BIO 475 - Parasitology Spring 2009

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http://www4.nau.edu/isopod

Lecture 15

Phylum - Platyhelminths
Class - Cestoidea
Subclass - Eucestoda

Order		
→	Caryophyllidea	Fish - Teleosts
	Spathebothriidea	Fish -Teleosts
	Nippotaeniidea	Fish -Teleosts
→	**Pseudophyllidea**	Fish, reptiles, birds, mammals
	Trypanorhyncha	Elasmobranchs
	Lecanicephalidea	Elasmobranchs
	Tetraphyllidea	Elasmobranchs
	Dioecotaeniidea	"
	Diphyllidea	"
	Litobothridea	"
→	Proteocephalata	Fish, amphidia, reptiles
→	**Cyclophyllidea**	Amphibians, reptiles, birds, mammals

Eucestoda: Representative Orders

Order Caryophyllidea

1. in fish and aquatic annelids
2. small, unsegmented worms
3. poorly developed scolex, no bothria

Figure 21.11
Penarchigetes oklensis, a typical caryophyllidean cestode, from a spotted sucker.

Order Caryophyllidea

Life cycle.

1. Small, unsegmented worms (often called monozoic).

2. Adult worm drops off, eggs are released

a. eggs (*oncospheres*; operculated, nonembrionated).

1. Ingested by annelids (usually oligochaetes)

a. *procercoids* develop in coelom.

Order Caryophyllidea

Life cycle, continued

1. Fish eat annelids, develop *pleurocercoid* in gut which later develops into adult tapeworm.

a. in *Archigetes*, procercoids may become gravid in *Tubifex*,

Order Proteocephala (Proteocephalata)

1. Short worms, mostly parasitic on fish,

a. A few in reptiles and amphibians.

2. Relatively ancestral looking worms:

a. conspicuous neck

b. lateral genital pore

c. laterally distributed vitellaria

d. 4-5 suckers, occasionally with 5th at scolex apex.

Order Proteocephala

e. Gravid proglottids with large sacklike uterus that fills the proglottid.

1. leave the host with fully mature eggs

f. Eggs with fully developed *hexacanth larvae*

1. usually eaten by copepod

2. encyst in hemocoel

g. Small fish as 2nd host; *plerocercoids* in coelom

h. Small fish eaten by larger fish - *definitive host*

Order Pseudophyllidea

1. Adult tapes usually parasites of fish, also other vertebrates.

2. Scolex is variable, but always with longitudinal slits.

a. Bothria (usually 2) as lateral slits.

b. Distinct from bothridia - more leaf shaped, often 4.

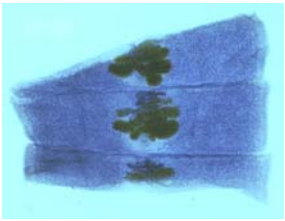
Order Pseudophyllidea

3. Testes and vitelliria are follicular and scattered on opposite sides of proglottid

a. testes - dorsal

b. vitellaria - ventral

4. Genital apertures are ventral -uterine pore is permanent.



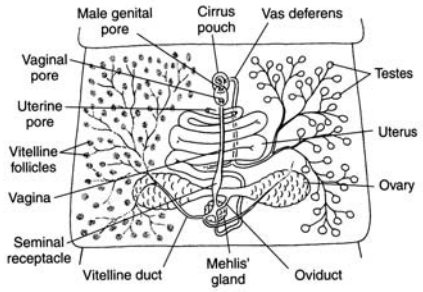


Figure 20.18
Diagram showing reproductive system of *Diphyllobothrium latum* (infracohort Pseudophylla). Note that the testes have been drawn on one side of the proglottid and the vitellaria on the other.
Drawing by William Ober and Claire Garrison.

Order Pseudophyllidea

5. Eggs are *unembryonated* when shed – also *operculated.*

a. Must mature outside of host.

b. After development, a ciliated *hexacanth* hatches – into a *coracidium.*

c. Eaten by copepod usually *Diaptomus* or *Cyclops*

6. forms *procercoid.*

Order Pseudophyllidea

7. fish eat copepods develop *plerocercoids*

8. definitive host infected by eating fish

Rutilus rutilus infected with plerocercoids of *Ligula intestinalis* (top two fish). Compare these with a non-infected fish (bottom fish).

