Alexopolous and Mims proposed fungal classification in 1979. They place the fungi including the slime molds in the kingdom mycetae of the super kingdom Eukaryota which, in addition, includes four other kingdoms.

They divide the kingdom mycetae into three divisions namely:

- Gymnomycota
- Mastigomycota and
- Amastigomycota

The division is subdivided into subdivision, classes, sub-classes, and orders.

Division I Gymnomycota

- It includes phagotrophic organism devoid of cell walls.
- This division comprises two subdivisions.
- These are Acrasiogymnomycotina and Plasmodiogymnomycotina.

Subdivision 1. Acrasiogymnomycotina

It includes a single class Acrasiomycetes.

Class 1. Acrasiomycetes

Lacks flagellated cells except for one species. The class comprises two subclasses.

Acrasiomycetidae and Dictyosteliomycetidae.

Subdivision 2. Plasmodiogymnomycotina

It is divided into two classes:

Class 1 Protosteliomycetes

Class 2 Mycomycetes

It includes the true slime mold and comprises three sub class namely:

Sub class 1. Ceratiomyxomycetidae

Order – Ceratiomyxales

Sub Class 2. Myxogastromycetidae

It comprise four orders.

Order

Liceales

Echinosteleales

Trichlales

Physarales

Sub Class 3. Stemonitomycetidae

Order 1. Stemonitales

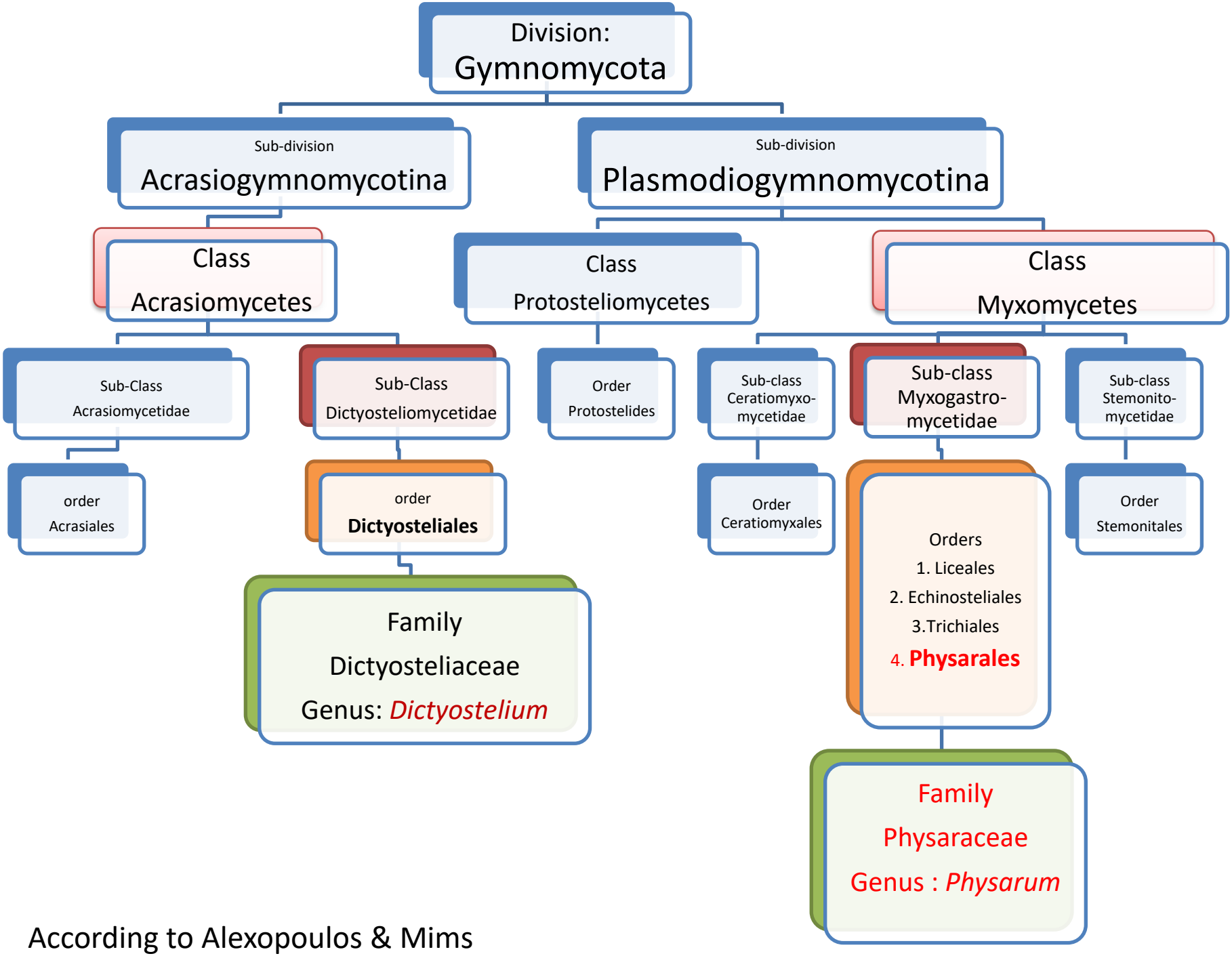
Division II Mastigomycota

- Includes fungi with absorptive nutrition, unicellular or filamentous, mycelium coemocytic.
- It comprises two sub divisions:
- **Sub division 1 Haplomastigomycotina**
- Includes fungi with uni-or, bi-flagellate zoospores.
- **Class 1 Chytridiomycetes**– Fungi producing zoospores furnished with a single whiplash flagellum inserted at the posterior end.
- **Class 2 Hyphochytridiomycetes-** Motile cells with a single tinsel flagellum inserted at the anterior end.
- **Class 3 Plasmodiophoromycetes-** Parasitic fungi producing biflagellate motile cells with both the flagella of whiplash type inserted at the anterior end.
- **Sub division 2. Diplomastigomycotina** Sexual reproduction ooagamous, zoospores biflagellate.
- **Class 1 Oomycetes**
- – It comprises four orders:

  Order 1 Lagenidiales
  Order 2 Saprolegnailes
  Order 3. Leptomitales
  Order 4. Peronosporales

Division III Amastigomycota

- Fungi with absorptive nutrition, motile cells lacking, mycelium aseptate or septate.
- This includes four sub divisions:
- **Sub division 1 Zygomycotina**
  - **Class 1 Zygomycetes** – it includes six orders.
  - **Class 2 Trichomycetes** – it comprises five orders.
- **Sub division 2 Ascomycotina**
- Fungi usually with a septate mycelium producing haploid ascospores in sac like cells called asci.
  - **Class 1 Ascomycetes-** divided into five sub classes:
  - Sub class 1. Hemiascomycetidae- comprising three orders.
  - Sub class 2. Plectomycetidae- Five orders
  - Sub class 3. Hymenoascomycetidae – Ten orders
  - Sub class 4 Laboulbeniomycetidae – Two orders
  - Sub class 5 Loculoascomycetidae – five orders
- **Sub division 3. Basidiomycotina**
- Septate mycelium, produces basidiospores, exogenously on various types of basidia.
  - **Class 1 Basidiomycetes:** it is split into 3 sub clases:
  - Sub class 1 Holobasidiomycetidae
  - Sub class 2 Phragmobasidiomycetidae
  - Sub class 3 Teliomycetidae
- **Sub division 4. Deuteromycotina**
- It includes imperfect fungi in which sexual stage is unknown. It comprises a single form class.
- Form **Class Deuteromycetes** with three form
  - sub classes
  - Blastomycetidae,
  - Coelomycetidae and
  - Hyphomycetidae.



