Vet 413 Parasites

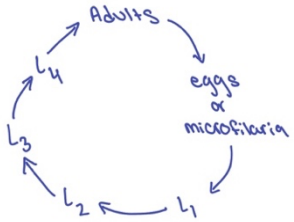
Nematodes Lectures 6, 8, 11
Key:
Ascarids
Hookworms
Strongyles
Trychostrongyles
Kidney Worms

Trematodes Lecture 14
Flukes
Schistosomes

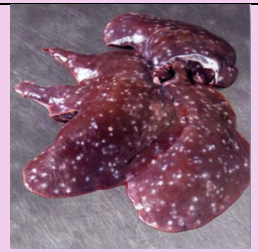
Cestodes Lecture 15
Tapeworms

Protozoa Lecture 22
Flagellates
Apicomplexa

Generic Life Cycle of Nematodes *All have larval stages*

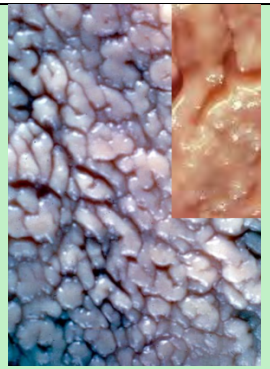


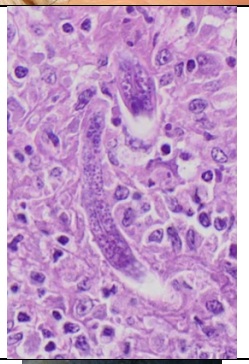
Vet 413 Parasites

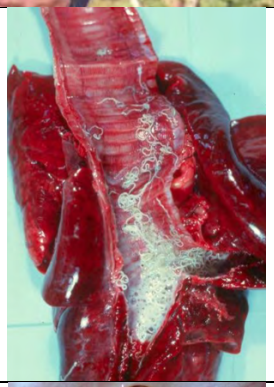
Species	Host	Paratenic Host?	Tissue Migration/ Route of infection	Miscellaneous	Picture
Toxacara canis	Dogs	Possible	Liver > lung> coughed up > swallowed	Transplacental migration and transmammary transmission is possible Fecal float Zoonotic Visceral larval migrans Ocular larval migrans	 Unthirfty, potbelly
Toxacara cati	Cats	Yes! -mouse	Liver > lung> coughed up > swallowed	Transmammary infections can occur but not transplacental	
Toxacaris leonina	Dogs + Cats	Yes	None		
Ascaris suum	Swine		Liver > lung> coughed up > swallowed	Mature to adults in small intestine **Big intestinal parasites not large-intestinal parasites** Take 2 weeks to mature in the environment	 Milk spots on pig liver
Parascaris Equorum	Equine		Liver > lung> coughed up > swallowed	Disease is dose dependent Diagnosed with a fecal float or necropsy	 “Summer Cold” Cough and nasal discharge

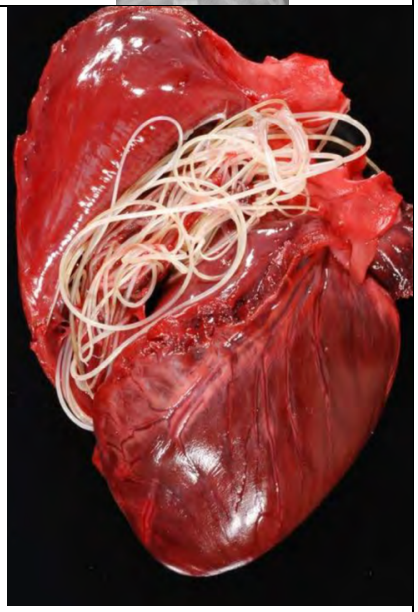
Ancylostoma caninum	Dogs		Ingested or migrate through skin Tracheal migration > lymphatics or blood stream > travel through heart to lungs > coughed up and swallowed *No liver migration	Larvae, not eggs are ingested Eggs are not as resistant as ascarid eggs Can have transmammary transmission in puppies Hemorrhagic anemia, emaciation, diarrhea, melena	 Cutaneous larval migrans! 
Habronema megastoma	Equine		Life cycle: Adult worms in the horse's stomach lays eggs that are passed in the feces. These eggs hatch and a fly ingests the larvae. The larvae develop into an infective third stage in the fly and then feed on the horse (lip / oral mucosa) and the horse ingests the larvae	Muscid flies are the vector (house and stable fly) Transmit larvae to the lips or oral mucosa Conjunctiva and glands penis are also common areas for lesions Fecal float for dx	 

