

# **Nemathelminths**

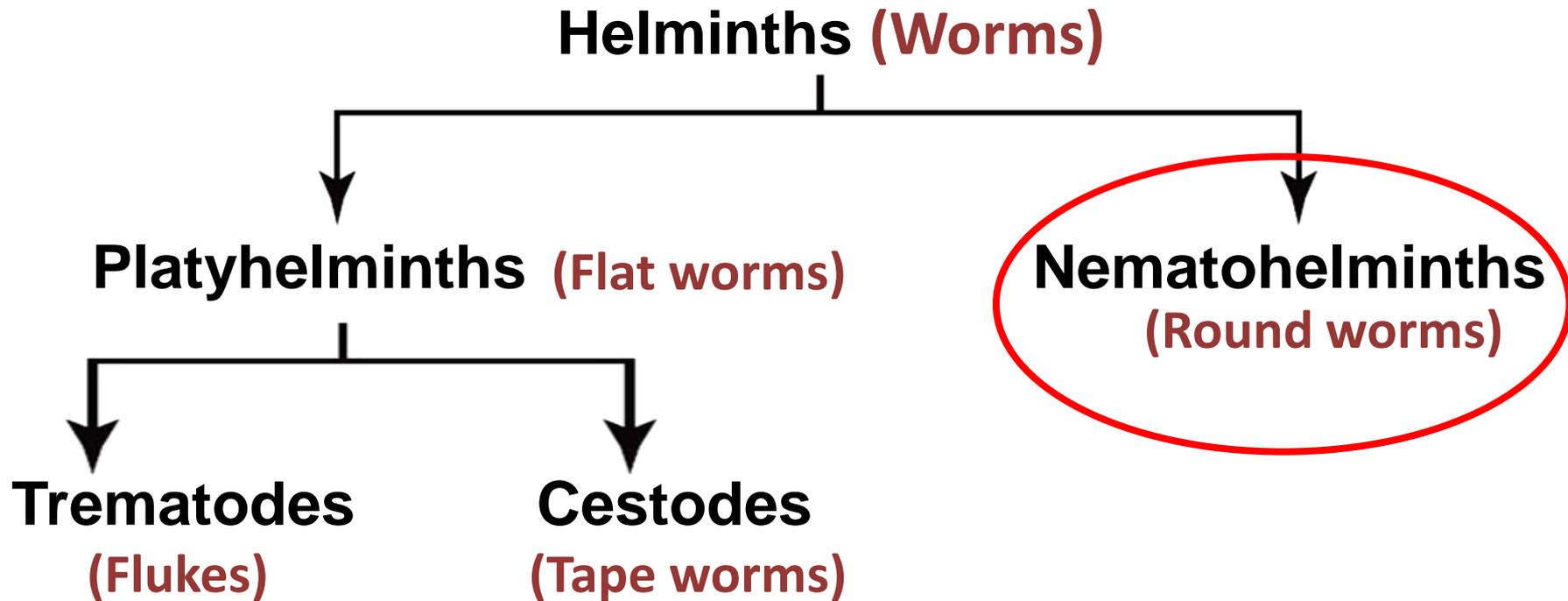
## **Class Nematoda**

**2020-2021**

Dr. Mohammad Odibate  
Mutah University  
Faculty of Medicine

# 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

## Tissue & Blood

Small intestine

### With tissue stage:

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

Large int.

### Without tissue stage:

- *Enterobius vermicularis*
- *Trichuris trichiura*

- *Wuchereria bancrofti*
- *Brugia malayi*
- *Loa loa*
- *Onchocerca volvulus*
- *Dracunculus medinensis*
- *Trichinella spiralis*
- Larva migrans:
  - *Ancylostoma spp.*
  - *Toxocara spp.*

# Nematodes of medical importance

---

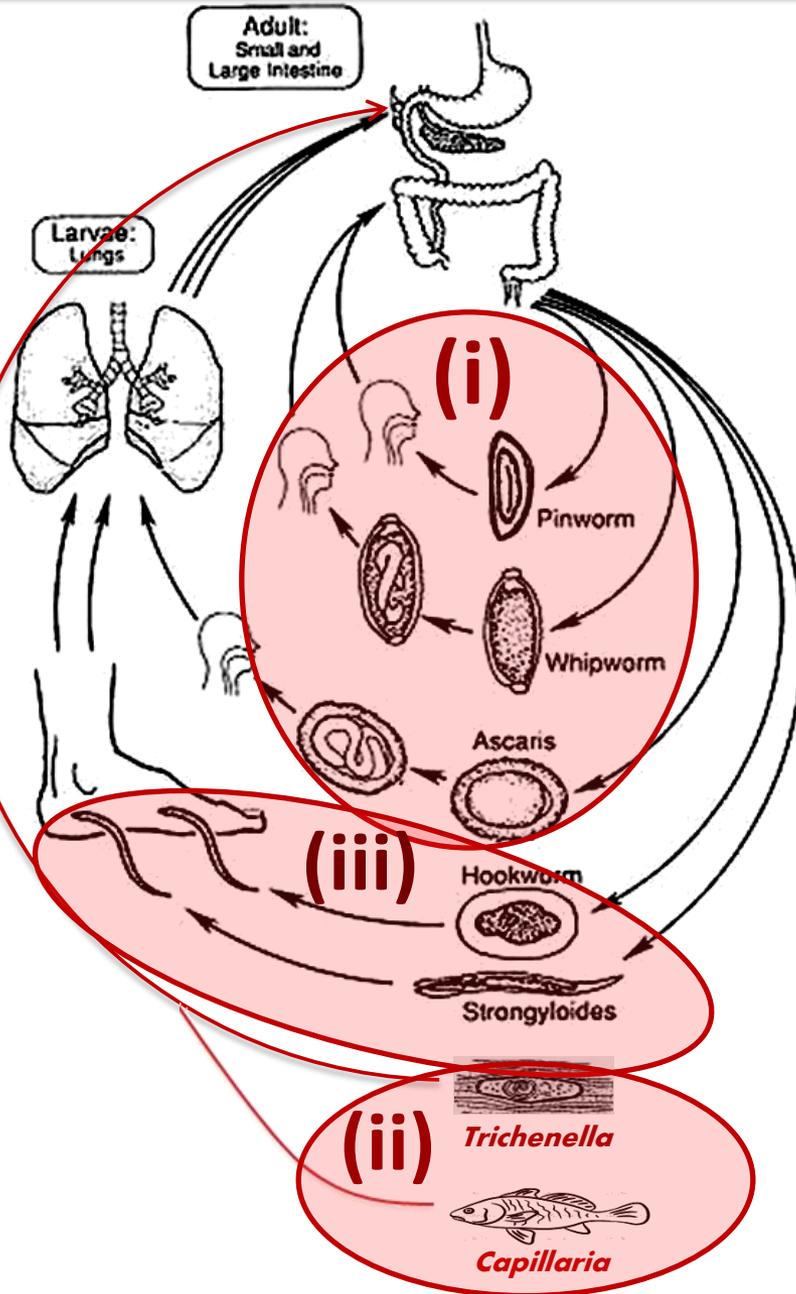
## Intestinal

- 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* embryonated **eggs**,

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

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

➤ Hatched and invasive larvae, either:

