

PARASITOLOGY

INTRODUCTION

DEFINITION

- Parasite means : one who eats at the table of another.
- Differs from bacteria and viruses in their complex life cycles, intermediate hosts and chronicity.
- Evolved to live under totally different environments according to the developmental stage and different host tissues.

SIGNIFICANCE

- Parasitic infections cause a lot of morbidity worldwide :
- 2nd most common infectious cause of blindness.
- One billion people harbour intestinal nematodes.
- Schistosomiasis affects 200-300 million people.
- Filariæ affect a similar number as well.
- Several hundred million people contract malaria every year, with the death of 1 million children.

DEFINITIONS

- PARASITE
- PRIMARY HOST : NORMALLY HUMAN, MAY BE AN ANIMAL.
- INTERMEDIATE HOST : NORMALLY ANIMAL OR INSECT, HUMANS (ACCIDENTAL). NOT ALWAYS REQUIRED.

DEFINITIONS

- VECTOR.
- DEAD END HOST.
- OCCASIONALLY SAME ANIMAL MAY SERVE BOTH AS PRIMARY AND INTERMEDIATE HOST.
- RESERVOIR.
- ZONONOSIS.

DEFINITIONS

- PARASITES MAY BE PRESENT IN THE LUMEN OF AN ORGAN (LUMINAL PARASITES).
- PARASITES INFECTING TISSUES ARE CALLED TISSUE PARASITES.
- ENDOPARASITES.
- ECTOPARASITES.

LIFE CYCLE

- DIRECT SPREAD :
- PRIMARY HOST -TO- PRIMARY HOST
- THROUGH EGGS, CYSTS, PARASITE (RARE).

- SPREAD THROUGH AN INTERMEDIATE HOST:
- PRIMARY HOST - INTERMEDIATE HOST (MAY BE MORE THAN ONE) - PRIMARY HOST.

CLASSIFICATION

- TWO GROUPS OF PARASITES.
- 1)- PROTOZOA.
- 2)- HELMINTHS (WORMS).

PROTOZOA

- UNICELLULAR ORGANISMS.
- SIZE RANGE: 3 MICRONS - 120 MICRONS.
- CAN BE EITHER INTRACELLULAR OR EXTRACELLULAR PARASITES.
- VEGETATIVE FORM OF THE ORGANISM IS USUALLY REFERRED TO AS TROPHOZOITE.

INTRACELLULAR/EXTRACELLULAR

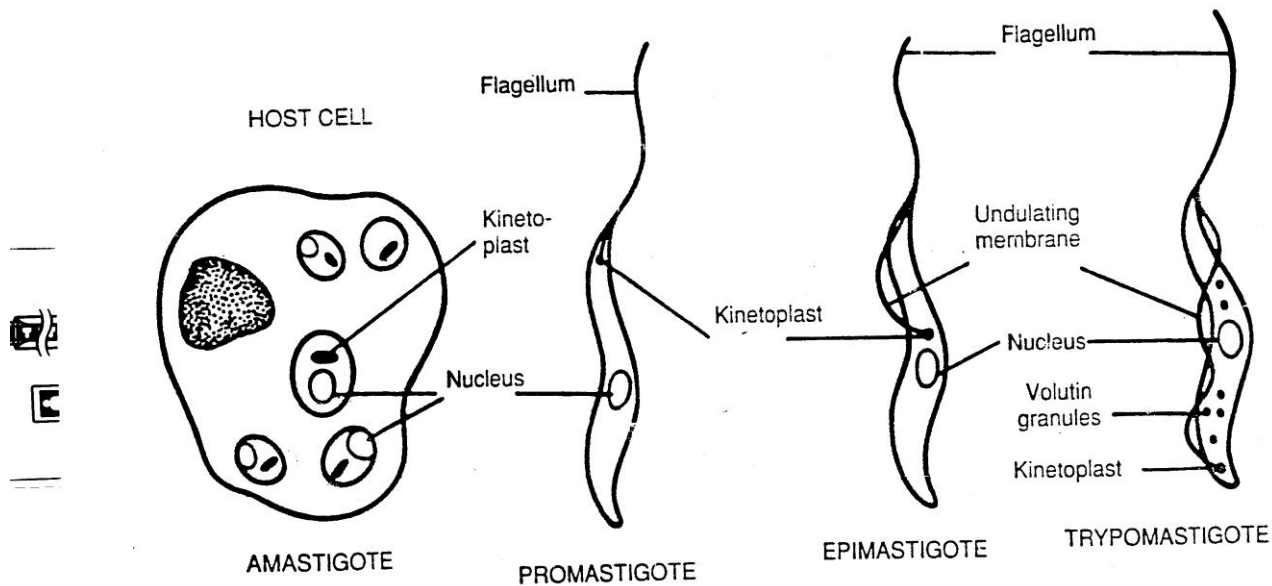


Figure 4-1. Developmental forms of Trypanosomatidae.

TRANSMISSION

- TROPHOZOITE IS USUALLY UNABLE TO SURVIVE OUTSIDE THE BODY LONG ENOUGH TO TRANSMIT INFECTION.
- TRANSMISSION IS THROUGH A TOUGH INERT FORM OF THE ORGANISM viz. A CYST.
- WHERE THERE IS AN INTERMEDIATE HOST NO CYST EXISTS, BUT ANOTHER FORM OF THE ORGANISM MAY BE INVOLVED.

CYST FORMATION

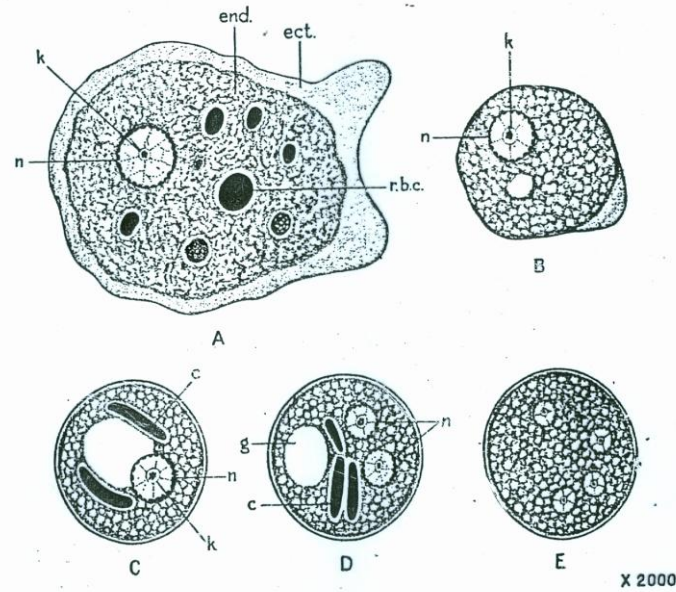


Figure 3-2. Schematic representation of *Entamoeba histolytica*. **A.** Trophozoite containing red blood cells undergoing digestion. **B.** Precystic ameba devoid of cytoplasmic inclusions. **C.** Young uninucleate cyst. **D.** Binucleate cyst. **E.** Mature quadrinucleate cyst. c = chromatoid bodies; ect. = ectoplasm; end. = endoplasm; g = glycogen vacuole; k = karyosome; n = nucleus; r.b.c. = red blood cells.

