Growth & Development

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Growth & Development

GROWTH

is defined as an irreversible or permanent increase in the size and dry weight of an organism.

Growth in multicellular organisms is brought about by 3 processes.

(i) *Cell division:* This involves increase in the number of cells mainly as a result of mitosis.

(ii) *Cell expansion:* This is the permanent increase in the cell size as a result of uptake of water or synthesis of living materials.

(iii) *Cell differentiation/cell specialization:* This is the change in the form and activity of a cell to enable it perform a certain activity more efficiently.

Growth is usually accompanied by an increase in the complexity of an organism which is also called ***development***.

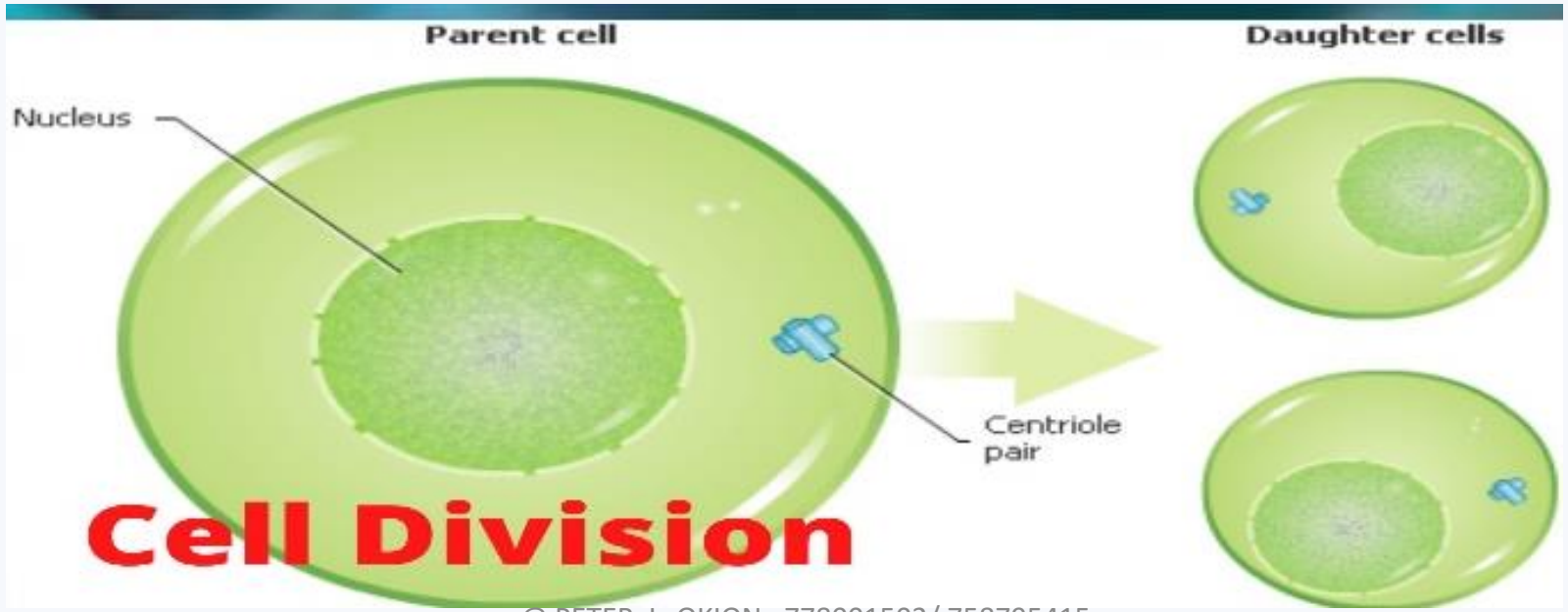
Development: is the permanent change in form and complexity of an organism. E.g. during development of a baby, they may learn to crawl or even walk using their legs

Differences between Growth and Development

Growth	Development
Permanent increase in size or dry weight of an organism	Increase in complexity of an organism
Does not continue throughout life	Continues throughout life
Occurs due to multiplication of cells	Occurs by formation of new tissues and organs
Stops after maturation	Development is progressive.

Mitosis & Growth

- Mitosis is the process by which a cell divides into two daughter cells, each of which has the same number of chromosomes as the original or parent cell.
- Chromosomes are structures that carry the DNA or genes or genetic material of a cell.



Mitosis contributes to growth of organisms in two ways;

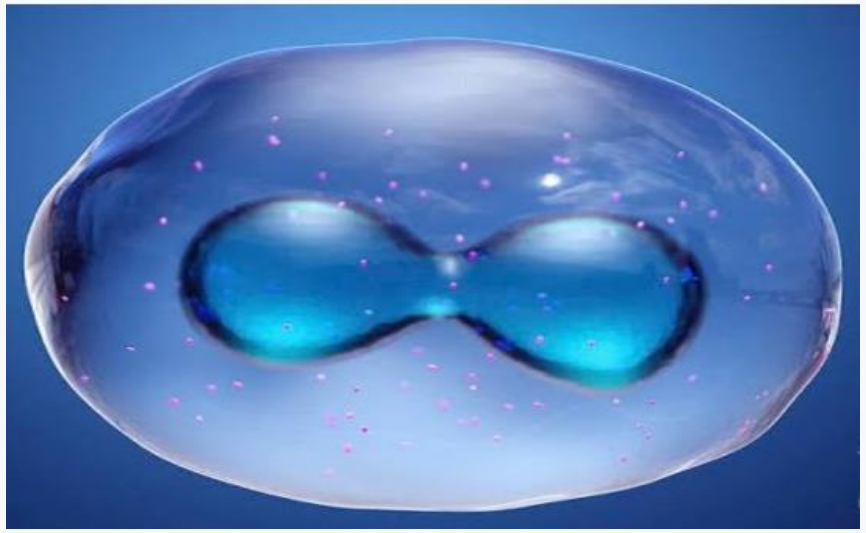
- ✓Increases the number of cells in the body of an organism. This is the basis of growth.
- ✓Replaces damaged and dead cells in the body.

Stages involved in the process of mitosis

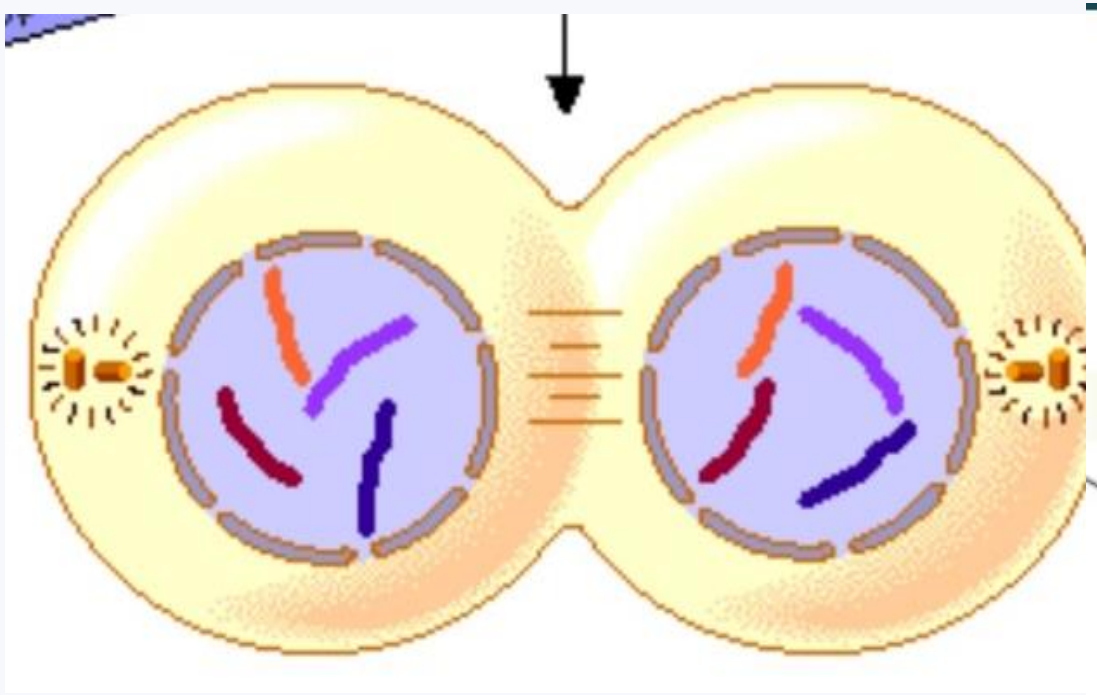
The process of mitosis occurs in ***three*** main stages i.e.

