Phylum Zygomycota

The second eumycotan phylum is the Zygomycota. This phylum contains two classes, class Zygomycetes and class Trichomycetes. Since most Trichomycetes are parasites or commensals inside the guts of living arthropods.

Class 1 - Zygomycetes - ~ 867 species in 125 genera, 30 families and 7 or 10 orders.

Class 2 - Trichomycetes - 189 species in 48 genera, 7 families and 4 orders.

•In Trichomycetes a few species are obligate commensals in guts or on exoskeleton of arthropods

• Found in freshwater (mayfly, stonefly, midges) and terrestrial (millipedes)

-Ecology of Zygomycota

Saprotrophs • Soil, dung, humus

Plant pathogens

• *Choanephora cucurbitarium,* on flowers & fruits of cucurbits

• *Rhizopus stolonifera*, Post-harvest pathogen of strawberries, sweet potatoes

Animal pathogens

Species of *Absidia, Mucor, Rhizopus, Saksanea*

-Industrial applications

Industrial production of amylases, rennins, secondary metabolites and organic acids

citric, fumaric, lactic and succinic acids

DISTINGUISHING FEATURES:

• SEXUAL SPORE = ZYGOSPORE

• ASEXUAL SPORE = NON-MOTILE SPORANGIOSPORES

• No motile cells

• Hyphae without septa, cell walls contain chitin

• Asexual spores formed in sporangia (except Trichomycetes)

• Sexual spore (zygospore) formed by gametangial fusion

• Life cycle is haploid with restricted diploid

• Saprobes of dead plant and animal material, mostly in terrestrial habitats although they can be isolated from water.

• Some pathogenic species on humans and other animals, especially invertebrates.

• Some species symbiotic with invertebrates or plants.

• They live close to plants, usually in soil and on decaying plant matter.

• Because they decompose soil, plant matter, and dung, they have a major role in the carbon cycle.

• Zygomycota are also pathogens for animals, amebas, plants, and other fungi.

• They form mutualistic symbiotic relationships with plants.

Zygomycota can also be found in aquatic ecosystems.

• They cause negative economic impact

• Certain species are used in Asian food fermentations.

• People have used their pathogenic powers to control insect pests.

• Certain species of Zygomycota also form relationships with animals.

• They know to cause serious infections, particularly for diabetics and immunocompromised individuals.

• The name of the class Zygosporangia is derived from the way in which they reproduce sexually by the physical blending - fusion or conjugation - of morphologically similar gametangia to form a zygosporangium (the teleomorphic phase). 'Zygos' is Greek for a yoke or joining.

• The gametangia arise from hyphae of a single mycelium in homothallic species, or from different but sexually compatible mycelia in heterothallic species. Zygosporangia usually develop thick walls, and act as resting spores.

• The asexual mitospores are usually formed inside mitosporangia borne at the tips of specialized sporangiophores. Zygomycete cell walls are mainly of chitin and the nuclei in their vegetative hyphae are haploid. Now for a taxonomic survey of the phylum and its two classes.

• **Class Zygomycetes**.

• 7 orders, 29 families, 120 genera, almost 800 species.

• The main orders are:

Mucorales, Mortierellales, Kickxellales, Dimargaritales, Zoopagales, Entomophthorales, Endogonales

1) **Order *Mucorales***. This order mainly saprotrophs, many to one sporangiospore/sporangium includes all the common saprobic zygomycetes. Here belong the ubiquitous bread mould, *Rhizopus stolonifer* and the equally common genus *Mucor*.

2) **Entomophthorales** – mainly parasitic on arthropods, limited mycelium, one sporangiospore/sporangium

