Nemathelminths
Class Nematoda

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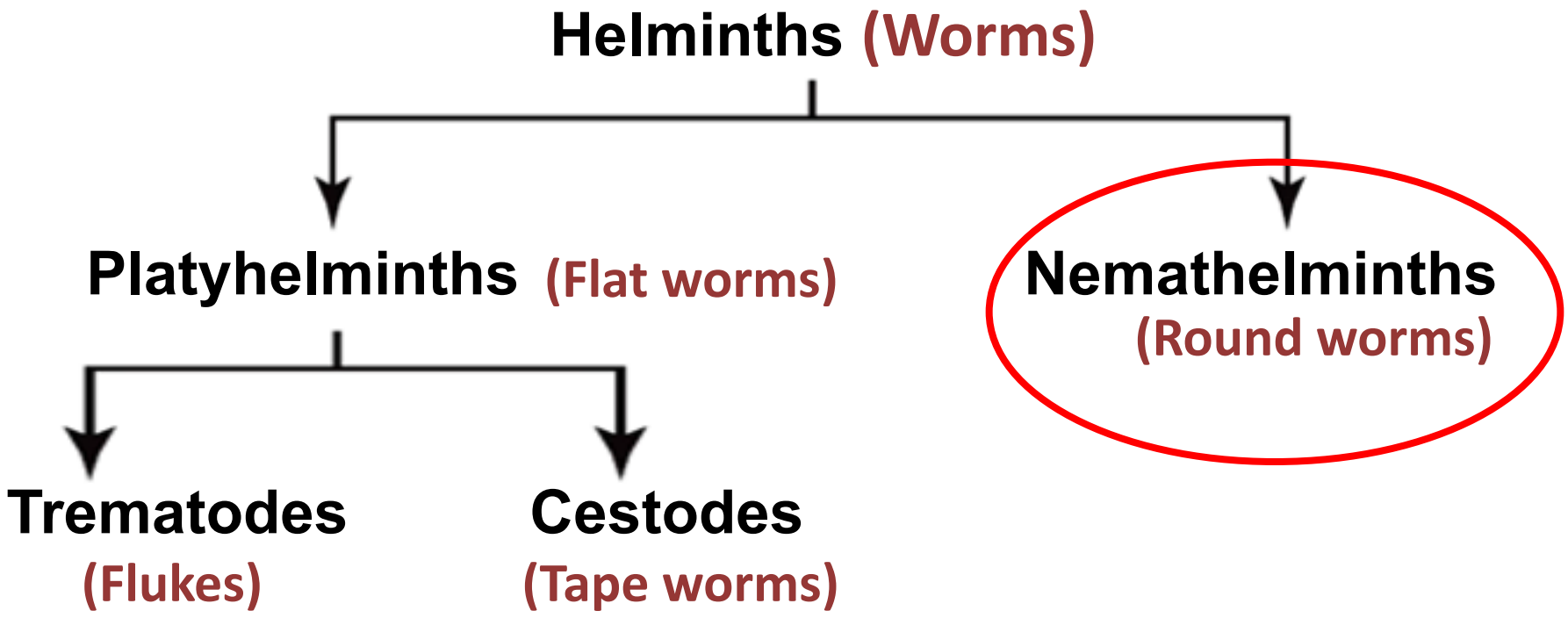
Classification of Helminths



Nematodes – General Characters

- Non-segmented cylindrical worms tapering at both ends.
- Sexes are separate, male is smaller than female & its posterior end is curved ventrally.
- Females are either
  - Viviparous (produce larvae/ embryos)
  - Oviparous (lay eggs) or
  - Ovo-viviparous (lay eggs which hatch immediately).
- Live in intestinal tract or tissues.

Nematodes of medical importance

Intestinal

Small intestine

With tissue stage:

- *Ascaris lumbricoides*
- *Ancylostoma duodenale*
- *Necator americanus*
- *Strongyloides stercoralis*
- *Trichinella spiralis*

Large int.

Without tissue stage:

- *Enterobius vermiculars*
- *Trichuris trichiura*

Tissue & Blood

- *Wuchereria bancrofti*
- *Brugia malayi*
- *Loa loa*
- *Onchocerca volvulus*
- *Dracunculus medinensis*
- *Trichinella spiralis*

❑ Larva migrans:

- *Ancylostoma spp.*
- *Toxocara spp.*

Nematodes of medical importance

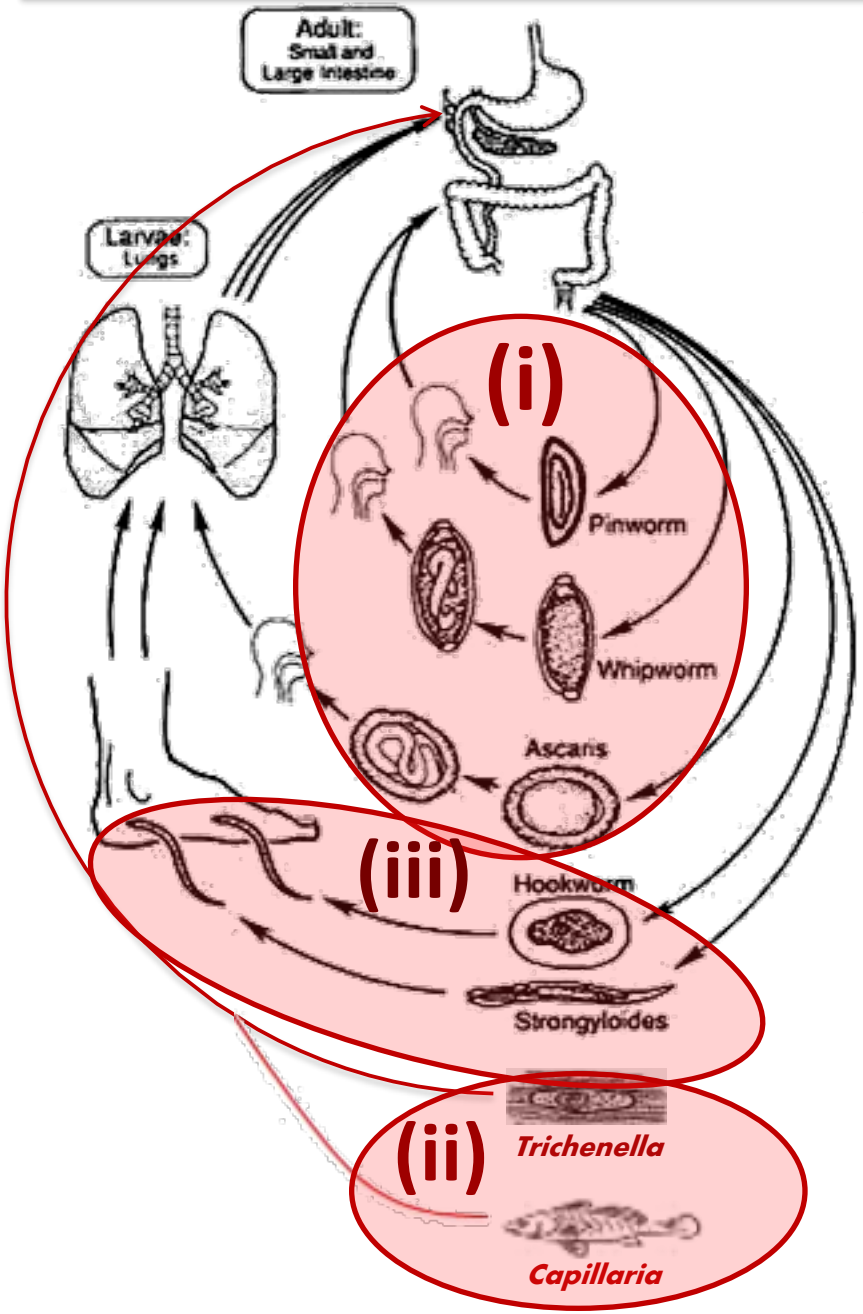
Intestinal

- IH: no need for IH.
- ♀ lay eggs (majority of species).
- Nutrition:
  - Sucking blood (hookworms).
  - Embedded worms ingest lysed tissues (*Trichuris* & *Strongyloides*).
  - Feeding on intestinal contents (*Ascaris* & *Enterobius*).

