Botany 1

1st year Biological sciences and Geology

Prepared by: Dr. Azza Misk

Part 1: Biodiversity

Earth Creation History

- **The Earth was created 2-5 billion years ago.**
- **Two out of four living groups were found to inhibit aquatic environment i.e. *Algae*.**

The Living Organism:

- **Any living being is called "Organism"**
- **Organism: an organized system**
- **With a specific identifiable shape**
- **Each organ within this system has a specific function i.e. growth, reproduction, sensitivity, metabolism, etc…**

Biodiversity:

- **Biodiversity: the variety and variability of living organisms, their types and numbers at the genetic, species and ecosystem level.**
- **Variability in the Ecosystem:**
  1. **Dominant species**
  2. **Relatively dominant species**
  3. **Or those rich and poor population in a biological community.**
- **Biodiversity with respect to seasonal and habitat variations:**

1. **Biodiversity increases in warmer habitats, while decreases in colder ones.**
2. **Biodiversity increases as you elevate higher from sea level especially in heavy rain fall areas.**
3. **Biodiversity is always rich in tropical regions, while poor in desert environments (either dry or glacial).**
4. **Tropical forests occupy 7% of the earth's area however comprise 90% of the biological species.**

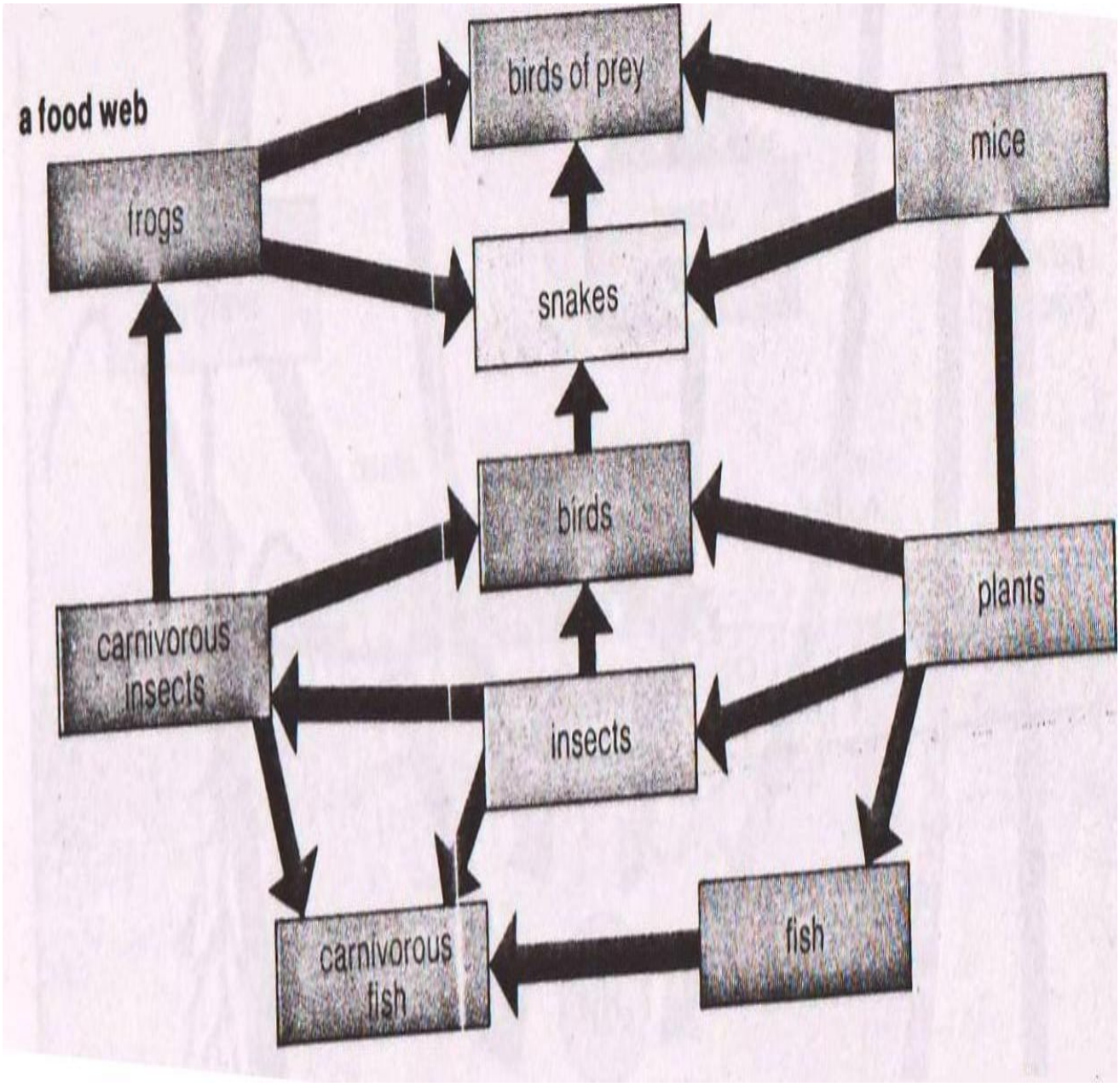


Fig. 1: Food Web

Fig. 2: Biodiversity with respect to habitat variations World wide

Classification Of Living Organisms:

- **Firstly, Organisms were classified as Plants and Animals for those reasons:**
  1. **A plant cell has a cellulosic (wooden) cell wall surrounding it, while animal cell has not, which allows it to change its shape i.e. *Amoeba***
  2. **Plant growth is unlimited unlike animal growth which is limited to a certain size**
  3. **Most animals have the ability to move**
  4. **Plants and animals differ in the type of nutrition: plants are auto- trophic, while animals are heterotrophic.**

- **Then, they were classified into *Prokaryotae* and *Eukaryotae*:**
  1. ***Prokaryotes* (primitive nuclei): Mostly primitive unicellular organisms or slightly multicellular that lacks a membrane-bound nucleus, their primitive nucleus is only comprised of DNA devoid of any nuclear membranes or nuclei. It divides by binary fission. i.e. *Monera***
  2. ***Eukaryotes* (True nuclei): Unicellular or multicellular organisms whose cell have a nucleus enclosed within membranes with chromatin matrix, nuclei, as well as organelles such as *Mitochondria* and Golgi apparatus. It reproduces vegetatively, sexually and asexually. i.e. *Fungi*, *Protista*, *Plantae* and *Anamilia*.**

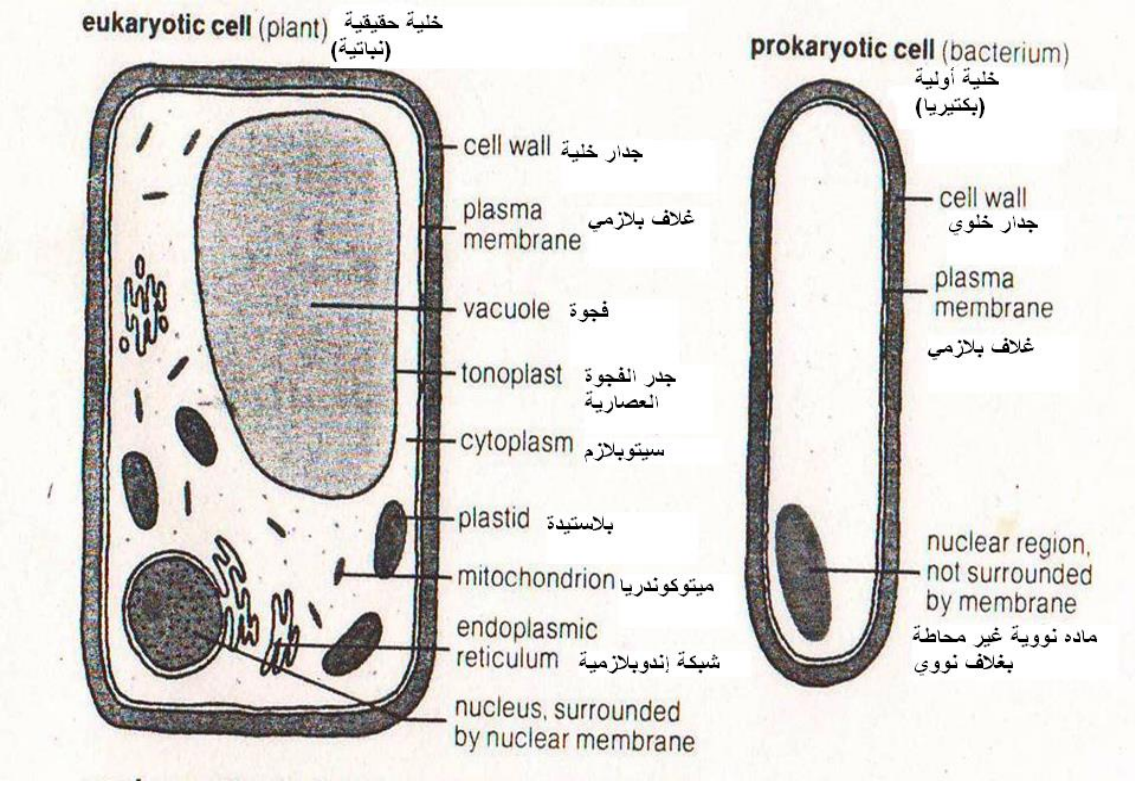


Fig. 3: Comparison between *Prokaryotes* and *Eukaryotes*

- **Finally, organisms were classified into five different groups according to different characters such as cell structure, form (shape), motility (movement) and nutrition.**

Table 1: Comparison bet\ween the five different kingdoms according to different characters:

Kingdom / Character	*Monera*	*Protista*	*Fungi*	*Plantae*	*Anamilia*
Cell Structure	**Prokaryotes**	**Eukaryotes**			
Form	**Unicellular**	**Mostly Unicellular**	**Multicellular**		
Nutrition	**Autotrophic or Heterotrophic**	**Phototrophic**	**Saprophytic, parasitic Or Symbiotic**	**Phototrophic**	**Holozoic**
Motility	**By flagella**	**By Flagella or Cilia**	**Non-motile**		**Contracting Fibrous tissue (muscles)**

Nutrition

Modes of Nutrition

A) Autotrophic:

- **Organisms that can make their own food through building their need from organic substances and inorganic ones.**
- **They were classified according to their use of energy into:**

1. **Phototrophs**
2. **Chemotrophs**

1. **Phototrophic Nutrition:**

   - **Organisms who can obtain energy from sunlight like green plants which contain *Chlorophyll*.**

   $6CO_2 + 12H_2O \xrightarrow{\text{light energy}} C_6H_{12}O_6 + 6O_2 + 6H_2O$

   - **Also there's a type of bacteria named Green Sulfur bacteria rely on H_2S instead of H_2O as a source of Hydrogen.**

   $6CO_2 + 12H_2S \xrightarrow{\text{light energy}} C_6H_{12}O_6 + 12\ S + 6H_2O$

2. **Chemotrophic Nutrition:**
   Organisms obtain their energy through the oxidation of some organic substances such as ammonia. Those organisms possess a special enzymatic systems that helps in oxidizing and forming phosphoric bonds rich in energy.
   1. *Nitrosomonas* : Oxidizing ammonia into Nitrite
   $NH_3 + O_2 \rightarrow HNO_2 + H_2O + \text{Energy}$
   2. *Nitrobacter*: Oxidizing Nitrite into Nitrate
   $HNO_2 + O_2 \rightarrow HNO_3 + \text{Energy}$

B) Heterotrophs:

- **Organisms that can't make their own food by itself and so feed on the expense of other living organisms. They are divided into:**

1. **Holozoic**
2. **Saprophytic**
3. **Parasitic**
4. **Symbiotic**

1. ***Holozoic* Nutrition (Predation):**
   - ***Herbivores*: Organisms feeding on plants.**
   - ***Carnivores*: Organisms feeding on animals and insects.**
   - ***Omnivores*: Organisms feeding on both plants and animals.**

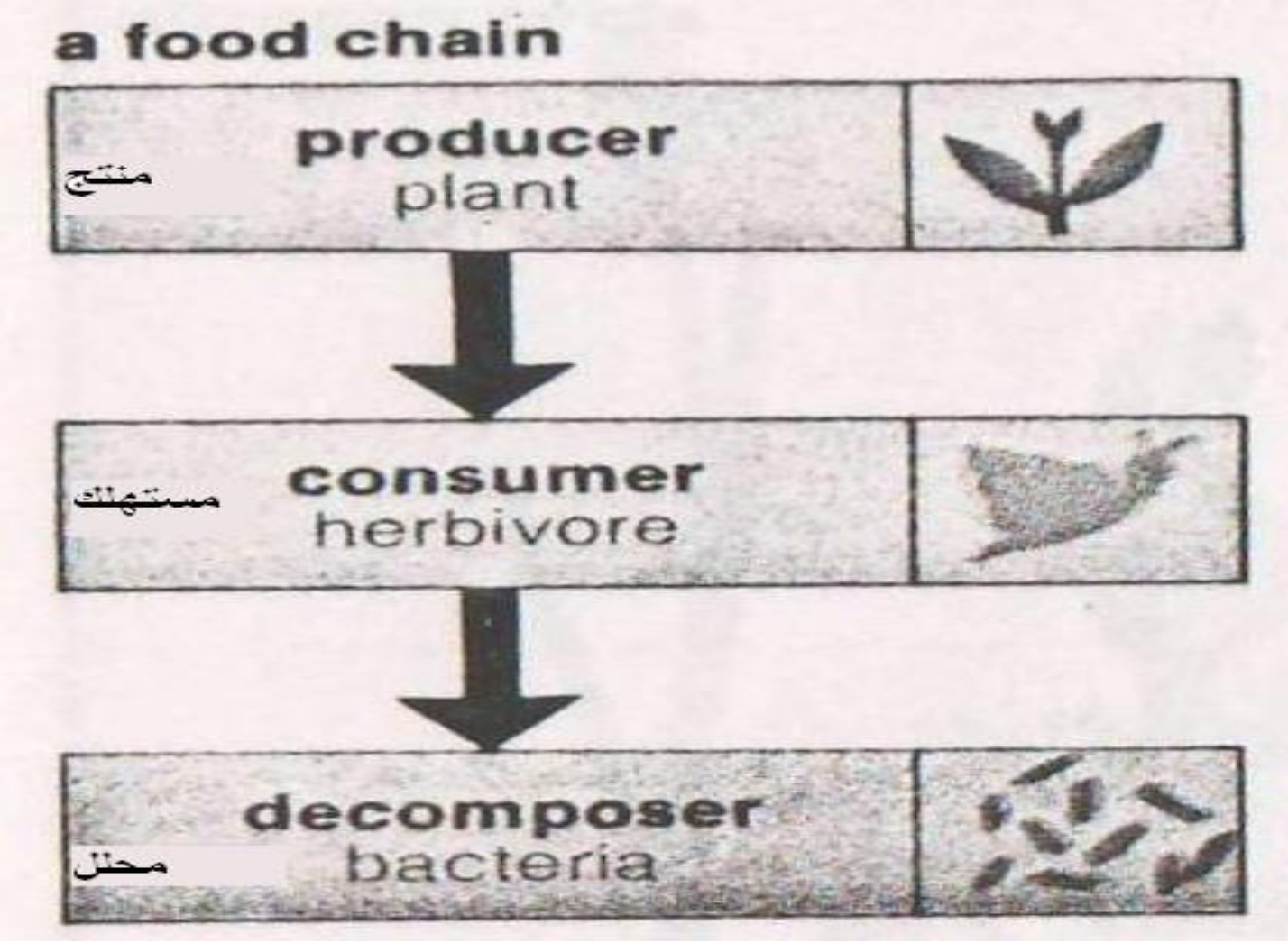
2. **Saprophytic Nutrition:**
   - **These organisms obtain their food from the bodies of decomposed plants and animals.**
   - **Examples of which are *Fungi* and yeasts as well as some bacteria.**
   - **They have the ability to secrete certain enzymes that can convert decomposed organic substances (as proteins, carbohydrates and fats) into simple substances that can be easily absorbed through their cellular membranes.**
3. **Parasitic Nutrition:**
   - **The Parasite organism gets its food from another organism called the Host.**
   - **Types of parasites:**
     1. **Obligate Parasites: Can not be cultivated in the lab *i.e. Poliovirus***
     2. **Facultative Parasites: Can be cultivated in the lab like many *Bacteria* and *Fungi.***

4. **Symbiotic Organisms:**

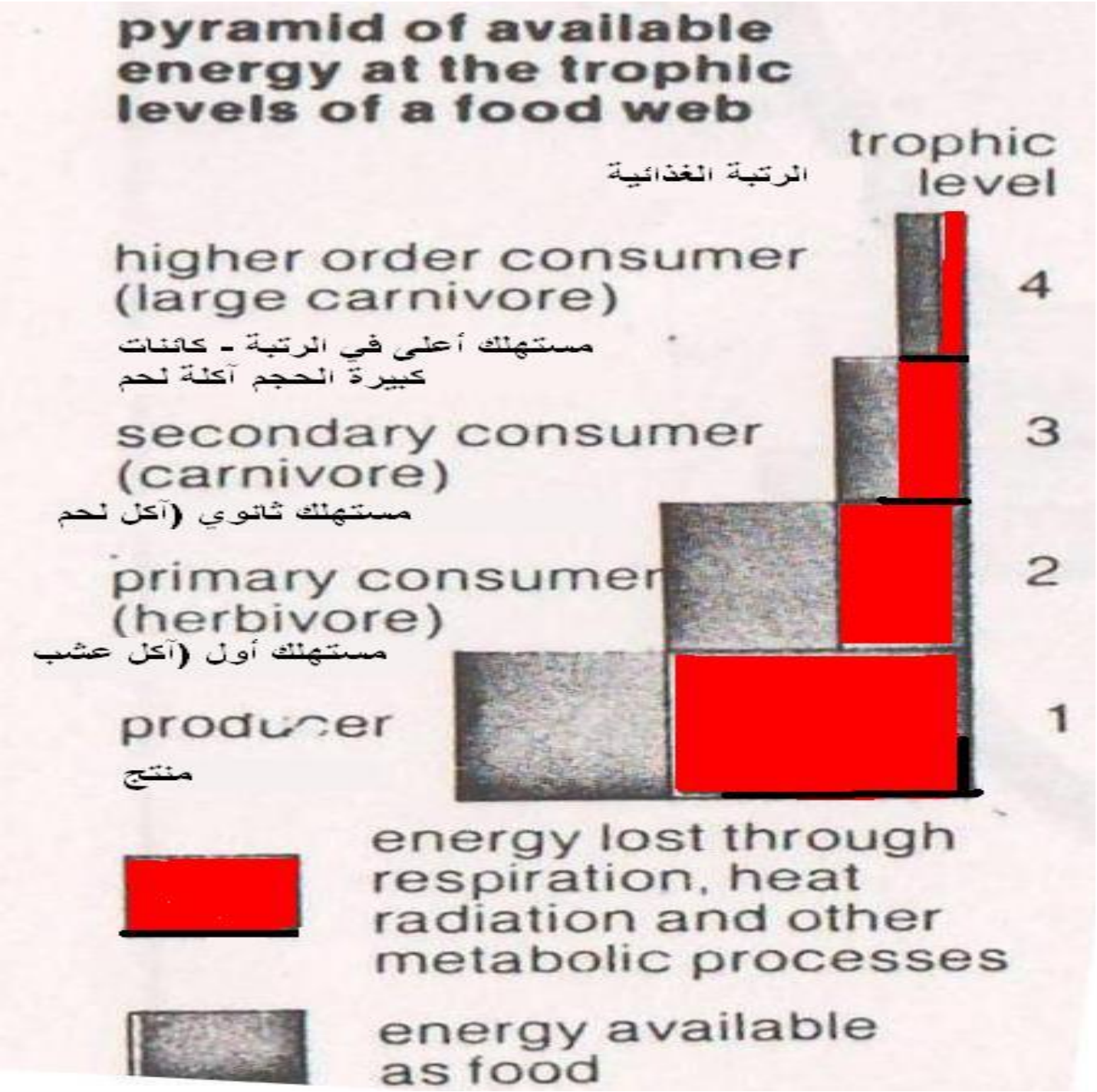
- **Some organisms can live together in cooperation where they exchange nutrients examples of which:**
  1. ***Lichens*: an *Alga* living in symbiosis with a *Fungus*.**
  2. ***Mycorrhizae* (root *fungi*): they exchange nutrients with roots of some plants.**
  3. **Bacterial nodules: *Rhizobia*; nitrogen fixing bacteria living in the root nodules of leguminous plants.**

Ecosystem

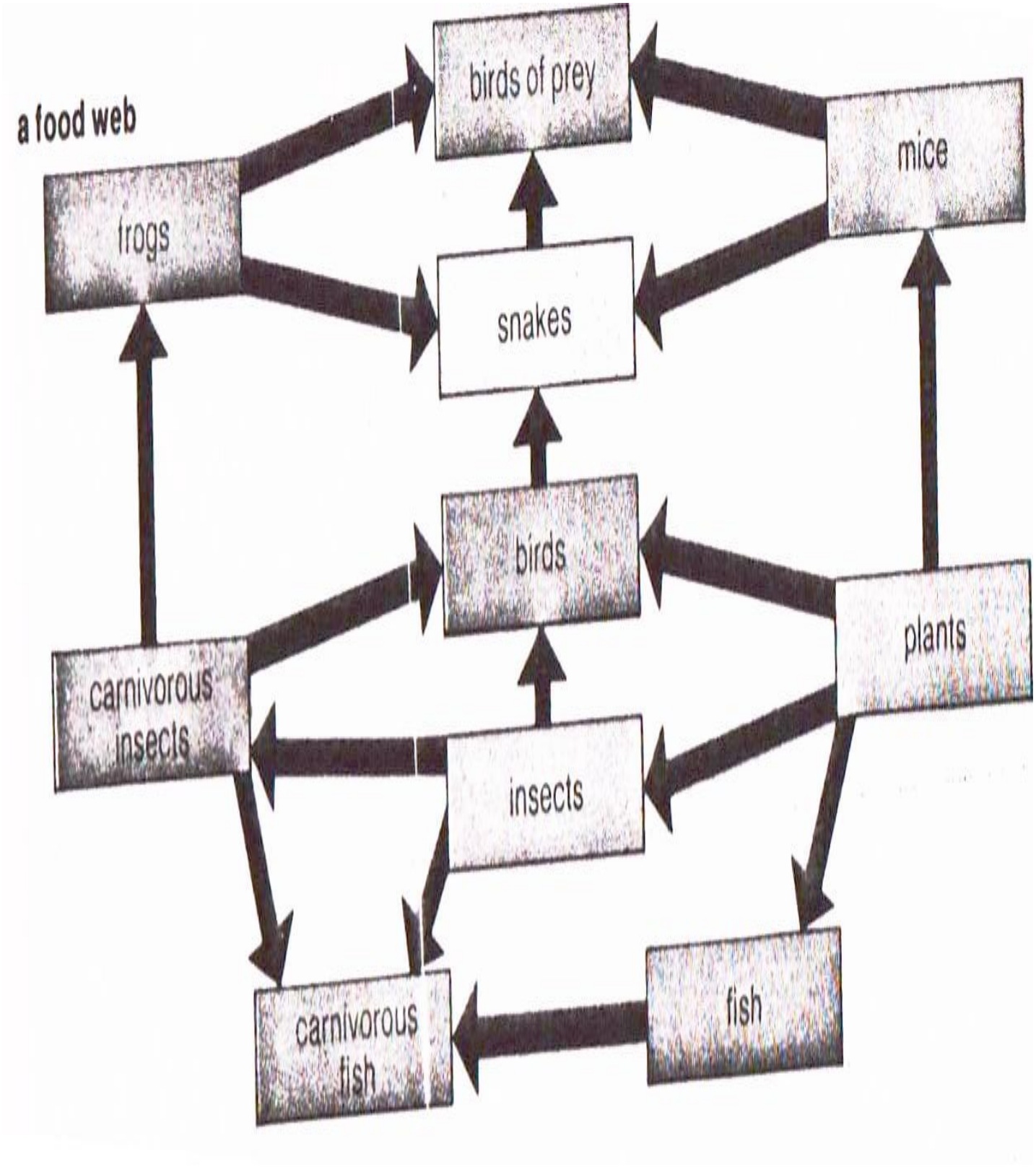
- **A community made up of living components (*<u>Biotic</u>*) and non-living ones (*<u>Abiotic</u>*), <u>interacting</u> as a system and functioning as a unit. The components of this system are <u>linked together</u> through <u>nutrient cycles</u> and <u>energy flows</u>.**
- **The biotic components consists of:**
  1. **Producers: Plants or algae**
  2. **Consumers: *Herbivores* and/or *Carnivores***
  3. **Decomposers: Saprophytes**



Energy Flow Of A Food Web:



A model of an Ecosystem demonstrating a food web:



Habitat and Ecologic Niche

- **<u>Habitat</u>: the place where the organism lives (Address).**
- **<u>Ecologic Niche</u>: the role of the organism (Job).**
- **One organism may live in different habitats and environments examples of that are:**
    1. **A tadpole (a frog stage) is a 1st consumer feeding on algae (*Herbivore*), while the mature frog is a 2nd consumer feeding on insects (*Carnivore*).**
    2. **Little tortoises are 2nd consumers as they feed on worms and snails (*Carnivores*), on the other hand mature tortoises are 1st consumers as they feed on algae (*Herbivores*).**

<u>Inter- and Intra- specific Interactions:</u>

A)Interspecific interactions: Environmental Interaction Between Different Species

- **<u>Competition:</u>**

1.Organisms living in the same habitat and competing for the same nutrients.

2. Examples: *Paramecium aurelia* , *P. caudatum*

- **<u>Commensalism:</u>**
    1. **A relation between two organisms where only one benefit without harming the other.**
    2. **Examples: Some worms find shelter on shells of marine organisms.**
- **<u>Proto-cooperation:</u>**
    1. **A relation between two organisms where they both benefit from this relationship with the possibility that one can live separately from the other.**
    2. **<u>Examples</u>: Some hermit crabs often pick up a sea anemone to attach to their shell to dissuade attackers, where sea anemone spreads out long stinging threads over the shell. These relationships go both ways as the anemones are able to pick up more food.**
- **<u>Mutualism:</u>**
    1. **Both organisms benefit from the relationship. Both organisms can't be apart and can't survive without each other.**

2. **Termites and microbes living in their guts, where termites depend on them to digest the complex sugars in wood into simpler molecules they can use for food. Digesting cellulose to acetic acid.**

- **<u>Amensalism:</u>**

    1. **A relation between two organisms in which one organism is inhibited or destroyed while the other remains unaffected .**

    2. **<u>Example</u>: Some organisms produce antibiotics affecting the growth of others. *i.e. Penicillum***

B) Intraspecific interactions: Environmental Interaction Between individuals of the same species. Two points of views were raised among ecologists:

1. **A group finds it positive for the community to cross-breed, reproduce and continue to thrive.**
2. **The other finds it negative for the community as they compete for limited resources.**

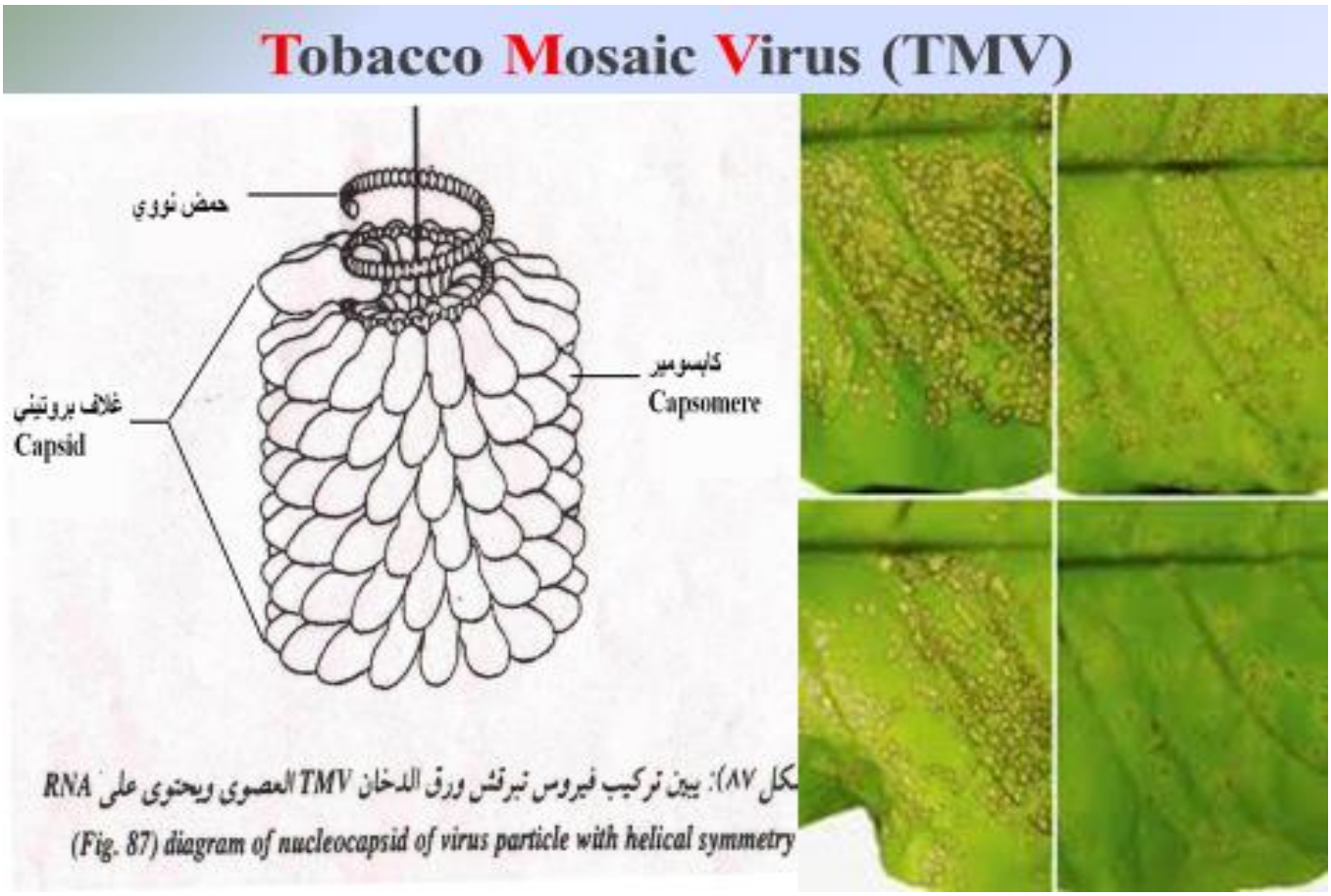
- **<u>Examples</u>:**

1. **A herd of deer and wolf (A wolf only chases the stray deer).**
2. **The experiment of the golden fish and the colloidal silver solution.**

Virus and *Bacteriophage*

Nature of Viruses:

- **One of the agents causing disease to man animals and plants.**
- **They were first named "Virions"; meaning toxins.**
- **Can not be isolated from the host body.**
- **They are now classified under "Nano-organisms".**
- **They are of different shapes and sizes.**
- **They appear to look like crystals with the ability of dividing as they contain Nucleic acids and Nucleoproteins.**
- **Viruses form a unique link between livings and non-livings .**
- **Evanowsky discovered Viruses by chance during the isolation of bacteria from Tobacco Leaves by filtration.**
- **Viruses are solid particles of constant sizes and an ability of changing forms and internal structure by mutation.**
- **Viruses are formed of : 1. Protein coat 2. Nucleic acid**



Viruses between living and non living worlds

- **<u>Two opinions are suggested about the formation of Viruses</u>:**

  1. Many scientists believe that Viruses are crystals developed from extinct organisms which by time lost many of its vital characters because of its obligate parasitism.

  2.Or it developed from a non living material that acquired some vital characters.

- **Living Characters of Viruses:**

  1. Their Ability to grow and reproduce.

  2. Their Obligate Parasitism.

  3.Each virus has a specific lethal temperature.

  4. They can produce mutant strains (electronically not genetically).

  5. They have a wide host range. (Table 1)

- **Non-living characters of Viruses:**

  1. Their ability to crystallize.

  2. Losing all life characters outside their host.

Table 1: Viral Diseases transmitted from animals to man

Viral Disease	Principal Host	Other Natural Hosts	Transmitted By
Yellow Fever	Man	Monkey	Mosquitos
Cowpox	Cow	Man	Touch
Rabies	Dog	Cat – Wolf – Fox - Man	Biting
Psittacosis (Parrots Fever)	Parrot	Pigeon And Other Birds-man	Touch

Viral Classification

- **Viruses are classified according to the followings:**

1. **The Host**
2. **Type of tissues**
3. **Type of Nucleic Acid**
4. ***Bergey*'s Classification Manual.**

Viral Classification according to:

1- The Host

Man	Animal	Plant	Insects	Bacteria
Poliovirus	*Sheep pox*	*Tobacco Mosaic Virus (TMV), Tomatoes, Cabbage, lettuce, etc…*	Many *Viruses* attack Silkworm and other butterflies	Different Bacterio-phages
Rabies	*Rabies*	*Banana Bunchy Top Virus (BBTV)*		
Mumps	*Parrot fever*	*Necrotic Spot Virus*		
Measles	*Cattle plaque*	*Streak Virus*		
Trachoma	*New Castle Disease*	*Dwarf Virus*		
Influenza	*Yellow fever*			
Smallpox	*Sarcoma*			
Chickenpox	*Exanthema*			

Viral Classification according to:

2- Type of Tissue

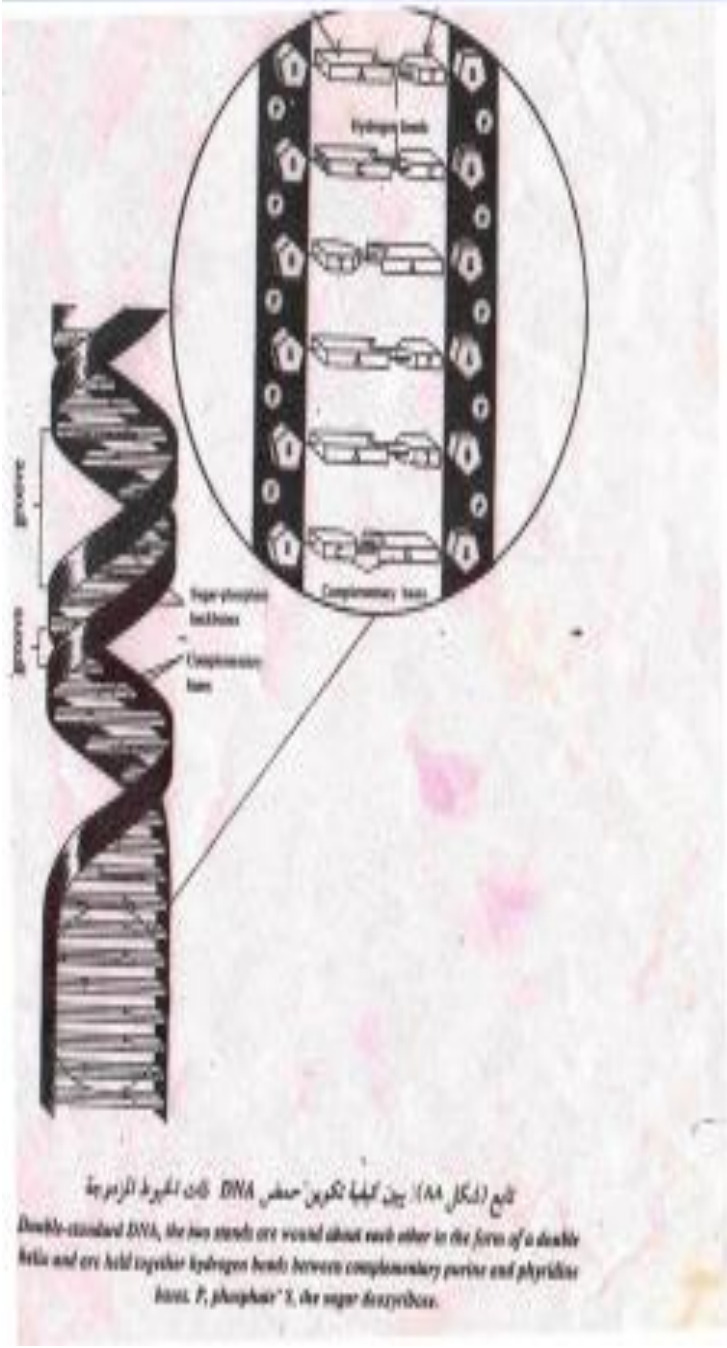
Tissue	Viral Group	Viral Disease
Nervous System	Neurotropic	*Encephalitis, Rabies, Poliovirus*
Skin and Mucous Membranes (Mouth and Nose)	*Dermatropic*	*Smallpox, Measles, Chickenpox, Cowpox*
Internal Organs	*Viscerotropic*	*Deng Virus, Yellow fever*
Respiratory System	*Pneumotropic*	*Influenza, Parrot fever*
Chicken and Rabbits tissues	*Neotropic*	*Lymphoma, Sarcoma, Leukemia*

3- Type of Nucleic Acid:

1. **Deoxyvira: It includes all Viruses with DNA like *Small pox* and *Trachoma Viruses.***
2. **Ribovira: It includes all Viruses with like *Influenza, Hepatitis, Poliovirus* and *Yellow Virus*.**

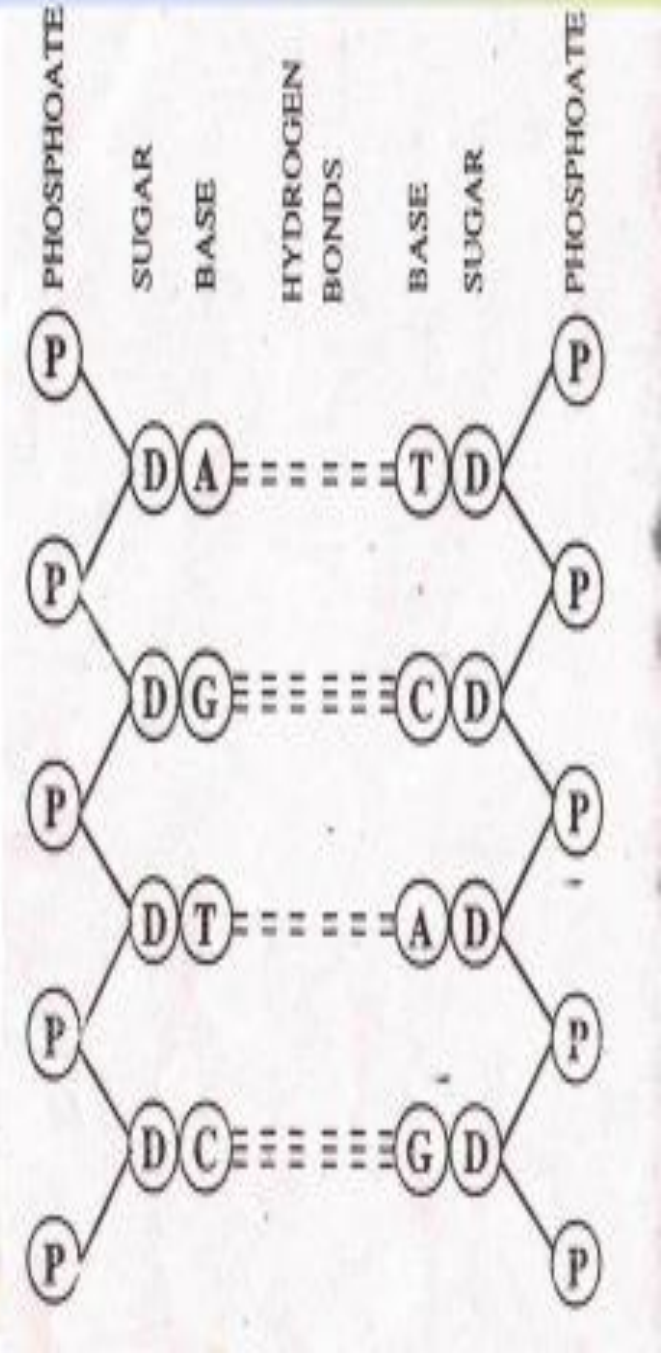
Nucleic Acid Structure

1. DeoxyNucleic Acid (DNA)



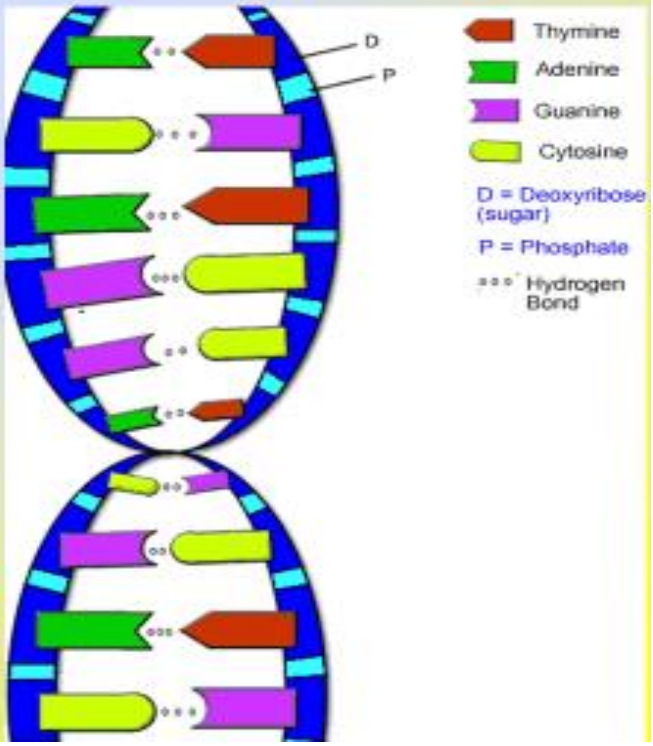
شكل (٨٨) يبين كيفية تكوين حمض DNA ثنائي الخيوط الزوجية

Double-stranded DNA, the two strands are wound about each other in the form of a double helix and are held together hydrogen bonds between complementary purine and pyrimidine bases. P, phosphate' S, the sugar deoxyribose.



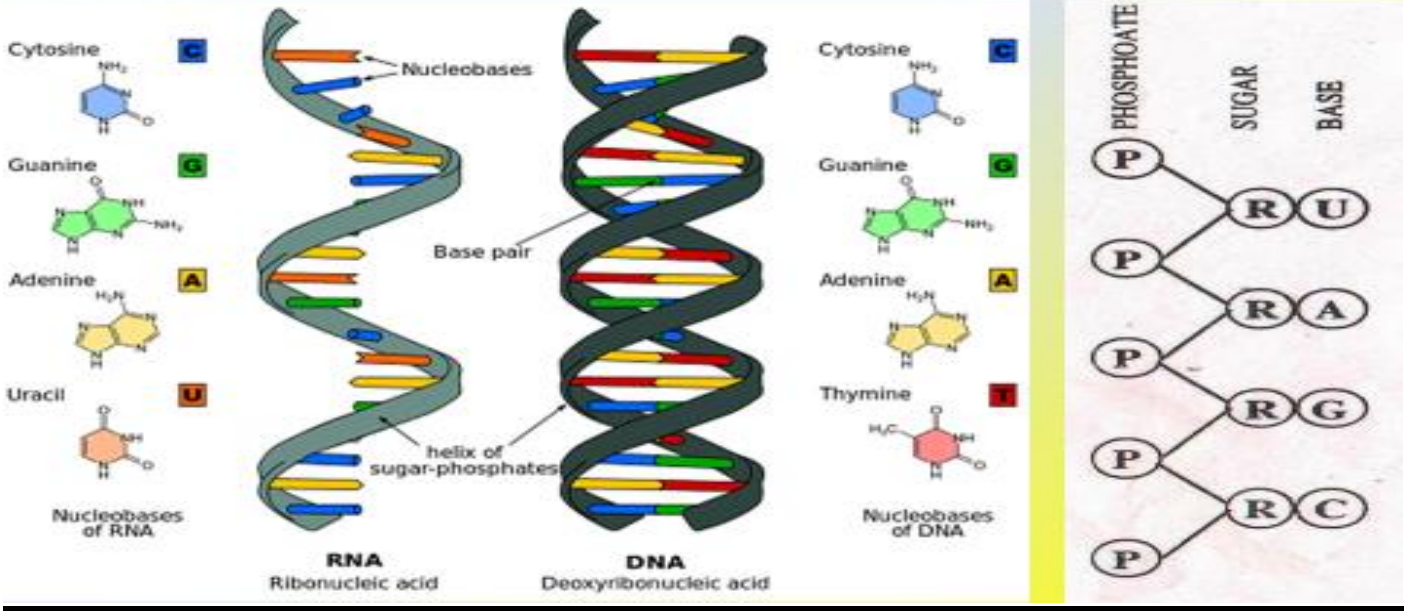
Nucleic Acid Structure

1. DeoxyNucleic Acid (DNA)



Nucleic Acid Structure

2. RiboNucleic Acid (RNA)



4- *Bergey's* Classification Manual:

- **It was used since 1957; but not anymore.**
- ***Microtatobiotes*, are classified into:**
    1. ***Protophytes*: which are classified into:**

        ***1.Schizophyceae* (*Cyanobacteria*)**

        ***2.Schizomycetes* (*Bacteria* & *Fungi*).**
        ***3. Rickettsiae* (*Virus* –like).**
        4. Viruses

    2. ***Thallophytes*: (Thallus form organism with stem, roots and leaves-like structures); they are classified into:**

        1. *Algae*

        2.Non flowering plants

        3. Flowering plants.

Viral Cultivation

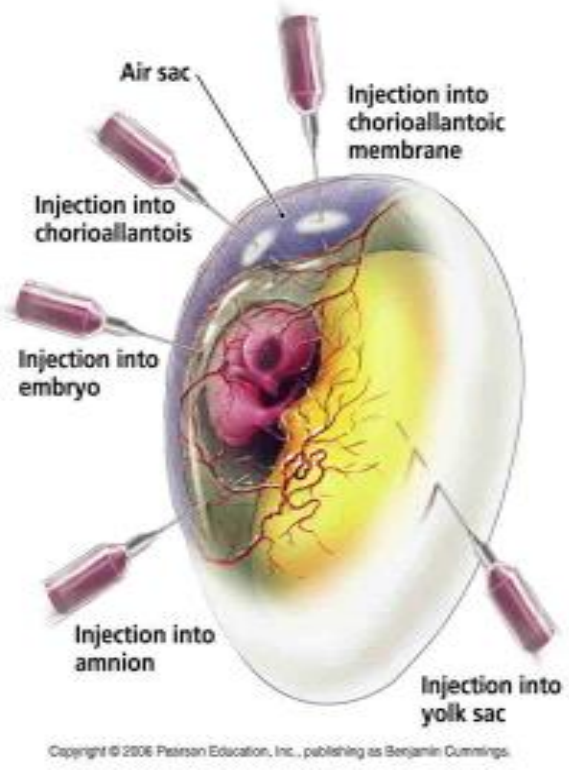
- **Viruses are Obligate Parasites and they are highly specific regarding their hosts, therefore they are only cultivated within the living cells of their host.**
- **<u>Ways of cultivating viruses</u>:**

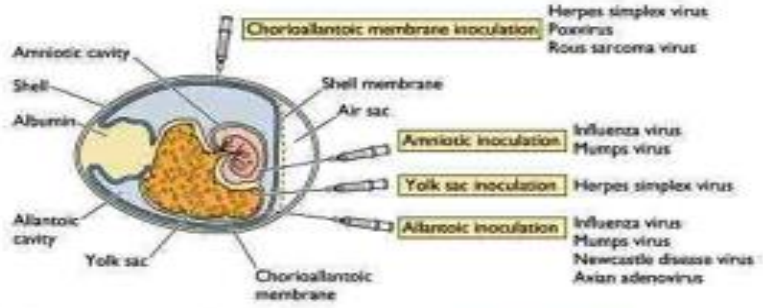
1. <u>Animal Infection</u>: injecting *Rabies* in dogs 'brains for obtaining vaccines.

2. <u>Embryonated Egg Infection</u>: using chicken eggs.

- **A method described by Good Pasteur:**

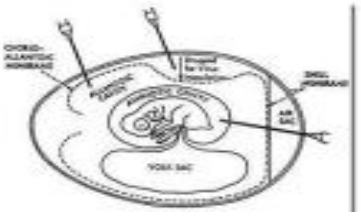
1. **Using Embryonated Fertile chicken eggs.**
2. **Incubating the eggs from 8-12 days for 37º C.**
3. **The *Virus* is injected into eggs after the shell surface is disinfected and sealed with gelatin or paraffin.**
4. **Infected eggs are incubated for another 3 days.**
5. **This method works with some viruses but not them all.**





Virus Production

- Embryonated Eggs (Dry Form)
  - –Fertile eggs (12 days)
  - –Virus injected into chorioallantoic membrane
  - –3 day incubation
  - –Membranes harvested (5x108viruses/egg)*
  - –Remove undesirable solids/concentrate
  - –Stabilize and freeze dry



3. <u>Cell or tissue cultures</u> (living).

- **First, this method was used:**

  1. Using blood clots, after separating plasma. The virus is then injected into a mixture of blood plasma and some tissues.

