BYJU'S Classes

B I O L O G Y

BIOLOGICAL CLASSIFICATION

KINGDOM FUNGI

NOTES

Key Takeaways

Kingdom Fungi

- Classification of Kingdom Fungi
  - Phycomycetes
  - Ascomycetes
  - Basidiomycetes
  - Deuteromycetes

Prerequisites

Five Kingdom Classification

- Monera
- Protista
- Fungi
- Plantae
- Animalia

- **Kingdom Monera:** Archaebacteria, eubacteria (autotrophic and heterotrophic)
- **Kingdom Protista:** Plant-like protists (Chrysophyta, Pyrrophyta, and Euglenophyta), Fungi-like protists (Slime moulds), Animal-like protists (Protozoans)

Kingdom Fungi

- Kingdom Fungi was introduced into the **five kingdom classification** by **R.H. Whittaker**.
- Fungi are **eukaryotic cells**.
  - They have a **membrane-bound nucleus**.
- **Kingdom Fungi** is also known as **Kingdom Mycota**.
  - Hence, the study of fungi is known as **Mycology**.
- They are **decomposers**.
  - They grow on dead and decaying matter and are involved in the degradation of organic matter.

Fungi in Daily Life

Mushroom

Bread mould

Puccinia on wheat

Lichen

Penicillium

Characteristics

- Except for **yeast**, all fungi are **multicellular** organisms.
- Their **cell walls** are made up of **chitin** and other **polysaccharides**.
- Food is stored in the cell in the form of **glycogen** and **oil bodies.**

Structure of Fungi

- Fungi have a filamentous body known as **hyphae** (singular - hypha).
- The hyphae form a network known as **mycelia** (singular - mycelium).
- The hyphae can be of following two types:

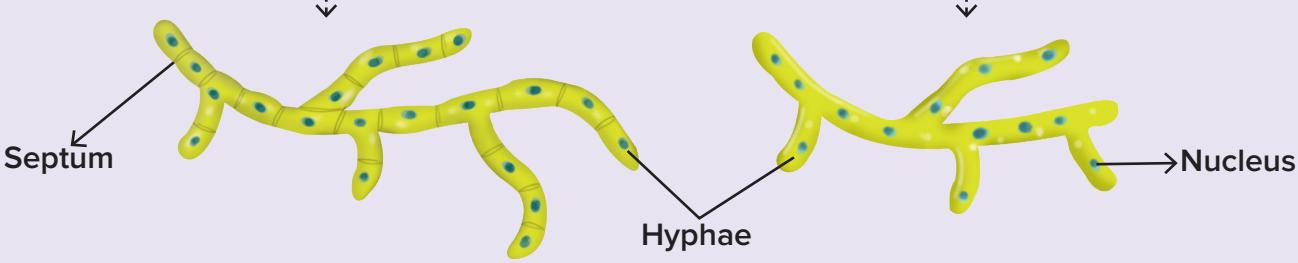
Hyphae

Septate Hyphae

Hyphae have septa or cross-walls.

Aseptate/Coenocytic Hyphae

Hyphae have multinucleated, continuous cytoplasm without septa or cross-walls.



Habitat

- Fungi are **cosmopolitan** in distribution (widely distributed).
  - They prefer **warm and humid environments**.
- They are predominantly **terrestrial**, but a few aquatic forms are also seen.

Terrestrial Fungi

- Coprophilous → Inhabiting dung
- Corticolous → Growing on barks
- Epixylic → Growing on wood

Mode of Nutrition

- Fungi are **achlorophyllous** — they lack **chlorophyll**.
- They are **heterotrophic**.

Heterotrophic Nutrition

- Saprophytic
- Parasitic
- Symbiotic

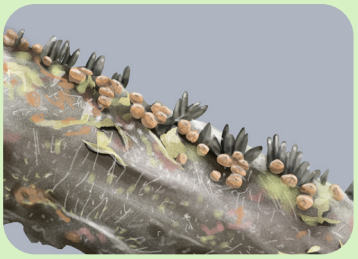
Saprophytic Nutrition

- **Saprophytic** fungi grow on dead plant and animal matter.
  - They are also known to be **opportunists**. They survive by exploiting temporary opportunities, like fallen fruit.
- They **break down** and **recycle** the **soluble organic matter** that they absorb from the dead substrates.
- Fungi play an important role in the **recycling of nutrients in the environment**.
  - They help release the **nitrogen**, **carbon**, and **phosphorus** trapped in the dead organic matter.

