



The Huntington Library, Art Collections, and Botanical Gardens

The Plant Cell: Peeping into Potatoes, Peppers, and Pears

Adapted from Vodopich and Moore. *Botany Laboratory Manual*, WCB McGraw-Hill, 1998.

Overview

Fresh mounts of cells from *Elodea*, pear, onion, potato, and pepper are prepared and placed under magnification to reveal many of the components of the plant cell.

Introduction

Though we see them in illustrations of biology books, it is uncommon to find a “generic” plant cell in live material. Plant tissues are made of many different types of specialized cells, functioning in tasks ranging from water transport to structural support to photosynthesis. A cell’s function is determined by its structure, and so cells that are viewed from actual plant material vary from the “generic” in many ways, from the number and types of organelles present to the structural components of the cell wall. Viewing cells from a variety of fresh material helps facilitate understanding of

- the function of different types of cells
- naming and identifying organelles and cell components
- the association between structure and function.

A mount from fresh plant material also helps identify key differences from animal cells, such as the plant cell wall; chloroplasts, chromoplasts, and amyloplasts; and the vacuole.

Motivation

Pears, peppers, potatoes, and onions might not seem like valuable specimens for laboratory explorations, but they are! Each has unique differences on the cellular level. These differences, in some cases, are even what can lead to a particular texture (pears, potatoes) or a particular color (red onions, peppers).

Objectives

After completion of the lab, students should be able to

1. Properly isolate and stain plant cells
2. Describe and sketch characteristics of the plant cell
3. Choose appropriate staining techniques based upon the part of the cell you wish to view
4. Describe the placement and structure of common organelles and cell components

Materials

- Onion
- *Elodea*
- Potato
- Pear
- Red pepper or carrots, flower petals, etc.
- Compound microscope, microscope slides, cover slips
- Forceps
- Pipette
- Iodine, Janus Green B, neutral red, toluidine blue
- 7% sucrose solution
- Razor blade
- Kim wipes or paper towels

Associated California State Biology Standards

- 1a. Students know cells are enclosed within semipermeable membranes that regulate their interaction with their surroundings.
- 1c. Students know how prokaryotic cells, eukaryotic cells (including those from plants and animals), and viruses differ in complexity and general structures.
- 1j. Students know how eukaryotic cells are given shape and internal organization by a cytoskeleton or cell wall or both.

Procedure

1. Instruct students in the proper method for preparing wet mounts.
2. Have student or student groups take one leaf each of *Elodea*. Each should prepare a mount of *Elodea* to view cell wall, cytoplasmic streaming, chloroplasts, vacuoles. The cells on the upper surface of the leaf will be bigger and easier to examine.
3. During their examination, students should focus up and down through the layers of the cells, estimate how many layers thick the leaf is, and look for cell walls and plasmodesmata.
4. Instruct students to look for the green chloroplasts. You may wish to direct their exploration:
 - On average, how many chloroplasts are in a cell?
 - Chloroplasts may be located nearer the edges of the cell, why? (Most of the cell's area is taken up by a vacuole).
 - Find evidence of cytoplasm streaming (Students may have to look around the edges of the leaf or prepare a new mount.)
 - Find the nucleus (a drop of iodine or various other stains may assist in viewing). Is the nucleolus visible too? Look for the cell wall and plasmodesmata, what are their roles?
5. Each student should sketch the *Elodea* cells and their components.
6. The specialized structural cells that give pears their gritty structure are called sclerids. Sclerids have a thickened primary cell wall, and also secrete a secondary cell wall as well. The thickening of both is mostly due to lignin. These cells are usually dead at maturity. (Lignin "waterproofs" the cell, effectively shutting it off from exchange in and out.) Have students carefully use a razor blade to cut a very thin section of pear (you may wish to perform this step), and place it on a microscope slide with a drop of water and apply a coverslip. Students are looking under magnification for the crystalline-looking sclerids.
7. Next, students can stain the specimen by applying a drop of toluidine blue to one side of the coverslip, while drawing it through with a Kim Wipe at the other. Ask how the stain changed the appearance of the cells? Why? Have students sketch the sclerids.
8. Next, the students should prepare a mount of onion cells to compare to *Elodea*. To do this, they should remove the fleshy leaves of an onion and snap in half, peeling back with forceps a thin epidermal layer from the break point. Place on a microscope slide and stain with 0.1% neutral red (stains nuclei), Janus Green B (stains mitochondria), or toluidine blue (stains a variety of cell components). Allow to sit for 5 minutes, then rinse by blotting with a Kim Wipe and applying water droplets to the mount, while continually blotting until the water runs clear. Place a coverslip over the onion and a drop of water. Place under the scope for viewing.
9. Encourage comparison of the stains. Which helped best with observing cellular components? Why?

