There is a fungus among us!

Major fungi groups

What do you think of when you hear the word "fungus"? Much like with bacteria, we often take a negative view of these guys! At best, we might think of the mushrooms on our favorite pizza. However, the kingdom of the fungi is much more varied and interesting (even if you're really fond of pizza with mushrooms!)

Fungi are a diverse bunch, comprised of six major groups:

- Yeasts
- Zygomycetes
- Ascomycetes
- Basidiomycetes
- Fungi-imperfecti
- Lichens

All fungi are eukaryotic and heterotrophic, with external digestion. Most fungi are multicellular. The fungal body is composed of **hyphae** (filaments), and some with groups of hyphae matted together to form a structure called a **mycelium**. Let's take a look at the fungi in a new light.

Yeasts

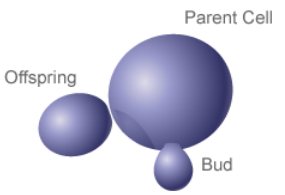
Yeasts are some of the simplest eukaryotic organisms on the planet. They are typically little more than single cells floating about the environment. Yeasts usually reproduce via a specific process called **budding**. A single cell simply produces a second cell by "budding" it.

This straightforward method of producing an individual cell without sex is also known as **asexual reproduction**. Millions of cells are produced with no true variation in genetics. This may be great for "strength in numbers", but it's not the best situation for adaptation to the environment. If you recall from first section of this two-part course, variability is the raw material of natural selection.

We can't discuss yeasts without mentioning what we use them for! You may know that yeast is instrumental in the production of bread and cheese, in addition to such things as beer, wine and other forms of alcohol. Of the six groups of fungi, yeasts are by far the most exploited by humans.

Budding

Yeast cells reproduce by budding, similar to a bud forming on the branch of a tree and then falling off. During budding, part of the yeast cell pinches itself off to produce small offspring.



Zygomycetes

Next, we have the zygomycetes, commonly referred to as "bread molds". Of course, *you'd* never let a loaf of bread go bad, but maybe you know someone who has! The mold was likely due to a member of the zygomycetes. That white fuzzy stuff that soon turns black is actually the spores reaching maturity – quickly working to spread the fungus to another unsuspecting loaf.

The zygomycetes are so-named based on when meiosis takes place in their lifecycle. As you may recollect, meiosis produces gametes in animals and spores in plants. Meiosis occurs in the zygote of the zygomycetes just after fertilization has produced it. Thus, the zygote is the only diploid cell in the zygomycete lifecycle.

Ascomycetes

Our next group of fungus is called the ascomycetes. "Asco" means "sac". Where might we find a sac in these guys? The sac (**ascus**) is where the spores of sexual preproduction are housed. Ascomycetes don't produce the typical "mushroom" that people equate to fungi. Generally, they form a gelatinous body that is often cup-shaped. This is useful, since the spores are water dispersed.

Think of the ascomycetes the next time you're eating sweet and sour soup at your favorite Chinese restaurant. The long, brown-black strips are part of an ascomycete. And for those of you who have tried the Morel mushroom –you're already familiar with one of the most "mushroom-looking" ascomycetes!

Basidiomycetes

The basidiomycetes are without a doubt the most common and most recognizable of the fungi. They produce the mushrooms that we all know and love. Similar to the ascomycetes, the basidiomycetes are so-called due to the structure that houses the spores. "Basidio" means "club".

The spores of Basidiomycetes are borne on microscopic club-shaped structures. Take note that the spores are borne on and not in the structure. This is a fundamental difference between the two groups. The spores are bone **in** sacs of the ascomycetes, while spores are borne **on** the basidia of basidiomycetes.

It is important to keep in mind that these mushrooms form only one part of the fungus structure. Biologists refer to mushrooms as **fruiting bodies**. They are the parts of the fungus that release spores into the environment for dispersal. In fact, the structures include a complete mycelium in addition to the fruiting body. One analogy would be that the mushroom is like an apple on an apple tree.

Here's something for you to digest: a certain fungus has been dubbed the largest organism on the face of the Earth. The entire fungal body is about fifteen miles across!

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Fungi-imperfecti

The name fungi-imperfecti suggests that these guys are missing something. In fact, they are lacking sexual reproduction in their lifecycle! In some cases, we had not been able to document sex and therefore labeled the specimen as being fungi-imperfecti. However, we later found out that it did occur after all! Imperfect fungi move about by producing asexual spores (sounds like the yeasts and zygomycetes, huh?)

These guys are what we commonly refer to as the "molds". When you went to eat that orange at your friend's house and stopped because of the green fuzz growing on it, that was a common mold! The spores produced by the molds are called **conidia** (a term to signify that they are the product of asexual reproduction).

Penicillium is a very common genus of imperfect fungi (it was most probably the green on the orange). You probably know a derivation of this term penicillin, a common antibiotic that you may or may not be able to take that was originally produced from the fungus.