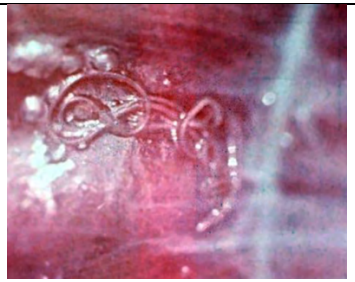
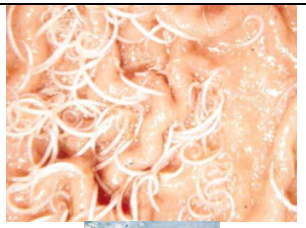
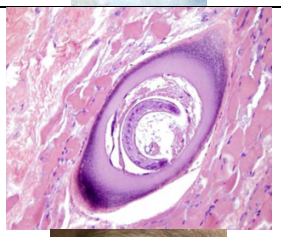
Oxyuris equi (pinworms) *Enterobius vermicularis*	Equine Humans!			Acetate tape method for diagnosis Pruritic! Look for patchy alopecia at tail-head or an unkempt, rough tail	 
Cyathostomes Small Strongyles			Larvae emerge from cysts in mucosa and damage the mucosa		
Strongylus vulgaris Large Strongyles *S. edentates* *S. equinus*			Infective larvae are ingested from pasture Leave the GIT and migrate along the wall of the cranial mesenteric artery When mature they reenter the cecum or colon	-GI migration -Blood loss due to feeding *more pathogenic because of the vasculitis **Vulgar=BAD**	 Cranial mesenteric artery damage
Haemonchus contortus	Small ruminants		*Most important parasites of grazing ruminants Adults live in the abomasum	Anemia, abomasal ulcers, bottle jaw, ill thrift McMaster Technique Estimates worm burden	 Bottle jaw

Ostertagia ostertagia *Ostertagia circumcincta*	Bovine Sheep/goats		Pathogenesis Developing stages in wall of stomach are most pathogenic Type 1: Acute, direct development, young cattle Type II: Postponed development, hypo-biotic larvae from stomach wall end their arrested period, older cattle	Intestinal inflammation Mucous metaplasia and hyperplasia of glandular epithelium	 "Moroccan leather"
Pearsonema plica	Canids, felids, mustelids		Earthworm is an intermediate host!	Nematode of the urinary tract! Can cause cystitis and pyelonephritis	
Stephanurus dentatus	Swine	Earthworm	Eggs shed in urine Larvae migrate through the liver	Swine kidney worm Adults along the ureters in perirenal fat or in the kidney	
Dioctophyme renale	Minks and dogs	Fish, frog, etc eats the worm	Require aquatic oligochaete L3	Unilateral renal infections	

