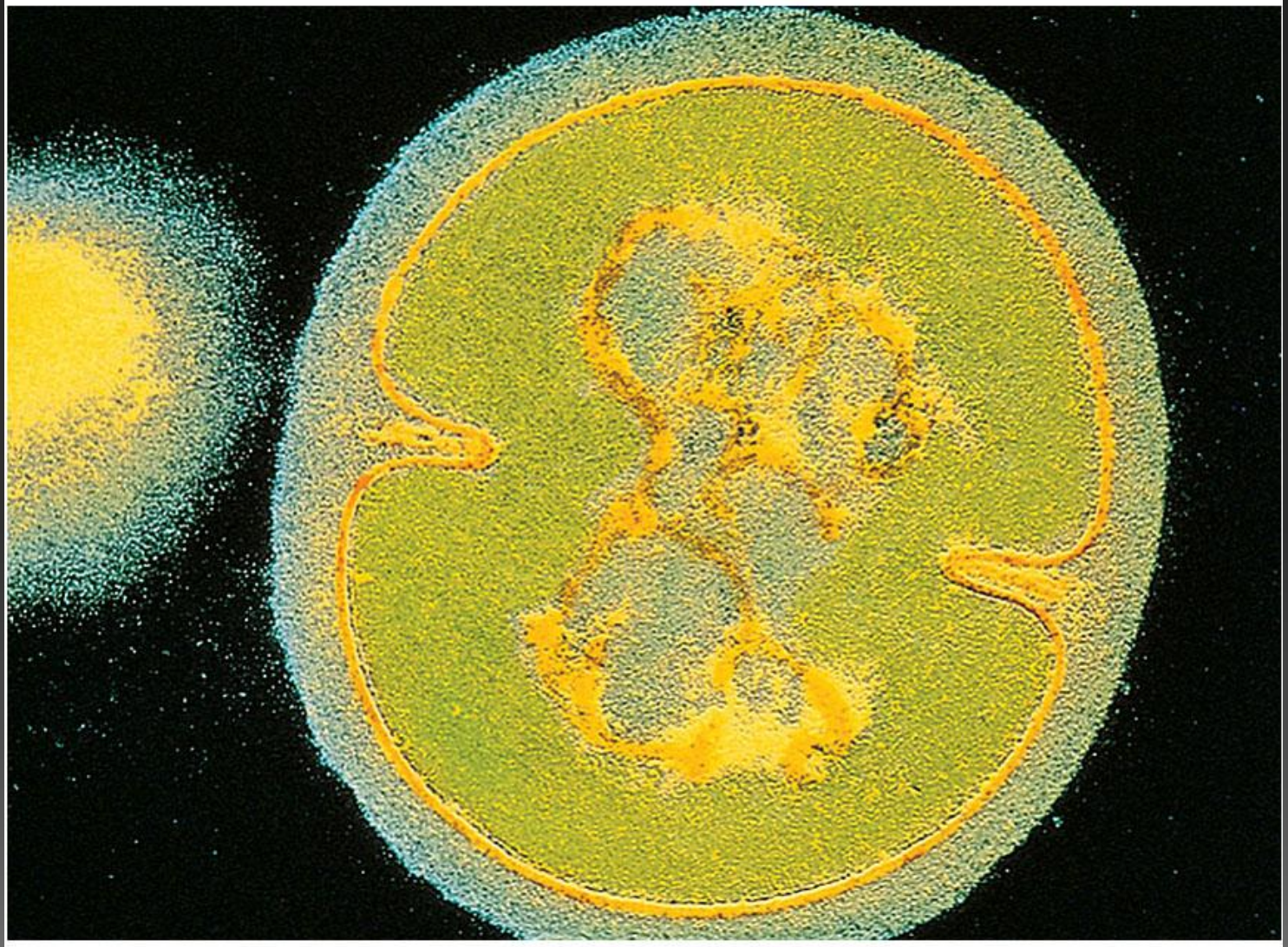
