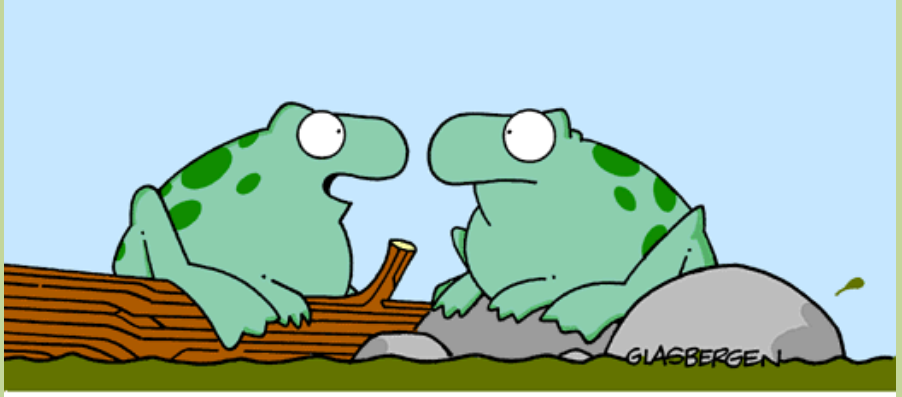
General Biology II

Lab Practical 2 Presentation



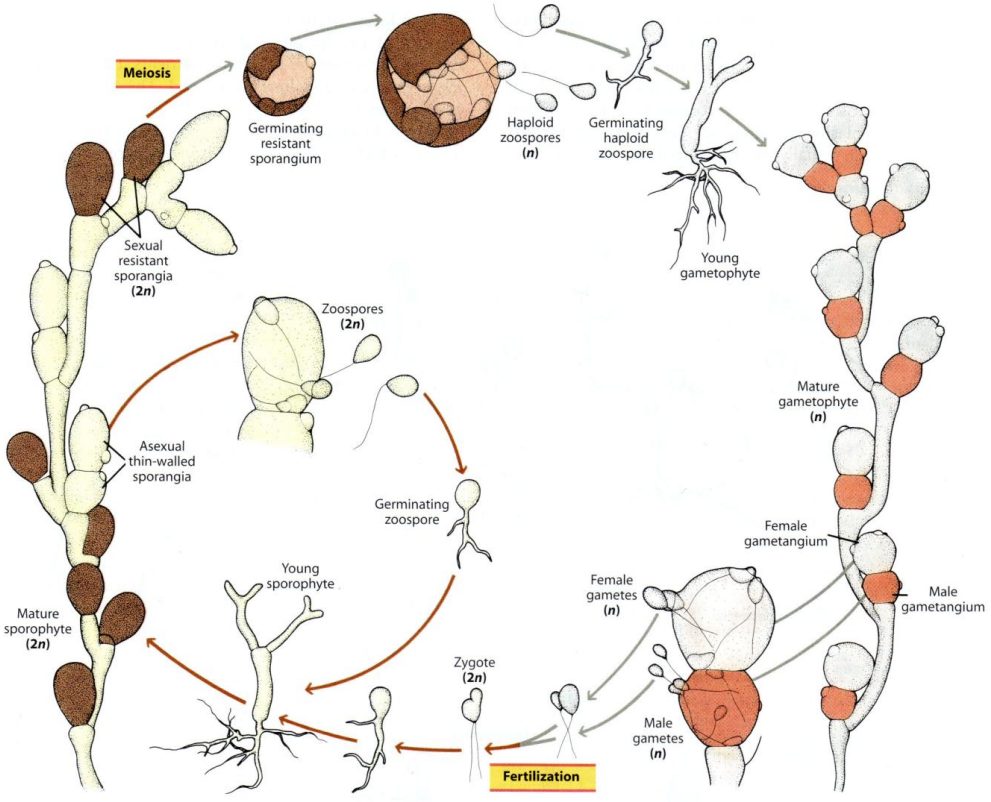
Animals and Fungi

Phyla & Classes

Kingdom Fungi

- Fungi are
  - Heterotrophic
  - Sessile
  - Sexual or Asexual Reproduction
  - Haploid
- Parts of a Fungus
  - Hyphae
  - Mycelium
  - Spores
  - Spore-Producing structures (zygosporangium, basidiosporangium, etc)
  - Cell Wall composed of chitin

Chytridiomycota

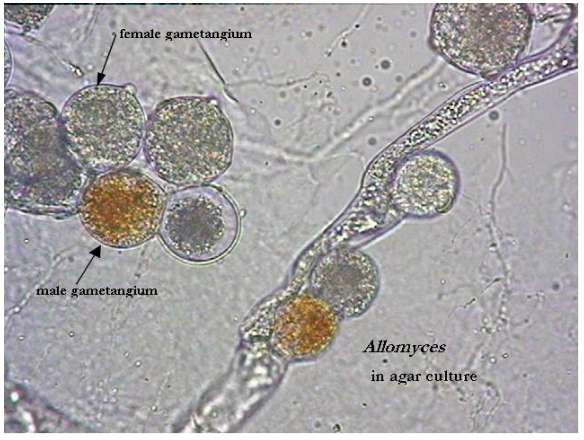


Chytridiomycetes

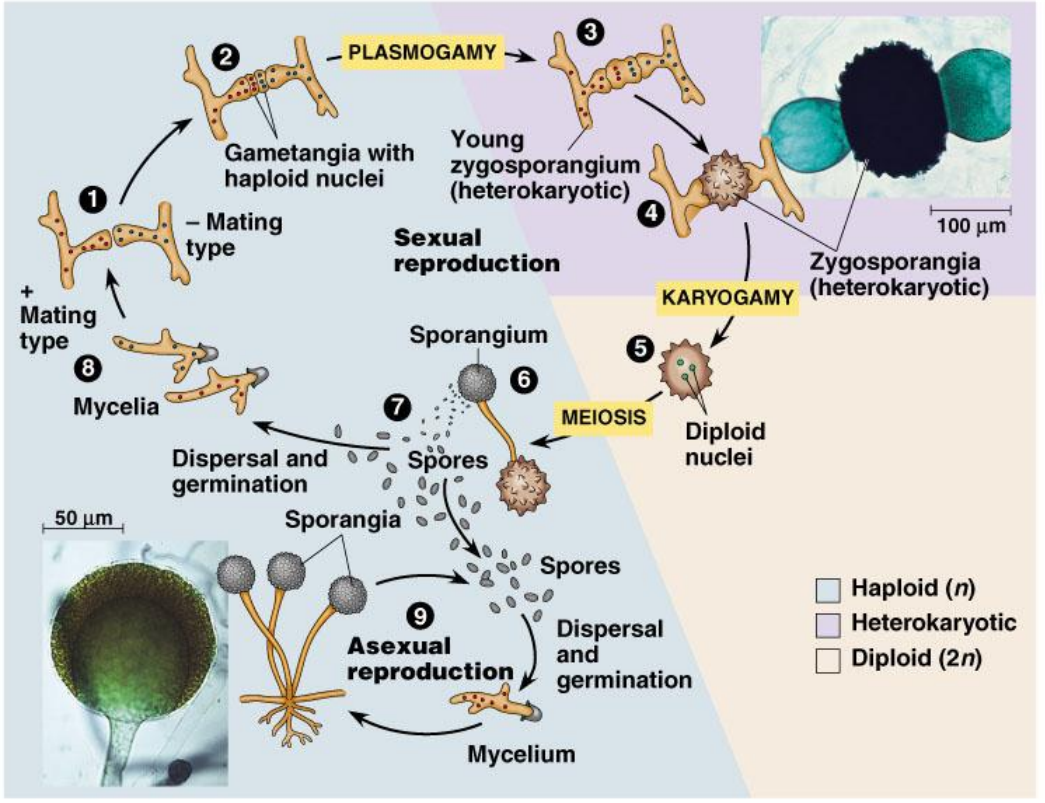
Unicellular Molds

Sexual and Asexual Reproduction

Zoospores



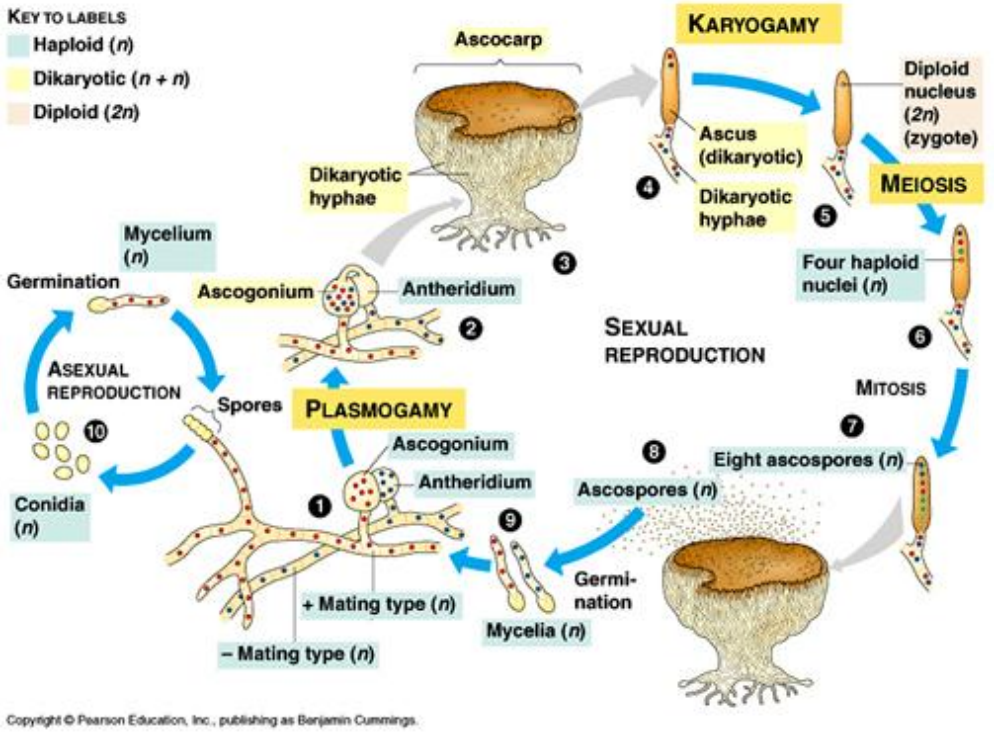
Zygomycota



Zygomycetes - Bread Molds

<u>Zygomycetes Have</u>
Sporangia
Hyphae
Zygosporangia
Mycelia
Sexual and Asexual Reproduction

Ascomycota



Ascomycetes – Sac Fungi

<u>Ascomycetes Have</u>

Hyphae

Mycelium

Antheridium

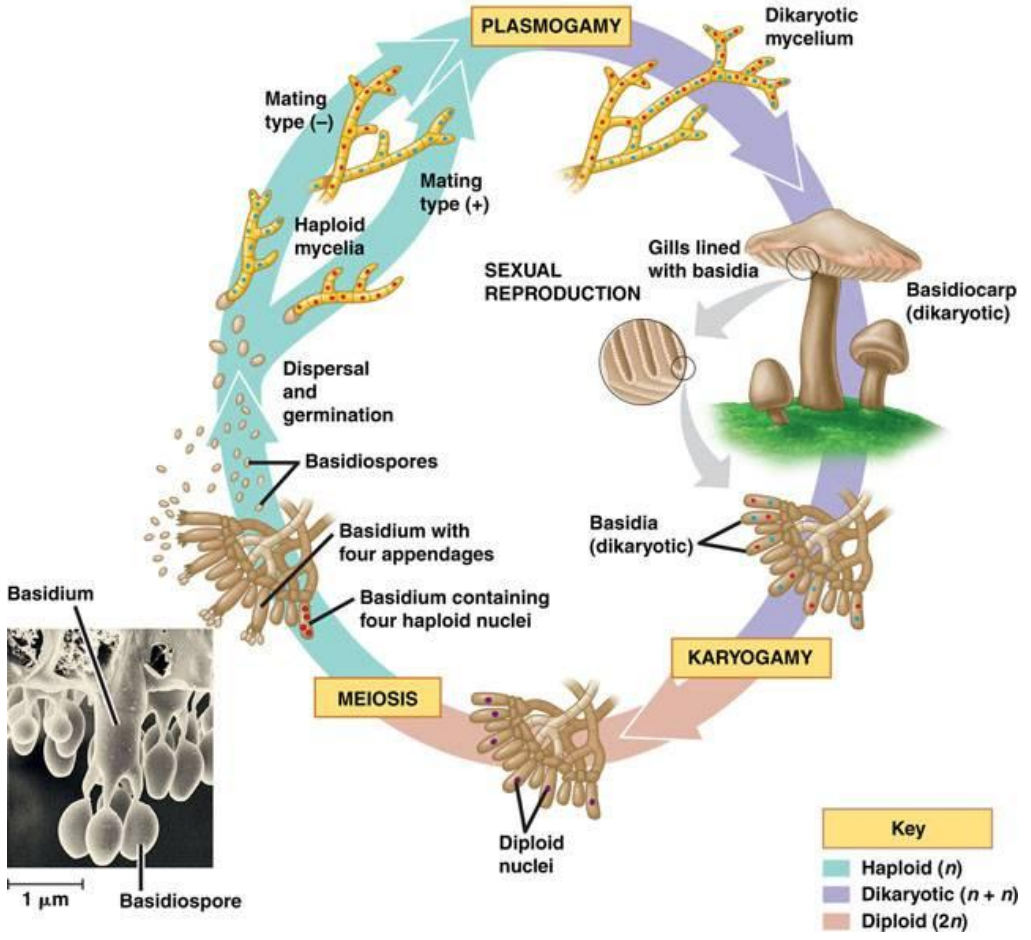
Ascogonium

Ascocarp

Ascus

Ascospores

Basidiomycota



Basidiomycetes – Club Fungi

<u>Basidiomycetes Have</u>

Hyphae

Mycelia

Mushrooms

Gills

Basidia

Basidiospores

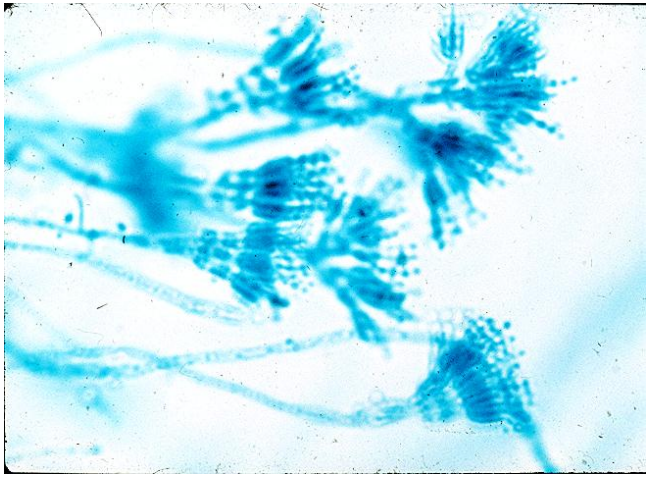
Fungi Imperfecta

Fungi Imperfecta

Asexual Reproduction

Example: Penicillin

Note: All Fungi have been moved to other Phylums due to all fungi being found to do sexual reproduction.



Kingdom Animalia

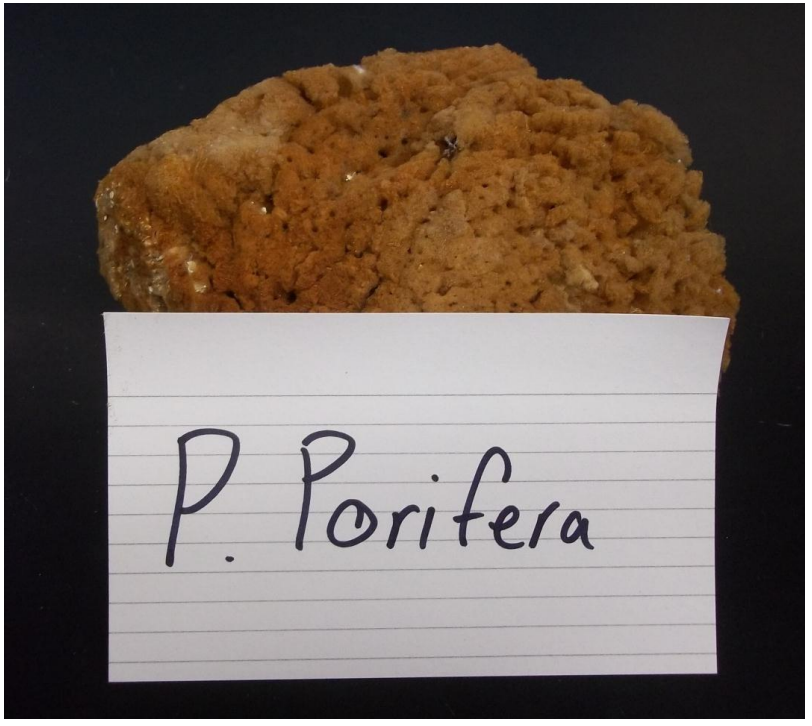
- Animals are
  - Heterotrophic
  - Motile
  - Diploid
  - Sexual Reproduction

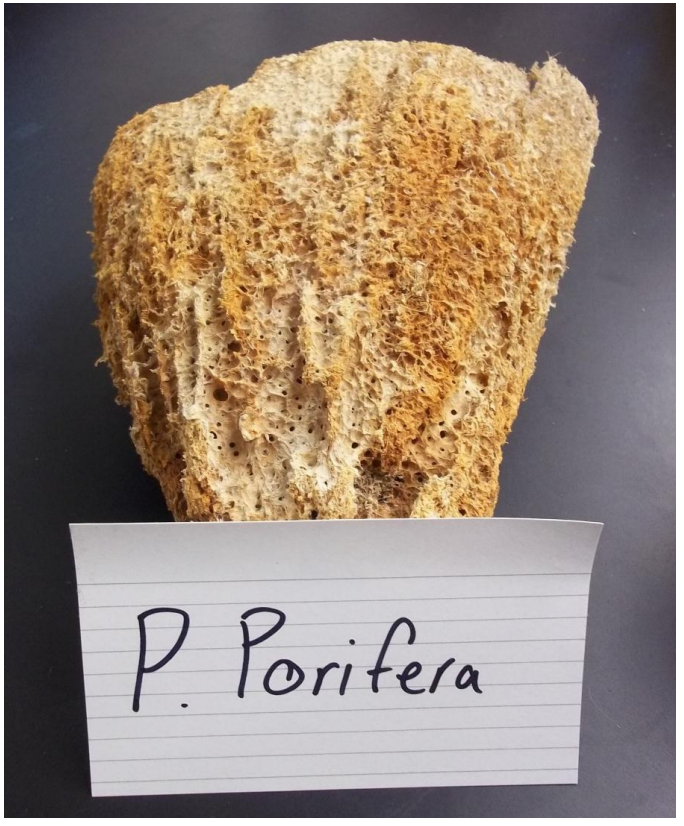
Phylum Porifera

Phylum Porifera – Sponges

<u>Poriferans Have</u>
Asymmetry
Begin as larvae
Below tissue level of organization
Collar Cells (Choanocytes) – bring in nutrients
Amoebocytes – distribute nutrients, make spicules
Spicules – calcium carbonate or silica spikes in the extracellular matrix
Both sexual and asexual reproduction.
Spongocoel – central cavity of a sponge
Sessile as adult, Mobile as larvae

Phylum Porifera





Phylum Porifera

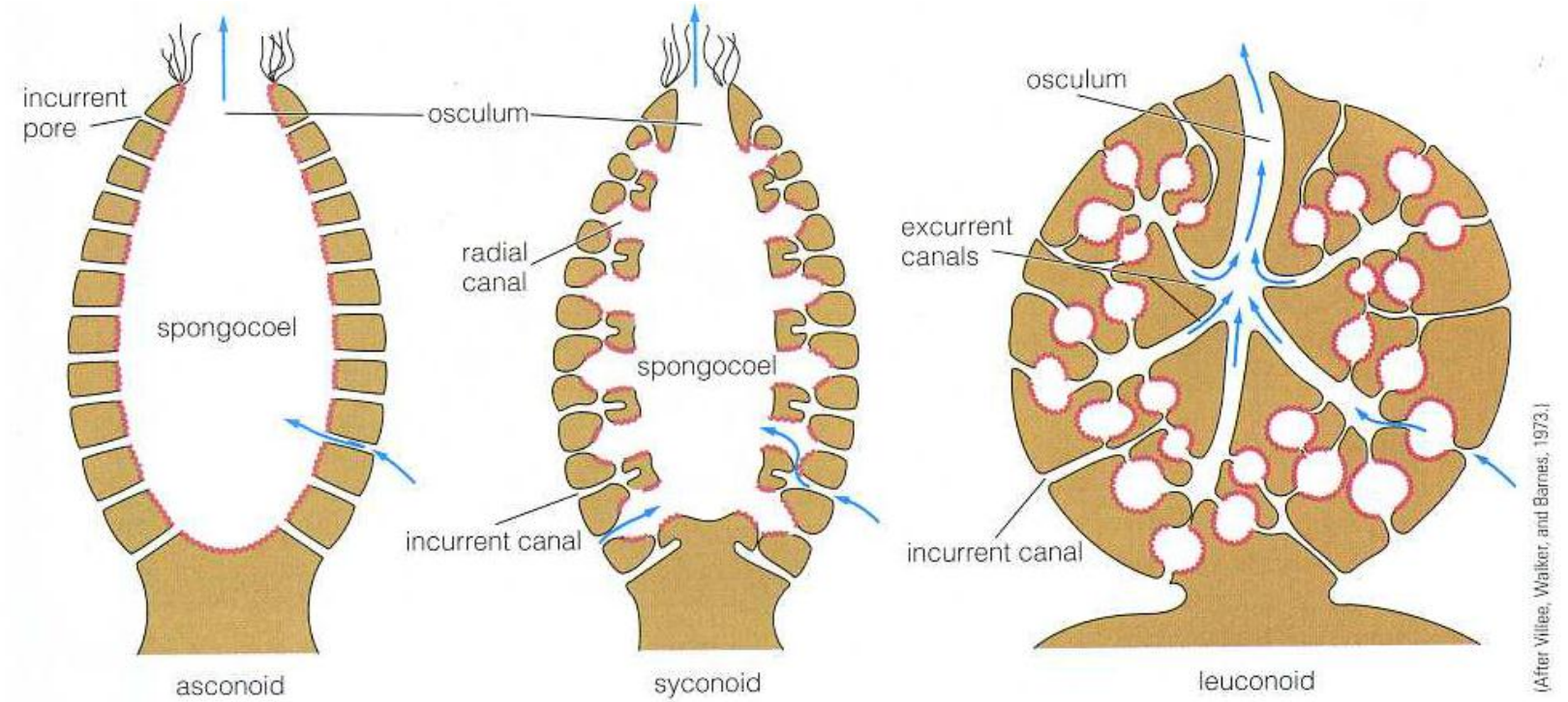


Figure 26-4 Three body plans of sponges. The blue arrows indicate the direction of water flow. Pink areas are lined by collar cells.

