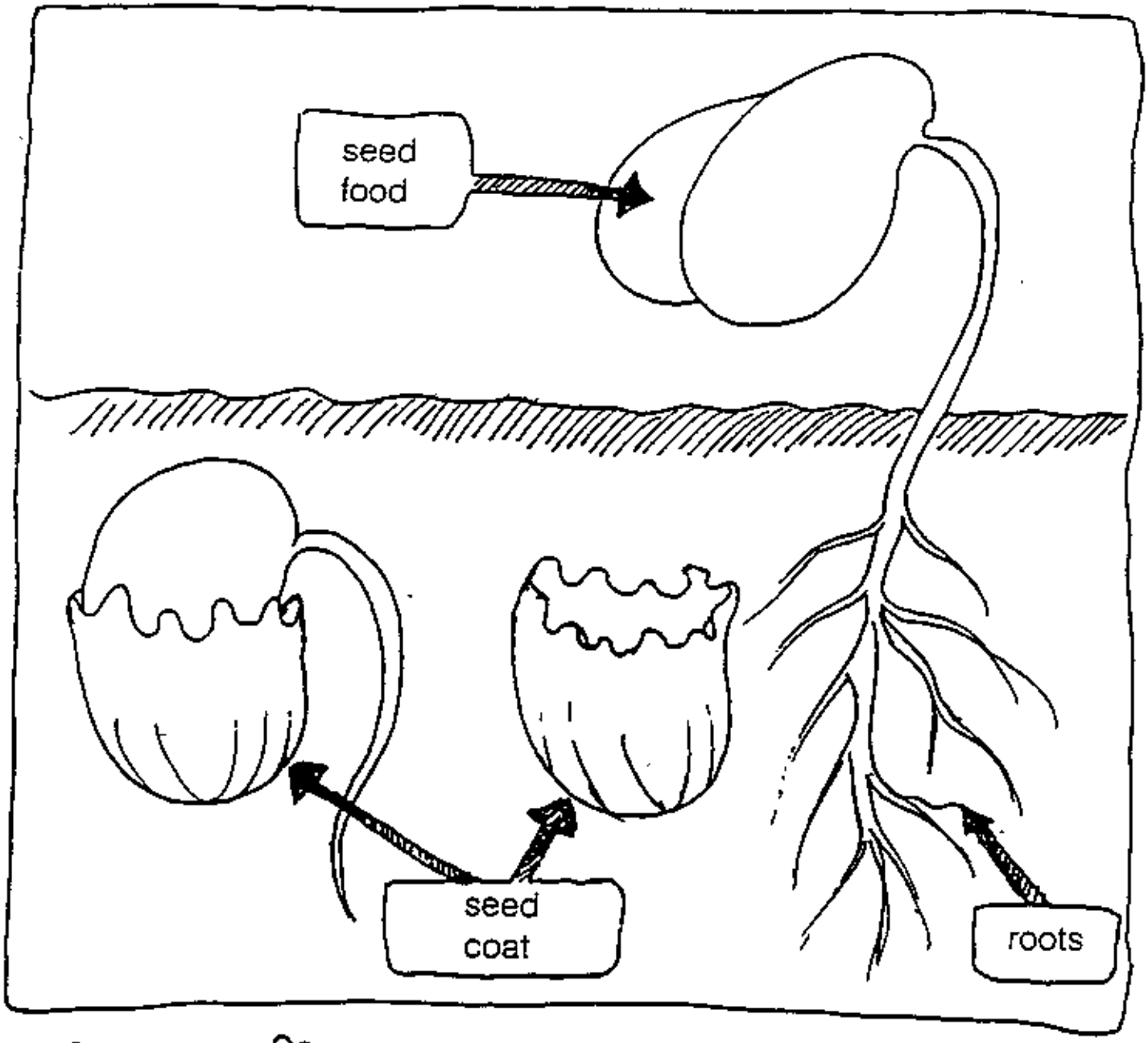
#3_____#3 _____

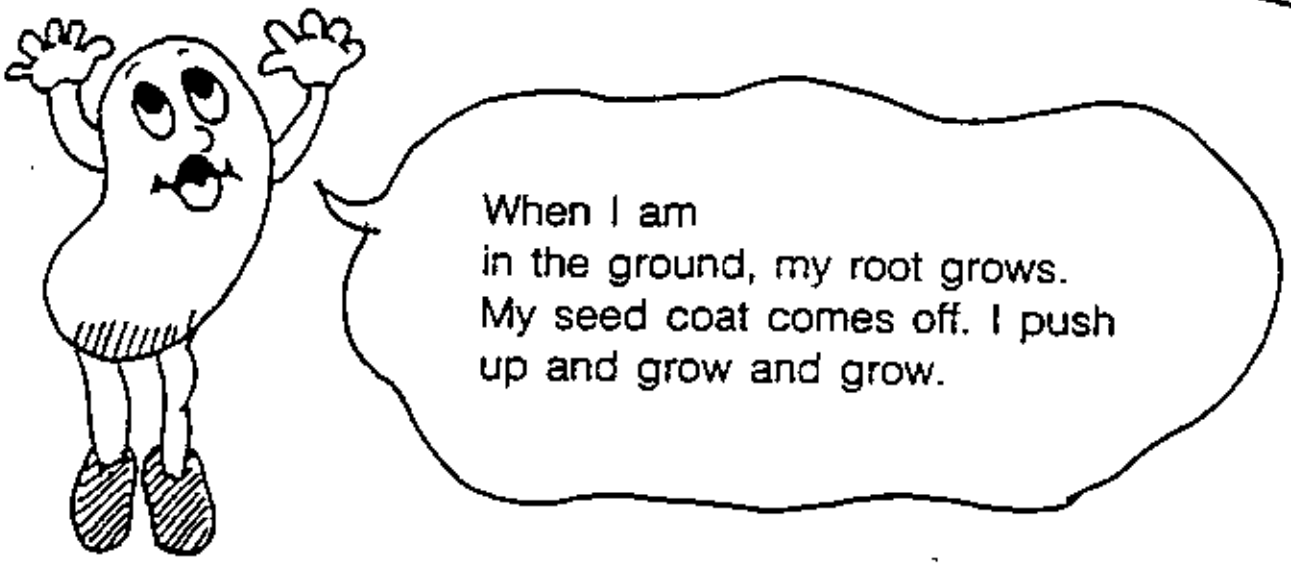
#4_____#4 _____

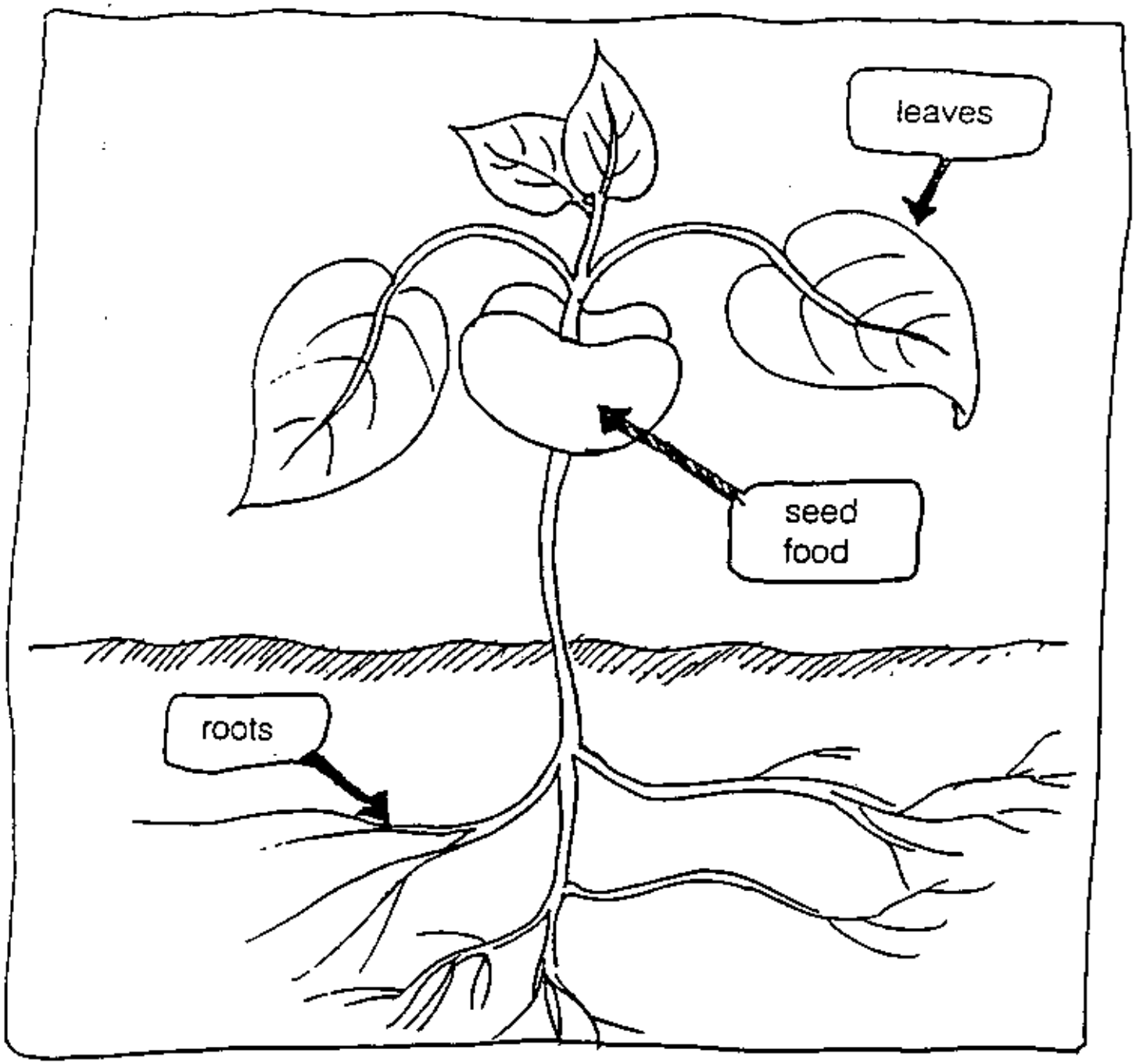
Prediction: I think the potatoes will grow best in #1_____

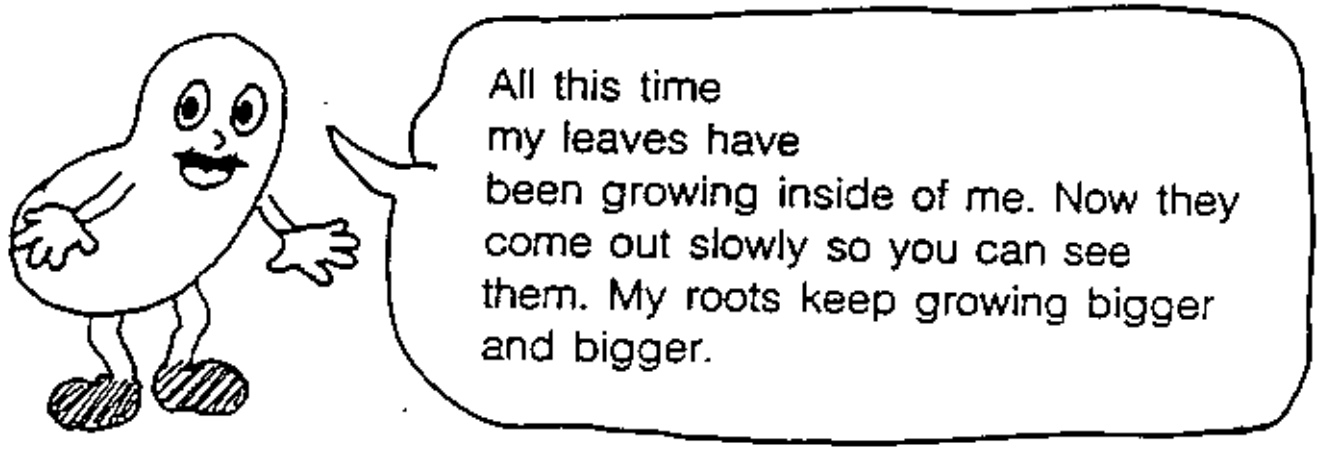
because _____

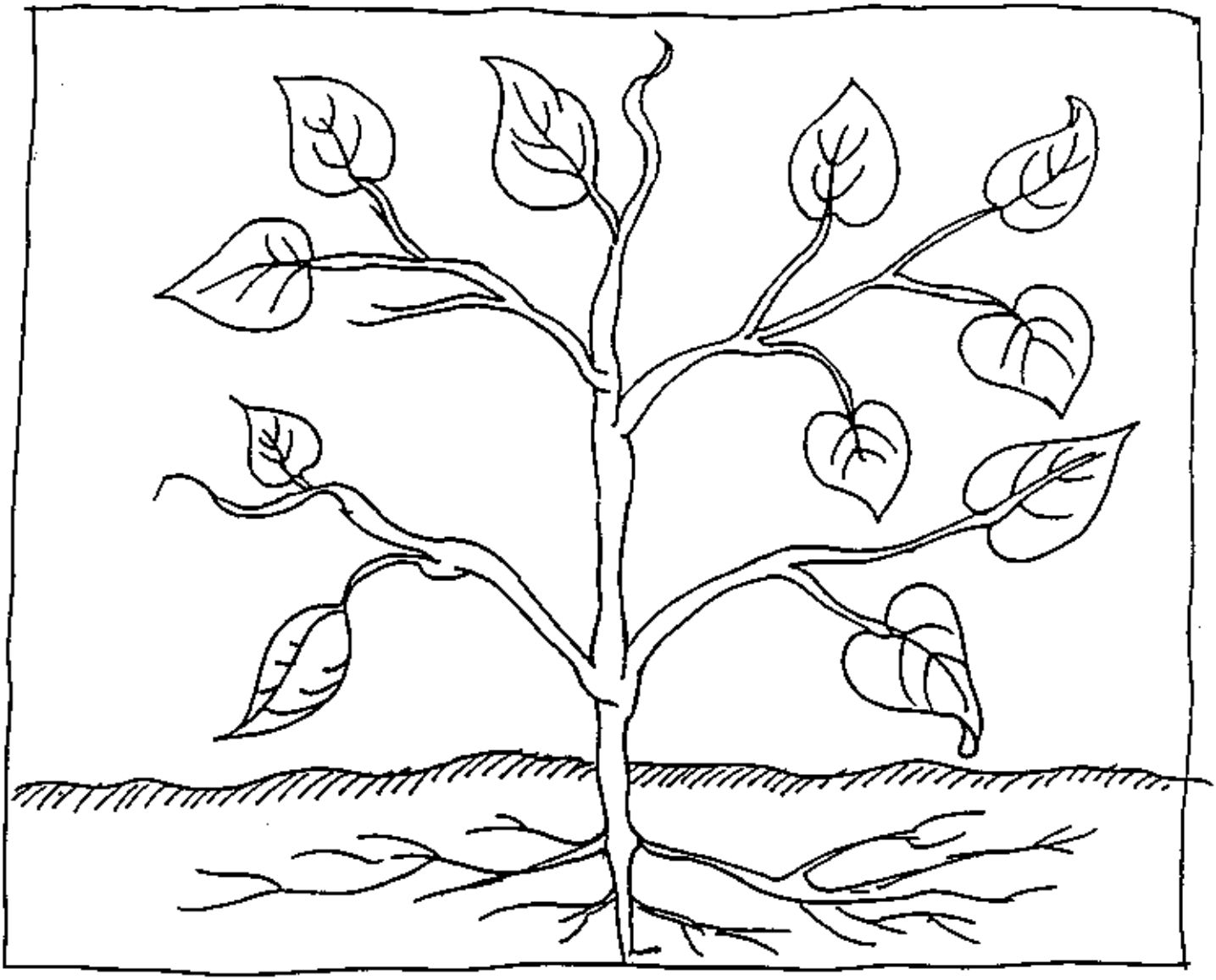
Results: My potatoes grew best in # _____. Why? _____