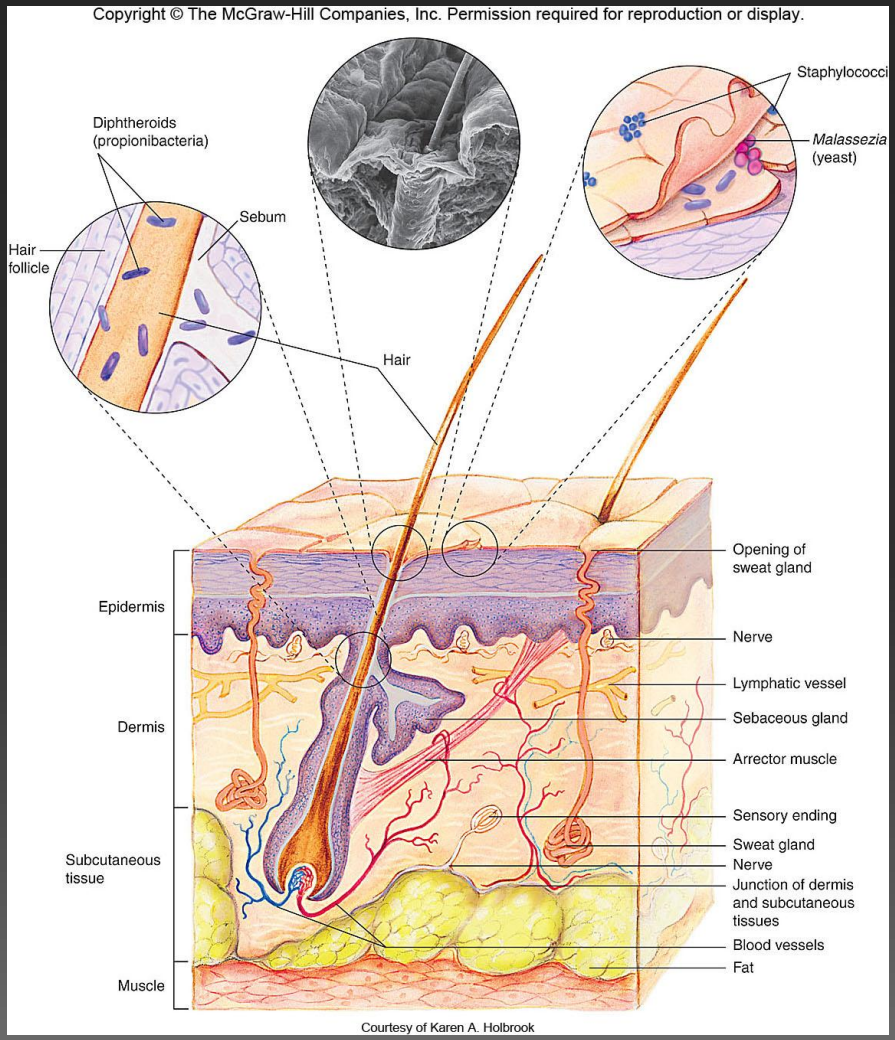
Skin Infections

