TREMATODES

CHARACTERISTICS

- Dorso-ventrally flattened
- Unsegmented
- Leaf-like
- Hermaphroditic except blood flukes
- Two radially striated suckers
- Incomplete digestive tract
- Adults are covered with spines, except
- Incomplete digestive tract
- Most of the body is occupied by reproductive organs

BLOOD FLUKES

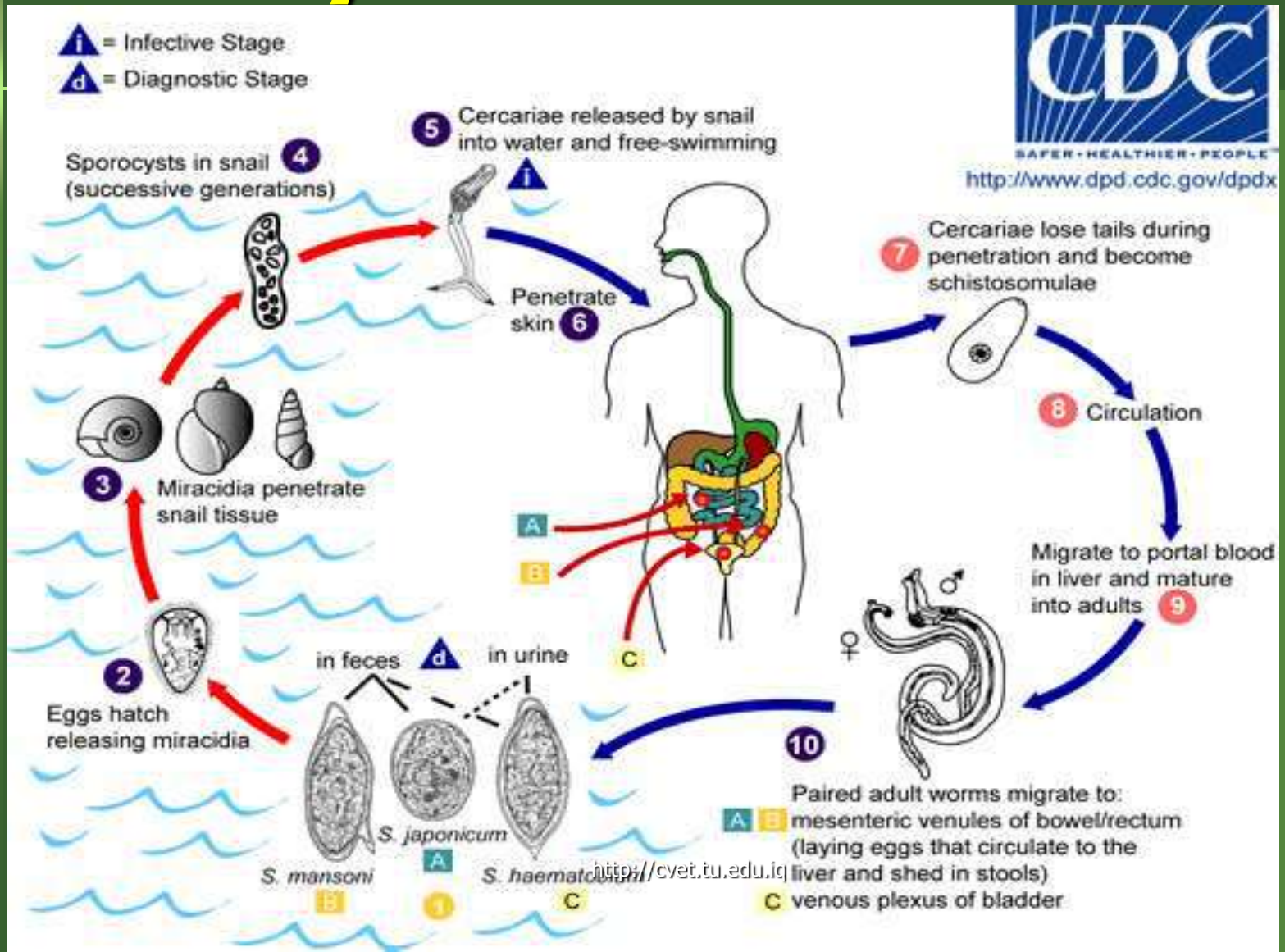
BLOOD FLUKES

- Characteristics
  - Dioecious
  - Males are shorter and stouter than females
  - Lateral margins of males are folded ventrally to form a gynecophoral canal in which females are received
  - Suckers are armed with delicate spines
  - There is no muscular pharynx
  - Eggs are non-operculated
  - Eggs are fully embryonated when laid
  - Embryonated eggs have a ciliated embryo called miracidium
  - Cercariae have bifid tails
  - There is no encysted metacerciarial stage
  - Infective Stage: cercaria penetrating the unbroken skin

BLOOD FLUKES: Schistosomes

- Schistosomes
  - *Schistosoma japonicum* : Oriental blood fluke
  - *Schistosoma haematobium*: Vesical blood fuke
  - *Schistosoma mansoni*: Manson's blood fluke

Life Cycle


i = Infective Stage
d = Diagnostic Stage
CDC
SAFER·HEALTHIER·PEOPLE
http://www.dpd.cdc.gov/dpdx
5 Cercariae released by snail into water and free-swimming
Sporocysts in snail 4 (successive generations)
Penetrate skin 6
7 Cercariae lose tails during penetration and become schistosomulae
8 Circulation
Migrate to portal blood in liver and mature into adults 9
3 Miracidia penetrate snail tissue
2 Eggs hatch releasing miracidia
in feces
in urine
10
Paired adult worms migrate to:
mesenteric venules of bowel/rectum (laying eggs that circulate to the liver and shed in stools)
venous plexus of bladder
S. japonicum
S. mansoni
S. haematobium
A
B
C
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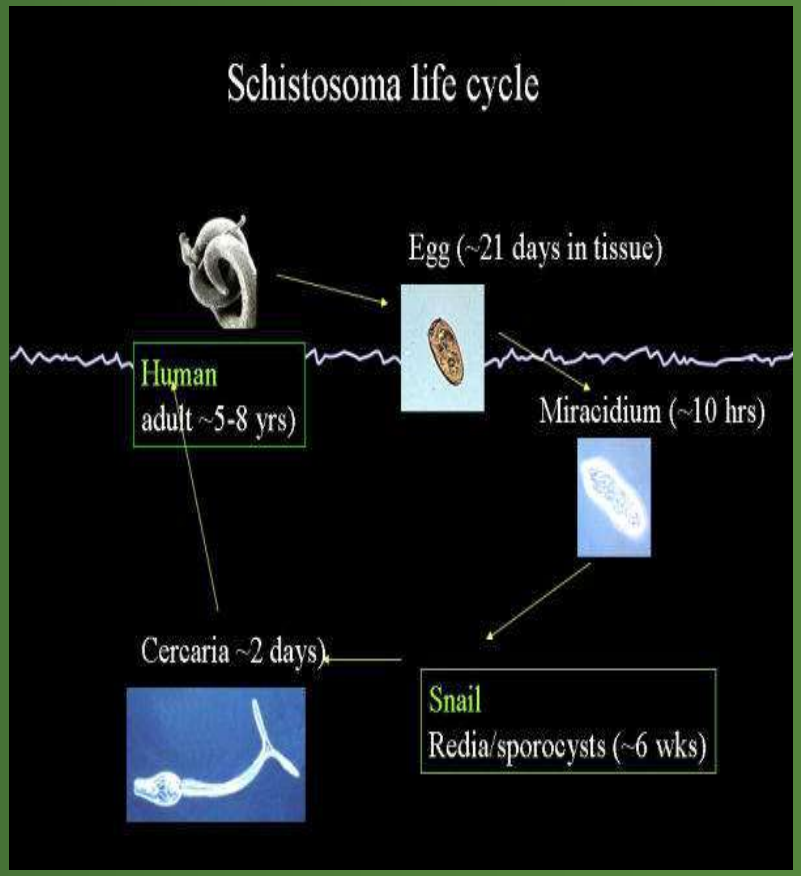
Schistosome Miracidium

- Miracidium
  - Hatches from the egg in slightly alkaline clean water with a temp. between 25 ^{0}C to 31^{0}C
  - Free swimming cilated embryo liberated from the egg
  - Photactic
  - Infect snails

Schistosome Sporocysts and Cercaria

- Mother sporocysts develop from miracidium within the snail
- Daughter sporocyst develops from mother sporocyst
- Cercariae develop from daughter sporocyst

