

GLOBAL
EDITION



Brock Biology of Microorganisms

FIFTEENTH EDITION

Madigan • Bender • Buckley • Sattley • Stahl



PowerPoint® Lecture
Presentations

CHAPTER 33

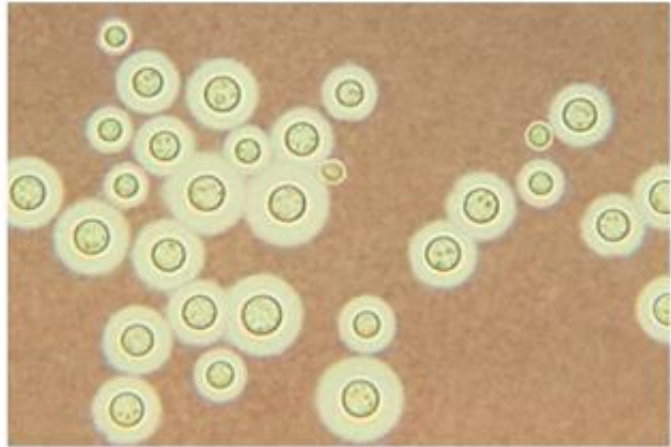
Eukaryotic Pathogens: Fungi, Protozoa, and Helminths

I. Fungal Infections

- 33.1 Pathogenic Fungi and Classes of Infection
- 33.2 Fungal Diseases: Mycoses

33.1 Pathogenic Fungi and Classes of Infection

- Only about 50 fungal species cause disease.
 - Fungi can be single celled *yeasts* or hyphae-forming *molds*. (Figure 33.1)
 - Some pathogenic fungi are *dimorphic*, meaning they can be either molds or yeasts.



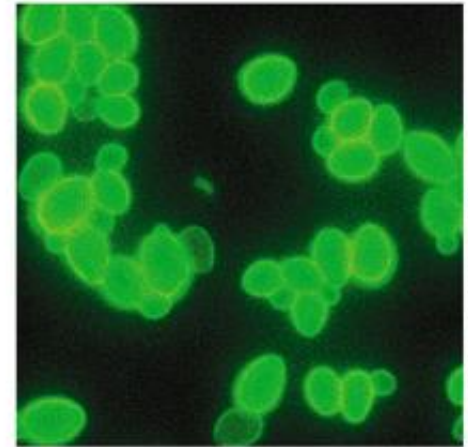
CDC/PHIL, L. Haley

(a)



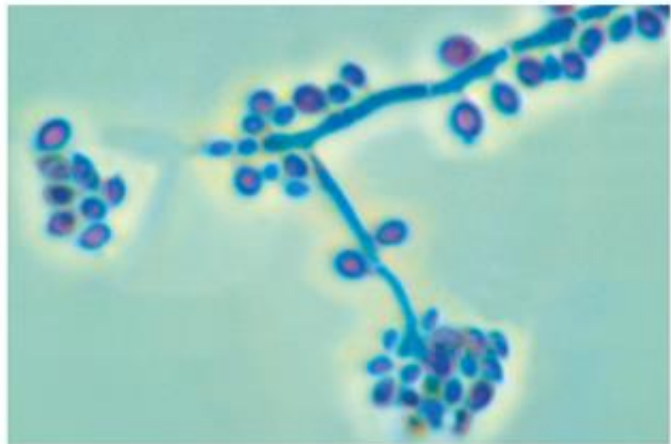
CDC/PHIL, A. Pachye

(b)



CDC/PHIL, M. Jaibert, L. Kaufman

(c)



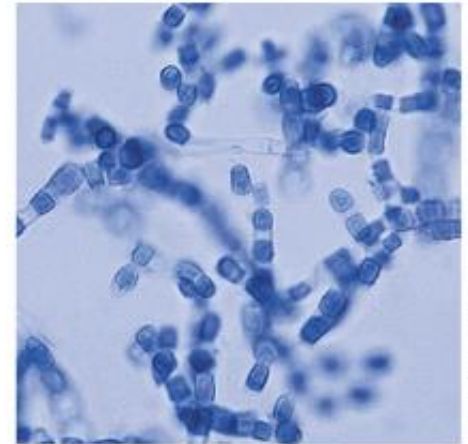
CDC/PHIL, L. Ajello

(d)



CDC/PHIL, L. Ajello

(e)



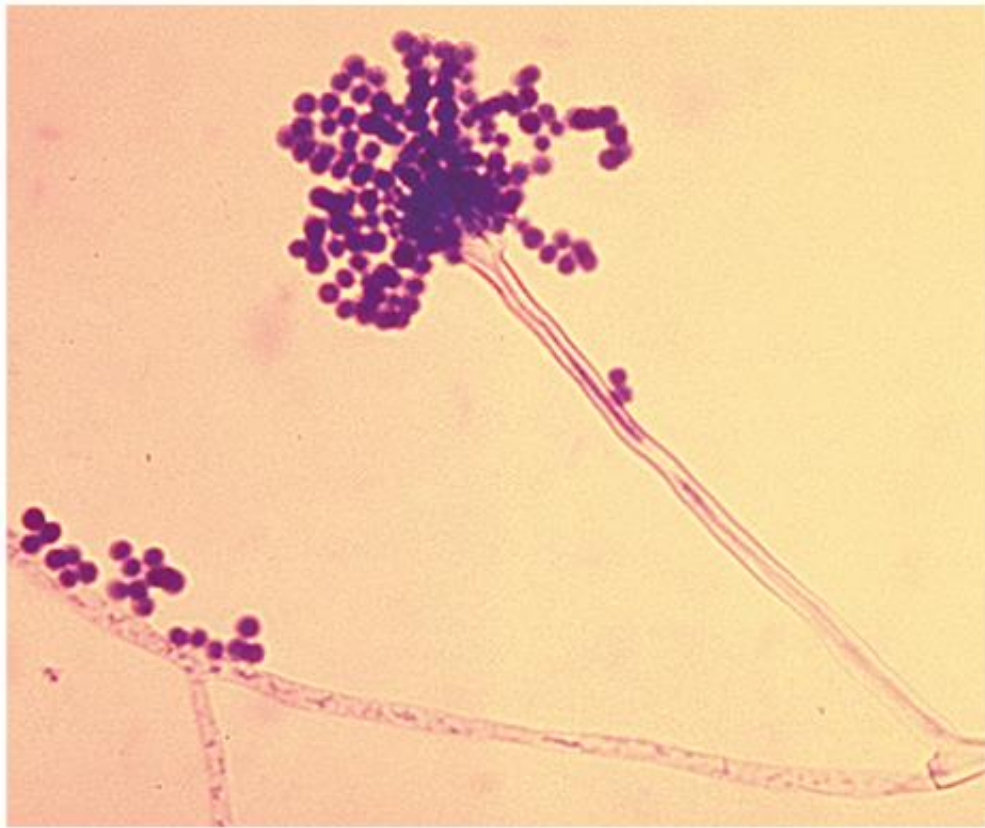
CDC/PHIL, L. K. Georg

(f)

Figure 33.1

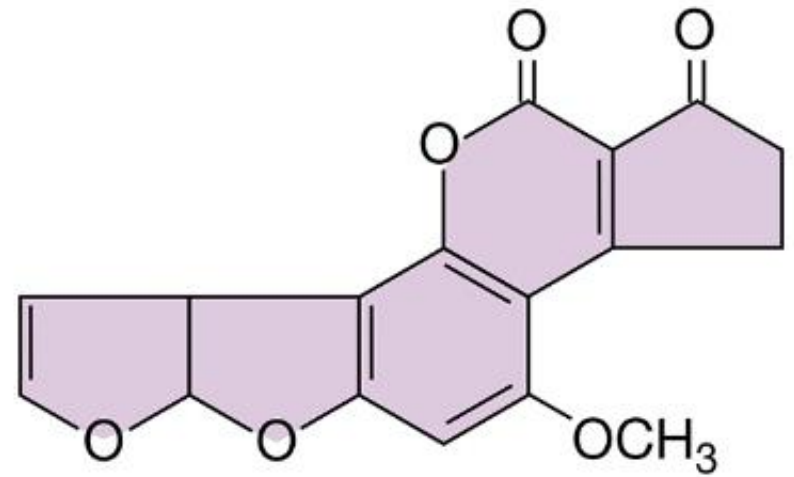
33.1 Pathogenic Fungi and Classes of Infection

- Fungi cause disease through three major mechanisms.
 - allergic responses to fungi
 - *mycotoxins* (e.g., aflatoxins; Figure 33.2)
 - infections (*mycoses*)
 - superficial
 - subcutaneous
 - systemic



CDC/PHIL

(a)



(b)

Figure 33.2

33.2 Fungal Diseases: Mycoses

- *Superficial mycoses* (Figure 33.3)
 - caused by *dermatophytes*, or fungus living in the skin.
 - *Dermato* = skin; *phyte* = plant (fungi were once considered degenerate plants).
 - *Trichophyton*
 - Fungi colonize the hair, skin, or nails and infect only the surface layers.

