Infectious diseases

	4/5th Semester Classes on Infectious Diseases, 8-9AM, Tuesdays (LT-1)
	Topics
1	Approach to Infectious Diseases and their prevention
2	Antibiotic stewardship practices
3	Community-Acquired Infections
4	Health Care–Associated Infections
5	Gram-Positive Bacteria (part-1)
6	Gram-Positive Bacteria (part-2)
7	Gram-Negative Bacteria (part-1)
8	Gram-Negative Bacteria (part-2)
9	Spirochetal Diseases
10	Diseases Caused by Atypical/Miscellaneous Bacterial Infections
11	**Revision-cum-exam on bacteria (Must to know type)**
12	Infections Due to DNA Viruses
13	Infections Due to RNA Viruses (part 1)
14	Infections Due to RNA Viruses (part 2)
15	HIV/AIDS – part 1
16	HIV/AIDS – part 2
17	Fungal Infections
18	Parasitic Infections (part 1)
19	Parasitic Infections (part 2)
20	**Revision-cum-exam on Virus, Fungal, and Parasite (Must to know type)**

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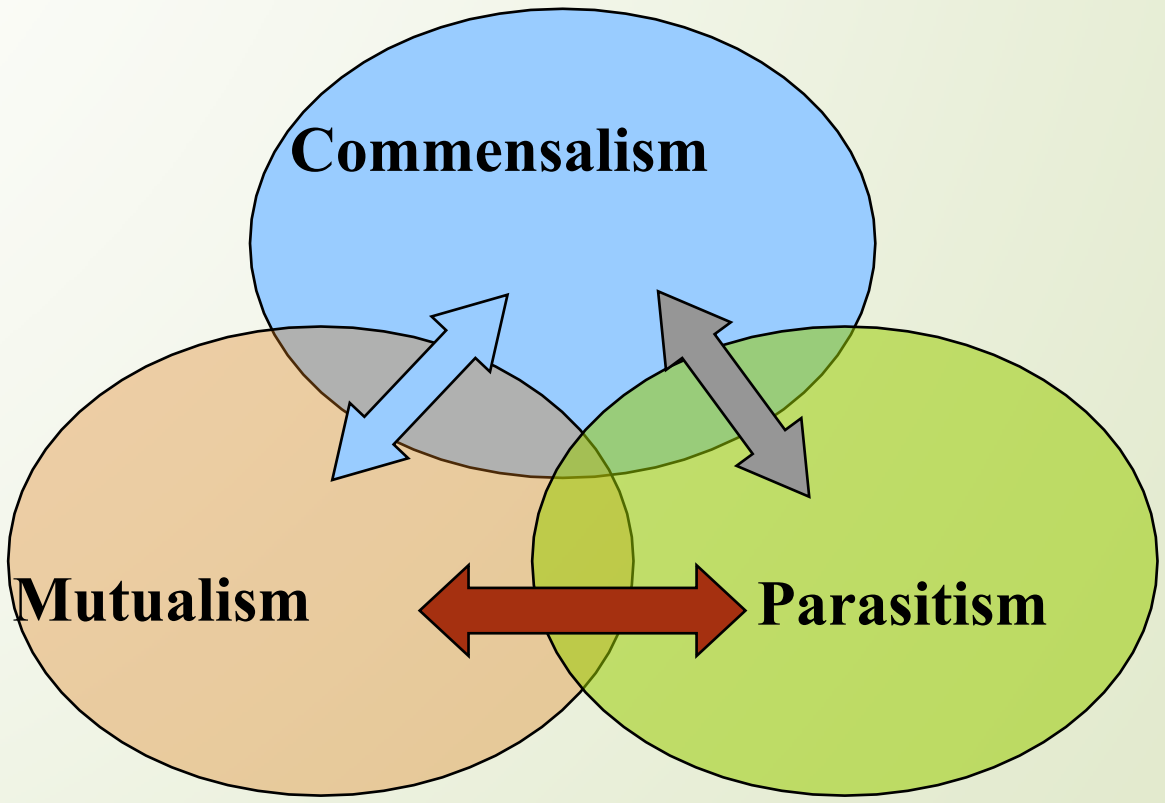
Symbiosis

