1. Plant Anatomy Tissues

Plant tissues are broadly classified into two categories based on their ability to divide:

Meristematic Tissues

- **Apical Meristems:** Located at root and shoot tips; responsible for *primary growth* (length).
- **Lateral Meristems:** Vascular cambium and cork cambium; responsible for *secondary growth* (girth).
- **Intercalary Meristems:** Located between mature tissues; helps in elongation of internodes (e.g., grasses).

Permanent Tissues

- **Simple:** Parenchyma (storage/photosynthesis), Collenchyma (flexible mechanical support), Sclerenchyma (rigid structural support, dead at maturity).
- **Complex:** Xylem (water/mineral transport: tracheids, vessels, fibers, parenchyma) and Phloem (nutrient transport: sieve tubes, companion cells, fibers, parenchyma).

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2. Photosynthesis Respiration

The fundamental energy conversions in plants occur across chloroplasts and mitochondria.

Light-Dependent Reactions

Occurs in the thylakoid membrane. Splits water photolytically:

$$2H_2O \xrightarrow{\text{Light}} 4H^+ + 4e^- + O_2$$

Generates ATP and $NADPH$.

Calvin Cycle (Light-Independent)

Occurs in the stroma. Key steps:

1. **Carboxylation:** Catalyzed by RuBisCO ($CO_2 + \text{RuBP} \rightarrow \text{3-PGA}$).
2. **Reduction:** Uses ATP and $NADPH$ to form G3P.
3. **Regeneration:** Restores RuBP.

Cellular Respiration

Glycolysis (Cytoplasm) → Krebs Cycle (Mitochondrial Matrix) → Electron Transport Chain (Inner Membrane).

$$\text{C}_6\text{H}_{12}\text{O}_6 + 6\text{O}_2 \rightarrow 6\text{CO}_2 + 6\text{H}_2\text{O} + \text{Energy (ATP)}$$

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3. Plant Hormones (Phytohormones)

- **Auxins (IAA):** Cell elongation, apical dominance, root initiation.
- **Gibberellins (GAs):** Stem elongation, seed germination, bolting.
- **Cytokinins:** Cell division (cytokinesis), delays leaf senescence.
- **Ethylene:** Gaseous hormone; fruit ripening, abscission.
- **Abscisic Acid (ABA):** Stress hormone; stomatal closure, seed dormancy.

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4. Plant Taxonomy Classification

- **Bryophytes (Non-vascular):** Mosses, liverworts. Gametophyte dominant; require water for fertilization.
- **Pteridophytes (Seedless Vascular):** Ferns, horsetails. Sporophyte dominant; vascular system present.
- **Gymnosperms (Naked Seeds):** Conifers, cycads. Seeds not enclosed in an ovary; wind pollination.
- **Angiosperms (Flowering Plants):** Divided into Monocotyledons (parallel veins, scattered vascular bundles) and Dicotyledons (reticulate veins, ringed vascular bundles).

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5. Genetics Reproduction

Alternation of generations defines the plant life cycle, shifting between a haploid gametophyte (n) and a diploid sporophyte ($2n$).

Double Fertilization in Angiosperms

- One sperm (n) fuses with the egg cell (n) to form the zygote ($2n$).
- Another sperm (n) fuses with two polar nuclei ($2n$) to form the primary endosperm nucleus ($3n$), which provides nutrition.