Exploring the Native Plant World

A Life Science Curriculum

1st–2nd Grade

Growth and Change in the Native Plant World

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Welcome to the Lady Bird Johnson Wildflower Center

The Lady Bird Johnson Wildflower Center is dedicated to North America's native flora. Our mission to inspire the conservation of native plants guides all that we do.

At the Wildflower Center, we apply nature's principles to designed landscapes. The Wildflower Center nestles gently into 284 acres of Central Texas Hill Country, and the landscape and the buildings reflect our Hill Country home. The Center's focus on native plants, resource conservation, and ecologically sensitive design reflects our deep concern for the environment.

Founded by former First Lady Lady Bird Johnson and actress Helen Hayes in 1982, the Lady Bird Johnson Wildflower Center encourages the conservation and restoration of native plants in all types of landscape situations. The Center's extensive environmental education program and national Native Plant Information Network combine to extend its mission across North America. Our commitment to education and young people is the foundation for all we do: Education is at the core of our mission, and children are the keys to our future. Together we can work to make a difference.

For more information about the Lady Bird Johnson Wildflower Center, please visit our website at www.wildflower.org.

Exploring the Native Plant World

A Life Science Curriculum for Pre-Kindergarten through Grade 6

This curriculum is divided into four grade-specific modules: Pre-K/K (Shapes and Patterns); 1-2 (Changes); 3-4 (Survival); 5-6 (Adaptation). The focus is to provide a basis for the study of botany and biological systems and to serve as a foundation for future botanical explorations. Children in pre-kindergarten and kindergarten are introduced to the shapes and patterns found in nature, beginning with the shapes in flowers and continuing through explorations of patterns in time throughout a plant's life. First and second graders find that plants change over time (as does everything on earth) and plants take care of their needs with specialized parts. In the third and fourth grade unit, students learn more about how plants survive and that this survival is carried out through a variety of relationships with other plants and animals and abiotic, or non-living, factors. In the final unit, fifth and sixth graders discover the concepts and mechanisms of natural selection and natural communities, as well as human impact on these communities.

Exploring the Native Plant World was designed using the Texas Essential Knowledge and Skills (TEKS) and the National Benchmarks for Science Literacy. A primary goal of this curriculum is to teach botanical principles through all elementary grades in order to build an ecologically literate citizenry. By focusing on native plants, this curriculum also provides an opportunity to learn more about imperiled ecosystems.

In the end, we will conserve only what we love;
We will love only what we understand;
And we will understand only what we are taught.
—BABA DIOUM, Senegalese conservationist

In today's culture many of us are urban dwellers. Too few children have the opportunity to engage in and observe the natural world. As educators and environmental specialists we can introduce nature to children from all walks of life. Studies show that just as there is a critical time in a child's life when he develops language, there is a time in a child's life when she develops an appreciation of the natural world. Our challenge is to open that window of opportunity and welcome children to a lifetime of exploring and understanding nature's wonders.

If we sustain plants, they will sustain us.
It is that simple. And it is that important.
—RICHARD H. DALEY, former director,
Arizona-Sonora Desert Museum

What is a native plant?

A native plant is a plant species that occurs naturally in a particular region, state, ecosystem,and habitat without direct or indirect human actions. Native plants are a part of the natural neighborhood, a component of the local ecosystem, and they function with other organisms within that ecosystem. They are a critical component of nature's web, and they have evolved and adapted to meet climatic and environmental changes over time without intervention or assistance from humans.

Native plants provide food and habitat for animals of all kinds (including humans). They filter the air and reduce soil erosion. Because native plants fill a niche, or specific function, within their ecosystem, they seldom grow beyond the needs and capacities of that ecosystem. The interaction and interdependence of plants and animals within that niche make up our biological community.

Native plants are in crisis

Farming, ranching, urban development, and chemical application have significantly reduced many of the Earth's native plant communities. Species have become endangered or extinct, natural habitats have degraded, soil erosion has increased, and the genetic diversity so essential for stable, balanced ecosystems has declined. Since the early nineteenth century more than 200 of America's native plant species have been lost, and more than 5,500 species are endangered or threatened. This means that other organisms dependent on those species have lost or might lose an important part of their food chain.

In many places well-meaning landowners have replaced native plants with non-native species in yards or landscapes. Non-native species often require more water, fertilizer, and herbicides than native plant species. Moreover, non-native plants occasionally escape cultivation and become aggressive, invasive weeds, choking out both native and other non-native plants.

The importance of native plants

There are several important reasons to garden with native plants. They are adapted to the particular combination of soil, temperature, nutrients, and rainfall of their region. Once established they require little, if any, supplemental water, fertilizer, pesticides, or other chemicals. In planned landscapes around schools, homes, commercial developments, or roadsides, native plants require far fewer additional resources.

Besides the practical benefits of using native species, these plants provide habitat for a host of regional animals. Native plants are a welcome mat for the birds, butterflies, and so many other animals that enjoy the habitat. Using native plants in a garden or landscape can provide ecological, economic, and aesthetic benefits—it's a win-win situation for both the gardener and the natural community.

A good way to start protecting and preserving native plants is by learning about your region's native plants. Remember that your region is unlike any other in the world. There are subtle differences everywhere. Visit the Lady Bird Johnson Wildflower Center's Native Plant Information Network (NPIN) for help in learning what native plants belong in your neighborhood. NPIN has regional fact sheets, which include species recommendations, plant and seed sources, and contact information for local native plant organizations. These resources provide tools that can help you teach about your region's native plants and their importance to our future.

Introduction

Growth and Change in the Native Plant World

Welcome to the 1st–2nd Grade Curriculum: *Growth and Change in the Native Plant World,* a collection of hands-on activities about native plants. This curriculum is designed to help educators introduce the world of native plants to students by integrating classroom projects with outdoor or field trip experiences.

There is a natural fit in teaching children about the wonders of plants. Plants and children share many things in common. In terms of their development, they both grow quickly at first and then slow down; their hormones dramatically change their shape and size; and both groups play vital roles in their communities with those roles changing over time. As our understanding of children has grown and changed, so, too, has our knowledge of the native plant world.

Plants are the building blocks of life on Earth. Without plants, we would not be here. Because plants are unable to move around, they have had to develop an amazing variety of ways to survive all the challenges that life has to offer—to protect themselves from being eaten, to survive childhood without parents to nurture them, and to create more plants.

These interactive activities allow students to explore plant growth and change while nurturing children's natural curiosity for living things. This student-centered approach engages students and allows teachers to build on a natural progression of concepts. Through this program, students will develop an awareness of the amazing world of plants and their ecological importance.

We hope you enjoy this exploration with your students!

Unit Overview

Suggested time: One to two weeks

Objectives

Before your field trip, students will learn:
- Plants change during their life cycles.
- Plant parts have different jobs.
- Growing plants have needs.

During your field trip, students will learn:
- Plants adapt to fit into a complex environment.

After your field trip, students will learn:
- Plants are part of changes that happen very slowly.

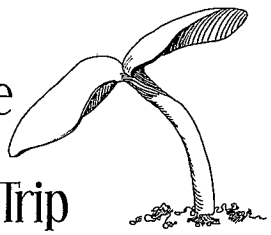
Changes in the Native Plant World addresses the following National Benchmarks for Science Literacy:

Concepts
- Animals eat plants and use them for shelter.
- Plants and animals need food and water.
- Plants and animals change their environment.
- Plants need light.
- Choices have consequences.
- Some living things that once existed on Earth are gone.

Skills
- Using a magnifier.
- Using a ruler to measure length.
- Using a model to learn something about a real thing.
- Using graphs to help describe observations.

Lesson 1:
Plants change during their life cycles

Before Your Field Trip



To prepare for your field trip, your class will:

- *watch the magic of seeds developing into sprouts*
- *observe the baby plant inside a seed*
- *learn about the life cycle of native plants*
- *graph varieties of flower color*
- *observe differences in flower shapes*
- *identify the variety of flower parts among different species*
- *strengthen a stem to hold a plant upright*
- *do the work of the carrying tubes in a plant stem*
- *hunt for leaves with different combinations of shape, color, texture, and edge*
- *separate out different leaf pigments with chromatography*
- *explore the role of roots as food storage bins for plants*
- *identify the root systems of weeds*
- *conduct an experiment about roots and erosion*
- *discover what happens if a plant doesn't get light*
- *discover how light, water, and soil meet the needs of plants*

ACTIVITY 1.1

Sponge Sprouts:
Watch the magic of seeds developing into sprouts

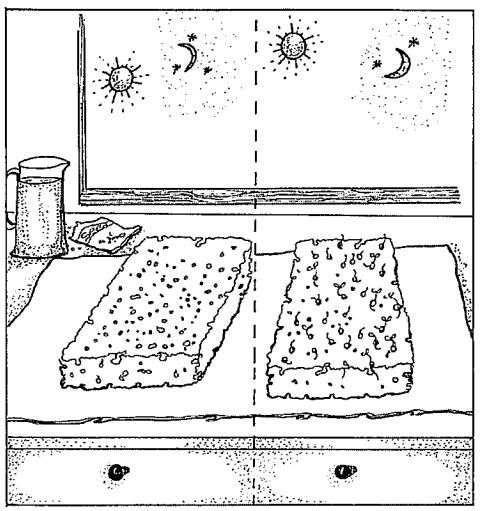
Before Activity

Gather materials:

__ fast sprouting seeds, such as bird seed, radish seed, winter rye seed, Indian blanket, pink evening primrose, purple coneflower, or horsemint

__ large sponge

__ shallow pan or dish



During Activity

1) Put wet sponge in pan or dish full of water. Sprinkle seeds on the sponge to form a pattern. (Set aside some seeds for later comparison to the sprouts.)
2) Place the pan where students can see but not disturb the seeds. Tell students to watch the sponge carefully because something magical will happen. Ask them to alert the rest of the class as soon as they notice any changes.
3) A visible pattern of sprouting seeds should appear after a week. Ask students about what happened: Was the sponge magic or were the seeds magic? How did the seeds change? Did they change in color, size, shape? Did the seeds need the sponge to sprout? Did they need the water? Would the seeds have sprouted if they had been sprinkled on something else, such as a desk? Have students count how many sprouts there are.

Activity Extension: Everything Grows–
Write about how plants, animals, and people all grow and change

Read one or more books about change and growth aloud to the class. Have students look at book illustrations to find some of the things that plants, animals, or children need to grow. Ask the students to each write a sentence about something that grows. Then have them cut their sentences into individual words and trade with a partner who puts the sentence back together.

Invite students to either write a story or draw a picture of themselves to make a class book called *Everyone Grows*.

Activity Extension: Guess Who's Grown?

Ask students to bring a baby picture of themselves to school for a bulletin board matching game called *Guess Who's Grown?* See if students can match the baby in each picture with one of their classmates. Don't forget to include your own baby picture!

ACTIVITY 1.2

Plant Package:
Observe the baby plant inside a seed

Before Activity

Gather materials:

- __ *Plant Package* template, page 30
- __ 30–60 beans
- __ magnifiers
- __ colored paper
- __ scissors
- __ brass brads

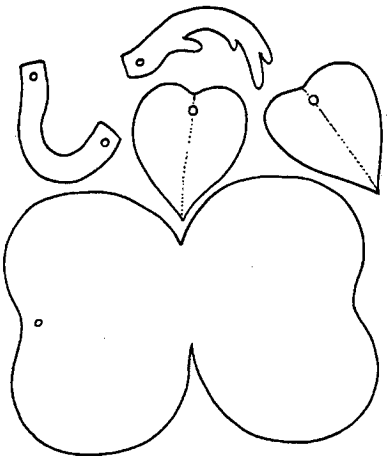
- Photocopy a class set of the *Plant Package* template on colored paper.
- Soak beans overnight.

During Activity

1) Give each student one or two bean seeds. Have students remove the seed coat and pry apart the halves. (Soaking the bean seed causes it to expand, splitting the outer coat. The halves then are easily pried apart.)
2) Have students use magnifiers to observe the baby plant inside the seed. Explain the job of each seed part. Let the class decide on names for these parts.
3) Have students use the *Plant Package* template to make seed booklets. Place the leaf stem and root over the hole on the lima bean. Put the brass brad through the holes and fasten them together. Place the two heart-shaped cotyledon leaves to the end of the leaf stem and fasten them together with another brass brad. Students may color and label the different parts of the plant package (seed, leaves, root).

Activity Extension: The Growing Seed–Record the changes in a seedling

Fold a damp paper towel to fit flat inside a sandwich bag. Place beans (or other seeds) in the bag and tape to a window with the beans facing *inside* the room. Have students keep a plant journal, daily recording observations and drawing pictures of changes the bean seeds go through as they grow.

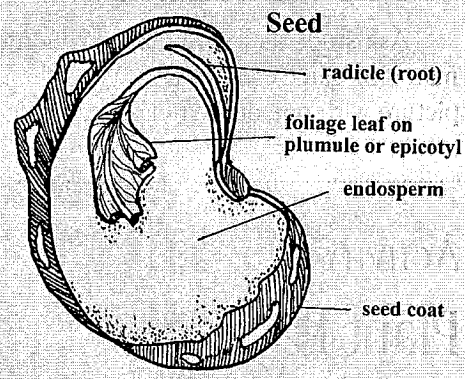


Teaching Tip

Letting students name seed parts according to their frame of reference helps them better understand seeds and how they develop into plants. When students make up the names for seed parts, they are doing the first job of a scientist—understanding an object's function and its relationships to other living things.

Scientists may equate a seed's embryo to the young in other phyla and divisions, but students simply understand it is a "baby." Likewise, scientists use the term "endosperm" for the part of the seed that feeds the embryo—tying it to the place of cell origin—but students may name it "lunchbox" for its function.

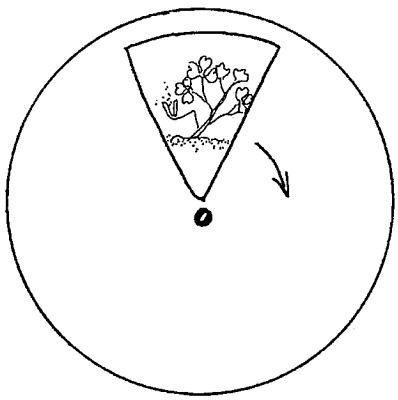
Birth of a Plant



Inside each seed is a tiny miniature plant called the *embryo*. Water triggers *germination* in the embryo. Then the complex starches in the *cotyledons* and *endosperm* are changed into usable sugars and sent to the embryo.

The embryo's root, called a *radicle*, begins to grow and push into soil, where water and minerals are available for future food production.

Soon the embryo's first leaves, or *cotyledons*, are pulled up through the soil by the stem. They expand and turn green.



ACTIVITY 1.3

Life Goes 'Round:

Learn about the life cycles of native plants

Before Activity

Gather materials:

- __ *Life Cycle Wheel* template, page 31
- __ *The Tiny Seed* by Eric Carle
- __ paper plates (double class set, plus two)
- __ scissors
- __ glue
- __ brass brads
- __ Photocopy a class set (plus one) of the *Life Cycle Wheel* template.

Create a Life Cycle Wheel:

- Cut out one photocopy of the *Life Cycle Wheel* template and glue to a paper plate.
- Cut the rim off of a second paper plate and cut a window that aligns with information on the first paper plate.
- Place the second plate on top of the first and attach with a brass brad in the center.

During Activity

1) Read *The Tiny Seed* aloud to the class.
2) Visit the schoolyard and show students a yellow wood-sorrel plant (*Oxalis dillenii*). (Students may know this plant as sour grass or banana plant.) This weed is often found in neglected flowerbeds or untended lawns. It blooms from February to November and grows in all habitats and soils.
3) Use the prepared *Life Cycle Wheel* to illustrate the life cycle of the yellow wood-sorrel.
4) Return to the classroom and have students create their own *Life Cycle Wheels*.
5) Let students use their *Life Cycle Wheels* to explore the schoolyard for other native plants. Can they find plants from the *Lifecycle Wheel*? How many of the different life stages can they find?

Lesson 2:
Plant parts have different jobs

ACTIVITY 2.1

Rainbow of Flowers: *Graph varieties of flower color*

Before Activity

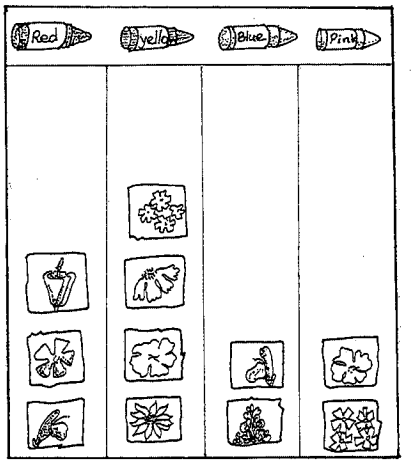
Gather materials:

- __ old seed or plant catalogs with pictures of flowers
- __ scissors
- __ glue or tape
- __ poster board

- Cut flower pictures from the catalogs, making sure they all are about the same size and represent a variety of colors.
- Make a chart on poster board by labeling columns with the colors of the flowers you have cut out.

During Activity

1) Give each student a flower picture. Have students form groups according to the color of their flowers.
2) Have students take turns gluing or taping pictures to the poster board chart to create a histograph. (Make sure students space the pictures evenly to make the chart accurate.)
3) Discuss the chart with the class. Which colors have the most pictures? Why would flowers use different colors to attract pollinators? How are these flowers alike or different in other ways—shape, number of petals, leaves?



Activity Extension: Flower Graphing

Divide class into three-person groups. Give each group a piece of poster board and 10 to 15 flower pictures from catalogs. Ask groups to look at their pictures and find ways the flowers are alike and different. Encourage them to think of several criteria for grouping their flowers, such as stalk length, number of petals, shape—and even whether or not they have seen the flowers before.

Each group must decide on the criterion they will use to graph their flower pictures (i.e., flower shape: long and thin, round, heart-shaped). This time, encourage groups to graph in rows instead of columns (as in Activity 2.1), to reinforce reading from left to right. For example, turn the above graph 90° to the left and you will have a graph in rows rather than columns.

