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ABSTRACT

This instructional packet is one of 14 school environmental education programs developed for use in the classroom and at the Dahlem Environmental Education Center (DEEC) of the Jackson Community College (Michigan). Provided in the packet are pre-trip activities, field trip activities, and post-trip activities which focus on the characteristics of seeds. Strategies for using these activities with second grade students are also provided. The pre-trip activities focus on the nature of seeds, student's dependence on seeds and plants, the requirements for seed growth, and methods of seed dispersal. Five activity sheets and a letter to parents explaining the purpose of the program are included. The post-trip activities provide students with opportunities to investigate seed germination and plant growth. A list of formal and non-formal objectives for both indoor and outdoor field trip activities at the DEEC are presented in a separate field trip guide. Most of the activities are interdisciplinary and can enhance student skills in mathematics, reading, and spelling as well as science. In addition, the activities are designed to sharpen such skills as observing, classifying, measuring, and interpreting. (JN)

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"Nature's Hitchhikers" is one of fourteen school environmental education programs developed by the Dahlem Environmental Education Center of the Jackson Community College. Assistance for the project was provided by the Institute of Museum Services Special Projects Grant #G008103172, of the U.S. Department of Education.

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Nature's Hitchhikers

A Fall Activity Packet for Second Grade

The answer is blowin' in the wind. What was the question? How do seeds get around, of course! This is just one of the topics in the program, "Nature's Hitchhikers."

Your study of seeds will begin in the classroom with an introduction to some of nature's more interesting seeds: seeds smaller than a pinhead and larger than a basketball. Pondering the many ways people depend on seeds comes next, then a field trip to the Dahlem Environmental Education Center to learn about seed dispersal. Back in the classroom, students' interest in plants will grow as they measure and observe plants from the seed stage through maturity.

The concepts in "Nature's Hitchhikers" are based on a survey of second grade science curriculums across the country. Most of the activities are interdisciplinary and can enhance student skills in mathematics, reading, and spelling as well as science.

"Nature's Hitchhikers" is designed to teach your students about the interdependence among plants, wild animals, and people. In this program, your students will be shown environmental concepts that apply to their own world as well as the world of nature. The activities are designed to sharpen skills such as observing, classifying, measuring, and interpreting.

So get ready for a study that will take you into the woods, the classroom, the closet, and the kitchen -- anywhere you can find seeds and their products!

Contents

Goals and Objectives

Program Goal

Second graders will become more aware of seeds and their characteristics.

Program Objectives

Students will:

-identify seeds and plants by pointing them out.

-appreciate ways in which people depend on plants by listing them.

-identify the parts of a seed by labelling them.

-classify seeds by matching them to their dispersal method.

-understand the requirements for germination by sprouting seeds.

-demonstrate an understanding of how plants respond to environmental conditions by predicting growth patterns.

-discriminate among trends in growth by measuring plants and making and interpreting graphs.

-understand the stages of seed germination and plant growth by sequencing them.

-demonstrate problem-solving skills by constructing a workable model of seed adaptations.

A Note to Teachers

The activities in this packet require seeds and plants in various stages of development. In order for the exercises to progress smoothly, it will be necessary for you to stockpile sprouts and ready-to-germinate seeds. These hints will help you get things growing!

Seeds vary widely in sprouting times. Radishes and corn sprout easily. Beans are almost fail-safe. Soak seeds overnight to soften the seed coats and speed up germination. These types of seeds should germinate in two or three days. Handle seeds as little as possible to prevent fungus infection.

Seeds can be sprouted easily in a germination tray. Cover the bottom of a shallow dish with moist paper toweling. Place the seeds on the towel, and cover the tray with cellophane to prevent drying. Be sure to keep the towel moist.

When planting seeds, potting soil from a garden shop is best. It is porous, free from contamination, nutritious -- and pretty cheap.

Most seeds can be planted one half to one inch deep. Lettuce, grass, and other small seeds can be sprinkled on the surface of moist soil. Dusting a little soil over them and watering them with a spray bottle prevents dislodging the seeds before they sprout.

Clay pots are best because of their porosity. Plastic and glazed porcelain pots are less desirable because they do not allow for the flow of oxygen and excess moisture.

Pre-Trip Activities

Plants are exciting, and your students need to realize this right from the start. This packet discusses three areas which will increase your students' awareness of plants: seeds, seed dispersal, and plant growth.

The following five activities provide important background information about seeds for your students. The activities should help students recognize their dependence on seeds and plants, the requirements for seed growth, and methods of seed dispersal.

1. A Positive Attitude Toward Plants

The world of plants is full of surprises! Student Handout 1 will introduce your students to some fascinating trivia about plants. A discussion of the stories may be all it takes to stir up your group of aspiring botanists!

Jungle Trees -- Trees in the jungle are huge! Often they are over 100 feet tall with canopies measuring 150 feet across. That's half a football field! On some trees, leaves are over three feet long! Palm leaves or fronds are even longer, sometimes measuring over twenty feet in length. Seed pods and fruits from many jungle trees are also larger than North American varieties.

Biggest Seeds -- The largest seed known is the giant coconut, Coco de Mer. It is the seed of a rare palm tree that grows on islands in the Indian Ocean. In ancient times, goblets made from the seeds were thought to have magical powers to neutralize any poison in beverages drunk from them. Because poisoning monarchs was a common practice at the time, kings paid high prices for the seeds. One king reportedly traded a whole merchant ship of goods for a single Coco de Mer seed!

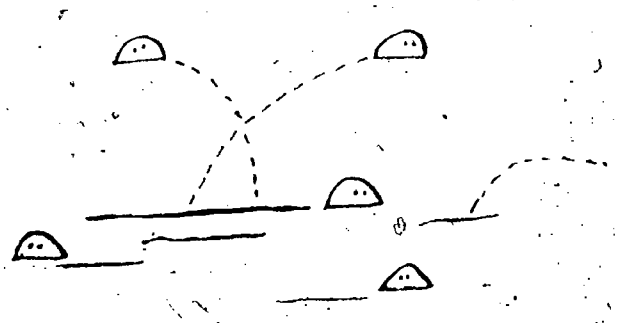
Tiny Seeds -- Some of the biggest plants have the smallest seeds. The Giant Redwood trees in California are an example. Over a hundred seeds from these giants would fit in the palm of your hand.

Folding plants -- Some varieties of the mimosa, or sensitive plant, fold up when you touch or even breathe on them! Scientists aren't sure why. They think that changes in water pressure or movement may cause the leaves to fold. Mimosa plants and seeds are available commercially in this country, but grow wild in the tropics.

Twelve Inches a Day -- Bamboo plants are members of the grass family. In tropical areas, they grow rapidly - often twelve inches a day! The abundant moisture and light in the tropics make lush vegetation possible.

Buried in Ice -- Scientists aren't sure how long seeds can remain dormant and still be alive. They were amazed when seeds found in a Yukon lemming burrow sprouted within 48 hours of planting. The seeds had been frozen for about 10,000 years!

Jumping Beans -- Jumping beans are the seeds from arrow plants that grow in Mexico. Small moths lay their eggs inside the beans. An egg hatches into a caterpillar that eats the inside of the seed. The caterpillar spins threads and lines the inside of the seed with silk. In hot sun, the seed jumps and hops as the caterpillar grabs the silk lining with its legs and flips its body, trying to move its seed home to a shady location. After about six months, the caterpillar pupates and develops into a moth, which breaks through the wall of the seed and escapes.



2. Linking Plants and Animals

Students may not realize that plants have many of the same characteristics as animals. You may want to write a list of things animals do to survive on the board:

eat breathe grow move reproduce

Can plants do all these things? Most second graders don't realize that some plants can move. The sensitive mimosa has already been mentioned. Some flowers "rubberneck" or rotate throughout the day so that they face the sun. Leaves and flowers on many plants open and close in response to light. Traps on carnivorous plants shut when an insect enters. More commonly, seeds move -- a lot! They have special structures that

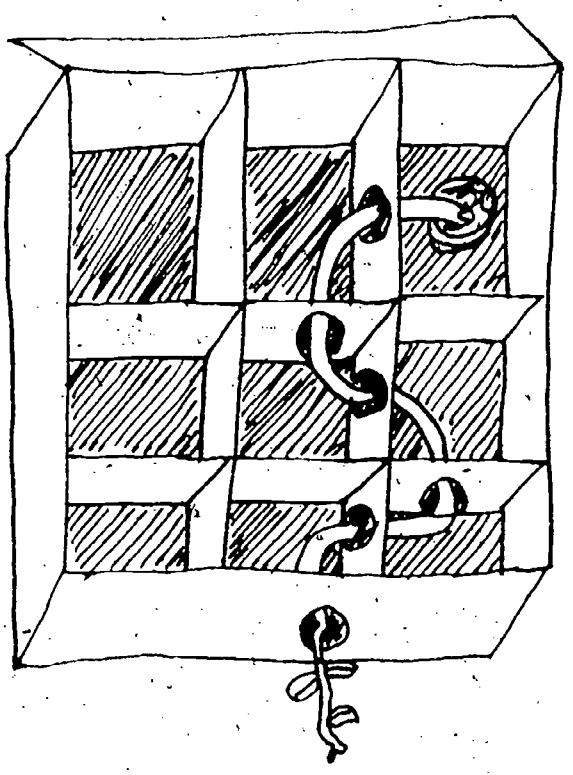
enable them to travel great distances in wind, water, or inside animals!

Smart Plants

Do plants do unexpected things? You bet! Introduce students to how "smart" beans are by showing them how plants grow through a maze when light is the reward.

A divided carton with a fitted lid obtained from a grocery or liquor store will serve as a maze. Cut a two inch hole in one side of the carton. Then cut two inch holes in the dividers to make the maze.