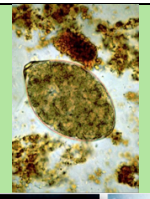
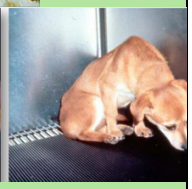
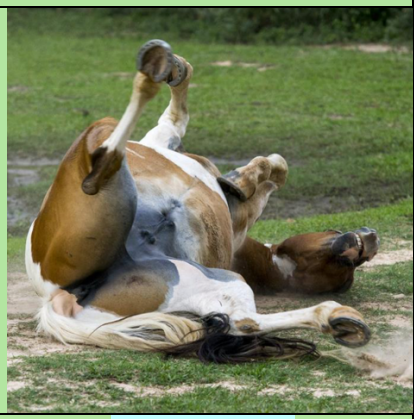
			Fish, frog, etc eats the worm and then the definitive host eats the paratenic host	*Usually on the right side due to duodenal migration Bilateral > Fatal	
Thelazia spp. *Eyeworm*	Mammals, avians and humans		Flies are intermediate hosts, ingest L1 in tear film, L3 fly to eye	May be associated with conjunctivitis Typically external	
Halicephalobus gingivalis	Equine rarely humans		Reproduces parthenogenetically Life w/o sex! Associated with swampy habitats	Associated with swampy habitats Can enter through oral abrasions Affects kidney, brain, oral cavity	
Stephanofilaria stilesi	Cattle		Requires an intermediate host Horn fly, *haemotobia irritans* mature into L3 in fly	Dermatitis on ventral midline	

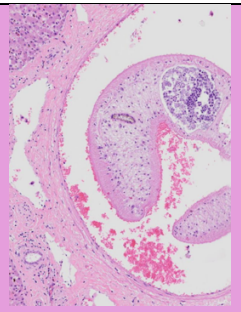
Onchocerca cervicalis	Equine		Microfilaria in skin are transmitted by Culicoides spp (biting midges *fly)	Dermatitis on head or neck	
Lung worm overview		Numerous nematodes affect the resp. system	Adults live in the lung Larvae passed in feces	Need to use a Baermann's apparatus with fresh feces!	
Parelaphostrongylus tenuis Meningeal worm	White-tailed-deer		Eggs embolize to lungs Larvae are coughed up and passed in feces Snail or slug are the intermediate host	Deer become infected by eating the mollusks In aberrant hosts the larvae get lost in CNS > fatal **LETHAL for camelids**	
Muellerius capillaris	Goats		Requires a **terrestrial snail** or slug as an intermediate host Livestock are infected when they consume these terrestrial mollusks	Small nodules (granulomatous inflammation) on dorsal aspect of lung	

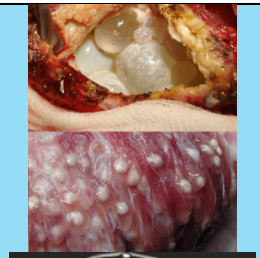
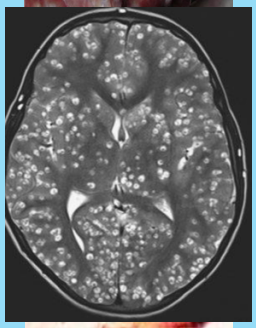
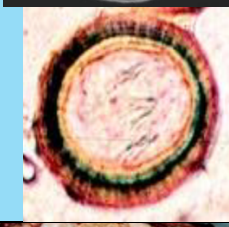
Dictyocaulus viviparous *Dictyocaulus arnfieldii*	Cattle and small ruminants Horses		Ingested larvae burrow through the intestine to lymphatics and then to the lungs Bronchitis, atelectasis, emphysema, edema	Usually found in the bronchi or distal aspect of the trachea Young animals, tachypnea, splayed-leg posture	
Aeleurostrongylus abstrusus	Felines	Rodents, frogs, lizards Snails and slugs are intermediate hosts	Ingested larvae migrate to lungs L1 larvae go up the airway and out in the feces	Multifocal interstitial pneumonia, alveolar septa and airways become thickened, hypertrophy of small arteries	
Dirofilaria immitis	Canine		Microfilariae circulating in the bloodstream of an infected dog, mosquito bites the dog and ingests the microfilariae, microfilariae develop into infective larvae in the mosquito's stomach, mosquito bites another dog injecting the larvae into the dog's bloodstream. Larvae maturation in the dog's bloodstream and make their way into the pulmonary arteries *Must pass through mosquito to become infective!	Adults are usually in the pulmonary arteries but can back up all the way to the right ventricle *Cats are occasionally infected, but the infections are usually occult and there are seldom microfilaria seen in the blood. This infection can resolve but can also be fatal with few worms! Antigen tests for dogs and cats detect antigen from adult female worms Antibody tests are necessary for cats because often they do not have enough adult females for a positive antigen test	

