

31 真菌多样性的进化

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Outline

31.1 真菌是重要的分解者

31.2 真菌多样性的进化

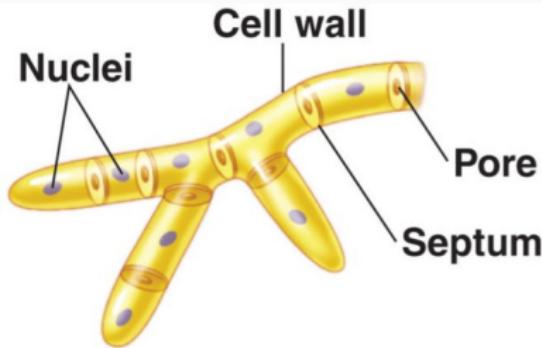
31.1 真菌是重要的分解者

- 植物: 生产者, 光合自养.
- 动物: 消费者, 吞咽式异养.
- 真菌: 分解者, 吸收式异养.

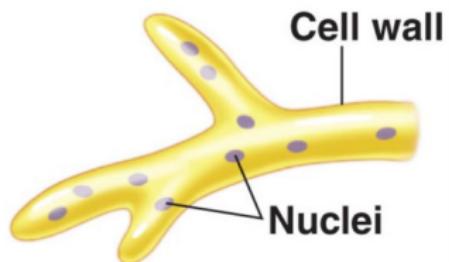
真菌的结构

■ 细胞组成: 菌丝

- ▶ 基本结构: 菌丝有横隔 (细胞一到二核), 或无 (细胞多核).
- ▶ 细胞器: 无叶绿体, 质体.
- ▶ 细胞壁: 壳多糖 (几丁质, 甲壳素, chitin).



(a) Septate hypha



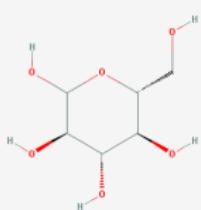
(b) Coenocytic hypha

Figure 1. 有隔菌丝与多核菌丝

■ 营养体除少数为单细胞(如酵母)外,一般是分枝或不分枝的菌丝(hypha),或由菌丝组成的菌丝体(mycelium).



Figure 2. 菌丝体



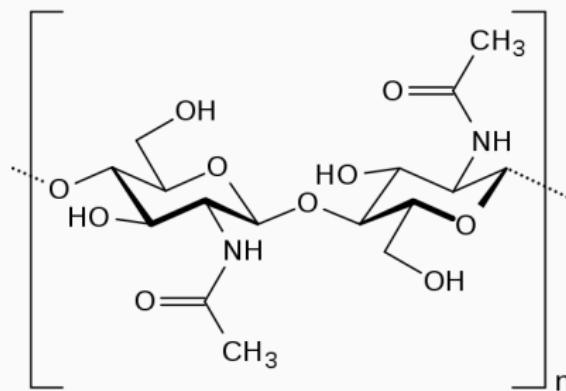
(a) 葡萄糖



(b) 葡糖胺



(c) N-乙酰葡糖胺



(d) 壳多糖

■ 养分: 糖原 (glycogen)

► 又称肝糖, 动物淀粉

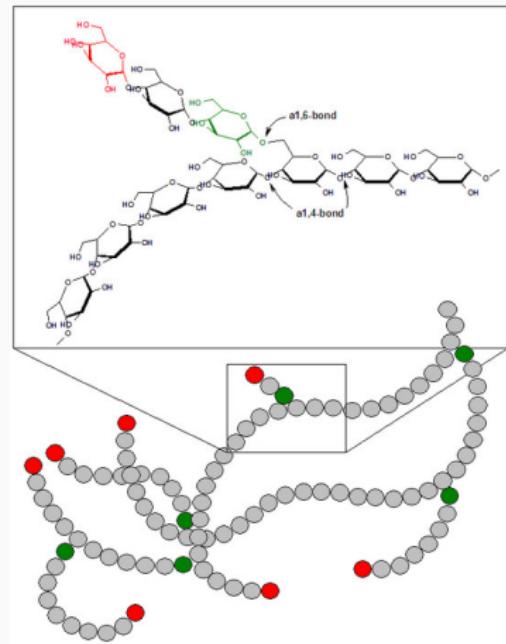


Figure 4. 糖原的构造

真菌的营养生活

方式: 腐生或寄生

亦可与藻类或植物等形成互利的共生结合体, 如地衣和菌根.



Figure 5. 白僵菌 *Beauveria bassiana*

- 具体过程:
 - ▶ 分泌水解酶, 分解食物成可溶性小分子;
 - ▶ 利用菌丝内高渗透压吸收食物.
- 菌丝与其吸收异养生活相适应的结构特点:
 - ▶ 可分泌水解酶消化植物细胞壁;
 - ▶ 柔韧性高, 可变态成各种吸器, 接触面积大;
 - ▶ 生长迅速.

31.2 真菌多样性的进化

真菌的三种主要类型

1. 接合菌
2. 子囊菌
3. 担子菌

根据营养体的形态和生殖方法的不同.

