

**Reference Guide to the Classification of Fungi and Fungal-like Protists,
with Emphasis on the Genera with Medical Importance (circa 2007)**

This outline lists some common genera of fungi and fungal-like protists, which are classified into a number of phyla, classes, and in most cases orders and families. The classification is patterned after the broad schemes of Margulis and Schwartz (1) Hawksworth et al. (2), Eriksson et al. (5), Alexopoulos et al. (7), and Lutzoni et al. (8) and was devised by PJS to reflect his perception of the relationships of the various organisms traditionally studied by mycologists and included in textbooks and manuals dealing with mycology. The classification ranks below class reflect interpretations of Koch (3), Hanlin and Ulloa (4), Alexopoulos et al. (7), and Hawksworth et al. (2). It should be noted that different biologists until recently have had varying opinions on which organisms to include in the Kingdom Fungi and on what rank should be accorded each major group. This classification outline distributes the fungi and fungal-like organisms often dealt with in mycology among the three kingdoms, Protozoa, Chromista and Fungi. With only a relatively few exceptions, the genera listed are very common or are of medical importance. However, not all genera of the Kingdom Fungi involved in human and animal medical mycology are listed.

Kingdom: Protozoa/Amebozoa/Eumycetozoa (collection of numerous phyla of eukaryotic, generally wall-less, unicellular, plasmodial, or colonial phagotrophic microorganisms, which includes at least four fungal-like phyla that are no longer considered to be part of the Kingdom Fungi). These have all been reclassified and renamed to reflect their nonfungal nature (see for example Reading Sz 5 which discusses the reclassification of *Rhinosporidium seeberi* into the additional new Phylum Mezymycetozoea).

Phylum: Acrasiomycota (acacid cellular slime molds)

Phylum: Dictyosteliomycota (cellular or social slime molds)

Phylum: Myxomycota (plasmodial or true slime molds)

Phylum: Plasmodiophoromycota (endoparasitic plasmodial water molds)

Phylum: Labyrinthulomycota (net slime molds)

Kingdom: Chromista/Stramenopiles/Chromalveolata (collection of eukaryotic walled microorganisms that produce heterokont wallless cells in their life cycles, and which includes two fungal-like groups that are not currently considered to be monophyletic ancestors of any members of the Kingdom Fungi).

Phylum: Hyphochytridiomycota (hyphochytrids)

Phylum: Oomycota (egg-bearing aquatic phycomycetes) or Peronomycota

Class: Oomycetes/Peronosporomycetes

Order: Peronosporales (damping-off fungi, white rusts, downy mildews)

Family: Pythiaceae

Pythium insidiosum (agent of swamp cancer of horses and pythiosis in man)

Kingdom: Fungi (collection of eukaryotic walled microorganisms, which includes four or five Phyla that are mostly amastigote [lack undulopodia (eukaryotic flagella) except for the Chytridiomycota] and usually form walled spores during their life cycle)

Subkingdom: Mastigomycotera (flagellate sporangial fungi, flagellate lower fungi, flagellate phycomycetes; aquatic phycomycetes)

Phylum: Chytridiomycota (chytrids, posteriorly uniflagellate fungi)

Class: Chytridiomycetes (3-5 orders)

Order: Chytridiales (also Blastocladales, Monoblepharidales, Spizellomycetales, Neocallimasticales)

Family: unnamed

Batrachochytridium (newly described genus for agents of chytridiomycosis of amphibians)

Subkingdom: Amastigomycotera (nonflagellate sporangial fungi, nonflagellate lower fungi, nonflagellate phycomycetes; nonaquatic phycomycetes)

Phylum: Zygomycota (nonaquatic phycomycetes, spore-forming sporangial fungi)

Class: Zygomycetes

Order: Mucorales (mucors, black bread molds; many agents of zygomycosis)

