


THERE'S A FUNGUS AMONG US

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Objectives

1. Discuss the epidemiology of various fungi.
2. Examine risk factors for fungal infections.
3. Describe laboratory techniques used to identify various fungi.



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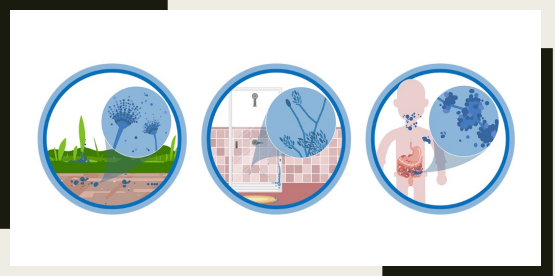
What are fungi?

- Classified separately from plants or animals
- Many live naturally in our body
- Spread by spores in air or on surfaces

Estimated to be **MILLIONS** of fungi in the world

Very small number cause human infection

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Why does it grow indoors?

Food sources

+

Temp.

+

Moisture

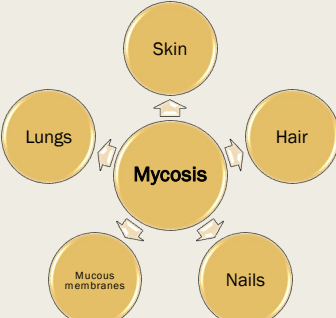
Fungal growth

Why does it grow indoors?

WATER INTRUSION

WATER VAPOR

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ANYONE can get a fungal infection!

- Most common fungal infections are not life-threatening
- Some more serious infections affect people that live or visit certain areas
- Immunocompromised people at highest risk

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Mold allergies

- Immune system overreacts when spores are inhaled
- Symptoms vary
- Often linked to asthma
- Affected by weather?
 - Spores spread in dry, windy weather
 - Spores in fog or dew with high humidity

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Mold allergies

- Many molds grow outdoors:
 - Rotting logs
 - Fallen leaves
 - Compost piles
 - Grass & grains
- Symptoms most common July through early fall
 - Year-round in warmer, humid climates

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Symptoms of mold allergies

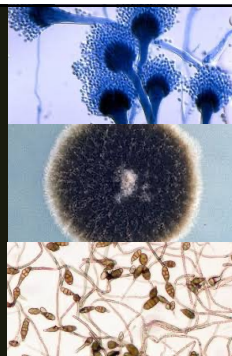
- Itchy nose, eyes, and/or throat
- Sneezing
- Congestion
- Runny nose
- Cough
- Postnasal drip
- Asthma symptoms if you have allergic asthma

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Common molds that cause allergy symptoms

- *Alternaria*
- *Aspergillus*
- *Cladosporium*
- *Penicillium*



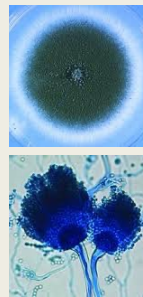
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Allergic Bronchopulmonary Aspergillosis

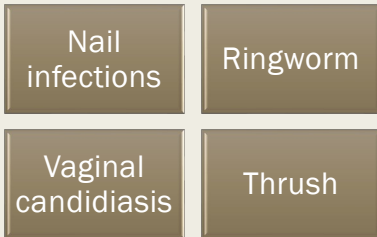
- Allergy or sensitivity *Aspergillus fumigatus*
- Both an allergic and inflammatory response to the mold
- Wheezing, coughing, shortness of breath
- Highest risk → people with asthma
 - Cough with brown flecks or bloody mucus
 - Fever
 - Weakness

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Most common fungal diseases:



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Fungal nail infections



- Onychomycosis
- Affects up to 14% population
- Typically, not serious
 - Discolored, thick nails
 - Cracked or fragile
 - Nail may separate from nail bed
- Often have concurrent skin infection (athlete's foot)



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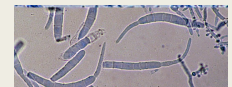
Fungal nail infections – higher risk

- Nail injury or foot deformity
- Trauma
- Diabetes
- Weakened immune system
- Venous insufficiency
- Fungal skin infections on other parts of the body

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Diagnosing fungal nail infection

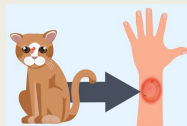
- Nail clippings sent to mycology lab
- Direct microscopy with KOH
- Fungal culture to identify dermatophyte
 - *Trichophyton rubrum* most common
- Often difficult to treat



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Tinea aka “Ringworm”

