National Aeronautics and
Space Administration

Educational Product	
Teachers	Grades 5-12

Teachers and Students Investigating Plants in Space

A Teacher's Guide with Activities for Life Sciences

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National Aeronautics and Space Administration

Office of Human Resources and Education
Education Division
and
Office of Life and Microgravity Sciences and Applications
Life Sciences Division

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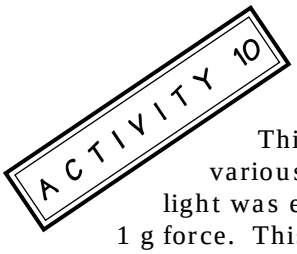


Phototropism: Do Plants Prefer the Blues?

Introduction

This activity will deal mainly with phototropism, illustrating how plants use various colors of light for different tasks. Unlike the gravitropism activity in which light was excluded, experiments in the classroom on Earth are done in the ever-present 1 g force. This fact can provide fascinating questions and design challenges for students.

Question: A Phototropic Riddle

If you were a plant
Or a plant were you,
Which hue would you choose
To tie your shoe?
Is it red, green or blue?

Sample Hypothesis:

My leaves are green,
Could it be green?
Or is it the red?
I'll guess blue,
And test if it's true.

Design

- Give germinating seedlings a choice of red, green or blue light, each coming from a different direction, and see if they bend toward one color more than toward the others.

Time Frame

Construction of the phototropism chamber will take approximately half of one 50 minute class period. The observational activities will take place over a period of 60 to 72 hours, with the actual time of observation and recording data requiring about 15 minutes at each interval.

Learning Objectives

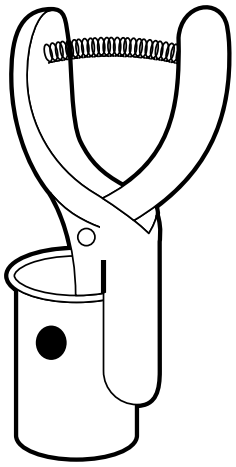
In participating in the activity students will:

- learn to construct their own experimental equipment from low-cost materials;
- learn to set up a simple experiment, make a prediction and observe results; and
- understand that blue wavelengths of visible light affect the bending of plants more than red or green, demonstrating the partitioning of various energy levels of light to different growth functions.

Materials

- 35 mm black film can with lid
- one floral foam disc, 28 mm diameter and 2 to 4 mm thick
- three grid strips, 0.5 cm x 4 cm (page 49)
- three wick strips, 1 cm x 4.5 cm, made of soft paper toweling (page 49)
- three brassica or other medium-sized seeds (turnip, lettuce or alfalfa)
- water bottle
- forceps to handle seed
- hand-held hole punch
- 2 cm wide clear adhesive tape
- 2 cm wide black vinyl electrical tape
- three 1.5 cm squares, 1 each of red, green and blue transparent plastic mylar (Roscolux® films red #26, green #89 and blue #69, work well) or colored acetate from art stores or theatre departments

Procedure



1. With a hand-held hole punch, make three windows about 1.5 cm from the rim of the black film can at approximately 120 degree intervals.

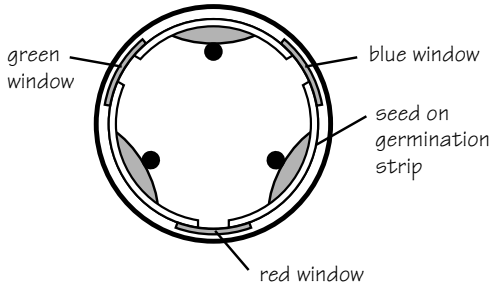
2. Use a 10 cm strip of clear adhesive tape to cover each window with a red, green and blue square.

3. As with the gravitropism chamber, place a floral foam disc in the chamber and wet it with water.

4. Set up three germination strips. The germination strips should be aligned vertically, each spaced between two windows (Figure 4). Be sure that the germination strips are below the chamber rim and that there is sufficient, but not excess, water in the floral foam disc.

5. Place a seed, oriented with micropyle down, 2 cm down on each strip.

Figure 4: Film can phototropism chamber, view from above.



6. Snap the lid tightly onto the film can and place the phototropism chamber under a light bank where light will enter all three windows.

7. Make a top view drawing of your chamber, predicting how the plants will appear after 48 to 72 hours of germination.

8. **After 48 to 72 hours**, open the lid and indicate whether or not your prediction is to be accepted or rejected. As evidence, draw what you observe and compare it with your prediction.

Concluding Activities and Questions

In this activity students will have observed the effects of light in orienting the growth of seedlings in the presence of gravity. Have students consider the following:

- Within the mix of colors making the white fluorescence of your plant lights, which color tells the plant which way is up? Is this the same for humans? Are you sure?

- What has been the influence of gravity on the phototropic response? How would the seedlings respond to light if this experiment were carried out in microgravity?

- What will happen to the seedlings if you darken the windows? What will happen if you darken only the blue window?

- Recently plant physiologists have isolated minute amounts of a yellow molecule called *flavochrome* that absorbs blue light and is active in the signal transduction pathway that transmits energy from the blue light to the bending response.