Lichens

The last group of fungi is one of the most intriguing. Lichens are unique in the organismal world because they are actually a composite organism. What's a **composite organism**? It's an organism that is composed of two separate organisms. In the case of the lichens, there is a fungus and an **alga** (a member of the Protista) that make up the lichen body. Each serves a specific purpose:

- **Algae** are photosynthetic, and hence, the primary producers.
- **Fungal hyphae** provide the structure to the lichen body and protection for the fragile algal cells. This association is so well-developed that the fungus and algae may not be able to survive outside of the lichen body.

Lichens may be **foliose** (leaf-like), **fruiticose** (stem-like branches) or **crustose** (crust-forming). The lichens are capable of growing on such things as bare rock. In fact, they are able to break down rock into soil particles, due to the excretion of acids that destroy the rock. The lichens are some of the first organisms to colonize bare rock. They grow on soil, tree bark, leaves and many other substrates as well.

Lichens are also some of the best pollution indicators on this planet. This means that they are among the first kinds of life to leave an area if pollution levels become too high. This leads us to our last topic: fungi and the environment.

Lichens

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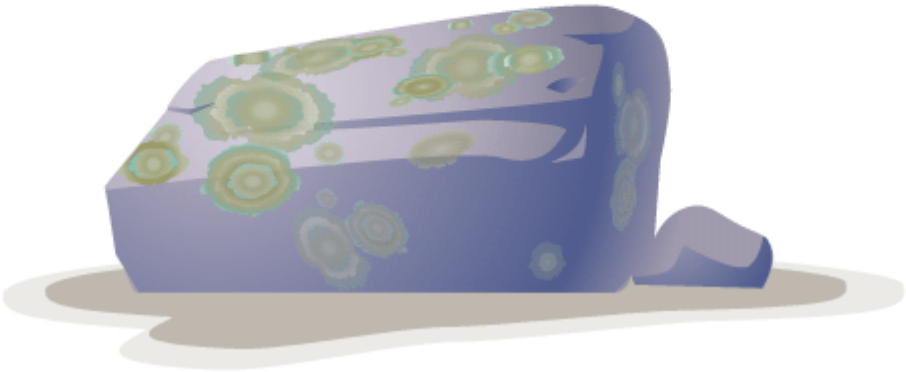


Fungi and the environment

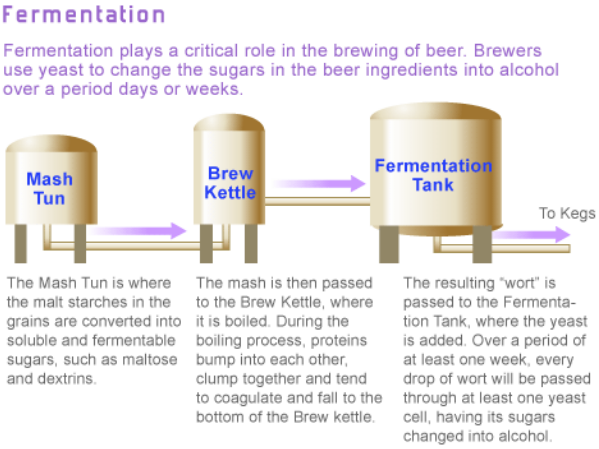
Like the bacteria, many fungi are involved in decomposition of the earth's wastes. When a fish goes bad, we are actually smelling the byproducts of the bacteria. While we cringe at the smell, the fungi sneak in and quietly digest the fish away (and they tend not to smell as bad!)

Fungi also break down the things that the bacteria do not, or cannot, touch. The next time you pass a rotten log, think of the fungi – they are helping the wood to decay. And fungi are not just decomposers, they are also fermenters.

Fermentation

Fermentation is one process that we utilize in many different forms. For example, many things are products of fermentation, such as alcohol, turpentine, cheese, bread – even chocolate. Fermentation naturally occurs in the absence of oxygen. If the layers of decomposing stuff get too deep, the lowest levels will not have any oxygen available. Therefore, it's a good thing the fungi and bacteria can "keep on trucking" when there is no oxygen in the vicinity!

Certain plants rely on fungi to survive. Many trees depend on fungi to help with water absorption and nutrient uptake. Fungi are in close association with the roots of these trees, either growing around the roots or inside the root tissue. This allows them to take in the extra water and nutrients – acting like a super-absorbent paper towel! During bulk tree plantings, it's common practice to add a fungal culture (either a liquid dip or powder) to promote early seedling growth and establishment.



Fungi and the environment (Continued)

Some of the root-associate fungi are prized as delicacies. Truffles are a group of fungi that typically grow in association with oak roots. We have trained both pigs and dogs to "sniff" out these tasty morsels, which sell for a premium.

Effects of mold and rot

We use many fungi to our advantage, but some forms cause an opposite effect on the economy each year. We lose millions of dollars in crops due to "mold and rot" before they can be processed into foodstuffs. We also lose millions due to spoilage after the raw materials are treated. Remember that moldy bread? How about that long-forgotten container of what used to be chicken noodle soup?

Consider that we are talking about biology – there is often good in the bad. The good old green mold gave us penicillin. And we've developed other drugs from fungi, including other antibiotics and hormone treatments.

As you can see, the fungi are major decomposers and they serve many other equally important roles in the world around us!