According to Alexopoulos & Mims

Three types of slime moulds
Group- mycetozoa ('fungus-animals')

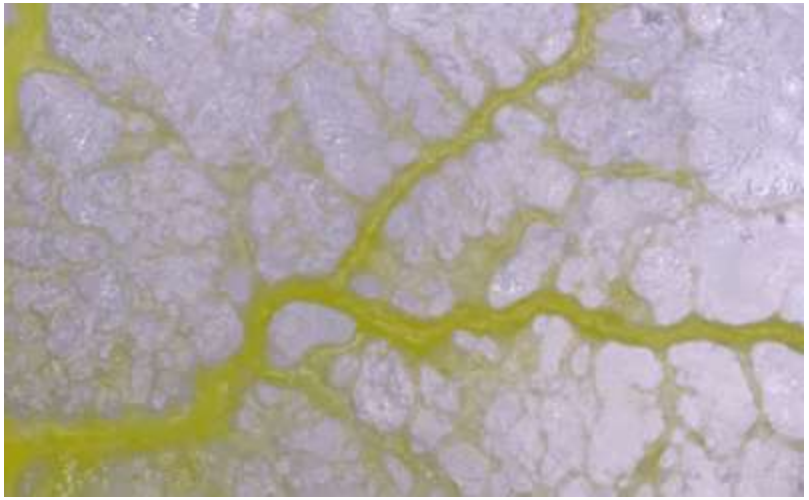
- Protostelida are mostly microscopic with tiny fruiting bodies, they were only discovered in the 1960's and haven't been studied much as they're hard to find and very difficult to keep alive in the lab.

- Dictyostelids live most of their lives as single celled amoebae but come together to form a structure called a slug (not related to actual slugs) or grex when they need to form spores. They're often kept in laboratories and often used as models for intercellular communication and cooperation.

- The myxogastria are the 'acellular' slime moulds that we're talking about on these web pages. They're not really acellular ('without cells') - they're single celled - 'unicellular'.They form single giant cells that look like a network of veins and can cover square metres of ground in some cases.

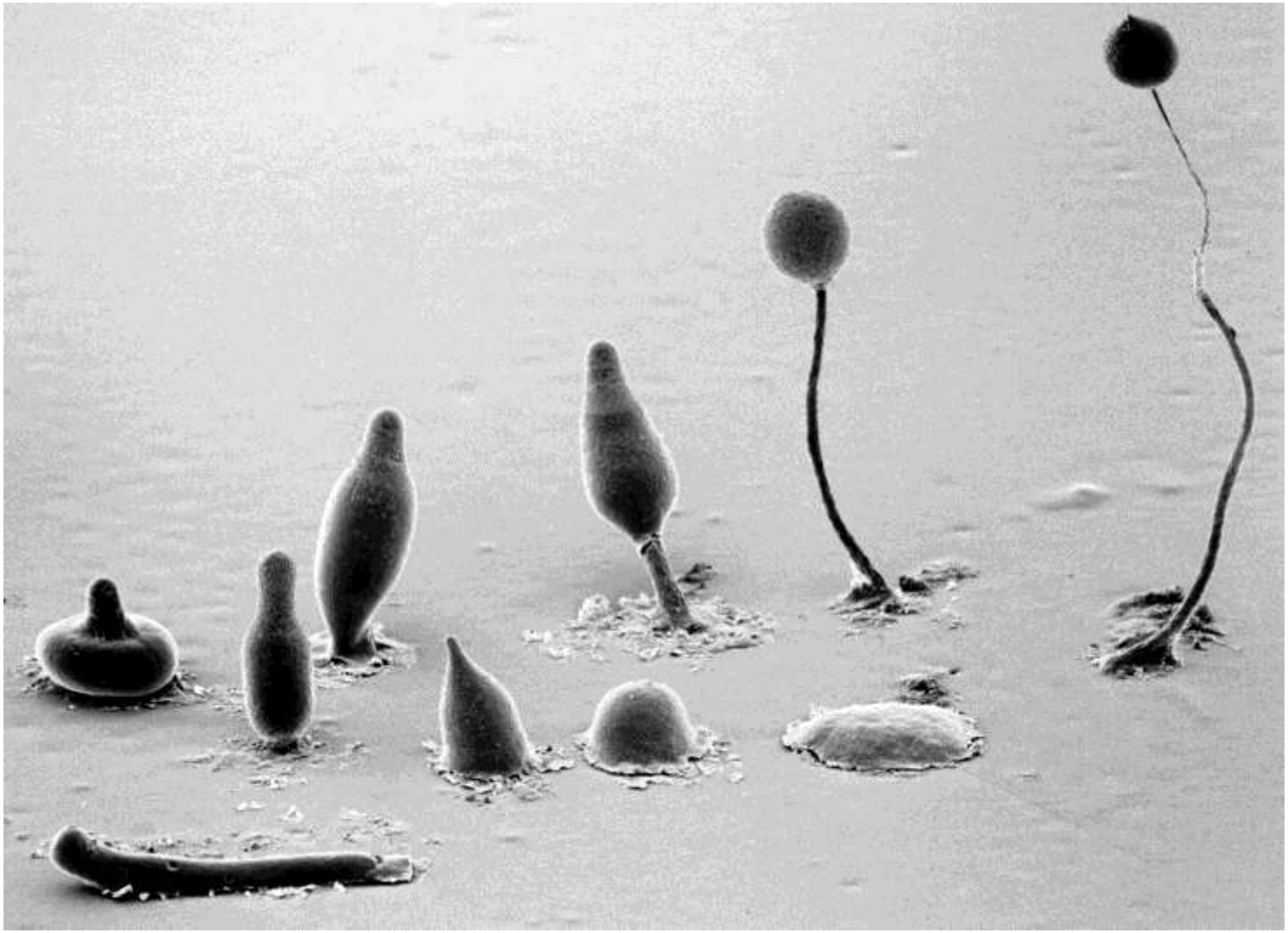
Dictyosteliomycota and Myxomycota

Dictyostelium discoideum

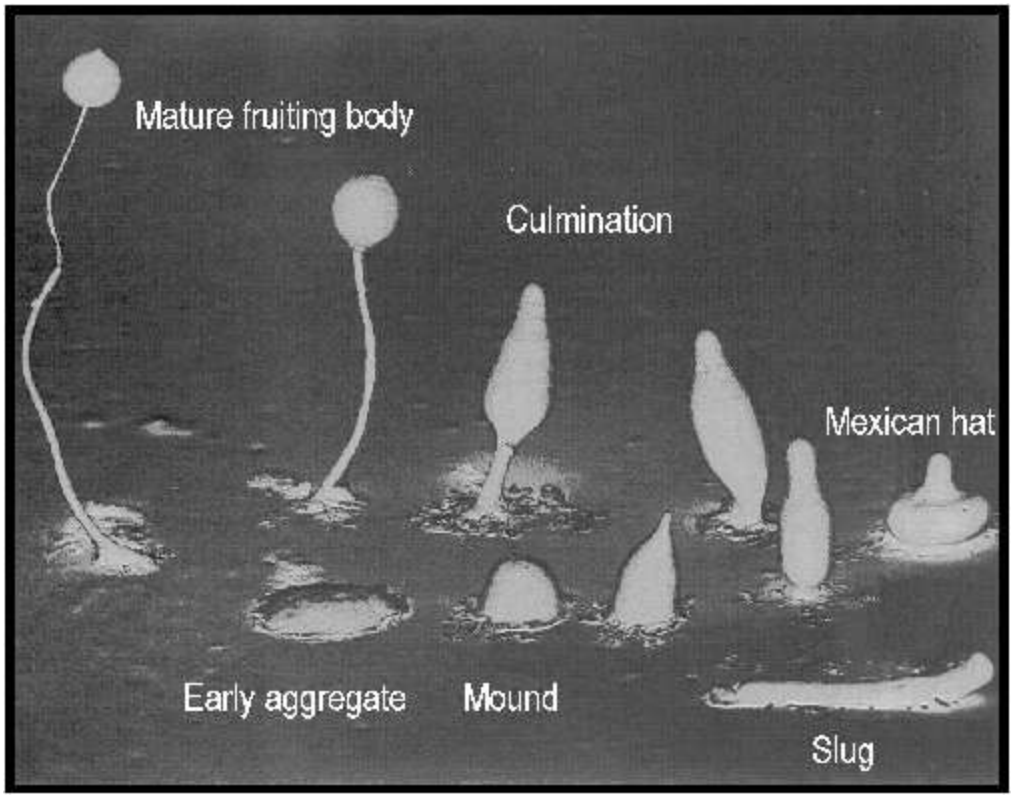


Most slime moulds in the wild live on woodland floors amongst the mosses and fallen tree branches where they feed on bacteria, fungi and rotting vegetation.

