

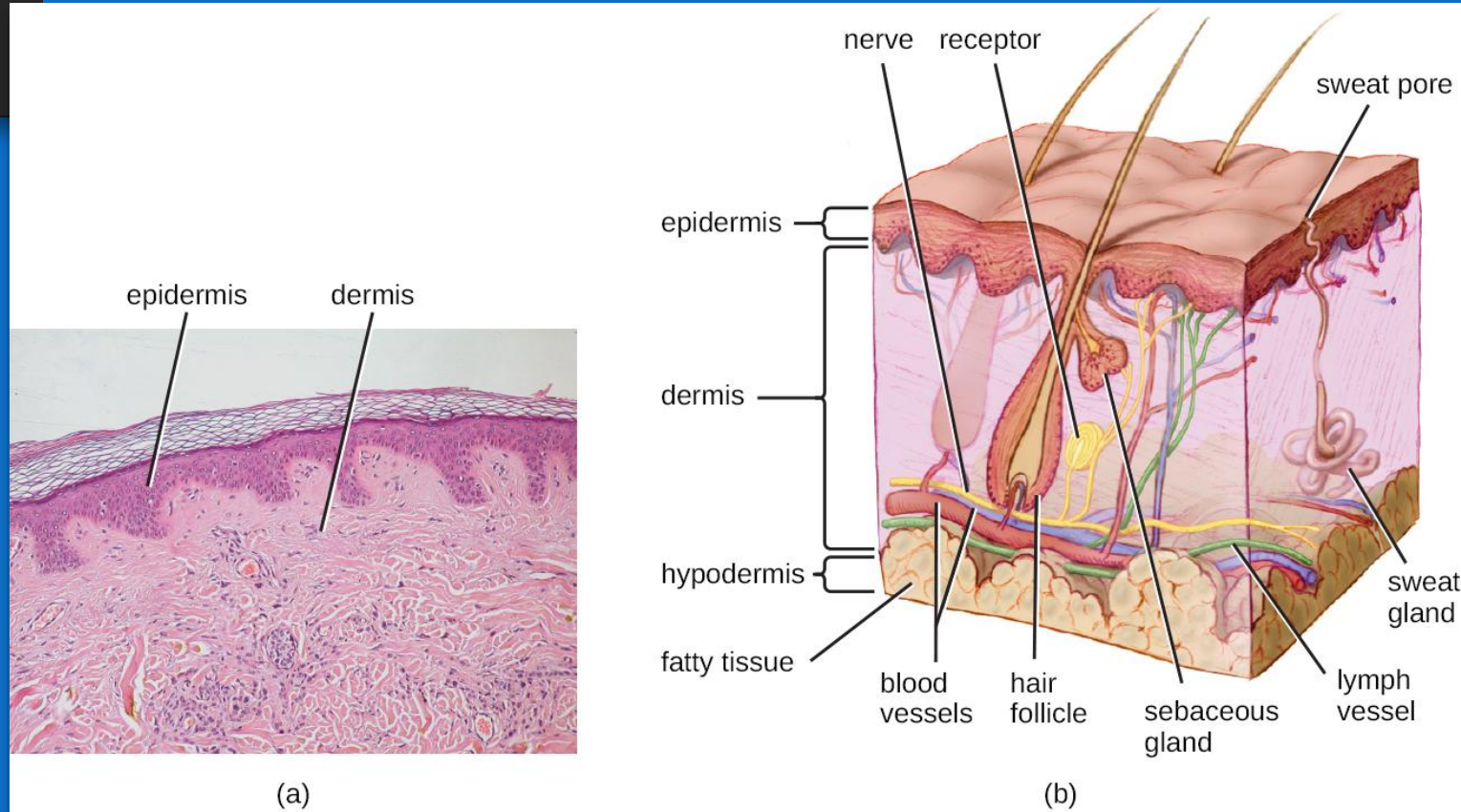


Skin and Eye Infections

OpenStax Microbiology Chapter 21

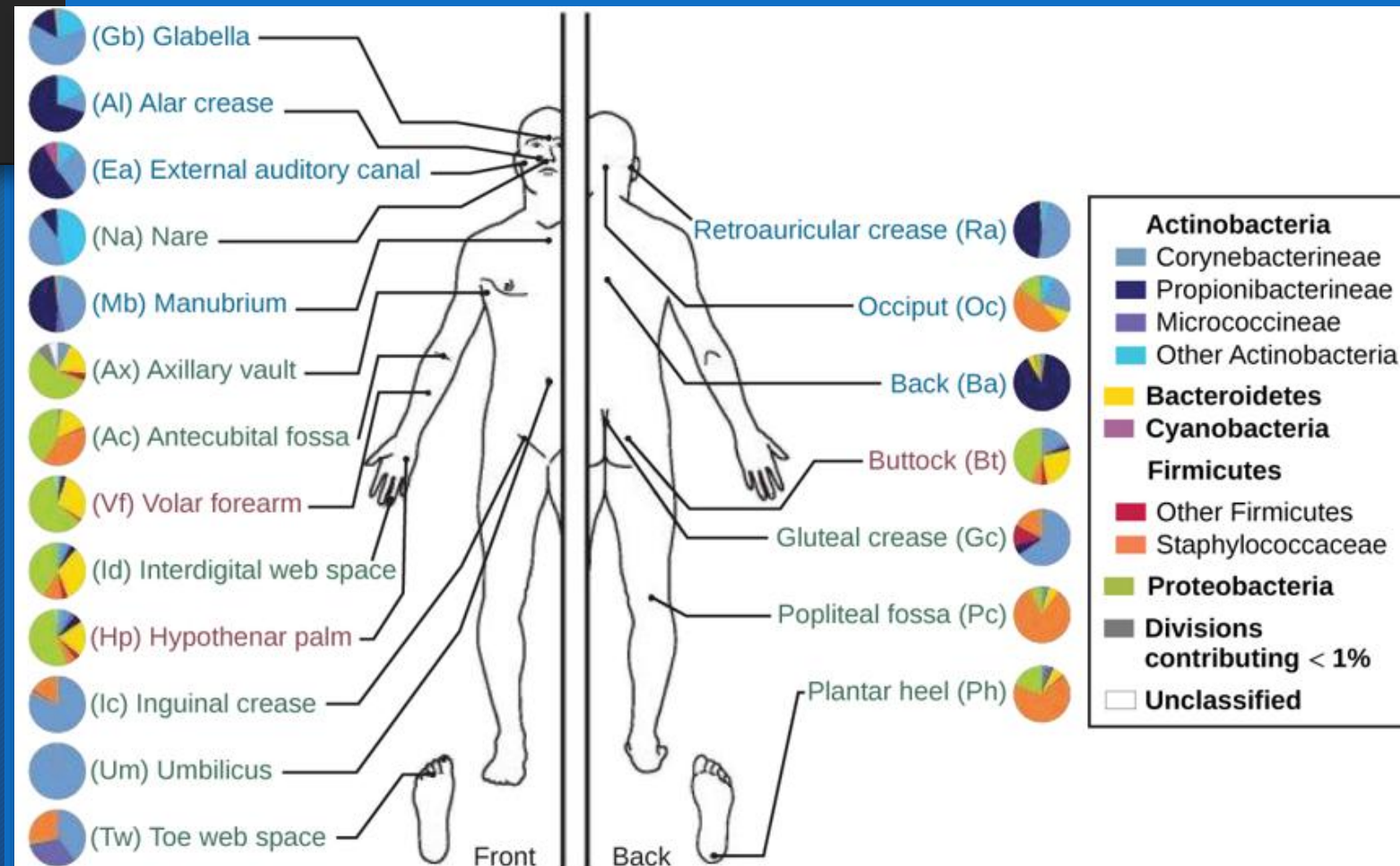
Skin Anatomy – Quick Review

- Lets review basic anatomy



Normal Skin Microbiota

- Wide variety of microbes
 - Some harmless
 - Some opportunistic
 - Inhibits transient microbe colonization

