جامعة أم القرى
UMM AL-QURA UNIVERSITY

General Biology

Lecture (8)
Plant Form and Function

College of Applied Sciences

Biology Department

Outline

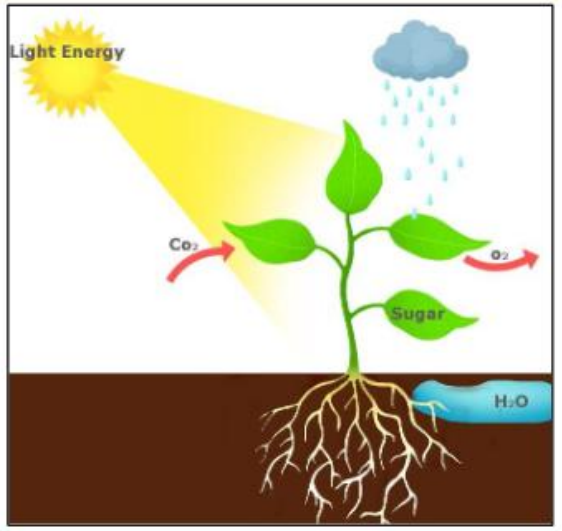
- Plant characteristics
- Highlights of plant evolution
- Plant diversity
- Seed plant structure
- Plant Function (Photosynthesis)

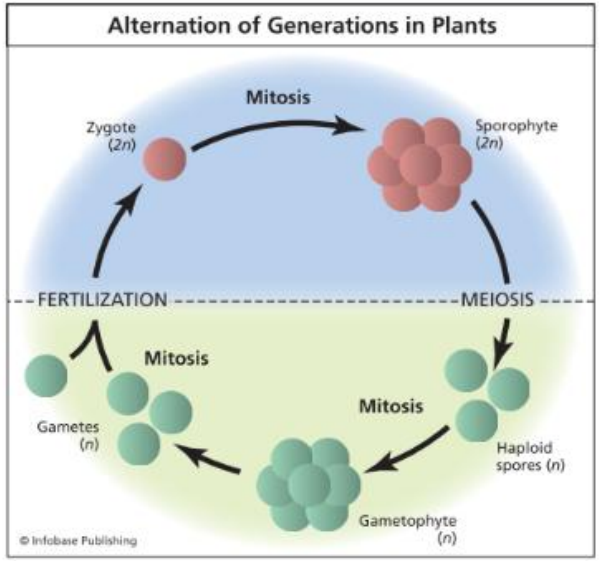
Section 1

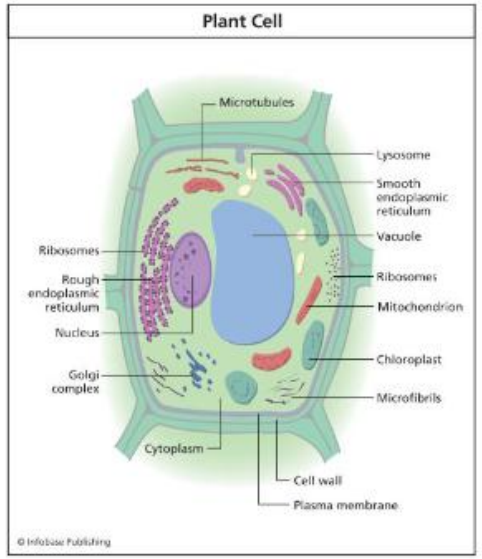
Plant diversity

Plant Characteristics

- **Autotrophic** (produce their own food by photosynthesis)
- **Non-motile**
- **Multicellular**
- **Eukaryotic** organisms
- Cell walls are composed of **cellulose**.
- Can **reproduce sexually and asexually.**
- **An alternation of generations occurs** (Gametophyte --> Sporophyte --> Gametophyte

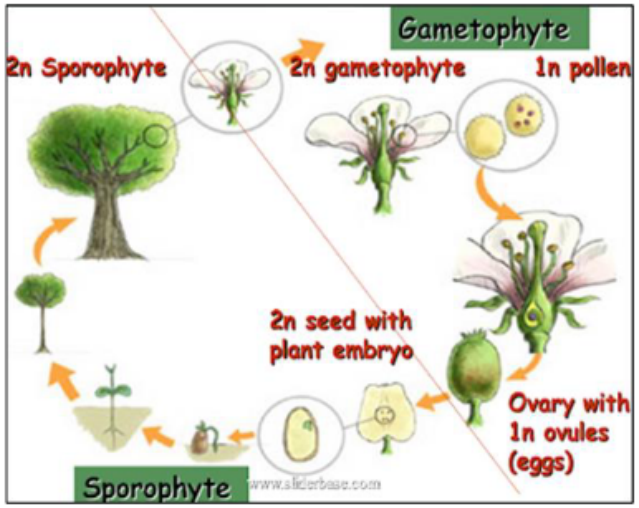


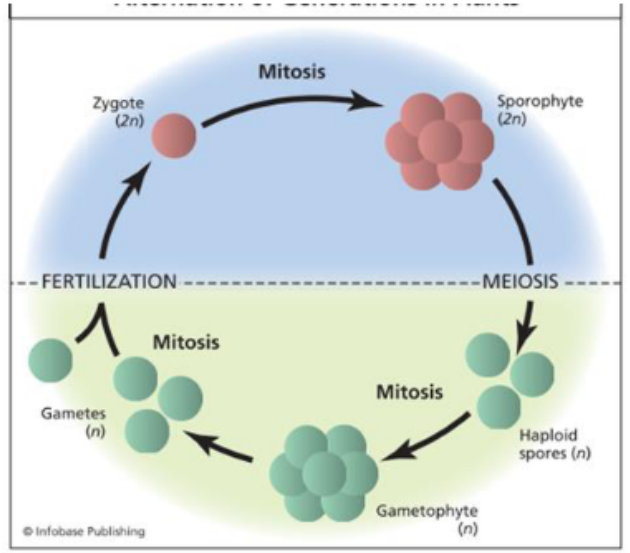




Alternation of Generations

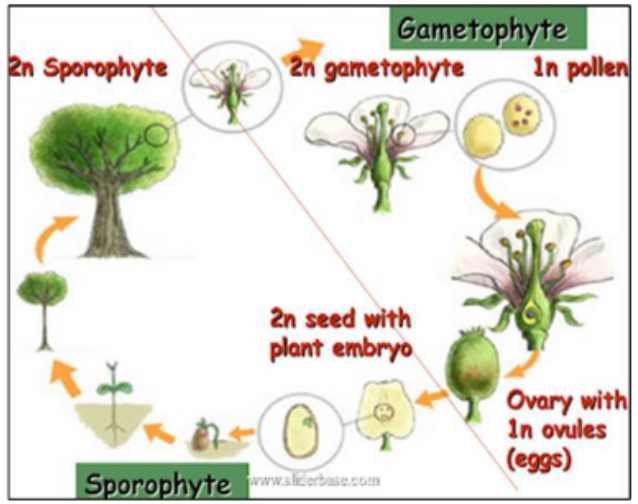
- The life cycle of any land plant has two distinct phases (**Gametophyte** and **Sporophyte**).
- The amount of time spent in each phase varies depending on the plant group.
- The first phase is called the gametophyte generation (phyte=plant, gameto=gamete).
- Gametophyte is a plant (multicellular, not just a single cell) that has a single set of chromosomes (**haploid**), which produces **gametes** via mitosis (egg and sperm cells), which are also **haploid**.

