
Week 1

Reading: Chapter 42, sections 1-3

Topic: Plant anatomy

I have a friend who's an artist, and he sometimes takes a view which I don't agree with. He'll hold up a flower and say, "Look how beautiful it is," and I'll agree. But then he'll say, "I, as an artist, can see who beautiful a flower is. But you, as a scientist, take it all apart and it becomes quite dull." I think he's kind of nutty... There are all kinds of interesting questions that come from a knowledge of science, which only adds to the excitement and mystery of a flower. It only adds.

Richard Feynman, *What Do You Care What Other People Think?* (1989, p. 11)

Main concepts:

- The cell is the basic unit of all living things. Tissues are made up of one or more types of cells, organs are made up of tissues, and systems are made up of organs. Most groups of multicellular organisms, including plants, are made up of multiple organ systems.
 - The organs and organ systems of a plant include roots (root system), stems, leaves, and flowers (shoot system)
 - Plants are divided into two broad groups, the monocots (single cotyledon in the seed) and dicots (two cotyledons in the seed). A number of structural differences make these two groups fairly easy to tell apart:
 - monocots: 3 petals and 3 sepals (though the sepals may look like the petals), parallel veins in the leaves, fibrous root system.
 - dicots: flower parts in 4's, 5's, and 6's, always has sepals distinct from petals, leaves have a network of veins, taproot system.
 - All plant cells arise from meristem cells. These are rapidly dividing, undifferentiated cells found at the shoot tips, root tips, edges of leaves and petals, and in a cylinder around many stems. In general, plants grow from the tips outward.
 - Apical meristems are found at the top shoot and the tip of the leading root. Lateral meristems are found in the stem of the plant, and are also called cambium.
 - Primary growth in plants is due to division of apical meristem cells. Primary growth makes shoots grow taller and roots grow longer.
 - Secondary growth occurs by the division of lateral meristem cells. Secondary growth makes stems and roots grow thicker.
 - Cells differentiate to form the three major tissue types:
 - Dermal tissue: covers the outer surface of plants
 - Vascular tissue: pipelines that transport water, dissolved minerals, and sugars
 - Ground tissue: Just about everything else; tissues that carry out photosynthesis, storage, and support.
 - Dermal tissue:
 - Epidermis: the "skin" of the plant, often as thin as one cell layer. May have a waxy cuticle layer on top, and may have various hairs growing out of it. (Cotton is a type of hair growing out of the epidermis of the seeds of the cotton plant.)
 - Periderm: composed of a layer of cork cells, forms the outer covering of roots and stems in woody plants, and the outer layer of bark.
 - Ground tissue: The "-enchyma" triplets
 - Parenchyma: thin-walled cells, alive at maturity, with many different functions, including photosynthesis, food storage, hormone production. Examples: the fleshy parts of edible fruits and vegetables.
 - Collenchyma: Long cells that are alive at maturity, but no longer divide. Cell walls are thick, but flexible. Used as support cells. Examples: Celery strings.
 - Sclerenchyma: Cells that may be long and stringy or short and blocky, but have thick cell wall stiffened with lignin. Used as support. Examples: "pear grit" (the gritty cells in the flesh of pears), plant fibers such as linen and hemp, cells that form nut shells.
 - Vascular tissue
 - Xylem: composed of hollow, dead cells that transport water and dissolved minerals from roots to leaves.
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- Phloem: made up of living cells that transport dissolved sugars either up or down plant as needed.
- Plant organs:
 - Leaves: made up of a blade and a petiole. On the underside, stomata, allow air into and out of the spongy ground tissue, the mesophyl, where photosynthesis takes place. Vascular bundles bring water into a leaf, and carry sugars away.
 - Stems: supports the leaves and raised them up into the sunlight. Some stems have photosynthetic tissue, and all have vascular tissue for moving water and sap. Woody stems show secondary growth, and build up layers of old xylem (wood) and old phloem (bark).
 - Roots: anchor a plant, absorb water and dissolved minerals from the soil, and may store starch. Fine root hairs increase the surface area of the roots, increasing the amount of water they can absorb.

Common misconceptions:

- Cartoons sometimes depict trees or other plants shooting up out of the ground, as though material is being shoved up from the bottom. In fact, all plants, including trees, grow from the tips outward.
- Because humans use many different plant products, from fruits to fibers, it's easy to forget that the plants produce these products for their own benefit, not ours. As you study the different plant tissues, consider how they are useful to the plant.

Reading notes:

- Sketch a generalized plant and label these parts: apical meristem, terminal bud, lateral bud, node, internode, flower, leaf, petiole, stem, taproot, branch roots, root system, shoot system.
- List the differences between monocots and dicots.
- Define: meristem, apical meristem, lateral meristem, primary growth, secondary growth.
- Make a table of the types of plant tissues. Include the three main types of tissues (dermal, ground, vascular), the subtypes listed in the text (epidermal, periderm, parenchyma, collenchyma, sclerenchyma, xylem, phloem), and the primary functions of each type.
- List the types of cells that make up xylem tissue, and state their functions.
- List the types of cells that make up phloem tissue, and state their functions.
- Define: leaf, blade, petiole, vascular bundle, stomata, guard cells, palisade mesophyl, spongy mesophyl.
- State the functions of the following stem parts: epidermis, cortex, pith, vascular tissue, vascular cambium.
- Define: heartwood, sapwood, annual rings. State what tissues give rise to these.
- State what bark on a tree is, and what tissues give rise to it.
- State the differences between fibrous roots and tap roots.

Useful websites:

- "Woody tissue growth animation" http://www.fw.vt.edu/dendro/forestbiology/cambium2_no_scene_1.swf explains how trees add girth and how tree rings develop.
 - "Stem and Root anatomy" <http://waynesword.palomar.edu/trjune99.htm> is a lengthy article with many pictures and interesting trivia about plant structure.
 - "Plant Fibers" <http://waynesword.palomar.edu/traug99.htm> has lots of information about how different fibers from plants are used in textiles, paper, and cordage.
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