33.2 Fungal Diseases: Mycoses

- Subcutaneous mycoses (Figure 33.4)
 - Situations where fungi colonize deeper layers of skin tend to be more serious than superficial fungal infections.
 - Different groups of fungi may cause subcutaneous infection.
 - *Sporothrix*
 - *Fonsecaea*
 - *Cladosporium*

33.2 Fungal Diseases: Mycoses

- *Systemic mycoses* (Figure 33.5)
 - Humans become infected by inhaling spores.
 - fungal growth in internal organs of the body
 - *histoplasmosis* caused by *Histoplasma capsulatum*
 - *coccidioidomycosis* caused by *Coccidioides immitis*
 - *blastomycosis* caused by *Blastomyces dermatitidis*
 - *paracoccidioidomycosis* caused by *Paracoccidioides brasiliensis*
 - *cryptococcosis* caused by *Cryptococcus neoformans*

33.2 Fungal Diseases: Mycoses

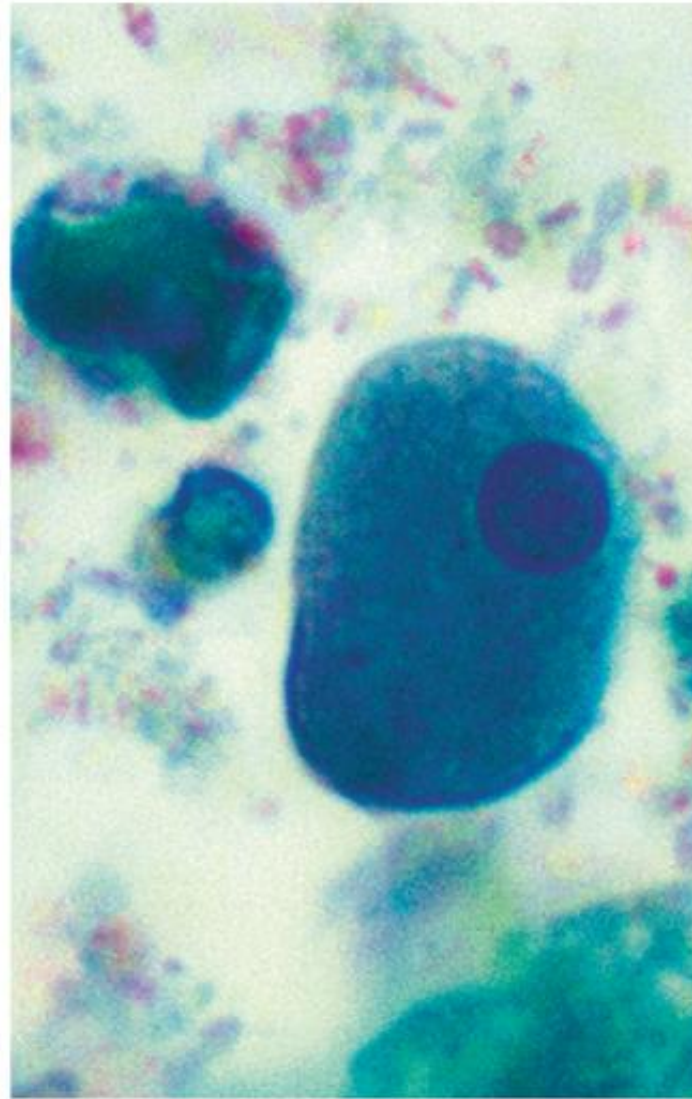
- Fungal infections can be especially serious in individuals with an impaired immune system (e.g., AIDS patients) or those taking immunosuppressive drugs.
- Other pre-disposing conditions for fungal infections are pregnancy, antibiotic use, and age.
 - Pregnant women have a weakened cellular immune response. Very young and very old individuals are more at risk for the same reason.
 - Antibiotic use disrupts the normal microbiota, often leading to fungal overgrowth. Example: Mucosal vaginal yeast (*Candida*) infections are common with antibiotic use.

II. Visceral Parasitic Infections

- 33.3 Amoebae and Ciliates: *Entamoeba*, *Naegleria*, and *Balantidium*
- 33.4 Other Visceral Parasites: *Giardia*, *Trichomonas*, *Cryptosporidium*, *Toxoplasma*, and *Cyclospora*

33.3 Amoeba and Ciliates: *Entamoeba*, *Naegleria*, and *Balantidium*

- *Entamoeba histolytica* (Figure 33.6a)
 - a pathogenic protist transmitted to humans primarily through contaminated water and sometimes food
 - anaerobic and produces resistant cysts
 - Infection can be asymptomatic or lead to diarrhea and/or *dysentery*.
 - If untreated, invasive cells can invade the liver and occasionally the lungs and brain.
 - can be treated with amoebicidal drugs



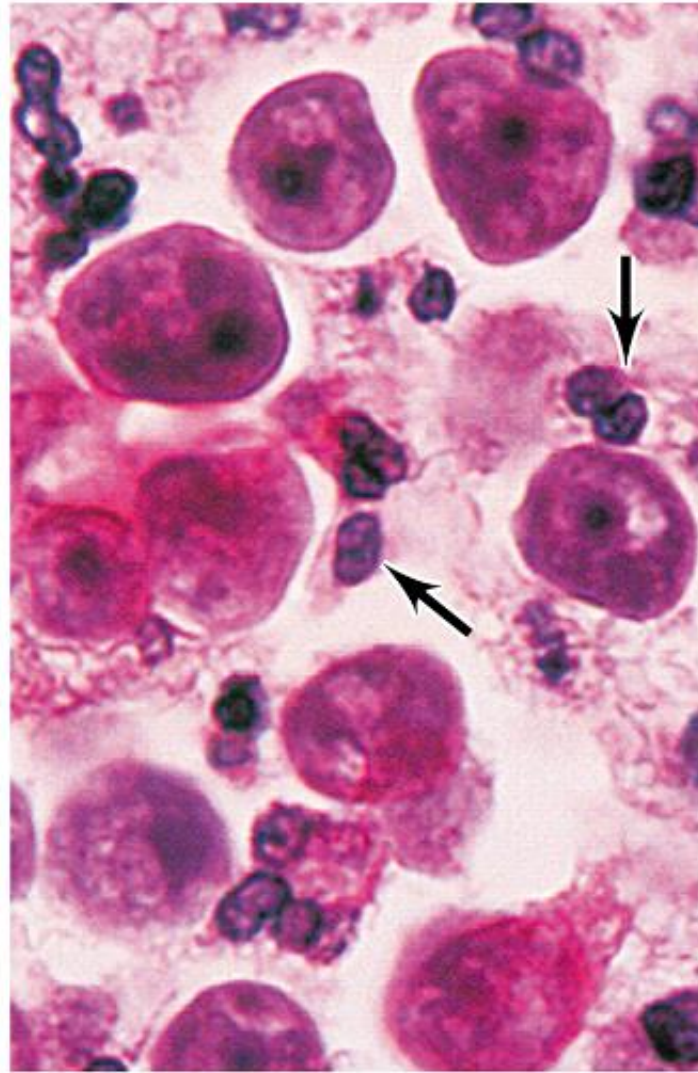
CDC/PHIL, M. Melvin

(a)

Figure 33.6a

33.3 Amoeba and Ciliates: *Entamoeba*, *Naegleria*, and *Balantidium*

- *Naegleria fowleri* (Figure 33.6b)
 - a free-living amoeba found in soil and water runoff that can also cause amebiasis
 - Infections usually result from swimming in warm, soil-contaminated natural water sources (e.g., hot springs or lakes).
 - enters the human body through the nose and burrows directly into the brain, causing extensive hemorrhage and brain damage (meningoencephalitis)
 - Drug treatment is effective if infections are identified early.



