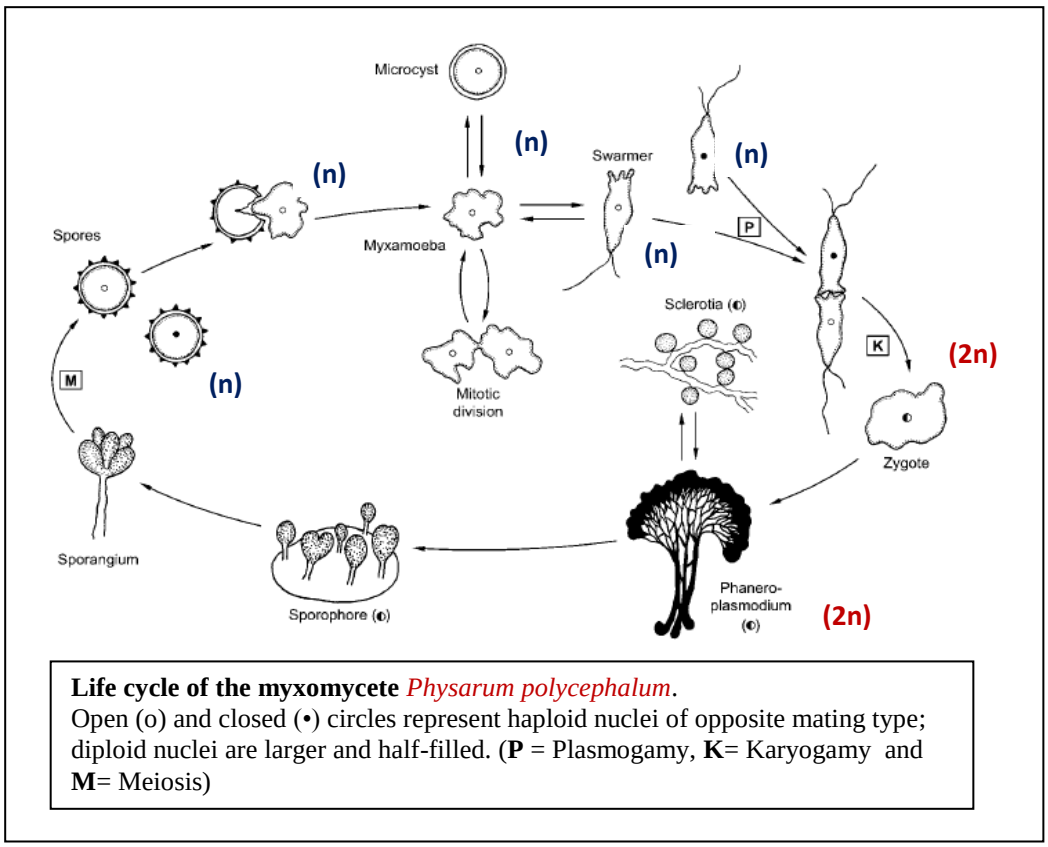
Unit 6: Myxomyota

Life cycle of Myxomycetes

The life cycle of ***Physarum polycephalum***, a typical myxomycete, is summarized here.



Life cycle of the myxomycete *Physarum polycephalum*.
Open (o) and closed (•) circles represent haploid nuclei of opposite mating type; diploid nuclei are larger and half-filled. (**P** = Plasmogamy, **K**= Karyogamy and **M**= Meiosis)

- The plasmodium is diploid and feeds by phagocytosis of bacteria, yeasts or fungal mycelia or spores. It gives rise to a frutification or sporophore containing haploid spores under appropriate conditions.

- The haploid spores are dispersed by wind or insects and, depending on environmental conditions such as moisture, germinate to produce haploid gametes either as myxamoebae or as swarm cells with usually two anterior whiplash flagella, of which one is shorter than the other and is thus often invisible.

- **Myxamoebae** move over the substratum feeding on microorganisms, mostly bacteria. These myxamoebae are capable of **asexual reproduction** by mitotic division.

- **Swarmers** cannot divide, but can readily and reversibly **convert into myxamoebae**. Both swarmers and myxamoebae form filose pseudopodia (acutely pointed) with which they engulf their food.