31.2.1 接合菌

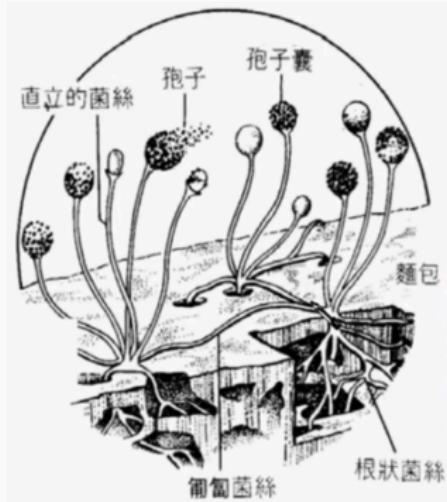


Figure 6. 代表种: 黑根霉



Figure 7. 黑根霉2

- 营养体特征:
 - ▶ 菌丝无间隔;
 - ▶ 核单倍;
 - ▶ 假根吸收营养.

- 无性生殖: 菌丝顶端膨胀成孢子囊, 散落萌发成新菌丝体.

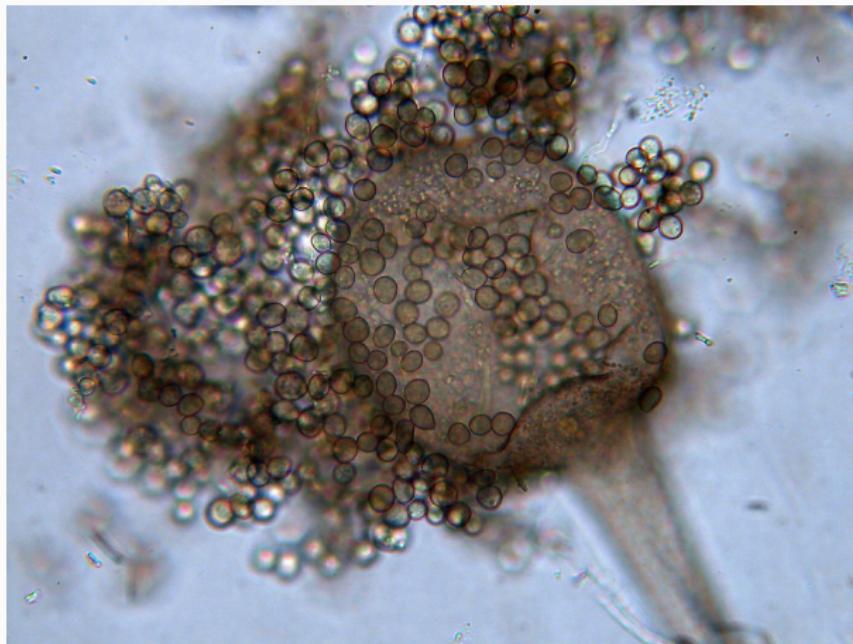


Figure 8. 孢子囊与孢子

■ 有性生殖: 环境恶劣时进行.

- ▶ 两种交配型菌丝体, +, -
- ▶ 胞质融合, 核融合

■ 有性生殖过程:

- ▶ 横隔隔开单倍体核, 配子囊形成;
- ▶ 配子囊融合, 形成二倍体的接合孢子;
- ▶ 接合孢子中止休眠, 二倍体核减数分裂成多个单倍异配孢子;
- ▶ 孢子囊壁破裂, 孢子萌发.

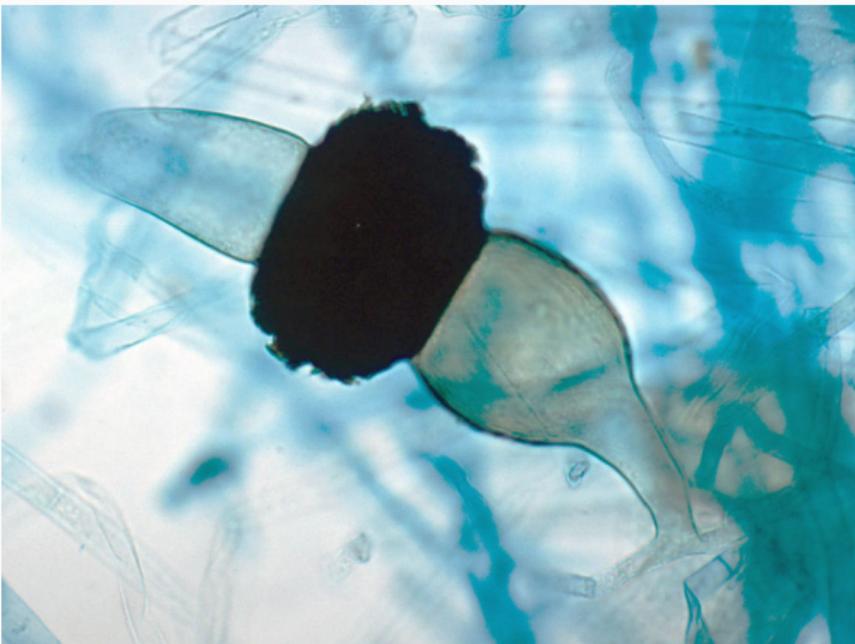
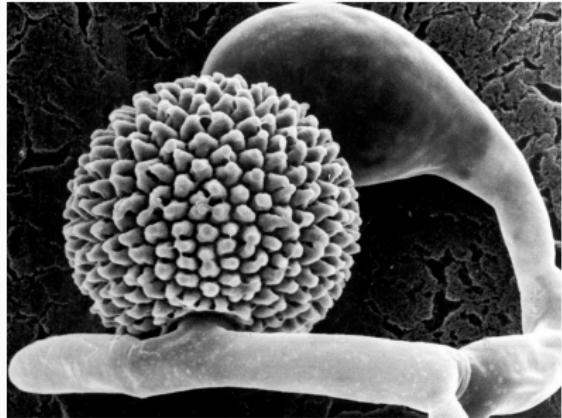
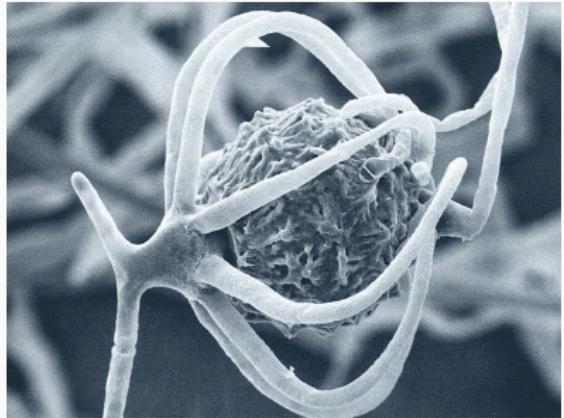