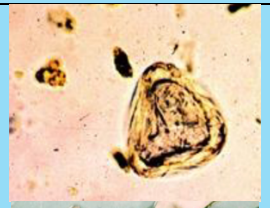
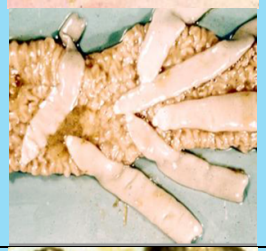
Dipetalonema reconditum	Canine		Fleas are an intermediate host!	Nonpathogenic *Microfilaria* are sometimes misidentified as *D. immitis*	 Adult worms are in the subcutis
Trichuris spp.	Swine Canine			Adults reside in the cecum and colon No clinical signs with a light infection Fecal float! Eggs can survive in moist environments for years!	 
Trichinella spiralis	Various		Larvae are encysted in muscle	Adults live in the small intestine Largest known intracellular parasite Persist in nurse cells Disease occurs when people consume meat with a high burden of larvae (pork)	 
WEEK 2					
Species	Species affected	Intermediate host/Misc.	Life Cycle	Clinical Signs / Significance	Picture

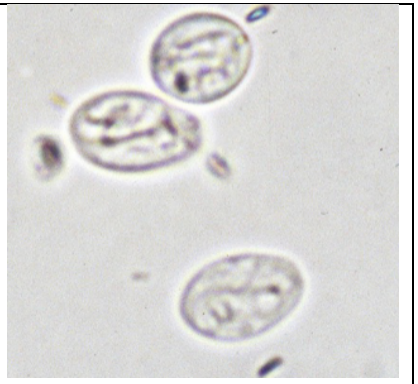
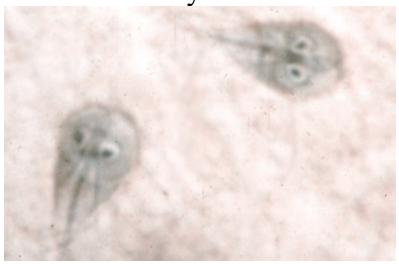
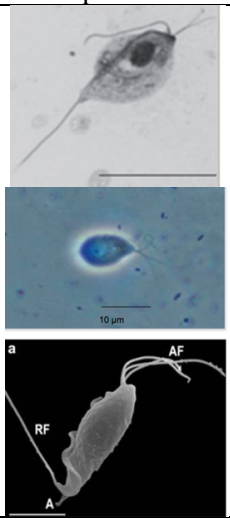
Fasciola hepatica	Sheep, cattle and humans		Hatch as miracidia which burrow through the feet of snails. The cercaria form sporocysts and the metacercaria develop from the cercaria. This is a hardy stage that encysts on vegetation which is a great place for it to be consumed by the host	Once the metacercaria are consumed (grazing) they encyst as adults and migrate to bile ducts causing chronic cholangiohepatitis Weakness, anemia, diarrhea, hypoproteinemia, poor weight gain or milk production Dx on fecal sedimentation	
Fascioloides magna	Cervids (deer) are the definitive host Cattle, goats and sheep are dead-end hosts		Aquatic life cycle Bigger concern in Oregon and Washington + Europe	*the LARGE liver fluke Parasite-containing cysts communicate with bile ducts Eggs passed in feces Liver contamination in cattle Possible loss of goats and sheep Some disease in cervids	
Paramphistomum spp.	Ruminants		Typical fluke life cycle; aquatic snails are the intermediate host Tied to aquatic environments (like the Delta)	Ingested: metacercaria excyst in duodenum and jejunum then penetrate intestinal wall and migrate to the rumen Adults are harmless Sudden ingestion of large numbers of metacercaria can cause enteritis and diarrhea due to tissue migration	 Compensatory hypertrophy of rumen papilla