Phylum Porifera

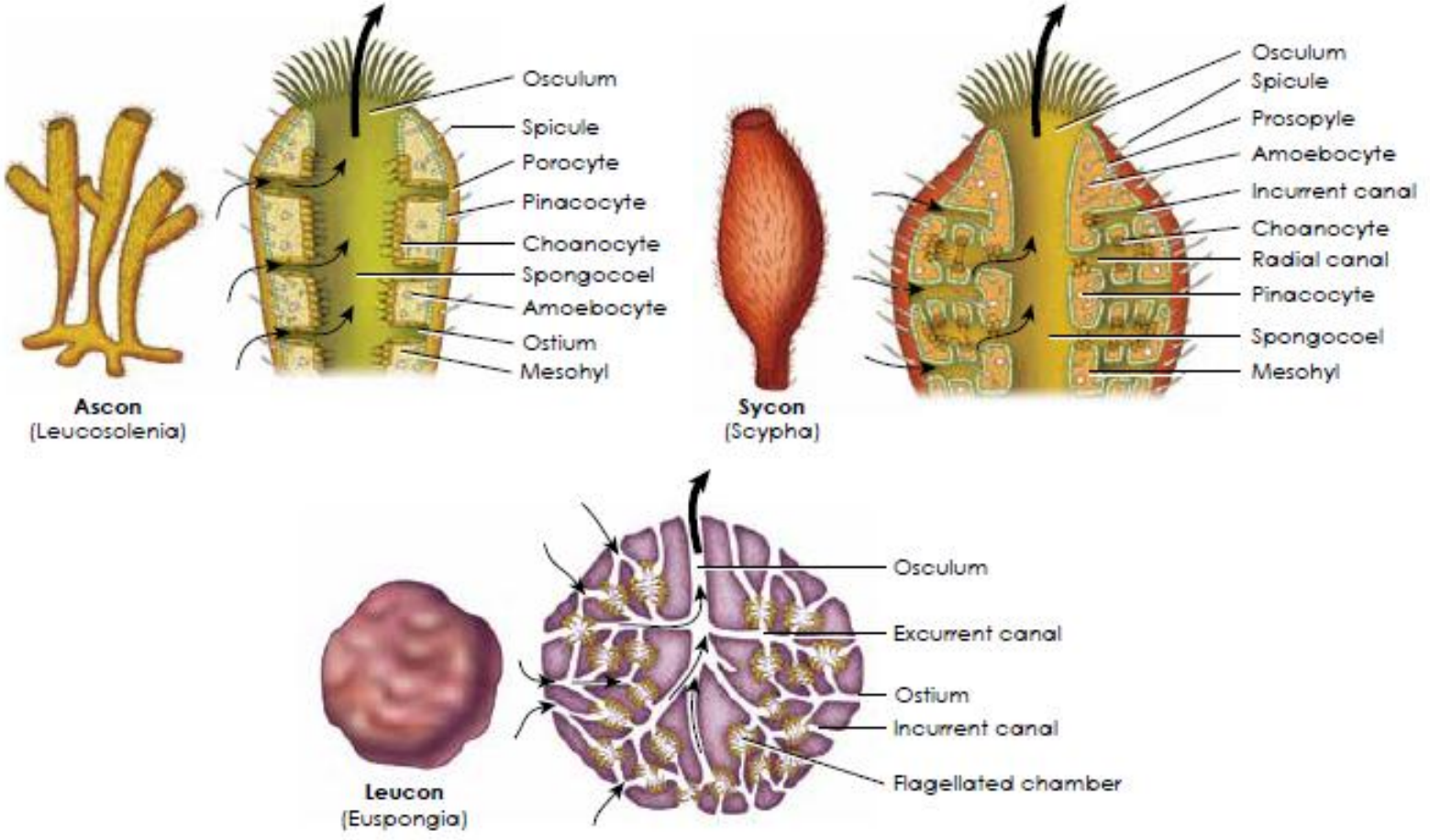


Figure 29.7 Examples of sponge body types. A diagrammatic representative of each of the three types depicts with arrows the flow of water through the body of the sponge.

Phylum Porifera – Class Calcarea

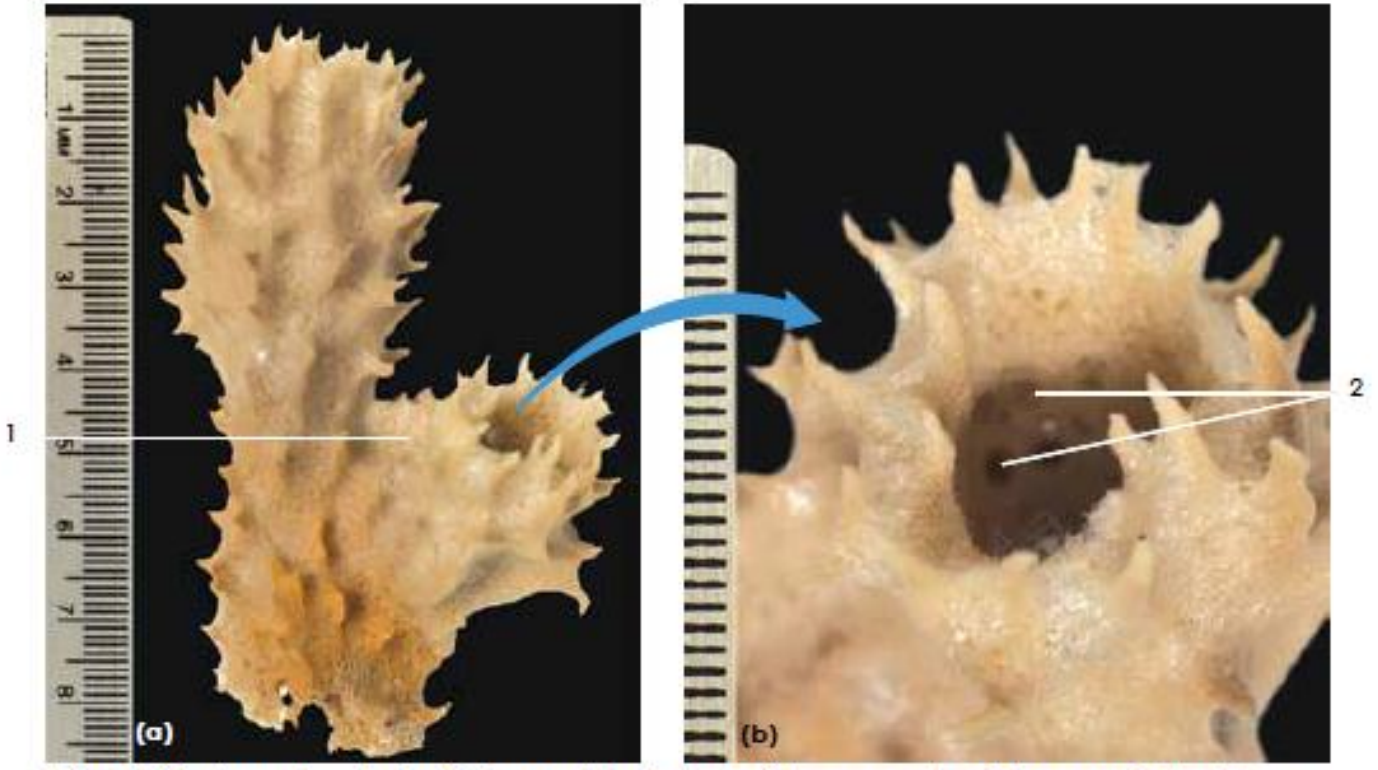


Figure 29.9 A member of class Calcarea: (a) a sponge with an ascon body type, and (b) a close-up view of osculum (scale in mm).

1. Osculum
2. Ostia (seen from inside osculum)

Calcareous Sponges

Phylum Porifera – Class Hexactinellida

Glass Sponges

Phylum Porifera – Class Demospongia

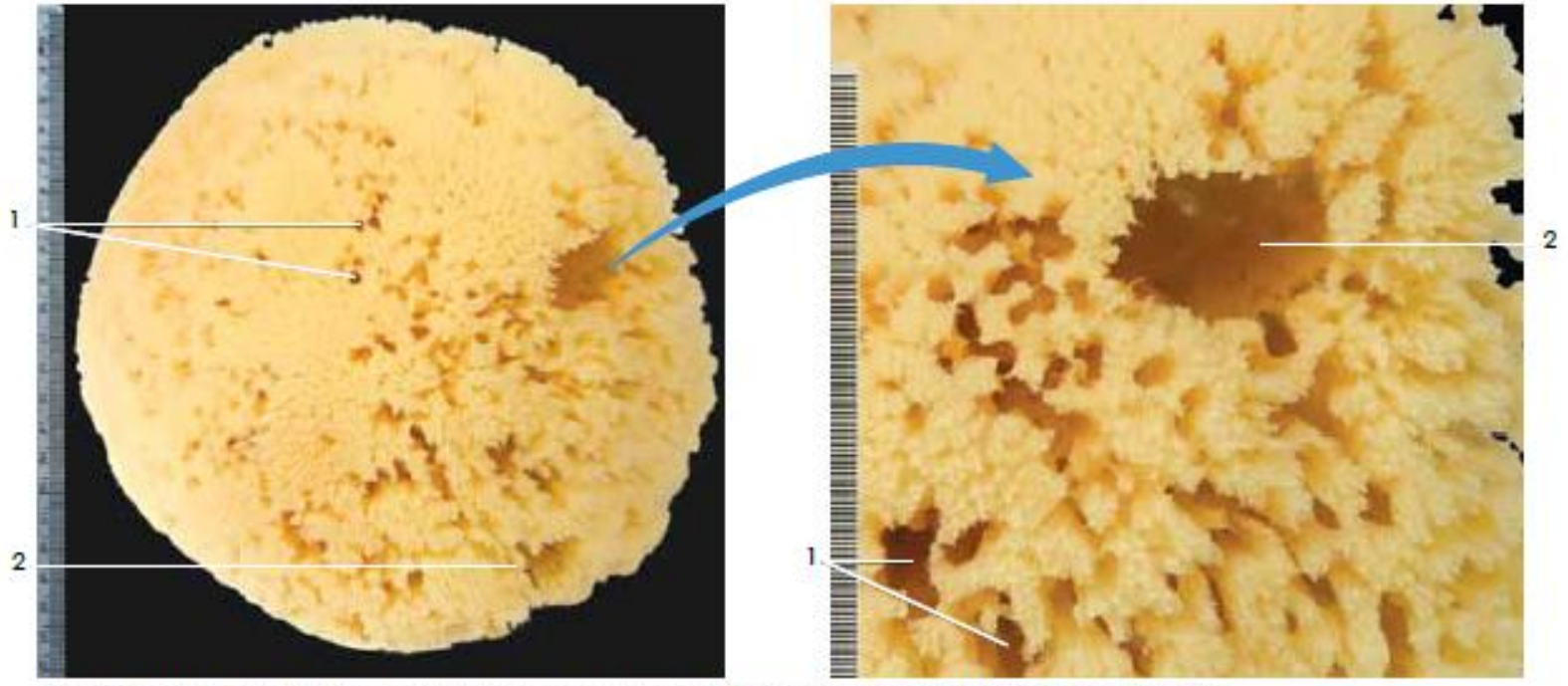
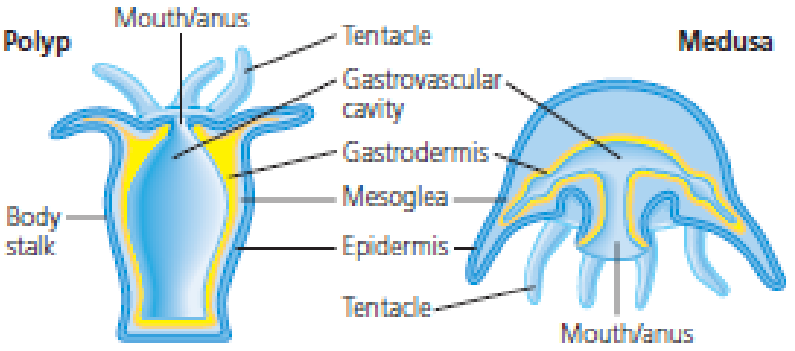


Figure 29.15 A bath sponge, class Demospongiae, has a leuconoid body structure (scale in mm).
1. Ostia 2. Osculum

Bath Sponges

Phylum Cnidaria



▲ **Figure 33.5 Polyp and medusa forms of cnidarians.** The body wall of a cnidarian has two layers of cells: an outer layer of epidermis (darker blue; derived from ectoderm) and an inner layer of gastrodermis (yellow; derived from endoderm). Digestion begins in the gastrovascular cavity and is completed inside food vacuoles in the gastrodermal cells. Flagella on the gastrodermal cells keep the contents of the gastrovascular cavity agitated and help distribute nutrients. Sandwiched between the epidermis and gastrodermis is a gelatinous layer, the mesoglea.

<u>Cnidarians have</u>

Radial Symmetry

Dimorphism

- Begin as Polyps
- Adults are medusa

Some have only a polyp or a medusa stage

Ectoderm and Endoderm tissue

Mesoglia

Incomplete Digestive System

No coelom

Cnidocytes – stinging cells

- Nematocysts

Phylum Cnidaria – Class Hydrozoa

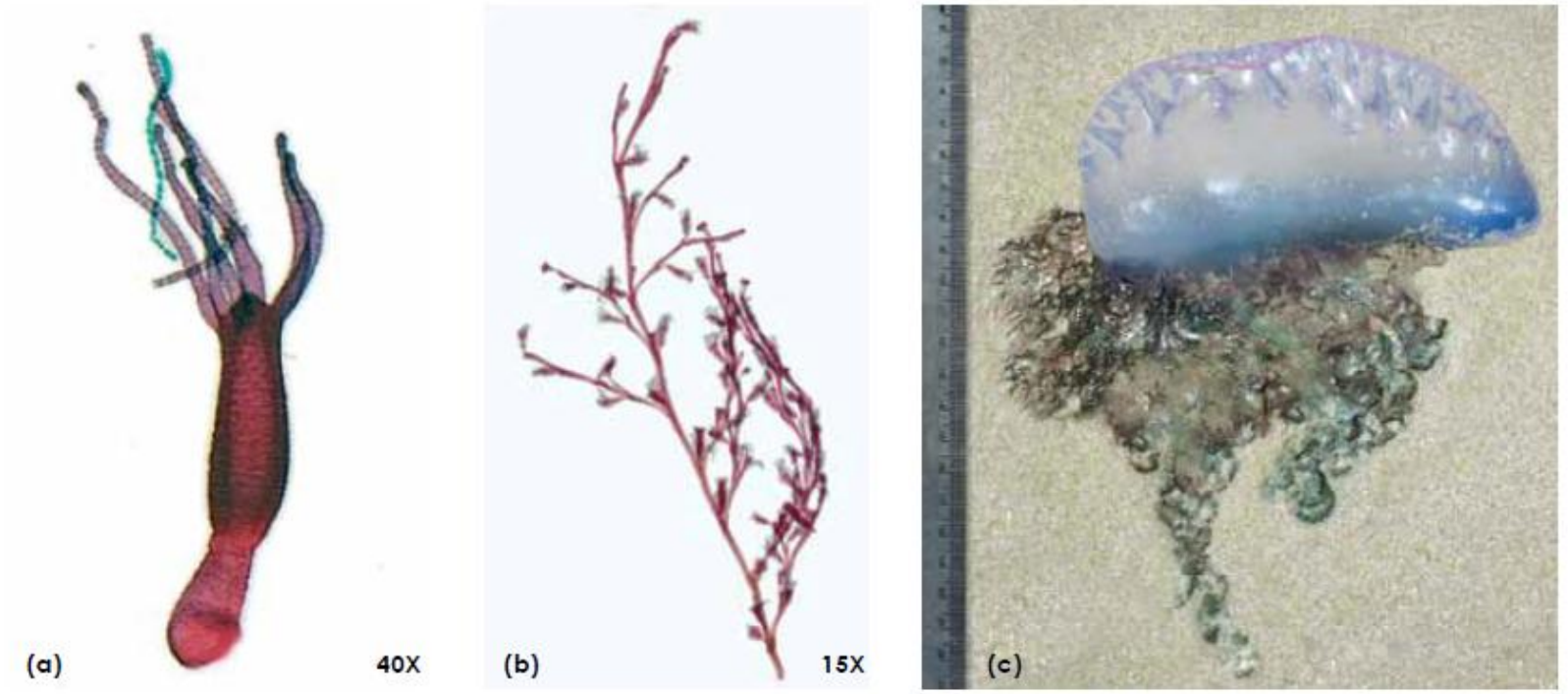


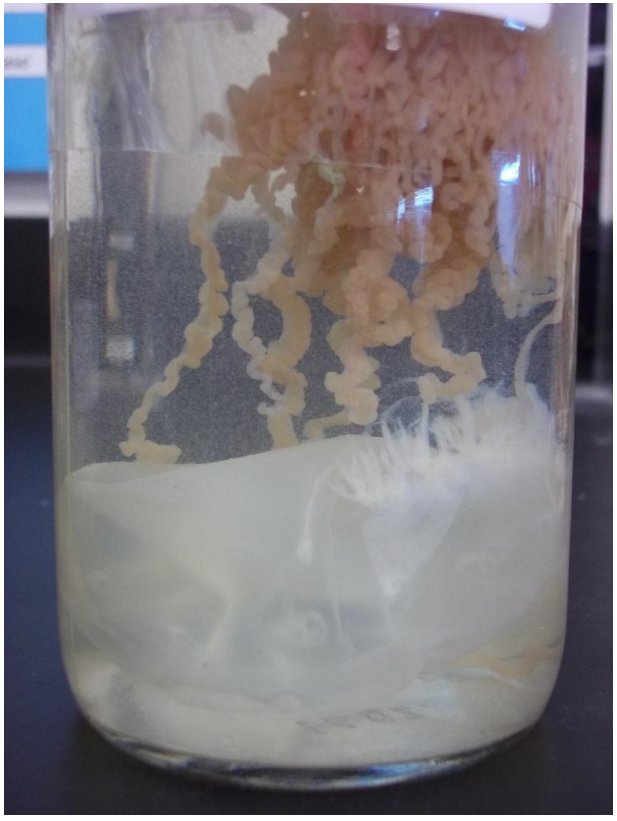
Figure 29.20 (a) *Hydra* is a common freshwater hydrozoan; (b) *Obelia* is a colonial hydrozoan found in brackish and marine water; (c) the Portuguese man-of-war, *Physalia* sp., is actually a colony of medusae and polyps acting as a single organism. The tentacles are composed of three types of polyps: the gastrozooids (feeding polyps), the dactylozooids (stinging polyps), and the gonozooids (reproductive polyps) (scale in mm).

Phylum Cnidaria

Hydrocoral – Class Hydrozoa

Hydrozoans have both a polyp and a medusa stage, and live as colonial polyps.

