

Fungi Mycobionta



Bert Engelen



Institut für
Chemie und
Biologie des
Meeres

General life mode of fungi

- Osmotrophic (absorptive) life mode
- Chemo organo heterotroph
- Tolerant to acids (acidotolerant or acidophilic) and drought (xerotolerant or xerophilic)
- Growth in string-like structures assures large contact surface with substrate or other organisms
- Fungal biomass accounts for up to 75% e.g. in soil

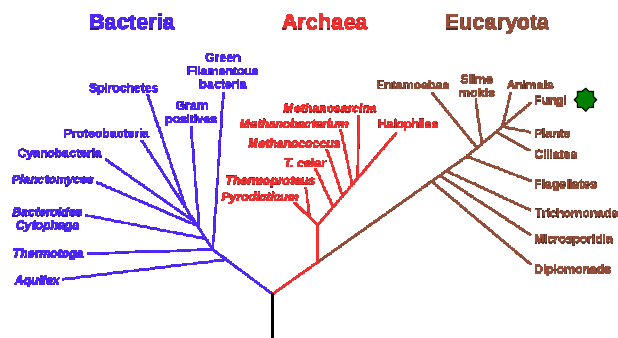
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Different habitats and "relationships"

- Saprophytes (Saprobionts):
 - Soil (1g contains 10 - 100 m of fungal mycelium)
 - Wood (degradation and discoloration)
 - All kinds of organic material
 - Inorganic material as substratum
- Parasites
 - On plants, algae, animals
- Symbionts
 - With plant roots (mycorrhiza), algae, cyanobacteria (lichens)

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Position in the tree of life



http://en.wikipedia.org/wiki/File:Phylogenetic_tree.svg

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A comparizon: Oomycetes and Slime molds

- **Protists, no** cell wall with chitin
- **Oomycetes** (Algal fungi, Cellulose fungus, e.g. *Saprolegnia*)
 - Heterokontobionta (protists, two types of flagella), some are phototrophic
- **Myxobionta** (slime molds), ameba without cell wall
 - **real** slime molds form polycaryotic **plasmodia**
 - **cellular** slime molds form multi-cellular **pseudo-plasmodia**
do not mix up with **Myxobacteria**
(also form multi-cellular aggregates and fruiting bodies)

<http://www.youtube.com/watch?v=VWGA7kleE0Q>

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Chitin fungi

- Eukaryotes
- Immobile (exceptions)
- Uni- or multi-cellular with cell wall
- Organo heterotrophic life mode, saprophytic, parasites or symbionts, osmotrophic
- App. 120 000 species (up to 1.5 mio.?), some pathogens

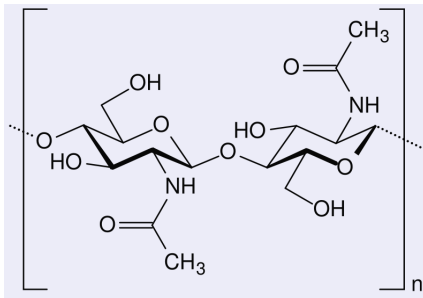


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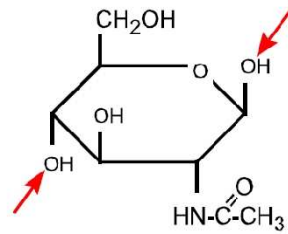
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Chitin

- Important component of the cell wall (together with glucanes and proteins)
- Polymer of **N-Acetyl-Glucosamine**
- Also found in insects

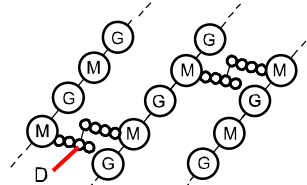


www.wikipedia.de



N-Acetyl-Glucosamin (G)

- also component of bacterial cell wall



Murein fragment

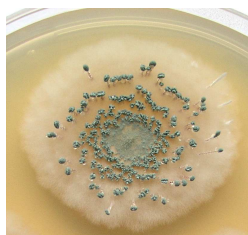
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Hyphae, mycelium

