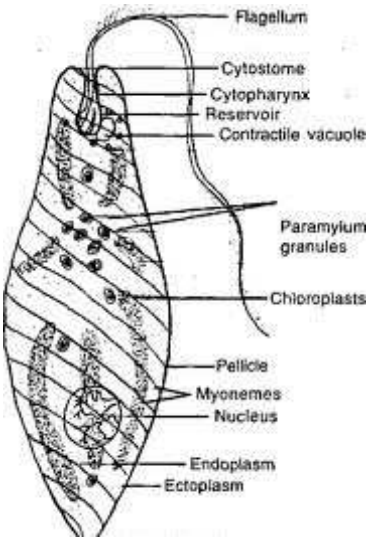
LOCOMOTION IN PROTOZOANS

VSAQs

1. **What are myonemes?**

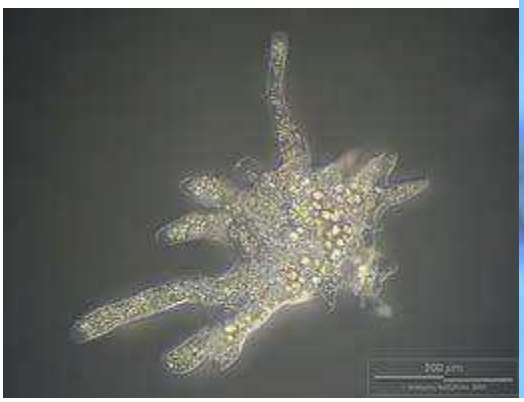
❖ Myonemes are contractile fibrils similar to myofibrils. They are present below the pellicle in ectoplasm of some protozoans. They cause Gliding locomotion.

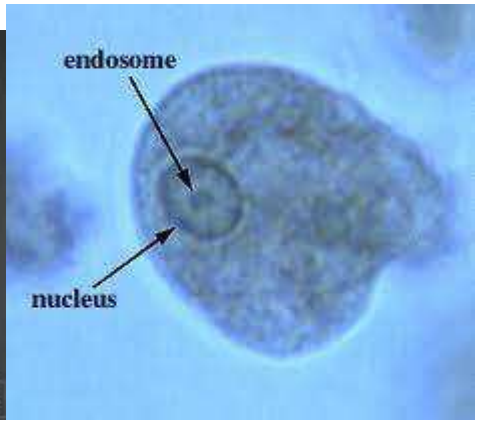


2. **Distinguish between monopodial and polypodial protozoans?**

❖ a) Monopodial : With single pseudopodium e.g. *Entamoeba histolytica*.

❖ b) Polypodial : With several pseudopodia e.g. *Amoeba proteus.*





3. **Distinguish between mastigonemes and flimmers of flagellum?**

❖ Mastigonemes and flimmers are the lateral appendages present on axoneme.

❖ Mastigonemes are tubular while flimmers are solid.

4. **Which pseudopodia primarily useful in ingestion of food material?**

❖ Reticulopodia and Axopodia/Actinopodia type of pseudopodia are concerned with ingestion of food as primary function. Locomotion is secondary function for them.

5. Which pseudopodia have transparent cytoplasm (ectoplasm) only?

- Filopodia type of pseudopodia are composed with ectoplasm only
- It is present in *Euglypha* and *Lecithium*

6. What are dynein arms? What is their significance?

- Dynein arms arise from microtubule 'A' of peripheral doublet of axoneme of either flagellum or cilium.
- Dynein arms are the sites of ATPase activity in the cilia and flagella.

7. List out differences between flagellum and cilium?

FLAGELLUM	CILIA
1.Number varies	More in number
2. Generally present at one end of cell	Present throughout cell surface or at one Area
3. Show undular movement	Show pendular movement
4. Do not form compound organelles	Form compound organelles like cirri, Membranelles etc.

8. Why Sol -- gel inconvertibility is a physicochemical change?

- Both physical and chemical properties are to be changed during interconvertibility.

9. Define Kinety.

- A longitudinal row of kinetosomes, kinetodesmal fibrils and their kinetodesmata form a unit known as kinety.
- All the kineties together form an infraciliary system present in ectoplasm.
- Infraciliary system is connected to motorium present near the cytopharynx and form the neuromotor system. It controls and coordinates the movement of cilia.

10. Distinguish between undular ad pendular movements.

- Vibratory movements shown by flagellum are known as undular movements.
- Cilia show swift back and forth movements like a pendulum or paddle.

