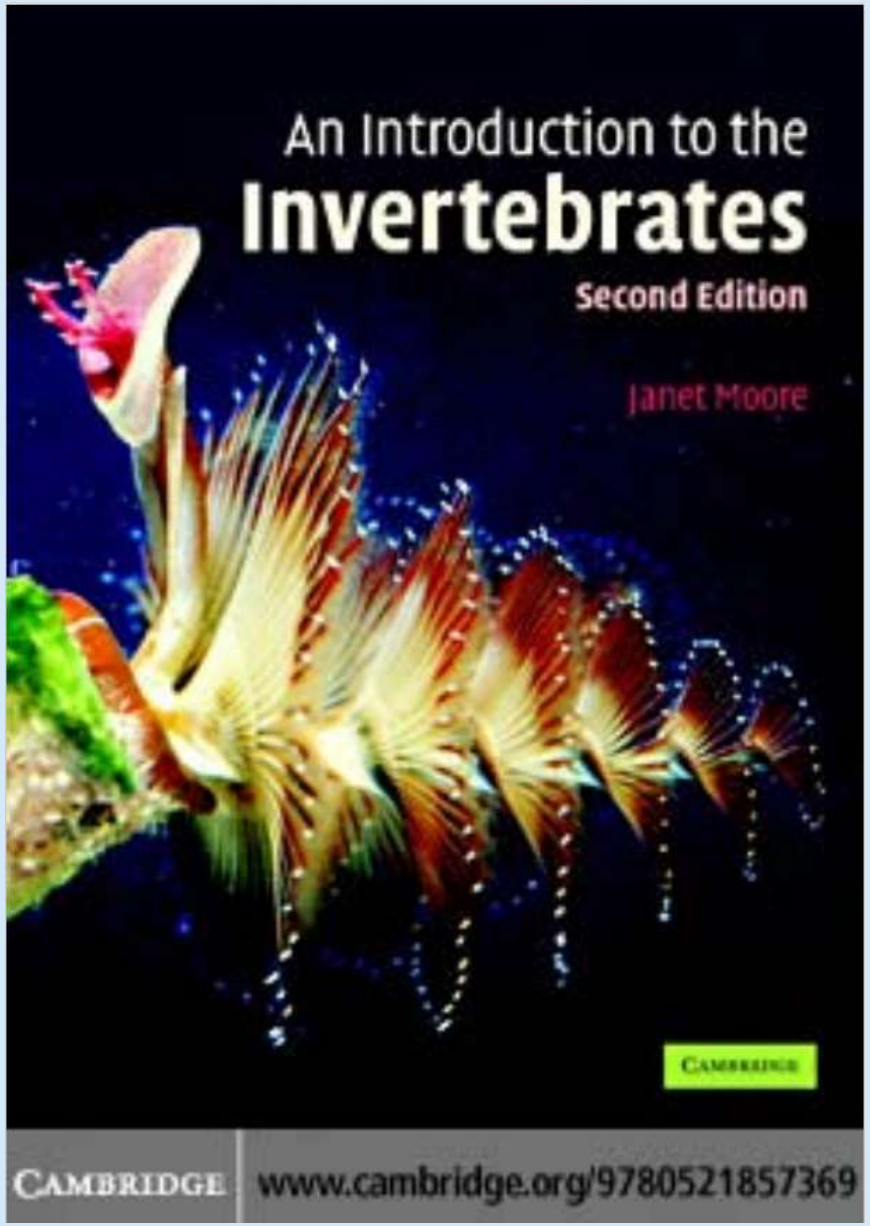
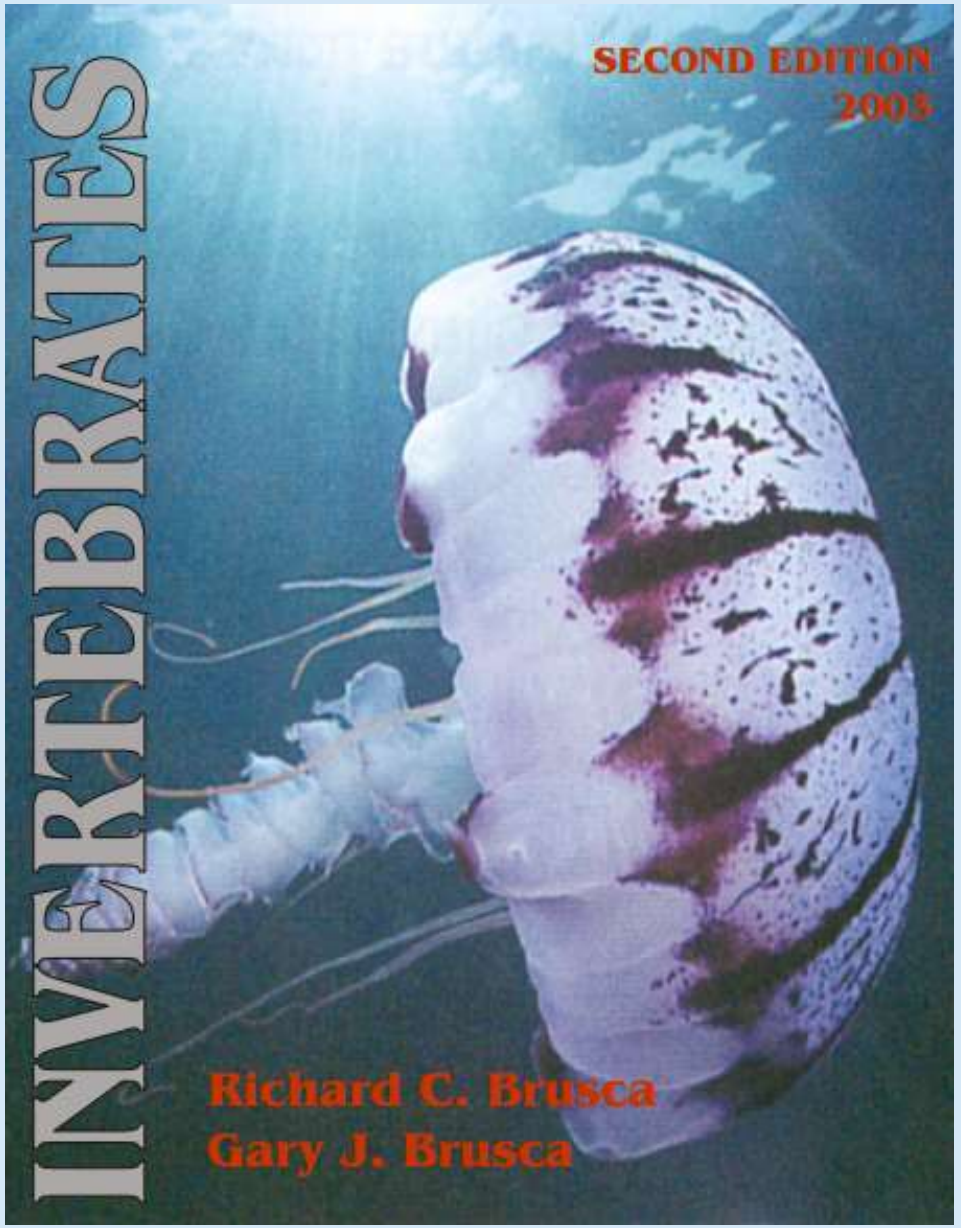
MATA KULIAH
ZOOLOGI INVERTEBRATA

Program Studi S-1 Biologi
Jurusan Biologi
Fakultas Matematika dan Ilmu Pengetahuan Alam
Universitas Lampung





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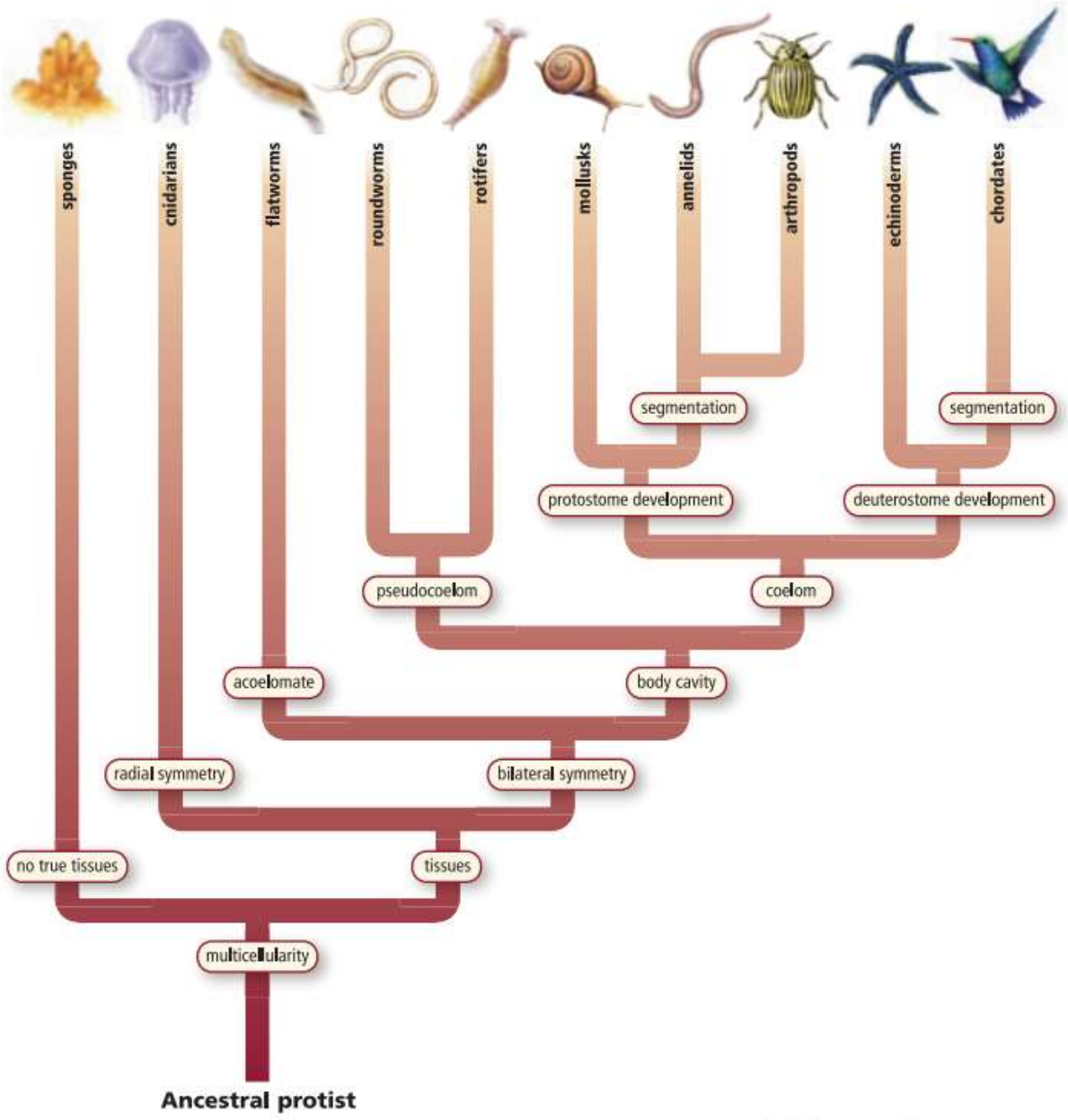