MULTIPLICATION

- PROTOZOA MULTIPLY THROUGH BINARY FISSION.
- THUS THE NUMBER OF ORGANISMS CAN INCREASE IN THE HOST.
- THAT CAN LEAD TO SERIOUS PATHOLOGY IN THE HOST.

MULTIPLICATION

- BINARY FISSION IS ASEXUAL REPRODUCTION.
- SOME PROTOZOA viz. SPOROZOA ALSO HAVE SEXUAL REPRODUCTION AT SOME STAGE OF THEIR LIFE CYCLE :
- MACROGAMETOCYTES
- MICROGAMETOCYTES
- ZYGOTE

MULTIPLICATION

- SEXUAL/ASEXUAL REPRODUCTION USUALLY OCCURS IN EITHER THE PRIMARY OR THE INTERMEDIATE HOST.
- IN CASE THERE IS ONLY ONE HOST BOTH CAN OCCUR IN THE SAME HOST.
- SEXUAL REPRODUCTION CAN ALSO BE ACCOMPANIED BY ASEXUAL MULTIPLICATION WITHIN THE HOST.

PLASMODIUM LIFE CYCLE

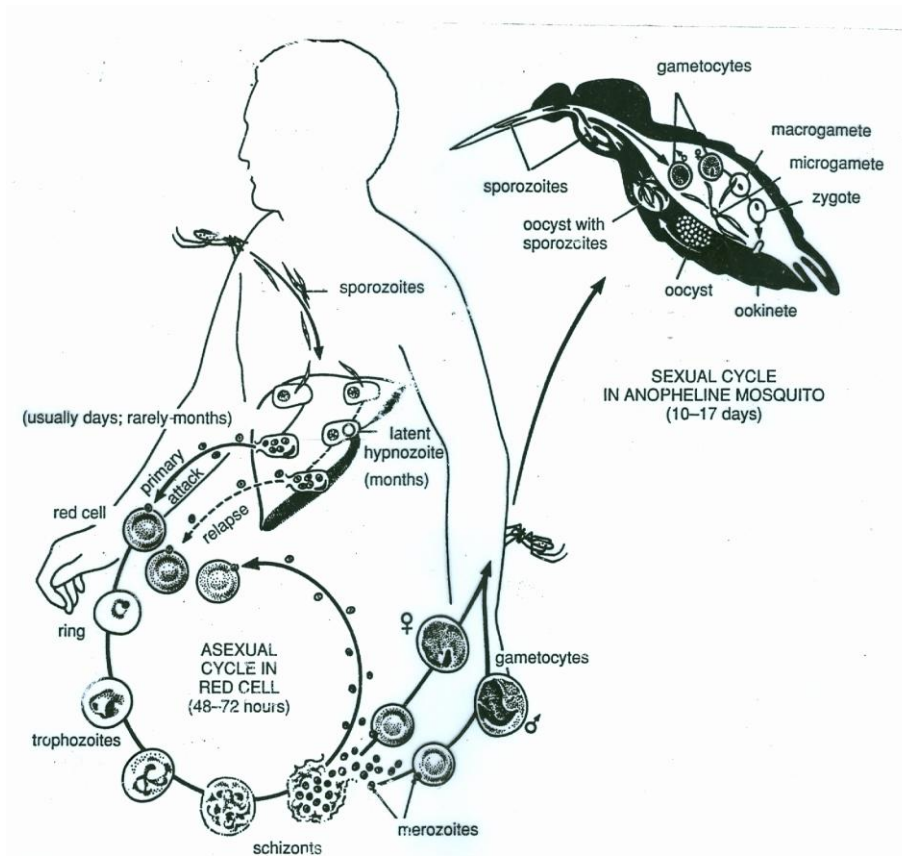
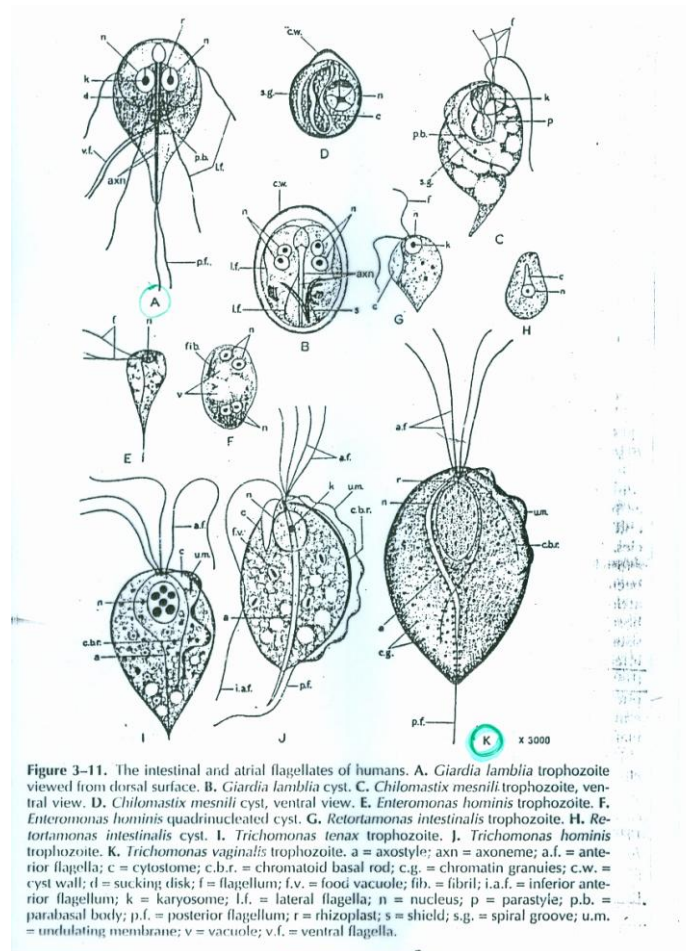


Figure 4-15. Life cycle of human malaria parasites.

