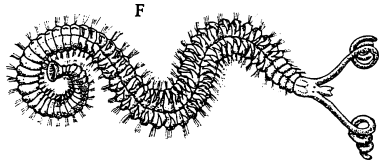

ENTOMOLOGY 322
LAB 1 Annelida

Among the invertebrates, the Annelida is traditionally considered the phylum most closely related to Arthropoda. This makes annelid morphology a good starting point for a survey of arthropods. Although annelids possess an array of unique, derived characters (autapomorphies) they also display numerous primitive features. In this lab, we will identify a number of these primitive features, and in subsequent labs, identify how they are modified in arthropods.

1.

Obtain a live or preserved earthworm (Annelida: Oligochaeta, *Lumbricus*). Examine its external anatomy. Note that the cylindrical body is subdivided into over 100 annuli (singular - annulus) that correspond to the body segments. The dorsal (top) surface is distinguishable by its darker color from the ventral (bottom) surface.

The prostomium is the anteriormost tip of the body. The mouth is ventral to the prostomium, and bounded largely by the anterior edge of the second annulus (which represents the first true body segment, called the peristomium). The remainder of the body segments are similar, except for the 5 or 6 segments beginning with number 32 or 33. This region is the clitellum, whose walls are swollen because of large glands responsible for the formation of the egg cocoon. Terminally located in the last segment is the anus.

The male genital pores occur as small transverse slits lying between two swollen lips ventrally in segment 15 (Fig 1.4). The female genital pores occupy a corresponding position on segment 14 but are less conspicuous. Small openings to the spermathecae occur on the lateral surface between segments 9 and 10, and 10 and 11. These are also difficult to locate.

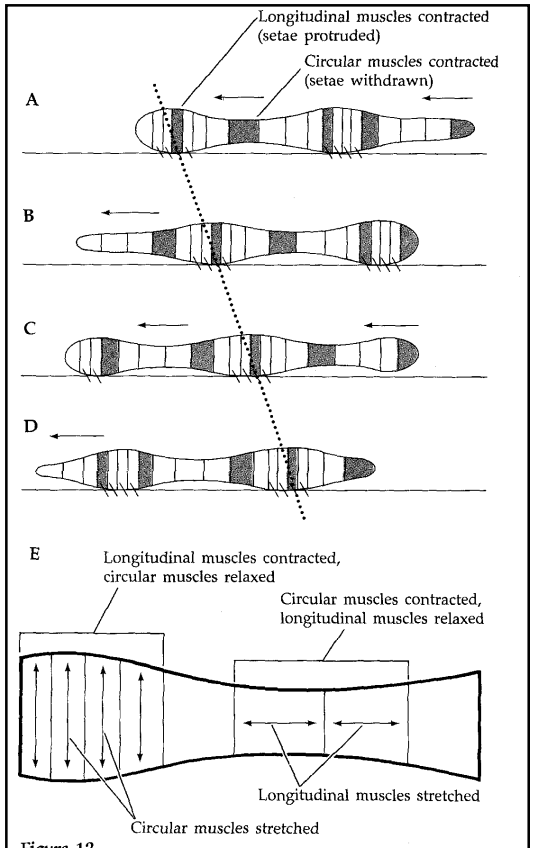

Figure 12

Earthworm locomotion. A–D, An earthworm moving to the left. Every fourth segment is darkened for reference. The dotted line passes through a posteriorly moving point of contact with the substratum. E, Several segments of an earthworm (sagittal section). Since each segment is a functionally isolated compartment, shortening and elongation accompany the contraction of longitudinal and circular muscles, respectively, while each segment essentially maintains a constant volume. See text for further explanation. (A–D after Russell-Hunter 1979, adapted from Gray and Lissmann 1938; E after Russell-Hunter 1979.)

Figure 1.1 (Brusca and Brusca, 1990)

2.