Activity Extension: Field Flower Graphing

Take students to a weedy part of the schoolyard (a lawn or planted beds) or to a field with a variety of wildflowers. Give each student or group of students a certain area to examine. Have them count all the different flower colors they find in the area. If the class is ready for more extensive graph work and can use numbers instead of pictures, have them graph both individual and class results for comparison.

Activity Extension: Flower Scents–Observe differences among flower scents

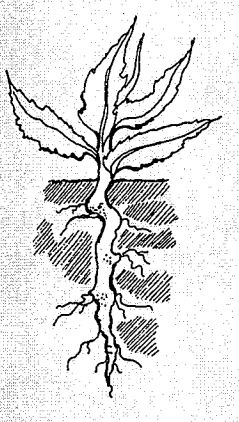
Put an assortment of scented soaps, candles, and incense out for students to smell. Can they guess the kinds of flowers these things are meant to smell like? Let students smell the cultivated flowers to compare with the man-made scents. Take the students outside and find flowers to smell. Ask them to describe the scents with terms such as *close sniff* (weakly scented), *big sniff* (strongly scented), *tangy* (spicy or acrid), *old trash can* (putrid, fly-pollinated), or *tasty* (food-like smells).

The Job of a Flower

The flower is where the seed is made, and each flower's design can use size, shape, scent, and color to help carry out this mission. Plants that depend on pollinators to reproduce make their flowers an invitation to "come visit."

The Job of a Stem

Stems—and the water-carrying tubes inside them—represent a big step in the evolution of plants. The earliest plants lived only in or near water and thus depended on submergence or frequent contact with water. The stems in today's plants have tiny tubes to carry water and minerals from the roots to other parts of the plant, and to carry food from the leaves to the rest of the plant. Most stems also hold up leaves and other plant parts that grow above ground.



The Job of a Leaf

The leaf is the life center of the plant. It functions as a food factory, using chlorophyll, sunlight, water, and air to make food. The leaf is also where transpiration, or breathing, takes place.

The Job of a Root

Roots have three jobs to do: They anchor a plant in the ground, take in water and minerals, and store excess food for the plant in case of future need.

ACTIVITY 2.2

Peek Between the Petals:
Observe differences in flower parts

English Language Arts and Reading: 18B

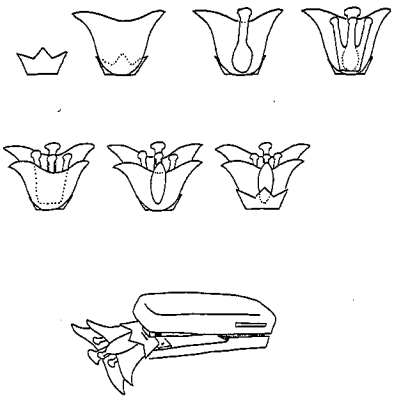
Before Activity

Gather materials:

- __ *Peek Between the Petals* templates, pages 32-35
- __ construction paper
- __ scissors
- __ stapler
- Photocopy a class set of the *Peek Between the Petals* templates.

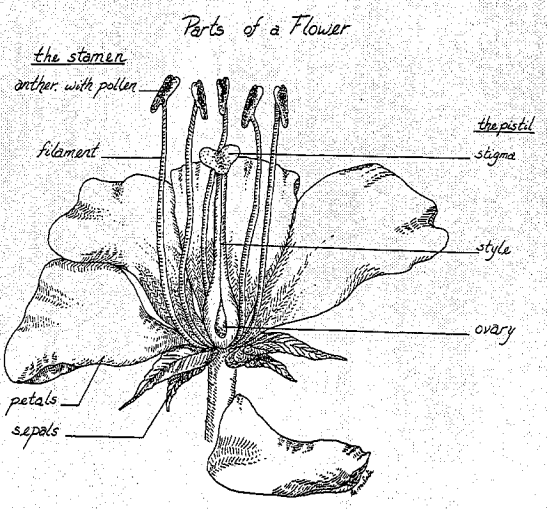
During Activity

1) Have students color and cut out their *Peek Between the Petals* handout.
2) Have students build a flower in proper order from back to front. Then have them staple all parts together at the bottom.
3) Help students label each of the parts and explain to them what each part does. (Students will need to know the correct names of flower parts for Activity 2.3, *Operation Dissection.*)



Parts of a Flower

The *sepals* are small, green floral parts that protect the developing flower bud like a suit of armor. They are the outermost flower parts and create a whorl called the *calyx*. When the flower blooms, the sepals usually remain green and are thicker than the petals.



Petals function to attract pollinators. They use their shape, size, and color to attract bees, butterflies, and birds to their nectar. These showy parts together make up the *corolla.*

Stamens are the male part of the flower that make and hold the pollen. Stamens consist of a *filament* growing with a pollen-bearing *anther.* Stamens can stand free or are sometimes fused together.

A *pistil* is the female part of the flower. It has a sticky top (*stigma*) to capture pollen. Once the pollen is on the pistil it travels down to the *ovary* and fertilizes the waiting egg, which eventually forms a seed. A pistil (sometimes called a *carpel*) consists of an ovary, which contains the egg-bearing ovules, and a *style,* the elongated tube connecting the sticky stigma to the ovary.

Activity Extension: Follow Your Nose– Using Your Sense of Smell to Find Hidden Objects

Fill one paper bag with crumpled paper, one with popped popcorn, and one with air. Staple the tops closed and hide around the room. Challenge one or more students to locate the food you have hidden *without using hands*. Once the bag of popcorn is found, ask how the student knew food was inside. Could he or she find the bag *just* by using the nose? Would the popcorn be easier to find if there were clues for the eyes?

Many pollinators are attracted to certain flowers by the smell they give off. Beetles, for example, are attracted to strong, spicy or fruity smells, while flies like flowers that smell like rotting meat.

Teaching Tip

These flowers are good choices for this activity:

- *Wildflowers: evening-star rain-lily, bindweed, onion or false garlic, evening primrose, silver-leaf nightshade, tobacco, partridge pea, velvetleaf, buttercup, wine-cup, rock rose, phlox, foxglove, erect dayflower, spiderwort, baby blue eyes, purple gerardia.*

- *Store flowers: any with large petals, such as gladiolas, alstroemeria, or lilies.*

Avoid very small flowers, compound flowers, or flowers with specialized parts.

ACTIVITY 2.3

Operation Dissection: *Identify the variety of flower parts among species*

Before Activity

Gather materials:

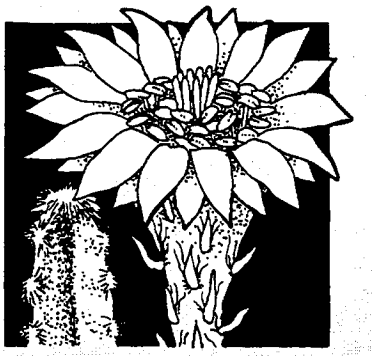
- ___ one-half class set of a single variety of flower
- ___ one-half class set of a mixture of 10 different varieties of flowers
- ___ one-half class set of tweezers
- ___ construction paper
- ___ *Parts of a Flower* template page 36
- ___ tape

- For the first dissection activity, place same-variety flowers on contrasting color construction paper. Write the plant's common name on each piece of paper, if possible.
- For the second dissection activity, place different-variety flowers on contrasting color construction paper. Write each plant's common name on its piece of paper, if possible.

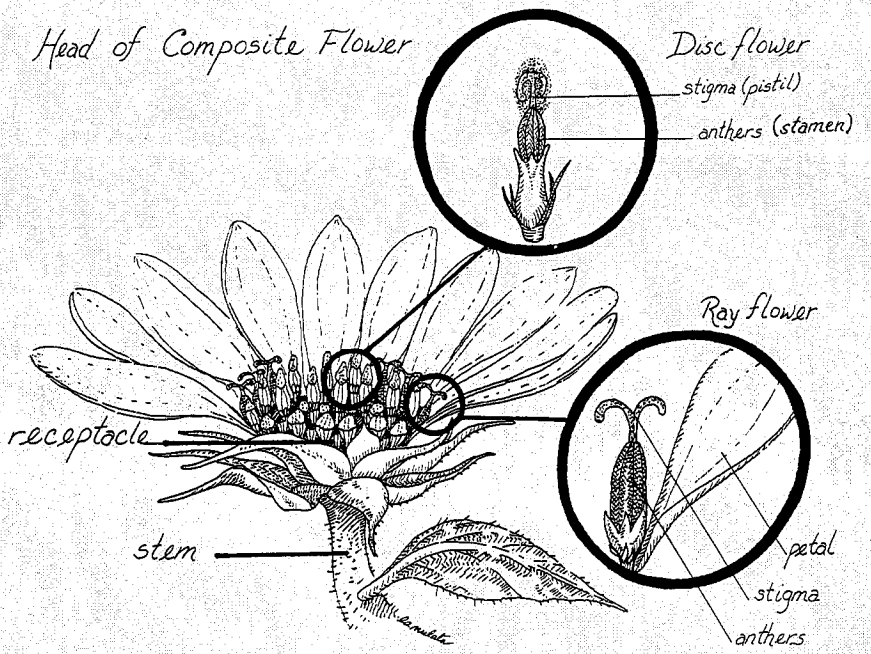
During Activity

1) Use the largest same-variety flower to demonstrate to the class how to dissect a flower. Use the *Parts of a Flower* template to help identify different flower parts.
   - First use tweezers to remove the outer green petal-like structures called sepals. Tape them to a piece of construction paper and label.
   - Next remove the petals, the stamens, and the pistil. Carefully tape and label them on the paper.
   - Before taping the stamens, shake some of the pollen grains from the anthers onto the paper and tape down.
2) Give student pairs one each of the same-variety flowers. Have them follow your procedure to dissect their flowers, tape the parts to a piece of construction paper, and label. Explain that any differences among the flowers (such as size) are not important; all the flowers belong to the same variety.
3) Next give student pairs one each of the ten different-variety flowers. Have them follow the same procedure for dissecting, taping, and labeling.
4) Have students compare the differences among the flower varieties. Do the parts have different shapes? Different amounts? Are all the flowers complete with sepals, petals, stamens, and pistils?

Simple Flowers



The oldest and simplest flowers have many petals of the same shape. As flowers changed during the last 100 million years, newer species eliminated parts or had parts that fused into more complex and specialized structures. Many of these modifications illustrate how flowering plants took advantage of small and unique pollination niches in the animal world.



Compound Flowers

When trying to identify the male and female structures in flowers, certain kinds of flowers will initially pose a challenge for both the teacher and students. One such challenge is the sunflower family or *Asteraceae* (*Compositae*).

Most members of the sunflower family have a "daisy type" flower composed of two different types of flowers. The "brown eye" of the Brown-eyed Susan is actually composed of many *disc flowers* surrounded by the outer *ray flowers*.

Activity Extension: Compound Flower Investigation

Give a copy of the *Head of Composite Flower* template on page 37 to the student groups with a compound flower (sunflower, Indian blanket, or Mexican hat) and a magnifier. Have them closely examine the flower to see if they can find the pistils and stigmas of the inner disc flowers and the single petals of the outer ray flowers.

Some members of the sunflower family may be missing one of the flower types. Basket flowers, for example, lack the outer ray flowers, while white dandelions have no disc flowers.

Activity Extension: Design a Flower–Create a flower garden.

Have students design and make their own craft flowers. Make sure they include all the different parts of a flower they have learned about. Attach the flowers to the classroom "flower garden." Have students measure and record the size of their flowers on the chart.

ACTIVITY 2.4

Keeping Up:
Strengthen a stem to hold a plant upright

Before Activity

Gather materials:

__ string

__ five to eight pompoms

__ modeling clay

__ glue and/or tape

__ assorted craft supplies and recycled materials, including thread or floss, craft sticks, stiff plastic mesh, etc.

- Cut 5 to 8 pieces of string 8" long. Make a "vine" by attaching pompoms at one end and anchoring the other end in a small ball of modeling clay.

During Activity

1) Divide class into small groups and give each a prepared "vine." Explain the string represents a stem that has no rigid structure, while the pompom represents a flower.
2) Give students glue/tape and craft supplies. Challenge them to make their stem stand upright and hold the pompom flower in the air. What will they use to strengthen their stem? (Some ideas: harden the string with glue or tape, wrap paper around it, or wrap it around a stick.)
3) Ask students to imagine they are plants with weak stems. Where can they live if they are not a climbing vine?

- on the ground where stems lie flat (like a watermelon or pumpkin plant)
- in the water, where plants are buoyant and can float (like a water lily)

Activity Extension: Make and Match Leaves–Make leaf pattern crafts

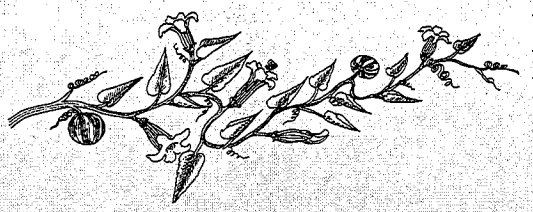
Ask each student to bring several leaves from home or the schoolyard. Have them select the leaves they like the best to make a leaf rubbing or a leaf print. To make a leaf rubbing, have students cover a leaf with a piece of white paper and rub a crayon sideways (along the length of the crayon, not on the point) across the paper.

To make a leaf print, have students paint the back of a leaf with tempera paint then turn it over onto a sheet of white paper. Next have them cover the leaf with a paper towel, rub it flat with their hand, and then take the towel and leaf away. Hang the leaf rubbings/prints around the room. Place the original leaves in a pile and have students match each leaf with its picture.

Lean On Me

Sometimes plant stems cannot hold up plants. These stems don't have any rigid strengthening cells—or at least not very many! What to do if you lack a backbone? Lean on something! Vines depend on other strong plants or structures to go up.

Twiners are vines that grow up in a spiraling direction, wrapping around woody stems and trunks or manmade posts and poles. Beans, for example, wrap around a stake or pole.



Some plants, such as ivy, throw out invasive roots along the stretch of vine to help them grip into a support structure. They can pull down walls if left to burrow into masonry.

Grasping parts, called *tendrils*, come out of the top of some vines to attach the plant to a support. This helps the thin and flexible stem grow straight up. Sweet peas, green briar, and clematis vines rely on tendrils to climb up to the sun's light.

ACTIVITY 2.5

Food Line:

Do the work of the carrying tubes in a plant stem

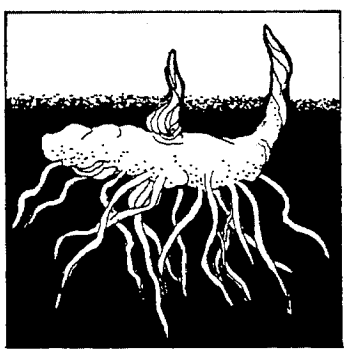
Before Activity

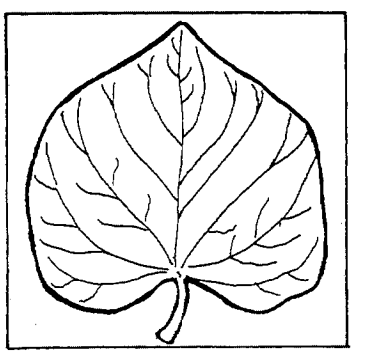
Gather materials:

- __ plastic balls
- __ poker chips
- __ bucket
- __ food tray
- __ small bag

During Activity

1) Tell students that today they are going to do the job of a stem. Have them line up side by side in two equal lines, facing each other. Put the bucket full of plastic balls at one end of the water line and the food tray with poker chips at the other end of that line.
2) Explain the jobs students will be performing:
   - One line will be the *xylem tubes;* they will carry water (plastic balls).
   - The other line will be the *phloem tubes;* they will carry food (poker chips).
   - The student closest to the water bucket will be a *root hair,* picking up the water one drop at a time and passing it along to the next child in line. This water drop gets passed all the way to the end of the xylem tube line.
   - The student at the end of the xylem tube line will be the *leaf chef,* taking the water drop and exchanging it for a food morsel. The food morsel is passed down the other line to the root hair, who will put the chip into storage in the small bag.
3) Have students practice passing several water drops and food morsels.





4) Tell students it has just rained and the weather is warm. Have the root hair pick up and pass along the water drops faster. Practice this and then add other elements:

- Days are getting shorter, so the leaf chef works shorter hours.
- Days are getting colder, so the leaf chef slows down.
- There is a drought, so the root hair picks up water very slowly.

5) The bucket runs dry, so no more food is made.

6) Have students in xylem tube line switch jobs with students in the phloem tube line.

7) Ask what happens to the leaves of many plants in the winter. If the leaf chef falls off the stem, what happens to food production? Try it and see.

Activity Extension: Transpiration

Observant students will notice that the food chef is left with a tray of water drops. What happens to the water left in the leaf? Answer this question with a demonstration.

In the morning, find a tree in a sunny part of the schoolyard. Place a clear plastic bag over one or more leaves and close with a twist tie. Return to examine the bag in the afternoon. The inside of the bag will be covered with drops of water. Tell students that a plant's extra water evaporates from the leaves.

Transpiration is the movement of water from the roots to evaporation from the leaves.

Extension 2.5: Leafy Observations–Identifying Plants Using Their Leaves

Take students on a hike to help you collect leaves from trees and bushes. Let them show you which leaves to pick. Pick *two* leaves each from 12 different plants for a total of 24 leaves.

When you return to the classroom, divide the class into two groups. Give each group one leaf from each of the 12 plants. Have each student in a group choose one leaf to draw. As students draw, point out the special edge or shape of their leaves, encouraging them to include specific details.

When all students have finished their drawings, collect each group's work in a stack and exchange it with the other group. Challenge students to identify the leaf drawing that is the same as theirs.

If students are able, have them describe the leaf in writing. Provide rulers and magnifiers. Give them words for the parts of the leaf, such as *blade, stem, midrib,* and *veins*.

