3

Plant Connections

What Makes Plants Grow?

PURPOSE:

- To become familiar with what makes plants grow.

OBJECTIVES:

For youth to:

- identify five basic plant needs.
- describe what a plant needs in order to manufacture its own food.
- describe how the nutrient content of a soil can be improved.
- describe a plants role in the hydrologic cycle.
- identify way plants compete.
- associate plants habitats with plant needs.

LESSON TIME:

- Lesson time may vary based upon learning activities selected. Most activities are approximately 30 minutes.

ADVANCE PREPARATION:

- Read the BACKGROUND BASICS on What Makes Plants Grow?
- Review activities and choose appropriate one(s) to use.
- Collect and prepare materials for appropriate activities.

LEARNING ACTIVITIES

1. NEW BEGINNINGS
2. LET'S EAT!
3. GROW UP!
4. KEEPING COOL!
5. SURVIVAL OF THE FITTEST!
6. PLANT HABITATS

DO

The following are suggestions for using the activities in Lesson 3. The materials needed for each are listed within the activity.

- Associate plant needs with plant growth in NEW BEGINNINGS.
- Explain how plants provide us with oxygen in LET'S EAT!
- Describe the importance of nutrients to plants in GROW UP!
- Explain the movement of water in the hydrologic cycle in KEEPING COOL!
- Identify ways plants adapt to their environment in SURVIVAL OF THE FITTEST!
- Identify types of plant habitats in PLANT HABITATS.

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REFLECT

After completing the activities in this lesson, help youth reflect on what they have learned with these questions:

What do plants need in order to grow?

sunlight, water, air, proper temperature, nutrients

What is photosynthesis?

food manufacturing process in green plants

How do plants get their water and nutrients?

absorption by the roots

Why is water important to plant growth?

used in photosynthesis, transports nutrients, regulates temperature, keeps cells turgid

What are some ways plants adapt to their environments?

hard seed coats, chemical defense, thorns and spines

Why do plants need space and shelter?

overcrowded areas increase competition for growth limiting growth factors

young plants need shelter from harsh environmental conditions

APPLY

Help youth learn to apply what they have learned.

- Name the limiting factors that effect plant growth.
- Investigate how the structure and shape of a leaf affects photosynthesis.
- Start a compost pile!!! Follow the instructions on the COMPOSTING information sheet.
- Find out what adaption desert plants have developed to minimize water loss.
- Collect and identify seeds around your schoolyard. How was each seed dispersed? What are it's chances of survival?
- Inspect an artificial habitat (vegetable garden, lawn, hedgerow). Discuss what the plants need and how those needs are met.

BACKGROUND BASICS … What Makes Plants Grow?

The vital needs of a plant are very much like our own - **light, water, air, nutrients**, and a **proper temperature**. The relative importance of each of these needs differs widely among plants. The ability of a plant species to spread throughout a geographic area is a direct result of its adaption to the abiotic and biotic components of the area. Although most habitat components act on a plant simultaneously and should be considered together, the lack of one essential component can determine the health of a plant. This factor, whatever it may be, is referred to as a **limiting factor**. The concept of limiting factors applies to all aspects of a plant's interaction with its habitat. Any factor in the ecosystem can act as a limiting factor. For example, water is important to many species; most species cannot live in desert regions because of lack of water and most cannot live in marshes because of excess water. Extreme temperatures inhibit plant growth in many regions; lack of warmth in winter is a limiting factor that keeps many species restricted to the tropics.

Another limiting factor is often competition from species that use the same resources. Competition is the principal interaction among plants. Plants of the same species are strongly competitive because they have the same requirements for sunlight, water, and nutrients.

Environmental Factors Affecting Plant Growth

Light

Light reaching the surface of a plant is either absorbed, reflected, or transmitted. Energy, in the form of sunlight is one of the driving forces in the chemical reaction known as photosynthesis. **Photosynthesis** is the process by which green plants manufacture food, mainly sugars, from carbon dioxide and water in the presence of chlorophyll (a green pigment), utilizing light energy and releasing oxygen and water. Together the quality, quantity, and duration of light influences plant growth. Plants grown in direct sunlight are typically compact, where as those in shade are taller and elongated. Seeds may start to grow (germinate) without light, but the plant growing from it must have light if it is to continue to grow.

Moisture

Water is essential for life, it is one of the most important requirements for plant growth. Water is the main component in plants cells, it keeps the plant turgid (stiff), it is used in photosynthesis, and transports nutrients throughout the plant. Plants also use water to lower leaf temperature, increase mineral absorption, and pull water from the roots to the top of the plants through a process known as transpiration.

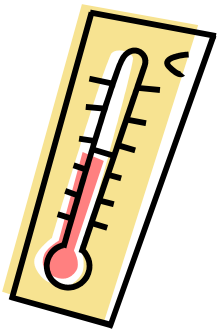
The hydrologic cycle. The hydrologic cycle is the cycle of water in the environment. Water moves in a series of processes. Water moves by precipitation, evaporation, transpiration, and condensation. The sun provides the energy for water to move in a cycle. All water on earth is part of the water cycle regardless if it is in a lake, our bodies, food, or underground. **Precipitation** (rain, snow, hail, etc.) either **infiltrates** the soil or runs into nearby ditches or streams. Water on the surface of a lake or pool will eventually **evaporate** from the sun's heat and become water vapor. This vapor then becomes part of a cloud and **condenses** to form precipitation. Plants release water vapor into the atmosphere by **transpiration**.

Air

One of the raw materials used in photosynthesis is carbon dioxide. The content of carbon dioxide in the atmosphere is relatively stable at about 0.03 percent, a seemingly small amount but totaling roughly 2,000,000,000,000 tons in the atmosphere surrounding the earth. Carbon dioxide is continually being added to the air by respiration of plants and animals, decaying organic materials, combustion of fuels, and volcanic activity. Carbon dioxide diffuses through the stomata (pores or openings in a plants epidermis) from the atmosphere into the intercellular spaces of the leaf.

Wind is air in motion and can be both beneficial and harmful to plants. Wind can benefit plants by accelerating the transfer of heat from leaf surfaces and increasing circulation in areas prone to fungal growth. Wind can be detrimental to plants by causing excessive drying, scattering of weed seeds, and sometimes destroying plants.

Proper temperature



The temperature of the atmosphere is the result of the transfer of heat from the earth's surface to the surrounding air. Temperature varies with latitude, altitude, and topography. The climate and temperature of an area determines what kinds of plants will grow. The ability of a plant to withstand cold temperatures is known as cold hardiness while plants that can not tolerate cool weather are known as tender. In the natural environment, temperature is continually changing.

Nutrients

In addition to carbon dioxide and water, plants need 17 different nutrients to maintain growth. Although carbon, oxygen, and hydrogen are obtained from the air, most nutrients that a plant needs must be present in the soil or growing medium. These elements are divided into macro and micro elements. Macro nutrients needed in the largest amounts are nitrogen (N) for healthy foliage, phosphorus (P) for flower development, and potassium (K) for root growth.

