Life Science
Plant Structure
Chapter 12

12 A – Form and Structure

What is a plant? Plants are living organisms which are eukaryotic and multicellular, with organized tissues, plastids (such as chloroplasts), and cell walls containing cellulose.

Botany- the study of plants

One reason the study of botany is so important to man is because all the food eaten by man comes directly or indirectly from green plants. About 2/3 of the food we eat comes directly from plants and 1/3 comes from animals which eat plants.

Ways plants are beneficial:
1) Provide most of man's food
2) Release O_2 needed by man and animals.
3) Plants are raw materials for many manufactured goods(paper, gum, wax, cloth, alcohol)
4) Plants are a source of beauty.

Morphology: the shape or form of an organism.
Anatomy: the bodily structure of an organism (deals with how cells and tissues are put together)

Three types of organs in plants:
- Roots
- Stems
- Leaves
- Flowers (study later)

Plant organs are determined by their relationships to nodes. **Nodes**: a region where a leaf is or was attached.
- Roots do not have nodes.
- Stems have nodes.
- Leaves do not have nodes but are attached to stems at nodes.

Types of Roots

Roots are the organs of the root system. A **root system** is all the roots of a plant.
Functions of a root:
1. anchors the plant
2. absorbs water and dissolved minerals
3. transports absorbed substances
4. stores food (carrots, radishes, beets)

Roots systems are of two basic designs:
1. **Taproots** - commonly found in dicots
   - pentrates the soil with very little branching
   often stores food (fleshy roots)
   has one or a few main roots that are thicker and longer than the other roots of the plant
   examples: carrots, dandelions

2. **Fibrous** - commonly found in monocots
   - have no main section but branch out into the soil in all directions
   has a cluster of roots that are approximately equal in size
   they branch several times
   examples: grasses

Types of Stems

Types of stems:

herbaceous stems: softer, more flexible type of stem
supported by cell walls and turgor pressure
woody plants often begin as herbaceous and then become woody as they grow older
examples: asparagus, wild flowers, peonies, tulips, irises, gladioli

woody stems: are hard and not very flexible
capable of supporting a lot of weight
examples: trees and shurbs

Leaf Characteristics

blade: the flat, green portion of a leaf (can be lobed, toothed, or smooth)
petiole: the stalk of a leaf that attaches it to the plant stem (the part of a leaf between the node and the blade)
Leaves which lack a petiole are referred to as **sessil leaves**. (grasses and certain other monocots have sessile leaves that attach to the stem by way of a sheath that seems to wrap around the stem)
margin: the edge of a leaf's blade
veins: the pipelines that carry food and water throughout the blade (water and sugar conducting tissues)
stipule: a small leaflike or scalelike structure on a plant that helps to cover a leaf while it is developing

Leaf Venation

venation: the pattern of the veins within leaves two basic patterns of leaf venation:

(1) **Parallel venation**: a series of veins which originate at the stem and proceeds to the tip of the leaf (roughly in a parallel) (larger veins are all parallel to each other)
occurs in monocots - corn, grass, irises, orchids

(2) **Netted venation**: large veins branch to form a network of smaller veins throughout the leaf
occurs in dicots

A. **Pinnate**: if the veins branch off one large central vein called a **midrib**
example - oaks, apple trees, African violets

B. **Palmate**: if there are two or more main veins coming from a single point
example - maples, ivy, geraniums

leaf mosaic - the arrangement of leaves on a stem

types of leaf mosaic:

1. **alternate** mosaic - leaves alternate from opposite sides of the stem (only one leaf attached at a node)
2. **opposite** mosaic - two leaves grow from the same point on the stem (two leaves at each node)
3. **whorled** mosaic - three or more leaves grow from a single point on a stem (3 or more leaves per node)

Leaves may be classified as either simple or compound

simple leaves - have one blade on every petiole (a leaf whose blade is not divided)
compound leaves - have more than one blade on every petiole
each small blade on a compound leaf is referred to as a **leaflet**
example - pecan

----------Quiz 12A

12 B – Anatomy

Two important characteristics of plant cells – cell walls & plastids.

