SUGGESTED ACTIVITIES

(*Plants*)

From *Invitations to Science Inquiry 2nd Edition* by Tik L. Liem:

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From *Harcourt Science* Teacher's Ed. Unit E: (For ALL grade levels)

Activity	Page Number	Concept
Needs of Plants	A4 (3rd grade text)	Needs of plants
Sprouting seeds	A10 (3rd grade text)	Germination
The Parts of Plants	A64 (5th grade text)	Parts of plants
Simple Plants	A72 (5th grade text)	Parts of plants
How Plants use leaves	A94 (5th grade text)	Leaves
How plants get the light they need	A102 (5th grade text)	Leaves
Flower Parts	A108 (5th grade text)	Flower
The parts of a seed	A114 (5th grade text)	Seeds

SEED GERMINATION

A. Question: *How do seeds germinate?*

B. Materials Needed:

- Small seeds (mustard, radish, green beans, etc.)
- Blotting paper or several layers of paper towel.
- A drinking glass or beaker

C: Procedure:

1. Cut a rectangular piece of blotting paper as wide as the drinking glass is tall (if a paper towel is used, triple or quadruple the layers).
2. Moisten the paper and place the seeds into it.
3. With the seeds sticking to the moist paper, roll the paper in a cylinder slightly smaller in diameter than the glass and insert the roll into the glass.
4. Let the paper stand against the glass wall and pour some water into the glass to keep the paper moist.
5. Put the glass in a warm place and cover loosely (make sure that some water stays in the glass at all times).

D: Anticipated Results:

In three to six days, depending on what type of seeds, the seeds will sprout and send their rootlets in a downward direction.

E: Thought Questions for Class Discussion:

1. Which seeds sprouted first? Which last?
2. In which direction did the rootlets grow?
3. How was the paper able to stay moist at all times?
4. Why did the glass have to be loosely covered?
5. What are the conditions for the germination of seeds?

F: Explanation:

The seeds positioned closest to the water should sprout first because they are first in line for accessing the water. The rootlets grow towards the direction of the water because of this. The blotting paper stayed moist because the water worked itself up through capillary action in the paper fibers. The glass has to be covered in order to prevent fast evaporation of the water. However, the glass cannot be tightly sealed because the seeds cannot be cut off from the atmospheric air. The ideal conditions for the germination of seeds are: presence of moisture, warm temperatures, and air supply.

THE BENDING PLANT

A. Question: *Do plants grow in a certain direction?*

B. Materials Needed:

- Bean or radish seeds
- A small flower pot and soil
- A cardboard box

C: Procedure:

1. Plant one seed in a small flower pot and water daily.
2. After the seed has started to sprout, let it grow until it is about 5 cm high.
3. Then place it in a cardboard box in which a hold has been cut out on one of its ends.
4. Place the box near a window so that light can enter the hole.
5. Keep the box, and the pot within the box, in the same position. Water daily for the next few days. Make sure to replace the cover of the box after watering.

D: Anticipated Results:

The plant should grow and bend in the direction of the hole in the box.

E: Thought Questions for Class Discussion:

1. How did the plant grow? In which direction?
2. How would the plant grow if the pot were turned everyday?
3. How would the plant grow if the box were turned everyday?
4. How would the plant grow if the box cover was left open?
5. What do plants need in order to grow?

F: Explanation:

Plants grow in the direction from where the light comes. In this case, towards the hole in the box, and even through the hole when left for a longer time. This shows that the plant needs light in order for it to grow. By turning toward the hole in the box, its leaves will catch more light and thus grow better. If the plant were turned half way around everyday, it would grow straight up, or keep bending back and forth. If the box were turned, the plant would still bend towards the hole. Without the box cover, the plant would just grow straight up (and bend slightly towards the window).

HOW DOES GRAVITY AFFECT GROWTH?

