CLASSROOM LEARNING ACTIVITES FOR ELEMENTARY STUDENTS

NUTRITION FROM TREES

ENVIRONMENTAL BENEFITS OF TREES

SOIL BIOLOGY FOR GROWING HEALTHY TREES

TREE BIOLOGY FOR MAINTAINING HEALTHY TREES

Curriculum provided by Kansas City Community Gardens
and sponsored by EPA Region 7

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SECTION TWO: TREE BIOLOGY

PARTS OF A TREE

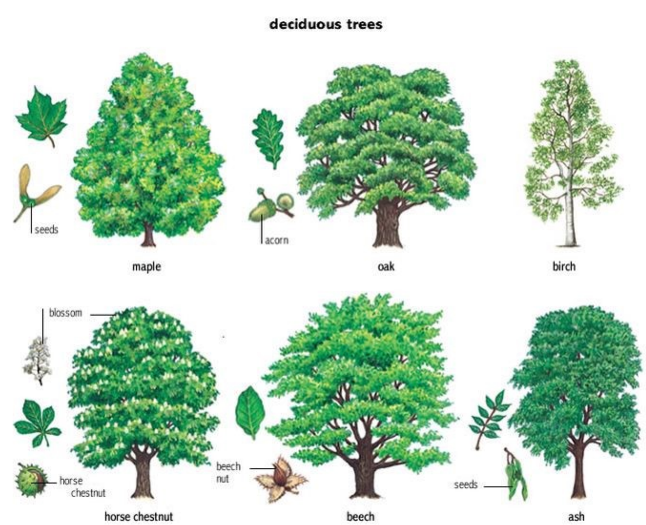
Lesson Objective: The Learner will identify the parts of a tree and tree trunk and describe the function of each part. The Learner will analyze cross-sections of the tree trunk to determine factors that affect tree growth.

Key Questions: How do trees help people, animals, and the environment? What are factors that affect the tree's growth? What can we determine about a tree's growth by analyzing a cross-section of the tree's trunk?

Background Information:

Trees are an important part of our world. They provide wood for building and pulp for making paper. They provide habitats (homes) for all sorts of insects, birds and other animals. Many types of fruits and nuts come from trees -- including apples, oranges, walnuts, pears and peaches. Even the sap of trees is useful as food for insects and for making maple syrup -- yum!

Trees also help to keep our air clean and our ecosystems healthy. We breathe in oxygen and breathe out carbon dioxide. Trees breathe in carbon dioxide and breathe out oxygen. We're perfect partners! Trees do lots for us, our environment and other plants and animals in nature but we don't just love trees for practical reasons. Trees can also be very beautiful -- tall enough they seem to touch the sky and so big around you can't even hug them. Thousands of artists, professional and amateur alike have painted pictures of trees and thousands of poems, songs and stories have been written about them. I would guess that just about everyone on earth has at some point in their life stopped to enjoy the beauty of a tree.



There are two main types of trees: deciduous and evergreen. Deciduous trees (including fruit trees) lose all of their leaves for part of the year. In cold climates, this happens during the autumn so that the trees are bare throughout the winter. In hot and dry climates, deciduous trees usually lose their leaves during the dry season.

Evergreen trees don't lose all of their leaves at the same time -- they always have some foliage. They do lose their leaves a little at a time with new ones growing in to replace the old but a healthy evergreen tree is never completely without leaves.

Parts of a Tree

- **Roots**

Roots are usually found underground, but in some cases this is not so. Some rainforest plants, known as epiphytes, grow right on trees. Their roots hang down in the air (called aerial roots) and are used to receive water and nutrient intake directly from the humid air. Most tree roots grow 2-3 feet deep, but under ideal soil and moisture conditions, roots have been observed to grow to more than 20 feet (6 meters) deep. There are two sorts of root systems:

⇒ taproot system: there is one very big root that goes down into the ground, and many smaller roots that come out of it

⇒ diffuse root system: there are many roots that go in all directions

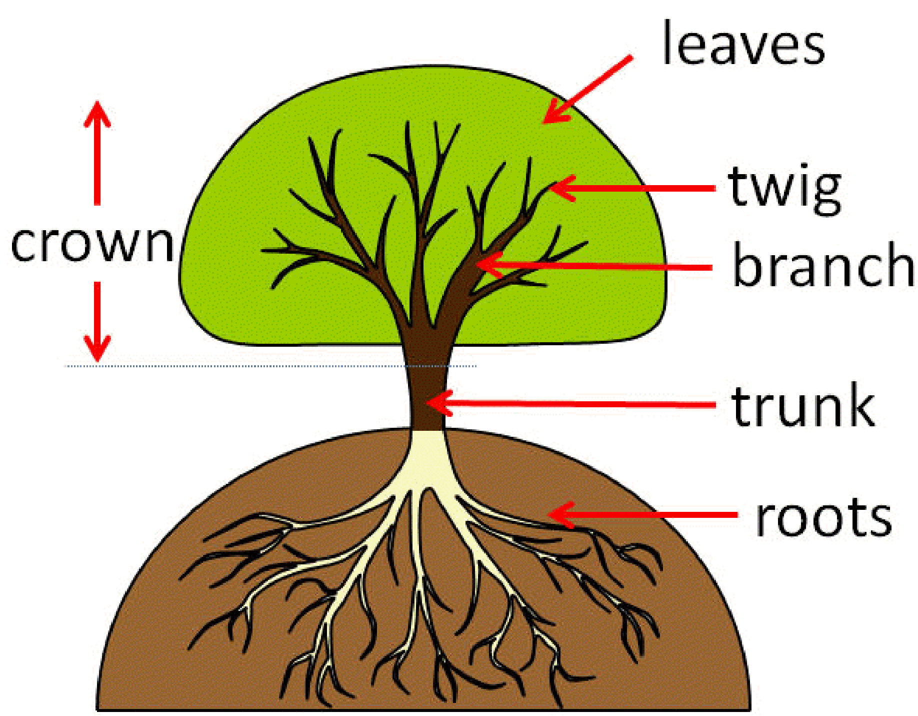
Roots generally spread out wider than the tree canopy. It is a common misperception that the tree roots are as deep as the height of the tree. Besides keeping the tree from tipping over, the main job of the roots is to collect water and nutrients from the soil and to store them for times when there isn't as much available.

- **Crown (Canopy)**

The crown is made up of the leaves and branches at the top of a tree. The crown shades the roots, collects energy from the sun (photosynthesis) and allows the tree to remove extra water to keep it cool (transpiration -- similar to sweating in animals). The crowns of trees come in many shapes and sizes!

- **Leaves (Foliage)**

Leaves are the part of the crown of a tree. They are the part of the tree that converts energy into food (sugar). Leaves are the food factories of a tree. They contain a very special substance called chlorophyll -- it is chlorophyll that gives leaves their green color. Chlorophyll is an extremely important biomolecule, used in photosynthesis -- leaves use the sun's energy to convert carbon dioxide from the atmosphere and water from the soil into sugar and oxygen. The sugar, which is the tree's food, is either used or stored in the branches, trunk and roots. The oxygen is released back into the atmosphere.



- **Branches (Limbs)**

The branches provide the support to distribute the leaves efficiently for the type of tree and the environment. They also serve as conduits for water and nutrients and as storage for extra sugar.

- **Trunk**

The trunk of the tree provides its shape and support and holds up the crown. The trunk transports

Parts of the Trunk

Inside the trunk of a tree are a number of rings. Each year of the tree's life a new ring is added, so many people refer to them as the annual rings. The rings are actually made up of different parts:

- **Bark**

The outside layer of the trunk, branches and twigs of trees. The bark serves as a protective layer for the more delicate inside wood of the tree. Trees actually have inner bark and outer bark -- the inner layer of bark is made up of living cells and the outer layer is made of dead cells, sort of like our fingernails. The scientific name for the inner layer of bark is Phloem. The main job of this inner layer is to carry sap full of sugar from the leaves to the rest of the tree.

A number of handy things are made from bark including latex, cinnamon and some kinds of poisons. Because bark is a protective layer for the tree, keeping it safe from insects and animals, it isn't surprising the strong flavors, scents and toxins can often be found in the bark of different types of trees.

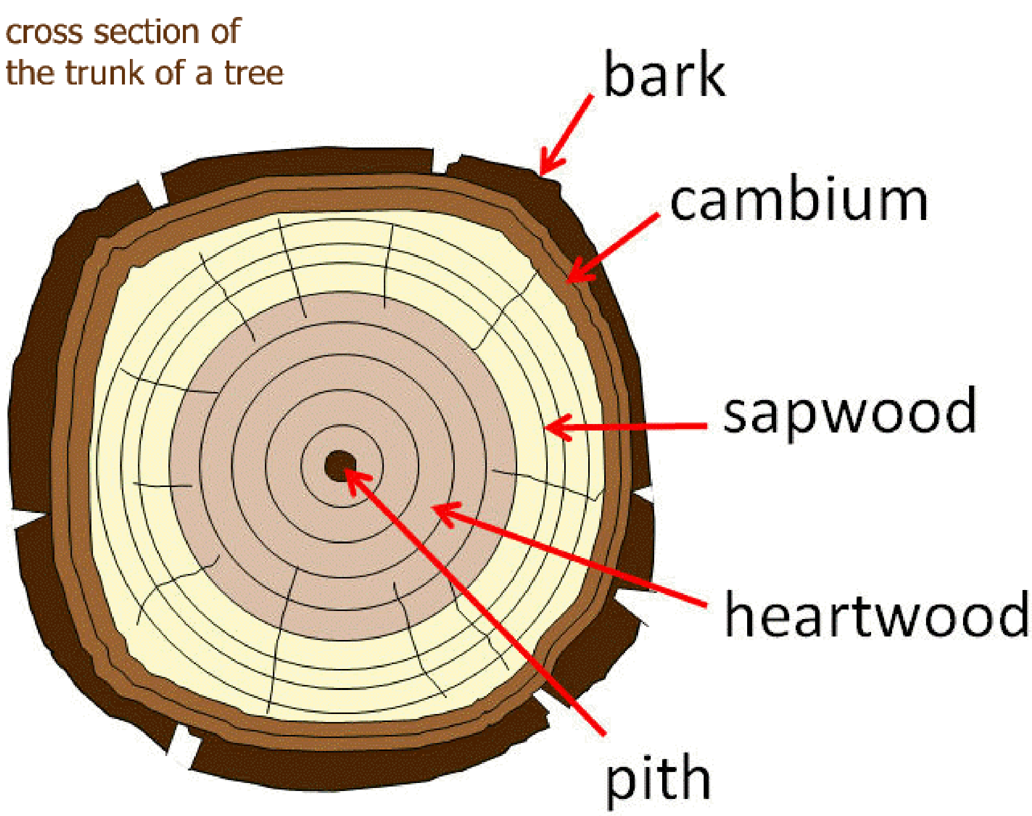
- **Cambium**

The thin layer of living cells just inside the bark is called cambium. It is the part of the tree that makes new cells allowing the tree to grow wider each year.

- **Sapwood (Xylem)**

The scientific name for sapwood is xylem. It is made up of a network of living cells that bring water and nutrients up from the roots to the branches, twigs and leaves. It is the youngest wood of the tree -- over the years, the inner layers of sapwood die and become heartwood.

- **Heartwood**



The heartwood is dead sapwood in the center of the trunk. It is the hardest wood of the tree giving it support and strength. It is usually darker in color than the sapwood.

- **Pith**

Pith is the tiny dark spot of spongy living cells right in the center of the tree trunk. Essential nutrients are carried up through the pith. It's placement right in the center means it is the most protected from damage by insects, the wind or animals.

Materials:

Cross section from various tree trunks (ask a local tree trimming company)

Activity Sheet “Reading Between the Rings” Science journal

Learning Activity:

- Provide students with several different cross sections of various types of tree trunks in conjunction with the Activity Sheet “Reading Between the Rings”.
- By “Reading between the Rings”, students will gain knowledge of the factors that affect tree growth.
- A cross section of a tree shows much more than its age! Diameter growth is particularly sensitive to fluctuations in the environment: moisture in the soil and air, temperature, and sunlight. Very broad rings generally indicate a good growing year. The tree apparently received everything it needed.
- The growth rate of a tree can be compared to the growth of a child. A young sapling grows much faster than an adult tree. A cross section of an older tree shows rings that are quite broad at the beginning of its life (in the center) but that become progressively smaller. An old tree produces very narrow rings and its diameter and height growth are considerably slower.