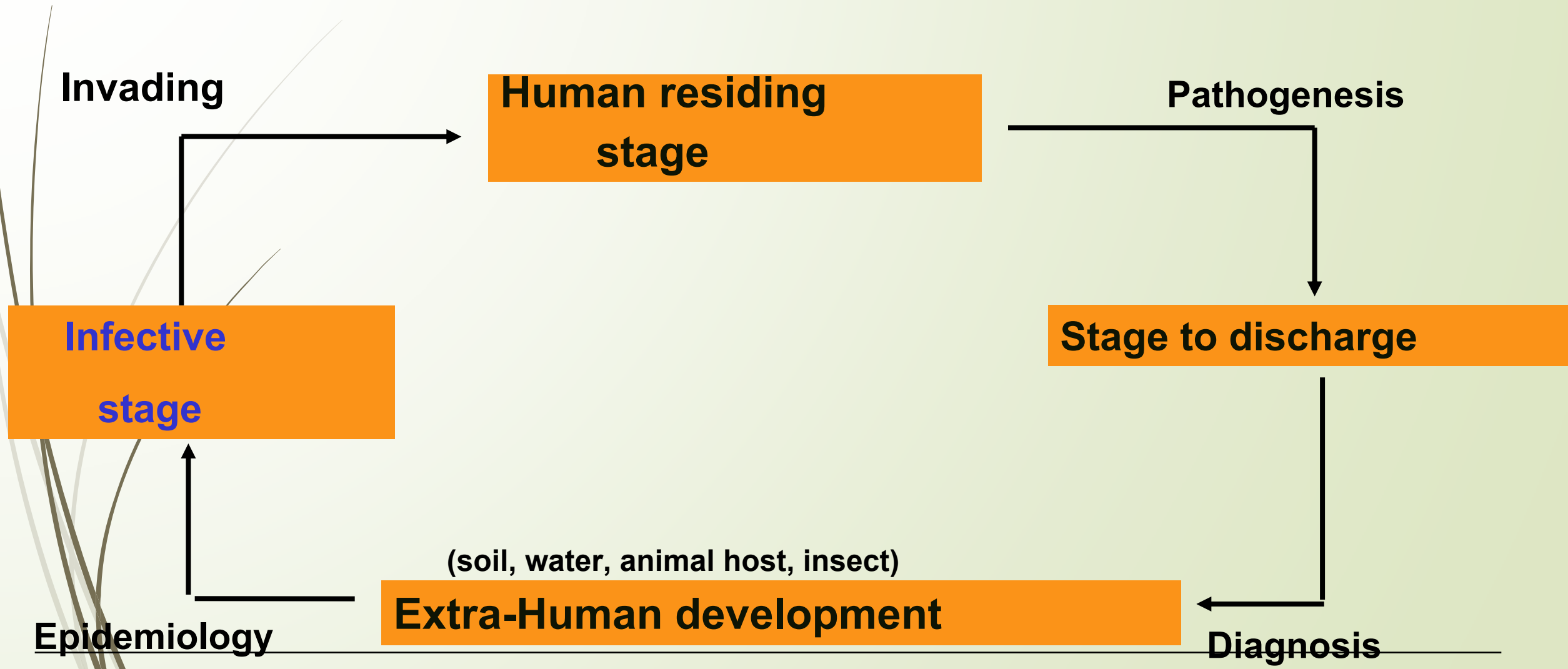


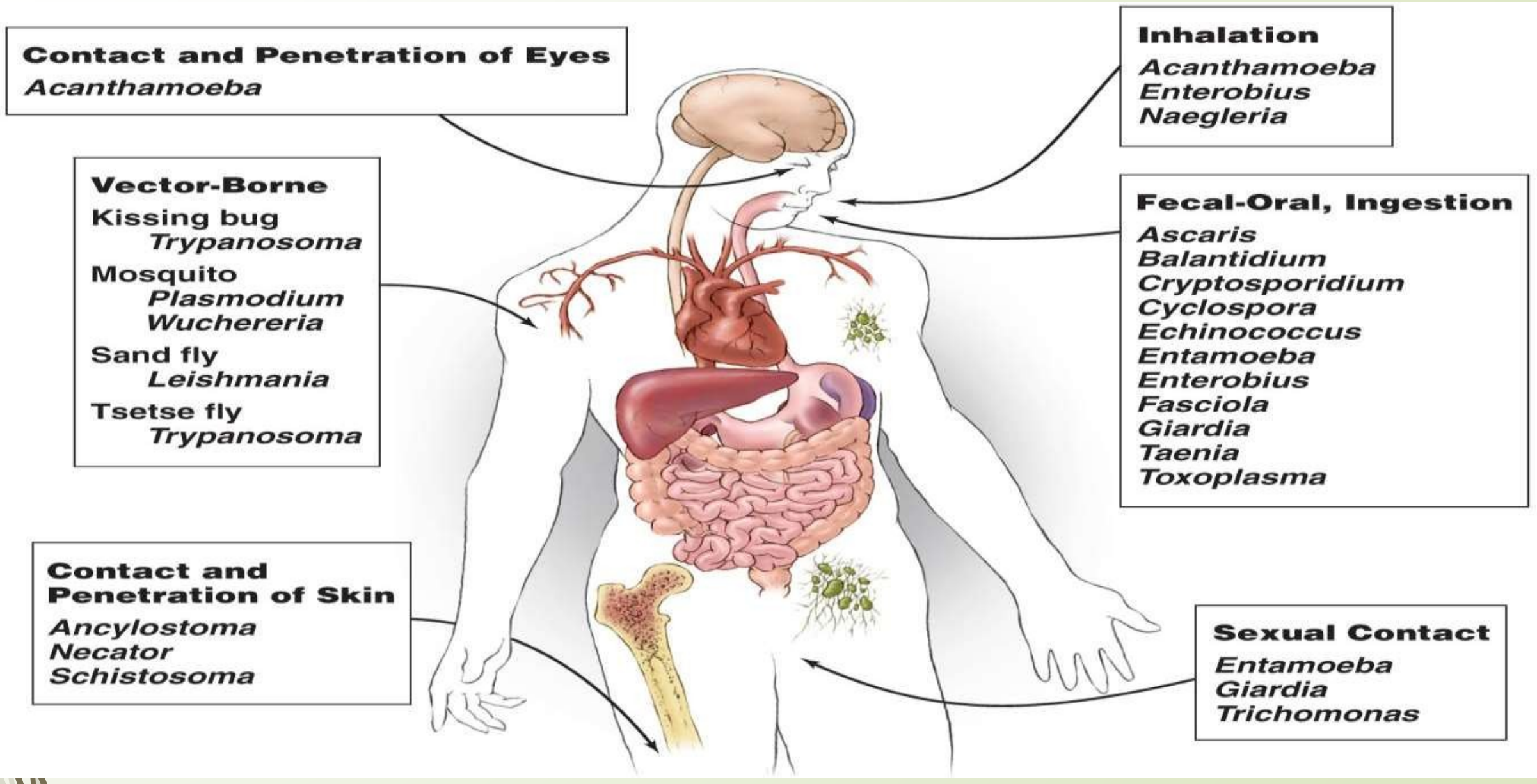
Overlap between the major categories of symbiosis

Human parasites are divided into:

1. Endoparasites, which cause infection inside the body
2. Ectoparasites, which cause infection superficially within the skin
   - Bedbug, Louse, Scabies, Demodex, Flea, etc