Plant three or four bean seeds in a small container and place it in the corner of the maze far away from the hole. Close the lid on the box and tape it if necessary so no light will enter through the lid. Open the box every few days to water the plants and to observe the plant growth. Over the course of two weeks, the "smart" beans will work their way through the maze toward the light.*



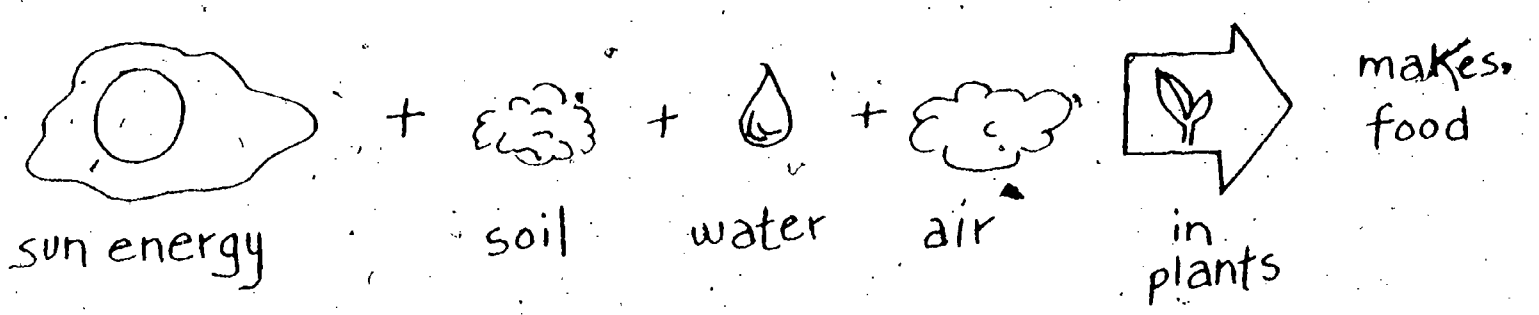
"Smart Bean"

* *adapted from The Science Book by Sara Stein and printed with permission from Workman Publishing.*

So what is the big difference between plants and animals? Plants make their own food from non-living substances. The green chemical in plants called

chlorophyll uses sun energy to make food from air, water, and raw materials in the soil. As long as these four life substances are available, plants can live almost anywhere.

Animals, however, depend on plants and other animals as food sources. They need the energy that is first stored in plants. Without plants, there wouldn't be any food for animals.



Dietician for a Day

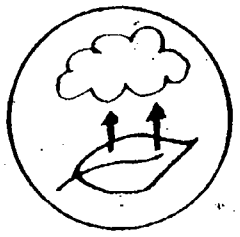
Students will realize their total dependence on plants for food when they try to make up a menu, complete with table settings, without plants! The only requirement is that the meal cannot include plants or plant products. Divide the class into groups of three students. On a sheet of paper representing a placemat, have each group design and draw the proposed meal.

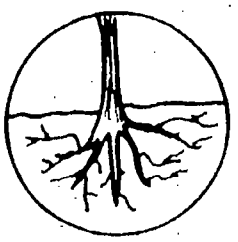
Generally students will suggest meat, cheese, milk, or dairy products. Remind them that the cow eats grass to make the milk for dairy products. All foods can be traced back to plants, and to the sun -- even vitamin tablets! Most vitamins useful to the human body are organic in origin. Point out that even the silverware and dishes that food is served on can be traced back to plants and the sun. Energy for extracting and processing the raw materials of silver and clay came from coal, and coal is made from plants.

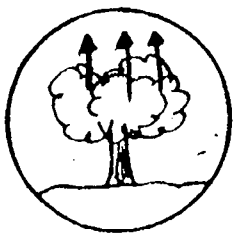
It shouldn't take students long to discover that they cannot make a meal without plants. Can they make a meal without animals? Try this to reemphasize the dependence of all living things on plants -- and on the sun.

3. Plants as People Pleasers

The last exercise may have started students thinking about the ways people depend on plants other than for food. With your students, compile a list like the one below of ways in which people depend on plants.

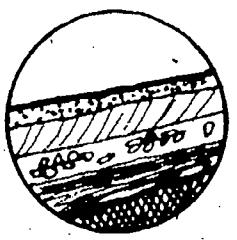


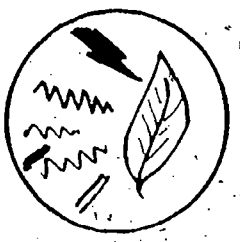


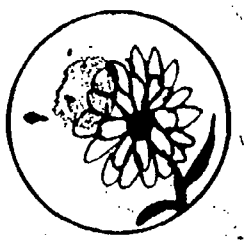


Plants:

- make oxygen, which we breathe.
- hold soil in place, so we can raise crops.
- cool the earth by releasing water vapor.
- filter solid particles out of the air.
- provide a source of fuel such as wood, coal, oil and gasohol.
- act as buffers to reduce noise.
- are just plain beautiful.







Plant-Go

Students will realize the wide range of ways in which they use plants every day by playing Plant-Go. The game, similar to bingo, sharpens reading and spelling skills.

Prior to introducing the game to your students, compose a list of clues for the words on the word list (Student Handout 3). Be sure to include items from both the natural and built environments. Clues should remind students that they use plants and their products at school, home, and in the natural world.

Here are some examples of clues that you might want to use:

- a plant that provides clothes for us (cotton, flax)
- a grain we eat (rice, wheat, corn, oats, rye)
- seeds found in candy (chocolate, coconut, peanut, walnut)
- a plant product used to make a hot drink (tea, coffee, chocolate)
- a grain made into a breakfast cereal (corn, oats, rice, wheat)
- a plant product used in building houses (lumber, bamboo)
- food sweetener made from plant roots (sugar)
- a seed used to make sauce for hot dogs (mustard)
- made from plant "sap" (rubber, maple syrup, resins)
- made from crushed flower parts (perfume)

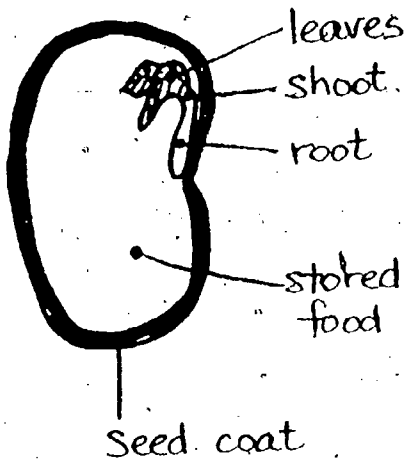
Next, duplicate and distribute a Plant-Go Sheet (Student Handout 2) and a Plant-Go Word List (Student Handout 3) for each student. Read Handout 3 aloud with students to make sure they are familiar with all the words. Point out that it is a partial listing of the ways people use seeds and plants. Next ask students to make their own "Bingo" cards by filling each space with one word on the Plant-Go Game Sheet. Words may be used more than once or omitted.

Explain the rules of the game. When you read a clue, students should search their Plant-Go cards for the word or words being described and place a marker on that space. Why not use seeds as markers? The first person to complete a horizontal, vertical, or diagonal column and to yell "Plant-Go!" is the winner.

Have students save their cards so that they can play the game again during the study of seeds.

4. Where Plants Come From

If plants are so useful to people, the more plants that are around, the better! Where do new plants come from? Many come from seeds. Others grow from spores or pieces of plant roots, stems, or leaves.



Some people refer to a seed as a baby plant in a box with its lunch! The inside of a seed is mostly food, stored in the form of starch. A tiny plant, complete with embryonic leaves, shoot, and root, is also present. During sprouting, the young plant depends on the food stored here until it develops leaves and can make its own food. The seed is covered with a protective coat that resists heat, drying, freezing, burying, and animal digestive juices. Seeds come in all sizes and shapes, but they all have these same basic parts.

Most types of seeds are protected from mechanical damage and environmental conditions in fruits. Ask your students to name fruits they know. Apples, oranges, raspberries, and avocados are fruits that contain seeds. Green peppers and cucumbers are fruits, too. What about peas and corn? They are seeds! Then what is a vegetable? Botanically speaking, a vegetable is any part of a plant which we eat that does not contain seeds. Turnips, potatoes, lettuce -- they're all vegetables.

Student Handout 4 will help students recognize the parts of a seed -- knowledge that will be applied in the post trip activities. It also requires students to hike through their kitchens and to list six seeds (dry mustard, dill, celery, etc.) that they find.

5. Getting Things Moving

True, some plants come from seeds, but a plant doesn't just drop from its parent plant, sink down roots, and become a healthy adult!

As previously mentioned, plants need light, water, air, and soil nutrients to grow. If all the seeds deposited near the parent plant sprouted and grew, there would not be enough of these essential elements for all the plants. Competition would be stiff.

Introduce the concept of seed dispersal to your students by using Student Handout 5. Duplicate and distribute a copy of the sheet to each student. Lead

students in observing the picture closely by asking them to:

- name things they see in the picture (bird, tree with cherries, sun and clouds, stream).
- discuss what would happen if all the cherries fell to the ground and grew into trees right by the parent tree (competition for space, nutrients and water in the soil, sunlight).
- identify things in the picture that could carry the cherries to new areas in which to grow (bird -- eats cherry and seed, stream, wind, tree itself -- some plants sometimes "fling" seeds far enough away to grow successfully. This does not happen with cherries, though).

Reiterate the answers by telling students about seed dispersal in the saguaro (sa-gwa-ro) cactus.

A mature saguaro produces at least 100 fruits per year, each with 2,000 seeds. Over 100 years, that comes to 20 million seeds! Why isn't the saguaro cactus choked out by its offspring? Some seeds fall on rocky ground and do not grow. Others sprout, but are destroyed by cutworm larvae and other enemies. Most of the seeds, however, are carried away by ants. In fact, ants can transport about 1,000 seeds per hour! Although the ants eat most of the seeds they carry away, some of the seeds are dropped onto ground where environmental conditions -- and the lack of competition from "mom and dad" -- allow the seeds to grow.

The movement of seeds from the parent plant to a suitable growth area is called dispersal. Ants are agents of dispersal for the saguaro. The wind and water are agents of dispersal for other plants. Some seeds hitchhike by clinging to animal fur or human clothes. Other plants disperse their seeds mechanically by literally flinging them away.