Phylum Cnidaria



Man of War – Class Hydrozoa
The man of war jellyfish is an example of the medusa stage of cnidarians

Phylum Cnidaria – Class Scyphozoa

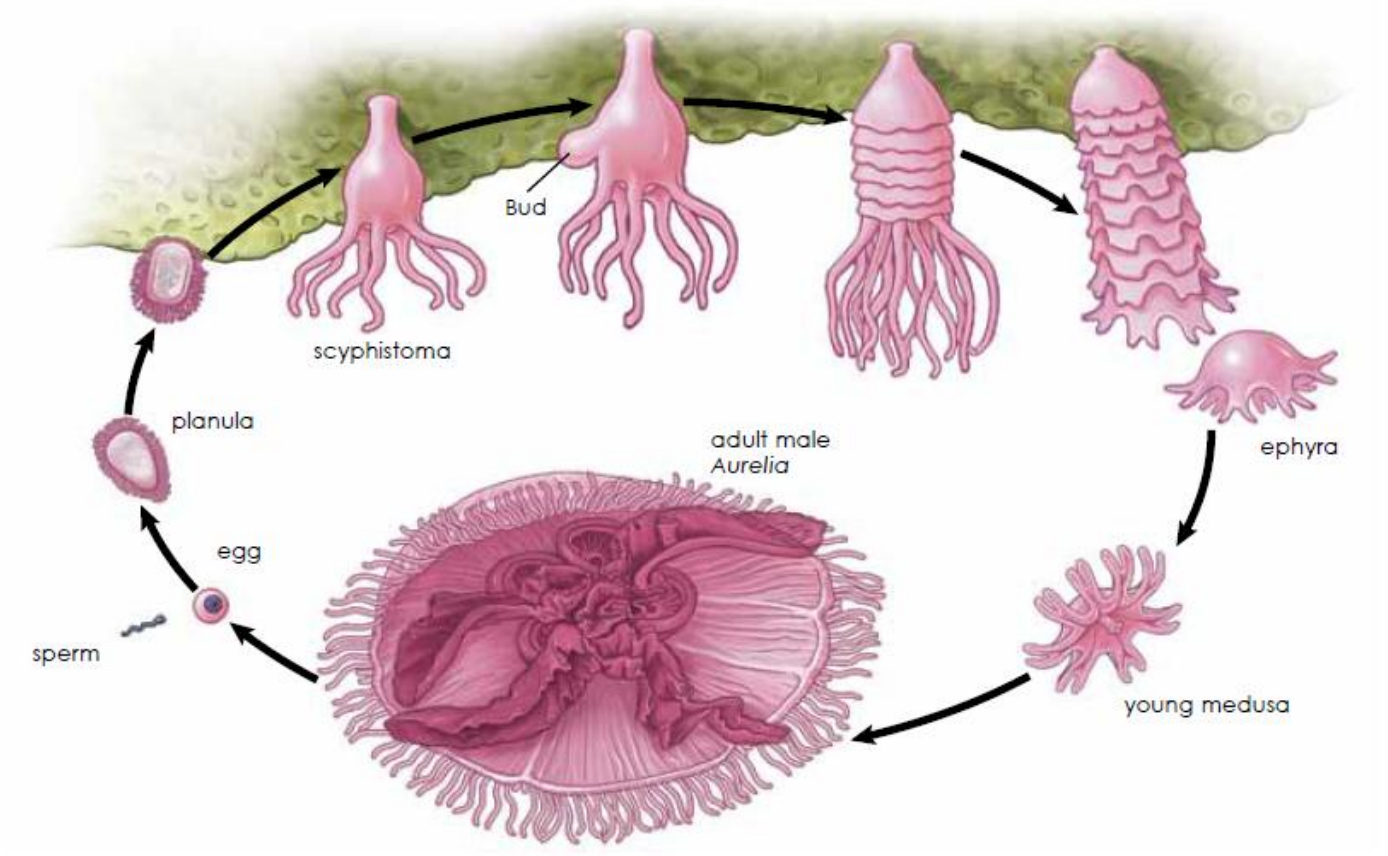


Figure 29.32 The life cycle of *Aurelia*.

True Jellyfish

Phylum Cnidaria – Class Scyphozoa

Figure 29.33 The *Aurelia* planula larva develops from a fertilized egg that may be retained on the oral arm of the medusa.

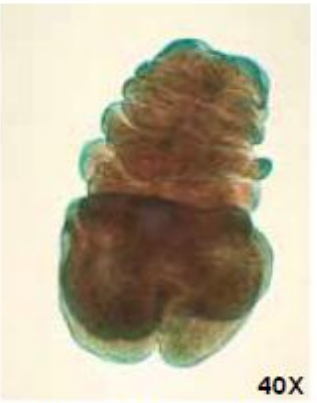


Figure 29.34 An *Aurelia scyphistoma*. The polyp is a developmental stage in the life cycle of the jellyfish.

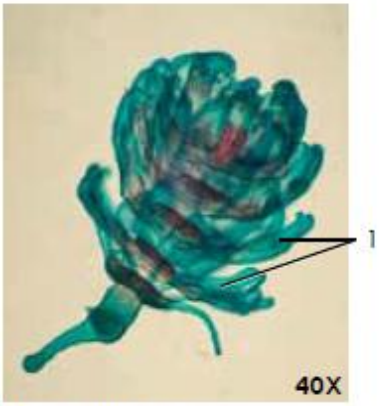


Figure 29.35 An *Aurelia strobila*. Under favorable conditions, the scyphistoma develops into the strobila.

1. Developing ephyrae

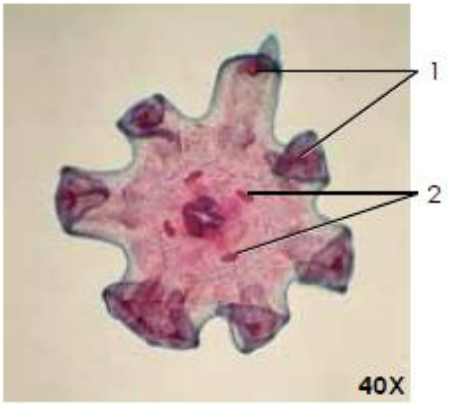


Figure 29.36 An *Aurelia* ephyra larva, which gradually develops into adult jellyfish.

1. Rhopalia (sense organs)
2. Gonads

Phylum Cnidaria – Class Scyphozoa

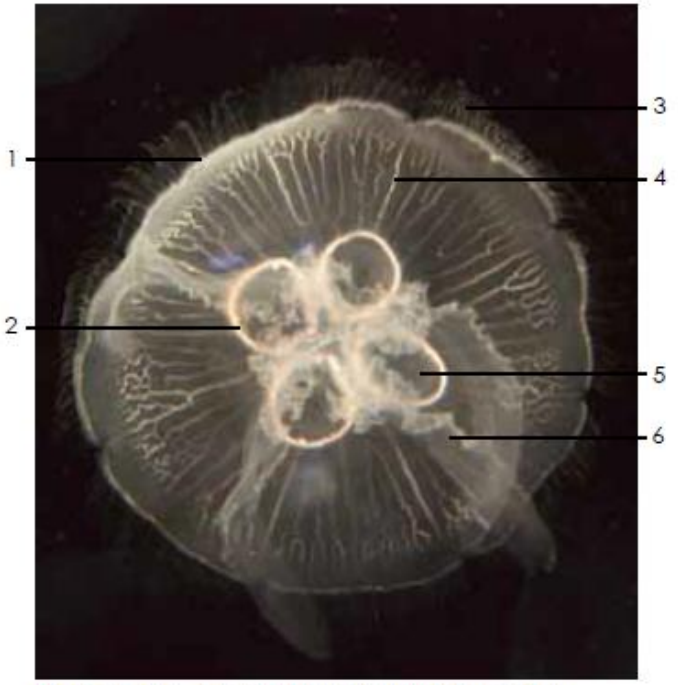


Figure 29.37 An oral view of *Aurelia* medusa.

1. Ring canal
2. Gonad
3. Marginal tentacles
4. Radial canal
5. Subgenital pit
6. Oral arm

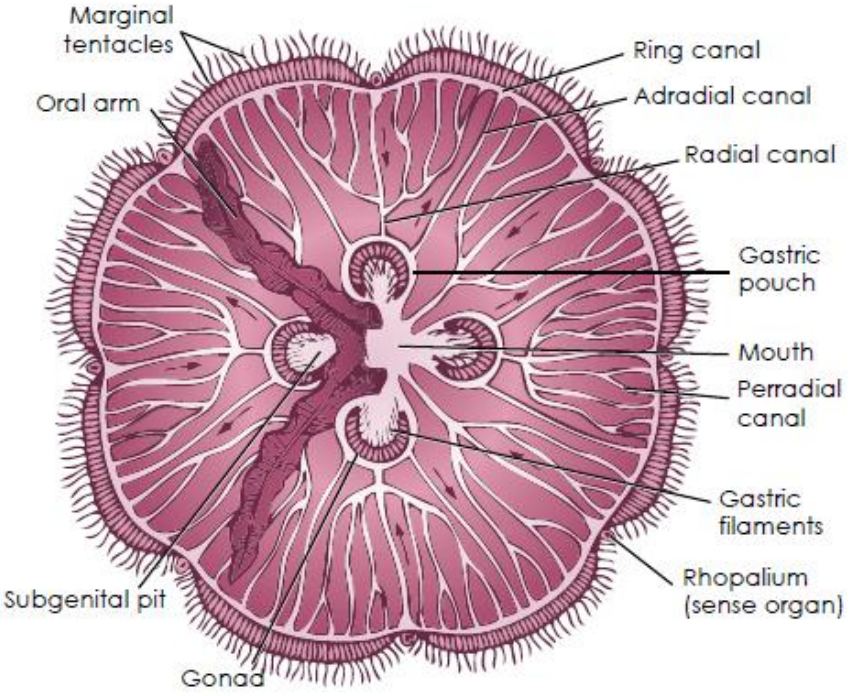


Figure 29.38 An oral view of *Aurelia* medusa. In this diagram, the right oral arms have been removed. The arrows depict circulation through the canal system.

Phylum Cnidaria

Cassiopeia – Class Scyphozoa
Scyphozoans have only a medusa stage or a very reduced polyp stage.

Phylum Cnidaria – Class Cubozoa

Box Jellyfish

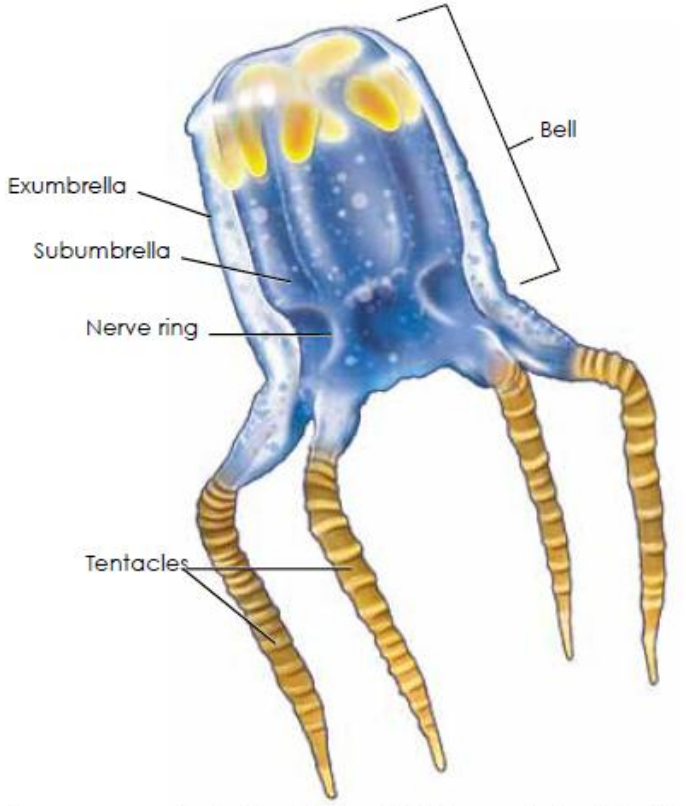


Figure 29.39 An illustration of a box jellyfish, *Carybdea sivickisi*, showing basic external structures.

Figure 29.40 The box jellyfish, *Carybdea sivickisi*, is named from their cube-shaped bell. All cubozoans have four tentacles.

Phylum Cnidaria – Class Anthozoa

Figure 29.43 The sunburst anemone, *Anthopleura sola*, gets its green coloration from symbiotic algae within it.

Figure 29.44 The firecracker coral, *Dendrophyllia*, a filter feeder actively feeds day and night.

Figure 29.45 The tube anemone, *Pachycerianthus fimbriatus*, makes a leathery tube and sinks it up to two feet into the sand.

Figure 29.46 The sea pen, *Ptilosarcus gurneyi*, is a colony of polyps that may reach two feet in height.

Sea Anemones, Sea Fans, Sea Pens, and Corals

Phylum Cnidaria – Class Anthozoa

Figure 29.50 Brain coral, *Goniastrea*.

Figure 29.51 The skeletal structure of brain coral, *Goniastrea*.

Figure 29.52 Mushroom coral, *Rhodactis*.

Figure 29.53 The skeletal structure of mushroom coral, *Rhodactis*.

Phylum Cnidaria – Class Anthozoa

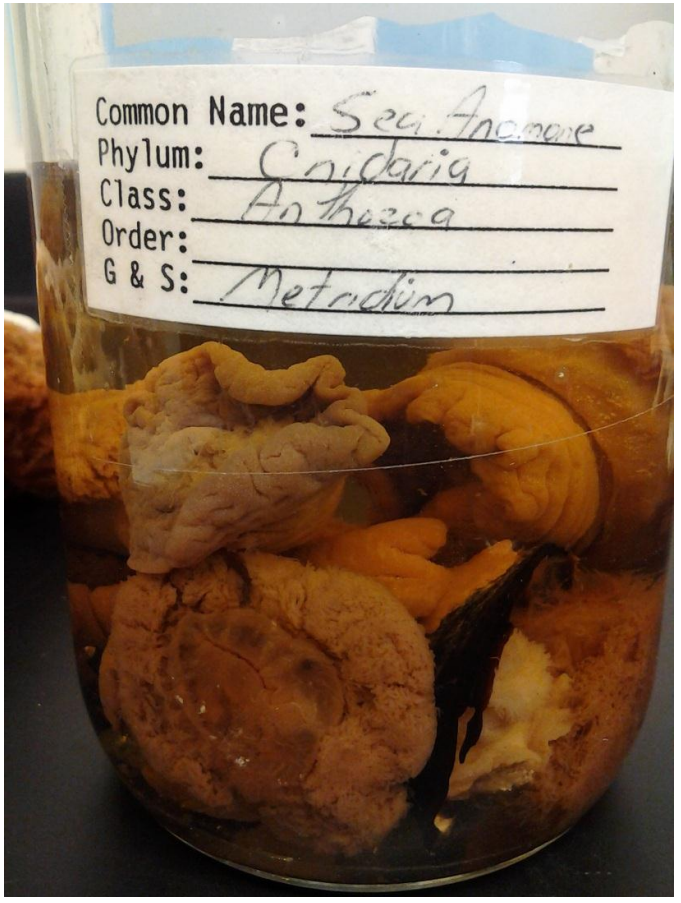
Figure 29.54 Elkhorn coral, *Acropora*.

Figure 29.55 The skeletal structure of elkhorn coral, *Acropora*.

Figure 29.56 A detailed view of the polyps of candy cane coral, *Caulastrea furcata*.

Figure 29.57 A detailed view of the polyps of glove xenia, *Xenia umbellata*.

Phylum Cnidaria



Sea Anemone – Class Anthozoa

Anthozoans only have a polyp stage

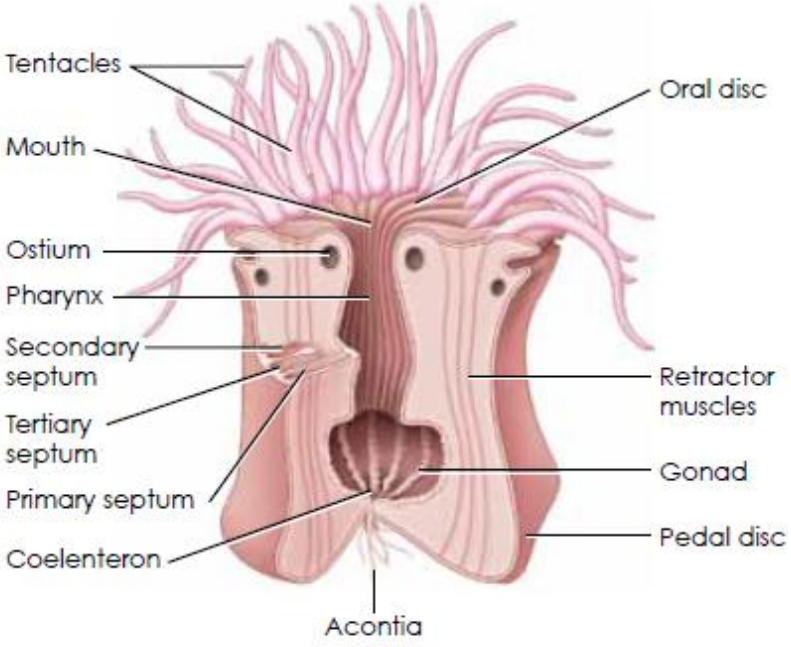
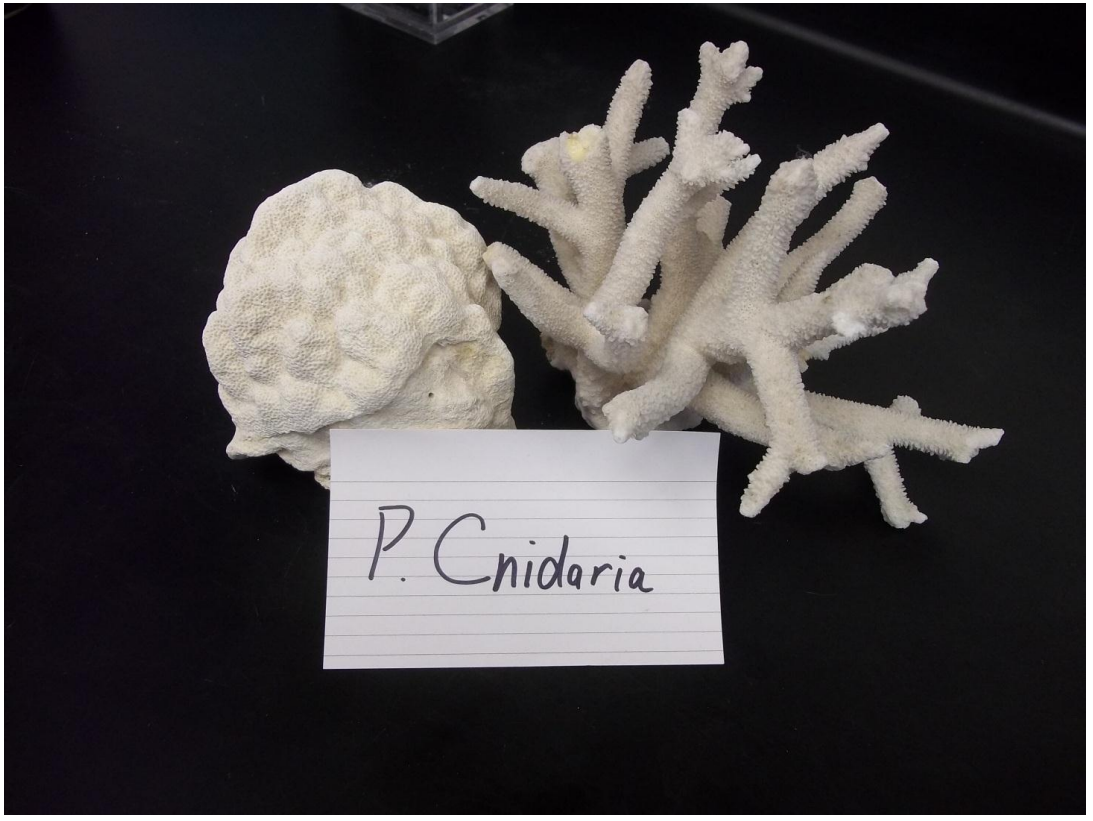


Figure 29.41 A diagram of a partially dissected sea anemone, *Metridium*.

Phylum Cnidaria



Class Anthozoa
- Corals are in the phylum Cnidaria, class Anthozoa

Phylum Ctenophora

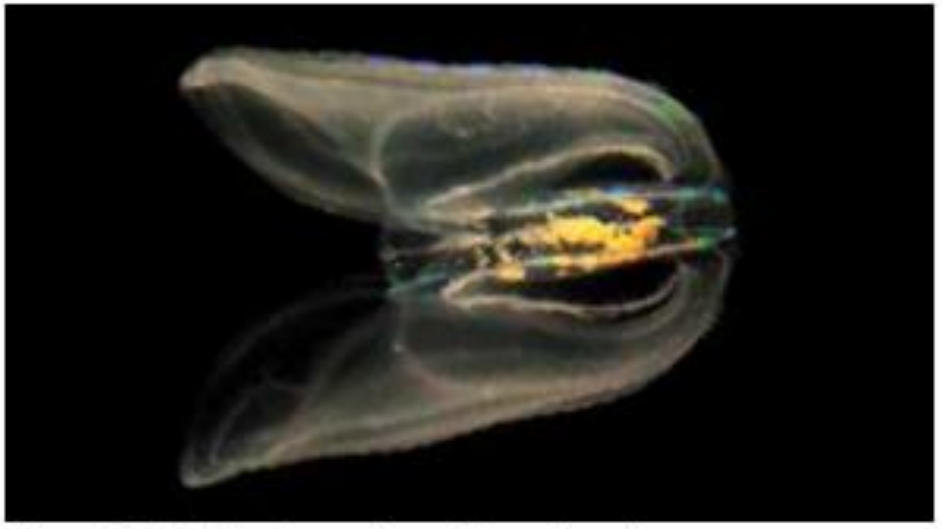
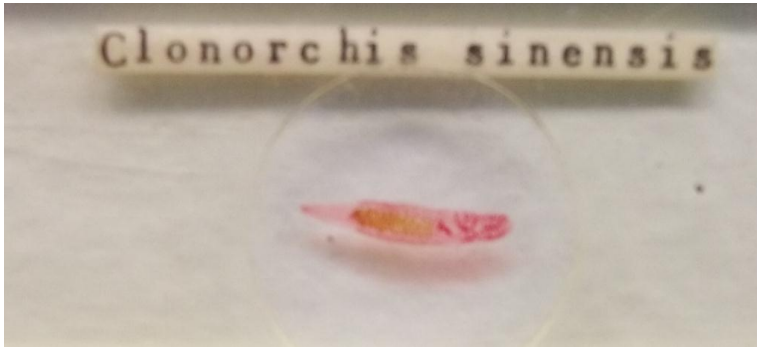


Figure 29.58 The ctenophore, *Mnemiopsis* sp.