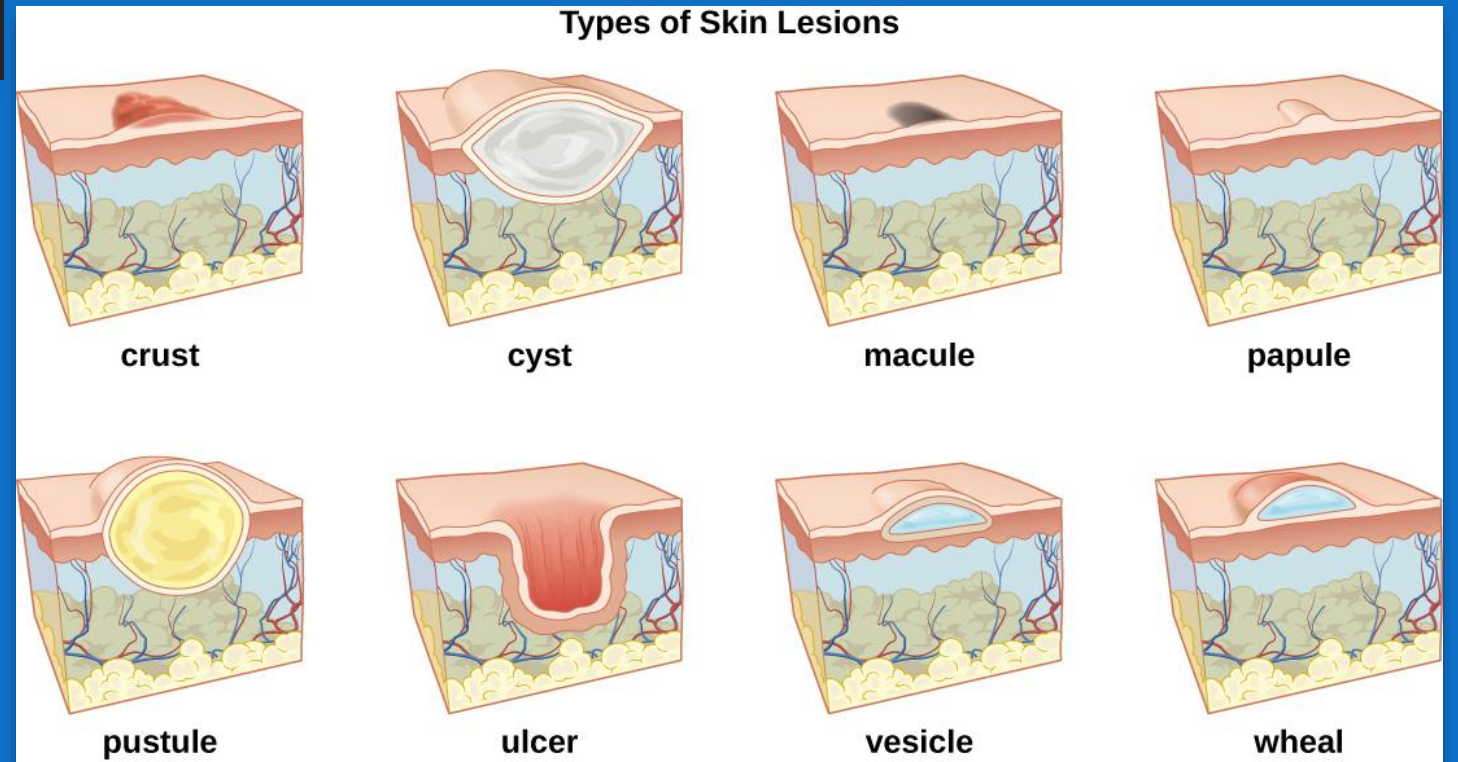


Infections of the Skin – Terminology

Some Medical Terms Associated with Skin Lesions and Rashes	
Term	Definition
abscess	localized collection of pus
bullae (pl., bullae)	fluid-filled blister no more than 5 mm in diameter
carbuncle	deep, pus-filled abscess generally formed from multiple furuncles
crust	dried fluids from a lesion on the surface of the skin
cyst	encapsulated sac filled with fluid, semi-solid matter, or gas, typically located just below the upper layers of skin
folliculitis	a localized rash due to inflammation of hair follicles
furuncle (boil)	pus-filled abscess due to infection of a hair follicle
macules	smooth spots of discoloration on the skin
papules	small raised bumps on the skin
pseudocyst	lesion that resembles a cyst but with a less defined boundary
purulent	pus-producing; suppurative
pustules	fluid- or pus-filled bumps on the skin
pyoderma	any suppurative (pus-producing) infection of the skin
suppurative	producing pus; purulent
ulcer	break in the skin; open sore
vesicle	small, fluid-filled lesion
wheal	swollen, inflamed skin that itches or burns, such as from an insect bite

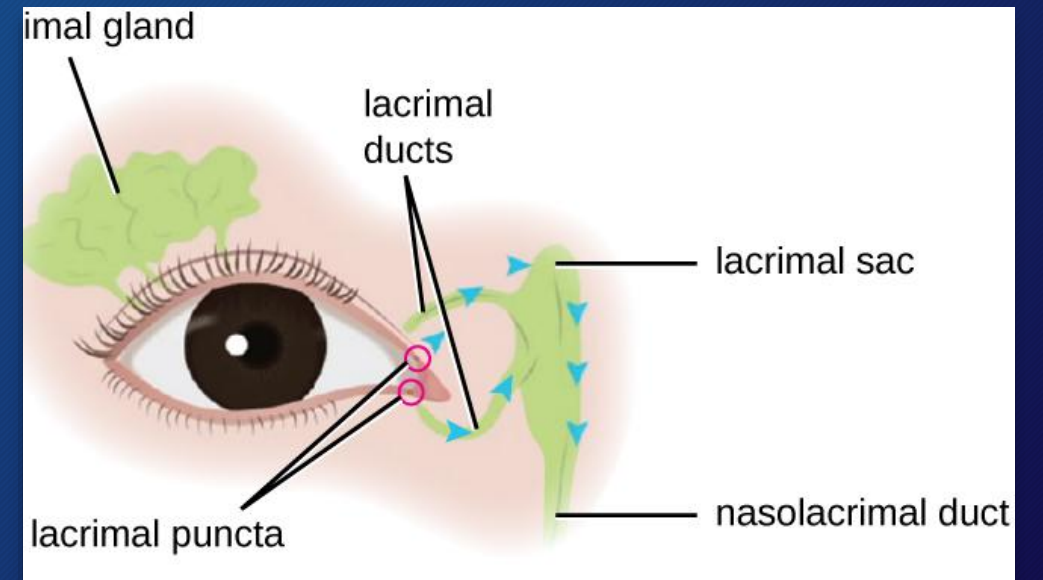
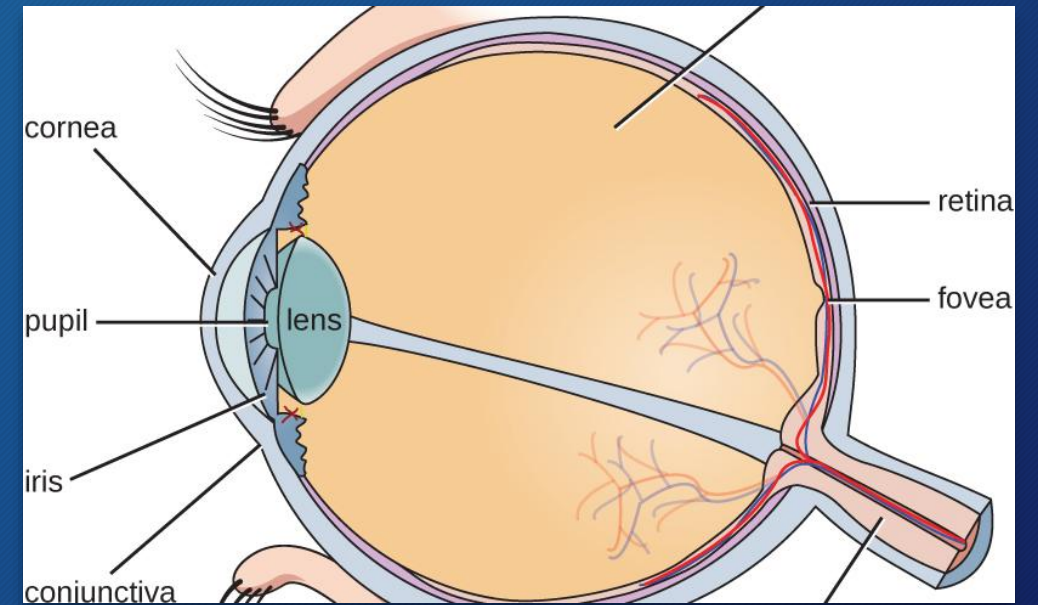
Types of Skin Lesions

- Can be helpful in diagnosis
 - Most not exclusive



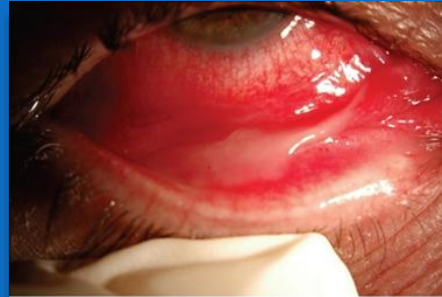
Anatomy of the Eye

- Lets review basic eye anatomy
 - Normal conjunctival microbiota does exist

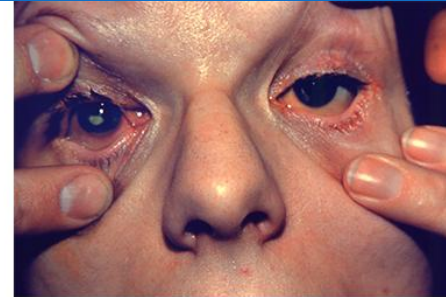


Infections of the Eye

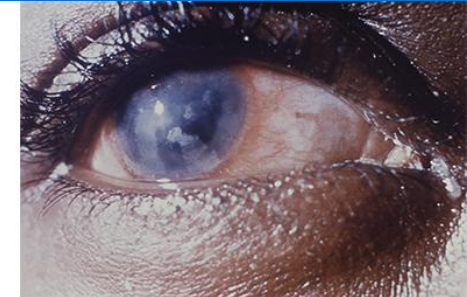
- Conjunctivitis
 - Inflammation of the conjunctiva
 - Acute or Chronic
- Blepharitis
 - Inflammation of eyelids
- Keratitis
 - Inflammation of cornea



