UG CBCS Semester-1
Phylum: Platyhelminthes

Free-living, and parasitic, bilaterally symmetrical, triploblastic Metazoa; usually flattened dorsoventrally; without anus, coelom or haemocoele; with a flame-cell system; and with complicated, usually hermaphrodite, organs of reproduction.

The name Platyhelminthes is given to a division of that heterogeneous collection of animals which in Linnaeus's time were called Vermes. The Vermes included everything that looked like a worm, but appearances have since been found to be deceptive and the collection has been broken up into separate phyla, one of which is the Platyhelminthes or flatworms. Of all the worm-like animals the flat-worms are undoubtedly the most primitive, for they alone show relationships to the Coelenterata. Some authors have suggested that the Turbellaria are the most primitive of the Metazoa, and that the Coelenterates are derived from the Platyhelminthes.

CLASSIFICATION

Class I: Turbellaria

Free-living platyhelminthes, with a gut, a cellular ciliated outer covering to the body, usually havingrhabdites, not forming proglottides. Suckers are rarely present. The system-atics are based primarily on the arrangement and structure of the gut.

Order 1: Acoela. The gut is not hollow but is a syncytium formed by the union of endodermal cells. There is no muscular pharynx. *Convoluta, Otocelis*

Order 2: Rhabdocoela. The gut is straight with the mouth at the anterior end. *Microstomum, Rhynchoscolex, Dalyellia*

Order 3: Alloiocoela. The gut has small diverticula arising from it. *Plagiostomum, Hofstenia, Otoplana*

Order 4: Tricladida. Gut with three branches, one directed forwards, two directed backwards. *Procerodes, Bdelloura*, *Phagocata, Polycelis, Planaria, Bipalium, Cotyloplana*

Order 5: Polycladida. Gut has many branches radiating out from central mouth. *Euplana, Leptoplana, Thysanozoon, Yungia*

Order 6: Temnocephalea. Ectocommensals on fresh-water crustaceans, reduced ciliation, develop prolongations on the anterior end, have suckers. *Temnocephala, Actinodactylella*

Class II: Trematoda

Parasitic platyhelminthes with a gut, a thick cuticle, and suckers that may be thickened by a series of chitinous ridges.

Order 1: Heterocotylea *or* **Monogenea.** Oral suckers usually absent or poorly developed, posterior suckers usually well developed and complex. No alternation of hosts. *Polystomum, Octobothrium*

Order 2: Malacocotylea *or* Digenea. Anterior sucker well developed, alternation of hosts. *Distomum, Schistosoma*

Class III: Cestoda

Endoparasitic platyhelminthes, no gut, adult has lost ciliated ectoderm and replaced it by a thick cuticle; proglottides usually formed.

Order 1: Cestodaria. Tapeworms with undivided bodies, do not form proglottides. *Amphilina*

Order 2: **Eucestoda.** Tapeworms with body divided into proglottides. *Taenia, Diphyllobothrium, Moniezia*

Unlike cnidarians, flatworms have an excretory system, which consists of a network of fine tubules (little tubes) that runs throughout the body. Cilia line the hollow centers of bulblike **flame cells** located on the side branches of thetubules. Cilia in the flame cells move water and excretory substances into the tubules and then to exit pores located between the epidermal cells. Flame cells were named because of the flickering movements of the tuft of cilia within them. They primarily regulate the water balance of the organism. The excretory function of flame cells appears to be a secondary one. A large proportion of the metabolic wastes excreted by flatworms diffuses directly into the gut and is eliminated through the mouth.

Like sponges, cnidarians, and ctenophorans, flatworms lack circulatory systems for the transport of oxygen and food molecules. Consequently, all flatworm cells must be within diffusion distance of oxygen and food. Flatworms have thin bodies and highly branched digestive cavities that make such a relationship possible.

The nervous system of flatworms is very simple. Like cnidarians, some primitive flatworms have only a nerve net. However, most members of this phylum have longitudinal nerve cords that constitute a simple central nervous system.

Free-living members of this phylum have eyespots on their heads. These are inverted, pigmented cups containing light-sensitive cells connected to the nervous system. These eyespots enable the worms to distinguish light from dark; worms move away from strong light.

The reproductive systems of flatworms are complex.

Most flatworms are **hermaphroditic,** with each individual containing both male and female sexual structures. In many of them, fertilization is internal. When they mate, each partner deposits sperm in the copulatory sac of the other. The sperm travel along special tubes to reach the eggs. In most free-living flatworms, fertilized eggs are laid in cocoons strung in ribbons and hatch into miniature adults. In some parasitic flatworms, there is a complex succession of distinct larval forms. Flatworms are also capable of asexual regeneration. In some genera, when a single individual is divided into two or more parts, each part can regenerate an entirely new flatworm.

