LECTURE #1: Part 1 GENERAL CONCEPTS

Part 1

Objectives:

1) Discuss the concepts of infection contrasted to disease in host-parasite interaction.
2) Outline the classification system for selected genera of helminths, arthropods and protozoa.
3) Describe the relationship of parasite life cycle to host disease, parasite control, and geographic distribution.
4) Define and give examples of mechanical and biological vectors.

Outline:

I. Definition of parasite
   A. Contrasts and comparisons with bacteria, viruses and fungi as infectious agents: e.g. no replication in primary host for most helminths.
   B. Metabolic dependence on a host
   C. Infection vs. disease

II. Parasite effects on host: a continuum
   A. Number and pathogenicity of the parasite determines 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 host important enough to justify treatment?

III. Classification based on morphology (details of morphology will be taught in the laboratory)
   A. Accurate communication requires knowing Genus and sometimes species names.
   B. Characteristics of helminths - multicellular, soft body.
      1. Nematoda - body cavity, pass-through alimentary canal, surface cuticle, male and female worms. Round worms.
      2. Trematoda - no body cavity, blind pouch digestive tract, surface tegument, most are hermaphroditic. Flukes.
      3. Cestoda - no body cavity, no digestive tract, surface tegument, all are hermaphroditic. Tapeworms.
   C. Characteristics of protozoa - unicellular
      1. Apicomplexa: coccidians and hemosporidians.
      2. Sarcomastigophora: mastigophora (flagellates and hemoflagellates).
      3. Ciliophora: ciliates.
      4. Sarcodina: amoebas.
   D. Characteristics of arthropods - chitinous exoskeleton, usually with legs.
      1. Arachnida - adult stage has 8 legs
         a. mites - lateral stigmata absent or variable location relative to legs.
         b. ticks - blood suckers, lateral stigmata posterior to 4th leg.
      2. Insecta - adult stage has 6 legs
         a. lice - chewing (Mallophaga) and sucking (Anoplura).
         b. fleas
         c. true bugs
         d. flies and mosquitoes

VI. Life Cycles

1. What information is contained in the "life cycle"?
   a) where the parasite is found in the primary host body.
   b) what morphological forms the parasite takes in various developmental stages.
   c) how long the parasite spends in various life stages.
   d) where the parasite is found outside of the primary host.
   e) what forms the parasite takes outside of the primary host.
   f) how long the parasite spends in various forms outside the host.
   g) route of infection to the primary host.
   h) time from infection to patency.
   i) time outside primary host before infective.
   j) host specificity.

A. 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-species infection and zoonosis
   5. Environmental management to minimize host infection
   6. Timing of when to treat and repeat treatment

B. Definitions - for quick reference.
   1. Prepatent - time before sexual maturity and generation of offspring by the parasite in its host.
   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. Primary host (definitive host) - animal infected by the adult stage parasite
   6. Intermediate host - animal infected by larval stage(s) that continue development, but do not mature to adult stage in that animal
   7. Paratenic host - animal infected by a larval stage that does not proceed in development. Also known as a "transport host".
   8. Larval migration - movement of immature stage(s) within the tissues of a host (intermediate, primary, aberrant).
   9. Direct life cycle - parasite does not require an intermediate host.
   10. Indirect life cycle - parasite requires an intermediate host.

C. Direct life cycle – requires no intermediate host
   1. Free-living stage - motile form of the parasite outside of a host.
   2. No free-living stage - sessile form of the parasite, usually in egg.

D. Indirect life cycle – requires an intermediate host.

E. Vector is not necessarily a required intermediate host.
   1. Mechanical vector
   2. Biological - living vector, supports infective stage in some way.

LECTURE #1: PART 2: HELMINTH LIFE CYCLES

Objectives:

1) Draw a detailed life cycle of a fluke, a tapeworm and a roundworm from word descriptions.
2) Describe each of the developmental stages in these life cycles and where it is located either in the host or in the environment outside the host.
3) Design a way to stop the life cycle for each of the three nematode life cycle types, the trematode life cycle and the cestode life cycle.

Outline:

I. **Nematodes** (direct and indirect life cycles)
   A. Direct - free living cycle
      1. Adult = mature fifth stage
      2. Eggs in host feces develop embryo
      3. Embryo develops to first stage larva, L1
      4. L1 hatches from egg and moults to L2
      5. L2 moults to L3 (infective stage)
      6. L3 ingested or enters host through skin
      7. L3 moults to L4 in host
      8. L4 moults to L5 in host and develops to mature nematode
   B. Direct - no free living stage
      1. Infective larva develops in the egg and remains there.
      2. Egg containing infective larva ingested by host
   C. Indirect
      1. Egg or embryo or L1 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.
      4. L3 develops to L4 in host
      5. L4 migrates and develops to L5 in host tissue
      6. L5 matures to adult nematode
   D. Other types of nematode life cycles
      1. No external stages
      2. Replicating free-living stages

II. **Trematodes**: REQUIRE SNAIL INTERMEDIATE HOSTS (in this course)
      1. Egg passed in feces of the host by hermaphroditic adult
      2. Miracidium develops in egg then emerges to infect a snail
      3. Mother sporocyst develops from the miracidium in the snail
      4. Many rediae develop in a sporocyst, and then emerge from sporocyst
      5. Many cercariae develop in a redia, and then emerge from the snail
      6. A cercaria becomes a metacercaria; (or is infective = Schistosomidae)
      7. Metacercariae are infective for the final host or a paratenic host
      8. A metacercaria in the host develops into a young fluke, fluke becomes sexually mature.

IV. **Cestodes**: ALL CESTODES REQUIRE INTERMEDIATE HOSTS

A. True tapeworm (Order - Cyclophyllidea or Eucestoda)
   1. Definitive host is often a predator of the intermediate host
   2. Adult (hermaphroditic) stage releases segments containing eggs in feces of definitive host
   3. Intermediate host ingests those eggs
   4. Larval stage is ingested when definitive host eats intermediate host
   5. Various Larval forms (metacestode) (FYI only – Cysticercus (bladder worm), Strobilocercus, Coenurus, Unilocular hydatid cyst, Alveolar hydatid cyst, Cysticercoid, Tetratherydian

B. Pseudotapeworm (Order – Pseudophyllidea)
   1. *Diphyllobothrium* and *Spirometra*
   2. Aquatic food chains - intermediate hosts have procercoid and plerocercoid larval forms

V. General cycle (applies to all helminths)

A. Contamination of the host's environment (habitat and/or food source)
B. Development of parasite preinfective stages (is fresh dog feces dangerous?)
C. Infection #
D. Maturation of adult parasite stage (prepatent time) #

The time for parasite development determines the interval and timing of control measures such as sanitation and/or treatment.