Tissue & Blood

- IH: arthropod vector needed.
- ♀ lay larvae.
- Nutrition:
  - Ingestion of food from body fluid.

Intestinal nematodes' general life cycle:



- Infection occurs by:

(i) ingestion of *Enterobius*, *Trichuris*, and *Ascaris* emryonated eggs,

(ii) ingestion of *Trichenella* infective larvae, or

(iii) skin penetration of hookworms' & *Strongyloides*' filariform larvae.

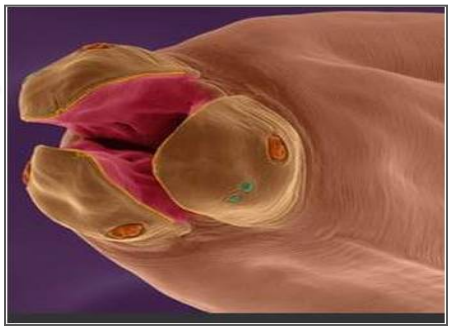
- Hatched and invasive larvae, either:
  - maturate in the intestine without migratory phase (*Enterobius* & *Trichuris*).
  - pass to circulation & undergo migratory phase passing to the lung before reaching to final habitat in the intestine (*Ascaris,* hookworms, & *Strongyloides*).
  - or pass to general circulation where larvae encyst in skeletal muscles (*Trichenilla*).

Digestive system of nematodes

Nematodes have a complete digestive system, with:

mouth (oral opening)

- Papillae (lips) →



- Cutting plates (teeth) →

oesophagus

- **Cellular**
- **Muscular**
  - Simple club
  - Double-bulbed
  - Rhabditiform
  - or Filariform

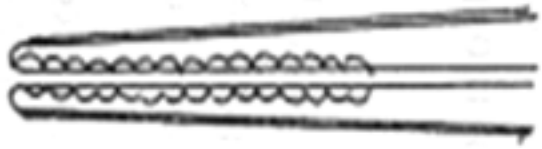
intestine (mid gut)

rectum

- in ♂: join the ejaculatory duct in a **cloaca**
- in ♀: opens in a separate **anus**

Oesophagus of nematodes

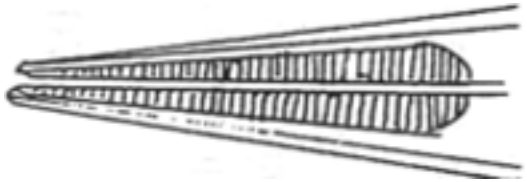
Cellular



Trichuris

Muscular

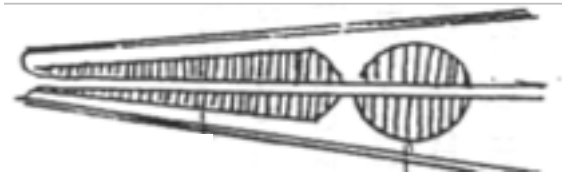
- **Club-shaped**



Ascaris
Hook worms

- **Double-bulbed**

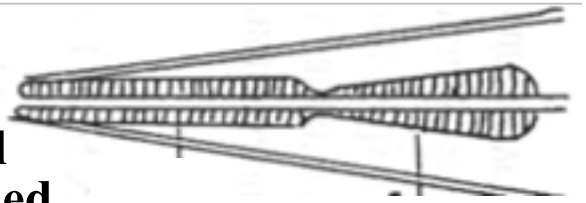
Ant. part: **club-shaped**
Post. part: **spherical**



Enterobius

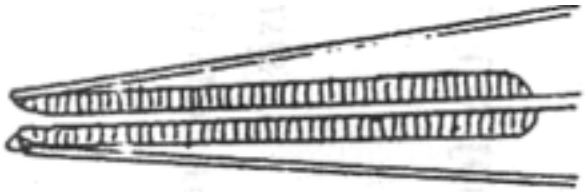
- **Rhabditiform**

Ant. part: **cylindrical**
Post. part: **club-shaped**



Strongyloides

- **Filariform**
(cylindrical)



Filaria

Nematodes of medical importance

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- *Wuchereria bancrofti*
- *Brugia malayi*
- *Loa loa*
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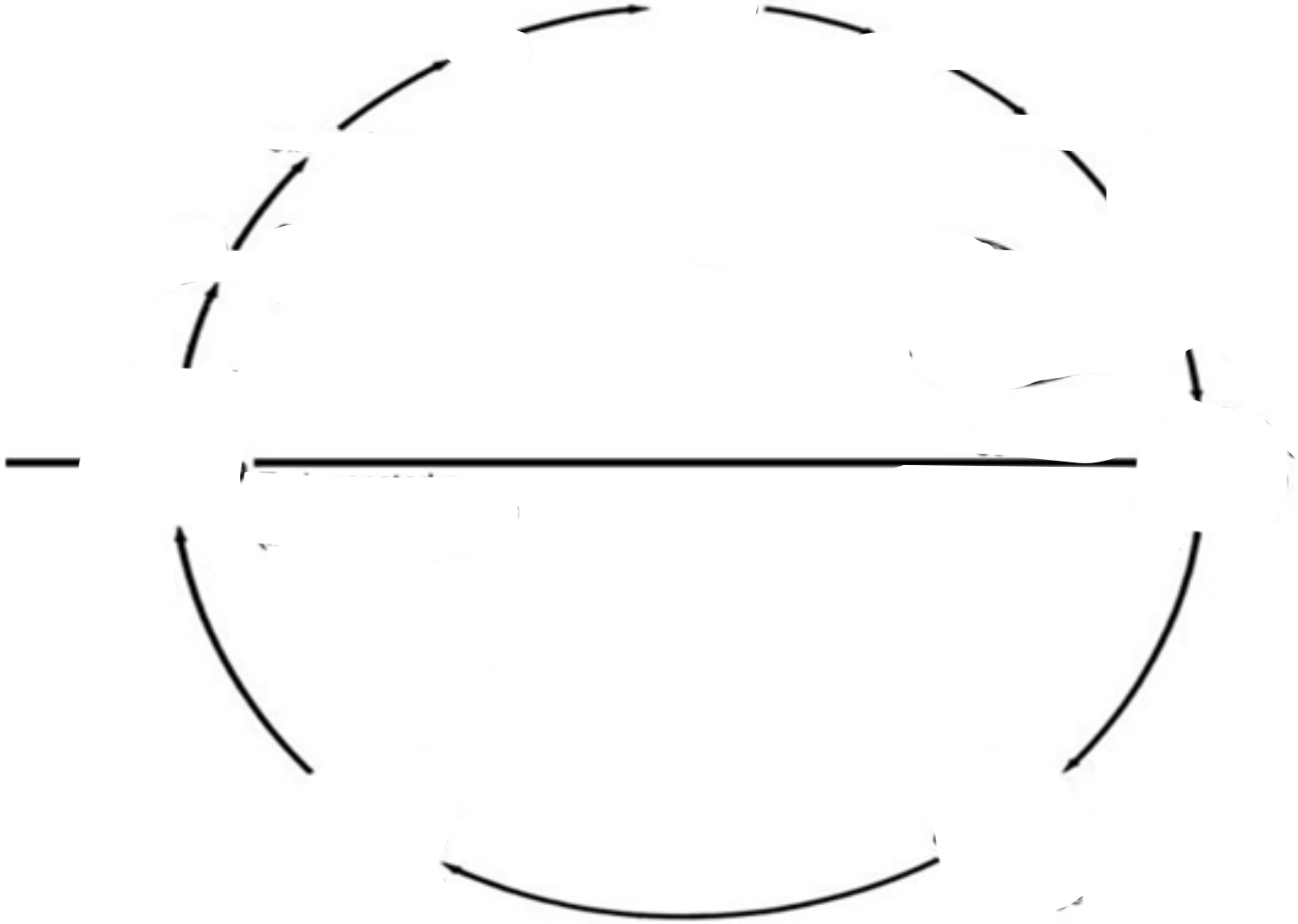
Intestinal Round Worms (Nematodes)