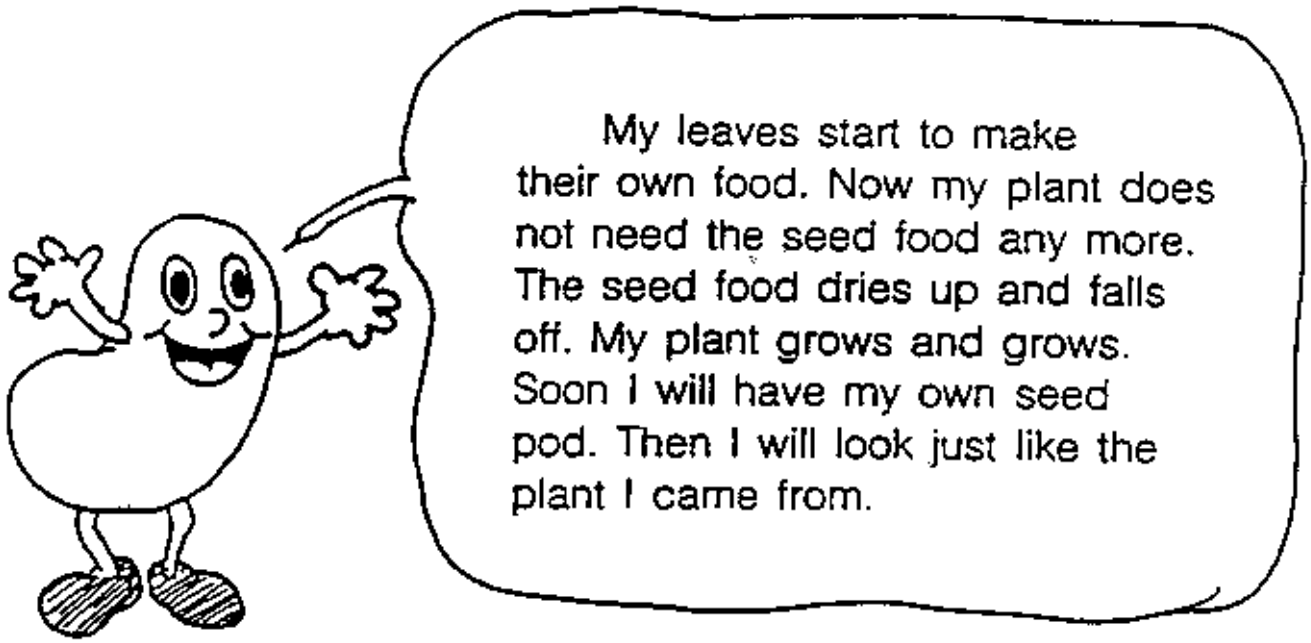












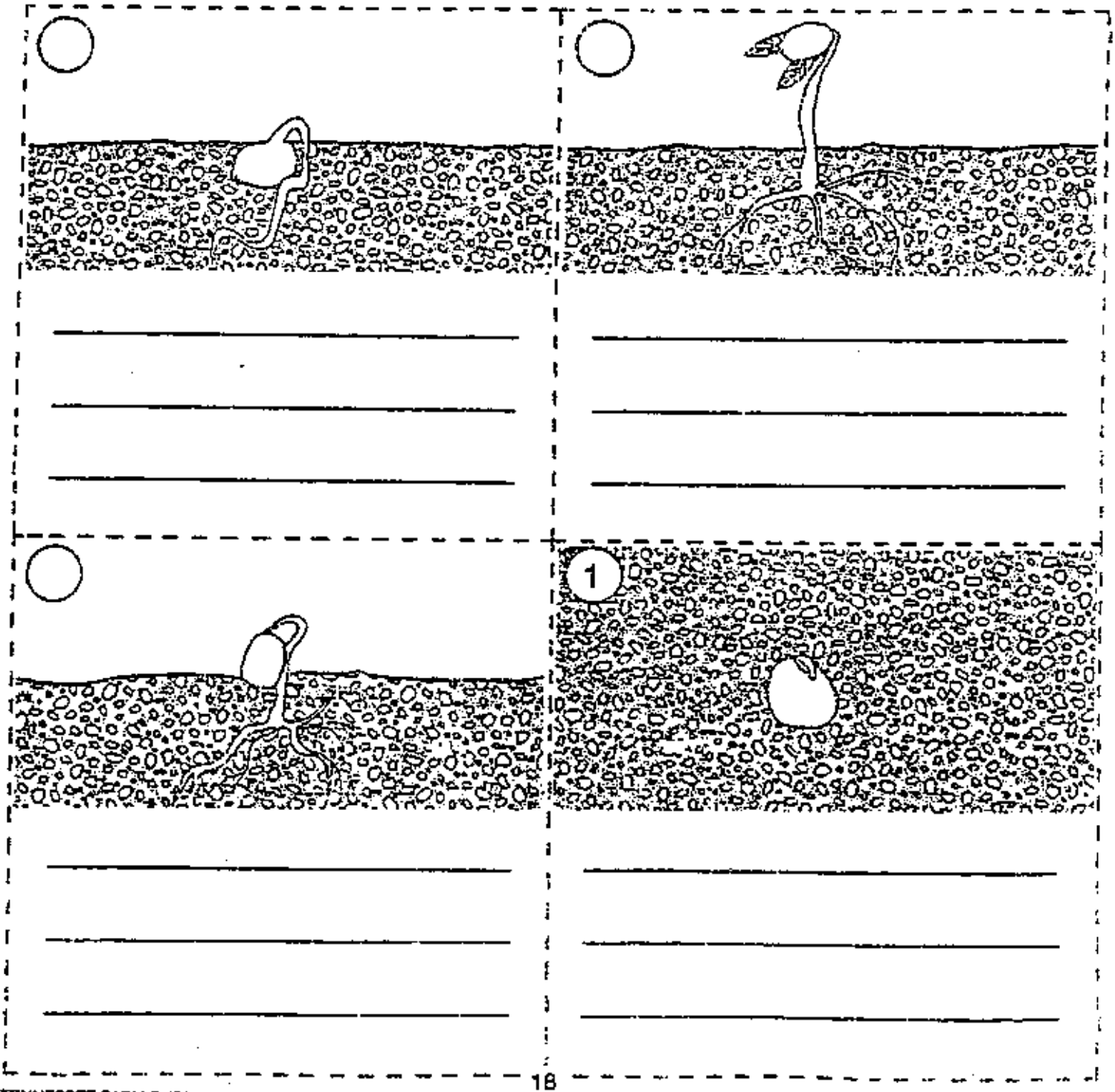
Name: _____

Dear _____ ,

I am studying seeds in school. I am learning how seeds grow into plants. May I put these pictures in order, number them, and tell my story about seeds to you?

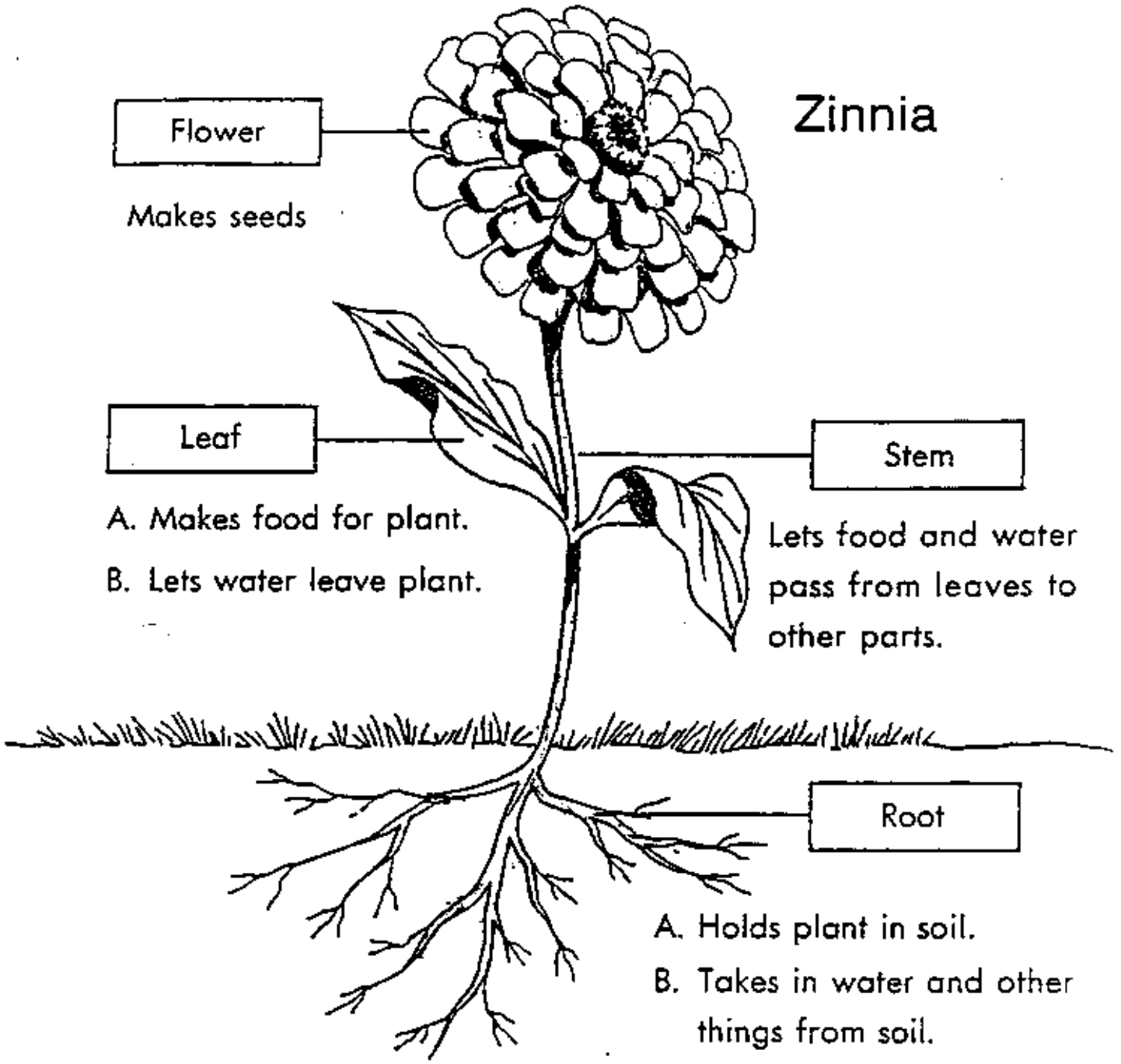
Thank you

A Story About Seeds



TENNESSEE FARM BUREAU FEDERATION, 1990
P. O. Box 313, Columbia, Tn. 38401

PARTS OF PLANTS



PUPIL ACTIVITIES

1. Circle the part of a plant that is under ground.
2. Draw a line under the part of a plant that lets air enter and leave the plant.
3. The part of the plant that makes seeds is called the _____.
4. Color each part of the plant a different color.

Child's Name_____

SEEDS FOR LITTLE SPROUTS
PRE-/POST-TEST
Grade: Kindergarten-First Grade

Teacher Directions
Write your name on the top line.
On each question you are to circle only one picture.

	Pre	Post
Total Score	_____	_____
Total Possible	_____	_____

Points Attained
Pre Post

_____ _____ 1. Put your finger on the number 1. There is a picture of a trowel, water, clippers and wheelbarrow. Circle the picture of something plants need to live.

_____ _____ 2. Put your finger on the number 2. There is a picture of water, the sun, a pot and soil. Circle the picture of the thing a plant can *live* without.

_____ _____ 3. Put your finger on the number 3. There is a picture of a fish, dog, ladybug and bird. Circle the picture of the thing most likely to eat seeds.

_____ _____ 4. Put your finger on the number 4. There is a picture of cauliflower, spinach, cabbage and corn. Circle the picture of the food that is the seed of a plant.

_____ _____ 5. Put your finger on the number 5. There are four parts of a plant. Circle the part that shows the stem.

_____ _____ 6. Put your finger on the number 6, at the top of the page. There is a picture of a tomato, corn, asparagus and carrots. Circle the picture of the food that is the fruit of a plant.

_____ _____ 7. Put your finger on the number 7. There is a picture of an onion, cherries, lettuce and potatoes. Circle the picture that is the root of a plant.

_____ _____ 8. Put your finger on the number 8. There is a picture of broccoli, celery, apple and peas. Circle the one that is the stem of a plant.

_____ _____ 9. Put your finger on the number 9. There is a picture of a smiling face with a "yes" and a frowning face with a "no". Circle the one which says "yes".

