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## Fungi



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### Introduction

The word fungus usually evokes images of mushrooms and toadstools. Although mushrooms are fungi, the forms that a fungus may take are varied. There are over 100,000 species of described fungi and probably over 200,000 undescribed.

Most fungi are terrestrial, but they can be found in every habitat worldwide, including marine (500 spp.) and freshwater environments. Fungi are nonmotile, filamentous eukaryotes that lack plastids and photosynthetic pigments. The majority of fungi are saprophytes; they obtain nutrients from dead organic matter. Other fungi survive as parasitic decomposers, absorbing their food, in solution, through their cell walls.

Most fungi live on the substrate upon which they feed. Numerous hyphae penetrate the wood, cheese, soil, or flesh in which they are growing. The hyphae secrete digestive enzymes that break down the substrate, enabling the fungus to absorb the nutrients contained within the substrate. There are four major groups of fungi: Zygomycota, Ascomycota (sac fungi), Basidiomycota (club fungi), and Deuteromycota (fungi imperfecti).

## **Zygomycota**

The fungal group Zygomycota is most frequently encountered as common bread molds, although both freshwater and marine species exist. Most of these live on decaying plant and animal matter found on the substrate. Aquatic species are primarily found in sediments or on algae, but some species are also free floating. A few are found attached to aquatic animals or on decaying leaves. Some are parasites of plants, insects, or small soil animals, while others cause serious infections in humans and domestic animals. They are usually recognized by their profuse, rapidly growing hyphae, but some exhibit a unicellular, yeast-like form of growth. Asexual reproduction is by means of spores produced in sporangia borne on the hyphae. Zygomycota get their name from the production of thick-walled sexual structures called zygosporangia, which can remain dormant for long periods.

## **Ascomycota**

The Ascomycota comprise about 30,000 described species, among them most of the blue-green, red, and brown molds that cause food spoilage, including the salmon-colored bread mold. Ascomycetes are the causes of a number of serious plant diseases, like Dutch elm disease, but the group also includes edible morels and truffles. This group is also comprised of the yeasts used in the production of beer, wine and bread. With the exception of unicellular yeasts, the Ascomycetes are filamentous during development and their hyphae are septate (divided into cells). Reproduction is usually by the formation of specialized spores, called conidia, borne at the tips of hyphae in specialized structures (conidiophores). Aquatic fungi in this group are predominantly found on submerged wood, but others are free floating or found on sediments and algae.

## **Basidiomycota**

The fungal group Basidiomycota, also known as the club fungi, includes some of the most familiar fungi. Within this group of 16,000 species are the mushrooms, toadstools, shelf fungi, and puffballs. Basidiomycetes play a key role in the environment as decomposers of plant litter. They are distinguished from other fungi by their production of basidiospores, which are borne outside a club-shaped, spore-producing structure called a basidium. This group is poorly represented in the aquatic environment. There are very few species of freshwater species known and the majority of marine species are free-floating with a couple of lignicolous (found on wood) species.

## **Deuteromycota**

The Deuteromycota, or conidial fungi, are a group of about 17,000 distinct species in which the sexual reproductive features are either not known or are not used to classify them. Their lack of sexual stages was the basis for them being called fungi imperfecti in the past. The term fungi imperfecti was misleading because these fungi are abundant and flourishing. Most Deuteromycota have only asexual reproduction as the sexual stage of the life cycle has been lost or has yet to be discovered. There are a great number of human uses for these fungi; most significant is the production of antibiotics for medicinal use. These substances are produced by the fungus to inhibit the growth of other living organisms around them—in particular, disease-causing bacteria. These substances are extracted from the fungus and are used to kill bacteria in the human body.

## **Morphology**

The majority of fungi are unicellular or filamentous: as fungi grow they produce an intertwined mass of delicate threads that branch freely and often fuse together. Fungal forms vary: the most commonly known are mushroom-like in appearance or form spongy, creeping growths. The individual, tubular threads are called hyphae, while a mass of threads is called a mycelium. Structures like mushrooms consist of a great many filaments packed tightly together. The surface-to-volume ratio of fungus is very high, ensuring that much of the fungus is in intimate contact with its environment and no part is more than a few micrometers away. Specialized hyphae, known as rhizoids, anchor some forms of fungus to the substrate. Parasitic fungi have similar specialized hyphae known as haustoria, which function in nutrient absorption (from the cells of other organisms) while anchoring the fungus. Fungi are nonmotile and lack flagella or cilia, dispersal throughout the environment occurring during reproduction.

## **Reproduction**

Fungus can reproduce either sexually or asexually. Reproductive structures of fungi are called gametangia if they are directly involved in the production of gametes, and sporangia if they are involved in the production of asexual spores. The asexual phase of the life cycle is known as the anamorph, while the sexual stage of the fungus is known as the teleomorph. Sexual reproduction involves the union of two compatible fungal nuclei followed by meiotic division. Nonmotile spores are the characteristic agents of fungal reproduction and are typically dry and very small. This enables them to remain floating in the air for long periods of time, thus increasing their chances of being carried to great heights and distances by air currents. Other spores are slimy and stick to the bodies of arthropods, like insects, to aid in their dispersal. Some spores are fired off in a sporangium and may travel distances of up to 2 meters, which is a huge distance considering the sporangia are only 80 micrometers in diameter.

## **Importance**

Fungi, together with bacteria, are decomposers, and their activities are necessary for the continued existence of the biosphere. Decomposition releases carbon dioxide into the atmosphere and returns nitrogenous compounds to the soil where they can be recycled by plants and eventually animals. Since fungi are decomposers, they often come in conflict with human interests and are considered a nuisance, in some cases, a destructive hazard. Fungus can break down human-made wooden structures with their powerful enzymes as well as many other substances (e.g., cloth, paint, leather, petroleum, and wires). Bread, fresh fruits, vegetables, and meat are particularly susceptible to fungal attack reducing nutritional value and palatability. Fungus may also produce toxins such as aflatoxin, which is highly carcinogenic and severely affects humans even when minute amounts are consumed.

Certain fungal yeasts are useful because they produce substances such as ethanol or carbon dioxide that play a key role in the brewing, baking, and wine-making industries. Fungi are also important in producing many kinds of medicines. The most important of these are antibiotics, like penicillin, which is used to kill bacterial infections.

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