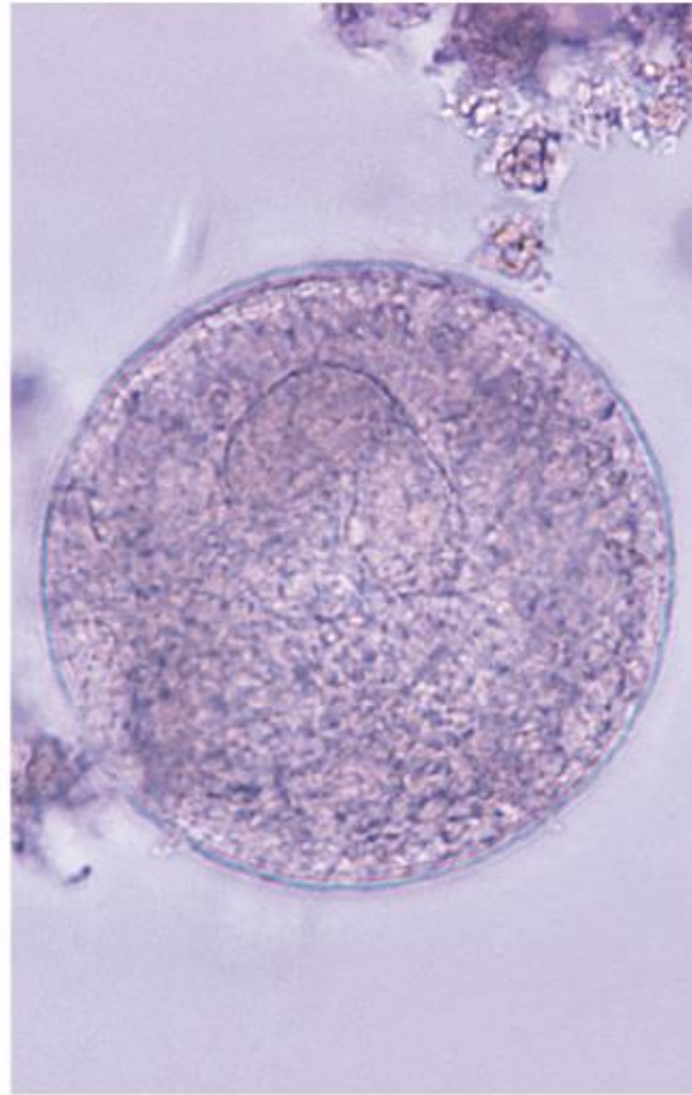
CDC/PHIL, M. Melvin

(b)

Figure 33.6b

33.3 Amoeba and Ciliates: *Entamoeba*, *Naegleria*, and *Balantidium*

- *Balantidium coli* (Figure 33.6c)
 - ciliated intestinal human and swine parasite
 - infections caused by cysts
 - transmitted to humans through fecally contaminated water
 - symptoms resemble those of amebiasis



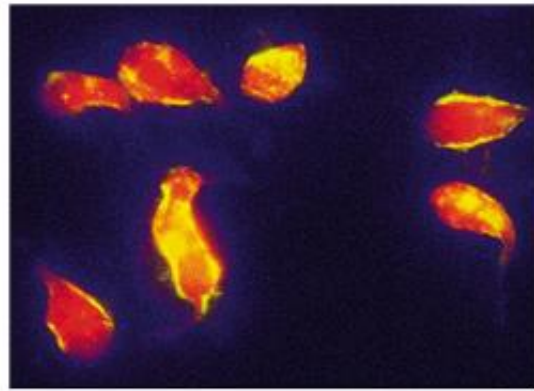
CDC/PHIL, L. L. A. Moore, Jr.

(c)

Figure 33.6c

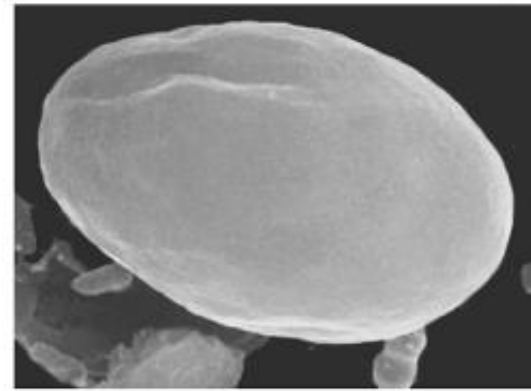
33.4 Other Visceral Parasites: *Giardia*, *Trichomonas*, *Cryptosporidium*, *Toxoplasma*, and *Cyclospora*

- *Giardia intestinalis* (Figure 33.7)
 - flagellated anaerobic parasite
 - has mitosomes
 - produces highly resistant cysts
 - cause of *giardiasis*, a common waterborne disease
 - explosive, foul-smelling diarrhea, intestinal cramps, nausea, weight loss, and malaise
 - Many individuals exhibit no symptoms and can act as carriers.



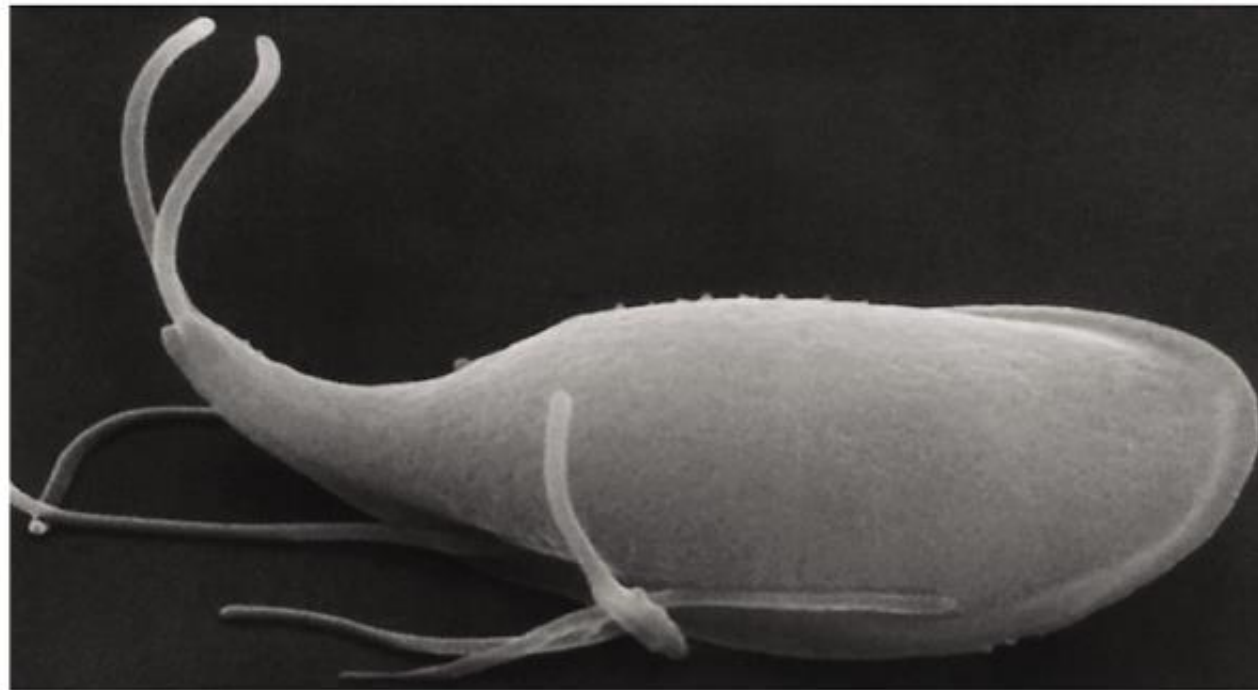
CDC/PHIL, G. S. Visvesvara

(a)