_____ _____ 10. Put your finger on the number 10. There are four parts of a plant. Circle the part that shows the roots.

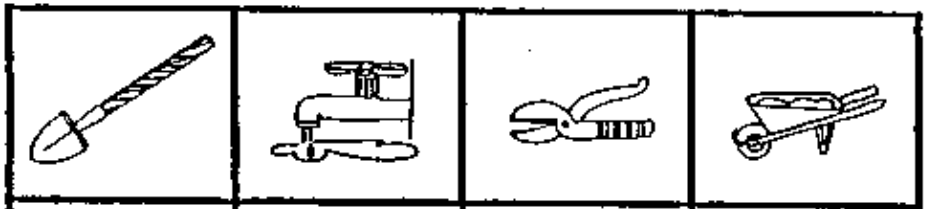
NAME _____

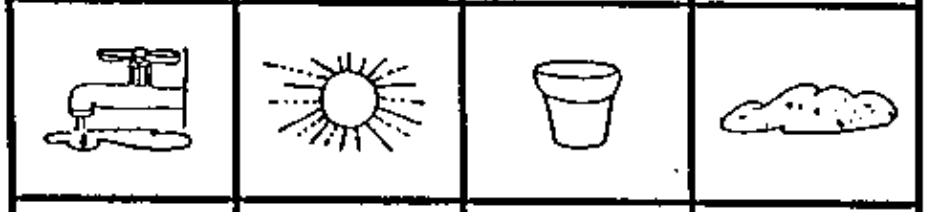
DATE _____

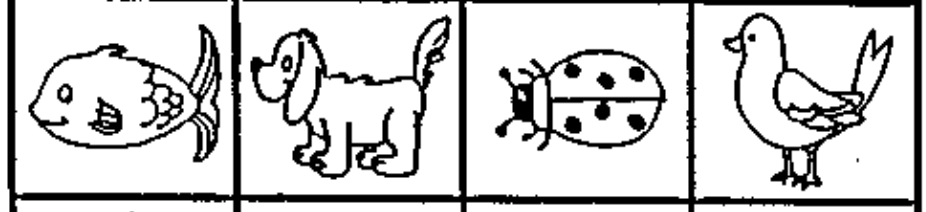
FIRST GRADE

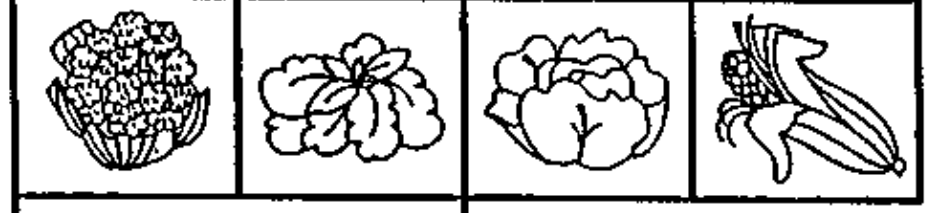
e-/POST-TES

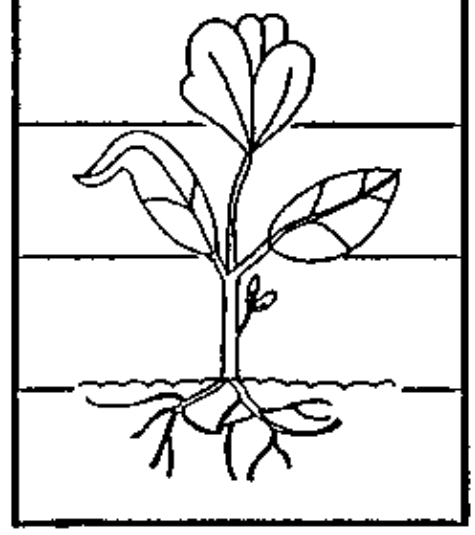
SCORE _____

1 

2 

3 

4 

5 

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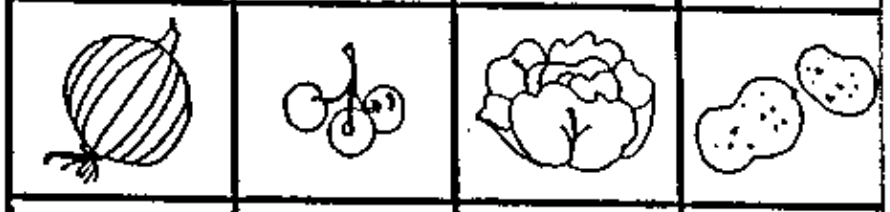
7 

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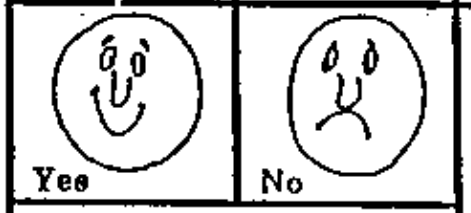
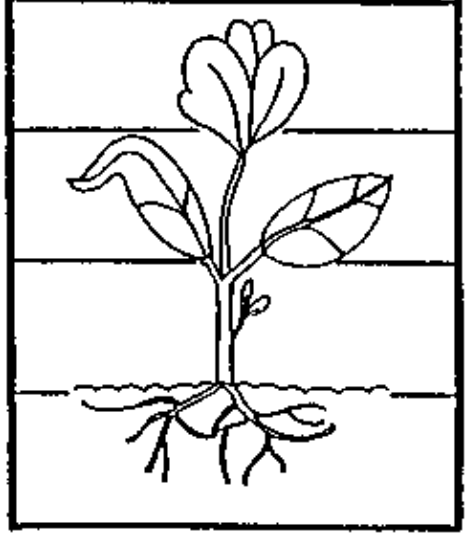
9 

10 

Seeds' Needs

Spring is the season for planting. This short fanciful skit for upper primary and intermediate students examines the role rain, sun, good soil, and air play in helping seeds grow.

CHARACTERS: Farmer Brown, Mr. or Ms. Meteorologist, Claudia Cloud, Raindrops (4), Sally Sun, Jack Frost, Snowflakes (any number), Seeds (any number).
TIME: Spring
SETTING: Farmer Brown's garden
PRODUCTION NOTES: Scenery is not really needed for this skit, though you could place a low border fence made from cardboard around a part of the garden. Farmer Brown can wear a straw hat and overalls. Meteorologist can wear everyday clothing and carry some maps and charts. Claudia Cloud could wear dark pants and a dark sweatshirt. The raindrops could wear white pants and white sweatshirts and have silver tinsel attached to their hair, arms and legs. Sally Sun could wear yellow or orange clothing and on her head, a paper hood with sun rays (with a hole cut for her face). Jack frost could be dressed in white, with a few paper icicles attached to his arms. Snowflakes could have paper snowflakes pinned around their bodies. Seeds could all wear dark colors.

(As the play begins, seeds are on the state crouched all in a row. Farmer Brown hoes around them. He or she can hum or sing happily).

Meteorologist *(Entering):* Are you starting your garden already, Farmer Brown?
Farmer: Why yes. This year I'm going to have a beautiful garden. I have planted seeds and covered them with dirt.
Meteorologist: How long will you have to wait?
Farmer: I don't know. *(Looks at watch)* It's been nearly a minute, and nothing has happened.
Meteorologist: It'll take much longer than one minute! You must be new to this business, Farmer Brown. It will take the seeds several weeks before they sprout. And to make them sprout, they'll need a few things. You've already covered them with good soil that's rich in nutrients. Now they could use a little moisture. Oh, Claudia Cloud!
Claudia Cloud *(Enters):* Here I am!
Meteorologist: It's time for these Seeds to have a little shower.
Cloud: *(Clapping hands)* Raindrops! It's time to fall!
Raindrops: *(Each enters individually and says name)* I'm Splash! I'm Splatter! I'm Drip! I'm Drop! *(Together)* We're ready to go falling down, down!
(Raindrops tiptoe around the seeds)
Seeds: We're growing. Won't Farmer Brown be pleased! *(Say individually)* I wonder what kind of vegetable I am? And me. And me. And me. I'm getting very wet. Oh, me too! I'm drenched. *(Together)* It's too much! We're drowning! Help! Help!
Farmer: What's happening? Meteorologist, stop the rain. The seeds are drowning.
Seeds *(Together):* Rain, rain go away come again some other day.
Cloud: Okay, Raindrops, the shower is over. Let's evaporate!
(Claudia Cloud and raindrops exit)
Farmer: I know seeds need rain, but not that much!
Meteorologist: Don't worry. I'll call Sally Sun. Seeds also need plenty of good healthy sunshine to grow. Oh, Sally, Sally Sun!
Sally Sun *(Enters):* It's good to be able to shine again. I've been trying to get away from Claudia Cloud all day *(Sun twirls around seeds).*
Seeds *(Spoken individually):* Oh, how nice! The sun is making me feel wonderful. I'm growing. It's warm in here. Oh, it's very warm! Stuffy! I feel droopy. *(Together)* It's to hot! Help! Help!
Farmer: My seeds will be baked! Meteorologist, send the sun away!
Meteorologist: You've better go now, Sally. You've outshone yourself.
(Seeds all droop or lay on sides).
Farmer: Look at my seeds! Please, cool them off.
Meteorologist: I could call Jack Frost. *(Shouts)* Jack Frost!
Jack Frost *(Enters)*: You called? I thought I was finished for the year.
Meteorologist: We need the air cooled.
Jack Frost: Okay, I'll ring for Snowflakes. *(Rings bell)*.
Snowflakes *(Enter, speak in unison):* Is it winter again? What would you like us to do?
Jack Frost: Create a blizzard please.
Snowflakes: Hurray, our favorite! *(Snowflakes dance around seeds)*
Seeds *(Speak individually):* How nice it is to be cool again! Now I'm almost too cold. I'm freezing! (*Seeds all shiver, call together).* Help! Help!
Farmer: This snow is hurting my seeds! Please stop it! Stop it!
Meteorologist: You wanted the seeds cooled off.
Farmer: I wanted them cooled, not frozen.
Meteorologist: Thanks, Jack Frost. You can stop the blizzard now. See you next year.
Jack Frost: So long. Stay cool. (*Jack Frost rings bell, and Snowflakes dance offstage with him*).
Farmer: You don't have to show me anymore, Meteorologist. I know what seeds need to grow. They need rain, but not too much; sun, but not too much; some good rich soil, air, and the one thing that I forgot – TIME.
Meteorologist: Well, you know, the weather is out of our control. That means it's not always easy to get rain without the danger of getting a flood, to get sun without the danger of a drought, to stop the snow from falling once planting time is here.
Seeds (*Together*): But we'll take our chances; and hopefully, with the right amounts of rain, sun, soil, air, and time, we'll be tasty vegetables in May!
(*Curtain*)

-SR. Marie Nadine
Leonard, C.S.J.

THE LITTLE SEED

Far down in Mother Earth a tiny seed was sleeping, safely wrapped in a warm brown jacket. The Little Seed had been asleep for a long time, and now somebody thought it was time for him to wake up. This somebody was an earth worm that lived close by. He had been creeping about and found that all the seeds in the neighborhood had roused themselves, and were pushing their heads up, up through the soil into the bright sunshine and fresh air.

So, when the worm saw this Little Seed still sleeping, he cried, "Oh, you lazy fellow, wake up, all the seeds are awake and growing and you have slept long enough."

But, how can I grow or move at all in this tight, brown jacket?" asked the Little Seed in a drowsy tone.

"Why push it off. That's the way the other seeds have done. Just move a little, and it will come off."

The Little Seed tried and tried, but the tough jacket wouldn't break, and all the time the worm was telling him how happy the other seeds were now that they had lifted their heads in to the sunshine.

"Oh dear! Oh dear!" said the seed. "What shall I do? I cant' break this jacket, and I shall never see the beautiful sunshine. Besides, I'm so sleepy I just can't keep awake any longer." And he fell asleep again.

"The lazy fellow," thought the earth worm. "But it is strange that the other seeds shed their jackets so easily. Who could have helped them, I wonder?"

The Little Seed slept soundly for a long while, but at last he woke, and found his jacket soft and wet, instead of hard and dry, and when he moved about it gave way entirely and dropped off.

"I woke you," said a soft, happy voice close by. "I'm a sunbeam and I came down to awaken you. My friend the raindrop moistened your jacket so that you might find it easier to slip off.

"Oh thank you," said the seed. "You're all very kind. Will you help me grow into a plant, too?"

"Yes," said the sunbeam, "I'll come as often as I can to help you and the raindrops will come, too, and then, if you work hard, without help you will become a beautiful plant, I'm sure."

So the Little Seed grew into a beautiful vine.

WHICH SOIL MAKES BEETS AND RADISHES GROW BEST?

(From the U.S. Department of Energy's "Science Activities in Energy")

PURPOSE: To confront students with a problem faced by farmers and a means of solving the problem.

OBJECTIVE: Students will participate in the demonstration as directed by the teacher and will record the results of the experiment.

MATERIALS: Beet and radish seeds, sand, soil, compost (a mixture of various decaying substances, such as dead leaves, manure, etc.), timed-release fertilizer (Follow the directions on the package), and 8 styrofoam cups.

PROCEDURE: Fill the styrofoam cups with the following:
2 cups, A and B, with washed sand
2 cups, C and D, with ½ sand and ½ soil
2 cups, E and F, with soil and fertilizer
2 cups, G and H, with soil and compost

Plant two beet seeds in cups A, C, E, and G, and plant two radish seeds in cups B, D, F, and H.
Place the cups on a sunny windowsill and add two teaspoons of water to each cup daily. Record the results. Which sprouts fastest? Which grows fastest?

Extend the lesson…

Are small amounts of soap or detergent harmful to the growth of plants?

MATERIALS: Radish or beet seeds, soap and detergent, 3 styrofoam cups, soil, water, and 2 quart jars.

PROCEDURE: Fill the two jars with equal amounts of water. To make the solutions add ¼ teaspoon of detergent to one jar and ¼ teaspoon soap to the second jar.

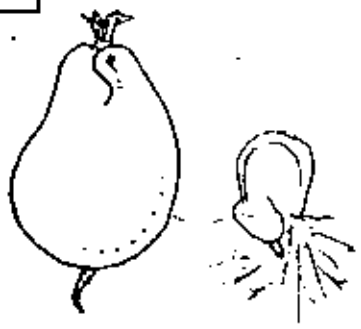
Fill the 3 cups with soil and plant two seeds in each cup about 1 cm deep. Label the cups 1, 2, and 3 and place them in a sunny window. Water cup number 1 with 2 tablespoons of the soap solution every day. Water cup 2 with 2 tablespoons of the detergent solution every day. Water cup 3 with 2 tablespoons of tap water everyday.

Chart the growth of each cup. Compare the results. Which sprouts first? Which grows fastest?

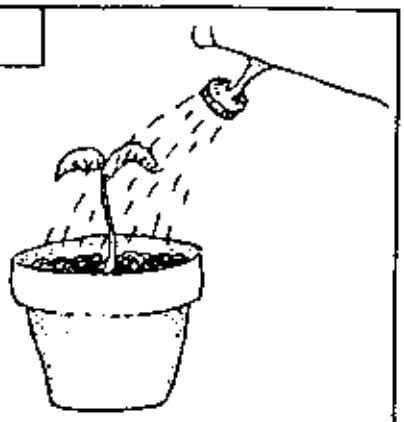
GROW BEANS GROW

Number the boxes below to place them in the right order.