(a)



(b)



(c)

Infections of the Eye

Types of Conjunctivitis and Blepharitis

Condition	Description	Causative Agent(s)
Acute purulent conjunctivitis	Conjunctivitis with purulent discharge	Bacterial (<i>Haemophilus</i> , <i>Staphylococcus</i>)
Acute hemorrhagic conjunctivitis	Involves subconjunctival hemorrhages	Viral (Picornaviridae)
Acute ulcerative blepharitis	Infection involving eyelids; pustules and ulcers may develop	Bacterial (<i>Staphylococcal</i>) or viral (herpes simplex, varicella-zoster, etc.)
Follicular conjunctivitis	Inflammation of the conjunctiva with nodules (dome-shaped structures that are red at the base and pale on top)	Viral (adenovirus and others); environmental irritants
Dacryocystitis	Inflammation of the lacrimal sac often associated with a plugged nasolacrimal duct	Bacterial (<i>Haemophilus</i> , <i>Staphylococcus</i> , <i>Streptococcus</i>)
Keratitis	Inflammation of cornea	Bacterial, viral, or protozoal; environmental irritants
Keratoconjunctivitis	Inflammation of cornea and conjunctiva	Bacterial, viral (adenoviruses), or other causes (including dryness of the eye)
Nonulcerative blepharitis	Inflammation, irritation, redness of the eyelids without ulceration	Environmental irritants; allergens
Papillary conjunctivitis	Inflammation of the conjunctiva; nodules and papillae with red tops develop	Environmental irritants; allergens

Bacterial Infections of the Skin and Eyes: Objectives

Identify the most common bacterial pathogens that cause infections of the skin and eyes

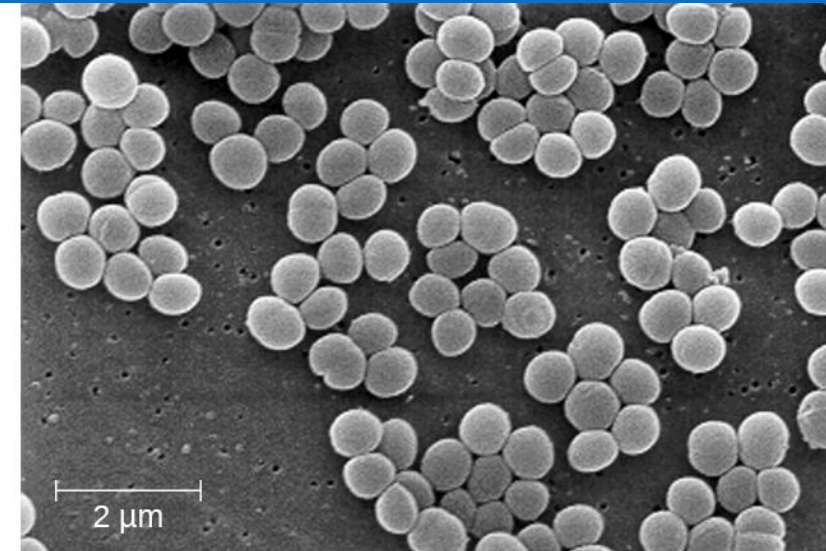
Compare the major characteristics of specific bacterial diseases affecting the skin and eyes

Staphylococcal Infections of the Skin

- Species commonly found on skin
 - *Staphylococcus epidermidis*
 - *Staphylococcus hominis*
 - *Staphylococcus aureus*
- Confirmation of Staph
 - Gram positive grape like clusters
 - Catalase positive
 - Coagulase test
 - Mannitol Salt Agar



(a)



(b)

Superficial Staphylococcal Infections

- *Staphylococcus aureus*
 - Often purulent
 - Folliculitis that progresses to furuncles or carbuncles



(a)



(b)

Staphylococcal Scalded Skin Syndrome

- *Staphylococcus aureus*
 - Toxins lead to erythema and peeling
 - Skin rubs off easily
 - IV antibiotics for treatment
 - Fluid therapy



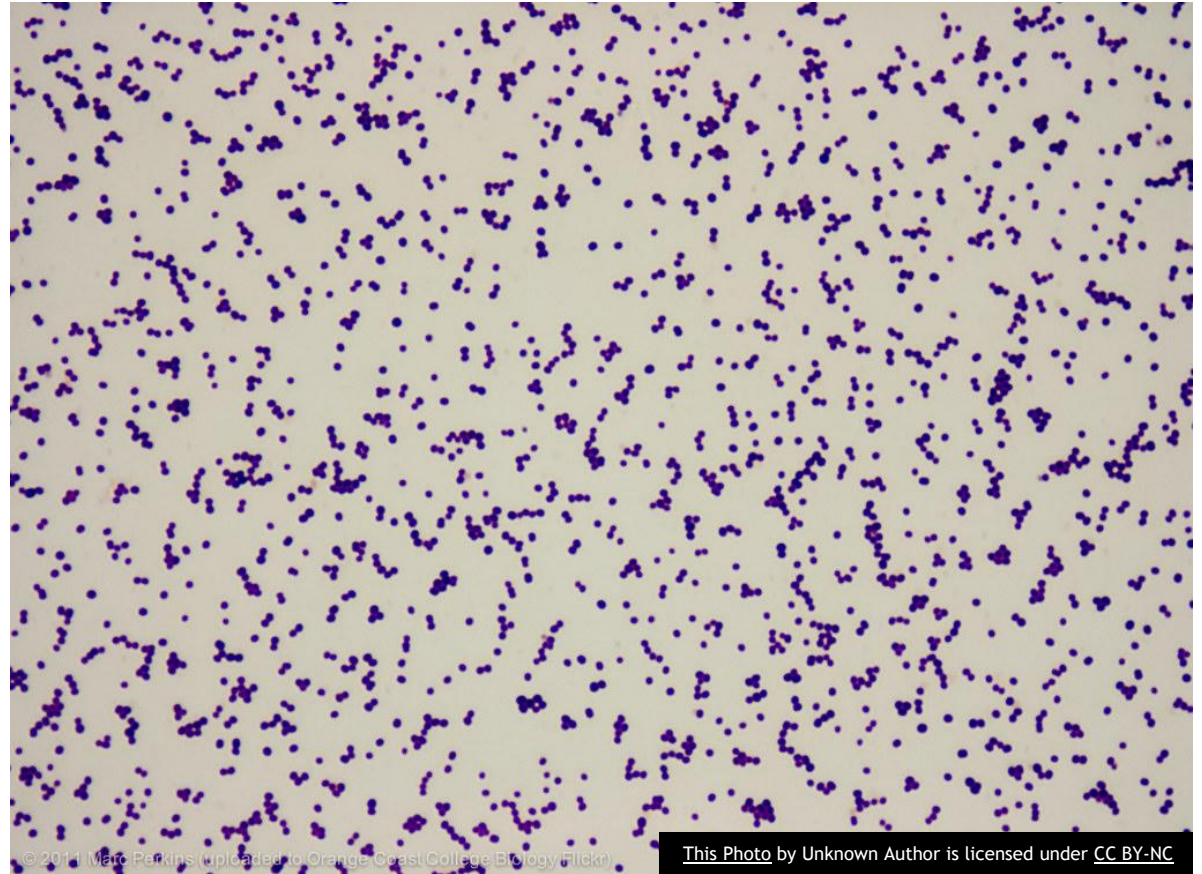
Impetigo

- *Staphylococcus aureus*
 - Common in children
 - Formation of vesicles, pustules, bullae
 - Highly contagious
- Nonbullous impetigo
 - Vesicles and pustules rupture
 - Become encrusted sores
- Bullous impetigo
 - Bullae fill and rupture
 - Larger lesions
- Treatment:
 - Topical or Oral antibiotic



Nosocomial *Staphylococcus epidermidis* infections

- Opportunistic pathogen
 - Medical devices such as catheters, prostheses, and indwelling medical devices
 - Once past the skin, infections become hard to treat



