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LEAF STRUCTURE

Color the epidermis (A) on the diagrams of the whole leaf, leaf section, and enlargement of a portion of the leaf section. Note that the cuticle (B) is separately colored only on the enlarged portion. Also color the guard cells (C) on the leaf section and the enlarged portion and on the diagrams illustrating their function at the lower right. The stoma (D), which is the pore formed by the guard cells, is not colored. Note that the fundamental system and vascular system features remain uncolored for now.

In most higher plants, the leaf is the primary photosynthentic structure (organ). A generalized dicot leaf is illustrated. Though the dermal, fundamental (ground), and vascular systems are found in most leaves, their arrangement and structure vary. The dermal system consists of a single cell layer, the *epidermis,* and a waxy layer, the *cuticle,* which is secreted by the *epidermis.* The dermal system covers the entire leaf surface to provide protection against desiccation. The epidermal cells are usually cuboidal in cross section, with the outer cell walls thicker than the inner walls. The *cuticle* varies in thickness, depending on plant species and aridity of the environment. *Cuticle* thickness is usually greatest in an arid environment.

Since the *epidermis* and *cuticle* effectively inhibit the movement of water and gases through the leaf surface and since gas exchange is necessary for photosynthesis, a means of allowing gases to pass into and out of a leaf is required. Numerous stomates, which are found only in the lower leaf *epidermis* in most plants, permit gas exchange and also regulate water loss. A stomate consists of two *guard cells* that function as gatelike valves that open the stomate by forming an opening, called a *stoma,* or that close the stomate by coming together. In most plants, stomates open during the day, for gas exchange while photosynthesis is occurring, and close at night to prevent water loss. Stomates may close during hot days to reduce water loss. Stomate function is controlled by internal hydrostatic (water) pressure, called turgor pressure (represented by the small arrows on the open stomate), within the *guard cells.*

Each *guard cell,* unlike the other cells of the *epidermis,* contains several chloroplasts. During the day, photosynthesis within the chloroplasts in the *guard cells* produces sugars. This causes an influx of water and therefore an increase in the turgor pressure within the *guard cells.* As a result, the *guard cells* swell. Since the outer, thin-walled areas (those away from the *stoma*) of the *guard cells* distend more readily than the inner, thick-walled areas (those adjacent to the *stoma*), the *guard cells* swell outward and pull the thick walls outward. This creates the opening, the *stoma,* of the stomate. At night, the sugars are used; the excess water leaves the *guard cells;* the turgor pressure drops; the *guard cells* shrink; and the *stoma* is closed.

Color the palisade parenchyma (E) and spongy parenchyma (F) cells of the mesophyll on the large leaf section diagram in the middle of the plate and on the enlarged section of leaf in the lower left corner. Do not color the air spaces (G).

The mesophyll, or middle leaf, is the fundamental tissue system of the leaf. Two regions of mesophyll, the *palisade parenchyma* and the *spongy parenchyma,* can be recognized. The *palisade parenchyma* consists of cylindrical, thin-walled parenchyma cells that contain numerous chloroplasts. This is the primary photosynthetic tissue of the leaf. *Palisade parenchyma* cells are closely packed, with only a very small air space between cells.

The thin-walled cells of the *spongy parenchyma* are irregularly shaped and loosely packed, forming large air spaces that create a continuous *air space* within the mesophyll. Most gas exchange, O_2 and CO_2, occurs in this area.

Color the bundle sheath (H) and bundle sheath extension (H¹) and the complex tissues of the vascular system, the xylem (I) and phloem (J), in the two large diagrams that are partially colored.

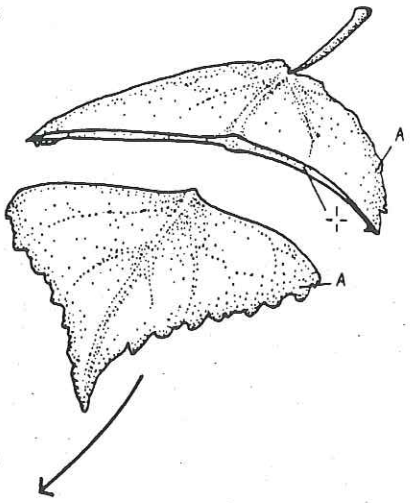
The vascular system forms a diversely branching network of conductive veins within the mesophyll. In the veins, the *xylem,* which conducts water and minerals, lies above the *phloem,* which conducts food materials. Each vein, or vascular bundle, is surrounded by a sheath of parenchyma cells called the *bundle sheath.* On major veins, *bundle sheath extensions* connect the vein with the upper and lower *epidermis.*