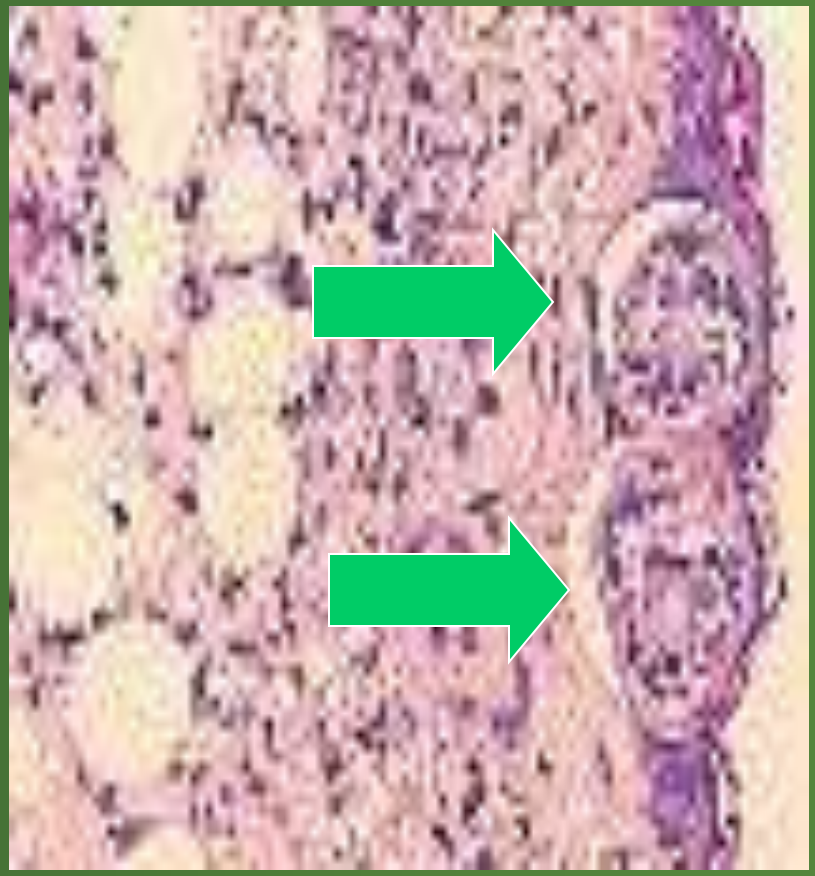


Schistosome Cercaria

- Cercaria
  - Emerges from daughter sporocysts
  - Escapes from the snail
  - Has a body and a forked tail
  - Infects man by skin penetration

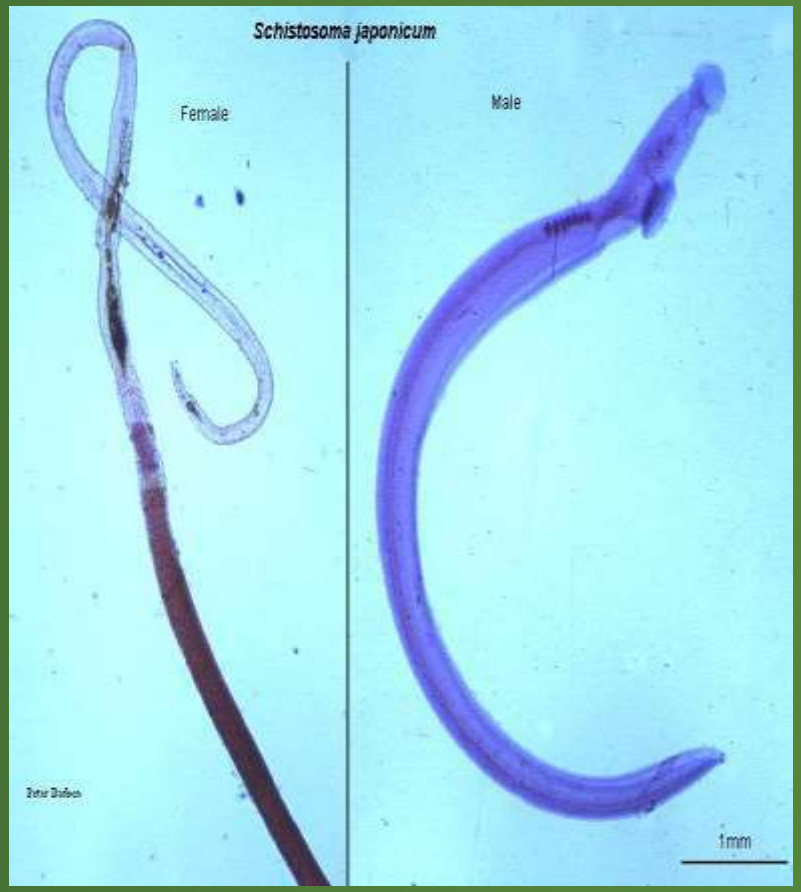
Schistosomulae

- Schistosomule
  - Develops from cercaria after skin penetration
  - Adapted to survive in serum or physiologic saline at 37 ^{0}C
  - Enter the pleural cavity---diaphragm---peritoneal space---penetrate the liver to reach the intrahepatic portions of the portal vein



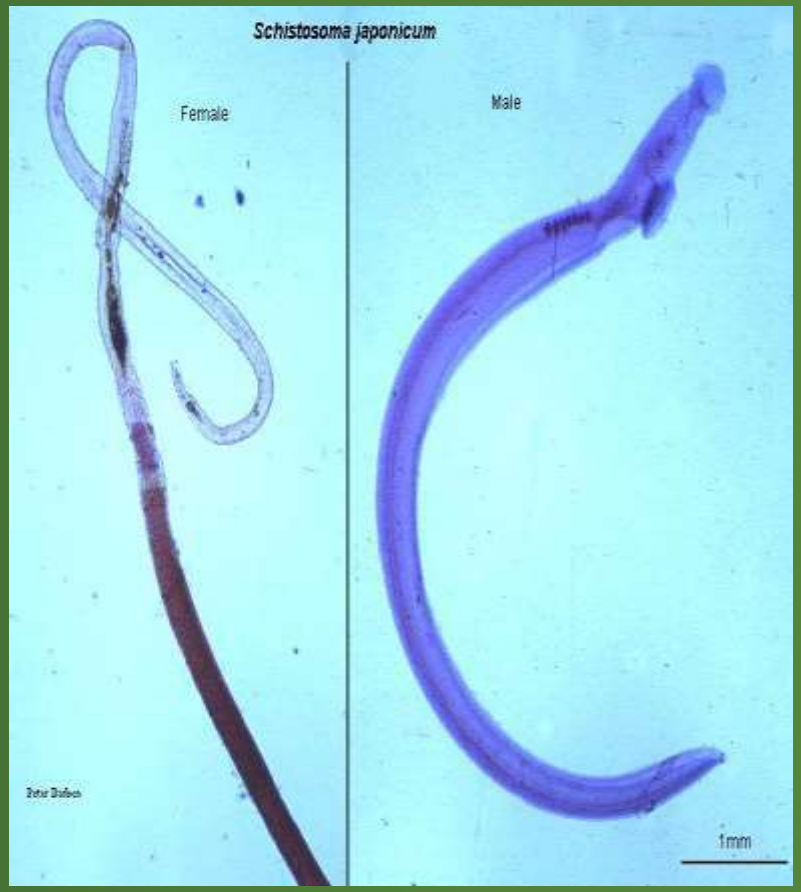
Schistosoma japonicum

- *Schistosoma japonicum*
  - Life cycle involves alternating parasitic stages in mammalian hosts and free living stages
    - Egg and miracidium
    - First stage (mother) sporocyst
    - Second stage (daughter) sporocyst
    - cercaria
    - Schistosomulum
    - Adult schistosome



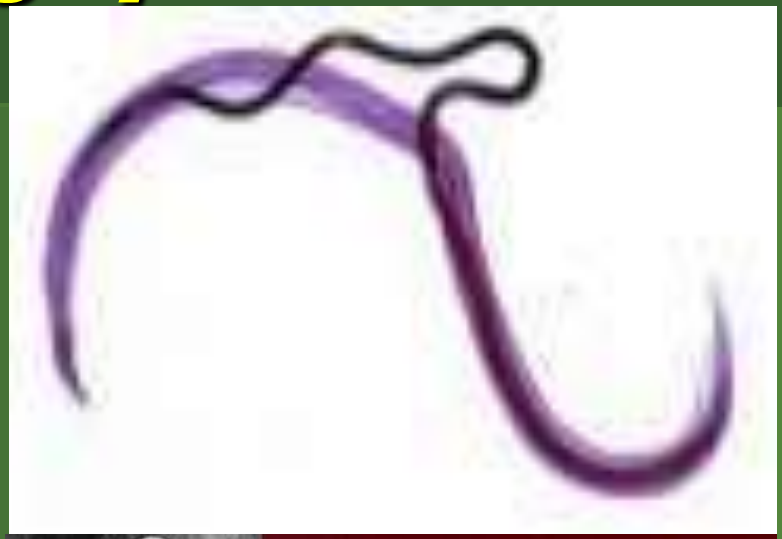
Schistosoma japonicum

- *Schistosoma japonicum*
  - Primarily parasites of the portal vein and its branches
  - Each female fluke deposits 500-2000 immature eggs/day
  - Embryonation takes place within 10-12 days
  - Eggs escape through ulcerations in the intestinal lumen and are passed out with the feces



