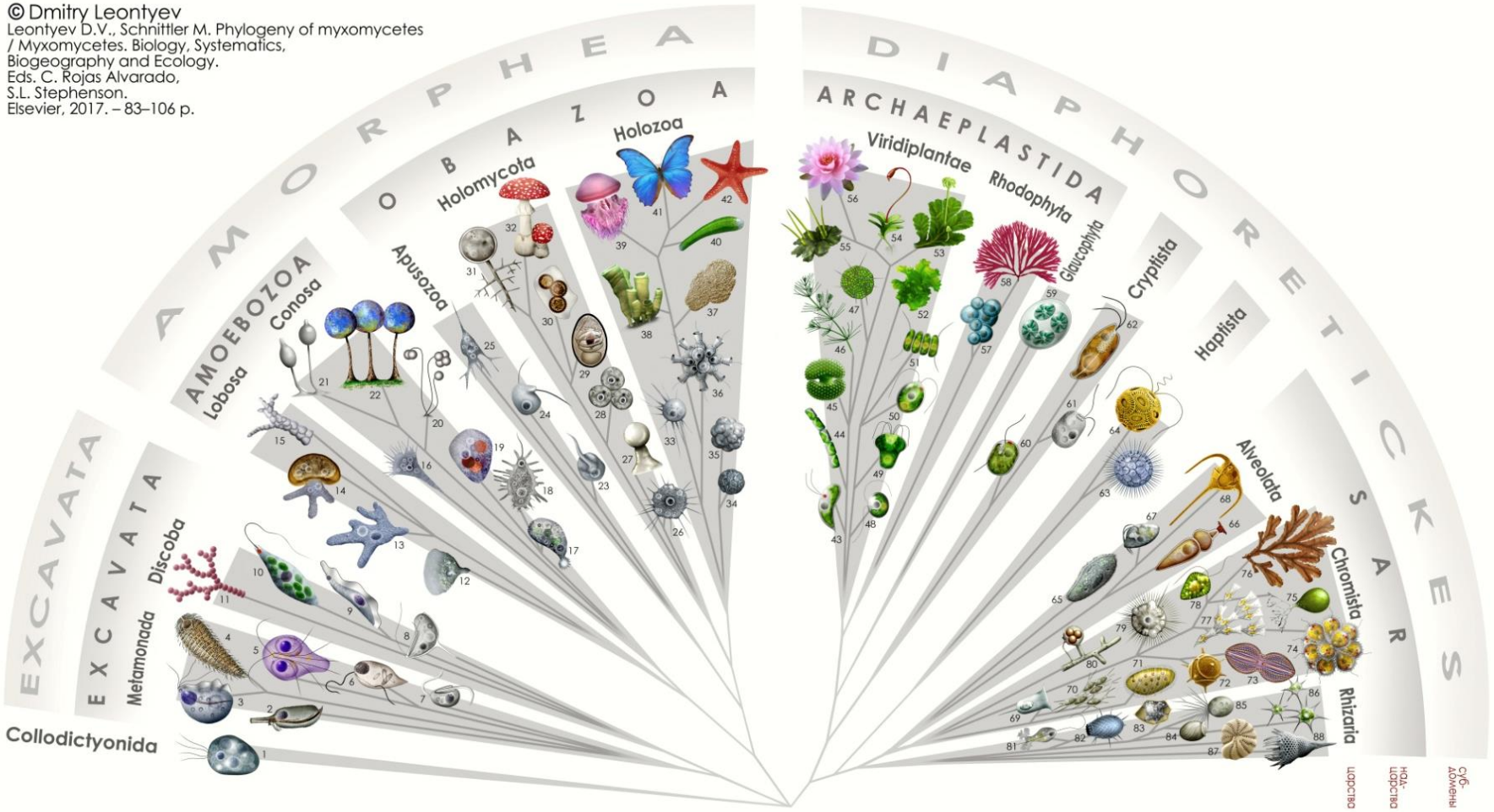
Lesson 1. "Fungi and algae"

Phylogenetic system of eukarytes



1. Collodictyonida; 2. Oxymonadida; 3. Trichomonadida; 4. Hypermastigida; 5. Diplomonadida; 6. Retortamonadida; 7. Malawimonadida; 8. Jakobida; 9. Kinetoplastida; 10. Euglenida; 11. Heterolobosea; 12. Flabellinea; 13. Euamoebida; 14. Arcellida; 15. Copromyxida; 16. Variosea; 17. Pelobiontida; 18. Mastigamoebida; 19. Entamoebidae; 20. Protosporangiida; 21. Dictyosteliomycetes; 22. Myxomycetes; 23. Apusomonadida; 24. Ancyromonadida; 25. Breviatida; 26. Nucleariida; 27. Fonticulida; 28. Aphelidea; 29. Microsporidia; 30. Cryptomycota; 31. Chytridiomycota; 32. Amastigomycota; 33. Filasterea; 34. Corallochytrida; 35. Mezomycetozoea; 36. Choanoflagellata; 37. Placozoa; 38. Parazoa; 39. Radiata; 40. Xenacoelomorpha; 41. Protostomia; 42. Deuterostomia; 43. Mesostigmatophyceae; 44. Klebsormidiophyceae; 45. Zygnematophyceae; 46. Charophyceae; 47. Coleochaetophyceae; 48. Nephroselmidophyceae; 49. Pyramimonadophyceae; 50. Chlorodendrophyceae; 51. Chlorophyceae; 52. Ulvophyceae; 53. Marchantiophyta; 54. Bryophyta; 55. Anthocerotophyta; 56. Tracheophyta; 57. Cyanidiophytina; 58. Rhodophytina; 59. Glaucophyta; 60. Katablepharida; 61. Goniomonas; 62. Cryptophyceae; 63. Centrohelida; 64. Haptophyta; 65. Ciliophora; 66. Apicomplexa; 67. Protaveolata; 68. Dinoflagellata; 69. Bicosoecida; 70. Labyrinthulomycetes; 71. Opalinida; 72. Bolidophyceae; 73. Bacillariophyceae; 74. Synurophyceae; 75. Xanthophyceae; 76. Phaeophyceae; 77. Chrysophyceae; 78. Raphidophyceae; 79. Actinophryida; 80. Oomycota; 81. Cercomonadida; 82. Euglyphida; 83. Plasmodiophoromycetes; 84. Haplosporidia; 85. Gromiida; 86. Chlorarachniophyceae; 87. Foraminifera; 88. Radiolaria.

FUNGI

Fungi or Mycota are heterotrophic organisms whose body is called a mycelium (fungus), consisting of individual filaments called hyphae. Cell walls contain chitin. The stored substance is glycogen.

Fungi reproduce vegetatively, asexually and sexually.

https://www.youtube.com/watch?v=UCkLORVZjis

The vegetative reproduction is carried out:

a) by mycelial particles with chlamydospores and arthrospores;
b) by cell budding (yeast).

Asexual reproduction is carried out by means of spores of different structures: fixed (without undulipodia):

a) sporangiospores developing endogenously in sporangia;
b) conidia developing exogenously on conidiophores,
c) mobile (with undulipodia): zoospores formed endogenously in zoosporangia.

Forms of sexual reproduction can be roughly divided into three groups:

1. Gametogamy - fusion of gametes formed in gametangia.
    a) isogamy - fusion of morphologically indistinguishable gametes.
    b) heterogamy - the fusion of gametes that differ in size.
    c) oogamy - the fusion of a fixed ovum forming in the oogonias with small, motile spermatozoa developing in the anteridia.

2. Gametangiogamy - fusion of two specialized sexual structures not differentiated into gametes.

3. Somatogamy - the fusion of the contents of two cells of the vegetative mycelium, with the formation of a sexual product - the basidia, upon which four basidiospores with different sexual characters are formed. Haploid basidiospores give rise to haploid mycelium.

Kingdom: Fungi, Mycota.
Divisions:
1. Real Fungi - Eumycota.
2. Oomycetes - Oomycota.
3. Lichens are Lichenes.

The Real Fungi (Eumycota) are divided into five classes according to the structure of mycelium and peculiarities of sexual reproduction:

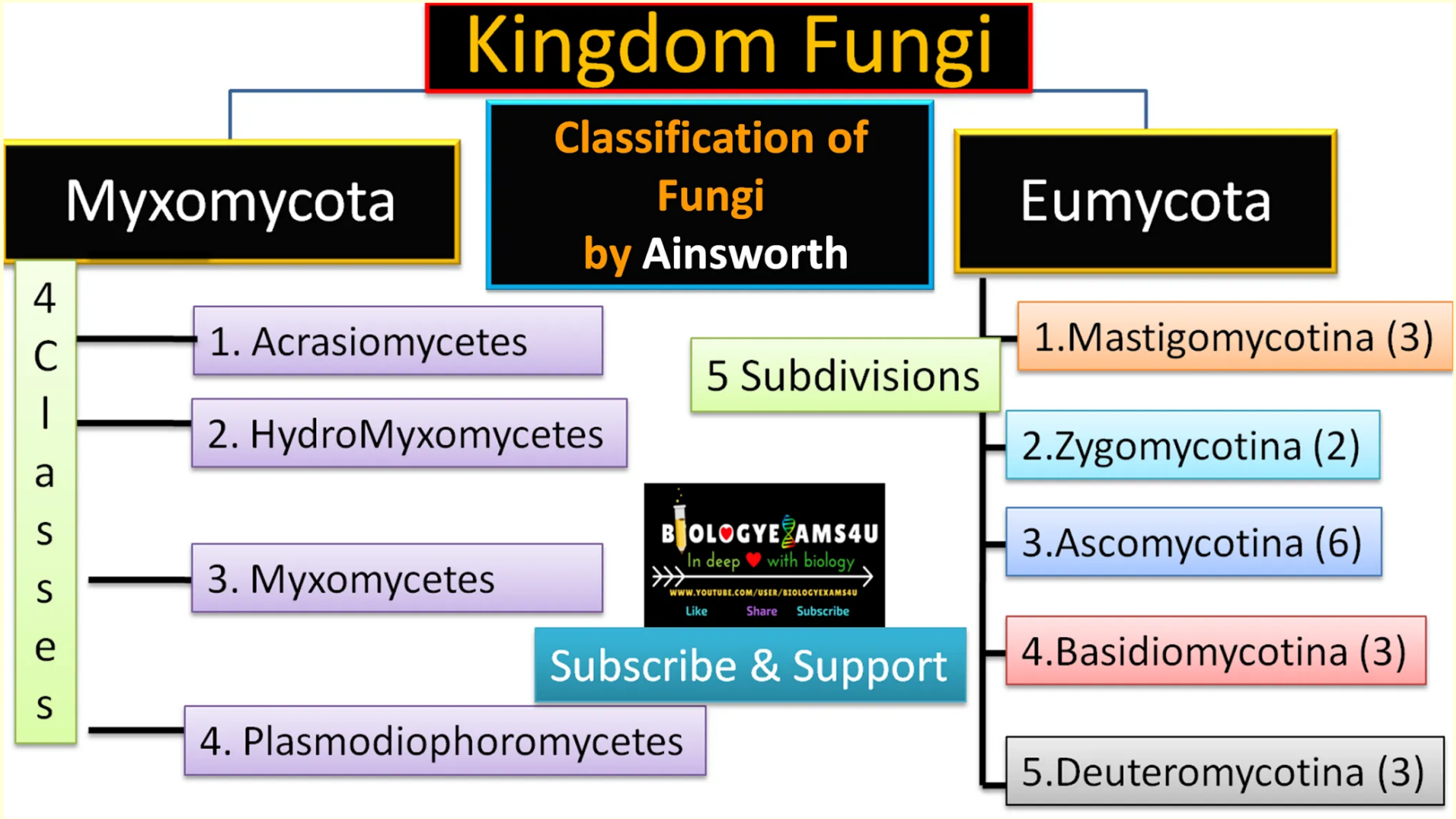
1. chytridomycetes - Chytridiomycetes. 2. Zygomycetes - Zygomycetes. 3. Ascomycetes. 4. Basidiomycetes - Basidiomycetes. 5. Deuteromycetes or Fungi imperfecti. In medicine, baker's yeast Saccharamyces cerevisiae and ergot Claviceps purpurea are used in the ascomycetes class; Penicillium species are used in the Deuteromycetes class; Chaga trutovikus oblique (Inonotus obliguus) and black birch mushroom (Fungus betulinus) are used in the basidiomycetes class. Translated with www.DeepL.com/Translator (free version)

Molecular systematics of the Eumycota are in the midst of radical revision.

About 20 years ago, a system of five fungal phyla achieved universal recognition based, in part, on initial rDNA phylogenies. The five phyla were the Chytridiomycota (water molds), Zygomycota (bread molds), Glomeromycota (arbuscular mycorrhizal fungi), Ascomycota (cup fungi), and Basidiomycota (club fungi).

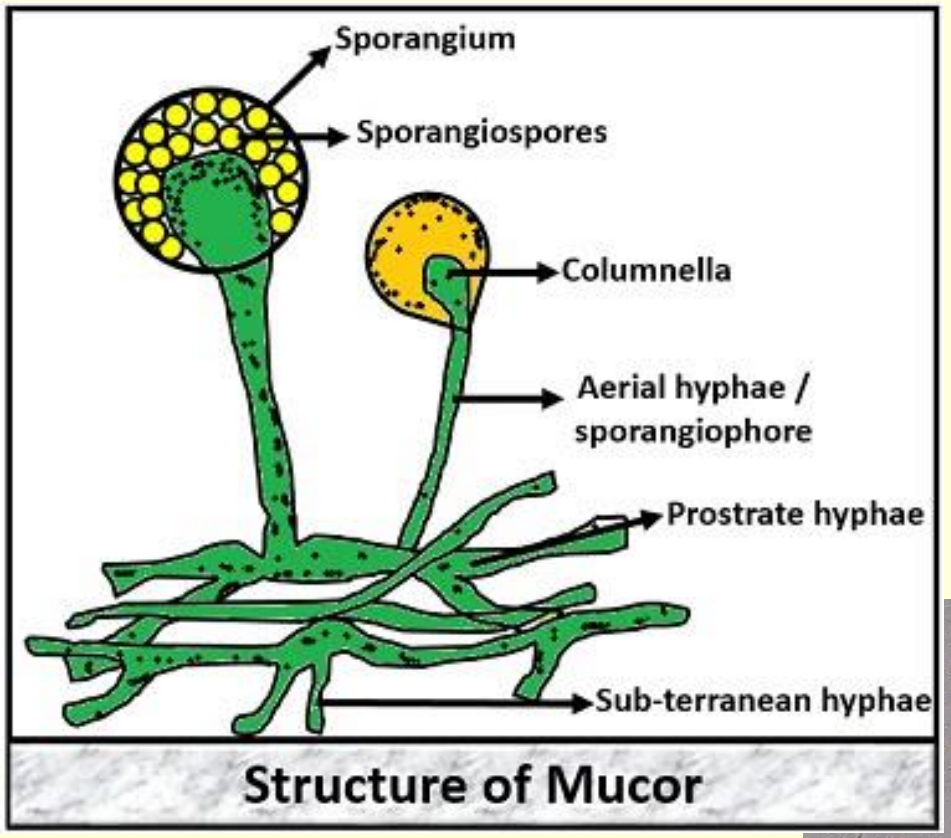
Later multilocus, molecular analyses suggest that neither the Zygomycota nor the Chytridiomycota are monophyletic groups. Several new phyla, subphyla, and unranked higher taxa have been proposed, including the Blastocladiomycota and Neocalimastigomycota (formerly members of Chytridiomycota), and the Entomophthoromycotina, Kickxellomycotina, Mucoromycotina, and Zoopagomycotina.