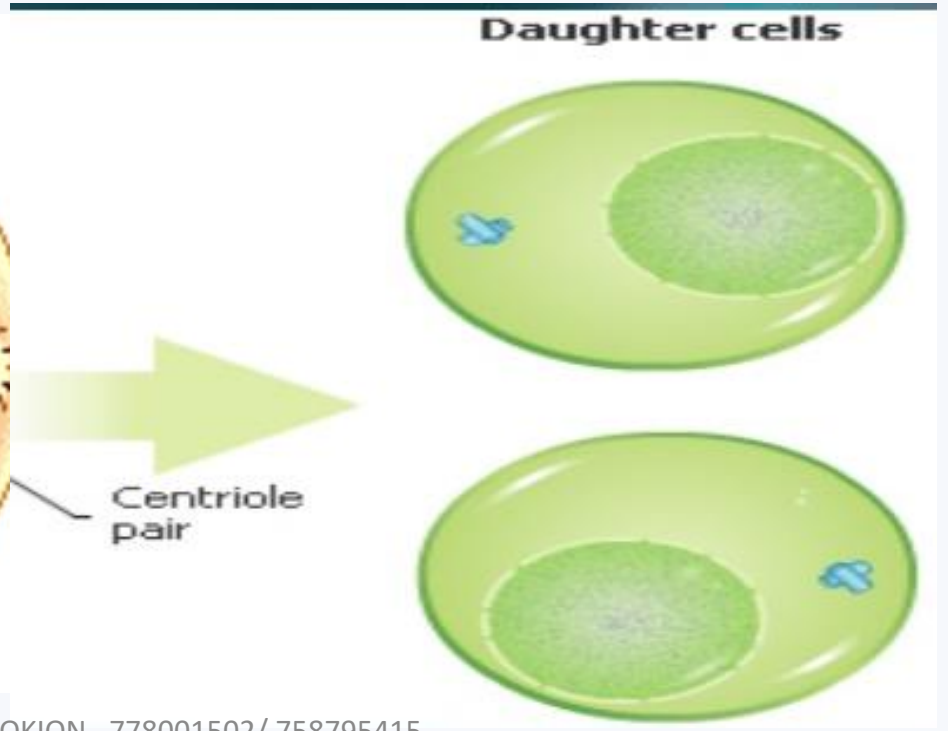
(i) Interphase: During this stage the cell prepares to divide

(ii) Nuclear division: The nucleus divides into two daughter nuclei. This stage occurs in ***four*** phases; Prophase, Metaphase, Anaphase and Telophase



(iii) Cytokinesis: The cell cytoplasm is then divided equally to form two daughter cells.





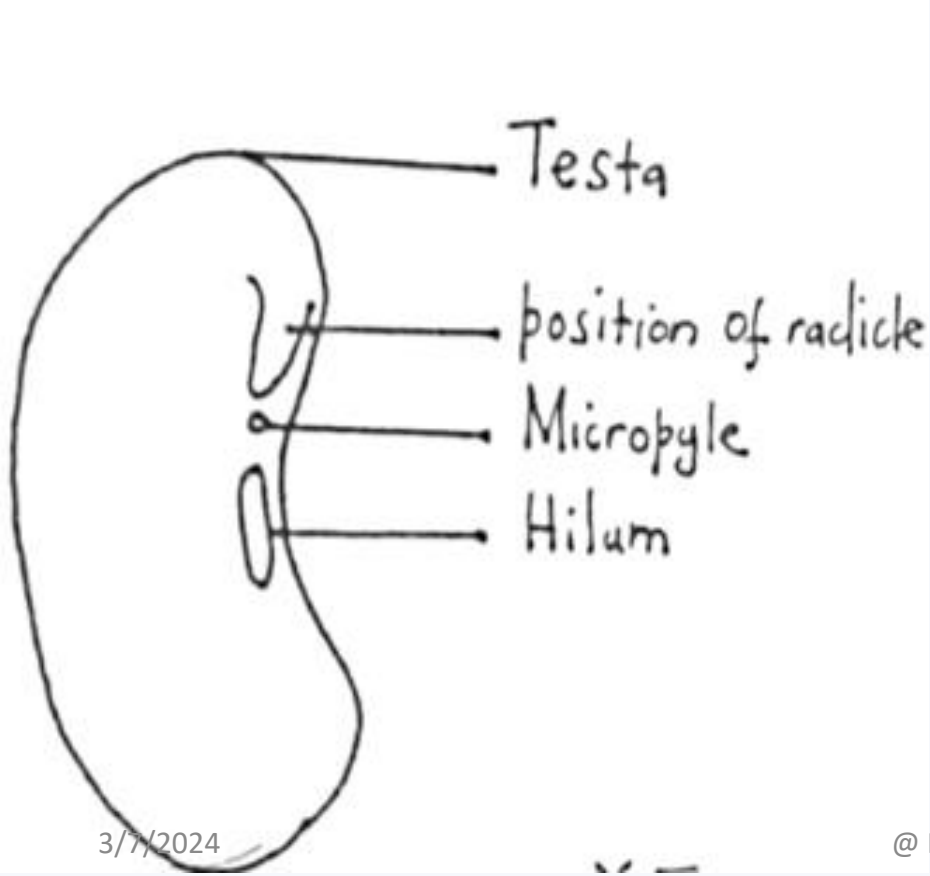
Importance of mitosis in living organisms

- ✓ Increases the number of cells in multicellular organisms which results into growth.
- ✓ Replaces damaged or worn out cells resulting into repair of tissues for example during wound healing.
- ✓ Maintains genetic stability since mitosis produces daughter cells with the same number of chromosomes as the parent cell.
- ✓ Regenerates lost body parts by forming new cells as in arms of a star fish.
- ✓ Forms the basis of asexual reproduction.

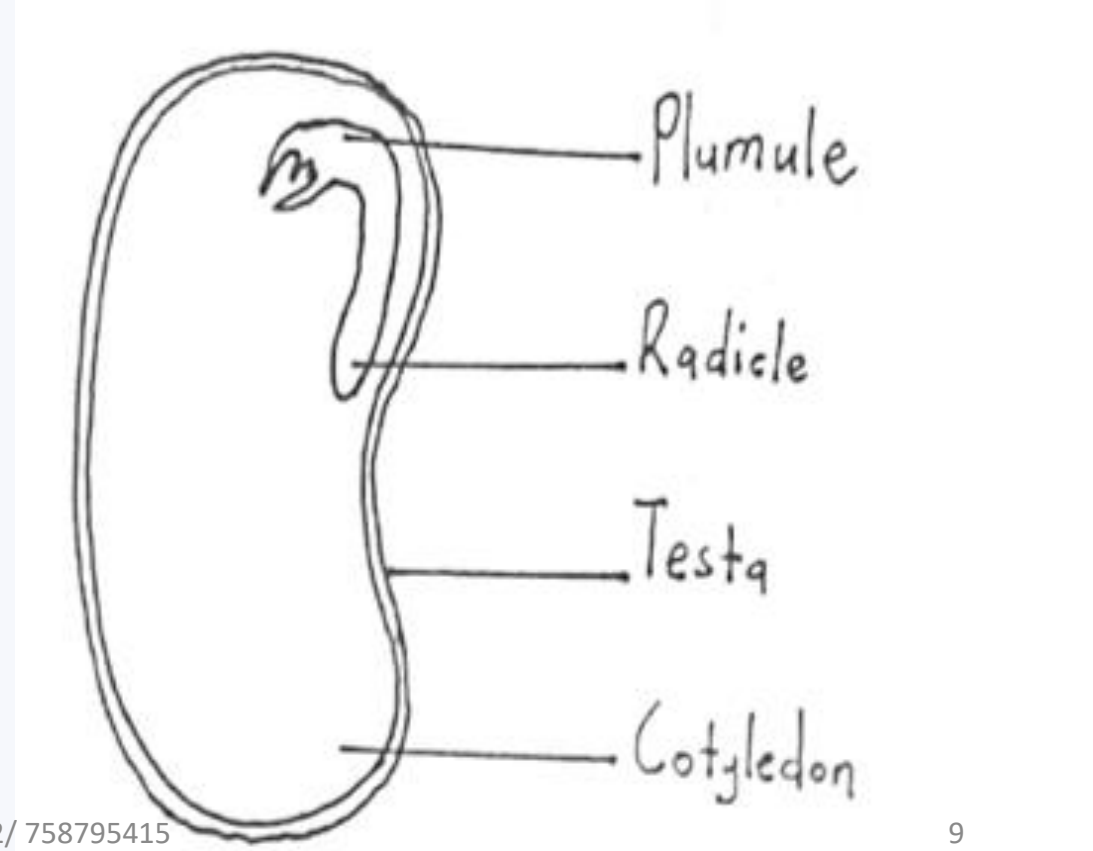
Internal and external structure of seeds

Qn. Identify the structural differences between the bean seed and the maize grain