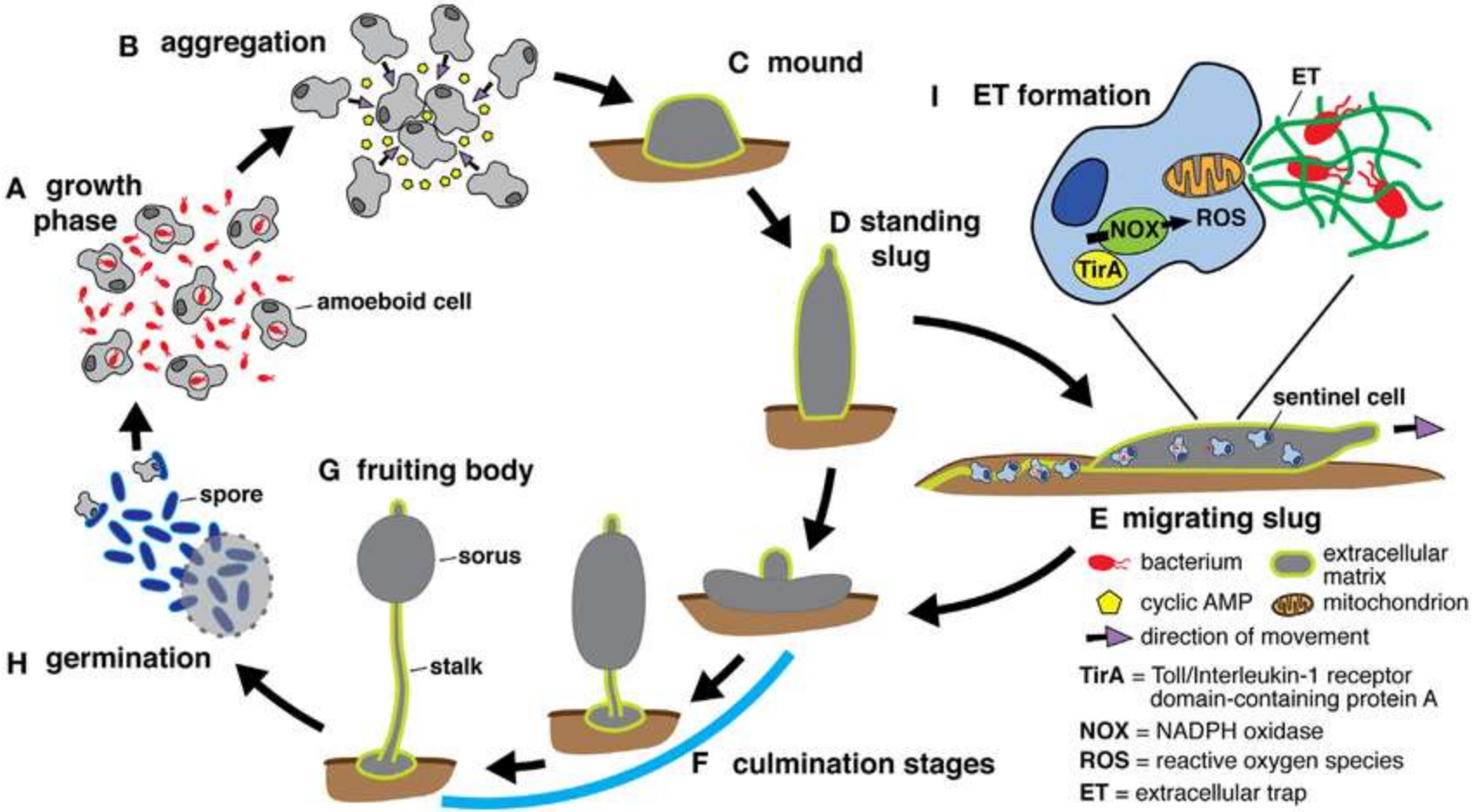
Dictyostelium discoideum



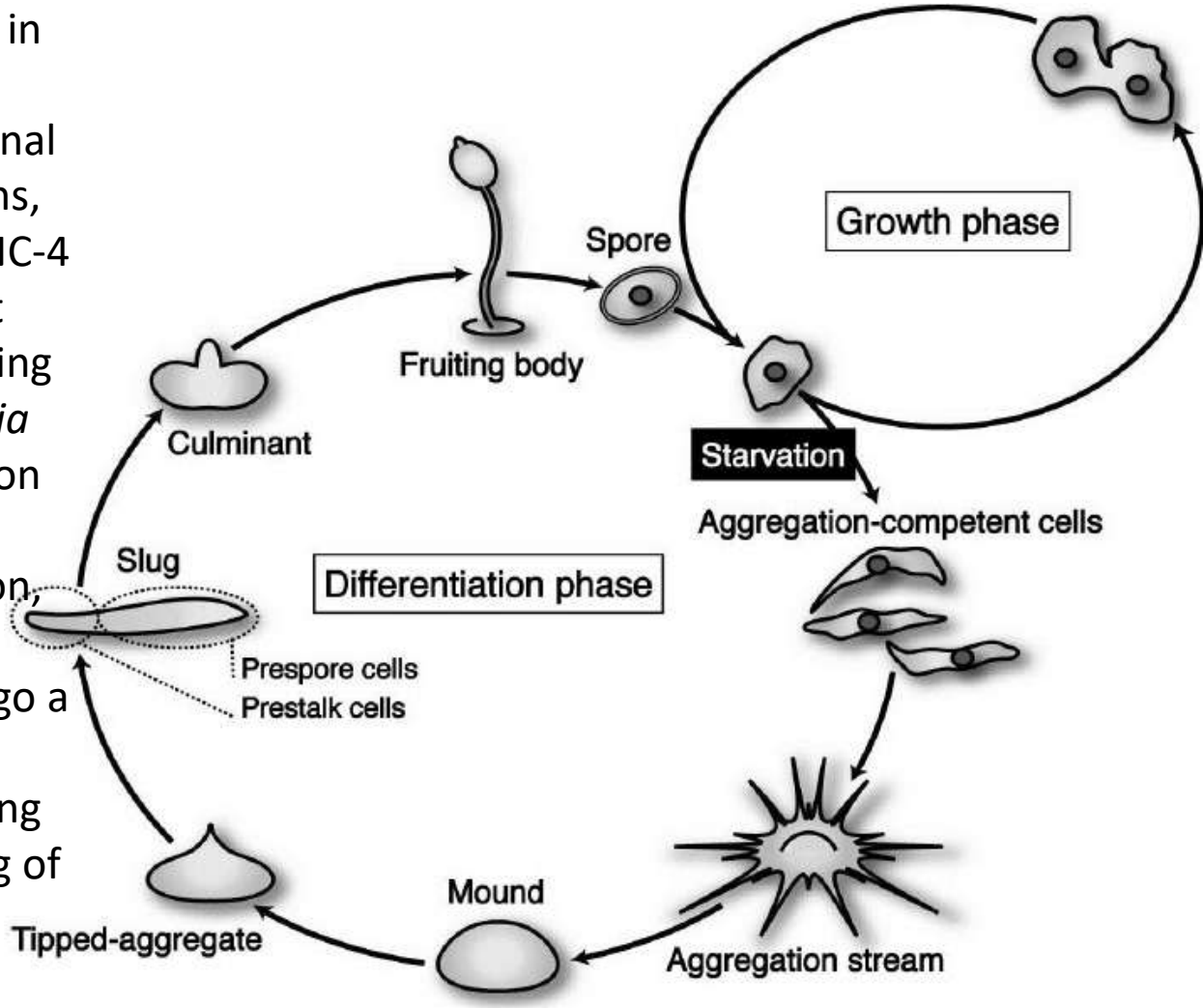
Dictyostelium discoideum

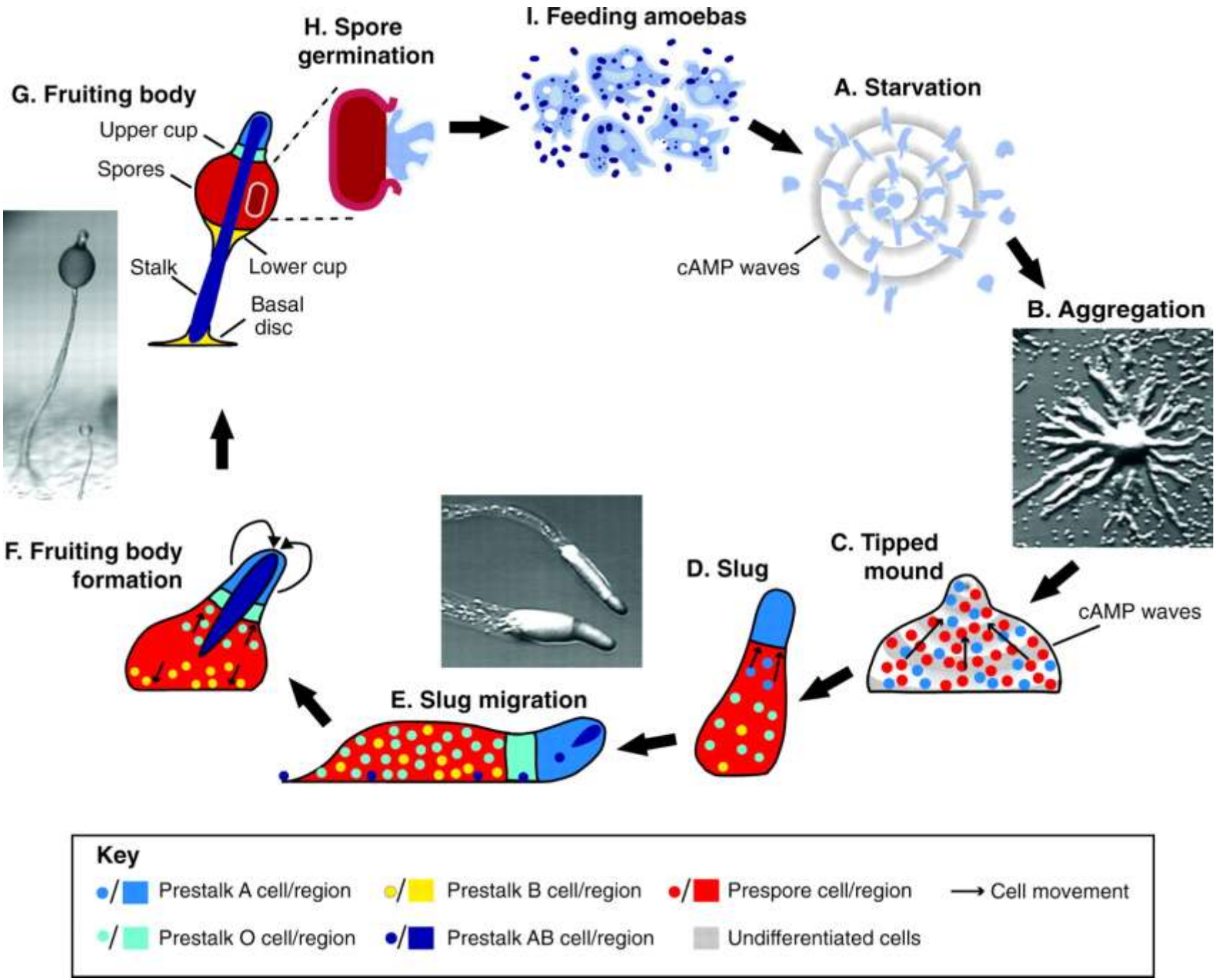


Dictyostelium



The life cycle of *Dictyostelium discoideum* axenic strain Ax-2. The vegetative cells are usually grown in liquid medium, by means of pinocytotic incorporation of external nutrients. Under natural conditions, its parental strain *D. discoideum* NC-4 grows and multiplies by mitosis at the vegetative phase, phagocytosing nearby bacteria such as *Escherichia coli* and *Klebsiella aerogenes* . Upon exhaustion of nutrients, however, starving cells initiate differentiation, form multicellular structures (aggregates; mounds), and undergo a series of well-organized morphogenesis to construct fruiting bodies, each of which is consisting of a mass of spores (sorus) and a supporting cellular stalk.




H. Spore germination
I. Feeding amoebas
G. Fruiting body
Upper cup
Spores
Stalk
Lower cup
Basal disc
A. Starvation
cAMP waves
B. Aggregation
C. Tipped mound
cAMP waves
D. Slug
E. Slug migration
F. Fruiting body formation
Key
Prestalk A cell/region
Prestalk B cell/region
Prespore cell/region
Cell movement
Prestalk O cell/region
Prestalk AB cell/region
Undifferentiated cells

INTRODUCTION

- Dictyostelium belongs to the phylum Dictyosteliomycota.
- They are commonly known as **cellular slime molds**.
- Habitat: Terrestrial, moist, decaying vegetation.
