Cornell Institute for Biology Teachers

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Title: **Plant Dissection Activities**

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Appropriate Level: Grades 4-6

Elementary Science Core Curriculum (NYS): Standard 1: Analysis, Inquiry, Design (Mathematical Analysis): Key Idea 3: M3.1a; (Scientific Inquiry): Key Idea 1: S1.1a, S1.3a; Key Idea 3: S3.1, S3.2.

Standard 6: Interconnectedness: Common Themes: Key Ideas 1, 5

Standard 4: Physical Setting: Key Idea 5: 5.1c.

Standard 4: Living Environment: Key Idea 1: 1.1b, 1/2a; Key Idea 2: 2.2a,b; Key Idea 3: 3.1b,c; Key Idea 4: 4.1b,d; Key Idea 5: 5.2a,g; Key Idea 6: 6.1a, 6.2a.

Abstract:

Special Materials:

Time Requirement:

Additional Teacher Information

Objectives

- Students will be able to examine a plant and identify its primary parts, as well as make guesses as to the functions of these parts.
- Students will be able to make a detailed observation of the leaves of at least three plants and identify and label their parts: petioles, midribs, stomata, blades and veins.
- Students will set up several plant experiments designed to show that photosynthesis and transpiration are taking place.
- Students will examine the roots of several different plants and identify and label their parts: roots, root tips and root hairs. They will also identify the two major types of roots, taproots and fibrous roots. Using a carrot, students will locate where the food moves down, where it's stored, and where the water moves up.
- Students will set up an experiment to determine the effect of gravity (geotropism) on the roots and stems of a plant.
- Students will examine the stems of several different kinds of plants and identify and label their parts: xylem and phloem. Then they will conduct an experiment to see how these tubes work and what their functions are.
- Students will examine several different flowers and be able to identify and label their parts: petals, stamens including anthers and filaments, pistils including stigmas, styles and ovaries, pollen, sepals, eggs, and stalks.
- Students will watch a video (*Science: Plant Life Cycl*e) showing the different ways plants reproduce. Students will then illustrate, in cartoon panel form, a form of plant reproduction or a form of pollination.
- Using different kinds of seeds, students will experiment with germination rate and the effect of darkness and light on germination.
- Students will use a microscope to look at prepared plant cell slides and be able to identify the parts: nucleus, cytoplasm, cell wall, chloroplasts, cell membrane and vacuole. Students will learn the function of these parts and also the idea that most plants and animals are made of many cells.
- Each student will construct a model of a plant of their own design, labeling the parts and their functions.

Activity One: Vegetative Parts of a Plant – Roots, Stems and Leaves

There are many different kinds of plants in this world but most share the structures of roots, stem and leaves in common. Children will examine a plant in detail and identify these parts. They will then try to predict the functions of each of the parts, using what evidence they can gather from their observations.

Activity Two: Detailed Observation of Leaves

This next activity focuses on the features of a leaf. There are many different kinds of leaves but they share features in common. The main part of a leaf is called a blade. Most leaves have a petiole that connects the leaf to the stem. Leaves also have veins that carry nutrients and water through the leaf. On the underside of a leaf are tiny openings called stomata that are used to let out waste gasses (e.g., oxygen) and to take in carbon dioxide. A bud can be located at the base of some leaves. The midrib is the central stalk of a leaf.

When choosing leaves for this activity make sure you have examples of both simple and compound leaves so you can also show them leaflets.

Activity Three: Photosynthesis / Transpiration / Respiration

Photosynthesis is the process through which green plants manufacture their own food. Leaves are the main food-making part of a green plant. Leaf cells contain chloroplasts with green chlorophyll. The chlorophyll in the leaves absorbs energy from the sun. Then, inside the chloroplasts, the light from the sun provides energy to allow plants to convert carbon dioxide from the air with water from the soil to make sugar and release oxygen gas (O_2) as a byproduct.