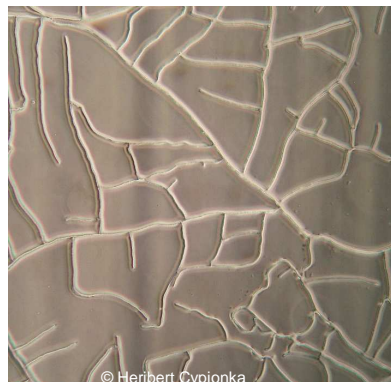
- Cell wall composed mainly of chitin, glucanpolymers, proteins and pigments, e.g. melanin
- Hyphae with a diameter of 1 to 10 μm , growth at tip
- Mycelium (= network of hyphae) penetration of substrate and increase of surface



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Fungi and their fruiting bodies

- Macroscopic mushrooms – only the fruiting bodies
- Network of microscopic hyphae
- "Function" of fruiting bodies: Protection and distribution of spores
- Periodic growth and formation of fruiting bodies "Hexenringe"



www.wikipedia.de



www.abc.net.au/reslib/200707/r159235_580502.jpg

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Spores

- Distribution- and resting stages
- Asexual or ...
- Sexual: after mating of cells and alternation of nuclear phase (haploid/diploid; mostly in fruiting bodies)
- Both types of spores occur in different stages of the life cycle
- Can cause allergic reactions



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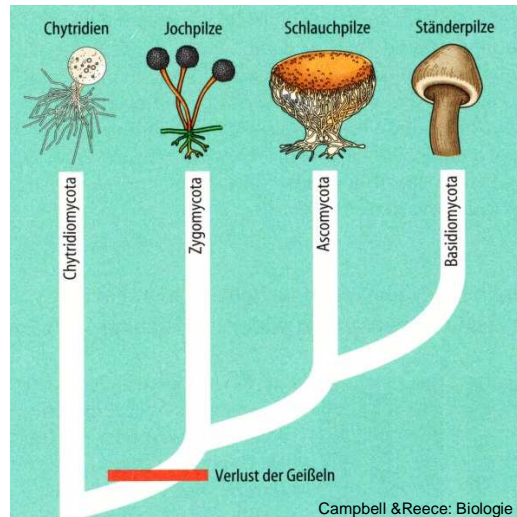


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Phylogeny of fungi (Mycobionta)

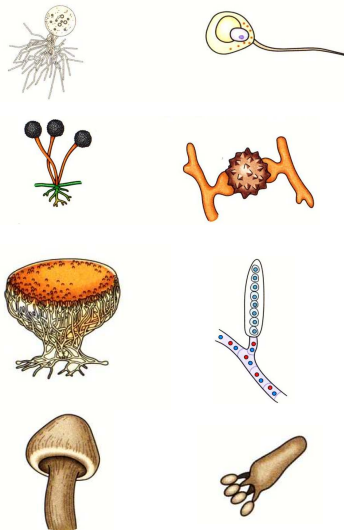
- Differences in reproduction, especially time of meiosis and meiotic spores
- Alternation of nuclear phases, alternation of generations
- Morphological characteristics proven by molecular data



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Groups of fungi

- Chytridiomycetes (flagella fungi)
Spores with flagellum
- Zygomycetes (black bread molds)
Zygosporangium as sex. state
- Ascomycetes (sac fungi)
Sexual spores in sacs
- Basidiomycetes (club fungi)
Sexual spores at basidia



Campbell & Reece: Biologie

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Chytridiomycota

- "Flagellaten- or Töpfchenpilze"
- Have flagellated gametes (zoospores)
- Small, primitive group (app. 500 species)
- Mostly aquatic (origin of fungi?)



www.wikipedia.org

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Zygomycota (Jochpilze)