Saprophytic fungi

Parasitic Nutrition

- These fungi grow on a **living host** and absorb nourishment from the host.
  - **Haustoria** are absorptive roots found in parasitic forms of fungi that grow into the host in search of nourishment.
- In this process, they may harm and sometimes even kill the host.



Parasitic fungi

Symbiotic Nutrition

- Fungi form a **symbiotic association** with organisms to derive nourishment.
- **Example 1: Lichen - Association of fungi with algae**

Lichen

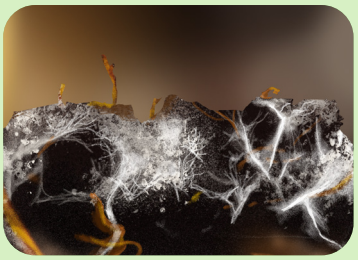
Lichen

- Algae → Autotrophic → Algae provide nutrition to the fungi
- Fungi → Heterotrophic → Fungi absorb water and minerals for the algae

- **Example 2: Mycorrhizae - Association of fungi with roots of higher plants**

Mycorrhizae

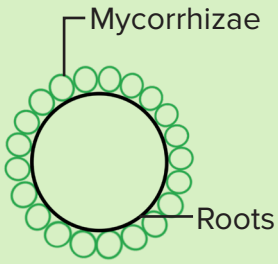
- Roots of plants → Autotrophic → Roots provide sugars to the fungi
- Fungi → Heterotrophic → Fungi absorb water and minerals for the plant



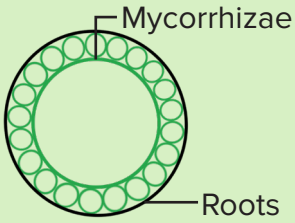
Mycorrhiza

Mycorrhizae

- **Ecto-mycorrhizae** → The mycorrhizae are formed outside the roots. →

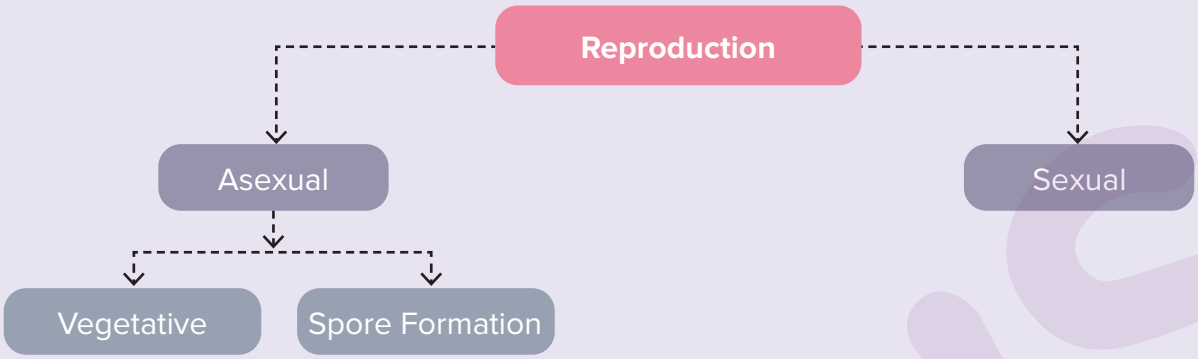


- **Endo-mycorrhizae** → The mycorrhizae are formed inside the cortex of the roots. →