Figure 9. 接合孢子

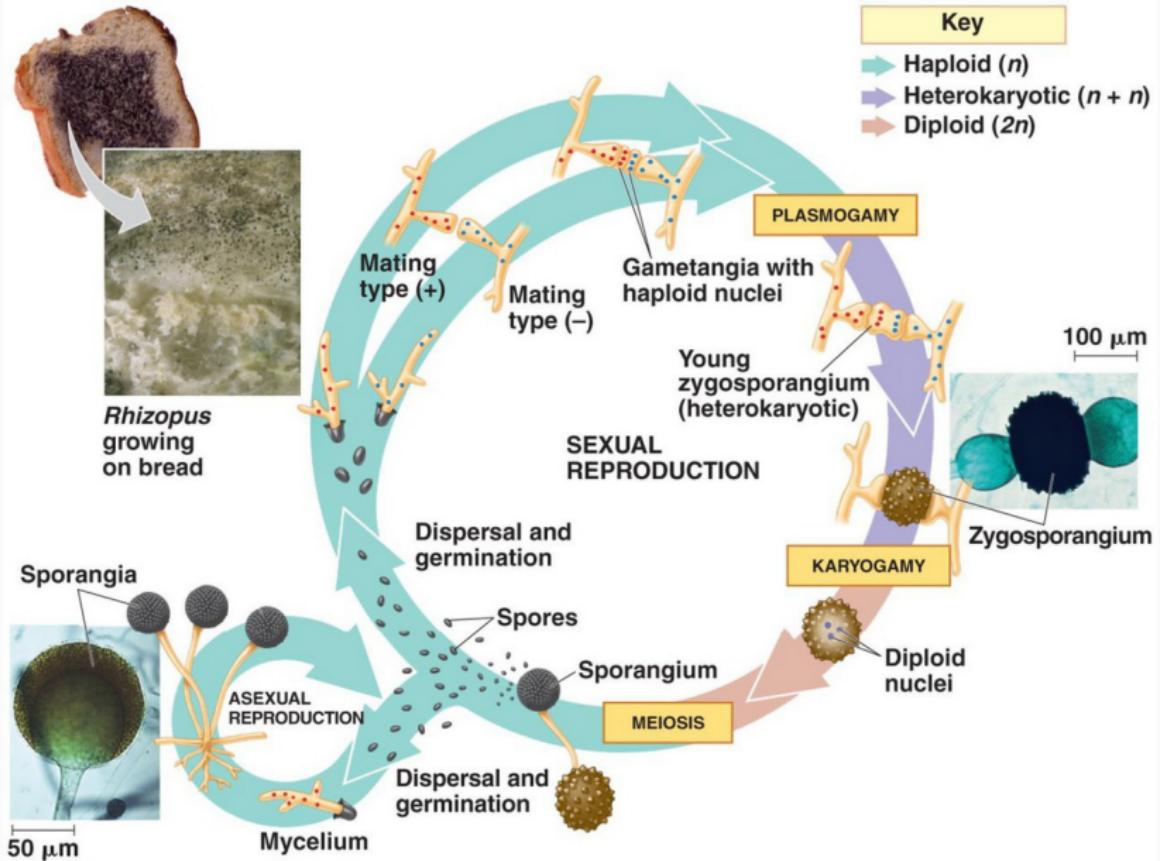


(a) *Zygorhynchus moelleri*



(b) *Absidia spinosa*

Figure 10. 扫描电镜下的接合孢子



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Figure 11 黑根霉生活中



Figure 12. 晶澈水玉霉

31.2.2 子囊菌



(a) 砖火丝菌



(b) 火烧火丝菌

Figure 13. 代表种: 火丝菌

■ 营养体特征:

- ▶ 菌丝具横隔, 多分枝
- ▶ 双核期

■ 常见子囊菌:

- ▶ 酵母, 青霉, 冬虫夏草

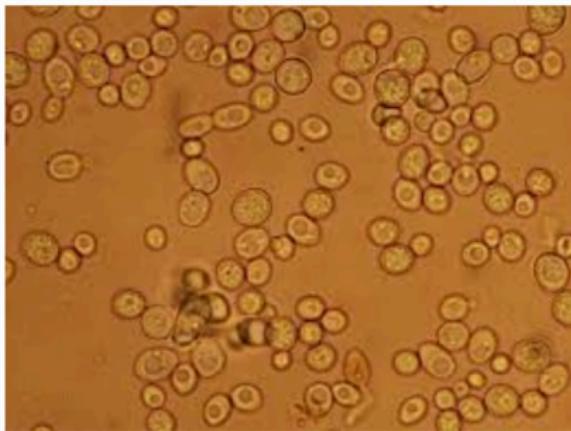


Figure 14. 酵母

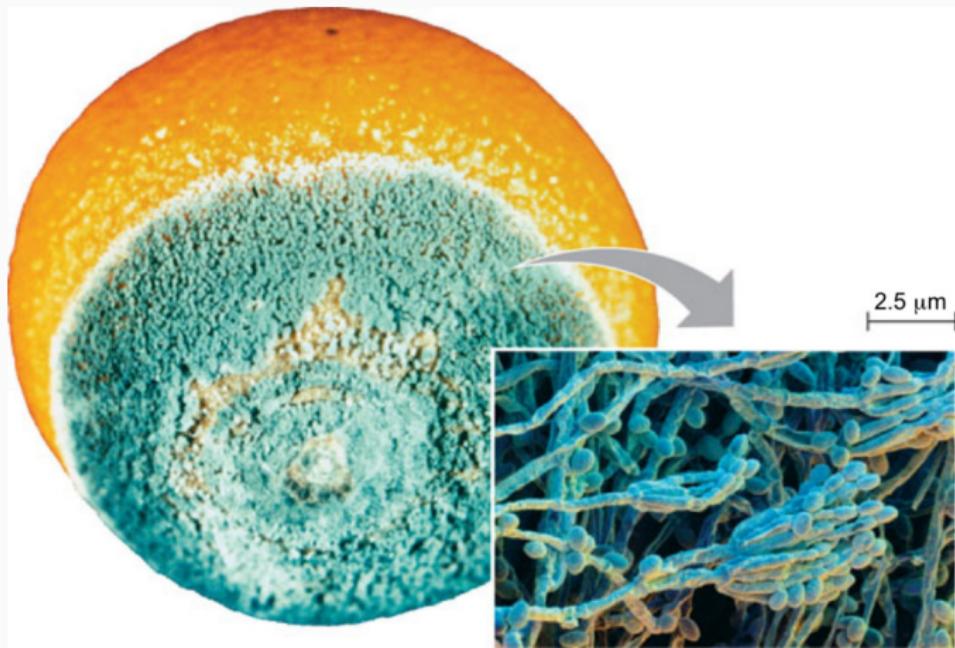


Figure 15. 青霉菌



Figure 16. 冬虫夏草



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Figure 17. 肉杯菌 *Sarcoscypha coccinea*

■ 无性生殖: 菌丝顶端产生分生孢子.

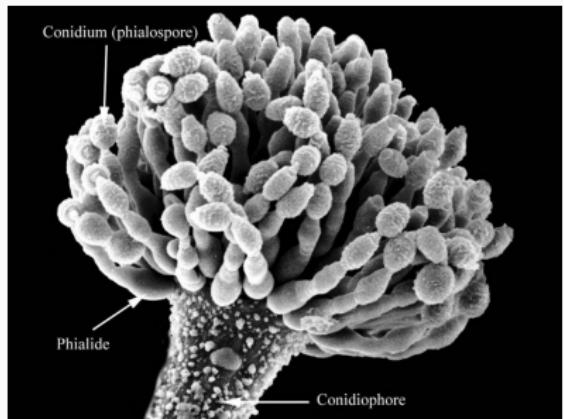
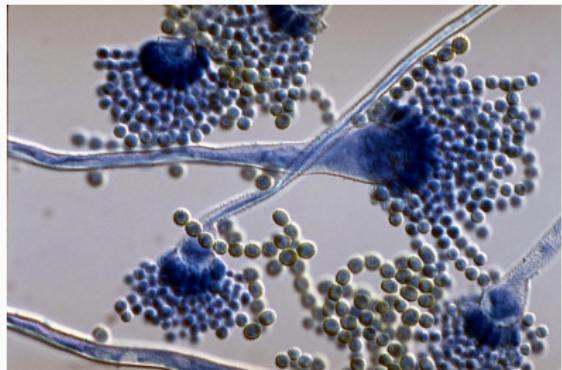


Figure 18. 黄曲霉的分生孢子

■ 有性生殖: 形成子囊、子囊孢子.