ACTIVITY 2.6

Leafy Combos: *Hunt for leaves with different combinations of shape, color, texture, and edge*

Before Activity

Gather materials:

- __ *Leafy Combo Wheel* template, pages 38-39
- __ cardstock or paper plates
- __ brass brads
- __ crayons or markers
- __ scissors
- __ assorted textured fabrics (fuzzy felts or furs, smooth leathers, rough sandpaper, spongy lined vinyls)

Create four to six different *Leafy Combo Wheels* using the following instructions:

- From the four leaf characteristics on the *Leafy Combo* template—color, texture, edges, and shape—select *two* to photocopy on cardstock or on plain paper.
- If using cardstock, cut into two circles. If using paper plates, glue plain paper copies in place.
- Prepare wheels as necessary:

  Leaf color: Color with shades that are dominant in the schoolyard or a park you will be visiting.

  Leaf texture: Select appropriately textured fabrics and glue in place.

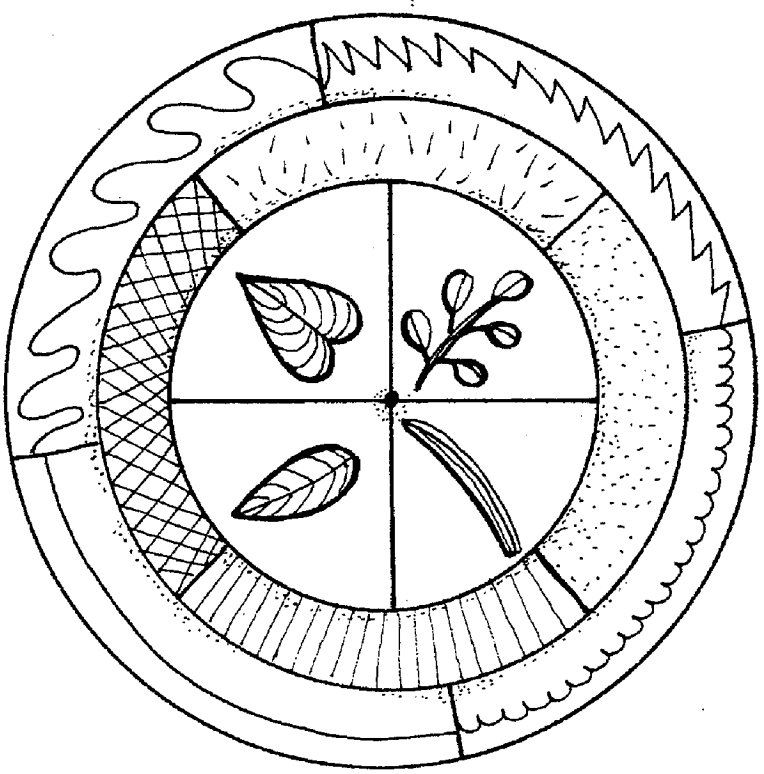
  Leaf edge: Cut appropriate edges on the outer rim of the plate or cardstock.
- Place one circle (or paper plate) on top of the other and attach with a brass brad in the center.

During Activity

1) Visit the schoolyard or a nearby park. Divide class into groups and give each group a *Leafy Combo Wheel.* Ask each group to turn the circles in their wheel to create a leafy combo to look for. For example:

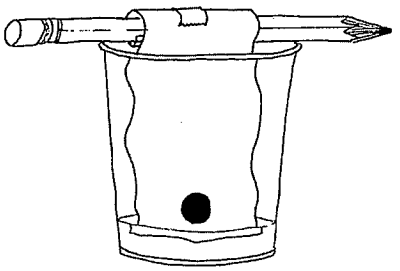
   Color/Shape Leafy Combo Wheel
   - light green, heart-shaped
   - dark green, lance-shaped

   Edge/Texture Leafy Combo Wheel
   - smooth-edged, hairy
   - tooth-edged, rough
2) Have students look for leaves matching their leafy combos.
3) Have groups trade their *Leafy Combo Wheels* and search for more leaves.



ACTIVITY 2.7

More Than Meets the Eye: *Separate out different leaf pigments with chromatography*



Before Activity

Gather materials:

- __ pecan leaf
- __ two coffee filters
- __ black marker (non-permanent)
- __ two small clear glasses
- __ two pencils
- __ rubbing alcohol
- __ scissors
- __ tape

- Cut two 3" wide strips from the coffee filters.

During Activity

1) Ask students about the color of leaves. They *look* green, but could other colors be hidden behind the green? Tell students they will do an experiment to find out.
2) On one filter strip use a black marker to make a dime-sized spot about 2" from the bottom edge. On the other filter strip rub a pecan leaf with the edge of a coin to make a green spot about 2" from the bottom edge.
3) Tape each filter strip to a pencil. Rest the pencils across the tops of the glasses so the strips hang down inside. Use a marker on each glass to show where the bottom of each strip is located.
4) Remove the filter strips and fill each glass with enough rubbing alcohol to wet the bottom inch of each strip without submerging the black and green spots. Then put the filter strips back in the glasses.
5) As the alcohol wicks up the filter strips, show student the separation of colors. Ask students what they think is happening. What colors are present in the black ink mark and in the green pecan leaf rubbing? Students will have to look closely at the leaf pigments to see the subtle colors of yellow and brown as they move out of the green spot. Ask students how this could relate to the changing colors of fall foliage.

Fall Colors

A leaf has a variety of pigments inside its cells. *Chlorophyll a* and *b* give the leaf the characteristic green color, and both gather light energy for the food production process. Occasionally a leaf may store the purple-red pigment *anthocyanin*. *Carotene*, like its namesake the carrot, comes in an orange-yellow shade and also assists in photosynthesis, as do the yellow *xanthophylls*.

When the cold weather of fall begins to seal off a leaf's *pedicel* or stem from the rest of the plant, the green chlorophylls die and fade away. When this happens, the red and yellow pigments become visible.

ACTIVITY 2.8

The Root of the Matter: *Explore the role of roots as food storage bins for plants*

Before Activity

Gather materials:

__ one or more books about plant roots, such as *The Carrot Seed* by Ruth Krauss and *Tops and Bottoms* by Janet Stevens

__ several examples of root vegetables, such as carrots, turnips, beets, and radishes

During Activity

1) Read the book aloud to the class.
2) Show students a carrot and ask which part of the plant it is. Ask students what other roots people eat. Show them the root vegetables you have on hand. (You may want to give students small pieces of these vegetables to taste.)
3) Ask students why a plant might need to store food. Why might some plants have bigger roots than others?

ACTIVITY 2.9

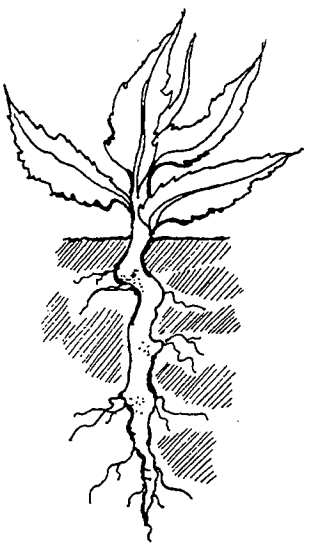
Root Roundup: *Identify the root systems of weeds*

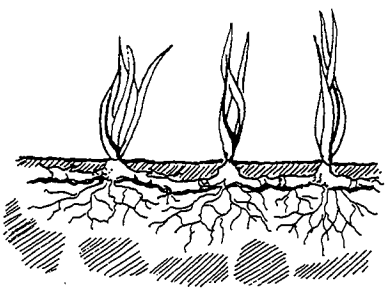
Before Activity

- Uproot several weeds from the schoolyard, some with fibrous root systems and some with tap root systems.
- Make a photocopy of each "mystery plant."

During Activity

1) Cover the top portion of each "mystery plant" picture—hiding all but the root system—as you show them to the class. Tell students these plants came from the schoolyard and ask if they can figure out which kinds they are. What hidden parts would they need to see to identify the plants?
2) Take the class outside to the schoolyard and pull several weeds out of the ground to show students the roots. (Pulling weeds is easier if the soil is damp.)
3) Show students which plants are not to be uprooted, then have them pull up assorted weeds they think might match your "mystery plants." This activity helps students see that certain types of plants have the same kind of root system. To keep up interest in pulling really tough plants out of areas where they are not wanted, have a contest for students to find the plant with the longest taproot. (Plants can have a fibrous root system, a tap root system, or a combination of both.)
4) Back in the classroom, uncover your "mystery plant" pictures and see if the students can now identify them.
5) Compare the root systems. How are the roots different? What might these roots do for anchoring the plants? From where would the different roots be collecting water and minerals?





ACTIVITY 2.10

Root Grippers:
Conduct an experiment about roots and erosion

Teaching Tip

Use this experiment to model the correct approach to the scientific method. When the experiment is over, help students recognize each part of the experiment design and its importance. Continue to reinforce the steps of the scientific method, and the purpose of each, for the experiments in the remainder of the Growth and Change curriculum.

Before Activity

Gather materials:

- ___ several small potted plants
- ___ four small pots, empty
- ___ potting soil
- ___ radish seeds

During Activity

1) Review with students the two functions of roots they have studied to this point: to get water and nutrients from the soil and to store food for the plant. Ask students to consider this question: Do roots hold soil in place?
2) Ask students how they might find an answer to this question—an experiment! Introduce them to the four steps of the scientific method. Point out that they already have the *question*. Now they must come up with a *plan*.
3) Introduce the concept of an experimental *control* and explain why it is important for understanding the results of the experiment. Tell students they should include controls in their experiment plans.
4) Help students brainstorm a variety of ways they can conduct their experiments. What procedures will they use? (For example, turning pots upside-down, putting pots in front of a strong fan, or flooding pots with streams of water.) Ask students what materials they will need besides what you have already provided.
5) Make a list of the steps in their plan. Remind students that plants need some time to grow (about one week for radishes).
6) As they conduct their experiments, help students record their results. When the experiments are concluded, ask students if the experiments really answered the question. Would they like to repeat the experiment with other kinds of plants, to see if they get the same result?
7) Ask students why holding soil in place might be important. What service do plant roots provide to the land? Discuss erosion and ask students to tell about places where they have seen erosion.

The Scientific Method

Question: What do we want to know? This is often restated as a problem.

Plan: How can we find the answer, using materials and procedures? This step depends upon previous knowledge.

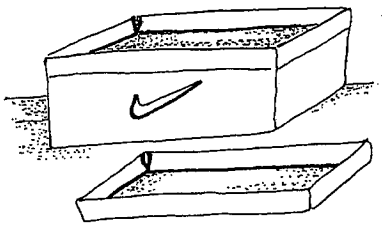
Results: What happened? Are the results reliable? Repeating trials are important in science, to see if we get the same results more than once.

So What: What might the results mean? What conclusion can we make from the results?

Lesson 3:
Growing plants have needs

ACTIVITY 3.1

A Light Experiment:
Discover what happens if a plant doesn't get light



Before Activity

Gather materials:

__ 2 small potted plants of the same variety

__ cardboard box large enough to fit over one of the plants

During Activity

1) Place both plants in a sunny spot. Cover one plant with the cardboard box so that it receives no light.
2) Water the plants equally for two weeks.
3) At the end of the two-week period, compare the plants. Which of the plants is greener? Taller? Record the findings.
4) Have students write their conclusions. What do they think would happen if they left the box on the plant? Could a green plant live without light?

ACTIVITY 3.2

Recipes for Research: *Discover how light, water, and soil meet the needs of plants*

Before Activity

Gather materials:

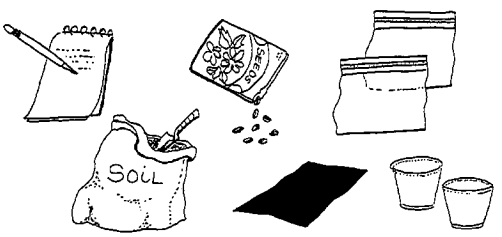
__ *Recipe Card* templates, page 40-44

__ materials and supplies, as itemized on each *Recipe Card* (if appropriate)

- If you intend to conduct *Recipe Card* experiments in class, set up a classroom center with the appropriate supplies.
- If you intend to have students conduct *Recipe Card* experiments at home with their parents, photocopy the appropriate amount of each card.

During Activity

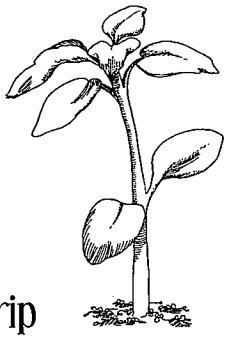
1) Have students conduct experiments on plant needs, either at a classroom center or at home.
2) If you wish, display results of the experiments in a small classroom science fair.



Teaching Tip

Keep these considerations in mind as you plan and conduct these experiments:

- *Science experiments with plants take an extended period of time, during which consistent maintenance is required.*
- *Science experiments often need to be repeated.*
- *The plants most easily available—low-light house plants or hardy succulents—will take much longer to show the effects of water and light deprivation. An outdoor, sun-loving bedding plant is recommended.*



During Your Field Trip

While you are on a field trip, your class will

- *explore the interdependence of plants and insects*
- *discover the ways leaves help roots get water*
- *discover how plant leaves have adapted to different amounts of light*
- *make a guidebook to help identify the life stages and parts of plants*
- *search for plant life stages and plant parts in nature*
- *examine and compare soil samples*
- *play a game of chance for seed germination.*

Teaching Tip

Throughout your field trip, remind students to be on the lookout for ways plants are interdependent with insects and other animals. Look for holes on leaves and grasses in bird nests. Look in tall grasses, bushes, and shrubs for insects; look for flowers that might provide sweet nectar to bees and butterflies; and search for beetles and earthworms in the mulch.

Lesson 4: Plants adapt to fit into a complex environment

ACTIVITY 4.1

Making a Joyful Noise:
Explore the interdependence of plants and insects

Before Activity

Gather materials:

- *Joyful Noise: Poems for Two Voices* by Paul Fleischman

During Activity

1) Tell students that just as wildflowers depend upon certain insects (pollinators) to help them survive, the insects and animals need wildflowers and other native plants, too. Explain that while students explore the plants, they will also meet many insects and other creatures that live there—including grasshoppers.
2) Read the poem "Grasshoppers" from *Joyful Noise: Poems for Two Voices* with an adult partner. (You might want to rehearse before the field trip.)
3) Teach students the last three lines of the poem.
4) Read the poem again with your partner several times, signaling for students to repeat their three lines at the end of the poem.

ACTIVITY 4.2

Water Route Search:
Discover the ways leaves help roots get water

Before Activity

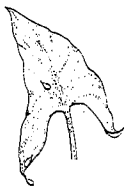
Gather materials:

__ spray bottles

During Activity

1) Briefly review with students the ways in which light, water, and soil meet plants' needs.
2) Tell students they will walk through a garden area to look for ways that plants' needs are being met. In particular, they will look for the ways that leaves help plants get the water they need.
3) Divide students into groups and give each group a spray bottle. Direct each group to a specific theme garden and ask them to use their spray bottles to look for plants with:

• leaves that steer water to the central stem,



• leaves that steer water away from the stem but down to the roots below the soil,

• leaves that trap water (with hairs), and

• leaves that funnel the water (with a drip tip) into the garden plot.

4) Ask students what happens when the water from their spray bottles goes from the leaves to the soil.
5) Point out any water features at your location (ponds, water gardens, irrigation systems, water harvesting systems, etc.) Ask students what they think the water source is for the water features. Have them look for ways that the systems are designed for collecting water.

ACTIVITY 4.3

Leaf Location Game: *Discover how plant leaves have adapted to different amounts of light*

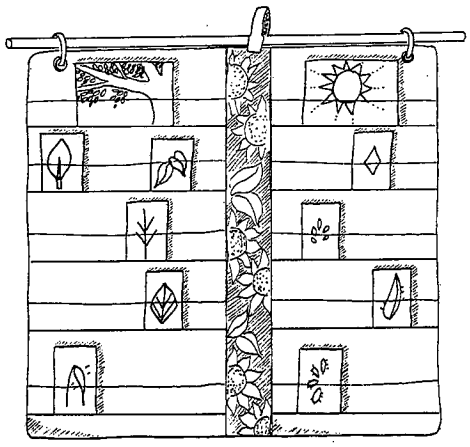
Before Activity

Gather materials:

__ *Leaf Location* chart
__ Set of *Sun and Shade Leaf Characteristic Cards* templates, pages 45-47
__ *Sun and Shade* templates, pages 48-49

During Activity

1) Use patterns of sun and shadows in an area to explain why light might not always be available to plants. Some plants need more light than others. Tell students they will play a game to explore the different light needs of plants.
2) Designate a collection area and display the *Sun and Shade* signs on a chart.
3) Give student partners each a plant characteristics card. Ask students to look around the area for plants that might have characteristics similar to the ones on their cards.
4) When partners find a plant or group of plants showing the characteristic on their card, have them decide if that plant lives in the sun, shade, or a combination of both.



5) Students then can put the card under the proper sign in the collection area.

Teaching Tip

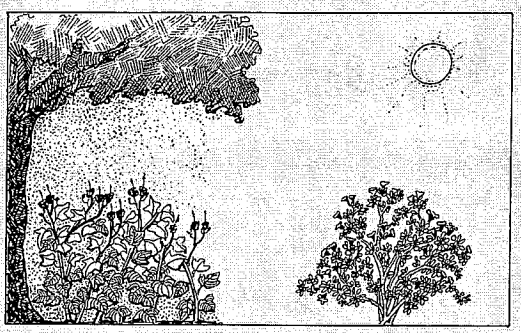
This is an observation game. If a student gives a plausible reason for a plant characteristic that does not follow the guidelines, please accept it. There are many variations in nature!

Sun or Shade?

Leaf morphology is strongly influenced by light levels. Leaves in full sun are usually smaller and thicker (more layers of mesophyll), with less of the light-harvesting green chlorophyll. Also, they are arranged more thickly on the stem.

Here's why: leaves on sun-drenched plants reach a light saturation point beyond which the sun's radiation cannot be used efficiently. Ideally, such a plant will have large enough leaves arranged strategically on the stem to evenly receive the light but small enough to reduce the impact of the sun's heat, which causes water loss in transpiration. These plants also often have leaves that are hairy or shiny to reflect some of the light.