11. Distinguish between zone of gelation and zone of solation?

ZONE OF GELATION	ZONE OF SOLATION
1. It is present at advancing end around Hyaline cap.	It occurs at uroid end.
2. Sol transforms into gel by losing water	Gel transforms into sol by getting water
3. Protein molecules are in unfolded state	Protein molecules are in folded state

12. Distinguish between synchronous and metachronous rhythms in *Paramecium*.?

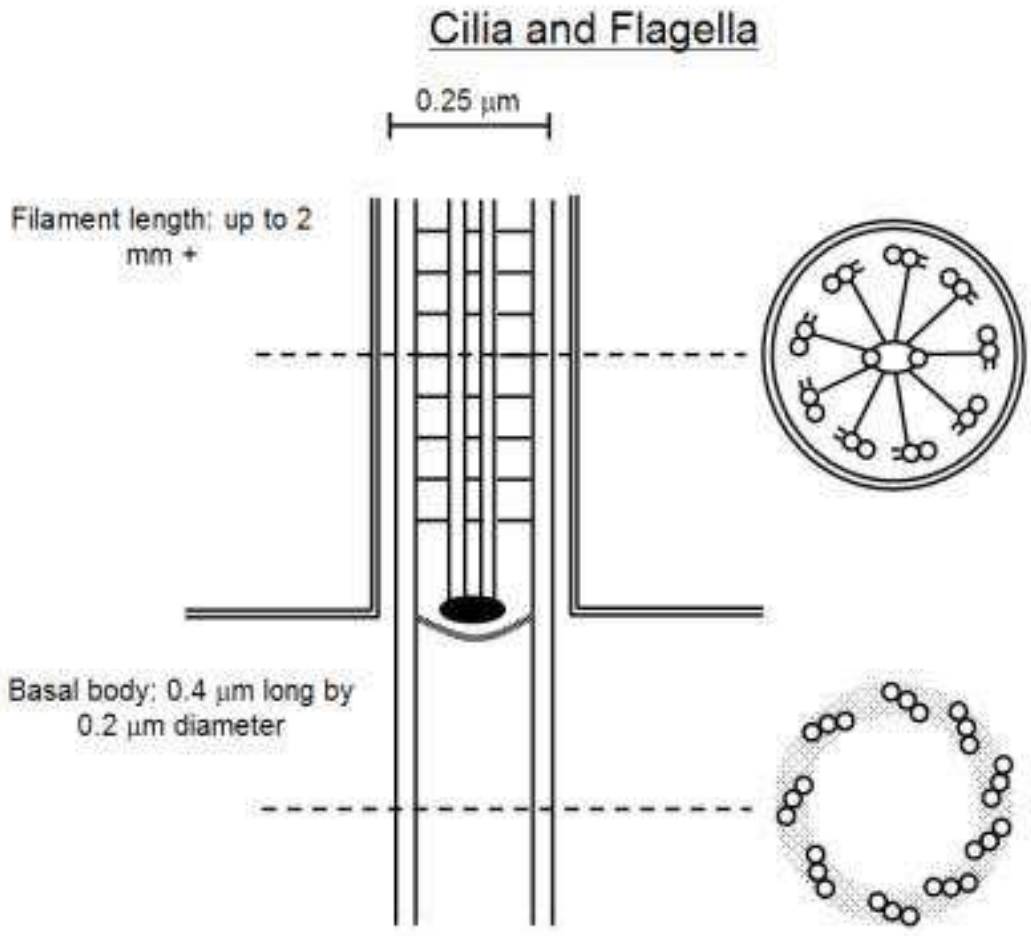
SYNCHRONOUS RHYTHM	METACHRONOUS RHYTHM
1.It is shown by cilia of transverse rows 2. All the cilia of transverse row beat simultaneously	It is shown by cilia of longitudinal rows Cilia of longitudinal row beat one after the other from anterior to posterior.

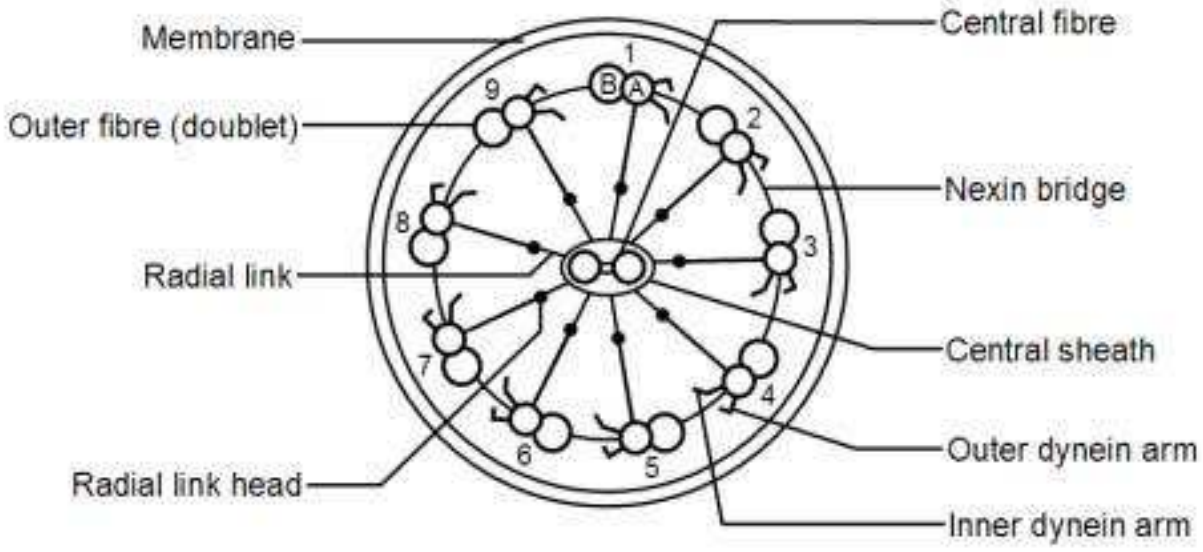
13. Why is infra ciliary system present only in ciliate protozoans ?

