What are the structures of a leaf?

BACKGROUND

The leaf of a plant is a specialized organ designed mainly for photosynthesis. With few exceptions, all other life depends on the functioning of the leaves of green plants. Various parts of the leaf structure perform different functions in helping the plant to live, to grow, and to produce food. This investigation will help you identify these structures. You will also see how leaves vary in size and shape. Leaves can be classified according to their type or form, the pattern of leaf margin, the arrangement of leaf veins, and the arrangement of the leaves on the stem.

OBJECTIVES

After completing this investigation, you will be able to

- *Identify* the main structures in a monocot, a dicot, and a conifer of a leaf.
- *Classify* leaves according to leaf type, venation, leaf margin, and leaf arrangement.
- *Identify* the various tissues and structures observed in a leaf cross section.
- *Describe* how some leaf structures function.

MATERIALS

Prelab (per student)
- any dicot leaf
- any monocot leaf
- any conifer leaf
- hand lens

Part A (per 5 students)
- 10 different leaves (include simple leaves, compound leaves, monocots, dicots)

Part B (per students)
- compound light microscope
- prepared slides of privet leaf or lilac leaf cross section

PROCEDURE

Prelab: Observation—External Leaf Structure

1. Review pages Chapter 23
2. Obtain a dicot leaf. Note the color of its upper and lower surfaces. Answer question 1 on the Answer Sheet.
3. Most dicots have a blade, or the broad, flat part of the leaf; and a petiole, or the stalk that connects the leaf to the stem. Look for these parts on your leaf. Use a hand lens to observe the midrib, a large central vein that runs the length of the leaf. Look for the smaller veins branching out from the midrib to all parts of the blade. Complete number 2 on the Answer Sheet.
4. Obtain a monocot leaf. Observe the shape of the leaf blade. Use a hand lens to examine the leaf veins. Notice that the lower edge of the blade surrounds the stem, forming a sheath. Complete numbers 3 through 5 on the Answer Sheet.
5. Obtain a conifer leaf such as a pine leaf, and examine its shape. Pine leaves are found in clusters that are enclosed by a scaly sheath. Pine leaves grow in groups of 2, 3, and 5 needles. Complete number 6 on the Answer Sheet.

