Observing Specialized Eukaryotic Cells

Lab VII-1

EQUIPMENT AND MATERIALS

You'll need the following items to complete this lab session. (The standard kit for this book, available from *www.thehomescientist.com*, includes the items listed in the first group.)

MATERIALS FROM KIT

- Goggles
- Forceps
- Slides (flat) and coverslips
- Eosin Y
- Gram's iodine
- Hucker's crystal violet
- Methylene blue
- Safranin O
- Sudan III

MATERIALS YOU PROVIDE

- Gloves
- Elodea leaf
- Microscope
- Onion, raw
- Prepared slides (see Note)
- Water, distilled

BACKGROUND

In this session, we use a variety of prepared slides. We have two goals: first, to observe the similarities and differences among different types of cells from the same or similar species. Second, to compare the same types of cells from different species to observe the similarities and differences.

For the first goal, you'll need to purchase prepared slides of various types of human cells. We suggest several of the following: blood, bone, muscle, nerve, ovary, skin, and sperm. Ideally, these should all be human cells, but in a pinch, any mammal cells are acceptable. For the second goal, obtain prepared slides of the same types of cell from other species. For example, compare mammal skin against frog or fish skin, and mammal muscle against bird muscle.

If you don't have any or all the prepared slides required for this session, there are various options. If you have prepared slides that don't exactly correspond to those we used, you can substitute them. (For example, you may have prepared slides of canine cells, which can be substituted for the human cells.) Many home science vendors sell prepared slide sets, which range in quality from mediocre to good, with corresponding price differences. Some of these sets cover a wide range of subjects with little depth, and others cover a much narrower range of subjects with greater depth. You will probably have to buy several different sets to get the breadth and depth you need to cover all of the topics in this book.

Note that images are not a perfect substitute for viewing actual slides. For example, Figures VI-1-1 and VI-1-2 show the cells of an onion epidermis at 100X and 400X, respectively. Because the cells have actual depth, we were forced to choose a compromise focus position when we shot these images. When we were actually viewing the slide, we could tweak the fine focus to bring various cell components into sharper focus, rather than having all of them slightly fuzzy. For most specimens, this problem is obvious at 400X or higher magnification. For many specimens, it's evident at 100X, and for some specimens, it's obvious even at 40X.

In unicellular organisms, such as bacteria and yeast, all life processes must by definition occur within that single cell. Multicellular organisms, such as animals and plants, are made up of many different types of cells, each of which is adapted structurally and biochemically for a specific function or functions.

For example, your epidermal (skin) cells provide a barrier between you and the environment, while your red blood cells are adapted to absorb oxygen as they move through your lungs and then transfer that oxygen to other cells throughout your body. There is a great deal of similarity between cells that have the same purpose in different species. For example, although there are differences, red blood cells from, say, humans, rabbits, and fish are more similar than different, as are (for example) epidermal cells from, say, deer, dogs, and chimpanzees. The similarities reflect the similar purposes of those cells across species, and the differences represent adaptations specific to the species in question.

In this lab session we'll use the skills you learned in session I-3 to prepare several wet mounts of eukaryotic cell specimens. We'll use those slides along with some prepared slides to investigate the structures of various eukaryotic cells and consider how those structures adapt the cells to their purposes. We will also test the effect of various stains on various types of cells.

PROCEDURE VII-1-1: OBSERVING ONION EPIDERMAL AND ELODEA LEAF CELLS

In this procedure, we'll observe the structure and components of cells from an onion epidermis and an Elodea leaf by preparing wet mounts of those cells. We'll also stain the cells with various stains to determine the effect of each stain on different components of the cells.

1. If you have not already done so, put on your goggles, gloves, and protective clothing.

2. Obtain a fresh onion scale (one layer). Snap it in two by bending it in half to leave the epidermal side (the moist side) exposed. At the broken edge of the scale, the epidermis should be visible as a paper-thin, almost transparent layer.

3. Use the forceps gently to pull off a small portion of the epidermis. Do not fold, wrinkle, or crush the epidermis, which may damage the cells. Transfer the piece of epidermis to a slide, add a drop of water, and put a coverslip in place.

4. Adjust the microscope's illuminator and diaphragm for optimum viewing, and observe the epidermis at low, medium, and high magnification. Look for organelles and cell structures such as the nucleus and nuclear envelope, cell wall, cell membrane, cytoplasm, vacuoles, and plastids (such as chloroplasts and chromoplasts). Note that not all of these structures are necessarily present in these cells, and even if present, they may be difficult or impossible to discriminate. Record your observations in your lab notebook, including sketches of the internal cell structure and the arrangement of cells in the epidermal tissue.

5. Repeat step 3 using methylene blue stain. After you have positioned the coverslip, place one drop of methylene blue stain at the edge of the coverslip. Use the corner of a paper towel at the opposite edge of the coverslip to draw water from beneath the coverslip and draw the stain under the coverslip. Allow the stain to work for several minutes to penetrate the cells. While you wait, you can be preparing additional onion epidermis wet mounts for the following steps.

6. Repeat step 4 using the methylene blue stained slide. Make sure to note which cell structures are stained by the methylene blue.

7. Repeat steps 5 and 6 using eosin Y, Gram's iodine, Hucker's crystal violet, safranin O, and Sudan III stains.

8. Use the forceps to remove one leaf from an Elodea (water weed), place it on a slide, add a drop of water, and put a coverslip in place.