External features of a bean seed

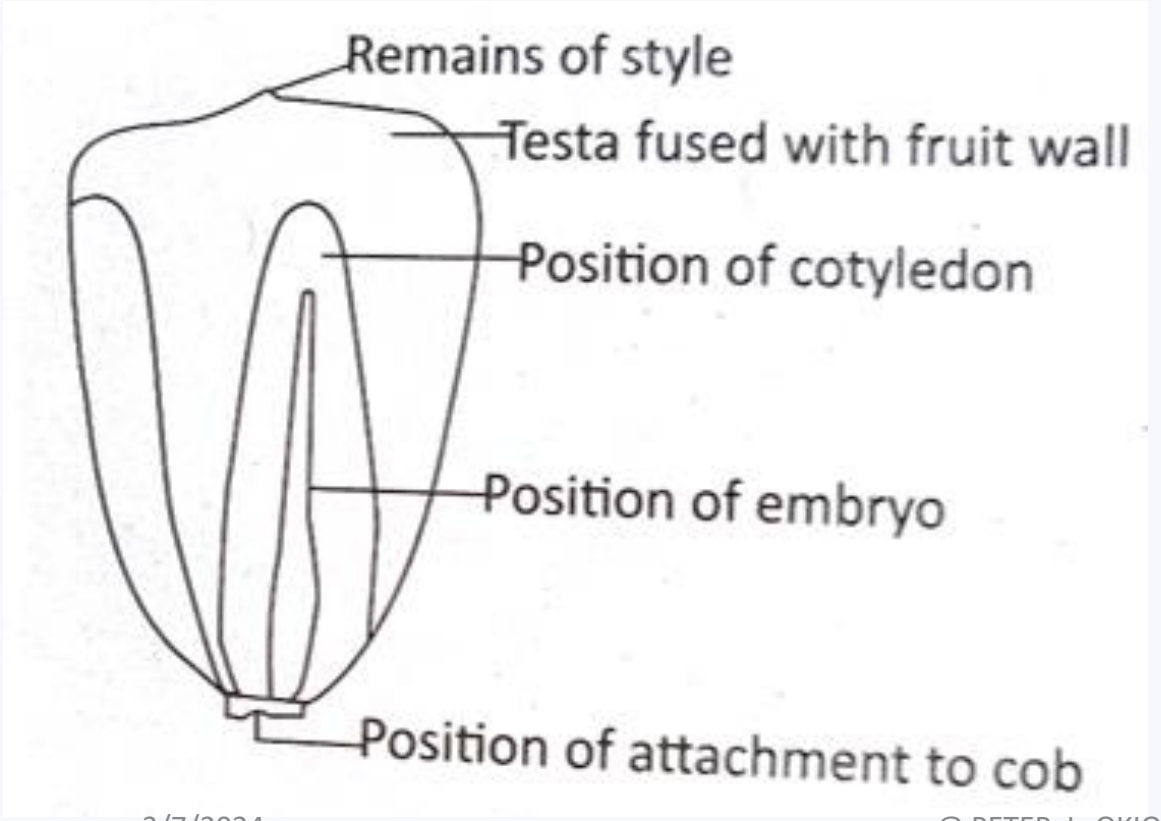


Internal features of a bean seed

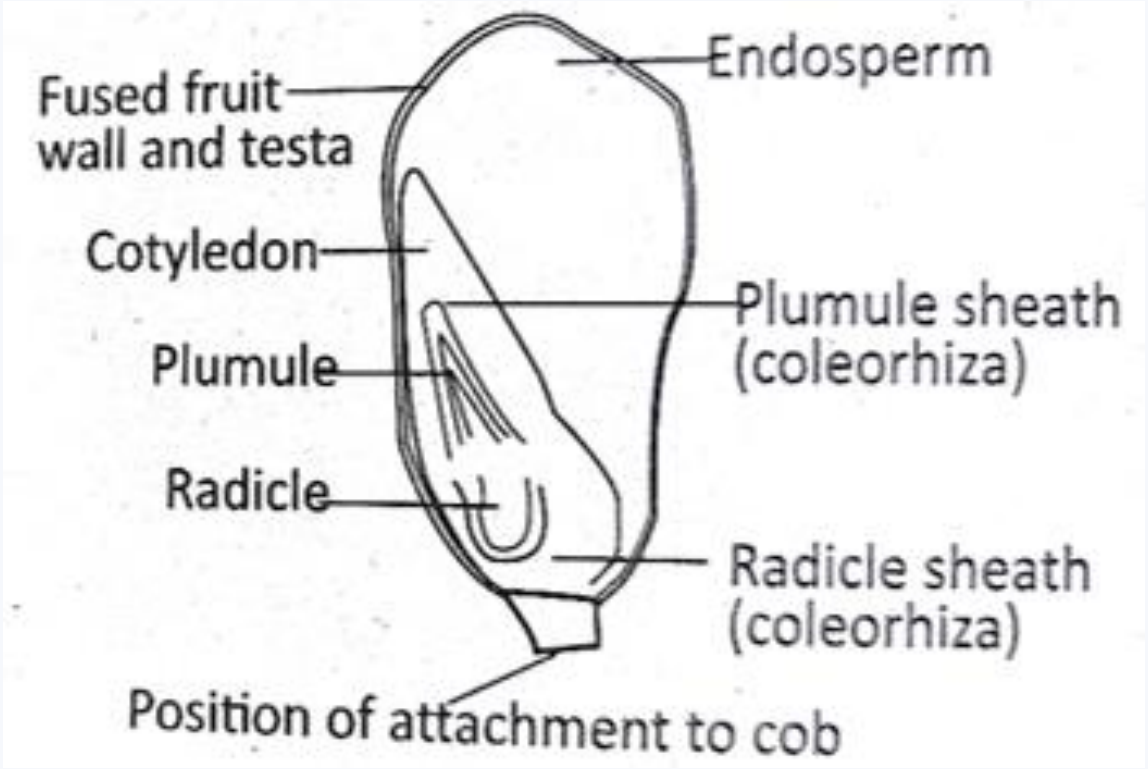


Internal and external structure of seeds

External features of a maize seed

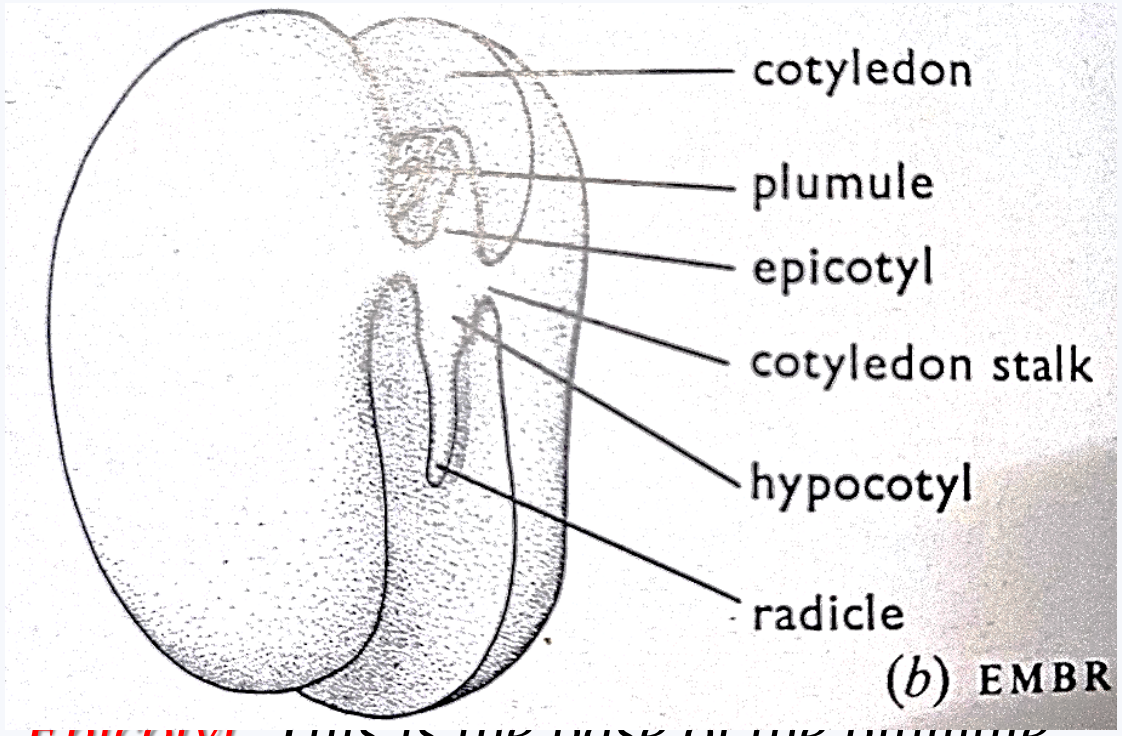


Internal features of a maize seed



Growth & development of the flowering plant

- ✓ In the flowering plant, development begins with the growth of a zygote into a simple embryo within a seed.
- ✓ The embryo is differentiated into an embryonic shoot known as the ***plumule*** and an embryonic root known as the ***radicle***.
- ✓ In *endospermic* seeds such as maize seeds, food for the embryo is stored in the endosperm where as *non-endospermic* seeds such as bean seeds, food is stored in the large fleshy cotyledons.