Rutilus rutilus dissected to reveal massive infection of *Ligula intestinalis*

Dibothriocephalus latum

1.The "broad fish tapeworm."

a. There are several species with similar appearance and life history.

1.Relatively common among picivorous vertebrates.

a. Including bears, raccoons, mink, humans.

3. Infects 9 million humans, worldwide.

a. Most infections via eating raw or smoked fish (e.g., salmon sushi, Gefilte fish, lutefisk, etc.).

Dibothriocephalus latum

1.Life Cycle:

a. *Egg* shed in feces

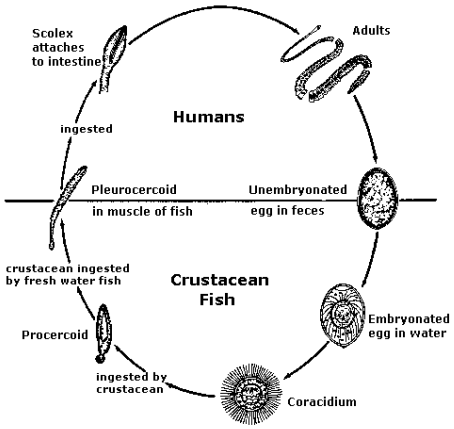
b. *Oncosphere* develops in egg

c. *Coracidium* hatches, eaten by copepod

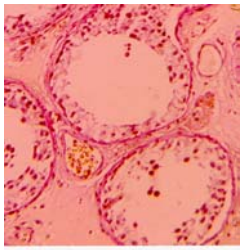
d. Develops to *procercoid*, eaten by fish

e. Develops to *plerocercoid*, eaten by mammal.

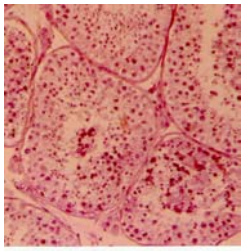
f. Matures to *adult* worm.



Vitamin B12 Deficiency

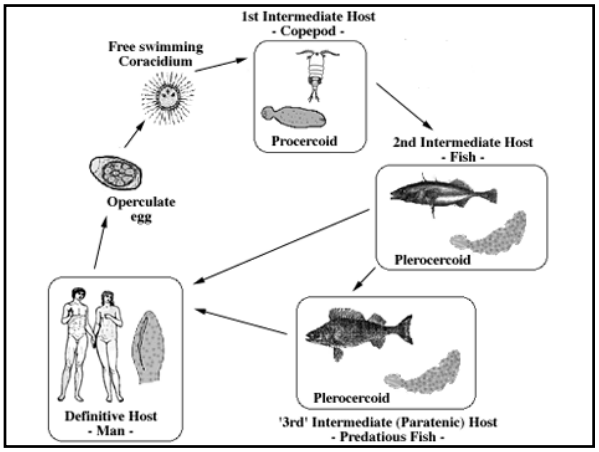


Testis biopsy from a patient with aspermia caused by B12 deficiency due to infestation with fish tapeworm (*Diphyllobotrium latum*)



Testis biopsy from the same patient demonstrating recovery of sperm production after treatment

Figure 20.32
Illustration of growth hormonelike action of *Diphyllobothrium mansonoides* plerocercoids. All rats were hypophysectomized when they weighed 90 g, but the two larger rats received 20 juvenile scolices of *D. mansonoides* approximately one month after the operation. The photograph was taken six months later, and the experimental animals outweigh the controls by three or four times.
From J. F. Mueller, "The biology of *Spirometra*," in *J. Parasitol.* 60:3–14.