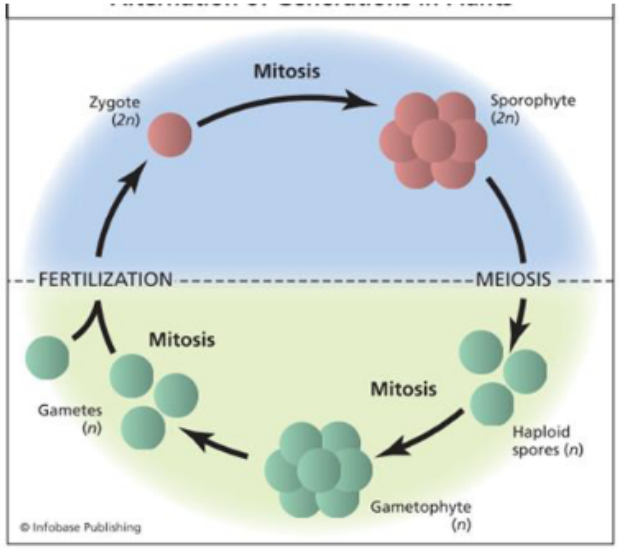




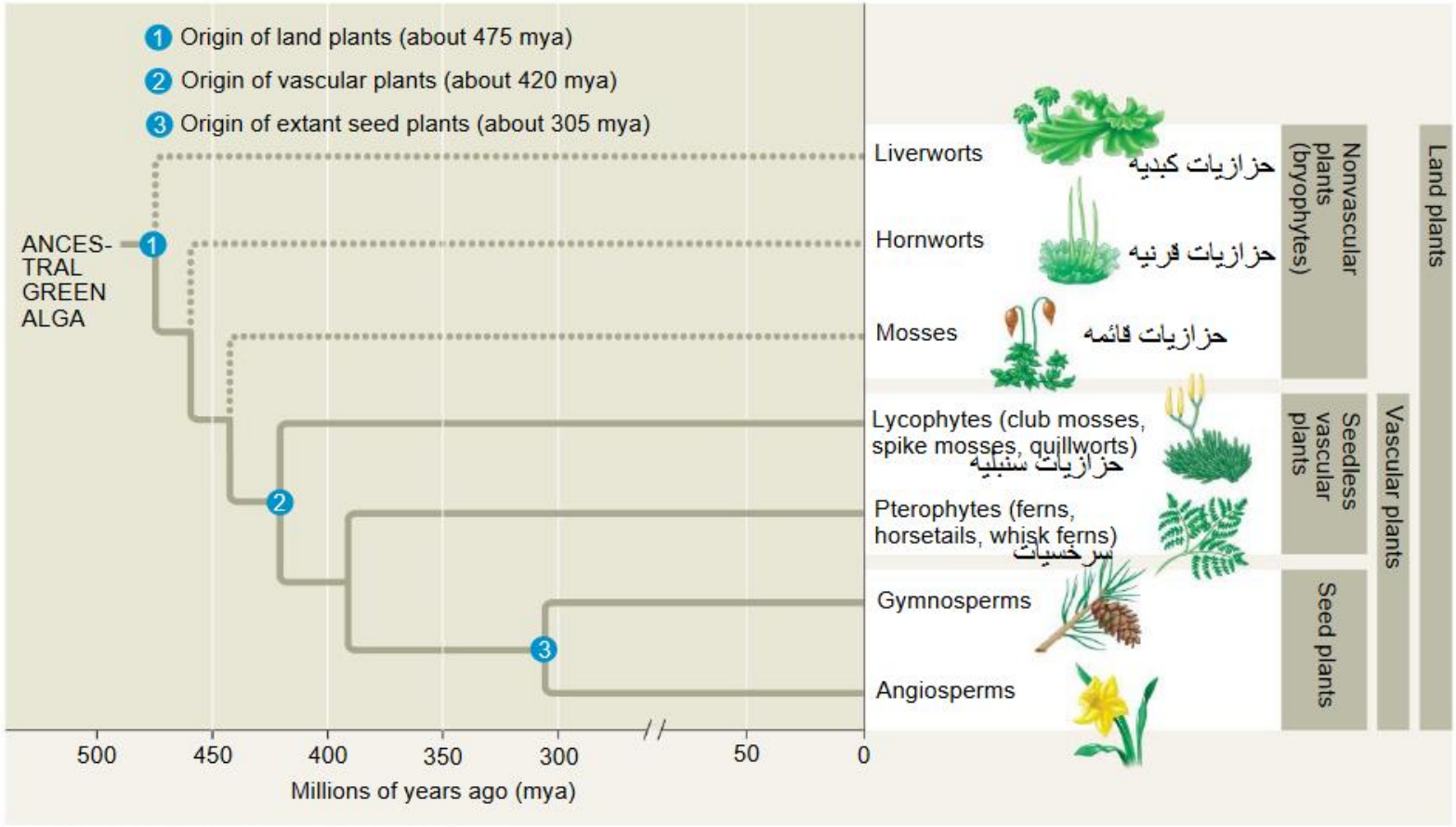
Alternation of Generations

- The second phase is called the sporophyte generation (phyte=plant, sporo=spore).
- Sporophytea is a plant (multicellular, not just a single cell) that has two sets of chromosomes (**diploid**), which is the result of the fusion of two gametes (sperm and egg), which produces **haploid spores** via **meiosis**.