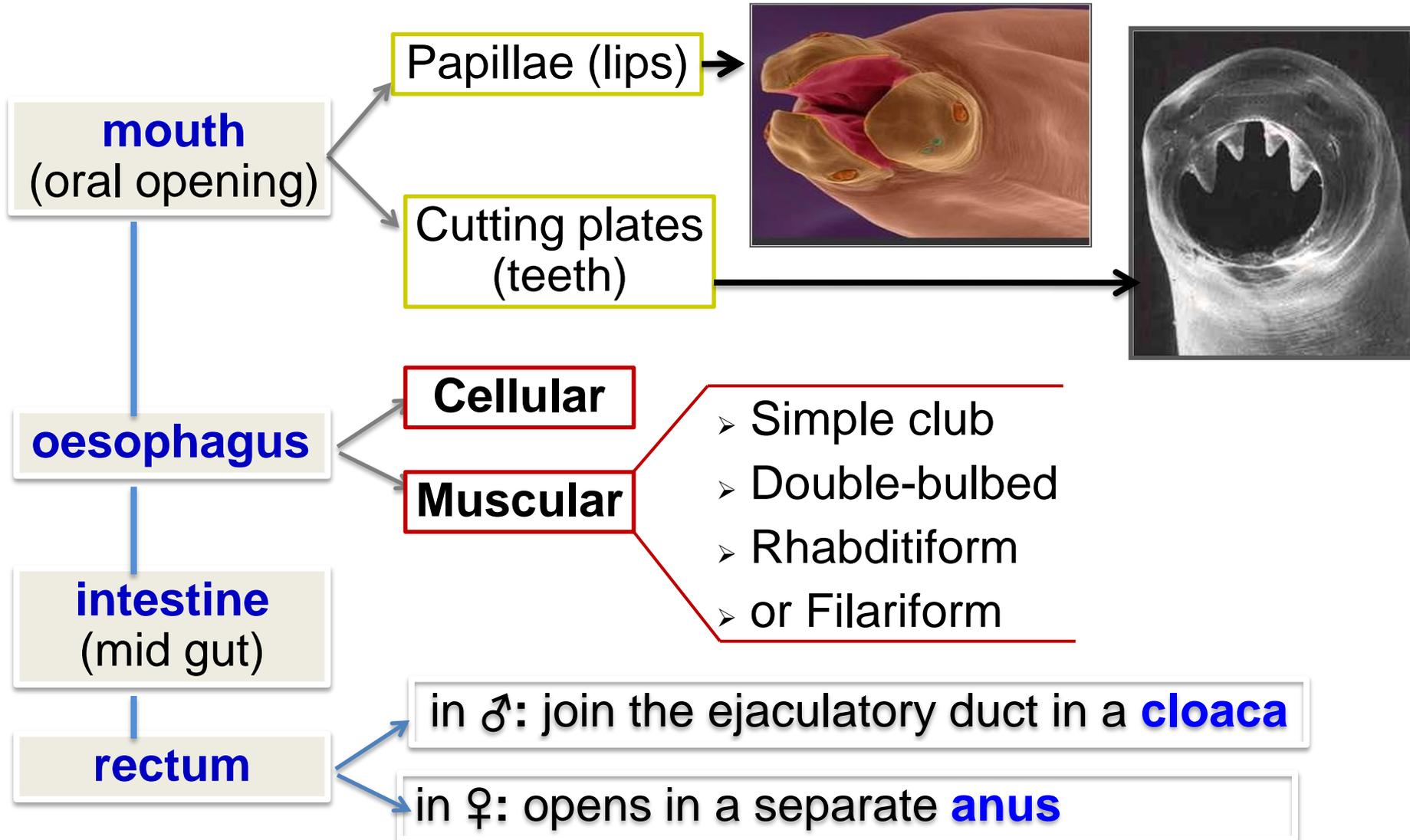
- mature in the intestine **without migratory phase** (*Enterobius* & *Trichuris*).

- 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 (*Trichinella*).

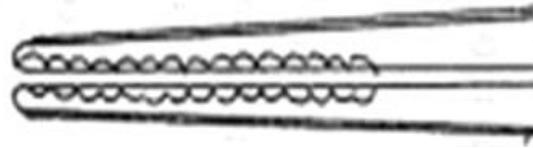
# Digestive system of nematodes

Nematodes have a complete digestive system, with:



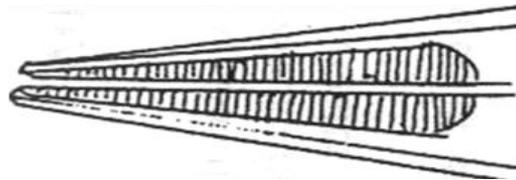
# Oesophagus of nematodes

Cellular



*Trichuris*

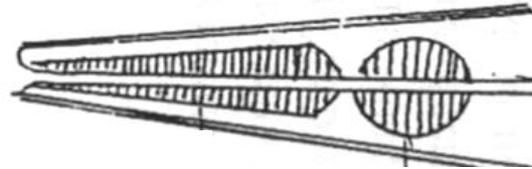
➤ **Club-shaped**



*Ascaris*  
Hook worms

➤ **Double-bulbed**

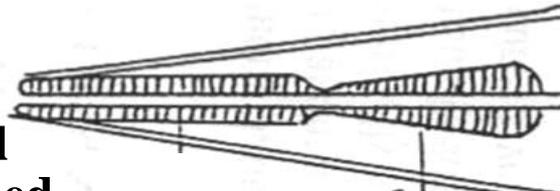
*Ant. part: club-shaped*  
*Post. part: spherical*



*Enterobius*

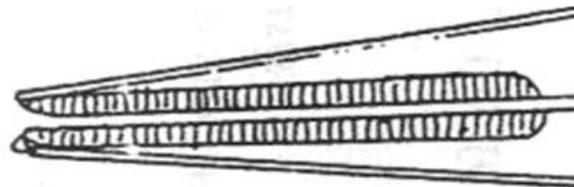
➤ **Rhabditiform**

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



*Strongyloides*

➤ **Filariform**  
(cylindrical)



*Filaria*

# Nematodes of medical importance

## Intestinal

## Tissue & Blood

Small intestine

### □ With tissue stage:

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

### • Without tissue stage:

- *Enterobius vermicularis*
- *Trichuris trichiura*

Large int.