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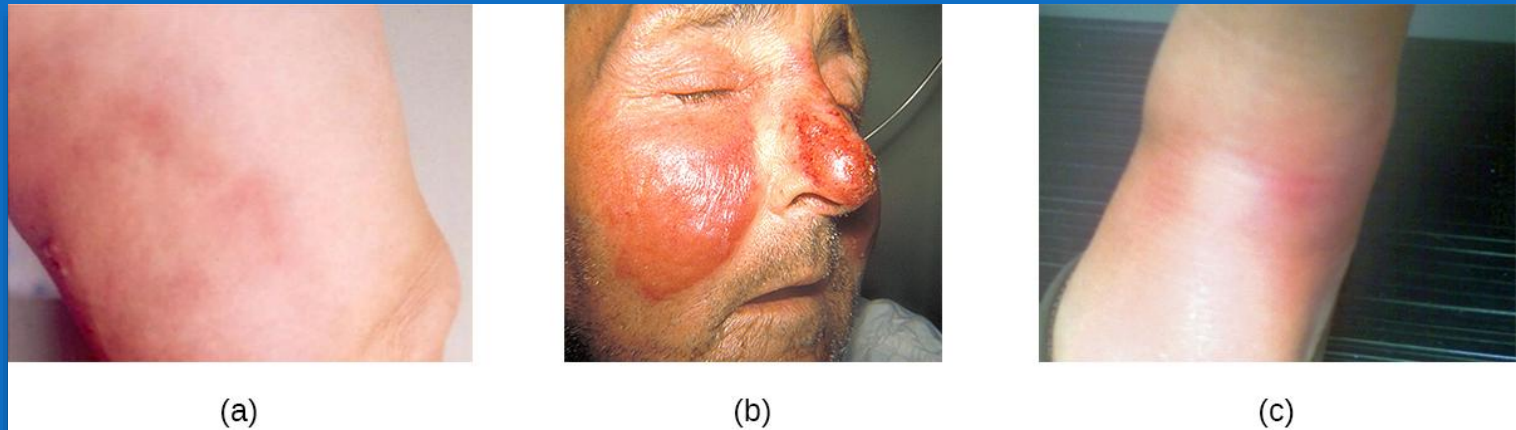
Streptococcal Infections of the Skin

- *Streptococci*
 - Gram positive chains of bacteria
- Pathogens are categorized in Lancefield groups
 - *Streptococcus pyogenes* (Group A streptococcus)
- *S. pyogenes*
 - Wide variety of extracellular enzymes
 - Capsule
 - M protein



Cellulitis, Erysipelas, Erythema Nodosum

- Cellulitis
 - Infection in dermis or hypodermis
 - *S. pyogenes* , Staphylococci
- Erysipelas
 - Large, intensely inflamed patch of skin
 - Suppurative
 - *S. pyogenes*
- Erythema nodosum
 - Inflammation of subcutaneous fat cells

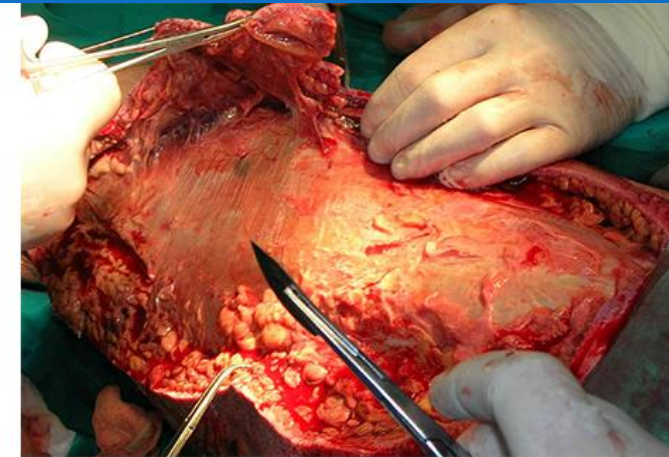


Necrotizing Fasciitis

- Flesh eating bacterial syndrome
 - *Streptococcus pyogenes*
 - *Klebsiella*
 - *Clostridium*
 - *Escherichia coli*
 - *Staphylococcus aureus*
- When caused by Streptococci:
 - Virulence factors overwhelm host cells
 - Aggressive infiltration and destruction
 - Rapid spread and tissue death
- Treatment
 - Debridement
 - IV antibiotics
 - Surgical



(a)



(b)

Pseudomonas Infections of the Skin

- *Pseudomonas aeruginosa*
 - Gram negative, oxidase positive, aerobic bacillus
 - Found in water, soil, and on skin
- Hot tub rash and Otitis externa



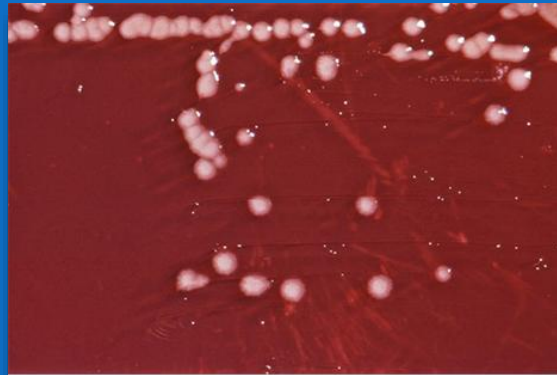
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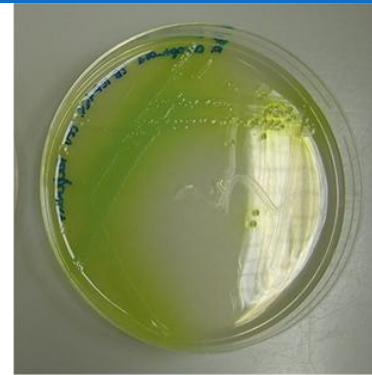
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Pseudomonas Wound Infections

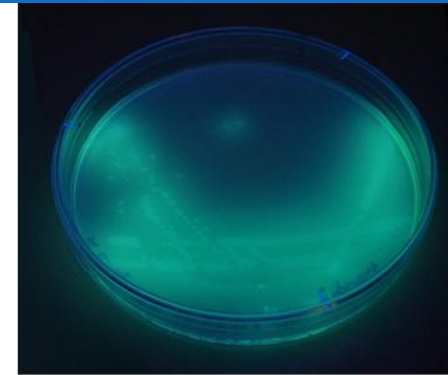
- Wounds
 - Grape soda
 - Corn tortillas
 - Possible pigmentation
- Treatment
 - Very resistant
 - Polymyxin B and Gentamicin
 - Fluoroquinolones



(a)



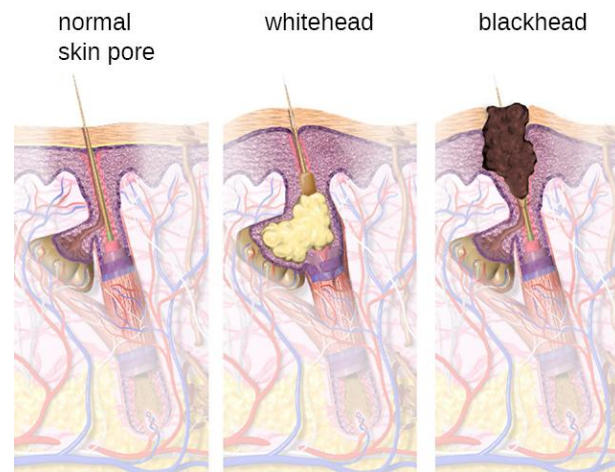
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(c)

Acne

- Ubiquitous skin condition
 - 80% of teenagers
 - Hair follicles become clogged
- Comedones
 - Whiteheads / blackheads / pimples
 - Lead to infection by *Propionibacterium acnes*
- *P. acnes*
 - Gram positive, non-spore forming, aerotolerant anaerobic bacillus
 - Consumes sebum
- Treatment:
 - Salicylic acid
 - Antibiotics



(a)



(b)

Anthrax

- *Bacillus anthracis*
 - Gram positive , endospore forming, facultative anaerobe
 - Main affects animals
 - Found in soil
- In Humans
 - 95-99% of cases anthrax enters through skin
 - Cutaneous Anthrax
 - Eschar
 - Untreated will lead to death in 20% of patients