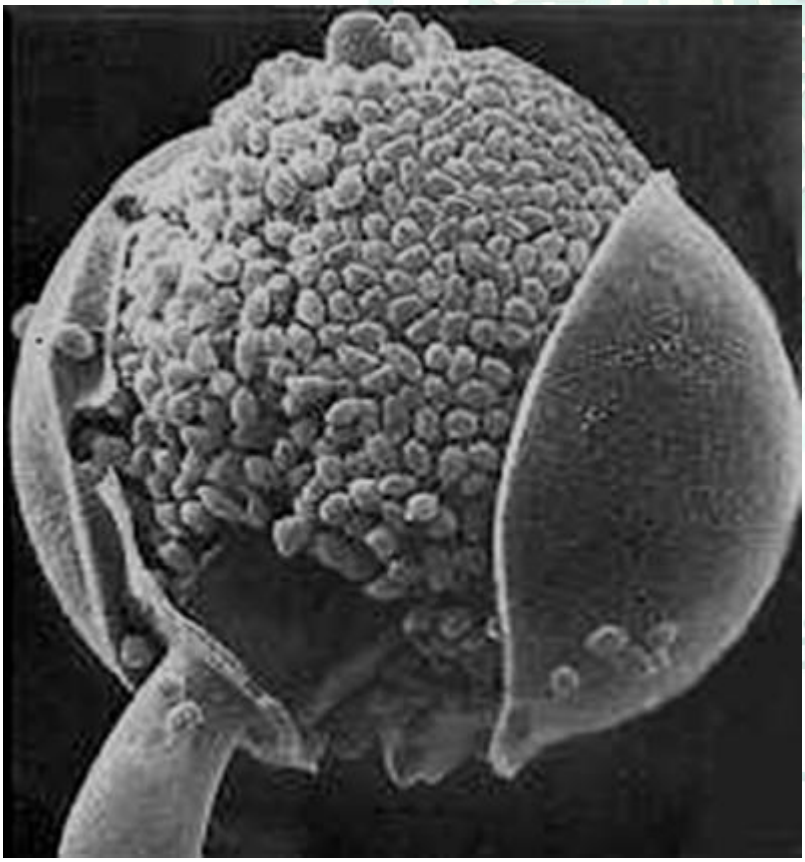
3) **Glomerales** – obligate biotrophs, form arbuscuar mycorrhizae

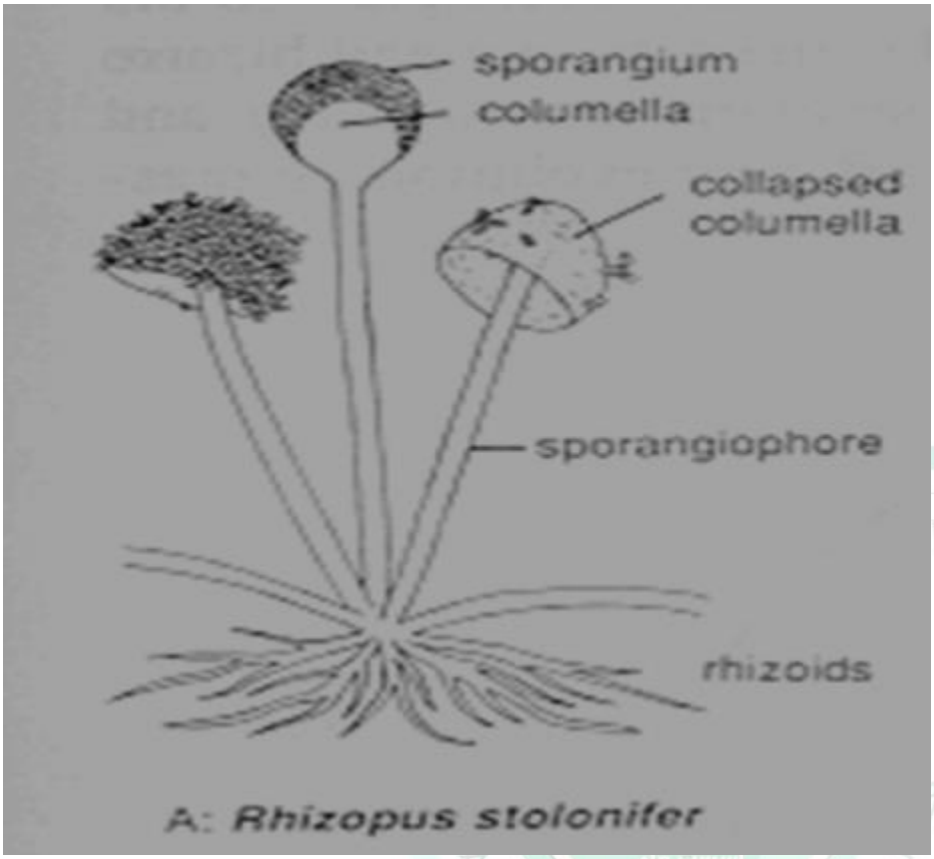
4) **Kickxellales** – produced septate hyphae and modified one spored sporangia