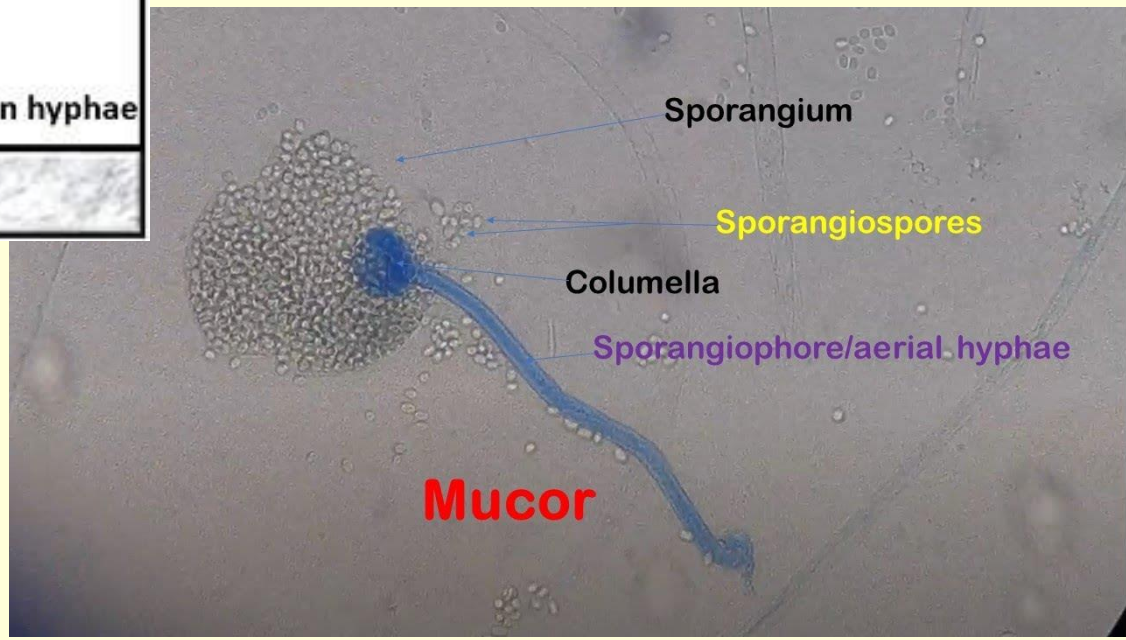
Even extremely data-rich phylogenomic analyses have yet to resolve with certainty relationships at the base of the fungal tree, so we can expect further rearrangements and optimization of high-order taxonomy in the years to come.

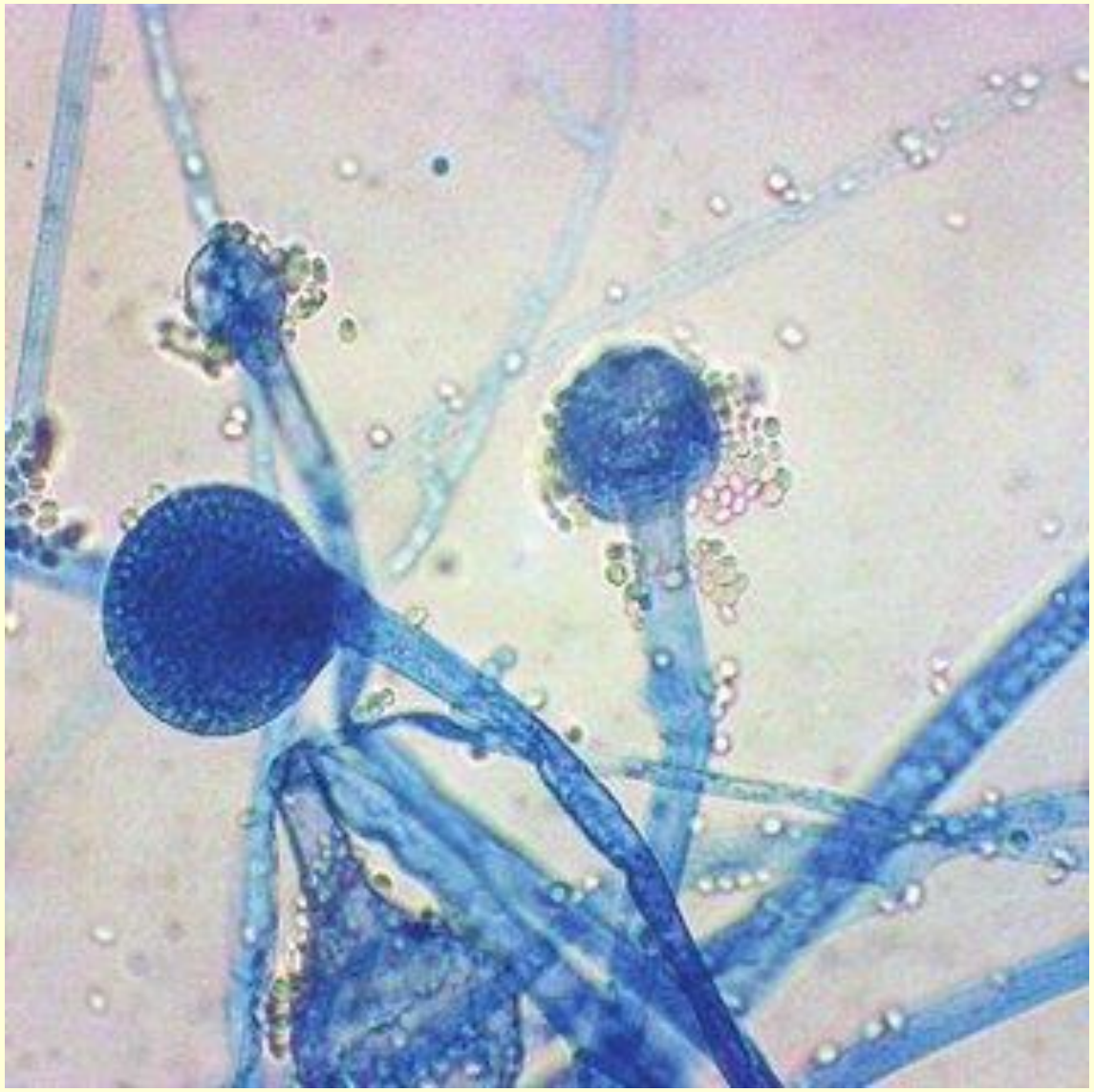


https://www.plantscience4u.com/2021/05/ainsworth-classification-of-fungi-flow.html

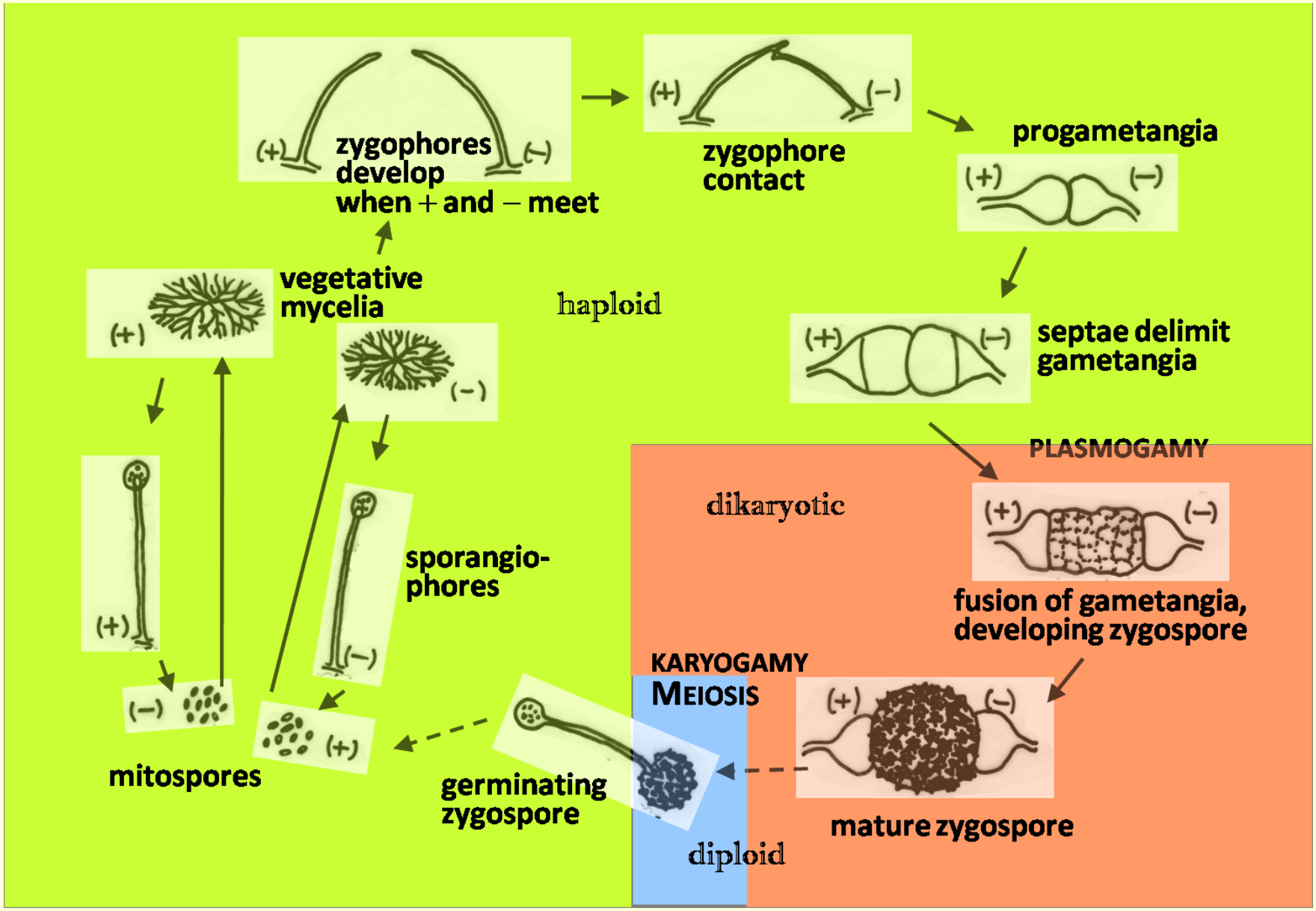
Task 1. The structure of fungi of the class Zygomycetes, using Mucor as an example.







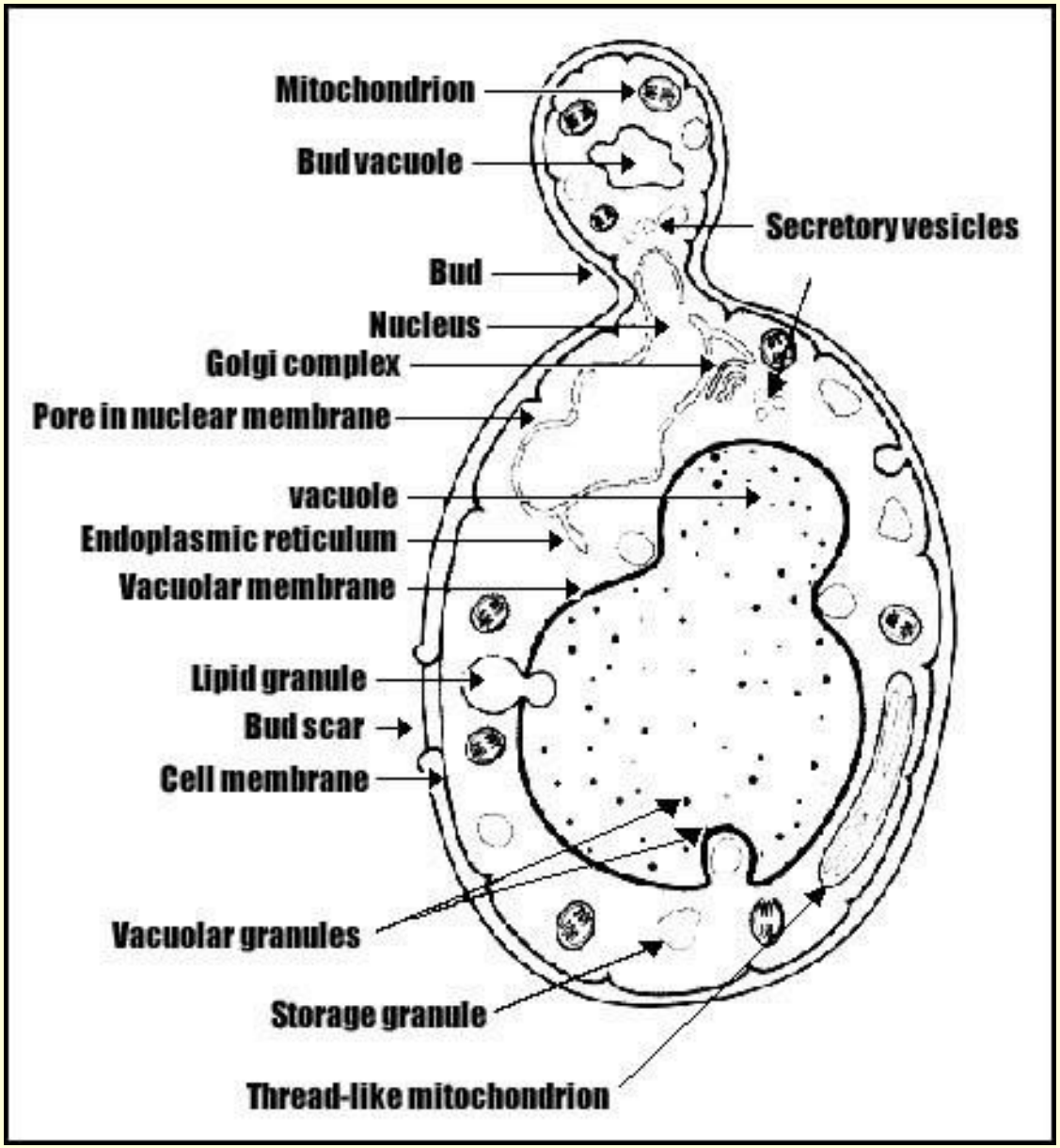
Draw Mukor's sporangium in a scrapbook and sign all its parts.

