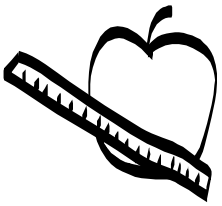


4: Can You See the Light?

Based on the Kansas quarter reverse

OBJECTIVE

Students will plan and conduct an investigation by collecting, recording, and reporting data. Students will use the scientific method to conduct their investigations. Students will explore basic life processes. Students will explain phototropism and heliotropism.

MATERIALS

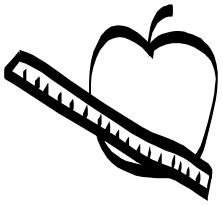
- Potted sunflowers (short varieties)
- "Sunflower Lab" worksheet
- 1 cardboard box
- Scissors
- 1 overhead projector (optional)
- "Kansas Quarter Reverse" page
- 1 class map of the United States
- Grow lights
- Masking tape
- Yardsticks
- Markers
- Protractors
- Clock
- Chalkboard/chalk

PREPARATIONS

- Make copies of the following:
  - "Sunflower Lab" worksheet (1 per student)
  - "Kansas Quarter Reverse" page (1 per student)
- Make an overhead transparency (or photocopy) of the "Kansas Quarter Reverse" page.
- Cut a hole in one side of the cardboard box approximately level with the top of the plant.

GROUPINGS

- Whole group
- Pairs
- Individual work



Can You See the Light?

CLASS TIME

Four 45- to 60-minute sessions

CONNECTIONS

- Science
- Mathematics

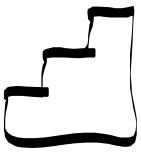
TERMS AND CONCEPTS

- Quarter
- Hypothesis
- Heliotrope
- Reverse (back)
- Observation
- Phototrope
- Conclusion
- Scientific Method
- Control

BACKGROUND KNOWLEDGE

Students should have a basic knowledge of:

- Plant growth
- Photosynthesis
- Scientific method
- Measurement with a protractor

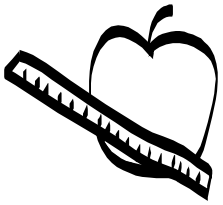


STEPS

Session 1

Note: This session will take place a few days before the lab itself begins.

1. Display a small potted sunflower in bloom for the students. Explain to the students that, in a few days, they will be experimenting with sunflowers to learn more about how they interact with the sun.
2. Lead a class discussion on the relationship between plants and the sun. Ask students to consider the ways in which plants use and depend on the sun for food and growth.
3. Distribute one "Sunflower Lab" handout to each student.
4. Display the cardboard box and point out the hole. Explain that the opening in the side of the cardboard box was placed level with the top of the plant.
5. Explain that the box will be placed over the sunflower so that the opening is level with the top of the plant and that the sun will shine through the hole.
6. Have the students read and discuss with a partner question 1 on their Lab handouts, then record their predictions. Remind the students that they need to include an illustration with their predictions.



Can You See the Light?

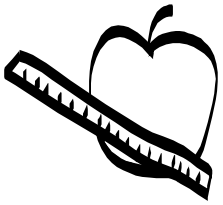
Session 2

1. As a class, review the student predictions and illustrations from their lab sheets. Discuss what might make the plant look different after being covered with the cardboard box.
2. Lift the box off the sunflower. Direct the students to complete question 2 (illustrate the sunflower and summarize the changes they observe) on their lab sheets. Student responses should reflect that the sunflower bent toward the hole in the cardboard box.
3. Have the students discuss why the plant is leaning toward the hole. The students should realize that the plant bent toward the opening in the cardboard box because that was the only source of sunlight. Explain that plants that grow or bend in response to light are called "phototropes." Direct the students to complete questions 3 and 4 on their lab sheets.
4. Have the students predict why a plant might bend toward the sunlight by completing question 5 on their lab sheets. Explain that a plant that bends toward the sun will be able to photosynthesize more efficiently than one that does not. If necessary, remind the students that photosynthesis is the process by which plants use sunlight as energy in creating food for themselves out of carbon dioxide and water. Direct the students to complete question 6 on their lab sheets.
5. Describe the 50 State Quarters® Program for background information, if necessary, using the example of your own state, if available. Then display the transparency or photocopy of the Kansas quarter reverse. Locate Kansas on a classroom map. Note its position in relation to your school's location.
6. Identify the sunflower on the Kansas quarter. Explain that Kansas selected the sunflower to be on its coin not only because it is the state flower, but also because it has some very interesting characteristics. Explain that sunflowers are not only phototropes, they are also heliotropes. Heliotropes are plants that can turn themselves to stay exposed to the sun throughout the day. Direct the students to record this definition on question 7 on their lab sheets.
7. Lead a class discussion on whether heliotropism is a positive or negative attribute for a plant. The students should realize that heliotropism is a positive attribute because it affords the plant more sunlight for photosynthesis (making food). Have the students answer question 8 on their lab sheets.
8. Explain to the students that they will be conducting an experiment during the next session to determine how far a sunflower will turn during one day.

Sessions 3 and 4

Note: In these sessions, students will need to take measurements at set time intervals. The time intervals need to be at least 20 minutes but no more than an hour apart.

1. Direct the students to complete the warm-up activity under the "Experiment" section of their lab sheets. Have the students discuss how heliotropism affects a plant's ability to photosynthesize. Answer student questions.

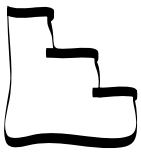


Can You See the Light?