5) **Dimargaritales** – mycoparasites

6) **Zoopagales** – parasites of small animals (amoebae, rotifers & nematodes) and fungi including the lethal lollipop, *Zoophagus*)

7) **Endogonales** – saprotrophs





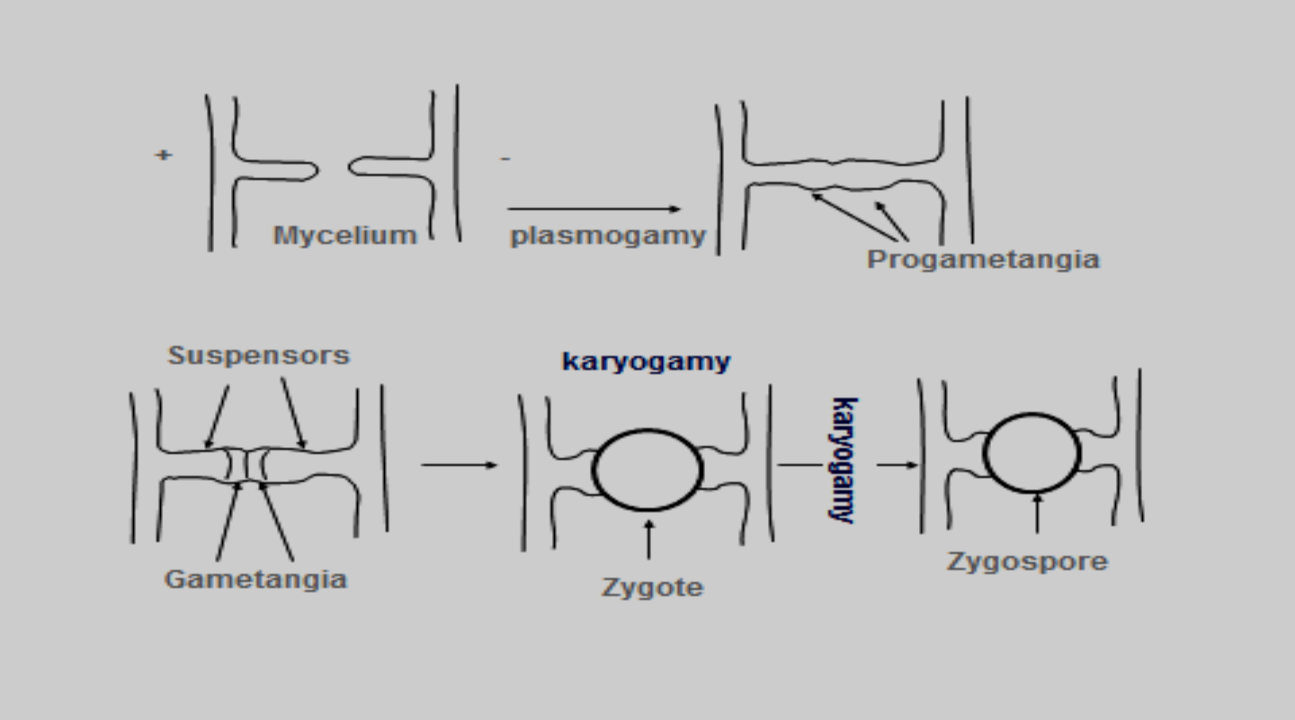
Sexual Reproduction

Sexual reproduction by production of **zygospores** (=thick-walled resting spores) within **zygosporangia** that are formed by fusion of **gametangia** • Involves fusion of two multinucleate gametangia that are similar in structure, may differ in size