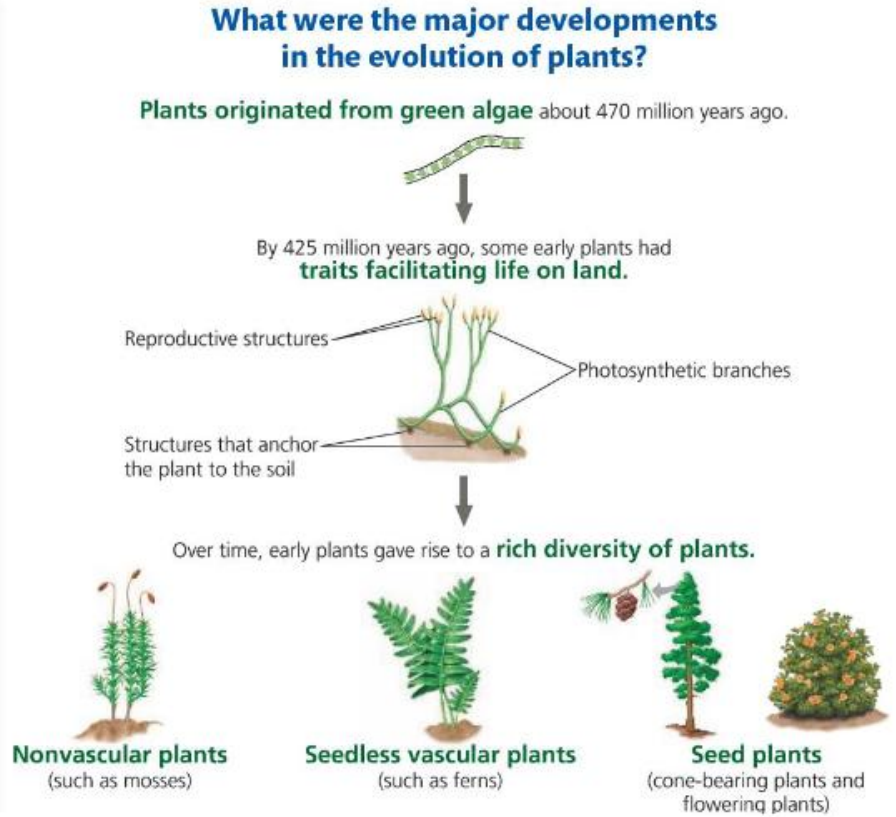




Highlights of Plant Evolution



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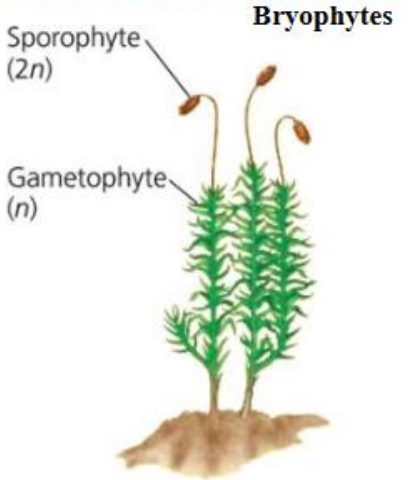
Plant diversity

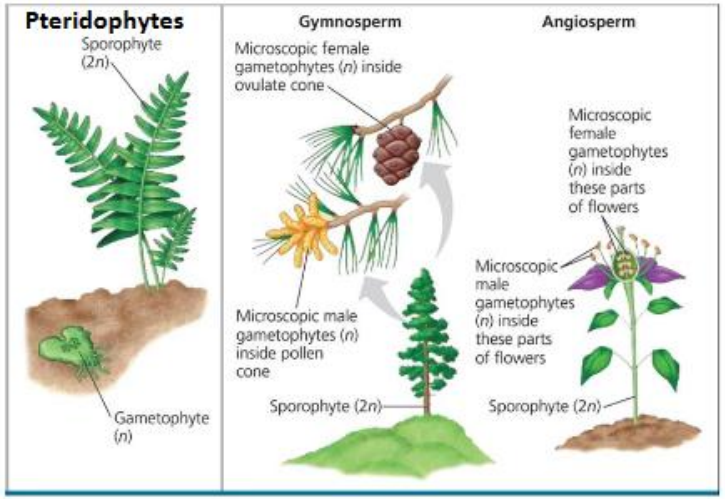




Land plants can be informally *grouped based on* the *presence or absence* of ***vascular tissue.***

Feature	Vascular Plants	Non-vascular Plants
Vascular system	They have a well-developed vascular system	They lack a specialised vascular system
Differentiation of body	They possess true roots, stem and leaves	They lack true roots, stems and leaves
Ploidy of main body	The main plant body is the diploid sporophyte	The main plant body is the haploid gametophyte
Vascular tissues	They contain complex vascular tissues, i.E. Xylem and phloem	They lack xylem and phloem
Size	They may grow very tall	They are small in size
Fertilisation	They may or may not require water for fertilisation	They require water for fertilisation
Examples	Pteridophytes, gymnosperms and angiosperms	Bryophytes





Section 2

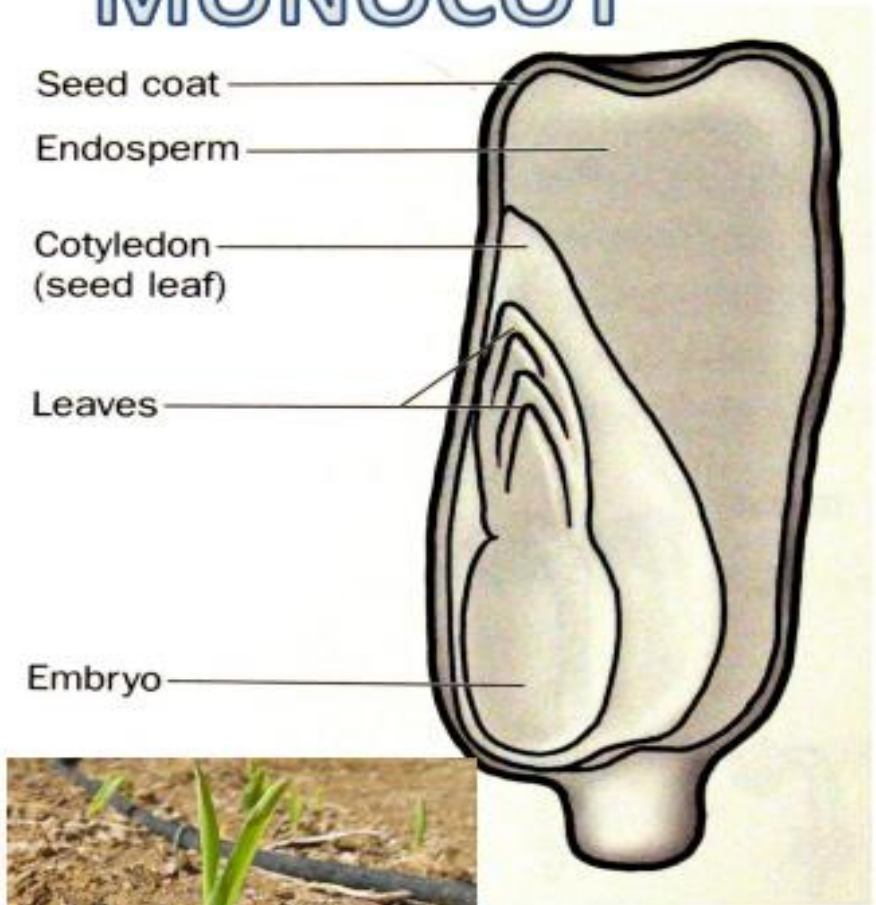
Plant Form

Seeds and Mature seed structure

- **Seed** is a **small embryonic** plant in the **dormancy state**, that produce of sexual reproduction in flowering plants.
- **Mature seed structure:**
  1. Seed coat (testa)
  2. Embryo
  3. Cotyledons