- Ciliate protozoans have many cilia all over their body surface. Each cilium can beat independently.
- To maintain coordination among the cilia during locomotion, infraciliary system is present in them.

14. **What is microtubular organizing centre?**

- Centrosome is the microtubular organizing centre





15**. Find out the number of microtubules in the basal granule and axoneme of a flagellum**?

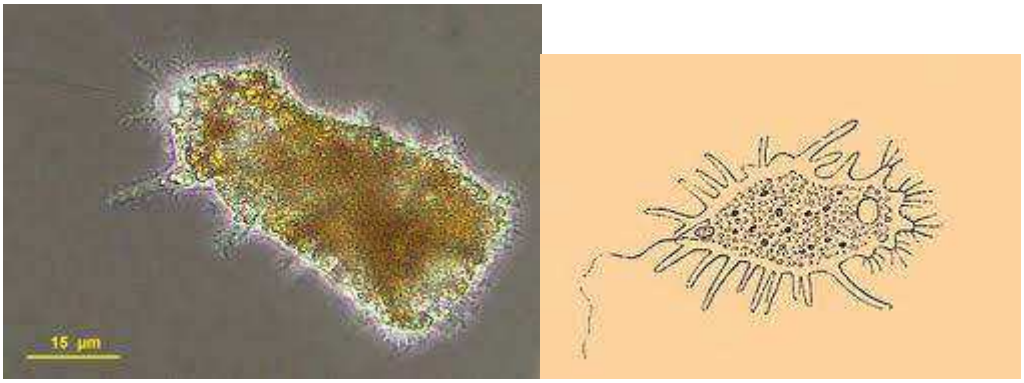
- 20 Microtubules (9 peripheral doublets and 2 central singlets) form axoneme.
- 27 microtubules (9 peripheral triplets) form basal granule below pellicle

16. Why is sol-gel theory of amoeboid locomotion called change of viscosity theory?

- Sol-gel theory of amoeboid locomotion explains the interconvertible nature of gel and so by changing their viscosities.
- At zone of gelation where sol transforms into gel, the viscosity increases.
- At zone of solation where gel transforms into sol, the viscosity decreases.
- This interconvertibility of gel and sol is responsible for the formation and disappearance of pseudopodium.

17. What is the significance of *Mastigamoeba ?*

- Mastigamoeba is mastigophoran with both flagellum and pseudopodia.



18. How are pull force and push force exerted in the flagellar locomotion?

- a)Undulation from tip to base of a flagellum causes a pulling force and the organism pulled forwards.

  b) Undulation from base to tip of a flagellum causes a pushing force and the organism is pushed backwards.

19. Large volume organisms like fishes are streamlined to reduce the pressure drag in water. But small volume organisms like Chlamydomonas are not streamlined. Why?

- Streamlined body increases the surface to which water molecules attach, which results in increasing of viscous drag.
- To reduce viscous drag, protozoans are not streamlined.

20. What are undulipodia ?

- Flagella and cilia are considered as undulipodia by Hyman as they cause progression by beating.

SAQ s

1. Describe Sol—gel theory related amoeboid movement.

- Sol-gel theory for amoeboid movement was advocated by Hyman and explained by Pantin and Mast as Change of Viscosity theory.
- Amoeboid locomotion can be described in the following steps
- a) Amoeba teaches to substratum by plasma lemma temporarily.

  b) Hyaline layer of ectoplasm at advancing end forms a thickened hyaline cap. Behind the hyaline cap, inner plasmasol flows forward and forms a pseudopodium. Later plasmasol changes into gel and joins ectoplasm.