Obtain a live earthworm and wash it in water. Place it gently in the bottom of a petri dish or finger bowl that is moistened with water. Observe its forward locomotion (you may have to probe its rear end). By what process is the prostomium extended? Does the wave of contraction initiate posteriorly or anteriorly? How is the rest of the body brought up to the prostomium? About how many segments are involved in each "bulge" that marks a wave of contraction? In a long worm, can more than one wave of contraction occur at one time? Can the worm move backwards (probe its front end)? What might be the selective advantage for doing so? How is the worm able to grasp the slippery wet glass? Grasp the worm tightly at its rear end. What is its reaction? How much of the body is involved? Pinch the head end tightly. Is the response different?

3.

Now it is time to dissect a live earthworm under Ringers (see Appendix VI) in a large dissecting pan. Orient the worm with its dorsal surface up and its head (=cephalic) end pointed away from you. **Carefully** slit the worm's body wall longitudinally along its (=your) left lateral surface, cutting along the lateral setae, starting

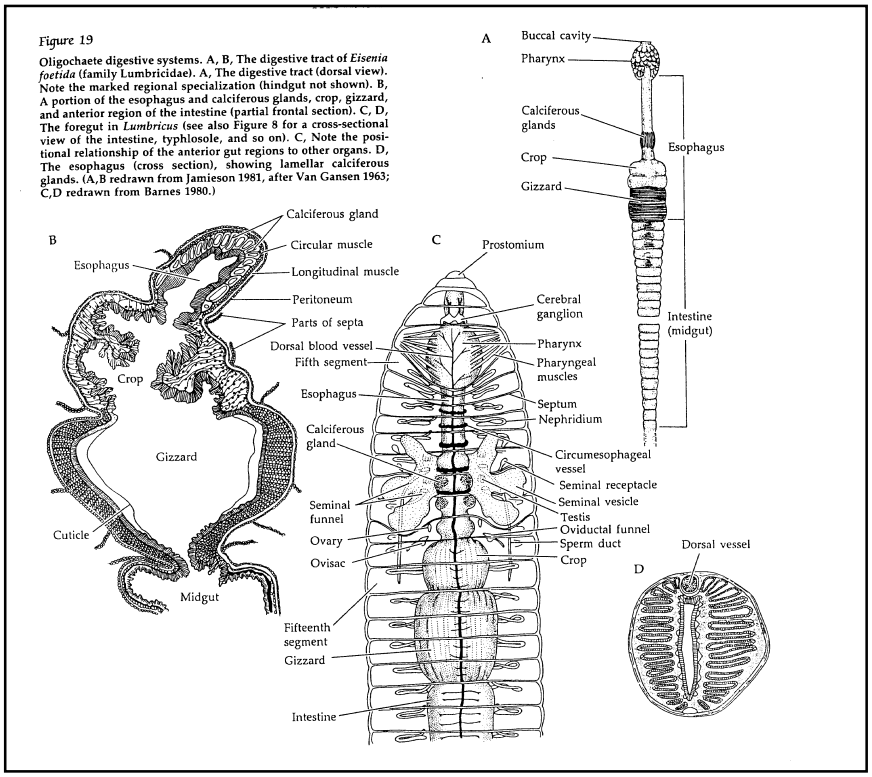

Figure 1.2 (Brusca and Brusca, 1990)

at about the 4th segment and cutting back to about 1/3 the length of the worm. **Do not cut** anterior to segment 4 at this time. Starting from the posterior end of the cut and working anteriorly, pin one edge of the body wall to the bottom of the dissecting pan, then carefully slit the septa (these are the internal divisions between the body segments - see below) near the gut so as to be able to pin the other edge of the body wall to the pan. Continue to spread open the body wall to the anterior end of the cut.

First identify the digestive system or gut (Fig. 1.2). The pharnyx is the swollen, muscular portion at the anterior end (it may still be hidden), which sucks food into the mouth. Posterior to the pharnyx is a narrower, thinner-walled esophagus which is expanded posteriorly to form a crop. Immediately posterior to the crop is

the proventriculus (="gizzard"), highly muscular and used for grinding the food. The proventriculus opens into the long intestine (=midgut), the principal digestive and absorptive portion of the gut.

