

Kids Growing with *Plant Connections*



*Florida 4-H Plant Science Curriculum
Leader's Guide*



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PREFACE

4-H PLANT CONNECTIONS

A Plant Science Curriculum for 9-11 year olds – Grades 3-5

The Florida 4-H Plant Science curriculum, a part of the Environmental Education and Science, Engineering and Technology Programs, includes the basic premise that plants are important in children's lives. The 4-H Plant Science program provides an opportunity for young people to practice a variety of life skills while learning subject matter.

PLANT CONNECTIONS is designed to help 9-11 year old children in grades 3 through 5 understand the role plants play in our lives and how to grow and care for them. To the informed Florida citizen, it is not surprising that plant science commands a priority within the total Florida 4-H education curriculum. An investment in young people's knowledge, understanding and attitudes about plants within our environments cannot be ignored now or in the future. Likewise, the Horticulture Industry is a large part of the Florida economy in which youth can explore and learn about the science behind the plant industry.

Science, Engineering and Technology (SET) is a national mission mandate of 4-H in which young people are learning the skills and knowledge of science through projects and programs, like Plant Connections. This curriculum provides youth an interface between learning specific plant related subject matter, the processes of science, engineering and today's technology while having fun in group environments that encourage and facilitate life skill development among youth.



More About Plant Connections...

The development of this 4-H Plant Science Project was driven by two basic principles:

1. Learning about plants can be fun! The project guide provides simple and inexpensive, yet fun activities that teach youth about major plant science concepts including What is a Plant?, Why Are Plants Important?, What Makes Plants Grow?, How to Grow Plants, How to Select and Handle Plants, and The Future In Plants.
2. 4-H volunteer teaching activities must be ready-to-use. This project includes materials needed to conduct plant science activities in an easy-to-use format. It was designed to be teacher-friendly and takes much of the guesswork out of teaching this subject.

This Leader's guide contains a complete, easy-to-read outline for lessons. Each lesson provides a variety of activities that can be conducted depending upon the time frame devoted to this project. The following activities are a mix of games, experiments, role plays or demonstrations that help to teach the basic principles and concepts in each lesson. The lesson concludes with a review using activity sheets and discussion questions for youth to REFLECT and APPLY.

This project was developed for youth ages 9-11. Both group and individual activities encourage participation and action in all aspects of plant science education. Teachers and volunteers are encouraged to select learning activities that are most suitable to their youth. The overall intent is to facilitate learning and to spark creativity in both teachers and youth.

Specific benchmarks within the Florida Department of Education's system of state standards have been correlated to the curriculum activities. The charts on pages 5-6 provide educators a quick glance to the benefits of this education package for classroom use.

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LESSON PROFILES

A brief description of the six Plant Connections Lessons:

- **LESSON 1: WHAT IS A PLANT?**

Big Idea: To become familiar with some basic principles of plants and the plant kingdom.

The youth will learn to recognize plants, their parts and function. They will also learn about the classification of plants and how they affect our lives.

- **LESSON 2: WHY ARE PLANTS IMPORTANT?**

Big Idea: To recognize the importance of plants with humans, animals and the environment.

The youth will learn skills in composting and landscaping, as well as, being able to identify producers, consumers and decomposers and their relationships within an ecosystem. They will learn the process of photosynthesis, its benefits, and how plants and animals depend on each other.

- **LESSON 3: WHAT MAKES PLANTS GROW?**

Big Idea: To become familiar with what makes plants grow.

The youth will learn to identify five basic plant needs and the ways plants compete for those needs. They will also learn to describe what a plant needs to manufacture its own food, how the nutrient content of soil can be improved and a plant's role in the hydrologic cycle.

- **LESSON 4: HOW TO GROW PLANTS**

Big Idea: To become familiar with the basic principles and management techniques for reproducing and taking care of plants.

The youth will learn to list requirements for plant growth, identify five major categories of plant pests, and ways to control them. They will also be able to explain why planning a garden is important, asexual propagation, and the differences between perfect and imperfect flowers.

- **LESSON 5: HOW TO SELECT AND HANDLE PLANTS**

Big Idea: To become familiar with wise consumer practices for selecting, handling, and storing plants and their products.

The youth will learn to discuss ways to minimize the risk of food related illnesses and the importance of food preservation. They will also identify qualities that are desirable in plant products and introduce native landscape plants. They will learn about the commercial production of vegetables and the physical and chemical defense mechanisms of different plants.

- **LESSON 6: THE FUTURE IN PLANTS**

Big Idea: To become familiar with the importance of becoming involved with plant science as a field of study, and a career choice.

The youth will be able to give examples of technological advances in agriculture, list the advantages and disadvantages of hydroponics and of organic/inorganic gardening and construct a terrarium. The youth will also identify occupational opportunities in horticulture and the different types of jobs involved with food production and distribution.

Next Generation Sunshine State Standards

Please Note: Multiple grade level are indicated in parentheses if standard is the same across grade levels.

	Lesson 1	Lesson 2	Lesson 3	Lesson 4	Lesson 5	Lesson 6
SCIENCE BENCHMARKS						
SC.2.E.6.3 Classify soil types based on color, texture (size of particles), the ability to retain water, and the ability to support the growth of plants.		●	●			
SC.3.L.14.1 Describe structures in plants and their roles in food production, support, water and nutrient transport, and reproduction.	●	●				●
SC.3.L.14.2 Investigate and describe how plants respond to stimuli (heat, light, gravity), such as the way plant stems grow toward light and their roots grow downward in response to gravity.			●			●
SC.3.L.15.2 Classify flowering and non-flowering plants into major groups such as those that produce seeds, or those like ferns and mosses that produce spores, according to their physical characteristics.	●					
SC.2.L.16.1 Observe and describe major stages in the life cycles of plants and animals, including beans and butterflies.	●	●				
SC.4.L.16.1 Identify processes of sexual reproduction in flowering plants, including pollination, fertilization (seed production), seed dispersal, and germination.			●			
SC.4.L.16.2 Explain that although characteristics of plants and animals are inherited, some characteristics can be affected by the environment.			●	●	●	
SC.4.L.16.4 Compare and contrast the major stages in the life cycles of Florida plants and animals, such as those that undergo incomplete and complete metamorphosis, and flowering and non-flowering seed-bearing plants.				●		
SC.4.L.17.1 Compare the seasonal changes in Florida plants and animals to those in other regions of the country.	●					
SC.3.L.17.2 Recognize that plants use energy from the Sun, air, and water to make their own food.			●	●		
SC.4.L.17.2 Explain that animals, including humans, cannot make their own food and that when animals eat plants or other animals, the energy stored in the food source is passed to them.	●	●				
SC.4.L.17.4 Recognize ways plants and animals, including humans, can impact the environment.		●	●			
SC.5.L.15.1 Describe how, when the environment changes, differences between individuals allow some plants and animals to survive and reproduce while others die or move to new locations.		●	●			
SC.5.L.17.1 Compare and contrast adaptations displayed by animals and plants that enable them to survive in different environments such as life cycles variations, animal behaviors and physical characteristics.		●	●		●	
SC.2.N.1.1 Raise questions about the natural world, investigate them in teams through free exploration and systematic observations, and generate appropriate explanations based on those explorations.			●			

Next Generation Sunshine State Standards

Please Note: Multiple grade level are indicated in parentheses if standard is the same across grade levels.

	Lesson 1	Lesson 2	Lesson 3	Lesson 4	Lesson 5	Lesson 6
SC.2.N.1.2 Compare the observations made by different groups using the same tools.			●			
SC.(3,4)N.1.2 Compare the observations made by different groups using the same tools and seek reasons to explain the differences across groups.			●	●		
SC.3.N.1.7 Explain that empirical evidence is information, such as observations or measurements, that is used to help validate explanations of natural phenomena.			●	●		
SC.4.N.1.6 Keep records that describe observations made, carefully distinguishing actual observations from ideas and inferences about the observations.			●	●	●	
SC.5.N.2.1 Recognize and explain that science is grounded in empirical observations that are testable; explanation must always be linked with evidence.			●			
MATH and LANGUAGE ARTS BENCHMARKS						
MA.3.S.7.1 Construct and analyze frequency tables, bar graphs, pictographs, and line plots from data, including data collected through observations, surveys, and experiments.			●			
LA.(3,4,5).4.2.2 The student will record information (e.g., observations, notes, lists, charts, map labels, legends) related to a topic, including visual aids as appropriate.			●	●		
LA.4.(3,4).1.1 The student will write narratives based on real or imagined ideas, events, or observations that include characters, setting, plot, sensory details, a logical sequence of events, and a context to enable the reader to imagine the world of the event or experience.						●
HIGHER Grade Level Standards:						
SC.6.N.1.4 Discuss, compare, and negotiate methods used, results obtained, and explanations among groups of students conducting the same investigation.			●	●		●
SC.7.N.1.6 Explain that empirical evidence is the cumulative body of observations of a natural phenomenon on which scientific explanations are based.			●			
SC.8.L.18.1 Describe and investigate the process of photosynthesis, such as the roles of light, carbon dioxide, water and chlorophyll; production of food; release of oxygen.			●	●		
SC.912.L.18.9 Explain the interrelated nature of photosynthesis and cellular respiration.			●			
MA.912.S.5.2 Apply the general principles of hypothesis testing.			●			

The Experiential Process... Steps and Techniques

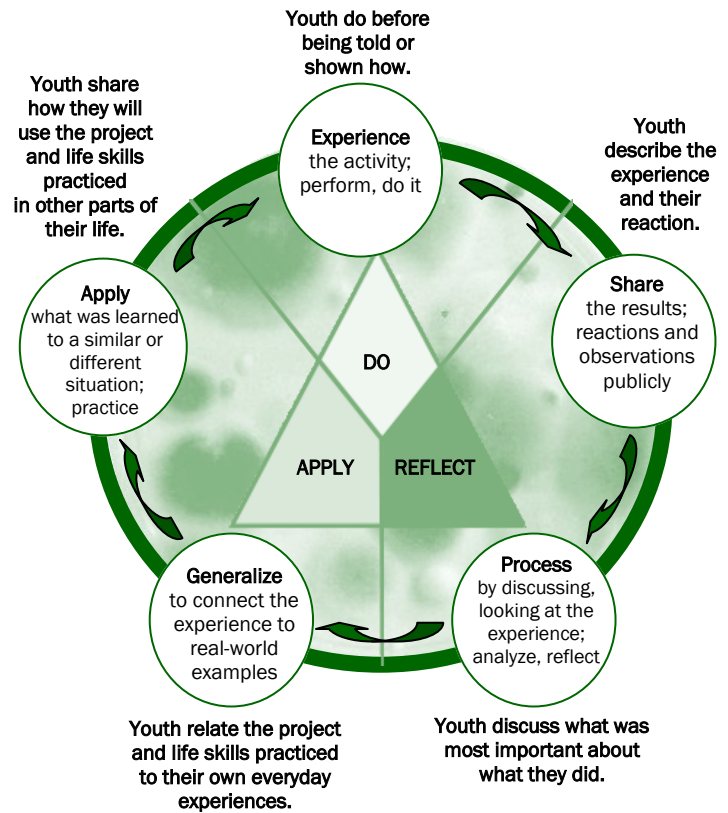
The 4-H Program has a long history of providing for a cooperative teaching-learning process between adults and youth. The activities in each project lesson, strive to involve young people in experiences that require them to interact, analyze, question, reflect and transfer what they have learned to personal application. The activity comes first, the "learning" comes from the "discovery" of new knowledge and skills as a result of the experience. This is the 4-H "learn-by-doing" process. However, to end with the experience without building upon it through REFLECTING and APPLYING does not help the young person understand the significance of what he/she saw, heard, or did. It is the transfer of this significance from one experience to another that helps young people apply their "learning" in future situations.

DO	Each lesson topic identifies the activity or series of activities to DO involving youth in a common EXPERIENCE.
REFLECT	At the conclusion of the activity(ies), allow time for the youth to REFLECT (share and process) what they learned from the experience. Each lesson guide outlines some key questions to assist you in this process.
APPLY	Help youth to APPLY their new knowledge and skill to real life situations. You can do this by helping them to identify key principles that are important for future decisions or personal action. Again, each lesson has outlined a few questions to direct this process.

Further Steps to Help Guide Learning Experientially

This model, adapted from Pheiffer and Jones (1983), illustrates the cooperative teaching-learning process that is the goal of 4-H curricula. A further description of the steps in the process may be helpful as you become an active participant in *Plant Connections*!

Experience - Begin with concrete experience. This can be an individual activity or a group experience, but it involves "doing something." The learning experience will most likely take place when the experience is unfamiliar or a first-time activity for the learner; pushes the learner beyond any previous performance levels; is uncomfortable; and includes the risk of failure.



Share - Next, get the participant(s) to talk about the experience. Share reactions and observations. Let the group talk freely. Acknowledge ideas; listing them visually is helpful. Allow time for volunteers to share responses. Encourage group members to answer questions posed by others. Avoid having the leader answer questions.

Process - Discuss how themes, problems and issues are brought out by the exercise. Speak to specific problems and issues that the group discovers from the exercise or recalls from personal experiences. Look for recurring themes and write them for all to see. Have small groups discuss and report back, have a panel discussion, or generate ideas individually on 3" x 5" cards.

Generalize - Find general trends or common truths in the experience. Draw out and identify the principles that are important - that apply to "real life," not just the activity. This focuses youth on the key messages. List key terms that capture the lessons. Identify situations where the principles apply.

Apply - Concentrate on how the new learning can be applied to everyday situations. Discuss how issues raised by this activity can be useful in the future. Describe how more effective behaviors can grow out of what is learned. Write personal goals for behavior changes, take turns solving problem situations in groups of two or three, or role-play situations that show how new behavior is learned. Each individual should feel a sense of ownership for what is learned.

Targeting Life Skills

A skill is a learned ability. Life skills are those competencies that assist people in functioning well in the environments in which they live. Youth development professionals and volunteers are concerned with helping youth become competent in the life skills that will prepare them for transition to adulthood. 4-H focuses on developing skills that are healthy and productive for both youth and their communities.

Positive youth development programs identify the skills within the four targeted competency areas that are appropriate to the age of the youth in the program and offer experiences to teach these skills. Because skills are best learned through practice, many experiences that teach or reinforce skills must be provided. Mastery of any skill requires opportunities to try, make mistakes, and try again. The following graphic represents a system for targeting skills that lead to mastery of targeted competencies.

4-H Focus of Youth Competencies

HEAD: Knowledge, Reasoning and Creativity Competencies

Thinking: using one's mind to form ideas and make decisions; to imagine, to examine carefully in the mind, to consider.

Managing: using resources to accomplish a purpose.

HEART: Personal/Social Competencies

Relating: establishing a mutual or reciprocal connection between two people that is wholesome and meaningful to both.

Caring: showing understanding, kindness, concern and affection for others.

HAND: Vocational/Citizenship Competencies

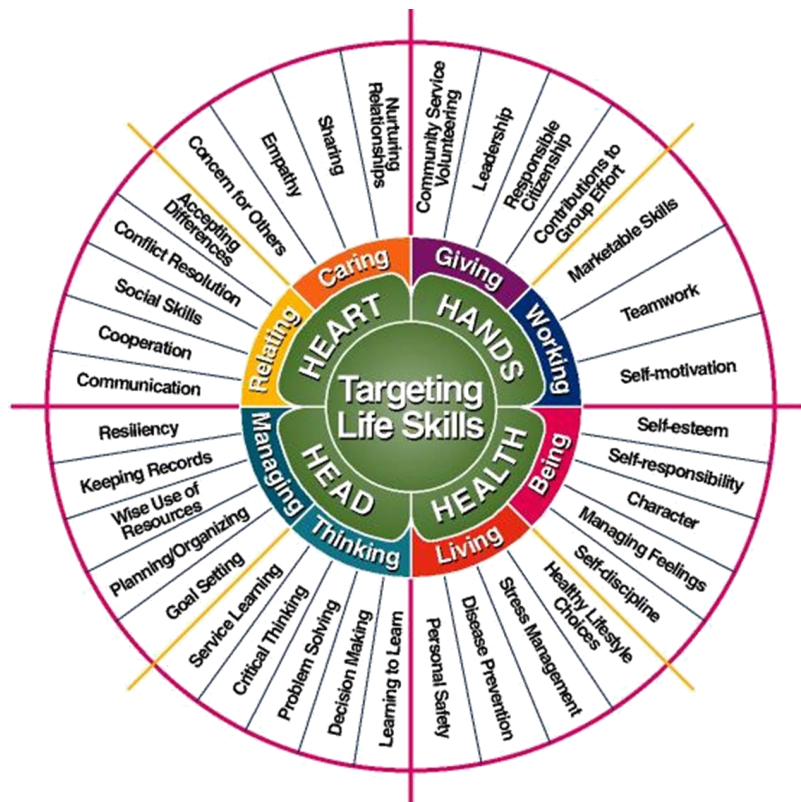
Giving: providing, supplying, or causing to happen (social responsibility).

Working: accomplishing something or earning pay to support oneself through physical or mental effort.

HEALTH: Health/Physical Competencies

Living: acting or behaving; the manner or style of daily life.

Being: living one's life; pursuing one's basic nature; involved in personal development.



INSTRUCTIONAL MATERIALS NEEDED

BASIC LIST

pens & pencils	glue
paper	poster board
markers/crayons	note cards
tape	paper bags
scissors	box

LESSON	SPECIALIZED	PLANT	ADVANCE PREP	TIME NEEDED
LESSON 1:				
Activity 1			X	30 min.
Activity 2			X	30 min.
Activity 3			X	45 min.
Activity 4			X	30-45 min.
Activity 5			X	45 min.
Activity 6			X	45 min.
LESSON 2:				
Activity 1		X	X	30 min.
Activity 2			X	45 min.
Activity 3			X	30 min.
Activity 4			X	30 min. + 15 min/ 3-4 days
Activity 5			X	30 min.
Activity 6	X	X	X	30 min.
LESSON 3:				
Activity 1		X	X	30 min. + 15 min/ 3-4 days
Activity 2		X	X	25 min. + 1 wk later, 40 min.
Activity 3		X	X	30 min.
Activity 4	X	X	X	45 min.
Activity 5		X	X	20 min., 1 wk later 30 min.
Activity 6		X	X	30 min.

LESSON	SPECIALIZED	PLANT	ADVANCE PREP	TIME NEEDED
LESSON 4:				
Activity 1			X	30 min.
Activity 2			X	30 min.
Activity 3		X	X	30 min.
Activity 4		X	X	30 min.
Activity 5	X		X	30 min.
Activity 6			X	30 min.
LESSON 5:				
Activity 1			X	30 min.
Activity 2	X	Fruit	X	20 min + 30 min/ 2-4 days
Activity 3		Potato	X	30 min.
Activity 4			X	45 min.
Activity 5	X	Cabbage	X	30 min.
Activity 6		Tomatoes/ Banana	X	30-45 min. + 3-4 days
LESSON 6:				
Activity 1			X	30-60 min.
Activity 2	X		X	30 min + 15 min/wk for 6 wks
Activity 3		X	X	30 min.
Activity 4			X	45 min.
Activity 5			X	30 min.
Activity 6			X	30 min.

REFERENCE MATERIALS USED FOR EACH LESSON

Introduction

Pheiffer, J.W. and Jones, J. E. Reference Guide to Handbooks and Annuals. John Wiley and Sons, Inc., 1983.

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Mauseth, James. Botany: An Introduction to Plant Biology. Orlando: Saunders College Publishing, 1991.

Muller, Robert. Botany: A Functional Approach. 4th ed. New York: Macmillan Publishing Co., Inc., 1979.

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Lesson 2

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Muller, Robert. Botany: A Functional Approach. 4th ed. New York: Macmillan Publishing Co., Inc., 1979.

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Lesson 3

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Lesson 6

- Instructional Materials Service. Key Developments Shaping Modern World Agriculture. Texas A&M University, 1987.
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- Muller, Robert. Botany: A Functional Approach. 4th ed. New York: Macmillan Publishing Co., Inc., 1979.
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1

Plant Connections

PURPOSE:

- To become familiar with some basic principles of plants and the plant kingdom.

OBJECTIVES:

For youth to:

- describe how agriculture affects their lives.
- state an interesting fact about the plant world.
- list ways of naming and classifying plants.
- describe a plant's life cycle.
- identify plant parts and their functions.

LESSON TIME:

- Lesson time may vary based upon learning activities selected. Most activities are approximately 45 minutes.

ADVANCE PREPARATION:

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

What is a Plant?

LEARNING ACTIVITIES

1. AGRICULTURE TODAY
2. WHAT'S MY NAME?
3. MY LIFE
4. VEGGIE RELAY
5. PARTS IS PARTS
6. PLANT FACTS

DO

The following are suggestions for using the activities in Lesson 1. The materials needed for each are listed within the activity.

- Describe the impact that agriculture has on our lives with AGRICULTURE TODAY.
- Learn new and interesting facts about plants in PLANT FACTS!
- Explain the importance of using scientific names with WHAT'S MY NAME?
- Distinguish between annuals, biennials, and perennials in MY LIFE.
- Get some exercise and learn how to classify plants in the VEGGIE RELAY.
- Identify six common plant parts or structures in PARTS IS PARTS.

REFLECT

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

- What is agriculture?
the production and associated science of plants and animals to meet basic human needs
- What does a botanist study?
plants and plant life
- What are some ways we classify plants?
scientific botanical names, life cycle, growing season
- What are some of the advantages of using a plant's scientific name?
there can be many common names for a single plant, but only one scientific name people all over the world use this same system
- What is the difference between annuals, biennials, and perennials?
the length of a plant's life
- What are six common plant parts or structures?
leaves, roots, stems, fruits, flowers, seeds

APPLY

After completing these activities, help youth learn to apply what they have learned. Have youth choose one or more to demonstrate their new knowledge and skills.

- Have youth list products they use daily and the agricultural crops associated with them.
- Have youth describe their favorite kind of pizza, then list the plants needed to make the pizza.
- Collect tree samples in your neighborhood and identify them using a tree identification field guide.
- Discuss and compare the life cycle of plants to the life cycle of humans.
- Visit a local farmers market and discover what fruits and vegetables are grown in your area.

BACKGROUND BASICS...What Is A Plant?

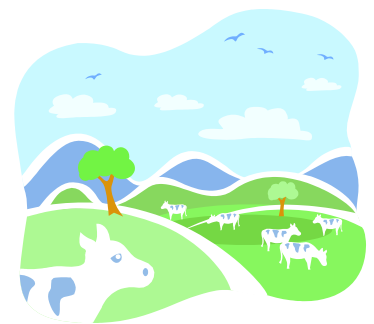
Covering the earth is a green mantle of life called vegetation. From this lush growth of plants we obtain the food we eat, the clothes we wear, the homes we build, and even the oxygen we breathe.

Agriculture and its associated sciences is responsible for the production and cultivation of plants and animals to meet these basic human needs. The gradual improvement in agricultural techniques has resulted in a dependable surplus of food and enabled individuals to develop religion, industry, language, art, and so forth. However agriculture has been around for a relatively short period of time. Scientists estimate that people have been on earth for 2.5 million years. Yet, humans have only been farming for 12,000 years. Let's put agriculture's short history into perspective: if 2.5 million years were equal to 24 hours, humans have been farming for just seven minutes. Yet, agriculture has been instrumental in the development of civilizations.

What is a plant?

It is difficult to precisely define what a plant is, there are so many types and variations that even simple definitions have many exceptions. No single criteria separates all plants from all animals. The more complex plants and animals are, the easier it is to discern them from one another, but simpler forms are not so readily distinguishable. The following characteristics refer primarily to more complex plants and animals:

1. **Manufacture food** - Most plants manufacture their own food through the process of **photosynthesis**. Green plants have the ability to synthesize complex food from simple substances such as carbon dioxide, water, and minerals in the presence of chlorophyll (a green pigment) utilizing light energy. In contrast, animals require ready-made food in the form of plants or other animals.
2. **Cell walls** - Most plants have cell walls made of cellulose. The rigid cell walls create a sturdy framework which results in the lack of mobility. Animal cells, in general, lack rigid cell walls and are typically flexible.
3. **Indeterminate growth** - Most plants have unlimited (or indeterminate) growth. The **meristematic tissue** (tissue containing actively dividing cells) remains active as long as the plant lives and the environment is suitable. While plants can continue to grow, most plants will have some expected mature size and form. The situation is very different in the case of animals, after an animal attains a certain characteristic size and form, growth often ceases.



Classifying plants

One of the goals of naming or classifying organisms is to provide each species with a unique name, thereby permitting easy and effective communication about organisms. The two basic types of plant categorization are known as natural and artificial classification systems. Artificial systems are used for basic plant identification while natural systems attempt to classify organisms according to their genetic and evolutionary relationships.

The **natural** system of classification attempts to categorize organisms according to their evolutionary relationships. **Taxonomists**, scientists who specialize in natural classification systems, have described over 400,000 different species of plants. Taxonomic groupings are devices that enable one to identify a specific organism. The largest groupings are called kingdoms, and the smallest are species (or, in some cases, subspecies or varieties). As we proceed from kingdoms into smaller categories, the plants in each category have more and more traits in common until they are so much alike that they can interbreed (these are species). The taxonomic hierarchy or taxon for classifying plants is: kingdom; division; class; order; family; genus; and species.

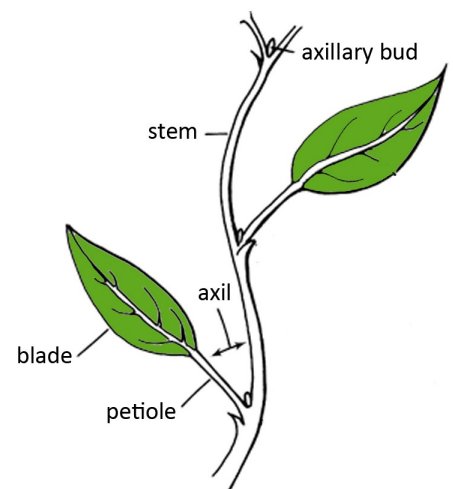
Another fundamental type of classification system is referred to as an **artificial** classification system. The goal of an artificial system is easy plant identification from observable plant characteristics such as flower color or plant habit. Artificial systems may also be used to group plants by economic or scientific features. From a practical standpoint, home gardeners may be more interested in grouping plants by their ability to tolerate shade or full sun rather than their evolution. Likewise, farmers classify crops according to their optimal growing temperature which can be broken down into warm and cool seasons plants. Examples of cool season crops are: asparagus, broccoli, cabbage, celery, garlic, leek, kale, onion, carrot, mustard, and white potato. Warm season crops include: cucumber, eggplant, melon, sweet potato, and tomato.

The classification of plants as annuals, biennials, or perennials is an example of an artificial system used by gardeners to identify plants. Gardeners know that once a seed germinates, its growth and development depends on its life cycle, as well as, surrounding environmental factors (temperature, nutrients, light, oxygen and carbon dioxide, and parasites or herbivores). In this system, plants are grouped into three kinds of life cycles: (1) **annuals** grow for one season only, producing seed then dying; (2) **biennials** grow vegetatively during the first season and do not produce seeds until the second year, after which they die; and (3) **perennials** have a life cycle of more than two years, with most producing seeds throughout their lifetime.

The plant body

The principle structures of most plants are the leaves, stems, roots, flowers, and ultimately fruits and seeds. Identifying these structures and determining their function is important to maintaining and reproducing plants.

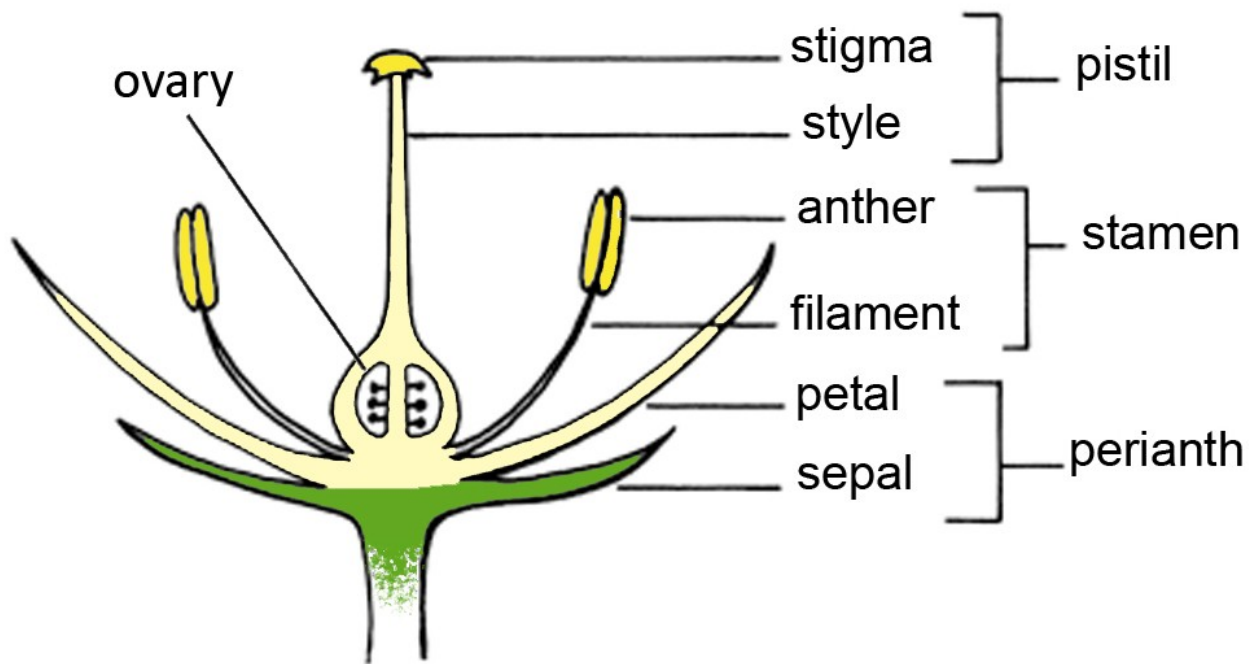
Leaf - Leaves are the most conspicuous part of the plant. A typical leaf is composed of a broad **blade** attached to a slender stalk or **petiole**, which attaches to the stem. At the base of the petiole, in the axil between the stem and the petiole is a bud called the **axillary bud**. Coursing through the petiole and extending into the leaf blade are veins which carry water and nutrients. The main function of a leaf is closely associated to the presence of **chlorophyll**, a green pigment which enables leaf cells to utilize light energy for the production of food in a process called **photosynthesis**.

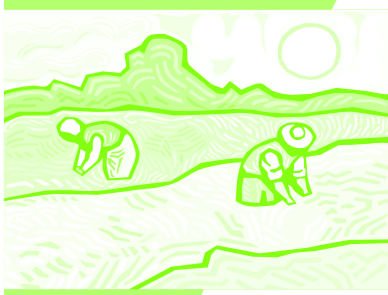


Stem - The stem is the continuation of the plant's axis typically found above the soil surface. Stems branch in a variety of ways resulting in a characteristic form. Stems function mainly in conducting water and minerals from the root to other parts of the plant and in conducting food materials from the leaves to the rest of the plant. Stems also serve as a support or frame for the plant and give rise to leaves.

Root - Roots are the underground portion of the plant. The two main functions of a root are anchorage for the plant and the absorption of water and minerals. They also serve as storage units for food used in future growth.

Flower - The flower is the reproductive structure of a plant. Flowers, like leaves, are quite variable. A flower containing both **stamens** (male reproductive structures) and **pistils** (female reproductive structures) are known as **perfect** flowers. A flower that lacks either stamens or pistils is called an **imperfect** flower. Fertilization occurs after pollen grains grow down the style (part of the pistil) and fuse with the egg located in the ovary. After fertilization of the egg, the ovary ripens into the **fruit** and the fertilized eggs develop into the **seed**.





Activity 1: Agriculture Today

OBJECTIVES:

For youth to:

- describe how agriculture affects their lives.
- identify local agriculturally related businesses and what they do.

LIFE SKILL:

- Communicating and relating to others.
- Critical thinking

MATERIALS:

- agriculturally related career opportunities in your community can be obtained from the County Extension Office or local farm service agency, (i.e. Farm Bureau)
- paper
- colored markers
- pens and pencils

TIME:

- 30 minutes

SETTING:

- A comfortable room with tables and chairs.

INTRODUCTION

Agriculture is the production and associated science(s) of plants and animals to meet basic human needs. It is the largest industry in the United States. Many people think that agriculture means farming, but the majority of jobs related to agriculture have nothing to do with farming. For example, there are entomologists that study plant-insect relationships, scientists that develop new varieties of plants, and marketing specialists who design the packages that sell products. Here in Florida, agriculture is the second largest industry, next to tourism. Do you know what the number one single agricultural crop in Florida is? (Answer: Oranges) The largest agriculture industry, however, is horticulture (includes nursery and greenhouse plants). Today, we're going to discuss how agriculture impacts our lives.

DO

- Divide youth into six groups.
- Assign a 'crop to product' association to each group. The associations are: **1)** cotton to blue jeans; **2)** oranges to orange juice; **3)** apples to apple sauce; **4)** pine trees to lumber; **5)** cows to shoes; and **6)** wheat to bread.
- Have groups discuss and list the steps necessary for the crop to become the product.
- There are many possible scenarios for each 'crop to product' association. Encourage youth to be as detailed and creative as possible. For example, groups may choose to include the chemists who develop fertilizers used on crops to the store clerks that sell the products.
- Have each group draw a chart connecting the steps necessary for the crop to become the product and how they are connected.
- Have each group give a presentation on their 'crop to product' associations.

REFLECT

What is agriculture?

the production and associated science of plants and animals to meet basic human needs

What is the largest agricultural crop in Florida?

oranges

What is the largest agricultural industry in Florida?

horticulture—greenhouse and nursery production

What is the largest industry in the United States?

agriculture

How many jobs were represented in your 'crop to product' associations?

answers will vary

Before doing this activity, had you ever thought about where we get the products that feed, clothe, and shelter us?

answers will vary

How did you like working in groups?

answers will vary

What were some of the advantages of working in groups? The disadvantages?

answers will vary



Optional Activity

Have youth research current U.S. and Florida Ag Facts via the internet

National Site:

<http://www.nass.usda.gov/>

Florida Web Resource:

<http://www.florida-agriculture.com/agfacts.htm>

APPLY

- Have youth list five products they use daily, and the agricultural crops (plants) associated with them.
- Can you name some agricultural crops that grow in your area?
- List examples of agriculture businesses in your community and discuss related career opportunities.
- Write to a local agriculturalist then visit their farm or business.



