

Chapt. 31 – Fungi

Fungal Form and Function

Anatomy [See Fig. 31.2]

Hyphae- thread-like filaments, one cell thick

Mycelium – interwoven mass of **hyphae**

Reproductive structure or fruiting body

Septate hypha vs. **Aseptate hypha** (a.k.a. **coenocytic**) [See Fig. 31.3]

Cell walls contain **chitin**

Immobile adults

Unlike plants and animals, no distinct **embryo** is formed during early development

Nutrition

Chemoheterotrophic

Fungi exude **exoenzymes** that break down organic molecules that the fungi can absorb and use as a supply of both energy and carbon

Saprobic – if they digest dead organisms and waste products

Parasitic – if they digest live organisms

Mutualistically symbiotic – if they form associations with other organisms for mutual benefit

Fungal Life Cycles

Three **ploidy** types

Haploid – most fungal hyphae and all spores have haploid nuclei

Diploid – diploid nuclei are found transiently during the sexual phase (if present)

Heterokaryon – unfused nuclei from different parents occupying the same unit of hypha

Reproduction [See Fig. 31.5]

Asexual – default mode under stable conditions; spores are produced

Haploid (1n) spores are produced by **mitosis**

Spores are genetically identical to original **mycelium**

Spores disperse and germinate to produce new **mycelium**

Sexual – usually only under stressful conditions; spores are produced; many mating types possible (essentially like having many different sexes or genders)

Sexual reproduction in fungi

Fusion of compatible **hyphae** (**plasmogamy**)

Fusion of **nuclei** (**karyogamy**)

Meiosis of “**zygote-like**” structures

Dispersal of **spores**

Haploid spores may disperse long distances away from the **fruiting body**

Sexual reproduction in fungi (once again)

Fusion of compatible **hyphae (plasmogamy)**

... initiates a **heterokaryotic phase**

Fusion of nuclei (karyogamy)

... initiates a **zygotic phase**

... which is perhaps best described as **“zygote like”**

Meiosis in **“zygote-like”** cells produces **spores** or cells that will produce spores

Both asexual & sexual reproduction produce **haploid spores**

Fungal Diversity [See Fig. 31.9]

Over 100,000 species described

Over 1000 additional species described each year

5 phyla

Classification of Fungi

Chytrids

Ancient group – diverged earliest from the other fungi

Aquatic – the only fungi with **flagellated spores (zoospores)**

Saprobic – majority

Parasitic – some

Zygomycetes = Zygote fungi [See Fig. 31.12]

Sexual reproduction via **zygosporangia** (resistant **heterokaryons**) that produce genetically variable **spores**

Asexual reproduction via **sporangia** that produce **spores**

Mostly **saprobic** decayers of organic matter, *e.g.*, soft fruit rot fungi and black bread mold

Some parasites, *e.g.*, single-celled **microsporidia**

Glomeromycetes = Arbuscular mycorrhizae

Associated with ~90% of plant species

Ascomycetes = Sac fungi [See Fig. 31.17]

Sexual reproduction via **spores** produced in **asci** (sac-like cases)

Asexual reproduction via naked **spores (conidia)**

Many **saprobic** species, *e.g.*, Scarlet cups

Many **parasites**, especially of plants, but also of animals, *e.g.*, *Candida* yeasts

Many **symbionts** with plants, *e.g.*, truffles

Morels – Delicacy or deadly

Sources of many interesting chemicals

E.g., *Penicillium* – the source of penicillin

E.g., the source of LSD

The yeasts used to brew beer...

...and bake breads and pizza crusts

...but the mushrooms that top your pizza come from a different phylum...

Basidiomycetes = Club fungi [See Fig. 31.20]

Include: common mushroom, puffballs, stink horns, shelf fungi, plant-parasitic smuts & rusts

Sexual reproduction via club-shaped reproductive structures, **basidia**, containing

basidiospores

Asexual reproduction is uncommon

Basidia are generally found on the surface of **gills**

Deuteromycetes = Imperfect Fungi

Eclectic group of currently unclassified species

Sexual structures unknown (*i.e.*, no **flagellated spores**, **zygosporangia**, **asci**, or **basidia** [See **Table 31.1**]), so these haven't been classified

Includes many **molds** and **mildews** (which demonstrates that certain commonly recognized "groups" are not good phylogenetic groups)

Functional Biology of Fungi

Molds

Many rapidly growing, asexually reproducing fungi (mostly ascomycetes and basidiomycetes)

Ecosystems on Earth would collapse without the molds and mildews (plus many bacteria) that break down organic matter into inorganic nutrients

Yeasts

Many unicellular fungi that inhabit liquid or moist surfaces and reproduce asexually
Occur in the Ascomycetes, Basidiomycetes & Zygomycetes
Free-living, parasitic, and mutualistic symbiotic forms exist

Mycorrhizae

Symbiotic associations with plants (representatives known from all fungal phyla, not just
Glomeromycetes)

Lichens

Obligate symbiotic associations with algae or cyanobacteria

Parasites

E.g., Ringworm and Chestnut blight

Toxin producers

E.g., Aflatoxin

Biotic control agents

E.g., the first antibiotic used by humans

E.g., used against termites, rice weevils, *etc.*

Interesting example... of agriculture in insects

Leaf-cutter ants cut and carry leaf fragments to their nests where the fragments are used
to farm fungi

Interesting example... of fungal cowboys

Some soil fungi snare nematode worms in hyphal nooses and then digest them

Interesting example... of fungi & conservation

The golden toad became extinct within the past 20 years, owing to anthropogenic
environmental deterioration, which also facilitated pathogenic chytrid fungi