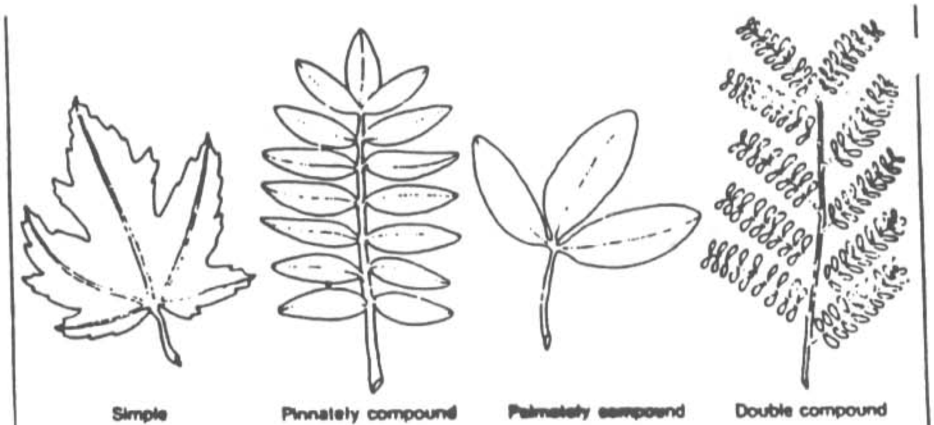

Fig. 32-1

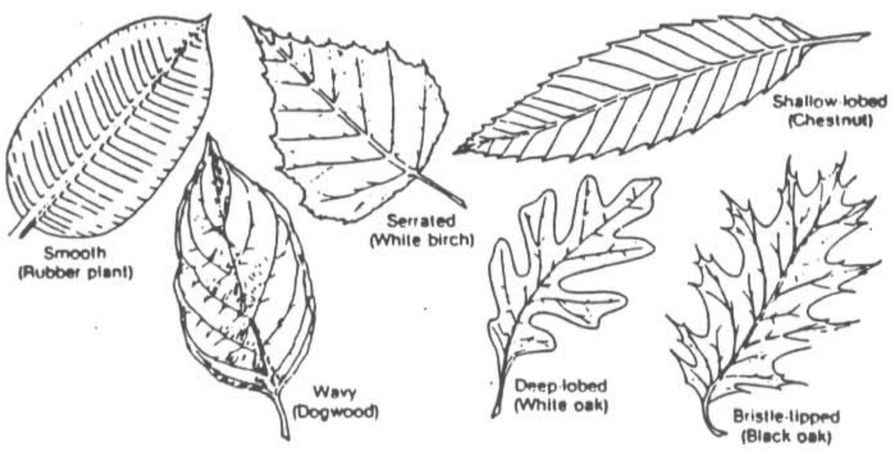

Fig. 32-2

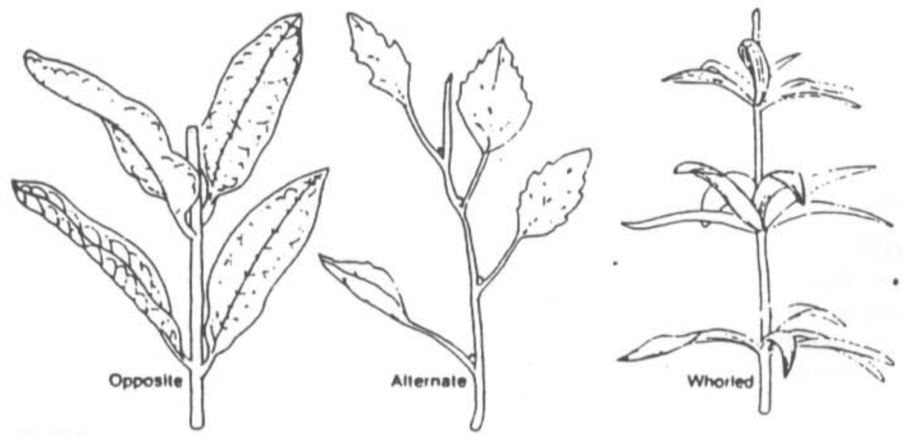

Fig. 32-3

Investigation

Part A—Classifying Leaves

1. Obtain 10 different leaves. Record each leaf name in Table 32-1 on the Answer Sheet.
2. Leaves may be classified according to leaf type. A leaf may be simple or compound. *Simple* leaves are those with one whole blade. *Compound* leaves are made up of several divisions called leaflets attached to a petiole. Compound leaves may be further classified into two subgroups. *Palmately compound* leaves have several leaflets that arise from the tip of the petiole. *Pinnately compound* leaves have leaflets that run along opposite sides of an extension of the petiole. Examine each of your leaf specimens, and identify its type by using Figure 32-1. Record the leaf type for each leaf in Table 32-1.
3. Leaves may also be classified by venation, or vein pattern. In *parallel venation*, several main veins run the length of the leaf. Most monocots have parallel venation. A leaf with *net venation* contains a netlike pattern of veins spread throughout the leaf. Most dicots have net venation. Hold each leaf specimen up to the light, and identify the vein pattern. You may need to use a hand lens to see the veins. Record the venation for each leaf in Table 32-1.
4. Leaves may be classified by the pattern of the leaf margin. Refer to Figure 32-2 for some types of leaf margins. Observe the margin of each leaf and record the type of margin in Table 32-1.
5. Leaves may also be classified by the arrangement of the leaves or leaflets on the stem. *Opposite arrangement* means the leaves are arranged opposite to each other on a stem. In *alternate arrangement* the leaves are attached at alternate positions on a stem. *Whorled arrangement* means several leaves arise together around one part of a stem. Refer to Figure 32-3 for typical leaf or leaflet arrangements. Observe the leaf or leaflet arrangement for each of your specimens and record it in Table 32-1.
6. Review the information you entered in Table 32-1. Complete numbers 1 and 2 on the Answer Sheet.

Part B—A Dicot Leaf Cross Section

1. Obtain a prepared slide of a privet or lilac leaf cross section. Examine the leaf under low power of the microscope. Notice the arrangement of the various layers of the leaf. Identify the *upper epidermis*, the top layer of the leaf. Notice also the *lower epidermis*, the bottom layer of the leaf. Both epidermal layers help protect inner tissues of the leaf. You may see epidermal hairs, which cut down the intensity of bright light and slow down water evaporation. These hairs may make the leaf surface feel fuzzy.
2. Focus the leaf cross section under high power. Use Figure 32-4 to help you select an area of the leaf where you can identify individual cells and cell layers.

Locate the upper and lower epidermis. Note the size of the epidermal cells and the fact that the epidermis is a layer of single cells. Complete number 1 on the Answer Sheet.

Cells in the epidermis secrete a substance called *cutin* that covers the whole leaf. Cutin resists water and prevents the leaf from drying out. Complete number 2 on the Answer Sheet.

5. Move the slide so that you can focus on the lower epidermis. Examine closely the openings, or *stomata*, in the epidermis. Through the stomata, carbon dioxide passes into the leaf and oxygen and water vapor pass out of the leaf. Also locate the *guard cells* that border each stoma. These specialized cells change their shape to control the opening and closing of the stoma. Complete number 3 on the Answer Sheet.

