Characteristics of Protozoan Phyla

1. They are unicellular with some colonial .
2. All are microscopic .
3. All symmetries are present within members of the group .
4. No germ layers are present .
5. No organs or tissues are formed , but specialized organelles serve many of these functions.
6. They include free-living , mutualistic , commensal and parasitic forms .
7. They move by pseudopodia , flagella , cilia and they can direct cell movements .
8. Most are naked , but some have a simple endoskeleton or exoskeleton .
9. All types of nutrition are present : autotrophic , heterotrophic and saprozoic .
10. They can be aquatic or terrestrial.
11. Reproduction is asexual by fission , budding or cysts ; or sexual by conjugation or syngamy of gametes.

Amoeba Proteus

1 - Discovery

It was first reported by Rosel von Rosenhof (1755) .

2 - Biology

A full and comprehensive account of Amoeba's biology was given by Hirschfield (1962).

3-Systematic Position of *Amoeba*

Domain	**Eukarya**
Kingdom	Protista
Group	Animal- Like Protists
Phylum	Sarcomastigophora
Subphylum	Sarcodina
Superclass	Rhizopoda
Class	Rhizopodea
Subclass	Lobosia
Order	Amoebida
Genus	*Amoeba*
Species	*Proteus*

4-Habit & Habitat

1- It is widely distributed in freshwater such as ponds , springs , ditches etc .

2- It is commonly found in bottom mud .

5- Derivation of the Scientific Name

*** Its name is derived from 2 Greek words :**

1- *Amoeba* : is taken from amoibe which means change .

2- *Proteus* : is taken from the name of mythical sea-god , proteus who could constantly change its shape.

3- This name is given to this organism because it is able to change its shape easily and constantly.

6- Structure

❖ Shape & size :

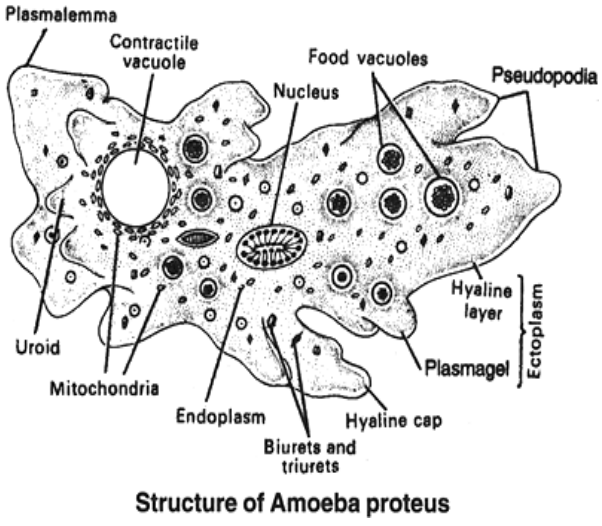
1- It is unicellular microscopic protist.

2- The body is irregular , transparent when viewed under compound microscope .

3- *Amoeba* measures about (250- 600) um in diameter.

4- Anteriorly , it sends **pseudopodia** , whereas posteriorly it shows a wrinkled zone called **uroid** .

تحت المجهر ***Amoeba proteus*** **-2**



Structure of Amoeba proteus

1- رسم تخطيطي لـ ***Amoeba proteus***

❖ Pseudopodia :

1- Pseudopodia are Locomotory organelles of *Amoeba proteus*.

2- They are temporary , finger- like, protoplasmic extensions.

3- They are formed anteriorly and withdrawn posterierly.

4- They are made of both ectoplasm and endoplasm, and are cylindrical or lobe- like with round tips , therefore , are called lobopodia .

5- They are used for both Locomotion and feeding .