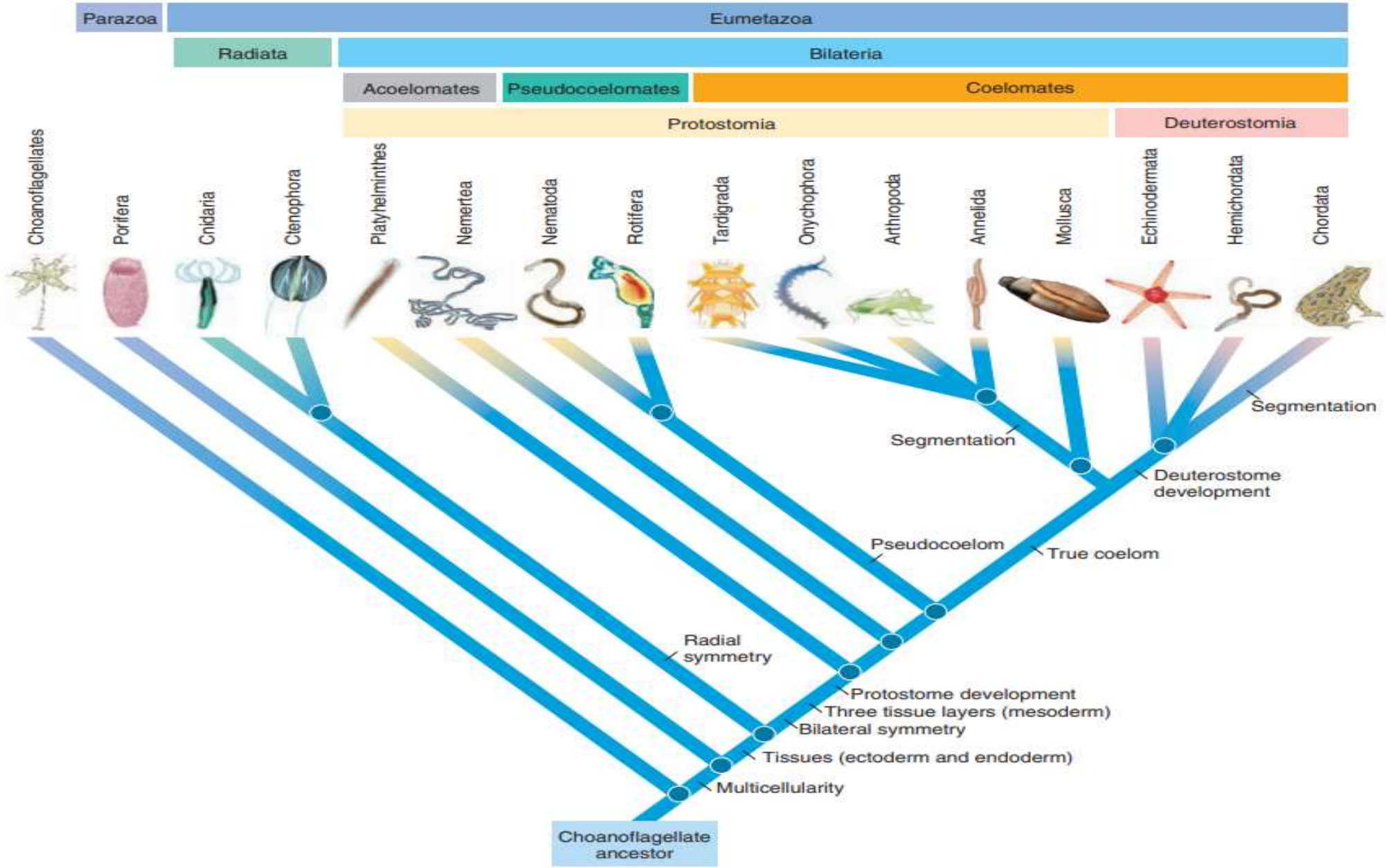

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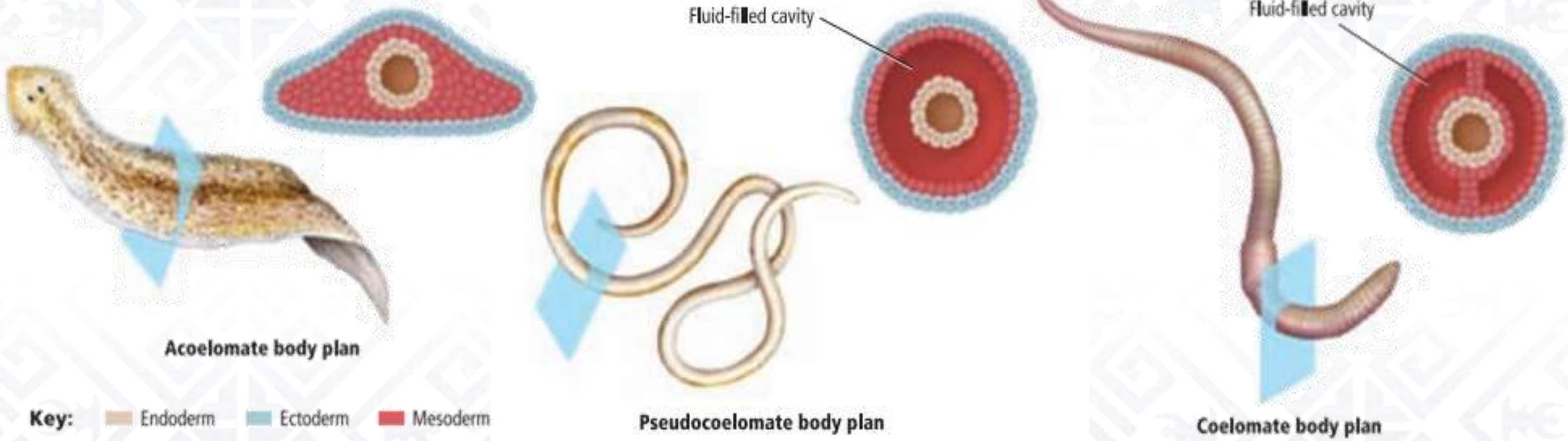
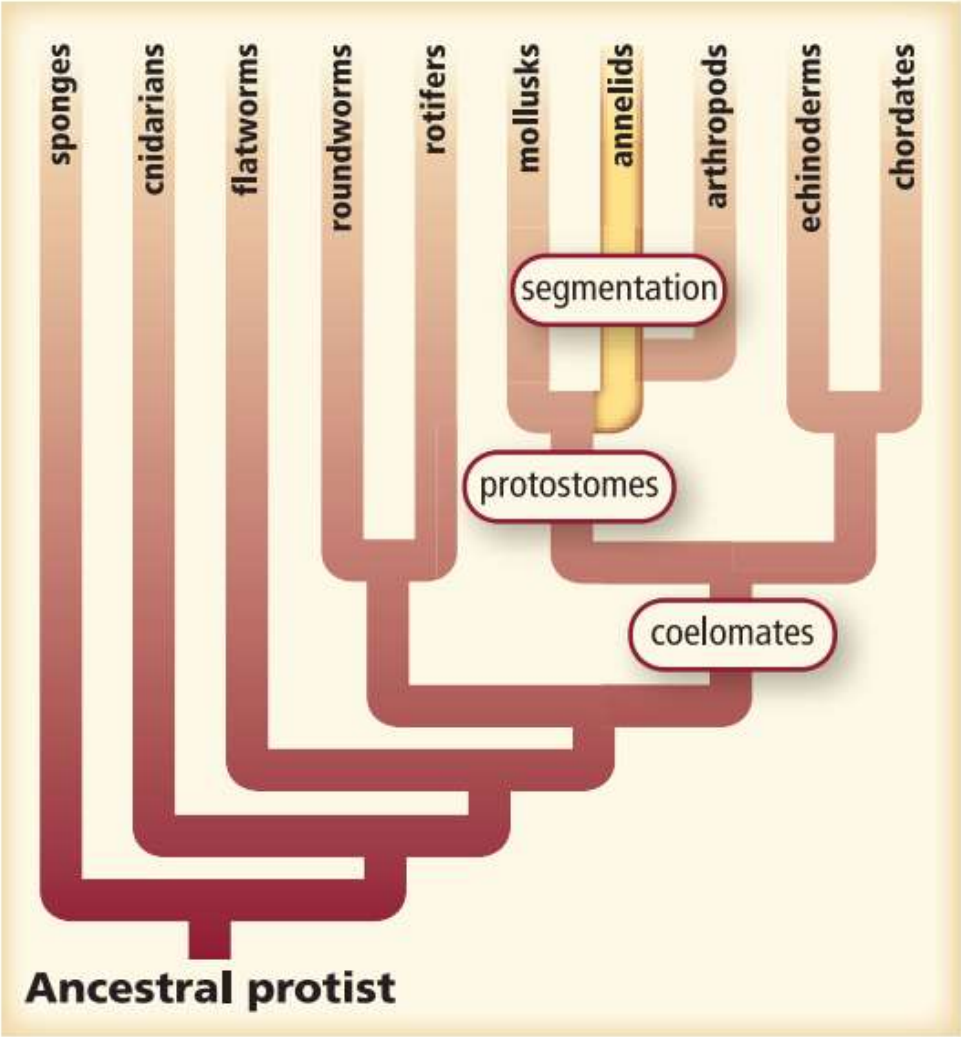
Body Plan of Worm



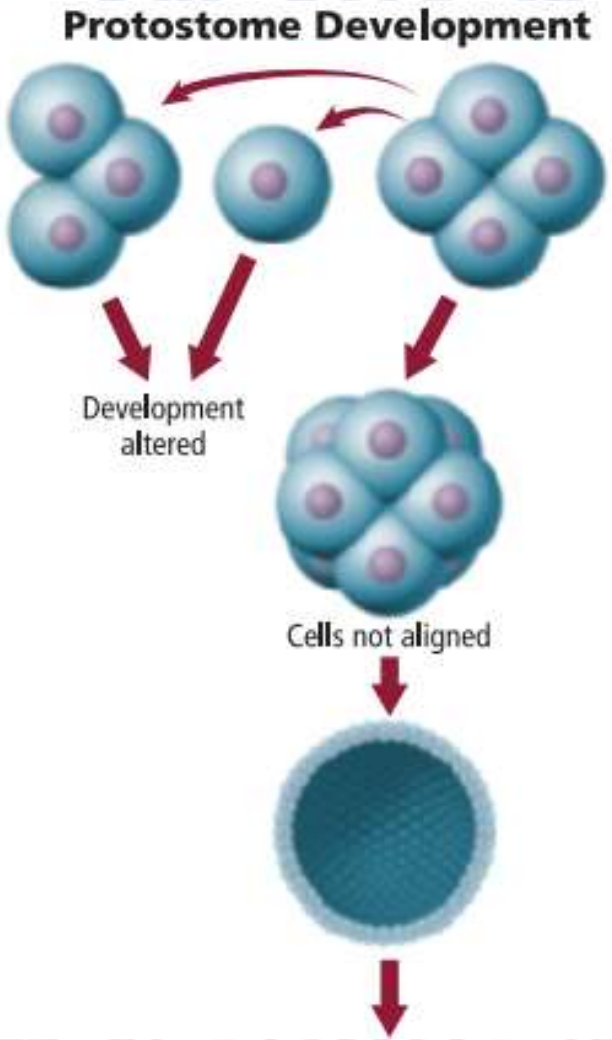
Annelids: Segmented Worm



Fan worm

Bristleworm

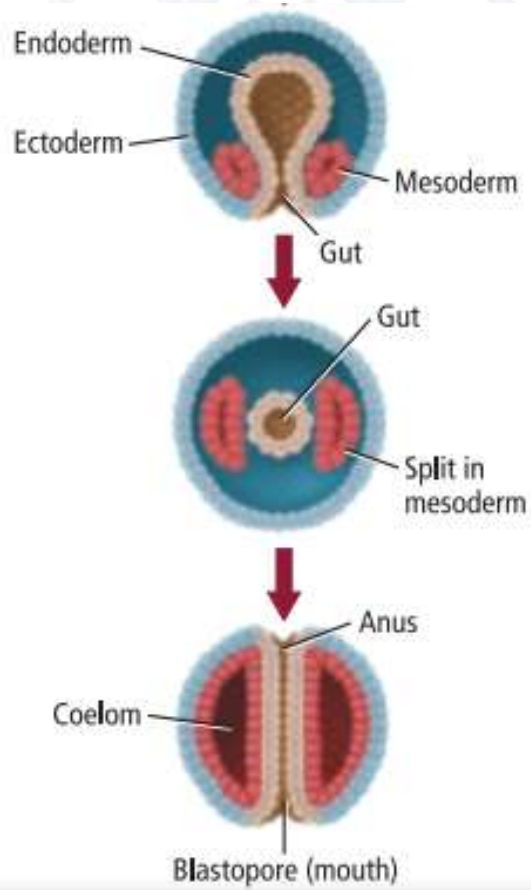
Annelids: Protostome organism



A If one cell is removed from a protostome at the four-cell stage, the development of all embryos is altered. If a cell is removed in a deuterostome at this stage, each cell or group of cells is not altered and will develop into a normal embryo.

B Another difference is apparent at the eight-cell stage. In protostomes, the four cells are between the other four cells. In deuterostomes, the cells align.

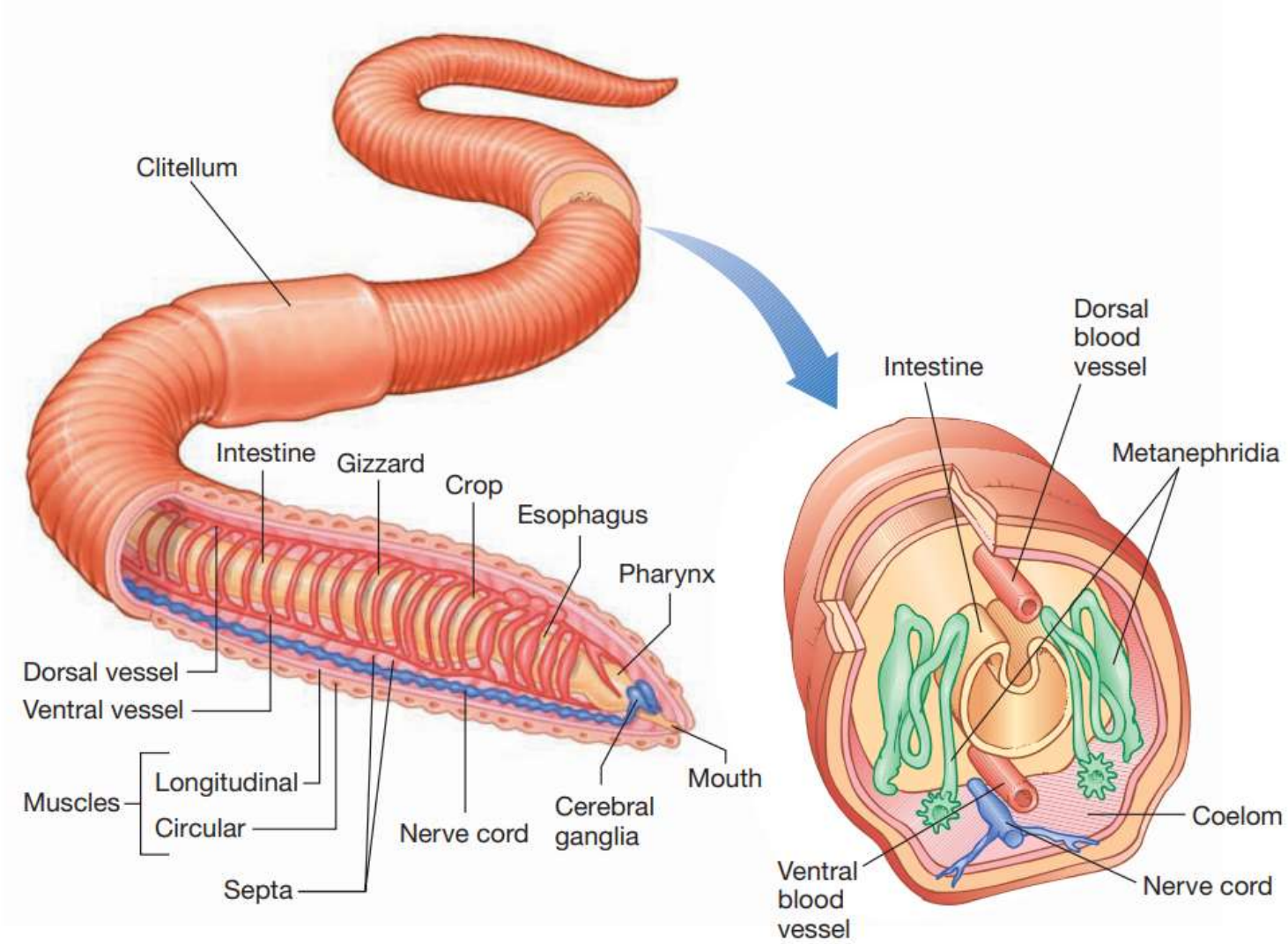
C A blastula forms in both types of development.



D Note the location of mesoderm as the gastrula forms.

E As the embryo continues to develop, the mesoderm splits in protostomes to form the coelom. In deuterostomes, the coelom is formed from pouches of mesoderm that separate from the gut.

F The opening in the gastrula, called a blastopore, becomes the mouth in protostomes and the anus in deuterostomes.



(a) The internal structure has been exposed at the anterior end of an earthworm.

(b) Cross section of an earthworm.