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

### □ Larva migrans:

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

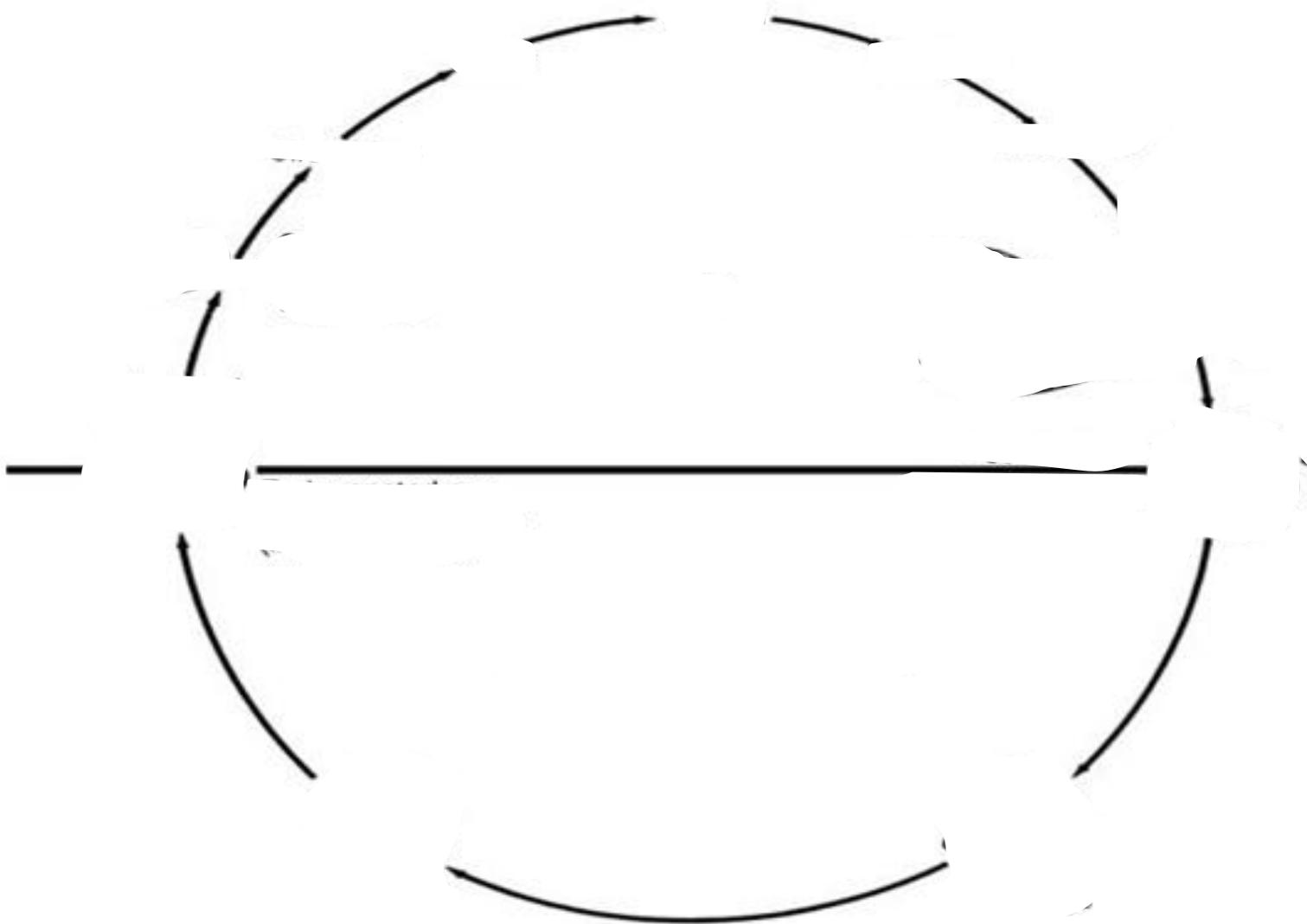
# Intestinal Round Worms (Nematodes)

## *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)



# Nematodes of medical importance

## Intestinal

## Tissue & Blood

Small intestine

### □ With tissue stage:

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

### • Without tissue stage:

- *Enterobius vermicularis*
- *Trichuris trichiura*

Large int.

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

### □ 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

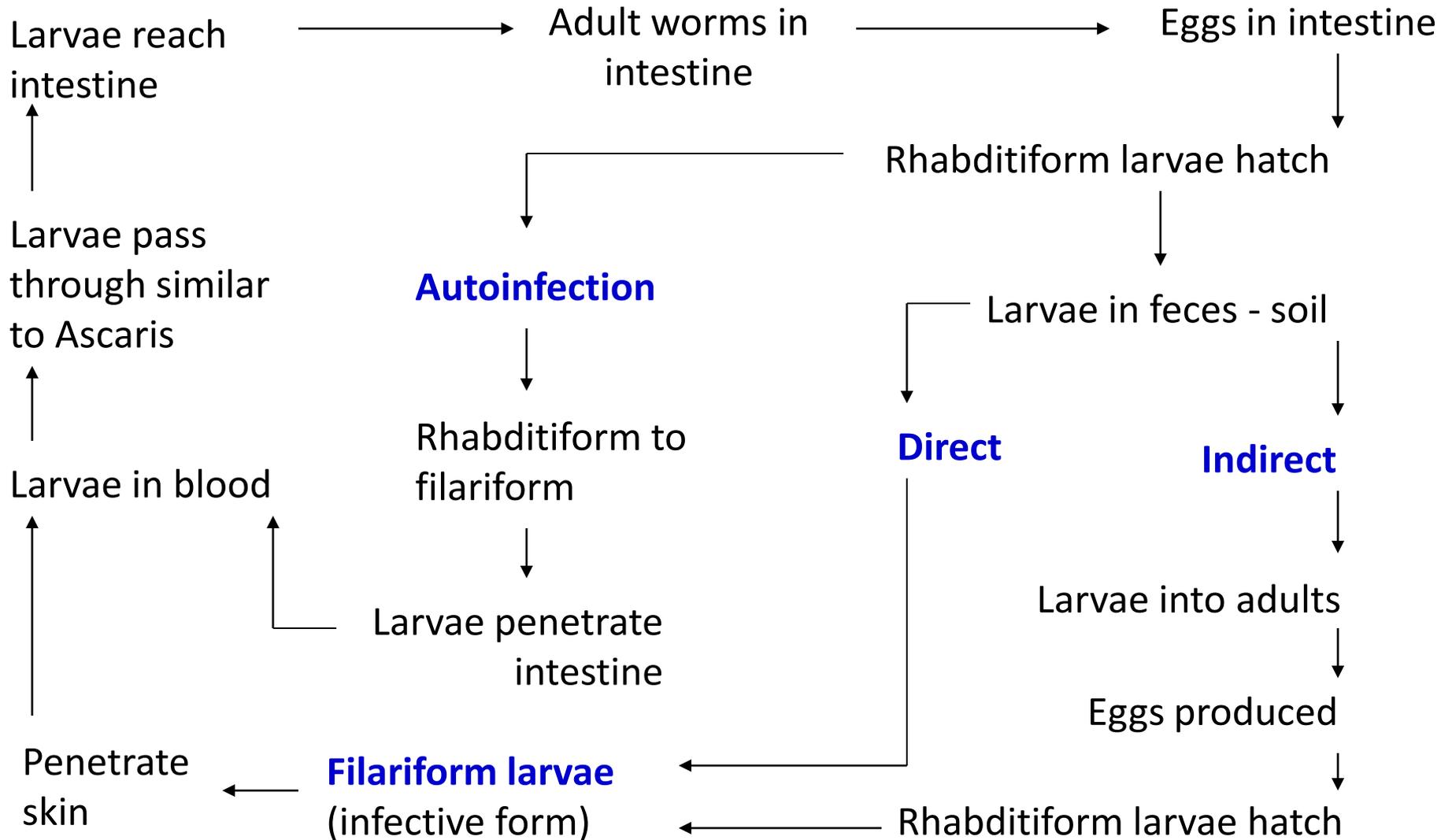
Mode of transmission

Penetration / autoinfection

Site of localization

Wall of Small intestine, mainly duodenum & jejunum

# Life cycle – Strongyloides stercoralis



# Nematodes of medical importance

## Intestinal

## Tissue & Blood

Small intestine

### □ With tissue stage:

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

### Without tissue stage:

- *Enterobius vermicularis*
- *Trichuris trichiura*

Large int.