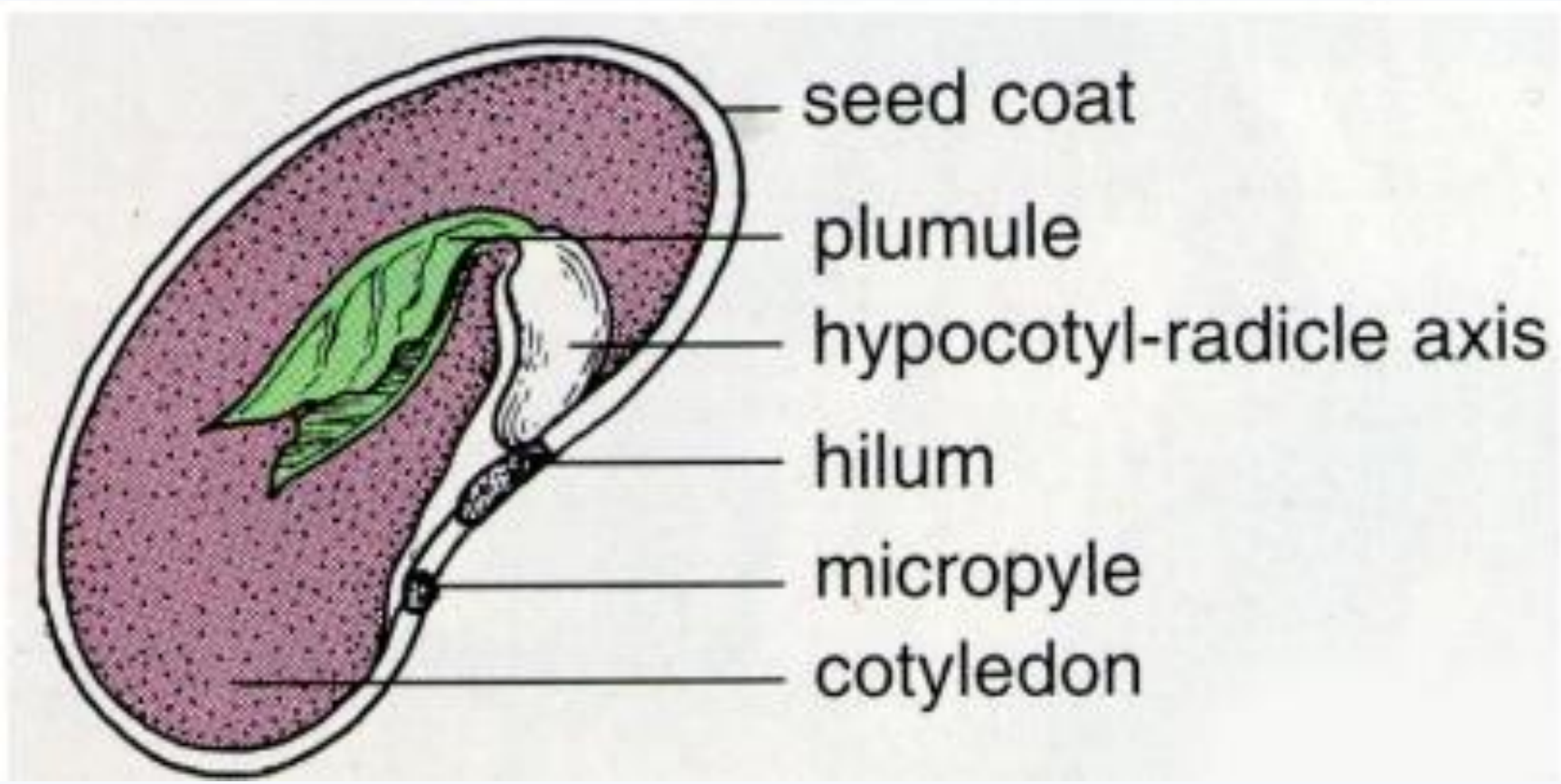


Epicotyl: This is the base of the plumule

Hypocotyl: This is the base of the radicle

SEED GERMINATION

This is the process by which the embryo of a seed grows into a seedling capable of existing as a new and independent plant under favorable conditions.



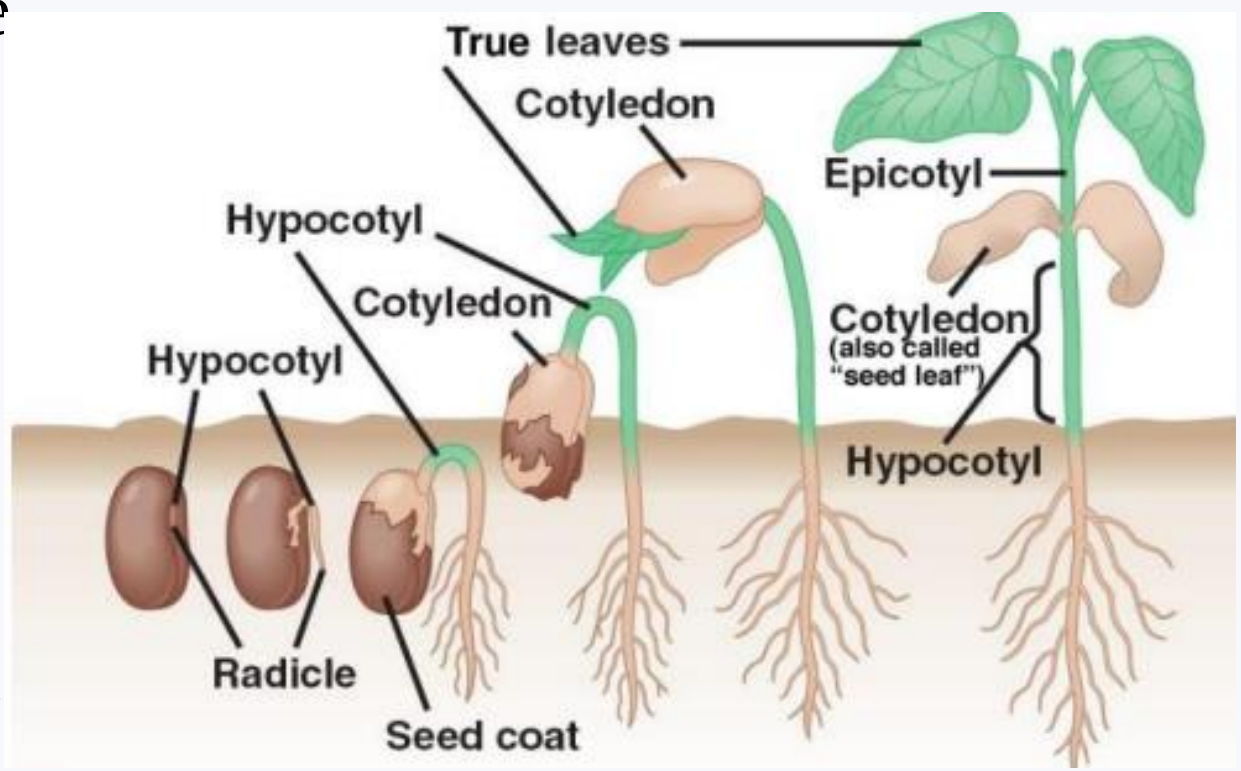
Types of Seed Germination

i) Epigeal germination:

This is where the cotyledons appear above the ground due to rapid elongation of the hypocotyl. E.g. ***beans, tomato, cotton, mangoes,*** etc.

Cotyledons mainly being **small**, once exposure to sun light turn **green** and become **photosynthetic**. This is because they contain ***chlorophyll***. This is when they assume the function of making food.

In this type of germination, the upper part of the hypocotyl is hooked or curved downwards as it grows through the soil so as to protect the delicate plumule.



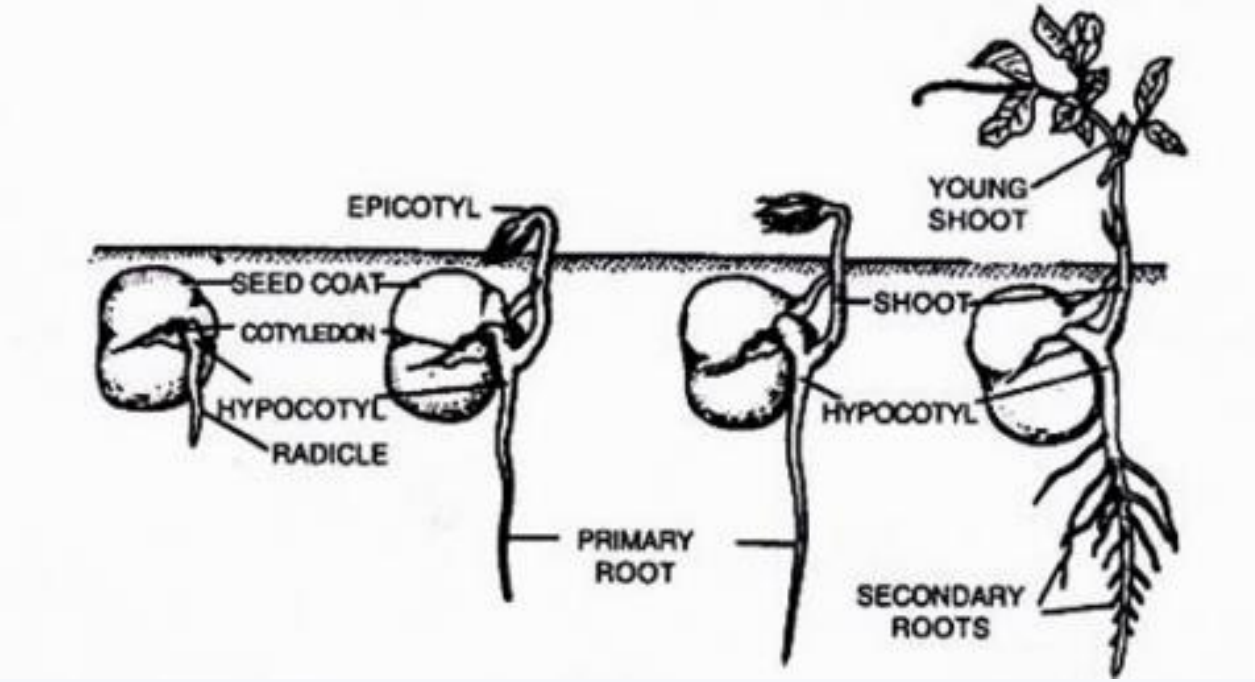
ii) Hypogeal germination:

The cotyledons remain underground due to the ***epicotyls*** growing faster than hypocotyls.

