ASSIGNMENT DISCOVERY ONLINE CURRICULUM

Lesson title:
The Importance of Tropisms

Grade level:
6-8, with an adaptation for older students

Subject area:
Life Science

Duration:
Two to three class periods. Students will set up the experiment during the first period and observe the seeds over the next two periods.

Objectives:
Students will do the following:
1. Complete a scientific experiment testing a single variable.
2. Understand how plants respond to different environmental conditions.
3. Identify how geotropism affects plants.

Materials:
For the class:
- Computers with Internet access (optional but very helpful)
- Reference materials: books and encyclopedias

For groups of three students:
- One petri dish
- Four soaked corn seeds
- One piece of filter paper
- One graduated cylinder
- Water (If there is not a sink in the classroom, water needs to be brought to class in a bucket.)
- Cotton
- Cellophane tape
- Grease pencil
- Scissors

For each student:
Pencils and paper
One copy of Classroom Activity Sheet: Geotropism Data
One copy of Take-Home Activity Sheet: Tropisms in Your Neighborhood

This lesson plan can be enhanced by purchasing a copy of the documentary *The Private Life of Plants: Plant Politics* from our School Store. This program airs on the Discovery Channel February 21, March 28, May 2, and June 6.

Note: You must prepare for the experiment by soaking four corn seeds per group of three students the night before you would like to do this activity. The seeds must soak for 24 hours.

Procedures:

1. Discuss with the class an interesting characteristic of plants: They can change their growth in response to their environment. These changes are called tropisms. Plants can exhibit the following kinds of tropisms:

   · Phototropism—the way a plant grows or bends in response to light
   · Geotropism—the way a plant grows or bends in response to gravity
   · Hydrotropism—the way a plant grows or bends in response to water
   · Thigmotropism—the way a plant grows or bends in response to touch

2. Explain that tropic responses can be positive or negative. A positive response is when the plant moves toward or in the direction of the stimulus. A negative response is when a plant moves away from the stimulus. For example, roots respond *positively* to gravity by growing down into the soil. The trunk and branches respond *negatively* to gravity by growing up toward the sky. (You may also want to note that the trunk and branches respond *positively* to light.)

3. Divide students into groups of three. Tell them that they are going to perform an experiment to test geotropism, a root's response to gravity. Have students follow the steps below:

   a. Take four corn seeds that have been soaked overnight. Place them flat in the bottom of a petri dish with the seeds' pointed ends facing inward. Think of them as "hands on a clock" at 12, 3, 6, and 9.

   b. Cut a piece of filter paper so that it just fits in the petri dish. Place the filter paper into the petri dish, covering the seeds. (Be careful not to disturb the positioning of the seeds.)

   c. Without moving the petri dish, pour 15 milliliters of tap water on the filter paper. Then place enough cotton over the filter paper so that when the cover of the petri dish is put on, the paper and the seeds will not be able to move. The cotton should absorb any excess water.

   d. Once you've placed the cover on the petri dish, tape it shut. Turn the petri dish over. You should be able to see the seeds in the bottom of the dish, in the same position they were originally placed.

e. With a grease pencil, write the name of your group on the side of the petri dish.

f. Tape the petri dish containing seeds to the wall of a cupboard, with the bottom of the dish (showing the seeds) facing out. Close the cupboard door so that no light is exposed to the seeds for the next few days.*

*The dishes are kept in a dark cupboard so that the only variable being tested is the seeds' response to gravity. Their response to light is not being tested. Students should find that the roots grow downward, illustrating the effects of geotropism.

4. After students have finished setting up and storing their petri dishes, have each student predict the results of the experiment by drawing how they think the roots will grow from each of the four seeds. Have students write their predictions on Classroom Activity Sheet: Geotropism Data.

5. Each day, students should make an observation and record the data on their sheets. Have them record the date and draw how the roots from each seed are growing. Have students record their observations for three days. As students are collecting data, have them look in reference books and on the Web to learn more about tropisms

6. Have students write a short paragraph summarizing the results of the experiment on their data sheets. Did the root growth match the predicted sketch? What do these results show about how roots grow?

7. Hand out copies of the Take-Home Activity Sheet: Tropisms in Your Neighborhood. Suggest that students collect information over a two-week period. Then have students bring in their sheets and share information with the class. How many tropisms did they observe? Was one kind of tropism more prominent than others? Did the tropisms vary from neighborhood to neighborhood within the community?

Adaptation for older students:
Have students design their own experiments to test one other plant tropism, such as light, water, or touch. Experiments must include a control and test only one variable at a time. For example, if students would like to test phototropism, they could put a control group upright under lights and an experimental group on its side under lights. To determine whether the plants are growing toward the light, students could use a protractor to measure the angle of the plant stems every 30 minutes for 2 hours. To record their results, students should design a data sheet. At the end of the experiment, have them present the experimental design and data to the class.

Questions:

1. How does the response of a root to gravity help a plant?

2. Consider plant roots and stems. Explain which tropisms affect both these plant organs. Do any tropisms affect both plant organs? Consider both positive and negative tropic responses.

3. Rain forests are unique and diverse plant habitats. Discuss tropisms that plants need to survive at various levels in the forest. Include the canopy, the understory, and the forest floor in your discussion.

4. Observe flowers growing in your neighborhood. Do they change the way they grow depending on where the light is? If so, how does this help the plant survive?

5. What do you think would happen if you place a light source below the plant? How would the stem grow?

6. Which do you think has a stronger influence on a plant—geotropism or phototropism? How could you design an experiment to test this?

Evaluation:

Use the following three-point rubric to evaluate students' work during this lesson. Students should be able to work in groups to set up the experiment, make a hypothesis about the way the roots will grow, observe the seeds over a period of time, record their observations, and draw conclusions from the experiment.

