Certified Nursery &
Landscape Professional

C N L P

New York State
Certified
Nursery & Landscape
Professional

Training Manual

New York State Nursery & Landscape Association

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HOW PLANTS FUNCTION

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How Plants Function

A horticulturist needs a general knowledge of plant anatomy, morphology, and growth and development. This is important to be able to identify the basic parts of a plant, gain an understanding of how a plant functions, and appreciate how environmental factors affect plant growth.

The beginning of this chapter provides several learning objectives, while the end includes 20 review questions and a glossary of important terms. You should be able to answer all of these review questions, as well as be familiar with all the terms.

This chapter will focus on these objectives:

1. Provide a general understanding of botany.
2. Describe and identify the basic parts of a plant.
3. Describe and identify overall plant functions.
4. Provide explanation as to how environmental factors affect plant growth and development.
5. Provide and identify the basic botanical terms used in plant classification.

Introduction

Botany is the study of all plant life. The science of botany includes the study of algae, mosses, ferns, grasses, palms, herbaceous flowers, vines and deciduous and evergreen trees and shrubs. Within botany, students can specialize in the anatomy, physiology, genetics, taxonomy, or the interrelationships among plants. Although the study of botany is a science all to itself, there are applied plant sciences that use the basic principles of botany within their specific-disciplines.

Traditionally, plant sciences on most college campuses are separated into the departments of botany, horticulture, agronomy, and forestry. The botany department usually includes the disciplines of plant physiology, taxonomy, ecology and morphology. The horticulture department deals primarily with the production of ornamentals, vegetables and fruit. The agronomy department typically covers the production and management of field crops and turf grass. Forestry covers the production and management of wood products and timber.

Related disciplines that are closely connected with the plant sciences listed above include soil science, weed science, plant pathology and entomology. Soil science investigates the components and structure of soils. Weed science investigates weed management practices within a crop. Plant pathology covers the diseases that attack plants. Entomology is the study of insects which includes those that feed on plants or plant products.

Anatomy and Morphology

Cell Structure

Living plant cells contain a nucleus, cytoplasm, various organelles, a vacuole, a cell membrane, and a cell wall (Figure 1 and 2). The existence of a cell wall is one of the fundamental differences between plant and animal cells. The rigid cell wall is made up primarily of the carbohydrate cellulose. Another obvious difference between animal and plant cells is that many plant cells contain the green pigment known as chlorophyll which is stored in organelles structures called chloroplasts. Plant cells can have specialized functions and there are many different cell types found within plants and the quality of the soil determines the capacity of the land to support a particular function.

