Locomotion in *Euglena, Paramecium* and *Amoeba*

Euglena viridis

Euglena viridis (Gr., eu = true; glene = eye-ball or eye-pupil; L., viridis = green) is a common, solitary and free living freshwater flagellate. It is found in freshwater pools, ponds, ditches and slowly running streams. It is found in abundance where there is considerable amount of vegetation.

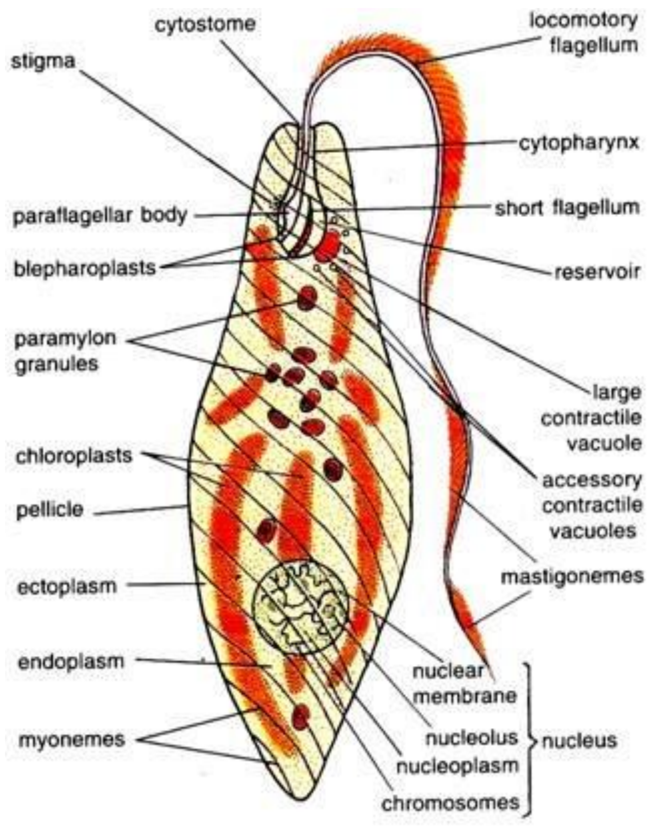


Fig. 12.1. *Euglena viridis.*

Locomotion in *Euglena viridis*:

There are two methods of locomotion in *Euglena viridis*, viz,:

(i) Flagellar movement

(ii) Euglenoid movement

(i) Flagellar Movement:

Flagellum makes direct contribution to locomotion. However, several theories have been put forth to explain the mechanism of flagellar movement. Flagellum undergoes a series of lateral movements and in doing so, a pressure is exerted on the water at right angles to its surface.

This pressure creates two forces one directed parallel, and the other at right angles, to the main axis of the body. The parallel force will drive the animal forward and the force acting at right angles would rotate the animal on its own axis.

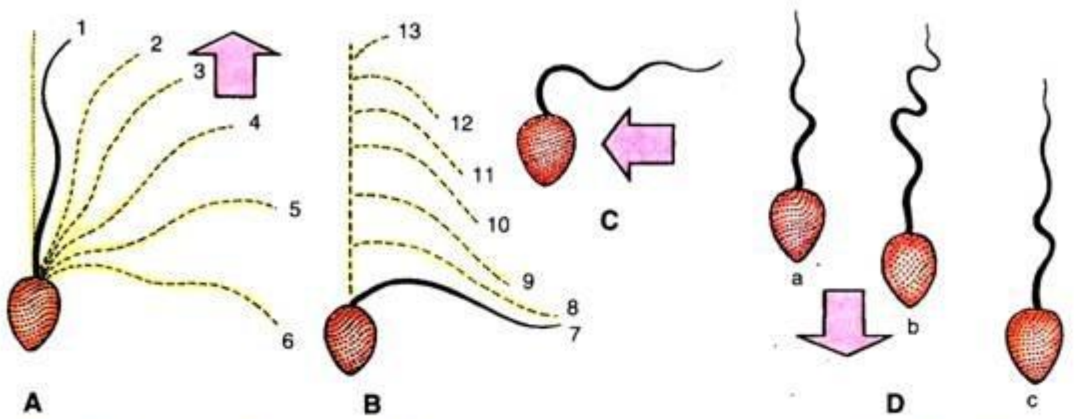


Fig. 12.5. Action of flagellum. A—Recovery stroke, successive stages from 1 to 7; B—Effective stroke, successive stages 8 to 13.

