BIOLOGICAL CLASSIFICATION

CLASSES OF FUNGI

CLASSIFICATION OF FUNGI:

- **Basis of classification: The morphology of the mycelium (Structure of mycelium), mode of spore formation and fruiting bodies (sexual reproduction)**

Modern scientists have been classified true fungi or Eumycota into 4 classes. (NCERT)

(1) Phycomycetes (including Oomycetes & Zygomycetes)

(2) Ascomycetes

(3) Basidiomycetes

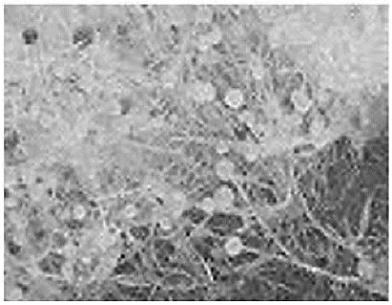
(4) Deuteromycetes

Phycomycetes (Algal fungi / Lower fungi):

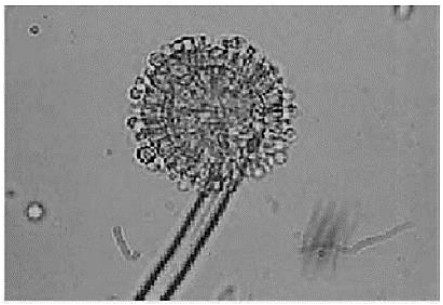
- **Members of phycomycetes are found in aquatic habitats and on decaying wood in moist and damp places or as obligate parasites on plants.**
- **The mycelium is aseptate and coenocytic.**
- **Asexual reproduction takes place by zoospores (motile) or by aplanospores (non-motile).** These spores are endogenously produced in sporangium.
- A zygospore / diploid zygote is formed by fusion of two gametes. These gametes are similar in morphology (isogamous) or dissimilar (anisogamous or oogamous).
- Phycomycetes further classified into oomycetes and zygomycetes.

	Oomycetes (Egg fungi)		**Zygomycetes (Conjugation fungi)**
1.	Cellulosic cell wall	1.	Chitinous cell wall
2.	Asexual spores – Motile zoospore and Conidia	2.	Asexual spores – non-motile Applanospore
3.	Sexual reproduction – Anisogamy / Oogamy – Gametangial contact – Oospore formed	3.	Isogamy Gametangial copulation / Conjugation Zygospore formed.

4.	e.g. Phytopthera infestans, Sclerospora, Albugo.	4.	e.g. Rhizopus (Bread mould), Mucor, Pilobolus - dung loving / coprophylous / hat thrower / fungal shotgun.



Mucor



Aspergillus

Agaricus

Table: Disease caused by the members of oomycetes

S.No.	Name of disease	Causal organism
1	Green ear disease of Bajra (Pearl millet) Downy mildew of cereal	*Sclerospora graminicola*
2	Late blight of potato	*Phytophthora infestans*
3	White rust of crucifers	*Albugo candida*
4	Damping off of seedlings	*Pythium debaryanum*
5	Black wart disease of potato	*Synchytrium endobioticum*

ASCOMYCETES

"The sac fungi"

Members of this class are mostly multicellular rarely unicellular (eg. yeast).

Habitat :- Members of Ascomycetes are saprophytic decomposers, parasitic or coprophilous (growing on dung)

Mycelium:- Septet and branched. Septa are found in mycelium of ascomycetes. Pores are present in septa. These pores allow cytoplasm to pass from one cell to other cell. Pores do not allow passing of nucleus.

Asexual reproduction :- By Conidia

Sexual reproduction :- By somatogamy and gametangial contact

Somatogamy

Ascospores are formed during sexual reproduction. On this basis they are named as Ascomycetes.