Chapter 23



Normal Microbiota of the Skin

- Large numbers of microorganisms live on or in the skin
- Numbers of bacteria are determined by location and moisture content
- Skin flora are opportunistic pathogens
- Most skin flora can be categorized in three groups:
  - Diphtheroids
  - Staphylococci
  - Yeasts



Normal Microbiota of the Skin

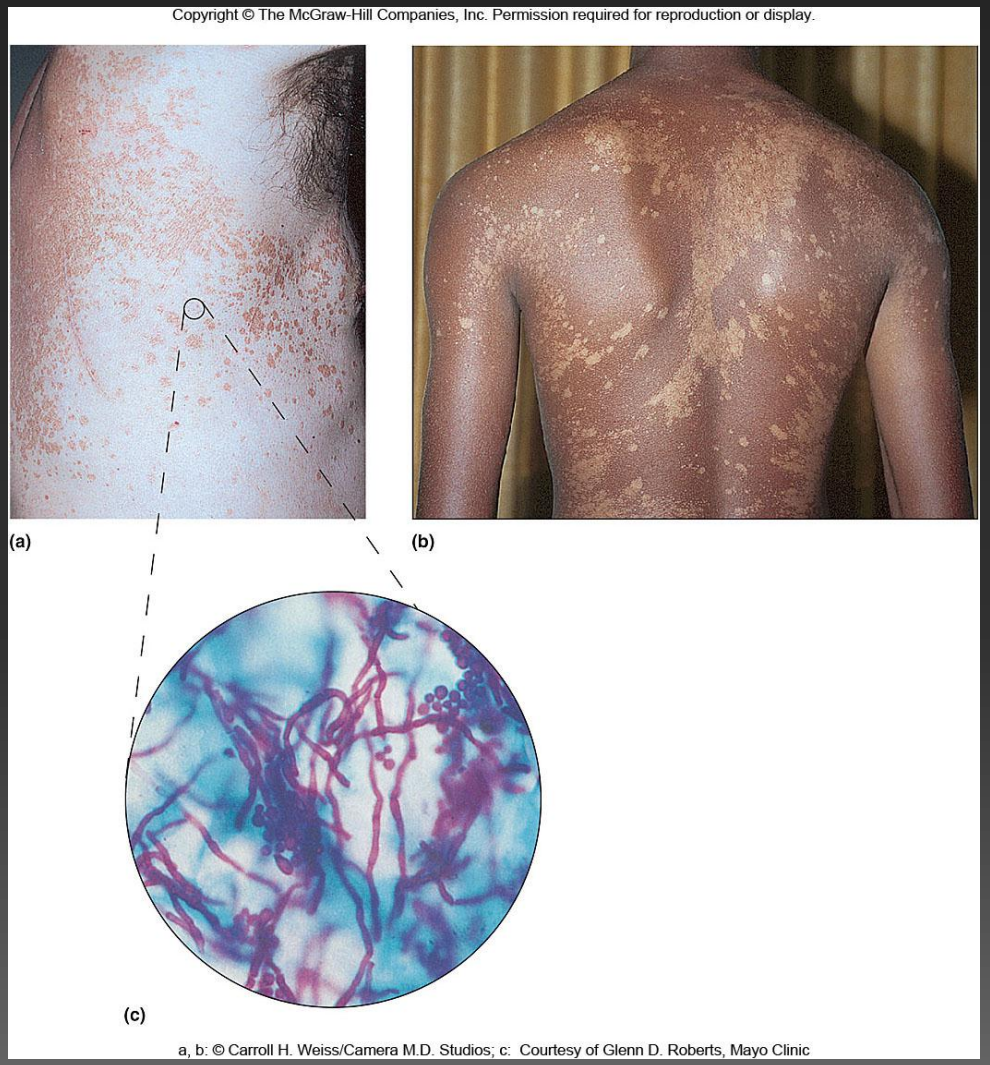
- Diphtheroids
  - Named for their resemblance to *Corynebacterium diphtheriae*
  - Gram-positive bacteria with varied shape and low virulence
  - Non-toxin producers like *C. diphtheriae*
  - Responsible for body odor
    - Odor caused by the bacterial break-down of sweat
  - Common diphtheroid is *Propionibacterium acnes*

Normal Microbiota of the Skin

- Staphylococci
  - Gram-positive, salt-tolerant organism
  - Relatively avirulent
    - Can cause serious disease in immuno-compromised people
  - Principle species is *Staphylococcus epidermidis*
  - Functions on the skin to prevent colonization of pathogenic flora
  - Maintains balance among microbial skin flora