  2. The mixture is filtered to obtain pure *Viruses*.

  • <u>Advantages</u>:

  1. Obtaining a large quantity of pure identifiable *Viruses*.

  2. It can be used for commercial production of *Viruses* and Vaccines.

  3. It avoids the complications caused by the Embryonated Inoculation method.

- **Now, the most used method is the one where a single type of cell tissue is used and it consists of:**

  1. Nutritive media prepared to grow the cell tissue (*i.e.* Terrod's solution).

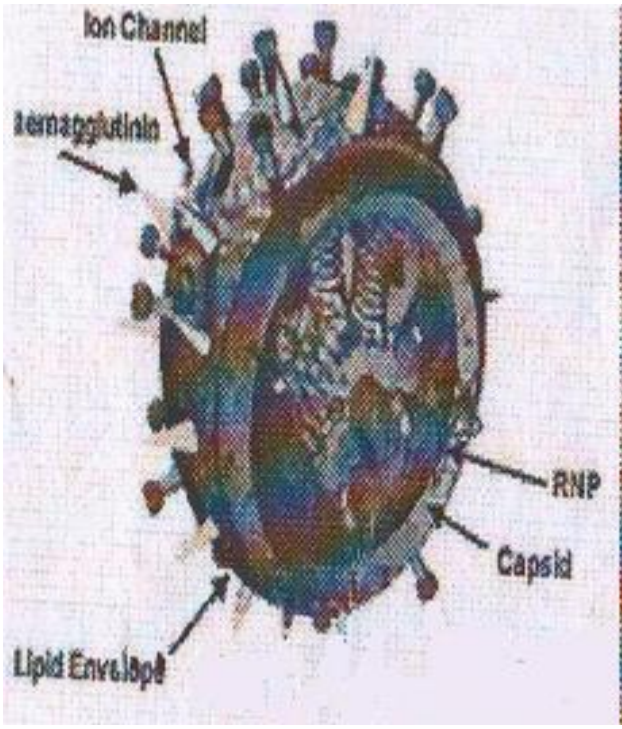
  2. Living tissue susceptible for viral infection (skin, kidney, liver or plants).

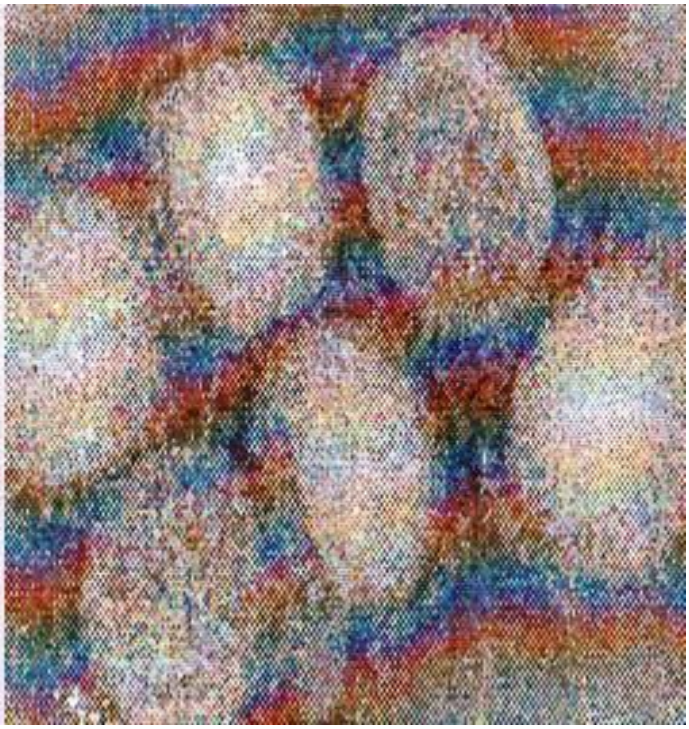
  3. Viral inoculum (infected tissues or blood).

  4. Antibiotics (to get rid of bacterial or fungal growth).

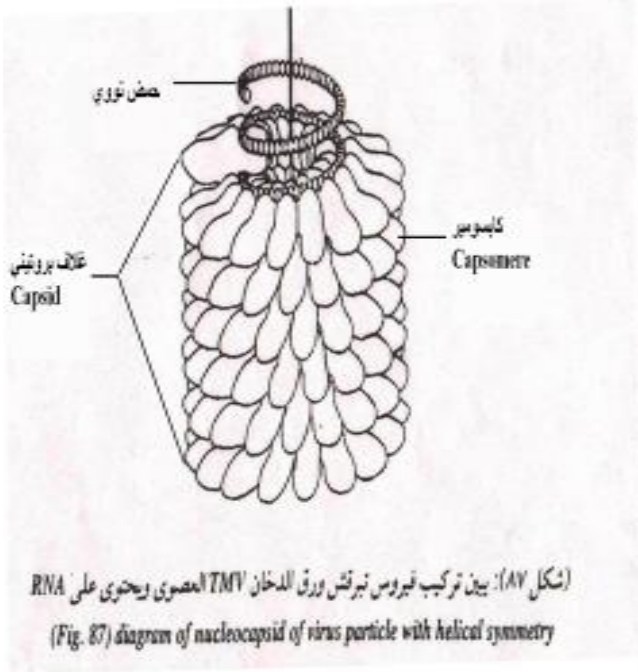
- **Forms and Sizes of Viruses:**

Spherical: The diameter of which ranges between 17-400 µm



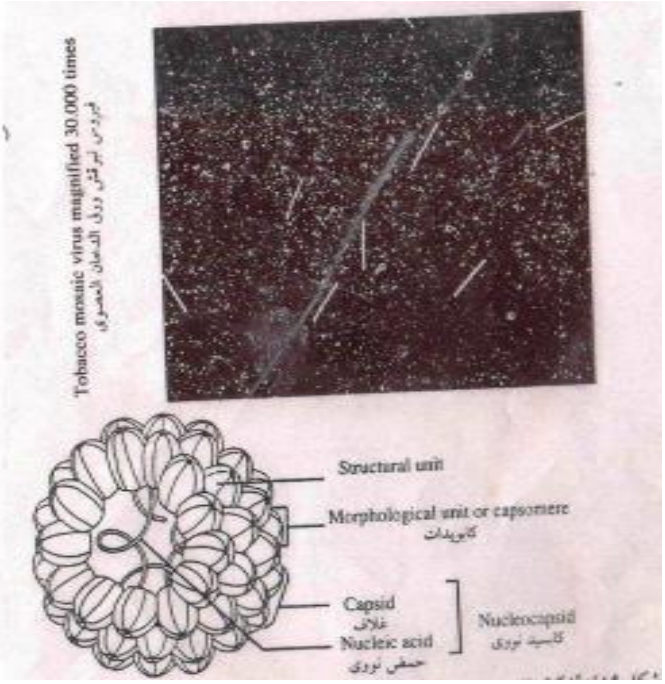


2. Rod – shaped: 15 X 300µm

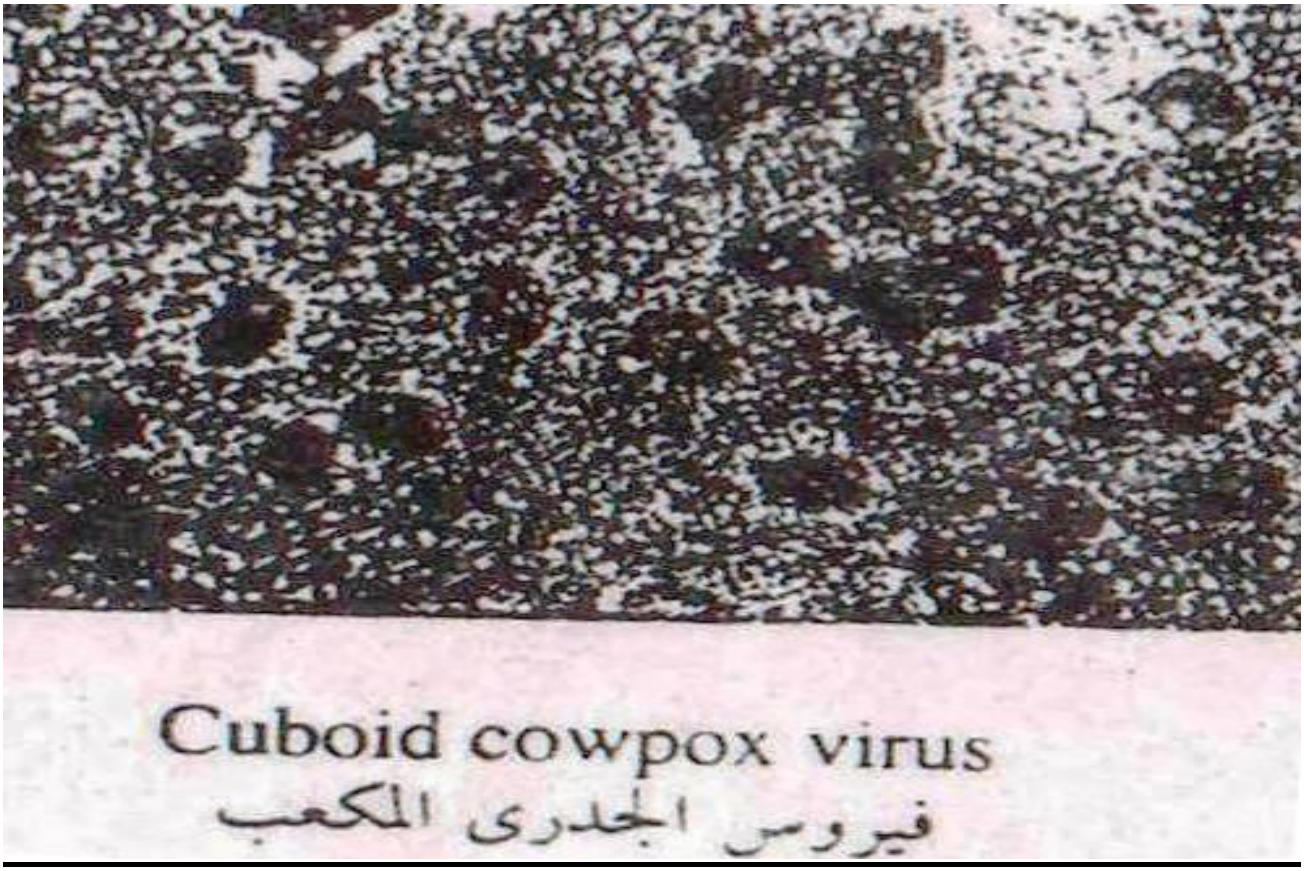


(شكل AV): بين تركيب فيروس تبرقش ورق الدخان TMV المصوى ويحتوى على RNA

(Fig. 87) diagram of nucleocapsid of virus particle with helical symmetry

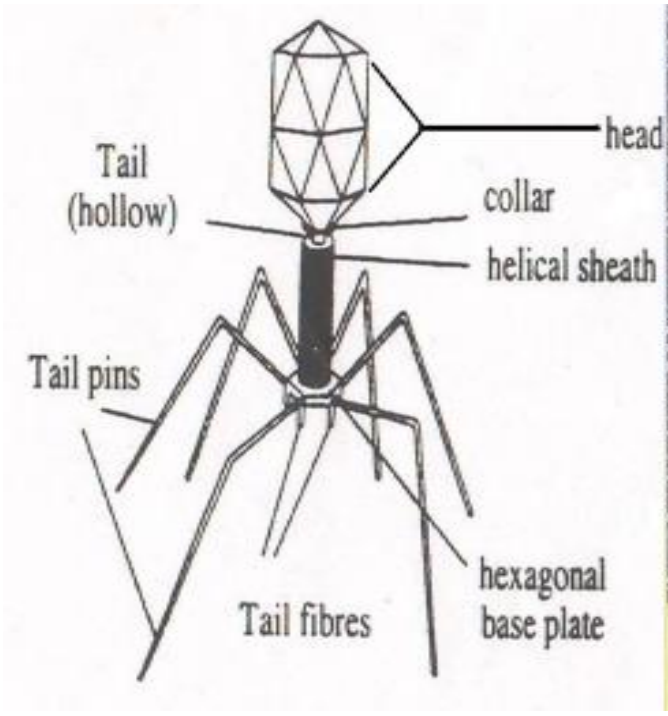


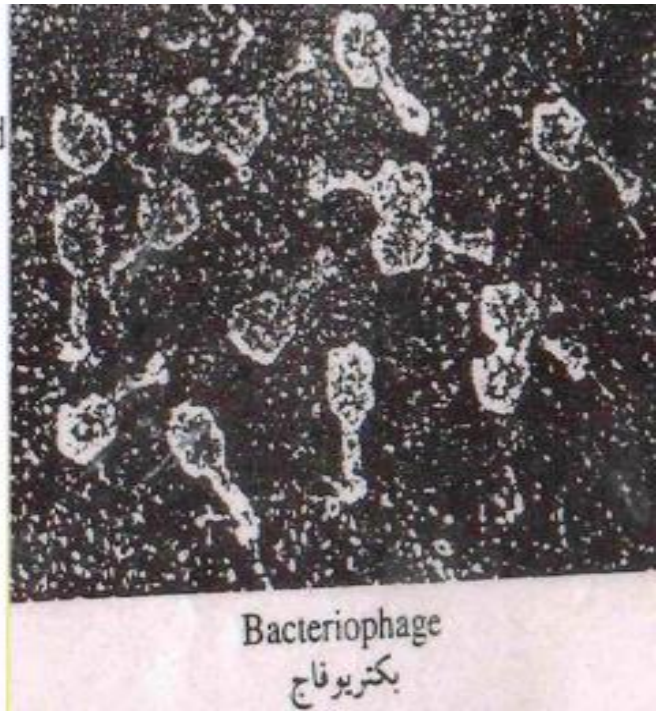
3.Cupoid: 200 X 300µm



Cuboid cowpox virus
فيروس الجدرى المكعب

4. Spermatozoid: 10 X 225µm





Bacteriophage
بكتريوفاج

- **Viruses, Viroids and Prions:**

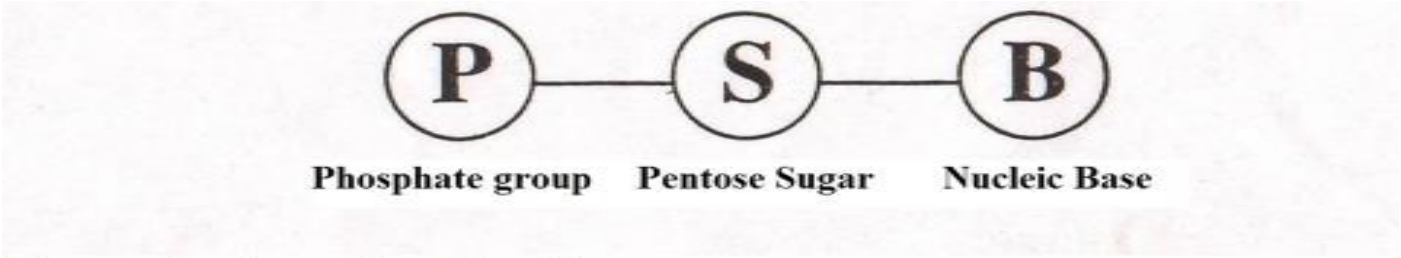
  Virus: consists of a protein coat and nucleic acid.

  Viroid: consists of nucleic acid only.

  Prions: consists of a protein coat only.

- **Chemical structure of Viruses:**
- **Simple Types;consists chemically of a nucleic acid core (DNA or RNA) surrounded by an outer protein coating or capsid. They are not united, but separated. e.g. TMV.**
- **Some complicated forms; beside protein and nucleic acid, they may contain phospholipids, carbohydrates, some minerals and vitamin like compounds e.g. Cowpox and Swine flu.**
  - **The protein coat (capsid) is made up of small units called capsomeres. Its main role is the protection of the viral nucleic acid against cell enzymes.**
  - **The protein coat never takes part in the infection process, only the nucleic acid is involved in the cell infection.**

1. **Nucleic acid Structure:**



There are two types of nucleic acids:

1. RiboNucleic Acid (RNA): It is composed of Ribose sugar (R), Nucleotide bases Adenine (A), Guanine (G), Cytosine (C), Uracil (U).

2. DeoxyriboNucleic Acid (DNA): It is composed of Deoxyribose sugar (D), Nucleotide bases Adenine (A), Guanine (G), Cytosine (C), Thymine (T).

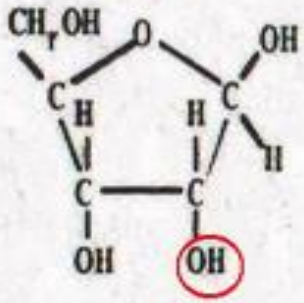
Chemical structure of Viruses

1. Nucleic acid Structure

Pentose Sugar (S)

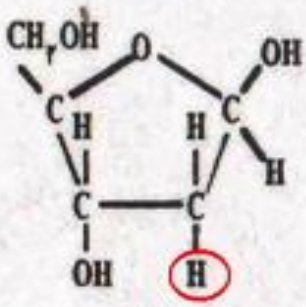
RNA

DNA



Ribose

ريبوز



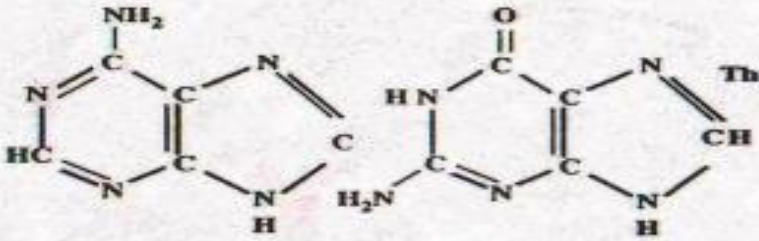
Deoxyribose

سكر ديوكسيريبوز خماسي

Chemical structure of Viruses

1. Nucleic acid Structure

Nucleic Bases



Adenine

أدينين

Guanine

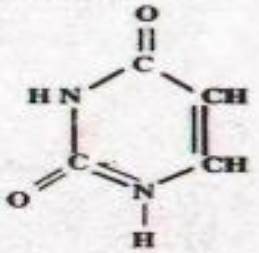
جوانين

The purine bases: Adenine (A) and Guanine (G)

قاعدة بيوريون

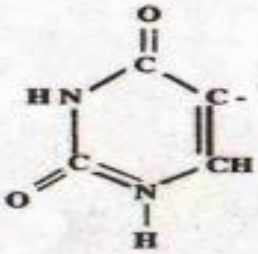
The pyrimidine bases: Uracil (U) , thymine (T) and Cytosine (C)

قاعدة بيريميدين



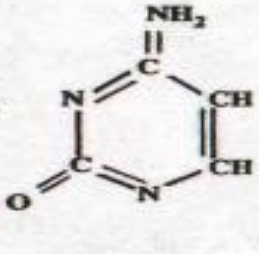
Uracil(U)

يوراسيل



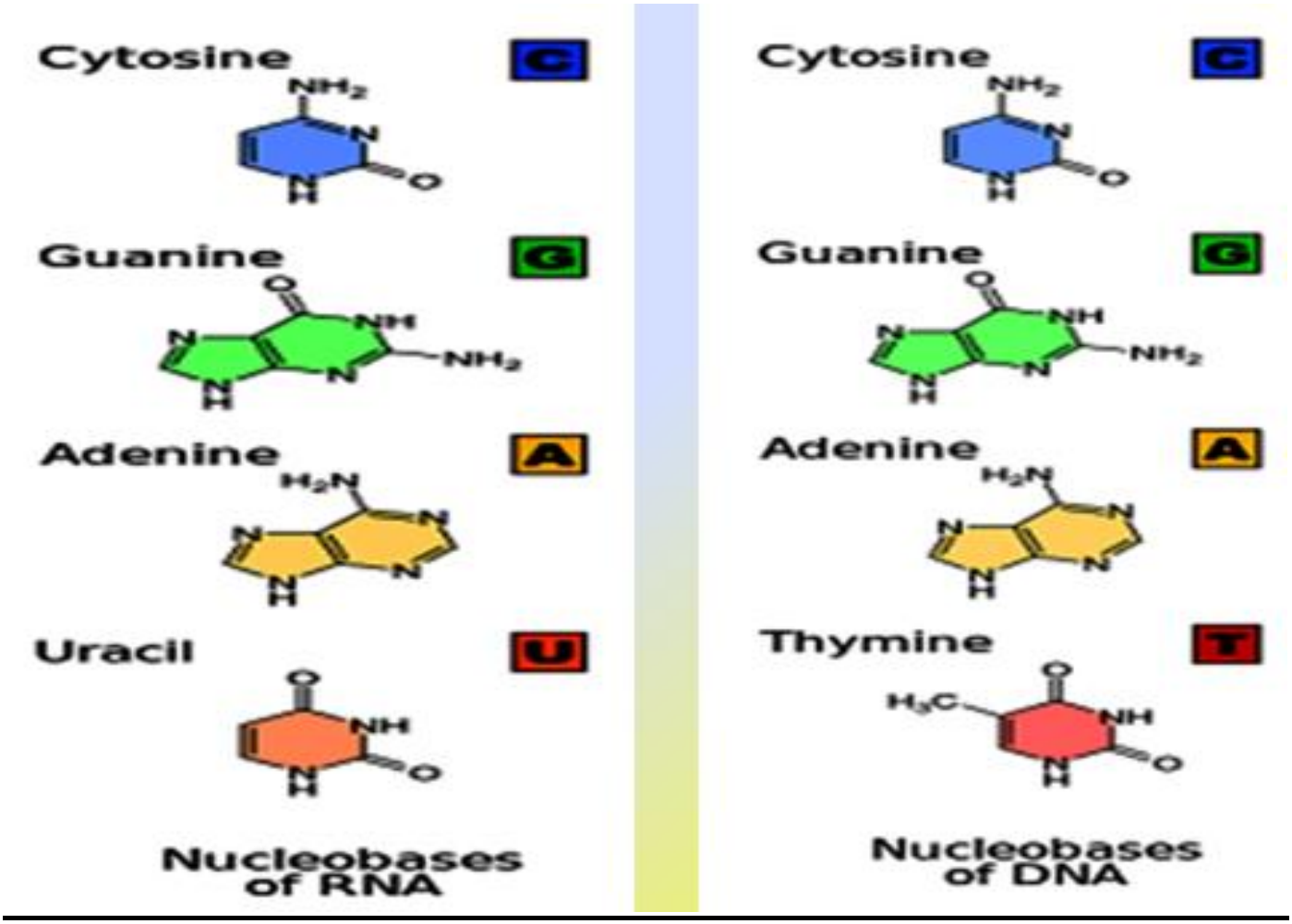
Thymine(T)

ثيمين



Cytosine(C)

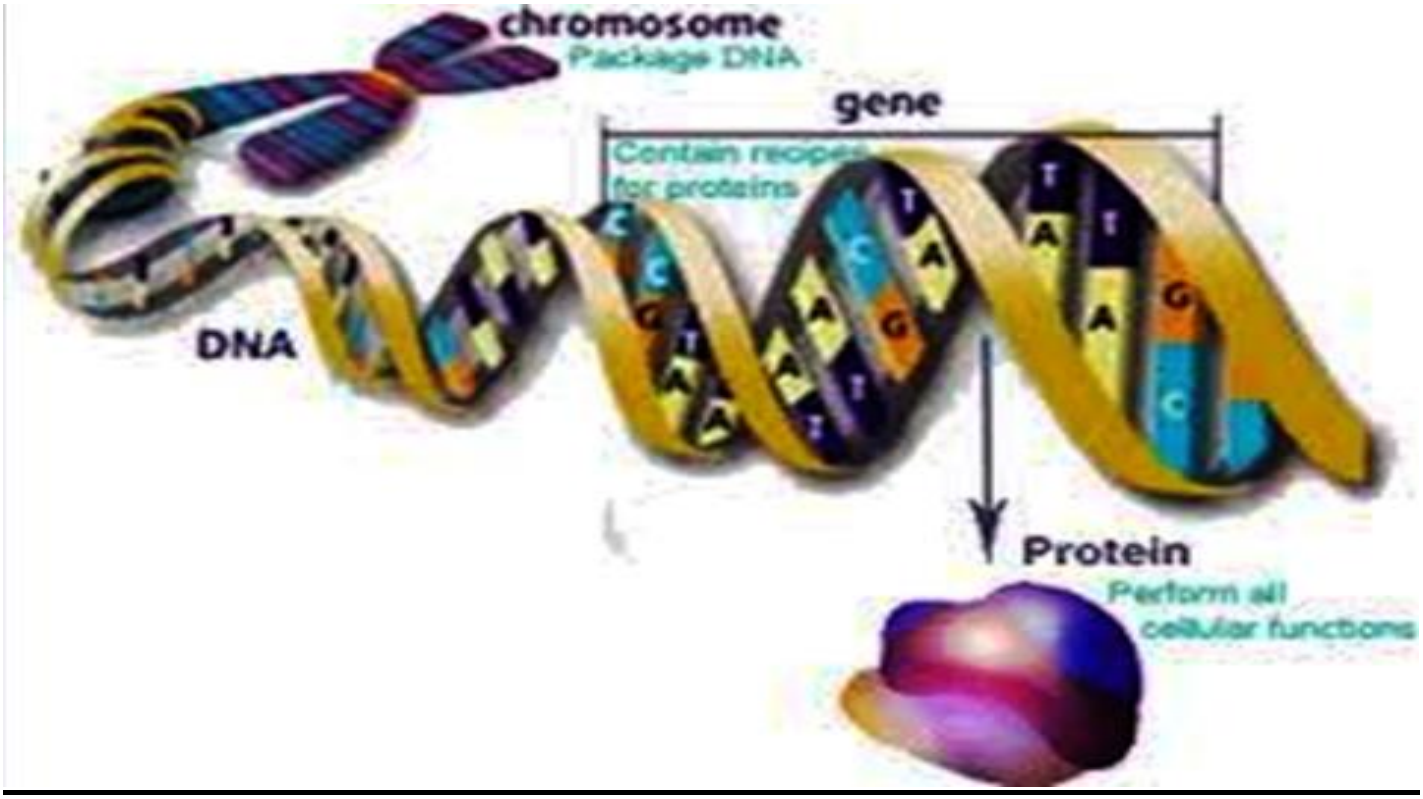
سيتوزين

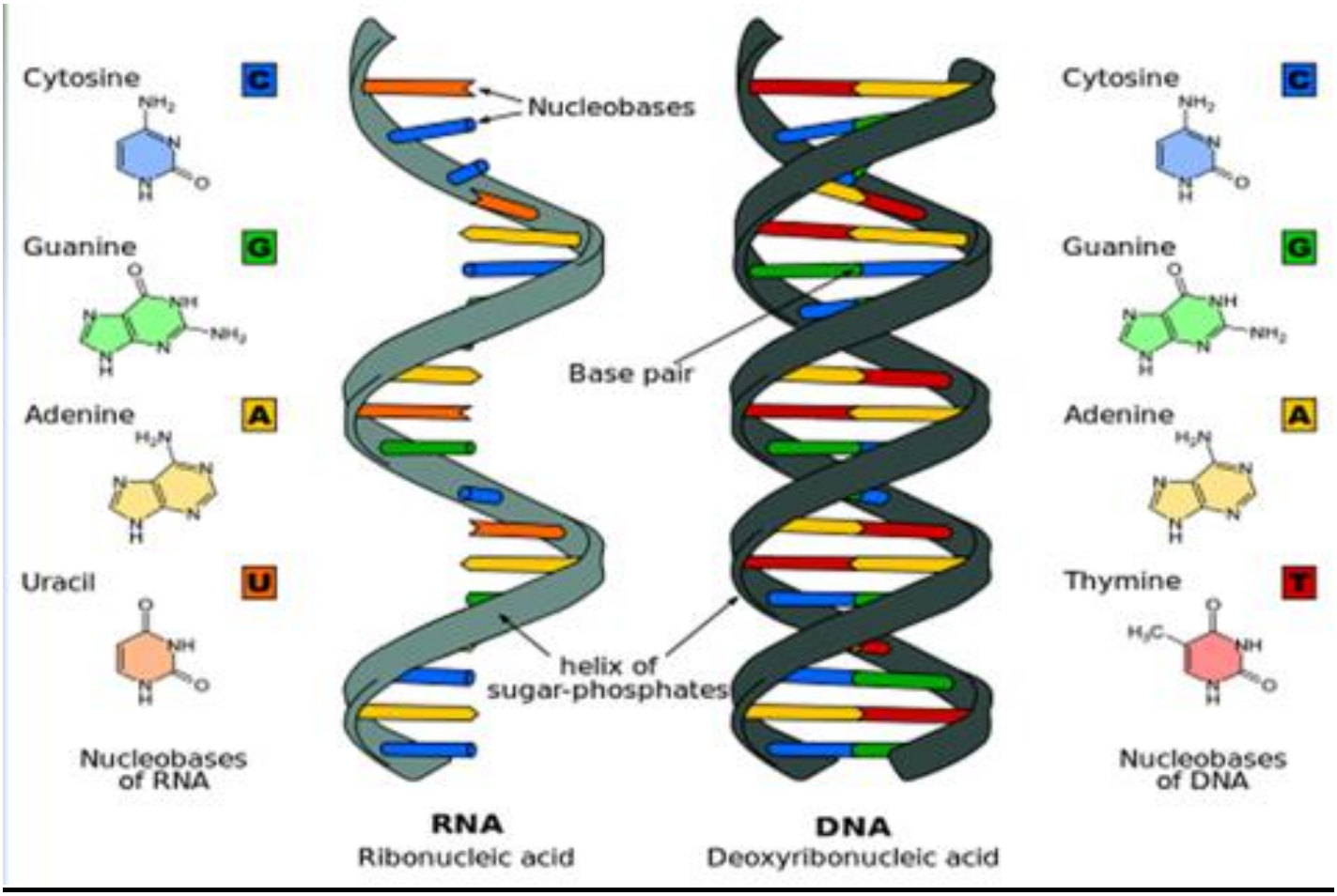


- **<u>Characteristic Features of DNA and RNA:</u>**
  1. **DNA is a double stranded molecule consisting of a long chain of nucleotides which are base-paired by hydrogen bonding. They are either a long (Purine Base) of A and G or a short (Pyridine base) of T and C. It is always either A-T or G-C.**
  2. **Each strand complements the other.**
  3. **The nucleic acid is found and formed in the nucleus.**
  4. **The Genetic profiling: is the process of determining an individual's DNA which are as unique fingerprints.**
  5. **RNA is built from DNA through the split of the two helix and the replacement of "Thymine" into "Uracil".**

Table 5.1. Difference between RNA and DNA

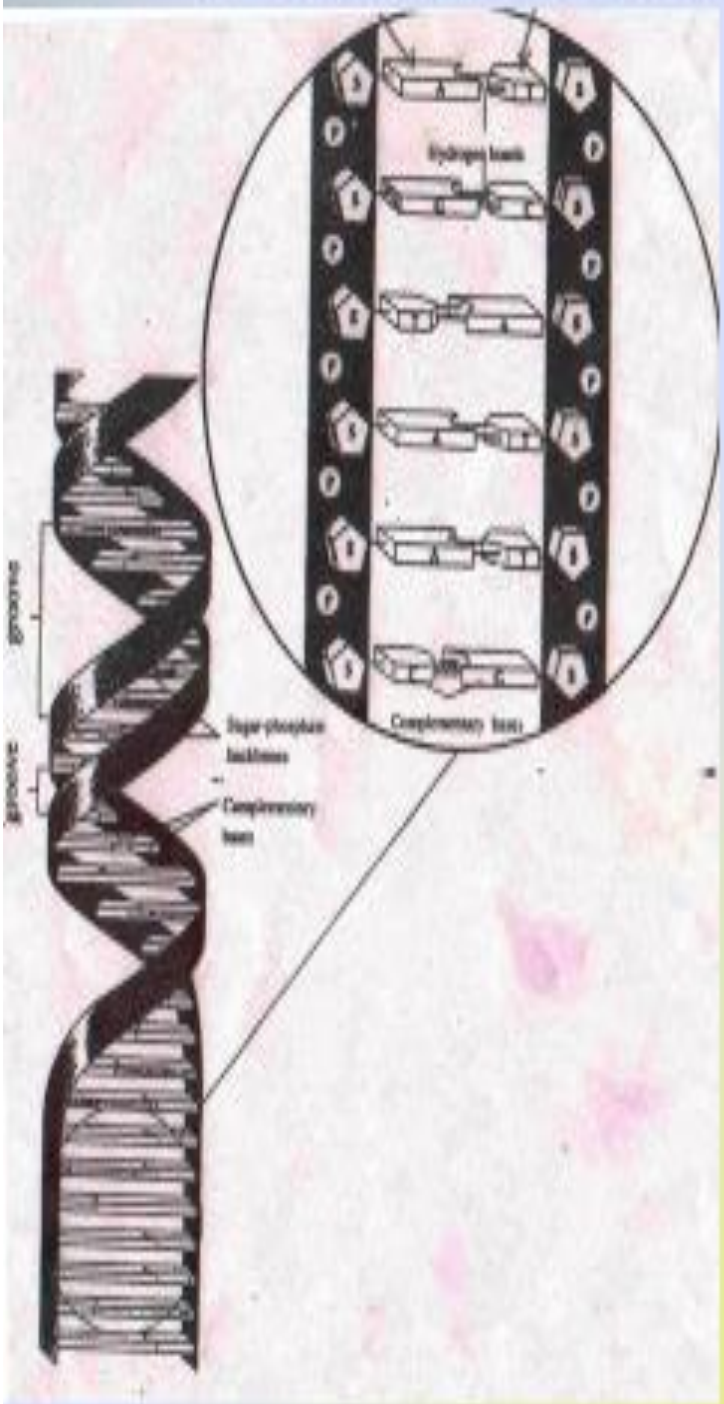
RNA	DNA
RNA is single stranded except in some viruses	DNA is double stranded except in few viruses
RNA have ribose sugar	DNA have deoxyribose sugar
Bases present are adenine, guanine, cytosine and uracil.	Bases present are adenine, guanine, cytosine and thymine.
Adenine pairs with uracil	Adenine pairs with thymine
Purine is not equal to pyrimidine	Purine is equal to pyrimidine (Chargaff's rule)
Regions having complementary nucleotides, pairs, and form hair pin loop like structure and helical.	Complementary nucleotides are present throughout the length of the DNA.
RNA is genetic material in some viruses.	DNA is the genetic material in all living organisms.
Length of RNA is short consisting of only few thousands nucleotides.	Length of DNA is quite large consisting of millions of nucleotides.
Three types of RNA are present in an organism: mRNA, rRNA, tRNA.	DNA occurs only in one form in an organism.
mRNA occurs in nucleolus, rRNA and tRNA occur in cytoplasm.	DNA occurs in nucleus, nucleolus, and extrachromosomal DNA in mitochondria and chloroplast.

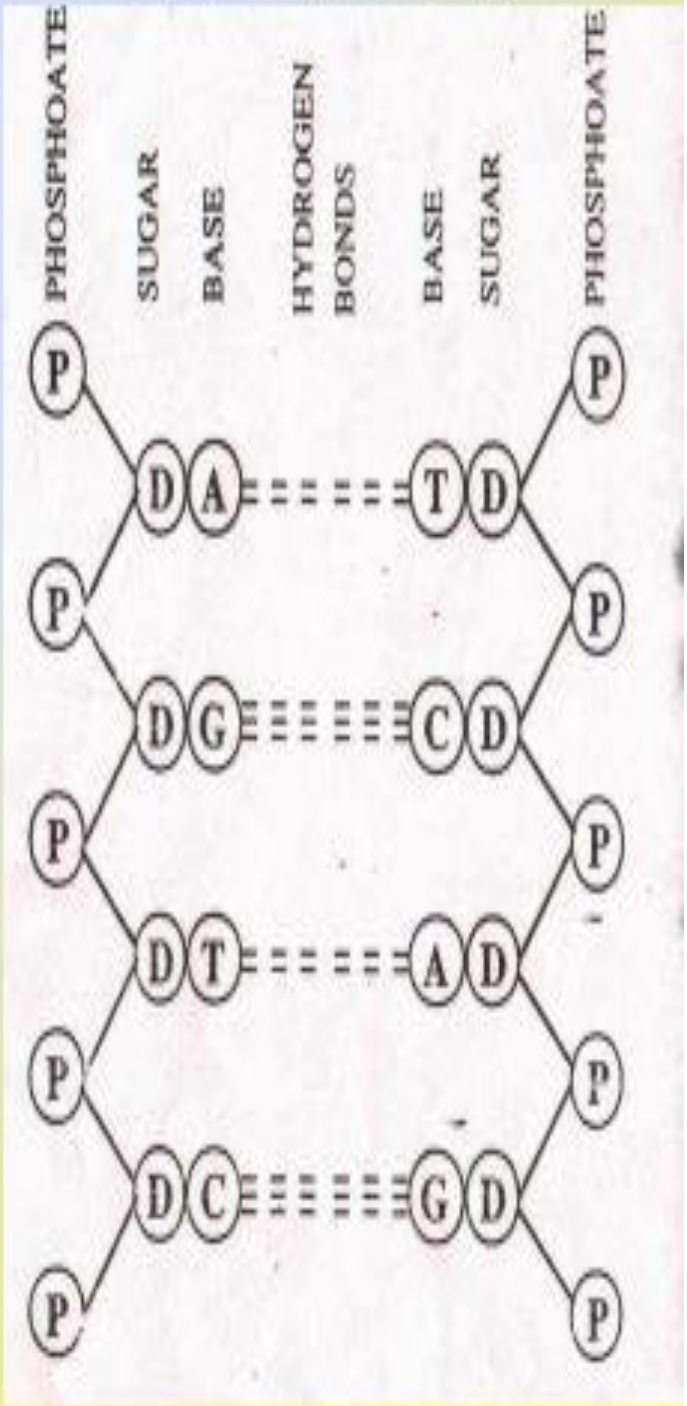

chromosome
Package DNA
gene
Contain recipe for proteins
DNA
Protein
Perform all cellular functions


Cytosine
C
Guanine
G
Adenine
A
Uracil
U
Nucleobases of RNA
Nucleobases
Base pair
helix of sugar-phosphates
RNA
Ribonucleic acid
DNA
Deoxyribonucleic acid
Cytosine
C
Guanine
G
Adenine
A
Thymine
T
Nucleobases of DNA

Nucleic Acid Structure

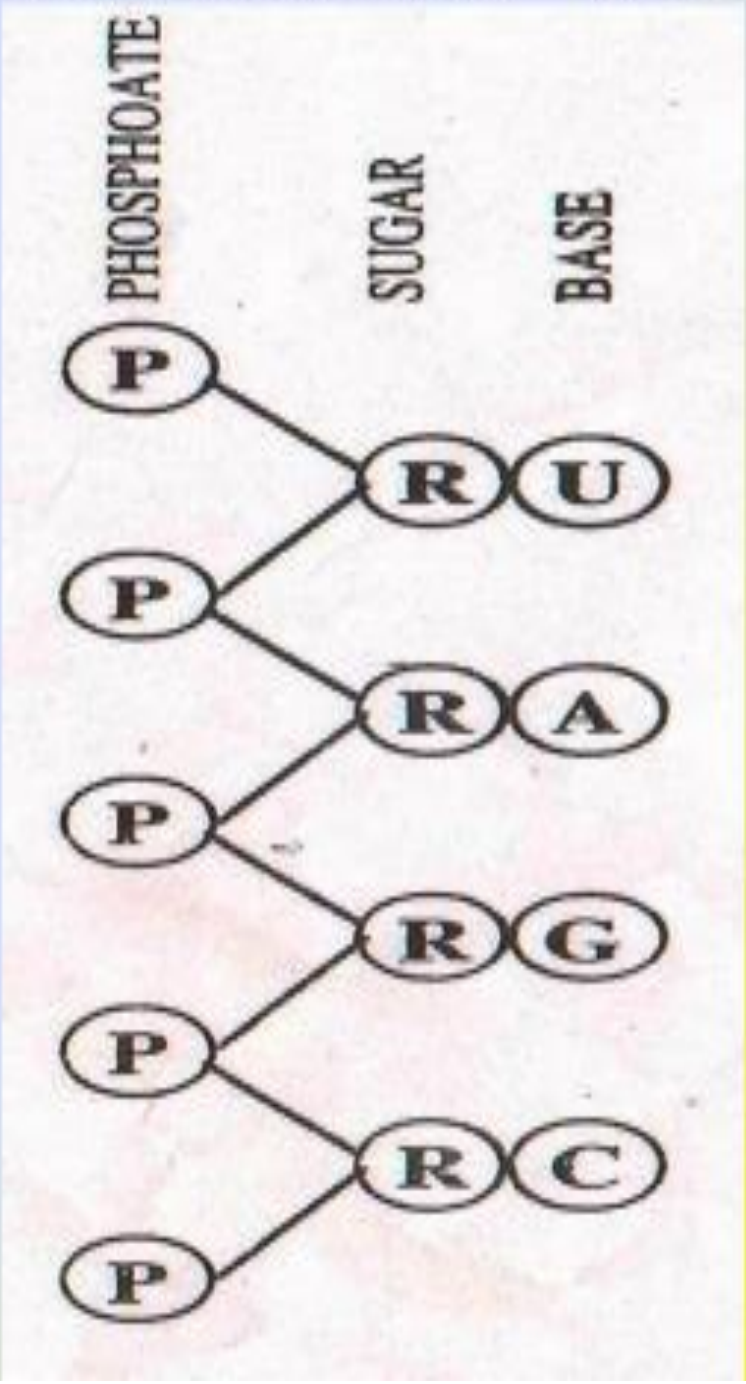
DeoxyriboNucleic Acid (DNA)



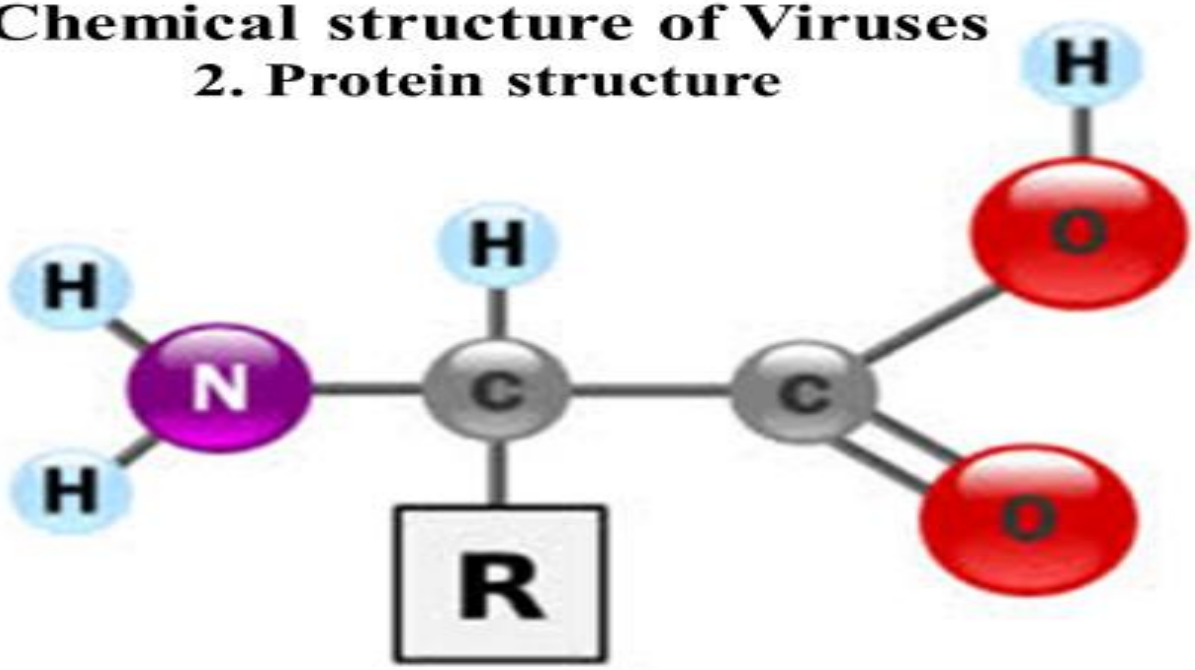


Nucleic Acid Structure

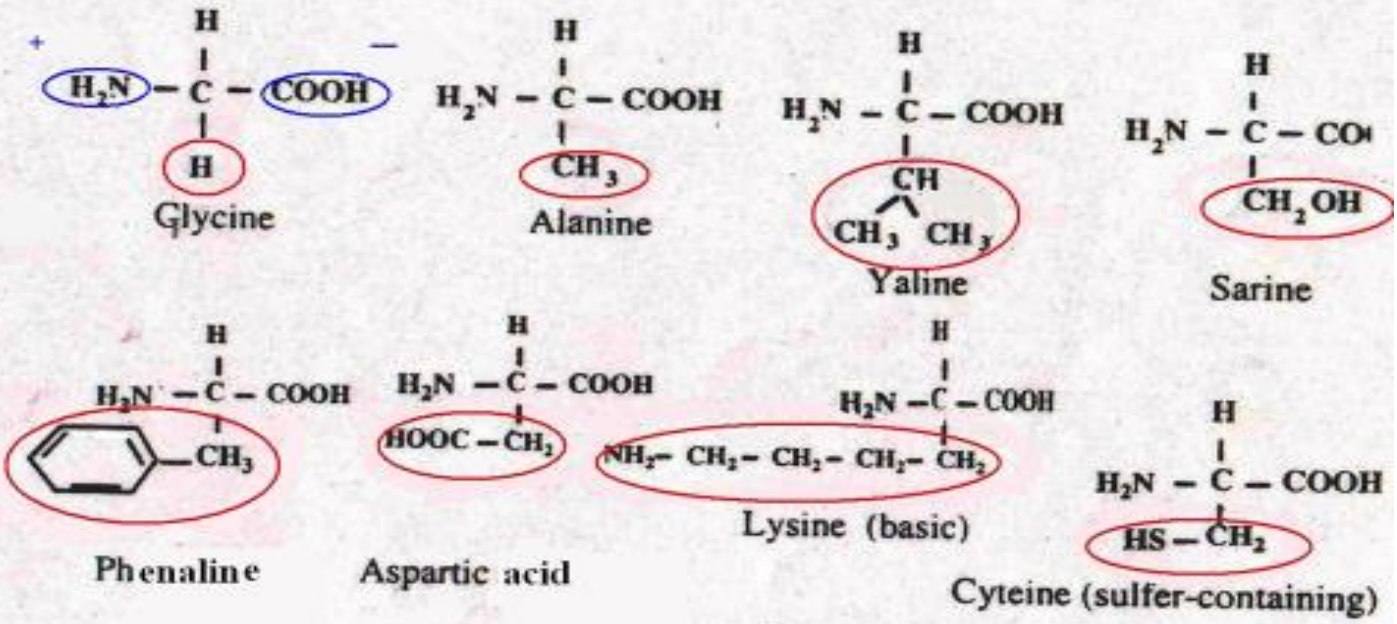
RiboNucleic Acid (RNA)



Chemical structure of Viruses
2. Protein structure



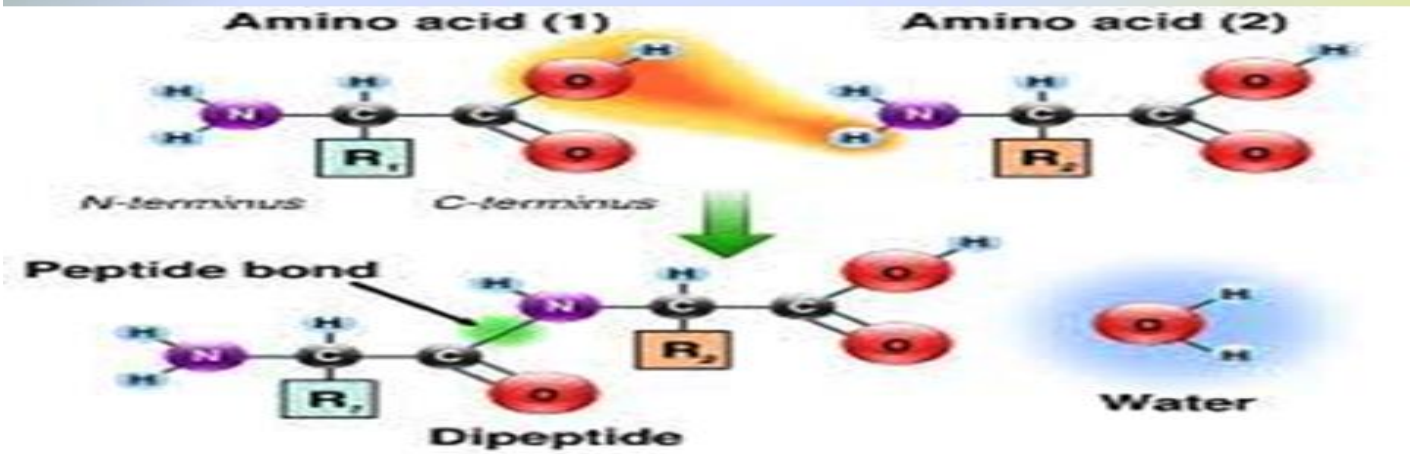
Chemical structure of Viruses
2. Protein structure



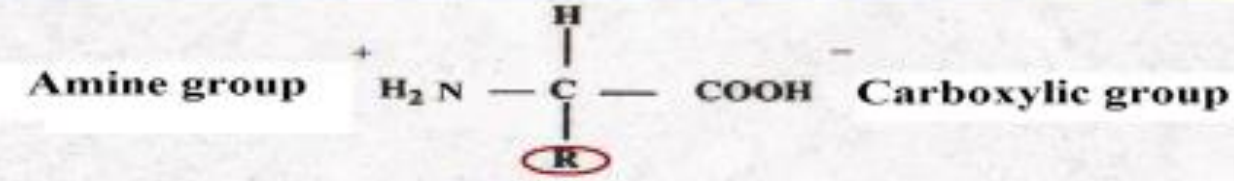
(شكل ٩١): بعض الأحماض الامينية

(Fig. 91) some amino acids

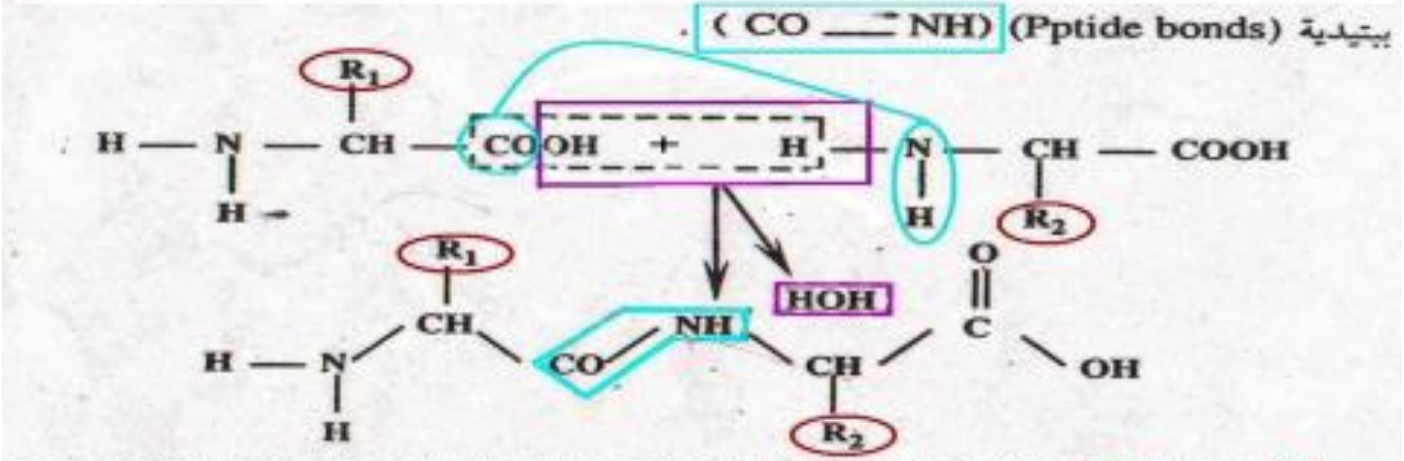
Chemical structure of Viruses
2. Protein structure



Chemical structure of Viruses
2. Protein structure



* The difference between the amino acids is due to the difference in the nature of the R group.
* The protein part consists of many amino acids connected together by a "Peptide Bond".