The soils in which plants grow consists of a mixture of mineral materials, organic matter, water, and air in varying proportions. The small fragments of mineral materials are derived from rock over long periods of weathering. The organic matter consists of living organisms, their excretions, and decay products. The texture of soils refers to the sizes of the particles that dominate. The texture of a soil influences the amount of air, water and nutrients held in the soil. In general, the penetration of air, water, and roots occurs much more readily through soils in which large particles (sand) dominate. On the other hand, water-holding capacity and fertility are mainly a result of small particle size (silt and clay) and organic matter.

Activity 1: New Beginnings

OBJECTIVES:
For youth to:
- identify five basic necessities to plant life.
- describe limiting factors of plants.
- associate plants needs with plant growth.

LIFE SKILL:
- Acquiring, analyzing, interpreting and using data.

MATERIALS:
- copies of HOW PLANTS GROW information sheet for each youth
- copies of TREATMENT and CONTROL Data sheets for each group
- 10 bean plants (2 per group)
- paper towels
- water
- 10 pots or cups with holes in bottom
- potting soil and sand for the 10 plants
- clear plastic bag
- large paper bag
- water soluble plant foot
- rulers
- pens or pencils
- Copies of INDOOR GARDEN Activity and supplies (optional)
  - shallow container (1/2 to 1 foot diameter)
  - potting soil and gravel
  - 1 cup granular fertilizer (6-6-6 or 8-8-8)
  - small plants (English Ivy, Philodendron, Pepperomia, Hoya)
  - water
  - masking tape
  - markers

TIME:
- 30 minutes
- 15 minutes every three days or four days to record data

SETTING:
- A comfortable room with tables and chairs and access to a freezer.

INTRODUCTION

Plants need five things in order to grow: sunlight, proper temperature, moisture, air, and nutrients. These five things are provided by the natural or artificial environments where the plants live. If any of these elements are missing they can limit plant growth. What do you think would happen if you limited the amount of sunlight or water given to a plant? Today, we're going to start an experiment to see exactly what happens to a plant when one of these five elements is missing.

ADVANCE PREPARATION:

Preparation can be done by either leader or youth. This is an opportunity for youth to learn additional plant concepts such as imbibition (uptake of water and swelling of a seed), germination (growth of a seed embryo), and transplanting (transfer of seedlings). Start bean plants three to four days before the experiment. Green, pole, and lima beans work well.

To help youth see the process of seedling roots , place twenty seeds on a plate between moist paper towels. Keep the paper towels damp. The seeds will germinate in two to four days, even without light.

To prepare for the experiments, plant seeds in small pots or cups using a mixture of 1/4 potting soil to 3/4 sand. Using a greater proportion of sand will enable the nutrient and moisture groups to detect noticeable differences within the experimental time frame.

DO

- Select several youth to read HOW PLANTS GROW Information sheet aloud.
- Divide youth into five groups: sunlight, temperature, moisture, air, and nutrients.
- Assign two plants to each group. Have groups label the plants with their group name and a C for control or T treatment. Example: C Air and T Air.
- Give each group copies of the CONTROL and TREATMENT Data sheets, a ruler, and pencil.
- Have each group record data on their control and treatment plants in the first blank column on their data sheets. Review the instructions on measuring plant height with youth.
- Read the experiment instructions aloud to youth:

Control Plants

- ◊ Each group will place their control plant in a windowsill. Water or fertilize when the soil is dry to the touch (probably every three to four days).

Treatment Plants

- ◊ The sunlight group will place a paper bag over their treatment plant. Water or fertilize when needed.
- ◊ The temperature group will place their treatment plant in a freezer. Water or fertilize when needed. (Although light will be excluded when the freezer is closed, the idea is for the plant to freeze and die due to improper temperature conditions.)
- ◊ The moisture group will place their treatment plant in a windowsill and withhold water. Apply only dry fertilizer.
- ◊ The air group will place their treatment plant in a clear plastic bag and tighten the bag around the plant so no air is let in or out. Place the plant in a partly shaded area so the plant won't overheat. Water or fertilize only when needed, try to minimize the amount of time the bag is open.
- ◊ The nutrient group will place their treatment plant in a windowsill and withhold plant food. Apply only water when needed.

- Every three to four days the groups will examine their plants and record their observations on the data sheets. At this time the control and treatment plants should be given water or nutrient solution.
- Once the data sheets have been completed (2 to 3 weeks) have groups present a control/treatment comparison report to the class.

REFLECT

What five things do plants need in order to grow?

light, moisture, air, temperature, and nutrients

What were the limiting factors used in the experiment?

blocking the sunlight, lack of moisture, keeping out the air, improper temperature, withholding nutrients

What were the differences between your control and treatment plants?

answers will vary

Do you think that any one of the five elements that a plant needs are more important than another? Hint: Have groups compare the health of their treatment plants.

answers will vary

Why do we use a control group in the experiment?

its used as comparison

APPLY

- Where do plants in the environment get the basics they need to grow?

  sunlight, rain, soil

- Where do indoor plants get the basic elements they need to grow?

  we provide them through fertilizing, water, etc.

- Can you name limiting factors that might affect your growth?

  lack of food or water

- Create a dish garden or terrarium using the INDOOR GARDEN Activity.

How Plants Grow

Information

Many things in nature help to regulate plant growth: sunlight, proper temperature, moisture, air, and nutrients. These are referred to as environmental factors. Each part of a natural or artificial environment affects the survival and quality of a plants life. Knowing the basic facts about the way in which plants live and grow will help you understand plants.

Light: All living things, except for a few groups of bacteria, depend on photosynthesis for their existence. Photosynthesis is the process by which green plants make their own food. In the presence of light energy, plants manufacture food (mainly sugars), by combining carbon dioxide and water in the presence of chlorophyll to release oxygen and water.

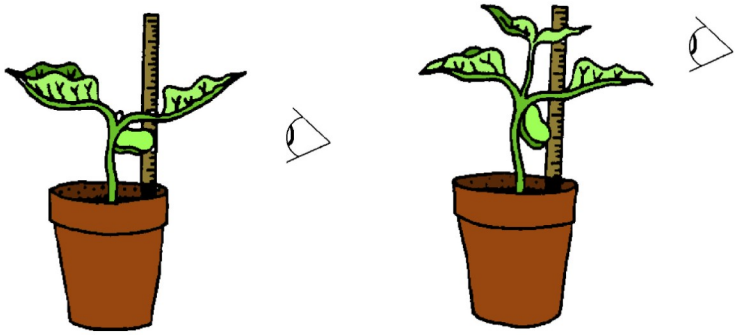
Proper Temperature: Temperature is the most important environmental factor affecting plant growth. Plants vary in their temperature needs. The ability of a plant to withstand cold temperatures is known as hardiness. Plants that cannot tolerate cold weather are known as tender plants.