Look carefully at the pictures and read the explanations to understand what may have caused the cross section. What story is told about the life of the tree?

1. Narrow rings do not only signify a lack of sun or water. A forest fire may have damaged the tree's crown and slowed its growth. Defoliation by insects or fungi can have the same effect. After several years, the tree gained strength and returned to normal growth.

2. This tree had a rough time during its first ten years! Maybe someone helped it by cutting the large trees around it to give it more light.

3. Trees don't all have their heart in the right place! This tree shows off-center growth. If the tree was in a location exposed to high winds, its wood would grow faster (wider rings) on the side away from the wind than on the side facing the wind.

This cross section may also come from a tree that was leaning. The tree formed reaction wood (compression wood) that enabled it to straighten up. The wider rings are on the underside of the leaning trunk because growth was faster there.

4. Do you see waves? Look at the outer bark. Wasn't there a branch here?

Lesson Extension:

- Distribute tree rounds to groups with measuring tapes. Identify various parts of the tree trunk.
- Measure the diameter. Multiply by (3.14) to find the circumference. (C = Xd)
- Check the location of the **PITH**. Is it in the center? Have students hypothesize why the pith may not be in the center of the trunk (i.e. too much shade from surrounding foliage blocked sunlight).
- Count the trunk rings, marking off each decade.
- Figure the percent of growth for each ten year period. Do this by dividing the measured section by the total radius.

  Example: total radius = 40 cm

  1st decade = 15 cm

  $15 \div 40 = .375 = 38\%$

  (in the first ten year period, the tree received 38% of its growth)

- Additional questions for class discussion/research:
  - ⇒ Life can be pretty tough on a tree! What factors affect the growth of trees? (i.e. drought, excessive rain, fire, insect plagues and disease epidemics, injuries, thinning, air pollution, all leave their mark on a tree's annual growth rings.)
  - ⇒ How can we identify the heartwood from the sapwood? The inner bark from the outer bark?
  - ⇒ What are the functions of each part of a tree/tree trunk? What benefits do trees provide for people, animals and the environment?
  - ⇒ What factors do you think might affect the position of the pith?
  - ⇒ When does a tree have its greatest percent of growth
  - ⇒ Are the rings of a tree all the same size? What might account for the different widths in the rings?
  - ⇒ Is there a relationship between trees within a certain area?
  - ⇒ Can we determine what year a tree germinated?
  - ⇒ Are trees with the same diameter the same age? Why?

Additional Resources

https://www.kidzone.ws/plants/trees.htm

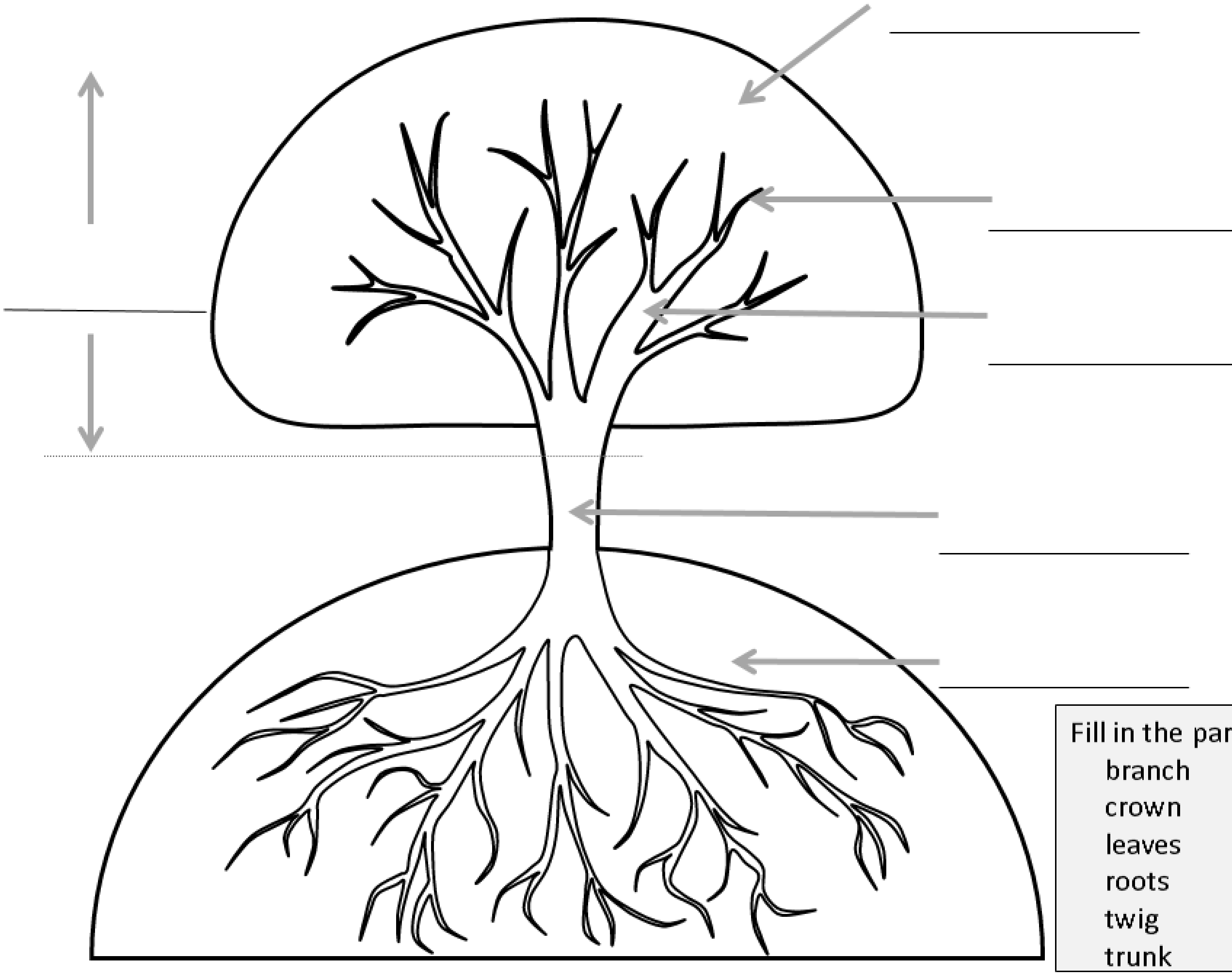
https://www.theforestacademy.com/tree-knowledge/annual-growth-rings/#.XGHKDlVKjcs

Extension activity adapted from AIMS Education Foundation “Our Wonderful World”

NAME: ____________________

PARTS OF A TREE

Use the Word Bank to fill in the parts of a tree.



Fill in the parts of a tree:
- branch
- crown
- leaves
- roots
- twig
- trunk

How do trees help people, animals, and the environment?

____

____

____

____

____

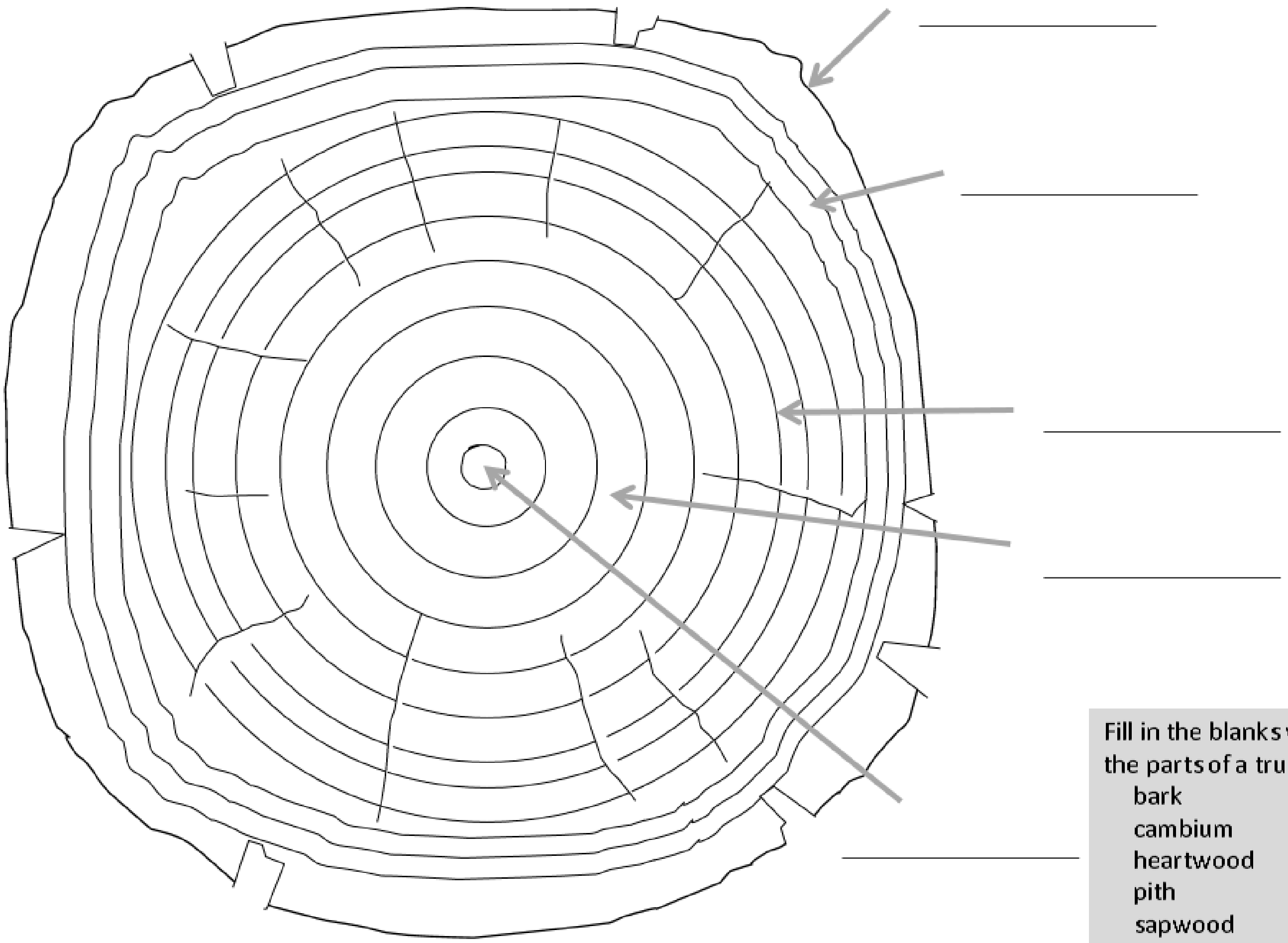
____

____

NAME: ___________________

PARTS OF A TREE TRUNK

Use the Word Bank to fill in the parts of a tree trunk.



Fill in the blanks with the parts of a trunk:
- bark
- cambium
- heartwood
- pith
- sapwood

1. What is the main job of the tree's outer bark and inner bark?:________________________
____
2. What part of the trunk makes new cells and allows the tree to grow wider each year?
____
3. What part of the trunk brings water and nutrients up from the roots to the leaves?
____
4. What part of the trunk gives the tree strength and support?
____
5. The _______________ is the tiny dark spot of living cells right in the center of the trunk.
6. What would cause some trunk rings to be wider than others? ________________________
____

NAME: ___________________

READING BETWEEN THE RINGS

Look carefully at these tree trunk cross-sections. Describe the story that is told about the life of the tree.

Where is the location of the PITH? ___________________________

What does that tell you about the growth of the tree?

____

What observations can you make about the rings? __________________

____

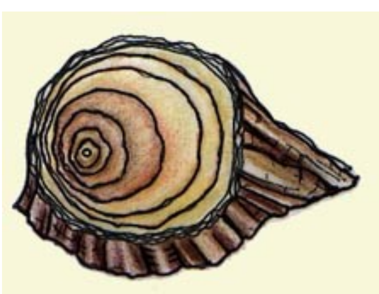
What observations can you make about the rings? __________________

____

What might have caused the tree to have such small rings in the first 10 years of its life? ____

____

____



Where is the location of the PITH? _____________________________

What might have caused the pith to be in this location?

____

____

____

What observations can you make about the rings? _________________

____

Look at the wave in the outer bark. What do you think caused this?

____

____

IDENTIFYING LEAVES

Lesson Objective: The Learner will identify various characteristics of tree leaves and create a dichotomous key for various leaf samples.

Key Questions: What are some differences between conifer and broadleaf (deciduous) trees? How can leaf characteristics help us identify trees?