Introduce the term and concept of seed dispersal to your students before the field trip. That way, they will be ready to jump right into their fieldwork exploring seed adaptations and dispersal.

Vocabulary

The following words may be new to you or your students. An understanding of them will help your students get the most out of their study of seeds.

ADAPTATION - any special feature of an organism that improves its chances for surviving and reproducing

DISPERSAL - the distribution or scattering of organisms, such as seeds

DORMANCY - a state of rest or inactivity

EMBRYO - the early developmental stage of an organism produced from a fertilized egg

FRUIT - a mature and enlarged ovary of flowering plants that protects seeds from mechanical damage and unfavorable conditions, (e.g., watermelon, tomato, pea pod, orange, coconut, grains)

GERMINATE - to begin to grow or develop

HORMONE - chemical substance produced in one part of a plant or animal that has an effect on another part some distance from the production site

NUTRIENT - a substance critical to life, (e.g., minerals and vitamins)

SEED - a fertilized, matured ovule of a flowering plant containing a food supply and embryonic plant, usually dispersed inside a fruit

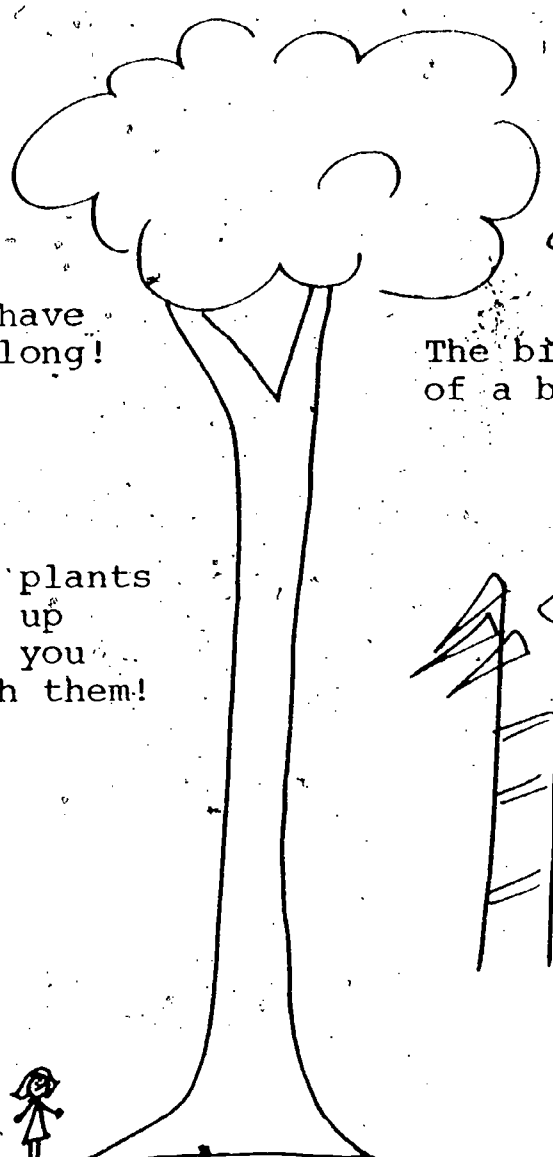
VEGETABLE - any part of a plant which we eat that does not contain seeds

Name _____

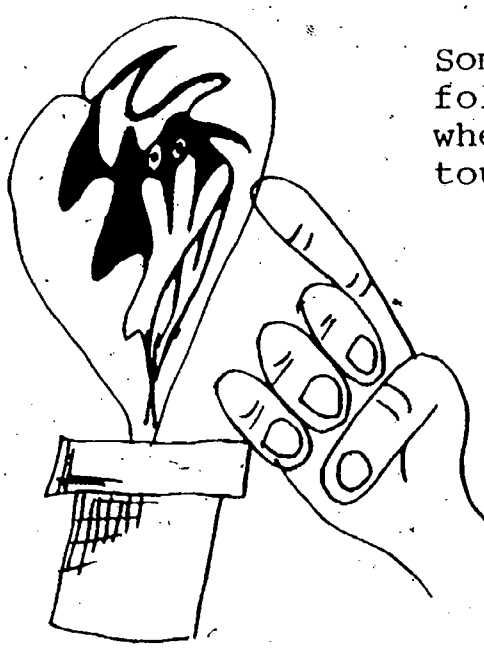
Plant Tales

Student Handout 1

Some jungle trees have leaves three feet long!

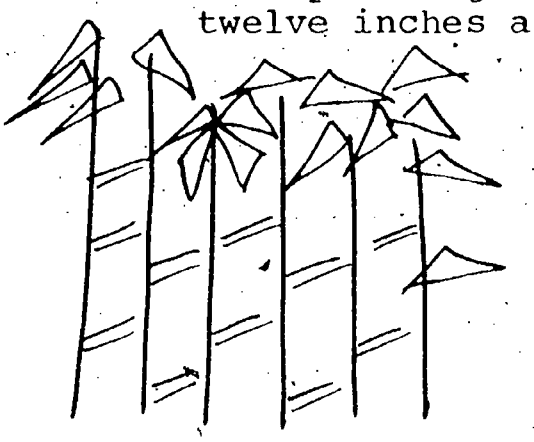


The biggest seed is the size of a basketball!

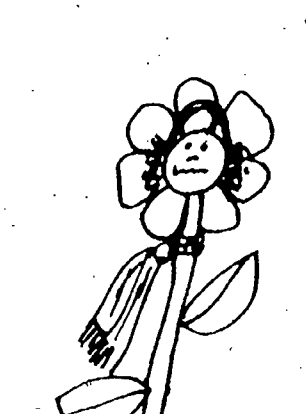


Some plants fold up when you touch them!

Some plants grow twelve inches a day!



Giant Redwood trees have tiny seeds. A hundred seeds would easily fit in your hand!



Seeds that were buried in ice for 10,000 years grew when they were planted!

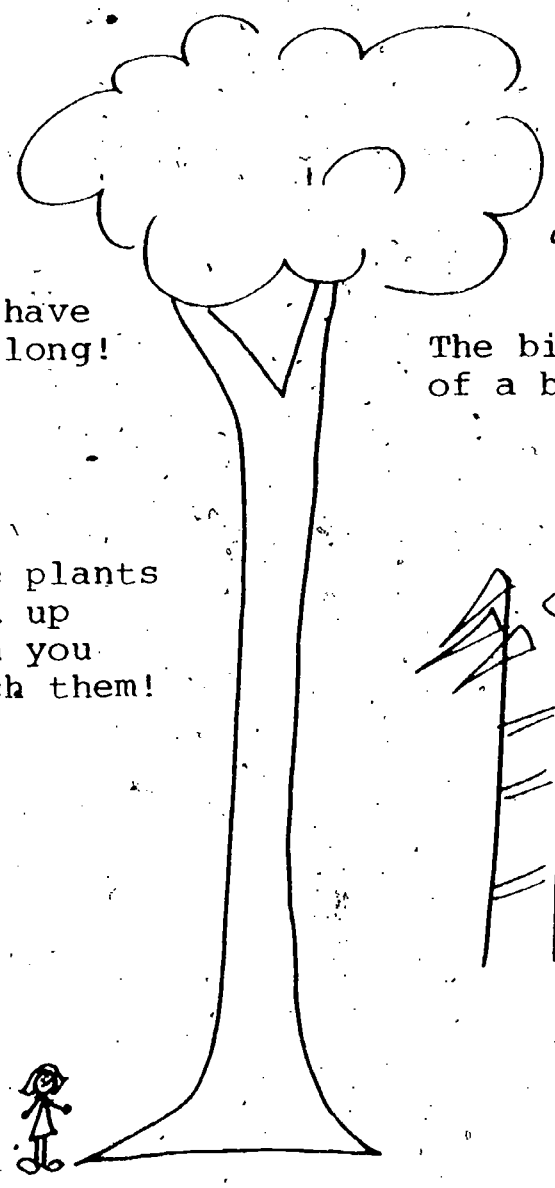
Jumping beans hop around when heated!

Name_____

Plant Tales

Student Handout 1

Some jungle trees have leaves three feet long!



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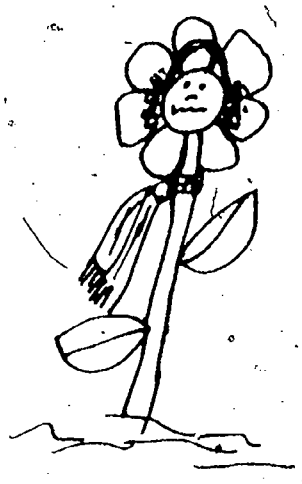

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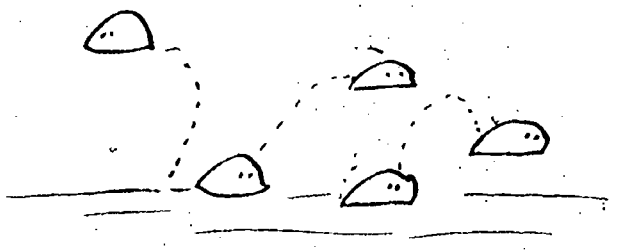


Jumping beans hop around when heated!

Name _____

Student Handout 2
Plant-Go

	P	L	A	N	T	G	O
P							
L							
A							
N				FREE SPACE			
T							
G							
O							

Name _____

PLANT-GO Word List

Student Handout 3

This is a list of some of the things people get from plants.