A protein molecule consists of a chain of amino acids with different R groups (R1, R2, R3, etc...), This chain ends with an AMINE group from one end and a CARBOXYLIC group from the other end.

- **Interferon:**
  - **A group of signaling proteins, similar to Hemoglobin in size.**
  - **Interferon is released in large amounts by the cell infected with virus to resist any upcoming infection attacks.**
  - **The importance of interferon in curing the infected organism is due of being released in large amounts before the formation of antibodies.**

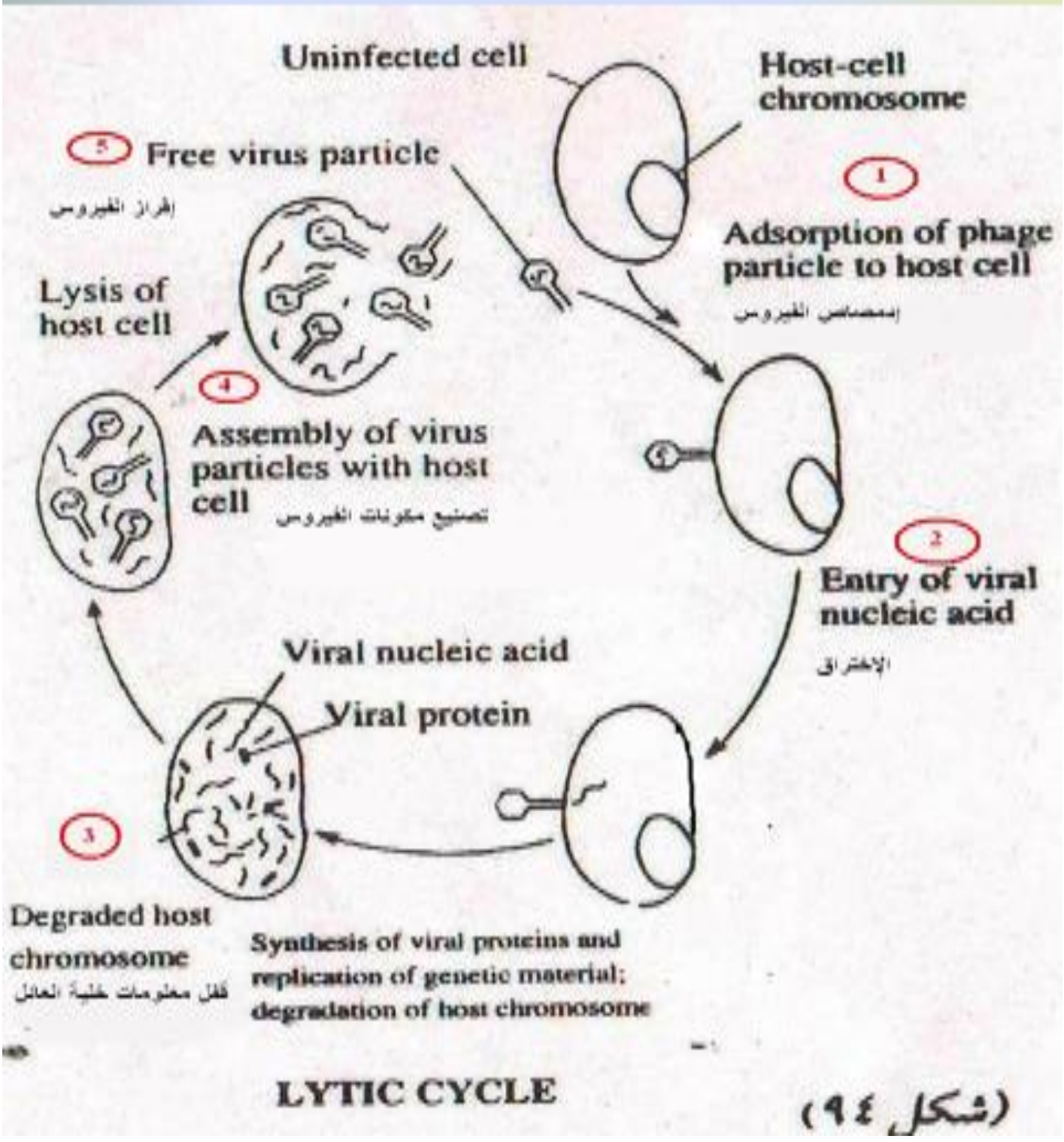
- **Replication of Viruses:**

1. **Viral Adsorption: 10 – 60 min.**
2. **Entry: There are two opinions:**
   a. **The First: The whole virus gets inside the cell.**
   b. **The Second: Only the nucleic acid penetrates the cell leaving the protein outside the cell.**
3. **Deleting the cell formation and taking control of the host cell's.**
4. **Replication where many copies of the virus are made by the host cell's. this only takes hours where viral nucleic acids and proteins are made.**
5. **Viral shedding where viruses are released out of the cell infecting another new cell.**

- **Bacteriophages:**

1. **They were discovered by Twort & D'Herelle in 1917 where they recorded a dramatic account of a man suffering from dysentery who was restored to good health by bacteriophages.**
2. **It is also known as "Phage", is a virus that infects and replicates within bacteria.**
3. **They have been used as an alternative of antibiotics, as they are seen as a possible therapy against multi-drug resistant strains of bacteria.**
4. **It can be cultivated in liquid or solid bacterial cultures by clearing the turbidity of the bacterial cultures by lysis.**
5. **Phage replication is similar to viral replication.**

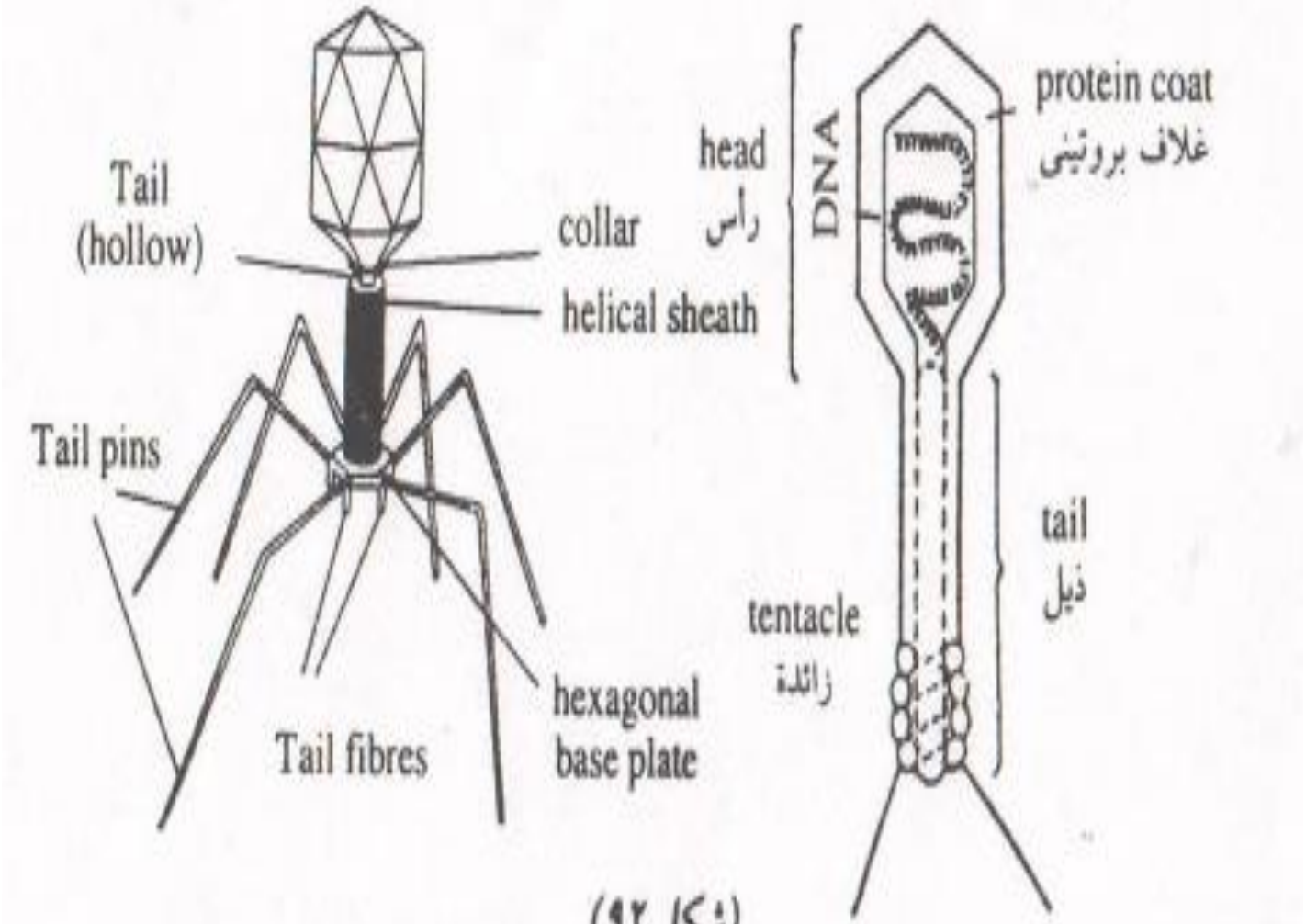
Replication of Viruses



LYTIC CYCLE

(شكل ٩٤)

Bacteriophage Structure



(شكل ٩٢)

رسم يبين تركيب فاج T_4 الذى ينتمى لمجموعة
الفاجات ذات الذيل المنقبض

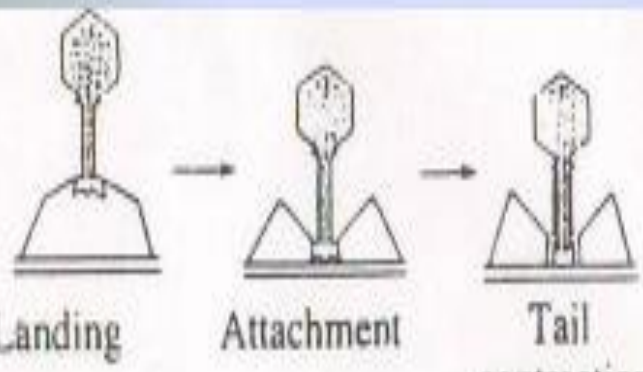
رسم يبين تركيب الفاج

A closer look at phage T4

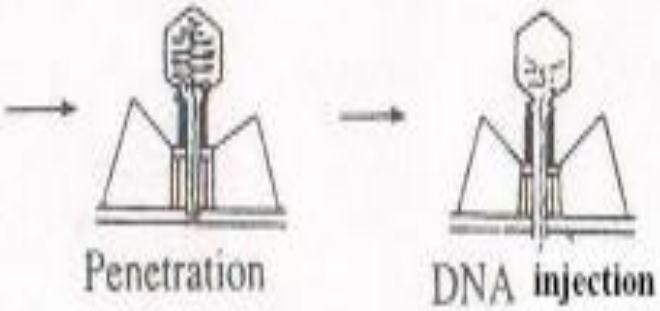
This phage belongs to the group that has contractile tails

Diagram of the structure of a phage

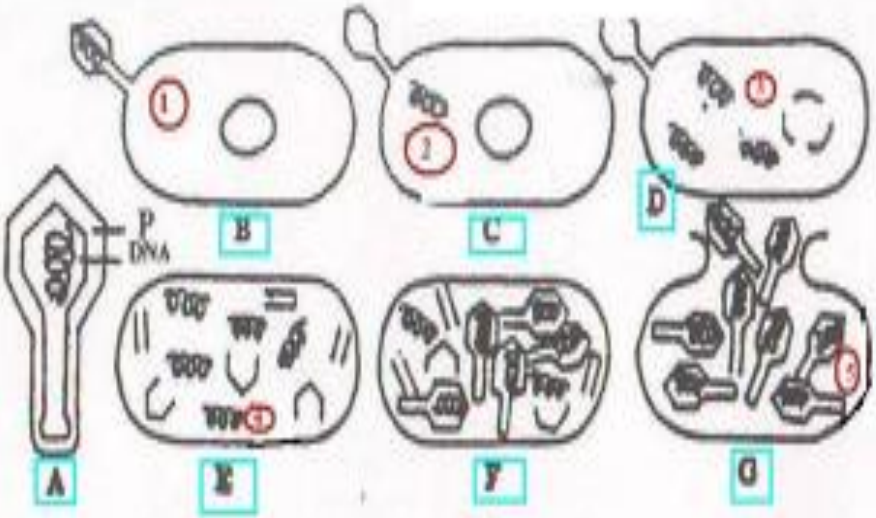
Bacteriophage Replication



Adsorption and penetration by phage T

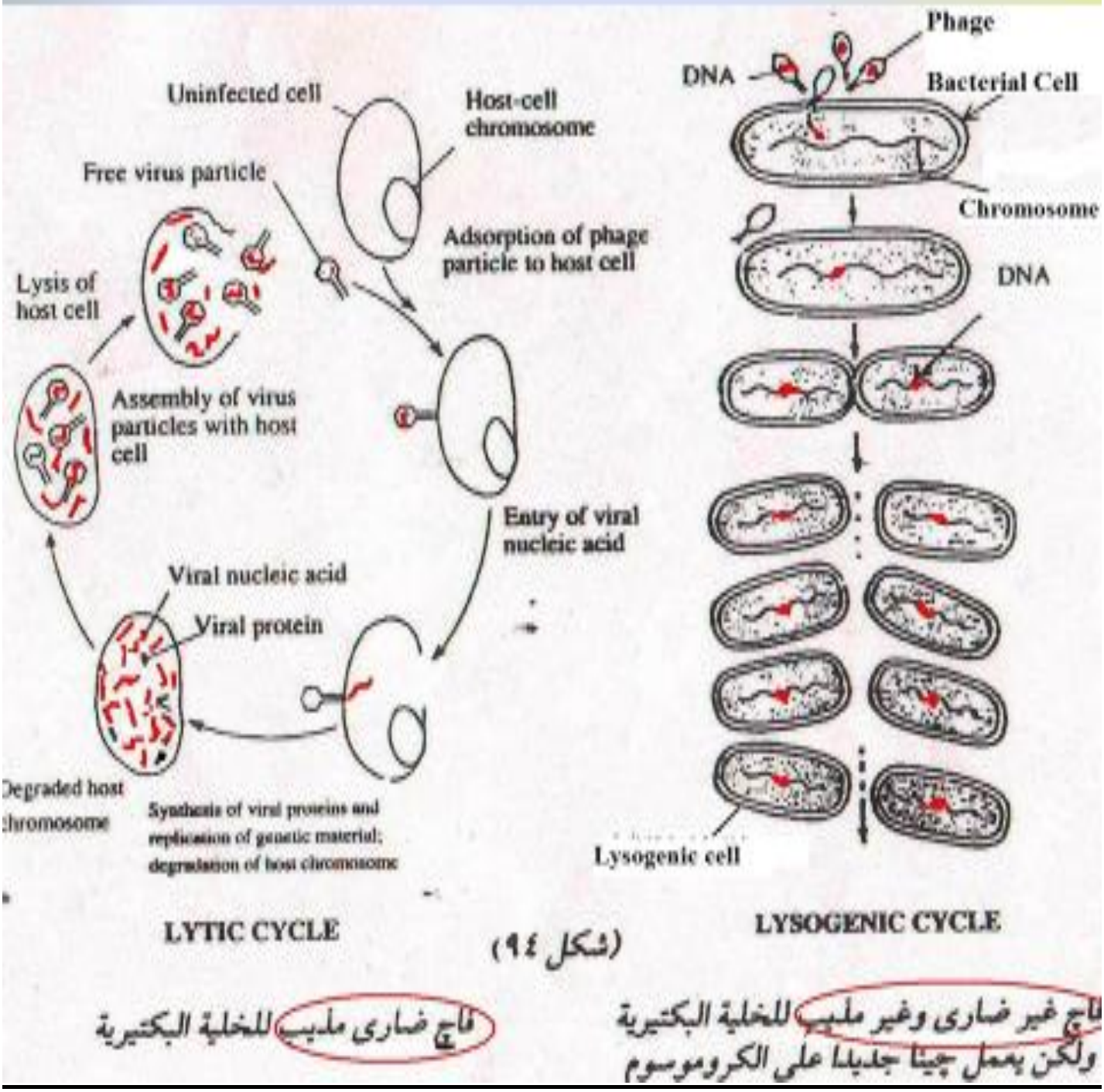


Mechanism of phage infection (Reproduction)



Bacteriophage: A, a virus particle showing its structure and composition (P, protein; DNA, deoxyribonucleic acid); B-G, stages showing how a bacteriophage infects a bacterial cell, destroys the bacterial chromosome (shown here diagrammatically as an oval body), and replicates itself.

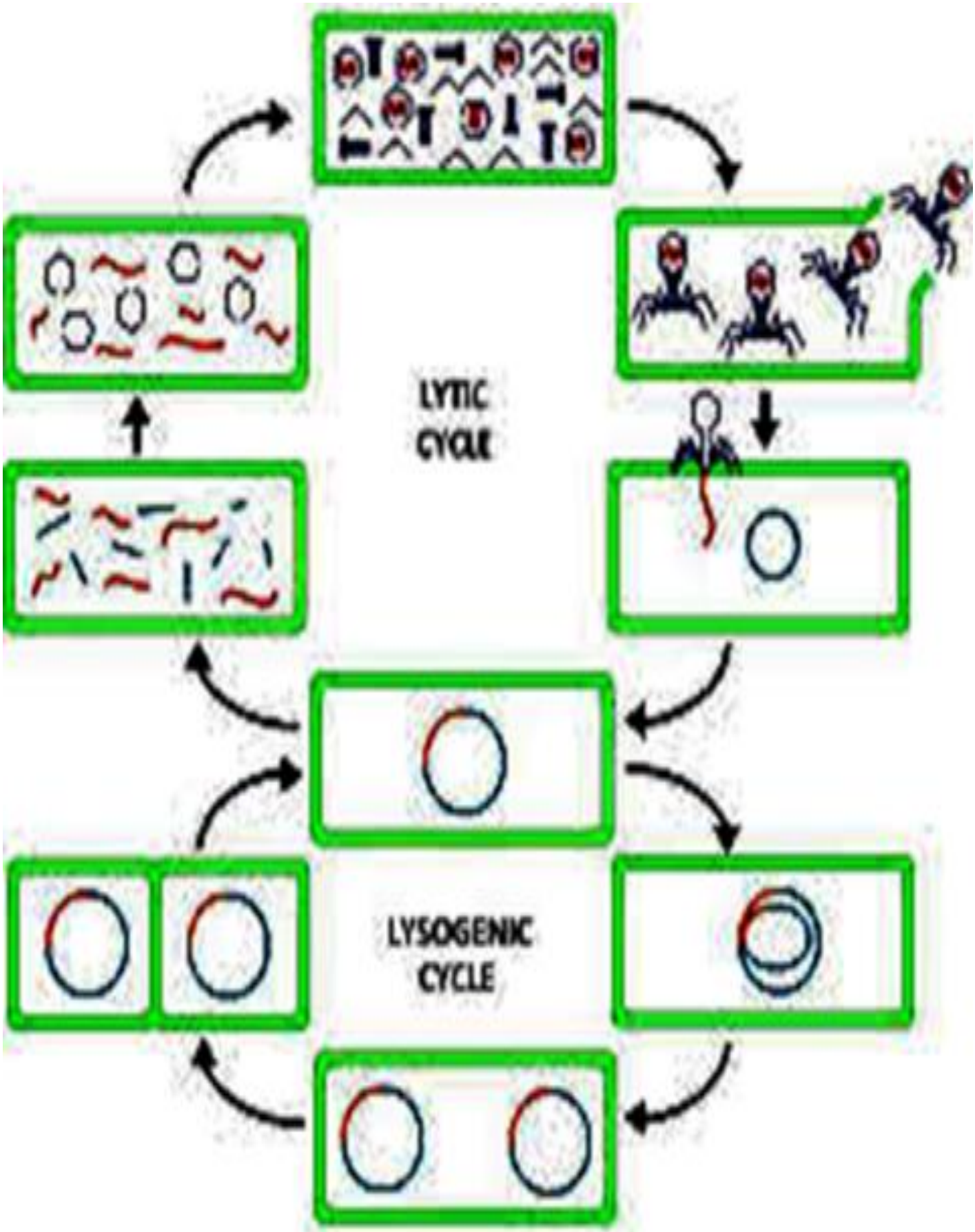
Bacteriophage Replication
Lytic and Lysogenic Cycles



(شكل ٩٤)

فاج ضارى مذيب للخلية البكتيرية

فاج غير ضارى وغير مذيب للخلية البكتيرية
ولكن يعمل جينا جديدا على الكروموسوم


LYTIC
CYCLE
LYSOGENIC
CYCLE

Bacteriophage Replication

- **Lytic and Lysogenic Cycles**

1. **Bacteriophages may have a Lytic Cycle or a Lysogenic Cycle and a few viruses are capable of both.**
2. **Lytic Cycle: Bacterial cells are broken open (lysed) and destroyed after immediate replication of the virion (Virulent). As soon as the cell is destroyed, the phage progeny can find the new hosts to infect.**
3. **Lysogenic Cycle: It doesn't result in immediate lysing of the host cell. The viral genome will integrate with the host DNA forming a "Prophage" which replicate with it harmlessly "Temperate phage" (may establish a plasmid). The virus remains dormant until host condition deteriorate "Lysogenic Bacterial Cell", maybe due to nutrients depletion, then the phage becomes active again and is able to undergo "Lytic cycle".**
4. **Two phenomena were discovered according to that:**
   - **Transduction: Introducing a foreign DNA into a cell by a virus.**
   - **Phage or (Lysogenic) Conversion: Changing phage characteristic from Virulent to temperate phage or otherwise by the induction of a phage into a bacterium.**

The Role of Food in Resisting Disease

The Role of Food in Resisting Disease:

- **Fresh Vegetables and Fruits: They contain antioxidant *i.e.* carrot, cabbage, Broccoli, Garlic, red and yellow onion, pepper, spinach, tomato and Avocado. Anti-cancer.**
- **Whole cereals: They contain the necessary fibers for bowl movement and a healthy digestive system. Besides, they contain a lot of vitamins and minerals that strengthen the immune system and disease resistance. *i.e.* whole rice grain (brown rice), brown bread of whole wheat (7 grains: wheat, rice, oat, rye, Barley, amaranth and flaxseed).**
- **Nuts: Walnuts are one of the most healthy nuts as it has twice the amount of antioxidants compared to the other nuts.**
- **Honey: Natural honey is one of the best food enhancing body immunity against bacterial and viral diseases. Physicians assure that drinking one cup of warm water with a spoon of honey on daily basis can enhance and strengthen the immune system in the long run.**
- **Herbs: Nigella (black cumin) is one of the most healthy seeds, it is advised to have it crushed and taken with honey as a cough treatment. Also, Ginger and Thyme are known to have antibacterial and antiviral effects. Besides they have an analgesic effect that strengthen the immune system indirectly by reducing stress and negative emotions that cause immunosuppression.**
- **Oriental spices: They play an important role in preventing diseases and strengthening the immune system *i.e.* Cumin, Clove, Turmeric, black pepper and sea salt. As well as organic apple cider vinegar and lemon juice to enhance the immune system. Nutritionists warn about the use of bouillon cubes (stock) and any other synthesized spices as they contain harmful preservative materials.**
- **Green tea and natural drinks: Green tea contains many antioxidants, also fennel, thyme, chamomile, ginger, hibiscus, cinnamon and mint.**

- **Dates: they contain many important vitamins and minerals that are anti-aging, soothing, anti-anxiety and diuretic. It helps cleaning the liver from toxins and activates the cardiovascular system.**
- **Garlic: it can revitalize the immune system as it is one of the most powerful antibiotics. Garlic is known to possess at least 400 chemical components that are known to be antioxidants.**
- **Olive oil: Beside Salmon fish, olive oil contains Omega 3 which prevent cardiovascular diseases. Olive oil enhances the formation of (High Density lipoprotein) HDL which is useful to the body. Also, it helps getting rid of (Low Density lipoprotein) LDL which is harmful to the body.**
- **Flex seeds: Flex oil contains Phytoestrogen which prevents breast, skin and lung cancer.**
- **Leafy dark-green vegetables: as lettuce and Swiss chard, it is rich in carotenoids which are antioxidant. They are able to get rid of free radicles produced by the body causing cancer. They are also rich in folic acid and vitamin "A" which play a role in preventing lung and breast cancer.**
- **Alfa biotech: It activates body functions to stop the oxidation of Vitamin "C" and neutralize free radicles produced by the body. It is found in lentil, broccoli, onion and garlic.**
- **Proanthocyanidins (OPCs): It contains bioactive and bioavailable polyphenols that get rid of free radicles and maintain cells and tissues healthy as it induces defense mechanisms. *i.e.* grapes, cranberries, strawberries and berries.**
- **Glutathion:It protects the heart, brain, kidneys against environmental toxins. *i.e.* bananas and soybean.**
- ***Ginkgo biloba*: It is extracted from *Ginko* herbs as it activates blood circulation and increases the flow of oxygen to the heart, brain, lungs**

and muscles so lift and enhance the performance of the immune system to resist different types of cancer *i.e.* Lung and bladder cancer.

- **Zinc: One of the most needed minerals and antioxidants necessary to maintain the level of vitamin ”H” (Biotin) in the blood as well as strengthening the immune system against cancer. It is found in <u>red meats, nuts, eggs, oysters, dairy products and cereals</u>.**
- **Desmbutaz: One of the important antioxidants necessary to activates the cells and revitalizes them. *i.e.* <u>wheat, barley, dark-green leaves and cabbage</u>.**
- **Selenium: One of the important antioxidant that gets rid of free radicles in the blood thus protecting the body from *Leukemia*. *i.e.* <u>mushrooms, beans specially lentil</u>.**
- **Beta-Carotene: It unites with Vitamin “A” activating the immune system destroying cancer cells. They are rich in Green and yellow fruits *i.e.* <u>oranges, lemon, kiwi, beside green vegetables as spinach, pepper, lettuce, tomato, potatoes, carrots and zucchini or squash.</u> It is worth mentioning that the more green and yellow the fruits and vegetables look the more it contains β carotene.**

Defensive Nutrients to Prevent Cancer Disease:

- **Vitamin "C": It is responsible for defending the body, protecting the spinal cord and the brain as well as cleansing the body from toxins. It collaborates with other antioxidants to prevent the oxidation of fats that causes the formation of tumours. One of its richest sources are guava, lemon, oranges and kiwis, besides other leafy green vegetables such as coriander, parsley, mint, radish and spinach in addition to other vegetables as all sorts of pepper, green kidney and goat bean.**
- **Melatonin: One of the most highly effective antioxidants as it can reach all types of cells and protect them against free radicles. Also, it plays an important role in protecting the cell nucleus by revitalizing and renewing its components to be able respond effectively to the orders of the immune system. Sweat corn, oat, tomato, barley, ginger and brown rice are one of the sources rich in Melatonin.**

Diet and Lifestyle

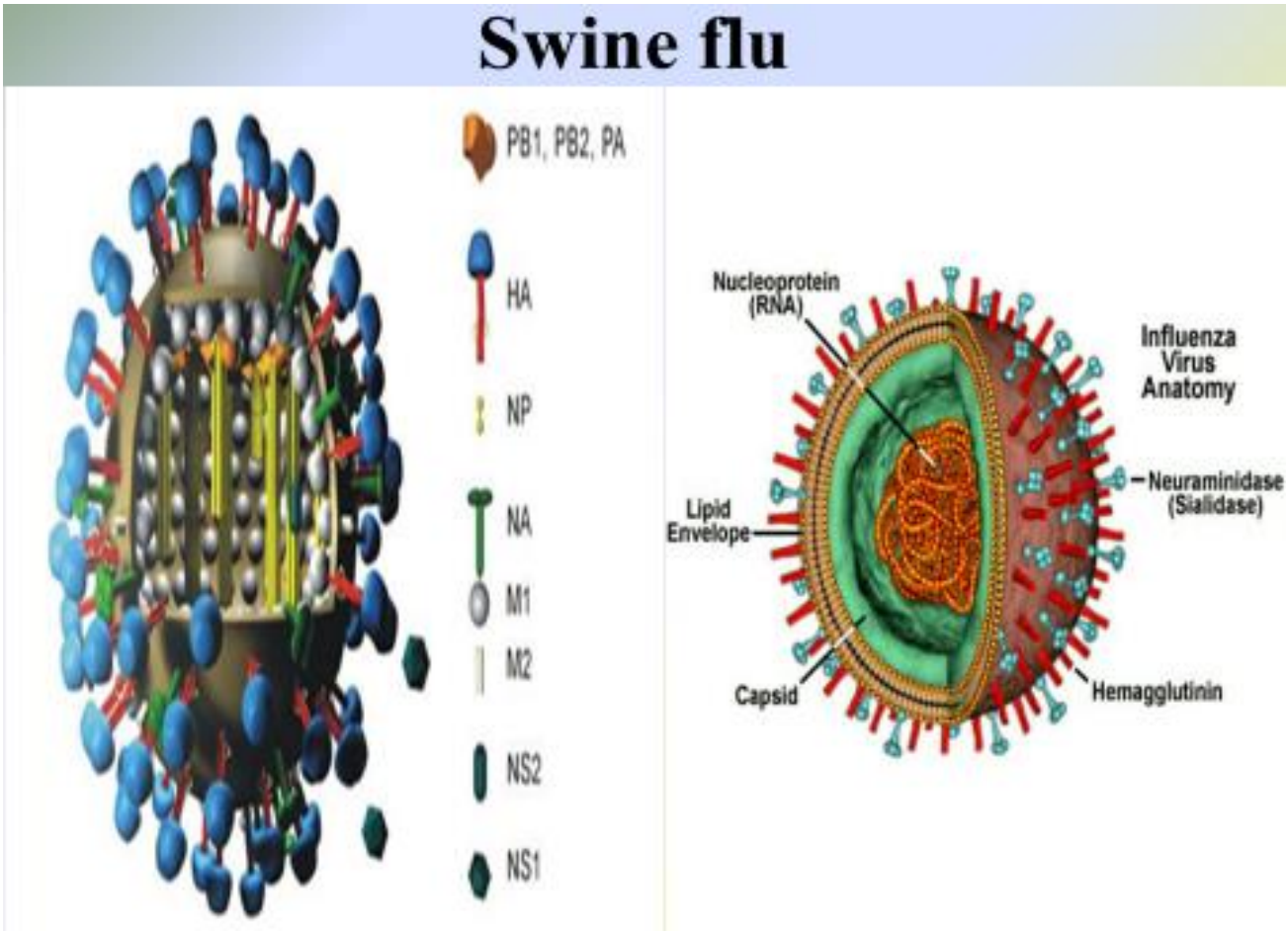
- **for Survivors, in 2007, The World Cancer Research Fund/ American Institute for Cancer Research (WCRF/AIRC) published a 2nd landmark report, Food, Nutrition and the Prevention of Cancer: a global perspective. A panel of expert scientists evaluated evidence collected on diet and cancer in the form of 20 systemic literature reviews specifically commissioned and compiled by 9 independent centres. Goals have been justified by the evidence of causality. The report includes conclusions and recommendations for cancer prevention and survivorship.**
- **AICR Diet and Health Guidelines for Cancer Prevention:**
- **1. Eat more variety of vegetables, fruits, whole grains, and legumes.**
- **2. Limit red meats (such as beef, pork, and lamb) and avoid processed meats.**
- **3. Avoid Sugary drinks and energy dense foods high in sugar, fat, low in fibre.**
- **4. Limit salty foods and foods processed with salt.**
- **5. Be as lean as possible without becoming underweight.**
- **6. Be physically active every day for at least 30 minutes.**

Nutrition after Cancer:

- **Limit alcoholic drinks.**
- **Don’t use supplements to protect against cancer.**
- **It’s best for mothers to breastfeed infants exclusively for up to six months and then add other liquids and foods.**
- ***And always remember…* Do not use tobacco in any form, *either smoking or chewing.***
- **Scientists estimate that these guidelines could help prevent 30-40% of all cancers.**
- **Rethink your ratio of plant foods to animal foods :Aim for two-thirds ⅔ (or more) plant-based foods - vegetables, fruits, whole grains and beans - and one-third ⅓ (or less) animal protein.**
- **Exercise Regularly**
- **Maintain a Healthy Weight by Eating Appropriate Portion Sizes**
- **Cook With Care :Avoid eating charred or burnt meat. Cut off any charred pieces.**

Handle Food Safely:

- **Keep your hands, counters, dishes, cutting boards and utensils clean. Change sponges and dishtowels often.**
- **Thoroughly wash all fruits and vegetables in cold, running water.**
- **Avoid "cross-contamination" by using separate dishes, cutting boards and utensils for preparing raw meat, fish or poultry.**
- **Thaw frozen items in the microwave or refrigerator. Do not thaw food on the kitchen counter.**
- **Use a food thermometer to ensure that meat is fully cooked.**
- **Read expiration dates on food products and look for signs of food spoilage. Some food, however, may be unsafe to eat although it looks and smells fine. If in doubt, throw it out.**



- **H1N1 is an acute respiratory very infectious disease belonging to the family of *Orthomyxoviridae.***
- **The infection rate is high, however the fatality rate is low (1-4%).**
- **Viral infection between pigs is though direct contact and indirectly between those pigs having no apparent symptoms.**
- **<u>The four genera of Influenza virus identified by antigenic differences and infect vertebrates:</u>**

  1. Influenza virus A **2. Influenza virus B**

  3. Influenza virus C **4. Influenza virus D**

- **Influenza Virus A: infects humans, other mammals and birds and causes all pandemics (what about endemic and epidemic?) this because the virus has the ability to change it genetical structure by:**

  1. **Drifting: Slight natural mutation in the genetic code or structure.**

2. **Shifting: Reassortment of genetic code, where two or more different strains of virus or viruses combine to form a new subtype.**

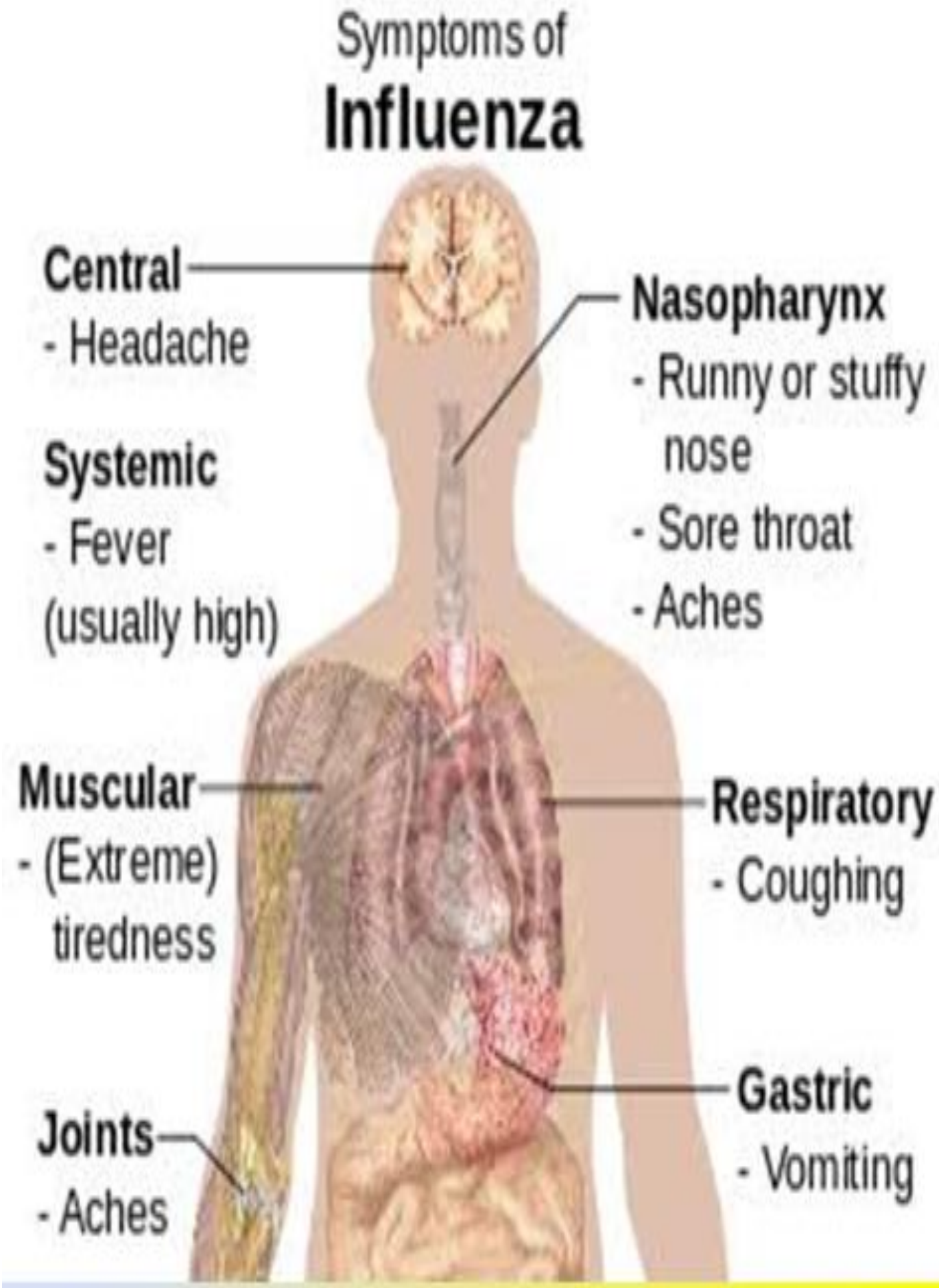
- **Influenza Virus B: It infects humans and seals. Less spread than Virus A**
- **Influenza Virus C: It infects humans, pigs and dogs.**
- **Influenza Virus D: It infects human pigs and cattle.**
- **The 9 influenza pandemics during the last 300 years :**

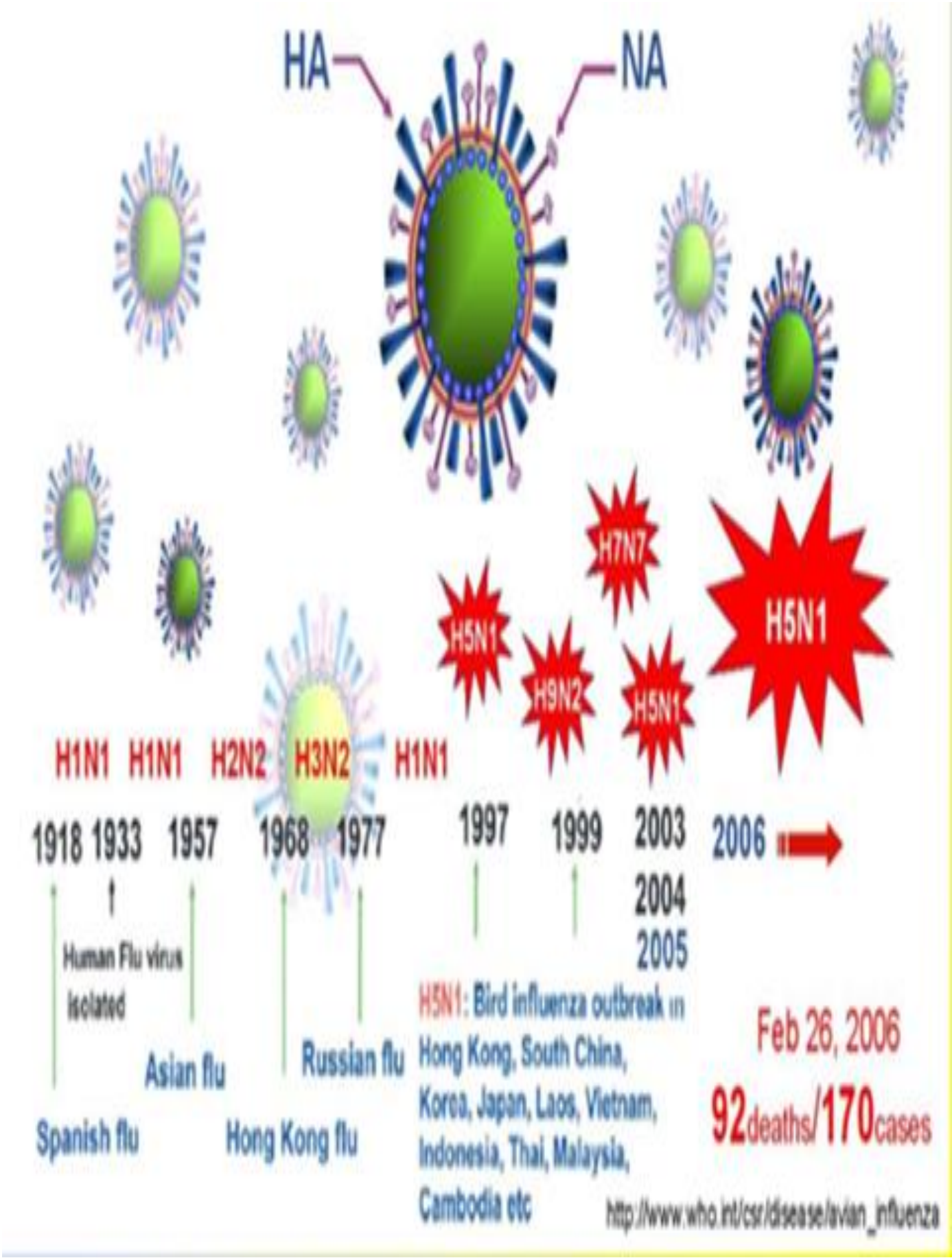
1. <u>Spanish Flu 1918 – 1919</u>: H1N1 virus caused it, resulting in 25 – 50 million fatality.

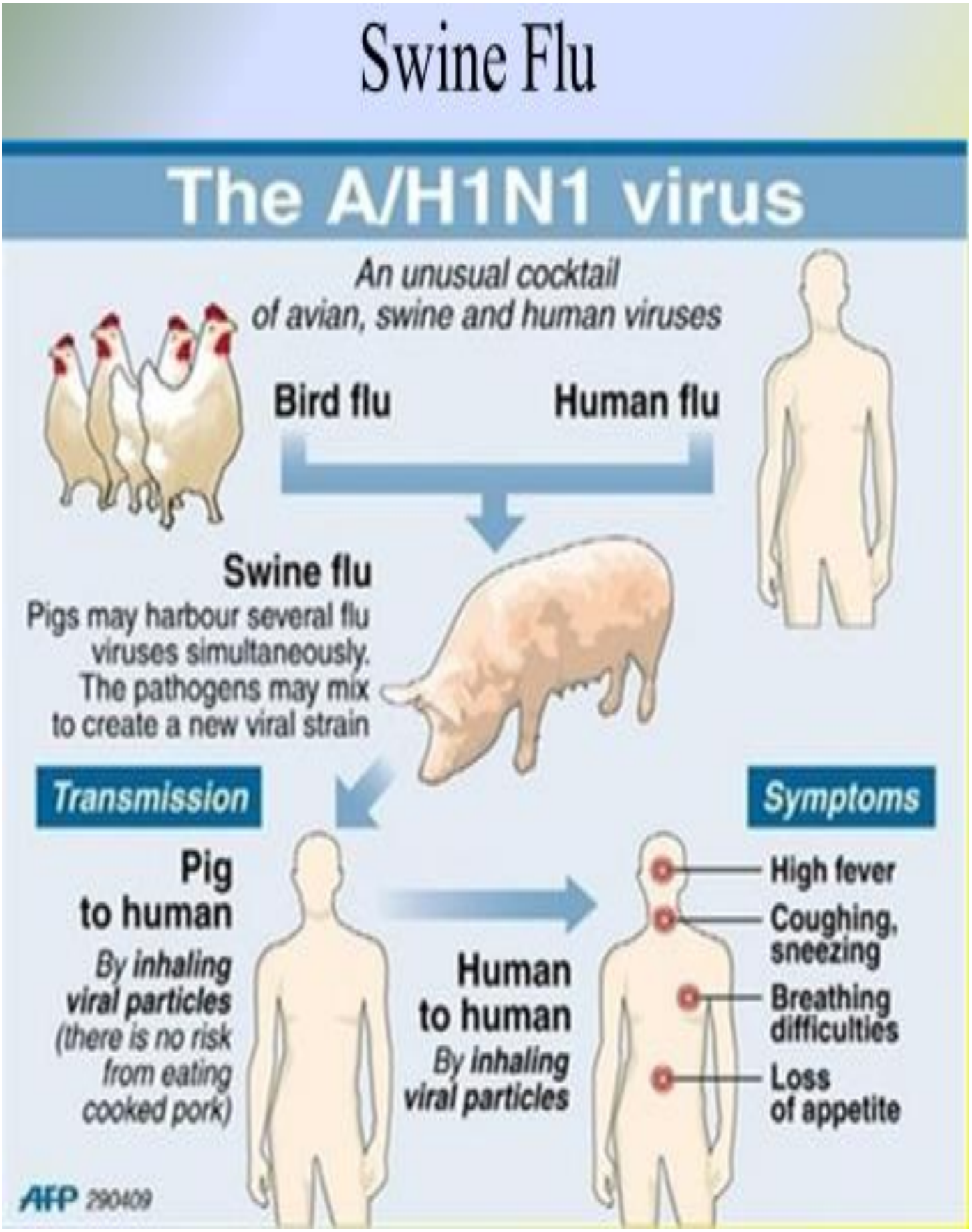
2. <u>Asian Flu 1957-1958</u>: H2N2 virus caused it, resulting in two millions fatality. It first started in China on February, 1957 and then spread in the US on the late of June of the same year.

3. <u>Hong Kong Flu 1968-1969</u>: H3N2 virus caused it. The estimated number of fatality is around 800 thousands to 2 millions victims.

4. <u>Russian Flu 1977-1978</u>: a mutant of H1N1 virus, resulting in the death of 700 thousand persons.


Symptoms of
Influenza
Central
- Headache
Systemic
- Fever
(usually high)
Nasopharynx
- Runny or stuffy nose
- Sore throat
- Aches
Muscular
- (Extreme) tiredness
Respiratory
- Coughing
Gastric
- Vomiting
Joints
- Aches


HA
NA
H7N7
H5N1
H5N1
H9N2
H5N1
H1N1
H1N1
H2N2
H3N2
H1N1
1918
1933
1957
1968
1977
1997
1999
2003
2004
2005
2006
Human Flu virus isolated
Spanish flu
Asian flu
Hong Kong flu
Russian flu
H5N1: Bird influenza outbreak in Hong Kong, South China, Korea, Japan, Laos, Vietnam, Indonesia, Thai, Malaysia, Cambodia etc
Feb 26, 2006
92deaths/170cases
http://www.who.int/csr/disease/avian_influenza


Swine Flu
The A/H1N1 virus
An unusual cocktail
of avian, swine and human viruses
Bird flu
Human flu
Swine flu
Pigs may harbour several flu viruses simultaneously. The pathogens may mix to create a new viral strain
Transmission
Symptoms
Pig to human
By inhaling viral particles (there is no risk from eating cooked pork)
Human to human
By inhaling viral particles
High fever
Coughing, sneezing
Breathing difficulties
Loss of appetite
AFP 290409

Symptoms of Influenza virus H1N1 :

1. **Resembles symptoms of common cold accompanied by high fever exceeding 38°C.**
2. **Coughing and sneezing with difficulties in breathing.**
3. **Sore throat.**
4. **Diarrhea and vomiting happen in some cases.**
5. **People with high risk fatality:**

   - Pregnant woman (especially during the first and third trimester), she maybe at a high risk of miscarriage as well as low birth weight and premature birth.

   - Those with respiratory chronic diseases such as Asthma.

   - Cardiovascular diseases.

   - Diabetic.

   - Immunodeficiency disorders.

   - Obesity.

