



A221 Microbiology

Problem 10

Treat or Threat?

Activity Owner: Ashley Chua, Kelvin Tan, Jamson Chow

Inputs By: Grace Loo

Approved By: Dr Serene Choo

Module Chair: Foo Toon Tien

What do you recognize?

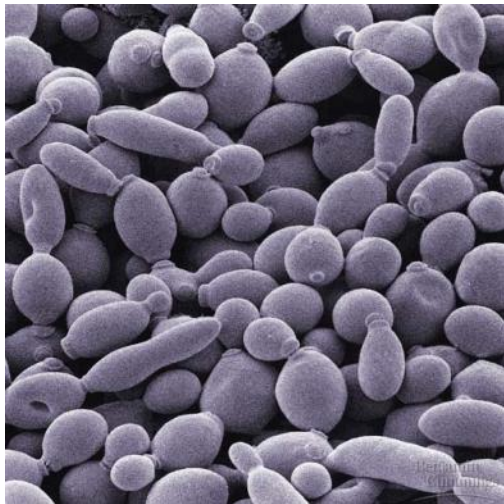
- *Cordyceps*, *Aspergillus* and *Penicillium* are used in the production of various food products
- Ants infected with *Cordyceps* were dumped far away from the ant colony by worker ants
- The newspaper reported the shutdown of Intensive Care Unit due to fungal invasion
- Questions were posed on why the worker ants and human had to resort to such drastic measures

One possible approach...

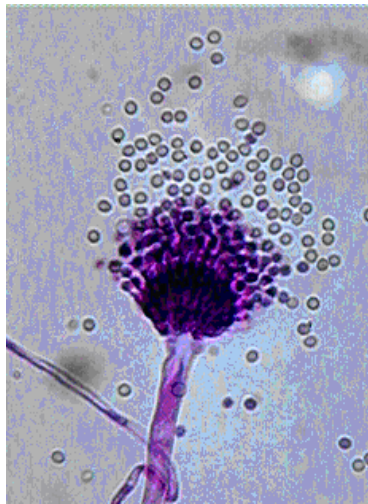
- What are *Cordyceps*, *Aspergillus* and *Penicillium*?
- What are the different mode of reproduction in fungi?
- What are molds / moulds?
- What is the gross morphology of molds / moulds?
- What are yeasts?
- How are they harmful to insects and human?
- Why did drastic measures have to be taken by both the worker ants and humans?

What are *Cordyceps*, *Aspergillus* and *Penicillium*?

- They are collectively known as molds / moulds as they grow in the form of multicellular filaments known as hyphae.
- They belong to a group of organisms known as **Fungi** (eukaryote), which include **mold / mould** and **yeast**.
- Fungi are classified into different phyla based on **phylogeny** (*i.e., evolutionary relationships among a set of organisms or groups of organisms*).



