GENERAL BOTANY

Course code: 112SCI

PREPARED BY STUFF MEMBERS OF BOTANY AND MICROBIOLOGY DEPARTMENT

<u>Course information:</u>
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Faculty: Education
Year: First
Contents:

- Plant morphology
- Plant anatomy
- Plant kingdom
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Content

Part 1: Plant morphology

What is Plant Morphology?

The expression "Morphology" is derived from two Latin words (Morphe = form + logos = study). It deals with the study of forms and features of different plant organs like roots, stems, leaves, flowers, seeds, fruits, etc.

The body of a typical angiosperm plant (shape 1) is differentiated into:

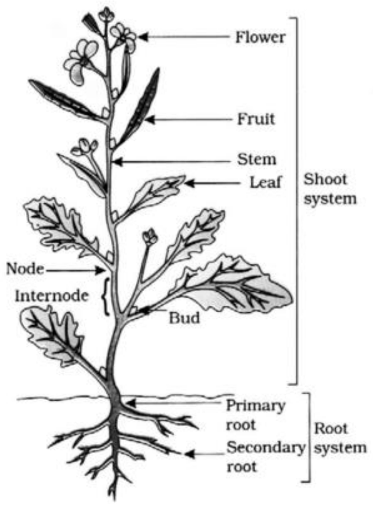
• An underground root system

• An aerial shoot system.

The shoot system consists of stem (including branches), leaves, flowers and fruits. The roots, stems and leaves are vegetative parts, while flowers constitute the reproductive part.

Adaptation: Any alteration in the structure or function of an organism or any of its part that results from natural selection and by which the organism becomes better fitted to survive and multiply in its environment.

Shape 1: pars of a plant body



Seeds

What is the Seed?

A seed is a basic part of any plant. The ovules after fertilization, develop into seeds. A seed is made up of a seed coat and an embryo. The embryo is made up of a radicle, an embryonal axis, and one (wheat, maize) or two cotyledons (gram and pea). A seed is found inside a fruit which converts into a new plant when we plant it. Hence, the seed is the most important part.

Let us now look at the different types of seeds and study their characteristics.

Types of Seeds

A Seed is primarily of two types. The two types are:

- Monocotyledonous Seed
- Dicotyledonous Seed

Structure of a Monocotyledonous Seed

A Monocotyledonous seed, as the name suggests, has only one cotyledon. There is only one outer layering of the seed coat. A seed has the following parts:

Seed Coat: In the seed of cereals such as maize, the seed coat is membranous and generally fused with the fruit wall, called Hull.

Endosperm: The endosperm is bulky and stores food. Generally, monocotyledonous seeds are endospermic but some as in orchids are non-endospermic.

Aleuron layer: The outer covering of endosperm separates the embryo by a proteinous layer called aleurone layer.

Embryo: The embryo is small and situated in a groove at one end of the endosperm.

Scutellum: This is one large and shield-shaped cotyledon.

Embryonal axis: Plumule and radicle are the two ends.

Coleoptile and coleorhiza: The plumule and radicle are enclosed in sheaths. They are coleoptile and coleorhiza.

Learn more about the Morphology of Flower here.

Structure of a Dicotyledonous Seed

Unlike monocotyledonous seed, a dicotyledonous seed, as the name suggests, has two cotyledons. It has the following parts:

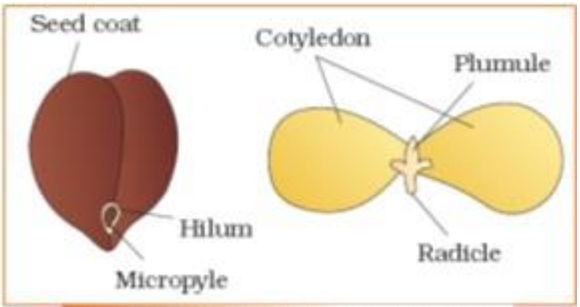


Fig: Structure of dicotyledonous seed

Seed coat: This is the outermost covering of a seed. The seed coat has two layers, the outer testa and the inner tegmen.

Hilum: The hilum is a scar on the seed coat through which the developing seed was attached to the fruit.

Micropyle: It is a small pore present above the hilum.

Embryo: It consists of an embryonal axis and two cotyledons.

Cotyledons: These are often fleshy and full of reserve food materials.

Radicle and plumule: They are present at the two ends of the embryonal axis.

Endosperm: In some seeds such as castor, the endosperm formed as a result of double fertilization, is a food storing tissue. In plants such as beans, gram, and peas, the endosperm is not present in the matured seed. They are known as non-endospermic.

Seed Germination

Germination is defined as the emergence and development from the seed embryo of those essential structures which indicates its ability to produce a normal plant under favorable conditions. Every seed consists of three essential parts:

1) An embryo, which will give rise to the new plant.

2) Storage tissues that contain the substances which will nourish the embryo during its development prior germination.

3) a protective covering or seed coat which shields the embryo and endosperm and may also play an important part in controlling factors that initiate germination of the seed, in particularly entry of moisture and gaseous exchange.

Germination begins with the imbibition of water into the seed, which in turn increases the metabolism and cell division inside the seed, leading to the enlargement of the embryo. The embryo penetrating the seed coat is the conclusion of the germination process.

What is Epigeal Germination?

Epigeal germination is the type of germination in which the cotyledons rise out of the soil due to the elongation of the hypocotyl. The hypocotyl is the part of the stem of an embryo plant beneath the stalks of the cotyledons. After emerging out of the soil, these cotyledons are called seed leaves, which become photosynthetic as well. The second leaves derived from the plumule become true leaves. Epigeal germination occurs in castor, cotton, onion, papaya, etc. In addition to food storage, cotyledons undergo photosynthesis and produce food for the development of the embryo.

Figure: Prominent Cotyledons in Castor

What is Hypogeal Germination

Hypogeal germination is the other type of germination in which the cotyledons remain inside the soil. Therefore, its hypocotyl is short. The epicotyl, which is the region of an embryo plant above the cotyledon, grows longer while pushing the plumule out of the soil. All monocotyledons such as maize, rice, wheat, and coconut show hypogeal germination. However, some dicotyledons such as groundnut, gram and pea show hypogeal germination.

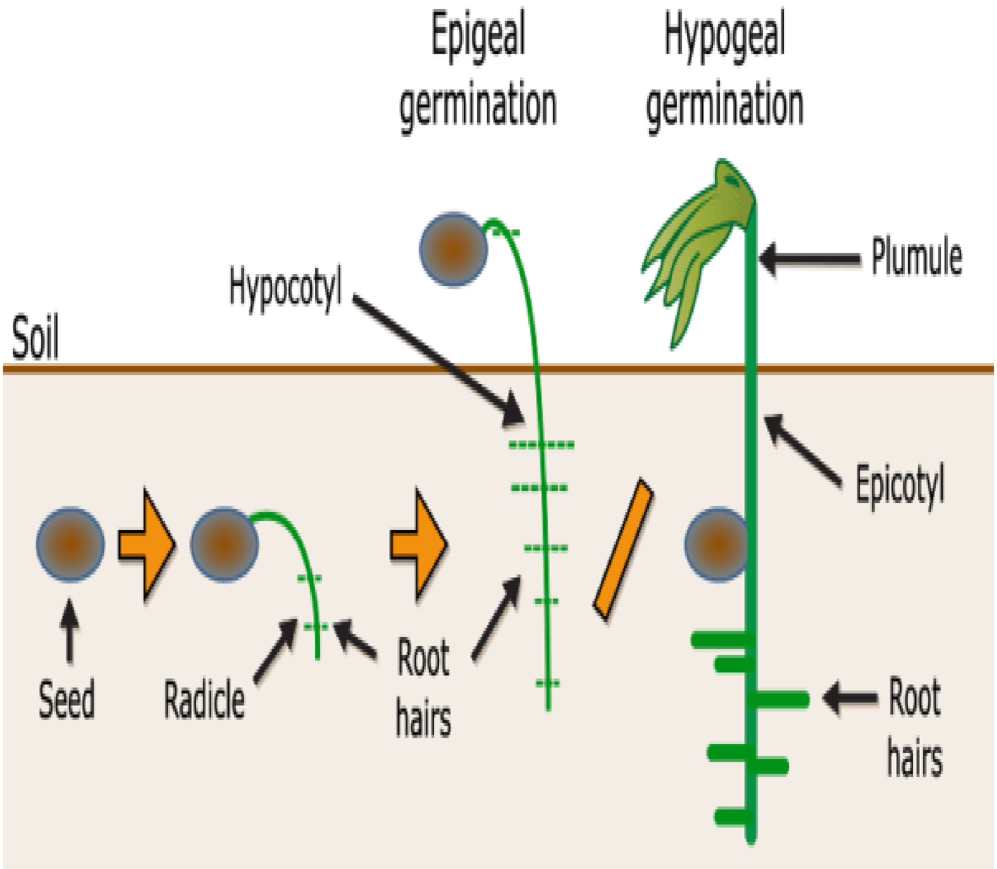


Figure: Epigeal and Hypogeal Germination

Similarities Between Epigeal and Hypogeal Germination

- Epigeal and hypogeal germination are two methods of seed germination.
- They are characterized by the relative position of the cotyledons to the soil during germination.

Difference Between Epigeal and Hypogeal Germination

Definition

Epigeal germination refers to the germination of a plant that takes place above the ground while hypogeal germination refers to the germination of a plant that takes place below the ground.

Cotyledons

In epigeal germination, the cotyledons emerge out of the soil while in hypogeal germination, the cotyledons remain inside the soil. This is the main difference between epigeal and hypogeal germination.

Length of the Hypocotyl

The hypocotyl is long in plants that show epigeal-gemination while the hypocotyl is short in plants that show hypogeal germination. Further, the upper part of the hypocotyl is curved down to protect the plumule in epigeal germination while hypocotyl in hypogeal germination does not feature this curvature.

Length of the Epicotyl

Epicotyl is short in plants that show epigeal germination while the epicotyl is long in plants that show hypogeal germination.

Photosynthetic Cotyledons

The cotyledons in epigeal germination turn green and undergo photosynthesis while the cotyledons in hypogeal germination do not undergo photosynthesis.

Energy for the Embryo Development

In epigeal germination, the energy comes from the cotyledons, while, in hypogeal germination, the energy comes from the endosperm.

Occurrence

Epigeal germination occurs in beans and castor while the hypogeal germination occurs in coconut, pea, and maize.

EPIGEAL GERMINATION VERSUS HYPOGEAL GERMINATION

EPIGEAL GERMINATION	HYPOGEAL GERMINATION
Germination of a plant that takes place above the ground	Germination of a plant that takes place below the ground
Cotyledons emerge out of the soil	Cotyledons remain inside the soil
Hypocotyl is long and its upper part of the hypocotyl is curved down to protect the plumule	Hypocotyl is short and its upper part of the hypocotyl is not curved down
Epicotyl is short	Epicotyl is long
Cotyledons turn green and undergo photosynthesis	Cotyledons do not undergo photosynthesis
Energy comes from cotyledons	Energy comes from endosperm
Occurs in beans and castor	Occurs in coconut, pea, and maize

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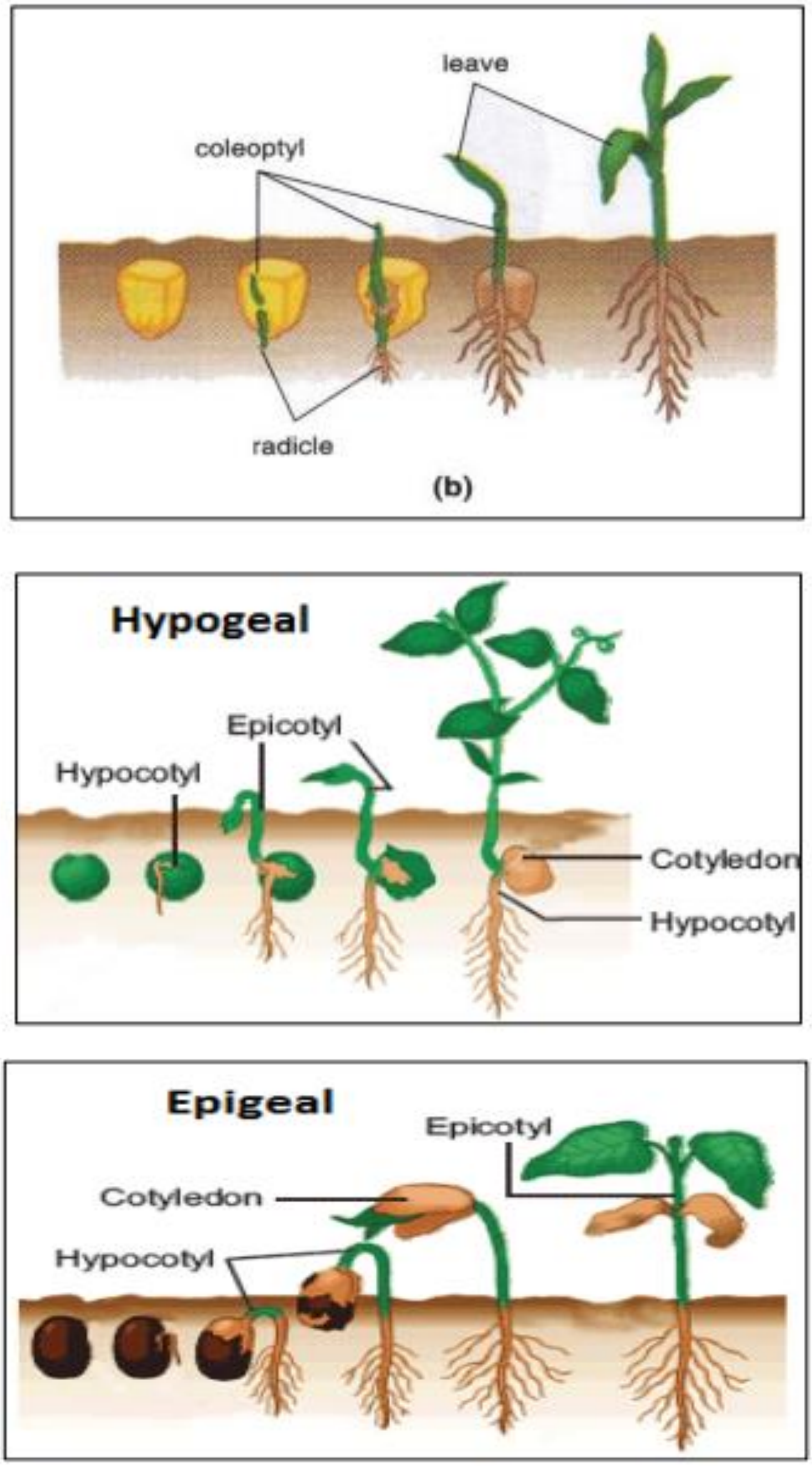


Shape 2: hypogeal germination (a, b) and epigeal germination (c)

Seed germination depends on both internal and external conditions. The most important external factors include right temperature, water, oxygen or air and sometimes light or darkness. Various plants require different variables for successful seed germination.

Water is required for germination. Mature seeds are often extremely dry and need to take in significant amounts of water. Most seeds need enough water to moisten the seeds but not enough to soak them. The uptake of water by seeds is called imbibition, which leads to the swelling and the breaking of the seed coat. When seeds are formed, most plants store a food reserve with the seed, such as starch, proteins, or oils. This food reserve provides nourishment to the growing embryo. When the seed imbibes water, hydrolytic enzymes are activated which break down these stored food resources into metabolically useful chemicals. After the seedling emerges from the seed coat and starts growing roots and leaves, the seedling's food reserves are typically exhausted; at this point photosynthesis provides the energy needed for continued growth and the seedling now requires a continuous supply of water, nutrients, and light.

Oxygen is required by the germinating seed for metabolism. Oxygen is used in aerobic respiration, the main source of the seedling's energy until it grows leaves. Oxygen is an atmospheric gas that is found in soil pore spaces; if a seed is buried too deeply within the soil or the soil is waterlogged, the seed can be oxygen starved. Some seeds have impermeable seed coats that prevent oxygen from entering the seed, causing a type of physical dormancy which is broken when the seed coat is worn away enough to allow gas exchange and water uptake from the environment.

Temperature affects cellular metabolic and growth rates. Seeds from different species and even seeds from the same plant germinate over a wide range of temperatures. Seeds often have a temperature range within which they will germinate, and they will not do so above or below this range. Many seeds germinate at temperatures slightly above 60-75 F (16-24 C), while others germinate just above freezing and others germinate only in response to alternations in temperature between warm and cool. Some seeds germinate when the soil is cool 28-40 F (-2 - 4 C), and some when the soil is warm 76-90 F (24-32 C). Some seeds require exposure to cold temperatures to break dormancy.

Light or darkness. Most seeds are not affected by light or darkness, but many seeds, including species found in forest settings, will not germinate until an opening in the canopy allows sufficient light for growth of the seedling

Seed Growth and Development Terms

Dormancy State of suspended growth to survive adverse conditions and aid in dispersion.

Seed coat dormancy When the seed coat is impermeable to water and gases (oxygen). It requires action by weathering, microorganisms, passage through an animal's digestive track, or fire to soften the seed coat.

Root Morphology

Radicle comes out/arise from the seed coat in the form of soft structure and move toward the soil. It develops and forms primary root.

General Characters:

1- Roots are non-green, underground, (+) geotropic, (–) phototropic and (+) hydrotropic.
2- Roots do not bear buds.
3- Buds present for vegetative propagation in sweet potato(Ipomea).
4- Roots do not bear nodes and internodes.5-
Roots have unicellular root hairs.

FUNCTIONS OF ROOT

1- Roots support the plant by keeping it fixed firmly in thesoil.

2- Absorption of water and minerals3-

Storage of food

4- Conduction of water

5- Photosynthesis and respiration6-

Climbing

7- Roots hold the soil particles together.

REGIONS OF ROOTS

Morphologically four distinct regions are present in roots:

- **Root cap (calyptra):**

  Root is covered at the apex by a coat called calyptra (cap).It protects root apex.

- **Meristematic zone:**

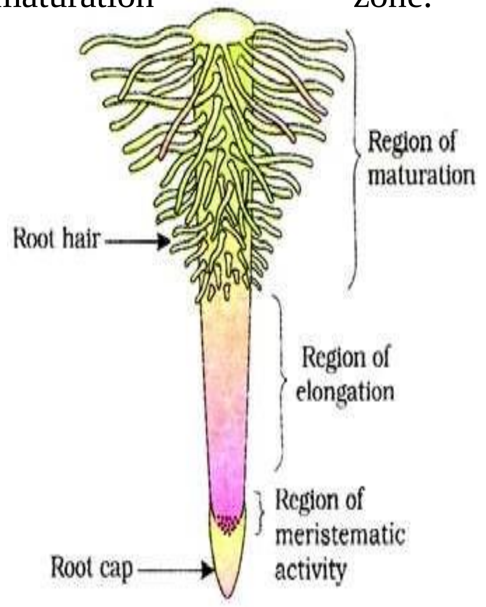
  Cells are very small, thin walled and filled with cytoplasm. They divide repeatedly to increase cell number and formation of new tissues.

- **Elongation region:**

  Cells undergo rapid elongation and enlargement and are responsible for rapid growth ofroots.

Maturation region:

Root hairs are present in maturation zone.



The regions of the root-tip

❖ <u>TYPES OF ROOTS</u>

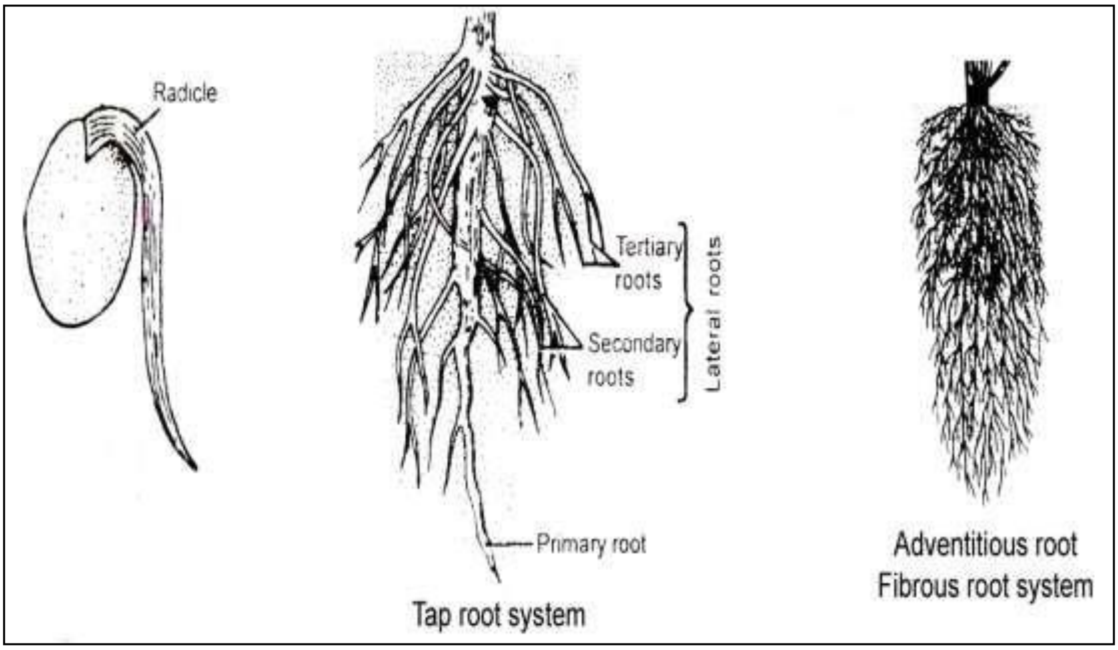
- **Roots are of two types:**

1- Tap root:

It develops from radicle and made up of one main branch and other sub branches. The primary roots and its branches constitute tap root system. e.g. Dicot roots.

2- Adventitious roots:

In some plants, after sometime of the growth of tap root which arises from radicle, stops and then roots, develop from other part of plant, which are branched or unbranched, fibrous or storage, are known as adventitious roots and constitute fibrous root system. e.g. Monocot roots.



❖ MODIFICATION OF ROOTS:

1. Modified tap root for storage:

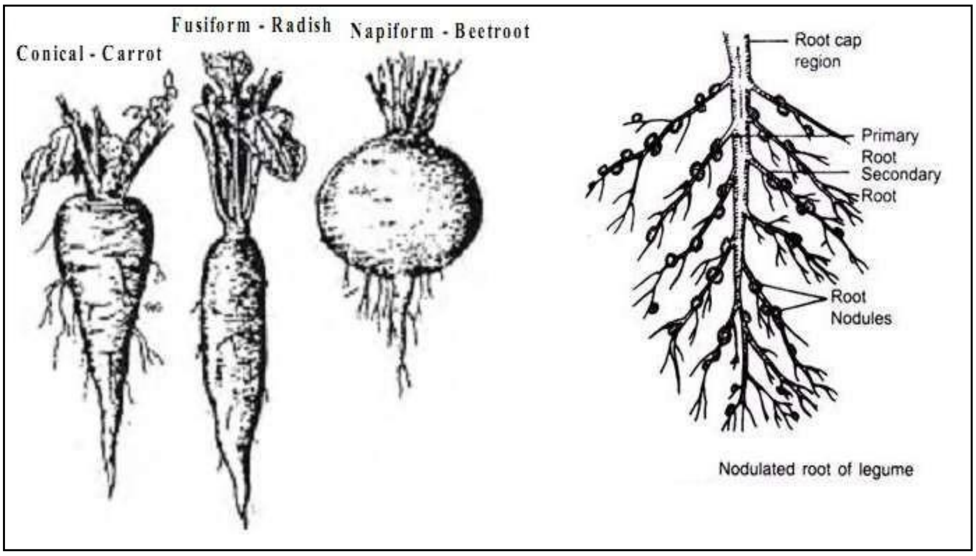
Fusiform roots:
These roots are thicker in the middle and tappered on both ends. This type of roots helps in storage of food. **eg. Radish**.

Conical roots:
These roots are thicker at their upper side and tapering at basal end.
eg. Carrot.

Napiform roots:
These roots become swollen and spherical at upper end and tappered like a thread at their lower end. **eg. Turnip (*Brassica rapa*), Sugarbeet**

2. Nodulated root:

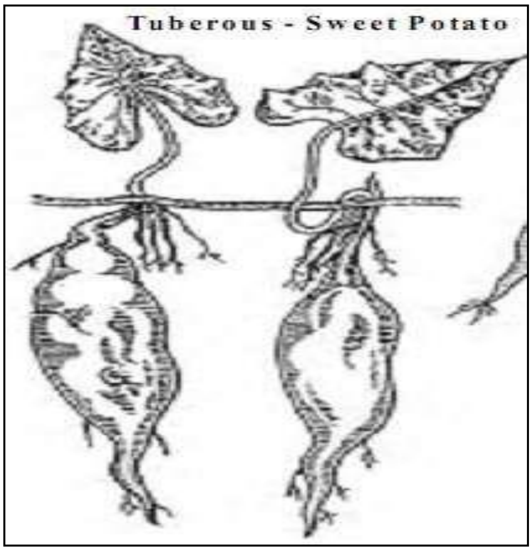
Nodules are formed on branches of roots by nitrogen fixing bacteria, (*Rhizobium*). eg. Plants of leguminosae family **Pea.**



❖ Modification of adventitious roots:

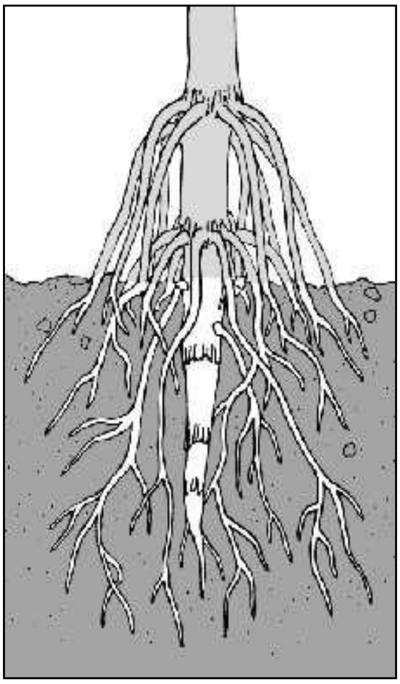
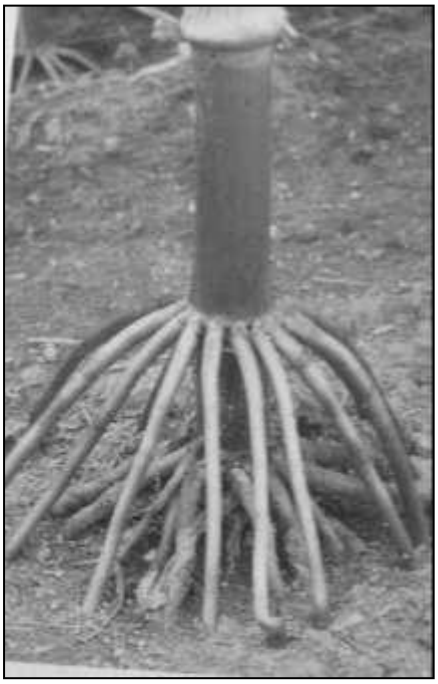
1- Tuberous root: eg. Maize

When food is stored in these roots, they become swollen and form a bunch. eg. Sweet potato (Ipomea batata)



2- Prop root:

when root arises from branches of plant and grows downward towards soil. It function as supporting stem for the plant.

Prop root

3- **Respiratory roots:**

Halophyte or mangrove grows in oxygen deficient marshy area. Some roots in these plants grow vertically & come out from soil. These roots are called pneumatophores through which air entered inside the plant. eg. Rhizophora, and other mangrove plant.

4- **Climbing roots:**

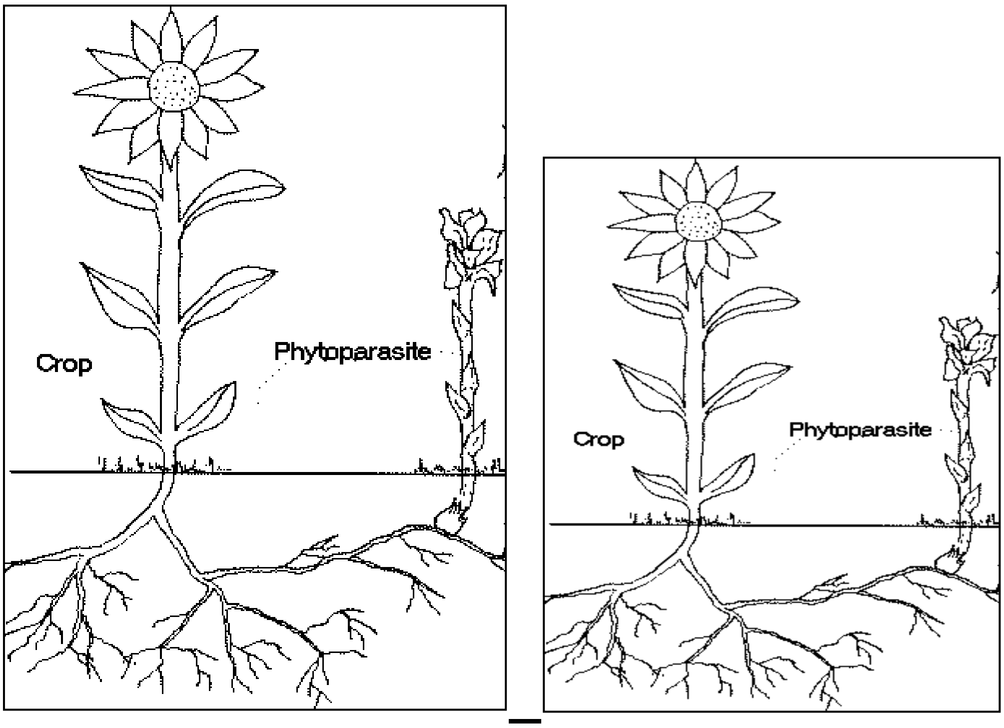
These roots arise from nodes and help the plant in climbing. eg. Money plant (Pothos), Betel, Black pepper, Techoma.

5- Foliar roots or Epiphyllous roots

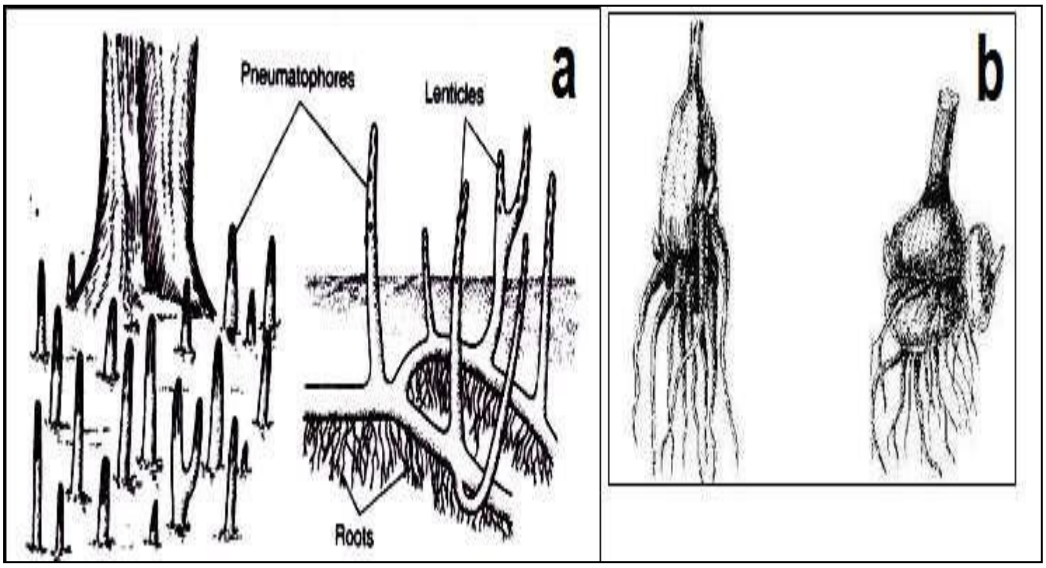
When roots arise from leaf they are called as foliar roots. eg. Bryophyllum, Bignonia.

6- **Sucking or haustorial roots or Parasitic roots:**

In parasitic plant roots enter in the stem of host plant to absorbed nutrition from host. eg. Cuscuta, Viscum.



parasitic roots and climbing roots



(a) respiratory roots **(b) contractile roots**

7- Hygroscopic roots:

These are found in epiphytes, especially in orchids and help in absorption of moisture from the atmosphere using special tissue called velamen. eg. Orchids, Banda

8- Contractile roots:

They shrink 60 – 70% of the original length and bring underground organ at proper depth in the soil e.g., corm of Crocus (saffron), Fresia.

9- Reproductive roots:

These are fleshy, adventitious roots used for vegetative reproduction e.g., sweet potato (Ipomea batata), Dahlia.

STEM MORPHOLOGY

- A stem develops from the plumule of embryo.
- It is one of two main structural axes of a vascular plant.
- The stem is normally divided into nodes and internodes.
- In most plants stems are located above the soil surface but some plants have underground stems.

❖ Characteristics of Stem:

1- Grows positively phototropic & negatively geotropic

2- Growth of stem is maintained by apical bud.

3- Stem is divisible into nodes and internodes.

4- Leaves are developed on the stem at nodes.

5- The upper angle between leaf and stem is called axil.

6- Axillary buds developed in the axis produce branches.

7- Young stems are green and woody stems are brown.

❖ Functions of Stems

1- Keep the leaves in the light and provide a place for the plant to keep its flowers and fruits.

2- Transport of fluids between the roots and shoots.

3- Storage of nutrients.

4- Production of new living tissue. Stems have cells called meristems that annually generate new living tissue.

Buds

Bud is an embryonic shoot with immature stem tip.

Buds may be classified and described according to different criteria:

location, status, morphology, function.

Botanists commonly use the following terms:

❖ Types of buds according to location:

1- Terminal, located at tip of a stem (apical is equivalent but rather reserved for the one at the plant top).
2- Axillary, located in axil of a leaf (lateral is equivalent but some adventitious buds may be lateral too).
3- Adventitious, when occurring elsewhere, for example on trunk, leaves or on roots.

❖ Types of buds according to status:

1- Accessory, for secondary buds formed besides a principal bud (axillary or terminal).
2- Dormant, for buds whose growth has been delayed for a rather long time; the term is usable as a synonym of resting, but is rather employed for buds waiting undeveloped for years.
3- Pseudoterminal, for an axillary bud taking over the function of a terminal bud when dies (beech).

Types of buds according to morphology:

1- Scaly (winter), brown scales (transformed reduced leaves) cover and protect embryonic parts. Present in deciduous plants (Vitis)
2- Naked (summer), when not covered by scales. Present in herbaceous and evergreen plants (Duranta).
3- Hairy, protected by hairs (apply either to scaly or to naked buds

❖ Types of buds according to function

1- Vegetative, if only containing vegetative pieces: embryonic shoot with leaves (a leaf bud is the same).
2- Reproductive, if containing embryonic flower(s)
3- Mixed, if containing both embryonic leaves and flowers.

There are two types of branching:

1- Apical (dichotomous) branching: A simple type of branching in plants where the apical bud splits at various intervals. Two equal branches are formed (Hyphaena).

2- Axillary (Lateral) branching: the axillary buds are normally present in the axils of the leaves and grow to give lateral branches. There are two main types (monopodial and sympodial).

2- Monopodial branching: occurs when the terminal bud continues to grow as a central leader shoot and the lateral branches remain subordinate. This pattern shows one main shoot with lateral branches emerging from it (Christmas tree, Casuarina).

3- Sympodial branching: occurs when the apical bud either died or is differentiated into a flower, a thorn or a tendril and thus lost its ability to grow. One or more axillary buds grow out (Vitis).

Type of Stems

Plant structure: - there are two main types:

Woody plant: is a perennial tree or shrub. The stem remains above ground during the winter. A woody stem also develops secondary tissue and increases in stem diameter. About 50 % of the plants in the world are woody plants.

Woody perennials can be divided into:

a. Arborescent: tree-like in size, usually with a single main trunk or stem.

b. Shrubby or fruticose: Woody throughout and large, usually with several main stems.

Arborescent **Shrubby**

2. **Herbaceous plant:** has a stem that die back to the ground each year. Herbaceous plants are often divided into 3 types:

a. **Annuals**: Plants that complete their life cycle in one year. They grow from seed; produce foliage, flower, fruits and seed in one season.

b. **Biennials**: Plants that live for two years from seed. They flower only ormostly in the second year (*Althea rosea)*.

c. **Perennials**: Plants that live for 3 years or more. Some perennials are short lived; others will grow well for many years.

. Growth pattern: - there are two types-

❖ Erect stems: These are strong stems that holding it self-stand, having a vertical or upright habit.

Weak stem:

❖ Weak stems: These are thin and slender and cannot stand erect. These need mechanical support to expose their leaves to the sun. They are of following types:

1- Trailers: These stems after trailing for some distance lift its apex that bears flowers (Euphorbia, Portulaca).

2- Prostrate: These weak stems lie horizontal on the ground and having one root system (Cucurbita).

3- Creepers /Runners: branches originate from the main plant in all directions. From parent plant daughter plants are produced. After growing for some time with the mother plant the daughter plant is separated from the mother plant. In most plants vegetative propagatio 4. Twiners: The weak stem of these plants have the habit of twining around supports without any special organs for attachment (Convolvulus, Phaseolus)

4- Climbers: In this case stem climbings with the help of special devices such hooks (Artobotyrs), thorns or prickles (Bougainvillea) and stems may modified into tendrils (Vitis).n takes place.

5- Underground Stems: Some plants develop non-green, underground, perennial stems for the purpose of perennation and food storage. During unfavorable period the aerial plant dies but these stem survives. Under favorable period they give out aerial shoots.

They differ from roots in:

(a) Presence of nodes and internodes.

(b) Presence of scale leaves and adventitious roots.

(c) Presence of axillary and terminal buds.

(d) Presence of exogenous branches.

<u>Types of underground stems are:</u>

1- Rhizome.

It is a prostrate, underground stem provided with distinct nodes and internodes, scaly leaves at nodes, axillary as well as terminal buds. These buds in favorable conditions give rise to aerial shoots which derive nourishment from them (Cynodon).

2- **Tuber**.

These are swollen ends of underground branches which store food. It has distinct notches called eyes which represent nodes. Axillary buds are present which give rise to new shoots e.g. Potato (Solanum tuberosum). Bulb: It is highly reduced and discoid underground stem bearing a large number of scaly leaves. In the center lie terminal buds which give rise to aerial flowering shoots. Stem is covered by numerous thickened overlapping leaves usually called scale.

3- **Corm**:

a short enlarged underground, storage stem. They are swollen up structures, axillary buds are present but they are not arranged, internodes are present. Scale leaves are around axillary bud. Contractile roots are present and they fix into the ground so that the stem will grow downwards. Axillary buds develop into a new corm (Colocasia).

Modification of stems:

There are many stem variations in plants. Some variations are forms of food, such as potatoes and asparagus. The runners of strawberries are an example of a stem modification used for propagation.

Rhizomes, the horizontal underground stems of plants, such as Cynodon and Carina, allow spreading of plants.

In some plants the aerial stem is modified to perform

1- Modification of stem into tendril:

These are leafless, spirally coiled branches. They help the weak stems to climb up. It can be modification of an axillary bud or modification of terminal bud (Grape vine).

2- Modification of stem into thorn:

The thorn is a hard, straight, and pointed structure. In Bougainvillea and Duranta, the axillary bud is modified into a thorn.

The thorn sometimes bears leaves, flowers and fruits as seen in Duranta and Citrus.

The thorns not only check the rate of transpiration but also protect the plants from herbivore grazing.

3- Modification of stem into phylloclade:

A phylloclade is a flattened stem of several internodes functioning as a leaf.

In Opuntia, the stem is modified into a green flattened structure called Phylloclade.

On the surface of the phylloclade, clusters of spines are formed. These spines are the modified leaves of the axillary bud.

These spines not only check the rate of transpiration but also protect the plant from herbivores. The phylloclade has distinct nodes and internodes.

4- Modification of stem into storage structure

Most plants have stems that are adapted to store some food but in some which are highly modified, such as tubers (potato), bulbs (onion) and corms (Tulip, Colocasia), food storage is a major function.

PLANT CELL CONTENTS

The cell is the unit of the structure of the organism. The plant is made up of distinct organs such as roots, stem, etc these organs are composed of various tissues. Each tissue is composed of units known as cells.

The cell is the site of the physiological processes. The cell is the bearer of hereditary material from generation to another. Cell wall is the characteristic part of the plant cell.

Plant cells are microscopic and cannot be seen with unaided eye. Plant cell generally ranges from 10-100 u. in flax and cotton, the fiber cells may reach a length up to 5.0 cm Plant cells are greatly varied in shape.

Plant cells are alike in consisting of living substances (protoplasm) enclosed by non-living cell wall and other-substances.

The Plant cell is composed of: -

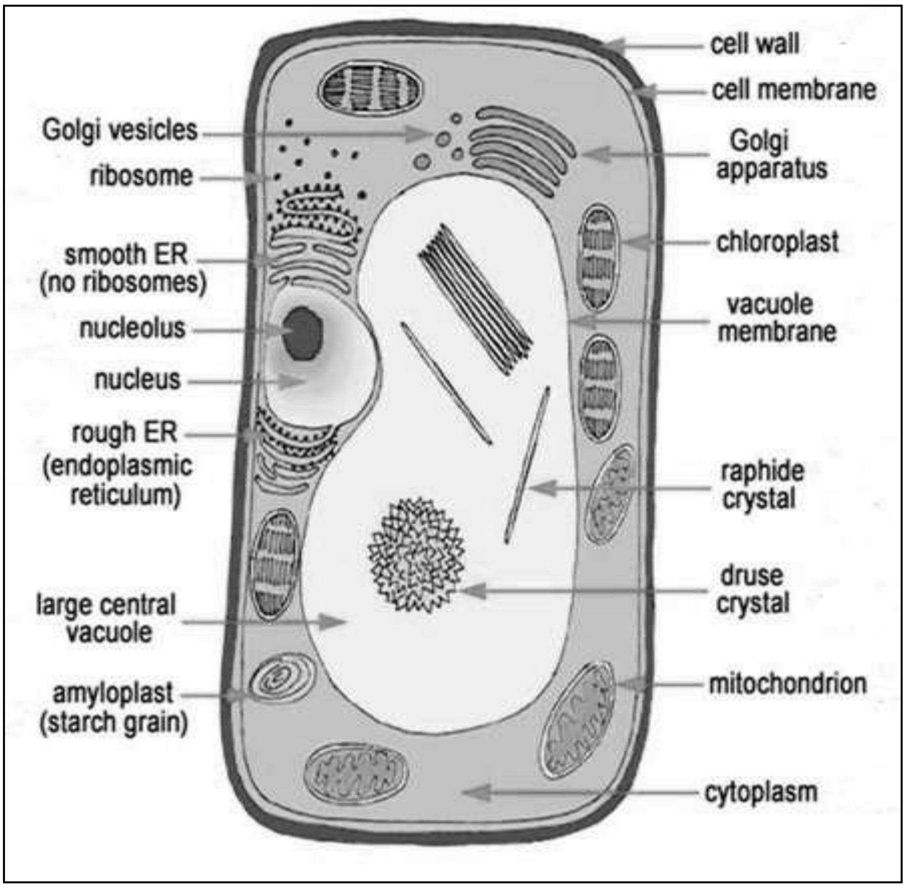
1- <u>Cell wall</u> (non living)

2- <u>Protoplast</u> (living portion): -

- Cytoplasm and cytoplasmic membranes.

- Nucleus: nuclear membrane - nuclear sap – chromatin reticulum - nucleolus

- Cytoplasmic organelles: - Plastids - Mitochondria – Golgi apparatus - Microsomes - Lysosomes



3- Non-protoplasmic contents: -

- Vacuoles and cell sap.

- Starch grains -Proteins - Fats and oils - Crystals -Tannins and pigments - Organic substances

1- Cell wall

The cell wall is rigid, non-living and not changes in shape. Only present in plant cells (distinctive between plant and animal cells),

2- Protoplast

The greater part is organic compounds but there are also accompanying inorganic substances- It contains proteins, lipids, carbohydrates, fats, electrical salts,enzymes and energy carriers (ATP).

The protoplast is composed of several well differentiated structures: -

• Viscous transparent fluid portion.

• System of membranes (endoplasmic reticulum)

• Variety of minute living bodies embedded in the cytoplasm known as cytoplasmic organelles (plastids, mitochondria, Golgi apparatus, Lysosomes and Microsomes).

The plasma membrane: -

The cytoplasm is surrounded by a thin membrane known as ectoplast. In plant cell, it is usually lying under the cell wall. There is a similar plasma membrane separate the protoplast than the vacuole, it known asendoplast.

Endoplasmic reticulum

It consists of a group of continuous channels, branches inside the cytoplasm to form a net like structure.

Ribosomes

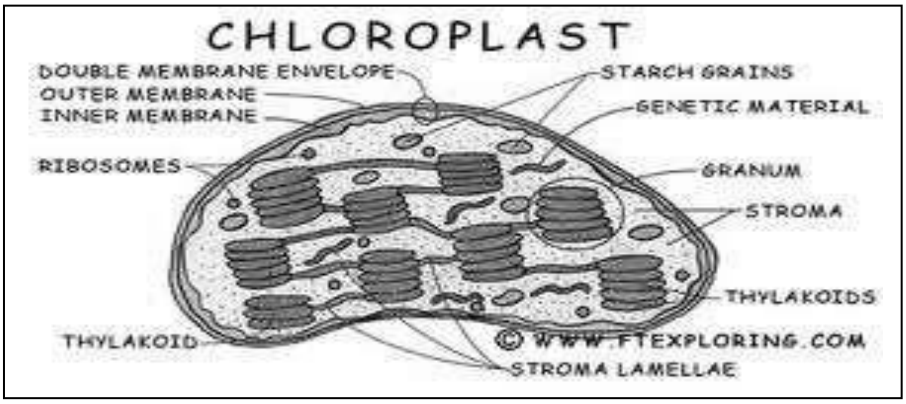
Ribosomes are the components of cells thatmake proteins from all amino acids.

Plastids

They are small cytoplasmic organelles, presentin the cytoplasm and characterized to plant cell. They are differing in shape, size and colors according to its activity and function. There are three types of plastids according to its colors: -

a- Chloroplast: -

It is the most important type of plastids for their role in forming carbohydrates through photosynthesis. The chloroplast contains two types of chlorophylls; chlorophyll a (bluish green) and chlorophyll b (yellowish green). Garotein (yellow, orange or red) and xanthophylls (yellow color) are also present.



The function of carotein and xanthophylls is not fully known, but it was suggested that they protect the chlorophyll from destruction by sunlight. Carotenoids are also important to animals since they are converted in their bodies to Vitamin A.

In microorganisms, highly divergent forms are seen. In Chlamydomonas, only one cup-shaped chloroplast is present. Spirogyra posses a ribbon like spiral shape chloroplast.

In some algae there are often special areas referred as pyrenoids, which act as centers for the formation of starch.

b- Chromoplasts: -

It is varying in color (orange yellow, or red), this color is due to the presence of carotenes and xanthophylls and the absence of chlorophylls. It occurs indifferent plant organs such as yellow petals of sunflower,roots of carrot, and ripe fruits of sweet pepper and tomato.

c- Leucoplasts: -

They are colorless and closely related to chloroplasts, not contain any pigments. It is characterized by high ability to enlarge and elasticity thus changes of shape.

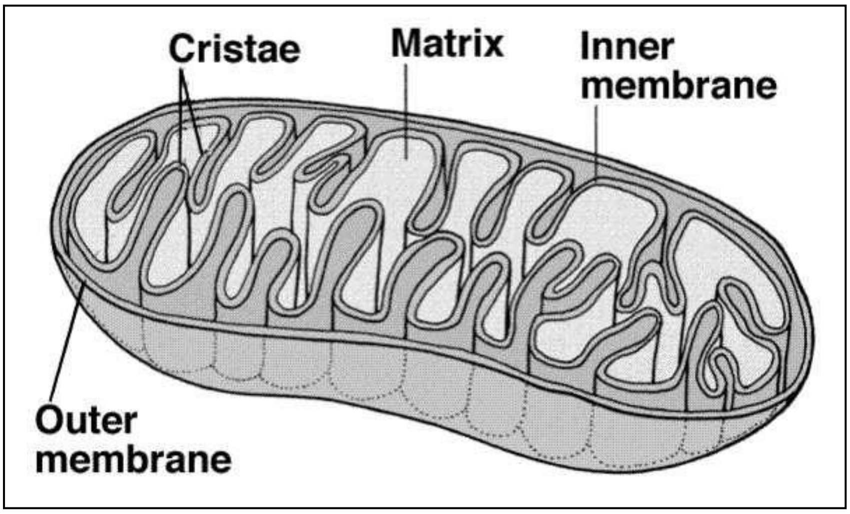
It is common in the subterranean parts such as roots of potato, storage organs such as tubers and in tissues not exposed to light such as the endosperm and some cotyledons.

They are concerned with storage of starch, fats and oils. Amyloplasts, associated with the storage of starch in them. Starch of amyloplasts is known as reserve starch (bigger, small numbered and persistent). They are differing than whose present in chloroplasts (very small, numerous and translated to sugar in the dark).

Leucoplasts, associated with the storage of fats and oils, are known as elajoplasts.

Mitochondria (singular = mitochondrion)

It is also called chondriosomes. It appears in different forms and numbers in different tissues, in some cells they are almost globoid, while the most general are elongated and filamentous.



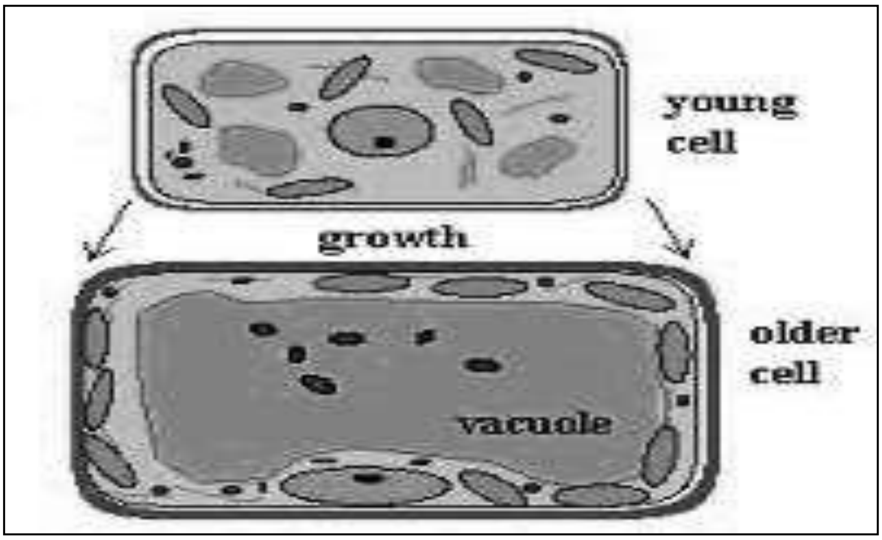
<u>Function of mitochondria</u>: -

The primary function of mitochondria is to provide chemical energy in the form of ATP for use by the cell

3- Non Living Contents

The vacuole

It present in mature cells, filled with cell sap.



Finally a single large vacuole is formed which occupies most of the cell

Carbohydrates

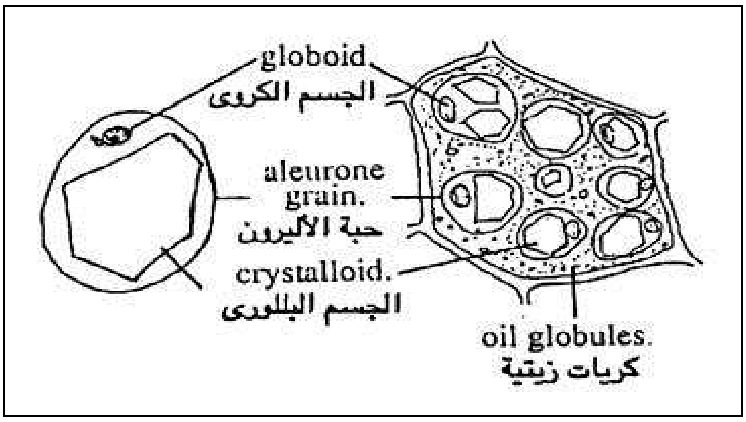
A number of sugars are known to occur in the cell sap of various plants. Glucose, fructose and Sucrose are the most dominant saccharides present in the cell sap.

Starch is the most important form of carbohydrates that stored in higher green plants. It is not found in the vacuole or the cytoplasm. It is produced only in plastids and deposited as grains.

Starch grains differ in shape from various plant species. It is possible to identify the species by microscopic examination. The starch grain may be simple compound or semi-compound.

Proteins

Proteins may occur either dissolved in the cell sap or in the form of crystal-like bodies called "**crystalloid**". In many seeds, the vacuoles contain large amounts of dissolved proteins, and as the dries out, these proteins aretransformed to "aleurone" grains.



In corn and wheat seeds.

Oils and Fats

It is commonly occur in the cytoplasm. It present in the endosperm and cotyledons of certain seeds such as peanut **(الفول السوداني),** castor beards, **(خروع)** and cotton seeds **(القطن).**

Organic Acids

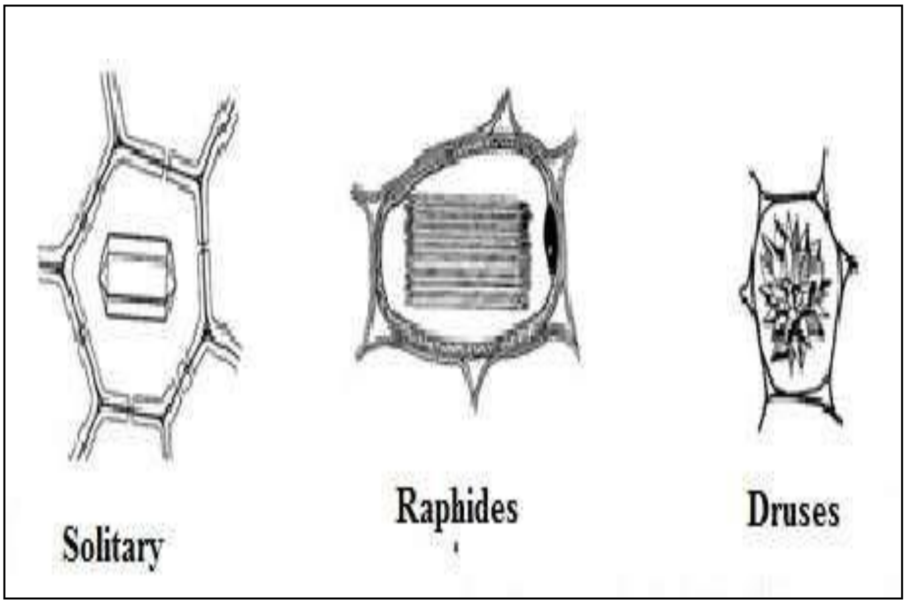
Calcium oxalate Crystals

It dissolve in mineral acids and occur in plant cells in different forms: -

<u>Solitary</u>: square prisms, pyramidal shapes, rhombohedral and others.

Raphides: needle-shaped crystals assocjated together in bundles. Itoccurs commonly in monocots,

Druses: rosette-shaped crystals, spheroid groups of tetragonal crystals. It present in *Carica papaya* and *Begnonia*.



Calcium carbonate crystals

The best known form the "cystolith". It consists of a cellulosic stalk,which is an in-growth of the cell wall *into* the cavity of epidermal cells of Ficus leaf.

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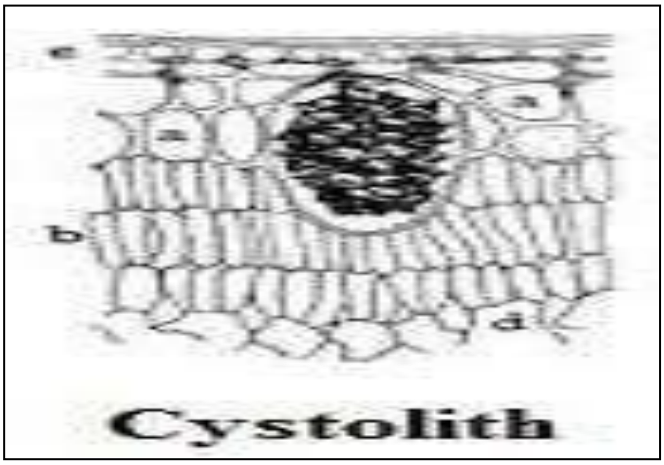


Anthocyanins

Most of the yellow, orange and some of the red colours of plants are due to plastid pigments. Blue, violet or purple and most of the dark red colours are due to pigments dissolved in the cell sap of the vacuole.

These pigments are the anthocyanins which are complex compounds composed of a pigment and a sugar.

These pigments are responsible for the colour of the purple turnip, red beet roots, blue and red colour of grape fruits, red of cherries and the purple, blue violet, pink and red colours of petals of many flowers. The colour of the anthocyanin changes with pH of the medium.

Tannins

It present in the cell sap and cell wall. It is a complex compounds soluble in water and alcohol.. It found in the leaves of tea,

Alkaloids

. It may represent by-products of the nitrogen metabolism in plants.

Their role in the plant is not known. (e.g., nicotine in tobacco; caffeine in tea.

PLANT TISSUES

Plant tissues are classified according to stage of development into:

1- Meristematic tissues: growth is taking place.

2- Permanent tissues: growth ceased at least temporarily.

MERISTEMATIC TISSUES

Meristem is used to describe regions of continuous cell formation. Embryonic describes meristematic tissue of the embryo. They are characterized by:

1- Actively dividing.

2- Abundant cytoplasm

3- Large nucleus.

5- Thin primary wall of cellulose.

6- Small or lacking vacuoles.

7- No intercellular spaces.

PERMANENT TISSUES

Permanent is used to describe tissues that do not have the ability to divide. These cells are already differentiated in different tissue types and are now specialized to perform specific functions.

The permanent tissues can be classified according to kind of constituent cells to:

1- Simple tissues: composed of a single type of cells (parenchyma, collenchyma and sclerenchyma).

2- Complex tissues: composed of several kinds of cells (xylem and phloem)

3- Tissue system: Certain cells dispersed among other tissues (secretory tissue system).

II. Ground Tissues

The ground tissue is makes up the majority of the inner part of a plant. The ground tissue system synthesizes organic compounds, supports the plant and provides storage for the plant

It is mostly made up of parenchyma cells but can also include some collenchyma and sclerenchyma cells as well. Ground tissue in leaves is packed with chloroplasts, which is where the photosynthesis process makes nutrients for the plant.

a. Parenchyma tissue: -

It is the main constituent of the ground tissue in plant organs. It present in all plant organs (cortex, pith, xylem and phloem). It is the least specialized permanent tissue in plant body. They can be returned meristematic (potentiallymeristematic).

1- It is a simple tissue, composed of one type of cells.
2- Its cell wall is composed of cellulose, hemicellulose and pectic compounds.
3- Cell wall mostly possesses simple pits, which permit the interchange between the neighboring cells. Intercellular spaces are present, when is large the parenchyma known as "aerenchyma". Some parenchyma has abundant chloroplast "chlorenchyma".

❖ It is function in food storage, aeration, support and photosynthesis.

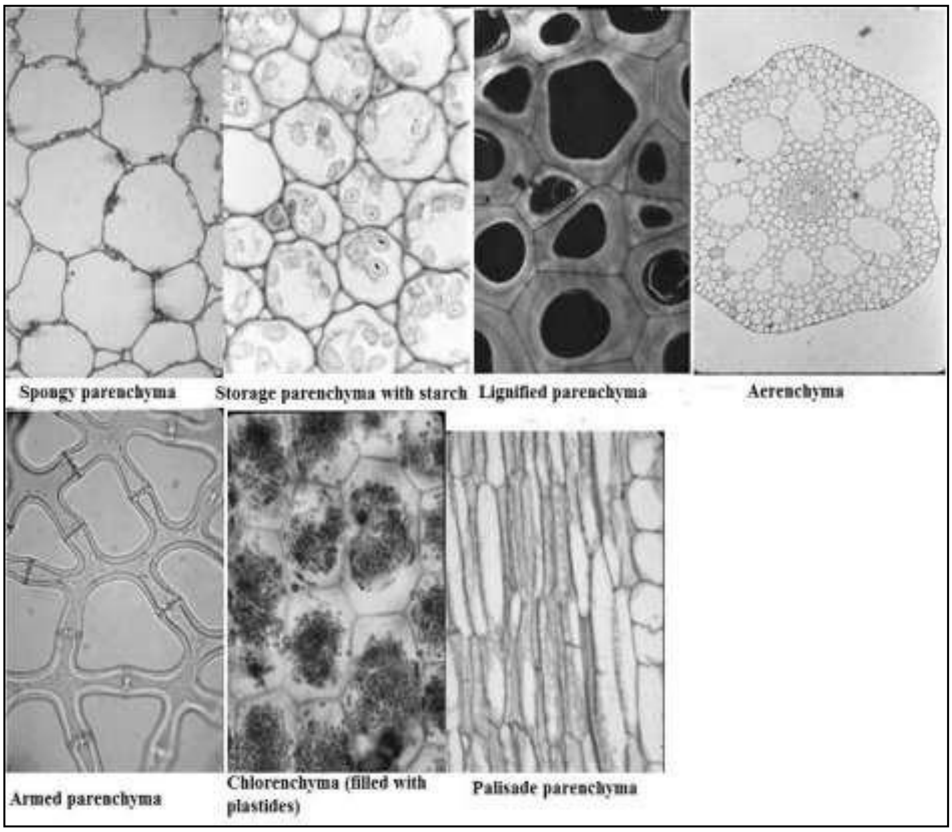
<u>Cell Shape:</u>

❖ <u>Spongy parenchyma</u>: - Isodiametric, oval, spherical or irregular. It seen in leaves, cortex of herbaceous plants.

❖ <u>Aerenchyma</u>: - for gaseous exchange. It found in stems of aquatic plants.

❖ <u>Palisade parenchyma</u>: - rich in chloroplasts. It found in leaves (one or two layers under the epidermis).

❖ Lignified parenchyma: - its walls are secondary lignified walls, function in support. Their shape are angular, without intercellular spaces and mostly Jiving.



b. Collenchyma Tissue: -

It is a simple living tissue (composed of one type of cells), formed from elongate meristematic cells. The tissue is comprises of elongate cells, without intercellular spaces (rarely present).

It functions mainly in support. Cell wall thickened,

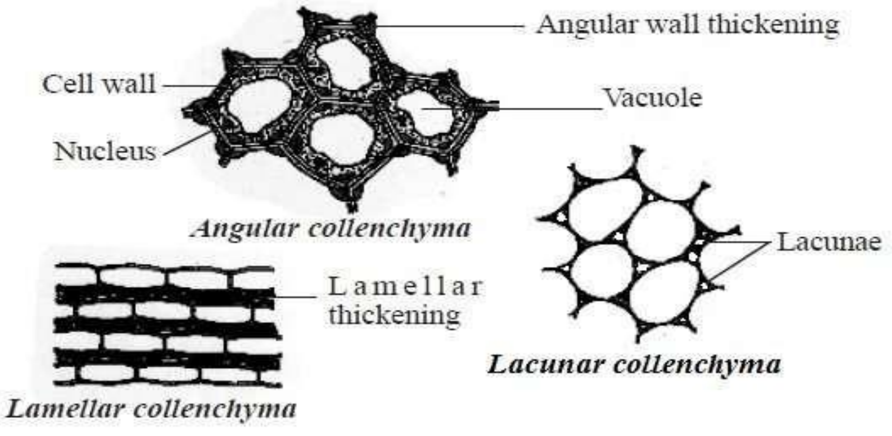
compose of cellulose pectic substances that are hydrophilic thus the cell walls are rich of water. These adapted it to rapidly growth especially increase in length.

Wall thickening (shape):-

❖ Angular: - thickening in corners *(Luffa & Cucurbits).*

❖ Lamellar: - thickening on tangential walls *(Helianthus).*

❖ Lacunar: - angular collenchyma with intercellular spaces *(Lactuca).*



Types of collenchyma

Distribution: -

❖ In dicot stems, it present under epidermis (continuous layer or as strands at the ridges.

❖ In dicot leaves, accompanying the large vascular bundle may be under lower epidermis. Sometimes on both sides and sometimes on the lower side only.

❖ In dicot roots and monocots, not present.