Treatments:

- **Drugs: The WHO stated that there are two types of drugs available:**
  1. **Admantan: Amantadine and Rimantadine (Not recommended because of recent resistance to other Influenza strains).**
  2. **Neuraminidase influenza inhibitors: Tamiflu and Relenza.**
- **These drugs are only effective if taken in the early stages of infection.**

Fatality rate in relation to infected cases

2 June 2009

Country	2003		2004		2005		2006		2007		2008		2009		Total	
	cases	deaths	cases	deaths	cases	deaths	cases	deaths	cases	deaths	cases	deaths	cases	deaths	cases	deaths
Azerbaijan	0	0	0	0	0	0	8	5	0	0	0	0	0	0	8	5
Bangladesh	0	0	0	0	0	0	0	0	0	0	1	0	0	0	1	0
Cambodia	0	0	0	0	4	4	2	2	1	1	1	0	0	0	8	7
China	1	1	0	0	8	5	13	8	5	3	4	4	7	4	38	25
Djibouti	0	0	0	0	0	0	1	0	0	0	0	0	0	0	1	0
Egypt	0	0	0	0	0	0	18	10	25	9	8	4	27	4	78	27
Indonesia	0	0	0	0	20	13	55	45	42	37	24	20	0	0	141	115
Iraq	0	0	0	0	0	0	3	2	0	0	0	0	0	0	3	2
Lao People's Democratic Republic	0	0	0	0	0	0	0	0	2	2	0	0	0	0	2	2
Myanmar	0	0	0	0	0	0	0	0	1	0	0	0	0	0	1	0
Nigeria	0	0	0	0	0	0	0	0	1	1	0	0	0	0	1	1
Pakistan	0	0	0	0	0	0	0	0	3	1	0	0	0	0	3	1
Thailand	0	0	17	12	5	2	3	3	0	0	0	0	0	0	25	17
Turkey	0	0	0	0	0	0	12	4	0	0	0	0	0	0	12	4
Viet Nam	3	3	29	20	61	19	0	0	8	5	6	5	4	4	111	56
Total	4	4	46	32	98	43	115	79	88	59	44	33	38	12	433	262

Dengue Virus

Dengue has become a global problem since the Second World War and is common in more than 110 countries. Each year between 50 and 528 million people are infected and approximately 10,000 to 20,000 die. The earliest descriptions of an outbreak date from 1779. Its viral cause and spread were understood by the early 20th century. Apart from eliminating the mosquitoes, work is ongoing for medication targeted directly at the virus. It is classified as a neglected tropical disease.

Dengue is spread by several species of mosquito of the *Aedes* type, principally *A. aegypti*. The virus has five types; infection with one type usually gives lifelong immunity to that type, but only short-term immunity to the others. Subsequent infection with a different type increases the risk of severe complications. A number of tests are available to confirm the diagnosis including detecting antibodies to the virus or its RNA.

Dengue Fever

Aedes aegypti- mosquito causing dengue

Symptoms

Febrile Phase

- sudden-onset fever
- headache
- mouth and nose bleeding
- muscle and joint pains
- vomiting
- rash
- diarrhea

Critical Phase

- hypotension
- pleural effusion
- ascites
- gastrointestinal bleeding

Recovery Phase

- altered level of consciousness
- seizures
- itching
- slow heart rate

Dengue fever

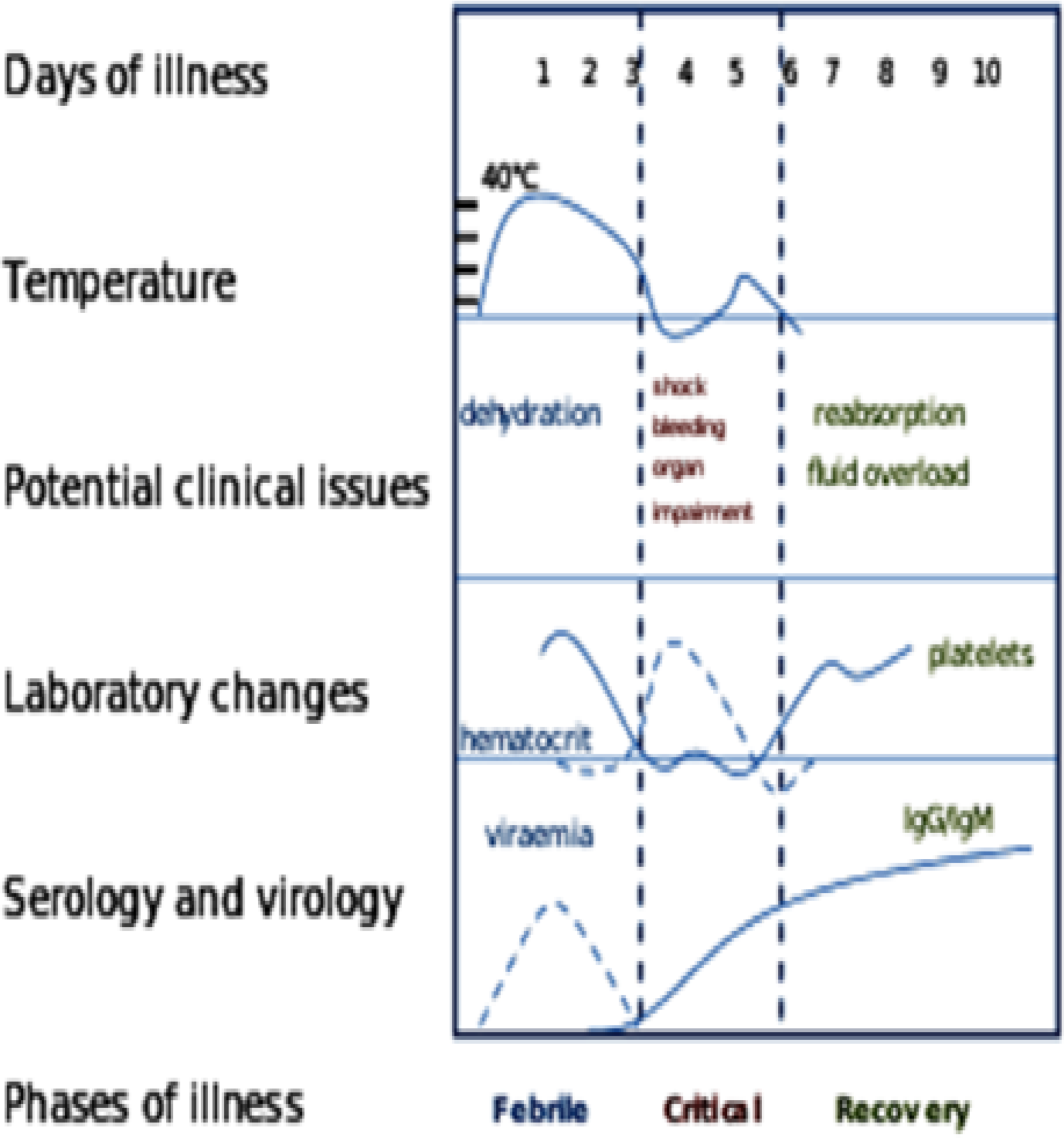
Synonyms Dengue, breakbone fever

The typical rash seen in dengue fever

The rash of dengue fever in the acute stage of the infection blanches when pressed

The rash that commonly forms during the recovery from dengue fever with its classic islands of white in a sea of red.

Dengue Virus



Dengue fever is a mosquito-borne tropical disease caused by the dengue virus. Symptoms typically begin three to fourteen days after infection. This may include a high fever, headache, vomiting, muscle and joint pains, and a characteristic skin rash. Recovery generally takes two to seven days. In a small proportion of cases, the disease develops into the life-threatening **dengue hemorrhagic fever**, resulting in bleeding, low levels of blood platelets and blood plasma leakage, or into **dengue shock syndrome**, where dangerously low blood pressure occurs.

Typically, people infected with dengue virus are asymptomatic (80%) or have only mild symptoms such as an uncomplicated fever. Others have more severe illness (5%), and in a small proportion it is life-threatening. The incubation period (time between exposure and onset of symptoms) ranges from 3 to 14 days, but most often it is 4 to 7 days. Therefore, travelers returning from endemic areas are unlikely to have dengue if fever or other symptoms start more than 14 days after arriving home. Children often experience symptoms similar to those of the common cold and gastroenteritis (vomiting and diarrhea) and have a greater risk of severe complications,

Dengue Virus

Clinical course

The characteristic symptoms of dengue are sudden-onset fever, headache (typically located behind the eyes), muscle and joint pains, and a rash. The alternative name for dengue, "breakbone fever", comes from the associated muscle and joint pains. The course of infection is divided into three phases: febrile, critical, and recovery.

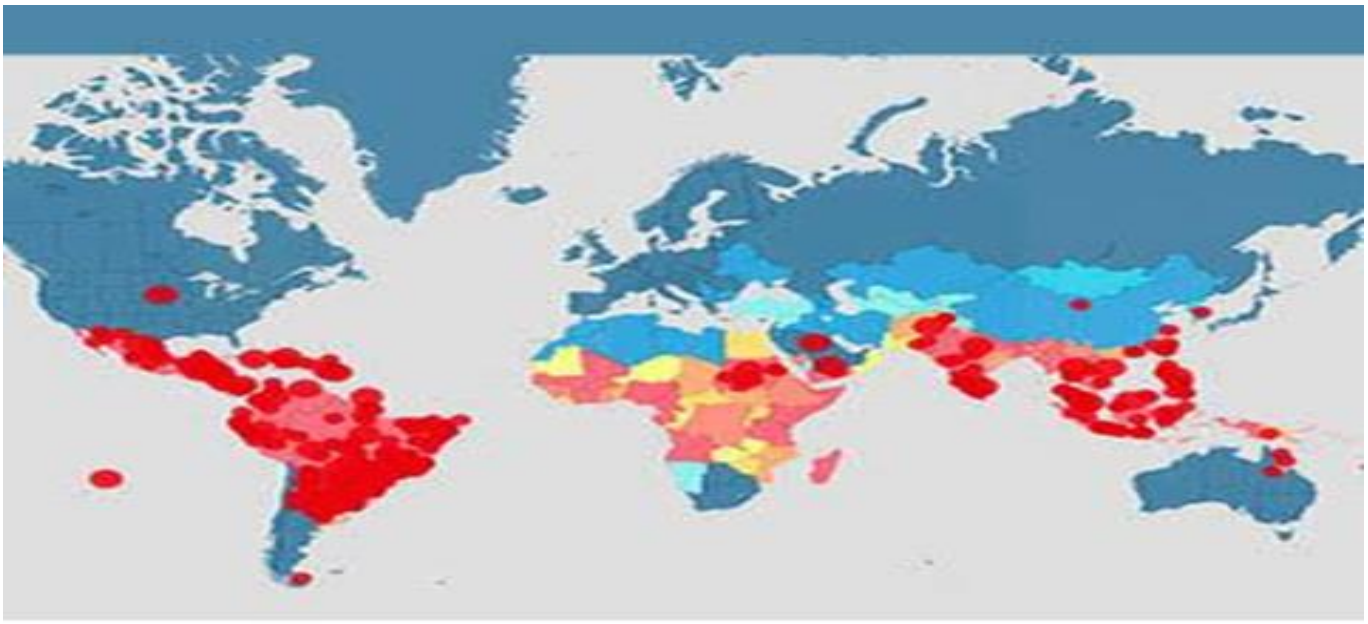
The febrile phase involves high fever, potentially over 40 °C (104 °F), and is associated with generalized pain and a headache; this usually lasts two to seven days. Nausea and vomiting may also occur. A rash occurs in 50—80% of those with symptoms in the first or second day of symptoms as flushed skin, or later in the course of illness (days 4—7), as a measles-like rash. A rash described as "islands of white in a sea of red" has also been observed. Some petechiae (small red spots that do not disappear when the skin is pressed, which are caused by broken capillaries) can appear at this point, as may some mild bleeding from the mucous membranes of the mouth and nose. The fever itself is classically biphasic or saddleback in nature, breaking and then returning for one or two days.

In some people, the disease proceeds to a critical phase as fever resolves. During this period, there is leakage of plasma from the blood vessels, typically lasting one to two days. This may result in fluid accumulation in the chest and abdominal cavity as well as depletion of fluid from the circulation and decreased blood supply to vital organs.

There may also be organ dysfunction and severe bleeding, typically from the gastrointestinal tract. Shock (dengue shock syndrome) and hemorrhage (dengue hemorrhagic fever) occur in less than 5% of all cases of dengue, however those who have previously been infected with other serotypes of dengue virus ("secondary infection") are

at an increased risk. This critical phase, while rare, occurs relatively more commonly in children and young adults.

The recovery phase occurs next, with resorption of the leaked fluid into the bloodstream. This usually lasts two to three days. The improvement is often striking, and can be accompanied with severe itching and a slow heart rate. Another rash may occur with either a maculopapular or a vasculitic appearance, which is followed by peeling of the skin. During this stage, a fluid overload state may occur; if it affects the brain

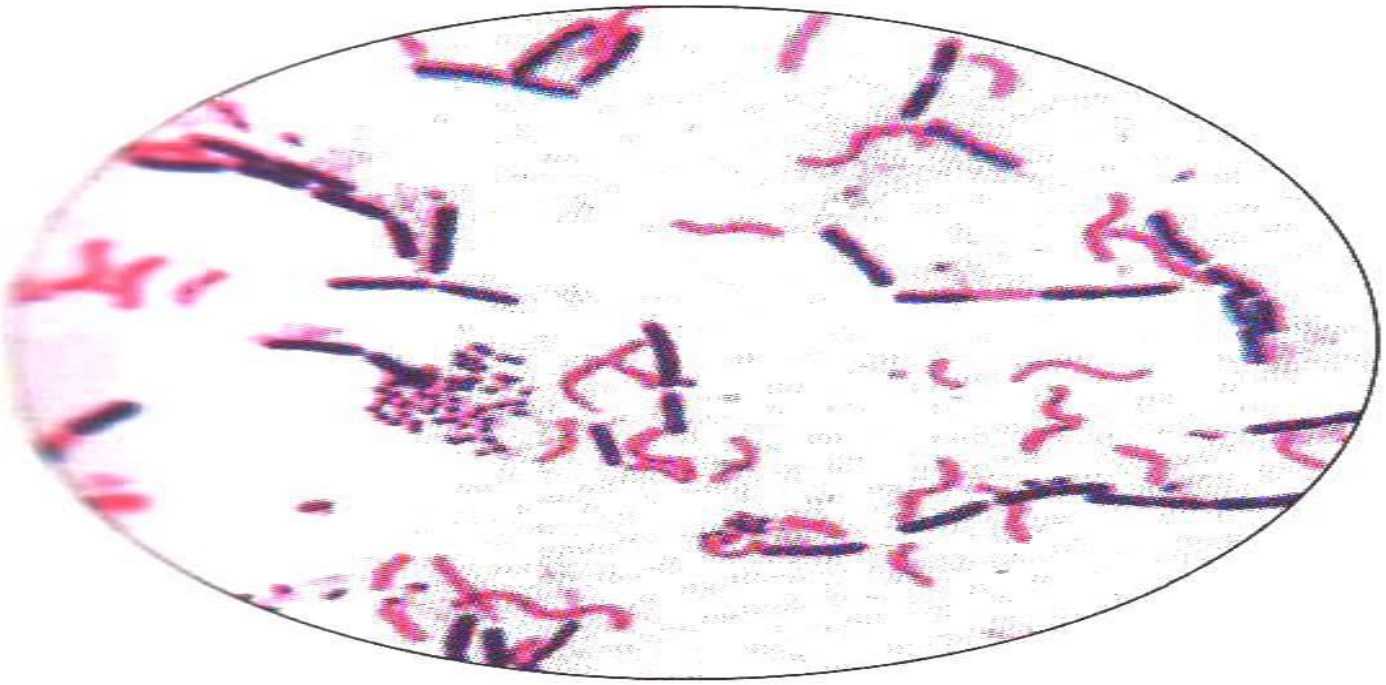


Dengue Fever Outbreaks
CDC 2016

A vaccine for dengue fever has been approved and is commercially available in a number of countries. Other methods of prevention are by reducing mosquito habitat and limiting exposure to bites. This may be done by getting rid of or covering standing water and wearing clothing that covers much of the body. Treatment of acute dengue is supportive and includes giving fluid either by mouth or intravenously for mild or moderate disease. For more severe cases blood transfusion may be required. About half a million people require admission to hospital a year. Paracetamol (acetaminophen) is recommended instead of nonsteroidal anti-inflammatory drugs (NSAIDs)

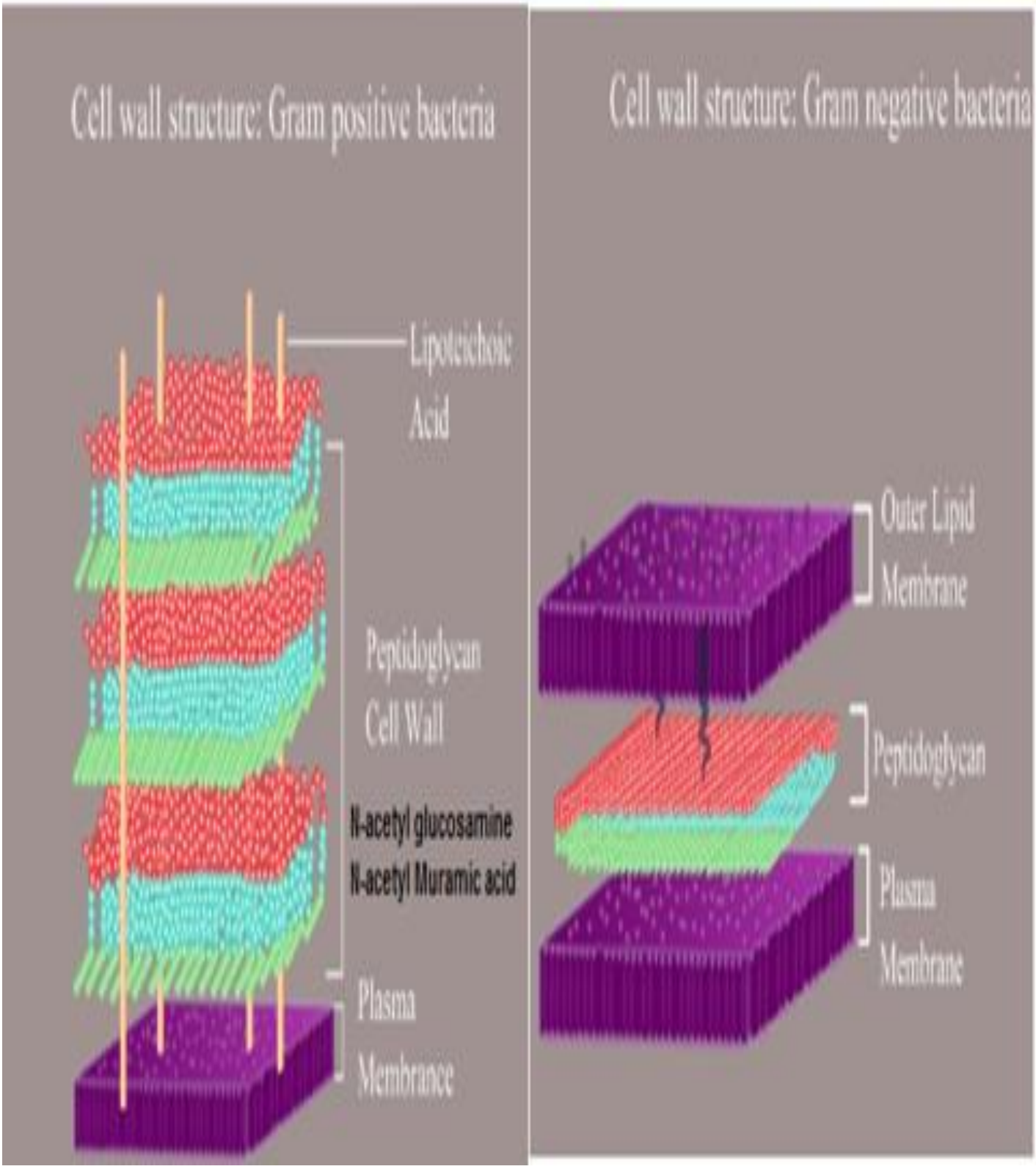
Prokaryotes

- ***Monera*:**
  - **It is classified under *Prokaryota*.**
  - **Mostly unicellular, although some are multicellular.**
  - **They have no true nucleus; as they possess only nuclear material devoid of any nuclear membrane nor nucleoli.**
  - **They divide by binary fission only.**
  - **Nutrition: Autotrophic (Photo- &chemotrophic) or heterotrophic (Saprophytic – parasitic).**
  - **They can survive in different habitats of different temperature.**
  - **They live in neutral or slightly alkaline habitats.**
  - **They are either Gram positive or negative.**

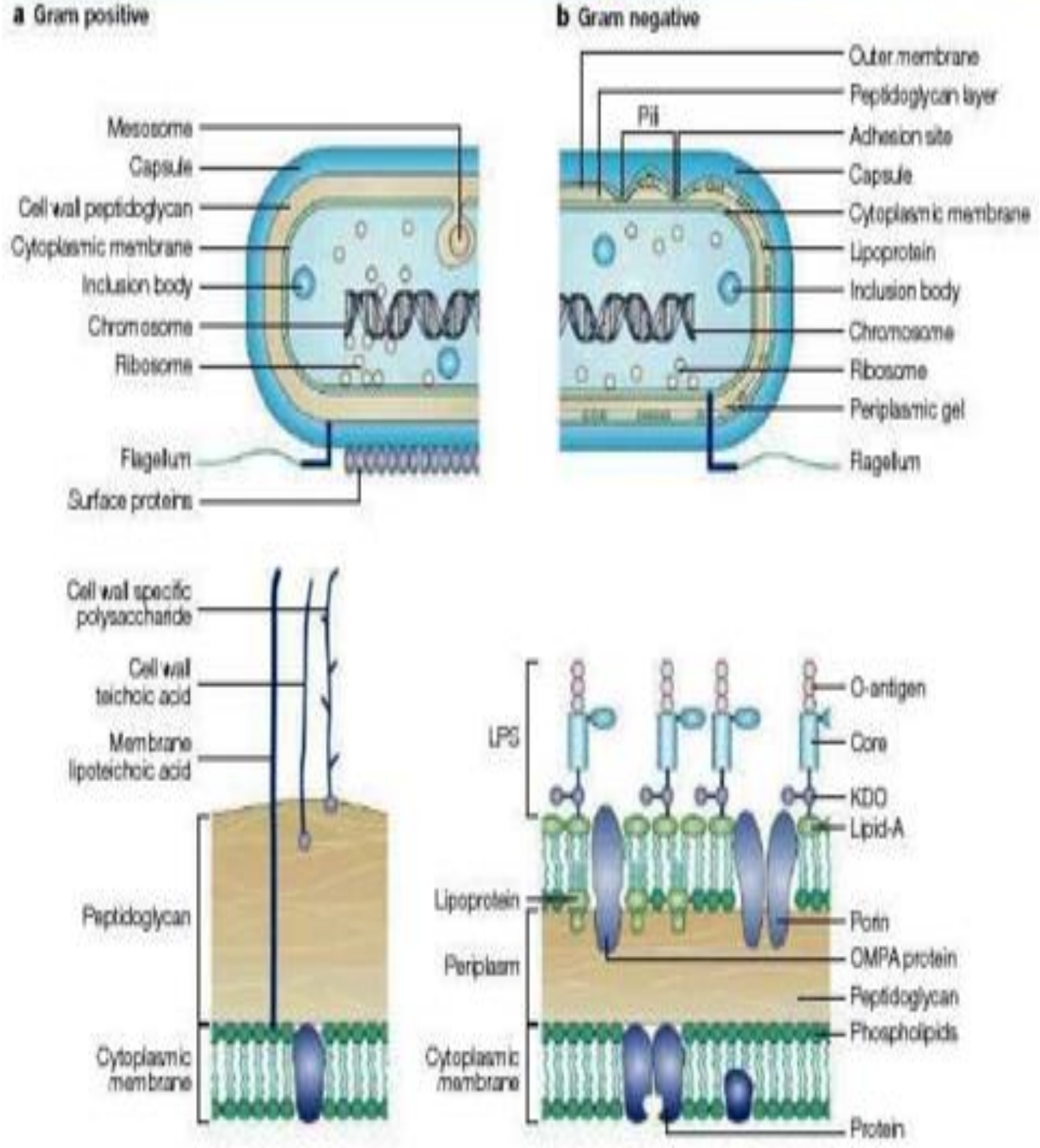


(a) Gram stain
Purple cells are gram positive.
Red cells are gram negative.

Gram Positive and Negative Bacteria



Gram Positive and Negative Bacteria



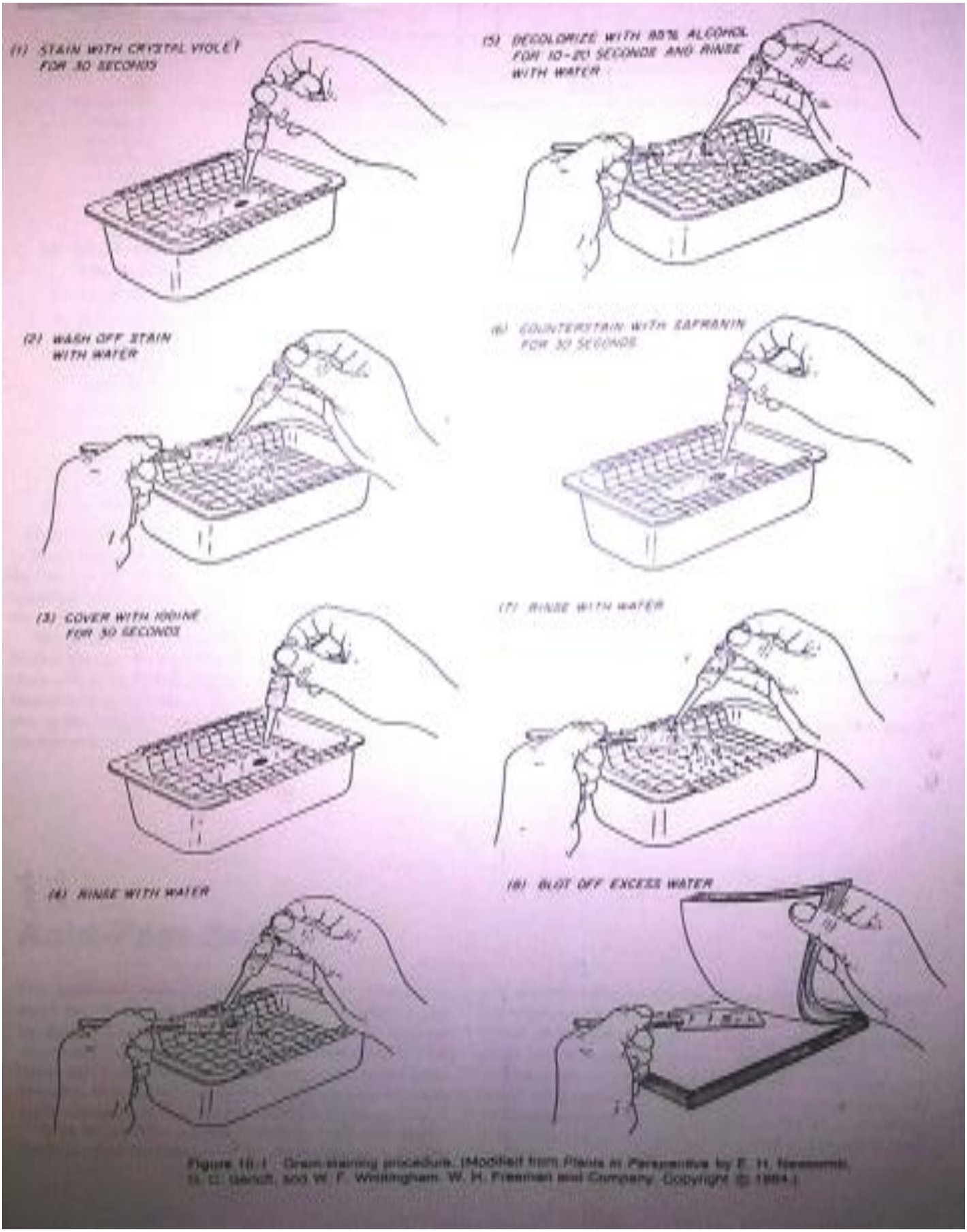
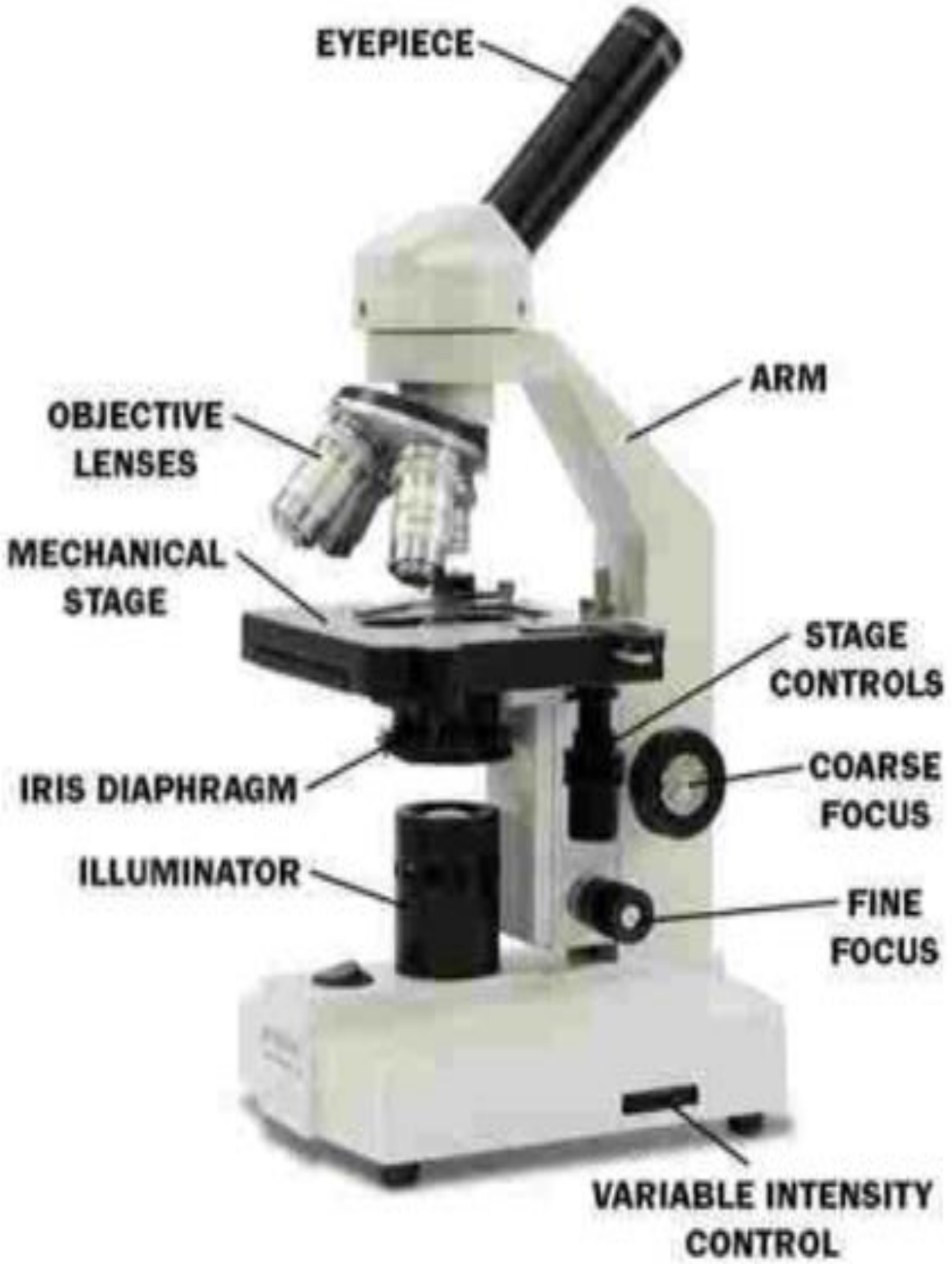
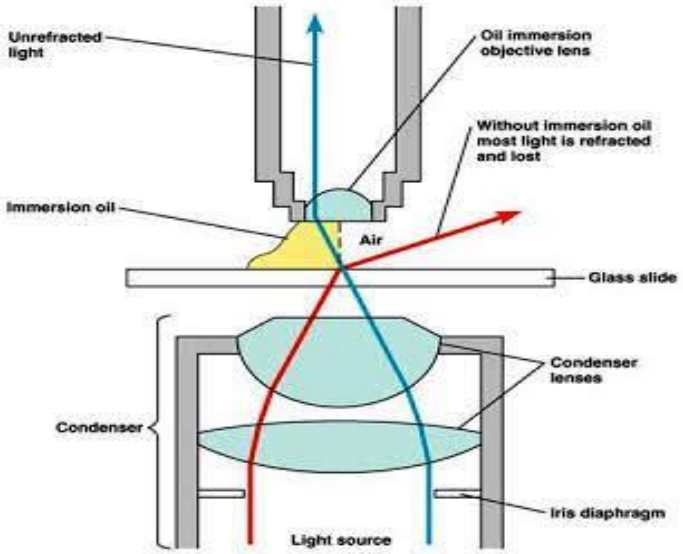
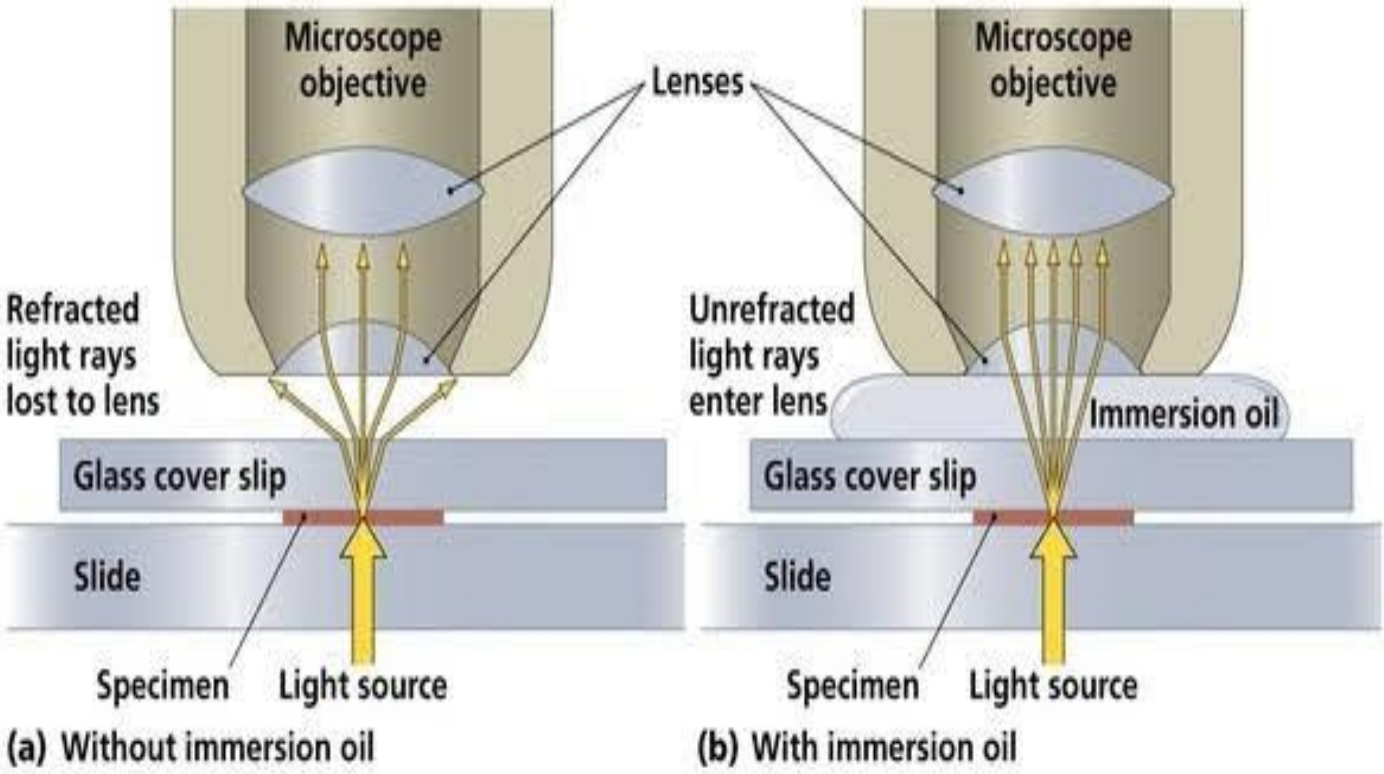


Figure 10.1 Gram staining procedure. (Modified from Plants in Perspective by E. H. Newcomb, H. C. Gerlott, and W. F. Wedinghem. W. H. Freeman and Company. Copyright © 1984.)


EYEPIECE
ARM
OBJECTIVE LENSES
MECHANICAL STAGE
STAGE CONTROLS
IRIS DIAPHRAGM
COARSE FOCUS
ILLUMINATOR
FINE FOCUS
VARIABLE INTENSITY CONTROL

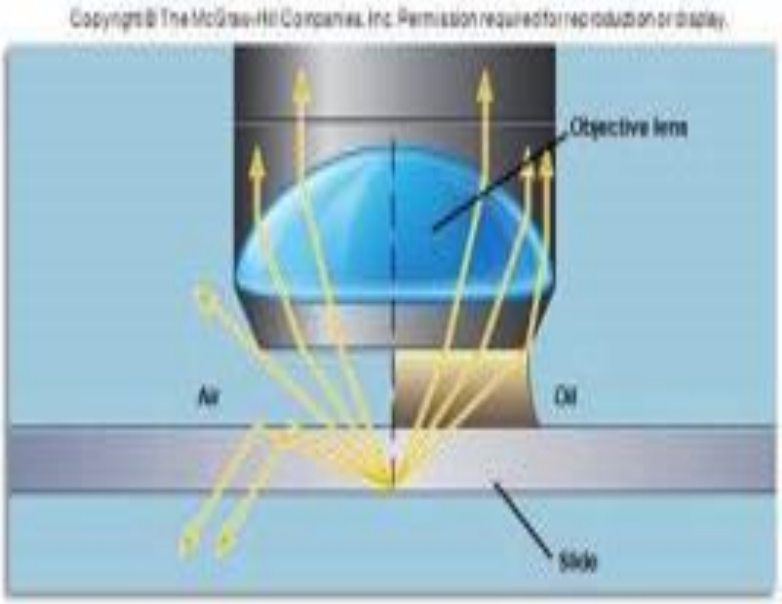
Oil immersion lens





The Oil Immersion Lens

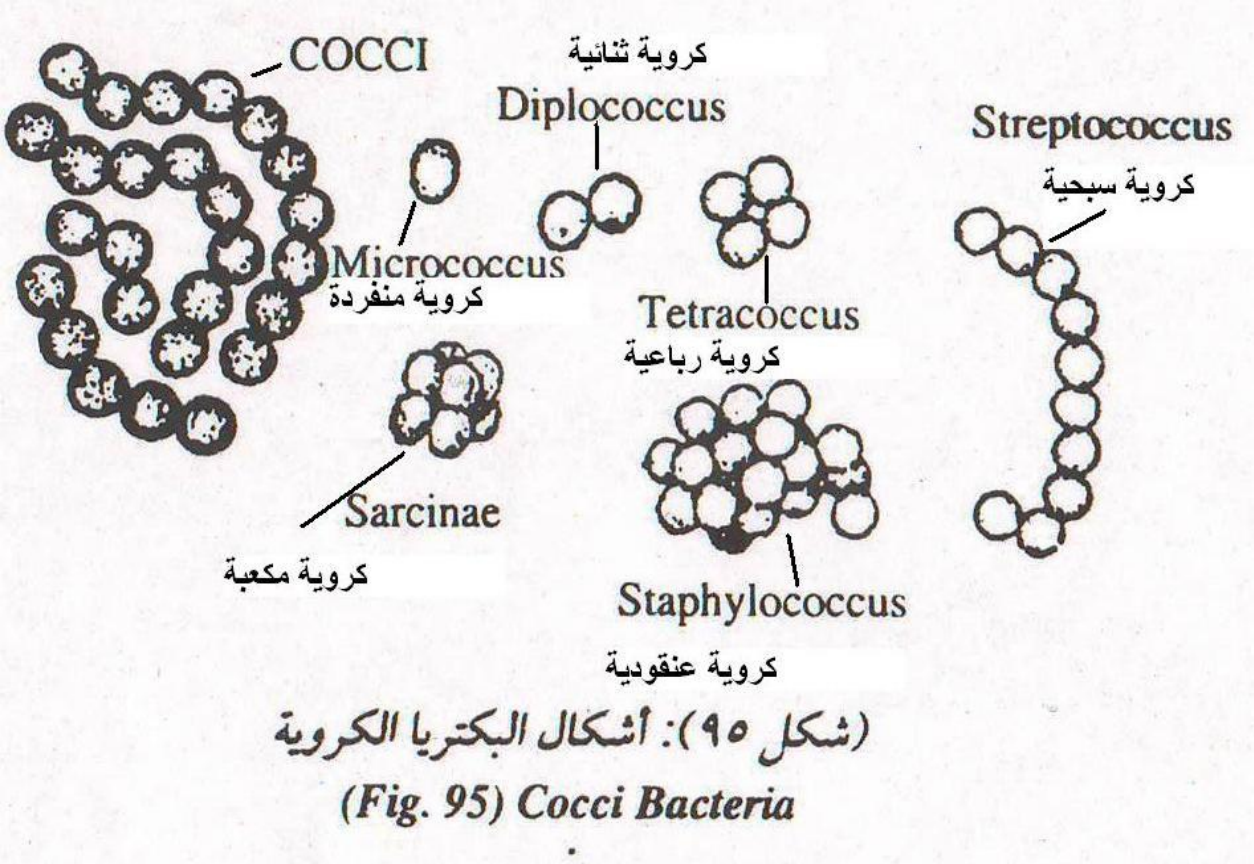
- Immersion oil reduces refraction of light
- More light is gathered
- Numerical aperture increases
- Resolution improved



Types of Lens	Magnification Power	Focal Length
Low Objective Lens	X 10	16 mm
High Objective Lens	X 40 – 45	4 mm
Oil Immersion Lens	X 100	2 mm

Eubacteria (types of bacteria)

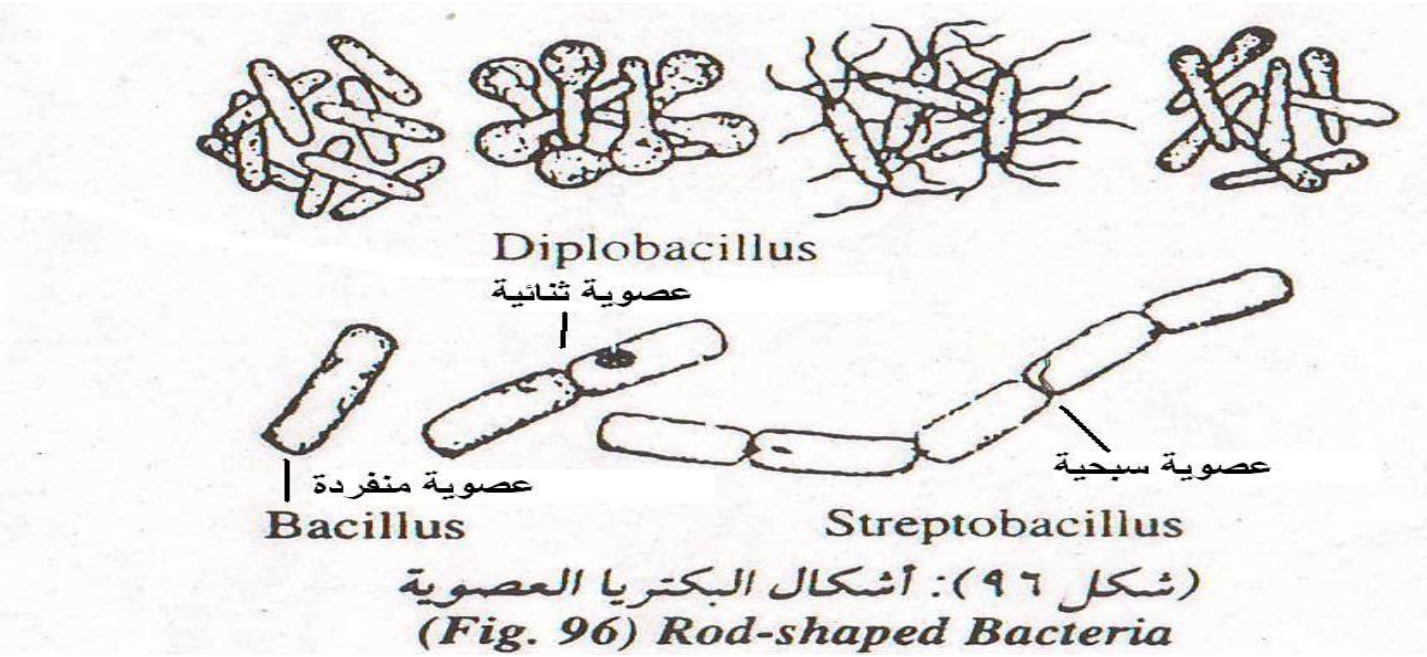
- **Sizes and Shapes of Bacterial Cell:**
  1. **Cocci (Spherical): Diameter of which ranges from 0.7 –1.2 µm**



(شكل ٩٥): أشكال البكتريا الكروية

(Fig. 95) Cocci Bacteria

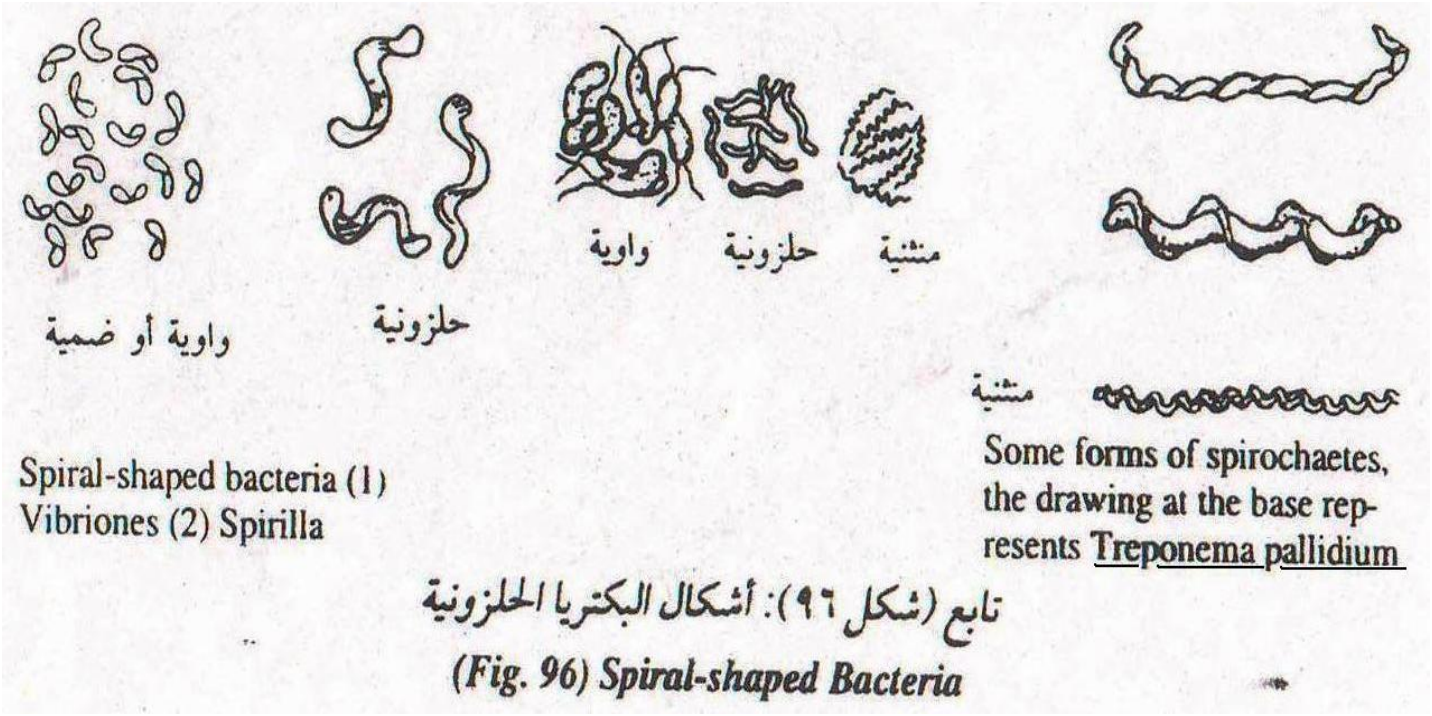
  2. ***Bacillus* (Rod- like): Length of which ranges from0.5 -1.25 um**



