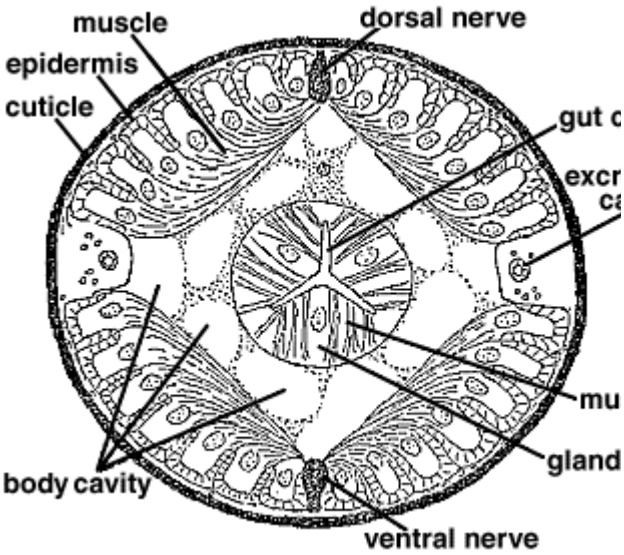
Introduction to the Nematoda

the roundworms



Roundworms : The image at left shows a living microscopic roundworm as viewed with an Environmental SEM. The worm is approximately one millimeter long. At right, a diagrammatic view of the internal anatomy of a roundworm, showing the simplicity of its organization. See text below for discussion. (Click on either of the pictures above for a larger image).

Morphology

Like mollusks, nematodes are triploblastic (having three primary germ layers: the ectoderm, mesoderm, and endoderm) protostomes. However, unlike mollusks, which have a true coelom (eucoelom; fluid filled body cavity with a complete lining derived from the mesoderm), the nematodes have a pseudocoelom (a "false cavity," whereby tissue derived from the mesoderm only partly lines the fluid filled body cavity). In nematodes, as with rotifers (Phylum Rotifera), the body cavity is lined on the inside by endoderm and on the outside by mesoderm (

Nematodes are thin and are round in cross section, though they are actually bilaterally symmetric. Most bilaterially symmetrical animals have a true coelom, unlike the nematodes.

Nematodes are one of the simplest animal groups to have a complete digestive system, with a separate orifice for food intake and waste excretion, a pattern followed by all subsequent, more complex animals. As a pseudocoel, the body cavity lacks the muscles of coelomate animals that force food down the digestive tract. Nematodes thus depend on

internal/external pressures and body movement to move food through their digestive tracts. The mouth is often surrounded by various flaps or projections used in feeding and sensation. Excretion is through a separate excretory pore.

Nematodes have no circulatory or respiratory systems, so they use diffusion to breathe and for circulation of substances around their body. Nematodes have a simple nervous system, with a main nerve cord running along the ventral side. Sensory structures at the anterior end are called amphids, while sensory structures at the posterior end are called phasmids.

The portion of the body past the anus or cloaca is called the "tail."

The nematode epidermis secretes a layered cuticle made of keratin that protects the body from drying out, from digestive juices, or from other harsh environments. In some species, it sports projections such as cilia that aid in locomotion. Although this cuticle allows movement and shape changes via a hydrostatic skeletonal system, it is very inelastic and does not allow the volume of the worm to increase. Therefore, as the worm grows, it has to ecdysis and form new cuticles. As cuticles do not allow volume to increase, high hydrostatic pressure is maintained inside the organism, yielding the round form of the worms.

Most free-living nematodes are microscopic, though a few parasitic forms can grow to several meters in length (typically as parasites of very large animals such as whales).

Behavior and life cycle

Nematodes lack circular muscles, so the body can only undulate from side to side. Contact with solid objects is necessary for locomotion; its thrashing motions vary from mostly to completely ineffective at swimming.

Nematodes generally eat bacteria, fungi, and protozoans, although some are filter feeders.

Reproduction is usually sexual. Males are usually smaller than females (often very much smaller) and often have a characteristically bent tail for holding the female for copulation. During copulation, one or more chitinized spicules move out of the cloaca and are inserted into the genital pore of the female. Amoeboid sperm crawl along the spicule into the female worm. Nematode sperm is thought to be the only eukaryotic cell without the globular protein G-actin.

Eggs may be embryonated or unembryonated when passed by the female, meaning that their fertilized eggs may not yet be developed. In free-living roundworms, the eggs hatch into larva, which eventually grow into adults; in parasitic roundworms, the life cycle is often much more complicated.

Free-living species

In free-living species, development usually consists of four molts of the cuticle during growth.

Different species feed on organic matter as varied as algae, fungi, small animals, fecal matter, dead organisms, and living tissues. Free-living marine nematodes are important and abundant members of the meiobenthos.

One roundworm of note is *Caenorhabditis elegans*, which lives in the soil and has found much use as a model organism. *C. elegans* has had its entire genome sequenced, as well as the developmental fate of every cell determined, and every neuron mapped.

Some nematodes can undergo cryptobiosis, an ametabolic state of life entered by in response to adverse environmental conditions. In the cryptobiotic state, all metabolic procedures stop, preventing reproduction, development, and repair. An organism in a cryptobiotic state can essentially live indefinitely until environmental conditions return to being hospitable.

Parasitic species

Parasitic forms of nematodes often have quite complicated life cycles, moving between several different hosts or locations in the host's body. Infection occurs variously by eating uncooked meat with larvae in it, by entrance into unprotected cuts or directly through the skin, by transfer via insect vectors, and so forth.

Nematodes commonly parasitic on humans include whipworms, hookworms, pinworms, ascarids, and filarids. The species *Trichinella spiralis*, commonly known as the trichina worm, occurs in rats, pigs, and human beings, and is responsible for the disease trichinosis. People can get infected when they consume undercooked pork. *Baylisascaris* usually infests wild animals, but can be deadly to humans as well. *Haemonchus contortus* is one of the most abundant infectious agents in sheep around the world, causing great economic damage to sheep farms.

Ancylostoma and *Necator* are two genera of hookworms that harm over 400 million people worldwide, and *Necator* causes about 90 percent of tropical and semitropical infestations (Towle 1989). Since they bore through the feet of hosts, shoes can protect against infestations.