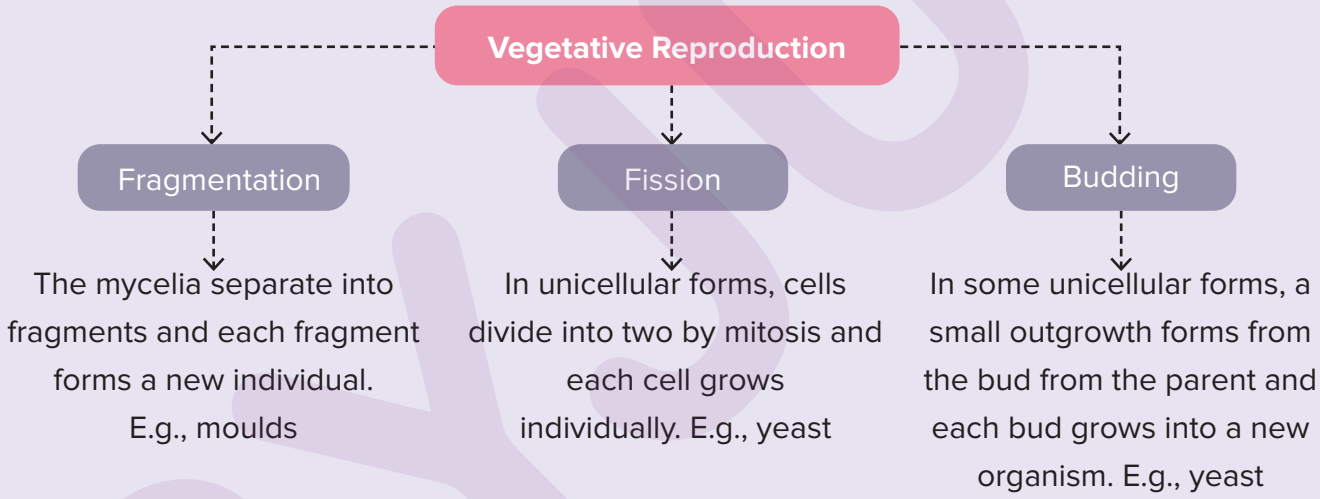
Reproduction

Three modes of reproduction observed in fungi are:



Vegetative Reproduction

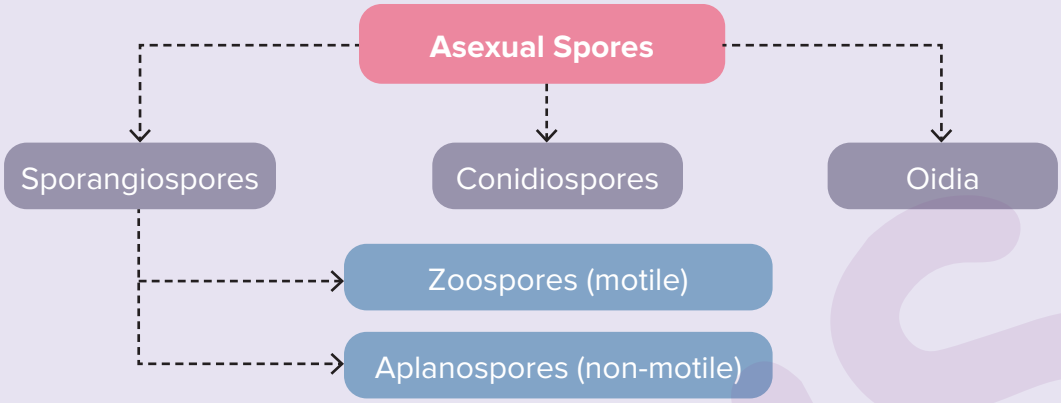
Three modes of vegetative reproduction are seen in fungi.



Spore Formation

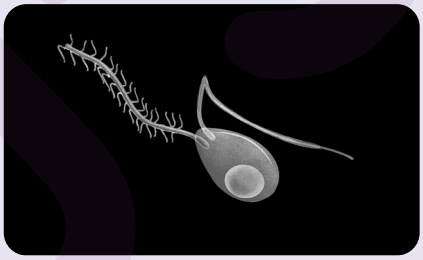
- Asexual reproduction also occurs with the help of **asexual spores**, which are produced in large numbers.
- Spore production allows fungi to spread and reach distant food sources.
- **Adaptations of spores**
  - Some spores have swimming cells that facilitate transport, while others drift passively in air or water.
  - Air-borne spores have walls that limit water loss with the help of waxy or oily molecules.
  - Some spores also have extensions that catch air currents.
  - Spores may also possess hooks or glue that help them attach to animals.
- **Characteristics of the spores**
  - Haploid (n)
  - Thick-walled
- The spores germinate to form new organisms.