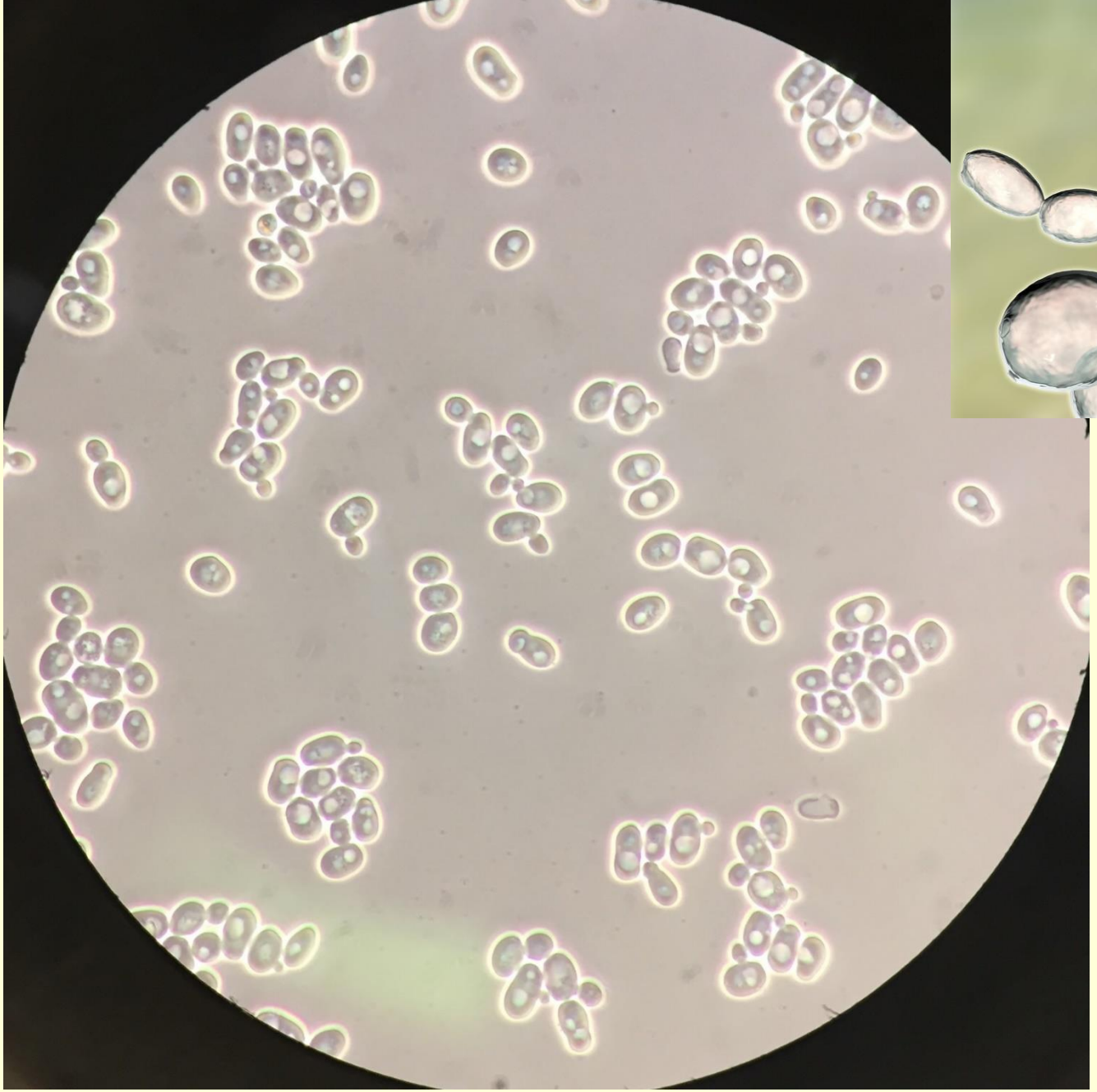


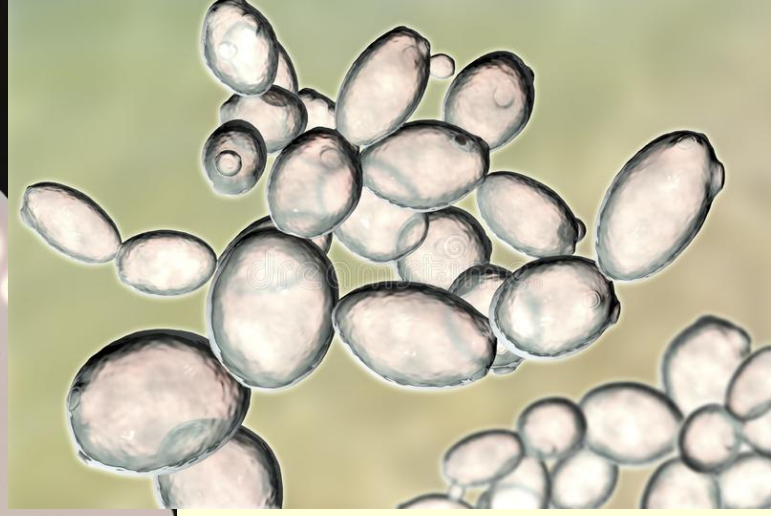
https://www.youtube.com/watch?v=Hjj8IRRaVw

https://www.youtube.com/watch?v=ozXdvtsIsXU

Task 2. Class Ascomycetes. Baker's yeast (Saccharomyces cerevisiae) its structure

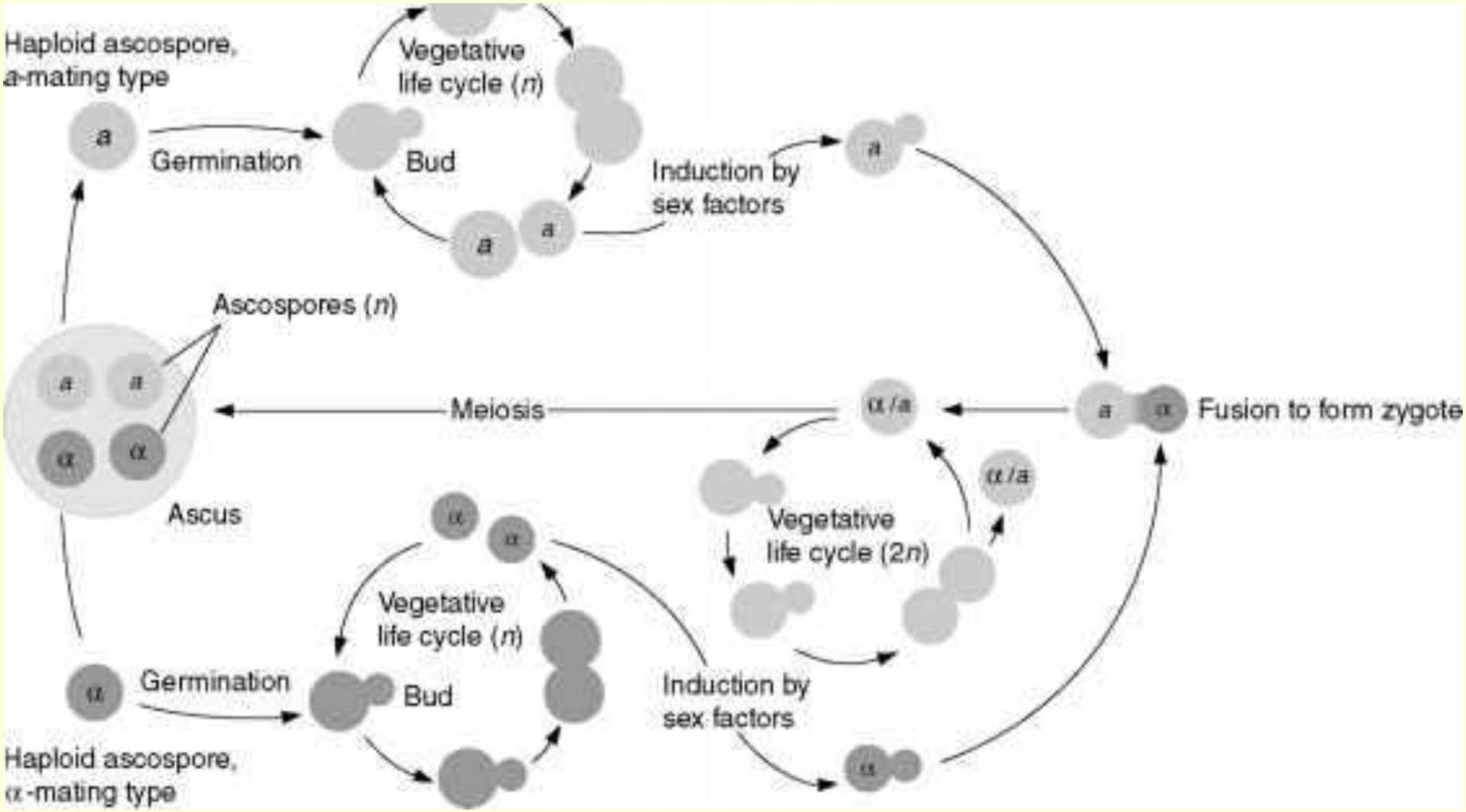






Saccharomyces cerevisiae 100x phase-contrast microscopy

Life-cycle of the yeast S. cerevisiae



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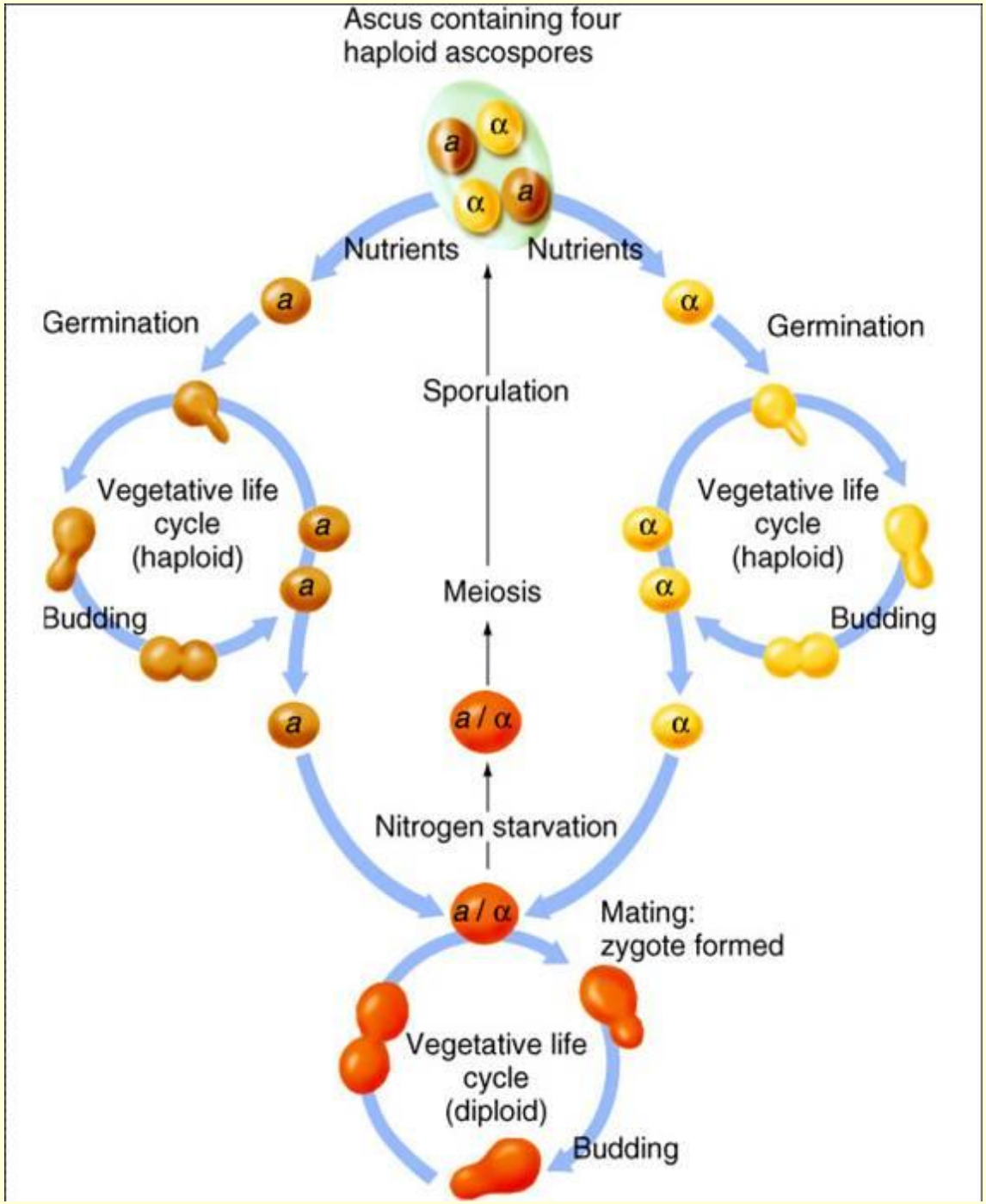
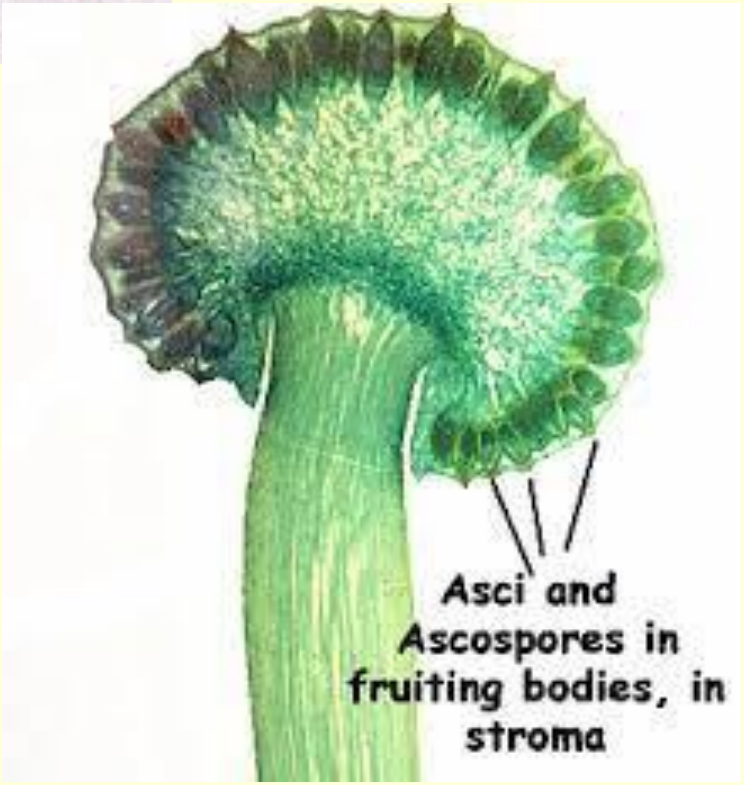

Ascus containing four haploid ascospores
a
α
α
a
Nutrients
Nutrients
a
α
Germination
Germination
Sporulation
Vegetative life cycle (haploid)
Vegetative life cycle (haploid)
a
a
α
α
Budding
Budding
Meiosis
a
a / α
α
Nitrogen starvation
a / α
Mating: zygote formed
Vegetative life cycle (diploid)
Budding