S. L. Erlandsen

(b)



D. E. Feely, S. L. Erlandsen, and D. G. Case

(c)

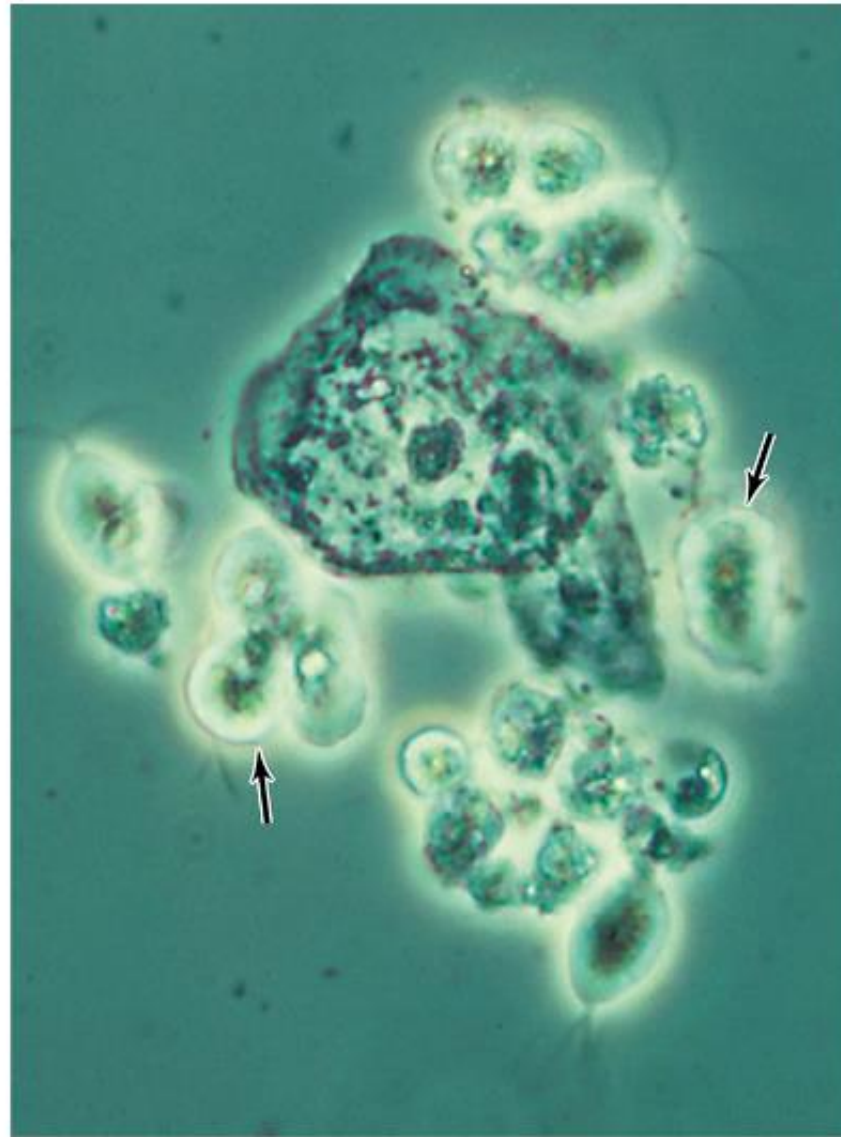
Figure 33.7

33.4 Other Visceral Parasites: *Giardia*, *Trichomonas*, *Cryptosporidium*, *Toxoplasma*, and *Cyclospora*

- *Trichomonas vaginalis* (Figure 33.8)
 - flagellated anaerobic parasite
 - has hydrogenosomes
 - transmitted person-to-person by sexual intercourse
 - can survive on moist surfaces
 - can be transmitted by toilet seats, sauna benches, and towels
 - asymptomatic in males
 - vaginal discharge, itching, and burning in women
 - antiprotozoal drug metronidazole used in treatment



(a)



CDC/PHIL

(b)

Figure 33.8

33.4 Other Visceral Parasites: *Giardia*, *Trichomonas*, *Cryptosporidium*, *Toxoplasma*, and *Cyclospora*

- *Cryptosporidium*, *Toxoplasma*, and *Cyclospora*
 - parasitic coccidia
 - transmitted to humans through fecally contaminated food or water

33.4 Other Visceral Parasites: *Giardia*, *Trichomonas*, *Cryptosporidium*, *Toxoplasma*, and *Cyclospora*

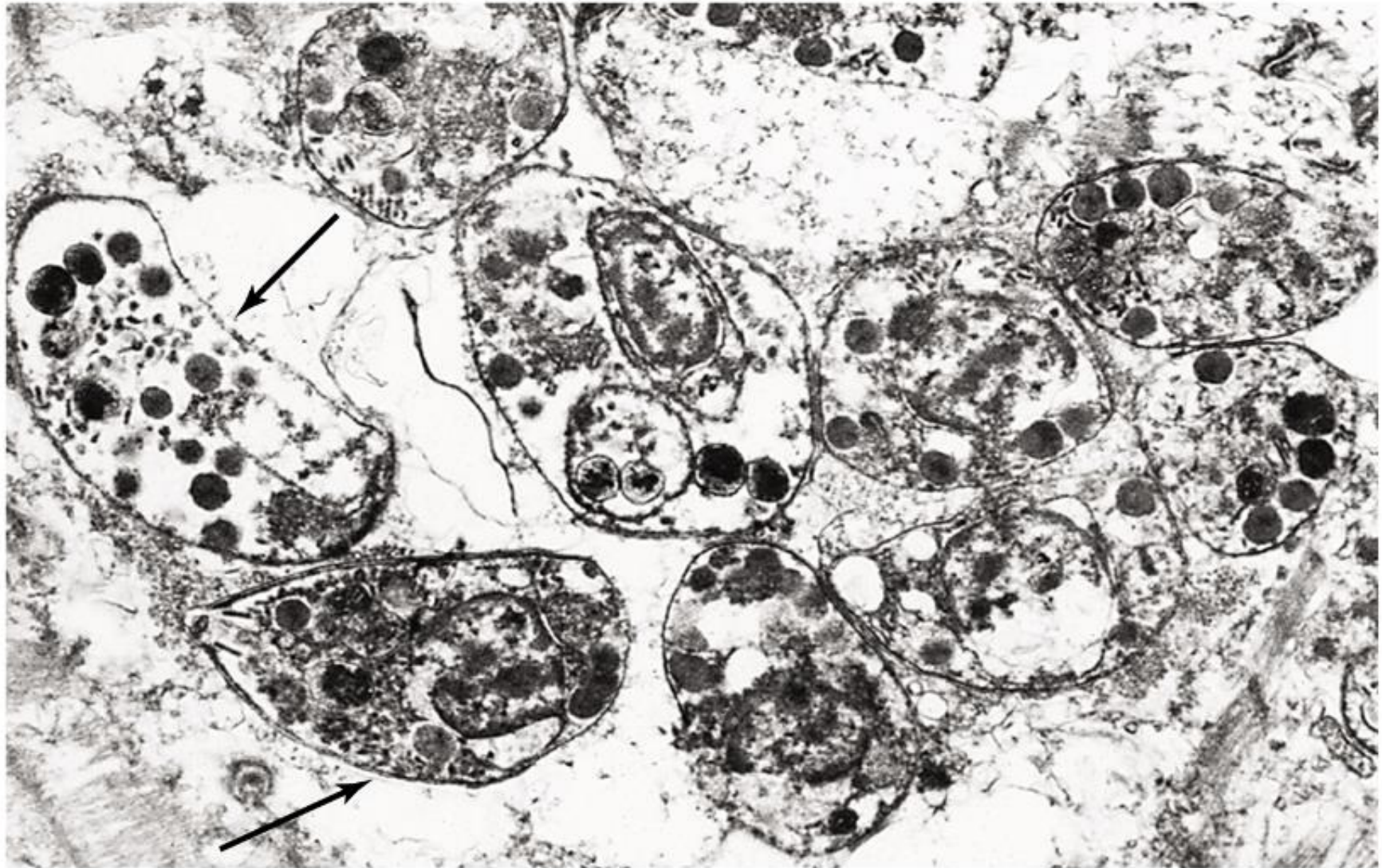
- *Cryptosporidium parvum* (Figure 33.9)
 - protist that lives as a parasite in warm-blooded animals
 - produces thick-walled cells (oocysts) that are shed in the feces of infected animals
 - The oocysts are transmitted in fecally contaminated water.
 - Oocysts are highly resistant to chlorine and UV radiation; thus, sedimentation and filtration methods are most effective at removal.