Comb Jellies

- Comb plates – fused cillia
- Colloblasts – adhesives cells

Phylum Platyhelminthes



Phylum Platyhelminthes consists of flatworms, tapeworms and flukes

<u>They have</u>
Bilateral Symmetry
Eye Spots with ganglia and two ventral nerve cords
Incomplete digestive system
No segments
No coelom
Protostomes

Phylum Platyhelminthes – Class Turbellaria

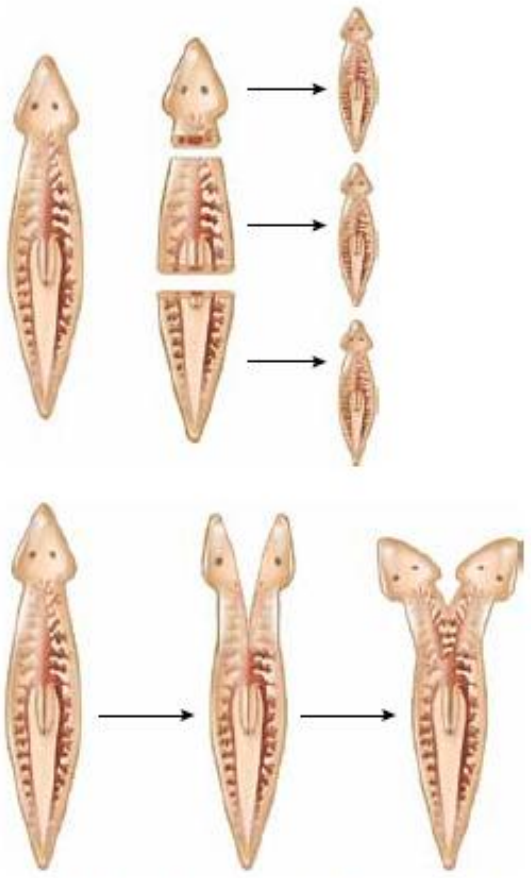


Figure 30.3 Planarians are capable of regeneration.

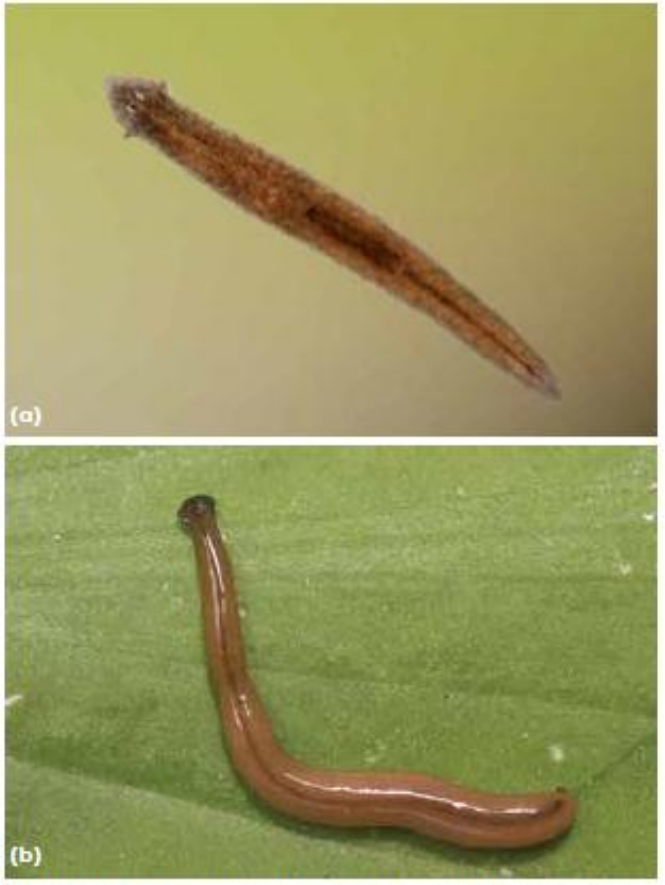


Figure 30.4 A Planarian (a) *Dugesia* sp. is aquatic, while (b) *Bipalium* sp. is a common inhabitant of gardens.

Free living flatworms

Phylum Platyhelminthes – Class Turbellaria

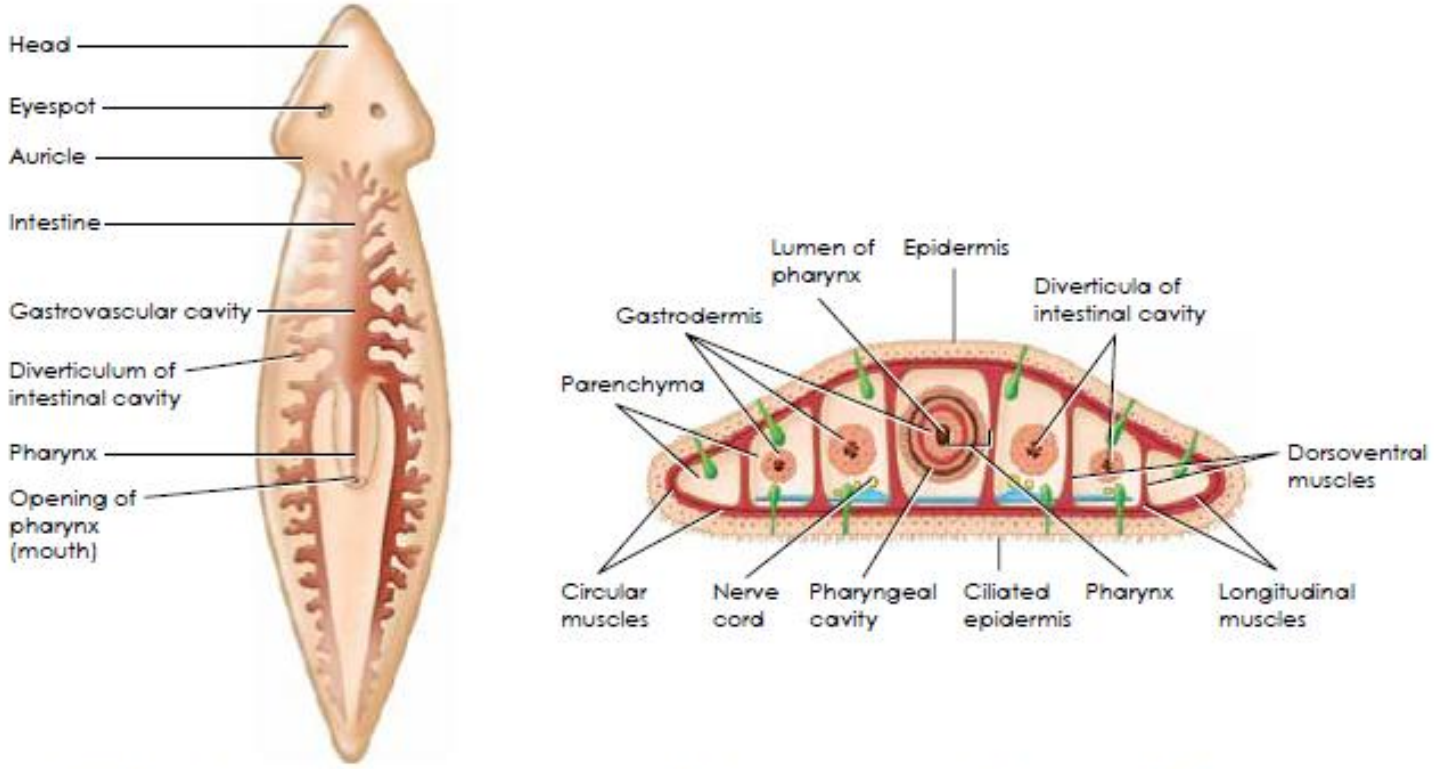


Figure 30.5 The internal anatomy of *Dugesia*: (a) A longitudinal section and (b) a transverse section through the pharyngeal region.

Phylum Platyhelminthes – Class Turbellaria

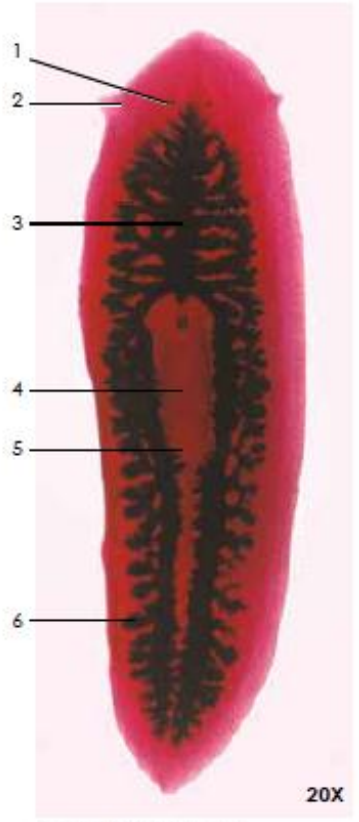
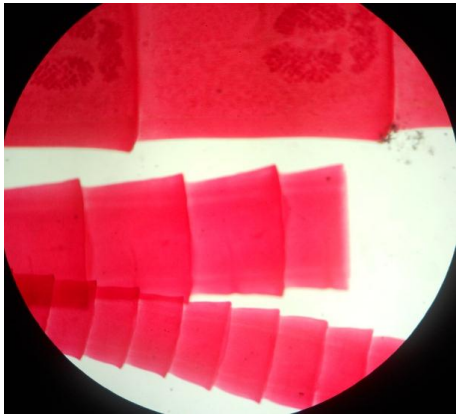


Figure 30.6 *Dugesia.*
1. Eyespot
2. Auricle
3. Gastrovascular cavity
4. Pharynx
5. Opening of pharynx (mouth)
6. Diverticulum of intestinal cavity

Phylum Platyhelminthes – Class Cestoda



Tapeworms

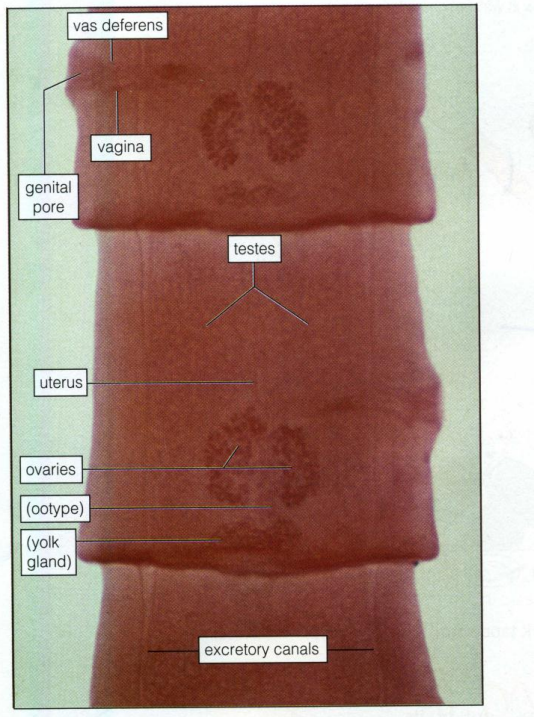


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Figure 27-9 Tapeworm mature proglottids (*Taenia pisiformis*).

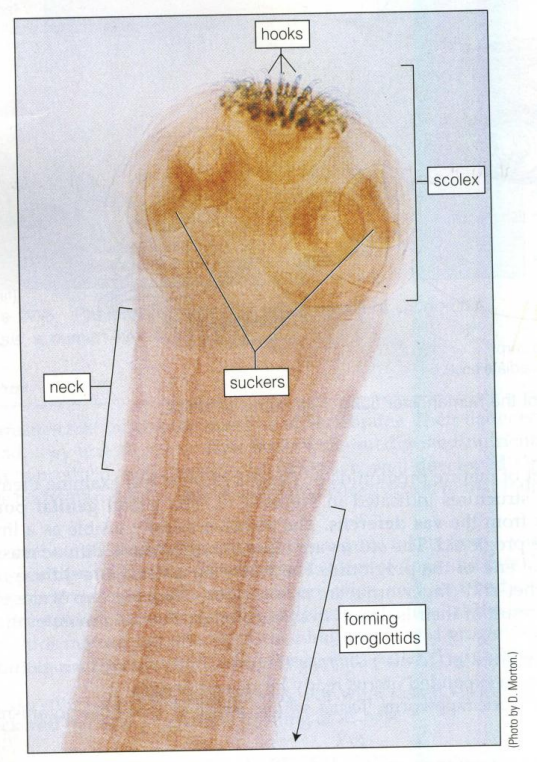


Figure 27-8 Tapeworm scolex (*Taenia pisiformis*), w.m. (40×).

Phylum Platyhelminthes – Class Trematoda

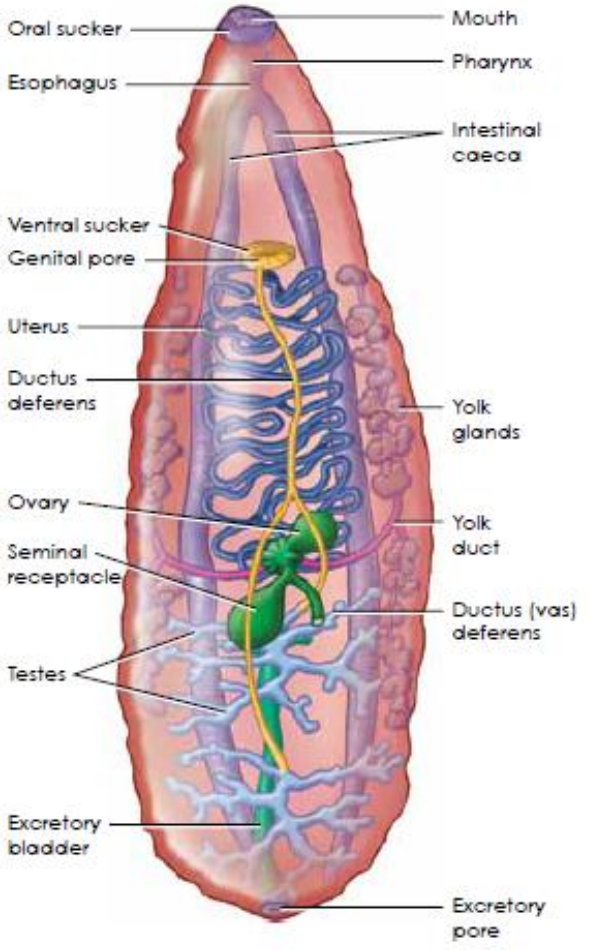


Figure 30.16 A diagram of the human liver fluke, *Clonorchis sinensis*.

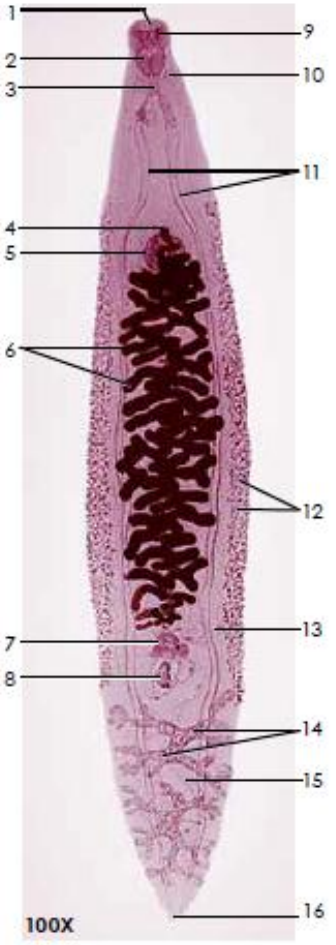


Figure 30.17 The liver fluke, *Clonorchis*.

1. Mouth
2. Pharynx
3. Esophagus
4. Genital pore
5. Ventral sucker
6. Uterus
7. Ovary
8. Seminal receptacle
9. Oral sucker
10. Cerebral ganglion
11. Intestine
12. Yolk glands
13. Yolk duct
14. Testis
15. Ductus (vas) deferens
16. Excretory pore

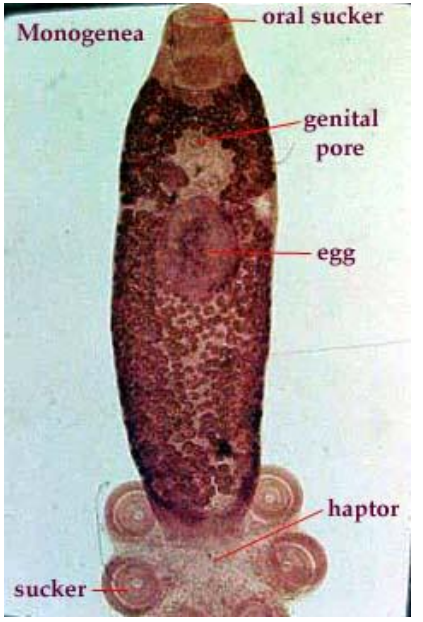
Parasitic Flukes

Phylum Platyhelminthes – Class Monogenea

Ectoparasitic flatworms

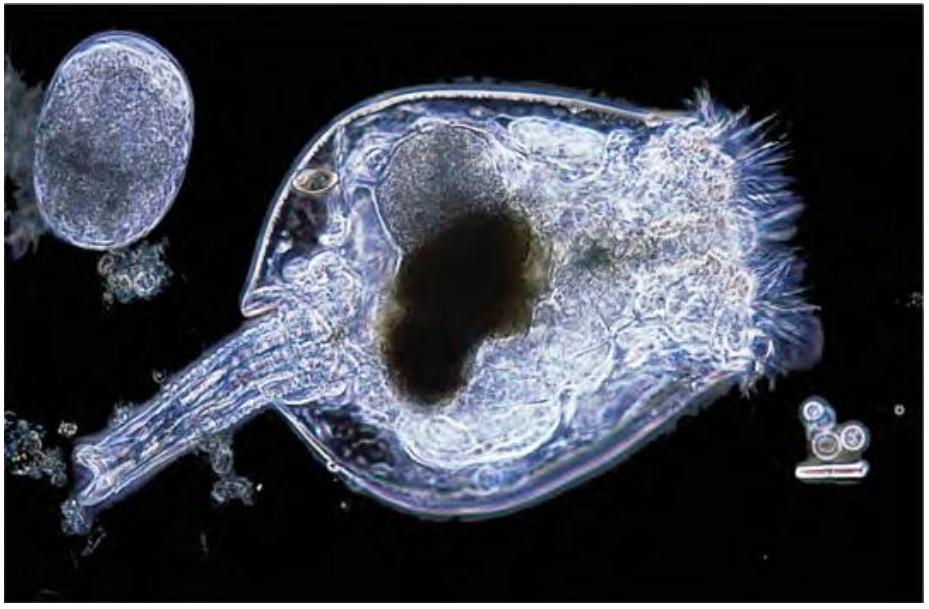
Phylum Platyhelminthes – Class Monogenea

Monogenea are tiny flukes that infect the outside of a host



Ectoparasitic flatworms

Phylum Rotifera



Phylum Rotifera consists of microscopic organisms with some complex organ systems, despite their tiny size

<u>Rotifers have</u>
Bilateral Symmetry
Complete Digestive System
Distinctive crown of cilia that draws water into the mouth
Pseudocoelom
Ability to undergo parthenogenesis
Protostome Development

Phylum Rotifera

Figure 30.27 Three rotifer species illustrating their diversity.

Phylum Rotifera

Figure 30.28 A rotifer.
1. Corona
2. Antenna
3. Stomach
4. Spur
5. Mastax
6. Vitellarium
7. Intestine
8. Toe

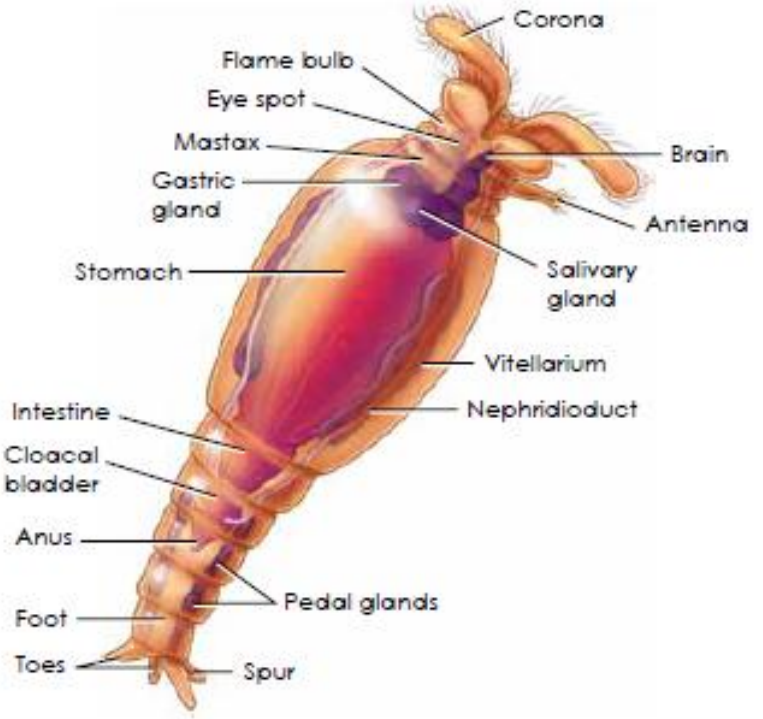


Figure 30.29 A diagram of the rotifer, *Philodina*.