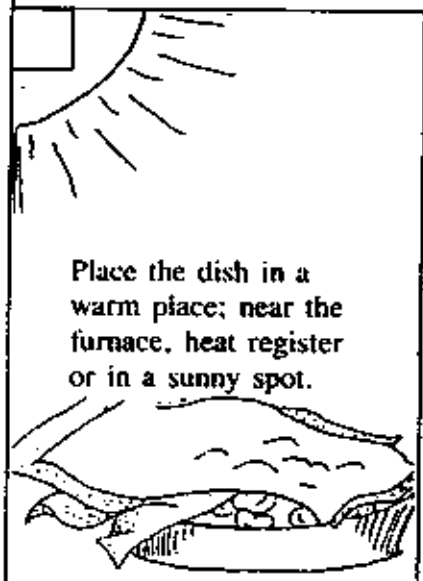
Harvest beans in the summer after the plant has matured.



In several days some of the beans will germinate (will grow a root).



Water the pot when the soil dries out.

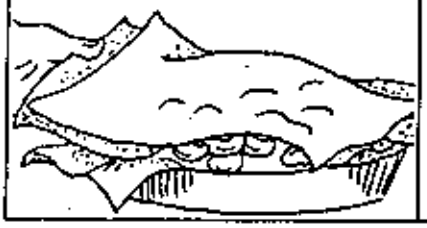


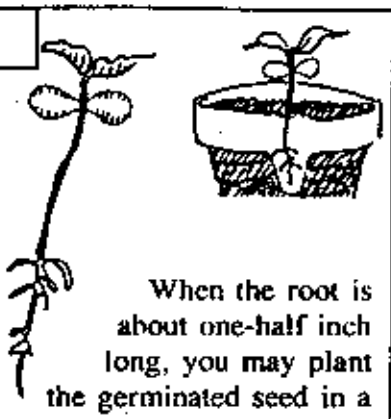
Place the dish in a warm place; near the furnace, heat register or in a sunny spot.

Plant it outdoors if it is spring.

Place two wet paper towels on the bottom of a shallow dish. (A pie plate is good.)

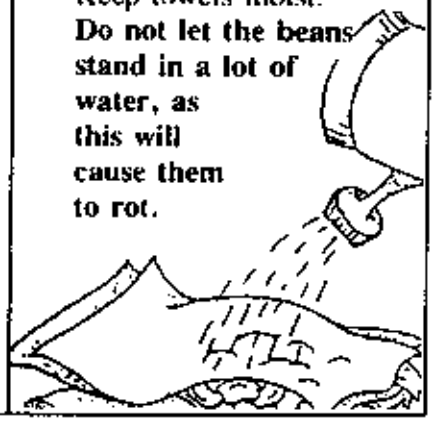
Put 10 navy beans on the towels and cover with two more wet paper towels.





When the root is about one-half inch long, you may plant the germinated seed in a small pot with dark, rich soil. Put the seed about 1 inch under the surface of the soil.

Sprinkle the towels with water every day. Keep towels moist. **Do not let the beans stand in a lot of water, as this will cause them to rot.**



Answers: 9/5/7/3/8/1/2/6/4

BUILD YOUR OWN AIR PURIFICATION PLANT

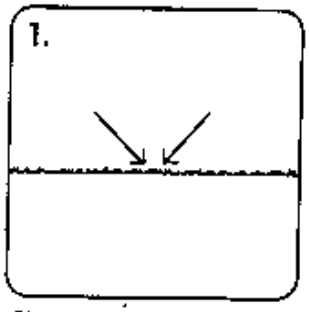
I think that I shall never see
a poem lovely as a tree!
—Joyce Kilmer

American farmers plant more than 9 billion trees each year, maintain 170,000 miles of windbreaks & 1.3 million acres of grass waterways.
THAT'S MORE THAN ANY OTHER ENVIRONMENTAL GROUP!!!!!!!!

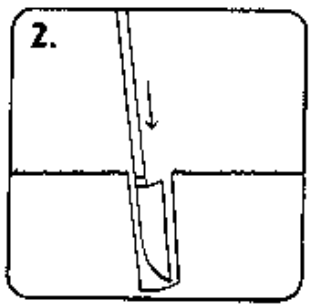
- Trees "scrub" our air by removing and using carbon dioxide. And they produce oxygen for us to breathe.
- Trees provide shade to cool our homes.
- Trees produce wood for buildings, paper, and model airplanes.
- Planting trees helps prevent soil erosion from wind and rain.
- Trees provide food and shelter for birds and other animals.
- Trees make our world more beautiful and interesting.

PLANT A TREE as a class activity or with your family!

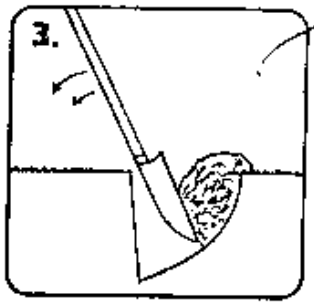
To plant a tree, you will need a tree seedling from your local nursery and a spade to dig the hole. Follow the steps below:



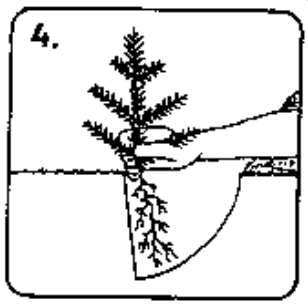
Choose a place for your young tree that is protected from the hot sun, wind, people, and animals. (When your tree is bigger, it can be moved.)



Sink a spade straight down into the soil.

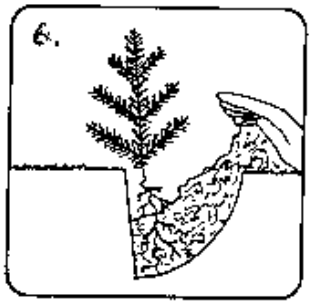


Pull back on the spade handle and remove a wedge of soil.

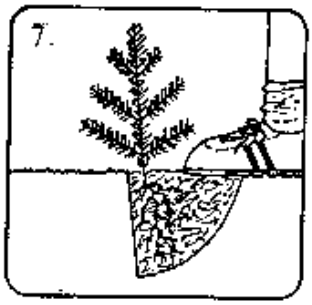


Gently spread the roots of the seedling and hold against the vertical side of the hole.

Sprinkle some soil around the lower roots.



Push the remaining soil back into the hole.



Use your hands or foot to pack the top soil down around the seedling. Water well.

Watch it GROW!

For more information, contact your local Soil Conservation Service or New Mexico State Forestry Department!

IF I HAD A FARM

Grade Level: Primary

Economic Concepts: Interdependence, Natural Resources, Factors of Production

Skills: Critical Thinking, Problem Solving, Evaluation, Art, Creativity

Time Frame: Five class sessions

The students will understand that farmers grow different products depending on soil, climate, and water availability by:

A. Simulating the purchase of farm land.

B. Brainstorming for possible products to produce.

C. Using problem solving steps and decision making grids to choose the best alternative.

D. Giving their farm a name and producing a visual display to show the results of their decision.

Vocabulary:

Environment, interdependence, dependence, real estate, criteria, alternatives.

Materials:

Area map, problem-solving poster (made by teacher), bulletin board activity, handout.

Procedures:

A. 1. Bring an area map to class and display on a bulletin board (a county or city map is fine). Help each student locate where he/she lives. Indicate just where the child lives on the map with a pin and slip of paper with child's name. This will generate interest in the project.

2. Tell students the class is going to pretend to purchase a few acres of farm land. Find some farm land in your attendance area, if possible. Of not possible, just pick any area on the map that the class would like to farm. Color the area in with a marker.

2. Have a real estate person come to visit and discuss available property with the class and what they should be aware of when purchasing farm property.

B. 1. Discuss the characteristics of the farm land with the students. Is the land rocky, flat, sloping, cleared, wooded, or mountainous? Does it have water available? Does it have fertile soil with good drainage? After discussing these features, tell the class you now have a problem that needs to be resolved. What should the class produce on the farm?

2. Tell the class that everyone is going to participate in a "brainstorming" activity. Everyone is to think of ideas or suggestions about what could be produced on the farm. Every suggestion is accepted and considered. There are no "good" or "bad" ideas. Write all the suggestions on the board. After a reasonable amount of time, look over the suggestions. Consider the features of the property. Mark through the suggestions that would not be suitable for the property. Narrow the list down to five products.

C. 1. Display poster of problem solving steps:
   - Define the problem
   - List alternatives
   - Establish criteria
   - Apply criteria to alternatives
   - Choose best alternative
   - Evaluate decision

   Tell the students that the problem has been defined: What to produce? Alternatives have been listed and narrowed down to five. Now it is time to establish the criteria. A county farm extension agent is invited to the class to help establish criteria. Be sure to talk about the type of questions the students should ask the resource person. Have each child write at least three questions he/she would like to ask.

   Criteria examples:
   - Reasonable price
   - Water source
   - Good location
   - Resale value
   - Fertile soil

2. Make a bulletin board or poster similar to the following:

CRITERIA

Problem: What to produce?					
Alternatives 1.					
2.					
3.					
4.					
5.					

Write the five alternatives in the appropriate space on the bulletin board. With help from the extension agent, develop the appropriate criteria (example – is the product marketable? Is there sufficient water? What specialized equipment is necessary?). Apply the criteria to the alternatives. Place a plus (+) for a positive and a minus (-) for a negative answer. Put (0) in the space for not applicable.

3. Weigh the results. Which product has the most +'s? Decide which product the class will produce.

D. 1. Have the children use their imagination to think of appropriate names for their farm. Example – Graham Gardens, Fox's Farm, Ratcliff's Ranch, Chick Holler, Nancy's Nursery.

2. Make a display for the class or hall showing your farm and the agricultural product it produces. Show the students providing the necessary labor and draw the capital that will be needed. If you raise cattle, you may want to design a brand.

3. Capable students might be assigned to evaluate the decision over a period of time. This will have to be simulated, however. They can compare and contrast different alternatives, research the products and the market, and even interview some area farmers to discover their opinions about the decision. Students should report their findings to the class.

DECISION MAKING GRID

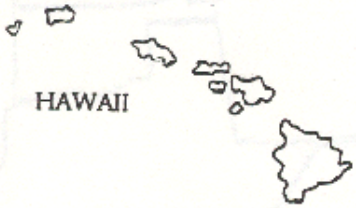
Name _____

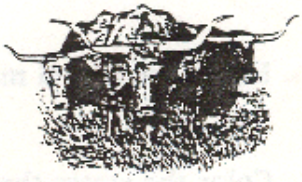
PROBLEM: ?

Criteria	Alternatives					
?						
?						
?						
?						
?						
?						
?						
?						
?						
?						
?						
?						
?						
?						
?						
?						
?						

This project was designed to help young people understand & appreciate rangeland. It contains learning activities for the beginner. The student will progress from basic ecological concepts through plant anatomy. Activities in this manual may be supplemented by field days, project tours and other learning activities.

Western 4-H Range Project





The following 48 pages of the Western 4-H Range Project was provided by Dr. Chris Allison, New Mexico State University (John Lacey, Gene Gade, Mike Cavey, Chris Allison, Kirk Astroth/supported by National 4-H Council/Univ. of Wyoming, MSU & NMSU/ Produced by MSU).

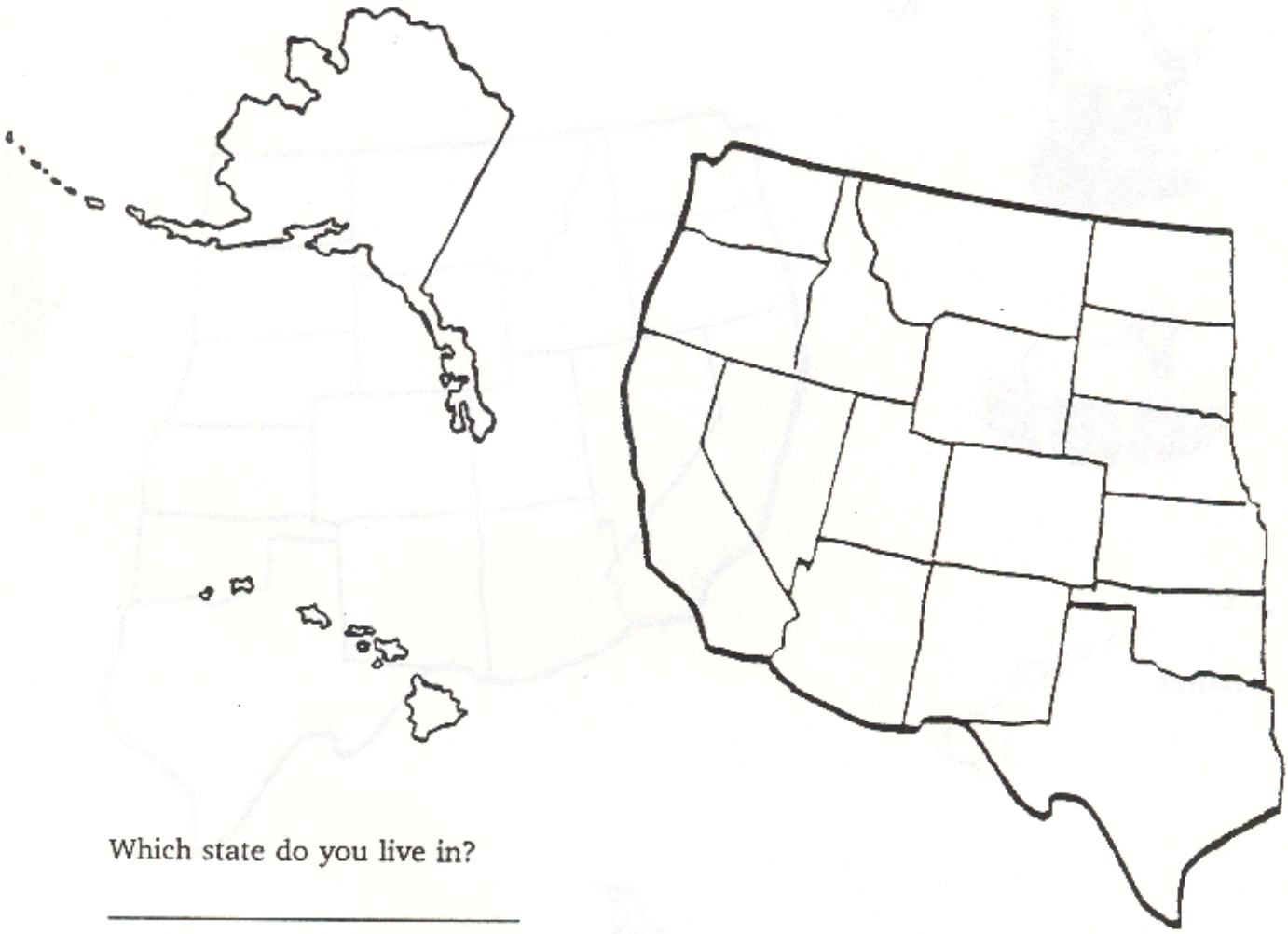
Western 4-H Range Project

KINDS OF LAND

The western half of the United States includes 19 states. Can you name them? _____

Write the name of each state on the map.

