

Transpiration Rate and Stomata

Introduction

An activity showing that water loss is determined by leaf surface area.

Concepts

- Plant physiology
- Plant structure
- Stomata

Background

Plants lose water by transpiration through their *stomata*—pore-like openings in the underside of a leaf that allow carbon dioxide and oxygen to diffuse in and out of a leaf. The rate of transpiration is influenced by a number of factors such as CO₂ concentration, temperature, light, humidity and wind. Generally, the larger a plant's leaf surface area, the greater the number of stomata and the greater the potential for water loss. Of course, this negative aspect of large leaf surface area is counterbalanced by increased surface area for light and CO₂ capturing ability.

In this activity, bean seedlings with different numbers of leaves will show varying transpiration rates. A plant with one leaf will transpire less than a plant with two leaves because it has fewer stomata. A plant with no leaves will not transpire at all. A plant whose stomata are covered with vaseline will also show no transpiration.

Materials

- | | |
|---|-------------------------------|
| Bean plants, approximately 2 weeks old, 4 | Test tube, 4 of the same size |
| Light source | Test tube rack |
| Vaseline® or petroleum jelly | Water, tap |
| Scissors | |

Safety Precautions

This activity is not considered hazardous but always follow appropriate laboratory safety rules.

Preparation

Begin growing bean plants about two weeks before this activity. Plan to grow more than required so that enough healthy plants of approximately the same size can be used.

Procedure

1. Place four test tubes in a rack.
2. Select four bean plants that are similar in height and with similar sized leaves.
3. Using scissors, cut the stems of the four bean seedlings at their base (where the stem meets the soil).
4. Put the plant cuttings into the test tubes (see Figure 1).
5. Fill each test tube to the top with water.
6. Carefully cut off one of the leaves (the seedlings should have two leaves) of one of the plants.
7. Carefully remove both leaves of another plant.
8. A third plant will not have any leaves removed.

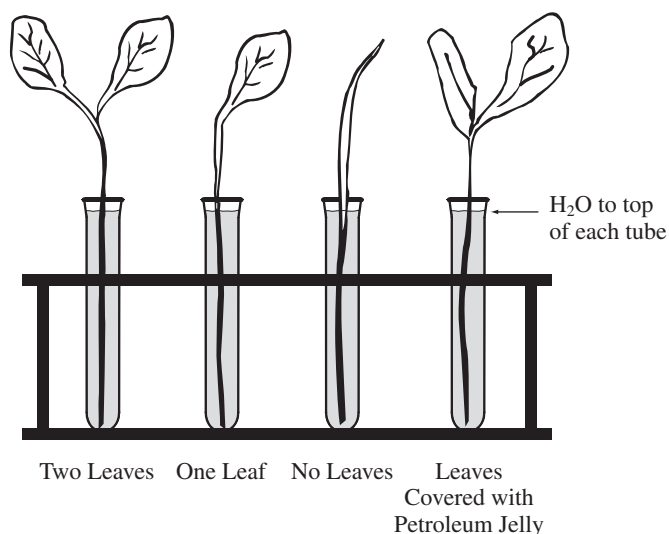


Figure 1.

9. On the fourth plant, smear petroleum jelly to cover the upper and lower sides of its leaves.
10. Predict what will happen to each plant test tube setup.
11. Place the plants under grow lights or on a window sill where they will remain undisturbed. The next day, observe the change in the water level of each test tube. The changes will be obvious. The water level in the tube with the two leaf plant will be lower than the one leaf. The one leaf tube will be lower than the no leaf and petroleum jelly-covered leaves.

Disposal

Throw the plant cuttings in the trash according to Flinn Suggested Disposal Method #26a. Please consult your current *Flinn Scientific Catalog/Reference Manual* for general guidelines and specific procedures governing the disposal of laboratory wastes.

Connecting to the National Standards

This laboratory activity relates to the following National Science Education Standards (1996):

Unifying Concepts and Process: Grades K–12

Evidence, models, and exploration

Constancy, change, and measurement

Content Standards: Grades 5–8

Content Standard A: Science as Inquiry

Content Standard C: Life Science, structure and function in living systems regulation and behavior

Content Standards: Grades 9–12

Content Standard A: Science as Inquiry

Content Standard C: Life Science, matter, energy, and organization in living systems, behavior of organisms

Reference

This activity was adapted from *A Demo A Day—A Year of Biological Demonstrations*, Bilash, Borislav, Shields, Martin; Flinn Scientific: Batavia, IL (2001), pgs 208 and 209.

Materials for *Transpiration Rate and Stomata* are available from Flinn Scientific, Inc.

Catalog No.	Description
AB1430	Bean, Lima, 4 oz.
P0230	Petrolatum (White Petroleum Jelly), 28 g

Consult your *Flinn Scientific Catalog/Reference Manual* for current prices.