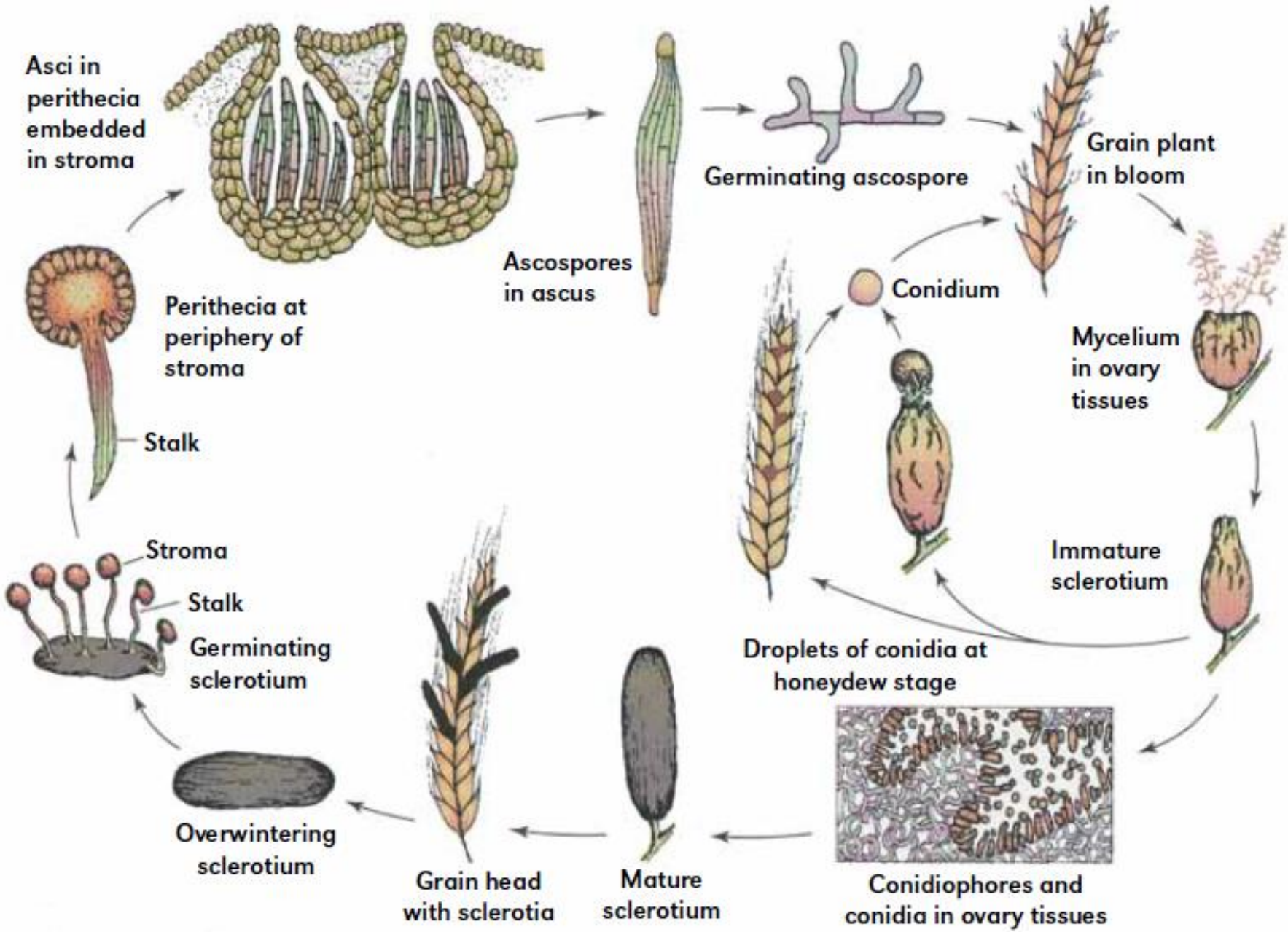
Task 3. Class Ascomycetes. The ergot (Claviceps purpurea) development cycle.

A - The ergot Claviceps purpurea on Spartina.
B - Contamination of spikes with sclerotia.
C - Isolated sclerotia.

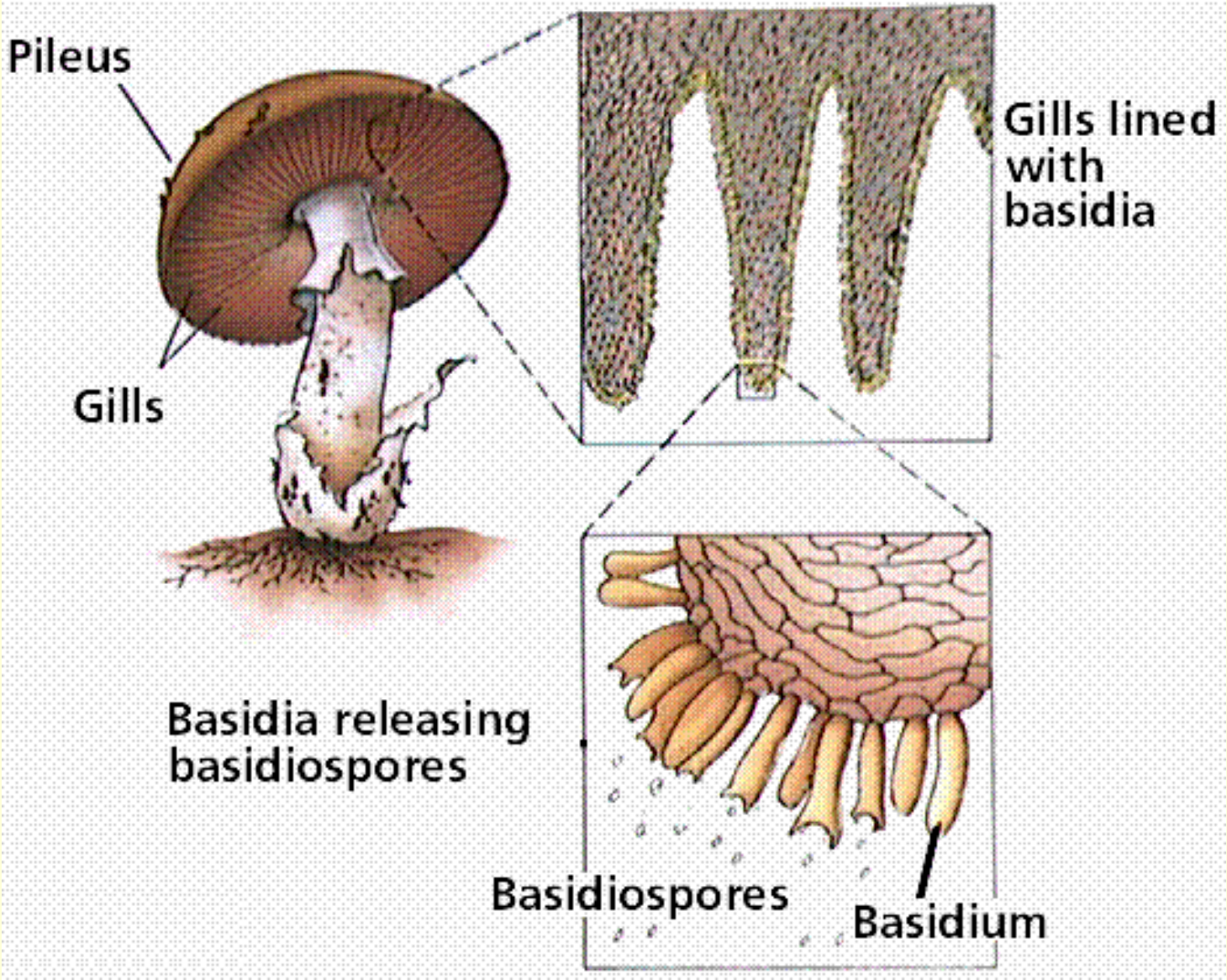

Stroma

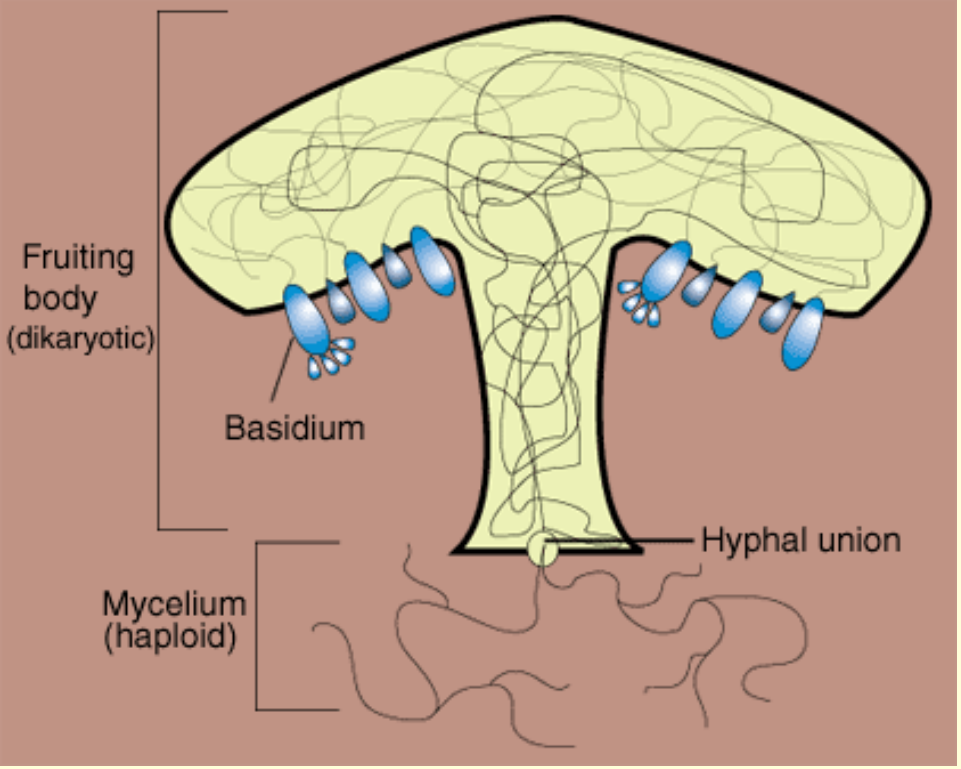

Asci and
Ascospores in
fruiting bodies, in
stroma

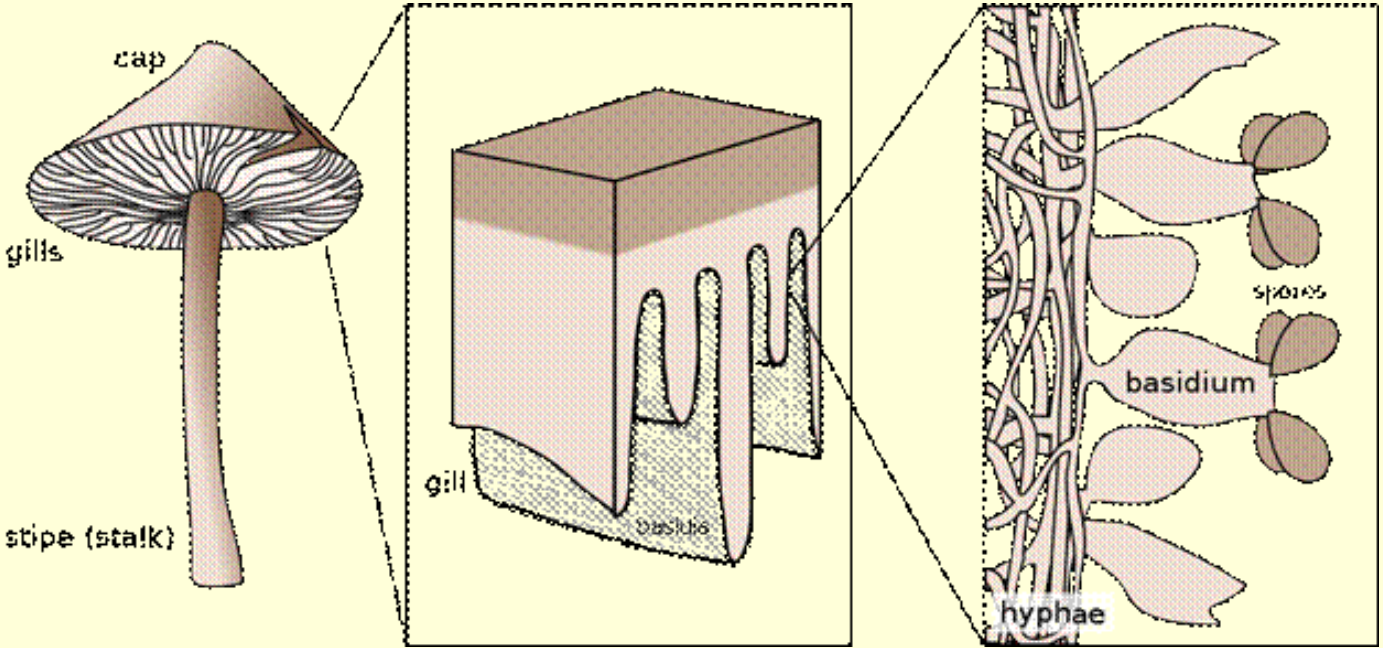
The ergot (Claviceps purpurea) life cycle