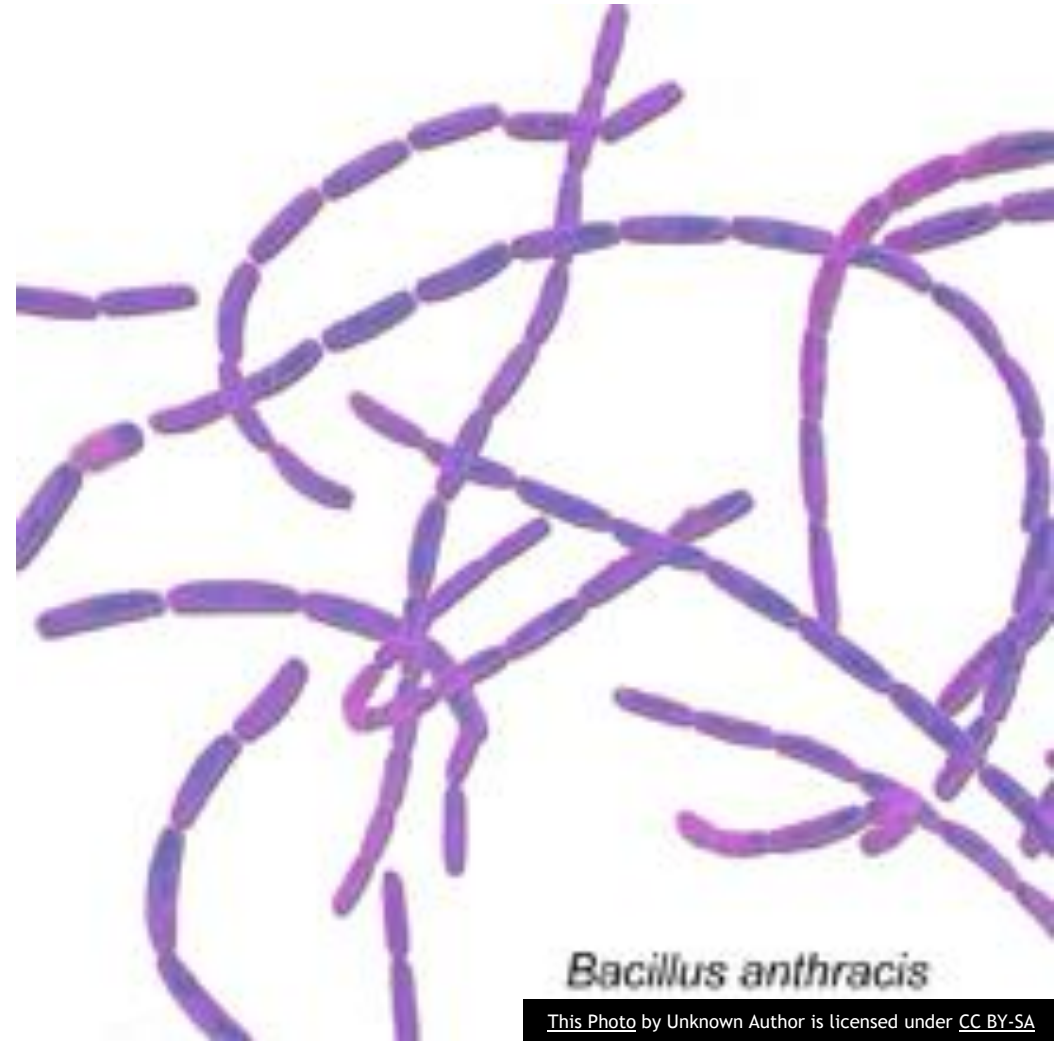
(a)



(b)

Anthrax

- Additional portals of entry
 - Digestive tract – 40% mortality even when treated
 - Respiratory tract – 45% mortality in treated, 85% when not treated
 - Injection anthrax
 - Biological weapon
- Treatment:
 - Vaccine
 - Antibiotics



Bacillus anthracis

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Bacterial Infections of the Skin

Bacterial Infections of the Skin				
Disease	Pathogen	Signs and Symptoms	Transmission	Antimicrobial Drugs
Acne	<i>Propionibacterium acnes</i>	Comedones (white-heads, blackheads); papules, pustules, nodules, or pseudocysts	Not transmissible; clogged pores become infected by normal skin microbiota (<i>P. acnes</i>)	Erythromycin, clindamycin
Anthrax (cutaneous)	<i>Bacillus anthracis</i>	Eschar at site of infection; may lead to septicemia and can be fatal	Entry of <i>B. anthracis</i> endospores through cut or abrasion	Penicillin, erythromycin, or tetracycline
Cellulitis	<i>Streptococcus pyogenes</i>	Localized inflammation of dermis and hypodermis; skin red, warm, and painful to the touch	Entry of <i>S. pyogenes</i> through cut or abrasion	Oral or intravenous antibiotics (e.g., penicillin)
Erysipelas	<i>S. pyogenes</i>	Inflamed, swollen patch of skin, often on face; may be suppurative	Entry of <i>S. pyogenes</i> through cut or abrasion	Oral or intravenous antibiotics (e.g., penicillin)
Erythema nodosum	<i>S. pyogenes</i>	Small red nodules, often on shins	Associated with other streptococcal infection	None or anti-inflammatory drugs for severe cases
Impetigo	<i>Staphylococcus aureus</i> , <i>S. pyogenes</i>	Vesicles, pustules, and sometimes bullae around nose and mouth	Highly contagious, especially via contact	Topical or oral antibiotics
Necrotizing fasciitis	<i>S. pyogenes</i> , <i>Klebsiella</i> , <i>Clostridium</i> , others	Infection of fascia and rapidly spreading tissue death; can lead to septic shock and death	Entry of bacteria through cut or abrasion	Intravenous broad-spectrum antibiotics
Otitis externa	<i>Pseudomonas aeruginosa</i>	Itching, redness, discomfort of ear canal, progressing to fever, pain, swelling	<i>P. aeruginosa</i> enters ear canal via pool or other water	Acidic ear drops with antibiotics, antifungals, steroids
Staphylococcal scalded skin syndrome (SSSS)	<i>S. aureus</i>	Erythema and severe peeling of skin	Infection of skin and mucous membranes, especially in children	Intravenous antibiotics, fluid therapy
Wound infections	<i>P. aeruginosa</i> , others	Formation of biofilm in or on wound	Exposure of wound to microbes in environment; poor wound hygiene	Polymyxin B, gentamicin, fluoroquinolones, topical anti-biofilm agents

Bacterial Conjunctivitis

- Many causes
 - *Haemophilus influenzae*
 - *Moraxella catarrhalis*
 - *Streptococcus pneumoniae*
 - *Staphylococcus aureus*
 - Identified with cultures
- Treatment
 - Topical antibiotics



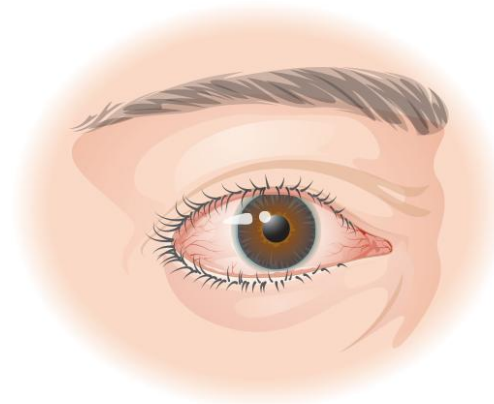
Neonatal Conjunctivitis

- Caused by:
 - *Neisseria gonorrhoeae*
 - *Chlamydia trachomatis*
- Prevention:
 - Antibacterial cream/drops at birth
 - Seriously complications if not treated

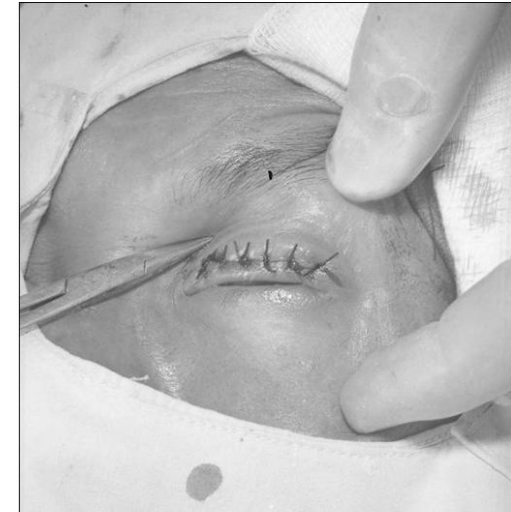


Trachoma

- Caused by:
 - *Chlamydia trachomatis*
 - Rare in the United States
 - Spread by flies
- Treatment
 - Azithromycin
 - Reducing transmission



