Name_____ Class_____ Date _____

Summary

21–1 The Kingdom Fungi

Fungi are eukaryotic heterotrophs that have cell walls. The cell walls of fungi are made up of chitin, a complex carbohydrate. Fungi do not ingest their food, as animals do. Instead, fungi digest food outside their bodies and then absorb it. Many fungi feed by absorbing nutrients from decaying matter. Some fungi are parasites.

All fungi except for yeasts are multicellular. Multicellular fungi are composed of thin filaments called hyphae. Each hypha is only one cell thick. The bodies of multicellular fungi are composed of many hyphae tangled together into a thick mass called a mycelium. The fruiting body of a fungus—such as the above-ground part of a mushroom—is a reproductive structure growing from the mycelium in the soil beneath it.

Most fungi reproduce both asexually and sexually. Asexual reproduction can occur when cells or hyphae break off and begin to grow on their own. Some fungi also produce spores. In some fungi, spores are produced in structures called sporangia. Sporangia are found at the tips of hyphae called sporangiophores. Sexual reproduction in fungi usually involves two different mating types.

Spores of fungi are found in almost every environment. Many fungi produce dry, almost weightless spores that are easily scattered in the wind.

21–2 Classification of Fungi

The four main groups of fungi are the common molds (phylum Zygomycota), the sac fungi (phylum Ascomycota), the club fungi (phylum Basidiomycota), and the imperfect fungi (Deuteromycota).

The common molds—zygomycetes—grow on meat, cheese, and bread. Zygomycetes have a life cycle that includes a zygospore. A zygospore is a resting spore that contains zygotes formed during the sexual phase of the mold's life cycle. The zygomycetes include the black bread mold, *Rhizopus stolonifer.* Black bread mold has two different kinds of hyphae. The root-like hyphae that penetrate the bread's surface are rhizoids. The stemlike hyphae that run along the surface of bread are stolons. During the sexual phase in the bread mold, hyphae from different mating types fuse to produce gamete-forming structures called gametangia.

Sac fungi—ascomycetes—have a reproductive structure called an ascus, which contains spores. Sac fungi include the large cup fungi as well as the unicellular yeasts. The life cycle of an ascomycete includes both asexual and sexual reproduction. In asexual reproduction, tiny spores called conidia form at the tips of specialized hyphae called conidiophores. In sexual reproduction, haploid hyphae from two different mating types (+ and −) grow close together and produce a fruiting body. An ascus forms within the fruiting body. Two nuclei of different mating types fuse within the ascus to form a diploid zygote. Yeasts are unicellular fungi. Yeasts are used by humans for baking and brewing. The process of asexual reproduction in yeasts is called budding.

The club fungi—basidiomycetes—have a specialized reproductive structure that resembles a club. The cap of the fruiting body of a basidiomycete—such as the familiar mushroom—is composed of tightly packed hyphae. The lower side of the cap is composed of gills, which are thin blades of tissue lined with basidia. A basidium is a spore-bearing structure. Two nuclei in each basidium fuse to form a diploid zygote cell. The zygote cell undergoes meiosis, forming clusters of spores called basidiospores. A single mushroom can produce billions of basidiospores. Club fungi include mushrooms, shelf fungi, and puffballs. Many types of fungi can be eaten, but many others are poisonous.

The imperfect fungi—deuteromycetes—include those fungi that are not placed in other phyla because researchers have never been able to observe a sexual phase in their life cycles. Most imperfect fungi look like ascomycetes, though others are similar to basidiomycetes or zygomycetes. An example of an imperfect fungus is *Penicillium notatum,* a mold that grows on fruit. It is the source of the antibiotic penicillin.

21–3 Ecology of Fungi

All fungi are heterotrophs. Many fungi are saprobes, which are organisms that obtain food from decaying organic matter. Others are parasites, and still others live in symbiosis with other species.

Fungi play an essential role in maintaining equilibrium in nearly every ecosystem. Fungi do this by recycling nutrients as they break down the bodies and wastes of other organisms. Many fungi feed by releasing digestive enzymes that break down organic material into simple molecules. Fungi food includes wastes and dead organisms. In breaking down this material, fungi promote the recycling of nutrients and essential chemicals. Without such decomposers, the energy-rich compounds that organisms accumulate would be lost forever.

Parasitic fungi cause serious plant and animal diseases. A few cause diseases in humans. Fungal diseases in plants include corn smut and wheat rust. Fungal diseases in humans include athlete's foot and ringworm, thrush, and yeast infections of the female reproductive tract.

Some fungi form symbiotic relationships in which both partners benefit, such as lichens and mycorrhizae. Lichens are not single organisms. Rather, lichens are symbiotic associations between a fungus and a photosynthetic organism. The photosynthetic organism in a lichen is either a green alga or a cyanobacterium, or both. The algae or cyanobacterium provides the fungus with a source of energy by carrying out photosynthesis. The fungus, in turn, provides the photosynthetic organism with water and minerals. The fungus also shades the alga or cyanobacterium from intense sunlight.

Mutualistic associations of plant roots and fungi are called mycorrhizae. The plant's roots are woven into a partnership with the web of fungal hyphae. The hyphae of fungi aid plants in absorbing water and minerals. In addition, the fungi release enzymes that free nutrients from the soil. The plants, in turn, provide the fungi with the products of photosynthesis. The presence of mycorrhizae is essential for the growth of many plants. Mycorrhizal associations were an adaptation that was critical in the evolution of plants.