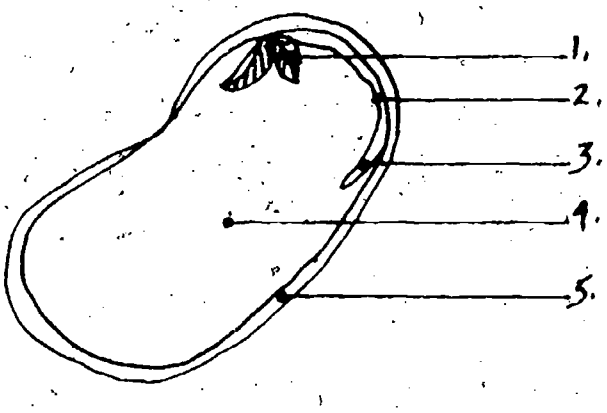
perfume	alcohol	coconut
dye	lumber	gum
rubber	charcoal	cotton
cork	paper	flax
drugs	tea	corn
rye	rice	walnuts
wheat	fruits	peanuts
tobacco	coffee	oats
resins	olive oil	beans
cashew nuts	peas	sesame seeds
mustard	chocolate	soybeans
coal	dill	poppy seeds
maple syrup	gasohol	sugar
bamboo	cinnamon	flour
catsup	pepper	cider
	root beer	

Name _____

Seeds

Student Handout 4

Part 1: Use the words at the right to label the parts of the seed below.



____ stored food

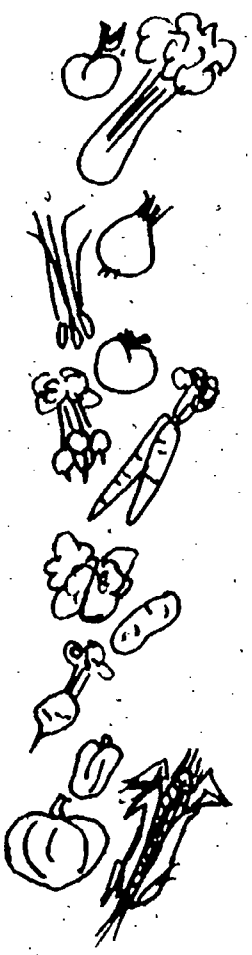
____ shoot

____ root

____ leaves

____ seed coat

Part 2: Take a hike in your kitchen! Look for seeds and things made out of seeds. List six of each below.



Seeds in my kitchen
Example: olives

1. _____
2. _____
3. _____
4. _____
5. _____
6. _____

Things made out of seeds in my kitchen.
Example: corn meal

1. _____
2. _____
3. _____
4. _____
5. _____
6. _____

Dear Parent,

Do you know why seeds have "whiskers" and how your dog helps plants? Your son/daughter will find the answers to these and other questions on our class field trip to the Dahlem Environmental Education Center. The trip is part of a program about seeds and plants called "Nature's Hitchhikers."

Please make sure your son/daughter is properly dressed for the field trip. Sturdy shoes and layered clothing, depending on the weather, are recommended. In the event of rain, raincoats and water repellent footwear are good.

You are encouraged to share the benefits of the field trip and program with your child by:

- inquiring about what the child saw and did on the trip.
- pointing out seeds and their products around the house.
- planting seeds to observe their growth.
- leading a field trip through your kitchen to find seeds and their products.
- taking a field trip in your own backyard to find seeds.
- visiting the Dahlem Environmental Education Center so your child can show you around.

Sincerely,

Second Grade Teacher

Field Trip

By now your students know why seeds and plants are so important. They also realize that many plants reproduce with seeds.

The next step is your field trip to the Dahlem Environmental Education Center to see seeds in action. Your experience will begin indoors with a review of seeds. Your students will be encouraged to role play the struggles and changes of an embryonic plant. Students will then be introduced to seed dispersal and have the opportunity to match seed structures to hitchhiking styles.

A hike through various natural communities at the Center will enable your students to see the "before" and "after" stages of a plant: the seed and the plant it could become. All the while, students will be observing seed adaptations for their post-trip activities.

At the end of the trip, you will be given a bag of assorted seeds to take back to your classroom. We're hoping you'll also carry back a new appreciation for those marvelous structures, seeds, and an enthusiasm that will motivate students to apply the natural concepts introduced thus far to a variety of situations in their everyday lives.

We're looking forward to meeting you and your class!

Post-Trip Activities

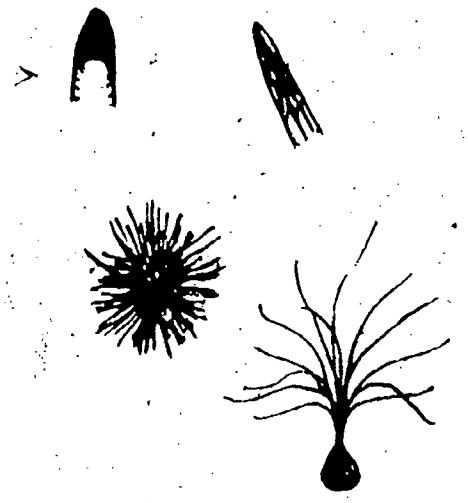
The pre-trip activities introduced your students to the world of seeds. On the field trip your students saw seeds in action and discovered the adaptations that help seeds take advantage of nature's agents of dispersal. Next let's move on to a study of seed germination and plant growth.

1. Dispersal Agents & Adaptations: A Review

It may be helpful to first review the field trip concepts with students. Student Handout 6 will give students a chance to match seed adaptations to their methods of dispersal.

Wind is one of the commonly observed dispersal agents. Seeds that depend on the wind to distribute them can have blades that spiral them away from their parents or tufts of parachute-like "hairs" or "wings" that catch the wind. Seeds on other plants are held in salt shaker-like pods and are shaken out when the wind blows the stalk. Others are scattered when the whole plant tumbles along the ground in the wind. Examples of wind-dispersed plants are maple, milkweed, dandelion, and cottonwood.

Animals are another dispersal agent. Seeds that hitch a ride on animals and people are equipped with hooks and spines. Burdock, beggar tick, and tick trefoil are examples. Squirrels and other animals collect and store seeds such as acorns. Birds are attracted to the fleshy covering on seeds like cherries and juniper berries. When they eat the fruit, the seed, protected by a tough seed coat, passes through the digestive tract and is deposited at another location -- complete with fertilizer!



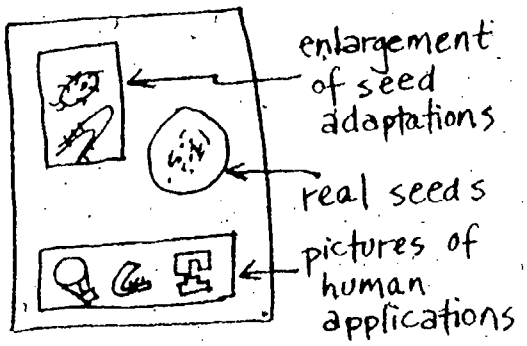
Water also disperses seeds. Water-dispersed seeds are light and corky. The champion of water-dispersed seeds is the coconut. The thick fibrous outer husk and waterproof coat enable the seed to drift in the ocean for a year before washing up on a beach and sprouting.

Some seeds are given a dramatic send-off by the parent plant. They are dispersed mechanically when seed capsules burst open and seeds explode out. Flowers with explosive fruits include snapdragons, jewelweed, violets, witch hazel, and some members of the bean family.

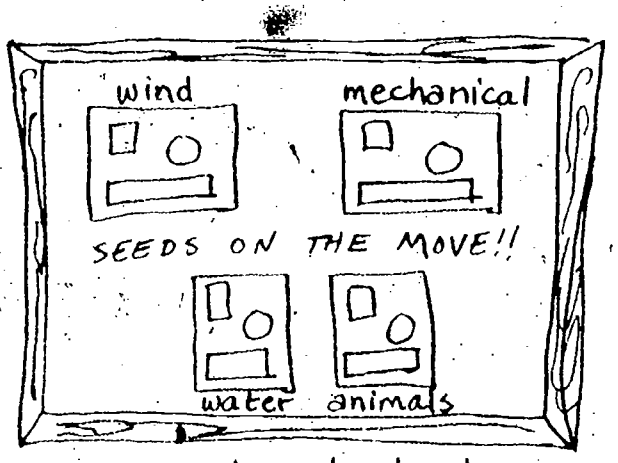
Seeds On The Move

An attractive bulletin board can be made with seeds you received at the Center and others that the students collected. Students working in groups can use egg cartons to sort the seeds based on their method of dispersal. Each group can make a display poster for a dispersal method. Posters can include an enlargement showing the seed adaptations, the real seeds, and pictures of human-made machines and inventions that "copy" nature's designs -- parachutes, propellers, gliders, balloons, rockets, hook-and-eyes, velcro, sugar-coated vitamins, catapaults, life rafts, buoys, etc. Either a library search or a good imagination will help students identify these applications.

Display all the posters on a bulletin board, and allow students to share what they found about ways in which humans have adapted seed structures to meet their needs for tools and machines.



individual display poster



bulletin board display

2. Seed Germination

So what happens to the seed after it is dispersed? It sprouts -- if everything goes right! Student Handout 7 gives students a chance to sequence the stages of seed germination that they learned on the field trip.

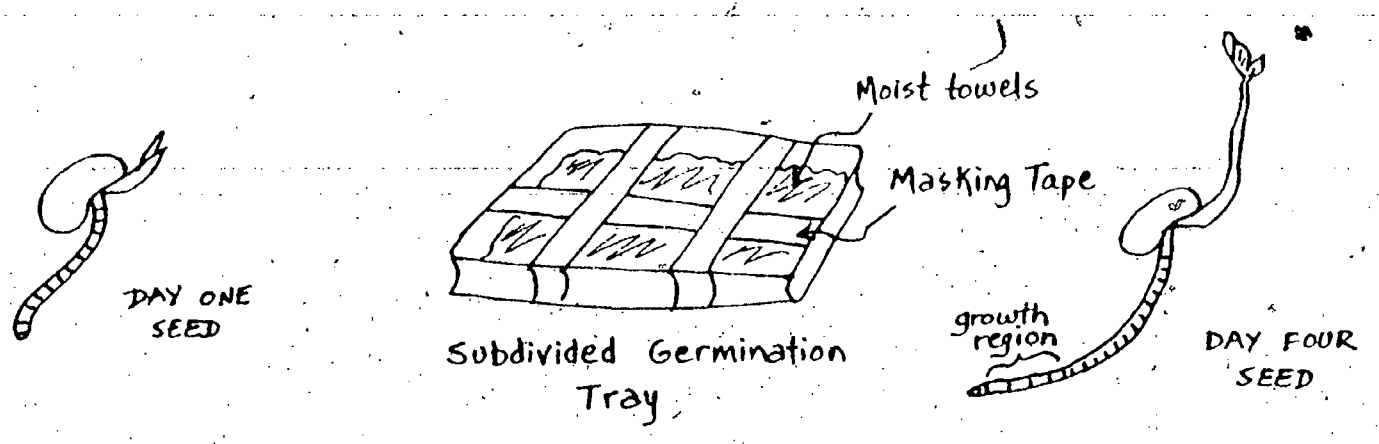
If necessary, review the steps of germination and growth with your students. Remind them that most wild seeds require a period of dormancy, which usually lasts for one winter but may last for hundreds of years! Seeds contain very little moisture when they are dormant. Their stored food is dehydrated. To germinate, seeds need moisture, oxygen, light, and the right temperature although the specific amount of each varies with the type of seed.