A. Question: *Will gravity affect the growth of a plant?*

B. Materials Needed:

- Three small potted plants (identical in size and kind)
- A ring stand, two pieces of wire, cardboard

C: Procedure:

1. Turn one of the flower pots on its side and face the plant away from a window.
2. Place another flower pot upside down on a ring stand supported by two wires (tape a piece of cardboard securely over the soil to prevent it from falling out). Place this stand below a window.
3. Place the third flower pot right side up (in normal position) in front of a window.
4. Observe plant growth in all three plants. Place the plants near the same window.

D: Anticipated Results:

All of the plants should grow vertically upwards.

E: Thought Questions for Class Discussion:

1. How did the plant on its side grow?
2. How did the upside down plant grow?
3. In what direction did all three plants grow?
4. Why did the plant on its side have to be faced away from the window?
5. How did the light from the window affect the growth?
6. Can we be absolutely sure that the light was not the cause of the plants to bend upwards?
7. How might we set up an experiment to investigate the influence of only gravity on the growth of a plant?

F: Explanation:

In general, plants grow in the opposite direction of the growth of the roots, which is vertically upwards. They grow in the opposite direction of the gravity force. In nature, we can especially notice this when trees are growing on a steep hill or on the side of a mountain of cliff.

An experiment investigating the influence of gravity only would need to have all variables controlled, including the light variable, which has to come from all sides of the plant. Another question to pose is: How might a plant grow without gravity?

WHAT DO GREEN LEAVES BREATHE OUT?

A. Question: *Do leaves release anything into the environment?*

B. Materials Needed:

- A green weed or shrub
- A large beaker, a funnel, a test tube, a wood split
- A ring stand and clamp

C: Procedure:

1. Fill the beaker with water. Immerse the funnel and the test tube in the water. Set the apparatus according to the sketch.
2. Raise the funnel and place some of the shrub underneath it.
3. Leave the apparatus in strong sunlight or under a spotlight and observe the bubbles given off by the leaves.
4. After collecting almost a full test tube of gas, test it with a glowing wood splint.

D: Anticipated Results:

The shrub will release oxygen.

E: Thought Questions for Class Discussion:

1. What gas is collected from the test tube?
2. What did the glowing wood splint do when lowered in the test tube.
3. What made the water in the test tube stand so much higher than the water level in the beaker?

F: Explanation:

Chlorophyll, which gives leaves their green color, produces sugar, cellulose, and starch in the plant. Carbon dioxide and water are utilized for this sugar production and oxygen is the waste product of this process. This synthesis of sugar, called photosynthesis, only occurs during the daytime because sunlight is a necessary driving force. The purpose of the funnel is to bring all the bubbles released by the weed together under the test tube. Since the glowing splint flares up into a bright flame in the presence of the gas, we know that the plant “breathed out” oxygen.

The fact that plants give off oxygen during the daytime makes having them in the living room a good thing. The air is enriched with oxygen and it is therefore healthy to have plants in the room.

HOW IS THE GREEN IN THE LEAVES PRODUCED?

A. Question: *What makes leaves green?*

B. Materials Needed:

- A plant with large wide leaves
- Carbon paper or black construction paper
- Paper clips or masking tape

C: Procedure:

1. Cut out several patterns (circle, square, triangle, etc) in several pieces of the carbon or construction paper.
2. Cover three or more leaves as much as possible with the cut-out paper shapes. Attach them with paperclips or masking tape.
3. Cover some of the leaves halfway with carbon paper, close to the stem. Leave the paper attached to the leaves for 2-3 days.
4. After several days have passed, removed the paper and observe the leaves.

D: Anticipated Results:

The areas that were covered with the paper will appear lighter in color in comparison to the other non-covered leaves. They may even appear almost whitish in color.

E: Thought Questions for Class Discussion:

1. How did the covered areas of the leaves compare to the uncovered ones?
2. Do plants need sunshine to produce the green color?
3. What is the green color in the plant leaves called?
4. What is the process of production of the green color called?
5. What is the function of the chlorophyll in the plant leaves?