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

### □ Larva migrans:

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

# Intestinal Round Worms (Nematodes)

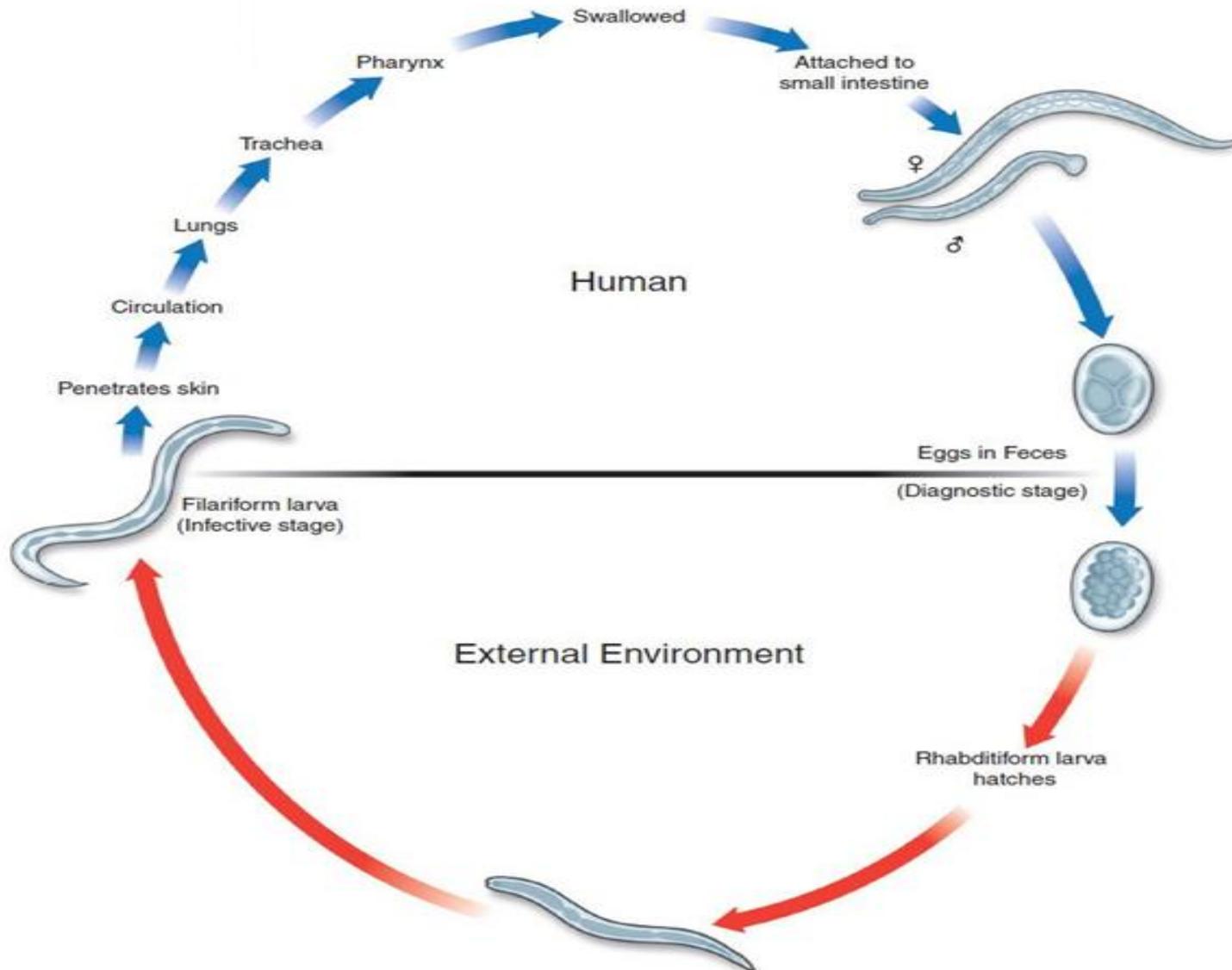
## *Necator americanus* and *Ancylostoma duodenale* (hookworms)

Infective form	3 <sup>rd</sup> 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

## Intestinal

## Tissue & Blood

Small intestine

### □ With tissue stage:

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

### • Without tissue stage:

- *Enterobius vermicularis*
- *Trichuris trichiura*

Large int.

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

### □ Larva migrans:

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

# Intestinal Round Worms (Nematodes)

## *Enterobius vermicularis* (Pin Worm)

### Geographical Distribution:-

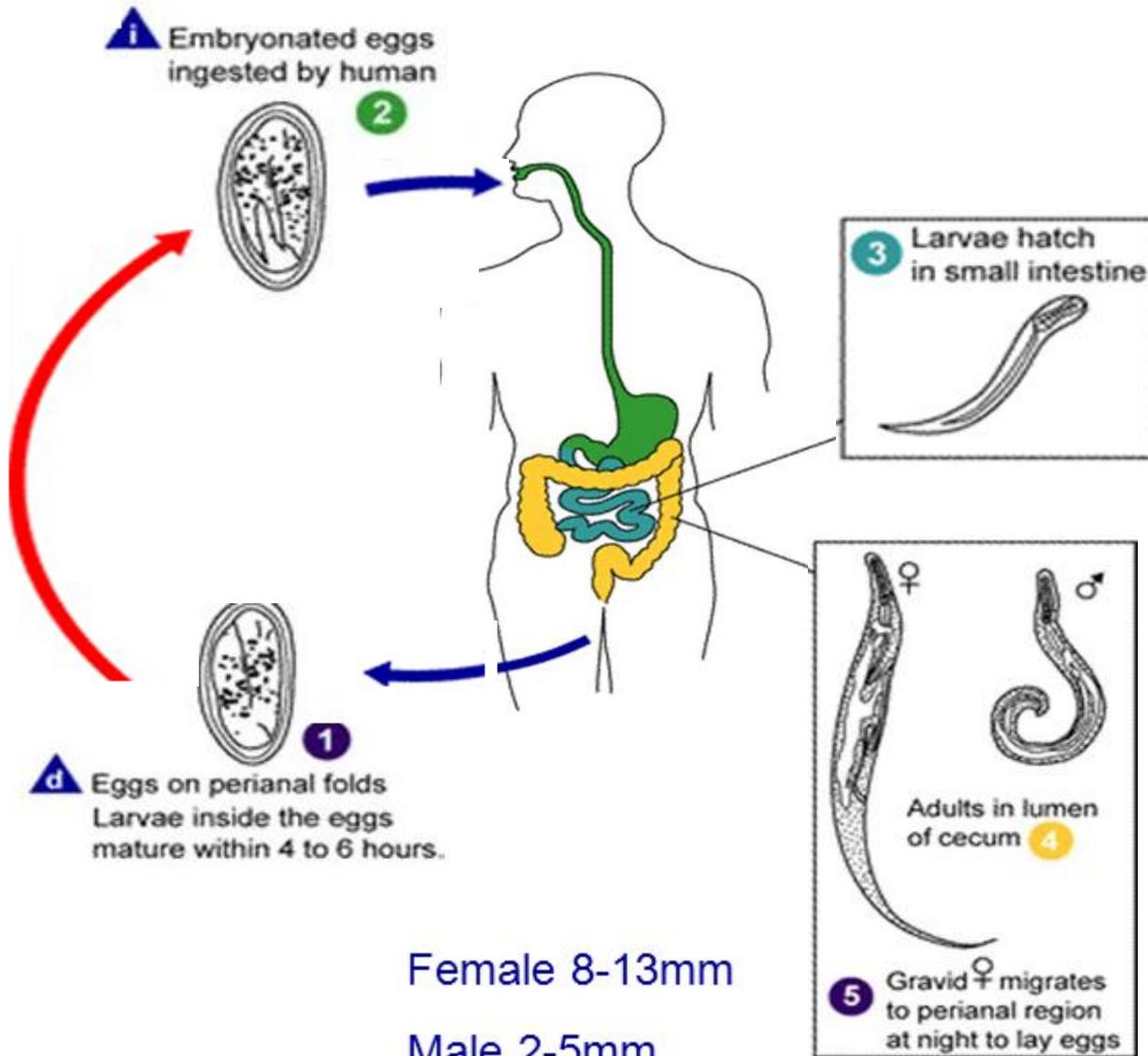
- Cosmopolitan more common in temperate and cold climates than in warm climates.