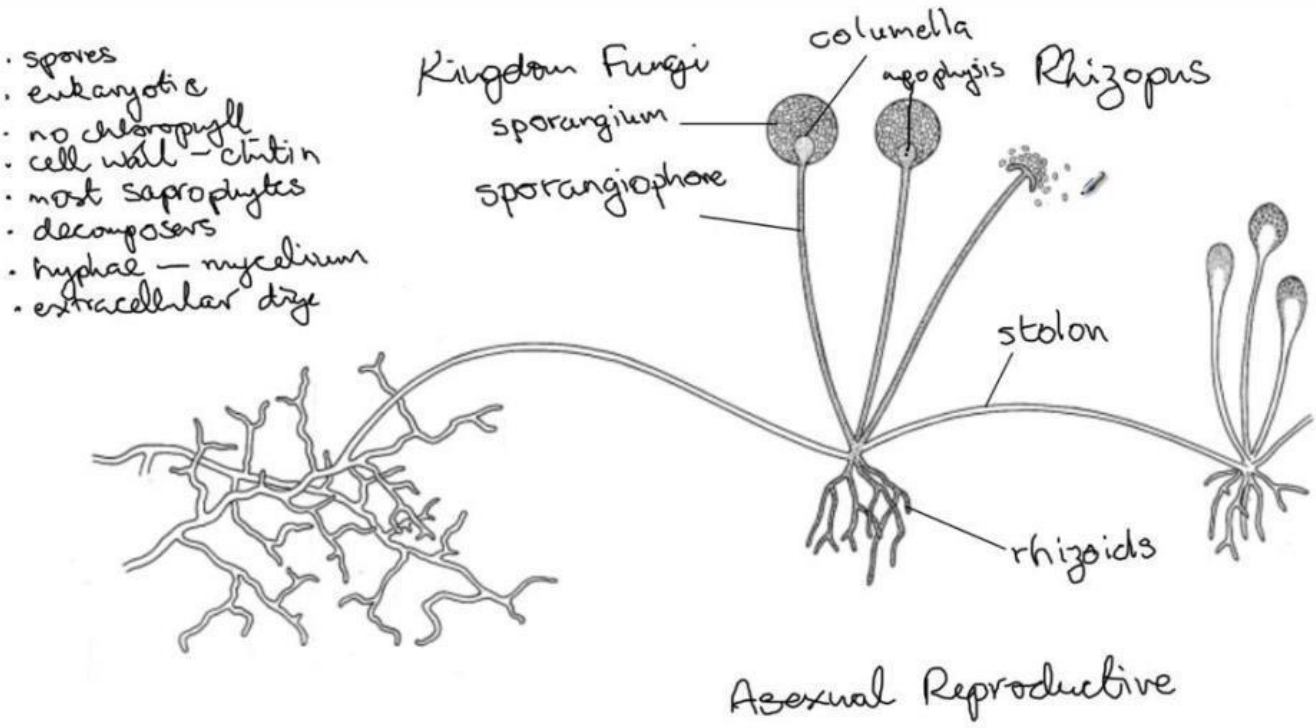
• Gametangia are produced as terminal swellings of hyphal branches

• After plasmogamy – a thick walled zygospore is produced with a zygosporangium

• Both homothallic and heterothallic species.



Asexual Reproduction



Zygospores

• Thick-walled, usually hyaline, but zygosporangium wall often pigmented and ornamented

• One zygospore per zygosporangium

• Germination by formation of hyphae or sporangium

• Zygospore production is generally similar among species, therefore classification is based on characteristics of asexual reproductive structures

• Asexual reproduction is typically by production of sporangiospores, but we will see lines of evolution in which the number of spores/sporangium is reduced until there is only 1 spore/sporangium - conidium

Mucorales

• Grow saprotrophically on decaying plant and animal remains in soils, dung, etc.

• Produce large numbers of asexual spores that are dispersed in the air

• Common contaminants in laboratory

• Some are important in spoiling food – common bread mold, storage diseases of fruits and vegetables, Some infect humans and animals – opportunistic pathogens

• Typically form aseptate hyphae, septa formed to delimit reproductive structures

• Some species form rhizoids

• 30% of known zygomycetes (~300 spp.)