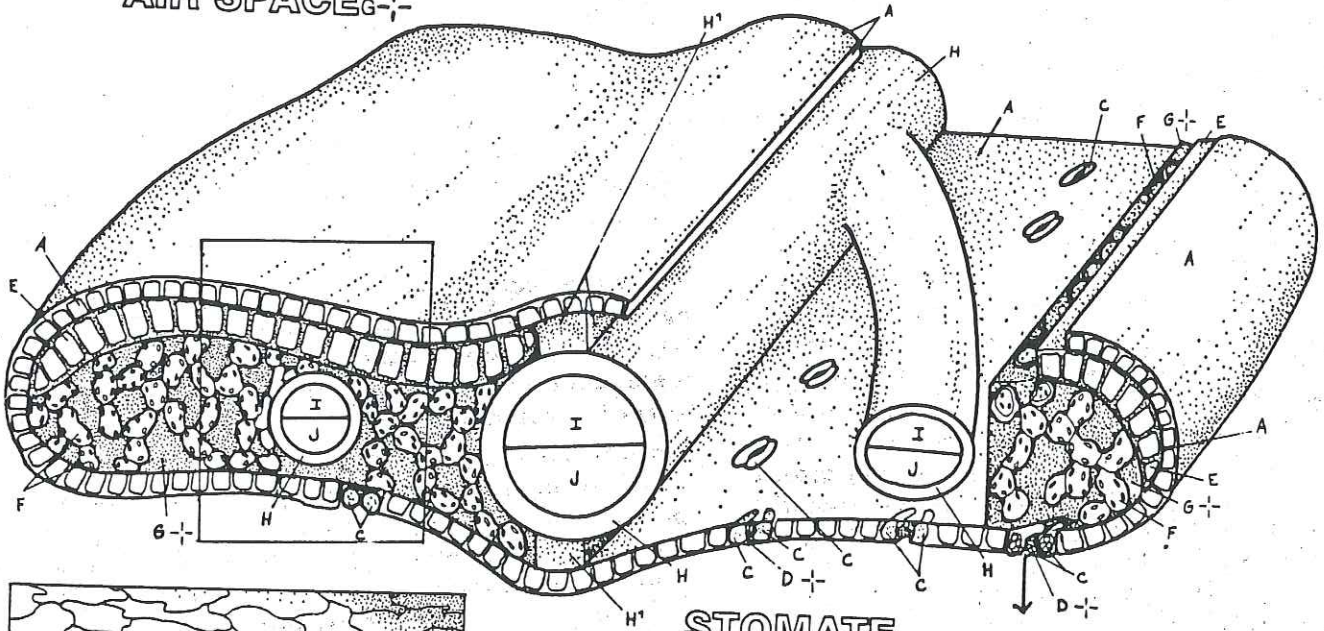
GENERAL LEAF ANATOMY.

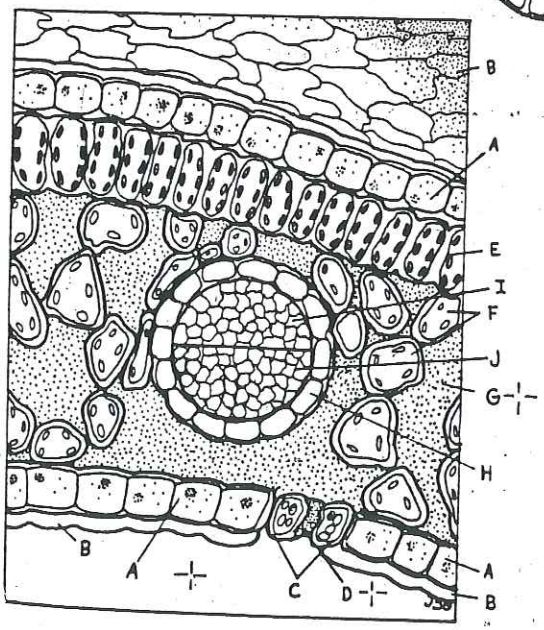
DERMAL SYSTEM ★
- EPIDERMIS A
- CUTICLE B

STOMATE ★
- GUARD CELL C
- STOMA D

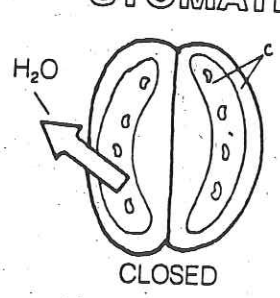
FUNDAMENTAL SYSTEM ★
- MESOPHYLL ★
- PALISADE PARENCHYMA E
- SPONGY PARENCHYMA F
- AIR SPACE G

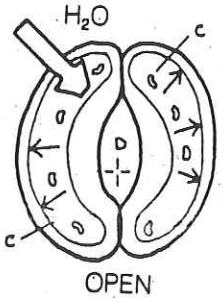






STOMATE ★





BUNDLE SHEATH H
BUNDLE SHEATH EXTENSION H'
VASCULAR SYSTEM ★
- XYLEM I
- PHLOEM J