### 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

# Nematodes of medical importance

## Intestinal

## Tissue & Blood

Small intestine

### □ With tissue stage:

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

### • Without tissue stage:

- *Enterobius vermicularis*
- *Trichuris trichiura*

Large int.

- *Wuchereria bancrofti*
  - *Brugia malayi*
  - *Loa loa*
  - *Onchocerca volvulus*
  - *Dracunculus medinensis*
  - *Trichinella spiralis*
- ### □ Larva migrans:
- *Ancylostoma spp.*
  - *Toxocara spp.*

# Intestinal Round Worms (Nematodes)

## Trichuris trichiura (The Whipworm)

### Adult worm

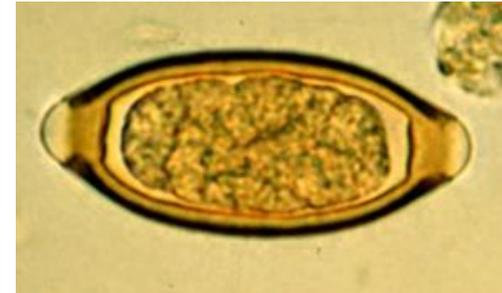
30 – 50 mm. whip-like shape, anterior 3/5th of the worm resembles a whip

### Eggs

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

### Infective form

Mature embryonated eggs



### Mode of transmission

Ingestion

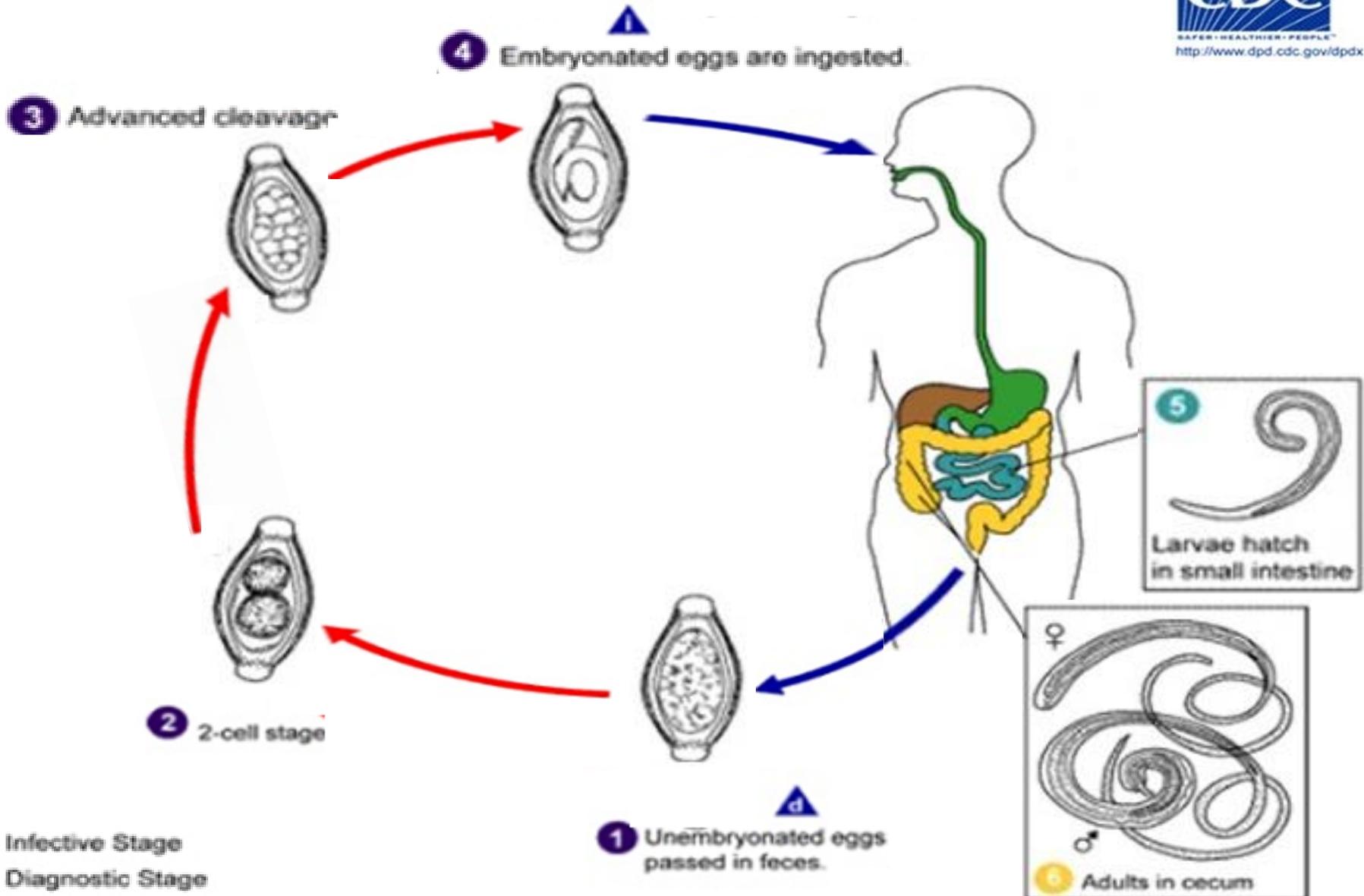
### Site of localization

Large intestine - caecum



# Intestinal Round Worms (Nematodes)

## Trichuris trichiura (Life cycle)



# Nematodes of medical importance

## Intestinal

## Tissue & Blood

Small intestine

### □ With tissue stage:

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

### • Without tissue stage:

- *Enterobius vermicularis*
- *Trichuris trichiura*

Large int.