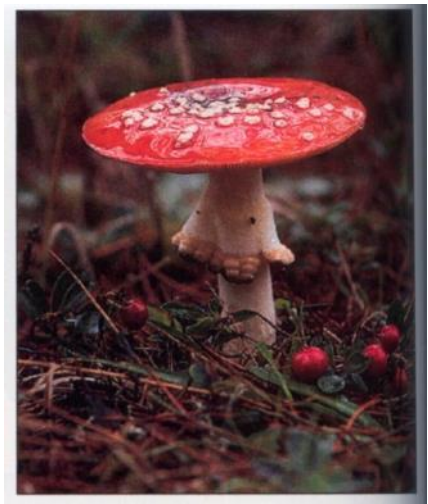
Yeast



Aspergillus



Penicillium

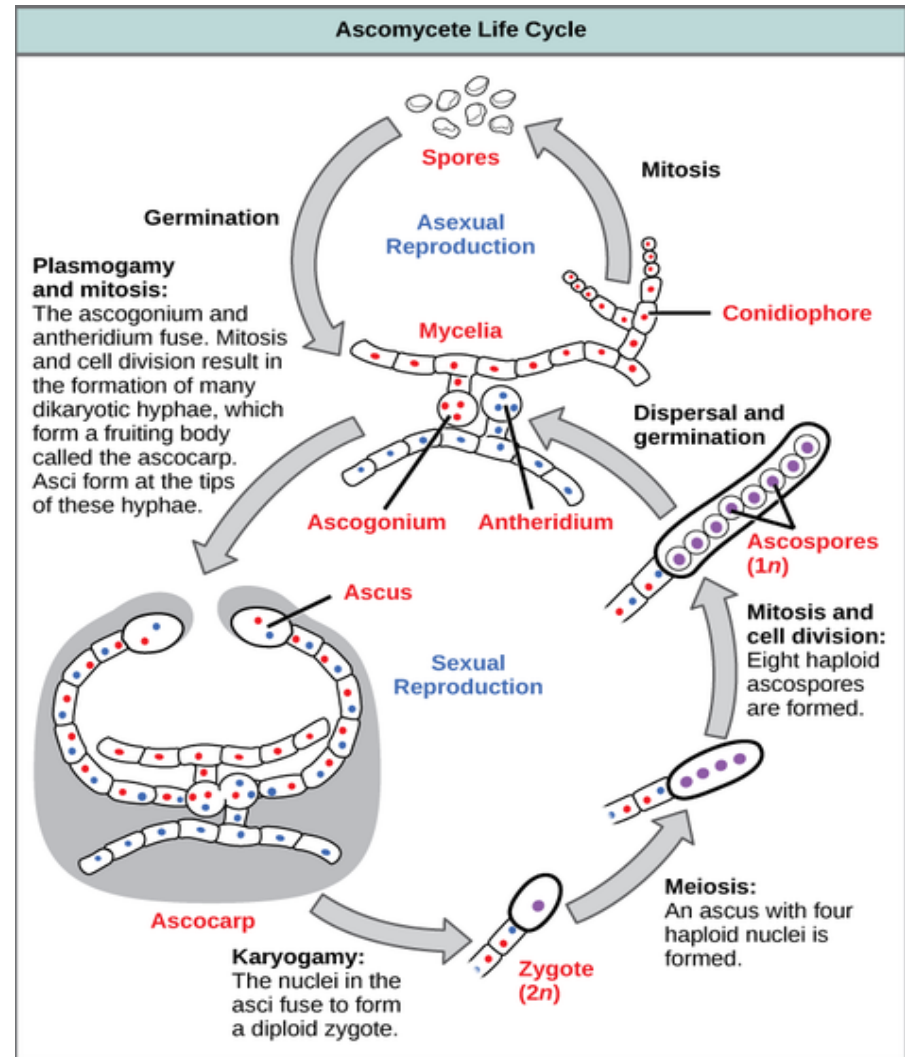


Mushroom

What are the different modes of reproduction in fungi?

Fungi can reproduce:

- **asexually** by budding, fission, spore formation or fragmentation.
- **sexually** by fusion of specialized fungal cells to increase genetic variation and hence enhance the survival of fungi.



