

Eukaryotic Microbes

Parasites

Protozoa, Helminths, Arthropods

Eukaryotic Microbes

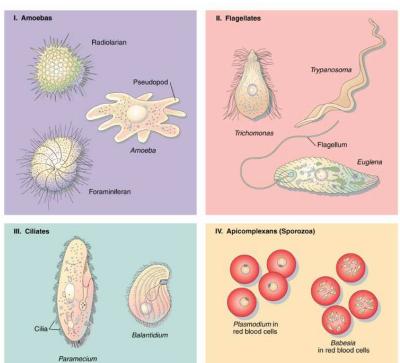
	Fungi	Algae	Protozoa	Helminths
Kingdom	Fungi	Protist	Protist	Animalia
Nutritional type	Chemoheterotroph	Photoautotroph	Chemoheterotroph	Chemoheterotroph
Multicellularity	All, except yeasts	Some	None	All
Cellular arrangement	Unicellular, filamentous, fleshy [such as mushrooms]	Unicellular, colonial, filamentous; tissues	Unicellular	Tissues and organs
Food acquisition method	Absorptive	Absorptive	Absorptive; ingestive (cytostome)	Ingestive (mouth); absorptive
Characteristic features	Sexual and asexual spores	Pigments	Motility; some form cysts	Many have elaborate life cycles, including egg, larva, and adult
Embryo formation	None	None	None	All

Table 12.1

Protozoa

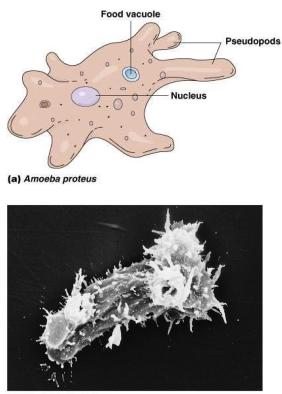
- Life Stages –
 - **Trophozoite** -vegetative; feeding, mostly motile
 - **Cyst** – dormant; protective thick wall
 - Most are free living in water and soil
 - Classified by motility & life cycle
 - Subdivided by location in human host (GI, blood, GU)
1. **Sarcodina**- Amoeba - move by pseudopods
 2. **Ciliophora** - Ciliates - move by cilia
 3. **Mastigophora** - Flagellates - move by flagella
 4. **Apicomplexan** - Sporozoa – complex life cycle

Diversity among Protozoa



Amoeba

- *Entamoeba histolytica*
 - Amoebic dysentery
- *Naegleria*
 - primary amoebic meningoencephalitis
- *Acanthamoeba*
 - contact lens contaminant



Amoebae

- Protozoa with no truly defined shape
- Move and acquire food through the use of pseudopodia
- Found in water sources throughout the world
- Few cause disease

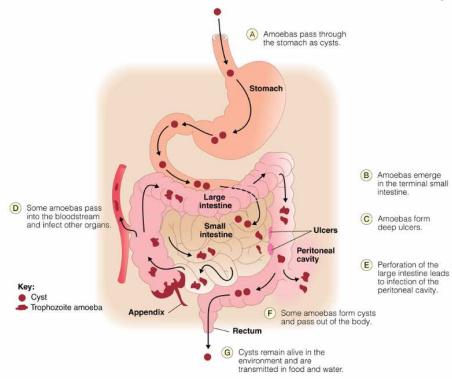
Entamoeba histolytica

- Carried asymptotically in the digestive tracts of humans
- No animal reservoir exists
- Infection usually occurs by drinking water contaminated with feces that contain cysts
- Trophozoites migrate to the large intestine where they multiply

Entamoeba histolytica

- Three types of amebiasis can result from infection
 - Luminal amebiasis
 - Least severe form that is asymptomatic
 - Invasive amebic dysentery
 - More common form of infection
 - Characterized by bloody, mucus-containing stools and pain
 - Invasive extraintestinal amebiasis
 - Trophozoites carried via the bloodstream throughout the body
- Maintaining clean water is important in prevention

The Course of Amebiasis Due to *Entamoeba histolytica*



Acanthamoeba and Naegleria

- Cause rare and usually fatal brain infections
- Common inhabitants of natural waterways as well as artificial water systems
- Contact lenses wearers who use tap water to wash their lenses can become infected
- *Acanthamoeba* diseases
 - Infection occurs through cuts or scrapes, the conjunctiva, or through inhalation
 - *Acanthamoeba* keratitis results from conjunctival inoculation
 - Amoebic encephalitis is the more common disease