Phylum Mollusca

Phylum Mollusca includes animals like clams, octopi, snails, and mussels

<u>Molluscs Have</u>
Bilateral Symmetry
Complete digestive system
True Coelom
Most have open, but some have closed circulatory systems (squid/octopi)
Calcareous Shells secreted by mantle
Muscular foot
Visceral Mass
Protostome Development

Phylum Mollusca

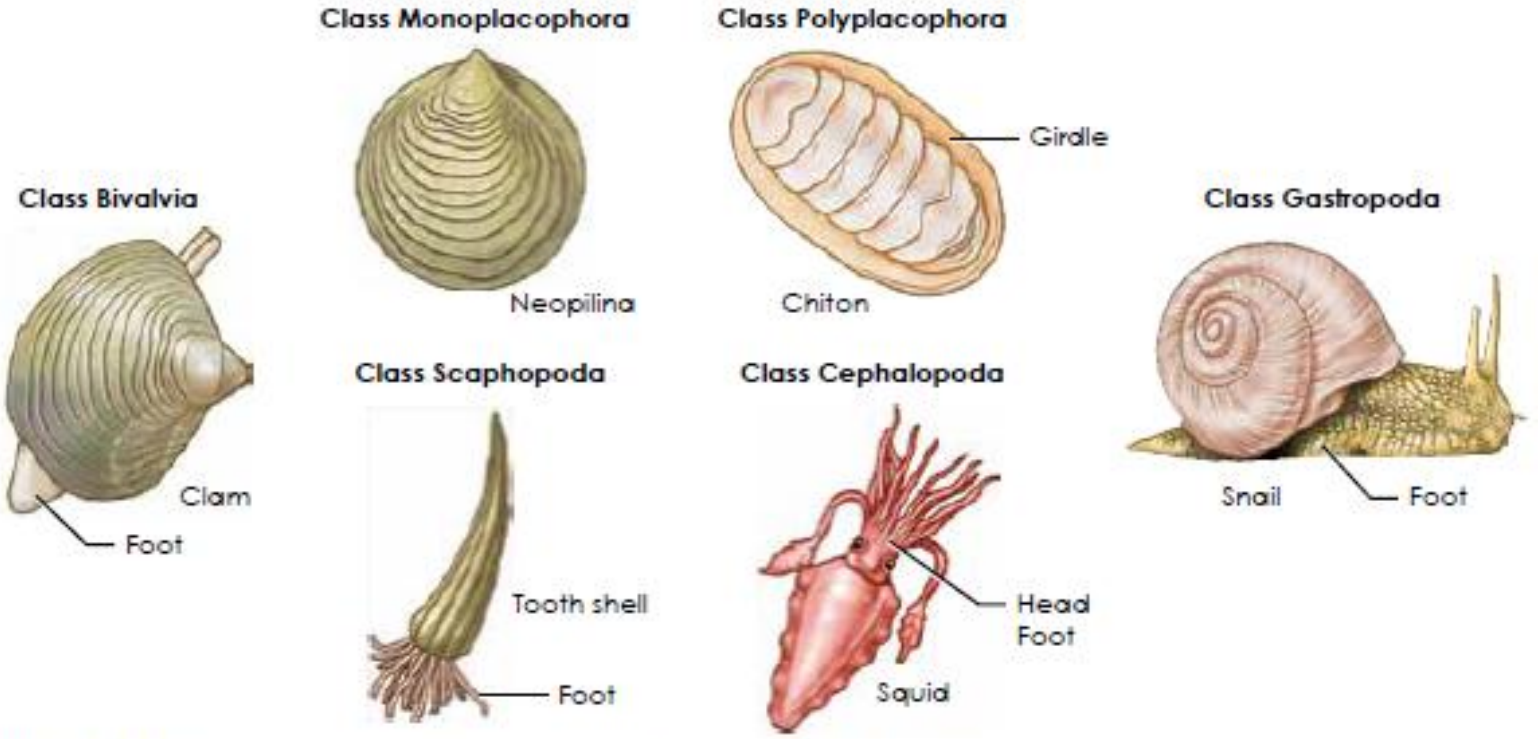


Figure 30.32 Diagrams of specimens representing several classes of molluscs.

Phylum Mollusca - Polyplacophora

Chitons

Dorsal shell with 8 plates
Ventral foot

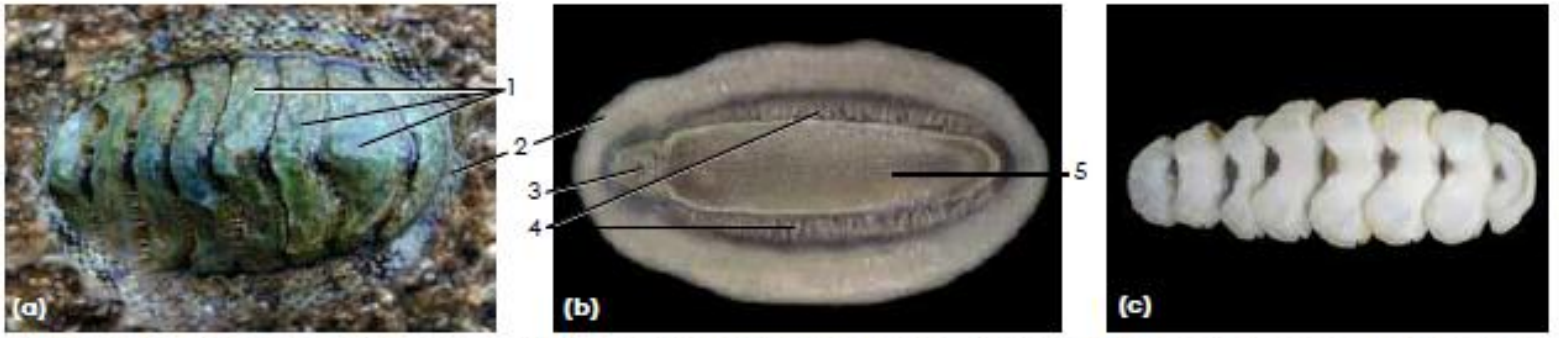


Figure 30.33 Chitons are easily recognized by their eight dorsal plates. (a) A dorsal view and (b) ventral view, and (c) A ventral view of a chiton skeleton showing the eight dorsal plates.

1. Dorsal plates 2. Girdle 3. Mouth 4. Gill filaments 5. Ventral foot

Phylum Mollusca – Class Gastropoda

Figure 30.34 Many gastropods have ornate shells, such as the Venus comb murex, *Murex pectin* (scale in mm).

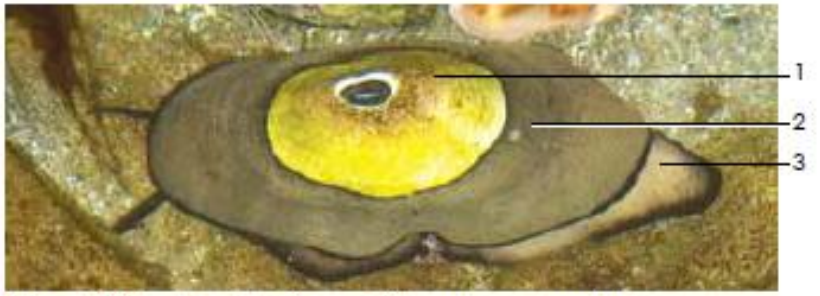


Figure 30.35 A keyhole limpet, *Megathura crenulata*.
1. Shell 2. Mantle 3. Foot

Figure 30.36 A snail.
1. Shell
2. Foot
3. Ocular tentacle
4. Head
5. Sensory tentacle

Figure 30.37 The locomotion of the slug, class Gastropoda, requires the production of mucus. Slugs differ from snails in that a shell is absent.
1. Foot
2. Mucus
3. Mantle
4. Head
5. Ocular tentacle
6. Sensory tentacle
7. Pneumostome

Phylum Mollusca – Class Gastropoda

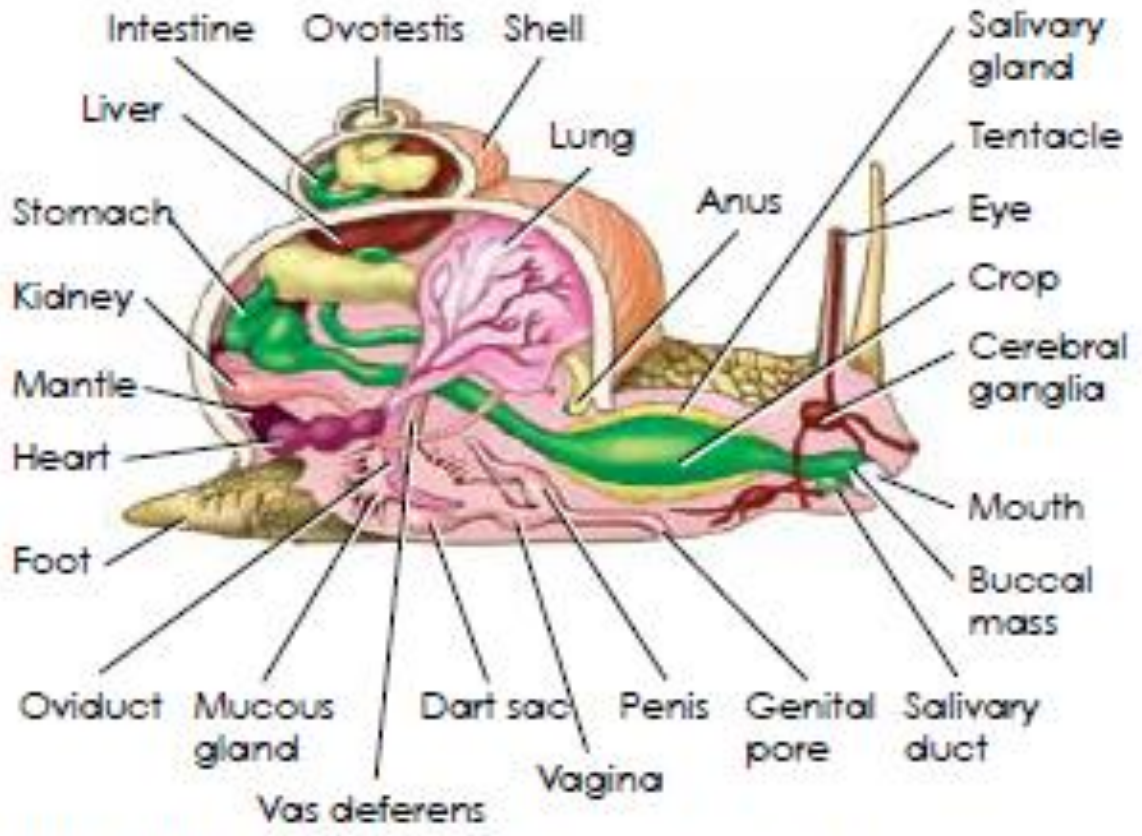


Figure 30.38 A diagram of pulmonate snail anatomy.

Phylum Mollusca

Class Gastropoda – Snails, Slugs

<u>Gastropods Have</u>
Single spiraled shell, or no shell in slugs
Complete Digestive System
Undergo torsion in embryonic development
Distinct head with eyes
Have Radula made of chitin
Have gills

Phylum Mollusca

Class Bivalvia – Clams, Oysters, Scallops, Mussels

<u>Bivalves Have</u>
Calcareous Shells secreted by the mantle, covers visceral mass
Muscular foot for movement
Complete digestive system
Open circulatory system

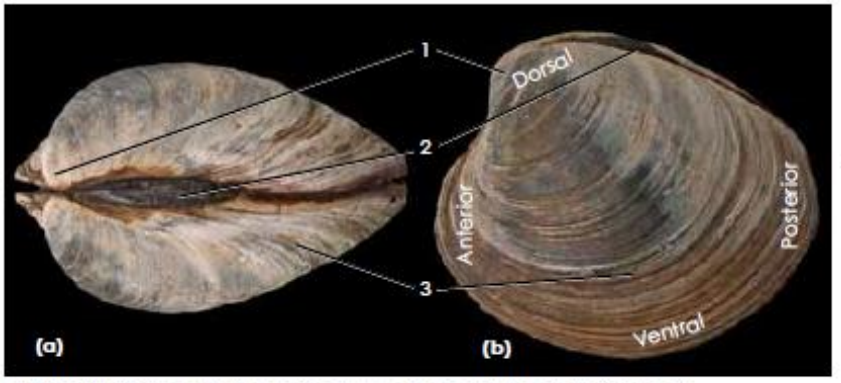
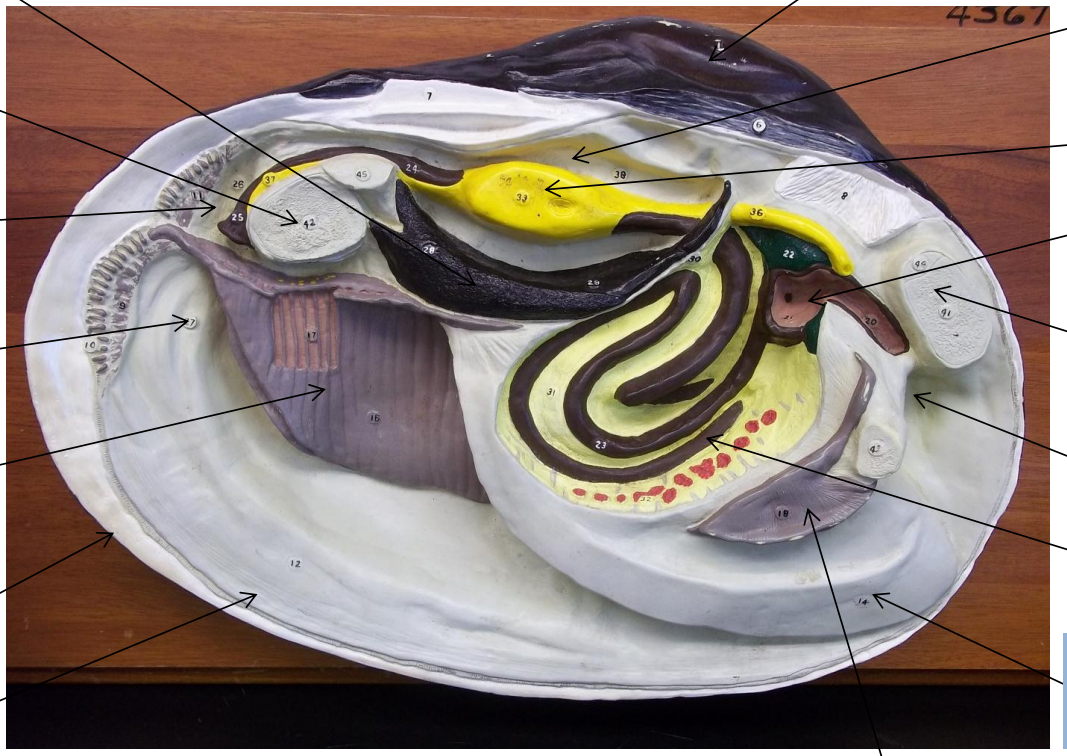


Figure 30.42 An external view of a clam shell: (a) dorsal view and (b) the left valve.
1. Umbo 2. Hinge ligament 3. Growth lines

Figure 30.43 Internal view of a clam shell showing the muscle scars where the adductor muscles attached to the shell.
1. Muscle scar

Phylum Mollusca – Class Bivalvia



Phylum Mollusca – Class Cephalopoda

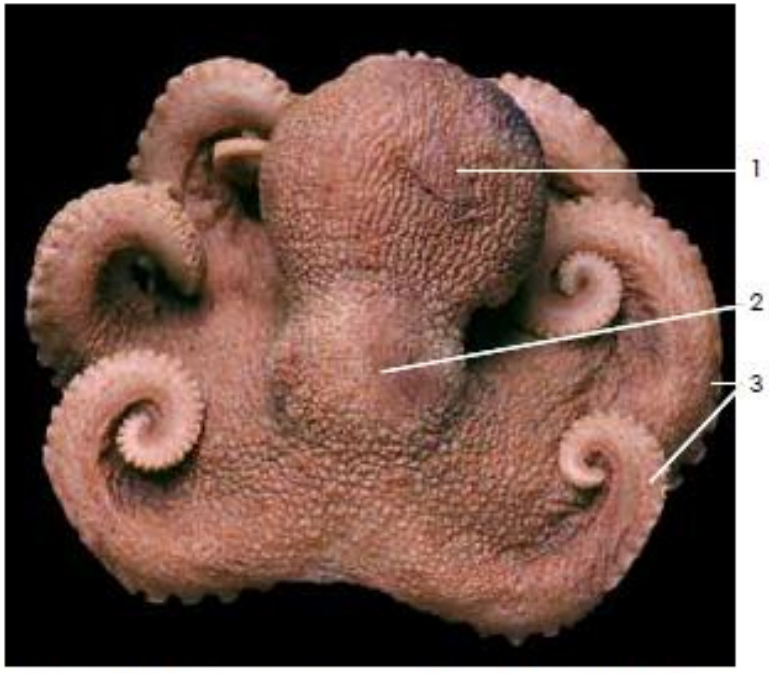


Figure 30.49 A dorsal view of an octopus collected in the Sea of Cortez, San Carlos, Mexico.
1. Mantle 2. Head 3. Arms

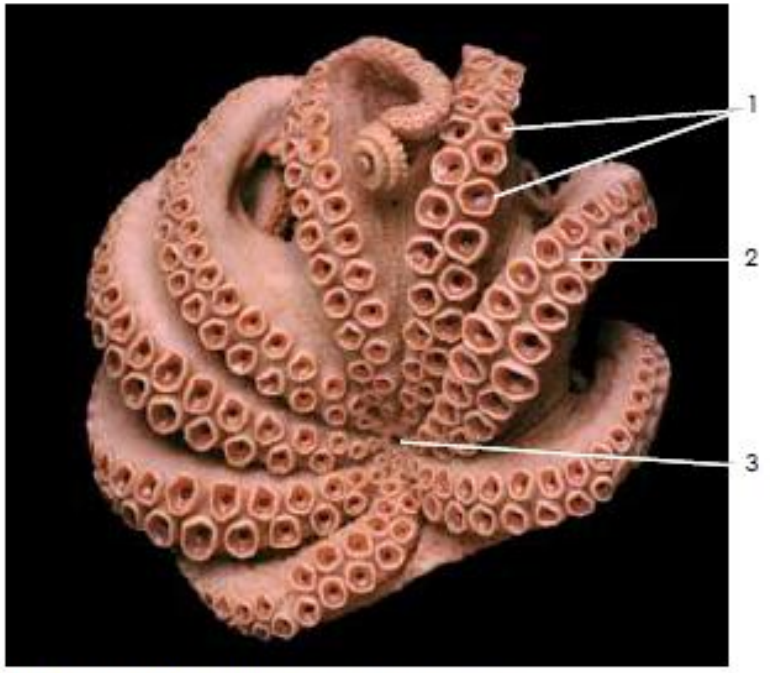


Figure 30.50 A ventral view of an octopus.
1. Suction cups 3. Mouth
2. Arm

Phylum Mollusca – Class Cephalopoda

Figure 30.48 The Nautilus (a), a cephalopod, has gas-filled chambers within its shell, as seen in this cross-section of the shell. (b) These chambers regulate buoyancy.

Phylum Mollusca - Cephalopoda

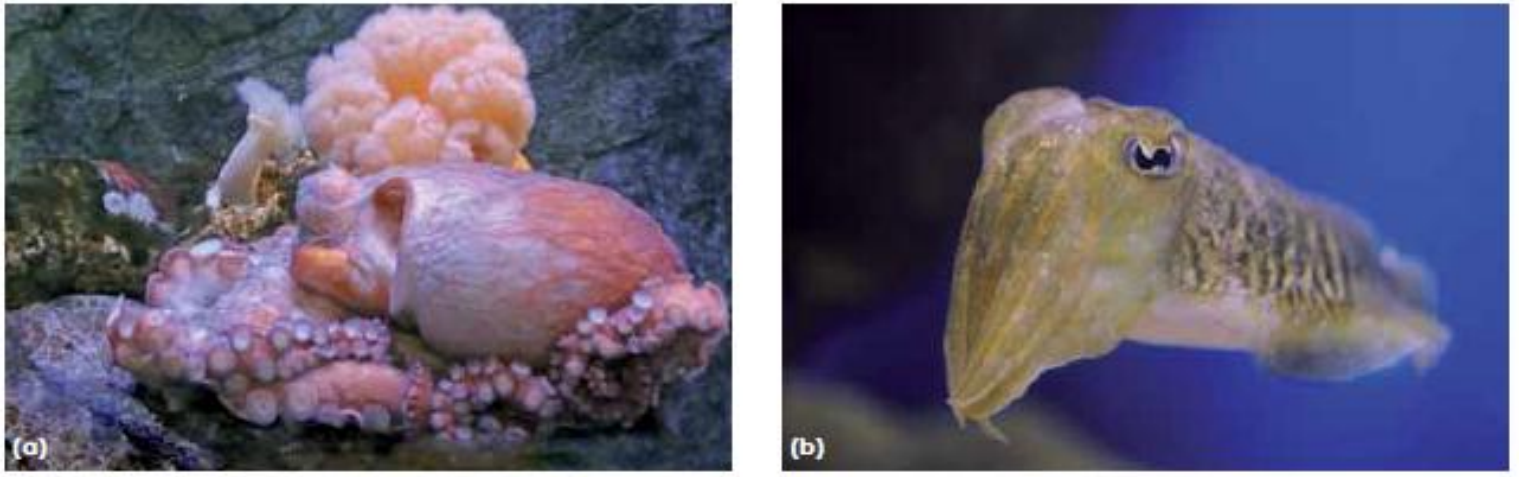


Figure 30.51 (a) The giant octopus lives in the cooler waters of the North Pacific while (b) the cuttlefish lives in tropical waters.