A series of waves pass from one end of the flagellum to the other. These waves create two types of forces, one in the direction of the movement and the other in the circular direction with the main axis of the body. The former will drive the animal forward and the latter would rotate the animal.

For quite a long time it was generally presumed that the flagellum is directed forwards during flagellar movement but now it is generally agreed that the flagellum is straight and turgid in effective stroke and dropped backwards in the recovery stroke.

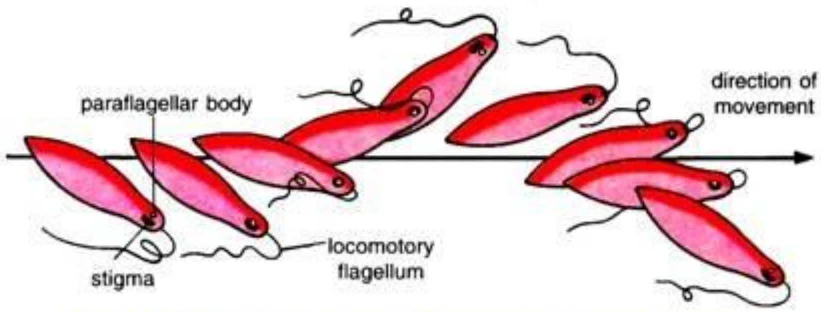


Fig. 12.6. *Euglena*. Successive stages in flagellar movement.

The waves proceed along the flagellum in a spiral manner and cause the body of Euglena to rotate once in a second. Thus, in its locomotion, it traces a spiral path about a straight line and moves forward. The rate of movement is 3 mm per minute.

However, movement of flagellum is related to the contraction of its all fibrils. The energy for the contraction of these fibrils is derived from ATPs formed in the mitochondria of blepharoplasts.

(ii) Euglenoid Movement or Metaboly:

Euglena sometimes shows a very peculiar slow wriggling movements. A peristaltic wave of contraction and expansion passes over the entire body from the anterior to the posterior end and the animal moves forward. The body becomes shorter and wider first at the anterior end, then in the middle and later at the posterior end.

This type of movement is called euglenoid movement by which slow and limited movement occurs. Euglenoid movements are g brought about by the contractions of cytoplasm or by the contractions of myonemes present in the cytoplasm below the pellicle.

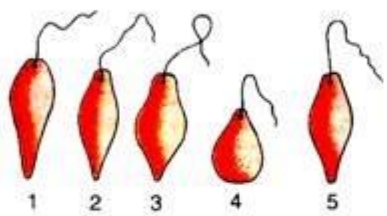
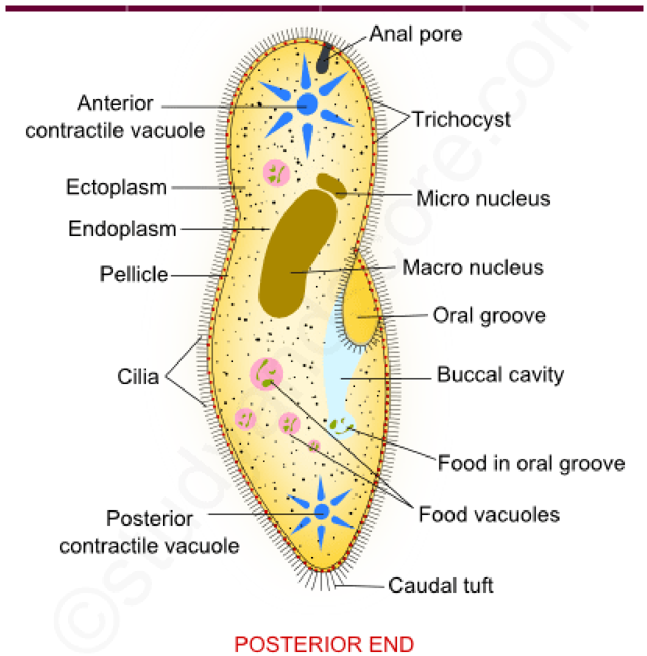


Fig. 12.7. *Euglena*. Stages of euglenoid movement.