(1) **Cell Walls**: outer boundary, provide support, made mostly of cellulose

Most plants are supported by two related systems: cell walls & turgor pressure.
Turgor pressure: water pressure inside a plant cell's central vacuole; causes the stiffness of the plant cells

(2) **Plastids**: storage center in plant cells. Stores pigments, starch or oil.
Chloroplasts: contain the green pigment **chlorophyll** which is used in photosynthesis to capture light energy.
Other types of plant pigments: xanthophyll (zan' tho fil) – yellowish colors
carotene – yellowish-orange colors
anthocyanin (an' tho si' a nin) – red, blue, purple colors

tissue: a group of similar cells working together to perform a particular function

Our bodies have four basic kinds of tissues: epithelial (skin)
muscle
connective
nerve

A typical plant has 3 distinct kinds of tissue:

(1) **Structural tissue**
most of the body, or structure, of the plant is structural tissue

(2) **Meristematic tissue**
purpose - the growth and repair of plants and plant parts

(3) **Vascular tissue**
the plant's sap-conducting tissues (compared in some ways with our circulatory system)
two types:

A. **Xylem** - transports water and dissolved minerals (one kind of sap) upward
long, thick-walled hollow cells (like staws)

B. **Phloem** - transports food manufactured in the leaves (the other kind of sap) downward
slightly thinner than xylem and not completely hollow tubes

In leaves and in non-woody plants, the xylem and phloem are usually arranged in **vascular bundles** (veins). Vascular bundles are often supported by thick-walled cells called fibers. **Fibrovasular bundles**: xylem and phloem surrounded by supporting tissues

The outer most tissue of most leaves, young roots, and young stems is the epidermis. Top and Bottom layer - **epidermis** (one cell thick) lack chlorophyll and service as protection. Often epidermal cells secrete a waxy substances that form a **cuticle** (a noncellular protective covering of leaves) give a leaf a shiny appearance

wood - a collection of layers of xylem that have built up over several years.

The oldest layer of xylem is at the center of the woody plant part newest layer is the outermost layer

heartwood - dead xylem cells that contain tars or resins (often darker in color)
sapwood - xylem that is alive and transporting water
bark - the outer covering of woody plant parts(makes new xylem and phloem cells)
cork - (the outer layer of bark) tough, thick-walled cells forming the outer layer of bark in woody plant stems
made of dead, thick-cell walls
forms a tough, water proof coating that keeps harmful organisms out and moisture
cork cambium - a layer of living cells just under the dead cork (produces new cork cells)

----------Quiz 12B

12 C – Major Plant Groups

One of the traits used in *classifying plants is the presence or absence of vascular tissue*. Xylem and phloem are the most familiar, but there are others.

Vascular plants: plants that have vascular tissue.
Nonvascular plants: plants that do not have vascular tissue.
Do you think that plants without vascular tissues are tall or short? Why?

Another important trait used to *classify plants is whether they produce seeds*.
Nonvascular plants – seedless and reproduce by producing gametes in one stage of their life cycle and spores.
Vascular plants – some reproduce by gametes and spores & others by gametes and seeds.

3 Major categories of plants:
1. nonvascular plants
2. seedless vascular plants
3. seeded vascular plants (seed plants)

Nonvascular Plants

These plants are called bryophytes. Examples: mosses, liverworts, & hornwood. Phylum Bryophyta (means "mosslike plant")
- Water and other materials are transported by diffusion.
- Fairly short.
- Sometimes have parts that look like roots, stems, or leaves, but there is no vascular tissue so they don't have roots, stems, or leaves.
- Live near water or shady places.

Just because a plant has the word "moss" in its name, doesn't make a moss. Examples: Spanish moss is a seed plant. Reindeer moss is a lichen.