Activity 2: Taxonomy

OBJECTIVES:

For youth to:

- identify the different characteristics that are used for grouping and naming plants.
- determine common names of plants from their scientific names.
- explain the importance of using scientific names.

LIFE SKILL:

- Acquiring, analyzing and using information.
- Critical thinking

MATERIALS:

- copies of PLANT NAMES Activity sheet for each youth
- copies of TREE PUZZLER Activity sheet for each youth
- pens and pencils
- Tree identification field guides
- TREE SCRAMBLE activity,

TIME:

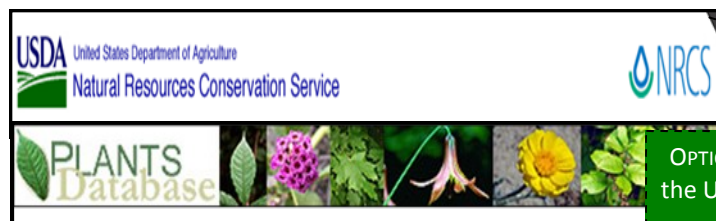
- 30 minutes

SETTING:

- A comfortable room with tables and chairs.

INTRODUCTION

We group plants into categories based on their characteristics and how we use them. For example: edible and non-edible; fruits and vegetables; poisonous and nonpoisonous; and terrestrial and aquatic plants. Can you think of some other ways plants are grouped? (Answers will vary, examples include: herbaceous and woody; deciduous and evergreen; and temperate and tropical plants.) Another way plants are grouped is by their scientific botanical name, which is based on the plant's structure and evolution. Taxonomists are responsible for naming species. Every kind (or species) of plant known to science has a scientific name consisting of two words. The first is the name of the genus to which a given species belongs, and the second is the species which describes the plant. Today, we'll learn more about this scientific classification system.



OPTIONAL ACTIVITY: Use the USDA Plant ID data base at:
<http://plant.usda.gov>

DO

- Give each youth a copy of the PLANT NAMES Activity sheet.
- Explain to the youth that the genus is capitalized, the species is not capitalized and the entire name is underlined or italicized.
- Have youth match the common plant names with the scientific name.
- When youth are finished, ask youth to pronounce the scientific names aloud.
- Have youth complete the TREE PUZZLER Activity sheet.
- When youth have finished (5 or 10 minutes), read the clues aloud and ask youth to fill in the missing species.

REFLECT

What are some ways we classify plants?

use, toxicity, where they grow, scientific name, plant (botanical) characteristics

What do taxonomists do?

classify and name species

How many scientific names were you familiar with before the exercise?

answers will vary

If you were not familiar with scientific names, what clues did you use to match the common plant names with their scientific names?

English words were derived from Latin

What are some of the advantages of using a plant's scientific botanical name?

Each plant has one and only one scientific name worldwide

Why is it important for you to learn the scientific names of plants?

answers will vary

APPLY

- Although they are hard to pronounce, what are some of the advantages of using Latin to name things?

Latin is accepted worldwide as the technical language of scholars.

Latin is considered a "dead" language and not subject to change. Using one language to name plants helps to standardize identification techniques.

- Do you know what your scientific name is?

Homo sapiens

- Imagine that you "found" a new species of plant. How would you go about naming it?
- Collect tree samples in your neighborhood and identify them using a tree identification field guide or key.
- Have youth unscramble common tree names with the TREE SCRAMBLE activity.
- Create leaf rubbings or other art project to display leaf structures of different trees .



Leaf collages and placemats

Activity 3 Taxonomy Answers

Plant Names

COMMON PLANT NAMES

asparagus
cinnamon
lemon
coffee
wild carrot
sunflower
black pepper
wild rose
sesame
sorghum
wild tulip
vanilla

SCIENTIFIC PLANT NAMES

Asparagus officinalis
Cinnamomum zeylanicum
Citrus limon
Coffea arabica
Daucus carota
Helianthus sp.*
Piper nigrum
Rosa arvensis
Sesamum orientale L.
Sorghum Moench
Tulipa sylvestris
Vanilla planifolia

* Sp: Sp is used when a specific species is unknown

Tree Puzzler Use the clues given on the right to match the species name with the genus:

CLUES

<i>Pinus echinata</i>	The bark on the twigs of the short leaved pine is rough and prickly.
<i>Carya aquatica</i>	The water hickory occurs mainly in drained river hammocks, floodplains, and natural levees.
<i>Pinus glabra</i>	The spruce pine occurs in mixed hardwoods and hammocks. The bark on young trees and small branches is smooth and dark gray.
<i>Magnolia grandiflora</i>	The southern magnolia is a large, handsome evergreen tree that grows in moist hammocks throughout northern Florida.
<i>Quercus falcata</i>	The leaves on the young southern red oak are characteristically 3-lobed at the top and sickle-shaped at the base.
<i>Myrica cerifera</i>	The southern bayberry is know for its aromatic leaves and waxy fruit on the twigs.
<i>Quercus alba</i>	The leaves of this oak are distinguished by their light gray or white lower surface.
<i>Ulmus alata</i>	The cork elm is a medium sized tree whose name is attributable to the wing like protrusions on either side of the twigs.

SPECIES

alata - winged
falcata - sickle-shaped
cerifera - wax-bearing

echinata - prickly
aquatica - of the water
grandiflora - large, grand

alba - white
glabra - smooth

Tree Scramble

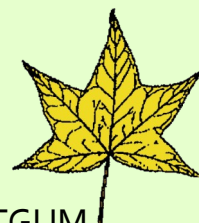
What kind of tree am I?



1. MAGNOLIA



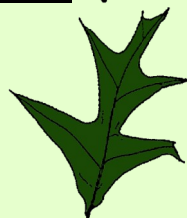
2. HOLLY



3. SWEETGUM



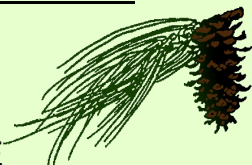
4. TULIP TREE



5. TURKEY OAK



6. RED MAPLE



7. PINE

Plant Names

INSTRUCTIONS: Match the common names (use key below) to the scientific name.

COMMON PLANT NAMES

SCIENTIFIC PLANT NAMES

Asparagus officinalis

Cinnamomum zeylanicum

Citrus limon

Coffea arabica

Daucus carota

Helianthus sp.

Piper nigrum

Rosa arvensis

Sesamum orientale L.

Sorghum Moench

Tulipa sylvestris

Vanilla planifolia

Clues to COMMON PLANT NAMES

asparagus

cinnamon

sesame

vanilla

black pepper

coffee

sorghum

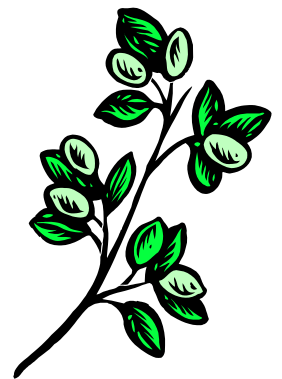
wild rose

carrot

lemon

sunflower

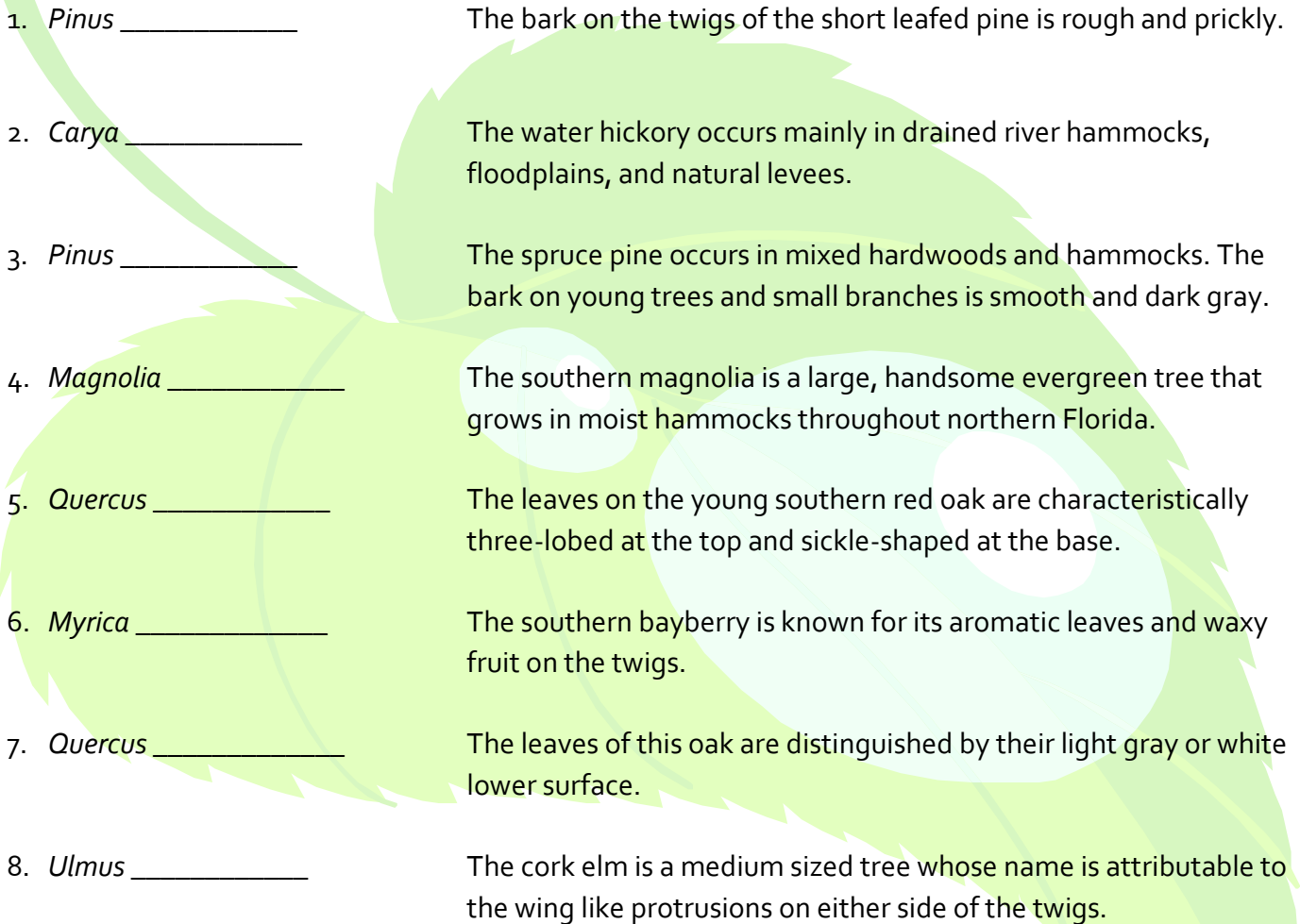
wild tulip



Tree Puzzler

Use the clues given on the right to match the species name with the genus:

CLUES

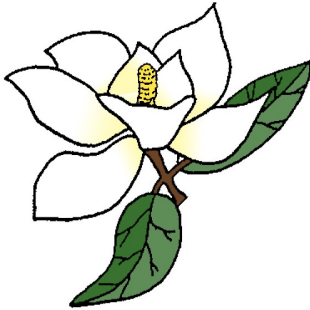
- 
1. *Pinus* _____ The bark on the twigs of the short leafed pine is rough and prickly.
 2. *Carya* _____ The water hickory occurs mainly in drained river hammocks, floodplains, and natural levees.
 3. *Pinus* _____ The spruce pine occurs in mixed hardwoods and hammocks. The bark on young trees and small branches is smooth and dark gray.
 4. *Magnolia* _____ The southern magnolia is a large, handsome evergreen tree that grows in moist hammocks throughout northern Florida.
 5. *Quercus* _____ The leaves on the young southern red oak are characteristically three-lobed at the top and sickle-shaped at the base.
 6. *Myrica* _____ The southern bayberry is known for its aromatic leaves and waxy fruit on the twigs.
 7. *Quercus* _____ The leaves of this oak are distinguished by their light gray or white lower surface.
 8. *Ulmus* _____ The cork elm is a medium sized tree whose name is attributable to the wing like protrusions on either side of the twigs.

SPECIES

- | | |
|--------------------------------|-----------------------------------|
| <i>alata</i> - winged | <i>echinata</i> - prickly |
| <i>alba</i> - white | <i>falcata</i> - sickle-shaped |
| <i>aquatica</i> - of the water | <i>glabra</i> - smooth |
| <i>cerifera</i> - wax-bearing | <i>grandiflora</i> - large, grand |

Tree Scramble

What kind of tree do I come from?
Unscramble the letters and you will have the answer!
If you need help, refer to the word list at the bottom.



1. _____

NOLIAGAM



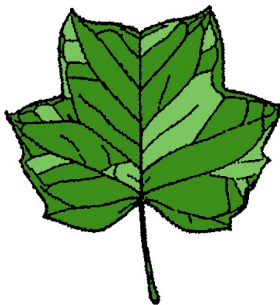
2. _____

HLYOL



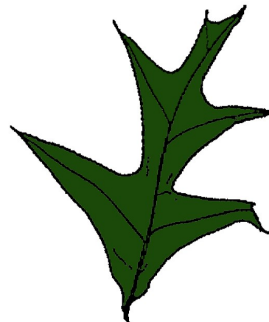
3. _____

WETES MUG



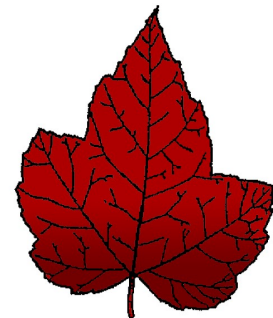
4. _____

UPTIL ETRE



5. _____

TRKUEY OKA



6. _____

DRE MPALE



7. _____

EPNI

**OBJECTIVES:**

For youth to:

- describe a plant's life cycle.
- distinguish between annuals, biennials, and perennials.
- give examples of annuals, biennials, and perennials.

LIFE SKILL:

- Problem solving and decision making.

MATERIALS:

- MY LIFE activity sheet
- five to ten nursery and seed catalogues
- list of common annuals, biennials, and perennials in your community (can be obtained from the County Extension Office or local nursery)
- poster paper
- pens and pencils

TIME:

- 45 minutes

SETTING:

- A comfortable room with tables and chairs.

Activity 3: My Life

INTRODUCTION

The life cycle of a plant refers to the length of a plant's life. Plants that are classified according to their life span generally fall into three groups: annuals, biennials, and perennials. Annuals are plants that germinate from seed, mature, flower, and produce seeds in one growing season. Some familiar annuals are marigolds, petunias, and spinach. Biennials are plants that complete their life cycle in two growing seasons. Did you know that cabbages and beets are biennials? In Florida, cabbages are planted in the fall and winter, this is their first growing season, during which they produce leaves, stems, and roots, at this point we harvest them for food. If we left the cabbages in the ground until spring, their second growing season, they would produce flowers and seeds and then the plant would die. Perennials are plants that live for more than two growing seasons. Examples of perennials are apple trees, roses, and maple trees. Can you give examples of other perennials? In this activity we will classify common plants according to their life cycles.

DO

- Hand out copies of MY LIFE diagrams and pencils to each youth.
- Have youth identify and label each life cycle diagram.
- Review the MY LIFE Work activity with youth.
- Divide youth into three groups.
- Assign a plant life cycle category to each group: annual, biennial, or perennial.
- Have groups cut pictures of plants from nursery and seed catalogues based on the category they were assigned.
- Have each group make a poster displaying their assigned life cycle along with the plants cut from the magazines.
- Have each group present their posters and explain their choice of plants.

REFLECT

What is the difference between annuals, biennials, and perennials?

the length of a plant's life

How did you know that a specific plant fit in your category?

past observation, seed catalogues or researched the plant

How long does it take for a biennial plant to produce its seed?

2 growing seasons

Give an example of an annual, biennial, and perennial plant.

annuals: marigold, petunia, pansy

biennials: cabbage, beet, hollyhock, broccoli

perennials: daffodil, strawberry, oak, maple

What were some of the problems you ran into while searching for pictures of annuals, biennials and perennials?

answers will vary

Besides using a seed catalog or an identification key how would you determine a plant's life cycle?

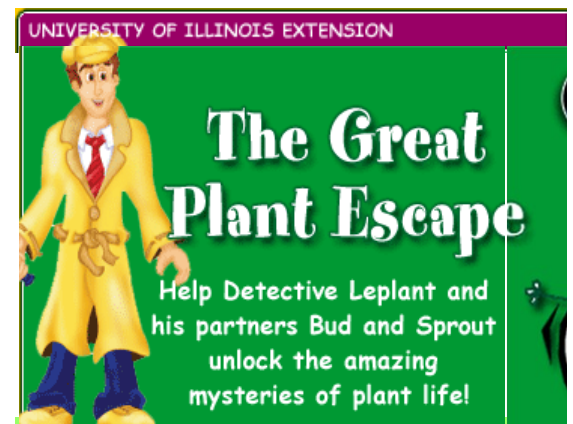
grow the plant and keep records on the plants growth

What are some ways we classify plants?

use, toxicity, where they grow, scientific name, plant (botanical) characteristics

APPLY

- Make a list of the fruits and vegetables grown in your area or a home garden, classify them as annuals, biennials, or perennials.
- Prepare an illustrated talk on the differences between annuals, biennials, and perennials. Present your talk at a county event.
- Use on-line nursery catalogs to research, print and create exhibit boards of plants and their life cycles.
- Discuss and compare the life cycle of plants to the life cycle of humans.

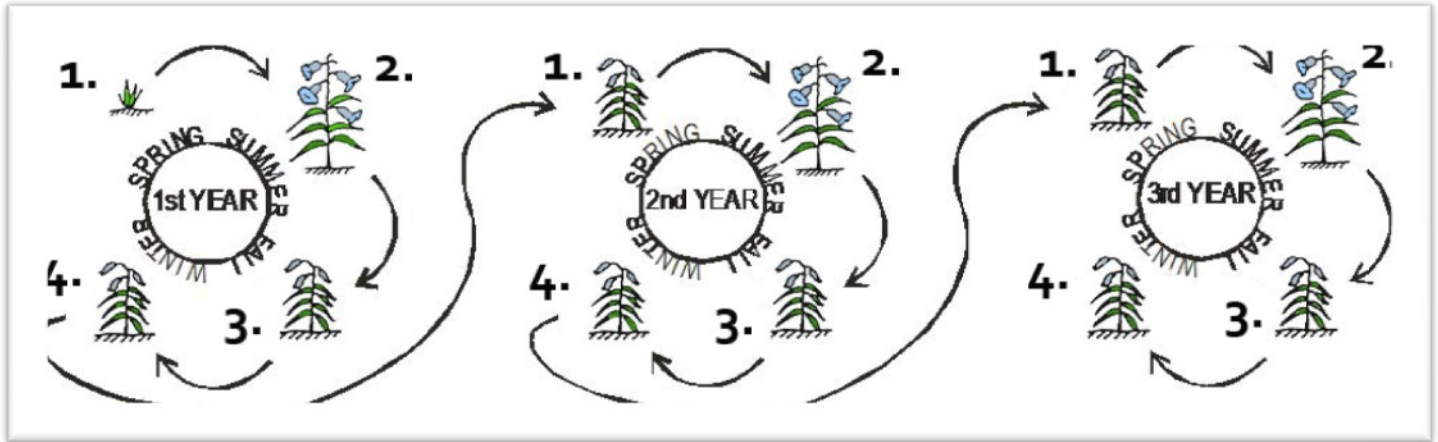


Check out this web-based program from the University of Illinois Extension Plant Science Project at: <http://urbanext.illinois.edu/gpe/case1/c1facts1b.html>

Case 1 introduces youth to plant life cycles.

My Life

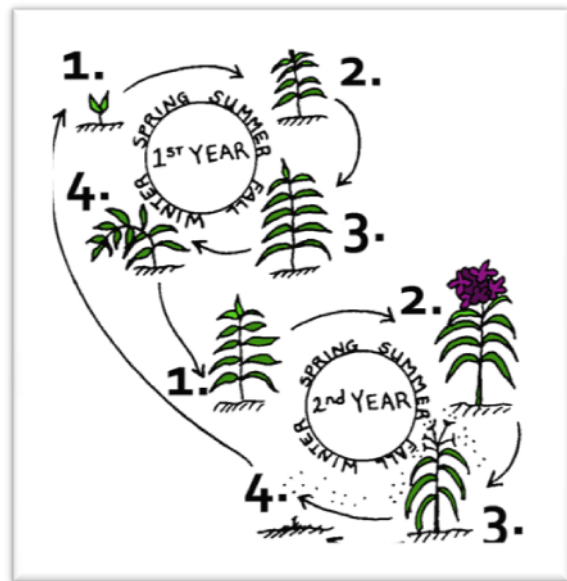
Identify each life cycle diagram below by labeling it Annual, Biennial, or Perennial and explain it's characteristics.



1. _____
Characteristics:



2. _____
Characteristics:



3. _____
Characteristics:



OBJECTIVES:

For youth to:

- give examples of ways to classify plants.
- predict which plants grow in cool and warm weather.
- identify warm and cool season fruits and vegetables in your area.

LIFE SKILL:

- Problem solving and decision making.

MATERIALS:

- 10-15 nursery and seed catalogues with pictures of cool and warm season produce (on-line catalogs are also available)
- 2 paper bags
- 2 boxes labeled warm season
- 2 boxes labeled cool season
- scissors
- tape

TIME:

- 30 to 45 minutes

SETTING:

- A comfortable room with tables and chairs.
- Outdoors where youth have running room.

Activity 4: Veggie Relay

INTRODUCTION

Can you solve this riddle? Botanists refer to this plant as *Solanum lycopersicon* (se LAN em lie-ko-PER-si-kon), home gardeners know this plant as a tender perennial, cooks use its fruit in pasta sauces, and growers call this a warm season crop. What plant are we talking about? (Answer: tomato). How did the botanist, gardener, cook, and grower classify the tomato plant? (botanist - scientific botanical name; gardener - life cycle; cook - type of fruit used in cooking; grower - growing season) Can you think of other ways plants are classified or grouped? (the plants use, plant part used for food) Today we are going to learn how growers classify crops according to growing temperatures. In this classification scheme plants are referred to as either cool or warm season crops

DO

- Divide youth into small groups of 2-3 youth. Have groups brainstorm lists of potential warm and cool season fruits and vegetables. Then merge these groups with another group to compare and contrast their lists. Have them come to consensus with one merged list of warm and cool season plants. Now, repeat this 1-2 times, merging groups until you have the total group into two large groups with combined lists. Have groups post their lists for the class to see.
- Have teams research plants on their lists to determine how accurate their predictions were of warm/cool season plants.
- Once they have checked their lists, have youth print/cut pictures of fruits and vegetables from on-line nursery and seed catalogues.

Examples of cool season crops are lettuce, asparagus, broccoli, cabbage, celery, kale, and garlic.

Some warm season crops include cucumber, eggplant, tomato, melons, summer squash, and sweet corn.

DO (continued)

- Mark each group's pictures with a colored pen or marker and place them in the group's bag.
- Move outdoors to a grassy field or area about 30 yards long where youth can run.
- Place a paper bag for each group at one end of the field and two boxes labeled warm season and cool season halfway between the paper bag and the starting line.
- Have groups gather behind their starting line then explain the rules.
 - ◇ The first youth in each group runs (walks, hops, skips) to the paper bag and takes one picture (fruit or vegetable) from the bag.
 - ◇ That youth will run (walk, hop, skip) back to the boxes marked warm season and cool season and place the picture into the correct box.
 - ◇ When the first youth returns he/she will tag the next youth in line.
 - ◇ Repeat the activity until each group member has had a turn.
- The group with the most fruits and vegetables in the correct boxes, wins.
- Go over correct answers with the youth.

REFLECT

What are some ways we classify plants?

botanical classification, life cycle, growing season

Which vegetables are grown in cool seasons? Warm?

cool - beets, broccoli, cabbage, carrots, cauliflower, celery, collards, kale, lettuce, mustard, onions, parsley, radish, spinach, strawberries, turnips

warm - beans, cantaloupes, sweet corn, cucumbers, eggplant, okra, peas, peppers, summer squash, tomatoes, watermelons

REFLECT (continued)

Which vegetable surprised you the most?

answers will vary

How did you decide what box to put a fruit or vegetable in?

answers will vary

What season is your favorite vegetable grown in?

answers will vary

Why is it important for a farmer to know the growing temperature of his/her crop?

so they don't plant out of season and lose the crop

APPLY

- What fruits and vegetables are grown in your area? Are they warm or cool-season crops?
- Conduct a relay based on the part of the crop that is eaten or the plant's life cycle.
- Visit a local farmers market and make a list of what is in season.
- If tomatoes are a warm season crop, why can we get them in the grocery stores in December and January?
- Have groups create a warm/cool season collage or poster with their cut pictures.



Activity 5: *Parts is Parts*

OBJECTIVES:

For youth to:

- identify six common plant parts or structures.
- list the different functions of plant parts.
- give examples of plant parts that are eaten.

LIFE SKILL:

- Communicating and relating to others.

MATERIALS:

- FORBIDDEN PLANTS game card for each youth
- stop watch for each group
- pens or pencils
- copies of PLANT PARTS SCAVENGER HUNT Activity sheet for each youth

TIME:

- 45 minutes

SETTING:

- A comfortable room with tables and chairs.

ADVANCE PREPARATION:

- Copy the FORBIDDEN PLANTS game sheets, paste onto construction paper and cut into cards.

INTRODUCTION

The structures common to most plants are the leaves, stems, roots, flowers, fruits, and seeds. Each of these structures has a function that is necessary to the survival of the plant. For example, the main function of a leaf is to produce food for the plant. Stems support leaves, flowers and fruits, and transport water and nutrients through the plant. Can you tell me what the main function of plant roots are? (Answer: absorb water and nutrients, store nutrients, and anchor the plant). What about flowers, fruits, and seeds? (Answer: reproductive structures of the plant) Today, we're going to play a game called FORBIDDEN PLANTS, where you will guess plant names, structures, and functions based on clues given by your teammates.

DO

- Divide youth into three groups.
- Give each group member one FORBIDDEN PLANTS game card. (This game is similar to the popular game called Taboo.)
- Have youth privately review their cards without showing other group members.
- Explain that the object of FORBIDDEN PLANTS is for group members to guess the word (in bold) at the top of the card. Each youth must give word clues to their own groups without saying the word (in bold) or the clues below the word.
- One member of the group should time how long it takes for the group to guess each word. The group taking the least amount of time to guess all the words are the FORBIDDEN PLANTS champs.
- If a group member accidentally says one of the clue words add 15 seconds to the final group score.
- To extend game time, have teams switch game cards and start again.

REFLECT

Can you name six common plant parts or structures?

seeds, flowers, fruit, stems, roots, and leaves

What is the function of a leaf, stem, root system, seed, flower, or fruit?

- **leaves produce food**
- **stems support leaves and transport water and nutrients: store food**
- **roots anchor the plant ;absorbs water, transports dissolved nutrients; stores food**
- **flowers, fruit, and seed are reproductive structures**

What are some examples of different plant parts? Which ones do we eat?

answers will vary

Which words were the most difficult to communicate to your groups?

answers will vary

What are some of the clues you gave the group when you described a particularly difficult word?

answers will vary

Using word clues, how would you describe yourself?

answers will vary

APPLY

- **Take-home Assignment: Have youth fill out PLANT PART SCANVENER HUNT Activity sheet.**
 - What kind of plant parts do you find in your house?
 - What kinds of seeds are in your kitchen? Check the spice rack!
 - What plant parts did you eat today and last night?

Forbidden Plants

Game Cards

SEED

EGG
EMBRYO
FRUIT
SMALL/LITTLE

BANANA

YELLOW
MONKEY
PEEL
FRUIT

CELERY

STALK
STEM
GREEN
CRUNCHY

FRUIT

SEED
SNACK
REPRODUCTION
TYPES OF FRUIT
(i.e. APPLES)

ROOT

ANCHOR/SUPPORT
UNDER-GROUND
CARROT
SOIL/DIRT

SOIL

DIRT
GROUND
BROWN
ROOTS

PETAL

FLOWER
ROSE
SMELL
COLOR

CARROT

ORANGE
RABBIT
ROOT
CELERY

ANNUAL

ONE
YEAR
SEASON
CYCLE

HERB

BASIL
SPICE
SEASONING
OREGANO

TREE

OAK
TALL
SHADE
WOODY

PECAN

TREE
NUT
PIE
WALNUT

Forbidden Plants

PHOTOSYNTHESIS

LEAF
FOOD
GREEN
SUNLIGHT

ROSE

FLOWER
SMELL
BUD
DOZEN

COMPOST

BREAKDOWN
ORGANIC MATTER
WORMS
PROCESS

POLLINATION

BEE
HONEY
REPRODUCTION
POLLEN

LIFE CYCLE

ANNUAL
BIENNIAL
PERENNIAL
GROWTH

NUTRIENT

FOOD
NITROGEN
FERTILIZER
SOIL

LETTUCE

SALAD
GREEN
LEAF
BAR

AGRICULTURE

GROW
CROP
FOOD
FARMER

ORANGE

ORANGE
FRUIT
CITRUS
JUICE

APPLE

FRUIT
RED
SAUCE
EAT

HYDROPONICS

SOILLESS
DIRT
SOLUTION
WATER

ENTOMOLOGY

INSECTS
BUGS
STUDY PESTS

MUSHROOM

FUNGI
SALAD
BROWN
SPORES

FERTILIZER

NITROGEN
N-P-K
NUTRIENT
PLANT

EVERGREEN

PINE
TREE
DECIDUOUS
LEAVES

Plant Part Scavenger Hunt

Instructions: Plant parts are used in a variety of things we may find common around our homes.
Can you identify examples of things around your house that are plant parts.

- Product: Cotton socks
- Plant and Part: Name the plant and its plant part you think the product comes from (ex. Cotton plant-cotton boll, which is the fruit of the cotton plant).
- Function/Use: the cotton fibers are used to make the cotton yarn knitted for my socks.



SEEDS

Product:

Plant and Part:

Function/Use:

LEAVES

Product:

Plant and Part:

Function/Use:

ROOTS

Product:

Plant and Part:

Function/Use:

Plant Part Scavenger Hunt

FLOWERS

Product:

Plant and Part:

Function/Use:

STEMS

Product:

Plant and Part:

Function/Use:

FRUIT

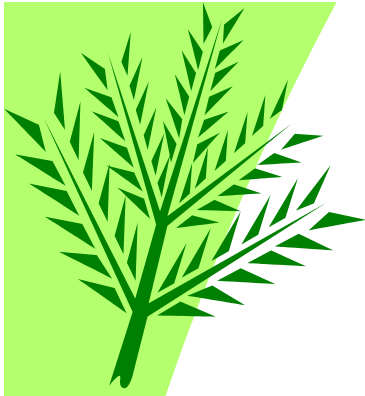
Product:

Plant and Part:

Function/Use:

*Hint: Don't forget to check the
Spice Rack in the Kitchen!*



**OBJECTIVES:**

For youth to:

- discover the world of plants.
- give examples of different kinds of plants.
- describe an interesting fact about the plant world.

LIFE SKILL:

- Teamwork

MATERIALS:

- PLANT FACTS trivia questions
- PLANT FACTS flower pieces: stems, leaves, petals, and button for each group
- colored paper for the flower pieces
- construction paper
- glue
- paper for each youth
- pens and pencils

TIME:

- 45 minutes

SETTING:

- A comfortable room with tables and chairs.

ADVANCE PREPARATION:

- Using the FLOWER TEMPLATE, cut green paper for stems and leaves.
- Cut colored paper into petals.

Activity 6: Plant Facts

INTRODUCTION

Did you know that there are over 400,000 different kinds of plants? These plants range in size from microscopic algae to gigantic seaweeds and California redwoods. Plants live on both land and in the sea. Some familiar categories of plants are trees, shrubs, ferns and grasses. Some of the lesser known plant categories include algae, stoneworts and mosses. There is such a great variety of plants that they can be found in any environment that will support life. They are found in the hottest, driest deserts to the cold arctic. Although there is great diversity among plants, there are also some common features. For instance, green plants make their own food through a process called photosynthesis. Let's see how much you already know about plants.

DO

- Divide youth into five groups.
- Give each group a green stem. Choose a member from each group to glue the stem onto a piece of construction paper. Each time the group receives a new flower piece, select a different member to glue it to the flower.
- Each group will attempt to answer questions from the PLANT FACTS trivia categories. The five categories are:
 1. vegetables and fruits;
 2. soil;
 3. plant structure;
 4. general; and
 5. bonus. (Do not use the PLANT FACTS bonus category until a group has received all its petals and leaves.)
- Ask group #1 a PLANT FACTS trivia question. If necessary, give the group several minutes to discuss the question and respond.

DO (continued)

If the question is answered correctly the group will receive a petal or leaf.

- Repeat with groups #2 through #5 using different PLANT FACTS questions from the same category. When all the questions from each category have been asked move to the next category.
- After a group has received all four petals and two leaves they will try to answer a PLANT FACTS bonus question. If the question is answered correctly the group will receive a button for the center of the flower.

Be sure to complete all PLANT FACTS Questions before finishing this activity.

REFLECT

Did anyone person in your group know all the answers?

How did working as a team help you become more successful?

What were some of the things you did not know?

During this Plants project you will be introduced to many of these concepts. For now, let's review what you recall from the game:

Can you name examples of different ways to classify plants?

Artificial systems (ex. tree, vine, shrub or herb or annuals, biennials, perennials or warm/cool season plants)

Natural systems (ex. kingdoms, genus, species)

What does a botanist study?

plants and plant life

What is the process that green plants use to make their own food?