Parasite Life Cycle—A generalized mode





- Intestinal entry, disease local/distant site

Intestinal protozoans

Giardia lamblia

Cryptosporidium parvum

Entamoeba histolytica

Intestinal worms

Ascaris lumbricoides

Trichuris trichiuria

Taenia saginata

Enterobius vermicularis

- Intestinal entry, disease elsewhere
  - *Acquired toxoplasmosis*
  - *Hydatid disease (echinococcus)*
  - *Cysticercosis (taenia solium)*
  - *Visceral larva migrans (toxocara canis)*
  - *Trichinosis (trichinella spiralis)*
- Skin entry, intestinal manifestations
  - *Hookworm*
  - *Strongyloides*
  - *Schistosoma mansoni*
- Skin entry, localized disease
  - *Leishmaniasis*
  - *Filariasis*
- Skin entry, disease by dissemination
  - *Malaria*
  - *Trypanosomiasis*
  - *Schistosomiasis*

Symptoms	Parasite
Abdominal pain and distension	Giardia Cryptosporidium Amoebiasis Ascaris, hookworm, taenia
Diarrhoea +/- malabsorption	Giardia Cryptosporidium Strongyloides
Diarrhoea with blood loss	Amoebiasis Trichuris Hookworm
Tenesmus, prolapsed rectum	Trichuris

Symptom	***Mechanism***	***Parasite***
Anaemia	Blood loss	Amoebiasis Hookworm Trichuris S mansoni
	Malabsorption	Giardia Diphyllobothrium
	Malnutrition	Heavy infestation

Symptom	***Mechanism***	***Parasites***
Skin rash	Papulovesicular Creeping eruption Peri-anal rash and pruritus	Hookworm Strongyloides Enterobius
Respiratory symptoms	Pulmonary migration	Ascaris Hookworm Strongyloides Toxocara

Symptom	**Mechanism**	**Parasite**
Intestinal obstruction	Worm bolus	Ascaris
Appendicitis	Obstruction	Ascaris
Jaundice, biliary colic	Biliary obstruction	Ascaris
Prolapsed rectum	Tenesmus, weight loss	Trichuris
Intestinal perforation and peritonitis	Transmural necrosis	Amoebiasis

Diagnostic approach

•The cornerstone for the diagnosis is a thorough history of the patient's illness

•Physicians must counsel their patients to ensure that specimens are collected properly and arrive at the laboratory promptly

•Laboratory personnel and surgical pathologists should be notified in advance when a parasitic infection is suspected

•The laboratory procedures for detection of parasites in other body fluids are similar to those used in the examination of feces

•**Stool collection kit** with instructions for patients to transfer portions of the sample directly into bacterial carrier medium and fixative

• Refrigeration will preserve trophozoites for a few hours and cysts and ova for several days

•Contamination with water (which could contain free-living protozoa) or with urine (which can damage trophozoites) should be avoided

•Microscopic examination of feces is **not complete until** direct wet mounts (physiologic saline and dilute iodine solution), concentration techniques (formalin -ether sedimentation and zinc sulfate flotation), and permanent stains have been applied

