

Fungi Lecture Outline

Written by Miranda Dudzik, for LBCC iLearn BI 101

*Number in outline corresponds to slide number the PowerPoint presentation.

1. The Diversity of Fungi
2. Diverse Lifestyles
 - a. The Fungi kingdom consists of diverse lifestyles, shapes and forms. Most fungi are decomposers, but some can be classified as parasites, and others form important mutualistic relationships with other organisms.
3. Key Features of the Fungi Kingdom
 - a. Fungi, to the uninformed are often believed to be a plant. But fungi are vastly different than their photosynthetic cousins. Fungi are eukaryotic, but that is about where the similarities end. Unlike plants, fungi are not photosynthetic and are classified as heterotrophs.
 - b. Additionally all fungi digest (or break down into simpler forms) their food outside their body before absorbing nutrients and reproduce using spores. There is quite a diverse array of fungi species, although when you think of a fungus, you most likely think of a mushroom.
 - c. But in reality, the structure that is known as a mushroom is only a small portion of the body of some fungi, and temporary at that. Most species of fungi don't even produce mushrooms! The majority of any fungus body consists of a complex mass of filaments known as mycelium.
4. The Mycelium
 - a. The mycelium is made up of cells known as hyphae, and are divided by porous spaces called septae. These cells are surrounded by an extra cell wall that animal cells don't have. The mycelium gives the fungus several distinct advantages. First of all, it facilitates a very high surface to volume ratio. What that means essentially is that there is a lot of surface contained in a small amount of space. And all of that surface area means the organism can maximize the amount of nutrients it can absorb at one time.
 - b. The structure and rigidity of the hyphae cells that grow into the substrate the fungus is growing on are strengthened by a cell wall that is made up of a substance known as chitin, a substance also found in the exoskeleton of arthropods such as lobsters and insects.
 - c. All fungi secrete digestive enzymes, known as exozymes, outside their body to digest organic material in their surroundings. Once digested into small inorganic molecules, the fungus absorbs these nutrients directly into its hyphae cells.
5. Reproductive Structures
 - a. For those species of fungi that do produce mushrooms, that structure is known as the fruiting body. It only appears during the reproductive phase of the fungus' lifecycle and is an extension of the mycelium. For species that do not produce a fruiting body, mold for instance, develop tiny structures called sporangia that produce and release reproductive spores.
 - b. The black or green fuzzy appearance of the mold we all know and love is the result of the development of sporangia. But again, these structures are only present when reproducing. The majority of the body, is growing into the substrate and the part that can't always be seen with the naked eye.
6. Fungal spores
 - a. All fungi reproduce using spores and the structures that produce these spores are used in part to classify the different phyla in the fungi kingdom. Fungal spores are extremely resistant to harsh conditions and are capable of remaining dormant for a very long time, laying in wait for conditions to improve.
 - b. Fungi are quite prolific in their reproductive strategy. One specimen, such as the one pictured here, can release literally billions of spores into the environment in one reproductive event.

7. Positive Contributions

- a. There are dozens of positive contributions to humanity. We use fungi in cheese making, brewing beer and baking bread, and use many species of mushroom as a direct food source. Fungi also gave us penicillin, an important part of the medical advancements made in the last 100 years.

8. Negative Aspects

- a. But there are lots of negative contributions as well. Diseases and infections such as athlete's foot and ringworm are fungal diseases, and for some people who are immune-compromised (HIV patients and burn victims) can potentially die from seemingly harmless fungal infections.
- b. We've learned earlier in the course that fungi are responsible in part for the alarming decline in amphibian species worldwide, and some fungi produce toxins.
- c. Fun fact to share at parties: It is now widely believed that the witch hunts in the late 1600's was caused by a toxin produced by a species of fungus that infects rye grains. The toxin, which LSD is derived from, caused the wild and erratic behaviors that were attributed to the practice of witchcraft. The mushrooms consumed recreationally have similar toxins that are associated with the hallucinogenic properties of these drugs. So essentially, you are poisoning yourself when you take shrooms!

9. Evolutionary Tree

- a. There are five major phyla of fungi that you will be exploring in this module's supplemental activity, so we will not spend any time with the lecture presentation covering the aspects. I will instead just share a couple of pertinent facts, such as pronunciation and leave the rest for you to discover on your own. This phylogeny gives you the basic time line of the emergence of each phylum. Remember as you explore each of these phyla that fungi identified in each based on the way they reproduce and the types of structures that produce spores. You will not be required to know the details of each group's reproductive cycle, only the main reproductive structures already discussed.
 - 1) Phylum Chytridiomycota are the most ancestral phylum, and are distinguished from other phyla because they live mostly in aquatic habitats and have flagellated spores that allow it to propel itself through the water.
 - 2) Phylum Zygomycetes reproduce using sporangia (no fruiting body) and most can be found living in the soil. While most zygomycetes are important decomposers, bread and fool molds that plague humanity fall into this phylum.
 - 3) Phylum Glomeromycetes are very ecologically important. This group lives almost exclusively in close association with plant roots and forms a symbiotic relationship known as mycorrhizae. This relationship will be described in more detail later in the lecture.
 - 4) Phylum Basidiomycetes are most likely what you think of as a mushroom. The majority of edible fungi come from this group and produce spores in gills found on the underside of the cap on the fruiting body.
 - 5) And finally phylum Ascomycetes. This group also produces fruiting bodies, but instead of producing spores in gill found under a cap, they are produced in cells called asci. It is this group of fungi that contain yeast, used in baking and brewing, produce penicillin, and are responsible for athlete's foot and yeast infections. Highly prized edible fungi such as truffles and morels also are found in this group.

10. Fungal Symbiosis

- a. There are two types of symbiotic relationships that fungi participate in, both are very ecologically important. One has been discussed on several occasions in previous modules, that being lichen. The other relationship is mycorrhizae.

11. Lichen: A Composite Organism

- a. Let's talk about lichen first, since it has already been mentioned so many times over the course of the term. Lichen is known as a composite organism, or a mutualistic relationship between a fungus species and a photosynthetic microorganism. The fungal component, known as a mycobiont, is typically an ascomycetes species and makes up the bulk of the lichen. The photosynthetic organism, or photobiont, is either green algae or cyanobacteria.

12. Lichen Cross Section

- a. The two bionts work together to gain energy and nutrients from the environment. The fungi bring nutrients it digests in its surroundings and the photobiont brings energy produced through photosynthesis. Both bionts can technically survive without the other, but life is much easier for both when they work together. Lichen typically reproduces simply by breaking fragments off of its body that get dispersed via wind or hitchhiking on animals.

13. Ecological Roles of Lichens

- a. As we have already learned, lichen are a wildly successful pioneer species, and now we know why. The lifestyle of each component makes it capable of obtaining nutrients from habitats that have very little available. Lichen are however fairly sensitive to environmental pollution because it is capable of absorbing toxins but no mechanisms in place to get rid of them. Often times the presence or absence of lichen in a habitat act as an early warning system for toxic substances and pollution.

14. Mycorrhizae

- a. Mycorrhiza (not to be confused with mycelium!) is a mutualistic relationship between plant roots and species classified as Glomeromycetes. The fungus grows in very close association with plant roots, oftentimes actually growing inside root cells.
- b. The decomposing action of the fungus liberates nutrients in the soil around the root system, and meanwhile the plant root shares sugars with the fungus that were produced in its leaves through photosynthesis. Some plants don't grow well at all without this relationship, and in fact it is believed that mycorrhizae played an important role in the invasion of land by the plant kingdom.