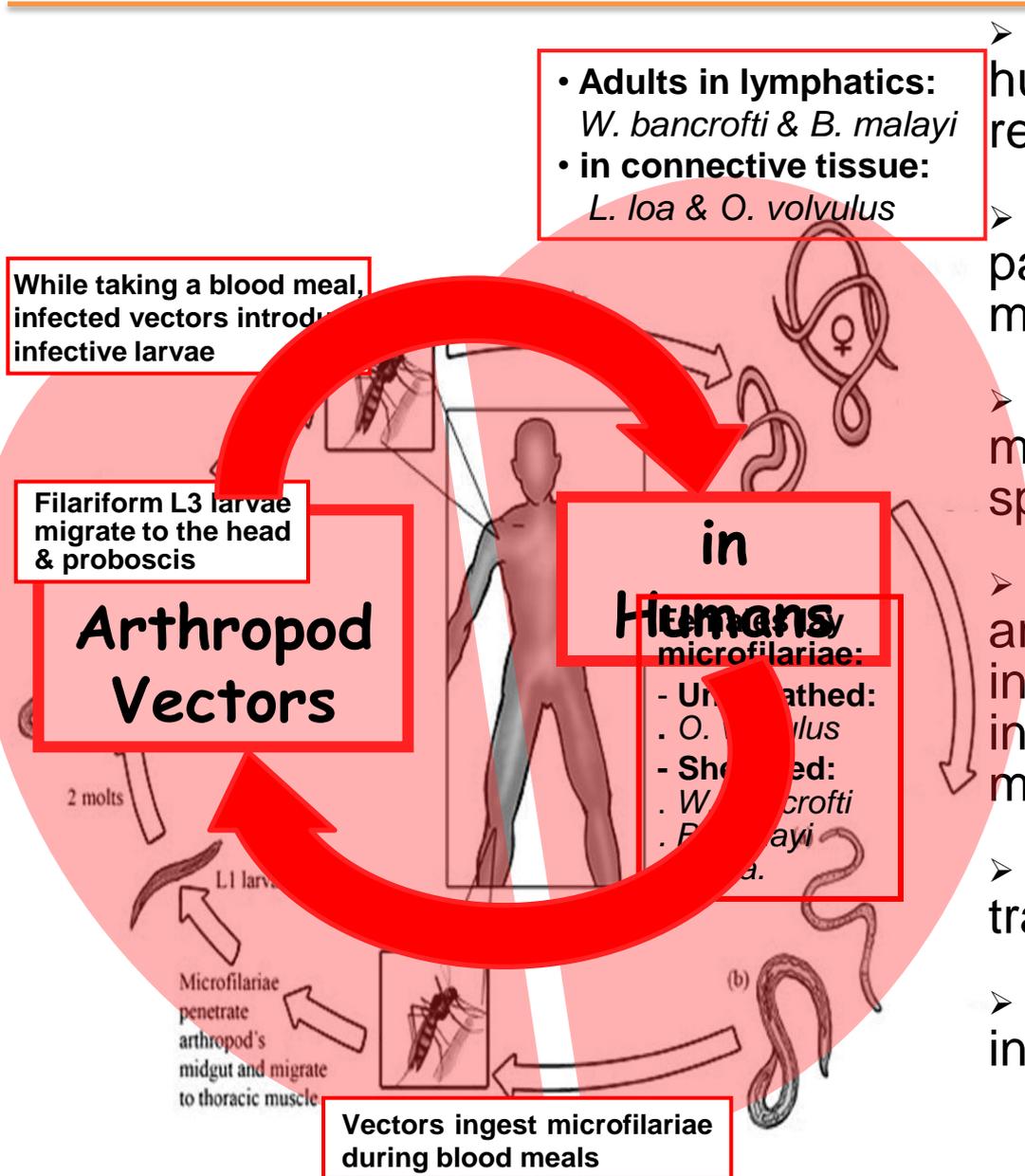
- *Wuchereria bancrofti*
- *Brugia malayi*
- *Loa loa*
- *Onchocerca volvulus*
- *Dracunculus medinensis*
- *Trichinella spiralis*