CLASSIFICATION

- PROTOZOA CAN BE CLASSIFIED ACCORDING TO LOCOMOTION ORGANELLES :
- RHIZOPODA (PSEUDOPODIA)
- FLAGELLATES. ALSO UNDULATING MEMBRANE.
- CILIATES
- SPOROZOA (APICOMPLEXA)

FLAGELLATES



CILIATE

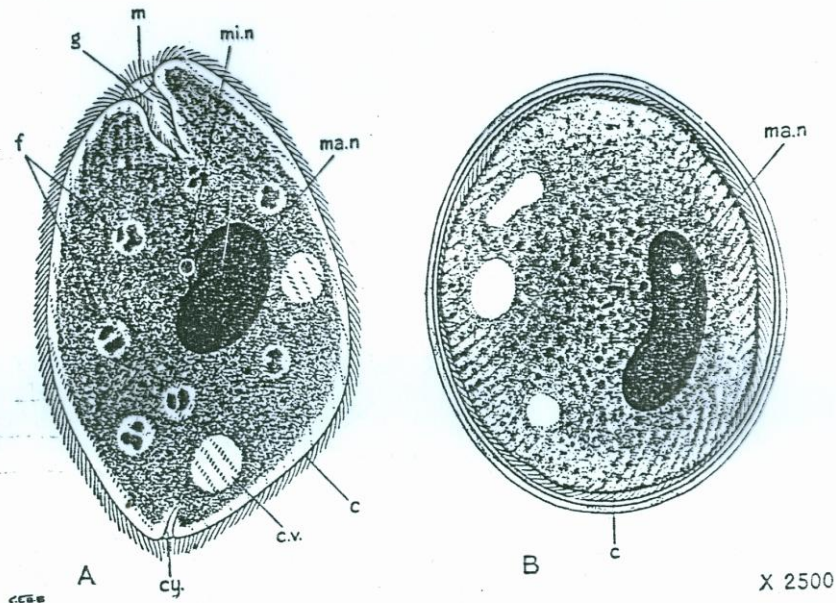
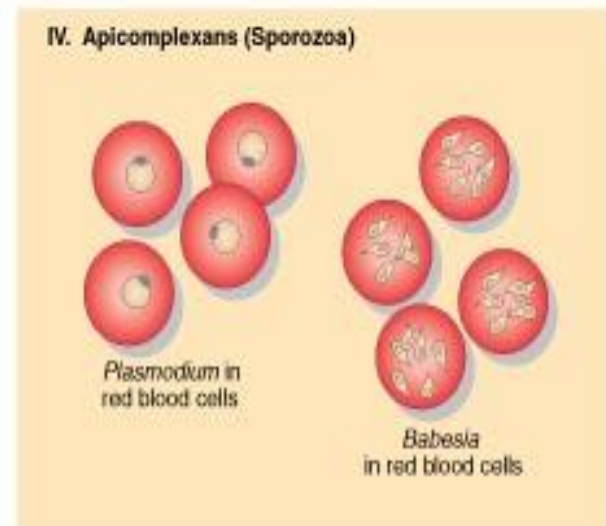
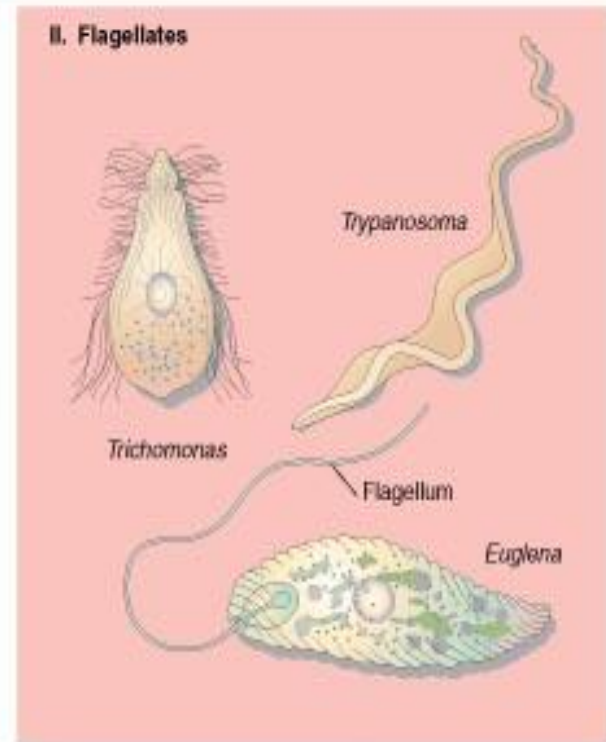
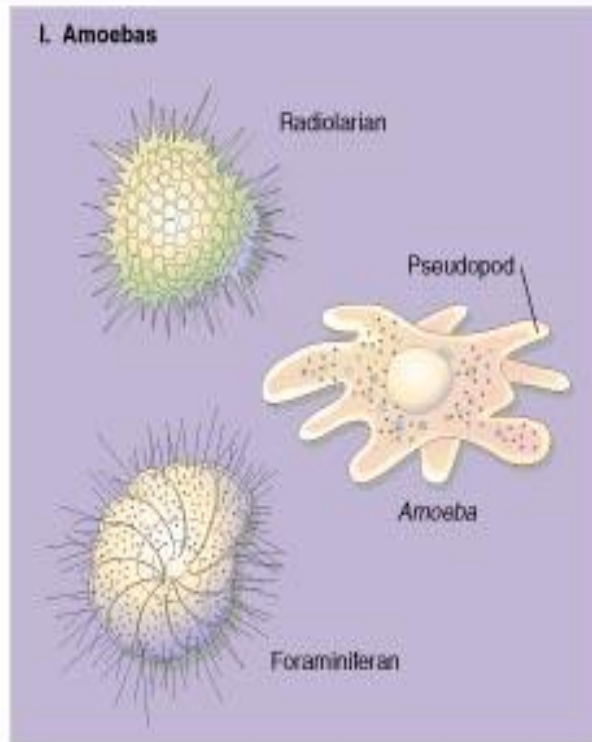


Figure 3-9. Schematic representation of *Balantidium coli*. **A.** trophozoite. **B.** Cyst. c = cilia; cy = cytophyge; c.v. = contractile vacuole; f = food vacuole; g = gullet; m = mouth; ma. n = macronucleus; mi. n = micronucleus. (Modified from Dobell and O'Connor, 1921.)