- Mode of nutrition: Heterotrophic ingestive.
- They are unduliopodia(No flagella).
- The mode of reproduction in dictyostelium are:

REPRODUCTION

- Dictyostelium has 3 modes of reproduction:
  -sexual
  -asexual (spores)
  -vegetative- mitotic division of unicellular organisms.
- **SEXUAL REPRODUCTION**:
- Dictyostelium are both haploid and diploid organisms.
- Sexual cycle is initiated by the fusion of cells that are of opposite mating types(heterothallic mating).

- It results in the formation of a multi-walled macrocyst (Gr. *makros*=long, large +*kystis*=bladder, cyst).
- It begins with the formation of zygote which ingest the surrounding myxamoeba as it increase in size on germination.
- Haploid myxamoebe escape from the ruptured macrocyst.
- These cells originate by cleavage of the single large protoplast of the mature macrocyst.

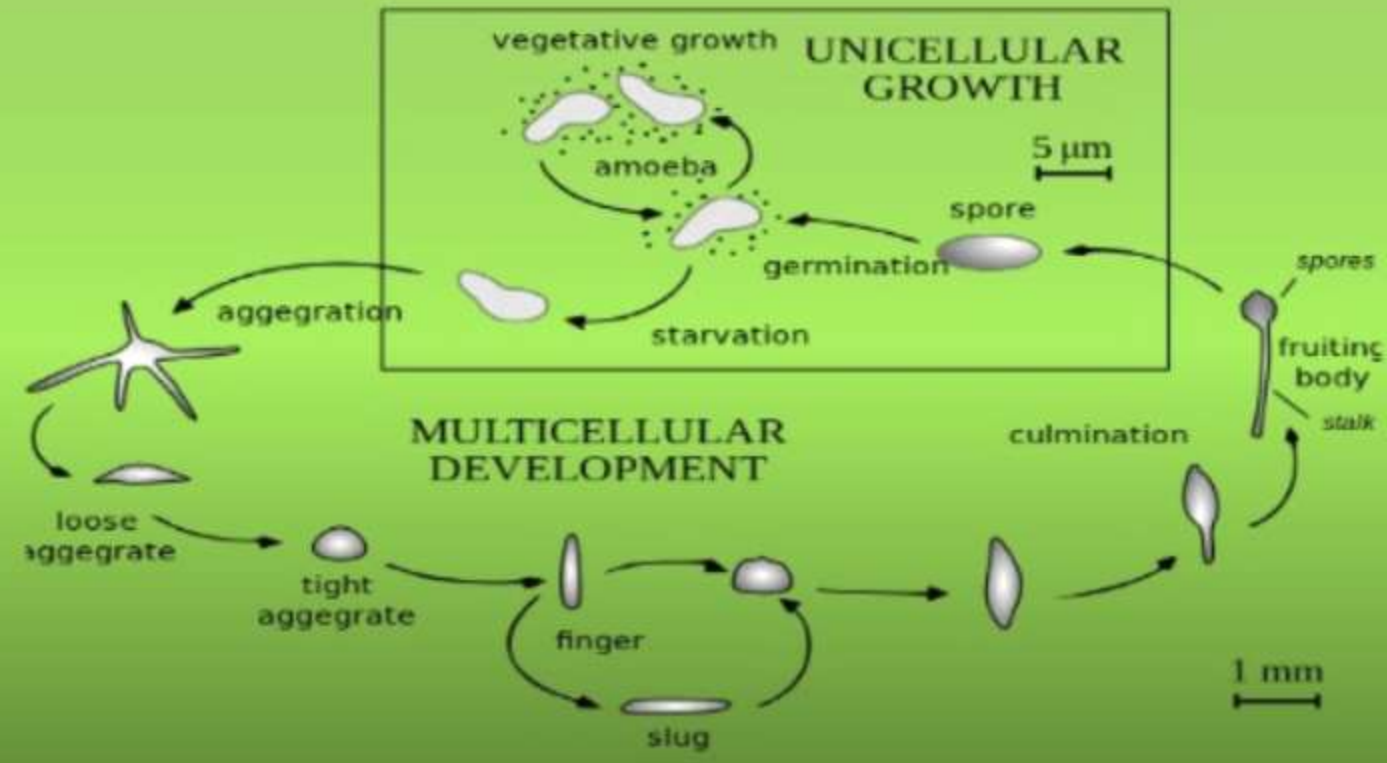
•Asexual Reproduction:

•It involves the following steps:

- 1. Aggregation 2.Stream formation 3. Loose aggregate and Tight aggregate 4. Mound 5. Slug 6. Culmination.
- AGGREGATION: Upon starvation a few amoebae acting as the aggregation center start to produce periodic cAMP pulses which are detected amplified and relayed by the surrounding amoebas; individual cells move chemotactically towards increasing cAMP concentrations the aggregate of approximately 100,000 cells undergoes a series of morphogenetic changes.