SEEDS

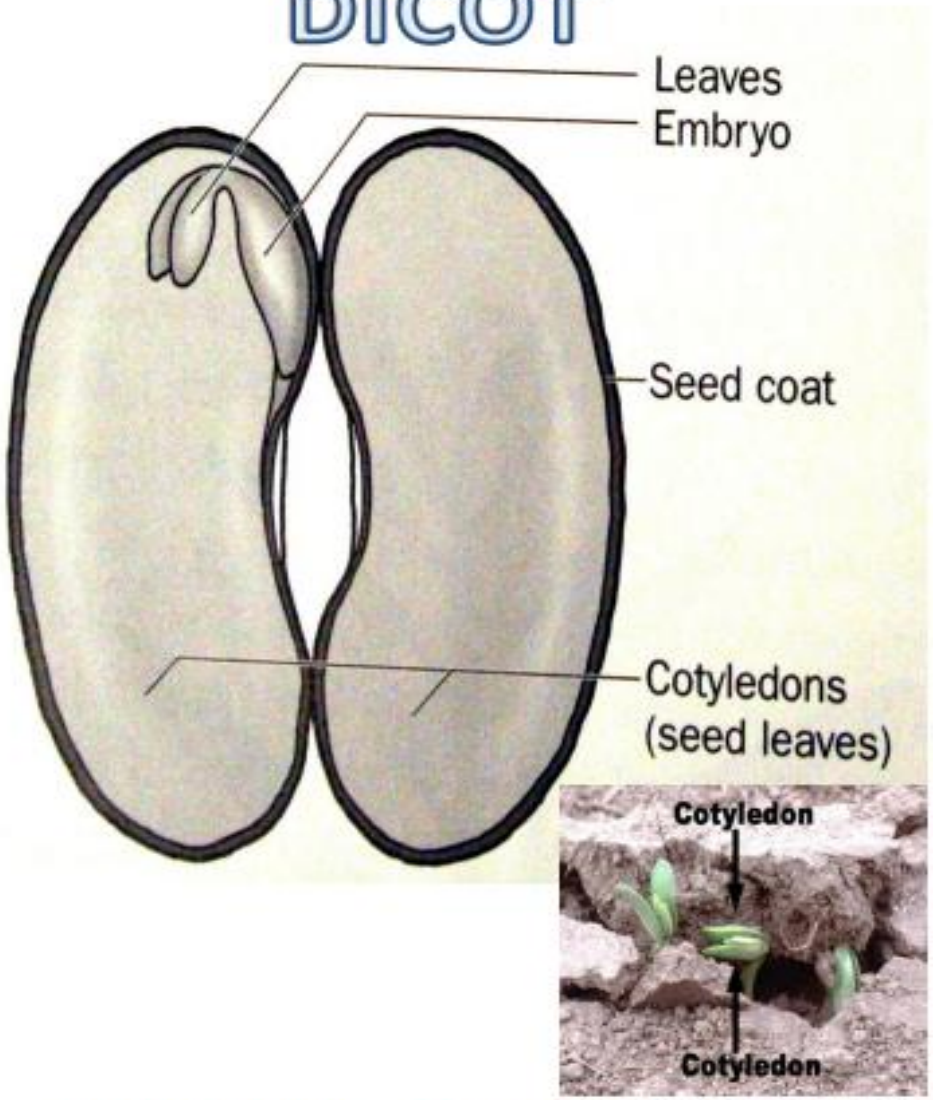
MONOCOT





Scientific name : ***Zea mays***

DICOT

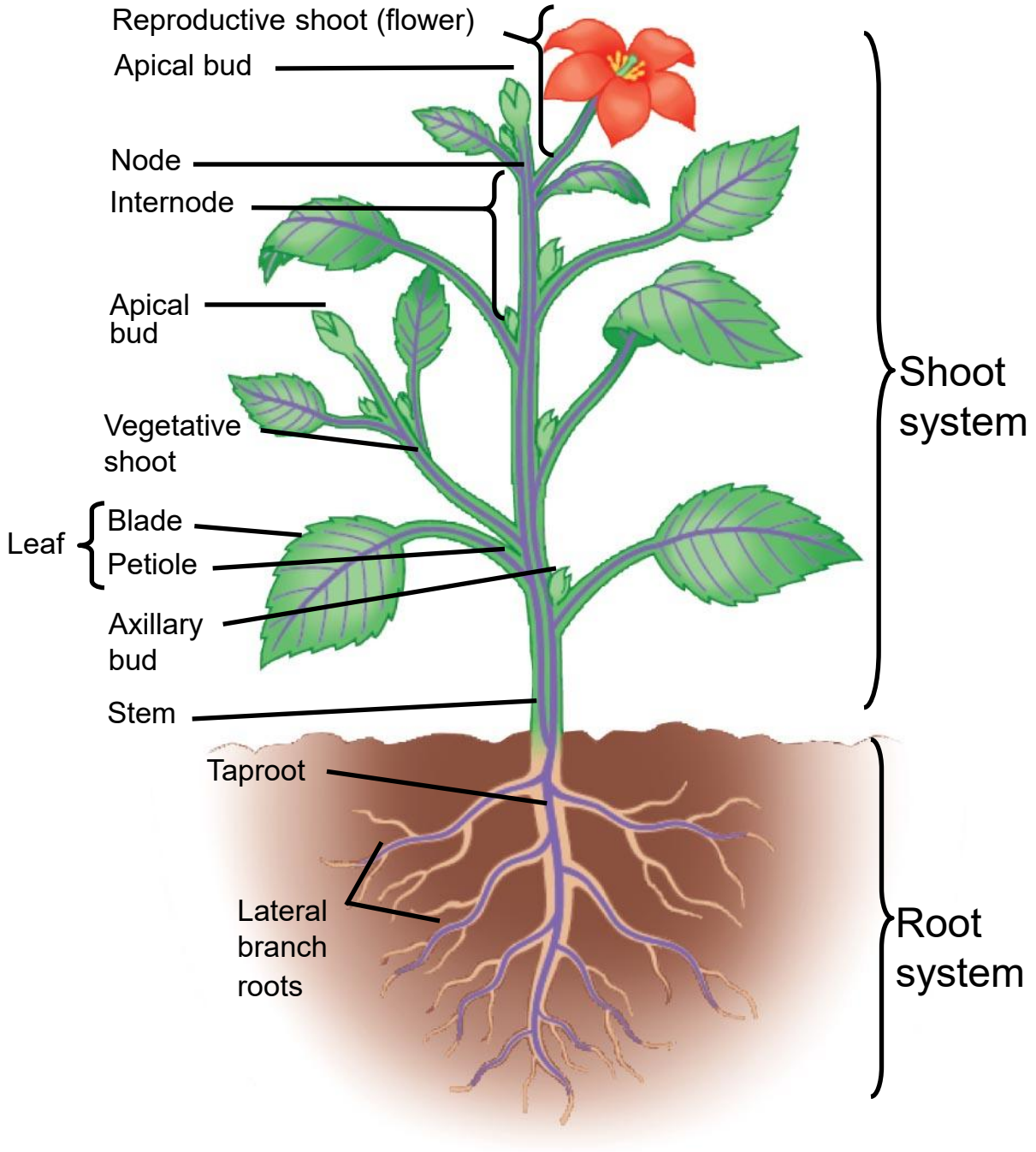


Scientific name : ***Phaseolus lunatus***

The Plant Structure

- **Three** basic organs evolved**: roots, stems, and leaves.**
- They are organized into a **root system** and a **shoot system:**
- **Roots** rely on sugar produced by photosynthesis in the ***Shoot system***.
- **Shoots** rely on water and minerals absorbed by the ***Root system***.

Flowering Plant Morphology



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The Root

- **Root:** an **underground** portion of Plant.

- **Types of Root:**
  - one main vertical root (Tap root) consists of lateral roots and root hairs.
  - Adventitious roots arise from stems or leaves

Functions of the root system

1. Responsible for **anchoring** and **support** the plant in the soil.