TABLE 245e-3 PROTOZOAL INFECTIONS

Parasite	Geographic Distribution	Life-Cycle Hosts: Intermediate (Transmission)	Life-Cycle Hosts: Definitive	Diagnosis: Parasite Stage	Diagnosis: Body Fluid or Tissue	Diagnosis: Serologic Tests	Diagnosis: Other
Intestinal Protozoans							
Entamoeba histolytica (amebiasis)	Worldwide, especially tropics	Fecal-oral	Humans	Troph, cyst	Feces, liver	EIA, antigen detection	Ultrasound, liver CT, PCR
Giardia lamblia (giardiasis)	Worldwide	Fecal-oral	Humans	Troph, cyst	Feces	Antigen detection	DFA, PCR
Isospora belli	Worldwide	Fecal-oral	Humans	Oocyst	Feces	—	Acid-fast[a]
Cryptosporidium	Worldwide	Fecal-oral	Humans, other animals	Oocyst	Feces	Antigen detection	Acid-fast,[a] DFA, biopsy, PCR
Cyclospora cayetanensis	Worldwide?	Fecal-oral	Humans, other animals?	Oocyst	Feces	—	Acid-fast,[a] modified safranin, autofluorescence, biopsy, PCR
Microsporidia: *Enterocytozoon bieneusi*, *Encephalitozoon* spp. (microsporidiosis)	Worldwide?	?	Animals, humans	Spore	Feces	—	Modified trichrome, biopsy, PCR
Free-Living Amebas							
Naegleria	Worldwide	Warm water	Humans	Troph, cyst	CNS, nares	DFA	Biopsy, nasal swab, culture
Acanthamoeba	Worldwide	Soil, water	Humans	Troph, cyst	CNS, skin, cornea	DFA	Biopsy, scrapings, culture
Balamuthia	The Americas	Soil?	Humans, other animals	Troph, cyst	Brain	DFA	Biopsy, PCR
Blood and Tissue Protozoans							
Plasmodium spp. (malaria)	Subtropics and tropics	Mosquitoes	Humans	Asexual	Blood	RDT	PCR
Babesia microti (babesiosis)	U.S., especially New England	Ticks	Rodents, humans	Asexual	Blood	IIF	Risk in asplenia, PCR
Trypanosoma rhodesiense (African sleeping sickness)	Sub-Saharan East Africa	Tsetse flies	Humans, herbivores	Tryp	Blood, CSF	IIF[b]	Also chancre, lymph nodes
T. gambiense (African sleeping sickness)	Sub-Saharan West Africa	Tsetse flies	Humans, swine	Tryp	Blood, CSF	Card agglutination,[c] IIF[b]	Also chancre, lymph nodes
T. cruzi (Chagas' disease)	Mexico to South America	Reduviid bugs (triatomes)	Humans, dogs, wild animals	Amastigote, tryp	Multiple organs/ blood	IIF, EIA	Reactivation in immunosuppression
Leishmania tropica, etc.	Widespread in tropics and subtropics	Sandflies (*Phlebotomus*)	Humans, dogs, rodents	Amastigote	Skin	IFA, EIA[d]	Biopsy, scrapings, culture
L. braziliensis (mucocutaneous)	Mexico to South America	Sandflies (*Lutzomyia*)	Humans, dogs, rodents	Amastigote	Skin, mucous membranes	IFA[b], EIA	Biopsy, scrapings, culture
L. donovani (kala-azar)	Widespread in tropics and subtropics	Sandflies (*Phlebotomus*)	Humans, dogs, wild animals	Amastigote	RE system	IFA[b], EIA	Biopsy, culture, PCR
Toxoplasma gondii (toxoplasmosis)	Worldwide	Humans, other mammals	Cats	Cyst, troph	CNS, eye, muscles, other	EIA, IIF	PCR