33.4 Other Visceral Parasites: *Giardia*, *Trichomonas*, *Cryptosporidium*, *Toxoplasma*, and *Cyclospora*

- *Cyclospora cayetanensis*
 - protist that lives as a parasite in warm-blooded animals
 - produces oocysts that are shed in the feces of infected animals
 - The oocysts are transmitted in fecally contaminated foods.
 - Most cases have been linked to fruits or vegetables.
 - major outbreak in the United States linked to contaminated packaged lettuce in 2013

33.4 Other Visceral Parasites: *Giardia*, *Trichomonas*, *Cryptosporidium*, *Toxoplasma*, and *Cyclospora*

- *Toxoplasma gondii* (Figure 33.10)
 - protist that lives as a parasite in warm-blooded animals
 - produces oocysts that are shed in the feces of infected animals
 - The oocysts are transmitted by cats.
 - also by undercooked meat
 - Toxoplasmosis is mainly asymptomatic.
 - Toxoplasmosis can damage eyes, brain, and other organs in immune-compromised individuals.
 - *Toxoplasma* can cause birth defects.



CDC/Dr. Edwin P. Ewing, Jr.

Figure 33.10

III. Blood and Tissue Parasitic Infections

- 33.5 *Plasmodium* and Malaria
- 33.6 Leishmaniasis, Trypanosomiasis, and Chagas' Disease
- 33.7 Parasitic Helminths: Schistosomiasis and Filariasis

33.5 *Plasmodium* and Malaria

- Malaria
 - a protist disease caused by *Plasmodium* spp.
 - has a complex life cycle that includes *Anopheles* mosquitoes as vectors (Figure 33.11)
 - estimates of 350 million people infected worldwide
 - Each year over one million people die from malaria.
 - generally found in tropical and subtropical regions

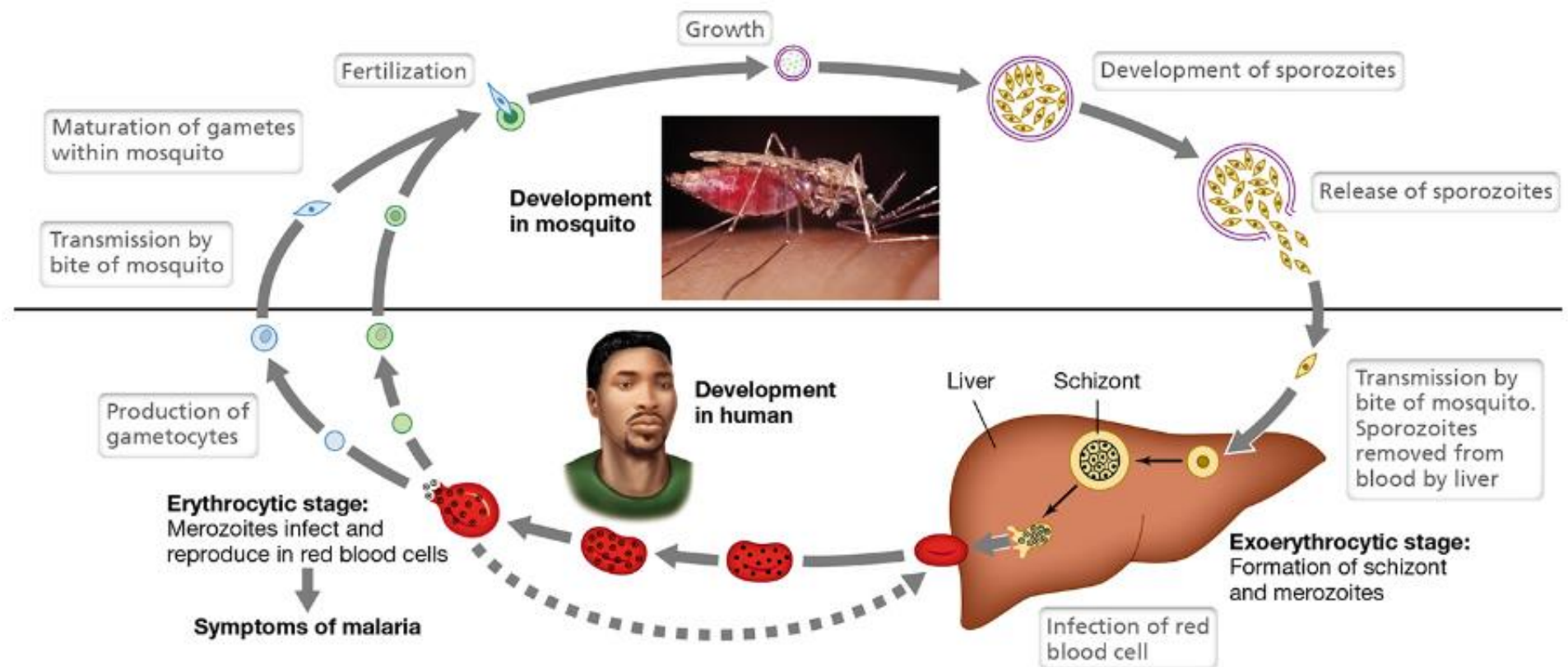
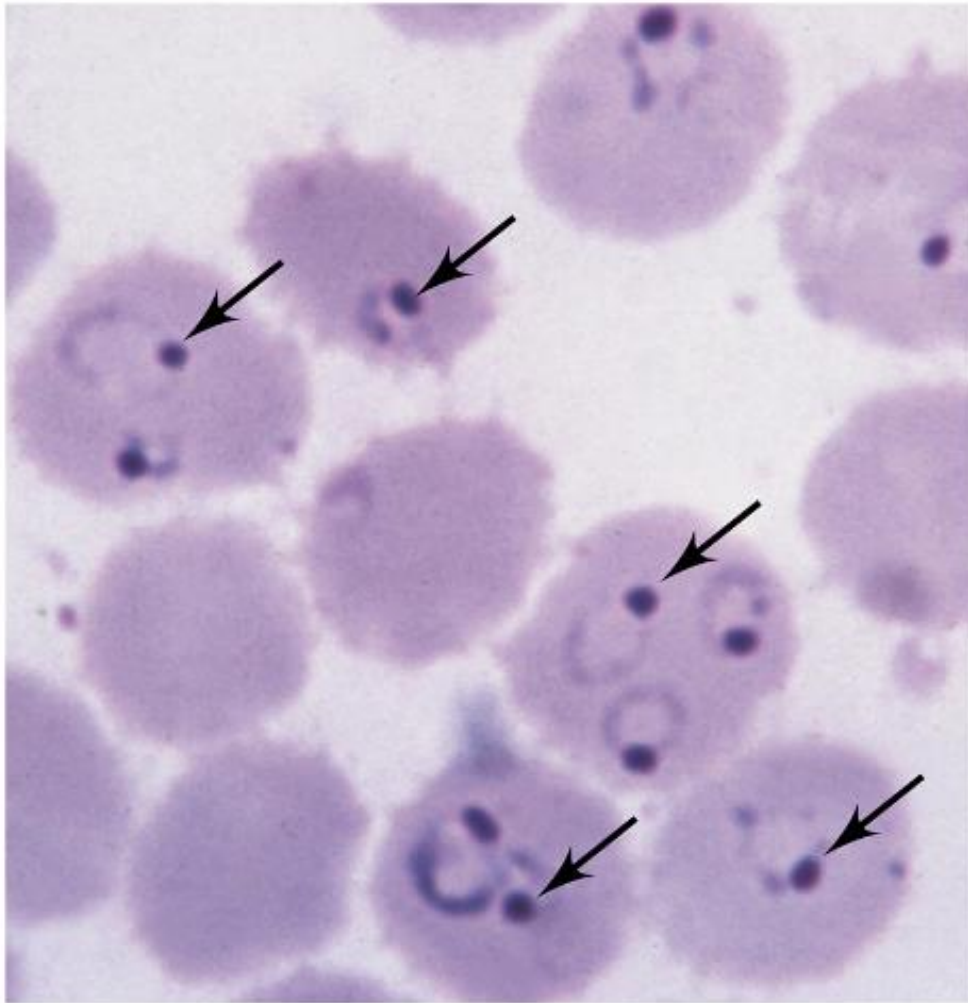