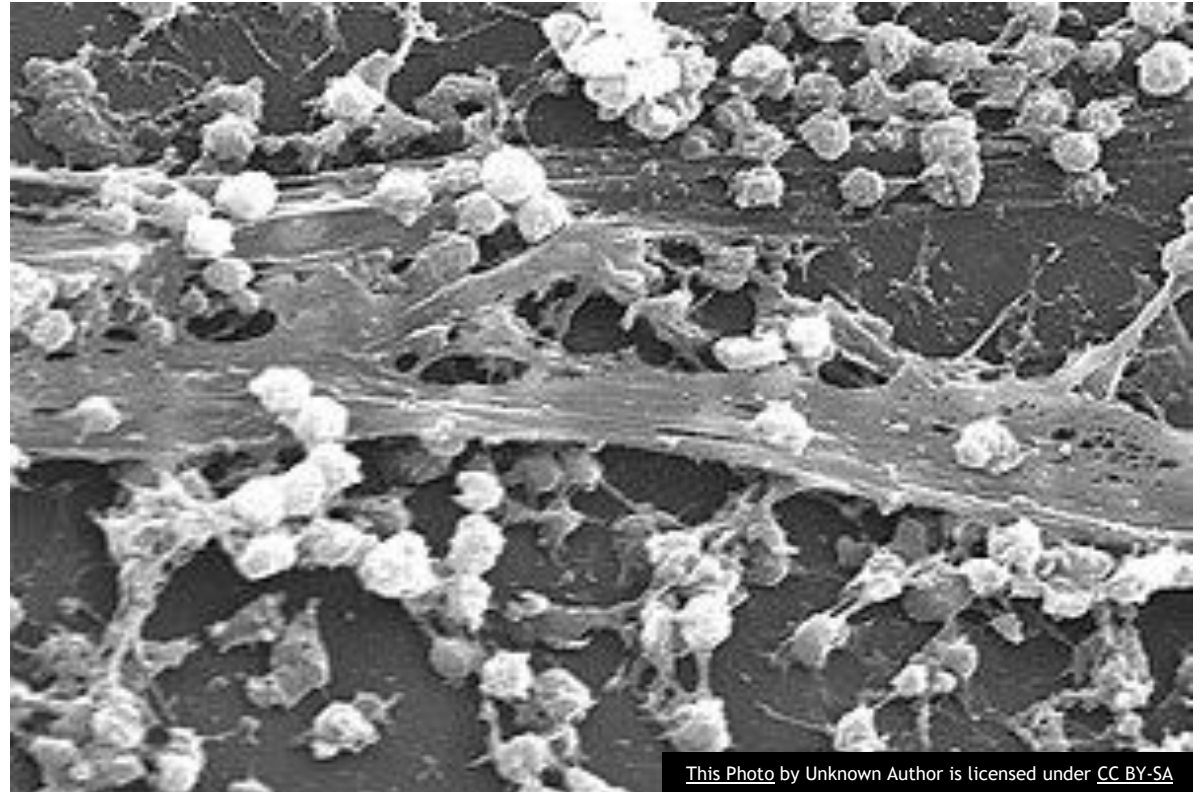
(a)



(b)

Bacterial Keratitis and Biofilms

- Keratitis
 - *Staphylococcus epidermidis*
 - *Pseudomonas aeruginosa*
- Biofilms
 - *Staphylococcus aureus*
 - *Pseudomonas aeruginosa*



Bacterial Infections of the Eye

Bacterial Infections of the Eyes				
Disease	Pathogen	Signs and Symptoms	Transmission	Antimicrobial Drugs
Acute bacterial conjunctivitis	<i>Haemophilus influenzae</i>	Inflammation of conjunctiva with purulent discharge	Exposure to secretions from infected individuals	Broad-spectrum topical antibiotics
Bacterial keratitis	<i>Staphylococcus epidermidis</i> , <i>Pseudomonas aeruginosa</i>	Redness and irritation of eye, blurred vision, sensitivity to light; progressive corneal scarring, which can lead to blindness	Exposure to pathogens on contaminated contact lenses	Antibiotic eye drops (e.g., with fluoroquinolones)
Neonatal conjunctivitis	<i>Chlamydia trachomatis</i> , <i>Neisseria gonorrhoeae</i>	Inflammation of conjunctiva, purulent discharge, scarring and perforation of cornea; may lead to blindness	Neonate exposed to pathogens in birth canal of mother with chlamydia or gonorrhea	Erythromycin
Trachoma (granular conjunctivitis)	<i>C. trachomatis</i>	Chronic conjunctivitis, trichiasis, scarring, blindness	Contact with infected individuals or contaminated fomites; transmission by eye-seeking flies	Azithromycin

Viral Infections of the Skin and Eyes: Objectives

Identify the most common viruses associated with infections of the skin and eyes

Compare the major characteristics of specific viral diseases affecting the skin and eyes

Papillomas

- Human papillomavirus (HPV)
 - Common warts
 - Plantar warts
 - Flat warts
 - Filiform warts
- Treatment
 - Freezing
 - Salicylic acid
 - Electrosurgery
 - Curettage
 - Excision



(a)



(b)

Oral Herpes

- Herpes simplex virus
 - HSV-1
 - HSV-2
- Latent virus
 - Trigeminal nerve
- Treatment
 - Acyclovir
 - Penciclovir
 - Famciclovir
 - Valacyclovir



Roseola and Fifth Disease

- Roseola
 - Human Herpes Virus 6
 - Human Herpes Virus 7
 - Mild infection
 - Common in children
 - High fever
- Fifth Disease
 - Parvovirus B19
 - 20% of infected individuals are asymptomatic
 - Adults may require treatment and may have more serious problems



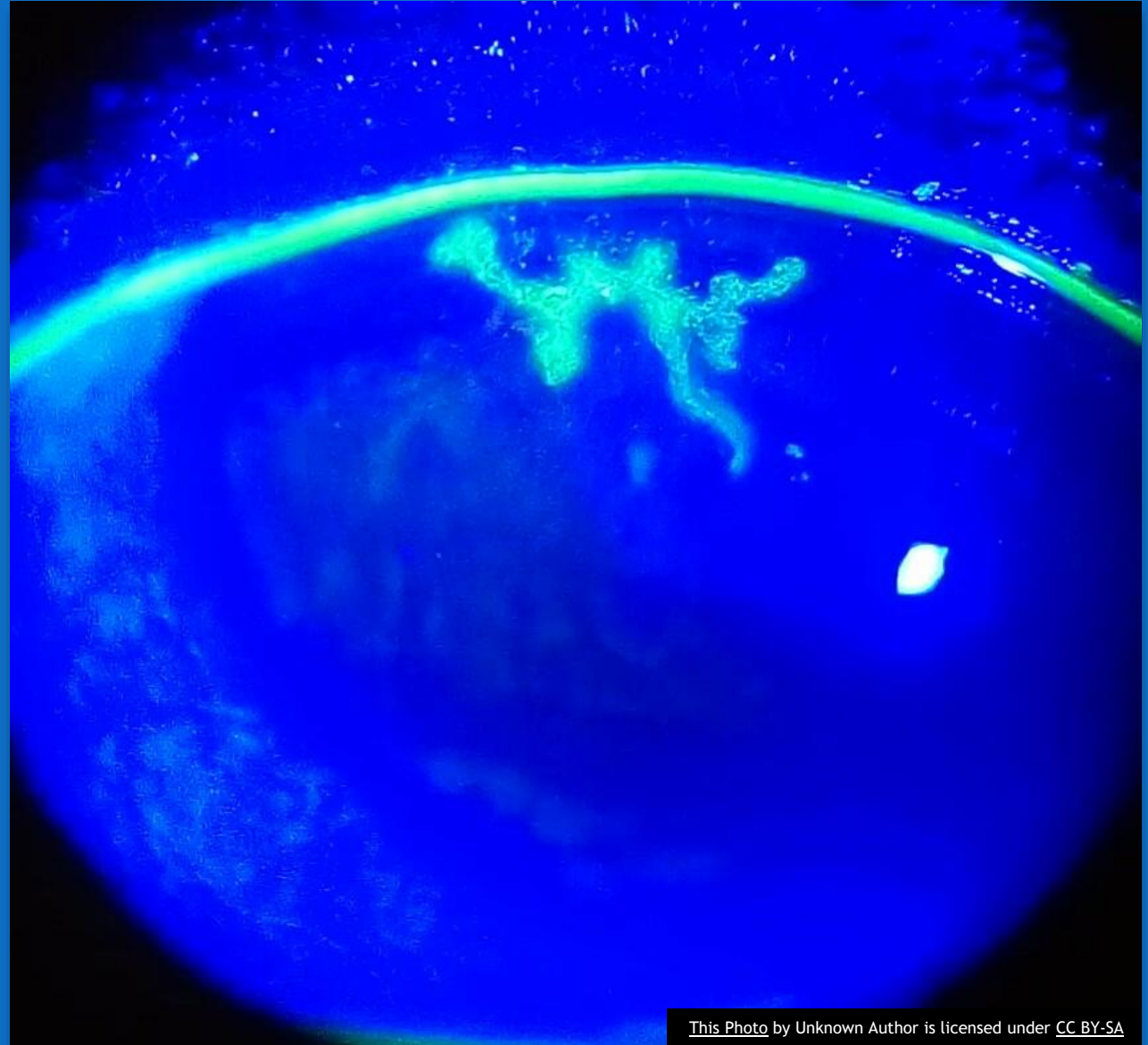
(a)



(b)

Viral Conjunctivitis and Herpes Keratitis

- Viral Conjunctivitis
 - Adenoviruses
 - Other viruses
- Herpes Keratitis
 - HSV-1
 - Deep lesions form and could lead to blindness
 - Antiviral treatment



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Viral Infections of the Skin and Eyes