In addition to producing oxygen as a byproduct of photosynthesis, plants also use it during respiration. Respiration is when the plant uses oxygen to break down sugars to produce energy, water and carbon dioxide.

In order to carry out photosynthesis and respiration, the tiny holes on the underside of the leaf (stomata) must allow gasses and water vapor to both enter and leave. Transpiration is the loss of water vapor (mainly) through the stomata. This water was produced by the plant during photosynthesis and respiration.

Activity Four: Roots

One of the most important parts of a plant is usually underground, namely the root system. It is usually made up of many roots, root tips and root hairs. It is the root hairs that absorb water and minerals from the soil. The root tips have slimy caps that help the roots push through the soil as they grow. Roots also hold the plant in the ground.

There are two main types of roots. Taproots have a main root that is longer and thicker than the rest of

their root system. Most plants with taproots store food in their thick roots for the winter. Fibrous roots have a network of branching roots with no main root. Most plants with fibrous roots live only one season.

Inside of a root, the center core is where the water moves up. The next layer is where the food moves down, and the outer layer is where the food is stored.

Activity Five: Geotropism

Geotropism is a plant's response to gravity. Geo means "earth" so geotropism is movement toward or away from the earth.

Activity Six: Stems

Stems of plants have two important functions. First, they carry water, food and minerals to all the different parts of the plants. They also hold up the leaves of the plants so they are in light.

They transport the water, minerals, and food through two different tubes. They are the xylem and the phloem. The phloem carries the food from the leaves to other parts of the plant. The xylem carries the minerals and water from the roots to its leaves.

Activity Seven: Flowers

Many plants are flowering plants. Flowers contain the parts that help plants reproduce. Flowers have a male part called the stamen and a female part called the pistil. The stamen includes the anther and filament and the pistil includes the stigma, style and ovary. Flowers may also have petals and sepals.

An overhead transparency is included with this kit which shows all the parts of a flower. The transparency comes from *Studying Plants* (12 color transparencies and 20 reproducible pages and guides), Milliken Publishing Co., St. Louis, MO. 1986.

The sepal is located at the base of the flower, it is usually green and protects the flower before it opens. The petals are usually brightly colored to attract insects and birds. The stamen is made up of a tiny bag-like structure at the top called an anther, which produces pollen, and a filament, which supports the anther. The pistil has three parts: the stigma, a sticky structure at the top that collects pollen; the style, which is passage for the pollen tube; and the ovary where the fertilized eggs become the seeds. The stalk of the flower supports it and transports water and food to it.

Flowers that contain both stamens and pistils are called perfect flowers. Male flowers have only stamen(s) and female flowers have only a pistil.

Activity Eight: Pollination / Fertilization / Reproduction

Flowers, fruits, and seeds all have the same function, reproduction. Not all plants are flowering plants, some like conifers have cones instead. However, both conifers and flowering plants are seed plants. Some plants, like ferns, reproduce by producing spores. Many plants can reproduce vegetatively via their roots, leaves and/or stems.

Your students will watch the video *Science: Plant Life Cycl*e exploring reproduction in plants, including pollination and fertilization. The video is available from SED at Office of Educational Television and Public Broadcasting, NYSED 1992

Activity Nine: Seeds / Germination

Seeds are a very important part of plant reproduction. Everything a plant needs to grow is inside the seed: the tiny young plant, its stored food, and a seed coat to protect it.

After examining seeds, your students will be learning about germination itself and germination rates. They will compare seeds germinated in the light with those germinated in the dark. Some may predict that those grown in the dark will not germinate. As the experiment unfolds they start to realize that germination usually happens underground in the dark.

Germination rate is a way to determine how many of your seeds are likely to grow. It is listed on seed packages you buy and can help you make better seed selections.