Seeds showing hypogeal germination are ***endospermic***.

Examples include ***maize, rice and G nuts***

Seeds germinating this way often have **large** cotyledons to **nourish** the growing embryo until the first green leaves develop at the tip of the plumule.



Differences between Epigeal & Hypogeal germination

Epigeal germination- bean seed	*Hypogeal germination- maize seed*
Cotyledons emerge out of the soil	Cotyledons remain inside the soil
Hypocotyl shows rapid elongation	Hypocotyl is short in this germination
Epicotyl is short in this germination	Epicotyl shows rapid elongation
Upper part of the hypocotyl is curved to protect the plumule	The hypocotyl shows no curvature
Cotyledons turn green and carry out photosynthesis	Cotyledons do not undergo photosynthesis

Physiology of germination or events which lead to germination of a seed

- ✓ *Water is absorbed into the seed through the micropyle and Testa by imbibition.*
- ✓ *The water **activates** enzymes.*
- ✓ *In the storage Centre (**endosperm**), the enzyme diastase catalyzes conversion of starch to glucose, proteins are converted to amino acids by proteases, and lipids to fatty acids and glycerol by lipase.*
- ✓ *Water dissolves these food nutrients and transports them to the growth center, the **embryo**.*
- ✓ *Glucose, fatty acids and glycerol are respired to provide energy for cell division. Amino acids are used for growth of the embryo*
- ✓ *The softened Testa raptures allowing the radicle to emerge first followed by the plumule.*

Conditions necessary for seed germination

Condition	Required for
Water	It activates the enzymes within the seed to hydrolyze the stored food. • It makes the seed swell, soft and the Testa to burst. • It dissolves the stored food. • It is a medium in which all the chemical and enzymatic reactions proceed • It is a medium of transport of the dissolved food substances to the developing shoot and root of the new plant. • Water is needed for the development of cell vacuoles. Large cell vacuoles contribute to increase in size of cells
Oxygen	Oxygen is used in **aerobic respiration**; the main source of the seedling's **energy** until it grows leaves
Warmth	Suitable temperature is important for enzyme-controlled reactions in the cotyledon of the germinating seed. At low temperatures, the enzymes are inactive and at very high temperatures, they are denatured hence no germination. Germination will require an **optimum** temperature which varies from 10°C-50°C for most tropical seeds.

An experiment to demonstrate the conditions necessary for germination

Materials:

refrigerator, 4 test tubes, Cotton wool, Seeds, Oil and Water.

Procedure:

✓• Arrange four test tubes labeled **A-D**

✓• To **test tube A**, add moist/wet cotton wool and seeds.

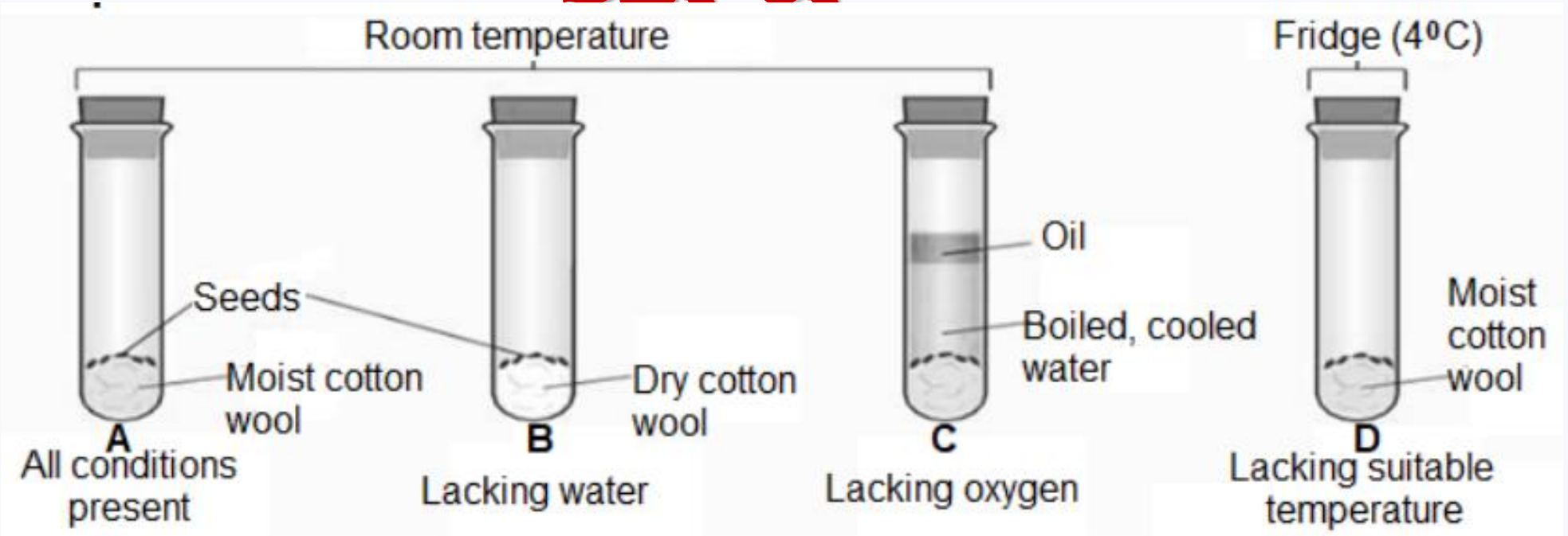
✓• To **test tube B**, add dry cotton wool and seeds.

✓• To **test tube C**, add seeds, boiled cooled water and a layer of oil.

✓• To **D**, add seeds, moist/wet cotton wool and keep in a refrigerator under non-freeze cold temperatures (about 4℃).

✓• Cork all the test tubes and leave them for **3 days.**

SET UP



Observations:

Seeds germinated in only test tube A.

Those in B, C and D did not germinate.

Conclusion:

Air, water and warmth are necessary for germination

QN: Explain your observations above

Experiment to show that oxygen is necessary for germination

Apparatus:

2 conical flasks, 2 corks, Water, Cotton wool, Seeds and Alkaline pyrogallic acid.

Procedure:

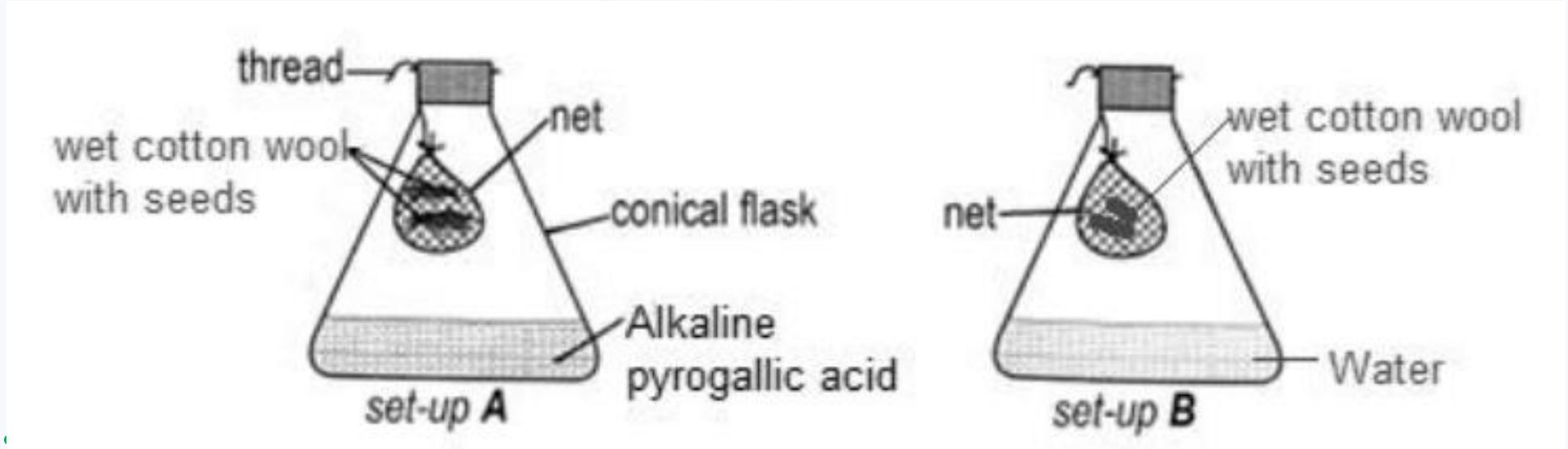
✓• Pour some water in one conical flask and some pyrogallic acid in another conical flask.