Figure 19 子囊

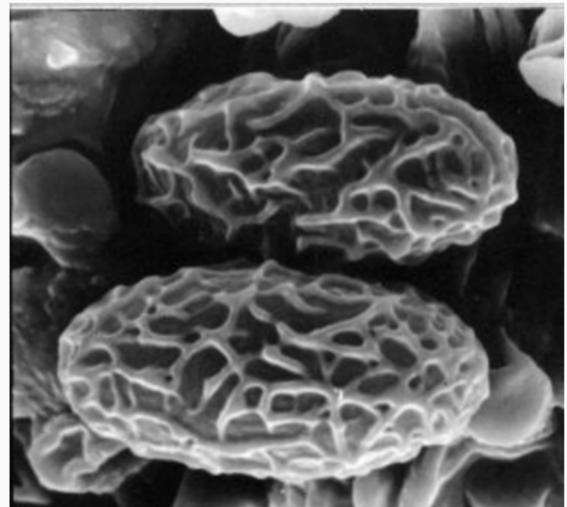
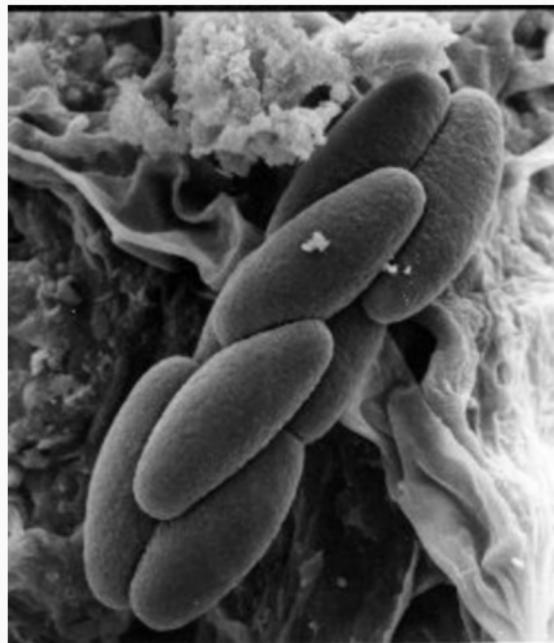
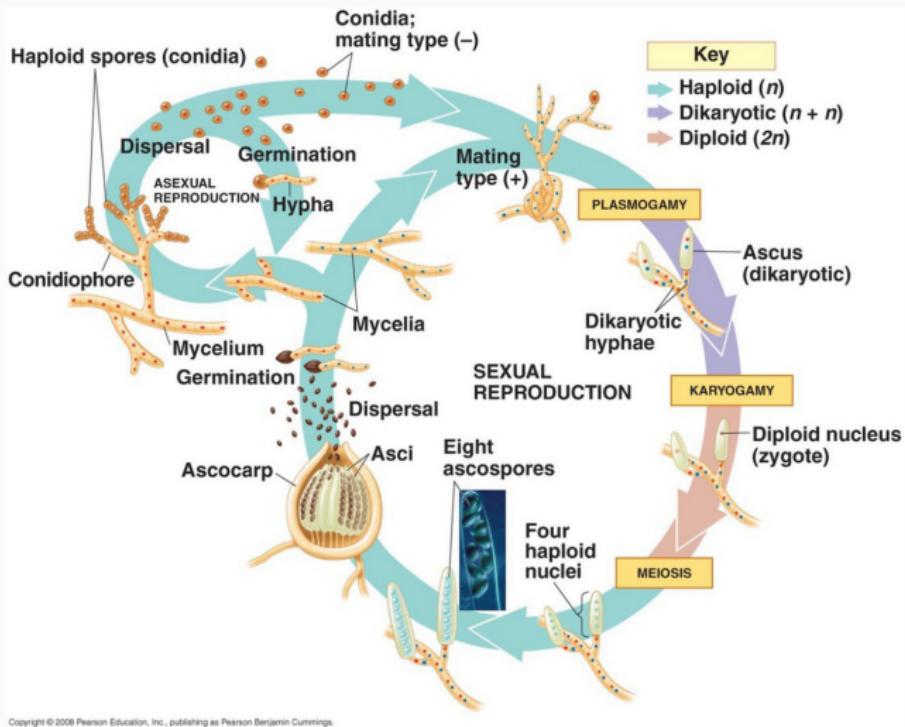


Figure 20. 子囊孢子

■ 有性生殖过程:

- ▶ 产生多核的精子囊和产囊体;
- ▶ 产囊菌丝的形成, 一对核;
- ▶ 子囊果和子囊母细胞的形成;
- ▶ 雌雄核融合, 形成含8个子囊孢子的子囊;
- ▶ 子囊成熟, 子囊孢子射出.



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Figure 21. 子囊菌生活史

31.2.3 担子菌

- 代表种: 蘑菇
- 营养体特征
 - ▶ 菌丝具横隔
 - ▶ 双核期
- 常见担子菌:
 - ▶ 蘑菇、灵芝、木耳、银耳等.