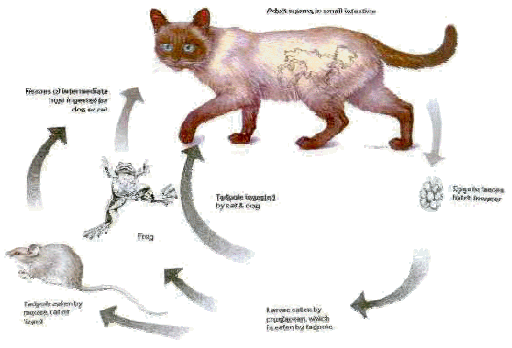


Spinometra (Diphyllobothrium) mansonoides

1. Usually definitive host is bobcat.

2. Intermediate host is frog or small aquatic mammal which is infected by eating copepods

Spirometra erinacei



"sparganosis"

Also called "sparaganum"

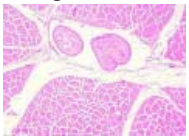
a. Where plerocercoid infects man by accident.

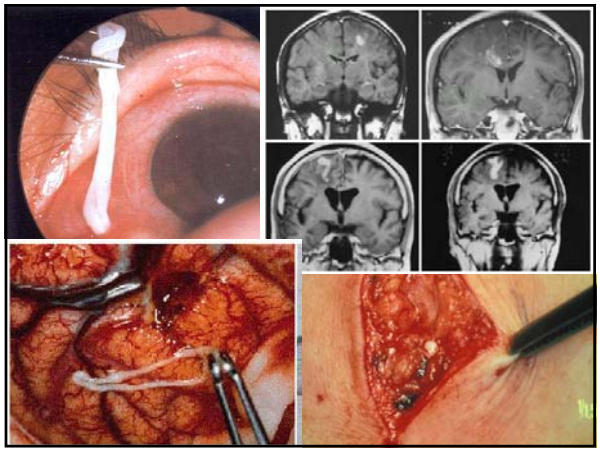
b. Occurs in three ways

1. Drinking copepods in water

2. Eating undercooked meat with plerocercoids

3. When raw meat is used as a poltice





Order Cyclophyllidea

1. Common tapeworm of birds and mammals

a. also a few reptiles and amphibians

2. Characteristics:

a.Scolex with 4 suckers

b. Often a hooked rostellum

Order Cyclophyllidea

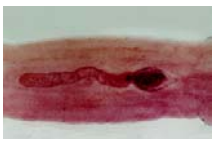
2. Other Characters:

a. Segments of proglottids usually longer than wide.

b. Proglottids leave host singly, or in groups

1. Usually motile.

e. Vitellaria concentrated in a single compact mass posterior to ovary.



Order Cyclophyllidea

2. Still Other Characters:

f. Genital duct opens into a common, lateral atrium.

g. Uterine pore is absent.

h. Gravid uterus is tubular with many lateral branches.

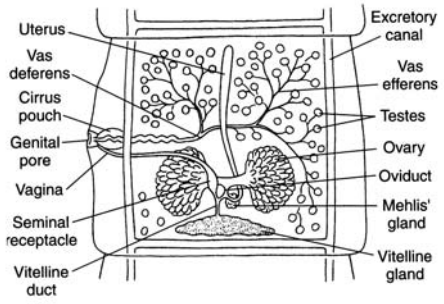


Figure 20.19
Diagram showing reproductive system of *Taenia* spp. (infracohort Saccouterina).
Drawing by William Ober and Claire Garrison.

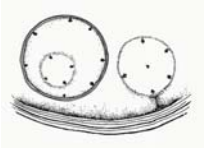
Order Cyclophyllidea

2. Still Other Characters:

i. Eggs escape by rupture of proglottid

j. non-operculated eggs are embryonated and develop into a bladderworm (cysticercoid) in the intermediate host.





Two Major Groups


2. Nontaenioid cestodes - several families

a. Eggs are variable but *never with thick shell*

b. Common larval form - *cysticercoid*

c. Usually forms in invertebrates and fish

d. Definitive host is a mammal.

