

PowerLecture:

Chapter 24

Fungi

Section 24.0: Weblinks and InfoTrac

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Videos: CNN

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- Environmental Science, 2003, Vol. 6, *Arctic National Wildlife Refuge* (3:16)  
Impacts, Issues: **Food, Forests, and Fungi**
- Lichen – a vegetative body in which a fungus and one or more photosynthetic organisms live together in mutual dependency (mutualism)
- Metabolic products and remains enrich nutrient-poor soil

Impacts, Issues: **Food, Forests, and Fungi**

- Lichens are sensitive to pollution and are on the decline
- Act as useful indicators of deteriorating environmental conditions

Section 24.1: Weblinks and InfoTrac

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Lichen

- Combination of fungus and photosynthetic organism(s)
  - Organisms are symbionts
  - Relationship is a mutualism
- Ecological Roles of Lichens**
- Survive in hostile habitats and colonize new habitats
    - Absorb mineral ions from substrates
  - Cyanobacteria-containing lichens can fix nitrogen
    - Convert atmospheric nitrogen to a form plants can use

**Early Warning Systems**

- Lichens are very sensitive to deteriorating environmental conditions
- Absorb toxins but cannot get rid of them
- Can serve as environmental indicators

**Mycorrhiza**

- “Fungus-root”
- Mutualism between a fungus and a tree root
- Fungus gets sugars from plant
- Plant gets minerals from fungus
- Many plants do not grow well without mycorrhizae

### **Fungi as Decomposers**

- Break down organic compounds in their surroundings
- Carry out extracellular digestion and absorption
- Plants benefit because some carbon and nutrients are released

### **A Variety of Roles**

- Pathogens
- Spoilers of food supplies
- Used to manufacture
  - Antibiotics
  - Cheeses

### **Fungi Are Heterotrophs**

- Cannot carry out photosynthesis
- Must acquire organic molecules from the environment
- Most are saprobes
  - Get nutrients from nonliving organic matter
- Some are parasites
  - Extract nutrients from a living host

### **The Mycelium**

- Most fungi produce a multicellular feeding structure called a mycelium
- It consists of branching tubular cells called hyphae
- Cell walls contain chitin

### **Mycelium**

#### **Mycelium**

#### **Extracellular Digestion**

- Mycelium grows into food source
- Tips of hyphae secrete digestive enzymes
- Enzymes break down organic material into simple forms that can be absorbed by hyphae

#### **Fungal Life Cycle**

- No motile stage
- Asexual and sexual spores produced
- Spores germinate after dispersal
- In multicelled species, spores give rise to a new mycelium

#### **Fungal Classification**

- Fungi known from 900 mya
- 56,000 known species
- Three major lineages:
  - Zygomycota

- Ascomycota (sac fungi)
- Basidiomycota (club fungi)
- Imperfect fungi are those not yet classified

### Diversity of Club Fungi

- 25,000 species
- Mushrooms
- Shelf fungi
- Coral fungi
- Stinkhorns
- Puffballs

### Fungal Spores

- Made up of one or a few cells
- Can resist dehydration
- Remain dormant until environmental conditions favor germination
- Produced asexually or sexually
- Fungal classification is based on type of sexual spores

### Types of Sexual Spores

- Club fungi make basidiospores on the surface of a club-shaped cell (basidium)
- Sac fungi produce ascospores inside a parent cell called an ascus
- Zygomycete hyphae fuse to produce a thick-walled zygospore

### Imperfect Fungi

- Species have never been observed to form sexual spores
- Many do make asexual spores
- Predatory fungus *Arthrobotrys dactyloides* captures prey in nooselike hyphae

### Imperfect Fungi

#### Predatory fungus

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#### A Zygomycete Life Cycle - 1

- *Rhizopus stolonifer* can reproduce sexually or asexually
- Sexual reproduction occurs, then hyphae of mating strains meet

- At point of contact, hyphae form gametangia

#### **A Zygomycete Life Cycle - 2**

- Gametangia tips fuse; form zygosporangium
- Nuclei inside zygosporangium fuse to produce a diploid zygospore
- Zygospore may remain dormant
- Meiosis of zygote nuclei produces haploid spores

#### **Imperfect Fungi**

#### **Zygomycete life cycle**

#### **Section 24.3: Weblinks and InfoTrac**

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#### **Club Fungus Life Cycle - 1**

- Hyphal cells of two mating strains meet
- Cytoplasm fuses to form dikaryotic mycelium
- Reproductive structure (basidiocarp) forms

#### **Club Fungus Life Cycle - 2**

- Spore-bearing structures form on basidiocarp
- Nuclei fuse to produce a zygote
- Zygote undergoes meiosis to produce haploid spores
- Spores give rise to haploid mycelia

#### **Club Fungus Life Cycle**

#### **Club Fungus Life Cycle**

#### **Club fungus life cycle**

#### **Section 24.4: Weblinks and InfoTrac**

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#### **Sac Fungi (Ascomycota)**

- Most diverse group (30,000 species)
- Produce asexual spores called conidia
- Produce sexual ascospores in sac-shaped cells called asci
- Multicelled species form reproductive structures called ascocarps that enclose the asci

#### **Example of Sac Fungus**

#### **Sac Fungus**

#### **Sac fungi**

#### **Section 24.5: Weblinks and InfoTrac**

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➤ Biology, 2004, Vol. 8, *Mold Exposure* (2:43)

#### Fungal Foes

➤ Most fungi are vital decomposers and plant symbionts

➤ Small proportion are plant pathogens

➤ Tiny minority adversely affect human health

#### Plant Pathogens

➤ Ascomycetes are responsible for

- Chestnut blight
- Dutch elm disease
- Apple scab

➤ Basidiomycetes cause smuts of cereal grains

#### Human Pathogens & Toxins

➤ Ascomycetes cause

- Histoplasmosis
- Valley fever
- *Candida* ("yeast") infections
- Ringworm
- Athlete's foot
- Ergotism

➤ Eating some basidiomycetes can be fatal

#### Histoplasmosis

➤ Respiratory disease

➤ Caused by inhalation of spores of *Ajellomyces capsulatus*

➤ Spores are found in soil, especially where there are bird or bat droppings

➤ Can be fatal in people with weakened immune systems

#### *Claviceps purpurea*

➤ Ascomycete that parasitizes cereal grains

➤ Produces alkaloids

- Some have been used medically
- Ingestion causes ergotism
  - Hallucinations, vomiting, diarrhea

#### Section 24.6: Weblinks and InfoTrac

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#### Lichen: A Composite Organism

➤ Fungal mycobiont plus a photosynthetic photobiont

➤ Fungal component usually is ascomycete

➤ Photobiont is cyanobacteria or green algae

➤ Fungus composes bulk of the structure

## Lichens

### Lichens

## Mycorrhizae

- Mutualistic fungus and tree roots
- Ectomycorrhizae
  - Hyphae form net around roots
  - Common in temperate forests
- Endomycorrhizae
  - Fungus actually enters root cell
  - Form in 80% of vascular plants
  - Zygomycetes are the fungal partners

## Mycorrhiza

### Mycorrhiza

#### Fungi in Decline?

- Numbers and kinds of mushrooms are declining
- Decline correlates with rising air pollution
- If the fungal symbionts of trees and other plants are killed, ecosystems will be disrupted