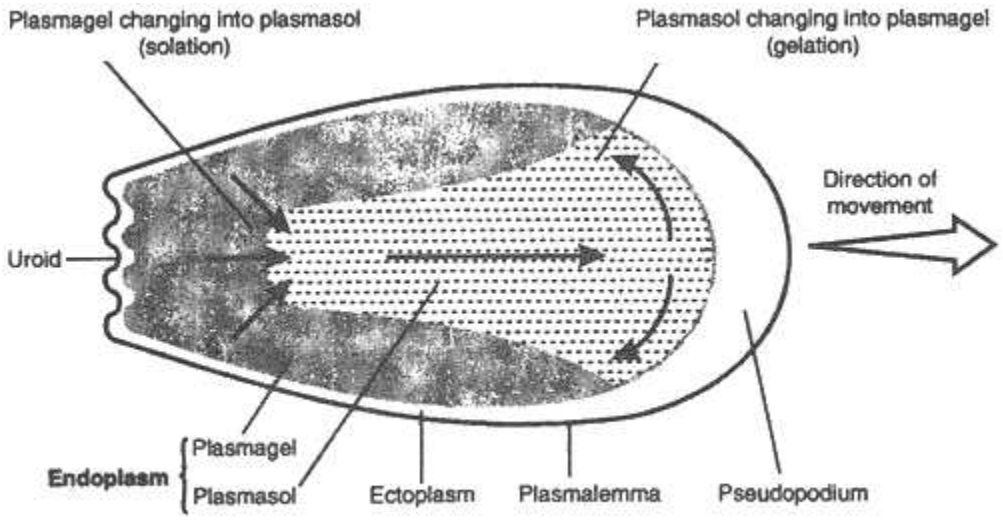
  c) A rigid plasmagel tube is formed. Now Amoeba has two ends i.e., Advancing end and Trailing end or uroid end with wrinkled surface.

  d) Zone of gelation is present around hyaline cap. Zone of solation occurs at uroid end.

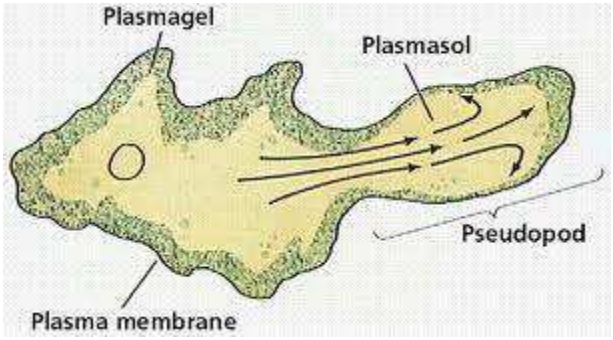
  e)Plasmagel at the uroid end changes into sol and flows forward. It leads the elongation of pseudopodium and moving of Amoeba in forward direction.

  f) Gelation at advancing end and solation at trailing end occur simultaneously at same rate. So Amoeba moves forward continuosly.

  g) Contraction of plasmagel tube at the trailing edn causes hydraulic pressure on sol and makes the sol flow forwards in plasmagel tube.



Sol-gel theory of amoeboid movement 2classnotes



2**. Describe the different types of flagella in protozoans?**

❖ Flagella are divided into several types of based on lateral appendages and terminal naked filament.

Type of flagellum	**Lateral appendages**	**Terminal naked Axial filament**	**Eg.,**
1.Stichonematic	One row	Absent	Euglena, Astasia
2.Pantonematic	Two or more rows	Absent	Peranema, Monas
3.Acronematic	Absent	Present	Chlamydomonas, Polytoma
4.Pantacronematic	Two or more rows	Present	Urceolus
5.Anematic(simple)	Absent	Absent	Chilomonas,Cryptomonas

3. Describe different types of pseudopodia in protozoans?

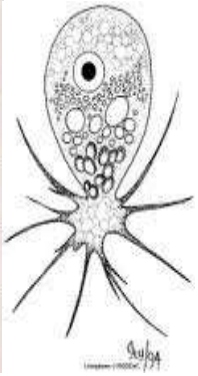
❖ Pseudopodia are of different types in protozoans in the following manner.

a) **LOBOPODIA** : Blunt and finger like. They have both ectoplasm and endoplasm. They have rounded tips.

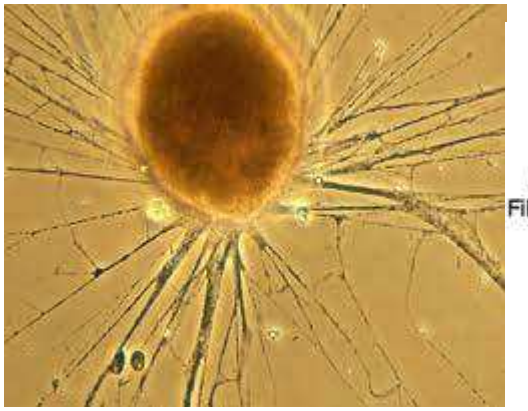
Eg ., *Amoeba proteus, Entamoeba histolytica*