Non-Taenioid Cestodes

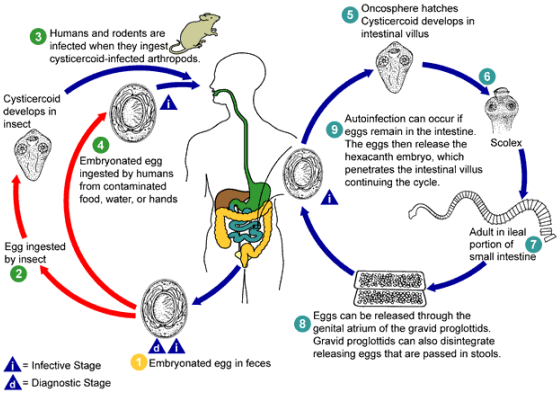
Hymenolepis diminuta, H. nana

a. Egg shed in feces

b. Eaten by beetle, oncosphere hatches, into body

c. Matures to cysticercus, eaten by mouse or human

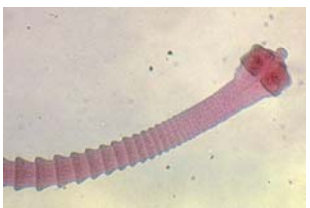
d. mature worm.

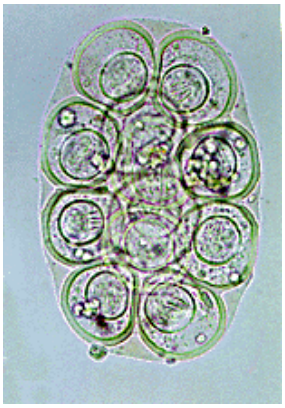


Dipilidium caninum

a. Recognizable by paired gonopores.

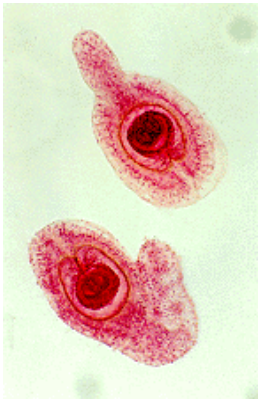
b. Often seen crawling on rugs.

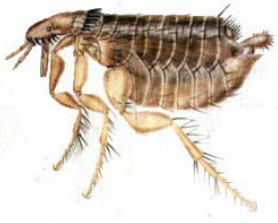




Dipylidium caninum - egg packets

The egg packets contain 15-20 eggs in each and are seldom seen free in the feces. They may, however, be readily expressed from the gravid proglottids.

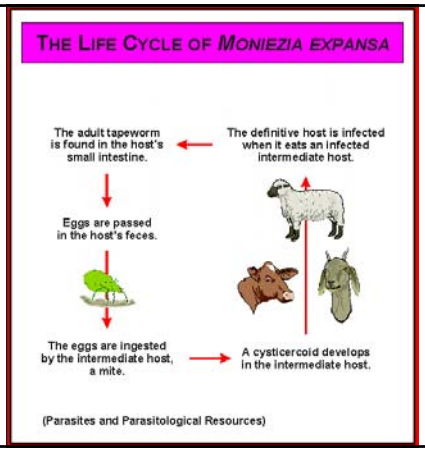


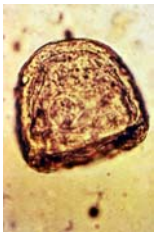


Dipylidium caninum cysticercoids from flea.

Moniezia expansa

1. A sheep tapeworm; proglottids very wide
2. Odd to have an herbivore with a tapeworm
3. Sheep become infected by eating orbatid mites with grass.





Anoplocephala perfoliata; horse tapeworms, found near ileocecal junction; eggs (right) are eaten by mites, which are consumed by horses in forage.

Two Major Groups

1. Taenioid cestodes (Family Taeniidae)

a. Eggs with thick shells that appear striated

b. Larval stages with fluid filled bladders

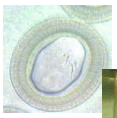
a. cysticercus

b. strobilocercus

c. coenurus

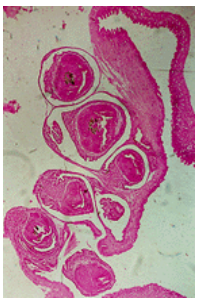
d. hydatid cyst

2. Can form within mammals that have swallowed eggs.

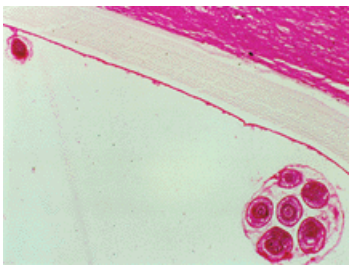


Strobilocercus of *Taenia taeniaformis* removed from an intermediate host (a mouse).