Before germination, water enters through the seed coat. The seed coat softens and ruptures as its contents swell. Soon the root and shoot of the embryonic plant emerge.

The young plant grows rapidly due to cell multiplication and enlargement. Much of the growth occurs near the tips of the root and shoot where new cells are rapidly being formed. The plant develops roots, a stem, and leaves. The root anchors the plant and absorbs nutrients, water, and air from the soil. The stem supports and displays the leaves, which take over the job of food production when the supply stored in the seed runs out. When the plant matures, flowers produce seeds that will sprout a new plant in the next generation.

Growing Pains

For this activity, you will need beans with roots about one inch long. Using a ruler and a felt-tipped pen with waterproof ink, gently place dots one millimeter apart along the entire length of the bean's roots. Mark one bean for each group of three or four students. Be careful not to damage the root, and hold the seed only by the seed coat. Then have students sketch the location of the marks on the first diagram on Student Handout 8.



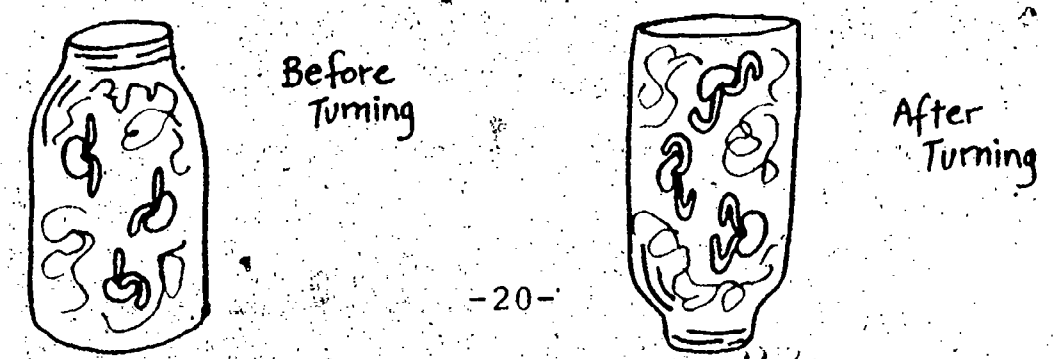
Subdivide a germination tray with masking tape. Make one section for each group. Number the sections to correspond with group numbers. Place the seeds in the appropriate sections of the germination tray. Be sure the paper towelling is damp. Cover the tray with cellophane to keep moisture in.

Students should observe the roots daily for four days, each day sketching the location of the root marks onto another drawing on the handout sheet. On the last day of observation, have each student decide how the root grows: from the base near the seed, evenly along the root, or from the tip of the root. Students can write their conclusions on their handouts. By observing that the marks near the end of the root become further aparts, students should identify the area just behind the root tip as the main growth region of the young root.

Way To Grow!

Why do roots grow down and stems grow up? What happens if you plant a seed upside down? These questions can be explored by "planting" bean seeds in a glass jar to determine how they respond to conditions in the environment.

"Plant" six beans along the outside edge of a glass jar with moist, crumpled paper towels. Keep the towel damp and observe the sprouting seeds for five days. Students can fill in the drawing on Student Handout 8 to show the direction in which the roots and shoots grow.



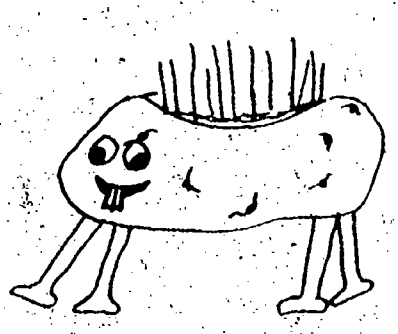
When roots and shoots are about an inch long, try to "fool" the seed by turning the jar upside down. Observe changes over the next few days. A change in direction should be apparent. Shoots bend so that they are again growing upward, and roots reverse to continue growing downward. Again, students can record results on Student Handout 8.*

* *adapted from The Science Book by Sara Stein and printed with permission from Workman Publishing.*

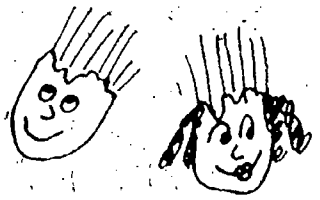
Grass plants show another plant response to the environment. Sprinkle grass seeds on moist, loose soil in a tuna fish can. Place the container in a window or near a directional light source. DO NOT ROTATE THE CONTAINER! After a few days of care, the plants will sprout and grow toward the light. On Student Handout 8, students can sketch the direction of plant growth.

Then have students think about what the plants would look like in a week if the can were rotated 180°. Have them sketch their prediction of plant growth on the second diagram. Rotate the can and see how accurate the predictions were!

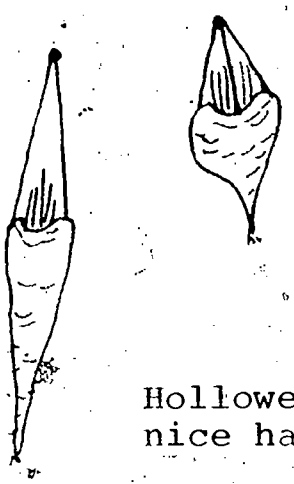
Have more fun observing the way grass responds to light by planting grass in "crazy containers." Use decorated egg shells or hollowed out vegetables (potatoes, carrots, turnips, etc.) as planters. Compare grass growing in sunlight, darkness, colored light, and other conditions you and your students can think of.



A hollowed out potato with golf tee legs makes a nice planter!*



Put faces on egg shells and plant grass in them. Don't forget: they'll need occasional hair cuts!*



Hollowed out vegetables also make nice hanging basket planters!

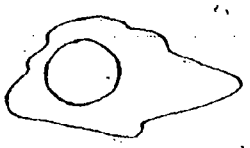
* *from Heath Science, Level K and printed with permission from D. C. Heath and Company.*

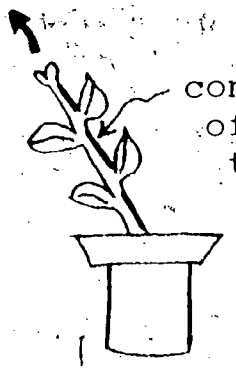
Why do roots and stems grow in these ways? Plants contain several types of chemicals called hormones. These hormones stimulate growth in plant cells, cause flowers to bloom, and enable fruit to mature.

Hormones respond to conditions in the environment. A hormone called auxin, which stimulates plant growth, is sensitive to light. It responds negatively to light by moving to the shady side of the stem. More hormone on the shady side causes cells on that side to grow faster, bending the plant toward the light.

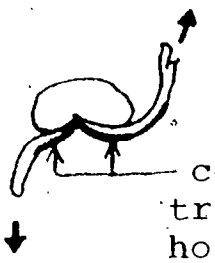
Auxins are also sensitive to gravity. In the sprouting beans, gravity pulls the hormones to the bottom side of the shoot, causing it to elongate and therefore bend and grow upward. The same hormone that stimulates growth in the shoot inhabits growth in the root cells. The hormone building up on the bottom side of the root causes the root to grow downward. When the stem or root grows vertically, it indicates that the hormones

are evenly distributed on both sides of the stem or root.





concentration of hormones on the shady side causes directional growth.



concentration of hormones due to gravity causes directional growth.

3. Plant Growth

In this activity, students will sharpen old skills and develop new ones. Observing plant growth should reinforce the basic needs of plants: nutrients, water, air, and light. Comparing plants that grow in different pots will show how plants respond to another environmental condition -- crowding. Measuring rates of growth will sharpen mathematic and graph interpreting skills. Group work will help to develop a sense of cooperation and responsibility.

Living Space

For this activity you will need four small and four large containers, potting soil, small pebbles, bean seeds, heavy paper, a ruler, and strips of construction paper one half inch wide.

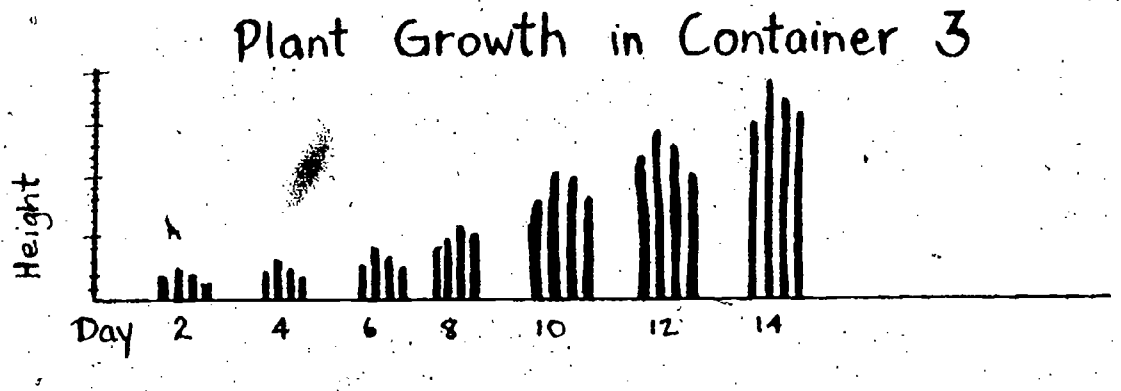
First, soak the beans overnight. Mark the containers with numbers from one through eight. Assign a group of students to be responsible for each planting container throughout the experiment. To plant the seeds, students should put a thin layer of pebbles in the bottom of the container, then fill the container to within an inch of the top with soil.