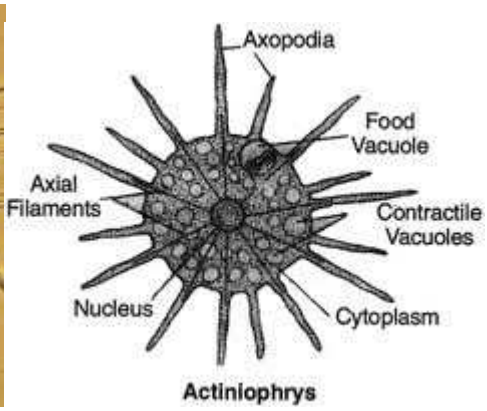
LOBOPODIA



FILOPODIA



RETICULOPODIA



ACTINOPODIA

b) **FILOPODIA** : Slender filamentous with pointed tips. Branched but not form net work.
Eg., *Euglypha, Lecithium*

c) **RETICULOPODIA or Rhizopodia or Myxopodia** : Filamentous, branched and interconnected to form a network. Their primary function is ingestion of food.
Eg., Foraminiferans like *Elphidium, Globigerina*

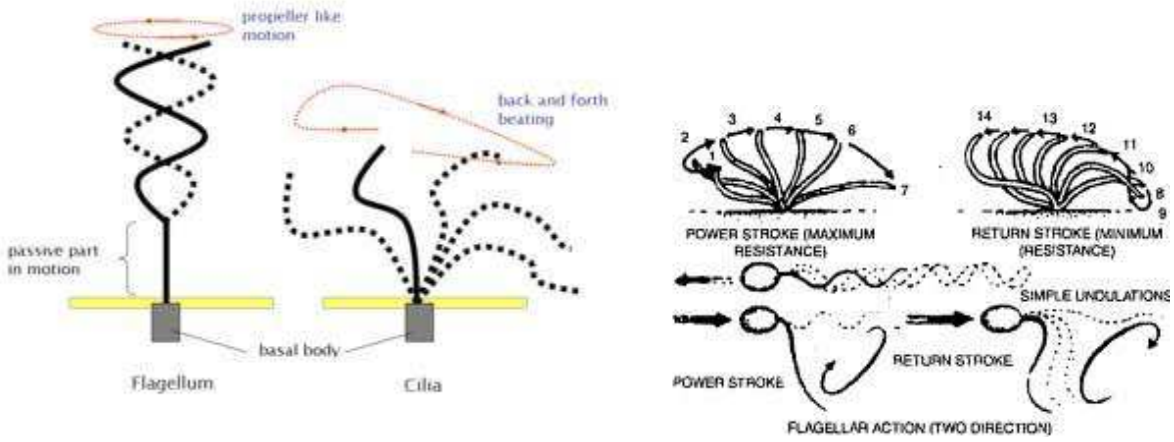
d) **AXOPODIA or Actinopodia** : Fine needle like structures radiating from surface. Each axopodium has central axial rod surrounded by granular and adhesive cytoplasm. They are concerned with food collection mainly.
Eg., Heliozoans like *Actinosphaerium, Actinophrys*
Radiolarians like *Collozoum.*

4. Explain the ciliary locomotion in Protozoans.?

- ❖ Ciliates show ciliary locomotion helped by bending movements of cilia.
- ❖ Cilium moves the water parallel to the surface of its attachment like that of paddle stroke movement. The movement of water is perpendicular to longitudinal axis of cilium.
- ❖ A) Effective stroke: Cilium bends and beats against the water.Body moves forwards as cilium pushes the water backwards.

B) Recover stroke: Cilium comes to original position by this stroke.

- In *Paramecium,* Transverse cilia show Synchronous rhythm as that cilia beat simultaneously. Longitudianl cilia show metachronous rhythm as that cilia beat one after another.
- Ciliary locomotion is coordinated by infraciliary system through a neuromotro centre known as motorium present near cytopharynx of Paramecium.
- Infraciliary system together with otorium forms the neuromotor system that coordinates the beating of cilia.
- Ciliary locomotion is considered as the fastest locomotion in protozoans.



5. Explain the Flagellary locomotion in Protozoans.?

- Flagellum shows undulation movements, sidewise lash movements and spiral gyration movements.
- **A)Undulation movements :**

i) Undulation from base to tip causes a pushing force which pushes the organism backwards.

ii) Undulation from the tip to the base causes a Pulling force which pulls the organism forwards.

iii) Undulations are spiral; they cause rotation of organism in opposite direction known as gyration.

B) Sidewise lash movements:

Sidewise lash or paddle beat of flagellum consist two strokes like effective and recovery stroke.

i)EFFECTIVE STROKE : Flagellum becomes rigid and starts bending to one side beating against the water. It is at right angles to to the longitudinal axis of the body. Organism moves forwards.

ii) RECOVERY STROKE: Flagellum becomes soft and comes to original position.

C) Simple Conical Gyration Movements:

Flagellum turns like a screw. It exerts the propelling action which pulls the organism forwards through water with a spiral rotation around axis of movement.

IMPORTANT QUESTIONS from Locomotion in Protozoans

VSAQ:

01. What is synchronous movement? (March'04)
02. What are myonemes ? (March'05 ; March'06 ; March'09
03. Monopodial and polypodial protozoans? (May'05 ; March'10)
04. Synchronous & metachronous movement? (March'06)
05. Mastigonemes ? (May'06)
06. Differences between flagellum and cilium? (May'09; March'11)
07. Kinety?
08. Dynein arms?
09. Number of microtubules in basal granule and axoneme?
10. Which pseudopodia are primarily for ingestion?
11. Mastigamoeba?
12. Undulipodia?