Photosynthesis

What is a weed?

any plant growing in an undesirable or unwanted location

REFLECT (continued)

What are three distinct parts of most plants?

roots, stems, leaves

What new plant fact did you learn today?

answers will vary

Which plant fact surprised you?

answers will vary

Why are these facts important to know?

answers will vary

APPLY

- Have the youth list three different plant parts and indicate how each of them may be useful to humans. These are not necessarily from the same plant.
- Have youth list how they used a plant today.
- Have youth describe their favorite kind of pizza, then list the plants needed to make the pizza.
- Discuss the following statement: "A rose is a rose, only if it is not a weed".



PLANT FACTS:

Vegetables and Fruits



This game has some items that are listed elsewhere in the book so you may still have to do additional research if not familiar with plants.

A plant or plant product that can be grown and harvested extensively for profit or nourishment is called a ____.

- crop
- vegetable
- food

Answer: crop

True or False: Agronomists study how crop quality and production can be improved?

Answer: True

Today, in the United States, one farmer produces enough food for approximately ____.

- 10 people
- 50 people
- 100 people

Answer: 100 people

Double cropping, raised beds and wide rows are all ways to ____.

- plant a garden
- harvest vegetables
- fertilize a garden

Answer: plant a garden

Iceberg, buttercrunch and bibb are varieties of ____.

- beans
- celery
- lettuce

Answer: lettuce

Beets, broccoli, peas, and radishes are considered ____ vegetables.

- cool-season
- warm-season

Answer: cool-season

Hamlin, navel and Ambersweet are varieties of ____.

- grapefruit
- peaches
- oranges

Answer: oranges

True or False: Sweet corn is a member of the grass family.

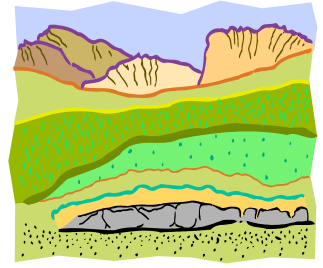
Answer: True

True or False: Olericulture is the branch of horticultural science involving the production of fruits and nuts.

Answer: False, production of vegetables

PLANT FACTS:

Soil



True or False: Soil is formed from the breakdown of rock into smaller particles through the actions of heat, cold, water, wind and organisms.

Answer: True

Which is the smaller soil type?

- silt
- sand
- clay

Answer: clay

Which type of soil holds more water?

- sand
- clay
- silt

Answer: clay

The term used to describe partially decomposed plant and animal materials is ____.

- soil structure
- organic matter
- physical properties

Answer: organic matter

True or False: A soil profile is a horizontal section of soil exposing its various layers.

Answer: False, a vertical section

Wearing away of the earth's surface by the forces of wind and water is called ____.

- excavation
- erosion
- drainage

Answer: erosion

_____ is a natural process which occurs on the forest floor and other places where bacteria, fungi, worms, and other organisms break down organic matter.

- Erosion
- Decomposition
- Mulching

Answer: Decomposition

Vermiculite and perlite are types of soil-less ____.

- structure
- media
- texture

Answer: media

True or False: Fertigation is the application of fertilizer through an irrigation system.

Answer: True

PLANT FACTS:

Plant Structure



Sepals, anthers, style and pollen are all parts of a ____.

- seed
- flower
- fruit

Answer: flower

The food-making process of green plants is called?

Answer: photosynthesis

The process by which the plant seed starts to grow is called ____.

- germination
- seedling
- cultivation

Answer: germination

True or False: Water, light, climate, temperature, animals and diseases are all factors in plant growth?

Answer: True

Nutrient storage, uptake and anchorage are all functions of plant ____.

- roots
- stems
- leaves

Answer: roots

The correct order of a plants life cycle is _____.

- seed, sprout, seedling, plant and flower
- sprout, seed, seedling, plant and flower
- flower, seed, seedling, sprout and plant

Answer: seed, sprout, seedling, plant and flower

Lenticels, bud scale scars and leaf scars are all part of a ____.

- stem
- leaf
- flower

Answer: stem

True or False: Stolons, corms, and bulbs are types of roots.

Answer: False: modified stems

True or False: The surface of some leaves are waxy to prevent oxygen loss.

Answer: False, prevent water loss

PLANT FACTS:

General



Adding plant nutrients to help plants grow better is called ____.

fertilization
nitrification

Answer: fertilization

Which chemical category is used to control weeds?

fungicide
herbicide
insecticide

Answer: herbicide

The science and art of growing fruits, vegetables, flowers and ornamental plants is called ____.

agriculture
horticulture
landscaping

Answer: horticulture

True or False: Measuring soil pH is a method of determining soil temperature.

Answer: False, acidity or alkalinity

Catnip, rosemary and horehound are examples of ____.

weeds
herbs
vegetables

Answer: herbs

_____ refers to process of growing plants without soil.

Culture
Germination
Hydroponics

Answer: Hydroponics

True or False: Carrots, beets, radishes and sweet potatoes all have edible roots.

Answer: True

True or False: Integrated pest management or IPM is a pest management strategy that uses high levels of pesticides to eradicate insects.

Answer: False, IPM uses a combination of measures to reduce pest damage with the least disruption to the environment. Pesticides are used as the last method.

____ is the art of dwarfing and shaping trees and shrubs in shallow containers by pruning and controlling fertilization.

Ikenobo
Floriculture
Bonsai

Answer: Bonsai

PLANT FACTS: Bonus



If a soil's pH is 3.5 then the soil is:

acidic

basic

Answer: acidic

____ grow for one season, producing their seeds and then die,
while ____ grow for several years, producing a new crop of seeds each year.

Biennials, annuals

Annuals, perennials

Perennials, biennials

Answer: Annuals, perennials

True or False: A plant pathogen is an organism which causes disease in plants.

Answer: True

True or False: A weed is any plant that is growing in an unwanted or undesirable place.

Answer: True

True or False: Most of the world's food comes from 3 crops: wheat, rice and corn.

Answer: True

A general-purpose fertilizer contains large amounts of which three primary macronutrients:

nitrogen, phosphorus, potassium

carbon, nitrogen, oxygen

calcium, nitrogen, potassium

Answer: nitrogen, phosphorus, potassium

Plant pathologists use a disease triangle to help them explain the relationship
between _____.

disease causing organisms, the plant and the environment

plants, nutrition and diseases

production, life cycle and drought

Answer: disease causing organisms, the plant and the environment. All three must be favorable for a disease to occur.

True or False: Pollination occurs when pollen is transferred from the female part of the flower to the male part of the same or different flowers.

Answer: False, transferred from male to female

True or False: Cordate, ovate, and wedge are terms used to describe the leaf margin.

Answer: False, leaf shapes

Biennials are plants that complete their life cycle in ____ growing seasons.

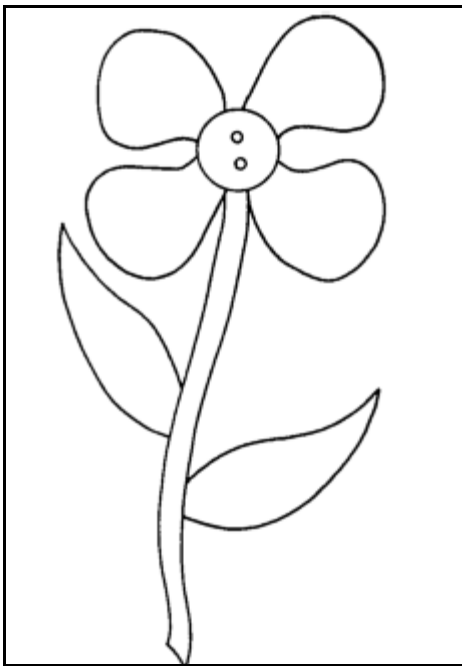
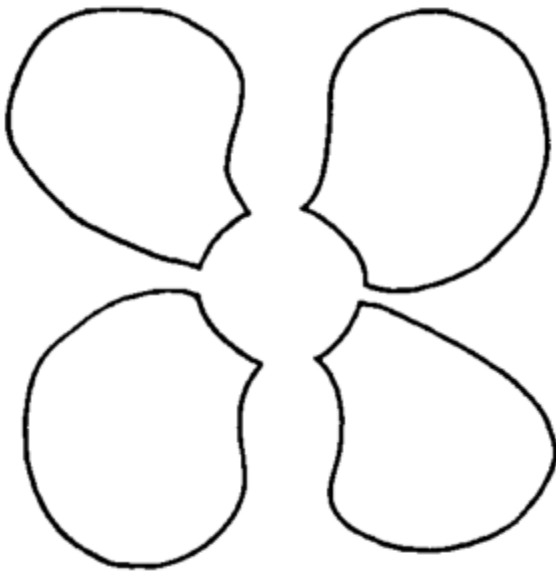
one

two

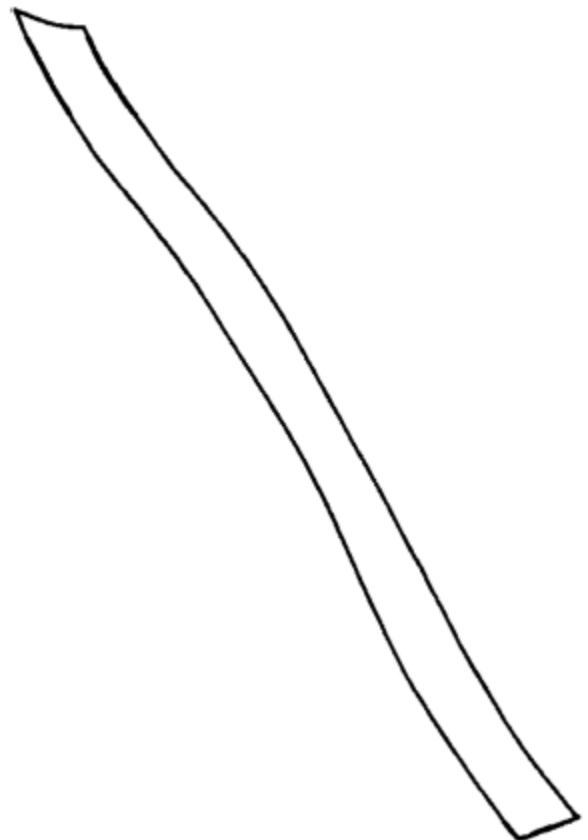
three

Answer: two

Flower Template



Sample Flower



2

Plant Connections

PURPOSE:

- To recognize the importance of plants: to humans, animals, and the environment.

OBJECTIVES:

For youth to:

- identify common uses of plants.
- describe ways that plants and animals depend on each other.
- create a landscape.
- list the benefits of composting.
- identify producers, consumers, and decomposers.
- discuss the end products of photosynthesis.

LESSON TIME:

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

ADVANCE PREPARATION:

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

Why Are Plants Important?

LEARNING ACTIVITIES

1. PLANT GOODIES
2. LET'S GET TOGETHER
3. DRESS ME UP
4. REUSABLE PLANTS
5. THE HEALTHY PROVIDERS
6. EVERY BREATH YOU TAKE

DO

The following are suggestions for using the activities in Lesson 2. The materials needed for each are listed within the activity.

- Give examples of plants and their uses in PLANT GOODIES.
- Describe ways in which plants and animals depend on each other in LET'S GET TOGETHER.
- Explain the importance of landscaping in DRESS ME UP.
- Demonstrate the rate of decomposition of natural products in REUSABLE PLANTS.
- Identify the components of an ecosystem in THE HEALTHY PROVIDERS.
- Discuss the importance of plants in EVERY BREATH YOU TAKE.

REFLECT

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

What are five common human uses of plants?

food, fiber, shelter, fuel, and medicine

What are some ways that plants and animals depend on each other?

food, shelter, transportation, protection

Why is landscaping important?

appearance, reduce noise, privacy, erosion control

What are the benefits of composting?

reduces yard waste going to the curb for pick-up and handling, saves money, adds nutrients to the soil

What are the four components essential in any ecosystem?

abiotic, biotic, energy, nutrient cycling

What products result from photosynthesis?

carbohydrates, oxygen, water

APPLY

Help youth learn to apply what they have learned.

- Have youth list products made indirectly from plants or plant parts.
- Take a nature walk, turn over a log, look under a pile of leaves and discover plant/animal relationships.
- Have youth design one area of their own home landscape.
- Build a garbage can composter.
- Have youth construct a concept map depicting ideas associated with an ecosystem and its producers, consumers, and decomposers.
- Calculate the amount of oxygen needed by a group of people each day.

BACKGROUND BASICS ... Why Are Plants Important?

Plants provide us with food, fiber, shelter, medicine, and fuel. The basic food for all organisms is produced by green plants. In the process of food production, oxygen is released. This oxygen, which we obtain from the air we breathe, is essential to life. The only source of food and oxygen are plants; no animal alone can supply these. Shelter, in the form of wood for houses; and clothing, in the form of cotton fibers, are obvious uses of plant materials. But we must not forget fuel, furniture, paper products, certain medicines like aspirin, and many other products like perfume and chewing gum. To these tangible aspects of the plant world we must also add the importance of beauty and relaxation derived from plants. Since animals are surrounded by and dependent upon plants, the factors that influence plant growth, structure, and distribution, affect the animal world as well.

Plant - Animal Relationships

Forests, lawns, streams, and marshes are all habitats that are easily recognized as unique biotic communities. A **community** is a naturally occurring, interactive assemblage of plants and animals living in the same environment. The interaction between plants and animals often exists out of the need for food, protection, transportation, and reproduction. The different kinds of interaction possible between organisms are extremely important in determining the abundance of species. If the interaction between species is beneficial, it is described as **mutualism**. Some of the most complex mutualistic relationships evolved between plants and pollinators. If the interaction proves disadvantageous, it is referred to as **competition**. **Commensal** relationships, in which one species benefits and the other is unaffected, are common between plants and animals. For example, when a bird builds a nest in a tree, the bird benefits and the tree is (usually) unharmed. Other relationships may positively affect one population and be detrimental to the other. Such relationships involve **predation** and **parasitism**. In predation, one organism directly kills and consumes its prey. Parasitism differs in that parasites live on or in the prey, but may not kill it outright. A good example of parasitism is mistletoe growing on a tree.

Ecosystems

An **ecosystem** is the **biotic** (living) and **abiotic** (nonliving) factors of an ecological community considered together. Ecosystems contain four components: the physical environment (abiotic), living things (biotic), energy input and use, and nutrients that cycle between the biotic and abiotic components. Based on this definition, ecosystems can vary from large unbroken tracts of forest to small ephemeral ponds to backyards.

1. Abiotic factors include temperature, climate, light, and other nonliving things.
2. The biotic elements can be classified according to their activities: **Producers** include photosynthetic organisms. **Consumers** feed on producers and each other. Consumers are classified as primary, secondary, tertiary, etc., according to their feeding level. For example, primary consumers (herbivores) feed on plants, secondary consumers (carnivores and parasites) feed on primary consumers, and tertiary consumers feed on both primary and secondary consumers. Animals and people who eat BOTH animals and plants are called



omnivores. Then there are **decomposers**, fungi and bacteria that feed on the dead through the breakdown of organic matter and eventual absorption by the decomposer.

In a given ecosystem, the interaction of organisms make up **food chains**. Usually, an organism has more than one source of food and is preyed on by more than one kind of organism. Under these conditions it is more appropriate to speak of a **food web**.

Photosynthesis and Decomposition

The most basic processes in the maintenance of the ecosystem are photosynthesis and decomposition. **Photosynthesis** is the process by which green plants utilize the sun's energy to convert carbon dioxide and water into carbohydrates and oxygen. Photosynthesis that occurs in plants is simplified by the chemical equation:



This equation as interpreted as six molecules of carbon dioxide and twelve molecules of water react in the presence of chlorophyll and light to form one molecule of glucose, and six molecules of oxygen.

Plants are one of the natural carbon “sinks” (natural systems that absorb and store carbon dioxide from the atmosphere). These naturally occurring “sinks” are critical in the effort to soak up some of the greenhouse gas emissions. Researchers are continuing to study the role plants can assist in reducing CO₂ emissions and the relationships of such things as deforestation, reforestation, urbanization impacts on climate changes and global warming. Plants grab carbon dioxide from the atmosphere to use in the photosynthesis process transferring some of this carbon to soil as plants die and decompose.



Involved in the return of nutrients to the ecosystem is the process of **decomposition**. In effect, decomposition is the reversal of photosynthesis - the reduction of organic matter into its inorganic compounds (water, carbon dioxide, and oxygen).

Composting

Composting is controlled decomposition that can be used in the garden as mulch or soil. It depends on microorganisms to feed on and break down plant debris. In order to do this the microorganisms also need oxygen and moisture. Microorganisms need a combination of materials rich in carbon (fallen leaves, branches, and twigs) and nitrogen (such as kitchen scraps). Reducing the particle size of the raw materials will increase the speed of the composting process. The proper mix of materials should result in a hot (135-160°F) compost pile which will destroy weeds seeds and diseases. When incorporated back into the soil, compost increases the soil's ability to retain moisture, improves drainage and aeration, supplies small amounts of nutrients, and increases the biological activity of soil organisms.

Beauty and Aesthetics

Plants fill an important psychological need. Plants in a landscape make work and play more enjoyable. A beautiful landscape doesn't just happen, it must be planned!! The first step in designing a landscape is to decide how the landscape is or will be used. Landscapes can screen unsightly views, increase property value, provide privacy and attract birds and other wildlife. The next step is to draw a bird's eye sketch of the area on a piece of paper. Include the location of property lines, structures, and existing plants on the sketch. Use the sketch to record characteristics about the site such as sunlight patterns, soil characteristics, water runoff and utility lines. Once you have prioritized your needs and examined your landscape site, you are ready to create the landscape plan. Draw in lines that separate the lawn from the landscape, then add trees, ground covers, and shrubs. Use colors, textures, and shapes of plants to create interest and draw attention to a particular area in a landscape. Attention must also be given to the proportion or size of a plant in relation to its surroundings .





Activity 1: Plant Goodies

OBJECTIVES:

For youth to:

- identify common uses for plants.
- match objects with their plant sources.
- give examples of plants and their uses.
- list several uses of trees and their products.

LIFE SKILL:

- Critical thinking

MATERIALS:

- household objects such as tomato sauce, cloth, spices, toilet paper, aspirin, blue jeans,
- *Aloe vera* plant
- knife
- 5 to 7 *Aloe vera* leaves split lengthwise
- colander or strainer
- wooden spoon
- small bowl
- small paper plate for each youth
- unscented lotion
- vanilla extract or food coloring
- copies of THE AMAZING TREE Activity sheet for each youth
- colored pencils or markers

TIME:

- 30 minutes

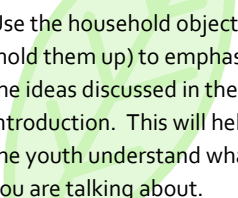
SETTING:

- A comfortable room with tables and chairs.

INTRODUCTION

Plants provide us with food, fiber, shelter, medicine, and fuel. Plants or plant parts are cooked, ground, treated, and processed to create products for our use. The paper you write on doesn't look like a tree, but it was once a part of a tree. A beef hamburger doesn't look like grass, but grass was eaten by a cow which produced the meat. Without plants our world would be a very different place. What would your life be like without paper, pizza, and blue jeans? Can you match the plant used to make these objects? (hold up objects and get responses as to the plant source). Today, we're going to take raw plant ingredients and make something we use. Has anyone ever seen an *Aloe vera* plant?

LEADER INFORMATION



Use the household objects (hold them up) to emphasize the ideas discussed in the Introduction. This will help the youth understand what you are talking about.

DO

- Show youth an *Aloe vera* plant. Cut one of the fleshy leaves from the plant and encourage youth to touch and smell the leaf.
- Ask youth, "Do you know what products the aloe plant is used in?" Answers will include: lotions, shampoos, cream rinse, burn creams.
- Explain to the youth that aloe is used in creams, lotions, and soaps to soften and moisturize the skin.
- Place 5 to 7 (precut) large fleshy leaves into a colander, use a wooden spoon to crush the leaves and extract the juices into a bowl.
- Give each youth a paper plate with 1/2 to 1 teaspoon of unscented lotion on it.
- Place a few drops of the aloe extract on the plate next to the lotion. Using their fingers have youth mix them together.

DO (continued)

- To enhance its appearance and smell, add a drop of food coloring and vanilla to the lotion.
- Have youth use the new lotion to moisturize their hands.
- Pass out THE AMAZING TREE Activity sheet and colored pencils or markers.
- Have youth draw a picture of a tree and list the products made from that tree.

REFLECT

What are five common human uses of plants?

food, shelter, fuel, medicine, and fiber

How many uses can you name for trees or their parts?

answers will vary

What types of products can Aloe be found in?

lotions, shampoos, cream rinse

Can you buy lotions without Aloe? **Yes** Then what is the advantage of adding Aloe?

lotions that contain Aloe have natural moisturizing properties

What are some other cosmetics or medicines that are manufactured from plants?

perfumes, lotions, make-up, toothpaste, tissue

What other cosmetic or medicinal products do you use that contain plant parts?

answers will vary

What are some of the uses for trees that you drew in your picture?

food, shelter, fuel, medicine, fiber, clothing, aesthetics, oxygen, erosion control, shade, and wildlife habitats

What are some of the tree products that you drew?

lumber, soaps, homes, paper, rubber, syrup

APPLY

- List five products made indirectly from plants or plant parts.
fish, eggs, meat products, poultry, milk
- Name some of the objects in this room that are made from plants. What plants do they come from?
- Let's plant a tree!! Each type of tree is different and requires special care. Directions for tree planting and care are available at your local nursery or Extension Office.



The Amazing Tree



Instructions: Draw a picture of your favorite tree and list the uses and/or products made from that tree.

Uses	Products



OBJECTIVES:

For youth to:

- list ways that plants and animals depend on each other.
- describe mutualistic, commensal, and parasitic plant/plant and plant/animal relationships.
- explain how plant and animal relationships help each other to survive.

LIFE SKILL:

- Critical thinking
- Planning and organizing
- Teamwork

MATERIALS:

- copies of LET'S GET TOGETHER Activity sheets for each youth
- scissors
- yarn cut in 3 inch pieces
- single hole puncher
- colored pencils or markers
- index cards for each youth
- tape
- skein of yarn

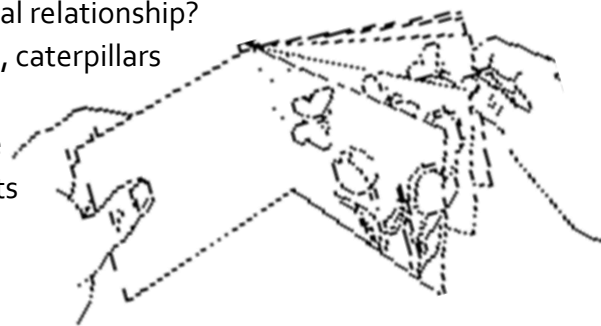
TIME:

- 45 minutes

Activity 2: Let's Get Together

INTRODUCTION

Plants and animals depend on each other for food, protection, transportation, and shelter. Some plants and animals have developed a relationship in which both the plant and animal benefit. This is called a mutualistic relationship. For example, raccoons eat fruit and seeds (which benefit the raccoons) then defecates and disperses the seeds in different locations (which benefit the plants). When one partner benefits from a relationship and the other is not affected it's called a commensal relationship. For example, spanish moss uses a tree's limbs for support but doesn't affect the tree. In other relationships one partner benefits and the other is negatively affected. This is known as a parasitic relationship. Can you think of a parasitic plant/plant or plant/animal relationship? (Mistletoe is parasitic on oak trees, caterpillars in a vegetable garden, and fungi on chestnut trees.) Which of these relationships do humans and plants have? (All three can be found.)



DO

- Give each youth(or pairs) a copy of the LET'S GET TOGETHER Activity sheets.
- Have youth create a moving comic strip of a mutualistic, commensal, or parasitic plant/animal relationship.
- Cut the comic strip into frames and stack them in order from 1 to 14.
- Punch a hole in the upper and lower left corners.
- Tie the frames in place with yarn.
- Hold the left edge and flip through the comic strip.

If computers are available, encourage youth to research their information to make their plans for the comic or "mini-movie" frames.

REFLECT

What are some ways that plants and animals depend on each other?

food, shelter, transportation, protection

What types of plant/animal relationships are formed because of a dependence on one another?

mutualistic, commensal, parasitic

Can you give some examples of a mutualistic, commensal, or parasitic relationship?

answers will vary

How do plants depend on animals?

seed dispersal, pollination

Can you think of some plant/animal relationships that could be going on in your backyard?

answers will vary

What are some ways that people and animals depend on their environment?

answers will vary

APPLY

- What kind of a relationship do humans and plants have? Can you give an example?

mutualistic, commensal, parasitic

- Take a nature walk, turn over a log, look under a pile of leaves, and discover plant/animal relationships.
- Share your moving comic strip with others and explain your plant/animal relationship.
- Play the WEB OF LIFE activity.



Web of Life

The WEB OF LIFE game illustrates relationships between organisms and their environment.

Materials:

- index cards
- markers
- ball of yarn



Instructions:

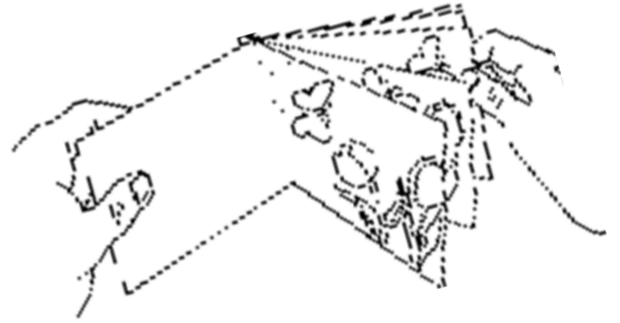
- Have youth volunteer to represent the sun, water, soil, air, and various plants and animals.
- Using an index card write what each youth represents. Have youth tape the card to their shirt front (or tie it to yarn and hang around their neck) so everyone can see who they represent.
- Have youth form a circle.
- The youth representing the sun will start the game by tossing a ball of yarn to someone else in the circle.
- The youth who passes the yarn must describe their relationship to the one receiving the string.
- Connect each plant, animal, or nonliving component with string until an entire ecosystem emerges.

Once the WEB OF LIFE has formed, ask youth the following questions:

1. What is the importance of the sun in this game?
2. What would happen if we cut the connection between a plant and an animal?
3. What role do humans play in the game?
4. Can you identify any parasitic, commensal, or mutualistic relationships among the organisms?

Let's Get Together

To create a moving comic strip: Think of a plant/animal interaction like a bee and flower, a caterpillar and tomato leaf, or a raccoon and grapes. Sketch the interaction frame by frame, then color the frames. Cut each frame and stack them in order (1-14). Punch holes in the upper and lower left corners. Tightly secure the comic strip with yarn. Hold the booklet by the left edge and flip the pages with your right hand.



1	2
3	4
5	6

7	8
9	10
11	12
13	14

Activity 3: Dress Me Up

OBJECTIVES:

For youth to:

- explain the importance of landscaping.
- create a landscape design.
- select the appropriate plants for their landscape.

LIFE SKILL:

- Planning and organizing
- Analyzing information and decision-making

MATERIALS:

- copies of the LANDSCAPE DESIGN Activity sheet for each youth
- magazines, lists, or catalogues of landscape plants (available from your local County Extension Office)
- rulers
- copies of the HOME LANDSCAPE DESIGN Activity sheet for each youth

TIME:

- 30 minutes

SETTING:

- A comfortable room with tables and chairs

INTRODUCTION

Have you ever mowed a lawn or pruned a bush? Why go to all the trouble? One reason why plants are important is because they look nice and they make us happy. Landscaping is using plants to make outdoor areas attractive to people. Can you think of other reasons why landscaping is important?

Landscaping can reduce noise from highways, block unsightly areas, provide privacy, and increase the value of a property. Today, we're going to design our own landscape.

Florida-Friendly
Landscaping™ PROGRAM



Visit the Florida Yards and Neighborhoods web site for information on how to design a Florida-friendly landscape.

http://fyn.ifas.ufl.edu/homeowners/nine_principles.htm

DO

- Give youth copies of the LANDSCAPE DESIGN Activity sheet and pencils.
- Discuss the elements and symbols used by landscape designers with youth.
- Have youth create a landscape plan using the design symbols and selecting the type of plants (shrubs, trees, vines, etc.)
- Have several magazines, lists, and catalogues of plants available for youth to select plants for their landscapes.

REFLECT

Why is landscaping important?

appearance, reduce noise, hide unsightly areas, privacy

What factors were most important to you when you were designing your landscape plan? (busy road, neighbors, power lines)

answers will vary

Why is it important to select the proper plants when landscaping?

selecting plants based on their height, texture, color, and form helps achieve the purpose of the landscape

If the purpose of your landscape is to create an area for wildlife, why not just leave the area in its natural state?

this is done in some landscapes but certain plants will attract wildlife to the area

Once a site has been landscaped, how can the health of the landscape be maintained?

fertilize, water, and control insects

you think of ways that people who live in apartments can landscape?

window boxes, container plantings, common gardens

APPLY

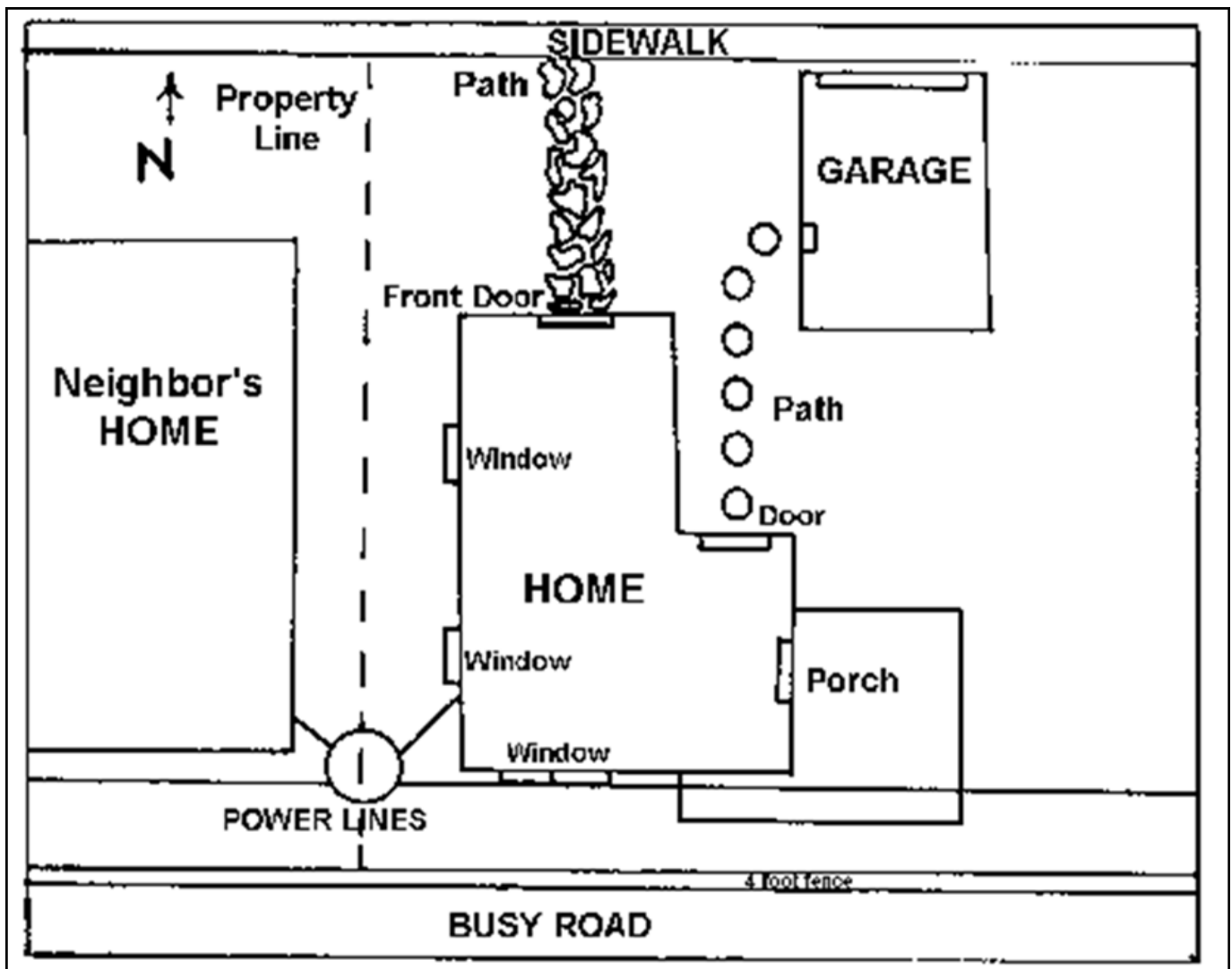
- Visit a professionally landscaped site. Discuss the placement and function of the plants used in the landscape.
- After youth have designed a landscape, have them complete the HOME LANDSCAPE DESIGN for their own yard.

Landscape Design



Landscape designers combine elements of art (color, texture, and shape) and science (proportion and balance) to create functional, pleasing outdoor areas. A landscaper may combine colors, textures, and shapes of individual plants to draw attention to particular areas in the landscape. Designers must also consider the placement of plants in the landscape. Attention must be given to the proportion or size of a plant in relation to its surroundings and the uniform appeal or balance of the landscape (both symmetrical and asymmetric strategies can be used).

Create a landscape plan by drawing the design symbols onto the landscape below. Check out examples of symbols used and create your own symbols representing the types of plants. Here is one site that has different symbols for ideas: <http://www.sustland.umn.edu/design/landscapesym.html>
Use the symbols on the plan below to represent your ideas and the types of plants your would use.



Home Landscape Design

The _____ Residence

Create a landscape plan for your own home!! Draw an aerial view of your home and the surrounding plants in the box below. Can you improve upon the landscape design of your home?