Figure 22. 担子菌

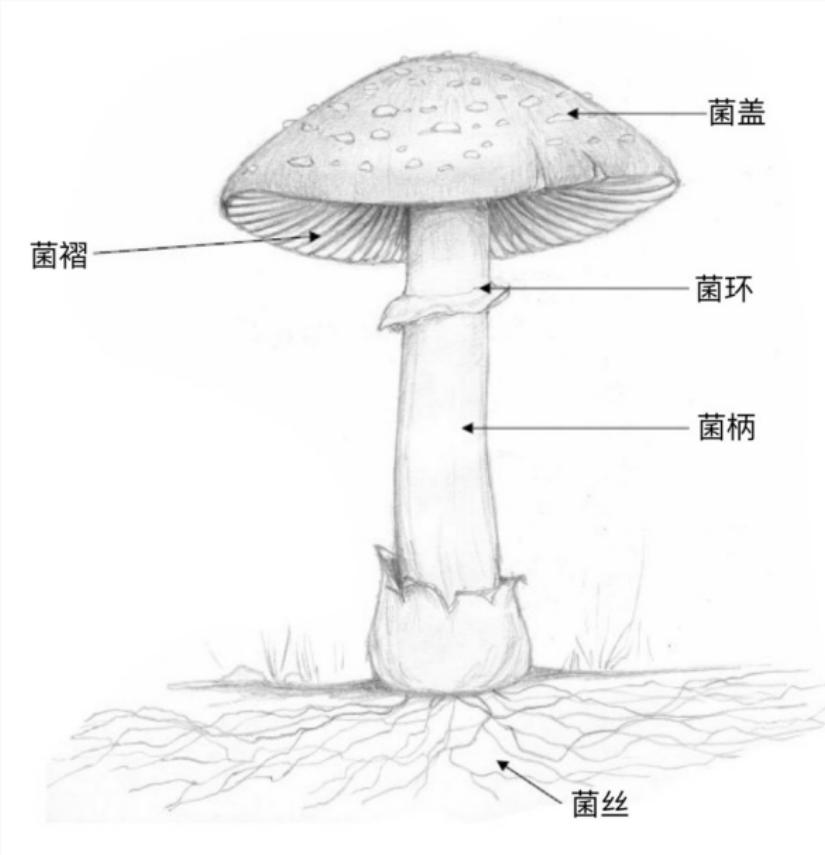


Figure 23. 子实体



Figure 24. 双孢蘑菇



Figure 25. 灵芝



Figure 26. 硫色绚孔菌



Figure 27. 粉红枝瑚菌



Figure 28. 世界最大真菌子实体



(a) 毒蝇伞



(b) 橙盖伞

Figure 29. 鹅膏菌属



(a) 毒鹅膏



(b) 白毒伞

Figure 30. 鹅膏菌属2



Figure 31. 迷幻蘑菇: 裸盖菇属



Figure 32. 茭白 (禾本科蕓属)



Photo courtesy of P.B. Matheny

(a) 菌褶



Photo courtesy of P.B. Matheny

(b) 菌孔



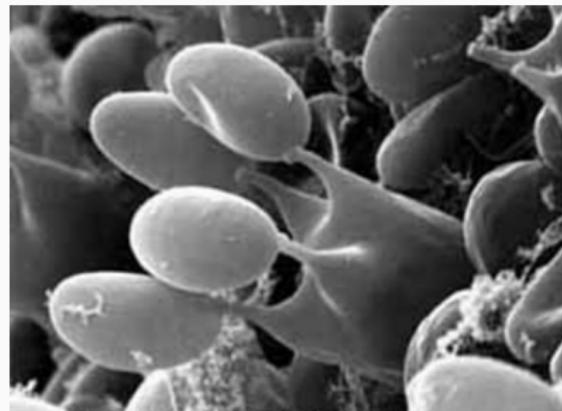
(a) 白黄小脆柄菇



(b) 红绒盖牛肝菌

Figure 34. 孢子印

- 有性生殖: 形成担子, 担孢子; 子实体(担子果).
- 有性生殖过程:
 - ▶ 双核菌丝体形成, 担子形成;
 - ▶ 担子果的形成;
 - ▶ 担子中双核融合成二倍体合子核;
 - ▶ 合子核减数分裂, 发育形成担孢子.



www.botamynus.de/schwamm.html

Figure 35. 担孢子

■ 担子菌与子囊菌差异:

- ▶ 子囊孢子在子囊内形成;
- ▶ 担孢子在担子外形成.

