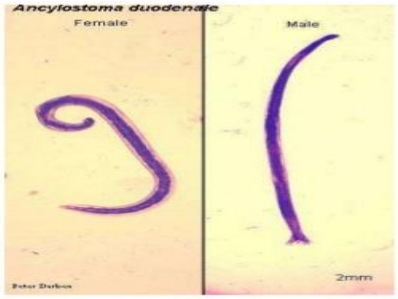
Necator americanes and *Ancylostoma duodenale* (Hookworms)

Kingdom:	Animalia
Phylum:	Nematoda
Class:	Secernentea
Order:	Strongylida
Family:	Ancylostomatidae
Genus:	*Necator*
Species:	***N. americanus***

Morphology: Adults

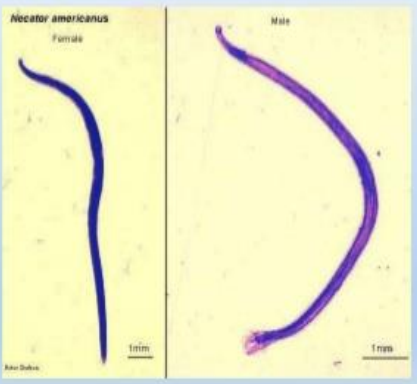
Ancylostoma duodenale

- Female is 10-13 mm in length by 0.6 mm in diameter
- Males are 8-11 mm by 0.4 mm
- Posterior end has an umbrella-shaped bursa with riblike rays
- Two pairs of curved teeth on the ventral wall of its buccal capsule



MORPHOLOGY

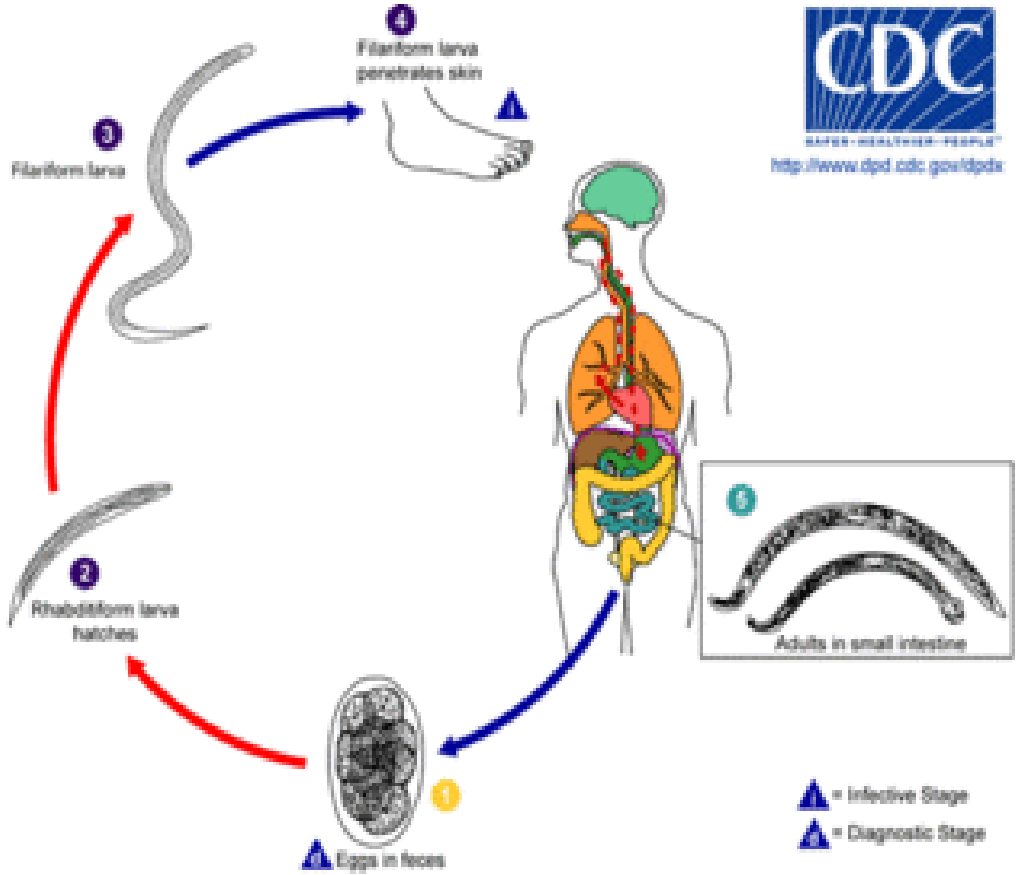
- *Necator americanus*
- Females are 9-11 mm in length by 0.4 mm in diameter
- Males are 7-9 mm by 0.3 mm
- Smaller than *A. duodenale*
- A pair of semilunar cutting plates on the ventral wall of the buccal capsule



Epidemiology
Hookworms parasitize more than 900 million people worldwide and cause daily blood loss of 7 million liters. Ancylostomiasis is the most prevalent hookworm infection and is second only to ascariasis in infections by parasitic worms. *N. americanes* (new world hookworm) is most common in the Americas, central and southern Africa, southern Asia, Indonesia, Australia and Pacific Islands. *A. duodenale* (old world hookworm) is the dominant species in the Mediterranean region and northern Asia.