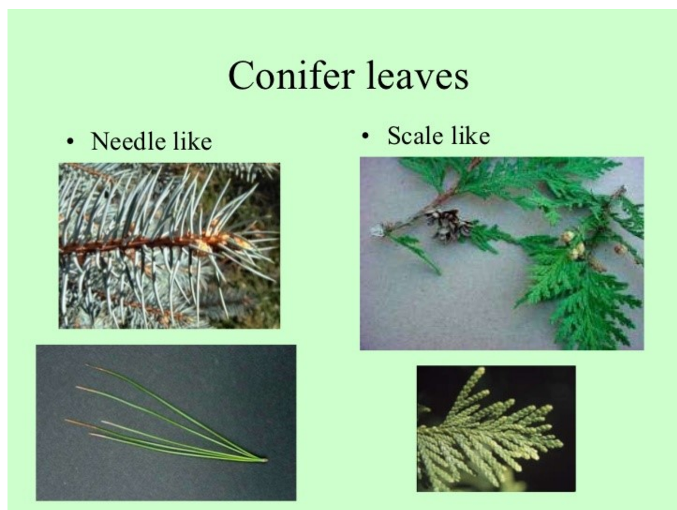
Background Information:

There is a scientific process scientists use to classify plants and animals. This process is called TAXONOMY. Taxonomy provides an organized system for grouping things based on certain "like" characteristics.

When scientists classify trees they start by dividing trees into two main groups.

1. **CONIFERS** – Conifers are cone bearing trees and most are evergreen. Conifers have needle-like or scale-like leaves.

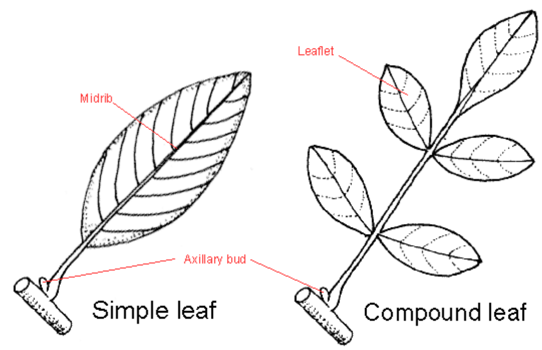
   A. **Conifers with needle-like leaves** –Closely examine a conifer sample with needle-like leaves. Look to see if each needle attaches singly to the twig or if the needles are attached to the twig in bundles of needles grouped together. This is one clue you may need to look for when identifying a mystery tree.



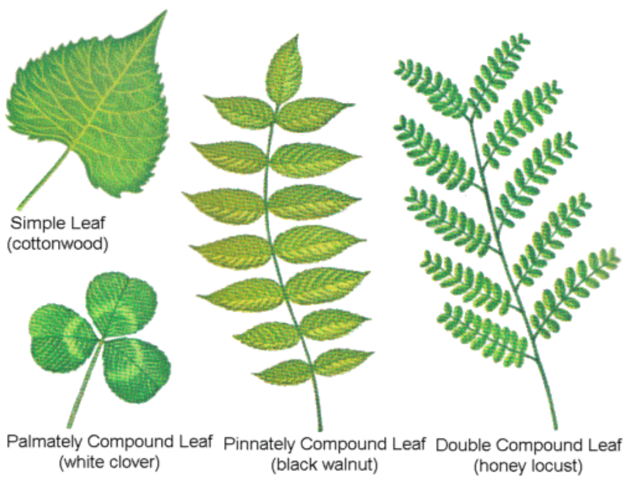
   B. **Conifers with scale-like leaves** – Look closely at a sample of a conifer that has scale-like leaves. Point out how the tiny, scale-like leaves overlap each other. Some of these conifers may have cones that look more like small berries. Make sure you can distinguish between conifers with needle-like and scale-like leaves before proceeding to a discussion of broadleaf trees.

2. **BROADLEAF TREES** – Broadleaf trees have thin, flat leaves that are usually shed annually (deciduous). Broadleaf trees bear a variety of fruit and flowers. In the classification process of broadleaf trees, scientists look at two important clues to further separate these trees into groupings. Where the leaf stalk attaches to the twig there is usually a BUD. That bud is next year's leaf, already on the tree. The leaf will fall off, but the bud will remain on the twig through the winter, opening into a leaf the following spring. Point out that if a bud is not exposed or visible, look for a swelling at the base of the leaf to determine attachment. The bud (or swelling) is an important clue...it tells them THE LEAF STARTS HERE!

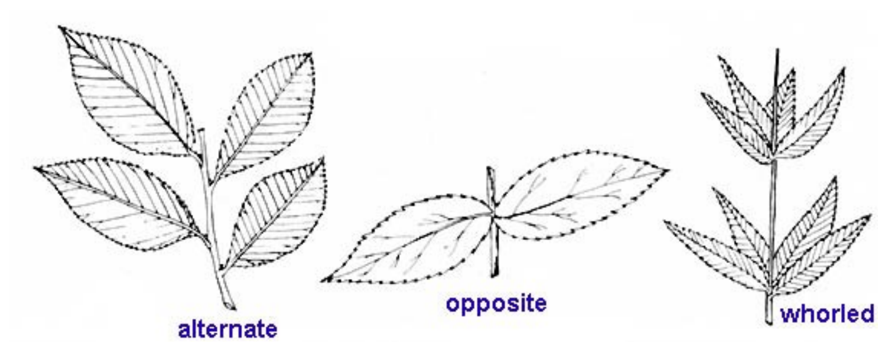
A. **Simple leaves OR Compound leaves** - One important reason to look for the bud is to determine if the tree has simple leaves or compound leaves. Find the bud and then look at the leaf stalk (petiole). If there is just one blade on the leaf stalk, it is a SIMPLE LEAF. If there are many blades on the leaf stalk, it is a COMPOUND LEAF. The multiple blades of the compound leaf are called LEAFLETS.



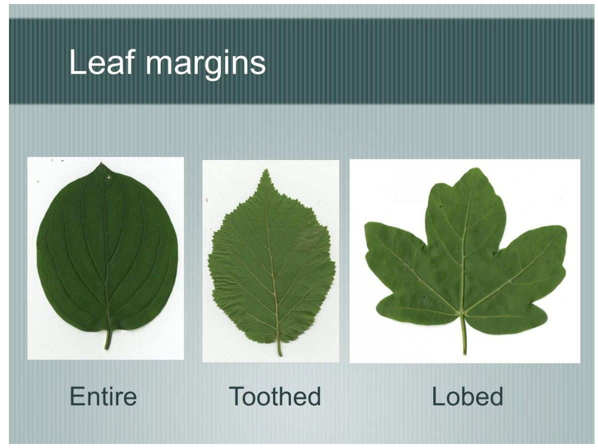
Also important to know is that the LEAFLETS of the compound leaves are attached to the leaf stalk (not the twig) in several ways. When leaflets are attached across from each other on the leaf stalk in a pattern that resembles a feather, that leaf is referred to as a PINNATELY COMPOUND LEAF. If the leaf stalk comes up and branches out again giving the appearance of a number of feathers attached to the leaf stalk, that leaf is referred to as a BIPINNATELY or DOUBLE COMPOUND LEAF. If the leaflets are arranged on the leaf stalk in a pattern that looks like the fingers on the palm of a hand, that leaf is referred to as a PALMATELY COMPOUND LEAF.



B. **Opposite Arrangement OR Alternate Arrangement** – Another very important reason to look for the bud or swelling where the leaf stalk attaches to the twig is that it will also help determine the ARRANGEMENT of the leaves on the twig. When two or three leaves are arranged directly across from each other on the twig it is called an OPPOSITE ARRANGEMENT. When leaves stagger up the twig and are not located directly across from each other on the twig that is called an ALTERNATE ARRANGEMENT. It is very important to stress that opposite and alternate arrangement refers to the way the LEAVES are arranged on the TWIG, not the way the leaflets are arranged on the leaf stalk. Sometimes many buds will be clustered close together near the end of the twig giving the impression of being opposite (often common with oaks) but if you look down a little further on the twig you will see that these buds or leaves actually have an alternate arrangement. A plant has whorled leaves when there are three or more equally spaced leaves at a node.



C. **Margin** – The MARGIN of a leaf is the leaf edge. Some broadleaf trees have leaves with smooth edges or ENTIRE MARGINS. Some broadleaf trees have LOBED LEAVES, leaves with projections that shape the edge of the leaf. Some broadleaf trees have TOOTHED MARGINS characterized by a saw-like edge on the leaf. Many other factors are important in tree identification. Other things scientists look at are the bark, the seeds/fruits, the shape of the tree, and the shape of the leaf.



Materials:

Various books about Trees (book ideas https://www.readbrightly.com/books-inspire-kids-love-trees/)

Science journal   Leaf samples (conifer & broadleaf)   Chart paper

Learning Activity:

- Read to students a book about trees. If the students are not familiar with **OKWHL** introduce these terms at this point.
  (O - What I observe   K - What I know   W - What I want to learn   H - How I will learn it
  L - What I've learned). Tell students they are going to spend some time learning to identify trees in their neighborhood.

- Start a OKWHL chart to be used for the entire lesson. List all the things students know about trees. (This is the K step of OKWHL.) Lead students in a discussion of how to identify trees. Guide students to list all the things they may need to know to identify trees in their neighborhood. (This is the W step of KWL.)

- Students may have listed leaves as a means of tree identification. Continue discussing leaves as a means of tree identification. Introduce leaf terminology at this point.

- Students will go on a field trip around the school to collect leaves from as many trees as possible. Students can bring in leaf samples from the trees in their own yard. Students may also use a digital camera to photograph the trees for future reference and later activities.

- Explore some of the things that make trees/leaves unique.
  - Does the tree have needles or flat leaves?
  - What color are the leaves?
  - What is the size of the tree? What is the number of leaves on the tree?
  - Do the leaves grow far apart or close together?
  - What do the flowers, berries, nuts look like?
  - What do the flowers/leaves smell like?
  - How do the leaves differ from each other?

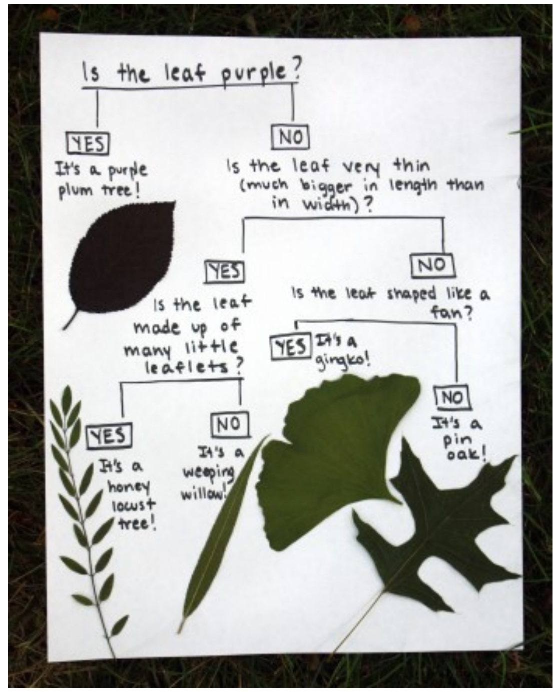
- Investigate different kinds of trees and how they grow. Identify trees by their bark and leaves. Take photographs of trees/leaves/bark, label. In science notebooks/journals, students can be encouraged to draw a picture of various trees and/or write a description.