Water: Water is essential for life. It is one of the most important requirements for plant growth. Water is the main component of plant cells, it keeps the plant turgid (stiff), it's used in photosynthesis, and it transports nutrients throughout the plant.

Air: The manufacture of carbohydrates and proteins which a plant needs to live and grow requires raw materials. These materials are either found naturally in the environment or supplied by the grower. Plants absorb the raw material carbon dioxide from the surrounding air and use it in photosynthesis.

Nutrients: Although plants are able to use a few nutrients from the air, most of the nutrients that a plant needs must be present in the growing medium (soil). Minerals such as nitrogen, potassium, phosphorous, calcium, and magnesium are taken up through the plant's roots.

Measuring Plant Height



5.0cm 6.2cm

Control Plant

Group Name:_____	Date:	Date:	Date:	Date:	Date:
Group Members: (List names)					
Height (inches) Height (centimeters)					
Number of Leaves					
Color of Plant					
General Appearance					
Other Comments					

Treatment Plant

Group	Date:	Date:	Date:	Date:	Date:
Group Members: (List names)					
Height (inches) Height (centimeters)					
Number of Leaves					
Color of Plant					
General Appearance					
Other Comments					

Indoor Garden

The object of creating an INDOOR GARDEN is to create an artificial environment that provides your plants with their basic needs.

To make your Indoor Garden you will need:

- shallow container (1/2 to 1 foot in diameter)
- soil or other potting medium
- drainage material like small rocks or gravel
- fertilizer (6-6-6 or 8-8-8)
- small plants (English ivy, philodendron, pepperomia, hoya)

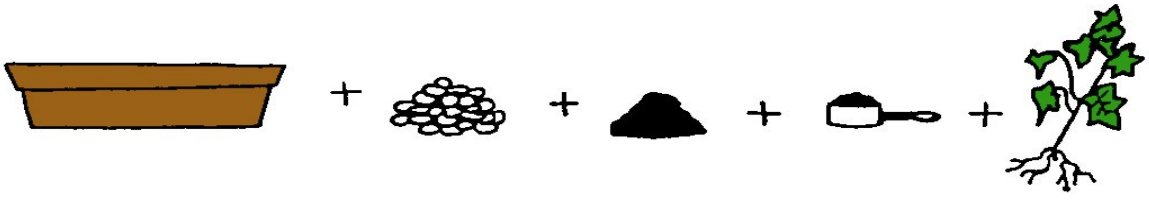
WHAT YOU DO:

1. Place half to one inch layer of the drainage material in the bottom of the container.

2. Mix one teaspoon of fertilizer to two quarts of soil and fill container to within one inch of the top.

3. Transplant the small plants in the container.

4. Water lightly.



Activity 2: Let's Eat!

OBJECTIVES:
For youth to:
- define photosynthesis.
- describe what a plant needs in order to manufacture its own food.
- explain how plants provide us with necessary oxygen.

LIFE SKILL:
- Acquiring, analyzing, and using information.

MATERIALS:
- copies of THE GROWING PROCESS Data sheet for each group
- copies of THE GROWING PROCESS Study questions for each group
- four plants (can be philodendron, bean, or grass)
- two clear plastic bags with twist ties
- two rulers
- poster paper
- colored markers
- pencils and pens
- masking tape

TIME:
- 25 minutes to introduce and set up the experiment
- 1 week later, 40 minutes to observe and discuss results

SETTING:
- A comfortable room with tables and chairs.

INTRODUCTION

All living things, except for a few groups of bacteria, depend on photosynthesis for their existence. Photosynthesis is the process by which green plants make their own food. Plants manufacture food, mainly sugars, from carbon dioxide and water in the presence of chlorophyll, utilizing light energy and releasing oxygen gas and water. Chlorophyll is the green pigment in the leaves of plants that absorbs light energy and enables photosynthesis to take place.

The process of photosynthesis is described as (write on poster or chalkboard):

$$6CO_2 + 12H_2O \xrightarrow[\text{chlorophyll}]{\text{light}} C_6H_{12}O_6 + 6O_2$$

Six molecules of carbon dioxide and twelve molecules of water react in the presence of chlorophyll and light to form one molecule of sugar and six molecules of oxygen. Today we're going to start an experiment where we change the photosynthesis equation by reducing the amount of carbon dioxide available to a plant. Let's get started!

DO

- Divide youth into two groups.
- Give each group two plants (all same species). Have groups label plants as follows:

  Group #1:
  - ◊ Sun/With Bag
  - ◊ Sun/Without Bag

  Group #2:
  - ◊ Dark/With Bag
  - ◊ Dark/Without Bag

DO (continued)

- Give each group a copy of THE GROWING PROCESS Data and Study question sheets.
- Measure and record the height (in centimeters) and appearance of each plant.
- Enclose the plants labeled Sun/With Bag and Dark/With Bag in clear plastic bags and tighten to remove excess air from around the plants.
- Group #1 should place both plants in a sunny location. Group #2 should place both their plants in a dark location.
- After one week, measure and record the height and appearance of each plant.
- Have groups graph their results and present a brief discussion of their findings.

REFLECT

What is photosynthesis?

food manufacturing process of green plants

What is produced during photosynthesis?

sugar, oxygen, water

Where does the carbon dioxide in the equation come from?

people and animals exhale carbon dioxide, plants and burning fossil fuels

What role does chlorophyll play in the process?

chlorophyll absorbs light energy needed for photosynthesis

How did we limit carbon dioxide and light energy from the plants?

carbon dioxide was limited by the bag and light energy was limited by placing a plant in a dark area

What do the plants in the sunny location look like?

the plant labeled "Sun/Without Bag" should look healthy and green, the plant labeled "Sun/With Bag" may have a wilted appearance and should have condensation on the inside of the bag.

REFLECT (continued)

What do the plants in the dark look like?

the plant labeled "Dark/Without Bag" may have elongated stems and a yellow (chlorotic) appearance. The plant labeled Dark/With Bag should appear yellow and wilted with condensation on the inside of the bag.

What would happen in the photosynthesis equation if you leave the plant labeled "Sun/With Bag" in the bag?

the plant would eventually use up the carbon dioxide in the bag and photosynthesis would stop

What would happen in the photosynthesis equation if you leave the plant labeled "Dark/With Bag "in the bag?

photosynthesis would stop due to the lack of light and carbon dioxide

APPLY

- Besides humans and animals exhaling, what else produces carbon dioxide?

  burning fuel, cars, buses, factories and plants

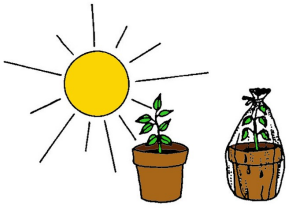
- How does the structure or shape of the leaf affect photosynthesis?

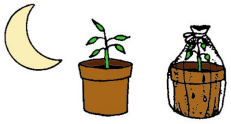
  Leaf shapes are usually broad, flat, and thin to ensure maximum exposure of the leaf to light.