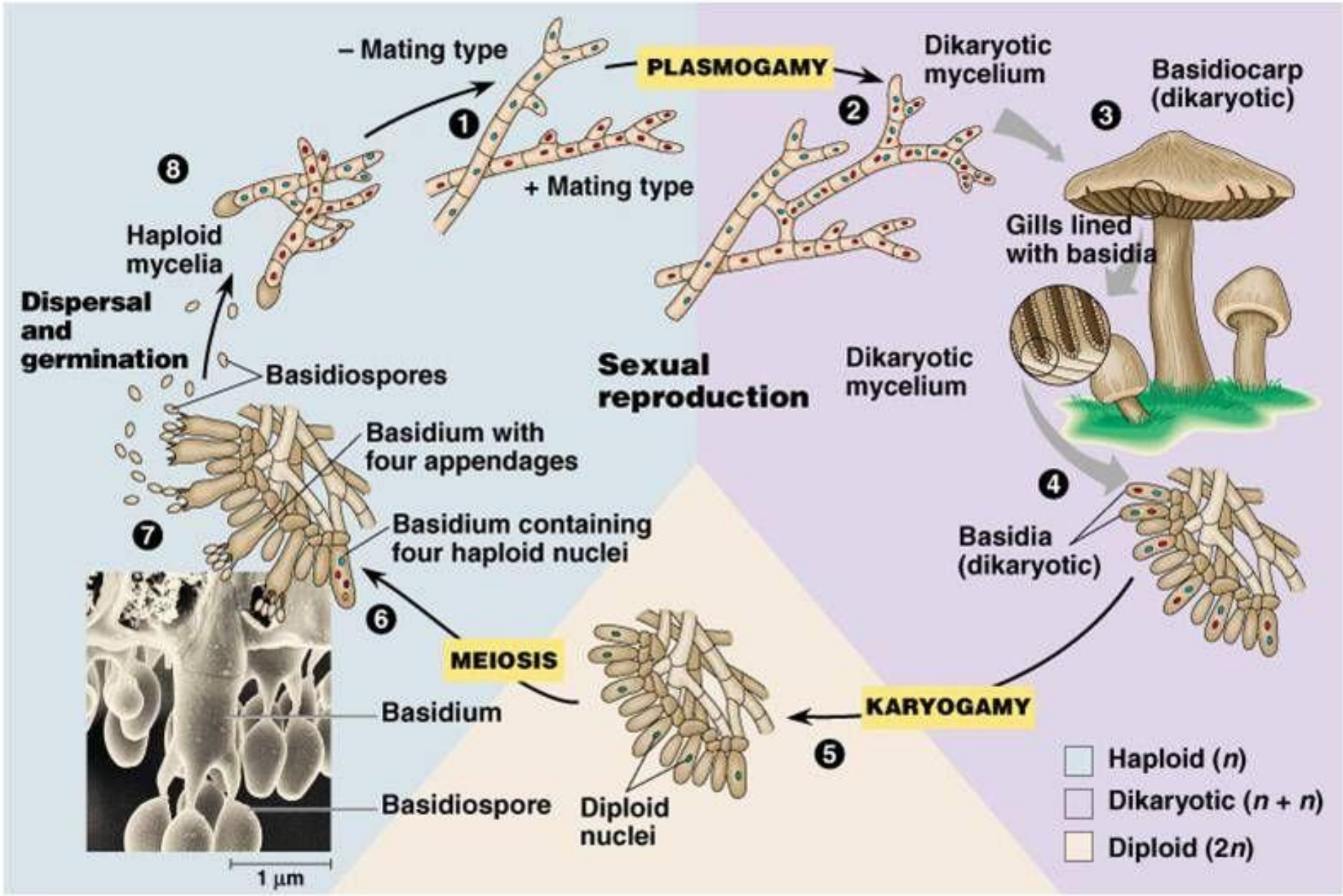


Task 4: Basidiomycetes: champignon, bracket fungus (shelf fungus, trametes)




Fruiting body (dikaryotic)
Basidium
Hyphal union
Mycelium (haploid)


cap
gills
stipe (stalk)
gill
basidia
spores
basidium
hyphae



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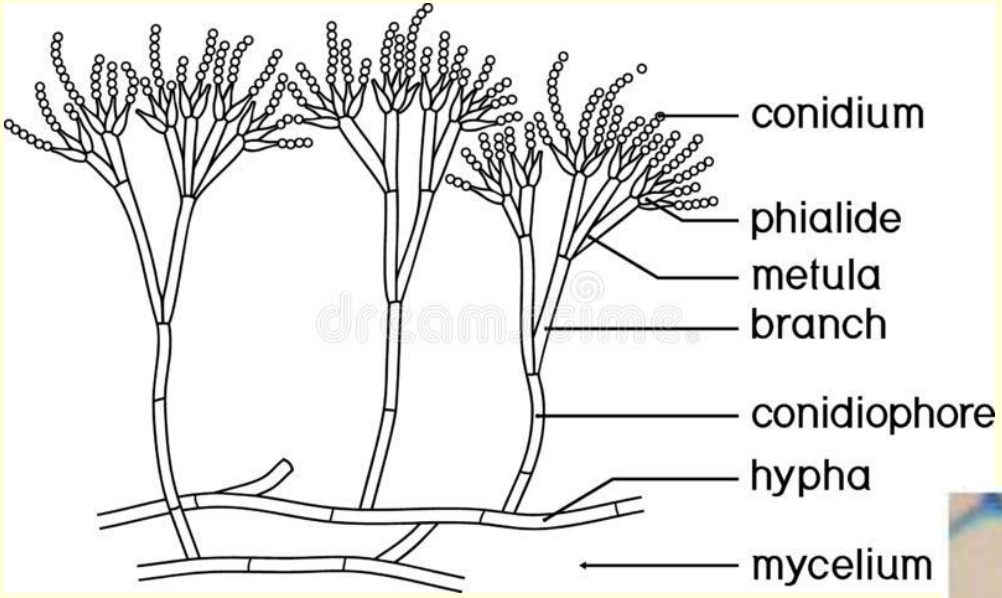
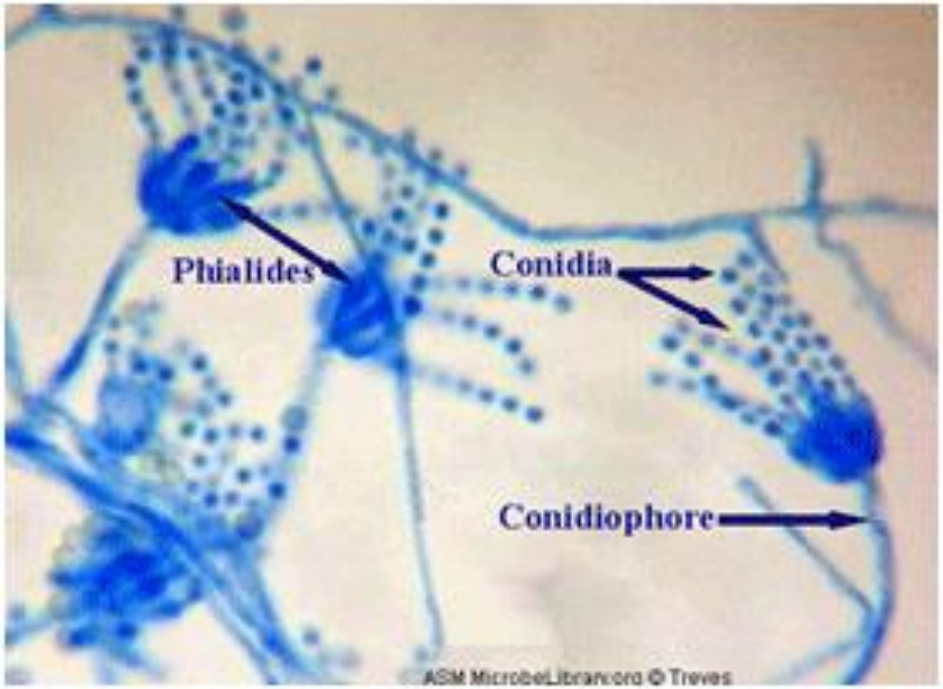
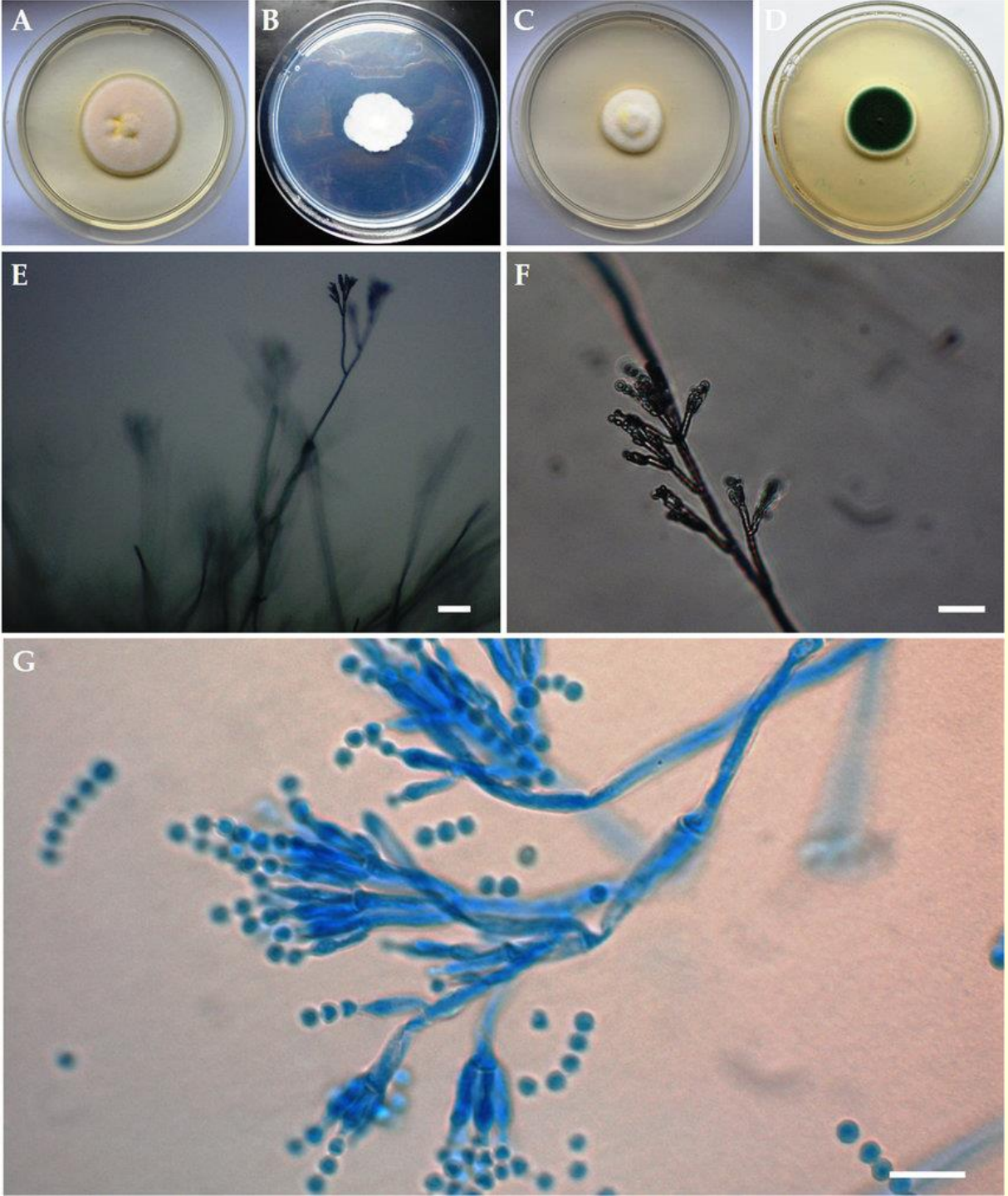
Bracket fungus

Inonotus obliquus or
Fungus betulinus (Chaga)

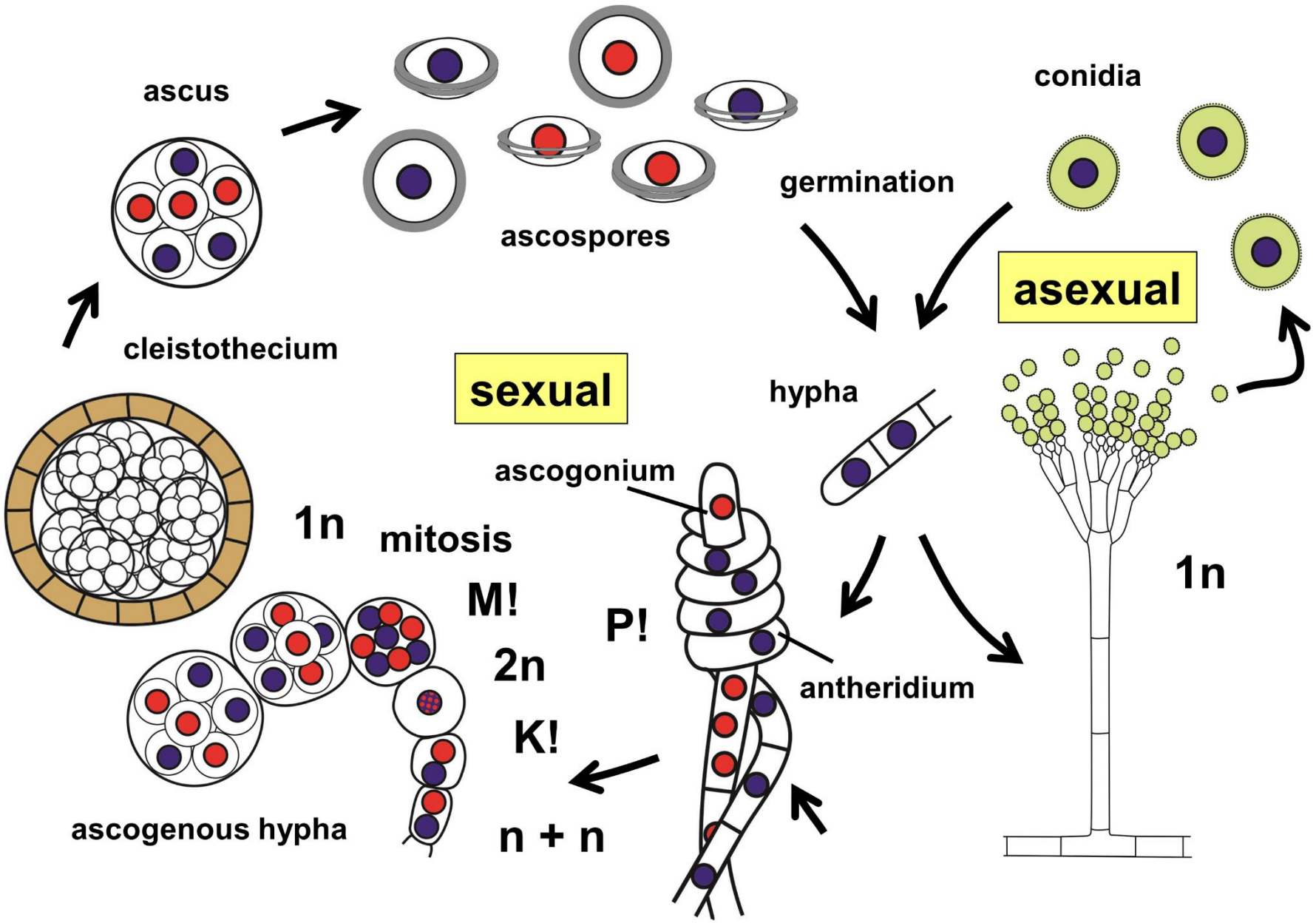
Task 5. The structure of Penicillum, a fungus of the class Deiteromycetes. (Deiteromycetes).







Macroscopic observations of Penicillium chrysogenum (A - D). Microscopic observations of morphological structures of P. chrysogenum (E,F). Petri dish cultures under the optical microscope with natural arrangement: stipe, branches, ramus, metulae, phialides, conidia, (G).



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ALGAE

The general term "algae" includes prokaryotic organisms — cyanobacteria, also known as blue-green algae — as well as eukaryotic organisms (all other algal species).

Algae are diverse group of relatively simple, chlorophyll containing, photoautotrophic and oxygen evolving aquatic thalloid (without differentiation into true roots, stems, leaves or leaf like organs) organisms.

The word algae has its origin from Latin, where alga means seaweed.

The term algae was first used by Carolous Linnaeus in 1753.

Most of them are photo-autotrophic but few are mixotrophic and myzotrophic (sucking through special feeding structure)

Study of algae is known as phycology (GK. Phykos- seaweed; logos= discourse or study) or algology.