Schistosoma japonicum

- *Schistosoma japonicum* in eternal copula
  - Males have a gynecophoral canal which receives the female during copulation



Schistosoma japonicum

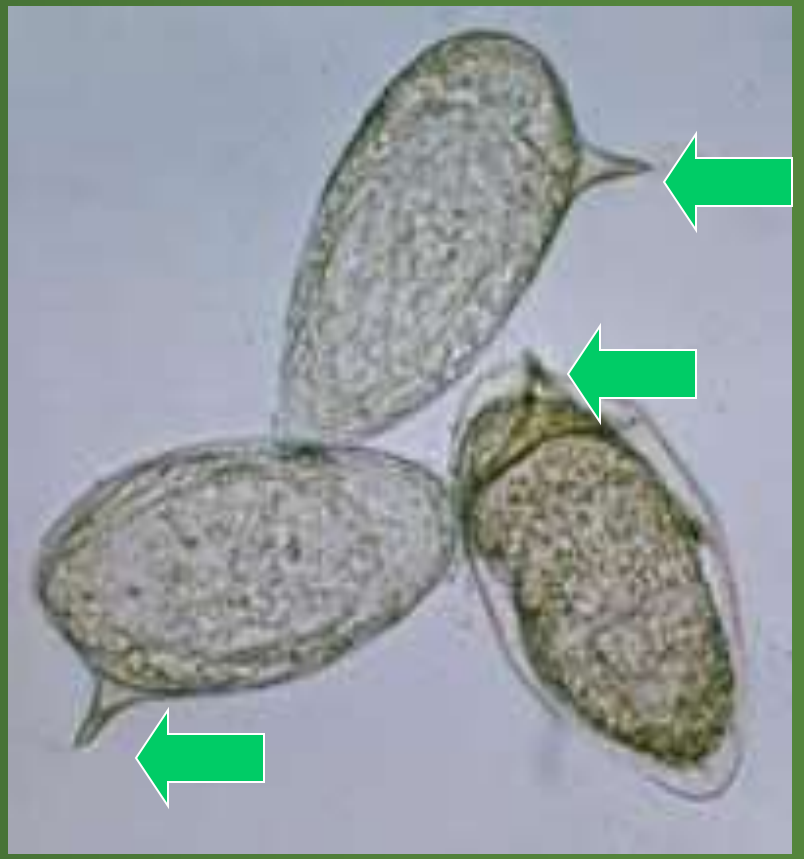
- *Schistosoma japonicum* Ova
  - Ovoidal, rounded or pear-shaped
  - Thin shell
  - Pale yellow
  - Curved hook or spine or lateral knob
  - Laid in the multicellular stage and embryonte within 10-12 days

Schistosoma mansoni

- *Schistosoma mansoni* male and female
  - Female inside the gynecophoral canal of male

Schistosoma mansoni

- *Schistosoma mansoni* male and female
  - Female inside the gynecophoral canal of male

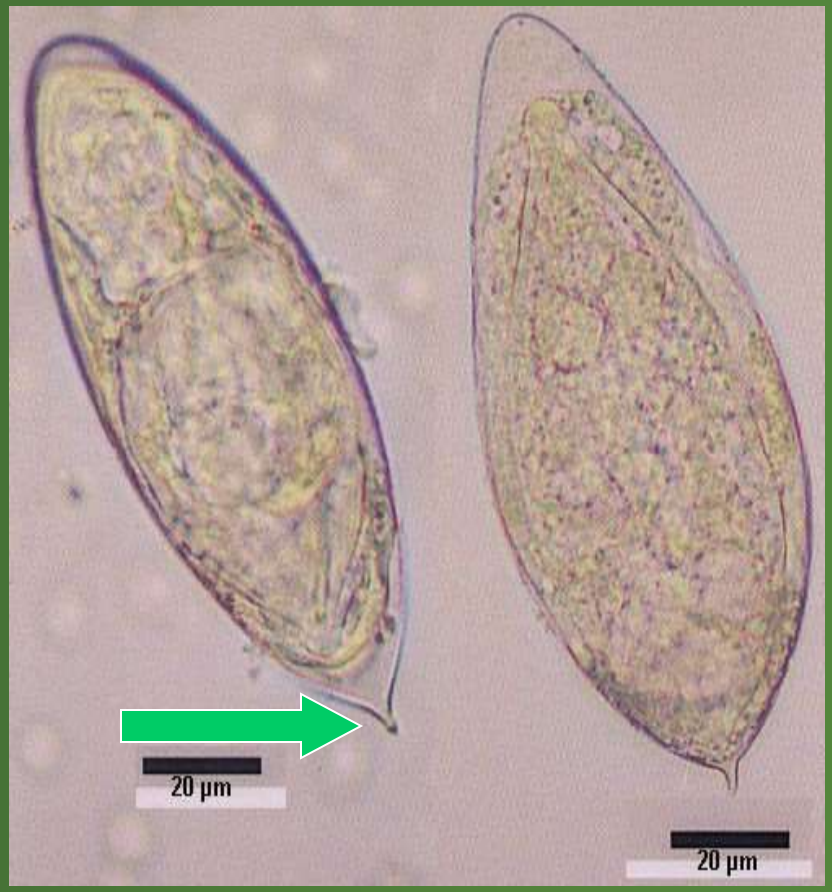


Schistosoma haematobium

- *Schistosoma haematobium* adult

Schistosoma haematobium

- *Schistosoma haematobium* ova
  - Note the presence of terminal spine



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Differentiating Features of Schistosomes

Feature	*S. japonicum*	*S. mansoni*	*S. haematobium*
Testes (male)	6-7 in a single file	8 -9 in a zigzag row	4 -5 in groups
Ovary (Female)	In the middle of the body; contains 50 or more eggs	Anterior to the middle of the body; contains 1-3 eggs	Behind the middle of the body; contains 20 – 30 eggs
Intestine	short	longest	long
Egg	Lateral knob	Lateral spine	Terminal spine
Intermediate Host	Oncomelania	Biomphalaria and Australorbis	Bulimus (Physopsis)
Definitive Host	Man and domestic animals	Man	Man

Blood Flukes:
Pathogenesis and Clinical Manifestations

- Schistosomiasis
- Host granulomatous reaction to eggs
- Pneumonitis due to schistosomula in the lungs
- Hepatosplenic disease
- Colonic schistosomiasis
- Cerebral schistosomiasis

Blood Flukes: Schistosomiasis

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Distended belly is one of the symptoms of schistosomiasis

Blood Flukes: Diagnosis

- Schistosomiasis
  - Eggs may not be demonstrable in the feces
  - Infections where there is scarring prevent passage of eggs into the intestinal lumen

Blood Flukes: Diagnosis

- Schistosomiasis
  - Stool Examination Techniques
    - Merthiolate-Iodine Formlin Concentration Technique (MIFC)
      - Sensitive for moderate and heavy infections
      - Not adequate for light infections (less than 10 eggs/gram of stool)
    - Kato KatzTechnique
      - For enumeration of eggs
      - Most commonly used for evaluating epidemiology, effect of control measures, drug trials

Blood Flukes: Diagnosis

- Schistosomiasis
  - Immunodiagnosis
    - Intradermal tests for immediate cutaneous hypersensitivity using adult worm extracts
    - Indirect hemagglutination using adult worm and egg antigens
    - Circumoval precipitin test
    - Enzyme-Linked Immunosorbent Assay (ELISA) using soluble antigens of adults and eggs

Blood Flukes: Treatment

- Treatment
  - Praziquantel (heterocyclic prazinoisoquinolone compound)
  - Single dose of 40-50 mg/kg
  - 25 mg/kg in two doses
  - 20 mg/kg in three doses

Blood Flukes: Epidemiology

- In the Philippines
  - 24 endemic provinces
    - Sorsogon
    - Oriental Mindoro
    - Samar
    - Leyte
    - Bohol
    - All provinces in Mindanao except Misamis Oriental