Ascaris lumbricoides

- **Geographical Distribution:**
  - Cosmopolitans. A. lumbricoides is one of the commonest and most wide spread of all human parasites.
- **Habitat:**
  - Adult: In the small intestine.
  - Egg: In the faeces.
- Infective form: Embryonated eggs

Intestinal Round Worms (Nematodes)

Ascaris lumbricoides (Life cycle)



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Larva migrans:

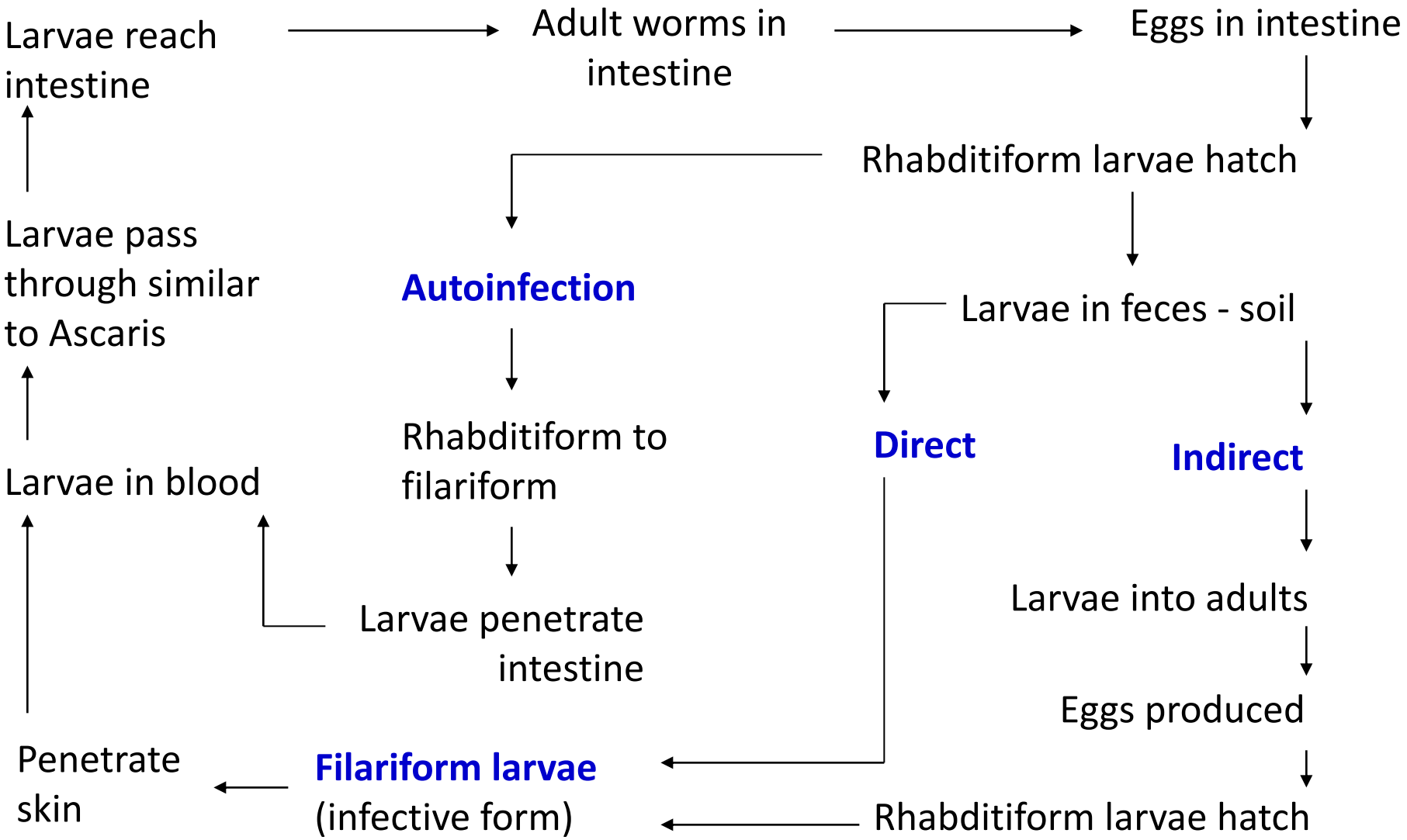
- *Ancylostoma spp.*
- *Toxocara spp.*

Intestinal Round Worms (Nematodes)

Strongyloides stercoralis (The dwarf thread worm)

Free living worms	Moist soil
Infective form	Filariform larvae
Mode of transmission	Penetration / autoinfection
Site of localization	Wall of Small intestine, mainly duodenum & jejunum

Life cycle – Strongyloides stercoralis



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Intestinal Round Worms (Nematodes)

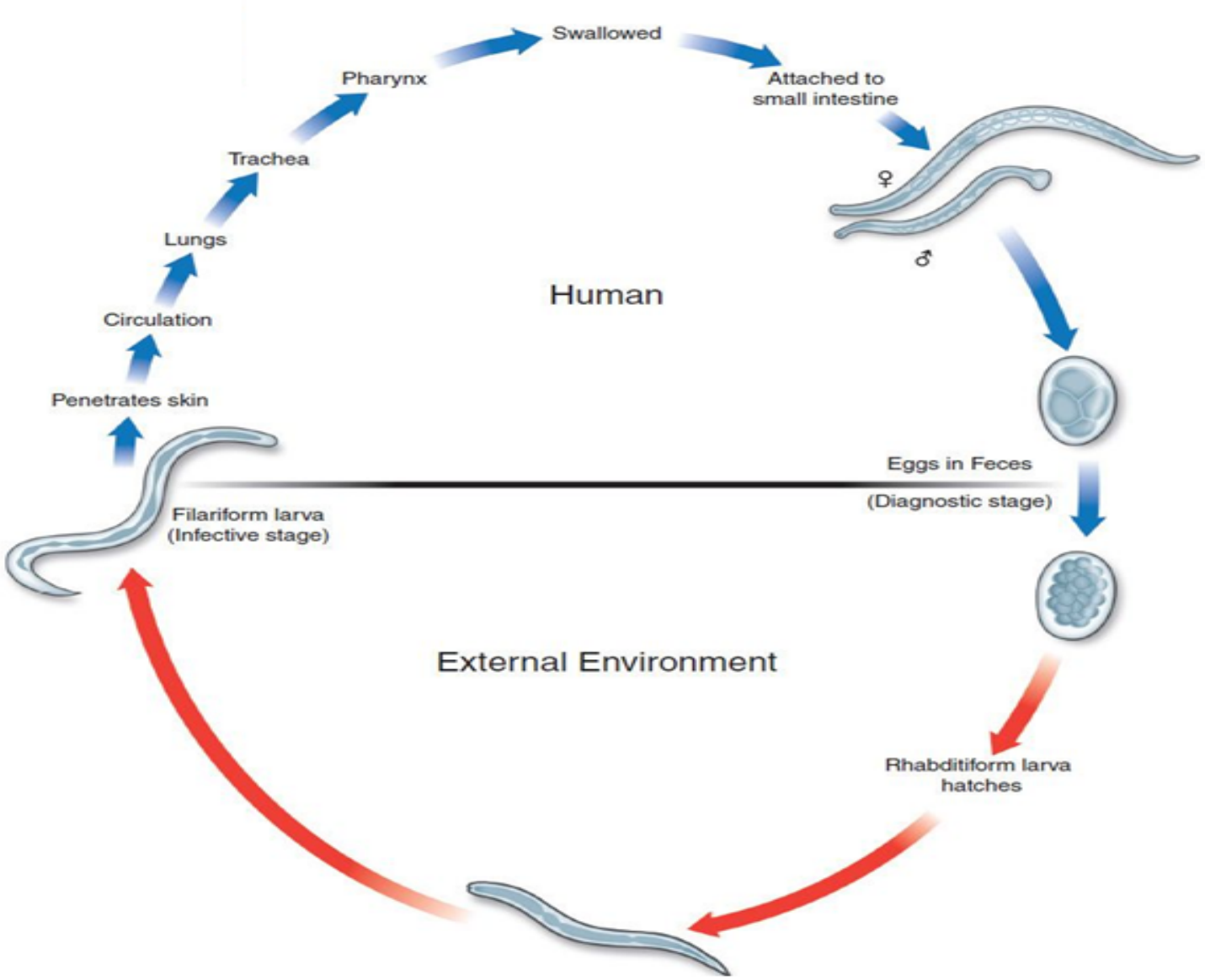
Necator americanus and *Ancylostoma duodenale* (hookworms)