- Let's think in terms of the big picture or the world view: The amount of people on the earth is increasing and forests are being cut to make products and places for people to live. The levels of pollution in our atmosphere are also increasing. What does this mean in terms of the amounts of oxygen and carbon dioxide in the atmosphere?

  an increase in carbon dioxide would benefit plants since it is needed for photosynthesis. Fewer plants and more carbon dioxide would increase pollution in the atmosphere. Fewer plants would mean less oxygen available for us to breathe.

The Growing Process Data Sheet





What is the height of each plant?

			Beginning	Final
Group #1	Sun/With Bag	=	_____ cm	_____ cm
	Sun/Without Bag	=	_____ cm	_____ cm
Group #2	Dark/With Bag	=	_____ cm	_____ cm
	Dark/Without Bag	=	_____ cm	_____ cm

What does each plant look like? Monitor your plants every 3-4 days.

Appearance

Group	Beginning (Day 1)	Day 3	Final Observation
Sun/With Bag			
Sun/Without			
Dark/With Bag			
Dark/Without Bag			

The Growing Process

Study Questions

Answer after the experiment to help organize group presentations.

1. How do the plants (in your group) differ in height from the beginning to the end of the experiment? Can you explain the differences?

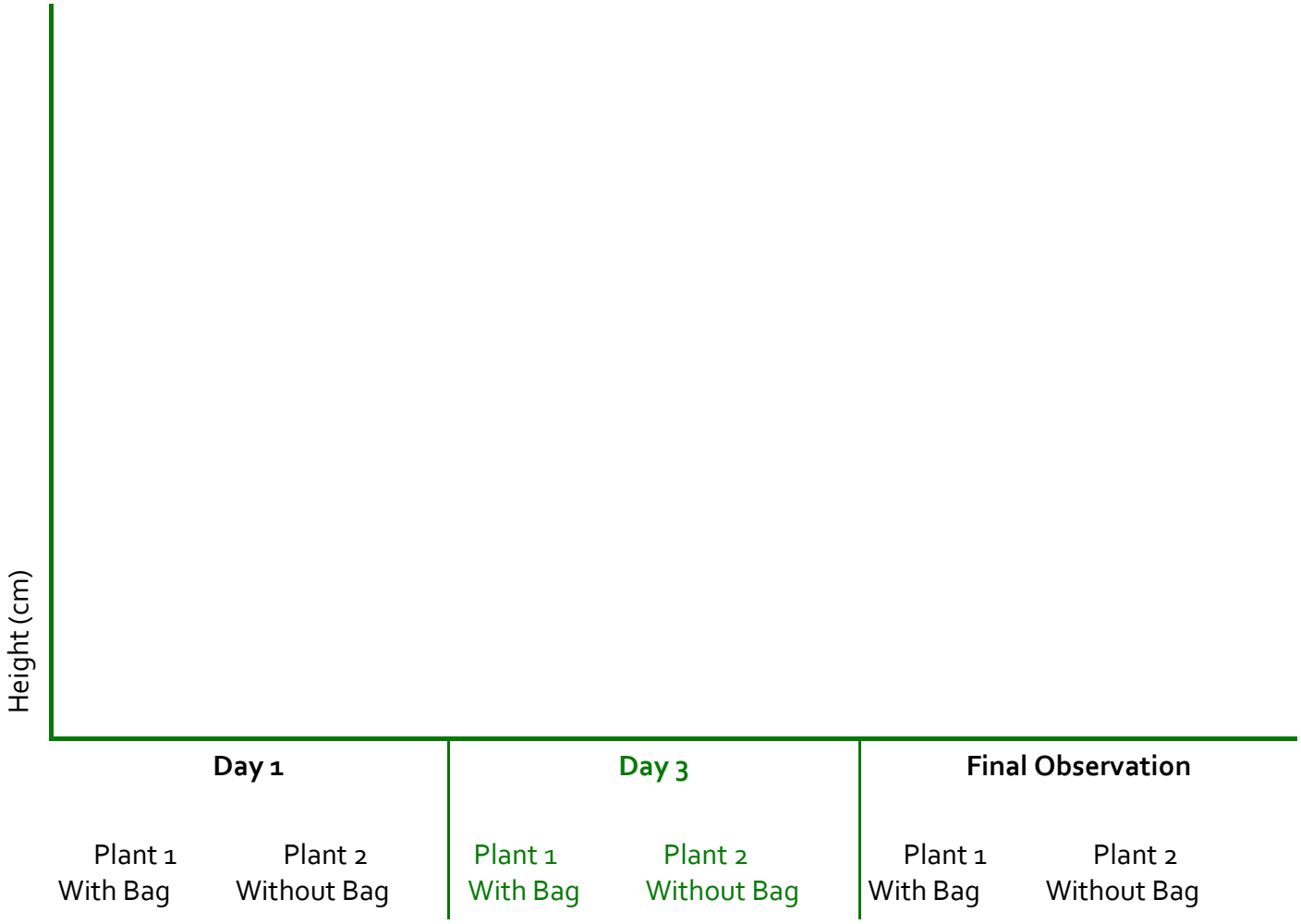
2. How do the plants (in your group) differ in appearance from the beginning to the end of the experiment? Can you explain the differences?

3. Was there a difference in the plants with and without a bag?

4. How did your group's results compare to the other group's findings?

The Growing Process Results

Graph your results below:



Activity 3: Grow Up!

OBJECTIVES:
For youth to:
- describe the importance of nutrients to a plant.
- explain the nutrient and water holding capacity of soils.
- describe how the nutrient content of a soil can be improved.

LIFE SKILL:
- Problem solving and decision making.

MATERIALS:
- copies of GROW UP! Data sheet for each group
- four corn or bean plants grown in varying types of soil
- four rulers
- two 1-liter plastic bottles with ends removed
- two mayonnaise jars or beakers
- copies of COMPOSTING Information sheet for each youth
- pens or pencils
- copies of COMPOSTING MAKES SENSE activity for each youth (optional)

TIME:
- 30 minutes

SETTING:
- A comfortable room with tables and chairs

ADVANCE PREPARATION:
- Grow four corn or bean plants five weeks before experiment. Each plant should be grown in a different soil type (e.g. sand, clay, potting soil, and a mixture

INTRODUCTION

Have you ever thought of soil as a living thing? Soil is a storehouse of animals, decaying vegetation, moisture, and nutrients. Plant roots uptake water and nutrients held in this storehouse. Although plants are able to use a few nutrients from the air, most of the nutrients that a plant needs must be present in the soil. Today, we're going to see how plants grow in different types of soil.