❖ Woody stems rarely possess collenchyma.

Adaptation of collenchyma structure to function: -

a. Cell wall is thick adapted to supporting.

b. Capable of (elastic) adapted to present in growing plants.

c- Rapidly elongate cells adapted to present in herbaceous plants.

d. Cell wall composed of cellulose not adapted to present in woody plants.

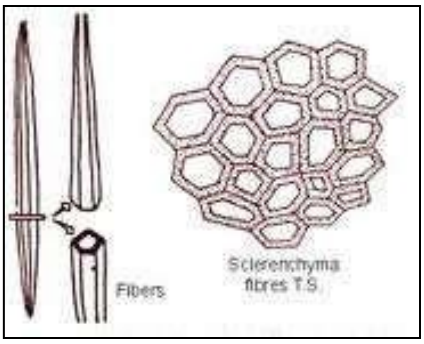
c. Sclerenchyma

It is a simple tissue composed of one type of cells. At maturity, it become non-living at (have no protoplast). The cell walls are uniform, hard, thickened and lignified.

It functions in support only since they are provided with strong lignified walls (non-elastic).

(i) Fibres

Firbres develop from meristematic cells. Their cells are elongate, usually with pointed ends. At maturity, protoplast disappear, becomes empty and dead.



Adaptation of fibres structure to function: -

❖ Cell wall is composed of lignin adapted to supporting.

❖ The cells are arranged in long masses and overlapping adapted to stretching.

❖ The secondary cell wall is thickly lignified adapted to wood plants.

(ii) Sclereids

The cells are isodiametric, boneThey develop from parenchyma cells.

It have very thick 2ry wall, strongly lignified. It present in groups in cortex, phloem, seeds and fruits.

It functions in supporting and protective tissues

III. Vascular or conductive tissue system

It is a complex conducting tissue, formed of more than one cell type (conducting elements, parenchyma and fibers). The primary components of vascular tissue are the xylem and phloem. These two tissues transport fluid and nutrients internally, also have supporting function. There is also a vascular cambium associated with vascular tissue.

The cells in differentiated vascular tissue are typically long and slander; it is not surprising that their form should be similar to pipes. As the plant grows, new vascular tissue differentiates in the growing tips of the plant.

Vascular tissue in plants is arranged in long strands called vascular bundles. These bundles include xylem and phloem, as well as supporting and protective cells.

The vascular cambium divides off cells that will be become additional xylem and phloem. This growth increases the girth of the plant, rather than its length.

a. Xylem:-

It is a complex tissue, composed of several types of cells differ in shape and function. It conducts the water and salts from the root system to the leaves, also has a supporting function.

In Gymnosperms xylem is composed of tracheids only. In Monocot plants, the xylem is composed of tracheids, vessels and parenchyma. In Dicots it is composed of vessels and parenchyma and fibers.

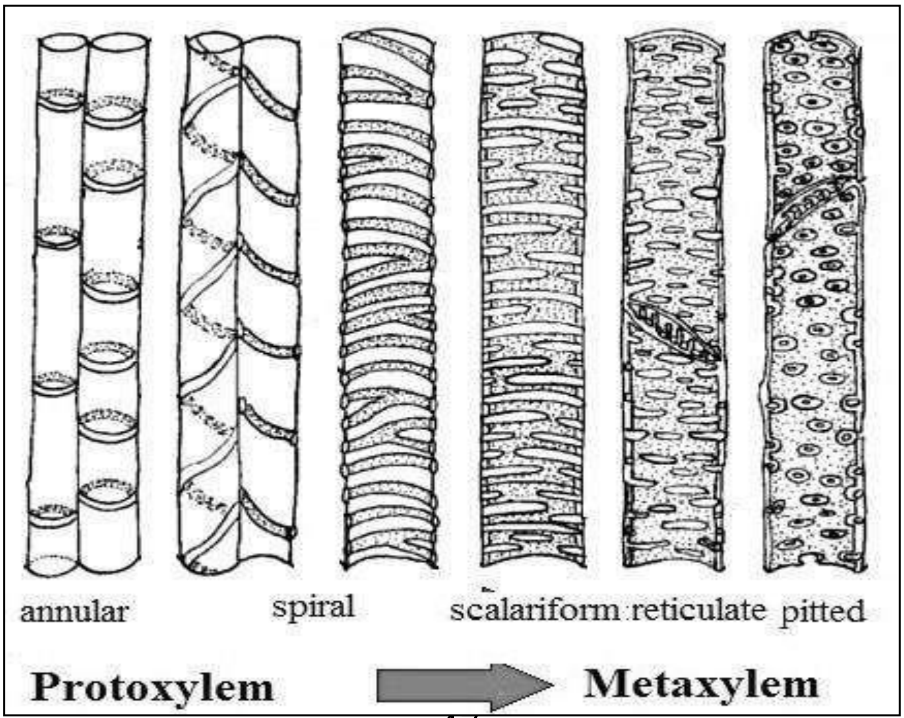
Tracheids:

They are the fundamental cells in seed plants xylem When mature, protoplast disappears and cell becomes non-living Walls are hard, relatively thick and are usually lignified, with bordered pits where water passes from cell to cell

In T. s., tracheid is typically angular. The end walls do not taper uniformly, but tapering is confined to one side of the cell only. The lumen is large and free of contents of any kind. Tracheids make channels for longitudinal conduction.

In gymnosperms and most angiosperms, the bordered pits are chiefly rounded with borders and the torus is best developing. The torus is acts like a valve, the pit is open when the torus is in a median position and closes when it moves to a lateral position.

Tracheid is adapted structurally for conduction due to their large lumen and the hard wall. It is adapted for supporting due to their thick wall, overlapping and interlocking to form strands. It plays the important role in support if fibres are absent.



Vessels:-

Vessels are more advanced than tracheids. They are characteristic of the angiosperms. In many monocots vessels are absent.

The vessel is a series of conducting cells which arranged end to end forming a definite tube-like system with perforations at the end walls providing conduction in straight line. Itpresent only in Angiosperms.

The more primitive vessels have the shape of tracheids with relatively small lumen. In advanced vessels, the diameter of the lumen is large.

In the evolution of tracheid, the angle of tapering ends becomes greater until the end walls become at right angles to side walls

The vessels wall is as thick as the tracheids. Pits are often more numerous and smaller than tracheids.

The vessels are differing in their lignifications (2ry cell wall). It may be annular (ring-like) or spiral shape, they are adapted to elongation and characteristic of protoxylem. The reticulate (net-like), scalariform (ladder-like) and pitted forms are characteristic to metaxyiem.

Wood parenchyma:

They are common constituent of the xylem of most plants They remain alive as long as the xylem is functioning (unlike tracheids, vessels and fibres).

In 2ry xylem they occur as vertical series of elongated cells placed end to end known as wood parenchyma, and radial transverse known as xylem-ray parenchyma.

They function as a food storage tissue; store starch, oils and many other ergastic substances. It also has a function in water conduction and supporting. They may form thick walls and become sclereids.

Xylem fibres or wood fibres:

Wood fibres are non-living cells with thick lignified walls They develop from tracheids by increasing the thickness of the walls, decreasing of lumen diameter and reducing the pit number and size or completely lost.

The fiber is longer than tracheids and more cylindrical It acts in supporting only, (can not conduct). It has greater overlapping, thicker wall and lignification.

The two tracheidal derivatives (vessels and fibres) together occupy, in function and position, the same place in most highly evolved vascular plants that the tracheids do in the lower vascular plants.

Adaptation of xylem structure to Function: -The xylem facilitates conduction by:-

• Conducting elements (tracheids and vessels) possess hard strong lignified walls.

• Conducting elements have greeted width lumen.

• Absence of cross walls in vessels

• Presence of pits in tracheids.

• Presence of parenchyma cells.

The xylem facilitates supporting due to:-

• Presence of wood fibers.

• Hardness of walls by lignification.

b. The phloem

It is the food conducting tissue of a vascular plant. It is a complex tissue (consists of sieve elements, companion cells, parenchyma and fibres). It can be classified developmentally into 1ry and 2ry phloem. The 1ry phloem develops from the procambium while the 2ry phloem is formed from the vascular cambium.

Some gymnosperms contain sieve cells and parenchyma only; other gymnosperms contain sieve cells, parenchyma and fibres.

Monocot plants contain sieve tubes and companion cells (regular phloem). Dicot plants contain sieve tubes, companion cells and parenchyma (irregular phloem). Secondary phloem is usually present in dicot plant (fibres or sclereides are added to the irregular phloem).

Sieve element:

It is the basic cell type (sieve cells-sieve tubes). They are resemblance in fundamental structure and function). Its end walls are perforated and are known as sieve plates, where connection between vertical cells is formed.

The sieve element is an elongate living cell with a thin cellulose wall. It has a large central vacuole and a thin peripheral cytoplasm. Its nucleus disappears when the cell is mature and its cytoplasm contains leucoplasts (store starch).

The sieve cell is formed of only one cell; its sieve area is less specialized and not aggregated into sieve plates. The sieve tubes form vertical series of cells connected by the sieve plates. They arranged end to end to form tube-like structure; its sieve areas are highly specialized and aggregated into sieve plates (at cell ends).

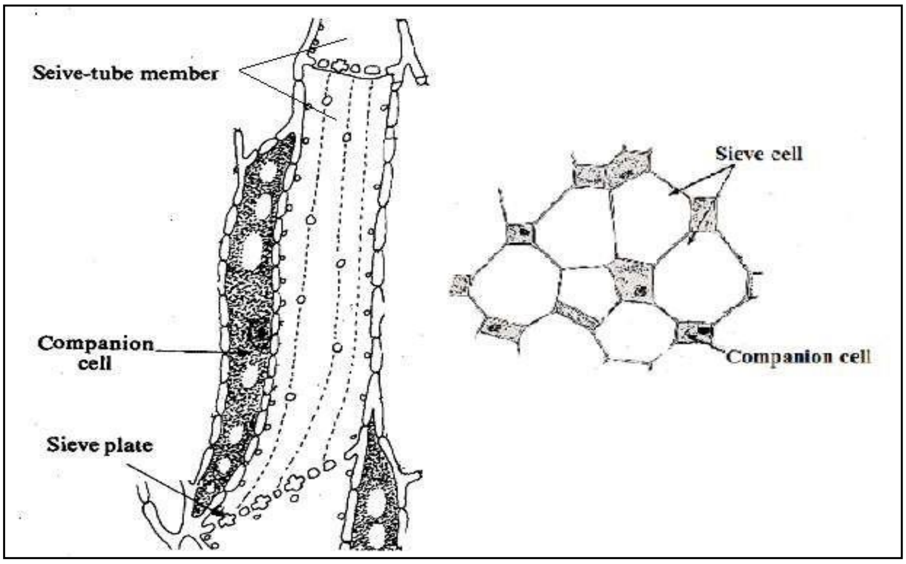
The sieve areas are wall areas with pores penetrated by cytoplasmic strands. It is function in connecting the protoplast of adjacent cells. Each connecting strand is surrounded by a callose which is a carbohydrate that stains blue with aniline blue. Callose forms first a thin layer around a strand. When sieve tubes get older, callose accumulates in the pores and loss their function.

Companion cells

They are special type of parenchyma cell and closely associated to sieve tubes in origin, position and function. It is characterized by its thin walls, dense cytoplasm and a conspicuous nucleus but do not contain starch.

It lives as long as the associated sieve tube element. In T.s. it is triangular, rounded, or rectangular. Its function is not clear but may be help in food conduction.

They occur only in angiosperms and accompany the sieve tubes. In monocots, make up the phloem with sieve tubes (regular phloem). In Gymnosperms, albuminous cells are associated with the sieve cells (no companion cells).



Phloem parenchyma:

They range from elongate and tapering to cylindrical or spherical. The cells are living, with thin walls. It may contain crystals, tannins, mucilage, latex or other substances. Also, it may contain starch or oil. It present in dicot plants only (absent in monocots). It has a function in storage and conduction.

The are dead long cells, with hard lignified walls. They have function in support and protection. They may be septate or non-septate- may be living or nonliving. They are long cells with thick walls and are the commercial source of fibres as in ***Linum*** (flax).

They have simple pits with round aperture. The walls may be composed of cellulose as in flax. They used in the manufacture of robes (known as bast fibres). Sclereides may be present in 1 ry and 2ry phloem.

It present in 1 ry and 2ry phloem. In 1 ry phloem, they occur in the outer most part of it. In 2ry phloem, they are distributed.

Function of phloem:

❖ Conduction of food such as proteins and carbohydrates

❖ Sieve elements are concerned with conduction with the companion cells or albminous cells.

❖ Fibres and sclereids serve in supporting and protection

❖ Many parenchyma cells are starch storage cells.

Vascular bundles:-

The vascular bundle is consists of xylem and phloem, there are four types:-

1- Collateral bundles: -

Phloem on one side of xylem strands, in all stems

a. <u>Open collateral bundles</u>:-

It present in dicot stems, no bundle sheath and cambium is present between xylem and phloem.

b. <u>Closed collateral bundles</u>:-

It present in monocot stems, bundle sheath is present. The cambium is absent.

2- Bicollateral bundles:-

Phloem occurs in both sides of xylem. It present in extreme dicot stems *(Luffa)*.

3- Concentric bundles:-

The xylem or phloem surrounds **the** other.

a. <u>Amphiciribial</u> (concentric xylem):- Xylem is surrounded **by** phloem.

b. <u>Amphivasal</u> (concentric phloem):- Phloem is surrounded **by** xylem.

**** Radial cylinder:-**

It is best to known as cylinder. It present in dicot and monocot roots. Xylem and phloem are separated from each others and lie in different radii of the axis.

IV. Secretory tissue

It is essential to isolate the result materials of cellular processes from the protoplasm in which they originate, or to be moved outside the plant body. These substances sometimes damage the protoplasm if left to accumulate within the cell.

The secretory tissues are cells or organizations of cells which produce a variety of secretions. The secreted substance may remain deposited within the secretory cell itself or may be excreted, that is, released from the cell. Substances may be excreted to the surface of the plant or into intercellular cavities or canals.

Some of the secreted substances are not further utilized by the plant (oils, resins, latex, rubber, nectar, tannins, perfumes and crystals), while others take part in the functions of the plant (enzymes and hormones).They sometimes have great commercial value.

Generally, secretory tissues are derived from parenchyma cells. **It** occurs in pith, cortex, xylem and phloem. It is organized into special structures known as glands and ducts.

Secretory structures range from single cells scattered among other kinds of cells to complex structures involving many cells; the latter are often called glands.

Secretory cells may be classified by their location in the plant, or on the basis of the product that is exuded. There are external and internal secretory systems identified on the basis of their position. They include various types: -

a. Digestive glands:-

They are extremely complex glands with a vascular supply present in insectivorous plants. The gland secretes digestive enzymes that digest insect proteins.

The secretory product (sticky material) that catches the insects and digestive enzymes are secreted by the outer layer of densely cytoplasmic glandular cells.

It is located on the leaf surface or at hair tips. The digestive enzymes could diffuse through the walls, enter back into the gland and digest the unprotected non-glandular cells, (e. g. *Drosera, Dionea, Nepenthes* and *Urticularia).*

b. Nectaries:-

They secrete a sugar solution (nectar), which attract insects. Its secretory tissue consists of an epidermal cells lack of cuticle and specialized parenchyma of small densely cytoplasmic cells often called nectariferous tissue.

They are often found on flower parts (floral nectaries), but also develop on some leaves and stems (extrafloral nectaries).

Floral nectar attracts insect pollinators of entomophilous plants. It usually forms multicellular outgrowths on the flower parts. It may be located in stamens (intrastaminal nectary) or at the ovary (septal nectary).

Extrafloral nectar may attract ants which defend the plant **from** herbivorous insects. They are usually represented by **glandular** hairs or glandular epidermis.

c. Hydathodes:-

They are external secretory structures exuding water under conditions of low transpiration and high humidity; it exudes as droplets on the surface of the organ in a process called guttation. It present in some plant leaves, such as corn, tomato and some grasses. Two types of hydathodes are recognized: -

❖ **Active** hydathodes: usually in the form of glandular trichomes. **Water is** actively exuded by secretory cells **not connected to water**-conducting tracheary elements.

❖ Passive hydathodes: usually located at **leaf** margins or tips **of** leaves. Water is released from tracheary elements and then passes through intercellular spaces of the epithem (cells have little or no chlorophyll). Water is exuded out of the leaf through modified stomata which are permanently open.

d. Resin, oil **and** gum glands:-

They secreted in cavities within plant tissue The cavities are surrounded by secretory cells known as epithelial cells The secretory cells are thin walled, with dense protoplasm There are two types-

* Schizogenous glands:- their cavities originate by separation of cells. They secrete resins (e. g. *Pinus).*

❖ Lysigenous glands:- cavities originate by disintegration of cells. They secrete essential oils (e. g. *Citrus* fruits).

e. Laticiferous glands:-

They secrete latex, which is a white, yellow or reddish viscous fluid. Latex contains proteins, sugars, gums, alkaloids and enzymes. In some plants, latex is economically important such as *Hevea* latex (rubber). There two types –

* Latex cells:- long cells extending for long distances through the plant It contains dense protoplast and many nuclei e g *Euphorbia* species

Latex ducts - composed of several tubes arranged longitudinally and may be branched. Each tube consists of row of cells with disintegrate end walls e g *Papaver Hevea Carica* and some plants of Compositae.

Another special, type of the external secondary structure is stinging hairs producing toxic substances which are stored in cell vacuoles.

Plant cell differentiation

Cell differentiation in plants refers to the processes by which distinct cell types arise from less specialized cells (meristematic cells) and become more specialized cell type (different from each other). The differentiation is a common process in all plants; the meristematic cells divide and create differentiated daughter cells during tissue repair and during normal cell turnover.

Plants have about a dozen basic cell types that are required for everyday functioning and survival. Differentiation changes a cell's size, shape and metabolic activity; modifications of cell walls also play a role in plant cell differentiation.

The apical meristem is an undifferentiated meristematic tissue found in the buds and growing tips of roots. Its main function is to begin growth of new cells in young seedlings at the tips of roots and shoots. Apical meristems are very small compared to the cylinder-shaped lateral meristems

The apical meristems are composed of several layers. The number of layers varies according to plant type. In general the outermost layer is called the tunica while the innermost layers are the corpus.

The tunica is consists of 1 or many peripheral layers of smaller cells. Its cells divide only in one plane resulting in increase in area. It gives rise to epidermis and the outer layers of the cortex.

The corpus divides in several planes resulting in increase in mass. It gives the inner portion of the cortex and the central region of the axis

The apical meristem is consists of definite histogens or tissue builders, they are meristematic regions. Each histogen is responsible for building a definite region of 1ry body.

a Protoderm (dermatogen): - gives rise to the epidermis.

b Ground meristem: gives rise to the cortex, pericycle, medullary ray and pith.

c. Procambial strands: - give raise the vascular tissue.

Moving away from meristematic regions, plant cells become increasingly differentiated according to their position in the plant organ and their function at maturity.

The major types of differentiated plant cells are the derma! cells of epidermis, guard cells and trichomes; ground cells (parenchyma, collenchyma and sclerenchyma) and water-conducting cells of xylem and phloem.

Differentiation of epidermal and guard cells

The epidermal cell is formed by anticlinal divisions of the outer layer of the tunica. Where tunica and corpus are not distinct, it is formed from the dermatagen.

In the epidermis of roots, cells develop hair-like outgrowths that help the root gather water and nutrients from the soil.

The epidermis in stems and leaves develops a covering of cuticle. The plastids in epidermal cells do not develop into chloroplasts except in specialized guard cells which form in pairs around pores in the plant surface called stomata.

Guard cell mother cell originates by unequal division of a protodermal cell. Small cell gives the mother cell The guard cells swells and connection between the two cells is weakened. The two cells separate in median parts and stomatal opening is formed.

Differentiation of trichomes

The distinctive branched unicellular trichomes of plants differentiate from undistinguished meristematic cells in the protoderm These meristematic cells initiate the differentiation pathway by cell expansion in the plane perpendicular to the epidermis, forming a tubular extension.

Once this stalk is formed, the nucleus migrates from the base of the stalk to its tip. The trichome then undergoes an unusual pattern of cell wall growth, in which the cell wall balloons out at three locations, forming the trichome.

Differentiation of ground tissues:

The meristematic tissues lose the ability to divide. This process of taking up a permanent shape, size and a function is cabled cellular differentiation. The ground tissues differentiate in the zone of maturation to form tissues called parenchyma, collenchyma or sclerenchyma.

Parenchyma tissues are the primary site of cellular metabolism. The organelles of parenchyma cells in different parts of the plant vary so that they can accommodate differences in metabolic functions,

Cells of leaf parenchyma and some stem parenchyma have large numbers of chloroplasts to carry out photosynthesis. Stem and root parenchyma cells have amyloplasts, organelles that store starch, Chromoplasts in the parenchyma of flower petals contribute to the color of the flower petals.

Collenchyma develops from elongate meristematic cells that appear very early in the differentiating meristem. Thickening of the walls occurs during elongation growth of the cells, with successive layers of wall material formed around the entire cell, but they are wider in the places of thickenings.

Fibers are derived from meristematic cells and differentiate early into elongated cells with few simple pits in their cell walls, and always appear in clusters. On the other hand, **sclereids** are developed from parenchyma cells that are secondarily modified. They usually deposit thick secondary walls that are heavily lignified.

Differentiation of conducting tissues:

Inside plant organs important pathways of cell differentiation include the xylem and phloem. The xylem of flowering plants contains two kinds of water conducting cells, tracheids and vessel elements.

Both of these cell types are elongated and dead at maturity thus water moves through them without crossing any lipid membranes. In tracheids the cell wall remains intact but the secondary wall does not develop in particular areas thus there are "pits" though which water move more readily than elsewhere in vessel elements end walls break down so that there is an open tube through which water can move unimpeded. Many individual cells can form a vessel that can be several centimeters long. As in the tracheids there are pits in the side walls so that lateral movement of water is possible as well as longitudinal

Differentiation of the Vessels:

Xylem derived from procambium in the primary plant body. The vessel is formed from series of xylem mother cells (meristematic) by the fusion of the cells end to end.

The vessel is formed from a series of xylem mother cells (meristematic) by fusion of cells end to end. The ends walls are loss thus the lumen of the cells are open into one another forming a tube. Vessel element enlarges rapidly by increase in diameter. At maturity, the cytoplasm begins to disintegrate.

The more primitive vessels have the shape of tracheids with relatively small lumen. In advanced vessels, the diameter of the lumen is large, in the evolution of tracheid into vessel, the angle of tapering ends becomes greater until the end walls become at right angles to side walls. Intermediate forms of vessels with tapered ends are known.

Differentiation of the phloem tissue:

The phloem cells contain living cytoplasm at *maturity* and are differentiated into pairs of sieve tube elements and companion cells. Sieve tubes form the pathway for movement of sugars and other organic molecules.

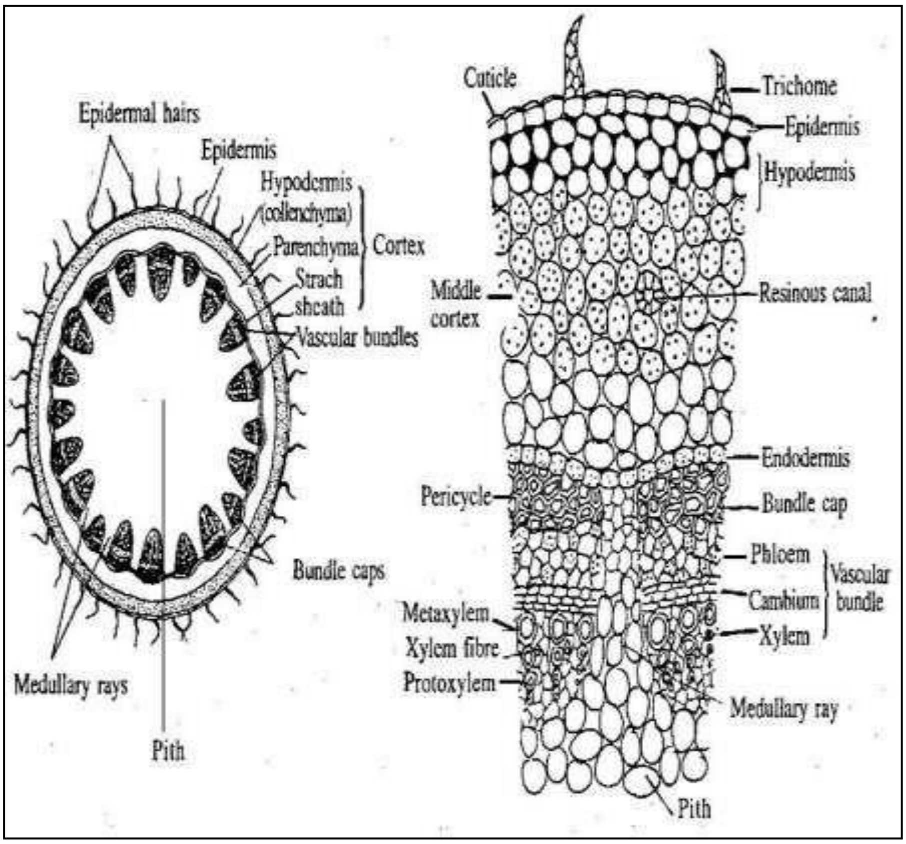
A sieve element and its companion cell derive from a single parent cell known as sieve tube mother cell which divides longitudinally. One daughter cell becomes a companion cell, and the other a sieve-tube element. Transverse division may form a row of companion cells.

The sieve tube cell elongates. Cytoplasm becomes highly vacuolated. Sieve areas develop in end walls, Callus develops around strands. At maturity, the wail becomes thinner, the nucleus disintegrates, the connecting strands increase in diameter, the cytoplasm becomes thin and the sieve tube becomes functioning in conduction.

Stem

A. The internal structure of Dicot Stems

The internal structure of dicot stem consists of epidermis, hypodermis, cortex, endodermis, pericycle, pith, medullary ray and the vascular tissue system. The stem also shows secondary growth.



Epidermis

Epidermis is the outermost covering of the stem. It is represented by a single layer of compactly arranged, barrel-shaped parenchyma cells. Intercellular spaces are absent. The cells are slightly thick walled.

Epidermis shows the presence of numerous multicellular projections called trichomes. Externally, a thin transparent waxy covering called cuticle, which prevents excessive evaporation of water, surrounds the epidermis. The epidermis also contains numerous minute opening called stomata, which are mainly involved in transpiration.

Hypodermis

Hypodermis is a region lying immediately below the epidermis. It is represented by a few layers of collenchyma cells with angular or lamellar thickenings. The cells are compactly arranged without any intercellular spaces. Hypodermis provides mechanical support and additional protection.

Cortex

Cortex is the major part of the stem represented by several layers of loosely arranged parenchyma cells; sometimes with chlorenchyma. Intercellular spaces are prominent. Cortex is the major storage organ in the stem.

Endodermis

Endodermis is the innermost layer of cortex represented by compactly arranged barrel shaped cells, without any intercellular spaces. The cells are richly deposited with starch grains, thus described as starch sheath.

Stele

The stele is the central cylinder of the stem, consisting of pericycle, vascular bundles, pith and medullary rays.

Pericycle

The pericycle is the outermost covering of the stele, which lies immediately below the endodermis. It is represented by a few layers of compactly arranged sclerenchyma cells. Above each vascular bundle, the pericycle forms a distinct cap-like structure known as bundle cap. It may form a continuous cylinder around the stele.

Vascular bundles

The number is various according to plant species; they arranged in form of a ring. The vascular bundles are open collateral. Each bundle consists of a group of xylem vessels to the inside (with the proto-xylem next to the pith) and a group of phloem to the outside. Xylem is described as endarch.

Between phloem and xylem there are several layers of thin walled cells known as cambial region. One of these layers is the cambium layer, whose meristematic activity later leads to the secondary thickening.

The rays between the bundles are called "medullary rays" The pith is surrounded by the ring of the vascular bundles. The pith and medullary rays usually consist of parenchyma meant for storage of food.

In some climbing and vegetable plants, each bundle has a phloem tissue to the inside in addition to the outer one "bicollateral"

Diagnostic Features of a Young Dicot Stem (Sunflower)

The following are some of the diagnostic features of a young dicot stem:-

1- Presence of cuticle and trichomes and stomata.

2- Presence of a hypodermis made up of collenchyma.

3- Presence of a wavy endodermis containing numerous starch grains.

4- Presence of a pericyclic fibres cap above each vascular bundle.

5- Presence of number of vascular bundles, arranged in form of a ring.

6- Presence of open collateral bundles with an endarch xylem.

7- Presence of wide medullary rays and wide pith also.

Secondary thickening in Dicot Stems

In herbaceous dicots, a limited amount of secondary thickening occurs, while it is more evident in perennial, woody dicots. The stem increases in thickness as it grows older.

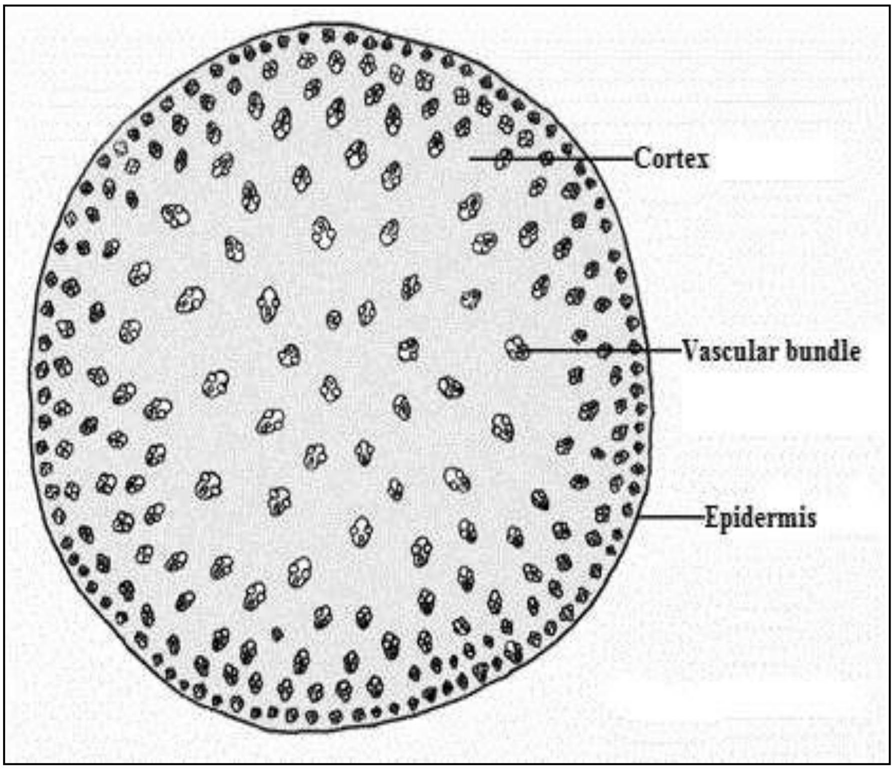
The cambium divides to form 2ry phloem to outside and 2ry xylem to the inside. The 2ry xylem and 2ry phloem are laid down on either side of the cambium. The primary xylem and phloem are pushed further apart. The pith remains alive.

Sometimes, the parenchyma of the medullary rays become meristematic and the cambium forms a continuous ring. Annual rings develop in the 2ry xylem, each' consisting of a spring wood layer and a layer of autumn wood.

Later, the cork cambium or phellogen (2ry meristem) develops in the Cortex. It gives rise to cork cells (phellen) on the outside and 2ry cortex (phelloderm) on the inside. Together this is known as the periderm. Opposite the stomata the cork cells (phellem) give rise to lenticells for gaseous exchange.

B. The internal structure of Monocot Stems

The internal structure of monocot stem consists of the epidermis, hypodermis, ground tissue, and the vascular tissue system.



Epidermis

Epidermis is the outermost covering of the stem represented by a single layer of compactly arranged, barrel-shaped parenchyma cells. Intercellular spaces are absent. Trichomes may be absent. A cuticle is present. The epidermis contains numerous minute openings called stomata. **Hypodermis**

The hypodermis lies immediately below the epidermis. It is represented by a few layers of compactly fiber cells.

Ground Tissue

The ground tissue is a major component of monocot stem. It is undifferentiated into cortex and pith. It is represented by several layers of loosely arranged parenchyma cells enclosing intercellular spaces. The ground tissue is meant for storage of food.

Vascular Bundles

They are found irregularly scattered in the ground tissue. Towards the periphery, the bundles are smaller in size while towards the centre, they are larger in size.

They bundles are closed collateral. Each bundle is surrounded by a bundle sheath formed of fibers. The xylem is found towards the outer surface and the phloem towards the center. Cambium is absent.

In Zea mays stem, there are 2 vessels of metaxylem and two protoxylem vessels arranged in 'the shape of 'Y'. The lower protoxylem vessel is non functional and become a cavity. Xylem is described as endarch.

The phloem is composed of sieve tubes and companion cells; phloem fibres and phloem parenchyma are absent.

Diagnostic Features of a Monocot Stem (Zea mays)

The following are some of the diagnostic features of a monocot stem:-

* Presence of a hypodermis made up of fibers.

* Presence of undifferentiated ground tissue.

* Presence of numerous vascular bundles.

Vascular bundles are closed collateral with endarch xylem.

* Presence of only 2 protoxylem & 2 metaxylem vessels in each bundle.

* Presence of a lysigenous cavity.

* Absence of phloem fibers and parenchyma.

* Presence of a bundle sheath made up of fibres.

	monocot stems	dicot stems
Hypodermis	Fibres	Collenchyma
Ground tissue	Not differentiated into cortex and Pith	Differentiated into cortex and pith
Starch sheath	Present as fibres	Absent
Pericycle	Absent	Present as fibres cap
Bundles arrangement	Scattered	Arranged in a cycle
Vascular bundles	Closed collateral	Open collateral or bicollateral
Bundle sheath	Present as fibres	Absent
Cambium	Absent	Present
Vessels	4 in (V) shape	Numerous in rows
Phloem	Regular	Irregular

Plant kingdom

How do we classify the living world

Life used to be simple! Early scientists classified organisms as either Animal or Plant. Animals moved, had nervous systems and showed **heterotrophic nutrition**, among other features. Plants, in contrast, were photosynthetic with a cell wall enclosing the cytoplasm. Bacteria and fungi aren't usually photosynthetic but as they have cell walls they were looked upon as being plant-like. (We now know their cell walls are really quite different.) In this simple system of plants and animals, "plants" which had no recognisable shoot/root/leaf regions were said to have a body termed a **thallus** and were termed Thallophytes. In this earliest classification system bacteria, fungi and algae were all put into this grouping.

Today we recognize;-

Monera (Prokaryotes) - with their radically different cell structure, namely the bacteria including the blue-green bacteria (once called blue-green algae).

Plants - photosynthetic (mainly terrestrial) eukaryotes with cell walls

Animals - motile, heterotrophic eukaryotes, the cells of which are not surrounded by cell walls.

Fungi - non-motile, cell wall-bound, spore-bearing eukaryotes with a saprophytic or parasitic mode of heterotrophic nutrition

A fifth kingdom is also recognized by many scientists;-

Protista - defined really as none of the above! It comprises eukaryotic microorganisms and their immediate descendants, viz. protozoa, slime molds, algae.

(Cavalier-Smith, 2004) proposes **a Six Kingdom System**

Prokaryote Empire

Bacterial Kingdom

With their radically different cell structure, including the blue-green bacteria (once called blue-green algae).

Eukaryote Empire

Plant Kingdom - all land plants as well as green and red algae

Animal Kingdom - motile, heterotrophic eukaryotic organisms, the cells of which are not surrounded by cell walls

Fungal Kingdom - non-motile, cell wall-bound, sporebearing eukaryotes with a saprophytic or parasitic mode of heterotrophic nutrition

Protozoan Kingdom- eukaryotic, motile unicells

Chromista Kingdom - includes brown algae, golden algae, yellow-green algae, diatoms, water molds.

The question is **How Many Kingdoms**?

Many botanists have a problem with the idea that algae, especially green algae, are not considered plants. This six kingdom system at least places green algae within the plant kingdom. In this course, we will not worry too much about classification systems and will focus on green algae and survey other major algal groups in order to get a better understanding of how land plants evolved.

PLANT CLASSIFICATION SYSTEMS

There are several plant classification systems and little agreement, e.g. some botanists believe the ferns are a class within the Division Pteridophyta, others consider them a division of their own. In this course, rather than use a formal classification system we will simply refer to these groups by their informal names;-

Algae, Bryophytes, Pteridophytes, Gymnosperms and Angiosperms.

There are a few other higher categories of classification you may come across in your reading.

Lower plants usually include algae and Bryophytes, while **higher plants** refer to Pteridophytes, Gymnosperms and Angiosperms.

The word **Cryptogams** literally means "hidden wedding" and alludes to the fact that the sex life of these plants (algae, Bryophytes and Pteridophytes) was once not understood.

Phanerogams ("open wedding") are the seed plants - the gymnosperms and angiosperms.

Thallophytes is an outmoded term for plants whose body is not differentiated into root/stem/leaves but is termed a thallus. Algae fall into this category (and fungi did too when they were considered to be plants).

Vascular plants are those with vascular tissue (xylem & phloem).

Embryophytes (all but algae) are plants that bear an embryo and are synonymous with land plants.

VIRUSES

Viruses are basically a way a form of genetic information insures its continued survival. They are entities which reproduces their DNA/RNA within living cells utilizing mechanisms of cells for this.

General Features of Viruses

1. small size

cannot be viewed with a light microscope pass through filters that retain bacteria

range of size = 0.1-0.3 micrometers

2. characteristic shapes - spherical (complex), helical, rod or polyhedral, sometimes with tails or envelopes. Most common polyhedron is the icosahedron which as 20 triangular faces.

3. obligate intracellular parasites Viruses do not contain within their coats the machinery for replication. For this they depend upon a host cell and this accounts for their existence as obligate intracellular parasites. Each virus can only infect certain species of cells. This refers to the virus **host range**.

4. no built-in metabolic machinery Viruses have no metabolic enzymes and cannot generate their own energy.

5. no ribosomes Viruses cannot synthesize their own proteins. For this they utilize host cell ribosomes during replication. Features 4 and 5 account for the obligate intracellular parasitism of viruses.

6. only one type of nucleic acid Viruses contain either DNA or RNA (never both) as their genetic material. The nucleic acid can be single-stranded or double stranded.

7. do not grow in size Unlike cells, viruses do not grow in size and mass leading to a division process. Rather viruses grow by separate synthesis and assembly of their components resulting in production of a "crop" of mature viruses.

Animal Virus Structure

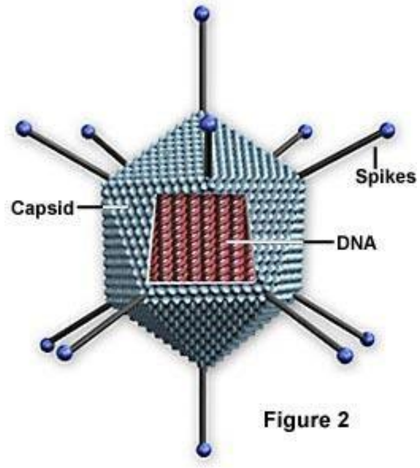


Figure 2

Kingdom Monera

BACRETIA

The Scope of Bacteriology

The Bacteria are a group of single-cell microorganisms with prokaryotic cellular configuration. The genetic material (DNA) of procaryotic cells exists unbound in the cytoplasm of the cells. There is **no nuclear membrane**, which is the definitive characteristic of eucaryotic cells such as those that make up plants and animals. Until recently, bacteria were the only known type of procaryotic cell, and the discipline of biology related to their study is called bacteriology.

Bacteria grow in a wide variety of habitats and conditions.

Structure and function of prokaryotic cells

Procaryotes are unicellular organisms of relatively simple construction, especially if compared to eukaryotes. Whereas eukaryotic cells have a preponderance of organelles with separate cellular functions, procaryotes carry out all cellular functions as individual units. A procaryotic cell has five essential structural components: a genome (DNA), ribosomes, cell membrane, cell wall, and some sort of surface layer which may or may not be an inherent part of the wall.

Cell Wall - Outer covering of the cell that protects the bacterial cell and gives it shape.

• **Cytoplasm** - A gel-like substance composed mainly of water that also contains enzymes, salts, cell components, and various organic molecules.

• **Cell Membrane** or Plasma Membrane - Surrounds the cell's cytoplasm and regulates the flow of substances in and out of the cell.

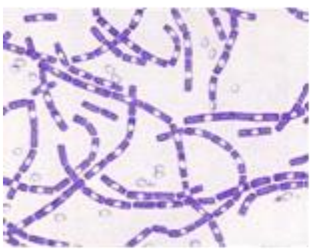
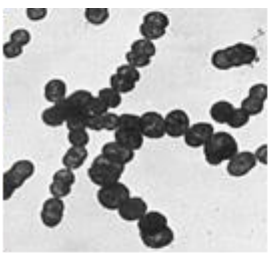
• **Flagella** - Long, whip-like protrusion that aids in cellular locomotion.

• **Ribosomes** - Cell structures responsible for protein production.

• **Plasmids** - Gene carrying, circular DNA structures that are not involved in reproduction.

• **Nucleiod Region** - Area of the cytoplasm that contains the single bacterial DNA molecule.

Bacteria: Systematics

Bacterial cells almost invariably take one of three forms: rod (bacillus), sphere (coccus), or spiral (spirilla and spirochetes). Rods that are curved are called vibrios. Fixed bacterial cells stain either Gram-positive (purple) or Gramnegative (pink); motility is easily determined by observing living specimens. Bacilli may occur singly or form chains of cells; cocci may form chains (streptococci) or grape-like clusters (staphylococci); spiral shape cells are almost always motile; cocci are almost never motile. This nomenclature ignores the actinomycetes, a prominent group of branched bacteria which occur in the soil. But they are easily recognized by their colonies and their microscopic appearance.  

CYANOPHYTA

Introduction and uniqueness

The group cyanobacteria include another successful group of prokaryotes namely blue green algae. They are photoautotrophic prokaryotes occupying a wide range of habitat. They are predominantly aquatic, found mostly in fresh water bodies. Some species occur in marine water. A few are terrestrial, found in moist soil and on moist rocks. The algae are the simplest members of the plant kingdom, and the blue-green algae are the simplest of the algae. They have a considerable and increasing economic importance; they have both beneficial and harmful effects on human life. Blue-greens are not true algae. They exist as unicells, colonies or filaments. They have a bacterial type cell wall, no nucleus and no flagella. In addition to bacterial chlorophyll, they have the pigments phycocyanin and phycoerythrin. Blue-greens are responsible for nitrogen fixation on land and in water. Like green algae, they can form lichen symbioses with fungi.

The Thallus

The plant body or thallus of blue green algae ranges from unicellular to multicellular, branched forms. There are no flagella but some members exhibit a movement caused by gliding.

Cell Structure

Each cell whether in a unicellular form like Gleocapsa or multicellular form like Nostoc, has a definite cell wall. Most often it is surrounded by a thin or thick mucilagenous sheath. The inner layer of cell wall has a chemical composition similar to bacterial cell, made up of peptidoglycans. The cell wall is followed by a cell membrane composed of lipids and proteins. The inner contents of the cell can be distinguished into an outer pigmented region called chromoplasm and a central clear, hyaline region called centroplasm.

The centroplasm contains photosynthetic pigments chlorophyll - a, b, carotene and others located in broad sheet-like, structures called thylakoids. The central nucleoid has many irregularly arranged fine strands of DNA.

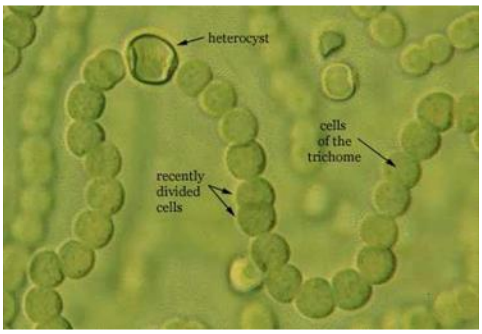
Pigments

Blue green algae contain in addition to chlorophyll, other photosynthetic pigments, such as Phycobillins. Phycobillins are of three types phycocyanin (blue), allophycocyanin (blue) and phycoerythrin (red).

Reproduction

Cyanobacteria reproduce mostly by vegetative and asexual methods. Vegetative reproduction occurs by fission or fragmentation or by the formation of hormogonia. Unicellular forms exhibit fission while filamentous multicellular forms exhibit fragmentation.

Asexual reproduction occurs by the formation of thick walled cells called akinites, which can also store reserve food material. In some members endogenous or exogenous spores may be formed. There is no sexual reproduction, but genetic recombination as in bacteria has been reported in some species like *Cylindrospermum majus* and *Anacystic ridulans.* Conjugation has not been observed in cyanobacteria, but gene recombination is known to occur in some forms.



Nostoc

ALGAE

The algae are an ancient group of aquatic plants. Some taxonomists consider the algae to be Protoctists but this approach will not be followed here. There are thought to be about 23,000 species of algae. There are 3 features which distinguish the algae from other plants;-

Body plan: There is no specialisation of the algal body into root, stem, leaves with vascular tissue. The photosynthetic portion of the alga is a thallus while the attachment portion comprises hair-like rhizoids. For this reason, old classification systems put the algae into a grouping known as the Thallophytes. **No Embryo**: For most algae, sperm and eggs fuse in the open water and the zygote develops into a new plant without any protection. For other plant groups the zygote develops into an embryo within the protection of the parent plant. For this reason, old classification systems termed all other plant groups Embryophytes.

Reproductive structures: The gametes are produced within a single cell. There is no jacket of sterile cells protecting the gametes.

Being aquatic, algae are

- marine
- freshwater Terrestrial

Terrestrial algae are effectively surviving in an aquatic environment on land. Soil algae survive in a film of soil water. The other major group of terrestrial algae are those in lichen symbioses.

As terrestrial plants the algae have a unique role as pioneer plants. They grow on bare rock, providing there is moisture. The rock weathers and crumbles. The algae die. The mineral contribution of the rock and the organic remains of the algae lead to formation of soil. This pioneering activity therefore paves the way for more demanding plants to invade. A succession such as this is precisely what would have occurred when the islands of the Caribbean first emerged from the sea.

FUNGI

The fungi (singular, fungus) include several thousand species of eukaryotic, spore bearing organisms that obtain simple organic compounds by absorption. The organisms have no chlorophyll and reproduce by both sexual and asexual means. The fungi are usually filamentous, and their cell walls have **chitin** (vs. cellulose in plant). The study of fungi is called **mycology**, and fungal diseases are called **mycoses**.

Together with bacteria, fungi are the major decomposers of organic materials in the soil. They degrade complex organic matter into simple organic and inorganic compounds. In doing so, they help recycle carbon, nitrogen, phosphorous, and other elements for reuse by other organisms. Fungi also cause many plant diseases and several human diseases. Two major groups of organisms make up the fungi. The filamentous fungi are called molds, made of strands called hyphae, a mass of hyphae is called mycelium. Multicellular hyphae that have separate cells are called septate, multinuclear hyphae that have no divisions between nuclei are called coenocytic while the unicellular fungi are called yeasts.

Reproduction of Fungi

•Asexual: budding (yeast), lightweight spores (filamentous)

•Sexual: sexual spores of the two sexual types fuse and

involve exchanges of genetic material

- Asexual reproduction of Yeast

– budding

– Psuedohyphae may form

Asexual spore formation in filamentous fungi

• Sporangiospore (sac)

• Chlamydospore (hyphae)

• Conidiospore (no sac)

Classification of Fungi

Division Zygomycota. Members of the division Zygomycota are known as zygomycetes. Zygomycetes produce sexual spores known, as as well as asexual sporangiospores. A familiar member of the division is *Rhizopus stolonifer*, a fungus found on fruits, vegetables, and breads. It is the familiar bread mold. It anchors itself to the substratum with special hyphae known as **rhizoids**.

Rhizopus is used in the industrial production of steroids, meat tenderizers, industrial chemicals, and certain coloring agents.During sexual reproduction, two haploid hyphae from different parents perform plasmogamy, joining together, producing a heterokaryotic cell. This multinucleate heterokaryotic cell forms a zygosporangium. Pairs of nuclei (one from each parent) perform karyogamy in the zygosporangium, fusing to form a diploid nucleus. These diploid nuclei are zygotes; they immediately undergo meiosis to begin producing haploid sexual spores. A sporangium sprouts out of the zygosporangium to release these spores.

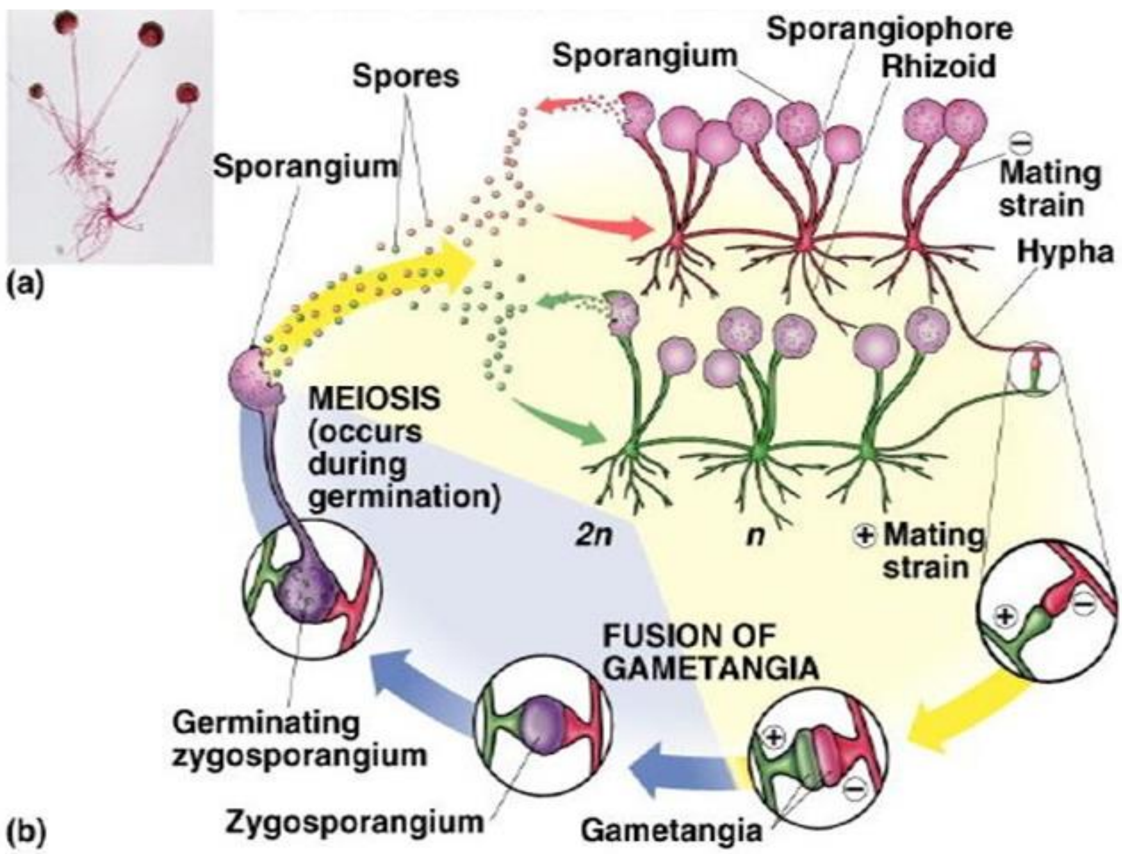


Figure 6. Sexual reproduction in the mold *Rhizopus stolonifer*. Plus and minus mycelia produce sexually opposite hyphae that fuse and give rise to zygospores, which germinate to form new mycelia.

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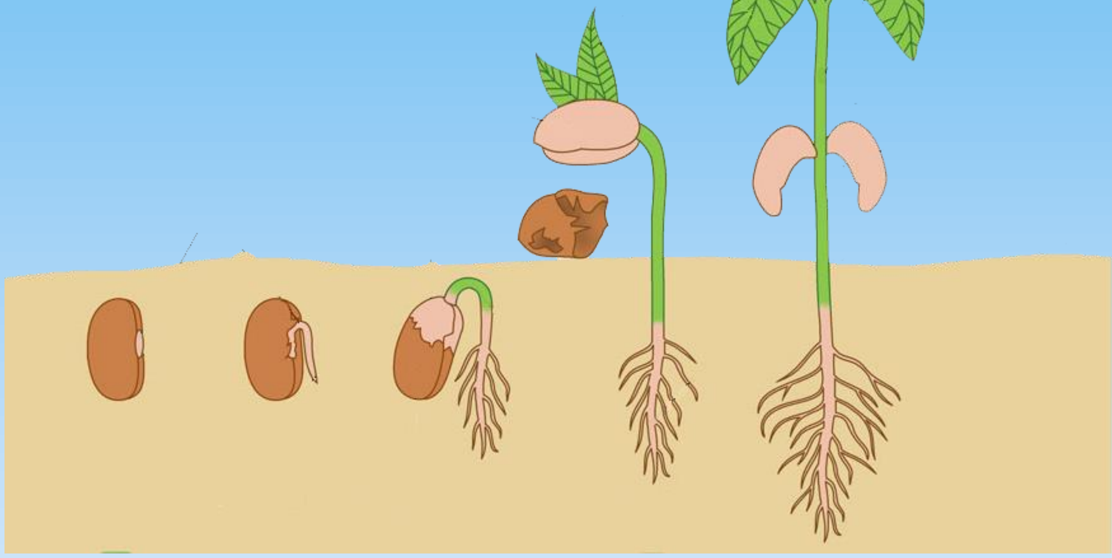
Plant Morphology

1st Year students

Practical Part



Prof. Dr. Ahmed Kamal Eldin Osman

Department of Botany & Microbiology

2022/2023

SEEDS AND SEED GERMINATION

DICOTYLEDONOUS SEEDS

1- *Vicia faba* (Broad Bean)

Examine the dry seed and sketch its outline from the side and front views. Label the hilum and the microphyle. Examine also the different stages of germination. In an old seedling, note the development of 2 small primary leaves or prophylls and later the first compound leaves typical of ***Vicia faba***. note the enlarged epicotyl which is the part between the point of attachment to the cotyledons and the propyls. the hypocotyl on the other hand remains small and thus the cotyledons remains below the soil surface. this type of germination is called **hypogeal** germination.

البذور والإنبات

بذور النباتات ذوات الفلقتين

(١) الفول:

١- افحص بذرة الفول الجافة ولاحظ القصرة والسرة ولاحظ أن البذرة لا إندوسبرمية.

٢- بتوفر الظروف المناسبة للإنبات تنفتح البذرة ويمكن رؤية النقير وجيب الجذير والفلقتان والجنين.

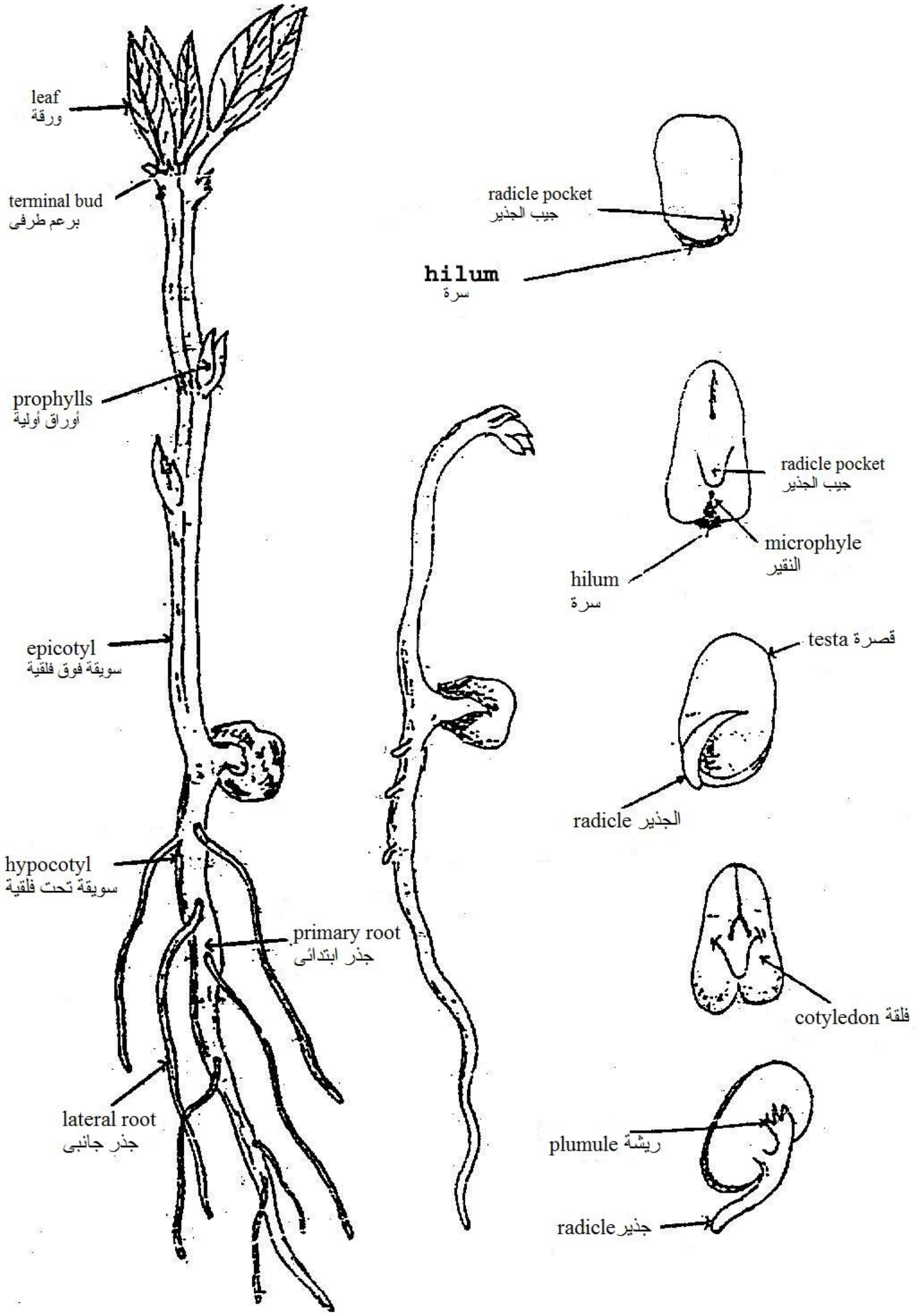
٣- يزداد انتفاخ الجنين وينمو الجذير ويمزق القصرة من جهة جيب الجذير ويظهر الجذير متجهاً فى نموه إلى اسفل وتنمو الريشة فى نفس الوقت بطيئاً إلى أعلى.

٤- يتم تمزق القصرة ثم تنمو الريشة إلى أعلى سطح التربة وتكون منحنيـة إلى أسفل لمقاومة الإحتكاك بحبيبات التربة.

٥- افحص البادرة الكاملة ولاحظ نمو الجذيرلتكوين مجموع جذرى مكون من جذر ابتدائى يتفرع منه جذور ثانوية وأن الريشة نمت لتكون مجموع خضرى مكون من ساق وأوراق.

٦- لاحظ إختلاف شكل الورقتين الأوليتين عن باقى الأوراق وأيضاً نلاحظ أن السويقة التحت فلقية صغيرة عن السويقة الفوق فلقية وان الفلقـات تتكمش وتظل تحت سطح التربة خلال فترة الإنبـات لذا يطلق على هذا النوع من الإنبـات **إنبات أرضى**.

Seed germination of *Vicia faba*. خطوات إنبات بذرة الفول



2- *Lupinus termis* (Lupin).

Examine lupinus seed and note the hilum, the microphyle and position of the radicle. Remove the testa and make a drawing of the embryo. Within the embryo there are the two cotyledons, plumule and radicle. The seed is exendospermic. Examine the seedling and note the long hypocotyl carrying the fleshy cotyledonary leaves. Note that the hypocotyl is longer than the epicotyl. This type of germination is called **epigeal germination**.

(٢) الترمس:

١- البذرة الجافة تميل إلى الإستدارة وهى لا إندوسبرمية.

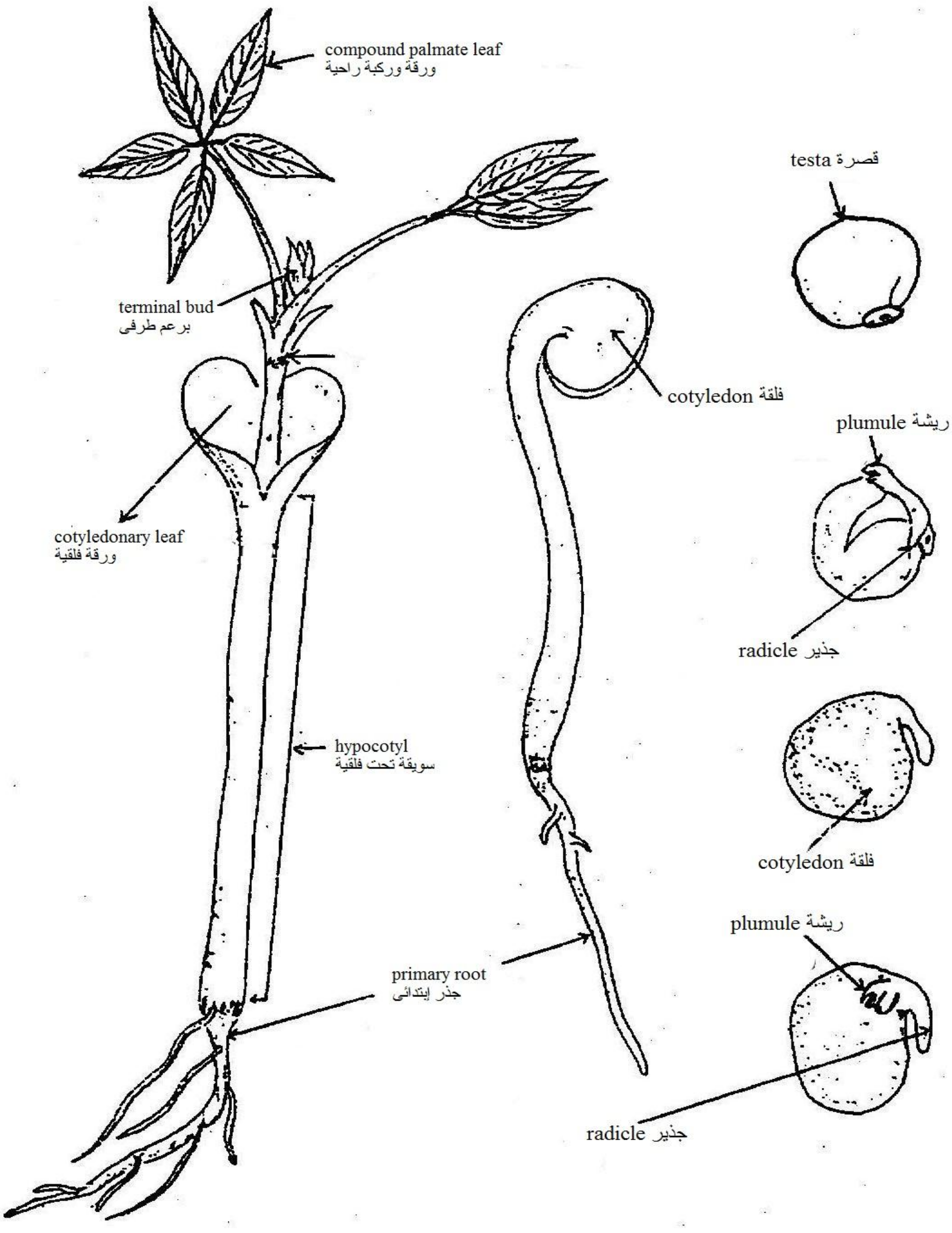
٢- البذرة المبتلة والجنين داخلها تشبه بذرة الفول المبتلة.

٣- ينمو الجذير إلى أسفل وتنمو الريشة إلى أعلى حاملة معها الفلقات ويكون ذلك مصحوباً بتمزق القصرة.

٤- تظهر الفلقات فوق سطح التربة وتخضران لتكونا الورقتان الفلقيتان.

٥- افحص البادرة الكاملة ولاحظ الفرق بين الورقتان الفلقيتان واوراق النبات الحقيقية. كما يلاحظ أن السويقة التحت فلقية أطول من السويقة الفوق فلقية ولذا يسمى هذا الإنبات **إنبات هوائى**.