ECOLOGY AND DISTRIBUTION

Algae are mostly aquatic but they are present almost every available ecological habitat on this earth.

On the basis of their habitat they are:

1. Aquatic Algae
2. Terrestrial Algae
3. Parasitic algae
4. Symbiotic Algae
5. Algae with some special habitats

AQUATIC ALGAE: most of algae are aquatic found in fresh water (lakes, ponds, rivers, ditches, tanks, streams, etc.) or sea (marine environment).

Bottom dwelling organism are called benthophytes (benthic algae or benthos) or may be present on the surface of water bodies are called Phytoplanktons. Phytoplanktonic algae are called euplankton (*Chlamydomonas, Cosmarium, Scenedesmus*) if they are free floating from the beginning or as tychoplankton (*Cladophora, Oedogonium, Zygnema*) if attached in the beginning but later got detached and became free floating.

SPECIAL HABITATS

1) THERMAL ALGAE (THERMOPHYTES): They grow in hot water springs at a temperature range of 65-850C, where ordinary plant life is not possible. Only BGA (blue-green algae) like *Mastigocladus*, *Phormidium* and *Oscillatoria brevis* etc.

2) CRYOPHYTES: such algae grow in polar regions on ice and snow. E.g. *Chalamydomonas* sp. and *Scottiella* sp. among green algae and *Nostoc* among BGA algae. Haematococcus nivalis causes red snow ball in alpine region. *Anclyclonema nordenskioldii* impart brown colour.

3) EPIPHYTES: Algae growing on the surface of other plant parts are called epiphytes e.g. species of *Oedogonium, Ulothrix* etc., other examples are *Coleochaete nitellarum* grows on *Nitella* and *Chara*. Some algae , such as *Trentepohlia, Rhodochytrium*, grows on the surface of angiosperms leaves, called epiphyllophytes. Some algae such as *Pleurococcus* sp. grow on barks called epiphloeophytes.

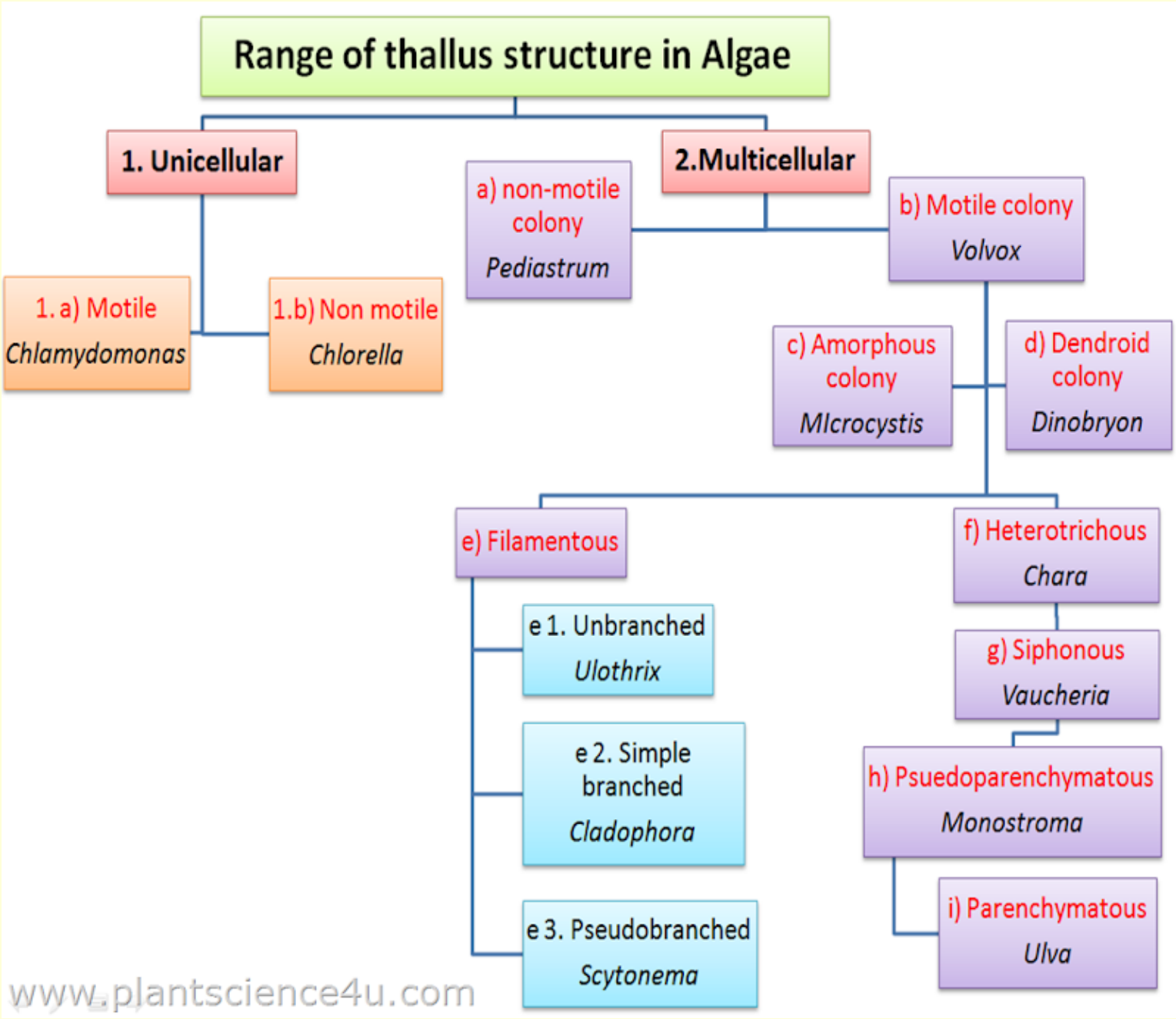
4) ENDOPHYTIC ALGAE: Some algae grows within the tissue of other plants, e.g. *Nostoc* grows inside thalli of *Anthoceros*.

5) EPIZOIC ALGAE OR EPIZOOPHYTES :which grown on the surface of other animals, e.g. *Cladophora* on snails, *Cyanoderma* (red algae) and *Trichophilus* (green algae) on the scales or outer hairs of Sloth.

6) ENDOZOIC ALAGE OR ENDOZOOPHYTE: Algae growing inside animals, e.g. *Chlorella* within the tissue of *Hydra* and sponges

7) LITHOPHILIC ALGAE: Which grows on rocks e.g. *Polysiphonia, Ectocarpus* etc.

8) OTHER ALGAE some algae like *Dunaliella, Chlamydomonas* chrenbergii grows in water with high salt concentration (Halophilic algae). *Fritchiella* grows on acidic soil while *Oscillatoria* sp , *Nostoc* etc. grow on alkaline soil.



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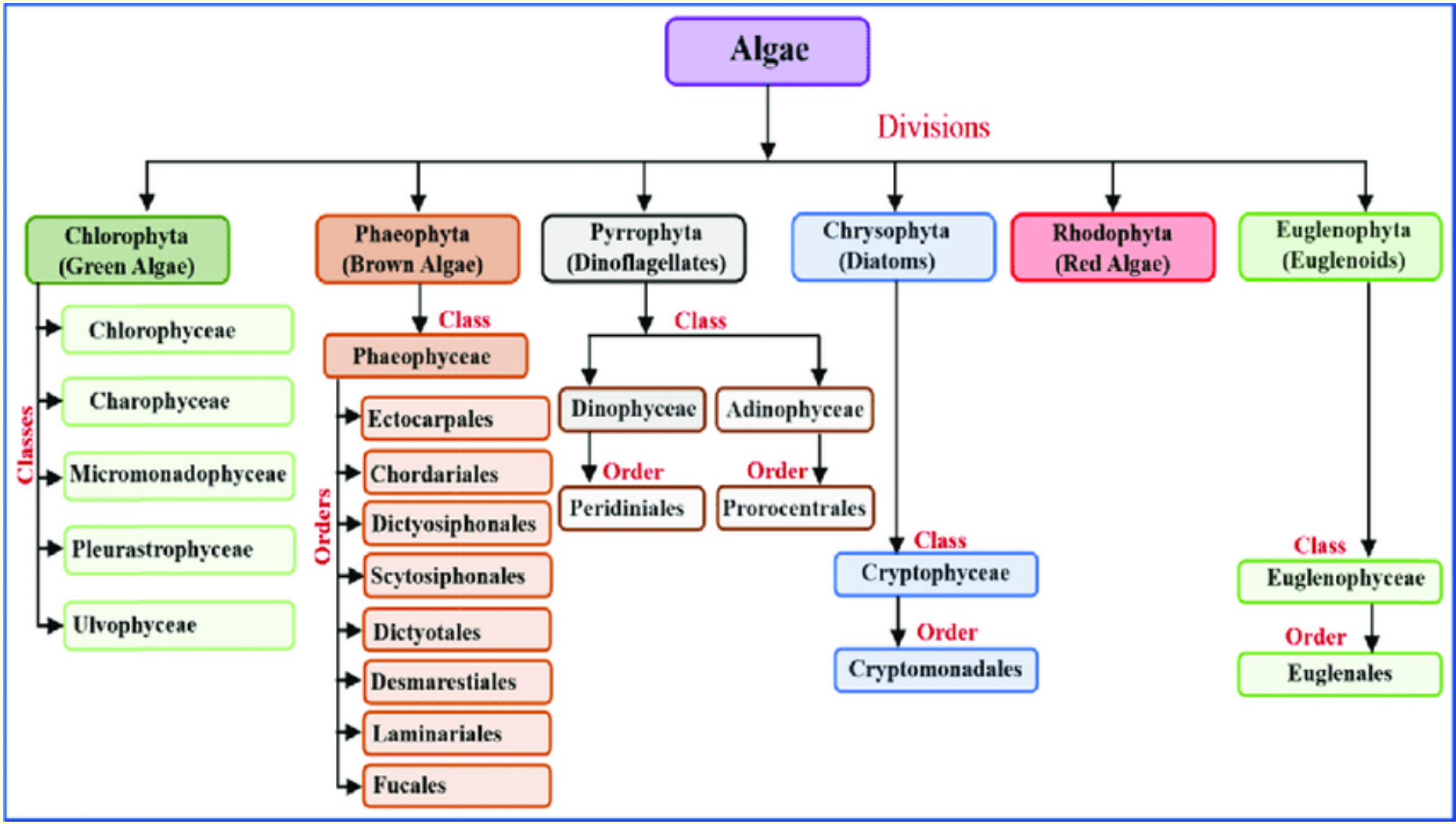
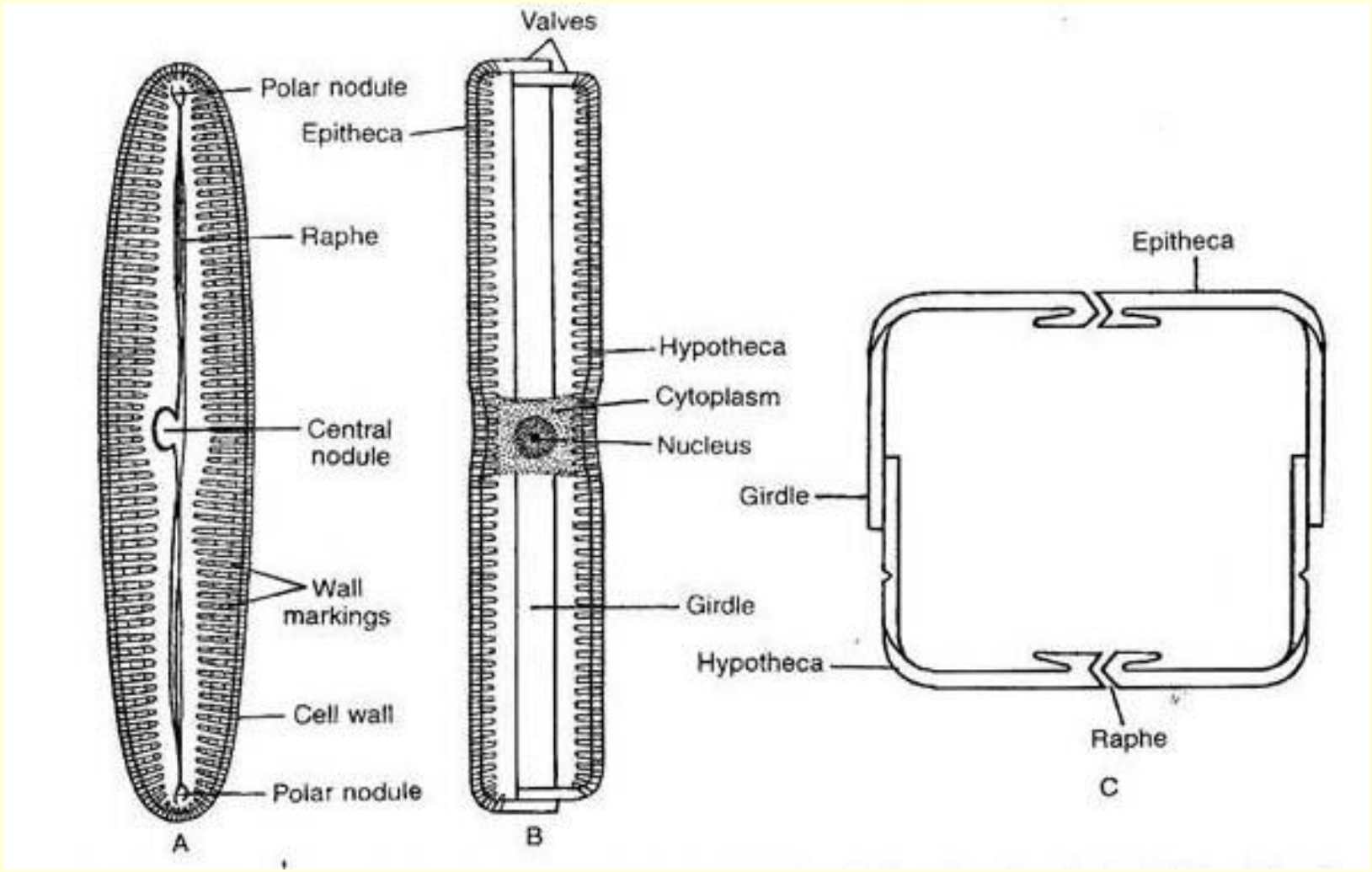
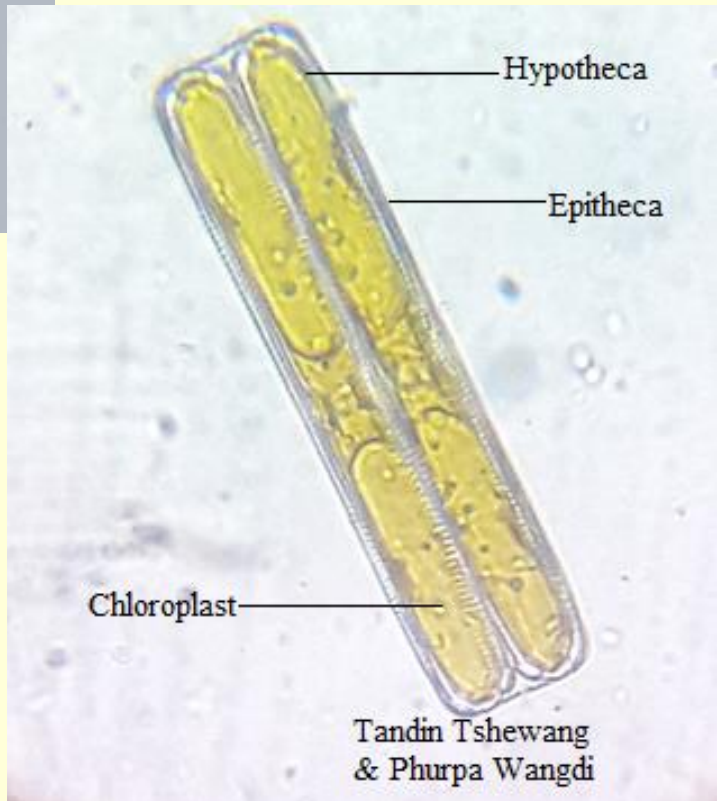