SAQ:

01. Types of flagella? (March'04 ; March'10)
02. Sol-gel theory? (May '04 ; March'05; March'06 ; March'08 ; March'09 ;May'10 ;March'11))
03. Types of pseudopodia? (May'06 ; May'09)
04. Ciliary locomotion? (March'07 ; March'08)

REPRODUCTION IN PROTOZOANS

VSAQs

1. **Distinguish between symmetrogenic and homothetogenic types of binary fission**.

- Symmetrogenic division is longitudinal binary fission in which daughter individuals formed are mirror images. E.g., Euglena
- Homothetogenic division is Transverse binary fission where the plane of fission is right angles to kineties. E.g., Paramecium

2. **What is plasmotomy ?**

- Division of a multinucleate protozoan into multinucleate daughter individuals by cytoplasmic division but without nuclear divisions is known as plamotomy.
  e.g., *Opalina*

3**. Differences between microconjugant and macroconjugants in Vorticella.?**

- Macro and microconjugants are formed from Vorticella by unequal longitudinal binary fission.
- Macroconjugant is stationary ad passive. It attracts the micrconjugant for about 2 hrs. It differs from the normal sessile adult physiologically.
- Microconjugant is motile and active. It gets a girdle of cilia (aboral cilia). It survives for about 24 hrs only. It does not either develops into an adult or form a stalk. It neither feeds or encysts.

4**. What is nuclear reorganization ? By which processes it occurs in protozoans?**

- Formation of new macronucleus in protozoans is considered as nuclear reorganization.
- Macronucleus becomes weak and old with repeated binary fissions during which amitotic divisions occur. Hence this weak macronucleus cannot function well in discharging vegetative activities. This macronucleus disintegrates and a new active macronucleus is formed from micronucleus.
- It occurs during conjugation.

5. **Difference between adoral ciliature and aboral ciliature in Vorticella?**

- Adoral cilia are formed by inner and outer circlets of cilia present around the mouth as peristomial cilia.
- Aboral ciliature is present at the aboral end of Microconjugant.

6. **Differences between Proter and Opisthae.?**

- PROTER is the anterior daughter formed from Paramecium after binary fission.
- OPISTHE is the posterior daughter formed from Paramecium after binary fission.

PROTER	OPISTHE
1. It retains cytopharynx of parent	It gets new cytopharynx
2. It retains anterior contractile vacuole of parent	It retains posterior contractile vacuole of parent
3. It gets new posterior contractile Vacuole	It gets new anterior contractile vacuole
4. It gets new oral groove	It also gets new oral groove

7. **What is a Clone?**

- All the daughter individuals formed asexually by repeated binary fission from a single parent form a clone.

8. **Difference between binary fission and multiple fission.**

- Division of parent into two daughter individuals is binary fission

- Division of parent into numerous daughter individuals is multiple fission.
- In both of them, karyokinesis occurs first which is followed by cytokinesis.

9. **How does binary fission of Vorticella that occurs during favourable conditions differ from the one that occurs during unfavourable conditions?**
   - Young individuals formed by binary fission during favourable conditions are free swimming and become adults.
   - But young ones formed during unfavourable conditions do not either develop into an adult or form a stalk.

10. How does autogamy differ from conjugation in ciliates ?
   - Autogamy occurs in *Paramecium aurelia* which contains a macronucleus and two micronuclei. It resembles conjugation but takes place within a single individual.
   - Conjugation occurs between two individuals.

11. What is an amphimixis ?
   - It occurs during conjugation in Vorticella.
   - Union of two pronuclei and cytoplasm between conjugants is known as amphimixis.
   - It results the formation of a diploid zygote nucleus or synkaryon.

12. What are mating types?
   - The individuals between which conjugation takes place are known as mating types.
   - Mating types belong to different clones.
   - Mating types show differences in both physiologically and morphologically in the case of Vorticella.

13. Differences between macroconjugant and microconjugant in Vorticella .?

MACROCONJUGANT	MICROCONJUGANT
1.larger 2.Stationary with a stalk 3.It attracts microconjugant of another clone for 2 hrs. If it fails to attract that it becomes somatic individual.	Smaller Motile and active It survives for 24 hrs.only. If it fails to attach with macroconjugant within 24 hrs it dies.

14. Define conjugation. Write its significance.
   - Conjugation is a temporary union between two ciliates belonging to two different mating types of the exchange and reconstitution of nuclear materials.
   - Conjugation provides ……
     a)Rejuvenation b)Nuclear reorganization
     c)Multiplication d)Occurrence of genetic variations

15. The orientation of mitotic spindle is always at right angle to plane of fission. Justify.
   - In Euglena, nucleus divides horizontally where mitotic spindle is formed in the same direction. But binary fission occurs longitudinally which is right angles to spindle.
   - In Paramecium, nucleus elongates vertically. But binary fission occurs transversely which is right angles to spindle formation.