2. Remind the students that they will be conducting an experiment using a sunflower. In order to conduct the experiment, the students will simulate the sun with a grow light. Explain to the students that this lab aims to answer the question, "How far (in degrees) will a sunflower turn itself to face sunlight?" Have the students record this question on their lab sheets.
3. Direct the students to write a hypothesis on the outcome of the experiment on their lab sheets.
4. Organize the class into groups of three or four. Direct the groups to discuss their individual hypotheses. As the groups discuss, distribute a grow light, a potted sunflower, masking tape, two yardsticks, a marker, and a protractor to each group.
5. Model the measurement process for the students. With a marker, place a dot in the center of the face of the sunflower. Then, hold the yardstick in front of the flower (parallel to the floor) and center it with the dot on the face of the flower. Lower the yardstick to the floor. Place one piece of tape at either end of the yardstick. Remove the yardstick and use masking tape to connect the two pieces of tape (which will form a straight line). Explain that this line will be the base line for all of the angle comparisons.
6. Continue modeling the measurement process by ahving the students pretend that time interval 1 has passed and it is time to measure again (be sure to move the sunflower slightly in order to create an angle for measurement). Repeat step 5 but, when lowering the yardstick this time, be sure that it touches one end of the base line. Then, place a piece of tape at either end of the yardstick. When you connect the two pieces of tape, the second line will create an angle for you to measure. Using the protractor, measure the angle between the base line and the newest line.
7. Remind the students that, when measuring, they should use the base line for measurement in each time interval.
8. Direct the students to closely follow the procedure on their lab sheet. Allow an appropriate amount of time for group work.
9. Reconvene as a class and have the groups share their conclusions. Record group data on the board and discuss factors contributing to discrepancies between group data.

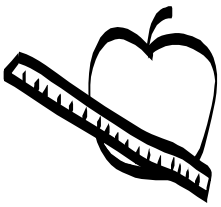
ENRICHMENT/EXTENSIONS

As an individual project, direct students to represent all groups' experiment data graphically and write an expository paper on why group results may have varied.



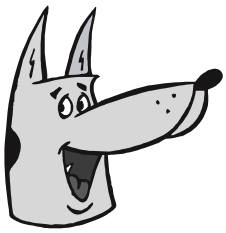
DIFFERENTIATED LEARNING OPTIONS

- Take (digital) pictures of one group's progress and save a record of their measurements. Students can use the data to create their own hypothesis and conclusion.



Can You See the Light?

- Instead of using protractors for measurement, have students draw the movement of the sunflower over the course of the experiment.



CONNECTION TO WWW.USMINT.GOV/KIDS

Did you know that former president Dwight Eisenhower hailed from Kansas? Learn more about him and the dollar coin minted in his honor. (www.usmint.gov/kids/index.cfm?fileContents=coinNews/cotm/2000/07.cfm)

NAME_____

Sunflower Lab

Session 1: The Background

Directions: Over the next few days, you will complete a sunflower lab. Record all the necessary information below.

1. What will the sunflower under the cardboard box look like? Draw it in box 1.

Prediction: _____

_____

2. What does the sunflower actually look like? Draw it in box 2.

Results: _____

_____

3. Define "phototrope." _____

_____

4. True or False: The illustration in question 2 is an example of a phototrope.

5. Predict *why* a plant grows or bends toward sunlight.

_____

_____

6. Photosynthesis is the process by which plants use sunlight as energy to turn carbon dioxide (from the air) and water into carbohydrates (food). Draw a picture that shows this process in box 3.

7. Define "heliotrope." _____

_____

8. Is heliotropism a positive attribute for a plant? Why or why not?

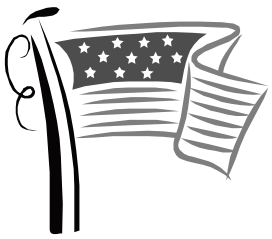
_____

_____

1

2

3



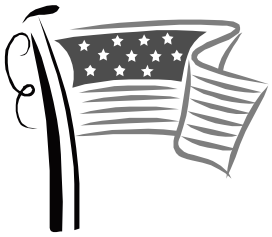
Sunflower Lab

Session 2: The Experiment (1)

HYPOTHESIS

PROCEDURE

1. Place the sunflower on the edge of a desk with the flower facing you.
2. Using a marker, place a dot at the center of the face of the sunflower.
3. Holding a yardstick parallel to the floor with the flat sides facing the floor and the ceiling, center one end of the yardstick on the dot on the sunflower so the yardstick is perpendicular to the flower.
4. Lower the yardstick slowly to the floor.
5. Place two small pieces of tape on the floor at either end of the yardstick.
6. Lift the yardstick up. Use masking tape to connect the two small pieces of tape, forming a straight line. Label this line "Base Line."
7. Place the grow light on the left side of the plant about 12 inches away and turn it on.
8. Illustrate the experiment in box 1 in the "Observations" section of this packet.
9. At the first time interval, repeat steps 3 through 6, but label the new line on the floor "Interval 1."
10. Using the protractor, measure the angle between the base line and the "interval 1" line. Record this information in number 2 under "Observations."
11. Illustrate the experiment in box 2.
12. Repeat observations, measurements, and illustrations at each time interval. Remember: Always use the base line and the most recent time interval line for your measurement.
13. Complete the "Conclusions" section of this packet.



Sunflower Lab

Session 2: The Experiment (2)

OBSERVATIONS

1. Beginning: _____

_____

1

2

2. Time interval 1: _____

_____

3

3. Time interval 2: _____

_____

4

4. Time interval 3: _____

_____

5

5. Time interval 4: _____

_____

CONCLUSIONS

- The face of the sunflower moved _____ degrees toward the light.
- The sunflower's movement averaged _____ degrees per time interval. (Hint: Add the angles together and divide by 4.)
- If the plant continued to move at this rate, about how long would it take for the plant to face the light? (Explain your theory!)

_____

_____

Kansas Quarter Reverse