Phylum Mollusca – Class Cephalopoda

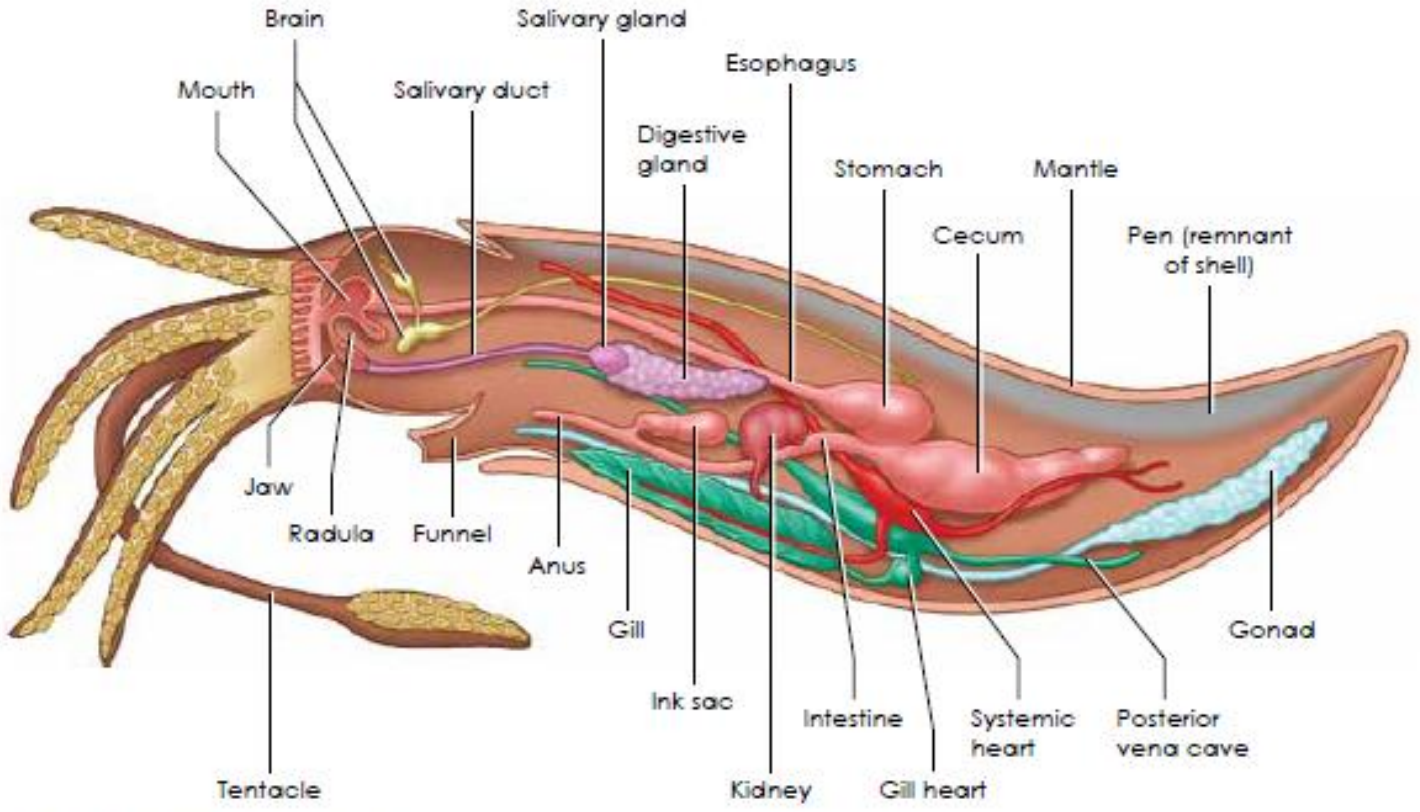


Figure 30.52 The internal anatomy of a squid.

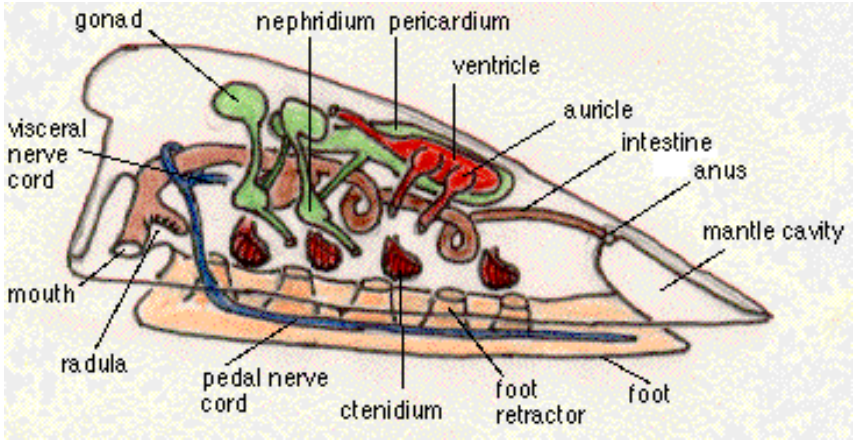
Phylum Mollusca

Class Cephalopoda – Squids, Octopi, Chambered Nautiluses

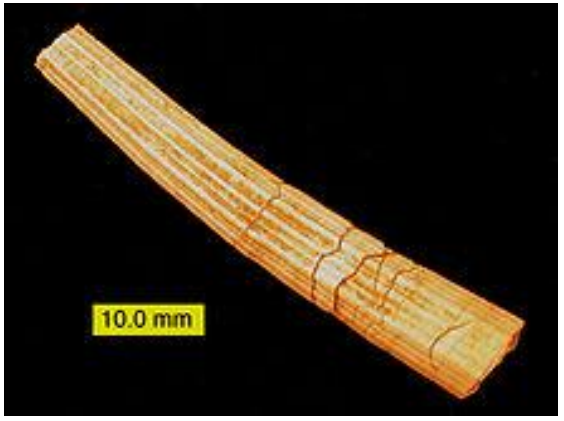
<u>Cephalopods Have</u>
Closed Circulatory System
Well Developed Brains
Internalized or nonexistent shell (nautiluses are the only cephalopods with a shell)

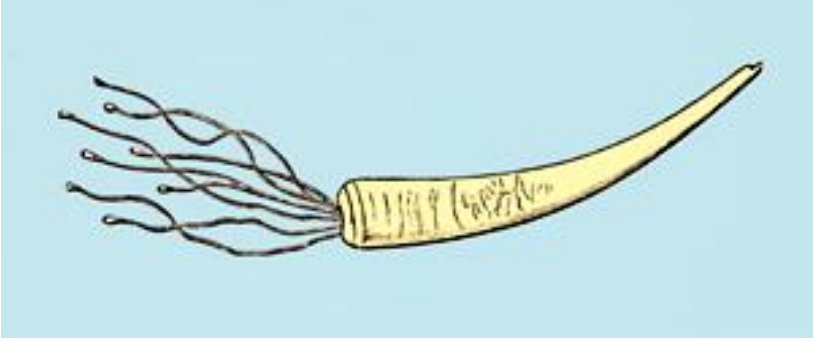
Phylum Mollusca – Class Monoplacophora

"Gastroverms"
Single cap-shaped shell
Thought to be extinct until 1952
Segmented with vital organs duplicated in each segment
Live in deep water mostly in ocean trenches



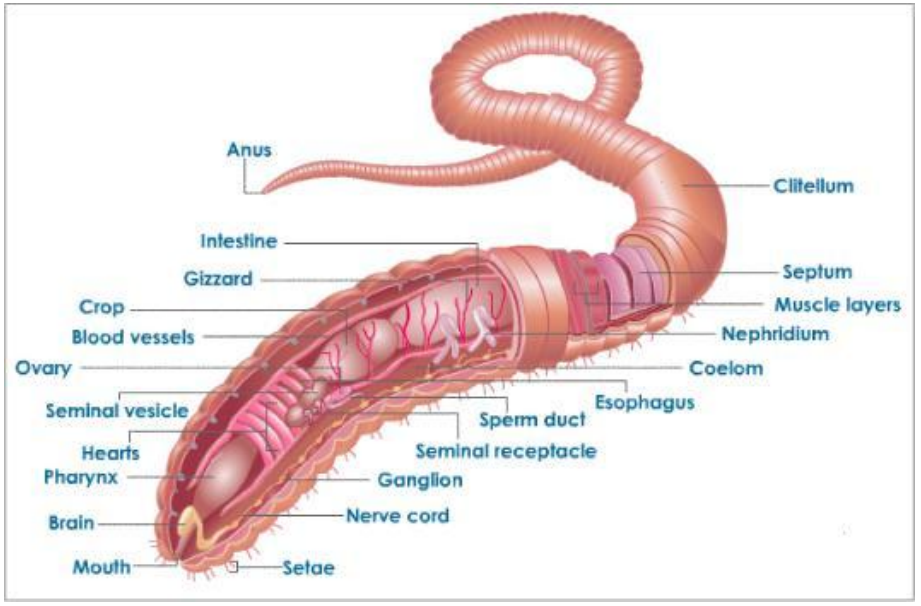
Phylum Mollusca – Class Scaphopoda





Tusk or Tooth Shells

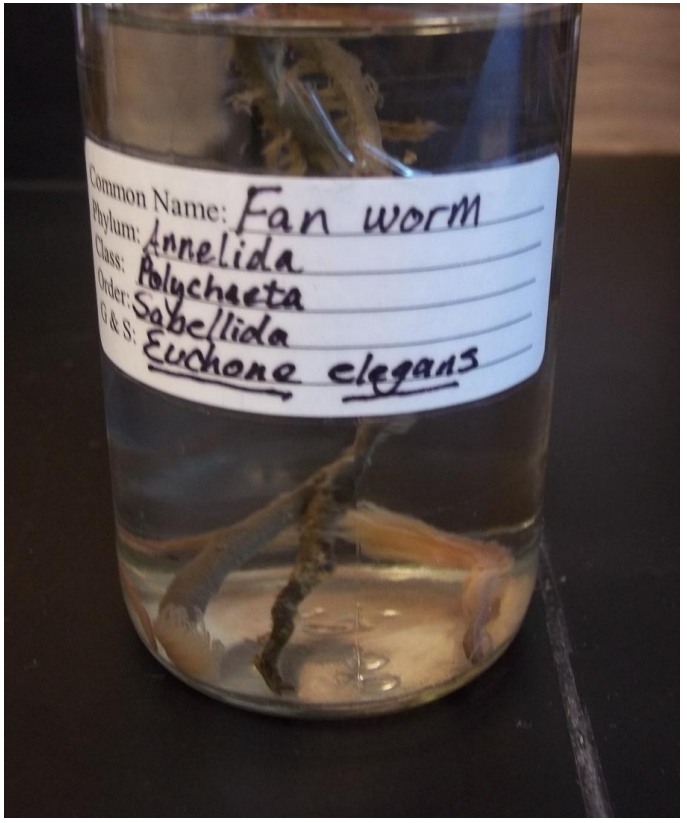
Phylum Annelida



Phylum Annelida – Segmented worms – Earthworms, Leeches

<u>Annelids Have</u>
Segmented body
Complete Digestive tract
True coelom
Closed circulatory system
Gas Exchange through skin (earthworms)
Gills (marine worms)
Pair of metanephridia in each segment
Both male and female reproductive organs
Protostome Development

Phylum Annelida – Class Polychaeta



Phylum Annelida – Class Polychaeta

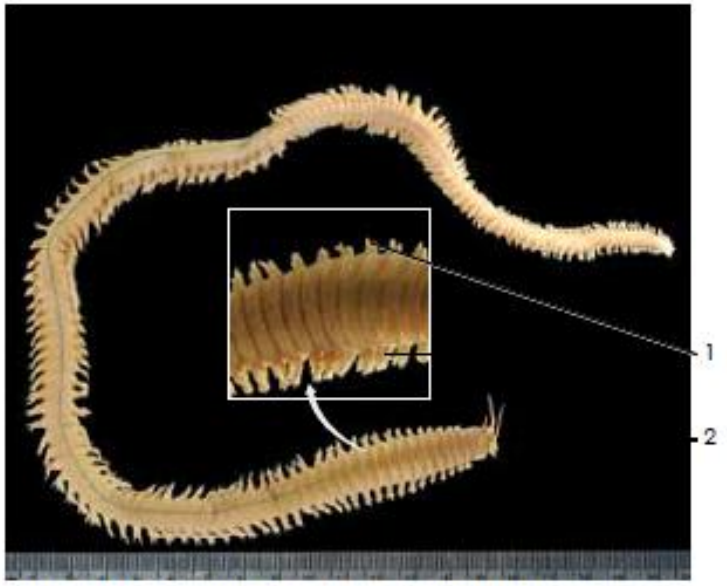


Figure 30.57 The sandworm, *Nereis* (scale in mm).
1. Parapodia
2. Mouth

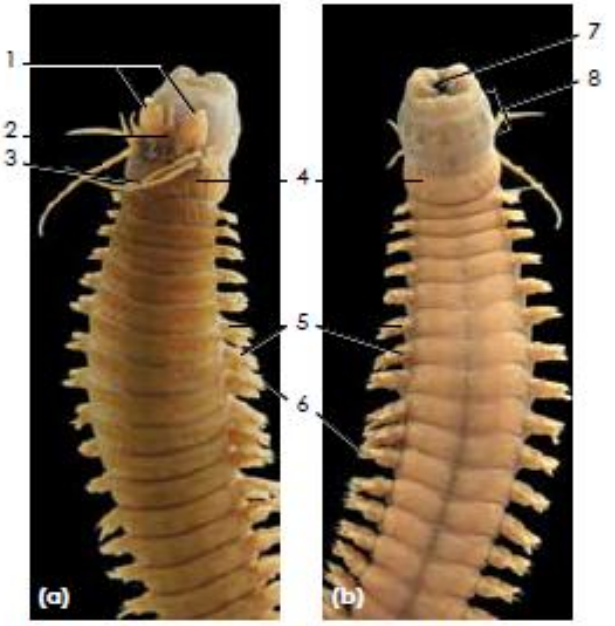
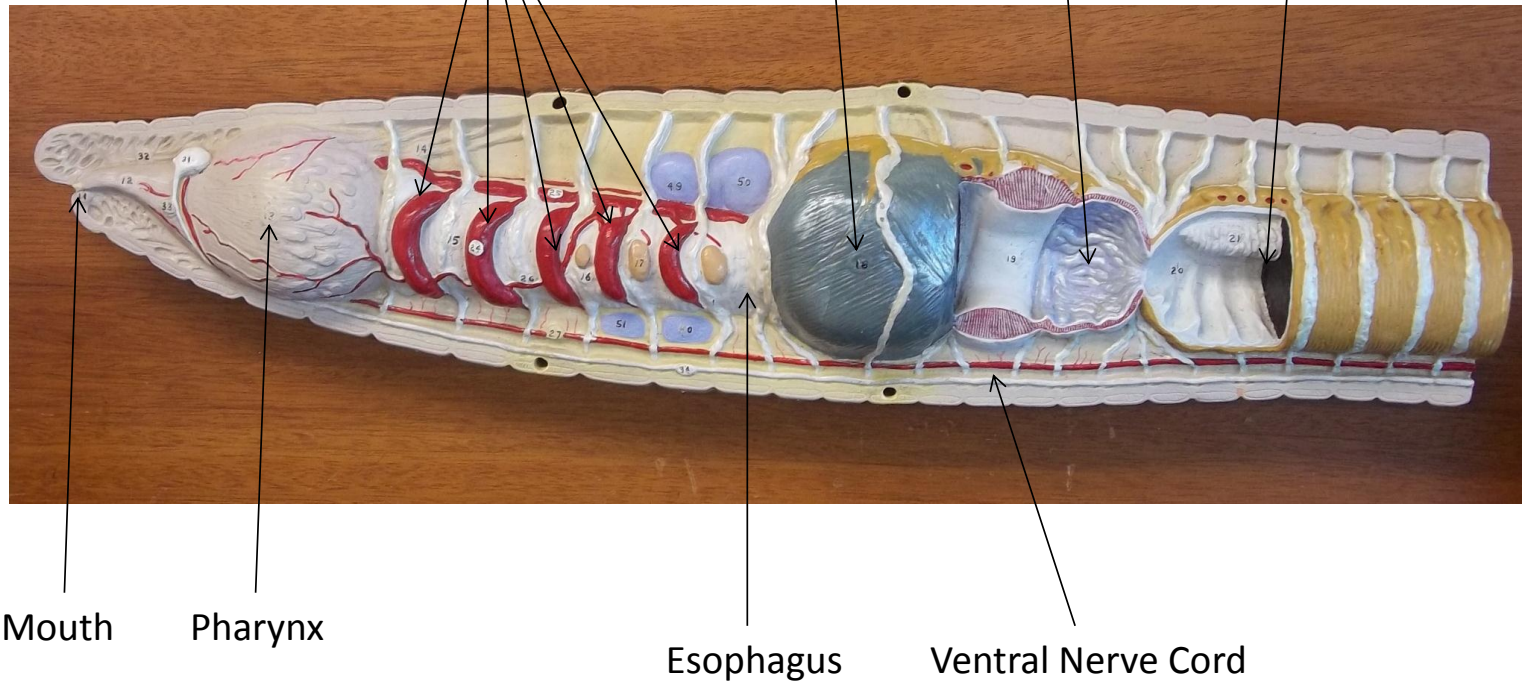
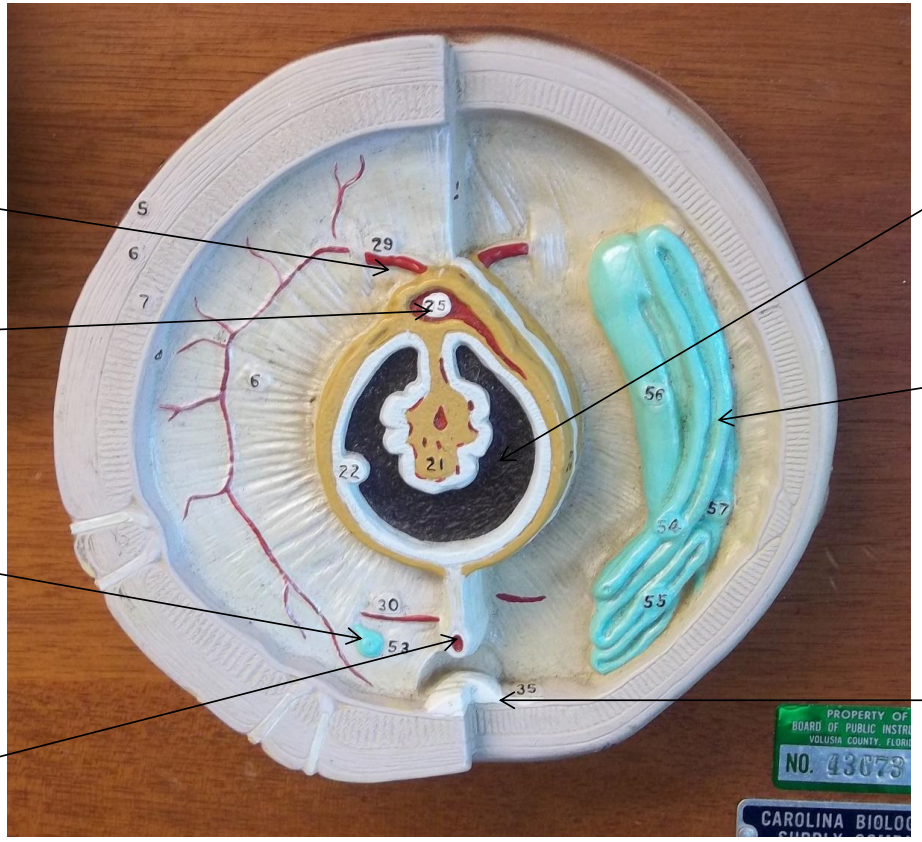


Figure 30.58 The anterior end of the sandworm, *Nereis*. (a) A dorsal view and (b) a ventral view.
1. Palpi
2. Prostomium
3. Peristomial cirri
4. Peristome
5. Parapodia
6. Setae
7. Mouth
8. Everted pharynx

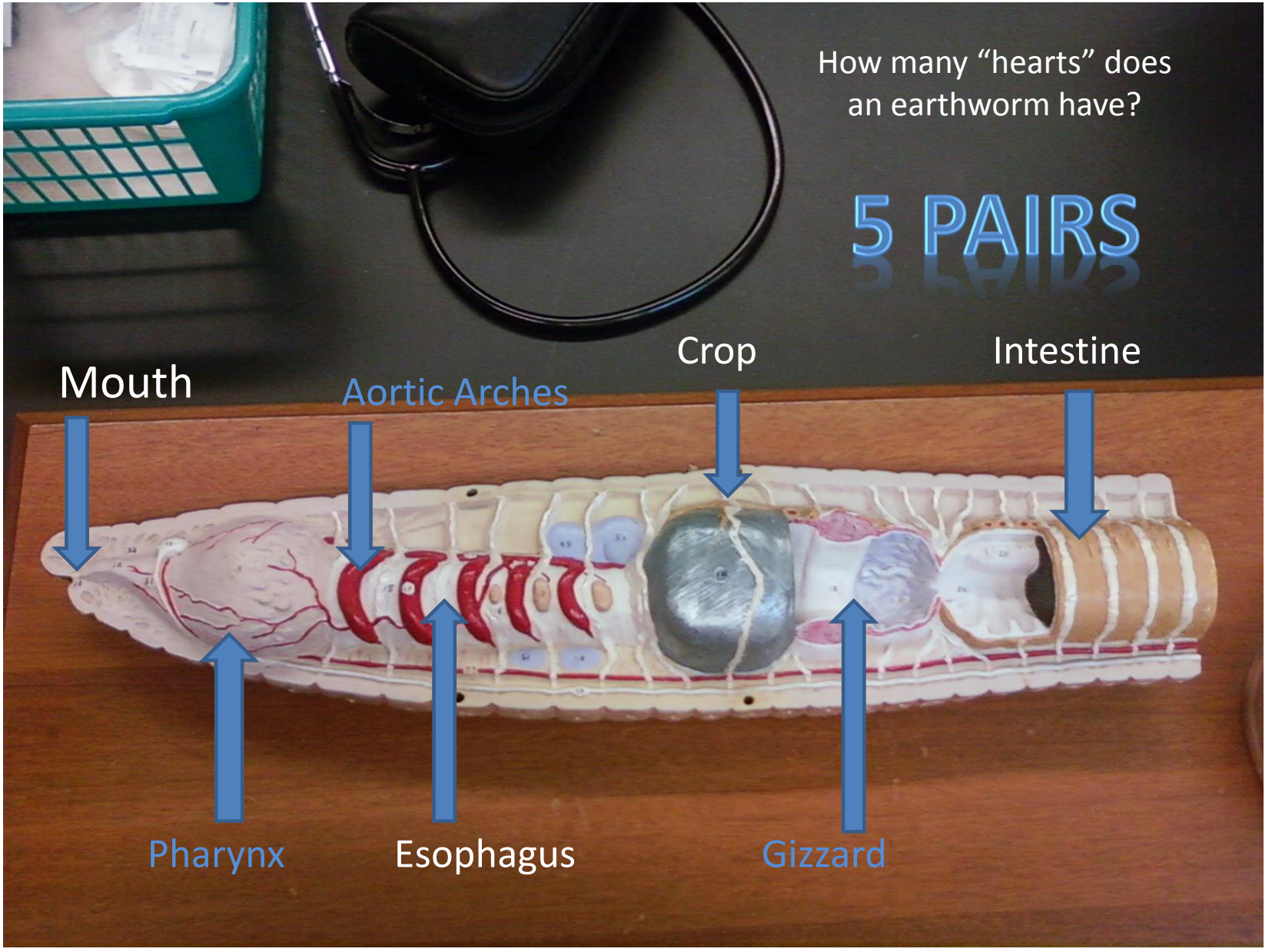
Phylum Annelida – Class Oligochaeta



Phylum Annelida – Class Oligochaeta



Phylum Annelida – Class Oligochaeta


How many “hearts” does an earthworm have?
5 PAIRS
Mouth
Aortic Arches
Crop
Intestine
Pharynx
Esophagus
Gizzard