Normal Microbiota of the Skin

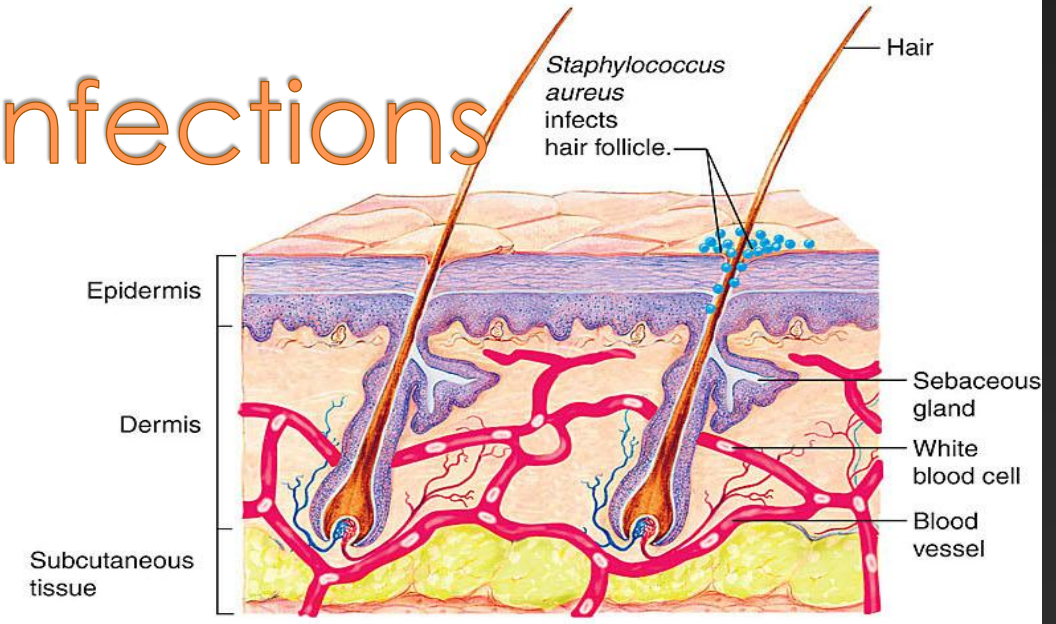
- Fungi (yeast)
  - Tiny lipophilic yeast universally found on normal skin
    - Usually from late childhood throughout life
  - Fungi shapes vary among strains
    - Usually round or oval; however can be short rods
  - *Melassezia* sp.
  - Fungi found on skin are generally harmless
    - Can cause skin conditions such as rash, dandruff or tinea versicolor

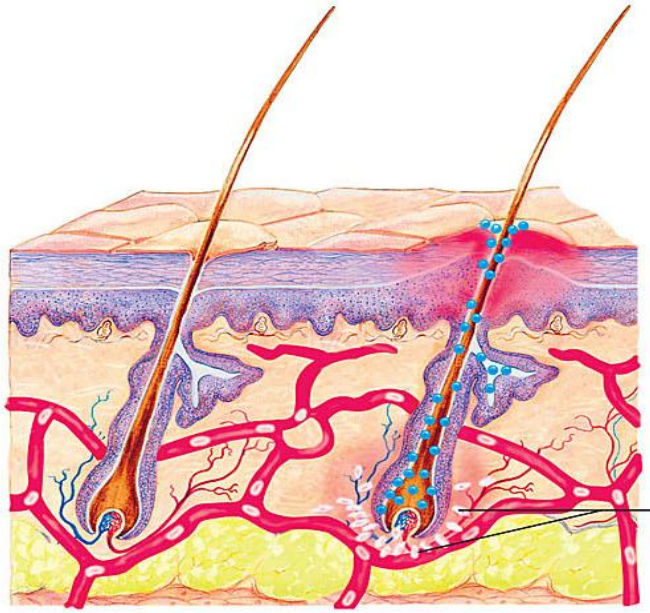


Folliculitis (Boils, furuncles and carbuncles)