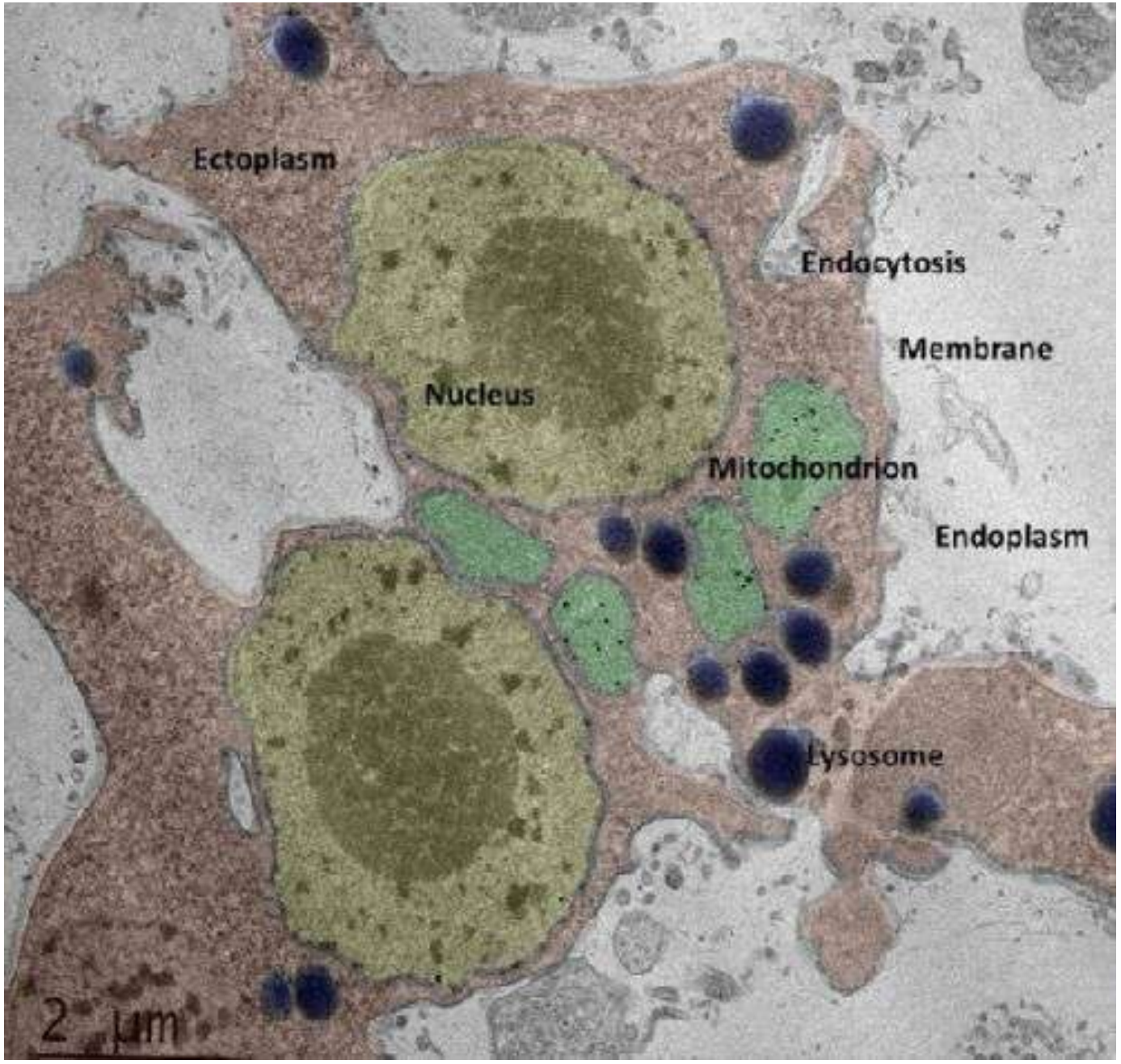
- STREAM FORMATION: Attraction of other amoebae to the forming group.
- LOOSE AND TIGHT AGGREGATE
- MOUND: Non-differentiated slug.
- SLUG: Psuedoplasmodium; typically consists of about 100,000 cells that are differntiated into 2 distinct cell types. Cells in posterior of the slug will become spores and cells in the anterior which direct the Pseudoplasmodium are destined to become stalk cells of the fruiting body. Slug stage enables cellular slime molds to migrate towards the surface of the soil thus to have a better chance for spore dispersed.

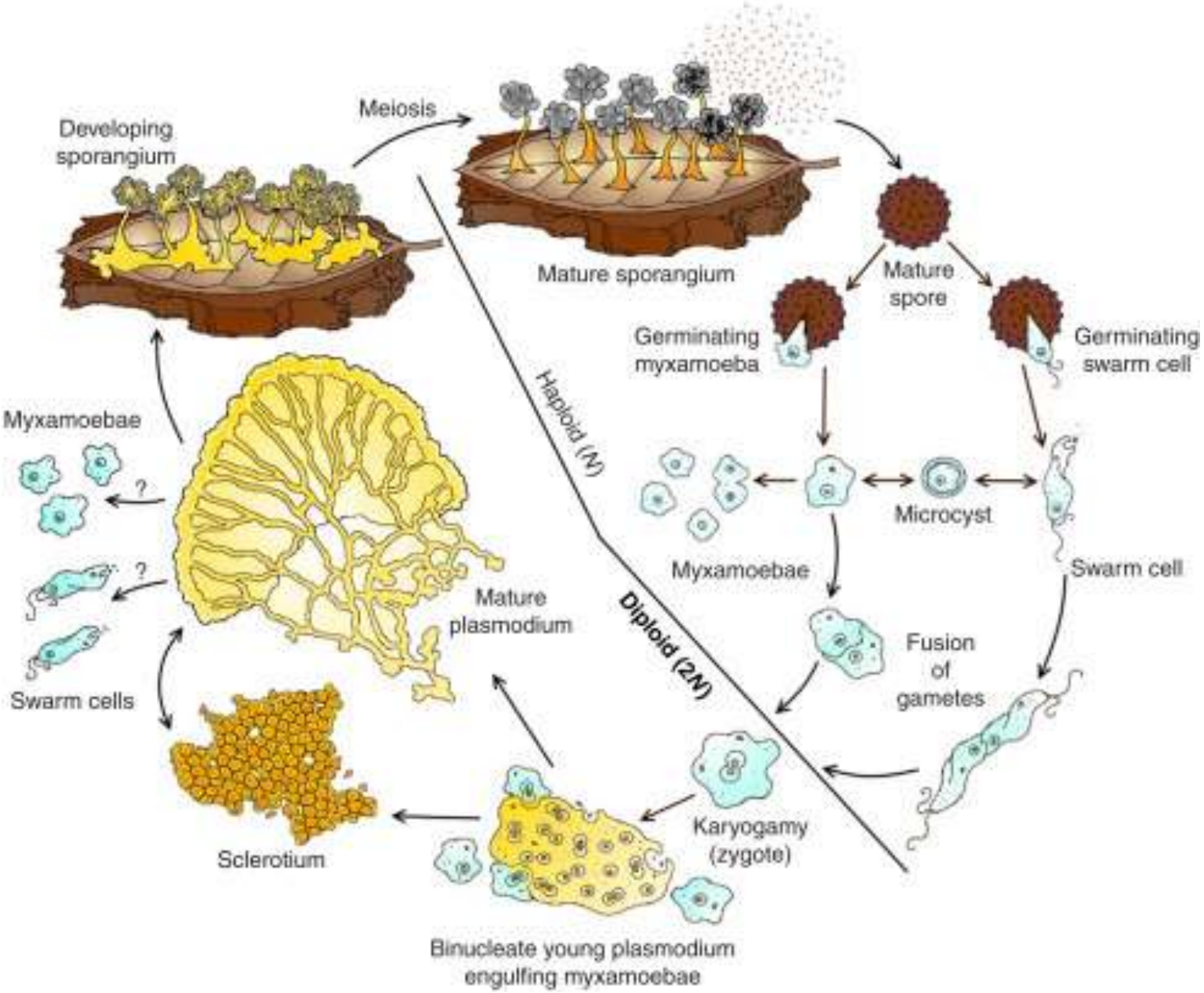
- CULMINATION: The stalk cells form a cellulose frame work on which the spore mass is lifted up in the air.
- **VEGETATIVE**: Myxamoeba stage - free living amoebae, uincellular form; vegetative growth by mitotic divison.