Seed germination of *Lupinus termis* . خطوات إنبات بذرة الترمس



3- *Ricinus communis* (Castor Bean)

Sketch the seed from the outside and note that the microphyle is covered by a spongy structure called caruncle. Crack the shell and cut transverse and longitudinal section to show the relation of the different parts. Note the embryo which consists of two membranous cotyledons, a radicle and a plumule. Note that the embryo is surrounded by the endosperm. The seed of *Ricinus* is called **endospermic**, while the seed of *Vicia* and *Lupinus* in which the reserve food is stored in the embryo itself is called **exendospermic**. Note that in the seedling stage, the hypocotyl is long and the two expanded cotyledons form the first green leaves of the plant. So the type of germination here is **epigeal germination**.

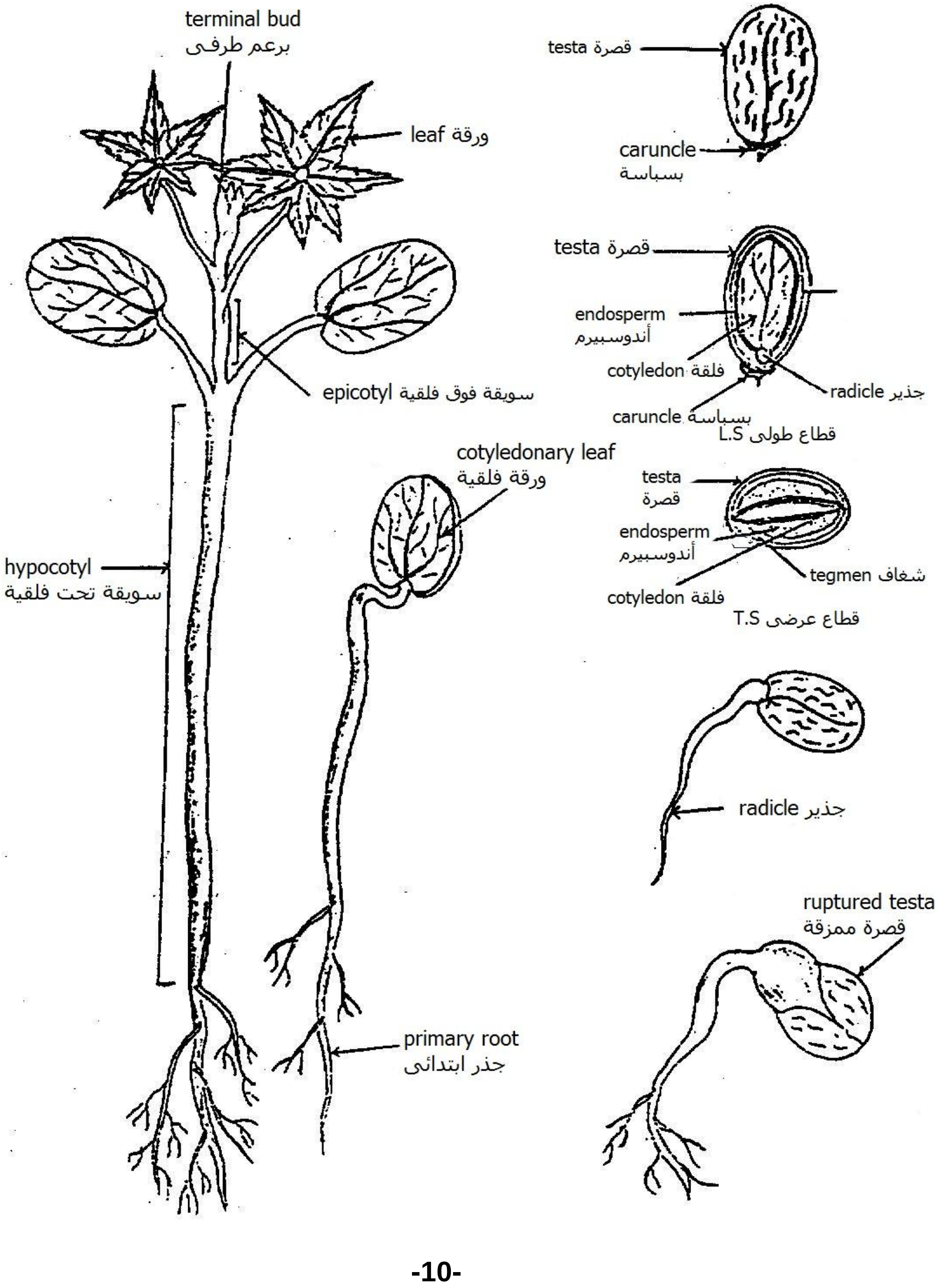
(٣) الخروع:

١- افحص البذرة الجافة ولاحظ القصرة المزركشة وكذلك الكتلة لبيشاء الطرفية والتى تسمى البسباسة.

٢- خذ قطاعاً طولياً وعرضياً فى البذرة ولاحظ وجود الطبقات التالية: القصرة- الشغاف- الإندوسبرم- الجنين. نلاحظ هنا أن البذرة اندوسبرمية.

٣- تتمزق القصرة وينمو الجذير إلى أسفل وتستطيل السويقة التحت فلقية إلى أعلى حاملة معها الفلقتان أعلى سطح التربة، حيث تخضران لتكونا الورقتان الفلقيتان. كما تنمو الريشة إلى أعلى مكونة المجموع الخضرى. الإنبات هنا من النوع الهوائى.

Seed germination of *Ricinus communis* . خطوات إنبات بذرة الخروع



MONOCOTYLEDONOUS SEEDS

1- *Zea mays* (Maize)

Note that one end of the grain is more or less tapering and leads to the former point of attachment to the cob, while the other end is broad and slightly rounded. Note also the oval depression on one of the flat faces. This marks the position of embryos. Above this, note the presence of sear-like projection marking the former stylar attachment.

Take a soaked grain of the same, split it into two halves along the axis of the embryo using a scalpel or safety razor. This cut will show the parts of the embryo and their relation to the endosperm. Make a sketch to show the plumule, plumule sheath, radicle, radicle sheath, the single cotyledon (Scutellum) and the white and yellow endosperm. In a young seedling note the appearance of the plumule sheath and radicle sheath enclosing the plumule and radicle respectively. The plumule and the radicle soon pierce through their sheaths and develop into the young shoot and young root. In an older seedling note the development of adventitious roots which come out from the base of stem.

بذورالنباتات ذوات الفلقة الواحدة

(١) الذرة الشامية:

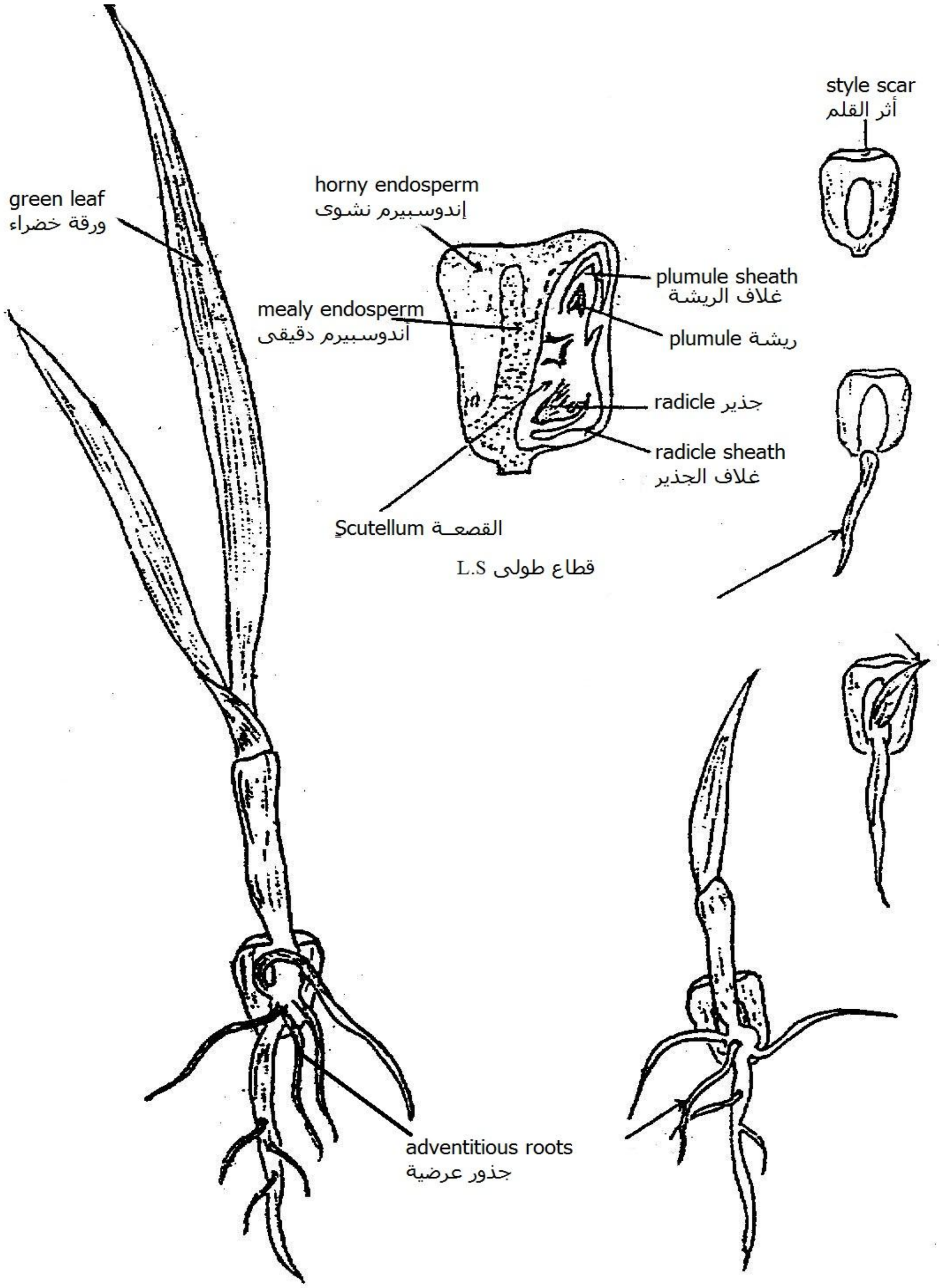
١- حبة الذرة ليست بذرة ولكنها ثمرة يلاحظ لى أحد سطحيها انخفاض بيضى الشكل يحدد موضع الجنين كما يوجد فى القمة العريضة نتؤ يمثل بقايا القلم.

٢- خذ قطاع طولى فى الحبة ولاحظ وجود الآتى: إندوسبيرم قرنى- إندوسبيرم دقيقى- جيب الجذير- الجذير- جيب الريشة- الريشة- القصعة.

٣- أثناء الإنبات ينمو الجذير إلى أسفل مخرقاً غمده ثم تظهر الجذور الجنينية كما تنمو الريشة إلى أعلى داخل غمدها حتى فوق سطح التربة حيث تخترق الغمد وتظهر الورقة الخضرية الأولى.

٤- افحص البادرة الكاملة ولاحظ ظهور الجذور العرضية وكذلك الأوراق الشريطية.

Grain germination of *Zea mays* . خطوات إنبات حبة الذرة



ROOT SYSTEM

Roots classified into:

I- **Primary or tap root:** Originate from the radicle and classified in to:

1- Normal tap roots: (e.g: cotton root).

2- Storage tap root:

a- Conical root: (e.g: carrot root).

b- Fusiform root: (e.g: radish root).

c- Napiform root: (e.g: turnip root).

II- Adventitious roots: Originate from some other organ than the radicle. It classified into:

a- Fibrous roots: (e.g: onion).

b- Prop roots: (e.g: maize).

c- Storage roots (tuberous): (e.g: sweet potato).

d- Climbing roots (tendrils): (e.g: *Cereus*).

e- Aerial roots (Pillar): (e.g: *Ficus beneghalensis*).

f- Respiratory roots: (e.g: *Avicennia* sp).

g- Haustoria of parasites: (e.g: *Orobanche* and *Cuscuta*).

المجموع الجذرى

تنقسم الجذور إلى:

أولاً: **جذر أولى أو وتدى:** ينشأمن الجذير وينقسم إلى

١- جذر وتدى عادى: جذر القطن.

٢- جذر وتدى متشحم:

أ- مخروطى: جذر الجذر.

ب- مغزلى: جذر الفجل.

ج- لفتى (كروى): جذر اللفت.

ثانياً: جذور عرضية: تنشأ من اى عضو عدا الجذير

أ- جذور ليفية: جذور البصل.

ب- جذور مساعدة: جذور الذرة.

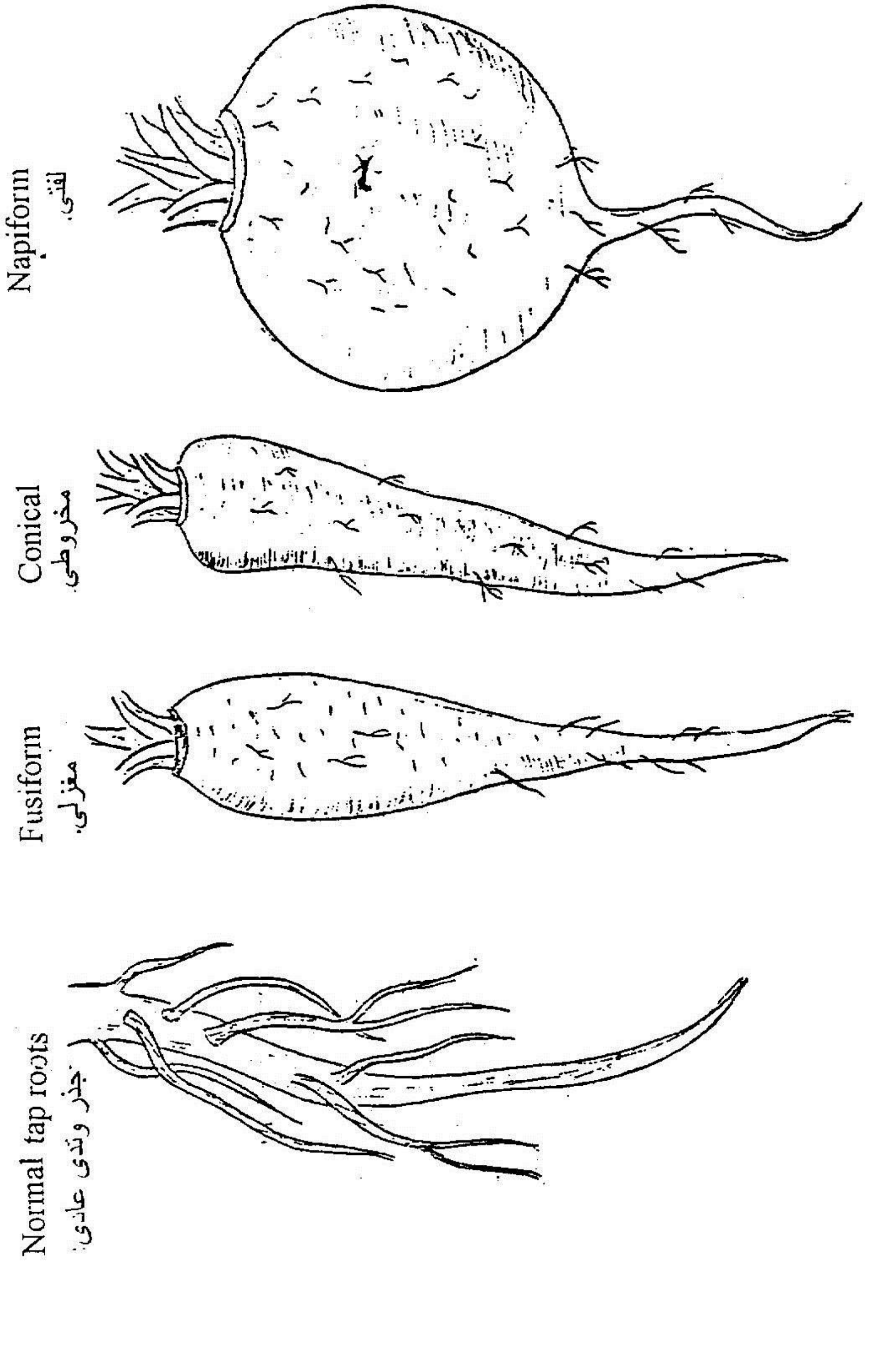
ج- جذور تخزينية (درنية): جذور البطاطا.

د- جذور متسلقة: جذور الشمع.

هـ- جذور هوائية (دعامية): جذور التين البنغالى.

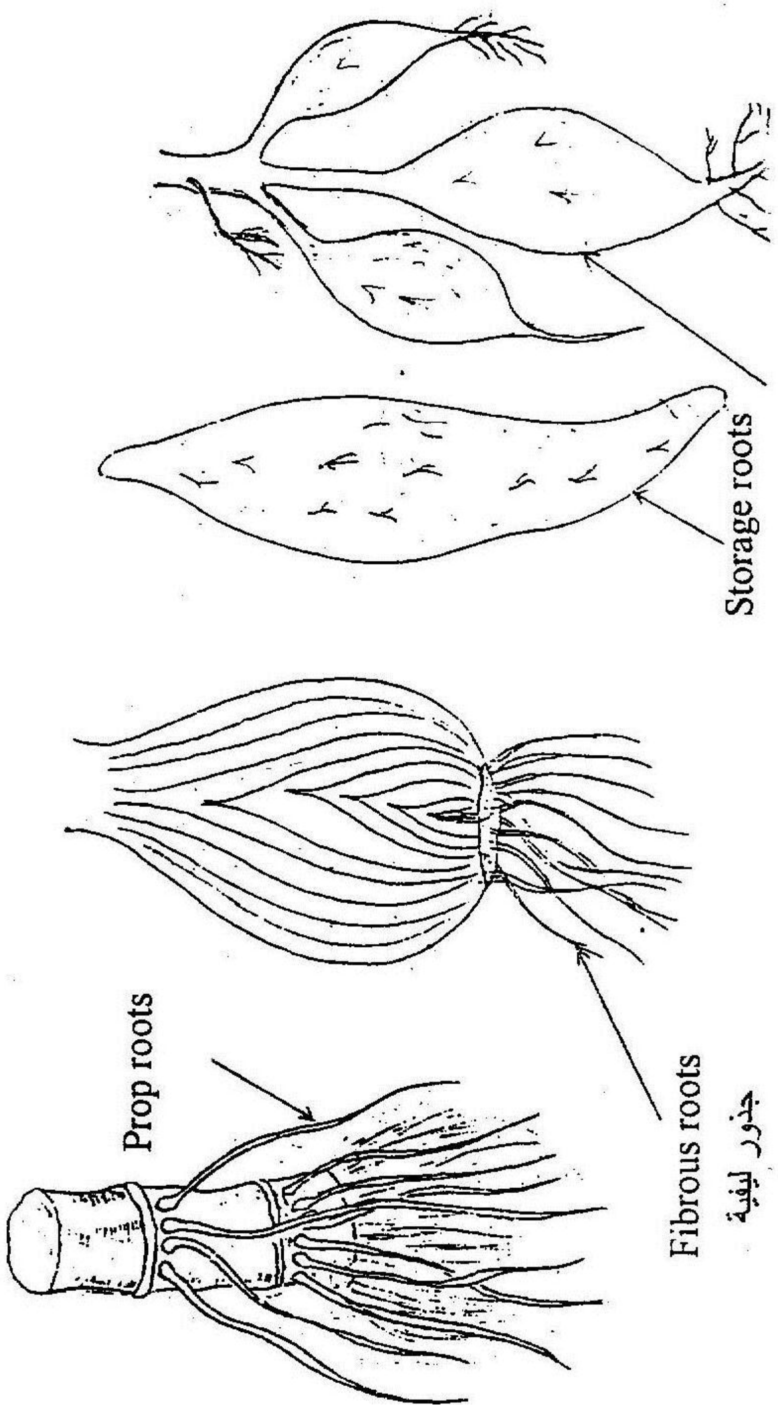
و- جذور تنفسية: جذور ابن سينا (المنجروف).

ز- جذور ممصات (طفيلية): جذور الهالوك والحامول.

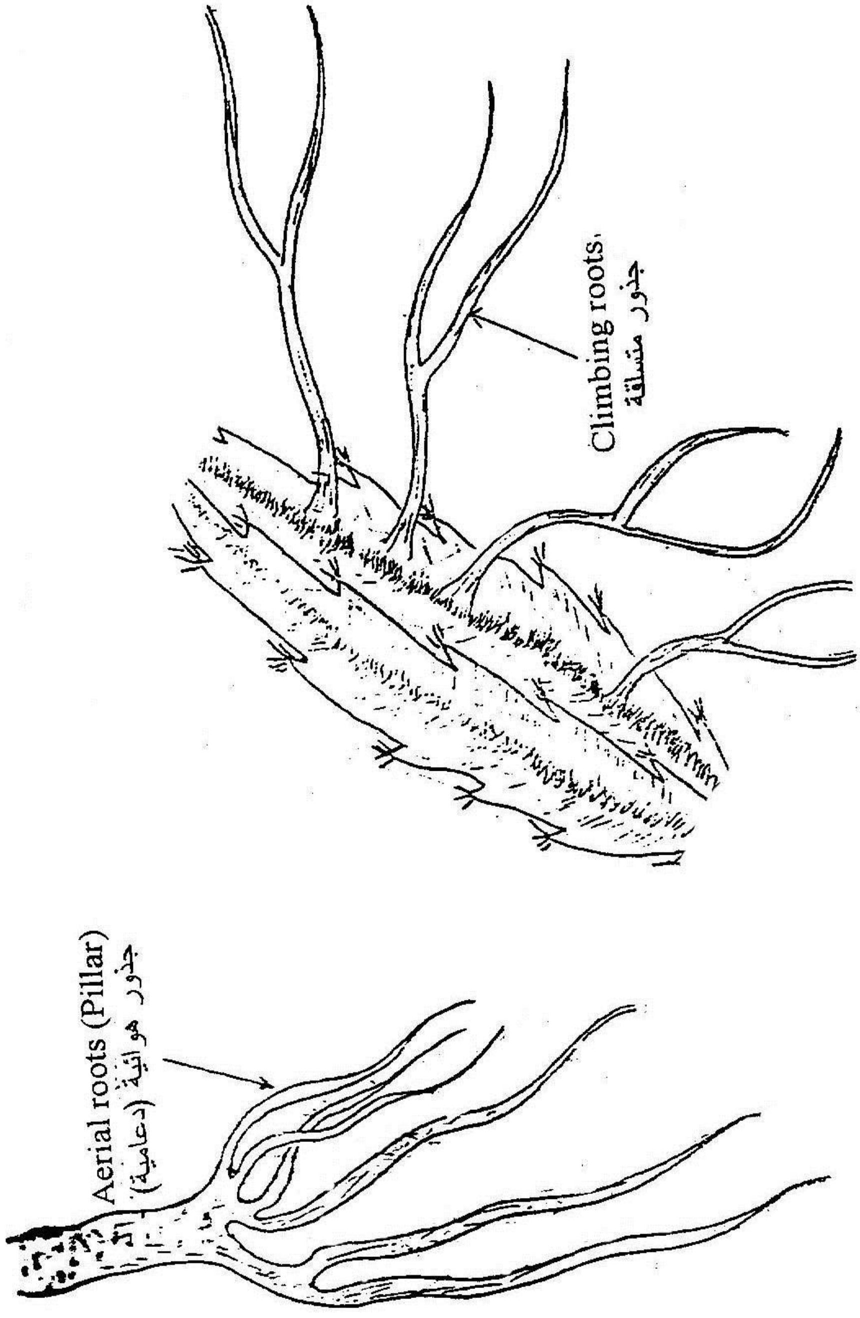


Different types of tap roots
الأنواع المختلفة للجذور الوتدية

Different types of adventitious roots
الأنواع المختلفة للجذور العرضية

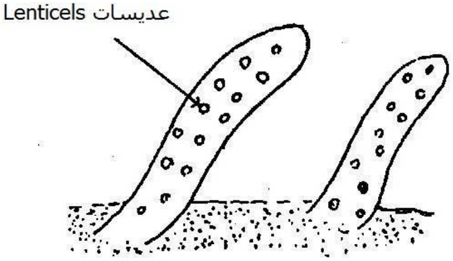


Different types of adventitious roots
الأنواع المختلفة للجذور العرضية



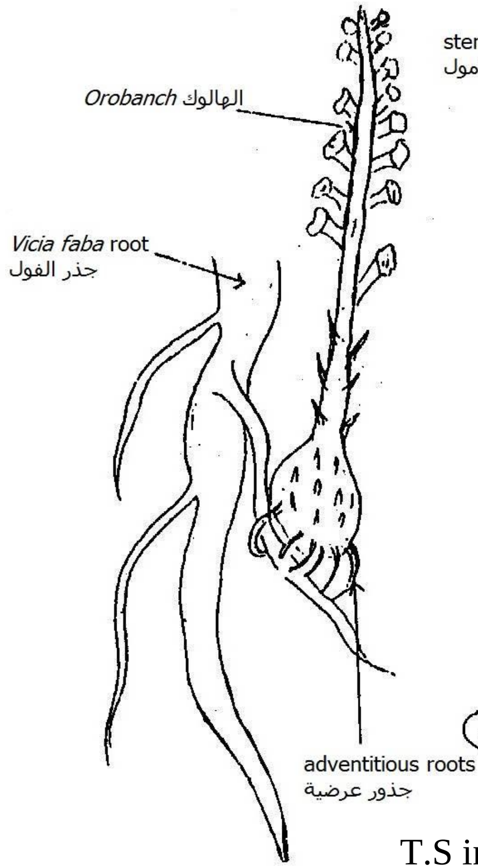
Different types of adventitious roots

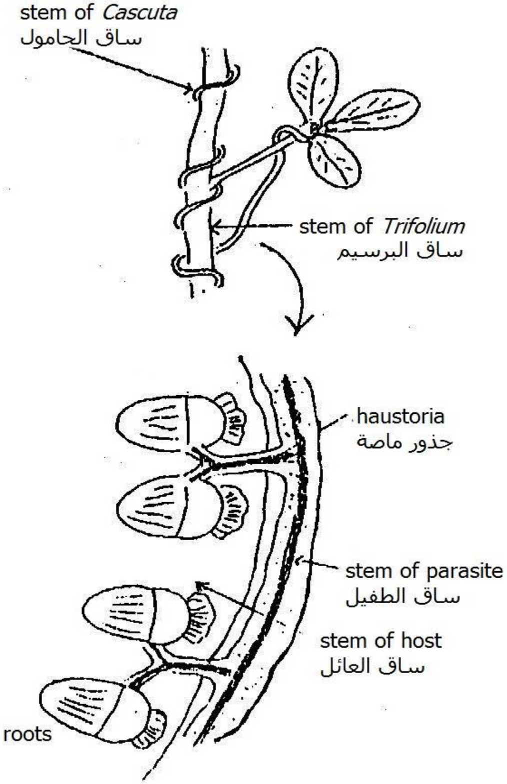
الأنواع المختلفة للجذور العرضية



Respiratory roots

جذور تنفسية





T.S in host stem ق.ع فى ساق العائل

SHOOT SYSTEM

The Stem

The buds:

1- **Classification according to their position on the stem:**
   - a- Terminal bud: found at the tip of stem (e.g: *Duranta*).
   - b- Lateral (axillary) buds: found on the sides of stem in the axils of leaves. Note also the accessory buds.

2- **Classification according to their nature:**
   - **a-** Leafy buds (summer buds) or naked buds: (e.g: Cabbage) composed of main axis from which arises folded bud leaves.
   - **b-** Scaly buds (winter buds) or covered buds: (e.g: *Morus* or *Populus*) the bud is enclosed in scale leaves.

المجموع الخضرى

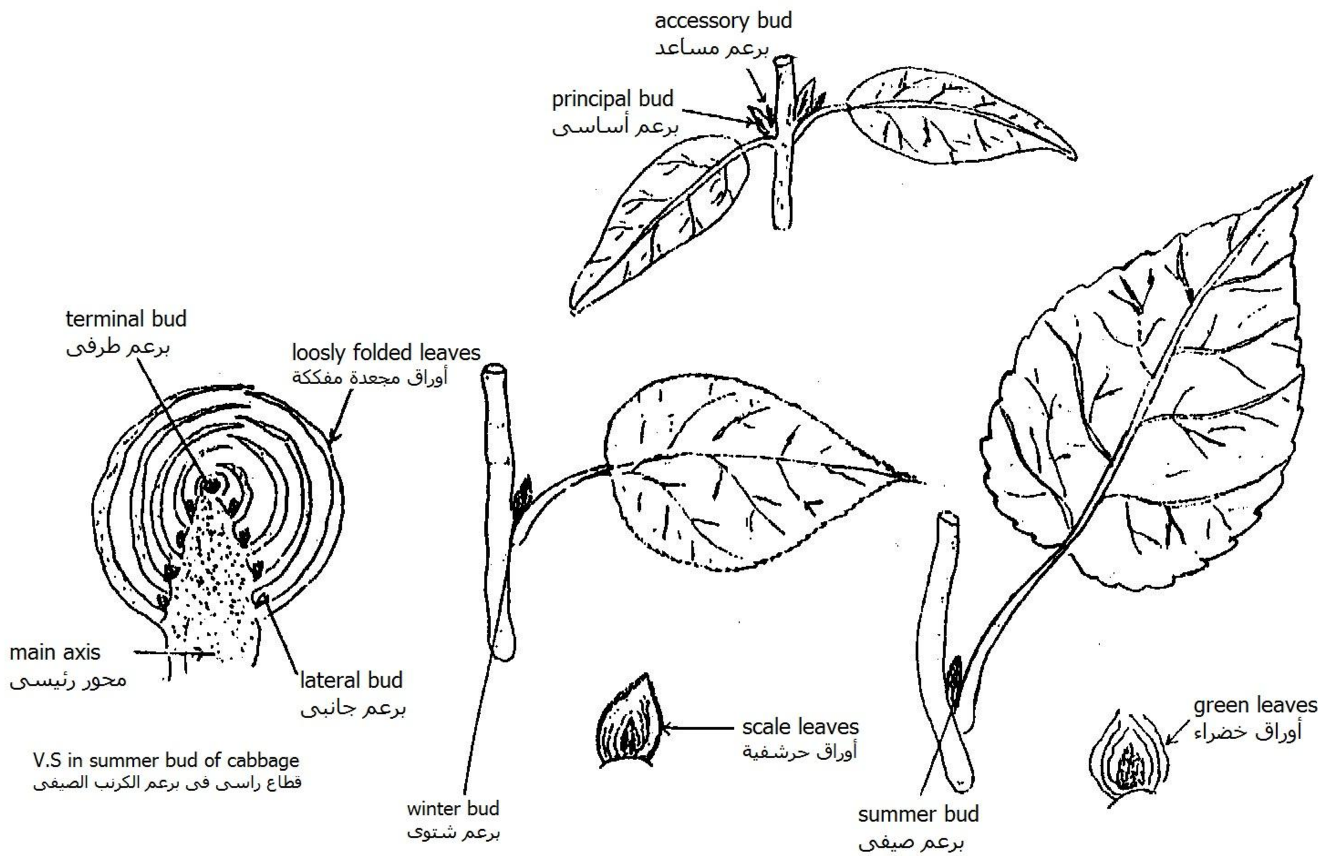
(الســاق)

البراعم:

١- **تنقسم البراعم تبعاً لموضعها على الساق إلى:**
   - أ- **برعم طرفى:** يوجد فى قمة الساق كما فى الدورنتا.
   - ب- **برعم جانبى (إبطى):** يوجد فى إبط الأوراق كما فى الدورنتا كما يوجد أحياناً بالإضافة إليه برعم مساعد.

٢- **كما تنقسم البراعم تبعاً لتركيبها إلى:**
   - أ- **براعم ورقية (صيفية أو عارية):** تتكون من اوراق برعمية خضراء مفككه كما فى الكرنب والدورنتا.
   - ب- **براعم حرشفية (شتوية او مغطاه):** تتكون من أوراق خضراء تغلفها بأوراق حرشفية جافة كما فى التوت والحور.

The buds البراعم



Branching of the stem:

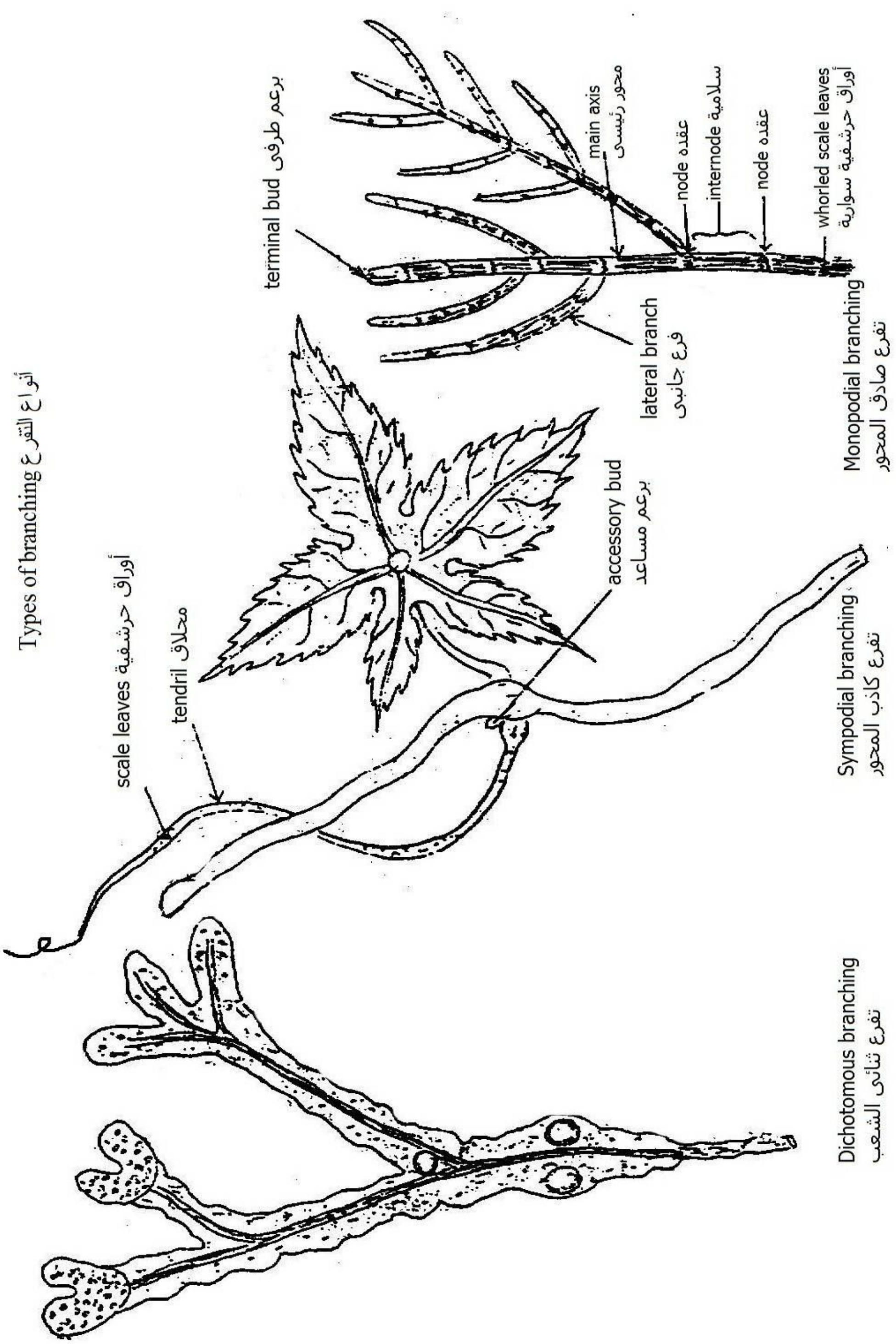
1- **Monopodial branching:** (e.g: *Casuarina*) the axis of the plant is given by the same terminal bud, leaves very small, whorled and united at the base, on short green branches.

2- **Sympodial branching:** (e.g: *Vitis*) the axis of plant consists of many segments which differ in origin. The terminal bud is transformed into tendril and the axillary bud completed the growth to form one or more segments or internodes of stem.

تفرع الساق:

١- **تفرع صادق المحور:** كما فى الكازورينا حيث يلاحظ أن البرعم الطرفى يظل مستمراً فى نموه والأفرع الجانبية تخرج من البراعم الأبطية والأوراق صغيرة وسوارية.

٢- **تفرع كاذب المحور:** كما فى العنب حيث يتوقف البرعم الطرفى عن النمو لتحوره إلى محلاق أو تكوينه زهرة ويواصل النبات نموه بواسطة أحد البراعن الإبطية.


Types of branching أنواع التفرع
terminal bud برعم طرفى
main axis محور رئيسى
node عقده
internode سلامية
node عقده
whorled scale leaves أوراق حرشفية سوارية
lateral branch فرع جانبى
Monopodial branching تفرع صادق المحور
scale leaves أوراق حرشفية
tendril محلاق
accessory bud برعم مساعد
Sympodial branching تفرع كاذب المحور
Dichotomous branching تفرع ثنائى الشعب

Forms of aerial stems:

1- **Erect stem:** e.g. *Duranta*.
2- **Climbing stem**
   a- **By tendrils:** e.g. *Vitis*.
   b- **By twining:** e.g. *Convolvulus*.
   c- **By petiols:** e.g. *Tropaeolum*.
3- **Weak stems**
   a- **Prostrate stem:** The stem creeps on the ground, but the roots do not arise at the nodes, e.g. watermelon.
   b- **Creepers –** The stem creeps on earth and the roots arise at the nodes, e.g.: Strawberry.

أشكال السيقان الهوائية:

١- **ساق قائمة:** الدورنتا

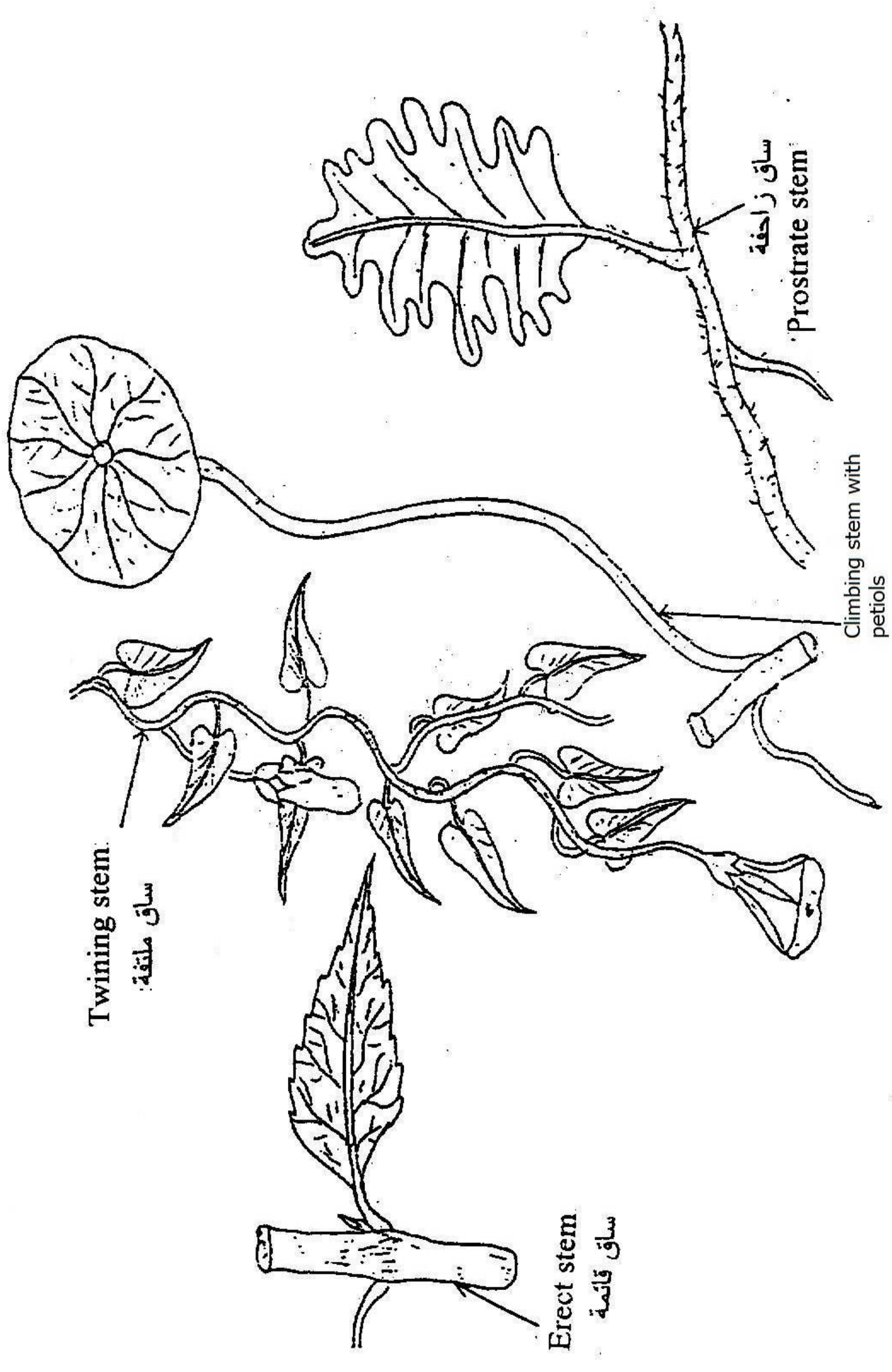
٢- **ساق متسلقة :** ويكون ذلك بإستخدام

أ- **المحلايق:** العنب. ب- **الإلتفاف:** العليق ج- **أعناق الأوراق:** ابوخنجر.

٣- **سيقان ضعيفة:** ومنها

أ- **ساق زاحفة:** البطيخ. ب- **ساق جارية**: الفراولة.

Forms of aerila stems أشكال السيقان الهوائية



Modified stems:

The stem may be modified to serve the following functions:

1- **Assimilation**:

a- ***Ruscus***: Here the shoots generally develop a reduced leaves, while the branch becomes flat and performs the functions of leaves (leafy stem).

b- ***Opuntia***: The metamorphosed shoot is large, flattened and green. It is fleshy owing to storage of water (**Succulent stem)**. It bears small fleshy leaves which drop often very early. Spines occur in leaf axis.

2- **Reduction of transpiring surface:** (e.g: *Alhagi*). The branches take the form of spines.

3- **Climbing:** (e.g: *Vitis*). Here the bud instead of giving a branch, gives a tendril.

4- **Perennation, food storage and vegetative reproduction:** In this case the metamorphosed stems are subterranean and bear scale leaves. The reserve food material is stored in the underground stems or in the leaves.

a- **Rhizome:** underground stem, horizontally divided into nodes and internodes, and covered by scale leaves. Note the adventitious roots, axillary buds, terminal bud and the aerial shoots. (e.g: Rhizome of *Canna* and *Cynodon*).

b- **Tuber:** (e.g: *Solanum tuberosum*). Fleshy tips of underground stems, small leaves and buds occur in surface pits (eyes). Note the terminal bud at one end and the position of attachment to the stalk at the other end.

c- **Corm:** (e.g: *Colcasia anticorm*). Subterranean swollen stem, vertically divided into nodes and internodes. Note that the internodes are encircled by scaly leaves arising at the nodes and axillary buds. Make a median longitudinal cut in the corm and sketch the cut surface. Note the corm of the present year (main bulk), with a remainant of the corm of the last year at its base. Corm of the next year will arise from any of the lateral bude.

d- **Bulb:** (e.g: Onion). Shortened shoot with a flattened discoid stem and fleshy leaf bases in which the reserve food material is stored. The terminal bud will give a flowering shoot. An axillary bud will give the bulb of the next year. Note also the dry brown scales and the adventitious roots.

5- **Dwarf stem:** e.g: *Pinus*.

6- **Discoid stem:** e.g: Carrot and radish.

تحورات السيقان:

تتحور السيقان لأداء الوظائف التالية:

١- التمثيل (البناء الضوئى):

أ- **السفندر:** الساق لها شكل ورقى وما يدل على أنها ساق أنها تخرج من إبط ورقة حرشفية وتحمل أوراق حرشفية فى آباطها براعم زهرية.

ب- **التين الشوكى:** ساق مفلطحة لها أوراق خضراء تتساقط مبكراً وفى آباطها إنتفاخات عليها أشواك عديدة (وهى **ساق عصيرية**).

٢- **تقليل معدل السطح الناتح:** وفيه تتحور السيقان الجانبية إلى أشواك.

٣- **التسلق:** كما فى العنب حيث تتحور الببراعم ألى محاليق للتسلق.

٤- **التعمير والتخزين والتكاثر الخضرى:** وفيها تكون الساق تحت أرضية

أ- **الريزوم:** ساق تحت أرضية يوجد عليها عقد يخرج منها جذور عرضية وأوراق حرشفية فى آباطها براعم وللريزوم برعم طرفى وآخر إبطى (الكانا- النجيل).

ب- **الدرنة: (البطاطس)**. ساق أرضية يلاحظ عليها العيون الغائرة التى بداخلها عدة براعم وتوجد العين فى غبط ورقة حرشفية تسقط مبكراً.

ج- **الكورمة: (القلقاس)**. ساق أرضية متضخمة تنمو عمودياً اسفل سطح التربة. لاحظ لعقد والسلاميات والأوراق الجرشفية التى فى آباطها براعم. كما يلاحظ البرعم الطرفى والجذور العرضية وبقايا كورمة السنة الماضية وكورمة السنة القادمة.

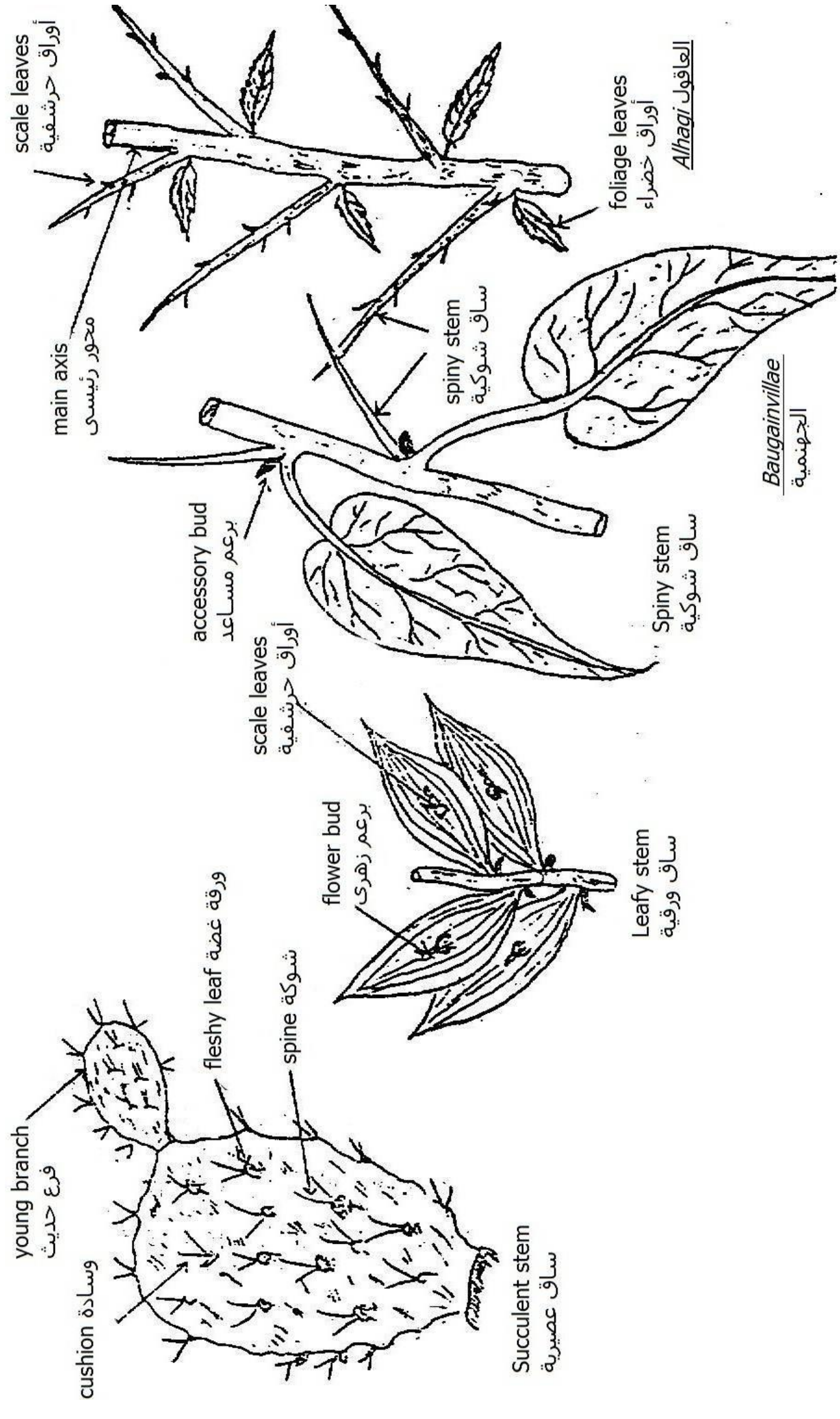
د- **البصلة: (البصل)** ساق أرضية قصيرة منبسطة قرصية الشكل تحمل أوراق حرشفية تغطى قواعد الأوراق المتشحمة. كما يلاحظ البرعم الطرفى والبراعم الإبطية والجذور العرضية الليفية.

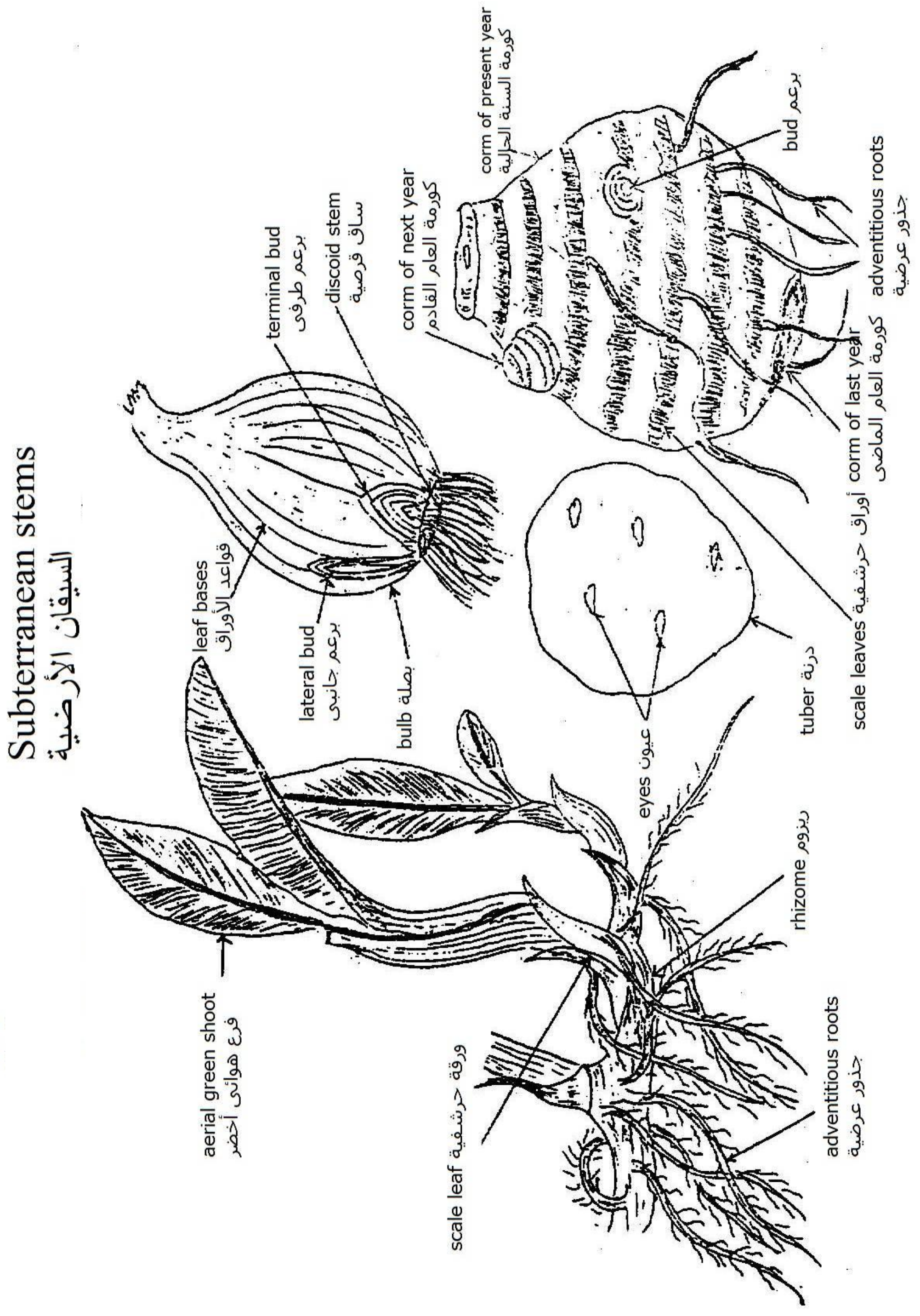
٥- **ساق متقزمة:** الصنوبر.

٦- **ساق قرصية:** الجزر والفجل.

Metamorphased aerial stems

السيقان الهوائية المتحورة




Subterranean stems
السيقان الأرضية
aerial green shoot
فرع هوائى أخضر
scale leaf ورقة حرشفية
leaf bases
قواعد الأوراق
lateral bud
برعم جانبى
bulb بصلة
terminal bud
برعم طرفى
discoid stem
ساق قرصية
corm of next year
كورمة العام القادم
corm of present year
كورمة السنة الحالية
bud برعم
adventitious roots
جذور عرضية
corm of last year
كورمة العام الماضى
scale leaves أوراق حرشفية
tuber درنة
eyes عيون
rhizome ريزوم
adventitious roots
جذور عرضية

Leaves and their modifications.

Leaf petiole:

a- Sessile: petiole absent: (e.g: *Linum*).

b- Petiolate:

1- Normal petiole: (e.g: *Eucalyptus*).

2- Elongate petiole: (e.g: *Colocasia*).

3- Climbing petiole: (e.g: *Tropaeolum*).

الأوراق وتحوراتها:

تنقسم الأوراق تبعاً لوجود العنق إلى:

أ- ورقة جالسة: لايوجد لها عنق كما فى الكتان.

ب- ورقة معنقة: وتنقسم إلى

١- **عنق عادى:** كما فى الكافور.

٢- **عنق طويل:** كما فى القلقاس.

٣- **عنق متسلق:** كما فى أبوخنجر.

Leaf base:

1- Exstipulate: e.g. *Eucalyptus*.

2- Stipulate: classified into the following:

a- Hairy stipules: e.g. *Corchorus*.

b- Ordinary stipules: e.g. *Rosa*.

c- Leafy stipules: e.g. *Lathyrus*.

d- Stipuleolate: e.g. *Phaseolus*.

e- Spiny stipules: e.g. *Acacia* and *Ziziphus*.

كما تنقسم الوراق تبعاً لقاعدتها إلى:

١- **ورقة غير مؤذنة:** كما فى اوراق الكافور.

٢- **ورقة مؤذنة:** وتنقسم إلى

أ- **أذينات شعيرية:** كما فى الملوخية.

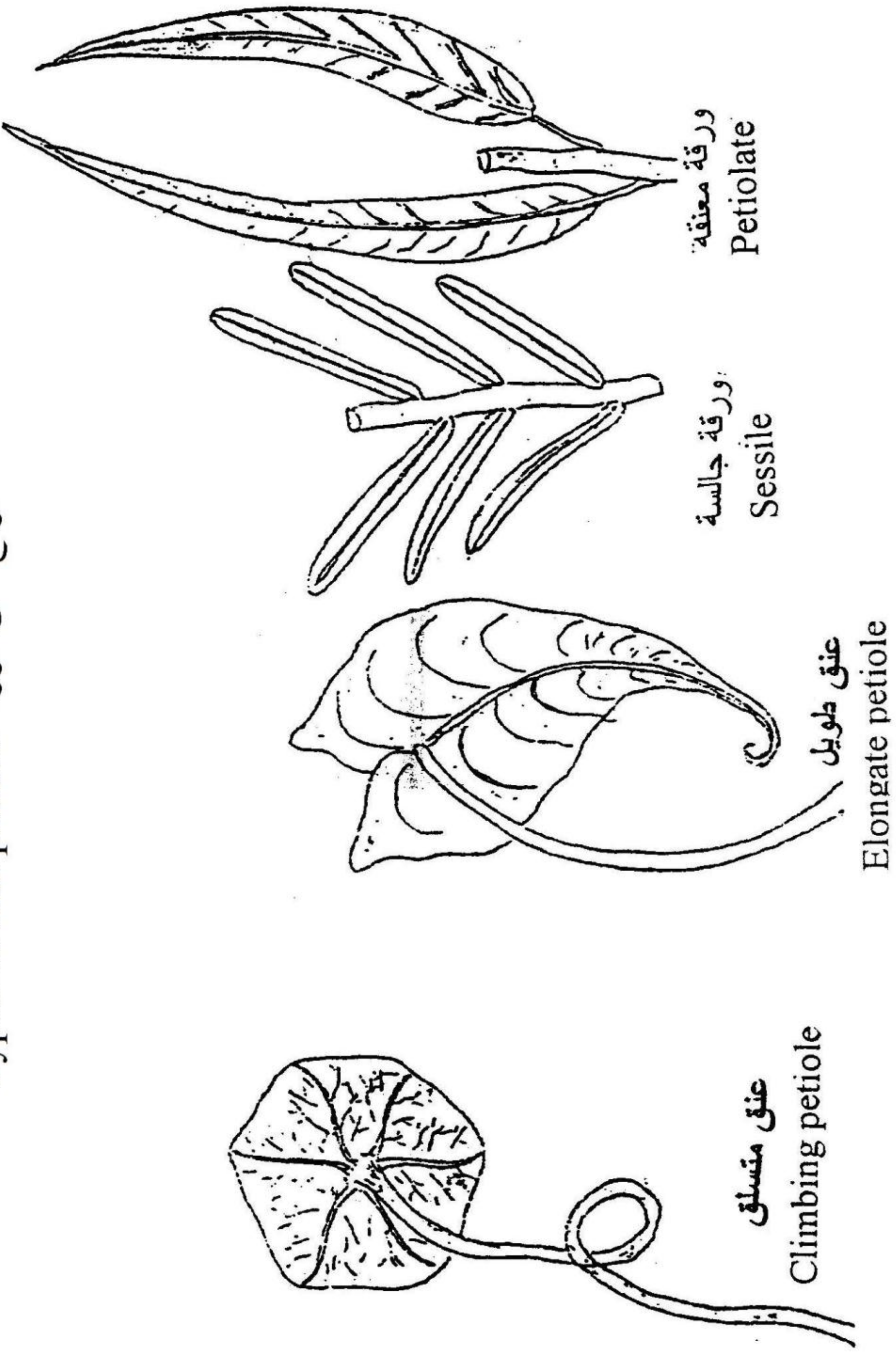
ب- **أذينات عادية:** كما فى الورد.

ج- **أذينات متورقة:** كما فى البسلة.

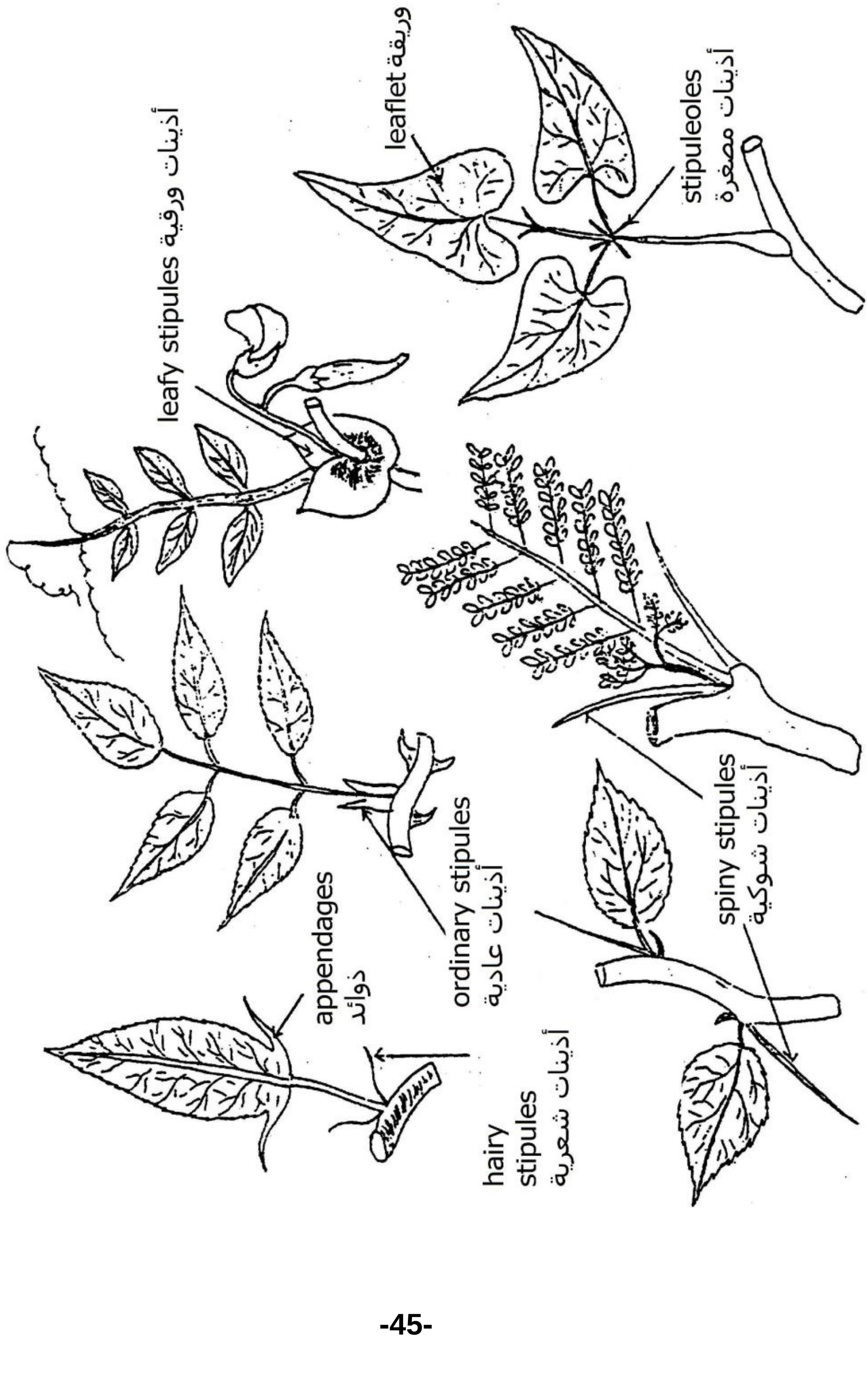
د- **أذينات مصغرة:** كما فى الفاصوليا.

هـ- **أذينات شوكية:** كما فى السنط والسدر.

Types of leaf petiole أنواع عنق الورقة



Leaf base قاعدة الورقة



Leaf venation:

1- **Reticulate:**
   - a- **Pinnate:** e.g. *Ficus*.
   - b- **Palmate:** e.g. *Ricinus*.

2- **Parallel:**
   - a- **Longitudinal:** e.g. *Triticum* (wheat).
   - b- **Transverse:** e.g. *Musa*.

التعرق فى الأوراق:

١- **تعرق شبكى:**

أ- **شبكى ريشى:** كما فى التين.

ب- **شبكى راحى:** كما فى الخروع.

٢- **تعرق متوازى:**

أ- **متوازى طولى:** كما فى القمح.

ب- **متوازى مستعرض:** كما فى الموز.

Leaf arrangement:

1- **Alternate:** e.g. *Eucalyptus*.

2- **Opposite superposed:** e.g. *Duranta*.

3- **Opposite decussate:** e.g. *Calotropis*.

4- **Whorled or verticillate:** e.g. *Nerium*.