The circulatory system is "closed," that is, capillaries connect the major vessels and hemolymph (=blood) does not flow freely through the body cavity or coelom. In a living worm, the hemolymph is red because it contains hemoglobin. The major vessels are a dorsal blood vessel above the gut, which transports blood anteriorly, and a ventral blood vessel below the gut, which transports blood posteriorly. Most of the other blood vessels are difficult to locate, except the "hearts," transverse vessels in segments 7-11 which aid in circulation (called circumesophageal vessels in Fig. 1.2).

The central nervous system (Fig. 1.3) visible in this dissection consists of a ventral nerve cord, with a pair of fused ganglia in each segment, each with 3 pairs of transverse nerves that extend to the gut and body wall.

The most conspicuous portions of the reproductive system (Fig. 1.4) are the seminal vesicles, sperm-holding organs in segments 10 and 11.

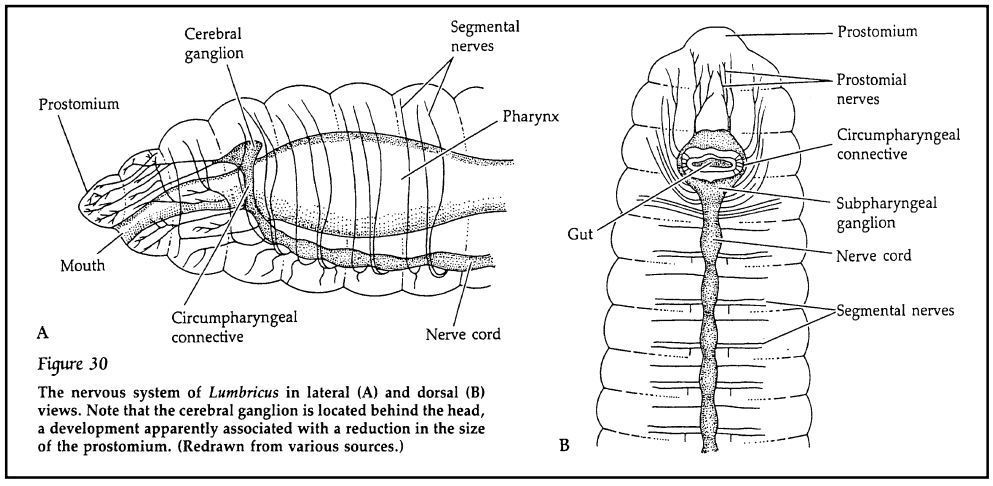

Figure 30

The nervous system of *Lumbricus* in lateral (A) and dorsal (B) views. Note that the cerebral ganglion is located behind the head, a development apparently associated with a reduction in the size of the prostomium. (Redrawn from various sources.)

Figure 1.3 (Brusca and Brusca, 1990)

Note the arrangement of the body wall. Each segment internally is bordered at each end by a membranous septum (pl-septa), thus forming a coelomic cavity (Fig. 1.5). The body wall is lined with a peritoneum (basement membrane). There are two layers of somatic muscles, an inner layer of longitudinal muscles (do they extend across more than one segment?) and an outer layer of circular muscles. Cut the earthworm in two at the posterior (=caudal) end of the longitudinal slit. Examine the arrangement of the somatic muscles in transverse section, and also the appearance of the midgut. From your dissection, can you hypothesize how the somatic muscles enable the worm to move? Which muscles extend the prostomium and which bring the rest of the worm up to it? What is the significance of the longitudinal muscles extending across several segments?