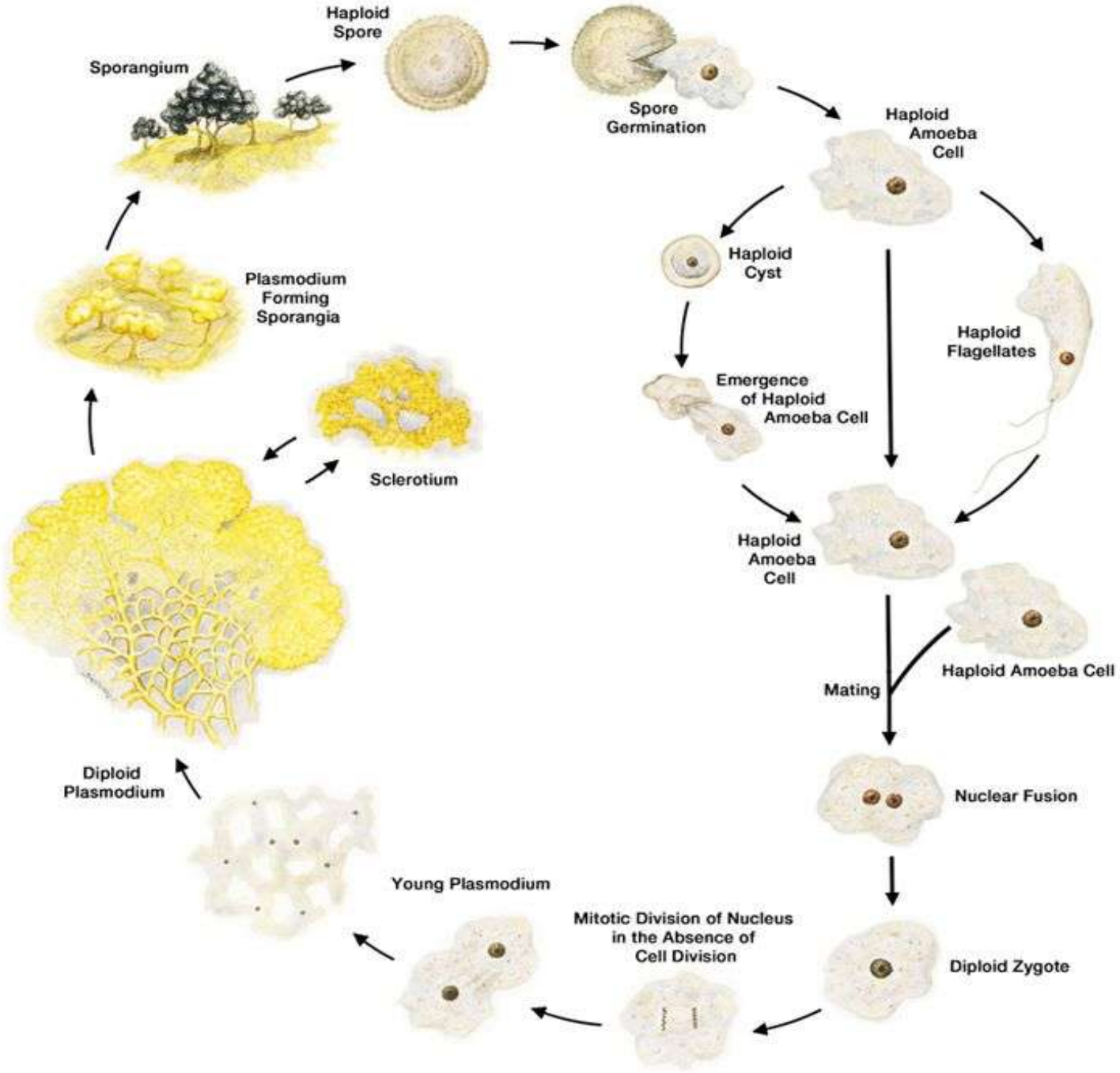


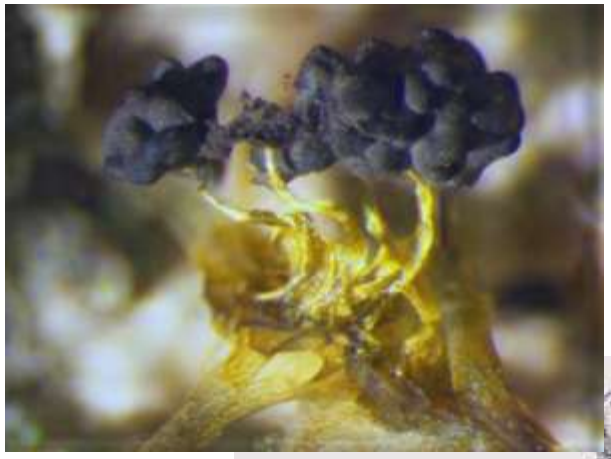
Physarum polycephalum

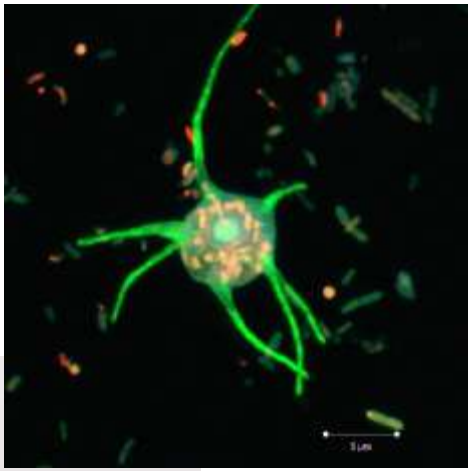
Physarum polycephalum

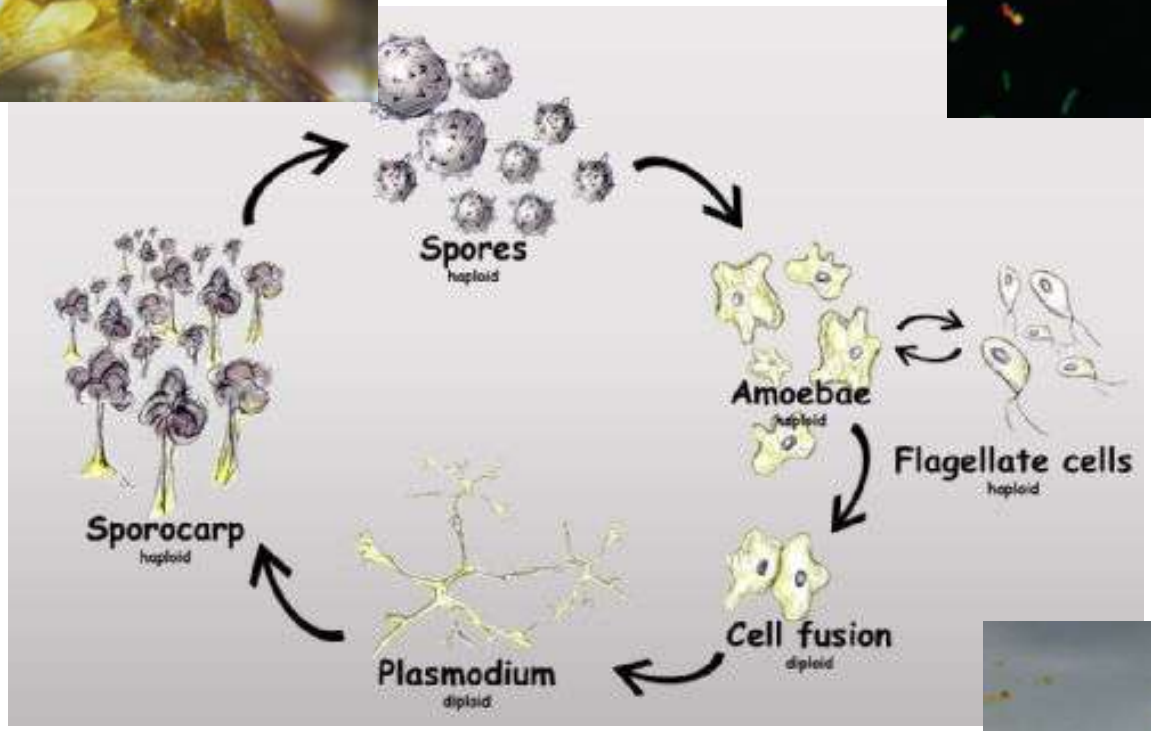

Ectoplasm
Endocytosis
Membrane
Nucleus
Mitochondrion
Endoplasm
Lysosome
2 µm

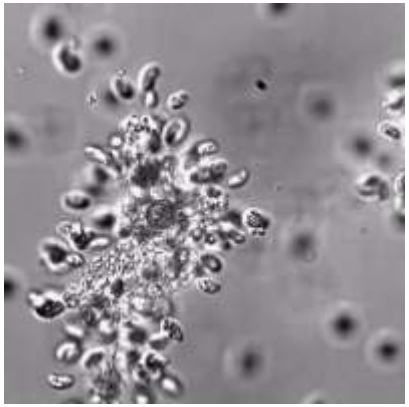

Developing sporangium
Meiosis
Mature sporangium
Mature spore
Germinating myxamoeba
Germinating swarm cell
Haploid (N)
Diploid (2N)
Myxamoebae
Microcyst
Swarm cell
Myxamoebae
Mature plasmodium
Fusion of gametes
Swarm cells
Karyogamy (zygote)
Sclerotium
Binucleate young plasmodium engulfing myxamoebae


Haploid Spore
Sporangium
Spore Germination
Haploid Amoeba Cell
Haploid Cyst
Haploid Flagellates
Plasmodium Forming Sporangia
Emergence of Haploid Amoeba Cell
Sclerotium
Haploid Amoeba Cell
Haploid Amoeba Cell
Mating
Diploid Plasmodium
Nuclear Fusion
Young Plasmodium
Mitotic Division of Nucleus in the Absence of Cell Division
Diploid Zygote






Spores
haploid
Amoebae
haploid
Flagellate cells
haploid
Cell fusion
diploid
Plasmodium
diploid
Sporocarp
haploid



The large brightly coloured networks of tube we see are the adult form of a slime mould - called a plasmodium but they have several stages in their lives.

Spores - where it all starts

Slime moulds have a primitive form of sexual reproduction. The nuclei in plasmodia are diploid - they have two sets of chromosomes. If the organism is exposed to light for a few days, the plasmodium clumps together and forms short stalks with minute mushroom like caps. At the end of these stalks nuclei undergo meiosis - chromosomes are reshuffled and nuclei divide making spores which are haploid - just one set of chromosomes. These mushroom like fruiting bodies are called sporangia.

Amoeba phase