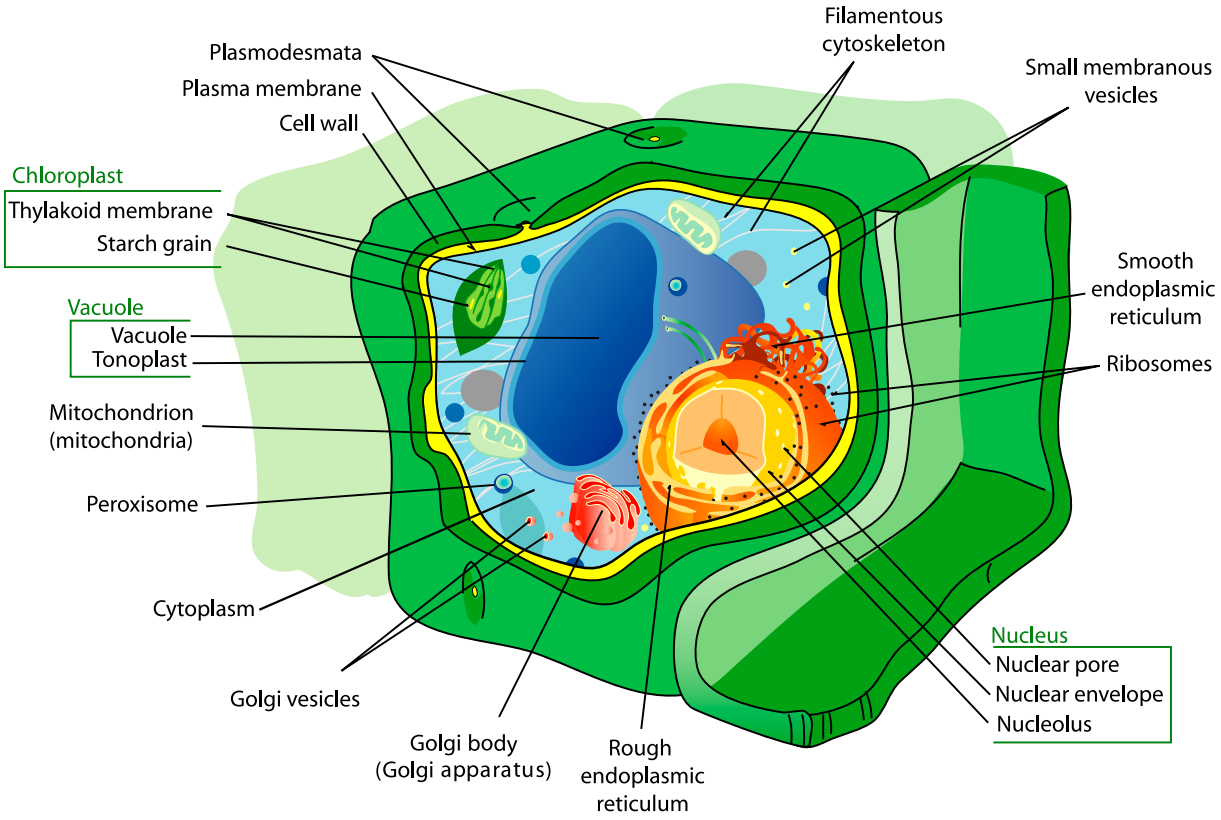

Figure 1 Plant Cell Example

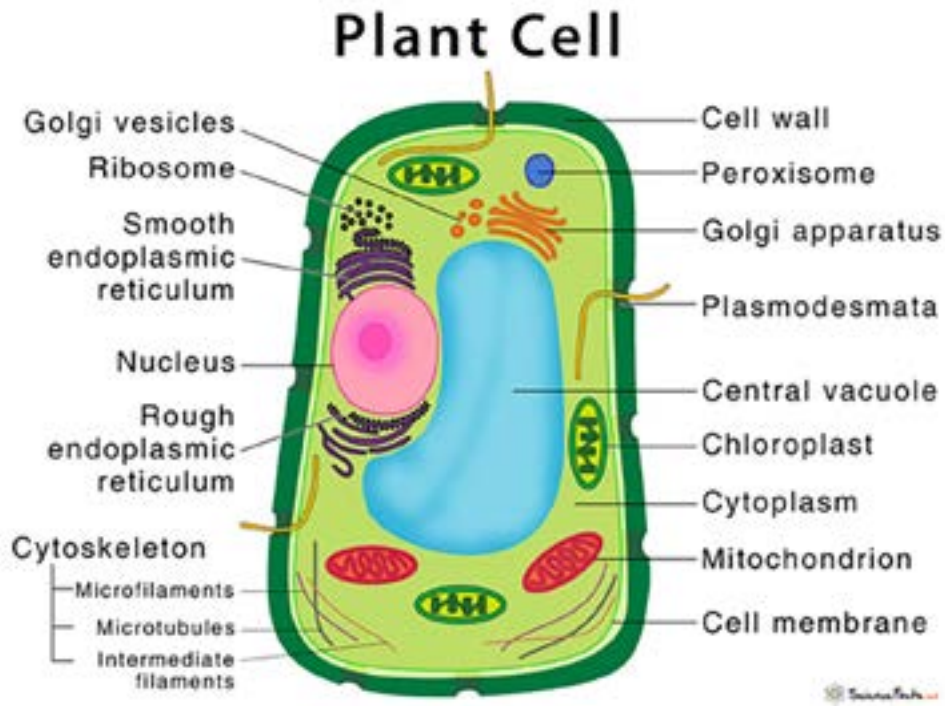

Figure 2- Plant Cell Example

Tissues

Plant cells are organized into tissues. These tissues have specialized forms and functions. Three important tissues of higher plants are the meristematic, epidermal and vascular tissues. The meristematic tissues are where cell division and growth take place (e.g. buds, shoot tips). The epidermis is the outermost covering of the plant and forms the surface of leaves, stems and roots (e.g. bark).

The vascular tissues consist of the xylem and phloem. The phloem is the major food and hormone conducting tissue of a vascular plant. These food passageways are made up of cells that have sieve-like end plates through which strands of cytoplasm extend from one cell to the next. The xylem is the major water and mineral conducting tissue of vascular plants. It is composed of hollow long tapered cells, called tracheids, and short hollow cells, called vessels, that form a continuous pipeline for water conduction from the roots up the stem into the leaves.

Seeds

Flowering plants begin their lives as seeds (Figure 3). A seed contains a miniature plant in an arrested state of development (dormancy) and it's initial food source. The outermost part of a seed is the seed coat, the protective covering for the seed.

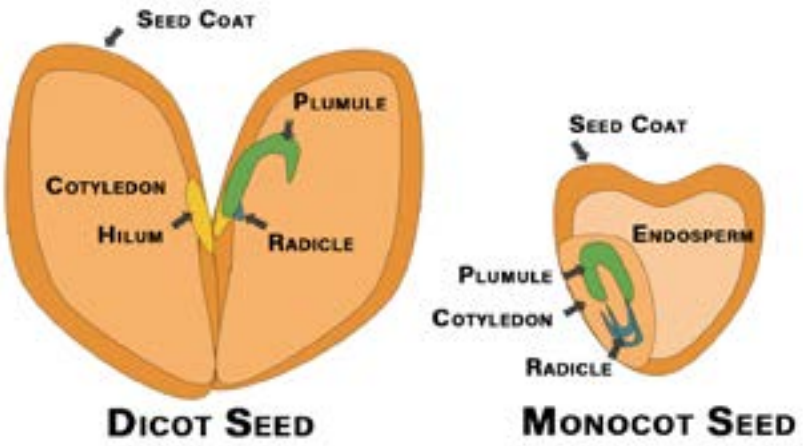

Figure 3- Seed Structure

The endosperm is the food source for the germinating plant until the plant emerges from the soil and can produce its own food in the sunlight. The young plant is called an embryo. Embryos have several parts. The cotyledons, or seed leaves, are an additional food source for the germinating embryo and in some cases begin photosynthesis before the true leaves emerge.

A major distinction within the plant kingdom is that monocotyledon plants (monocots), as their name would imply, have only one cotyledon and dicotyledon plants (dicots) have two cotyledons (Table 1, below). The plumule develops into the stem and true leaves. The radicle develops into the roots.

Germination

Germination is the emergence of a plant from a seed. Seeds remain dormant until conditions are right for germination. Dormancy may be chemically induced. Chemical inhibitors in seeds will leach out only when sufficient water is available. Seeds with mechanically induced dormancy will only germinate after the seed coat has been partially worn away or damaged. Cracks or thin places in the seed coat allow water penetration. Environmental factors such as chilling may also be required before seeds are released from dormancy.

There are five steps in germination. Seeds must first take up water. Water uptake is followed by a period of intense metabolic activity. The embryo grows and expands. The radicle forces its way out through the seed coat. The final step is the emergence of the shoot.

Characteristic	**Dicots**	**Monocots**
Flower parts	In fours or fives (usually)	in threes (usually)
Pollen	Usually tricolpate (having three furrows or pores)	monocolpate (having one furrow or pore)
Cotyledons	Two	One
Leaf venation	Usually net-like	Usually parallel
Primary vascular bundles in stems	In a ring	Complex arrangement
True secondary growth with vascular cambium	Commonly present	Absent
Typical examples	Most familiar trees and shrubs other than conifers	Cattails, grasses, irises, lilies, orchids

Table 1 - Differences between Dicots and Monocots:
Adapted from Raven, Evert and Bettors, 1986.

Shoot and Root Systems

There are two basic parts of a plant, the above ground portion called the shoot system (stems, leaves and flowers) and the below ground portion called the root system (Figure 4).

