

BIOLOGY REVIEW – CHAPTER 18 – FUNGUS

- Why are fungi important?
 - o Because they decompose waste and dead organisms – they return organic materials from that waste back to earth.
- Fungi are NOT closely related to plants based on comparison studies of plant DNA vs. fungi DNA.
- Fungi are HETEROTROPHS.
- **BASIC STRUCTURE OF FUNGI:**
 - o A fungus is made up of thread-like structures called **hyphae** (one thread is called a hypha).
 - Hyphae are tiny strands of cytoplasm surrounded by plasma membrane and covered by an outer cell wall.
 - Hyphae usually have an additional second cell wall that surrounds the first cell wall. These second cell walls are called *cross walls*.
 - Cross walls divide long hyphae into rows of cells that sit end-to-end; therefore, most fungi are multicellular.
 - Cross walls have pores that allow ribosomes, mitochondria, and nuclei to move from one cell to another. Cytoplasm can also flow through the pores, which allows food to move one part of a fungus to another.
 - o Hyphae branch as they grow. A highly branched hyphae forms a woven network called a **mycelium**.
 - The mycelium is the feeding structure of the fungus because it has a very high surface area and therefore has a lot of contact with any food sources found in soil.
 - A mycelium can grow very fast as it spreads along its food source.
 - A mycelium gets food by **absorptive nutrition**, meaning the mycelium soaks up its food from the soil.
 - How does a fungus absorb large food particles from soil?
 - o Fungal cells digest/break down food in the soil by releasing enzymes into the soil.
 - o These enzymes break down food into pieces small enough for the mycelium to absorb.
 - o Cell walls of fungi:
 - Made of chitin – this is a tough carbohydrate also found on insects' outer skeletons.
 - Plant cell walls are NOT made of chitin; they instead are composed of a different, less tough sugar called cellulose.
- **FUNCTIONS OF FUNGI:**
 - o Decompose decayed material and dead organism and return nutrients from these waste material to earth
 - o Parasitic function: fungi absorb nutrients from cells of living hosts.
 - Fungi are responsible for most plant diseases.

- **REPRODUCTION OF FUNGI:**
 - Most fungi reproduce both sexually and asexually.
 - (Note: fungi that reproduce ONLY asexually are often grouped together in a classification called the “imperfect fungi”.)
 - Fungi reproduce by releasing large numbers of microscopic spores.
 - **Spores** – haploid single cells with very thick cell walls.
 - Spread by the wind.
 - Tough cell walls can withstand bad weather.
 - When weather conditions are good/mild, a spore will grow into an adult fungus with **haploid hyphae cells**.
 - **Haploid spores can be produced asexually** by mitosis at the tip of a haploid hyphae.
 - **Haploid spores can also be produced sexually:**
 - 2 haploid hyphae from two different fungi fuse together and combine genetic material
 - The resulting diploid cell then undergoes meiosis to produce haploid spores.
 - *During fungal sexual reproduction, because two separate fungal hyphae fuse, different genetic material combines and forms the diploid cell.*
 - *Therefore, once spores are formed from that zygote, they are genetically different from one another – this allows for genetic variation in fungi.*
- Fungi are divided into groups based on their life cycles and what kind of reproductive structures they have...
- **MAJOR FUNGAL GROUPS:**
 - **1) ZYGOTE FUNGI:**
 - Usually live in soil or on decaying plant/animal
 - Has a spore forming structure called a **sporangium**.
 - Mitosis occurs within the sporangium to produce haploid cells (see above, under “haploid cells can be produced asexually”).
 - If food supply is low or weather conditions are bad, a zygote fungus can reproduce sexually.
 - 2 haploid mycelia from two separate fungi will fuse to make a thick walled structure called a **zygosporangium**.
 - Inside the zygosporangium, haploid nuclei from the two parent fungi fuse, making one diploid nucleus.
 - The zygosporangium can protect the diploid nucleus from drought or freezing conditions.
 - Once the weather is better, the diploid nucleus undergoes meiosis to make haploid spores. These spores are released and each new spore grows into new haploid hyphae.
 - Example of zygote fungus: Rhizopus (commonly found in mold form on bread)

