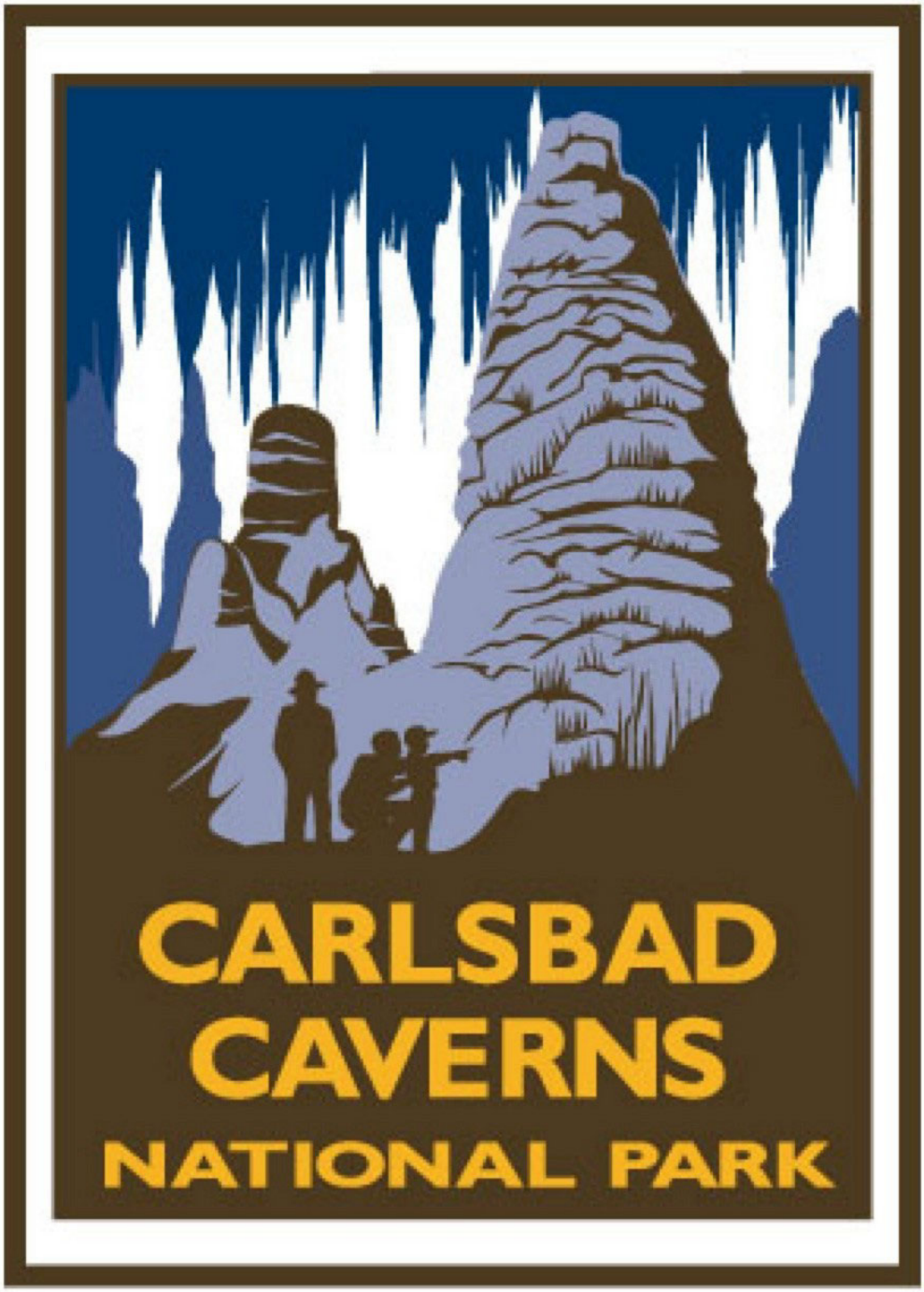
Life Science

A curriculum and activity guide for Carlsbad Caverns National Park

Middle School Biology



Life Science
Biology Curriculum

Plant Life

With searing heat, dry air, and little rainfall, a desert hardly seems like a good spot for plant to grow. In many ways it's not. Deserts can go for years without rain. When it does hit they can receive a year's worth within hours. This deluge often washes away immediately with only a little water soaking into the ground where a plant's roots can absorb it.

The hot sun can raise a plant's internal temperature too high for photosynthesis to occur and even to the point where the plant's tissues can literally cook. In a cold desert temperatures can dip to the point where a plant's inner fluids expand as ice forms and results in rupturing the plant's cell walls.

All in all, the desert is a challenging place for plant survival. Yet for thousands of years plant species have adapted and thrived in arid lands.

It is these adaptations that are the focus of this unit.

This unit will look at other aspects of plants, from their function to their importance. In the lesson, *Structurally Sound*, students will identify the basic parts and functions of plants, leaves, and flowers. The students will gain a greater understanding of the process of photosynthesis and transpiration in the lesson, *Don't Leaf Out Photosynthesis*. Students will participate in experiments designed to encourage observation of various desert plant adaptations. In *To Be or Not to Be* students will start a plant by means of vegetative propagation. A field trip will be taken so students can identify trees through the use of a dichotomous key. In the last lesson, students will understand the importance of plants in the economy by identifying various plant byproducts.

Structurally Sound

Properties of leaves, plant, and flower

Summary: This lesson is an introduction to the properties of the parts of leaves, plants, and flowers.
Duration: 1 class period
Setting: classroom
Vocabulary: *Leaf* - lamina, leaf apex, axil, petiole, midrib, vein, stipule, stem; *Flower*-stigma, style, ovary, sepal, filament, anther, stamen, carpel (pistil), stem, petal, whorls; *Plant* - axillary bud, terminal bud, flower, flower stalk, axil, lateral shoot, leaf, petiole, root, root cap, tap root, stem, node, internode, angiosperms, dicotyledon, monocotyledon
Standards/Benchmarks Addressed: SC1-E1, SC3-E1, SC4-E6, SC6-E1, SC6-E2, SC6-E3, SC6-E6, SC10-E2, SC11-E4, SC11-E5, SC12-E2

Objectives
Students will:

- be able to label the parts of a flower.
- be able to label the parts of a plant.
- be able to label the parts of a leaf.
- be able to describe the plant-seed cycle.

Background

Plant Seed Cycle

Seed Dispersal – Plants have ways of scattering their seeds. A few plants burst open throwing their seeds out while others depend on the wind to spread them. Some rely on animals and people to disperse the seeds in a variety of ways. Some “hitchhikers” cling to clothing or fur. Animals that feed on the fruits disperse the seeds through their droppings.

Germination – Seeds need three things to germinate: warmth, moisture, and oxygen. Moisture works to soften the seed coat. Once softened it will swell and split, allowing the primary root to anchor the plant to the ground. As the root system develops, the epicotyl grows upward and the stem breaks through the soil. This growth carries the cotyledons above the ground. It is then that the seed coat falls off. The cotyledons open. This frees a bud called a plumule, which then produces the first leaves. Since the seedling now has its own developed roots and leaves and can make its own food, it no longer needs the cotyledon.

Pollination – When pollen grains are fully developed, the anther bursts open. Unable to move by themselves, the pollen grains must be carried or moved to the female parts of the flower before they can begin fertilization. One way pollen grains find their way to the pistil of another flower is by wind. The sweet scent or nectar of some flowers attracts insects or birds who will also carry the grains with them as they move from flower to flower. The transfer of pollen from the stamen to the pistil of the same flower is called self-pollination. When the pollen grain reaches the pistil of another flower, it is called cross-pollination.

Fertilization – As soon as the pollen lands on the pistil, a very thin tube begins to grow down to the ovary. It grows through the ovary wall and reaches the ovule inside. When the pollen tube touches the ovule, fertilization begins and a seed develops.

Flower Structure: Flowers vary in shape, size, and color. Fragrances of flowers range from sweet ones to those that smell like rotten meat. Flower shapes also vary among species. Flowers are the reproductive structures of angiosperms, plants whose seeds develop from fertilized ovules. Flowering plants are divided into two classes: Dicotyledon and Monocotyledon. Approximately seventy-five percent of flowering plants are dicots. This includes flowering trees, shrubs, annual, and perennial plants. Most flowers consist of four structural parts, which are attached to the flower base in whorls. The outer whorl consists of the sepals; followed by the petals, then the stamens, and the inner most whorl is the pistil. At the base of the pistil is the ovary which envelops the ovules, and this is where fertilization occurs. The outer two whorls, sepals and petals, serve to protect the inner parts of the flower and attract pollinators to the flowers. Flowers which contain all four whorls are considered "complete." Flowers lacking one or more of the four whorls are termed "incomplete."

Leaves: A leaf is a part of the plant where most of its food is made. Most leaves have two parts, the blade and the stalk. The lines or ridges on the leaf are veins. Veins hold tubes like those in the stems. Some of these tubes in the veins transport food from the leaves to the stems. Other tubes in the veins carry water and minerals from the stems to the leaves. Plants get air from openings on the underside of the leaf. These openings are called stomates. The stomates can be opened and closed. Air also moves in and out through tiny slits in stems. Plants with flat leaves like those found on flowering plants are called broad-leaved plants. There are two types of broad-leaved plants; those with simple leaves and those with compound leaves. A simple leaf has a single blade attached to a stalk. A compound leaf has one stalk with several blades attached. A conifer has leaves that look like needles, so they are called needle-leaved plants. These leaves have a tough outer covering that keeps the plant from losing a lot of water.

Materials
Different types of leaves
Several plants (flowering and non)
Flowers (preferably large flowers such as day lilies or tiger lilies)
Black construction paper
Flour
Celery stalk
Container
Water
Food coloring

Procedure
Warm up: Begin class by passing around different plants, leaves, and flowers for student observation. Have students examine the flower. Ask students to identify the feature of the flower that allows the pollen to attach to the stigmas. Next, ask students to name the different parts of the plants. Write their responses on the chalkboard. Show students a label list of all the different parts of the plants and explain to them that they will be participating in an activity that will allow them to identify the parts of a plant and a leaf. Explain that they will also be dissecting a flower in order to better understand the parts of a flower and their function.