10. Direct the students to locate the central vacuole, cell wall, and nucleus. How does the onion cell compare with the *Elodea*? Students should sketch the onion cells. Are chloroplasts present? Why or why not? (An onion is a bulb. It grows underground and lacks chloroplasts as it does not photosynthesize.)
11. To view mitochondria, student will need to prepare another onion skin mount as above, but place in a drop of 7% sucrose solution and 2-3 drops of Janus Green B. For mitochondria to stain well, the onion cells must be healthy and metabolically active. Ask they class why they add the sucrose? (Mitochondria metabolize sugars.) Direct the students to look around the periphery of cells to locate the stained mitochondria. New preps should be made every 5-10 minutes for continued viewing, as the staining will fade. When one group finds mitochondria, they should share with the class as not all groups will see this in their mount. Everybody should sketch the cells containing mitochondria.
12. To view amyloplasts, each student or group should prepare a potato mount by using a razor blade (you as the instructor may want to do this step) to cut a very thin section of potato, place it on a slide in a drop of water, and apply a coverslip. When students view under magnification, they are looking for the clam-shaped amyloplasts.
13. To stain the amyloplasts, add a drop of iodine to the edge of the coverslip and draw through with a Kim Wipe applied to the opposite edge. Now again have students view the amyloplasts. Iodine reacts specifically to starch. The students should sketch the potato cells.
14. Finally, have the class prepare mounts for viewing chromoplasts, which are another kind of plastid, carrying accessory pigments (other than chlorophyll). Use a razor blade to prepare a thin section of red pepper, carrot, or a flower petal. Have students place in a drop of water on a microscope slide, cover, and view under increasing magnification. Next, they should determine and sketch the size, shape, and color of the chromoplasts.

Evaluation

The following questions (many of which are included in the procedure) are listed under the Analysis section of the student handout and may be used as part of a report, class discussion, or assessment. You may also wish to use the students sketches of various cells and cellular components in your evaluation.

1. What are the unique components of plant cells?
2. Where are chloroplasts mostly located in a plant cell? Why?
3. What is cytoplasmic streaming? Why do you think it occurs?
4. When and why is iodine effective as a stain?
5. What are sclerids? Why are they dead at maturity? What stain makes them more visible and why?
6. Why are cells in which you wish to observe mitochondria placed in a sugar solution?
7. Compare the cells from onion and *Elodea*: what cellular components did they have in common? What were unique? Why?

Extension Activities

1. The class may next wish to conduct the lab “The ‘You’ in Diffusion”, which uses *Elodea* to demonstrate the functions of the cell membrane.
2. Students can make comparisons between the plants cells viewed in this lab and prepared mounts of animal cells.
3. Students can complete some of the cell worksheets found in *The Botany Coloring Book*.