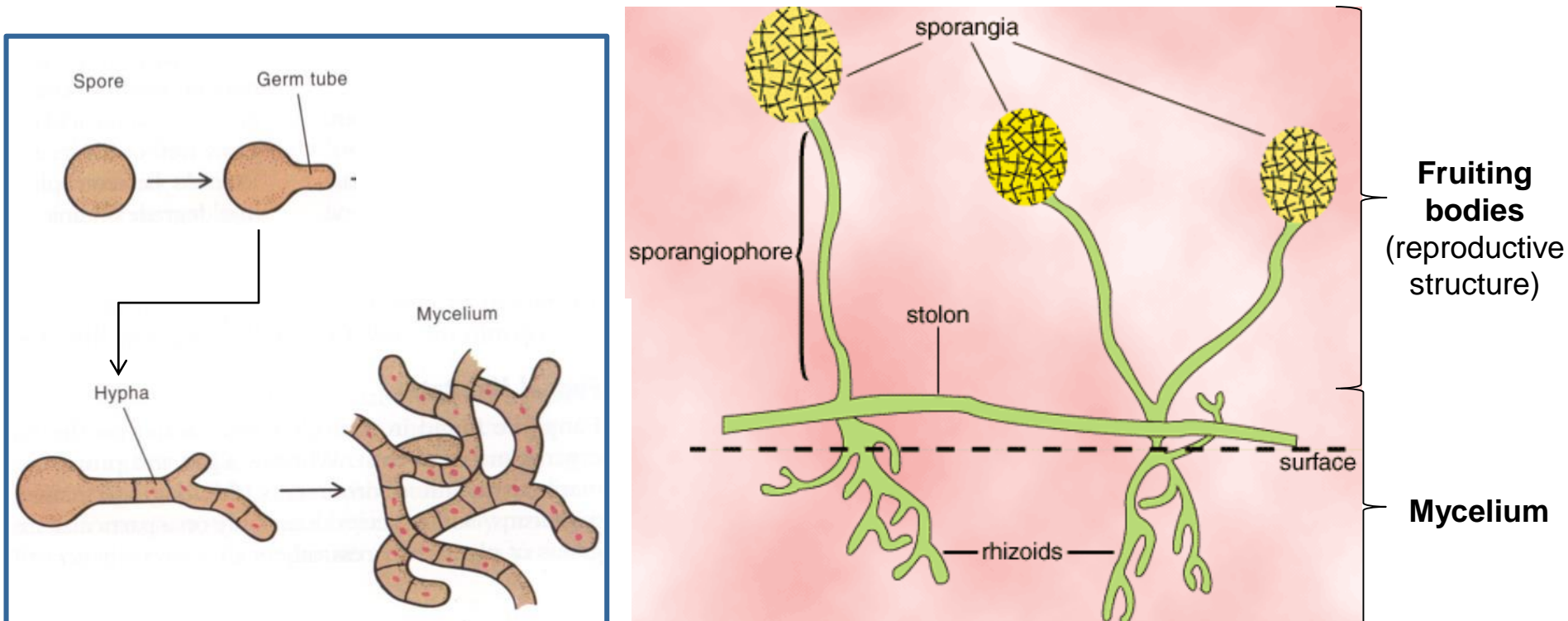
What are molds / moulds?

- **Multicellular** plant-like organisms.
- Fungi cell wall is made up of **chitin**.
- Reproduce sexually, asexually or a combination of both.
- Reproductive structures produce spores (sexual or asexual)



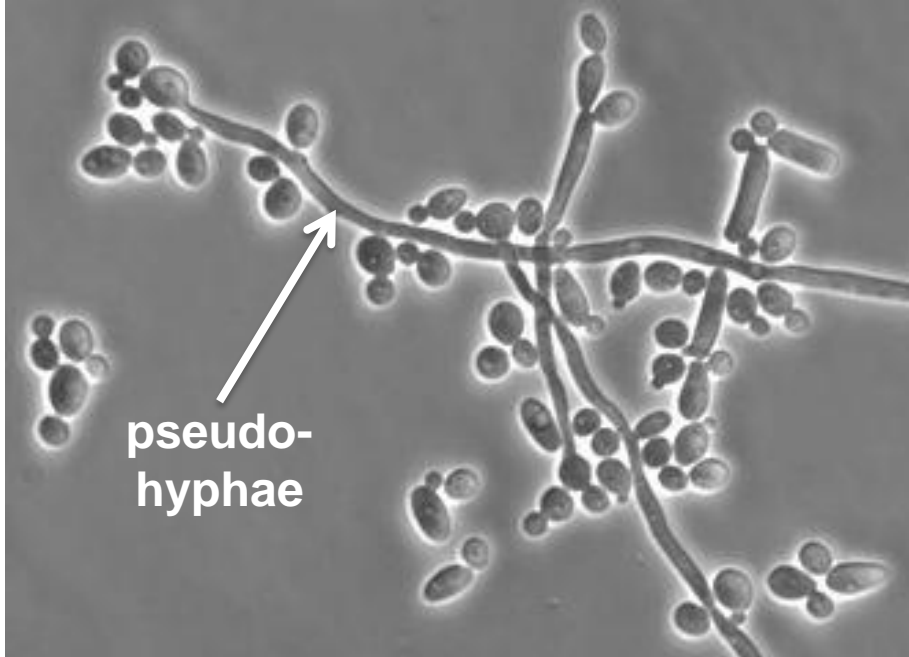
What is the gross morphology of molds / moulds?