(شكل ٩٦): أشكال البكتريا العصوية

(Fig. 96) Rod-shaped Bacteria

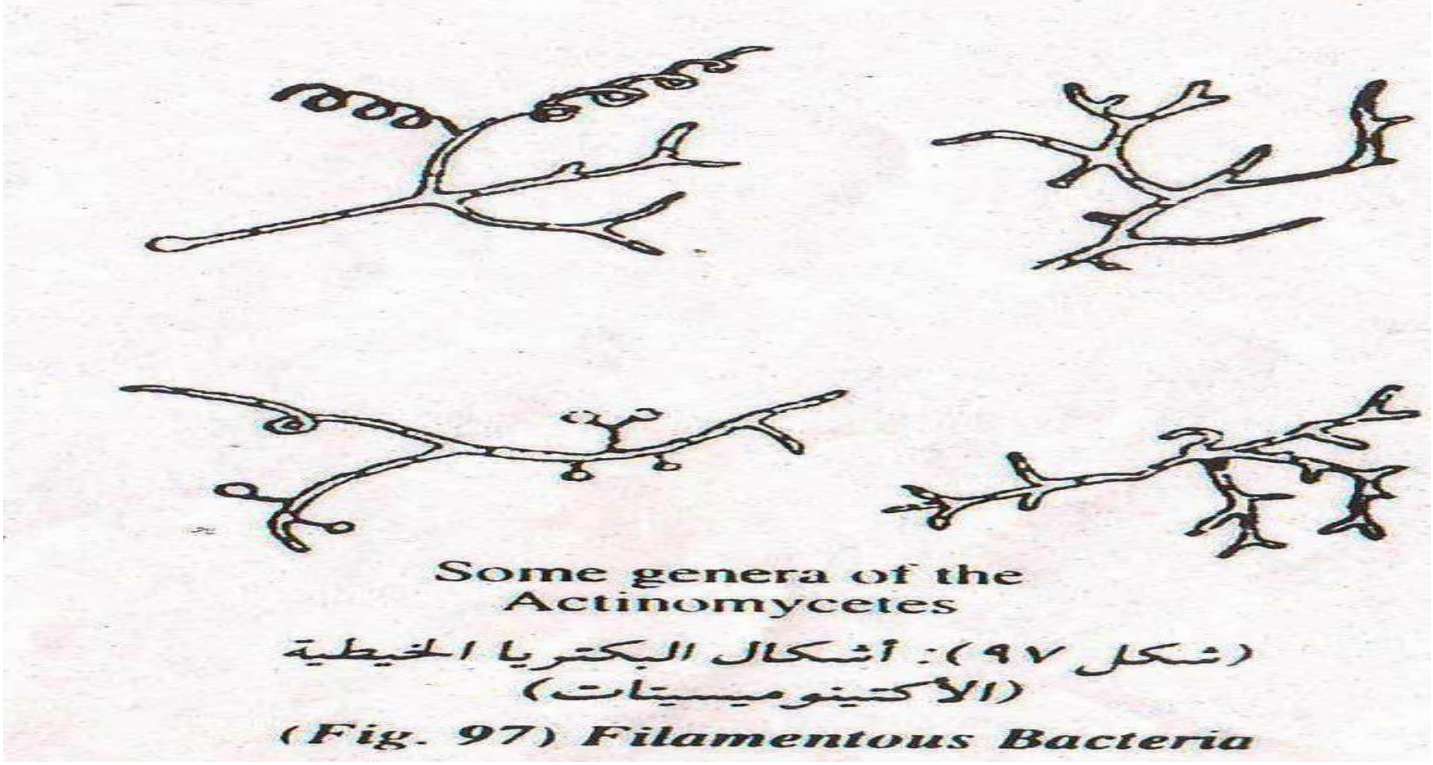
3. Spiral-Shaped:



تابع (شكل ٩٦): أشكال البكتريا الحلزونية

(Fig. 96) Spiral-shaped Bacteria

4. ***Actinobacteria:*** **It was recently separated from *Fungi*, where it was considered a transitional stage between *Bacteria* and *Fungi*. It resembles bacteria in its wall composition. However, it is similar to *Fungi* in their form, reproduction and ability to produce antibiotics.**



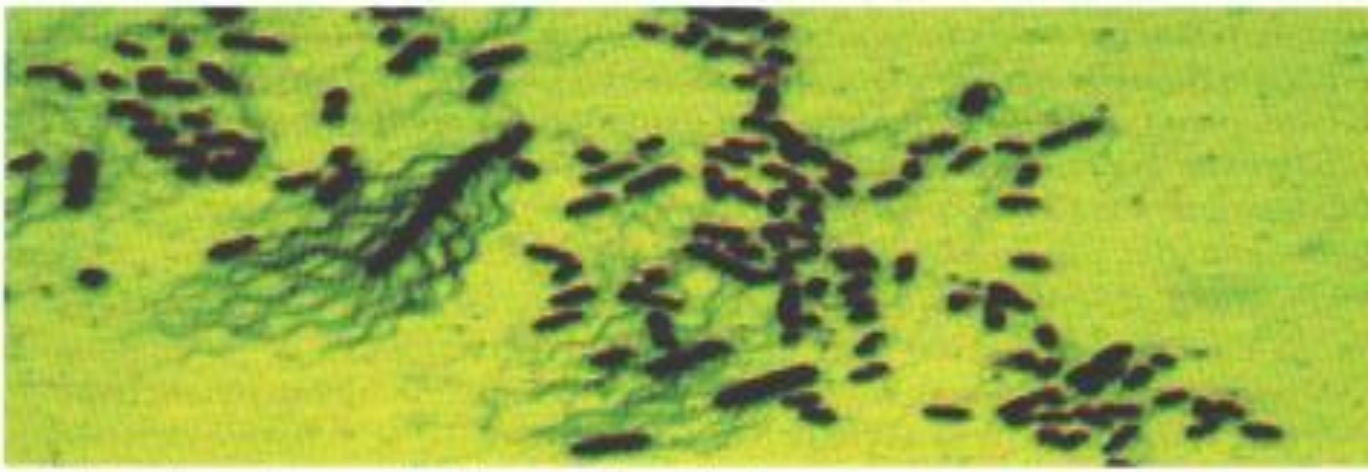
(شكل ٩٧): أشكال البكتريا الخيطية (الأكتينوميسيتات)

(Fig. 97) Filamentous Bacteria

- **<u>Motility in *Bacteria:*</u>**
  - **Non-motile**
  - **Motile: 1. swarming or gliding 2. By Flagella**

(a) *Pseudomonas*—monotrichous polar flagellation

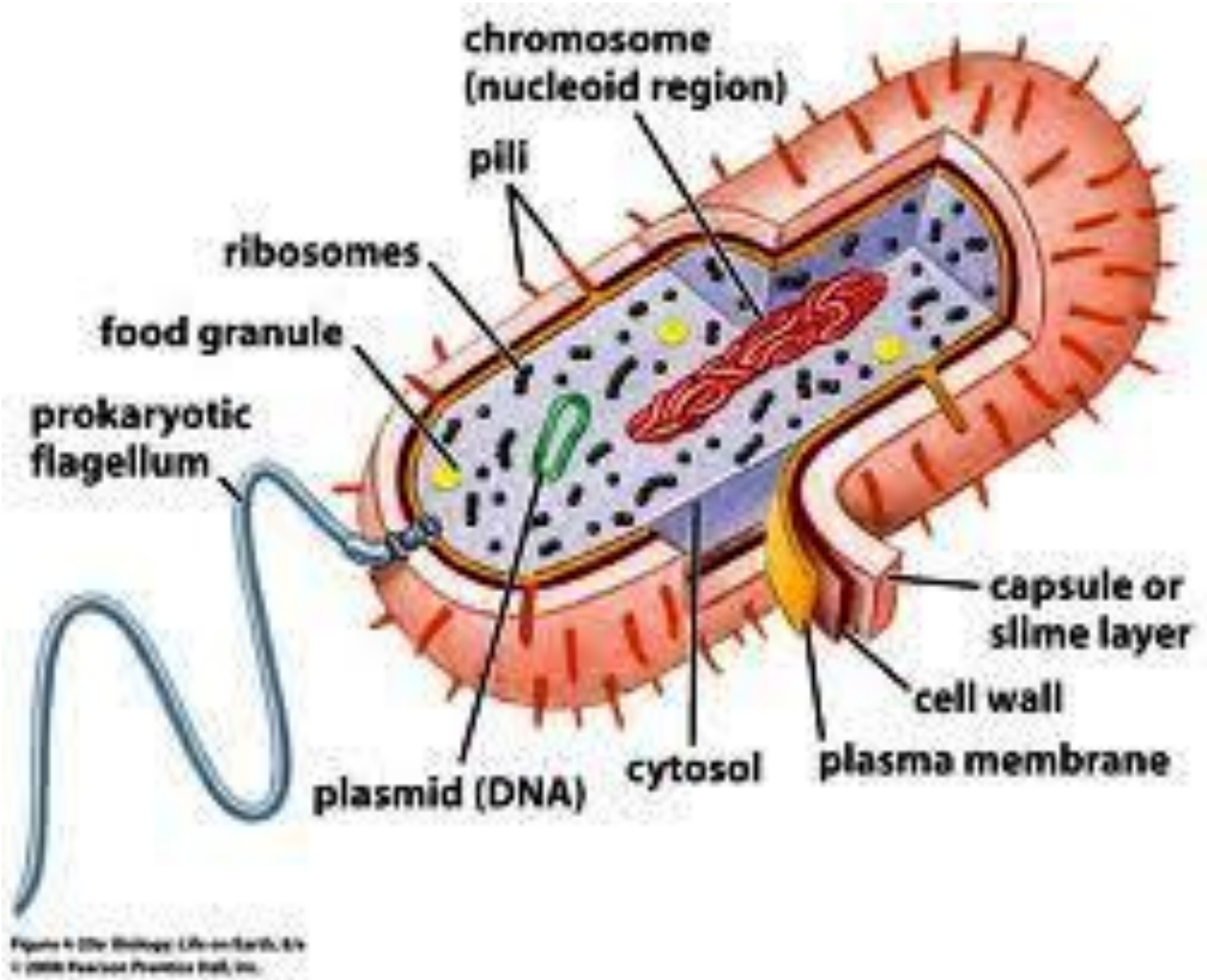
(b) *Spirillum*—lophotrichous flagellation



(c) *P. vulgaris*—peritrichous flagellation

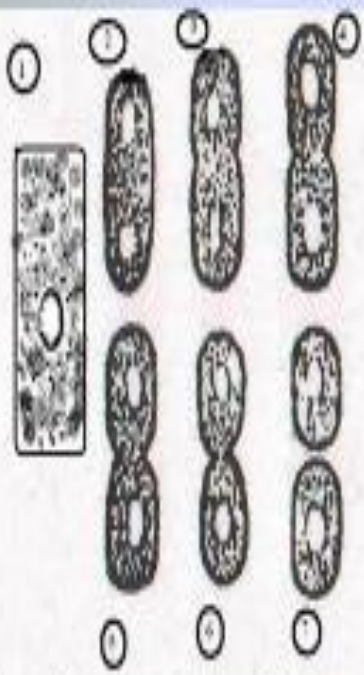
Bacterial Cell Structure:

- **The cell wall composed of Diamino pimelic acid and *Muramic* acid, the wall is surrounded by gelatinous sheath.**
- **There is no true nucleus; only nuclear material od DNA, devoid of any nuclear membrane nor nucleoli.**
- **Cytoplasm contains Glycogen, protein and lipids.**
- **There is no *Mitochondria* or *Endoplasmic reticulum***



Reproduction in *Bacteria*

Binary Fission



(شكل ١٠٠): الانقسام الثنائى البسيط فى الخلية البكتيرية

(Fig. 100) fission of a bacterial cell

It happens in **favorable** environmental conditions

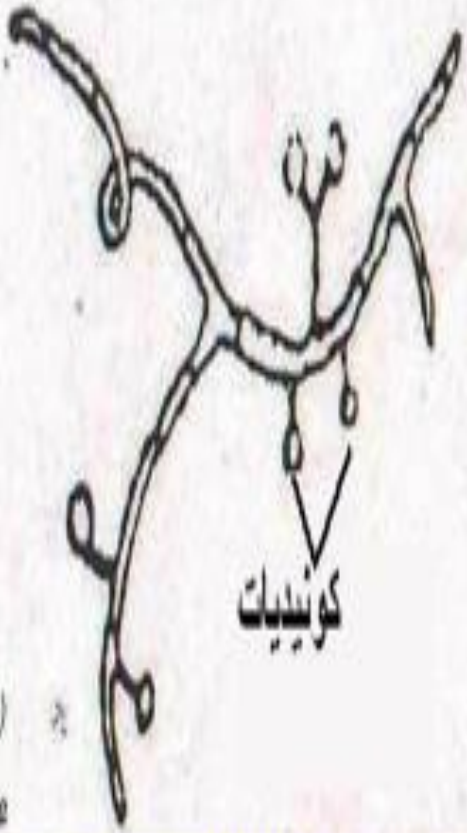
Endospore

(شكل ١٠١): تكوين الجراثيم الداخلية فى الخلية البكتيرية

(Fig. 101) spore formation in two types of bacteria

It is **not** considered a way of **reproduction**, there is no increase in numbers

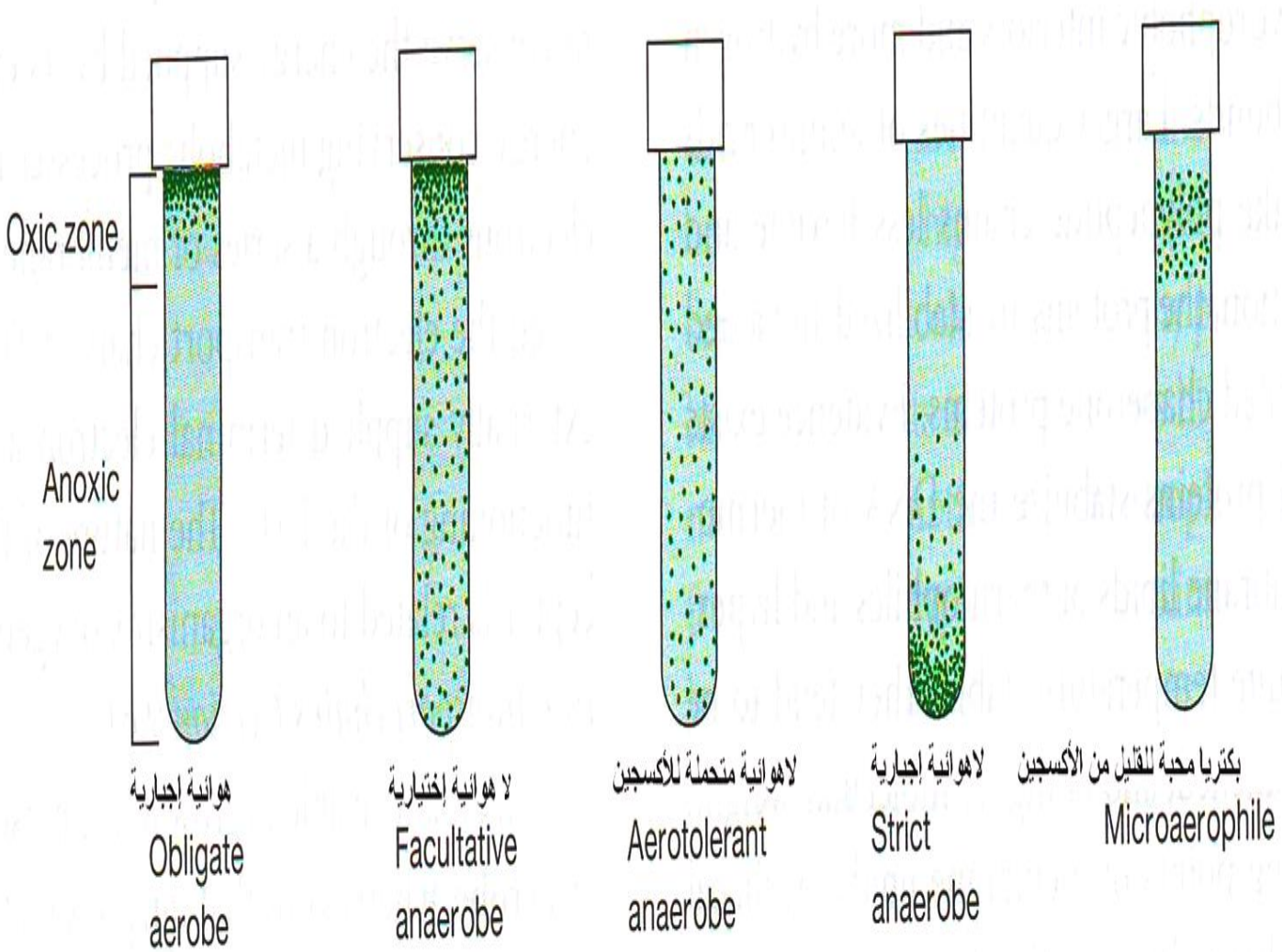
Conidia



Formation of chain of Conidia, a way of reproduction in ***Actinomycetes***

Respiration in *Bacteria:*

- ***Anaerobic Bacteria*: They can not use or live in presence of O_2.**
- ***Aerobic Bacteria*: They use O_2 and can not live without.**
- **Types of Bacteria according to their way of respiration:**
  1. ***Obligate Aerobes***
  2. ***Facultative Anaerobes***
  3. ***Aerotolerant Anaerobes***
  4. ***Facultative Anaerobes***
  5. ***Microaerophilic***



Economic Importance of *Bacteria:*

- **Advantages:**

  1. **Methane *Bacteria* can produce "Natural Gas" CH4. (Wildfire in forests).**
  2. **Organic Farm Waste Composting: it is used as animal fodder or as manure.**
  3. **Oil dissolving or eating *bacteria* can be used in cleaning oil spills.**
  4. **Dairy production (yogurt & butter).**
  5. **Production of organic acids (butanol, acetone & citric acid) by the fermentation (*Anaerobic* respiration) of sugars, proteins & organic substances.**
  6. **It plays a role in the ripening of coco fruits and coffee beans as well as tea leaves.**
  7. **It is used in the biodegradation process of flax fibers.**
  8. **It plays an important role in the production of vitamins and drugs (Biotechnology).**
  9. **It plays significant role in genetic engineering (Transduction and cloning).**

- **Disadvantages: (Biological War)**

  1. **It infects many plants, fruits and vegetables during storing them.**
  2. **Some air-born bacteria can cause serious diseases to man and animals.**
  3. **Producing different toxins *i.e.* Botulism (food poisonning).**

Rickettsia:

- **They were discovered by Howard Taylor Rickttes.**
- **It is a transitional stage between *Viruses* and *Bacteria.***
- **Polymorphic: it is either spherical, rod–like or filamentous.**
- **It causes very serious diseases *i.e. Typhus.***
- **Similarities to *Viruses*:**
    1. **Size.**
    2. **Obligate parasite.**
    3. **Way of cultivation**
    4. **It has no motile organs nor can form spores**
- **Similarities to *Bacteria*:**
    1. **Cellular structure *(Prokaryotes*).**
    2. **It divides by binary fission.**
    3. **Gram negative.**

Diseases Caused by *Rickettsia*

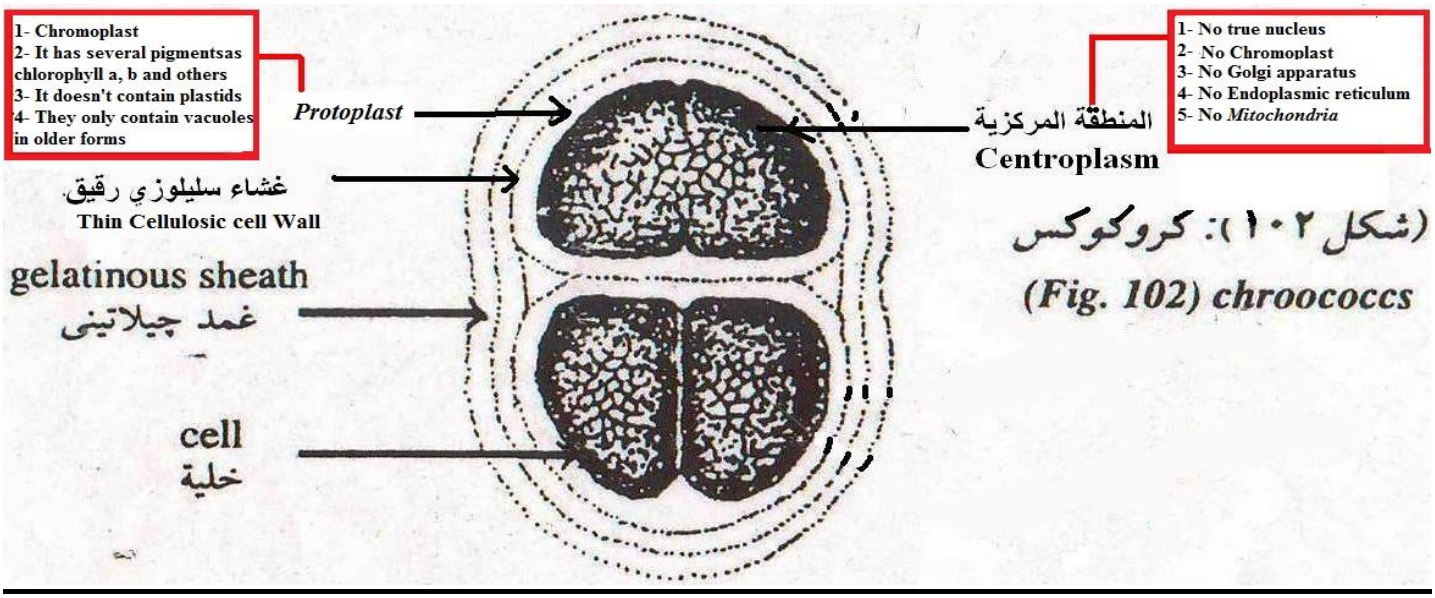
Disease Name	Viral Name	Transmitted By	Natural Host	Route of transmission
Epidemic Typhus	*Rickettsia prowazekii*	Lice	Humans Rodents	Lice to Humans Humans to Lice
Endemic Typhus	*R. typhi*	Fleas	Rodents	Rat to Flea to Rat Rat to Flea to Human Human to Flea to Human
Spotted Fever	*R. rickettsii*	Ticks	Wild rabbits, Rodents Dogs Sheep	Rodents to Ticks to Human Rodents to Ticks to Dogs Dogs to Ticks to Human

Cyanobacteria

- ***Cyanobacteria*** **(blue-green bacteria) are classified under kingdom *Monera.***
- **In the past, they were classified under *Myxophyta* (slime algae). They were considered the simplest, most primitive and widely spread algae.**
- **They are one of the *Prokaryotes*. Their genetic material is of DNA which is not surrounded by a nuclear membrane and devoid of any nuclei.**
- **Non motile, respire aerobically and anaerobically.**
- **They absorb nutrients from their surrounding. They live symbiotically on or within bodies of living organisms *i.e. Nostoc* within *Anthoceros* plant and *Anabena* within *Cycus* plant. Some of them live with other *Fungi i.e. Lichens*.**
- **They reproduce by binary fission or asexual reproduction by spores.**
- **They live in fresh or marine water environment. They can live as well in wet soil on the surface of upper layer or one meter deep.**
- **They can live under high temperatures *i.e.* hot springs. On the other hand some live in cold water bodies.**
- **Some *Cyanobacteria* live in stagnant water where organic mater accumulate forming the so called algal mats (Blooms) on the surface of a pond.**
- **They have mucilaginous envelope.**

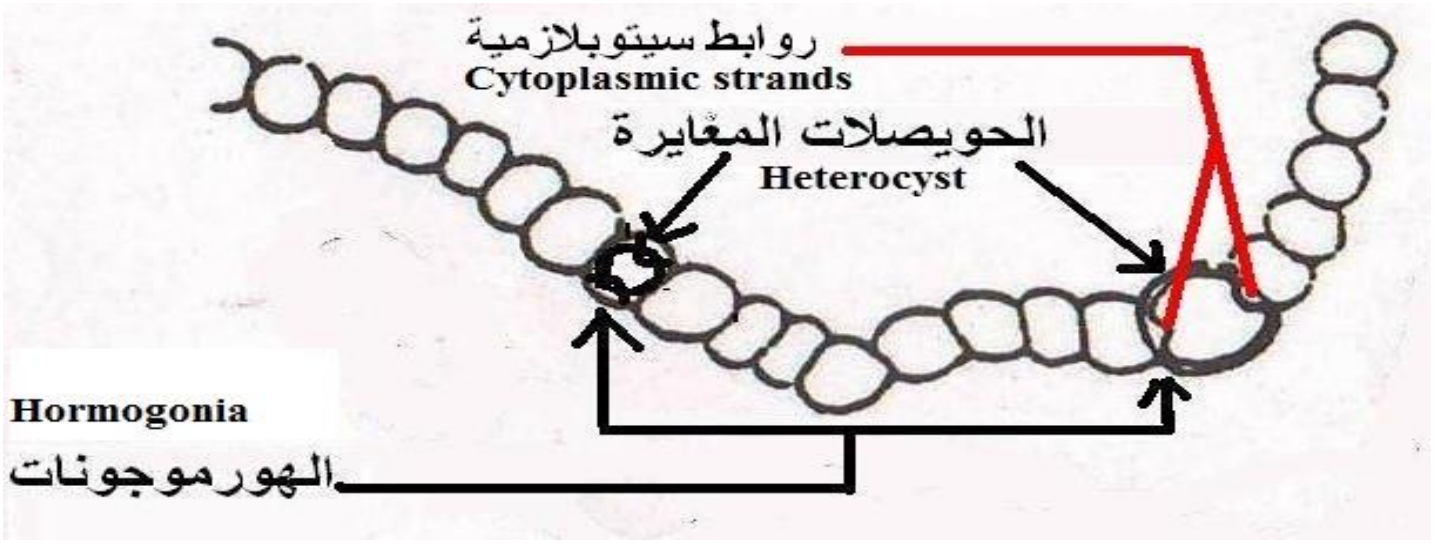
***Chroococcus*'s cellular Structure:**

- **Only contains vacuoles in older forms which makes it resistant to high osmotic pressure.**
- ***Pseudo vacuoles* or gas vacuoles (stored by respiration & photosynthesis) are found in the cytoplasm where they equilibrate with gases in the surroundings. They help it to float or sink according to light and temperature. This is a way of self-locomotion.**
- **They store glycogen.**

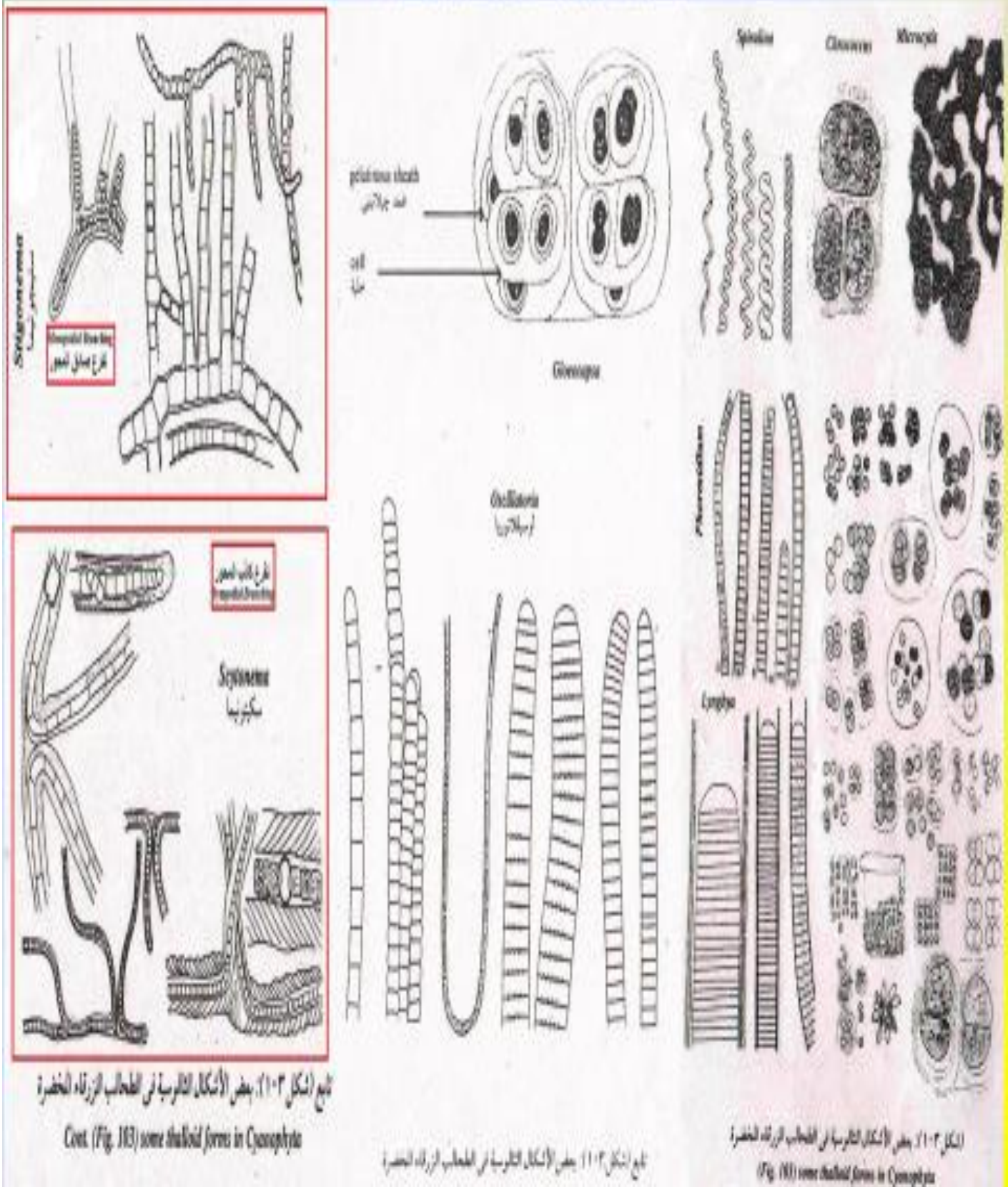


Thallus Structure:

1. **Trichome: A row of similar cells coated with gelatinous sheath.**
2. **It consists of one trichome or a number of trichomes branched or unbranched:**
   - ***Monopodial* Branching (branched): *Oscillatoria, Phormidium, Lyngbya, Nostoc***
   - **Or *Sympodial* Branching (Unbranched): *Scytonema, Stigonema.***
3. **They divide by binary fission and live in colonies.**
4. ***Hormogonium*: Portion of a filament that is detached as a reproductive body.**
5. ***Heterocyst*: Specialized nitrogen-fixing cells formed during N starvation. They are enlarged cells with thick walls, lacking chlorophyll. At these cells division takes place.**



Thallus Structure



تابع (شكل ٣-١٠٢): بعض الأشكال التالوسية في الطحالب الزرقاء الخضراء

Cont. (Fig. 10.3) some thalloid forms in Cyanophyta

تابع (شكل ٣-١٠٢) بعض الأشكال التالوسية في الطحالب الزرقاء الخضراء

(شكل ٣-١٠٢) بعض الأشكال التالوسية في الطحالب الزرقاء الخضراء

(Fig. 10.3) some thalloid forms in Cyanophyta

Reproduction:

- **There are two types of reproduction:**
  1. **Vegetative: By binary fission.**
  2. **Asexual: By spores:**

     - *Akinetes* : found singly close to the *Heterocyst.*

     - *Endospores*: Many cells with thick-walls.

     - ***Exospores*: Many cells with thin walls. Spores liberates to the outside.**
     - ***Nanospores* : Many cells, small in size with no cell wall.**

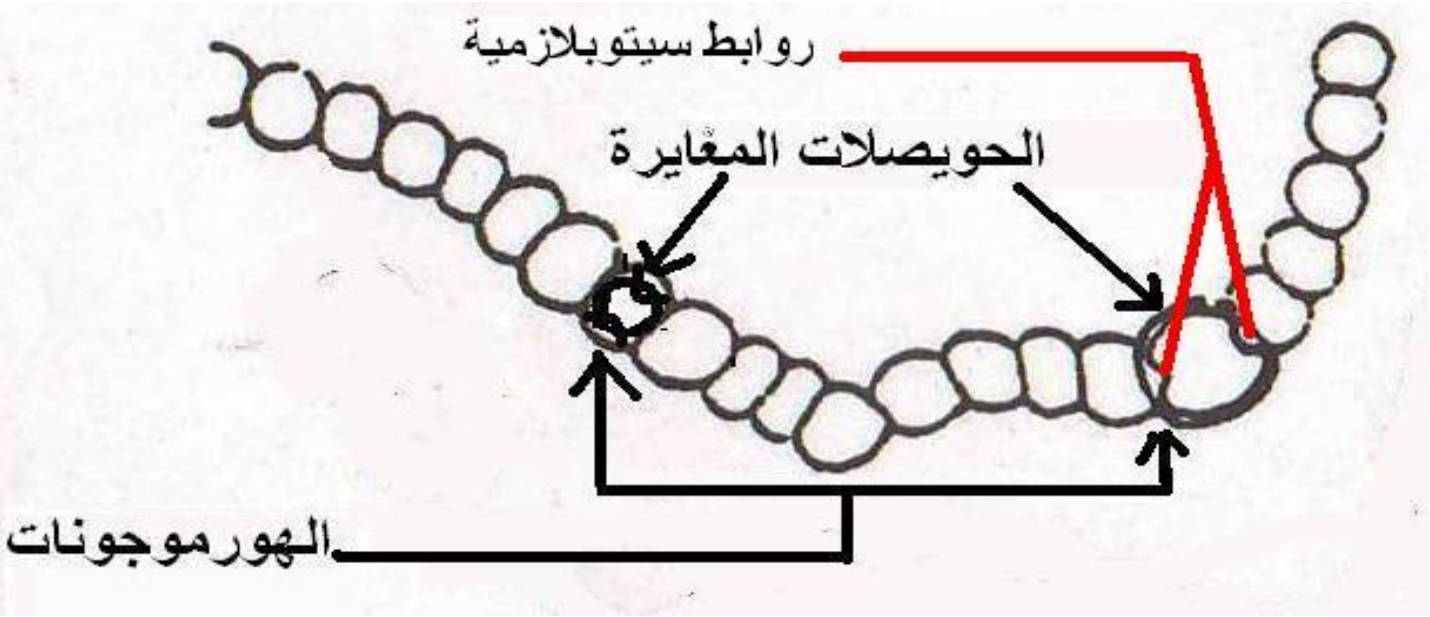
(شكل ١٠٤): جراثيم خارجية Exospores
طحلب كاميسيفون Chaemosiphon

Heterocysts and their importance:

- ***Heterocysts*: Formed from the binary fission of vegetative cell. They later became pale in color and their walls get thicker where some changes occur:**
  1. **They are connected to vegetative cells by cytoplasmic strands.**
  2. **An internal cellulosic wall is formed.**
  3. **An *Akinete* spore is found close to it.**

- **Importance:**
  1. **They are centers of starch formation.**
  2. **They have the ability to fix-nitrogen.**
  3. **A way for asexual reproduction**
  4. **Secrete substances that help in growth and division.**
  5. **They have a strong connection to and filament branching.**
- **Formed due to:**
  1. **Low amount of light.**
  2. **Excess amount of phosphates.**
- **Not formed due to:**
  1. **Excess amount of Nitrogen.**

Nostoc:



Reproduction by:

1. **Filament fragmentation.**
2. ***Hormogonia***
3. ***Akintes***
4. ***Hormogonium* becomes active to give a new filament**

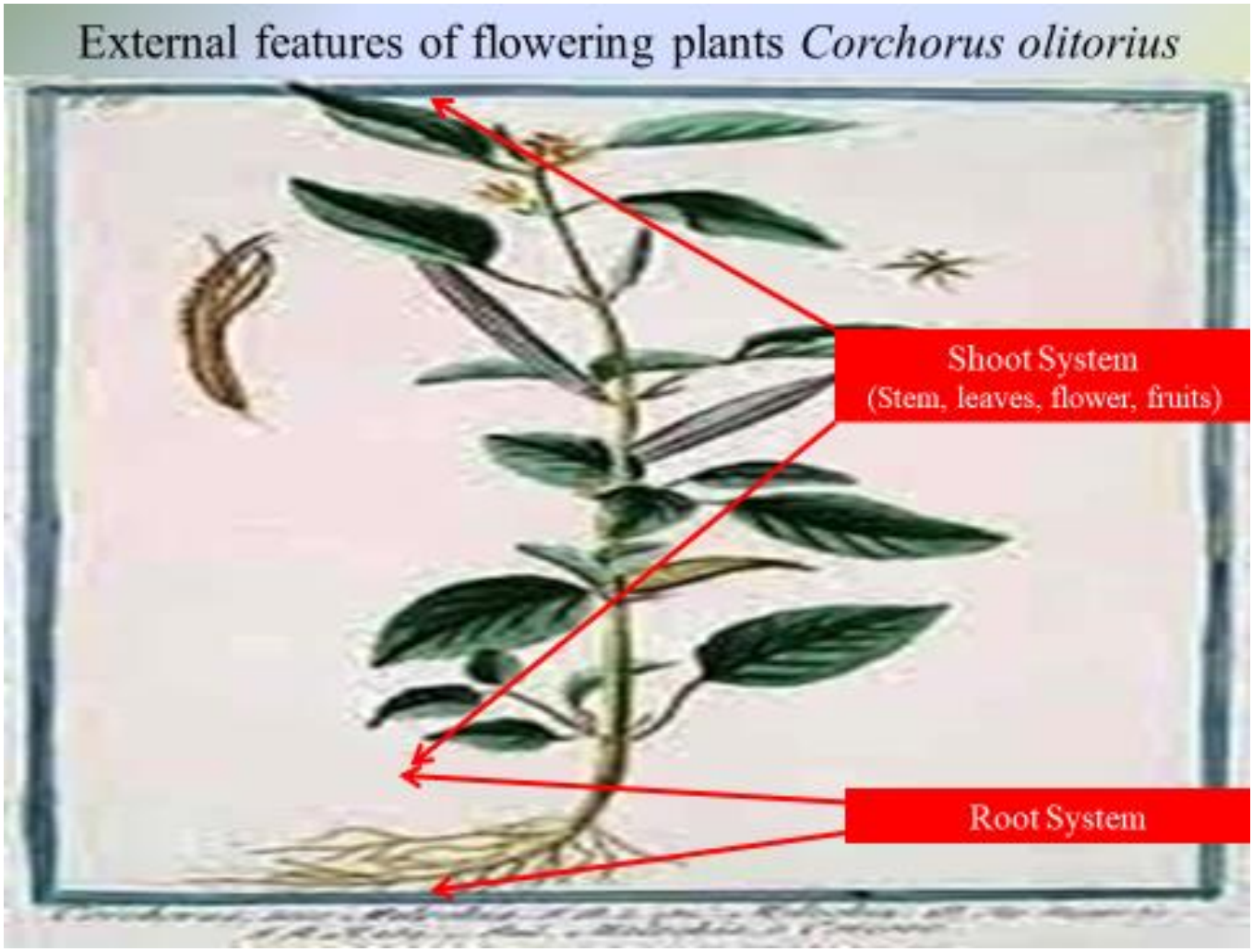
Part 2: Plant Morphology

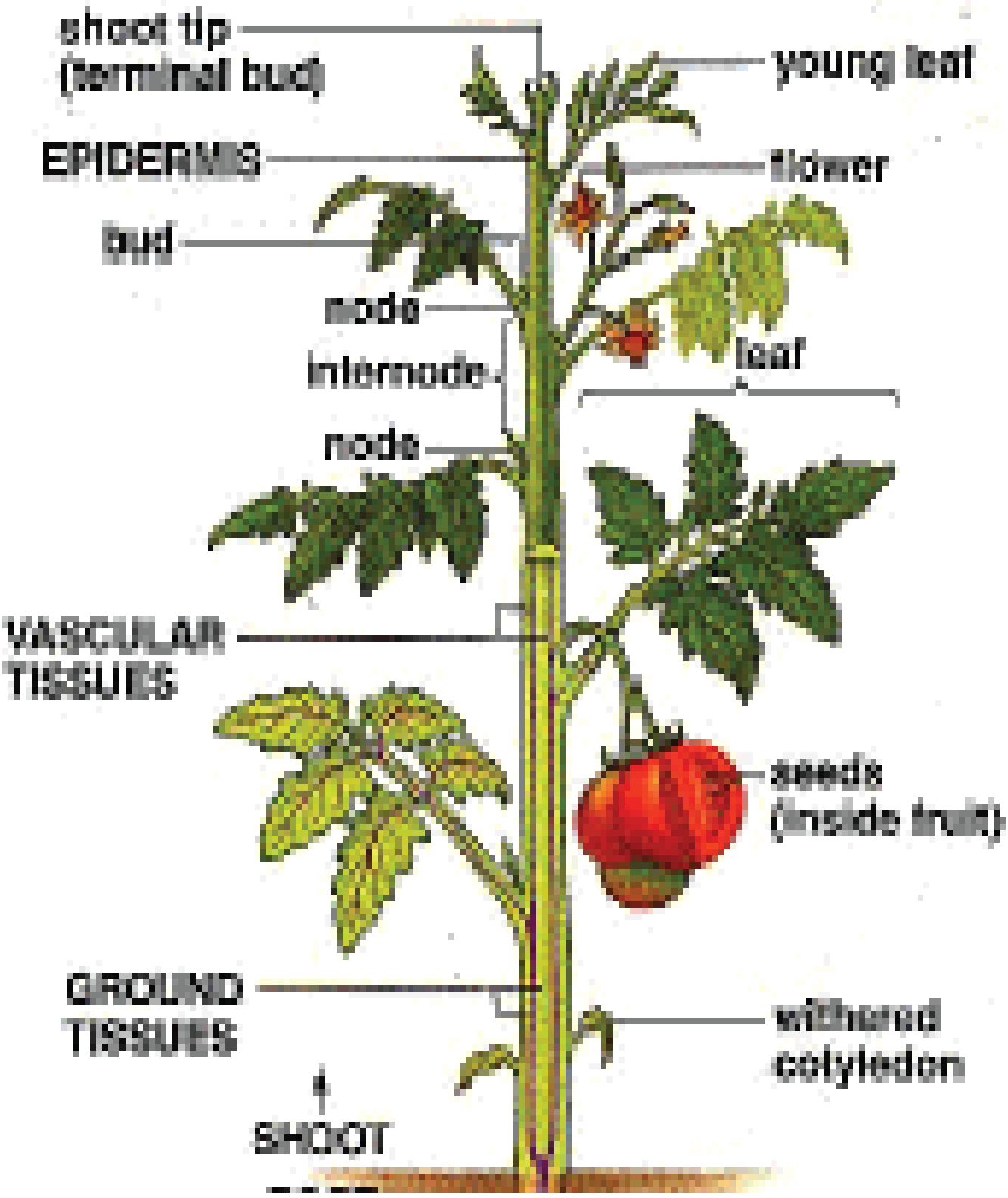
Prepared by: Dr. Azza Misk

External features of flowering plants:

Most plant consists of two parts:

1. **Shoot System: which lies above ground and is characterized into the Stem, leaves, flower, fruits.**
2. **Root System: which lies in most plants in the underground where the root carries the secondary roots and rootlets.**




shoot tip
(terminal bud)
young leaf
EPIDERMIS
flower
bud
node
internode
leaf
node
VASCULAR
TISSUES
seeds
(inside fruit)
GROUND
TISSUES
withered
cotyledon
SHOOT

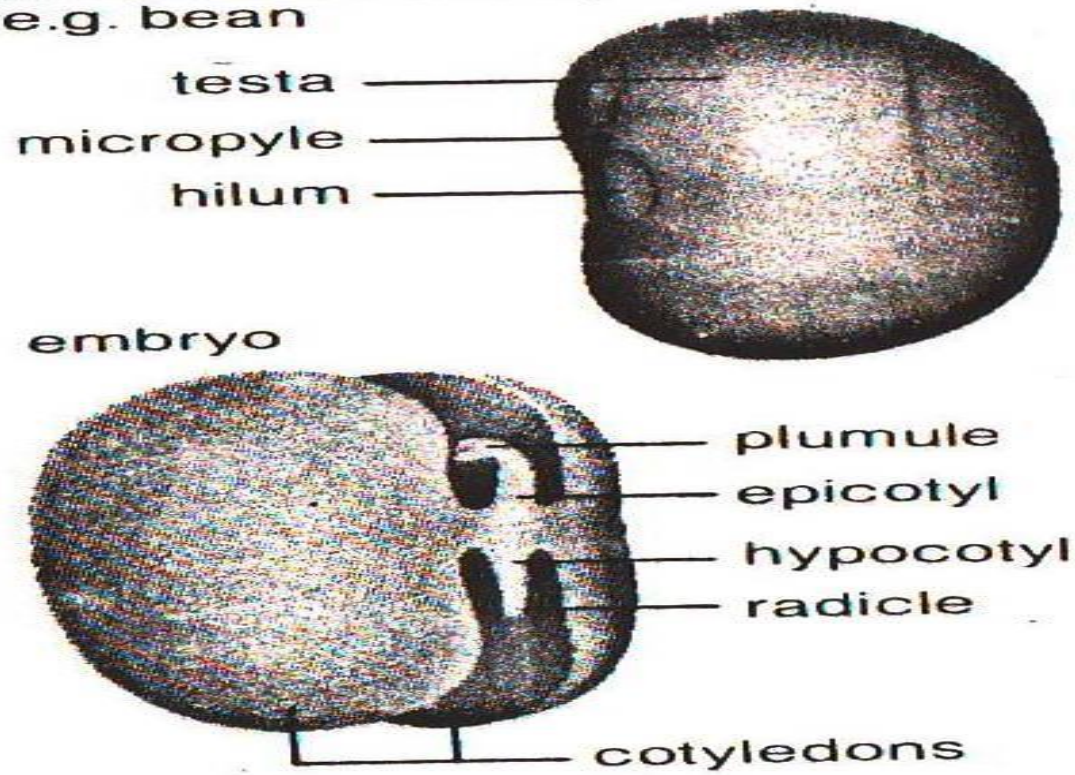
The Seed

- **<u>Seed:</u> A fertilized ovule. It consists of; a young *Dicot* plant called the Embryo in dormancy; feeds on a variable amounts of Endosperm (seed is <u>Endospermic</u> where it appears small in size) or none (seed is <u>Exendospermic</u> where it appears fleshy and large); and protective layers Testa. It has only one scar that represents the Hilum.**

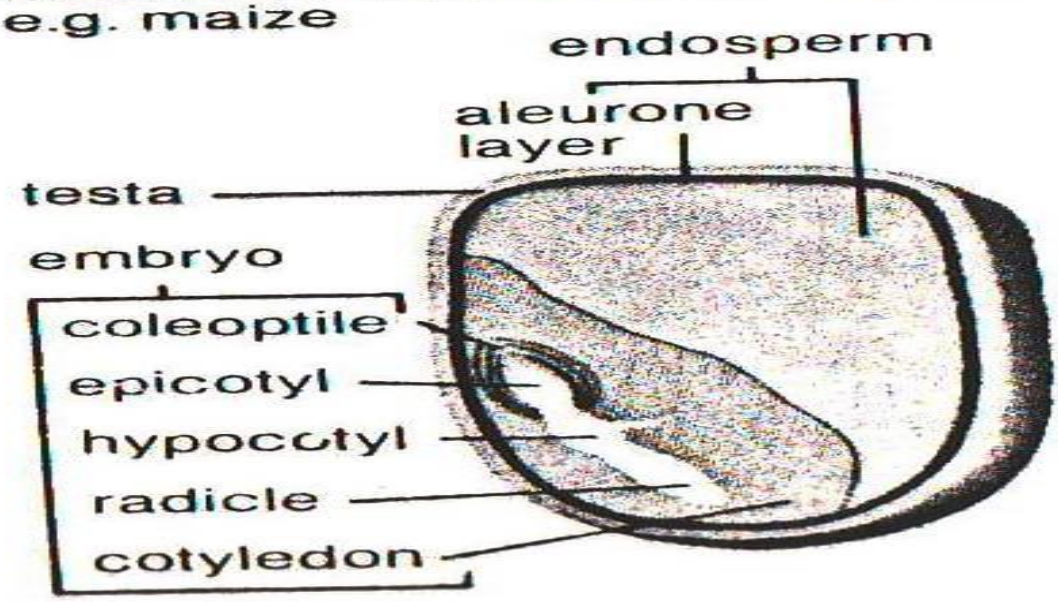
- **<u>Embryo</u>: It consists of one (Monocot) or two (*Dicot*) leaves Cotyledons; primary root Radicle; primary shoot Plumule.**
- **<u>Types of Seeds</u>:**
  - **<u>Endospermic (*Albuminous)* Seed:</u> A young embryonic plant with reserve food material to supply the developing embryo in its early stages of germination where it is kept outside the embryo in a separate tissue known as Endosperm. The seed is usually <u>small</u> in size.**
  - **<u>Exendospermic (*Exalbuminous)* Seed:</u> A young embryonic plant with no endosperm where the seed is <u>large</u> and the reserve food is stored in the cotyledons.**
- **<u>Grain:</u> A fertilized ovary. It consists of; a young embryonic *Monocot* plant; two scars : one represent the point of attachment to the style and the other is the point of attachment to the receptacle (Hilum).**
- ***<u>Micropyle</u>*: a hole where the seed obtain its water.**
- ***<u>Caruncle</u>* : a spongy tissue above the Micropyle**
- ***<u>Testa</u>* : Protective layers covering the embryo.**

- **<u>Types of Germination</u>:**
  1. ***<u>Hypogeal</u>*: Elongation of the *Epicotyl.***
  2. ***<u>Epigeal</u>*: Elongation of the *Hypocotyl***