Lung Flukes

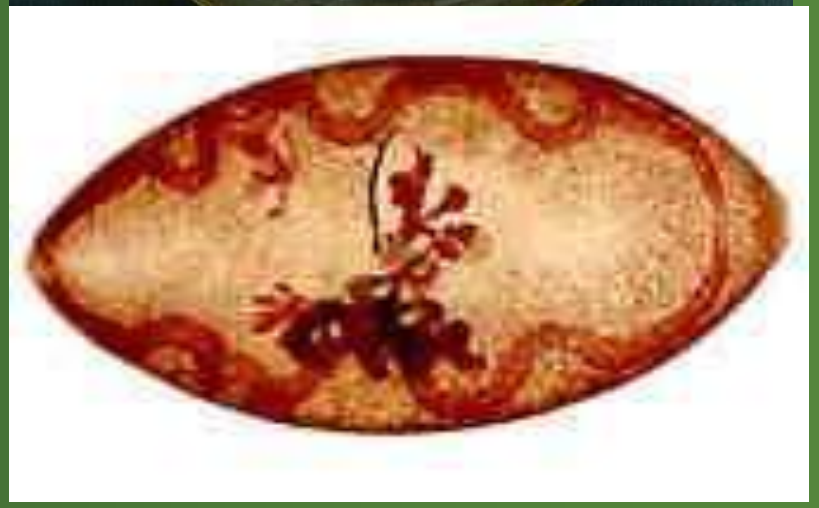
Lung Flukes

- *Paragonimus westermani*
- Oriental Lung Fluke

- *Paragonimus philippinensis*
- *Paragonimus siamensis* (cats)

Lung Flukes: *Paragonimus westermani*

- *Paragonimus westermani* adult
  - Hermaphroditic
  - Body covered with spines
  - Reddish brown
  - Measures 4-6 mm in width and 3.5-5 mm in thickness
  - Resembles a coffee bean
  - Adult worms are found in pairs or in threes in fibrotic capsules or cysts in the lungs



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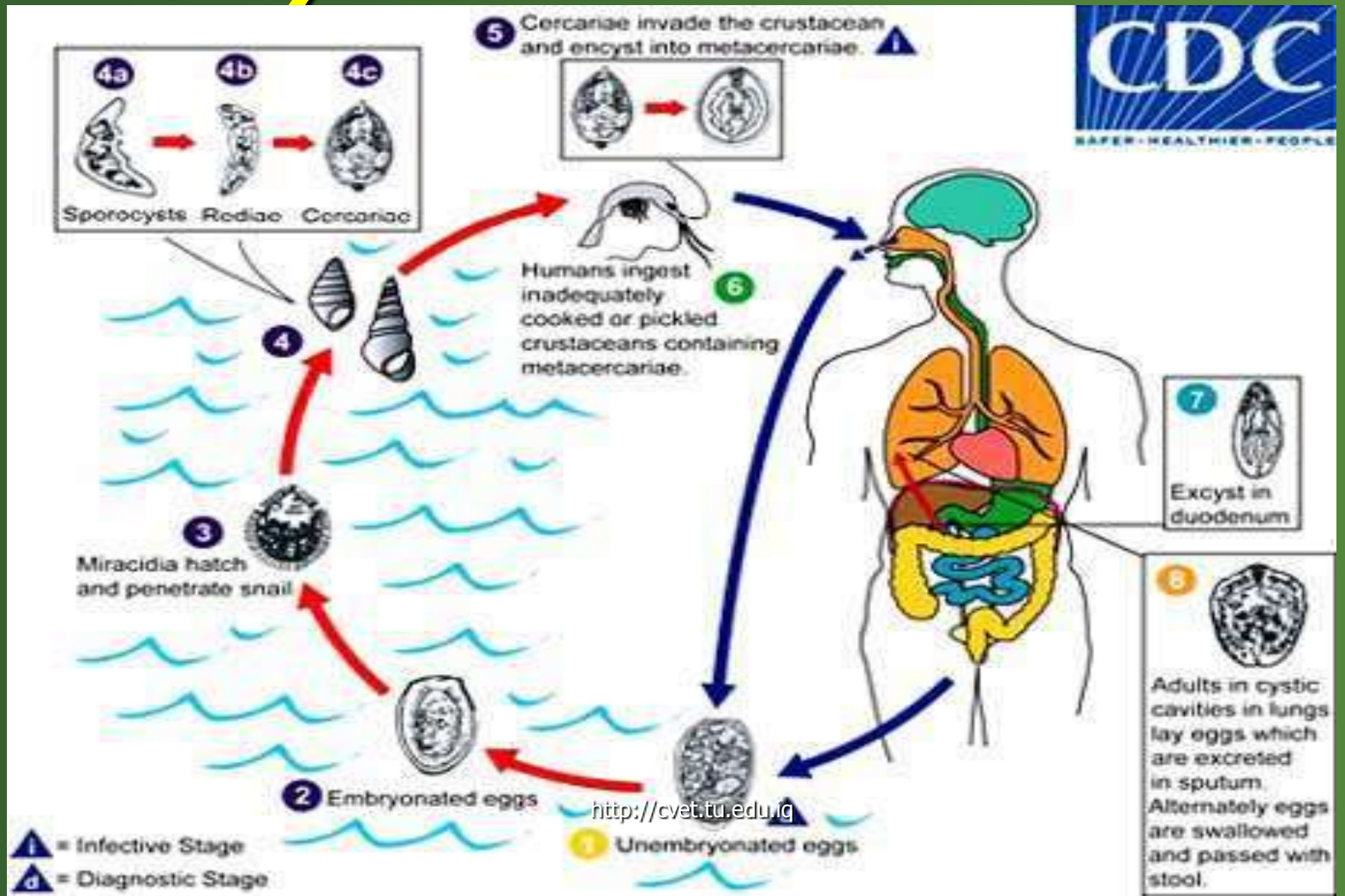
Lung Flukes: *Paragonimus westermani*

- *Paragonimus westermani* ova
  - Yellowish brown
  - Thick-shelled
  - Operculated with a thickened abopercular egg
  - May be seen in the sputum or in feces if the sputum is swallowed

Lung Flukes: *Paragonimus westermani* Life Cycle



Lung Flukes:
Epidemiology of Paragonimiasis

- First Intermediate Host
  - *Brotia asperata* (snail)
  - Where miracidium develops into 1 sporocyst and 2 redial stages of development

Lung Flukes:
Epidemiology of Paragonimiasis

- Second Intermediate Host
  - *Sundathelpusa philippina* or *Parathelpusa grapsoides* (former name)
  - Harbors the metacercaria that is infective to man

Lung Flukes: *Paragonimus westermani*

- Man gets infected after ingestion of raw or insufficiently cooked crabs harboring the metacercariae

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Lung Flukes:
Pathogenesis and Clinical Manifestations

- Paragonimiasis
  - Cough
  - Hemoptysis
  - Symptoms consistent with pulmonary tuberculosis
  - Misdiagnosed as PTB

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Lung Flukes: Diagnosis of Paragonimiasis

- Radiographs aid in diagnosis
- Definitive diagnosis is based on the finding of ova in the sputum, stool or less frequently in aspirated material from abscesses or pleural effusions
- Multi-dot ELISA

Lung Flukes: Treatment of Paragonimiasis

- Praziquantel
  - Drug of choice
  - 25 mg/kg body weight 3x a day for three day
- Bithionol
  - 15 – 25 mg/kg / day on alternate days for a total of 10-15 days

Lung Flukes:
Epidemiology of Paragonimiasis

- Has a global distribution
- In the Philippines
  - Leyte
  - Sorsogon
  - Mindoro
  - Camarines
  - Samar
  - Davao
  - Cotabato
  - Basilan