F: Explanation:

The covered areas of the leaves will become much paler. The longer it stays covered, the paler the color, because no sunshine is penetrating the green pigment in the leaves. This green pigment is called chlorophyll. All plants contain chlorophyll; and if the plant receives water, sunlight, and carbon dioxide in addition to this pigment, sugar will be produced. This sugar making process is called photosynthesis. The sugar that plants produce is what give us (and animals) energy when we consume them.

The chlorophyll also produces cellulose, which is a much larger molecule than sugar. Cellulose is a basic building material in plants; without it plants cannot grow. Therefore we realize that plants depend on cellulose, which depend on chlorophyll, which depend sunlight. We see that there are many factors needed to keep plants alive and green.

CAN AIR ENTER THROUGH A LEAF?

A. Question: *Can air be extracted from a leaf?*

B. Materials Needed:

- A leaf with a long stem
- A small Erlenmeyer flask
- A 2-hole stopper that fits in the flask
- A bent glass tube
- A candle and matches

C: Procedure:

1. Stick the leaf stem through one of the holes in the 2-hole stopper and seal it with dripping wax from a lit candle. An adult should assist with the step.
2. Insert the bent glass tube in the other hole of the stopper.
3. Fill the Erlenmeyer flask with water to such a level that only the leaf stem immerse in it. The glass tube should NOT be immersed.
4. Place the stopper tightly into the flask and suck air through the bent glass tube.
5. Observe air bubbles issuing from the end of the stalk.

D: Anticipated Results:

Air bubbles will be observed leaving the end of the leaf's stalk.

E: Thought Questions for Class Discussion:

1. Why does the stem have to be sealed in the stopper?
2. What would happen if the glass tube were also immersed in the water?
3. Are the leaf and the stem actually that porous that air can go through them?
4. What is the actual structure of leaves?

F: Explanation:

By sucking in air through the bent glass tube, you caused the pressure inside the flask to decrease. This caused the atmospheric air to seep through the leaf and stalk, resulting in the bubbles issued from the end of the stalk. When looking through a microscope to examine the underside of a leaf, it is possible to see the breathing pores called stomata. On each side of the stomata are two guard cells.

GROW SWEET POTATO AND CARROT LEAVES

A. Question: *What is needed to grow leaves on a sweet potato and carrot?*

B. Materials Needed:

- A sweet potato and end stump of a carrot (about 5cm in height)
- A drinking glass or beaker
- A shallow dish (Ex. petri dish)
- Three toothpicks or thin nails
- Some pebbles or gravel

C: Procedure:

1. Fill the drinking glass halfway with water.
2. Hold the sweet potato with the eyes or buds on the top side.
3. Immerse the potato about one-third into the water of the drinking glass
4. Support the potato by sticking three toothpicks or nails into its side and resting them on the rim of the glass.
5. Next, remove the old leaves from the top of the carrot stump. Place the stump in water in the shallow dish. It can be supported by placing pebbles or gravel around it.
6. Put the sweet potato and carrot in a warm and sunny place and observe foliage growth.

D: Anticipated Results:

New leaves will grow out of the carrot stump and leaves will grow from the sweet potato.

E: Thought Questions for Class Discussion:

1. Where did the potato and carrot get its food from?
2. How does the potato leaf differ from that of a carrot leaf?
3. Would these plants develop new potatoes or carrots?
4. What other plants could be grown this way?

F: Explanation:

The potato, like the carrot, beet or turnip, contains much stored food. When placed in water, the stored food is enough to produce thick foliage. When this food supply is depleted, it needs to be placed in soil and receive other nutrients in order to produce new potatoes and carrots. When a pineapple is cut about 5 cm below the base of the leaves and placed in water, the leaves will continue to grow for quite some time. Nutrients needed for this growth are drawn from the stored food inside the pineapple itself.