The Four Major Groups of Protozoa

Figure 5.3



HELMINTHS

- MUTICELLULAR ORGANISMS.
- SIZE RANGES FROM 2 mm TO 10 m.
- ALL ARE EXTRACELLUAR PATHOGENS.
- CAN BE TISSUE OR LUMINAL PARASITES.
- PRODUCE EGGS OR LARVAE.

CLASSIFICATION

- NEMATHELMINTHS, NEMATODES OR ROUND WORMS.
- PLATYHELMINTHS : FLAT WORMS
 - - CESTODES (TAPEWORMS).
 - - TREMATODES (FLUKES).

NEMATODES

- CYLINDRICAL WORMS
- SIZE 2 mm. TO 1m. IN LENGTH.
- TISSUE OR LUMINAL PARASITES.
- LIFE SPAN WEEKS TO SEVERAL YEARS.
- SEPARATE SEXES.
- PRODUCE EGGS OR LARVAE.

MORPHOLOGY

- CUTICLE.
- GASTROINTESTINAL TRACT.
- EXCRETORY SYSTEM.
- NERVOUS SYTEM.
- MALE AND FEMALE REPRODUCTIVE SYSTEMS.
- LUMINAL NEMATODE POSSESS DIFFERENT MEANS FOR ATTACHMENT.

NEMATODE STRUCTURE

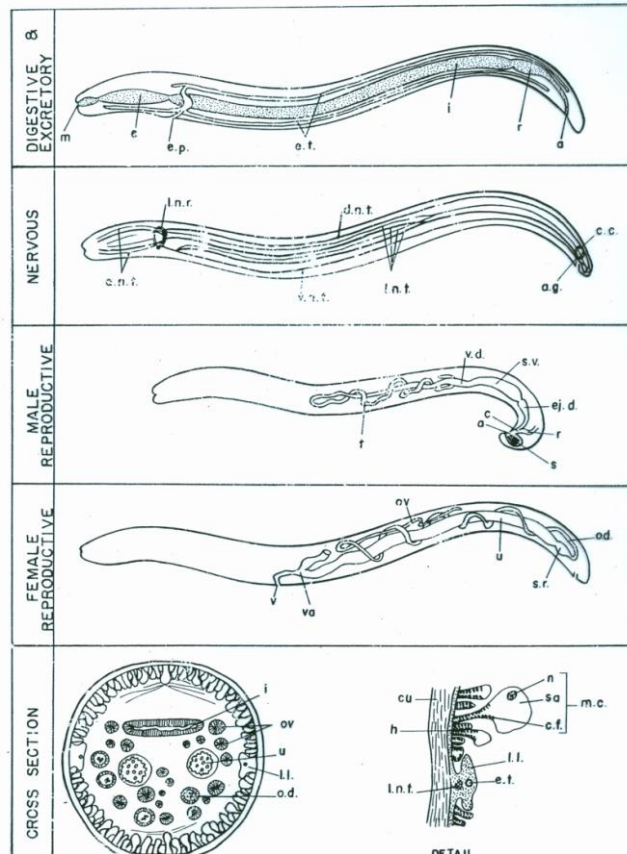


FIGURE 11



Ancylostoma duodenale

Scanning electron micrograph of the oral opening of *Ancylostoma duodenale*, another species of human hookworm. Note the presence of four cutting "teeth," two on each side.

LIFE CYCLE

- MANY (LUMINAL) DO NOT REQUIRE AN INTERMEDIATE HOST.
- DIRECT SPREAD BY MEANS OF EGGS.
- OTHERS (TISSUE) REQUIRE AN INTERMEDIATE HOST. PRODUCTION OF LARVAE.
- INTERMEDIATE HOST IS USUALLY AN ARTHROPOD.

HELMINTHS EGGS

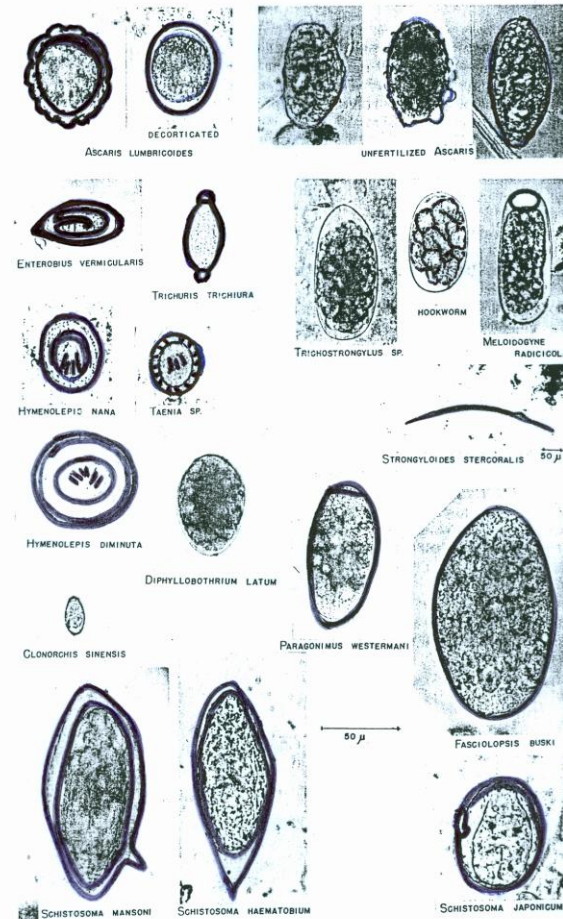


Figure 17-1. Helminth eggs.