### □ Larva migrans:

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

# *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.

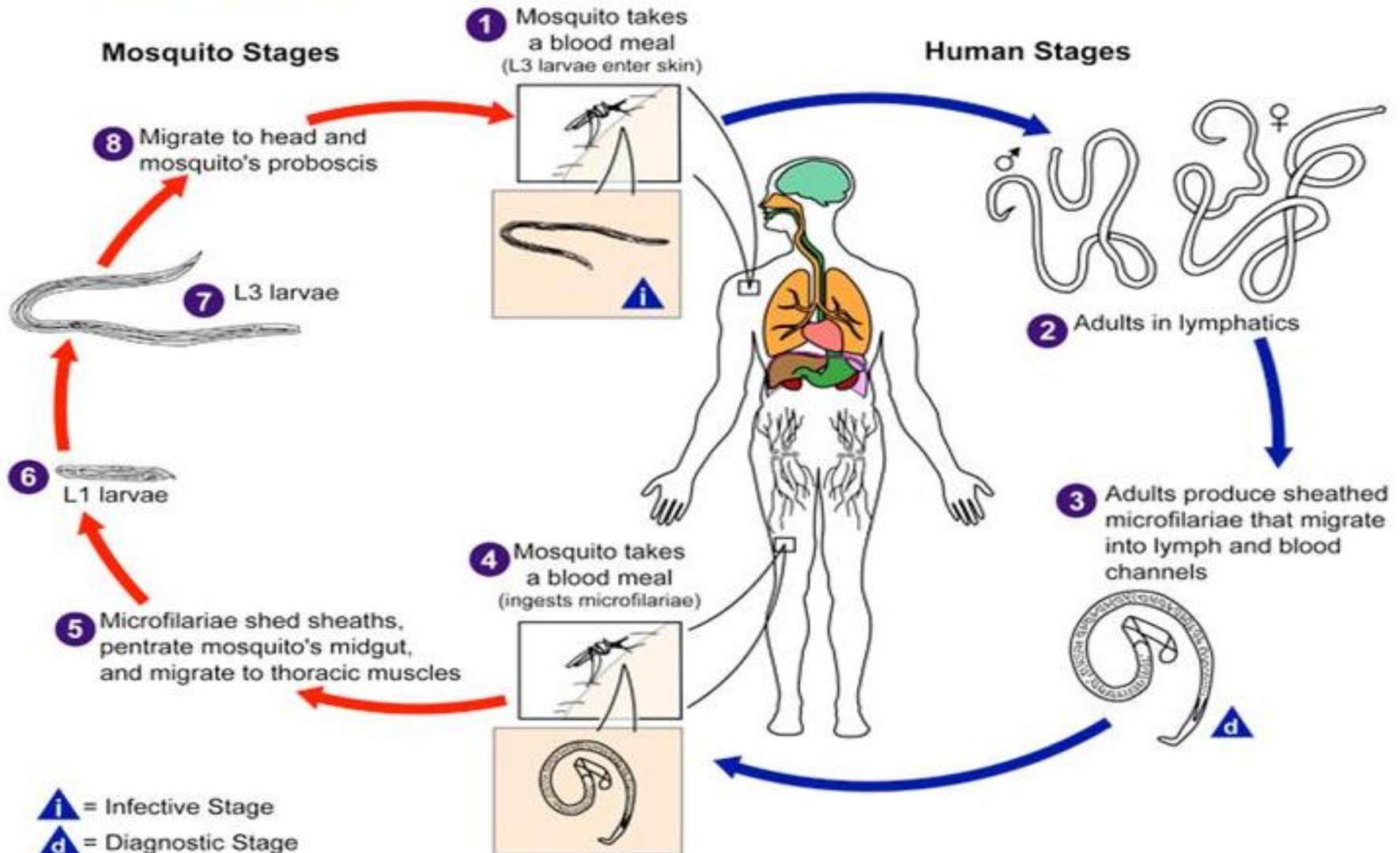


# Tissue Nematodes

## Wuchereria bancrofti

### Filariasis

(*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

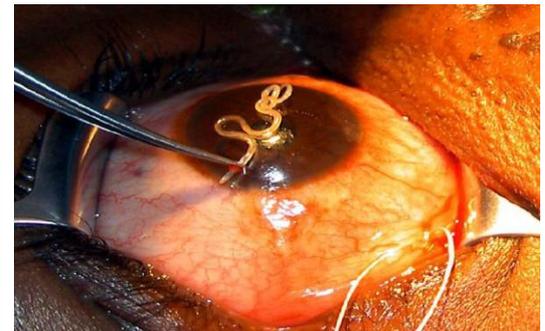
## Loa Loa (Eye worm)

### 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*

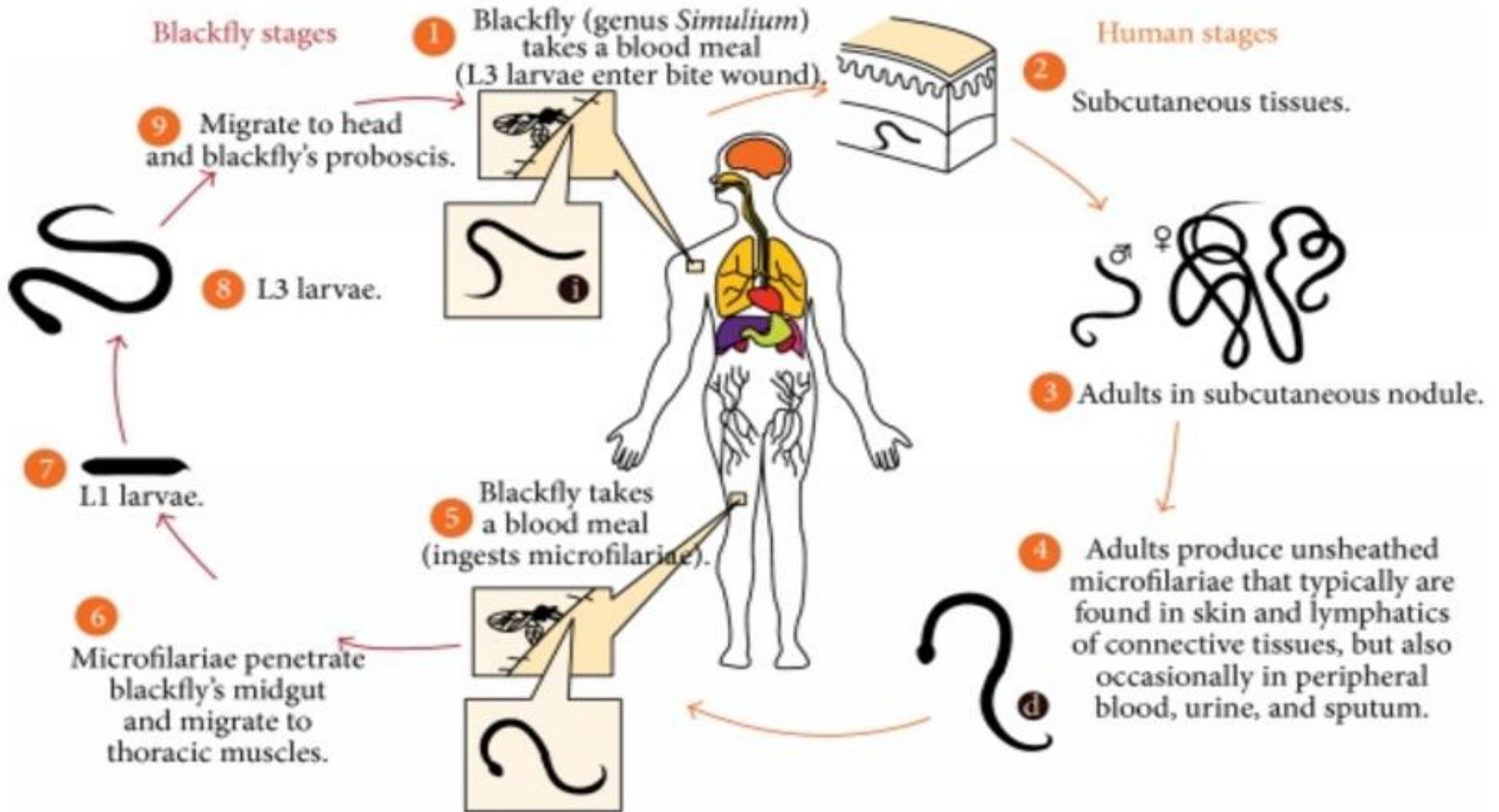
### **Geographical Distribution:-**

- 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 Guatemala).