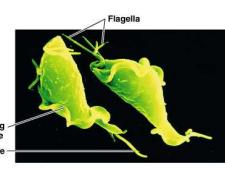
Acanthamoeba and Naegleria

- *Naegleria* disease
 - Infection occurs when swimmers inhale contaminated water
 - Amoebic meningoencephalitis results when trophozoites migrate to the brain
- Prevention is difficult because these organisms are environmentally hardy

Flagellate

Trichomonas vaginalis

- no cyst stage
- Trichomoniasis - STI



Giardia lamblia

- intestinal malabsorption
- Traveler's diarrhea, day care centers, hikers

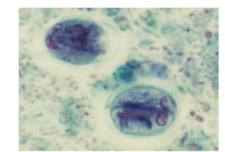
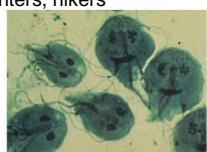
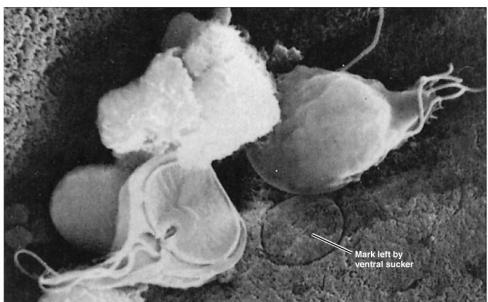


Figure 12.17b-d

Giardia



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Hemoflagellates

– *Trypanosoma*

- African sleeping sickness or Chagas disease
- Transmitted by tsetse flies or reduviid bugs



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– *Leishmania*

- leishmaniasis – “Baghdad Boil” - Desert Storm
- Transmitted by sand fly vector

Ciliates

- Complex cells with rudimentary mouth (cytostome)
- *Balantidium coli* is the only human parasite
 - intestinal disease
 - associated with pork
- *Paramecium*
- *Vorticella*

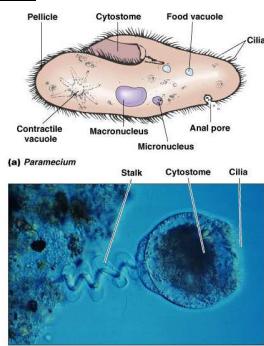


Figure 12.20

Ciliates

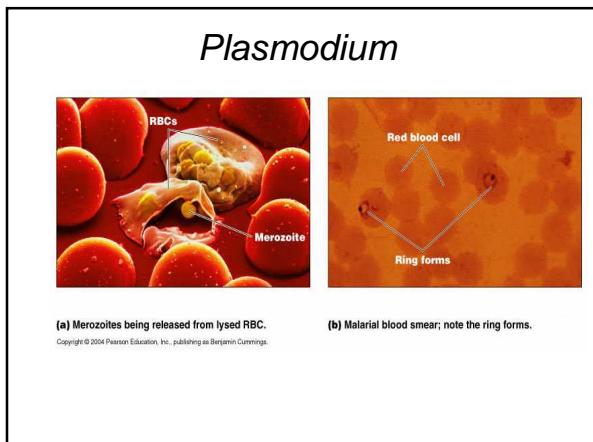
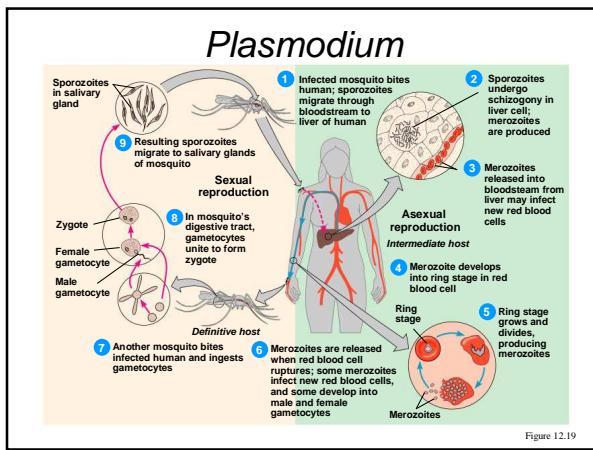
- Protozoa that use cilia in their trophozoite stage
- *Balantidium coli* is the only ciliate known to cause disease in humans
- Commonly found in animal intestinal tracts
- Humans become infected by consuming food or water contaminated with feces containing cysts
- Trophozoites attach to the mucosal epithelium lining the intestine
- *B.coli* infections are generally asymptomatic in healthy adults