Deciduous Tree

Evergreen Tree

Ground Cover

Deciduous Shrub

Evergreen Shrub

Vine

Grouped Symbols

Plant People

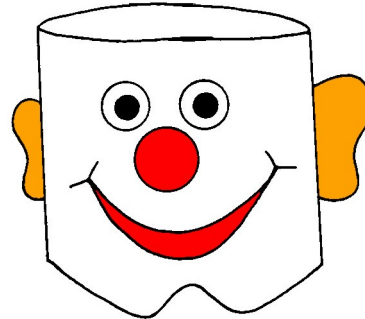
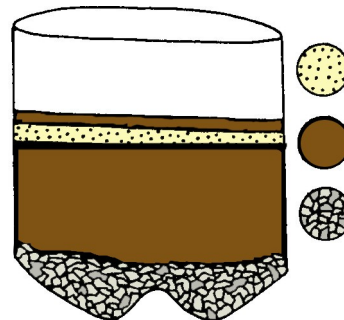
To make a plant person you will need:

bottom of a 1-liter soda bottle (4" tall)
rye grass seed (straight hair)
colored markers
buttons/yarn/ribbon
any other available craft supplies

potting soil
curly cress seed (curly hair)
gravel
construction paper

WHAT YOU DO:

1. Place 1 inch of gravel in the bottom of the container.
2. Fill the container with potting soil.
3. Spread a thick layer of seed on the top of the soil then cover with about 1/8 inch of soil.
4. Pat gently and water.
5. Decorate the outside of the container.



In 3 or 4 days your PLANT PERSON will be ready for a hair cut!



Activity 4: Reusable Plants

OBJECTIVES:

For youth to:

- demonstrate the rate of decomposition of natural products.
- list the benefits of composting.
- identify other recycling efforts.

LIFE SKILL:

- Acquiring, analyzing and using information

MATERIALS:

- copies of REUSABLE PLANTS Data sheet for each group
- REUSABLE PLANTS recipe cards
- copies of REUSABLE PLANTS Study questions
- 5 large plastic zipper seal bags (1 gallon)
- 2-1/2 cups soil
- hole punch
- 6 cups of brown leaves
- 6 cups of grass clippings
- 4 cups food (vegetable and fruit) scraps and brown pine needles
- water
- measuring devices (cup and tablespoon)
- Fahrenheit thermometer
- gram scale
- pens and pencils
- 20 to 30 gallon bucket
- hammer and nail
- 2 to 4 bricks
- soil or peat moss
- kitchen scraps, grass clippings, and yard waste
- shovel
- newspaper, styrofoam cups, paper plates, coffee filters, and paper towels

TIME:

- 30 minutes
- 15 minutes every 3 or 4 days

SETTING:

A comfortable room with tables and chairs.

INTRODUCTION

What would happen if plant leaves, twigs, branches, flowers, and grass clippings didn't decompose? Fortunately, nature has a continuous recycling system. Right now, in forests, prairies, swamps, and your backyard, plant and animal remains are being decomposed with the help of fungi, bacteria, insects, and other organisms. But if you've ever raked a pile of leaves or had a fallen log in your backyard you would know that it can take years for organisms to decompose some plant materials. Today, we're going to see what kinds of materials break down the fastest.

DO

- Separate youth into five groups.
- Give each group a copy of the REUSABLE PLANTS Data sheet, a large zipper seal bag, and a recipe card.
- Have groups read and follow the recipe card instructions.
- Close the bag and punch four holes along the top seam of the bag.
- Have groups label their bags with their group number.
- Have groups fill in their REUSABLE PLANTS data sheet with today's information and answer the hypotheses questions using the REUSABLE PLANTS Study questions.
- Place the bag in a shady place either in the room or outside under a tree.
- Every 3 to 4 days: open, mix, and water (if dry to the touch) the material in the bags. Record observations on the data sheets and share the information with the other groups.
- After 3 weeks, have youth conduct their final observations and present their findings to the class.

REFLECT

Which compost bag mixture decomposed the fastest?

decomposition rates may vary but groups 5, 4, and 1 should have decomposed the fastest

Why was it important to add soil to your compost bag?

the soil is where the organisms that do the composting live

What happens during composting?

micro-organisms break down the organic matter

What are some examples of compost materials?

weeds without seeds, grass clippings, leaves, kitchen vegetable and fruit waste, garden clippings

What would happen if you put weeds with seeds in your compost pile?

if the seeds survive and the compost is incorporated into the soil, the weed seeds will grow

Does size play a factor in the rate of decomposition?

small, finely ground material decomposes faster

What are the benefits of composting?

reduces waste, saves money, adds nutrients to the soil

Composting is recycling, what other things do you recycle?

answers will vary

What would happen if you put diseased plants into your compost pile?

if the disease organism survives and the compost is incorporated into the soil, the disease could spread





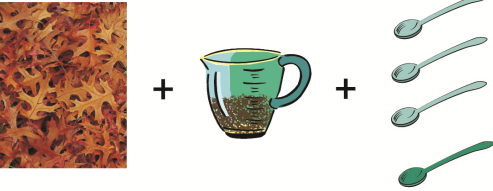

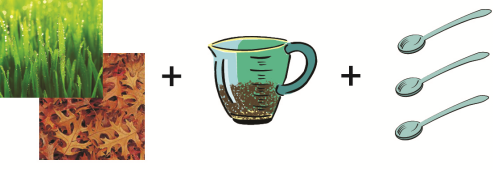
APPLY

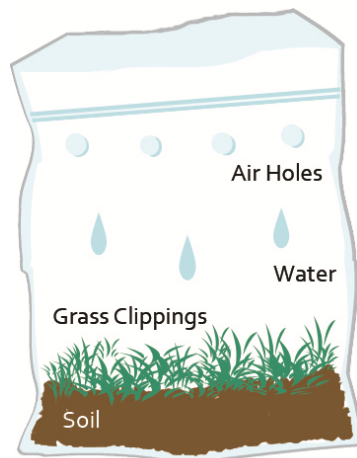
- Create a garbage can composter and have youth add their bag compost.

Garbage compost can be produced easily and tucked out of the way in the corner of a yard or garden. Buy a 20 or 30 gallon can and punch several holes in the bottom with a hammer and a large nail. Put the can on a few bricks to let excess moisture drain from the can. Add 4 to 6 inches of kitchen scraps, grass clippings, shredded newspaper, and leaves. Keep a lid on the can. Every few days add more kitchen scraps and yard wastes. Turn and water the compost every other week. The compost should be ready in about 2 or 3 months. When your garbage can compost is finished, incorporate it into a garden or landscape.

- Repeat the composting experiment and add newspaper, paper plates, coffee filters, and paper towels to the bags.
- Composting is a type of recycling and it shows that you care about the environment. Can you think of other ways you recycle?
- How has this lesson helped you become more environmentally conscious?

Composting Recipes

<p>Group 1: Add these ingredients to your bag and mix.</p> <ul style="list-style-type: none"> 4 cups vegetable and fruit scraps 1/2 cup soil 3 tablespoons water 	
<p>Group 2: Add these ingredients to your bag and mix.</p> <ul style="list-style-type: none"> 4 cups brown pine needles (whole) 1/2 cup soil 3 tablespoons water 	
<p>Group 3: Add these ingredients to your bag and mix.</p> <ul style="list-style-type: none"> 4 cups brown leaves (whole) 1/2 cup soil 3 tablespoons water 1 teaspoon mixed water and soluble plant food 	
<p>Group 4: Add these ingredients to your bag and mix.</p> <ul style="list-style-type: none"> 4 cups grass clippings 1/2 cup soil 3 tablespoons water 	
<p>Group 5: Add these ingredients to your bag and mix.</p> <ul style="list-style-type: none"> 2 cups grass clippings 2 cups brown leaves (crushed) 1/2 cup soil 3 tablespoons water 	





Reusable Plants

Data Sheet

Composting is the controlled decomposition of organic. Microorganisms (such as bacteria and fungi), worms and other organisms decompose the material, but we can speed up the process by providing oxygen (turning the compost) and keeping it moist. As these organisms eat or decompose organic material they generate heat. The higher temperatures destroy weed seeds and kill disease causing organisms. **The temperature in your bag should reach 110° to 120°F in about 3 days.** Remember that organisms are actually doing the work of composting, so don't forget to give them some air and water once in awhile.

Group	Compost Appearance	Temperature (F)	Weight (grams)
Date:			
Date:			
Date:			
Date:			
Date:			

Reusable Plants

Study Questions

What's your hypothesis? Try and answer the following questions before starting the experiment. What do you think will happen? At the end of the experiment check your answers was your hypothesis correct?



1. Which bag do you think will decompose the fastest? Why?
2. Do you think the weight of your bag will change over time? What about the size of the plant material?
3. Do you think some bags will get hotter than others? Which ones? Why?
4. What would have happened to the compost if you forget to mix and add water?

CHECK IT OUT!

Check out how long each of these products take to decompose in the environment...

- Banana Peel: **3-4 weeks**
- Paper Bag: **1 month**
- Cardboard: **2 months**
- Wool Sock : **1 year**
- Tinned Steel Can: **50 years**
- Aluminum Can: **200-500 years (But if recycled, it can be reused within 6 weeks!)**
- Disposable Diapers: **550 years**
- Plastic Bags : **20-1000 years**
- Plastic Jug: **1 million years**
- Glass : **1-2 million years**
- Styrofoam: **1+ million years**

Source: Joe Fier, How Long Does It Take to Decompose? Nov. 8, 2007

<http://behealthyandrelax.com/2007/11/how-long-does-it-take-to-decompose/>



OBJECTIVES:

For youth to:

- identify the components of an ecosystem.
- identify producers, consumers, and decomposers.
- explain relationships between the biotic and abiotic factors in an ecosystem.

LIFE SKILL:

- Problem solving and decision making

MATERIALS:

- Copies of THE LUNCH PLATE Activity
- copies of the HEALTHY PROVIDERS Activity sheet for each youth
- magazines of plants and animals for youth to cut
- poster board
- scissors
- tape
- pushpins
- yarn
- pens and pencils

TIME:

- 30 minutes

SETTING:

- A comfortable room with tables and chairs

Activity 5: The Healthy Providers

INTRODUCTION

What is an ecosystem? An ecosystem is simply the biotic (living) and abiotic (nonliving) factors of an ecological community considered together. In order to say something is an ecosystem it has to contain four components: the physical environment (abiotic); living things (biotic); energy (input and use); and the nutrients that cycle between the biotic and abiotic components. Based on this definition, an ecosystem can refer to the entire earth or a puddle in your back yard. Today, we're going to look at the biotic or living component of the ecosystem. The biotic component is divided into: producers, consumers, and decomposers. Have you heard of these terms? Can you tell me what a producer is or give me an example? (Producers produce their own food, green plants.) What about a consumer? (Consumers eat producers and each other.) Consumers are subdivided according to their position in the food chain, also called their trophic level. For instance, herbivores are primary consumers, while carnivores, which feed on herbivores, are secondary consumers. Carnivores that eat other carnivores are called tertiary consumers. What trophic level are humans in? (*humans, omnivores, are consumers within the earth's ecosystem*) Finally, decomposers, like bacteria and fungi, are a type of consumer that consume dead material. We can illustrate the different biotic factors of an ecosystem by looking at our lunch.

DO

- Give each youth a copy of THE LUNCH PLATE Activity and a pencil.
- Allow approximately 15 minutes for youth to complete the activity then discuss their answers.
- To develop a broader concept of the food chain, discuss the following questions with youth:
 - ◇ Who is eating water? (**raw fruit or vegetable**)
 - ◇ Who is eating sun? (**trapped light, e.g. in green leaves**)
 - ◇ Who is eating minerals? (**nutrients in foods**)

DO (continued)

- Give each youth a copy of the HEALTHY PROVIDERS Activity sheet.
- Allow approximately 15 minutes for youth to complete the activity then discuss their answers.

REFLECT

What is an ecosystem?

interactions between the living and non-living components in an area

Using the four components essential in any ecosystem (abiotic, biotic, energy, nutrient cycling) describe how the entire earth can be considered an ecosystem? Your back yard?

**Abiotic—the physical environment;
Biotic—plants, animals, people;
Energy—sun, food intake, energy expended during activities;
Nutrient cycling—plant and animal waste recycled into nutrients**

What are some examples of producers? consumers? decomposers?

answers will vary

If you drew a pyramid and placed all the biotic components (producers, herbivores, omnivores, carnivores, and decomposers) into the pyramid, which component would be at the bottom? Hint: Which component is most abundant?

producers - green plants

Who would be at the top of the pyramid?

top carnivores - humans, lions, tigers, birds of prey

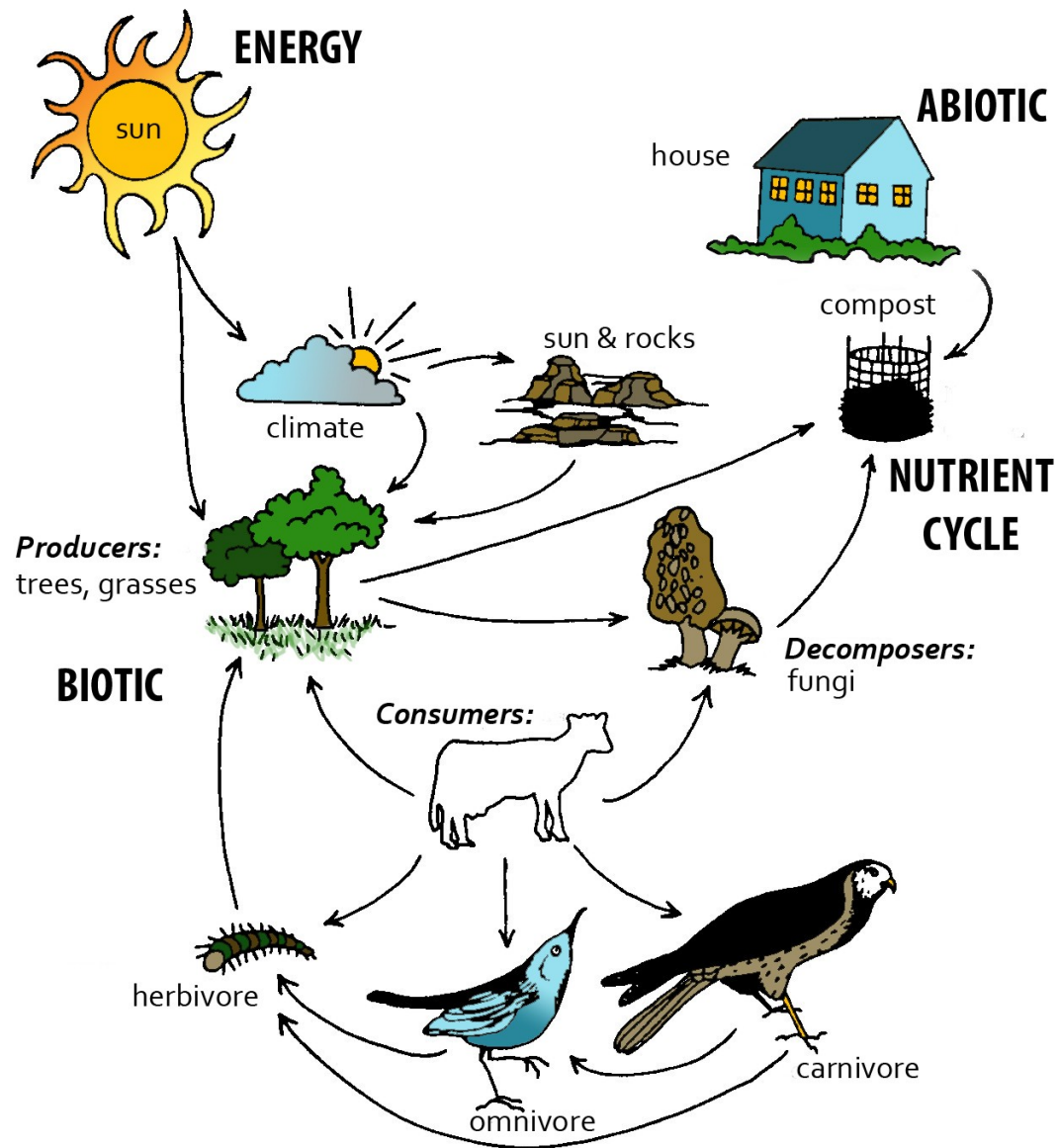
APPLY

- Make a food web poster. Tape pictures of plants and animals on a piece of poster board. Insert a pushpin by each picture and use yarn to connect the plants and animals that eat each other. Identify them as producers, consumers, and decomposers.
- Investigate additional foods that come from decomposers.
- Have youth construct a concept map depicting ideas associated with an ecosystem and its producers, consumers, and decomposers. Have youth share their concept maps with the class.

APPLY (continued)

- A *concept map* is a way of organizing and graphically displaying ideas relevant to a given concept or topic, so that the relationships among ideas are clarified.

EXAMPLE BACKYARD ECOSYSTEM

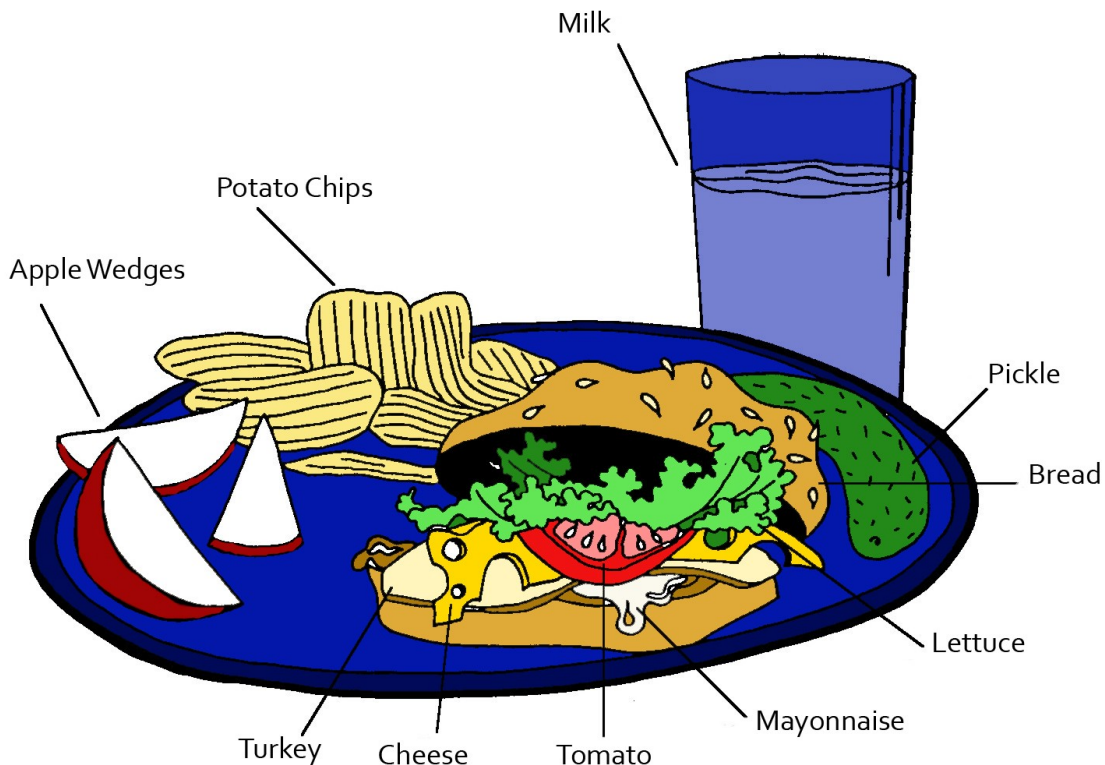


THE LUNCH PLATE

Answer Key

Look at this lunch plate and answer the following questions:

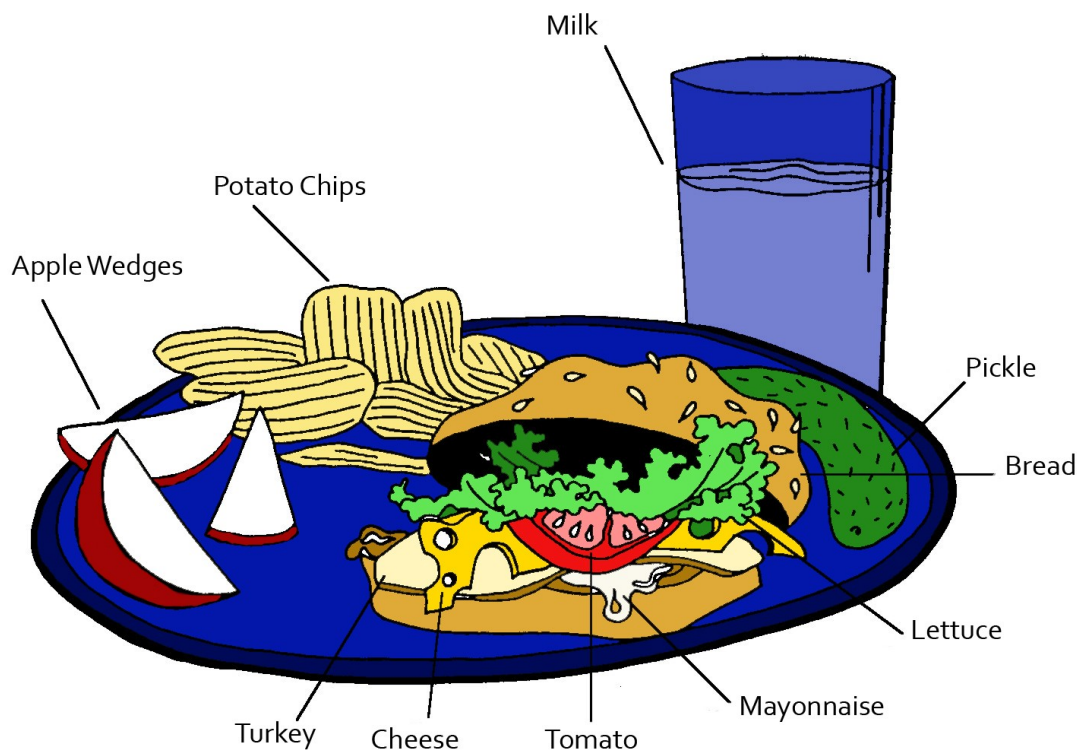
1. Can you identify the producers on this plate?
pickle, apple, potato chips, bread, lettuce, tomato
2. Can you identify foods that come from consumers on this plate?
turkey, cow, mayonnaise (eggs)
3. What do the consumers eat?
grass, seeds
4. What trophic level are the consumers in?
primary
5. Are there any decomposers on the plate?
no



The LUNCH Plate

Look at the lunch plate below and answer the following questions:

1. Can you identify the producers on this plate?
2. Can you identify foods that come from consumers on this plate?
3. What do the consumers eat?
4. What trophic level are the consumers in?
5. Are there any decomposers on the plate?

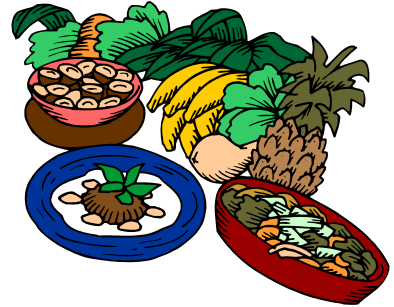


HEALTHY PROVIDERS

What did you eat for lunch yesterday? List the contents of yesterday's lunch then answer the following questions.

I ate:

List the producers you ate for lunch.



Does your producer grow locally?

Could your producer have been transported from another state or country?

If your producer was not fresh, how was it stored?

☐ Dried

☐ Canned

☐ Bottled

☐ Frozen

☐ Pickled

Were any changes made to your producer before it was sold for consumption?

What would happen if we didn't have the ability to store foods?

Did you eat a consumer for lunch?

What kinds of producers did your consumer eat when it was alive?

When was the last time you ate a decomposer?



OBJECTIVES:

For youth to:

- discuss the importance of plants.
- discuss the end products of photosynthesis.
- demonstrate the importance of plants in providing oxygen.

LIFE SKILL:

- Communicating and relating to others.

MATERIALS:

- large, clear bowl for each group
- clear baby food jar for each group
- 6 to 8 inch sprig of *Elodea* or *Hydrilla* for each group
- baking soda
- table lamp or portable light
- microscopes
- leaves
- pens or pencils

TIME:

- 30 minutes

SETTING:

A comfortable room with tables and chairs.

Activity 6: Every Breath You Take

INTRODUCTION

Did you know that plants play a part in every breath you take? Green plants make their own food in a process called **photosynthesis**. Plants use energy from the sun to convert carbon dioxide and water into simple sugars. This process takes place in the presence of **chlorophyll**, a pigment which enables plants to absorb the sun's energy. One of the end products of photosynthesis is oxygen. Plants release the oxygen through small openings on the underside of the leaves called **stomata**. Today we're going to watch a plant make oxygen.



DO

- Divide youth into two or three groups.
- Give each group a large bowl, a jar, and a 6 to 8 inch section of a freshwater plant obtained from a pet store or lake (eg. *Elodea*, *Hydrilla*). If available, give each group a different type of plant.
- Have each group fill their bowl with tap water.
- Mix 1 or 2 teaspoons baking soda in the water. This provides the plants with carbon dioxide needed for photosynthesis.
- Have groups place their plants into the jars.
- Lower the jar sideways into the bowl until it fills with water and no air bubbles are left in the jar. Turn the jar upside down in the bowl without letting air in the jar.
- Aim a light at one side of the bowl. Let stand for approximately 20 minutes.
- Have youth hypothesize about what is happening in the jar.
- After 20 minutes, observe the plants. A large bubble should have formed at the top of the jar and small bubbles should form on the leaves. Most bubbles will come from the area nearest the light. The bubbles contain the oxygen being given off by the plant.

REFLECT

Did what you hypothesized happen? Why or why not?

What caused the bubbles to appear? Where did they occur?

**the bubbles contain the oxygen being given off by the plant;
most bubbles will come from the area nearest the light**

What products result from photosynthesis?

carbohydrates (simple sugars), oxygen, water

Why did we add baking soda to the water?

**increase the CO₂ content in the water and enhance
photosynthesis**

How do water plants naturally obtain carbon dioxide?

**diffusion of CO₂ at the waters surface and mixing by wind
and wave action**

Can you guess which organisms carry out 80 to 90% of the photosynthesis that takes place on earth?

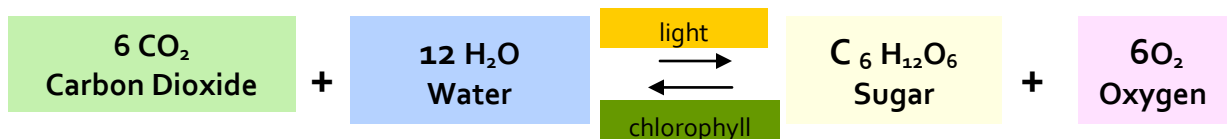
phytoplankton

Why are plants important?

provide us with oxygen, food, fiber, shelter, aesthetics

APPLY

- Write the equation for photosynthesis on the board. Have youth draw the photosynthesis process without using words. Encourage youth to be creative.



- Scientists have calculated that an average person uses 360 liters of oxygen per day and it takes a 25 square foot plot of grass or an average size tree to produce enough oxygen for one person each day. How many liters of oxygen are needed by the entire class each day? Are there enough trees in the neighborhood or schoolyard to meet the oxygen need?
- Leave the experiment as is for several days. Have youth observe the size of the air bubble over a period of days.
- Contact your local Extension office or nursery, ask for a volunteer to come speak about the importance of trees.
- Have youth look at several different leaves under a microscope and draw what they see. Be sure to look for the stomata.

3

Plant Connections

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 plant's 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.

What Makes Plants Grow?

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.

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**.

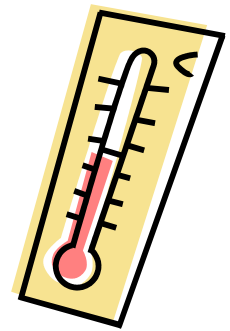
Air

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 food
- 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 plant's 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.

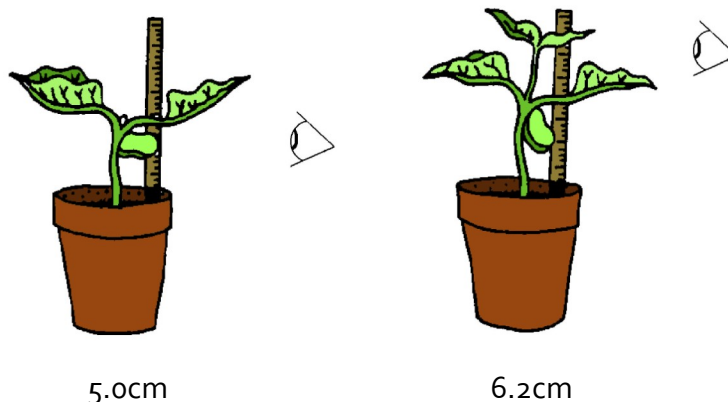
Proper Temperature: Temperature is the most important environmental factor affecting plant growth. Plants vary in their temperature needs. The ability of a plant to withstand cold temperatures is known as hardiness. Plants that cannot tolerate cold weather are known as tender plants.

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



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

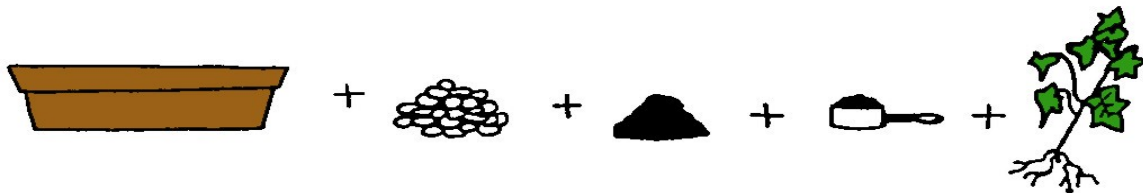
The object of creating an INDOOR GARDEN is to create an artificial environment that provides your plants with their basic needs.

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, peperomia, 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

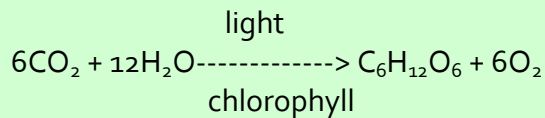
SETTING:

- 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):



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

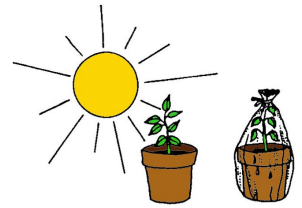
- How does the structure or shape of the leaf affect photosynthesis?

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

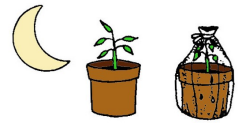
- Let's think in terms of the big picture or the world view: The amount of people on the earth is increasing and forests are being cut to make products and places for people to live. The levels of pollution in our atmosphere are also increasing. What does this mean in terms of the amounts of oxygen and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

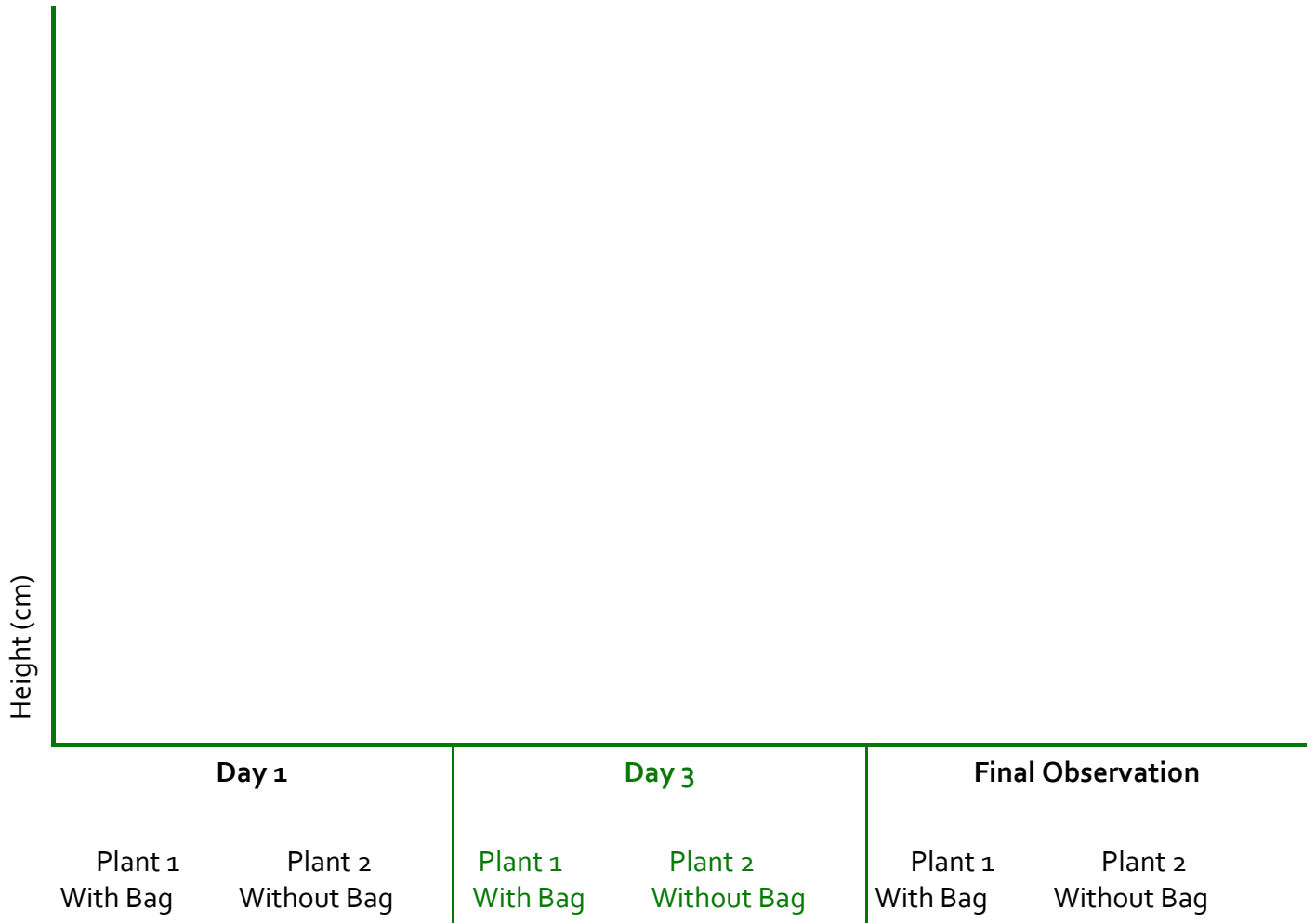
Study Questions

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:





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

Activity 3: Grow Up!

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.