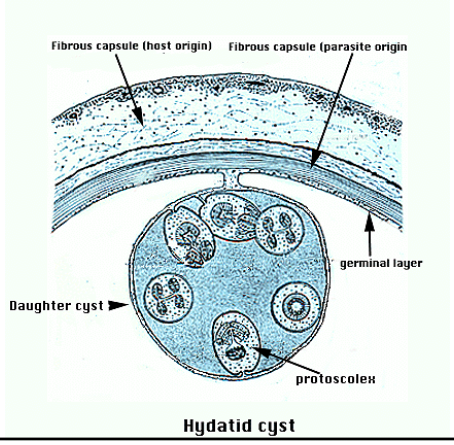
A bottle filled with *Taenia* cysticerci from the peritoneal cavity of a groundhog.



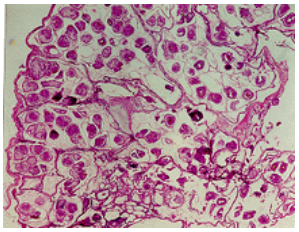
Taenia multiceps - coenurus (Cestoda: Cyclophyllidea) cross section through the coenurus. Note the many protoscolecies growing from the germinal layer.



Hydatid cyst of *Echinococcus granulosus*. Note the thick laminated cyst wall and the fibrous host response outside the cyst wall. Also note the daughter cyst with protoscolices within the main cyst.

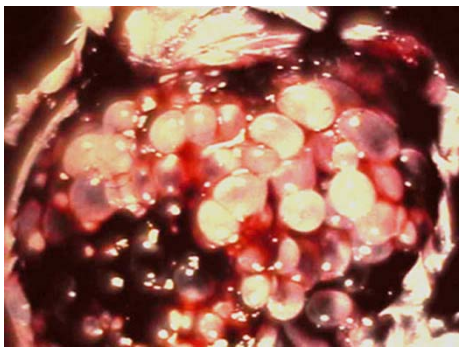


Hydatid cyst



Echinococcus multilocularis
This animal was infected 9 weeks ago. The alveolar cysticerci contain small scoleces.

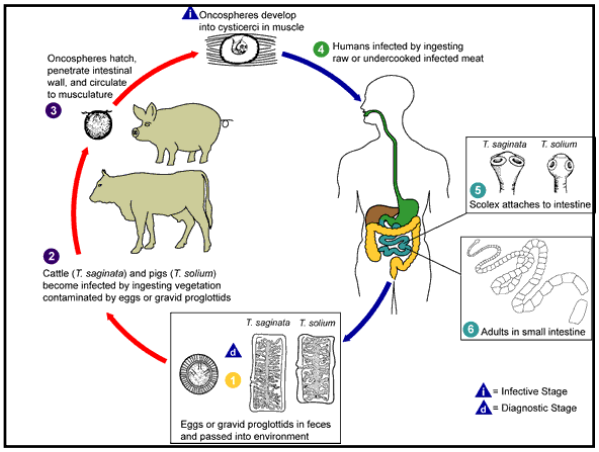
Taenia taeniformis multilocular cysticerci in mouse



Taenioid Cestodes

Taenia saginata

1. Beef tapeworm
2. Common in beef eating countries, SA, Mexico
3. Over 20 m long, but 3-5 most common.
   a. scolex lack rostellum
   b. proglottids with more narrow branches



Taenia saginata

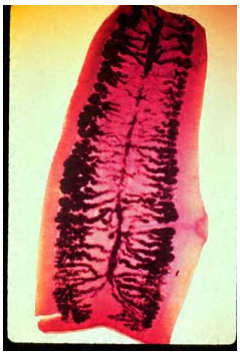
Life Cycle:

a. Worm in carnivore gut -> eggs in feces with proglottids.

b. Cattle contact eggs with forage; hexacanth hatches in gut, penetrates lumen and gets into bloodstream.

c. Cysticercus forms in flesh; evidently not in humans.