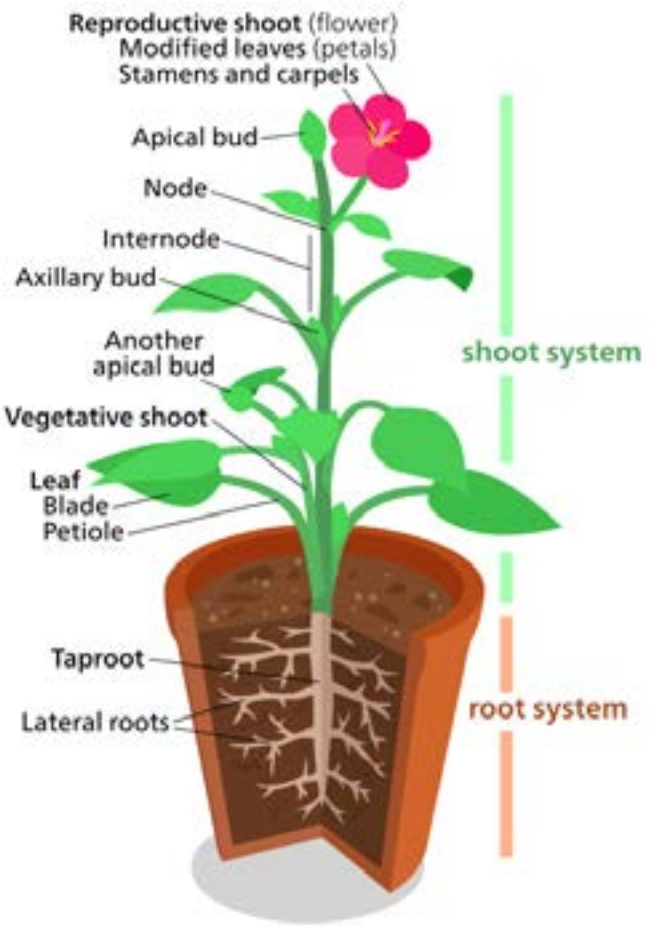

Figure 4- Plant Systems

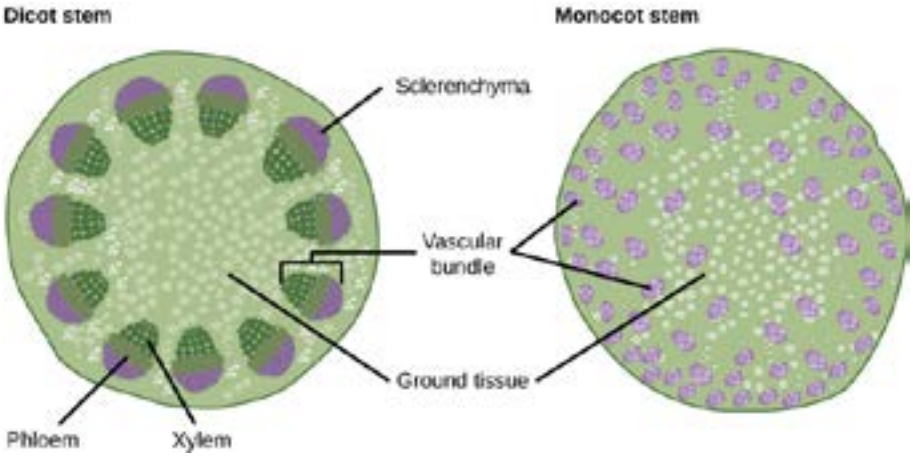

Figure 5- Shoot Details

The major tissues in the stem are the xylem, phloem, vascular cambium, pith, cortex, parenchyma and epidermis (Figure 5). The xylem and phloem tissues make up the plant's vascular system. Xylem transports water and minerals upwards from the roots and Phloem transports foods throughout the plant.

The arrangement of the vascular system in monocots is different from that of dicots. In dicots the vascular cambium (a meristematic tissue) lies between the xylem and phloem and is a site of cell division and active growth. The pith is located in the center of the stem and the cortex surrounds the vascular system. In monocots, the vascular bundles are embedded in parenchyma. The epidermis is the outermost layer of cells on the surface of the stem.

Stems of monocots and herbaceous dicots grow vertically, but rarely grow outwards horizontally. Stems of woody dicots however, exhibit radial growth. Cells of the vascular cambium divide and enlarge and form new xylem cells to the inside and new phloem cells to the outside of the stem. As a result, the stem expands outwards. Cells formed in the spring become quite large, but cells grown later in the season stay small. This is the reason for the formation of annual rings. Old xylem in the central portion of the stem is not functional, and old phloem is crushed by the newly formed cells pressing outwards. Only a very narrow ring of cells inside the bark is alive and functional. This is why ropes or wires are placed too-tightly around a stem; they will eventually squeeze the vascular tissue, prevent transport, and girdle the plant. Bark is formed by a layer of cells outside the phloem called the cork cambium.

Stems may be simple or highly branched. Stems called crowns have internodes so short that the leaves form a rosette. An example of this is cabbage. Stems may also be climbing or creeping, for example Ivy. A horizontal stem (fleshy or semi-woody) that lies on top of the ground, as in strawberry runners, is called a stolon. A rhizome is a continuously growing horizontal underground stem which puts out lateral shoots and adventitious roots at intervals. An example of this is Iris.

Buds

A bud is an undeveloped shoot from which embryonic leaves or flower parts arise (Figure 6). Examples of buds include leaf buds and flower buds. As mentioned earlier,

buds may be located at the terminals (stem tips) or laterally in leaf axils.

Figure 6 - Bud detail

Leaves

Leaves are borne on the stems and function in food production and gas exchange (Figures 4 and 7). The broad flat part of the leaf is called the blade, and the edge of the blade is called the margin. For each species of plant the blade has a characteristic shape (e.g. oval or pointed), margin (e.g. smooth or toothed), and texture (e.g. smooth or hairy) (Figure 7). The blade is often attached to the stem by the stem-like petiole.

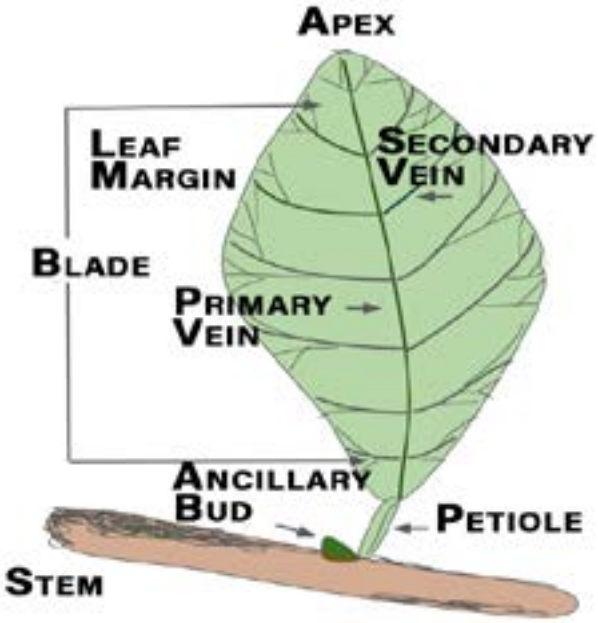

Figure 7 - Leaf Parts

Leaves at the nodes may occur in pairs opposite one another. Leaves may also occur singly at each node, and alternate from side to side along the stem. Or there may be several leaves at each node that are arranged in a whorl. Leaves may be simple or compound. A compound leaf is divided up into smaller units called leaflets. Compound leaves can be further classified as pinnate (feather-like) or palmate (handlike) (Figure 8). In monocot leaves, the veins are arranged parallel to one another and run from the base to the tip of the leaf. The veins in dicot leaves are branched and form a network.