Intestinal Flukes

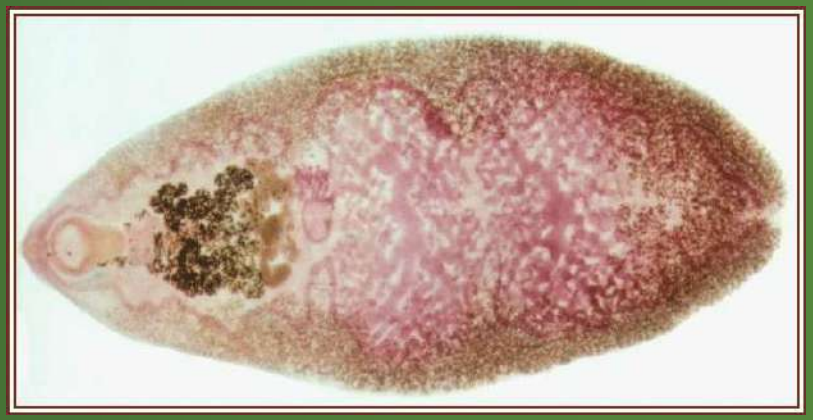
Intestinal Flukes: *Fasciolopsis buski*

- Giant intestinal fluke of man
- Parasite of the intestines of humans and pigs

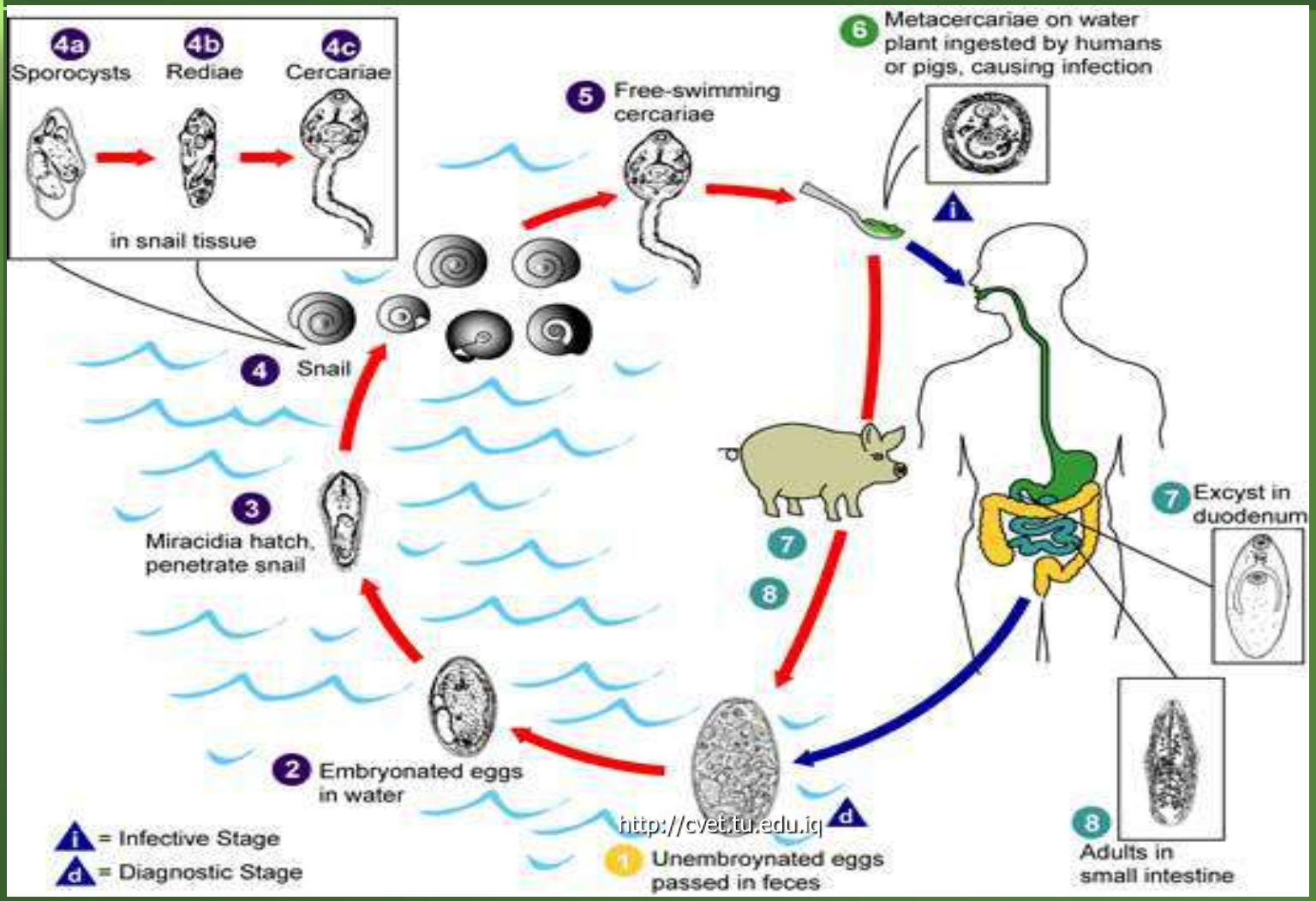
- Mode of transmission is by ingestion of encysted metacercariae on aquatic plants
- The viable metacercariae excyst in the duodenum and becomes mature in about three months

Intestinal Flukes: *Fasciolopsis buski*

- Elongated
- Oval
- 20 – 75 mm in length and 8 -20 mm in width
- Covered with spines
- No cephalic cone
- Unbranched intestina caeca which reach up to the posterior end



Intestinal Flukes:
Life cycle of *Fasciolopsis buski*



Intestinal Flukes:
Pathogenesis of *Fasciolopsis buski*

- Fasciolopsiasis
- Pathological changes caused are:
- Traumati c
  - Inflammation and ulceration
- Obstructive
  - Intestinal obstruction due to heavy infection
- Toxic
  - Due to absorption of worm metabolites by the host

Intestinal Flukes: Diagnosis Fasciolopsiasis

- Detection of parasite eggs in stool
- Resemble *Fasciola* eggs
- Provided with an operculum

Intestinal Flukes: Diagnosis Fasciolopsiasis

- Detection of parasite eggs in stool
  - Provided with an operculum
  - Large
  - Unembryonated when laid
- Resemble *Fasciola* eggs

Intestial Flukes: Treatment of Fasciolopsiasis

- Praziquantel
- 25 mg/kg for 3 doses for one day
- Side effects:
  - Diziness
  - Drowsiness
  - Epigastric pain

Intestinal Flukes:
Epidemiology of Fasciolopsiasis

Intestinal Flukes:
Epidemiology of Fasciolopsiasis

- Endemic in
  - Southeast Asia
  - China
  - Korea
  - India
- Endemicity in the Philippines has not been demonstrated yet
- Fasciolopsiasis in Filipinos are probably imported cases

Intestinal Flukes: *Echinostoma ilocanum*

- Garrison's fluke
- Echinostomid
- There are several species that infect man
- There are 2 identified echinostomids that infect man in the Philippines:
  - *Echinostoma ilocanum*
  - *Artyfechinostomum malayanum*

Intestinal Flukes: *Echinostoma ilocanum*

- Adult
  - Reddish gray
  - Horse-shape collar of spines (circum oral disk) around the oral suckers
  - 49-51 collar spines
  - Integument is covered by plaque like scales
  - Simple intestinal caeca

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Echinostoma ilocanum showing circum-oral disk

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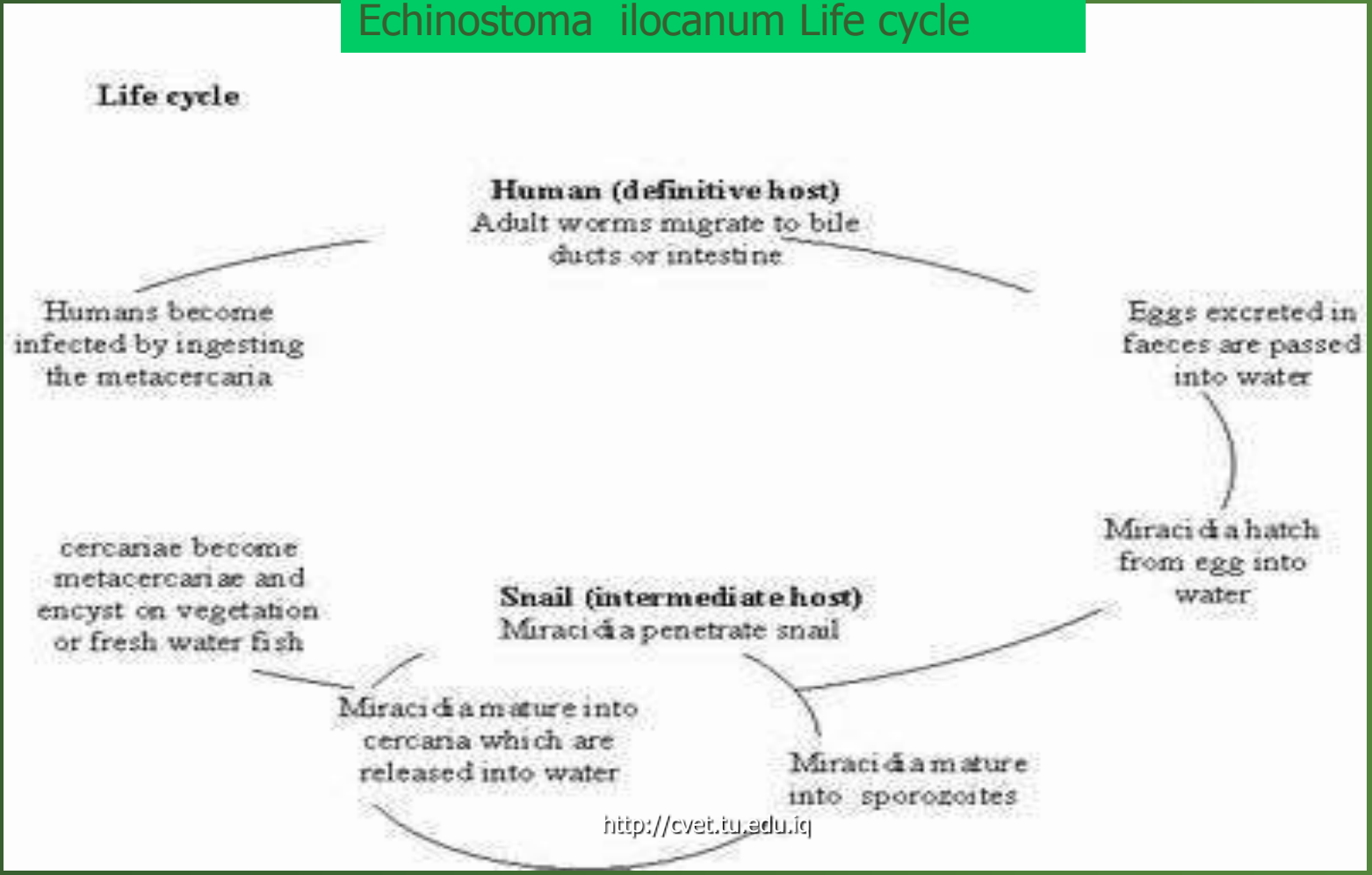
Intestinal Flukes:
Echinostoma ilocanum