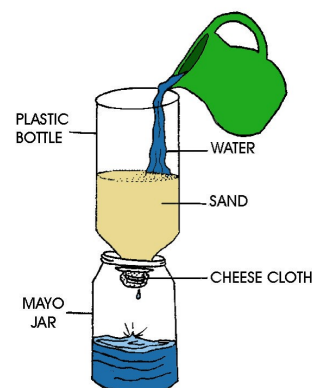
DO

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?



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:*





OBJECTIVES:

For youth to:

- list the importance of water in plant growth.
- describe a plant's 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.

Activity 4: Keeping Cool!

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 known 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?

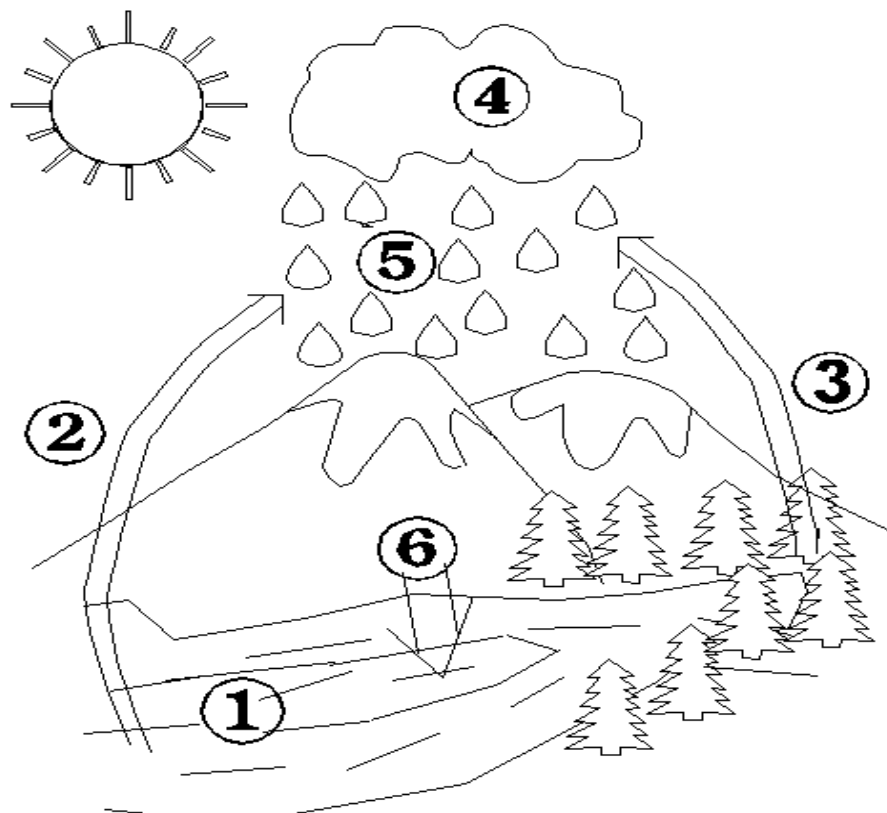
Hint: Compare a cactus with a philodendron.

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.

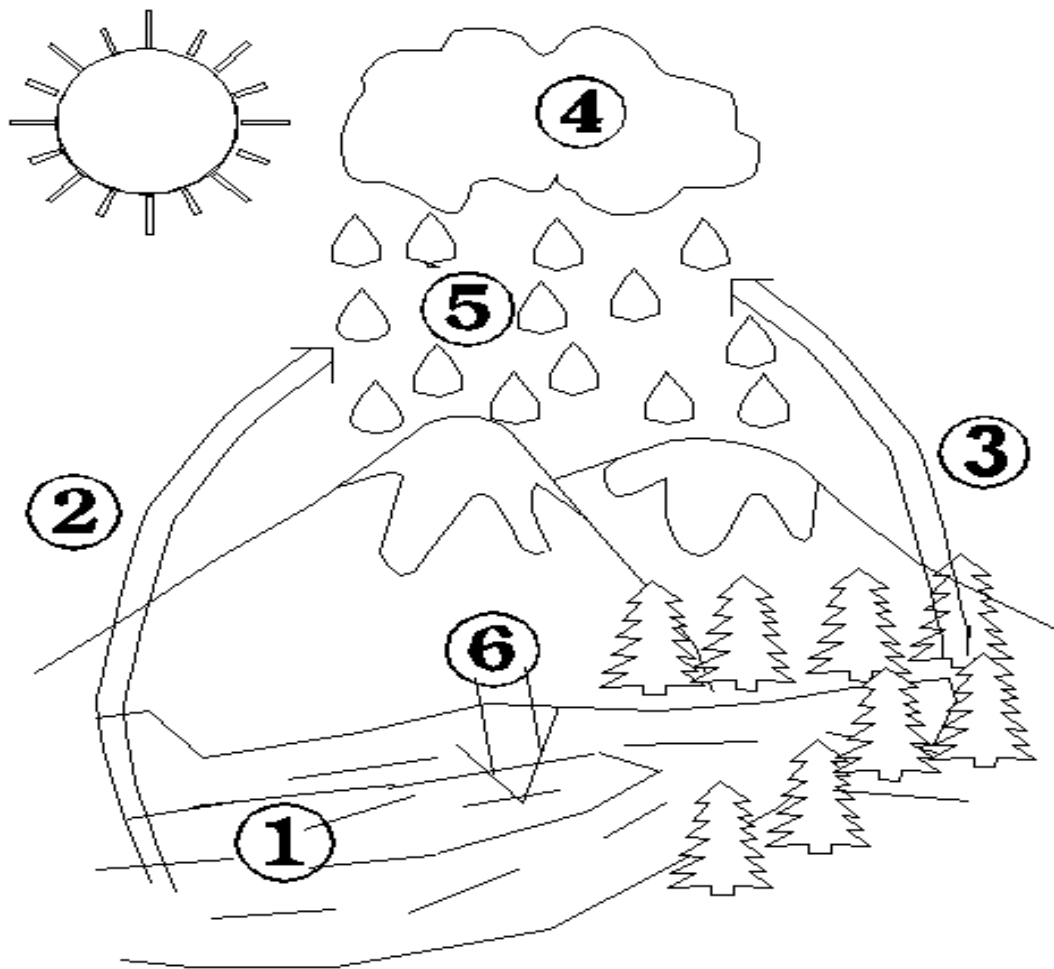
Hydrologic Cycle Answer Key

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. _____

4. _____

2. _____

5. _____

3. _____

6. _____

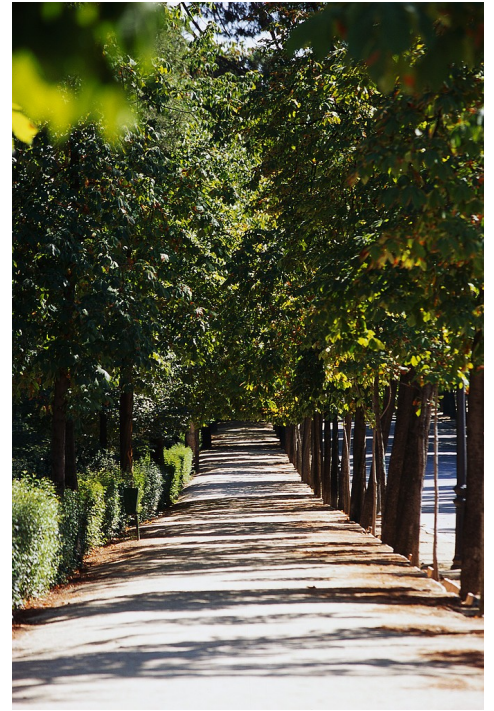
Keeping Cool!

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: _____

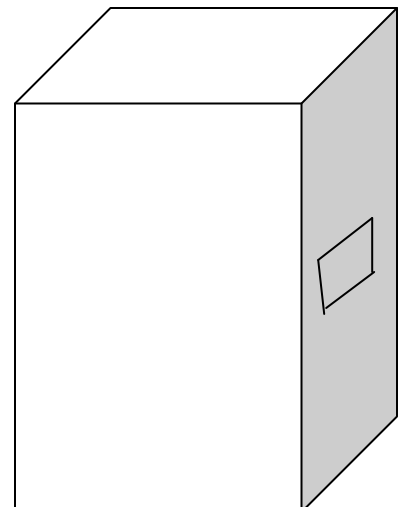
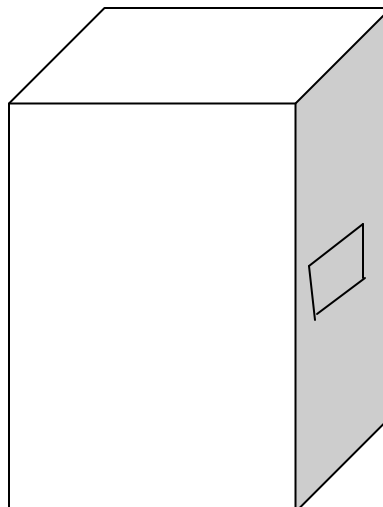
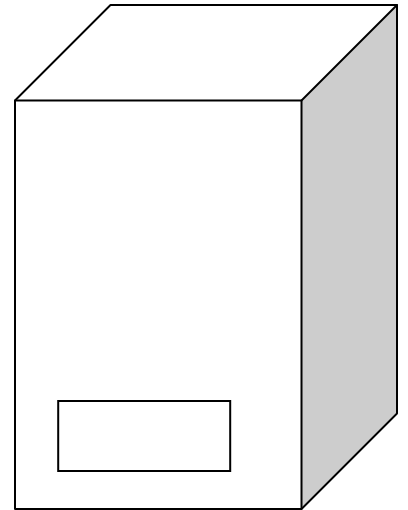
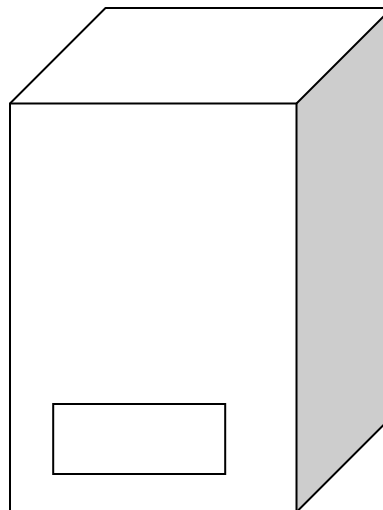
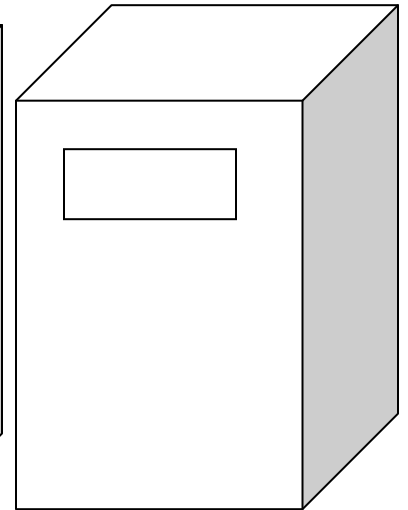
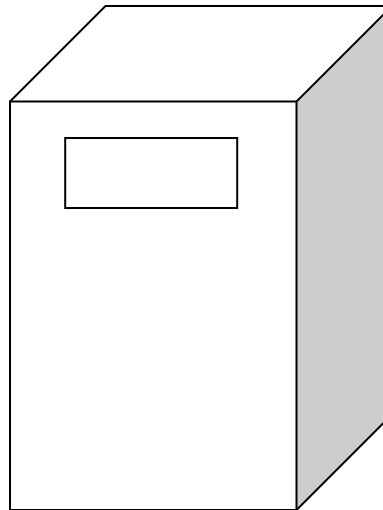
Date 2: _____

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?



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.

Activity 6: Plant Habitats

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.

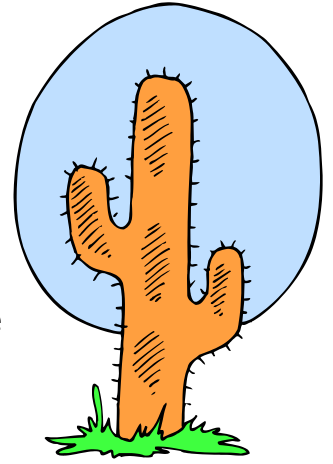
plants (especially young plants) need shelter from harsh environmental conditions

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: _____



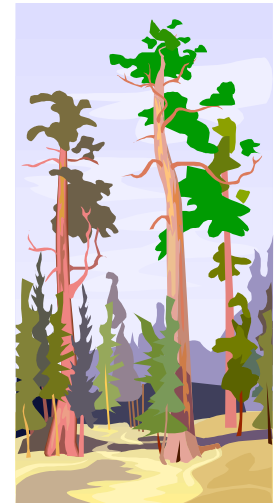
1. In which region (south, central, north, west, east) of Florida can your plant be found?

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?



4

Plant Connections

PURPOSE:

- To become familiar with the basic principles and management techniques for reproducing and taking care of plants.

OBJECTIVES:

For youth to:

- list requirements for plant growth.
- explain why planning a garden is important.
- distinguish between perfect and imperfect flowers.
- explain asexual propagation.
- identify five major categories of plant pests.
- discuss alternative pest control measures.

LESSON TIME:

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

ADVANCE PREPARATION:

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

How to Grow Plants

LEARNING ACTIVITIES

1. A MATTER OF LIFE OR DEATH
2. GARDEN PLANNER
3. REPEATING THE PROCESS
4. CLONING AROUND
5. MEET MY FRIENDS
6. BLAST THAT PEST!

DO

The following are suggestions for using the activities in Lesson 4. The materials needed for each are listed within the activity.

- Describe the requirements for plant growth in A MATTER OF LIFE OR DEATH.
- Plan a garden using the GARDEN PLANNER.
- Label the parts of a flower in REPEATING THE PROCESS.
- Demonstrate an asexual propagation method in CLONING AROUND.
- Identify common plant pests in MEET MY FRIENDS.
- Discuss alternative pest control practices in BLAST THAT PEST!

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, space

How would someone in an apartment plant a garden?

plant in containers or window boxes

plant dwarf or smaller varieties

What is the difference between perfect and imperfect flowers?

perfect flowers have both male and female parts, imperfect flowers have only male or female parts

What are some reasons for reproducing plants without seeds?

**to produce plants with the same characteristics as the parent
some plants may not produce viable seeds**

How can insects benefit plants?

pollination

prey on plant pests

What are the five major categories of plant pests?

insects, weeds, nematodes, diseases, animals

APPLY

Help youth learn to apply what they have learned.

- Have youth list the things that plants need to grow and compare it with a list of things people need to grow.
- Have youth display their garden plans. After looking at all the plans, develop one plan for the entire group and plant a garden.
- Using craft supplies, have youth put together a model of a perfect or imperfect flower.
- Compare the growth and development of potato seeds to potato pieces.
- Have youth collect weeds from a garden or schoolyard. Identify the weeds using a plant identification key or get a copy of the "Weeds of Southern Turfgrasses (SP 079) at the IFASbooks.ufl.edu

BACKGROUND BASICS ... How to Grow Plants

Plants exist in close association with each other and their environment. Each part of a natural or artificial environment affects the survival and quality of plants. Environmental factors such as sunlight, water, air, nutrients, and a proper temperature help to regulate plant growth. When one or more of these factors are missing, the plant will not grow as it should and may die.

Review Lesson 3 Background Basics for information regarding environmental factors that affect plant growth.

Plant propagation

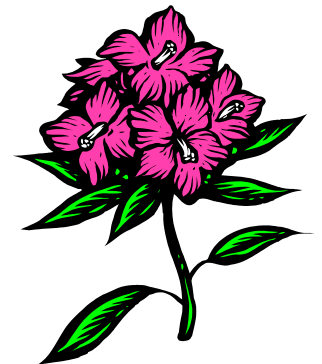
Plant propagation refers to the sexual and asexual reproduction of plants. **Sexual propagation** in plants is the reproduction of plants by seeds. Since most plants reproduce naturally from seeds, this method is often the easiest and least expensive. Sexual reproduction takes place in the flower of the plant. A typical or **complete** flower consists of four parts:

Sepals - leaf-like structures beneath the petals which form a protective covering around the flower until it opens. The calyx is made up of all the sepals on one flower.

Petals - brightly colored leaf-like part of a flower which attracts pollinators.

Stamen - the male reproductive portion of a flower. A stamen consists of a filament or stalk which supports the anther. The anther produces the pollen or male sex cells.

Pistil - the female reproductive portion of a flower. A pistil consists of the stigma, style, and ovary.



Examples of complete flowers include apple, lily, and pea. Flowers that lack sepals, petals, stamens, or pistils are known as **incomplete** flowers.

Flowers are further grouped by the presence or absence of stamens and pistils. **Perfect flowers** contain both stamen (male) and pistil (female) reproductive structures in the same flower, while **imperfect flowers** contain only the stamen or pistil. Examples of imperfect flowers include corn, holly, squash, and willow.

Pollination occurs when a pollinator, such as wind, insects, or animals, transfer pollen grains from the anther to the stigma. The pollen grows from the stigma down the style to the ovary. **Fertilization** occurs when the male and female cells unite to produce a seed. After pollination and fertilization, the flower petals begin to drop and the ovary enlarges and develops into a **fruit**. The fruit is the seed bearing organ of the plant. There are basically two types of fruit:



Fleshy fruit - The mature fleshy fruit is composed of a soft fleshy material with seed or seeds inside. Blueberry, peach, tomato, and melons are all fleshy fruits.

Dry fruit - The dry fruit consists of seeds enclosed in a fruit wall that is hard and brittle when mature. Pea, sunflower, and oak produce dry fruits.

Seeds are the mature, fertilized ovules or eggs. They consist of a seed coat, endosperm (food storage tissue), and embryo. Seed **germination** is a process that begins when the seed absorbs water (imbibition). Besides water, seeds also need oxygen, warmth, and some need light to germinate. The germination process is complete when the seedling can manufacture its own food.

Asexual propagation is the production of new plants from stems, leaves, or roots of a parent plant. In this method of plant reproduction no seeds are used, just portions of the parent plant which are placed in soil, soil-less media (potting soil, vermiculite, peat moss), or even test tubes containing nutrient rich agar. Asexual propagation permits growers to produce more plants faster, especially in cases where seeds are difficult to germinate or are not viable (alive). One of the most important benefits of asexual propagation is that the plants produced are genetically identical to the parent plant.

The most common method of asexual propagation is the use of cuttings. **Cuttings** are detached portions of the plant, such as stems, leaves, or roots which grow into complete plants. Cuttings are often treated with a root inducing hormone and placed in an environment that favors root initiation and development. Other methods of asexual propagation include layering, division, and grafting.

Controlling pests

A **pest** is anything that causes injury or loss to a plant. The five major kinds of pests are: insects, weeds, nematodes, diseases, and animals. The presence of pests in our environment impacts the quality of the plants we produce. Although pest damage can reduce a plant's productivity or even destroy it, the amount and kind of damage varies from pest to pest. For example, conspicuous damage caused by chewing and sucking insects can be less harmful than a difficult to diagnose, but deadly disease. The key to managing a pest control program is to correctly identify the pests and understand their life cycles.

Integrated pest management (IPM) is a pest management strategy that uses a combination of practices to reduce pest damage with the least disruption to the environment. Research has shown that no single control measure works consistently over a long period of time. One reason is that pests can develop a resistance to pesticides and a resurgence can occur. The goal of IPM is to keep pest populations below the point at which plant losses are equal to the cost of control. Crucial steps in IPM involve **pest identification, monitoring, and establishing a tolerable level of plant loss**. When the amount of plant damage is no longer tolerable, a combination of methods is used to control pests.

The combination of methods used to control pest populations include **cultural**, **genetic**, **mechanical**, **biological** and **chemical** controls.

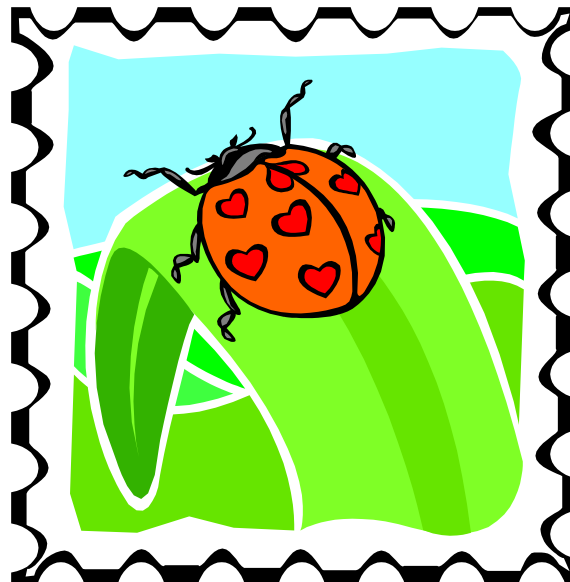
Cultural pest control utilizes management techniques like crop rotation, sanitation and inter-planting to control pests.

Genetic pest control uses plant breeding (genetic manipulation) to make plants resistant to specific pests.

Mechanical pest controls include mowing, plowing and mulching to discourage or destroy pests.

Biological pest control uses predators like lady beetles, praying mantis, and lacewings to control pests.

Chemical pest control includes using pesticides such as insecticides to control insects, herbicides to control weeds, fungicides to control fungi, and bactericides to control bacterial growth. In IMP chemicals are used as a last choice and the least toxic product is used first.





OBJECTIVES:

For youth to:

- list five requirements for plant growth.
- describe plant responses in growth limiting situation.

LIFE SKILL:

- Acquiring, analyzing, and using information through a scientific process.

MATERIALS:

- copies of A MATTER OF LIFE OR DEATH Activity sheets for each youth
- copies of WHAT DID YOU SEE? data sheet for you each youth
- 16 pots or containers with holes in the bottom
- grass seed (rye grass)
- builders sand
- potting soil
- rulers
- mixture of seeds
- seed trays or flats
- pens and pencils
- water
- scissors
- tape

TIME:

- 30 minutes

SETTING:

- A comfortable room with tables, chairs, and access to sunlight.

Activity 1: A Matter of Life or Death

INTRODUCTION

Grasses, like all plants, require certain things to grow - can you name them? (sunlight, water, air, proper temperature, and nutrients) How does a plant use each of these elements? (sunlight - energy and photosynthesis; water - photosynthesis, nutrient transport, cooling; air - carbon dioxide for photosynthesis and oxygen for respiration; and proper temperature and nutrients - to build and maintain plant tissues and to aid in photosynthesis) In this experiment we are going to explore how sunlight, water, and nutrients contribute to plant growth.

DO

- Separate youth into four groups: 2 SUN and 2 SHADE.
- Give each youth a copy of the A MATTER OF LIFE OR DEATH Activity sheet.
- Have each group fill two pots with sand and two pots with potting soil.
- Plant ten grass seeds in each pot (not too deep - add just enough soil to cover them).
- Water each pot with $\frac{1}{3}$ cup of water.
- Fill-in the correct label from the activity sheet and attach it to your pots.
- The SUN groups will place all of their pots in a sunny window and the SHADE groups will place their pots in full shade.
- Lightly water one sand and one potting soil pot in each location every other day for the duration of the experiment.
- Observe the pots for two weeks. Record the number of seeds germinated and the average height of the grass blades in each pot on the WHAT DID YOU SEE? Chart.
- Have the SUN and SHADE groups share their data.
- Have groups present their findings to the class using graphs or charts.

REFLECT

What happened to the plants that had nutrients (potting soil) and water but not enough light?

some seeds may have germinated and the seedlings may appear leggy and yellowed

What happened to the plants that had nutrients and light but not enough water?

no seeds should have germinated

What happened to the plants that had light and water but not enough nutrients?

fairly high germination rate but the seedlings may be smaller or yellowish

What do we do to our lawns or plants to make sure they get enough nutrients, light, and water?

fertilize or use nutrient rich soil, plant in a sunny location, and water

APPLY

- What do plants need in order to grow?

sunlight, water, air, proper temperature, nutrients

- Compare these with a list of things people need to grow.
- Sow several types of seeds in flats. Compare their percent germination, germination time, and rate of growth. Once developed, transplant the seedlings to larger containers.
- Visit a greenhouse operation and observe how the grower artificially supplies plants with the elements they need to survive. Ask the grower to describe how they provide their plants with sunlight, water, air, proper temperature, and nutrients.

A Matter of Life or Death

- Fill 2 pots with sand and 2 pots with potting soil.
- Plant 10 grass seeds in each pot.
- Water each pot.
- Complete the labels below and attach them to your pots.
- The SUN groups will place their pots in a sunny location.
- The SHADE groups will place their pots in the shade.
- Water 1 of the sand pots and 1 of the potting soil pots in each location every other day for the duration of the experiment.
- Do NOT water the other pots!



LABELS:

GROUP: SUN # SAND WATERED DATE:	GROUP: SUN # SAND NOT WATERED DATE:
GROUP: SUN # POTTING SOIL WATERED DATE:	GROUP: SUN # POTTING SOIL NOT WATERED DATE:

GROUP: SHADE # SAND WATERED DATE:	GROUP: SHADE # SAND NOT WATERED DATE:
GROUP: SHADE # POTTING SOIL WATERED DATE:	GROUP: SHADE # POTTING SOIL NOT WATERED DATE:

What Did You See?

GROUP	Number of seeds germinated	Average Height 1 Date: _____	Average Height 2 Date: _____	Average Height 3 Date: _____
<i>SUN</i>				
Sand Watered				
Sand Not Watered				
Potting Soil Watered				
Potting Soil Not Watered				
<i>SHADE</i>				
Sand Watered				
Sand Not Watered				
Potting Soil Watered				
Potting Soil Not Watered				

(over)

What Did You See?

(continued)



Determine the **percent germination rate** for:

sun vs shade pots _____

watered vs not watered pots _____

sand vs potting soil pots _____

Use this formula:

seeds sprouted

of seeds planted

X 100 = _____ % germination

Which treatment had the highest percent germination?

Which pots grew the most? Least?

Why did these similarities and differences take place?





OBJECTIVES:

For youth to:

- identify plants wanted in a garden.
- plan a garden.
- explain why planning a garden is important.

LIFE SKILL:

- Problem solving and decision making.
- Planning and organizing.

MATERIALS:

- copies of the SAMPLE GARDEN PLAN Activity sheet for each youth
- copies of GARDEN PLANNER Activity
- seed and nursery catalogs for youth to share
- list of recommended vegetable crops that can be grown in area from EDIS article: Florida Vegetable Gardening Guide (can be obtained from the County Extension Office or online at: <http://edis.ifas.ufl.edu/vh021>)
- pens and pencils

TIME:

- 30 minutes

SETTING:

- A comfortable room with tables and chairs.

Activity 2: Garden Planner

INTRODUCTION

In previous activities we talked about the five things plants need to grow, can you tell me what they are? (sunlight, water, air, nutrients, and proper temperature) If you give a plant these five elements you'll have a healthy plant, right? Unfortunately it's not that simple. If it were, we'd throw seeds, water, and fertilizer out the back door and we'd have fresh fruits and vegetables every day. In order to get the most out of our plants we also need to consider factors like the amount of space plants need, plant varieties that grow best in your area, watering and fertilizing schedules, and pest control measures. Today, you're going to plan a summer garden where you will concentrate your plants into an area where they will receive appropriate amounts of sunlight, water, air, nutrients, and proper temperature while keeping in mind factors like spacing, variety selection, and pest control. Let's get started!

DO

- Give each youth a SAMPLE GARDEN PLAN Activity sheet.
- Review the SAMPLE GARDEN PLAN with youth. Be sure to point out the spacing between plants, walking room between rows, the watering and fertilizer schedule, and pest control measures.
- Give each youth a GARDEN PLANNER activity.
- Have youth make a preliminary list of vegetables, fruits, herbs, and flowers they would like to grow in a spring/summer garden.
- Once youth have selected their garden plants have them look up the available varieties and growing requirements in printed or online seed and nursery catalogs

DO (continued)

- Have youth make a final list of plants based on the information gathered.
- After the appropriate plants have been selected, have youth draw a garden plan that meets the plant needs, including a maintenance schedule.

REFLECT

How did you supply your garden with the five things they need to grow?

answers will vary

How would someone in an apartment plant a vegetable garden?

plant in containers or window boxes, plant smaller varieties

How would your garden planner change if you were planting a winter garden?

the plants would be different

Summer is when pests can be a real problem in the garden. What kind of pest control measures would you use in your garden?

answers will vary

What might happen if you didn't plan a garden before planting it?

answers will vary

Why do you need to plan a garden?

a plan will help you organize your garden and place the plants where they will grow the best

a plan will help you develop a crop rotation schedule to reduce pest problems.

APPLY

- Have youth display their garden plans. After looking at all the plans, develop one plan for the entire group and plant a garden.
- Visit your local Extension office, nursery, or garden center where garden variety trials are taking place. Find out how they planned their garden.
- Obtain a list of recommended vegetable crops in your area from the local Extension office or search online publications using the University of Florida Extension EDIS (Electronic Digital Information Service) article: Florida Vegetable Gardening Guide: <http://edis.ifas.ufl.edu/vho21>. Make a table listing vegetable crops and the major diseases and insect pests that affect them.

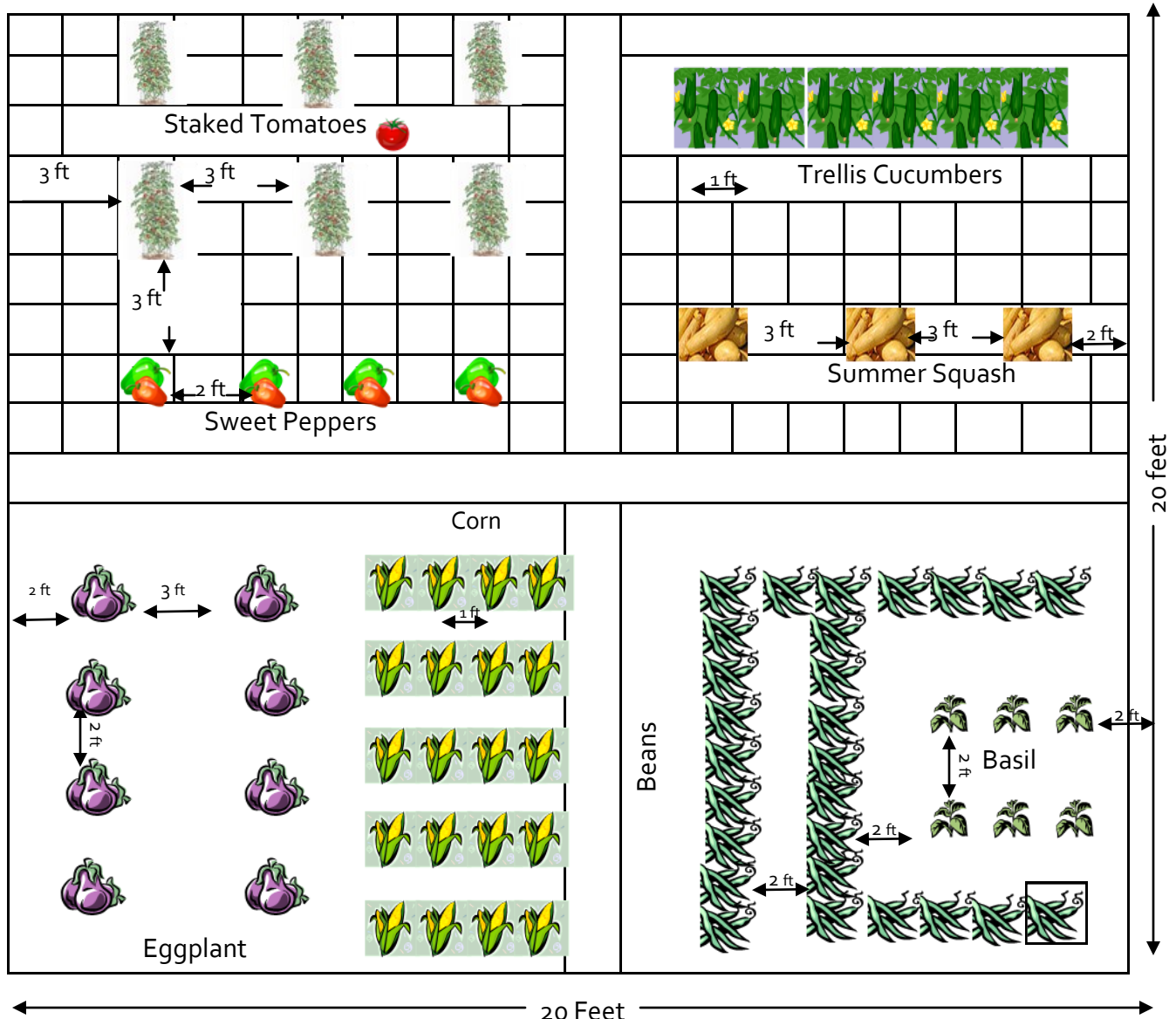
Sample Garden Plan

Preliminary Plant List

<i>Tomatoes</i>	<i>Eggplant</i>
<i>Peppers</i>	<i>Corn</i>
<i>Cucumbers</i>	<i>Beans</i>
<i>Squash</i>	<i>Basil</i>

Final Plant List

Note: Your choices will need to vary depending on your location and recommendations for growing season.



Maintenance schedule:

- ☒ Water in mornings when needed.
- ☒ Fertilize once every 2 or 3 weeks.
- ☒ Monitor for pests.

Garden Planner

Make a preliminary list of vegetables, fruits, herbs, and flowers you would like to grow in a garden. Look up available varieties and growing requirement in seed and nursery catalogs then make a final list of plants based on the information you gathered.