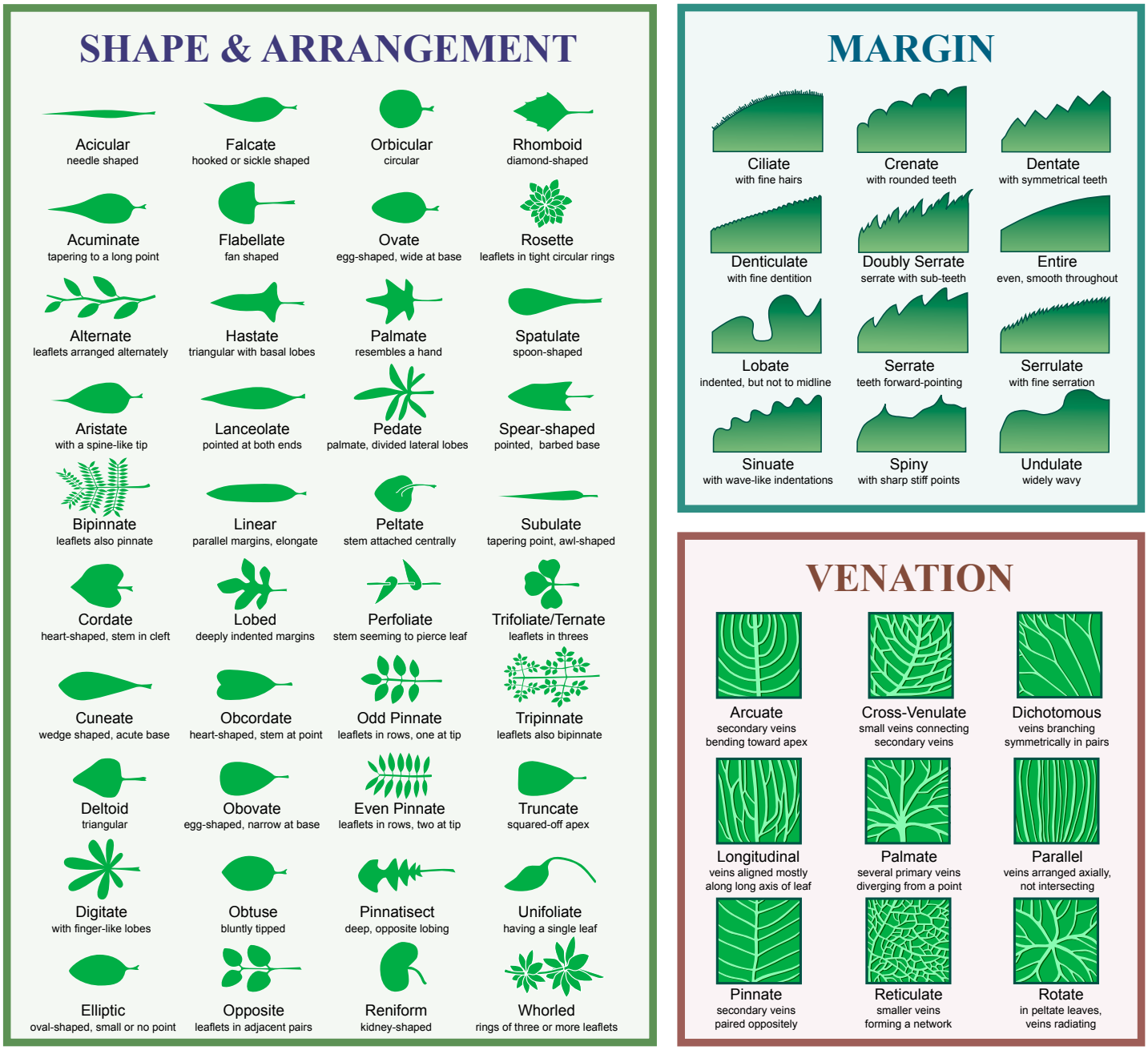

Figure 8 - Leaf Morphology

The internal anatomy of a leaf can be described as a "sandwich" (Figure 9). The "pieces of bread" in the "sandwich" are the upper and lower epidermis. The epidermis is usually covered with a waxy layer called the cuticle to prevent desiccation. The middle of the "sandwich", where photosynthesis takes place, contains two layers of mesophyll cells. The upper layer is called the palisade layer and the lower, more loosely arranged layer, is called the spongy mesophyll layer. The open arrangement of the spongy layer allows for free exchange of gases such as water vapor, carbon dioxide and oxygen. Gases diffuse in and out of leaves through tiny openings called stomates. Each stoma is bordered by a pair of guard cells. The opening and closing of the guard cells permits the plant to control the rate of gas exchange within the leaf.

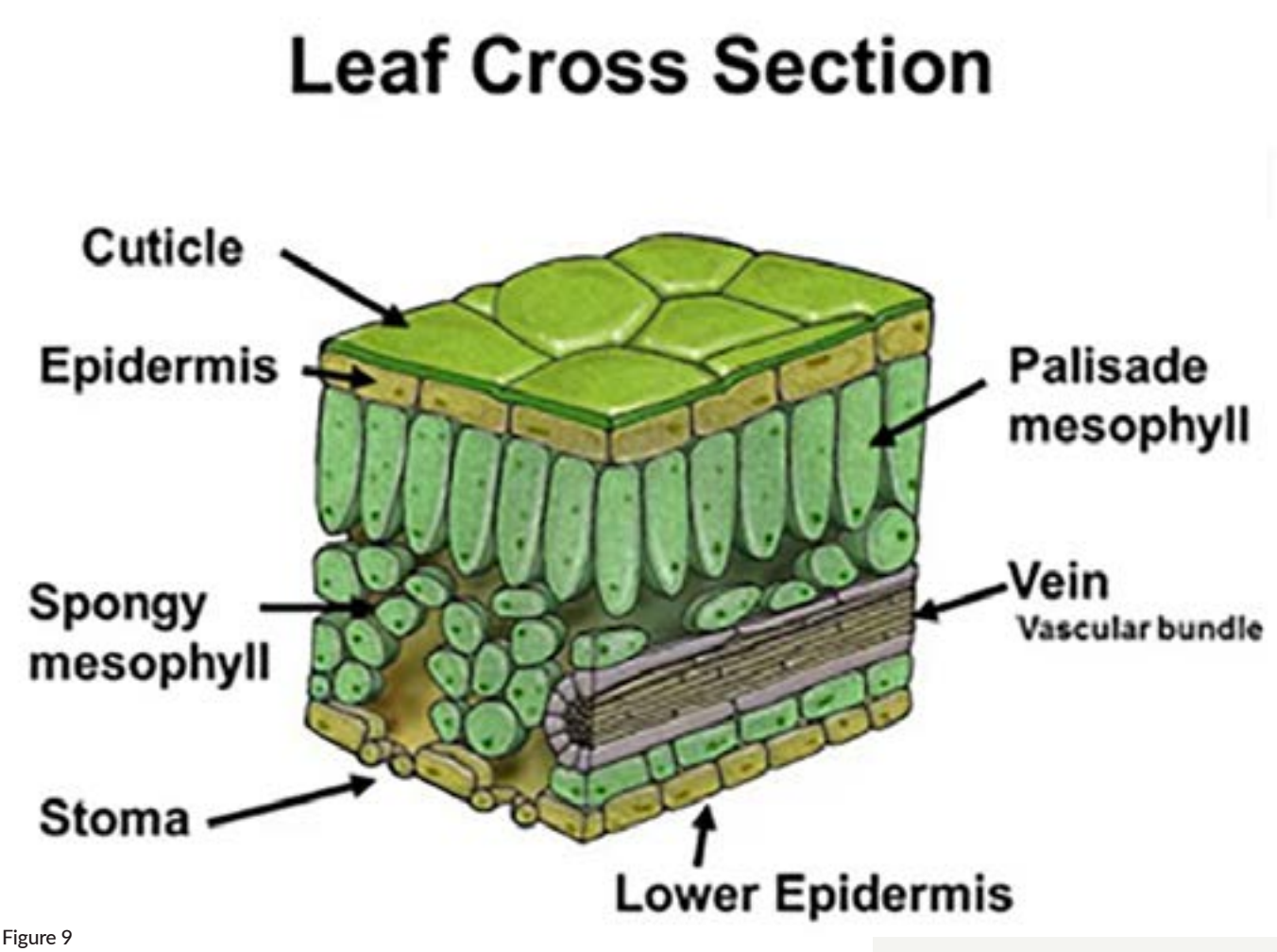

Figure 9

Roots

Roots are responsible for the uptake of water and nutrients in the soil. The extensive root system (both its spread and depth) anchors the plant in the soil. An important difference between roots and stems is that roots have no nodes and never bear leaves or flowers. The primary root originates at the lower end of the embryo. A taproot is formed when the primary root continues to elongate downward. A lateral or secondary root is a side or branch root, that arises from another root. Root hairs are projections of epidermal cells of roots and are responsible for the actual uptake of water and mineral absorption. Adventitious roots are formed along the stems.