Plants in the shade will have more green chlorophyll and larger leaves, without the light-reflecting characteristics of hairy or shiny surfaces.



Leaf Characteristics for

Sun	**Shade**
hairy	smooth
long and narrow	broad
gray-green	dark green
thick	thin
shiny	dull
small	large

Note: There are many variations in nature. If a student gives a good reason for a plant characteristic that does not follow this guideline, accept it. This is a game of observation.

ACTIVITY 4.4

Get Ready for a Plant Scavenger Hunt!

Make a guidebook to help identify the life stages and parts of plants

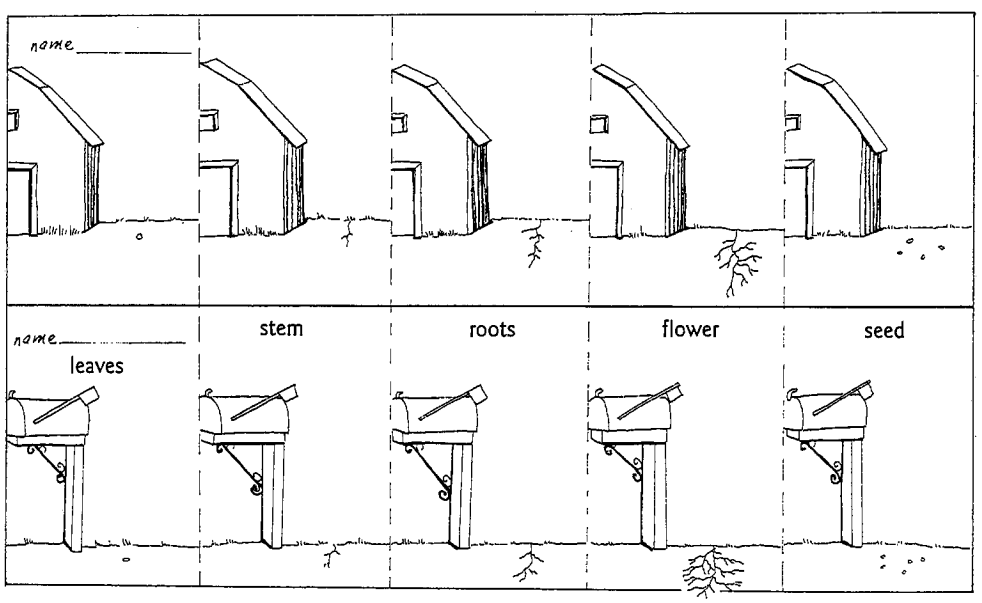
Before Activity

Gather materials:

- ___ class set of the *Scavenger Hunt Guidebook* template, page 50
- ___ assorted craft materials, colored pens, pencils, and crayons

During Activity

1) Tell students they will be going on a plant scavenger hunt, but first they must make a guidebook to help them on the trail. The guidebook will have two parts: One part will show a sunflower life cycle timeline; the other part will show plant parts. Give each student a *Scavenger Hunt Guidebook* template.
2) Have students begin with the sunflower life cycle timeline on Row 1. Tell them to use the five frames to draw and color 1) a seed, 2) seedling, 3) a flowering plant, 4) a plant gone to seed, and 5) a dead plant with scattered seeds.
3) Next have students work on Row 2, which focuses on plant parts. The name of a plant part—stem, roots, leaves, flower, and seed—is written at the top of each frame. Tell student to draw and color each plant part (or have them use craft materials to make the parts and then tape them to the pattern).
4) When the two rows are complete, cut page in half at solid line, and have students fold along the vertical lines in a fan or accordion fashion.
5) Tell students to bring their guidebooks as you lead them to the trail to begin their Plant Scavenger Hunt.



Teaching Tip

Explain that individuals of many plant species go through their life cycles at pretty much the same time. If students find a particular plant in bloom, then most members of that species will probably be blooming, too. Some plant species can bloom most of the year, while others may have a flowering season that lasts only a month. The flowering season can be spring, summer, or fall.

ACTIVITY 4.5

Plant Scavenger Hunt

Search for plant life stages and plant parts in nature

Before Activity

Gather soil collecting materials (for Activity 4.6, *Soil Sort*):

__ trowels

__ four labeled soil sample bags

- Make sure all students have their *Plant Scavenger Hunt Guidebooks.*

During Activity

1) Tell students they will begin by hunting for the different plant parts in their *Guidebooks.* As they walk the trail, do they recognize flowers, leaves, and stems? Can they see any fruits or seeds?

2) As you continue on the trail, have students look for the different stages in the plant life cycle. Have any of the plants gone to seed? Do any of them have flower buds ready to open? Students may need help recognizing seedlings of different species.

3) During this activity you will be collecting soil to use in Activity 4.6. Give four students each a trowel and a labeled soil sample bag. Have each student use the trowel to collect one soil sample along the trail—two students at a box in the meadow grassland and two at the oak grove at the end of the trail. There are also two bags of commercial potting soil they will use in Activity 4.6.

The Lady Bird Johnson Wildflower Center Cave

Ira Yeats grew up on the land that later became the Lady Bird Johnson Wildflower Center. His early childhood memories include searching for sick goats that liked to hide in the dark, cool cave on the Yeats' ranch. Also hidden away in the back recesses of the cave were trash mounds—leftovers from living and working that couldn't be burned. Filling in the caves with unwanted items seemed to be a good solution at the time.

Today scientists go into the cave to look for unusual animals and to study the way water moves through the earth. They now understand that the cave systems here at the Wildflower Center are a part of the honeycombed limestone aquifer recharge zone, feeding percolating rainwater into the underground waterway that comes up in spring-fed creeks and pools downstream. The cave can be seen as a direct route to groundwater—water used for swimming, bathing, and drinking by many Central Texas communities.

ACTIVITY 4.6

Soil Sort:

Examine and compare soil samples

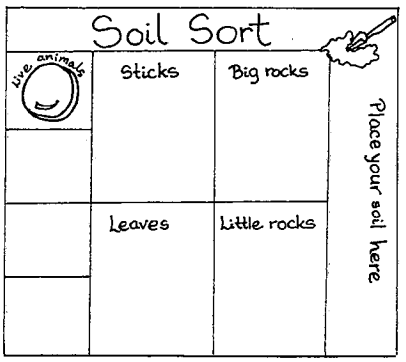
Before Activity

Gather materials:

- __ laminated soil sorting mats, page 51
- __ petri dishes for sorting individual samples
- __ two bags of commercial potting soil
  - Gather the trowels and soil sample bags from students (see Activity 4.5, *Plant Scavenger Hunt*).

During Activity

1) Divide students into six groups. Give each group one of the collected soil samples or a bag of commercial soil.
2) Tell the groups to sort their soil samples on the laminated mats. Have them sort twigs, leaves, pebbles, rocks, animal parts, and live animals from their samples into different petri dishes.
3) Have the class compare the soil samples. How are the soils different? How are they the same? Does the commercial soil have something that might be important to plants? Could different kinds of soils be better for growing different kinds of plants?



ACTIVITY 4.7

Bluebonnet Relay:

Play a game of chance for seed germination

Before Activity

Gather materials:

- __ six small traffic cones: three labeled on the bottom ("Early Spring Freeze," "Drought," and "Deer") and three blank
- __ six "bluebonnet seed" labels
- __ six "soil with buddies" labels
- __ six "warm day" labels
- __ six "sunlight" labels
- __ six "water" labels
  - Make labels using felt or index cards and permanent markers.

During Activity

1) Discuss with students the needs of bluebonnet plants, including light, water, warm weather, and soil with the proper "buddies."
2) Divide the class into relay teams with a minimum of five students on each team. To set up the relay race area: Mix up the traffic cones and place one at the start of each line to mark the starting position for each team. Mix up all the labels, and put at least five labels on the ground at the far

Teaching Tip

You may want to organize the second race differently from the first. Here are two options:

- *Roll up the labels so teams are still subject to the laws of chance found in nature.*
- *Leave the labels visible and tell students they are playing the game as gardeners. Unlike nature, gardeners can purposefully bring together all the elements a seed needs to grow.*

end of the race area opposite each team's cone.

3) Begin the race. Have each member of a team run to the label area—one at a time—grab a label, and run back. Continue until every student has gotten a label. When the race is over, congratulate the fastest team.

4) Ask students to look at their labels. Who has a bluebonnet seed label? Those teams with a seed might be able to grow a bluebonnet if the team also has all the other necessary elements. Does any team have all the elements—seed, water, light, warm days, and good soil—necessary to grow a bluebonnet plant? Discuss the amount of luck or chance involved for a team to have all the necessary elements. Point out that luck is just as important in nature.

5) Help the teams redistribute their labels so every team has all the necessary elements to grow a bluebonnet plant. Then flip over each team's cone to see if their plant has been damaged by a natural hazard, such as an early spring freeze, a drought, or a grazing deer. If it has, the plant will not bloom. If it has not, it will bloom and produce seeds.

6) Let students run the race again if time allows. Shuffle the traffic cones around so teams won't know if they are facing a hazard.

Lesson 5:
Plants are part of changes that happen very slowly

ACTIVITY 5.1

Soil Silhouettes: *Observe the composition of soil*

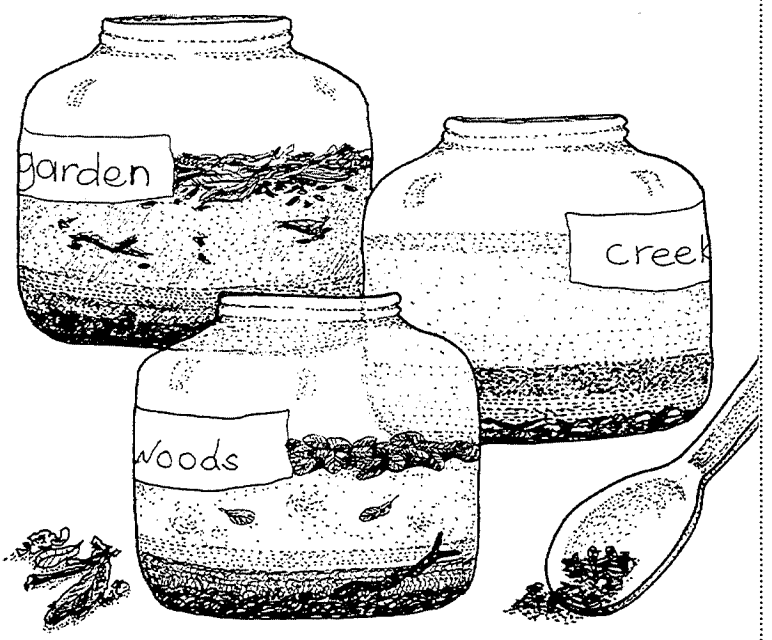
Before Activity

Gather materials:

__ three jars with lids that close tightly

During Activity

1) Have students help you collect three soil samples (at least one cup each) from different locations on the school grounds.
2) Put each soil sample in a jar and label with the location where it was collected.
3) Fill each jar with water, leaving two inches of space at the top. Put the lid on tightly and shake each jar vigorously for one minute. Then set the jars aside overnight.
4) In the morning use a marker to indicate the different levels of rock and silt. Have students draw a picture of each jar and color the different layers.
5) Ask students why each jar had soils with different amounts of rocks or clay layers. Where did the different layers in the soil come from?



After Your Field Trip

To follow up on your field trip visit, your class will

- *observe the composition of soil*
- *change rocks into soil*
- *observe how plants help break rocks into soil*
- *observe how rocks can melt away to form caves.*

Teaching Tip

Previous lessons have addressed changes that happen over a short, observable time period—germination, growth, blooming, and producing seeds. However, plants also help create and are affected by changes that happen very, very slowly.

Help students think about changes that occur on a much longer timeline. Explain that the Earth has gone through changes since the beginning of time. These changes are still happening, although very slowly. Examples of long-term changes include the extinction of plants and the change of entire ecosystems. The activities for this lesson focus on changes in rock, such as rock turning to soil and rock wearing away to form caves.

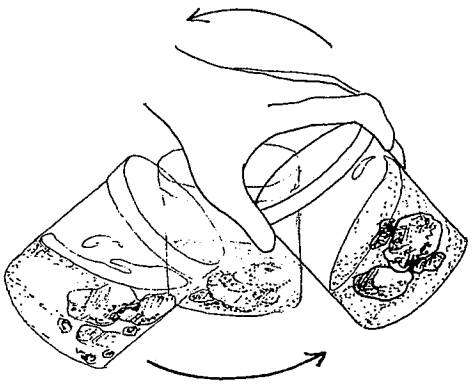
ACTIVITY 5.2

The Work of Ages: *Change rocks into soil*

Before Activity

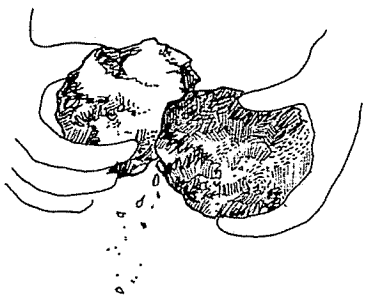
Gather materials:

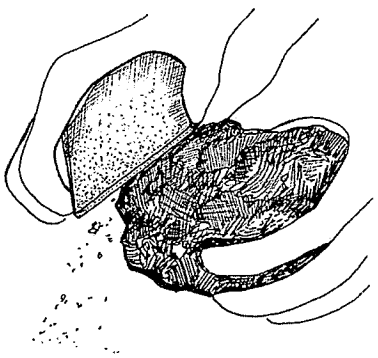
- __ rocks: sandstone, limestone, granite, and shale
- __ leaf litter
- __ sandpaper
- __ ice cubes in a medium-sized bowl
- __ water in plastic jars with lids
- __ paper
- __ petri dishes
- __ spray bottle with water

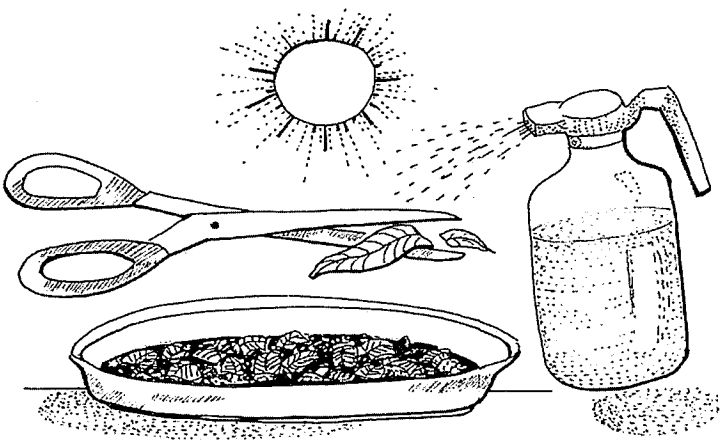


During Activity

1) Put all materials except leaf litter on a large, clean work surface where students can easily gather around.
2) Tell students they are going to change rocks into soil using the same processes nature uses: water erosion, wind erosion, friction, and freezing. Describe or demonstrate different things they can do. For example, rub two rocks together, swirl several rocks together in water, scrape rocks with sandpaper, or put rocks in ice. Encourage students to try using several processes in combination and in different sequences to see if their results change.
3) Tell students to collect their rock dust and fragments on pieces of paper and save them in petri dishes. As they are working, ask students to imagine how long it would take to change a rock the size of their school into rock dust.
4) For the final step in soil making, have students cut up the leaf litter and mix it with the rock dust in the empty ice bowl. Have them spray it thoroughly with water and then set it in the sun to dry.
5) When the soil is dry, ask students what they see. Would a plant be able to live and grow in this "soil"? What else might a plant need as an ingredient in the soil? Vitamins, minerals, organic nutrients?







ACTIVITY 5.3

Plants' Feet of Strength:

Observe how plants help break rocks into soil

Before Activity

Gather materials:

__ several dried beans

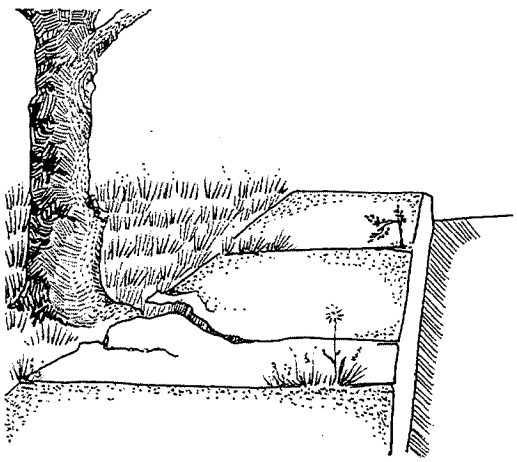
__ one or more plastic cups of moist soil

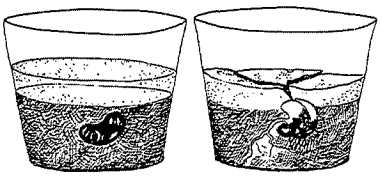
__ Plaster of Paris

- Soak beans overnight.

During Activity

1) Place several beans on top of each cup of moist soil.
2) Pour a thin layer of freshly prepared Plaster of Paris on top of the beans and place in a sunny window. Tell students to watch the cups and alert the class when they notice any changes. (As the beans germinate, their roots will split the plaster, just as growing plant roots are able to split boulders.)
3) Take students out to the school grounds to look for examples of this in nature. Can they find places where plants are growing in small cracks of pavement? Or places where plant roots have moved the sidewalk? How would this help make soil?