✓• Tie some seeds in wet cotton wool and suspend the cotton wool in the flasks using a thread.

✓• Fix the threads using a cork.

✓• Leave the set up for three days.

SET UP



Observation:

After a few days the seeds in B germinated while those in A did not germinate.

Conclusion:

Oxygen is necessary for germination.

Explanation:

Alkaline pyrogallic acid absorbs oxygen from air in flask A thereby preventing germination

Development in Plants & Animals

Development: refers to increase in complexity of an organism.

This process continues throughout life and occurs by formation of new tissues and organs as a result of ***cell differentiation***.

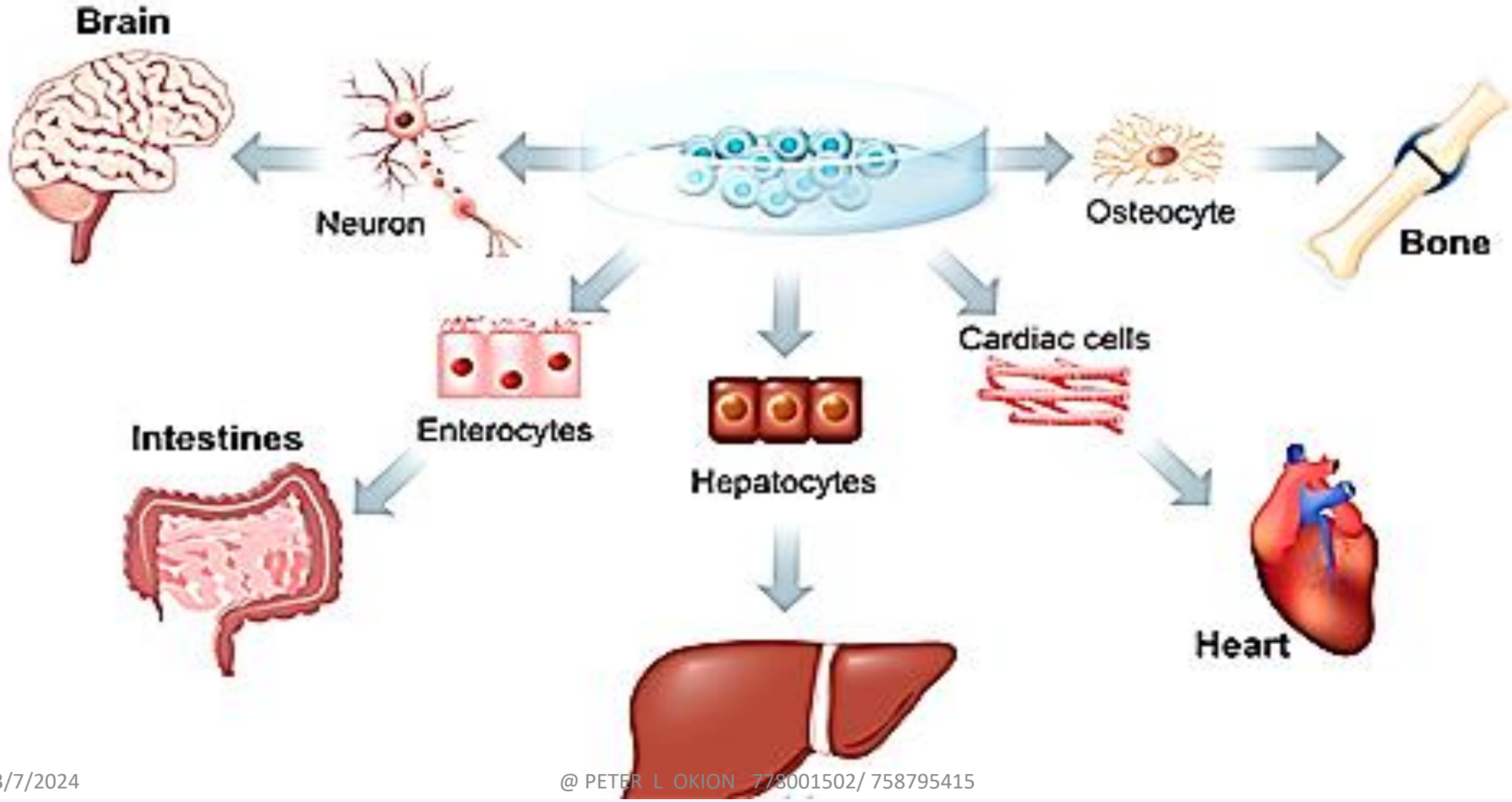
Cell differentiation

This is the process by which dividing cells undergo changes in their structure which enable them perform ***specific functions*** or ***roles*** in the body of an organism.

For example; in animals the first type of cells in the developing embryo are the ***stem cells.***

Stem cells are undifferentiated cells that later on form the different cell types in an adult.

STEM CELL


Brain
Neuron
Osteocyte
Bone
Enterocytes
Cardiac cells
Intestines
Hepatocytes
Heart

Importance of cell differentiation

Cell differentiation allows cells to specialize and perform specific functions in the body. This results into formation of tissues and organs in the body performing different roles.

Growth and development of the shoot and root

Unlike in animals where growth and development occurs all over the whole body, growth in plants only takes place at points or regions known as ***meristems***.

Meristems

These are the actively growing points or regions of the plant.

Meristems contain ***undifferentiated*** cells which continuously divide by ***mitosis*** producing daughter cells that form the rest of the plant tissues and organs.

Types of meristems

(a)Apical meristems: These are found at the **apex** or **tips** of the shoot and root. They are responsible for primary growth of the shoot and root.

(b)Lateral meristems: These include the vascular cambium and the **cork** cambium. They are responsible for **secondary** growth.

Primary Growth

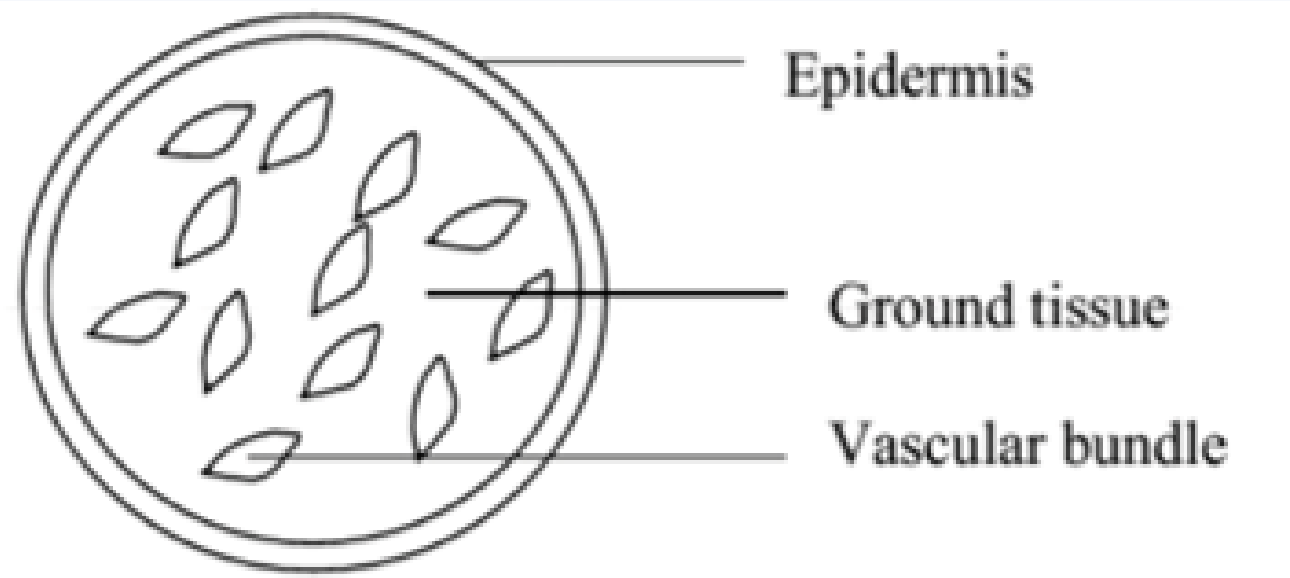
This is the form of growth which results into increase in length of the shoot and root.

Primary growth occurs by formation of the ***primary plant tissues*** known as the *primary* ***xylem*** and the *primary* ***phloem*** as a result of cell division in apical meristems found at the tip of the shoot and root.