• Well developed, typically coenocytic mycelium

• Wall composition of chitosan, chitin and polyglucoronic acid

• Asexual reproduction by formation of sporangiospores cleaved out from the cytoplasm of sporangia

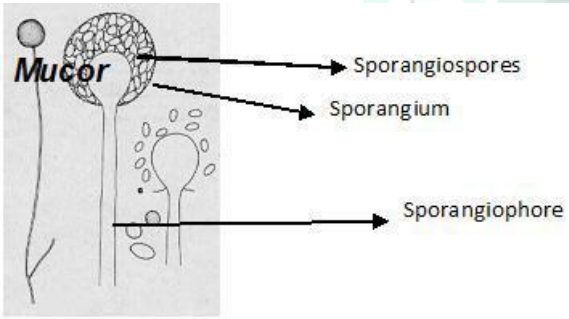
• Chlamydospores may be formed

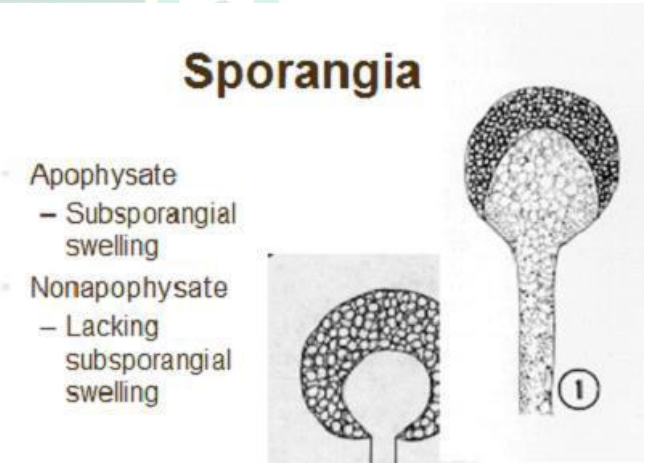
• Called mucoralean or mucoraceous fungi

Sporangia

• Most taxa produce globose sporangia

• Sporangial wall can be persistent or fragile, of various colors, and is usually smooth