ACTIVITY 5.4

Dissolving Rock Cave:

Show how rocks can melt away to form caves

Before Activity

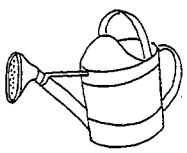
Gather materials:

__ sugar cubes

__ modeling clay

__ watering can

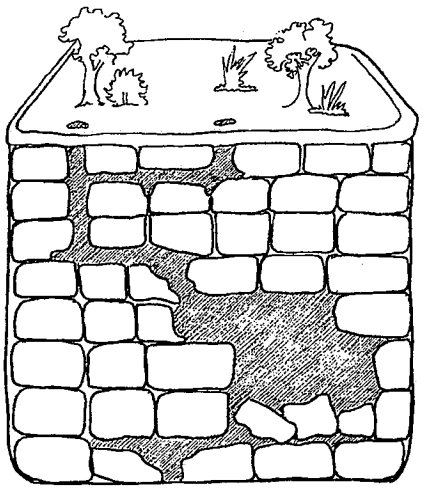
__ clear glass container, such as a jar, bowl, or casserole dish



During Activity

1) Ask students if they have ever seen a cave. How do they think the cave was formed? Explain that many caves in the Southwest are limestone that has "melted" by rainwater over thousands of years. The rainwater "percolates" through cracks in the rock until it reaches an underground waterway called an aquifer. As it "percolates,"

the water gradually dissolves and carries away small layers of limestone. Eventually, enough limestone has melted away to leave a cave. Tell students you will demonstrate how this happens.

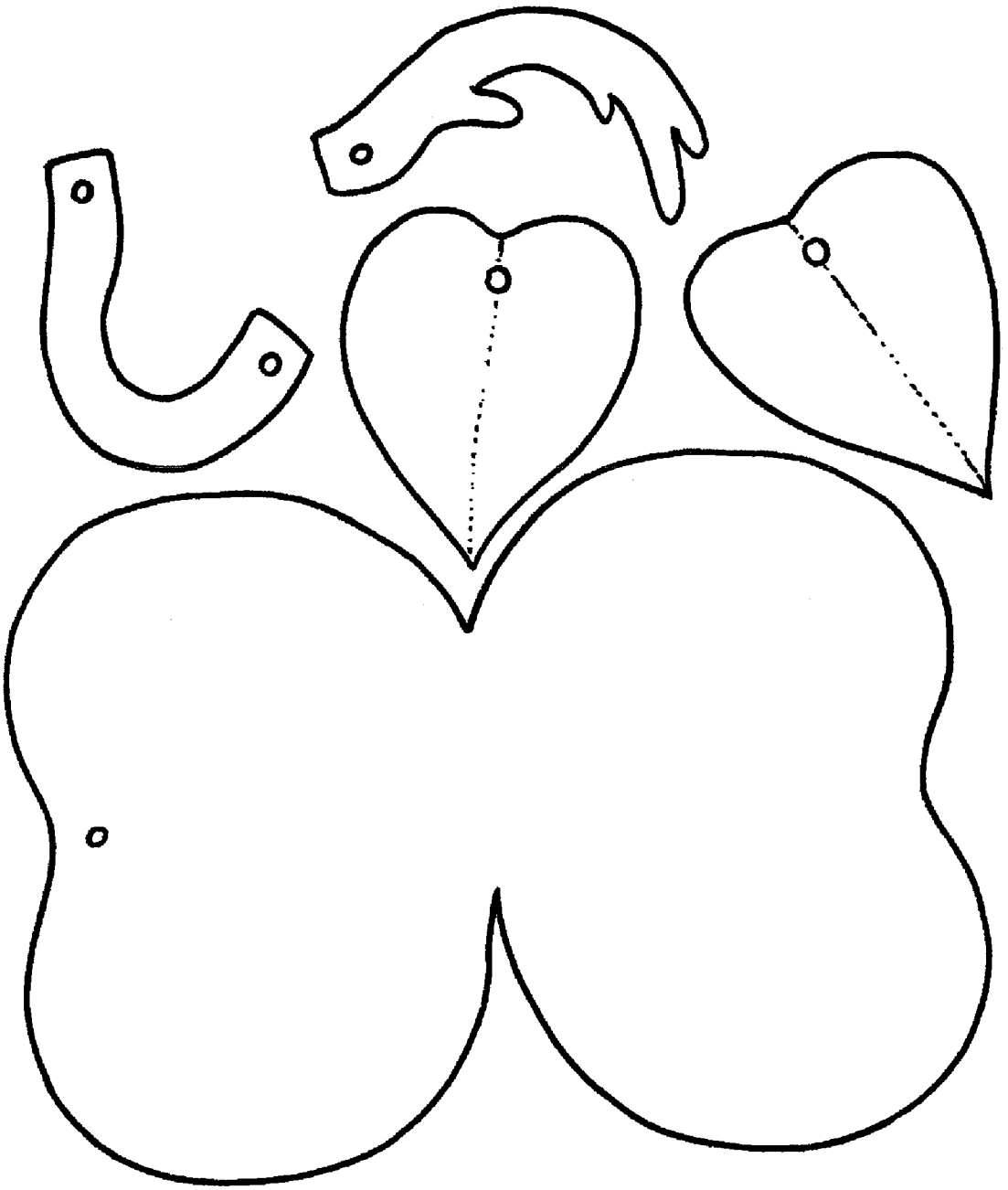


2) Cover the bottom of the container with at least four layers of sugar cubes. The sugar cubes represent limestone rock.
3) Place a layer of modeling clay, representing topsoil, on top of the sugar cubes and seal the edges against the container wall. Poke several holes in the clay with a pencil to represent cracks, crevices, and other breaks in the surface of the topsoil.
4) Sprinkle a small amount of water on the clay with the watering can. What happens? Sprinkle a little more water on the clay. Do students see any changes? Continue to sprinkle and observe as "caves" form and change.

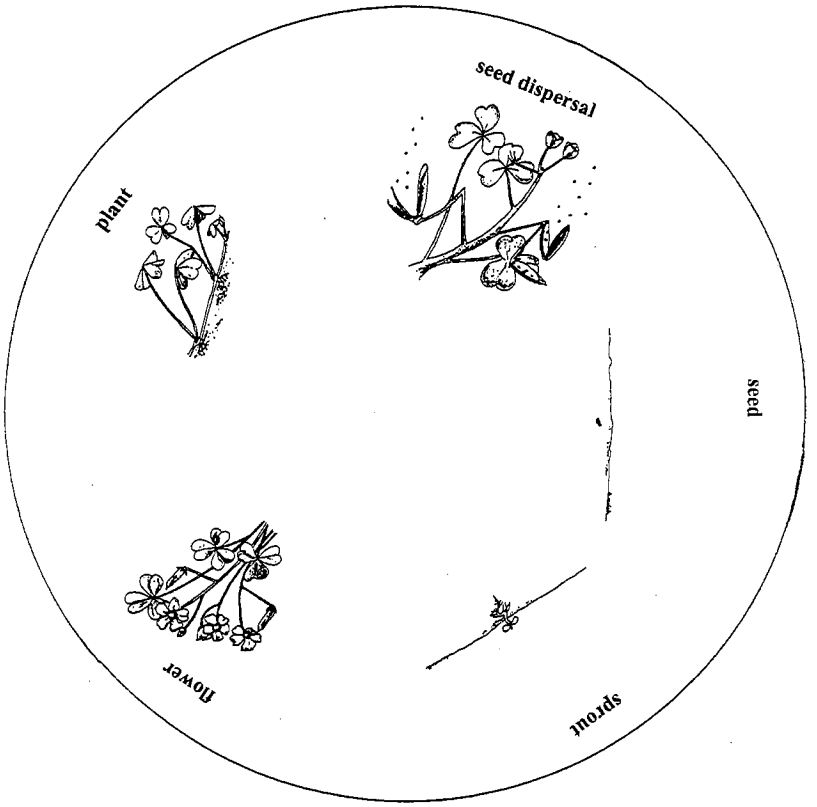
Appendix 1: Booklist

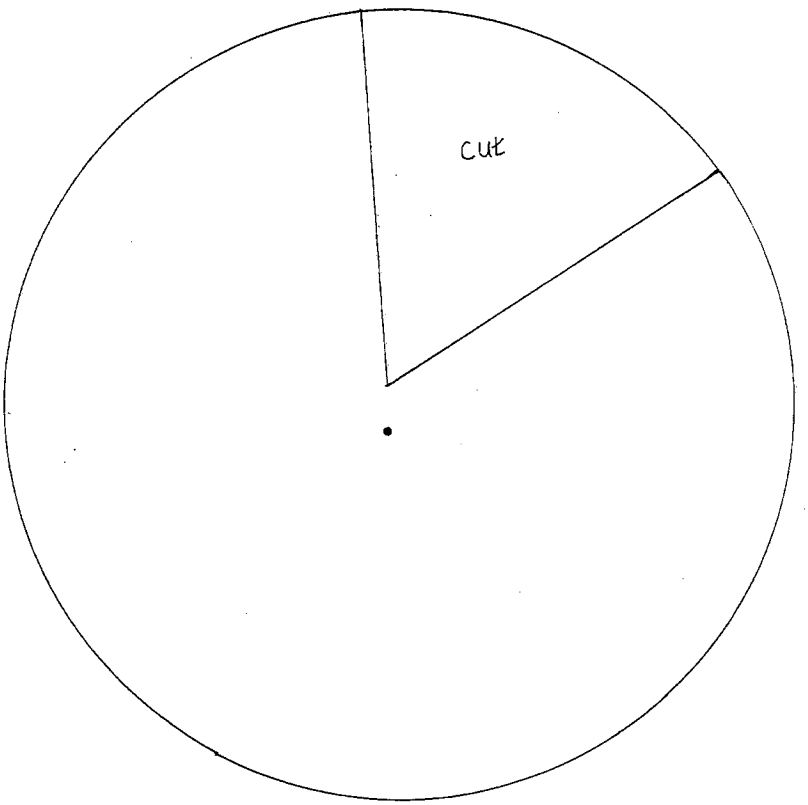
Carle, Eric. 1970. *The Tiny Seed.* New York: Crowell.
Gomi, Taro. 1999. *Spring is Here.* San Francisco: Chronicle.
Hutchins, Pat. 1985. *You'll Soon Grow Into Them Titch.* New York: Puffin Books.
Krauss, Ruth. 1974. *The Carrot Seed.* New York: Scholastic Book Services.
Raffi. 1993. *Everything Grows.* New York: Crown.
Stevens, Janet. 1994. *Tops and Bottoms.* San Diego: Harcourt Brace.
Yabuuchi, Masayuki. 1985. *Whose Baby?* New York: Philomel Books.