Family: Mucoraceae

Absidia

Mucor
Rhizopus
 Family: Pilobolaceae
Pilobolus
 Family: Coanophthoraceae
Cokeromyces
 Family: Cunninghamellaceae
Cunninghamella
 Family: Mortierellaceae
Mortierella
 Family: Saksenaeaceae
Saksenaea
 Order: Entomophthorales (many pathogens of insects)
 Family: Entomophthoraceae
Conidiobolus
 Family: Basidiobolaceae
Basidiobolus
Class: Trichomycetes
Phylum: Glomeromycota (the endomycorrhizal fungi)⁸
Class: Glomeromycetes
 Order: Glomerales
Glomus
Subkingdom: Eumycotera/Dikariomycotera (higher fungi, septomycetes)
Phylum: Ascomycota (sac fungi)
Subphylum: Hemiascomycotina/Sacchromycotina^{5, 8} (nonascocarpic ascomycetes I)
Class: Hemiascomycetes/Saccharomycetes⁵, (contains known or suspected candidiasis agents)
 Order: Saccharomycetales (ascomycetous yeasts, mostly)
 Family: Saccharomycetaceae
Debaromyces, teleomorphic genus of some *Candida* sp.
Kluyveromyces, teleomorphic genus of some *Candida* sp.
Lodderomyces, teleomorphic genus of some *Candida* sp.
Pichia, teleomorphic genus of some *Candida* sp.
Saccharomyces (budding yeasts)
Subphylum: Archiascomycotina/Taphrinomycotina^{5, 8} (nonascocarpic ascomycetes II)
Class: Archiascomycetes/Schizosaccharomycetes⁶
 Order: Schizosaccharomycetales
 Family: Schizosaccharomycetaceae
Schizosaccharomyces (fission yeasts)
Class: Pneumocystidiomycetes⁵
 Order: Pneumocystidiales
 Family: Pneumocystideaceae
Pneumocystis jirovecii (agent of human *Pneumocystis* pneumonia (PCP))
Class: Taphrinomycetes⁵
 Order: Taphrinales
Taphrina
Subphylum: Euascomycotina/Pezizomycotina^{5, 8} (ascocarpic ascomycetes)
Class: Plectomycetes/Eurotiomycetes⁵ (cleistothecial ascomycetes)
 Order: Eurotiales
 Family: Eurotiaceae
Eurotium, *Emericella*, teleomorphic genera of some *Aspergillus*
Talaromyces, teleomorphic genus of some *Penicillium*
 Order: Onygenales
 Family: Gymnoascaceae/Ajellomycetaceae
Ajellomyces, teleomorphic genus of *Blastomyces dermatitidis* and *Histoplasma capsulatum*;
 possibly also *Lacazia loboi* and *Paracoccidioides brasiliensis*
 Family: Gymnoascaceae/ Arthrodermataceae

Arthroderma, teleomorphic genus of sexual *Microsporum*, *Trichophyton* and probably *Epidermophyton* anamorphs; possible teleomorphic family of *Uncinocarpus*, a possible teleomorphic kin of *Coccidioides immitis*

Class: Pyrenomycetes/Sordariomycetes⁵ (perithecial ascomycetes)

Order: Microascales

Family: Microascaceae

Pseudalleschia, teleomorphic genus of *Scedosporium apiospermum*

Order: Ophiostomatales

Family: Ophiostomataceae

Ophiostoma, possible teleomorphic genus of *Sporothrix schenckii*

Order: Hypocreales

Family: Possible order for many *Fusarium* species

Order: Clavicipitales

Family: Clavicipitaceae

Claviceps, ergot alkaloids (causes St. Anthony's Fire)

Class: Discomycetes/Pezizomycetes⁵ (apothecial ascomycetes)

Order: Pezizales (epigean, operculate discomycetes)

Family: Helvellaceae

Gyromitra (false morels) causes ascomycete mushroom poisoning

Class: Loculoascomycetes I/Dothidiomycetes^{5,8}

Order: Dothideales, possible teleomorphic order for *Hortaea werneckii*

Family: Piedraiaceae

Piedraia hortae (agent of black piedra)