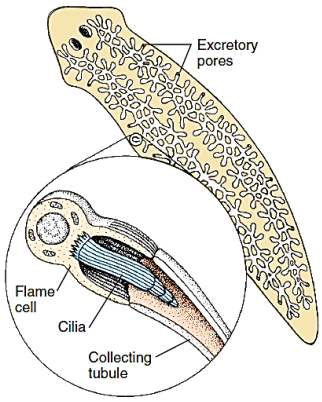

FIGURE 58.9
The protonephridia of flatworms. A branching system of tubules, bulblike flame cells, and excretory pores make up the protonephridia of flatworms. Cilia inside the flame cells draw in fluids from the body by their beating action. Substances are then expelled through pores which open to the outside of the body.

Class Turbellaria: Turbellarians.

Only one of the three classes of flatworms, the turbellarians (class Turbellaria) are free-living. One of the most familiar is the freshwater genus *Dugesia,* the common planaria used in biology laboratory exercises. Other members of this class are widespread and often abundant in lakes, ponds, and the sea. Some also occur in moist places on land.

Class Trematoda: The Flukes.

Two classes of parasitic flatworms live within the bodies of other animals: flukes (class Trematoda) and tapeworms (class Cestoda). Both groups of worms have epithelial layers resistant to the digestive enzymes and immune defenses produced by their hosts—an important feature in their parasitic way of life. However, they lack certain features of the freeliving flatworms, such as cilia in the adult stage, eyespots, and other sensory organs that lack adaptive significance for an organism that lives within the body of another animal.

Flukes take in food through their mouth, just like their free-living relatives. There are more than 10,000 named species, ranging in length from less than 1 millimeter to more than 8

centimeters. Flukes attach themselves within the bodies of their hosts by means of suckers, anchors, or hooks. Some have a life cycle that involves only one host, usually a fish. Most have life cycles involving two or more hosts. Their larvae almost always occur in snails, and there may be other intermediate hosts. The final host of these flukes is almost always a vertebrate.

To human beings, one of the most important flatworms is the human liver fluke, *Clonorchis sinensis*. It lives in the bile passages of the liver of humans, cats, dogs, and pigs. It is especially common in Asia. The worms are 1 to 2 centimeters long and have a complex life cycle. Although they are hermaphroditic, cross-fertilization usually occurs between different individuals. Eggs, each containing a complete, ciliated first-stage larva, or **miracidium,** are passed in the feces. If they reach water, they may be ingested by a snail. Within the snail an egg transforms into a *sporocyst*—a baglike structure with embryonic germ cells. Within the sporocysts are produced **rediae,** which are elongated, nonciliated larvae. These larvae continue growing within the snail, giving rise to several individuals of the tadpole-like next larval stage, **cercariae.**

Cercariae escape into the water, where they swim about freely. If they encounter a fish of the family Cyprinidae—the family that includes carp and goldfish—they bore into the muscles or under the scales, lose their tails, and transform into **metacercariae** within cysts in the muscle tissue. If a human being or other mammal eats raw infected fish, the cysts dissolve in the intestine, and the young flukes migrate to the bile duct, where they mature. An individual fluke may live for 15 to 30 years in the liver. In humans, a heavy infestation of liver flukes may cause cirrhosis of the liver and death.

Other very important flukes are the blood flukes of genus *Schistosoma.* They afflict about 1 in 20 of the world's population, more than 200 million people throughout tropical Asia, Africa, Latin America, and the Middle East. Three species of *Schistosoma* cause the disease called schistosomiasis, or bilharzia. Some 800,000 people die each year from this disease.

Recently, there has been a great deal of effort to control schistosomiasis. The worms protect themselves in part from the body's immune system by coating themselves with a variety of the host's own antigens that effectively render the worm immunologically invisible. Despite this difficulty, the search is on for a vaccine that would cause the host to develop antibodies to one of the antigens of the young worms before they protect themselves with host antigens. This vaccine would prevent humans from infection. The disease can be cured with drugs after infection.