Echinostoma ilocanum Life cycle



Intestinal Flukes: *Echinostoma ilocanum*

- *Echinostoma ilocanum* Ova
  - Straw-colored
  - Operculated
  - Ovoid
  - Similar to *Fasciola* and *Fasciolopsis buski* ova

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Intestinal Flukes: *Echinostoma ilocanum*

- First Intermediate Host:
  - *Gyraulus convexciusculus*
  - *Hippeutis umbilicalis*

Intestinal Flukes: *Echinostoma ilocanum*

- Second Intermediate Host:
  - *Pila luzonica* (kuhol)
  - *Vivipara angularis* (susong pampang)

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Pila luzonica

Intestinal Flukes:
Pathogenesis and Clinical Manifestations
Echinostoma ilocanum

- Man gets infected when metacercariae in the second intermediate hosts are ingested
- Inflammation at the site of attachment of adults
- Ulceration
- Diarrhea (sometimes bloody)
- Abdominal pains
- General intoxication

Intestinal Flukes:
Diagnosis
Echinostoma ilocanum

- Detection of characteristic eggs in the stool

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Intestinal Flukes
Treatment
Echinostoma ilocanum

- Praziquantel
  - 25 mg/kg for 3 doses for one day
  - No alcohol; no fats must be taken 24 hours before and after treatment
  - Only water must be taken within 3 hours of medication

Intestinal Flukes
Epidemiology
Echinostoma ilocanum

- *Echinostoma ilocanum* is endemic in:
  - Northern Luzon
  - Leyte
  - Samar
  - Mindanao provinces

- Artyfechinostomum malayanum
  - First reported in 1987
  - Northern and Central Luzon

Intestinal Flukes Heterophyids

- Many species live in the intestine of fish-eating hosts:
  - *Heterophys heterophyes*
  - *Metagonimus yokogawai*
  - *Haplorchis taichui*
  - *Haplorchis yokogawai*

Intestinal Flukes Heterophyids

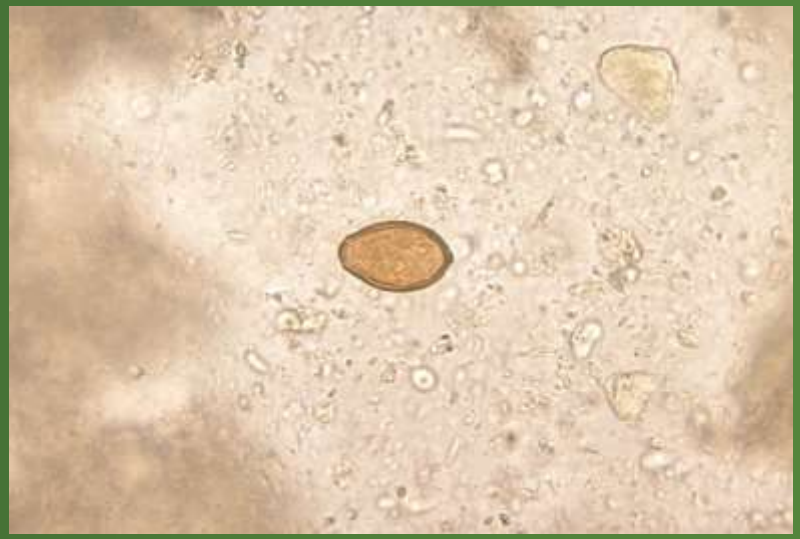
- Mode of transmission is by ingestion of metacercariae encysted in fish
- Metacercariae in the abdomen excysts, liberating a larva that attaches to the intestinal wall

Intestinal Flukes Heterophyids

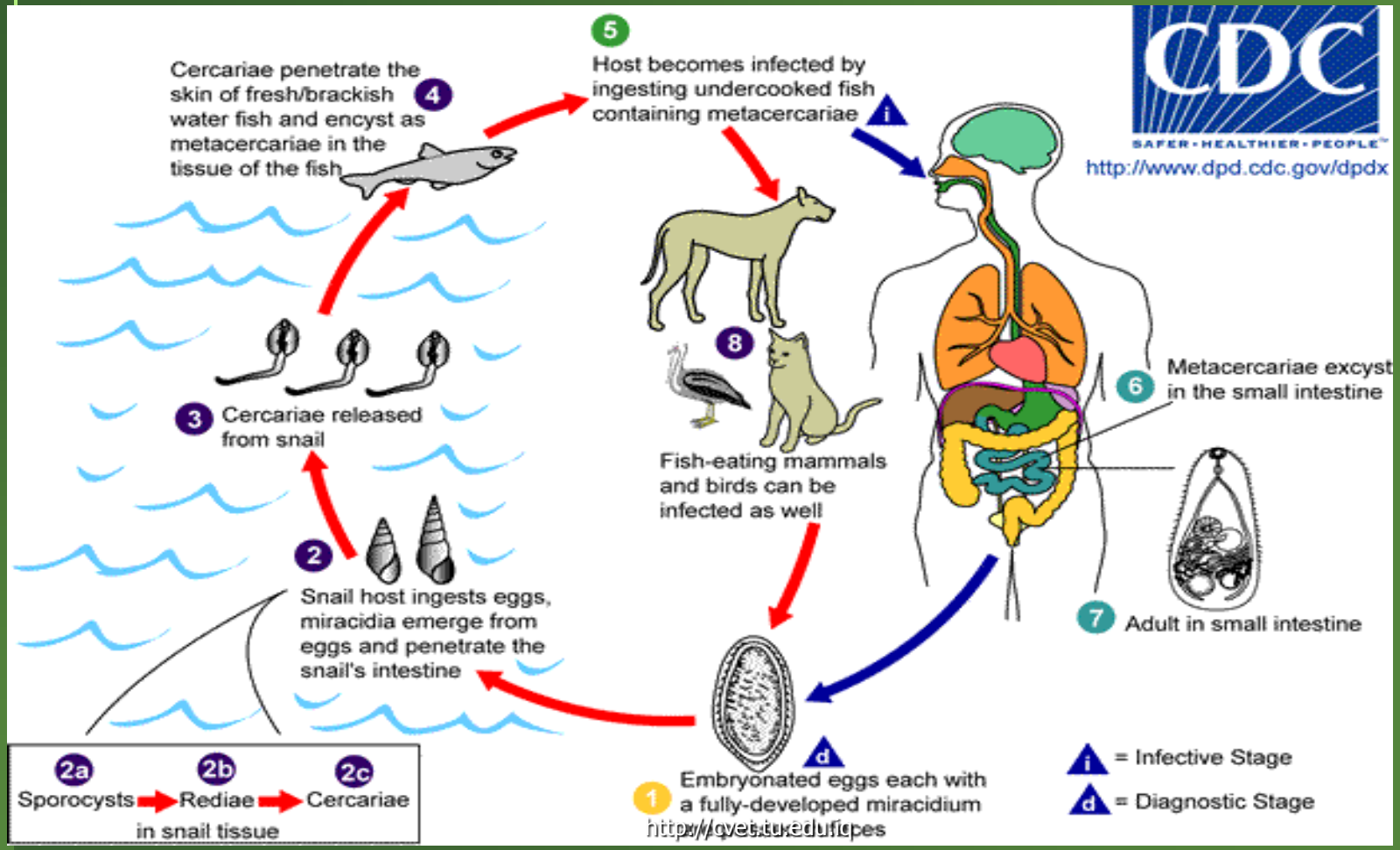
- *Heterophyes heterophyes* Adult
  - Elongated
  - Oval or pyriform
  - Measures less than 2 mm in length
  - Integument has fine scale-like spines
  - Some species have gonotyl or genital sucker