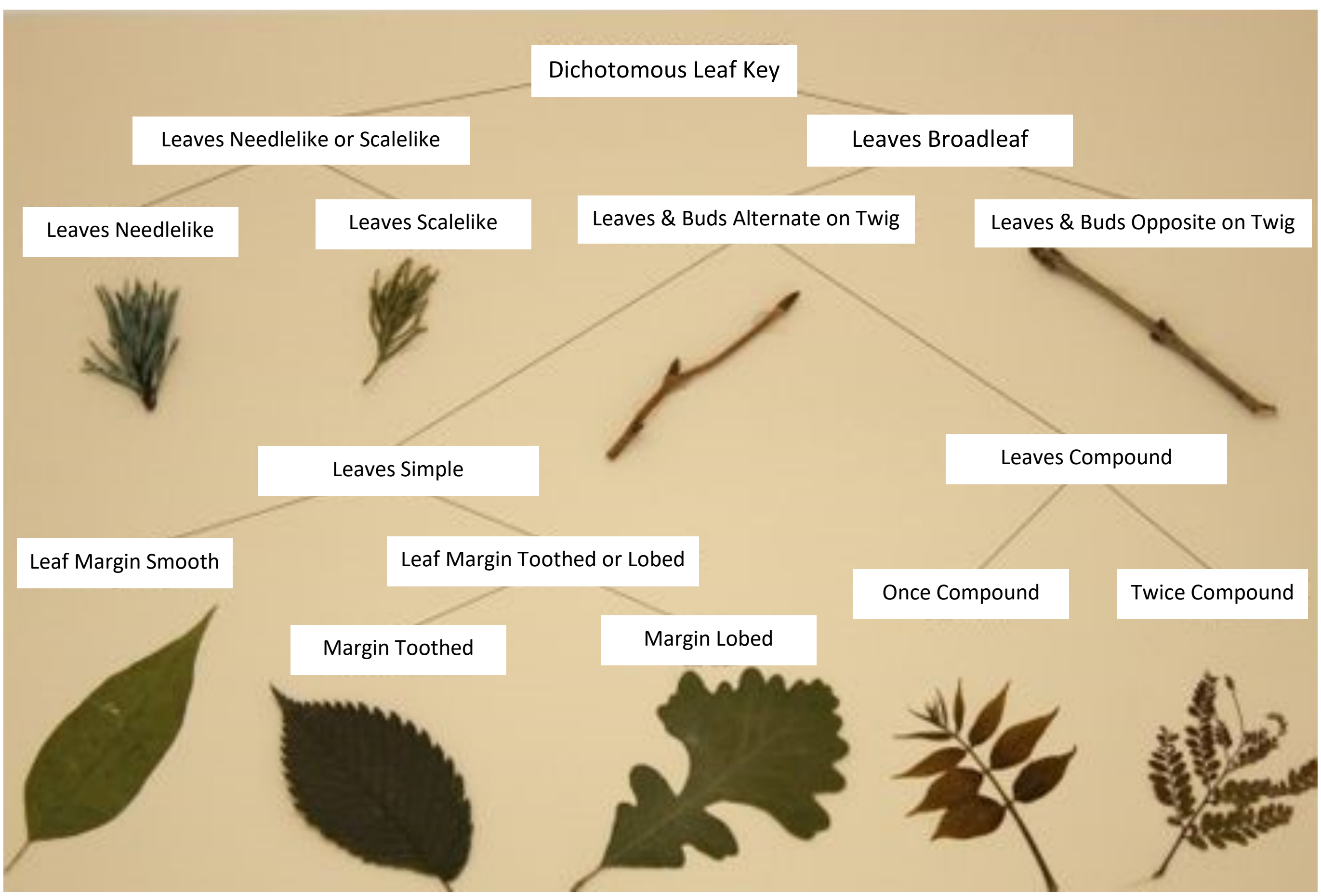
- Have students create a dichotomous key to sort the leaf samples. The key can be simple or complicated, depending on the grade level. You can also determine what vocabulary you want students to use in their key.

- For example, younger students can sort the leaves by using words like Large or Small? Wide or Narrow? Long or Short? Rough or Smooth? Smooth Edges or Jagged Edges? Heart-shaped or Oval-shaped?

- Older students can use vocabulary such as Conifer or Deciduous (Broadleaf)? Simple leaf or Compound leaf? Are the lobes Pinnate or Palmate? Are leaves arranged Opposite or Alternate? Are the leaf margins Toothed (Jagged) or Lobed?

- Have students use chart paper to create various dichotomous keys. Encourage students to use different leaf characteristics that will help them sort their leaf samples.





Extension Activities:

- Place the leaves (or pictures of leaves) that the students collected between clear contact paper. Cut around each leaf, being careful to leave about a ½ inch edge of contact paper around the leaf. Give students time to examine the leaves and share with each other their observations. You can help document their observations by recording them on a chart.

- You can facilitate their observations and help them focus their learning about leaves by asking them questions about what they see. For example, ask questions such as:

  ⇒ Do all the leaves look the same?
  ⇒ How are the leaves same/different?
  ⇒ Are there any features that all the leaves have in common?

- You can also facilitate student thinking about the various ways in which they can group the leaves. You could use masking tape to make a grid on a tabletop, and put the contact paper leaves in a basket on the table. Encourage students to sort and classify according to the attributes they see. You can help them see that like leaves belong to the same kind of tree. This is just one way of grouping. Using the grid can also lead to some simple graphing.

- A more complex way of grouping is to have students not only consider size, but also measurement. Exposure to many different kinds of measuring tools in a free-exploration situation allows students to experience the act of measuring. You can put the leaves on a table and make rulers, paper clips, string, tape measures, and yardsticks available.

- Students can create a crayon leaf rubbing which is a fun way for students to see some of the details of leaves.

- One option for having students reflect upon their learning is to utilize journals. You might ask students to choose one leaf that they would like to put in their journal. They could use their journal pages to respond to promptings like the following, in words and/or pictures:
  ⇒ When I look at my leaf, this is what I see.
  ⇒ This is what I want to remember about my leaf.
  ⇒ This is what I can tell you about my leaf.
  ⇒ There are a lot of ways to sort leaves, for example….
  ⇒ This is how leaves change over time.

- In responding to these ideas, students will be practicing their observation, documentation, and communication skills. They will also be thinking about and integrating the types of things they have learned about leaves through this lesson.

Additional Resources:

https://serc.carleton.edu/sp/mnstep/activities/26457.html

https://www.arborday.org/trees/whattree/whatTree.cfm?ItemID=E6A

https://www.readbrightly.com/books-inspire-kids-love-trees/

http://sciencenetlinks.com/lessons/look-at-those-leaves/

PHOTOSYNTHESIS

Lesson Objective: The Learner will explain the process of photosynthesis, list the components necessary for photosynthesis to take place, and compare plants that are missing necessary components.

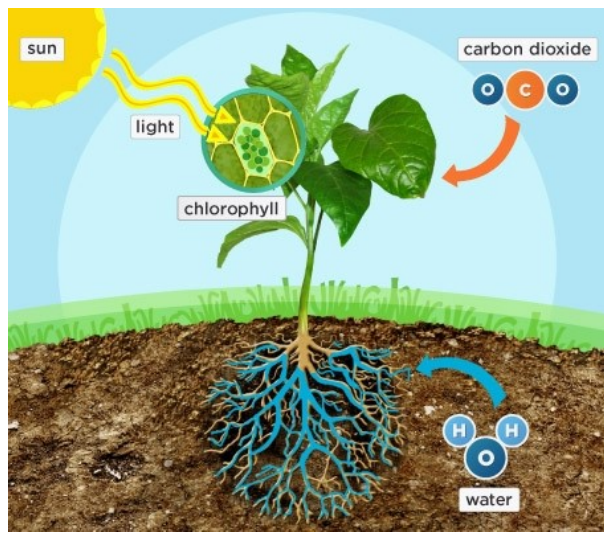
Key Questions: What do trees/plants need to grow? How do trees/plants make food? What happens to trees/plants if they don't have what they need to make food?

Background Information:

Every cook needs ingredients to make a meal. Consider a simple sandwich: cheese, tomato, and all the ingredients that go into the bread: flour, water, salt and yeast. Oh, and don't forget the pickle! But if you're a plant, you'll make your meal through photosynthesis—and all you'll need is a little light, water, and carbon dioxide.

Animals (including us!) need energy to grow and thrive. We get that energy from eating food. Plants need energy, too, in order to grow and reproduce. Plants use light energy from the sun to produce the food they need to survive. This process is called **photosynthesis**.

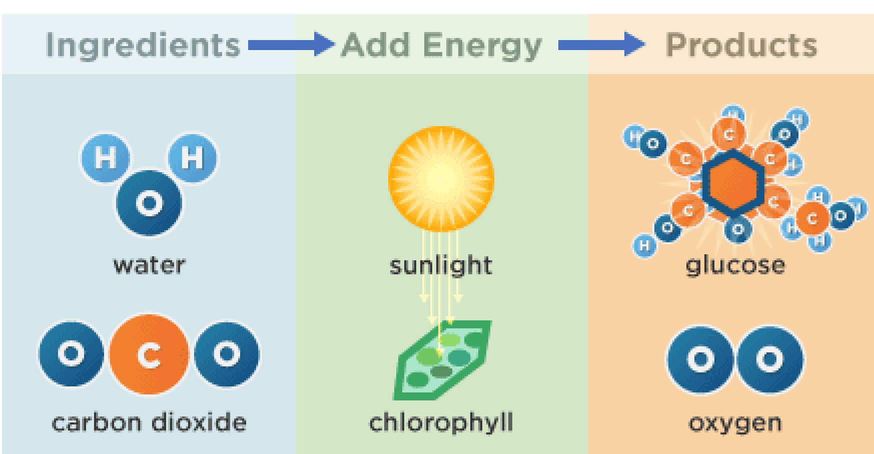
The word **photosynthesis** contains clues to its meaning: the prefix *photo* comes from a Greek word meaning "light." The root *synthesis* comes from another Greek word meaning "to put together." Through photosynthesis, plants use the energy of light to put a meal together using water and carbon dioxide. To absorb the light, the plants use chlorophyll, the pigment that makes leaves green.



Photosynthesis is the process through which plants make their own food.

The food plants make is a carbohydrate, or sugar, called glucose.

In the process of photosynthesis, plants also release a gas we all need: oxygen.



Here's a diagram that shows the ingredients plants use and the products plants produce in the process of photosynthesis.

If we were to rewrite this diagram as a chemical formula, we would get:

$$\text{water} + \text{carbon dioxide} \xrightarrow{\text{light}} \text{glucose} + \text{oxygen}$$

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

The C's, H's, and O's in this formula are symbols for **chemical elements**, like those you'd see on the **periodic table**.

C = carbon **H = hydrogen** **O = oxygen**

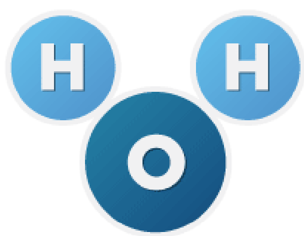
So H_2O is the chemical formula for water. It shows that water is made up of the elements hydrogen (H) and oxygen (O).

The capital letters in chemical formulas stand for chemical elements, and the *subscript* number after the element symbol tells you how many atom(s) of that element are in the molecule.

For instance, one **molecule** of water, or H_2O, is made of 2 hydrogen atoms and 1 oxygen atom. The $_2$ after the H means there are 2 hydrogen atoms. If there is no number following an element symbol—like O in H_2O—that means there is only 1 atom of that element.

Here's a model an **H_2O** molecule:

Note: We can't see actual molecules and atoms with the naked eye. One droplet of water is made up of *trillions and trillions* of H_2O molecules.



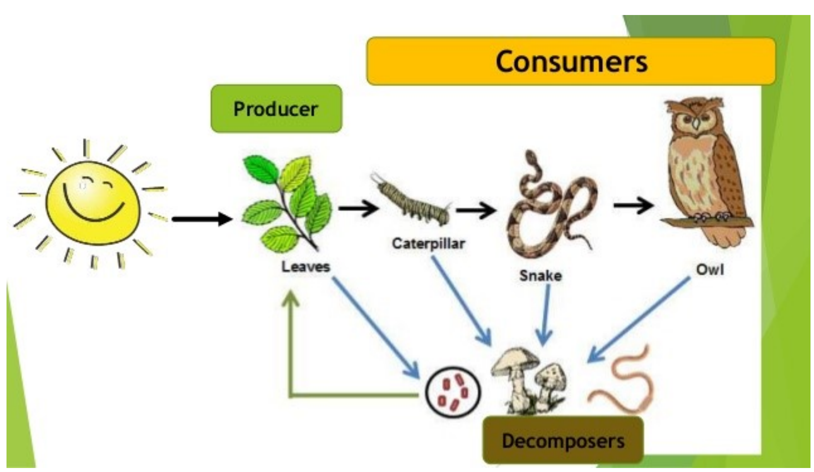
Whenever you sit down to a good meal, say a word of thanks to photosynthesis. With a little light, water, and carbon dioxide, plants produce food for themselves and for the animals that eat the plants. Whether you eat a salad or steak, you're powering up on the energy captured by photosynthesis.

The flow of energy through an ecosystem begins with plants- they are the producers. Every consumer in the ecosystem depends on plants for the energy they need to survive.

Through photosynthesis, plants can make their own food: glucose. Organisms like plants that make their own food are called **producers**.