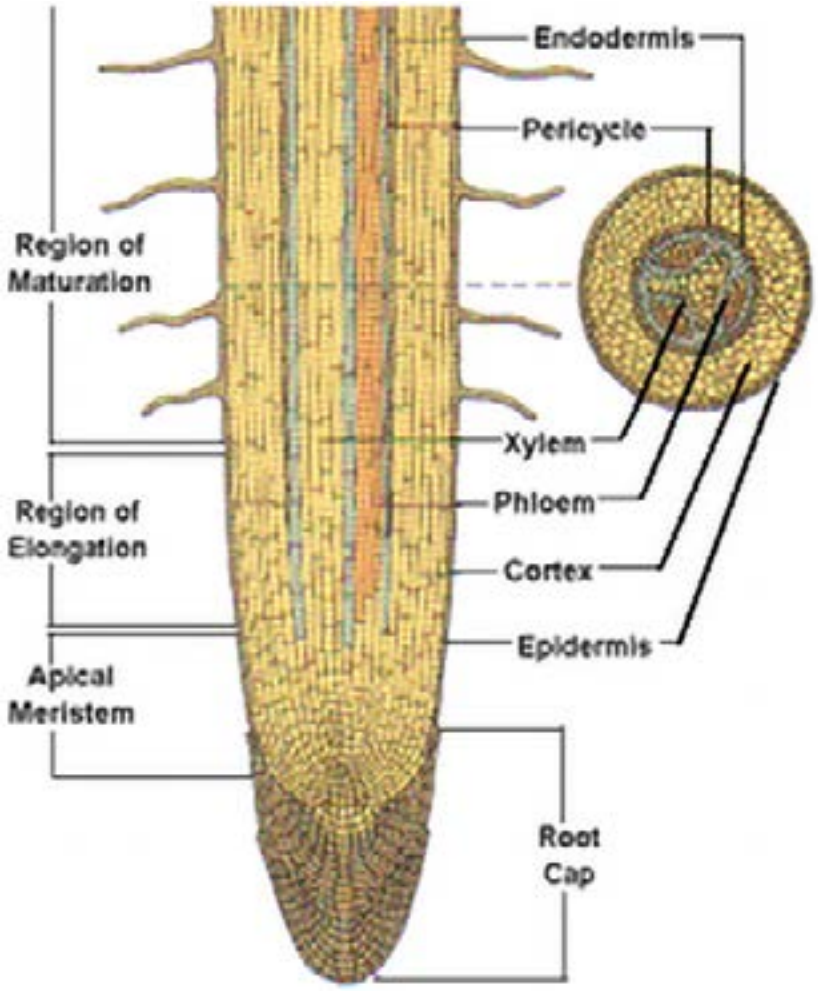

Figure 10

There are three major zones of a root (Figure 10). The meristem is where cell division occurs at the tip of a root. The meristem is protected by a layer of cells called the root cap. The zone of elongation is where cells increase in size. By elongating, these cells push the roots through the soil.

The zone of maturation is where cells undergo changes to become specific tissues i.e. epidermis, cortex or vascular tissue.

The cells of the cortex move water from the epidermis into the vascular tissue. Occasionally, food is stored in the cortical cells. The vascular tissue is located in the center of the root. It conducts food and water throughout the root. Phloem and xylem of the roots is continuous with the phloem and xylem' of the stem. The vascular cambium is the meristematic tissue located between the phloem and xylem of dicot root. The cambium divides and produces xylem cells to the inside and phloem cells to the outside.

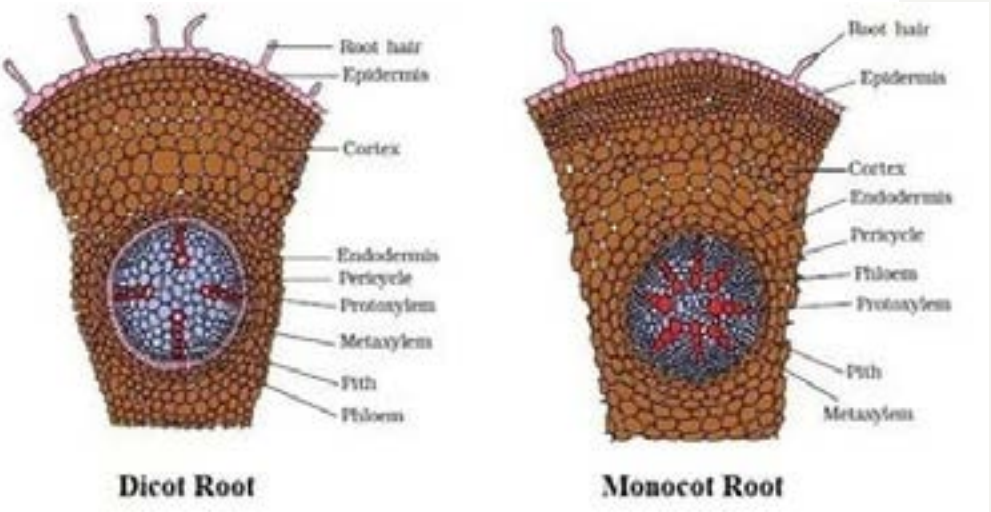

Figure 11

The pericycle is the layer of cells between the endodermis and the vascular tissue (Figure 11). The pericycle is the tissue that gives rise to lateral roots. The endodermis regulates the substances that get into the xylem and phloem. The cork is the bark like tissue on the surface of older roots.

There are several types of roots. Dicots usually have a tap root system which consists of one main root that grows downward from which lateral roots grow. It may be fleshy (example, a carrot) or woody (like a Walnut tree). Monocots have a fibrous root system in which numerous thin roots develop and branch repeatedly.

Flowers

The function of a flower is sexual reproduction. The flower is generally the showiest part of the plant. Its attractiveness, color and fragrance are devices to attract pollinators. Many flowers match the body forms of the animal that performs the pollination (bees, hummingbirds, bats). Some flowers are less showy and are wind pollinated. The flower can be considered a specialized stem with leaves. The parts of a typical dicot flower are illustrated in (Figure 12).