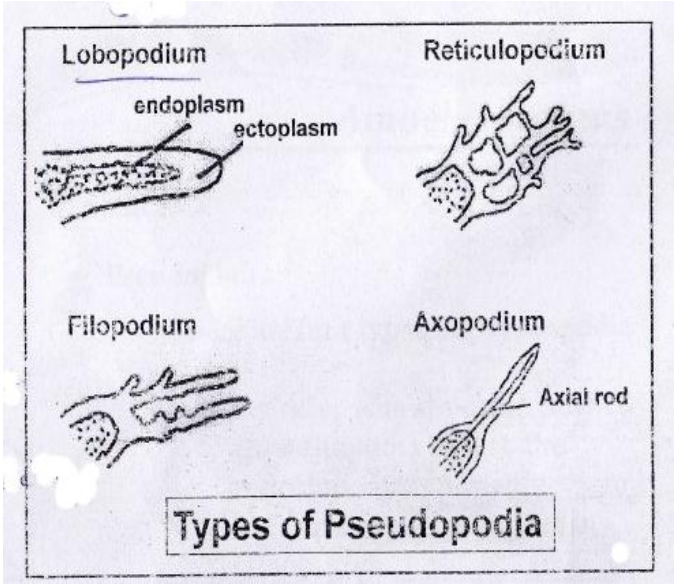
6- There are four types of Pseudopodia:

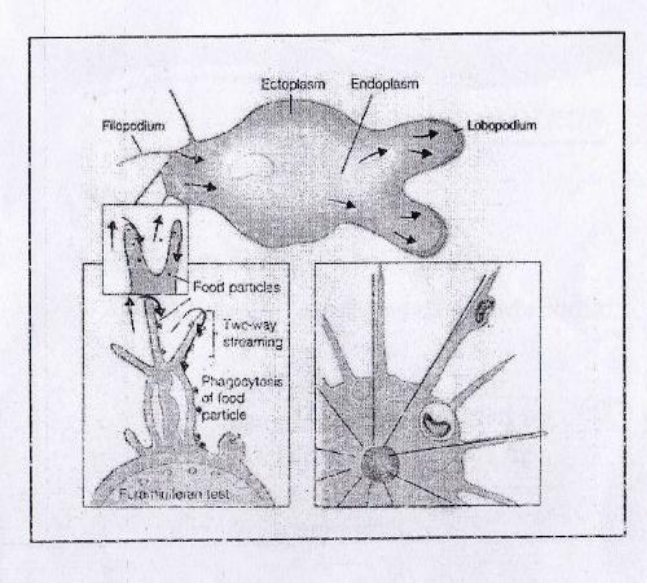
1- Lobopodia : are rather large , blunt extensions of the cell containing both ectoplasm and endoplasm .

2- Filopodia : are thin extensions , usually branching and containing only ectoplasm as in *Euglypha* .

3- Reticulopodia : are distinguished from filopodia in that the reciculopodia repeatedly rejoin to from a net-like mesh as in *Globigerina*.

4-Axepodia : are long thin pseudopodia supported by axial filaments or rods of microtubules as in *Actinophrys* .





❖ Plasma Membrane or Plasmalemma :

1- It is a thin , flexible and delicate membrane surrounding *Amoeba* .

2- It is selectively permeable membrane .

3- Plasmalemma can be regenerated when lost.

4- It regulates the exchange of H_2O , O_2 , and CO_2 .

5- This membrane retains the protoplasm within the body .

❖ Cytoplasm or Protoplasm:

1- It is a dense mass of protoplasm .

2- The protoplasm is surrounded by plasma membrane .

3- It contains several important organelles , like vacuoles and nucleus , two zones : the ectoplasm and endoplasm .

*** Cytoplasm :**

1- **The ectoplasm** is the outer or peripheral zones it is thin agranular , denae , and devoid of vacuoles and nucleus .