Paramecium caudatum

Paramecium is a unicellular microscopic protozoan. The largest species of this genus is *Paramecium caudatum* and it measures about 170-290 µ. It is visible to naked eye as whitish or grayish spot. The greatest diameter of the cylindrical body is about two-thirds of its entire length. It is elongated, slipper-shaped animal and is commonly called as slipper animalcule due to its shape. The anterior end is rounded and the posterior end is cone-shaped. Ventral or oral surface is flat and the dorsal or aboral surface is convex.



STRUCTURE OF PARAMECIUM CAUDATUM

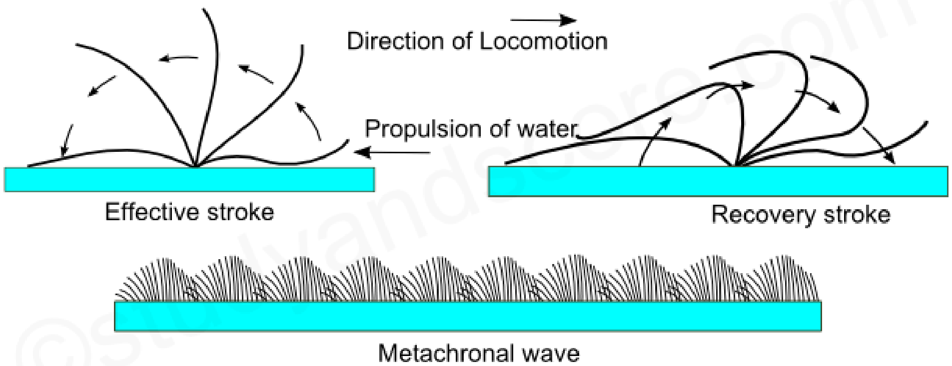
LOCOMOTION IN PARAMECIUM

Paramecium has a streamlined body which helps it to swim in the water which less friction. The rapid swimming is facilitated by the beating of fine and hair-like cellular organelles called cilia. Cilia cover the entire body surface of this protozoan.

Ciliary movement

In *Paramecium* locomotion mainly occurs by movement of cilia. It can move forward and backward. While moving forward, cilia strongly move from anterior to posterior. Similarly, for backward movement cilia strongly move from posterior to anterior. All the cilia do not move at a time. Cilia of transverse row move at the same time. It is called synchronous rhythm, whereas cilia of longitudinal row move one after another. It is called Metachronous rhythm.

The back and forth movements of the cilia are also called as effective and recovery strokes respectively. Cilium moves just like a pendulum or a paddle. The cilium moves the water parallel to the surface of its attachment like that of paddle stroke movement. The movement of water is perpendicular to the longitudinal axis of cilium.



CILIARY MOVEMENT-TYPES OF STROKES

Effective stroke: During effective stroke, the cilium bends and beats against water thus bringing the body forward and sending the water backwards.

Recovery stroke: During recovery stroke, the cilium comes back to original position by its backward movement without any resistance.

Cilia shows two types of coordinated rhythms,

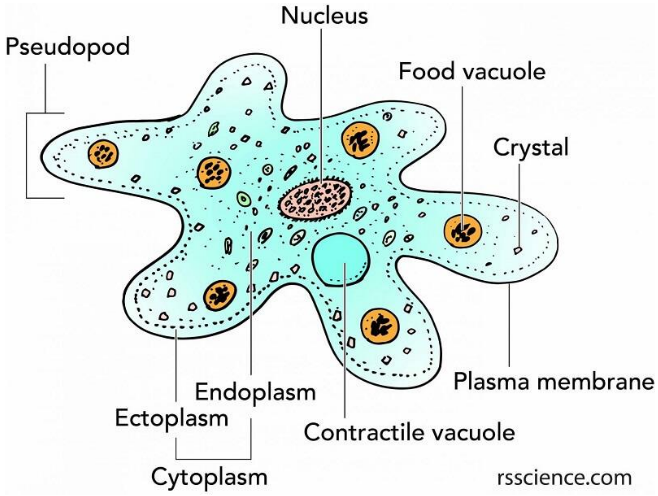
***** Synchronous rhythm, where in the cilia beast simultaneously in a transverse row.

***** Metachronous rhythm, where in cilia beat one after another in a longitudinal row. The metachronal waves pass from anterior to posterior end.