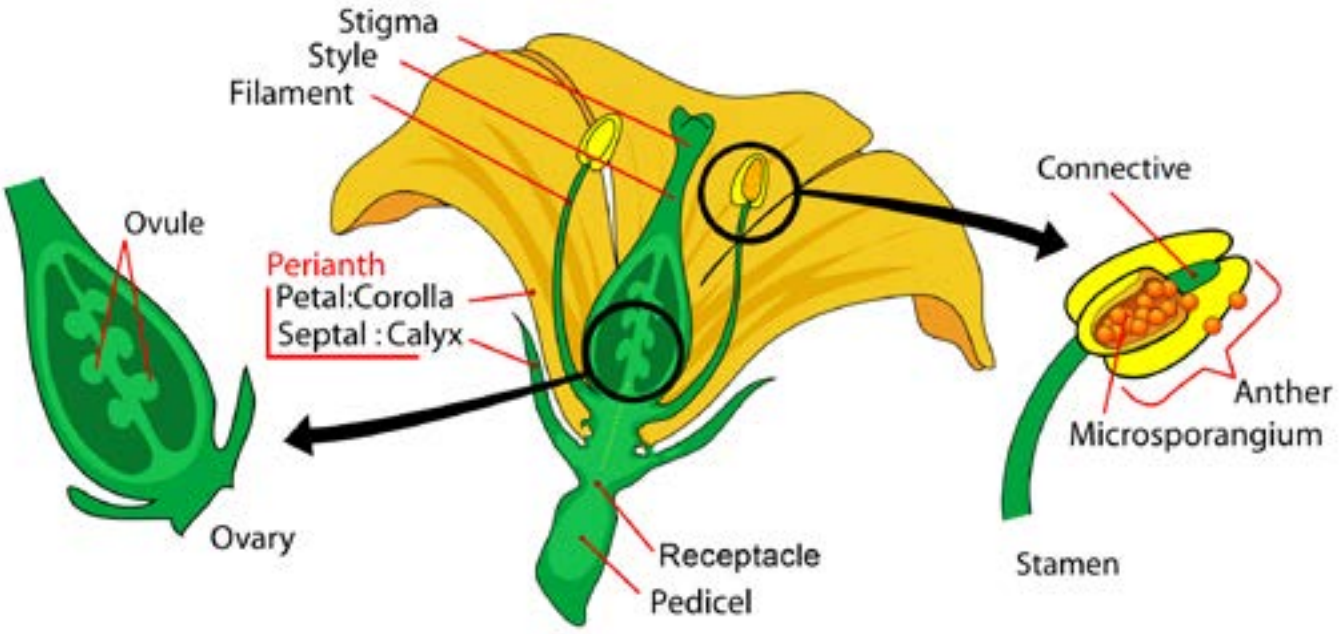

Figure 12

The receptacle supports the rest of the flower parts. The outer row of leaves that enclose an immature flower are called the sepals. The calyx is the term that describes the collection of sepals. The petals are generally the colored set of modified leaves that may aid in insect attraction for pollination. The corolla is the collection of petals and the perianth is the made up of both the calyx and corolla. The stamens are the male reproductive organ. The stamen is made up of the filament and anther. Pollen develops inside the anther. The pistils are the female reproductive organ and are made up of the ovary, style and stigma.

A complete flower contains pistils; stamens, petals and sepals. An incomplete flower lacks one of the above organs. A staminate flower has only male organs and a pistillate flower has only female organs. Dioecious plants have separate male and female plants and monoecious plants have both male and female flowers on the same plant.

Pollination takes place when the pollen grains are transferred from the anther to the stigma. After pollen lands on the stigma, a pollen tube carrying the male sperm nucleus grows down the style that carries the male sperm nucleus. Fertilization occurs when the male sperm nucleus unites with the female egg inside the ovary. The fertilized egg develops into a seed, and the fruit develops from the mature ovary.

Fruit

Fruit is the mature ovary and contains the seeds. A fruits function is to protect the seeds until they are ready for dispersal. Fruits may be either dry or fleshy when ripe. Dehiscent, dry fruits open at maturity and release their seeds (legumes). Indehiscent, dry fruits remain closed at maturity (nuts).

The fruit wall (pericarp) of a fleshy fruit has three layers. The outermost layer is called the exocarp. The middle layer is the mesocarp, and the inner layer is the endocarp (Figure 13). Fruits may be simple or compound. Simple fruits are formed in flowers with a single ovary or several fused ovaries. A peach is a drupe formed from a single ovary. An apple is a pome fruit formed from five fused ovaries.

Compound fruits may be either aggregate or multiple fruits. If a flower has several separate female organs all of which stay together as a unit to form the fruit, the fruit is called an aggregate (for example, a Raspberry). A Strawberry is a unique type of fruit of aggregate. The fruit of a Strawberry is actually an indehiscent dry fruit called an achene. The fleshy part of a strawberry is not formed by an ovary, but instead is an enlarged receptacle. If the female organs of several flowers stay together to form a fruit, the fruit is called a multiple fruit (for example, Pineapple).

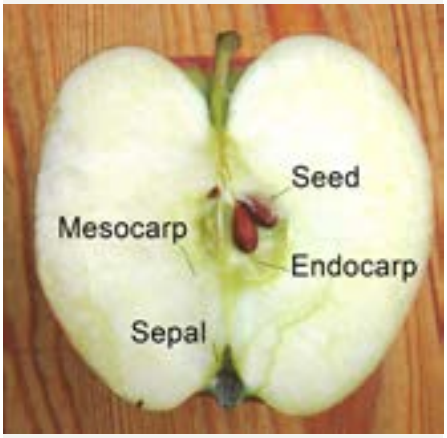

Figure 13 A and B

Adaptive Structures

Water and Food Storage

Plants have adapted to life under a variety of harsh environmental conditions. Dry spells are common in some climates either because of drought or because water is frozen in the soil and is unavailable. Annuals survive these dry seasons as seeds. Perennials have evolved a variety of survival mechanisms. Some plants store food and water in modified stems. Bulbs are short stems protected by thick fleshy leaves. Corms are short, swollen stems covered by dry, scale-like leaves. Tubers are swollen tips of rhizomes. The "eyes" of a white potato are the axillary buds. Tuberous roots can be differentiated from tubers because they have no nodes or internodes, for example, sweet potatoes and dahlias.

Defense

Animals can be a threat to a plant's survival. Plants have evolved several mechanisms to deter herbivores. Thorns are modified short branches that arise from axillary buds. Spines are modified leaves or parts of leaves. Cactus spines are really the remnants of rigid petioles and midribs. On Holly leaves, the major veins terminate in marginal spines. Rose thorns are correctly called prickles. Prickles are short outgrowths from the epidermal tissue of stems, leaves and fruit. Special epidermal hairs on Stinging Nettle protect the plant by causing a rash in animals who come in contact with them. Poison ivy also has evolved irritable compounds that ward off potential plant feeding animals.

Climbing

One mechanism for competing with other plants for sunlight and nutrients, is the development of climbing structures that elevate the leaves closer to the available sunlight. This can be a distinct advantage in a dense forest setting. Tendrils are either modified stems derived from axillary buds, or modified leaves. Twining stems display climbing characteristics by exhibiting spiral growth patterns. Other plants have holdfasts or adhesive disks at the ends of short branches.

Plant Growth and Development

Plant Hormones

A hormone is defined as a substance produced in one part of a plant that affects development in another part of the plant. Hormones are active at very low concentrations. The growth of plants is regulated by five classes of hormones: auxins, gibberellins, cytokinins, ethylene, and abscisic acid.

Auxins promote cell division and cell elongation and induce adventitious root formation on cuttings. Auxins are responsible for gravitropism (growth response to gravity), phototropism (growth response to light), and apical dominance. Apical dominance is the suppression of lateral buds by auxin produced by the terminal bud. Removal of the terminal bud eliminates the flow of auxin, and causes lateral buds to sprout.