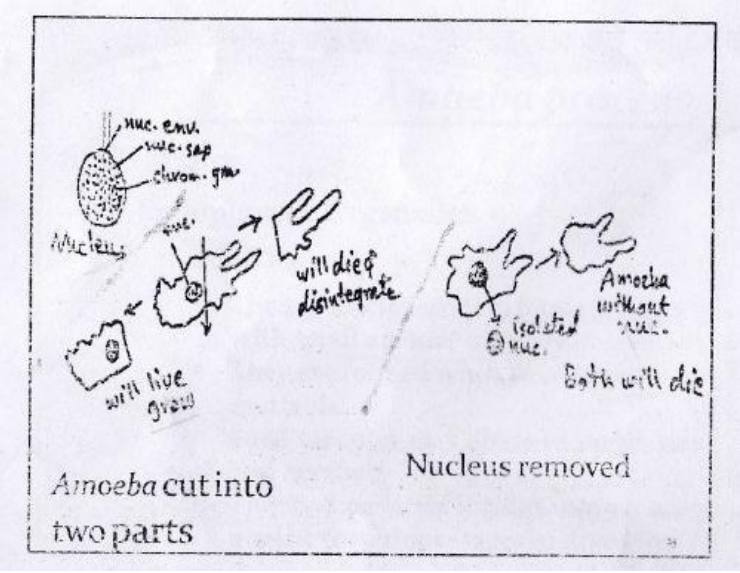
2- **Endoplasm** is the inner zone . It is thicker, granular , more fluid , and possesses vacuoles and nucleus .

❖ Endoplasmic Organelles :

*** Nucleus:**

1- Nucleus plays an important role in metabolic activities during life . If it is removed , *Amoeba* will die and the nucleus also will die.

2-When *Amoeba* is cut in two parts , one of them containing the nucleus , the one having the nucleus will live and grow. The part without nucleus will die.



* Contractile Vacuole :

1- It is a single, clear , transparent , rounded , temporary , pulsating , water- filled vacuole .

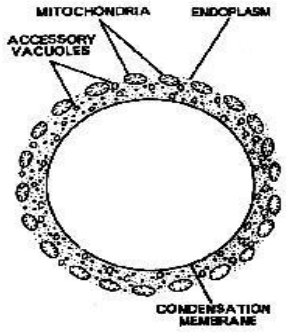
2- Contractile vacuole has no fixed place (generally posterior) .

3- It is surrounded by unit membrane and mitochondria which help the vacuole to function properly.

4- This vacuole regulates water contents of the body, i.e., it is osmoregulatory organelle , it removes exess water .

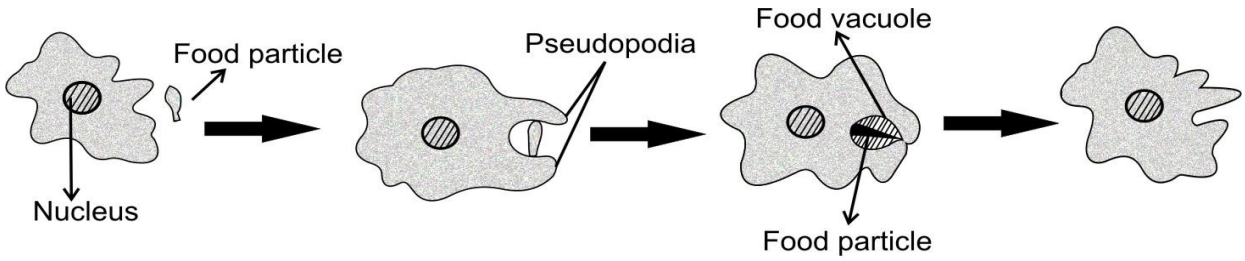
5- It also removes CO_2 . Thus , it helps in excretion and respiration as well.

6- When it reaches its full size , it fuses with plasma membrane and discharges its watery contents to the outside .



* Food Vacuoles :

1- These vacuoles contain food particles with small amount of water. 2- They are formed when food or preys are available. 3- Food vacuoles may differ in shape , size , and number. 4- The food particles inside these vacuoles my be in various stage of digestion . 5- They are formed by pseudopodia which engulf food particles along with little amount of water . 6- In *Amoeba proteus* , they are formed by two methods : **a- Circumvallation** **b- Circumfluence** 7- The type of nutrition in *Amoeba* is **heterotrophic** or **holistic**. 8- Food is digested inside food vacuoles by **addition of lysosomes (enzymes)** to the vacuole contents. 9- Digestion is **intracellular** the digested food is absorbed and utilized , whereas the indigested food is discharged when these vacuoles fuse with plasma membrane .