Ciliates

- Balantidiasis occurs in those with poor health
 - Characterized by persistent diarrhea, abdominal pain, and weight loss
 - Dysentery results in severe infections
- Presence of trophozoites is diagnostic for the disease
- Prevention relies on good personal hygiene and efficient water sanitation

Apicomplexans (Sporozoa)

- Characteristics:
 - Nonmotile, Intracellular parasites
 - Complex life cycles, Asexual/sexual reproduction
- *Plasmodium* – malaria
 - transmitted by *Anopheles* mosquito
- *Cryptosporidium* – diarrhea; AIDS related
- *Toxoplasma* – toxoplasmosis; AIDS related



Cryptosporidium parvum

- Waterborne
 - Found in cattle
 - Attach to intestinal lining
 - Cause watery diarrhea
 - Acid-fast Oocysts
 - Resistant to chlorine

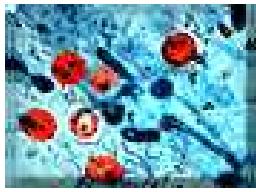
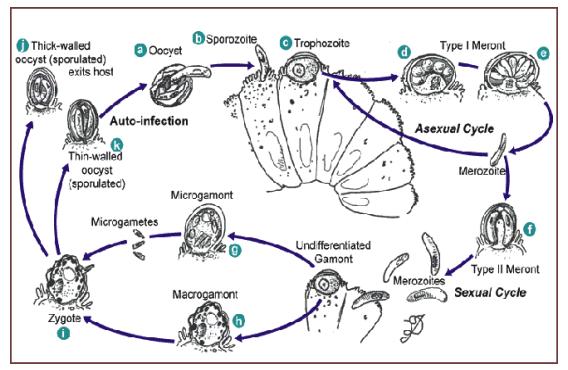
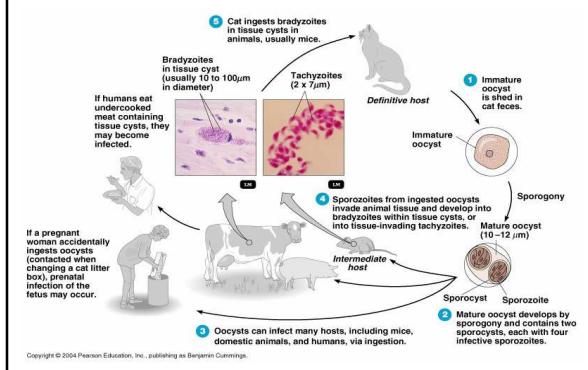


Figure 25.19

Cryptosporidium life cycle



Toxoplasma gondii



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Table 12.1

Helminths - worms

- Life Stages

- egg, larva, adult; complex life cycles
- infective stage: egg or larva
- definitive host: harbors adult stage
- intermediate hosts: may be more than one

- Classifications:

- Nematodes - roundworms
- Platyhelminthes - flatworms
 - Trematodes - flukes- nonsegmented
 - Cestodes - tapeworms- segmented

Nematodes- Roundworms

- Intestinal roundworms:

- *Ascaris* (Giant intestinal roundworm)
- *Enterobius* (Pinworm)
- *Necator / Ancylostoma* (Hookworm)

- Tissue roundworms

- *Trichinella spiralis* - trichinosis

Features of the Life Cycle of Roundworms

- Parasites of almost all vertebrates
- Have a number of reproduction strategies
 - Most intestinal nematodes shed their eggs into the lumen of the intestine
 - Eggs are eliminated in feces
 - Eggs are consumed in contaminated food or water
 - Some intestinal nematodes release their eggs into the soil
 - Larvae actively penetrate the skin of a host
 - Inside the body, they travel to the intestine
 - Other nematodes encyst in muscle tissue and are consumed in raw or undercooked meat
 - Mosquitoes transmit a few species of nematodes
- Adult sexually mature stages are found only in definitive hosts

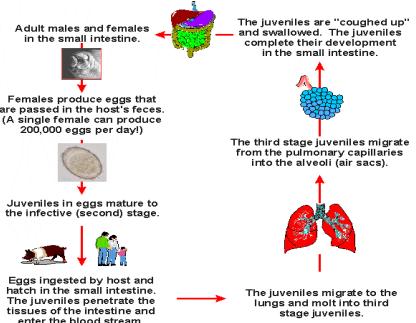
Nematodes - roundworms



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Ascaris lumbricoides- adult stage