MICROFILARIA

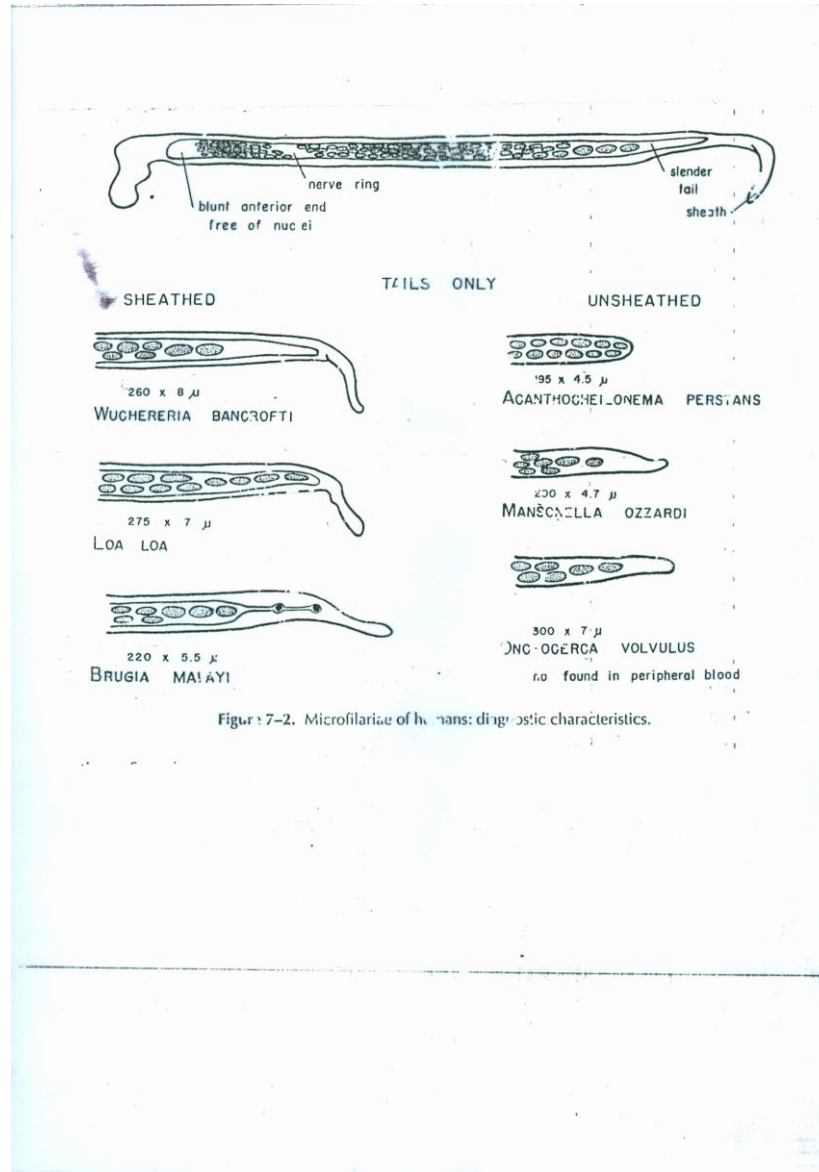


Figure 7-2. Microfilariae of humans: diagnostic characteristics.

CESTODES

- FLATTENED. TAPE LIKE.
- SIZE 1 cm TO 10 m.
- CONSIST OF UNITS CALLED PROGLOTTIDS.
- EACH UNIT IS A SEPARATE ENTITY.
- NUMBER OF PROGLOTTIDS RANGES FROM 3 TO 3000.
- TISSUE OR LUMINAL PARASITE.
- PRODUCE EGGS.

CESTODES

- WITH ONE EXCEPTION ALL REQUIRE AN INTERMEDIATE HOST FOR TRANSMISSION.
- LIFE SPAN FROM WEEKS TO MANY YEARS.
- HERMAPHRODITE : WORM IS BOTH MALE AND FEMALE.

MORPHOLOGY

- SCOLEX : FOR ATTACHMENT.
- SUCKER : ROUND SHAPED USUALLY, MAY BE ELONGATED.
- HOOKS : SHAPED IN A RING CALLED ROSTELLUM, MAY BE SINGLE OR DOUBLE.
- NECK REGION FROM WHICH PROGLOTTIDS PROLIFERATE.

Cestode morphology

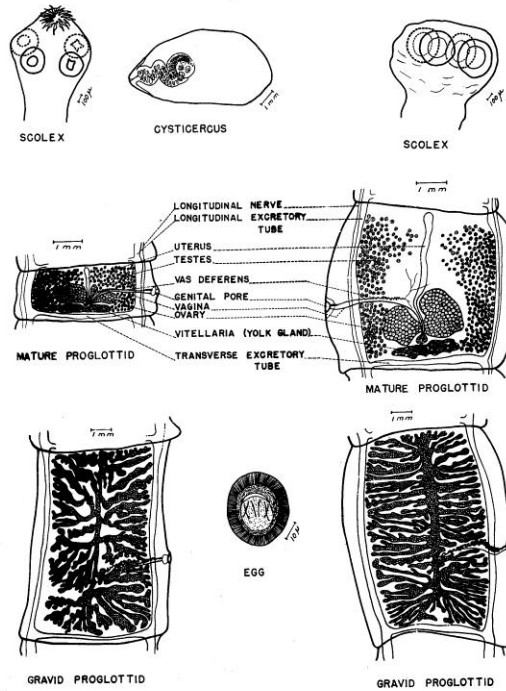
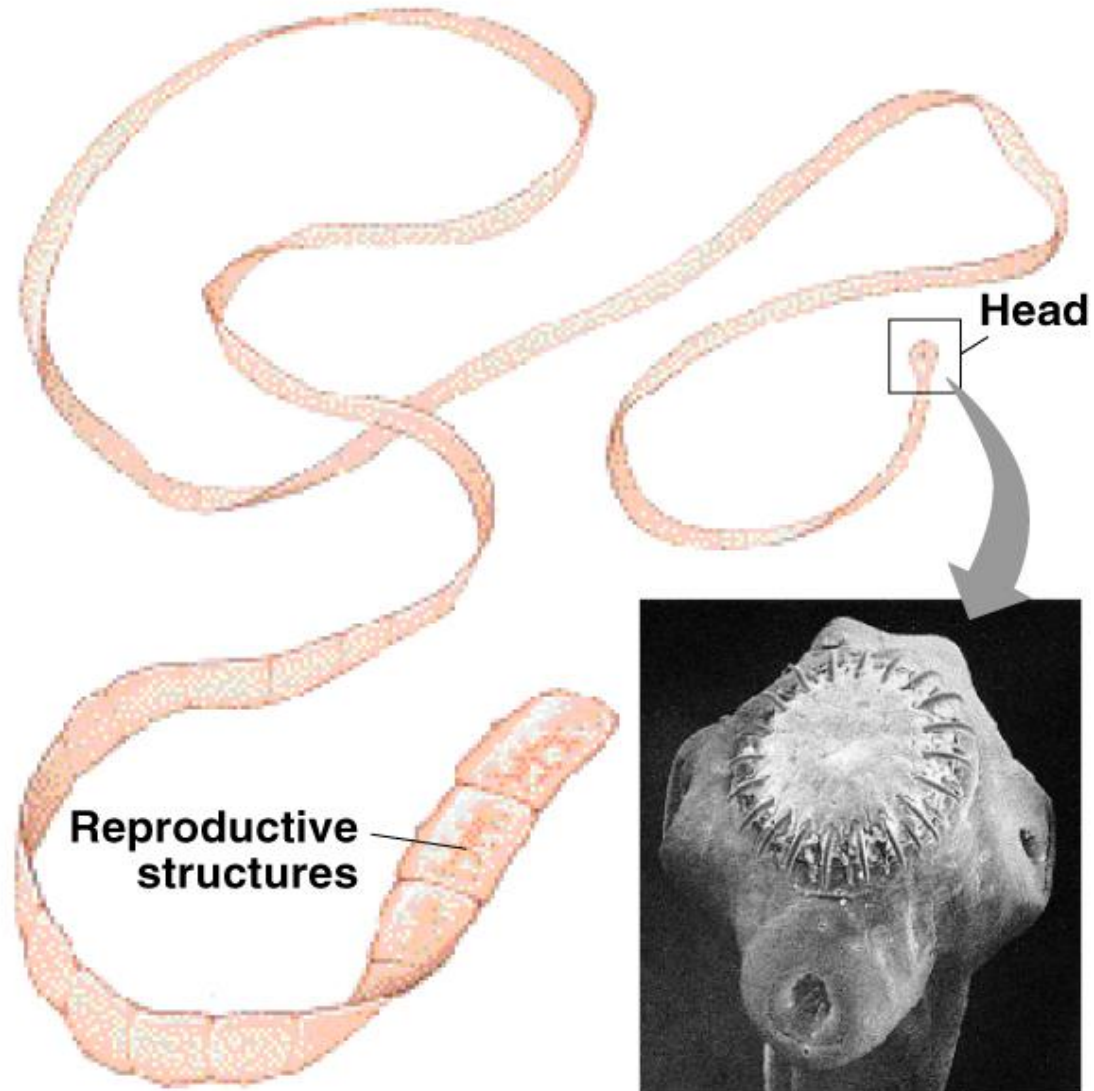