- Caused by dermatophytes
- Very common
- Anyone can get ringworm
 - Easily transmittable
- Fungi survives on skin, surfaces, and household items
- Distinctive circular rash
 - Red & itchy



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Tinea is named for location of infection

- Feet (tinea pedis, commonly called “athlete’s foot”)
- Groin, inner thighs, or buttocks (tinea cruris, commonly called “jock itch”)
- Scalp (tinea capitis)
- Beard (tinea barbae)
- Hands (tinea manuum)
- Toenails or fingernails (tinea unguium, also called “onychomycosis”)

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Signs & Symptoms of Tinea

- Itchy skin
- Ring-shaped rash
- Red, scaly, cracked skin
- Hair loss

Appear 4-14 days following exposure



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Ringworm and Pets



- Ringworm is easily transmitted from animals to humans
- Most common in dogs and cats
- Wash hands well after handling animals
- Wear gloves and long-sleeves if handling an animal with ringworm
- Take pet to vet if ringworm is suspected

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Tinea

- ~40 different species of fungi may cause tinea/ringworm
 - *Trichophyton*
 - *Microsporum*
 - *Epidermophyton*
- Diagnosed with KOH & fungal culture from skin scraping

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Treatment for ringworm

- Athlete's foot → over-the-counters anti-fungal medications
- Tinea capitis → Requires systemic anti-fungal medications
- Tinea corporis/tinea cruris → topical anti-fungal medications

DO NOT treat with corticosteroid creams!

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Vaginal candidiasis aka "yeast infection"

- Infection caused by *Candida*
- *Candida* is normal flora of skin, GI tract, mouth, vagina
- Causes infection when conditions change that promote growth of *Candida*
 - Hormones
 - Antibiotics
 - Weakened immune system
 - Diabetes

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Vaginal candidiasis

- Symptoms
 - vaginal itching and soreness
 - Pain during sexual intercourse
 - Pain or discomfort when urinating
 - Abnormal vaginal discharge
- Symptoms often mild
- Diagnose with bacterial or fungal culture of vaginal discharge
- Treatment with fluconazole

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Vaginal pH & candidiasis

- Yeast flourish in acidic environment
 - *Lactobacillus* help maintain the acid pH
- Infections, antibiotics, douching, presence of menstrual blood, and postmenopause can change the pH

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Thrush (Oral candidiasis)



- Fungal infection in mouth or throat
 - Creamy, white lesions
- Caused by *Candida*
- Most commonly in babies and toddlers
- Caused by disturbance in balance of normal oral flora

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Risk factors for thrush

- Babies under 1 month old
- Toddlers
- Adults over 65 years old
- People that are immunocompromised

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Signs & Symptoms of Thrush

- Sudden onset
- Creamy, white, slight raised lesions in mouth
 - Most commonly on tongue or inner cheek
 - May be observed on tonsils, roof of mouth, gums, or throat
- Redness, pain, and swelling
- Loss of sense of taste
- Cottony feeling in the mouth

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Fungal infections that affect people that live or travel to certain areas

Blastomycosis

Cryptococcus gattii

Paracoccidioidomycosis

Coccidioidomycosis

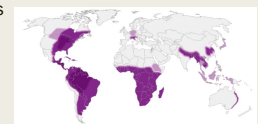
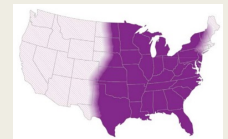
Histoplasmosis

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Histoplasmosis

- *Histoplasma capsulatum*
- Pulmonary infection
- Endemic in:
 - Ohio & Mississippi River Valleys
 - Southeastern U.S.
- Most common endemic mycosis in U.S.



CDC U.S. Department of Health and Human Services

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Histoplasma capsulatum

- In moist soil that has large amounts of bird or bat droppings
 - Bats carry *H. capsulatum* in GI tract
 - Birds carry *H. capsulatum* on feathers



Birds, bats, or their droppings were present in 77% of outbreak settings

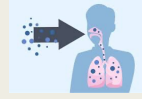


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Histoplasmosis

- Frequently asymptomatic
 - Granulomatous disease observed on chest x-ray
- Primary disease → Pulmonary
 - Acute pulmonary histoplasmosis
 - Mild, flu-like illness
 - Usually self limiting (~10 days)
 - 6% patients develop acute pericarditis
- Immunocompromised
 - More severe infection that may disseminate to other organs



Pets can get histoplasmosis, but it does not spread between pets and people or from person to person

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Pathogenesis of *H. capsulatum*