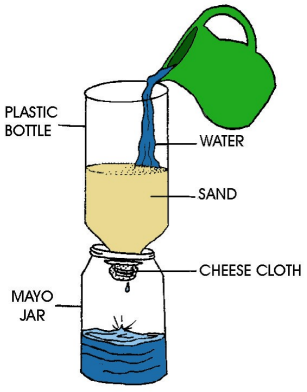
DO

How plants grow in different soil types:

- Divide youth into four groups.
- Give each group a copy of the GROW UP! Data sheet, a ruler, and a plant.
- Have groups record the plant's height (in inches and centimeters) and general appearance on their data sheet.
- Repeat data measurements over the next 3 weeks.
- Have groups answer the questions at the bottom of the data sheet.
- Discuss the results with youth.

Water holding capacity of soils:

- Remove the bottom from two 1-liter clear plastic bottles.
- Fasten a piece of cloth (cotton or cheese cloth) over the small end with rubber bands.
- Fill bottles half way with equal amounts of soil (one with sand and the other with clay).



- Place the bottles over a mayonnaise jar or beaker.
- Add an equal amount of water to each container (about half a cup).
- At the end of 5 or 10 minutes measure the amount of water that has seeped through each soil type and into jars.
- Discuss the results with the youth.

REFLECT

What are some basic plant needs?

air, water, nutrients, light, and temperature

How do plants get water and nutrients into the plant?

the roots absorb them

How does the type of soil affect a plants growth?

soils that lack appropriate amounts of nutrients and water can limit growth

How does soil type affect its ability to hold water?

large soil particles (sand) allow water to quickly drain out of the soil while smaller soil particles (clay) hold moisture in the soil

How could you improve the nutrient content of a soil?

add nutrient rich soil, compost, or fertilizer to an area

Do you need soil to grow plants?

no, plants can be grown in soilless media (vermiculite, sphagnum, perlite), water, nutrient solutions

APPLY

- Make a list of ways in which soil is important to us.
- Start a compost pile!! Follow the instructions on the COMPOSTING information sheet.
- Why is it necessary to add fertilizers to an area where crops have been grown for years?
- Complete the COMPOSTING MAKES SENSE activity.

Grow Up!

Data Sheet

How plants grow in different soil types:

Soil Type	Date: Height 1 (cm) (inches)	Date: Height 2 (cm) (inches)	Date: Height 3 (cm) (inches)
Sand			
Clay			
Potting Soil			
Mixture			

Soil Type	Appearance 1	Appearance 2	Appearance 3
Sand			
Clay			
Potting Soil			
Mixture			

Questions to be answered after the experiment

1. Which plant grew the most? the least?

2. How did soil type effect the plants' growth?

3. Did you notice any other differences in the appearance of the plants?

4. Which soil type contains the most nutrients?

Graph the results:

Composting Information

Composting is the controlled decomposition of organic materials by bacteria, fungi, worms, and other organisms. Decomposition is a natural process that has occurred since the beginning of time. Composting just manipulates this natural process. Decomposition and recycling of organic wastes are an essential part of soil building and healthy plant growth in forests, meadows, and in your garden.

How to Compost

1. Place the compost pile in a partially shaded area where it will be comfortable for you to "work" the pile (turn and water it).

2. Layer yard wastes in the composting pile. Start by placing brown materials like twigs and leaves on the bottom of the pit, this will hold the pile off the ground and aerate it. Then add a layer of green material like grass clippings, food scraps, or fertilizer to provide a food source rich in nitrogen for organisms. Nitrogen gives organisms energy to decompose tough carbon-laden materials like leaves and wood.

3. Mix in a shovel full of soil. Soil contains micro-organisms and other soil animals that make the compost., although the leaves and other materials you add are also loaded with microorganisms.

4. Continue to add ingredients and you should have a 4 foot pile with layers of brown and green materials.

5. Your pile should be damp to the touch but not so wet that drops come out when you squeeze it.

6. Mix your compost about once a week. And watch…….when your compost is ready, it will look like dark crumbly soil and have an earthy smell.

What Can Be Composted?

The do's and don'ts of composting.

DO's

grass clippings
banana peels
egg shells
orange peels
flowers
twigs
leaves
weeds (without seeds)
manure (cow, horse, chickens)

DON'TS

diseased plants
seeds
meats and oils
manure
(if from meat-eating animals like cats, dogs, pigs)

Composting Makes Sense

- ✓ Composting reduces yard waste.
- ✓ Composting improves soil and keeps your plants healthy.
- ✓ Compost provides food for beneficial soil organisms.

..... Can you think of other reasons composting makes sense?

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

Word Search

Find these compost-related words:

COMPOST
DECOMPOSE
FUNGI
PILE
PITCHFORK
RECYCLE
REDUCE
REUSE
SOIL
WASTE
WATER
WORM

Solve this maze to help Mighty Mike find his food:

Activity 4: Keeping Cool!

OBJECTIVES:
For youth to:
- list the importance of water in plant growth.
- describe a plants role in the hydrologic cycle.
- define transpiration.
- explain the movement of water in the hydrologic cycle.

LIFE SKILL:
- Acquiring, analyzing, and using information.

MATERIALS:
- wilted plant
- copies of KEEPING COOL! Activity Sheet for each group
- copies of HYDROLOGIC CYCLE Activity sheet for each youth
- 6 small clear plastic bags
- 6 rubber bands
- thermometer
- 100 ml graduated cylinder
- pens and pencils

TIME:
- 45 minutes

SETTING:
- A comfortable room with tables and chairs. Outdoor area with sun and shade plants.

SUGGESTION

To demonstrate wilting and turgidity:

Bring a wilted plant into the room.
Ask youth what they think is wrong with the plant.
Water the plant and set aside.
After the activities look at the plant and discuss what has happened.

INTRODUCTION

What happens to a plant if it doesn't get enough water? [Show youth the wilted plant] Where do plants get water? (Answers: precipitation, humidity, dew, ground water) **Water** is essential for life, it is one of the most important requirements for plant growth. Water is the main component in plant cells, it keeps the plant turgid (stiff), it's used in photosynthesis, and it transports nutrients throughout the plant. Plants also use water to lower leaf temperature, increase mineral absorption, and pull water from the roots to the top of the plant through a process know as transpiration. **Transpiration** is the loss of water vapor from a plant. Can you guess how much water is lost each day by a single corn plant in midsummer? (Answer: 4 quarts) Today we are going to learn about the water cycle and the role plants play in this cycle.

DO

- Divide youth into two groups.
- Give each group a copy of the KEEPING COOL! Activity sheet.
- Read the instructions aloud to the groups:

Group #1: In a sunny outdoor location, place a small plastic bag over 4-5 leaves on a branch of a small to medium size bush. Secure with a rubber band. Repeat this procedure two more times. Record the temperature in the area where the bags are placed.

Group #2: In a shaded outdoor location, place a small plastic bag over 4 -5 leaves on a branch of a small to medium size bush. Secure with a rubber band. Repeat this procedure two more times. Record the temperature in the area where the bags are placed.