Infective form	3rd stage filariform larva
Mode of infection	Penetration into skin
Site of localization	Small intestine

Intestinal Round Worms (Nematodes)

hookworms

Life Cycle



Nematodes of medical importance

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Larva migrans:

- *Ancylostoma spp.*
- *Toxocara spp.*

Intestinal Round Worms (Nematodes)

Enterobius vermicularis (Pin Worm)

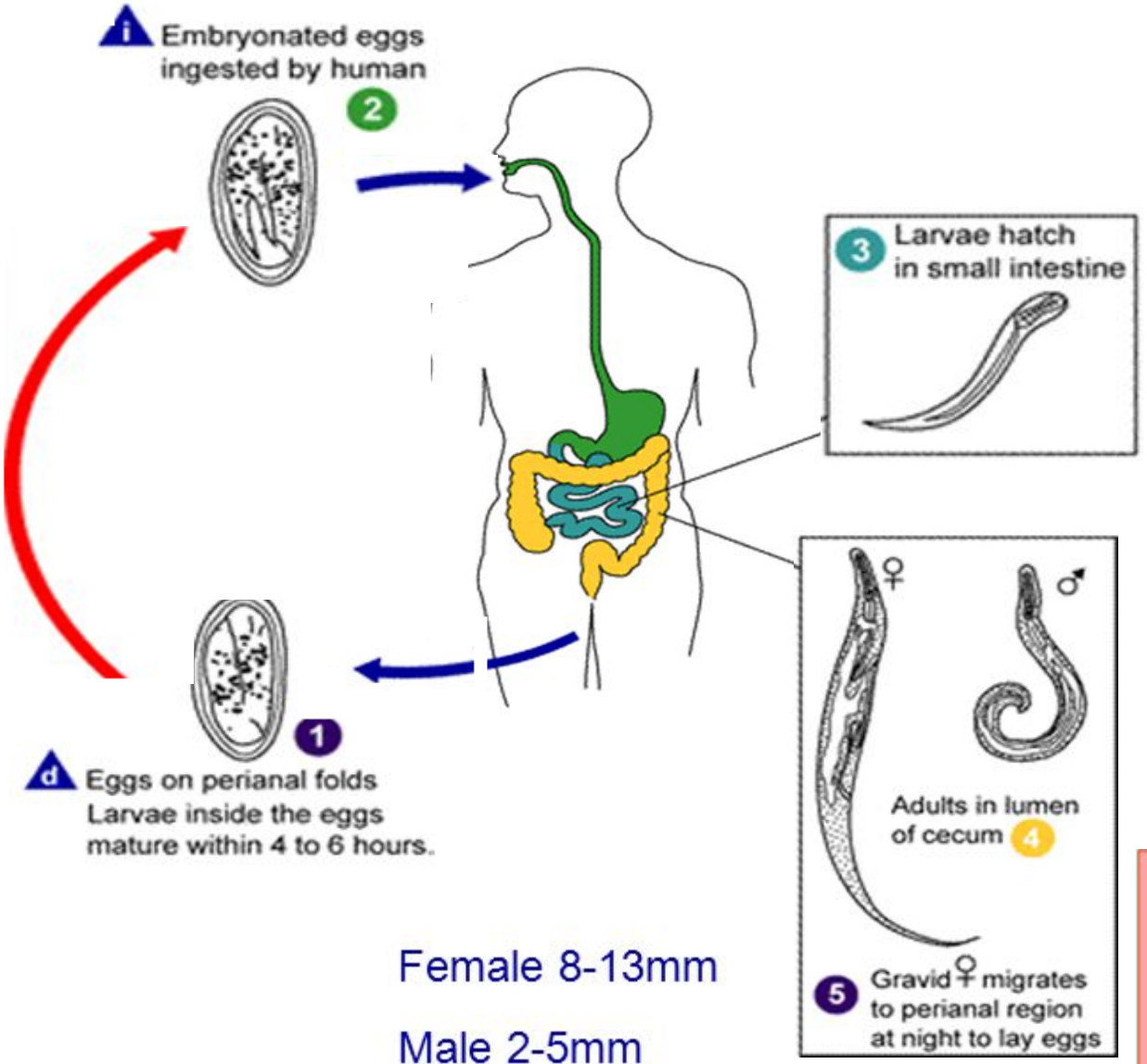
Geographical Distribution:-

- Cosmopolitant more common in temperate and cold climates than in warm climates.

Habitat:

- Adult: small intestine (terminal ileum)
- Gravid female: Caecum and rectum
- Eggs : In faeces or deposited on perianal skin

Enterobius vermicularis (Life cycle)



The time interval from ingestion of infective eggs to oviposition by the adult females is about one month.

Adult worm in caecum, colon or rectum

•The life span of the adults is about two months.

Female 8-13mm

Male 2-5mm

i = Infective Stage

d = Diagnostic Stage

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Intestinal Round Worms (Nematodes)

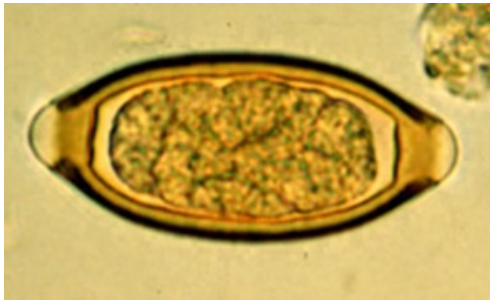
Trichuris trichiura (The Whipworm)

Adult worm

30 – 50 mm. whip-like shape, anterior 3/5th of the warm resembles a whip

Eggs

- 60 µ, bile stained (yellow brown).
- Barrel-shaped with Mucus plug at each pole
- Unsegmented ovum