Figure 33.11

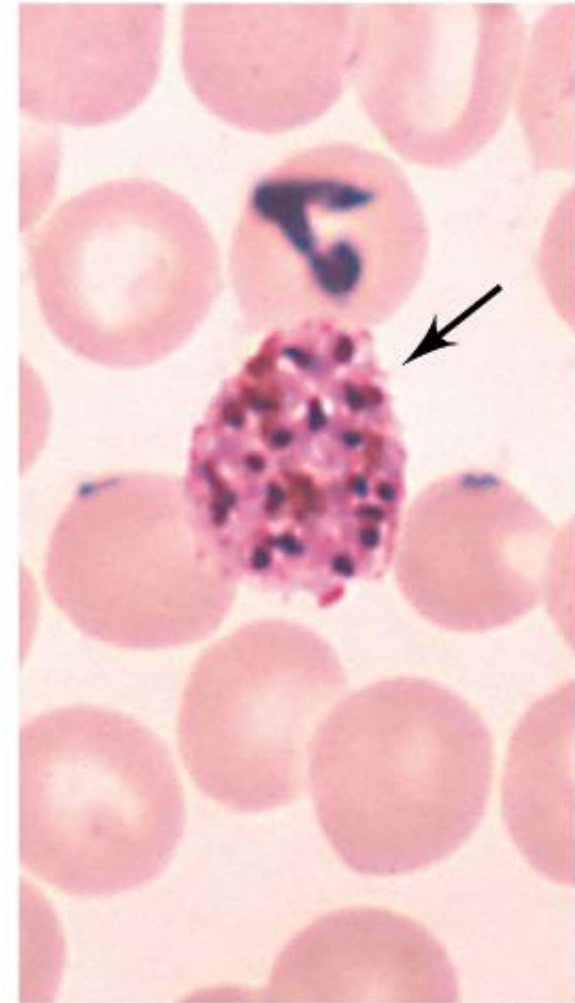
33.5 *Plasmodium* and Malaria

- Diagnosis requires identifying *Plasmodium*-infected erythrocytes in blood smears. (Figure 33.12)
- Drugs are used to prevent and treat infections.
 - *chloroquine* and *primaquine*
- Malaria may recur years after the primary infection.
- Several vaccines are currently in development.
- can be controlled by draining swamps or eliminating mosquitoes



CDC/Steven Glenn

(a)



CDC/PHIL, M. Melvin

(b)

Figure 33.12

33.6 Leishmaniasis, Trypanosomiasis, and Chagas' Disease

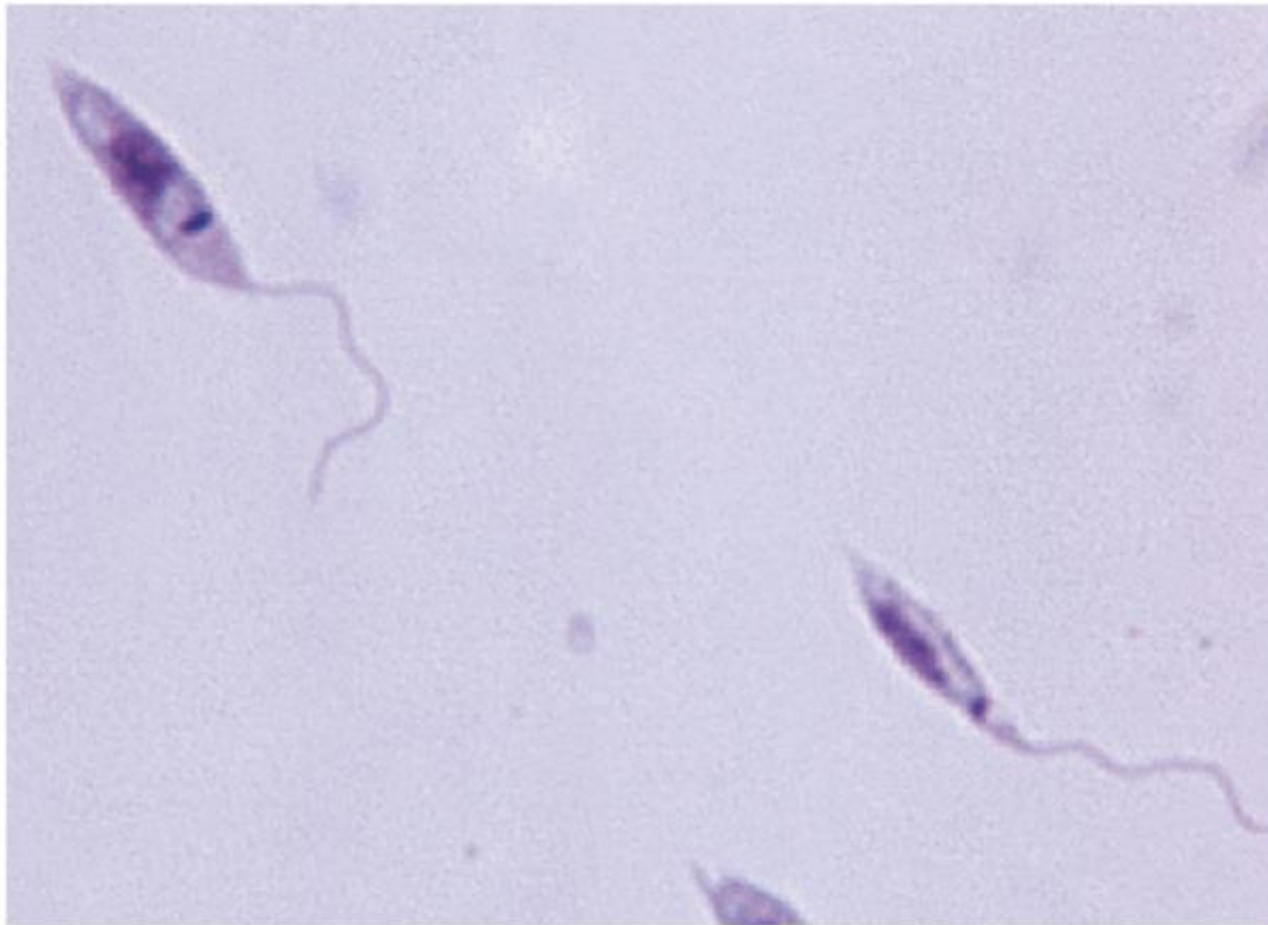
- *Leishmania tropica* or *L. mexicana* (Figure 33.13b)
 - flagellated protozoan
 - related to *Trypanosoma*
 - causes *cutaneous leishmaniasis*
 - transmitted by bite of sandfly (Figure 33.13a)
 - infects and grows in macrophages
 - forms nodules and ulcers on skin (Figure 33.13c)
 - treatment with antimony compounds



CDC/PHIL, F. Collins, J. Gathany

(a)

Figure 33.13a



CDC/PHIL, M. Melvin

(b)

Figure 33.13b



CDC/PHIL, D.S. Martin

(c)