19 WESTERN STATES



Which state do you live in?

_____

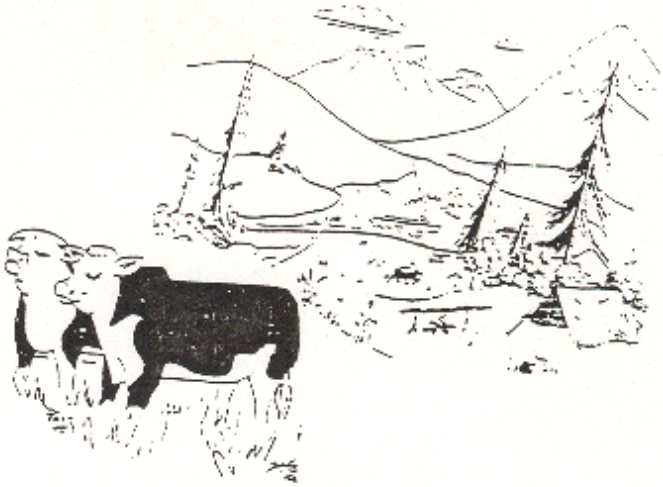
Have you visited many of the western states? _____

Color the states that you have visited.

FOUR KINDS OF LAND

There are four main kinds of land in the 17 western states. They are range, forest, farm, and urban. Each kind is somewhat alike, and somewhat different from the other kinds.

1. **Rangeland** is land that grows many different kinds of grasses, flowers, and trees. Rangelands are usually too steep, too rocky, or too dry to be used for farming. Therefore, the plants on rangeland provide food for cattle, sheep, deer, antelope, and other animals.



Many different animals live on rangeland. People often fish, hunt, and camp on rangeland.

a) Think about **rangelands!**

Are you thinking about -- (check yes, maybe, or no):

	Yes	Maybe	No
Lots of people	____	____	____
Streets, cement	____	____	____
Wild animals	____	____	____
Cow, sheep, horses	____	____	____
Rivers and lakes for fishing	____	____	____
Factories and stores	____	____	____
Big fields of grain	____	____	____
Lots of tractors and equipment	____	____	____
Some dogs on leash	____	____	____
Lots and lots of big trees	____	____	____
Loggers	____	____	____
Business people	____	____	____
Cowboys	____	____	____
Farmers	____	____	____
Many different plants	____	____	____

b) Find a magazine. Cut out a picture of range or cut out several pictures and make a collage that shows the animals and plants that are found on rangeland. Tape or glue your picture or collage here:

c) Write about the plants and animals in your rangeland photo or collage.

d) Pretend that you have some friends visiting from a large city, tell them about rangelands.

2. **Forest land** is different from rangeland. Trees are the most common plant. Forest lands in the western United States are usually located in the mountains. They receive more rain and snow than rangelands. Forest trees provide lumber for our homes and other buildings.

Deer and elk, and other animals often make their home in the forests. Sometimes they are hard to find.

a) Think about **forest land!**

Are you thinking about -- (check yes, maybe, or no):

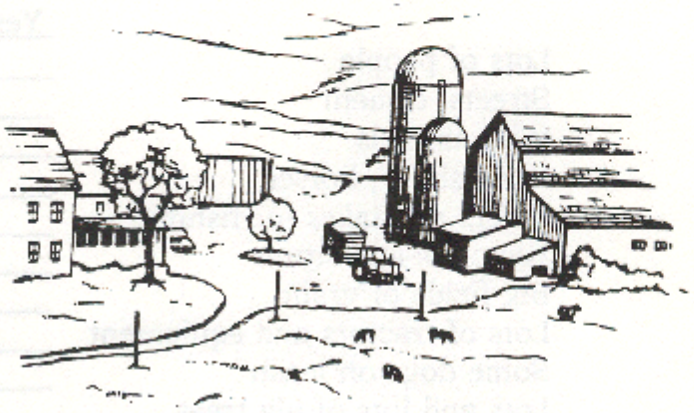
	Yes	Maybe	No
Lots of people	____	____	____
Streets, cement	____	____	____
Wild animals	____	____	____
Cow, sheep, horses	____	____	____
Rivers and lakes for fishing	____	____	____
Factories and stores	____	____	____
Big fields of grain	____	____	____
Lots of tractors	____	____	____
Some dogs on leash	____	____	____
Lots and lots of big trees	____	____	____
Loggers	____	____	____
Business people	____	____	____
Cowboys	____	____	____
Farmers	____	____	____
Equipment	____	____	____

b) Find a magazine. Cut out a picture of a forest or cut out several pictures and make a collage that shows the trees and animals that are found on forest land. Tape or glue your picture or collage here:

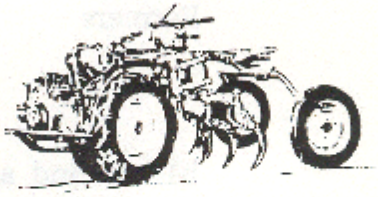
c) Write about plants and animals in your forestland photo or collage.

d) Pretend that you have friends from a large city visiting, tell them about forest land.

3. **Farmland** is easy to identify. Wheat, barley, oats, and hay are usually grown on farmland.



Farmers use tractors and equipment to grow their crops.



The plants and animals that live on farmland are different than the ones on rangeland or forestlands.

a) Think about **farmland!**

Are you thinking about -- (check yes, maybe, or no):

	Yes	Maybe	No
Lots of people			
Streets, cement			
Wild animals			
Cow, sheep, horses			
Rivers and lakes for fishing			
Factories and stores			
Big fields of grain			
Lots of tractors and equipment			
Some dogs on leash			
Lots and lots of big trees			
Loggers			
Business people			
Cowboys			
Farmers			

b) Find a magazine. Cut out a picture of a farm or cut out several pictures and make a collage that shows the animals and plants that are found on farmland. Tape or glue your picture or collage here.

c) Write about the plants and animals in your farmland photo or collage.

d) Pretend that you have friends visiting from a large city. Tell them about farmland.

Urban land, or towns and cities, is the fourth major kind of land. Many people live in towns and cities.

Instead of wild plants, house plants, green lawns, and sidewalks are common.

Instead of wild animals, we see dogs and cats.

a) Think about **towns and cities!**

Are you thinking about -- (check yes, maybe, or no):

	Yes	Maybe	No
Lots of people	____	____	____
Streets, cement	____	____	____
Wild animals	____	____	____
Cow, sheep, horses	____	____	____
Rivers and lakes for fishing	____	____	____
Factories and stores	____	____	____
Big fields of grain	____	____	____
Lots of tractors and equipment	____	____	____
Some dogs on leash	____	____	____
Lots and lots of big trees	____	____	____
Loggers	____	____	____
Business people	____	____	____
Cowboys	____	____	____
Farmers	____	____	____

b) Find a magazine. Cut out a picture of a city or town, or cut out several pictures and make a collage that shows the "busy activities" than can be found in towns and cities. Tape your picture or collage here:

c) Write about the plants and animals in your photo or collage.

d) Pretend that you have friends visiting from a farm or ranch. Tell them about towns or cities.

UNDERSTANDING THE KINDS OF LAND

1. USE OF LAND

Each kind of land is important. Most of our food is grown on farms. Most cattle and sheep are raised on rangeland. Most wildlife live on range and forest lands. Wood, to build houses, is produced on forest land. We buy food, lumber, clothes, and other products from stores in cities.

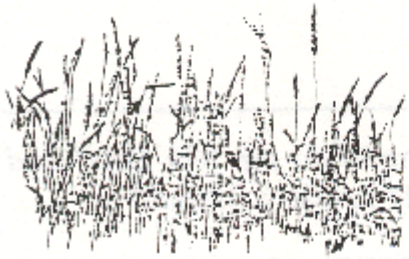
Pretend you are a detective and match the letter with the best places to go, if you

____ were hungry
____ wanted to go hunting
____ wanted to see a milk cow
____ wanted to build a house
____ wanted to eat in a cafe
____ wanted to buy a hat
____ wanted a Police Officer
____ wanted to see an antelope
____ wanted to see a deer
____ wanted to buy a loaf of bread
____ wanted to see a big tractor
____ wanted a quiet peaceful place
____ wanted to look for arrowheads
____ wanted to see many different kinds of plants
____ wanted to see buffalo roam
____ were looking for Superman or Dick Tracy
____ wanted to raise wheat and livestock
____ wanted to cut trees to make paper
____ wanted to go to a ball park and see the New York Yankees play the Oakland Athletics

a. forest

b. city or town

c. range



d. farm

2. ENVIRONMENT

Your **environment** is everything around you that affects your life. It includes non-living things, such as air, water, and soil. It also includes living things, such as plants and animals.

Describe your environment!
Are you indoors or outdoors?

_____

List 3 non-living things that you see:

1) _____
2) _____
3) _____

List 3 living things that you see:

1) _____
2) _____
3) _____

Each plant and animal has a special place that it calls "home". A home is "good" if it provides food, water, shelter, and space. Every living thing needs to eat, to drink, a place to be protected from enemies, and "room to live and grow". Draw a picture of your "home" showing the 4 things that you need from the environment.

Suggest to your 4-H Leader or Teacher that it is time to do the "Oh Deer" and "Habitat Lap Sit" activities. They are explained in the Leader's Manual.

Pretend that the plants and animals are lost. Help them back to their home by matching the letter with their home. (Hint: Some may have more than one home.)

Cities: ___ ___ ___ ___ ___

Forest: ___ ___ ___ ___ ___

Farm: ___ ___ ___ ___ ___

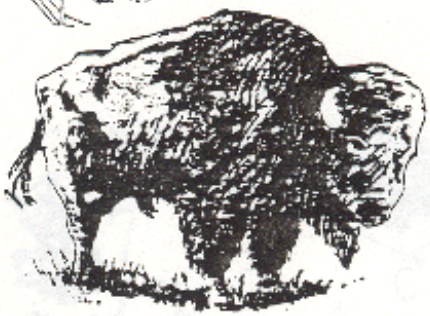
Range: ___ ___ ___ ___ ___

a.

b.

c.

d.



e.

f.

g.

h.

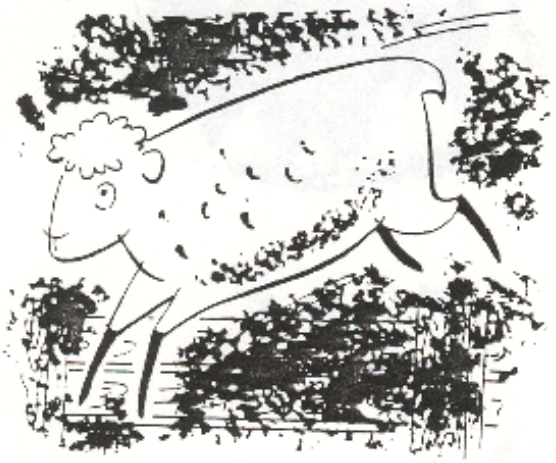
i.

j.

Now that we have studied the 4 kinds of land, tell how rangeland is **like** the other kinds of land.

Now tell how range land is **different** from the other kinds of land.

Keep up the good work!
As a famous sheep said,
"Where there's a wool,
there's a way."

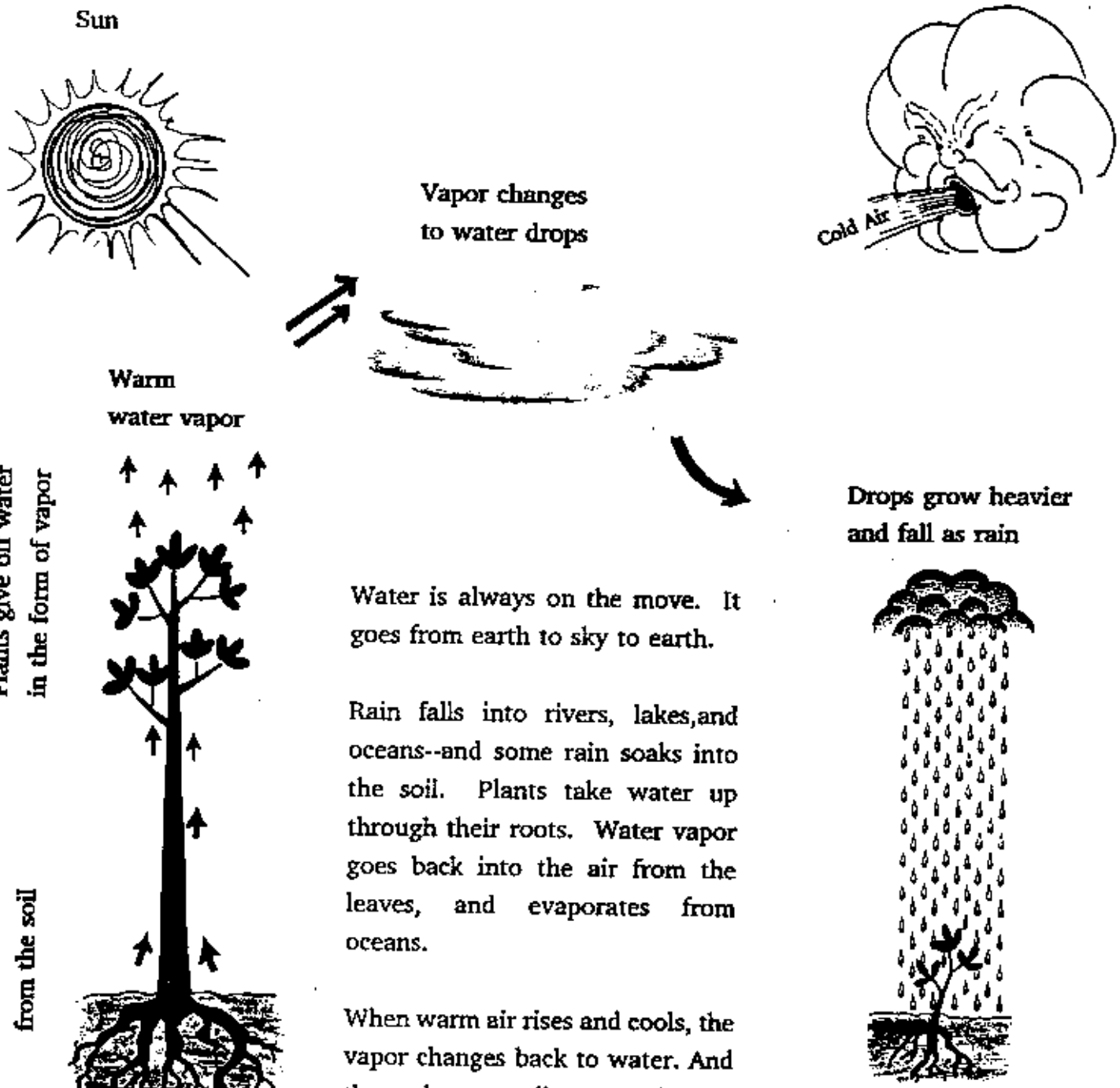


NATURE'S BALANCE

WATER CYCLE

Water, soil, and air are non-living things. Living plants and animals need water, food, soil, and air to live and grow. They use non-living things over and over again.