- Under adverse conditions, myxamoebae secrete a wall to form **microcysts.**

- **Sexual reproduction** is initiated when two haploid myxamoebae or swarmers of compatible mating type fuse to form a zygote from which the diploid plasmodium develops.

- Plasmogamy usually takes place between swarmers of different mating types. Karyogamy follows, and the diploid zygote establishes a phaneroplasmodium.

- The plasmodium can survive adverse conditions by turning into a resistant sclerotium in which numerous walled compartments (**spherules**), each containing several nuclei, are formed. These spherules resume growth by the release of protoplasts which fuse to re-establish the plasmodium.

- When nutrients become limiting, the entire content of a plasmodium is then converted into one or more sporangia in which meiosis takes place and haploid spores are formed.

Somatic phase: Plasmodium

- **Plasmodium** is a multinucleate wall-less (naked) mass of protoplasm, delimited only by a thin plasma membrane and a gelatinous sheath. The slime sheath gives some protection from desiccation and helps in locomotion.

- Inside the slime sheath is the plasma membrane that surrounds the cytoplasm which consists of nuclei, mitochondria, endoplasmic reticulum, ribosomes, golgi apparatus food granules and small vacuoles etc.

- The protoplasm is fluid in some portions and gelatinous in others.

- The fluid portion of the protoplast is usually in the form of an intricately branched network streaming through the gelatinous portion of the vigorously growing plasmodium.

- Reverse cytoplasmic streaming: The protoplasmic granules flow in one direction at a greater speed and this flow of protoplasm slows down, comes to a momentary stop and then begin to flow in the opposite direction for a certain length of time only to reverse itself again and again. The motive forces in the plasmodium is generated by the interaction between actin-myosin protein filaments present in it *e.g*. in *Physarum polycephalum* the recorded velocity of protoplasmic flow is 1.35 mm/sec.

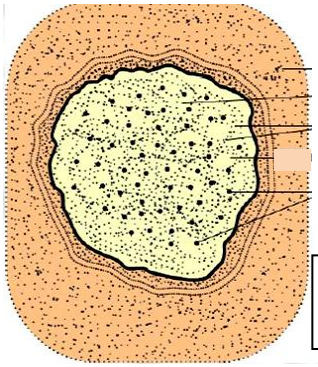
- Slime mold plasmodia are of various colours, from colourless to white, gray, yellow, orange. In some plasmodia, the pigments responsible for the colour are chemical indicators and their colour change with variations in hydrogen ion concentration of the plasmodium. These pigments function as photoreceptors to receive and absorb light for fruiting or sporulation.

Types of plasmodium

Plasmodia vary in shape and size and can be loosely grouped into three categories.

(1) Proto-plasmodium *(protos*= first)

- Primitive type of plasmodium and remains microscopic throughout its existence.
- Highly granular and more or less homogenous protoplasm, plate-like appearance.

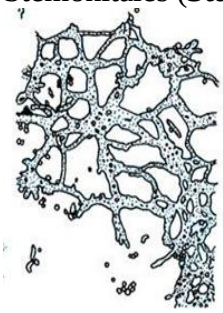


Diagrammatic representation of a typical protoplasmodium

- Does not form any veins and shows a very slow irregular streaming of protoplasm instead of rapid, rhythmic, reversible streaming of the other plasmodial types**.**
- Usually giving rise only to a single, tiny sporangium. They resemble the simple plasmodia of protostelids.
- Example: plasmodium in ***Echinostelium and Licea***

2. Aphano-plasmodium (*aphanes*=invisible)

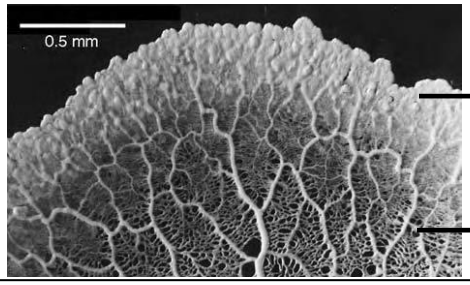
- Networks of transparent, flattened, thin thread-like plasmodial strands which are almost invisible and lack polarity and directional movement.
- Affinity for growing under submerged water.
- Individual strands are only 5-10 µm wide and the entire plasmodium about 100-200 µm in diameter.
- Protoplasm homogenous, not coarsely granular, streaming rapid and rhythmically reversible.
- Example: Order Stemonitales (***Stemonitis)***