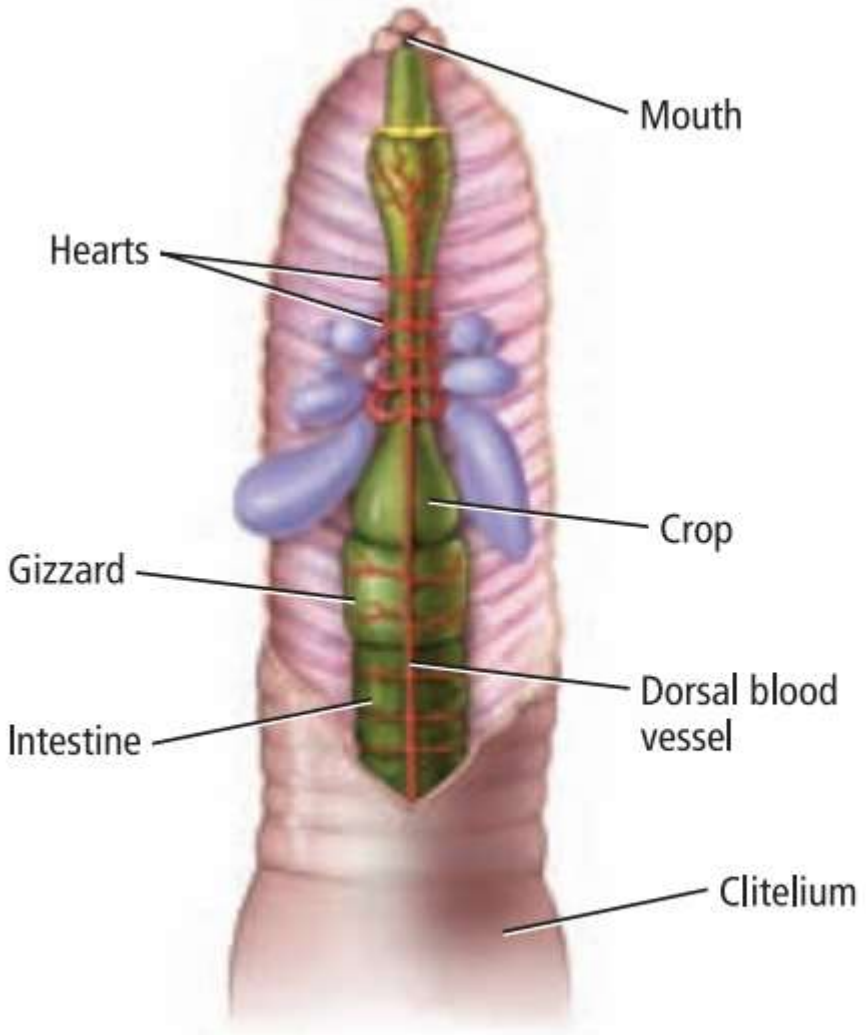
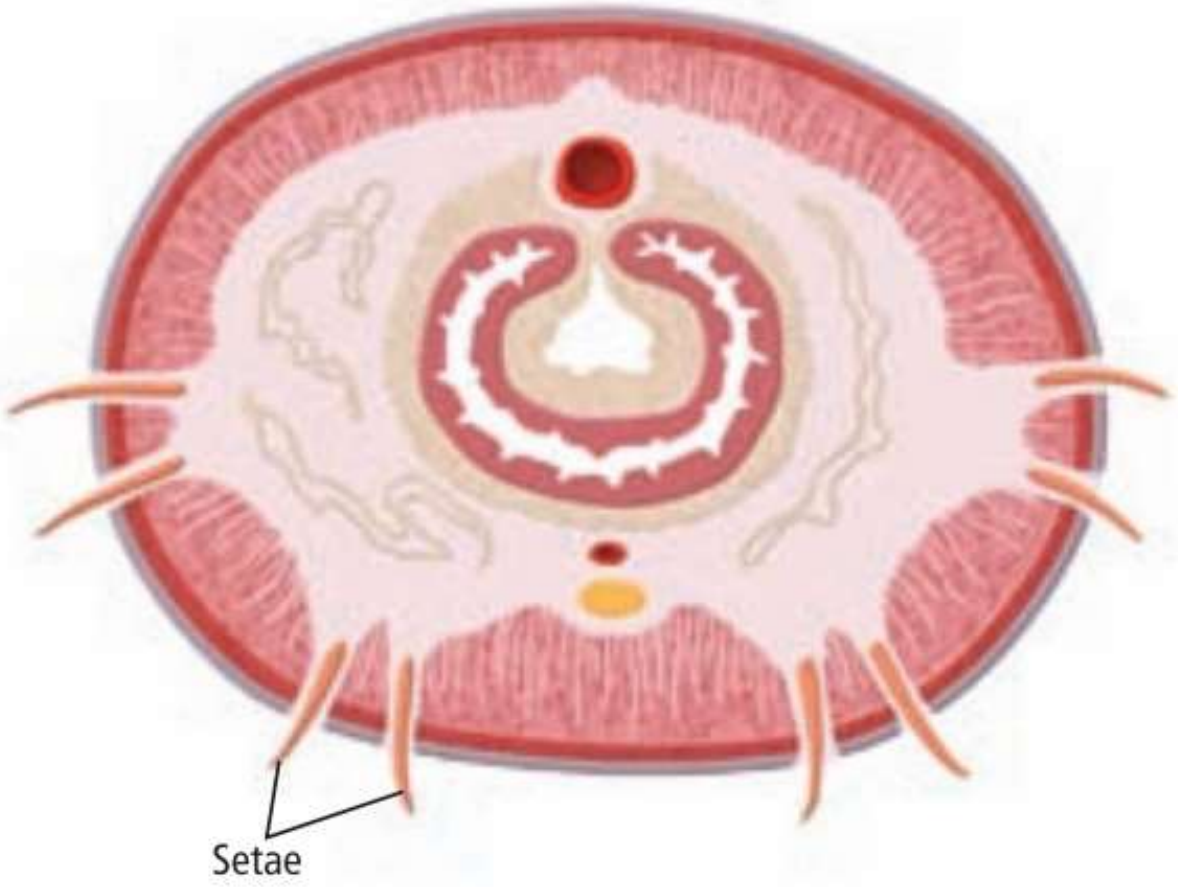
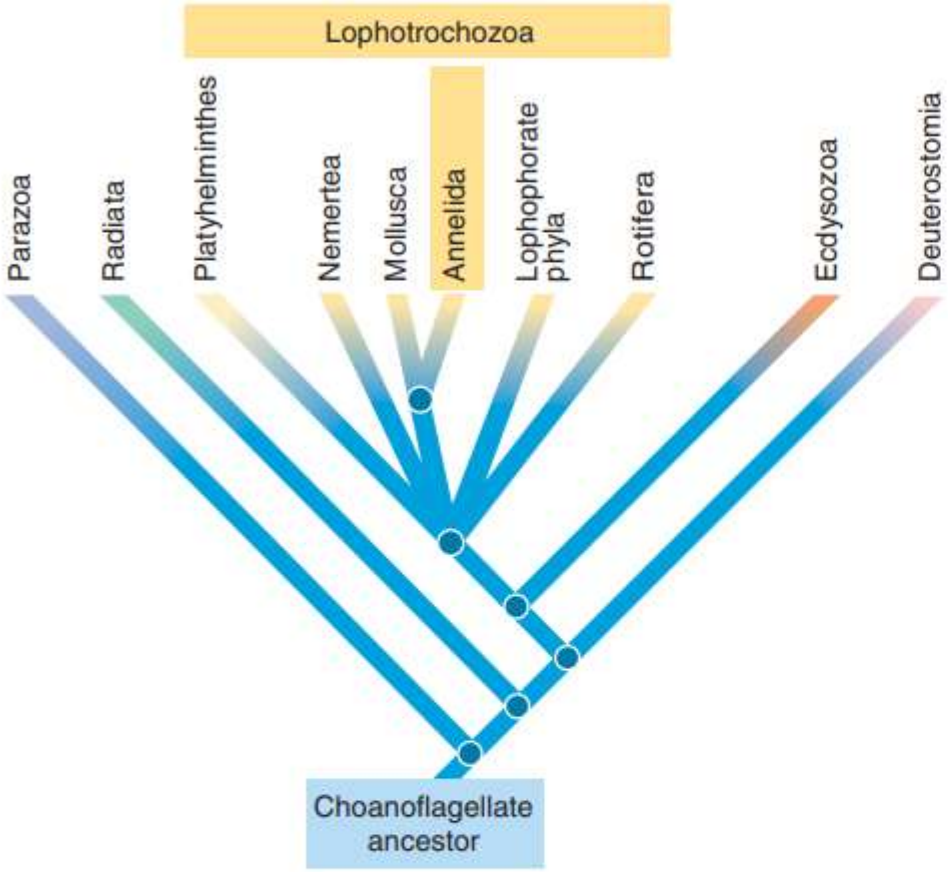


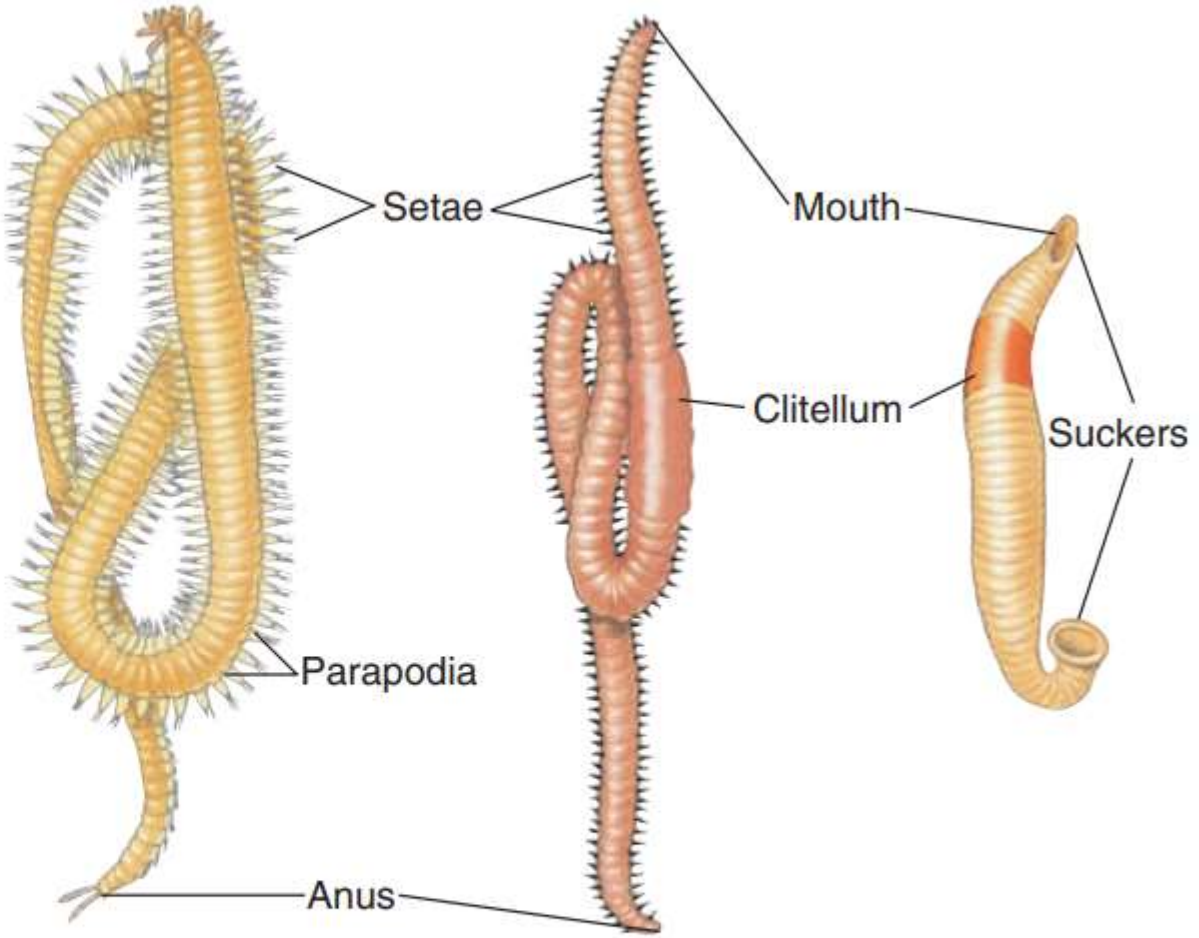
Figure 25.24 An earthworm has five hearts that pump blood through its circulatory system.

Figure 25.25 This earthworm cross section shows how the setae extend from the body. Setae dig into soil and anchor the worm as it pushes forward.

Evaluate *whether an earthworm would move faster on a rough or a smooth surface.*







(a) Class Polychaeta. Polychaetes are marine worms with paddle-shaped parapodia.

(b) Class Oligochaeta. Oligochaetes, which include the earthworms, inhabit fresh water and moist terrestrial areas.

(c) Class Hirudinea. Many leeches are parasites that feed on blood.

Type of Annelid	Example	Characteristics	Habitat	Ecological Benefit
Earthworms		• Few setae on most body segments	Terrestrial	• They aerate soil so roots can grow more easily and water can move efficiently. • They are food for many different animals.
Polychaetes		• Well-developed sense organs • Many setae on most body segments • Parapodia	Mainly marine	• They convert organic debris in oceans into carbon dioxide, which is used by marine plankton for photosynthesis.
Leeches		• Usually no setae on body segments • Front and rear suckers	Mainly freshwater	• They maintain blood flow after microsurgery.

(a) *Spirobranchus* sp.

(b) *Lumbricus* sp.

(c) *Microbdella* sp.

(d) *Riftia* sp.

32.24 Diversity among the Annelids
(*a*) The feather duster worm is a marine polychaete with striking feeding tentacles. (*b*) Earthworms are hermaphroditic (each individual is simultaneously both male and female). When they copulate, each individual donates and receives sperm. (*c*) This Australian tiger leech is attached to a leaf by its posterior sucker as it waits for a mammalian host. (*d*) Vestimentiferans live around hydrothermal vents deep in the ocean. Their skin secretes chitin and other substances, forming tubes.

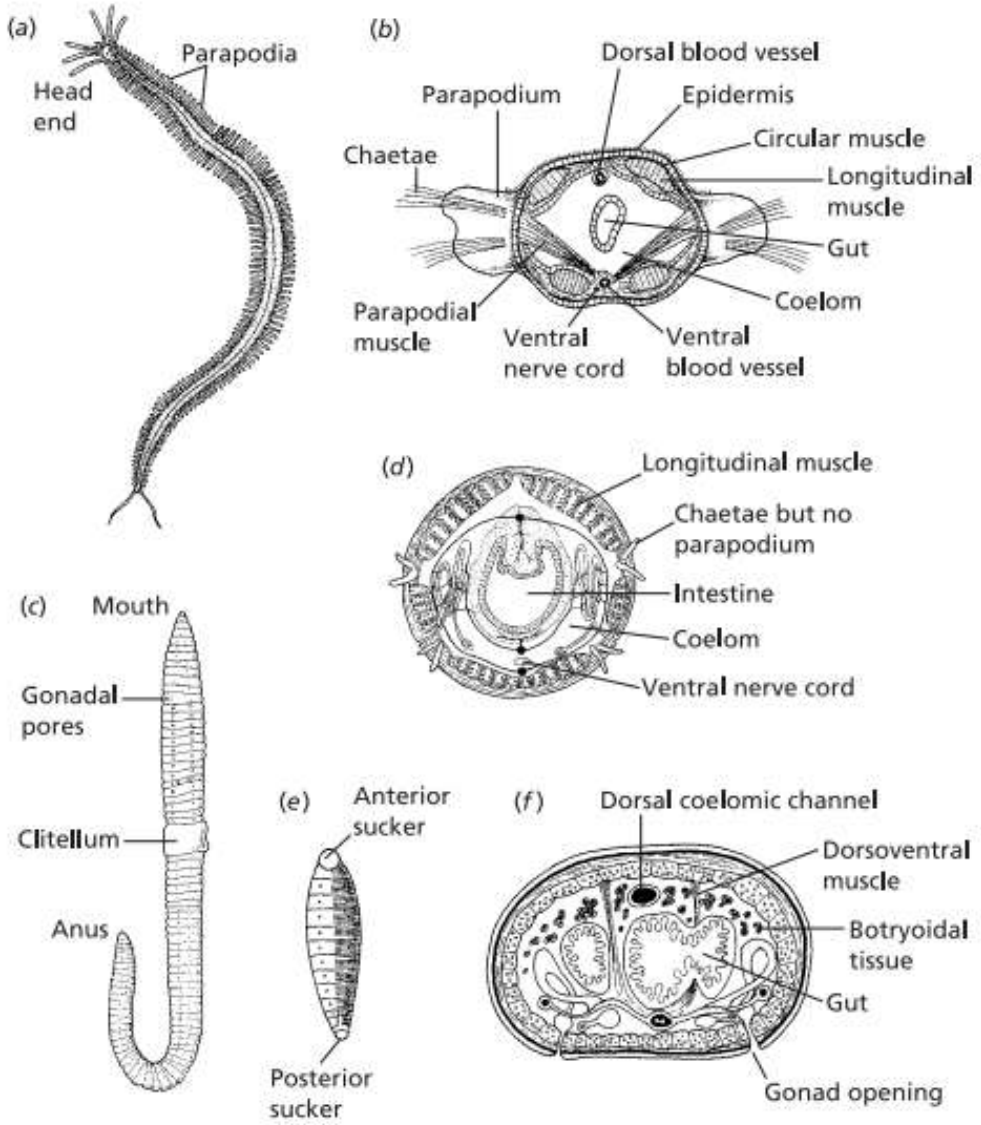


Fig. 9.2 (a) A nereid polychaete; (b) transverse section (TS) of a nereid; (c) the earthworm *Lumbricus terrestris*, an oligochaete; (d) TS *Lumbricus*; (e) a leech (Hirudinea); (f) TS leech.