- **Auxins** inhibit abscission and stimulate ethylene production. In some species auxins promote flowering and in others flowering is prevented. Auxins can cause fruit formation in the absence of fertilization (parthenocarpy).
- **Gibberellins** promote internode elongation and regulate the production of seed enzymes in cereals. Gibberellins also stimulate flowering in long-day plants and biennials.
- **Cytokinins** promote cell division. They enhance shoot growth and counteract the effects of auxins in apical dominance. Cytokinins also help tissues resist aging.
- **Ethylene** is the only hormone which is a gas. It speeds the aging of tissues and enhances fruit ripening.
- **Abscisic acid** is involved in dormancy of seeds and buds and promotes abscission. Abscission is the dropping off of leaves, flowers, fruit, or other plant parts.

Artificial Growth Regulators

Chemical compounds have been developed which act as artificial hormones that mimic hormone activity. These growth regulators are used by growers to promote fruit set, promote synchronous fruit ripening, or to promote fruit ripening after harvest. Some artificial hormones are potent herbicides.

Environmental Growth Regulation

Environmental factors such as light, temperature and water regulate the growth of plants. Light influences growth by its duration (photoperiod), quality (wave length) and quantity (foot candles or microeinsteins). Photosynthesis in plants is most efficient at red and blue light wave-lengths. The flowering of some plants is controlled by the length of the dark period at night. Short-day plants flower only when the dark period is long (Poinsettia, Chrysanthemum) and long-day plants flower when nights are short (Spinach, Petunias, Marigolds). The flowering of day-neutral plants is independent of the night length (some Strawberry cultivars). Plants are adapted to certain intensities of light. Shade plants are easily "burned" in full sun, and some sun-loving plants become "leggy" when grown in the shade.

Temperature is involved in flowering and dormancy. Some plants, especially fruit trees, require a chilling period before they will flower (Apples, Peaches). Chilling is often necessary before bulbs will sprout (tulips, daffodils).

Water is important for the transport of food and nutrients within the plant. Water is consumed in photosynthesis and is also lost in transpiration. Water taken up by cells allows them to expand. Water within a cell presses the cell membrane against the cell wall and keeps the cell turgid. When plants encounter a shortage of water they wilt. Wilting is the result of a loss of turgor pressure within the cell.

Metabolism

The metabolism of a plant is the sum total of the physical and chemical activity that occurs inside cells. Plants are unique in that they can produce their own food molecules by the process called photosynthesis.

Photosynthesis occurs in two phases. In the first phase, or light phase, the energy from sunlight is absorbed by chlorophyll and is converted into chemical energy. In the first phase water molecules are split and oxygen is released. The second phase of photosynthesis is independent of light. The chemical energy produced in the first phase is used to fix carbon dioxide into sugars. Sugar is then transported from the leaves to the rest of the plant. Sugars are linked together to form complex carbohydrates such as cellulose, or starch. Sugars can also be used to make other necessary molecules such as proteins, fats, oils, and DNA. A plant needs CO2 from the air, water from the soil, sunlight

and chloroplasts to produce sugars. If any one of those four are lacking, food production stops.

In the process of respiration sugars are broken down completely to carbon dioxide and water to release their chemical energy. This chemical energy is then used to drive other metabolic processes.

Water Movement

Transpiration is the evaporation of water from leaves which moves water up through the plant stem from the roots. As water molecules evaporate from the surface of the leaves other water molecules move up to take their place. Ninety percent of the water taken up by roots is lost in transpiration (the remaining 10% is used in photosynthesis). As the water is pulled up the xylem, it carries minerals with it. The evaporation of the water from the leaf surface cools the leaf. Transpiration increases as air movement (wind) increases, temperature increases or humidity decreases.

Nutrition

Macroelements are nutrients used in the greatest quantity by plants and occasionally their availability is limited. Carbon, hydrogen, and oxygen are components of sugars, protein, fats, DNA etc. Hydrogen is also involved in the regulation of pH in cell sap. Plants get carbon from carbon dioxide, hydrogen from water and oxygen from the air. The rest of the macroelements are obtained from the soil. Proteins contain nitrogen and sulfur. Sulfur is also part of coenzymes. Phosphorus is essential for the high energy molecules involved in all chemical reactions. Potassium is important for ion balance in the cell. Calcium is used in the cell wall. Iron is involved in the synthesis of chlorophyll and the function of some enzymes. Magnesium is an essential part of chlorophyll and also functions in some enzymes.

Microelements are needed in lesser amounts and are usually plentiful. All are obtained from the soil. Boron is important for the metabolism of carbohydrates. Manganese is used in enzyme function, root growth, and chlorophyll synthesis. Molybdenum is involved in nitrogen metabolism. Zinc and copper are active in enzyme function. Silicon is found in cell walls. Sodium and chloride are used in photosynthesis and ion balance in cells. Cobalt is an essential part of vitamin B12.

Taxonomy

Botanical Nomenclature

Common names for many garden plants differ from one location to the next. Since there are many different languages around the world, botanists have adopted the practice of identifying a plant by its Latin binomial. When identifying a plant, it is more important to learn its Latin binomial rather than its common name. When asked about a Red Maple, someone might think of Acer rubrum, while someone else may think of the red-leafed Japanese maple Acer japonicum, while still a third might think of a red-leafed variety of Acer palmatum. However, when people talk about a red maple, Acer rubrum, they all know which plant they are referring to.

The convention in botanical nomenclature is that the first word, the genus, is a singular, Latinized noun and is always capitalized. It can be either underlined or italicized. The second word is called the specific epithet (Table 2). The names are often adjectives and are written in lowercase. They are either underlined or italicized. The initial of the author who named the plant is printed after the name (Phaseolus vulgaris L.). The letter L in this case stands for Carl Linnaeus who devised the binomial system of nomenclature.

Because there are so many different types of plants and animals, they have all been placed in a series of categories or logical classes which have been ordered or arranged to show their relationships to each other. This sequence of categories has been set by the International Code of Botanical Nomenclature (ICBN). These arranged categories constitute the taxonomic hierarchy.

Plants within the same genus share similar characteristics up to a point. For instance, the botanical name for the potato is Solarium tubemsum, and that of eggplant is Solarium melongena. These two crops belong to the same genus. They have similar flower shapes and share a few other characteristics. However, they differ significantly, so they are given different species names. Genera that share similar characteristics are grouped into families. Families are grouped into orders, orders are grouped into classes, and classes are grouped into divisions (phyla).

All plants, primitive and advanced, are categorized into this classification system. Within this system, each type of living

organism is given a specific name which separates it from all other organisms. A species is defined as a category of organisms capable of interbreeding.

It is often quite useful to recognize taxonomic categories below the species level. The three most commonly used are the subspecies, variety, and form in horticulture, many varieties are purposely bred and are called cultivated varieties, or cultivars.

A variety is a group of individuals that display a rather marked difference in nature. A cultivar is a group of plants clearly distinguished by any one of several characteristics (morphological, physiological, cytological, chemical, or other), and which when reproduced sexually or asexually, retains its distinguishing features. A form is a slight variation that occurs in nature on a sporadic or random basis and generally does not come true-to-type from seed. For example Lindera benzoin f. rubrum, features red flowers instead of the typical yellow-flowered Spicebush.