Algae
Divisions
Chlorophyta (Green Algae)
Phaeophyta (Brown Algae)
Pyrrophyta (Dinoflagellates)
Chrysophyta (Diatoms)
Rhodophyta (Red Algae)
Euglenophyta (Euglenoids)
Classes
Chlorophyceae
Charophyceae
Micromonadophyceae
Pleurastrophyceae
Ulvophyceae
Class
Phaeophyceae
Orders
Ectocarpales
Chordariales
Dictyosiphonales
Scytosiphonales
Dictyotales
Desmarestiales
Laminariales
Fucales
Class
Dinophyceae
Adinophyceae
Order
Peridiniales
Order
Prorocentrales
Class
Cryptophyceae
Order
Cryptomonadales
Class
Euglenophyceae
Order
Euglenales

Phylum	Common Name	Form	Locomotion	Pigment	Examples
Euglenophyta	Euglenoids	Unicellular	Two Flagella (one long & one Short)	Chl.a, Chl.b, Carotenoids	Euglena
Pyrrophyta	Dinoflagellates	Unicellular	Two Flagella	Chl.a, Chl.c, carotenes (including Fucoxanthin)	Gonyaulax, Ceratium
Chrysophyta	Diatoms	Usually Unicellular	Usually None	Chl.a, Chl.c, carotenes (including Fucoxanthin)	Diatoma, Frequilaria, Pinnularia
Phaeophyta	Brown Algae	Multicellular	Two Flagella (on reproductive cells)	Chl.a, Chl.c, carotenes (including Fucoxanthin)	Fucus, Macrocystis
Rhodophyta	Red Algae	Multicellular or Unicellular	None	Chl.a, Carotenes, Phycoerythrin	Chondrus, Polysiphonia
Chlorophyta	Green Algae	Unicellular, Colonial, Multicellular	Most have Flagella	Chl.a, Chl.b, Carotenes	Chlorella, Ulva, Acetabularia, Spirogyra

Task 6. Structure of diatomic algae (Pinnularia)

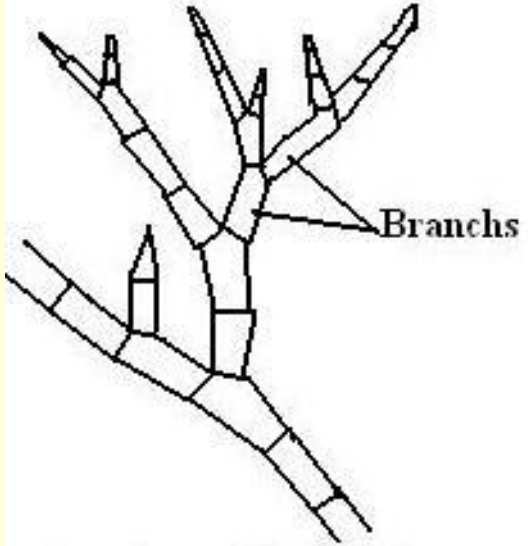




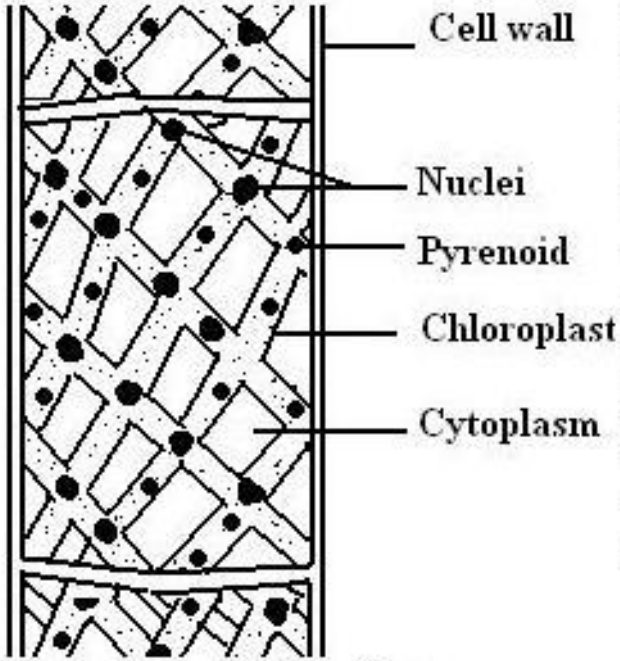
https://alchetron.com/Pinnularia

https://www.youtube.com/watch?v=hIYtC06t2e4

Task 7. Structure of the Green Algae of the class Isocontophyceae, using Cladophora as an example.



A portion of thallus of Cladophora



Cell structure of Cladophora

Cladophora is characterized by branching green filaments, whether sparse or profuse. The alga is divided into two parts a basal, rhizoida base with short branches forming a so of mini holdfast to a substrate, and erect thalli branching out to form filamentous sheets, dense cushions, o in certain environments, free-living hollow "balls." The cells are multinucleate and contain plenty of pyrenoid-packed chloroplasts.

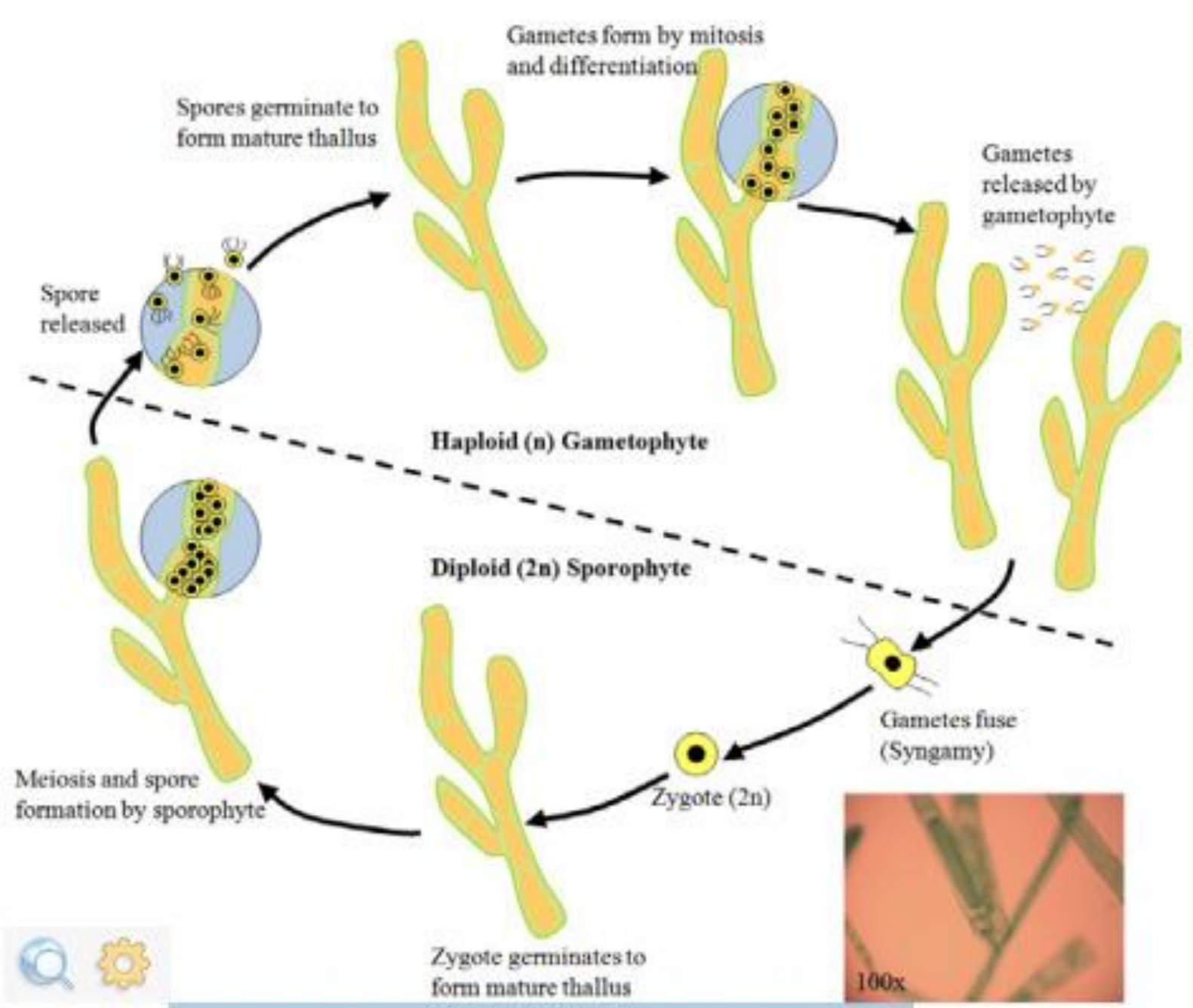
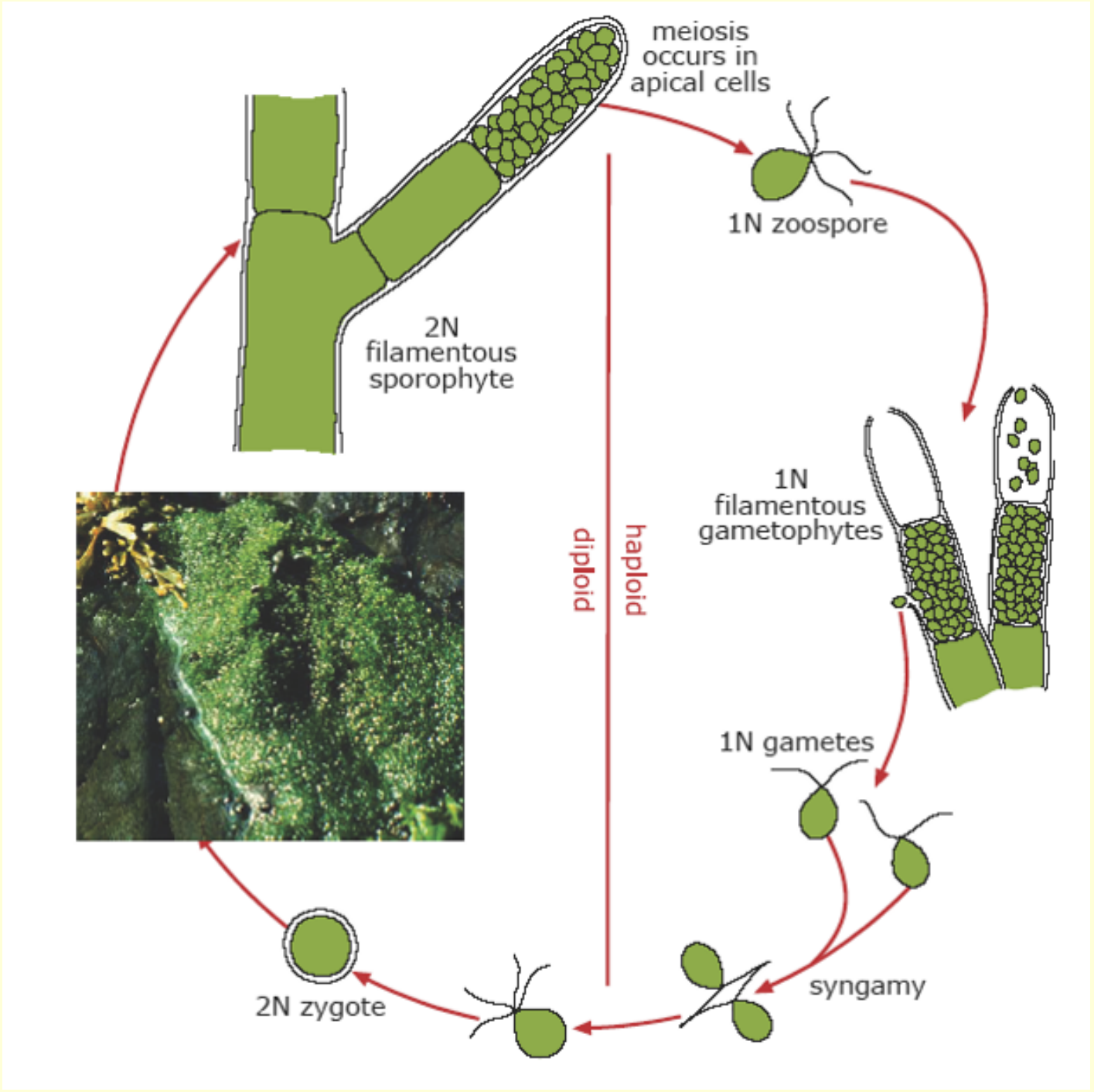
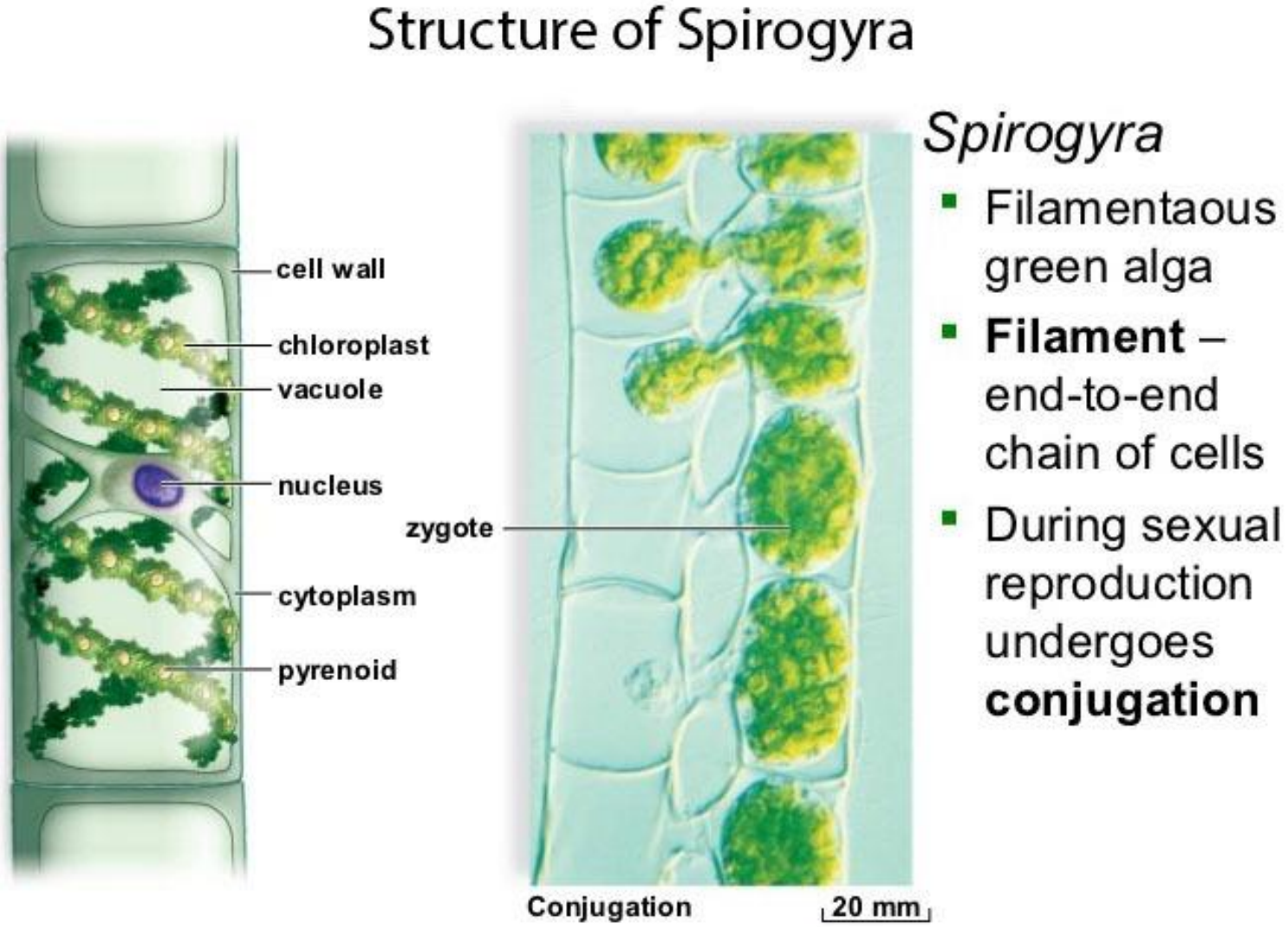