Diagrammatic representation of a typical aphanoplasmodium

3. Phanero-plasmodium (*phanero* =visible)

- Largest, most colourful (yellow) and frequently seen.
- Massive and visible to the naked eye.
- Protoplasm granular.
- The gellified and fluid portions of the veins are easily distinguishable.
- Rhythmic streaming is very conspicuous.
- Polarity and directional movement, terminating anteriorly in an advancing, fan-shaped feeding edge, and posteriorly in a trailing network of veins, shows cytoplasmic flows.
- Grows best under drier condition where water is absent.
- Example: Order Physarales **(*Physarum, Didymium)***



Phaneroplasmodium of *Physarum polycephalum*

Reproductive Phase: Fruiting bodies

Myxomycetes are holocarpic in nature *i.e*. somatic phase passes into reproductive phase completely. The entire plasmodium under the exhaustion of food, rise in temperature, acidic or acute basic pH, deficiency of water, chemical factors like Ca^{2+}, malate, and sufficient light, gets converted into one or more fruiting bodies. Once the plasmodium reaches to the fruiting stage, it cannot resume its further growth as a somatic phase.

Myxomycetes produce four general types of fruiting bodies:

1) Sporangium

Sporangia are mostly small, few mm long and one mm in diameter, **stalked** or sessile, have definite shape, spherical or linear and has its own covering during development called **peridium**. Sporangia arise from thin cellophane like base called **hypothallus** *i.e*. a common base for all sporangia, e.g. *Arcyria*, *Didymium*, *Physarum*, *Stemonites* etc. In some sporangia the lower part is cup like or saucer like base called **calyculus,** *e.g. Arcyria* and *Cribraria* etc.

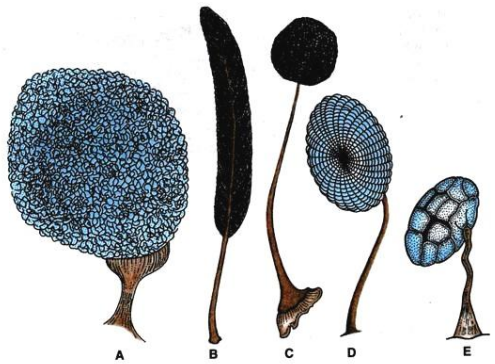


Fig.2.2. Different types of sporangia in slime molds : A, *Arcyria*; B, *Stemonitis*; C, *Comatricha*; D, *Didymium*; E, *Physarum*

2). Plasmodiocarp

Fruiting body is **sessile,** elongated, simple worm-like, branched, ring-like netted which retains the branching habit of the plasmodium. The protoplasm concentrates around some of the main veins of plasmodium, secretes a membrane around it and is converted into a fruiting structure retaining the shape of plasmodial venation, *e.g.* ***Hemitrichia serpula.***

Hemitrichia serpula showing plasmodiocarpous type of fruiting body

3). Aethalium

- Relatively large, massive, sessile, generally cushion shaped fruiting body.
- Formed from one plasmodium that does not differentiate into individual sporangia. In some aethalia the peridium of sporangia are evident; in others the wall is difficult to see and in still others aethalium shows no traces of sporangial wall e.g. *Lycogala spp.*, *Fuligo septica.*
- ***Fuligo septic* is the largest type of myxomycetes fruiting body.**

*Lycogala sp.*showing fruiting body of aethalium type

4). Pseudoaethalium

- In this structure, several sporangia are packed or crowded together appearing like a single sporangium or aethalium e.g. *Dictydiaethalium* or only partially fused *e.g.* in ***Tubifera*.** The individual sporangia are clearly distinguished at maturity.

- Pseudoaethalia are formed on a common hypothallus which is sometimes massive and stalk like.

Pseudoaethalium of *Tubifera species* showing compacted mass of individual sporangia.

For further details on this topic refer book:
Sethi, I.K. and Walia, S.K. (2018). *Text book of Fungi and Their Allies.* (2nd Edition), Medtech Publishers, Delhi (Chapter #5)