MAKE A RED-BLUE CARNATION

A. Question: *Is it possible to change the color of a flower?*

B. Materials Needed:

1. A white carnation (with a long stem)
2. Red food coloring and blue ink
3. Two small beakers or cups

C: Procedure:

1. Take the carnation and cut the stem so that it is about 25 cm long.
2. Carefully split the stem in half. Start the cut with a knife and further split the stem along the fibers. However, be careful not to break them. An adult should assist with this part.
3. Fill the two small beakers or cups with water. Place red food coloring in one and blue ink in the other.
4. Place each half of the stem in a different beaker and observe the flower.

D: Anticipated Results:

The white flower will turn red on one side and blue on the other.

E: Thought Questions for Class Discussion:

1. What was the purpose of splitting the stem in half?
2. Did the whole white carnation get colored?
3. Is it possible to color only part of the flower and leave the other part white?
4. How would the stem have to be split to obtain three colors in the flower. For example, red, white, and blue?
5. What force is pulling the colored solution up the stem?
6. Would leaves be able to be colored the same way?

F: Explanation:

The colored water is drawn up the stem of the carnation by osmosis and capillary action. The water molecules diffuse through the fiber membranes from a lower to a higher concentration of plant sap; this is osmosis. The fibers are so tiny that the adhesive force in combination with the osmotic pressure sucks the water up to the flower.

When the stem is split three ways, it is very likely that the flower will be three colored. This shows that the fibers must somehow run all the way from the stem to the petals of the flower.

Plant Cells

Goal: To observe plant cells under a microscope.

Material:

- Onion
- Tweezers
- Microscope
- Slide
- Cover slip
- Water
- Iodine stain or methylene blue

Procedure:

1. Pull a thin piece of onion skin (smaller than your finger nail) with a pair of tweezers and place it on a microscope slide with a drop of water.
2. Add a drop of methylene blue dye or iodine from publix or Eckerd
3. Place the edge of the cover slip at an angle at the edge of the drop of water and let it drop over the onion skin. This will reduce the amount of air pockets in the slide.
4. Look at the slide through the microscope (always start on the lowest magnification and work your way up from there).
5. Sketch the specimen.

Observation: While observing the slide try answering the following questions.

1. How would you describe the shape of the things you see?
2. Are the blocks all exactly the same?
3. Are they about the same size?
4. Are they all exactly the same shape?
5. What do you see inside?

Other Possible Specimens that can be observed:

- Animal cells: cheek cells (require methylene blue), human hair, cat or dog hair, prepared slide of a mouse kidney (look at shape of specimen before putting it under the microscope; it should be kidney-shaped!)

- Protists: Use pond water to find unicellular eukaryotes. Some of the specimens may be autotrophic (unicellular algae), while others maybe heterotrophic (e.g. amoebas, paramecium).

REMEMBER: Plants are multicellular autotrophs (make their own food), animals are multicellular heterotrophs (cannot make their own food) and protists are generally unicellular (some are colonial) autotrophs and heterotrophs.

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Parts of a Flower

Goal: To observe the parts of a flower and discuss the function of the parts

Material:

- Paper towels
- Plastic dropper
- Hand lens
- Microscope
- Slide
- Coverslip
- Large flower (Easter lilies work great!)
- Scalpel or box-cutter or sharp scissors
- Tape
- Water
- Metric ruler
- Labeled diagram of cross-section of a flower

Procedure Part I (Outer parts of a flower)

1. Tape four paper towel sheets on your work area.
2. Obtain a flower from your teacher.
3. While handling the flower gently, observe its shape and color.
4. Use the ruler to measure it.
5. Notice whether the petals have any spots or other markings.
6. Does the flower have a scent?
7. Record your observations with sketches and descriptions.
8. Identify all the parts on the labeled diagram.
9. Observe the sepals. How many are there?
10. Record your observations with sketches and descriptions.
11. Cut off the sepals without damaging the structures beneath them.
12. Observe the petals. How many are there? Are all the petals the same, or are they different?
13. Record your observations with sketches and descriptions.