Test Preparation

1. Which of the following is *not* normally found in a plant cell?
 - (A) mitochondria
 - (B) endoplasmic reticulum
 - (C) plastids
 - (D) plasma membrane
 - (E) centrioles**

2. The cytoplasmic channels between plants cells are called
 - (A) desmosomes
 - (B) middle lamellae
 - (C) plasmodesmata**
 - (D) tight junctions
 - (E) reticulum

3. Which of the following organelles is common to plant *and* animal cells?
 - (A) chloroplasts
 - (B) wall made of cellulose
 - (C) tonoplast
 - (D) mitochondria**
 - (E) centrioles

Name: _____

Student Sheet for The Plant Cell: Peeping into Potatoes, Pepper, and Pears

Procedure

1. Prepare a mount of *Elodea* to view cell wall, cytoplasmic streaming, chloroplasts, vacuoles. Remove a leaf from the young tip of an *Elodea* sprig and place on a slide with a drop of water. The cells on the upper surface of the leaf will be bigger and easier to examine. Add a coverslip and place under the scope.
2. Focus up and down through the layers of the cells. Estimate how many layers thick the leaf is. Look for cell walls and plasmodesmata.
3. Find the green chloroplasts. On average, how many chloroplasts are in a cell? Chloroplasts may be located nearer the edges of the cell, why? Find evidence of cytoplasm streaming. You may have to look around the edges of the leaf or prepare a new mount. Find the nucleus (a drop of iodine or various other stains may assist in viewing). Is the nucleolus visible too? Look for the cell wall and plasmodesmata, what are their roles?
4. Sketch the *Elodea* cells and their components.
5. The specialized structural cells that give pears their gritty structure are called sclerids. Sclerids have a thickened primary cell wall, and also secrete a secondary cell wall as well. The thickening of both is mostly due to lignin. These cells are usually dead at maturity. Why? Use a razor blade to cut a very thin section of pear, and place it on a microscope slide with a drop of water and apply a coverslip. Look under magnification for the crystalline-looking sclerids. Apply a drop of toluidine blue to one side of the coverslip, while drawing it through with a Kim Wipe at the other. How does the stain change the appearance of the cells? Why? Sketch the sclerids.
6. Prepare a mount of onion cells to compare to *Elodea*. Remove the fleshy leaves of an onion and snap in half, peeling back, with forceps, a thin epidermal layer from the break point. Place on a microscope slide and stain with 0.1% neutral red, Janus Green B, or toluidine blue. Allow to sit for 5 minutes, then rinse by blotting with a Kim Wipe and applying water droplets to the mount, while continually blotting until the water runs clear. Place a coverslip over the onion and a drop of water. Place under the scope for viewing. Compare the stains. Which helped best with observing cellular components? Why?
7. Locate the central vacuole, cell wall, and nucleus. How does the onion cell compare with the *Elodea*? Sketch the onion cells. Are chloroplasts present? Why or why not?
8. To view mitochondria, prepare another onion skin mount as above, but place in a drop of 7% sucrose solution and 2-3 drops of Janus Green B. For mitochondria to stain well, the onion cells must be healthy and metabolically active. Why do you add the sucrose? Look around the periphery of cells to locate the stained mitochondria. New preps should be made every 5-10 minutes for continued viewing, as the staining will fade. Sketch the cells containing mitochondria.
9. To view amyloplasts, prepare a potato mount by using a razor blade to cut a very thin section of potato, place it on a slide in a drop of water, and apply a coverslip. View under magnification and locate the clam-shaped amyloplasts.
10. Next, stain the amyloplasts by adding a drop of iodine to the edge of the coverslip and drawing through with a Kim Wipe applied to the opposite edge. Now again view the amyloplasts. What did the iodine do? Why? Sketch the potato cells.

11. Finally, prepare mounts for viewing chromoplasts, which are another kind of plastid, carrying accessory pigments (other than chlorophyll). Use a razor blade to prepare a thin section of red pepper, carrot, or a flower petal. Place in a drop of water on a microscope slide, cover, and view under increasing magnification. Determine and sketch the size, shape, and color of the chromoplasts.

Analysis

On a separate sheet of paper please complete the following:

1. What are the unique components of plant cells?
2. Where are chloroplasts mostly located in a plant cell? Why?
3. What is cytoplasmic streaming? Why do you think it occurs?
4. When and why is iodine effective as a stain?
5. What are sclerids? Why are they dead at maturity? What stain makes them more visible and why?
6. Why are cells in which you wish to observe mitochondria placed in a sugar solution?
7. Compare the cells from onion and *Elodea*: what cellular components did they have in common? What were unique? Why?