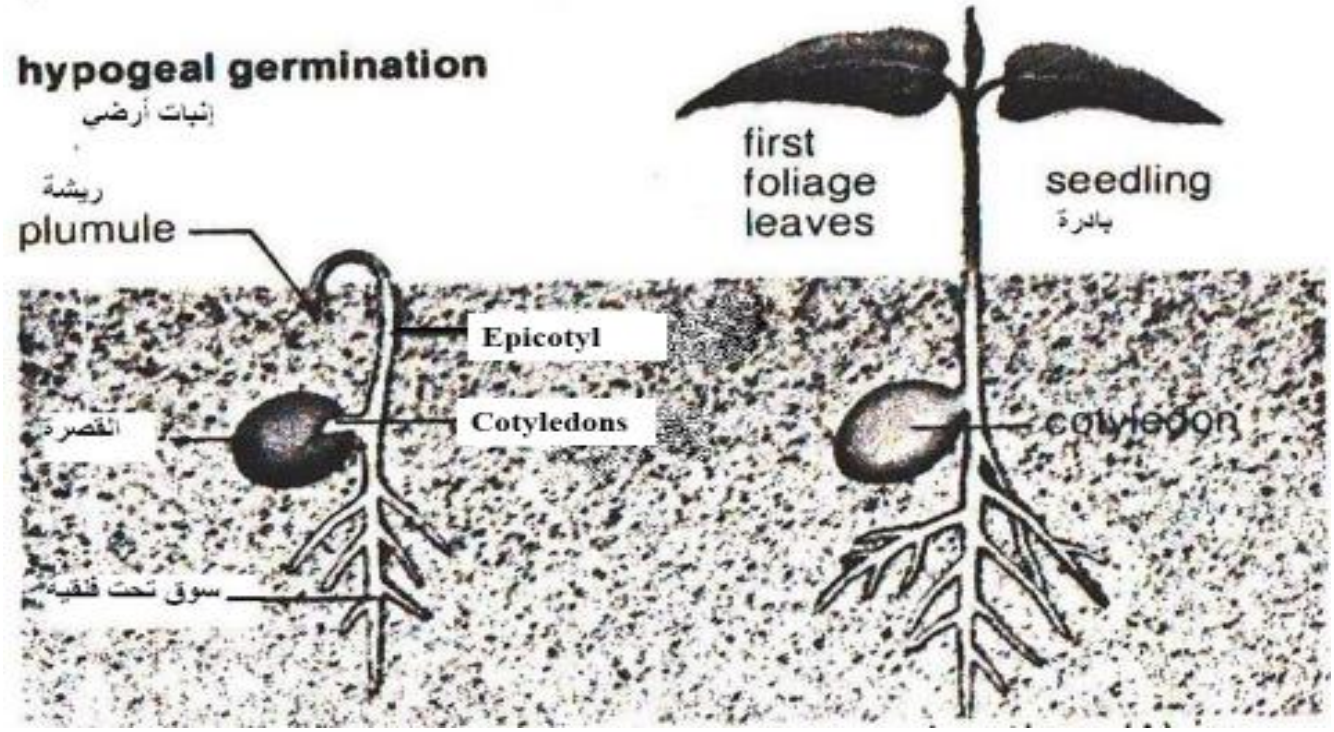
exalbuminous seed
food stored in cotyledons
e.g. bean



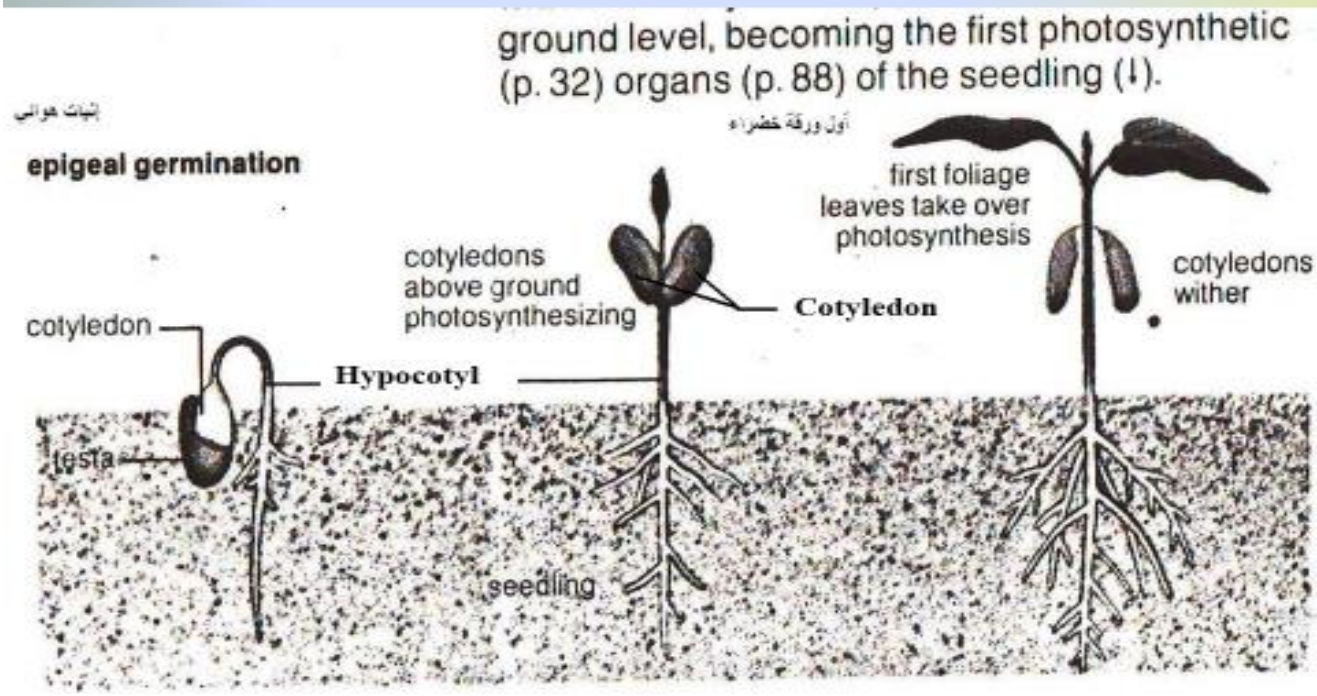
albuminous seed
most food stored in endosperm
e.g. maize



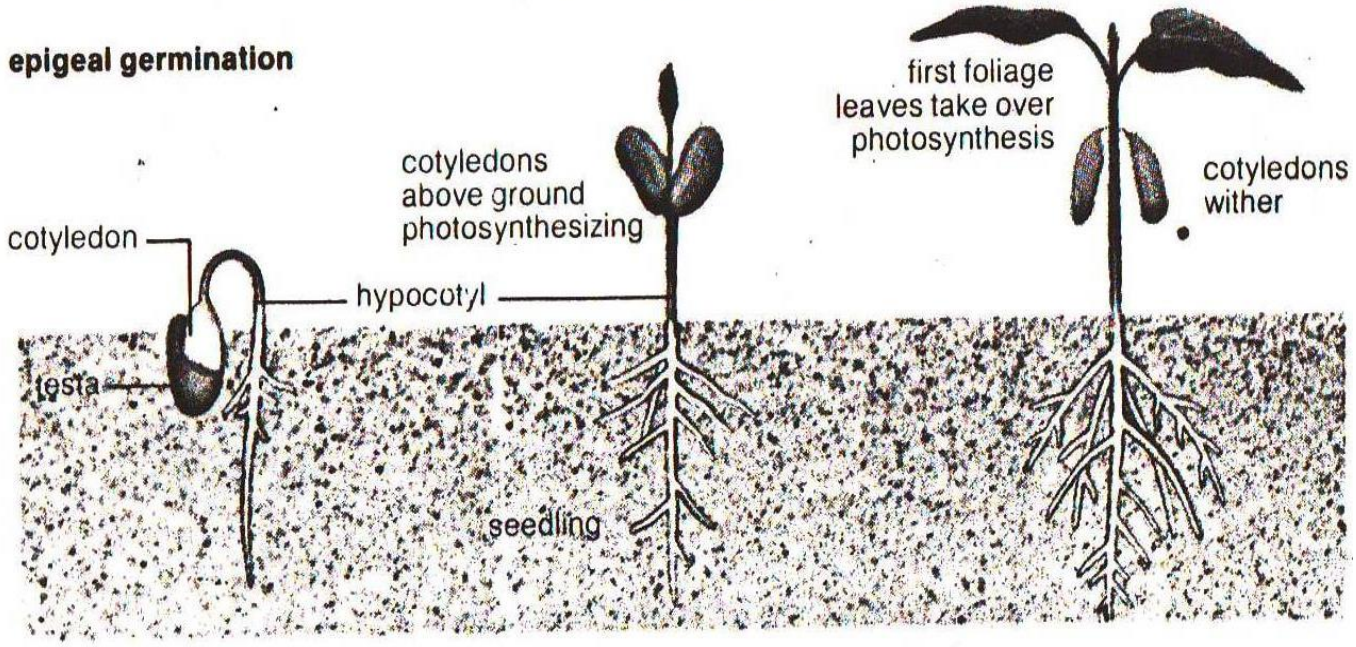
Hypogeal Germination

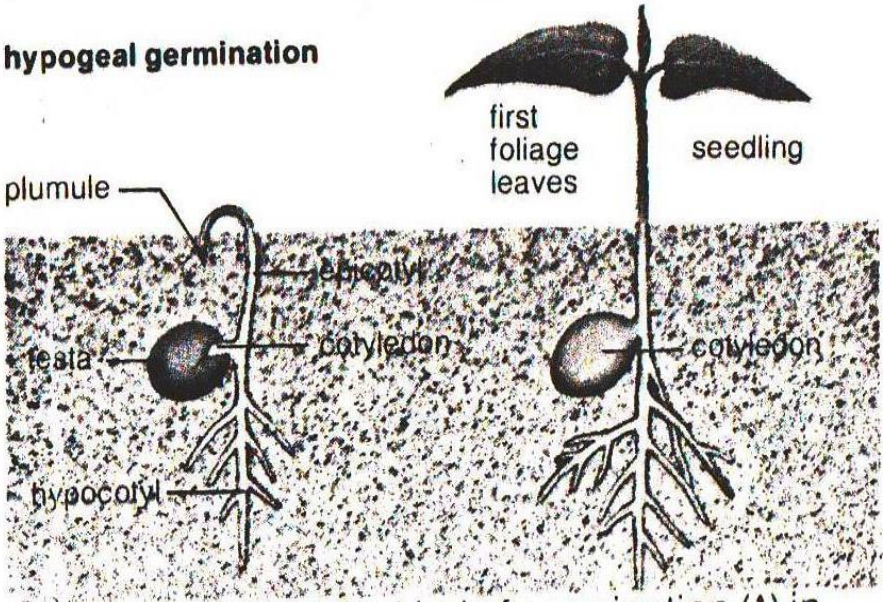


Eipogeal Germination



ground level, becoming the first photosynthetic (p. 32) organs (p. 88) of the seedling (↓).





hypogeal (*adj*) of the kind of germination (↑) in which the cotyledons (↑) remain below ground. Their stored food is used up in the early growth of the epicotyl (↑) and the hypocotyl (↑).

seedling (*n*) a young plant growing from its seed. It is usually called a seedling until it loses its cotyledons (↑).

Conditions necessary for germination:

- **<u>Internal</u>: (Concerning the Seed):**

  Vitality of the Embryo: It depends on the dormancy period of the embryo, seed storage in dry silos (water content of the seed is 1%). Some need long dormancy periods, short or no dormancy at all; it is according to the seed type and nature:

  1. ***Testa* Hardness**
  2. **Incomplete growth of the embryo.**
  3. **Genetic factors**

- **<u>External</u>: (Concerning environmental conditions):**

  1. Humidity (Water Content) **2.Oxygen**

  3.Temperature **4. Light**

- **<u>Other Factors</u>: *i.e.* mechanical removal of the Testa by:**

  1. Oxygen **2. Radiation**

  3. Acids **4. High Temperature**

  5. Mixing the host seeds with parasite seeds

Changes occurring in seed during germination:

<u>Seed changes during soaking in water</u>:

- **<u>Physical</u>: 1. Increase in Size** **2. Breakage of *Testa***
- **<u>Chemical</u>:**

  1. **<u>Catabolism</u>: the dissolution of the solid complex reserve food material to simple one through enzymatic activity.**
  2. **<u>Enzymatic Activity</u>:**

     Starch $\xrightarrow{\text{Diastase}}$ **Monosaccharide sugar**

     Protein $\xrightarrow{\text{Protease}}$ **Amino acids**

     Lipids $\xrightarrow{\text{Lipase}}$ **Triglyceride acids + Glycerin**

- **Vitality:**

  Physiological Activity:

  1. **The protoplasm turns from gel to sol (semi-solid).**
  2. **Cells get turgid (enlarged)**
  3. **Growth of the radicle and then the plumule.**
  4. **The seed becomes a seedling by forming its 1st foliage leaf.**

Stages of Germination

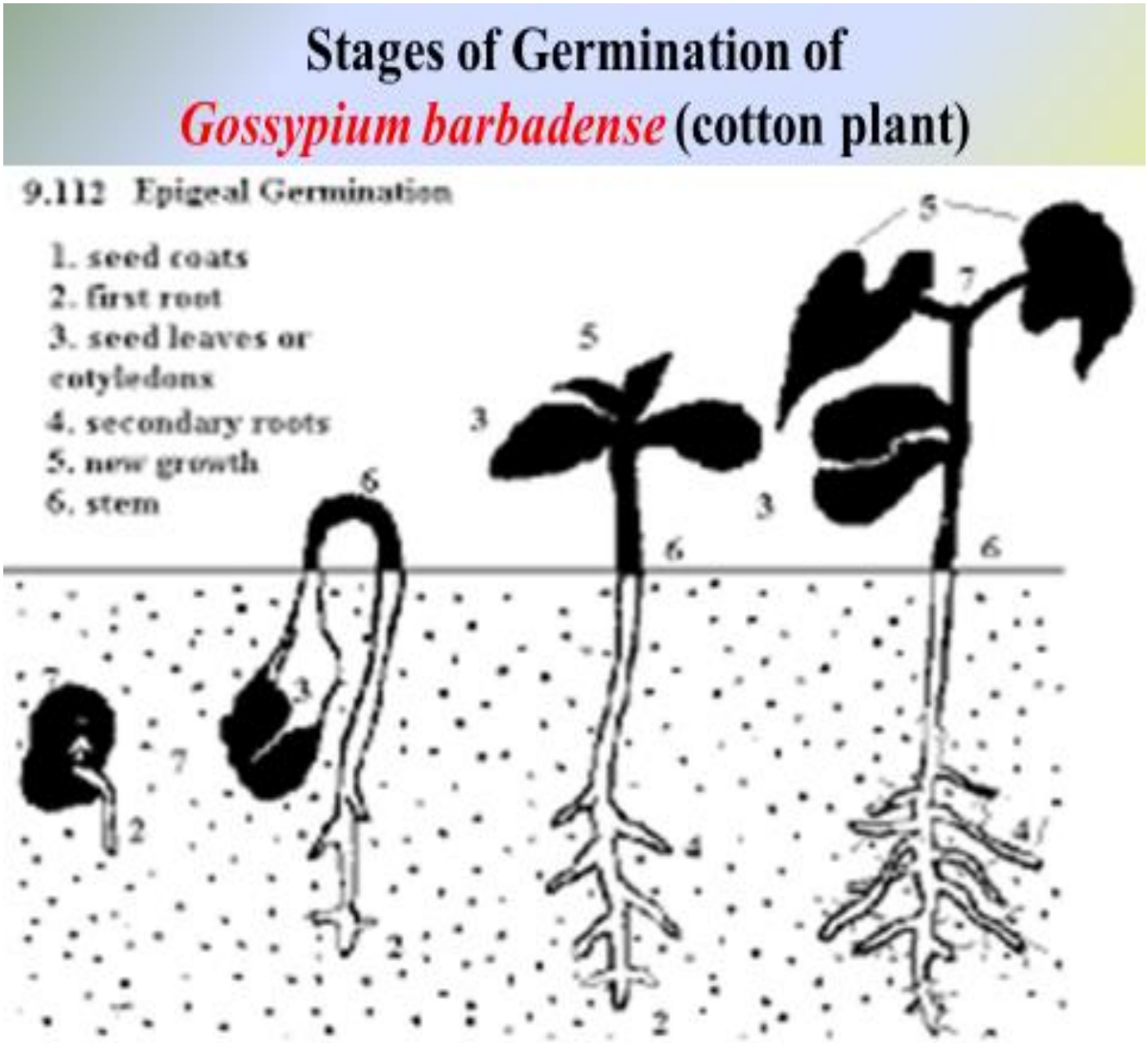
1st Stage: Swelling of seed and removal of *Testa*.

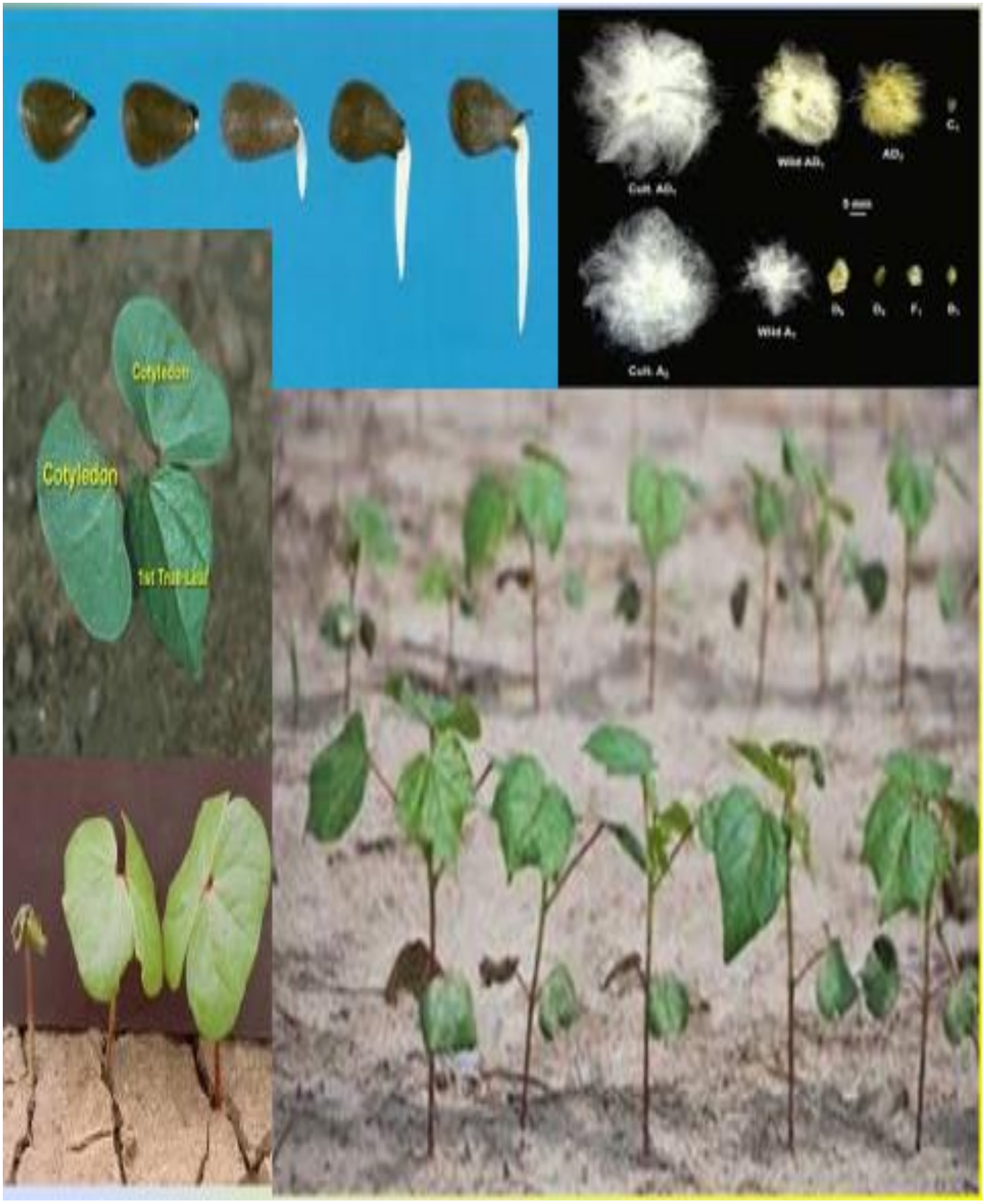
2nd Stage: Growth of Radicle.

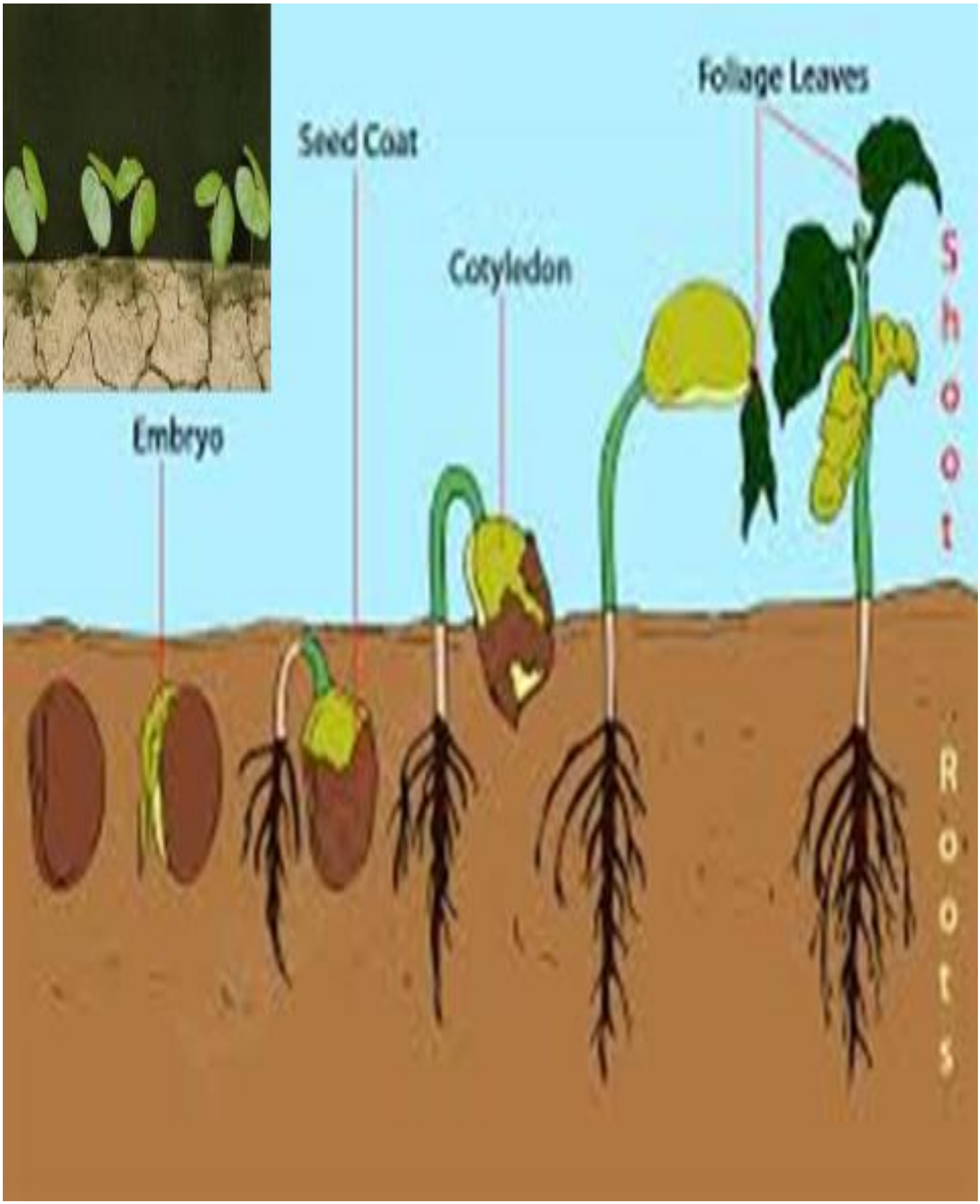
3rd Stage: Growth of Plumule.

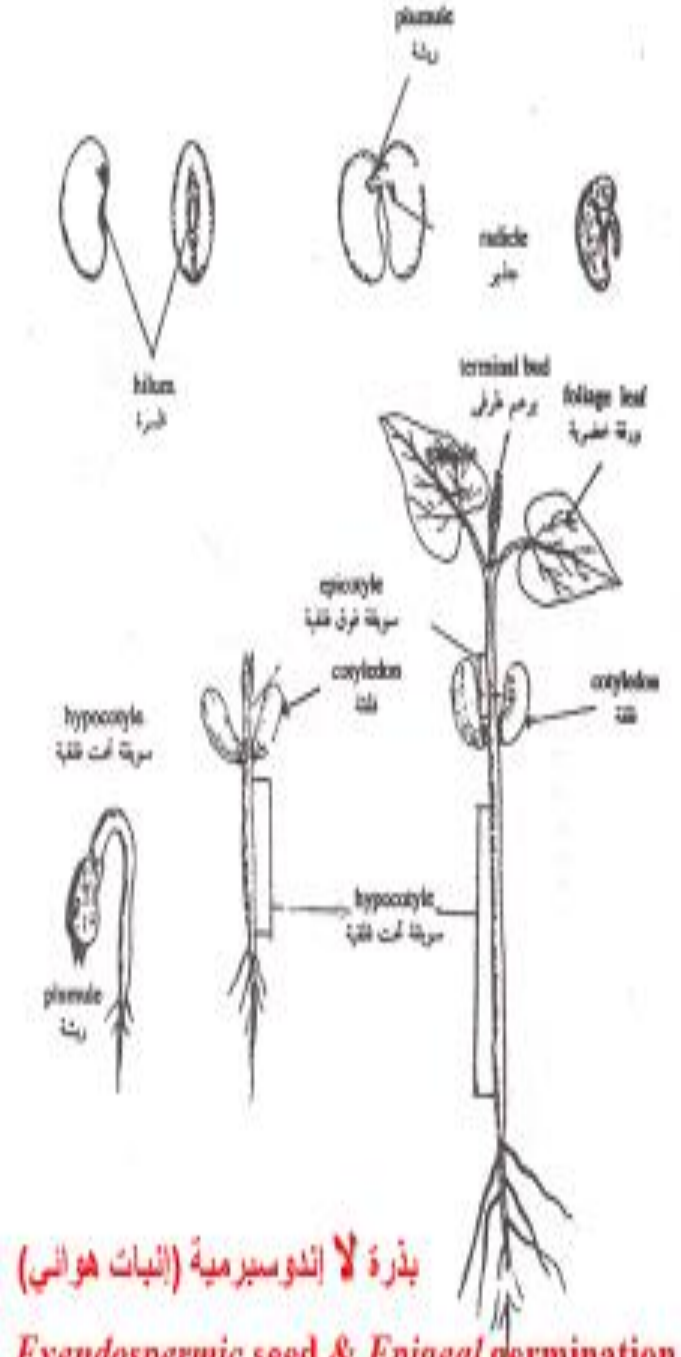
4th Stage: Formation of the first foliage leaf.

Examples of *Dicotyledonous* Seeds and seedlings




Cotyledon
Cotyledon
1st True Leaf


Foliage Leaves
Seed Coat
Cotyledon
Embryo
Shoot
Roots

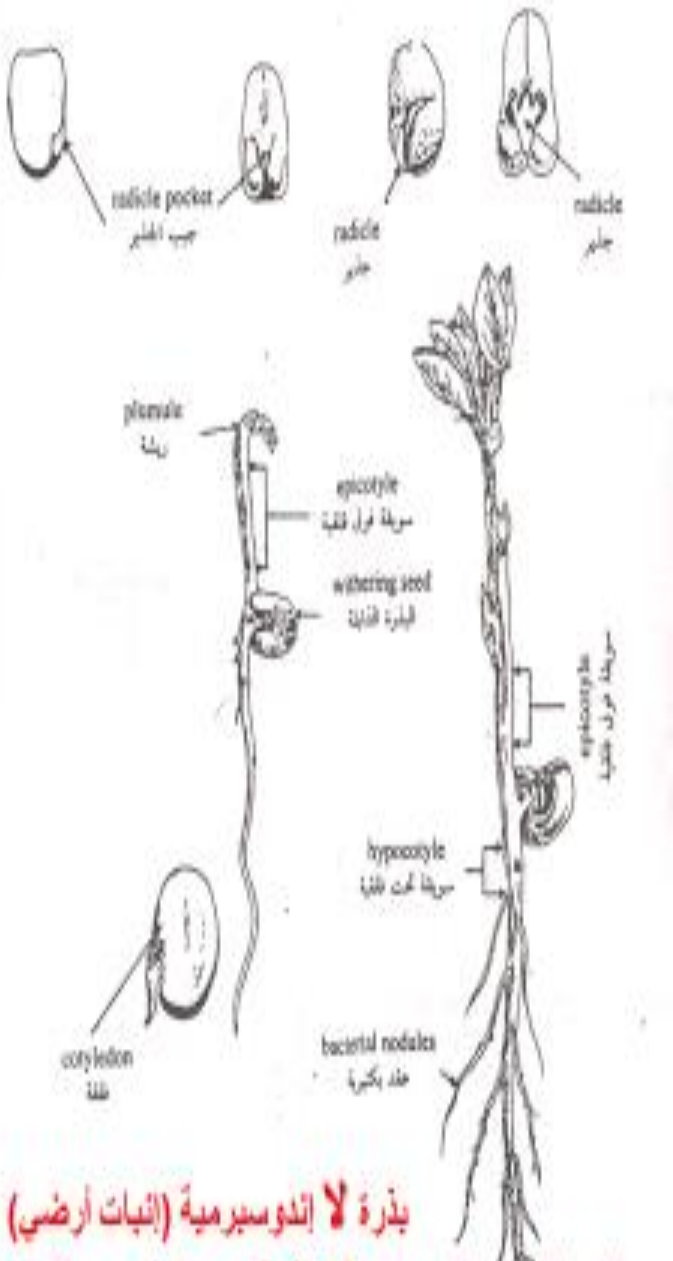


بذرة لا إندوسبرمية (النبات هوائي)

Exendospermic seed & *Epigeal* germination

(Fig. 31) Phaseolus vulgaris seed & germination.

(شكل ٣١): بذرة نبات الفاصوليا وإنباتها

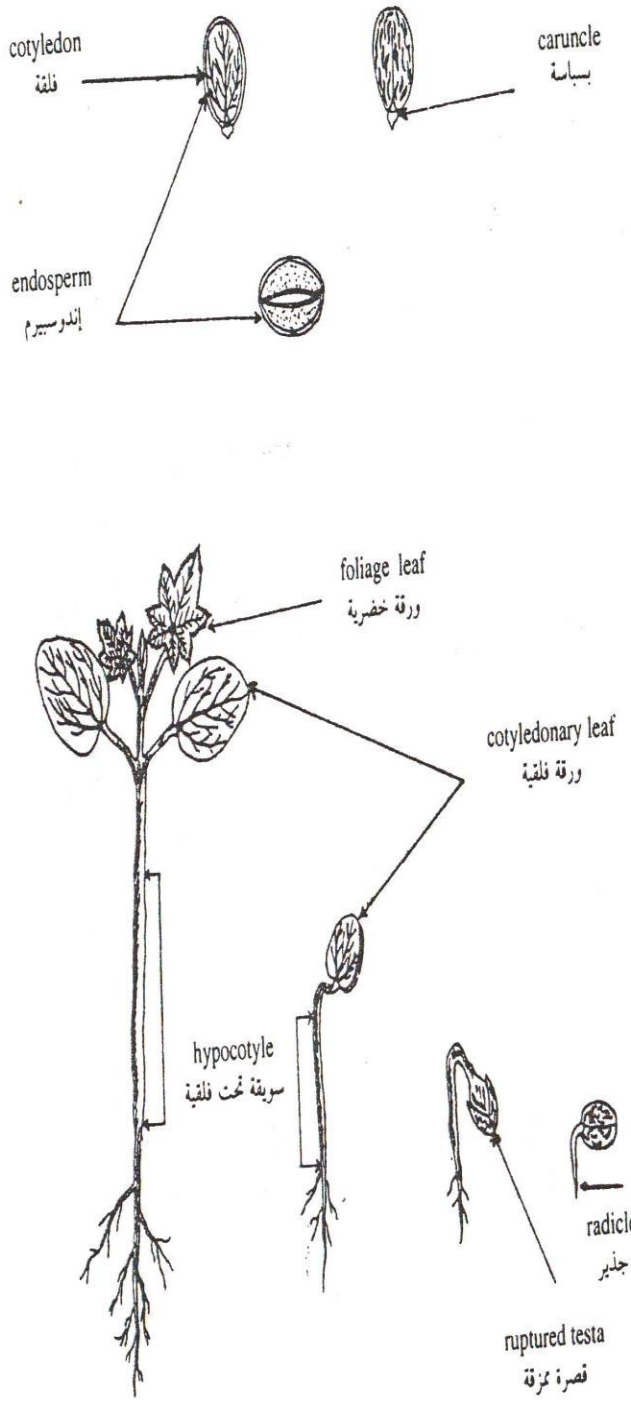


بذرة لا إندوسبرمية (إنبات أرضي)

Exendospermic seed & *Hypogeal* germination

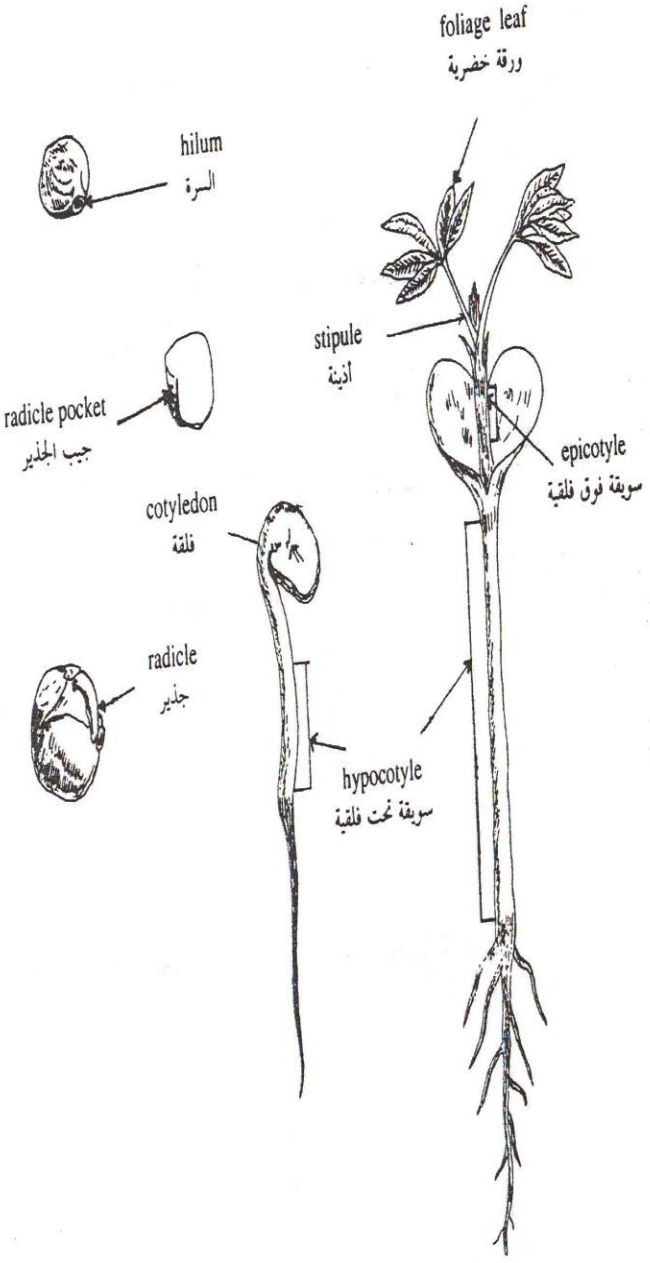
(شكل ٣٠): بذرة الفول الرومي وإنباتها

(Fig. 30) vicia faba seed & germination.



(Fig. 32) Ricinus communis seed & germination.

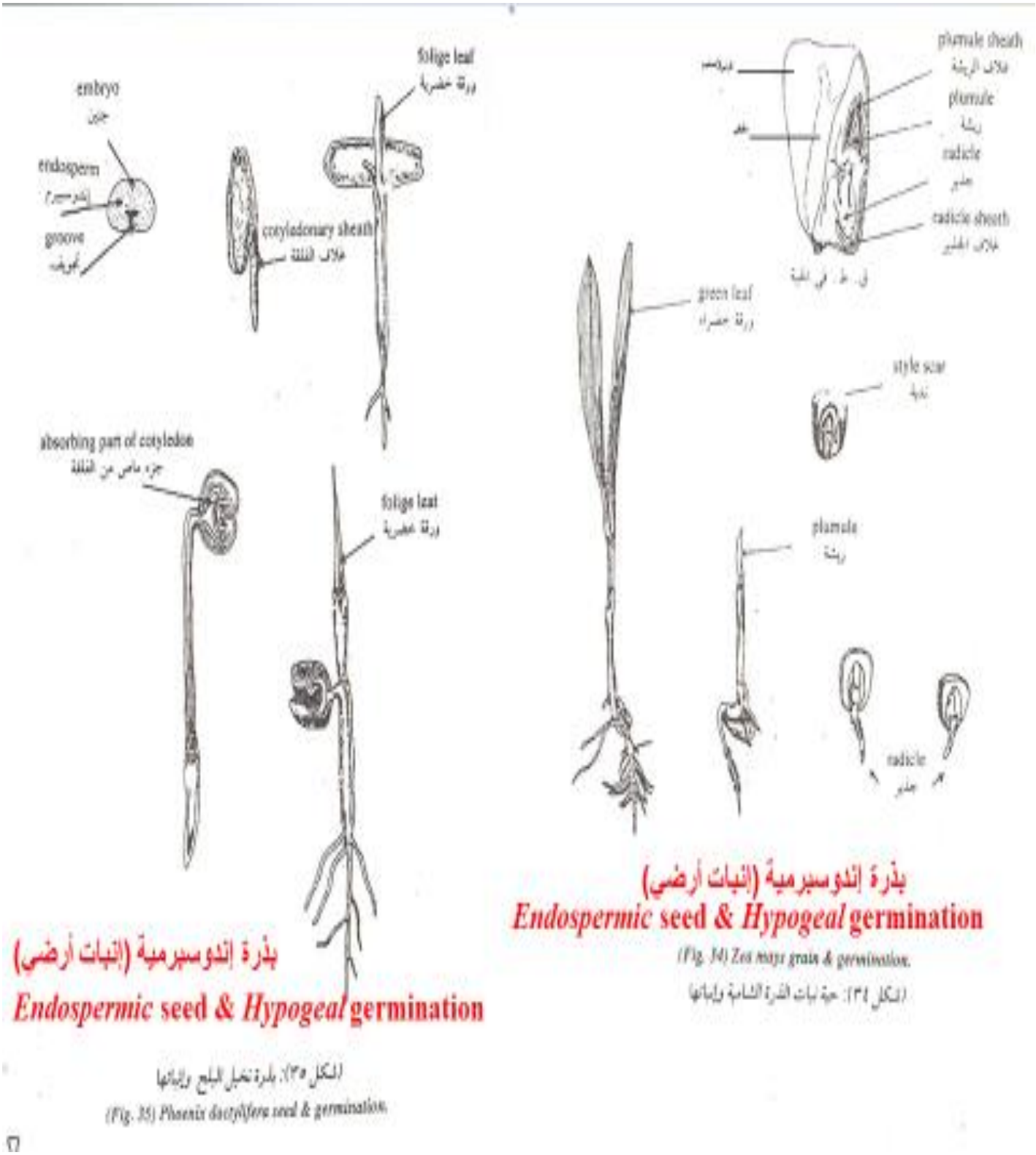
(شكل ٣٢): بذرة نبات الخروع وإنباتها



(Fig. 33) Lupinus termis seed & germination.

(شكل ٣٣): بذرة نبات الترمس وإنباتها

Examples of *Monocotyledonous* Seeds and seedlings



Roots

- **Function:**

  1. Absorption 2. Anchor 3. Storage

- **Root forms:**

  1. **Smooth.**
  2. **Whitish or yellowish in color**
  3. **Tapering towards the end.**

- **Root Structure:**

  1. **Growing apex: A root cap protecting the delicate meristemtic cells (of growing point at the tip of the root) from injury. The root cap (Calyptra) is slimy to allow the root to slide easily in its course. It is continuously torn away and renewed from the underlying meristem.**
  2. **Elongation zone: A bare zone next to the growing zone. The increase in length of the whole root takes place in this region.**
  3. **Absorption Zone: limited area of length and life-span (that does its function for a few days and then dies out). They are covered by numerous root hairs.**

- **Root can be characterized by the presence:**

  1. **Bare zone: It lacks any root hairs.**
  2. **Permanent Zone: lateral roots are produced in succession, the youngest being the nearest to the root hairs. Root branches are almost always endogenous.**

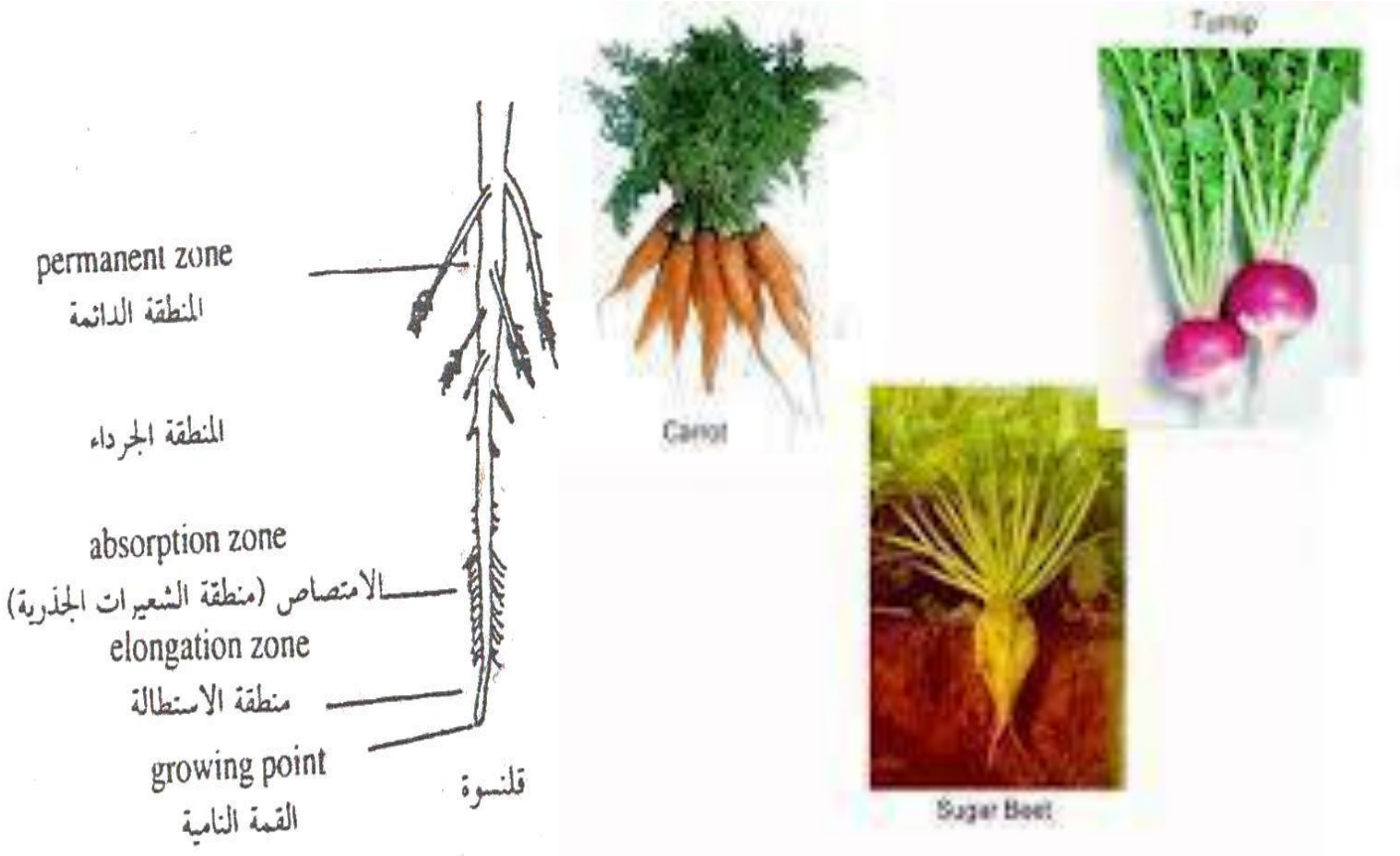
- **Root Forms:**

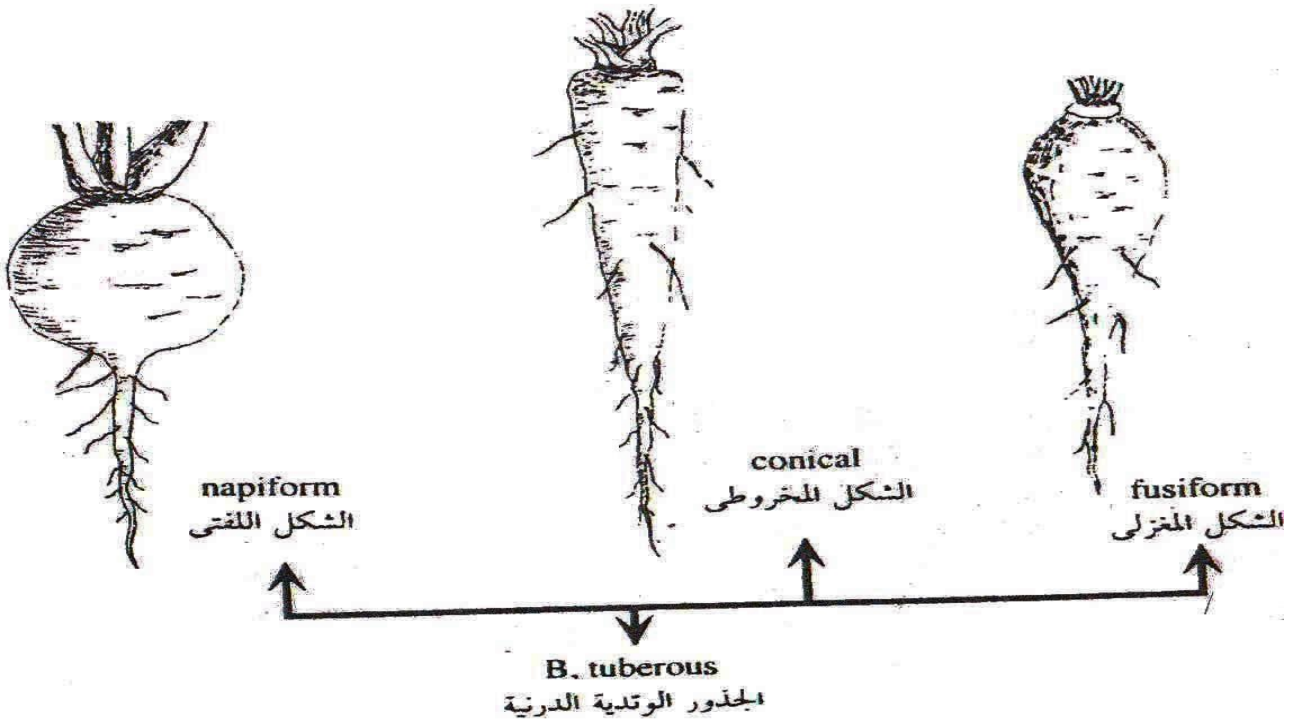
  1. **Primary Root: Originates from the embryo (radicle). It is divided into:**

     a. Normal Tap Root: Smooth, whitish or yellowish in color and tapering towards the end.

     b.Tuberous Root: It's thickened for storage, examples:

     - **Conical: *i.e.* Carrot**
     - **Fusiform: *i.e.* Radish**
     - **Napiform: *i.e.* Turnip**





(شكل ٣٦): الأنواع المختلفة للجذور الوتدية

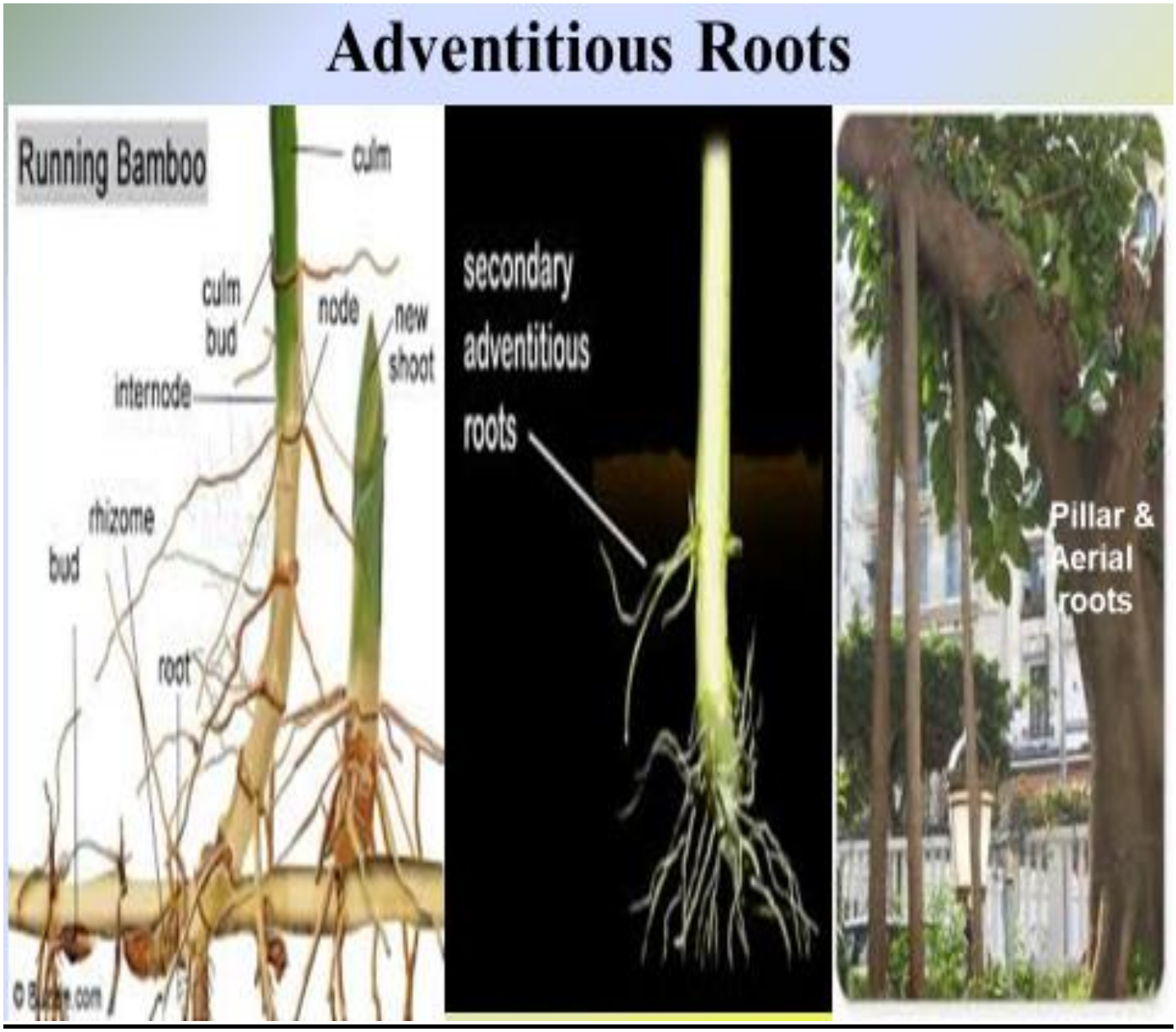
(Fig. 36) different types of tap roots.