Procedure Part II (The male part of the flower)

14. Carefully pull off the petals to examine the male part of the flower. Try not to damage the structures beneath the petals.
15. Observe the stamens. How many are there? How are they shaped? How tall are they?
16. Record your observations with sketches and descriptions.
17. Cut the stamens away from the rest of the flower.
18. Lay the stamens on the paper towel.
19. Obtain a clean slide and coverslip.
20. Hold a stamen over the slide, and gently tap some pollen grains from the another onto the slide.

21. Add a drop of water to the pollen. Then place the coverslip over the water and pollen.
22. Observe the pollen under the low-power objective and the high-power objective of a microscope.
23. Draw a pollen grain.

Procedure Part III (The female part of the flower)

24. Cut the pistil away from the rest of the flower.
25. Measure the height of the pistil.
26. Examine its shape.
27. Observe the top of the pistil.
28. See if the sticky surface will pick up a small piece of paper towel.
29. Record your observations with sketches and descriptions.
30. Place the pistil on a paper towel.
31. Hold it firmly and have the teacher cut the pistil in half at its widest point.
32. How many compartments do you see?
33. How many ovules do you see?
34. Record your observations with sketches and descriptions.

Analysis and Conclusion

1. **Observing**: Based on your observations, describe how the sepals, petals, stamens, and pistils of a flower are arranged.

   _____
   _____

2. **Inferring**: How do the sepals, petals, stamens, and pistil help with the function of a flower?

   _____
   _____
   _____

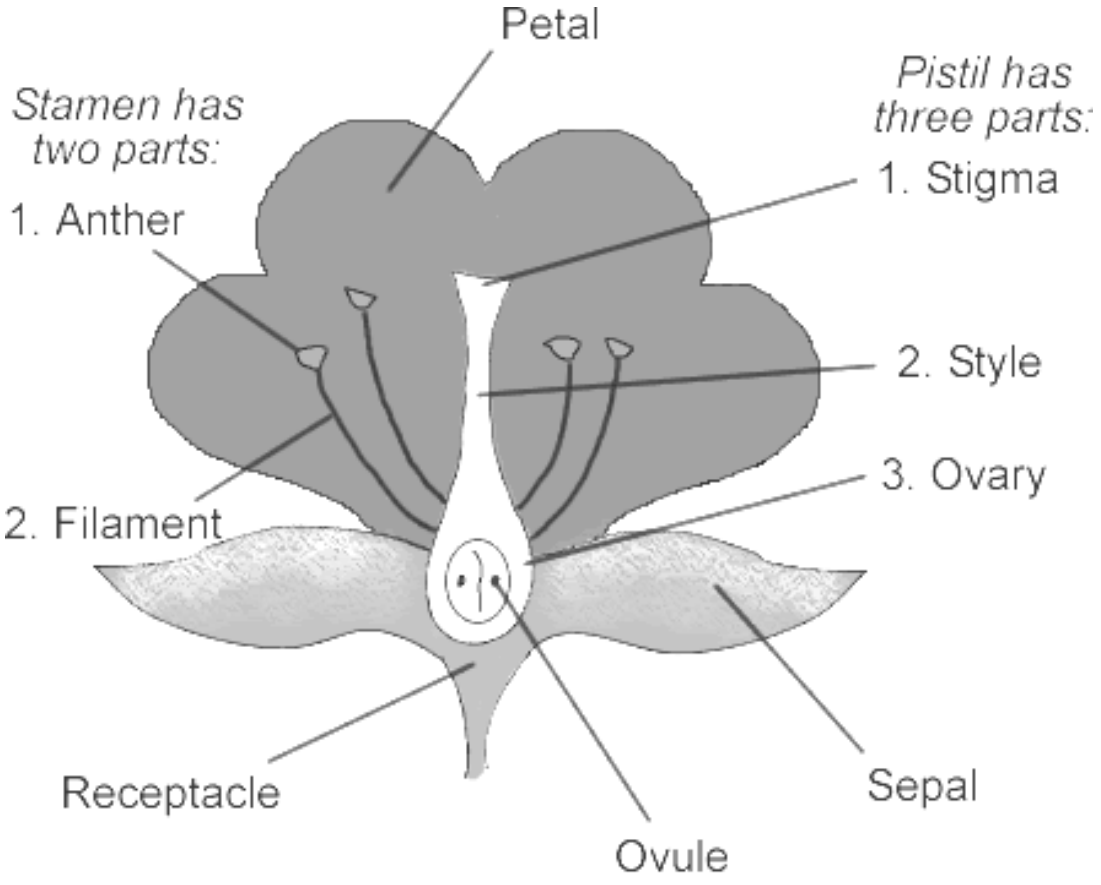
3. **Measuring**: Based on your measurements of the heights of the pistil and stamens, how do you think the flower you examined is pollinated (wind, animal, self, cross). Use additional observations to support your answer.