Activity Ten: Plant Cells

Most living things are made up of cells so small they are only visible under a microscope. There are hundreds of cells in a single tree leaf. Plant cells have the following main parts:

1. The *cell membrane* is a thin structure that regulates the passage of materials in and out of the cell.

2. The *cell wall* supports and protects the cell. It is outside the cell membrane.

3. The *nucleus* is usually in the center of the cytoplasm and is the information control center of the cell. It contains the genetic information and is responsible for the overall regulation and control of the cell's functions.

4. The *cytoplasm* is inside the cell and contains organelles that have different jobs. The cytoplasm is everything inside the cell membrane apart from the nucleus.

5. The *chloroplasts,* the green colored bodies that contain chlorophyll, help the plant to make food from the energy provided by light. They also produce oxygen gas.

6. The *vacuole* stores food and waste.

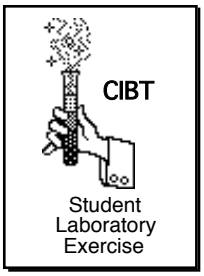
7. *Mitochondria* are the bodies where energy is made from breaking down foods. Mitochondria are responsible for converting oxygen gas to water.

Activity Eleven: Original Plant Model

Students will have the opportunity to show their creativity as well as demonstrate a basic understanding of the parts of plants and the functions of these parts, when they are asked to design a model of a plant and then label the parts and their functions.

Activity One:

Vegetative Parts of a Plant



Background

All plants have three main parts in common. Each part has one or more functions that are responsible for part of a plant's life activities.

Materials

- Different plants with all their parts
- Sheets of newspaper
- Hand lens
- Paper

Procedure

Work with a partner or small group.

1. Spread the newspaper on your desk and lay three different plants on it.
2. Examine each plant and identify its three main parts.
3. On a clean sheet of paper, draw and label your three plants and their main parts.
4. What parts do all your plants have in common?

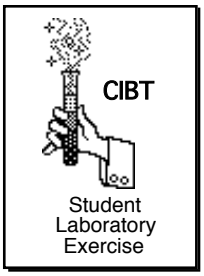
5. Examine each part closely with the hand lens. Using what you may already know about plant life and anything you can now see, predict the functions of each of the three main parts. Explain your prediction in detail.

6. Were there any parts that some plants had that others did not? Draw those parts. Explain why only some plants have these.

7. Share your results with other groups. Illustrate and label any other parts they found but you did not.

Activity Two:

Detailed Observation of Leaves



Background

Leaves share some of the same features although they are very different in other ways.

Materials

- Leaf collections, including both simple and compound leaves gotten on a class hike or from home ahead of time
- Paper to record data
- Hand lenses or a microscope if available

Procedure

Work with a partner or small group.

1. Select five different leaves and group them according to size. Then examine each leaf, carefully noticing their similarities and differences. Look at as many properties as you can. (For example: color, shape, texture and edge.) Record your data in the leaf chart provided.
2. You should have noticed that most of your leaves are connected to the stem by a part called a petiole. Look for the petiole on each of your leaves. Explain why some leaves might lack a petiole.

3. Leaves also have veins. Hold your leaves up toward the light and you should be able to clearly see the veins. Are the vein patterns similar in all leaves? How many different patterns can you find? Draw some leaves showing the different vein patterns.

4. Parallel veins run from the petiole to the tip. Pinnate veins branch out from the midrib like a feather. Palmate veins fan out from the petiole to form smaller veins throughout the leaf. Label your leaf drawings as parallel, pinnate, or palmate.

5. What do you think the function of the veins on the leaf could be? Suggest an experiment to test your idea.

6. One feature of a leaf is located on the underside of the leaf. These are tiny holes called stomata. They are usually too small for you to see but they are important because they allow air to move in and out of the leaf. If you have a microscope available you may be able to see them. If so, draw and label what you see.

7. If you divided your leaves by shape you were concentrating on the blade. The blade is the main part of the leaf and helps us identify what plant a leaf comes from. Draw two blade shapes you are familiar with and identify the plant each comes from.