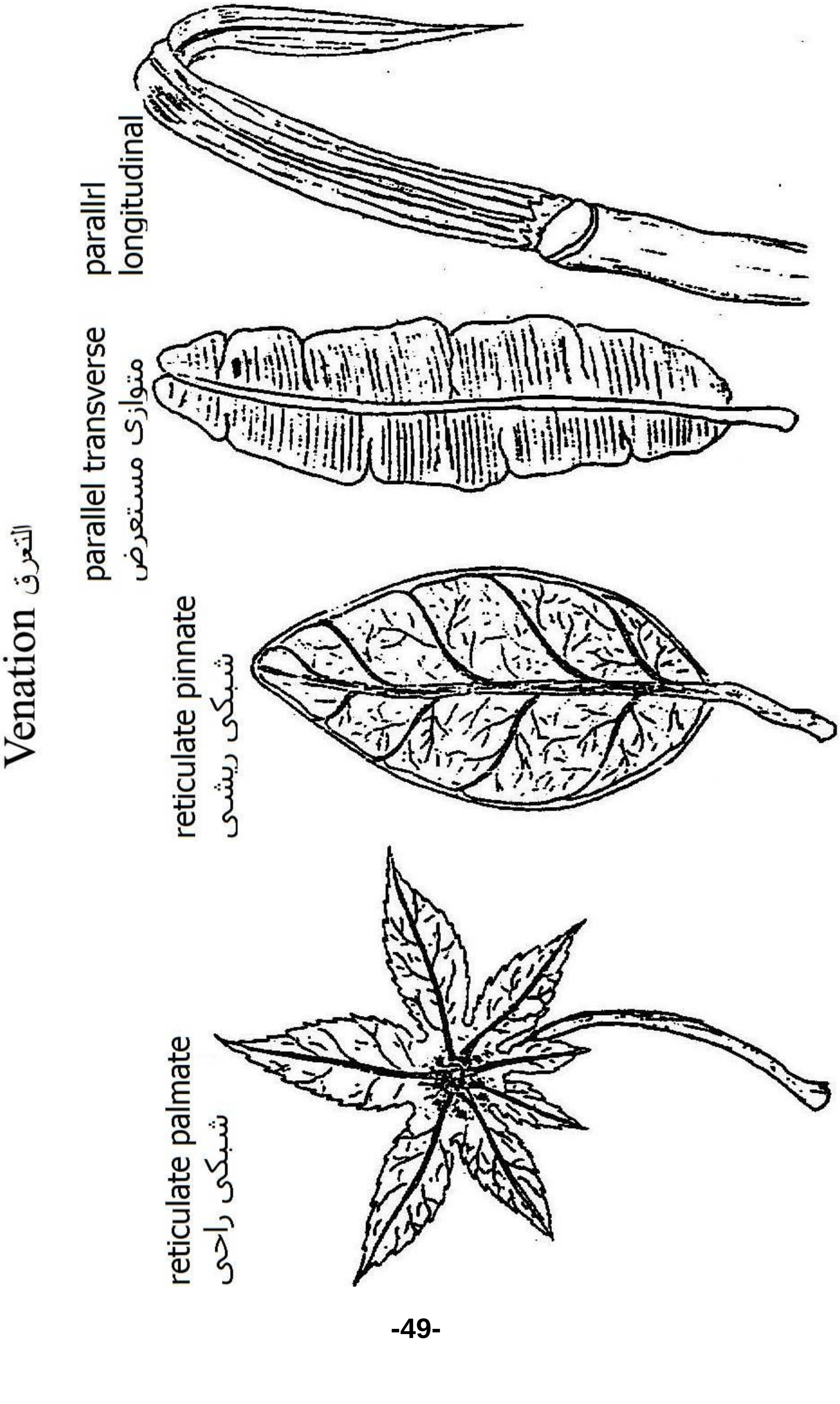
توزيع الأوراق على الساق:

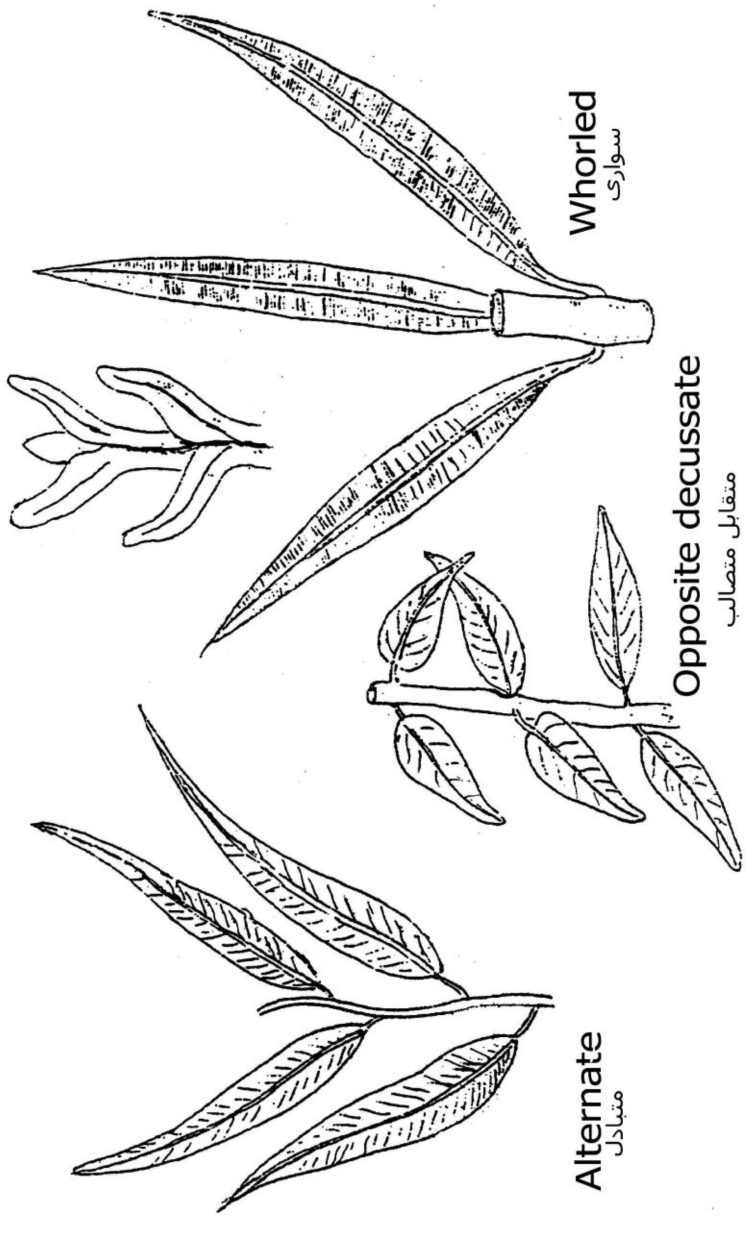
١- **متبادل:** الكافور.

٢- **متقابل:** الدورنتا.

٣- **متقابل متصالب:** أم العشار.

٤- **سوارى (محيطى):** الدفلة.


Venation التعرق
parallrl longitudinal
parallel transverse
متوازى مستعرض
reticulate pinnate
شبكى ريشى
reticulate palmate
شبكى راحى



Arrangemet of the leaves on the stem ترتيب الأوراق على الساق

Leaf blade

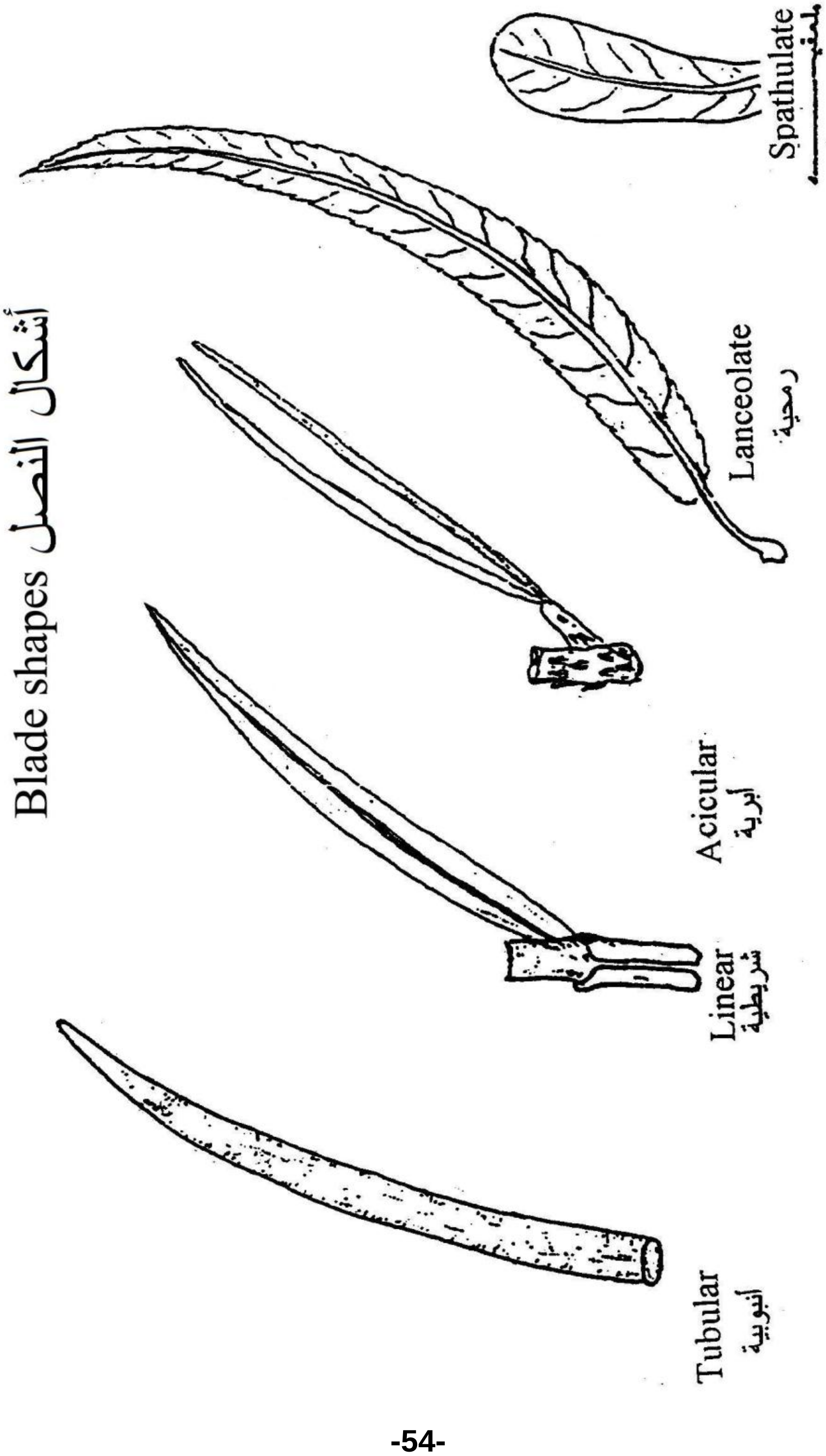
A- Shape:

1- **Needle like or acicular:** e.g. *Pinus*.
2- **Linear:** e.g. wheat.
3- **Ovate:** e.g. *Ficus*.
4- **Spathulate:** e.g. *Portulaca*.
5- **Cordate:** e.g. *Ipomoea*.
6- **Reniform:** e.g. *Bauhenia*.
7- **Peltate:** e.g. *Tropaeolum*.
8- **Lanceolate:** e.g. *Eucalyptus*.
9- **Hastate**: e.g. *Convolvulus*.
10- **Tubular**: e.g. *Allium.*
11- **Sagittate:** e.g. *Calla*.
12- **Elliptical:** e.g. *Poinciana*.

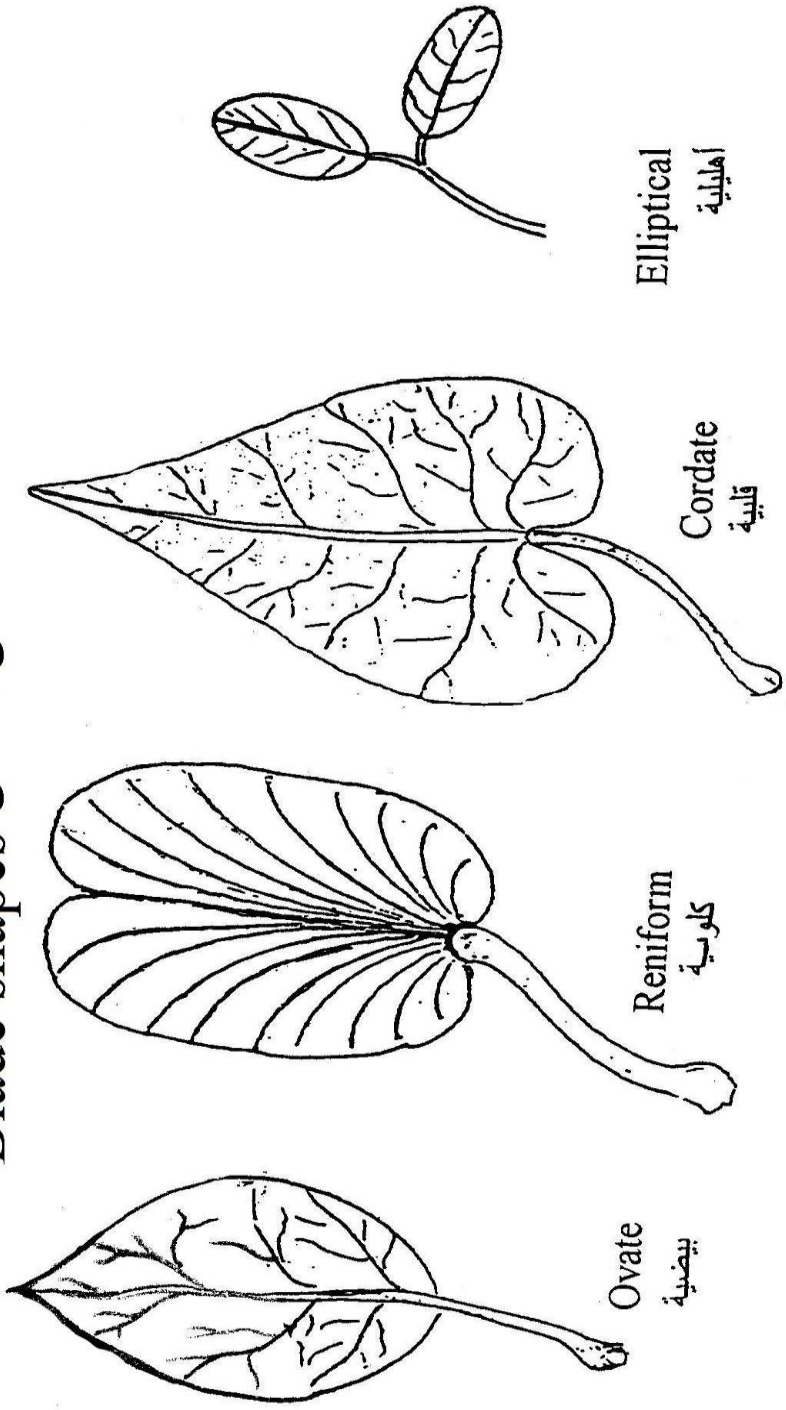
النصـل:

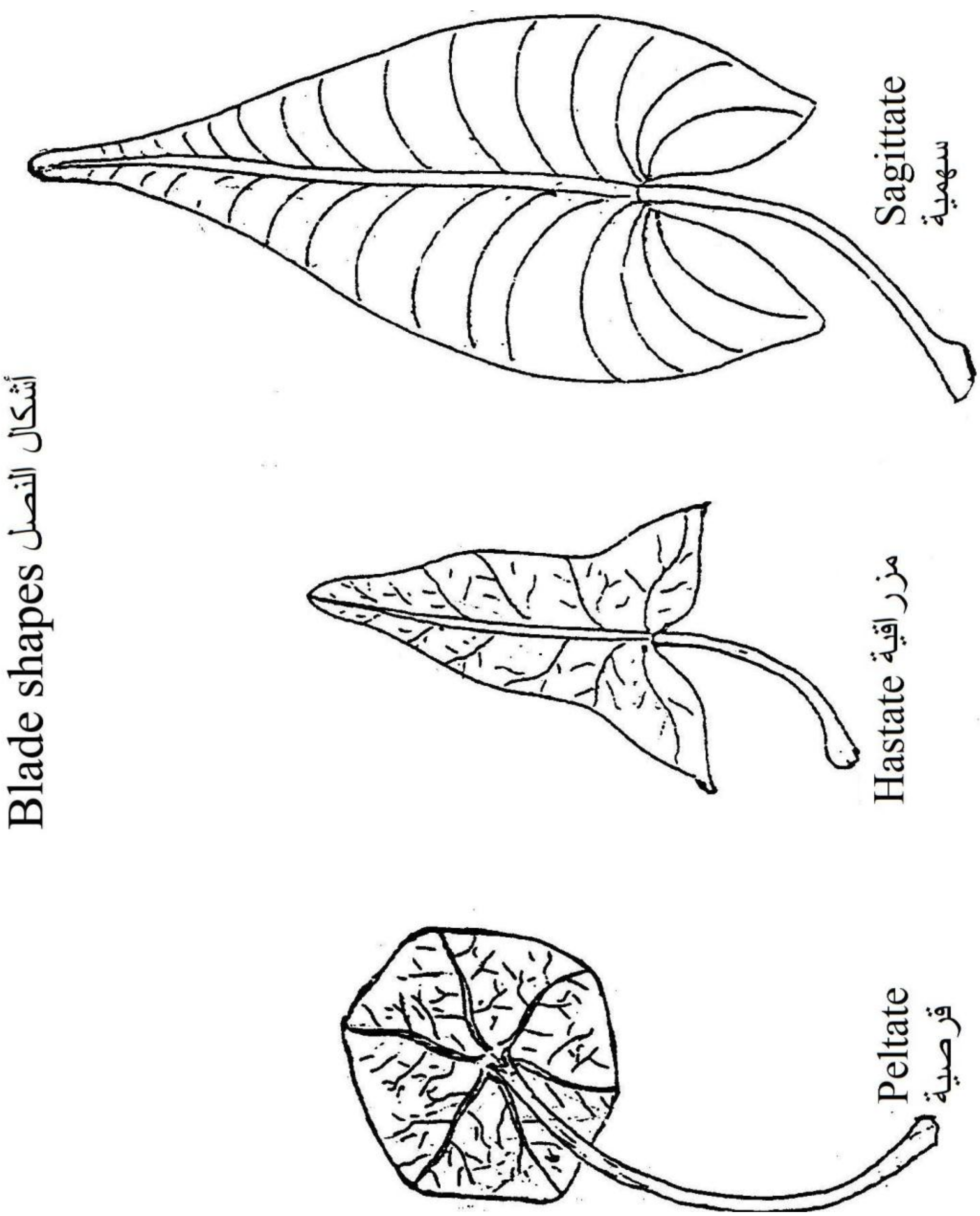
أ- **شكل النصل:**

١- **ورقة إبرية:** الصنوبر.
٢- **ورقة شريطية:** القمح.
٣- **ورقة بيضية:** التين.
٤- **ورقة ملعقية:** الرجلة.
٥- **ورقة قلبية:** ست الحسن.
٦- **ورقة كلوية:** خف الجمل.
٧- **ورقة قرصية:** أبوخنجر.
٨- **ورقة رمحية:** الكافور.
٩- **ورقة مزراقية:** العليق.
١٠- **ورقة انبوبية:** البصل.
١١- **ورقة سهمية:** الكالا.
١٢- **ورقة أهليلية:** البوانسيانا.


Blade shapes أشكال النصل
Spathulate
ملعقية
Lanceolate
رمحية
Acicular
ابرية
Linear
شريطية
Tubular
انبوبية

Blade shapes أشكال النصل




Blade shapes أشكال النصل
Sagittate
سهمية
Hastate مزراقية
Peltate
قرصية

B- Leaf margin:

1- **Entire:** e.g. *Ficus*.
2- **Dentate:** e.g. *Duranta*.
3- **Serrate:** e.g. *Rosa*.
4- **Crenate:** e.g. *Morus*.
5- **Sinuate:** e.g. *Cuercus*.

ب- حافة الورقة:

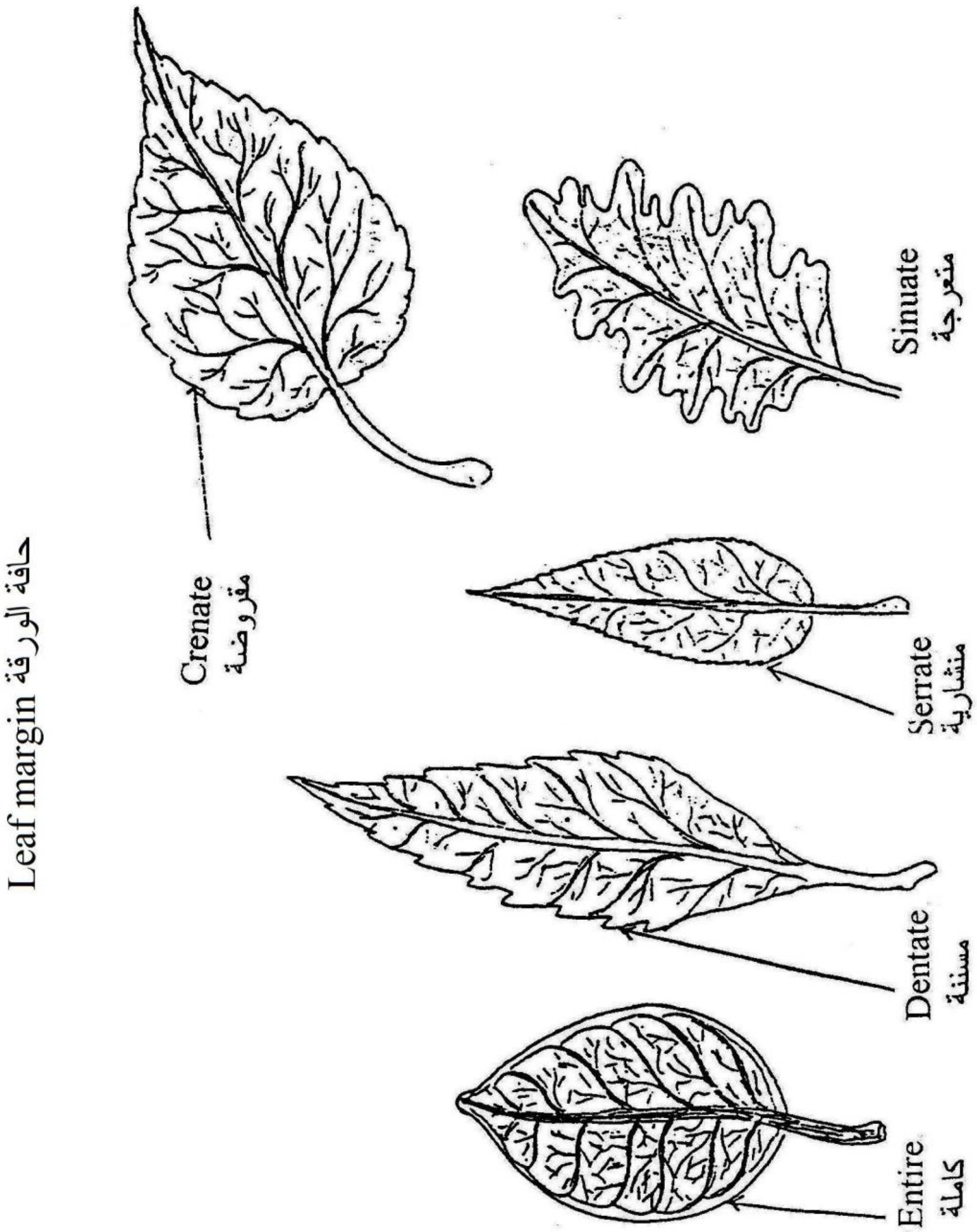
١- **كاملة:** التين.
٢-**مسننة:** الدورنتا.
٣-**منشارية:** الورد.
٤- **مقروضة:** التوت.
٥- **متعرجة:** البلوط.

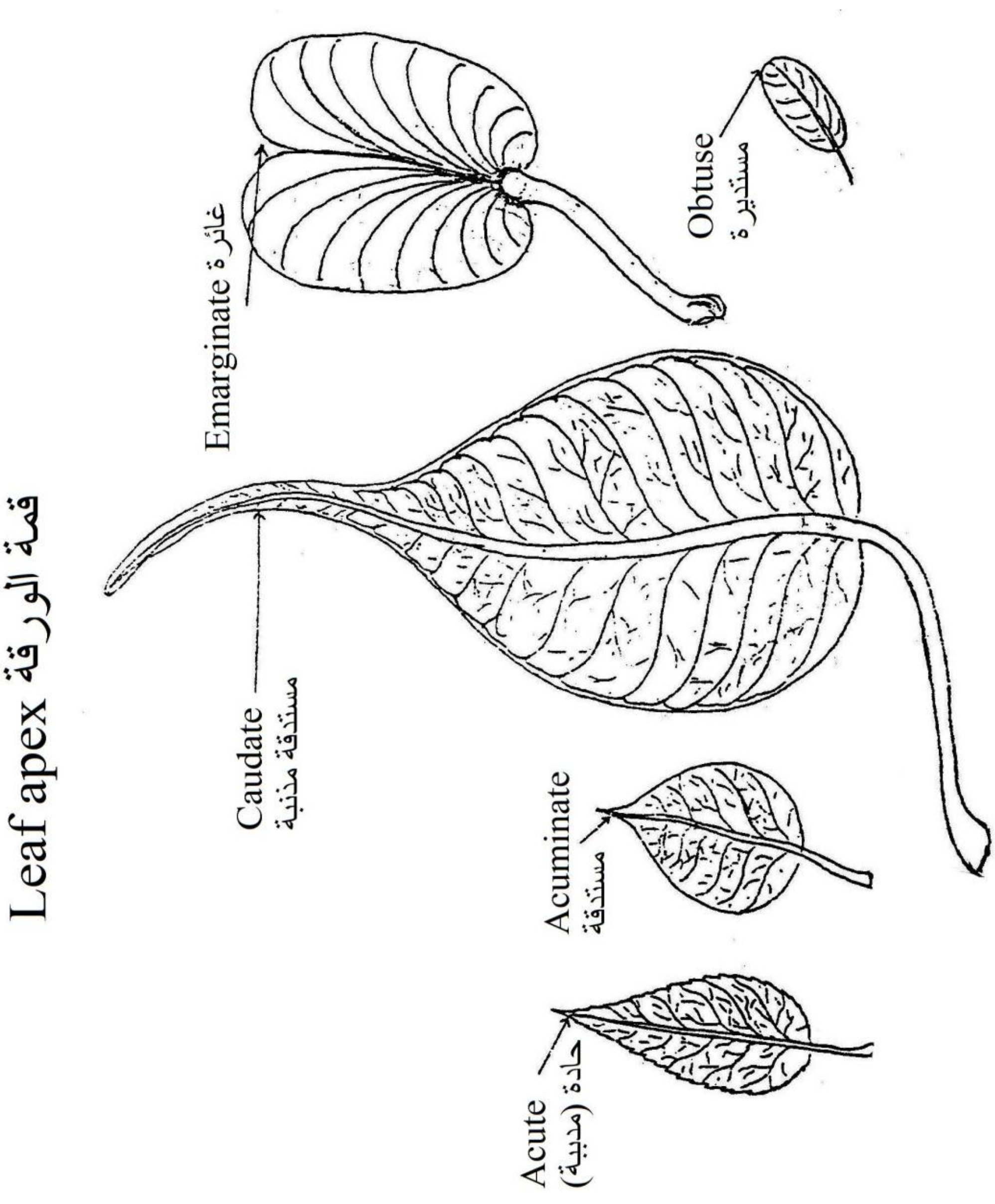
C- Leaf apex:

1- **Acute:** e.g. *Duranta*.
2- **Laminata:** e.g. *Dalbergia*.
3- **Caudate:** e.g. *Ficus religiosa*.
4- **Obtuse:** e.g. *Albezzia*.
5- **Emarginate:** e.g. *Bauhinia*.

ج- قمة الورقة:

١- **حادة (مدببة):** الدورنتا
٢- **مستدقة:** السرسوع.
٣- **مستدقة مذنبة:** التين المذنب.
٤- **مستديرة:** اللبخ.
٥- **غائرة:** خف الجمل.


Leaf margin حافة الورقة
Crenate مقروضة
Sinuate متعرجة
Serrate منشارية
Dentate مسننة
Entire كاملة


Leaf apex قمة الورقة
Emarginate غائرة
Caudate
مستدقة مذنبة
Obtuse
مستديرة
Acuminate
مستدقة
Acute
حادة (مدببة)

D- Leaf composition:

1- **Simple:** e.g. *Ficus nitida*.

2- **Compound leaf:**

  a- **Compound pinnate:**

    1- **Paripinnate:** e.g. *Albizzia*.

    2- **Imparipinnate:** e.g. *Rosa*.

    3- **Bipinnate:** e.g. *Poinciana*.

  b- **Compound palmate:** e.g. *Lupinus*.

3- **Lobed leaf:**

  a- **Palmately lobed:**

    1- **Palmatifid:** e.g. *Pelargonium*.

    2- **Palmatipartite:** e.g. *Ricinus*.

    3- **Palmatisect:** e.g. *Ipomoea* sp.

  b- **Pinnately lobed:**

    1- **Pinnatifid:** e.g. *Chrysanthemum*.

    2- **Pinnatipartite:** e.g. *Sernaria*.

    3- **Pinnatisect:** e.g. *Foeniculum*.

د- تركيب الورقة:

١- **بسيطة:** التين.

٢- **مركبة:**

(أ) مركبة ريشية:

١- **مركبة ريشية زوجية:** اللبخ.

٢- **مركبة ريشية فردية:** الورد.

٣- **مركبة ريشية متضاعفة:** البوانسيانا.

(ب) مركبة راحية: الترمس.

٣- **مفصصة:**

(أ) مفصصة راحية:

١- **ضحلة التفصص الراحى:** الجارونيا.

٢- **عميقة التفصص الراحى:** الخروع.

٣- **مشرحة التفصص الراحى:** ست الحسن المشرحة.

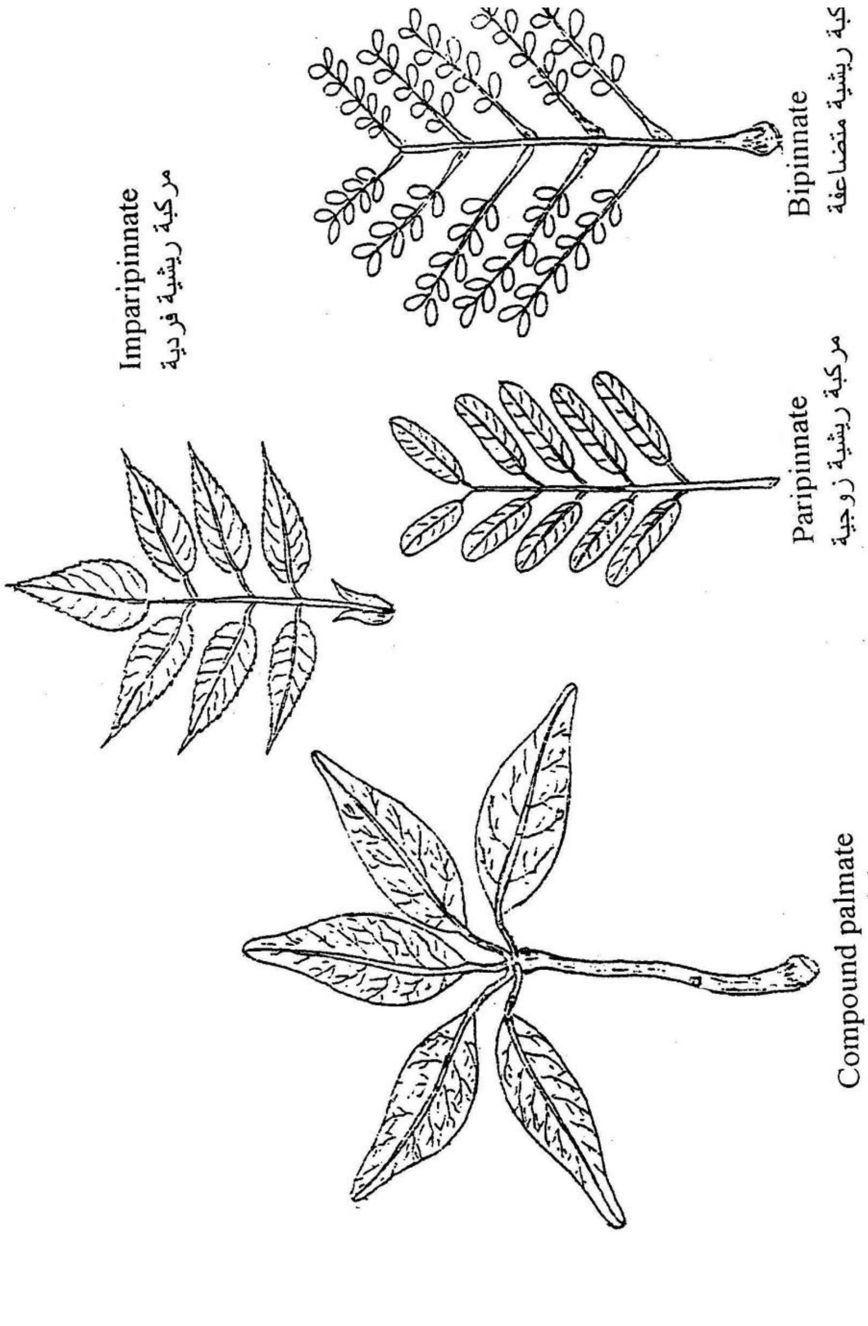
(ب) مفصصة ريشية:

١- **ضحلة التفصص الريشى:** الكريزانثيم.

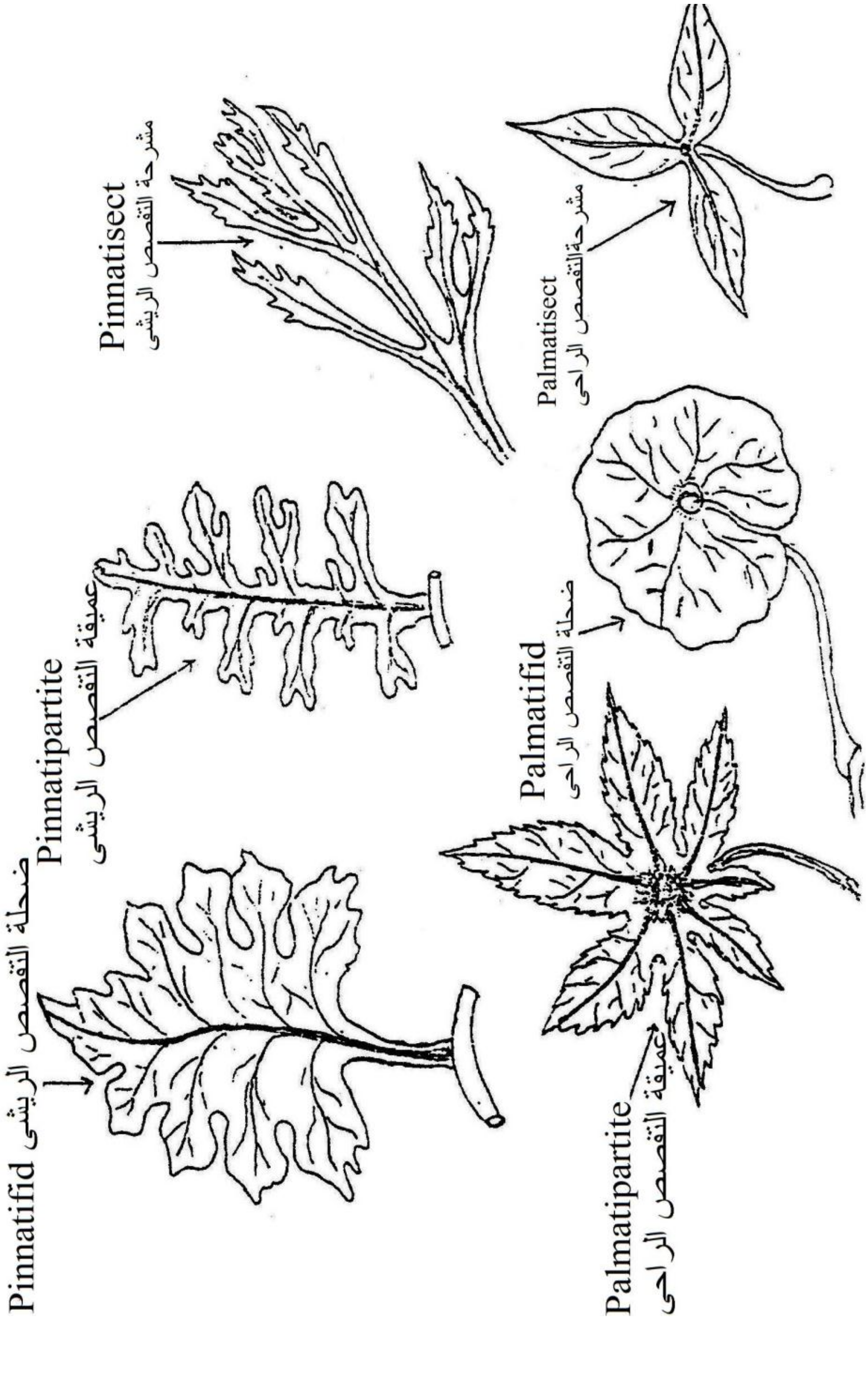
٢- **عميقة التفصص الريشى:** السيناريا.

٣- **مشرحة التفصص الريشى:** الشمر.

Compound leaves الأوراق المركبة



Lobed leaves الأوراق المفصصة



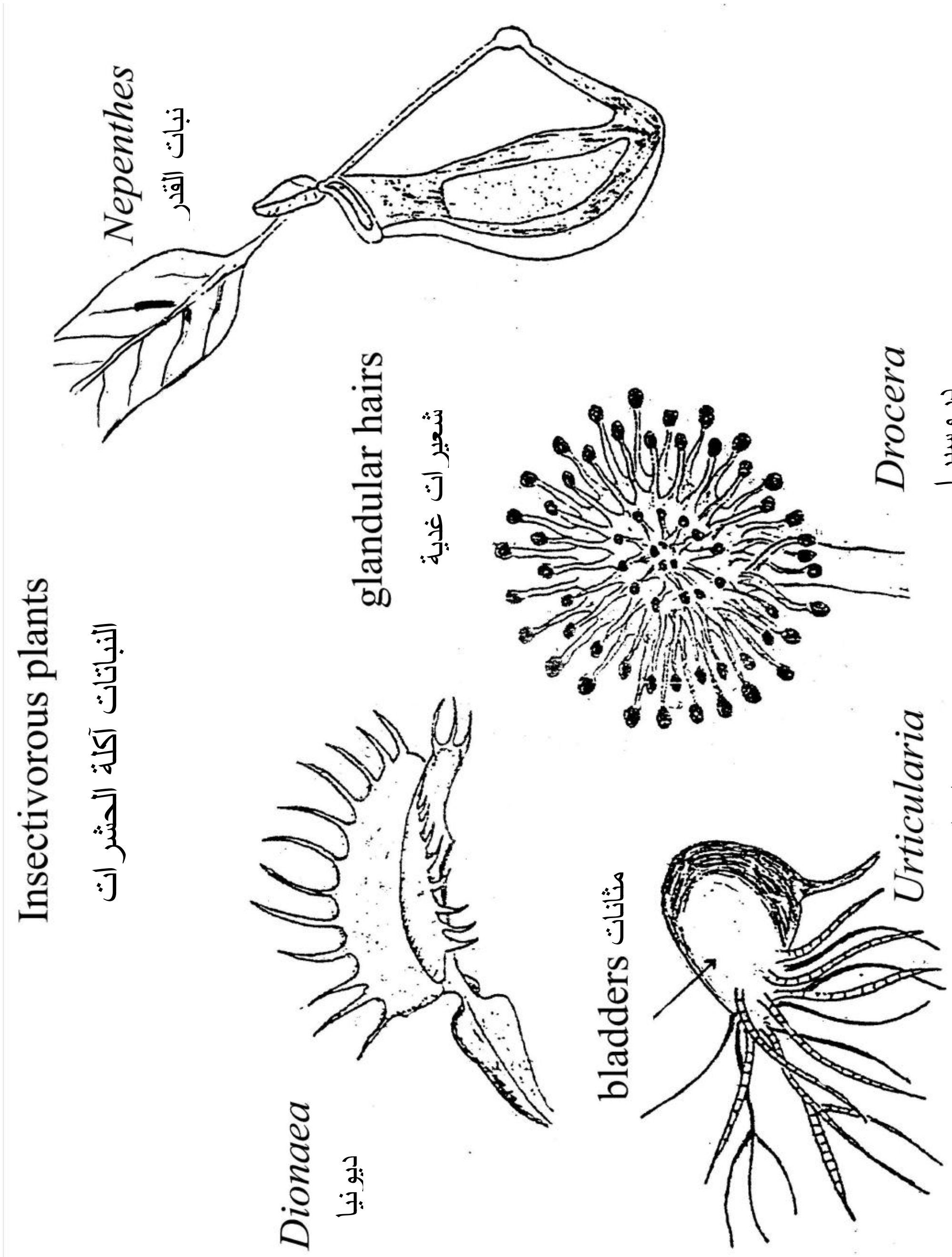
Modifications of the leaf

1- **Scale leaf:** e.g. *Cynodon*.
2- **Tendrils:** e.g. *Pisum* (leaflet modified into tendril).
3- **Spiny leaf:** e.g. *Acacia* (stipules modified into spines).
4- **Storage leaf:** e.g. *Zygophyllum*.
5- **Insectivorous plants:**
   a- ***Nepenthes*:** The leaf modified into pitcher.
   b- ***Drocera*:** Possesses cylindrical petioles and oval shape blades covered with glandular hairs.
   c- ***Dionaea*:** The blade composed of two lobes which captures insects.
   d- ***Urticularia*:** Some leaflets are modified into bladders.

تحورات الورقة:

١- **ورقة حرشفية:** النجيل. ٣- **أذينات شوكية:** السنط.
٢- **وريقات محلاقية:** البسلة. ٤- **ورقة تخزينية:** الرطريط.

٥- **تحورات أوراق النباتات آكلة الحشرات:**
أ- **النبنسس:** تتحور الورقة إلى وعاء يشبه القدر.
ب- **الدروسيرا:** لها عنق اسطوانى ونصل بيضى الشكل عليه شعيرات غدية.
ج- **الديونيا:** النصل يتكون من مصراعين على حافتهما ذوائد حادة.
د- **حامول الماء:** بعض الوريقات تتحور إلى مثانات.


Insectivorous plants
النباتات آكلة الحشرات
Nepenthes
نبات القدر
glandular hairs
شعيرات غدية
Drocera
دروسيرا
Dionaea
ديونيا
bladders مثانات
Urticularia
حامول الماء

بسم الله الرحمن الرحيم

اسم الطالب: --

الكلية:------------------------- الفرقة/الشعبة:-----------------------------------

الفصل الدراسى:--------------- العام الجامعى:-------------------------------------

الأسبوع	التاريخ	توقيع المعيد أو المدرس المساعد	توقيع المشرف
الأول			
الثانى			
الثالث			
الرابع			
الخامس			
السادس			
السابع			
الثامن			
التاسع			
العاشر			
الحادى عشر			
الثانى عشر			
الثالث عشر			
الرابع عشر			

Practical
Plant Anatomy

Prepared by:

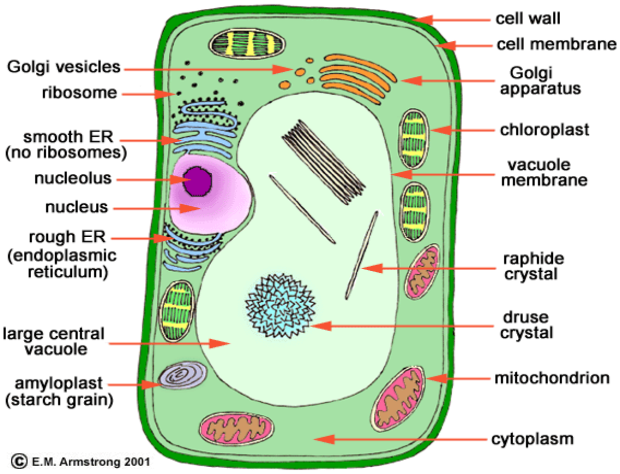
Ahmed Kamal El-Din Osman

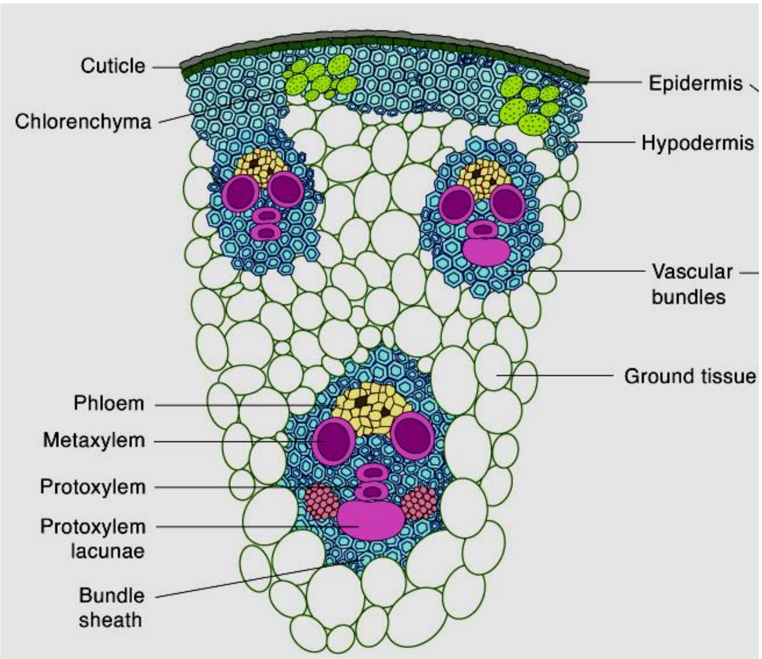
Faculty of Science

Botany and Microbiology Department

2022 / 2023

الدروس العملية في التشريح





Microscope

Study the different parts of the microscope, with the aid of the plate. **Preparation of material for examination:**

Place a drop of water on a clean slide. The material to be examined is placed in this water. With the edge of the clean cover slip touching this water and tilted at an angle with slide, drop the cover slip until no air bubbles are formed. Blot off any excess water.

General remarks on using the microscope:-

1-Before using the microscope be sure all lenses are clean.

2–Always, keep the stage clean and dry.

3 - Move the mirror before the test to provide the best illumination and the best image.

4 – To study an object use first the low power and then high power. Do not use the latter before putting a cover slide.

5 - When you use the high power, use only the fine adjustment.

6 - Use both your eyes when looking in the microscope.

الميكروسكوب

ادرس اجزاء الميكرسكوب وذلك بالاستعانة بالرسم الموجود امامك.

طريقة تجهيز عينة للفحص ميكروسكوبيا:

ضع نقطة ماء علي شريحة نظيفة ثم ضع العينة المراد فحصها علي نقطة الماء ثم امسك الغطاء cover بين الاصبعين في وضع مائل ثم تخفض تدريجيا حتي يلامس سطح نقطة الماء بحيث يكون مرتكزا علي جانبه لتلافي تكوين فقاعات هوائية.

ارشادات عامة لاستعمال الميكروسكوب:

1- قبل استعمال الميكروسكوب نظف جميع عدساته بورق البفره.

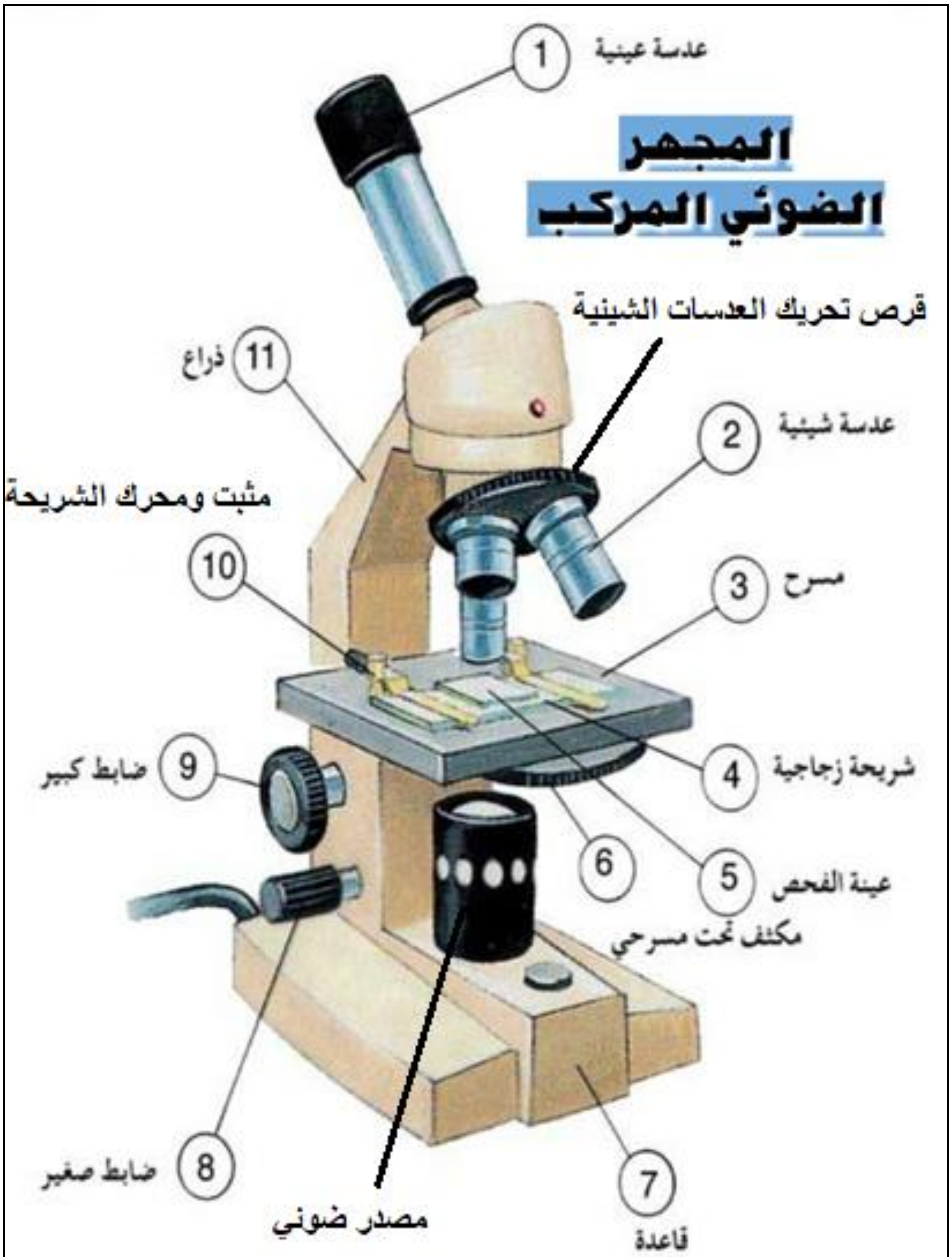
2- دائما اجعل المسرح او المنصة نظيفا وجافا.

3- حرك المرآة قبل الفحص للحصول علي احسن اضاءة.

4- افحص العينة اولا بالقوة الصغري ثم الكبري ولا تستعمل القوة الكبري دون استعمال غطاء للشريحة.

5- عند استعمال العدسة الكبري استعمل الضابط الصغير او الدقيق فقط.

6- استعمل كلتا عيناك عند النظر في الميكرسكوب.



تركيب الميكرسكوب الضوئي

Plant anatomy

Structure of the plant cell.

I. Living cell contents:

a) Cytoplasm b) nucleus

Examine a stripe of upper epidermis of fleshy onion.

c) Plastids

1- Chloroplast: Examine the leaf of *Elodea* and examine the spiral shape chloroplast of *Spirogyra*.

2- Chromoplast : squash little of tomato fruit and observe the different shape of chromoplast.

I. Non-living cell contents:

1- Starch grains:

a) Potato starch: three types which are simple (with excentric hilum), semi compound and compound grains.

b) *Phaseolus* starch: characterized by a branched hilum.

c) Wheat starch: simple grains with a concentric hilum.

d) Rice starch: very small and grouped in compound grains.

e) *Zea* starch: characterized by elongated and branched hilum.

2- Aleurone grains: composed of crystalloid and globoid (e.g. *Ricinus* seed).

3- Calcium oxalate crystals:

a- Solitary crystals as in *Tamarix* stem.

b- Druses as in *Tilia* stem.

c- Raphides as in *Draceana* stem.

4- Calcium carbonate: Examined T.S. in *Ficus elastica* leaf. Notice the enlargement of some epidermal cells forming a **cystolith**. A cellulose protuberance arises internally on the cell wall and becomes impregnated with calcium carbonate.

5- Anthocyanin pigment: stripe off a piece of the upper epidermis of a *Pelargonium* petal and examine to notice the red colour of anthocyanin pigment.

تشريح النبات

تتركيب الخلية النباتية من:

المحتويات الحية:

أ- **السيتوبلازم** ب- **النواة**

افحص سلخا في بشرة قواعد البصل ولاحظ تركيب خلاياه بالقوة الصغري والكبري للميكروسكوب.

ج- **البلاستيدات:**

1- بلاستيدات خضراء: افحص طحلب الاسبيروجيرا والزيجنيما وارسم البلاستيدة الحلزونية والنجمية وكذا افحص ورقة الالوديا ولاحظ البلاستيدات القرصية.

2- بلاستيدة ملونة: افحص هرسا من الطماطم ولاحظ البلاستيدات الملونة العصوية.

المحتويات الغير حية:

1- **حبيبات النشا:**

أ- نشا البطاطس: خذ كشطا من درنة البطاطس وافحصه ولاحظ السرة الغير مركبة ولاحظ وجود ثلاثة انواع من الحبيبات وهي : الحبيبات البسيطة والنصف مركبة والمركبة.

ب- نشا الفاصوليا: ويتميز بسرة متفرعة نجمية.

ت- نشا القمح: يتميز بوجود سرة مركزية.

ث- نشا الارز: حبيبات دقيقة مضلعة متجمعة.

ج- نشا الذرة: يتميز بوجود سرة طويلة متفرعة.

2- **حبيبات الاليرون**: وتتركب من جسم اساسي داخله جسم بلوري واخر شبه بلوري (بذرة الخروع).

3- **بلورات اكسالات الكالسيوم:**

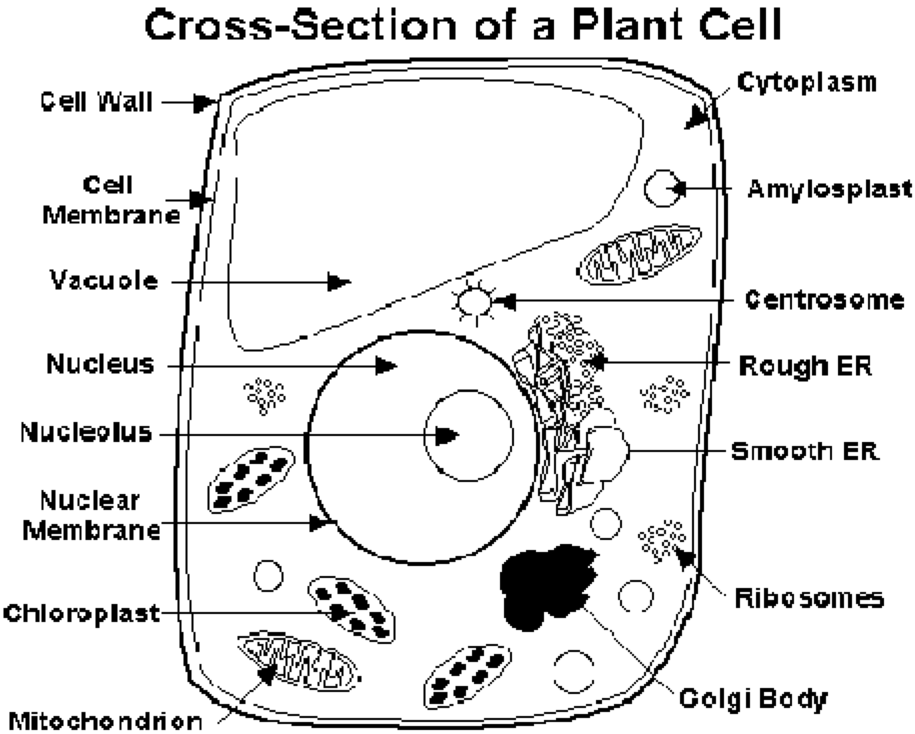
أ- بلورة مفردة (معينة): توجد في قشرة نبات اللبخ.

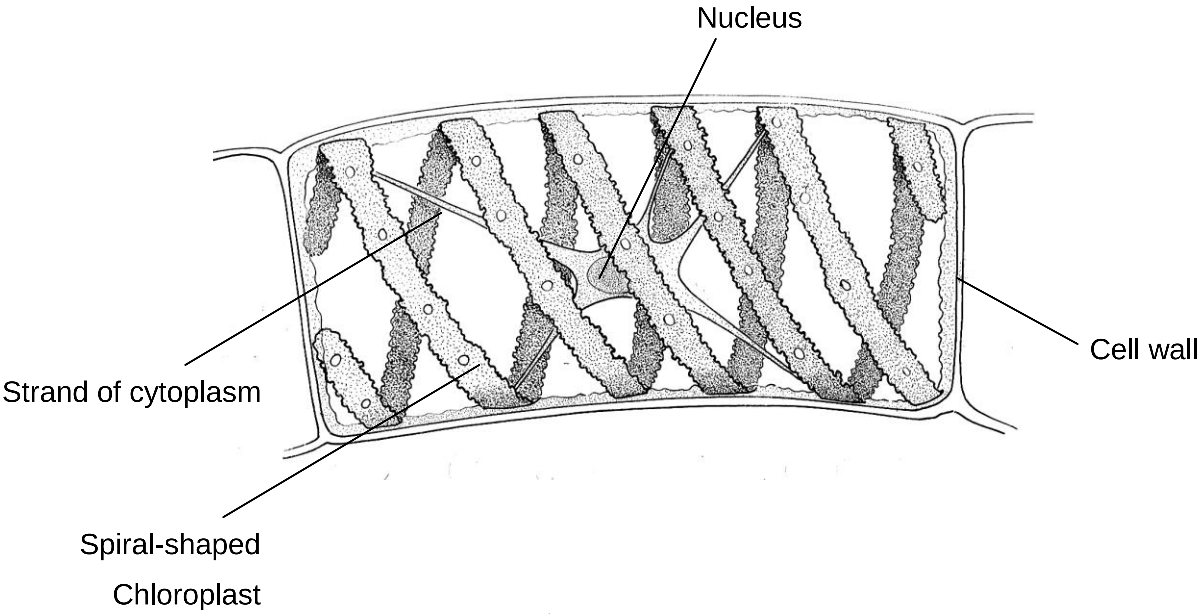
ب- بلورة ابرية: توجد في قشرة نبات الدراسينا المسن.

ت- بلورة نجمية: توجد في ساق نبات التيليا المسن.

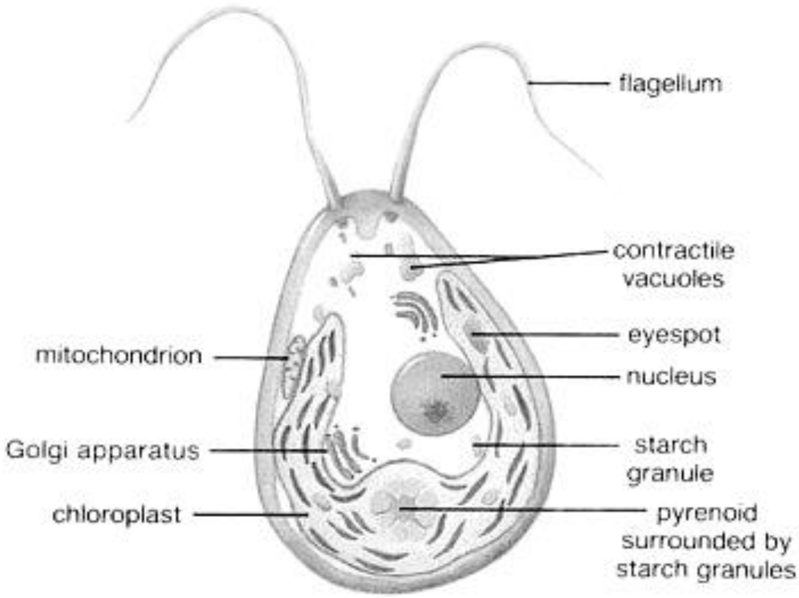
4- **كربونات الكالسيوم:** افحص قطاع عرضي في ورقة التين المطاط ولاحظ كربونات الكالسيوم الموجوده في صورة ما يسمي بالحويصلة الحجرية التي تتدلي من احد خلايا البشرة بواسطة نتوء سليلوزي.

5- **صبغة الانثوسيانين**: افحص بشرة بتلات نبات الجارونيا ولاحظ ان جدر الخلايا مضلعة وتمتد من جذرها نتوءات سليلوزية متجهة نحو الداخل ويوجد بداخل الخلية صبغ الانثوسيانين الاحمر.