### **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

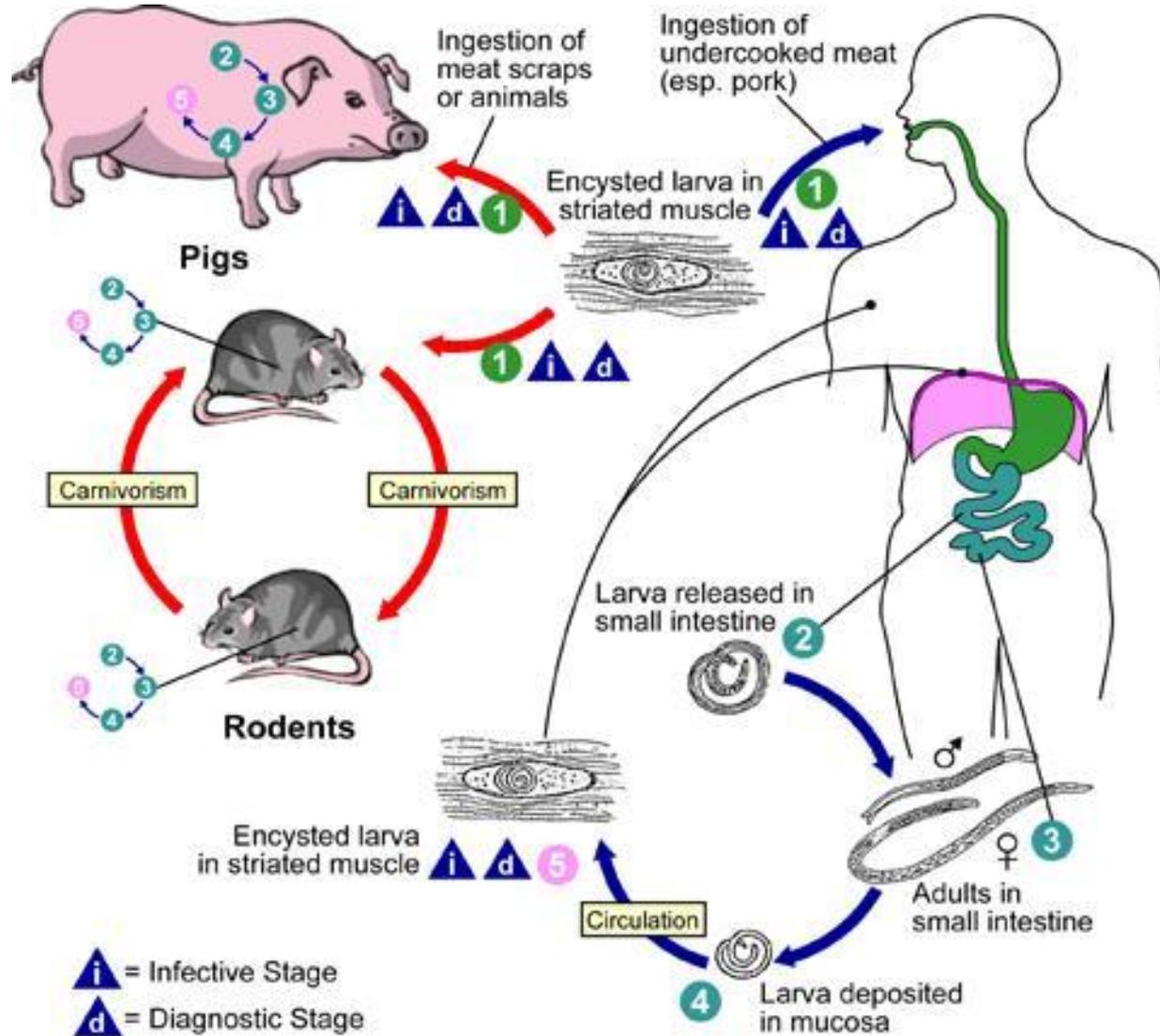
### Habitat

- **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

## Trichinella Spiralis

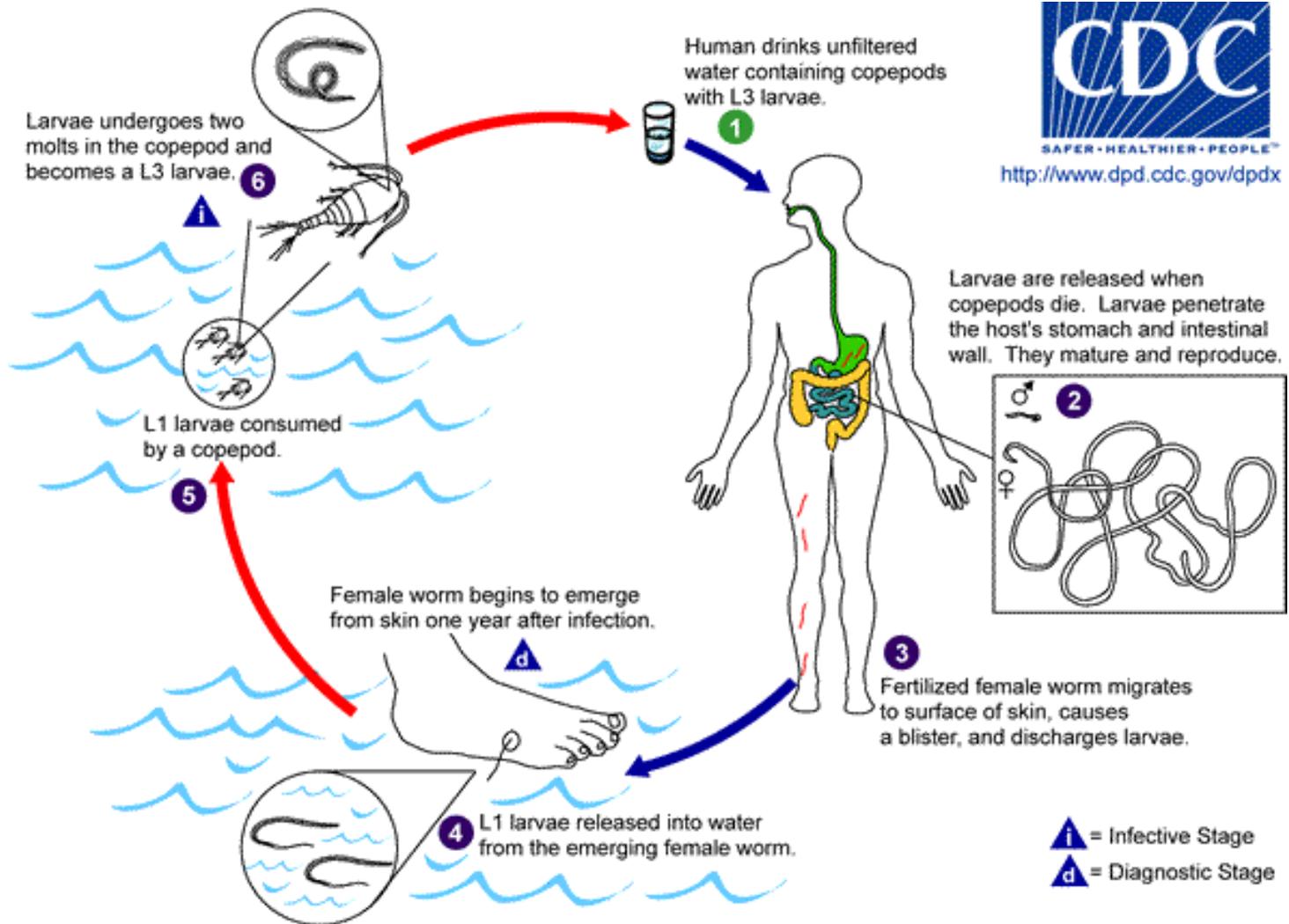
### Life cycle



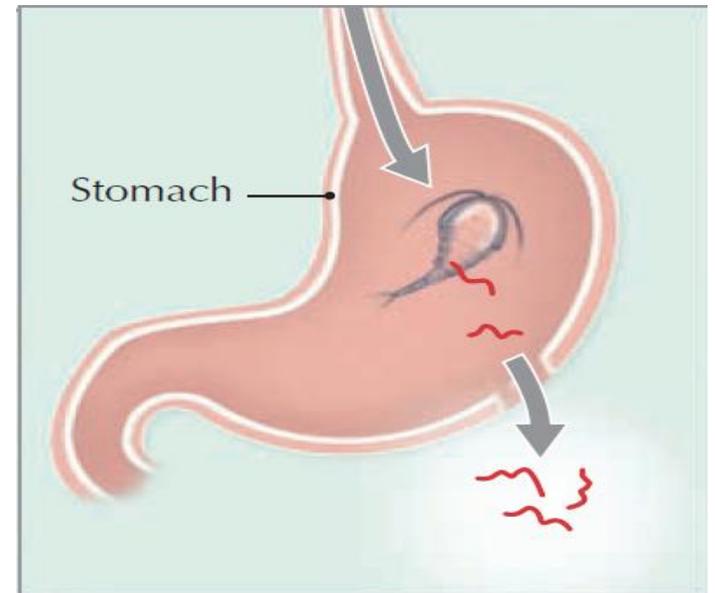
# Tissue Nematodes

## 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

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