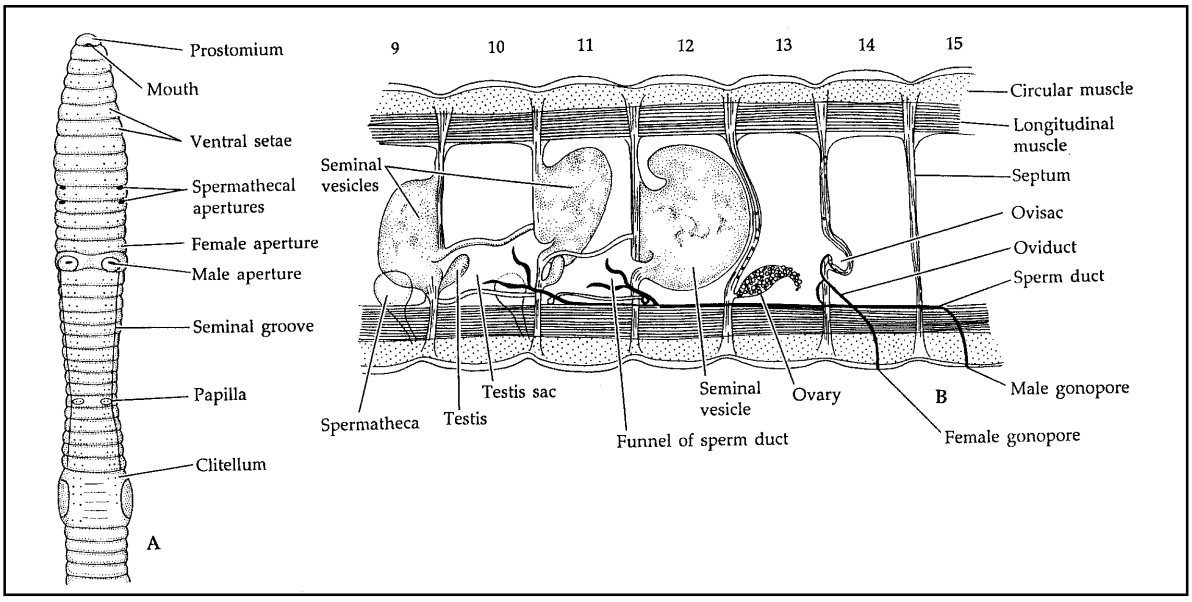

Figure 1.4 (Brusca and Brusca, 1990)