TABLE 245e-1 FLATWORM INFECTIONS

Parasite	Geographic Distribution	Life-Cycle Hosts: Intermediate (Transmission)	Life-Cycle Hosts: Definitive	Diagnosis: Parasite Stage	Diagnosis: Body Fluid or Tissue	Diagnosis: Serologic Tests	Diagnosis: Other
Tapeworms (Cestodes)							
Intestinal tapeworms							
Taenia saginata (beef tapeworm)	Worldwide	Beef	Humans	Ova, segments	Feces	—	Motile segments
Hymenolepis nana (dwarf tapeworm)	Worldwide	Grain beetles	Humans, mice[a]	Ova	Feces	—	—
Diphyllobothrium latum (fish tapeworm)	Worldwide	Copepods–fish[b]	Humans, other mammals	Ova, segments	Feces	—	Megaloblastic anemia in 1%
T. solium[c] (pork tapeworm)	Worldwide	Swine	Humans	Ova, segments	Feces	WB	Especially Mexico, Central and South America, Africa
Somatic tapeworms							
Echinococcus granulosus (hydatid disease)	Sheep-raising and hunting areas	Sheep, camels, humans, others	Dogs	Hydatid	Lung, liver	WB, EIA	Chest radiography, CT, MRI
E. multilocularis (hydatid disease)	Subarctic areas	Rodents, humans	Foxes, dogs, cats	Hydatid	Liver	—	May resemble cholangiocellular carcinoma
T. solium[c] (pork tapeworm)	Worldwide	Swine, humans	Humans	Cysticercus	Muscles, CNS	WB	CT, MRI, radiography
Flukes (Trematodes)							
Intestinal flukes							
Fasciolopsis buski	China, India	Snails–water chestnuts	Humans	Ova	Feces	—	—
Heterophyes heterophyes	Far East, India	Snails–fish	Humans	Ova	Feces	—	—
Metagonimus yokogawai	Far East, Balkans, North Africa	Snails–fish	Humans	Ova	Feces	—	—
Liver flukes							
Clonorchis sinensis	China, Southeast Asia	Snails–fish	Humans	Ova	Feces, bile	—	Recurrent bacterial cholangitis
Fasciola hepatica	Sheep-raising areas	Snails–watercress	Humans, sheep	Ova	Feces,[d] bile	EIA	Cirrhosis, portal hypertension
Lung flukes							
Paragonimus spp.	Orient, Africa, the Americas	Snails–crabs/crayfish	Humans, other mammals	Adults, ova	Lung, sputum, feces	WB, EIA	Chest radiography, CT, MRI
Blood flukes							
Schistosoma mansoni	Africa, Central and South America, West Indies	Snails	Humans	Ova, adults	Feces	EIA, WB	Rectal snips, liver biopsy
S. haematobium	Africa	Snails	Humans	Ova, adults	Urine	WB	Liver, urine, or bladder biopsy
S. japonicum	Far East	Snails	Humans	Ova, adults	Feces	WB	Liver biopsy