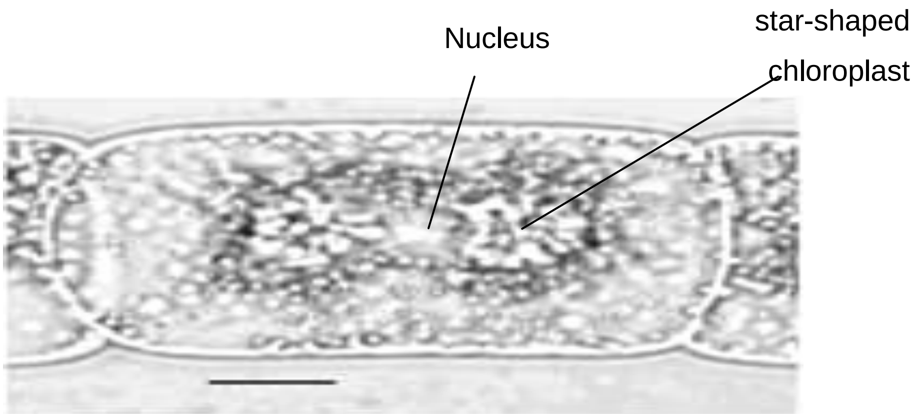




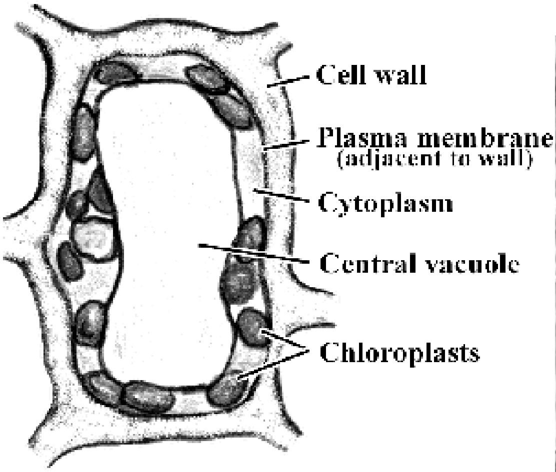
Spirogyra sp



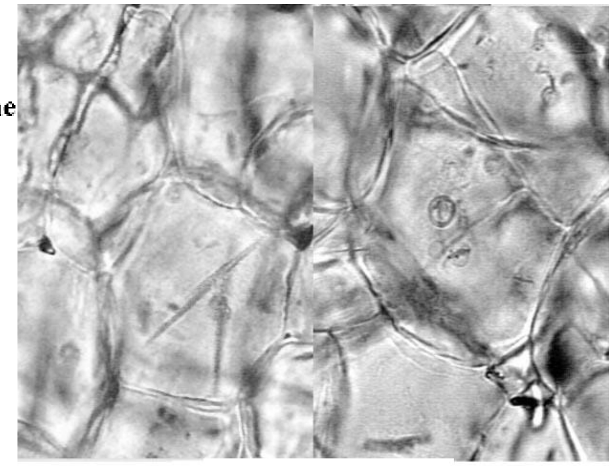
Chlamydomonas sp



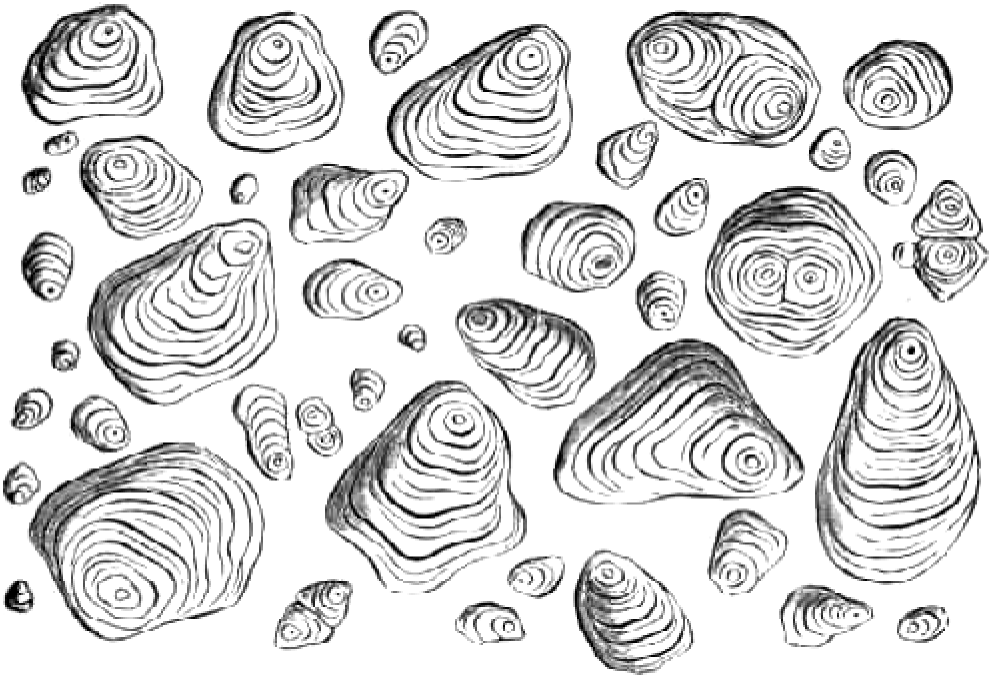
Zygnema sp



Normal Elodea Cell

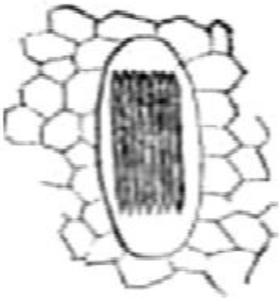


Chromoplast

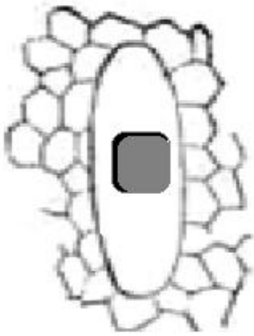


Potato starch

Phaseolus starch

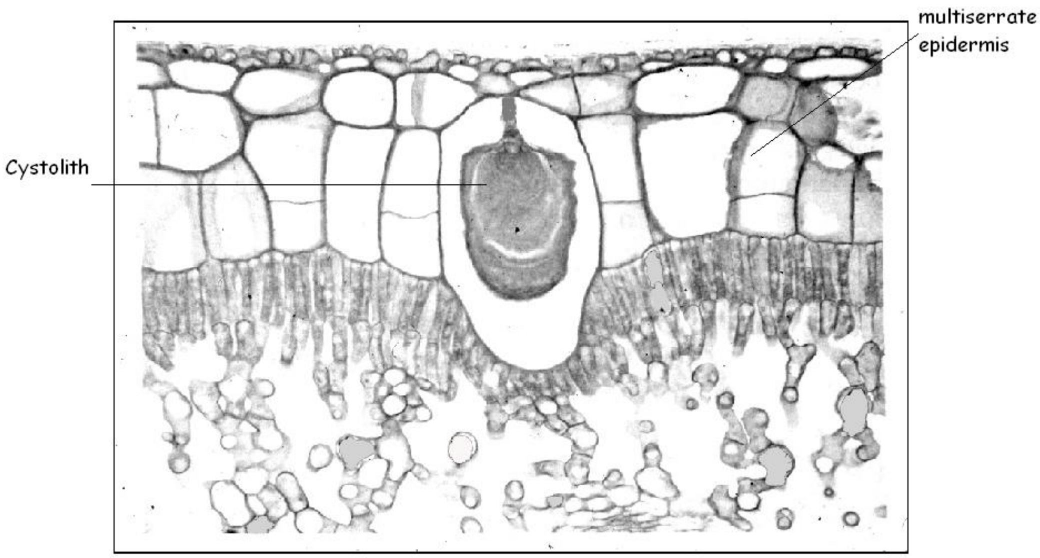


Raphides



Solitary

Druses



Calcium carbonate (cystolith)

Cells and tissues

a- Epidermal cells:-

1- Normal epidermis: T.S. in *Helianthus* stem.

2- Cutinized epidermis: T.S. in *Aloe* leaf.

3- Multiserriate epidermis: T.S. in *Ficus elastic* leaf.

Hairs and tricomes:-

1- Simple hair: *Zea* hairs.

2- Compound hair: *Helianthus* hairs.

3- Glandular hair: *Pelargonium* hairs.

4- Branched unicellular hair: *Matthiola* hairs.

5- Peltate hair: Olea hairs.

6- Papillae: *Pelargonium* petals.

Stomata:-

1- Kidney shape: e.g. *Vicia faba* leaf.

2- Dumb-bell shape: e.g. *Zea* leaf.

3- Sunken: e.g. *Pinus* leaf or *Aloe* leaf.

4- Sunken stomata with hairs: e.g. *Nerium* leaf.

انواع الخلايا والانسجة

أ- نسيج البشرة:-

1- بشرة عادية: ق.ع. في ساق عباد الشمس.

2- بشرة متادمة: ق.ع. في ورقة الصبار.

3- بشرة عديدة الطبقات: ق.ع. في ورقة التين المطاط.

الشعيرات والزوائد السطحية:-

1- شعيرة بسيطة: شعيرات الذرة.

2- شعيرة مركبة: شعيرات عباد الشمس.

3- شعيرة غدية: شعيرات الجارونيا.

4- شعيرة متفرعة وحيدة الخلية: شعيرات المنثور.

5- شعيرة قرصية: شعيرات الزيتون.

6- خملات: بتلات الجارونيا.

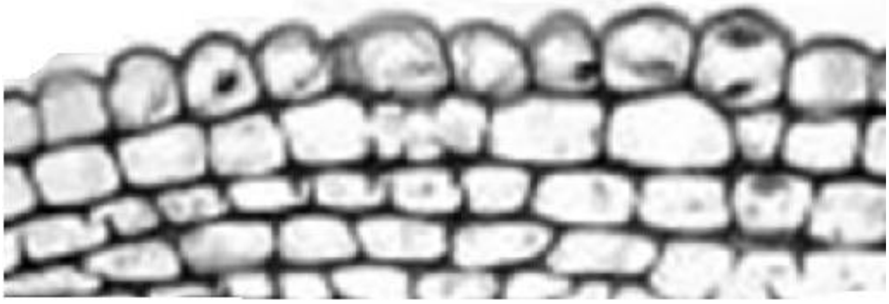
الثغور:-

1- ثغر كلوي: ورقة الفول.

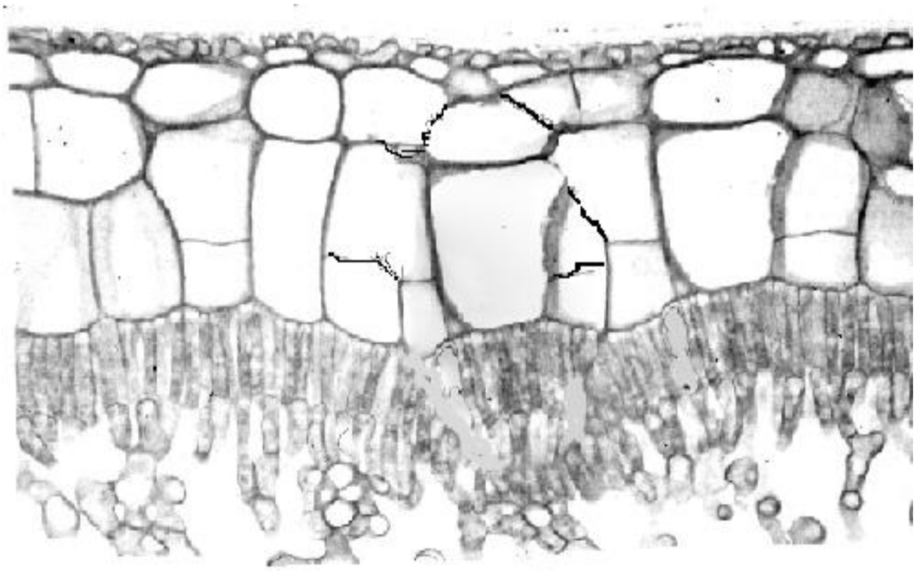
2- ثغر صولجاني: ورقة الذرة.

3- ثغر غائر: ورقة الصنوبر.

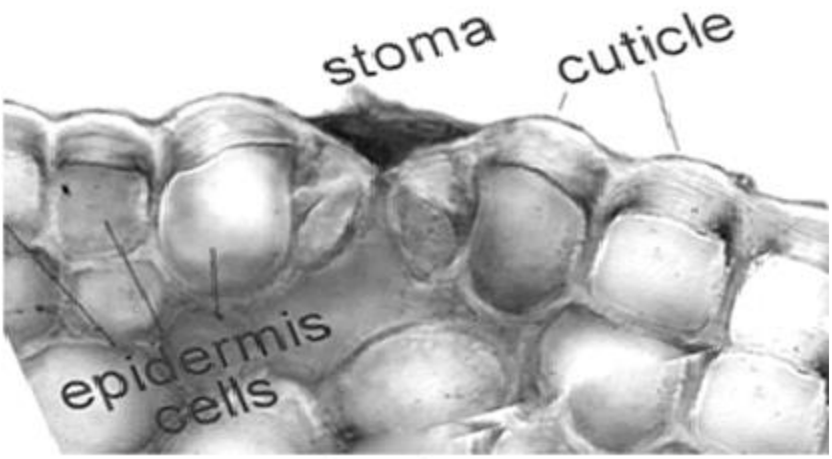
4- ثغر غائر بشعيرات: ورقة الدفلة.



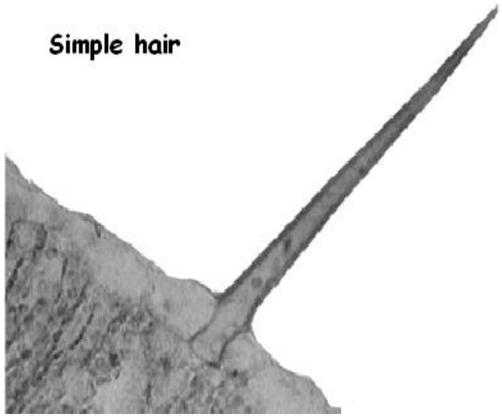
normal epidermis



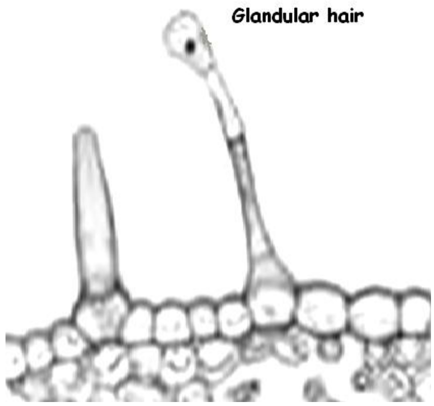
multiserrate epidermis

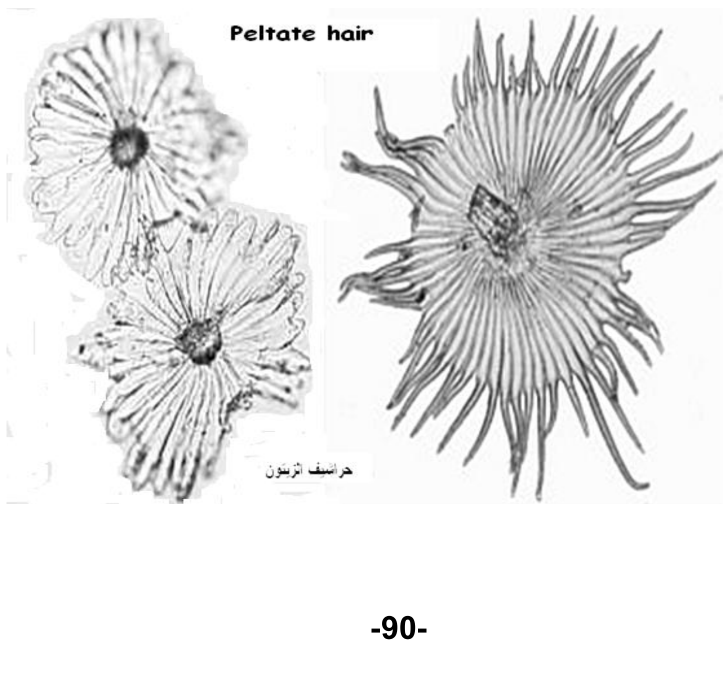


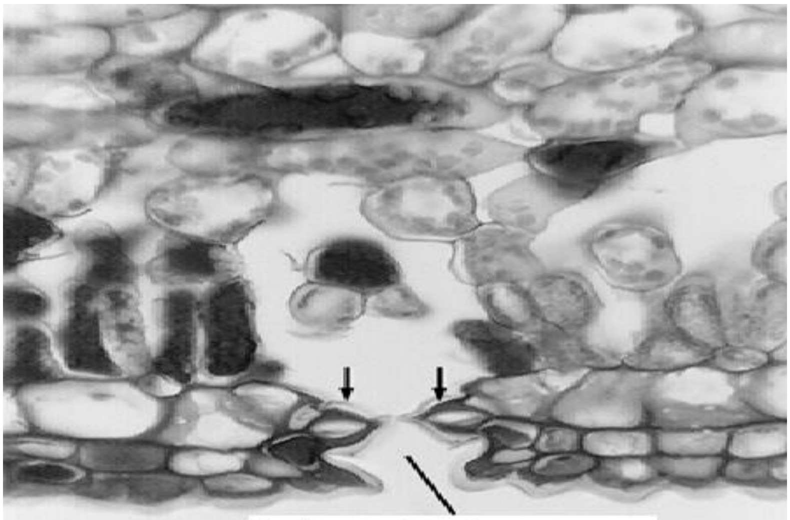
cutinized epidermis

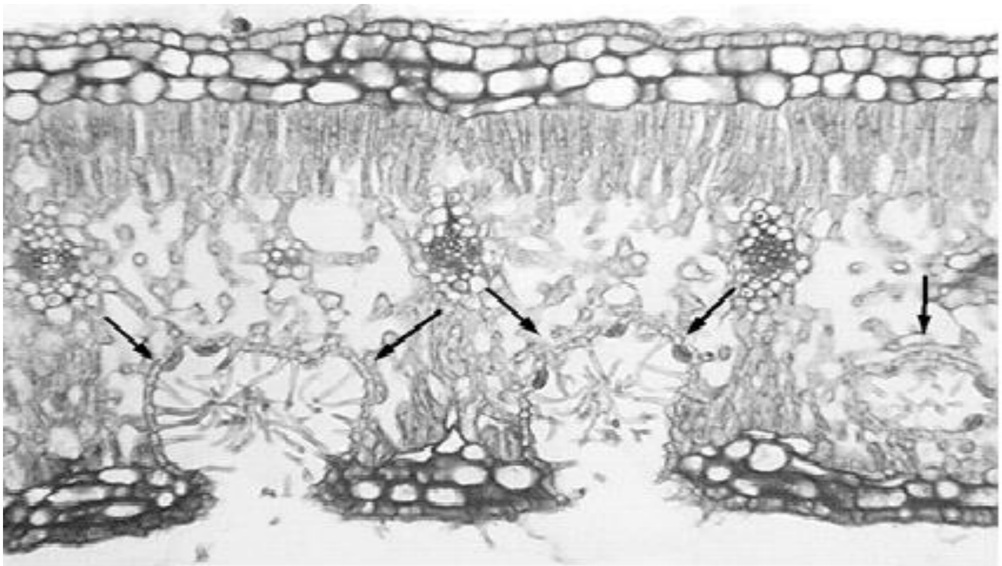

Simple hair


Glandular hair


Glandular hair


Peltate hair
حراشيف الزيتون


Sunken stomata


Sunken stomata with hairs

b- Parenchyma cells:-

1- Polyhedral (spongy) 2- Armed 3- Aerenchyma

4- Lignified parenchyma 5- Chlorenchyma

c- Collenchymas cells:-

1- Angular 2- lamellar 3- lacunar

d- Sclerenchyma cells:-

1- Fibers 2- stone cells

e- Xylem tisse:

1- Vessels: differ in the type of lignifications:-

a- Annular b- Spiral c- Scalariform

d- Pitted e- Reticulate

2- Tracheids: posses bordered pits.

3- Xylem parenchyma.

4- Xylem fibers.

f- Phloem:-

1- Sieve cells

2- Companion cells

3- Phloem parenchyma 4- Phloem fibers

g- Secretory tissue:-

1- Schizogenous gland : e.g. *Pinus* stem.

2- Lysigenous gland: e.g. *Citrus.*

ب- **الخلايا البرانشيمية** : ومنها عدة انواع هي :-

1- عديدة الاضلاع (اسفنجية): ساق الذرة 2- مزرعة: ورقة الهاكيا 3- هوائية: ساق الالوديا 4- ملجننة: جذر الذرة 5- الكلورنشيمة: ساق اللوف

ج- **الخلايا الكولنشيمية:** ومنها ثلاثة انواع هي:-

1- زاوية: ساق اللوف 2- صفائحية: ساق عباد الشمس 3- تجويفية: عنق التوت

د- **الخلايا الاسكلرانشيمية**: خلايا مغلظة باللجنين سميكة الجدر وتنقسم الي:-

1- الياف: بريسيكل ساق عباد الشمس

2-خلايا حجرية: تتميز بوجود نقرة متفرعة وهي موجوده في ثمار الجوافة

هـ- **نسيج الخشب**: ويتركب من:-

1- اوعية الخشب: تختلف في طريقة تغلظها باللجنين الي:-

أ- حلقي ب- حلزوني ج- سلمي د- منقر هـ- شبكي

2- القصيبات: وتوجد عليها نقر مضفوفة.

3- بارنشيمة الخشب.

4- الياف الخشب

و- **نسيج اللحاء**: يتركب من:-

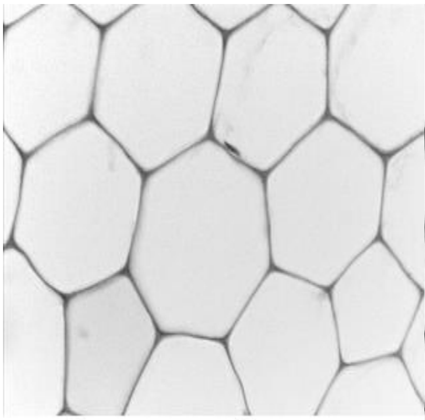
1- الخلايا الغربالية 2- خلايا مرافقة

3- بارنشيمة اللحاء 4- الياف اللحاء

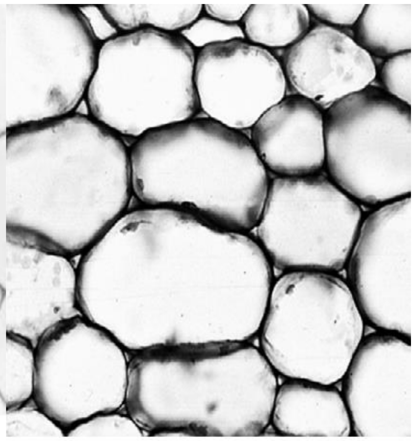
ز- النسيج الافرازي:

1- غدة انفصالية: ساق الصنوبر

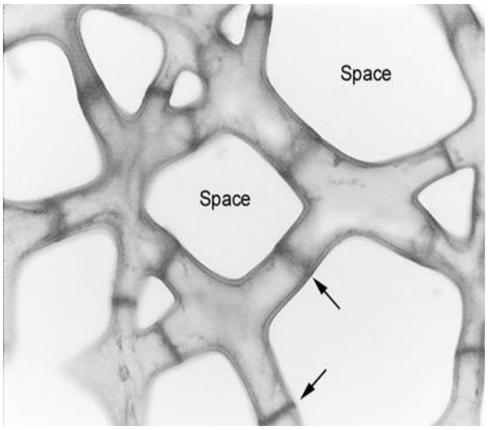
2- غدة انقراضية: قشرة البرتقال



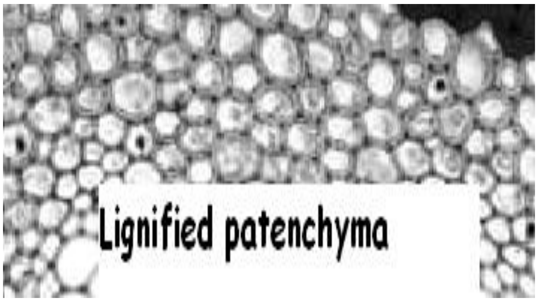
Spongy parenchyma



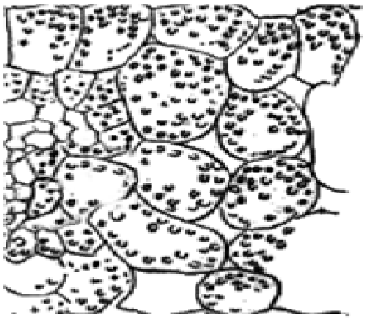
Spongy parenchyma



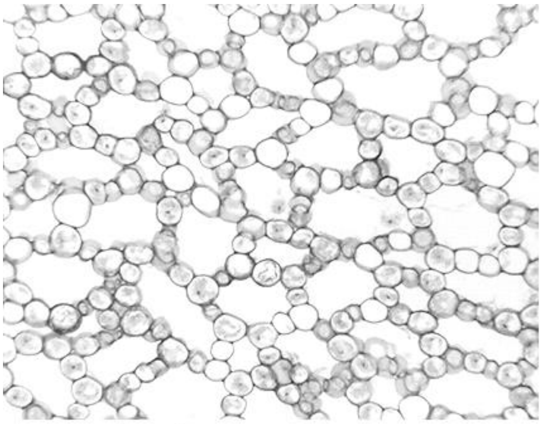
Armed parenchyma



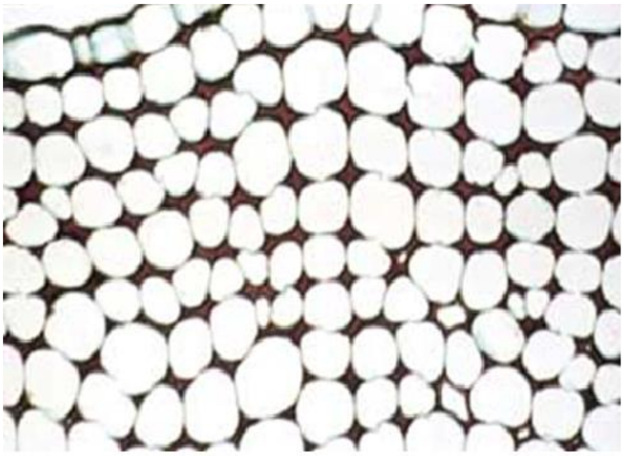
Lignified patenchyma



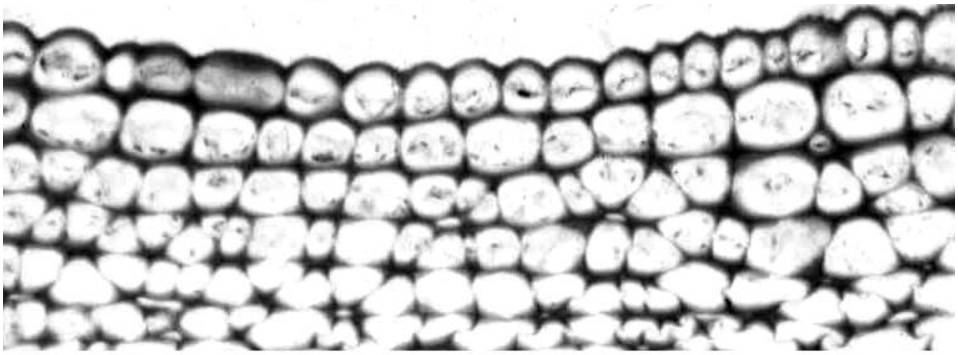
Chlorenchyma



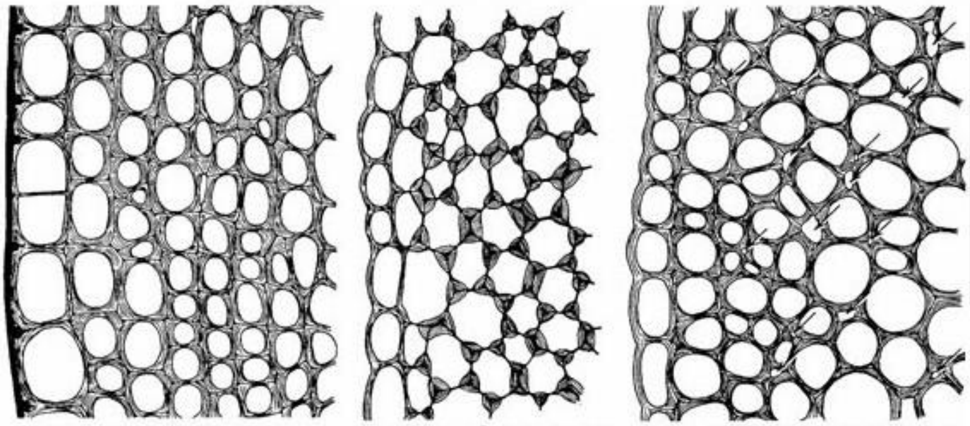
Arenchyma



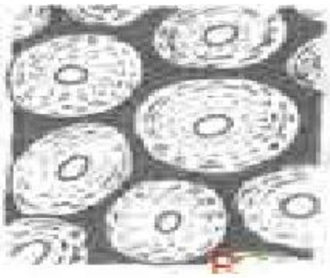
Angular collenchyma



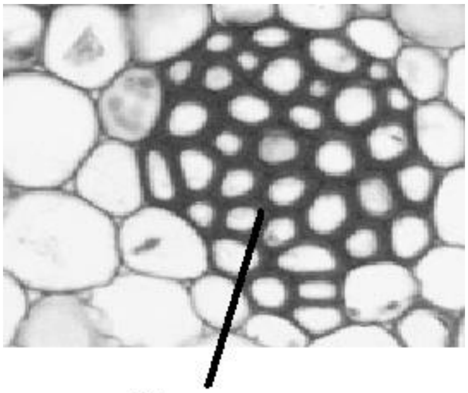
Lamellar collenchyma



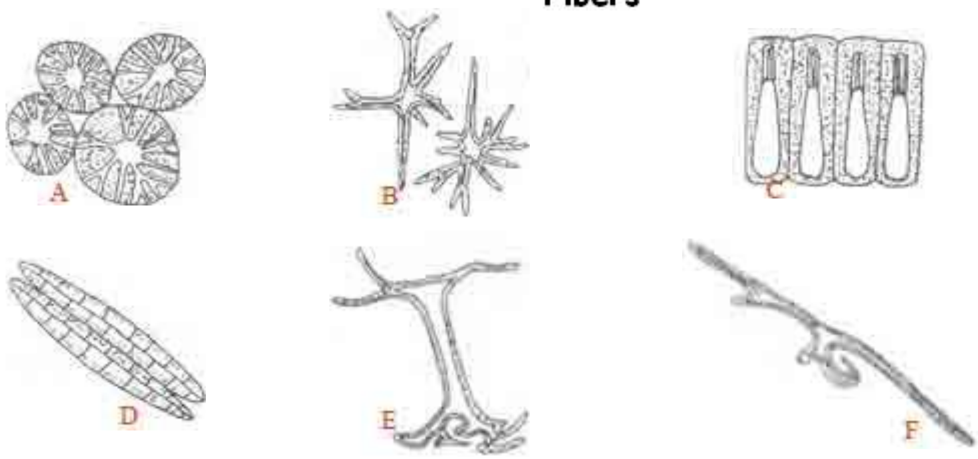
Lamellar collenchyma Angular collenchyma Larcunar collenchyma



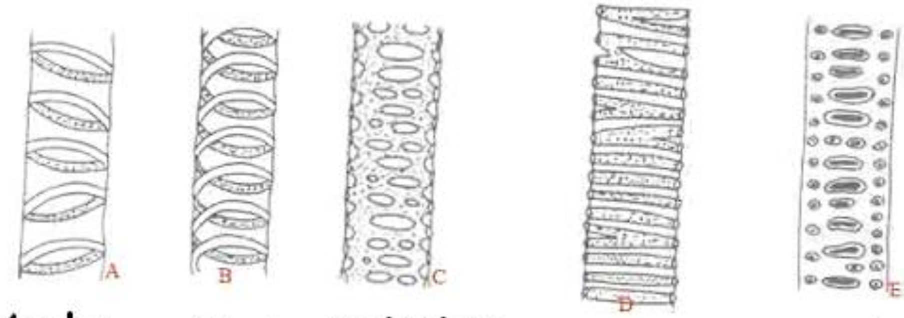
Fibers



Fibers

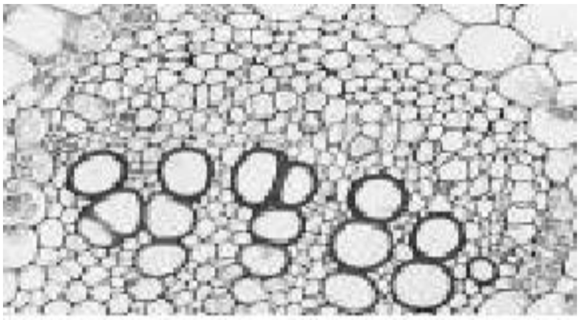


Types of Sclereids

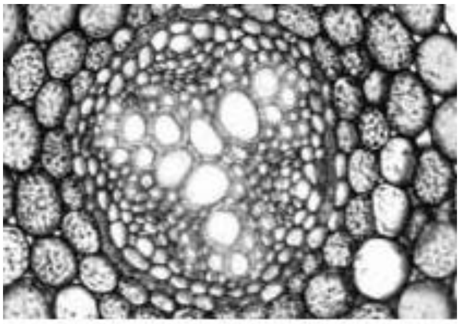


Annular Spiral Scalariform Reticulate Pitted

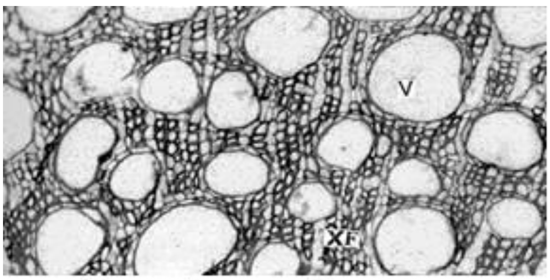
Types of Wall Thickenings in Tracheary Elements



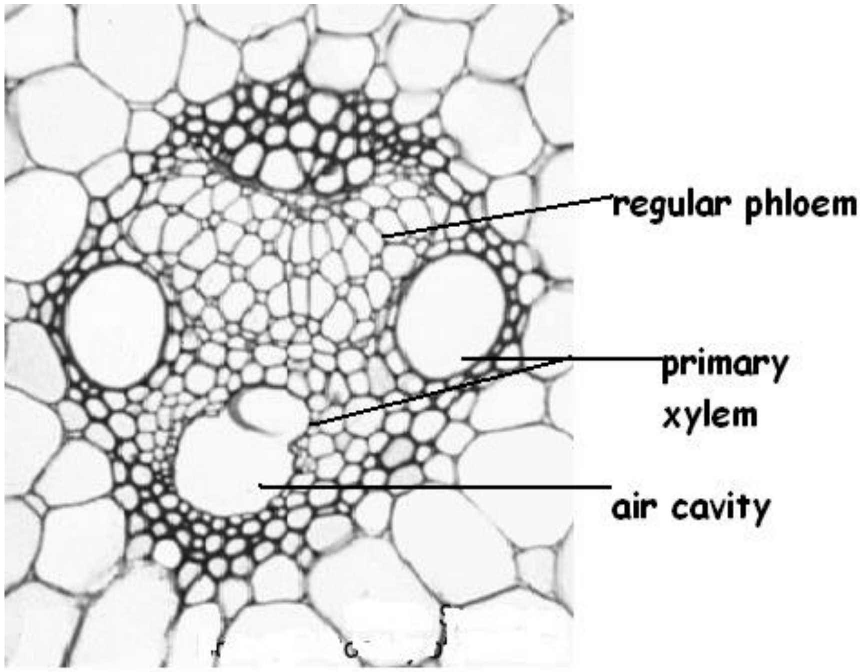
Primary xylem

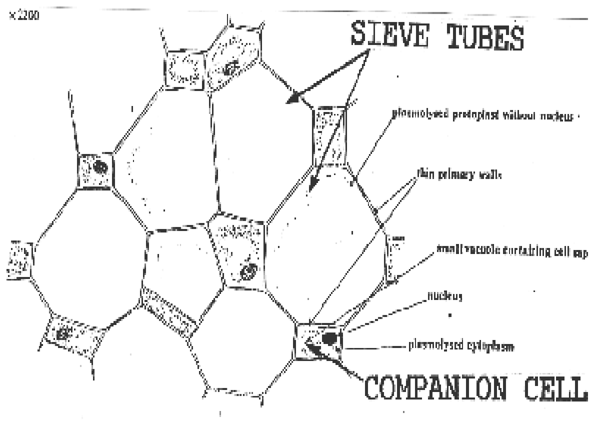


Primary xylem

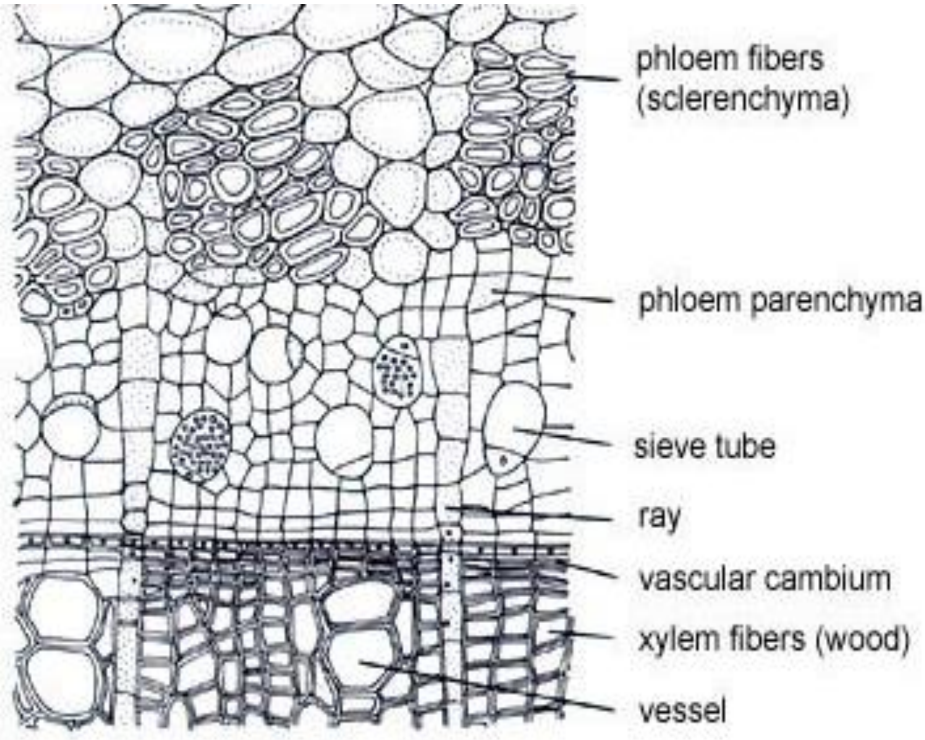


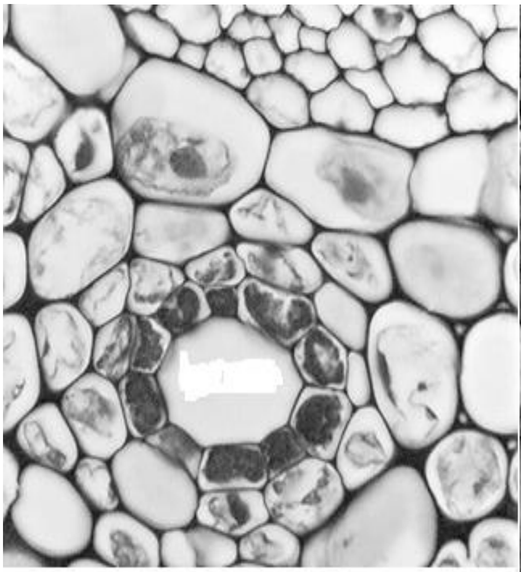
Secondary xylem



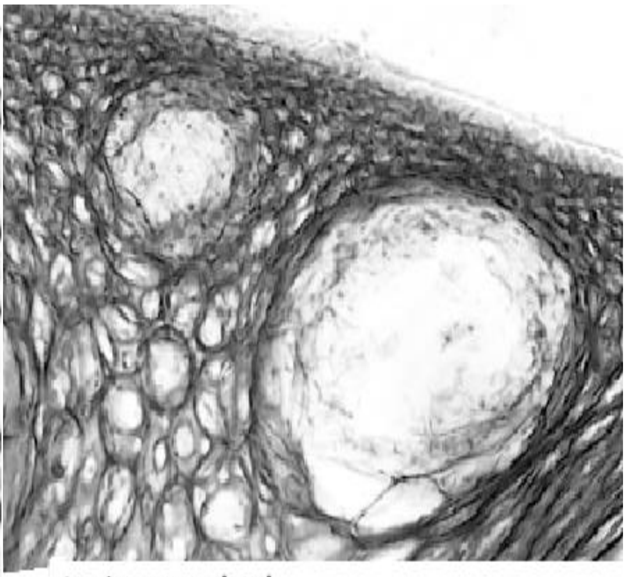


Regular phloem





Schizogenous gland



Lsyigenous gland

Anatomy of the stem

A-young dicotyledonous stem

1- *Helianthus* stem

Examine a T.S. in *Helianthus* stem and notice the following layers:-

1- The epidermis: this tissue covers the outside of the cortex.

2- The cortex: it is composed of collenchymas and parenchyma. The innermost layer of the cortex which is adjacent to the vascular cylinder may have a specialized type of parenchyma having starch grains known is starch sheath.

3- Pericycle: composed of fibers.

4- Vascular cylinder: it is composed of the vascular tissues and the surrounding tissues such as the pith and medullary rays. The vascular tissues is composed of xylem consists of vessels separated by rows of xylem parenchyma. The vascular tissues are arranged in bundles generally forming a definite cycle. The xylem is endarch i.e. the protoxylem is directed inwards. The cambium persists in the vascular bundle which is therefore said to be **open**. The strips of cambium within these open bundles or fascicular cambium. The pith (medulla) is composed of parenchyma.

أ-ساق فلقتين حديث

1- ساق عباد الشمس

افحص قطاع عرضي في ساق عباد الشمس ولاحظ الاتي:

1- البشرة: صف واحد من خلايا برميلية متراصة ومغطاة بطبقة من الكيوتين من الخارج.

2-القشرة: تتكون من خلايا كولنشيمية اسفل البشرة ثم خلايا بارنشيمية ثم الغلاف النشوي.

3-البريسيكل: كتل من الياف توجد فوق كل حزمة.

4- الاسطوانة الوعائية: تتكون من حزم وعائية مرتبة في دائرة واحدة والحزم من النوع المفتوح تتكون من :

-اللحاء: خلايا غربالية وخلايا مرافقة وبارنشيمة لحاء.

-الكمبيوم: صف من خلايا مرستيمية.

-الخشب: اوعية يفصلها بارنشيمة خشب والخشب الاول للداخل.

5- الاشعة النخاعية: خلايا بارنشيمية تفصل الحزم عن بعضها البعض.

6- النخاع: يتوسط القطاع ويتكون من خلايا بارنشيمية تشغل مساحة كبيرة من القطاع.

2-*Luffa* stem

Not that:

1- The pith is hollow.
2- Presence of a broad ring of sclerenchyma (pericycle).
3- There are two rings of vascular bundles of which the larger and inner alternate with the smaller and outer.
4- The vascular bundles are **bicollateral** i.e. two group of phloem occur in each bundle, one external, the other internal and separated from the protoxylem by parenchyma.

1-ساق اللوف

افحص ساق اللوف ولاحظ انها تتميزبما يلي:-

1- ان النخاع مجوف في منطقة الوسط.
2- ان البريسيكل يوجد في حلقة الياف متصلة مع بعضها البعض.
3- توجد الحزم الوعائية في حلقتين الخارجية يوجد بها الحزم الاصغر وتتبادل معها الحزم الداخلية الاكبر.
4- الحزم الوعائية ذات الجانبين اي لها لحائين لحاء خارجي يفصله عن الخشب الكمبيوم ولحاء داخلي يفصله عن الخشب خلايا بارنشيمية.

B- Monocotyledonous stems

1- Zea mays (maize)

Stems of monocotyledons exhibit a large number of bundles which frequently appear scattered throughout the whole of the ground tissue, so that a definite cortex and pith can't be distinguished.

The phloem is composed of sieve tubes and companion cells, phloem parenchyma is absent. There is no cambium between the xylem and the phloem i.e. the vascular bundle is **closed**. The shape of xylem as a whole is often roughly that of Y, the stem of which is occupied by a radial row of protoxylem vessels, whilst the arms are formed by a pair of large metaxylem vessels. The phloem tends to be sunken between the xylem. The bundles are enveloped in a sheath of fibers.

ب- سيقان ذوات الفلقة الواحدة

2- ساق الذرة

افحص قطاع عرضي في ساق الذرة ولاحظ انه يتكون من الاتي:-

1- البشرة: صف من الخلايا البرميلية مغطاة بالكيوتين.

2-النسيج الاساسي: غير متميز الي قشرة ونخاع واشعة نخاعية ويتكون من عدة طبقات من الالياف تلي البشرة والباقي خلايا بارنشيمية.

3-الحزم الوعائية: حزم مغلقة مبعثرة في النسيج الاساسي يزداد حجمها كلما اتجهنا للداخل وتتركب كل حزمة من الاتي:

أ- غلاف الحزمة: نطاق من الالياف يغلف الحزمة.

ب- اللحاء: يتكون من خلايا غربالية وخلايا مرافقة.

ت- الخشب: يترتب الخشب التالي والاولي علي شكل y او z ويكون الخشب الاولي للداخل ويوجد بعض القصيبات بين وعائي الخشب التالي كما يوجد فجوة هوائية بعد الخشب الاول وهي ناتجة معن انقراض احد اوعية الخشب الاول.

The differences between Dicot and Monocot. stems

CHARACTERS	DICOT STEM (e.g., Sunflower)	MONOCOT STEM (e.g., Maize)
1. Epidermis		
a) Trichomes	Present	Absent
b) Cuticle	Present	Present
2. Hypodermis	Made up of collenchyma	Made up of sclerenchyma
3. Ground tissue	Differentiated into cortex, endodermis, pericycle, medullary rays and pith	Undifferentiated
4. Vascular bundles		
a) Number	Eight	Numerous
b) Arrangement	In the form of a broken ring	Irregularly scattered
c) Bundle Cap	Present	Absent
d) Bundle Sheath	Absent	Present
5. Nature of the vascular bundles	Conjoint, collateral and open with endarch xylem	Conjoint, collateral and closed with endarch xylem
6. Xylem vessels	Many protoxylem and meta-xylem vessels in each bundle	Only two protoxylem vessels in each bundle

Anatomy of the root

a- Dicotyledonous root

Vicia faba

Examine and note:

1- The piliferous layer: one and thick.

2- Cortex: several layers of parenchyma cells.

3- Endodermis: signal layer of cells.

4- Pericycle: one layer of thin walled cells.

5- The xylem consisting of 4 to 8 radiating strands. Note that the smallest xylem elements (protoxylem) are situated towards the periphery and the widest (metaxylem) towards the centre.

6- The phloem consists of 4 - 8 strands alternating with xylem. Parenchyma cells are found between the xylem and phloem.

7- Medulla: consist of parenchyma.

تشريح الجذور

جذور ذوات الفلقتين

الفول

افحص قطاع عرضي في جذر الفول الحديث ولاحظ الاتي:-

1- طبقة الشعيرات الجذرية: صف واحد من خلايا قد تستطيل مكونة شعيرات جذرية. وهذه الطبقة لا تلبث ان تزول ليحل محلها خلايا مسوبرة تشمل اكسوديرمس.

2- القشرة: عدة طبقات من خلايا بارنشيمية.

3- الاندوديرمس: صف واحد من خلايا مغلظة علي الجدر الجانبية بما يسمي سريط كاسبار.

4- البريسيكل: صف واحد من خلايا بارنشيمية.

5- الخشب: يتكون من اذرع فيها الخشب الاول للخارج وعدد هذه الاذرع لا يزيد عن 8 اذرع.

6- اللحاء: يتبادل مع الخشب علي انصاف اقطار اخري ويتكون من انابيب غربالية وخلايا مرافقة وبارنشيمة لحاء.

7- النخاع: منطقة صغيرة مكونة من خلايا بارنشيمية وقد لا توجد.

b- Monocotyledonous roots

Zea mays (maize)

Examine and note:

1- Exodermis: one or more layers (subarised).

2- Cortex: several layers of parenchyma cells.

3- Endodermis: one layer of cells with thickening on the radial and inner walls (casparian stripe).

4- Pericycle: complete circle one cells in thickness.

5- Vascular tissues: consisting of numerous alternating strands of xylem and phloem. The protoxylem elements are placed towards the periphery and the metaxylem towards the centre.

ب-جذور ذوات الفلقة الواحدة

جذر الذرة

افحص قطاع عرضي في جذر الذرة الحديث ولاحظ الاتي:-

1- الاكسوديرمس: صف او اكثر من خلايا مسوبرة تحل محل طبقة الشعيرات الجذرية.

2- القشرة: عدة طبقات من خلايا بارنشيمية.

3- الاندوديرمس: صف واحد من خلايا مغلظة بمادة اللجنين علي الجدر الجانبية والقطرية بما يسمي شريط كاسبار.

4- البريسيكل: صف واحد من خلايا بارنشيمية.

5- الاسطوانة الوعائية: وهي تتكون من:

-الخشب: يتكون من اذرع كل ذراع بعه عدد من الاوعية فيها الخشب الاول يتجه ناحية الخارج ويحاط الخشب ببرانشيمة ملجننة.

- اللحاء يتبادل مع الخشب ويتكون من خلايا غربالية وخلايا مرافقة.

6- النخاع: خلايا بارنشيمية تشغل منتصف القطاع.

The differences between Dicot. and Monocot. roots

Young dicot. root	**Monocot. root**
1- Wide cortex	- Narrow cortex.
2- Small number of xylem arches (2-8).	- Large number of xylem arches (more than 8).
3- Numerous xylem vessels in each arch.	- Few xylem vessels in each arch.
4- Medulla narrow.	- Medulla wide.
5- Phloem parenchyma present.	- Phloem parenchyma absent.
6- Casparian strip on the lateral walls only	- Casparian strip on the lateral and radial sides.

The differences between young root and young stem

young stem	young root
1- Cortex is narrow and with starch sheath.	- Cortex is wide and with endodermis.
2- Pericycle consists of parches of sclerenchyma fibers opposite the bundles.	- Pericycle consists of one layer of thin walled cells.
3- Vascular bundles are collateral, i.e. xylem and phloem are on the same radius.	- Vascular bundles are radial, i.e. xylem and phloem are on different radius.
4- Protoxylem is directed inwards while the metaxylem is directed outwards.	- Protoxylem is directed outwards while the metaxylem is directed inwards -
5- Pith is usually wide.	- Pith is usually narrow.

Anatomy of leaf

1- Dicot. leaf

Ricinus leaf

Examine a T.S. in ***Ricinus*** leaf to see the following:-

1- Upper epidermis: one cell thick. Notice the absence of stomata.

2- Mesophyll:

a- palisade tissue: elongated cells perpendicular to the epidermis and full of chloroplasts.

b-spongy tissue: parenchyma cells with large intercellular spaces and contain less amount of chloroplasts than palisade cells.

3- Vascular bundles: surrounded by collenchyma and parenchyma. Each bundle is formed of xylem and phloem and covered from above with pericycle (sclerenchyma).

4- Lower epidermis: similar to upper epidermis except the presnt of stomata.

تشريح الورقة

1- ورقة فلقتين

ورقة الخروع

افحص قطاع عرضي في ورقة الخروع ولاحظ الاتي:-

1- البشرة العليا: صف واحد من خلايا متراصة لا يوجد عليها ثغور ومغطاة بالكيوتين.

2- النسيج الوسطي: يتكون من أ- النسيج العمادي: صفين من خلايا طويلة تحوي بلاستيدات خضراء.

ب-النسيج الاسفنجي: خلايا بارنشيمية غير منتظمة الشكل بينها مسافات بينية واسعة وتحوي بلاستيدات خضراء اقل.

3- الحزم الوعائية: تكون حلقة وكل حزمة تتكون من بريسيكل (الياف) ولحاء وخشب وتحاط هذه الحزم بخلايا بارنشيمية ثم خلايا كولنشيمية توجد اسفل البشرة.

4- البشرة السفلي: تشبه البشرة العليا ولكن توجد ثغور.

2- Monocotyledonous leaf

Zea mays

Examine a T.S. in ***Zea*** leaf and notice the following:-

1- The leaf is bifacial with stomata equally distributed on both surfaces.

2- The mesophyll is not differentiated into palisade and spongy cells but composed of one type of cells.

3- Each vascular bundle is surrounded by a sclerenchymatous sheath.

4- Strands of sclerenchyma occure on both sides of the vascular bundle beneath the upper and lower epidermis.

5- The arrangement of the elements of the vascular bundle is similar to that of the dicot. leaf, i.e. the metxylem is towards the lower epidermis of the leaf, while the protoxylem is towards the upper epidermis. The phloem lies below the metaxylem.

3- ورقة فلقة واحدة

ورقة الذرة

افحص قطاع عرضي في ورقة الذرة ولاحظ الاتي:-

1- الورقة لها بشرة عليا وسفلي توزع عليها الثغور.

2- النسيج الوسطي لا يتميز الي نسيج عمادي واسفنجي وانما يتكون من نوع واحد من الخلايا.

3- الحزم الوعائية محاطة بغلاف اسكلرانشيمي كما في سيقان ذوات الفلقة الواحدة ولها نفس التركيب الداخلي ولكنها توجد علي البشرة السفلي للورقة في وضع مقلوب ومتصلة بالبشرة بواسطة خلايا اسكلرانشيمية.

Secondary thickening

a- Old dicot. stem

Vitis stem

Examine a T.S. in an old ***Vitis*** stem and notice the following:-

1- Epidermis: one cell thick covered with cuticle.

2- Cortex: contains collenchyma in patches followed by parenchyma.

3- Vascular cylinder:

a- Pericycle: patches of sclerenchyma.

b- Phloem:

- primary phloem: small compressed elements of sieve cells, companion cells and phloem parenchyma.
- Secondary phloem: alternating patches of sclerenchyma and sieve tube cells, companion cells and phloem parenchyma.

c- Cambium: complete ring, comprises fascicular and inter fascicular cambium.

d- Xylem:

- Secondary xylem: wide vessels, fibres and xylem parenchyma.

- Primary xylem: narrow vessels and comprises protoxylem and metaxylem.

e-Medullary rays: comprise the primary medullary rays connecting the pith with the cortex and secondary medullary rays.

f- Pith (medulla): parenchyma cells.

التغلظ الثانوي

أ- ساق فلقتين

ساق العنب

افحص قطاع عرضي في ساق عنب مسن ولاحظ الاتي:-

1- البشرة: طبقة واحدة مغطاة بالكيوتين.

2- القشرة: تحتوي علي قطع من الكولنشيمة يتبعها بارنشيمة.

3- الاسطوانة الوعائية:

أ- البريسيكل: كتل من خلايا اسكلرانشيمية توجد فوق الحزم.

ب- اللحاء:

- اللحاء الابتدائي: طبقة صغيرة مضغوطة تحوي انابيب غربالية وخلايا مرافقة وبارنشيمة لحاء.
- اللحاء الثانوي: كتل من الالياف تتبادل مع خلايا مرافقة وانابيب غربالية وبارنشيمة لحاء.

ج- الكمبيوم: حلقة كاملة من خلايا مرستيمية ويشمل نوعان هما الكمبيوم الحزمي والبين حزمي.

د- الخشب:

- الخشب الثانوي:اوعية واسعة محاطة بالياف وبارنشيمة خشب.
- الخشب الابتدائي: اوعية صغيرة تحوي خشب تالي وخشب اولي محاط ببارنشيمة خشب.

ه- الاشعة النخاعية: يوجد اشعة نخاعية ابتدائية تصل بين القشرة والنخاع كما يوجد اشعة نخاعية ثانوية.

و- النخاع: خلايا بارنشيمية.

b- Old dicot. root

Gossypium root

Examine a T.S. in an old ***Gossypium*** root and notice the following:-

1- Periderm: more than one layer covering the root.

2- Cortex: composed of parenchyma.

3- Phloem: as in old dicot. stem.

4- Cambium: as in old dicot. stem.

5- Xylem:

   a- Primary xylem: present in the centre of the root and are opposite to the primary medullary rays.

   b- Secondary xylem: as in old dicot. stem.

ب- جذر فلقتين

جذرالقطن

افحص قطاع عرضي في جذر القطن ولاحظ الاتي:-

1- البريديرم: اكثر من صف تغطي القطاع من الخارج.

2- القشرة: خلايا بارنشيمية.

3- اللحاء: كما في ساق فلقتين مسن.

4- الكمبيوم: كما في ساق فلقتين مسن.

5- الخشب:

أ- الخشب الابتدائي: يوجد في مركز القطاع وعلي امتداد الاشعة النخاعية الابتدائية.

ب- الخشب الثانوي: كما في ساق فلقتين مسن.

FACULTY OF SCIENCE, QENA
كلية العلوم بقنا

SOUTH VALLEY UNIVERSITY
جامعة جنوب الوادي

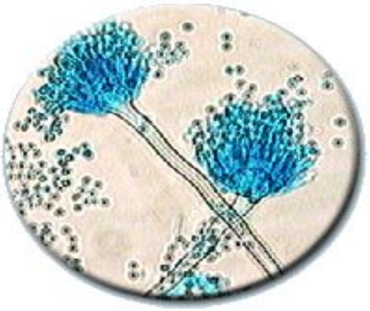
الدروس العمليـــة

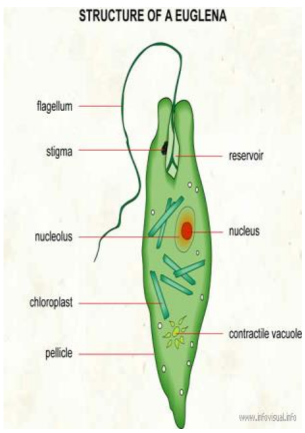
فــي

المملكـــــة النباتيـــة

اعداد

اعضاء هيئة التدريس بقسم النبات والميكروبيولوجي





Microscope

Study the different parts of the microscope, with the aid of the plate.

❖ **Preparation of material for examination:**

Place a drop of water on a clean slide. The material to be examined is placed in this water. With the edge of the clean cover slip touching this water and tilted at an angle with slide, drop the cover slip until no air bubbles are formed. Blot off any excess water.

❖ **General remarks on using the microscope:-**

1- Before using the microscope be sure all lenses are clean.

2- Always, keep the stage clean and dry.

3- Move the mirror before the test to provide the best illumination and the best image.

4- To study an object use first the low power and then high power. Do not use the latter before putting a cover slide.

5- When you use the high power, use only the fine adjustment.

6- Use both your eyes when looking in the microscope.

الميكروسكوب

ادرس اجزاء الميكرسكوب وذلك بالاستعانة بالرسم الموجود امامك.

طريقة تجهيز عينة للفحص ميكروسكوبيا:

ضع نقطة ماء علي شريحة نظيفة ثم ضع العينة المراد فحصها علي نقطة الماء ثم امسك الغطاء cover بين الاصبعين في وضع مائل ثم تخفض تدريجيا حتي يلامس سطح نقطة الماء بحيث يكون مرتكزا علي جانبه لتلافي تكوين فقاعات هوائية.

ارشادات عامة لاستعمال الميكروسكوب:

1- قبل استعمال الميكروسكوب نظف جميع عدساته بورق تنظيف العدسات الخاص, ويجب تجنب استعمال القماش أو القطن أو ورق التنشيف, لانه قد يخدش العدسات كما انه قد يترك عليها وبرآ مما يسبب عدم وضوح الرؤية بالمجهر.

2- دائما اجعل المسرح او المنصة نظيفا وجافا.

3- حرك المرآة قبل الفحص للحصول علي احسن اضاءة.

4- افحص العينة اولا بالقوة الصغري ثم الكبري ولا تستعمل القوة الكبري دون استعمال غطاء للشريحة.

5- عند استعمال العدسة الكبري استعمل الضابط الصغير او الدقيق فقط.

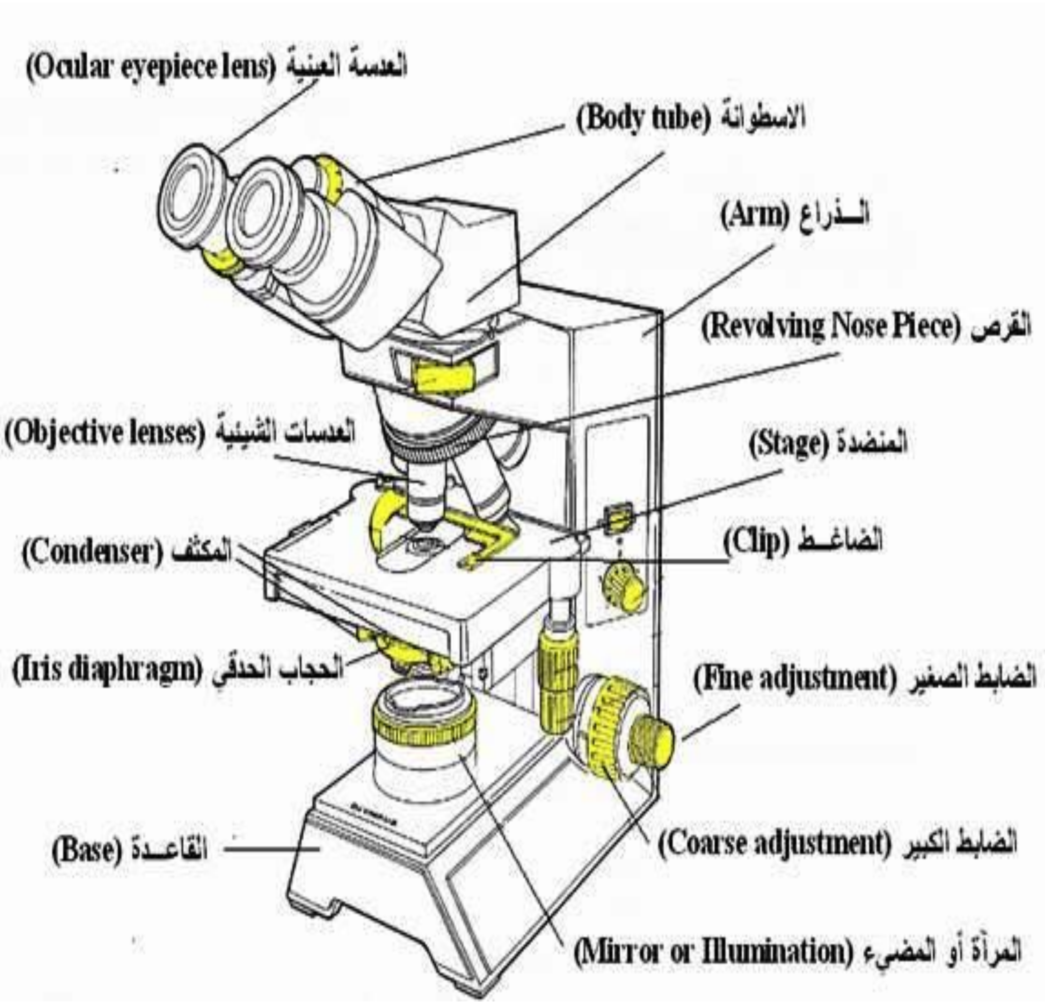
6- استعمل كلتا عيناك عند النظر في الميكرسكوب.

7- أعد العدسة الشيئية الصغري الي مكانها بعد الانتهاء من الفحص.

8- يجب إطفاء المجهر في حالة عدم استخدمه.

9- أعد المجهر إلي خزانته بعد وضع غطاءه عليه,حتي يظل نظيفا للاستعمالات الاخري.

تركيب الميكرسكوب الضوئي



❖تعليمات خاصة بالرسم:

الرسومات الجيدة للعينات تتطلب الاهتمام بالتفاصيل, وبالتالي عند الرسم في المعمل يجب الانتباه إلي ما يلي:-

1- ادرس ولاحظ العينات المعطاة لك بعناية بقدر الإمكان, ثم ارسم مباشرة ما تشاهده من العينات أو الشرائح المعطاه لك.

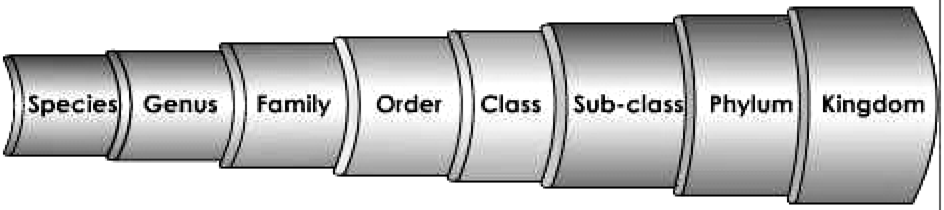
2- يجب مراعاة النسبة بين العينات المعطاة لك والرسم الذي تقوم برسمه لهذه العينات من حيث الحجم أو المساحة.

3- احرص علي الانتهاء من كل الرسومات في وقت المعمل.

4- رتب رسوماتك في دفتر المعمل بطريقة منسقة ومتسلسلة.

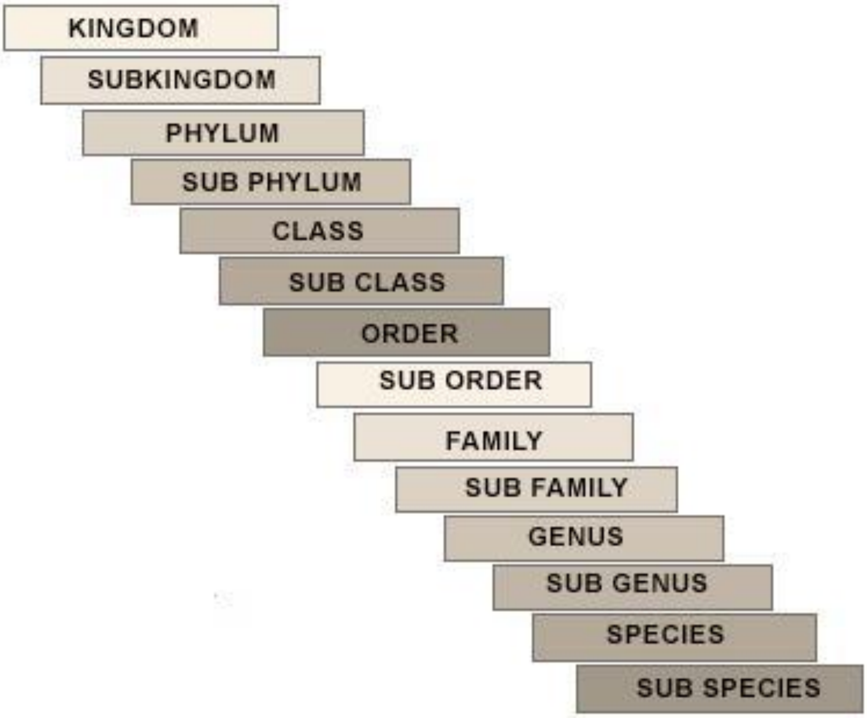
5- تجنب استخدام أقلام الرصاص اللينة أو أقلام الحبر.