- Meanwhile, conduct the HYDROLOGIC CYCLE activity.
  - ◊ Give each youth a copy of the HYDROLOGIC CYCLE Activity sheet.
  - ◊ Give youth 5 or 10 minutes to read about the hydrologic cycle.
  - ◊ Based on the description provided, have youth show how water moves through the hydrologic cycle.
  - ◊ Allow youth to share their drawings with each other when finished.
- Collect the bags after one hour making sure not to spill any water that has collected in the bags.
- Record the observations on the data sheets.
- Discuss the differences in moisture collected from the sunny and shaded locations.

REFLECT

Why is water important to plant growth?

used in photosynthesis, transports nutrients, regulates temperature, component of cells, keeps cells turgid (or stiff)

Where do plants get their water?

ground water sources, precipitation, fog, dew

What role do plants play in the hydrologic cycle?

plant roots take up moisture from ground water and precipitation and release water through their leaves via transpiration

What is transpiration?

loss of water vapor from a plant

How did temperature affect transpiration?

higher temperatures increase transpiration

APPLY

What other environmental factors might increase transpiration?

temperature, light, wind

Since plants, people, and animals are all using water, does the amount of water on earth decrease?

The amount of water on earth does not change, only the location and usability of the water changes.

What adaptations have desert plants developed to minimize water loss?

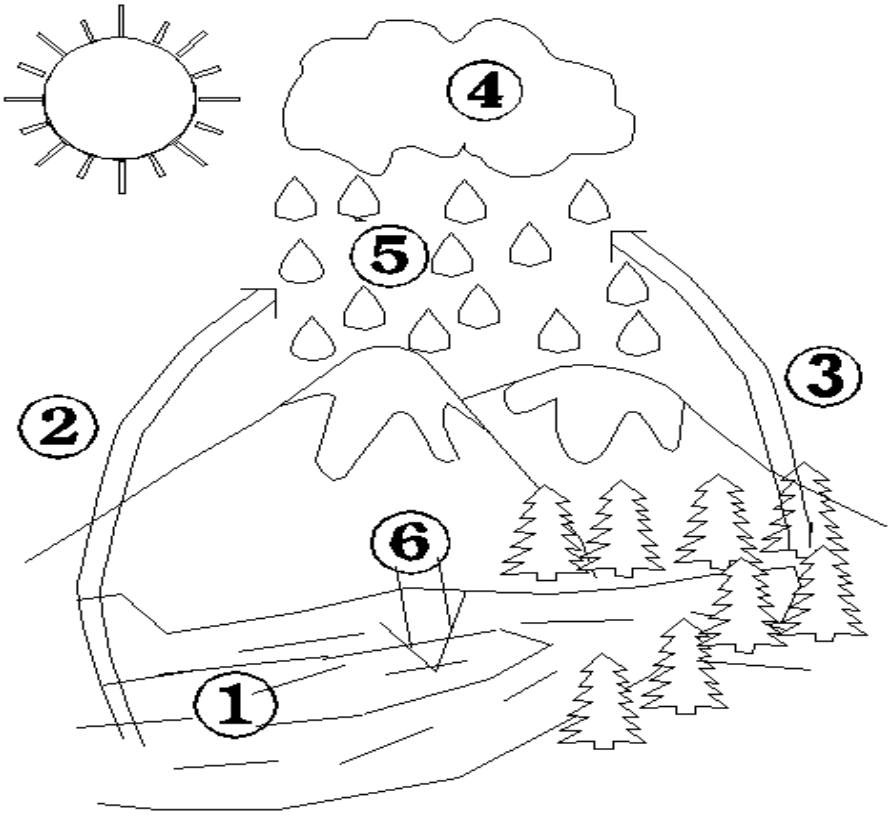
Hint: Compare a cactus with a philodendron.

desert plants tend to be small with few leaves, they have fewer stomata, and a thick waxy cuticle.

Draw a picture of the water cycle which includes neighborhood septic systems, city drinking water supply, automobile run off, and airborne industrial pollutants.