Morphology
Adult female hookworms are about 11 mm x 50 micrometers. Males are smaller. The anterior end of *N. americanes* is armed with a pair of curved cutting plates whereas *A. duodenale* is equipped with one or more pairs of teeth. Hookworm eggs are 60 micrometers x 35 micrometers.

Life cycle (figure 11 and 12)
The life cycle of hookworms is identical to that of threadworms, except that hookworms are not capable of a free-living or auto-infectious cycle. Furthermore, *A. duodenale* can infect also by oral route.



Symptoms

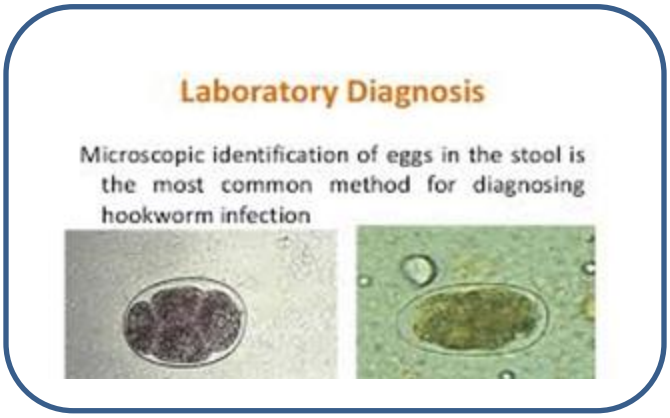
Symptoms of hookworm infection depend on the site at which the worm is present (Table 2) and the burden of worms. Light infection may not be noticed.

Table 2. Clinical features of hookworm disease

Site	Symptoms	Pathogenesis
Dermal	Local erythema, macules, papules (ground itch)	Cutaneous invasion and subcutaneous migration of larva
Pulmonary	Bronchitis, pneumonitis and, sometimes, eosinophilia	Migration of larvae through lung, bronchi, and trachea
Gastro-intestinal	Anorexia, epigastric pain and gastro-intestinal hemorrhage	Attachment of adult worms and injury to upper intestinal mucosa
Hematologic	Iron deficiency, anemia, hypoproteinemia, edema, cardiac failure	Intestinal blood loss

Diagnosis

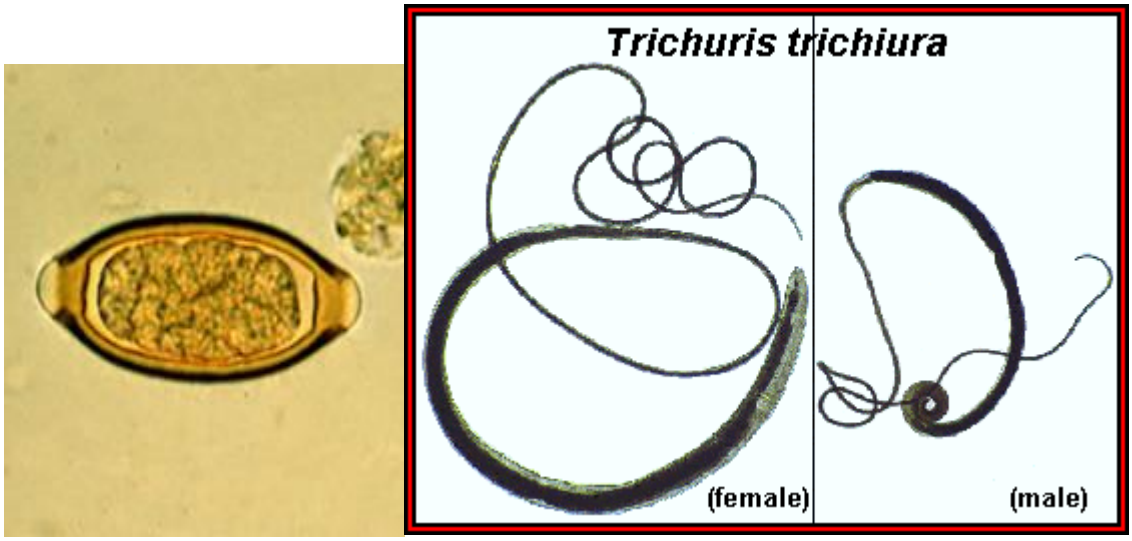
Diagnosis is made by identification of hookworm eggs in fresh or preserved feces. Species of hookworms cannot be distinguished by egg morphology.



Treatment and control

Mebendazole, 200 mg, for adults and 100 mg for children, for 3 days is effective. Sanitation is the chief method of control: sanitary disposal of fecal material and avoidance of contact with infected fecal material.