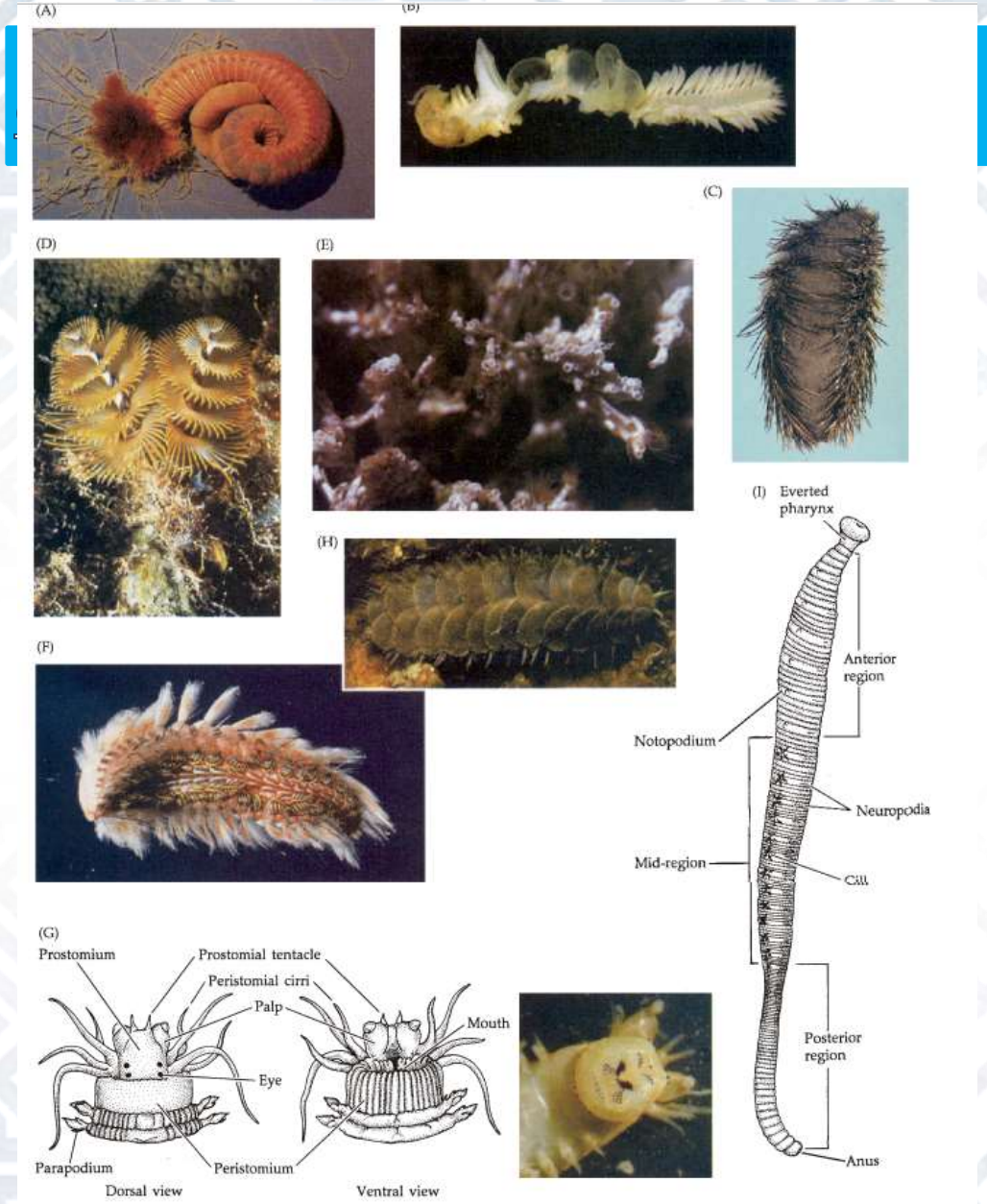


Figure 13.2 Some polychaete worms. (A) *Thelepus*, a deposit-feeding polychaete, removed from its burrow (family Terebellidae). (B) *Chaetopterus*, a filter-feeding polychaete, removed from its burrow (family Chaetopteridae). (C) *Aphrodita*, the "sea mouse" (family Aphroditidae). (D) *Spirobranchus grandis* (family Serpulidae). Note the tentacular feeding and gas exchange crowns. (E) A colony of *Filograna implexa* (family Serpulidae). (F) *Notopygos ornata*, a colorful Pacific polychaete (family Amphinomidae). (G) The head of a nereid polychaete (dorsal and ventral views); photograph shows jaws. (H) *Halosydna*, a scale worm (family Polynoidae). (I) *Arenicola* (family Arenicolidae), a burrower in soft sediments. (J,K) The rare pelagic polychaete *Tomopteris* (family Tomopteridae). (L) *Protodrilus*, an interstitial archiannelid.

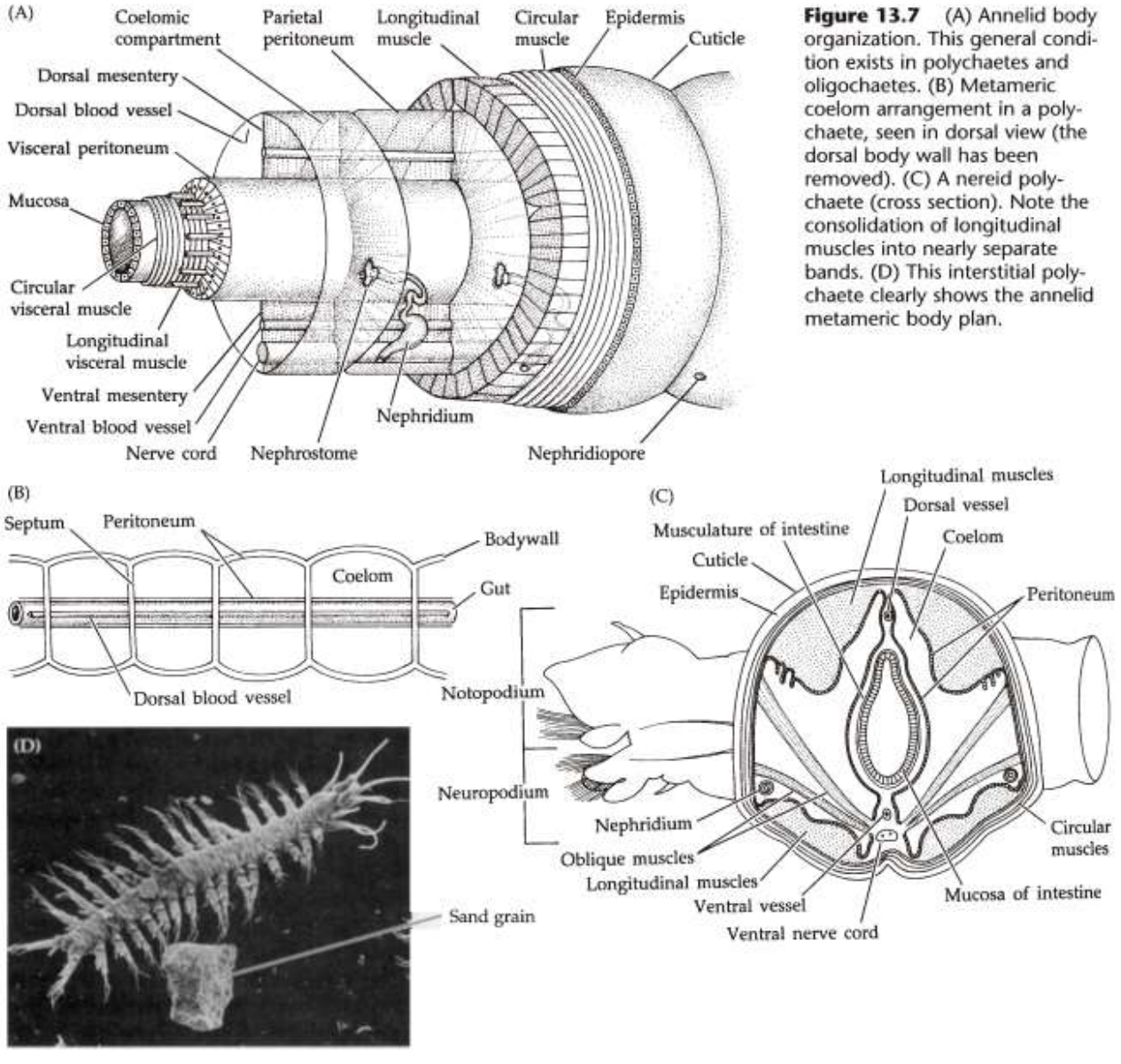


Figure 13.7 (A) Annelid body organization. This general condition exists in polychaetes and oligochaetes. (B) Metameric coelom arrangement in a polychaete, seen in dorsal view (the dorsal body wall has been removed). (C) A nereid polychaete (cross section). Note the consolidation of longitudinal muscles into nearly separate bands. (D) This interstitial polychaete clearly shows the annelid metameric body plan.

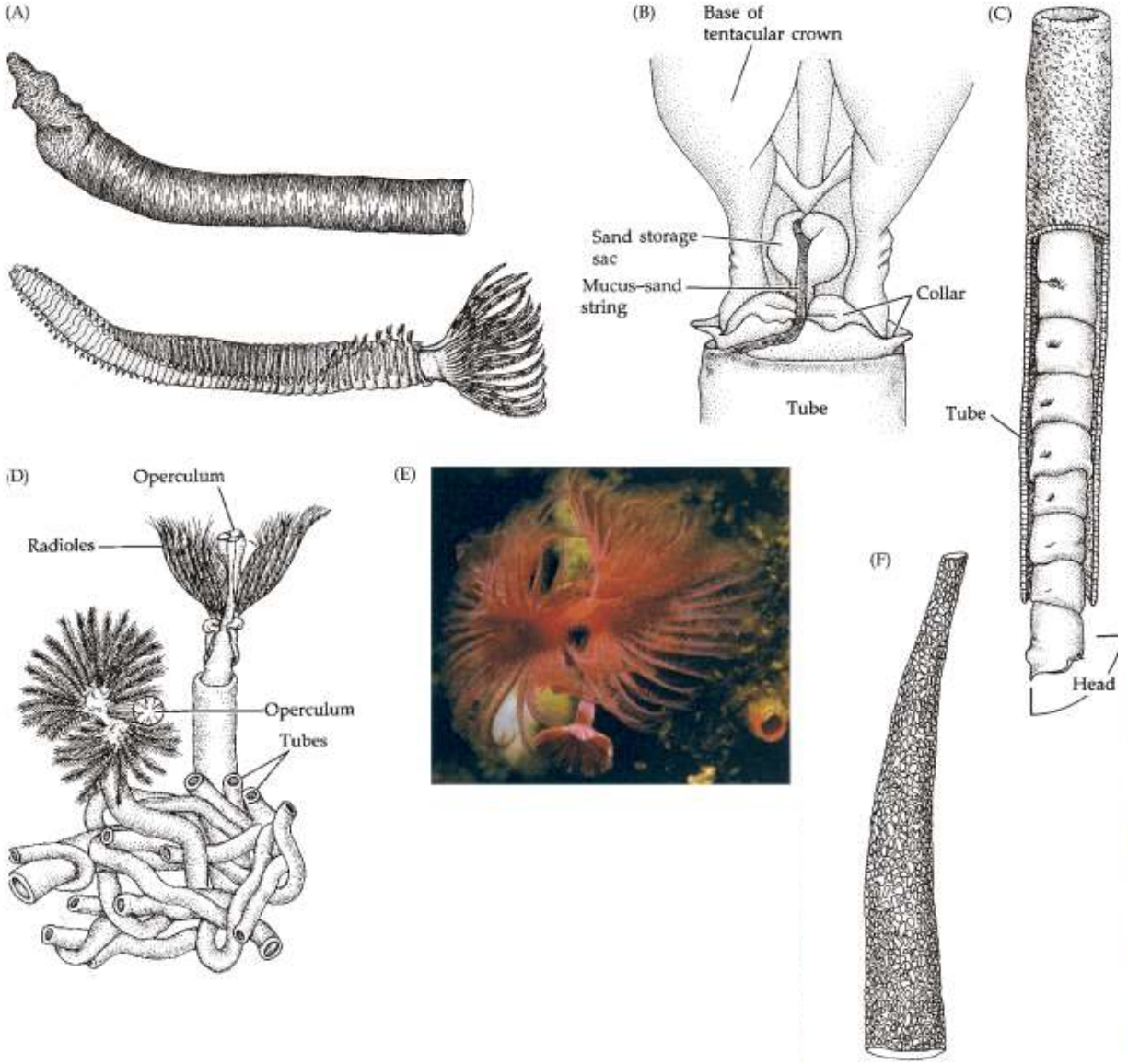


Figure 13.11 Tube-dwelling polychaetes. (A) *Eudistylia* (family Sabellidae) and its parchment-like tube. (B) The base of the tentacular crown of a sabellid. Note the addition of a mucus–sand mixture to the lip of the tube. (C) The bamboo worm, *Axiothella rubrocincta* (family Maldanidae), oriented head down in its sand tube. (D) A cluster of serpulid tubes formed of calcium carbonate and cemented to the substratum. (E) An individual serpulid extended from its tube. (F) The particulate tube of the ice-cream-cone worm, *Pectinaria* (family Pectinariidae). (G) A colony of *Phragmatopoma* (family Sabellariidae). (H) The feeding and gas-exchange tentacular crowns of *Eudistylia* (family Sabellidae).

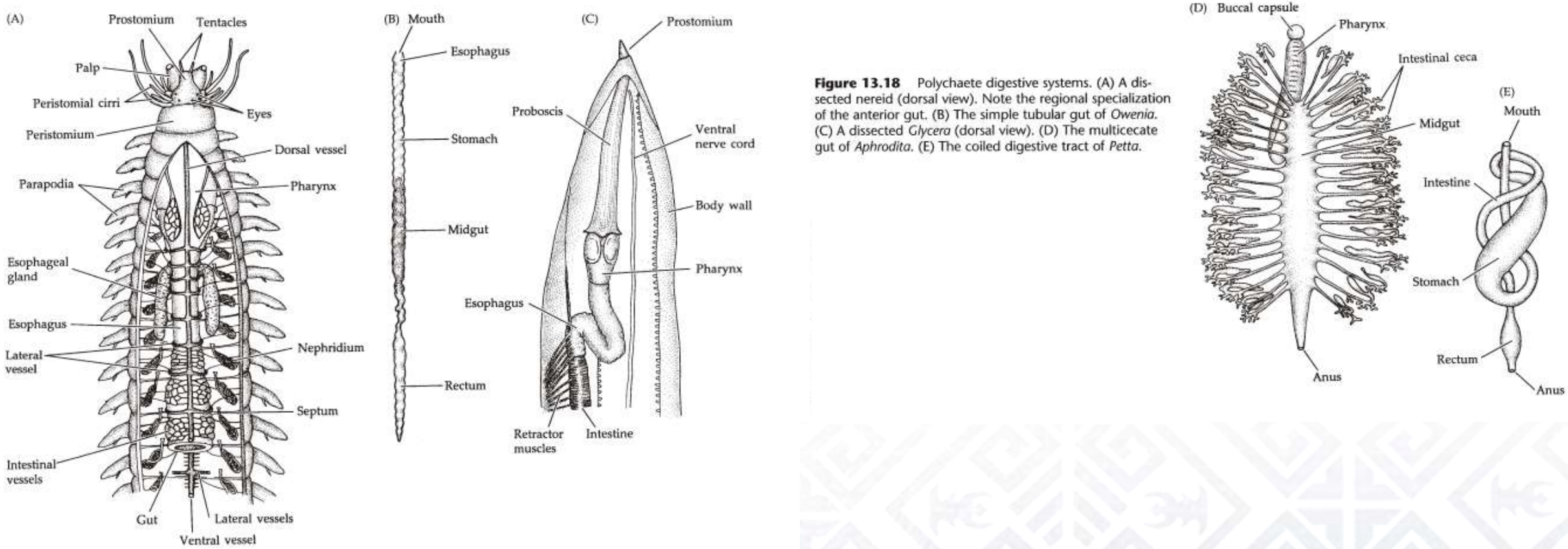


Figure 13.18 Polychaete digestive systems. (A) A dissected nereid (dorsal view). Note the regional specialization of the anterior gut. (B) The simple tubular gut of *Owenia*. (C) A dissected *Glycera* (dorsal view). (D) The multicecate gut of *Aphrodita*. (E) The coiled digestive tract of *Petta*.