- Fungi have the following three types of asexual spores:



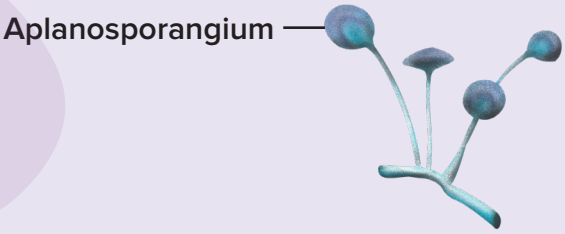
(a) Sporangiospores

- **Zoospores**
  - These spores are **flagellated** and **motile**.
  - They are produced in **zoosporangia endogenously** (produced within).



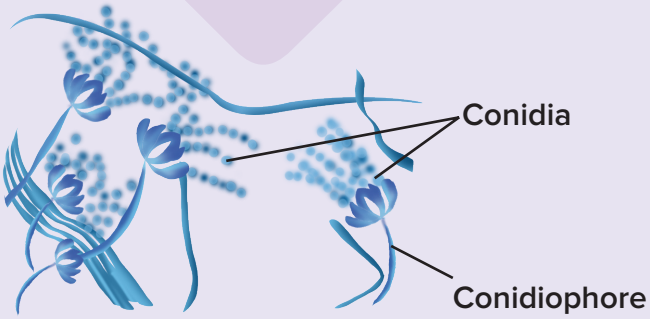
Zoospores

- **Aplanospores**
  - These spores are **non-motile.**
  - They are produced in **aplanosporangium endogenously**.



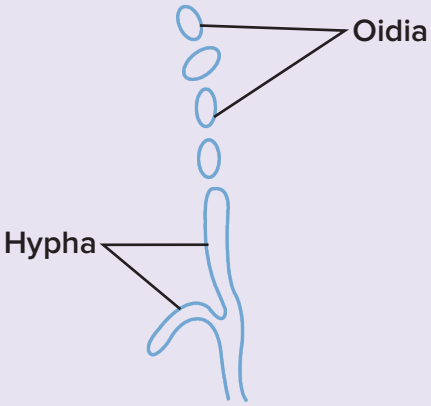
(b) Conidiospores

- These spores are **non-motile**.
- They are formed **exogenously** (produced outside) on branches known as **conidiophores**.