2. Roots **absorb** water and dissolved nutrients or solutes (nitrogen, phosphorous, magnesium, boron, etc.) needed for normal growth, development, photosynthesis, and reproduction.
3. In some plants, roots have become adapted for specialized functions ex: **storage**..

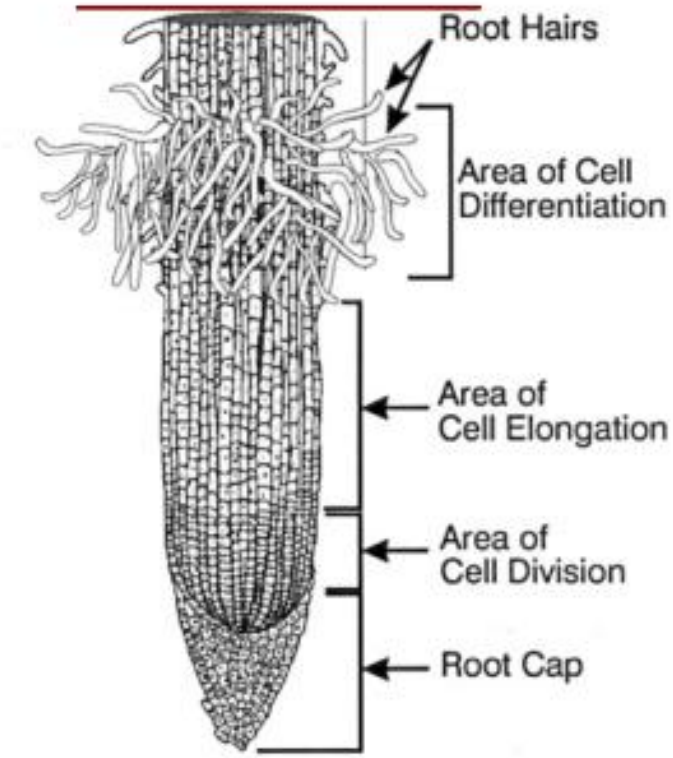
Zones of the Root - External Anatomy

1. Meristematic zone

- Root cap
- Region of cell division

2. Elongation zone

3. Maturation (or differentiation) **zone**



Many plants have modified roots



Prop roots



Storage roots



"Strangling" aerial roots



Pneumatophores

Buttress roots

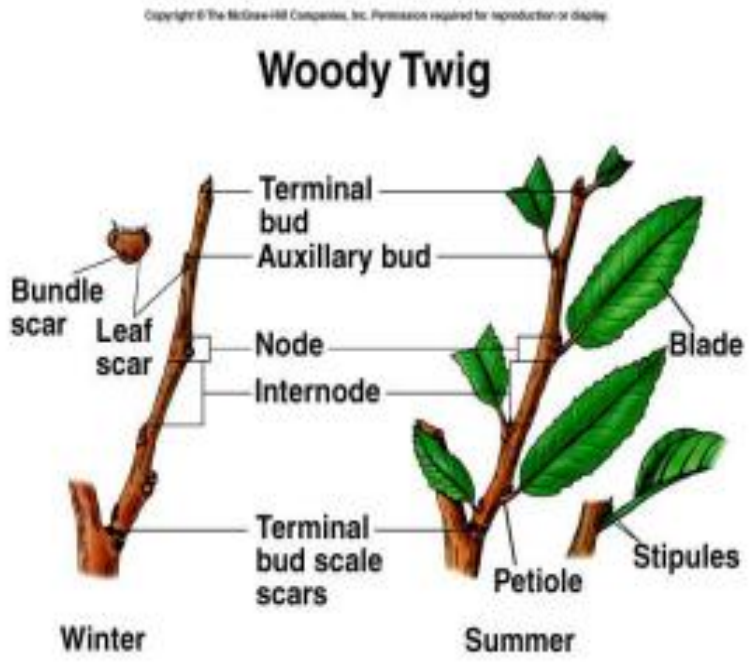


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The Stem

- **Stem**: **aboveground** portion of shoot, bearing leaves.

- **Divided into:**
  - Nodes (where leaves attach)
  - Internodes (where no leaves attached)



Functions of the Stem

1. **Support** of leaves, flowers, fruits
2. **Conduction** of water, minerals, sugars, etc.
3. **Photosynthesis**
4. **Storage**
5. **Defence**