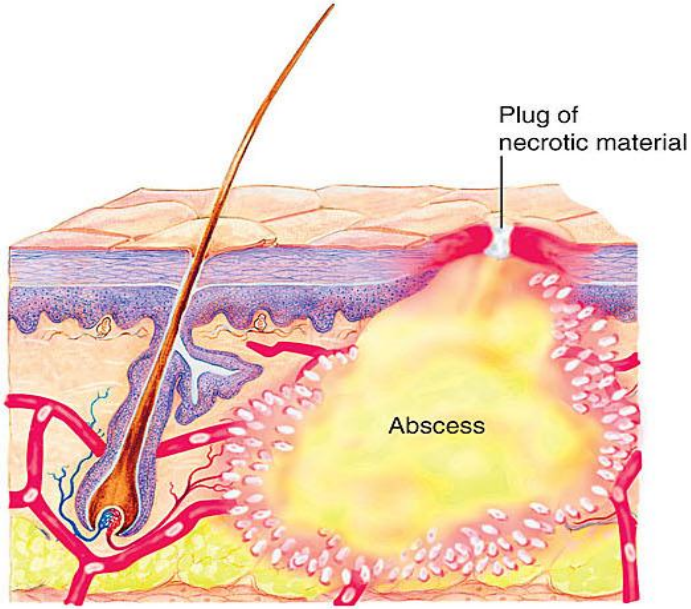
- Causative Agent
  - *Staphylococcus aureus*
    - 90% penicillin resistant
    - Surgical drainage and removal.
- Symptoms –
  - Presents as a small red bump or pimple
  - Furuncle: Infection can spread from infected follicle to adjacent tissues
    - Causes localized redness, swelling and tenderness
  - Carbuncle: large areas of redness, swelling, tenderness, fever, pus

Hair Follicle Infections





Infection spreads to subcutaneous tissue.



Scalded Skin Syndrome

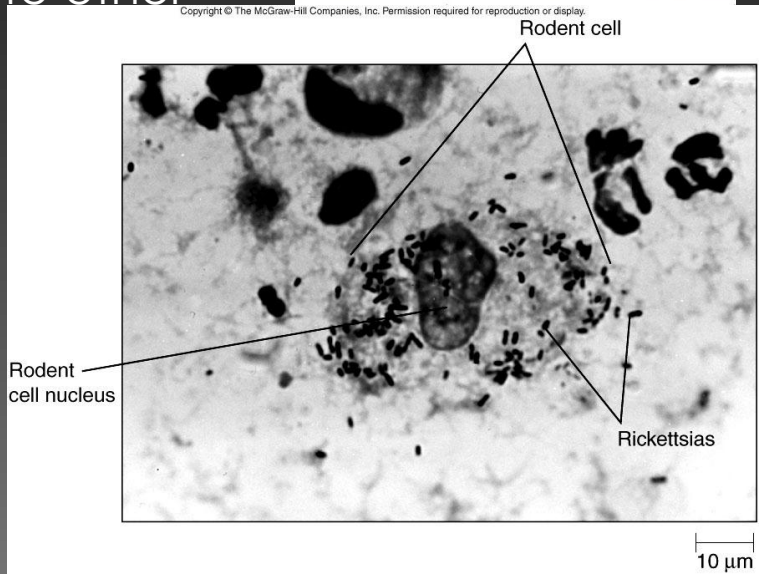
- Staphylococcal scalded skin syndrome (SSSS)
  - Occurs primarily in infants, potentially fatal
- *Staphylococcus aureus*
  - Disease is due to the production exfoliatins toxins
  - Destroy integral layers of the outer epidermis
  - Toxins are coded either by plasmid or on the bacterial chromosome
  - Mortality rates can reach 40%