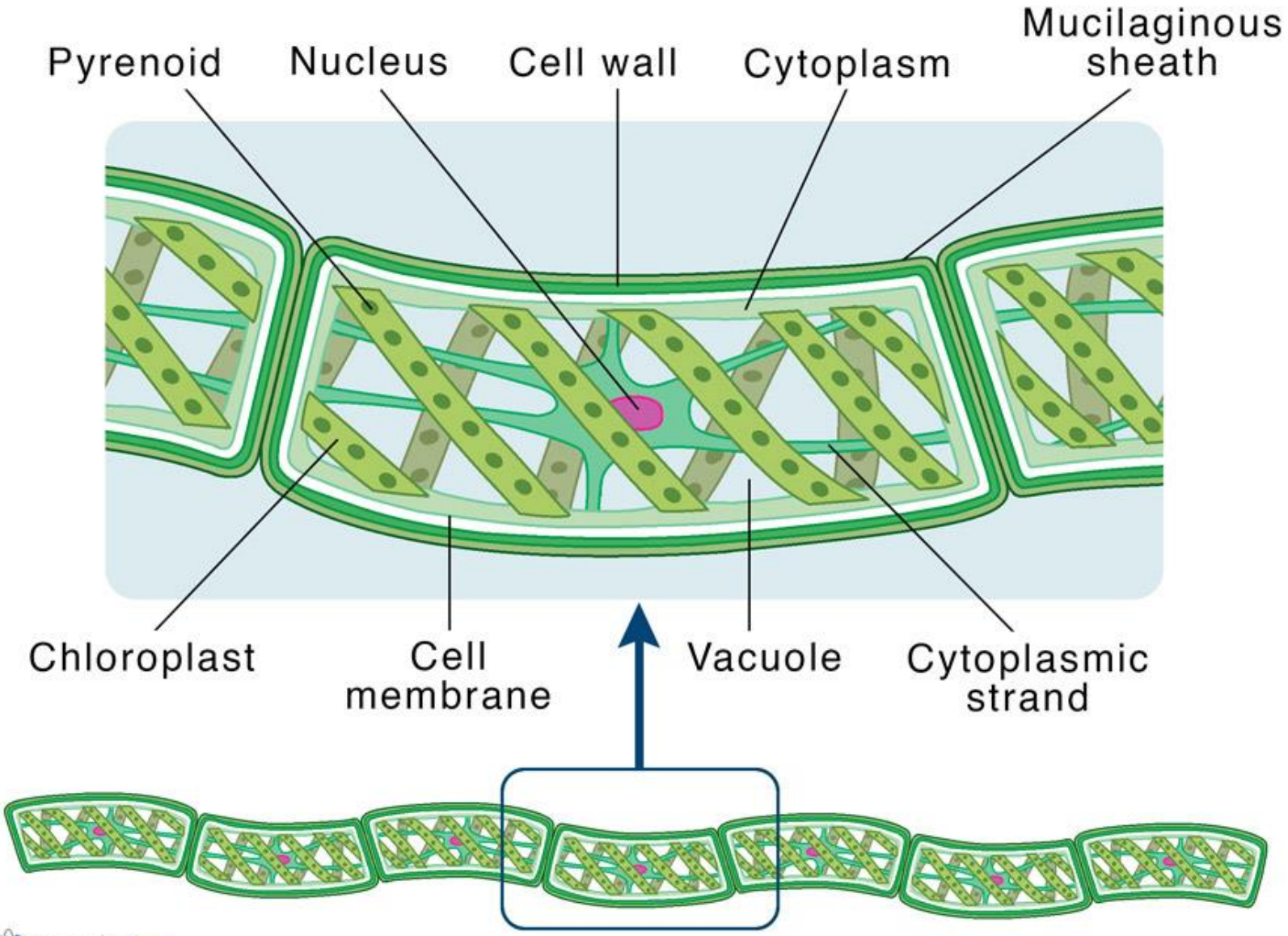
Figure 3: Alternation of generations in *Cladophora*.

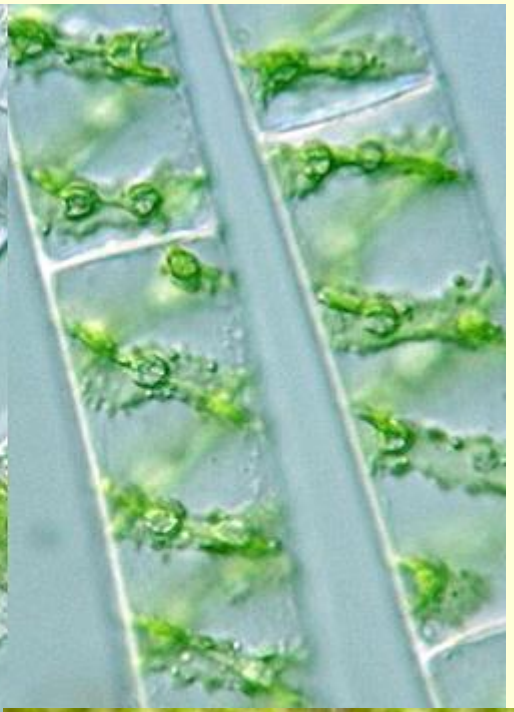

meiosis
occurs in
apical cells
1N zoospore
2N
filamentous
sporophyte
1N
filamentous
gametophytes
diploid
haploid
1N gametes
syngamy
2N zygote

Task 8. The structure of members of the Green Algae, class Conjugataphyceae, using Spirogyra as an example and their sexual process

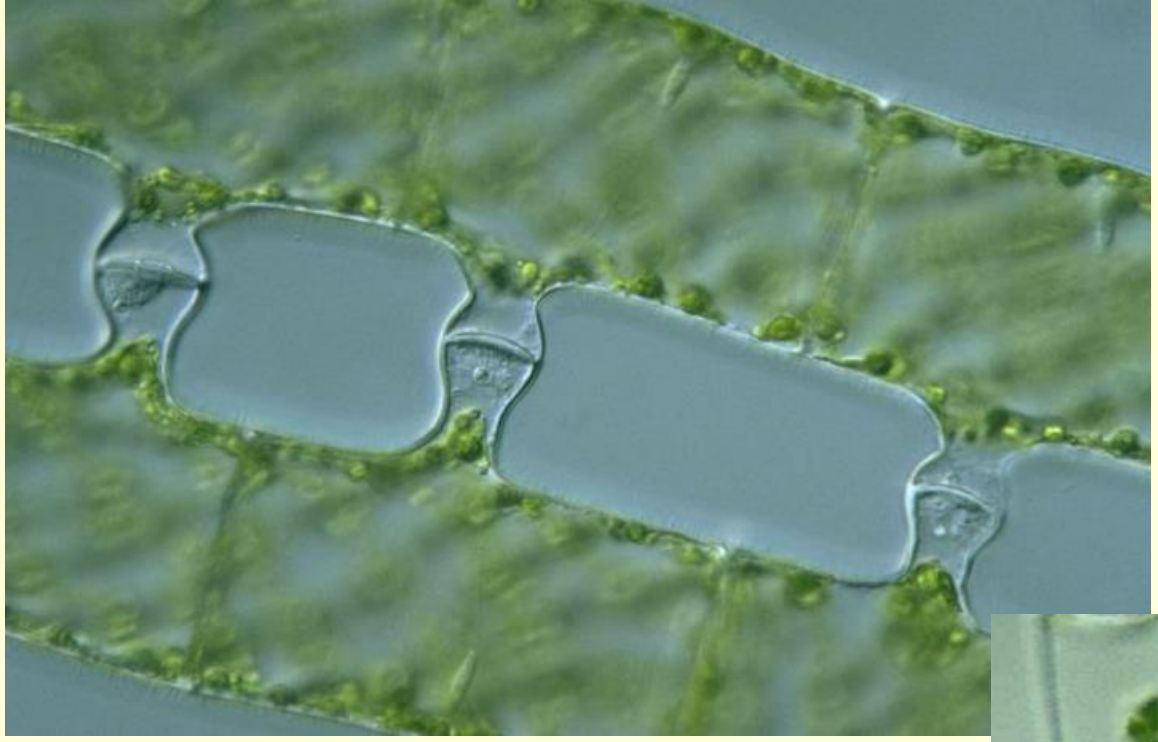


Spirogyra


Pyrenoid
Nucleus
Cell wall
Cytoplasm
Mucilaginous sheath
Chloroplast
Cell membrane
Vacuole
Cytoplasmic strand
ScienceFacts.net



https://www.youtube.com/watch?v=kz6Ctbq-elo

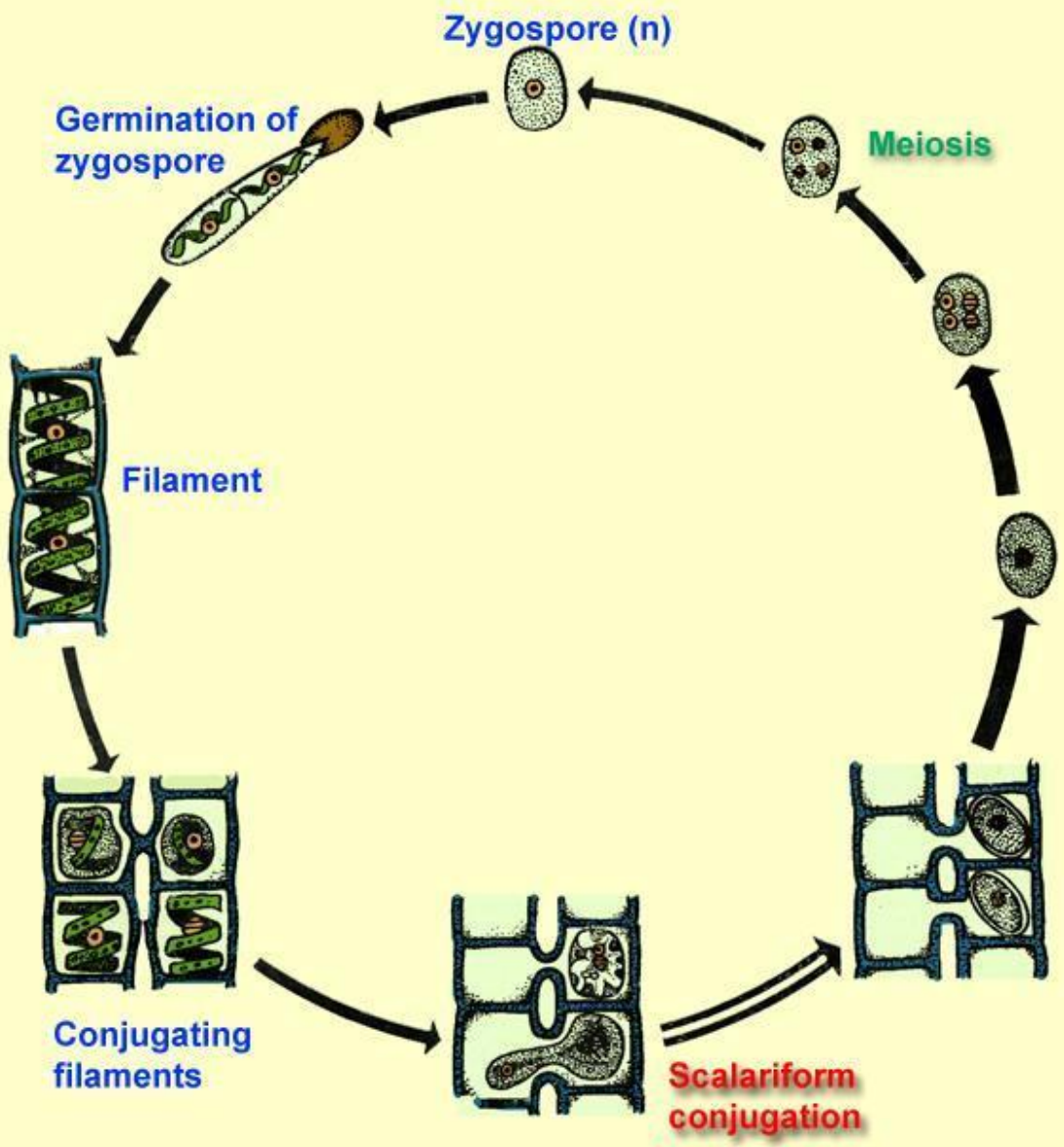


https://www.youtube.com/watch?v=O9v-xj2fjQI

https://www.youtube.com/watch?v=IseYUKR_p-8

https://www.youtube.com/watch?v=CejNEHZH5CM

LIFE CYCLE OF *SPIROGYRA* (GREEN ALGAE)



https://www.youtube.com/watch?v=E8lpUgcyJd0

https://www.youtube.com/watch?v=ZZj329wE7K8