Many Plants have Modified Stems

▼ Rhizomes



▶ Bulbs



▶ Stolons





◀ Tubers

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The leaf and Leaf Functions

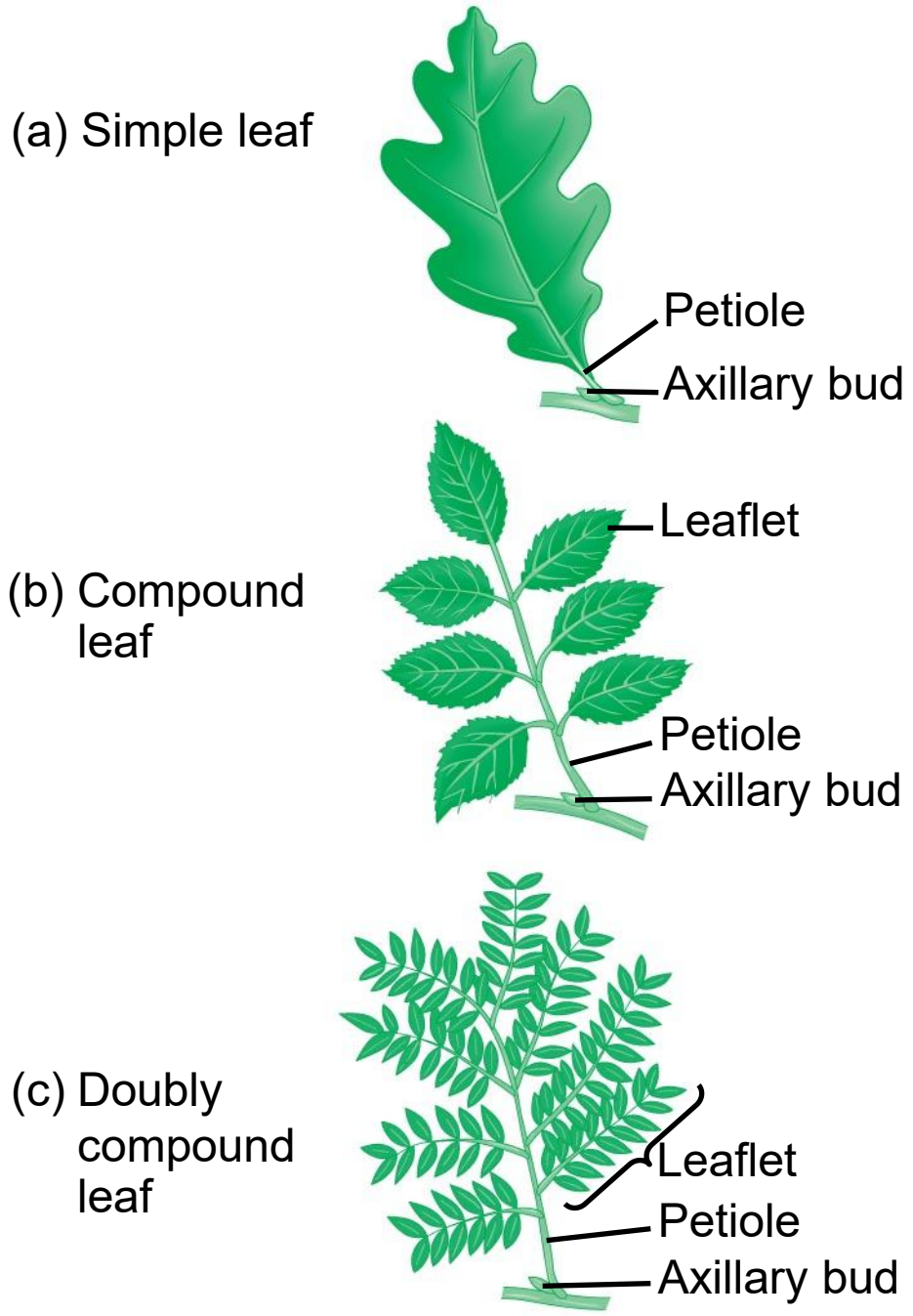
The leaf is the most important vegetative organ of the plant.

It is generally green flat body, have phototropism.

Leaf Functions:

- **Photosynthesis**
- **Gaseous Exchange**
- **Transpiration**, **Absorption** and **Reproduction**…etc

Simple vs. Compound Leaves



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Some plant species have evolved* modified leaves *that serve various functions

Tendrils
cling



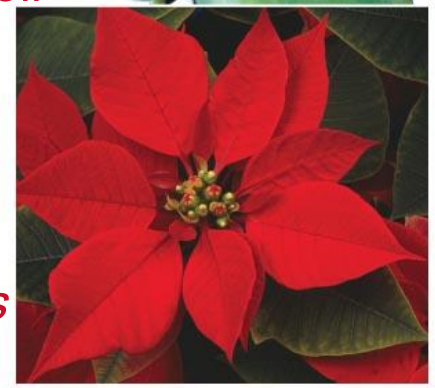


Spines *"prickly" Photosynthesis is carried out mainly by the fleshy stems*



Storage Leaves *succulent plant leaves store water*

Reproductive leaves
Little plantlets fall off and take root in the soil



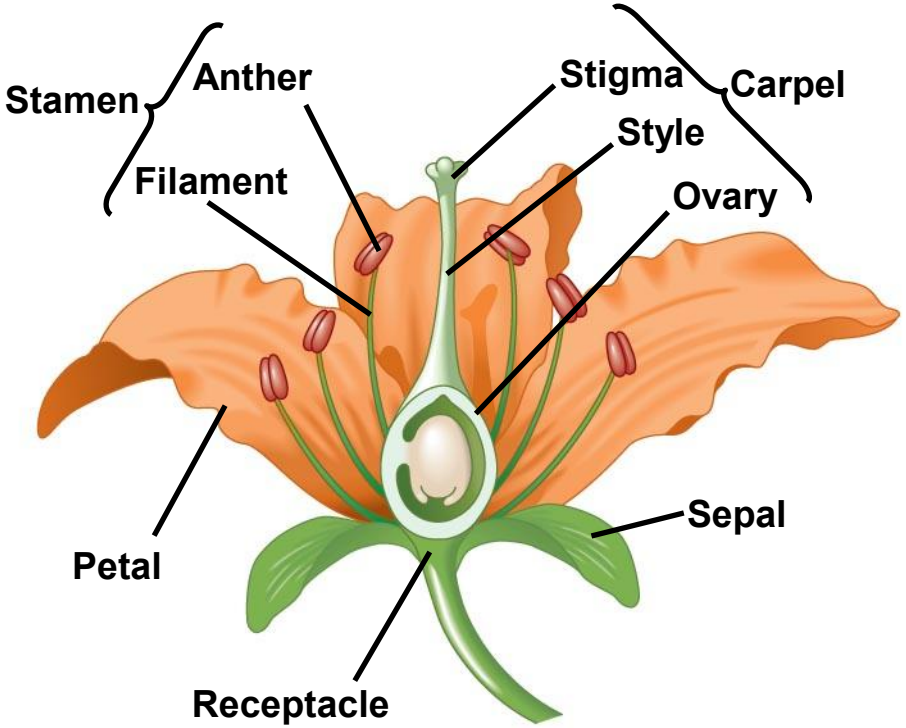
Bracts
Look like petals
Attract pollinators

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Flower Structure and Function

- **Flowers** are the reproductive shoots of the angiosperm sporophyte.
- **Flowers consist** of **four** floral organs: **sepals**, **petals**, **stamens**, and **carpels**.
- A **stamen** consists of a filament topped by an anther with pollen sacs that produce pollen.
- A **carpel** / pistil has a long style with a stigma on which pollen may land.
- At the base of the style is an ovary containing one or more ovules.