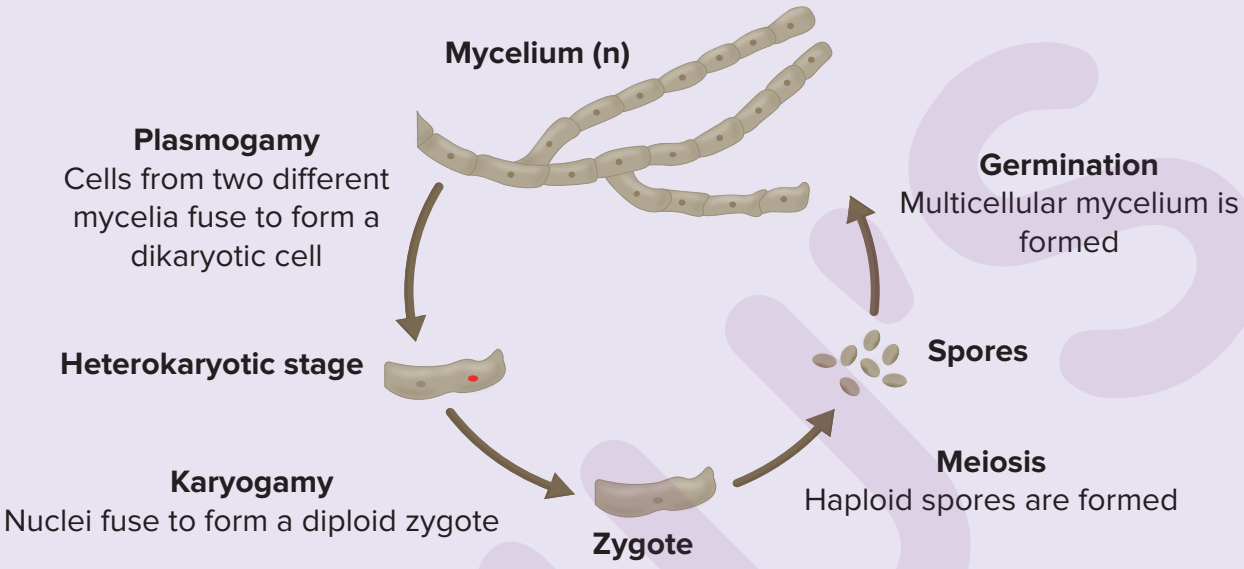
(c) Oidia

- Oidia are formed by the **fragmentation of hypha.**
- Each oidium gives rise to a new hyphae.



Sexual Reproduction

- Sexual reproduction in fungi is as shown:

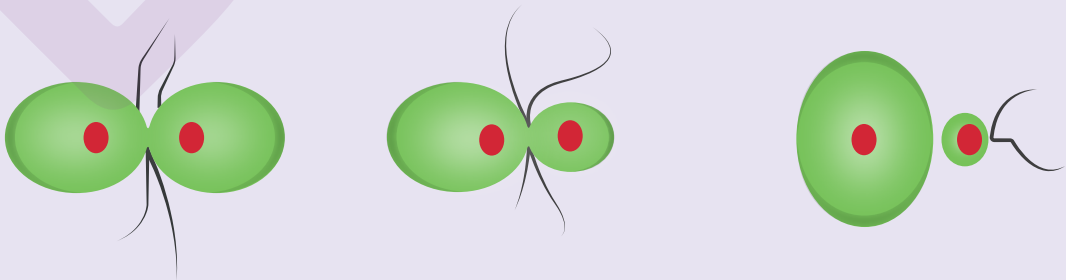


Sexual reproduction in fungi

- During sexual reproduction, three types of gametic fusion are observed.

Gametic Fusion

Isogamy	Anisogamy	Oogamy
Fusion of two motile or non-motile gametes of **similar size**	Fusion of two motile or non-motile gametes of **different sizes**.	Fusion of a **large**, **non-motile female** gamete, and a **small, motile male** gamete



Isogamy | Anisogamy = Heterogamy | Oogamy

Sexual reproduction in fungi takes place through four kinds of **sexual spores** that are borne on special structures known as **fruiting bodies**.

- Sexual spores
  - Oospores
  - Zygospores
  - Ascospores
  - Basidiospores

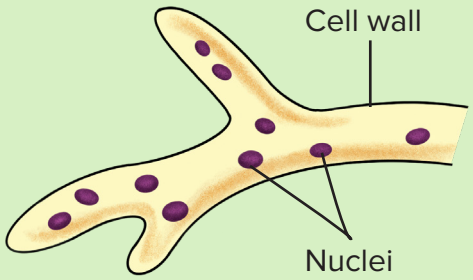
Classification of Fungi

- **Basis of Classification of Fungi**
  - Morphology of the mycelium
  - Mode of spore formation
  - Type of fruiting bodies

- **Fungi**
  - **Aseptate Mycelium**
    - Phycomycetes
  - **Septate Mycelium**
    - Ascomycetes
    - Basidiomycetes
    - Deuteromycetes

Phycomycetes

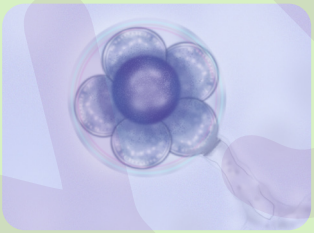
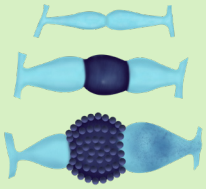
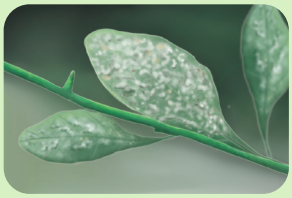
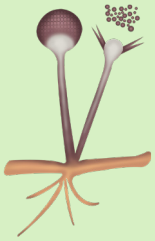
- They have **septate** or **coenocytic** mycelium.