Activity

1. Students will work in pairs.
2. Give each student copies of *Label the Plant, Label the Flower,* and *Label the Leaf.*
3. Give each group a plant, a flower, and some leaves.
4. Have students run their hands up the stem (also called the pedicel) until they reach the top portion of the stem. Here the students locate the outer whorl of three-petal-like structures or sepals. Instruct students to tear off the sepals carefully, keeping them intact.
5. The next whorl of three parts is the petals. Have students tear off the petals.
6. The reproductive parts are in the center of the flower. Have students locate the stamens. Have students tear them off and look at them through hand lenses. Direct students to locate the two parts of the stamen (filament and anther). What is produced in the anther?
7. The last structure in the center is the pistil. Ask students to locate the three parts of the pistil (stigma, style, and ovary). The stigma is the top part of the pistil and receives the pollen during pollination.
8. Have students remove the stigmas from the flowers and view them with a hand lens. Instruct students to lightly touch the tips of the stigmas. How do they feel?
9. Students will then sprinkle some white flour onto pieces of black construction paper, then gently tap the stigmas into the flour.
10. Students should then view the stigmas (with a hand lens) to determine which part of the stigma is capable of holding pollen grains. What is the purpose of the sticky area on the stigma?
11. Students should then cut longitudinally through the pistil. The long, thin section below the stigma is the style. At the base of the pistil is the ovary which holds the ovules.
12. Have students use the hand lenses to locate the ovules and count how many they find. Why are the ovules hidden in the base of the ovary?
13. Students will then turn their attention to the plant structure.
14. Students will remove the plants from the container. They should shake off excess soil in order to examine the root structure. The root is a plant structure that obtains food and water from the soil, stores energy, and provides support for the plant. Is it a taproot or is it fibrous? Students should note the ends of the roots and identify the root cap, which is the protective covering over the actively growing region.
15. Students should then work their way up the stem, which is the part of the plant that supports the leaves, flowers, or cones. Students will cut a stem in order to examine the tubes that carry food, water, and minerals to all parts of the plant. Placing a celery stem in a container filled with water and food coloring can show this. After several hours the leaves of the celery should be the same color as the food coloring.
16. Students should continue along the stem of the plant until they come to the first node. This is the part of the stem of a plant from which a leaf or branch grows. A plant has many nodes.
17. The students will then follow the lateral shoot, an offshoot of the stem of a plant, to the petiole. The petiole is a leaf stalk that attaches the leaf to the plant. Students may identify a stipule in this area, which is the small, paired appendage that is found at the base of the petiole of leaves of many flowering plants.
18. Students will identify the area between two nodes as the internode.

19. Students should now locate the angle between the upper side of the stem and a leaf, branch, or petiole and identify it as the axil. Students should try to locate an axillary bud, which is one that develops in the axil.
20. Students should identify the flower stalk, the structure that supports the flower. Students should also look for a terminal bud that would be located at the apex (tip) of the stem.
21. Students will then turn their attention to the leaf. Students should understand that the blade of the leaf is also called the lamina.
22. They should locate the petiole again and follow it up to the midrib, which is the central rib of the leaf.
23. From there they should note the veins which provide support for the leaf and transport both water and food through the leaf.
24. At the tip of the leaf the students will find the leaf apex with is the outer end of the leaf (opposite of the petiole).

Wrap Up: As a class, students should discuss what they have discovered about plants.

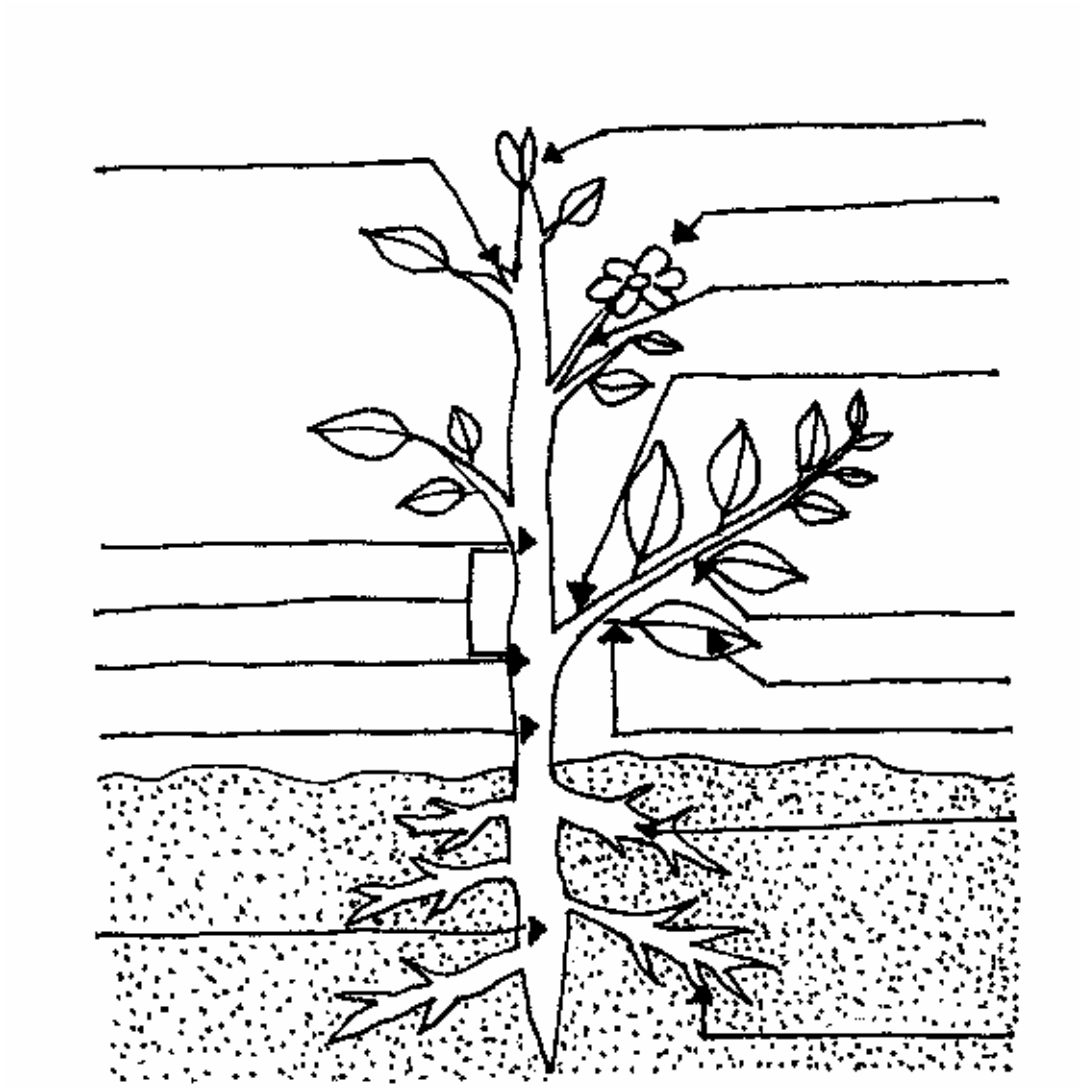
Assessment
Students will label the parts of a plant, flower, and leaf.

Name _____

Label the Plant

Directions: Correctly label the following plant parts:

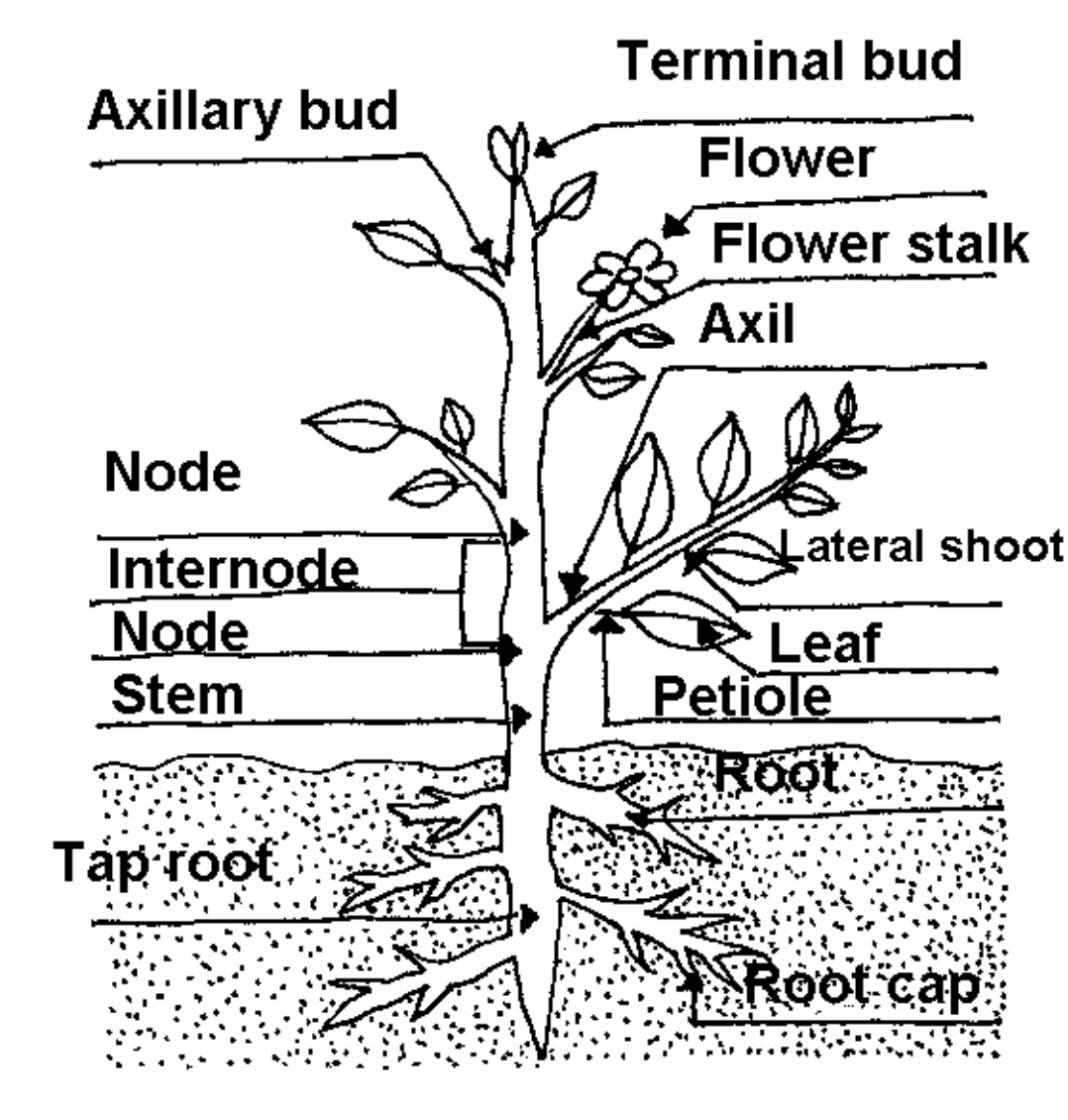
axillary bud, terminal bud, flower, flower stalk, axil, lateral shoot, leaf, petiole, node (2), internode, stem, tap root, root, root cap