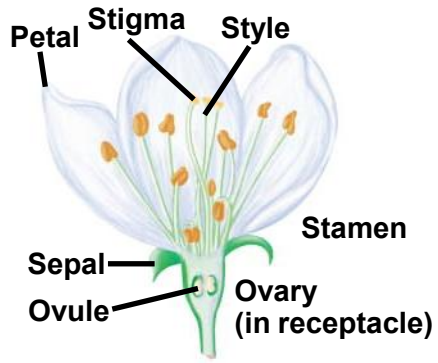
Flower Structure



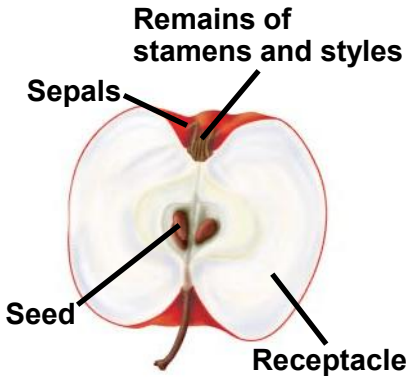
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Fruit Structure and Function

- A **fruit** develops from the ovary.
- It **protects** the enclosed **seeds** and aids in seed dispersal by wind or animals.
- A **fruit may be classified** as:
  - dry, if the ovary dries out at maturity
  - fleshy, if the ovary becomes thick, soft, and sweet at maturity.



Apple flower



Apple fruit

(d) Accessory fruit

Section 3

Plant Function (Photosynthesis)

Overview: The Process That Feeds the Biosphere

- Plants need food to respire, grow and reproduce. Unlike animals, plants are able to make their own food by the process of photosynthesis.
- Almost all plants are photoautotrophs, using the energy of sunlight to make organic molecules from H_2O and CO_2
- Photosynthesis occurs in plants, algae, certain other protists, and some prokaryotes.
- These organisms feed not only themselves but also most of the living world.

Photosynthesis occurs in plants, algae, certain other protists, and some prokaryotes

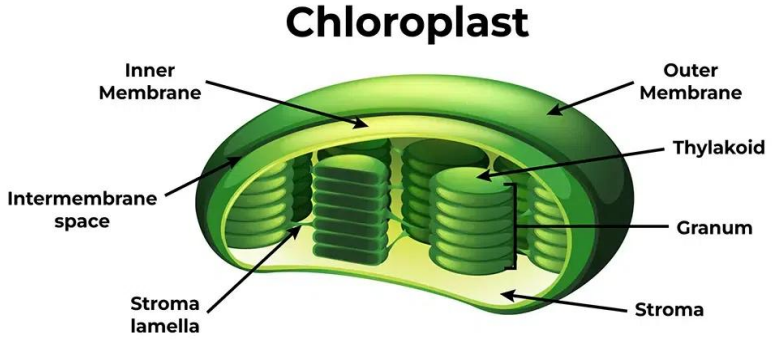


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Chloroplasts: The Sites of Photosynthesis in Plants

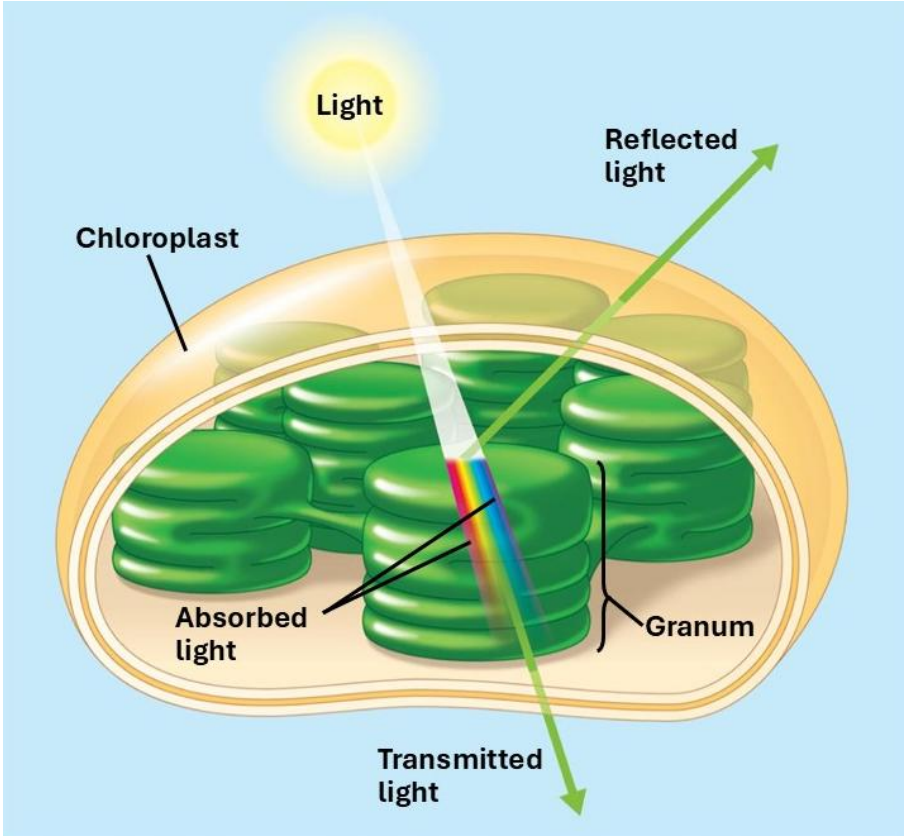
- Chloroplasts are small organelles inside the cells of plants and algae.
- They absorb light to make sugar in a process called photosynthesis.
- The sugar can be stored in the form of starch.
- Chloroplasts contain the chlorophyll, which absorbs sunlight for photosynthesis.
- The chlorophyll is in the membranes of **thylakoids** (connected sacs in the chloroplast); thylakoids may be stacked in columns called grana.
- Chloroplasts also contain **stroma**, a dense fluid
- Photosynthesis can be summarized as the following equation:

$$6\ CO_2 + 12\ H_2O + \text{Light energy} \rightarrow C_6H_{12}O_6 + 6\ O_2 + 6\ H_2O$$



Photosynthetic Pigments(Light Receptors)

- Visible light consists of wavelengths (including those that drive photosynthesis) that produce colors we can see.
- Pigments are substances that absorb visible light.
- Different pigments absorb different wavelengths.