Viral Infections of the Skin and Eyes				
Disease	Pathogen	Signs and Symptoms	Transmission	Antimicrobial Drugs
Fifth disease	Parvovirus B19	May have initial cold-like symptoms; "slapped cheek" rash	Highly contagious via respiratory secretions of infected individuals	None
Herpes keratitis	Herpes simplex virus 1 (HSV-1)	Inflammation of conjunctiva and cornea; irritation, excess tears, sensitivity to light; lesions in cornea leading to blindness	Direct eye contact with discharge from herpes lesions elsewhere in the body or from another infected individual	Acyclovir, ganciclovir, famciclovir, valacyclovir
Oral herpes	Herpes simplex virus 1 (HSV-1)	May cause initial systemic symptoms; cold sores	Highly contagious via direct contact with infected individuals	Acyclovir, penciclovir, famciclovir, valacyclovir
Papillomas	Human papillomavirus (HPV)	Common warts, plantar warts, flat warts, filiform warts, and others	Contact with infected individuals	Topical salicylic acid, cantharidin
Roseola (roseola infantum, exanthem subitum)	Human herpesvirus 6 (HHV-6), human herpesvirus 7 (HHV-7)	Initial cold-like symptoms with high fever, followed by a macular or papular rash three to five days later	Spread by viral and respiratory secretions of infected individuals	Typically none; ganciclovir for immunocompromised patients
Viral conjunctivitis	Adenoviruses and others	Inflammation of the conjunctiva; watery, nonpurulent discharge	Associated with common cold; contagious via contact with eye discharge	None

Mycoses of the Skin: Objectives

Identify the most common fungal pathogens associated with cutaneous and subcutaneous mycoses

Compare the major characteristics of specific fungal diseases affecting the skin

Tineas

- Superficial Mycoses

- Caused by Dermatophytes
- *Trichophyton*
- *Epidermophyton*
- *Microsporum*

Some Common Tineas and Location on the Body

Tinea corporis (ringworm)	Body
Tinea capitis (ringworm)	Scalp
Tinea pedis (athlete's foot)	Feet
Tinea barbae (barber's itch)	Beard
Tinea cruris (jock itch)	Groin
Tinea unguium (onychomycosis)	Toenails, fingernails



(a)



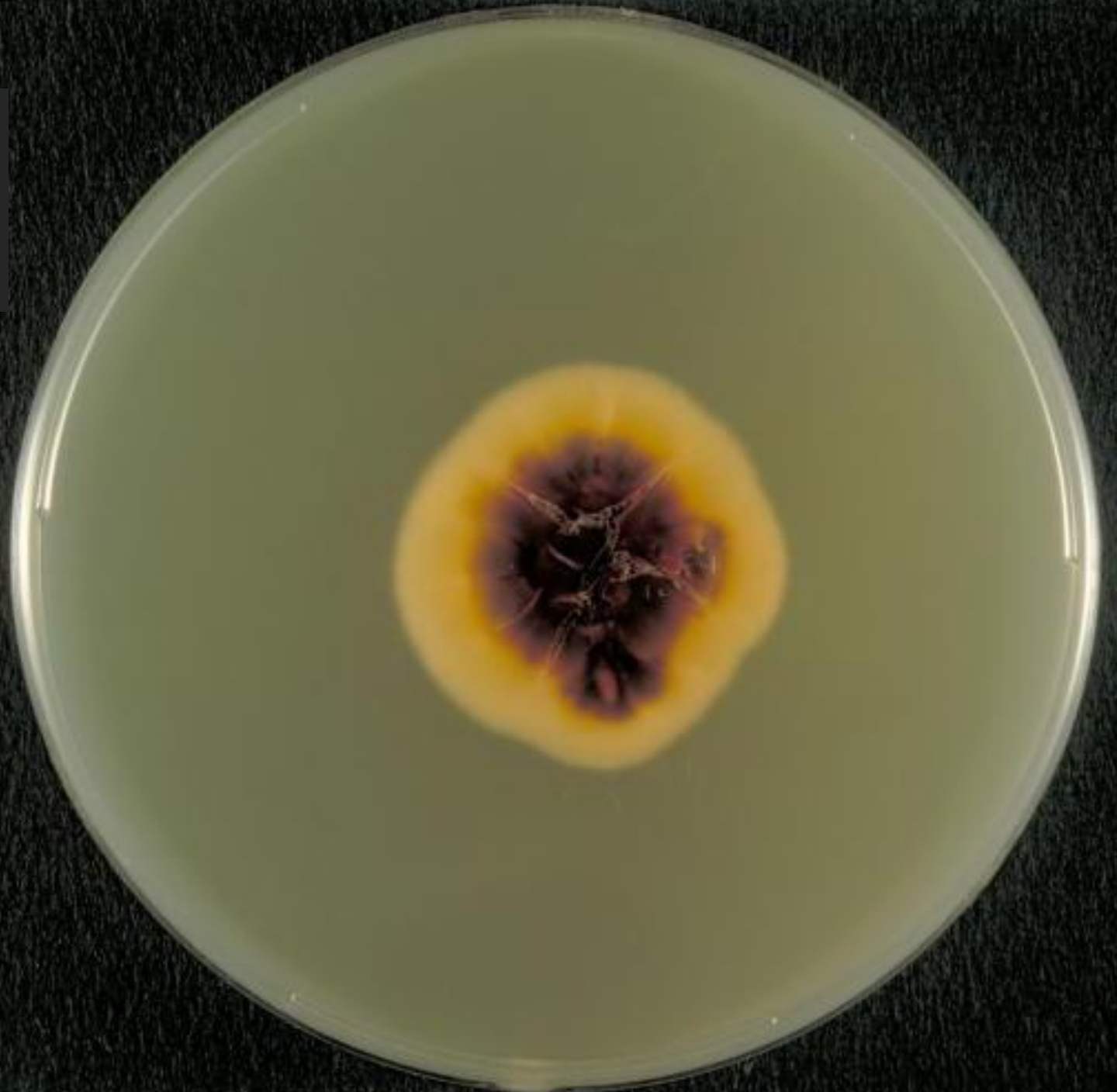
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(c)

Tineas

- Diagnosis
 - Wood's lamp
 - Sabouraud dextrose CC agar
- Treatment
 - Antifungal medication
 - Allylamine ointments
 - Miconazole
 - Clotrimazole



Cutaneous Aspergillosis

- *Aspergillus fumigatus* or *Aspergillus flavus*
 - Usually in patients who have had injury while working in agricultural or outdoor environment
- Diagnosis
 - Patient history, culture, histopathology
- Treatment
 - Voriconazole
 - Itraconazole
 - Amphotericin



(a)



(b)

Candidiasis of the Skin and Nails

- *Candida albicans*
 - Intertrigo – skin fold rash
- Diagnosis
 - Observation and culture
- Treatment
 - Topical or systemic azole antifungal medications
 - Clotrimazole
 - Econazole
 - Fluconazole
 - ketoconazole



(a)



(b)



(c)

Sporotrichosis

- *Sporothrix schenckii*
 - Rose gardener's disease
 - Presents as small ulcers
 - Can spread to lymphatic system
- Diagnosis
 - Histologic examination
 - Culture on potato dextrose agar
- Treatment
 - Itraconazole



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Mycoses of the Skin

Mycoses of the Skin				
Disease	Pathogen	Signs and Symptoms	Transmission	Antimicrobial Drugs
Aspergillosis (cutaneous)	<i>Aspergillus fumigatus</i> , <i>Aspergillus flavus</i>	Distinctive eschars at site(s) of infection	Entry via wound (primary cutaneous aspergillosis) or via the respiratory system (secondary cutaneous aspergillosis); commonly a hospital-acquired infection	Itraconazole, voriconazole, amphotericin B
Candidiasis (cutaneous)	<i>Candida albicans</i>	Intertrigo, localized rash, yellowing of nails	Overgrowth of normal skin microbiota, especially in moist, dark areas	Azoles
Sporotrichosis (rose gardener's disease)	<i>Sporothrix schenckii</i>	Subcutaneous ulcers and abscesses; may spread to a large area, e.g., hand or arm	Entry via thorn prick or other wound	Itraconazole
Tineas	<i>Trichophyton</i> spp., <i>Epidermophyton</i> spp., <i>Microsporum</i> spp.	Itchy, ring-like lesions (ringworm) at sites of infection	Contact with dermatophytic fungi, especially in warm, moist environments conducive to fungal growth	Terbinafine, miconazole, clotrimazole, griseofulvin