Animals—fish, reptiles, birds, and mammals (like humans)—must get their food by eating other organisms like plants and other animals. Organisms that get their food by eating other living things are called **consumers**.

After learning about the process of photosynthesis, the lesson can naturally be extended to discuss PRODUCERS, CONSUMERS, and DECOMPOSERS and their role in nature's food web.



Materials:

Two small, healthy potted plants with larger leaves for each group of students

Enough construction paper squares (cut a little bigger than the size of a leaf) for each group to fully cover all the leaves of one plant

One piece of white construction paper per student

One piece of notebook paper per student

Pencils, colored pencils, crayons

Stapler

Science Journal

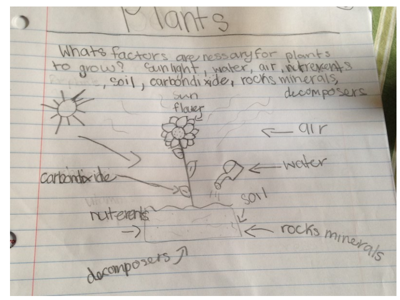
Paperclips

Activity sheet on Photosynthesis

Learning Activity:

- Ask students: What factors are necessary for a plant to grow?
- Have them write their answers in their Science Journal, as well as to draw a diagram of what plants need. Here are a few examples:

  Plants need sunlight, water, nutrients, air, carbon dioxide, soil



- Show students a picture of a plant or a live plant and ask them to think about what they already know about plants, particularly that they are living, and living things need food. Have the class brainstorm ideas explaining how a plant gets its food. Record their ideas on the board.
- Discuss the process of **PHOTOSYNTHESIS** using diagrams or videos. A good video for primary students is: https://youtu.be/D1Ymc311XS8. A good video for upper elementary students is https://youtu.be/LEQqd91uWsY.
- Write the key vocabulary words on the board. Discuss what each terms means in relation to photosynthesis, and the products it creates.
- Now ask students to think about what happens to the process of photosynthesis if sunlight is not available. Have them write a hypothesis stating what they think will happen to a plant if it can't get the sunlight it needs. Encourage them to use the key terms in their hypothesis and share a few of their answers.
- Break the class into groups and give each of group 2 identical potted plants. Have students observe the plants, and discuss what they see (leaf color, soil condition, etc.) and how it relates to what they know about photosynthesis.

- Pass out one piece of construction paper to each student and have them fold the paper in half horizontally (hamburger fold). On the top half of the paper, ask them to use colored pencils or crayons to illustrate their hypothesis and draw a picture of what they think a leaf would look like after 5 days with no sun. Staple the notebook paper with the hypothesis to the illustration and collect for later use.
- Give each group enough pre-cut construction paper squares and paperclips to cover all the leaves of one plant. Students will place a piece of construction paper over the leaf and paperclip it so that it stays. When they are finished, one plant will have all its leaves covered in construction paper squares and the other will have its leaves exposed.

- Put all the plants in a place where they will receive bright sun for the next 5-7 days. During those days, have students check the plants to see if they need water, and discuss any observations they make regarding the difference in the plants, but do not remove the construction paper squares.
- After 5-7 days, break students back into their groups and return their plants to them. Ask them to carefully remove the construction paper squares and observe the leaves of that plant. Discuss their observations.
- Pass out their hypothesis papers and ask them to illustrate what they see on the bottom half of the folded construction paper, below their first illustration.
- When they finish their illustration, have them write a conclusion about what really happened, using the key vocabulary terms, and if their initial hypothesis was correct.

<u>Lesson Extension</u>

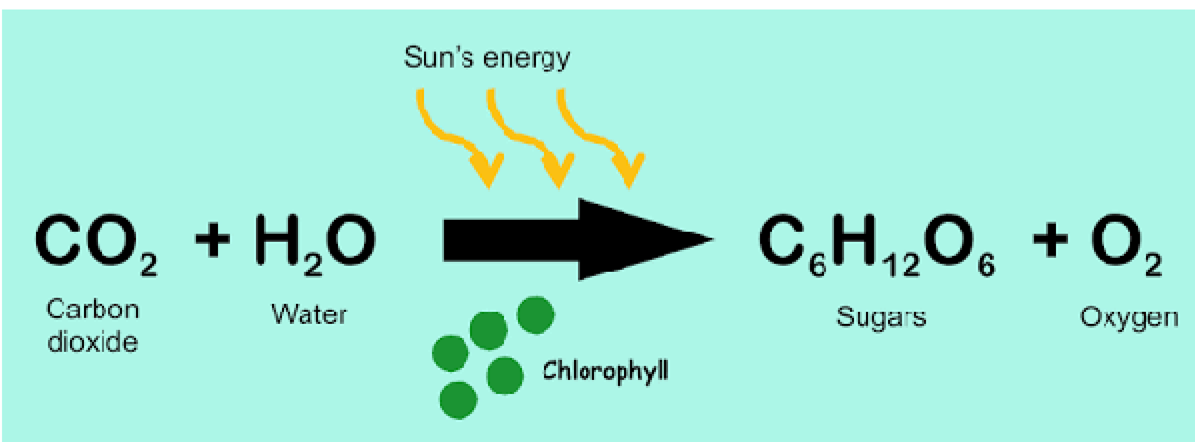
- Materials Needed: Unifix cubes or legos (6 red, 12 blue, 18 green)
  Stickers that say "The Sun's Energy"
- Use unifix cubes, legos, pattern blocks (or similar manipulatives) to lead students in a discussion about the chemical formula for photosynthesis.
- You will need 6 red cubes (Carbon), 12 blue cubes (Hydrogen), and 18 green cubes (Oxygen)

$$\text{water} + \text{carbon dioxide} \xrightarrow{\text{light}} \text{glucose} + \text{oxygen}$$

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

- Ask students, "*What is water made of? What elements? Do you know other names for water?"* This question should lead to the idea that water is made of H_2O.
- Write H_2O on the board next to the key. Ask, "*What does H_2O mean? Can you make H_2O out of the blocks that are provided?"* Water is made out of two hydrogen atoms and one oxygen atom (two green blocks and one blue blue).
- Tell students; "*Plants take in six molecules of water at a time. Please make six molecules of water."* Write on the board "6 $H_2$0 +"
- Ask students, *"Plants need water to survive. What else to they need?"* Allow students to answer carbon dioxide.
- Ask students, *"What do you think carbon dioxide looks like?"* Allow them time to build their idea and then invite students up to explain their thinking. Carbon dioxide is made up of one carbon atom and two oxygen atoms (one red and two blue blocks), have them use the remaining blocks to make carbon dioxide.
- Ask students, *"How many molecules of carbon dioxide did you make?"* When students answer six, add this to your equation on the board: "6 H_2O + 6 CO_2"
- Ask students, *"What else does a plant needs to survive?"* Most likely they will answer sunlight. Ask, *"What is the sunlight made out of? Are there any more blocks to make more molecules? What can you tell about sunlight?"* With guidance, students should conclude that sunlight is an energy source.

- Ask students, *"What is the energy source in this model? What is moving the blocks?"* They will answer that they are the energy source in the model, and they should realize that in this model they are playing the role of the sun.
- Give each student a sticker that say's "The Sun's Energy," so they can remember that they are the energy in the model.
- On the equation on the board of "6 H_2O + 6 CO_2" write the "Sun's Energy" and draw an arrow toward the equation to show that it helps the reaction take place but is not part of the molecular equation itself.
- Ask students, *"What does a plant release during photosynthesis?"* Students should answer with oxygen. Tell students that, *"a plant does give off oxygen. In fact, it gives off six molecules of oxygen in the form of O_2. Can you **REARRANGE** your blocks to make six molecules of O_2?"*
- Add oxygen to your equation, "6 H_2O + 6 CO_2 $\longrightarrow$ 6 O_2"
- Say to students, "*Now look at all the blocks you have left. What else can the plant make? Use the blocks to make only one molecule of the last remaining chemical a plant makes during this chemical reaction. Figure out the molecular equation and write it down yourself from the blocks you have left."*
- Have students share the chemical equation of the molecule that they have left. They should come up with $C_6H_{12}O_6$. Add that to the equation "6 H_2O + 6 CO_2 $\longrightarrow$ 6 O_2 + $C_6H_{12}O_6$".
- Ask students what they think this is. Tell them that, *"this molecule is called glucose. It is really a type of sugar. Plants go through a process called photosynthesis to make this sugar. When you eat plants, you consume the sugar."*
- If you want students to show the entire chemical formula with their blocks, you will need double the amount (12 red, 24 blue, 36 green). This will demonstrate that a BALANCED FORMULA shows the same amount of each element is used on both sides of the formula.



Additional Resources

http://www.tv411.org/science/tv411-whats-cooking/photosynthesis-science-lesson

https://educators.brainpop.com/bp-topic/photosynthesis/

https://study.com/academy/popular/photosynthesis-lesson-plan.html

Videos: primary students https://youtu.be/D1Ymc311XS8.

upper elementary students is https://youtu.be/LEQqd91uWsY

NAME: ________________

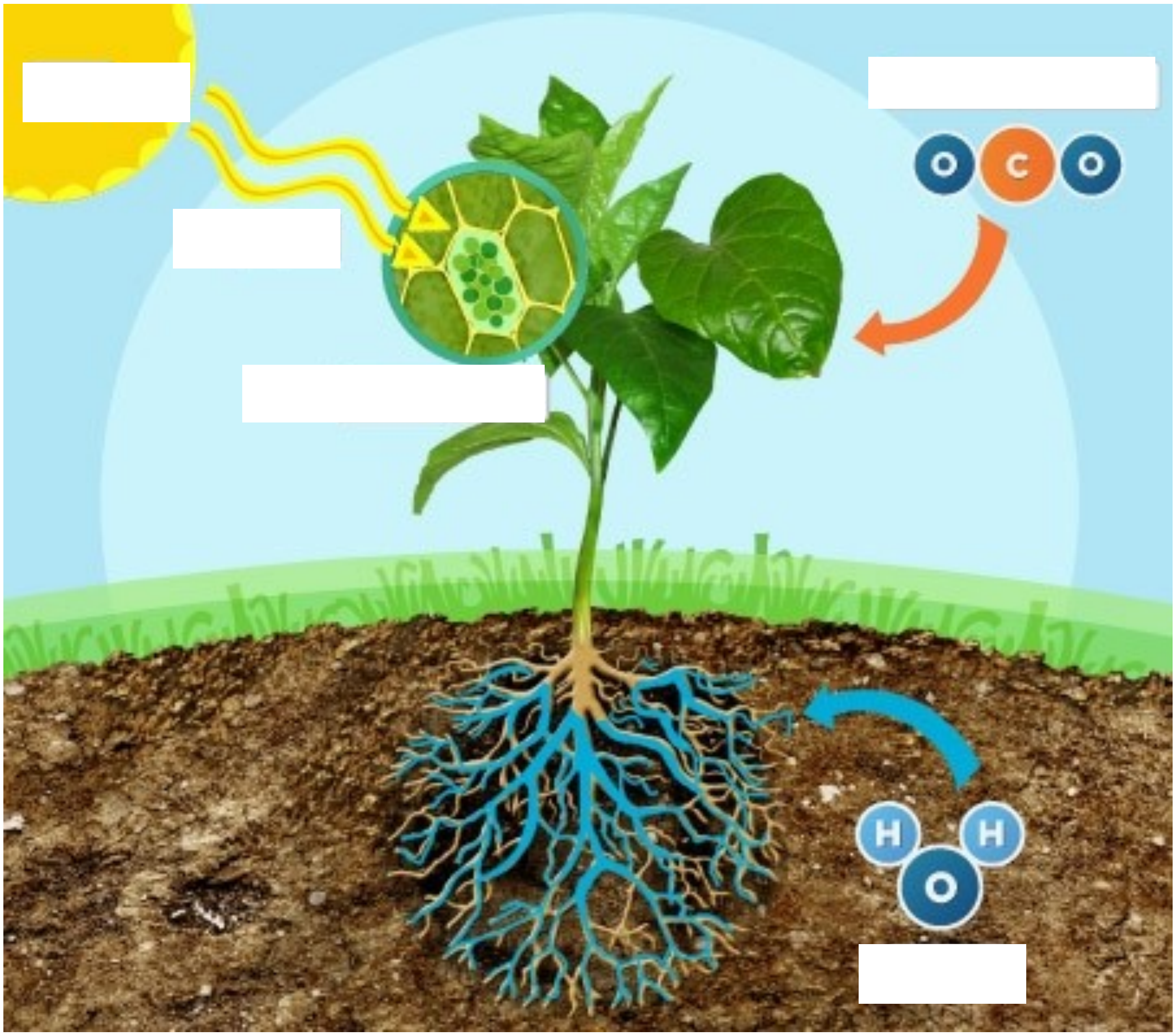
PHOTOSYNTHESIS

Describe the process of PHOTOSYNTHESIS: ____

____

Use these words to label the diagram:

WATER **CARBON DIOXIDE** **LIGHT** **CHLOROPHYLL** **SUN**



What do plants make during photosynthesis? How does photosynthesis benefit you?