The beating of the cilia can be reversed to move backwards when a *Paramecium* encounters any undesirable object in its path. The ciliary movement is coordinated by infraciliary system though neuromotor center called as motorium present near the cytopharynx in the ciliates like *Paramecium*. The infraciliary system together with motorium form neuromotor system which helps in coordination of the beating of the cilia. Ciliary movement is the fastest locomotion in protozoans.

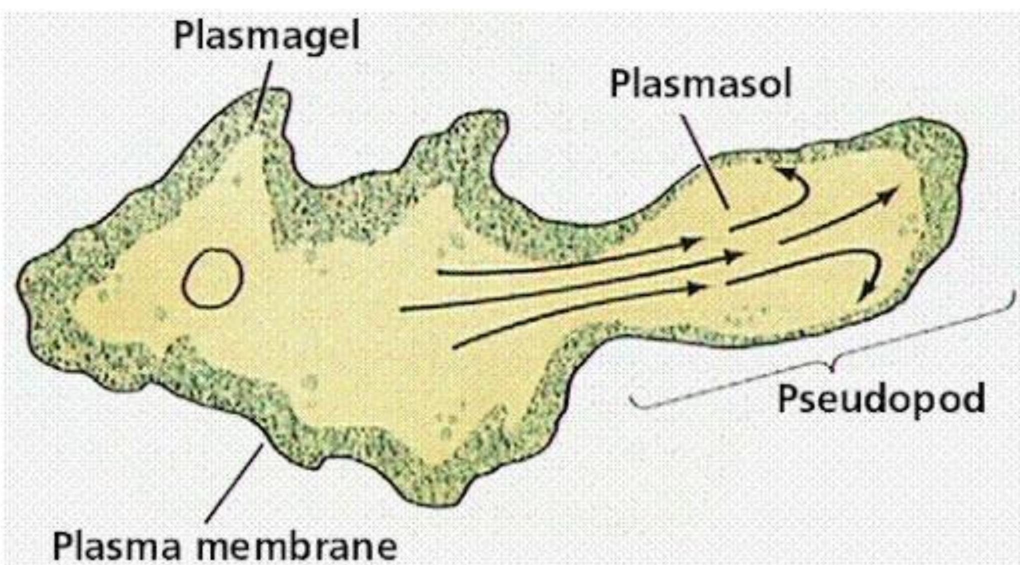
Amoeba proteus

It is a unicellular organism and measures about 250 to 600 µm in maximum diameter and so transparent that is invisible to naked eyes. *Amoeba* has no fixed shape and the outline of the body continues changing due to the formation of small finger-like outgrowths called pseudopodia. When it withdraws all its pseudopodia, it becomes spherical in shape.



Locomotion in *Amoeba proteus*

In Amoeba movement occurs by means of pseudopodia. The pseudopodia are finger-like projections in the direction of flow of the cytoplasm consequently, the body moves in that direction. The specific system of formation of pseudopodia is still debatable.



The cytoplasm present inside the cell is capable of changing into different forms viz. from fluid to solid and vice versa. When the cytoplasm is in fluid state, it is known as plasmasol and when in solid or gel like state, is called the plasmagel. The interchange of these two states, i.e. from plasmasol to plasmagel is known as Sol-Gel theory, which is responsible for movement of amoeba.

Amoeba is capable of propelling itself only when its cytoplasm is in fluid state. First the amoeba attaches itself to a substrate. In the advancing end of its body, an ectoplasm is formed. Immediately the plasmasol flows through the center of the body towards the advancing end. Movement takes place when plasmasol flows. The plasmasol then gets converted to plasmagel by losing water. Locomotion stops at this stage as the cytoplasm becomes solid. This interchange of sol to gel is known as the sol-gel theory. Now, when the amoeba needs to propel itself once again, the gel transforms itself to sol by obtaining water from its uroid end. The process of formation of sol and gel is known as solation and gelation, respectively.

An amoeba forms protuberances from its body. These tentacles like extended structures, known as pseudopodium not only aid in locomotion but also helps in capturing preys. The number of pseudopodia they form ranges from one to a dozen. When the plasmasol flows towards the advancing end, the pseudopodium also extends and the amoeba drags itself. The pseudopodium is also connoted as false feet and it can develop from any part of the body. It grows in size and engulfs its prey by a technique known as phagocytosis. They shrink when phagocytosis is over.