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Lasting Impressions—Counting Stomata

Introduction

Ever been on a stoma hunt? Where do you find them? Are they in predictable places?

Concepts

- Stoma
- Guard cells
- Plant gas exchanges

Background

Plant tissue, just like animal tissue, is composed of specialized cells to perform specific functions. Plants have an *epidermis layer*, an outer skin-like layer, just like animals. Animal skin contains specialized "holes" or pores for specific body regulatory functions. Plant epidermis likewise has "pores." A single pore in plant epidermis is called a *stoma*.

The location and density of these numerous pores is interesting and relates to plant genetics and niche adaptations. Stomata are most numerous on the leaves of plants. They occur on both the upper and lower epidermis of the leaves in some species (alfalfa, corn), exclusively on the upper epidermis in some plants (water lily), and are absent altogether on submerged leaves of aquatic plants. Stomata are very numerous, ranging from about 1,000 to more than 1.2 million per cm^2. An average-sized sunflower leaf has about 2 million stomata on its lower epidermis.

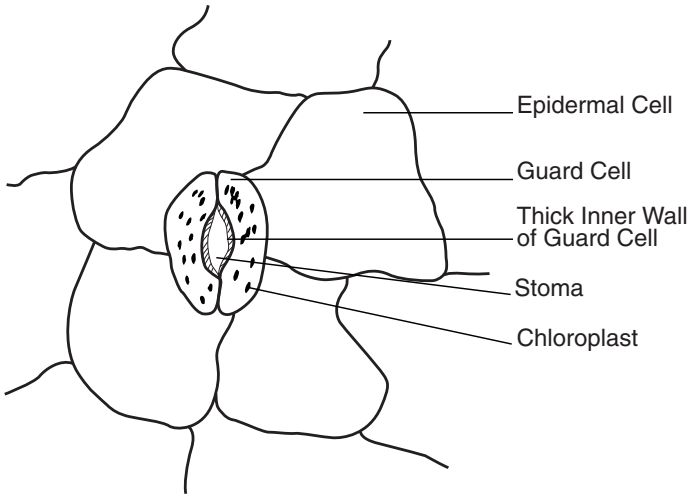

Figure 1. Leaf Stoma

Each stoma is bordered by two sausage-shaped cells that are usually smaller than surrounding epidermal cells. These small cells are called *guard cells* and, unlike other cells in the epidermis, contain chloroplasts (see Figure 1).

The photosynthesis that takes place in the guard cells aids in the functioning of these cells, i.e., the opening and closing of the stomata openings. This regulated opening and closing of the pores permits gas exchange between the interior of the leaf and the outside atmosphere. The opening and closing of the stomata also helps regulate the water balance inside the plant as water can more easily escape when the stomata are open.

It is the unique structure of the guard cells that allows the opening and closing to occur. Internal microfibrils and thicker inner walls of the guard cells cause these guard cells to "bulge" when osmotic pressure builds up inside them. When the water content of the guard cells is high the stoma is open and when the water content is low the stoma is closed. (With fresh epidermal tissue this open and closing can be viewed under the microscope by applying different water concentrations.)

Materials

Plant leaves
Clear fingernail polish
Clear cellophane tape (clear package sealing tape)
Microscope
Microscope slides
Scissors

Safety Precautions

Nail polish is toxic by ingestion and inhalation. Avoid eye contact. This activity requires the use of hazardous components and/or has the potential for hazardous reactions. Please review current Material Safety Data Sheets for additional safety, handling, and disposal information before beginning this activity.

Procedure

1. Obtain a study leaf or other plant tissue.
2. Paint a thick patch of clear nail polish on the leaf surface being studied. Make a patch at least one square centimeter.
3. Allow the nail polish to dry completely.
4. Tape a piece of clear cellophane tape to the dried nail polish patch. (The tape must be clear. Do not use Scotch® Tape or any other opaque tape. Clear carton-sealing tape works well.)
5. Gently peel the nail polish patch from the leaf by pulling on a corner of the tape and "peeling" the fingernail polish off the leaf. This is the leaf impression you will examine. (Only make one leaf impression on each side of the leaf, especially if the leaf is going to be left on a live plant.)
6. Tape your peeled impression to a very clean microscope slide. Use scissors to trim away any excess tape. Label the slide as appropriate for the specimen being examined.
7. Examine the leaf impression under a light microscope to at least 400X.
8. Search for areas where there are numerous stomata, and where there are no dirt, thumb prints, damaged areas, or large leaf veins.
9. Count all the stomata in one microscopic field. Record the number.
10. Repeat counts for at least three other distinct microscopic fields. Record all the counts. Determine an average number per microscopic field.
11. From the average number/400X microscopic field calculate the stomata per square millimeter.
12. Trade slides with classmates so you examine three different slides under the microscope. Repeat steps 8–11.

Disposal

Please consult your current *Flinn Scientific Catalog/Reference Manual* for general guidelines and specific procedures, and review all federal, state and local regulations that may apply, before proceeding. Used plant material can be disposed of following Flinn Suggested Disposal Method #26a.

Tips

- Once the technique of "lifting" stomata prints has been mastered, students can make hypotheses about variables that might affect stomata density. Students can then design their own experiments and collect data to determine the validity of their hypotheses. How do upper and lower surfaces compare? How do they vary from species to species? Do the densities vary in the same species growing in different areas?
- Lettuce leaves also work very well in this activity.

Connecting to the National Standards

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

Unifying Concepts and Processes: Grades K–12
Evidence, models, and explanation
Form and function
Content Standards: Grades 5–8
Content Standard C: Life Science, structure and function in living systems
Content Standards: Grades 9–12
Content Standard C: Life Science; organization in living systems

Materials for *Lasting Impressions—Counting Stomata* are available from Flinn Scientific, Inc.

Catalog No.	Description
ML1398	Microscope slides, glass
MS4070	High School Compound Microscope, 4X, 10X, 40XR

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