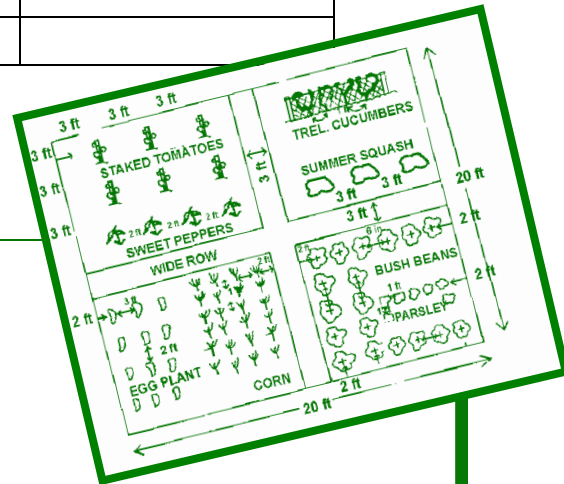
PRELIMINARY PLANT LIST

FINAL PLANT LIST

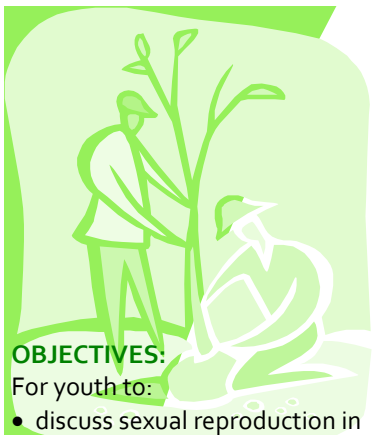
Garden Plan

Now, on separate piece of paper draw a garden plan for your list of plants above. You can use graph paper or a computer program to help design your plan. Be as creative as you would like.

Once you have your garden planned, complete your maintenance schedule below.



Maintenance Schedule:

**OBJECTIVES:**

For youth to:

- discuss sexual reproduction in plants.
- distinguish between perfect and imperfect flowers.
- identify male and female parts of a flower.

LIFE SKILL:

- Observation skills
- Recordkeeping skills

MATERIALS:

- copies of REPEATING THE PROCESS and SEED to SEED Activity sheets for each youth
- flowers for each youth (perfect and imperfect)
- hand lenses for youth to share
- window box or pots for each youth
- fast growing annual seeds (e.g. salvia, marigold, phlox)
- potting soil
- water soluble plant food
- cotton swabs
- copies of PARTS OF A FLOWER Activity (optional)
- craft supplies
- Farmer's Almanac
- paper and pens/pencils

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 of soil types).

Activity 3: Repeating the Process

INTRODUCTION

Plant propagation refers to both the sexual reproduction of new plants from seeds, and the asexual reproduction of plants from vegetative structures (leaves, stems, and roots). Today, we're going to learn about sexual reproduction in plants. In most plants, sexual reproduction starts when pollen or male sex cells are transferred to the stigma or female part of a flower. How does pollen travel from one flower to the next? (bees, other insects, wind, water) Let's take a closer look at the sexual reproductive cycle of plants and the role flowers play in the cycle.

DO

- Give each youth a flower and a hand lens (if the flowers are small).
- Give a copy of REPEATING THE PROCESS Activity sheet to each youth and review the information aloud.
- Have youth sketch and label the flower parts.
- Give each youth a copy of the SEED TO SEED Activity sheet.
- Have youth fill window boxes or pots with potting soil (within 1 inch of the top).
- Place a few seeds in each pot.
- Cover with soil then water.
- Place pots in a windowsill where they will receive lots of light.
- Water the pots every other day or when the soil is dry to the touch. After plants have emerged, water with a water soluble plant food once a week.
- If time allows, have youth pollinate flowers using cotton swabs.
- Collect the seed and start again.
- Have youth keep a record of the plants growth and development.

REFLECT

What is the difference between imperfect and perfect flowers?

perfect flowers have both male and female parts in the same flower

imperfect flowers have only male or female parts

What are some ways in which pollen is transferred from flower to flower?

insects, wind, people, water

What is meant by the term asexual reproduction?

reproduction of new plants from the stems, leaves, or roots

How can growers manipulate a plants' sexual reproduction?

hand pollinate, select the parents based on certain characteristics

Can you think of a reason why a grower would want to manipulate a plants sexual reproduction?

to produce plants with fragrant flowers, bigger fruit, or increased disease resistance

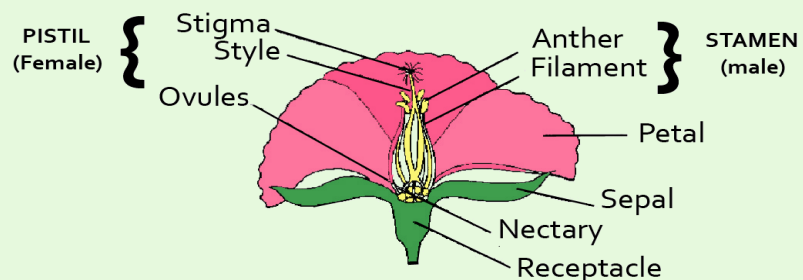
APPLY

- Create a skill-a-thon or use the PARTS OF A FLOWER Activity sheet to have youth demonstrate their knowledge of parts of the flower.
- Have youth collect seeds from their neighborhood or schoolyard. Compare the size, shape, and color of the seeds.
- Using craft supplies, have youth put together a model of a perfect flower.
- Look at a Farmer's Almanac or and Extension publication on annual flower gardening to learn about planting times in different areas.

Parts of a Flower-Answer Key

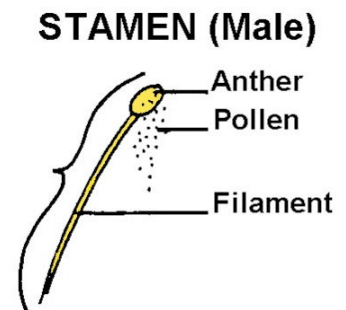
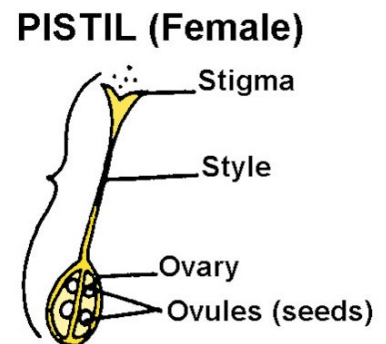
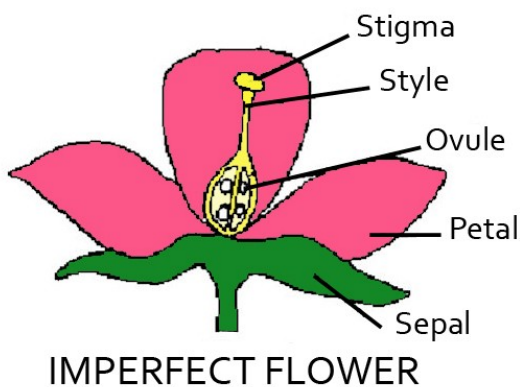
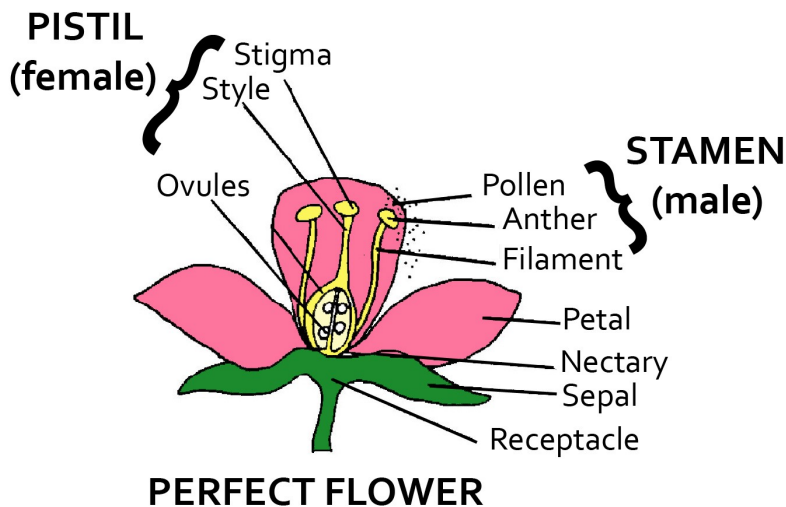
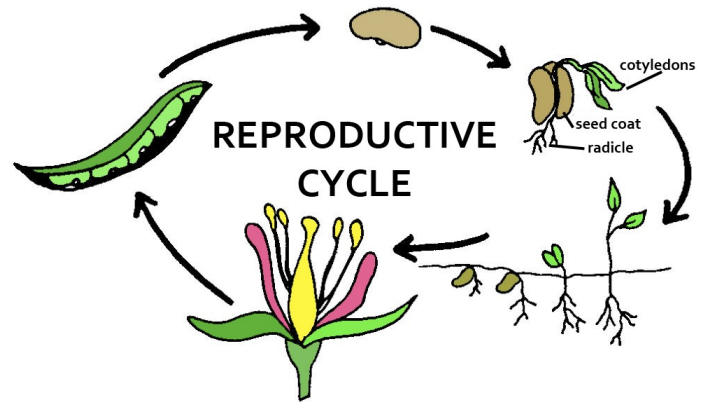
Label the parts of this flower using the following words:

stamen	pistil	filament	ovule	petal	nectary
sepal	receptacle	anther	stigma	style	



Repeating the Process

Seeds are dispersed by wind, animals, water, and a wide variety of self-propulsion mechanisms. When the environmental conditions are favorable, the seed will swell and sprout (germinate). The young plant will grow and develop flowers. Perfect flowers contain both male and female parts in the same flower, while imperfect flowers have male and female parts in different flowers. In either case, pollen must be transferred from the anther to the stigma for sexual reproduction to occur. The pollen grows from the stigma down the style and into the ovary. In the ovary, the male and female cells unite to produce seeds. Review the sexual reproductive cycle of a plant and learn the parts of a flower.

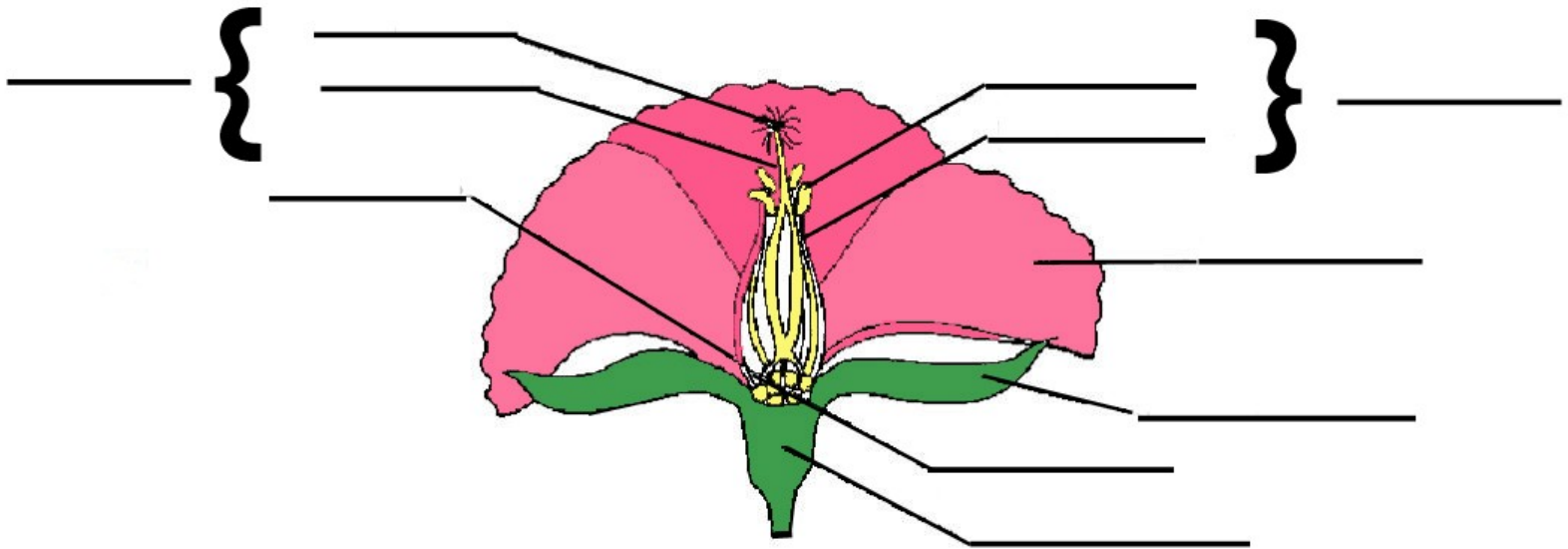


Parts of a Flower



Label parts of this flower using the following words:

stamen	pistil	nectary	anther
stigma	style	sepal	receptacle
filament	ovule	petal	



Seed to Seed

Planting Instructions:

- 1) Fill a window box or pot with potting soil (to within 1 inch from the top).
- 2) Place a few seeds in each pot.
- 3) Cover with soil and water.
- 4) Place pots in a windowsill where they will receive lots of light.
- 5) Water every week with a nutrient solution.
- 6) Keep a weekly record of your plant's growth and development.



Observations

DATE	What's Happening Here?
Week 1	
Week 2	
Week 3	
Week 4	
Week 5	

Seed to Seed (continued)

Compare your observations with the information on the back of the seed packets. Was the information accurate?

How many days did it take for your seeds to germinate?

When did flowers appear?

Did you hand pollinate your flowers?

How many days did it take for your plants to go from seed to seed?



Could you start over again with your new seeds?



OBJECTIVES:

For youth to:

- explain asexual reproduction.
- demonstrate asexual propagation methods.
- list reasons for reproducing plants without seeds.

LIFE SKILL:

- Observation skills.
- Record keeping skills.

MATERIALS:

- house plant (begonia, ivy, African violet, philodendron)
- scissors
- small pot filled with potting soil
- one precut leafy carrot top for each youth
- small shallow bowl or plastic dish for each youth
- water
- sphagnum moss
- plastic wrap
- aluminum foil
- potato pieces and seeds

TIME:

- 30 minutes

SETTING:

- A comfortable room with tables and chairs.

ADVANCE PREPARATION:

- Cut the top inch off of a carrot for each youth.

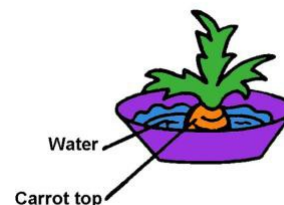
Activity 4: Cloning Around

INTRODUCTION

Asexual propagation is the production of new plants from the stems, leaves, or roots of a parent plant. The most common method of asexual propagation is the use of cuttings. A stem, leaf, or piece of root is cut from the plant, eventually it will grow a new plant. Asexual propagation allows growers to produce more plants faster, especially in cases where seeds are difficult to germinate or the seed is not viable (alive). One of the most important benefits is that the plants produced are genetically identical to the parent plant, therefore they have the same characteristics as the parent. This type of plant is called a **clone**. Today, we're going to produce clones.

DO

- Using a pair of scissors, take a leaf cutting (begonia, African violet) or stem with leaf cutting (begonia, philodendron) from a house plant and plant in a small pot filled with potting soil. Explain that after time, new roots, shoots, and leaves will emerge from the cutting.
- Have youth produce new plants from carrot tops.
 - ◇ Give each youth a precut carrot top.
 - ◇ Have youth place the carrot top in a shallow bowl with about 1/2 inch of water.
 - ◇ Keep a journal of the carrot's root and shoot development.



Please note: While carrots will allow for a quick view of sprouting roots and new tops, they will not produce an edible tap root. Pineapple tops do produce a great house plant as another alternative.

REFLECT

Farmers grow carrots from seeds and not from cuttings - why not grow carrots from cuttings?

seeds are cheaper; furthermore, the cutting will not grow a long orange carrot which can be sold, the carrot plant will have a shallow root system, the plant will send up new shoots, then flowers

Farmers usually grow potatoes from potato pieces - why not grow potatoes from seeds?

**clones will have the same characteristics as the parents
seeds may not be viable
cuttings grow faster**

What are some reasons for reproducing plants without seeds?

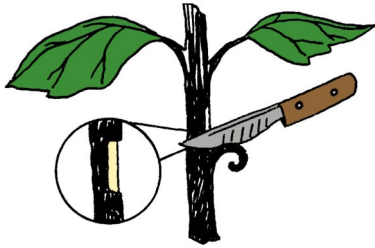
- 1) to produce plants with the same characteristics as the parent**
- 2) seeds may not be available or are slow and difficult to grow**
- 3) plants may not produce viable seeds**

APPLY

- Ask an horticultural extension agent, Master Gardener, or nursery to demonstrate other methods of asexual propagation (grafting, budding, and tissue culture) to youth.
- Have youth practice air layering on a nearby shrub (eg. azalea).
- Conduct a sexual versus asexual experiment where youth compare the growth and development of potatoes using potato seeds and potato pieces (if it is conducive to the growing conditions or season in your location).

How to Grow Plants

Air layering is a simple method of asexual propagation in which roots are formed on a stem (branch) while it is still attached to the parent plant.



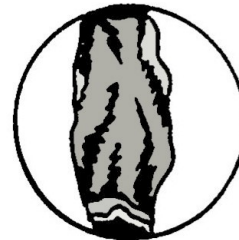
Remove a two inch portion of bark from around a branch.

Place moist, sphagnum moss over the exposed area.

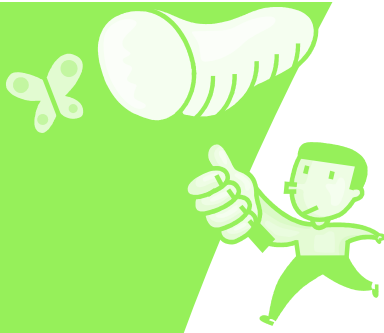


Cover with plastic wrap.

Then place a piece of aluminum foil over the plastic wrap and tighten the ends.



Be sure to label the stem with the your date and name. Periodically, check under the wrapped layers to make sure the moss is moist. By the end of the growing season new roots should have formed in the moss. Cut the new plant from the stem and plant it.



Activity 5: Meet My Friends

OBJECTIVES:

For youth to:

- identify common plant pests.
- distinguish between beneficial and harmful insects.
- describe the negative effects of pests on plants.

LIFE SKILL:

- Acquiring, analyzing, and using information.

MATERIALS:

- jar with lid for each youth
- hammer and nails for poking holes in lid
- copies of PLANT FRIENDS AND ENEMIES Activity sheet for each youth
- insect field guides and keys for youth to share
- hand lenses or dissecting microscope, if available
- weeds from a schoolyard or neighbor
- weed identification guides
- poster paper

TIME:

- 30 minutes

SETTING:

- An outdoor area and a comfortable room with tables and chairs.

INTRODUCTION

Can someone describe a plant pest? A pest is anything that causes injury or loss to a plant. Pests damage plants by making them less productive, affecting reproduction, or by destroying them. Pests can be put into five categories - insects, nematodes, weeds, diseases, and animals. Can you give me an example of an insect pest? (caterpillar, aphid, cut worm) Are all insects plant pests? Can you name some insects that are beneficial to plants? (lady bug, butterfly, bee) There are about 100,000 insect species in North America, so identifying the pests from the beneficials can be tricky. Today, we're going to collect insects and identify which insects are plant friends or enemies.

DO

- Using a hammer and nail have youth poke air holes in their jar lids.
- Give youth about 15 minutes to collect insects (avoid bees, wasps, and spiders). Insects tend to hide under the leaves or in dark places, early morning is a good time to collect them.
- After the insects have been collected, move youth indoors.
- Have youth complete the PLANT FRIENDS AND ENEMIES Activity sheet.
- Using field guides and insect keys help youth identify their insects.
- Youth may need to use a hand lens or dissecting microscope to identify the insects.

REFLECT

What type of insect (beneficial or pest) did you find more of?

answers will vary

Do you think we would find these same insect species if we looked six months from now?

some of the same species would be present but many more insects will be found in the summer than the winter (some insects have a dormant stage, migrate, or lay their eggs over winter and new generations appear in spring and summer)

What do beneficial insects do for plants?

pollinate, eat plant predators

What do lady bugs do in the garden?

they eat insect pests like aphids

What are the names of some of the pests you saw?

answers will vary

What are the effects of insect pests on plants?

destroy the plant, render it less productive, affect reproduction

Besides insects, what are some other plant pests?

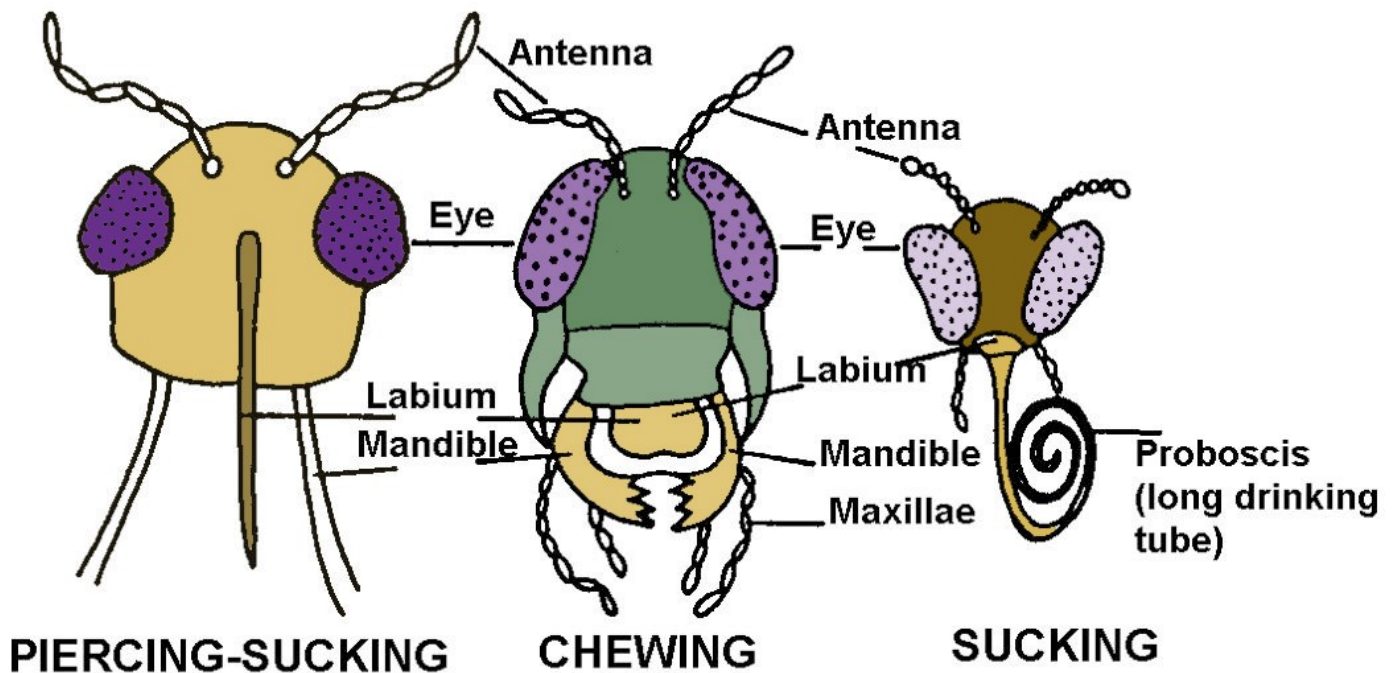
diseases, weeds, animal predators

APPLY

- Take your insects home and observe their behavior. Make sure your insects have food, water, warmth, and shelter. After a few days release in a field (pest) or in your garden (beneficial).
- Have youth bring in articles and report on insects that are in the news.
- Collect weeds from your neighborhood or schoolyard and try to identify them using a plant identification key.
- Select an insect and learn about its life cycle. Make a poster of the insects life and share it with the class.

Plant Friends and Enemies

Insects have three distinct body parts (head, thorax, and abdomen), three pairs of legs, and zero, one, or two pairs of wings. Of the 1 million different species of insects in the world approximately 100,000 species are found in the United States and less than 1,000 are pests to plants and people. Plant damage caused by insects is often related to the structure of the insects mouth. Mandibles are for chewing leaves and stems and elongated beaks are used for piercing and sucking plant sap. Chewing insects include grubs, beetles, and caterpillars. Piercing-Sucking insects include aphids, leafhoppers, and mosquitoes.

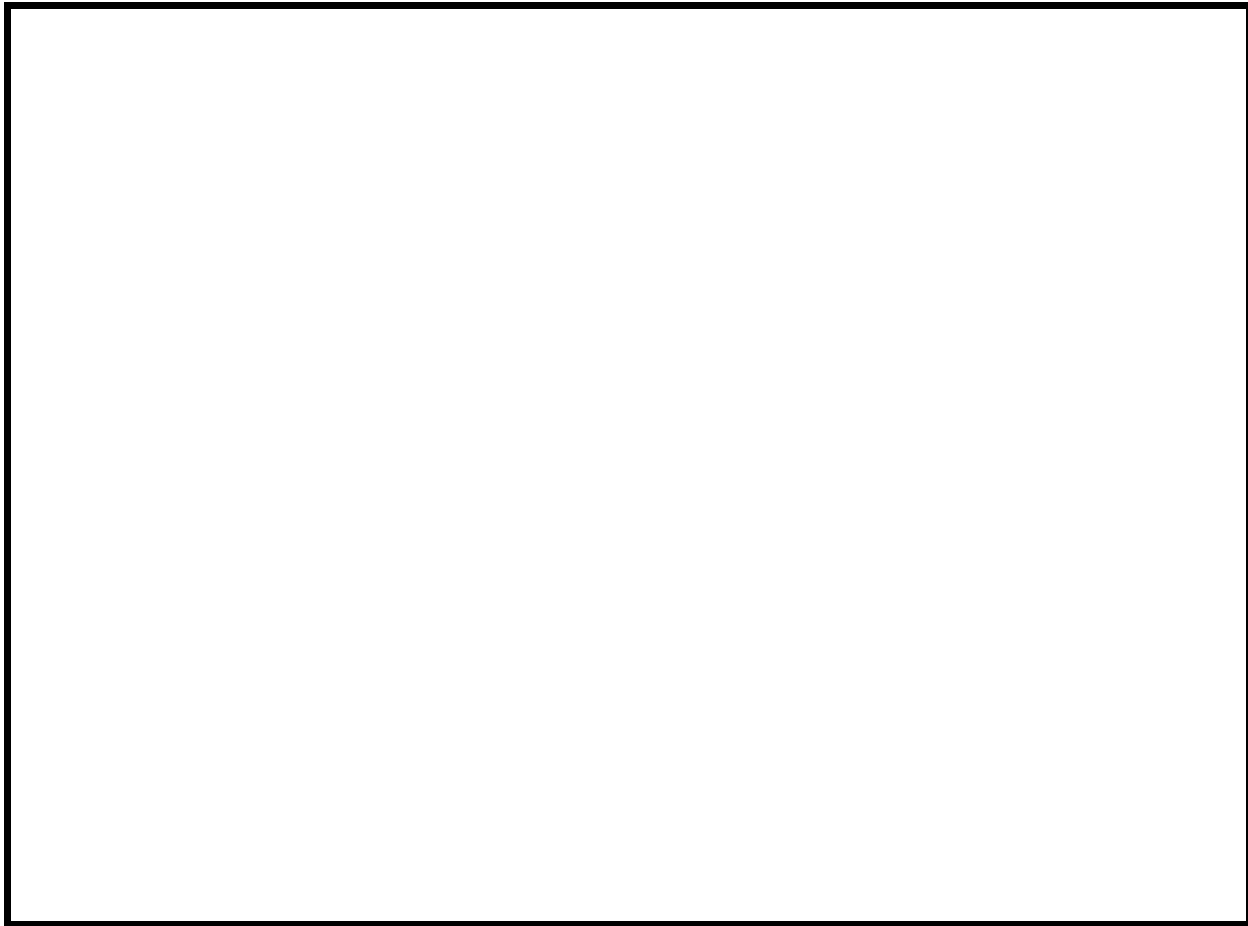


Mexican bean beetle damage.



Eggplant leaf damage caused by the melon thrips, *Thrips palmi* Karny.

Sketch and label your insect:



Where did you find your insect?

Does your insect have three distinct body parts?

Does your insect have 3 pairs of legs?

Does your insect have wings? How many pairs?

What type of mouth parts does your insect have?

Using a field guide or an insect key, try to identify your insect.





OBJECTIVES:

For youth to:

- identify five major categories of pests.
- explain integrated pest management.
- discuss alternative pest control techniques.

LIFE SKILL:

- Working with groups.
- Problem solving

MATERIALS:

- copies of BLAST THAT PEST! Activity sheet for each youth
- insect identification guides
- cardboard
- vaseline
- string
- 6 cloves garlic
- 1 medium onion
- 1 tbsp cayenne pepper
- 1 tsp liquid soap
- 1 gallon water
- fine mesh strainer
- 3 or 4 spray bottles
- weed identification guides
- pens or pencils

TIME:

- 30 minutes

SETTING:

A comfortable room with tables and chairs.

Activity 6: Blast That Pest!

INTRODUCTION

The presence of pests in our environment impacts the quality of plants we grow. The five major kinds of pests are: insects, nematodes, weeds, diseases, and rodents and other animals. Controlling pests can be expensive and may cause damage to the environment. **Integrated pest management (IPM)** is a pest management strategy which uses a combination of biological, cultural, mechanical, genetic, and chemical controls to keep pests at a manageable level with the least disruption to the environment. It is important to use an integrated program, but it is also important to use methods that are safest for the environment. Can you name a biological or genetic control method that we might use in a garden? (biological control - using a predator to control other pests, e.g. ladybugs eating aphids; genetic control - using pest resistant plants, e.g. planting watermelon that is resistant to virus) Today, we're going to identify pests in our area and learn ways to control their populations.

DO

- Give a copy of the BLAST THAT PEST! Activity sheet to each youth.
- Read and discuss the information sheet aloud with youth.
- Divide youth into four groups:
 1. home gardener with an insect problem
 2. golf course manager with a weed problem
 3. tomato grower with a rodent problem
 4. vegetable grower with a fungus disease.
- Have groups discuss a strategy to solve their pest situation using IPM controls.
- Have groups present their strategies and solutions to the class.

REFLECT

What are the five major categories of pests?

insects, weeds, nematodes, diseases, rodents and other animals

What is integrated pest management?

a pest management strategy which uses biological, cultural, genetic, mechanical, and chemical methods to control pests

How does a grower determine when to act on a pest problem?

when the amount of plant damage is no longer tolerable

What are some IPM controls that a gardener can use to reduce pests?

cultural - wash tools after working on the garden to prevent the spread of diseases to other areas

biological - grow plants that attract beneficial insects so they will prey on garden pests

mechanical - mulch to prevent weed growth

genetic - plant disease resistant varieties

chemical - spray an insecticide

APPLY

- Make an inventory of all pesticides at your school or home. List the pest controlled, active ingredient, and toxicity (or poison) level of each pesticide. Discuss what was found and alternative methods that could be used instead of or in combination with the chemicals.
- Make insect traps using yellow or blue cardboard, petroleum jelly (like Vaseline), and a string. Place them around a garden or landscaped area. Collect and identify the insects. Determine if they are pests.
- Make an organic pesticide to control chewing insects. Combine 6 cloves crushed garlic, 1 minced onion, 1 tablespoon cayenne pepper, 1 teaspoon dish washing soap, and 1 gallon of water. Mix ingredients and let sit for 15 minutes. Strain into a spray bottle and mist the plants. (NOTE: This is not guaranteed to work!)
- Collect weeds from your garden or school yard. Identify, label, and press the weeds. Be sure to include common name, date, scientific name, where it was found, and collectors name.



Blast That Pest!

Integrated pest management (IPM) is a pest management strategy that uses a combination of practices to reduce pest damage with the least disruption to the environment. Research has shown that no single control measure works consistently over a long period of time. One reason is that pests can develop a resistance to pesticides and a recurrence can occur. The goal of IPM is to keep pest populations below the point at which plant losses due to the pests are equal to the cost of control. Crucial steps in IPM involve pest identification, monitoring, and establishing a tolerable level of plant loss. The combination of methods used to control pest populations include cultural, genetic, mechanical, biological and chemical controls. The cultural, genetic, mechanical and biological controls should be in constant use. However, when the amount of plant damage is no longer tolerable, a chemical methods may be used to control the pests.

Cultural pest control uses management techniques to control pests. Examples: keeping tools clean, crop rotation, and proper watering and fertilizing.

Genetic pest control uses genetic manipulation to make plants resistant to specific pests. Examples: planting crops which are resistant to fungi and nematodes.

Mechanical pest control methods involve tools or equipment for control. Pests are destroyed or removed. Examples: mowing, plowing, pruning, mulching, and crushing the pests.

Biological pest control uses living organisms that are predators to control pests, e.g. lacewings and ladybugs.

Chemical control of:

- insects = insecticides
- weeds = herbicides
- nematodes = nematicides
- fungi = fungicides
- bacteria = bactericides



Which method or combination of methods will you use to solve the following pest problems?

- Groups:
- (1) home gardener with an insect problem
 - (2) golf course manager with a weed problem
 - (3) tomato grower with a rodent problem
 - (4) vegetable grower with a fungus disease

5

Plant Connections

PURPOSE:

- To become familiar with wise consumer practices for selecting, handling, and storing plants and their products.

OBJECTIVES:

For youth to:

- give examples of a plant's physical and chemical defense mechanisms.
- discuss ways to minimize the risk of food related illnesses.
- identify qualities that are desirable in plant products.
- identify introduced and native landscape plants.
- discuss the importance of food preservation.
- learn about the commercial production of vegetables.

LESSON TIME:

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

ADVANCE PREPARATION:

- Read the BACKGROUND BASICS on How To Select & Handle Plants.
- Review activities and choose appropriate one(s) to use.
- Collect and prepare materials for appropriate activities.

How To Select & Handle Plants

LEARNING ACTIVITIES

1. WATCH OUT!
2. EVERYWHERE!
3. FIRST CLASS PLANTS
4. GREEN SENSE
5. ON THE SHELF
6. NATURE'S HARVEST

DO

The following are suggestions for using the activities in Lesson 5. The materials needed for each are listed within the activity.

- List several precautions when handling plants in WATCH OUT!
- Identify sources of bacterial contamination in EVERYWHERE!
- Judge a produce exhibit in FIRST CLASS PLANTS.
- Discuss water conserving landscape concepts in GREEN SENSE.
- Identify way of preserving food in ON THE SHELF.
- Compare fresh market to commercial produce in NATURE'S HARVEST.