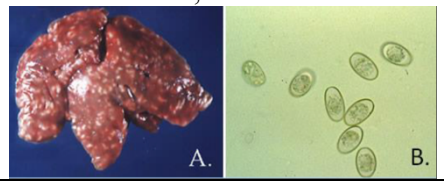
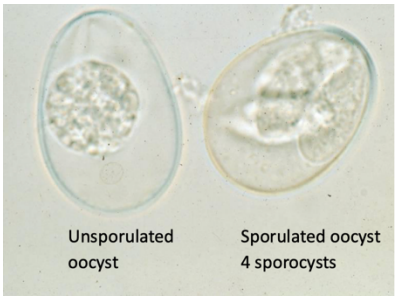
Nanophyetus salmincola	Canine	Fluke is nonpathogenic, it is the bacteria that hurts the dog	1st intermediate host: Snail (Oyxtrema silicula) 2nd intermediate: Fish (trout or salmon), the metacercaria encyst in the fish	Bacterial infection is highly fatal! **Neorickettsia helminthoeca is the bacteria that causes harm, not the fluke** Sudden fever 5-7 days after infection, dehydration, anorexia, vomiting diarrhea, hemorrhagic enteritis, lymphadenomegaly Tx: Doxycycline and supportive care	  
Multiple fluke species involved	Equine	Potomac Horse Fever "equine monocytic ehrlichiosis"	Horse ingests insects containing metacercaria or possibly free-swimming cercaria – Seasonal because of insect activity • Mayflies • Caddisflies	**Neorickettsia [Ehrlichia] risticii is the bacteria that causes problems** – Diarrhea (>60% of cases – Colic – Fever – Dehydration – Depression Prevention: Vx Tx: Antibiotics	
Paragonimus kellicoti	Canine, feline, mink, foxes, racoons		Two intermediate hosts: Snail and crayfish Larvae leave ingested crayfish and migrate to lungs	Can cause multifocal pneumonia and bronchiectasis More common in wildlife but can infect pets and people (cook your crayfish)!	

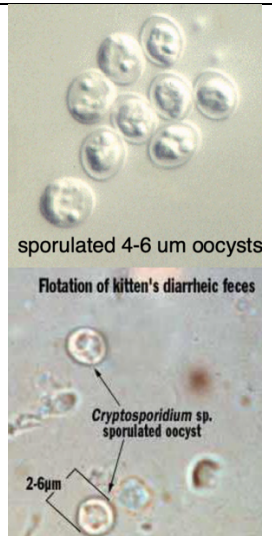
Heterobilharzia americana	Dogs and racoons		Adults commonly live in mesenteric veins and embolize to small intestine Ova passed in feces, miracidia infest snails, cercaria leave snails and swim to the definitive host	Heavy infestations: Granulomatous enteritis with possible diarrhea, vomiting, anorexia, and weight loss Eggs embolize to liver, multifocal fibrosis and portal granulomas (usually self-limiting but notable in surgery)	 Adult female in hepatic vein
Trichobilharzia szidati	Humans	"Swimmer's itch"	Cercarial dermatitis Intravascular parasites People are paratenic hosts	Cutaneous hypersensitivity in people due to skin invasion by cercaria. These flukes are schistosomes of birds	
Acanthocephala *Oncicola canis* *Macrocanthorhynchus hirudinaceous*	Dogs, cats Swine	Thorny-headed worms that lack a GIT	Arthropods are intermediate hosts		
Diplidium caninum	Canine		Must treat tapeworms and fleas, reinfestation will occur without this approach Flea larvae eat eggs, fleas mature, pet eats flea, parasite larvae migrate to small intestine where they mature, proglottids containing eggs are shed in feces	Almost always subclinical infestation Severe worm burdens: Possible diarrhea, weight loss, poor growth, anal puritis > scooting	 