THE LIFE CYCLES OF *ASCARIS LUMBRICOIDES* AND *ASCARIS SUUM* (INTESTINAL ROUNDWORMS OF HUMANS AND PIGS)



(Parasites and Parasitological Resources)

Pinworm disease is the most prevalent helminthic infection in the United States

- *Enterobius vermicularis*
- Life cycle
- Diagnosis with cellophane tape
- Transmission

Enterobius - Pinworm

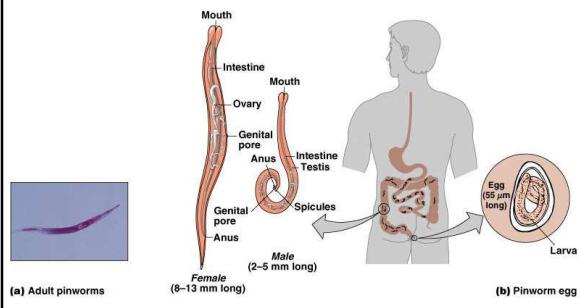
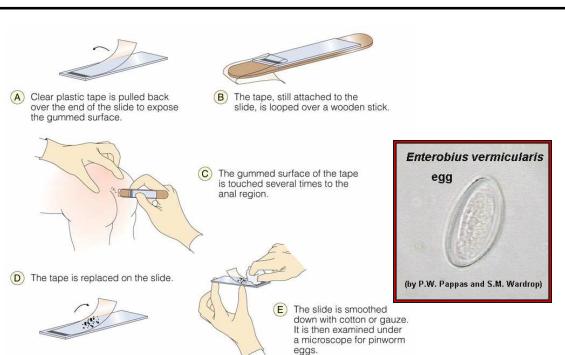
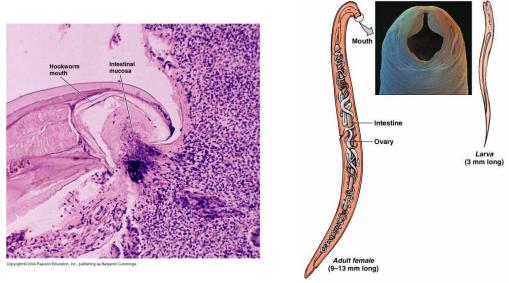


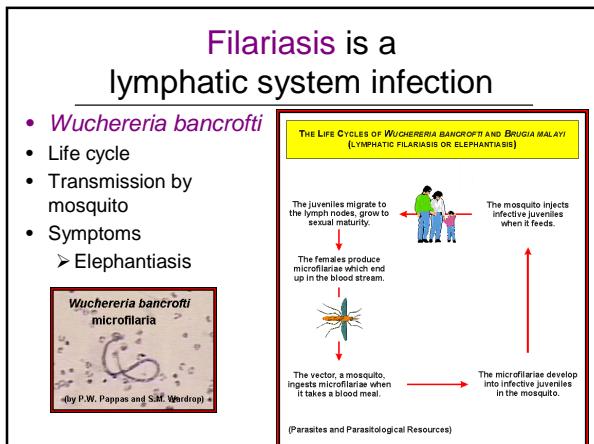
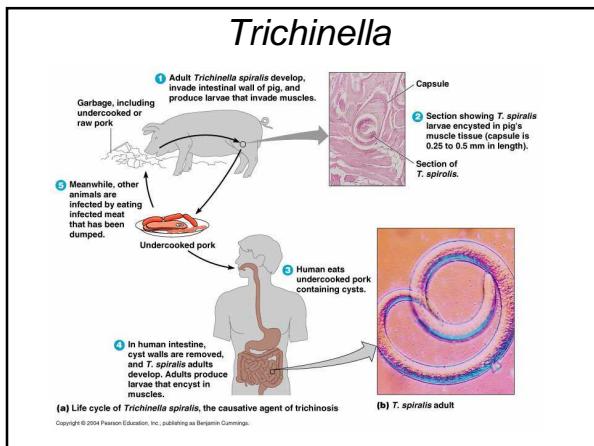
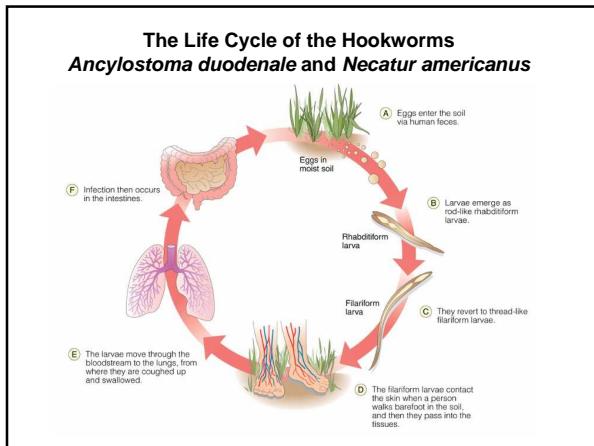
Figure 12.29