Intestinal Flukes Heterophyids

- *Heterophyes heterophyes* Ova
  - Light brown in color
  - Ovoid in shape
  - Operculated
  - A fully developed symmetrical miracidium is already present
  - Operculum fits into the egg smoothly
  - No abopercular protuberance like that of *Clonochis sinensis* ovum



Intestinal Flukes Heterophyids



Intestinal Flukes

Heterophyes heterophyes

Pathogenesis and Clinical Manifestations

- Heterophyiasis
- Inflammation at the site of attachment
- Manifesations are consistent with peptic ulcer (observed among infected individuals in Compostela Valley)
  - Upper abdominal discomfort
  - Gurgling abdomen

Intestinal Flukes
Diagnosis
Pathogenesis and Clinical Manifestations

- Detection of eggs in the stool using Kato Katz method

- Care must be taken to distinguish them from *Clonorchis* and *Opistorchis* ova

Intestinal Flukes
Treatment
Pathogenesis and Clinical Manifestations

- Praziquantel
  - 25 mg/kg in 3 doses for 1 day

Intestinal Flukes
Epidemiology
Pathogenesis and Clinical Manifestations

- Found in
  - Egypt
  - Greece
  - Israel
  - Western India
  - Central and South China
  - Japan
  - Korea
  - Taiwan
  - Philippines
    - Compostela Valley
    - Mindanao
    - Emerging public health concern

Liver Flukes

Liver Flukes
Fasciola species

- Found in the liver and biliary passages of humans and ruminants

- *Fasciola hepatica*
  - Sheep liver fluke
  - Temperate liver fluke

- *Fasciola gigantica*
  - Giant liver fluke
  - Tropical liver fluke

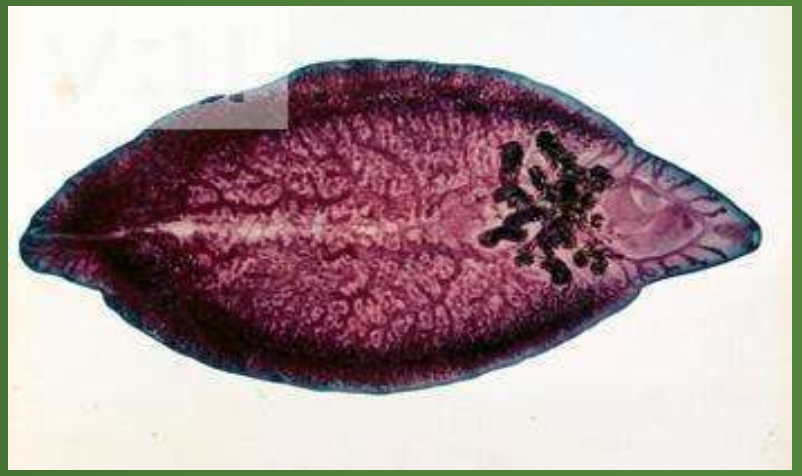
Liver Flukes
Fasciola species

- Mode of transmission is by ingestion of metacercariae found in edible aquatic plants or by drinking water with floating metacercariae

- Metacercariae excsts in the duodenum or jejunum and liberate the juvenile fluke
- Juvenile fluke penetrates the intestinal wall and reaches the liver capsule
- The parasite burrows into the liver parenchyma where it grows and develops
- It becomes sexually mature in the bile ducts

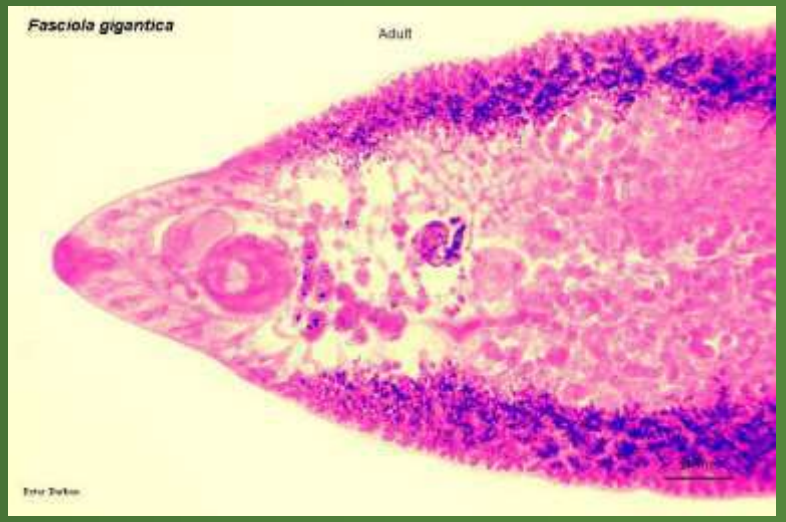
Liver Flukes
Fasciola hepatica

- Adult Worm
  - Large, broad, flat body
  - Anterior end forms a prominent cephalic cone
  - Small oral and ventral suckers
  - Long and highly branched intestinal caeca



Liver Flukes
Fasciola gigantica

- Adult Worm
  - Larger
  - More lanceolate
  - Less developed shoulders (shorter cephalic cone)
  - Larger ventral sucker



Liver Flukes
Fasciola hepatica and gigantica

Liver Flukes
Fasciola hepatica and gigantica

- First Intermediate Host:
  - *Lymnea philippinensis*
- Second Intermediate Host
  - Watercress
  - grass

Liver Flukes
Fasciola hepatica

- *Fasciola hepatica*
  Ova
  - Large
  - Ovoid
  - Operculated
  - Bile stained
  - unsegmented

Liver Flukes
Fasciola hepatica

- *Fasciola gigantica* Ova
  - Larger but very similar to *Fasciola hepatica* ova

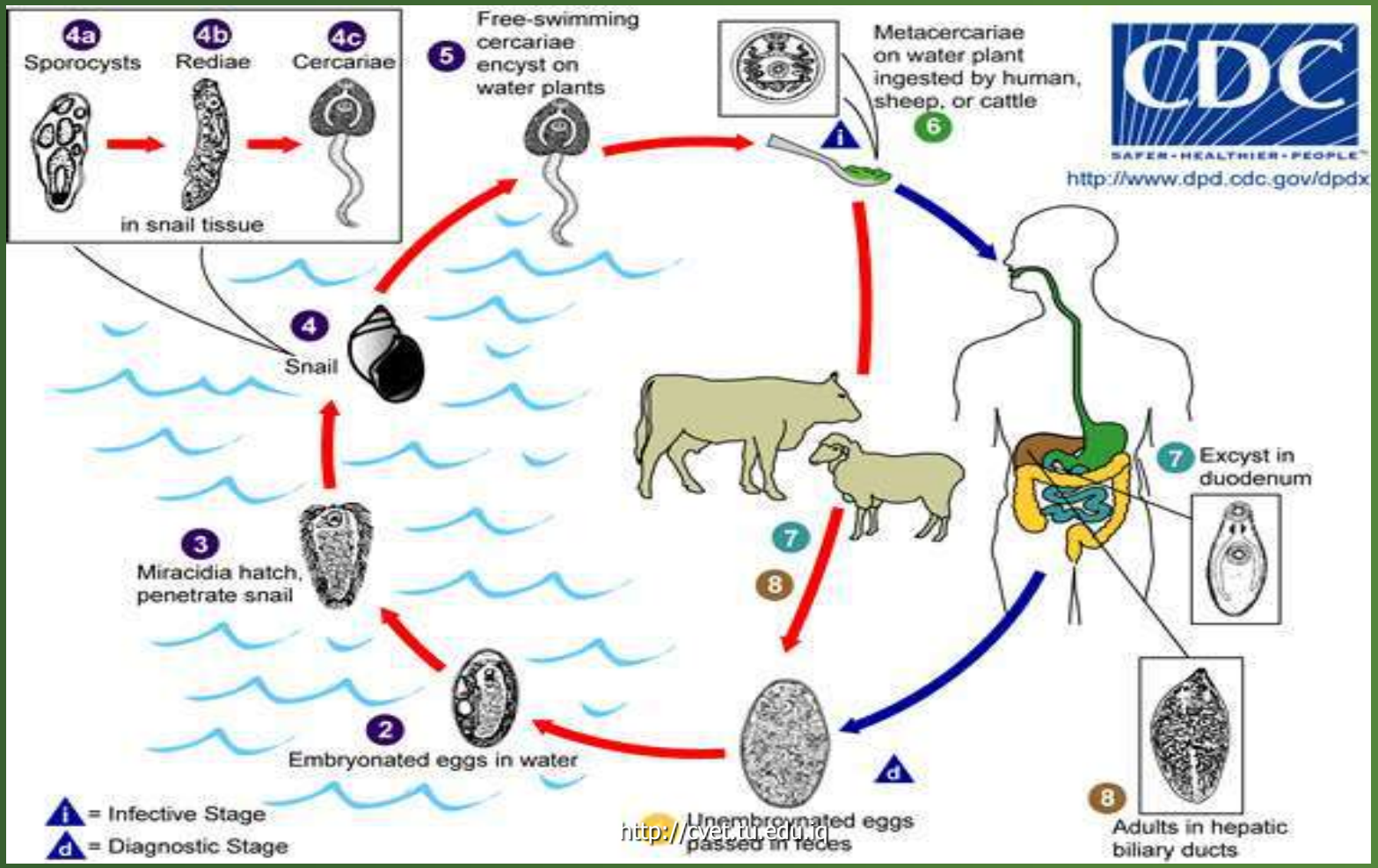
*Because of similarities, it is just safe to say *Fasciola* ova