6. Locate a layer of elongated, rectangular cells just below the upper epidermis. These *palisade parenchyma* cells contain many *chloroplasts*, which appear as tiny green bodies in the cells. When light strikes the chloroplasts, photosynthesis begins.

Most photosynthesis occurs in the palisade cells. Complete number 4 on the Answer Sheet.

7. Just below the palisade cells, you will observe the irregularly shaped *spongy parenchyma* cells. Spongy cells contain fewer chloroplasts than the palisade cells. The spongy cells form a honeycomb pattern with intercellular air spaces. These air spaces contain gases and connect with the stomata in the lower epidermis. Complete number 5 on the Answer Sheet.

8. Together, the palisade cells and spongy cells make up the *mesophyll* layer. Complete number 6 on the Answer Sheet.

9. Move the slide sideways and locate a circular structure in the mesophyll layer. Each circular unit is a cross section of a leaf vein, or *vascular bundle*. This view of the vein is similar to looking straight into the openings of a bundle of straws. Complete number 7 on the Answer Sheet.

10. Find the xylem and phloem cells within the vascular bundles. *Xylem* cells generally have thick walls and are bunched toward the top of the vein. These cells carry water and minerals to the leaf. *Phloem* cells are thinner and are located toward the bottom of the vein. Phloem carries food from the leaf to the rest of the plant. Surrounding and supporting the vascular bundle are cells forming *bundle sheaths*. Complete number 8 on the Answer Sheet.

. After completion of the labeling on the cross section, complete numbers 9 through 11 on the Answer Sheet.

FURTHER INVESTIGATION

Examine some examples of leaf adaptations. Leaf adaptations occur when the leaf changes its form for protection, storage, support, or some other need. Look for the following specially adapted leaves: an onion or flower bulb, a spine or prickle from a cactus, a tendril on a climbing plant, and a leaf from a succulent plant such as a jade. Also visit a greenhouse or a florist for an example of an insect-eating plant such as a Venus's flytrap. Resource books at the library may contain pictures of plants with carnivorous leaves. Try to determine what function each of these different leaf adaptations serves for the plant.

What are the external and internal structures of leaves?

ANSWER SHEET

Prelab

1. Which surface, upper or lower, of the leaf contains the most chlorophyll? Why? ______

journal

2. Draw your dicot leaf and label the blade, petiole, midrib, and smaller veins.

Draw in your

Dicot Leaf

3. Draw your monocot leaf and label the blade, sheath, stem, and veins.

journal

Monocot Leaf

4. How is the structure that attaches the leaf to the stem different in monocots as compared to dicots? ______

5. How are the veins important to the leaf's function? ______

journal

6. How does the conifer leaf differ from the dicot leaf? ______

Part A

Table 32–1

Leaf Name	Leaf Type	Venation	Leaf Margin	Leaf Arrangement

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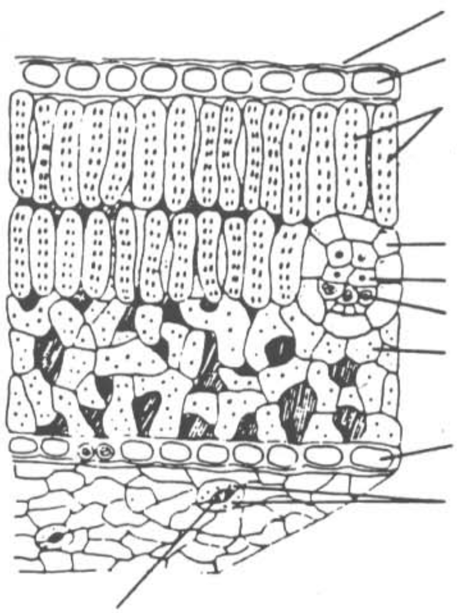
1. Look at the data in your table. How many dicot leaves did you examine? journal

2. What information does the table give you about the leaf type for monocots as compared to that of dicots?

Part B

1. On Figure 32–5, label the upper epidermis and lower epidermis.
2. Label the cutin.
3. Label one stoma and its guard cells.
4. Label the palisade parenchyma and chloroplasts.
5. Label the spongy parenchyma.
6. Label the mesophyll layer.
7. Label a vascular bundle.
8. Label the xylem, phloem, and bundle sheath.



Draw & label in your journal

Fig. 32-4

9. What is the main function of the following cells found in the leaf?

   Upper epidermis

   Mesophyll journal

   Vascular bundle

   Stomata

10. Refer to Figure 32–5, and examine closely the stomata in the epidermis, the intercellular air spaces, and the spongy cell layer. How do the stomata and air spaces work together to help the leaf survive?

    journal

11. A cross section of a pine leaf would show a thickened cutin and a thickened epidermis. How does this design help the pine leaf to survive in the northern United States?

    journal

Extension

Some people mist their house plants with water. Do you think the plant can absorb the water into its leaves?

Why or why not?

journal