4. **Classifying**: Did you find any patterns in the number of sepals, petals, stamens, or other structures in your flower? If so describe that pattern, is your flower a monocot or a dicot?

5. **Communicating**: Write a paragraph explaining all you can learn about a plant by examining one of its flowers. Use your observations in this lab to support your conclusions.

Answers:

1. In circles, in this order: sepals on the outside, then petals, then stamens, the pistil at the center.
2. The sepals protect the flower as it develops and support the base of the flower. The petals may attract the attention of animals by color or scent. Stamens produce pollen, which releases sperm cells. Pistils hold egg cells.
3. Answers vary. Colorful petals suggest the flower is pollinated by organisms attracted to colors. A pistil taller than the stamens may suggest that the flower does not self-pollinate. A flower with anthers and stigma l0cated deep within the flower suggests pollination by small insects such as bees or hummingbirds.
4. Flower parts of monocots are usually in threes or multiples of threes. Flower parts of dicots are usually in fives or fours, or multiples of those numbers.
5. Answers vary. Paragraph should indicate that examination of the flower parts can determine how the structures are arranged in a flower, how the flower parts function relative to one another, the most likely way the flower is pollinated, and whether the flower is a monocot or a dicot.

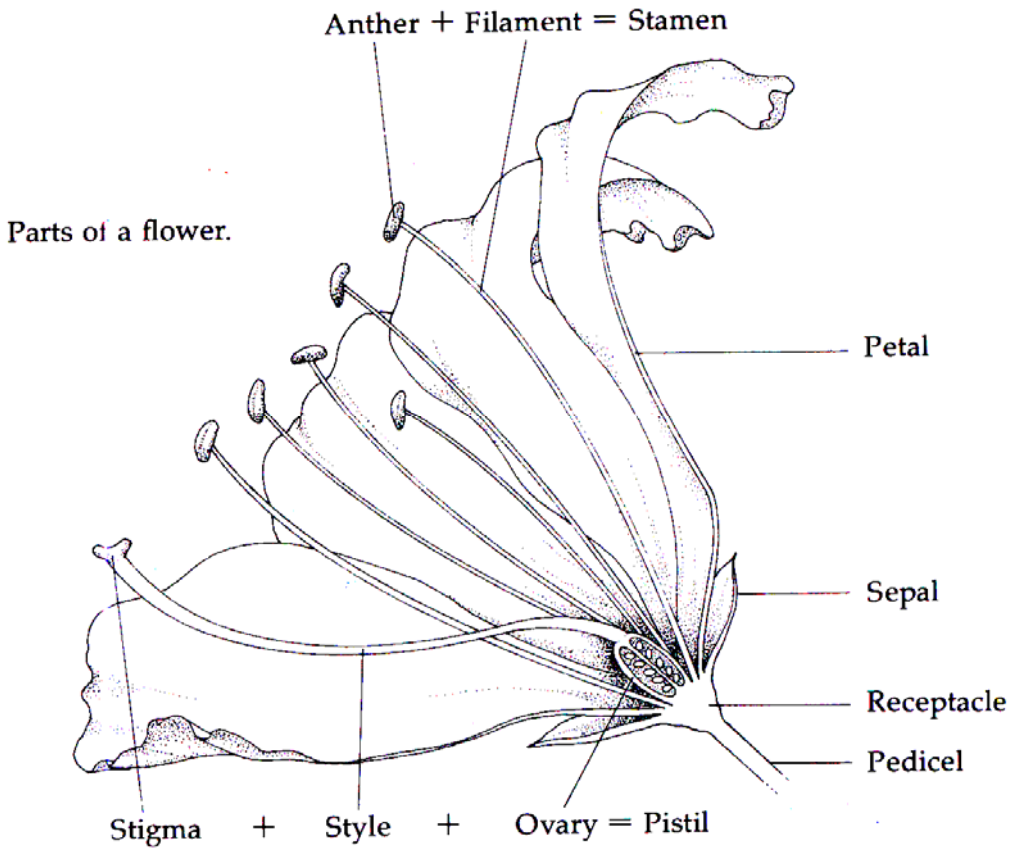


Flower Anatomy Investigation

Remove two petals from your flower, and sketch it including all of the inner organs. Label each part of your sketch. Make sure you include: **Sepal** **Petal** **Stigma** **Style** **Ovary** **Pistil** **Anther** **Filament** **Stamen**	
Remove an Anther from your flower, and view it under a magiscope. Sketch what you see, and label any parts you recognize. Label the: **Anther** **Pollen**	

Flower Anatomy Reference Sheet

Flower Anatomy



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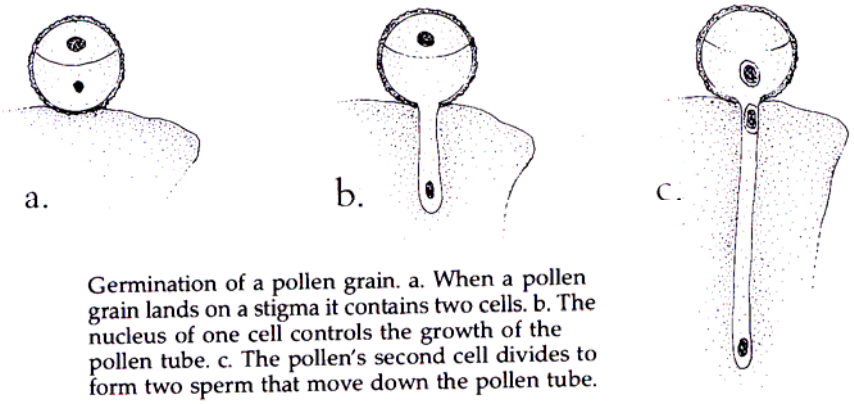
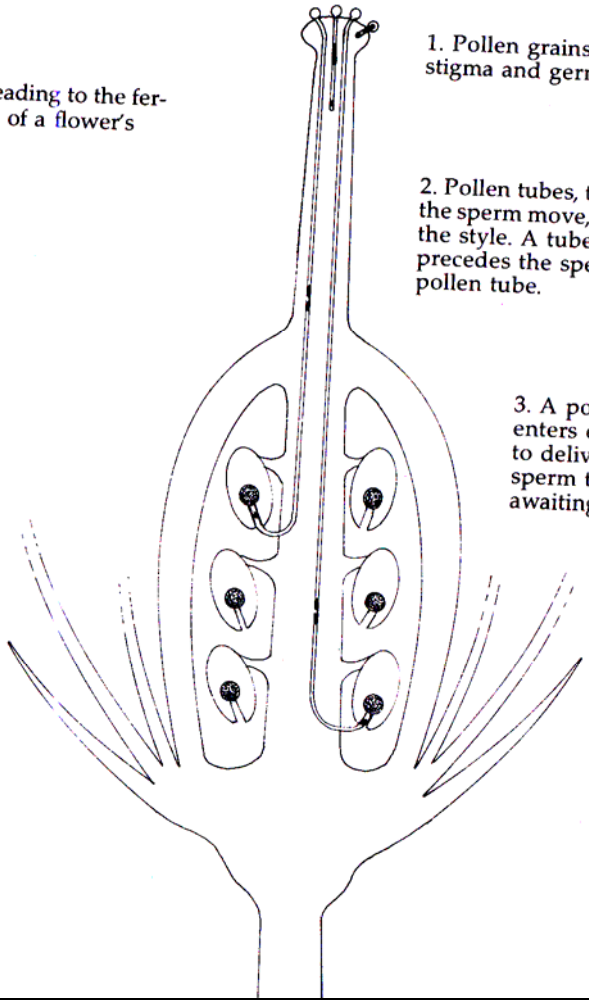
Pollen Germination