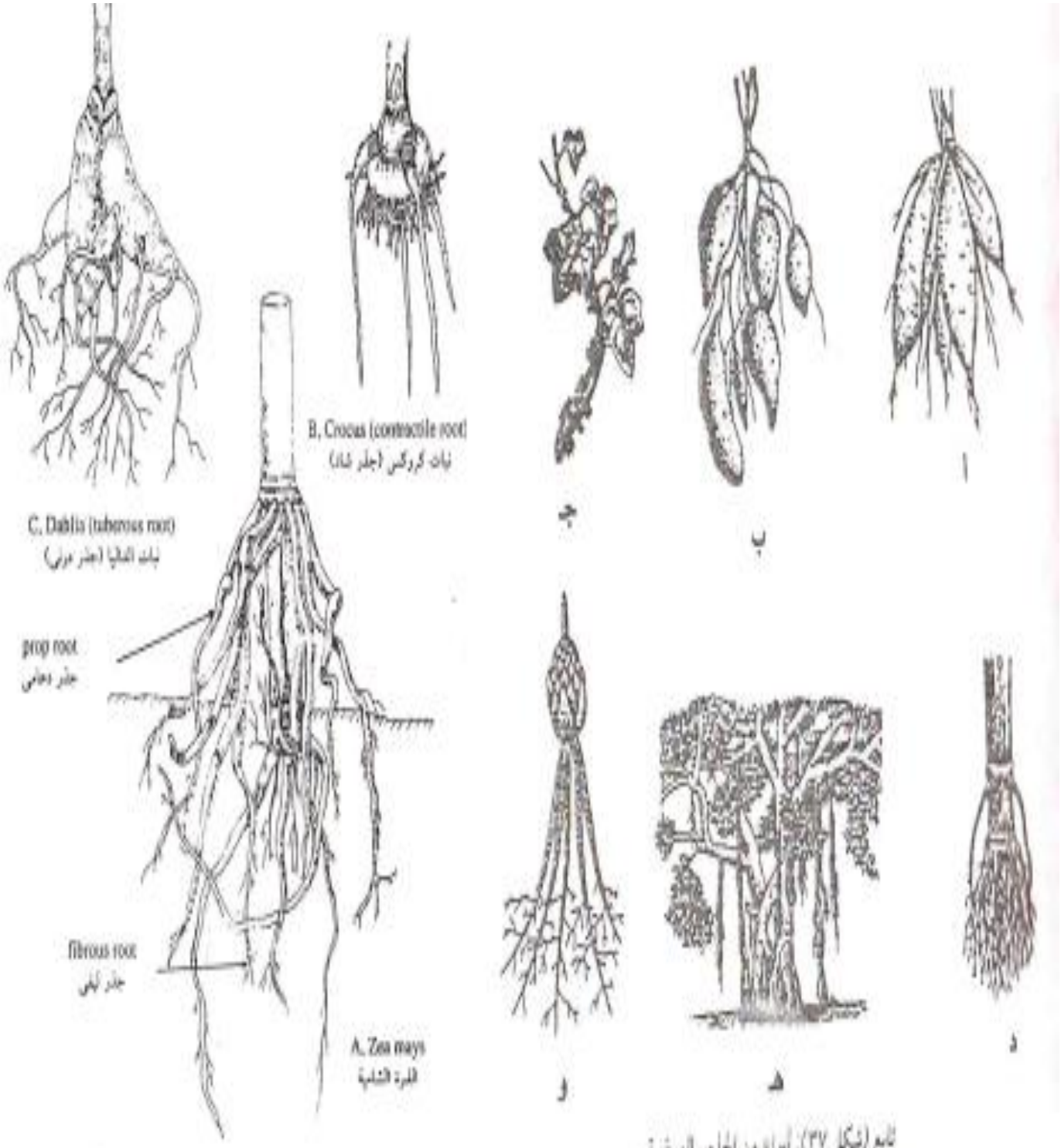
2. Adventitious Root: It arises from any parts of the plant *i.e.* stems and leaves. It is mostly found in *Monocots*. It is divided into:

1. Fibrous roots **2. Prop roots** **3. Storage roots**

4. Climbing roots **5. Aerial roots** **6. Haustoria**

7. Pillar roots **8. Contractile roots** **9. Respiratory roots**





(شكل ٣٧): الأنواع المختلفة للجذور العرضية

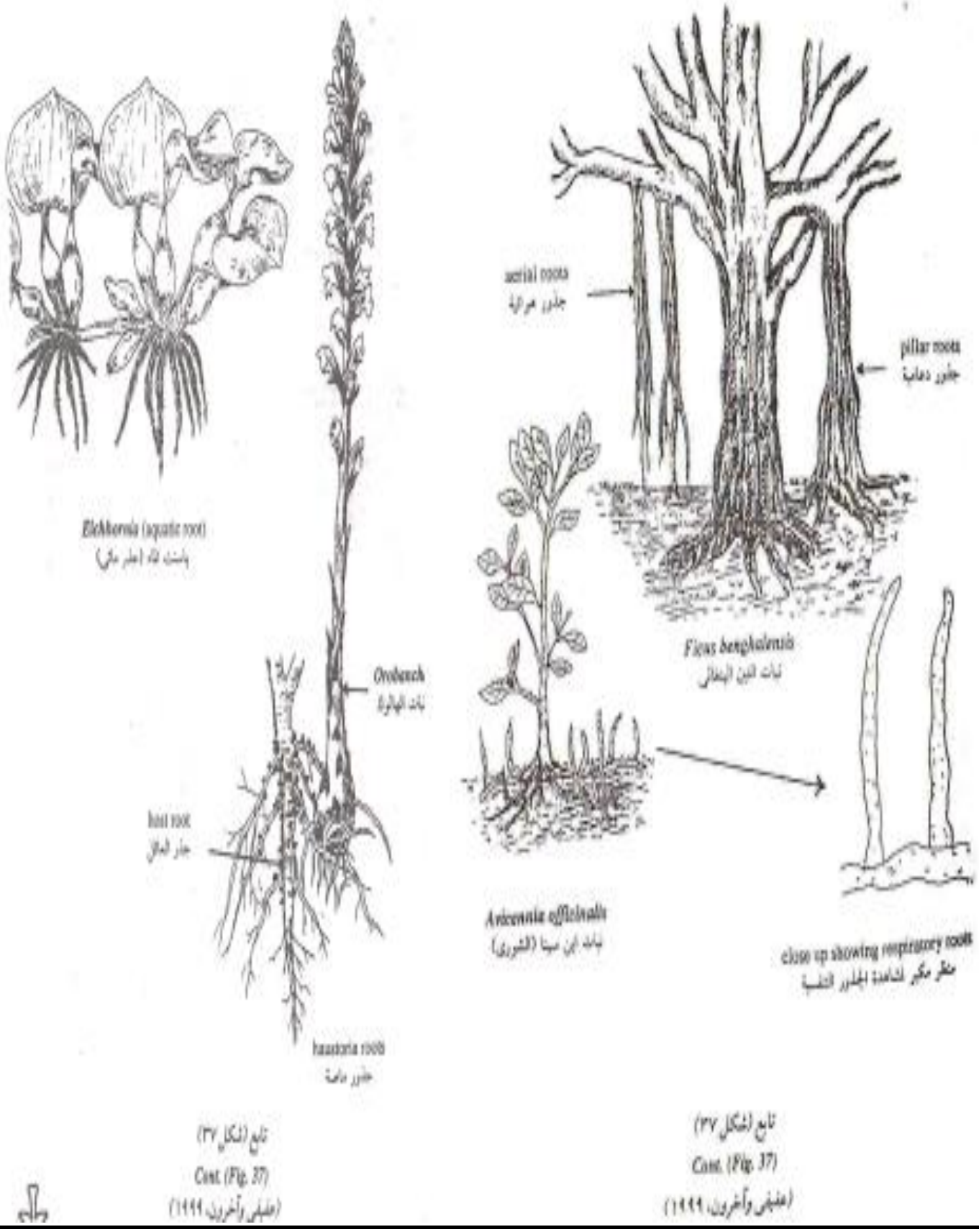
(Fig. 37) different types of adventitious roots

(عفيفي وآخرون، ١٩٩٩)

تابع (شكل ٣٧): أنواع من الجذور العرضية

Cont. (Fig. 37) types of adventitious roots

أ- جذور درنية في نبات الدالیا
ب- جذور درنية في نبات البطاطا
جـ- جذور معلاقية
د- جذور لبنية ومساعدة
هـ- جذور هوائية دعامية
و- جذور شادّة



تابع (شكل ٣٧)

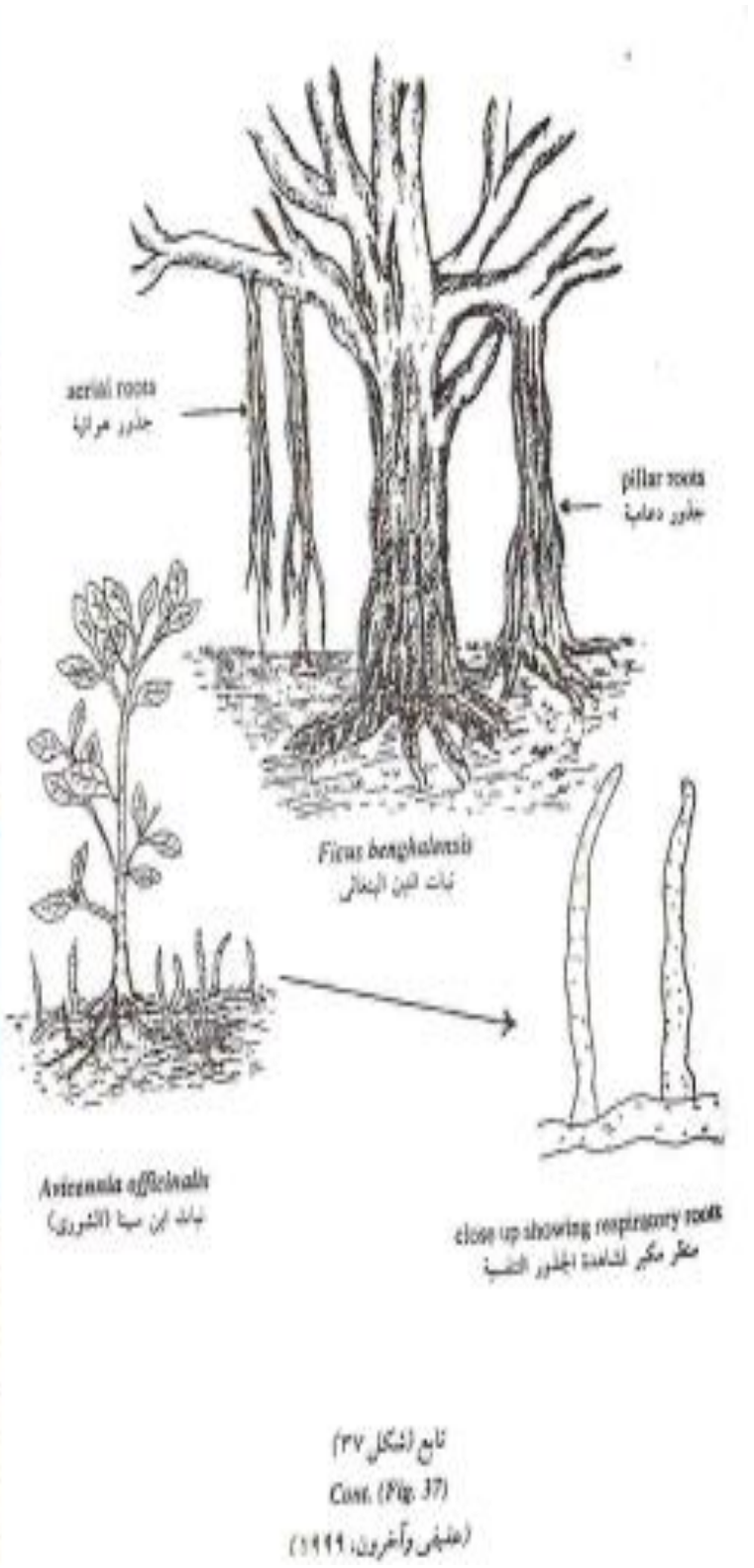
Cont. (Fig. 37)

(عفيفي وآخرون، ١٩٩٩)

تابع (شكل ٣٧)

Cont. (Fig. 37)

(عفيفي وآخرون، ١٩٩٩)



تابع (شكل ٣٧)

Cont. (Fig. 37)

(عفيفي وآخرون، ١٩٩٩)

Stems

- **Morphology of different Stems**

Definition:

It's a leaf-bearing axis. It arises from the plumule. In the majority of plants, the stem, the leaves, buds, flowers and fruits collectively constitute the Shoot System.

Function:

1. **It carries leaves, buds and flowers.**
2. **It conducts the Xylem and Phloem sap.**

Types of Stems:

1. **Aerial**
2. **Subterranean (underground)**

Nature of the Stem:

1. **Woody or Herbaceous**
2. **Erect or Weak (Prostrate, twining or runner)**
3. **Long or dwarf**

T.S. in Stems:

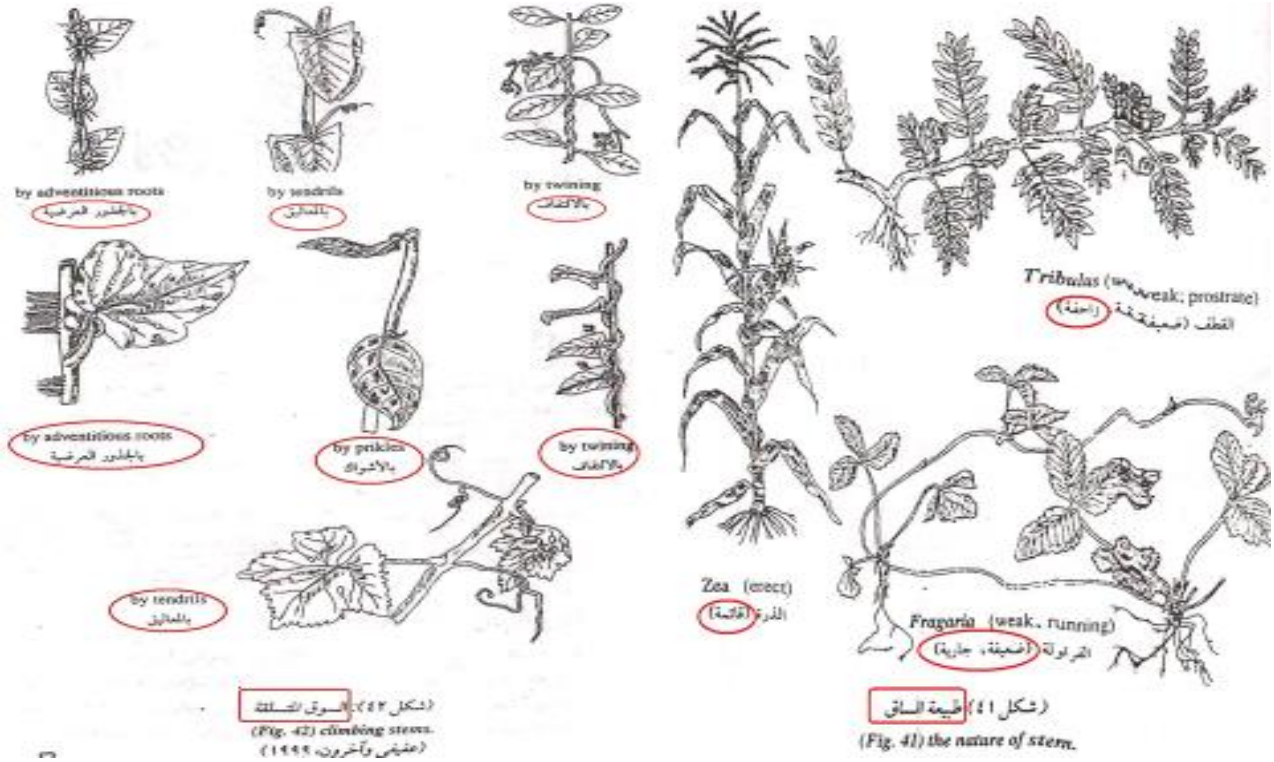
1. **Solid**
2. **Hollow**

Stem Outline:

1. **Circular**
2. **Flattened**
3. **Angular**

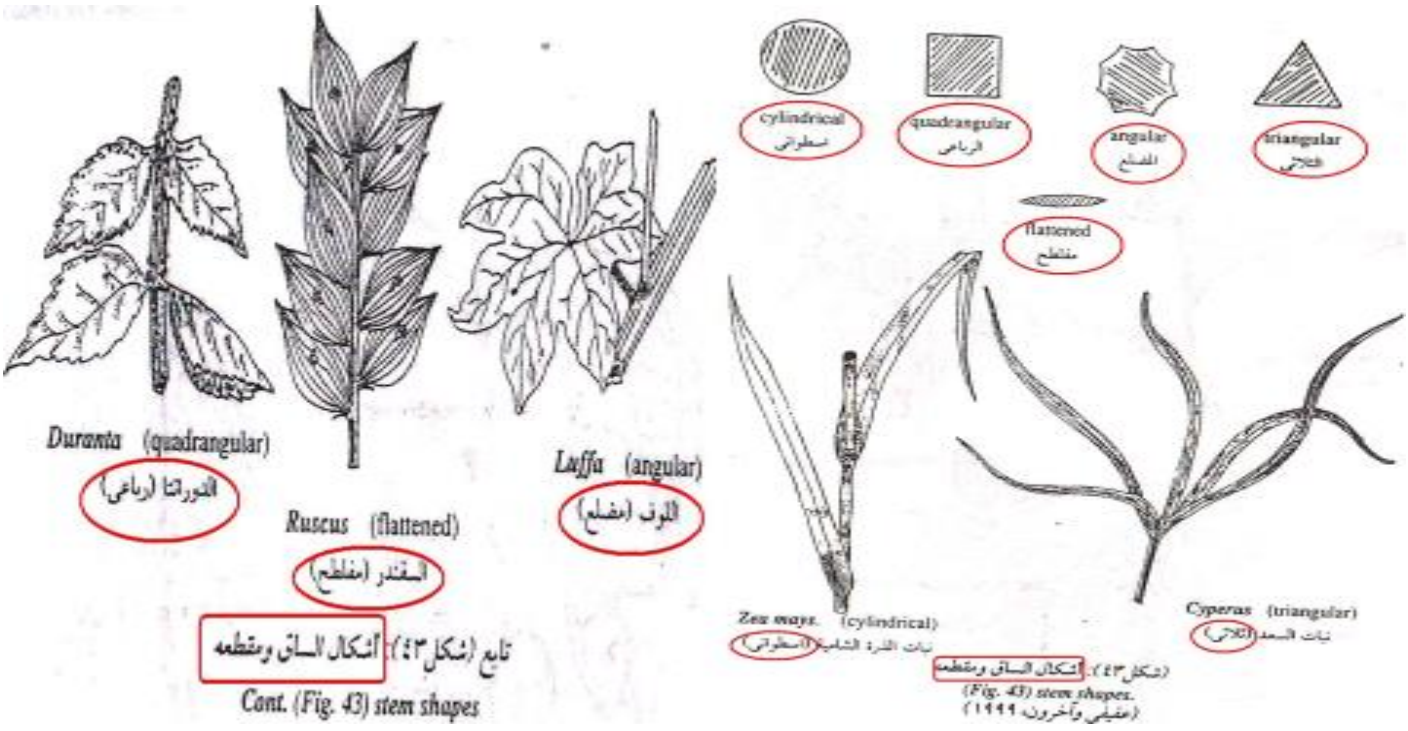
Surface:

1. **Smooth**
2. **Rough**
3. **Hairy or Prickly**



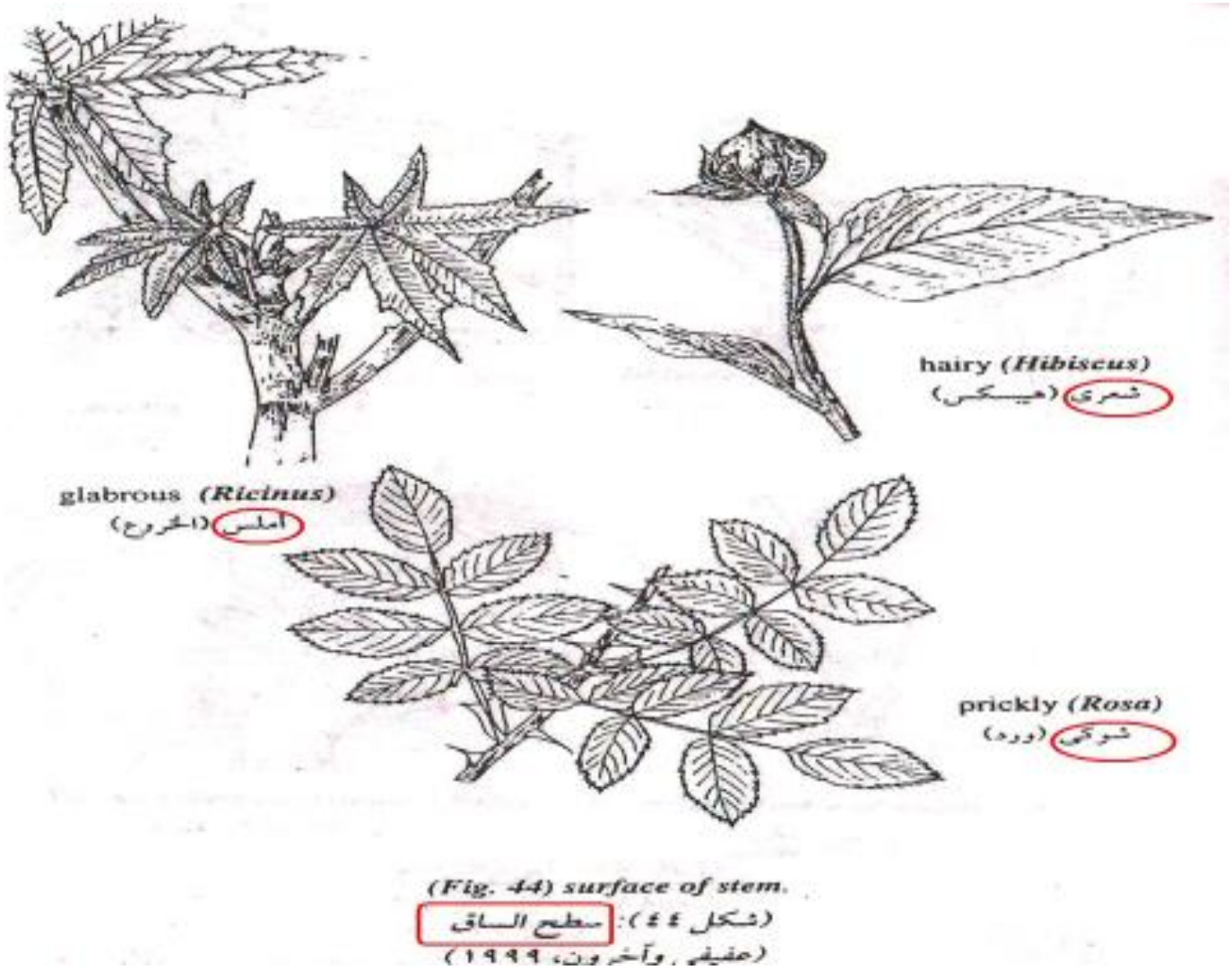
(شكل ٤٢): السوق المتسلقة
(Fig. 42) climbing stems.
(عفيفي وآخرون، ١٩٩٩)

(شكل ٤١) طبيعة الساق
(Fig. 41) the nature of stem.



تابع (شكل ٤٣): أشكال الساق ومقطعه
Cont. (Fig. 43) stem shapes

(شكل ٤٣): أشكال الساق ومقطعه
(Fig. 43) stem shapes.
(عفيفي وآخرون، ١٩٩٩)



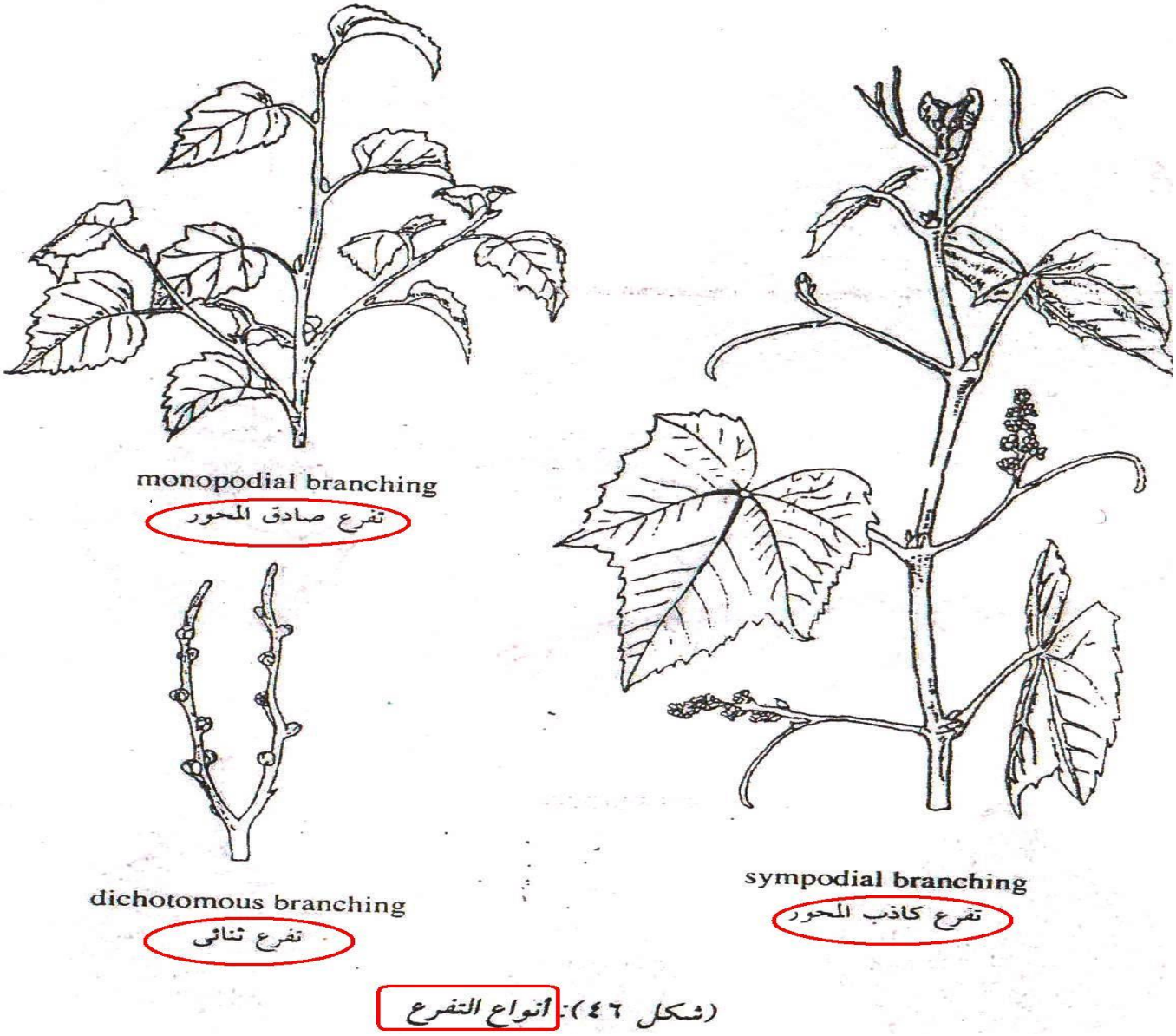
(Fig. 44) surface of stem.
(شكل ٤٤): سطح الساق
(حفيظ وآخرون، ١٩٩٩)

Branching:

1. **Apical: Dichotomy**
2. **Axillary:**

1. Monopodium: The apical bud retains permanently its capacity for active growth and the branches develop from axillary bud which remain lateral and subordinate to the main axis and again branch in the same manner.

2. Sympodium: Frequently the apical bud is transformed into a flower or tendril which ends its career. The axillary bud of the terminal leaf continues the growth of the axis forming one or more internodes which are terminated by another flower or a tendril and so on.



(شكل ٤٦): أنواع التفرع

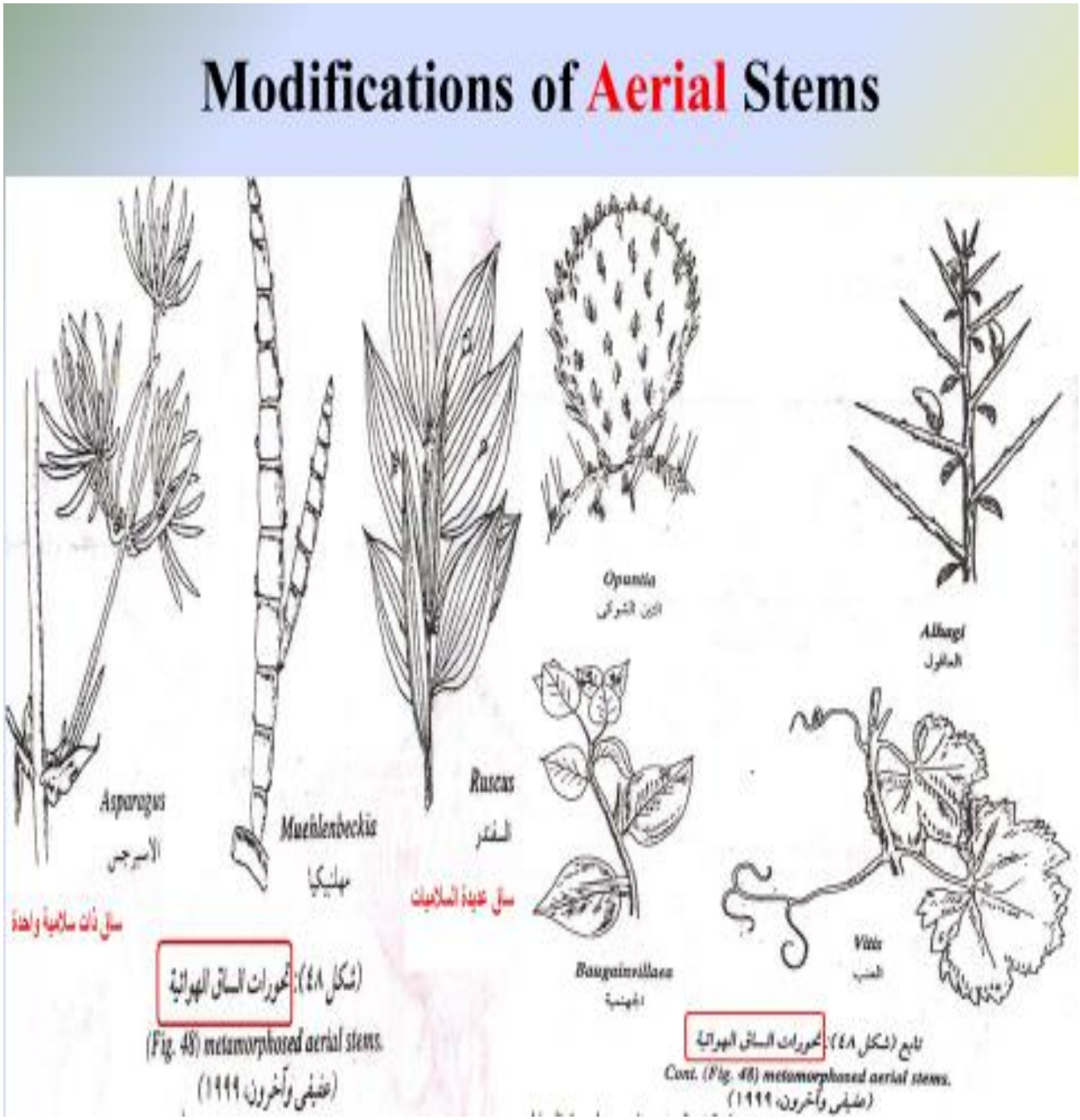
Stem Modifications:

- **Aerial:**

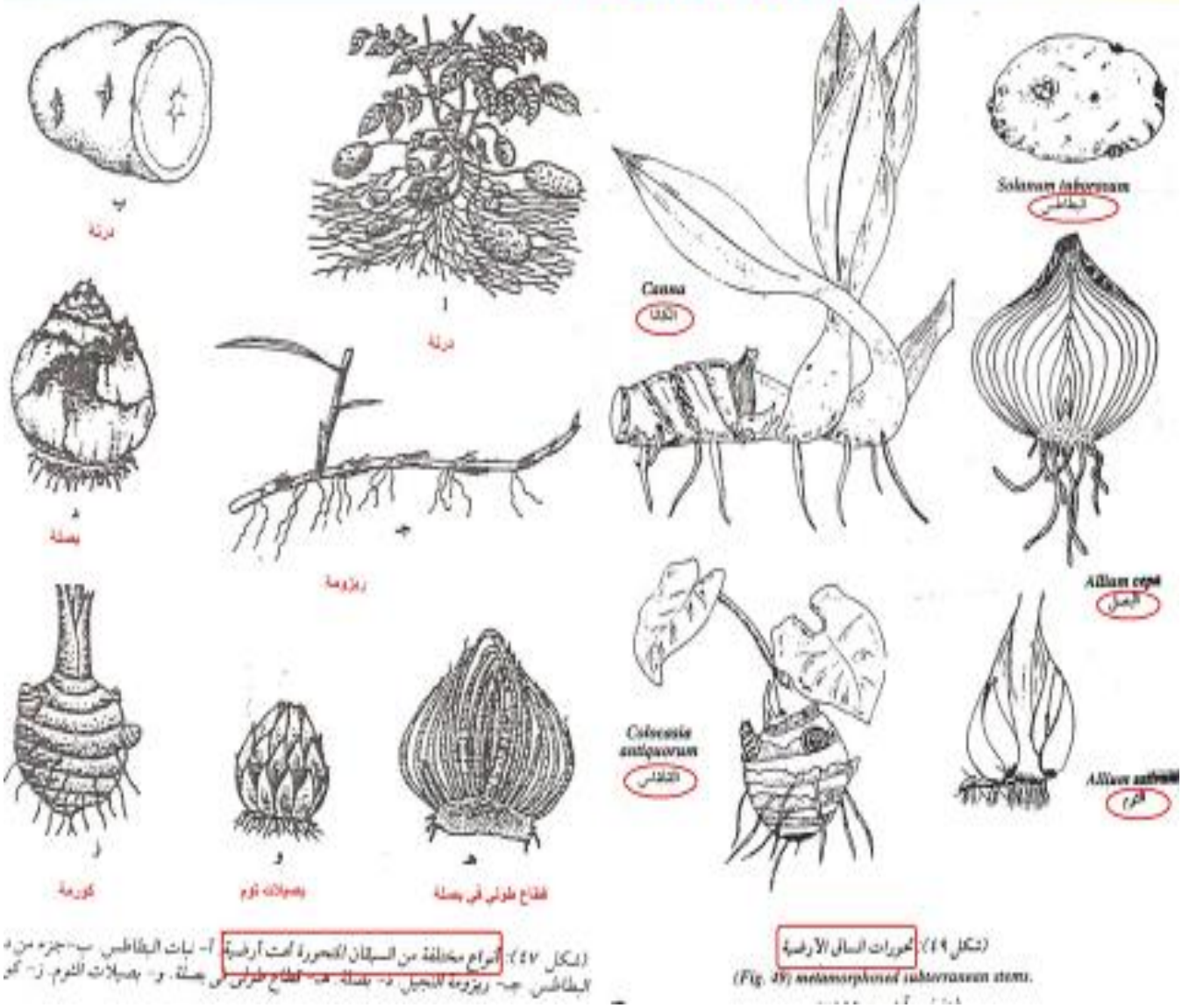
  1. **Leafy stems: Leaves are reduced to mere scales. Leaf's function is taken over by modified flat branches containing chlorophylls tissue.**
     1. **Cladode: *Asparagus***
     2. **Phylloclade: *Ruscus***
  2. **Juicy Stems: *Opuntia***
  3. **Thorny Stems: *Zilla spinosa , Alhagi***

4. **<u>Stem Tendrils</u>: *Vitis***

- **<u>Subterranean</u>: In addition to perennation, they serve for food storage and also for vegetative reproduction. Types of which:**
  1. **<u>Rhizome</u>: *Cyperus***
  2. **<u>Corm</u>: *Colocasia***
  3. **<u>Bulbs&Bulbils</u>: Onion and garlic**
  4. **<u>Tubers</u>: potatoes**



Modifications of Subterranian Stems



(شكل ٤٧): أنواع مختلفة من السيقان المحورة تحت أرضية أ- نبات البطاطس ب- جزء من درنة البطاطس جـ- ريزومة الزنجبيل د- بصلة هـ- قطاع طولي في بصلة و- بصيلات الثوم ز- كورمة

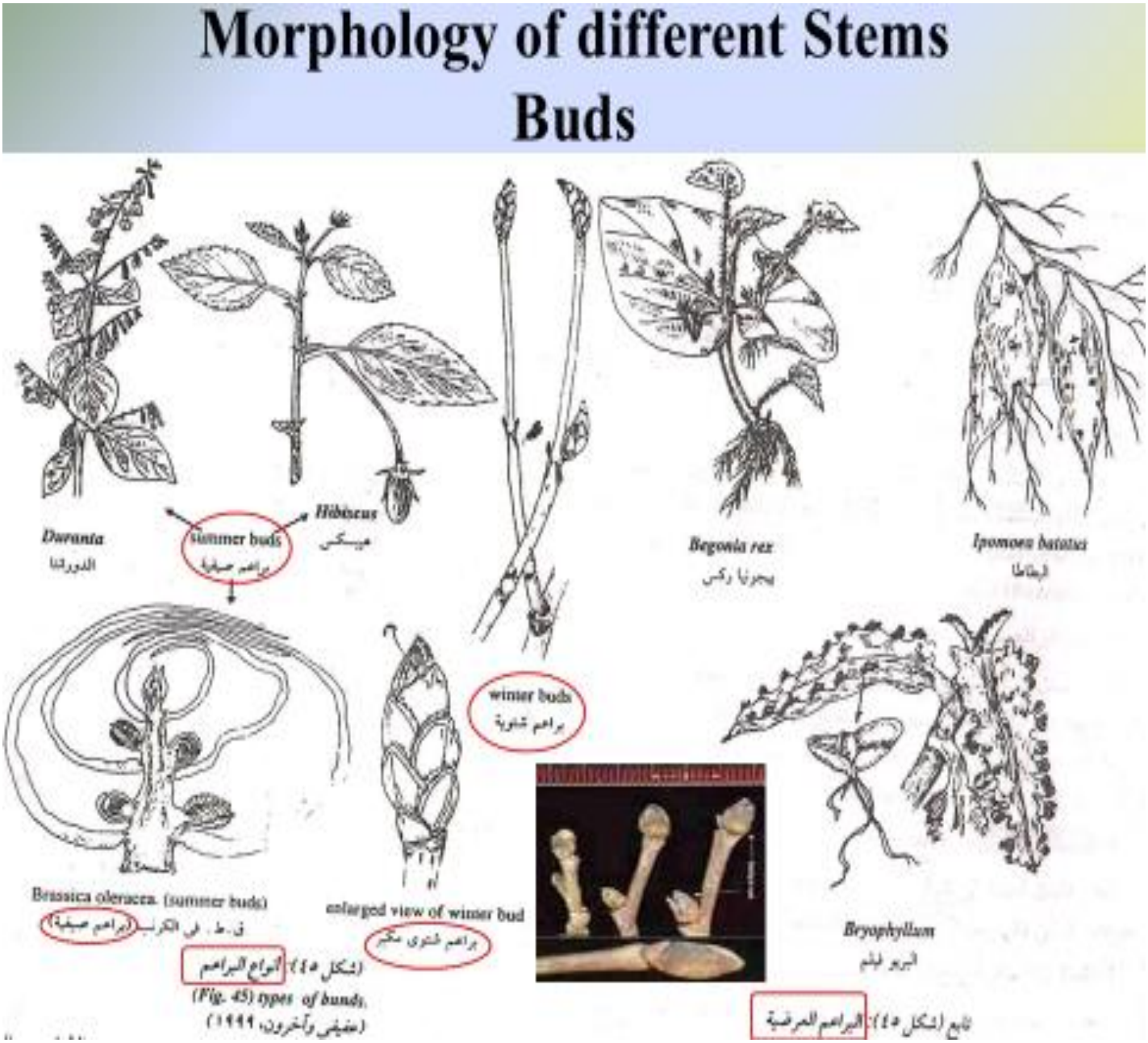
(شكل ٤٩): محورات الساق الأرضية
(Fig. 49) metamorphosed subterranean stem.

Buds

- **Divided into:**
    1. **Principal Bud: The largest in size.**
    2. **Accessory Bud: Additional buds.**
- **Types according to seasons:**
    1. **Summer Bud: Green and small in size**

2. **Winter Bud: Brown covered by scale leaves and are larger in size.**

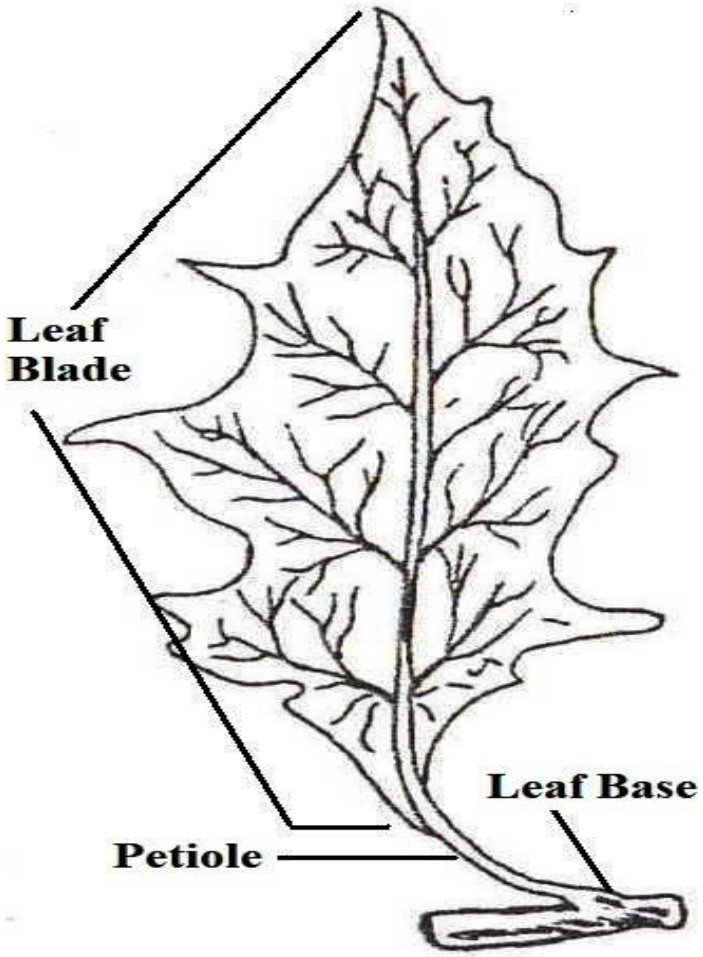
- **<u>Position:</u>**
  1. **Terminal: At the Apex of the stem**
  2. **Axillary: At the axis of the leaf.**
     - **<u>Cladode</u>**
     - **<u>Phylloclade</u>**



Leaves

Leaf parts

- **Definition: They originate as lateral protuberances just behind the growing point. They arise in regular succession at the tip of the axis. They are exceedingly variable in form, but the most common ones are green-colored, flat and broad to allow maximum exposure to the sun rays.**
- **Function:**
  1. **Photosynthesis**
  2. **Anabolism**
  3. **Respiration**
  4. **Transpiration**
- **Leaf Composition:**
  1. **Leaf Base**
  2. **Leaf Stalk (Petiole)**
  3. **Leaf Blade (Lamina)**



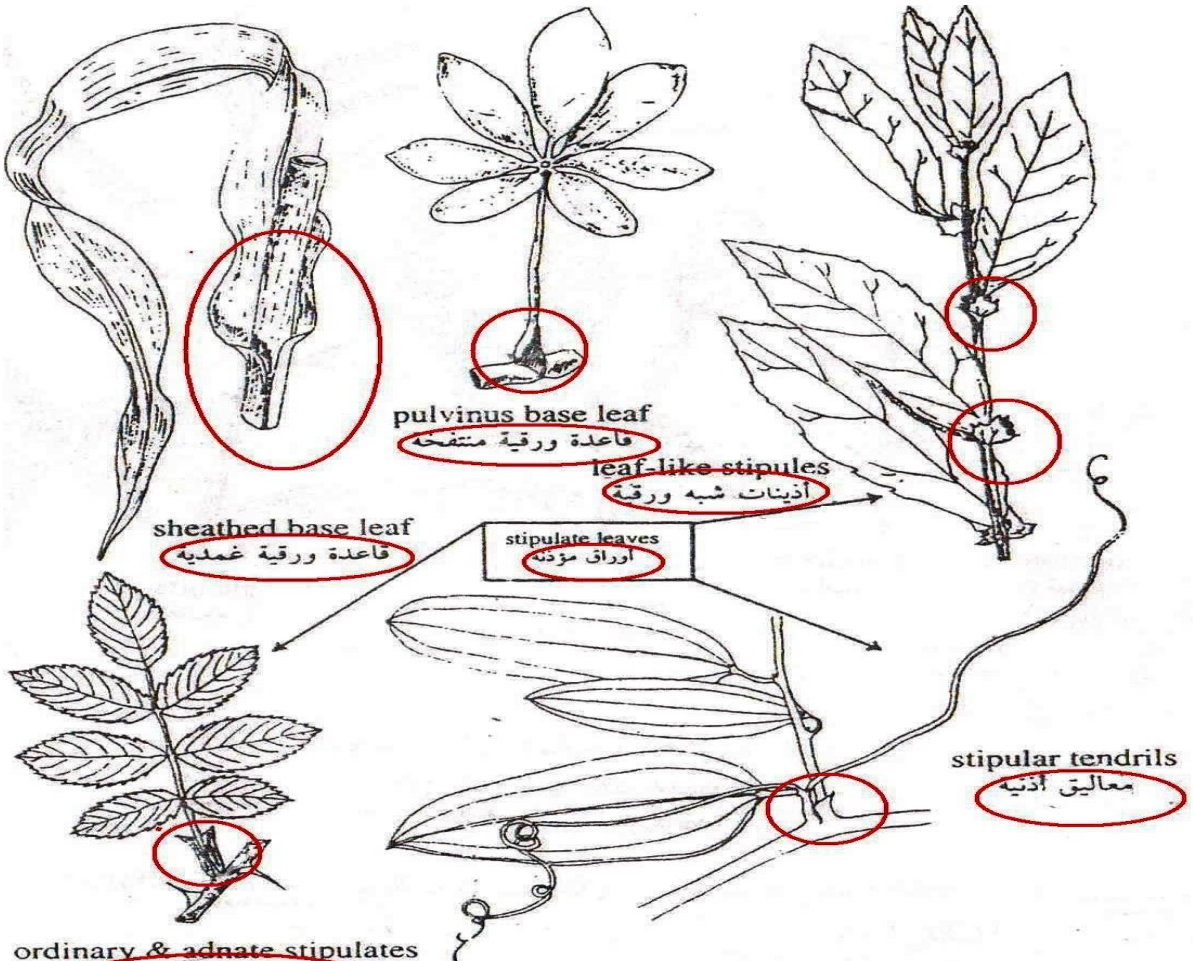
1. Leaf Base:

It is the part next to the stem at the node. It usually serves to protect the bud.