Soil and water play a big part in our lives. Soil is the starting point of the food chain in nature's pantry. Plants grow in the soil. That is where plants get water and minerals.



Water is always on the move. It goes from earth to sky to earth.

Rain falls into rivers, lakes,and oceans--and some rain soaks into the soil. Plants take water up through their roots. Water vapor goes back into the air from the leaves, and evaporates from oceans.

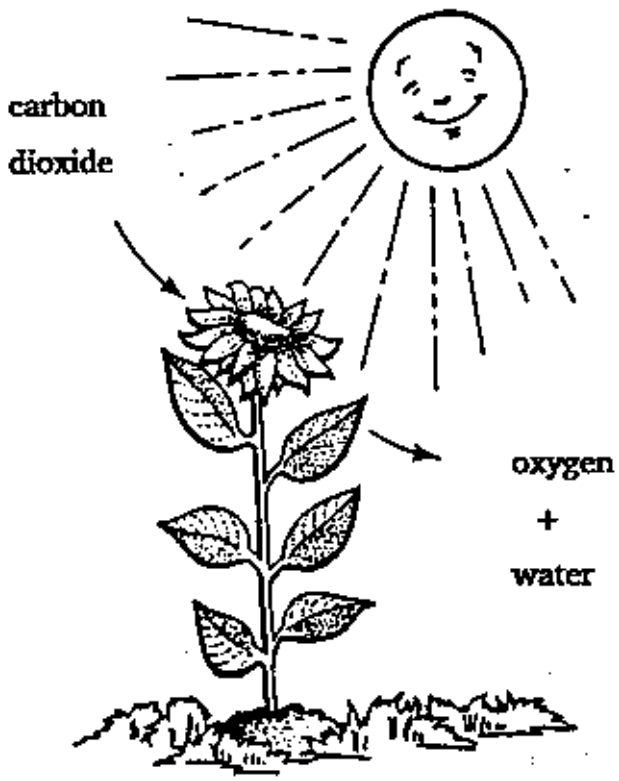
When warm air rises and cools, the vapor changes back to water. And the cycle starts all over again.

GREEN PLANTS CAPTURE ENERGY

Green Plants are **producers**, they capture the sun's energy. By adding carbon dioxide and water, the sun's energy is put in a chemical form that we call food. They use carbon dioxide, water, and sunlight to make their food. This is **photosynthesis**. As long as the sun shines, green plants continue to replenish the energy that living things need.

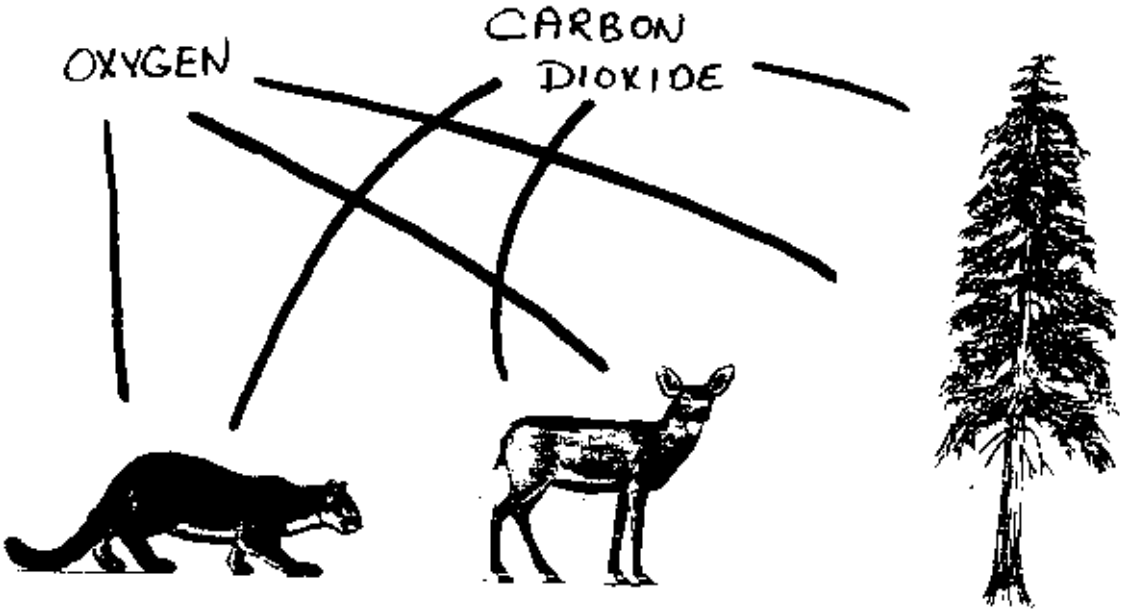
Animals are not producers. They cannot make their food from sunlight, water and air.

Plants produce the oxygen that we breathe. When they absorb carbon dioxide to make energy, they use the carbon and give off oxygen. Whew! What a breath of fresh air for us.



Suggest to your 4-H Leader that it is time to learn about "Nature's Air Conditioners". The activity is explained in the Leader's Manual.

But plants also need animals. We, and other animals, return carbon to the air when we breathe. This means that carbon is used over and over again by plants and animals. Draw arrows at the end of the lines to show that animals use oxygen and give off carbon dioxide when they breathe.



Now draw arrows to show how the plant uses carbon dioxide and gives off oxygen.

PLANT PROJECT

Let's learn how easy it is for plants to make energy.
You will need:

One package of lentil seeds
2 small flower pots or styrofoam cups.

Each pot should have holes in the bottom to allow water to drain. If they do not have holes, drill or cut some small drain holes. Put gravel and pebbles in the bottom of the pots.

1. Put soil in both pots.

2. Plant five lentil seeds in each pot about 1/4 inch deep.

3. Water both pots.

4. Put both pots on the floor or a table near a window where they can get light.

5. Look at both pots once a day until the first seed sprouts.

6. Record the day that each seed sprouts on Chart A.

7. After seeds have sprouted in the pots, pull all seedlings except one per pot. Put one pot in a dark place with no light, leave the other pot in the light, near the window.

8. Apply water if the soil gets dry.

9. Measure the height of the first plant each day for 12 days.
and record on Chart B.

Start this chart with day 0, the day you plant your seeds. Record the day that each seed sprouts.

CHART A	Number of seeds that sprout	
	Pot 1	Pot 2
Day	Light	Light
0 -	Plant the seeds	
1	_____	_____
2	_____	_____
3	_____	_____
4	_____	_____
5	_____	_____
6	_____	_____
7	_____	_____
8	_____	_____
9	_____	_____
10	_____	_____
11	_____	_____
12	_____	_____

Measure how tall the 1st plant is on each day for 12 days on Chart B.

CHART B		Height of Plant	
	Day	Seeds In Light	Seeds In Dark
	0	--The 1st seed sprouts	
	1	_____	_____
	2	_____	_____
	3	_____	_____
	4	_____	_____
	5	_____	_____
	6	_____	_____
	7	_____	_____
	8	_____	_____
	9	_____	_____
	10	_____	_____
	11	_____	_____
	12	_____	_____

Why was one group of lentil seeds unable to grow? (Hint...was it soil, water, air or light?)

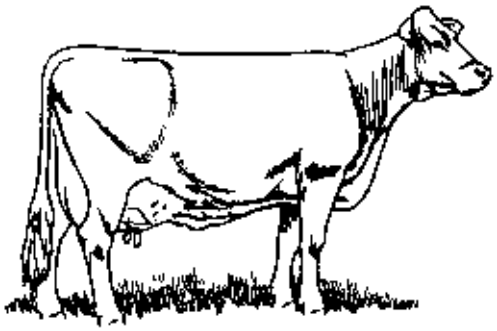
Explain._____

ANIMALS NEED PLANTS

Animals cannot make food. Therefore, they must get their food by eating something. They are called **consumers**. There are three kinds of consumers.

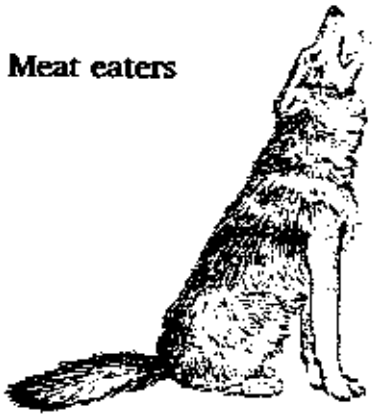
1. Some animals get their food by eating plants. They are **herbivores**. Rabbits, deer and cows are herbivores.

Plant Eaters



2. Some animals get their food by eating other animals. They are **carnivores**. Lions, wolves and foxes are carnivores.

Meat eaters



3. Other animals get their food by eating other animals. They are **omnivores**. Coyotes, man, and bears are omnivores.

We like to eat some fruits and vegetables. But how would you like to eat grass and trees? Yuk! Remember! Nearly one half of the earth's land is rangeland. We can not eat or use most range plants. The only way that humans can get food and clothing from rangeland is through animals.

Are you a **carnivore** or **herbivore**? _____

Explain your answer _____

_____

Are you a **producer**? _____ Explain your answer. _____

_____

_____

Are you a **consumer**? _____ Explain your answer. _____

_____

_____

c) Bacteria and fungi are **decomposers**. They have an important job. They are nature's recyclers and return the nutrients to the soil.

Are you a **decomposer**? _____ Explain your answer. _____

_____

Now is the time for you to ask your 4-H Leader about the activity "Eating Pine Trees". It is explained in the Leader's Manual.

Plants and animals are "linked" or connected in the environment. Plants capture energy from sunlight. Herbivores get energy by eating plants. Carnivores get energy by eating herbivores. This movement of food or energy from one link to another is called a **food chain.**

Each plant and animal is a "link" in this food chain.

The eagle got its food by eating the skunk.

The skunk got its food by eating the mouse.

The mouse got its food by eating plants.

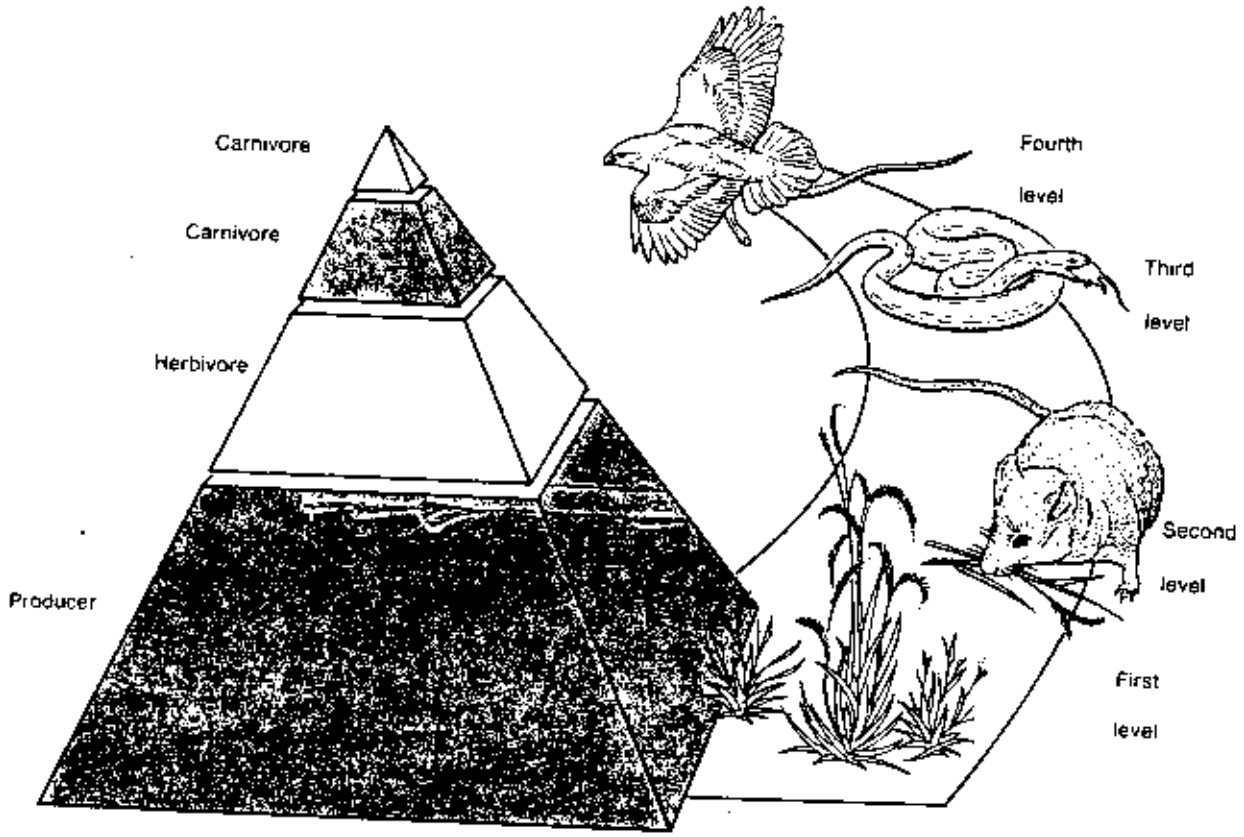
The plant captures energy from sunlight.

Most food chains are not as simple as this one. For example, the grass might get eaten by a deer which is then eaten by a mountain lion. When animals are in two or more food chains, the chains are called a **food web.**

ENERGY IS LOST IN FOOD CHAINS

It is often hard work for animals to find, catch, and eat plants and other animals. They use and waste energy. Much energy is lost when food moves from one link to the next link of a food chain. Because energy is lost at every link, most food chains have less than 5 links.

We have learned that plants capture the sun's energy and convert it to a useful form, food. Plants also use many nutrients from air, water and soil. These nutrients all go through a cycle and are used over and over. In contrast, energy is always lost from the food chain, and must always be replenished by plants. Because of energy, the number of living things in a food chain is shaped like a pyramid. The number of living things at the bottom is much greater than the number at the top.

