• 1 Describe three traits that are characteristic of the fungi
• 2 What are the three major groups of fungi we discussed in class
• 3 Hyphae are the main structures produced by fungi: what other structures do they produce and what is their purpose
• 4 Compare and contrast asexual vs. sexual spores: provide some names and their different function
- Symptoms of bacterial, phytoplasma and viral diseases

- Fungi: traits that make them the perfect plant pathogens: indefinite growth, extracellular digestion, modified structures such as sclerotia, stroma, rhizomorphs, sexual and asexual reproduction

-- Ascomycetes: meiospores in sacks (asci) contained within fruiting bodies of various shapes. Life cycle mostly n. A few macromycetes, most micromycetes

- Basidiomycetes: meiospores naked carried by sterigma on basidia (club): forcible ejection, life cycle mostly n+n

- Fungi impercti: no sexual stage but DNA analyses show they are mostly ascomycetes
Oomycetes (Div. Oomycota) Kingdom: straminopila (prev. Chromista)
Important group of forest pathogens, includes the genera *Pithyum* and *Phytophthora*. Although apparently similar to the fungi, oomycetes are an example of convergence, basically the same morphology was selected because of their lifestyle similar to that of the fungi. They all have a water dependant phase, they have cellulose in the cell wall, and are mostly 2n.
Types of disease

- **Infectious**: a disease that is caused by a pathogen which can spread from a diseased to a healthy host.

- **Non-infectious**: a disease that is caused by an environmental or host factor. It is not spread between a diseased and healthy individual.
Types of diseases

- Foliar diseases and blights
- Stem diseases: cankers, wilts
- Trunk rots
- Root diseases
- Seedling diseases
- Fruit and flower disease
<table>
<thead>
<tr>
<th>Type</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cankers</td>
<td>Death of cambium</td>
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<tr>
<td></td>
<td>typical target</td>
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<td></td>
<td>diffuse</td>
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<tr>
<td></td>
<td>with ooze</td>
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<tr>
<td></td>
<td>cold or heat, mechanical</td>
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<tr>
<td>Leaf spots</td>
<td>Death of a few or many leaf cells</td>
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<tr>
<td></td>
<td>angular or circular—on deciduous hardwoods</td>
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<td></td>
<td>spot bordered by yellow or brown bar—on conifers</td>
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<td></td>
<td>air pollution, toxic chemicals, temperature extremes</td>
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<tr>
<td>Decay</td>
<td>Death of parenchyma cells in wood of roots and stems of living trees</td>
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<tr>
<td></td>
<td>sap, white, and brown decays</td>
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<tr>
<td>Vascular wilts</td>
<td>Death of parenchyma cells in wood of roots and stems of living trees</td>
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<tr>
<td></td>
<td>sap, white, and brown decays</td>
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<td>Blight, or dieback</td>
<td>Sudden dying of all or part of tree—due to vascular wilt, sudden</td>
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<td></td>
<td>temperature change, air pollution, or drought</td>
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<td>Hypertrophy</td>
<td>Overgrowth of tissues</td>
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<tr>
<td>Witches' brooms</td>
<td>Proliferation of adventitious buds—dwarf mistletoe</td>
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<td></td>
<td>&quot;Cronartium&quot; bushes—fusiform rust/broom rusts</td>
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<tr>
<td></td>
<td>genetic abnormality</td>
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<tr>
<td></td>
<td>mycoplasmas</td>
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<tr>
<td></td>
<td>some insects, mites and aphids</td>
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<tr>
<td>Leaf blister</td>
<td>Localized enlargements causing puckering</td>
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<tr>
<td>Galls</td>
<td>On leaves, stems or roots—due to insects, nematodes, or associated with</td>
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<tr>
<td></td>
<td>some cankers and rusts</td>
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<tr>
<td>Atrophy</td>
<td>Failure of Development or Growth of Plant or Some Organs</td>
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<tr>
<td>General, marginal, or interveinal chlorosis</td>
<td>Due to absence of chlorophyll</td>
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<tr>
<td></td>
<td>caused by pathogens, toxins, mineral deficiency, air pollution, drought, excess water, or chemical burns</td>
</tr>
<tr>
<td>Dwarfing</td>
<td>Due to root disease, mineral deficiency, or mycoplasmas</td>
</tr>
</tbody>
</table>
FIGURE 2.3 Schematic representation of the effects of diseases on tree health, showing vital functions of a tree and their impairment by various types of pathogenic influences.
Foliar diseases
Sycamore anthracnose caused by *Apiognomonia venata*

Oak anthracnose caused by *Apiognomonia errabunda*
Hypodermella larcis on larch
Vascular wilts
Dutch elm disease (*Ophiostoma ulmi* and *O. novo-ulmi*)
Black stain root disease

*Leptographium wagneri*

On Douglas-fir
Trunk rots
Seedling diseases
“Native diseases”:

- Indigenous microbes
- Plant ecosystems have co-evolved to resistance
- Native diseases are an important component of forest ecosystems
“Roles of native diseases”:

- Thin natural populations of trees
- Optimal allocation of resources
- Selection for a genetically diverse host population
- Maintain tree ranges
- Succession: nutrient cycling and host species selection
The endophytic-pathogenic saprobic continuum

- Many tree disease can be latent or endophytic for decades
- A change in water/oxygen ratio in the tree will trigger the shift from endophytism to pathogenic lifestyle
- Several causes for such change in water/oxygen ratio: age, root or vascular diseases, drought, change in water table, wounding or mechanical damage, self pruning
- Pathogen kills host and then continues to decay wood as a saprobe
- Fungal pathogens are the only organisms to be able to effectively decay lignin and wood
- Fungi play a key role in the C and nutrient cycling of forest ecosystems
“Emergent diseases”: diseases on the rise

• New introduced, exotic, organisms

• Good gone bad: e.g. climate change or human activities trigger excessive pathogenicity of native organism
DISEASE TRIANGLE

Host

Pathogen

Environment
DISEASE TRIANGLE

HIGH DISEASE

Host

Pathogen

Environment
Pathogen

Does it need a wound to infect a host?

Can it survive in the environment without a host?
  soil, water
  on alternate host

How does it move around?
  airborne/waterborne
  animal vectors
  humans
Host

Must be physically present with pathogen

Must be physically compatible with pathogen

Must provide window of opportunity for infection

Genetic resistance?
  often lack of resistance
  if disease is introduced

What type of resistance?
  simple = one gene
  complex = several genes
Environment

Climatic

As modified per human management

Species composition

Plant density