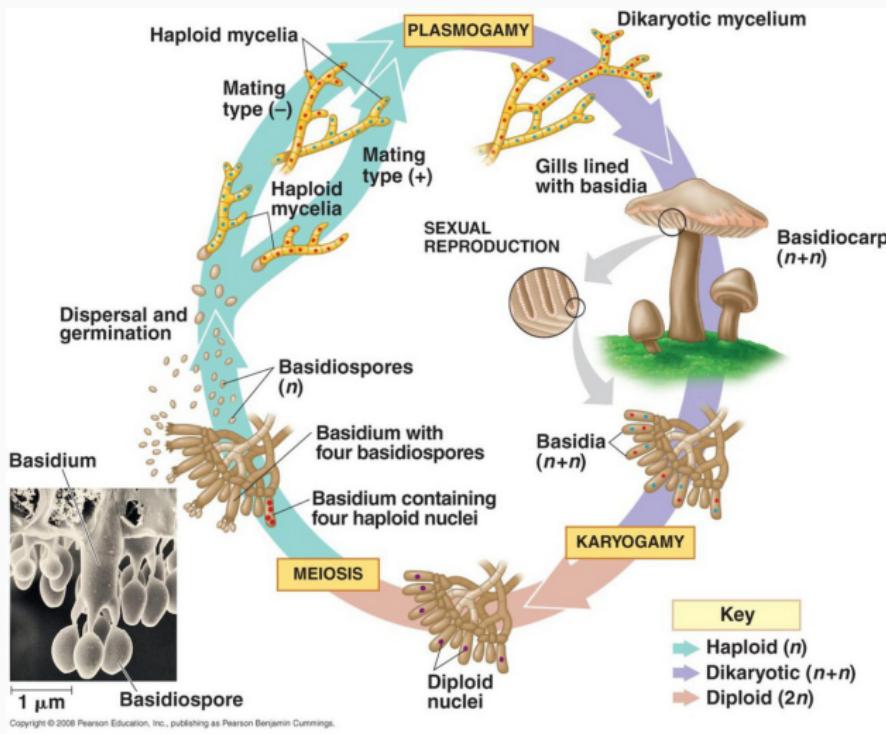


Figure 36. 担子菌生活史



水晶兰
Monotropa uniflora

Figure 37. 水晶兰



Figure 38. 苜蓿根部的菌根(球囊菌门丛枝真菌)

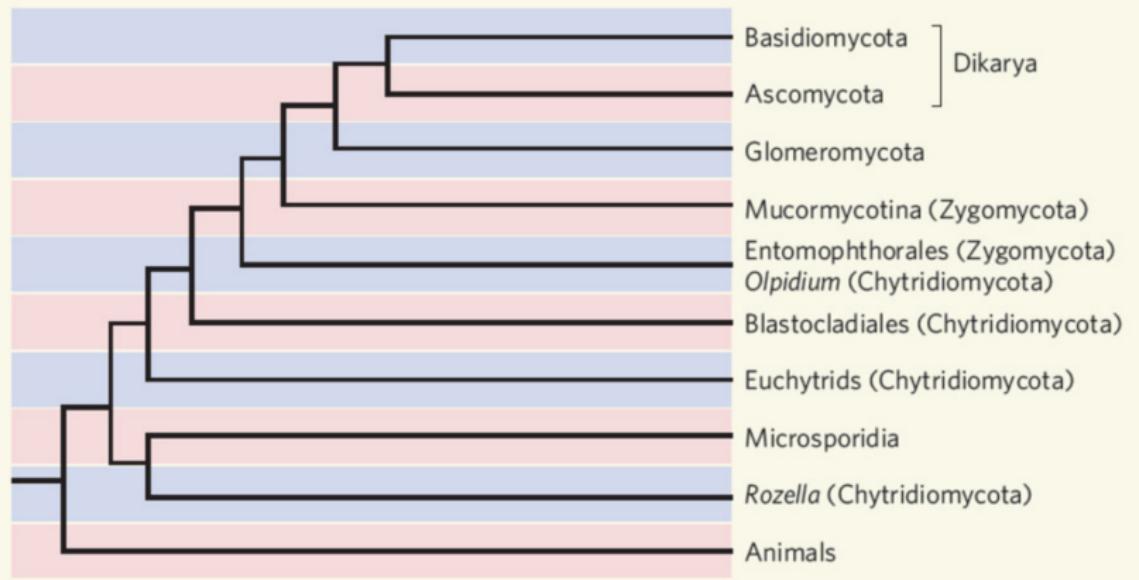
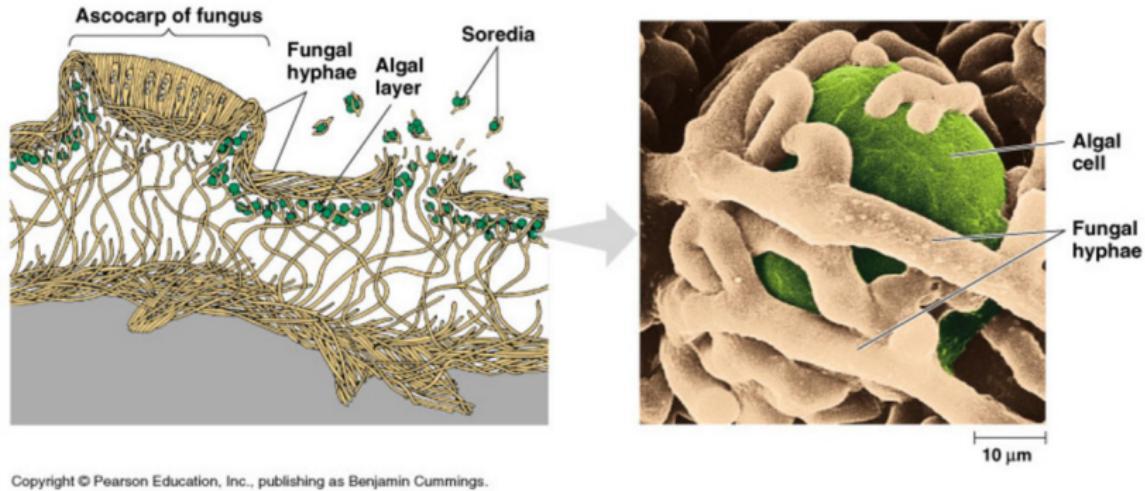


Figure 39. 最新的分类系统

- 微孢子虫 (Microsporidia)
- 壶菌门 (Chytridiomycota)
- 球囊菌门 (Glomeromycota)

31.2.4 地衣

- 地衣的结构: 真菌和绿藻的共生体
 - ▶ 藻类: 蓝藻、绿藻, 制造有机养料.
 - ▶ 真菌: 多数为子囊菌, 少数为担子菌, 提供水等.
- 地衣的基本形态: 壳状, 叶状, 枝状.
- 地衣的颜色: 灰白、暗绿、鲜红等色.