> Three points: students were able to work successfully in their groups to set up the experiment and develop a hypothesis about the way the roots will grow; students could keep complete records of their observations, including sketches, and could write a clear, concise summary of the experiment
>
> Two points: students worked somewhat successfully in their groups to set up the experiment and develop a hypothesis about the way the roots will grow; students were able to record most of their observations, including some sketches, and wrote a short paragraph summarizing the experiment
>
> One point: students worked in their groups to set up the experiment and develop a hypothesis about how the roots will grow; students were able to make some observations, but they did not include sketches with each observation; students wrote some ideas summarizing the experiment

Extensions:

<u>Light in a Shoebox</u>

At one end of a shoebox, cut out a small opening that will allow sunlight in. The rest of the box should remain covered and dark. Put a small plant in the shoebox, and place the box near a light

source. Make daily observations by carefully lifting off the cover of the box. Have students measure the length of growth each day and make a map of the direction of growth.

Invent a Tropism

Have students select an environment, such as the desert or the grasslands, and invent and name a tropism that would be advantageous to a plant's growth in that environment. Then have students build a model of the plant and its environment illustrating how the tropism works. For example, if the tropism is response to fertilizer placed deep in the ground, show how the plants grow downward in search of these nutrients.

Suggested Readings:

A Forest's Life: From Meadow to Mature Woodland
Cathy and Robert Mania, Franklin Watts, 1997.
How would a forest recover from a fire or other natural disaster? This brief book outlines a typical scenario of such a recovery, following the natural succession of plants that would inhabit an area devastated by fire.

Web Links:

Tropical Rainforest Plants
This site focuses on environmental adaptations and plant survival. It is easy for students to navigate.
http://mbgnet.mobot.org/sets/rforest/index.htm

Adaptation to Fire
Adaptation to Fire has long been part of the Australian environment and has played an important role in shaping the flora and fauna.

http://www.anu.edu.au/Forestry/fire/ecol/as20.htm

Homeostasis: Plants
This site has a full explanation of how plants respond to various types of environmental stimuli. The guard cell concept is fully explained and illustrated.
http://bioserve.latrobe.edu.au/vcebiol/cat1/aos2/u3aos23.html

Vocabulary:

geotropism
Context: The effect of geotropism on plants is tremendous, causing both the roots and the stems and leaves to grow in a certain way.
Definition: Growing or bending in response to gravity.

gravity
Pronunciation: grav i te
Context: Gravity causes the roots of plants to grow down so that the plant is anchored in the ground and has enough water to grow and thrive.
Definition: Force drawing objects to the center of Earth.

hydrotropism
Context: One of the reasons that roots grow down is in search of water, exhibiting most plants' tendency toward positive hydrotropism.
Definition: Growing or bending in response to water.

photoperiodism
Pronunciation: fo to pir e e diz em
Context: Sunflowers are known for their photoperiodism, or their ability to open and close in response to the changing position of the sun throughout the day.
Definition: The response of an organism to naturally occurring changes in light during a 24-hour period.

phototropism
Context: The stems and leaves of a geranium plant growing on the windowsill always turn toward the light, an example of phototropism.
Definition: Growing or bending in response to light.

thigmotropism
Context: Some people notice that their houseplants respond to thigmotropism, growing better when they touch them and pay attention to them.
Definition: Growing or bending in response to touch.

tropism

Pronunciation: tro piz em
Context: Tropisms are a unique characteristic of plants that enable them to adapt to different features of their environment—gravity, light, water, and touch—so that they can flourish.
Definition: The movement of an organism in response to an external stimulus.

Academic Standards:

Grade level:
6-8
Subject area:
Life Science
Standard: Understands how species depend on one another and on the environment for survival.
Benchmark: Knows how an organism's ability to regulate its internal environment enables the organism to obtain and use resources, grow, reproduce, and maintain stable internal conditions while living in a constantly changing external environment.

Grade level:
6-8
Subject Area:
Life Science
Standard: Understands how species depend on one another and on the environment for survival.
Benchmark: Knows that organisms can react to internal and environmental stimuli through behavioral response (e.g., plants have tissues and organs that react to light, water, and other stimuli; animals have nervous systems that process and store information from the environment), which may be determined by heredity or from past experience.

Grade level:
6-8
Subject area:
Life Science
Standard:
Understands the nature of scientific inquiry.
Benchmark:
Knows that scientific inquiry includes evaluating results of scientific investigations, experiments, observations, theoretical and mathematical models, and explanations proposed by other scientists (e.g., reviewing experimental procedures, examining evidence, identifying faulty reasoning, identifying statements that go beyond the evidence, suggesting alternative explanations).

Credit:
Mary C. Cahill, middle school science coordinator, Potomac School, McLean, Virginia.

DiscoverySchool.com
http://www.discoveryschool.com

Name: _____

Geotropism Data

Prediction

How do you think the seeds will grow? (Include an explanation and a sketch.)

Observations

Day	How the Roots Grew	Sketch of Petri Dish
Day 1 Date:		
Day 2 Date:		
Day 3 Date:		

Conclusions

How did the roots grow? Why? (Write your answer on the back.)

Name: _____

Tropisms in Your Neighborhood

Directions: Spend some time out in your yard, around your home, or in a park or field looking for plants that show a response to an environmental stimulus. Look in shady areas and sunny areas. Look at small plants and tall trees. Note the season; new growth in spring will show different responses than old woody growth in winter. As you observe these areas, complete the data table below.

Following are tropisms that you might be able to observe easily:
- Phototropism: response to light
- Geotropism: response to gravity
- Hydrotropism: response to water
- Thigmotropism: response to touch

Plant Name	Date	Location	Type of Tropism	Sketch