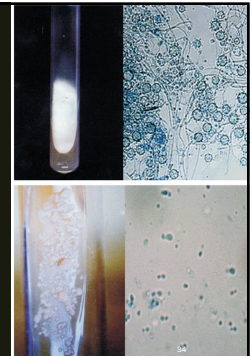
- Microconidia inhaled and penetrate alveoli
 - Pulmonary disease develops 3-17 days following inhalation of spores
- Convert to small budding yeast
 - Phagocytized by alveolar macrophages
- Yeast cleared through upper respiratory tract or may disseminate via bloodstream
- Dissemination may lead to life-threatening infection
 - Often of the reticuloendothelial system

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Histoplasma capsulatum

- Does not survive well in clinical specimens
 - Process immediately
- Slow growth – about 14 days
- Thermally dimorphic



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Histoplasmosis – Risk & Prevention

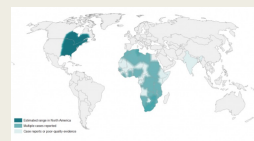
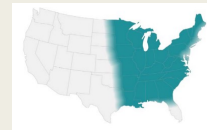
- Anyone can get the infection if they are in an area where *Histoplasma* is in the environment
- Higher risk:
 - Immunocompromised
 - Infants
 - Adults over age 55
- Difficult to avoid if living in endemic area
- People with weakened immune systems should avoid doing activities known to be associated with histoplasmosis

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Blastomycosis

- *Blastomyces dermatitidis*
- Pulmonary infection
- Endemic in:
 - Ohio & Mississippi River Valleys
 - Great Lakes region
 - Southeastern U.S.



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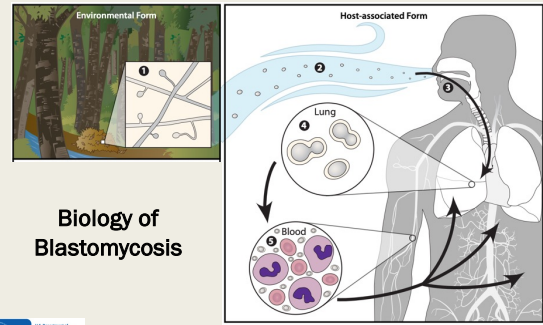
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Blastomyces dermatitidis

- Ubiquitous in soil and environment
- Pathogenesis:
 - Inhalation of spores is most common
 - May progress to acute respiratory distress syndrome (ARDS)
 - 25%-40% develop extrapulmonary infection → cutaneous, genitourinary, or CNS
 - Primary cutaneous blastomycosis is uncommon, but can result from traumatic inoculation

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Signs & Symptoms of Blastomycosis

- 50% of people are asymptomatic
- Initially, flu-like symptoms
 - Resolves in a few days
- Acute or chronic pneumonia
- Organism binds to macrophages, allowing dissemination through the blood and lymphatics
 - Causes a pyogranulomatous inflammatory response
 - Leads to extrapulmonary disease

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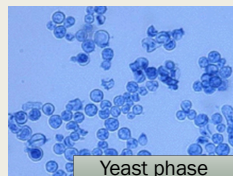
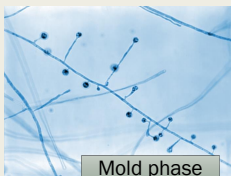
Blastomyces dermatitidis - Identification

- Does not survive well in clinical specimens
 - Process immediately
- Slow growth – about 14 days
- Thermally dimorphic



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Blastomyces dermatitidis



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Coccidioidomycosis (Valley Fever)

- *Coccidioides immitis*
- Endemic to arid regions of Western Hemisphere
- Clinical manifestations range from asymptomatic to fatal
- Typically, pulmonary infection



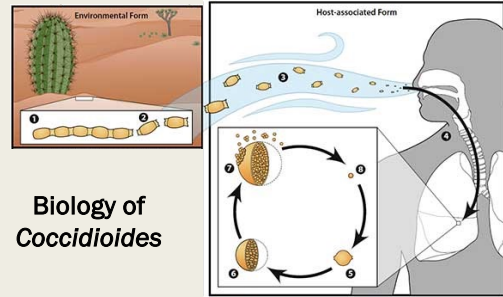
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Coccidioides immitis

- Found in soil in southwestern U.S., parts of Mexico, Central America, and South America
- Infected following inhalation of spores
- Primary disease: Pulmonary and cutaneous
 - Usually mild and self limiting
- Disseminates systemically
 - More severe and requires treatment