Figure 9-5. *Taenia solium* and *T. saginata*—a diagrammatic comparison.



Cestode (Tapeworm) Body Structure: Scolex and Proglottids



Tapeworm Scolex



CESTODES

EARLY PROGLOTTIDS ARE IMMATURE.

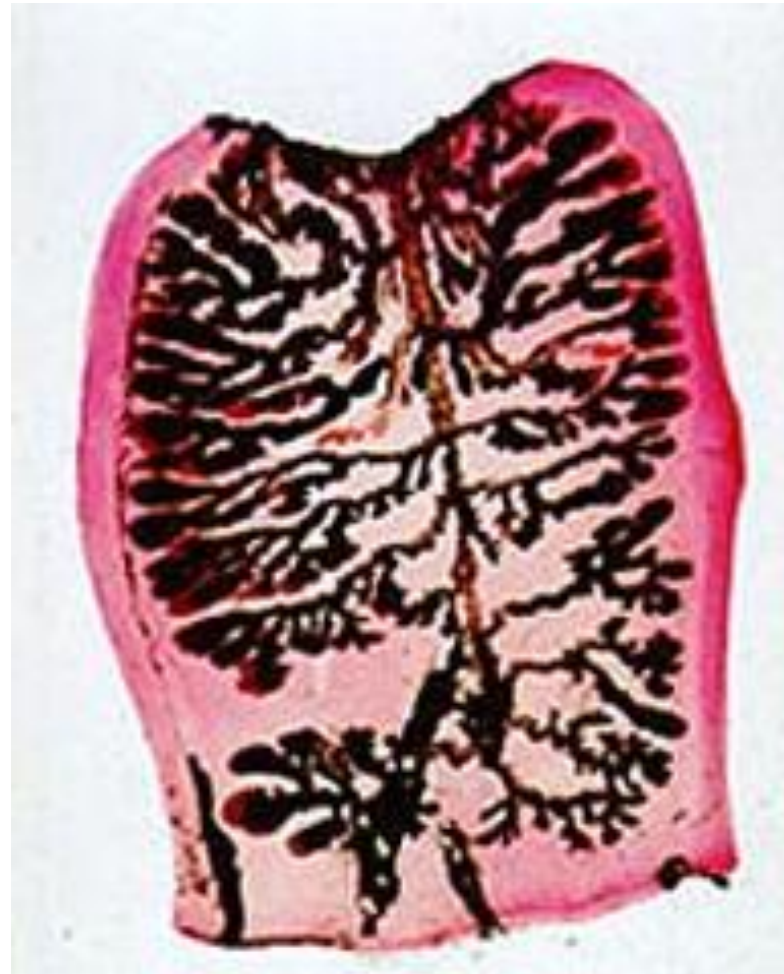
FOLLOWED BY MATURE THAT EXHIBIT
REPRODUCTIVE ORGANS :

UTERUS, OVARIES, TESTES.

GRAVID PROGLOTTIDS CONTAIN DILATED
UTERUS WITH LATERAL BRANCHES FULL OF
FERTILIZED EGGS.

Pork Tapeworm

Uterine
branches in
proglottid



CESTODE

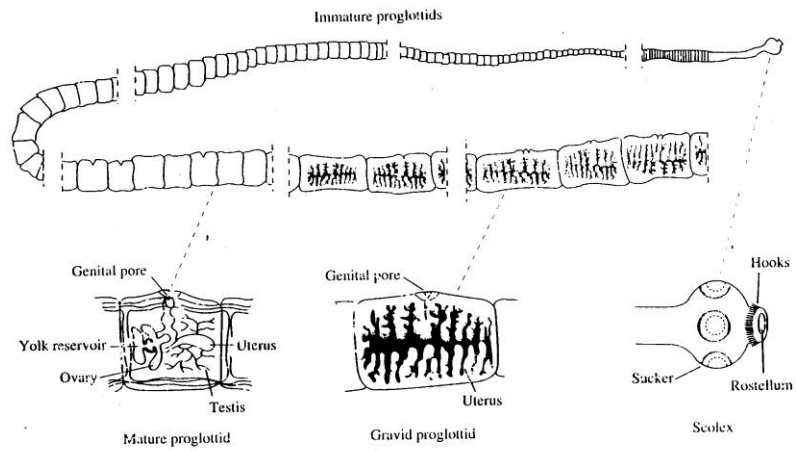


FIGURE 51-1 Major morphologic parts of an adult tapeworm.

CESTODES

- THE SURFACE IS COVERED BY TEGUMENT WITH MICROTRICHIA TO INCREASE SURFACE AREA FOR ABSORPTION.
- MUSCLE FIBRES.
- NERVOUS TISSUE.