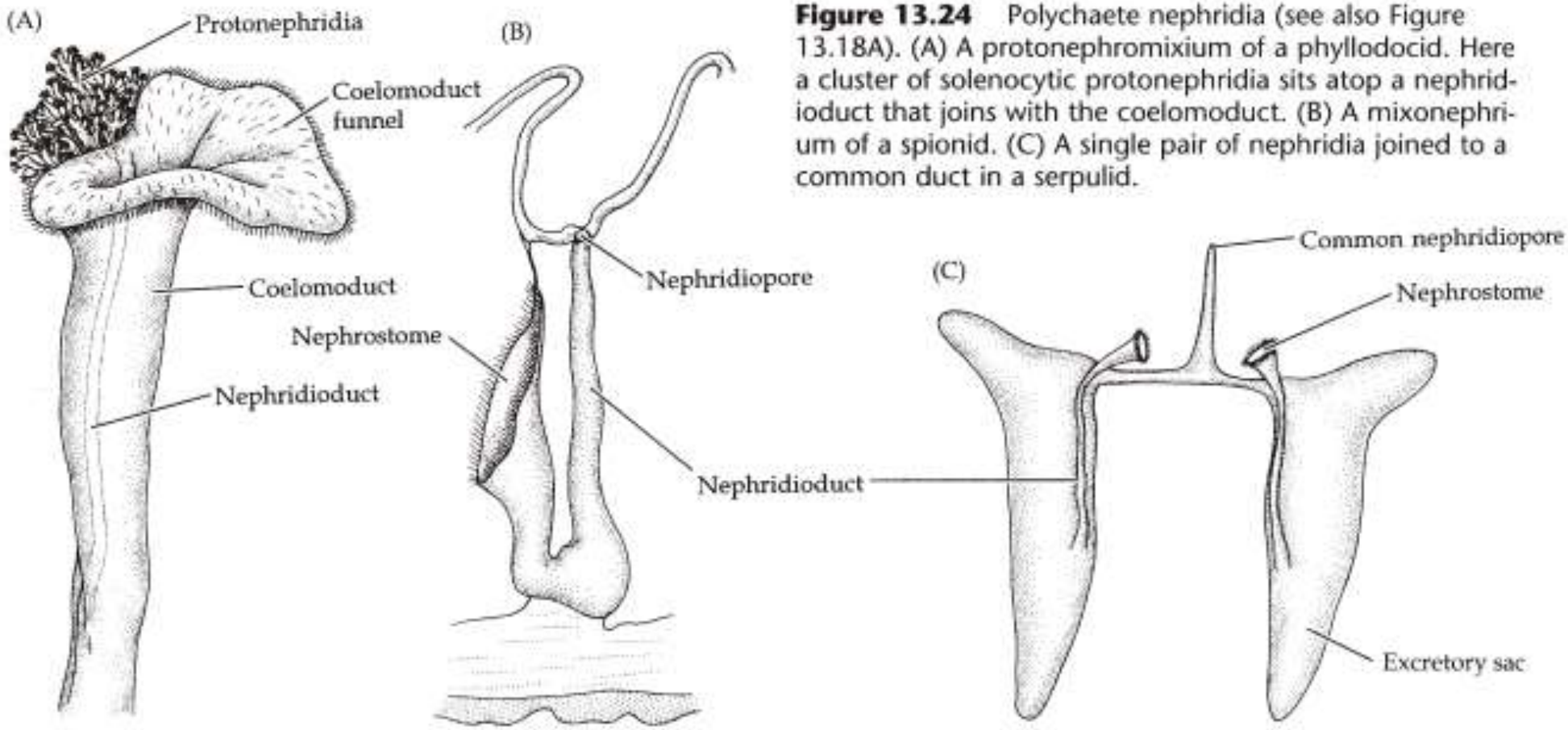


Figure 13.24 Polychaete nephridia (see also Figure 13.18A). (A) A protonephromixium of a phyllodocid. Here a cluster of solenocytic protonephridia sits atop a nephridioduct that joins with the coelomoduct. (B) A mixonephrium of a spionid. (C) A single pair of nephridia joined to a common duct in a serpulid.

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Distribusi Spasial *Polychaeta* di Perairan Pesisir Tangerang, Provinsi Banten

(Spatial Distribution of Polychaeta at Tangerang Coastal Water, Banten Province)

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Volume 16 Nomor 1 Juni 2018
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TEKNIK IDENTIFIKASI POLYCHAETA DI DELTA MAHAKAM, KALIMANTAN TIMUR

Dewi Apriyanti dan Tumiran
Tekhnisi Balai Riset Perikanan Perairan Umum dan Penyuluhan Perikanan
Teregistrasi I tanggal: 13 Agustus 2018; Diterima setelah perbaikan tanggal: 21 Agustus 2018;
Disetujui terbit tanggal: 19 November 2018

PENDAHULUAN

Secara geografis Delta Mahakam terletak pada 117° 26' – 117° 63' BT dan 0° 33' – 0° 92' LS. Secara administratif kawasan delta Mahakam berada dalam wilayah kabupaten Kutai Kartanegara, tepatnya berada di Kecamatan Anggana, Muara Jawa dan Sanga-Sanga.

Kawasan ekosistem di Delta Mahakam memiliki vegetasi mangrove yang telah rusak akibat alih fungsi lahan menjadi tambak dan kegiatan tambang batubara. Selain itu, kerusakan hutan mangrove di Delta Mahakam juga diakibatkan oleh jalur kapal berenang yang disebut parapodia, pada cacing yang bergerak aktif (*Errantia*), tetapi pada cacing yang relative lambat bergerak (*Sedentaria*) tidak memiliki parapodia. Parapodia berperan sebagai alat pernapasan. Ukuran polychaeta sebagian besar berukuran 5 – 10 cm, tetapi ada yang kurang dari 1 mm (misalnya *Diurodrilus*), ada juga yang mencapai 3 mm (*Namalycastis rhodochorde*).

Di lingkungan perairan, makrozobentos benthos khususnya polychaeta telah lama dikenal sebagai suatu kesatuan dari lingkungan laut dan muara. Polychaeta hidup di dalam sedimen permukaan yang

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Komunitas Cacing Laut Dalam (Polychaeta) di Selat Flores, Lamakera dan Alor, Nusa Tenggara Timur

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Abstrak

Struktur dan sebaran spasial komunitas cacing laut (Poychaeta) di selat Flores, Lamakera dan Alor dikaji berdasarkan perolehan sampel hasil penurunan box corer di 13 stasiun cuplik berkedalaman 147-2996 m pada bulan Juli 2011. Secara keseluruhan berhasil diperoleh 68 jenis polychaeta (n = 536) yang dapat dikelompokkan kedalam 31 famili dengan kepadatan per stasiun bervariasi antara 9 hingga 95 individu/0.3 m^2. Sedangkan kekayaan jenis, nilai indeks keragaman Shannon Wiener (H') dan kemerataan Pielou (J) masing-masing bervariasi antara 3-24, 1,03-2,93 dan 0,83-0,94. Uji korelasi Spearman mengindikasikan keterkaitan positif antara kepadatan dengan kekayaan jenis (S) maupun H' (P<0,01). Hubungan antara atribut komunitas tersebut dengan parameter lingkungan (kedalaman, % kerikil, % lumpur dan kandungan total bahan organik) tidak dapat terdeteksi secara jelas, kecuali antara kepadatan dengan kandungan pasir (r=0,56; P=0,05).

Kata kunci : *Polychaeta, cacing laut ,laut dalam, Nusa Tenggara Timur*

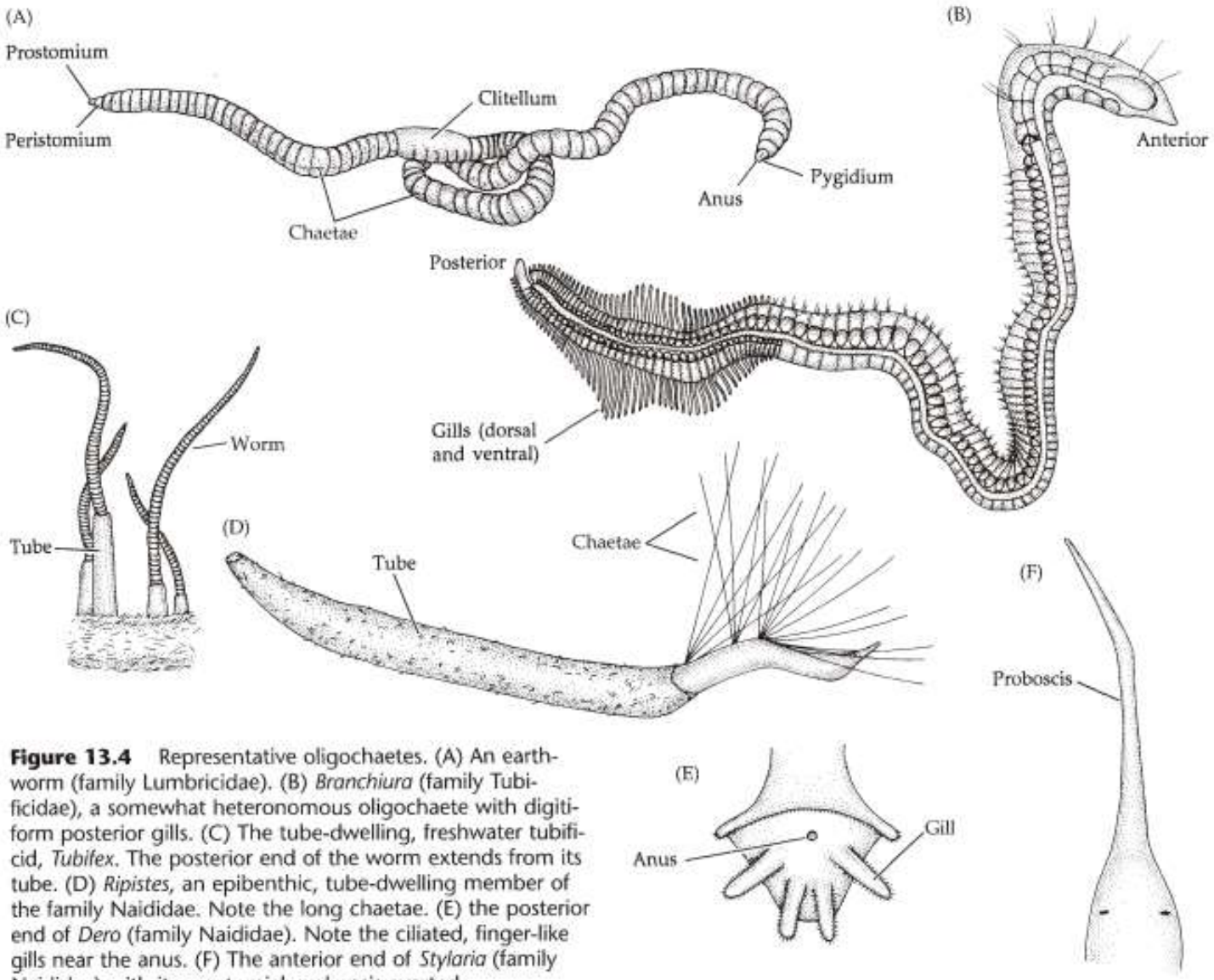

Figure 13.4 Representative oligochaetes. (A) An earthworm (family Lumbricidae). (B) *Branchiura* (family Tubificidae), a somewhat heteronomous oligochaete with digitiform posterior gills. (C) The tube-dwelling, freshwater tubificid, *Tubifex*. The posterior end of the worm extends from its tube. (D) *Ripistes*, an epibenthic, tube-dwelling member of the family Naididae. Note the long chaetae. (E) the posterior end of *Dero* (family Naididae). Note the ciliated, finger-like gills near the anus. (F) The anterior end of *Stylaria* (family Naididae) with its prostomial proboscis everted.