They should place the beans on the soil, then add loose soil to fill the container.

Plant the following number of seeds in each container:

	Container	Number of Seeds
small containers	1	1
	2	2
	3	4
	4	16
large containers	5	1
	6	2
	7	4
	8	16

Students should give the plants the same amount of water on the same days. Observe the plants for fourteen days. Every other day, have students cut a strip of construction paper to show the height of the plant above soil. The strips should be pasted on a poster board graph that you have made for each group. (See diagram.) In containers with 16 plants, select and mark only four representative plants to be measured. Be sure to leave enough room to paste all the strips on the graph.*



As the graphs are completed, lead the class in interpreting them. Which population grows the fastest? Slowest? What seems to influence plant growth? By comparing growth patterns it should be evident that living space is necessary for plant growth. Remind students that seeds are dispersed to prevent crowding.

This activity can be extended by introducing more sophisticated mathematics skills: use of a ruler, measuring in inches and centimeters, calculating the average, making line graphs. It can also be applied to many practical areas. How would a gardener use this information? What does this say about raising house plants? Are these findings applicable to animal populations as well? Can people be overcrowded? How does nature prevent overcrowding? How do people react to crowding?

* *adapted from "Room for Living," The Green Box and printed with permission from Humboldt County Schools, Eureka, CA.*

4. Wrapping It Up

There are probably as many ways of concluding this unit as there are types of seeds! Listed below are several interdisciplinary activities. Choose one or more to do with your class based on your students' interests and the next unit you will be studying.

Garbage Garden: Students can compare patterns of growth among various plants they eat by planting a Garbage Garden. Seeds, potato eyes, carrot tops, etc. can be salvaged from household scraps and planted. See if students realize that cooking kills plants and seeds so they won't grow! Students will be able to see a variety of foliage patterns.*

* *from The Reasons for Seasons by Linda Allison and printed with permission from Little, Brown and Company.*

Mystery Garden: Collect a shovelful of topsoil from a forest or field area and watch it come to life under your care. By matching the young plants to pictures in a plant guide, students can identify many of the plants in nature's garden.

Write On! A variety of plant-related information is available from private industries. Language arts skills can be sharpened by having students compose and write letters. Don't forget to reinforce etiquette by having students send thank-you notes once the materials have been received. Try contacting the following:

1) Peanut Food Promotions
P.O. Box 1709
Rocky Mount, NC 27801

-- for recipes, posters, history, and answers to peanut questions

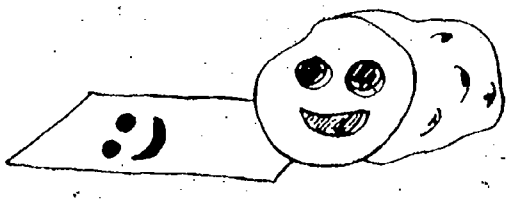
2) Kansas Wheat Commission
1021 North Main St.
Hutchinson, KS 67501

-- for a poster and nutritional information on wheat

3) Nabisco Inc.
East Hanover, NJ 07939

-- for wheat seeds and instructions on planting, plus the story of how wheat is made into graham crackers

Potato Prints: Potato prints can decorate all kinds of things -- from stationary and notebooks to t-shirts. Cut a potato in half. Draw a simple design on the open face of the potato. Using a table knife, carefully cut away everything but the design. Press the design onto a stamp pad or poster paint. Press onto paper. Voila -- potato notes! Use acrylic paints to get a lasting design on t-shirts or other cloth.



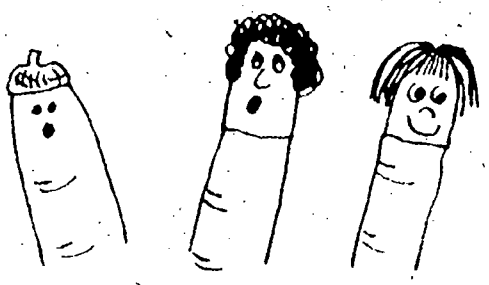
Potato Prints

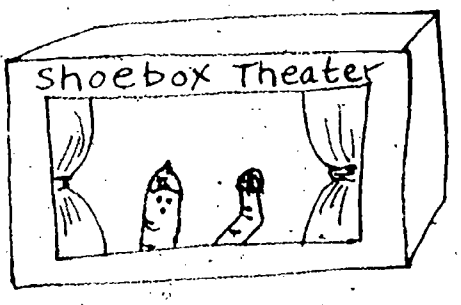
Uncle Sam Wants Seeds! Seeds were part of the recycling rave during the World Wars. People collected cattail down (the soft, fluffy seeds from the ripe cattail heads) and supplied it to the armed forces to make life rafts and to stuff life preservers. People

also used down to stuff mattresses which, like feather beds made for warmer sleeping in unheated bedrooms. Reenact history by having students collect cattail heads and sort the fluff. See how buoyant the fluff is by holding a handful of it under water. Small pillows, pincushions, and stuffed animals can be made with scraps of cloth.

Measurements, Again! Dried beans and grains can be used to give students practice at measuring with rulers. Have students layer the seeds in a glass jar in a pattern that you supply, such as "2 cm of kidney beans, 3 cm dried lentils, 1 cm corn, 4 cm black-eyed peas," etc. The reverse activity is also a good measuring exercise: students can measure and record the thickness of the seed layers after they have completed the project. Be sure the seeds are firmly packed and the lid is secure. What an attractive paper weight, kitchen display, or gift for someone special!

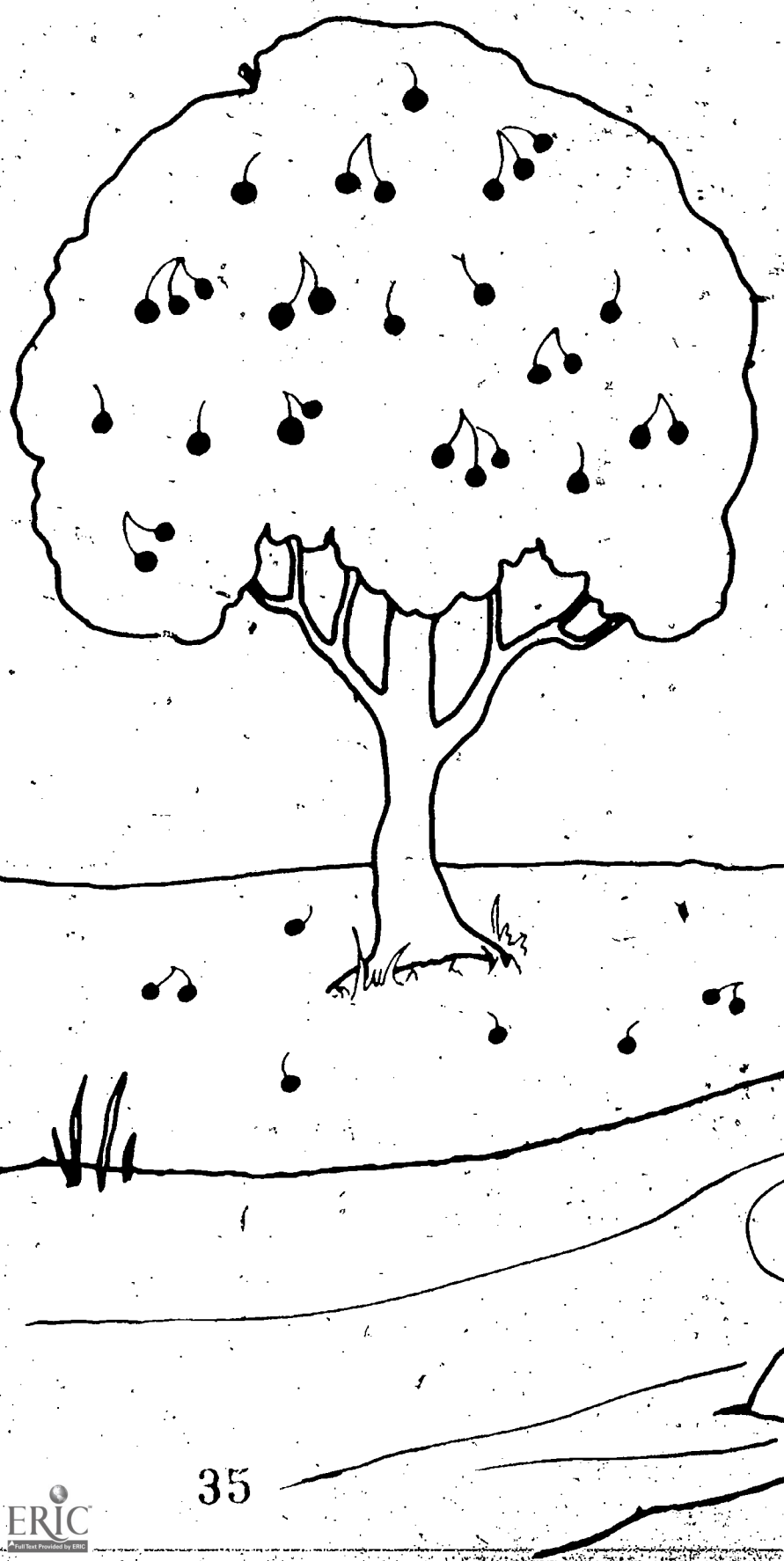
Seedy Shakespeare: Students can make finger puppets out of acorn tops or peanut shells and perform plays in a shoe box theater. Suggest topics that will review what students have studied about seeds and plants, such as "Goldilocks and the Three Seeds" or "Little Red Raspberry." Try a fashion show as well. Puppets or people can model seed adaptations: the windblown look, beachwear, and styles for game hunting.