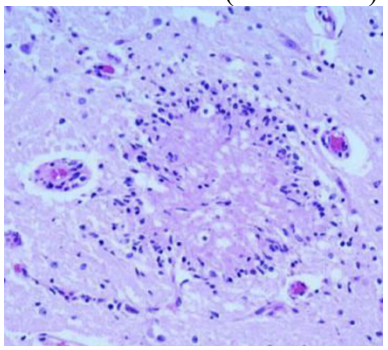
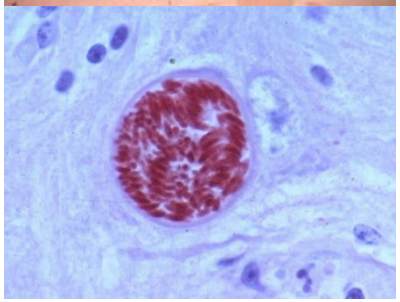
Taenia spp. *Taenia solium* *Taenia saginata*	Canine, feline and other carnivores	Cysticerci of *Taenia* form in intermediate hosts Pigs/cows are intermediate hosts	Species preyed upon or scavenged by the definitive host are the intermediate hosts (rabbits, deer, rodents, etc) Avoid undercooked pork and use good hygine Tx: praziquantel and corticosteroids	Dx: fecal floatation Cysticercosis due to *T. solium* humans can be definitive hosts if we ingest cysticerci. We can develop cysticercosis if we ingest **eggs or proglottids** meaning that the cysticerci then develop in our tissues Neurocysticercos is a more severe form of the disease	  
Mesocestoides	Canine	At least TWO intermediate hosts	1st intermediate host: Arthropods (develop cysticerci) 2nd intermediate host: Rodents, lizards, birds (develop tetrathyridia that can reproduce asexually) **ANTS** can be a source of *Mesocestoides*	Common carnivore tapeworm, adults are nonpathogenic Some dogs develop larval infestations in the peritoneum which can become an aberrant infestation and lead to severe disease Dx: Peritoneal aspirate and ultrasound Tx: Surgical removal	 Canine peritoneal larval cestodiasis

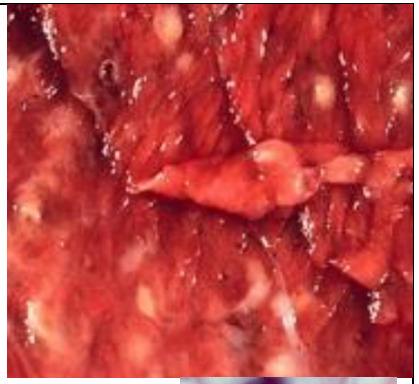
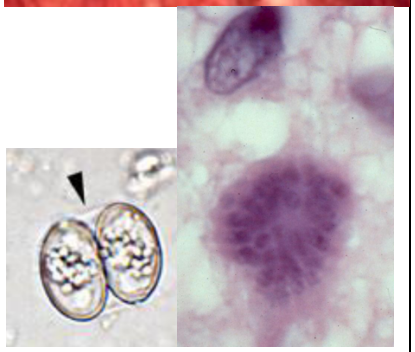
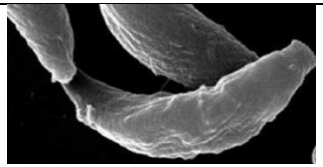
Echinococcus spp. *Echinococcus granulosus* *Echinococcus multiocularis*	Canine and less commonly feline	Likely originated from wild canids (sylvatic cycle)	Seen worldwide and can be moved in canids (domestic and wild) Intermediate hosts aquire the parasite from ingesting ova	No clinical significance to dogs or other canids (just little tapeworms) Hydatid cysts form in intermediate hosts, commonly for sheep for *E. granulosus* and rodents for *E. multilocularis* Reproduce asexually, the hydatids can rupture and seed other organs which is an important zoonotic concern!	 Hepatic hydatid cyst in a human
Anoplacephala magna *A. perfoliata* *Paranoplocephala mamillana.*	Equine	Intermediate hosts are oribatid mites found on vegetation		Nonpathogenic unless worm burden is extremely heavy! Eggs are round or D-shaped Hexacanth embryo visible	 
Moniezia spp.	Ruminants	Uses mites as an intermediate host	Orbatid mites (box imtes) are the most prevalent arthropods in forest soils Non -parasitic and are intermediate hosts for numerous tapeworms	Nonpathogenic with typical worm burdens	 