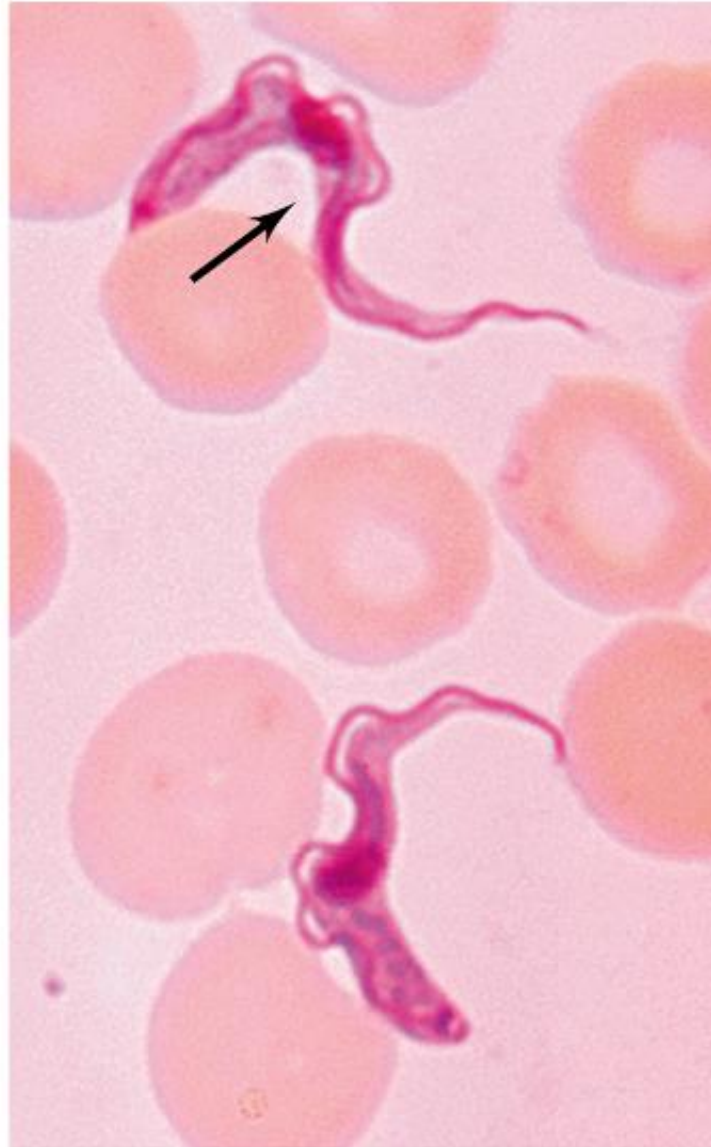
Figure 33.13c

33.6 Leishmaniasis, Trypanosomiasis, and Chagas' Disease

- *Leishmania donovani*
 - causes *visceral leishmaniasis*
 - transmitted by bite of sandfly
 - parasite travels to internal organs
 - damage to liver, spleen, and bone marrow
 - If untreated, visceral disease is fatal.
 - Treatment includes antimony, compounds, bed rest, and blood transfusions.

33.6 Leishmaniasis, Trypanosomiasis, and Chagas' Disease

- *Trypanosoma brucei* (Figure 33.14a)
 - two subspecies
 - *T. brucei gambiense*
 - *T. brucei rhodesiense*
 - causes African sleeping sickness (African trypanosomiasis)
 - transmitted by bite of tsetse fly
 - Parasite multiplies in blood.
 - infects central nervous system and multiplies in spinal fluid
 - Treatment includes anti-trypanosomal drugs.



CDC/PHIL, Myron G. Schultz

(a)

Figure 33.14a

33.6 Leishmaniasis, Trypanosomiasis, and Chagas' Disease

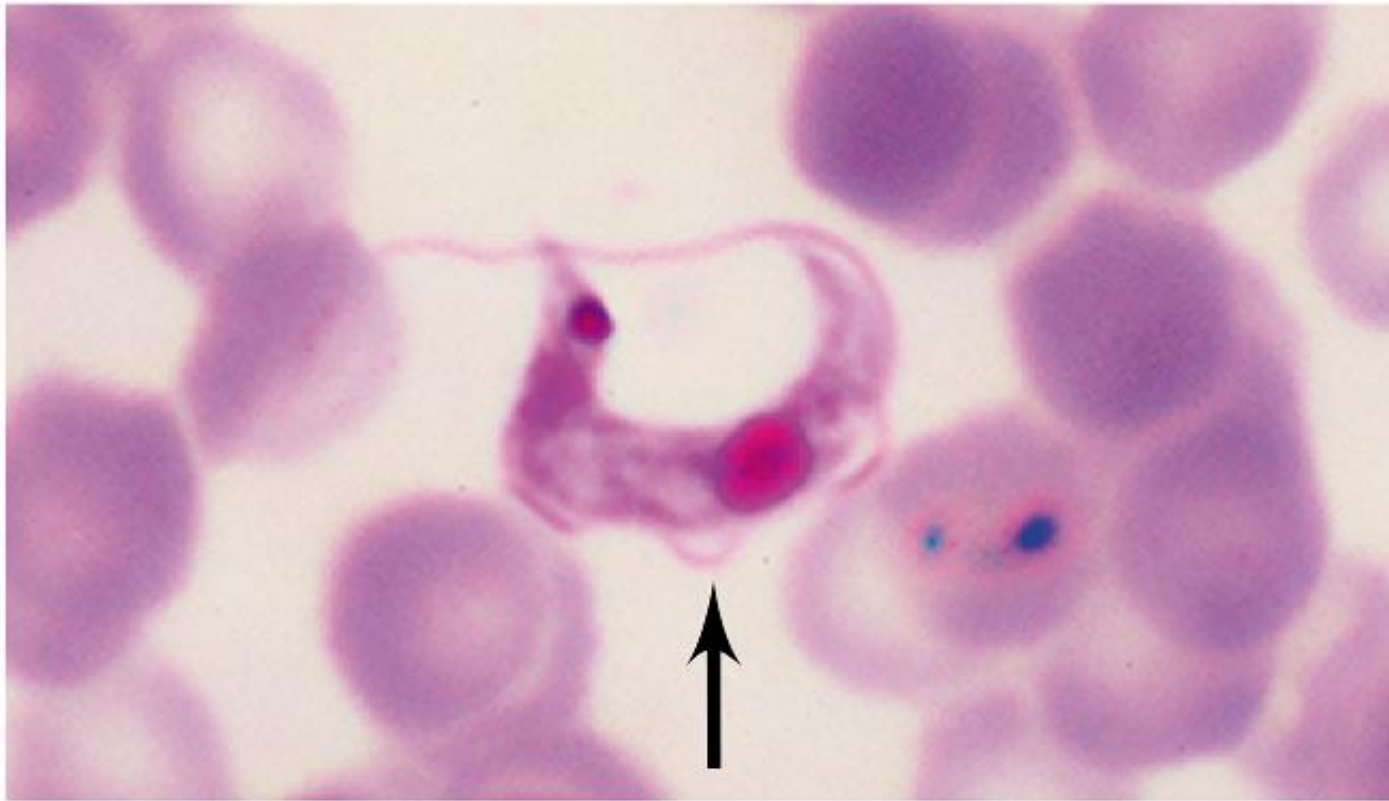
- *Trypanosoma cruzi* (Figure 33.14c)
 - causes Chagas' disease (American trypanosomiasis)
 - transmitted by bite of “kissing bug” (Figure 33.14b)
 - Parasite affects heart, gastrointestinal tract, and central nervous system.
 - occurs in Latin American countries



CDC/PHIL, WHO

(b)

Figure 33.14b



CDC/PHIL, M. Melvin

(c)

Figure 33.14c

33.7 Parasitic Helminths: Schistosomiasis and Filariases

- Schistosomiasis (Figure 33.15a)
 - called *snail fever*
 - caused by the trematode *Schistosoma*
 - Life cycle requires snails and humans.
 - Eggs released into freshwater. (Figure 33.15b)
 - Eggs become *miricidia*.
 - Miricidia infect snails and become *cercaria*. (Figure 33.15c)
 - Cercaria burrow into skin, leaving surface lesions. (Figure 33.15d)
 - occurs in tropical and subtropical countries
 - treatment with praziquantel



CDC/PHIL, S. Maddison

(a)

Figure 33.15a



CDC/PHIL

(b)