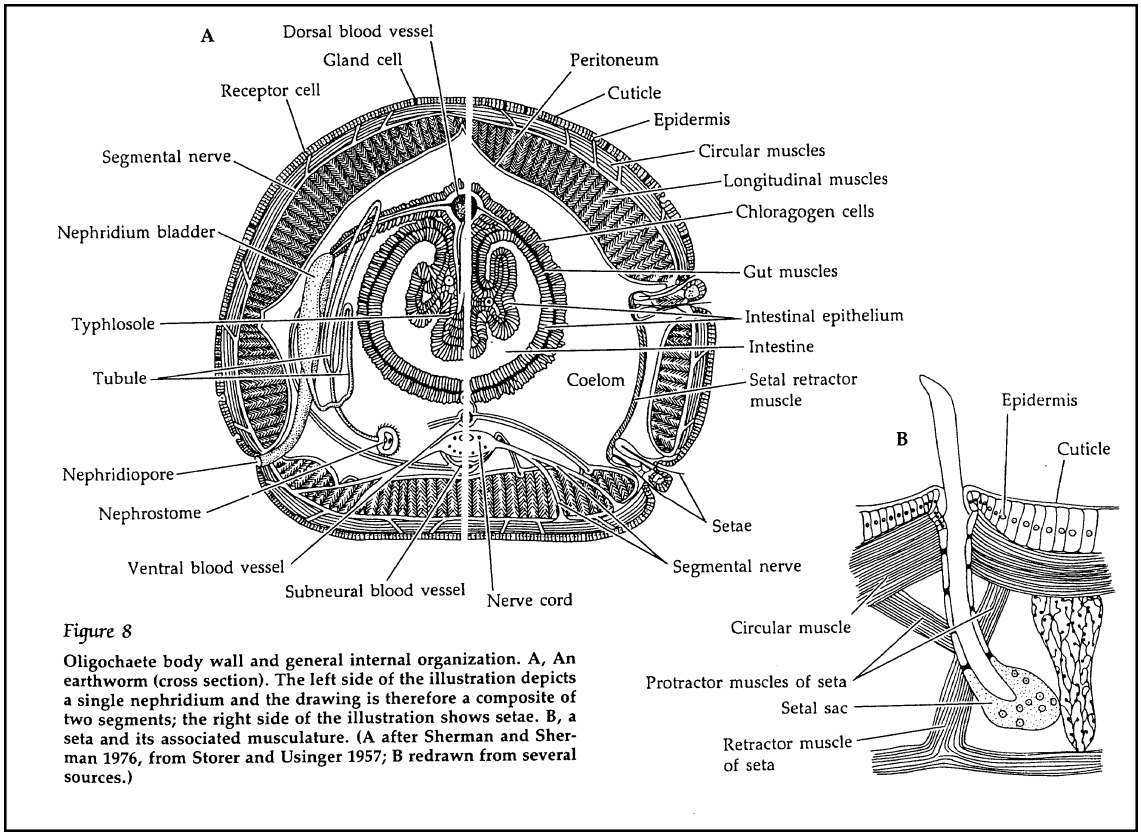

Figure 8

Oligochaete body wall and general internal organization. A, An earthworm (cross section). The left side of the illustration depicts a single nephridium and the drawing is therefore a composite of two segments; the right side of the illustration shows setae. B, a seta and its associated musculature. (A after Sherman and Sherman 1976, from Storer and Usinger 1957; B redrawn from several sources.)

Figure 1.5 (Brusca and Brusca, 1990)

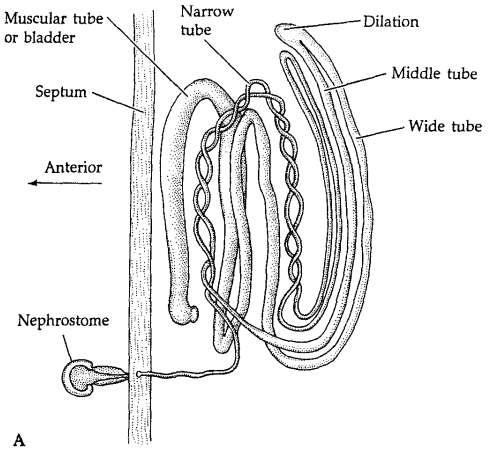

Figure 25

***Lumbricus* nephridia. A, A single nephridium and its relationship to a septum. B, Details of the nephrostome. Evidence suggests (see Laverack 1963) that earthworm nephridia are highly selective excretory and osmoregulatory units. The nephridioduct is regionally and functionally specialized along its length from the nephrostome to the nephridiopore. The narrow tube receives body fluids and various solutes, first from the coelom through the nephrostome and then from the blood across the walls of capil-**

Figure 1.6 (Brusca and Brusca, 1990)

4.

The excretory organs consist of a pair of nephridia in each segment (Fig. 1.6), that appear as small feathery masses to either side of the gut. Observe the demonstration of the nephridium (technically, metanephridium), the excretory organ. The figure accompanying the demonstration may not greatly resemble what you see. Locate: 1) the nephrostome, the ciliated, funnel-shaped opening into the coelom; 2) the bladder; and 3) the nephridiopore. Note that the end of the nephridium passes through the septum so the nephrostome opens in the segment anterior to that containing the main part of the nephridium and nephridiopore.

5.

Continue the lateral cut anteriorly with great care to the prostomium. Pin the body wall back. Again, locate the mouth, prostomium, and peristomium. Locate the anterior portion of the pharnyx and carefully expose the anterior regions of the central nervous system. Use Fig 1.3 to locate the suprapharyngeal ganglia (brain), circumpharyngeal connectives, and subpharyngeal ganglia. Locate the prostomial nerves and trace their path into the prostomium. Locate the peripheral nerves issuing from each ventral nerve cord ganglion. Is the number and arrangment the same for each of segments 1-4?

6.