Phylum Annelida – Class Hirudinea

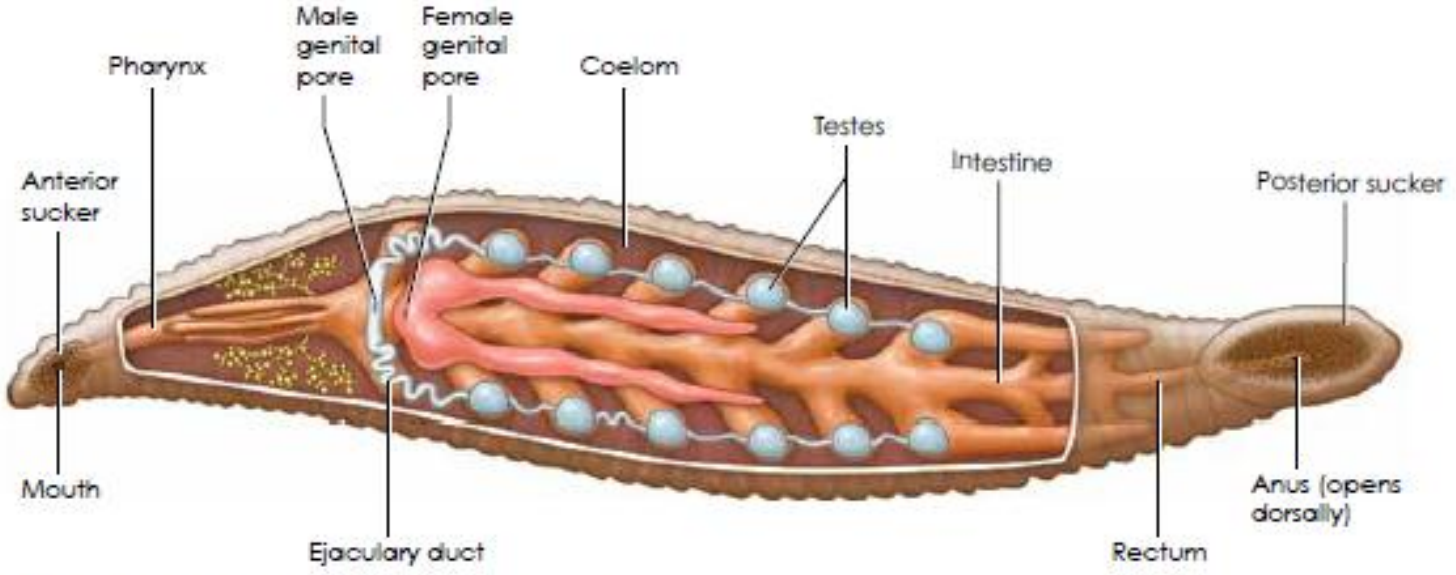


Figure 30.71 A diagram of a leech (ventral view).

Phylum Bryozoa (Ectoprocta)

Figure 30.74 A freshwater bryozoan such as *Pectinatella magnifica* is often mistaken for a mass of eggs.

Figure 30.75 A preserved bryozoan exoskeleton or zoecium.

Most Bryozoa are colonial.
Have a lophophore (crown of hollow tentacles)
Individuals are referred to as zooids

Phylum Brachiopoda

Figure 30.76 A fossil brachiopod.

Lamp shells

Have lophophores

Figure 30.77 (a) A fossil of the brachiopod, *Lingula* sp. and (b) a living example of a lamp shell, *Lingula* sp.

Phylum Nematoda

Figure 31.11 Micrograph of a hookworm, *Necator americanus*.

Roundworms

Figure 31.12 Micrograph of a pinworm, *Enterobius vermicularis*.

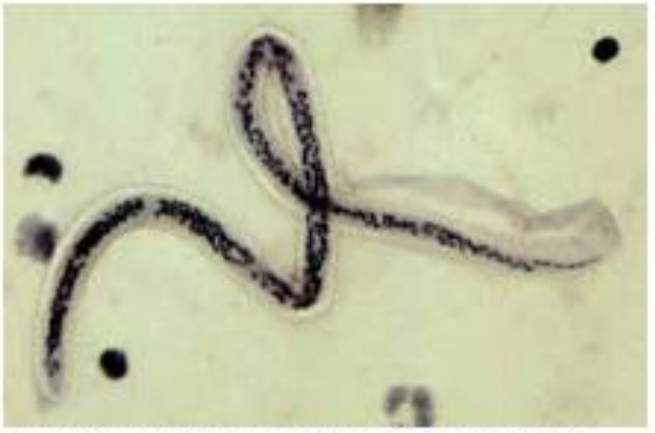


Figure 31.13 Micrograph of *Wuchereria bancrofti*. *Wuchereria* causes elephantitis.

Phylum Nematoda

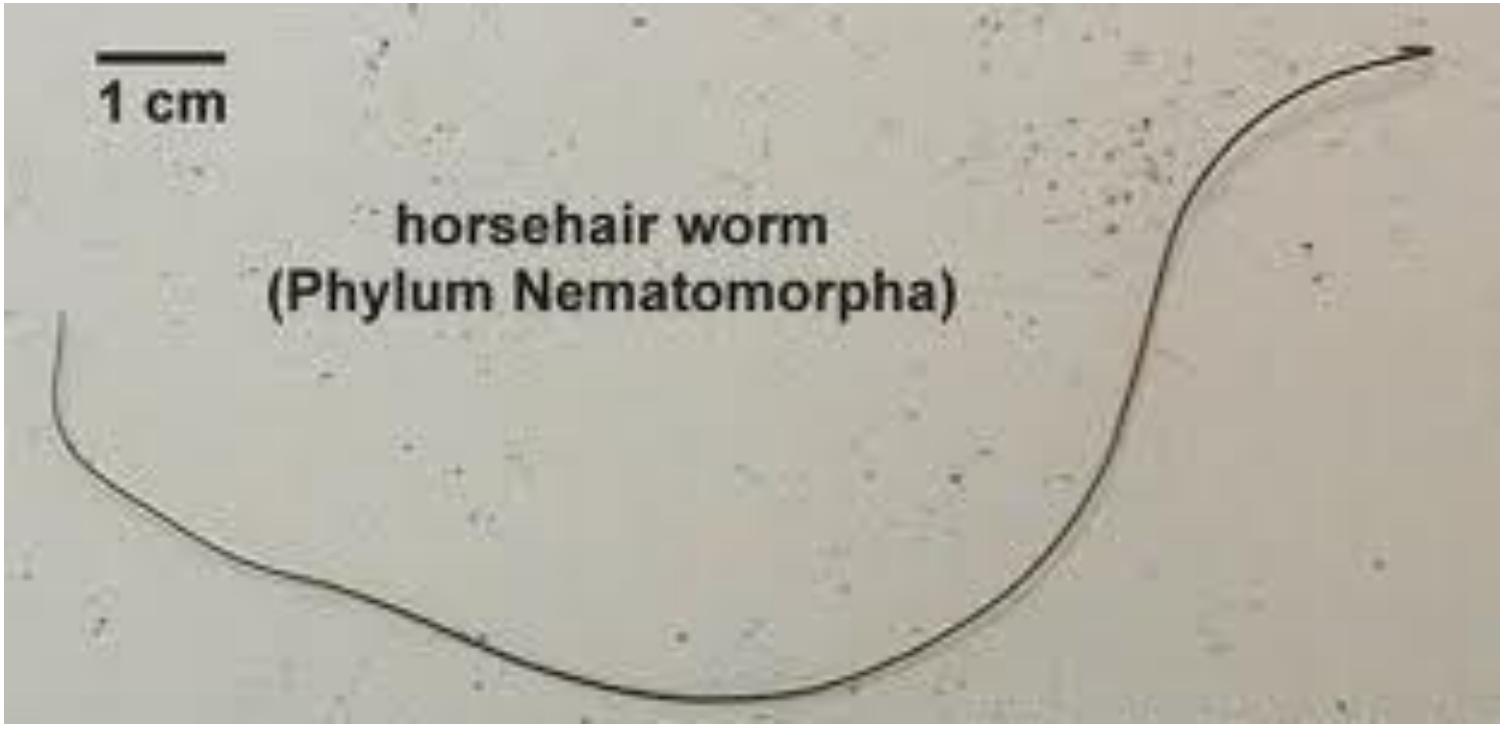
Phylum Nematoda – Roundworms

<u>Nematodes Have</u>
Non-segmented body
Non-living Cuticle covering (form of exoskeleton)
First complete “tube within a tube” body scheme
Pseudocoelom
Lateral Nerve Cords
Protostome Development

Phylum Nematomorpha

Horsehair Worm

- Vestigial digestive system
- Digestion occurs through absorption
- Adults are free living in damp environments



Phylum Kinorhyncha

Characteristics of Kinorhyncha

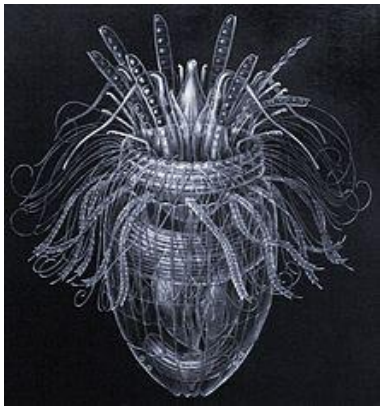
Bilateral Symmetry
Pseudocoelomate
Through gut with anus
Ventral nerve cord
No circulatory system
Live in marine environments

Phylum Priapulida

Penis worms

- No circulatory system
- Complete digestive track
- Pseudocoelom
- Cuticle of chitin

Phylum Loricifera



Loricifera

- Adults are pseudocoelomates
- Most Larvae are acoelomates
- Produce protective case – lorica
- Have distinct cuticle
- Have retractable head.
- Complete digestive tract
- Lives in marine environments

Note: a species of Loricifera is the only animal that does not do aerobic respiration

Phylum Tardigrada

Water Bears

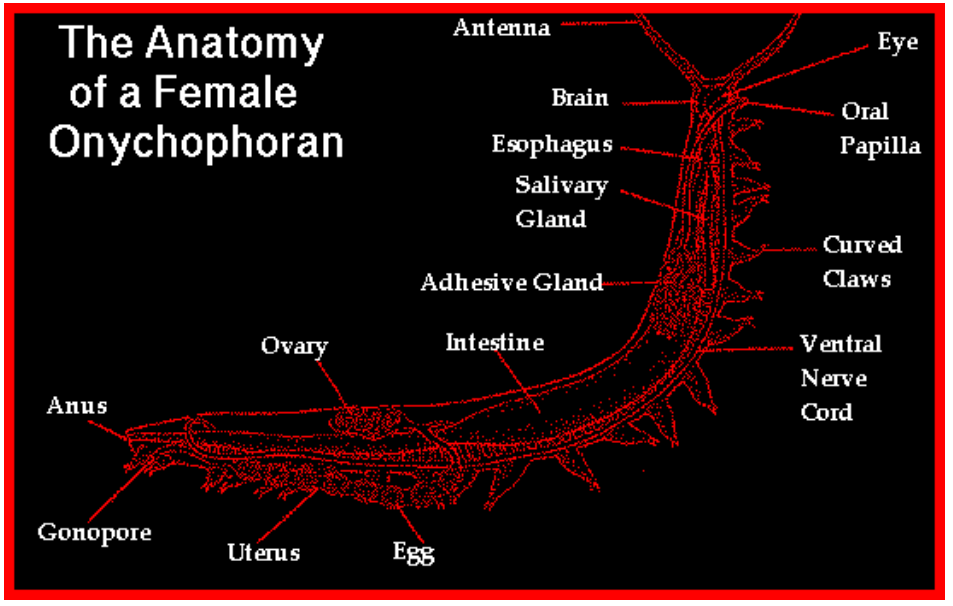
- Most microscopic
- Polyextremophyles
- Segmented bodies
- Ventral nervous system
- Open circulatory system with hemocoel
- True Coelom

Figure 31.17 Tardigrades, *Macrobiotus* sp., are commonly called water bears.

Phylum Onychophora

Velvet worms

- Chitinous exoskeleton
- Open circulatory system with hemocoels
- Ventral heart



Phylum Arthropoda

Phylum Arthropoda –
Insects, Arachnids, and Crustaceans

<u>Arthropods have</u>
Exoskeleton made of chitin
Open circulatory system
Bilateral Symmetry
Complete Digestive Tract
Ventral nerve cords
Segmented Bodies
Jointed legs
Protostome Development

Phylum Arthropoda – Class Merostromata

Horseshoe Crabs

- Heavy Carapace
- Compound eyes
- Long Spiked Telson
- Book gills

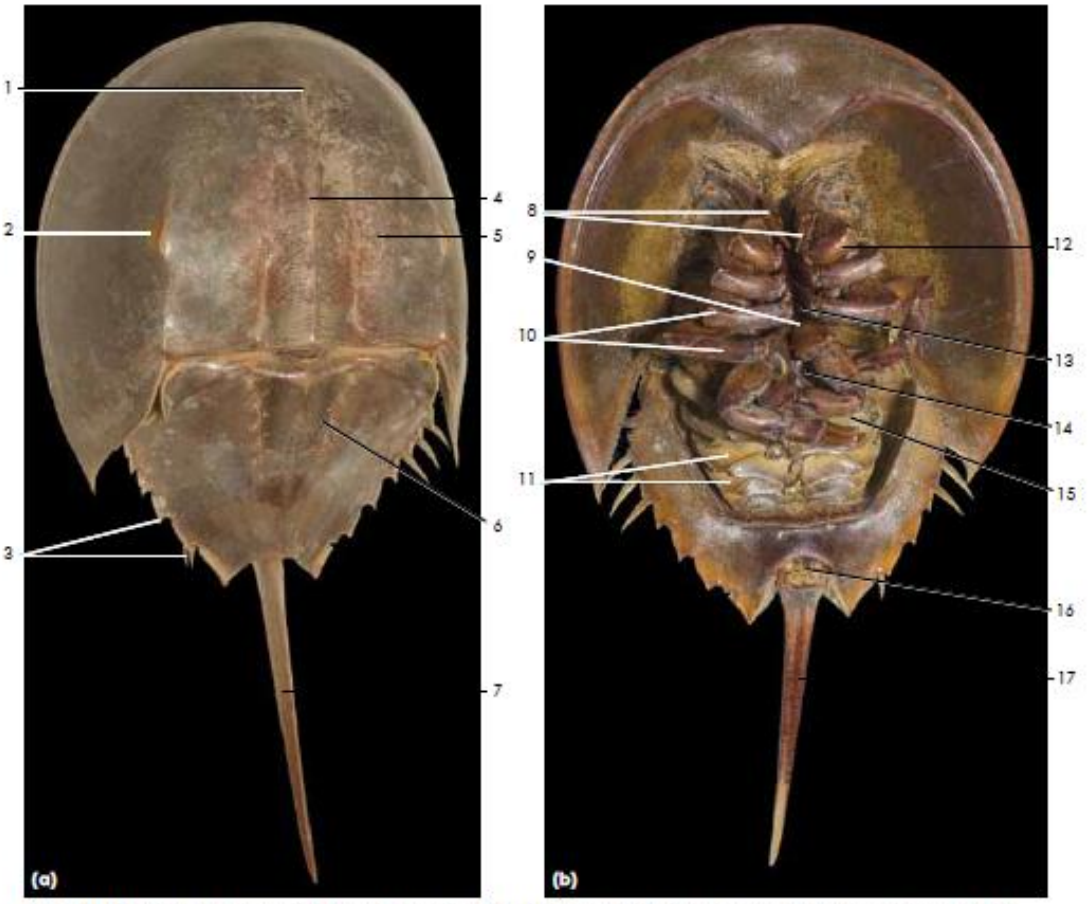


Figure 31.19 (a) A dorsal view and (b) a ventral view of the horseshoe crab, *Limulus*. This animal is commonly found in shallow waters along the Atlantic coast from Canada to Mexico.

1. Simple eye
2. Compound eye
3. Abdominal spines
4. Anterior spine
5. Cephalothorax (prosoma)
6. Abdomen (opisthosoma)
7. Telson
8. Chelicerae
9. Gnathobase
10. Chelate legs
11. Book gills
12. Pedipalp
13. Mouth
14. Chilarium
15. Genital operculum
16. Anus
17. Telson

Phylum Arthropoda – Class Pycnogonida

Sea Spiders

Phylum Arthropoda – Class Arachnida

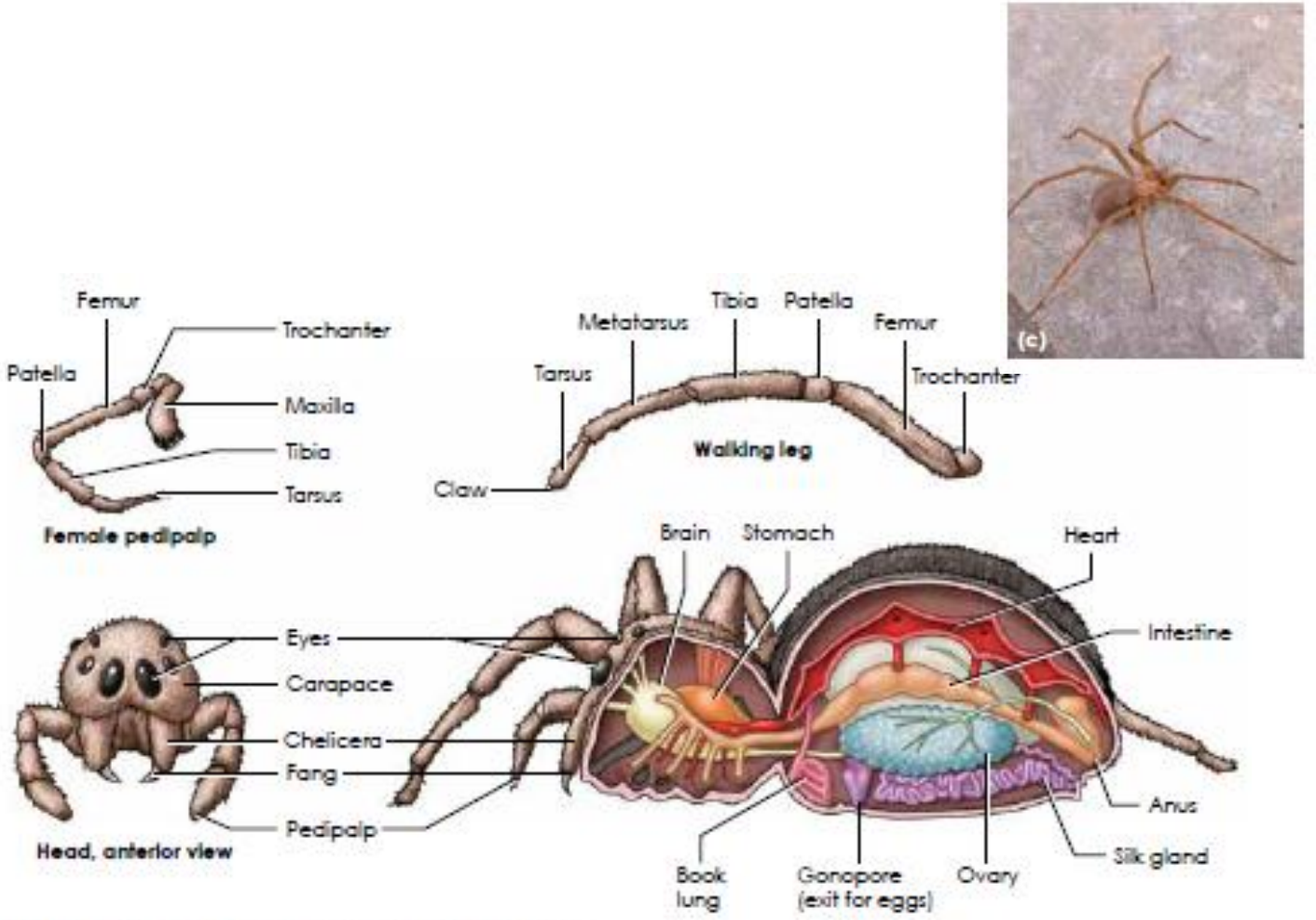
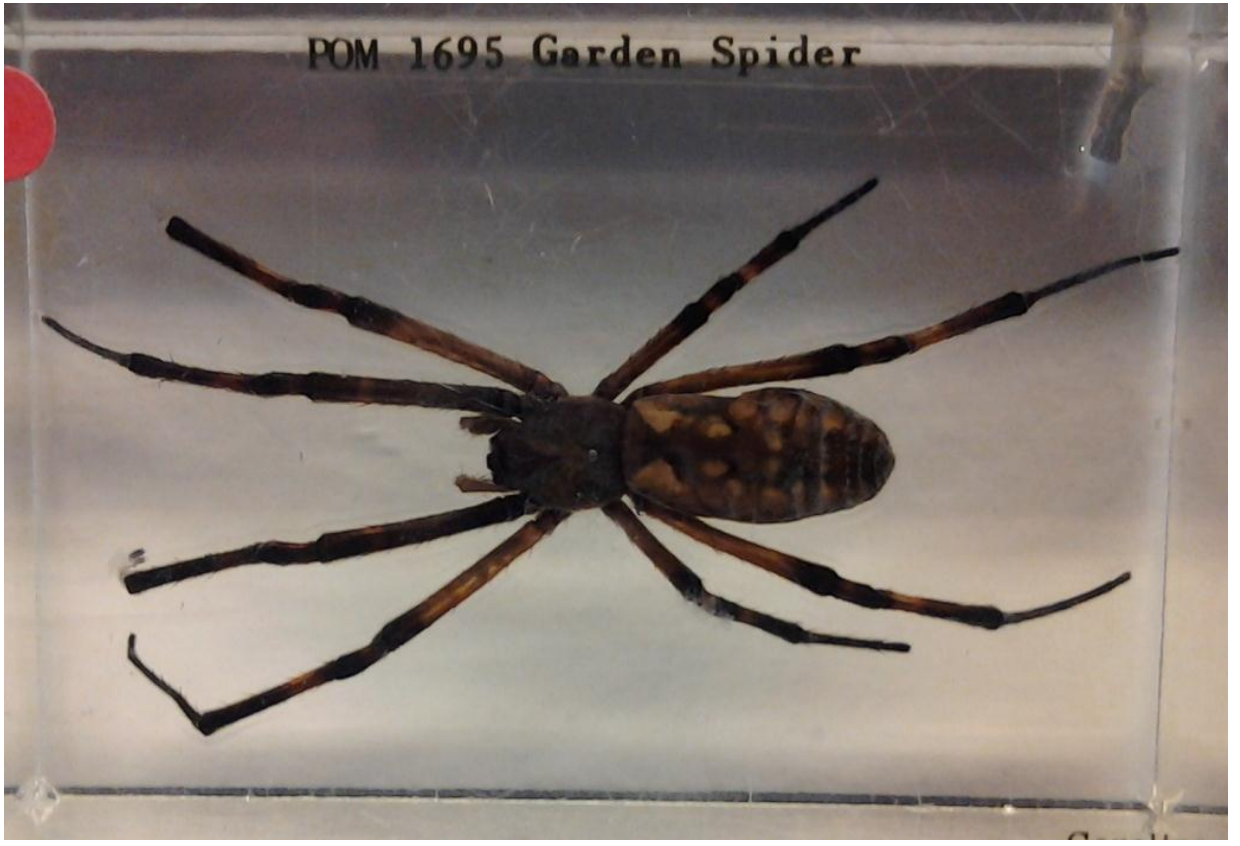


Figure 31.20 A diagram displaying the anatomy of a spider.