Making sporangia (spore capsules) is fatal for a slime mould - the end of the adult organism but its spores are dispersed by wind and germinate when they land somewhere damp. The spores hatch into amoebae (strictly speaking they're myxamoebae). Under the microscope they're indistinguishable from ordinary amoeba - they feed by engulfing bacteria and they reproduce by splitting in two. If things get dry, they form a cyst that can withstand dehydration until conditions are better and if things get too wet, they grow flagella (tails) and switch to a free-swimming cell form.

They can live independently like this indefinitely, it's an extreme form of the alternation of generations we see in ferns and mosses. The amoeba are actually gametes - sex cells. Most species on earth have two different sizes of gamete - one large and immobile - the egg or ovum and the other smaller and mobile - sperm or pollen. This isn't the case for a slime mould, all their sex cells are the same size and shape, this is called isogamy. What determines if they're able to fertilise each other is a set of genes that form the cells mating type – the average slime mould can have hundreds of different mating types maximising the potential number of mates.

Plasmodia - Grown up Slime

When two amoebae with compatible mating types meet their cells merge and their nuclei fuse – going from being haploid to being diploid. Once this happens the cell stops dividing but the nuclei do – the cell just expands and forms a new plasmodium . In some cases, a single plasmodial slime can cover a few square metres.

Drying out

Most slime moulds live in leaf litter, rotting wood or soil - damp places, they're very vulnerable to drying out but it isn't always a problem for them.

Sclerotia

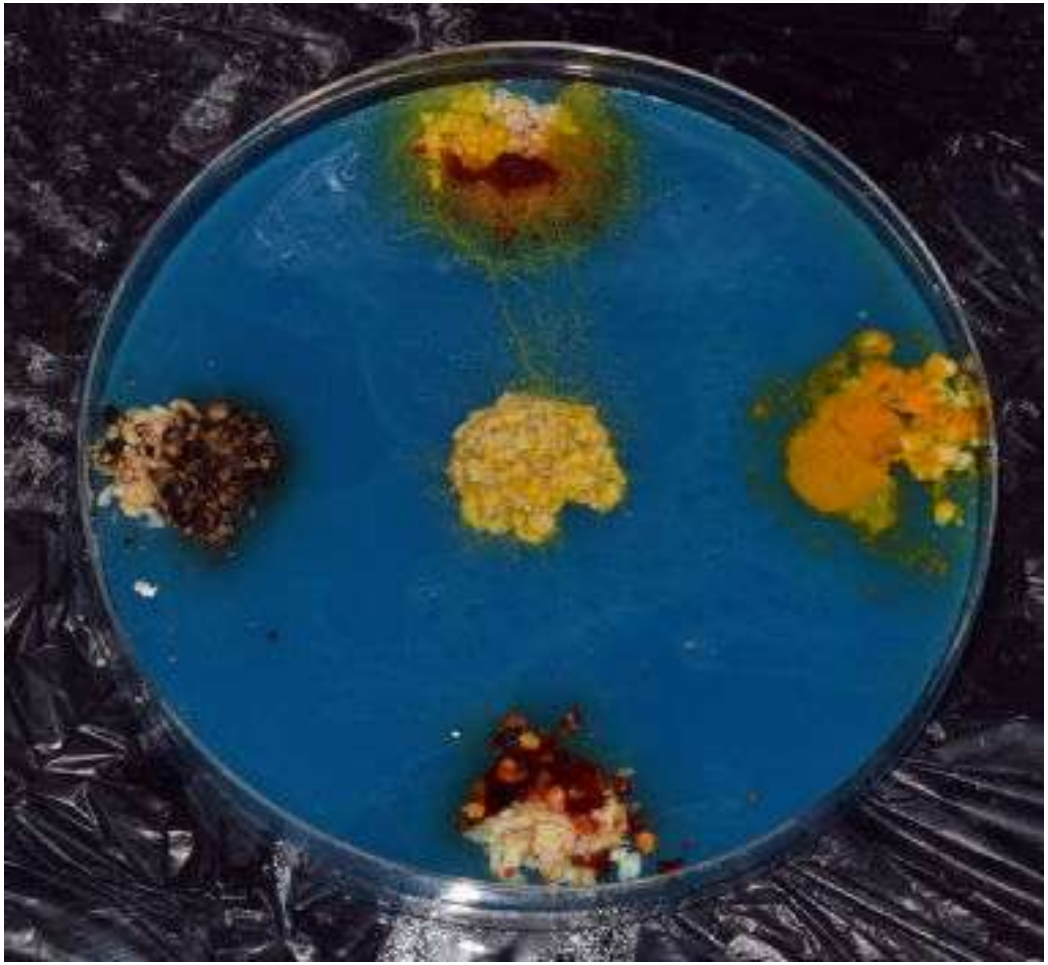
Plasmodia can tough it out by forming a sclerotium (sclerotia is the plural). This is a hardened mass of tissue that has dried completely and can survive for years. If it gets wet, it reactivates and the slime mold resumes its former life.