Liver Flukes
Fasciola hepatica

- *Fasciola gigantica* Ova
  - Larger but very similar to *Fasciola hepatica* ova

*Because of similarities, it is just safe to say *Fasciola* ova

Liver Flukes
Fasciola species



Liver Flukes
Fasciola species
Pathogenesis and Clinical Manifestations

- Fascioliasis
- Asymptomatic
- Can produce fever
- Right upper quadrant abdominal pain
- Hypereosinophilia
- Acute or invasive phase
  - Migration from intestine to liver
  - Traumatic and necrotic lesions in liver parenchyma
- Chronic or latent phase
  - Asymptomatic
  - Parasite has reached the bile ducts
  - Obstruction
  - Stimulates inflammation in the biliary epithelium leading to fibrosis

Liver Flukes
Fasciola species
Diagnosis

- Microscopy
- Serologic tests
  - Low specificity because of cross reactivity with antigens of other parasites
- RFLP
  - PCR restriction Fragment Length Polymorphism

Liver Flukes
Fasciola species
Treatment

- Bithionol
  - 20-50 mg/kg body weight on alternate days to complete 10 to 5 doses

- Triclabendazole
  - Also a recommended drug of choice due to:
    - Efficacy
    - Safety
    - Ease of use

Liver Flukes
Fasciola species
Epidemiology

- Worldwide distribution
- Economic importance n livestock raising
- In the Philippines, the dominant species is *Fasciola gigantica* affecting cattle and water buffalos
- Few human cases are reported locally

Liver Flukes
Clonorchis sinensis

- Chinese liver fluke
- Oriental Liver Fluke
- Distome of China
- First intermediate Host:
  - *Bulimus fuchsiana* (snail not found in the Philippines)
- Second Intermediate Host:
  - *Ctenopharyngondon idellus* (fish)

Liver Flukes
Clonorchis sinensis

- Adult Worm
  - Narrow, oblong, flat worm
  - Oral sucker is slightly larger than the ventral sucker
  - Blind intestinal caeca are simple and extend to the caudal region
  - Life span is 20-30 years

Liver Flukes
Clonorchis sinensis

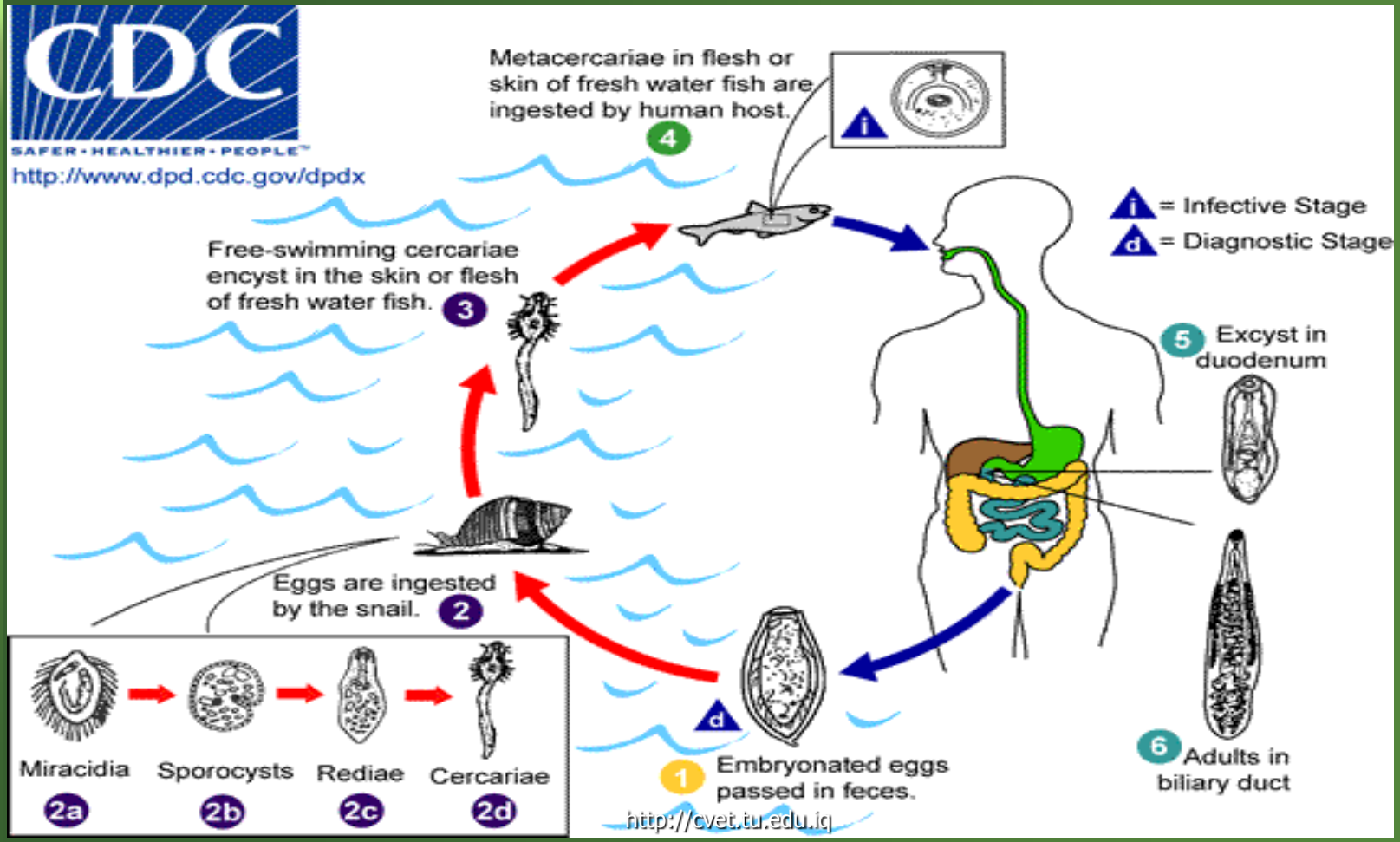
- Ova
  - Bile stained
  - Flask-shaped
  - Operculated
  - Contains a miracidium when oviposited
  - Does not hatch in water but is ingested with a molluscan host
  - Has a terminal spine
  - Electric bulb in shape
  - Infective to snails only

http://cvet.tu.edu.iq

Liver Flukes

Clonorchis sinensis

Life Cycle



Liver Flukes
Clonorchis sinensis
Pathogenesis and Clinical Manifestations

- Clonorchiasis
- Provokes intense proliferation of intestinal epithelium
- Acute stage (less than 1 month of infection)
  - Chills
  - Fever
- Chronic stage
  - Cirrhosis
  - Portal hypertension

Liver Flukes
Clonorchis sinensis
Diagnosis

- Detection of parasite egg in stool
- Clonorchis, Opistorchis and Hetrophyid ova may not be differentiated under ordinary light microscope
- ELISA with crude *Clonorchis sinensis* antigen
- Enzyme immunoassay (EIA
- Polymerase Chain Reactions

Liver Flukes
Clonorchis sinensis
Treatment

- Praziquantel
  - 25 mg/kg three times a day for two days
  - 60 mg/kg in three doses for one day
  - May be used together with albendazole for light and moderate infections

Liver Flukes
Clonorchis sinensis
Epidemiology

- Transmission is due to consumption of raw, undercooked fish and salted and dried fish harboring the metacercariae
- Over 30 million people are infected in Southeastern Asia
- No reported cases in children below 10 years old
- Endemic in:
  - China
  - Japan
  - Korea
  - Vietnam

Pancreatic Fluke

Pancreatic Fluke *Eurytrema pancreaticum*

- Pancreatic fluke
- Stout worm with ruffled margins
- oral sucker is larger than the ventral sucker

Pancreatic Fluke *Eurytrema pancreaticum*

- First Intermediate Host:
  - *Macrochlamys indica* (snail)

- Second intermediate Host:
  - *Technomyrmex deterquens* (ant)

Pancreatic Fluke *Eurytrema pancreaticum*

- Ova
  - Operculated
  - Thick shelled
  - Dark brown in color
  - Embryonated when laid