TRANSPIRATION: THIRSTY GREENS

Lesson Objective: The Learner will describe the process of transpiration and demonstrate a plant's ability to absorb and evaporate water.

Key Questions: Why do plants require so much water to survive?

Background Information:

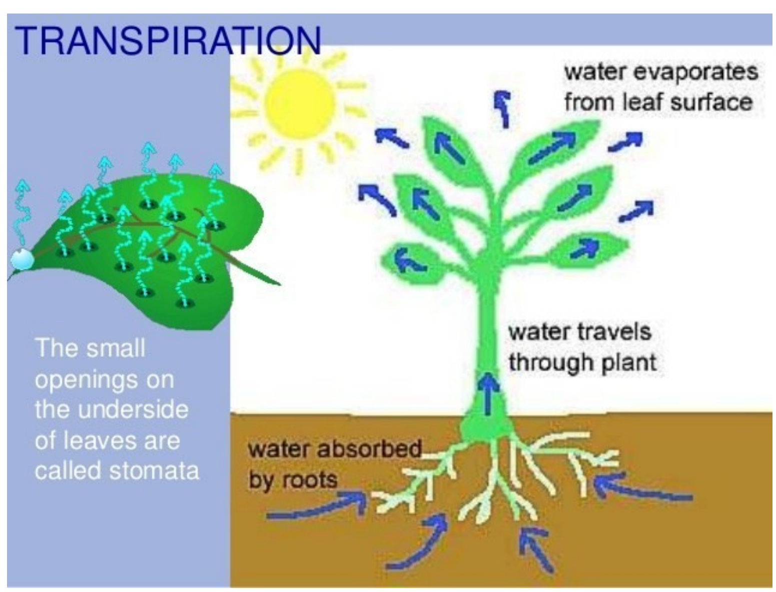
Plants have many important functions, like making leaves, making flowers and seeds, and storing starches in the roots. But we are usually unaware of an invisible process called **TRANSPIRATION**. Plants lose gallons of water every day, mainly through the pores in their leaves, through a process called **TRANSPIRATION**.

It is estimated that 98% of a plants energy is used in the work of transpiration. How does this process work? and why is it so essential to a plant?

Water moves from the soil into plant roots, up through the sapwood into the leaves. The water, warmed by the sun, turns into vapor (evaporates), and passes out through thousands of tiny pores (stomata) mostly on the underside of the leaf surface. This is transpiration. It has two main functions: cooling the plant and pumping water and minerals to the leaves for photosynthesis.

Plants need to cool themselves for several reasons. When temperatures are too high, energy systems (metabolic functions) slow, and growth and flowering slows or stops. In extreme heat, plants are severely stressed and can die. Sometimes heat will cause bubbles to form that block the flow of water, leading to dehydration. Transpiration is an evaporative cooling system that brings down the temperature of plants, but since it leads to water loss, it must be accurately regulated. The ingenious system that regulates this function consists of a guard cell on each side of the tiny pores (stomata). When water moves into the guard cells, they swell and arch open; as water moves out, the guard cells relax and close. The guard cells are sensitive to light intensity, temperature, wind, relative humidity and carbon dioxide concentrations inside the leaf.

The stomata (pores) must open to take in carbon dioxide for photosynthesis (especially important on mornings of sunny days). And the more they are open, the more plants transpire and lose water. So watering plants early in the morning will support plant energy, especially on hot summer days.



What causes water to rise up through a plant (sometimes 100 feet or more) against the force of gravity? This is achieved by the pumping action of transpiration, which is another ingenious system. It depends on the tiny (capillary) xylem water channels, the extremely strong cohesive (bonding) properties of water molecules, and a sucking force created when water at the top of the channels evaporates. Like sucking on a soda straw, transpiration causes a negative pressure which lifts the column of water to the leaf surface.

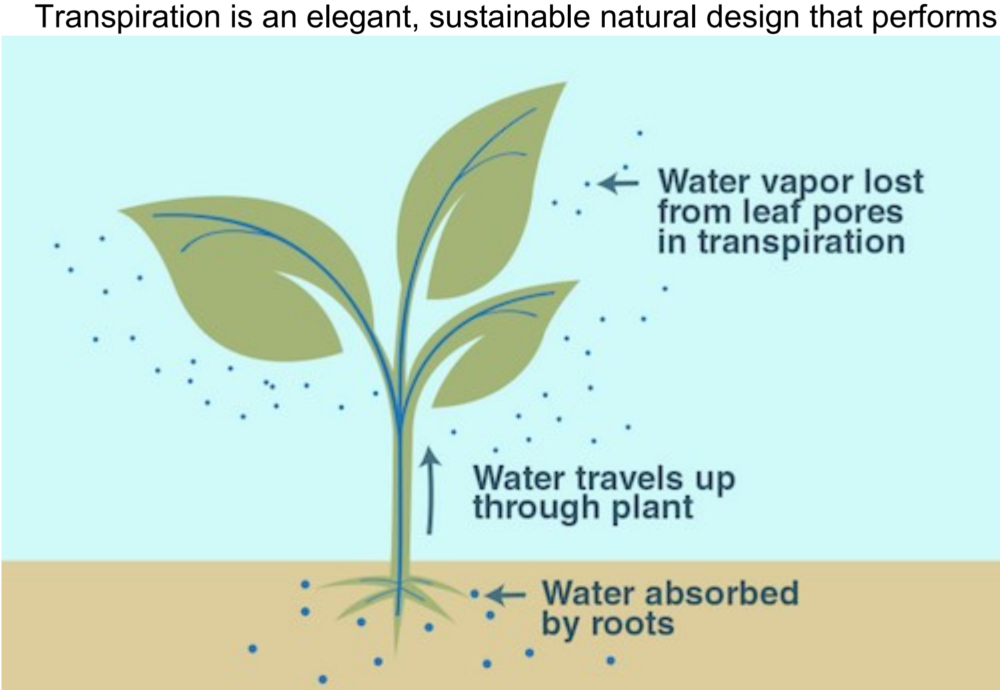
As plants transpire, the soil becomes dryer. Then in summer, if the soil becomes very dry, plants cannot transpire enough to keep cool. In desperation plants may start losing leaves or completely defoliate as a way to keep transpiration from dehydrating the plant. In order to help our plants keep cool and keep them photosynthesizing, we can give them extra water in the hottest, driest months. We can plant wind breaks and trees and shrubs that will offer a little shade, and we can mulch to keep soil moisture from evaporating.

The state of evaporation will depend on several variables. Transpiration increases in dry air and decreases in moist air. Factors that affect air moisture levels also affect transpiration rates. Consequently, plants lose more water on hot, dry days than on cool, moist nights. Windy conditions also increase transpiration rates because the evaporated moisture around a plant is more quickly carried away to be replaced by drier air.

Plant wilting is related to transpiration. The plant's stiffness depends on the pressure of protoplasm against the plant cell walls. Protoplasm consists mostly of water. When the loss of water through transpiration is greater than the ability of the plant to replace the water, wilting occurs because the protoplasm no longer exerts the same pressure on the cell walls. When the pressure of the protoplasm decreases, the cell walls lose some of their rigidity, and the plant wilts.

Plant transpiration is pretty much an invisible process, since the water is evaporating from the leaf surfaces, you don't just go out and see the leaves "sweating". Just because you can't see the water doesn't mean it is not being put into the air, though. During a growing season, a leaf will transpire many times more water than its own weight. An acre of corn gives off about 3,000-4,000 gallons (11,400-15,100 liters) of water each day, and a large oak tree can transpire 40,000 gallons (151,000 liters) per year.

Transpiration is an elegant, sustainable natural design that performs its vital functions without electricity, without fossil fuels and without moving parts. It does not pollute or use excessive resources. It actually adds moisture to the atmosphere and contributes to rainfall.



Materials:

Celery stalks with leaves Mason jars Food coloring Science journal

Learning Activity:

- Take one stick of celery off the bunch and cut the bottom 2 cm off of the stick. Cut your celery stems on a diagonal to allow the greatest possible surface area for the colored water to pass through (like when cutting fresh flower stems to put into a vase.) Choose a length of celery that won't tip over your cup of water when it's placed in the cup.

- Add some food coloring to the cup of water (make the color quite dark).

- The celery should be able to lean against the cup without tipping it over. Put the cut end of the stick of celery into the cup of darkly colored water.

- Leave the cup and celery for at least half an hour. Check on the leaves regularly to see if there is any discoloration at the ends of the leaves.

- Look near the outside of the cut celery stem. Cut the celery stick around halfway up, and have a look at the inside of the stem. Can you see where the food coloring went?

- Try testing different variables (different colors, different plant types, sugar or salt in the water, etc).

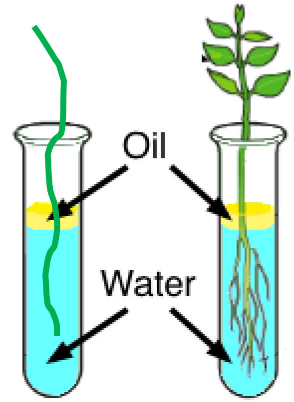
- You should have seen that the food colored water travelled up the stem of the celery and into the leaves. How does food color get up there? Gravity should be holding the water down, right?

- Water is found all the way through the celery: in the stems, the leaves and the roots. The water in the leaves of the celery evaporates through the surface of the leaves, and this leaves a space inside the leaves where the water was. This process is called transpiration. That new empty space inside the leaves creates a low pressure, and like a drinking straw, this low pressure allows water below the leaf to travel up the stem. You'll see the little tubes the water travels up when you cut the celery stem, and you can see the color up in the leaves. These tubes are called Xylem and are part of the plant's vascular system. This how plants transport the water and nutrients from the soil up to the very highest leaves. The tubes that transport sugars from the leaves downwards are called phloem.

Lesson Extension:

Materials: Twigs with leaves Quart-sized Mason jars Science journal Oil

- Find two twigs with leaves on them. Put each one in a separate quart-sized Mason jar.
- Remove the leaves from one of them.
- Add exactly the same amount of water to both jars and mark the level with a permanent marker.
- Very carefully, pour a layer of oil onto the water to keep it from evaporating.
- Leave the plants in the jars undisturbed for five days.
- Each student will record daily observations in their science notebooks of what happens to the water level in the jars each day.
- At the end of the five days, compare the water levels in each jar. Record your findings in your Science notebooks, and be sure to finish the Scientist Checklist.
- Questions for Science journal:



⇒ Write a Hypothesis/Prediction.
"I think ______________ will happen because ______________."
Or, "If _______________ then_____________ will happen because__________________."

⇒ Be thinking: What was my evidence? Why does the evidence support my claim?
"I claim that when _______________, then ___________________."
"I know this because I observed _____________________."

⇒ Write a Conclusion.
"The evidence supported/did not support my hypothesis because
____."
How was your hypothesis supported by the evidence, or how would you revise/change your thinking based upon your findings?
"I learned ___________________________________."
Or "In conclusion ________________________________."

⇒ Write a Reflection.
"I would like to learn more about ____________________."
"I was surprised when ___________________________."
"This reminds me of ______________________________."
"Now I wonder ___________________________________."