TABLE 245e-2 ROUNDWORM INFECTIONS

Parasite	Geographic Distribution	Life-Cycle Hosts: Intermediate (Transmission)	Life-Cycle Hosts: Definitive	Diagnosis: Parasite Stage	Diagnosis: Body Fluid or Tissue	Diagnosis: Serologic Tests	Diagnosis: Other
Intestinal Roundworms							
Enterobius vermicularis (pinworm)	Temperate and tropical zones	Fecal-oral	Humans	Ova	Perianal skin	—	"Cellophane tape" test
Trichuris trichiura (whipworm)	Temperate and tropical zones	Soil, fecal-oral	Humans	Ova	Feces	—	Rectal prolapse
Ascaris lumbricoides (roundworm of humans)	Temperate and tropical zones	Soil, fecal-oral	Humans	Ova	Feces	—	Sx of pulmonary migration
Ancylostoma duodenale (Old World hookworm)	Eurasia, Africa, Pacific	Soil to skin	Humans	Ova/larvae	Feces	—	Sx of pulmonary migration, anemia
Necator americanus (New World hookworm)	U.S., Africa, worldwide	Soil to skin	Humans	Ova/larvae	Feces	—	Sx of pulmonary migration, anemia
Strongyloides stercoralis (strongyloidiasis)	Moist tropics and subtropics	Soil to skin	Humans	Larvae	Feces, sputum, duodenal fluid	EIA	Dissemination in immunodeficiency
Capillaria philippinensis	Southeast Asia, Taiwan, Egypt	Raw fish	Birds	Ova, larvae, adults	Feces	—	Malabsorption/ autoinfection, biopsy
Tissue Roundworms							
Trichinella spiralis (trichinellosis)	Worldwide	Swine/humans	Swine/humans	Larvae	Muscle	EIA	Muscle biopsy
Wuchereria bancrofti (filariasis)	Coastal areas in tropics and subtropics	Mosquitoes	Humans	Microfilariae	Blood, lymph nodes	EIA, RAPID, PCR[b]	Nocturnal periodicity[a]
Brugia malayi (filariasis)	Asia, Indian subcontinent	Mosquitoes	Humans	Microfilariae	Blood	EIA, RAPID, PCR[b]	Nocturnal
Loa loa (African eye worm)	West and Central Africa	Mango flies (*Chrysops*)	Humans	Microfilariae	Blood	LIPS[b], PCR[b]	May be visible in eye, diurnal
Onchocerca volvulus (river blindness)	Africa, Mexico, Central and South America	Blackflies	Humans	Adults/larvae	Skin/eye	LIPS[b], PCR[b]	Examine nodules or skin snips
Dracunculus medinensis (guinea worm)	Africa	*Cyclops*	Humans	Adults/larvae	Skin	—	May be visible in lesion
Angiostrongylus cantonensis	Southeast Asia, Pacific, Caribbean	Snails/slugs, shrimp/fish	Rats	Larvae	CSF (rarely found)	—	Eosinophilic meningitis
Larva Migrans Syndromes							
Ancylostoma braziliense (creeping eruption)	Tropical and temperate zones	Soil to skin	Dogs/cats, humans	Larvae	Skin	—	Dog and cat hookworm
Toxocara canis and *T. cati* (visceral larva migrans), *Baylisascaris*	Tropical and temperate zones	Soil, fecal-oral	Dogs/cats, raccoons, humans	Larvae	Viscera, CNS, eye	EIA	Also caused by roundworms of other species

TABLE 245e-4 ALTERNATIVE PROCEDURES FOR LABORATORY DIAGNOSIS OF PARASITES FOUND IN FECES[a]

Parasites and Fecal Stages	Alternative Diagnostic Procedures
Tapeworms (Cestodes)	
Taenia saginata ova and segments	Perianal "cellophane tape" test for ova
T. solium ova and segments	Serology; brain biopsy for neurocysticercosis
Flukes (Trematodes)	
Clonorchis (Opisthorchis) sinensis ova	Examination of bile for ova and adults in cholangitis
Fasciola hepatica ova	Examination of bile for ova and adults in cholangitis
Paragonimus ova	Serology; sputum; biopsy of lung or brain for larvae
Schistosoma ova	Serology for all; rectal snips (especially for *S. mansoni*), urine (*S. haematobium*), liver biopsy and liver ultrasound
Roundworms	
Enterobius vermicularis ova and adults	Perianal "cellophane tape" test for ova and adults
Trichuris trichiura ova	None
Ascaris lumbricoides ova and adults	Examination of sputum for larvae in lung disease
Hookworm ova and occasional larvae	Examination of sputum for larvae in lung disease
Strongyloides larvae	Duodenal aspirate or jejunal biopsy; serology; sputum or lung biopsy for filariform larvae in disseminated disease
Protozoans	
Entamoeba histolytica trophozoites and cysts	Serology; liver biopsy for trophozoites
Giardia lamblia trophozoites and cysts	Duodenal aspirate or jejunal biopsy
Isospora belli oocysts	Duodenal aspirate or jejunal biopsy[b]
Cryptosporidium oocysts	Duodenal aspirate or jejunal biopsy[b]
Microsporidial spores	Duodenal aspirate or jejunal biopsy