Impetigo: *Streptococcus pyogenes*

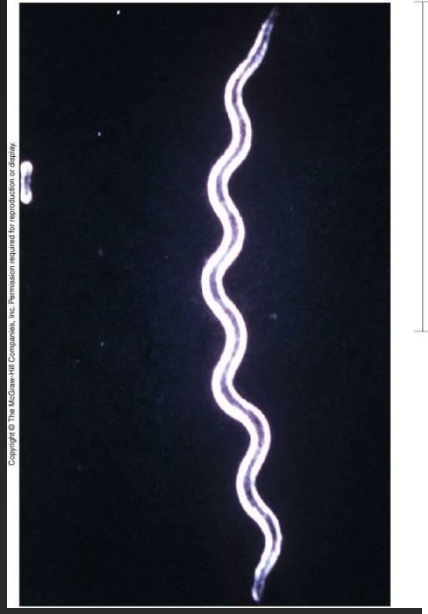
- Pyoderma infection
  - Characterized by pus
  - Person-to -person
- Infection established through scratches and minor injuries
  - Bacteria produce destructive enzymes
    - Proteases – degrade skin proteins
    - Nucleases – degrade nucleic acid

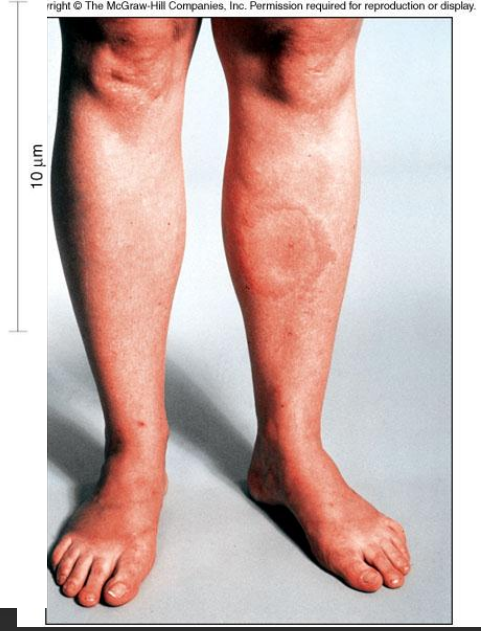
Rocky Mountain Spotted Fever

- Causative Agent
  - *Rickettsia rickettsii*
  - Obligate, intracellular bacteria
  - Enter blood vessel epithelium by endocytosis
  - Endotoxin shock
  - Zoonotic disease--tick, mites and lice
- Symptoms
  - Initial rash of faint pink spots on palms, wrists, ankles and soles of feet
  - Hemorrhagic rash eventually spreads to other parts of the body
  - Shock or death can occur untreated mortality reaches approximately 20%
- Prevention and Treatment
  - No vaccine—Avoid ticks
  - Antibiotics are highly effective
    - Doxycycline and chloramphenicol