Now we will briefly examine a relatively generalized member of the class Polychaeta, the clamworm, *Neanthes*. This predatory worm inhabits shallow marine environments. The parapodia function as simple limbs for crawling over and through loose substrate, or function as paddles enabling *Neanthes* to swim freely via lateral undulations of its body. Obtain a preserved specimen and examine its external anatomy, use Fig 1.7 to locate the following structures:

pharynx (may not be everted)
prostomium
peristomium
tenacles and palps
parapodium

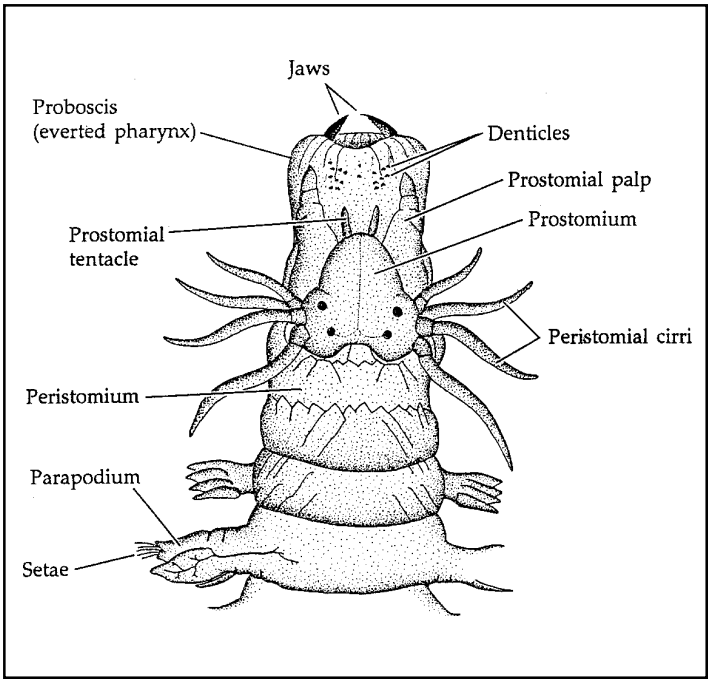

Figure 1.7 *Nereis* (Annelida: Polychaeta) (Brusca and Brusca, 1990)

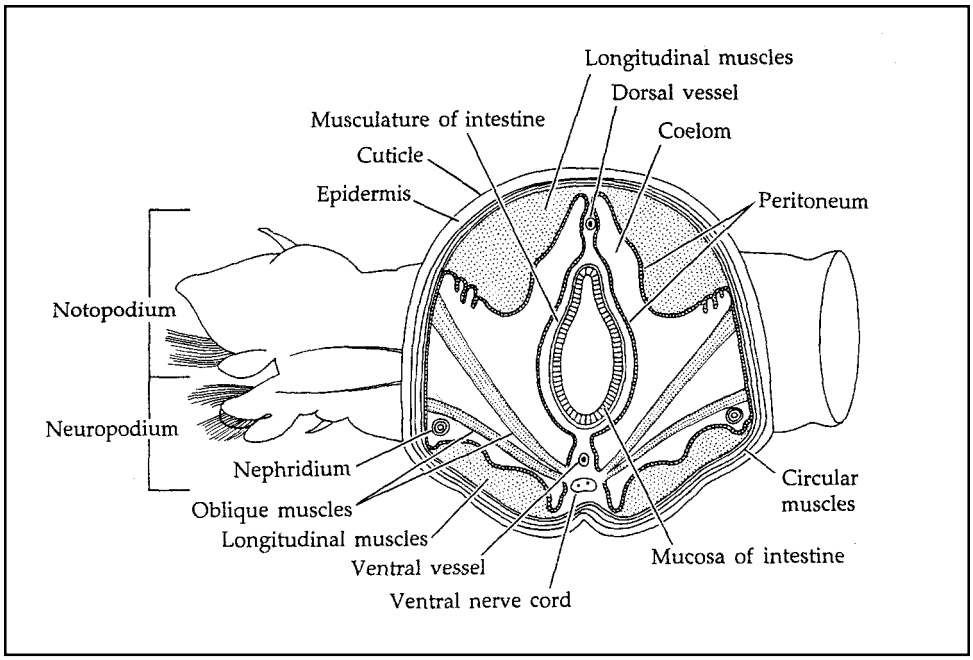

Figure 1.8. *Nereis* (Annelida: Polychaeta) (Brusca and Brusca, 1990)

Observe the demonstration of a transverse section of a segment. Use Fig 1.8 to locate the following structures:

parapodia
muscles
body wall
circular muscles
longitudinal muscles
septum
intestine (midgut)
dorsal and ventral blood vessels
ventral nerve cord