INTRODUCTION TO PLANT DEVELOPMENT

Development	is the progression from earlier to later stages in maturation. It is the process whereby tissues, organs, and whole plants are produced.
	involves: growth, morphogenesis (the acquisition of form and structure), and differentiation.
Growth	refers to an irreversible increase in mass.
Differentiation	The process in which the cells of the apical meristems mature to perform specific functions.
Morphogenesis	is the acquisition of form, how a plant or organ acquires its distinctive shape or form.
Plasticity	is the ability to change form or shape in response to a change in environment; no genetic change is involved.

Plant development is highly plastic

Types of growth in Plants

Indeterminate growth	Plant organ grow continuously	Plant organ grow continuously Ex. Root and stem
Determinate growth	Organs stop growing after reaching a certain size.	Ex. Leaves, flowers and fruits

TYPES OF PLANT GROWTH

Primary growth	is an increase in stem and root length
Secondary growth	is an increase in the girth of plant.

Structural and functional unit

cell	basic structural and functional unit of plants

basic structural and functional unit of plants

Plant tissue systems fall into one of two general types:	meristematic tissue
	permanent (or non-meristematic) tissue

MERISTEMS

Meristems	plant regions of continuous cell division and growth
meristematic tissue	is a group of identical cells that are in a continuous state of division
initials	Cells that remain as sources of new cell.
derivatives	The new cells displaced from the meristem.

Types of Meristematic Tissues

apical meristem

intercalary meristem

intercalary meristem

Apical meristem

Apical meristem	A small mitotically active zone of cells found at the shoot tip or root tip

Primary growth occurs as a result of the activity of apical meristem

primary tissues	Tissues derived from the apical meristems are
Form primary meristems that produce the tissues of the stem and root	**a. Protoderm (which forms the epidermis)**
	b. Procambium (which forms phloem and xylem)
	c. Ground meristems (which form parenchyma)

Lateral Meristem

are known as secondary meristems because they are responsible for secondary growth, or increase in stem girth and thickness

Give increase in girth (secondary growth)

Produces secondary vascular tissues

Two lateral meristems: **the vascular cambium and the cork cambium** are responsible for secondary growth

Vascular Cambium

sometimes known just as cambium) is a cylinder of cells that forms new phloem and xylem.

Division of the cells of the vascular cambium adds more cells to the wood(secondary xylem) and inner bark (secondary phloem).

You can find out the age of a tree by counting the number of dark rings

Cork Cambium

the outermost lateral meristem.

It produces **cork cells**, which contain a waxy substance that can repel water.

The phloem together with the cork cells form the **bark**.

The cork cambium also produces a layer of cells known as **phelloderm**

The cork cambium, cork cells, and phelloderm are collectively termed the periderm.

Intercalary meristem

Regions of meristematic tissue between regions of more mature tissues

Occur only in monocots, at the bases of leaf blades and at nodes (the areas where leaves attach to a stem).

PERMANENT TISSUES

Permanent tissue	consists of plant cells that are no longer actively dividing
Three main types:	**Dermal**
	Vascular
	ground

Plant Reproduction and Embryogenesis

Alternation of generation	All land plants (and *some* green algae) reproduce via the alternation of generations life cycle, where both the haploid and the diploid stage are multicellular.
Sporophyte (Diploid stage)	produces spores
Gameto-phyte (Haploid) stage)	formed from the spore and give rise to the haploid gametes
Haploid (n)	the quality of a cell or organism having a single set of chromosomes
Diploid (2n)	a cell or organism that has paired chromosomes
Gamete	a mature haploid male or female germ cell that is able to unite with another of the opposite sex in sexual reproduction to form a zygote

Plant Reproduction and Embryogenesis (cont)

Spore	a minute, typically one-celled, reproductive unit capable of giving rise to a new individual without sexual fusion

Flower

The reproductive structure found in flowering plants which is specialized for sexual reproduction

Pollination and Reproduction

PLANT GAMETOGENESIS

Male Gametophyte (The Pollen Grain)

Pollen	is the male gametophyte in angiosperms and gymnosperms.
microsporangium (micro = small)	this is where ollen development occurs, located within the anthers.
microsporangia (P of microsporangium)	are pollen sacs in which the microspores develop into pollen grains.

Female Gametophyte (The Embryo Sac)

Embryo sac / female gameto-phyte	is an oval structure present in the ovule of flowering plants.
	It possesses two haploid nuclei and six haploid cells which do not have cell walls.

How does pollination and fertilization occur?