TABLE 245e-5 IDENTIFICATION OF PARASITES IN BLOOD AND OTHER BODY FLUIDS

Body Fluid, Parasite	Enrichment/Stain	Culture Technique
Blood		
Plasmodium spp.	Thick and thin smears/ Giemsa or Wright's	Not useful for diagnosis
Leishmania spp.	Buffy coat/Giemsa	Media available from CDC
African trypanosomes[a]	Buffy coat, anion column/wet mount and Giemsa	Mouse or rat inoculation[b]
Trypanosoma cruzi[c]	As for African species	As above and xenodiagnosis
Toxoplasma gondii	Buffy coat/Giemsa	Fibroblast cell lines
Microfilariae[d]	Filtration/wet mount and Giemsa	None
Urine		
Schistosoma haematobium	Centrifugation/wet mount	None
Microfilariae (in chyluria)	As for blood	None
Spinal Fluid		
African trypanosomes	Centrifugation, anion column/wet mount and Giemsa	As for blood
Naegleria fowleri	Centrifugation/wet mount and Giemsa or trichrome	Nonnutrient agar overlaid with *Escherichia coli*

TABLE 245e-7 PARASITES FREQUENTLY ASSOCIATED WITH EOSINOPHILIA[a]

Parasite	Comment
Tapeworms (Cestodes)	
Echinococcus granulosus	When hydatid cyst leaks
Taenia solium	During muscle encystation and in cerebrospinal fluid with neurocysticercosis
Flukes (Trematodes)	
Paragonimus spp.	Uniformly high in acute stage
Fasciola hepatica	May be high in acute stage
Clonorchis (Opisthorchis) sinensis	Variable
Schistosoma mansoni	50% of infected travelers
S. haematobium	25% of infected travelers
S. japonicum	Up to 6000/μL in acute infection
Roundworms	
Ascaris lumbricoides	During larval migration
Hookworm species	During larval migration
Strongyloides stercoralis	Profound during migration and early years of infection
Trichinella spiralis	Up to 7000/μL
Filarial species[b]	Varies but can reach 5000–8000/μL
Toxocara spp.	>3000/μL
Ancylostoma braziliense	With extensive cutaneous eruption
Gnathostoma spinigerum	In visceral larva migrans and eosinophilic meningitis
Angiostrongylus cantonensis	In eosinophilic meningitis
A. costaricensis	During larval migration in mesenteric vessels

TABLE 245e-6 MINOR PROCEDURES FOR DIAGNOSIS OF PARASITIC INFECTIONS

Parasite(s) and Stage	Procedure
Onchocerca volvulus and *Mansonella streptocerca* microfilariae	*Skin snips:* Lift skin with a needle and excise ~1 mg to a depth of 0.5 mm from several sites. Weigh each sample, place it in 0.5 mL of saline for 4 h, and examine wet mounts and Giemsa stains of the saline either directly or after filtration. Count microfilariae.[a]
Loa loa adults and *O. volvulus* adults and microfilariae	*Biopsies of subcutaneous nodules:* Stain routine histopathologic sections and impression smears with Giemsa.
Trichinella spiralis larvae (and perhaps *Taenia solium* cysticerci)	*Muscle biopsies:* Excise ~1.0 g of deltoid or gastrocnemius muscle and squash between two glass slides for direct microscopic examination.
Schistosoma ova of all species, but especially *S. mansoni*	*Rectal snips:* From four areas of mucosa, take 2-mg snips, tease onto a glass slide, and flatten with a second slide before examining directly at 10×. Preparations may be fixed in alcohol or stained.
Trypanosoma gambiense and *T. rhodesiense* trypomastigotes	*Aspirate of chancre or lymph node:*[b] Aspirate center with an 18-gauge needle, place a drop on a slide, and examine for motile forms. An otherwise insufficient volume of material may be stained with Giemsa.
Acanthamoeba spp. trophozoites or cysts	*Corneal scrapings:* Have an ophthalmologist obtain a sample for immediate Giemsa staining and culture on nutrient agar overlaid with *Escherichia coli*.
Cutaneous and mucocutaneous *Leishmania* spp.	*Swabs, aspirates, or punch biopsies of skin lesions:* Obtain a specimen from the margin of a lesion for Giemsa staining of impression smears; section and culture on special media from the CDC.

Thank you