- Molds / moulds are composed of long filaments of cells termed **hyphae** that differentiate to form **fruiting bodies**, which produce **spores**.
- When hyphae group together, they form a **mycelium**.

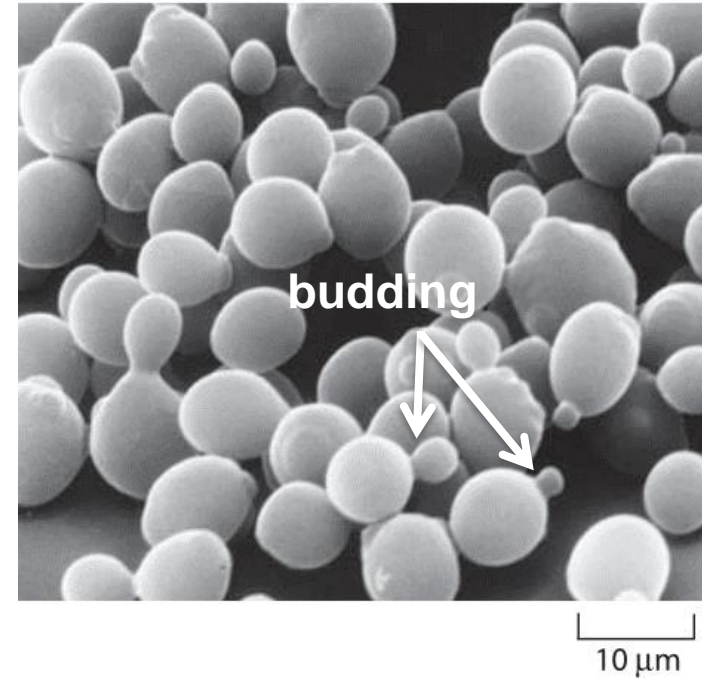


What are Yeasts?

- Yeasts are **unicellular** fungi.
- May reproduce asexually (most commonly by **budding**) or sexually.
- May form elongated buds that look like hyphae called **pseudohyphae**.



Saccharomyces cerevisiae
(also known as baker's yeast)



Candida albicans causes
yeast infections

Why did the worker ants dump the infected ants far away from the ant colony?

- Ants infected with parasitic *Cordyceps* will die.
- Fruiting bodies of *Cordyceps* will develop and release spores from the tip.
- The spores are numerous and light, and can spread very easily via wind dispersal to infect and wipe out whole colonies of ants.



Why was there a need to shut down the ICU?

- Molds / Moulds spores are small, light and can spread easily in the air circulation systems.
- Fungi can cause human diseases generally termed as human **mycotic disease**, or **mycosis**:
 - True fungal infection in healthy non-compromised individuals. E.g., Histoplasmosis
 - Opportunistic infection in immuno-compromised individuals (pneumonia in individuals with weakened immunity including elderly, children or AIDS/ cancer patients). E.g., *Candida* and *Aspergillus* infections
- Toxins found in some molds / moulds species can be fatal e.g., aflatoxin.