- **2) SAC FUNGI:**
 - Live on land and in salt and fresh water.
 - Have a sac-shaped reproductive structure called an **ascus** that holds haploid spores. (First three letters of **ascus** can spell **sac**.)
 - Can reproduce sexually or asexually just as the zygote fungi do.
 - One major difference in reproduction:
 - In sexual reproduction, when two separate mycelia fuse, a dikaryotic hyphal cell is formed.
 - In a dikaryotic cell, there are two nuclei (one from each parent fungus), but they remain separate within the cell.
 - A dikaryotic cell is neither haploid (n) nor diploid ($2n$), but " $n + n$ ".
 - The dikaryotic cell will undergo mitosis to keep making exact copies of the " $n + n$ " cells, so that eventually the original dikaryotic cell has grown into a large above-ground structure called a **fruiting body**.
 - An ascus forms at the tip of a hypha within the fruiting body.
 - In the ascus, the dikaryotic nuclei finally fuse to form a true, single, diploid nucleus.
 - This diploid nucleus will undergo meiosis to form haploid spores.
 - An example of sac fungi: morels
- **3) CLUB FUNGI:**
 - Have club shaped structure called a basidium that produces spores. (**BA**sidium = **Bat** = baseball bat is like a **club** in shape).
 - **ONLY REPRODUCE SEXUALLY**
 - Mycelia of club fungi grow so rapidly that a full sized mushroom can appear in just a few hours from a spore.
 - Club mushrooms grow at the outer edge of an underground mycelium; this ring of mushrooms is sometimes called a "fairy ring" – all mushrooms in the ring are connected to the same mycelium.
 - Club fungi play a major role in decomposing wood.
 - Ex: mushrooms, rusts.
- **4) YEASTS:**
 - Yeasts are **single-celled** fungi.
 - Live in moist habitats (inside animal tissues, plant sap)
 - Reproduce asexually by mitosis or budding.
 - (Any yeast-like fungi that do reproduce sexually using an ascus or basidium are placed in the sac or club fungi groups)
 - Yeasts are used by humans to make bread dough rise and to ferment alcohol. (Yeasts perform fermentation, which releases CO_2 bubbles, allowing for bread to rise.)

- **5) MOLDS**

- **ANY** fungus that grows quickly on a surface can be called a mold. (So, the Rhizopus fungus from the zygotic fungi group can also be considered a mold.)
- Molds thrive in warm, moist environments.
- Another mold example: the sac fungus *Penicillium* – grows as mold on fruit. (*Penicillium* is also the source of the Penicillin antibiotic.)

- **IMPACT OF FUNGI ON OTHER LIFE:**

- **First, a review of symbiotic relationships:**

- The term **symbiosis** refers to *any* relationship between two organisms.
- There are three types of symbiotic relationships:
- 😊 + 😊 = **MUTUALISM** (Both organisms benefit from the relationship.)
- 😊 + 😐 = **COMMENSALISM** (One organism benefits, the other is neither helped nor harmed.)
- 😊 + 😞 = **PARASITISM** (One organism benefits, the other is harmed.)

- **Examples of symbiotic relationships with fungi and other organisms:**

- **LICHEN** – a combination of an alga (usually green alga or cyanobacterium) and a fungus (usually sac fungus)
 - Looks like a moss
 - Millions of algal cells are embedded in the mesh of fungal hyphae
 - This is a **mutualistic** relationship
 - The alga does photosynthesis and therefore provides food to the fungus.
 - The fungus provides a safe habitat for the alga and helps absorb water from the earth for the alga's use.
 - Lichens can live in places where neither fungi nor algae could survive alone (burned-out forests, arctic environments, etc.)
 - Lichens provide an important food source to other organisms.
 - Lichens cannot survive in the presence of certain air pollutants like sulfur dioxide.
 - If there is a sudden decrease in the lichen population in a given environment, it may indicate poor air quality in that environment.
- **MYCORRHIZAE** – a combination of fungus and plant in a **mutualistic** pairing.
 - The fungi absorb water to give to the plants.
 - The plant produces food to nourish the fungus.
 - *Almost all plants have mycorrhizae as part of their structure!*
- **DISEASE CAUSING FUNGI:** Relationship between host cell (human, plant, etc.) and fungus that is **parasitic**.
 - The fungus gets shelter and nutrition from the host but the host is harmed.
 - 30% of all fungi are parasites, mostly using plants as hosts.

- Dutch Elm Disease is caused by fungi.
- Human infections caused by fungi: yeast infections on skin, in lungs, ringworm (ringworm on feet = athlete's foot)

- **COMMERCIAL USES OF FUNGI:**

- Edible
- Used to ripen cheese
- Used in bread and alcohol production

- **ROLE OF FUNGI IN CHEMICAL CYCLING:**

- Along with bacteria, fungi are decomposers that supply the soil with nutrients required for plant growth.
 - Fungi break down dead organisms and return carbon and nitrogen from the dead organisms back to the soil for easy plant access.
- Fungi are responsible for destroying major portions of the worldwide fruit harvest each year.
- Fungi digest not just wood in nature, but the wood of homes, boats, etc.