LIFE CYCLE

- SELF FERTILIZATION OF EGGS IS THE RULE.
- CROSS FERTILIZATION MAY OCCUR IF THERE IS MORE THAN ONE WORM.
- EGGS ARE PASSED IN FAECES.
- EGGS ARE INGESTED BY INTERMEDIATE HOST WHICH IS USUALLY AN ANIMAL : CATTLE, PIG, FISH DEPENDING ON SPECIES.

LIFE CYCLE

- TYPICAL CESTODE EGG HAS A STRIATED OUTER LAYER.
- THE EMBRYO HAS SIX HOOKS HENCE THE NAME HEXACANTH.
- HEXACANTH PENETRATE THE WALL OF THE INTESTINE OF INTERMEDIATE HOST.
- BECOMES DISTRIBUTED IN THE TISSUES.

Taenia Egg



LIFE CYCLE

- IN THE TISSUES DEVELOPS INTO CYSTICERCUS
- WHICH IS A FLUID FILLED SAC CONTAINING AN INVAGINATED RUDIMENTARY SCOLEX.
- WHEN RAW FLESH IS EATEN THE CYSTICERCUS DEVELOPS INTO AN ADULT WORM.
- COOKING KILLS CYSTICERCI.

CESTODES

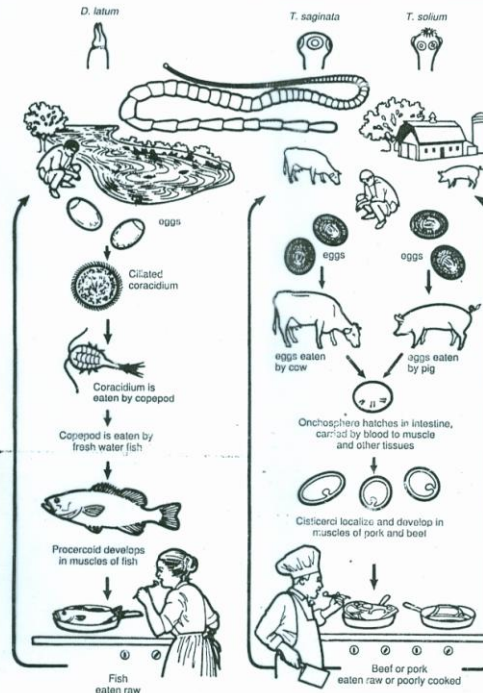


Figure 9-1. Life cycles of the 3 main human intestinal tapeworms.

TREMATODES

- FLAT LEAF SHAPED WORMS (EXCEPT SCHISTOSOMES).
- SIZE 2 TO 8 cm.
- WITH ONE EXCEPTION ALL ARE HERMAPHRODITES (SCHISTOSOMES).
- LIFE SPAN UP TO MANY YEARS.
- ALL REQUIRE AN INTERMEDIATE HOST FOR TRANSMISSION.

MORPHOLOGY

- INTERMEDIATE HOST IS A FRESH WATER MOLLUSC (SNAIL).
- LUMINAL OR TISSUE PARASITES.
- TEGUMENT IS SPINY.
- TWO SUCKERS : ORAL & VENTRAL.
- BIFURCATE G.I. TRACT.
- NO ANAL OPENING.

TREMATODES

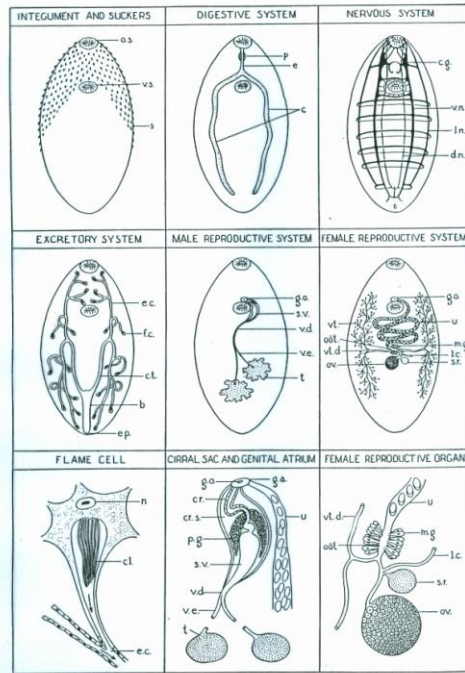


Figure 11-2. Schematic representation of morphology of a typical trematode. b=bladder; c=ceca; c.g.=cephalic ganglia; cl.=cilia; cr.=cirrus; cr.s.=cirral sac; c.t.=collecting tube; d.n.=dorsal nerve trunk; e=esophagus; e.c.=excretory capillary; e.p.=excretory pore; f.c.=flame cell; g.a.=genital atrium; g.o.=genital opening; l.c.=Laurer's canal; l.n.=lateral nerve trunk; m.g.=Mehlis' gland; n=nucleus; oot=ootype; o.s.=oral sucker; ov.=ovary; p=pharynx; p.g.=prostate gland; s=spines; s.r.=seminal receptacle; s.v.=seminal vesicle; t=testis; u=uterus; v.d.=vas deferens; v.e.=vas efferens; v.n.=ventral nerve trunk; v.s.=ventral sucker; vt.=vitellaria; vt.d.=vitelline duct.

TREMATODES

- MUSCLE AND NERVE TISSUES.
- EXCRETORY SYSTEM.
- EGGS ARE LARGE WITH AN OPERCULUM (LID). EXCEPT SCHISTOSOMES.
- SCHISTOSOME EGGS ARE SPINED.

LIFE CYCLE

- EGGS ARE PASSED INTO WATER.
- OPERCULUM OPENS RELEASING A CILIATED MIRACIDIUM.
- MIRACIDIUM ENTERS SNAIL.
- DEVELOPS INTO SPOROCCYST.
- SPOROCCYST GIVES RISE TO DAUGHTER SPOROCCYST OR REDIA DEPENDING ON SPECIES.

LIFE CYCLE

- CERCARIA DEVELOP IN REDIA OR SPORO CYST.
- CERCARIA ARE RELEASED INTO WATER.
- TWO PATHWAYS :
- 1)- CERCARIA ENTER SKIN OF NEXT HOST.
- 2)- ENCYST INTO METACERCARIA AND SETTLE ON AQUATIC PLANTS OR CREATURES TO BE INGESTED BY NEXT HOST.