POLLINATION

The transfer of pollen from a male part of a plant to a female part of a plant, later enabling fertilization

Self-poll-ination	is pollination of a carpel by pollen from the same flower or another flower on the same plant
Cross--pollin-ation	is the pollination of a carpel by pollen from a different individual

Methods of Pollination

Biotic Pollin-ation	☐ involves pollinators (also called pollen vectors)
Abiotic Pollin-ation	☐ wind, water and rain

Double Fertilization

How does pollination and fertilization occur? (cont)

Double fertilization involves two sperm cells; one fertilizes the egg cell to form the zygote, while the other fuses with the two polar nuclei that form the endosperm.

Embryogenesis

Embryo genesis	is the first stage of the development of a new organism from its first cell named zygote, which appears as a result of the sexual fertilization.

Seed development

After double fertilization.

	each mature ovule develops into a seed
	the ovary develops into a fruit enclosing the seed(s)
Seeds	are protective structures that contain plant embryos and nutritive tissue to support the embryo until it can survive on its own
A typical seed contains:	a. Seed coat
	b. Endosperm/cotyledon
	c. single embryo

PARTS OF A SEED WITH FUNCTION

1. Seed coat	They are the protective outer covering of a seed. The seed coat is formed from the outer covering of the ovule called the integument.
It usually contains two layers:	**testa** – the thick outer layer
	tegmen – the delicate inner layer.
FUNCTIONS:	Protecting the seed from physical and mechanical damage
	Preventing the seed from germination even under favorable conditions of growth (seed dormancy)
	Preventing the excessive loss of water from the seeds

PARTS OF A SEED WITH FUNCTION (cont)

	Acting as a physical barrier against the entry of parasites
2. Endosperm	It is a tissue that is rich in oil, starch, and protein.
Non-endos-permic or exalbuminous seeds	Characterized by the complete absence of the endosperm, such as the seeds of the pea plant, groundnut, and gram.
Endospermic or albuminous seeds	Characterized by the presence of the endosperm, such as the seeds of millets, palms, and lilies.
Functions:	-Storing of reserve foods that provide nouris-hment to the developing plant
	-Protecting the embryo, the next part of the seed, by acting as the mechanical barrier
3. Embryo	the young plant that is developing inside the seed coat.

contains the underdeveloped tissues of leaves, stem, and roots of a plant.

Epicotyl	The tiny shoot of an embryo, from which the entire shoot system develops. The tip of the epicotyl is called plumule.
Hypocotyl	The stage of transition for the growing shoot and root of the embryo
Radicle	The tiny root of the embryo
Cotyledons	They are the leaves of the embryo that provide nourishment to the developing plant.
Functions	Giving rise to a new complete new plant
	Storing food and nourishing the baby plant

two types of cotyledons

PARTS OF A SEED WITH FUNCTION (cont)

monocotyledonous or monocots	embryo with one cotyledon and
dicotyledonous or dicots	– embryo with two cotyledons.

MONOCOTS

scutellum	The single cotyledon
	is connected directly to the embryo via vascular tissue (xylem and phloem).

Food reserves are stored in the large endosperm

dicots

The two cotyledons in the dicot seed also have vascular connections to the embryo.

In endosp ermic dicots	the food reserves are stored in the endosperm.
non-endos-permic dicots	The triploid endosperm develops normally following double fertilization, but the endosperm food reserves are quickly remobilized and moved into the developing cotyledon for storage

Seed Germination

dormancy	mature seeds enter a period of inactivity, or extremely low metabolic activity:
Germin-ation	is the development of a plant from a seed after a period of dormancy.
	Germination depends on imbibition, the uptake of water due to the low water potential of the dry seed

FRUITS

Any structure that develops from a fertilized ovary and contains seeds of the plant.

The ovary surrounding the ovules develops into a fruit that contains one or more seeds.

Vegetable	is actually not a scientific term and simply refers to the edible part of the plant: roots/tubers, stems, leaves, etc.
fruit	is the seed-containing part of a plant
	is the fleshy or dry ripened ovary of a plant.

FRUIT DEVELOPMENT

While the seeds are developing from ovules, the ovary of the flower is developing into a fruit, which protects the enclosed seeds and, when mature, aids in their dispersal by wind or animals.

Fertilization triggers hormonal changes that cause the ovary to begin its transformation into a fruit. If a flower has not been pollinated, fruit typically does not develop, and the entire flower usually withers and falls away

Parts of a fruit

the ovary wall becomes the pericarp, the thickened wall of the fruit.

Exocarp	the outer layer
Mesocarp	middle layer
Endocarp	inner layer

THE PLANT BODY

The shoot system consists of two portions:	the vegetative (non-repr-oductive) parts of the plant,	leaves and the stems,
	the reproductive parts of the plant,	flowers and fruits.
The root system	which supports the plants and absorbs water and miis usually underground.	

TYPES OF PLANT BODY

primary plant body	derived from shoot and root apical meristem
	composed of primary tissues
	constitutes the herbaceous parts of a plant
secondary plant body	derived from meristems other than apical meristem
	composed of secondary tissues