Appendix 2: 1.2 Plant Package

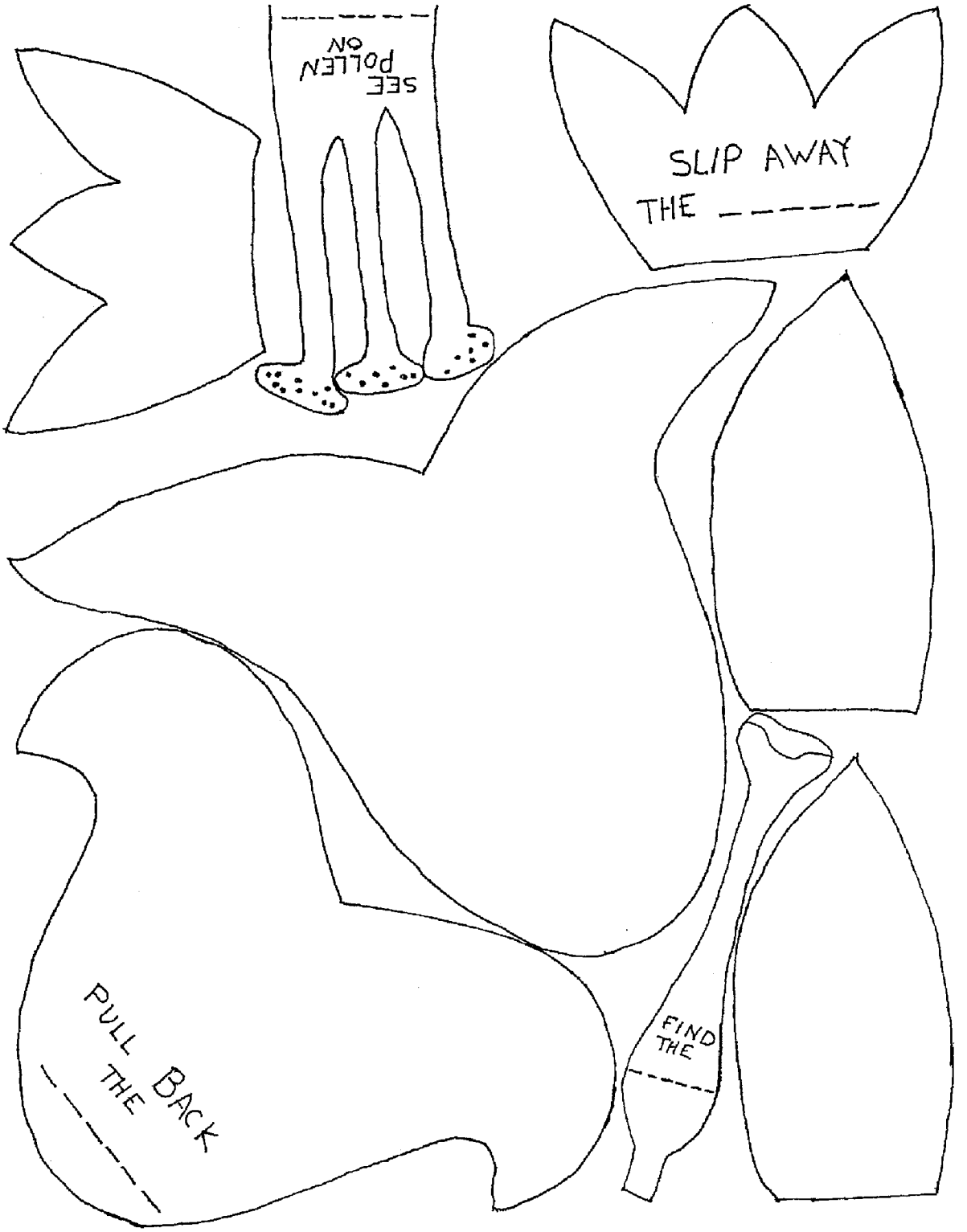


1.3 Life Cycle Wheel





2.2 Peek Between the Petals



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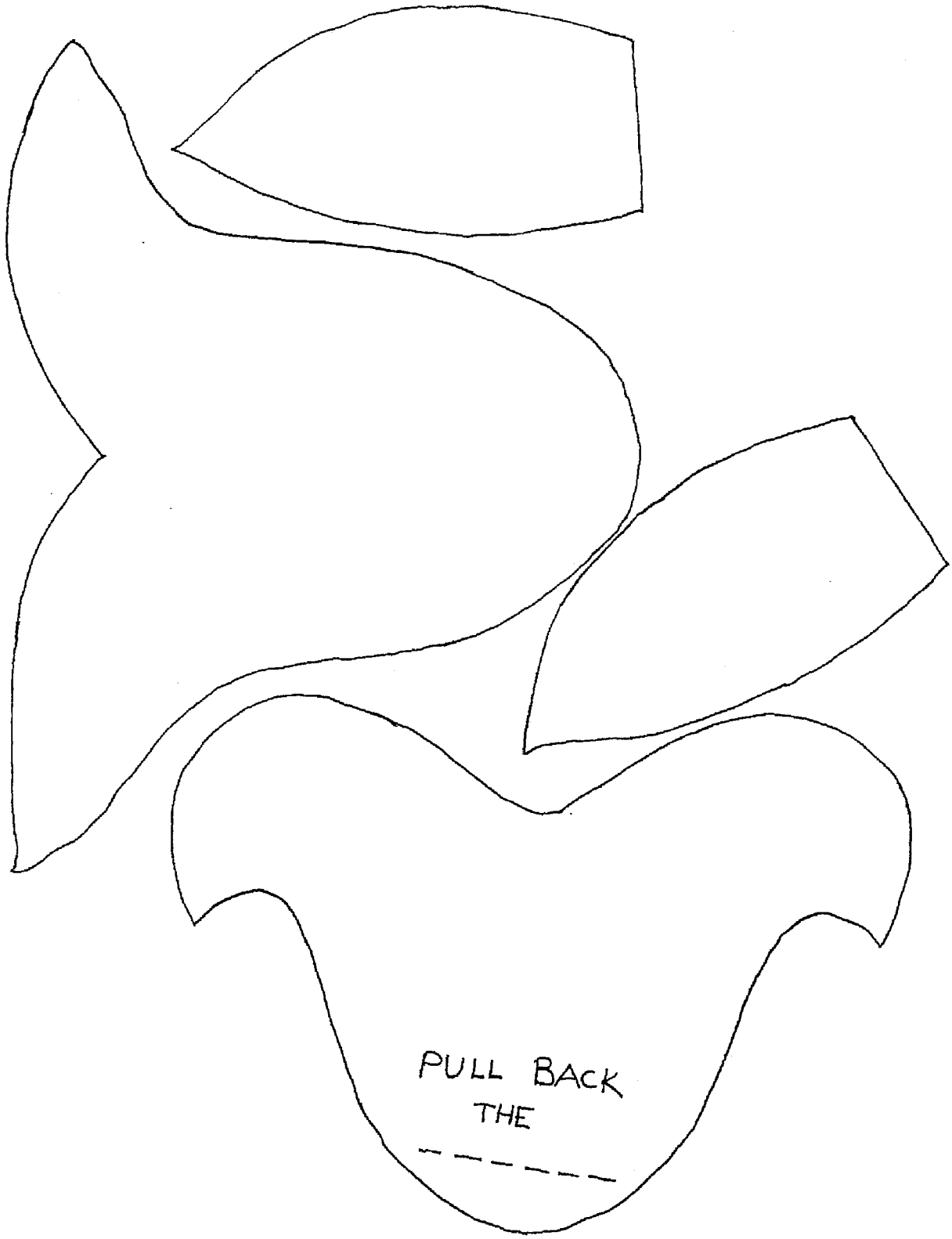
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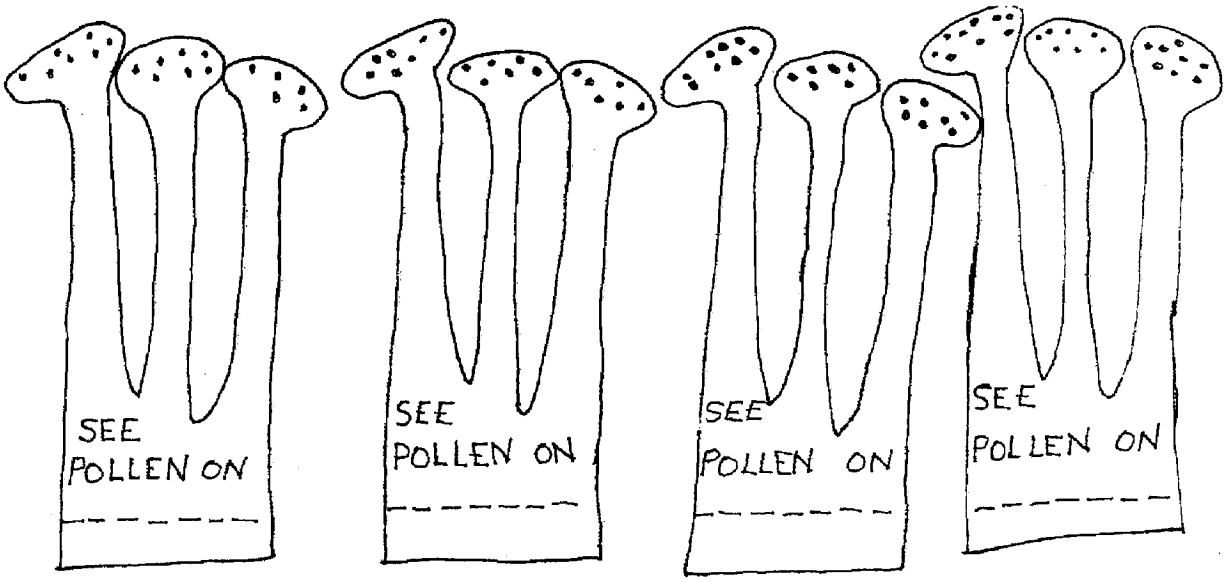
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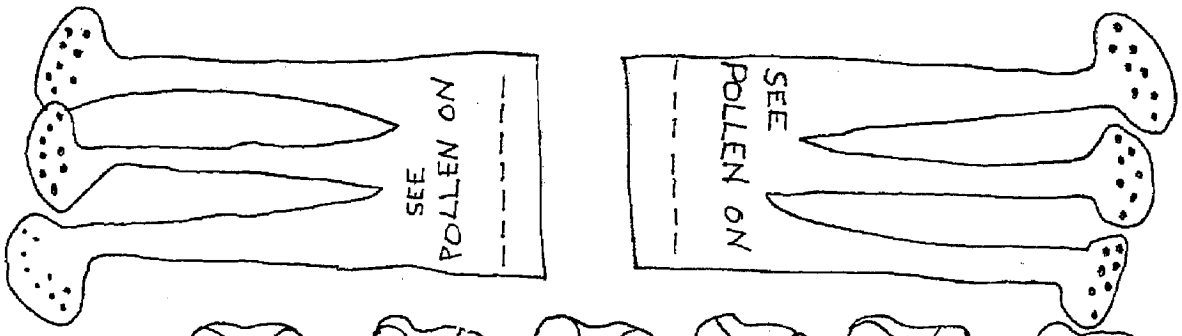
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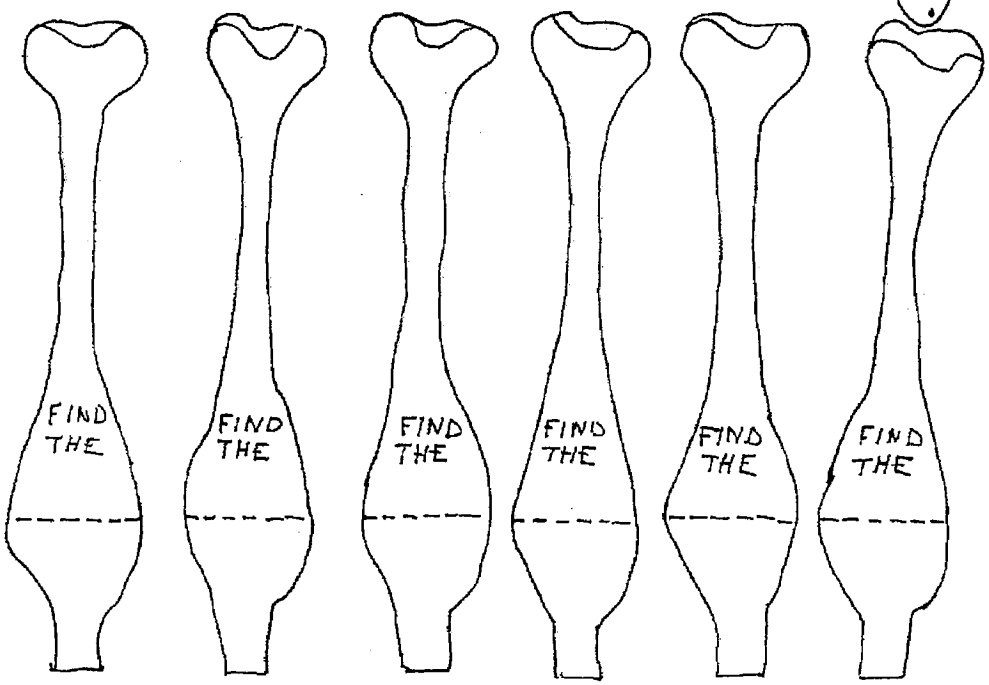
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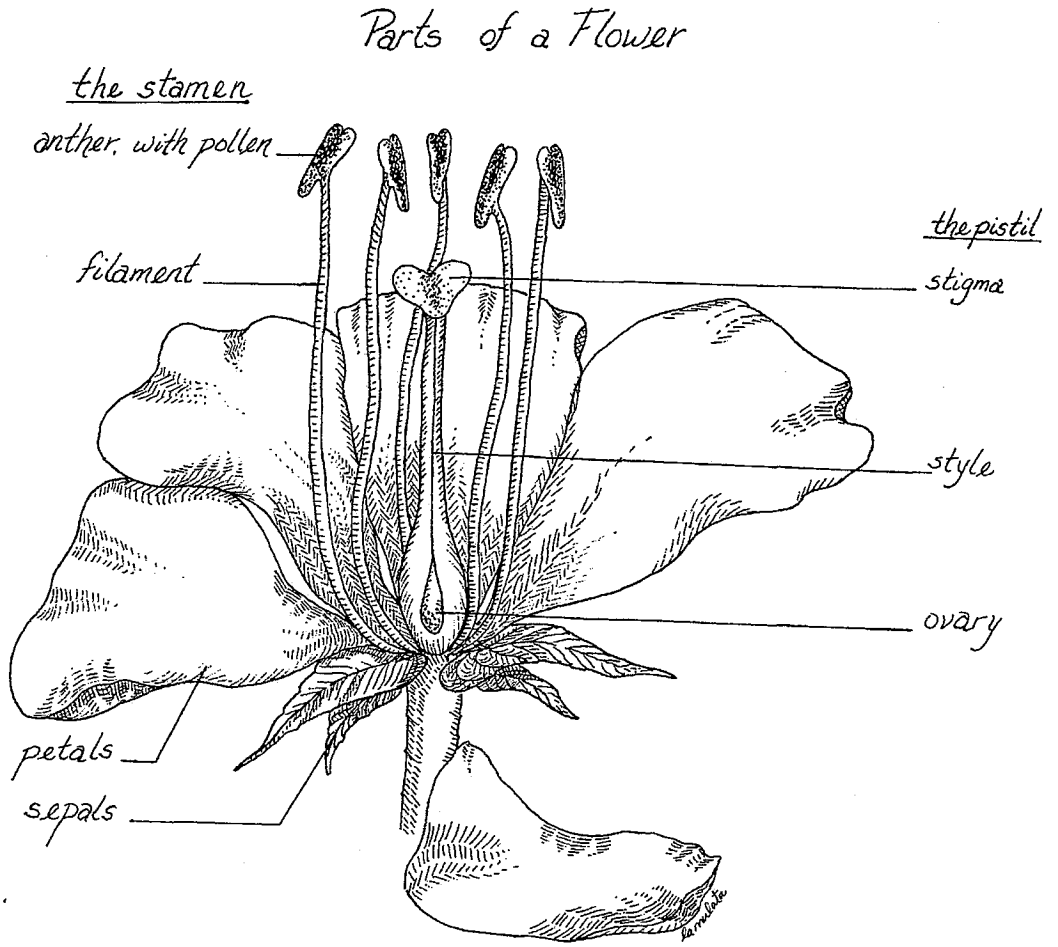
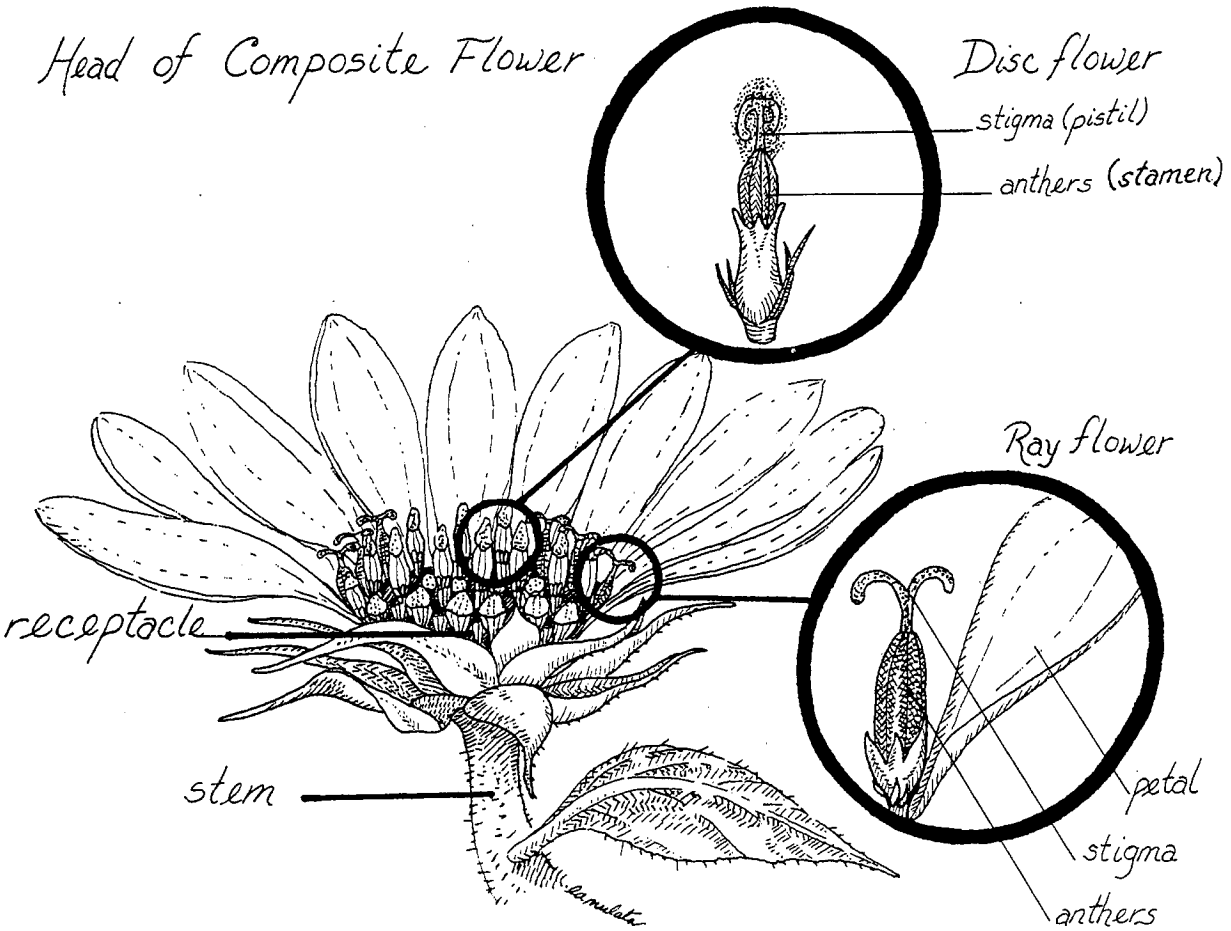
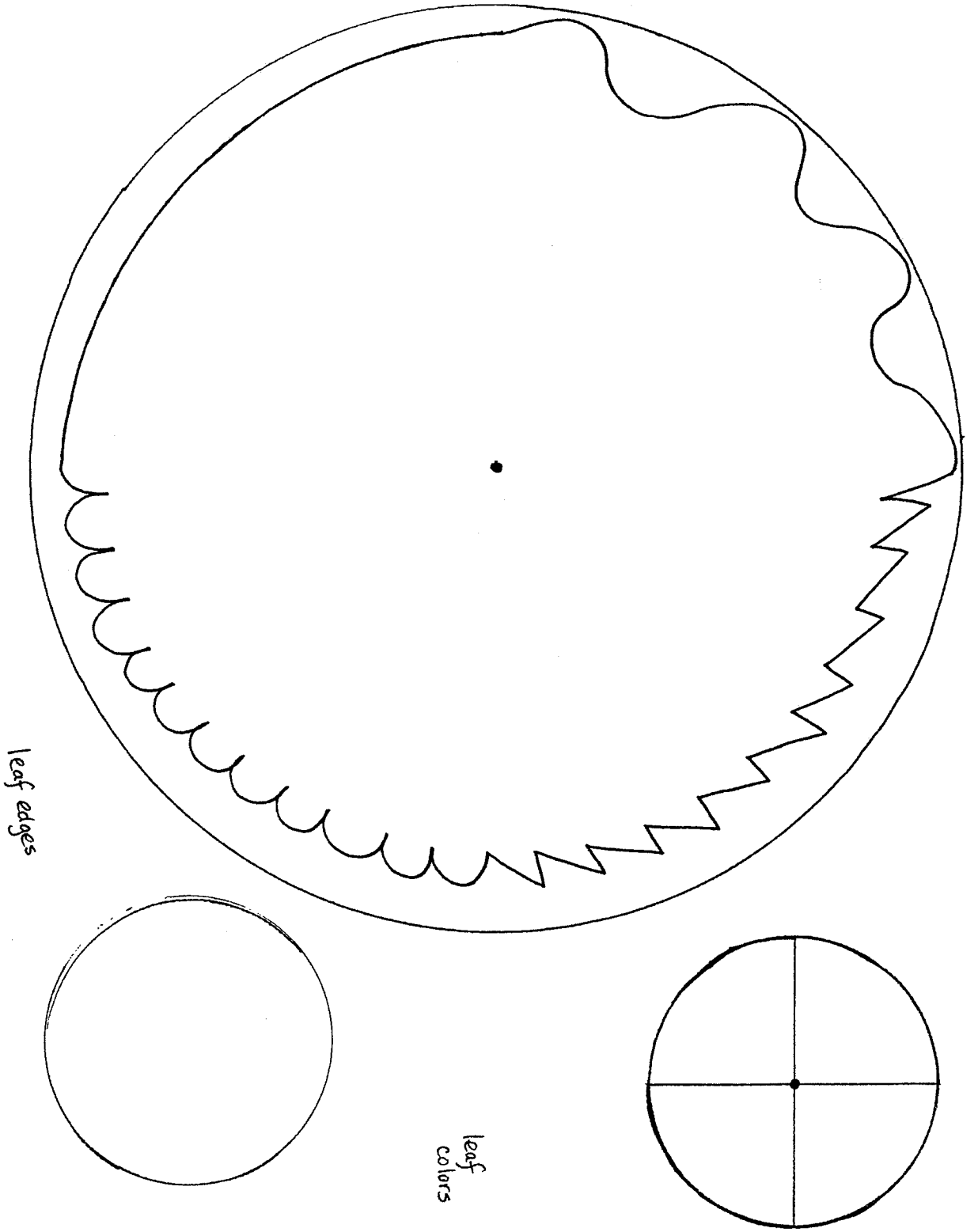
2.3 Parts of a Flower