Lyme Disease

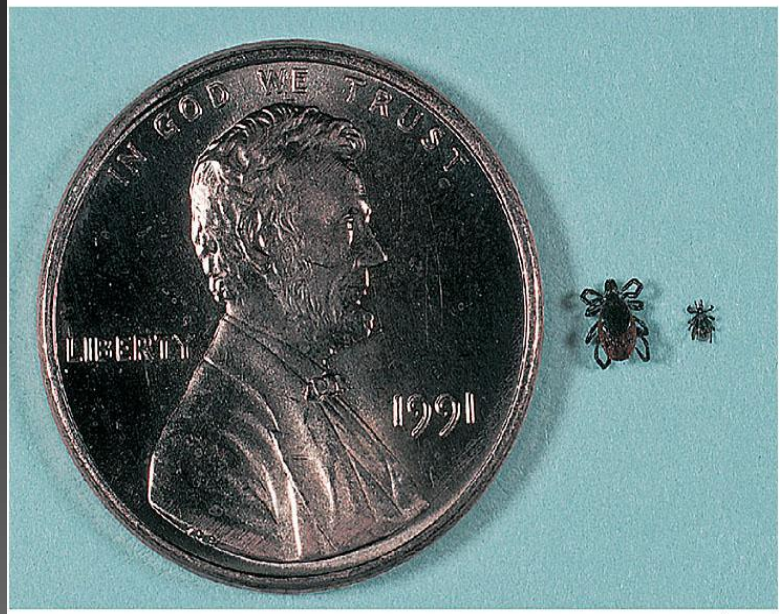




- Causative Agent
  - Bacterium called *Borrelia burgdorferi*
  - Large microaerophilic spirochete
  - Zoonotic disease--tick
- Symptoms
  - First Stage—Antibiotics now are effective
    - Characterized by erythema migrans ("Bull's eye" rash) and enlargement of lymph nodes
    - Other influenza-like symptoms
  - Second Stage 2 to 8 weeks post rash
    - Electrical conduction to heart is impaired
    - Nervous system involvement leads to paralysis of facial muscles and impaired concentration and emotional instability
  - Third Stage 6 months after rash—Antibiotics now not so effective
    - Characterized by arthritis
    - Symptoms develop in 60% of untreated cases
    - Chronic nervous system impairment may occur

Lyme Disease

- Pathogenesis
  - Bacteria introduced into skin through bite of infected tick
    - Once in skin, bacteria migrate outward in radial fashion
    - Cause inflammatory reaction in the skin
- Host immunity is initially suppressed
  - Allows for continued multiplication of bacteria
- Bacteria enter bloodstream and circulate to other parts of the body
  - Bacteria do not cross the placenta
- Epidemiology
  - Disease is zoonotic
  - Several tick species implicated as vectors
    - Most important is black-legged tick, *Ixodes scapularis*
    - Nymph stage actively seeks blood meal, therefore mainly responsible for transmitting disease



Chicken Pox: Varicella zoster virus

- Herpes virus family
  - Medium-sized enveloped virus
  - Double-stranded DNA genome
- Once of the most common rashes among children
  - Incidence declined due to vaccine
- Respiratory and contact spread
    - 2 week incubation
    - Infective until pustules crust over
- Skin rash appears on back of head, face and mouth
    - Rash progression
      - red spots called macules
      - small bumps called papuales
      - small blisters called vesicles
      - pus filled blisters called pustules
    - Lesions itch and appear at different times
    - Healing begins after pustules break and crust over
  - Varicella infection major threat to newborn
    - May lead to congenital varicella syndrome
  - Immunocompromised patients are also at higher risk

Chicken Pox

- Complication and Recurrance
  - Vaccination
    - 1 year-12 years
    - Immune compromised individuals, pregnant or 3 months prior to pregnancy should not be vaccinated
  - Shingles or herpes zoster
    - Caused by reactivation of dormant virus
    - Rash restricted to area supplied by branches of involved sensory nerve
  - Reye's Syndrome
    - Characterized by liver and brain damage
    - Condition evident by vomiting and coma
    - Predominantly seen in children 5 to 15
    - Mortality around 30%
    - Evidence suggests aspirin therapy increases risk

Measles: rubeola

- Human population is reservoir.
- No longer endemic in US due to effective immunization programs: MMR
- Causative Agent
  - Rubeola virus
  - Pleomorphic, medium sized, enveloped
    - Envelope contains projections
      - One for viral attachment to host
      - One for fusion with host membrane
  - Single-stranded RNA genome
  - Belongs to paramyxovirus family

Measles

- Symptoms
  - Begins with fever, runny nose, cough, red weepy eyes
  - Fine rash appears first on forehead, then spreads to rest of body within a few days
  - Symptoms generally disappear within 1 week
  - Many cases complicated by secondary infections
    - Pneumonia and earaches are most common secondary conditions
    - Less common complications include encephalitis and subacute sclerosing panencehalitis (SSPE)
- Pathogenesis
  - Infection via respiratory route
  - Virus replicates in epithelium of upper respiratory tract
  - Spreads to lymph nodes
    - Further replication takes place here
  - Spreads to all parts of the body

Rubella: German or 3-day Measles

- Causative Agent
  - Rubella virus
  - Small, enveloped
  - Single-stranded RNA genome
- Symptoms:
  - Typically mild
  - Enlarged lymph nodes behind ears and back of neck
  - Faint rash on face
    - Rash consists of light pink spots
  - Adults commonly complain of joint pain
  - Significant infection in pregnant women
- Pathogenesis
  - Enters body via respiratory route
  - Virus multiplies in nasopharynx, then enters bloodstream