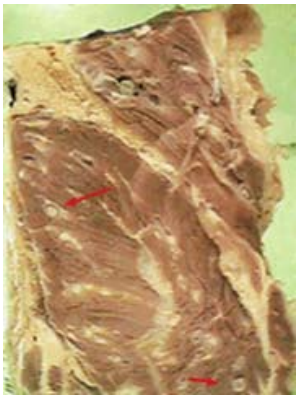
Taenia saginata



d. Uncooked or undercooked meat allows cysticercus to hatch and mature in host gut.

5. Humans with worm can infect herds of cattle

6. Symptoms not too severe; NOT hunger.

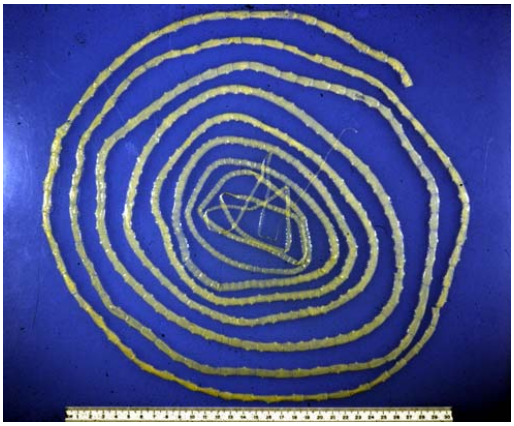


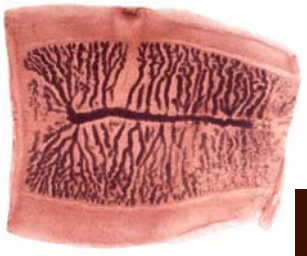
Taenia saginata-cysticercus

(Cestoda: Cyclophyllidea)

Cysticercus in the skeletal muscle of a cow.

Note the pea-sized cysts.





Taenia solium

1. Most infections in Africa, Mexico; also Asia

2. 2-7 m long

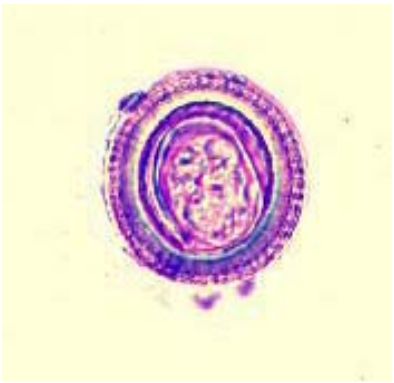
2. proglottids with wide branches

a. rostellum with hooks

3. Life cycle similar to that of *T. saginata* except

a. hosts are pigs and humans

b. eggs are infective to humans.



Taenia solium

c. Cysticerci form in brain and other locations

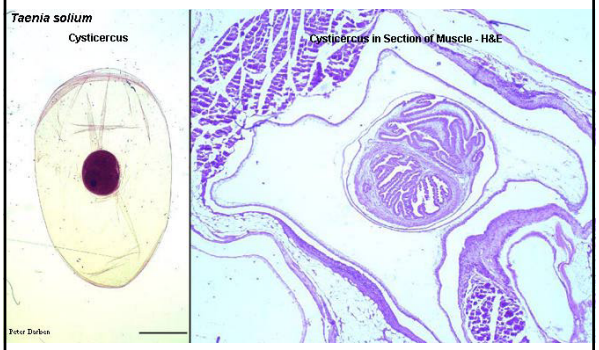
1. adaptive value probably to enhance transfer

d. in host intestine, long sections of proglottids shed.