Infective form

Mature embryonated eggs

Mode of transmission

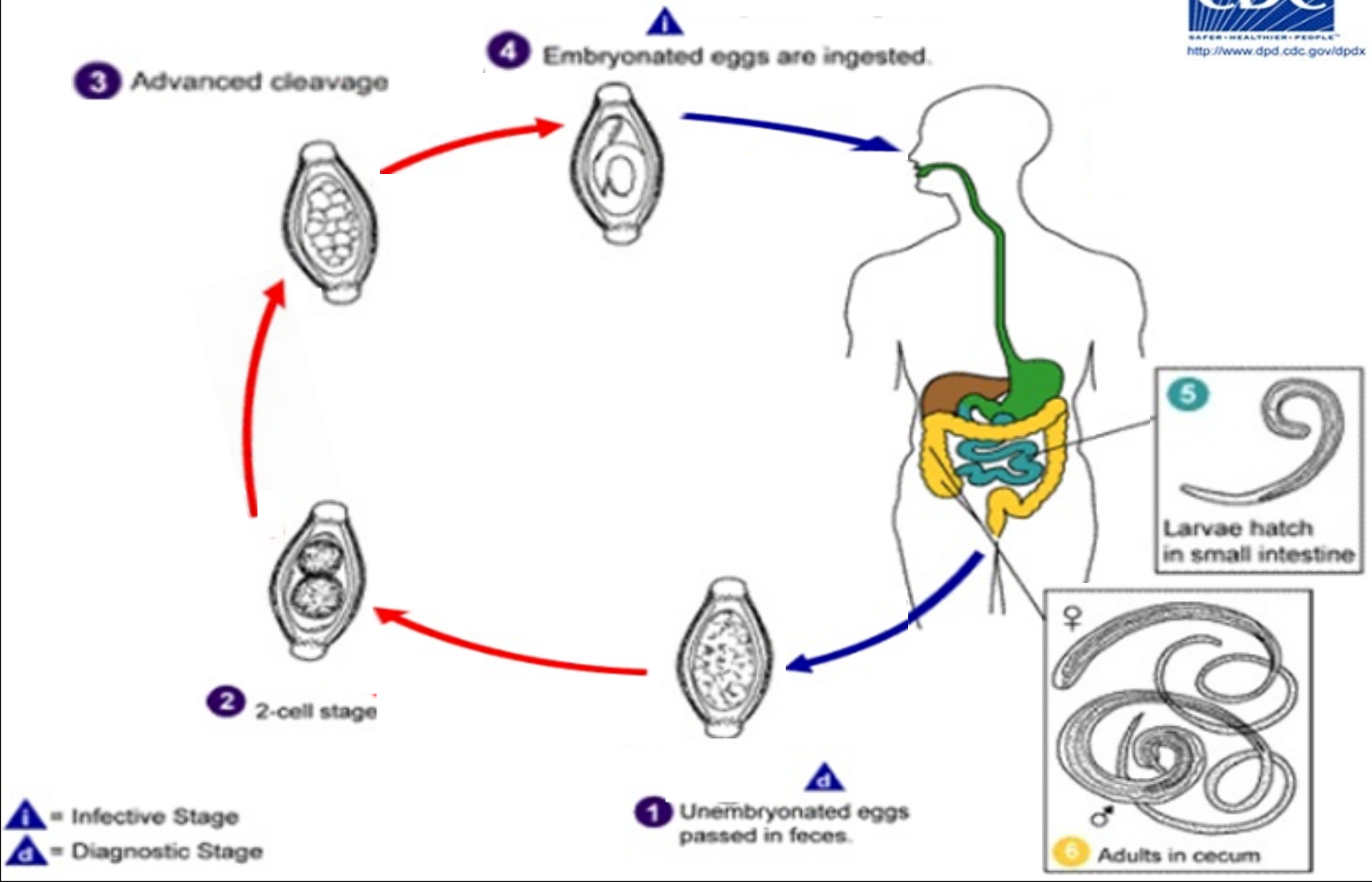
Ingestion

Site of localization

Large intestine - caecum

Intestinal Round Worms (Nematodes)

Trichuris trichiura (Life cycle)



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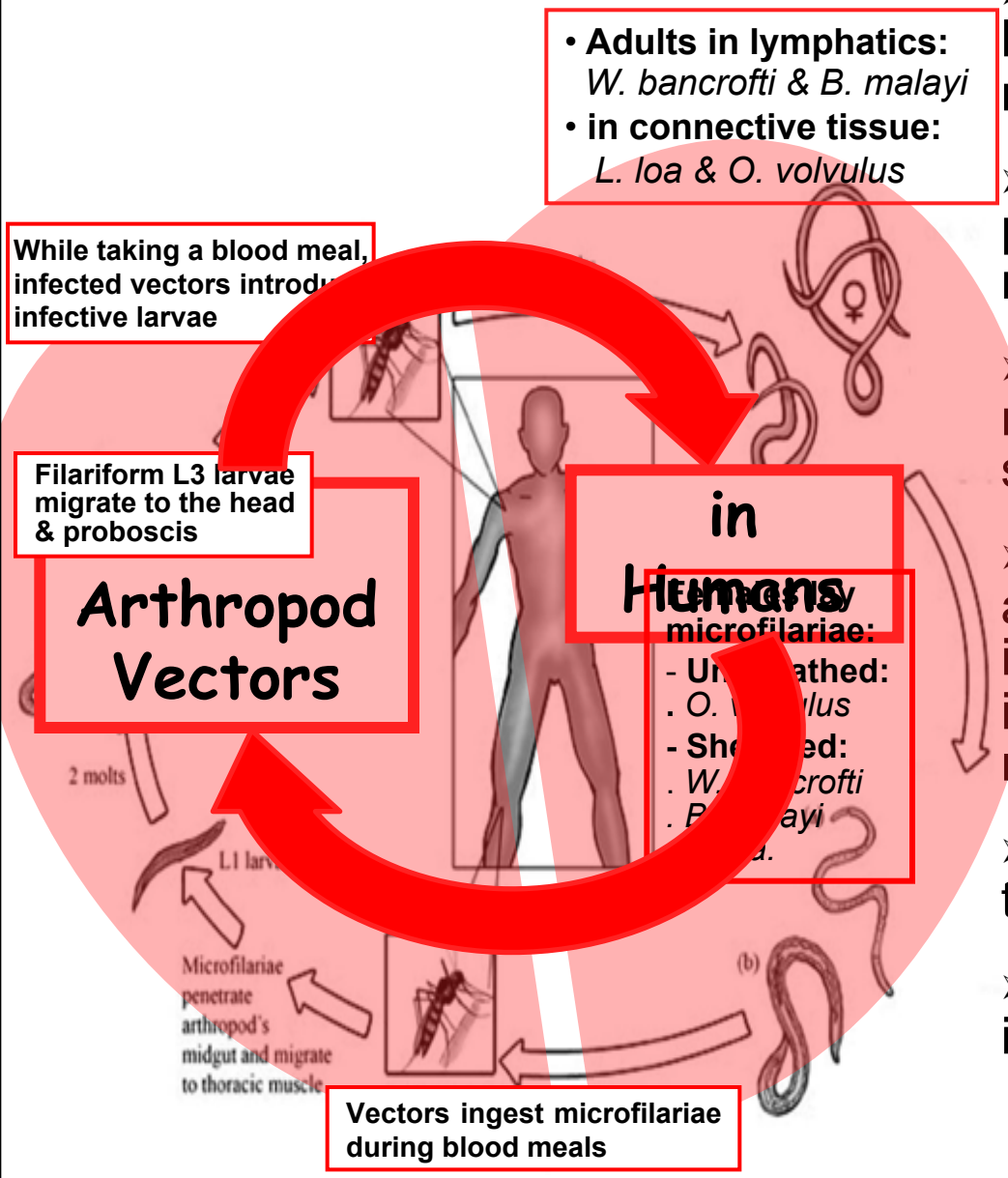
Wuchereria bancrofti, Brugia malayi, Loa loa, & Onchocerca volvulus



General life cycle

- During blood feeding bites on humans, infected arthropod vectors release infective filariform larvae.
- These penetrate humans' skin, pass to their habitat where they mature (in ~ one year), and mate.
- Adult females produce many microfilariae that, according to the species, migrate to various tissues.
- Microfilariae are ingested by arthropod vectors when feeding on infected persons. They develop into infective filariform L3 stage during migration towards vector's head.
- Infective larvae is ready for transmission in 2-3 weeks
- No multiplication of larvae occur in the vector, only growth.