Label the Plant: Key

Directions: Correctly label the following plant parts:

axillary bud, terminal bud, flower, flower stalk, axil, lateral shoot, leaf, petiole, node (2), internode, stem, tap root, root, root cap

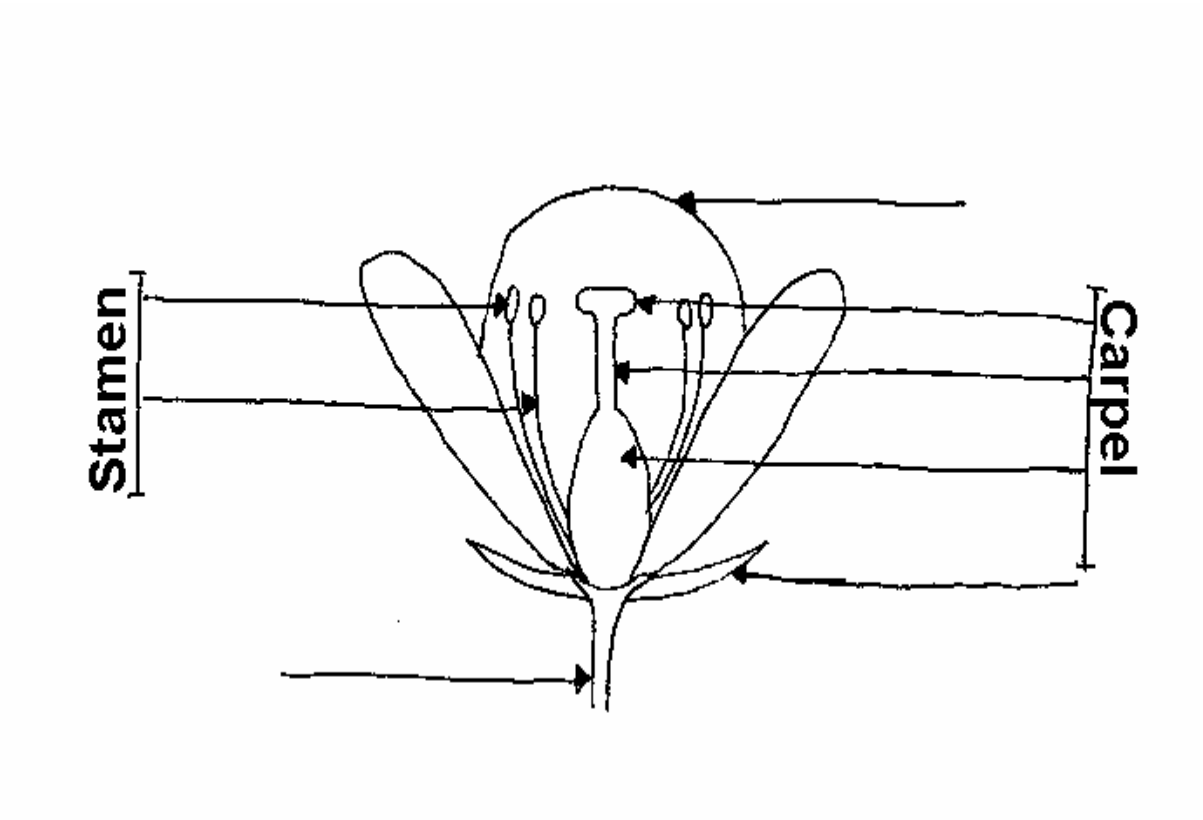


Name _____

Label the Flower

Directions: Correctly label the following flower parts:

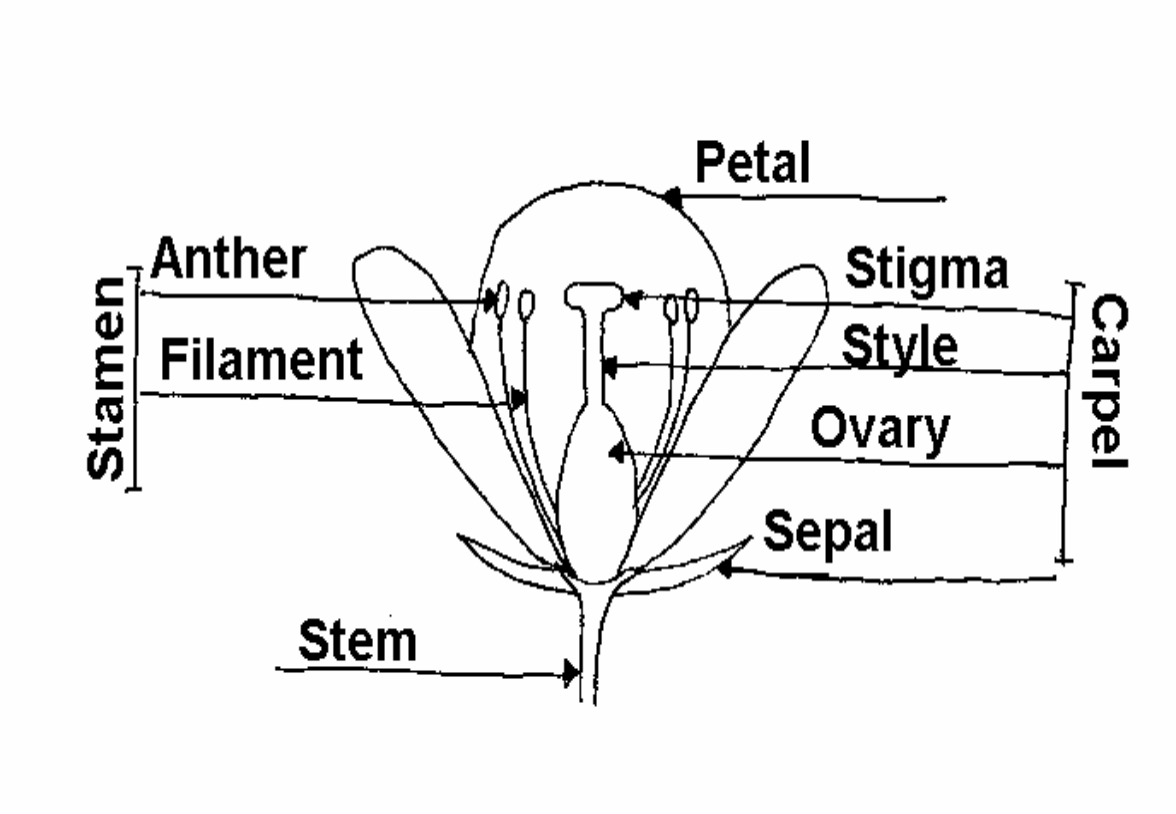
anther, petal, filament, ovary, sepal, stem, stigma, style



Label the Flower: Key

Directions: Correctly label the following flower parts:

anther, petal, filament, ovary, sepal, stem, stigma, style

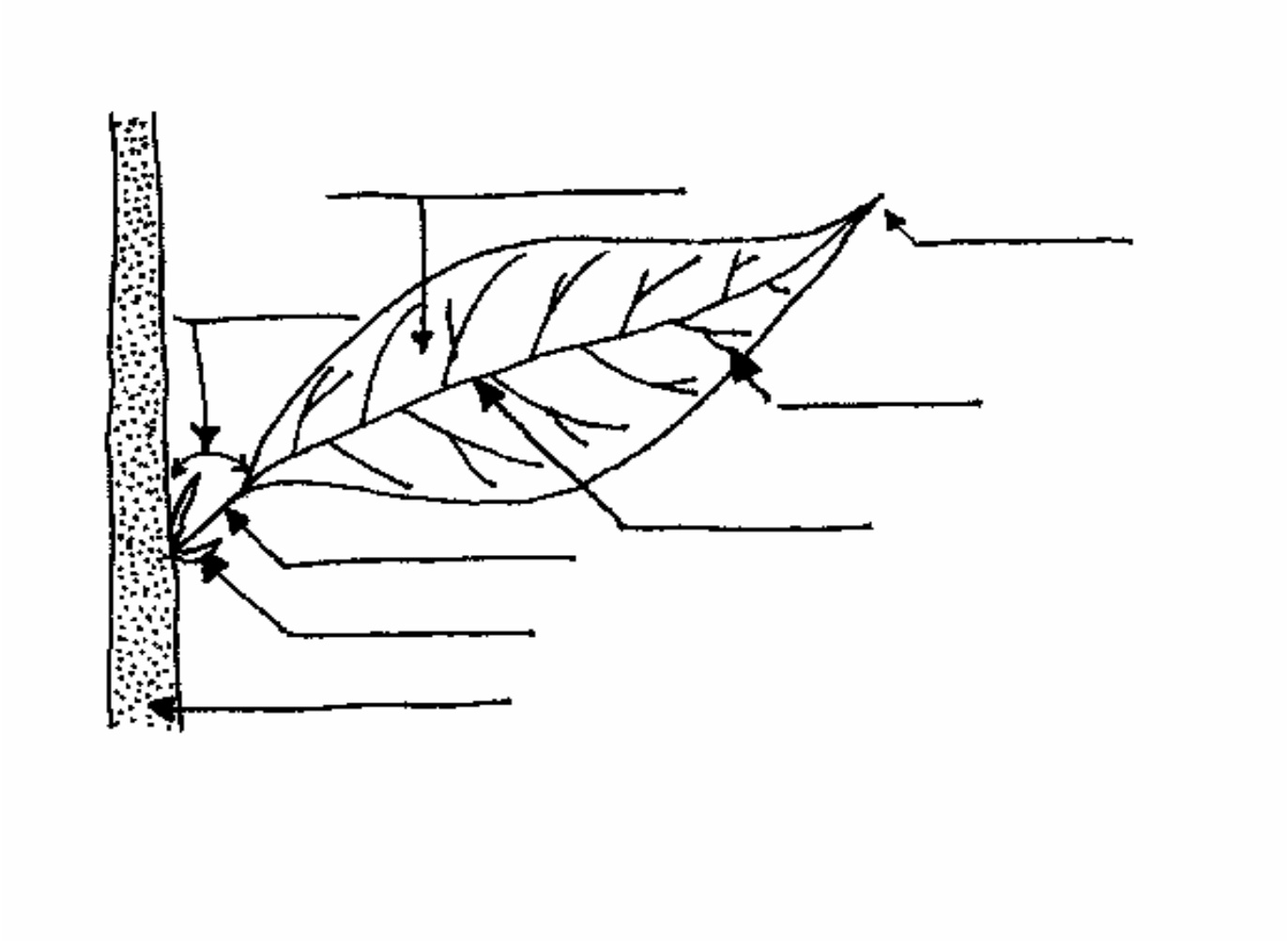


Name _____

Label the Leaf

Directions: Correctly label the following leaf parts:

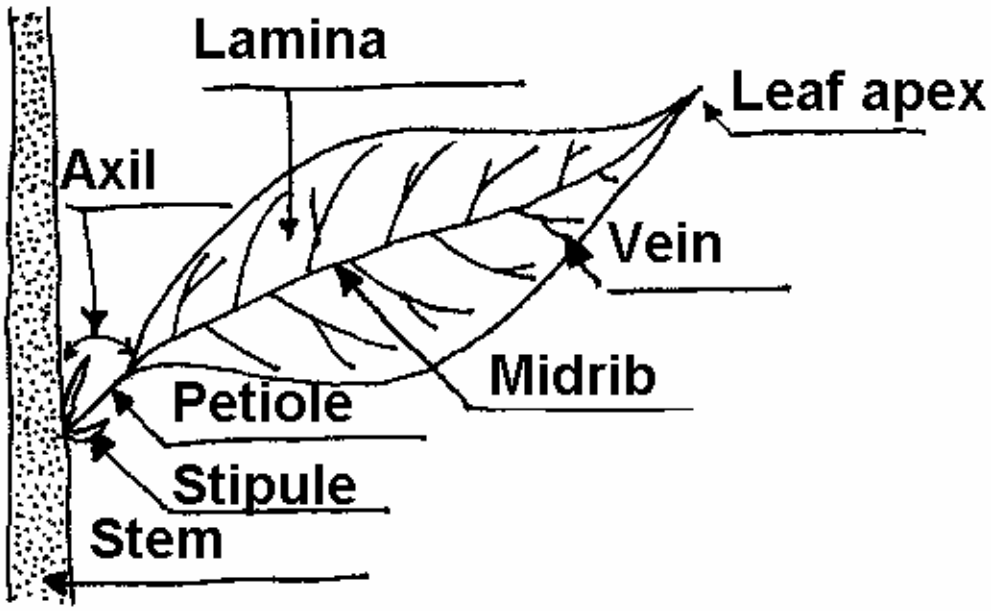
axil, lamina, leaf apex, midrib, petiole, stipule, stem, vein



Label the Leaf: Key

Directions: Correctly label the following leaf parts:

axil, lamina, leaf apex, midrib, petiole, stipule, stem, vein



Don't Leaf Out Photosynthesis

What exactly is photosynthesis?

Summary: Fall is a wonderful time of year to teach about the process that gives life to trees. In this lesson students will use hands-on methods to explore photosynthesis.
Duration: 1 class period
Setting: Classroom
Vocabulary: photosynthesis, chlorophyll, pigment
Standards/Benchmarks Addressed: SC1-E1, SC2-E1, SC3-E1, SC4-E1, SC4-E3, SC4-E5, SC5-E2, SC6-E1, SC6-E2, SC6-E3, SC6-E6, SC7-E2, SC7-E3, SC9-E1, SC11-E1, SC11-E2, SC11-E3, SC12-E2

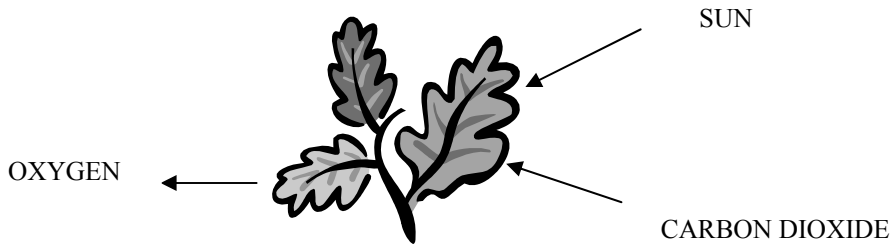
Objectives
Students will:

- be able to identify the various pigments often found in leaves.
- be able to explain the process of photosynthesis.

Background
Producers obtain food (complex organic compounds) from inorganic materials and an energy source. Producers form the first level of an ecosystem. Producers most familiar to us are green plants. Their energy source is the sun, and they convert energy to food through reactions of photosynthesis. Less than 1% of the sunlight reaching the Earth's atmosphere is transformed by photosynthesis. The rest is reflected back into space, absorbed by the atmosphere, or absorbed by the Earth.

Photosynthesis is the process by which plants, algae, and a few bacteria capture this tiny fraction of the sun's energy and convert it into stored chemical energy for their biological processes. Photosynthesis is the process plants use to produce their own food. The chemical formula for photosynthesis is: $6CO_2 + 6H_2O + \text{light} \rightarrow C_6H_{12}O_6 + 6O_2$. What sustains life for all non-photosynthetic species is the ability to use that stored energy. The glucose and other food molecules produced by plants can be broken down by animals into water and carbon dioxide in a process called respiration. Respiration is photosynthesis in reverse. During respiration, the stored chemical energy captured originally by the plant is released for use by the plant eater. It is during this process that the leaves release oxygen, which become part of the air that we breathe.

Plants use photosynthetic pigments to capture radiant energy by converting carbon dioxide and water into glucose. Photosynthesis can take place only in the presence of chlorophyll, the green pigment that is found in all green plants. Chlorophyll absorbs the sunlight needed for photosynthesis. Plants contain several pigments, including chlorophyll. Chlorophyll is the most abundant pigment and causes most plant leaves to appear green. Did you know that most leaves are orange and yellow even in the summer? This is because most leaves include the pigments of all three colors. The other pigments, xanthophyll (yellow), carotene (orange), anthocyanin (red and/or purple) are present but in much smaller quantities. As winter nears plants receive less sunlight and less water. Soon the photosynthesis process shuts down until spring. It is this process that allows to experience the "turning of colors" in the fall.



1. Light strikes the leaf and is trapped by chlorophyll.
2. Inside the leaf, light changes part of the water to hydrogen and oxygen.
3. Carbon dioxide from the air enters the leaf through stomates located on the underside of the leaf.
4. The hydrogen joins with carbon dioxide to make food for the plant.
5. Oxygen is released through stomates.

Materials
Leaves
Small jars
Plastic wrap
Rubbing alcohol
Coffee filters
Shallow pan
Hot tap water
Tape
Pen
Plastic spoon

Procedure
Warm up: Ask students if they have ever been outside and picked up something that had been sitting in a grassy area for a few days. If so what had they noticed? If they saw an area of yellowish, wilted-looking grass, they have witnessed how light (or lack of light) affects color development. Explain that the activity for today will allow students to recreate this phenomenon and help them to better understand the process of photosynthesis.

Activity: Students will work in groups to complete this experiment.

Step 1 - Chop leaves into very small pieces and place them into small jars. Be sure to label the jar with the name of the leaf.

Step 2 – Add enough rubbing alcohol to cover the leaves. Use the plastic spoon to stir and grind the leaves in the alcohol.

Step 3 – Cover the jars and allow them to sit in a shallow tray filled with 1 inch of very hot tap water.

Step 4 – Allow the jars to sit for at least 30 minutes or until the alcohol has become colored. Replace the hot water if it cools off. Twirl the jars gently about every 5 minutes.

Step 5 – Using long strips of coffee filter paper, place one in each jar so that one end is in the alcohol and the other bends over the edge of the jar. Secure the lid.

Step 6 – After approximately 1 hour students should be able to see the various colors traveling up the paper.

Step 7 – Remove the strips and let them dry.

Wrap Up: Discuss the findings.

Assessment
Participation and discussion

Extensions
Students can complete the same activity using fall leaves that have already changed colors. Steps 4 and 6 will take longer. Have them compare the results.

Am I Leaking?

Where is the Water?

Summary: Using the scientific method, students will complete a hands-on experiment that will allow them to discover that cacti lose less water through transpiration than broad-leaf plants do.
Duration: 2 class periods
Setting: Classroom
Vocabulary: transpiration, stomata, photosynthesize
Standards/Benchmarks Addressed: SC1-E1, SC1-E2, SC2-E1, SC2-E2, SC2-E3, SC3-E1, SC4-E1, SC4-E3, SC4-E5, SC5-E1, SC5-E2, SC6-E1, SC6-E2, SC6-E3, SC6-E4, SC6-E5, SC6-E6, SC11-E1, SC11-E2, SC11-E3, SC12-E2

Objectives
Students will:

- design an investigation to answer questions about transpiration.
- compare the rate of transpiration of a cactus to that of a leafy plant.

Background
Photosynthesis is the process by which plants, algae, and a few bacteria capture a tiny fraction of the sun's energy and convert it into stored chemical energy for their biological processes. Photosynthesis is the process plants use to produce their own food. The chemical formula for photosynthesis is: $6CO_2 + 6H_2O + \text{light} \rightarrow C_6H_{12}O_6 + 6O_2$.

What sustains life for all non-photosynthetic species is the ability to use that stored energy. Animals can break down the glucose and other food molecules produced by plants into water and carbon dioxide in a process called respiration. Respiration is photosynthesis in reverse. During respiration, the stored chemical energy captured originally by the plant is released for use by the plant eater.

During the respiration process, small pores (stomata) on a plant's leaves and stems open to absorb CO_2 from the air and in return release oxygen (O_2). Each time the stomata open, some H_2O is lost. This water loss process is called transpiration. For some plants losing a large amount of water isn't a problem. But, for desert plants, replacing this lost H_2O is not easy with so little annual moisture. If the H_2O can not be replaced, the desert plants will die. In order to survive some plants such as evergreens, cacti, and many plants that live in the dry climates have acquired special adaptations that limit the amount of water they give off.

Desert plants are unlike most plants that carry out photosynthesis during the day and lose a large amount of H_2O through transpiration. If transpiration occurs during daytime hours, high temperatures can cause water to evaporate quickly. If the process can occur at night, less H_2O is lost. One type of adaptation desert plants use is known as Crassulacean Acid Metabolism (CAM). In CAM plants, the stomata are only open at night, when the temperatures are much lower. Many plants in the desert environment have this method of photosynthesis, which is distinctly different.