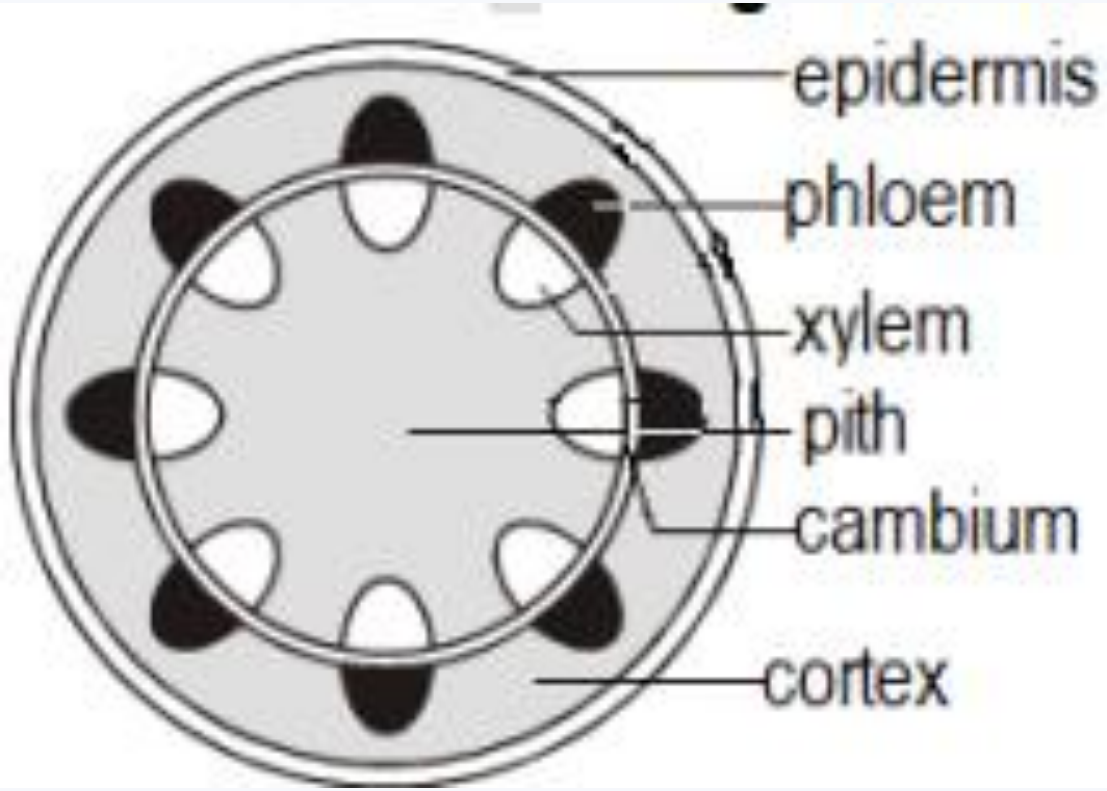
Note: It is the first type of growth to occur after seed germination during which the radicle and plumule increase in length. In monocots and herbaceous plants, it's the only form of growth which occurs.

Transverse drawings of:

Monocot stem



Dicot stem



Secondary Growth

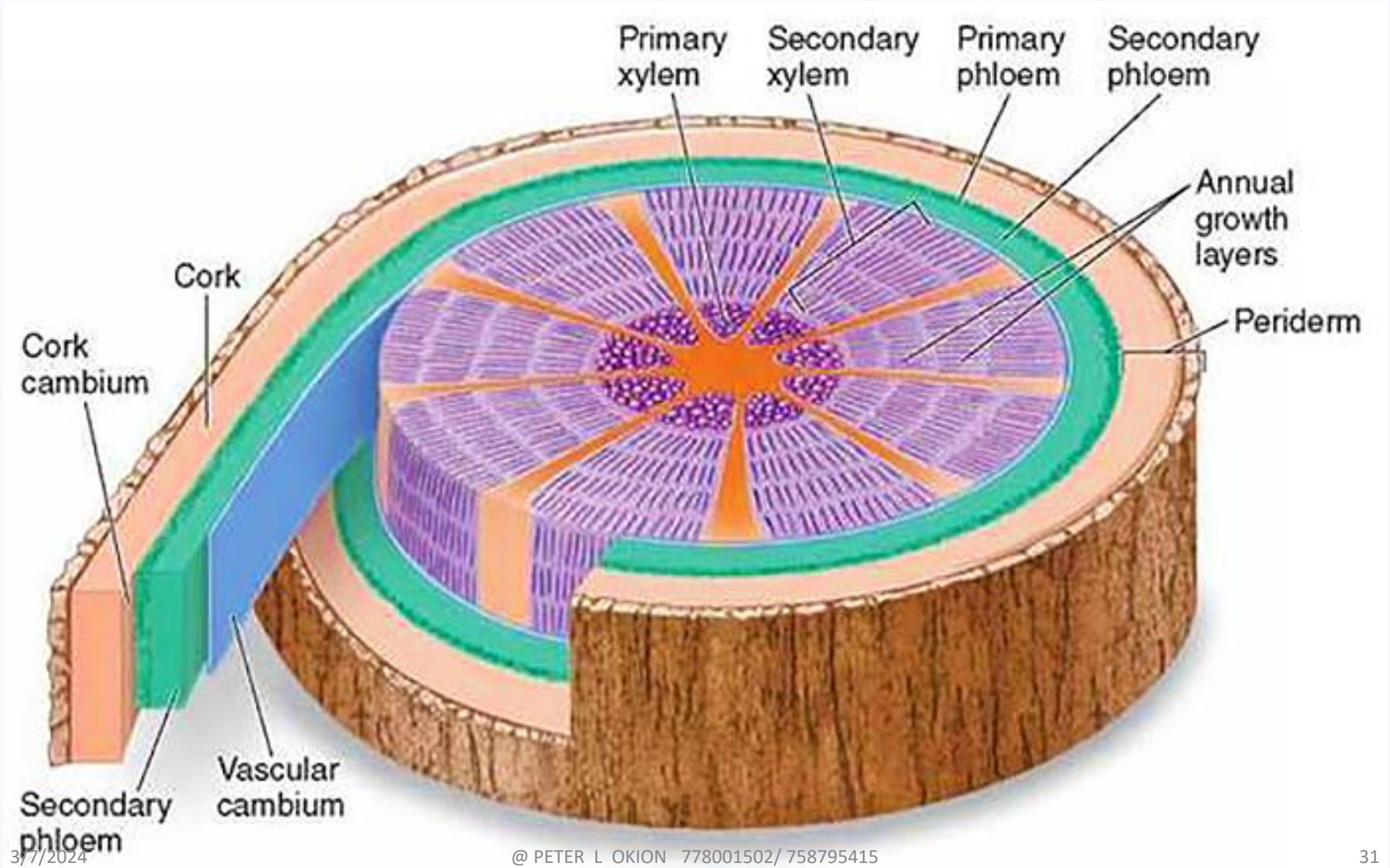
This is the form of growth which causes the stems and roots of dicot plants to ***thicken*** or ***widen*** or ***increase*** in ***diameter*** (**girth**).

Secondary growth occurs by formation of the ***secondary xylem*** known as ***wood*** and ***secondary phloem*** as a result of cell division in the **vascular cambium** which is located between the primary xylem and primary phloem.

How secondary growth or increase in girth of stems is brought about in dicot plants

- ✓ During secondary growth, meristematic cells in the vascular cambium divide by **mitosis**.
- ✓ The cells formed on the **inside** of the cambium develop into the secondary xylem (**wood**) while those cells formed on the **outside** form the secondary phloem.
- ✓ As more secondary xylem and secondary phloem are added to the inner and outer side of the cambium continuously throughout life, the stem increases in **girth** or **diameter** or **width**.

NB: Secondary growth **does not** occur in **monocots** because secondary growth occurs at the vascular cambium which is **absent** in monocot stems but only present in dicot stems.


Primary xylem
Secondary xylem
Primary phloem
Secondary phloem
Annual growth layers
Periderm
Cork
Cork cambium
Vascular cambium
Secondary phloem

Insect metamorphosis & life cycles

Insect metamorphosis are a series of developmental stages of an insect from eggs to adult.

Types of insect metamorphosis

(a)Complete metamorphosis: This is a form of metamorphosis involving four stages of development i.e. egg, larva, pupa and adult. It occurs in insects e.g. housefly, butterfly, mosquito.

(b)Incomplete metamorphosis: This is a form of metamorphosis involving three stages of development i.e. egg, nymph and adult. It occurs in insects e.g. cockroach, locust, grass hoppers.