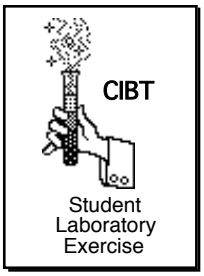
8. Share your group's observations with other groups and see if they found any features that you did not. Discuss what you learned.

LEAF CHART

	COLOR	SHAPE	TEXTURE	EDGE
LEAF 1				
LEAF 2				
LEAF 3				
LEAF 4				
LEAF 5				

Activity Three:

Photosynthesis / Transpiration / Respiration



Background

A plant, in the process of making sugar for food, takes carbon dioxide from the air in through the stomata and then releases oxygen gas into the air. This process of making food is called photosynthesis. Photosynthesis requires energy from light. Any extra water vapor is also released through the stomata; this is called transpiration. Plants can also break down sugars to produce energy, water and carbon dioxide. This process is called respiration. Respiration can happen both in darkness and in light.

Materials

per group:

- Two healthy, leafy plants
- One sandwich bag
- Twist tie
- Yarn or tape
- One large jar with lid
- Petroleum jelly
- Paper

Procedure

You will be divided into three groups. Each group will set up two experiments.

1. Each group gets the materials needed.
2. Take one potted plant and place a sandwich bag over one leaf. Without hurting the plant, attach the bag tightly to the stem using the twist tie. Place the bag in the sun for several hours. What do you see inside of the bag?

   What leaf process does this represent?

   Explain what you think happened.

3. Take your other plant and place it in the dark for two days. Then choose two leaves and coat their upper surfaces with petroleum jelly. Choose two different leaves and coat their undersurfaces with the same jelly. Place the plant in a sunny window for a week and watch it. What do you think will happen to the four leaves? Make predictions and explain why you think this will happen.

   Prediction for leaves whose upper surface is coated with petroleum jelly:

   Prediction for leaves whose undersurface is coated with jelly:

4. Examine the plant after a week. What happened to the four leaves?

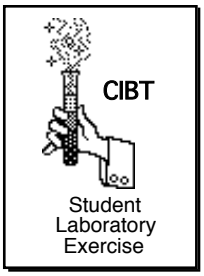
   On a separate sheet, illustrate what happened to each leaf, labeling upper and undersurface. Did this surprise you?

   What processes were being blocked by the petroleum jelly?

   What part of an animal's body could you block to stop the same type of process?

   Would it take as long? Why or why not?

Activity Four: Roots



Background

Plant roots have many functions including holding the plant in the ground, storing food, and getting water and minerals for the plant.

The root tips are used by plants to push the roots through the soil. Root hairs absorb water and minerals and bring them to the plant.

Materials

- Samples of different plants, some with taproot and some with fibrous root systems
- Carrots cut the long way
- Hand lens
- Colored pencils
- Paper

Procedure

Work in pairs or a small group.

1. Take several examples of plants to examine in detail the root systems. Use a hand lens to help you. You should be able to identify the roots, root tips and root hairs on each plant. Divide your plants into two groups based on similarity of their root systems. Describe your two groups in detail.

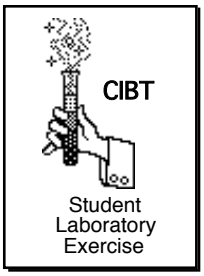
On a separate sheet, draw an example from each group, labeling the three parts of each root.

2. Taproots have a long thick main root with smaller roots branching off from the main roots. Fibrous roots have a network of branching roots, with no main root. Go back and label your groups as taproots or fibrous roots.

3. Pick up a carrot half and look carefully at the layers inside this root. You should see a large part in the middle, this is where the water moves up to the stem. Just outside that layer is another skinnier layer, this is where the food moves down. Finally, there is one more layer, this is where the food is stored. Draw the carrot. Color and label these three parts.