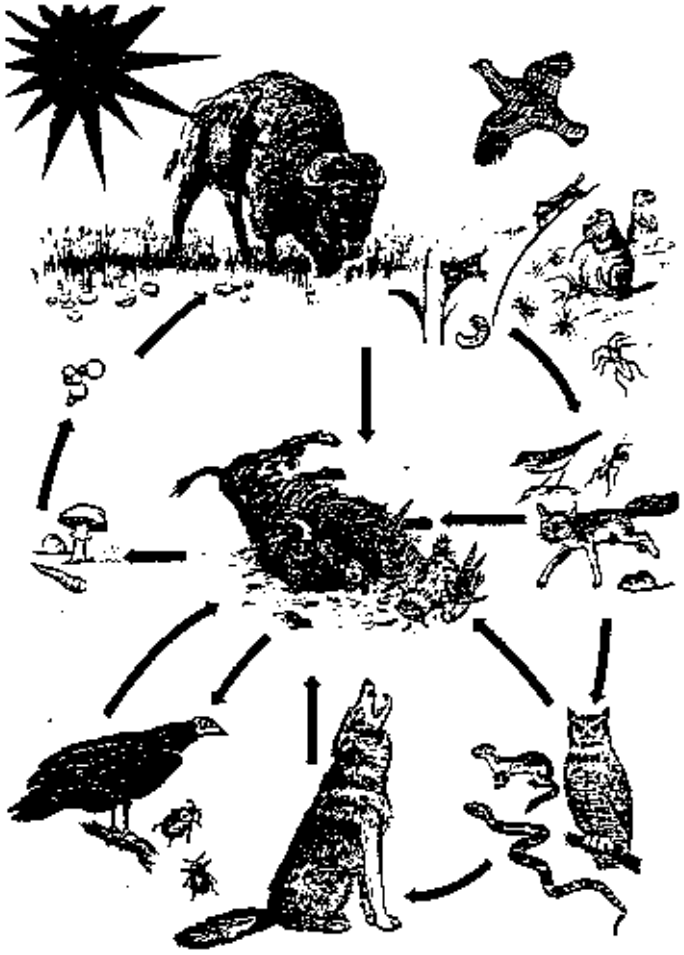


NUTRIENT CYCLES

Nitrogen, phosphorus, potassium, and other chemicals all cycle in the environment. Unlike energy, they are not lost from the earth. They are used over and over.

Many insects, animals and birds live by eating smaller ones. Still larger ones eat those smaller than themselves. In time, plants and animals die and fall to the ground. The sun shines on them. Wind and the rain beat on them. As the plants and animals rot and go to pieces, the nutrients are taken back into the soil. In turn, the soil feeds the plants.

Write **producers, consumers,** or **decomposers** on the lines to show why each living thing is important.

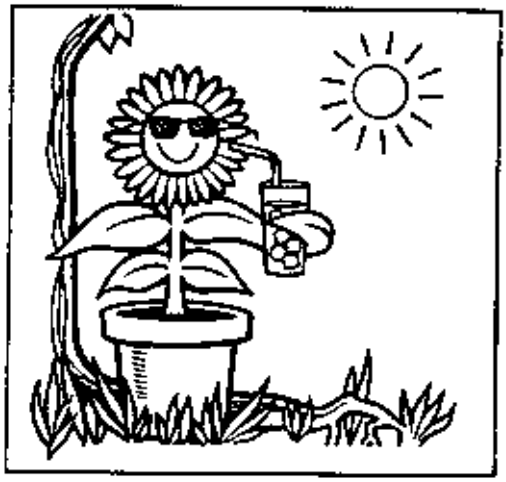


Living Things

Grass = _____
Live Buffalo = _____
Grasshopper = _____
Gopher = _____
Fox = _____
Snake = _____
Owl = _____
Wolf = _____
Vulture = _____
Mushroom = _____

Suggest to your 4-H Leader that it is time to learn about the "Web of Life" and "Sow Bugs 'n' Soil". The activities are explained in the Leader's Manual.

INTRODUCTION TO RANGE PLANTS



WHY WE STUDY PLANTS

Thousands of different kinds of plants grow on rangeland. Plants are living things. They live and grow. They are different from animals. Most plants make their own food. They are unable to move from place to place by themselves.

It is important to study plants. Without them, we could not live. The air we breathe, the food we eat, the clothes we wear, our houses, medicine, our coal and oil all come from plants. There are two main kinds of plants. Some produce seeds and some do not produce seeds.

NON-SEED PLANTS

Plants that do not produce seeds are non-seed plants. They are the oldest plants on earth. Algae, fungi, and ferns are non-seed plants. They begin life as tiny, wind-blown spores. Spores can only grow if they find food where they land.

Algae grew 500 million years ago. Algae grow in oceans and ponds--not on land.

Algae are usually green or bluish-green. Have you ever seen algae in a pond, lake or horse trough? _____ If yes, explain. _____

_____

Suggest to your 4-H Leader that it is time to learn about "With or Without". The activity is explained in the Leader's Manual.

Some plants are not green and cannot use the sun to make food. They are called **fungi.**

Fungi do not have roots, leaves, or flowers. They get their food from green plants, rotting wood, and dead leaves. The molds that grow on stale bread, or the yeast that is used to make bread, and mushrooms are fungi.

Take 2 pieces of bread. Toast one piece and place it on a sunny window sill. Sprinkle a couple of drops of water on the other piece. Place the damp bread in a loose plastic sack and let it sit in a dark place for a few days. Peek at the bread each day and describe what happens:

Day	Did Mold Grow? (answer yes or no)	
0 -	Bread in Sack	Toasted bread on window sill
1	_____	_____
2	_____	_____
3	_____	_____
4	_____	_____
5	_____	_____
6	_____	_____
7	_____	_____
8	_____	_____
9	_____	_____
10	_____	_____

Did mold grow on the wet piece of bread? _____ Did mold grow on the dry piece of toast? _____ Why do you think the mold grew on one piece but not on the other? _____

_____

Smell the mold! How did it smell? _____

_____

Go on an outdoor walk with your 4-H Leader or parent. Look for mushrooms and other fungi on trees and stumps. Tell about your hike. (What day did you go? Who went with you? Did you walk on range, forest, cropland or in a city? Did you find a mushroom?

_____

_____

_____

_____

_____

Draw a picture of a mushroom that you saw.

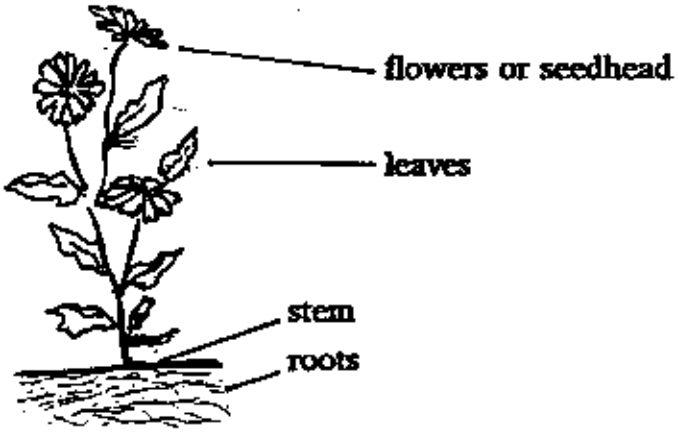
Was it part of a nutrient cycle? _____ Explain: _____

_____

_____

Ferns were on earth 300 million years ago. They then grew as big as trees. Although they are much smaller now, they still reproduce by spores. The spores are a fine, brown powder. They can usually be found in small brown dots on the back of the leaves.

It is easy to learn seed plants if we know plant anatomy. Most seed plants have 4 main parts. They have **flowers, leaves, stems,** and **roots.**

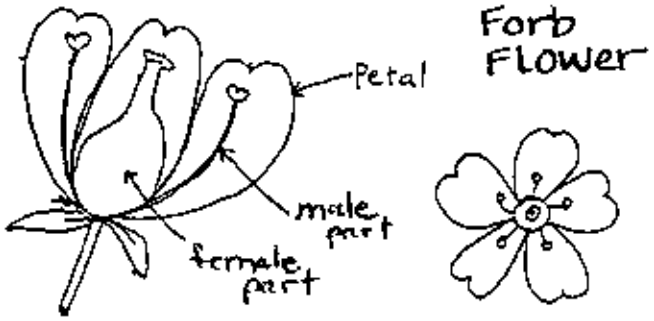


Flowers

Some flowers have bright colors. Other flowers are small and plain. Flowers grow into fruits. Fruits may hold one or many seeds.

The bright parts of flowers are petals. Most flowers also have male and female parts. Pollen from the male flowers must be put on the female parts before the seed will form. Bees, flies, ants, and other insects carry pollen on bright, or showy flowers. Wind carries the pollen on the non-showy or plain flowers. Pollen in the wind often causes hay fever.

Showy flowers



Petals are usually a bright color --flowers are usually big

Plain flower

Petals are usually green or brown--flowers are usually small

Examine a fern plant. Draw a picture of the fern. Does it have spores on the leaf? _____

Plants are part of the nutrient cycle. When they die, they rot and fall apart and return to the soil.

Find a pile of dead leaves. (Spring is a good time to look for them.) Pick up a handful of them and rub them together. Throw them into the air and watch the wind blow them.

How far did the wind blow them?

_____

PLANTS THAT PRODUCE SEEDS

There are many kinds of seed plants. Each kind of seed plant has seeds. Seeds grow into plants. Each plant is like the one from which the seed came.

Go for a walk around your home or in a park. See if you can find a showy flower, and a plain flower. Pick the flowers and tape or glue them below.

Showy flower

Plain flower

Explain whether the pollen in the flowers are carried by insects or wind.

_____

_____

Some seeds are large, others are small. Large seeds often drop from the plant and grow right where they fall.

Other seeds are moved from place to place in many different ways. People pick and move seeds such as wheat, corn, alfalfa. Squirrels and other animals sometimes hide seeds and then forget them. Some seeds have tiny hooks and hitch a ride on an animal's fur or on our clothes. Many seeds are blown by the wind. They are usually small, light and fluffy. Other seeds float far away on streams and rivers. Birds, livestock, wildlife, and people eat seeds. Some of these pass through the animal's stomach and grow into new plants.

Go for a walk along a creek, in a park, or along an old road. Look for seeds. Try to find at least one seed that looks like it is moved by the wind, one that is eaten by animals, and one that is a hitchhiker. Tape or glue your seeds below.

Probably Wind blown	Probably eaten By animals	Probably A hitchhiker

Explain what type of animal would eat the seed that you collected?

_____

List several seed plants that you eat.	List some non-seed plants that you eat.
_____	_____
_____	_____
_____	_____

Suggest to your Leader that now is the time to learn about "Seed Dispersal". The activity is explained in the Leader's Manual.

Do you like to eat non-seed or seed plants?

_____

What two garden vegetables help fight crime?

_____

(Beetman and Radish)

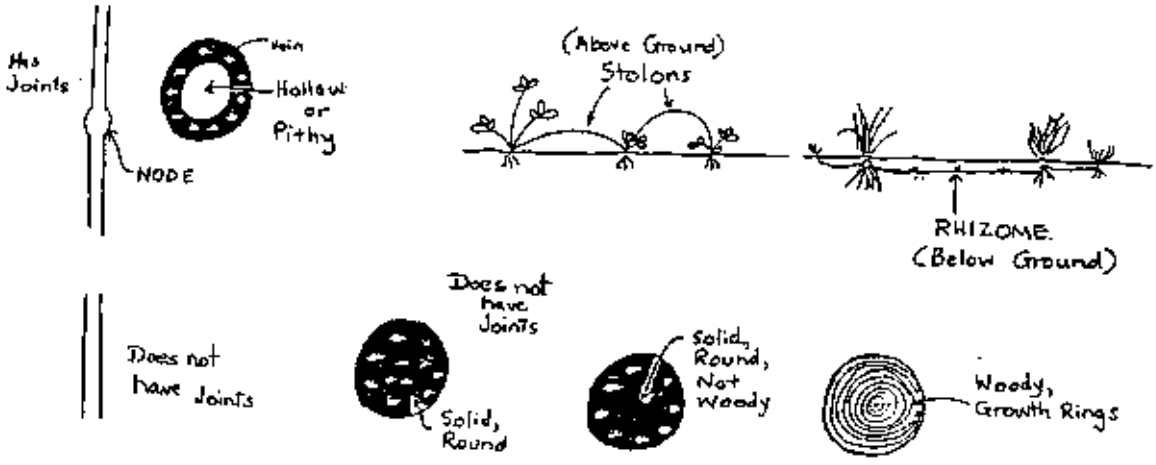
Stems

Seed plants have **stems**. The stem is the part of the plant that holds it upright. It also serves as a canal. Food made in the top part of the plant is often moved to the lower parts of the plant. Water and minerals taken from the soil move up the stem.

Some stems are round and hollow. Others are round and solid. Other stems are woody. **Annual** plants live one year. New plants have to grow from seeds each year. **Perennial** plants live more than 1 year.

Plants with woody stems usually live many years. They add one growth ring each year. By cutting these stems and counting the rings, we can tell how old they are.

A few stems grow sideways. Stems that grow sideways underground are rhizome. If stems grow sideways along the surface of the ground they are **stolons.**



Go for a walk along a creek, in a park, or along a road. Look at the plants. Try to find one stem that has nodes and is hollow. Find another stem that has nodes and is hollow. Find another stem that is solid, but not woody. Now find one with a woody stem. Tape or glue your stem below.

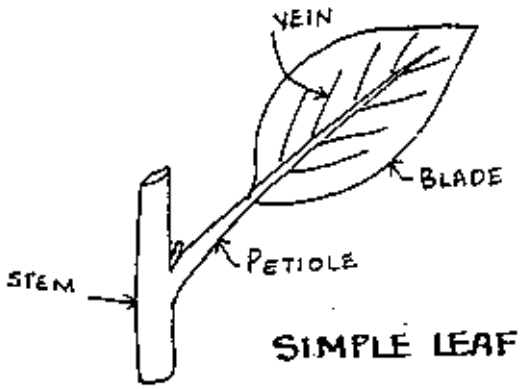
A stem with nodes and <u>is hollow</u>	A stem without nodes and is not <u>hollow or woody</u>	A woody <u>stem</u>

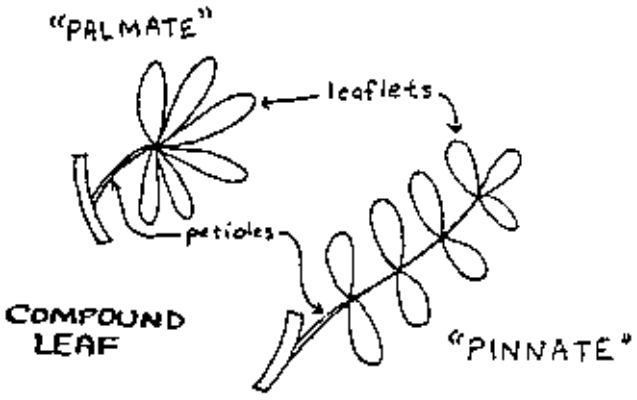
Did you try to count the growth rings on your woody stem? _____
How old was it? _____ (Hint: you may need a magnifying glass to count them).