REFLECT

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

What are some examples of a plant's physical defenses?

thorns, spines, barbs

Why is it important to wash fruits and vegetables before eating them?

pesticide residues, harmful bacteria, yeast, and mold may be present

Who set the quality standards for the plants we buy?

government agencies, USDA, FDA

What are some environmental considerations for selecting plants?

amount of rainfall, temperature, soil pH

Why is it important to preserve food?

reduce spoilage, to consume it at a later time

Why is it important to manage the harvest and handling of a crop?

to ensure the freshest product gets to the consumer

APPLY

Help youth learn to apply what they have learned.

- Have youth identify poisonous plants around their homes.
- Have youth research and prepare a report on bacteria that cause food related illnesses.
- Visit a local farmers market, find out what farmers/growers do with blemished produce.
- Visit the IFAS gardening website at: http://solutionsforyourlife.ufl.edu/lawn_and_garden/getting_started/ or listen to Gardening in a Minute broadcasts, available at: <http://gardeningsolutions.ifas.ufl.edu/giam>.
- Check out this cool virtual tour of the Michigan 4-H Children's Garden. <http://4hgarden.msu.edu/kidstour/tour.html>
- Experiment with other food preservation methods like drying and freezing.
- Research the harvest, handling, and marketing of other crops (oranges, cucumbers, onions). Compare similarities and differences in production.

BACKGROUND BASICS ... How To Select & Handle Plants

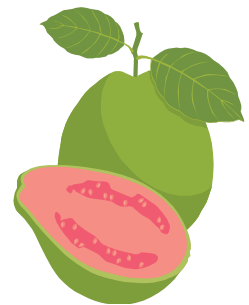
Over 400,000 species of plants exist today. An unknown number of species, perhaps several hundred thousand, existed at one time but are now extinct. Virtually all this diversity came about through evolution by natural selection - survival of the fittest. Because organisms are exposed to various adverse conditions, those individuals best-fit (adapted) to a particular environment are more likely to survive. For any particular aspect of the environment many adaptations are possible. Plants have developed physical and chemical defense mechanisms to cope with adverse environmental conditions. Consider plants growing in freezing winters; frozen soil is physiologically dry because roots cannot extract water from it. They survive because mutations have occurred that cause their leaves to drop in the fall. They also have bark on the stems that reduces the amount of water lost through their stems. Desert plants conserve water in different ways: they are smaller with fewer leaves and have thick waxy cuticles. Another adaption is seen in the aster family (sunflowers, daisies) which produce a group of chemical compounds that discourage herbivores. Other plant adaptations include leaf modifications like thorns, spines, and barbs.

Plant defense mechanisms can have adverse effects on people. It is never a good idea to pick or disturb plants you are unfamiliar with! The following is a list of plant tips to consider when you are dealing with plants:

1. Know the poisonous plants in your house or garden
2. Do not put any plant or plant part in your mouth unless you know for sure it is not poisonous.
3. Don't eat unfamiliar berries; they may be OK for birds but not for us.
4. Don't eat any wild mushrooms.
5. Do not touch plants that have milky secretions.
6. Don't burn unfamiliar sticks; especially for marshmallows or hotdogs.
7. Don't leave dangerous plants near young children or pets.
8. Call the Poison Control Center if you suspect someone has eaten a poisonous plant.
9. Call 911, the police, or an ambulance for emergencies.
10. Stay calm! Most poisonous plants cause a mild reaction and have a cure.

Selecting Adapted Plants

Recognizing and selecting plants based on their adaption to certain environmental conditions is an important component of natural or ecological landscaping. **Natural** or **ecological landscaping** involves plant selection based on the climate and environment of the area. Factors in plant selection include water requirements, growth rate, color, hardiness, nutrient, and pH needs. **Xeriscaping** is a type of ecological landscape design that is water efficient. Xeriscaping requires careful planning and installation. A soil analysis is needed to determine nutrient needs. An efficient irrigation system should be used and properly maintained. The amount of turf grass and annual flowering plants are limited. Drought tolerant perennial flowers and ornamental grasses should be selected. Mulch should be used to cool the surface, prevent erosion, and conserve moisture.



Handling and Preserving Produce

The purpose of food preservation and packaging is to increase the life of foods so that after harvesting and preparation, foods can be stored and shipped to consumers. Microorganisms grow in fresh food because it contains all the nutrients, including water for their growth. Bacteria and mold, including those that can cause food-borne illnesses, are found naturally all around us. Safe handling, cooking, and serving practices are necessary to prevent bacteria from multiplying and causing food related illnesses. Food-borne illnesses have been traced to many types of foods including fruit, vegetables, eggs, meat, and poultry. According to the Center for Disease Control and Prevention, the majority of food borne illnesses can be prevented by improved food handling practices. Although the threat of food borne illness is relatively small, the use of safe food handling techniques will ensure that the threat of food related illness is greatly reduced.

Safe food handling practices:

1. Wash hands with warm soapy water prior to handling food.
2. Keep everything that touches food clean - hands, utensils, bowls, and countertops.
3. Thoroughly wash all produce with clean, drinkable water; use a brush if necessary.
4. When using a cutting board, it is best to use separate boards for each type of food.
5. Direct sneezes and coughs away from food.
6. Store meat, poultry, eggs, milk, cheese, and other perishables in the refrigerator.
7. In the supermarket, pick up cold foods last.
8. Refrigerate leftovers immediately.
9. Keep hot food hot until you serve it.
10. If you are sick, try not handle /prepare foods for others.

Not all microorganisms are bad, in fact, some are important in making and preserving food products. Bacteria, molds, and yeast are used to turn one food into another (milk + bacteria = yogurt, cabbage + bacteria = sauerkraut, Kimchee) and to create medicines (nutrient agar + mold = penicillin). Sauerkraut or kimchee is an example of a preserved or pickled vegetable food that is changed as a result of microorganisms present on the raw cabbage. Shredded cabbage is mixed with salt and placed in a container in which almost anaerobic conditions can be achieved. The salt is used to extract liquid from the vegetable tissue so that it becomes available for the fermenting bacteria and control growth of undesirable ones. The first bacteria to grow are lactic acid bacteria, such as *Leuconostoc*, which produce carbon dioxide. As the carbon dioxide accumulates and the mixture becomes more acidic (due to the lactic acid) growth of undesirable bacteria is inhibited. Later in the fermentation process more acid-tolerant bacteria (*Lactobacilli*) grow and contribute to the end products of fermentation or pickling.

Selecting Fruits and Vegetables

Judging fruits and vegetables is simply a matter of making choices. Consumers buy produce at the market by selecting those most appealing on the basis of external quality and past experiences. However consumers are not alone in the assertion of produce quality. Government agencies set quality standards for the fruits and vegetables we buy. In order for produce to be considered under quality grade standards it must meet **size**, **color**, and **shape** criteria as well as be **free from defects**. These four major government agencies regulate food safety:

EPA - Environmental Protection Agency

- determine the type and amount of pesticides that can be used by farmers
- sets water quality standards

FDA - Food and Drug Administration

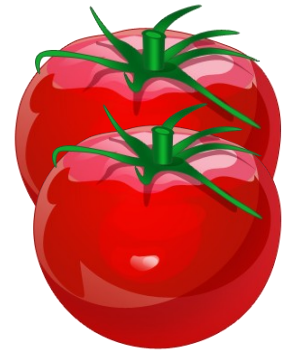
- inspects food processing plants
- enforces labeling, additive, sanitation, and pesticide regulations
- develops standards for the use of food additives

USDA - United States Department of Agriculture

- inspects meat, poultry, and egg products and the plants that process them

State Board of Health

- inspects food processing plants, grocery stores or warehouses, and restaurants
- enforces labeling, additive, sanitation, and pesticide regulations
- sets additional food safety standards



Commercial Production of Fruits and Vegetables

The tomato is not only the most important commercial vegetable in Florida, it is also the most popular garden vegetable. Tomatoes are commercially grown on more than 45,000 acres in Florida. Because of their perishable nature, growers closely manage the harvest, marketing, and handling of crops.

Cultivar selection is one of the most important management decisions made by the grower. A cultivar is a plant variety that retains its features when reproduced. The following characteristics are included in the selection of a tomato cultivar: yield, disease resistance, shipping quality, taste and adaptability.

Cultural practices include physical and mechanical preparations to the area throughout the growth of the crop. Examples of cultural practices include soil preparation, mulching, providing windbreaks, crop establishment, irrigation, fertilization, staking and frost protection.

Tomatoes are subject to damage by a variety of pests: insects, nematodes, fungal and bacterial pathogens, and weeds. Pest control should consist of an integrated pest management (IPM) system which relies on efficient use of all control techniques available.

The Florida tomato industry is based primarily on harvesting tomatoes at the mature green stage. Growers use a combination of external characteristics like size, shape, and color to determine when a crop is ready to harvest. Most tomato packing houses are large, sophisticated, high volume operations. Generally, tomatoes are washed, pre-sized, waxed, sorted, graded, sized, packed into containers, stored, and shipped. Most packaged green tomatoes are stored in ripening rooms which initiates ripening with ethylene treatments. Ethylene gas is used to promote faster, and more uniform ripening before shipping.



OBJECTIVES:

For youth to:

- give examples of plant's physical and chemical defense mechanisms.
- identify dangerous plants.
- list several precautions when handling plants.

LIFE SKILL:

- Listening and following instructions.

MATERIALS:

- copies of TEN PLANT TIPS Information sheet for each youth
- several poisonous plant guides of Florida (with pictures) for youth to share
- Poison Control Center phone number

TIME:

- 30 minutes

SETTING:

- Indoors and outdoors.

ADVANCE PREPARATION:

- Collect a variety of poisonous plants for youth to view.
- Find a trail or path in your area where you can point out some dangerous plants to youth.

Activity 1: Watch Out!

INTRODUCTION

Plants have developed physical and chemical defense mechanisms to protect themselves from predators. Humans are sensitive to some of these defense mechanisms. For example, has anyone ever gotten poison ivy? Is it possible to get poison ivy without touching the plant? (yes, indirect contact can result from touching animals or clothes that have been in contact with the plant) Can you think of some physical defense mechanisms plants use for protection? (thorns, spines) Today, we are going to identify some dangerous plants. Knowing their names, what they look like, and where they grow will help us to protect ourselves from possible harmful effects of coming in contact with them.

DO

- Give each youth a copy of the TEN PLANT TIPS Information sheet. Go over the information sheet aloud with youth.
- Show youth pictures of poisonous plants in your area.
- Have youth review the display plants and compare them to the pictures shown.
- Caution the youth not to touch any of the display plants. If youth do touch the plants, make sure they wash their hands thoroughly.
- Take a short walk and try to identify poisonous or harmful plants in your area.

REFLECT

What are some examples of a plant's physical defenses?

thorns, spines, barbs

Can you name plants that have these defense measures?

roses have thorns, cacti have spines

What plants have chemical defense measures?

poison ivy, Rhododendron, foxgloves

Why would a plant need defense mechanisms?

to protect itself from grazing or browsing

What's your best defense against poisonous plants?

stay away from them

What are some general precautions one should take when handling plants?

refer to the TEN PLANT TIPS

APPLY

- What plants might be poisonous in your house?

philodendron, English ivy for other examples refer to a poisonous plant book or search online for plants relative to your area

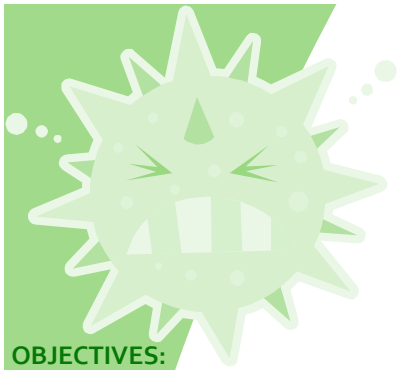
- Where is a good place to hang the TEN PLANT TIPS in your house?
- Make a list of important telephone numbers (e.g. poison control, fire and rescue, police) and place it by the phone or add to your cell phone contact list.
- Ask a Master Gardener to show youth other common poisonous plants in the area.

Ten Plant Tips

1. Know the poisonous plants in your house/garden.
2. Don't put any plant or plant part in your mouth unless you know for sure it is not poisonous.
3. Don't eat unfamiliar berries; they may be O.K. for birds but not us.
4. Don't eat any wild mushrooms; eat only the ones from the supermarket.
5. Don't touch plants that have milky secretions.
6. Don't burn unfamiliar sticks; especially not for marshmallows or hot dogs.
7. Don't leave dangerous plants near young children or pets.
8. Call the Poison Control Center if you suspect someone has eaten a poisonous plant.
9. Call 911, the police or an ambulance for emergencies.
10. Stay Calm! Most poisonous plants cause a mild reaction and have a cure.

Poison Control Center hotline: _____





Activity 2: Everywhere!

OBJECTIVES:

For youth to:

- learn that microorganisms are everywhere.
- understand that microorganisms are both harmful and helpful.
- identify sources of bacterial contamination.
- discuss ways to minimize the risk of food related illnesses.

LIFE SKILL:

- Acquiring, analyzing, and using information.

MATERIALS:

- copies of the BACTERIAL PLATING EXPERIMENT Activity sheets for each youth
- 1 Petri plate with sterile nutrient agar for each youth
- contamination sources (quarter, fruits, vegetables)
- transparent tape
- permanent marking pen
- colored pencils and markers
- resource materials on bacteria that cause food related illnesses

TIME:

- 20 minutes
- 30 minutes 2 to 4 days after the plates have been inoculated

SETTING:

- A comfortable room with tables and chairs.

ADVANCE PREPARATION:

- Complete experiment 2-3 days before conducting activity with youth so they can see what might happen when they finish the activity.

INTRODUCTION

Have you ever washed an apple before you ate it? Why? (fruits and vegetables may have microorganisms on them that can make you sick) Microorganisms like bacteria and mold, including those that make you sick, are found naturally all around us. Safe handling, cooking, and serving practices are necessary to prevent bacteria from multiplying and causing food related illnesses. It is important that you, as consumers, understand that a simple practice like washing your hands, fruits, and vegetables can help minimize food related illness. Today, we are going to learn that microorganisms are everywhere.

DO

- Give each youth a copy of the BACTERIAL PLATING EXPERIMENT Activity sheets.
- Have each youth select a contamination source from the list provided.
- Give each youth a Petri plate and caution them to keep the lid on until they are ready to contaminate it.
- Once the plates have been contaminated have youth wrap transparent tape around the edge of the plate to seal it.
- Using a permanent marker, have youth label the bottom of the plate with their name and type of contaminant.
- Have youth wash their hands after handling the plates.
- Incubate the plates upside down at room temperature for two to four days. Keep the plates out of direct sunlight.
- After bacteria and mold has formed, have youth examine the plates.
- Have youth draw their plates on the BACTERIAL PLATING EXPERIMENT Activity sheet and discuss the results.

REFLECT

What percent of the plate was covered by microorganisms?

answers will vary

Which contamination source had the highest percent of microorganisms?

answers will vary

Why do we wash fruits and vegetables before eating them?

bacteria, mold, yeast may be present

Which fruits and vegetables do you have to worry about the most?

those fruits and vegetables where you eat the skin

The word microorganism simply means a living being too small to be seen without a microscope. Can you think of other microorganisms besides bacteria and molds?

viruses, protozoa, yeasts

Are all bacteria and mold harmful? Can think of an example of a bacteria or mold that benefits us?

molds are used to produce cheeses, penicillin

bacterium is used in yogurt

other microorganisms eat oil spills and sewage

APPLY

- Have youth research and prepare a report on bacteria that cause food related illnesses. (Examples: *Salmonella*, *Clostridium*, *Staphylococcus*). The report should include the life cycle of the bacteria and ways to minimize the risk of food related illnesses.
- Have youth collect pictures of products that are made with the help of microorganisms. (bread, beer, wine, green olives, cheese, yogurt, soy sauce, salami, pickles, and pepperoni) Have youth look up the starting ingredient of each product and the microorganism needed to turn the ingredient into the product. Have youth share their findings.
- Conduct an internet search of USDA or university sources for safe food handling, cooking, and serving information.

Bacterial Plating Experiment

Materials:

Petri plates with sterile nutrient agar (a general food source for microorganisms)

transparent tape

contamination sources (quarter, fruit)

permanent marking pen

Procedure:

1. Obtain one Petri plate with sterile nutrient agar. Keep the lid on until you are ready to contaminate the plate.
2. Select a contamination source and wipe on the agar surface (try not to tear the agar).

Contamination Sources:

hands - gently touch your fingers or lightly trace an S pattern on the agar

hair - place a piece of your hair on the agar

cough - hold the plate 2-3 inches from your mouth and cough into the agar

fruit - rub the skin of an apple, pear, plum, etc. on the agar

quarter - rub a quarter over the surface of the agar



3. Seal the plate by wrapping scotch tape around the edge.
4. Label the bottom of the plate with a permanent marker. Be sure to include your name, date, and contamination source.
5. WASH YOUR HANDS.
6. Incubate the plates upside down at room temperature (78-85°F) for 2 to 4 days. Keep the plates away from direct sunlight. You incubate the plates upside down so that water droplets don't fall into the agar.

Bacterial Plating Experiment (continued)

7. Two to four days after the plates have been inoculated examine your plate (keep the lids on your plates) and draw what you see.

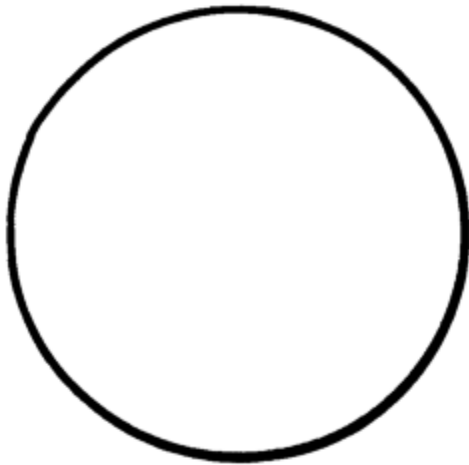
Be sure to note the:

- # of colonies
- color of microorganisms
- presence of fuzziness
- shape of the colonies
- percent of plate that is covered by microorganisms

Hints:

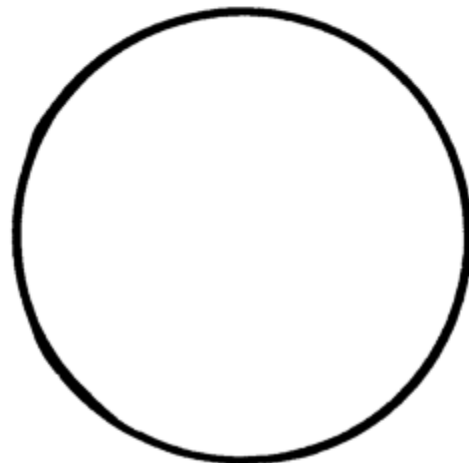
- Fuzzy things are molds.
- Blobs that aren't fuzzy may be bacteria or yeast.
- Each blob is a colony. Each colony is made up of millions of individual cells.

Note: It is not important to identify the organisms on the plates. The point is to understand that microorganisms are everywhere.



Plate

Date



Plate

Date

8. Return the plate (upside down) to its incubation area. After two more days, reexamine the plate and draw what you see.

**OBJECTIVES:**

For youth to:

- identify the qualities that are desirable in produce.
- judge a produce exhibit using preset indicators of quality.
- learn how to exhibit and select produce.

LIFE SKILL:

- Decision making.

MATERIALS:

- copies of EXHIBITING VEGETABLES activity sheet for each group
- five potatoes of varying quality
- paper and marker to label each potato
- pencils

TIME:

- 30 minutes

SETTING:

- A comfortable room with tables and chairs

ADVANCE PREPARATION:

- Purchase 5 potatoes –label 1 to 5 and display for youth to “judge”.

Activity 3: First Class Plants!

INTRODUCTION

I want you to imagine that you are in the produce section of the grocery store and you're hungry for an apple. You walk into the produce section, right in front of you is a display of apples loose in a bin, to the left of you is a display of apples in 5 pound bags, and further down on the left are apples in packages of four. Besides the number of apples per package, are there any other differences in the apples? (yes, loose apples are generally of higher quality, larger, and unblemished) Government agencies like the United States Department of Agriculture (USDA) set quality standards for the fruits and vegetables that we buy. For instance, in order for a potato to be considered U.S. No.1 each tuber must have the shape and color characteristics of the variety being graded, it must be at least 1-7/8 inches in diameter, and free from defects. When a fruit or vegetable crop meets U.S. No. 1 grade quality standards it can be sold at a higher price. Today, we're going to use some of the USDA's standards to grade a potato exhibit.



DO

How plants grow in different soil types:

- Pass out EXHIBITING VEGETABLES Activity sheet.
- Review the grading standards and classifications with youth.
- Exhibit 5 potatoes of varying quality on a table.
- Have youth judge each potato using the grading standards on the activity sheet.
- Have youth total their grading sheets and assign a classification (excellent, good, worthy, unworthy) to each exhibit.

REFLECT

If you were creating quality standards for apples, what characteristics would you choose to indicate quality?

size, appearance, shape, color, aroma, taste, ripeness

Who sets quality standards for the plants we buy?

government agencies, USDA, FDA

Would you buy produce with blemishes if you could pay less for it?

answers will vary

What do you think happens to produce that is too blemished to be sold?

feed to animals, donated to food banks, plowed under, burned

What are some economic considerations of standardizing the quality of produce?

higher quality plants cost more

APPLY

- Visit a local USDA laboratory or agricultural inspection station to learn more about grades and standards for produce.
- Visit a local farmers market, ask the farmers/growers what they do with their blemished produce.
- Look up grades and standards for other vegetable crops.
- Check out this site for the National Junior Horticulture Judging Competitions at: http://www.njha.org/projects_hortid_judging.html

Exhibiting Vegetables

Grading standards are indicators of quality. Grade each of the five exhibits and record a score for each in the table below.

EXHIBITS

Indicator of Quality	Possible Score	1	2	3	4	5
Appearance of the exhibit	20					
Labeling	10					
Uniformity (shape, color, size)	30					
Firmness	20					
Freedom from Blemishes	20					

Vegetables falls into four classifications:

1. **excellent** - clean, free from injury, uniform in size, shape, color, and best quality
2. **good** - clean, free from injury, fairly uniform and good quality
3. **worthy** - fairly clean, free from serious damage, fairly uniform, and fair quality
4. **unworthy** - dirty, seriously damaged, not uniform, and poor quality

Classification	Total Score
Excellent	90-100
Good	75-89
Worthy	60-74
Unworthy	0-59



Which exhibit had the highest classification ranking? The lowest?

How many of your classmates agreed with you? Disagreed with you?

Would you consider buying an unworthy vegetable from a grocery store? Why? Why not?

**OBJECTIVES:**

For youth to:

- discuss environmental considerations for selecting plants.
- identify introduced and native landscape plants.
- discuss water conserving landscape concepts.

LIFE SKILL:

- Managing resources.

MATERIALS:

- research information for youth to share (eg. soil surveys, plant identification keys, county statistics, and local extension bulletins)
- paper bag for each youth
- scissors
- paper
- pens and pencils

TIME:

- 45 minutes

SETTING:

- A comfortable room with tables and chairs

Activity 4: Green Sense

INTRODUCTION

Have you ever driven by a lawn, an office, or a school yard on a rainy day and noticed that the sprinklers were on? Every day in the United States we use approximately 137 billion gallons of water for irrigation. Florida's increasing population and periodic drought conditions are placing demands on our water supply. In response to limited water resources a number of landscaping ideas have evolved to reduce water and maintenance requirements in the landscape. The concept of **natural** or “**Florida-friendly**” **landscaping** involves plant selection based on the climate and environment of the area. Today, we're going to identify plants in our landscape and determine if they were ecologically landscaped.

DO

- Using soil surveys, county statistics, and extension bulletins have youth research environmental characteristics in their county. Characteristics should include: amount of rainfall, temperature ranges, soil type, and native plant species.
- Give each youth a brown paper bag then move outdoors.
- With permission, tour a nearby landscape and have youth collect 1 or 2 plant samples (stems and leaves) and place them in the bags. Be careful not to damage the plant when collecting samples.
- Bring plant samples back to the classroom and have youth identify them using plant keys or other resource materials. Try to determine if the plants are introduced or native species.
- Have youth determine if the maintenance needs of the plants collected are met through the natural environmental characteristics of their county.
- Press plant samples that you are unable to identify and send or take them to your local horticultural extension agent at the County Extension Office for identification.

REFLECT

What are some environmental considerations for selecting plants?

rainfall, temperature, and soil characteristics of the area

Can you think of ways to conserve water in your landscape?

plant drought tolerant plants, don't water when its raining

Did you identify any introduced plants (not native) that were ecologically landscaped for the area?

answers will vary

What would happen if you introduced a water loving plant into the landscape then forgot to water it?

it would eventually die

Did you identify any Florida-friendly plants that you have in your yards at home?

answers will vary

APPLY

- Meet with the landscape maintenance person in your school, church, or meeting facility and find out why particular plants were used in the landscape. Ask if you can help install an automatic rain shut off device (required by state law) on the sprinkler system to conserve water.
- Take a landscape tour of the local extension office or nursery. Ask a horticultural extension volunteer to point out the water conservation concepts used in the landscape.
- Have youth research and report on other water-conserving landscape techniques like using mulches, grouping plants with similar water needs, and creating windbreaks.

**OBJECTIVES:**

For youth to:

- identify various ways of preserving food.
- discuss the importance of food preservation.
- demonstrate the food preservation method of pickling.

LIFE SKILL:

- Working with groups.

MATERIALS:

- copies of the KIMCHEE RECIPE Activity for each student
- 1 to 1-1/2 heads of Chinese cabbage (bok choy, napa) for each group
- chili powder
- crushed garlic
- non-iodized or pickling salt
- 2-liter soda bottle for each group
- 4 wooden spoons
- muslin or cheese cloth
- pH indicator paper (litmus paper)
- 4 heavy bowls or jars to keep cabbage submerged
- strainer
- measuring spoons
- 4 large bowls or stock pots
- scissors
- knife

TIME:

- 30 minutes

SETTING:

- A comfortable room with tables and chairs.

ADVANCE PREPARATION:

- Make kimchee six and three weeks in advance to use in pH comparison.
- Cut the top off the 2-liter bottles.

Activity 5: On The Shelf

INTRODUCTION

Without the techniques of canning, drying, and pickling, humans would have a difficult time preserving food. Pickling is one of the most ancient forms of food preservation. It involves the conversion of sugar into lactic acid through the growth and activity of acid producing bacteria know as *Lactobacilli*. As the bacteria grow they create a high acid environment where spoiling organisms cannot grow. Can you think of any foods that are preserved by pickling (e.g. sauerkraut, yogurt, pickles, kimchee) Today, we're going to make kimchee, an ancient Korean recipe for pickling Chinese cabbage.

DO

- Give each youth a copy of the KIMCHEE RECIPE activity
- Divide youth into three or four groups.
- Review the kimchee recipe and instructions with youth.
- Have youth follow the kimchee recipe.
- Once the kimchee is finished have youth compare the pH and appearance of their kimchee to the kimchee made six and three weeks in advance.
- Avoid any risk from bacterial contamination, do not allow youth to taste the kimchee.

REFLECT

Why is it important to preserve food?

so it won't spoil, to consume it at later time

Name different ways of preserving food.

freezing, drying, canning, pickling

The cabbage has to sit out for 5 to 6 weeks, what will stop it from rotting?

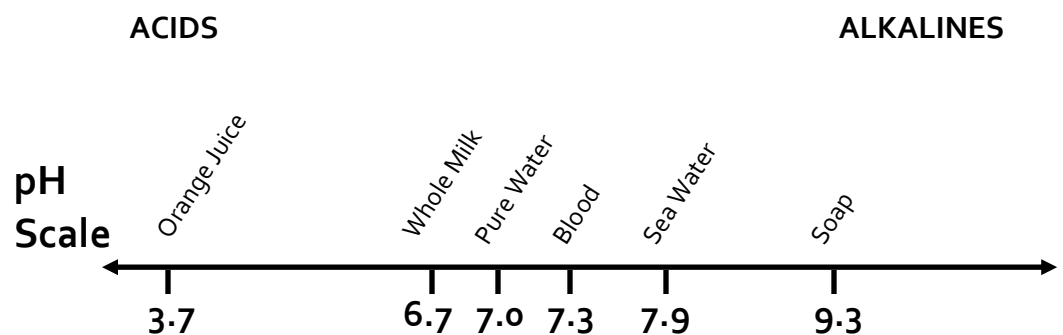
acid producing bacteria, *Lactobacilli*

Did you eat anything today that was preserved? What was it and how was it preserved?

answers will vary

APPLY

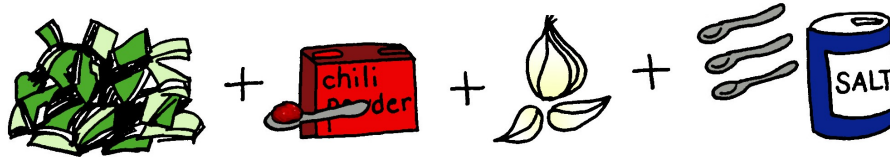
- Visit your local home economics extension agent or a canning club and watch a canning demonstration.
- Experiment with other food preservation methods like drying and freezing.
- Research the food preservation techniques of early settlers. How do the methods differ from today?
- Determine the pH of several liquids. Prepare a table showing the pH range of (acidic to alkaline) of the liquids.



Kimchee Recipe

To make your Kimchee you will need these ingredients:

- 1 to 1 1/2 heads of Chinese cabbage (bok choy, napa) cut into chunks
- 1 tsp chili powder
- 2 cloves crushed garlic
- 3 tsp pickling salt (non-iodized)



and you will need these materials:

- 2-liter soda bottle cut below the shoulder
- teaspoon for measuring
- large bowl or stock pot
- wooden spoon
- muslin or cheese cloth
- heavy bowl or jar to weight down cabbage
- pH indicator paper (litmus)
- room temperature of 68° to 72° F
- knife
- scissors



WHAT YOU DO:

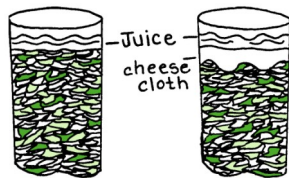
1. In a large container, thoroughly mix all ingredients and let stand for 5 minutes.



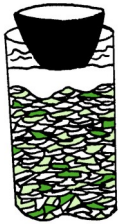
2. Fill the bottle with the cabbage mixture. Pack the cabbage firmly and evenly into the bottle with a wooden spoon.



3. Using the wooden spoon, press down firmly until juice comes to the surface.

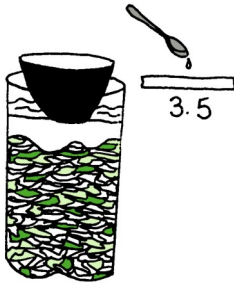
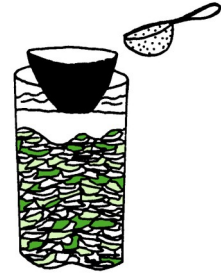


4. Cover the cabbage with a clean, thin, white cloth (muslin or cheese cloth) and tuck the edges down against the inside of the container.



5. Set a clean, heavy bowl or jar on the cloth to keep the cabbage submerged under the juice.

6. Formation of gas bubbles indicates fermentation is taking place. Using a strainer, remove and discard scum formation when needed.



7. Each week take a teaspoon of juice out of the container and check its pH using litmus paper. When the pH drops to about 3.5, your kimchee is done! (5 to 6 weeks)

	Week 1	Week 2	Week 3	Week 4	Week 5	Week 6
pH						

Answer the following questions. You may need to research the pickling process further.

1. What stops the cabbage from rotting?
2. *Lactobacilli* are anaerobic bacteria which are found almost everywhere in your environment. What is an anaerobe? What conditions are needed for them to live?
3. Why did you measure the pH of your kimchee?

**OBJECTIVES:**

For youth to:

- learn about the commercial production of tomatoes.
- compare fresh market and commercial tomatoes.

LIFE SKILL:

- Communicating and relating to others.

MATERIALS:

- copies of Tomato Production Guide for Florida (Circular 98C, University of Florida Cooperative Extension Service) or other tomato production information for reference
- ripe store bought tomato
- ripe garden or road stand tomato
- 2 paper plates
- 2 green tomatoes
- 1 ripe banana
- small paper bag
- paper clip
- paper
- pens and pencils

TIME:

- 30 to 45 minutes; 3-4 days

SETTING:

- A comfortable room with tables and chairs.

ADVANCE PREPARATION:

- Label the bottom of two paper plates "store bought" and "garden", slice the tomatoes and place on the plates. Before the discussion, have youth taste and compare the tomatoes. Can they distinguish between the two?

Activity 6: Nature's Harvest

INTRODUCTION

Have you ever compared the taste of a store bought tomato with one fresh from the garden? How were they different? Did you know that commercially grown tomatoes are picked green then ripened on their way to the store? Does anyone know how commercial growers and retailers ripen tomatoes? (ethylene gas) What would happen if growers waited until their tomatoes were ripe before they shipped them? (they would be over ripe or rotten when they arrived at the store) Because of the perishable nature of food, growers closely manage the harvest, marketing, and handling of crops. Today we're going to learn more about tomato production in Florida.

DO

- Give youth a copy of the Tomato Production Guide for Florida and any other tomato production information available for reference.
- Divide youth into four groups: 1) cultivars; 2) cultural practices; 3) pest management; and 4) harvest and handling.
- Have each group prepare a report or poster demonstrating their role in the production of tomatoes.
- Have groups share their information with the class.
- Demonstrate the ripening process by placing a ripe banana and a green tomato in a paper bag. Fold the top of the bag and place a paper clip on the fold to keep it closed.
- Place a green tomato on the counter about 3 feet from the paper bag.
- Every other day have youth compare the tomato in the bag to the tomato alone on the counter.

REFLECT

Why is it important to manage the harvest and handling of a crop?

to ensure the freshest product gets to the consumer

Which tomato ripened fastest?

the tomato in the bag

Why did we put a ripe banana in the bag with the tomato?

bananas release ethylene gas, a natural ripening agent

What interesting fact did you learn about the production of tomatoes?