(a) There are three stages in sexual reproduction of Ascomycetes

- Plasmogamy
- Karyogamy
- Meiosis

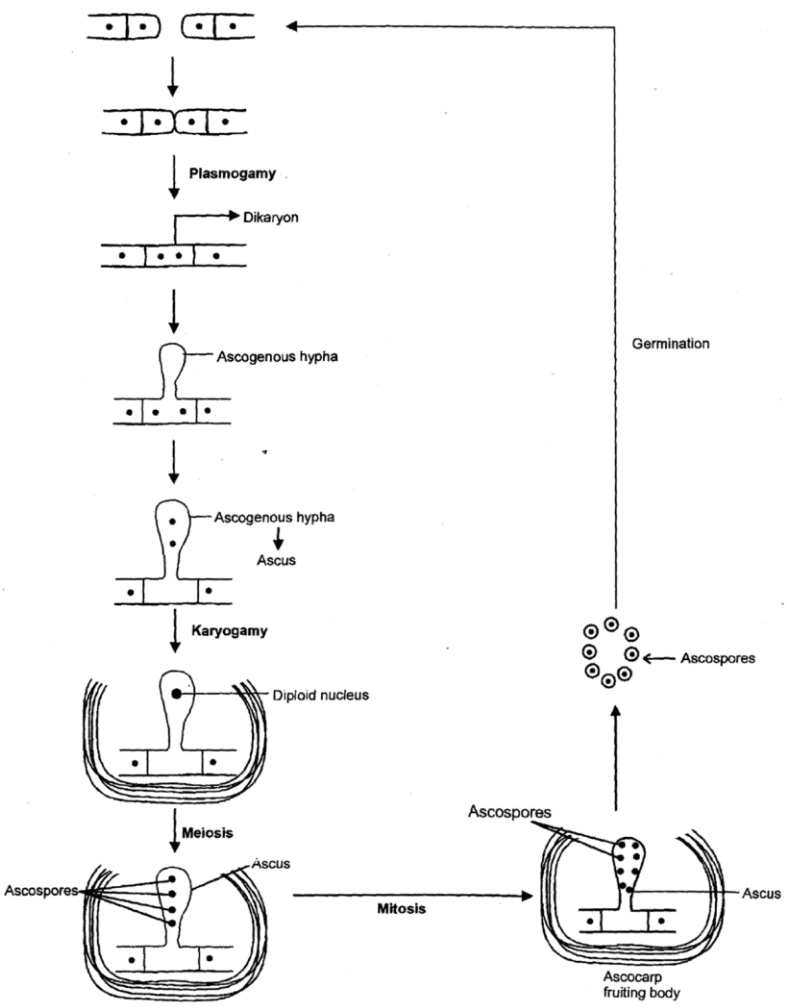
(b) In it two fungal hypha of mycelium come dose to each other and their cells fuse to form dikaryon.

(c) After this an outgrowth originates from dikaryon which is called ascogenous hypha. Ascogenous hypha develops and form a sac like structure which is called ascus (Plural-Asci). Due to this sac like ascus, ascomycetes are called as sac fungi.

(d) Now both the nuclei reach in ascus and fuse to form diploid nucleus. Now ascus is protected by some fungal filaments to form a fruiting body, called as ascocarp in which reductional division occurs leading to formation of haploid ascospores.

Note : Minimum four ascospores are formed in one ascus but generally '8' ascospores are formed in one Ascus.

(e) By the rupturing of ascocarp & ascus, ascospores become free and each ascospore forms a new mycelium.



Three Types of Ascocarp

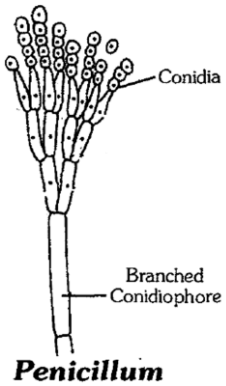
Cleistothecium	**Perithecium**	**Apothecium**
Closed, ball shaped	flask shaped	Open, disc shaped

eg. Of Ascomycetes

(1) **Penicillium :-** Blue or Green mold

P. notatum - A. Fleming obtained the antibiotic penicillin from it. Penicillin is the first discovered antibiotic. A Fleming was awarded Nobel Prize for it. But now a dyas more quantity of Penicillin is obtained from P. chrysogenum. A. Fleming was doctor in British

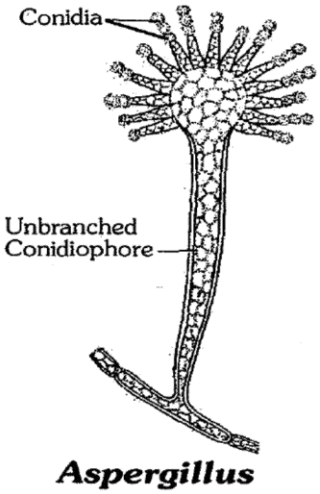
army and while working on bacterium Staphylococcus, he by chance discovered the penicillin. Discovery of Penecillin was a serendipity i.e. by chance discovery.