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Biology of *Coccidioides*

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Coccidioidomycosis

- Most people do not get sick following exposure
 - ~60% asymptomatic
- Pulmonary disease develops
 - 1-3 weeks after inhalation
 - Fatigue, cough, fever, shortness of breath
 - Headache, weight loss, rash
 - Often self-limiting (few weeks to a few months)
- Infection disseminates in 1% people (immunocompromised)



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Coccidioides immitis

- H&E stain on tissue: Observe large, round, thick-walled spherules that contain endospores
- Mold at 25-30 °C



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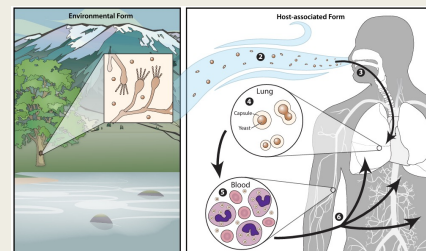
Cryptococcosis

- *Cryptococcus gattii*
 - Previously known as *Cryptococcus neoformans* serotypes B and C
- Usually affects lungs and/or central nervous system
- Fungi found in soil and trees, primarily in tropical and subtropical climates
- Most infections in humans and animals along west coast of U.S.

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Biology of *Cryptococcus gattii*



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Symptoms of *C. gattii* infection

LUNGS

- Pneumonia-like illness
- Cough
- Shortness of breath
- Chest pain
- Fever

Incubation period: 2-13 months following exposure

BRAIN

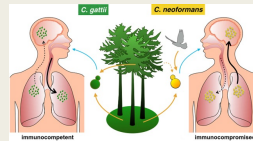
- Cryptococcal meningitis
- Headache
- Fever
- Confusion
- Neck pain
- Nausea & vomiting
- Sensitivity to light

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C. gattii

- Cryptococcosis
- Worldwide distribution
- Most disseminated infection is in immunocompromised



C. neoformans

- Cryptococcosis
- Prevalence in tropical and subtropical climates; recent outbreaks in Pacific Northwest U.S.
- Affects immunocompetent people

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Paracoccidioidomycosis

- *Paracoccidioides* sp.
- Endemic in parts of Central and south America
- Most often affects males that work outdoors in rural areas



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Paracoccidioidomycosis

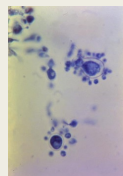
- Most people asymptomatic
- Usually affects lungs and skin
- Symptoms often differ:
 - Adults → pulmonary infection; lesions in mouth and throat
 - Children → swollen lymph nodes and skin lesions
- Affects immunocompromised and immunocompetent people

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Paracoccidioides - Identification

- Slow growth – about 21 days
- Thermally dimorphic



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Fungal infections that affect immunocompromised

- Many fungal infections are opportunistic
- Weakened immune systems cause people to be more prone to infections

Aspergillosis	<i>Candida auris</i>
Invasive candidiasis	<i>Cryptococcus neoformans</i>
Pneumocystis pneumonia	Candidiasis

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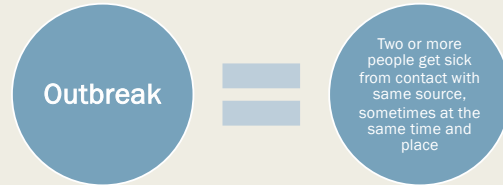
Healthcare-associated fungal infections

- Aspergillosis
- Candidemia
- *C. auris*
- Mucormucosis
- Weakened immune systems
- Outbreaks have been observed
- Prevention of HAI is critical

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Investigating fungal disease outbreaks



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Impact of Fungal Disease in U.S.

- Although many fungal infections are mild and treatable, other can cause serious illness and death
- Many people are affected
- Difficult to estimate the impact of fungal diseases:
 - Many fungal infections go undiagnosed
 - No national public health surveillance for common fungal infections (ringworm, vaginal candidiasis)
 - No national public health surveillance for certain serious fungal infections (cryptococcosis, aspergillosis)

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Impact of Fungal Disease in U.S.

- Cost:
 - Annual direct medical costs ~\$6.7-7.5 billion
- Healthcare visits/year:
 - >75,000 hospitalizations
 - ~9 million outpatient visits
- Infections/year
 - ~23,000 cases invasive candidiasis
 - >100,000 cases of coccidioidomycosis
- Deaths/year
 - ~7200 deaths from fungal disease

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Conclusion



- Fungi are EVERYWHERE!
- Fungal infections are not uncommon
- Exposure may cause a multitude of problems
- Only beginning to understand how the interconnections between humans, animals, & environment affect fungal diseases

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References

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