The plight of the Giant Gippsland Earthworm

By Angela Heathcote • December 7, 2017

Beverley holding a Giant Gippsland Earthworm during a Museums Victoria field trip back in the 1980s. Image credit: Rodney Start/Museums Victoria

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RESEARCH ARTICLE

The Role of Local Knowledge and Traditional Extraction Practices in the Management of Giant Earthworms in Brazil

Maria Auxiliadora Drumond, Artur Queiroz Guimarães, Raquel Hosken Pereira da Silva

Published: April 14, 2015 • https://doi.org/10.1371/journal.pone.0123913

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Fig 4. Mature specimens of *Rhinodrilus alatus* with laterally projected clitellum.
https://doi.org/10.1371/journal.pone.0123913.g004

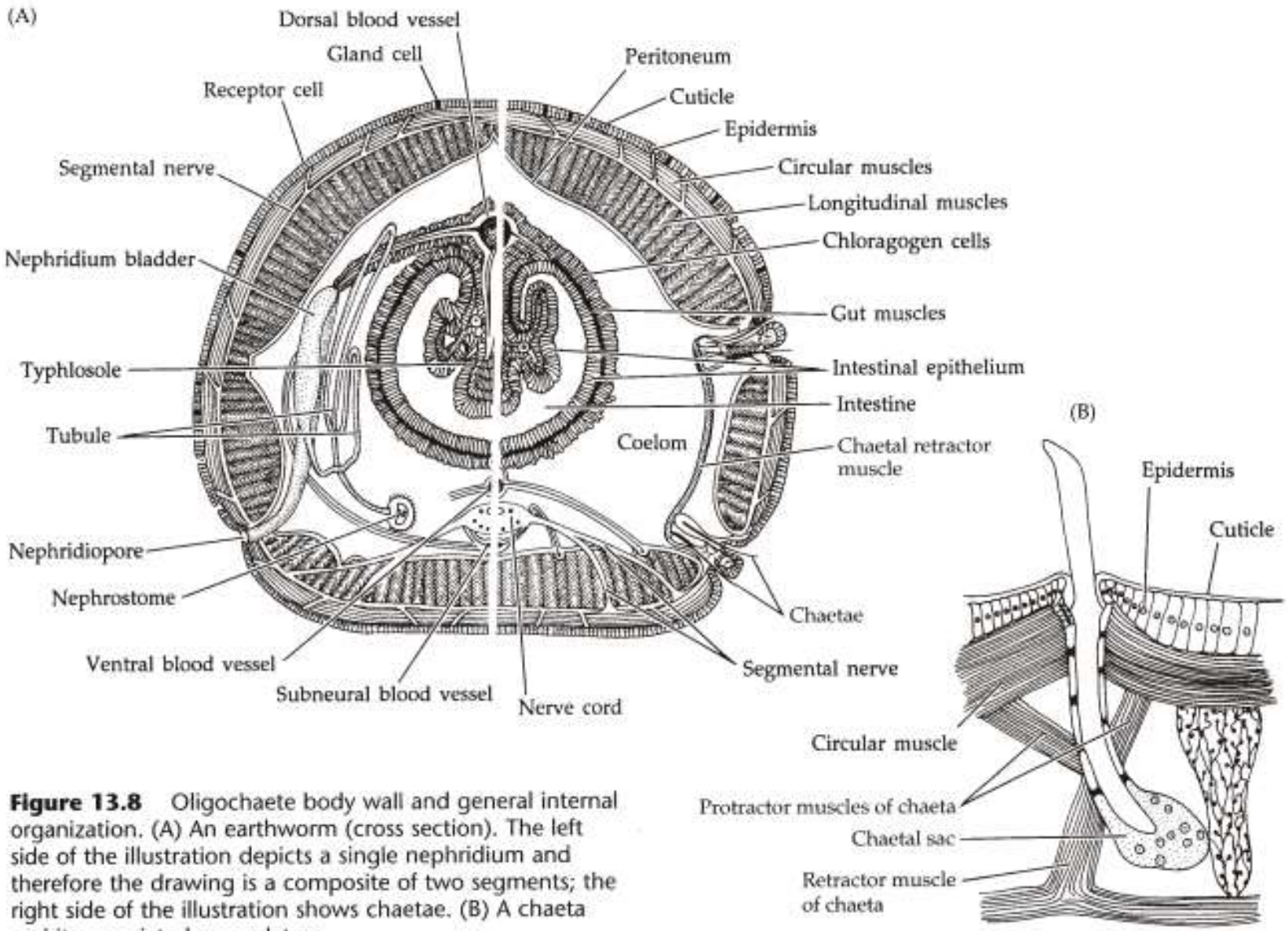


Figure 13.8 Oligochaete body wall and general internal organization. (A) An earthworm (cross section). The left side of the illustration depicts a single nephridium and therefore the drawing is a composite of two segments; the right side of the illustration shows chaetae. (B) A chaeta and its associated musculature.

Figure 13.19 Oligochaete digestive systems. (A,B) The digestive tract of *Eisenia foetida* (family Lumbricidae). (A) The digestive tract in dorsal view; note the marked regional specialization (hindgut not shown). (B) A portion of the esophagus and calciferous glands, crop, gizzard, and anterior region of the intestine (partial frontal section). (C,D) The foregut of *Lumbricus* (see also Figure 13.8 for a cross-sectional view of the intestine and typhlosole). (C) Note the positional relationship of the anterior gut regions to other organs. (D) The esophagus (cross section) showing lamellar calciferous glands.

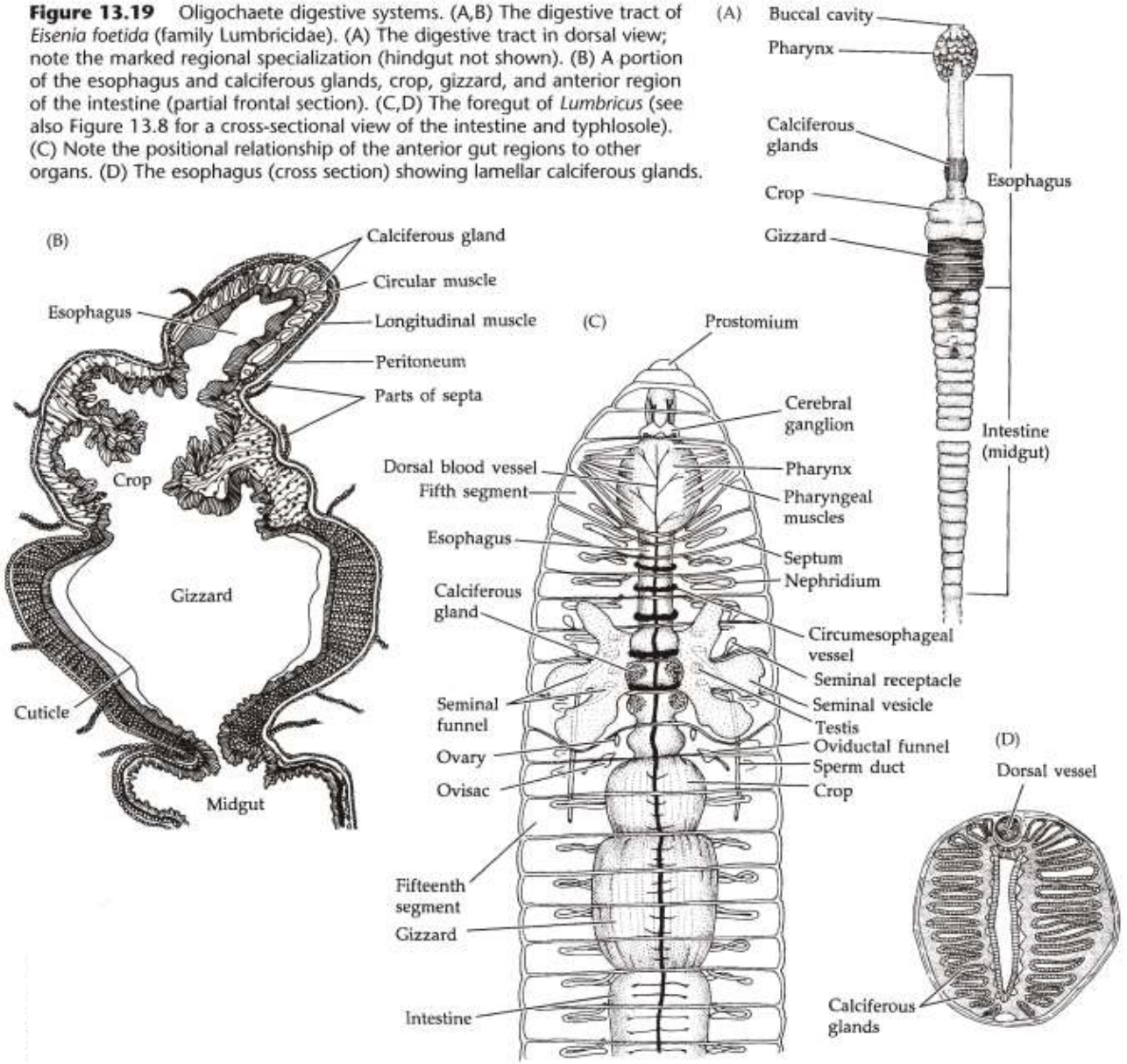
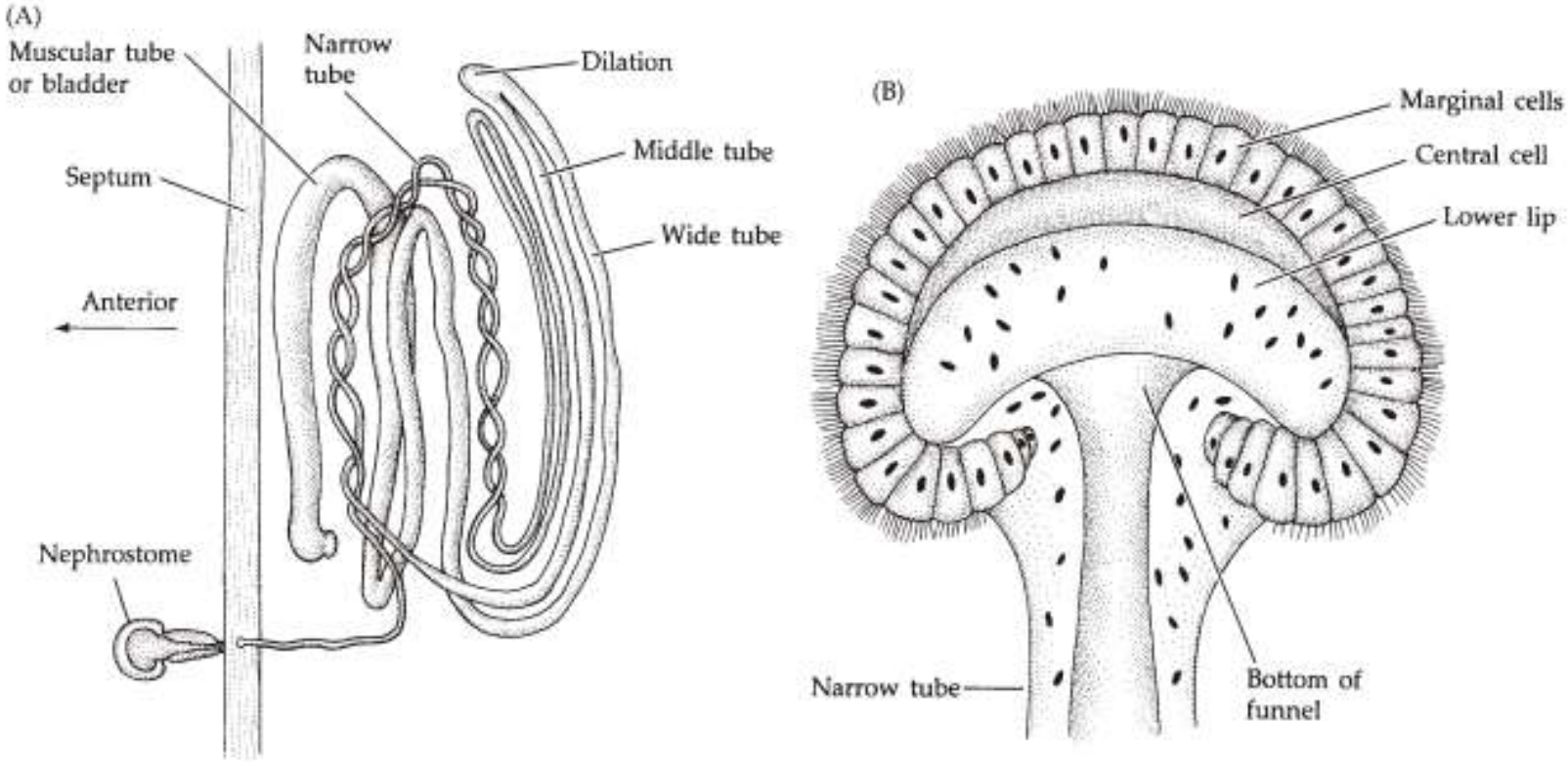


Figure 13.25 *Lumbricus* nephridia. (A) A single nephridium and its relationship to a septum. (B) Details of the nephrostome. Evidence suggests that earthworm nephridia are highly selective excretory and osmoregulatory units. The nephridioduct is regionally specialized along its length. The narrow tube receives body fluids and various solutes, first from the coelom through the nephrostome and then from the blood via capillaries that lie adjacent to the tube. In addition to various forms of nitrogenous wastes (ammonia, urea, uric acid), certain coelomic proteins, water, and ions (Na^+, K^+, Cl^-) are also picked up. Apparently, the wide tube serves as a site of selective reabsorption (probably into the blood) of proteins, ions, and water, leaving the urine rich in nitrogenous wastes.



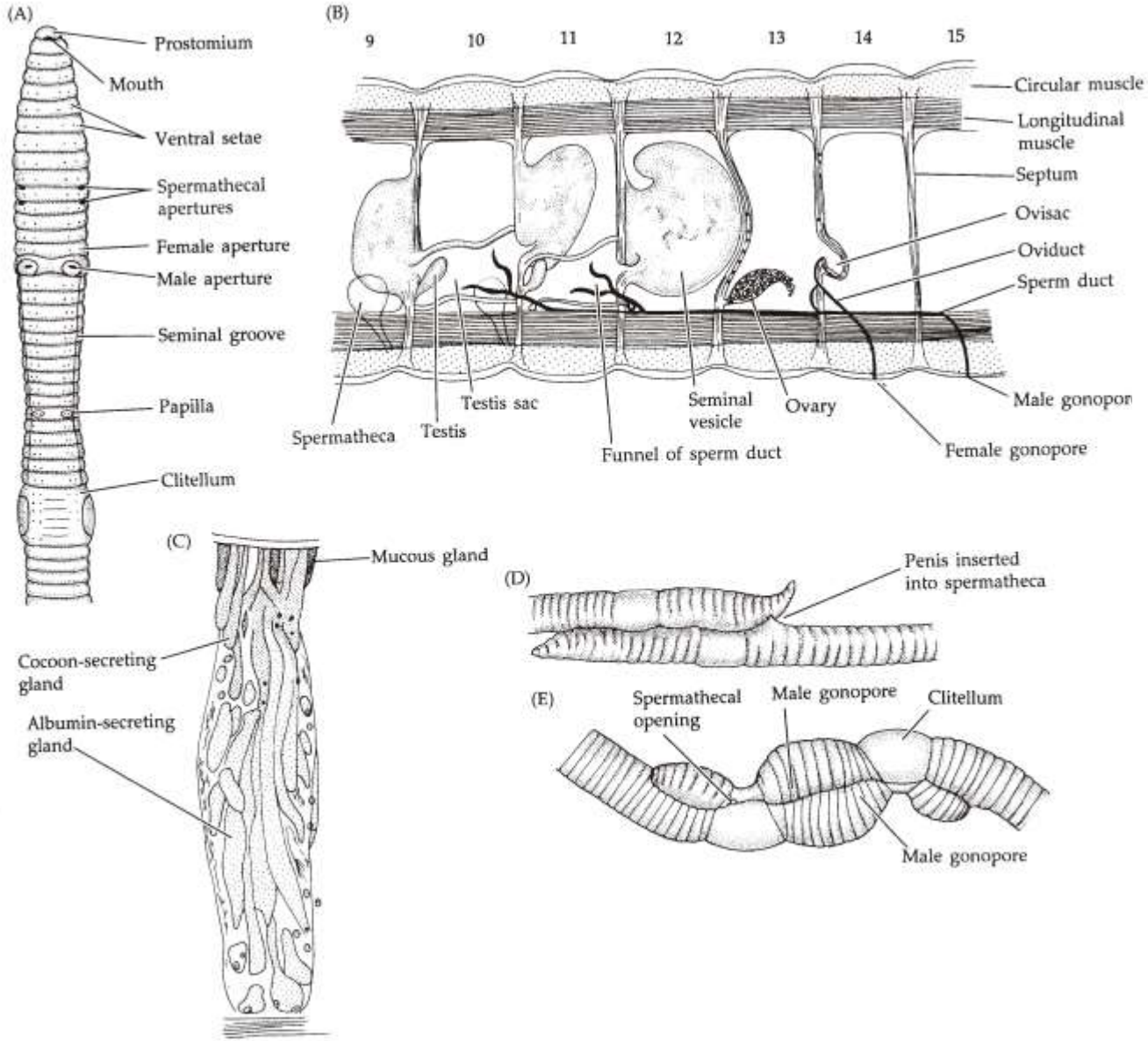


Figure 13.36 The reproductive system of *Lumbricus* and mating in earthworms (see also Figure 13.19C). (A) External structures associated with reproduction of *Lumbricus* (ventral view). (B) Segments 9–15 of *Lumbricus* (composite lateral view). (C) The clitellum epithelium (section) showing the three types of secretory cells. (D,E) Copulating earthworms. (D) *Pheretima* transfers sperm directly from the male pore, through a penis, into the mate's spermatheca. (E) *Eisenia* uses indirect sperm transfer. As in *Lumbricus*, the sperm leave the male pores and travel along paired seminal grooves to the spermathecal openings of the mate. (F–H) An earthworm forming and releasing a cocoon. As the cocoon slides over the worm, it receives ova and sperm. (I) Engaged copulatory apparatus of *Rhynchelmis*, an oligochaete with direct sperm transfer. (J) Copulating earthworms (*Lumbricus*).