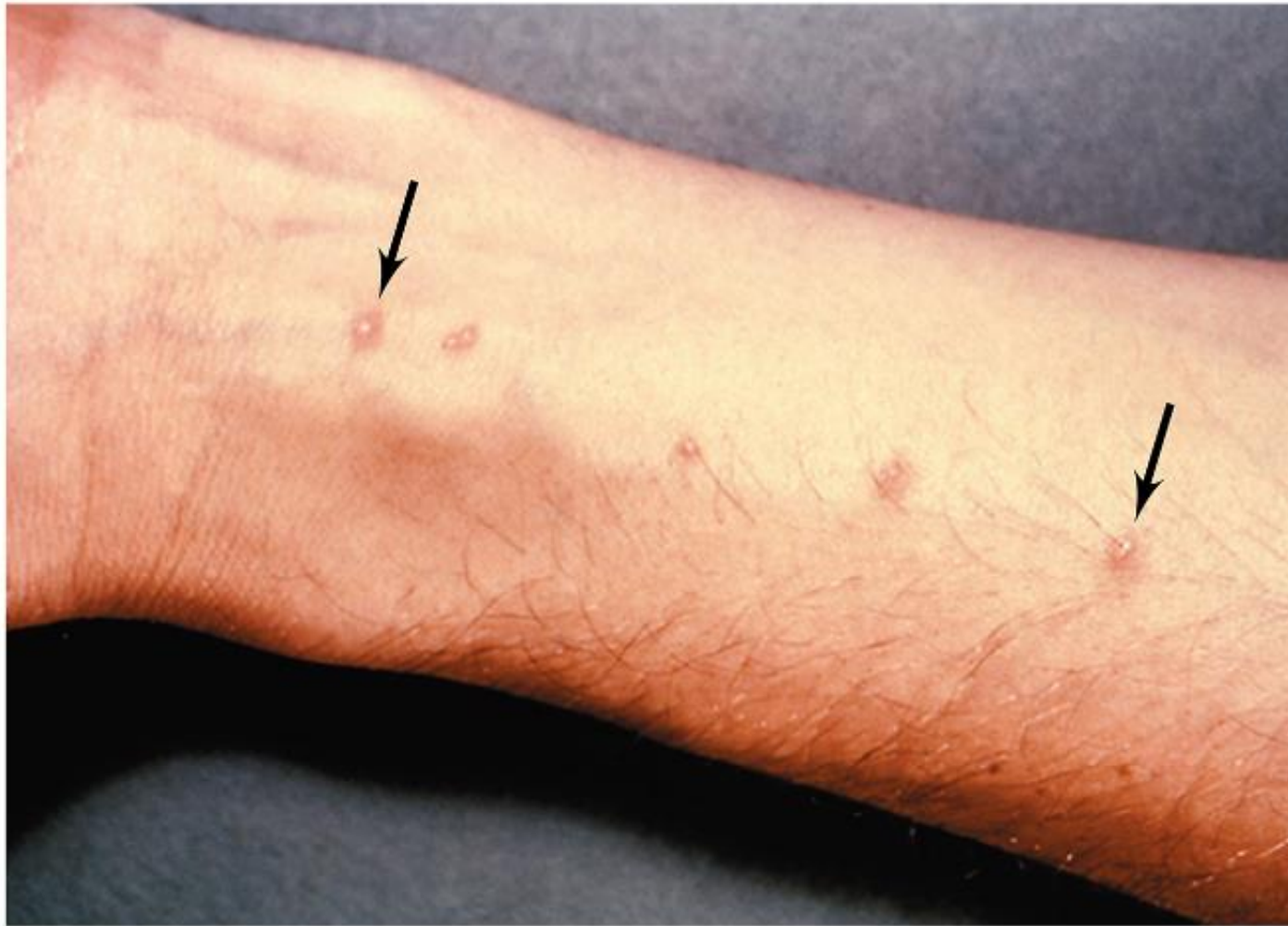
Figure 33.15b



CDC/PHIL, A.J. Sulzer

(c)

Figure 33.15c



CDC/PHIL

(d)

Figure 33.15d

33.7 Parasitic Helminths: Schistosomiasis and Filariases

- *Filariasis* (Figure 33.16b)
 - transmitted by bite of mosquito
 - called *Bancroft's filariasis* (“elephantiasis”)
 - caused by the nematode *Wuchereria bancrofti*
 - Worms interrupt lymph flow.
 - chronic infection of the lymphatic system
 - causes massive enlargement of the legs



CDC/PHIL

(b)

Figure 33.16b

33.7 Parasitic Helminths: Schistosomiasis and Filariases

- *Onchocerciasis*
 - transmitted by flies
 - called “river blindness”
 - caused by the nematode *Onchocerca volvulus*
 - Worms invade cornea, iris, and retina.
 - causes scarring of eye and loss of vision
 - occurs in equatorial Africa

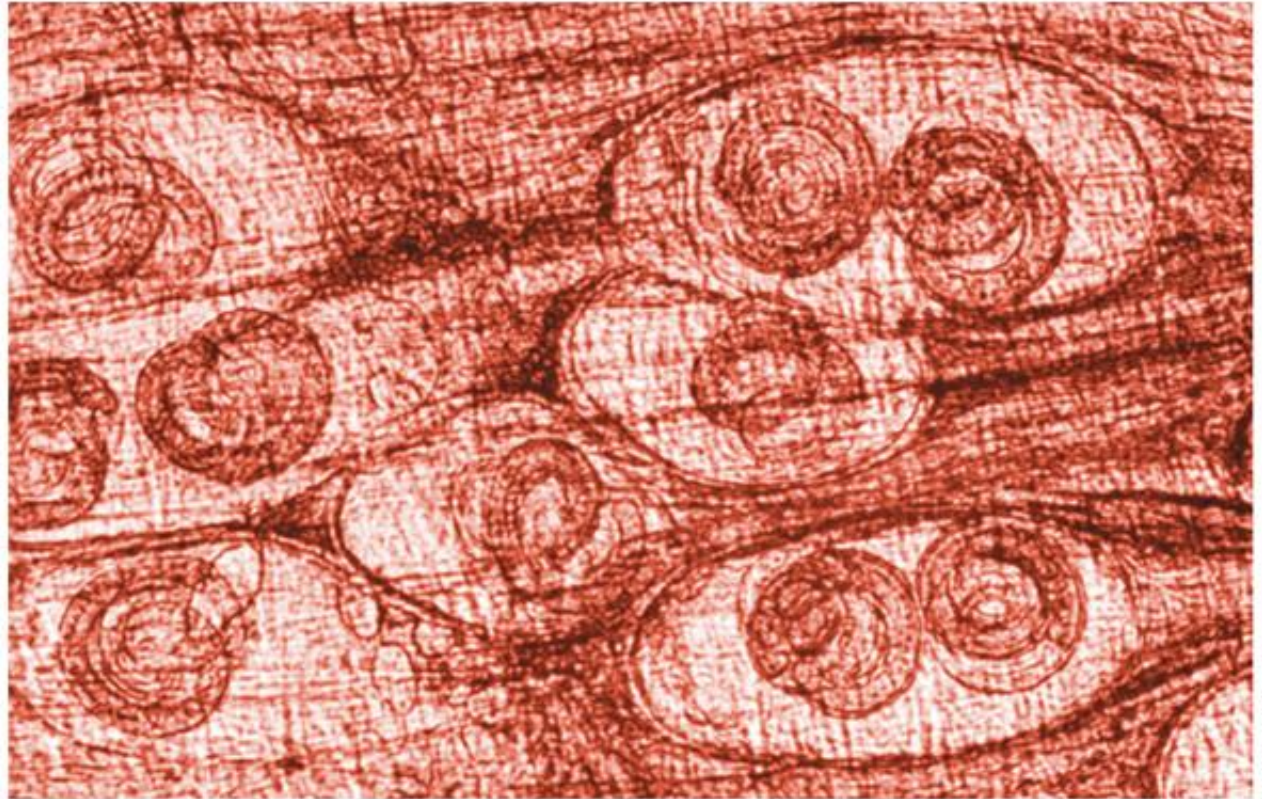
33.7 Parasitic Helminths: Schistosomiasis and Filariases

- *Trichinosis*
 - Caused by the nematode *Trichinella spiralis*
 - Worm lives in muscle tissue of wild mammals.
(Figure 33.17)
 - Worm infects pigs.
 - Humans consume undercooked meat.
 - Larvae enter intestinal mucosa.
 - Larvae can circulate throughout body.
 - Trichinosis is treatable with antihelminthic drugs.



CDC/PHIL

(a)



CDC/PHIL

(b)

Figure 33.17