Parts of a moss plants:
leafy shoot- a slender stalk with leaflike structures
each of the tiny leaflike structures on moss is 1 cell layer thick
rhizoids- tiny hairless threads which grows into the soil to absorb water and minerals
not roots- lack conditioning tissue

Life Cycle of a moss:
Involves both asexual and sexual reproduction
This marvelous process is known as the *Alternation of Generations*
The 2 generations are
(1) the sporophyte - produces spores Asexual
(2) the gametophyte - produces gametes Sexual

1) the top of the male gametophyte bears the **Antheridia** which produces **sperm**
2) the top of the female gametophyte has 1 or more **Archegonia** which contains the **ovum**
3) Sperm swim from the antheridia to the ova and fertilize the ovum (zygote)
4) Zygote grows into a stalk with a capsule which produces spores
5) When mature the cap comes off the capsule and the wind distributes the spores
6) Spore grows when environmental conditions are right
7) Fist grows into a cellular filament called a **protonema**
8) Protonema then forms the leafy shoots and rhizoids

The dominant generation is the gametophyte generation (because it is more often seen)

Benefits of mosses:
1. Help to replenish the soil.
   Secrets acids which gradually break down the minerals in rocks (chemical weathering)
2. Help prevent soil erosion.
3. Peat (main constituent is peat moss or *sphagnum*
   Dried peat is used as fuel in Iceland and other northern regions.
   Gardeners use peat moss to pack plants for shipment and to mix with soil as fertilizer.
4. Has been used for surgical dressing (because of its superior absorptive quality)

Other Bryophytes: Liverworts & hornworts; named for what their shapes resembled.

The name "liverwort" dates from the 9th century. Means "liver plant"
Marchantia - a common liverwort with a Y-shaped thallus. Have splash platforms which look like little umbrellas

Seedless Vascular Plants

Vascular plants are capable of growing taller and living in drier areas than nonvascular plants.
They require water for sexual reproduction.

Ferns are nonflowering vascular plants with spore-bearing leaves and horizontal underground stems.
Most are only 1 or 2 feet tall
Some tree ferns in tropical regions grow as tall as 50 feet and have leaves 12-14 feet long.

parts of a fern:

Fronds - the fern leaves
Rhizome - underground stem
Sori - groups of spore-bearing sporangia that appear as brownish dots on the underside of fern fronds
(singular - sorus)
They are dense clusters of minute sporangia, each of which contains between 48 and 64 microscopic spores.
sori - Greek "*a heap*"

Some ferns are **epiphytes** - plants that grow on other plants but are not parasitic

The Fern Life Cycle

Asexual (sporophyte) and sexual (gametophyte) - *Alternation of Generations*

A new fern's life cycle typically begins in July when the brownish sori appear on the undersurface or along the margins of the sporophytes' fronds.

Sori may be round, kidney-shaped, oblong, linear, curved, or star-shaped.

Asexual:

1. Sori appear on the underside of a frond.
2. Sori first open and discharge millions of spores.

Sexual:

3. Spore develops into a tiny green, heart-shaped structure called a **protallium** or **prothallus**.
Quite different from the original fern plant and is seldom seen (only 1 cell layer in thickness).
4. The underside of the prothallus develops archegonia and antheridia.
Archegonia - at the matched end of the prothallus (ova)
Antheridia - near the point of the "heart" (sperm)
5. Sperm are released from the antheridia and swim to the ovum at the bottom of the archegonia.
6. Zygote matures and sends the first leaf up and the first root down (fiddlehead)

It usually requires between 3 and 7 years to reach reproductive maturity. Fern plants (sporophytes) live for several years and produce new fronds each year. Prothellia (gametophytes) only live 3 to 7 weeks, in which time they produce the archegonia and antheridia. *Dominant generation - sporophyte*

Other seedless vascular plants: club moss & horsetail

club mosses: (also called "ground pine" because they grow along the ground in temperate regions)
horsetails: all but one group have become extinct
the epidermis contains a glasslike substance (silica) which feels very rough to the touch.
Called "scouring rushes" - used for scouring pots and pans before scouring powder and pads were known.

Seed Plants

These plants do not require water for sexual reproduction. They reproduce by seeds rather than spores.

Seeds are multicellular and contain a young plant called an embryo.

Two main groups of seed plants:

- gymnosperms
- angiosperms

gymnosperms - the seed plants that do not first produce a flower before the seed; means "naked seed" - produce seeds not covered by the walls of an ovary.
Do not form flowers or fruits.
Produce cones or cone-like structures.

Angiosperms - *The Flowering Plants* – means “covered seed”
All have seed enclosed in a fruit
All have flowers (not all are colorful blossoms - corn tassels and catkins of oak trees)

----------Quiz 12C