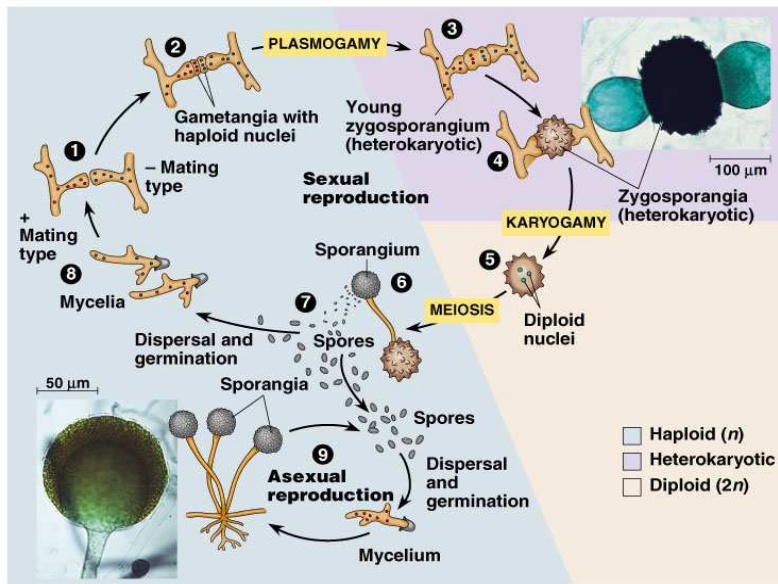
- Example *Rhizopus*,
"gemeiner Brotschimmel"
- Reproduce sexually via zygospores
- Partly parasites of insects
- Partly symbionts (mycorrhiza)



www.davidnelson.md/Cazadero/Fungi.htm

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Life cycle of Zygomycota (Jochpilze)



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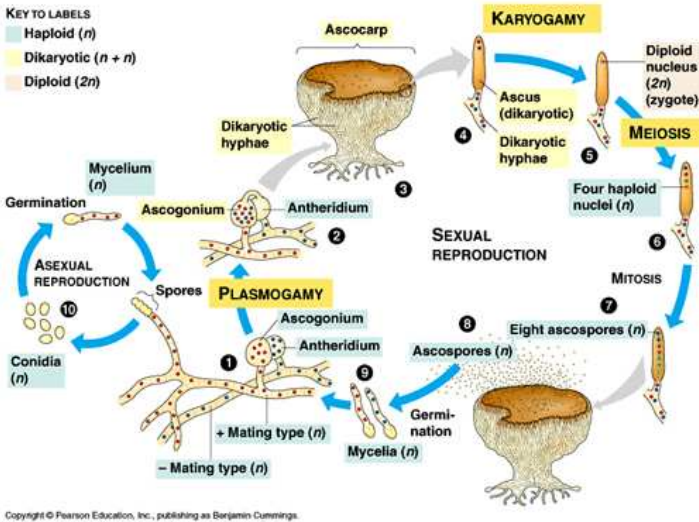
Ascomycota (Schlauchpilze)

- Biggest group (> 60 000 species)
- Saprophytes
- Parasites ("Echter Mehltau"),
- Symbiontes (lichens, mycorrhiza)
- Example: truffle
- Chitin in cell wall
- Spores asexual – exogen;
- sexual – in Ascocarp (dicaryotic)



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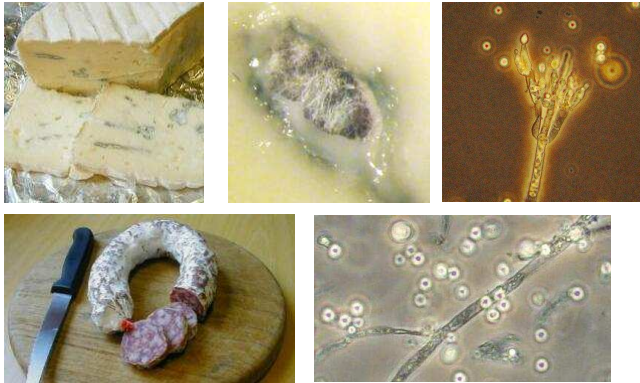
Life cycle of Ascomycetes



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Penicillium roquefortii

- "Pinselschimmel, Edelschimmel"
- Producer of antibiotics

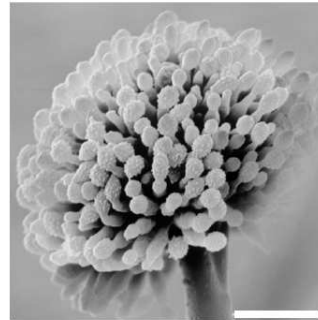
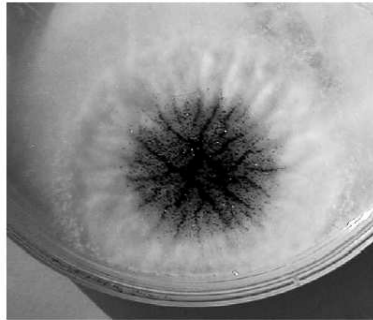