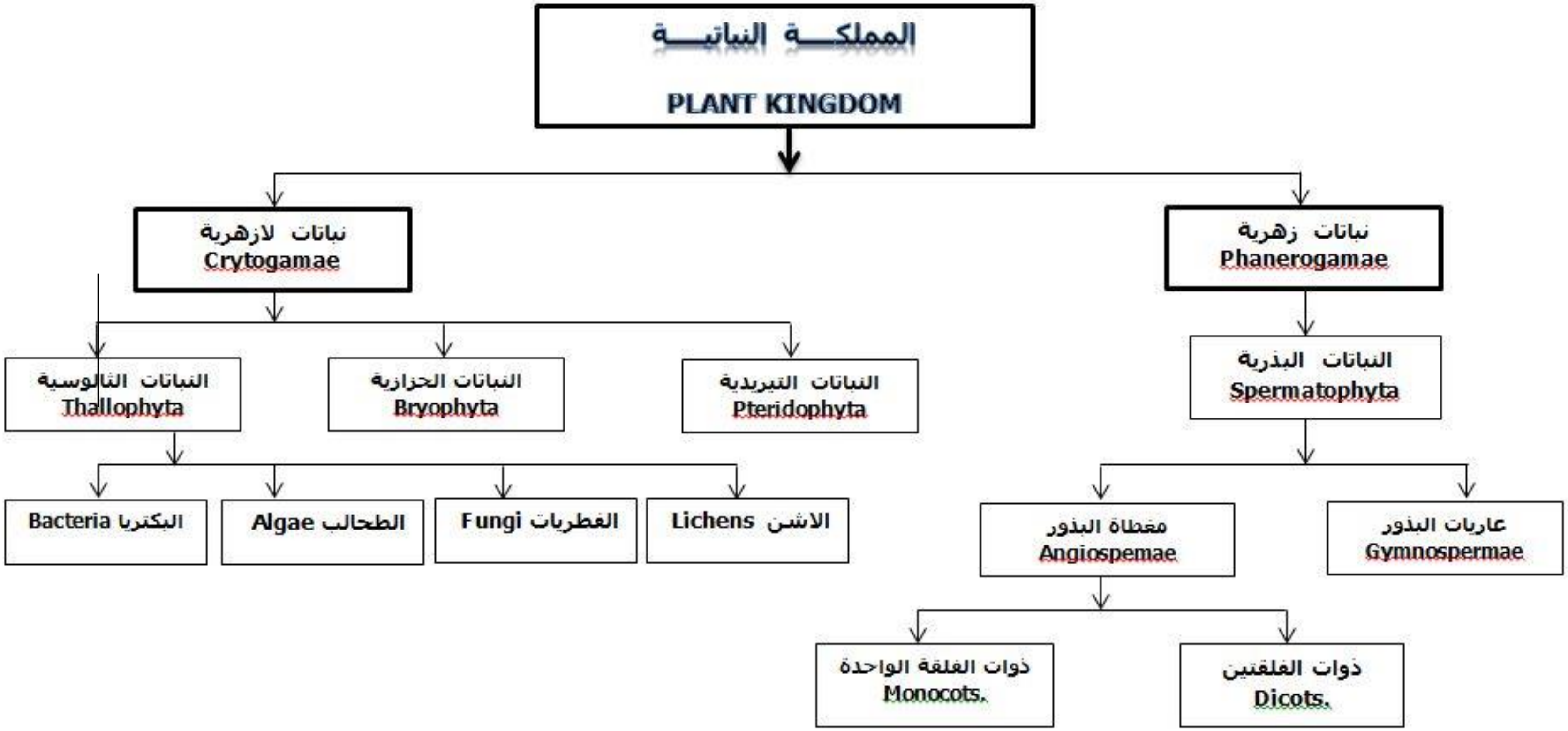
6- اترك مساحة كافية حول الرسم لوضع البيانات علي أجزاء الرسم, وأشر بخط (سهم) إلي اجزاء العينة المختلفة, واكتب عند نهايتها اسم الجزء المشار إليه.



The Classification Telescope for the Plant Kingdom

The classification telescope for the plant kingdom





رسم تخطيطي يوضح تقسيم ايشلر للمملكة النباتية.

A-Thallophyta

1- Schizophyta (Bacteria)

Bacteria commonly known as microbes mostly possess a heterotrophic nutrition.

❖ **Forms and groups of Bacteria**

The main forms of Bacteria are:-

1- **Spherical Bacteria (Cocci):** Cocci are classified into several groups:

- **Micrococci:** single cell.
- **Diplococcic:** in pairs.
- **Streptococci:** in chains.
- **Staphylococci:** cocci in masses, shaped like a clusters of graps.
- **Sarcinae:** cocci in cubes of eight.

2- **Cylindrical or rod-like Bacteria (Bacilli):** Bacilli are straight, cigarette-shaped. Some bacilli are curved. Bacilli may be divided into:-

- **Bacilli:** single cell.
- **Diplobacilli:** in pairs.
- **Streptobacilli:** in chains.

3- Spiral bacteria (Helicodial): They are shaped like a coiled wire spring some species are shaped much like a slightly twisted commas, these are grouped in the genus vibrio.

4- Filamentous bacteria: e.g. *Actinomycetes.*

أ- تحت مملكة الثالوسيات

1- البكتيـــريـــا

❖ **أشكال البكتيـــريا**

1-**بكتريا كرويـــة**: وتنقسم إلي:-

كروية وحيدة- كروية ثنائية- سبحية كروية- عنقودية- سارسينا (في مجموعات مكعبة).

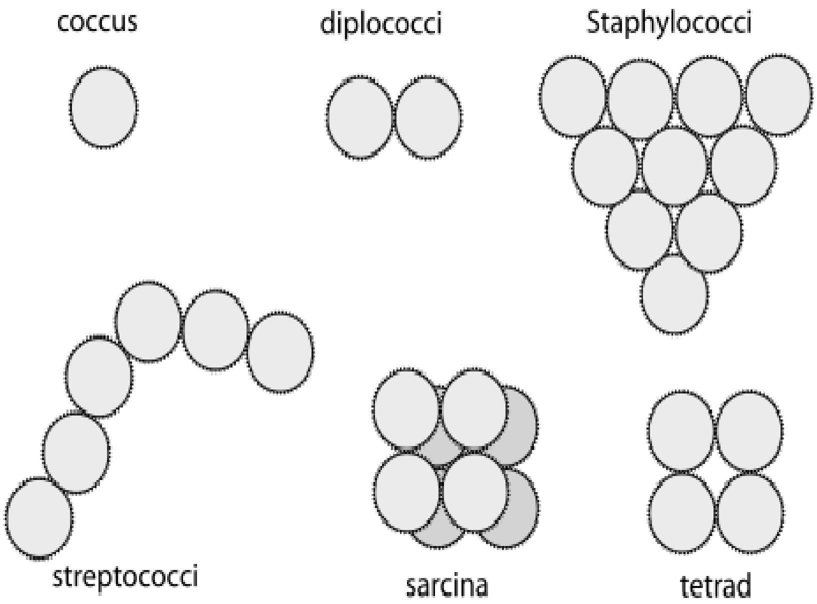
2-**بكتيريا عصويـــة**: وتنقسم إلي:-

عصوية وحيدة- عصوية ثنائية- عصوية في سلسلة.

3-**بكتيريا حلزونيـــة**: حلزونية الشكل او زاوية.

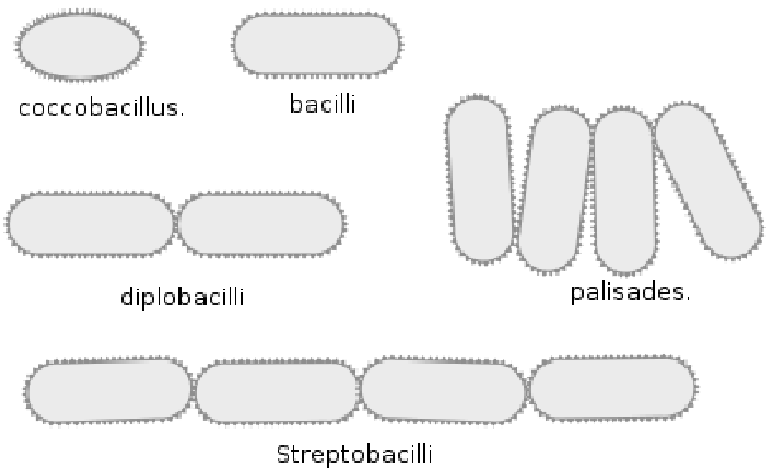
4-**بكتيريا خيطيـــة**: خيوط متفرعة تتكاثر بالكونيدات كما في مجموعة البكتريا الشعاعية.

Arrangments of Cocci

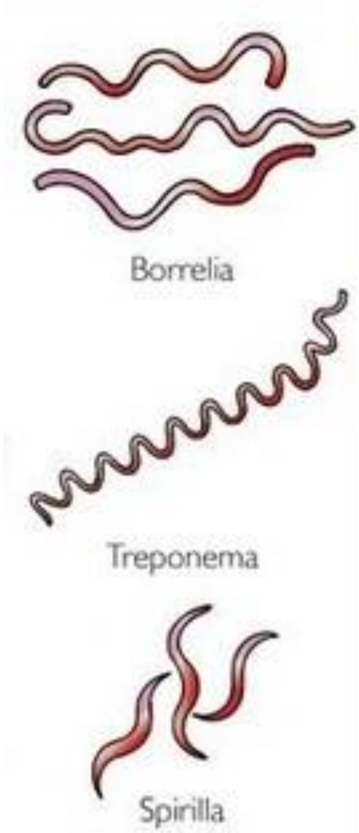


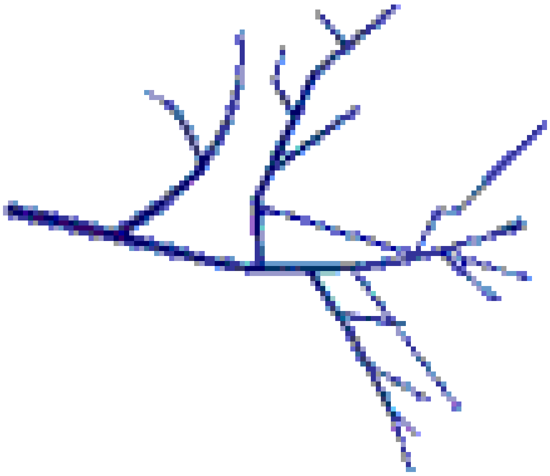
بكتيريا كروية

Arrangments of Bacilli



بكتيريا عصوية





بكتيريا حلزونية

بكتيريا خيطية

Algae

2- Euglenophyta

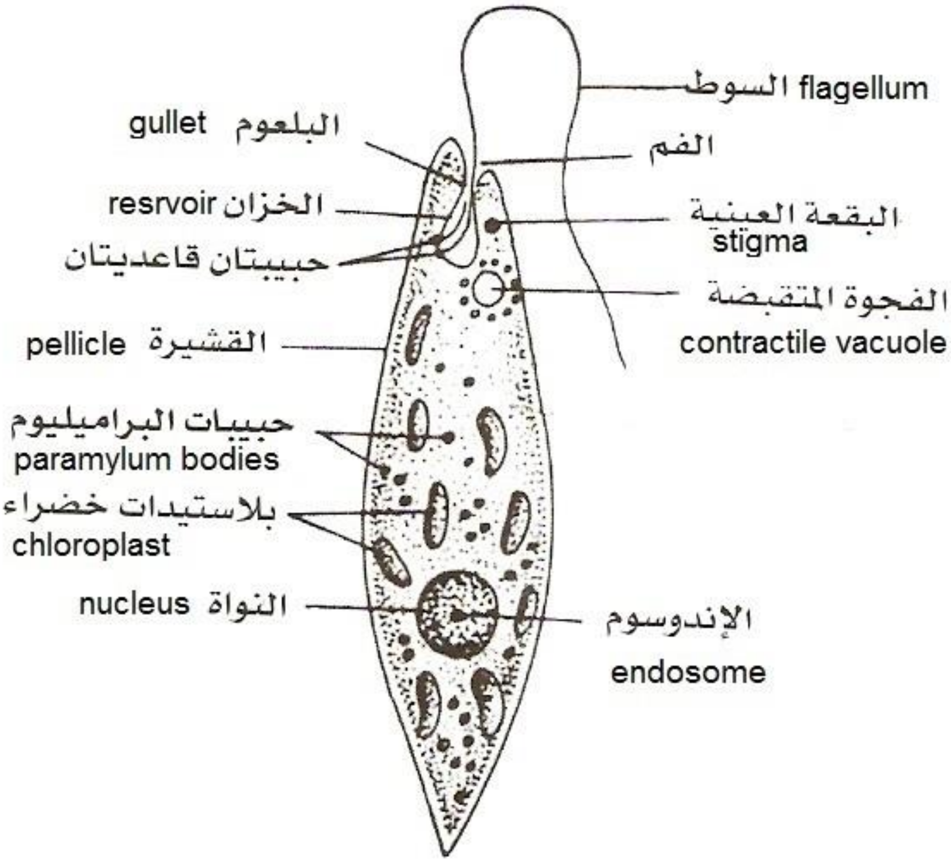
Euglena:

Mount a drop of water containing *Euglena*, examine under the low and high power of the microscope. The unicellular organism appearing as an elongated, spindle shaped cell. The absence of a rigid cell wall results in a continuous change of the cell shape while it is moving. The eye spot or stigma appears as a red spot near the base of the gullet. There is also a contractile vacuole. Note also the nucleus, paramylon bodies (reserve food) distributed in the cytoplasm.

2-**الطحالب اليوجلينية**

اليوجلينا:

افحص خلايا طحلب اليوجلينا تحت المجهر. لاحظ السوط الذي يخرج من خلايا المرئ وعلي جانبيه البقعة العينية, واسفله فجوات قابضة. ولاحظ النواة والبلاستيدات الخضراء, والاجسام الباراميليونية المنغمسة في السيتوبلازم.



تركيب اليوجلينا

3- Cyanophyta

Nostoc:

Nostoc colonies occur in the form of spherical of cushion like masses. Within these masses are numerous coiled, interwoven, and unbranched filaments of *Nostoc*. The filament is composed of more or less rounded or barrel-shaped cells with constrictions between them. Intercalary heterocysts (these are specialized cells and arise by the metamorphosis of ordinary vegetative cells) are present. Vegetation reproduction takes place by the formation of hormogonia which are delimited by the heterocysts.

Oscillatoria :

The filaments are unbranched; the mucilaginous sheath around the filament is very thin. The cells are cylindrical and more broad than long, each cell has the usual detailed structure. The apex of the terminal cell may be produced into a cap-like calyptra.

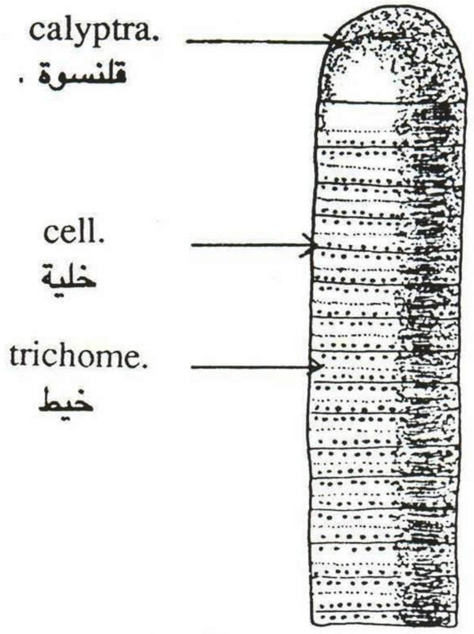
3- الطحالب الخضراء المزرقة

النوستوك

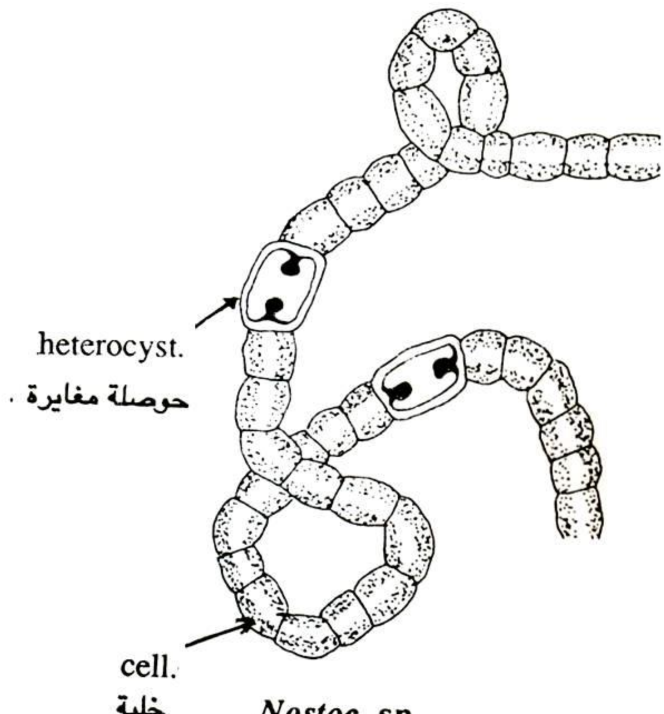
افحص طحلب النوستوك ولاحظ ان شكل الطحلب كالسبحة, فهو عبارة عن شريط من خلايا كروية.لاحظ أيضا وجود خلايا متسعة برميلية الشكل تسمي حويصلات مغايرة, كما أن خلايا الطحلب تحتوي علي انوية محدودة.

الاوسيلاتوريـــــا

افحص خيوط طحلب الاوسيلاتوريا تحت المجهر.لاحظ ان جدار الخلية تغلفه طبقة هلامية تبطن جدار الخلية البلازما الملونة وبداخلها تظهر الحبيبات الكروماتينية والفجوات الكاذبة والغازية.



Oscillatoria sp.
أسيلاتوريا



***Nostoc* sp.**
النوستك .

4- Chlorophyta

Chlamydomonas:

Examine the unicellular organism under the high power of the microscope. The general shape is usually oval, at the anterior end of the organism there are two flagella. Notice the two contractile vacuoles and the eye-spot at the anterior part of the cell. The cup shape chloroplast with one pyrenoid acting as a center around which starch is formed.

Pandorina:

Spherical solid conobium of 8 or 16 cells closely packed together and surrounded by mucous. The cells which have chlamydomonal structure are spindle in shape and each cell has two flagella attached to its broad end.

Volvox:

It is a hollow sphere colony with a large number of cells embedded in an external mucous material. The following types of cells can be distinguished:

1) Somatic cells.
2) Gonidia.
3) Sexual cells, they are antheridia (male cells) and oogonia (female cells).

4-الطحالب الخضراء

الكلاميدوموناس

خذ عينة من مياه البرك علي شريحة نظيفة بواسطة انبوبة شعرية ثم ضع غطاء الشريحة علي نقطة الماء, وافحص بالعدسة الكبري, وتحقق من وجود صحلب الكلاميدوموناس.

الطحلب وحيد الخلية كمثري الشكل والطرف المدبب به نقطة حمراء عينية ويخرج من هذا الطرف هدبان تساعدان الطحلب علي الاندفاع في الماء بحركة لولبية تشبه البريمة.لاحظ وجود بلاستيدة فنجانية الشكل في الطرف المتسع للخلية. أضف للتحضير نقطة من محلول اليود تجد ان المركز النشوي الموجود في قاع البلاستيدة يتلون باللون الازرق مما يدل علي أن هذا الجسم له علاقة بتكوين النشا.

الباندورينـــــا

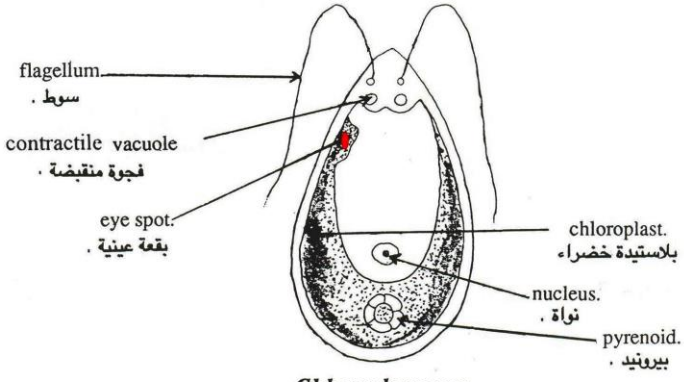
لاحظ ان الطحلب عبارة عن مستعمرة طحلبية مصمتة تتكون من ثمانية أو ستة عشر خلية متشابهة, كل واحدة منها شبيهة بالكلاميدوموناس مرتبة في مستعمرة بشكل خاص حيث ان سطح طرف الخلية العريض يتجه إلي الخارج.لاحظ أيضا انه لا يوجد تمييز بين خلايا الطحلب.

الفولفوكس

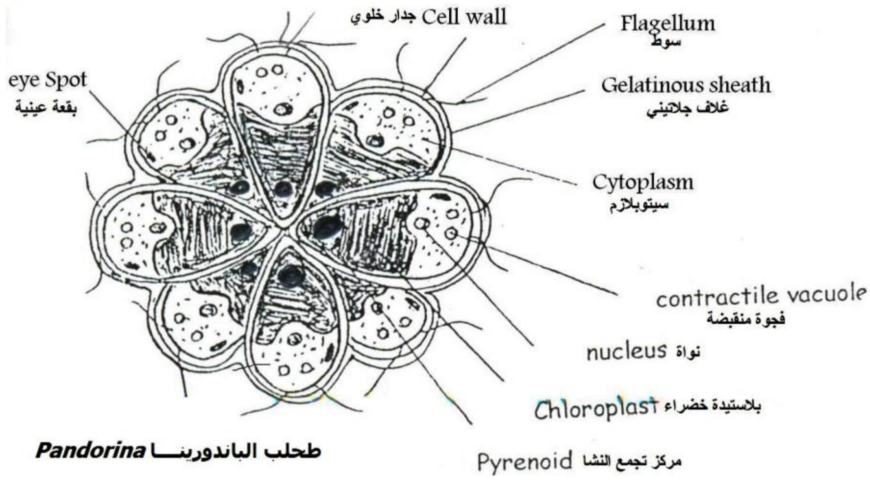
افحص الشرائح الجاهزة لطحلب الفولفوكس ولاحظ أن الطحلب عبارة عن مستعمرة كروية جوفاء متكونة من عدد كبير من الخلايا تتصل ببعضها بواسطة خيوط سيتوبلازمية وتتميز الخلايا في المستعمرة إلي أربعة أنواع هي:-

1) خلايا خضرية هدبية.
2) خلايا جونيدية.
3) خلايا تكاثرية: وهي عبارة عن الانثريدات (خلايا بها امشاج ذكرية) والاووجونات (خلايا بها البويضات الانثوية).

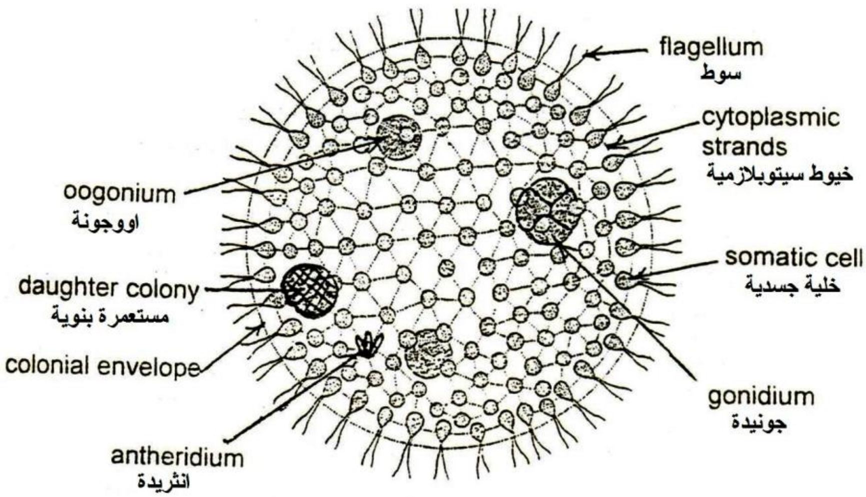
- لاحظ وجود مستعمرة بنوية في تجويف المستعمرة الاصلية.



Chlamydomonas
كلاميدوموناس .



Pandorina **طحلب الباندورينا**



Volvox **تركيب طحلب الفولفوكس**

Spirogyra:

Unbranched filament, consisting of a row of similar cells. The spiral arranged chloroplasts with many pyrenoids. The nucleus is central and suspended by cytoplasmic strands.

Sexual reproduction:

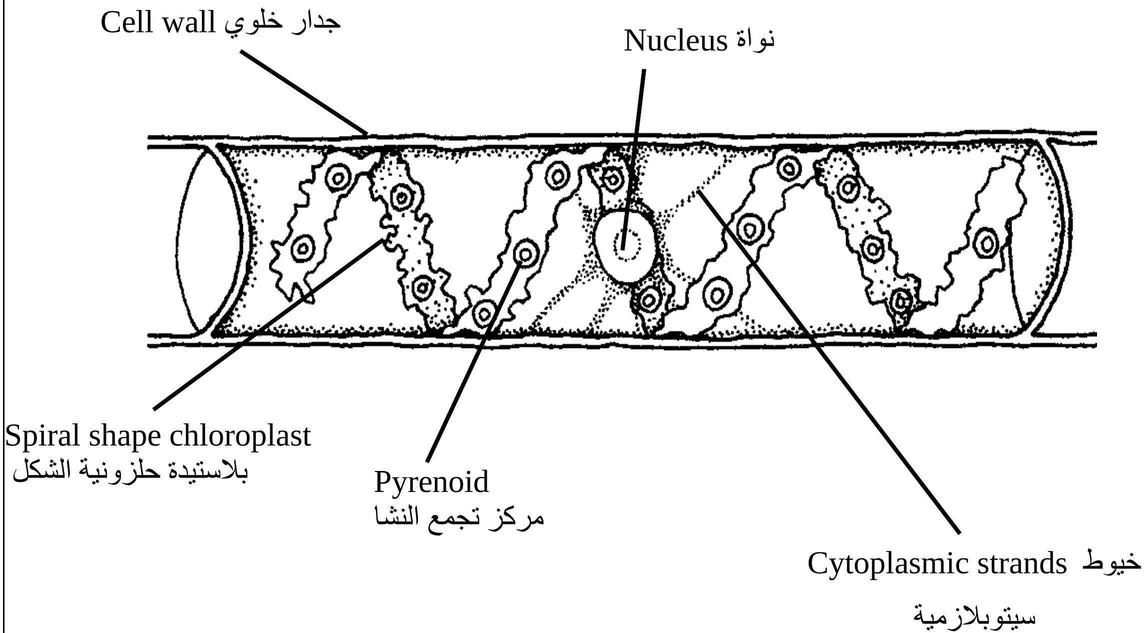
1) Scalariform conjugation.

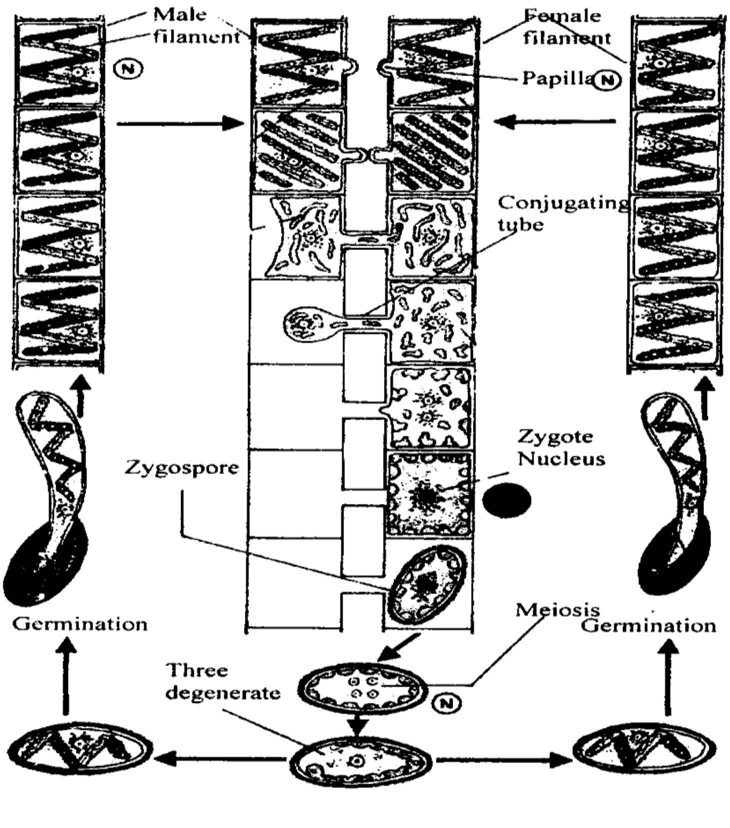
2) Lateral conjugation.

الاسبيروجيرا

خذ عينة من الريم الاخضر وافحصها ميكروسكوبيا. لاحظ وجود خيوط عديدة غير متفرعة والخيط الواحد مكون من عدة خلايا مستطيلة متلاصقة طرفا إلي طرف. وفي كل خلية بلاستيدة خضراء او أكثر. والبلاستيدة عبارة عن شريط ملتف كالحلزون ذو حافة متموجه. ويوجد بالخلية نواة واحدة تكون عادة معلقة في مركز الخلية بواسطة خيوط سيتوبلازمية.

ابحث عن خيطين في حالة تزاوج سلمي ولاحظ ان محتويات أحد الخيطين الذي يعتبر مذكرا تمر خلال انابيب التزاوج الي الخيط الاخر الذي يعتبر مؤنثا, وعليه فالخيط الاخر يكون مملؤا بالزيجوتات.





الاقتران السلمى فى طحلب الاسبيروجيرا

5- Chrysophyta

Vaucheria:

The filament consists of tubular coenocytic, non-septate branched filaments. The coenocyte contains numerous small disc shaped chloroplasts and nuclei embedded in the cytoplasm. The reserve material is mainly oil which appears as droplets.

Examine the oogonium (female). It is cut from the rest of the coenocyte by a wall, it contains one egg. The antheridium is an elongated curved tube, separated from coenocyte by transvers septum.

Diatoms:

Examine and draw the material provided. Notice the symmetrical shape of the cells. Diatoms are unicellular organisms with radial or bilateral symmetry. In the side (or girdle) view you can detected one or the two valves, the outer (epitheca) and the inner (hypotheca), the view where the valves meet, is called the girdle.

Notice the silica protrusions laid on the cell wall giving it a very characteristic feature. In the valve view, note the raphe which is a narrow slit connecting two polar nodules with a central one.

5- الطحالب الخضراء المصفرة

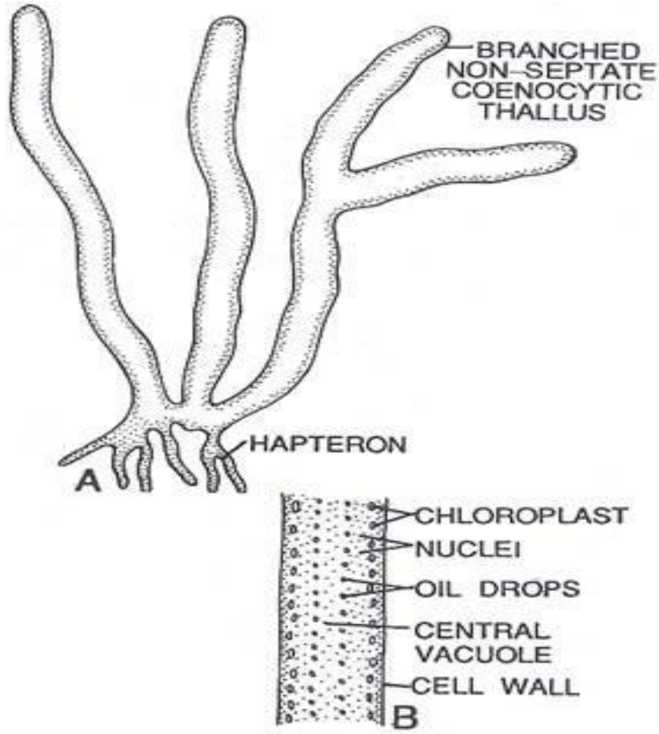
الفوشيريا

يتكون ثالوس هذا الطحلب من خيوط متفرعة عبارة عن مدمج خلوي. لاحظ أن الطحلب وحيد المسكن, فالاووجونة كروية وبها بيضة واحدة ولها بروز او منقار أما الانثريدة فتنشأ بجوار الاووجونه وهي اسطوانية مقوسة, يفصل كل من الاووجونة والانثريدة بجدار مستعرض عن بقية الخيط.

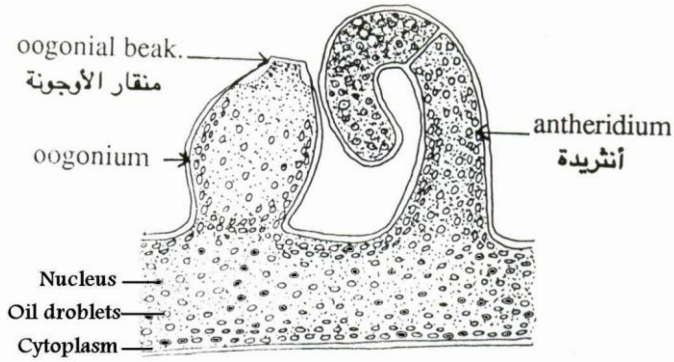
الدياتومـــات

افحص الشرائح الميكروسكوبية المجهزة او عينة مياه ولاحظ ان غالبية الدياتومات توجد منفردة. ومما تجدر الاشارة اليه:

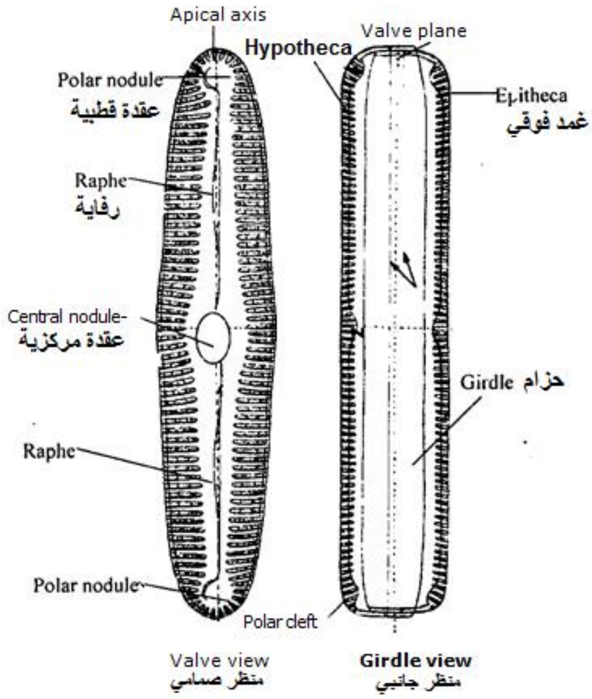
1) المقدار الكبير من السيليكا الذي يتخلل الجدار الخلوي.
2) ان الجدار الخلوي يتكون من نصفين يسمي كل منهما مصراع وهما يتراكبان معا ويسمي المصراع الخارجي بالغمد الفوقي ويسمي المصراع الداخلي بالغمد التحتي.
3) في الدياتومات المستطيلة يوجد شق طولي يسمي الرفاية تنتظم عليه عقدتين قطبيتين وعقدة وسطية.

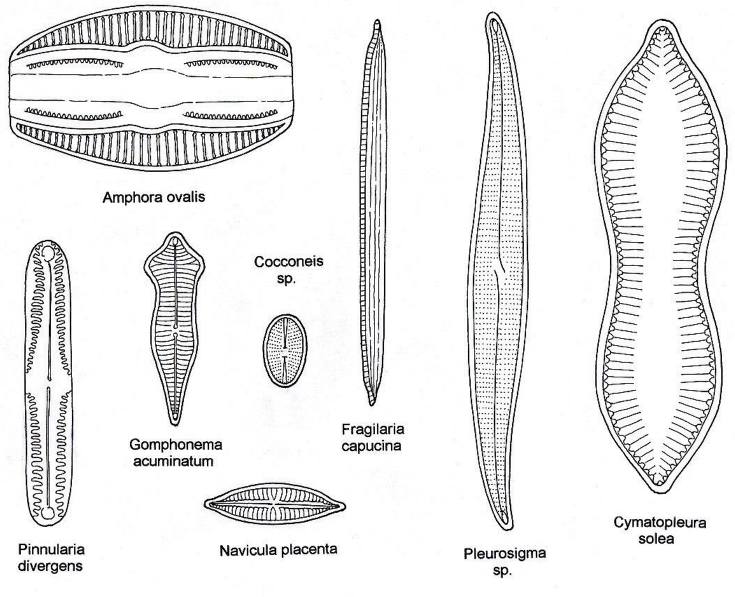


Vaucheria sp. Vegetative structure; A, a complete thallus; B, a part of thallus (enlarged).



Vaucheria sp. sexual reproduction.





A selection of diatoms.

6- Phaeophyta

Fucus:

The thallus is a dichotomously branched ribbon shaped structure presenting leathery appearance and narrowed below into a short stalk-like stipe which ends in the holdfast. Each lobe of the thallus has a distinct midrib, when the plants become fertile, cavities or conceptacles containing sex organs appear towards the tips of the branches. Some species possess air bladders.

The thallus is formed anatomically of assimilating layer, storage layer and the medulla.

Examine the prepared sections of male and female conceptacles.

Male conceptacle:

It consists essentially of an outer multilayered wall. The inner surface of this wall produces hairs. Some of which project to the outside through the ostiols. These hairs are called paraphysis which are numerous branched and carry the antheridia on their lateral branches.

Female conceptacle:

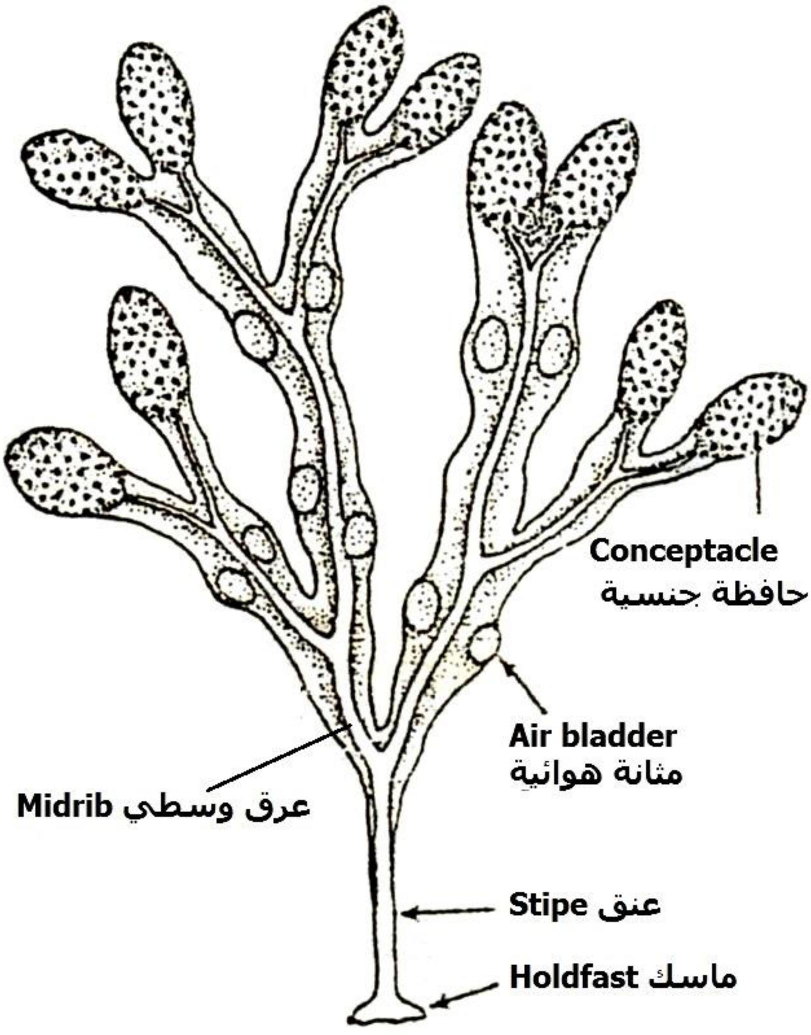
The macrosporangia (oogonia) are carried very short stalks arising directily from the conceptacles wall. These macrosporangia are intermixed with multicellular unbranched paraphysis. Each macrosporangium (oogonium) contains eight eggs.

6- الطحالب البنية

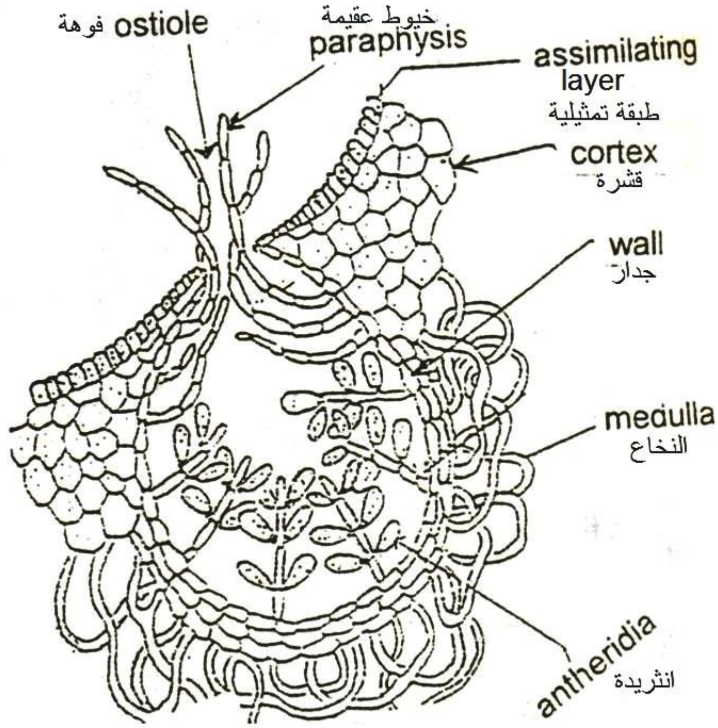
الفيوكس

ارسم الشكل الخارجي لثالوس الفيوكس مبينا أن الثالوس المتورق يتفرع تفرعا ثنائي الشعب ولاحظ ان النبات يثبت نفسه في الصخور بواسطة ماسك Holdfast وأما الجزء السفلي غير المتفرع فيسمي بالعنق.

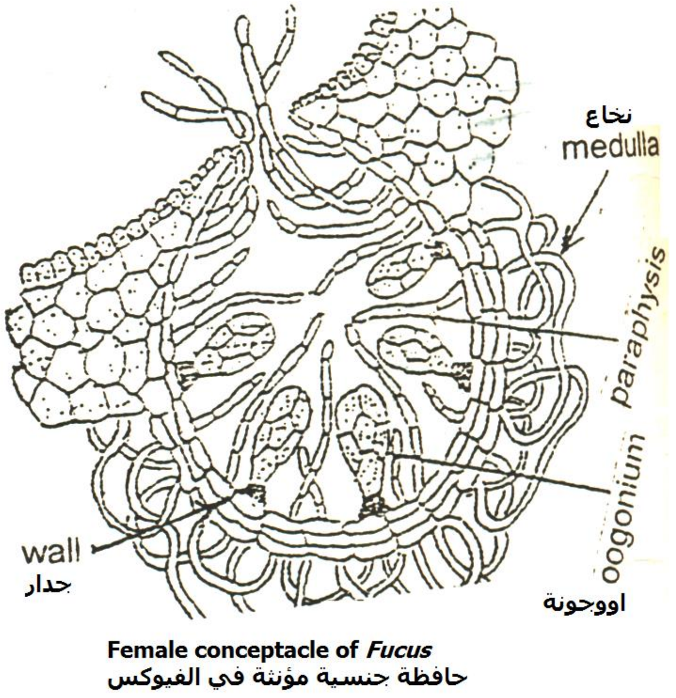
افحص القطاعات المجهزة للحوافظ الجنسية لمشاهدة الاعضاء الجنسية التي توجد بداخلها اووجونه معنقة بكل منها ثماني بويضات ويوجد بين الاووجونات خيوط عقيمة غير متفرعة. اما الحافظة الجنسية المذكرة فتحتوي علي عدد كبير من الخيوط العقيمة المتفرعة تنتظم عليها الانثريدات كفروع جانبية. وتتصل كل حافظة جنسية بالخارج عن طريق ثقب صغير علي السطح يسمي الفوهة.



Fucus
الشكل الخارجي للفيوكس



Male conceptacle in Fucus
حافظة جنسية مذكرة في الفيوكس



Female conceptacle of *Fucus*
حافظة جنسية مؤنثة في الفيوكس

B- Eumycophyta

1) Calss:Phycomycetes (algal fungi)

<u>Rhizopus</u> **(black mould)**

Examine the growth of *Rhizopus* (Black mould) on the moist bread with a lens.

Make out the creeping hyphae stolen and the vertical branches with mature and immature sporangia.

Mount a small piece of young *Rhizopus* in water, examine with the microscope and sketch a portion of it showing the cell wall and the protoplasm containing numerous vacuoles which become smaller towards the growing tip of the hyphae.

Draw young sporangia, some showing sporangiospores columella and some in earlier stages of development as seen under the high power.

Sexual reproduction:

Examine and draw the demonstration slide showing conjugation hyphae and the successive stages in zygospore. (Thick- walled and dark colored formation).

ب- الفطريات الحقيقية

1- الفطريات الطحلبية

عفن الخبز الاسود

هذا الفطر يسبب تعفنا للخبز والفاكهة . خذ قطعة صغيرة من الميسيليوم علي شريحة وحملها في قطرة من الماء او الجلسرين ثم افحصها ميكروسكوبيا وارسم الفطر وبين الاجزاء التالية:-

1- الهيفا المدادة الرئد (stolon) تمتد فوق سطح الوسط الغذائي او المادة العضوية (قطعة خبز).

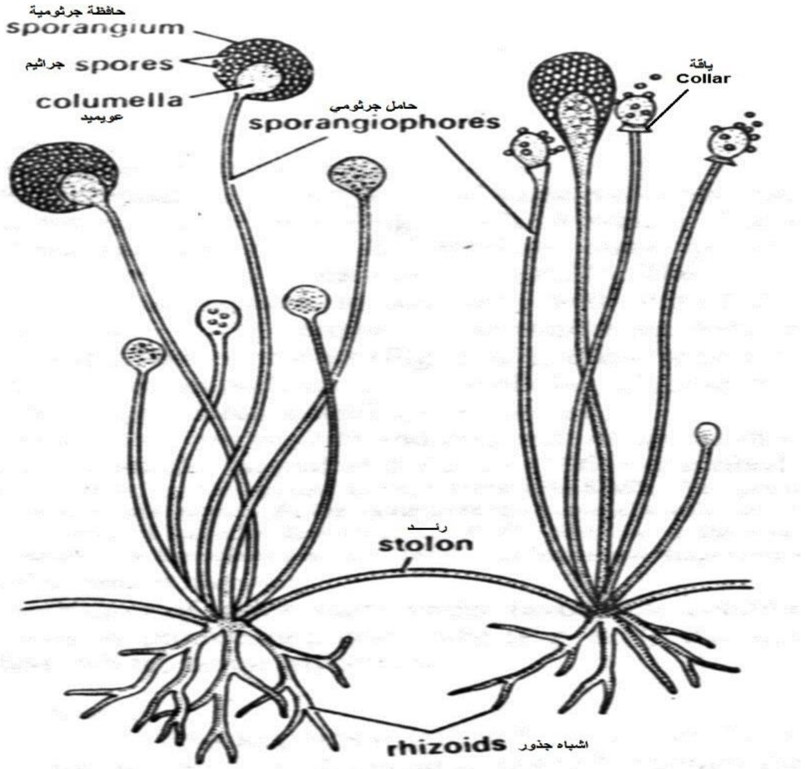
2- أشباه الجذور: تقوم بتثبيت الفطر في الوسط الغذائي وامتصاص الغذاء.

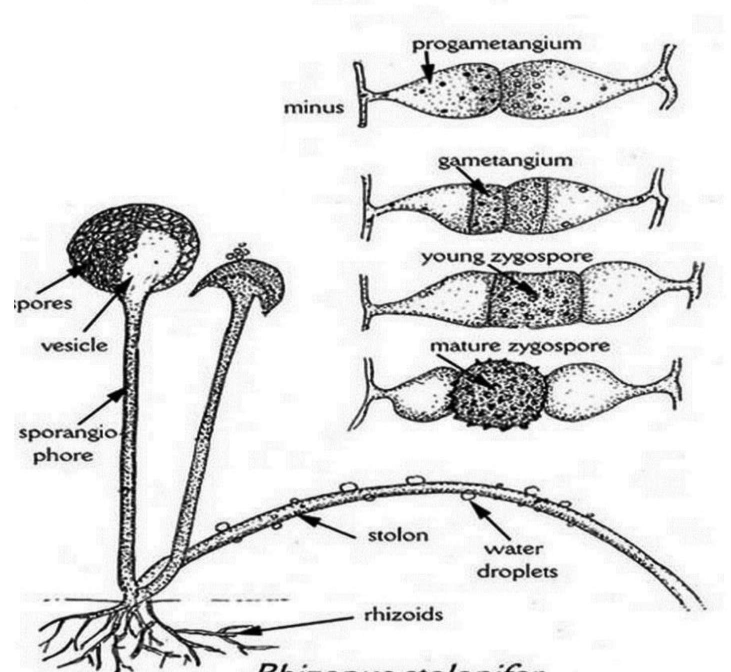
3- حوامل الحواظ الجرثومية : وتنبثق مقابل أشباه الجذور.

4- الحافظة الجرثومية: وبها عدد كبير من الجراثيم الحافظية متجمعة فوق العويميد.

5- عند انتشار الجراثيم يتمزق جدار الحافظة الجرثومية ولا يتبقي منه الا حلقة بسيطة تسمي الباقة (collar).

ادرس مراحل التكاثر الجنسي في شريحة مجهزة ولاحظ شكل وتركيب اللاقحة الجرثومية.





Rhizopus stolonifer

2) Calss:Ascomycetes

***Saccharomyces* (Yeast):**

Examine a drop of the material provided and notice that the yeast is a unicellular organism, the cell being more or less ovoid. There is a distinct cell wall, and the cytoplasm surrounds a big nucleus.

The nucleus consists of vacuole traversed by chromatin filaments and there is a small nucleolus lying adjacent to but distinct from vacuole.

In the cytoplasm several inclusions are embedded as mitochondria, reflective volutin granules, Oil droplets and glycogen particles.

Observed that a new bud can separate from the original cell to form a new cell, when rapid budding is taking place, small chains or clusters of buds may be seen.

2- الفطريات الزقية

الخميرة

خذ نقطة من معلق الخميرة في الماء المصبوغ بأزرق الميثيلين علي شريحة نظيفة, ضع غطاء الشريحة بإحتراس وافحص التحضيري بالعدسة الكبري.

خلايا الخميرة كروية الشكل او بيضية الشكل وبكل منها جهاز نووي, لاحظ التكاثر الخضري بالتبرعم.

Aspergillus (Black mold):

The mycelium consists of much branched and septate hyphae with multinucleate cells, from the mycelium arise non-septate conidiophores, the free end of the conidiophore swells up into a vesicle, numerous phialides or sterigmata, are budded out from the vesicle and cover its entire surface, the sterigmata produce conidia chains, the youngest conidia being at the base of the chain (acropetally succession).

Penicillium (Green mold):

Examine the growth of *Penicillium* on agar under the low power of the microscope. Mount a small piece in water. Examine and sketch a portion of showing, the cell wall and the protoplasm. Note the presence of transverse walls (septa) (i.e. septate and branched multinucleate filaments).

Peziza:

Examine a vertical section in the ascocarp or apothecium and notice that asci are vertically arranged, each containing eight ascospores. Below the hymenium we find the sub-hymenium layer which composed of compact hyphae. The hymenium and sub-hymenium layers are both surrounded with a wall called peridium composed of interwoven hyphae.

اسبرجيللس (العفن الاسود):

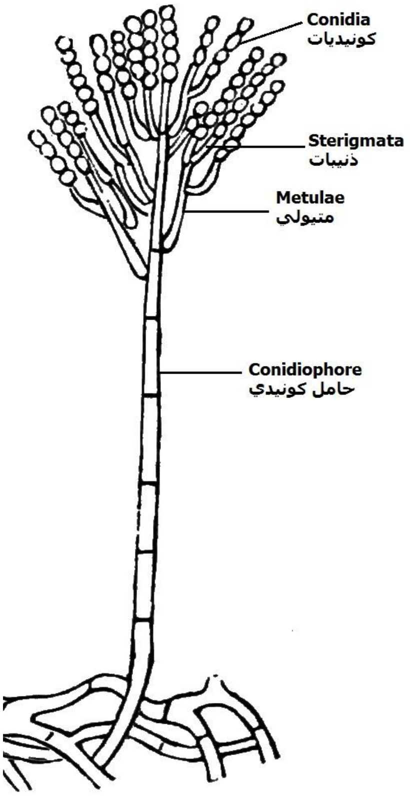
جهز شريحة لهذا الفطر النامي علي البيئات الصناعية داخل أطباق بتري ثم افحص التحضير بالعدسة الكبري للميكروسكوب. لاحظ ان الحامل الكونيدي غير مقسم, مع ان الغزل الفطري نفسه مقسم وينتهي الطرف الحر للحامل الكونيدي بانتفاخ عليه عدة ذنيبات يحمل كل منها سلسلة من الكونيدات.

بنسيليوم (العفن الاخضر):

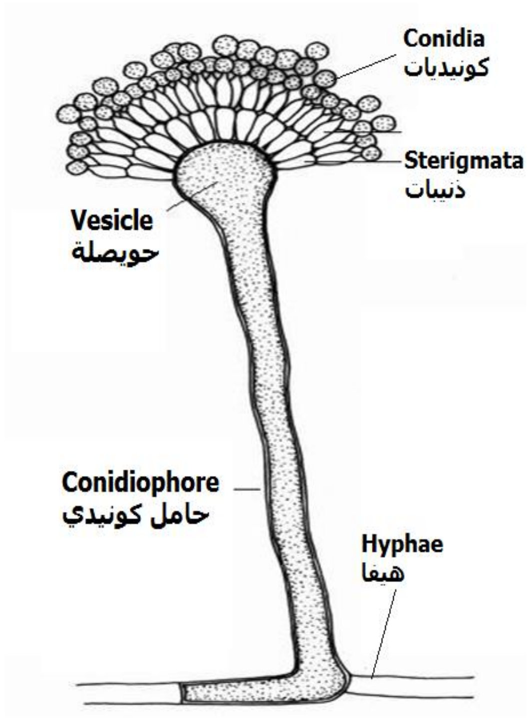
لاحظ الاعراض علي ثمرة البرتقال المصابة بالعفن الاخضر, حمل جزء من الفطر في الماء او الجليسيرين, وافحص العينة بالعدسة الكبري للميكروسكوب ثم ارسم الحوامل الكونيدية للفطر. تحقق من وجود حواجز عرضية في الحامل الكونيدي وأنه ينتهي بتفرع يشبه المقشه, واطراف الفروع تسمي الذنيبات وهي بدورها تحمل الكونيدات في سلاسل.

البيزيزا:

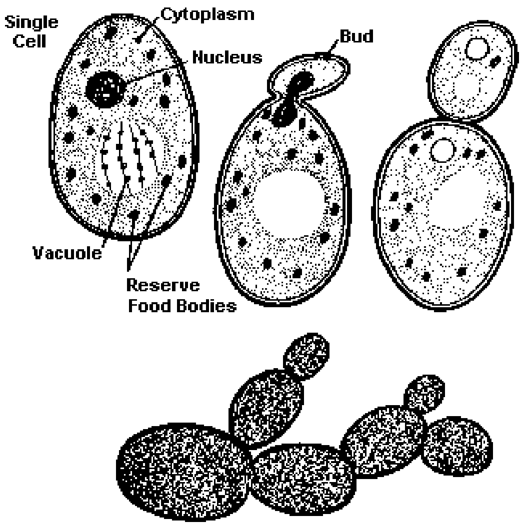
ارسم الجسم الزقي الكاسي الشكل للفطر الذي ينمو علي روث البهائم. ادرس القطاع العمودي للكأس الزقي الذي يتكون جداره من خلايا برانشيمية كاذبة ويوجد بداخله الطبقة تحت الخصيبية التي تتكون من خيوط متشابكة ويوجد بأعلي هذه الطبقة الاخيرة الطبقة الخصيبية التي تحتوي علي زقاق تتخللها خيوط عقيمة ويحتوي كل زق علي ثمانية جراثيم مرتبة في صف واحد.



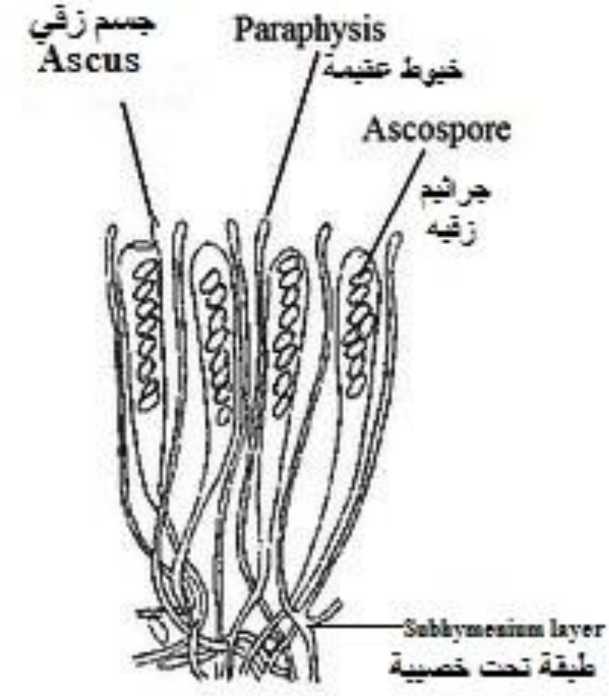
Penicillium sp. فطر البنسيليوم

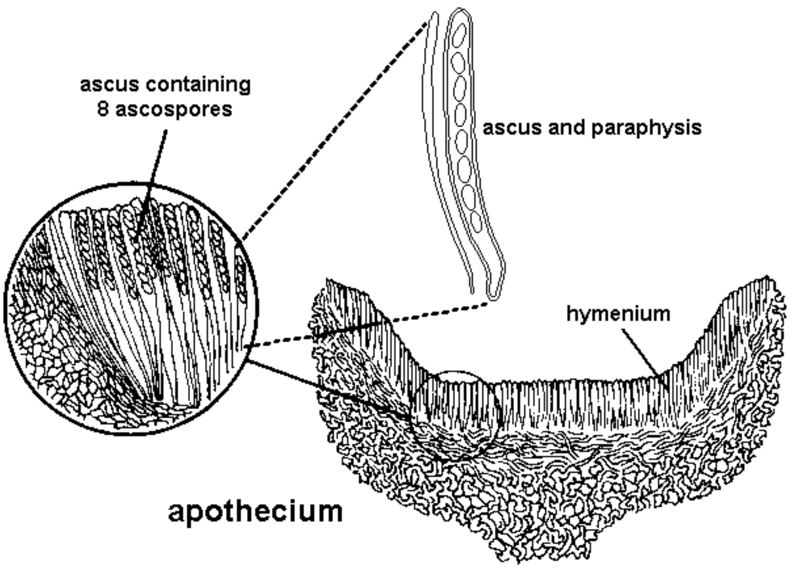


Aspergillus sp. فطر الاسبرجيلليس



Saccharomyces (Yeast) فطر الخميرة





Peziza sp. البيزيزا

3) Calss:Basidiomycetes

Puccinia graminis (wheat rust):

It causes the black or stem rust of wheat, oat, barley and several grasses. It is a parasitic member of basidiomycetes which completes its life cycle on two hosts and produces several kinds of spores.

a) Uredial stage (red rust stage):

Examine the surface of stem or leaf segments of wheat carrying uredia. Uredosori have a red or orange color due to the abundance of uredospores. Study a cross section of infected wheat stem and note that the surface covered with huge numbers of oval shaped uredospores borne on the terminal ends of stalks (hyphae), each spore contain two nuclei, and is composed of one cell with an outer spiny thick wall.

b) Telial stage (black rust stage):

Examine the teleutospores which are elongated, black instead of red and are two-celled with an outer smooth thick wall. Each cell contains one nucleus.

c) Aecidial stage:

Note also the several large cup-shaped aecia located on the lower surface of Berberis leaf. From the bottom of each aecium arises a closely packed parallel chain of bi-nucleate, sub-globose, light orange yellow aecidiospores. Note that each aecium is surrounded by a protective layer of compact hyphae known as the peridium.

***Agaricus* (Mushroom):**

It is a saprophytic fungus, note that the basidiocarp (fruit body) consists of a stalk and an umbrella shaped cap. An annulus may be found as membranous ring around the upper part of the stalk.

Examine a vertical section through the gills; note that each gill is composed of three layers:

a- Outer surface layer (hymenium) composed of basidia borne each 4 basidiospores and paraphyses.

b- The second layer is found as a compact zone of hyphae forming the sub-hymenium layer.

c- A central zone composed of loose hyphae known as trama.

3- الفطريات البازيديـــــة

باكسنيا جرامينس (صدأ القمح)

يعيش الفطر متطفلا ويتم دورة حياته علي عائلين مختلفيم هما: نبات نجيلي (القمح) ونبات البيربري.افحص نبات القمح المصاب بصدأ الساق الاسود ولاحظ وجود نوعين من البثرات:

ا) بثرات مستطيلة برتقالية اللون تعرف **بالبثرات اليوريدية**. خذ قطاعا عرضيا مارا بالبثرة اليوريدية ولاحظ وجود الجراثيم اليوريدية وهي جراثيم معنقة ذات شكل بيضي, ولها جدار سميك نوعا ويحمل عددا من البروزات الشوكية ومكونة من خلية واحدة بها نواتان ولها عدد من ثقوب الانبات في الجزء الوسطي.

ب) بثرات مستطيلة سوداء اللون تعرف **بالبثرات التليتية**, خذ قطاعا عرضيا مارا بالبثرة التيليتية ولاحظ وجود الجراثيم التليتية وهي جراثيم معنقة ذات شكل مغزلي ولها جدار سميك

املس, وهي مكونة من خليتين بكل منها نواة ثنائية المجموعة الكروموسومية ولكل منها ثقب إنبات.

ج) **البثرات الأسيدية:** تصل علي السطح السفلي لورقة نبات البيربري وهي تراكيب كأسية الشكل محاطه بجدار عقيم يسمي البريديام ويوجد عند قاعدة الكأس صفوف من الخلايا المستطيلة ينبثق من كل منها سلسلة من الجراثيم الاسيدية والجرثومة الاسيدية لها جدار رقيق وهي وحيدة الخلية وثنائية الانوية.

عيش الغراب

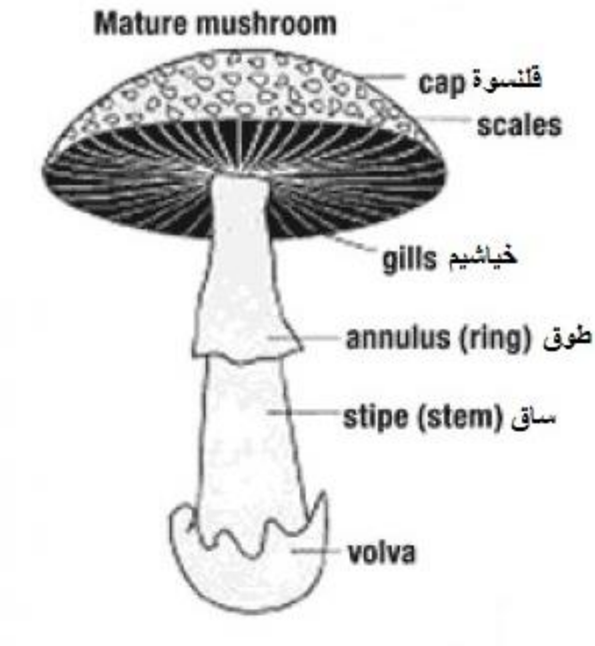
افحص الجسم الثمري اي الحامل الجرثومي ملاحظا انه يتكون من عنق وقلنسوة تشبه المظله وتحمل القلنسوة علي سطحها السفلي صفائح رقيقة تسمي الخياشيم, لاحظ وجود جزء من نسيج متبقي حول الطرف العلوي للعنق يعرف بالطوق.