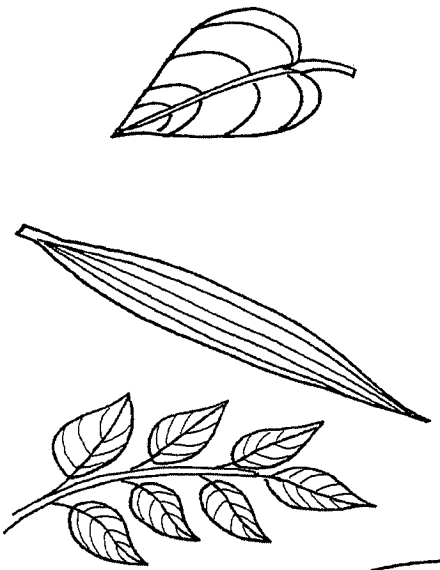
2.3 Head of Composite Flower

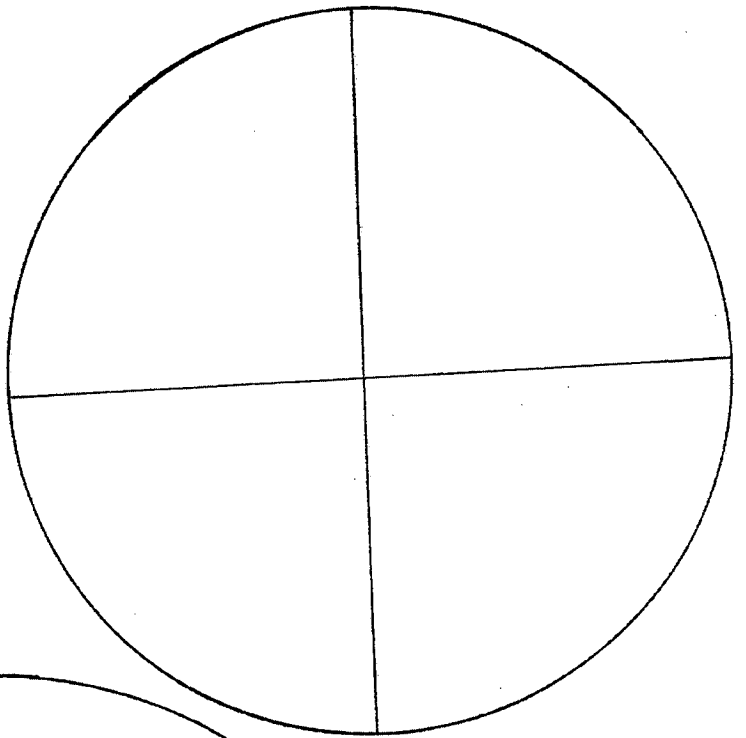


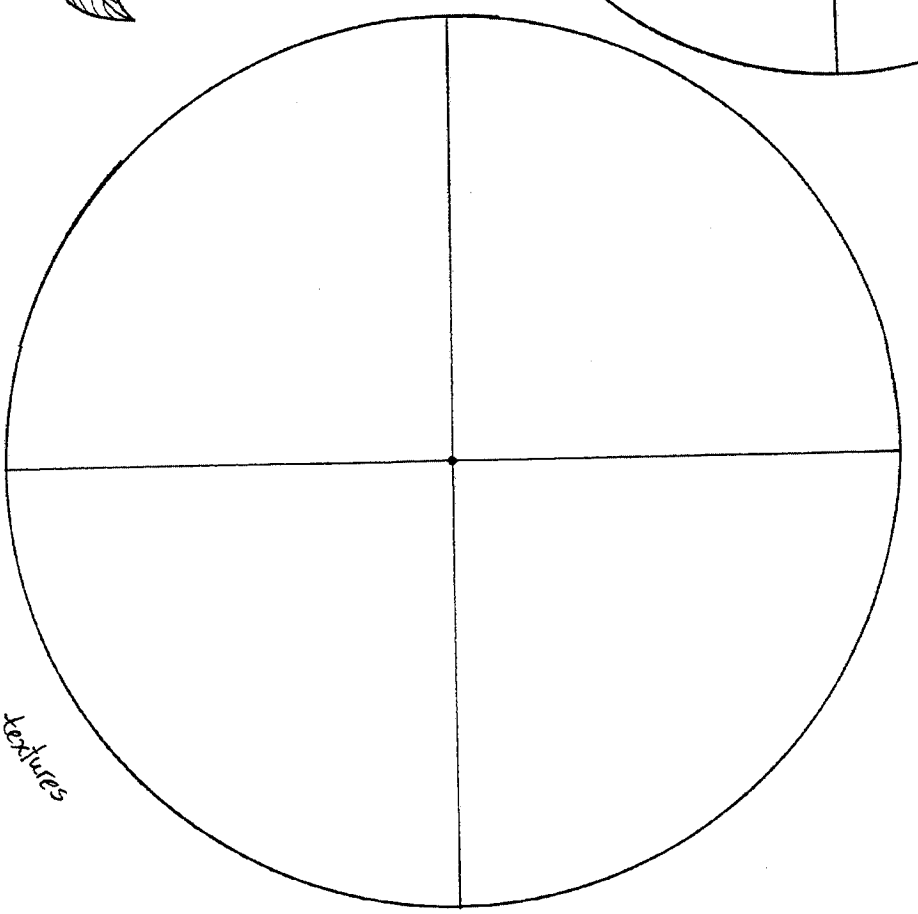
2.6 Leafy Combo Wheel



leaf shapes

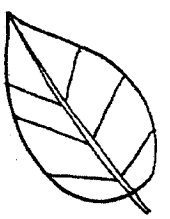


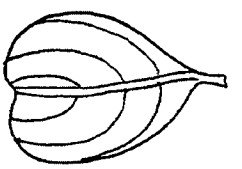




textures

leaf shapes

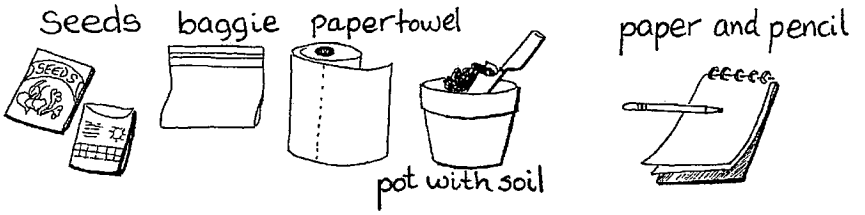


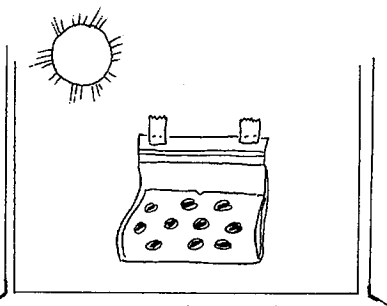


3.2 Recipes for Research Cards

Down & Dirty Recipe

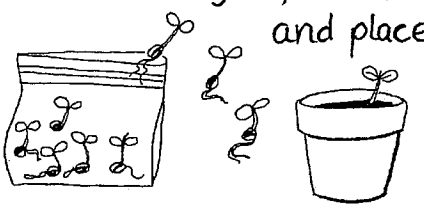
Materials:





1. Put 10 seeds in bag with wet paper towel. Tape to a sunny window.

2. When seeds grow, remove 4 plants and place them in the pot with soil.

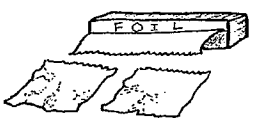


3. Keep soil and papertowel damp.
4. Record your observations.

Light Supper Where Did it Go?

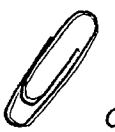
Materials:

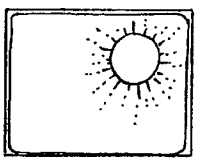
potted plant



Two foil squares

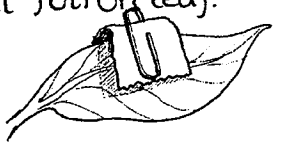
one paper clip



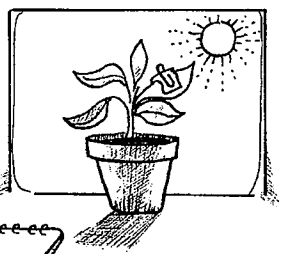


a sunny window

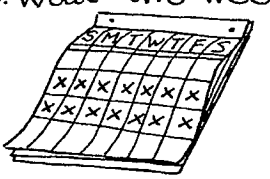
1. Put foil on leaf.



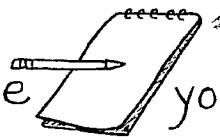
2. Place plant by a sunny window.



3. Wait two weeks and then remove the foil.



4. Write



your results.

Light Supper
"Follow the Light!"

Materials:

one potted plant

a sunny window

1. Put the plant in front of the sunny window.

2. Wait one week.

3. Turn the pot.

4. Look at your plant every day. Draw what you see.

Light Supper
"Show Me"

Materials:

seeds

soil

baggies

cups

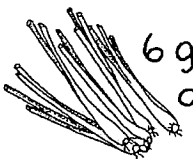
black paper

shoe box

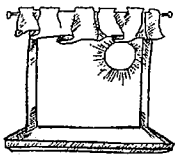
1. Think: Do seeds need light?
2. Do: Make your own experiment.
3. Remember: write down your results.

Light Supper
"Reaching Out"

Materials: 2 pots with soil



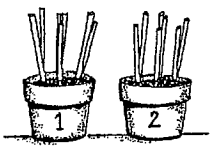
6 green onions



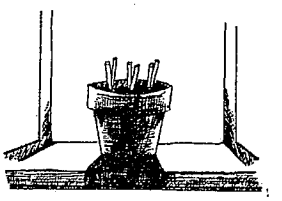
a sunny window

a dark corner

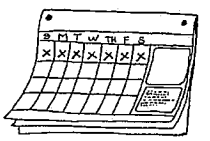
1. Plant 3 onions in each pot.



2. Cut the onion tops 1 inch tall.



3. Put one pot in the window and one in the dark corner.

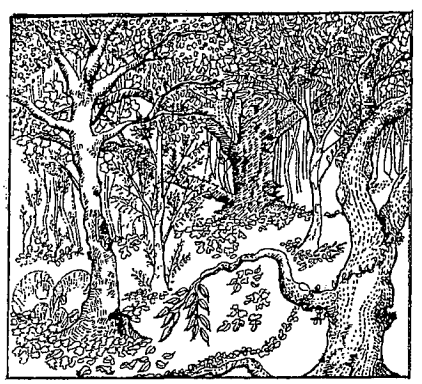


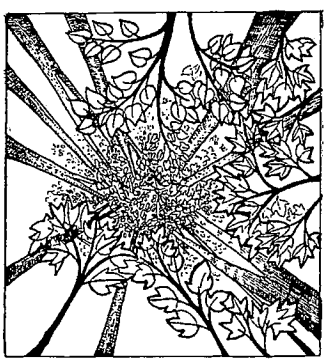
4. Wait 1 week.

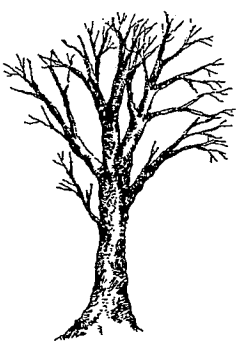
5. Write your results.

Light Supper
"Walk in the Woods"

Materials: a wooded area and a friend.





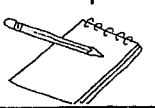


1. Walk in the woods.

2. Look up!

3. Find where the leaves grow.

4. Record your observations.



Drink Recipe
"Dry 'n' up"

Materials:

Two plants

water

Two signs

1. Put one sign in each potted plant.

2. Put plants by a sunny window.

3. Water one plant as needed.

4. Wait 3 weeks.

5. Write your observations down.

Drink Recipe
"Leaf It Alone"

Materials:

Two plants Labeled 1, 2.

a cardboard circle.

spray bottle with water.

1. Place cardboard around plant #1.

2. Spray your plants every day.

spray the leaves

spray the soil

3. Wait 3 weeks.

4. Record your observations.

Drink Recipe "In the Beginning"

Materials: beans, clear cups, papertowels

1. Soak beans in water overnight.
2. Line cups with paper towels.
3. Put one inch of water in <u>one</u> cup. Leave the other dry.
4. Put soaked beans in between the paper towels and the cup.
5. Wait one week.
6. Write what you see.

Drink Recipe "Swimming In It"

Materials:

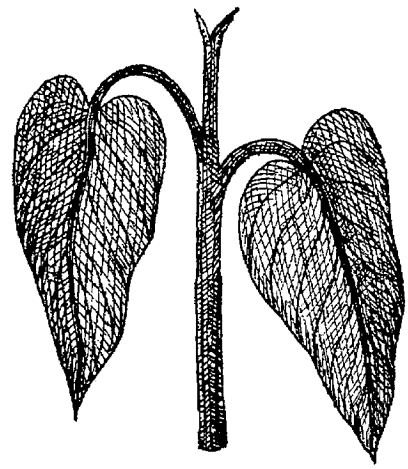
Two plants, a bowl of water, a sunny window

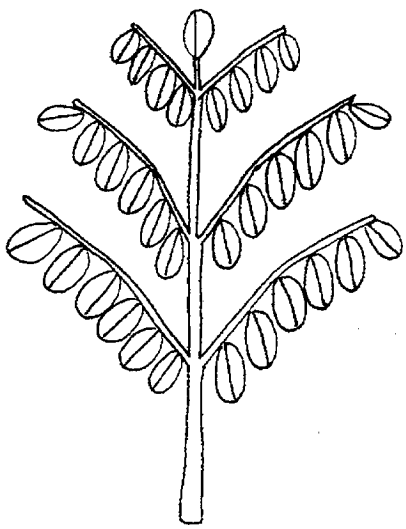
1. Place one plant in a bowl of water.
2. Place both plants in a sunny window.
   Keep bowl full of water.
   Keep soil damp.
3. Wait 3 weeks.
4. Write your results.

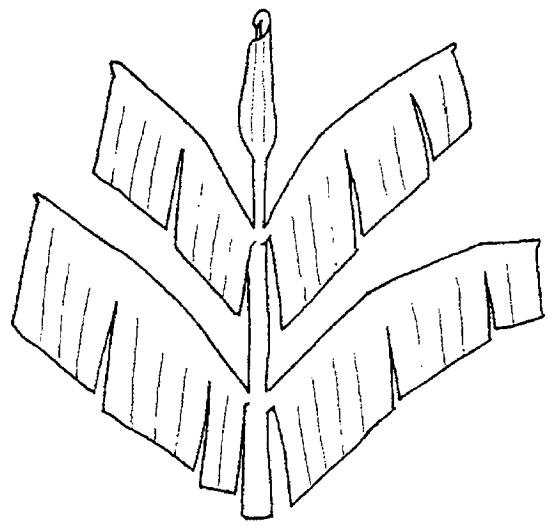
4.3 Sun and Shade Leaf Characteristics Cards

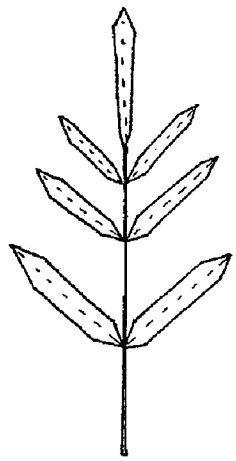
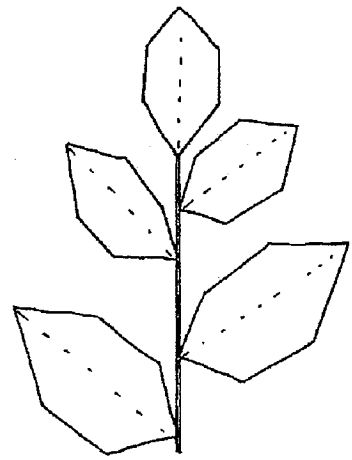
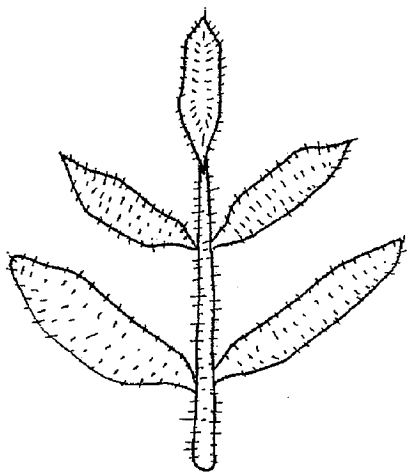
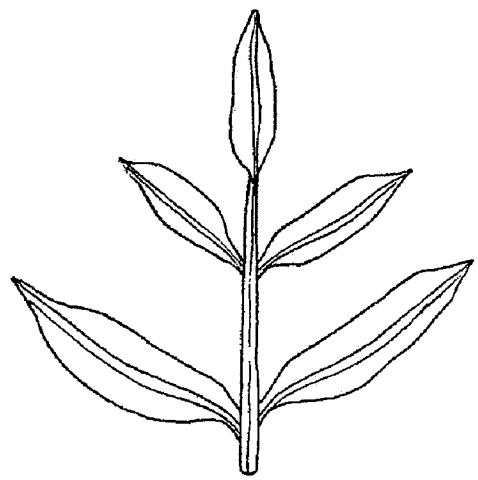
Sun