You've come a long way, teacher! You've shown your class the importance of seeds, how seeds hitchhike, and how plants grow and develop. You've helped to sharpen your students' sense of observation, their skills in measuring, and their awareness of seeds in the natural and built environments. The concepts and cooperation they learned will help them understand more about the environment and the role of people in it. So congratulate yourself! You deserve a pat on the back!

Name _____



Seed Scene

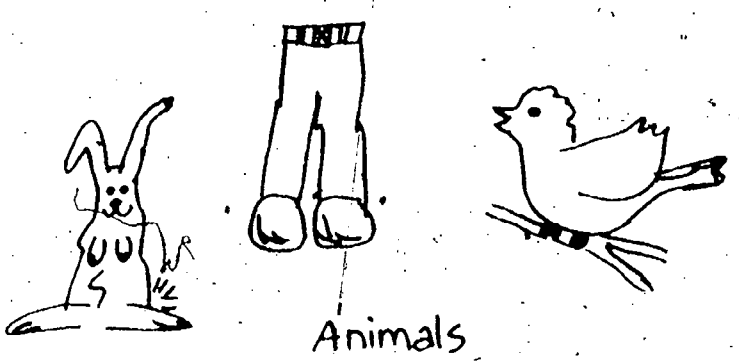
Student Handout 5

Name _____

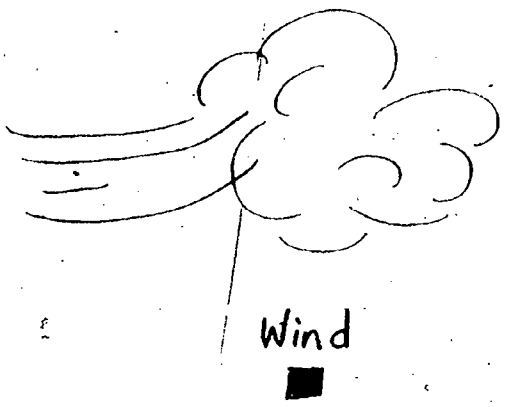
Nature's Hitchhikers

Student Handout 6

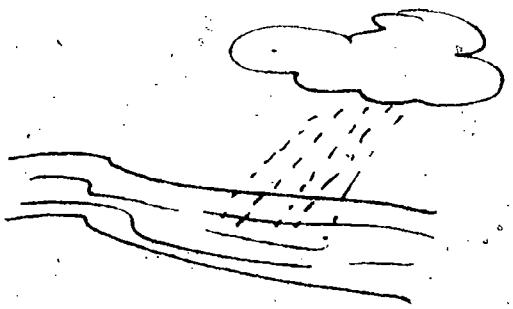
Connect the seed to the way it moves in nature.



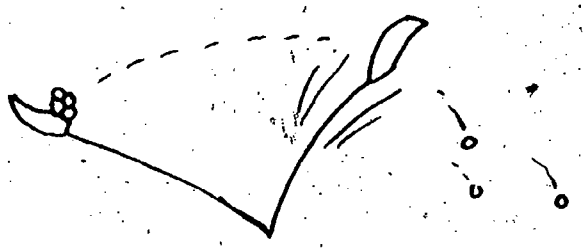
Animals



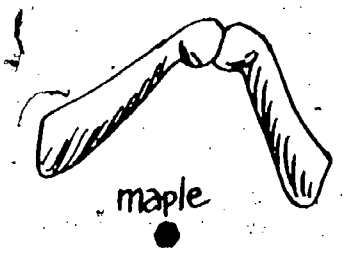
Wind



Water

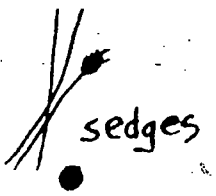


Mechanical

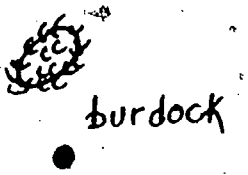


maple

dandelion



sedges



burdock

coconut

raspberry

tick trefoil

wafer ash

touch-me-not

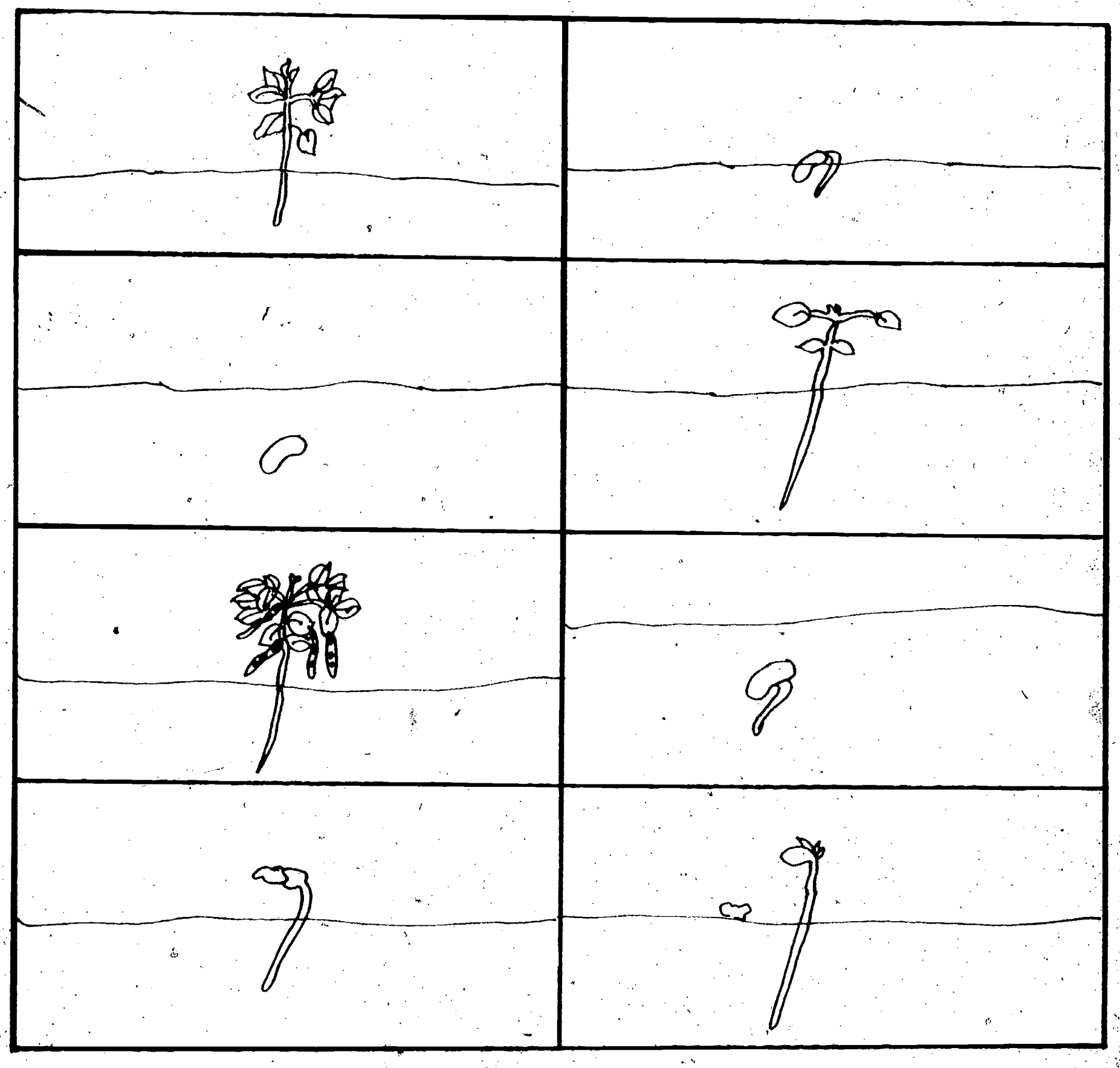
American lotus

Name_____

Growing Seeds

Student Handout 7

Cut out the picture boxes below. Then put them in order to show how a bean seed grows.



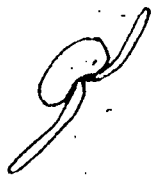
Name _____

Lab Sheet

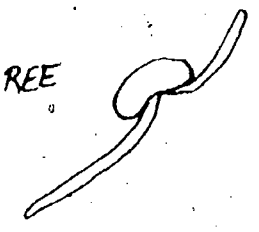
Student Handout 8

Growing Pains

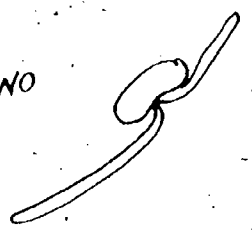
DAY ONE



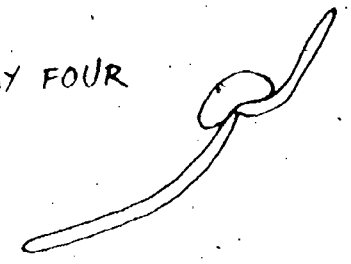
DAY THREE



DAY TWO



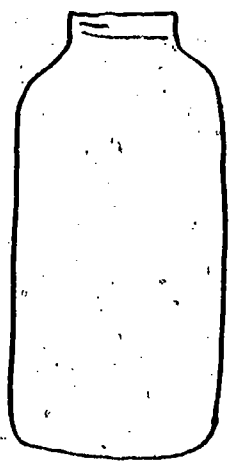
DAY FOUR

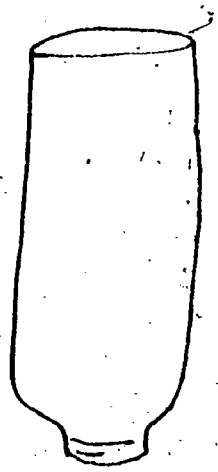


Conclusion: The root grows from _____.

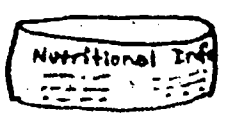
Way to Grow!

Beans





Grass



Answer Sheet

Student Handout 1:

Refer to the packet text for details about these seed types.

Student Handout 2 and 3:

See the packet text for details on playing Plant-Go.