Giardia spp. *Giardia duodenalis* *G. lamblia* *G. intestinalis*	Dogs Cats Cattle Horses Wildlife Laboratory mammals Wildlife Non-human primates Humans		Infection via cyst ingestion Trophozoites divide by binary fission in the intestine Cysts are in the environmentally resistant stage excreted in feces **Trophozoite** is the pathogenic stage Adhesion of trophozoites to gut epithelium via adhesive disk, increases epithelial permeability, loss of intestinal brush border, villus flattening, overgrowth of enteric bacterial flora > maldigestion/malabsorption	Many infections are asymptomatic Chronic or intermittent diarrhea Steatorrhea Mucus in stool Weight loss Growth retardation in animals Most cases occur in young puppies and kittens who are immunosuppressed in kennels or catteries but it may also occur in older animals Dx method: direct smear to see trophozoites (diagnostic but rare) Floatation (see cysts) most common Direct fluorescence antibody test id the gold standard	 Cysts  Trophozoites
Tritrichomonas *Tritrichomonas foetus*	Cattle Cats		Trophozoite stage only, directly transmitted from host to host (no cysts) Dx: Direct smear and ID trophozoite, Culture, PCR PCR is specific and highly sensitive Tx: Metronidazole is ineffective, Ronidazole is considered the tx of choice but there are neurotoxicity concerns	STD of cattle that can result in early embryonic death and infertility Affects reproductive organs (penis, uterus, vagina) due to reduced oxygen environment. Natural breeding in pasture is a primary transmission route. AI has led to reduced incidence Explosive diarrhea in cats! Still active with no weight loss. Affects the distal ileum and colon. Misdiagnosis of *Giardia*	

Week 3					
Eimeria	Cattle Sheep Goats Poultry NOT Zoonotic!	A sporulated oocyst has 4 sporocysts and each sporocyte has 2 sporozoites	Infected bird sheds **noninfective** oocysts in feces, oocysts sporulate within 48 hours and become **infective**, other birds ingest infective oocysts while drinking/eating. Oocysts hatch and invade intestinal tissue, causing damage and creating more oocysts **Infective Stage = Sporulated Oocyst** Dx: Double centrifugation fecal floatation	Often asymptomatic, the diarrheal disease mostly occurs in young animals / intensive production Developmental stages in intestinal epithelial cells, damage to and destruction of intestinal epithelial cells from asexual reproduction Diarrhea, fever, inappetence, weight loss, emaciation, death Eimeria in rabbits: Localizes in the liver and causes liver failure + nodules, can be fatal 	 Eimeria in horses  General Eimeria

