GENERAL CONCEPTS

I. Parasitology
   A. Parasitism -- Intimate relationship between two hetero-specific organisms, in which the parasite, usually the smaller symbiont, is metabolically dependent on the host.
   B. Parasites / Parasitology – Infectious groups of Protozoa, Helminths, and Arthropods.
   C. Microbes / Microbiology – Infectious groups of Bacteria, Viruses, and Fungi.
   D. Which groups asexually replicate in the primary host?
      1. Bacteria, Viruses, Fungi and Protozoa
      2. Replication => disease is population dependent
   E. Which groups do not asexually replicate in the primary host?
      1. Helminths and Arthropods
   C. Infection vs Infectious vs. Disease

II. Parasite effects on host: a continuum
   A. Parasite number and pathogenicity determine disease state
      1. No effect on host
      2. Subclinical infection - no obvious signs; subtle performance losses
      3. Clinical infection - disease manifestation
   B. Clinical judgement: "Is the effect on the patient important enough to justify treatment?"

III. Classification based on morphology
   A. Accurate communication requires knowing Genus and sometimes species names.
   B. Protozoa - unicellular
      1. Apicomplexa: coccidians and hemosporidians.
      2. Mastigophora: mucoflagellates and hemoflagellates.
   C. Helminths - worms
      1. Nematoda (Roundworms): body cavity, a pass-through alimentary canal, surface cuticle, dioecious.
      2. Trematoda (Flatworms: Flukes): no body cavity, blind pouch digestive tract, surface tegument, hermaphroditic.
      3. Cestoda (Flatworms: Tapeworms): no body cavity, no digestive tract, surface tegument, hermaphrodic.
   D. Arthropods – "bugs"
      1. Arachnida - adult stage has 8 legs (larval stage has 6 legs)
         a) mites, ticks
      2. Insecta - adult stage has 6 legs, some with wings
         a) lice - chewing (Ma llophaga) and sucking (Anoplura).
         b) fleas
         c) flies, maggots, bots

VI. Life Cycles

A. What information is "contained" in the life cycle?
   1. Where the parasite is found in/on the host.
   2. Morphologic & pathologic forms at various developmental stages.
   3. Duration of various life stages.
   4. Parasite developmental forms and habitat outside of the primary host
   5. Duration of parasite's development outside the host.
   6. Route of infection
   7. Time from infection to patency. (aka pre-patent period)
   8. Developmental time before becoming infectious.
   9. Host specificity.

B. Importance of knowing life cycles:
   1. Control of disease (drug resistance increasing)
   2. Diagnosis of disease and parasite identification
   3. Prediction of disease
   4. Protect against cross host infection and zoonosis
   5. Environmental management to minimize host infection
   6. Timing of when to treat and repeat treatment

C. Important terms and definitions
   1. Prepatent Period – developmental / maturation time needed between time of infection to the production of offspring. Determines the timing of control measures such as sanitation and/or treatment.
   2. Patent - an infection where sexually mature parasites are generating offspring
   3. Larval stage - sexually immature form of the parasite
   4. Adult stage - sexually mature form of the parasite
   5. Definitive host (primary host) - animal infected by the mature parasite
   6. Intermediate host - animal infected by larval stage(s) that continue development, but do not mature
   7. Paratenic host (transport host) - host infected by a larval stage that does not develop further.
   8. Aberrant host (dead-end host) – host that is accidently infected, but the parasite doesn't continue development
   9. Larval migration - movement of immature stage(s) within the tissues of a host.
   10. Direct life cycle - parasite does not require an intermediate host. The infectious stage (egg, cyst or larva) is in the environment)
   11. Indirect life cycle - parasite requires an intermediate host.
   12. Vector - transmits a pathogen from one host to another
      a) Mechanical vector – not necessary for pathogen development (facefly proboscis)
      b) Biological vector - necessary for pathogen development (tick)

HELMINTH LIFE CYCLES

I. General cycle (applies to all helminths)
   A. Contamination of the host's environment (habitat and/or food source)
   B. Development of parasite preinfective stages
   C. Infection by infective stage
   D. Maturation of adult parasite stage (prepatent time)

II. **Nematodes** (direct and indirect life cycles)
   A. Direct Life Cycles
      1. Non-free living infectious stage
         a) Infective larva develops and remains within the egg shell.
         b) Egg containing infective larva ingested by host
      2. Free-living infectious stage
         a) Infective larva develops in the egg and hatches in the environment.
         b) Environmental development to an infective larva (L3).
         c) Infective (L3) larva ingested by host or enters host through skin
   B. Indirect Life Cycle
      1. Egg or embryo or larva ingested by or penetrates intermediate host
      2. Infective larval stage develops in intermediate host
      3. Infective stage (usually L3) remains in intermediate host until that host transmits the larva to the definitive host.
   C. Other types of nematode life cycles
      1. No external stages (ex. *Trichinella*)
      2. Replicating free-living stages (ex. *Strongyloides*)

III. **Trematodes**: REQUIRE SNAIL INTERMEDIATE HOSTS
      1. Egg passed in feces of the definitive host
      2. Larval stage (miracidium) develops in egg then:
         a) Is ingested by a terrestrial snail OR
         b) Larva hatches and penetrates an aquatic snail
      3. Larval stages (sporocysts & redia) in the snail host replicate through asexual reporoduction and produce many dispersal larvae (cercaria), which leave the snail host
      4. Dispersal larval stage (cercaria) develops to an infective stage (metacercariae)
      5. Infective larva (metacercariae) may:
         a) Encyst within a 2nd-intemediate host OR
         b) Encyst on environmental substrate like semi-aquatic vegetation.
      6. Infective larvae (metacercariae) are ingested by the definitive host.

IV. **Cestodes**: ALL CESTODES REQUIRE INTERMEDIATE HOSTS
   A. Advanced tapeworms (ex. *Taenia, Dipylidium*)
      1. Definitive host is often a predator of the intermediate host
      2. Segments containing eggs are passed in the feces of definitive host
      3. Intermediate host ingests the eggs
      4. Infective larval stage develops in the intermediate host.
      5. The infective larva is ingested by the definitive host when it eats the intermediate host
   B. Primitive tapeworms (*Spirometra*)
      1. Ususally involves an aquatic food chain
      2. Eggs are passed in the feces of definitive host
      3. Eggs develop in water and a free-living larval stage (coracidium) hatchs
      4. The free-living larval stage (coracidium) is ingested by a 1st intermediate host (a crustacean).
      5. A 2nd larval stage (procercoid) develops in the crustacean, which is in turn ingested by a 2nd intermediate host (fish or frog).
      6. A 3rd larval stage (pleurocerecoid) develops in the 2nd intermediate host, which is in turn ingested by the definitive host.