Order: Pleosporales, possible teleomorphic order for *Maderella grisea*

Class: Loculoascomycetes II/Chaetothyriomycetes^{5,8}

Order: Chaetothyriales, possible teleomorphic orders of some Dematiaceae

Family: Herpotrichileaceae, possible teleomorph family of such Dematiaceae form-genera as

Cladophialophora, *Exophiala*, *Fonsecea*, *Phialophora*, *Rhamichloridium*, *Wangiella*

Class: Lichenomycetes (class that contains the fungal partners of lichens)⁸

Phylum: Basidiomycota (club fungi)

Subphylum: Heterobasidiomycotina ("lower" basidiomycetes)

Class: Urediniomycetes (rusts)

Class: Ustilaginomycetes (smuts)

Order: Ustilaginales

Order: Malasseziales, possible teleomorphic order for *Malassezia furfur*

Subphylum: Holobasidiomycotina/Basidiomycotina ("higher" basidiomycetes)

Class: Phragmobasidiomycetes/Tremellomycetes (jelly fungi; septate basidial fungi)

Order: Trichosporonales (some have "crucially-septate" basidia), possible teleomorphic order of

Trichosporon asahii

Order: Filobasidiales

Family: Filobasidiaceae

Filobasidiella, the teleomorphic genus of *Cryptococcus neoformans*

Order: Auriculariales (have "transversely septate" basidia)

Class: Holobasidiomycetes/Hymenomycetes⁶ (many orders of mushrooms, toadstools, etc.)

Order: Dacrymycetales (have "tuning fork-type" basidia)

Order: Tulasnellales (have holobasidia with swollen sterigmata)

Family: Schizophyllaceae (split gill fungi)

Schizophyllum - rare infections

Order: Agaricales (gill fungi)

Family: Amanitaceae

Amanita (death angel genus) - most important mushroom poisoning genus

Family: Agaricaceae

Coprinus - mushroom poisonings

Lepiota - mushroom poisonings

Order: Lycoperdales (puffballs)

Family: Lycoperdaceae

Lycoperdon (snuff)

Order: Porales (woody pore fungi)

Phylum: Fungi Imperfecti/Deuteromycota (imperfect fungi, asexual fungi, anamorphic fungi, mitosporic fungi; fungi that cannot be classified by traditional means, because sexual states are unobserved or unknown, although they can now be classified very well using molecular means).

Form-class: Blastomycetes (imperfect yeasts, most common yeast form-genera that cause infections)

Form-order: Cryptococcales

Form-family: Cryptococcaceae

Candida

Cryptococcus

Malassezia

Pityrosporum

Rhodotorula

Trichosporon

Form-class: Hyphomycetes (asexual hyphal form-genera that do not form multihyphal aggregates in association with their conidiophores and conidia; cause infections, allergies and mycotoxicosis)

Form-order: Moniliales (conidial and synnematus imperfects)

Form-family: Moniliaceae (abbreviated list of form-genera that produce mostly colorless vegetative growth, at least when young)

Aspergillus

Blastomyces

Coccidioides

Epidermophyton

Geotrichum

Histoplasma

Microsporum

Paracoccidioides

Penicillium

Sporothrix

Trichophyton

etc.

Form-family: Dematiaceae (abbreviated list of asexual form-genera that produce dark brown or black vegetative growth throughout their life cycle)

Alternaria

Bipolaris

Cladophialophora

Curvularia

Exophiala

Fonsecea

Helminthosporium

Phialophora

Wangiella

etc.

Form-family: Tuberculariaceae

Form-class: Coleomycetes (asexual form-genera that produce multihyphal structures in association with their conidia and conidiophores)

Phoma

Form-class: Mycelia Sterilia (asexual form-genera that produce hyphae but no conidia)

References

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