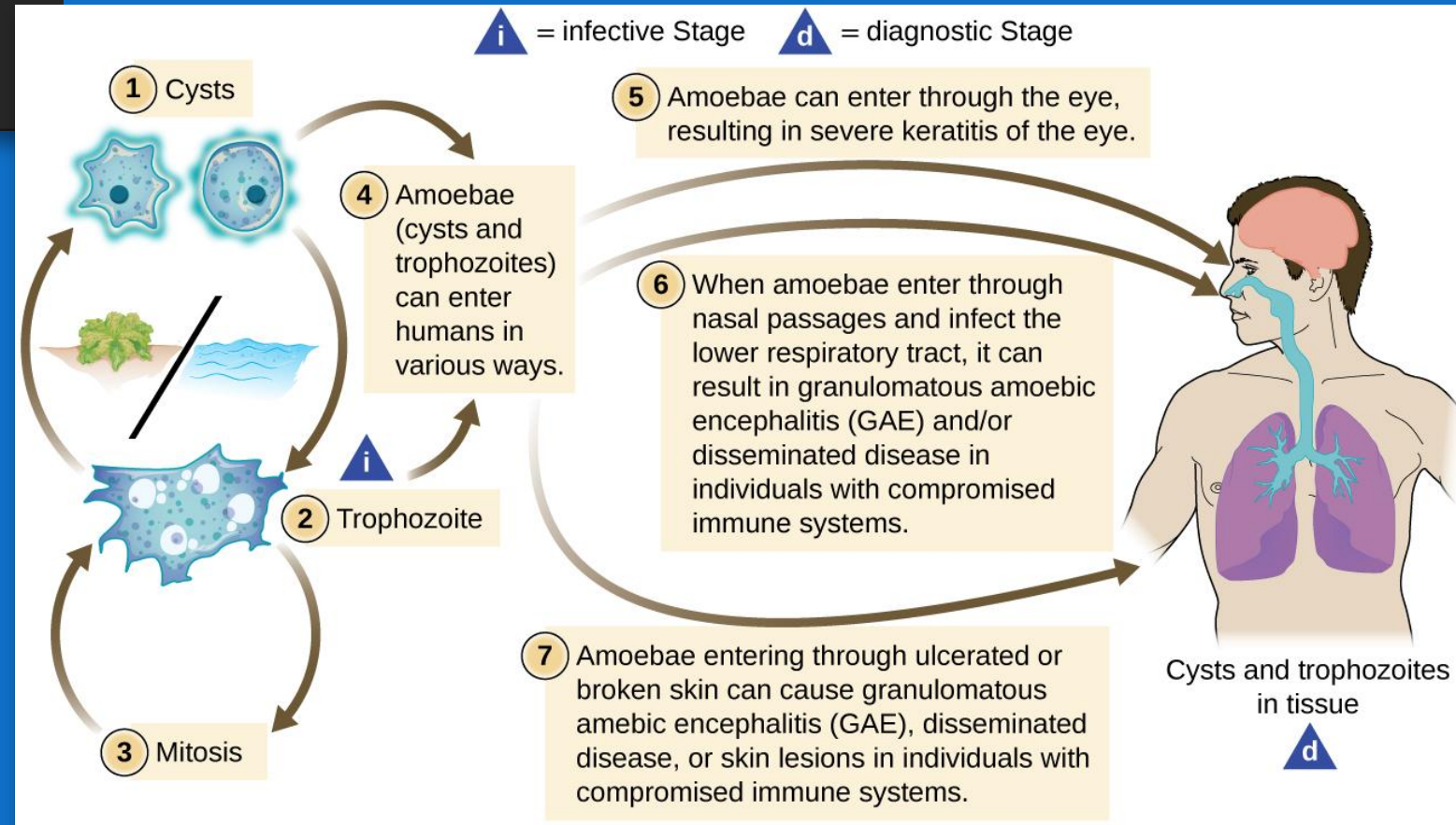
Protozoan and Helminthic Infections of the Skin and Eyes: Objectives

Identify two parasites that commonly cause infections of the skin and eyes

Identify the major characteristics of specific parasitic diseases affecting the skin and eyes

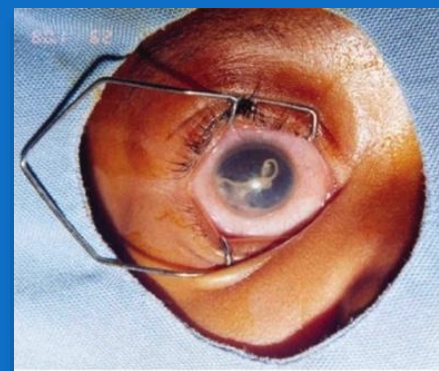
Acanthamoeba Infections

- *Acanthamoeba keratitis*
 - Caused by *Acanthamoeba*
 - Common in soils and unchlorinated fresh water
- Infection
 - Starts mild, can lead to severe corneal damage and vision impairment
- Treatment
 - Difficult to treat, must treat promptly
 - Antiseptics – chlorhexidine
 - Azoles



Loiasis

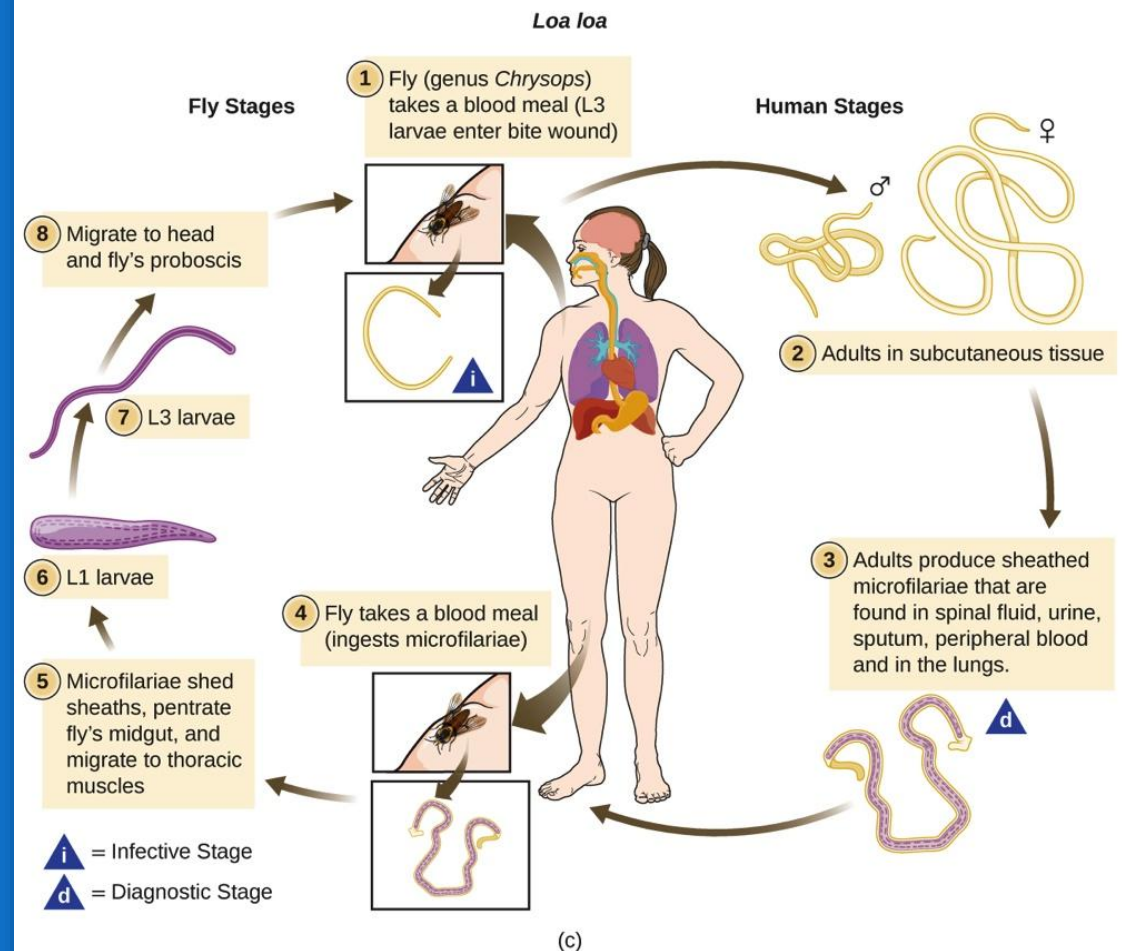
- *Loa loa*
 - Parasitic worm
 - Endemic to West and Central Africa
- Lifecycle
 - Spread by deerflies
- Treatment
 - Surgical removal
 - Diethylcarbamazine (severe side effects)
 - Albendazole



(a)



(b)



Parasitic Skin and Eye Infections

Parasitic Skin and Eye Infections				
Disease	Pathogen	Signs and Symptoms	Transmission	Antimicrobial Drugs
<i>Acanthamoeba</i> keratitis	<i>Acanthamoeba</i>	Inflammation and damage to cornea; vision impairment or blindness	Exposure to pathogens in contaminated water or on contact lenses	Polyhexamethylene biguanide, chlorhexidine, azoles
Loiasis	<i>Loa loa</i>	Recurring fever and localized Calabar swelling, itching, and skin or eye pain during subcutaneous migration of worms	Larvae transmitted between humans by deerfly vector	Diethylcarbamazine, albendazole