Protobiont (2017) Vol. 6 (3) : 108 – 117

Struktur Komunitas Cacing Tanah (Kelas *Oligochaeta*) di Kawasan Hutan Desa Mega Timur Kecamatan Sungai Ambawang

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Abstract

Community structure can be reviewed from its species composition, species density, species evenness, species diversity, species dominance, and species biomass in an ecosystem. Earthworms have an important role in decomposition process of organic matters. The existence of earthworms can be considered as a bioindicator of soil productivity. A research about community structure of earthworms in Mega Timur Village forest area had been conducted in August 2016. This research aims to know the community structure of earthworms (class *Oligochaeta*) that are found in Mega Timur Village forest area as well as the condition of their habitat. Plot sampling was taken randomly with 5 plots whose size is 5x5m^2 on every location. The sampling method used was quadrate method with size 30x30cm^2, taking 5 spots on each location and hand-sorting method. Earthworms found in the site included three genera: *Pheretima*, *Perionyx*, and *Pontoscolex*. The highest composition of earthworms was found in Station I and III with two genera each, and the lowest composition was found in Station II with only one genus. Genus *Pontoscolex* had the highest density index, while genus *Pheretima* had the lowest index. The highest diversity index was observed in Station III (H'=0,64), while the lowest diversity index was on Station I (H'=0).

Keywords : Community structure, earthworms, *Oligochaeta*, Mega Timur Village Forest

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Jenis-jenis Cacing Tanah (Oligochaeta) yang Terdapat di Kawasan Cagar Alam Lembah Anai Sumatera Barat

The Earthworms Species (Oligochaeta) at Lembah Anai Nature Reserve West Sumatera

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Abstract

A study on the earthworms (Oligochaeta) at Lembah Anai Nature Reserve, West Sumatera has been conducted from February to May, 2013. The purpose of this study was to identify earthworms species at the Nature Reserve. The earthworms were collected from different altitudinal levels ranged from 400 to 800 m above sea level using *hand sorting* method. There were three species of earthwoms found; *Pontoscolex corethrurus* (Glossoscolecidae), *Pheretima posthuma* and *Megascolex kempi* (Megascolecidae) these three species belong to sub order Neooligochaeta. All species were found at all altitudinal level.
Keywords: Earthworm (Oligochaeta), *Hand sorting*, Lembah Anai

A Taxonomical Review on Pheretimoid Earthworms (Oligochaeta : Megascolecidae) From Indonesian Archipelago. Zoo Indonesia 2010. 19(2): 93-108

A TAXONOMICAL REVIEW ON *PHERETIMOID* EARTHWORMS (OLIGOCHAETA : MEGASCOLECIDAE) FROM INDONESIAN ARCHIPELAGO

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ABSTRAK

Kegiatan penelitian tentang cacing tanah Pheretimoid di Indonesia banyak dilakukan pada periode 1860-an sampai dengan tahun 1940-an. Setelah periode tersebut hanya sedikit hasil penelitian yang diterbitkan, dan publikasi terbaru ditulis oleh Easton (1979). Koleksi specimen cacing tanah diperoleh dari hampir semua pulau-pulau utama di kawasan Indonesia, tetapi lokasinya hanya terbatas di tempat-tempat tertentu. Sebanyak 162 jenis cacing tanah Pheretimoid tercatat dari kawasan kepulauan Indonesia dan dikelompokkan kedalam Sembilan genus: Amynthas, Archipheretima, Metaphire, Metapheretima, Pheretima, Pithemera, Planapheretima, Pleionogaster dan Polypheretima. Saat ini diketahui hanya terdapat empat specimen tipe yang disimpan di Museum Zoologicum Bogoriense (MZB) dan berada dalam kondisi rusak. Sedangkan dua spesimen tipe yang seharusnya tersimpan di MZB tidak dapat ditemukan. Di dalam tulisan ini, permasalahan-permasalahan taksonomi cacing tanah Pheretimoid diungkapkan dan dibahas, sehingga dapat digunakan sebagai bahan penelitian di masa yang akan datang.

Kata Kunci: *Review, Taksonomi, Pheretimoid, Cacing Tanah, Indonesia.*

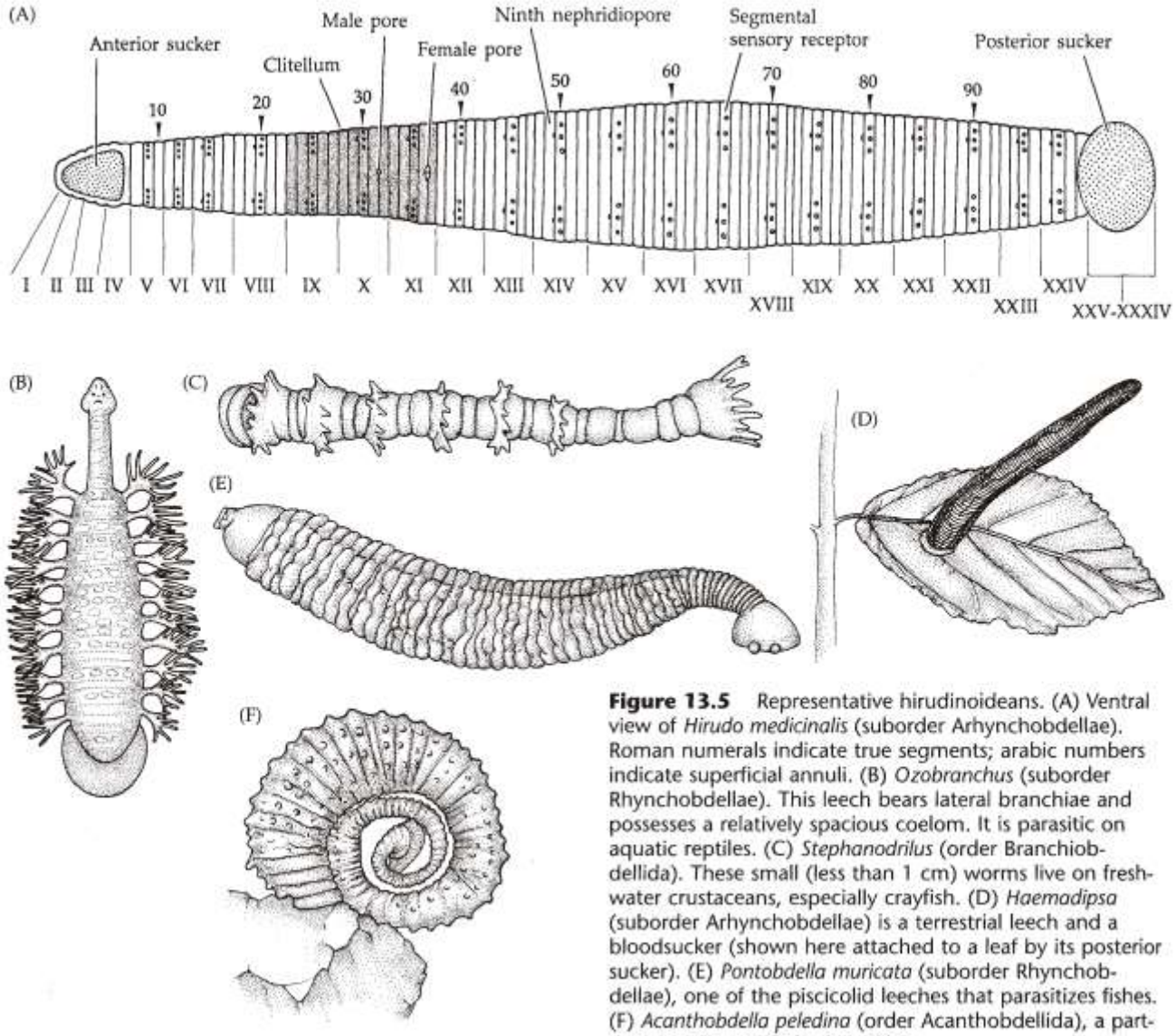


Figure 13.5 Representative hirudinoideans. (A) Ventral view of *Hirudo medicinalis* (suborder Arhynchobdellae). Roman numerals indicate true segments; arabic numbers indicate superficial annuli. (B) *Ozobranchus* (suborder Rhynchobdellae). This leech bears lateral branchiae and possesses a relatively spacious coelom. It is parasitic on aquatic reptiles. (C) *Stephanodrilus* (order Branchiobdellida). These small (less than 1 cm) worms live on freshwater crustaceans, especially crayfish. (D) *Haemadipsa* (suborder Arhynchobdellae) is a terrestrial leech and a bloodsucker (shown here attached to a leaf by its posterior sucker). (E) *Pontobdella muricata* (suborder Rhynchobdellae), one of the piscicolid leeches that parasitizes fishes. (F) *Acanthobdella peledina* (order Acanthobdellida), a part-time parasite of freshwater fishes.

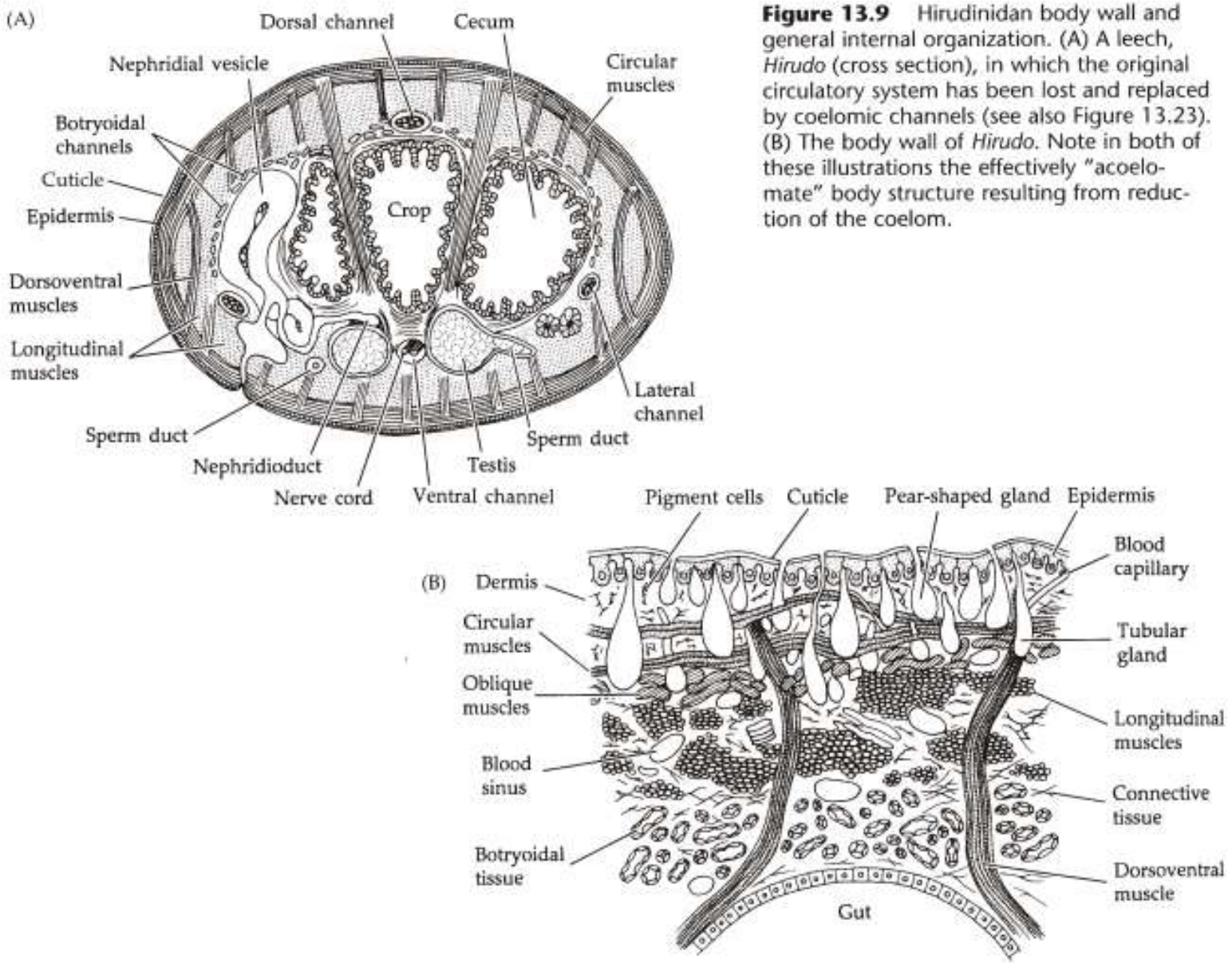


Figure 13.9 Hirudinidan body wall and general internal organization. (A) A leech, *Hirudo* (cross section), in which the original circulatory system has been lost and replaced by coelomic channels (see also Figure 13.23). (B) The body wall of *Hirudo*. Note in both of these illustrations the effectively "acoelomate" body structure resulting from reduction of the coelom.