خذ قطاعا في القلنسوة والخياشيم لدراسة التركيب الداخلي للصفيحة الخيشومية وافحصه ميكروسكوبيا ولاحظ انها تتركب من:-

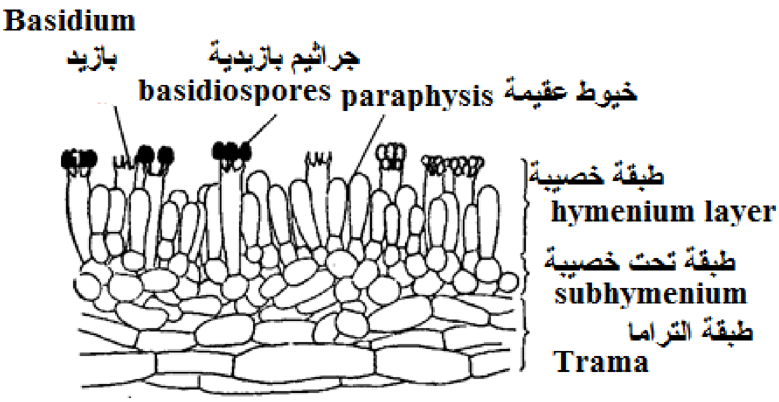
1- الترام: تتكون من خيوط فطرية مفككة في مركز الخيشوم.

2- الطبقة تحت الخصيبية: تقع خارج الترام من كل من الجانبين وهي تتكون من طبقة من الخلايا والخيوط الفطرية المتماسكة.

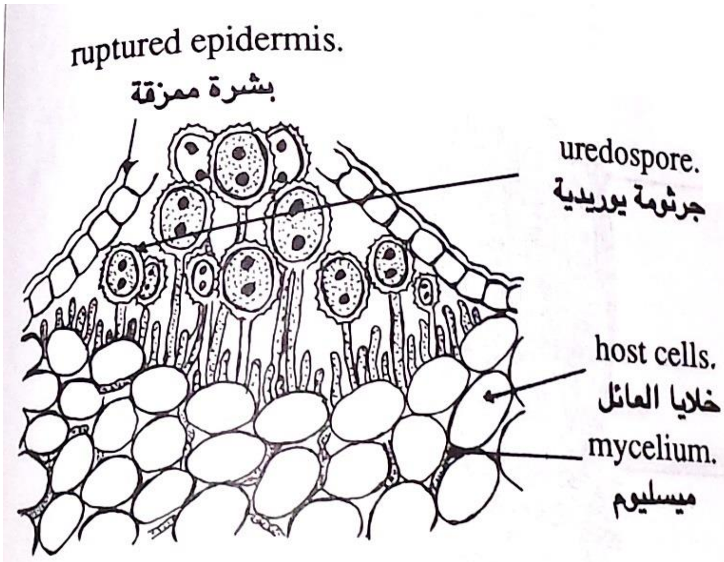
3- الطبقة الخصيبية: أقصي الطبقات الخارجية وهي مكونة من عدد كبير من البازيدات والهيفات العقيمة, يحمل كل بازيد أربع جراثيم بازيدية علي اربعة اعناق قصيرة هي الزنيبات.



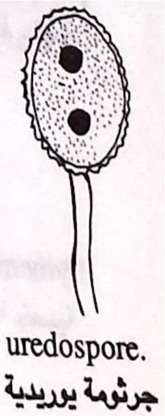
Agaricus عيش الغراب

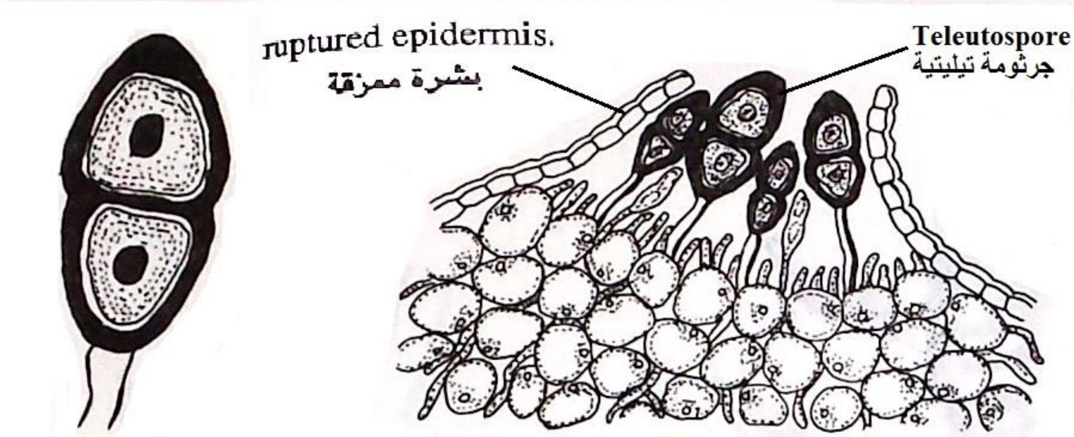


T.S. in gills of *Agaricus*
قطاع في الخياشيم لفطرعيش الغراب



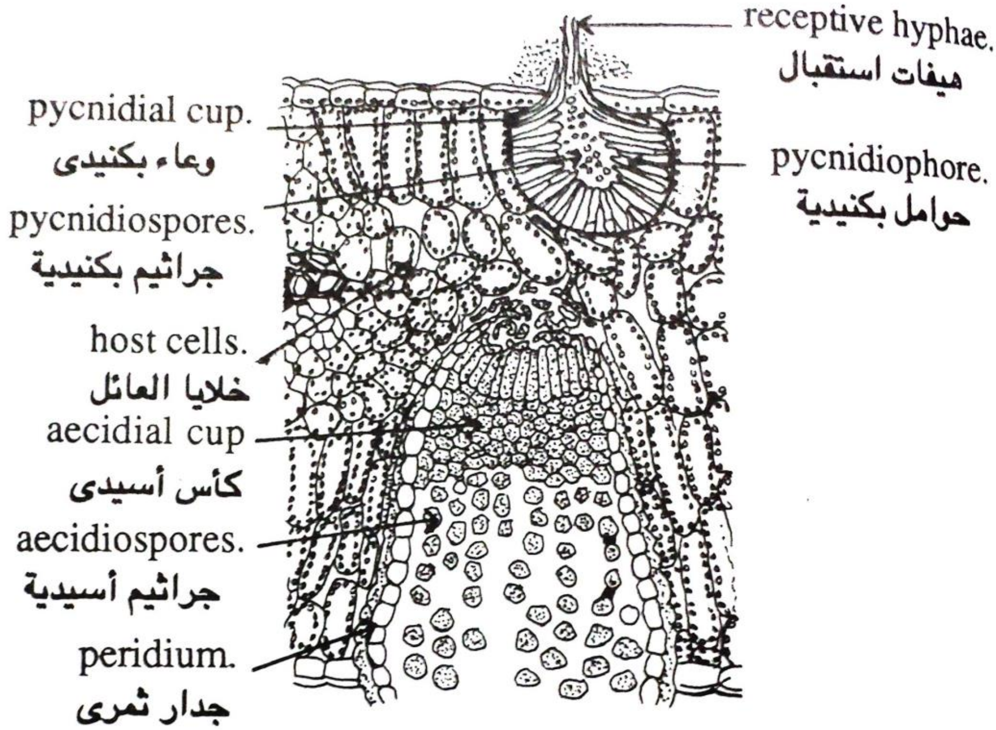
Uredosorus in *Puccinia graminis*
بثرة يوريدية في فطر الباكسينيا جرامينيس





***Puccinia* sp.T.S wheat leaf through teleutasorus and magified teleutospore**

باكسينيا قطاع عرضى فى بثرة تيليتية
وجرثومة تيلينية مكبرة



Puccinia sp. T.S Berberis
leaf showing pycnidial and aecidial cups.
باكسينيا . كئوس الأسدية
والأوعية البكنية بداخل ورقة نبات البيربيرس

Lichens

The lichens are composite plants made up of an alga and fungus, the two being very intimately associated together. The thallus mainly consists of fungus, the alga being held between the fungus hyphae.

Note the growth habit of lichens, which may be either **crustose, foliose (**leaf-like**)** and **fruticose (**much branched and shrub-like**).**

Study a vertical section through a foliose thallus and notice the following zones:

a) Upper cortex: consists of compact fungal hyphae.

b) Algal layer (gonidial layer): composed of loose hyphae surrounding the algal cells.

c) Medulla: composed of very loosely interwoven hyphae.

d) Lower cortex: composed of compact hyphae. The outer surface of this zone gives rise to rhizoid-like hyphae called rhizoid for fixation.

الأشـــــــن

الصفة المميزة للاشن هي انها تتكون من كائنين مميزين مختلفين هما فطر وطحلب. لاحظ ان الاشن تتشكل الي ثلاثة انواع هي:-

1- **اشن قشرية:** وهي تظهر علي سطح الصخور والأحجار في صورة قشور رقيقة.

2- **أشن ورقية:** وهي توجد عالقة علي قلف بعض الاشجار كالموالح والتين علي هيئة صفائح عريضة مفلطحة تشبه الوراق.

3- **أشن شجيرية:** وتتميز بأنها متفرعة كشجيرة صغيرة وهي أما تنمو علي سطح التربة او عالقة بأغصان الاشجار.

افحص قطاعا في احد انواع الاشن ولاحظ الطبقات التالية:-

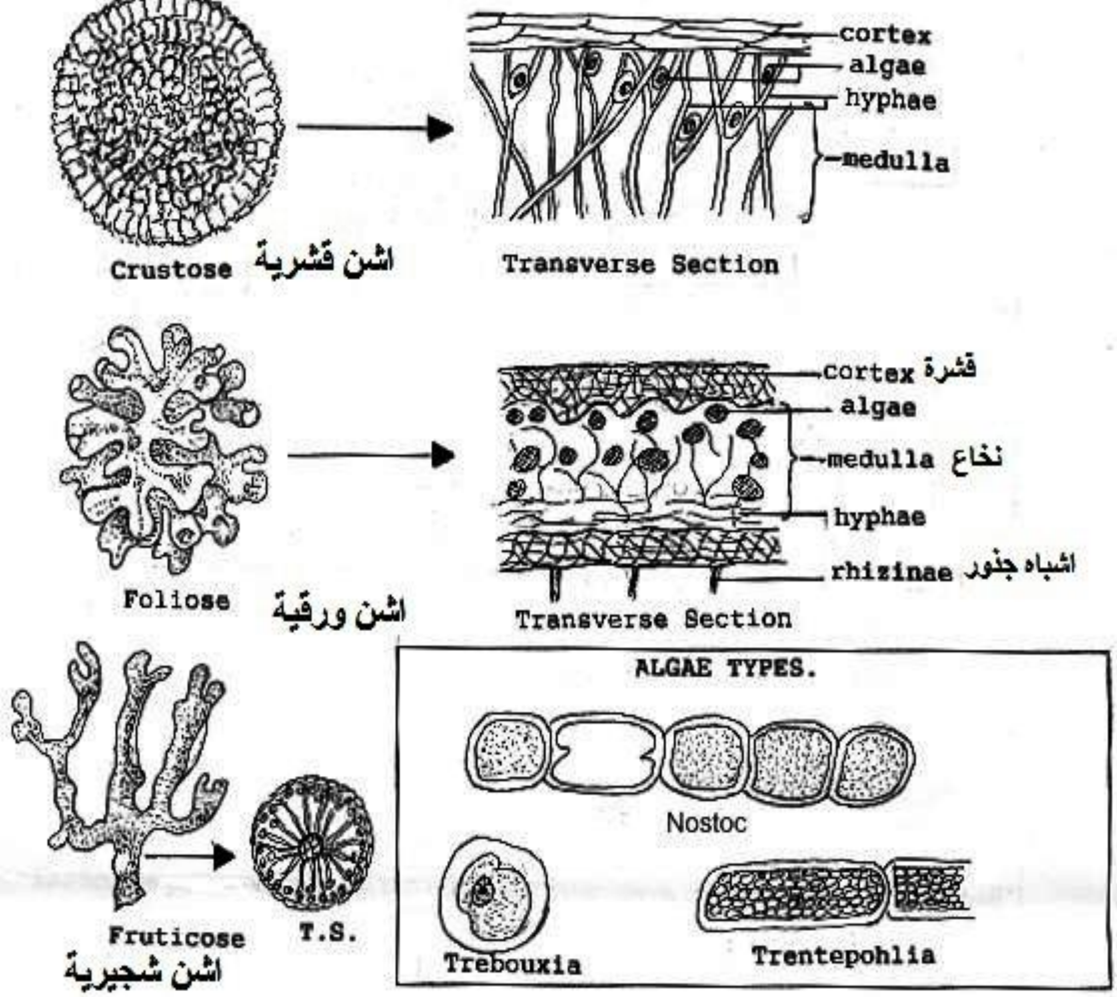
1- القشرة العليا: وهي تتكون من هيفات الفطر المتماسكة.

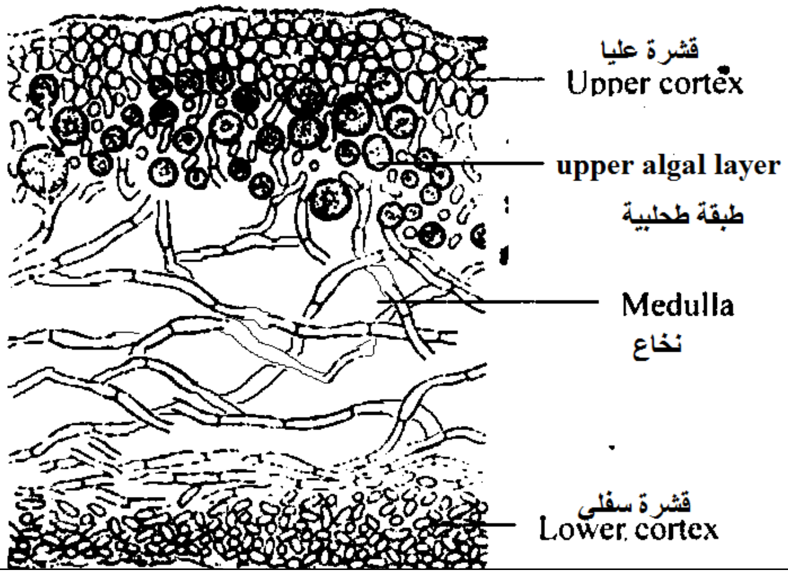
2- الطبقة الطحلبية: وهي تتكون من هيفات غير متماسكة وتختلط معها خلايا الطحلب.

3- طبقة النخاع: وتتكون من هيفات غير متماسكة.

4- القشرة السفلي: وتشبه القشرة العليا.

LICHEN TYPES:-





T.S. in Lichens قطاع في الاشن

C-Bryophyta

1- Hepaticeae (liverworts)

<u>Riccia:</u>

Gametophyte of *Riccia* is the domination plant green, thalloid and rosette- shaped. It has an undulating margin and its branching is dichotomous.

Its middle part is thickened to form the midrib. It is fixed to the substratum by unicellular rhizoids and multicellular scales. Examine and make a labelled drawing of gametophyte. On the dorsal side note the sporangia which appear as black dots. Examine a vertical section in the thallus and notice that it is composed of two types of tissues:

1- An upper assimilating tissue which consists of assimilating filaments rich in chloroplast and separated by air cavities. The upper most layer of cells is devoid of chloroplasts and forms a sort of discontinuous epidermis.

2- A lower storage tissue which consists of few layers of large cells devoid of chloroplasts and rich with reserve food materials.

3- Examine the sex organs (archegonia and antheridia) in the basal part of the air canal. Examine the sporophyte or sporangium and notice its simple structure, it is composed of a sac surrounded by a sterile wall enclosing a fertile tissue known as sporongenous tissue. The inside sporogenous tissue is formed of a large number of spore mother cells, each of which produces a spore tetrad. Notice also that the wall of the archegonium remains attached to the sporophyte and known as calyptra.

تحت مملكـــــة النباتات الجنينية

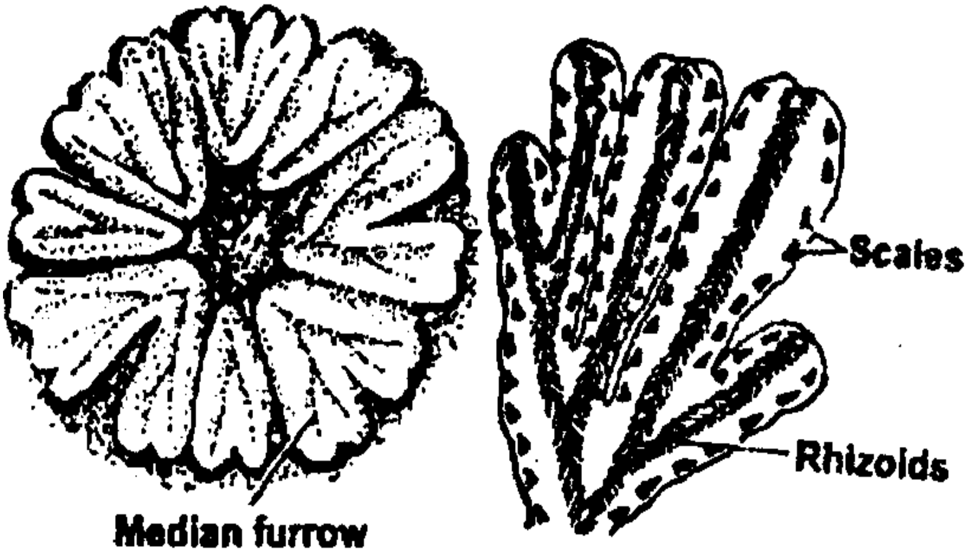
النباتات الحزازية

1- الحزازيات المنبطحة

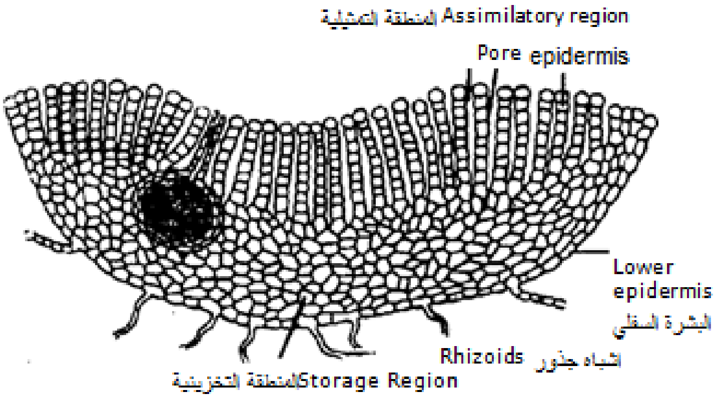
الريشيا

ارسم الشكل الخارجي للثالوس (الطور الجاميتي) ولاحظ أنه مفلطح ودائري, ويتفرع تفرعا ثنائيا ويتصل بالتربة بأشباه الجذور وبحراشيف. خذ قطاعا عرضيا لدراسة التركيب الداخلي للنبات ولاحظ أن الجزء العلوي يعرف بالنسيج التمثيلي ويتكون من خيوط تمثيلية والجزء السفلي يعرف بالنسيج التخزيني ويتكون من خلايا برانشيمية. وفي نهاية بعض القنوات الهوائية عند قواعد الخيوط التمثيلية تحقق من وجود الارشحونيات والانثريدات.

النبات الجرثومي يتواجد علي هيئة كرتذات جدار عقيم بداخله رباعيات جرثومية ومحاط بالجدار الارشيجوني.



Riccia gametophyte الطور الجاميتي للريشيا



Internal section of *Riccia*
قطاع في الطور الجاميتي للريشيا

2- Mosci (mosses)

Funaria:

It is a unisexual (dioecious) moss in which the gametophyte is composed of an upright stem that carries spirally arranged simple sessile leaves. It is fixed to the substratum by branched multicellular rhizoids.

Sketch the gametophyte

Examine a vertical section in the male moss flower and notice that it is composed of the involucre surrounding the antheridia (club-shaped, brownish or golden in color) and the paraphysis (composed of single row of cells).

Examine a vertical section in the female moss flower and notice the involucre, archegonia and paraphysis that end with acute tips.

Examine the sporophyte that is carried on the gametophyte and notice that it is differentiated into a foot which remains embedded in the tissues of the gametophyte, a long stalk or seta and the capsule. Also notice that the wall of the archegonium (clyptra) remains attached to the capsule.

Examine a longitudinal section (L.S.) in the capsule and notice its multi a yered wall, the assimilating tissue known as apophysis, at its base, the barrel-shaped sporogenous tissue, the columella, the air cavities traversed by the assimilating filaments or trabeculae, the annulus, the peristome teeth and the operculum or lid.

2- الحزازيات القائمة

الفيوناريا

ارسم الطور الجاميتي الورقي وهو يتميز إلي ساق قائمة وأوراق مرتبة ترتيبا لولبيا, وعلي قاعدة الساق أشباه جذور متعددة الخلايا. لاحظ ان الاعضاء الجنسية تتجمع عند طرف الساق في تركيب يشبه الزهرة يحيط به قلافة, بمساعدة أبرتي تشريح افصل اوراق القلافة واختبر قمة الساق تحت الميكروسكوب.

1) **الزهرة الحزازية المذكرة:** بها انثريدات صولجانية الشكل ذات اعناق قصيرة وتنتشر بينها خيوط عقيمة تنتهي بخلايا منتفخة.
2) **الزهرة الحزازية المؤنثة:** بها ارشيجونيات معنقة بينها خيوط عقيمة متعددة الخلايا غير ان خلاياها الطرفية غير منتفخة.
3) **النبات الجرثومي:** يتكثف علي ساق نبات جاميتي انثوي, والاول يتميز خارجيا الي قدم وعنق وعلبة وغالبا ما تكون محاطة بالجدار الرشيجوني, وللعلبة منطقة تعرف بالابوفيسيس, وتوجد عند اتصال العنق بالعلبة. كما يوجد عند قمة العلبة غطاء تقع عند قاعدته حلقة وتقع تحت الغطاء مباشرة طبقة من أسنان منفصلة تعرف بالاسنان البيرستومية.

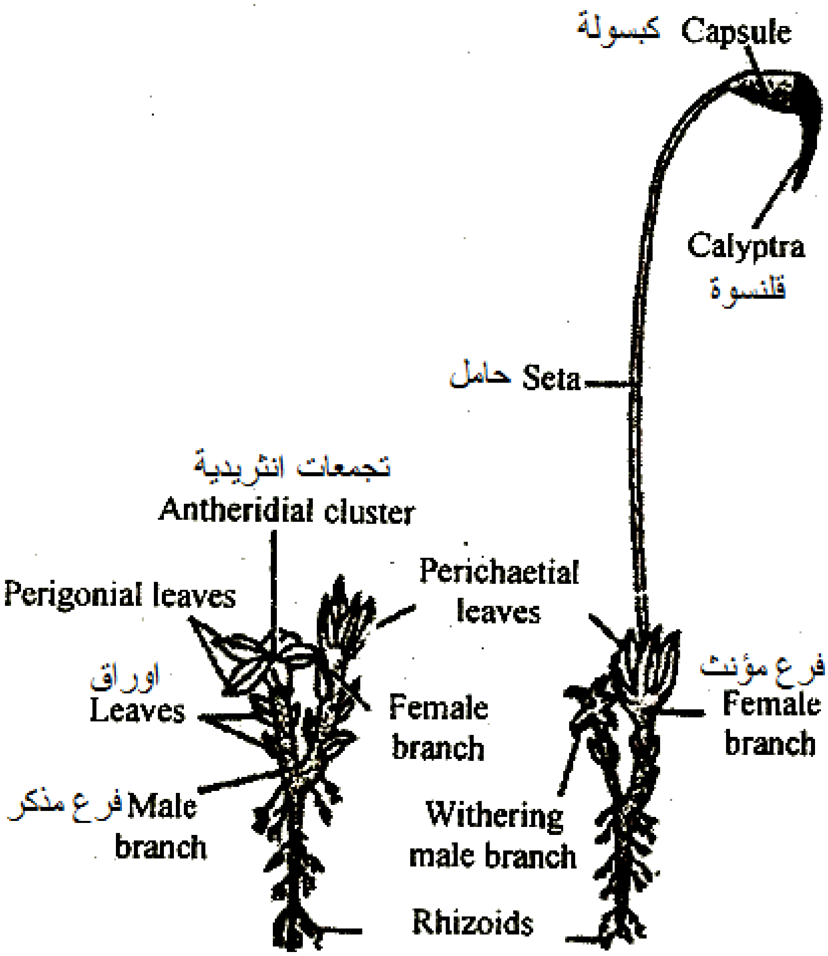
التركيب الداخلي للعلبة

أ- النسيج الجرثومي: ويوجد علي هيئة اسطوانة مفتوحة الطرفين.

ب- طبقتان عذائيتان: وهما خارج وداخل اسطوانة النسيج الجرثومي

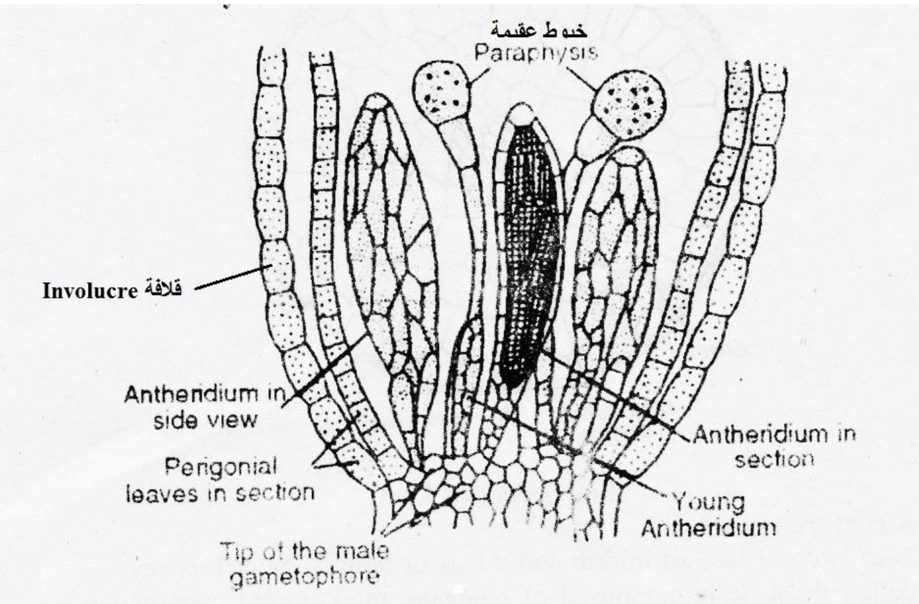
ت- العويميد: ويوجد داخل الاسطوانة الجرثومية.

ث- فراغ هوائي به خيوط خلوية تصل ما بين الاسطوانة الجرثومية وجدار العلبة.

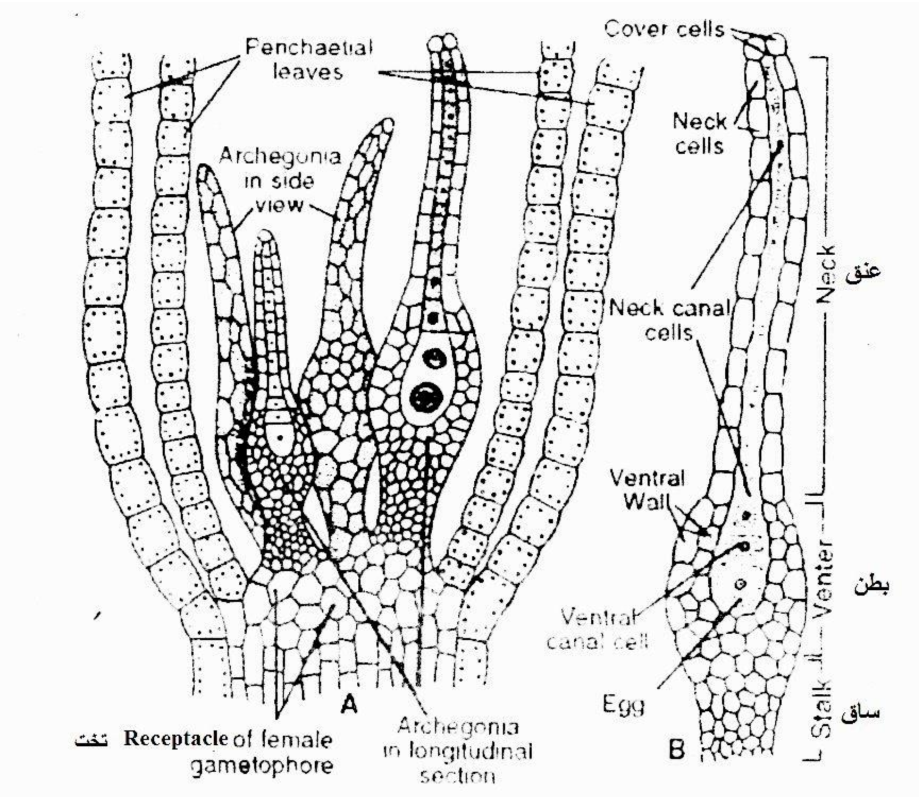


طور مشيجي حديث يحمل الاعضاء الجنسية
young gametophye bearing sex organs

طور مشيجي يحمل الطور الجرثومي علي فرع مونث
Gametophyte with attached to sporphyte on the female branch



Funaria , **male flower** زهرة حزازية مذكرة في الفيوناريا



***Funaria*, female flower** زهرة حزازية مؤنثة في الفيوناريا

D- Gymnosperms

Pinus

Examine and draw a portion of the *Pinus* stem provided. Note the scale leaves each bearing in its axial a dwarf shoot carrying few scale leaves and acicular (foliage) leaves.

Examine and notice that the female cone occur solitary and each replaces a long branch. Examine L.S. in the young female cone and notice the main axis bearing spirally arranged macrosporophylls (carpels). Each carpels is distinguished into an upper part known as the ovuliferous scale and lower part known as the bract scale, the ovuliferous scale bears on its upper surface two inverted ovule.

Examine the male cones of *Pinus* and note that they are in clusters and occupy the position of dwarf shoots. Dissect a male cone and note each microsporophyll (or staminal leaf) bears on its lower side two microsporangia (or pollen sacs) containing a number of microspores (or pollen grains). Each grain has its outer coat expanded into air bladders.

In the slide provided, which shows a longitudinal section through the male cone, note that the short stalked staminal leaves are spirally arranged on the axis and below a microsporangium is observed.

النباتات معراة البذور

الصنوبر

ادرس الشكل الخارجي لفرع شجرة نبات الصنوبر ولاحظ وجود أوراق ابرية الشكل توجد علي فروع قصيرة تسمي بالسوق القزمية, وهي تخرج من إباط أوراق حرشفية موجوده علي الساق الاصلية ويحمل الفرع نوعين من المخاريط, مخاريط صغيرة في مجاميع تأخذ مواضع السوق القزمية هي المخاريط المذكرة, ومخاريط كبيرة مفردة تأخذ موضع أحد الفروع الجانبية وهي المخاريط الانثوية.

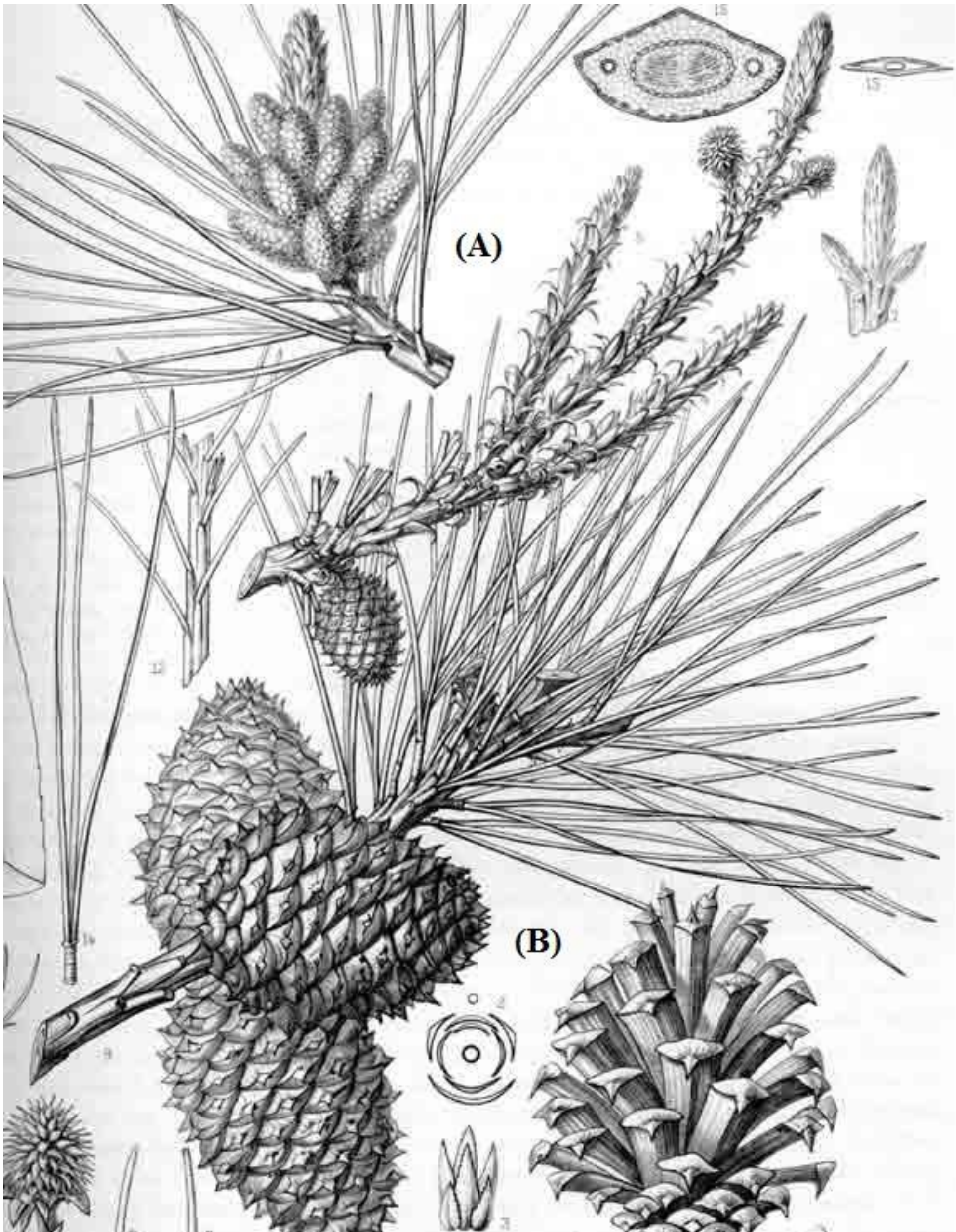
تركيب المخروط المذكر

افحص القطاع الطولي, ولاحظ ان الاوراق الجرثومية الصغيرة تحمل أعلي محور المخروط في ترتيب لولبي, والاوراق الجرثومية الصغيرة يطلق عليها أيضا حراشيف سدائية وتتكون الواحدة منها من عنق ينتهي بطرف منتفخ يحمل علي سطحه السفلي كيسين لقاحيين يوجد بداخلهما الجراثيم الصغيرة أي احبوب اللقاح ولكل حبه جناحان يعملان علي مساعدتها في الانتشار بواسطة الرياح.

تركيب المخروط المؤنث

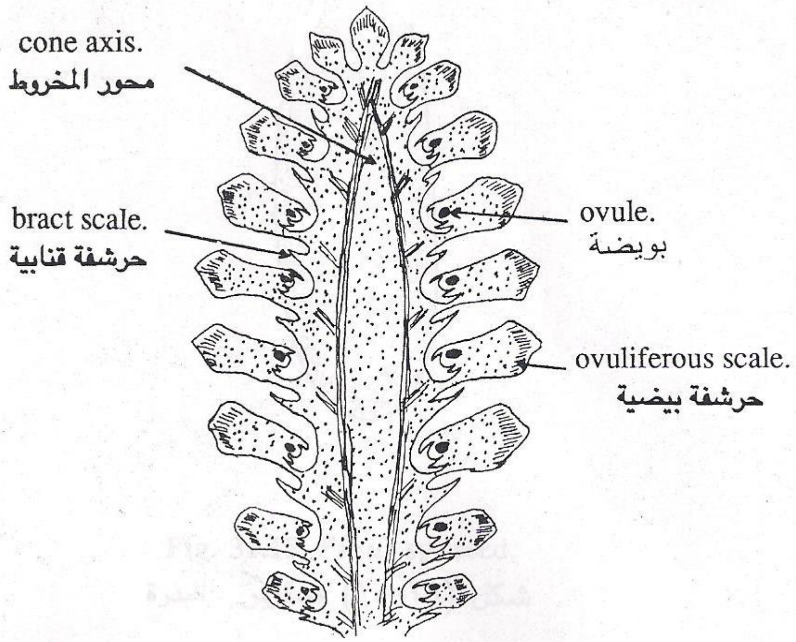
افحص القطاع الطولي ولاحظ أن الاوراق الجرثومية الكبيرة مرتبة في تركيب لولبي علي محور المخروط ويطلق عليها أيضا كرابل, وتتميز كل إلي حرشفة كبيرة علوية تعرف بالحرشفة البويضية واخري صغيرة تقع بأسفلها وتعرف بالحرشفة القنابية وتحمل الاولي بويضتين وبكل منها نقير يتجه نحو محور المخروط.

ادرس النموذج الناضج للمخروط المؤنث ولاحظ أنه متخشب كبير الحجم كما انه يوجد علي الحرشفة البويضية بذرتان, ولكل منها جناح مستمد من السطح العلوي للحرشفة البويضية.

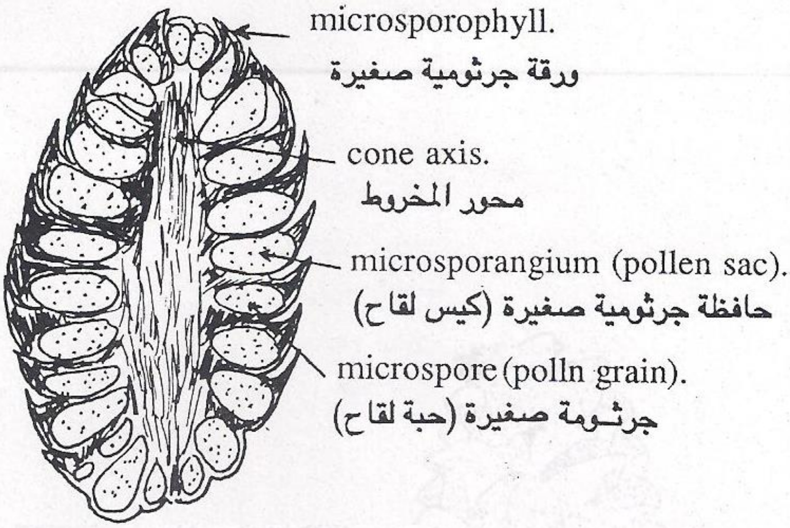


(A): Cluster of male cones of *Pinus*. (B): Abranch bearing female cones of *Pinus*.

مجموعة مخاريط مذكرة فرع حامل مخاريط مؤنثة للصنوبر



Pinus sp. L.S. female cone.
قطاع طولى فى مخروط مؤنث



Pinus sp. L.S. male cone.
صنوبر . قطاع طولى فى المخروط المذكر

المراجع

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Cell and Tissues

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2023

/

Part 1

The Cell

Part 2
Tissues

List of figures

Introduction

The **cell** (from Latin *cellula* 'small room) is the basic structural, functional, and biological unit of all known organisms. A cell is the smallest unit of life.

Therefore, cells are often described as the "building blocks of life".

Cells consist of cytoplasm enclosed within a membrane, which contains many biomolecules such as proteins and nucleic acids. Most plant and animal cells are only visible under a light microscope, with dimensions between 1 and 100 micrometres. Electron microscopy gives a much higher resolution showing greatly detailed cell structure. Organisms can be classified as unicellular (consisting of a single cell such as bacteria) or multicellular (including plants and animals).Most unicellular organisms are classed as microorganisms.

The number of cells in plants and animals varies from species to species; it has been approximated that the human body contains roughly 40 trillion (4×10^{13}) cells. The brain accounts for around 80 billion of these cells.

Cells were discovered by Robert Hooke in 1665, who named them for their resemblance to cells inhabited by Christian monks in a monastery. Cell theory, first developed in 1839 by Matthias Jakob Schleiden and Theodor Schwann, states that all organisms are composed of one or more cells, that cells are the fundamental unit of structure and function in all living organisms, and that all cells come from pre-existing cells. Cells emerged on Earth about 4 billion years ago.

Types of Cells

Cells are of two types: eukaryotic, which contain a nucleus, and prokaryotic cells, which do not have a nucleus, but a nucleoid region is still present. Prokaryotes are single-celled organisms, while eukaryotes can be either single-celled or multicellular.

Prokaryotic cells

A **prokaryote** is a typically unicellular organism that lacks a nuclear membrane-enclosed nucleusThe word *prokaryote* comes from the Greek πρό (*pro*, 'before') and κάρυον (*karyon*, 'nut' or 'kernel' In the two-empire system arising from the work of Édouard Chatton, prokaryotes were classified within the empire **Prokaryota**. But in the three-domain system, based upon molecular analysis, prokaryotes are divided into two domains: *Bacteria* (formerly Eubacteria) and *Archaea* (formerly Archaebacteria). Organisms with nuclei are placed in a third domain, Eukaryota. In the study of the origins of life, prokaryotes are thought to have arisen before eukaryotes.

Prokaryotes lack mitochondria, or any other eukaryotic membrane-bound organelles; and it was once thought that prokaryotes lacked cellular compartments, and therefore all cellular components within the cytoplasm were unenclosed, except for an outer cell membrane. But bacterial microcompartments, which are thought to be simple organelles enclosed in protein shells, have been discovered, along with other prokaryotic organelles. While typically being unicellular, some prokaryotes, such as cyanobacteria, may form large colonies. Others, such as myxobacteria, have multicellular stages in their life cycles. Prokaryotes are asexual, reproducing without fusion of gametes, although horizontal gene transfer also takes place.

Molecular studies have provided insight into the evolution and interrelationships of the three domains of life. The division between prokaryotes and eukaryotes reflects the existence of two very different levels of cellular organization; only eukaryotic cells have an enveloped nucleus that contains its chromosomal DNA, and other characteristic membrane-bound organelles including mitochondria. Distinctive types of prokaryotes include extremophiles and methanogens; these are common in some extreme environments.

History of Cells

The distinction between prokaryotes and eukaryotes was firmly established by the microbiologists Roger Stanier and C. B. van Niel in their 1962 paper The concept of a bacterium (though spelled procaryote and eucaryote there). That paper cites Édouard Chatton's 1937 book *Titres et Travaux Scientifiques*[for using those terms and recognizing the distinction. One reason for this classification was so that what was then often called blue-green algae (now called cyanobacteria) would not be classified as plants but grouped with bacteria.

Cell Theory

- The cell is the basic functional and structural unit of life. All the living organisms are composed of cells.
- All cells are formed by the division of the already existing cells which in terms of biology means reproduction. Every cell of our body comprises of genetic material which is passed down during the process.
- All the basic physiological and chemical functions i.e. the growth, repair, movement, communication, immunity and digestions are performed inside the cells.
- All the activities of the cell depend mainly on the activities of the subcellular structures that lie within the cell. These subcellular structures comprise of the plasma membrane, organelles and if present, the nucleus.

Here is the revised introduction to cell. In all the living beings, cells are the basic structural units. We can compare the presence of cells in our body to the bricks in a building. All the bricks are assembled to make a building. Similarly, all the cells are assembled to make the body of an organism.

Thus, it is the basic structural and functional unit of life and all the organisms are made up of cells. The subcellular structures of the cell comprise of the plasma membrane, organelles and in some cases a nucleus as well. As for the size of the cell, it is variable and maybe anything from 1 to 100 micrometre.

How Are Cells Produced?

Every cell is produced by the division of a cell that is already existing in our body. This is possible because of the genetic material contained in the cell. The genetic material is passed down from one cell to another during the reproduction process. Unlike the non-living bricks, the cells of the living organisms are rather complex living structures. Therefore, the cells can divide the genetic material and form two new cells.

Types of Cell

Broadly, there are two key types of cells i.e. the Prokaryotic Cell and the Eukaryotic Cell. The difference between the two is defined mainly by the presence or the absence of the nuclear membrane. Let’s know more about the two types of cells.

1) Prokaryotic Cell

If a cell has a nuclear material without a nuclear membrane, then it is known as the prokaryotic cell.

Those organisms which have these type of cells are commonly known as the prokaryotes where ‘pro’ stands for primitive and ‘karyon’ stands for the nucleus. Some of the organisms that have prokaryotic cells include bacteria and the blue-green algae.

2) Eukaryotic Cell

If a cell has a nuclear material with a nuclear membrane, then it is known as the Eukaryotic Cell. Those organisms which have these type of cells are commonly known as eukaryotes where ‘eu’ stands for true and ‘karyon’ stands for the nucleus. All the living organisms except bacteria and blue-green algae have Eukaryotic Cells.

Functions of a Cell

As you already know that a cell is a structural and functional unit of living. Let us study 6 of the most vital functions performed by a cell.

Structure and Support

You know a house is made of bricks. Similarly, an organism is made up of cells. Though there are certain cells such as collenchyma and sclerenchyma are present for offering structural support however in general too, all cells generally provide the structural basis of all organisms.

Growth

In complex organisms such as humans, the tissues grow by simple multiplication of cells. Hence, cells are responsible for the growth of the organism. The entire thing takes place via a process of mitosis.

Transport

Cells import the nutrients that are used in the different chemical process which take place inside them. As a result of these processes, a waste product is produced. Cells then work to get rid of this waste. In this manner, the small molecules like the such as oxygen, carbon dioxide, and ethanol pass through the cell membrane by diffusion. This method is known as passive transport. On the other hand, the larger molecules like the proteins and polysaccharides, go in and out of the cell via active transport.

Energy Production

Organisms need energy to perform different chemical reactions. In plants, the energy comes from the process of photosynthesis while in the animals the energy comes via respiration.

Metabolism

Cell is responsible for metabolism that includes all the chemical reactions that take place inside an organism to keep it alive.

Reproduction

A cell helps in reproduction by the processes of mitosis (in more evolved organisms) and meiosis.

Different Cell Organelles and their Functions

Organelles make up the subunits of a cell. There are numerous each with their own function.

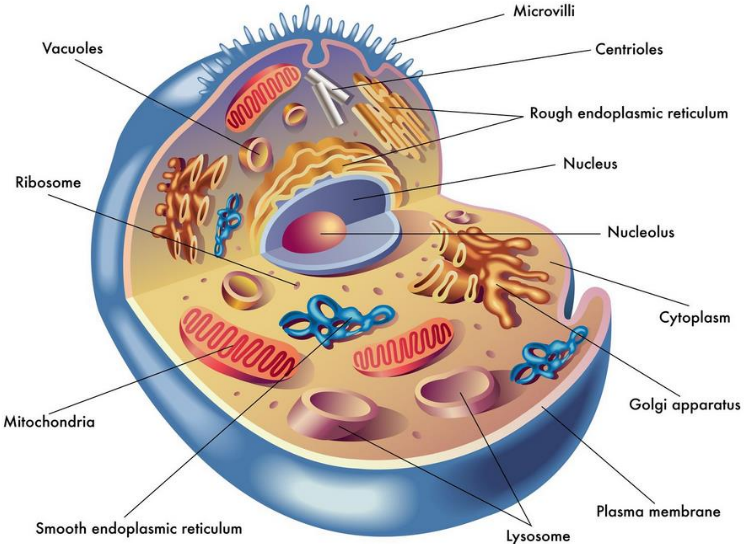


Fig. (1): Cell Organelles

Plasma Membrane

The plasma membrane is the organelle that encapsulates the contents of the cell. Apart from encapsulating cell contents, the plasma membrane also plays a vital role in regulating the movement of substances in and out of the cell.

As such, it is actively involved in such both passive and active transportation to and from the cell. These processes also help maintain balance even when conditions outside the cell change.

The plasma membrane is made up of two layers of phospholipids (phospholipids bilayer).

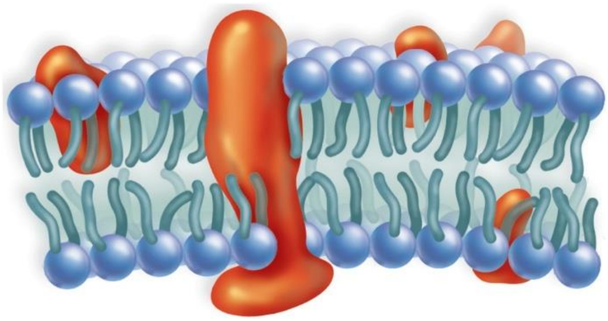


Fig. (2): The plasma membrane

Nucleus/DNA

Some of the main components of the nucleus include the chromatic, nucleoplasm/nuclear sap and the nucleolus. The nucleus houses DNA (the hereditary material) as well as various proteins and the nucleolus. In eukaryotic cells, the nucleus is enclosed in a nuclear membrane. It is the organelle that controls the hereditary traits of an organism by directing such processes as protein synthesis and cell division among others. For prokaryotes, the DNA lacks a nuclear membrane. The genetic material is therefore bound in the nucleotide region. The nucleolus plays an important role in ribosome production.

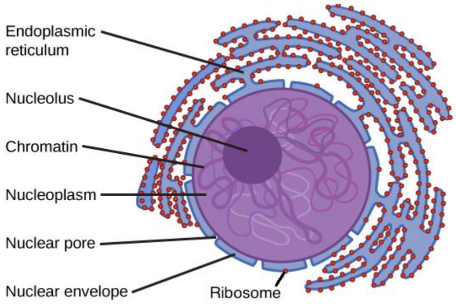


Fig. (3): The nucleolus Structural

Ribosome

Ribosomes are tiny organelles that contain RNA and specific proteins within the cytoplasm. Within the cell, ribosomes are directly involved in the manufacture of proteins by using their RNA and amino acids.

This process involves decoding the information contained in the mRNA and using amino acids to produce the required proteins.

Mitochondria

Mitochondria are some of the largest organelles within a cell. Compared to some of the other organelles, mitochondria contain DNA which makes them semiautonomous. Mitochondria also contain a double-membrane with the inner membrane folding to form cristae. Also known as the powerhouse, mitochondria play an important role in respiration where they generate ATP (adenosine triphosphate) from substrates in the presence of oxygen. Using their DNA, mitochondria are able to encode for some of the components they require to perform their functions.

ATP stores energy in the form of chemical bonds and is released whenever it is needed for various cell functions.

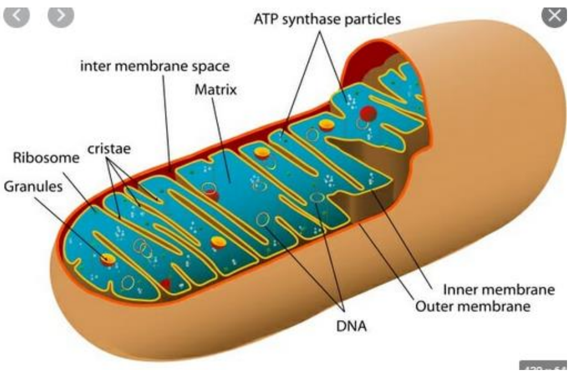


Fig. (4): The Mitochondria structural

Endoplasmic Reticulum

Found in eukaryotic cells, Endoplasmic reticulum (ER) is the organelle that forms an interconnected network of flattened sacs (cisternae). Like some of the other organelles found in eukaryotes, ER is enclosed in a membrane. The ER is divided into two regions that vary in structure and function.

These include:

Smooth endoplasmic reticulum

The smooth ER is named so because it lacks a ribosome on its surface. As a result, it is more smooth in appearance as compared to the rough ER. It is involved in the synthesis of lipids (e.g. phospholipids) and carbohydrates that are used to build the cell membrane.

Some of the other functions of the smooth ER include:

-Transportation of vesicles

- Enzyme production in the liver
- Contraction of muscle cells in the muscles
- Synthesis of hormones in the brain cells

Rough endoplasmic reticulum

Unlike the smooth ER, rough ER has ribosome attached to its surface. It's involved in the manufacture of various proteins in the cell. On the other hand, the rough ER is involved in the production of antibodies, insulin as well as transportation of proteins into the smooth ER.

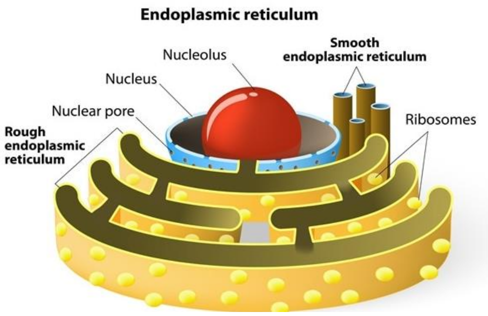


Fig. (5): Rough endoplasmic reticulum

Golgi Apparatus

Golgi apparatus are found in eukaryotic and are highly folded into cisternae (flattened sacs). They are enclosed in a membrane that varies in thickness from different regions.

In the cell, Golgi apparatus are actively involved in the manufacturing, storage as well as transportation of products from the ER.

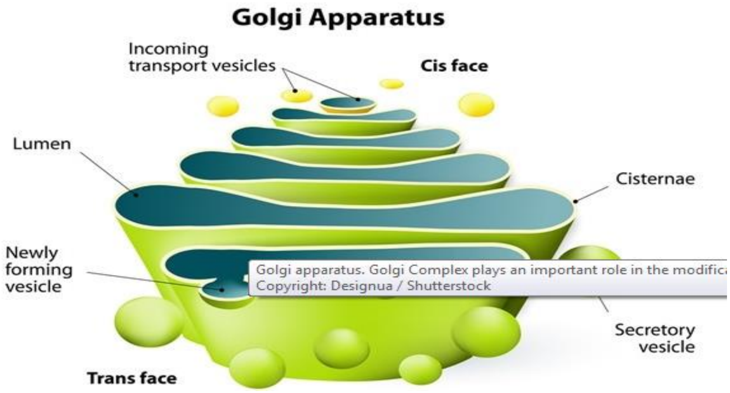


Fig. (6): Golgi Apparatus

Vacuoles

A vacuole may be described as a space inside the cell that does not contain cytoplasm. It is surrounded by a membrane and filled with a fluid. Vacuoles store various molecules including enzymes, waste products of the cell, water, and even food material depending on the type of cell.

In cases were vacuoles contain waste products of the cell, they are also involved in the exportation of waste from the cell thus protecting the cell from toxicity.

***** Some vacuoles also play a role in maintaining the internal hydrostatic pressure of the cell as well as regulating pH.

Cytoskeleton

The cytoskeleton is made up of microtubules and microfilaments. By spreading throughout the cell (in the cytoplasm), the cytoskeleton helps maintain the shape of the cell while also ensuring its elasticity.

***** The cytoskeleton is also involved in anchoring the nucleus and supporting cell contents.

Centriole

Centrioles are cylindrical organelles found in most eukaryotic cells. They contain tube-shaped molecules known as microtubules that help separate chromosomes and move them during cell division.

Lysosome

A lysosome is commonly referred to as sacs of enzymes. They are membranous organelles that contain acidic enzymes (hydrolase enzymes) that serve to digest various macromolecules (e.g. lipids and nucleic acids) in the cell.

Conditions inside lysosomes have been shown to be acidic. These conditions are maintained by the lysosome membrane thus providing favorable conditions for the enzymes to perform their functions.

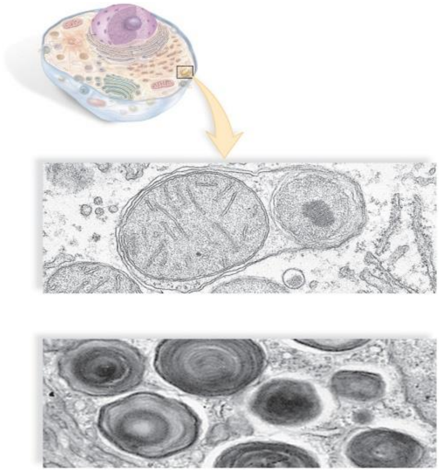


Fig. (7): lysosome

Other features of a cell include:

Cell Wall

- Some books do not consider the cell wall to be an organelle. However, it's one of the most important components of plant cells. The cell wall surrounds the cell membrane and serves to strengthen and protect the cell.

For instance, in the cells of plant roots, the cell wall protects the cell as they grow deeper in the soil. The cell wall also serves as a filter that controls the movement of molecules in and out of the cell.

Cytoplasm

is also not considered as an organelle in some books. However, it is an important component of the cell. Cell cytoplasm is composed of protoplasm in which all the other cell organelles are suspended.

Many of the cell processes (protein synthesis, respiration etc) take place in the cytoplasm. The cytoplasm also plays an important role in the movement of various materials around the cell.

Chemical Composition of the Cell

Chemical compounds in the cell can be divided into two major groups: Organic and Inorganic compounds

Organic compounds are chemical compounds that contain the element carbon. Organic compounds in the cell include carbohydrates, protein, lipids and nuclei acids. Some of these compounds are synthesized by the cell itself.

Water is an inorganic compound which is composed of hydrogen and oxygen. It is an important compound in the cell.

Table 1: inorganic chemical compounds in the cell.

Percentage of Body Weight	Element	Usage
65%	Oxygen	This element is obviously the most important element in the human body. Oxygen atoms are present in water, which is the compound most common in the body, and other compounds that make up tissues. It is also found in the blood and lungs due to respiration.
18.6%	Carbon	Carbon is found in every organic molecule in the body, as well as the waste product of respiration (carbon dioxide). It is typically ingested in food that is eaten.
9.7%	Hydrogen	Hydrogen is found in all water molecules in the body as well as many other compounds making up the various tissues.

3.2%	Nitrogen	Nitrogen is very common in proteins and organic compounds. It is also present in the lungs due to its abundance in the atmosphere.
1.8%	Calcium	Calcium is a primary component of the skeletal system, including the teeth. It is also found in the nervous system, muscles, and the blood.
1.0%	Phosphorus	This element is common in the bones and teeth, as well as nucleic acids.
0.4%	Potassium	Potassium is found in the muscles, nerves, and certain tissues.
0.2%	Sodium	Sodium is excreted in sweat, but is also found in muscles and nerves.
0.2%	Chlorine	Chlorine is present in the skin and facilitates water absorption by the cells.
0.06%	Magnesium	Magnesium serves as a cofactor for various enzymes in the body.
0.04%	Sulfur	Sulfur is present in many amino acids and proteins.
0.007%	Iron	Iron is found mostly in the blood since it facilitates the transportation of oxygen.
0.0002%	Iodine	Iodine is found in certain hormones in the thyroid gland.

The Importance of Organic Compounds in the Cell

1. Carbohydrates

- Supply energy for cell processes
- A means of storing energy
- Give structural support to cell walls

2. Lipids

- Store large amounts of energy over long periods of time
- Act as an energy source
- Play a major role in the structure of the cell membranes
- Act as a source of metabolic water
- Reduce the loss of water by evaporation

3. Proteins

- Act as building blocks of many structural components of the cell ; required for growth
- Form enzymes which catalyze chemical reactions
- Form hormones which control growth and metabolism

4. **Nucleic acids**

- Contain the genetic information of cells
- Play a vital role in protein synthesis

The importance of water in the cell

- Water is important for life because its chemical and physical properties allow it to sustain life.
- Water is a polar molecule which consists of 2 hydrogen atoms and 1 oxygen atom. A polar molecule is a molecule with an unequal distribution of charges. Each molecule has a positively charged and a negatively charged end. Polar molecules attract one another as well as ions. Because of this property, water is considered the solvent of life.
- It is the transport medium in the blood
- It acts as a medium for biochemical reactions.
- Water helps in the maintenance of a stable internal environment within a living organism. The concentration of water and inorganic salts that dissolve in water is important in maintaining the osmotic balance between the blood and interstitial fluid.
- It helps in lubrication.
- Water molecules have very high cohesion. Water molecules tend to stick to each other and move in long unbroken columns through the vascular tissues in plants.

Cell Division Definition

Cell division is the process cells go through to divide. There are several types of cell division, depending upon what type of organism is dividing. Organisms have evolved over time to have different and more complex forms of cell division. Most prokaryotes, or bacteria, use binary fission to divide the cell. Eukaryotes of all sizes use *mitosis* to divide. Sexually-reproducing eukaryotes use a special form of cell division called *meiosis* to reduce the genetic content in the cell. This is necessary in sexual reproduction because each parent must give only half of the required genetic material, otherwise the offspring would have too much DNA, which can be a problem. These different types of cell division are discussed below.

Types of Cell Division

Prokaryotic Cell Division

Prokaryotes replicate through a type of cell division known as *binary fission*. Prokaryotes are simple organism, with only one membrane and no division internally. Thus, when aprokaryote divides, it simply replicates the DNA and splits in half. The process is a little more complicated than this, as DNA must first be unwound by special proteins. Although the DNA in prokaryotes usually exists in a ring, it can get quite tangled when it is being used by the cell. To copy the DNA efficiently, it must be stretched out. This also allows the two new rings of DNA created to be separated after they are produced. The two strands of DNA separate into two different sides of the prokaryote cell. The cell then gets longer, and divides in the middle.

The DNA is the tangled line. The other components are labeled. Plasmids are small rings of DNA that also get copied during *binary fission* and can be picked up in the environment, from dead cells that break apart. These plasmids can then be further replicated. If aplasmid is beneficial, it will increase in a population. This is in part how antibiotic resistance in bacteria happens. The ribosomes are small protein structures that help produce proteins. They are also replicated so each cell can have enough to function.

Eukaryotic Cell Division: Mitosis

Eukaryotic organisms have membrane bound organelles and DNA that exists on chromosomes, which makes cell division harder. Eukaryotes must replicate their DNA, organelles, and cell mechanisms before dividing. Many of the organelles divide using a process that is essentially *binary fission*, leading scientist to believe that eukaryotes were formed by prokaryotes living inside of other prokaryotes.

After the DNA and organelles are replicated during *interphase* of the cell cycle, the eukaryote can begin the process of mitosis. The process begins during prophase, when the chromosomes condense. If mitosis proceeded without the chromosomes condensing, the DNA would become tangled and break. Eukaryotic DNA is associated with many proteins which can fold it into complex structures. As mitosis proceeds to *metaphase* the chromosomes are lined up in the middle of the cell. Each half of a chromosome, known as*sister chromatids* because they are replicated copies of each other, gets separated into each half of the cell as mitosis proceeds. At the end of mitosis, another process called *cytokinesis* divides the cell into two new daughter cells.

All eukaryotic organisms use mitosis to divide their cells. However, only single-celled organisms use mitosis as a form of reproduction. Most multicellular organisms are sexually reproducing and combine their DNA with that of another organism to reproduce. In these cases, organisms need a different method of cell division. Mitosis yields identical cells, but meiosis produces cells with half the genetic information of a regular cell, allowing two cells from different organisms of the same species to combine.

Eukaryotic Cell Division: Meiosis

In sexually reproducing animals, it is usually necessary to reduce the genetic information before fertilization. Some plants can exist with too many copies of the genetic code, but in most organisms it is highly detrimental to have too many copies. Humans with even one extra copy of one chromosome can experience detrimental changes to their body. To counteract this, sexually reproducing organisms undergo a type of cell division known as meiosis. As before mitosis, the DNA and organelles are replicated. The process of meiosis contains two different cell divisions, which happen back-to-back. The first meiosis, meiosis*I* separates homologous chromosomes. The homologous chromosomes present in a cell represent the two alleles of each gene an organism has. These alleles are recombined and separated, so the resulting daughter cells have only one allele for each gene, and no homologous pairs of chromosomes. The second division, *meiosis II*, separated the two copies of DNA, much like in mitosis. The end result of meiosis in one cell is 4 cells, each with only one copy of the genome, which is half the normal number.

Organisms typically package these cells into *gametes*, which can travel into the environment to find other gametes. When two gametes of the right type meet, one will fertilize the other and produce a *zygote*. The zygote is a single cell that will undergo mitosis to produce the millions of cells necessary for a large organism. Thus, most eukaryotes use both mitosis and meiosis, but at different stages of their lifecycle.

Cell Division Stages

Depending upon which type of cell division an organism uses, the stages can be slightly different.

Mitosis Stages

Mitosis starts with *prophase* in which the chromosome is condensed. The cell proceeds to *metaphase* where the chromosomes are aligned on the metaphase plate. Then the chromosomes are separated in *anaphase* and the cell's cytoplasm is pinched apart during *telophase*. *Cytokinesis* is the final process that breaks the cell membrane and divides the cell into two.

Meiosis Stages

The stages of meiosis are similar to mitosis, but the chromosomes act differently. Meiosis has two phases, which include two separate cell divisions without the DNA replicating between them. *Meiosis I* and *meiosis II* have the same 4 stages as mitosis: prophase, metaphase, anaphase, and telophase. Cytokinesis concludes both rounds of meiosis.