Trichuris trichiura (whipworm)



Epidemiology

Trichuriasis is a tropical disease of children (5 to 15 yrs) in rural Asia (65% of the 500 - 700 million cases). It is, however, seen in the two Americas, mostly in the South and is concentrated in families and groups with poorer sanitary habits.

Kingdom:	Animalia
Phylum:	Nematoda
Class:	Enoplea
Order:	Trichocephalida
Family:	Trichuridae
Genus:	*Trichuris*
Species:	***T. trichiura***

Morphology

Trichuris trichiura is typically 54 mm x 22 mm long, but sizes of the whipworm range from 49-65 mm x 20-29 mm. It is elongated, and barrel-shaped with a polar "plug" at each end. Its color varies from yellow to brown

and the "plugs" are colorless. It appears as 1 cell or unsegmented in its stage of development when being passed. Female and male *T. trichuria* are easily distinguishable by the shape of their heads. The females have a straight and thick head while the mails have a curly ended head.

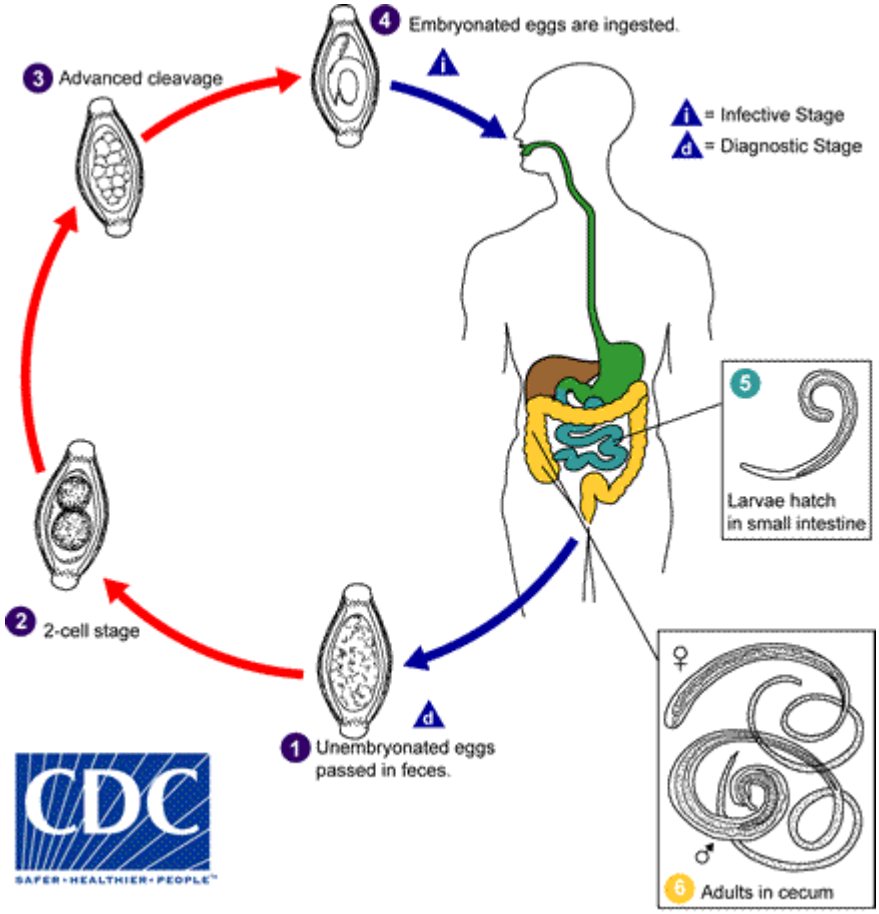
Life cycle

Infection occurs by ingestion of embryonated eggs in soil. The larva escapes the shell in the upper small intestine and penetrates the villus where it remains for 3 to 10 days. Upon reaching adolescence, the larvae pass to the cecum and embed in the mucosa. They reach the ovipositing age in 30 to 90 days from infection, produce 3000 to 10,000 eggs per day and may live as long as 5 to 6 years. Eggs passed in feces embryonate in moist soil within 2 to 3 weeks (Figure 5 and 6). The eggs are less resistant to desiccation, heat and cold than ascaris eggs. The embryo is killed under desiccation at 37 degrees C within 15 minutes. Temperatures of 52 degrees C and -9 degrees C are lethal.

Symptoms

Symptoms are determined largely by the worm burden: less than 10 worms are asymptomatic. Heavier infections (e.g., massive infantile trichuriasis) are characterized by chronic profuse mucus and bloody diarrhea with abdominal pains and edematous

prolapsed rectum. The infection may result in malnutrition, weight loss and anemia and sometimes death.



Diagnosis

Diagnosis is based on symptoms and the presence of eggs in feces (50 to 55 x 20 to 25 micrometers).

Treatment and Control

Mebendazole, 200 mg, for adults and 100 mg for children, for 3 days is effective. Accompanying infections must be treated accordingly. Improved hygiene and sanitary eating habits are most effective in control.