Diagnosing Pinworm Disease

Necator or Ancylostoma - Hookworm





Platyhelminthes - Flatworms

- Trematodes – Flukes - nonsegmented
 - *Schistosoma* - blood fluke; Swimmer's itch
- Cestodes – Tapeworms - segmented
 - *Taenia* – beef or pork tapeworm
 - *Echinococcus* – wild dog tapeworm

Trematodes - Flukes

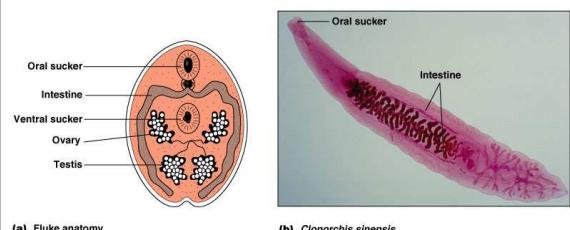
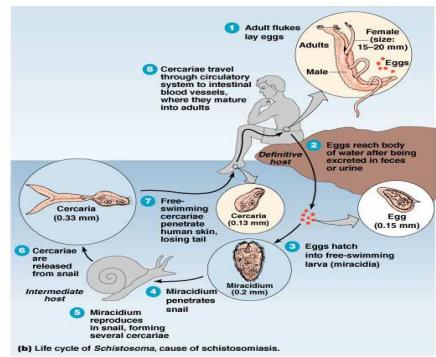


Figure 12.25

Schistosoma – blood fluke



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Cestodes - Tapeworms

- Tapeworm parts:**

- Scolex**
head with attachment site
- Proglottids**
body segments with testes and ovaries

Taenia saginata

- beef tapeworm

Taenia solium

- pork tapeworm
- cysticercosis

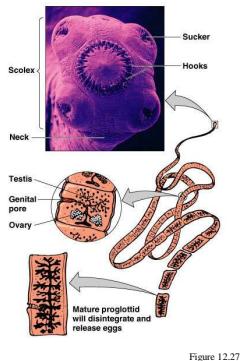
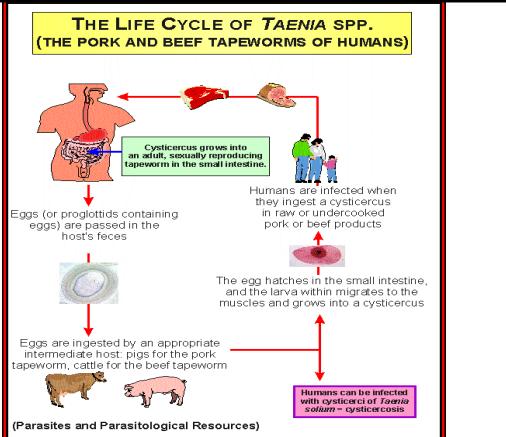
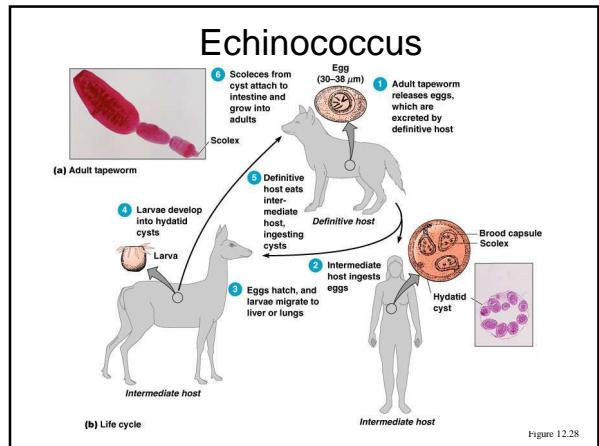