16. Explain the types of budding?
   - Bud is a smaller individual formed after nuclear division.
   - Monotonic budding --- Only one bud is formed. E.g., Vorticella
   - Multiple buds --- Many buds are formed. E.g.,Suctorians.

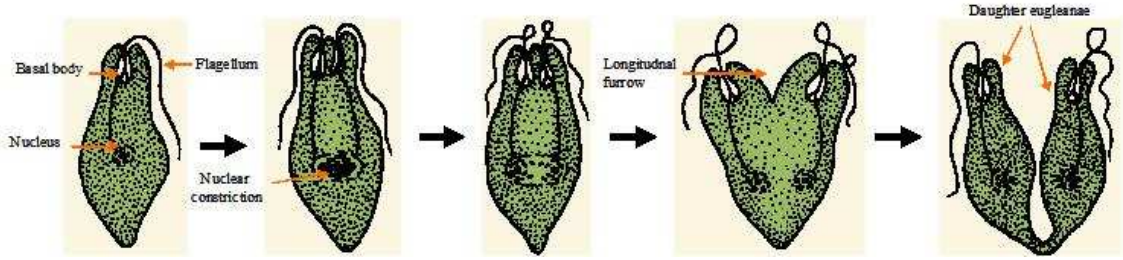
a) Exogenous budding --- Buds are formed on surface of parent. E.g.,*Ephelota*
b) Endogenous budding – Buds are formed inside the body of parent eg.,*Acineta*

SHORT ANSWER QUESTIONS

1. Describe the process of longitudinal binary fission in Euglena*?*

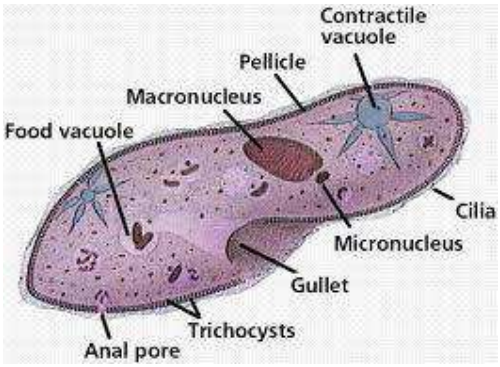
- *Euglena* is a spindle shaped organism. It undergoes binary fission during favourable conditions and also in the encysted stage.
- Nucleus divides mitotically into two nuclei (Karyokinesis). It is followed by cytokinesis.
- A longitudinal furrow begins at the anterior end and proceeds towards the posterior end. It deepens and finally divides Euglena into two daughter individuals. Various organelles distribute to daughters in the following methods.
  a) Organelles divide and distribute equally to both daughter
  e.g., Nucleus, Blepharoplasts and Chloroplasts
  b) Organelles of parent retained by one daughter while other daughter gets new.
  e.g., Flagella
  c) Organelles which disappear and appear newly in both daughters.
  e.g., Contractile vacuole, Stigma, Paraflagellar body.
- Daughter individuals formed in the binary fission of Euglena are mirror images. So the longitudinal binary fission is described as Symmetrogenic division.