Comparison between complete and incomplete metamorphosis

Similarities

- ✓ In both the first stage is an egg
- ✓ In both, there are structural changes of the organism
- ✓ In both, the adult has the largest size
- ✓ Both involve moulting which stops once an adult emerges

Differences

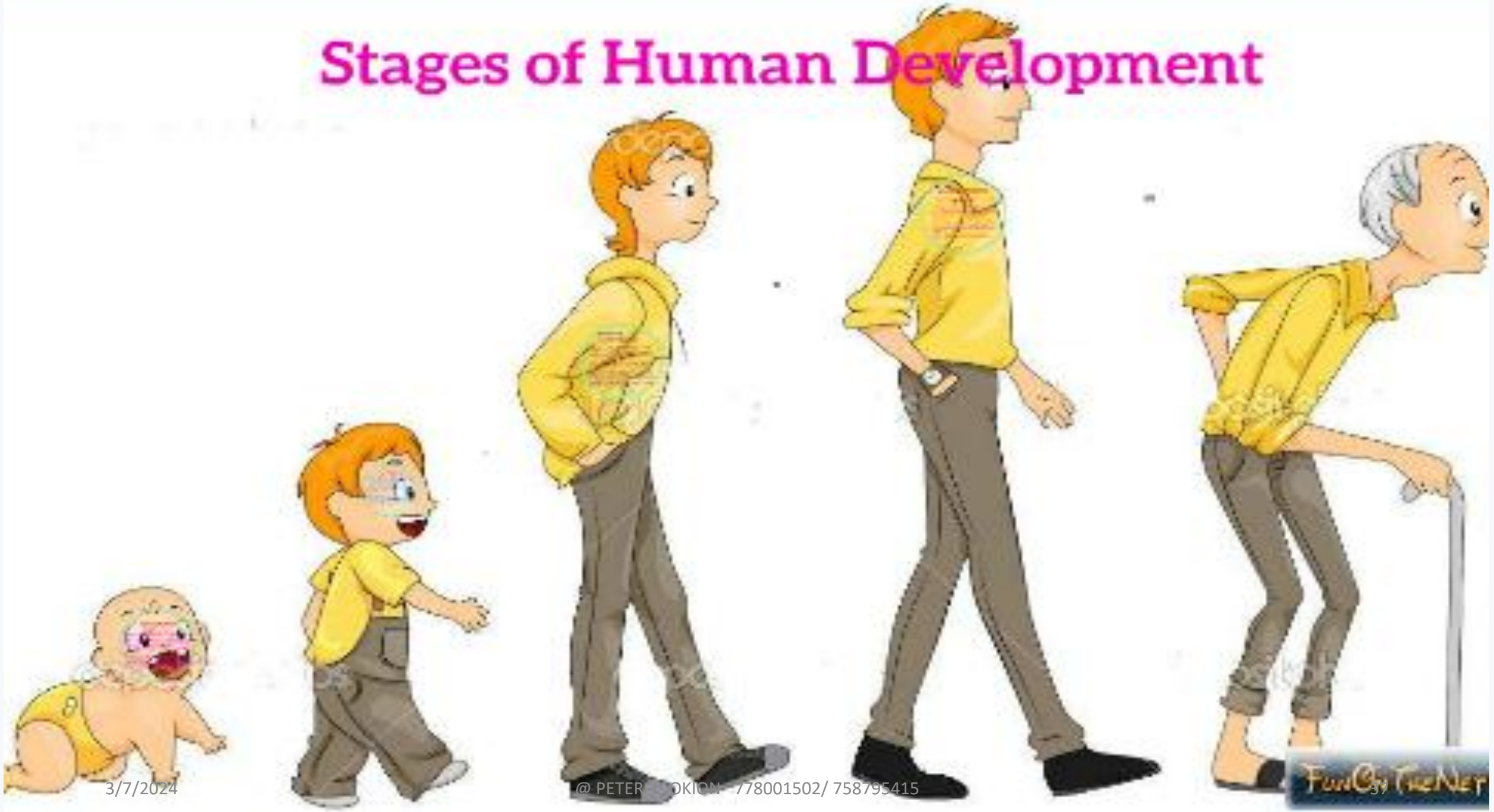
Complete metamorphosis	*Incomplete metamorphosis*
Involves four stages of development	Involves three stages of development
Each stage is considerably different from the next in structure	Considerable similarity in structure between nymph and adult
has larva and pupa stage	There is no larva and pupa stage
There is no nymph stage	Has nymph stage
Larva and adult have feed on different food types	Nymph and adult have same nutrient sources

A Must Do Assignment

Using Active Biology Book 1 or any other form of Biological Literature, Read and Summarize in form of a written description; the life cycles of the following insects; Illustrations showing the different stages in the Lifecyle should also be included.

[housefly, cockroach, mosquito, bee, butterfly] (in about 5 pages)

Stages of Human Development




What Is Human Life?

Infancy (0-5 years)

- ✓ Infant is dependent on other people and develops bonds of love and trust with their parents
- ✓ Infant starts crawling and walking, learns to focus their vision, develop curiosity to explore new objects, learns to play, imitate behavior of others especially adults and older children.

Childhood (5-12 years)

- ✓ The child starts to establish **independence** away from other people.
- ✓ Physical growth is rapid, appearance starts to become adult like.
- ✓ Thinking is a little self centered but understanding of other people's perspectives grows, mental immaturity, predictable intelligence, memory and language skills improve
- ✓ Children can dress themselves, socially confident in other areas of life like school work, plays.

Adolescence or teens (12-20 years)

- ✓ Independence increases on how the child spends their free time, how they dress, nature of friends.
- ✓ Effort to improve self identity by trying out new things such as clothing styles, music, friendship groups. Effort to improve appearance of self including comparing one's body with those of friends and peers
- ✓ Sexual identity by trying out romantic relationships, dates, pressure to have sex
- ✓ Eating disorders especially for females
- ✓ Mood swings, strong feelings and emotions (depression). This is exhibited through unpredictable behaviour resulting into conflict with peers as the child's brain is learning to control and express emotions

- ✓ In males, voice deepens, enlargement of scrotum, testes and penis, growth of hair around the genital area, under armpits, chest and beards, body becomes hard, more muscular, chest widens, wet dreaming, increased attraction to girls.
- ✓ In females, body becomes soft, less muscular, enlargement of uterus, fallopian tubes and vagina, growth of hair in the genital area and under arm pits, enlargement of nipples, hips and breasts, softening of voice, menstruation and ovulation begin, increased attraction to boys.

Assignment:

Classify the above changes associated with adolescence into physical, psychological, cognitive and behavioral.

Early adulthood (20-40 years)

- ✓ Physical maturation is complete, height and weight may slightly increase. Physical abilities are at their peak
- ✓ By 30, aging process begins; lens of the eye starts to harden and thicken resulting into changes in vision especially difficulty focusing close objects
- ✓ Sensitivity to sound decreases, hair starts to thin and become gray around the age of 35
- ✓ Skin becomes drier and wrinkles start to appear
- ✓ Immune system starts weakening
- ✓ Reproductive capacity starts to decline for example erection in men and sexual desire in women.

Middle adulthood (40-60 years)

- ✓ Aging process is more apparent, hearing further decreases
- ✓ By 60 years, eye lose ability to focus clearly objects at varying distances known as presbyopia. Most people start using external lenses
- ✓ Skin continues to dry out and is more prone to wrinkling particularly on the sensitive face area
- ✓ Accumulation of fat in the stomach area. Age spots and blood vessels become more apparent
- ✓ Women experience a gradual decline in fertility as they approach onset of menopause around the age of 50 years.

How teens can cope with the changes that occur during puberty and adolescence

- ✓ Talk to a trusted doctor incase you feel the changes are abnormal and different from what you expect.
- ✓ Surround yourself with people of the same age as they are undergoing the same changes with minor differences.
- ✓ Talking to adults such as mothers, teachers, school nurses, counselors who have experience.
- ✓ Thinking positively about your body changes. Learn to love your new appearance, and be confident about your new image
- ✓ Do regular exercise, maintain proper hygiene, and eat healthy foods.

AGING

This is the gradual decline in the efficiency of the physiological functions which are necessary for survival and reproduction.

The process of aging begins right from the time an individual attains adulthood until death.

Features of aging

- ✓ Blood vessels harden such that the hear uses too much pressure to pump blood through them. This increases the risk of hypertension or high blood pressure.
- ✓ Bones shrink in size and density. This makes them weak and can easily fracture increasing the risk of osteoporosis.
- ✓ More constipation due to age-related structural changes in the colon
- ✓ Bladder becomes less elastic resulting into frequent urination. In men, there is enlargement or inflammation of the prostate.

- ✓ Loss of neurones resulting into reduction in brain functioning such as memory loss, dementia.
- ✓ Great decline in hearing or complete loss of hearing.
- ✓ Lens weakens or becomes less flexible making it hard to focus both distant and close objects clearly.
- ✓ Gums and teeth become more vulnerable to decay and infection
- ✓ Skin becomes very dry, less elastic, develops wrinkles, age spots and skin tags
- ✓ Decline in sexual desire and performance. In females, vaginal dryness causes extreme sexual discomfort, for men impotence becomes a concern, take longer to get and maintain an erection
- ✓ Metabolic diseases
- ✓ Reduced immunity to disease, low rate of recovery from infection, wounds take longer to heal.

END

BIOLOGY IS LIFE

SLIDES PREPARED BY TR. PETER L OKION