4. Which kind of root system, taproots or fibrous roots, is likelier in plants that live through the winter? Explain.

Activity Five: Geotropism



Background

Geotropism is a plant's response to gravity in its environment.

Materials

- Potted plants
- Books
- Paper towels
- Plastic ziplock bags
- Bean seeds treated with chlorine bleach
- Black paper
- Permanent markers
- Paper

Procedure

Class demonstration.

To observe the effect of gravity on plant growth, lay a potted plant on its side and watch it for at least a week, recording on the attached sheet daily observations of the position of the stem and the leaves. These observations should be both pictorial and include possible explanations about what is happening.

Small group activities.

1. Get two plastic bags and cut a paper towel to fit into each bag. Add just enough water to dampen the paper towel.

2. Place two of the treated bean seeds vertically, without touching the top or bottom of the bag, in the bag. Seal the bag.

3. Label the sides of each bag: "1" on the bottom, "2" on the right side, "3" on the top and "4" on the left side. Attach one bag to a bulletin board in indirect sunlight with the number "1" toward the bottom. Attach the other bag the same way to another bulletin board away from direct sunlight. Cover this bulletin board with black paper.

4. 0bserve the seedlings after one week. Make a chart recording what the seedling looked like in the light and in the dark. Then return the bags to the walls, this time with side 2 towards the floor.

5. Wait three days then record your observations on your chart again. When you return the seedlings to the walls, make sure side 3 faces the floor.

6. Wait three days again and record your observations on the chart. Before returning the seedlings to the wall predict what you think will happen if side 4 faces the floor. Now return the seedlings to the boards and place side 4 toward the floor.

7. After three more days record your data. Was your prediction correct?

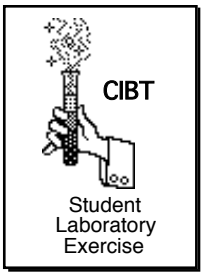
8. What was the effect of gravity on your seedlings? This effect is called geotropism.

Why was the experiment done in both darkness and light? Explain.

Daily observations of the potted plant put on its side.

DAY 1
DAY 2
DAY 3
DAY 4
DAY 5
DAY 6
DAY 7
CONCLUSION

Activity Six: Stems



Background

Although stems of plants can be very different in appearance, they all share the two main functions of holding the leaves towards light and transporting food, water and minerals throughout the plant.

Materials

- Collection of stems of many different plants
- Carnations
- Food coloring
- Fresh celery stalks with leaves
- Hand lens
- Glasses
- Sugar
- Centimeter ruler
- Paper

Procedure

Work with a partner or a small group.

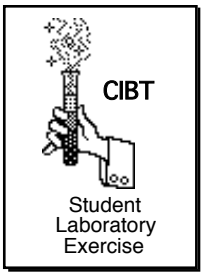
1. Look at the stems of several different plants. Describe how they are both similar and different.

2. Look at the place where the leaf grows, this is called a node. Draw one of your stems and label the leaf node. Now look at the tip of the stems. You should see a terminal bud. If you look down the stem a little, you should be able to see a scar where last year's terminal bud was. The distance between the bud and the scar is one year's growth. Label the terminal bud and the scar on your drawing of the stem. In centimeters, measure how much your plant grew and record the observation here:

   _____ cm in one year

   Cut the bottom off of your carnation stem. Examine the stem with your hand lens. Can you see the tubes that allow water and nutrients to flow up and food to flow down? Draw what you see and label where you think the tubes are. Now get a glass and add food coloring to make colored water. Put your carnation in the water overnight. Draw what you see and record below what occurred. Can you locate the tube, called the xylem, which brings water and nutrients up the stem? Label the xylem on your second picture. Why is it easier to find now?

Activity Seven: Flowers



Background

The purpose of a flower is to make seeds to provide for the survival of the plant. The flowers of some plants contain both a male stamen and a female pistil. Other kinds of plants make two kinds of flowers: the male flower contains just a stamen while the female flower contains just a pistil. Each part has a function that allows fertilization to take place.