Tissue Nematodes

Wuchereria bancrofti

Geographical Distribution:-

- In subtropics and tropics, Asia, Africa, America, Middle East, Far East,

Habitat

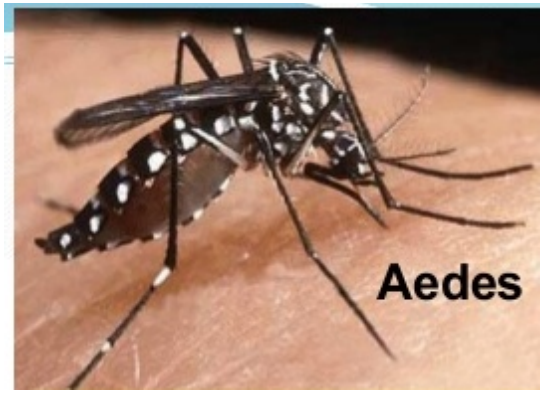
- Adults:
  - Coiled in lymphatic glands, or lying in lymphatic vessels, superficial abscesses, or wondering in retroperitoneal tissues.
  - Found usually in lymphatic of the lower limb.
- Microfilariae:
  - In lymphatic vessels, and in the peripheral blood normally at night but during day in lung and other internal organs.
  - Infective larvae: In the gut and muscles including mouth parts of certain species of mosquitoes.

Tissue Nematodes

Wuchereria bancrofti

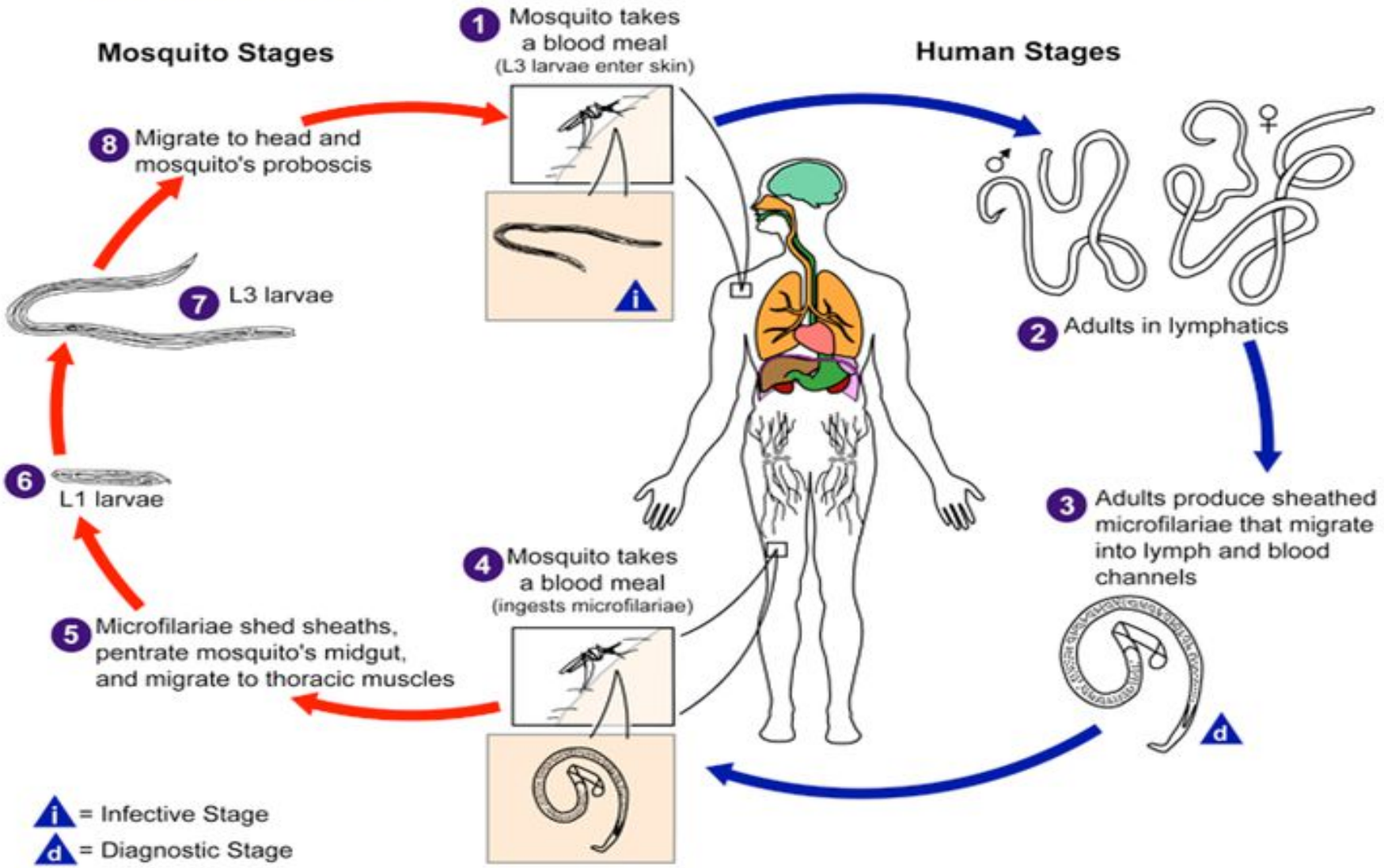
Life Cycle:

- Infective filariform larvae→Adult worm→microfilariae
- It requires two hosts to complete its life cycle :
  - Definitive host: man.
  - Intermediate hosts: species of female culex, Anopheles and Aedes mosquitoes.



Tissue Nematodes

Wuchereria bancrofti



Tissue Nematodes

Wuchereria bancrofti

Pathology:

- Causes lymphatic filariasis or elephantiasis of usually the limbs, genital organs and breasts.

Prevention and Control:

- Controlling mosquitoes vector.
- Avoid mosquitoes bite.
- Treating infected person.
- Giving health education.

Tissue Nematodes

Brugia malayi

Life cycle:

- The life cycle of B. malayi is similar to the life cycle of W. bancrofti.

Pathology:

- Causes elephantiasis of the lower limbs.

Prevention and Control :

- similar method like W. bancrofti.

Tissue Nematodes

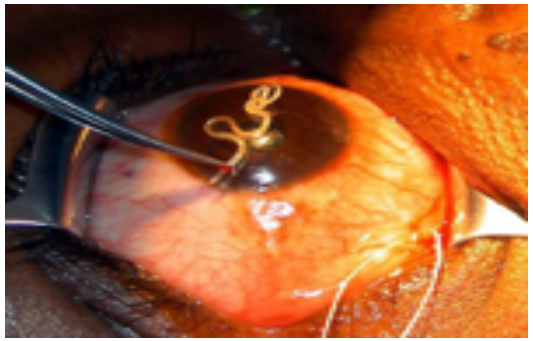
Loa Loa (Eye worm)

Geographical Distribution:

- The Distribution is restricted to the rain forest area of west and central Africa.

Habitat:

- Adults: In connective tissues under the skin, in the mesentery and the parietal peritoneum.
- Microfilariae: In peripheral blood of man during day time.
- Infective larvae: In the gut, mouth parts and muscles of tabanide flies of the genus Chrysops.



Tissue Nematodes

Loa Loa (Eye worm)

Life cycle

- Natural Definitive hosts are Man & Monkeys.
- Reservoir host are simian hosts.
- Similar to the life cycle of W. bancrofti but the habitat of the adult worms is in the subcutaneous tissues and they are freely moving in these tissues.
- The intermediate hosts are species of chrysops (horsefly).

Prevention and Control:

- Similar with the previous filaria worms.