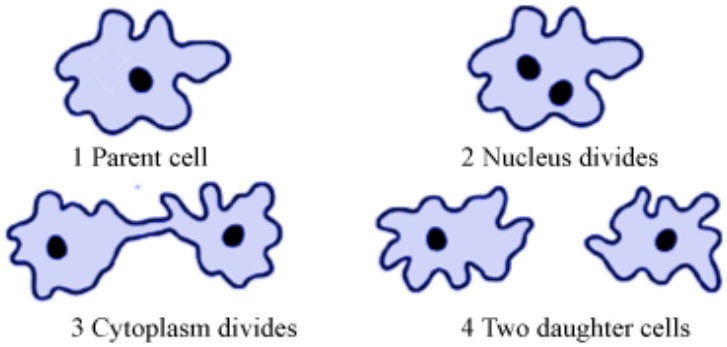


Nutrition by Amoeba

7- Reproduction

1- *Amoeba* reproduces by **Simple binary fission** :

This division takes place by mitosis (indirect division) . It is completed within half an hour at 24^0 C . This happens at favorable environmental conditions (food , temperature , Oxygen , and pH) .



2- When Amoeba reaches its maximum size, binary fission takes place in the following manner :

1- *Amoeba* becomes sluggish , spherical , and withdraws its pseudopodia .

2- Contractile vacuole disappears .

3- Nucleus undergoes mitosis (Prophase, metaphase, anaphase and telophase). Nuclear division takes place within the nuclear membrane . Nuclear division is called **karyokinesis**.

4- Cytoplasmic division or **cytokinesis** is follows the karyokinesis .

5- Two small daughter amoebas are formed in this division .

8- Respiration

1- **Respiration** takes place **by diffusion** i.e., the gases transfer from higher concentration to lower concentration.

2-The O_2 concentration is higher in water surrounding *Amoeba* , whereas CO_2 is higher inside *Amoeba* , Thus, O_2 will enter Amoeba whereas, CO_2 will come out of it.

9- Excretion

1- The excretory products or metabolic waste materials are H_2O, CO_2, ammonia , urea and indigestible food in the food vacuoles .

2- *Amoeba* gets rid of water , carbon dioxide , ammonia , and urea either via contractile vacuole or selective plasma membrane .

3- The solid waste products of food vacuoles are thrown out when these organelles fuse with plasma membrane and discharge their indigestible contents .

10- Encystment

1- Encystment is protective are not a reproductive phenomenon .

2- It occurs in adverse environmental conditions , such as food scarcity, dryness increase of CO_2 concentration or change in pH .

3- In such adverse environmental conditions , the following changes takes place.

4- *Amoeba* withdraws its pseudopodia and becomes almost spherical .

5- food particles in cytoplasm are either absorbed or ejected . Contractile vacuole disappears and Ectoplasm secretes a double- walled protective cyst .

6- When favorable condition return , *Amoeba* ruptures the cyst and comes out .

7- There is no increase in the number of amoebae inside the projective cyst. Therefore, this phenomenon is a protective one and not a reproductive.

10- Locomotion

1- How pseudopodia work or are formed has long attracted the interest of Zoologists .

2- Many theories have been proposed to explain the pseudopodia formation or amoeboid movement .

3- However , only recently we have gained insight into this phenomenon.

4- When a typical pseudopodium begins to form , an extension of ectoplasm called **a Hyaline cap appears :**

1- Endoplasm begins to flow toward and into the hyaline cap .

2-The following endoplasm contains actin subunits attached to regulatory, actin-binding proteins (ABP_S), which prevent actin from polymerizing .

3- As endoplasm flows into the hyaline cap , it fountains out to the periphery.

4- Interaction with phospholipids in the cell membranes releases the actin subunits from their regulatory proteins and allows them to polymerize into actin microfilaments .

5- These microfilaments becomes cross- linked to each other by actin- binding proteins (ABP) to form a semisolid gel, transforming the ectoplasm into a tube through which the fluid endoplasm flows as the pseudopsdium extends .

6- Near the trailing edge of the calcium ions activate an actin- severing protein , releasing microfilaments from the gel and permitting myosin to associate with and pull on these microfilaments.