

Topic 7: Plants – 7a. Plant Race

Resources: Miller, K., Levine, J. (2004). *Biology*. Boston, MA: Pearson Prentice Hall.

Hershey, D. RE: How do the amounts of fertilizer affect plant growth? [Internet]. MadSci Network. 17 Apr. 2002. Available from: <http://www.madsci.org/posts/archives/2002-04/1019088560.Bt.r.html>

Building on: *Botany*, the study of plants, becomes more interesting when students witness it. This lab will cover how *seeds* and *bulbs* can grow into plants. Discussion of *seed structure* and the storage of food in the seed are helpful. Different plants, both *monocots* and *dicots* will be seen. The function and structure of the *cotyledon*, particularly in the dicots will be seen. The need for *water* and the damage of too much water will become apparent. The use of *fertilizer* can be discussed, and the destruction of plants by too much fertilizer may also be witnessed.

Links to Chemistry and Physics:

Experimental design
Potential versus kinetic energy
Growth and energy
Gravitational influence and geotropism

Stories: Plants must have minerals to grow. Most of the time these minerals are available in the soil, often in the form of a compound or ion. When the soil is deficient, fertilizer can be applied.

The amount and kind of fertilizer depends on several factors: the type of plant, the type of soil, the amount of water, and the growing conditions (weather, time of year).

Most fertilizer will come with three numbers clearly displayed on the package or bottle. The numbers represent the % of each of the three most important nutrients needed by plants: nitrogen, phosphorus, potassium.

Nitrogen is needed by plants to make amino acids and proteins as well as for the production of chlorophyll. Phosphorous is needed for root growth and for photosynthesis (remember NADP). Potassium is needed to move water, nutrients, and carbohydrates through the plant.

Some minerals in fertilizer are considered mobile; others are non-mobile. Nitrogen is a mobile mineral. Since the most protein synthesis would occur at the site of growth, the growth regions of the plant have priority for the available nitrogen. For that reason, when a plant is nitrogen deficient, the older leaves will show the first signs of damage as they give

up their nitrogen to the new developing leaves. Calcium is needed for cell walls and is a non-mobile mineral. When a plant is calcium deficient, the damage will first be seen in the new growth. Even if the cell walls of the older growth have excess calcium, it can't be effectively transported to the new growth area.

Too much fertilizer is also damaging. The most common problem caused by over fertilizing is called the salt effect. The excess fertilizer stays outside the root in an ionic form. This makes the environment around the root hypertonic and water moves out of the plant and into the surrounding soil. In other words, too much fertilizer dehydrates the plant.

Materials for the Lab:

- Soil (Keep a large garbage container, and when the students finish the lab, they can take their plant home or dump the whole thing back in your soil container, and it can be used year after year.)
- Graduated cylinders for students to measure out the water
- Grow lights (fluorescent bulbs)
- Meter sticks and rulers for measuring the plants
- Students need to supply seeds/bulb, container, stakes to support the plant if it gets tall.

Instructions for the Teacher:

This lab is pretty straightforward. Start it about a week before you start plants. It will take about a week before seeds germinate, though many students think there seeds should be growing within 24 hours! Other students think their plant will be bearing fruit or flowers within six weeks. This is quite a learning experience.

Watch the plants and you will see examples for your discussions in your plant unit. You will be able to show the dicotyledons on some of the beans that are planted. You can point out how those cotyledons shrivel as the new leaves grow in. Show them a monocotyledon as some people may plant grass seed. You can talk about stem structure and point out nodes and internodes. You will probably have some students that over water their plant and you can talk about why roots need air and why they make those plugs in the athletic fields every year to help the grass.

A few students will not be able to get a plant going, try as they might. If it is two weeks before the end of the project, you might suggest that they try planting rye grass. It won't be tall, but it grows fast. If all else fails, remind them they can still get 14 points just for their journal (a C grade) and they can take farmer off their list of future careers.