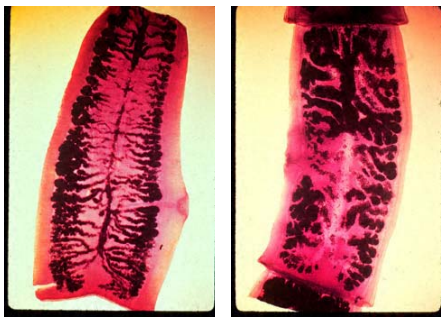
5. epidemiology

a. 138 cases in LA between 1988-1990.

b. Has been used as biological warfare in Iran, Java and Papua New Guinea

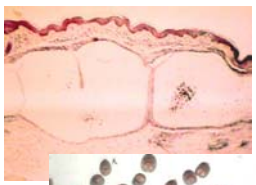


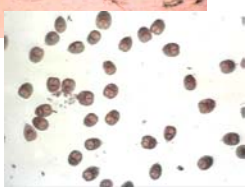
Gravid proglottids of (left) *Taenia saginata* and (right) *T. solium*. Injection of India ink in the uterus allows visualization of the primary lateral branches. Their number allows differentiation between the two species: *T. saginata* has 15 - 20 branches on each side, while *T. solium* has 7 - 13. Note the genital pores in mid-lateral position.



Echinococcus granulosus

a. egg
b. oncosphere
c. hydatid cyst
d. adult worm
e. epidemiology
1. a problem in locations with grazing animals and canids

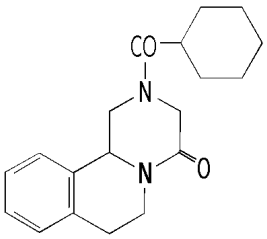




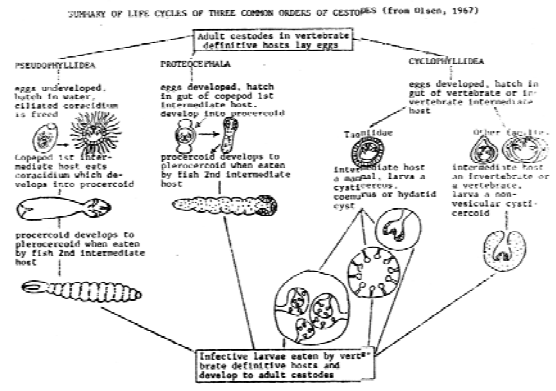
Echinococcus granulosus

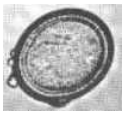
Numerous hydatid cysts in the liver of a horse. A horse may become infected with a number of cysts at one time (each egg ingested will result in one cyst).

Praziquantel



Praziquantel* is the drug of choice for most helminth infections



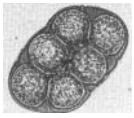


Taenia pisiformis
Dog/Cat Tapeworm

Echinococcus granulosus
Dog/Cat Tapeworm

Taenia taeniformis
Dog/Cat Tapeworm

Taenia solium
Pig/Human Tapeworm



Dipillidium caninum
Dog/Cat Tapeworm

Hymenolepis diminuta
Rat/Human Tapeworm

Moniezia expansa
Sheep Tapeworm

Anoplocephala magna
Horse Tapeworm

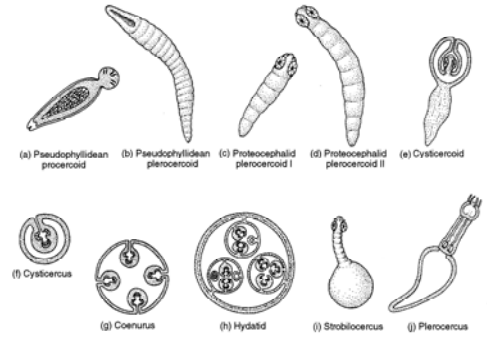


Figure 20.25
Types of cestode metacestodes. (*a*) The procercoid can be regarded as a differentiating plerocercoid of pseudophyllideans (*b*). According to some authors, the differentiating plerocercoid of proteocephalatans is a plerocercoid I (*c*), and the infective stage develops into plerocercoid II (*d*). Cysticercoids and cysticerci are metacestodes in the Cyclophyllidea. Cysticercoids (*e*) have an invaginated scolex and a solid body, and the scolices of cysticerci (*f–i*) are both invaginated and introverted into a fluid-filled bladder. The plerocercus (*j*), found in some Trypanorhyncha, is like a plerocercoid with a posterior bladder.
Drawings by William Ober and Claire Garrison.