Materials

- Newspaper
- Large flower such as a tulip or lily
- Knife
- Hand lens
- Pape

Procedure

Work in small groups.

1. Look at the overhead on the screen. Now carefully examine your flower and see how many of the parts you can identify. Draw your flower so it takes a full page. Color the parts so they match the actual flower. You may also want to tape the actual parts of your flower down to another piece of paper to make a real diagram.

2. The easiest part to recognize is the petals. How many petals does your flower have? Label your petals and put the number right next to the name. Why do you think flower petals are so colorful? Explain.

3. Another simple part to find is the stalk, which supports the flower and also contains the tubes that bring water and nutrients to the flower. Label the stalk. At the spot where the stalk meets the flower you will find the sepal. These are specialized leaves that protect the petals. Label your sepal.

4. Find the part of your flower that produces the pollen. It is called the anther and it is located on the stamen and held up by the filament. Label these features on your diagram. Carefully cut your stamen out of the flower. Is there more than one? Why? Draw a stamen and label the parts.

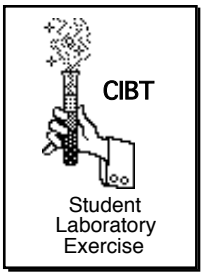
5. Find the pistil. It should have a large part at the top called a stigma. Rub an anther on the stigma. The pollen attaches itself because the stigma is sticky. The pollen then grows down the style, to the ovary of the pistil. Label the pistil, stigma, and style on your diagram. Carefully cut open your ovary. What do you see? That is why the ovary is sometimes called a seedpod. Draw a pistil and label its parts.

6. Observe flowers in a natural setting. See how many you can find that have all the parts we examined. These are called perfect flowers. Can you figure out a reason for that name? Explain.

7. You should also have found flowers that had just stamen, called male flowers, or just pistil called female flowers. Which type of flower, male, female or perfect, do you think would be the easiest to pollinate? Why?

Activity Eight:

Pollination / Fertilization / Reproduction



Background

Like all organisms, plants need to reproduce to continue their kind. Most plants undergo sexual reproduction involving pollen from anthers pollinating eggs in the ovary. Some plants can also reproduce asexually by growing new plants from their leaves, stems or roots.

Materials

- Video on plant reproduction
- Paper

Procedure

Whole class viewing, individual reporting.

1. You will watch a video on plant reproduction. As you watch the video take short notes on the different ways plants reproduce. Also pay careful attention to the ways plants are pollinated and note these as well.

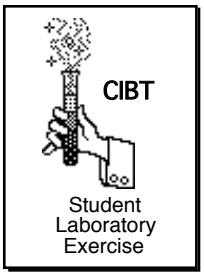
2. After seeing the video, compare notes with a partner or small group. How many ways can plants reproduce? How many forms of pollination did you see?

3. Illustrate a story or cartoon panel that shows the different forms of plant reproduction or pollination.

4. Explain why you think there are so many ways plants can be pollinated. Support your answer with ideas from the video.

Activity Nine:

Seeds / Germination



Background

Seeds contain everything needed for a new plant to grow. The germination of a seed and its rate of germination help to determine whether a plant will continue another generation.

Materials

- Assorted seeds, including tomato seeds
- Petri dishes
- Bean seeds presoaked in water
- Masking tape
- Paper towels
- Paper clips
- Black paper bag
- Paper

Procedure

Work in a small group or with a buddy.

1. Examine your collection of seeds. Divide them into a few similar groups. Describe each group.

2. Take a bean seed that has been soaked in water. Carefully open it up. Draw a picture of what you see. Label the young plant, the stored food and the seed coat. Beans are dicots, which means that they will develop two seed leaves, have branching leaves and flower parts will be in multiples of four or five.