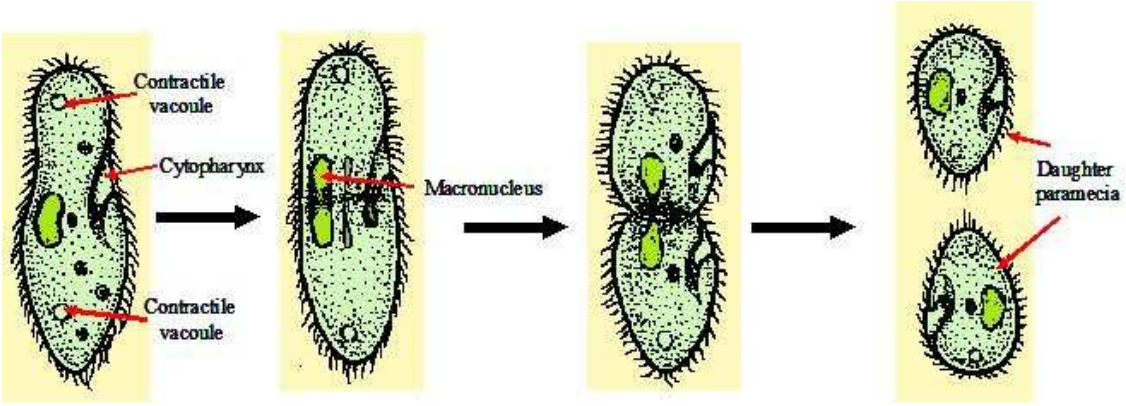


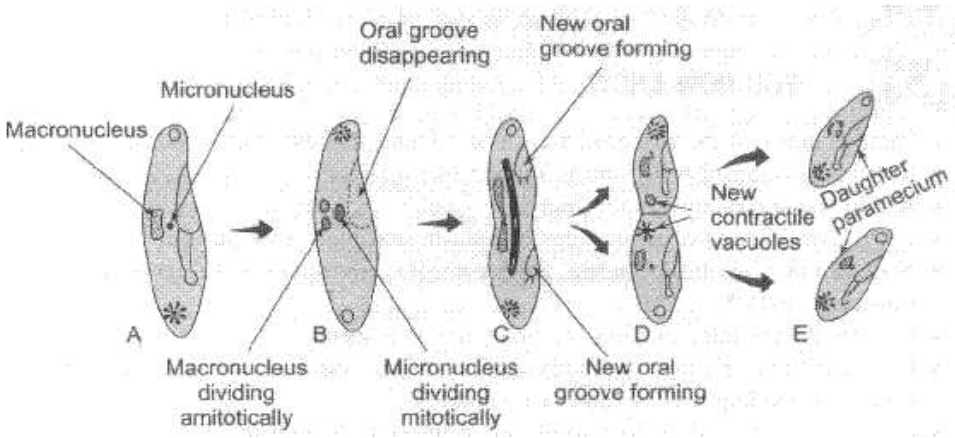


2. Describe the process of transverse binary fission in *Paramecium?*

- *Paramecium* is a ciliate protozoan. It undergoes transverse binary fission during favourable conditions.
- It stops feeding and its oral groove disappears.
- It undergoes karyokinesis. Micronucleus divides mitotically and forms 2 daughter nuclei. Macronucleus also divides by amitosis.
- Two oral grooves now begin to appear, one in the anterior half and the other in the posterior half.
- A constriction appears in the middle of the body. It deepens and divides the animal transversely in to two daughter individuals.
- The anterior one is PROTER and the posterior one is OPISTHE.
- Proter receives anterior contractile vacuole, cytopharynx from parent. It gets new posterior contractile vacuole.
- Opisthe receives posterior contractile vacuole only from parent. It gets anterior contractile vacuole and cytopharynx newly.
- The process of binary fission completes in two hours and may take place 4 times per day.
- All the paramecia formed by repeated binary fissions from a single parent form a clone.
- Transverse binary fission is considered as homothetogenic binary fission.
- The plane of fission is at right angles to the Kineties (perkinetal fission).
- The plane of fission is perpendicular to the longitudinal axis of the body.





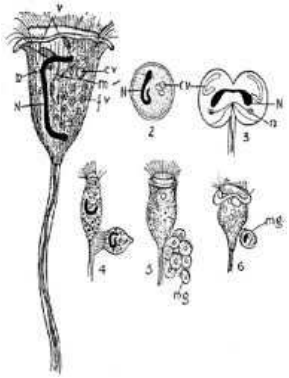


3. Explain the post conjugation fissions in the process of conjugation in *Vorticella* .

- During conjugation in Vorticella, zygote with 8 nuclei (7 macro and 1 Micro) undergoes a series of 3 successive post conjugation binary fissions.
- Macronuclei never divide but distribute during this process. But micronucleus and cytoplasm divide.
- After 1st post conjugation fission two daughters are formed. One receives 4 macronuclei and one micronucleus. Other one receives 3 macronuclei and 1 micronucleus.
- After 2nd series of postconjugation fissions, 4 second generation daughters are formed. Three of them receive two macronuclei and one micronucleus.Fourth one gets one macronucleus and one microneucleus.
- Three daughters of 2nd generation undergo Third series of fissions.
- Finally 6 third generation daughter individuals are fromed. Each one has one macronucleus and one micronucleus.
- Finally 7 daughter individuals are formed. Each daughter has one macronucleus and one micronucleus.
- Each daughter acquires stalk and grows into an adult.

4. Explain the formation of conjugants in the process of conjugation in Vorticella.

- Vorticella divides by longitudinal binary fission into two unequal parts.
- The larger part is the ordinary somatic individual which develops into the Macroconjugant.
- The smaller part is the Microconjugant. It acquires a girdle of cilia (aboral cilia) and detaches from stalk of parent. It swims freely in water. It does not either develop into an adult or from a stalk. It neither feeds nor encysts. It survives for 24 hrs only.
- Macroconjugant attracts the microconjugant for about 2 hrs. Later it becomes the somatic individual. Macroconjugant is stationary and passive.



Vorticella

IMPORTANT QUESTIONS

VSAQ ::

01. Distinguish between proter and opisthae? (March'04 ;June'04 ;March'05,March'07)
02. Differences between micro and macroconjugants ? (March'07)
03. Difference between symmetrogenic and homothetogenic binary fissions (March'08;May'06)
04. Amphimixis?

SAQ :

01. Process of transverse binary fission ? (May'05 ; March'09 ; March'10)
02. Process of longitudinal binary fission ? (May'09; May'10 ; March'11)
03. Post conjugation fissions in vorticella?