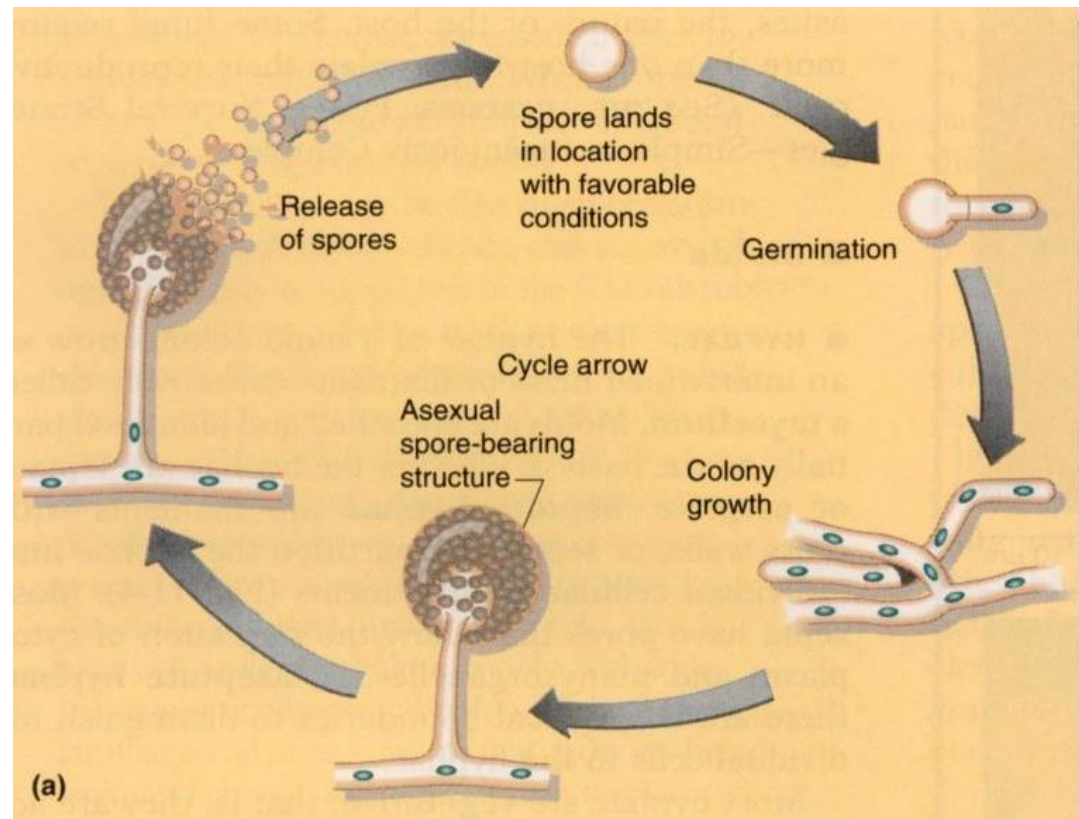
What are common human mycotic diseases?

- **Superficial infections:** fungi that attack the skin or its appendages (nail, feathers and hair). E.g., ringworms, jock-itch and athlete's foot.
- **Systemic infections:** fungi that attack vital organs and/or the nervous system. Entry into the body is usually through inhalation of spores or open wounds.
- **Intermediate infection:** The infection will occur below the skin but will remain localized. E.g., infections on tongue, commonly referred to as Thrush.



Why is it difficult to control the spread of molds / moulds?

- *Aspergillus* and *Penicillium* molds / moulds can **grow on variety of surfaces** (e.g., plastic, concrete and wood).
- Reproduction via spores ensures **easy dispersal**, therefore easier to spread around.
- Widespread dispersion of spores makes **isolation and decontamination difficult**.



What are some uses/ benefits of fungi?

- **Production of food:**

- e.g., *Cordyceps*, *Aspergillus oryzae* - soy sauce, *Saccharomyces cerevisiae* - beer, wine, bread

- **Medical uses:**

- Production of antibiotics (e.g., penicillin) for treatment of infections

- **Industrial and research uses:**

- Production of enzymes (e.g., rennin for cheese production), metabolites (e.g., plant growth stimulators for crop production)
- Model organisms for eukaryotic genetic research (e.g., *Saccharomyces cerevisiae*)

What have you learnt today?

- The fundamentals behind basic mycology
 - Define the fundamentals behind basic mycology
 - Recall that fungi are key members in the diverse microbial ecology
 - Define what differentiates fungi from other eukaryotic cells and bacteria
 - Identify what are yeasts and molds / moulds
 - Compare the similarities and differences between yeasts and molds / moulds
 - Outline and identify the gross morphology of fungi
 - List the functions of various structures in yeasts and molds / moulds
 - Define how fungi reproduce and propagate using spores
 - Relate how fungi get their nutrients

What have you learnt today?

- The role fungi plays in industry, health and disease
 - Compare how fungi can be both beneficial and harmful to humans
 - Interpret the medical implications of fungal infection
 - Outline the difficulties in controlling the spread of molds / moulds