TREMATODES

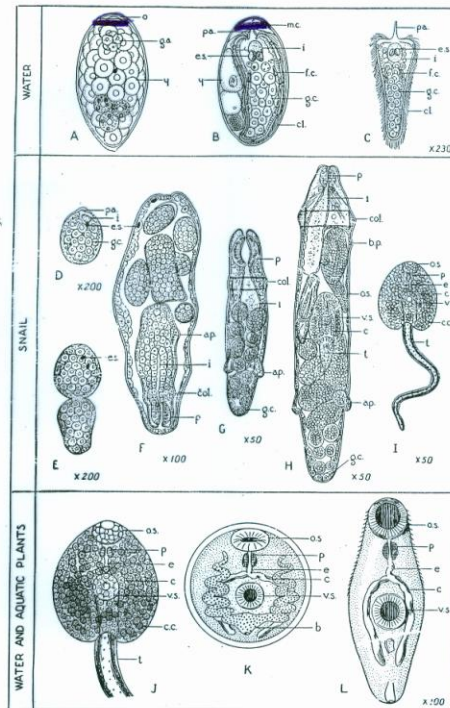


Figure 11-3. Larval forms of *Fasciola hepatica*. A. Immature egg. B. Miracidium in egg shell. C. Miracidium ready to enter snail. D. A very young sporocyst, immediately after completion of metamorphosis. E. Young sporocyst undergoing transverse fission. F. Adult sporocyst with rediae. G. Immature redia. H. Redia with developing cercariae and one daughter redia. I. Cercaria. J. Body of cercaria. K. Encysted metacercaria. L. Encysted metacercaria. ap.—appendages; b.—excretory bladder; b.p.—birth pore; c.—ceca; c.c.—cystogenous cells; cl.—cilia; col.—collar; e.—esophagus; e.s.—eye spots; f.c.—flame cells; g.a.—germinal area; g.c.—germinal cells; i.—digestive tract; m.c.—mucoid cap; o.—operculum; o.s.—oral sucker; o.—pharynx;

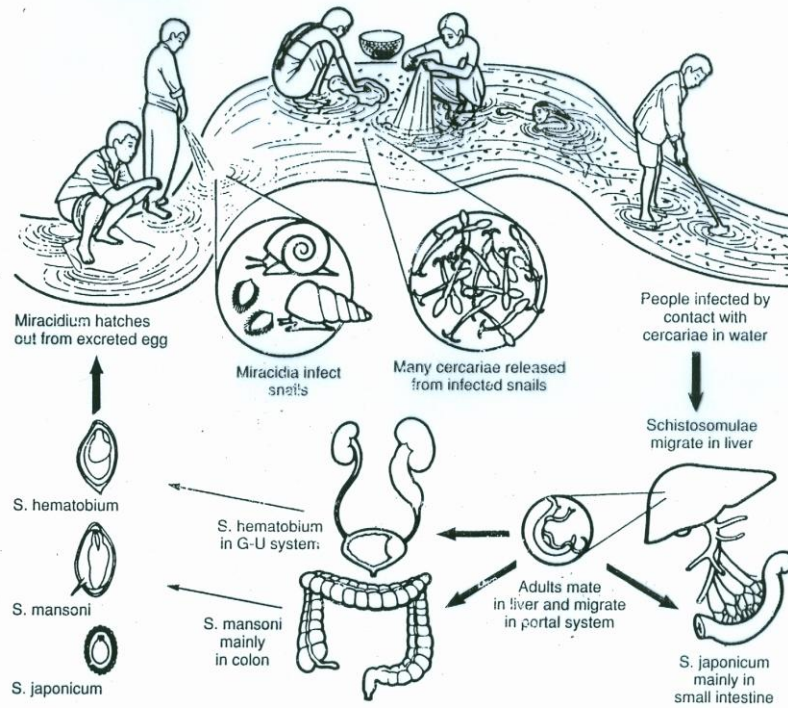


Figure 13-2. Life cycle of three main species of human schistosomes (*S. mansoni*, *S. haematobium*, and *S. japonicum*).



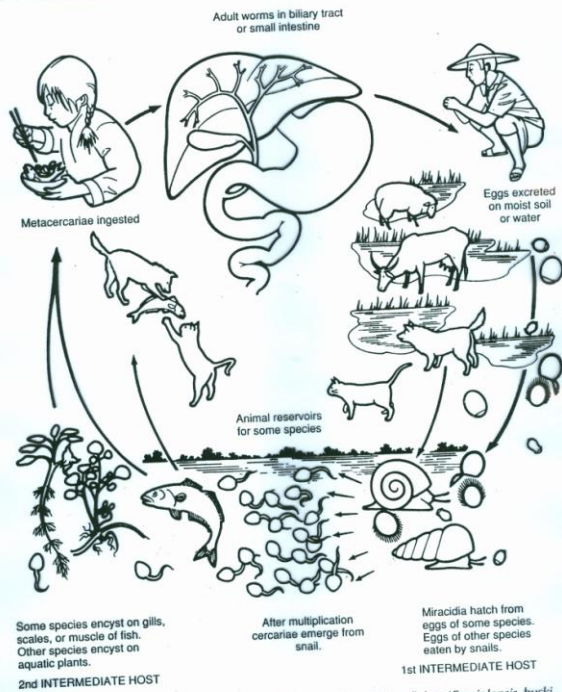


Figure 12-3. General life cycle for human intestinal and liver flukes (*Fasciolopsis buski*, *Heterophyes heterophyes*, *Metagonimus yokogawi*, *Nanophyes salmincola*, *Clonorchis sinensis*, *Opisthorchis felineus*, *O. viverrini*, and *Fasciola hepatica*).

PATHOGENESIS

- SYMPTOMS MAY BE ABSENT OR MINIMAL ESPECIALLY WITH LUMINAL PARASITES.
- PATHOLOGY MAY BE INDUCED BY THE PHYSICAL PRESENCE OF THE PARASITE e.g. BLOOD LOSS, MALABSORPTION, INTESTINAL OBSTRUCTION.
- INFLAMMATION AND TISSUE DEATH.

PATHOGENESIS

- IN CERTAIN CASES THE PATHOLOGY IS MEDIATED THROUGH AN ALLERGIC PROCESS DTH.
- PARASITIC INFECTIONS MAY BE ACCOMPANIED BY RAISED IgE AND EOSINOPHILIA

DIAGNOSIS

- EXAMINATION OF STOOLS, URINE, BLOOD, CSF
- BODY SECRETIONS, TISSUE BIOPSY :
- FOR THE PRESENCE OF PARASITES, CYSTS, EGGS, LARVAE.
- EOSINOPHILIA, RAISED IgE TOTAL AND SPECIFIC.
- Specific IgG

MANAGEMENT

- TREATMENT.
- PREVENTION OF TRANSMISSION.
- VACCINATION.