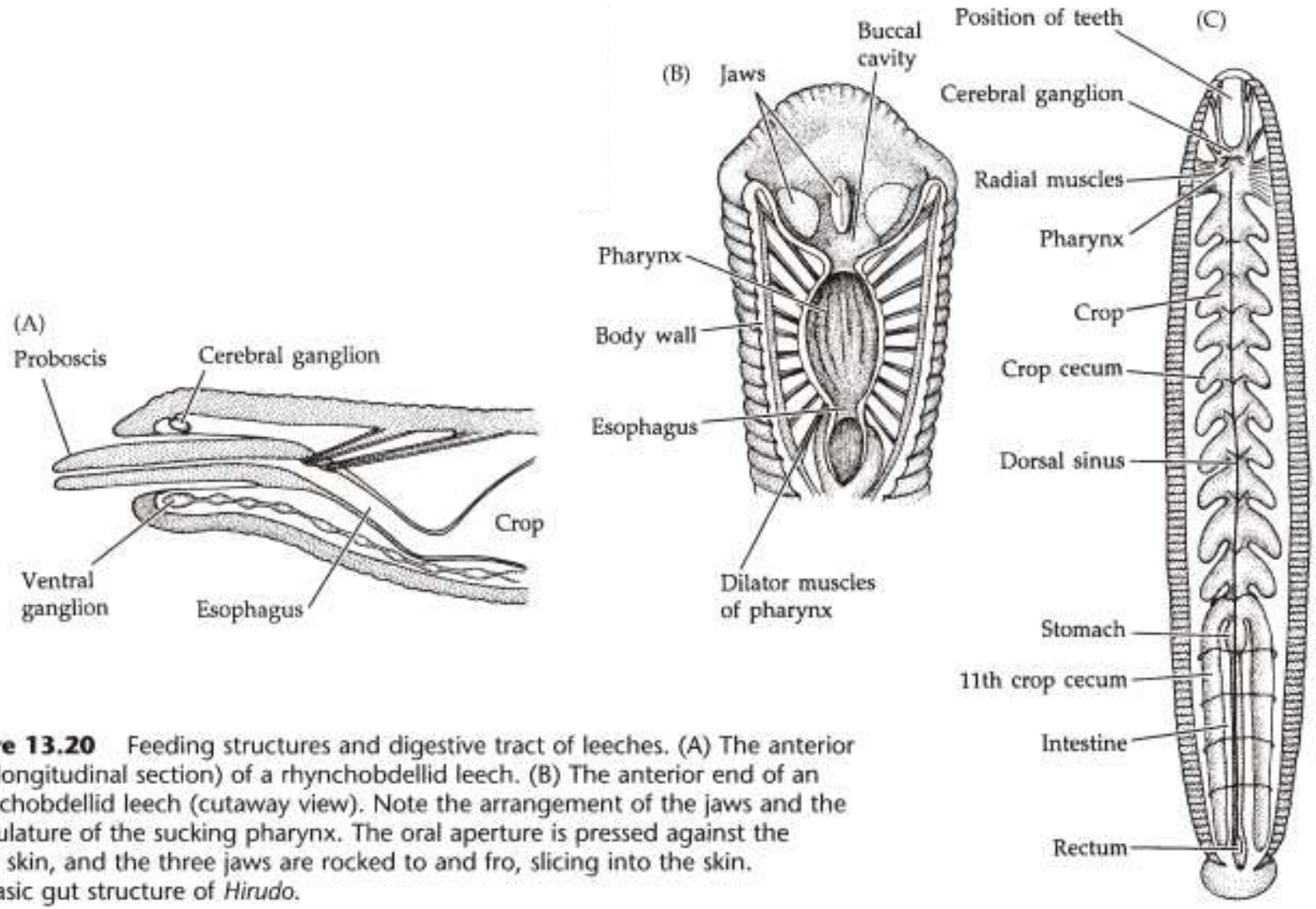


Figure 13.20 Feeding structures and digestive tract of leeches. (A) The anterior end (longitudinal section) of a rhynchobdellid leech. (B) The anterior end of an arhynchobdellid leech (cutaway view). Note the arrangement of the jaws and the musculature of the sucking pharynx. The oral aperture is pressed against the host's skin, and the three jaws are rocked to and fro, slicing into the skin. (C) Basic gut structure of *Hirudo*.

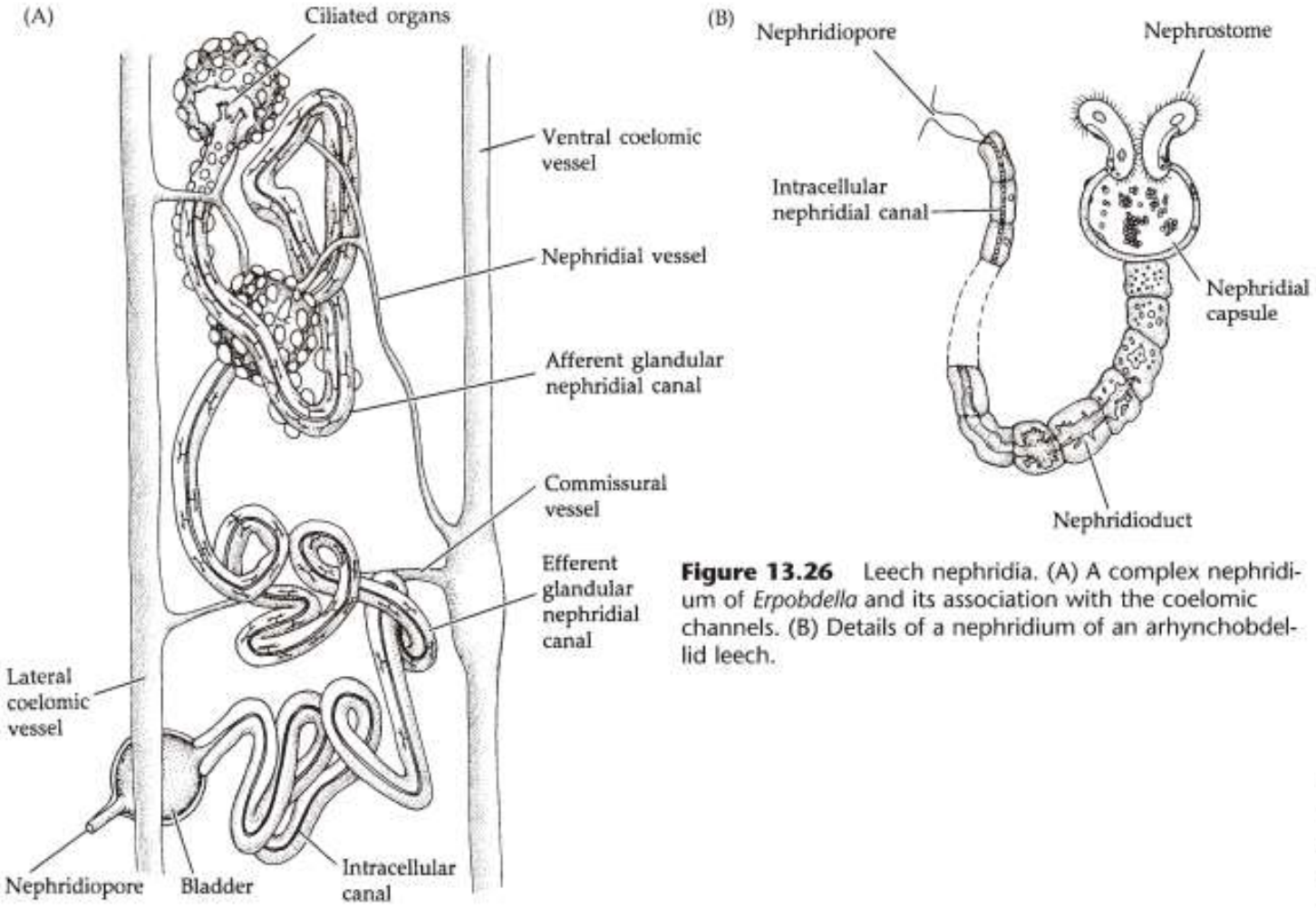
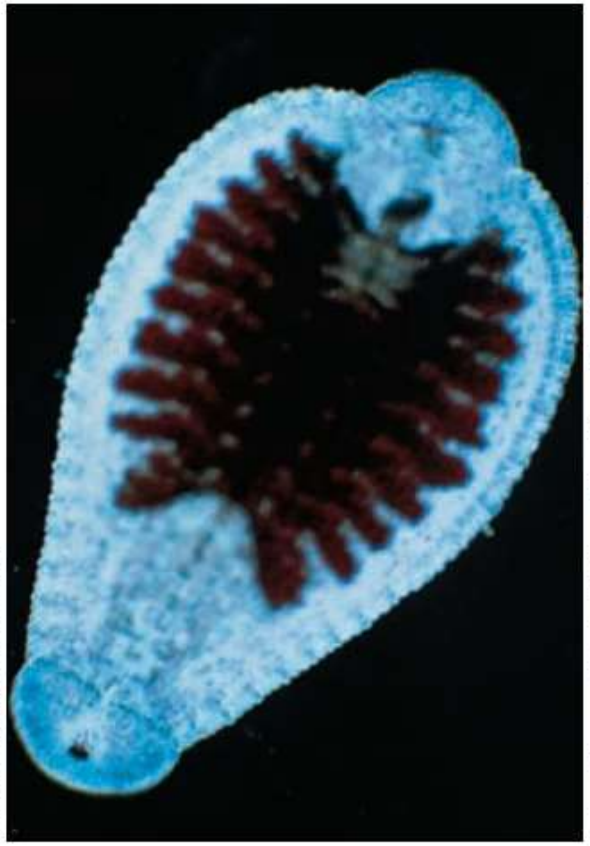


Figure 13.26 Leech nephridia. (A) A complex nephridium of *Erpobdella* and its association with the coelomic channels. (B) Details of a nephridium of an arhynchobdellid leech.



T. E. Adams/Visuals Unlimited

500 µm

(a) LM of a blood-sucking leech (*Helobdella stagnalis*) that feeds on mammals. The digestive tract (*dark area*) of its swollen body is filled with ingested blood.

St. Bartholomew's Hospital /Science Photo Library/Photo Researchers, Inc.

(b) Medicinal leeches (*Hirudo medicinalis*) are used here to treat hematoma, an accumulation of blood within tissues that results from injury or disease.

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Penentuan Kadar Protein Air Liur Lintah *(Hirudo medicinalis L.)* dengan Metode Bradford

Protein Content Leech Saliva (*Hirudo medicinalis L.)* with Bradford Assay

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Abstract. This research aims to determine the content of protein from leeches' saliva *(Hirudo medicinalis L.)*. The leeches were starved for 14 weeks. They were fed a phagostimulatory solution by sucking through parafilm membrane, then forced to regurgitate the solution by soaking them in an ice-container and also squeezing them from posterior to anterior. The content protein was tested by using Bradford assay which produces complex of brilliant blue coomassie dye of G-250 with protein. The complexity was analyzed in colorimetry way by using UV-VIS spectrophotometer at 595 nm wavelength. The result from calculating protein content of the leeches' saliva was 0.038 mg / mL ± 0.005.

Keywords: Leech (*Hirudo medicinalis* L.), protein, Bradford assay.

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STRUKTUR KOMUNITAS *ANNELIDA* SEBAGAI BIOINDIKATOR PENCEMARAN SUNGAI ANCAR KOTA MATARAM

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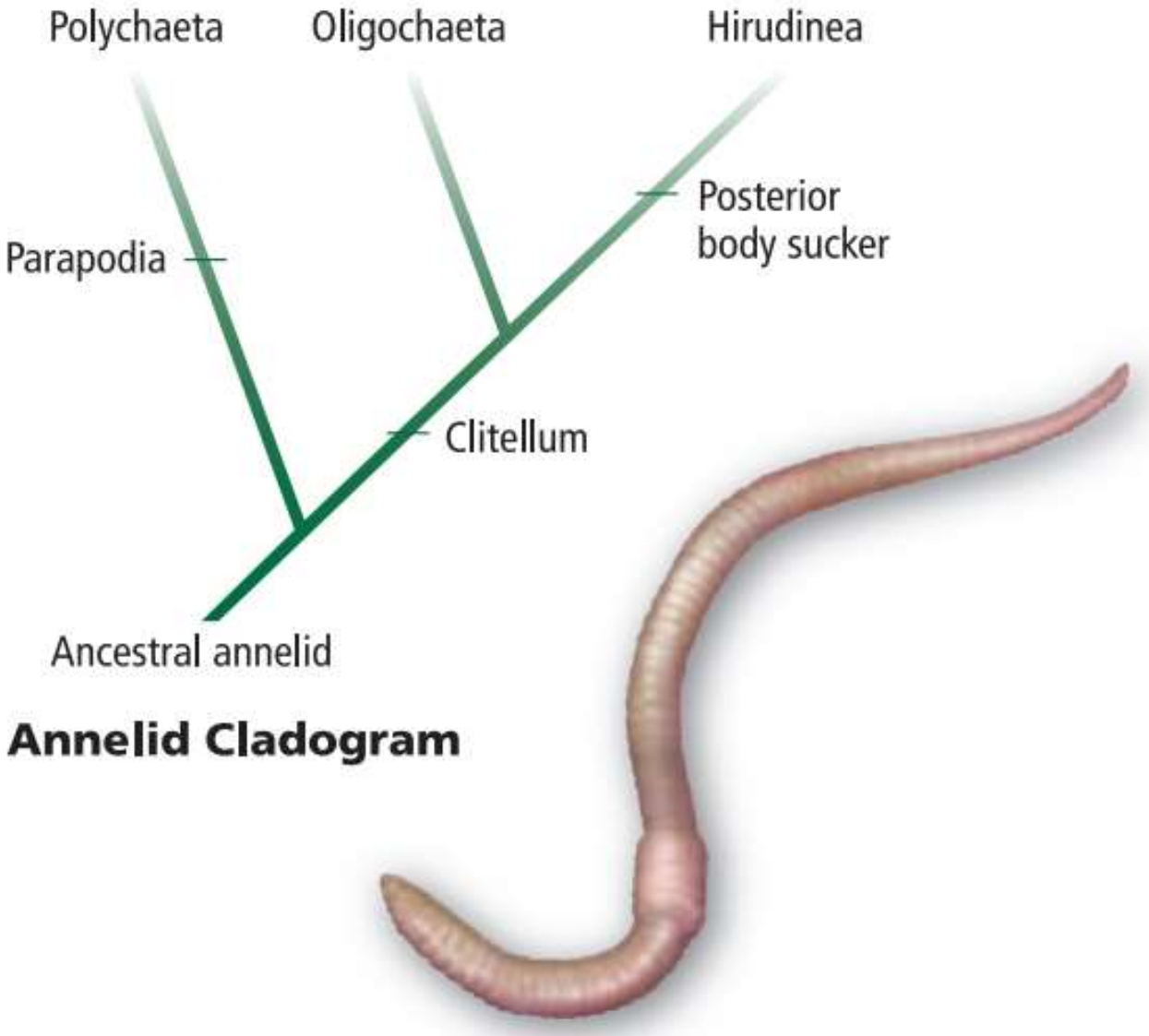
ABSTRAK: Sungai Ancar merupakan aliran Sungai yang banyak dimanfaatkan oleh penduduk sekitar untuk berbagai aktivitas, seperti kegiatan pertanian, perikanan, dan tempat penanaman kangkung. Selain kegiatan tersebut, Sungai Ancar digunakan juga sebagai tempat pembuangan limbah rumah tangga dan pembuangan industri limbah tahu sehingga dapat berdampak negatif terhadap sumber daya air, antara lain menyebabkan penurunan kualitas air. Respon *Annelida* terhadap perubahan lingkungan dapat digunakan untuk melihat pengaruh berbagai kegiatan, seperti dampak kegiatan industri, pertanian, dan tata guna lahan. Penelitian ini bertujuan untuk mengkaji struktur komunitas *Annelida* sebagai bioindikator perairan terhadap kandungan bahan tercemar yang terdapat di Sungai Ancar. Penelitian ini bersifat deskriptif eksploratif, dengan menggunakan pendekatan kuantitatif dan kualitatif. Penelitian ini menggunakan metode "*Sampling Purposive*" yaitu penentuan stasiun pengamatan didasarkan atas tata guna lahan di sekitar lingkungan Sungai Ancar. Setiap stasiun pengambilan sampel dilakukan di 3 titik yaitu kiri, tengah dan kanan Sungai. *Annelida* yang didapatkan di Sungai Ancar terdiri atas dua kelas yaitu *Oligochaeta* dan *Hirudinea*. Kelas *Oligochaeta* terdiri atas *Tubifex* sp., *Lumbricus terrestris*, kelas *Hirudinea* terdiri atas *Hirudo medicinalis*. Struktur komunitas *Annelida* dapat dijadikan sebagai bioindikator pencemaran Sungai. Dari hasil penelitian diketahui bahwa Sungai Ancar telah mengalami pencemaran yang disebabkan oleh bahan organik baik dari limbah rumah tangga maupun limbah industri tahu. Berdasarkan nilai BOD diketahui bahwa stasiun 1 dikategorikan sebagai lokasi tidak tercemar, stasiun 2 dan 4 tercemar ringan, dan stasiun 3, 5, dan 6 tercemar sedang.

Kata Kunci: Struktur Komunitas, *Annelida,* Bioindikator Pencemaran.



Annelid Cladogram