Sporangiospores

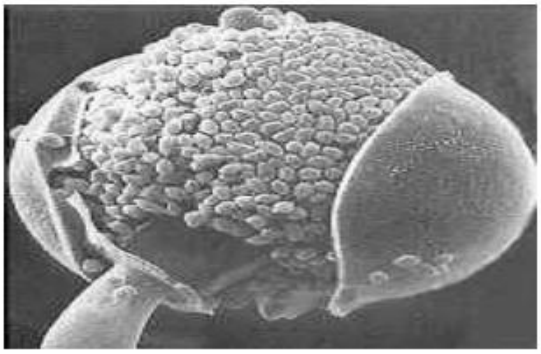
• One-celled

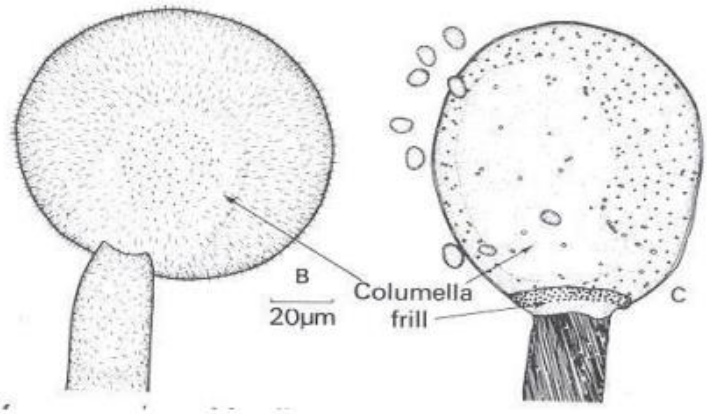
• 1- to multinucleate

• Smooth-walled, or ornamented with spines, warts or striations

• Most taxa produce hyaline spores

• Some taxa produce spores with hyaline appendages

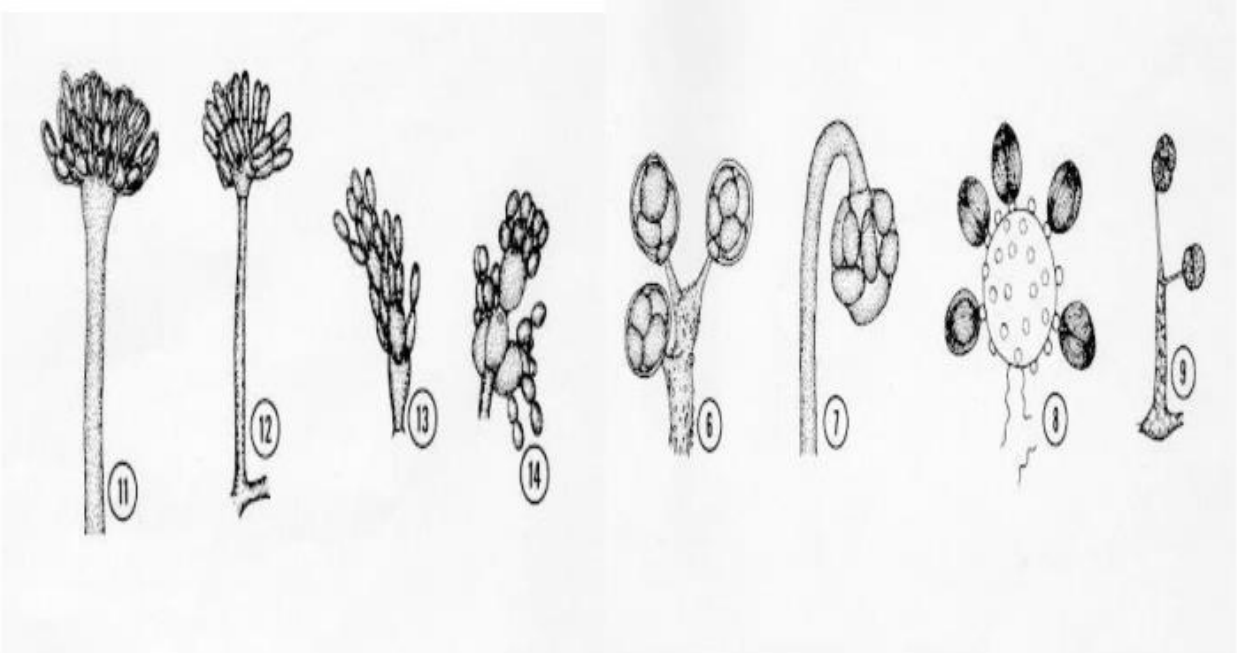




Sporangiolum

• Sporangium containing 1-50 spores

• Merosporangium is a sporangiolum with spores in linear series



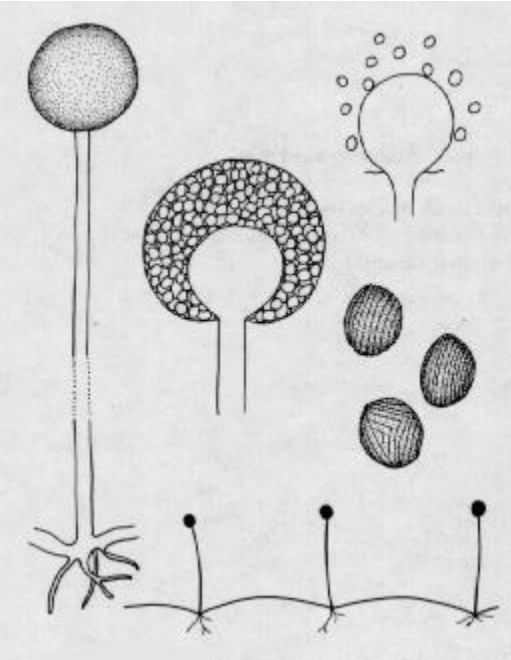
Development of sporangium

• Tip of sporangiophore swells

• Swelling increases, contains multinucleate cytoplasm

• Cytoplasm is cleaved to form all spores at one time – cell membrane and cell walls laid down around nuclei

• After formation, sporangial wall may break and release spores into the air or



Pilobolus

• Common fungus sporulating on dung

• Sporangia with dark, thick, persistent wall

– Sporangiophores are phototropic (bend towards light)

• As the sporangium and sporangiophore mature, the sporangiophore builds up a very high turgor pressure

• Sporangium as a whole is shot off suddenly, directly at the light – up to 3 m