Plants do not only lose H_2O through their pores; they also lose it through the cell walls on their leaves. The leaves and stems of many desert plants have a thick covering that is coated with a waxy substance, allowing them to open and absorb CO_2.

Desert plants have developed many adaptations in order to conserve the small amount of water they receive. The two adaptations discussed will be evident in the following experiment which shows how the waxy outer skin of a cactus helps it conserve water.

Materials
One plant (for each group of students)
One cactus (for each group of students)
1 clear plastic bag for each plant
String or tape
Mirror

Procedure
Warm up: Breathe on the mirror and then quickly hold it up and ask the students what they see. They should answer moisture. Explain to the students that in much the same manner, leaves give off moisture. How do we know this? How can we see this? Do all plants give off the same amount?

Activity: Review the background information with the class. Have students work in small groups of three or four. Each group should develop a step-by-step plan for trapping water vapor given off by their plants and for determining which plant lost the most water.

For example, some groups may decide to place their plants in direct sun while others may choose to place them in indirect sun or shade. The groups should identify the conditions that should be kept the same for both plants. Rather than sealing an entire plant in a bag, the groups may use intact limbs for the experiment. If so, they should tightly secure their plastic bags so that no water vapor can escape. Teachers should point out that this method is one of many desert survival techniques humans (hikers) use to extract water from plants.

Have the groups design and conduct their experiment. Students will keep a journal of their experiment. It should include such things as start and completion time of the experiment, observation notes, etc.

Wrap Up: Have each group explain their procedure and results. Discuss how this would help the desert plant save water.

Assessment
Scientific Procedure Project Report
Am I Leaking Rubric

Am I Leaking?
Scientific Procedure Project Report

Title: _____

Purpose: _____
_____
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Hypothesis:_____
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Materials:_____
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Procedure (Step-by-Step Directions):_____
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Each student is required to attach a copy of their journal, which will include dates and times of their observations, observation notes, etc. In addition to this record how else will you record your data?

Data:_____
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Results:_____
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Conclusion:_____
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Am I Leaking?
Scientific Method Rubric

Transpiration Project	Self Evaluation	Teacher Evaluation	Comments
Visual:		**/12**	
Includes display of leaf samples to illustrate the type of plants tested.			
Presentation board is visually attractive (fills the board, colorful, neat).			
Display identifies each step of the scientific process (title, hypothesis, purpose, materials, procedure, conclusion, results).			
Written:		**/12**	
Students provide a completed *Scientific Procedure Project Report*.			
Information is accurate.			
Proper grammar, spelling, etc.			
Presentation:		**/8**	
Presenters followed appropriate speaking rules (eye contact, voice, enthusiasm).			
Presentation quality, organization, information, appeal			
Teamwork:		**/4**	
Are the efforts of each team member clearly demonstrated, or did it appear to be the work of one or two			
Responsibility:		**/4**	
Turned in on due date and presented in class with visual.			

4 – no mistakes 3 – few mistakes 2 – many mistakes 1 – incomplete (however is present) 0 – not evident or not included

Visual _____ Written _____ Presentation _____ Teamwork _____ Responsibility _____ Overall_____

One Tough Dude

How does plant life survive such harsh desert conditions?

Summary: This lesson provides a discovery approach to learning about desert plant life. Students will complete three simple experiments in order to gain a greater knowledge of how plants adapt to desert life.
Duration: 1 class period
Setting: Classroom
Vocabulary: photosynthesis, transpiration, adaptation, drought-deciduous
Standards/Benchmarks Addressed: SC2-E1, SC3-E1, SC4-E1, SC4-E3, SC4-E5, SC5-E2, SC6-E1, SC6-E2, SC6-E3, SC6-E4, SC6-E5, SC10-E2, SC11-E1, SC11-E2, SC11-E3, SC11-E4, SC11-E5, SC12-E2

Objectives
Students will:

- explain how plants adapt to harsh desert environment.
- explain the concept of transpiration as it applies to desert plant life.

Background
For plants dependent on water for their basic life processes the dryness and heat of the desert make survival difficult. Unlike animals, plants cannot set out in search of water, they cannot retreat to a different location in order to avoid the intense heat of the sun. In response to these limitations, plants have developed several strategies for dealing with the harsh conditions of the desert. Plants use a variety of means to survive. Some have tough outer coatings while others depend on a rapid rate of growth after a rainfall. A large number of plants survive by their extensive shallow root systems. Other plants such as the mesquite tree have long taproots that may grow 100 feet deep to reach the water table. Some plants store water in their pulpy trunks or roots. Many desert plants have small, thick leaves with waxy coatings and will even shed their leaves during intense drought to further reduce water loss. Cacti carry out photosynthesis not in leaves, but in their thick stems. Thick stems are less likely to dry out. These stems have less surface area than broad, thin leaves. A cactus's spines are actually modified leaves.

For a more detailed explanation of the various adaptations see *Tricks of the Trade.*

Materials
Station #1 – Aloe Vera plant, a cactus, and a cutting instrument
Station #2 – wax paper, water droppers
Station #3 – sponges, dishpans, and a measuring cup
Station #4 – plastic water bottles (One with holes in the bottom the size of pins. The other with holes in the bottom the size of a pencil.), tub of water

Procedure
Warm up: Students will be asked to brainstorm words they think of when we say the word desert. Discuss why these particular words come to mind.

Ask students to brainstorm various adaptations of desert plants. Explain to the students that they will be looking for similar adaptations as they complete the following series of activities.

Activity: Students will work in four groups and the groups will rotate from station to station.

Station #1 – The Pulpy Insides: At this station students will examine a desert plant (the Aloe Vera) and the cacti. Before they start the activity, students are asked to draw what they think a desert plant looks like on the inside (don't forget to include the root system). As they cut open the plants students should be examining the amount of moisture, the look, and the feel of the plant.

Students should be prepared to discuss the following questions as a class.

1. How would you describe the texture of the plant skin?
2. Why do you feel the plant was able to hold the amount of moisture it held?
3. Describe the stems (thick, thin, rounded, flat).
4. Compare your drawing with the actual plant.

Station #2: How the Waxy Skin Works

1. Students will use the water droppers to squeeze a few drops of water onto wax paper.
2. Students should observe how the water reacts on the wax paper (does the paper absorb or resist the water?)

After completing this station, students should write a brief response to, "What type of adaptation does this activity represent?"

Station #3: The Spongy Roots

1. Students will dip the sponge into the tub of water.
2. Students should observe how the sponge soaks up the water.
3. Students will then squeeze out the water into a measuring cup in order to determine the amount of liquid the sponge was able to hold.

After completing this station, students should write a brief response to, "What type of adaptation does this activity represent?"

Station #4: Pore Size Matters

1. Students will fill the plastic containers with water (one container should have tiny holes poked in the bottom and the other should have larger holes poked in the bottom) by submerging the two bottles into a tub of water and then pulling them out by the neck of the bottle.
2. Students should observe the different rate at which the bottles drain.

After completing this station, students should write a brief response to, "What type of adaptation does this activity represent?"

***Wrap Up*:** Bring students back to the whole group. Group discussion should focus on the findings as a result of the previous experiments.

Students will then be asked to create a desert plant survival guide. This guide will consist of identifying six different Chihuahuan Desert plants, their specific adaptation(s), the way in which

the adaptation helps the plant, and an illustration of each plant. Teachers may choose to have students research other types of plants depending on location or field of study.

Assessment
Evaluate the student's survival guidebook by looking for a variety of adaptations. Students should also be able to explain how each adaptation helps the plant.

Students will receive three copies of the Desert Plant Survival Guide. A cover may be created with construction paper or may be computer generated.

Tricks of the Trade… How Desert Plants Survive
One Tough Dude Activity

How do desert plants save water?

Desert plants work hard to make use of what's available. They use the sun's energy to convert carbon dioxide (CO_2) and water (H_2O) into sugar, a process called photosynthesis. During this process, small pores (stomata) on a plant's leaves and stems open to absorb CO_2 from the air and in return release oxygen (O_2). Each time a plant opens its pores, some H_2O is lost. This is called transpiration. Replacing this lost H_2O is not easy with so little annual moisture. If the H_2O cannot be replaced, the desert plants will die. Desert plants have acquired special adaptations that help them in reducing H_2O loss.

- **Smaller, fewer, and deeper pores** – Many desert plants have very small, fewer, and deeper pores. With such pores, hot and dry winds are inhibited from blowing directly across the pores and reducing H_2O loss.
- **Waxy cover** – Plants do not only lose H_2O through their pores, they also lose it through the cell walls on their leaves. The leaves and stems of many desert plants have a thick covering that is coated with a waxy substance, allowing them to still open and absorb CO_2.
- **Nocturnal** – Unlike most plants that carry out photosynthesis, plants lose a large amount of H_2O through transpiration, and if transpiration occurs during daytime hours, high temperatures can cause water to evaporate quickly. If the process can occur at night, less H_2O is lost. Many plants in the desert environment have a method of photosynthesis that is distinctly different. It is known as Crassulacean Acid Metabolism (CAM). In CAM plants, the stomata are only open at night, when the temperatures are much lower.
- **Little leaves** – Most desert plants have small leaves or no leaves at all. The smaller or fewer leaves a plant has, the less H_2O is lost during transpiration since it has less surface area exposed to the sun and wind. For desert plants with small leaves or none at all, the twigs and stems help carry out photosynthesis.
- **Hide and rest**-During the hottest part of the day many desert grasses and other plants "roll" their leaves to reduce the amount of surface area exposed to sun and wind. Some plants simply position themselves so they have less exposure to the climatic elements on a hot, sunny day. Some plants grow best if they sprout under a "nurse" plant. The "nurse" plant shades the young plants from damaging sun, drying winds, and animals that might trample it.
- **Drop 'em in drought** – Some desert plants grow leaves during the high moisture period of the year and then shed them when it becomes dry and hot again, such plants are called drought-deciduous. These kinds of plants will carry out photosynthesis only during the moist period.

How do plants get water?

One way desert plants, trees, and shrubs suck up as much water as possible is by growing very deep taproots. Sometimes these roots can get to be more than 100 feet long. The above ground plant parts may remain small for years simply because the plant puts most of its energy into developing its taproot system. Desert plants may have a huge, tangled network of shallow roots that spread out from the plant in all directions. The roots can be as long as the plant is tall, and can quickly absorb water from the slightest rainfall.