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Aspergillus

- "Gießkannenschimmel"
- Can cause allergic reactions



Nina Gunde-Cimerman

Abb. 4.3. Der Gießkannenschimmel *Aspergillus* gehört zu den Ascomyceten. Links eine Kolonie auf einer Agarplatte, rechts ein Sporangium mit Sporen unter dem Raster-Elektronenmikroskop (Maßstab = 20 µm) Cypionka, Grundlagen der Mikrobiologie, 3. Aufl.

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Mushrooms (Basidiomycota)

- Chitin in cell wall
- Dikaryotic phase (time shift of reproduction)
- Spores exogenic at basidium (located at fruiting body (protection and dispersal))
- Saprophytes, parasites, symbionts



www.wikipedia.de



Agric ("Blätterpilz")

- Example: *Amanita muscaria* ("Fliegenpilz")
- Related to "Pantherpilz" and "Knollenblätterpilz"
- Poisons in red skin of the cap, hallucinogenic (Berserker)

www.wikipedia.de



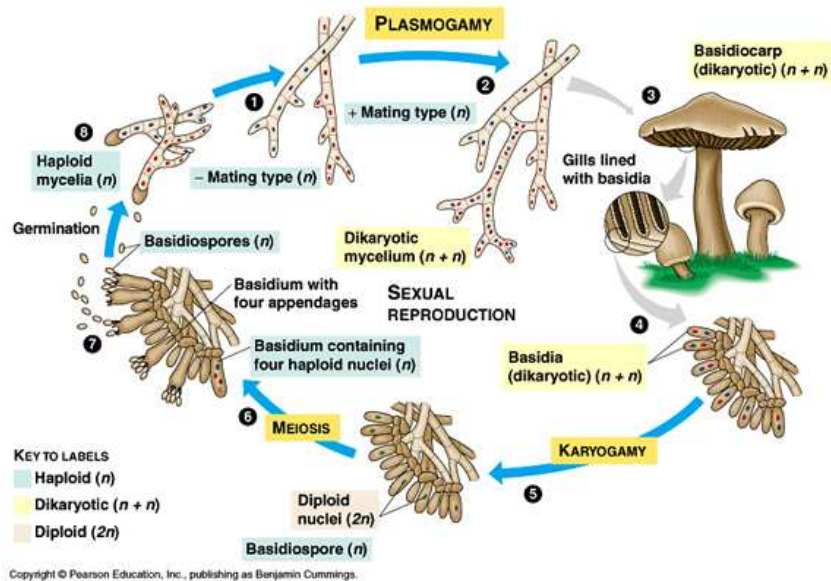
Boletus ("Röhrling")

- Example: *Boletus edulis* ("Steinpilz")
- Eatable, do not mix-up with the "Gallenröhrling"



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Life cycle of Basidiomycetes



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Deuteromycetes or "Fungi imperfecti"

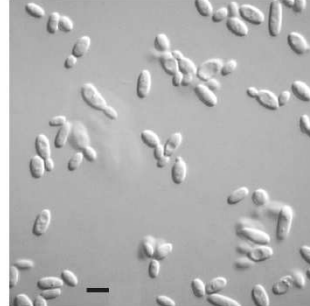
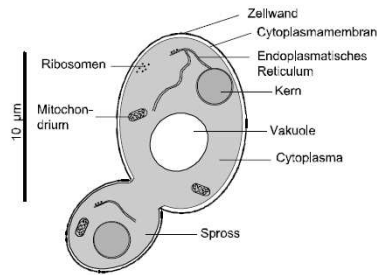
- It is not the fungi that are imperfect, it is us, the scientists!
- Fungi without known sexual reproduction stages
- Can be ascomycetes or basidiomycetes
- Example: yeast, ergot ("Mutterkorn"), athlete's foot ("Fußpilz")



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Example yeast

- Can be ascomycetes or basidiomycetes
- *Saccharomyces cerevisiae*, fermentation



Cyptonka, Grundlagen der Mikrobiologie, 3. Aufl.