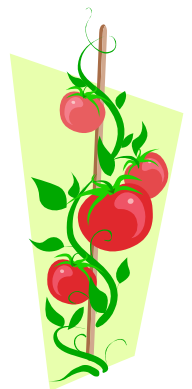
answers will vary

How does the commercial production process of tomatoes differ with a home gardeners production process? Are there any similarities?

answers will vary, encourage youth to speculate

APPLY

- Write or visit your local agricultural extension agent and request information on the commercial production of crops grown in your area.
- Tour a local vegetable or fruit processing plant or packing company.
- Research the harvest, handling, and marketing of other crops (oranges, cucumbers, onions). Compare similarities and differences among production.
- Compare the production process of a commercial grower, roadside stand farmer, and home gardener.



6

Plant Connections

PURPOSE:

- To become familiar with the need to become involved with plant science as a field of study, and a career choice.

OBJECTIVES:

For youth to:

- give examples of technological advances in agriculture.
- list the advantages and disadvantages of hydroponics.
- construct a terrarium.
- debate the advantages and disadvantages of organic/inorganic gardening.
- identify occupational opportunities in horticulture.
- discover the types of jobs involved with food production and distribution.

LESSON TIME:

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

ADVANCE PREPARATION:

- Read the BACKGROUND BASICS on The Future In Plants.
- Review activities and choose appropriate one(s) to use.
- Collect and prepare materials for appropriate activities.

The Future In Plants

LEARNING ACTIVITIES

1. KEEPING UP TO DATE
2. TEST THE WATERS
3. INTERIORSCAPES
4. THE DEBATE
5. WHAT DO YOU WANT TO BE?
6. HOW DOES IT GO?

DO

The following are suggestions for using the activities in Lesson 6. The materials needed for each are listed within the activity.

- Identify ways that technology has helped farmers increase food production in KEEPING UP TO DATE.
- Construct a hydroponic vegetable garden in TEST THE WATERS.
- Construct a terrarium in INTERIORSCAPES.
- List gardening techniques used in THE DEBATE.
- Define careers in the horticulture industry in WHAT DO YOU WANT TO BE?
- Discover career opportunities in the field of plant science in HOW DOES IT GO?

REFLECT

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

What are some advances in agricultural technology that have helped people?
new varieties, fertilizer, pesticides, plant breeding, improved equipment

What are the advantages of hydroponics?
higher yields, control plant nutrients, no threat of soil borne diseases, controlled conditions

What is interiorscaping?
the use of foliage plants to create attractive indoor environments

What are some unique features of an organic garden?
absence of synthetic chemicals, pesticides or fertilizers

What does a person need in order to make a wise choice about a horticultural career?
research, education, experience, hard work

Where could you look for information about plant related jobs?
library, teachers, counselors, career placement agencies, companies

APPLY

Help youth learn to apply what they have learned.

- Have youth research and prepare a speech on the question: How did the development of agriculture make civilization possible?
- Design your own hydroponic growing system. Have youth research hydroponics and set up an alternative growing system based on the information collected.
- Invite an interiorscaper to visit your group. Find out more about job opportunities in this field.
- Compare the production of commercially grown organic and inorganic crops. Are more people needed to grow organic or inorganic produce?
- Interview someone who works in a horticultural occupation. Determine the nature of their work and the requirements needed to obtain that type of job.
- Prepare a poster or bulletin board that depicts plant related occupations in your area. Create job descriptions for each occupation.

BACKGROUND BASICS ... The Future In Plants

Contrary to the image portrayed on television, the lives of American pioneers were not filled with adventure and romance. Until the mid 1600's day to day life in colonial America centered around survival. Old World agricultural techniques did not work in the New World. New crops and methods of production were learned from native Indians. It wasn't until the 1700's that American farmers produced a notable surplus of food. Farmers learned how and what plants to grow. The demand for draft (working) animals lead to advances in livestock management practices like selective breeding. During the 1800's animal powered machines improved farm productivity. By the 1850's John Deere invented a wrought iron plow with a moldboard bottom and a replaceable steel cutting edge. American agriculture was expanding at a frantic rate. Farm mechanization and an improved transportation system encouraged more extensive agriculture.



Mechanization of farm equipment continued to dominate technological innovations between 1900 and 1930. The development of the gasoline powered tractor replaced animal powered machines. By 1940 farmers had completely converted from animal to mechanical power. In addition to mechanization, farmers adopted biological innovations. Hybridization improved crop yields with varieties resistant to disease and drought. Chemical fertilizers and pesticides gained wide acceptance. Chemical fertilizers probably increased yield more than any other single innovation. During the 1950's and 1960's farmers began to use advanced management techniques. Most farmers began to keep accurate records and employ computerized information systems to help make decisions.

Farmers who use mechanical, chemical, biological, and managerial advances are more productive. New technologies such as genetic engineering and computers will continue to improve yields and efficiency in agriculture.

Agricultural choices....

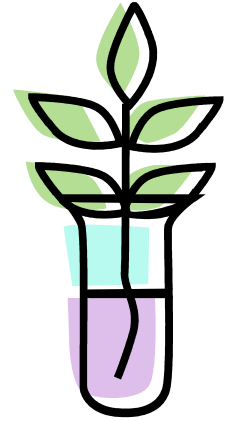
Gardening is the number one hobby in the United States. Americans make choices based on accumulated knowledge and methods in agriculture. For example, many gardeners choose to garden without the aid of chemical fertilizers or pesticides but instead rely on cultural methods and pest resistant plant varieties.

Organic gardening differs from inorganic gardening mainly in the areas of fertilization and pest control. Organic gardeners apply generous quantities of organic material to the soil. These materials include plant trimmings, compost, animal manures, and cover crops. The benefits of adding organic matter include: improved structure and condition of the soil, increased ability to hold nutrients and water, and a slow release of nutrients. Organic gardeners also use natural methods to control pest

infestations. Gardeners plant pest resistant varieties, rotate crops, dispose of diseased plants before they contaminate others, hand-pick insects, and use mulch to keep insect populations low. Although inorganic gardeners generally use a combination of natural materials and methods they also apply synthetic materials to fertilize plants and control pests.

Hydroponics

Hydroponics is a method of growing plants in which the nutrients needed by the plant are supplied by a nutrient solution(water and soluble fertilizer). Since roots cannot anchor plants in solution, other methods of anchoring must be used. Placing plants in styrofoam materials which float on the surface is one method of support.



Hydroponic growing systems offer several advantages over soil culture: plant nutrition is completely controlled through prepared nutrient solutions; yield per unit area is greater since plants may be placed closer together; the need for weed, disease, and insect control is greatly reduced due to absence of soil. Hydroponics is also used commercially to grow high-value crops in greenhouses during the winter. This allows production at a time when the crops can not survive outside. Commercial producers grow lettuce, tomatoes, peppers, and cucumbers hydroponically in large greenhouse complexes. Some growers use these crops to supplement other agricultural operations. The disadvantage of using hydroponics to grow plants are construction, cost of production, maintenance of hydroponic facilities, and demand in the marketplace.

The field of hydroponics is rapidly expanding and will continue to grow as scientists look for new ways to grow plants without soil. Various career opportunities exist in the field of hydroponics:

- producers or growers** own and operate hydroponic greenhouses
- truck drivers** transport hydroponically grown produce to supermarkets
- produce managers** order and receive fresh produce from farms and greenhouses
- plant pathologists** provide information about diseases and pests affecting their produce
- agricultural scientists** work to find new ways to grow plants hydroponically

Interiorscaping

Growing foliage plants inside office buildings and shopping malls is big business. **Interiorscaping** uses foliage plants to create attractive interior environments. Plants give people the feeling of the outdoors when inside. Interiorscapers maintain foliage plants under conditions that may not be the best for plant growth.

Terrariums are one method of bringing the outdoors inside. A terrarium or bottle garden is a miniature landscape growing in a covered glass or plastic container. The terrarium originated in the 1850's as a way of transporting living plants to different parts of the world. Today, terrariums are more decorative in nature.

Common misconceptions about terrariums are that they require no care and that just about any kind of plant will thrive in a bottle. Plant selection is very important when starting a terrarium. Cactus and succulent type plants will not do well in the terrarium environment. Instead pick plants that thrive under high humidity and low light.

Any number of containers can be used as terrariums, as long as the material is either clear glass or plastic. Large-necked bottles and fish tanks make good terrarium containers because it's easier to reach inside when positioning the plants. Terrariums do best in bright, but not direct, sunlight. If the sun shines directly into the container, the plants inside are likely to burn. Covered terrariums will not require additional water, but moisture can condense on the inner glass surface destroying the beauty of your mini garden.

Agricultural Career Choices

Horticulture deals with the development, improvement, growth, distribution, and use of fruits, vegetables, and ornamental plants. Many different careers are available in the horticulture industry. Every local community in North America has plant related career opportunities. Education, experience, and hard work are needed to advance in these careers. Examples of some plant related careers include:

Agronomists are concerned with field crop production and soil management.

Botanists study or investigate plant structure, function, and evolution.

Ecologists study the interrelationships between organisms and their environment.

Floriculturists are involved in the production, transportation, and use of flower and foliage products.

Horticulture Extension Agents are employed by the Extension Service, with offices in local communities and on college campuses. Agents work with a variety of audiences including: 4-H youth clubs, home gardeners, commercial growers, processors and distributors. Agents disseminate research based information and recommendations on horticultural practices to the public.

Landscapers plant and maintain home and commercial landscapes.

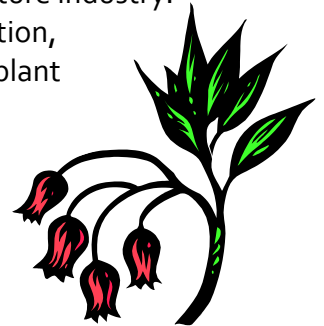
Interiorscapers use foliage plants to create pleasing and comfortable areas inside buildings.

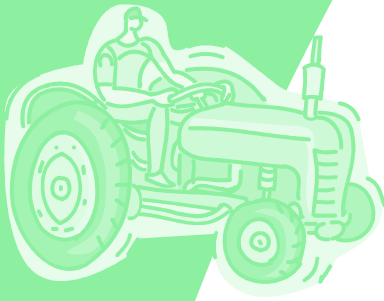
Olericulturists deal with the production, storage, processing, and marketing of vegetables.

Pomologists are involved in the growing, harvesting, storing, processing, and marketing of fruits and nuts.

Plant pathologists provide plant growers with information about disease pests affecting plants.

Plant Physiologists study processes that take place within a plant. They are interested in plant nutrition, the influence of the environment on plants, the products of plant activities, and the sequence of events that result in the growth and development of plants.





Activity 1: Keeping Up to Date

OBJECTIVES:

For youth to:

- give examples of some technological advancements in agriculture.
- identify ways that technology has helped farmers to increase food production.

LIFE SKILL:

- Acquiring, analyzing, and using information.

MATERIALS:

- journals, books, magazines, and bulletins on agriculture and technology
- pens/pencils
- Paper

TIME:

- 30 - 60 minutes

SETTING:

- A comfortable room with tables and chairs.

INTRODUCTION

It wasn't that long ago our great grandfathers used draft horses to plow their fields, now they use computers and motorized machinery. From 1930 to 1970, American agriculture experienced a technological revolution. Farmers started to use mechanical, chemical, and biological advances to tend their crops. Can you give me an example of a mechanical, chemical, or biological advance that a farmer might use today? Over the years, technology has increased the production and quality of the food we produce. Today, we are going to investigate advances in technology.

DO

- Divide youth into 4 groups.
- Have groups research a technological advance in the history of agriculture. Examples include: improved seed through genetic engineering, ripening techniques, or pesticide and fertilize treatments.
- Have groups write a brief report and present their findings.

REFLECT

What are some ways that advances in agricultural technology have helped people?

**new varieties, fertilizers, pesticides, selective
plant breeding, specialization of equipment**

REFLECT (continued)

Based on your research, what types of problems (if any) arose from the technological advances you investigated?

answers will vary based on technology researched

How do you think technology will change over the next few years?

answers will vary

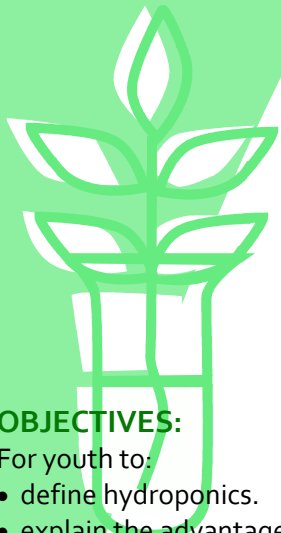
How do you think the United States compares to other countries in production efficiency of agricultural crops?

farmers in the United States are among the world's most efficient

APPLY

- Visit a local farm or nursery and find out how they have changed over the years. What new technologies are they using?
- Research and prepare a speech for county events on the question: How did the development of agriculture make civilization possible?
- Have youth research the history of American agriculture. Have them select a significant event in the history of agriculture and share it with the group.
- Have youth investigate the agricultural regions of the United States and tell what agricultural products are grown there.





OBJECTIVES:

For youth to:

- define hydroponics.
- explain the advantages and disadvantages of hydroponics.
- construct a hydroponic vegetable garden.

LIFE SKILL:

- Problem solving and decision making.

MATERIALS:

- copies of HYDROPONICS Activity sheet for each youth
- pan 6 to 8 inches deep
- styrofoam panel 3/4 to 1 inch thick
- soluble fertilizer or hydroponic nutrient mix
- tomato and pepper seedlings
- knife
- permanent marker
- ruler

TIME:

- 30 minutes
- 15 minutes every week for six weeks

ADVANCE PREPARATION:

- Review Building a Floating Hydroponic Garden at: <http://edis.ifas.ufl.edu/hs184>

SETTING:

- A comfortable room with tables and chairs.

Activity 2: Test The Waters

INTRODUCTION

Hydroponics is the method of growing plants where the nutrients needed by the plant are supplied by a nutrient solution of water and soluble fertilizer. There are several advantages to growing plants hydroponically rather than in soil. For instance, plant nutrition is controlled through preparation of the nutrient solution, yield is greater since the plants can be placed closer together, the produce stays cleaner and the need for weed, disease, and insect control is reduced due to the absence of soil. Another advantage is that hydroponics is often used to grow high-value crops during the winter. This allows production at a time when the crop would not normally survive outside. Can you think of any disadvantages of using hydroponics to grow plants? (cost of production is higher, labor, construction, and maintenance of hydroponic facilities, establishing a need in the market) Today, we're going to test the waters and start our own hydroponic experiment. Let's get started!

DO

- Give each youth a copy of the HYDROPONICS Activity sheet.
- Review the instructions aloud with youth.
- Divide youth into four groups.
- Give each group a basil or lettuce seedling.
- Have groups follow the instructions on the HYDROPONICS Activity sheet.
- Have groups record their observations of plant growth and development over several weeks.

REFLECT

What is hydroponics?

method of growing plants in a nutrient solution

What are the advantages of hydroponics?

higher yields

control of plant nutrients

grow valuable crops all year

no threat of soil borne diseases

What are some of the disadvantages of hydroponics?

expensive

need to establish a place in the market

complex facilities

Is it important to find ways to grow plants without using soil?

answers will vary

What other kinds of plants could grow hydroponically? Could you grow trees? Flowers?

answers will vary

APPLY

- Visit a greenhouse or nursery that grows hydroponic vegetables. Ask your guide about the jobs associated with hydroponics.
- Plants can be hydroponically grown in a wide variety of containers and growing systems. Have youth research hydroponics and set up an alternative growing system based on the information collected.
- Design your own hydroponic growing system. Combine elements of existing systems or design a totally new system. Make a poster illustrating your design and share it with the group.
- Take a behind the scenes tour of EPCOT. Their scientists may conduct research on the latest hydroponic technology. They could also supply the surrounding restaurants with fruits and vegetables.

Hydroponics

Materials:

- Styrofoam panels (3/4 to 1 inch thick) cut to fit in the pan
- pan or plastic tub (6 to 8 inches deep)
- knife
- soluble fertilizer or hydroponic mix
- tomato and pepper seedlings
- small Styrofoam cups (unless your seedlings are in a small container that the bottom can be removed)
- permanent marker

Instructions:

- Mix the nutrient solution according to the package directions and pour into a pan. If you are using an aquarium or clear pan, cover the sides with dark paper to prevent algal growth.
- Cut a small hole cup in the Styrofoam panel to fit each Styrofoam plant cup. It is recommended that plants are usually six inches apart.
- Cut slits in the bottom of the Styrofoam cups to let roots pass through. You may also need to cut off some of the top of the cup to make it shorter for your seedlings. Gently wash the soil from the roots then put them in your Styrofoam cups. Place them in the holes in your Styrofoam panel..
- Using a permanent marker label your plant. Place the Styrofoam panel in the nutrient solution. It is important to keep the roots moist during the process, you may need to dunk them into the nutrient solution from time to time.
- Add extra water and nutrient solution to keep a minimum of 4-5 inches of solution if needed.





Record Your Observations

Plant Label	Height (cm)	Number of Leaves	Length of Roots (cm)	General Appearance of the Plant
Date:				
Date:				
Date:				
Date:				
Date:				
Date:				

**OBJECTIVES:**

For youth to:

- construct a terrarium.
- define interiorscaping.
- investigate job opportunities in horticulture.

LIFE SKILL:

- Acquiring, analyzing, and using information.

MATERIALS:

- TERRARIUMS Workbook activity pages 17-19
- newspaper
- clear container (large enough for 2 or more plants)
- gravel, small rocks, charcoal
- potting soil
- foliage plants (ivy, pepperomia, begonias, philodendrons, ferns)
- clear lid to fit over container opening

TIME:

- 30 minutes

SETTING:

- A comfortable room with tables and chairs.

Activity 3: Interiorscapes

INTRODUCTION

Have you ever heard the term interiorscaping? Interiorscaping is the use of live foliage plants to create attractive interior environments. Can you think of a business that interiorscapes? (restaurant, shopping mall, dentist office) In addition to making an area more attractive, businesses use plants to convey an overall mood or feeling. For example, shopping malls use interiorscaping to create a pleasant, relaxed environment so their customers feel comfortable spending the whole day indoors. What message would a dentist want to convey to his/her patients? Today we're going to build our own interiorscapes. Let's get started!

DO

- Pass out copies of the TERRARIUMS Workbook activity pages 17-19.
- Review the instructions with youth.
- Choose a clear container big enough to hold two or more plants.
- Cover tables with newspaper to catch spilt soil.
- Place a one inch layer of gravel, small rocks, broken pottery, or charcoal in the bottom of the container.
- Cover the gravel with two to four inches of potting soil.
- Select and arrange plants in the terrarium. Plant the plants only as deep as they were growing in their pots.
- Gently water until water can be seen draining into the bottom of the terrarium. Wash the soil from the sides while watering.
- Place a glass or plastic lid on the terrarium and place in a well light spot (avoid direct sunlight).

- Have youth take their terrariums home.
- To maintain the terrariums, water when soil feels dry to the touch (about once a month).
- If water droplets form on the terrarium surface remove the lid to evaporate the moisture.
- Remove dead or diseased leaves and prune overgrown plants.

REFLECT

What is interiorscaping?

the use of foliage plants to create attractive indoor environments

What kind of mood will your terrarium convey?

answers will vary

What types of businesses interiorscape?

malls, doctors offices, nursing homes

Do you think plants affect the way you feel?

answers will vary

What is it about plants that might make a person change their mood or attitude?

smell, color, taste

APPLY

- Invite an interiorscaper to visit your class. Find out more about job opportunities in this field.
- Interiorscaping is a specialty in the broad and diverse science of horticulture. Select another area of horticulture and investigate how it is practiced. Examples include: landscaping, floriculture, floristry, olericulture, pomology.
- Help a friend or family member create their own terrarium.

Terrariums

Build your own interiorscape!

To make your interiorscape you will need:

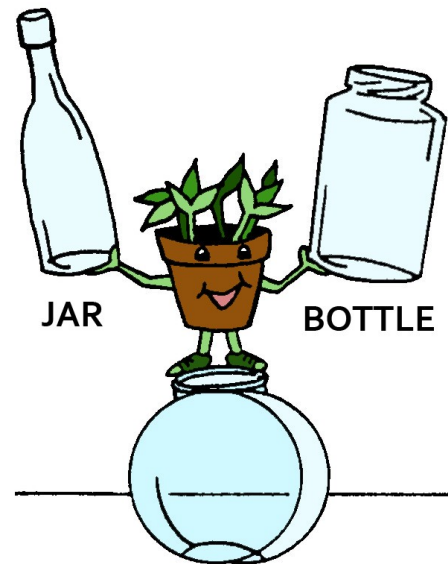
- ☑ newspaper
- ☑ clear container (large enough for 2 or more plants)
- ☑ gravel, small rocks, charcoal
- ☑ potting soil
- ☑ foliage plants (ivy, peperonia, begonias, ferns, etc.)
- ☑ clear lid to fit over container opening

WHAT YOU DO:

1. This is a terrarium:
a mini-garden in a clear container.



2. To build one, choose a container big enough to hold two or more plants, such as a...



or an OLD FISH BOWL

continued...

3. Terrariums have solid bottoms and drainage must be provided so any excess water will not cause root rot.



4. Now, to build a garden in the container...

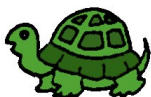
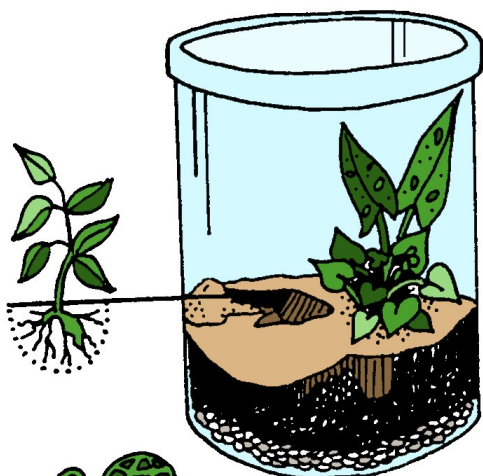
Place 1 inch of the drainage material on the bottom.



Put 2 - 4 inches of soil in next.



5. Place the plants in the soil of the terrarium in scooped-out holes. Plant only as deep as they have been growing.



Add plastic or ceramic figures for an accent.

6. Plant narrow-necked bottles with tweezers, tongs, and scoops made from thin sticks, spoons, or other handy materials.



continued...

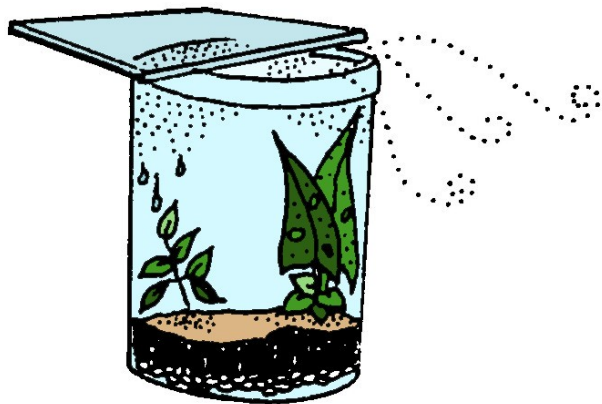
7. Water carefully and only until some water can be seen in the bottom of the terrarium. Wash soil bits from the sides while watering.



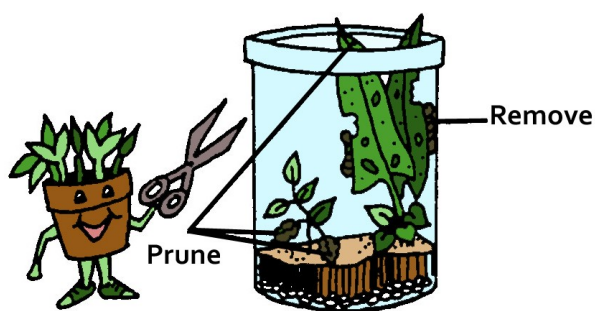
8. Cover the terrarium with glass or plastic and place in a well-lit area, but not in direct sun.



9. If a large amount of water droplets condense on the lid and sides, open the top a little, or uncover for a short while. Do this also if the terrarium is accidentally over-watered.



10. Watch for diseased leaves and insects - remove at once. Prune or remove any overgrown plants.



With a little care, your terrarium will reward you with natural beauty and hours of enjoyment!!

**OBJECTIVES:**

For youth to:

- define organic/inorganic gardening.
- debate the advantages and disadvantages of an organic/inorganic garden.
- list gardening techniques used in organic/inorganic gardens.

LIFE SKILL:

- Working with groups.
- Research skills
- Communication and public speaking skills

MATERIALS:

- copies of the GARDEN DEBATE Activity sheet for each youth
- journals, bulletins, and textbooks with information on organic and inorganic gardening
- pens and pencils

TIME:

- 45 minutes

SETTING:

- A comfortable room with tables and chairs.

Activity 4: The Debate

INTRODUCTION

Throughout the years, horticulturists have debated organic versus inorganic gardening methods. As with any issue, there are advantages and disadvantages of each method. Today we are going to research the organic versus inorganic controversy and hold our own gardening debate.

DO

- Give each youth a copy of the GARDEN DEBATE Activity sheet.
- Divide youth into two groups: ORGANIC and INORGANIC.
- Have groups research the advantages and disadvantages of their assigned gardening method. Make sure groups answer the questions on the activity sheet.
- Seat groups facing each other.
- Have one member of each group present a short informative presentation on their gardening topic.
- Start the debate by asking each group questions from the activity sheet. Ask youth to raise their hands when answering a question.
- After groups have responded to the GARDEN DEBATE questions, have them form questions of their own to ask the opposing group.

REFLECT

What are some unique features of an organic garden?

absence of synthetic pesticides or fertilizers

What are some unique features of an inorganic garden?

use of synthetic chemical pesticides and fertilizers

What are the advantages of organic/inorganic gardening?

answers will vary based on the information presented in the debate

What are the disadvantages of organic/inorganic gardening?

answers will vary based on the information presented in the debate

What type of gardening method would you choose?

answers will vary

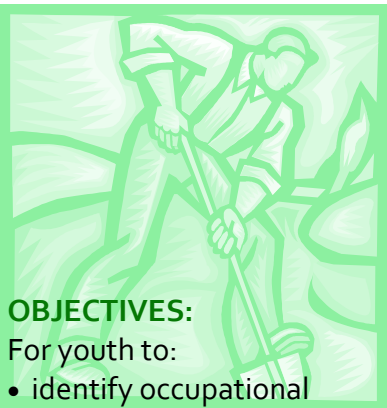
APPLY

- Compare the production of commercially grown organic and inorganic crops. Are more people needed to grow organic or inorganic vegetables?
- Grow an organic vegetable garden. Be sure to keep a journal of your experiences. Hypothesize what you might have done if you were growing an inorganic garden.
- Visit an organic grower. Ask the grower questions from the GARDEN DEBATE activity sheet.
- See for yourself!! Experiment with organic and inorganic gardening.

Garden Debate

QUESTIONS

1. What is organic/inorganic gardening?
2. What are the benefits of your gardening method?
3. Are there any disadvantages of your gardening method?
4. What methods of pest control do you use?
5. What do you fertilize your plants with?
6. How would you convince an inorganic gardener to become an organic gardener?
7. How would you convince an organic gardener to become an inorganic gardener?



OBJECTIVES:

For youth to:

- identify occupational opportunities in horticulture.
- define careers in the horticulture industry.
- match aspects of plants to their area of study.

LIFE SKILL:

- Acquiring, analyzing, and using information.
- Communication skills.

MATERIALS:

- copies of WHAT'S YOUR OCCUPATION Activity sheet cut for each player
- textbooks, journals, and dictionaries with occupational definitions for youth to share
- access to computers for on-line resources
- paper
- pens and pencils

TIME:

- 30 minutes

SETTING:

- A comfortable room with tables and chairs.

ADVANCE PREPARATION:

- May need additional adult supervision or help with groups.

Activity 5: What Do You Want to Be?

INTRODUCTION

If I told you that I work in the horticulture industry, what would you guess I do for a living? Since, the horticulture industry includes all of the activities that meet the needs of consumers for horticultural products, I could have any number of jobs, including supply, maintenance, grower, entomologist, extension agent, production specialist, and marketing representative. Can you think of any other careers involved in the horticulture industry? Choosing a career in horticulture takes research, education, experience, and hard work. Today we're going to learn more about some plant related career opportunities.

DO

- Divide youth into groups of four.
- Copy and cut the WHAT'S YOUR OCCUPATION Activity sheets and give each player in each group an occupation.
- If several groups are playing simultaneously, separate them so they cannot hear the groups' definitions.
- Have youth look up the definition, duties, and responsibilities of their occupation. **Do not let the players share their information.**
- When the occupation definitions are completed, youth are ready to play WHAT'S YOUR OCCUPATION.

- Read the instructions aloud to the groups:

The object of the game is to choose the correct definition for a given occupation.

Player 1 will read the name of his/her occupation.

Each player (including player 1) will write a definition for that occupation on a piece of paper.

All the definitions are passed to player 1 where he/she will read each definition aloud.

Players 2 through 4 will try to choose the correct definition for the occupation of the first player.

Player 1 then reads the correct definition aloud to the group.

Scoring: Player 1 gets 5 points for each wrong definition chosen (meaning that he/she has stumped the other players) and each player that chooses the correct definition wins 5 points.

Repeat with each player.

Hint: Rewrite the correct dictionary definition in your own words.

REFLECT

If you were to pick an area of plant science to study, which one would it be?

answers will vary

How and where would you begin to look for information about jobs in this field?

counselors, university, library, journals

Can you think of any other plant science fields that were not included in the game? What are they?

answers will vary

Which occupations were you familiar with before you played the game?

answers will vary

How many of you knew what a pomologist and an olericulturist was before you played the game?

answers will vary

What does a person need in order to make a wise choice about a horticultural career?

research, education, information, experience, hard work

APPLY

- Select an individual who made important contributions in the development of horticulture. Conduct library or computer research to collect details about their work. Give an oral report to the group.
- Investigate educational opportunities in horticulture. Contact a local college or university and request information on majors in plant science. Prepare a poster or bulletin board that reports your findings.
- Interview a person who works in horticulture. Determine the nature of their work and the requirements needed for entry. If possible, go to work with them for a day. Find out what goes on during "a typical day at the office".



What's Your Occupation?

1. Pomologist

2. Agronomist

3. Plant Pathologist

4. Botanist

5. Olericulturist

What's Your Occupation?

6. Horticultural Extension Agent

7. Ecologist

8. Floriculturist

9. Interiorscaper

10. Plant Physiologist

What's Your Occupation?

11. Landscaper

12. Arborist

13. Pest Control Technician

14.

15.



OBJECTIVES:

For youth to:

- discover the types of jobs involved with food production and distribution.
- discover several career opportunities in the field of plant science.

LIFE SKILL:

- Problem solving and decision making.
- Teamwork.
- Critical thinking.

MATERIALS:

- Copies of the COOKIE FACTORY activity for each youth.
- poster paper
- telephone directory
- pens and pencils
- ingredients for cookies (optional)

TIME:

- 30 minutes

SETTING:

A comfortable room with tables and chairs.

Activity 6: How Does It Go?

INTRODUCTION

Have you ever thought about where food comes from? It's easy to forget when all you have to do is open the refrigerator or drive to the nearest grocery store. How would your life change if you didn't have a refrigerator or a nearby grocery store? The advances in agriculture and technology have enabled farmers in the United States to provide us with a dependable food supply. Today, we're going to use a simple cookie recipe to look at where our food comes from and the diversity of jobs involved in cookie production.

DO

- Give each youth a copy of the COOKIE FACTORY activity.
- Divide youth into groups and have them work together to answer the questions on the activity sheet.
- Review the activity sheet with groups.
- Have each group develop a concept map of different jobs involved in making cookies.

REFLECT

What ingredients directly and indirectly came from plants?

directly: flour->wheat
 walnuts->walnut tree
 vanilla->vanilla bean
 chocolate->coco plant
 sugar->sugar cane

indirectly: margarine->cow->grass
 eggs->chicken->chicken feed (corn)

What jobs were involved in making cookies?

farmers, seed distributors, fertilizer and pesticide distributors, food processors, packing plant supervisors, sales and marketing, transportation (truck drivers, pilots), researchers, teachers, chemists, food brokers, poultry and dairy producers...

Do you know anyone who does one of these jobs? If so what do they do?

answers will vary

Did any of these jobs interest you?

answers will vary

Where could you get more information about these jobs?

library, counselors, career placement agencies, companies, job corps conditions

APPLY

- Visit a local farm or processing plant. Find out how the crop is grown or processed and ask your guide for a description of the types of employment available.
- Use a telephone directory to list the plant related businesses in your area. Categorize each business into one of the following career areas: landscape horticulture, research, extension, agriculture, floriculture, fruits and vegetables, education, and science. Create your own classification for jobs that do not fit into one of the above categories.
- Prepare a poster or bulletin board that depicts plant related occupations in your area. Create job descriptions for each occupation.
- In the 1800's one farmer produced enough food to feed only five people. Today, in the United States, one farmer produces enough food to feed about 100 people. How is this possible? Research and report on the history of agriculture.

Cookie Factory



To make your cookie you will need these ingredients:

- | | |
|----------------------------------|------------------------|
| 1 cup butter or margarine | 2 eggs beaten |
| 1 tsp. baking soda | 1 tsp. salt |
| 3/4 cup packed light brown sugar | 1 tsp. hot water |
| 3/4 cup granulated sugar | 1 tsp. vanilla extract |
| 2 pkg. semi-sweet chocolate | 1 cup chopped nuts |
| 2 1/4 cups all-purpose flour | |

and you will need these materials:

- oven (preheated to 375° F)
- 2 large bowls
- flour sifter
- cookie sheet

WHAT YOU DO:

1. Preheat oven to 375° F.
2. Mix eggs, butter, sugar, vanilla, walnuts and chocolate in a large bowl.
3. In another bowl sift flour and salt.
4. Dissolve baking soda in hot water and add to flour mixture. Mix well.
5. Add flour mixture to butter mixture.
6. Place teaspoon sized balls on greased cookie sheet, cook 10 to 12 minutes.

WHAT DID YOU LEARN?

Which ingredients come directly from plants?

Which ingredients come indirectly from plants?

What plants do the ingredients come from?

What people are involved with growing these plants?

How are these plants processed to form the ingredients?

Where are the ingredients sold?

How do they get to the stores?