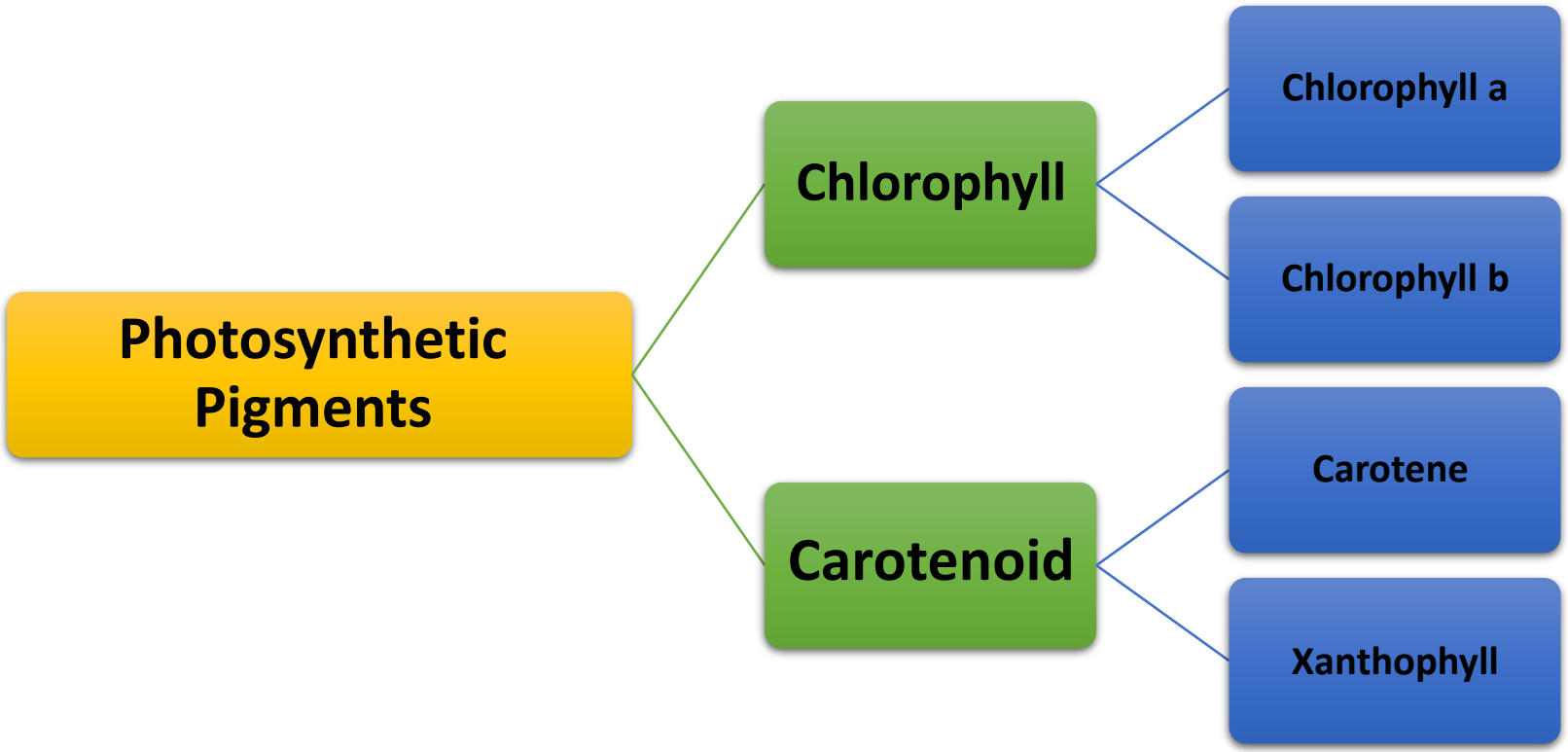


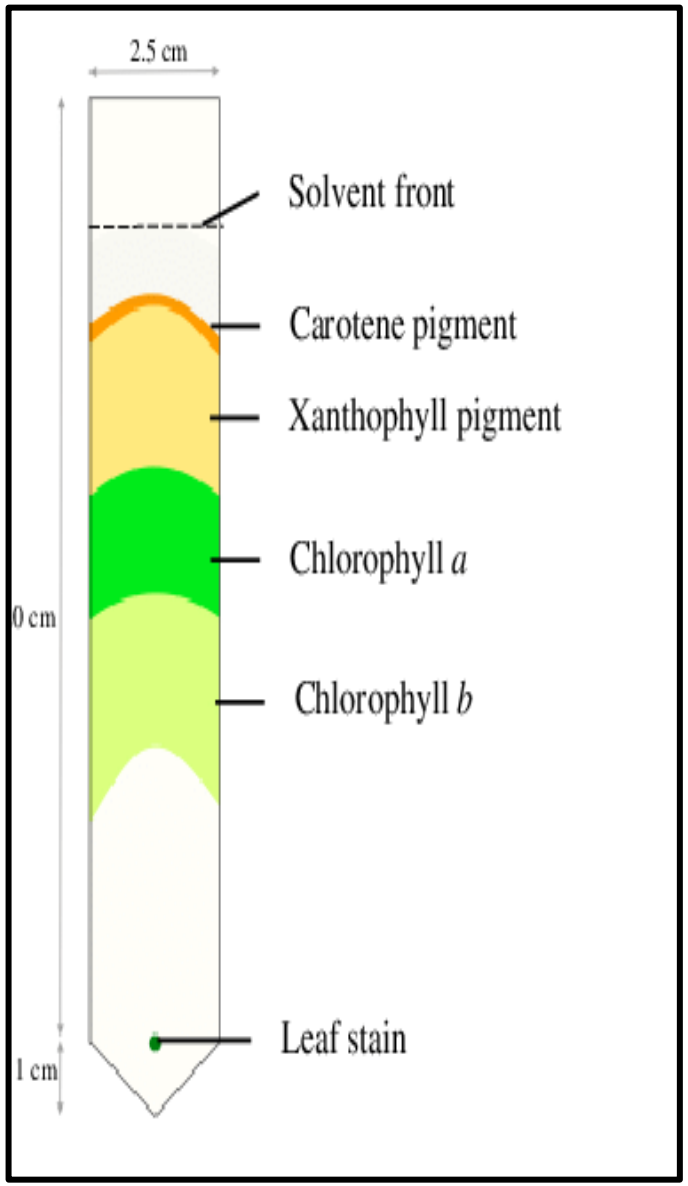
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Photosynthetic Pigments(Light Receptors)

- **Chlorophyll a** is the most abundant and important photosynthetic pigment. It is the **primary pigment** for Photosynthesis.
- The other photosynthetic pigments are called **accessory pigments, such as; Chlorophyll b and Carotenoid (Carotene & Xanthophyll)**
- They enables the plant to absorb sunlight of greater range of wavelength.
- They protect chlorophyll a from destruction by absorbing excessive sunlight

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Photosynthetic Pigments

References

Urry, L. A., Cain, M. L., Wasserman, S. A., Minorsky, P. V., Orr, R. B., & Campbell, N. A. (2020). Campbell Biology, 12th Edition (12th ed.). Pearson.