Cryptosporidium *C. parvum* *C. hominis*	Livestock Canine Feline Equine Humans Non-human primates Wildlife		*C. parvum* **is zoonotic** Oocysts are shed in the feces and are immediately infective Thick and thin walled oocysts are secreted, the thin-walled cysts can rupture and reinfect the host Dx: Double centrifuge fecal floatation Acid Fast Stain Direct fluorescence antibody test = Gold Standard PCR for species conformation	Leading cause of diarrhea in neonatal calves! Invades microvillous brush border of intestinal epithelial cells **Zoites = pathogenic stage** Secretory diarrhea	
Cystoisospora	Canine Feline Swine!		2 sporocysts x 4 sporozoites Infection by ingestion of sporulated oocysts or paratenic host (rodents) Rigidly host-specific Not known to be host specific	Typically asymptomatic Primarily a problem in puppies and kittens Acute or chronic diarrhea with weight loss, dehydration, rarely hemorrhage	
Cryptosporidium	Canine Feline			Typically asymptomatic, rare as cause of diarrhea	
Neospora caninum	Canine	Intermediate hosts Canine Cattle, sheep, goats, camelids, water buffalo, deer, rabbits,	Transplacental transmission Multiple puppies and consecutive litters may be affected, neonatal death and/or neurologic signs within 6 months	Puppies and young dogs may have congenital issues Neuromuscular disease Congenital: Myositis polyradiculoneuritis Posterior ataxia to tetraparesis	

		rodents, rhino, chickens	Diagnostic stage: Unsporulated oocyst Diagnostic and Infectious stage Sporulated oocyst Th1 Immune response is important to control intracellular parasites such as *Neospora* Dx: Fetal brain lesions, heart lesions are also common, focal necrosis, nonsuppurative cellular infiltrates (diffuse foci)  Brain lesion IHC using anti-*N. caninum* sera can ID parasites in tissue	Oocysts are usually not seen in heces of clinically affected dogs Tx: Clindamycin 4-8 weeks Tripmethoprim sulfadiazine and pyrimethamine Horizontal and vertical transmission in cattle **Abortion storms in cattle due to oocysts in contaminated food** Mummification, abortion, and congenital infection are all symptoms depending on when the infection occurred during gestation IHC using anti-*N. caninum* sera can ID parasites in tissue Can also use Indirect Fluorescent Antibody Test Or ELISA PCR detection is also great!	   Tissue cyst with bradyzoites 

Sarcocystis spp. *Sarcocystis cruzi* *Sarcocystis hirsute* ***Sarcocystis neurona*** *Sarcocystis hughesi*	Carnivore Canines Cats Opossum Unknown	Intermediate host Cattle Horses Horses	Typically have a 2-host lifecycle Definitive host: Sexual reproduction occurs in the intestine leading to oocyst shedding, the intermediate hosts ingest the sporocysts leading to tissue cyst formation *S. calchasi* Definitive host = accipiter hawks, intermediate hosts = domestic pigeon Dx: *S. neurona* using CSF from a spinal tap to see if there are antibodies present Dx in an intermediate host: Muscle biopsy and histopathology, PCR for cyst ID, serology to detect exposure, serum Western blot, IFAT, ELISA	Mostly asymptomatic Tissue cysts form in muscle leading to chronic infection, myositis, neurologic signs (horses), systemic illness -fever, weight loss, abortion in cattle) Immune evasion mechanisms: Bradyzoite persistence, low immunogenicity of cyst walls *S. cruzi:* fever, anorexia, cachexia, decreased milk yield, diarrhea, muscle spasms, anemia, loss of tail hair, hyperexcitability, weakness, and death. Cows infected during the last trimester may abort Equine Protozoal Myeloencephalitis (EPM) Progressive asymmetric nerve damage, muscle atrophy, limb ataxia, cranial nerve dysfunction	  *Sarcocystis neurona* in CNS
Toxoplasmosis	All warm-blooded animals	Felines are the definitive host	Failure of the adaptive immune system is the main cause of Toxoplasmosis in humans and many animals Bradyzoite: Chronic Infection Tachyzoite: Acute infection	Abortion in sheep and goats Transplacental transmission Rare in cattle Cats are usually asymptomatic carriers unless they have immunosuppression then they may get ocular lesions or systemic toxoplasmosis Foodborne pathogen	

				Protozoal encephalitis in sea otters- Death