Germination of a pollen grain. a. When a pollen grain lands on a stigma it contains two cells. b. The nucleus of one cell controls the growth of the pollen tube. c. The pollen's second cell divides to form two sperm that move down the pollen tube.

Events leading to the fertilization of a flower's eggs.



1. Pollen grains land on the stigma and germinate.

2. Pollen tubes, through which the sperm move, grow through the style. A tube nucleus precedes the sperm in each pollen tube.

3. A pollen tube enters each ovule to deliver the sperm to an awaiting egg.

A World in a Bottle

Goal: To observe how living organisms survive in a closed environment

Material:

- Gravel
- Soil
- Moss plant
- Plastic spoon
- Charcoal
- Spray bottle
- Large rubber band
- 2 vascular plants
- Plastic wrap
- Pre-cut, clear plastic bottle

Procedure: In this lab, you will place plants in moist soil in a bottle that will be sealed. This setup is called a terrarium.

1. Spread about 2.5cm of gravel on the bottom of the precut bottle. Sprinkle a spoonful of charcoal over the gravel
2. Use the spoon to layer about 8 cm of soil over the gravel and charcoal. Tap it a bit to pack the soil.
3. Scoop out 2 holes in the soil. Remove vascular plants from their pots. Gently place their roots in the holes. Then pack the loose soil firmly around the plant stem.
4. Fill the spray bottle with water. Spray the soil until you see water collecting in the gravel.
5. Cover the soil with moss plant including the area around the stems of vascular plants and spray them lightly with water.
6. Tightly cover the terrarium with the plastic wrap. Secure the cover with a plastic band. Place it in bright indirect light.
7. Observe for 2 weeks. Record your observations. If its sides fog, move to an area with different amount of light. You may need to move it a few times. Note any changes you make in the location.

Observation:

1. List all the biotic and abiotic factors that are a part of your ecosystem.
2. Were any biotic or abiotic factors allowed to enter the ecosystem? If so which ones?
3. Draw a diagram showing the interactions between the biotic and abiotic factors.
4. Suppose a plant eating insect were added to the terrarium. Predict whether it would be able to survive. Explain your prediction.

Does the Color of Light Matter?

Goal: To see if plants can grow under different colors.

Material:

- Small margarine or yogurt tubs
- Tissue paper
- Sheets of colored plastic or cellophane(clear, red, green)
- Packet of cress seeds.

Procedure:

1. Put some damp paper in the bottom of each tub.
2. Add some seeds to it.
3. Place it in warm, light place.
4. Cover each tub with a different colored plastic or cellophane.
5. Check the tubs everyday and add water if necessary.
6. Watch to see if the color of light reaching the seedlings affects how they develop.

Observation:

1. Describe in detail which plant grew the best.
2. Which color(s) of light is/are absorbed by plants?
3. Which color(s) of light is/are reflected by plants?

Remember:

Plants absorb most of the wavelengths of sunlight except for green (it is reflected)