Why do plants shrink and swell?

Desert plants can soak up water, store it, and prepare to use it during drought. For example, cacti and many other desert plants store water in their fleshy leaves and stems. Desert plants may also have other adaptations for water storage, such as pleats or folds that will allow the plant to swell with added water when it can. The pleats or folds can almost disappear if the plant soaks up a lot of water; then the plant can shrink, and its pleats or folds can become visible again as drought sets in and the plant makes use of water it has stored. Though many desert plants die to the ground during the hottest part of each year, the water they have stored in underground roots, tubers, and bulbs will sustain them until the next moist period.

Why do plants grow hairs and spines?

The hairs and spines that grow on desert plants help reduce moisture loss by breaking the effects of the wind. They also help cast minute shadows on desert plants, which can protect them from the sun. The light colored hairs and spines can even serve to reflect the sun's rays away from the plant. Lastly, hairs and spines can help protect plants from hungry animal predators.

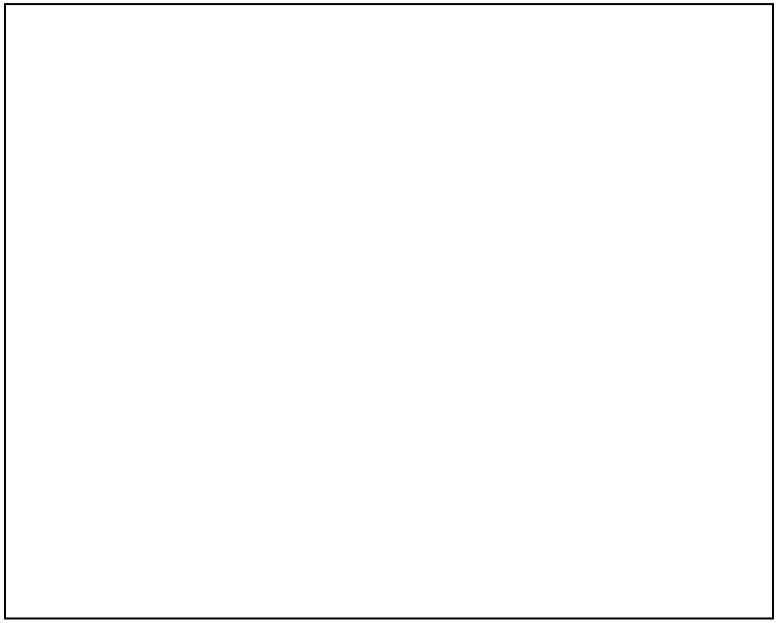
Why do plants produce special chemicals?

Scientists believe that desert plants may produce and give off chemicals from their leaves or roots that keep other plants from growing nearby. It is thought that plants do this to reduce competition, especially when water is scarce.

Why do seeds of plants sleep?

Some desert plants cope with the desert's dryness by not coping at all. As a result, during drought they are present only as seeds in the soil. For months, years, or even decades these seeds "sleep" to wait out the dry spell in a dormant state. When the right amount of rain falls and soaks into the soil, they sprout and bloom. When this happens the desert's dry brown landscape can quickly change into colorful fields of wildflowers, herbs, and grasses. Most of these fast-growing desert plants do not last very long. So aside from having seeds that are adapted to drought, they have few or no special adaptations to desert conditions. This is why desert plants of this kind sprout, flower, and leave behind a generation of seeds as quickly as possible. Short-lived desert plants are called ephemerals. With little water available to help them grow, dormant ephemerals are covered and protected by natural chemicals called inhibitors. The primary function of inhibitors is to keep seeds from germinating until enough moisture and specific temperatures are present. Once the inhibitor has been washed off, the seeds can sprout.

Desert Plant Survival Guide



Plant Name (common and scientific):

_____

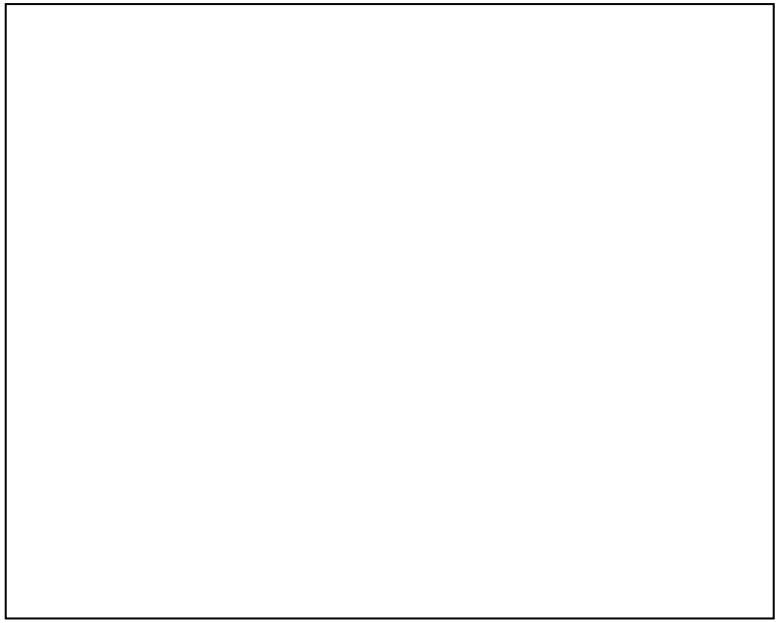
Description (color, size, location, etc.):

_____

Adaptations:

_____

_____



Plant Name (common and scientific):

_____

Description (color, size, location, etc.):

_____

Adaptations:

_____

_____

Desert Plant Survival Guide Rubric

Desert Plants	Self evaluation	Teacher evaluation	Comments
Visual:		**/4**	
Illustrations are accurate, colorful, and fill the page.			
Written:		**/12**	
Provides the common and scientific name of the plant.			
Identifies an area in which each of these can be found.			
Identifies the adaptations utilized by the various plants.			
Presentation:		**/8**	
Organization of information, quality, etc.			
Presenter follows appropriate speaking rules (eye contact, voice, enthusiasm).			
Responsibility:		**/4**	
Turned in on due date and presented in class.			

4 – no mistakes 3 – few mistakes 2 – many mistakes 1 – incomplete (however is present) 0 – not evident or not included

Visual _____ Written _____ Presentation _____ Responsibility _____ Overall_____

To Be or Not to Be

What is asexual reproduction?

Summary: This activity introduces the concept of asexual reproduction. While utilizing the scientific method, students will choose a plant, research it, choose a method of propagation, and keep a scientific journal of its treatment.
Duration: Activity time approximately 6 weeks
Setting: Classroom
Vocabulary: vegetative propagation, alternation of generations, antheridia, archegonia, antheridium, marchegonium, dicotyledon, monocotyledon, dormant
Standards/Benchmarks Addressed: SC1-E1, SC1-E2, SC2-E1, SC2-E2, SC2-E3, SC3E1, SC4-E1, SC4-E3, SC4-E5, SC5-E1, SC5-E2, SC6-E1, SC6-E2, SC6-E3, SC6-E4, SC6-E5, SC10-E1, SC11-E1, SC11-E2, SC11-E3, SC11-E4, SC11-E5, SC12-E2

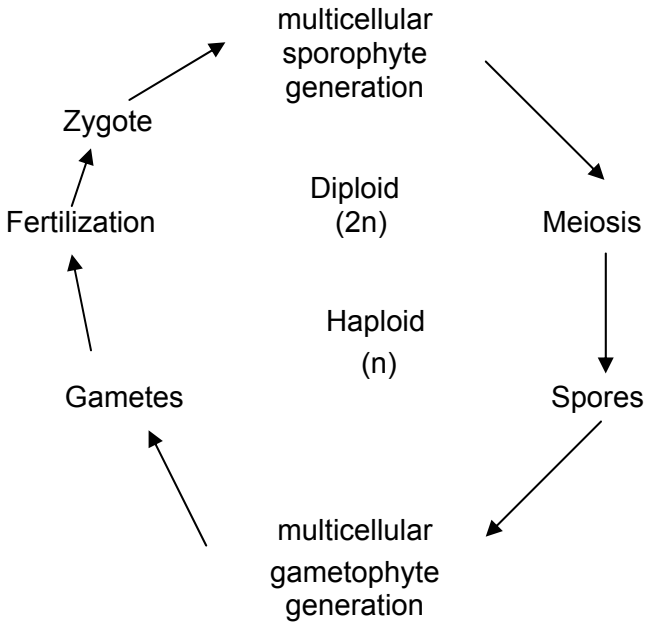
Objectives
Students will:

- understand the different methods of plant propagation.
- successfully start a new plant by any means of vegetative propagation.
- keep a laboratory journal on the progress of the plant.
- use the scientific process in order to complete an experiment on propagation.

Background
Whenever plants reproduce asexually by any means, either natural or induced, the term vegetative propagation applies. It simply means that vegetative tissues (non-reproductive tissues) are used to reproduce new plants. All members of the plant kingdom have some means of reproduction whether it produces sperm and eggs or spores. In the mosses and the ferns, the sexual structures are called antheridia and archegonia. The antheridium produces sperm and the marchegonium produces one or more eggs. These plants also have a spore-producing asexual phase.

Alternation of generations is a term that describes the life cycle of most plants and some algae. In most plants, meiosis and fertilization divide the life of the organism into two distinct phases or “generations.” The term generations is misleading since it refers to two different phases that make up a single life cycle. Sexual reproduction involves the two alternating processes of meiosis and fertilization. In one phase, the plant is known as a gametophyte or gamete-bearing plant and produces sex cells called gametes. Gametophytes can produce male sperm cells, female egg cells, or both. In fertilization, the nuclei of two gametes fuse, raising the chromosome number from haploid to diploid. When a sperm cell and an egg cell unite, they form a zygote (fertilized egg). The zygote develops into the next phase of the reproductive cycle. In this phase (meiosis) the plant is known as a sporophyte or spore-bearing plant and produces reproductive cells called spores. The chromosome number is reduced from the diploid to the haploid number. Then spores develop into gamete-producing plants, and the cycle begins again.

Alternation of Generations
Plant Life Cycle



In higher plants, the monocotyledon and the dicotyledon, flowers contain the sexual structures. The sperm are borne in pollen grains produced in the stamen of the flowers, and the eggs are held in ovules within the pistils. Some higher plants also have common means of asexual reproduction which do not involve floral parts. Strawberries, for example, send out runners, while many trees send up new shoots from their roots. Black cherry and quaking aspen both send up shoots.