   Other plants, such as corn, are monocots. They will have one seed leaf, parallel leaf veins and flower parts in multiples of three or six.

3. Get two petri dishes, a paper towel, ten bean seeds, ten tomato seeds and two small pieces of masking tape. Put the tape on the petri dishes, labeling one beans and the other tomatoes.

4. Tear your paper towel in half and put half in each petri dish. Place the ten bean seeds, not touching each other, in the bean dish and do the same with the ten tomato seeds in the tomato dish. Draw what the seeds look like now. Then place the dishes away from direct sunlight and do not move them. Watch them carefully.

Date:	
Bean Seeds	Tomato Seeds

5. Check your beans after about four days. Circle all the bean seeds that germinated. Count them and compare that number to the ten seeds you started with. If nine seeds germinated then write 9/10, which is equal to 90%. What was the germination rate of your bean seeds?

Bean Seed Germination Rate

_____ / 10 = _____ %

6. After seven days check your tomato seeds, again circle the ones that germinated in your drawing. Calculate the germination rate as before. ?/10 = ?%. What was the rate of germination of your tomato seeds?

Tomato Seed Germination Rate

_____ / 10 = _____ %

7. If you were buying seeds, what kind of a germination rate would you be looking for? Explain why.

8. Get two petri dishes, 20 bean seeds, a paper towel, a black bag and paper clips. Tear the paper towel and put half in each dish. Dampen the paper towels with water and place ten bean seeds in each dish. Place one dish in indirect sunlight, the other in the black bag and clip shut.

9. Predict which dish will have a higher germination rate after three days and explain why.

10. Wait the three days and check the dishes. Determine the germination rate of each dish.

Germination rate for beans in light

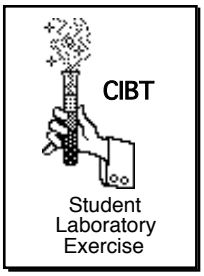
_____ / 10 = _____ %

Germination rate for beans in darkness

_____ / 10 = _____ %

11. Based on your results, what conclusions can be made about the effect of darkness or light on seed germination? Explain.

Activity Ten: Plant Cells



Background

Most living things are made up of cells so small they are only visible under a microscope. Cells are the basic unit of life, with structures that all work for the good of the cell.

Materials

- Prepared *Elodea* cell slides
- Microscope
- Paper

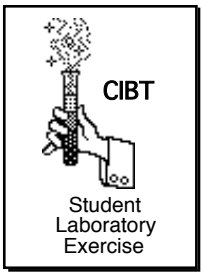
Procedure

Work in a small group.

1. Place your slide on the microscope and focus so the *Elodea* cells are clear. On a clean sheet of paper, draw the four or five cells as you see them. Label the cell wall.
2. Just inside the cell wall, you should see another wall-like structure. This is the cell membrane, which allows movement in and out of the cells of water, wastes, and gasses.
3. The part with tiny dots that seems to be all around the inside is the cytoplasm, which contains the organelles.
4. The little green organelles are chloroplasts, which contain the chlorophyll needed for the cell to produce food from the energy in light.
5. The larger, oddly shaped organelle is the vacuole, which stores food and waste.
6. Finally there is a nucleus which controls all the cell's activities. Label all these parts on your cell worksheet.
7. From what you have learned about plant life and cells, do you think all plants cells are the same? Explain your answer.

Activity Eleven:

Original Plant Model



Background

Using all the information you have learned about plant parts and their functions, you will construct a model of your own design.

Materials

- Art supplies, such as construction paper, markers, crayons, straws, string, cardboard tubes, tape, glue, etc.

Procedure

Work alone.

1. Draw a design of the original plant you would like to construct. Share your plan with another student to make sure no important parts are left out.

2. Start constructing your plant model. Once the construction is complete, check to see if all the parts are represented so that your plant could "function" as a plant. Add any missing details.

3. Make a label key for the parts and their functions. Share with the class.