- Epidemiology
  - Humans are only natural host
  - Disease is highly contagious

Erythema infectiosum: Fifth disease

- Parvovirus B-19
  - Small, nonenveloped virus
  - Single-stranded DNA genome
  - Infects certain bone marrow cells
    - Can cause aplastic crisis due to decreased production of blood cells
  - 10% of women infected during pregnancy miscarry
  - Diffuse redness appears on cheeks
    - Appears as if face was slapped
    - Rash spreads in lacy pattern to other parts of body
  - Rash may come and go for about 2 weeks
  - Joint pain most prominent in adult infections

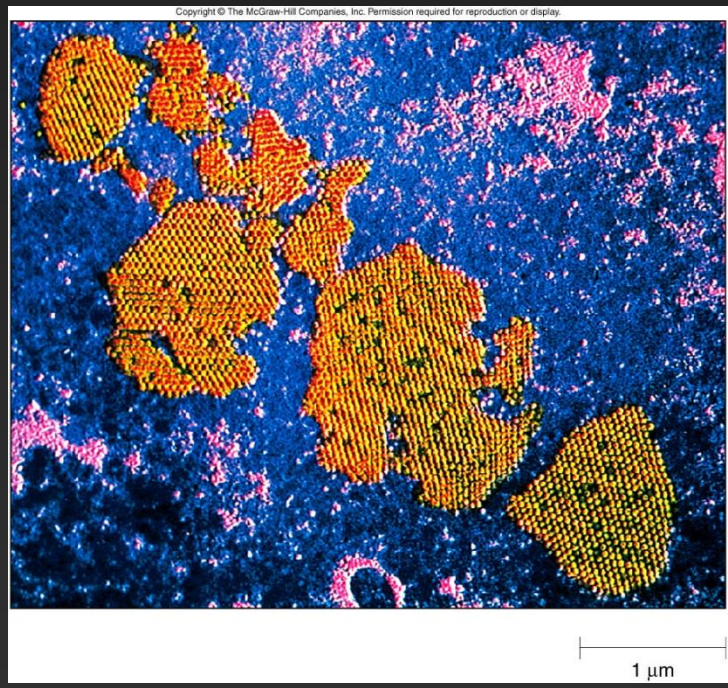
(a) (b)

(both): © CDC

Other Viral Rashes of Childhood

- Roseola
  - Herpes virus type 6
  - No vaccine
  - Common in children 6 months to 3 years
  - Disease begins abruptly with high fever (>102°)
  - After fever subsides, rash appears
    - Generally on chest and abdomen
    - Rash vanishes in a few hours to 2 days

Other Viral Rashes of Childhood



- Warts
  - Caused by Papillomavirus
  - Papovirus family
    - Small nonenveloped
    - Double-stranded DNA genome
  - Can infect skin through minor abrasion
    - Forms small tumors called papillomas
      - A.k.a warts
    - Warts rarely become cancer
      - Some sexually transmitted warts associated with cervical cancer
    - Nearly ½ skin warts disappear within 2 years without treatment

Skin Diseases Caused by Fungi

- Superficial Cutaneous Mycoses
  - Group of diseases caused by numerous species of molds
  - Invade nails, hair and keratinized layer of the skin
  - Examples include
    - Tinea capitis = mycosis of the scalp
    - Tinea axillaris = mycosis of the underarm
    - Tinea cruris = mycosis of the groin
      - Jock itch
    - Tinea pedis = mycosis of the foot
      - Athlete's foot

Superficial Cutaneous Mycoses

- Symptoms
  - Some colonized individuals show no symptoms
  - Others complain of
    - Itching
    - Bad odor
    - Rash
- Causative Agent
  - Three genera responsible for most infections
    - *Epidermophyton*
    - *Microsporum*
    - *Trichophyton*
  - *Collectively these are termed dermatophytes*

(a)

(b)

20 µm