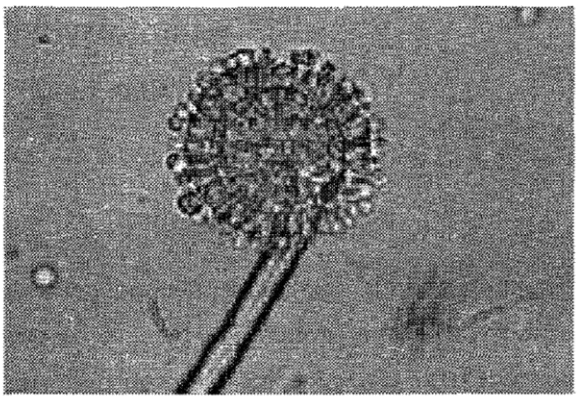
Penicillum

(2) Aspergillus :- Black or Brown mold or Blacky - smoky mold .

- **proliferans -** An antibiotic 'Proliferin' is obtained from it.
- fumigatus- It causes many diseases in humans & cattles. These disease are known as "aspergillosis"
- flavus- It prefers to grow on stored food (groundnut, cashewnuts etc.) and fodder. It secre't s toxic substances. These toxic substances are known as aflatoxins.
- flatoxins -They are carcinogenic i.e. they develop cancer. Aflatoxin causes liver cancer.
- Niger - Known as weed of laboratory and produce citric acid.



Aspergillus



(3) Claviceps :-

- Claviceps purpurea- It causes "Ergot disease" of Bajra and Rye.
- "Ergotin" (drug) is obtained from it.
- A narcotic drug (LSD) is also obtained from it. LSD (Lysergic acid diethylamide) is a hallucinogenic drug.

(4) Morchella :- The species of Morchella are commonly called as morels. It is an edible fungus.

(5) Neurospora :- Red or Pink mold "Drosophila of plant Kingdom". It is used for the study of genetics and biochemical studies in Plant kingdom.

Beadle and **Tatum** proposed "One gene - one enzyme theory" in Genetics by experimenting on Neurospora. They were awarded Nobel prize for it.

(6) Erysiphe :- Different species of Erysiphe causes "powdery mildew" disease on plants.

(7) Truffles :- Some members of Ascomycetes are known as Truffles. It is an edible fungus.

YEAST

Yeasts are unicellular fungi.

Yeast grows on ripened fruits like grapes, sugarcane, date palm and flowers. Mycelium is absent in yeast. If yeasts are grown in sugar solution then pseudomycelium is formed. Because in sugar solution, they grow very fast i.e. it reproduces fast and exhibit excessive budding.

Economic Importance:-

Yeasts are also called as fermentation fungi, because different types of products are formed by fermentation, with the help of yeast.

- It is used as fermentation agent in bakery (bread industry) and brewery (wine industry). So Saccharomyces, cerevisiae is also called "Baker's yeast".
- Riboflavin (vitamin B2) is obtained from Saccharomyces cerevisiae.

Basidiomycetes (Club Fungi):

It includes Mushrooms, Rust, Smut, Puff ball, Toad stools and Bracket fungi.

General characters:

(i) **They grow in soil, on logs and tree stumps and in living plant bodies as parasites, e.g., rusts and smuts.**

(ii) These are most advanced fungi and best decomposers of wood. Their fruiting bodies are large and visible.

(iii)Mycelium is septate and branched. Septa has dolipore except in rusts and smuts.

Mycelium is of two types –

Primary mycelium is monokaryotic, short lived, haploid and formed by basidiospores.

Secondary mycelium is dikaryotic, long lived (longest in all type of fungi) and containing inucleated cells (n + n) formed from primary mycelium by somatogamy.

(iv) Flagella are absent.