In prophase I, the chromosomes are condensed. In metaphase I, the chromosomes line up across from their homologous pairs. When they are separated in anaphase I and telophase I, there is only one form of each gene in each cell, known as a reduction division. Meiosis II proceeds in the same manner as mitosis, which sister chromatids dividing on the metaphase plate. By telophase II, there are 4 cells, each with half of the alleles as the parent cell and only a single copy of the genome. The cells can now become gametes and fuse together to create new organisms.

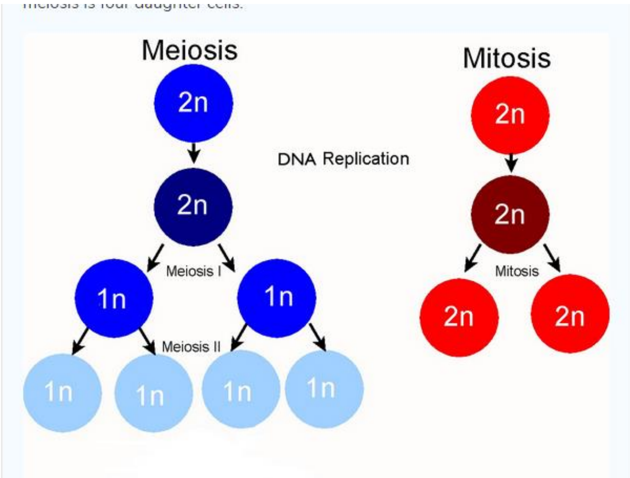


Fig.(8): Types of Cell Division

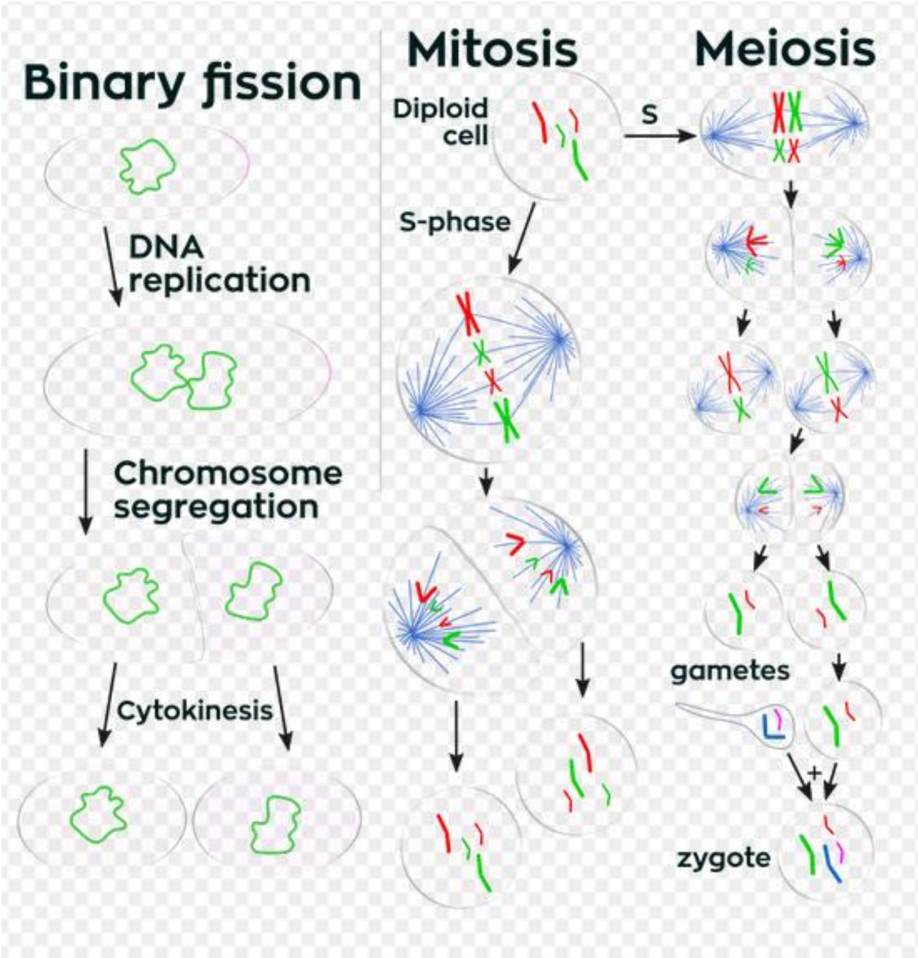


Fig.(9): Types of Cell Division

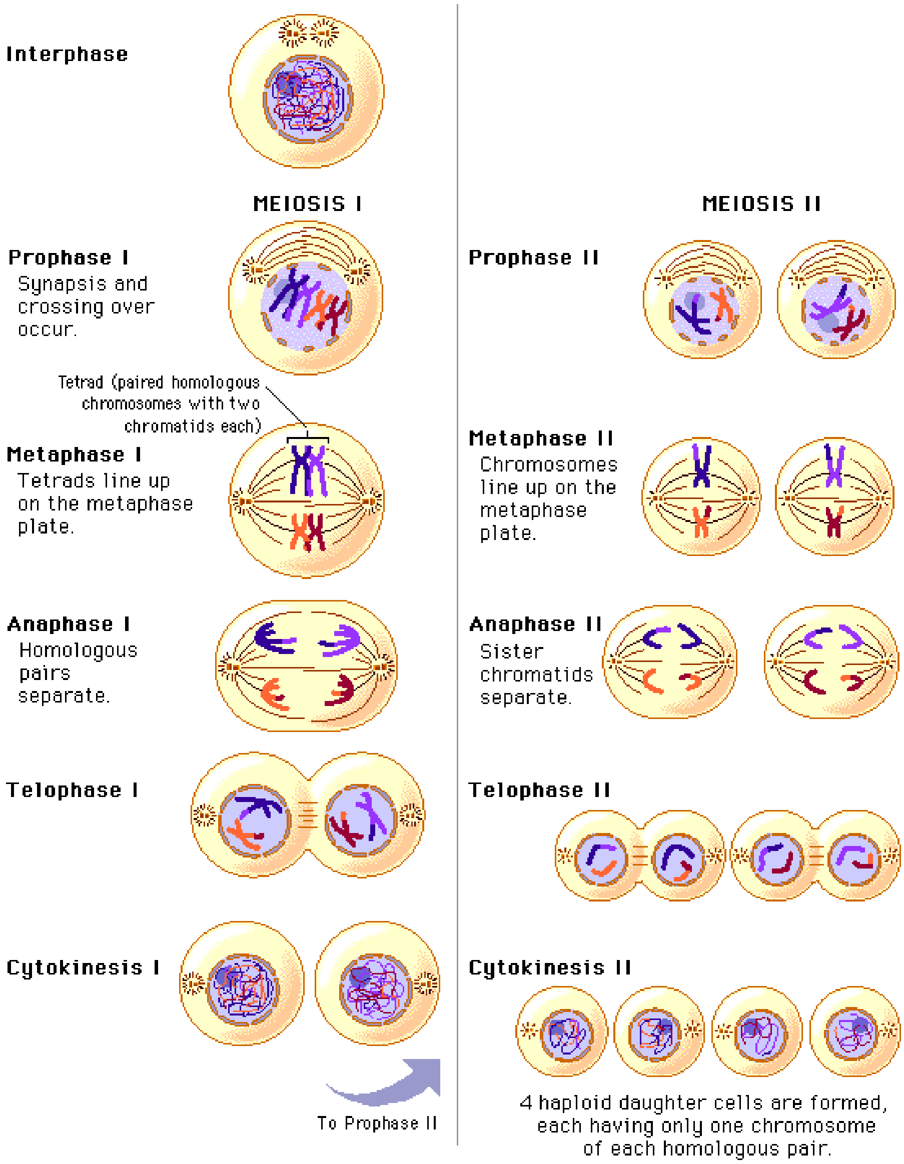


Fig.(10): Cell Division

Part 2

Tissues

Tissues

Cells work together in functionally related groups called tissues

Types of tissues:

1- Epithelial – lining and covering
2-Connective – support
3-Muscle – movement
4-Nervous – control

Epithelial Tissue

General Characteristics & Functions

Covers a body surface or lines a body cavity
Forms most glands

Functions of epithelium
-Protection
-Absorption, secretion, and diffusion
-Filtration
-Forms slippery surfaces (mucus secretion)

Classifications of Epithelia

First name of tissue indicates number of layers
Simple – one layer of cells

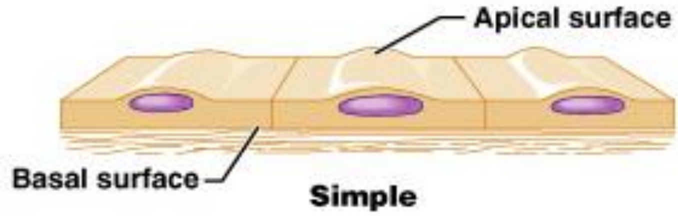


Fig. (11): Simple Epithelia cells

***Stratified – more than one layer of cells**

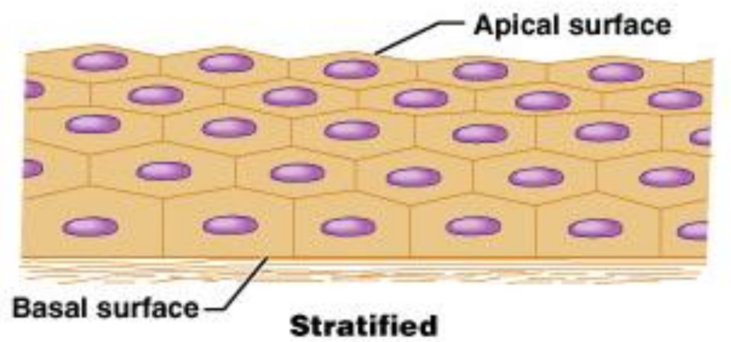


Fig. (12): Stratified – Epithelia cells

***Last name of tissue describes shape of cells**
Squamous – cells wider than
tall (plate or "scale" like)

Fig. (13): Squamous cells

***Cuboidal – cells are as wide as tall, as in cubes**

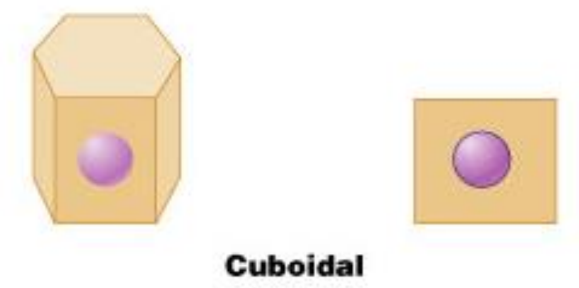


Fig. (14): Cuboidal cells

***Columnar – cells are taller than they are wide, like columns.**

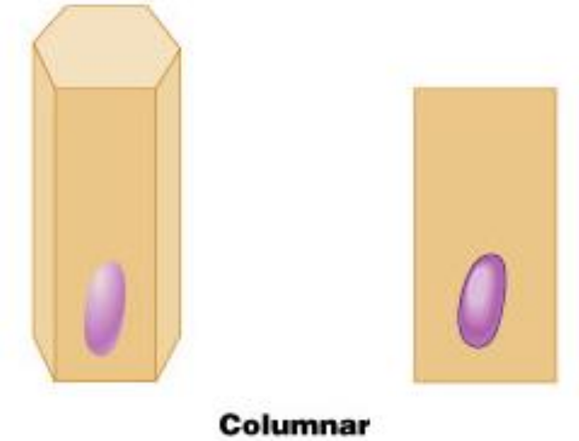


Fig. (15): Columnar – cells

Naming Epithelia

Naming the epithelia includes both the layers (first) and the shape of the cells (second)
i.e. stratified cuboidal epithelium
The name may also include any accessory

structures

Goblet cells
Cilia
Keratin

<u>Simple Squamous Epithelium</u>

Description

single layer of flat cells with disc-shaped nuclei, Special types

Endothelium (inner covering) slick lining of hollow organs

Mesothelium (middle covering)
Lines peritoneal, pleural, and pericardial cavities Covers visceral organs of those cavities

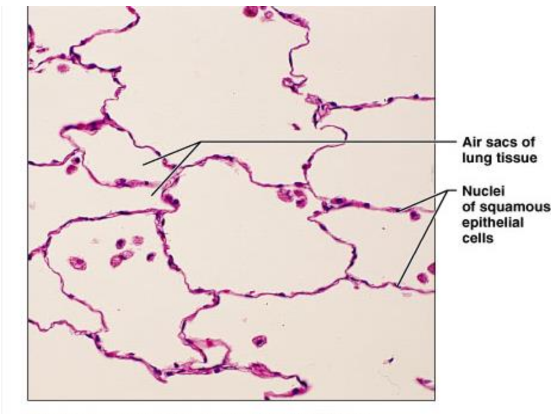
Function

Passage of materials by passive diffusion and filtration

Secretes lubricating substances in serous membranes

Location

-Renal corpuscles (kidneys)
-Alveoli of lungs
-Lining of heart, blood and lymphatic vessels
-Lining of ventral body cavity (serosae/serous memb.)



Photomicrograph: Simple squamous epithelium forming part of the alveolar (air sac) walls (400×).

Fig. (16): **Simple Squamous Epithelium**

<u>Simple Cuboidal Epithelium</u>

Description

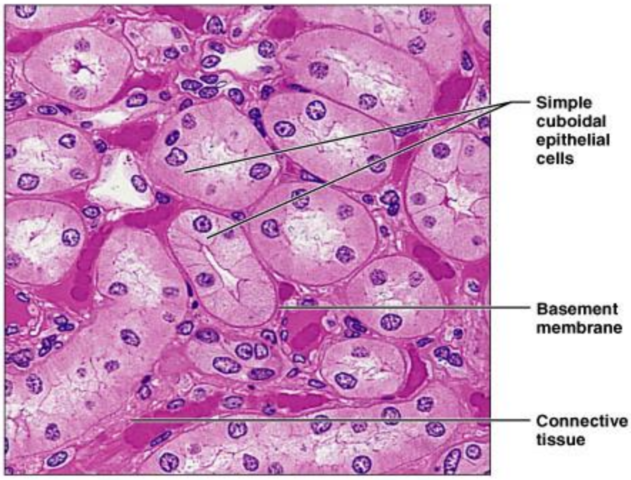
single layer of cube-like cells with large, spherical central nuclei

Function

secretion and absorption

Location

kidney tubules, secretory portions of small glands, ovary surface



Photomicrograph: Simple cuboidal epithelium in kidney tubules (400×).

Fig. (17): Simple Cuboidal Epithelium

<u>Simple Columnar Epithelium</u>

Description

single layer of column-shaped (rectangular) cells with oval nuclei
Some bear cilia at their apical surface
May contain goblet cells

Function

Absorption; secretion of mucus, enzymes, and other substances
Ciliated type propels mucus or reproductive cells by ciliary action

Location
Non-ciliated form
-Lines digestive tract, gallbladder, ducts of -some glands

-

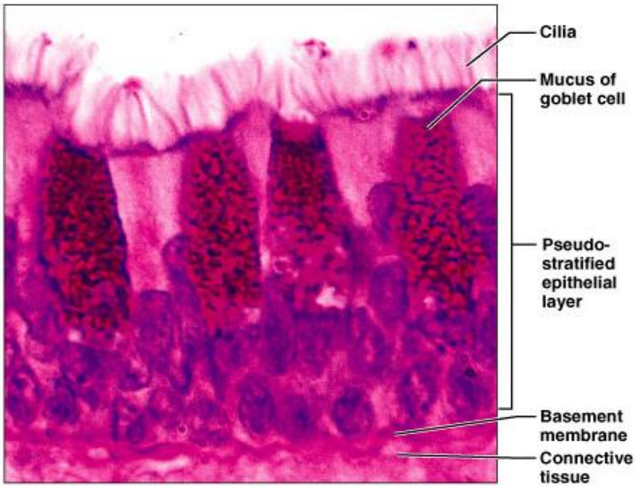
Photomicrograph: Simple columnar epithelium of the stomach mucosa (1300×).

F**ig. (18): Simple Columnar Epithelium**

<u>Ciliated Columnar Epithelium</u>
Lines small bronchi,
Description
-All cells originate at basement membrane
-Only tall cells reach the apical surface
-May contain goblet cells and bear cilia
-Nuclei lie at varying heights within cells
Gives false impression of stratification

Function

Secretion of mucus; propulsion of mucus by cilia



Photomicrograph: Pseudostratified ciliated columnar epithelium lining the human trachea (400×).

Fig. (19): ciliated Simple Columnar Epithelium

Stratified Epithelial cell

Contain two or more layers of cells
Regenerate from below
Major role is protection
Are named according to the shape of cells at apical layer

Stratified Squamous Epithelium
Description

Many layers of cells – squamous in shape

Deeper layers of cells appear cuboidal or columnar

Thickest epithelial tissue – adapted for protection

Function

Protects underlying tissues in areas subject to abrasion

Location

Keratinized – forms epidermis

Non-keratinized – forms lining of esophagus, mouth, and vagina

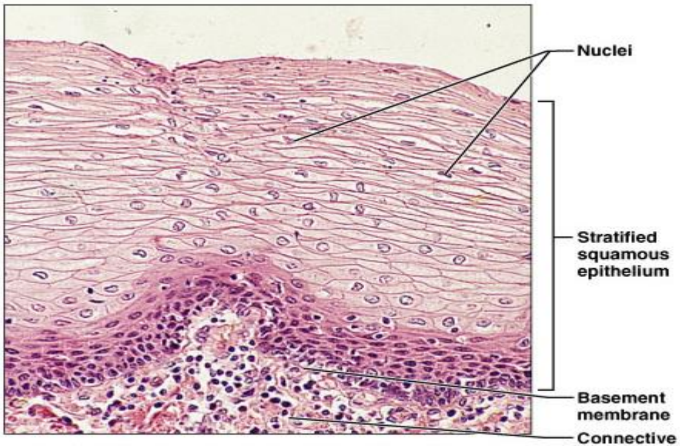


Fig. (20): Stratified Squamous Epithelium

Transitional Epithelium

Description

Basal cells usually cuboidal or columnar

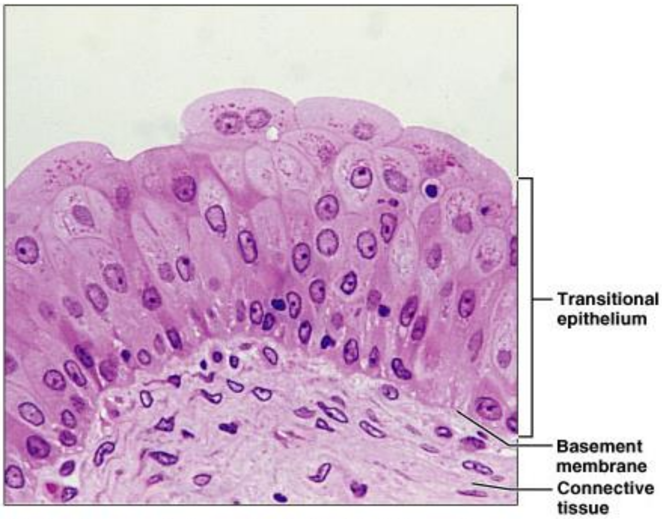
Superficial cells dome-shaped or squamous

Function

stretches and permits distension of urinary bladder

Location

Lines ureters, urinary bladder and part of urethra



Photomicrograph: Transitional epithelium lining of the bladder, relaxed state (500×); note the bulbous, or rounded, appearance of the cells at the surface; these cells flatten and become elongated when the bladder is filled with urine.

Fig. (21): Transitional Epithelium

<u>Connective Tissue</u>

Most diverse and abundant tissue

Main classes

-Connective tissue proper
-Cartilage
-Bone tissue
-Blood

Components of connective tissue:

-Cells (varies according to tissue)
-Matrix

-Fibers (varies according to tissue)
-Ground substance (varies according to tissue) dermatin sulfate, hyaluronic acid, keratin sulfate, chondroitin sulfate…

Common embryonic origin
– mesenchyme

<u>Connective Tissue Proper</u>
-Loose Connective Tissue
-Areolar
-Reticular
-Adipose
-Dense Connective Tissue
-Regular
-Irregular
-Elastic

<u>Areolar Connective Tissue</u>
Description
-Gel-like matrix with:
all three fiber types (collagen, reticular, elastic) for support
-Ground substance is made up by glycoproteins also made and secreted by the fibroblasts.
Cells – fibroblasts, macrophages, mast cells, white blood cells
Function
-Wraps and cushions organs
-Holds and conveys tissue fluid

-Important role in inflammation Main battlefield in fight against infection
-Defenders gather at infection sites
Macrophages
Plasma cells
Mast cells
Neutrophils, lymphocytes, and eosinophils

Location

-Widely distributed under epithelia
-Packages organs
Surrounds capillaries

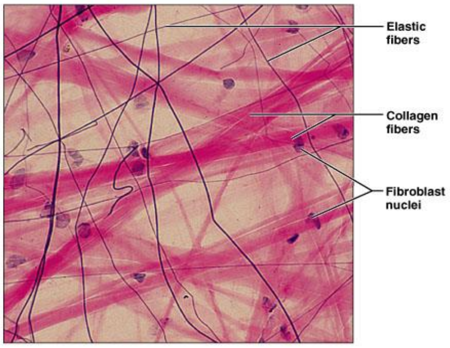


Fig. (22): Areolar Connective Tissue

Adipose Tissue

Description

Closely packed adipocytes
Have nucleus pushed to one side by fat droplet

Function

Provides reserve food fuel
Insulates against heat loss
Supports and protects organs

Location

Under skin
Around kidneys
Behind eyeballs, within abdomen and in breasts

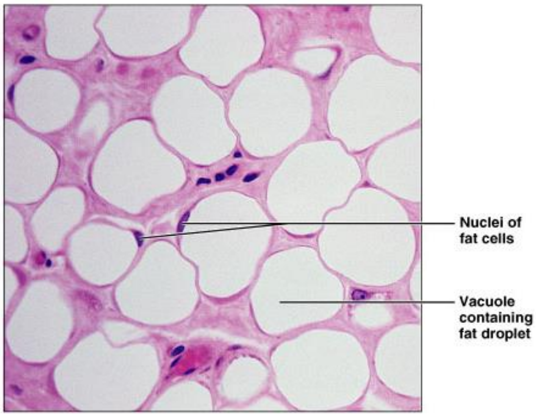


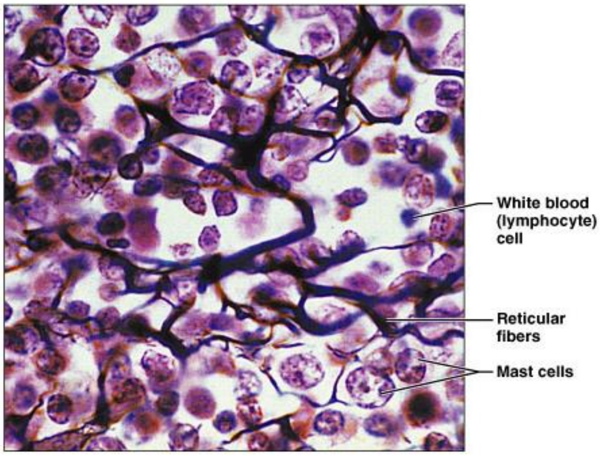
Fig. (23): Adipose Tissue

<u>Reticular Connective Tissue</u>

Description
– network of reticular fibers in loose ground substance

Function
– form a soft, internal skeleton (stroma) – supports other cell types

Location
– lymphoid organs
- Lymph nodes, bone marrow, and spleen



Photomicrograph: Dark-staining network of reticular connective tissue fibers forming the internal skeleton of the spleen (350×).

Fig. (24): Reticular Connective Tissue

<u>Dense Regular Connective Tissue</u>

Description
Primarily *parallel* collagen fibers
Fibroblasts and some elastic fibers
Poorly vascularized

Function
Attaches muscle to bone
Attaches bone to bone
Withstands great stress in
one direction

Location
Tendons and ligaments
Aponeuroses
Fascia around muscl

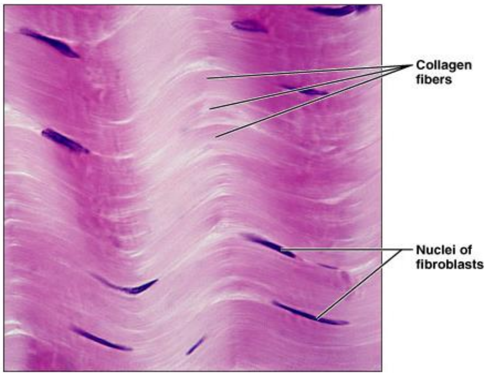


Fig. (25): Dense Regular Connective Tissue

Cartilage

Characteristics:
Firm, flexible tissue
Contains no blood vessels or nerves
Matrix contains up to 80% water
Cell type – chondrocyte

Types:
Hyaline
Elastic
Fibrocartilage

Hyaline Cartilage

Description

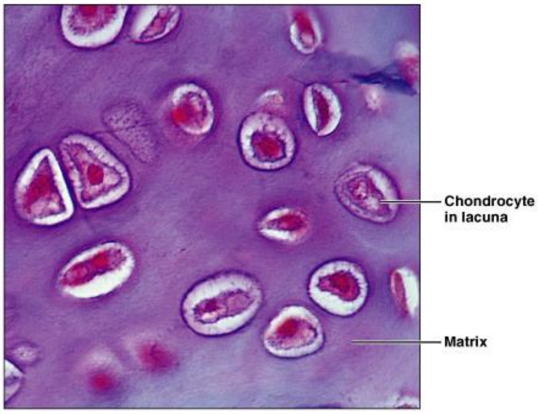
Imperceptible collagen fibers (hyaline = glassy)
Chodroblasts produce matrix
Chondrocytes lie in lacunae

Function

-Supports and reinforces
-Resilient cushion
-Resists repetitive stress

Location

Fetal skeleton
Ends of long bones
Costal cartilage of ribs
Cartilages of nose, trachea, and larynx



Photomicrograph: Hyaline cartilage from the trachea (300×).

Fig. (26): Hyaline Cartilage

Elastic Cartilage

Description
Similar to hyaline cartilage
More elastic fibers in matrix

Function
-Maintains shape of structure
-Allows great flexibility
Location
-Supports external ear
-Epiglottis

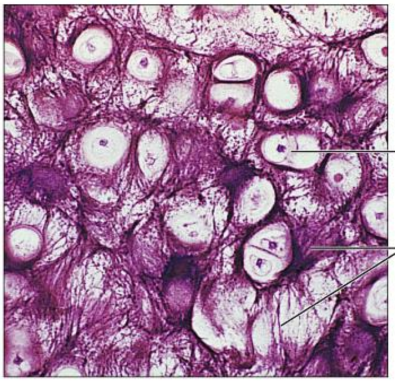


Fig. (27): Elastic Cartilage

Fibrocartilage

Description
Matrix similar, but less firm than hyaline cartilage
Thick collagen fibers predominate

Function
Tensile strength and ability to absorb compressive shock

Location
Intervertebral discs

Pubic symphysis
Discs of knee joint

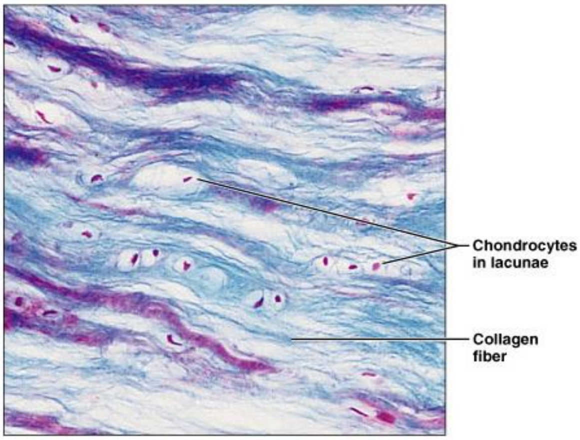


Fig. (28): Fibrocartilage

<u>Bone Tissue</u>

Function
-Supports and protects organs
-Provides levers and attachment site for muscles
-Stores calcium and other minerals
-Stores fat
-Marrow is site for blood cell formation

Location
Bones

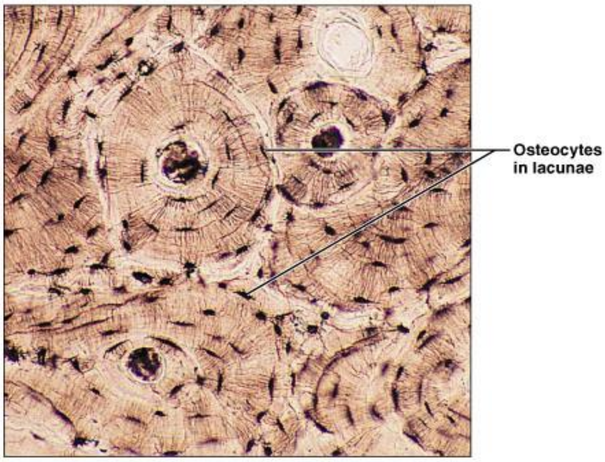


Fig. (29) Bone Tissue
:

<u>Blood Tissue</u>

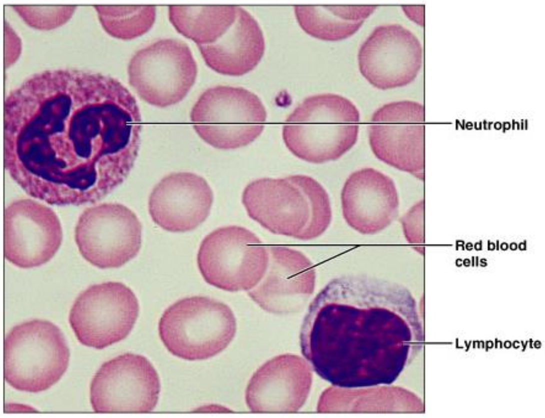
Description
red and white blood cells
in a fluid matrix

Function
-transport of respiratory gases, nutrients, and wastes

Location
within blood vessels

Characteristics

An atypical connective tissue
Develops from mesenchyme
Consists of cells surrounded by nonliving matrix



Photomicrograph: Smear of human blood (1500×); two white blood cells (neutrophil in upper left and lymphocyte in lower right) are seen surrounded by red blood cells.

Fig. (30): Blood Tissue

Muscle Tissue

Types
-Skeletal muscle tissue
-Cardiac muscle tissue
-Smooth muscle tissue

Skeletal Muscle Tissue

Characteristics
Long, cylindrical cells, Multinucleate Obvious striations

Function
Voluntary movement
Manipulation environment

Facial expression

Location

Skeletal muscles attached to bones (occasionally to skin)

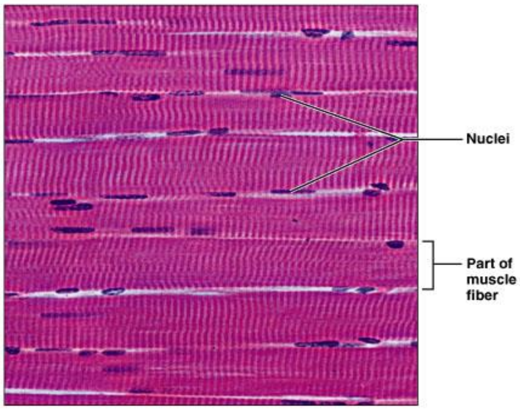


Fig. (31): Skeletal Muscle Tissu

Cardiac Muscle Tissue

Function

Contracts to propel blood into circulatory system

Characteristics

Branching cells, Uninucleate, Striations Intercalated discs

Location

Occurs in walls of heart

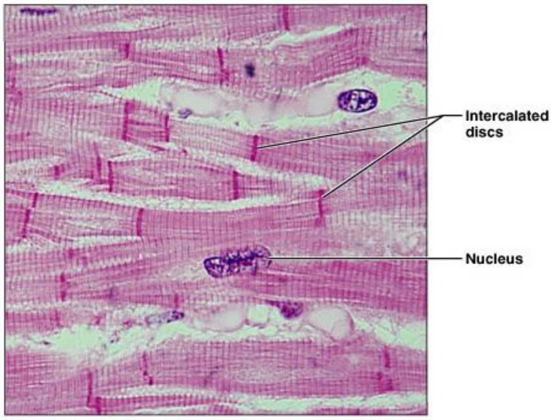


Fig. (32): Cardiac Muscle Tissue

Smooth Muscle Tissue

Characteristics
Spindle-shaped cells with central nuclei
Arranged closely to form sheets
No striations

Function
Propels substances along internal passageways
Involuntary control

Location
Mostly walls of hollow organs

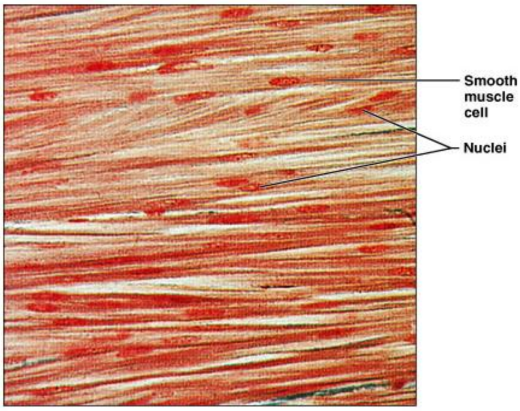


Fig. (33): Smooth Muscle Tissue

Nervous Tissue

Function
Transmit electrical signals from sensory receptors to effectors.
Location
Brain, spinal cord, and nerves

Description
Main components are brain, spinal cord, and nerves
Contains two types of cells
Neurons – excitatory cells

Supporting cells (neuroglial cells)

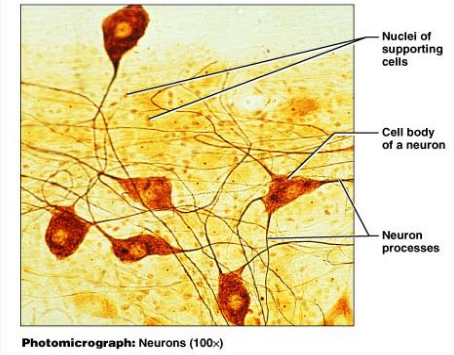


Fig. (34): Nervous Tissue

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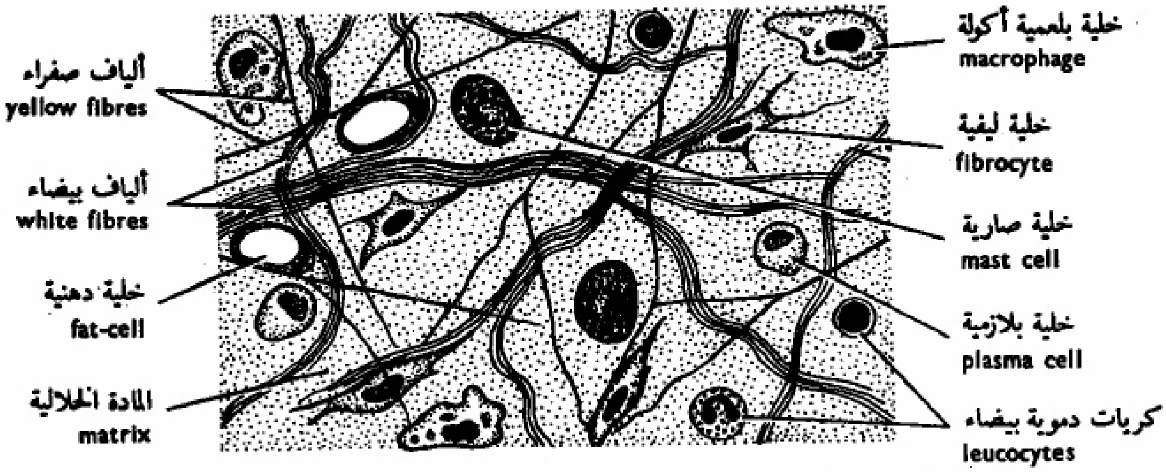
الأنسجة الضامة

1-الأنسجة الضامة الأصيلة:

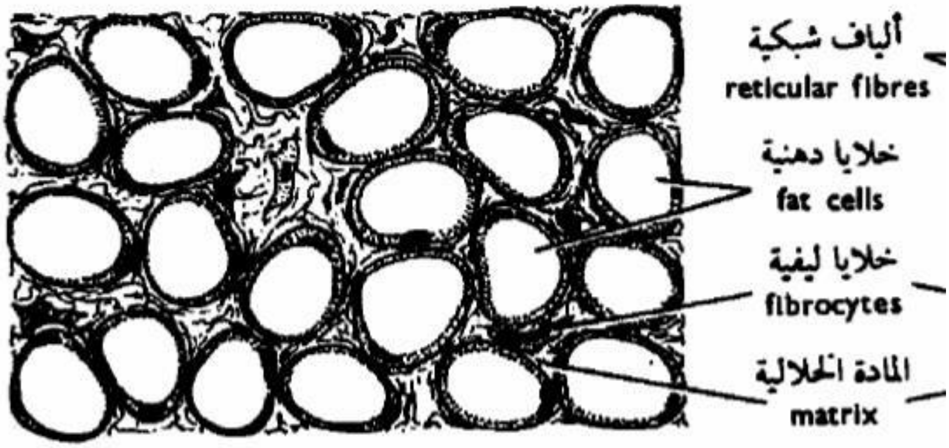
أ- النسيج الضام الفجوي (شكل 1):



Areolar connective tissue نسيج ضام فجوى
(From subcutaneous layer) (من الطبقة تحت الجلد

شكل 1

ب- النسيج الضام الدهني (شكل 2):



نسيج ضام دهني

Adipose connective tissue

(S. of Fat-body قطاع من الجسم الدهني)

شكل 2

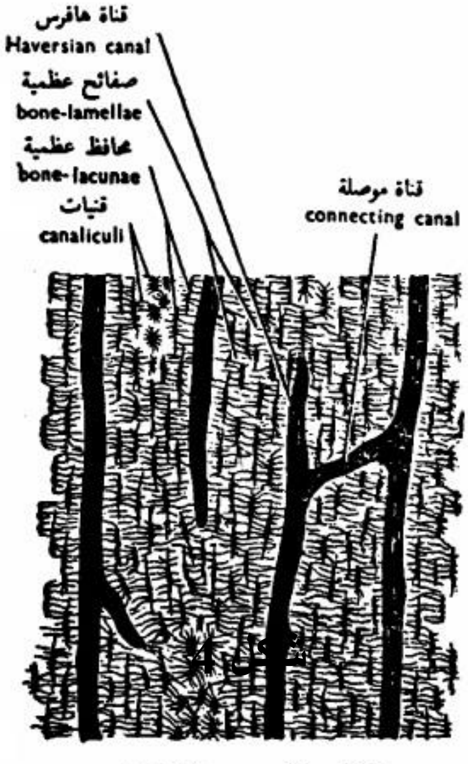
2-الأنسجة الضامة الهيكليه:

أ- الغضروف الزجاجي (شكل 3)

شكل 3

ب-قطاع طولي من عظم كثيف (شكل 4):

غضروف زجاجى
Hyaline cartilage
(من القصبة الهوائية)
(From Trachea)



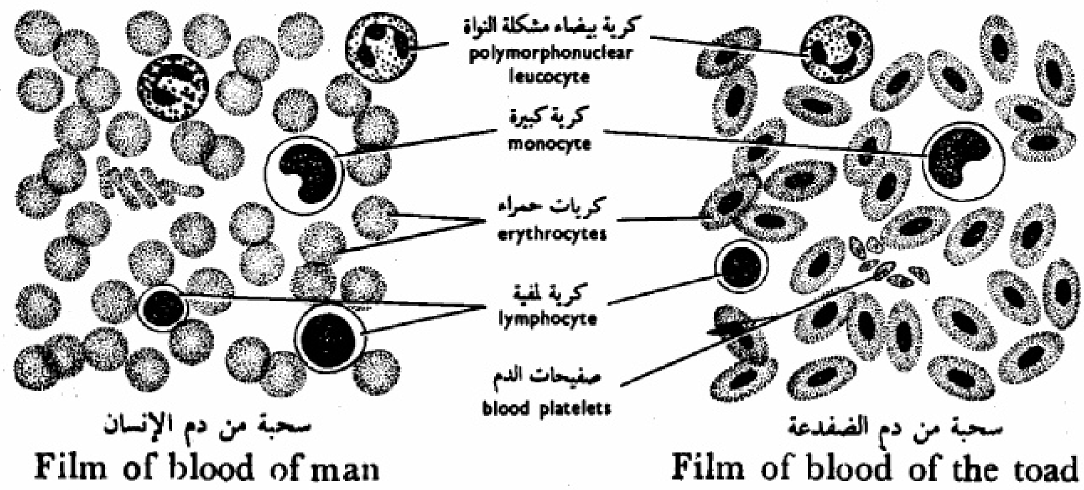
شكل 4

قطاع طولى من عظم كثيف
L.S. of Dense Bone

3- الأنسجة الضامة الوعائية:

أ- سحبة من دم إنسان (شكل 5):

ب- سحبة من دم ضفدعة (شكل 6):



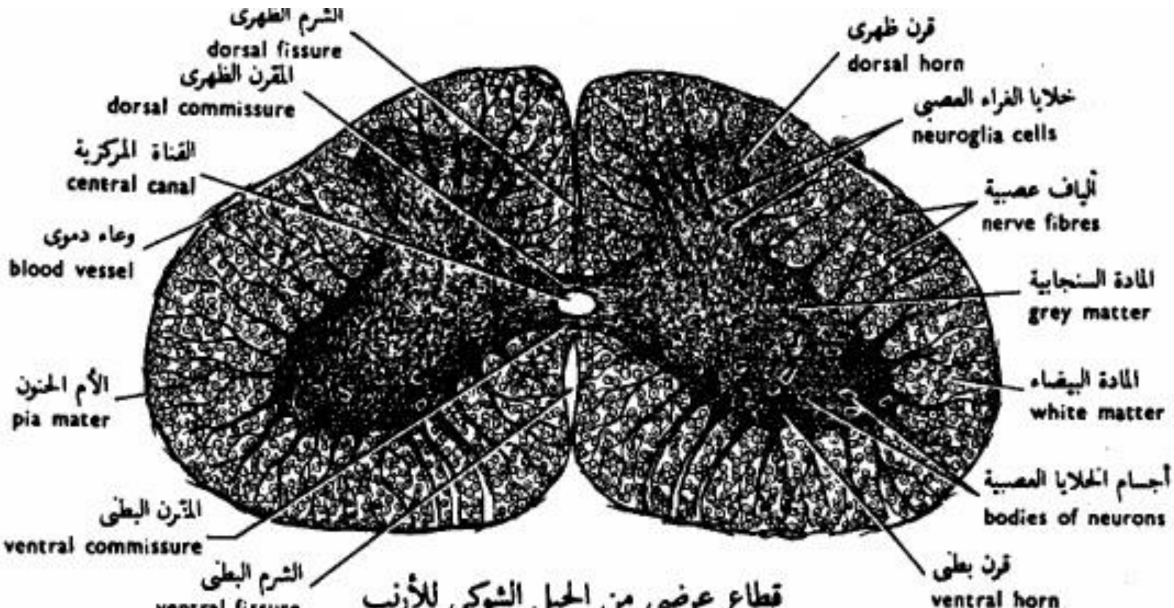
شكل 6

شكل 5

الأنسجة العصبية

قطاع عرضي من الحبل الشوكي للأرنب (شكل 7):

شكل 7



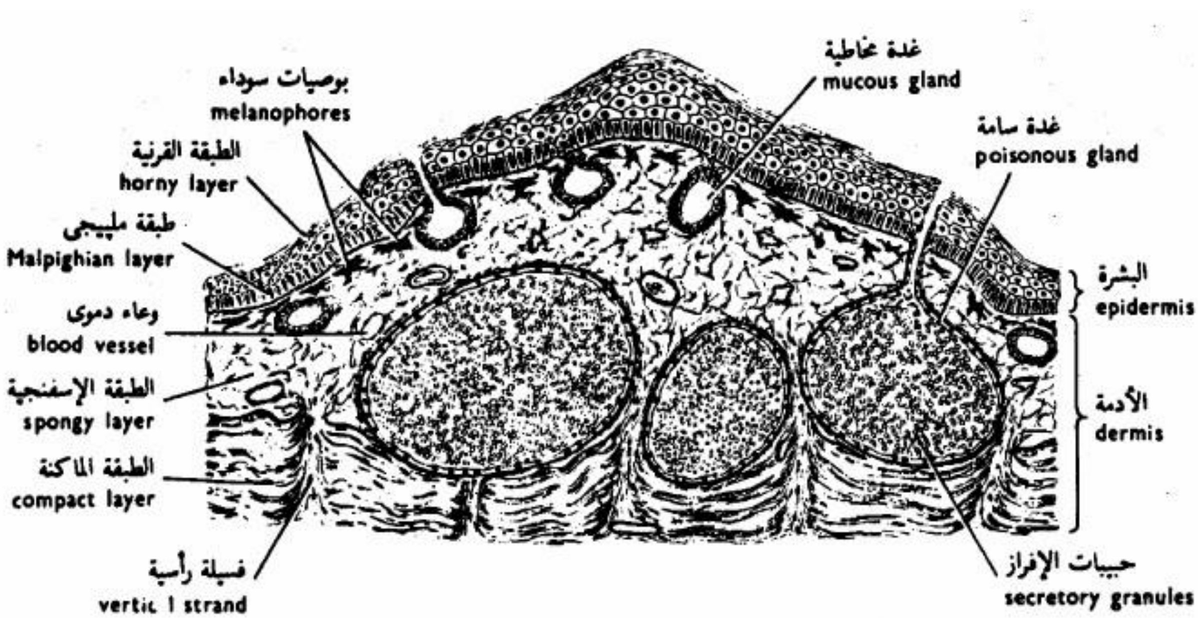
قطاع عرضى من الحبل الشوكى للأرنب

T.S. of the Spinal Cord of the Rabbit

الأعضاء

1-الجلد:

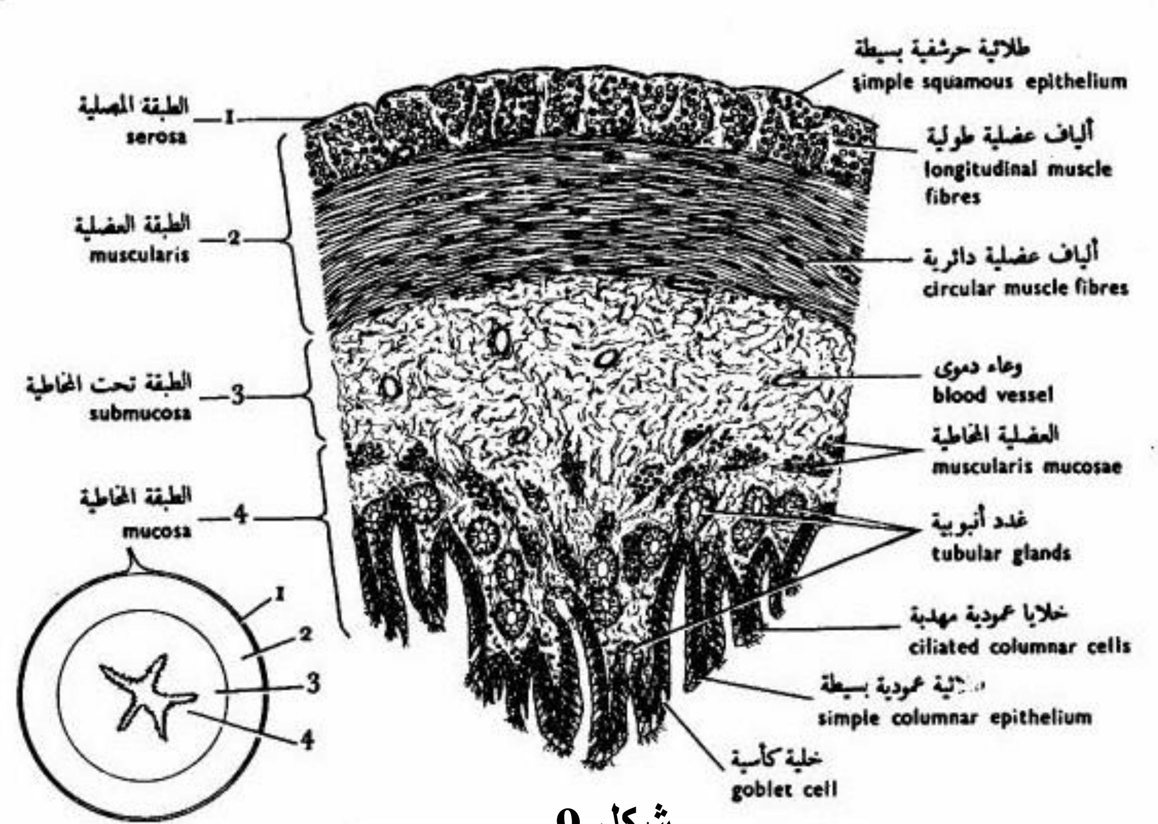
قطاع رأسي من جلد الضفدعة (شكل 8):



شكل 8

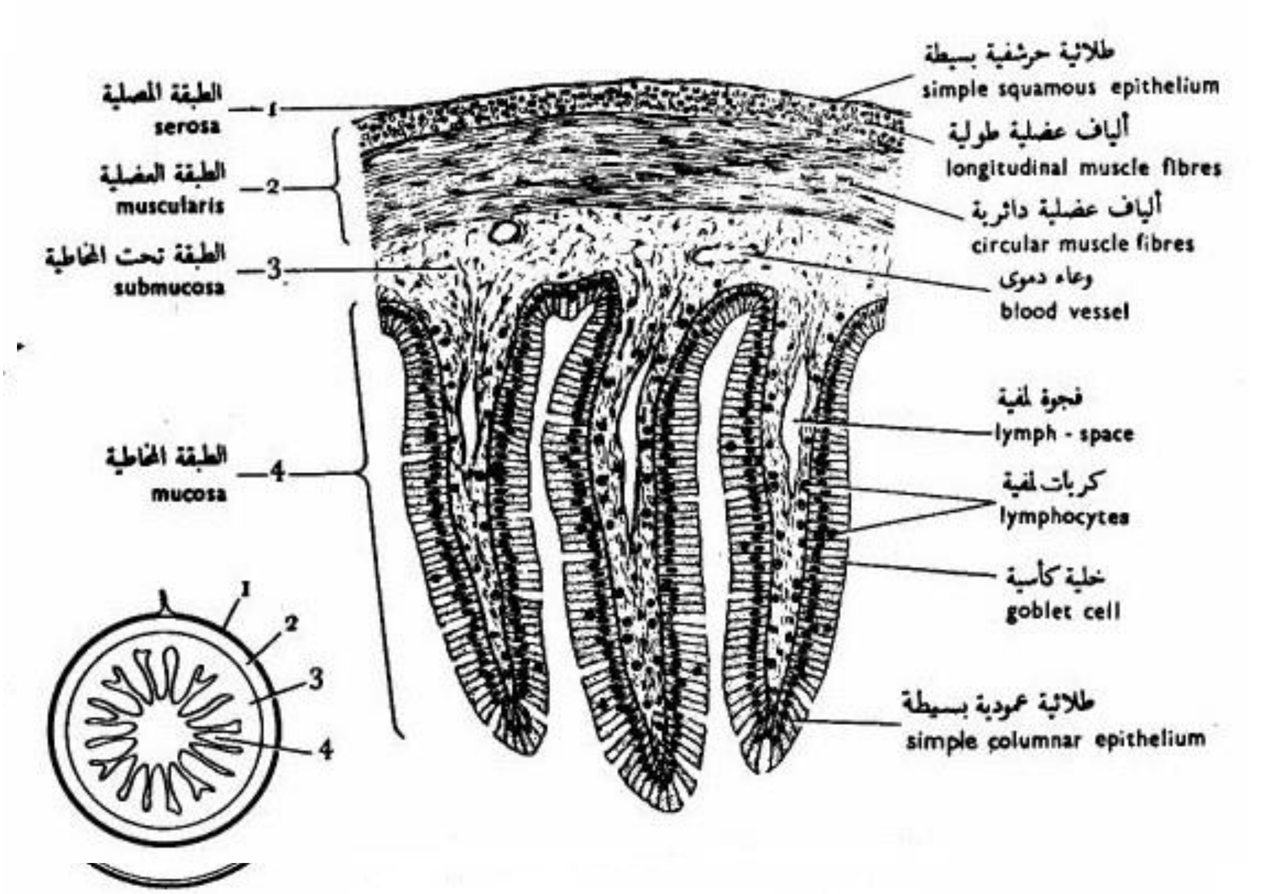
2-أعضاء الهضم (القناة الهضمية):

أ- قطاع عرضي من مرئ الضفدعة (شكل 9):



شكل 9

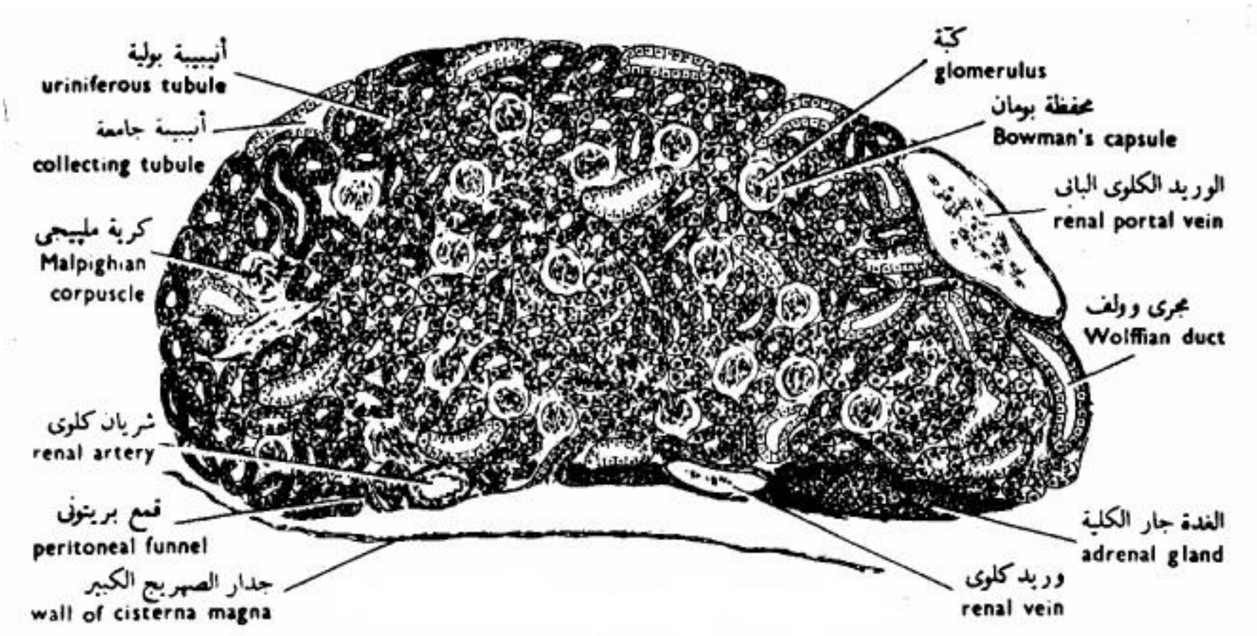
ب- قطاع عرضي من معدة الضفدعة (شكل 10):



ج- قطاع عرضي من لفائفي الضفدعة (شكل 11):

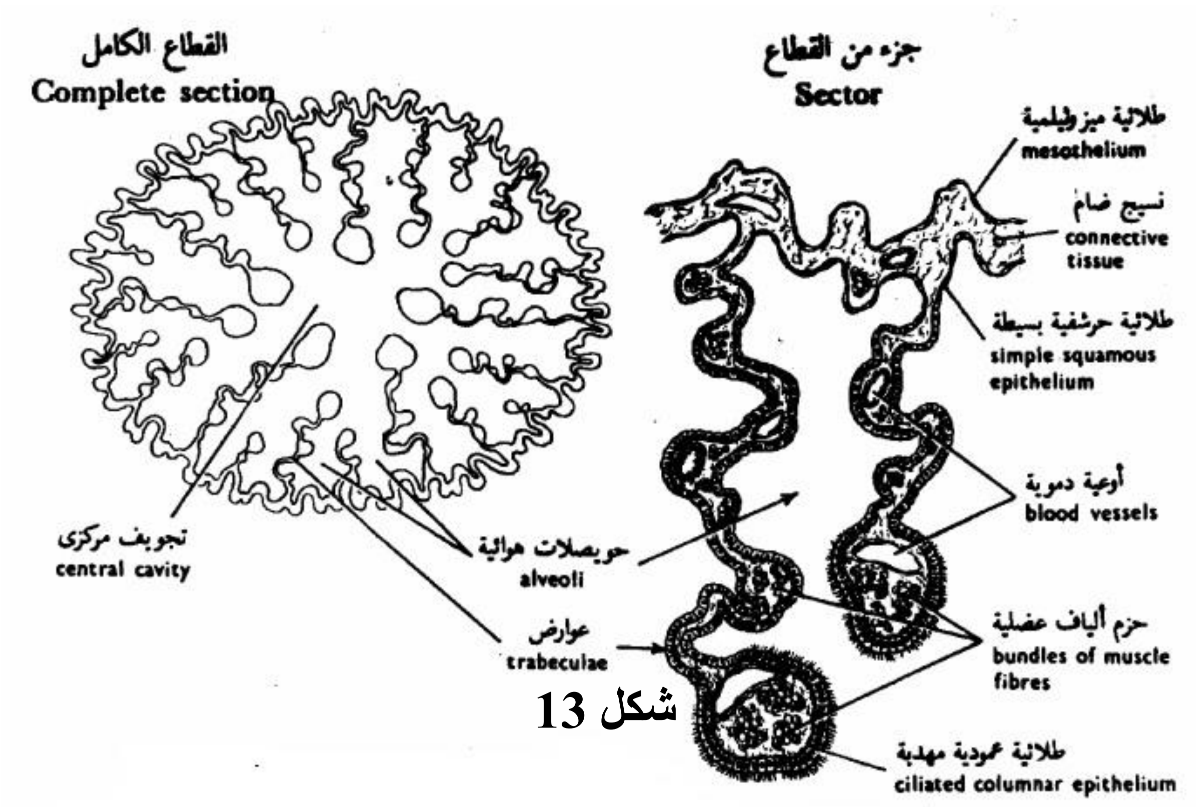
3-الأعضاء البولية:

قطاع عرضي من كلية الضفدعة (شكل 12):



4-أعضاء التنفس:

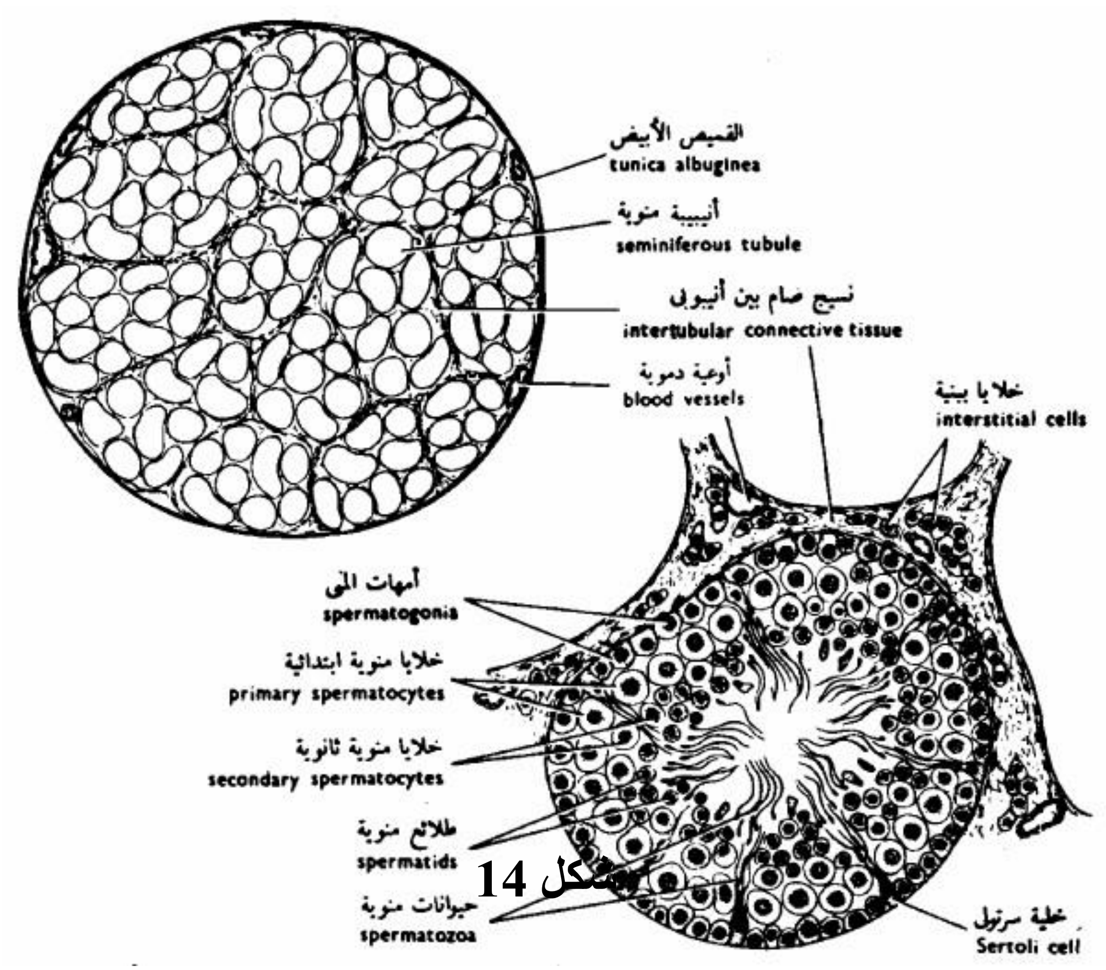
قطاع عرضي من رئة الضفدعة (شكل 13):



شكل 13

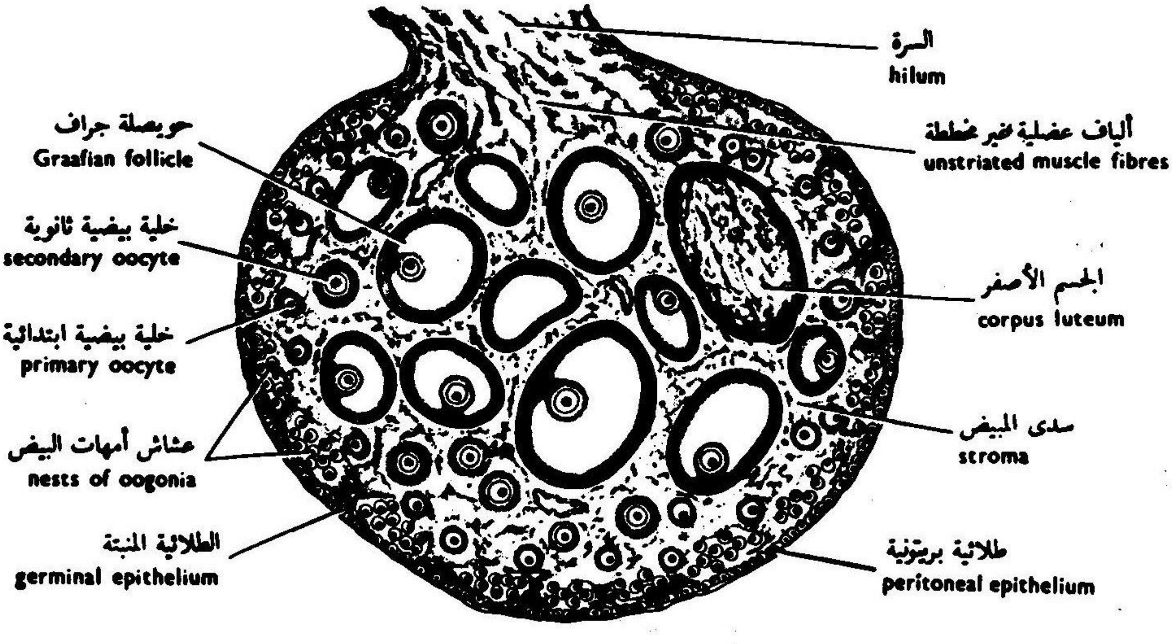
5-أعضاء التناسل:

أ- قطاع عرضي من خصية فأر (شكل 14):



شكل 14

ب- قطاع عرضي من مبيض قطة (شكل 15):



شكل 15

المراجع

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