Shade



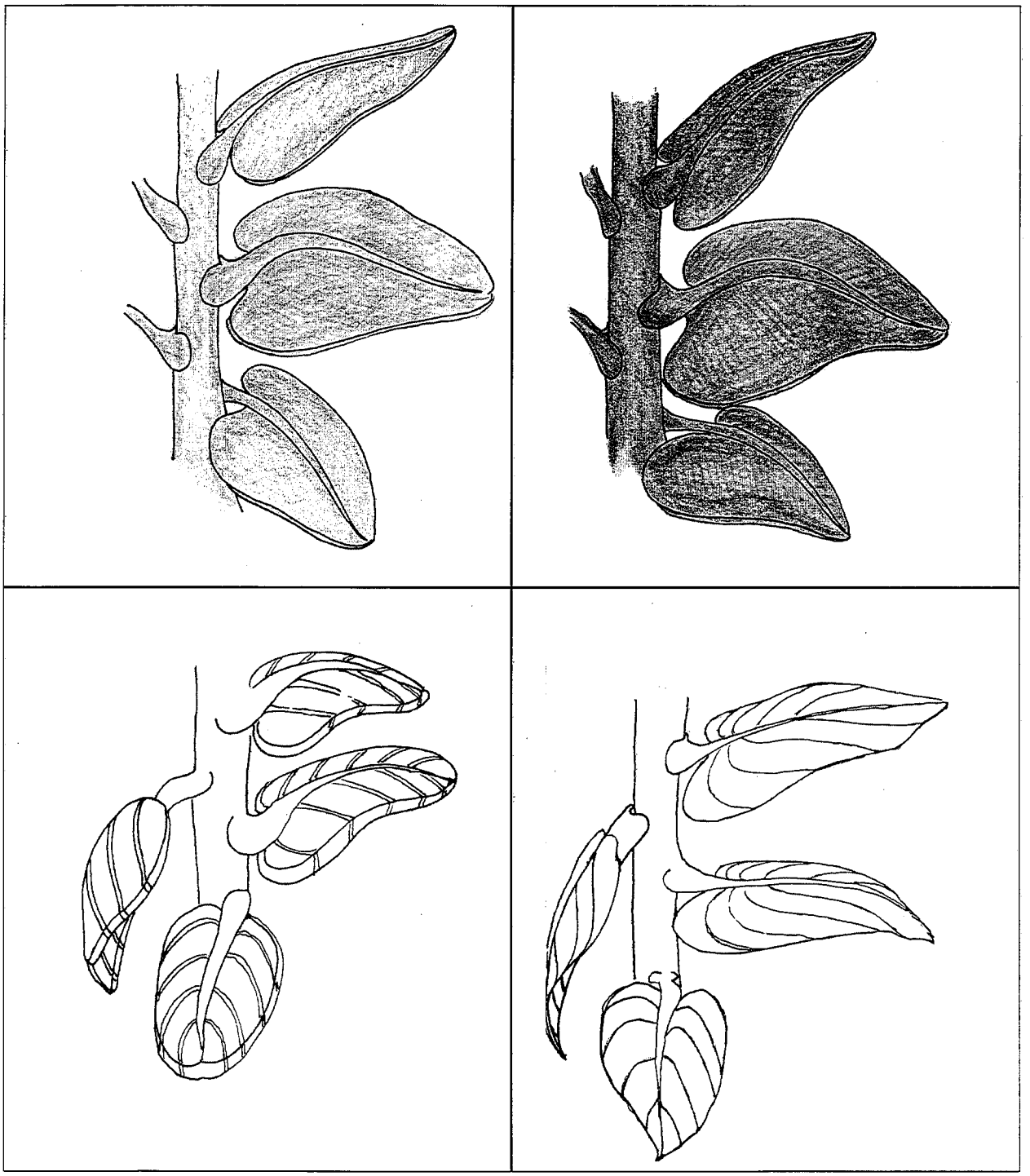


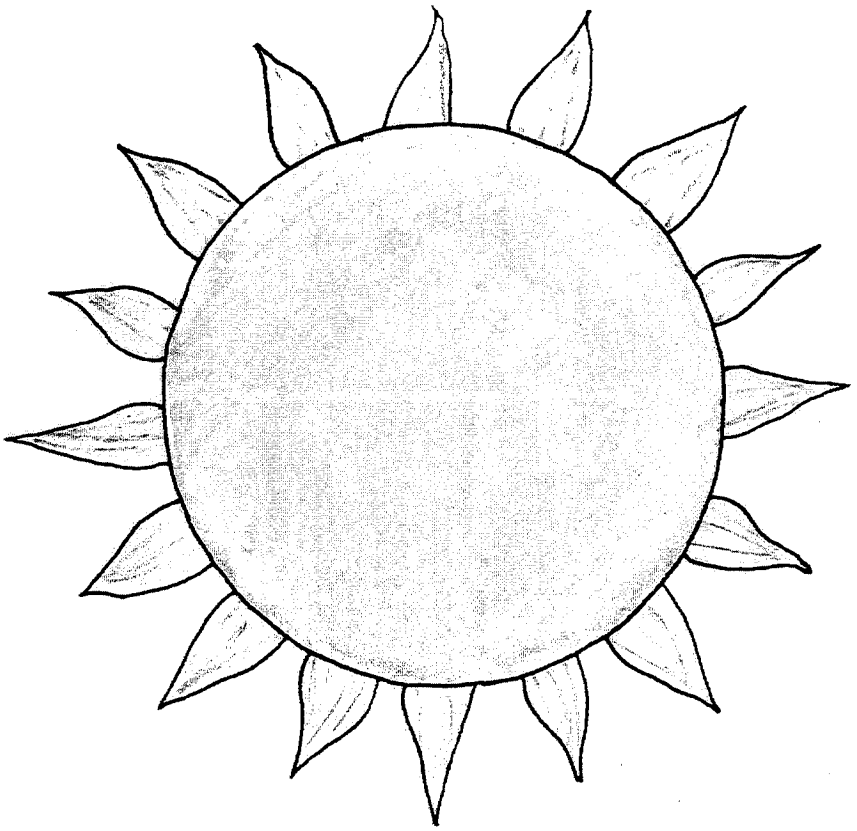


Sun	Shade
	
	

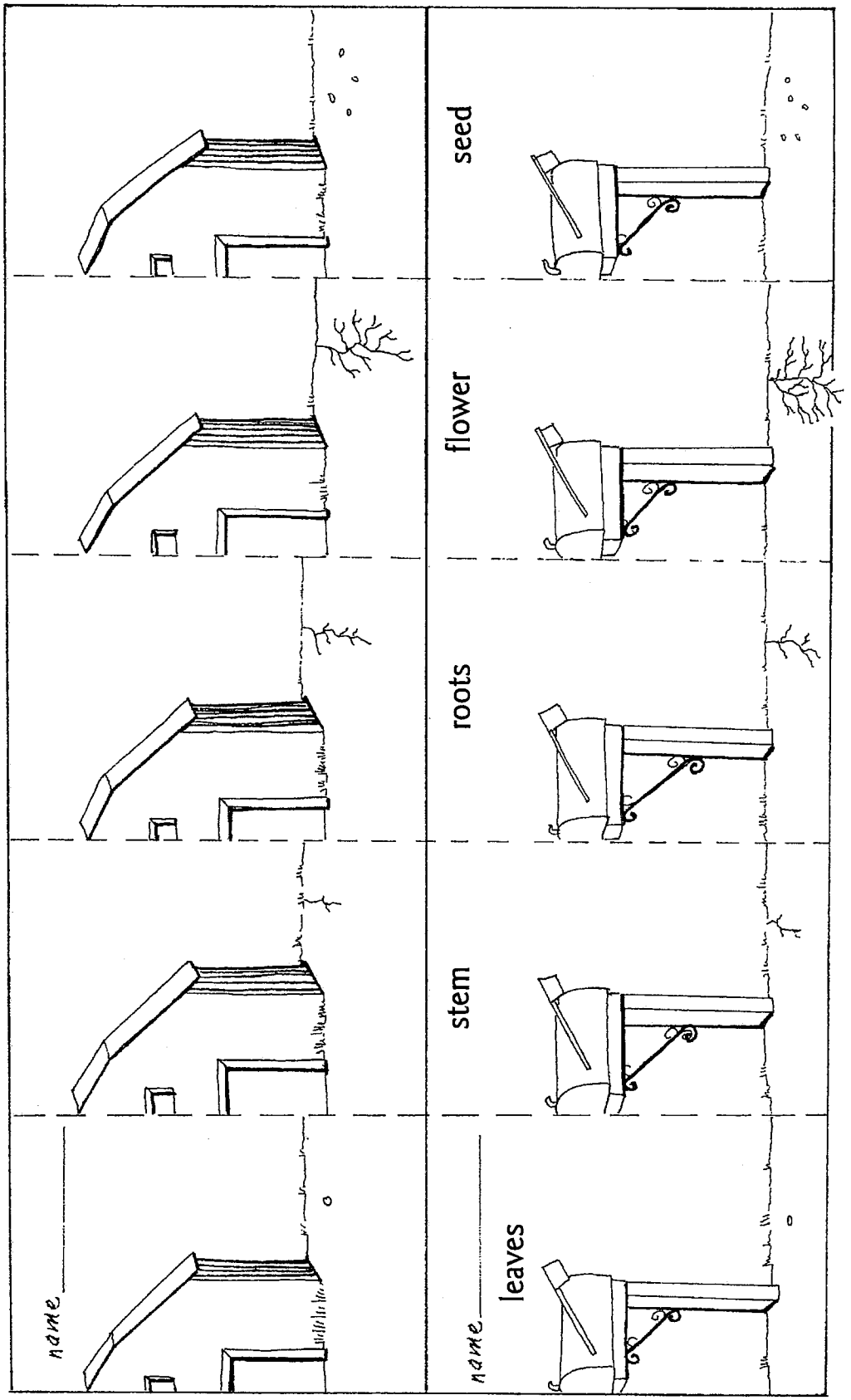
Sun

Shade

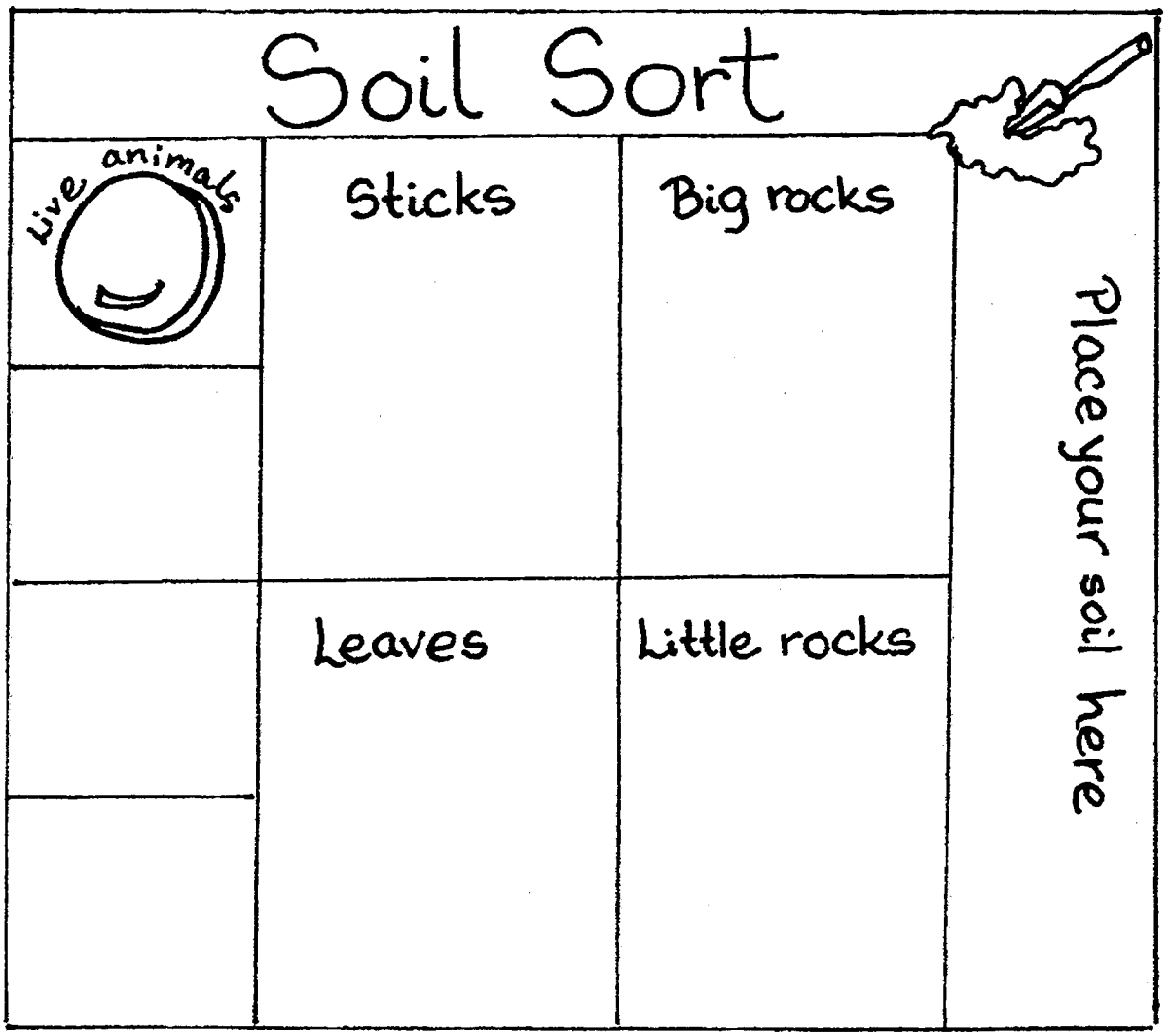




4.4 Scavenger Hunt Guidebook



4.6 Soil Sort


Soil Sort
Live animals
Sticks
Big rocks
Leaves
Little rocks
Place your soil here

Appendix 3: Texas Essential Knowledge and Skills

Lesson 1 **Plants change during their life cycles.**

Activity 1.1 Sponge Sprouts: *Watch the magic of seeds developing into sprouts.*
TEKS: Science 1.2A, 1.6B Math: 1A, 2(3A)

Activity 1.2 Plant Package: *Observe the baby plant inside a seed.*
TEKS: Science 1.4A, 1.7D, 2.4A

Activity 1.3 Life Goes 'Round: *Learn about the life cycles of native plants.*
TEKS: Science: 1.7D, 1.2B-C, 1.5B, 2.2D, 2.4A, 2.7A; English Language Arts and Reading: 1A,D, 2A, 4A

Lesson 2 **Plant parts have different jobs.**

Activity 2.1 Rainbow of Flowers: *Graph varieties of flower color.*
TEKS: Science: 1.2B, 1.4B, 1.5A-B, 1.6A, 2.4B, 2.5A-B

Activity 2.2 Peek Between the Petals: *Observe differences in flower parts.*
TEKS: Science: 1.6A, 2.4B, 2.6C

Activity 2.3 Operation Dissection: *Identify the variety of flower parts.*
TEKS: Science: 1.1A, 1.4A, 1.6A-B, 2.1A, 2.4A-B, 2.6C; English Language Arts and Reading: 18B

Activity 2.4 Keeping Up: *Strengthen a stem to hold a plant upright.*
TEKS: Science: 1.1A, 1.3A,B, 1.6B, 2.A, 2.3A-B, 2.6

Activity 2.5 Food Line: *Do the work of the carrying tubes in a plant stem.*
TEKS: Science: 1.1A, 1.5B, 1.6B,C,D, 1.7D, 1.9A, 2.1A, 2.5B, 2.6A,B,C, 2.7, 2.9A;
English Language Arts and Reading: 1A, B, D, 3D

Activity 2.6 Leafy Combos: *Hunt for leaves with different combinations of shape, color, texture, and edge.*
TEKS: Science: 1.1A, 1.2C, 1.3A, 1.4A, 1.5A, 1.6A-B, 1.9A, 2.1A, 2.2D, 2.3A, 2.4A, 2.5A, 2.6C, 2.9A

Activity 2.7 More Than Meets the Eye: *Separate out different leaf pigments with chromatography.*
TEKS: Science: 1.1A, 1.2C, 1.4A-B, 4.6B, 1.9A, 2.1A, 2.2C,C, 2.4A, 2.6C, 2.9A

Activity 2.8 The Root of the Matter: *Explore the role of roots as food storage bins for plants.*
TEKS: English Language Arts and Reading: 1A,B,D,E, 3C,4A

Activity 2.9 Root Roundup: *Identify the root systems of weeds.*
TEKS: Science: 1.1A, 1.2A,B,C, 1.3A, 1.4A-B, 1.5A, 1.6A-B, 1.9A, 2.1A, 2.2A,B,C,D, 2.3A, 2.4A-B, 2.5A, 2.6A-B, 2.9A

Activity 2.10 Root Grippers: *Conduct an experiment about roots and erosion.*
TEKS: Science: 1.1A, 1.2A,B,C,D,E, 1.3A,B,C, 1.4A-B, 1.7A, 2.1A, 2.2A,B,C,D,E,F, 2.3A,B,C, 2.4A-B, 2.7A; English Language Arts and Reading: 1A-B, 3A,C

Lesson 3 **Growing plants have needs.**

Activity 3.1 A Light Experiment: *Discover what happens if a plant doesn't get light.*
TEKS: Science: 1.1A, 1.2A,B,C,D,E, 1.4B, 1.7A, 1.9, 2.1A, 2.2A,B,C,D,E,F, 2.4B, 2.7A, 2.9;
Math: 1(7A), 2(9B); Social Studies: K.16A, K.17B

Activity 3.2 Recipes for Research: *Discover how light, water, and soil meet the needs of plants.*
TEKS: Science: 1.1A, 1.2A,B,C,D,E, 1.4B, 1.7A, 1.9, 2.1A, 2.2A,B,C,D,E,F, 2.4B, 2.7A, 2.9;
Math: 1(7A), 2(9B); Social Studies: K.16A, K.17B

Lesson 4 **Plants adapt to fit into a complex environment.**

Activity 4.1 Making a Joyful Noise: *Explore the interdependence of plants and insects.*
TEKS: English Language Arts and Reading: 1A,B,C,F; 13 A,B

Activity 4.2 Water Route Search: *Discover the ways leaves help roots get water.*
TEKS: Science: 1.1A, 1.2A,B,C,D,E, 1.4A, 1.5A, 1.6A,B, 1.9A, 2.1A, 2.2A,B,C,D,E, 2.4A, 2.5A, 2.6A,B,C, 2.9A

Activity 4.3 Leaf Location Game: *Discover how plant leaves have adapted to different amounts of light.*
TEKS: Science: 1.1A, 1.2C,D, 1.3A, 1.5A, 1.6A-B, 1.9A, 2.1A, 2.2B,D, 2.3A, 2.5A, 2.6C, 2.9A; English Language Arts and Reading: 5A

Activity 4.4 Get Ready for a Plant Scavenger Hunt!: *Make a guidebook to help identify the life stages and parts of plants.*
TEKS: Science: 1.1A, 1.6B, 1.9A, 2.1A, 2.6C, 2.9A; English Language Arts and Reading: 4A, 5A-B

Activity 4.5 Plant Scavenger Hunt: *Search for plant life stages and plant parts in nature.*
TEKS: Science: 1.1A, 1.2C, 1.4A, 1.5A, 1.6A-B, 1.7D, 1.9A, 2.1A, 2.2B, 2.4A, 2.6C, 2.9A

Activity 4.6 Soil Sort: *Examine and compare soil samples.*
TEKS: Science: 1.1A, 1.4A-B, 1.5A-B, 1.6A-B, 1.10B, 2.1A, 2.4A,B, 2.5A,B; English Language Arts and Reading: 2A, 3A,C, 4B

Activity 4.7 Bluebonnet Relay: *Play a game of chance for seed germination.*
TEKS: Science: 1.1A, 1.3A, 1.9A, 2.1A, 2.3A, 2.9A

Lesson 5 Plants are part of changes that happen very slowly.

Activity 5.1 Soil Silhouettes: *Observe the composition of soil.*
TEKS: Science: 1.1A, 1.2C,D, 1.4B, 1.10B, 2.1A, 2.2C, 2.4B, 2.8B

Activity 5.2 The Work of Ages: *Change rocks into soil.*
TEKS: Science: 1.1A, 1.2B,E, 1.7A-B, 1.10B, 2.1A, 2.2B,C,D,E,F

Activity 5.3 Plants' Feet of Strength: *Observe how plants help break rocks into soil.*
TEKS: Science: 1.1A, 1.2B, 1.7A, 1.9A, 2.1A, 2.2B,C, 2.7A, 2.9A

Activity 5.4 Dissolving Rock Cave: *Show how rocks can melt away to form caves.*
TEKS: Science: 1.1A, 1.2B, 1.7A, 1.10A,B,C, 2.1A, 2.2B,C, 2.7A; Social Studies: Geography 1.6A