Abb. 4.4. Hefezellen. *Links* der Aufbau einer sprossenden Zelle schematisch, *rechts* ein Präparat unter dem Mikroskop. Im differentiellen Interferenzkontrast (s. Kap. 6) erscheinen die Zellen und innere Strukturen reliefartig räumlich. Maßstab = 10 µm

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Example parasite



Weizenähre mit Mutterkom
www.wikipedia.de

Claviceps purpurea

- Ascomycete
- Only one grain is infected (in flower)
- Resting stage (over winter),
fruiting bodies are formed afterwards
(meiotic spores)
- Many secondary metabolites (LSD)

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Example parasite: Dermatomycosis

Ort:	Köln	
Teilnehmergruppe:	Sportstudierende, Laufsportler	
Anzahl der Teilnehmer insgesamt:	94	männlich: 54 weiblich: 40
Alter der Teilnehmer, Mittelwert:	22,8 Jahre	MIN: 18 Jahre MAX: 30 Jahre
Mykologische Infektionsrate insgesamt:	61,7 %	
Tinea pedis interdigitalis:	45,7 %	
Onychomykose:	40,4 %	
Tinea pedis (Mokassin-Typ):	11,7 %	
Erregerspektrum „Füße“:	Trichophyton rubrum	65,7 %
	T. mentagrophytes var. interdigitale	34,2 %
	Epidermophyton floccosum	13,2 %
Schuhuntersuchungen:	35,4 % kontaminierte Schuhe	
Erregerspektrum „Schuhe“:	Trichophyton mentagrophytes	51,5 %
	Trichophyton rubrum	33,3 %
	Epidermophyton floccosum	9,1 %



www.wikipedia.de

Jan Ries (2002) Mykosen und Sport – Verbreitung von Mykosen bei Sportschuh-tragenden Sportlern. Dissertation, Univ. Frankfurt

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Symbiotic fungi

- **Myccorrhiza** – Symbiosis with higher plants (trees, grass)
- **Lichens** – Symbiosis with algae and/or cyanobacteria



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Mycotrophy of plants

- 80% of all plants are obligat mycotroph, 10% facultativ mycotroph
- Fungi grow in close contact with the plan root
 - within the cell
 - as fungal sheat around the root
- Characteristic morphology
- Complementary benefit:
Water, P-, N- and Ca-components for the plant (function of haustorium is subjected to hyphae),
Assimilated carbohydrates for the fungus

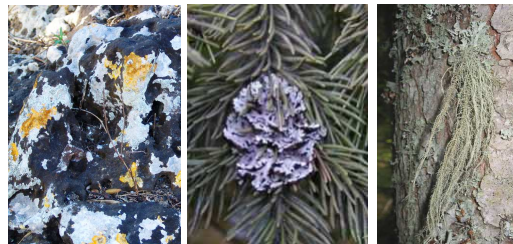


www.wikipedia.de
Wurzelspitzen mit Ektomykorrhiza

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Lichens

- Different substrates
 - Wood, trees
 - Rocks, glas, soil
 - Leaves (tropical)
- Competition low due to low growth rate
- At exterme sites with short vegetation periods (desert, mountains, permafrost, tundra); often predominant over plants
- In the tundra, main vegetation as photosynthesis even starts a low temperatures



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Lichens

- Dual organisms
- Photobionts: green algae and cyanobacteria
- Mycobionts: asco- and basidiomycetes
- Photobionts also occur free living
- Mycobiont regulates shape and reproduces sexual
- Contact: Cell wall/cell wall or Cell membrane/cell membrane
- Configuration:
 - Cortex
 - Layer of photobionts and
 - Medula
- Shape
 - Crustal lichens
 - Leaf lichens
 - Bush lichens



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Different kinds of lichens

Crustal lichens

- Located close to substratum
- Contain only upper cortex
- Growing zone at border



Leaf lichens

- Lies only loose on substratum
- Protected via upper and lower cortex
- Growing zone at border of "leaf"



Bush or beard lichens

- Bush like, cross section is round
- Cortex around the lichen
- Growing zone at end of branches
- Only in areas with clean air,
- sensitive against air pollution



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www.microbiological-garden.net



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