Cysts

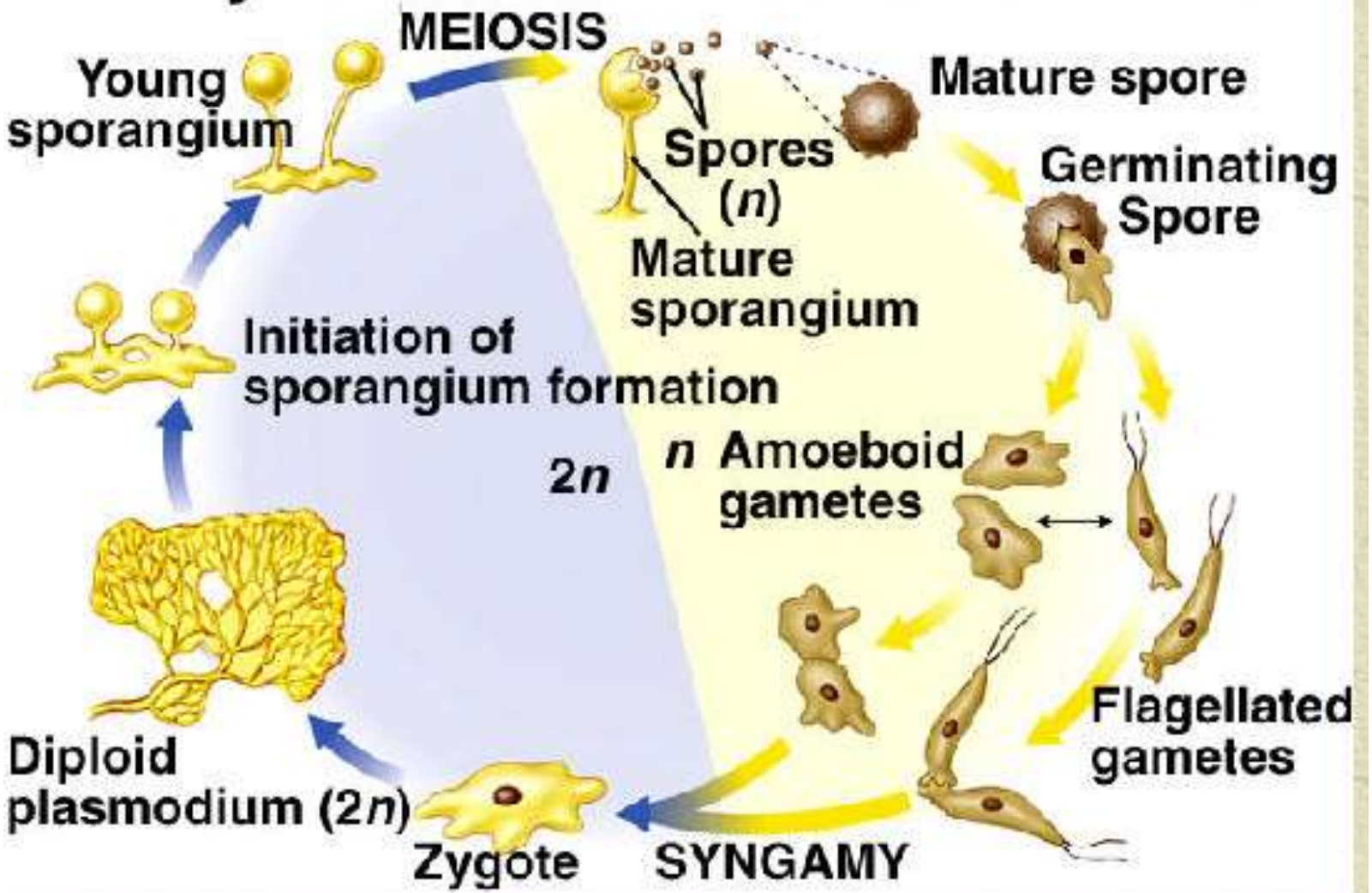
Amoebae and swarmer cells that start to dry out will thicken up their cell wall and form a cyst - a tough single celled structure that withstands drying and will wake up when it gets damp again.

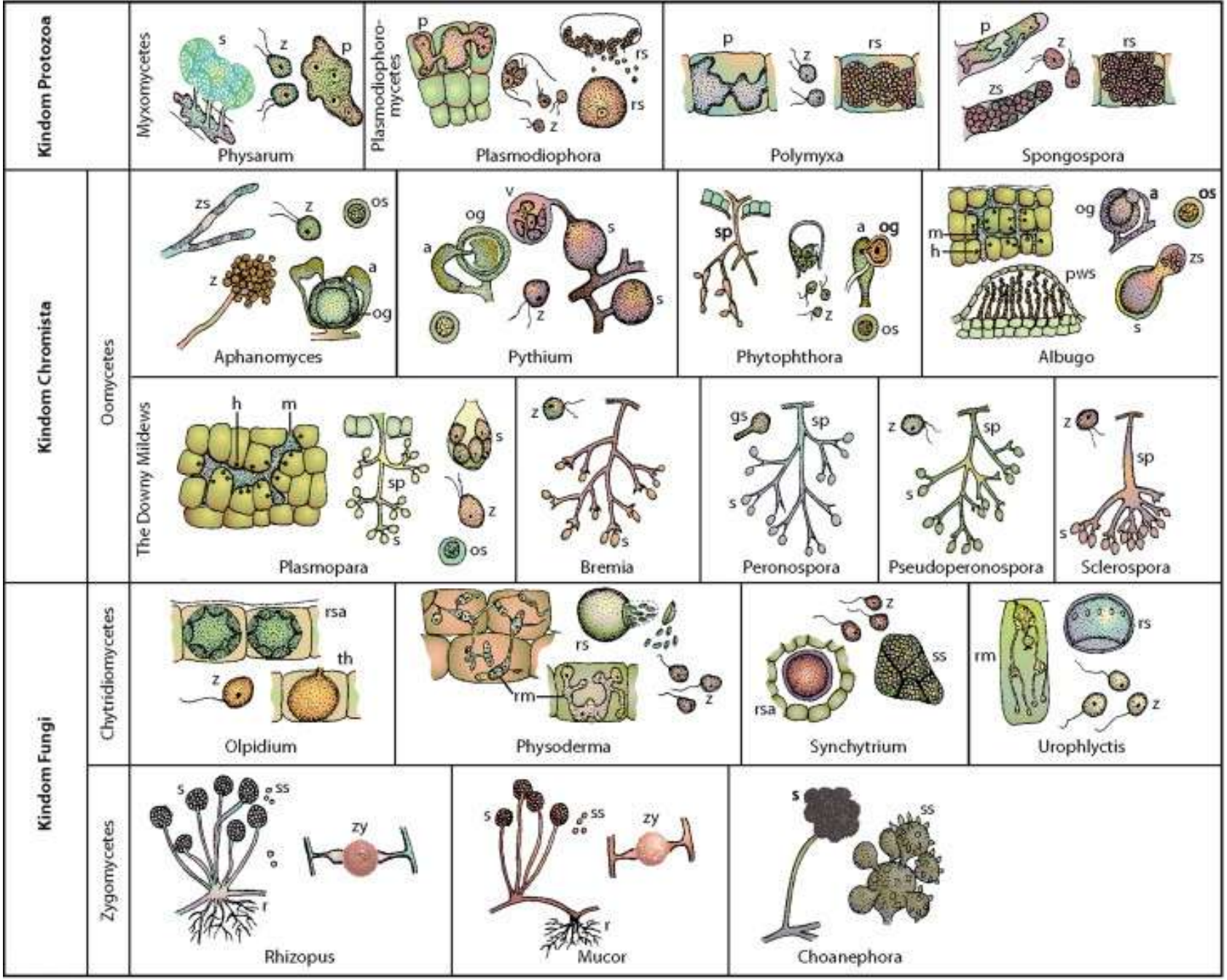
Chemotaxis

One of the best known abilities of slime moulds is that they show chemotaxis - they move towards or away from different chemicals they sense in their environment. When we make mazes or choice chambers for them, we're exploiting that behaviour to test their ability to navigate towards food or test their preference for difference sources of nutrition. In the picture below a slime is attracted towards oats mixed with paprika (positive chemotaxis) but repelled by black pepper and turmeric (negative chemotaxis).



Life Cycle of a Plasmodial Slime Mold




Kindom Protozoa
Myxomycetes
Physarum
Plasmodiophoro-mycetes
Plasmodiophora
Polymyxa
Spongospora
Kindom Chromista
Oomycetes
Aphanomyces
Pythium
Phytophthora
Albugo
The Downy Mildews
Plasmopara
Bremia
Peronospora
Pseudoperonospora
Sclerospora
Kindom Fungi
Chytridiomycetes
Olpidium
Physoderma
Synchytrium
Urophlyctis
Zygomycetes
Rhizopus
Mucor
Choanephora