9. Repeat steps 4 through 7 to observe the Elodea leaf cells with and without the various stains.

Figure VII-1-1: *At 100X, the onion epidermis shows its overall structure*

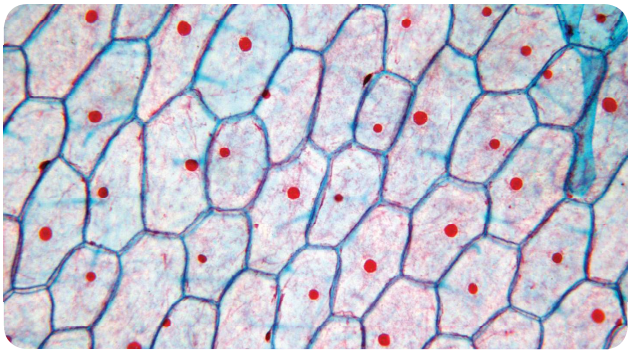


Figure VII-1-2: *At 400X, details of the onion epidermis cells are visible, including distinct cell walls and cell membranes*

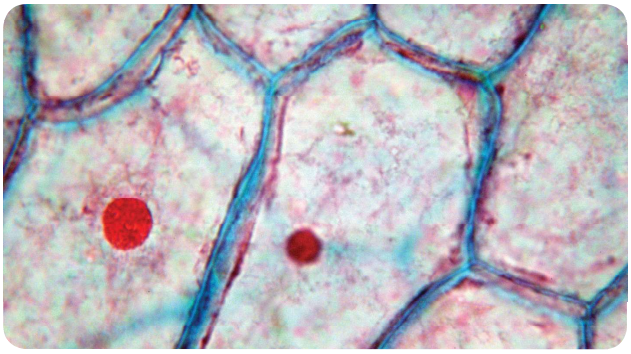
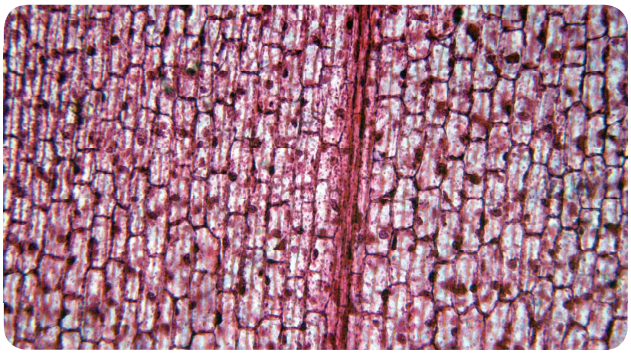


Figure VII-1-3: *At 100X, the structural similarities between the elodea leaf cells (shown here) and the onion epidermis cells are obvious*



PROCEDURE VII-1-2: COMPARING AND CONTRASTING EUKARYOTIC CELLS

In this procedure, we'll observe the structure and components of cells of different types of cells from the same (or a closely related) organism, as well as similar types of cells from different organisms. Form follows function in cells, both structurally and biochemically. For example, because the cells that make up lung tissue have the same purpose across species, lung cells from, say, a human are closely similar to lung cells from a canine or other mammal. Lung cells from a bird will also be similar to those of a human or a dog, but will also exhibit more differences because the species are not as closely related. Cells of a particular type from two closely related species may be difficult or impossible to discriminate visually. For example, skeletal muscle cells from a lion are very similar to those from a tiger or, for that matter, a house cat.

Since you'll be working only with prepared slides in this procedure, you needn't put on gloves or protective clothing. However, it's a matter of good practice to wear gloves any time you're working with specimens, if only to avoid getting fingerprints on the slides.

1. Place the first of your human (or mammal) cell prepared slides on the stage and examine it at low magnification to locate a good example of the cell in question. Center that area and switch to medium and then high magnification to observe as much as possible about the structures of that cell. Record your observations in your lab notebook, including a sketch or sketches of the cell and its components.

In particular, note the presence or absence and the appearance of the cell wall, cell membrane, cytoplasm, any vacuoles or plastids present in the cytoplasm, the nucleus, and the nuclear envelope.

2. Repeat step 1 for each of your other mammal slides, noting the similarities and differences among them.
3. Repeat step 1 for your nonmammal slide(s), comparing them to the similar cell type(s) from mammals.

REVIEW QUESTIONS

Q1: What was the most significant difference between observing the onion epidermis unstained and stained? How did the effects of the different stains vary? How would you prepare a slide to show as much detail as possible in as many different cell components as possible?

Q2: What is the shape of an individual epidermal cell, and what did the structure of the epidermal tissue resemble?

Q3: What similarities and differences did you observe between the onion epidermis cells and the Elodea leaf cells?

Q4: What similarities and differences did you observe between the onion epidermal cells and the mammal epidermal (skin) cells? Reviewing your notes from procedure I-3-1, when you used methylene blue to stain epithelial cells from your cheek, what differences did you notice in staining the onion epidermal cells?

Q5: In procedure VI-1-2, what features did most or all of the cells you observed have in common? What prominent feature in the onion and Elodea cells was absent in the animal cells?

Q6: In procedure VI-1-2, what similarities and differences did you observe while comparing animal cells?