Aseptate mycelium

- **Phycomycetes**
  - **Oomycetes**
  - **Zygomycetes**

- They are **lower fungi** (algal fungi).
- **Habitat**
  - They are found in aquatic habitats.
  - They grow on moist, decaying wood.
  - They also survive as **obligate parasites**
- **Reproduction**
  - **Asexual reproduction** by **sporangiospores** that endogenously produce the following:
    - **Zoospores**
    - **Aplanospores**
  - **Sexual reproduction**
    - **Oospores**
    - **Zygospores**

Types of Phycomycetes	**Oomycetes (Algal fungi, egg fungi)**	**Zygomycetes**
Characteristics	Cell wall has **cellulose**	Cell wall has **chitin**
Asexual reproduction	Zoospores	Sporangiospores
Sexual spores	 Oospores	 Zygospores
Sex organs	Antheridia (♂) Oogonia (♀)	Antheridia (♂) Oogonia (♀)
Types of gametic fusion	Isogamous or Anisogamous	Isogamous or Anisogamous
Process of sexual reproduction	Oospores $\xrightarrow{\text{Meiosis}}$ Haploid spores $\xrightarrow{\text{Germination}}$ New organism	Zygo-spores $\xrightarrow{\text{Meiosis}}$ Haploid spores $\xrightarrow{\text{Germination}}$ New organism
Examples	 *Phytophthora infestans*  *Albugo candida*	 *Rhizopus* (bread mould)  *Mucor*

Ascomycetes

1

Characteristics

- Commonly known as 'sac fungi'
- Coprophilous (growing on dung)
- Rarely unicellular (yeast) mostly multicellular (*Penicillium*)
- Mycelia are branched

2

Reproduction

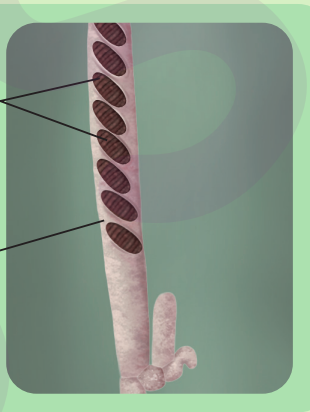
- Vegetative by budding
- Asexual by conidiospores
- Sexual by ascospores

3

Sexual Reproduction

Ascocarp (fruiting body)
↓
Ascus (sac)
↓
Ascospores

Ascocarp

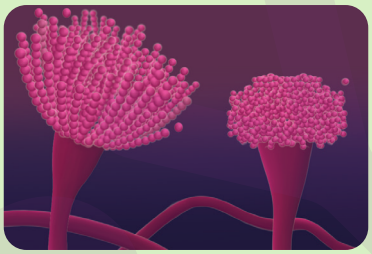


4

Mode of Nutrition

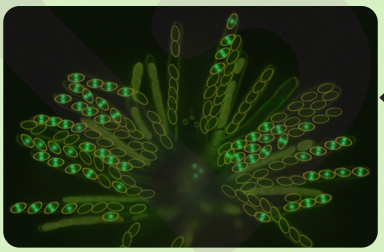
- Parasitic
- Saprophytic

Economically Important Ascomycetes



Aspergillus
(Alcohol production)

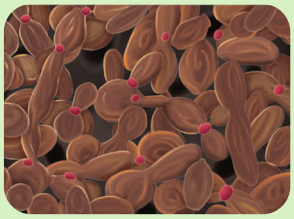
Penicillium notatum **(Antibiotic production)**



Neurospora
(Used in experimental genetics)

Claviceps purpurea
(Causes ergot of rye)

Morels
(Have edible, fleshy ascocarps



Saccharomyces cerevisiae (yeast)
(Bakeries, breweries)

Basidiomycetes

1

Characteristics

- Commonly known as 'club fungi'
- Grow in soil, on logs, and tree stumps
- Parasitic (rusts and smuts)

2

Reproduction

- They reproduce asexually by budding or asexual spore formation.