(v) Asexual reproduction is generally absent but vegetative reproduction by fragmentation is common.

(vi) The sex organs are absent, but plasmogamy is brought about by fusion of two vegetative or somatic cells **of different strains or genotypes or mating type (+ / –).**

(vii) The resultant structure is dikaryotic (formed by clamp connection) which ultimately gives rise to basidium.

(viii) Karyogamy and meiosis take place in the basidium producing four basidiospores.

(ix) The basidiospores (4) are exogenously produced (on sterigmata) on the basidium (pl.: basidia). The basidia (club shaped) are arranged in fruiting bodies called basidiocarps.

Economic importance:

1. **Puccinia :** Rust fungi.

- Disease **"Black rust of wheat"** is caused by **Puccinia graminis tritici.**
- It is heterocious fungi which complete its life cycle in Wheat (primary infection through aeciospores and secondary infection through Uredospore) and Barbery.
- It is polymorphic fungi.
- **The collateral hosts of** Puccinia **are Briza, Bromus, Hordeum.**
- The life cycle of puccinia was studied by **K.C. Mehta (1931)** in Indian plains.

Spores produce by puccinia.

S.No.	Spore	Formed on	Cell	Nucleus
1	Uredospore	Wheat	Unicelled	Dikaryotic
2	Telio or Telutospores	Wheat	Bicelled	Dikaryotic
3	Basidiospores	Soil	Unicelled	Monkaryotic
4	Pycniospores or Pycnidiospores or Spermatiospores	Upper surface of Barberry leaf	Unicelled	Monokaryotic
5	Aeciospores	Lower surface of Barberry leaf	Unicelled	Dikaryotic

2. **Ustilago:** Smut fungi

- They are pathogenic fungi and cause **smut diseases**.
- They bear thick walled black coloured resting spores called **chlamydospores, smut spores**.

Smuts are of two types.

(a) Loose smut: In this type spores are exposed from the beginning

e.g. Loose smut of wheat (caused by Ustilago tritici**),**

Note: Spread by flower and seeds. Loose smut of oat (caused by Ustilago avenae**).**

(b) **covered smut:** The spore mass remains with the sorus till before liberation

e.g. Smut of corn (caused by Ustilago maydis).

Covered smut of barley (caused by Ustilago jensenii).

3. **Agaricus: Agaricus bisporus** is edible mushroom. Also called as **gill fungi / fairy rings** because its fruiting body is ring shaped and have gills for dispersal of spores**.**

   Note: Poisonous mushrooms are commonly called as **toad stool**.

   Amanita muscaria - It is poisonous mushroom (Hallucinogenic).

4. **Puff balls:** Fruiting body is large and burst to release basidiospores e.g. Lycoperdon.

5. **Bracket fungi (Shelf fungi) :** e.g. Polyporus.

6. **Nidularia and Cyathus:** Commonly called as bird nest fungi.

DEUTEROMYCETES

It is also called "fungi imperfect", because perfect stage or sexual reproduction is absent in this class of fungi. Those fungi are included in this class in which sexual reproduction is absent or is not discovered at yet. When the sexual forms of this class of fungi were discovered they were moved into right class ascomycetes or basidiomycetes from deuteromycetes.

Mycelium :- Septate and branched

Asexual reproduction :- Takes place with the help of conidia.

- Some members are saprophytic or parasitic.
- A large number of members of this class are decomposers of litter and help in mineral cycling.
  e.g. Trichoderma
- Trichophyton & Microsporum :- It produces "Ringworm" in humans. e.g. -eczema, itching.
- Trichophyton interdigitale and Tinea pedis - It causes "Athelete foot disease" in humans. It is also called "Ring worm of foot".

S.No.	Name of disease	Causal organism
1.	Early Blight of potato	Alternaria solani
2.	Red rot of Sugarcane	Colletorichum falcatum
3.	Brown leaf spot of rice	Helminthosporium oryzae
4.	Tikka disease of Groundnut	Cercospora arachidicola, C.personatum.
5.	Ringworm of Foot / Athlete's foot	Trichophyton interdigitate / Tinia pedis.
6.	Ringworm of Scalp / Head	Microsporum lanosum