Tissue Nematodes

Onchocerca volvulus

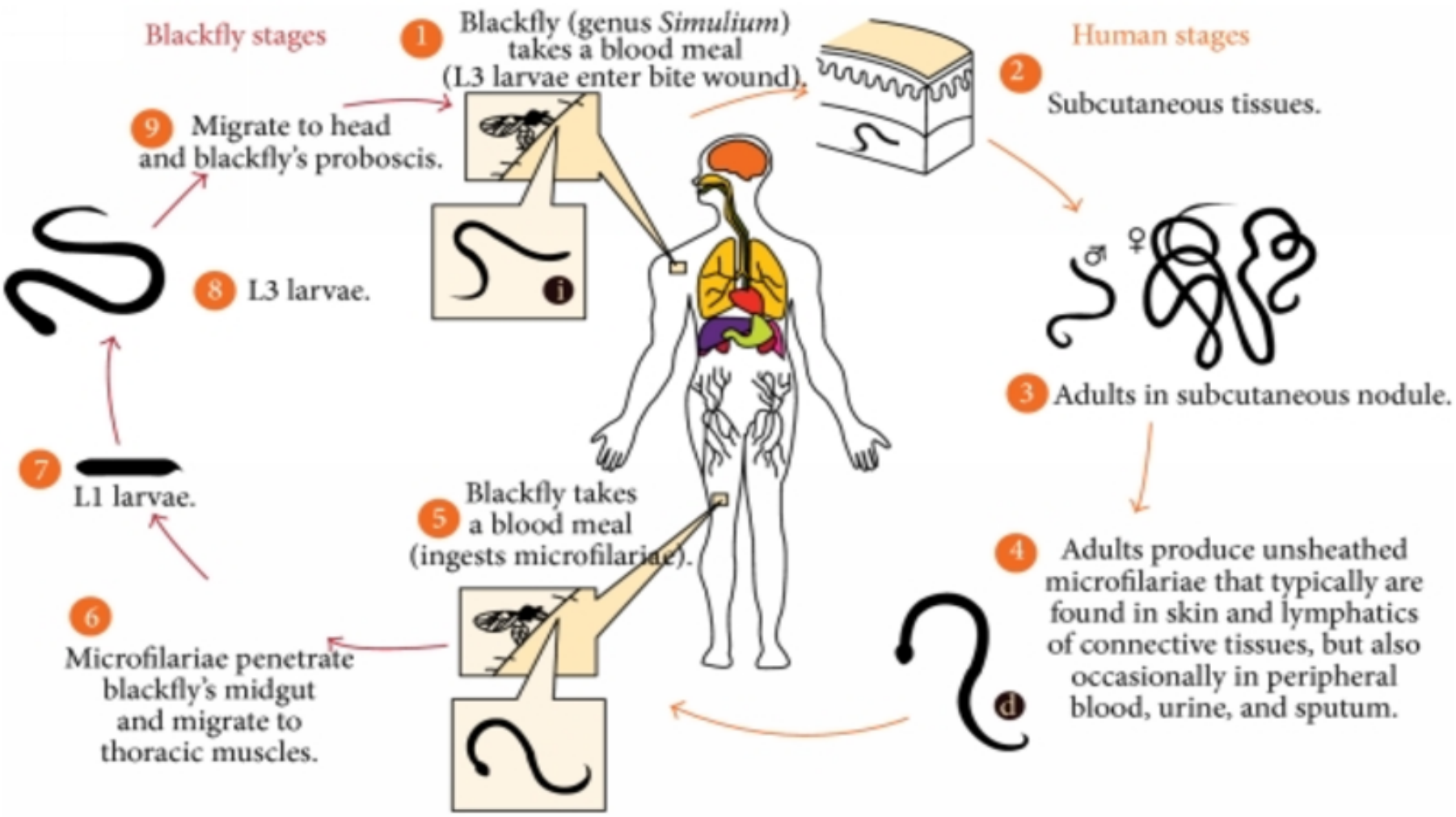
Geographical Distribution:-

- It is endemic from Senegal in the west to Uganda and Ethiopia in the East and as far as south as Zambia.
- It also occurs in the Yemen Arab Republic. Saudi Arabia and in central America (Mexico and Guatimala).

Habitat:

- Adults:- Subcutaneous nodules and in skin.
- Microfilariae:- Skin,eye and other organs of the body.
- Infective larvae: In the gut, mouth parts and muscles of Simulium black fly.

Tissue Nematodes



Tissue Nematodes

Trichinella Spiralis

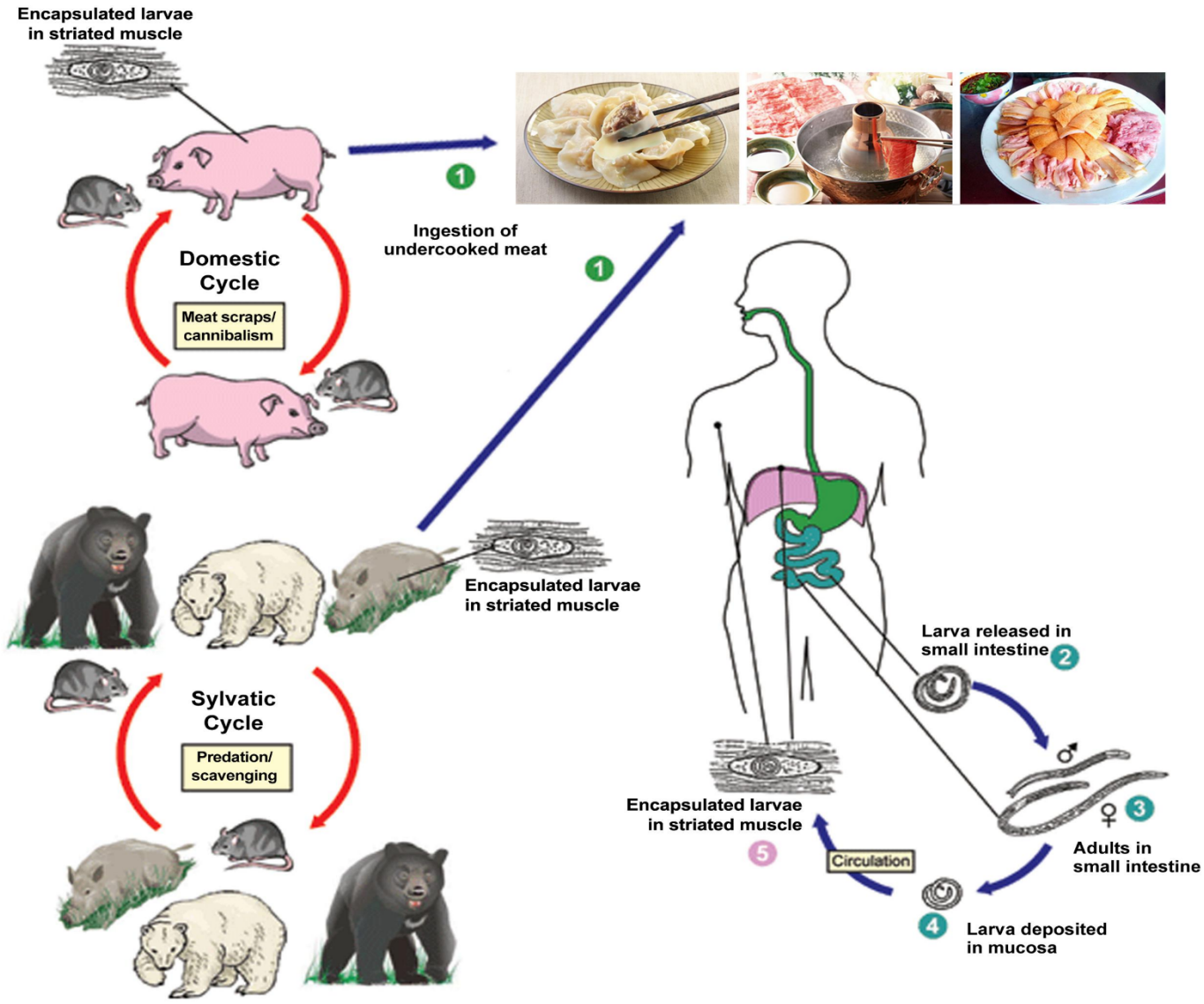
Habitat

- **Adults:** Embedded by its anterior part in mucosa of muscular epithelium of duodenum and Jejunum of Man, Dog, Rate, Cat, Pigs and wild Carnivores.
- **Larvae:**
  - Encysted in the straited muscle of the body of meat eating animals including man.
- **Egg:** No eggs passed in the faeces , female gives birth to larvae.