3

Sexual Reproduction

- Sex organs absent
- Sexual reproduction is by somatogamy
- Fusion of somatic or vegetative cells (somatogamy) result in formation of basidium

Basidiocarp

Basidium

Basidiospore

Basidiocarp (fruiting body) → Basidia —Plasmogamy, karyogamy, and meiosis→ 4 Basidiospores

Basidiomycetes

- Mushroom

- Bracket fungi

- Puffballs

Some important members of basidiomycetes are as follows:

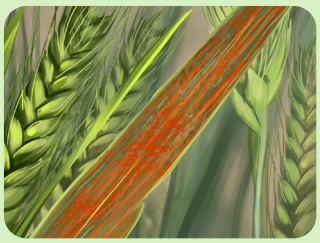
Ustilago

- Causes **smut disease**
- Ears of cereals turn into black powder
- Seen in **wheat, corn** and ***Sorghum***

Corn smut

Puccinia

- Causes **rust disease**
- **Parasitic**
- Completes life cycle in two hosts — **wheat** and **barberry**
- Forms the following four types of spores:
  - Urediniospores, teliospores, basidiospores - Infecting wheat
  - Aeciospore - Infecting barberry



Puccinia

Deuteromycetes

1 Characteristics

- Also known as fungi imperfecti (sexual reproduction not reported)
- Mycelia are septate and branched.
- Saprophytic or parasitic mode of nutrition
- Help in mineral cycling

2 Reproduction

- Vegetative reproduction
- Asexual reproduction by conidia
- Sexual reproduction not reported

It is possible that the asexual and vegetative stage of some fungi have been given one name (and placed under deuteromycetes) and the sexual stage has been given another (and placed under another class).
Later, when the linkages were established, the fungi were correctly identified and moved out of deuteromycetes.
Once perfect (sexual) stages of members of dueteromycetes were discovered, they were often moved to ascomycetes and basidiomycetes.

Alternaria

Trichoderma

Colletotrichum

Examples of Deuteromycetes

Summary Sheet

Coprophilous
Grow on animal dung

Corticolous
Grow on the bark of trees

Epixylic
Grow on wood

Kingdom Fungi

Vegetative reproduction
Happens through fragmentation, fission, and budding

Asexual reproduction

Sexual reproduction

Spore Formation

Conidiospores
Non-motile asexual fungal spores that are produced endogenously on branches known as **conidiophores**

Oidia
Asexual fungal spores produced by the fragmentation of hyphae

Sporangiospores

Zoospores
Flagellated and motile sporangiospores that are produced on the zoosporangia

Aplanospores
Non-motile sporangiospores that are produced endogenously on the aplanosporangium

Isogamy
Fusion of two motile or non-motile gametes of similar size

Anisogamy
Fusion of two motile or non-motile gametes of different sizes

Oogamy
The fusion of a large, non-motile female gamete, and a small, motile male gamete

Coenocytic mycelium
The cells are not divided

Phycomycetes
Fungi that have aseptate mycelium. They include **Oomycetes** and **Zygomycetes.**

Septate mycelium
The cells are divided and separate

Ascomycetes
Commonly known as 'sac fungi'

Basidiomycetes
Commonly known as 'club fungi'

Deuteromycetes
Commonly known as 'fungi imperfecti'

Terminologies

Mycology

Mycology is the study of fungi.

Yeast

Yeast are unicellular fungi.

Hyphae

It is the filamentous body of the fungi. Hyphae form networks known as **mycelium**.

Lichen

It is a symbiotic association between an alga and fungus.

Mycorrhiza

It is a symbiotic association between fungi and the roots of higher plants.

Heterokaryotic stage

It is the stage in fungal sexual reproduction in which cells contain two genetically distinct haploid nuclei that do not fuse right away.

Plasmogamy

It is the fusion of cells from two different mycelia to form a dikaryotic cell.

Alternation of generation

It is a life cycle which shows an alternation between a haploid gametophytic phase and a diploid sporophytic phase.

Karyogamy

It is the fusion of nuclei to form the diploid zygote.