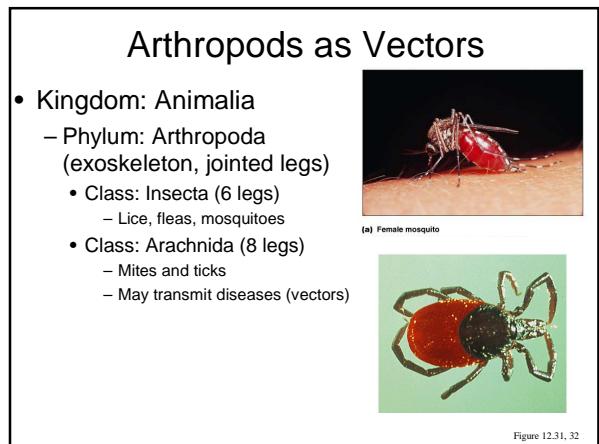
Figure 12.27

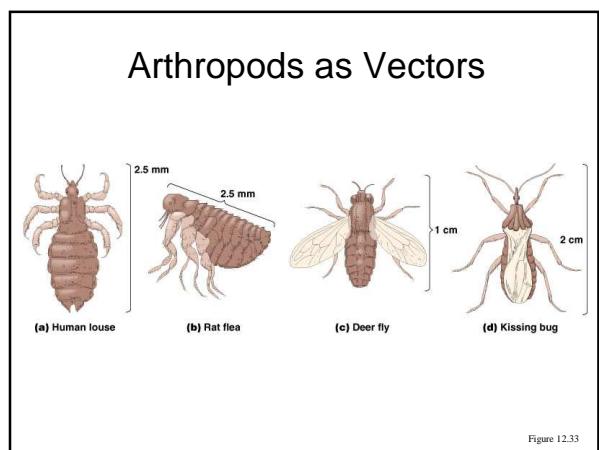


A few other tapeworms also cause disease

- Hymenolepis nana*, the dwarf tapeworm, most common human tapeworm worldwide
- Echinococcus granulosus*, the dog tapeworm, humans are **intermediate hosts**







Arthropod Vectors

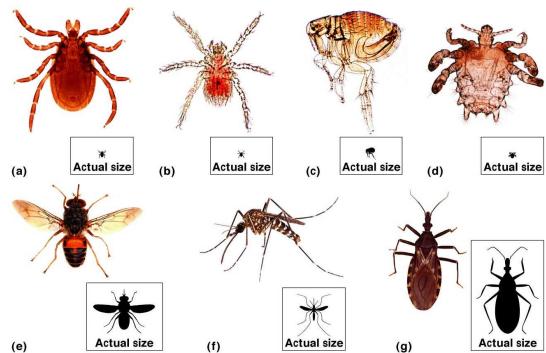


Figure 23-24

Scabies - mite



Arachnids

- Adult arachnids have four pairs of legs
 - Ticks and mites resemble each other morphologically
 - Ticks are the most important arachnid vectors
 - Serve as vectors for bacterial, viral, and protozoan diseases
 - Second only to mosquitoes in the number of diseases they transmit
 - Hard ticks are the most prominent disease vector
 - Transmit Lyme disease, Rocky Mountain spotted fever, tularemia, relapsing fever, and tick-borne encephalitis

Arachnids

- Parasitic mites are found wherever humans and animals coexist
 - Transmit rickettsial diseases among animals and humans

Insects

- Adults have three pairs of legs as well as a head, thorax, and abdomen
- Fleas
 - Most fleas are not associated with humans but a few do feed on humans
 - Plague is the most significant disease transmitted by fleas
- Body lice
 - Parasites that can also transmit disease
 - Most common among poor or overcrowded communities

Insects

- Flies
 - Among the most common insects
 - Those that transmit disease are generally bloodsuckers
- Mosquitoes
 - Most important arthropod vector of disease
 - Carry some of the world's most devastating diseases
- Kissing bugs
 - Often take blood meals near the mouth of their human hosts
 - Feed on blood nocturnally while the host sleeps

Eukaryotic Microbe Parasites

- **Protozoa**

- Amoeba
 - *Entamoeba histolytica*
 - *Naegleria*
 - *Acanthamoeba*
- Flagellates
 - *Giardia lamblia*
 - *Trichomonas vaginalis*
 - *Trypanosoma*
 - *Leishmania*
- Ciliates
 - *Balantidium coli*
- Sporozoa
 - *Plasmodium*
 - *Cryptosporidium*
 - *Toxoplasma*

- **Helminths**

- Roundworms
 - Intestinal
 - *Ascaris lumbricoides*
 - *Enterobius vermicularis*
 - *Necatur americanus*
 - Tissue
 - *Trichinella spiralis*
 - *Wucheraria bancrofti*
- Flatworms
 - Flukes
 - *Schistosoma*
 - *Taenia*

- **Arthropods**

- Insects
- Arachnids