Many plants that do not commonly reproduce asexually can be induced to do so. For example, stem cuttings of geraniums or jade plants will often root in water, and can then be planted in potting soil.

Types of propagation
Plant propagation can be completed by various means. One method is by seed. In the wild, seed germination is erratic by design, spanning the longest possible time in order to eventually strike upon a favorable set of conditions and there insure continuation of the species. In a controlled environment, good quality seed is the basis for successful seed production. Other key factors in successful propagation include; moisture, pollination, insect control, and temperature. In collecting seeds from the wild there are many things to consider. Timing of collection is critical. Seeds should be cleaned of debris. Often seeds need to be pretreated by means of an acid scarification or hot water soak. Scarification is the pretreatment used when the limiting factor is a hard seed coat that prevents water penetration and gas exchange or physically restricts the growth of the embryo.

Propagation by cuttings is another means of reproduction. The cuttings from some plants such as the cherry sage or four o'clocks root easily. Again correct timing and cutting material is essential. When selecting the plant to propagate it is important to remember that plant material that has had adequate moisture to produce healthy new growth will root and grow more rapidly than cuttings that have been dependent solely upon rainfall.

A third type of propagation is by root cuttings. This method can be used to propagate arid-land natives with fleshy root systems. Root cuttings should be taken when the plant is dormant. When using this method it may take several months for the cutting to form new terminal buds. It is important not to over-water them.

The layering method entails selecting a healthy lower branch of a plant and cutting a notch in the stem about ten inches from the tip just below the node (the point where a leaf is attached to the stem). Bend the stem down to the ground, loosen the soil where the notched stem touches, and push the stem into the soil so that the growing tip is exposed but the notched portion is buried. Pin the stem in place with wire. This method may take six months to one year to develop a root system.

Dividing established specimens can increase plants that have a matted growth habit or form offshoots from a central crown. Dig up the entire plant, split it into sections, and replant where desired. This method is most successful when the plant is in the dormant stage.

Materials
A variety of plants
Variety of potting soils
Pots

Procedure
Warm up: Bring in a piece of prickly pear cactus for students to examine. Ask students to consider whether or not this plant could form a new one. Write the term “vegetative propagation” on the board and ask students if they know what the term means. If none of them know the definition, write it on the board and then explain to the students that they will be completing an experiment in order to observe vegetative propagation.

Activity: Students will select a healthy plant to be propagated. The plant may be a house plant, a landscape plant, or a wild plant. Students will be required to research the plant paying specific attention to the proper propagation method for their plant. Once students have selected the method of propagation they will use the scientific process to complete their experiment.

Wrap Up: Six weeks after the initial set-up of this project students will take turns sharing their plant research, progress or lack thereof, and what they gained from this experience.

Assessment
Laboratory journals and project report using the attached rubric.

To Be or Not To Be
Project Report

Title: _____

Purpose: _____
_____
_____
_____
_____

Hypothesis:_____
_____
_____
_____

Materials:_____
_____
_____
_____

Research:_____
_____
_____
_____
_____
_____
_____
_____
_____
_____
_____
_____

Procedure (Step by Step Directions):_____
_____
_____
_____
_____
_____
_____
_____
_____
_____
_____
_____

Each student is required to attach a copy of their journal, which will include dates and times of their observations, observation notes, etc. In addition to this record how else will you record your data?

Data:

Results:

Conclusion:

TO BE OR NOT TO BE
Scientific Method Rubric

Propagation Project	Self Evaluation	Teacher Evaluation	Comments
Visual:		**/12**	
Include propagated plant.			
Presentation board is visually attractive (fills the board, colorful, neat).			
Display identifies each step of the scientific process (title, hypothesis, purpose, materials, procedure, conclusion, results).			
Written:		**/12**	
Students provide a completed *Project Report.*			
Information is accurate.			
Proper grammar, spelling, etc.			
Presentation:		**/8**	
Presenters followed appropriate speaking rules (eye contact, voice, enthusiasm).			
Presentation quality, organization, information, appeal			
Responsibility:		**/4**	
Turned in on due date and presented in class with visual.			

4 – no mistakes 3 – few mistakes 2 – many mistakes 1 – incomplete (however is present) 0 – not evident or not included

Visual _____ Written _____ Presentation _____ Teamwork _____ Responsibility _____ Overall_____

Which is Which?

Deciduous or Coniferous – a lesson designed to differentiate between the two.

Summary: Through a hands-on approach students will be able to identify the distinguishing characteristics of the deciduous and coniferous tree.
Duration: 1 day
Setting: Outdoors-field trip, classroom
Vocabulary: deciduous, coniferous, simple, compound, dichotomous key
Standards/Benchmarks Addressed: SC1-E1, SC4-E3, SC5-E2, SC6-E1, SC6-E2, SC6-E3, SC6-E4, SC10-E2, SC11-E1, SC11-E4, SC11-E5, SC12-E2

Objectives
Students will:

- be able to explain the difference between deciduous and coniferous trees.
- use a dichotomous key to identify types of trees.

Background
What is a tree? Trees come in all shapes and sizes, from the bristlecone pines to saguaro cacti. In North America there are over 800 different species of trees. Some scientists use size as a way to help define trees. Yet, when you consider harsh environments such as the Arctic or deserts, trees can often be smaller than other plants. One way trees are defined is by the woody roots, trunks, and limbs that provide physical support. Trees also live longer than most other plants. They are a type of perennial. Although they become dormant during the winter, the stems, branches, and roots are still alive and will continue to grow taller and thicker each year.

Trees are classified according to how they reproduce, what types of flowers and seeds, how they grow, and how they are structured inside. Most trees fall into two main plant groups. Gymnosperms, which have seeds not enclosed in flowers. These seeds are produced on the surface of the scales of female cones. Conifers are the most common types of gymnosperms. Angiosperms are the types of plants that have true flowers and bear their seed in fruits.

Deciduous trees are those trees that shed their leaves at the end of the growing period, so they are bare for part of the year. This shedding typically occurs in the months of September and October. They rest during this part of the year. The trees grow new leaves when there is enough sun and rain for them to grow. Deciduous trees have two types of leaves, simple or compound. A simple leaf is one leaf that attaches to the stem. A compound leaf is two or more leaves, usually many, that connect to the stem. In North America, most broad-leaved trees are deciduous, while most needle-leaved trees are coniferous. Coniferous trees, often called evergreens, keep their leaves for several years and lose them gradually, while growing new ones, so they are never bare. Coniferous trees have leaves that look like needles.

From pine leaves to broad palm leaves, all leaves serve the same purpose: to make food for the tree. Leaves use carbon dioxide from the air, water from the roots, and the sun's energy to make sugar. This food-making chemical reaction is called photosynthesis. Photosynthesis can only take place in the presence of chlorophyll. Chlorophyll is the green pigment that is found in

all green plants. Chlorophyll absorbs the sunlight needed for photosynthesis. During photosynthesis the leaves release oxygen which becomes part of the air that we breathe.

Materials
Tree samples
Dichotomous key
Grab bag items (might include such things as pencil, magazine, wooden spoon, aluminum foil, cork, plastic comb, etc.)

Procedure
Warm up: Begin by drawing the students' attention to the classroom window. Ask, "What do you see when you look out the window?" Answers will vary. Next, ask, "How many of you look outside and say, "Hey, that's an evergreen…, a Desert Willow…, a Mesquite …?" We don't pay much attention to trees and yet they play an important part of our world. Today the students will be tying to "key" different leaves found on an outdoor hike (for example McKittrick Canyon).

Before the trip, make a transparency of *Different Types of Leaves*. Discuss the shape of each leaf and whether it is compound or simple and opposite or alternate. Hand out the dichotomous key, or make one of your own,* and explain that it is based on the idea of making a choice between two alternatives. As the student "keys" their leaf, they will need to decide which phrase applies to the particular leaf being "keyed."

*Directions: Pick 6 trees you know you will encounter on your hike, separate the characteristics, and make a dichotomous key from those characteristics (see example).

Activity: Take a field trip (a suggested area is McKittrick Canyon). While there, students should practice using the dichotomous key to identify the various deciduous and coniferous trees.

Take students back to the classroom for the next activity. Divide the class into groups of five. Pass out small branches of leaves to each group. Students will work cooperatively in groups to identify which trees the leaves came from. Students will create a poster by illustrating the leaf sample and placing it on the deciduous side or the coniferous side.

When students are done they will share their findings with the group.

Wrap Up: As a closing activity, students can play a game of "Who Wants to be a Biologist?" "Who Wants to be a Biologist?" can be played with a variety of items in a grab bag. Have students choose an object out of the grab bag and decide whether or not it comes from a tree. Grab bag items might include such things as, pencil, magazine, wooden spoon, aluminum foil, cork, plastic comb, etc. Students may also choose to be asked a question. Examples are listed below.

1. Name five trees that are commonly encountered in the area surrounding our school.
2. Define the terms "Simple" and "Compound."
3. True or false: All broad-leaved trees are deciduous.
4. What are deciduous trees?
5. What gives plants their green color?
6. True or false: Evergreen trees never shed their leaves.
7. Show differences between the terms "Simple" and "Compound."
8. True or false: Gymnosperms do not produce true flowers or fruit.
9. True or false: Pine needles are leaves.