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Figure 40. 地衣结构

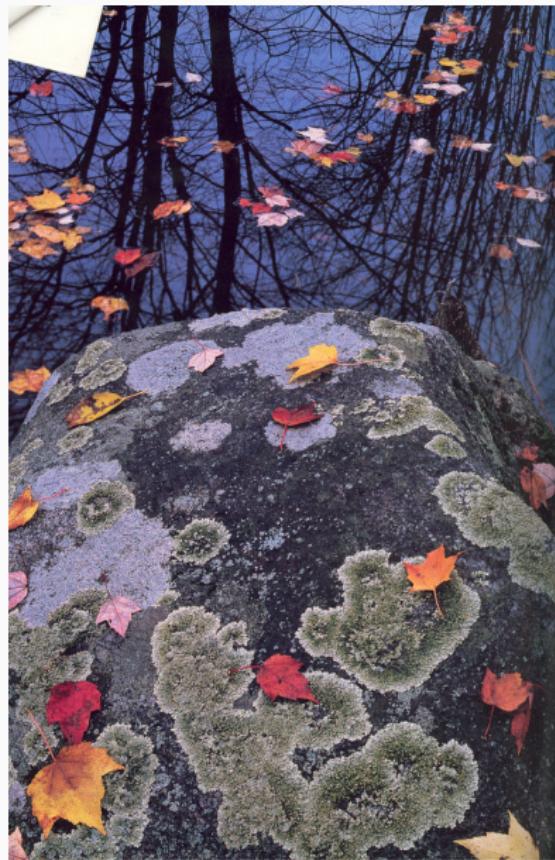


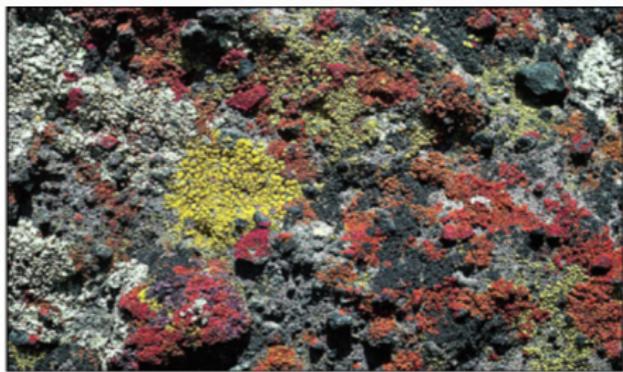
Figure 41. 地衣



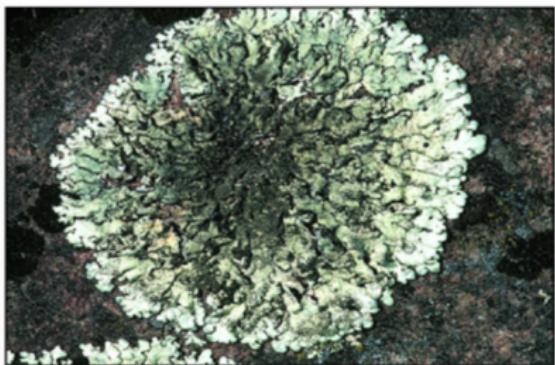
Figure 42. 地衣2



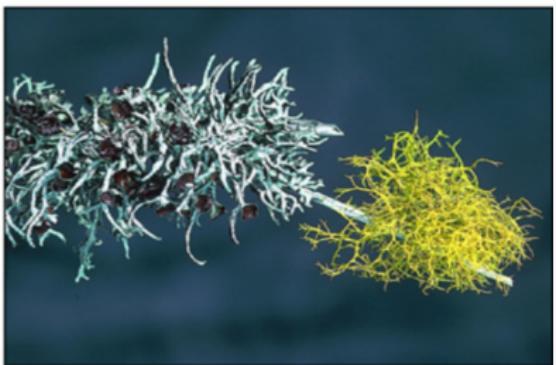
Figure 43. 黃山石耳



A.



B.



C.

Figure 10.36 Three types of lichen thalli. A. Crustose lichens on the surface of a rock. B. A foliose lichen. C. Fruticose lichens.

■ 地衣对环境的适应

- ▶ 生存环境: 岩石、树皮、高山、极地.
- ▶ 北极驯鹿, 以地衣为食物.

- 地衣可在极端恶劣的环境中生存, 生命力极强.
 - ▶ 生长极慢, 几十年仅长几厘米, 干旱时进入休眠状态.
 - ▶ 对污染敏感, 是很好的环境指示植物.
- 地衣又是自然界的先锋植物.
 - ▶ 它能促进岩石的风化和土壤的形成, 为其它生物的生存创造条件.