Table 2. Commonly Used Descriptive Latin Terms

Commemorative Names	Franklinia Torreya Lewisia nuttallii	Benjamin Franklin Jahn Torrey Meriwether Lewis Thomas Nuttall
Geographical Names	anglicus gallium japonica	of England of France of Japan
Growth Form	arborescens repens wardens	tree-like creeping climbing
Growth Form	arenarius Campestris fluviatilis	growing in sand of the fields of the rivers
Morphological Feature	Penstemon Sanguinaria amabilis campanulatus foetidus	5 stamens red latex (blood) lovely bell-shaped foul-smelling

Chapter 2 Review Questions:

1. What are the two basic parts of a plant?
2. Name the functions of plant roots
3. Name at least three parts of plant shoots.
4. What are two functions of plant stems?
5. Name one above ground and one below ground type of stem variation.
6. What are the two functions of leaves?
7. What is the name of the process in which leaves absorb sunlight to make plant food?
8. What are two names used to describe the location of plant buds?
9. Name the male and the female reproductive organs of a flower.
10. What is the function of a seed?
11. Describe the functions of plant auxins.
12. What is the major difference between plants and animals?
13. What are the four ingredients that plants need to make their own food?
14. From what source does a plant receive carbon dioxide?
15. What is the name of the process in which plants convert food into energy?
16. What are two functions of transpiration in plants?
17. Name the three factors that affect transpiration in plants.
18. Identify three environmental factors that affect plant growth.
19. What is the principal internal factor that affects plant growth and development?
20. Why does photosynthesis only occur during the day?

Glossary:

A

Abscisic Acid - a plant hormone involved in the dropping of leaves, flowers, and fruits.

Abscission - the dropping of leaves, flowers, fruits or other plant parts.

Achene - a simple, dry, one-seeded indehiscent fruit.

Adventitious - shoots or roots located at some place other than the usual or expected.

Aggregate Fruit - a fruit developed from a single flower with several free (not fused) pistils.

Angiosperm - a plant with seeds enclosed within a developed ovary (fruit).

Annual - plant that completes its entire life cycle, from germination to seedling to death, within one year (marigold, tomato).

Annual Ring - a layer of secondary xylem (wood) produced in the stem of a plant in one year.

Anther - the pollen bearing portion of a stamen.

Apical Dominance - influence exerted by a terminal bud that suppresses the growth of lateral buds

Auxins - a class of plant hormones that promote cell elongation and cell division.

Axillary bud - a bud located at a node in the axil of a leaf.

B

Biennial - plant that completes its life cycle in two years, usually germinating the first year and blooming the second.

Blade - the expanded portion of a leaf.

Bracts - a modified, reduced leaf-like structure.

Bulb - a specialized bud or underground storage organ with a greatly shortened stem surrounded by fleshy leaves or scales.

C

Cambium - a lateral meristem that gives rise to secondary tissues such as secondary phloem and xylem.

Cellulose - a carbohydrate; the chief component of the cell wall in most plants.

Chlorophylls - green pigments found in chloroplasts, necessary for photosynthesis.

Chloroplasts - a specialized organelle in the plant cell where photosynthesis occurs.

Complete Flower - a flower that has all parts present (sepals, petals, stamens and pistils).

Compound Fruit - a fruit formed from a single flower with several fused pistils.

Compound Leaf - a leaf made up of a number of leaflets.

Cork Cambium - lateral meristem producing cork (bark).

Corm - a short thickened underground stem covered by dried leaf bases but without scales that contains stored food.

Corolla - a collective term to designate all of the petals of a flower.

Cortex - the tissue between the vascular tissue and the epidermis.

Cotyledon - a seed leaf, the food-storage leaves of an embryo.

Cultivar - a man-made variation of a species, persistent under cultivation.

Cuticle - the waxy coating of the epidermis.

Cytokinins - a class of hormones that promote cell division.

D

Dehiscent fruit - a fruit that splits open at maturity.

Dicotyledon - a flowering plant with two seed leaves or cotyledons.

Dioecious - bearing male and female flowers on separate plants.

Drupe - a simple fleshy fruit whose innermost part of the ovary wall is hard and stony.

E

Embryo - the young plant within a seed.

Endodermis - a single cell layer present in roots that separates the vascular tissue from the cortex.

Endosperm - the nutritive tissue developed around the embryo in the seed that is consumed by the embryo during germination.

Epidermis - the outermost layer of cells on leaves, stems and roots.

Ethylene - a hormone in the form of a gas that is involved with tissue aging and fruit ripening.

F

Filament - the stalk of the stamen supporting the anther.

Fruit - a ripened ovary containing seeds.

G

Germination - the growth of a plant embryo.

Gibberellins - a class of hormones that promote internode elongation and are involved in seed germination and flowering in some plants.

Gravitropism - growth in response to a gravitational field.

Guard cells - two specialized cells around a stoma responsible for opening and closing the stomata.

Gymnosperm - plant that produces seeds not enclosed in an ovary or fruit

H

Herbaceous - any non-woody plant.

Hormone - a growth substance produced in small amounts in one part of a plant and transported to another part of a plant where it exerts its effects.

I

Incomplete Flower - a flower lacking one or more of the four kinds of flower parts (sepals, petals, stamens, or pistils).

Indehiscent Fruit - a dry fruit that does not split open at maturity.

Internodes - a part of the stem between two nodes. Meristem - a region of cell and tissue initiation.

M

Mesophyll cells - the interior cells of a leaf between the upper and lower epidermal layers.

Monocotyledon - plant that has only one cotyledon, or seed leaf in its embryo

Monoecious - bearing male and female flowers on separate plants.

Multiple fruit - the ripened ovaries of a flower cluster adhering together as a single unit.

N

Node - the part of the stem where leaves and axillary buds arise.

O

Ovary - the portion of the pistil containing the ovules.

Ovule - the immature structure that develops into the seed after fertilization.

P

Palmate - leaves or veins radiating from a common point.

Parthenocarpy - the development of fruit without fertilization.

Perennial - a plant that persists for more than two years.

Perianth - the collective term for the petals and sepals.

Pericycle - a layer of cells just outside the primary phloem and inside the endodermis.

Petiole - the stalk of a leaf.

Phloem - the vascular tissue that conducts food.

Photosynthesis - the production of carbohydrates from carbon dioxide and water using light energy and releasing oxygen.

Pinnate - leaves or veins in a feather-like arrangement; having parts arranged along two sides of an axis.

Pistillate flower - a female flower that bears pistils but no stamens stomate.

T

Tissues - a group of cells performing a special function; simple tissues are made up of similar cells, complex tissues contain several cell types.

Transpiration - the movement of water up a plant stem as a result of evaporation of water from the epidermis.

Tree - perennial, woody plant and usually one main trunk at maturity.

Tuber - a fleshy underground stem.

V

Variety - a naturally occurring subdivision of a species.

Vascular Cambium - the layer of meristematic cells that gives rise to secondary xylem and phloem.

Vascular Tissue - the tissue made up of the xylem and phloem involved in the conduction of food, minerals and water within the plant.

W

Whorl - a circle of flower parts or leaves around a stem.

Wood - secondary xylem consisting largely of cellulose and lignin.

X

Xylem - the vascular tissue that conducts water and minerals.

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Figure Sources:

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f 2 - https://www.sciencefacts.net/plant-cell.html

f 3 - https://courses.lumenlearning.com/wm-biology2/chapter/development-seeds-and-fruit/

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f 8 - https://en.wikipedia.org/wiki/Dendrology#/media/File:Leaf_morphology.svg

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