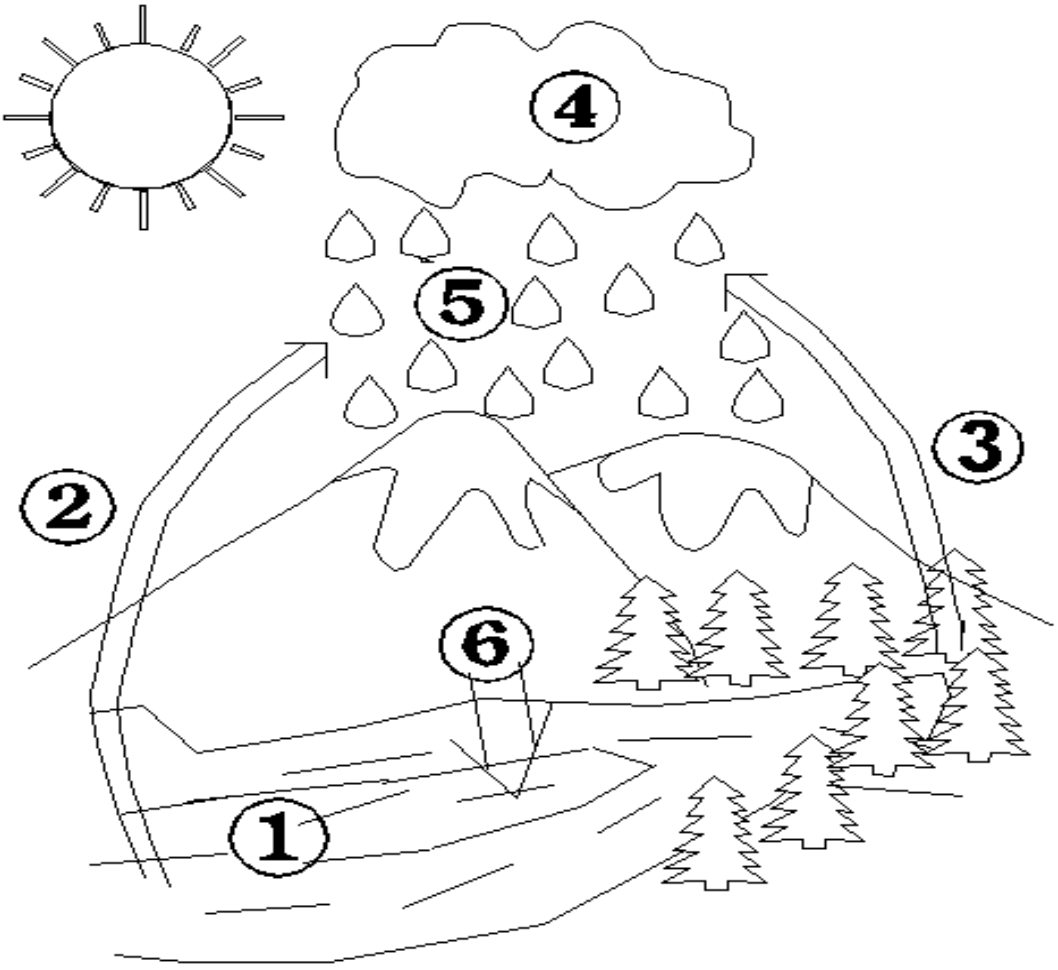
Hydrologic Cycle Answer Key

1. Ground Water
2. Evaporation
3. Transpiration
4. Condensation
5. Precipitation
6. Infiltration



Hydrologic Cycle

Water moves by precipitation, evaporation, transpiration, and condensation. The sun provides the energy for water to move in a cycle. All water on earth is part of the water cycle regardless if it is in a lake, our bodies, food, or underground. Precipitation (rain, snow, hail, etc.) either infiltrates the soil or runs into nearby lakes or streams. Precipitation provides water for crops and refills nearby water bodies (lakes and rivers). Water on the surface of a lake or pool will eventually evaporate from the heat of the sun, and become water vapor. This vapor then becomes part of a cloud and condenses to form precipitation. Plants also release water vapor into the atmosphere by transpiration. Fill in the blanks by the corresponding number in the hydrologic cycle below using the terms precipitation, transpiration, evaporation, condensation, infiltration, and ground water.



1. _____

2. _____

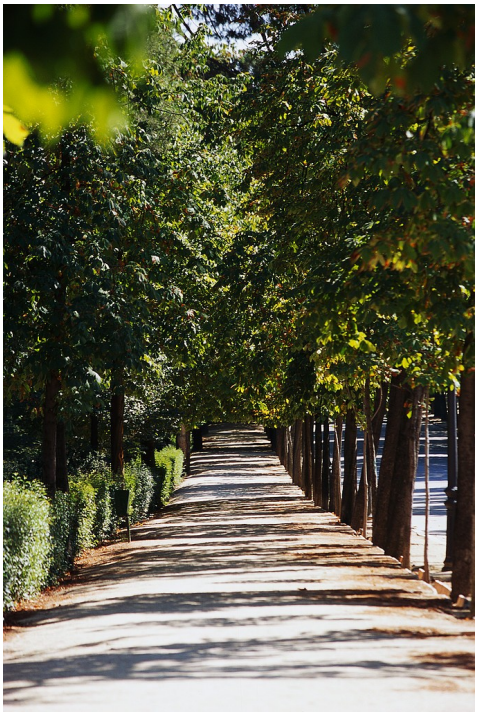
3. _____

4. _____

5. _____

6. _____

Keeping Cool!



Group #1: Temperature _____ ° F

Group #2: Temperature _____ ° F

Total Amount of Water Collected

	Total Water (ml)
Group #1	
Group #2	

To be answered after the experiment:

1. What was the difference in temperature between the sun and shade group?

2. Was there a difference in the amount of water collected between the sun and shade group?

3. By what process does water move out of the plant?

4. What environmental factors influenced the transpiration process?

Activity 5: Survival of the Fittest!

OBJECTIVES:
For youth to:
- identify ways that plants compete.
- identify ways that plants adapt to their environment.
- discuss the role of competition and adaptation in natural selection.

LIFE SKILL:
- Acquiring, analyzing, and using information.

MATERIALS:
- copies of SURVIVAL OF THE FITTEST! Activity sheets for each youth
- 3 potted plants (of equal size)
- 3 large boxes
- knife
- marker
- pens/pencils

TIME:
- 20 minutes
- 1 week later, 30 minutes to observe and discuss results

SETTING:
- A comfortable room with tables and chairs. Access to a sunny window.

ADVANCE PREPARATION:
- Precut holes (4x3 inches) and label boxes as follows:
  - ◊ **Box 1:** Top - cut hole 1 inch from the top edge of the box.
  - ◊ **Box 2:** Bottom - cut hole 1 inch from the bottom edge of the box.
  - ◊ **Box 3:** Side - cut hole in the side of the box, roughly in the middle.

INTRODUCTION

Competition is important for all living things. Plants compete for the things they need to survive. Can you tell me what those things are? (Answer: light, water, nutrients, air, and space) Through the years, plants have developed adaptations to ensure their survival. For example, roses have thorns to keep predators away, trees have seeds with hard shells to protect them from predators and harsh environmental conditions, and some kinds of bacteria produce poisons that kill fungi which compete for the same food source. In this activity we're going to take a closer look at plant responses to competition.

DO

- Give each youth a copy of the SURVIVAL OF THE FITTEST! Activity sheet.
- Divide youth into three groups.
- Give each group 1 plant and 1 box (precut and labeled - top, bottom, or side).
- Have groups place their boxes in a sunny window.
- Have groups sketch their plant on the SURVIVAL OF THE FITTEST! Activity sheet.
- Allow the plant to grow inside the box for one week.
- After one week, observe the plants and record the changes.
- Have groups share their observations with each other.

REFLECT

How did each plant adapt to its environment?

it grew towards the light

What differences were noticeable after one week?

answers will vary

What are some other ways that plants adapt to their environment?

seeds have hard coats to protect them from cold, chemicals that defend them from pests, thorns and spines

Besides a hard seed coat, what are other ways seeds have adapted to survive in their environment? Hint: How do seeds disperse?

seeds can disperse by wind, attached to animal fur, eaten and eventually distributed through feces

How does competition and adaptation by plants result in the "survival of the fittest"?

plants that cannot compete or adapt will not be able to reproduce

APPLY

- Take a nature walk and look for signs of plants adapting - trees tilting toward sunlight, scattered seeds, differing sizes of leaves on the same plant.
- Besides competing for light, what other things do plants compete for?

  water, nutrients, space
- How do plants adapt to compete for moisture and nutrients?

  increased root development
- Collect and identify seeds around your neighborhood. Discuss how each type of seed was dispersed (wind, animals, water).

Survival of the Fittest!

Circle your group name:

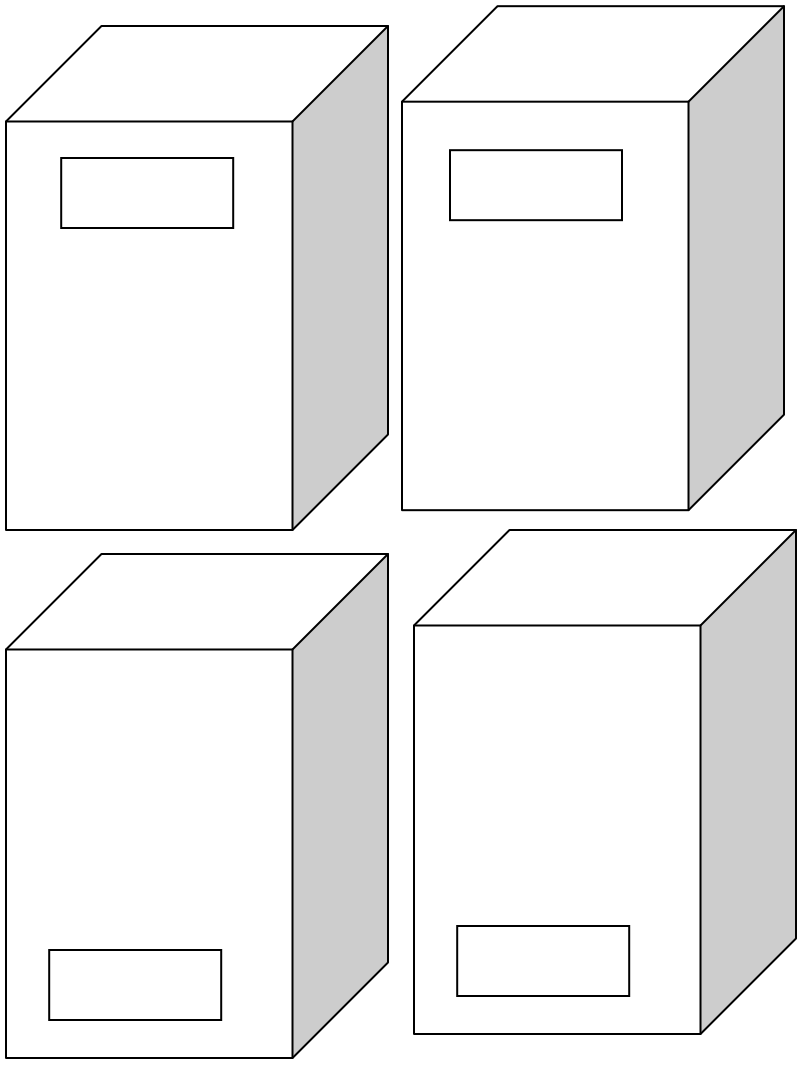
Date 1: _____ Date 2: _____

Sketch your plant (in it's box).

Top

Bottom

Side

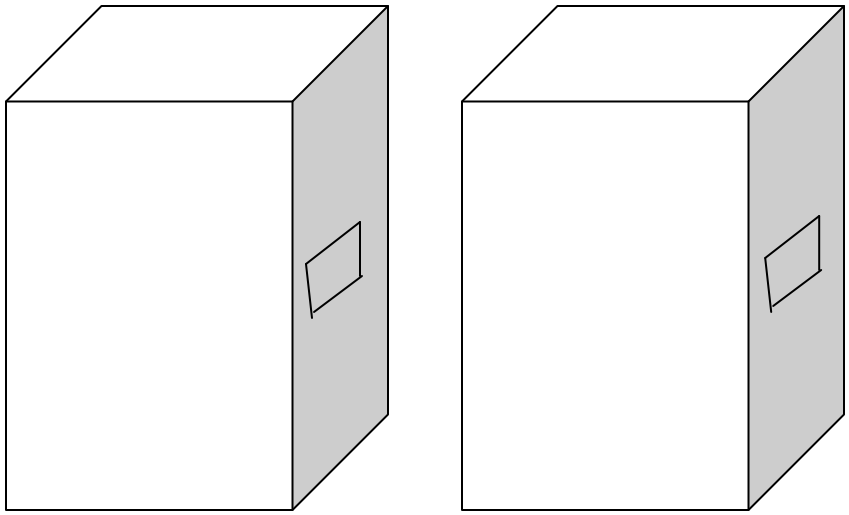


Answer the following questions:

1. Do you see any noticeable changes in your plant after three days? What are they?

2. How does excluding light from the plants stimulate competition?

3. What do you think would happen if we leave the boxes off and place the plants back in the window?



Activity 6: Plant Habitats

OBJECTIVES:
For youth to:
- identify plant needs.
- name and list plant habitats.
- associate plant habitats with their needs.

LIFE SKILL:
- Acquiring, analyzing, and using information.

MATERIALS:
- copies of PLANT HABITATS Activity sheet for each youth
- 3 to 4 plant identification books for each group
- writing paper
- pens and pencils

TIME:
- 30 minutes

SETTING:
A comfortable room with tables and chairs.

INTRODUCTION

A **habitat** is a place where plants and animals live and grow. Habitats provide plants and animals with everything they need to survive, including food, water, shelter, and space. Habitats vary in size from a crack in the sidewalk where a dandelion lives, to a forest where long leaf pine trees grow. Can you give me an example of a plant or animal and its habitat? (Answers: grass-backyard, squirrels-park, fish-aquarium, aquatic plants-marsh, etc.) Today we're going to learn about different kinds of plants and their habitats.

DO

- Divide youth into groups of three or four.
- Give each group a copy of the PLANT HABITATS Activity sheet.
- Assign a plant to each group. Examples of plants might include: Torreya tree, pitcher plant, pond cypress, southern live oak, sabal palm, cattail, and orange tree.
- Assign reading materials to each group.
- Allow groups 20 minutes to research their assigned plant and answer the questions on the PLANT HABITATS Activity sheet.
- Have groups share their PLANT HABITATS information with the entire group.

REFLECT

What kinds of habitats did you find your plants living in?

answers will vary

Do you think a southern live oak could live in the same area as the pitcher plant?

no, pitcher plants live in areas that are too wet for live oaks

What were some unusual characteristics of your plants or their habitats?

Answers will vary

How did your plant habitat meet the needs (water, food, air, light, proper temperature, space, and shelter) of your plant?

Answers will vary

Why do plants need space and shelter?

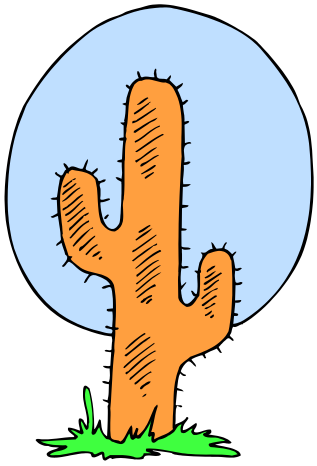
plants need space to grow, overcrowded areas can limit resources that plants need and increase competition.

plants (especially young plants) need shelter from harsh environmental conditions

APPLY

- Take a nature walk in your neighborhood or schoolyard. Look for plants or animals and discuss their habitats.
- Create an artificial habitat (vegetable, flower garden). Discuss how youth will meet all the plants needs.
- Select a plant and build a habitat around it using cuttings from magazines and craft supplies. Remember to include all the things that plants need to live.
- Discuss the role of plants in animal habitats. Can one tree be a habitat for an insect?

Plant Habitats



Plant Name: _____

1. In which region (south, central, north, west, east) of Florida can your plant be found?

2. Does your plant live in an aquatic or terrestrial environment?

3. Does your plant require warm temperatures to survive?

4. Does your plant grow in a small specialized area or large areas?

5. Does your plant depend on animals for food or seed dispersal?

6. What animals (if any) depend on your plant? How?

7. How are your plant's needs (food, water, light, air, proper temperature, space, shelter) met in this habitat?

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