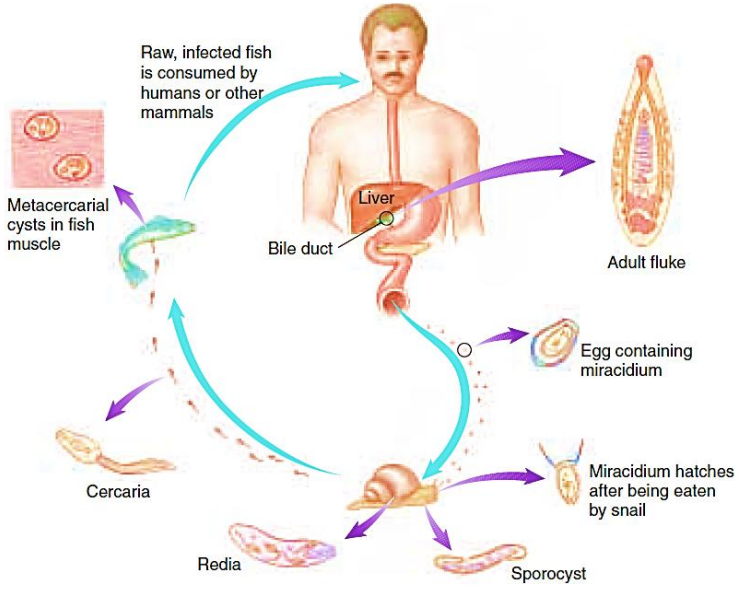

FIGURE 44.17
Life cycle of the human liver fluke, *Clonorchis sinensis.*

Class Cestoda: The Tapeworms. Class Cestoda is the third class of flatworms; like flukes, they live as parasites within the bodies of other animals. In contrast to flukes, tapeworms simply hang on to the inner walls of their hosts by means of specialized terminal attachment organs and absorb food through their skins. Tapeworms lack digestive cavities as well as digestive enzymes. They are extremely specialized in relation to their parasitic way of life. Most species of tapeworms occur in the intestines of vertebrates, about a dozen of them regularly in humans. The long, flat bodies of tapeworms are divided into three zones: the **scolex,** or attachment organ; the unsegmented **neck;** and a series of repetitive segments, the **proglottids**. The scolex usually bears several suckers and may also have hooks. Each proglottid is a complete hermaphroditic unit, containing both male and female reproductive organs. Proglottids are formed continuously in an actively growing zone at the base of the neck, with maturing ones moving farther back as new ones are formed in front of them. Ultimately the proglottids near the end of the body form mature eggs. As these eggs are fertilized, the zygotes in the very last segments begin to differentiate, and these segments fill with embryos, break off, and leave their host with the host's feces. Embryos, each surrounded by a shell, emerge from the proglottid through a pore or the ruptured body wall. They are deposited on leaves, in water, or in other places where they may be picked up by another animal.

The beef tapeworm *Taenia saginata* occurs as a juvenile in the intermuscular tissue of cattle but as an adult in the intestines of human beings. A mature adult beef tapeworm may reach a length of 10 meters or more. These worms attach themselves to the intestinal wall of their host by a scolex with four suckers. The segments that are shed from the end of the worm pass from the human in the feces and may crawl onto vegetation. The segments ultimately rupture and scatter the embryos. Embryos may remain viable for up to five months. If they are ingested by cattle, they burrow through the wall of the intestine and ultimately reach muscle tissues through the blood or lymph vessels.

About 1% of the cattle in the United States are infected, and some 20% of the beef consumed is not federally inspected. When infected beef is eaten rare, infection of humans by these tapeworms is likely. As a result, the beef tapeworm is a frequent parasite of humans.

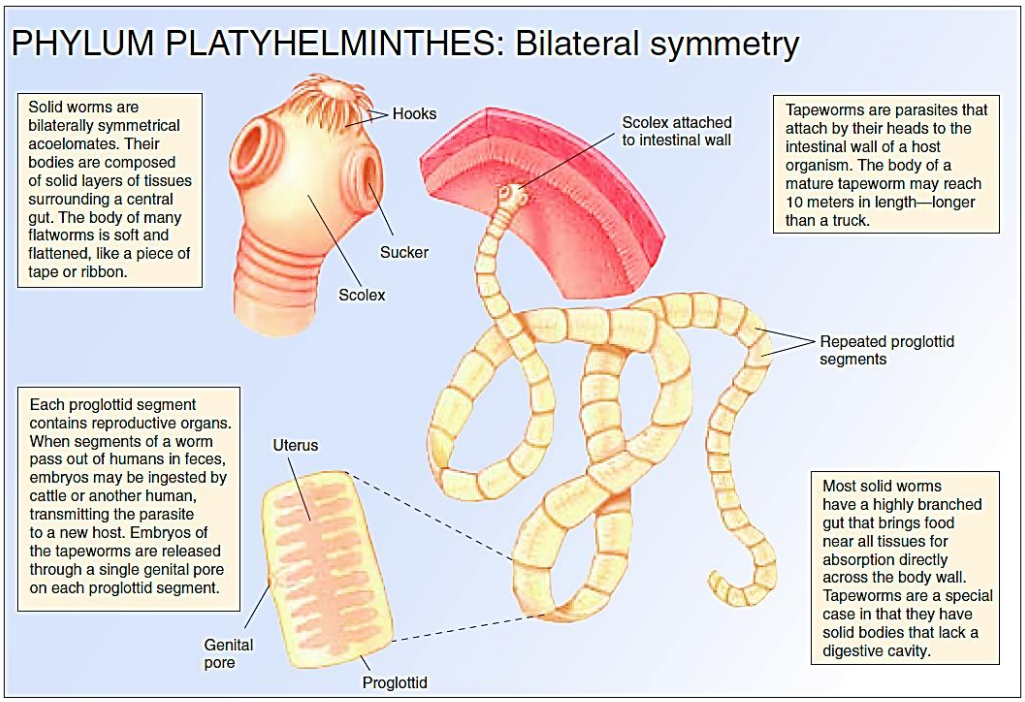

FIGURE 44.16
The evolution of bilateral symmetry. Acoelomate solid worms like this beef tapeworm, *Taenia saginata*, are bilaterally symmetrical. In addition, all bilaterians have three embryonic layers and exhibit cephalization.