10. Why do many deciduous trees' leaves change from green to other colors in the fall?

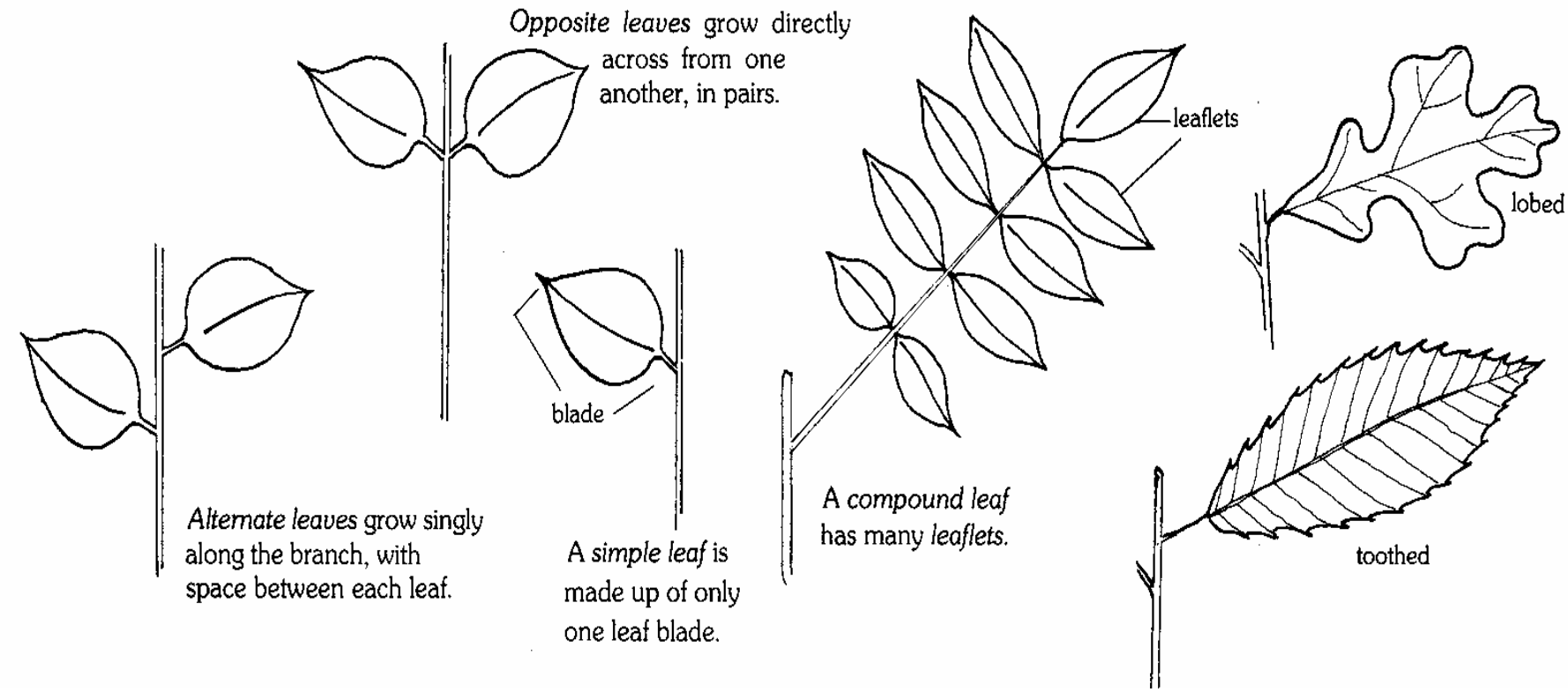
Assessment
Classroom participation

Which is Which? Activity
Dichotomous Key

Their shape, bark, buds, and leaves can identify trees. A key is a valuable tool that can be used to identify a tree by its characteristics.

1. a. The tree has leaves	go to 5
b. The tree has needles	go to 2
2. a. The needles are in clusters	go to 3
b. The needles are arranged singly on the twig	go to 4
3. a. If there are 2 or 3 needles ¾ to 1 ½ inch long	Pinyon Pine – Reddish barked tree that is small and many branched. Cones are about 2 inches long and contain wingless edible seeds, ½ inch in length.
b. If there are 2 or 3 needles approx. 5 inches long	Ponderosa Pine – Large tree with bark that is dark brown to black turning yellowish-red with age. Immature cones are green and tightly closed, changing to reddish-brown as they ripen.
4. If needles are scale-like	Juniper – Bark deeply furrowed and checkered with rectangular scales; branch tips usually stiff; green to reddish brown cones appear bluish.
5. a. If leaves are simple	go to 6
b. If leaves are compound	go to 9
6. a. If several main veins branch from one point	go to 7
b. If leaf has one main vein with smaller side branches	go to 8
7. If notches are lobed	Bigtooth Maple – Leaves are opposite and typically 2 ½ inches in diameter, with three broad, blunt lobes. Bark is gray to light brown and may be smooth or scaly.
8. a. If leaves are lanced-shaped and approx. 6 inches longwith wavy edges and coarse teeth	Chinquapin Oak – Bark is ash gray, rough and flaky. The fruit or acorn is small and half-enclosed in a cup.
b. If leaves are small, oval, smooth margined, and dusty blue-gray in color with star-shaped hairs on both sides of the leaf	Gray Oak – a common Shrubby oak of the Southwest that grows in dry rocky sites.
9. a. If leaves are bipinnate with 2 to 8 pinnae each with 12 to 60 leaflets	Honey Mesquite – A common desert shrub with sturdy branches that have straight thorns.
b. If leaves are compound with 5 to 7 leaflets up to 5 inches long with toothed margins	Mexican Buckeye – A small much-branched tree that grows in rocks and canyons. It is a member of the soapberry family.

Different Types of Leaves
(Which is Which? Activity)



Where in the World?

What are the various uses of the plants we grow?

Summary: Students develop an understanding that plants are not just for food but that in fact are found in most everything we use daily. Students will explore the plant products that they use everyday.
Duration: 3 weeks
Setting: Classroom
Vocabulary: byproduct
Standards/Benchmarks Addressed: SC1-E1, SC3-E1, SC4-E5, SC5-E2, SC6-E2, SC6-E3, SC6-E4, SC6-E5, SC6-E6, SC6-E7, SC11-E5, SC12-E1

Objectives
Students will:

- identify various products that are a byproduct of plants.
- use research skills to gain information on various types of plants.

Background
The Southwest, or more specifically, the Chihuahuan Desert area, has been chosen for an example of research on byproducts of plants. This particular region has a rich history of Native American uses of plants. Although some still carry on their traditions, many desert natives no longer practice their traditional ways of life.

Medicines: Plants of the Southwest have long been valued for their medicinal uses. The Desert has a variety of plants that are being used, not only in traditional, but also in modern day medicines. One such plant is the Chihuahuan Desert's Sangre De Drago, which contains a reddish juice traditionally used to treat eye and gum diseases. The Algerita plant contains the drug berberine, and has been used to treat toothaches. Native Americans used Creosote bush as a herbal medicine to cure colds, intestinal discomfort, and stomach and menstrual cramps. Today, researchers have a scientific basis for many of these traditional uses. They have identified compounds and resins in the creosote bush that act as painkillers and dissolve kidney stones. There is current investigation into its anti-aging effects and its ability to help control the growth of cancer cells.

Cosmetics: The juices of the desert plants aloe and jojoba are used in shampoos, burn remedies, lotions, and cosmetics. Jojoba also has potential uses in lubricants and wax for cars because it doesn't spoil like other oils. Red chiles lend their fiery color to cosmetics, including lipstick. Soaptree yucca roots are still peeled and pounded or boiled to make a gentle soap for washing hair and for cleaning hand-woven rugs and blankets.

Beverages: Agave is best known for the sugary pulp that is mashed, fermented, and distilled to make mescal and tequila. Pinon-juniper berries are used to flavor gin. The red velvety berries of sumac have long been used to make a beverage similar to lemonade. Mormon tea is a plant long used by settlers and Indians to treat a variety of ills ranging from kidney infection to hayfever.

Clothing and Dyes: Agave supplied desert-dwellers in the Southwest with tough leaf fibers for use in hunting nets, baskets, mats, ropes, and sandals. Cotton was first cultivated by desert Southwesterners around 2,000 years ago. Today, New Mexico is the fourth-largest producer of cotton. Lichens, which are composed of fungi and algae, are used to furnish dyes for Southwest rug weavers. Algerita is used to produce a brilliant yellow dye. Brown and red dyes can be extracted from the netleaf hackberry. Indian paintbrush can produce yellow dye from its flower and black dye from its roots.

Other uses: Aspen can be used for building and is also shredded to make the excelsior for evaporative cooler pads. Mistletoe, the familiar Christmas "kissing ball" is one of the few truly parasitic plants that grow in the Southwest.

Although the Southwest no longer grows the bulk of the nation's supply, corn remains a traditional Southwest crop. Corn has been a staple in the Southwest for at least 2,000 years. Corn is eaten fresh, ground into meal and flour, cooked into mush, or drunk as a creamy high-energy drink. Corn byproducts are found in the majority of our processed foods in the form of corn syrup, cornstarch, etc.

Mesquite wood is used today as barbecue flavoring, fuel, and fence posts.

This list is but a small sampling of the variety of uses of plants in the Southwest. With research, your students will be able to produce a comprehensive list of the many byproducts of plants in their chosen region.

Materials
Access to library and or Internet resources
Item(s) that are a byproduct of plants

Procedure
Warm up: Bring in an item (anything that is a byproduct of a plant), such as soda, ask students if they can name some of the ingredients of the item. Ask students if this item is a byproduct of plants. Explain that plant products are found in their everyday lives. Have students name some items that are a byproduct of plants (medicines, beverages, clothing and dyes, cosmetics and perfumes, snack foods, and cafeteria food).

Activity: Explain to the students that they have been hired to promote plant byproducts from various regions. To do this, students will break up into groups. Each group will choose a region to promote. The group will then identify plant byproducts from that region. They should consider the following categories as they research plant products.

- clothing and dyes
- beverages
- cosmetics and perfumes
- medicines

Within their groups, students will produce a list of products from their assigned region. Each student within the group will select a product from that list to research. The following questions should be addressed in that research. What plant does your product come from? What part of the plant does your product come from? Do/Did the native people use your product? Is your product processed? How is your product processed? How/When was your product discovered? Does your product grow anywhere else now?

Each group will create an advertisement for their region. The advertisement will highlight the researched products and should describe why consumers would want to use these items.

Wrap Up: Have each group present their advertisement to the class.

Assessment
Where in the World Rubric

Where in the World? Rubric

Regional plant products	Self Evaluation	Teacher Evaluation	Comments
Visual:		**/8**	
Advertisement is visually attractive (fills the page, colorful, neat).			
Advertisement contains interesting facts/information about the product (uses, medicinal purposes, etc.).			
Written:		**/16**	
Identifies uses of plants in each of the four categories (clothing and dyes, beverages, cosmetics and perfumes, medicines).			
Information is accurate.			
Proper grammar, spelling, etc.			
Advertising techniques are evident (sells this region's products).			
Presentation:		**/4**	
Organization of information, quality, etc.			
Teamwork:		**/4**	
Are the efforts of each team member clearly demonstrated, or did it appear to be the work of one or two?			
Responsibility:		**/4**	
Turned in on due date and presented in class with visual.			

4 – no mistakes 3 – few mistakes 2 – many mistakes 1 – incomplete (however is present) 0 – not evident or not included

Visual _____ Written _____ Presentation _____ Teamwork _____ Responsibility _____ Overall_____