Tissue Nematodes

Life cycle

Trichinella Spiralis



Tissue Nematodes

Dracunculus Medinensis (Guinea or Medina worm)

Morphology

- **Adults:** White with smooth surface
- **Male:** 12-29mm , coiled posterior end.
- **Female :**
  - 70-120 cm (average 100 cm)
  - The longest nematode of man
  - Has cylinderical oesophagus
  - Viviparous

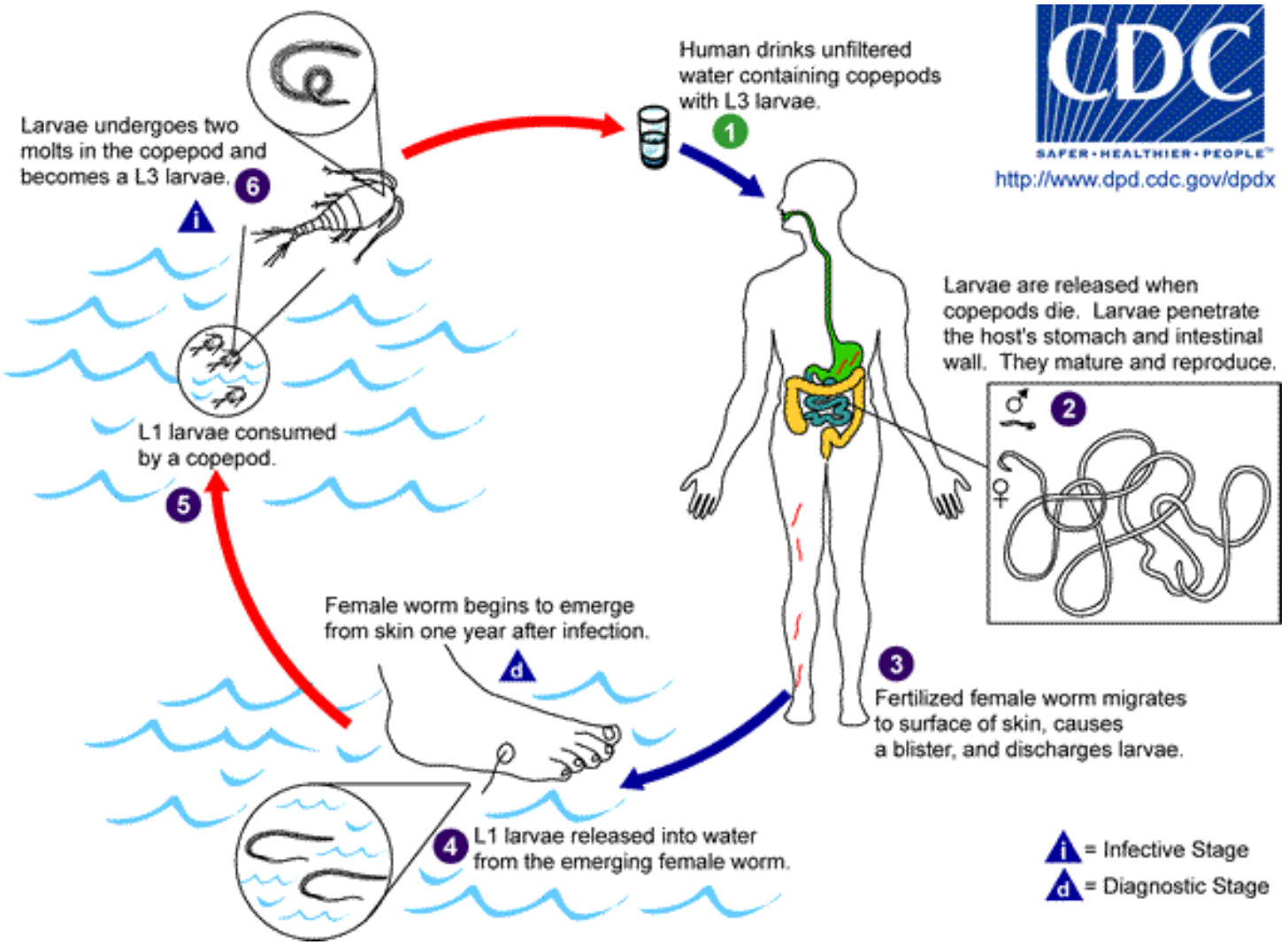
Larva: Size:500-700 µm

  - Rounded anterior end
  - Long and pointed tail
  - Has Rhabiditiform Oesophagus

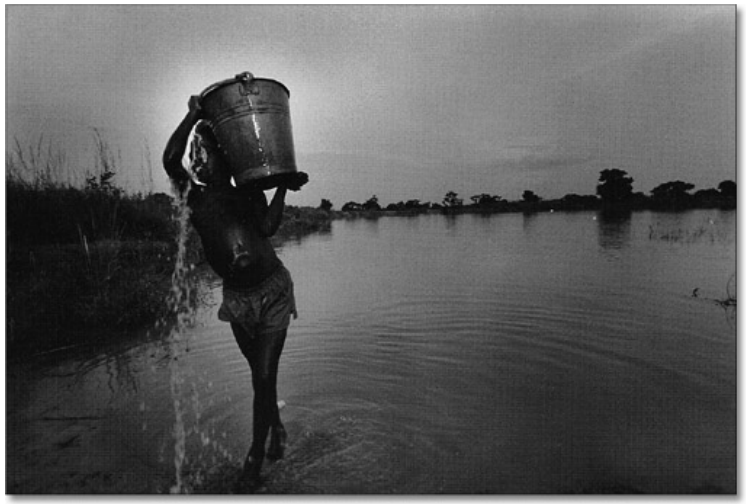
Tissue Nematodes

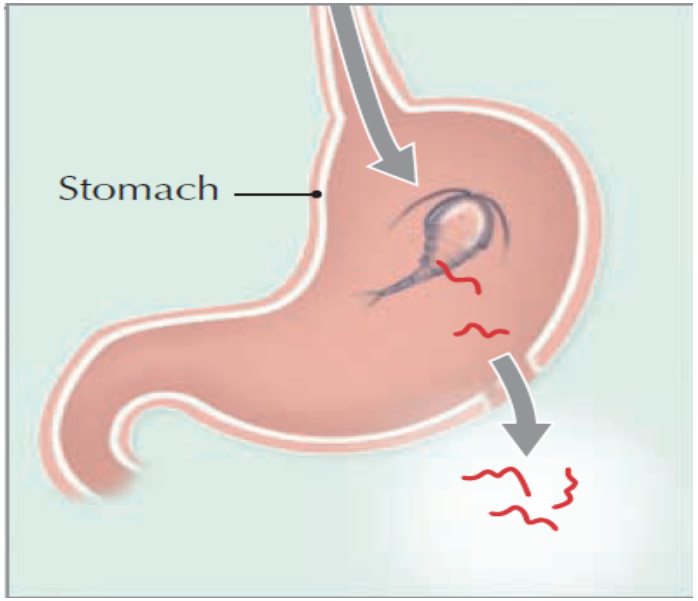
Dracunculus Medinensis (Guinea or Medina worm)

Life cycle



Ingestion of contaminated water leads to human *D. medinensis* transmission





D. Medinensis migrate to lower limbs and induce blisters

Diagnosis made by observing worm head protruding from blister

Tissue Nematodes

Dracunculus Medinensis (Guinea or Medina worm)

Main features of Nematodes

	Intestinal Nematodes	Tissue Nematodes
Shape	Large size, Cylindrical	Elongated, Slender (slim)
Habitat	Most adult worms live in the intestinal tract	Inhabit either lymph vessels; or skin and subcutaneous tissues
Diseases	Diseases are diagnosed by identifying their characteristic eggs in stool	Diseases are diagnosed by demonstrating microfilariae in blood, in tissue or tissue fluids