Additional Resources

http://www.harlequinsgardens.com/mikls-articles/what-is-transpiration-and-why-should-we-know-about-it/

https://www.wesselmanwoods.com/wp-content/uploads/TREE-MENDOUS-TREES-Supplement-Lesson-Plans.pdf

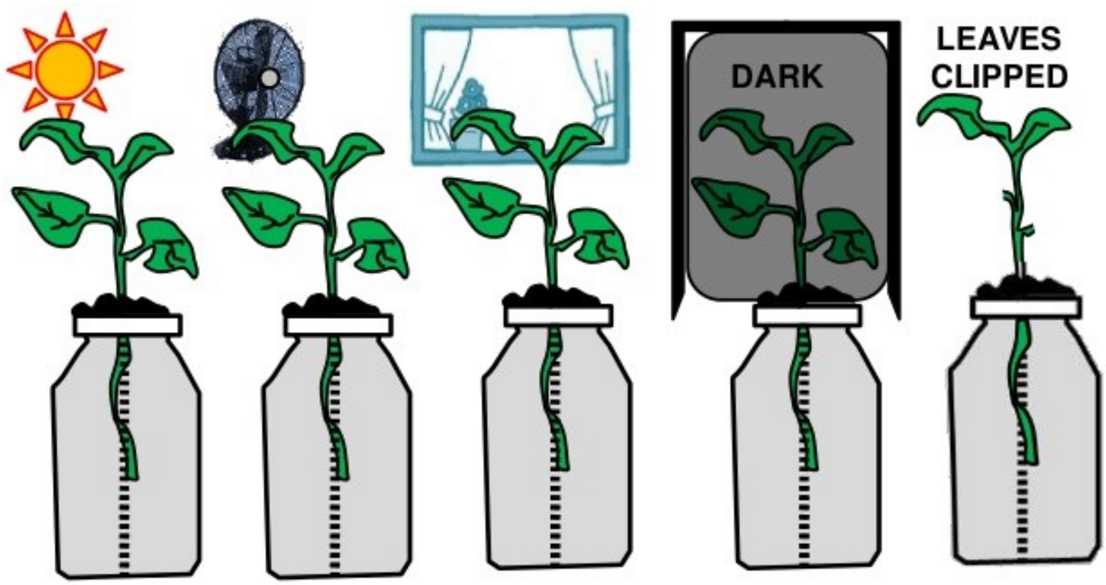
https://www.fizzicseducation.com.au/150-science-experiments/botany-experiments/celery-transpiration/

Lesson Extension:

Try this experiment!

This experiment is exciting. Look at Celery stalk that has been divided into two parts. Each part is put in different colours. after about 1 day, you'll notice that the water carrying tubes in each half will be different in colour – according to the colour of water they were put in.

Each celery is put into different coloured water. after a day, take out the celery stalks and cut across the stem. You will notice that the water-carrying tubes in each will have the colour of water that the stem was put in.



Place the five set ups under different environmental conditions. The first set up should be placed in sunlight. The second should be placed close to a fan. The third should be placed near the window but in shade. The fourth one should be kept in a dark corner, while in the fifth remove half of the leaves from the twig. Measure the change in water level after every 30 minutes. Record your observations and discuss.

POLLINATION: FLOWER TO FRUIT

Lesson Objective: The Learner will identify the different parts of a flower, describe their functions, and understand the importance of pollen/pollinators for plant reproduction and diversity.

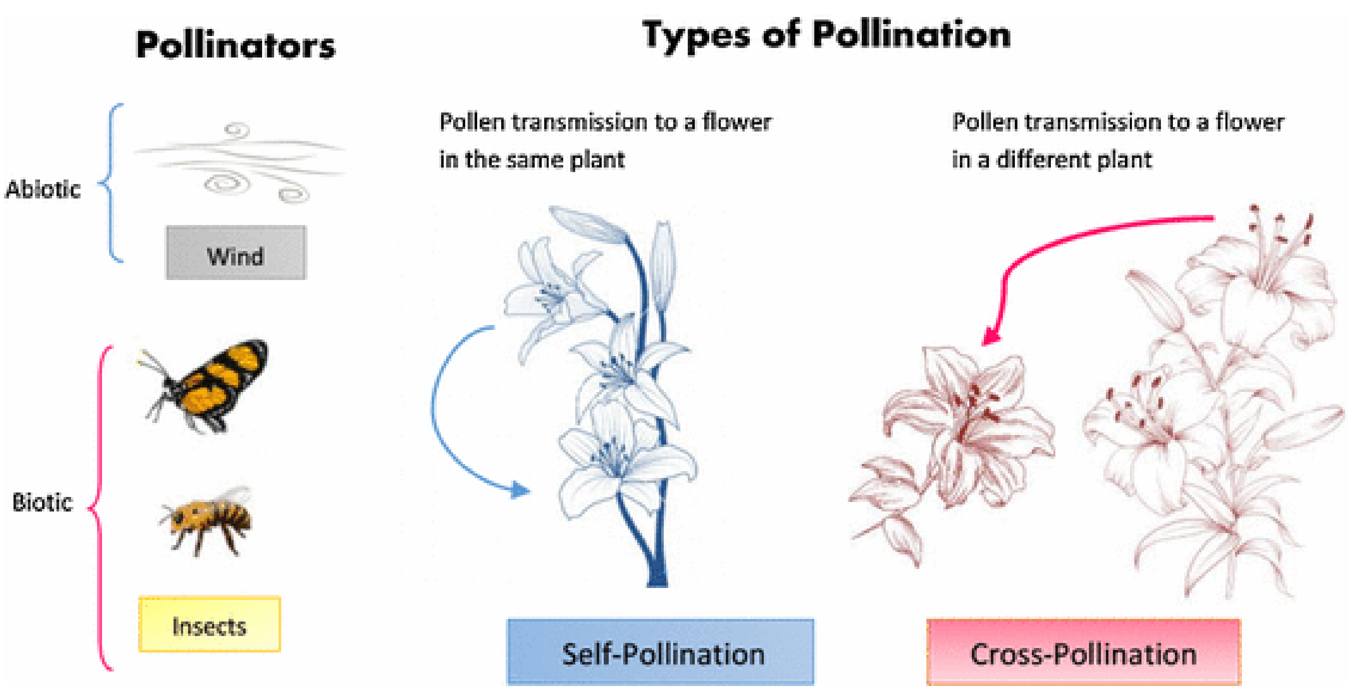
Key Questions: How do plants reproduce? What is pollination? What attracts pollinators to flowers? How does fruit form?

Background Information:

For angiosperms, or flowering plants, to reproduce, they go through pollination, create fruits, and disperse seeds. For the students, it is useful to describe the process in four steps: flower, pollination, fruit, and seed dispersal. In some cases, plants do not need animals for pollination or seed dispersal. In other cases, plants rely on animals for both processes and must attract each animal in a different way.

1. Pollination: Pollination is the transfer of pollen from the stamens to the stigma of flowers. Pollen can be carried by insects, other animals, wind, or water. Self-pollination refers to the process in which pollen lands on the stigma of its own flower or another flower on the same plant. Cross-pollination refers to the process where pollen is transferred to the stigma of a flower on another plant of the same species. Since ovules within the same plant can differ genetically from one another, self-pollination can result in some variation in the offspring. Cross-pollination, in which genetic material comes from two parents, results in greater variation and is therefore considered advantageous.

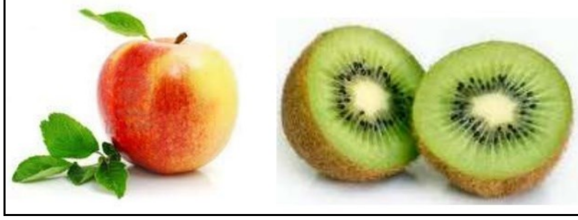
2. Fertilization: Once the pollen grain reaches a compatible stigma, it receives a chemical signal from the stigma. The pollen then produces a tube, which grows down through the style, into the ovary, and into one of the ovules. This allows the male pollen cell to fuse with the female cell inside the ovule. This process if called fertilization. Afterwards, the ovule develops into a seed.



3. Formation of the fruit: After fertilization has occurred, the ovule develops into a seed. The seed(s), surrounded by the ovary wall, develop into the fruit. In some plants, other parts of the flower may also help to form the fruit. Many of the seeds formed inside the fruit do not land in a suitable place for germination or do not survive the early stages of growth. Plants produce large numbers of seeds in order to make sure that at least some of the new plants survive.

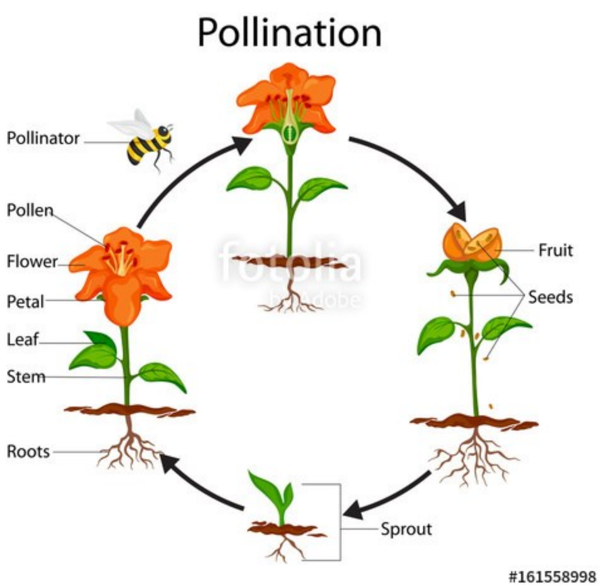
How does fruit form?

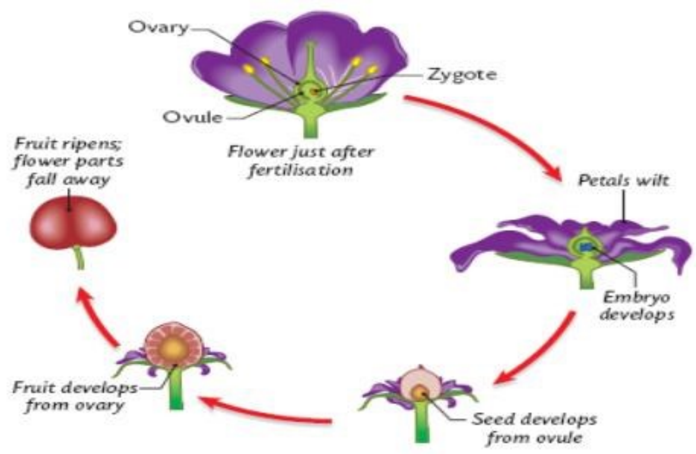
1) A flower is pollinated.
2) Fertilization occurs, and a zygote forms.
3) The ovary where the zygote is swells up and becomes a fruit. Meanwhile, the petals and other parts of the flower fall off so only the fruit is left.



4. Seed dispersal: To avoid overcrowding and reduce competition for light, water and mineral salts, the seeds must spread away from the parent plant and from each other. Seed-containing fruits disperse in four ways:

- *Animal dispersal*. Animals may eat the fruits and drop seeds in other places. The seeds may also pass through the animal's digestive system and be deposited in the animal's feces. Some fruits are covered in hooked bristles that cling to an animal's fur (or your socks) and ensure that the seeds get carried elsewhere.
- *Wind dispersal*. Some seeds are small enough to float in the air. Others have special structures, comparable to wings or parachutes, which keep them airborne for a longer period.
- *Water dispersal*. The seeds of these plants (found in or near water) are buoyant.
- *Self dispersal*. As some fruit ripens, the fruit wall dries and twists until the two halves of the fruit wall are pulled violently apart and the seeds shoot out. Other plants, such as the poppies, produce capsules full of small seeds. When the seeds are ripe, small holes develop around the top of the capsule and the seeds get knocked out by wind and passing animals. This process is nicknamed "pepperpot."





Materials:

Magnifying glasses (microscope)

Science journals

Activity page “Parts of a Flower”

Activity pages “What Attracts Pollinators?”