- **Enlargement:**
  It appears as a more or less marked enlargement at the base of the leaf which facilitate the movement of the leaf. Types of which are:

  1.Ordinary **2.Pulvinus** **3.Sheathed**

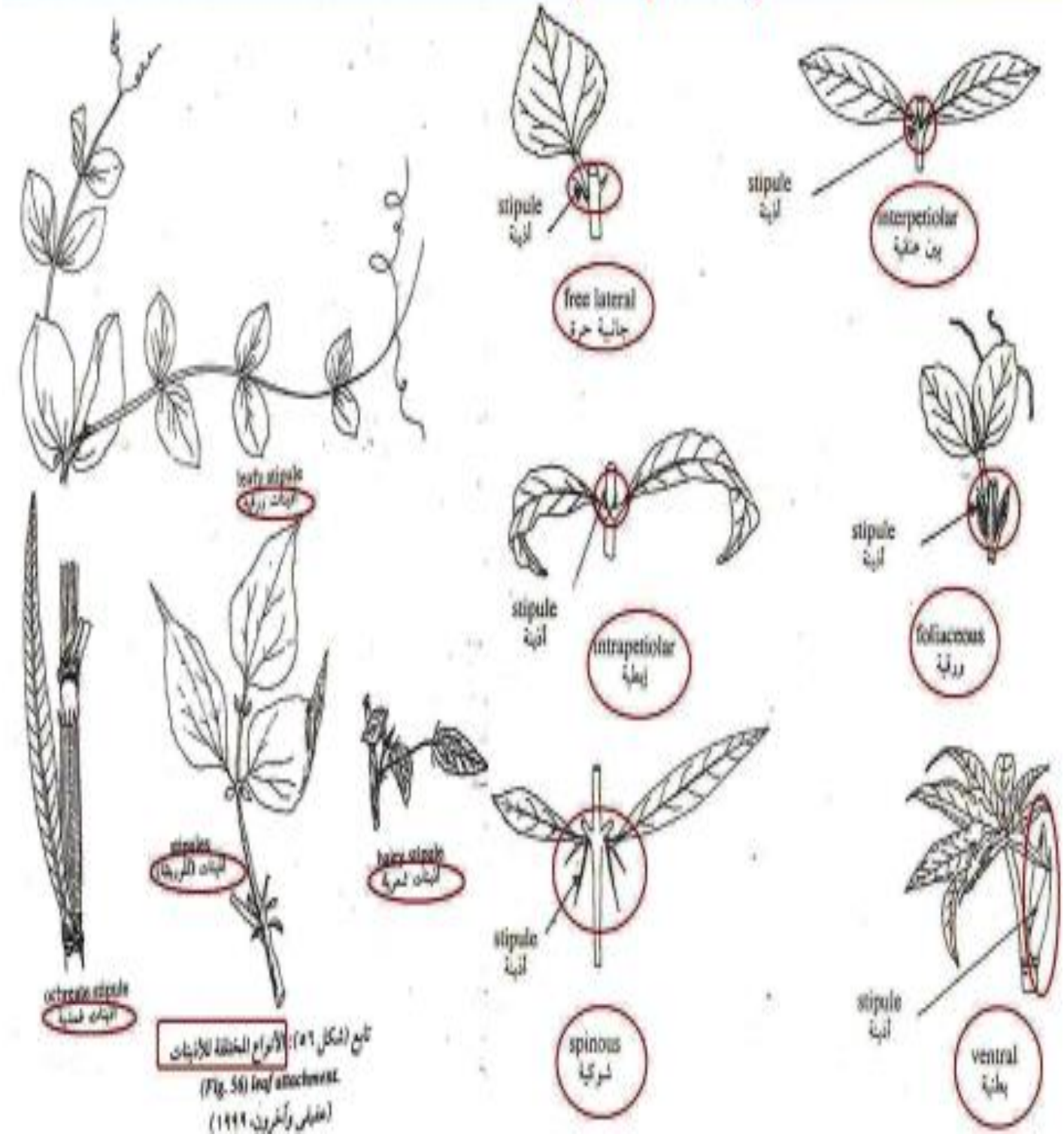
- **Stipules:**
  They frequently developed from the leaf base, forming a pair. Types of which are:
  1.Exstipulate
  2.Stipulate:
  - **Hairy**
  - **Foliaceous**
  - **Tendrillar**
  - **Spinous**
  - **Adnate**
  - **Ochreate**



(شكل ٥٥): قاعدة الورقة
(Fig. 55) leaf base.
(عفيفي وآخرون، ١٩٩٩)

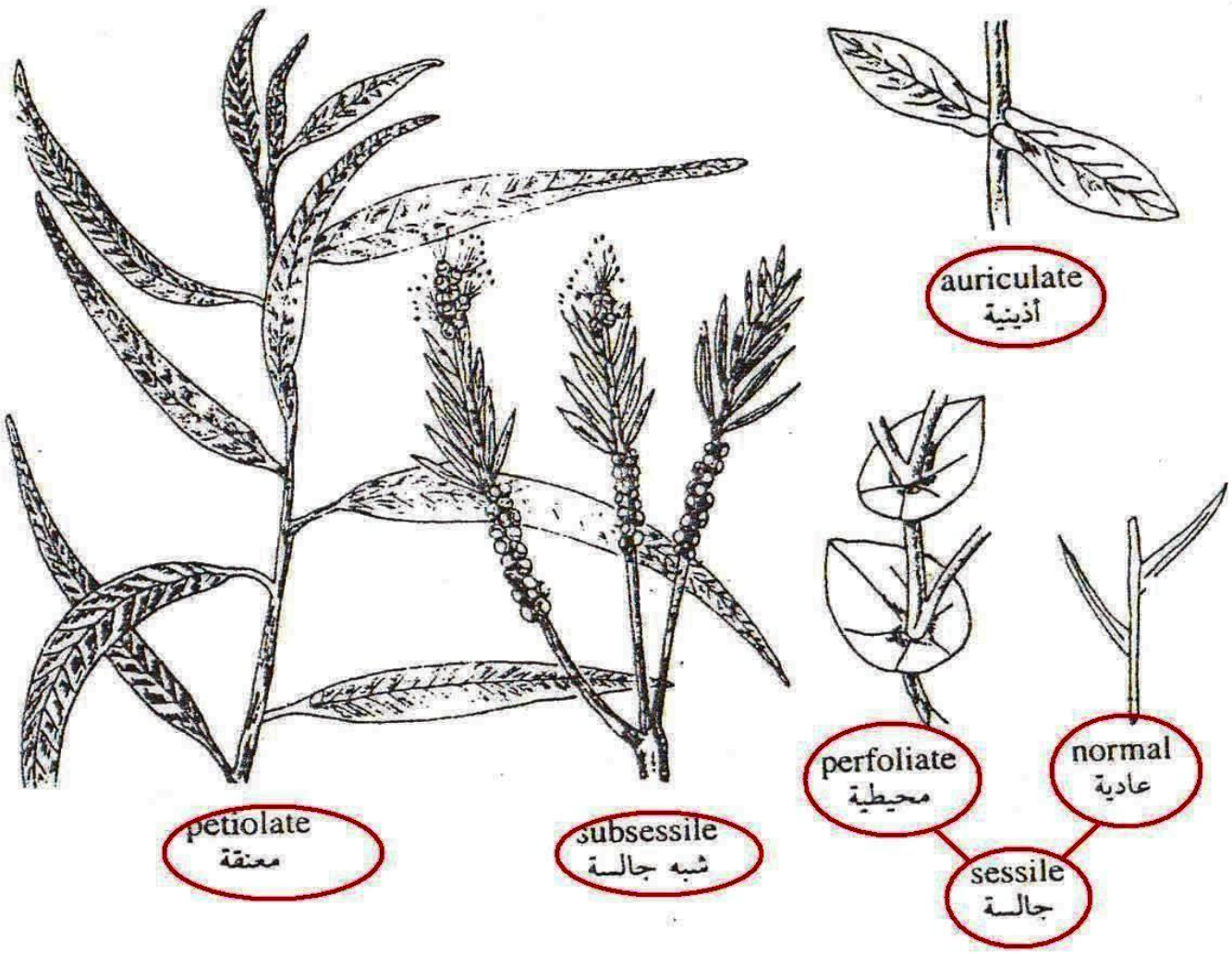
Leaf parts

1. Leaf Base (Stipules)



تابع (شكل ٥٦): الأنواع المختلفة للإذينات
(Fig. 56) leaf attachment.
(عفيفي وآخرون، ١٩٩٩)

3. **Leaf Stalk (Petiole):**
    1. **Petiolate**
    2. **Subsessile**
    3. **Sessile**



(شكل ٥٦): اتصال الأوراق بالساق

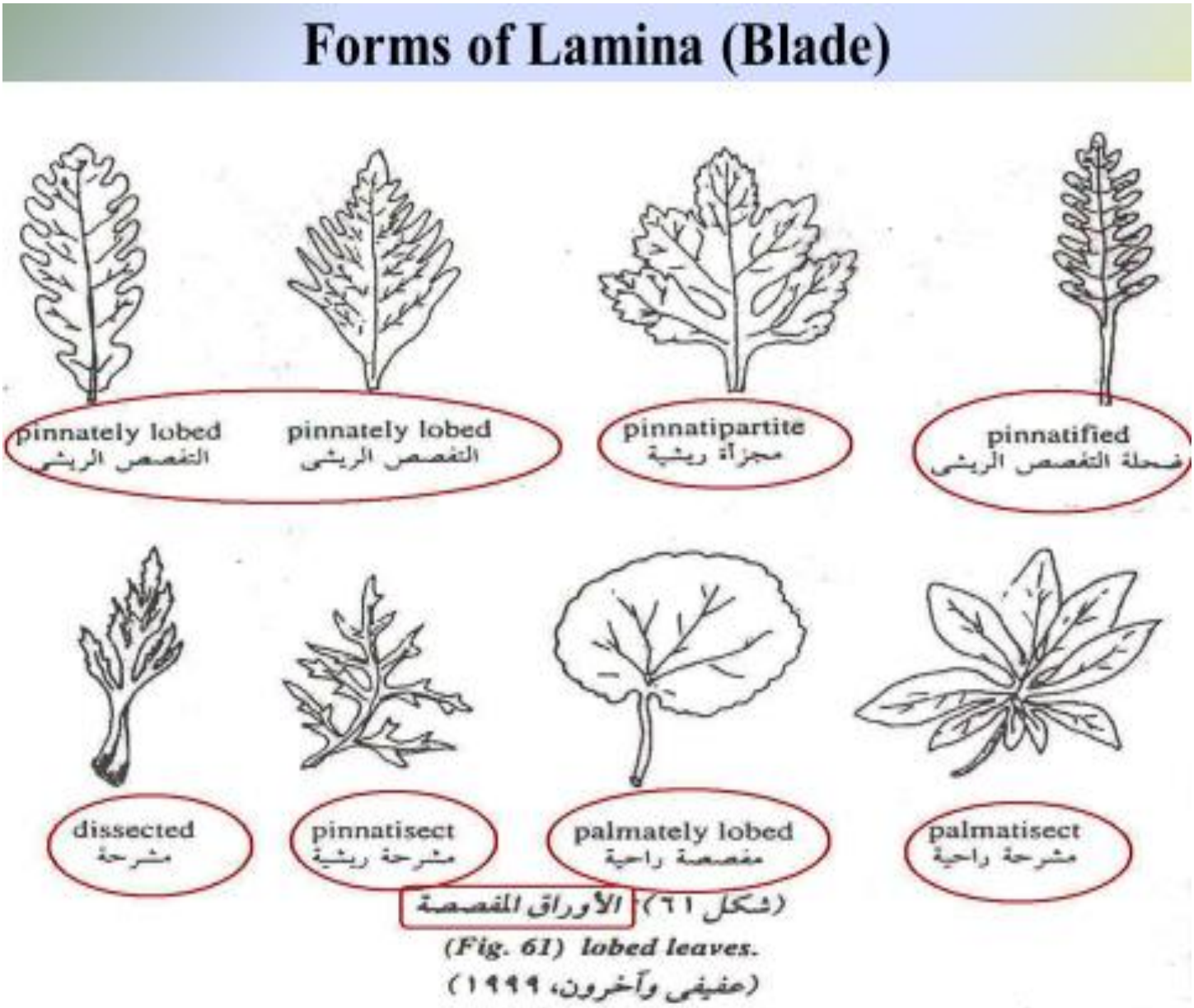
(Fig. 56) leaf attachment.

(عفيفى وآخرون، ١٩٩٩)

4. **Leaf Blade:**

- **Forms of Leaf Blade (Lamina):**
    1. **Simple: One continuous or slightly divided surface.**
    2. **Lobed: Incomplete deep divisions, divided into a number of lobes connected by an undivided portion (not reaching the midrib). Lyrate, Runcinate.**

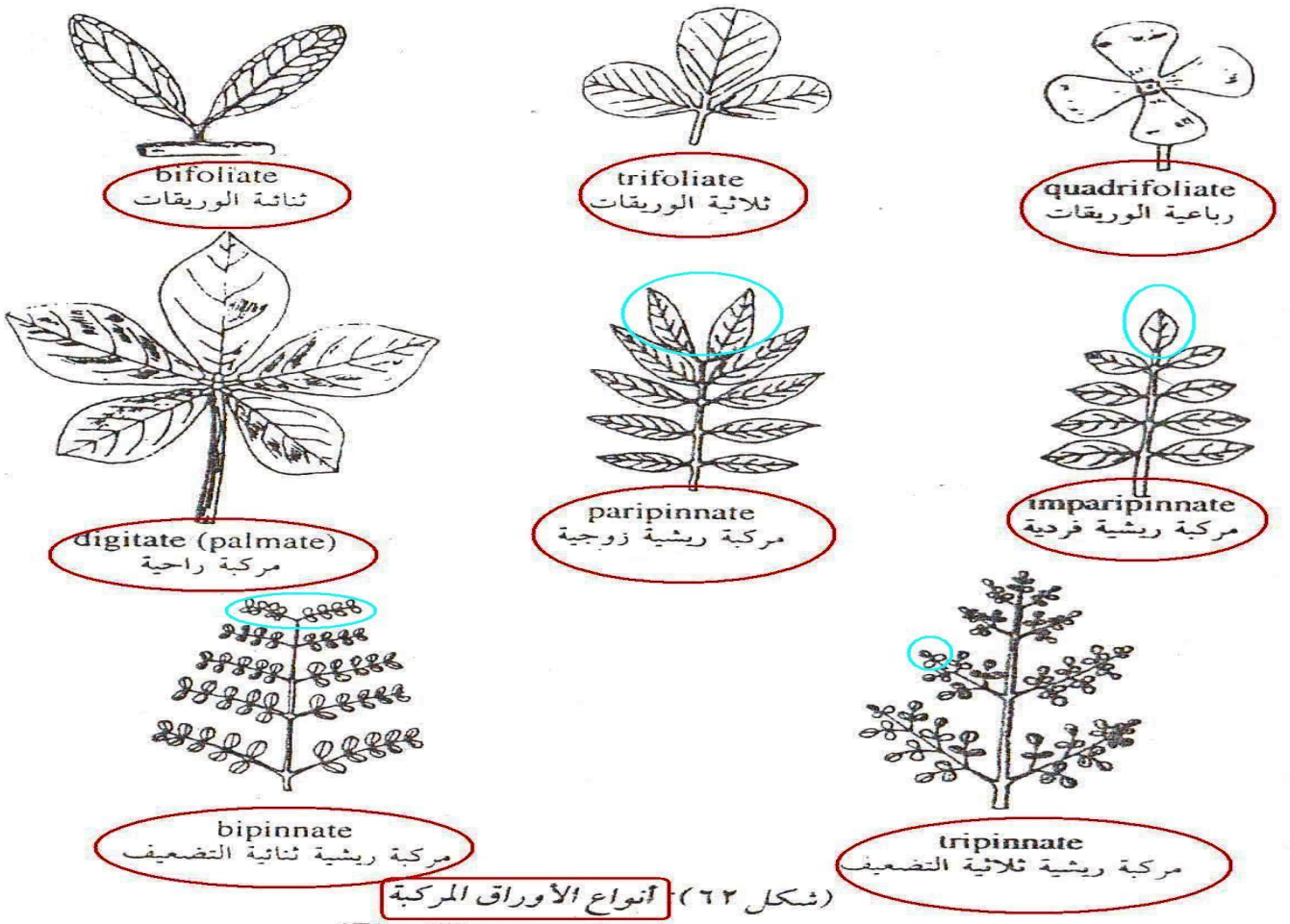
3. **<u>Dissectified:</u> Complete deep divisions (Close to the midrib).**
4. **<u>Palmate:</u> They are palm-like. If the incisions are less than half the distance between the margin and the midrib *i.e.* Palmatified, but if they are more than half *i.e.* Palmatisect.**
5. **<u>Pinnate:</u> If incisions are less than half the distance between the margin and the midrib *i.e.* Pinnatified, if they are more than half *i.e.* Pinnatipartite, but if incisions are so deep reaching the midrib *i.e.* Pinnatisect.**
6. **<u>Compound</u>: The divisions are so independent that they appear as distinct leaflets born on a common stalk (Palmately or Pinnately), (Bifoliate, Trifoliate, Paripinnate, Imparipinnate), or the leaflets of compound leaves themselves exhibit subdivision called *Pinna* (Bipinnate, Tripinnate).**



(شكل ٦١) الأوراق المفصصة

(Fig. 61) lobed leaves.

(حفيفي وآخرون، ١٩٩٩)



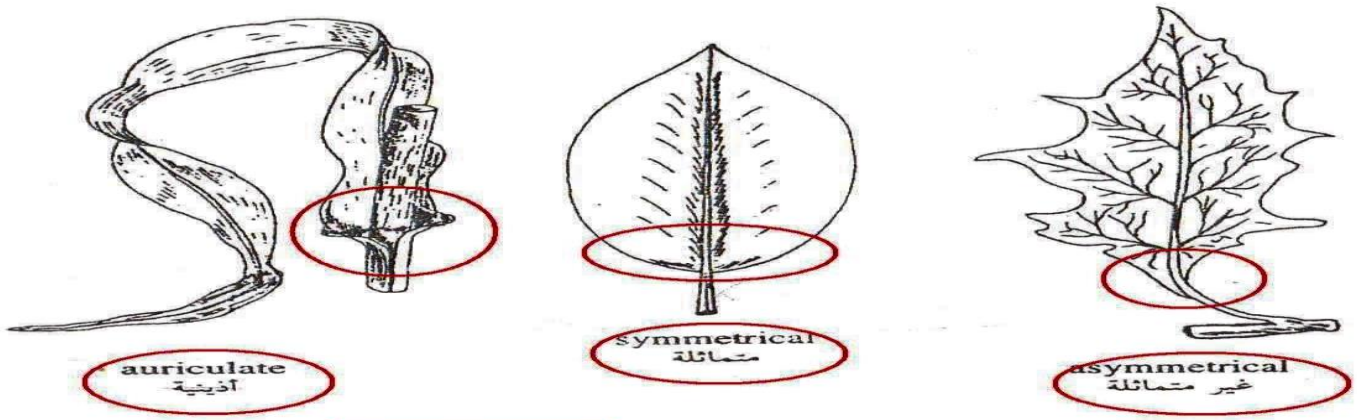
أنواع الأوراق المركبة (شكل ٦٢)

(Fig. 62) types of compound leaves.

Lamina

1. **Base Of Lamina:**

   Symmetrical, Asymmetrical or Auriculate



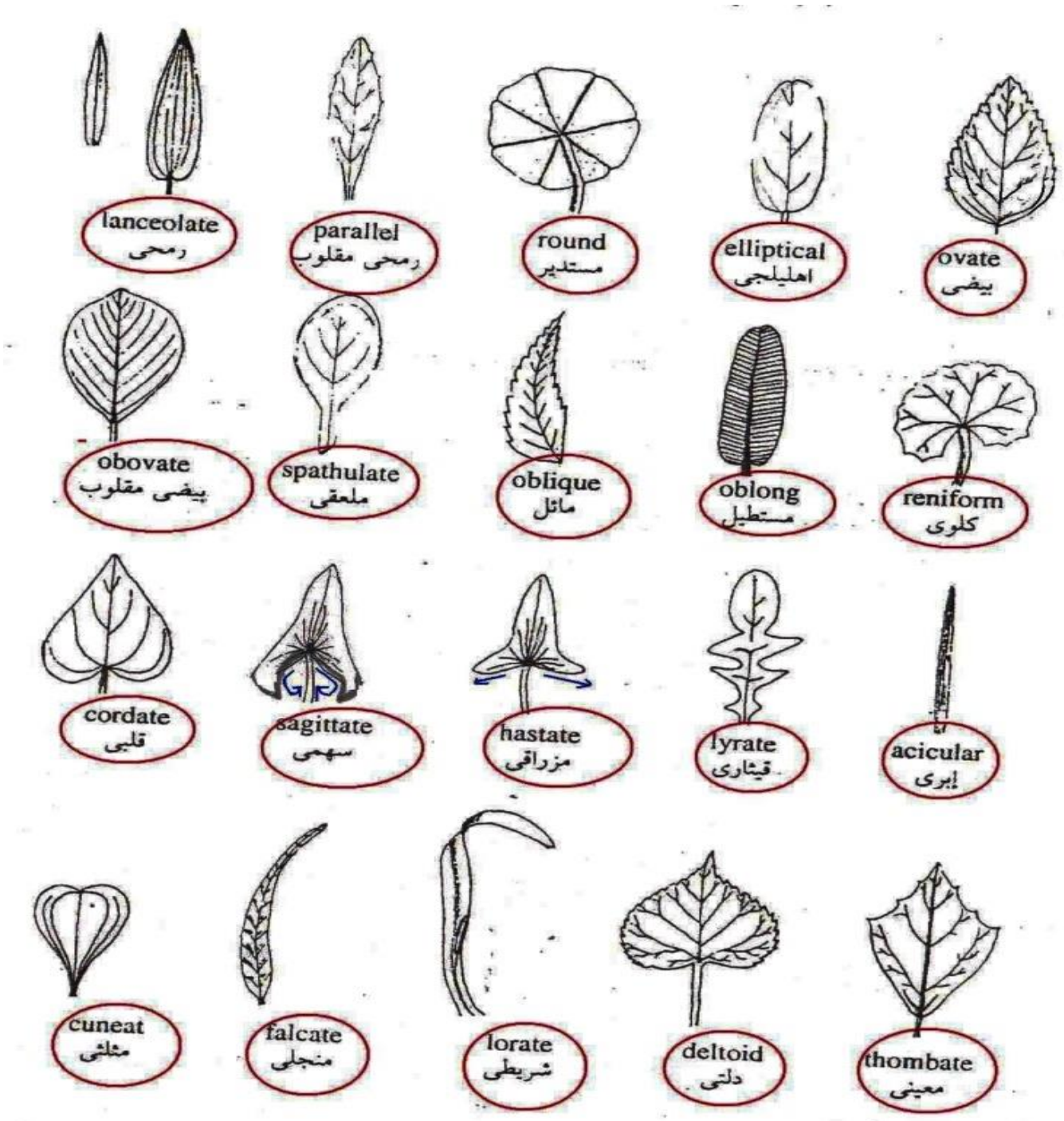
تابع (شكل ٥٥): أشكال قاعدة نصل الورقة

Cont. (Fig. 55) forms of the lamina base.

(عفيفي وآخرون، ١٩٩٩)

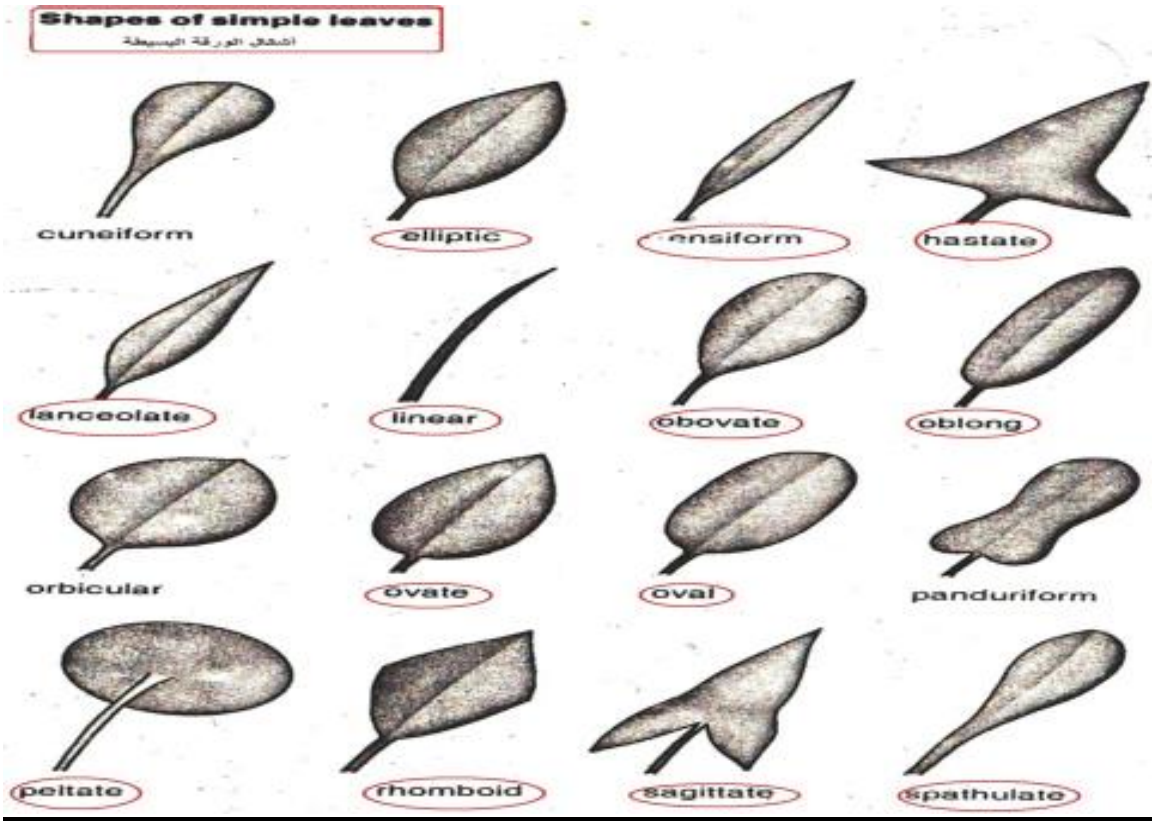
Shape Of Lamina:

Acicular, Tubular, Lanceolate, Ovate, Oblong, Spathulate, round, Reniform, Sagitate, Hastate, Lorate, Cordate, Lyrate, etc…



(شكل ٥٨): أشكال نصل الورقة

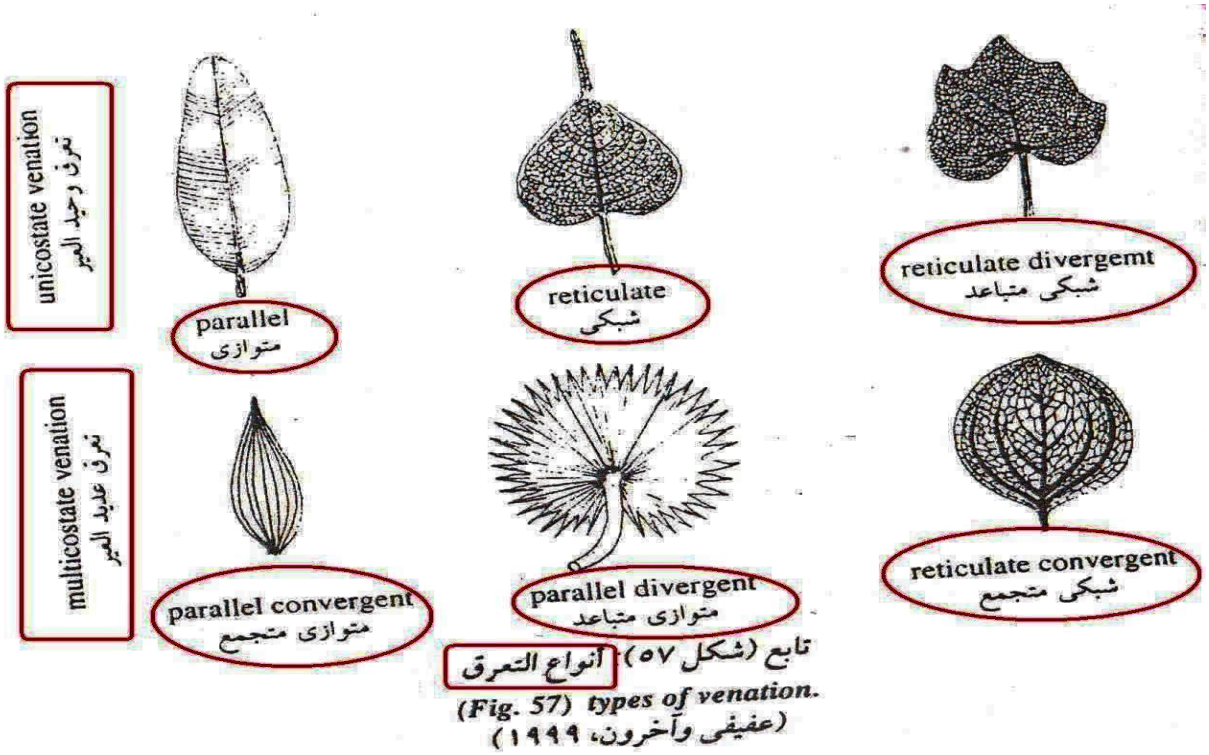
(Fig. 58) leaf shapes.



3. Leaf Vennation:

1. Reticulate

2.Parallel:(Longitudinal or Transverse)

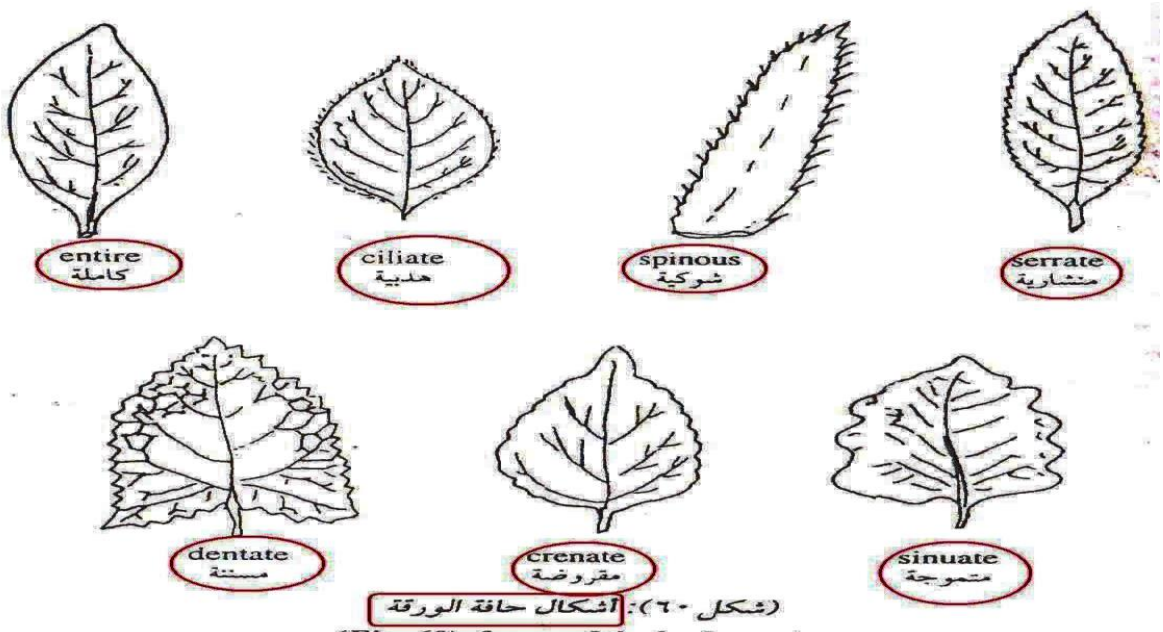


أنواع التعرق تابع (شكل ٥٧)

(Fig. 57) types of venation.
(عفيفى وآخرون، ١٩٩٩)

4. Margin Of Lamina:

Entire, Ciliate, Spinous, Serrate, Dentate, Crenate, Sinuate, *etc*…



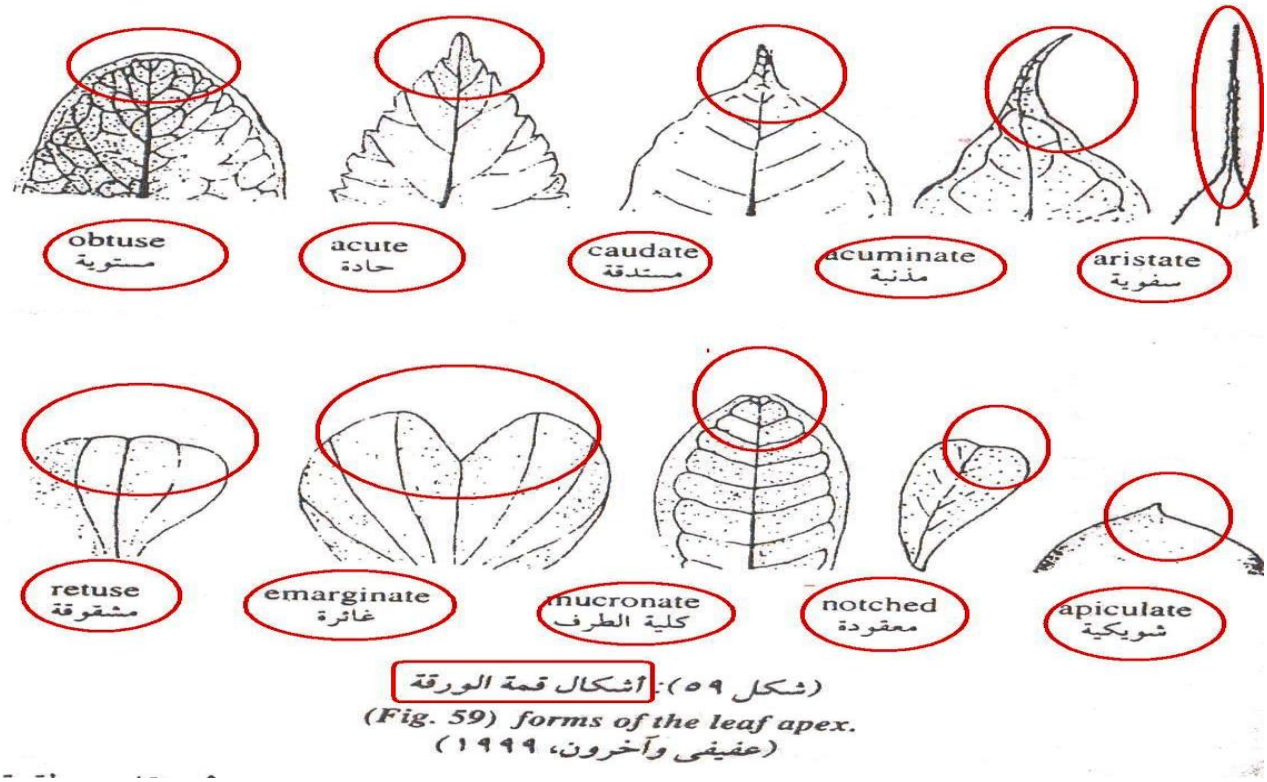
(شكل ٦٠): أشكال حافة الورقة

(Fig. 60) forms of the leaf margin.

(عفيفي وآخرون، ١٩٩٩)

5. Apex Of Lamina:

Obtuse, Acute, Caudate, Acuminate, Aristate, Retuse, Emarginate, Mucronate, Notched, Apiculate, etc…



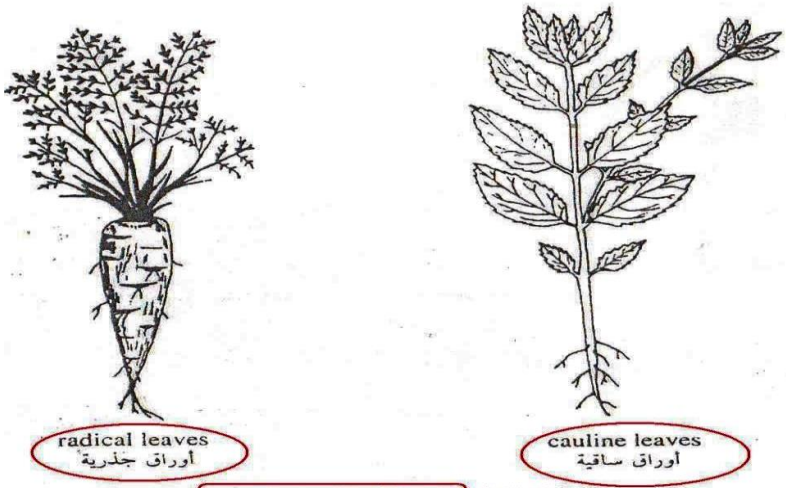
(شكل ٥٩): أشكال قمة الورقة

(Fig. 59) forms of the leaf apex.

(عفيفي وآخرون، ١٩٩٩)

Leaf Insertion

1. **Radical**
2. **Cauline**



(شكل ٦٣): وضع الأوراق على الساق

(Fig. 63) insertion of leaves.

Leaf Arrangement (*Phyllotaxis*):

1. **Dwarfed: Carrot**
2. **Alternate**
3. **Opposite superposed**
4. **Opposite decussate**
5. **Whorled**

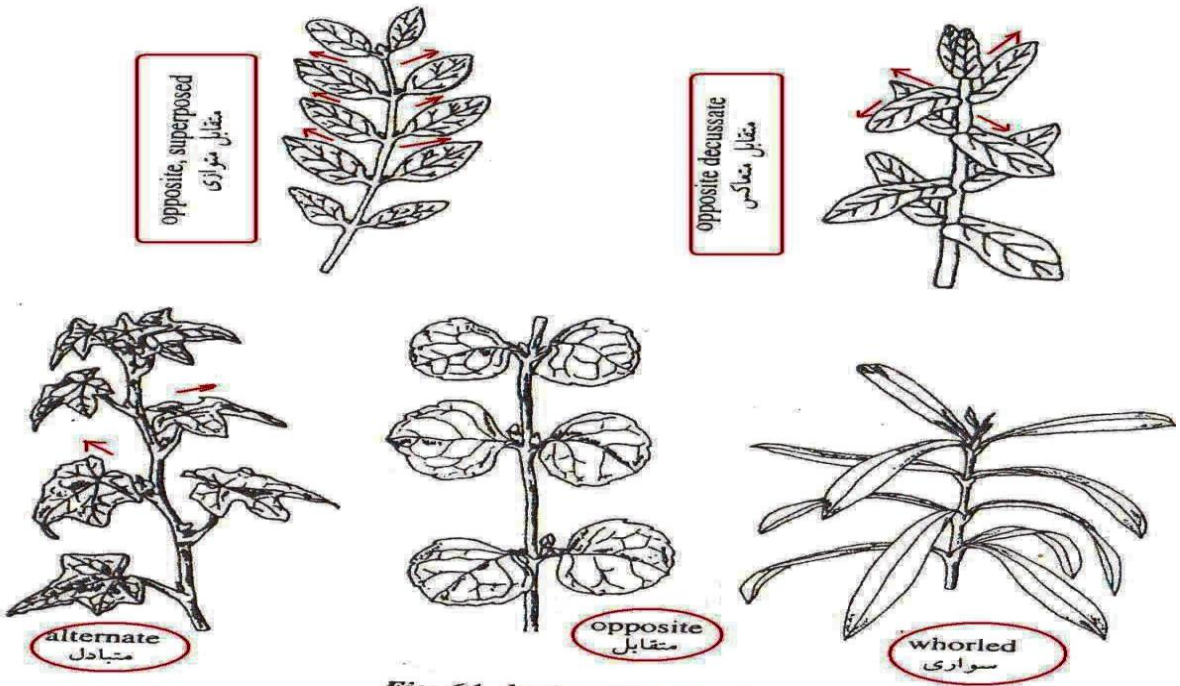


Fig. 64, leaf arrangement.

(شكل ٦٤): نظام الأوراق (ترتيب الأوراق)

Leaf Duration

1. Evergreen plants **2. Deciduous plants**

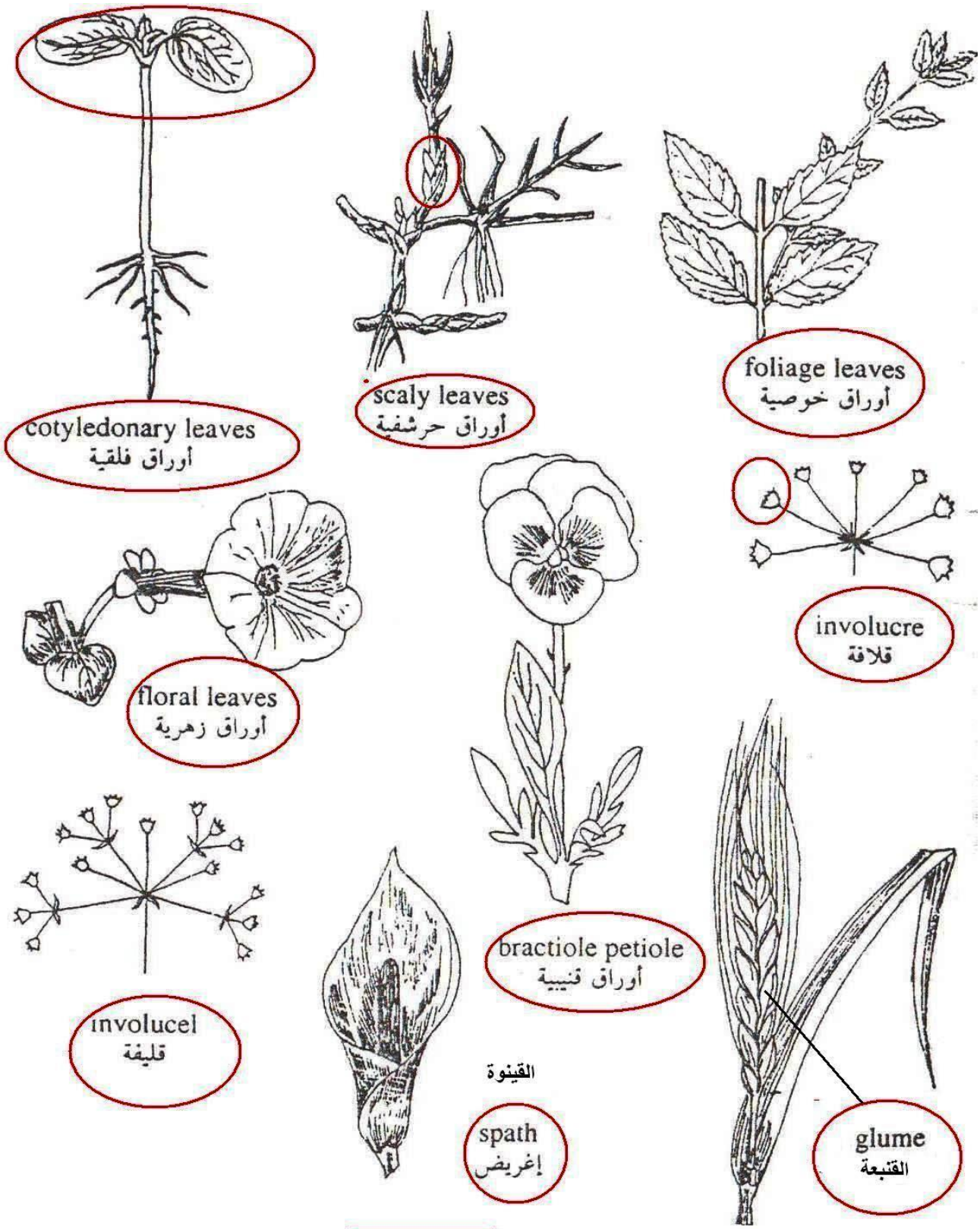
(شكل ٦٥): عمر الورقة

(Fig. 65) duration of the leaf.

Leaf forms

- **Cotyledonary leaves: *Epigeal* germination**
- ***Prophyllus*: *Fava* beans**
- **Scale leaves: Onion & Rhizomes**
- **Foliage leaves: Photosynthesis**
- **Floral leaves:**

1. Bract **2. Perianth (Invlocure)** **3. Glume** **4. Spath**



(شكل ٦٧): طراز الأوراق

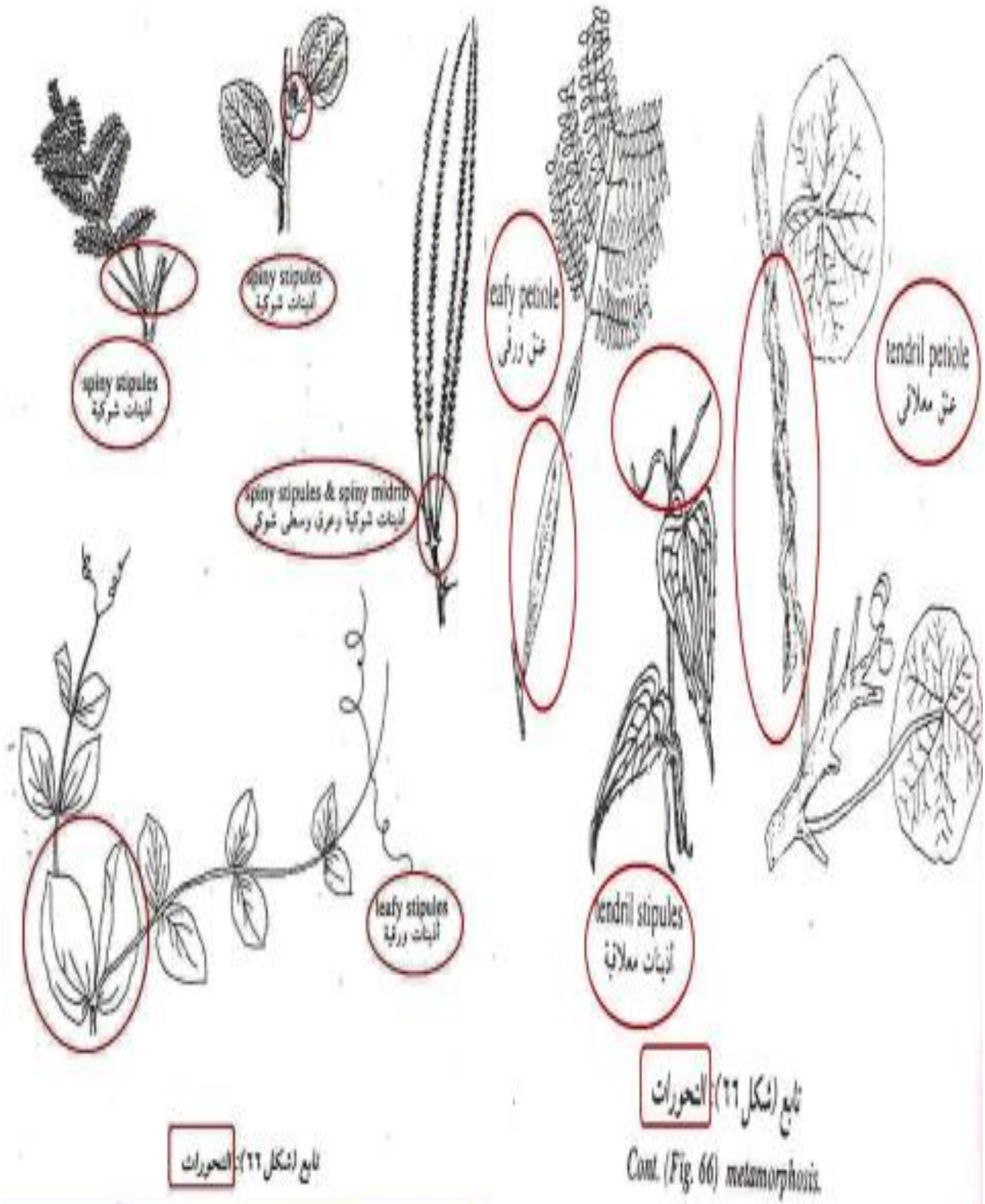
(Fig. 67) kinds of leaves.

(عفيفى وآخرون، ١٩٩٩)

1. **Leaf Modifications:**
    - **Spiny leaves:** ***Berberis, Parkinsonia***
    - **Fleshy (Storage) leaves:** ***Zygophyllum***
    - **Leaf tendrils:** ***Lathyrus decoratus***
    - ***Phylloclade*** **(leafy petiole):** ***Zygophyllum, Acacia***
    - **Insectivorous leaves:** ***Drocera***

(شكل ٦٦): بعض أنواع تحورات الورقة

(Fig. 66) some types of metamorphosis in the leaf.



تابع (شكل ٦٦): التحورات

Cont. (Fig. 66) metamorphosis.

REFERENCES

1. **Khalil *et al.* (1975). General botany. Cairo Univ. Press.**
2. **Sinnott andWilson (1983). Botany Principles and Problems Mc Graw-Hill Company 6th edition.**
3. **El Sahar, Kasem (1987). Systematic Botany. Mediterranean Sea Publication house. 1st edition.**
4. **Eskarous *et al.*(1987). Practical Botany. Cairo Univ. Press.**
5. **Megahed *et al.*(1996). General Botany. Anglo Press. 7th edition.**
6. **Afiffy *et al.* (2004). General Botany. Dar El Fikr El Araby Pub.**
7. **Kamel *et al.* (2005). Basics of Plant Sciences. Dar El Fikr El Araby Pub. 2nd edition.**
8. **Kumar (2010). Microbiology and Nanobiology. Daya Publishing, Delhi, India.**
9. **Plant Atlas (2010).**
10. **Willey *et al.* (2011). Prescott's Microbiology. Mc Graw Hill 8th edition**
11. **WHO web site.**

GRADING

1. **Student activities & attendance (30 marks): 2 lab notebook+2quiz+1attendance**
2. **Practical exam: 90 marks**
3. **Final written exam: 180 marks**

TEACHING HOURS

1. **Lectures: 5 hours**
2. **Lab: 4 hours**