Student Handout 4:

Part 1: 1. leaves 2. shoot 3. root
4. stored food 5. seed coat

Part 2: Seeds in the kitchen include olives, many spices (but not black pepper and cloves), rice, fruits, vegetables, and nuts.

Seed products in the kitchen include corn meal, flour, cereals, vanilla and some flavor extracts, mustard, spaghetti and noodles, bread and rolls, etc. Sugar is not a seed product but made from beets or from the stem of sugar cane.

Student Handout 5:

Refer to the discussion of this sheet in the packet text.

Student Handout 6:

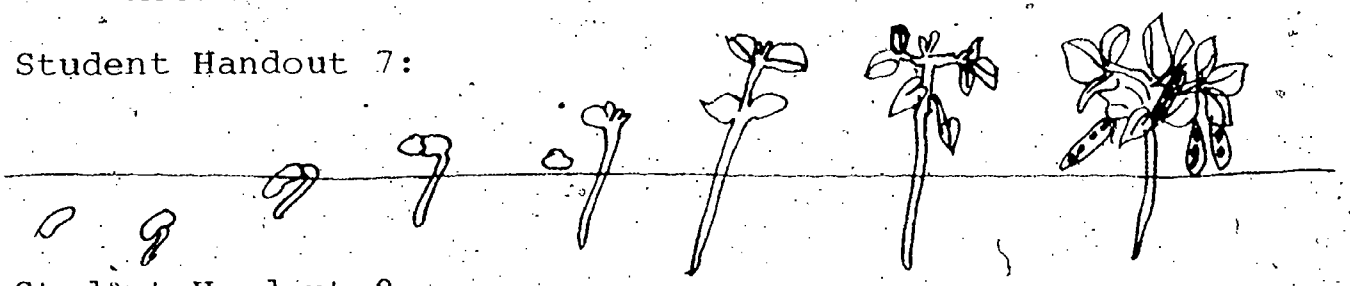
Animal: burdock, raspberry, tick trefoil

Wind: maple, dandelion, wafer ash

Water: sedges, coconut, American lotus

Mechanical: touch-me-not

Student Handout 7:



Student Handout 8:

Growing Pains: By Day Four, the ink marks just behind the root tip should be farther apart than the other marks. This is the main growth region of the root.

Way to Grow! Bean stems always orient upward, and roots grow downward. Grass blades will bend toward the light.

References

BOOKS FOR KIDS...

J580 H721 *Hoke, Alice. First Book of Plants. New York: Franklin Watts, 1953.

J582.046 L *Lauber, Patricia. Seeds, Pop, Stick, Glide. New York: Crown, 1981.

J580 M664 *Miner, O. Irene. True Book of Plants We Know. San Francisco: Children's Press, 1953.

J581 N *Nussbaum, Hedda. Plants Do Amazing Things. New York: Random House, 1977.

J580 P742 *Podendorf, Illa. True Book of Plant Experiments. San Francisco: Children's Press, 1960.

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J580 S468 *Selam, Millicent. Play With Plants. New York: William Morrow, 1949.

J574.072 S *Simon, Seymour. Exploring Fields and Lots. Westport, CT: Garrand 1978.

Warbach, Oscar. Mother Nature's Michigan. Hillsdale, MI: Hillsdale Educational Publishers, Inc., 1976.

*These books are available at the Jackson District Library. Similar titles may be found at the Jackson District Library's 16 branches under the same Dewey Decimal numbers.

BOOKS FOR TEACHERS...

Allison, Linda. The Reasons for Seasons. Boston: Little, Brown and Co., 1975.

Allison, Linda. The Wild Inside. New York: Charles Scribner's Sons, 1979.

Barufald, James P., George T. Ladd, and Alice Johnson Moses. Health Science, Level K. Lexington, MA: D.C. Heath and Co., 1981.

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Stein, Sara. The Science Book. New York: Workman Publishing, 1979.

Green Box Curriculum Kit. Eureka, CA: Humboldt County Office of Education, 1975.

AT REMC...

The Jackson County Intermediate School District's Regional Educational Media Center has these audio-visual aids:

Books

Forte, Imogene and Joy MacKenzie. Creative Science Experiments for the Young Child. SE 349.3

Filmstrip/Cassette Sets

"First Ideas About Plants" 4SE0505
--six filmstrips with tapes and 48 activity cards

Magazines

Ranger Rick

National Geographic World

Motion Pictures

"A Visit to a Nature Center"	MP 2452
"Watch Out for My Plant"	MP 1678
"What Do Plants Do -- A First Film"	MP 1699
"What Do Seeds Do -- A First Film"	MP 1700
"What Do They Eat?"	MP 2724
"Wheat -- From Field to Flour"	MP 1714
"Visit to a Maple Sugar Farm"	MP 1645

Picture Sets

"Some Plants...A Look at Variety" SE 1390
--picture series on various plants

AND ELSEWHERE...

These films can be rented for under $5 from the Audio-Visual Education Center, University of Michigan, 416 Fourth Street, Ann Arbor, MI 48103.

"Growth of Seeds"
IJ 14 min.

"How Seeds Are Scattered"
PI 10 min.

"How Plants Help Us"
P 10 min.

"Let's Watch Plants Grow"
PI 11 min.

NATURE'S HITCHHIKERS

Second Grade Field Trip

Formal Objectives:

Students will:

-identify seeds and the plants they grow into by pointing them out.

-classify seeds by matching them to their dispersal method.

-understand the requirements for germination by sprouting seeds.

-understand the stages of seed germination and plant growth by sequencing them.

-demonstrate problem-solving skills by constructing a workable model of seed adaptations.

Non-formal Objectives:

Students will be given the opportunity to:

-notice the variety of seeds and plants in nature.

-see how seeds use special structures to travel.

-experience nature by finding seeds, eating sprouts, and building seed models.

-enjoy the outdoors.

Indoors:

Welcome the group. Introduce yourself and the Dahlem Center. Find out how much they know about seeds.

1. WHAT IS A SEED? -- Review the basics of seeds by asking them what a seed is. They should know that: 1) seeds are made by plants, and 2) seeds contain a baby plant and a food supply.

2. PLANT DEVELOPMENT -- Use the sequence of flash cards to discuss how seeds sprout and grow. Reinforce that seeds sprout when exposed to the right conditions in the environment. What is needed for germination? Moisture (water), and the right temperature. What do the sprouts need to continue to grow? Water, sun, air, and the right temperature.

Go over the stages of growth in a plant. Point out the seed parts (seed coat, stored food, baby plant with root, shoot and leaves), and describe sprouting as the baby plant "stretching its legs" after being cramped up all that time. Do we use sprouts? You bet! Pass out alfalfa sprouts to munch on and ask the students what other sprouts they know or have used.

Depending on the group, you may want to try a role play. What does a young plant feel like? Have the students curl up on the floor with arms (shoot) and legs (root) tucked in close. Pretend you are a baby plant in a dark seed coat, waiting... Water and warmth are provided and each "seed" begins to sprout. They struggle and grow through the sequence of stages on the growth cards -- extending arms and standing on tip toes to get closer to the sun. Have them use arms/body parts to indicate what kind of plant they are (i.e., if they're a daisy, arms circled around their head could indicate petals, if a pine tree arms should form a triangle). Ask them what kind of plant they are.

3. SEED DISPERSAL -- Stress that when mature plants reproduce with seeds, most of the seeds are taken to another location to grow. Otherwise, they would compete with the parent plant for water, light, and nutrients in the soil.

How do seeds move around or disperse? There are four ways seeds travel. Seeds have adaptations that help them move around.

Method	Seed Adaptations
Wind	parachutes and salt shakers
Water	corky, water resistant coats
Animals and people	hooks, spines, edible coatings
Mechanical	"pop gun" parents

Use the picture board and velcro labels to have the students match the seeds to their dispersal method. Ask them how they knew which label to match to the seed. Point out that they could tell by looking at the seed's structure.

Tell the group that they are now ready to go outdoors on a safari or seed hunt! They should stay on trails (there's poison ivy out there!) and find (point out, not pick) seeds. They need to get ideas because they'll have a chance to design a seed themselves then they get back to the Center, if there's time.

Outdoors:

On the hike, try to find and discuss dispersal adaptations.

Animals: cocklebur -- point out that it inspired the invention of velcro.
acorns/nuts -- squirrels and birds bury and hide them
buckthorn/berries -- pass through digestive tract of birds.

Water: sedges -- light and corky to float

Wind: maple -- wings for helicopter effect (fly some!)
dandelions/milkweed -- parachutes; try blowing some and waving arms to see how sensitive they are to air currents.
Queen Anne's Lace -- salt-shaker effect of sprinkling seeds

Mechanical: Jewel weed -- if none are available, have some dried beans or locust pods.
witch hazel
wild geraniums
bean family

Along the hike, remind the group to be looking for ideas on how to build a moving seed back at the Center after the hike. At minimum, point out these plants and seed adaptations: oak, maple, buckthorn, milkweed, and Queen Anne's Lace.

Near a field, run a special search for animal-dispersed seeds. Use a volunteer child to run through a field and collect seeds that stick to animals. Observe the seeds and return them to the field.

Other ideas:

If you have additional time and a singing voice, you can teach Billy B's Sprout Song.

Wet ground, warm sun my life as a tree has just begun
I'm so sure, I have no doubts
Cause my shell is cracked and I have a sprout.
It's growing up and growing out, (2X)
Yipee hurrah I am a sprout. (4X)

All of the materials for a Great Seed Derby are located in the pavilion. This would be a great activity to fill up 15 - 20 minutes, or a rainy day. Have the students engineer a seed that can float, fly, or attract animals, using a grain of rice and the box of miscellaneous craft supplies. Cotton, feathers, tissue paper, balloons, tooth picks, tape, wax paper, etc. will help.

Return:

Give the teachers a bag of assorted seeds to take back to the classroom to use during post-trip activities.

Thank the group for their healthy participation, and invite them to return.

References:

°"Nature Prepares for Winter," Kent EE District.
°OBIS - "Seed Dispersal"