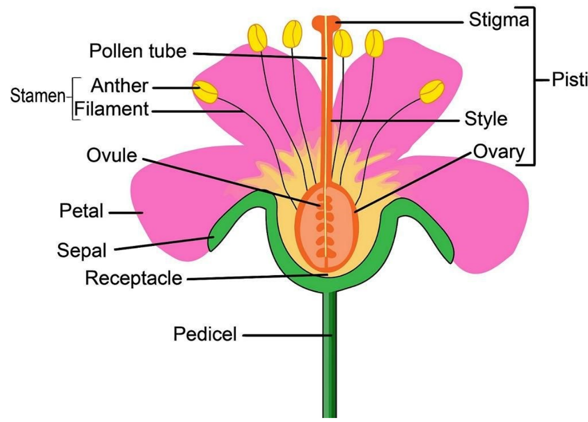
Activity pages “Pollinator Profile”

Activity page “Imaginary Garden”

Real flowers (lilies, irises, daffodils, tulips, gladiolas, poppies, or other large flowers with distinguishable parts)

Learning Activity:

- Ask students questions such as: “What are your favorite flowers?” “Why do plants have flowers?” “Are plants trying to win a beauty contest?” *Flowers are for reproduction - flowers have their traits to attract pollinators.* “Do you think all flowers are trying to attract the same pollinators?” “Why are there so many different types of flowers?” *Different flowers attract different pollinators.*



- Use Activity Page “Parts of a Flower”, or show a flower diagram to students. Flowers have both male and female parts. Pollination is achieved when the pollen from the male part, the stamen, is transferred to the female part, the stigma. This can happen between the male and female parts of one flower (self-pollination) or between separate flowers of the same species (cross-pollination). Flowers can’t do it themselves. What in the natural world can help move the pollen? *Animals, wind, or water!*
- Pass out flowers for students to investigate. Have them peel the petals back to look for the different parts. Can they find all of the parts on the Flower Diagram?
- Why do pollinators (e.g. birds, insects, bats) visit flowers? Most feed on the nectar of a flower. The nectaries are usually located deep in the middle of a flower so that pollinators have to first brush against the anthers, and then the stigma to get to the nectar. Some pollinators, like bees, need pollen in addition to nectar. Some pollinating insects (e.g. some flies) are attracted to flowers by scent but gain no reward when they visit. The insects try to leave quickly but the flowers may have traps to slow the insects down.
- It may be useful to ask a few students to role-play the pollination process. You may also ask students to “hand-pollinate” the real flowers.
- Pass out the Activity Sheets “What Attracts Pollinators?”. Students should take time to read the descriptions of all the flowers and look at the data before completing their observations on the chart provided. Which pollinators are attracted to similar flower traits? Which pollinators are attracted to different flower traits?
- Let students know that they are beginning to construct explanations about what flower features attract their pollinator. Their explanations right now are only based on observations in the field, which is exactly how research scientists build their explanations. In the next step, they will receive more information about their pollinator to modify or strengthen their explanations.

- Divide students into groups (or have students work individually). Assign each group a pollinator: bee, bat, bird, butterfly, moth, or fly. They can pick a name out of a hat or you can assign them.
- Pass out the "Pollinator Profile" cards. Each group should get the Pollinator Profile that corresponds to their pollinator. *Teacher tip: Depending on the size of your class, it may be helpful to have more than one set so it's easier to share.*
- Use the Activity Sheet "Imaginary Garden" to guide the final activity. Each group (or student) will create an Imaginary Garden.
- Once students have read their Pollinator Profile, they will write down 3 flower traits that are attractive to their pollinator using the Activity Sheet "Imaginary Garden". This time, they will have more information to use, so remind students to consider the following:
    - Compare the information in the profile to the data gathered from pollinator observations. This can indicate if it's a trait that the pollinator is attracted to, or is a trait the flower has for a different reason.
    - Encourage students to not just look at the data from the flower their pollinator visited the most, but look at trends amongst all the flowers. For example, bees went to Flower 2 the most, but they also went to Flower 6 – do Flowers 2 and 6 have anything in common?
    - These may end up being the same traits that they wrote down earlier, but they need to be supported by the information they just learned about their pollinator.
- Each group will design an Imaginary Garden. Tell them that their job is to design flowers that that their pollinator would be most attracted to, based on their observation data and the information in their Pollinator Profile. It is important that they look not only at the observable flower traits (color, shape), but the unobservable traits (smell, when it blooms).
- Groups can use craft materials (tissue paper, pipe cleaners, etc.) to create their gardens, or they can simply draw a picture of their garden on construction/butcher paper.

Lesson Extension:

- Ask students what they think would happen to their flower if their pollinator disappeared. Would it survive? If it did, how would it change?
- Take a field trip to a flower garden. Record your observations on what pollinators you see there. Be sure to include notes about the flowers themselves. Did you find anything surprising?
- Dissect a Fruit: After studying a number of different flowers, have students study fruits. What part of the fruit was the ovary? What part of the fruit were the ovules? Compare the fruit structure of apples, berries, and olives (or other one-seeded fruits).

Additional Resources

Lesson adapted from https://www.calacademy.org/educators/lesson-plans/flowers-seeking-pollinators

http://www.discoveryeducation.com/teachers/free-lesson-plans/plant-pollination.cfm

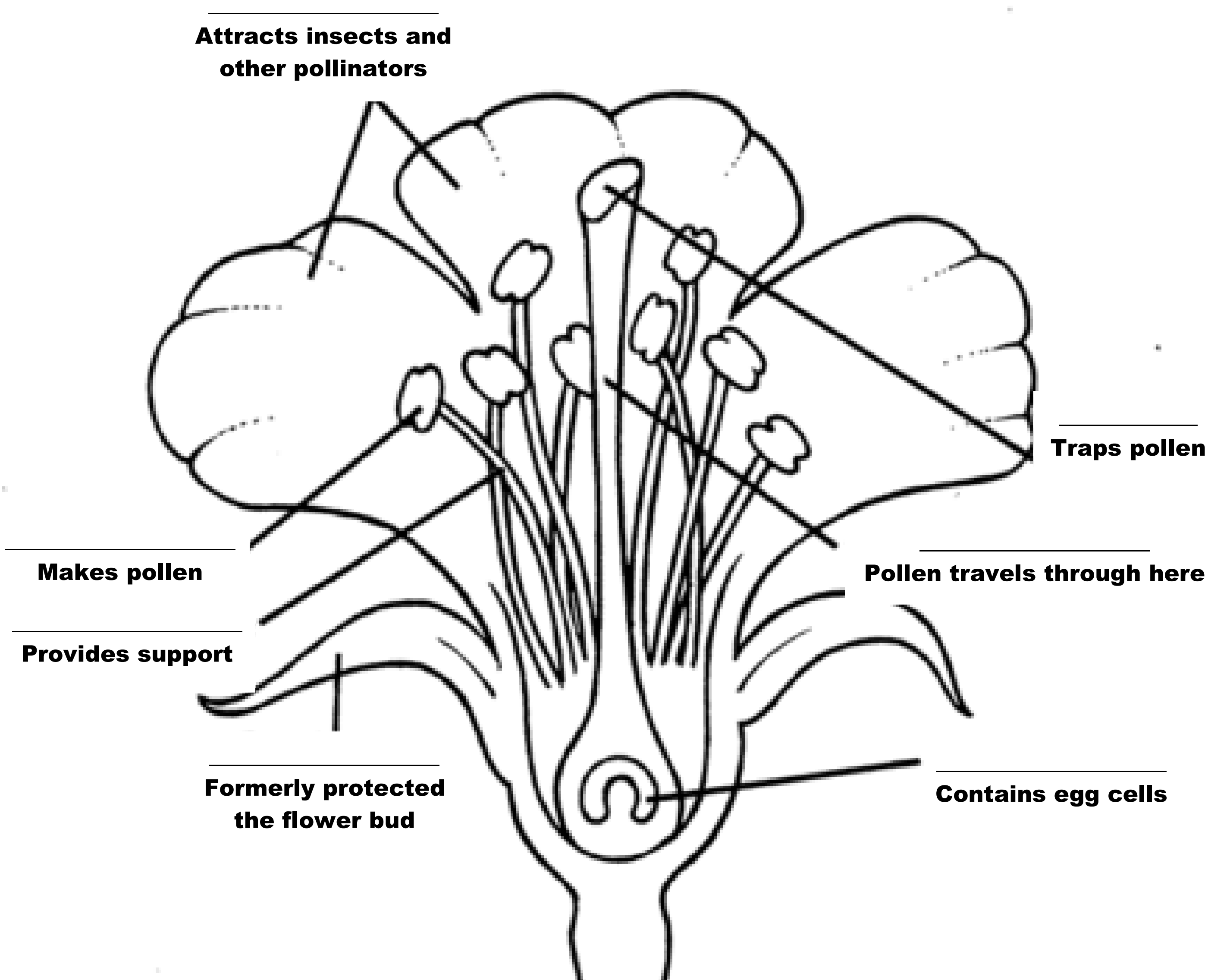
https://www.hunker.com/13429275/how-does-a-fruit-tree-grow-fruit

NAME:____________________

PARTS OF A FLOWER

Use the Word Bank to label the parts of a flower:

OVARY ANTHER STIGMA PETAL STAMEN SEPALS PISTIL



Why is pollen important? ____

____

Can you name 3 animals that are pollinators? ______________________________

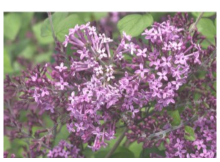
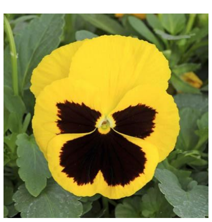
____

What are other ways that pollen spreads (besides animals)? ________________

____

NAME:____________________

WHAT ATTRACTS POLLINATORS?

	FLOWER TRAITS	NUMBER OF POLLINATOR VISITS					
		BUTTERFLY	BAT	BIRD	BEE	MOTH	FLY
	**FLOWER 1** —No scent —Sweet nectar at base of large, long tube-shaped flower —No place to rest while feeding —Flower points down —Blooms during day	5	0	28	0	0	2
	**FLOWER 2** —Sweet, fragrant smell —Sturdy petal platform —Bulls-eye design in center of flower, visible only under UV light —Blooms during day	0	0	0	65	0	30
	**FLOWER 3** —Large white tube-shaped flower —Sweet, fragrant smell —Blooms at night	7	11	0	0	25	0
	**FLOWER 4** —Putrid odor, like rotting meat, carrion, dung, sap or blood —Flower low to ground —Blooms during day	0	5	0	0	18	42
	**FLOWER 5** —No smell —Brightly colored —Small, long tube-shaped flowers	55	0	0	14	3	0
	**FLOWER 6** —Sturdy petal platform —Bulls-eye design in center of flower, visible only under UV light —Blooms during day	0	0	0	44	0	8
	**FLOWER 7** —Large white flower —Strong, musky smell —Sturdy petal platform —Blooms at night	0	19	0	6	12	0

NAME:____________________

WHAT ATTRACTS POLLINATORS?

POLLINATOR	Which flower(s) did it visit the most?	Why did it like this flower?	My conclusion is...
BUTTERFLY			Butterflies are attracted to flowers that are:
BAT			Bats are attracted to flowers that are:
BIRD			Birds are attracted to flowers that are:
BEE			Bees are attracted to flowers that are:
MOTH			Moths are attracted to flowers that are:
FLY			Flys are attracted to flowers that are:

Can you find 2 pollinators who are attracted to similar flower traits? ________________________

____

POLLINATOR PROFILE

MOTHS

- Visit flowers during the nighttime
- Use their long mouth parts to reach inside flowers to drink nectar
- Do not rest on the flower petals to eat
- Attracted to flowers that are pale colors, or white
- Attracted to sweet smelling flowers

FLIES

- Visit flowers during the daytime
- Land on the flower petals to gather pollen
- Attracted to flowers that smell like rotting meat because they lay their eggs on rotten meat
- Like to visit flowers that are low to the ground
- Like to visit flowers that are pale colors with dark brown or purple patches

BIRDS

- Visit flowers during the daytime
- Use their beaks to reach inside flowers to drink nectar
- Do not rest on the flower petals to eat
- Have good vision but a poor sense of smell
- Attracted to bright colors, like red or orange

POLLINATOR PROFILE

BEES

- Visit flowers during the daytime
- Land on the flower petals to gather pollen
- Attracted to sweet smelling flowers
- Seeks bright colors, like yellow, blue, and violet
- Can see colors in the UV spectrum

BUTTERFLIES

- Visit flowers during the daytime
- Use their long mouth parts to reach inside flowers to drink nectar
- Rest on the flower petals when they eat
- Attracted to bright colors, like violet, red, or orange
- Have good vision but a weak sense of smell

BATS

- Visit flowers during the nighttime
- Land on the flower petals to feed on the nectar deep inside the flower
- Attracted to large flowers with strong smells
- Like to visit flowers that are white because they are visible at night

NAME:____________________

IMAGINARY GARDEN

Who is your pollinator? Butterfly Bat Bird Bee Moth Fly

Using the information you have learned about your pollinator, what are 3 flower traits that you think attract your pollinator?

You will create an Imaginary Garden that contains flowers that will attract your pollinator. Use the materials supplied by your teacher to create your Imaginary Garden. Can you think of creative names for your imaginary flowers? Sketch your ideas below.

Write a sentence that explains why these flowers are most attractive to your pollinator:

____

____

____

Compare your Imaginary Garden with your classmate who has a different pollinator. Name one similarity and one difference between the flowers in your garden and your classmate's garden:

____

____

____

____