Leaves

The main purpose of leaves is to make food from sunlight and carbon dioxide. Leaves can be used to identify plants.

Leaves are either simple or compound. A **simple** leaf has one blade for each stalk.





A **compound** leaf has several small leaves or leaflets on each stalk or **petiole**. Some leaflets are hooked to the stalk at one place---like the palm of your hand. They are **palmate**. **Pinnate** leaflets are connected to the stalk at different points.

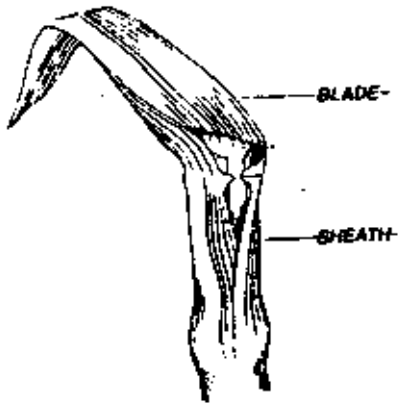
Go for a hike and look at several seed plants. Find a plant with simple leaves and one with compound leaves. Tape or glue your leaves here. Be sure to label the petiole and the blade.

Simple leaf

Compound leaf

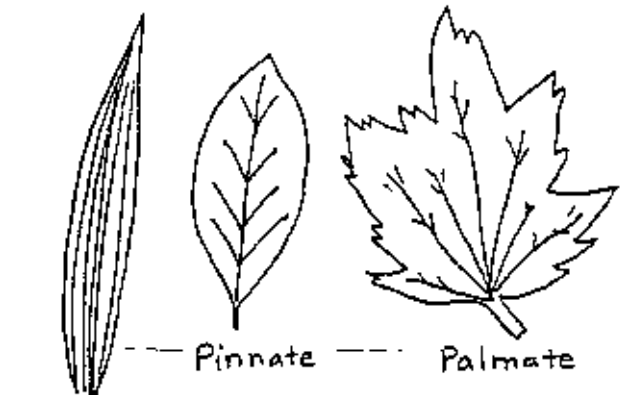
Some simple leaves are long and linear. They have a flattened part (blade) that is shaped like a strap, and a part (sheath) that wraps around the stem like a tube.

The simple, long-thin leaves usually have some ribs or **veins** that run side-by-side (parallel) from one end to the other. Veins are groups of long, thin cells. Plants use veins to move food and water.



LONG, LINEAR LEAF

Some simple, and all compound leaves, are net-veined. If the veins are attached to the main vein at many different points, they are **pinnately-veined.** In contrast, some veins are attached only at the base of the main vein. These are **palmately-veined** leaves.

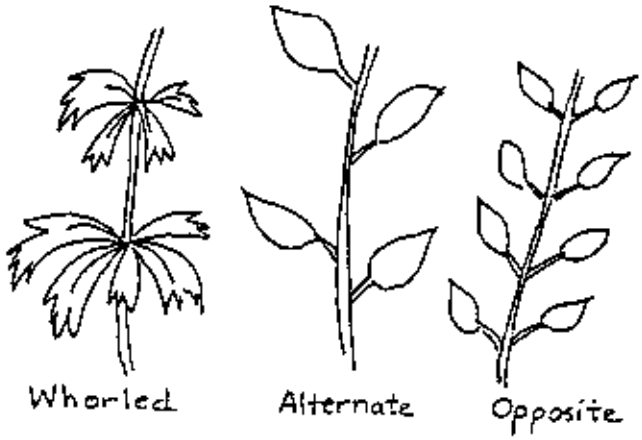


Leaf Veination

Go for a walk and collect one leaf that has parallel veins, and one that has pinnate veins, and one that has palmate veins. Tape or glue your leaves below.

Parallel Veins	Pinnate Veins	Palmate Veins

Leaves are also arranged differently on plants. If plants only have one leaf at each point of the stem, the leaf arrangement is **alternate**. If there are 2 leaves at each point of a stem, the leaf arrangement is **opposite**. A **whorled** arrangement has 3 or more leaves attached to the same point of a stem.



Leaf Arrangement

Go for a hike and collect 2 stems with leaves. One stem should have alternate leaves. The other should have opposite leaves. Glue or tape them below.

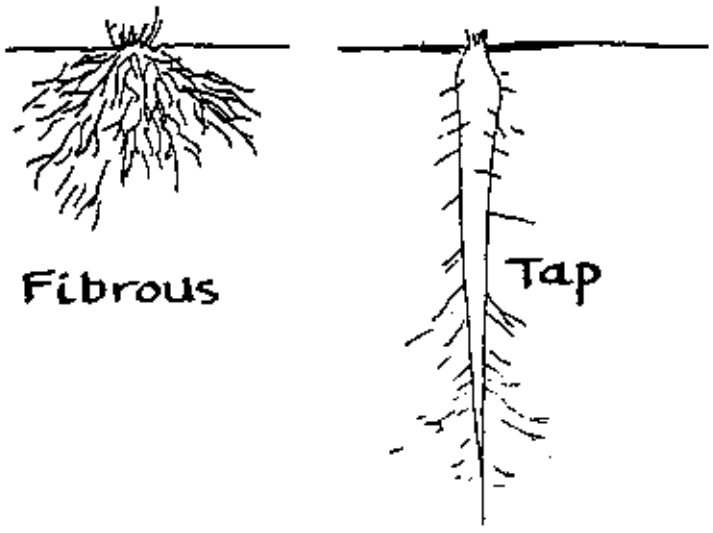
Alternate leaf arrangement

Opposite leaf arrangement

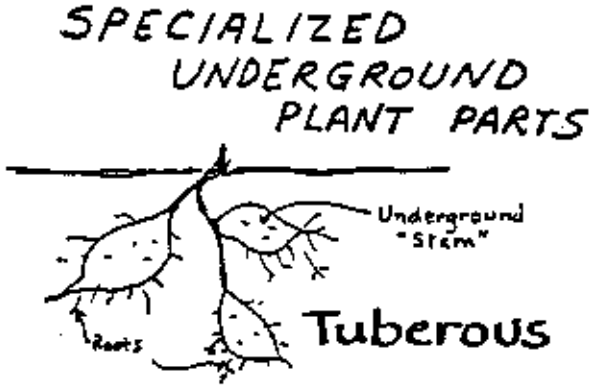
Roots

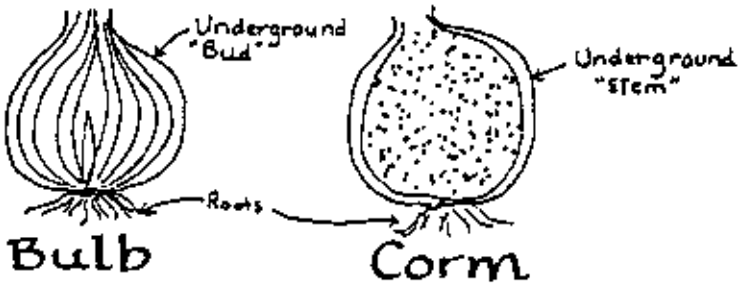
Roots are the below-ground part of plants. They absorb water and minerals from the soil. They also anchor the plant.

Just as many plants are different above ground, they are also different below ground. Most plants have either **fibrous** or **tap** roots. Tap roots are long and pointed--like a carrot. Fibrous roots have small, medium, and large-sized parts that go in all directions.



Other plants have **bulbs, tubers,** or **corms.** They are not real roots. They are special underground parts that are used for food storage.





Find a small shovel or other digging tool. Go for a walk and look for a plant that is growing along a road, in a pasture, or in a yard. (Be sure not to dig up roots in a park.) Glue or tape roots below.

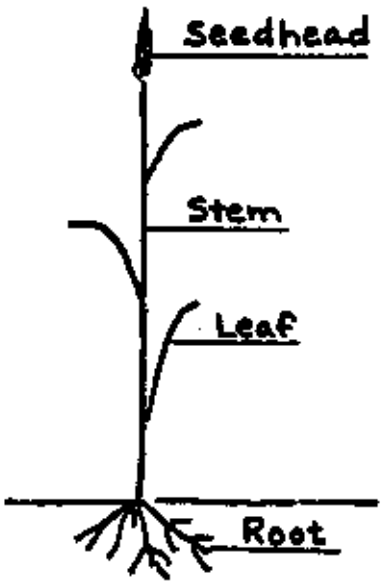
Fibrous Tap root

Would you rather eat a fibrous or a tap-root? _____

FOUR KINDS OF SEED PLANTS

Now that you know the plant parts, it will be easy to learn the four major kinds of plants. They are **grasses, forbs, shrubs,** and **trees.**

Grasses



A grass is a seed plant. Grasses have long, skinny leaves and plain flowers. Their stems are usually hollow, and have bumps or nodes. Grasses have fibrous roots.

Grasses are the most important kind of range plants. They protect the soil from erosion.

Collect a grass plant and tape or glue it below. Label the four main parts.

Was your grass growing on range, forest, farm or urban land? _____

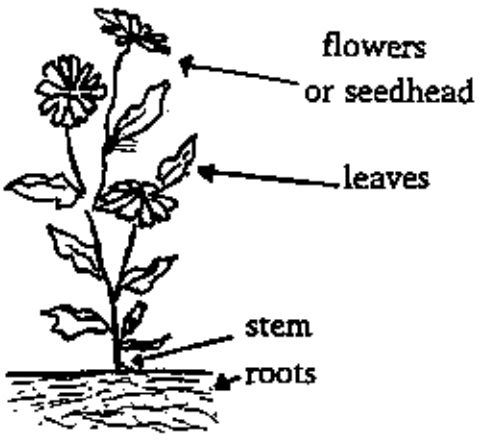
Was it growing alone, or with other plants? _____

Were there any animals eating it? _____

Do you think your grass was part of a food chain? _____

Draw the food chain.

Forbs



Forbs are often called flowers. But many plants have flowers. Therefore, remember that forbs are plants with showy flowers. They do not have woody stems. They have tap or fibrous roots. Leaves are usually net-veined.

Dig (or pull) a small forb and tape or glue it here. Label the four main parts.

Was your forb growing on range, forest, farm, or urban land? _____

Was it growing alone or with other plants? _____

Were there any animals eating it? _____

Do you think your forb was part of a food chain? _____

Shrubs

Shrubs have woody stems. They are usually less than 10 feet tall. Flowers are usually showy. Leaves have net-like veins. Shrubs often have large tap roots.

Go for a hike and dig up a small shrub. Glue or tape it below. Label the four main parts.

Was your shrub growing on range, forest, farm or urban land? _____

Were there any animals eating it? _____

Do you think your shrub was part of a food chain? _____

USES OF PLANTS

Plants are useful. We get all kinds of fruits, vegetables, and grains from plants. Lumber, paper, and some clothing are made from plants. The animals from which we get meat, milk, eggs, and other foods are plant eaters. What kind of a plant would you need if you:

a. wanted to build a home. _____

b. were a bee and wanted to make honey. _____

c. were a cow and were hungry. _____

d. were a squirrel and wanted to climb. _____

e. were a woodpecker and needed a home. _____

f. wanted to build a boat? _____

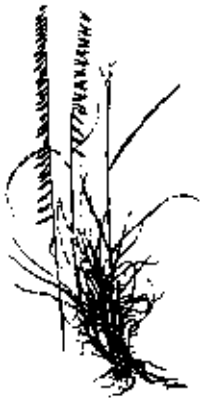
g. wanted to build a fire? _____

h. wanted to sit in the shade. _____

i. wanted to feed livestock? _____

j. wanted to give your Mom something on her birthday? _____

grass



forb

tree

Trees

Trees have a woody stem, and are usually more than 10 feet tall. Some trees lose their leaves every year. They are **deciduous**. All deciduous trees have flowers and net-leaf veins.

Some trees are evergreen. They do not lose their leaves every year. The **conifers**, which produce cones, do not have flowers.

Go for a hike and collect a leaf from two different trees. Glue or tape them below. Be sure to label them as deciduous or evergreen.

Did you collect your leaves on range, forest, crop, or urban land? _____

What animals do you think were using your tree? _____

_____ Do you think your tree was part of a food chain?

Now is a good time to ask your 4-H Leader about the candle-making activity that uses plants. The activity is explained in the Leader's Manual.

Build a Plant

Now is the time to show how much you know about plants. You will build your own plant.

a) You will need the following:

scissors	crayon, marking pencils
tape or paste	blank sheet of paper

b) Cut out your plant. Be sure that it has all of the major parts.

c) Glue the parts to this page.

d) Color your plant.

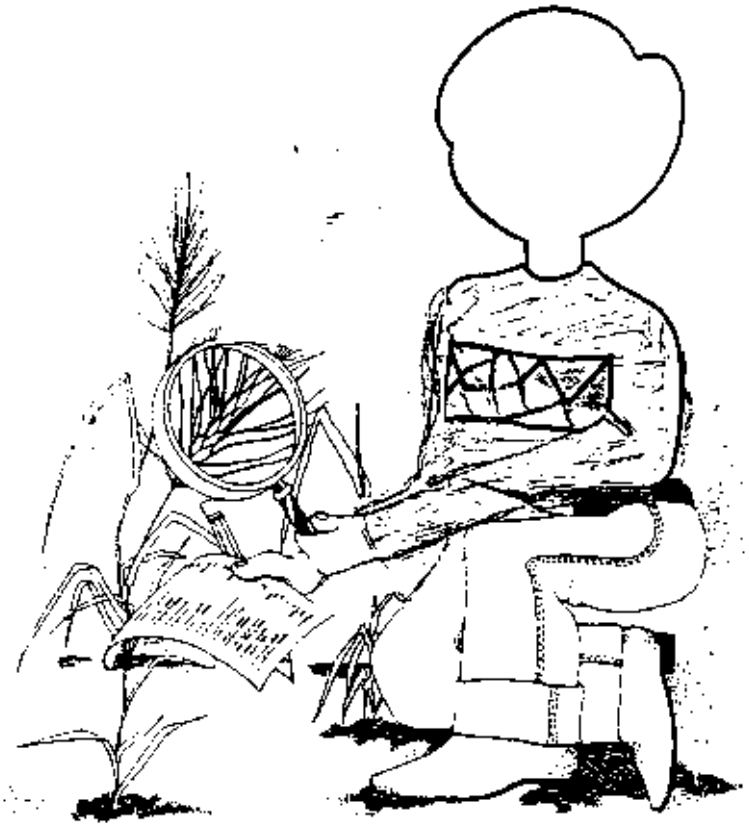
e) Tell about your plant. (Is it a grass, tree, forb, or shrub? How long does it live? Do you know its name? What is it good for?)

Glue your plant here!

YOUR FEELINGS ABOUT THE RANGE

Please complete the following:

Pick out the face that shows how you feel about completing this range project. Draw the face on the young person studying plants.



Now tell a story about you and your range project. _____