Phylum Arthropoda - Arachnida



Phylum Arthropoda – Class Arachnida

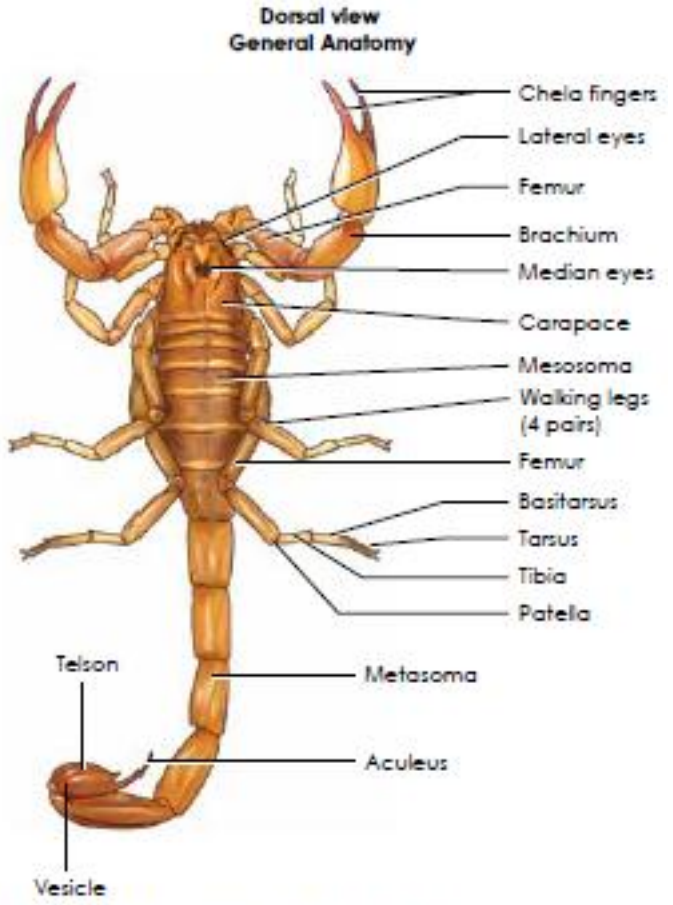


Figure 31.23 External anatomy of a scorpion.

Figure 31.22 Examples of scorpions: (a) three-lined, *Hottentotta trilineatus*, (b) bark, *Centruroides hentzi*, (c) tri-colored, *Opistophthalmus coristatus*, and (d) emperor, *Pandinus imperator*.

Phylum Arthropoda – Class Chilopoda

Centipedes
- one pair of legs per segment
- chitinous skeleton
- carnivorous

Figure 31.26 Examples of centipedes: (a) giant Sonoran, *Scolopendra heros*, (b) Florida blue, *Hemiscolopendra marginata*, and (c) Vietnamese centipede, *Scolopendra subspinipes*.

Phylum Arthropoda – Class Diplopoda

Millipedes
- two pairs of legs per segment
- have repugnatorial glands
- herbivorous

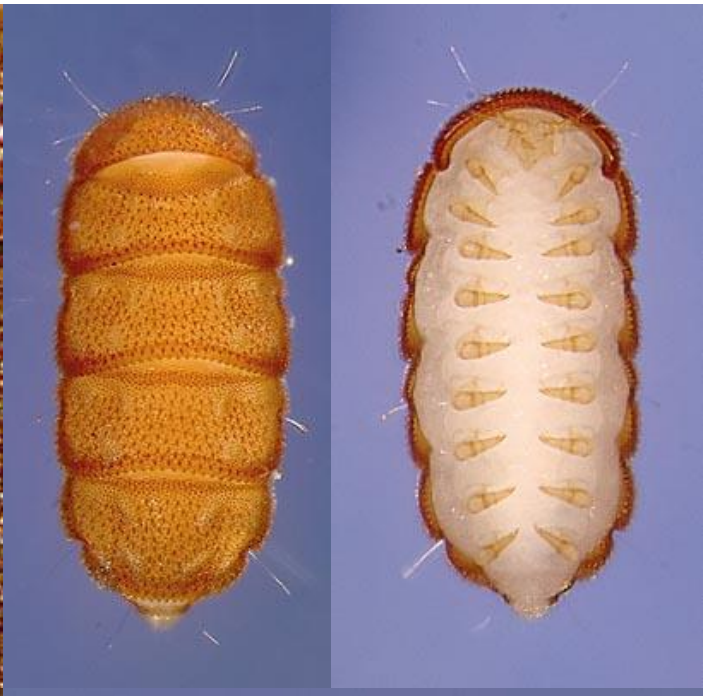
Figure 31.27 Examples of millipedes: (a) American giant millipede, *Narceus americanus*, (b) Sonoran desert, *Orthoporus ornatus*, and (c) African giant millipede, *Archispirostreptus gigas*.

Phylum Arthropoda – Class Symphyla

Symphylans

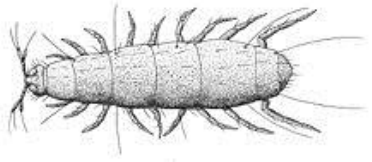
- Juveniles have 6 pairs of legs.
- With each moult, 1 pair of legs is gained.
- Translucent lacking pigment
- Two body regions

Phylum Arthropoda – Class Pauropoda



Pauropods

- 12-segmented trunk
- 9 pairs of legs
- lack eyes and hearts



Phylum Arthropoda – Subphylum Trilobita

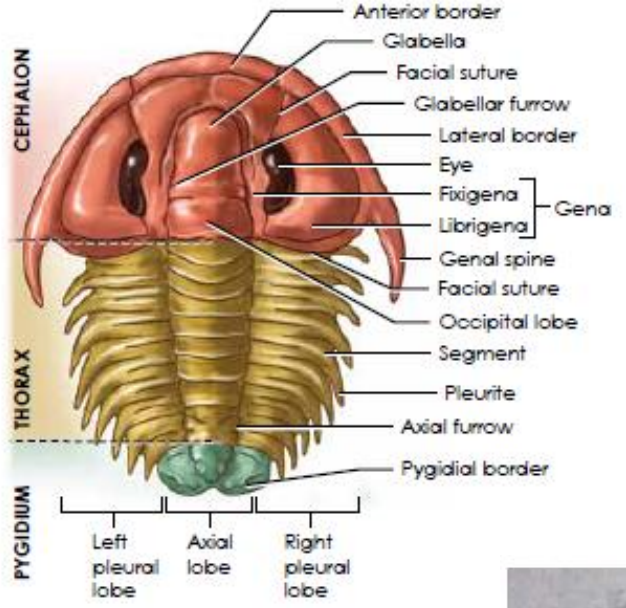


Figure 31.29 Basic external anatomy of a trilobite.

Trilobites

- Ancestral arthropods
- Extinct

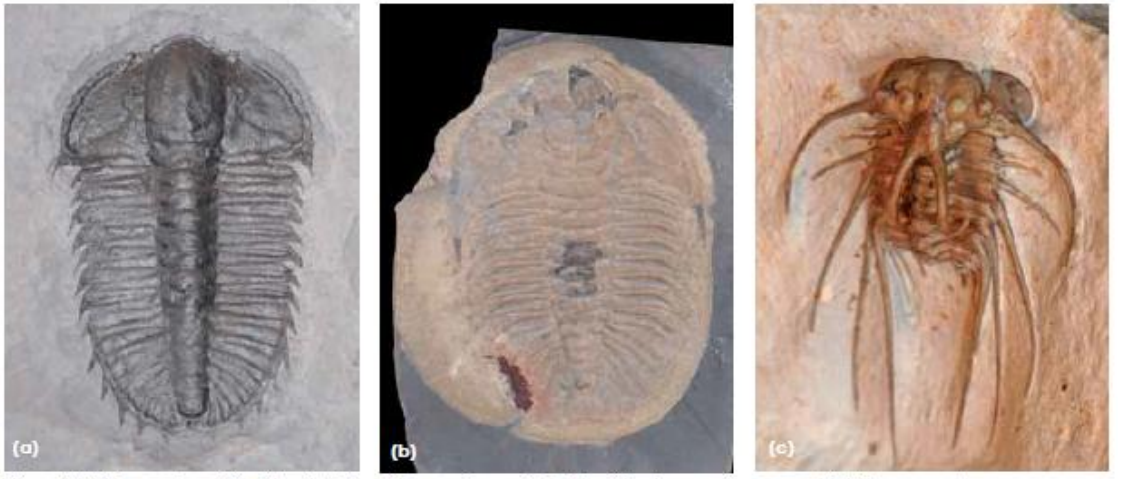


Figure 31.28 Examples of trilobites: (a) *Olenoides marjumensis*, (b) *Hemirhodon amplipyge*, and (c) *Dicranurus elegans*.

Phylum Arthropoda – Class Branchiopoda

Brine shrimp

Tadpole shrimp

Fairy shrimp

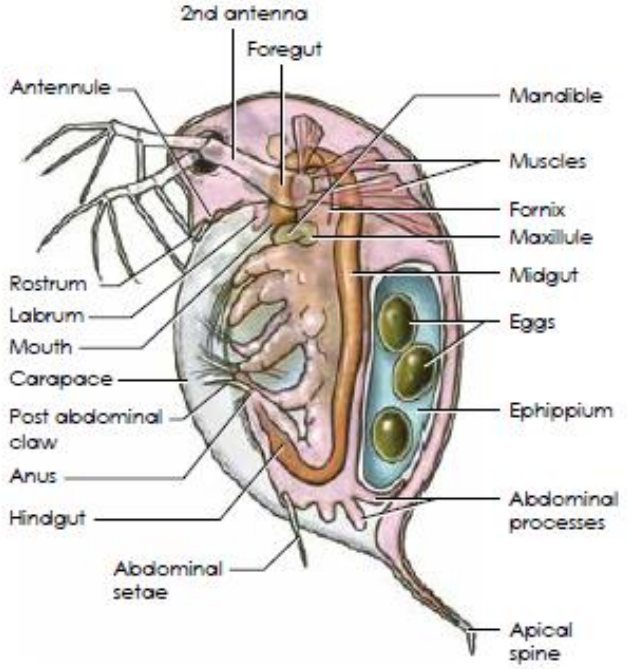


Figure 31.31 Internal anatomy of the water flea, *Daphnia* sp.

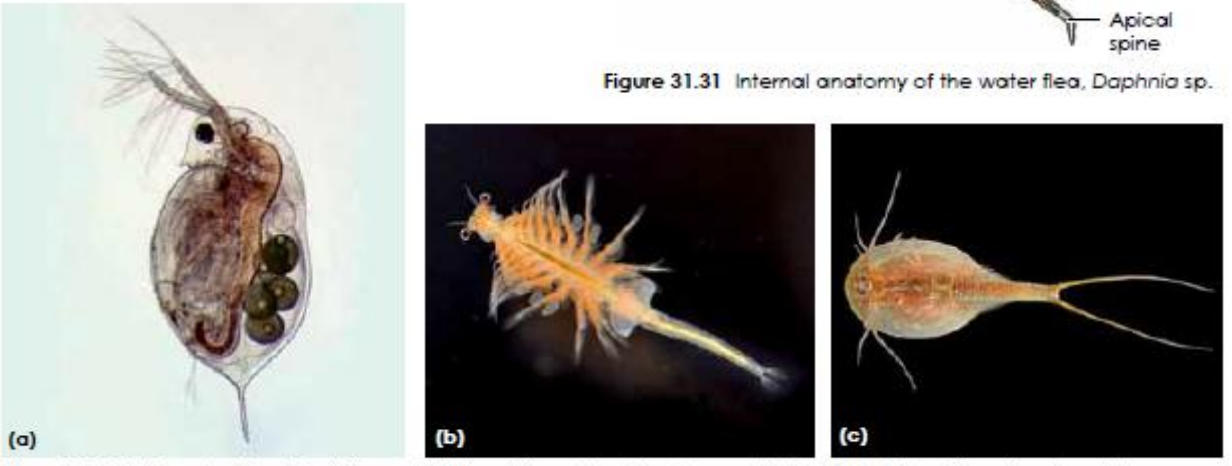
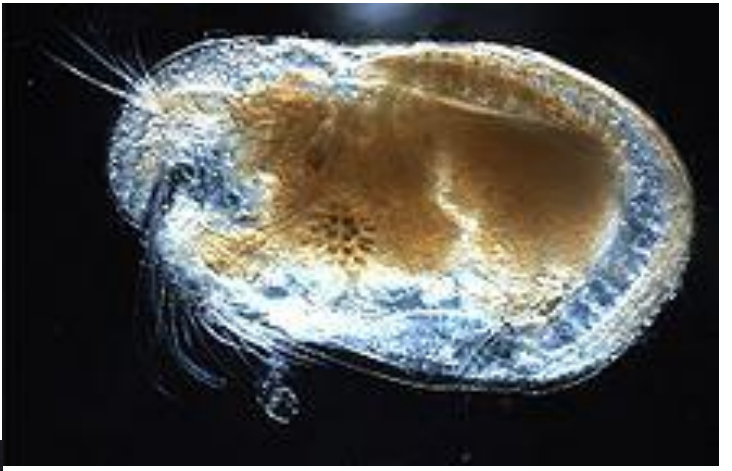


Figure 31.32 (a) A water flea, *Daphnia* sp., (b) brine shrimp, *Artemia salina*, and (c) tadpole shrimp, *Triops longicaudatus*.

Phylum Arthropoda – Class Ostracoda

Ostracods

Seed Shrimp



Phylum Arthropoda – Class Maxillopoda

Barnacles

Tongue worms

Fish Lice

Copepods

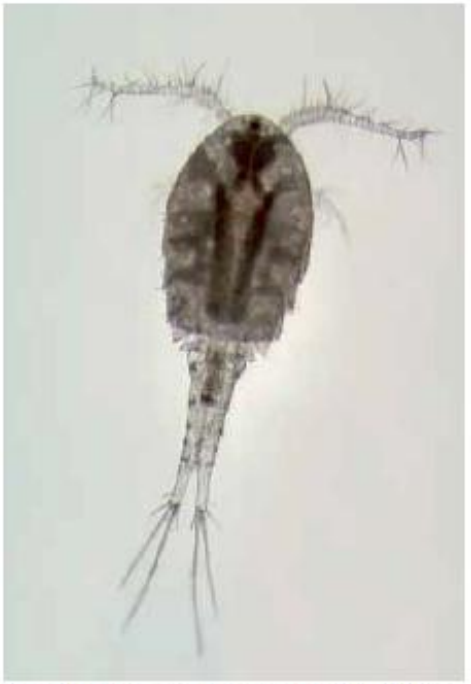


Figure 31.33 A cyclops copepod, *Abyssorum tatricus*.

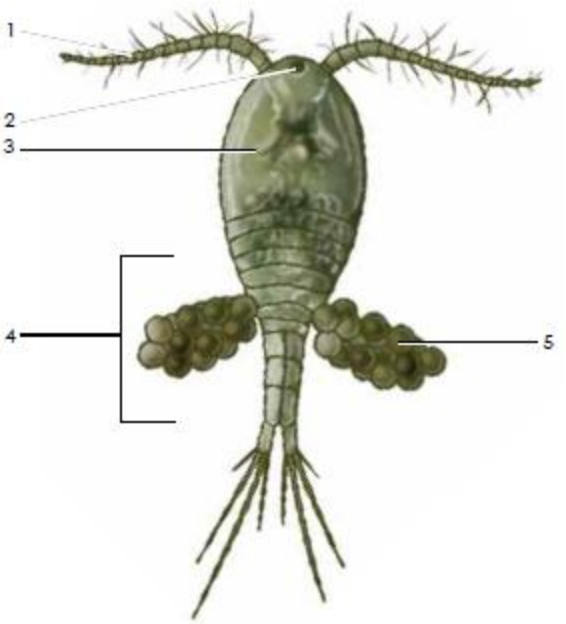
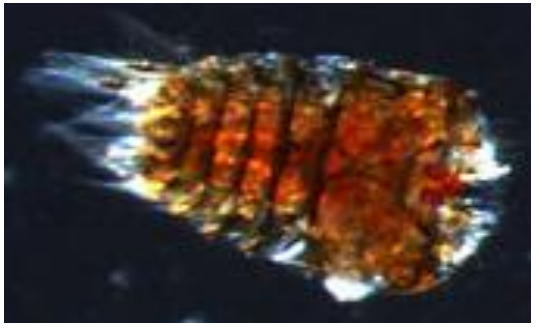


Figure 31.34 Generalized copepod anatomy.
1. Antennule
2. Compound eye
3. Cephalosome
4. Abdomen
5. Egg sac

Figure 31.35 Gooseneck barnacles, *Pollicipes polymerus*.



Phylum Arthropoda – Class Malacostraca

Lobsters
Crabs
Shrimp
Isopods
Pill bugs

Figure 31.37 Example crustaceans: (a) peppermint shrimp, *Lysmata wurdemanni*, (b) fiddler crab, *Uca* sp., (c) hermit crab, *Coenobita clypeatus*, (d) ghost crab, *Ocypode ceratophthalmus*, (e) blue crab, *Callinectes sapidus*, and (f) red reef lobster, *Enoplometopus* sp.

Phylum Arthropoda – Class Malacostraca

Lobsters
Crabs
Shrimp
Isopods
Pill bugs

Figure 31.38 A lateral view of the crayfish.

1. Carapace
2. Abdomen
3. Uropod
4. Swimmeret (pleopod)
5. Rostrum
6. Compound eye
7. Maxilliped
8. Cheliped
9. Walking legs

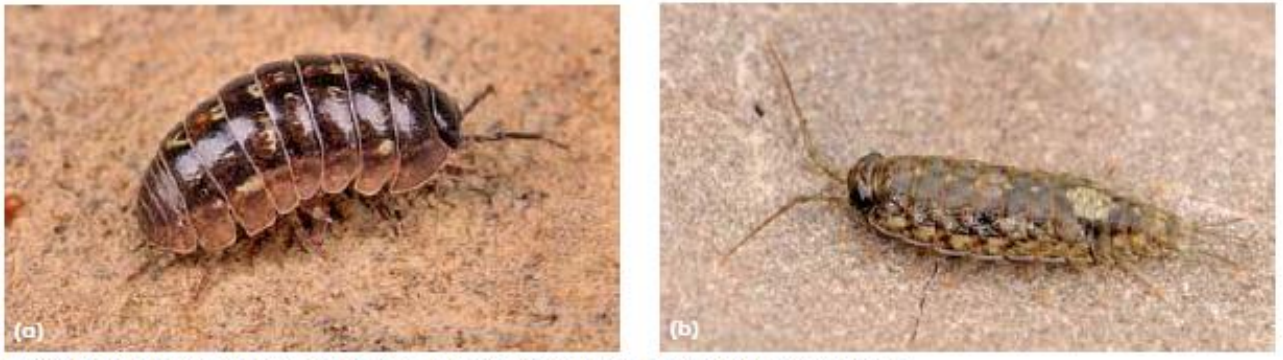


Figure 31.36 Example isopods, (a) Pill bug, *Armadillidium* sp., and (b) sea slater, *Ligia italica*.

Phylum Arthropoda – Class Malacostraca

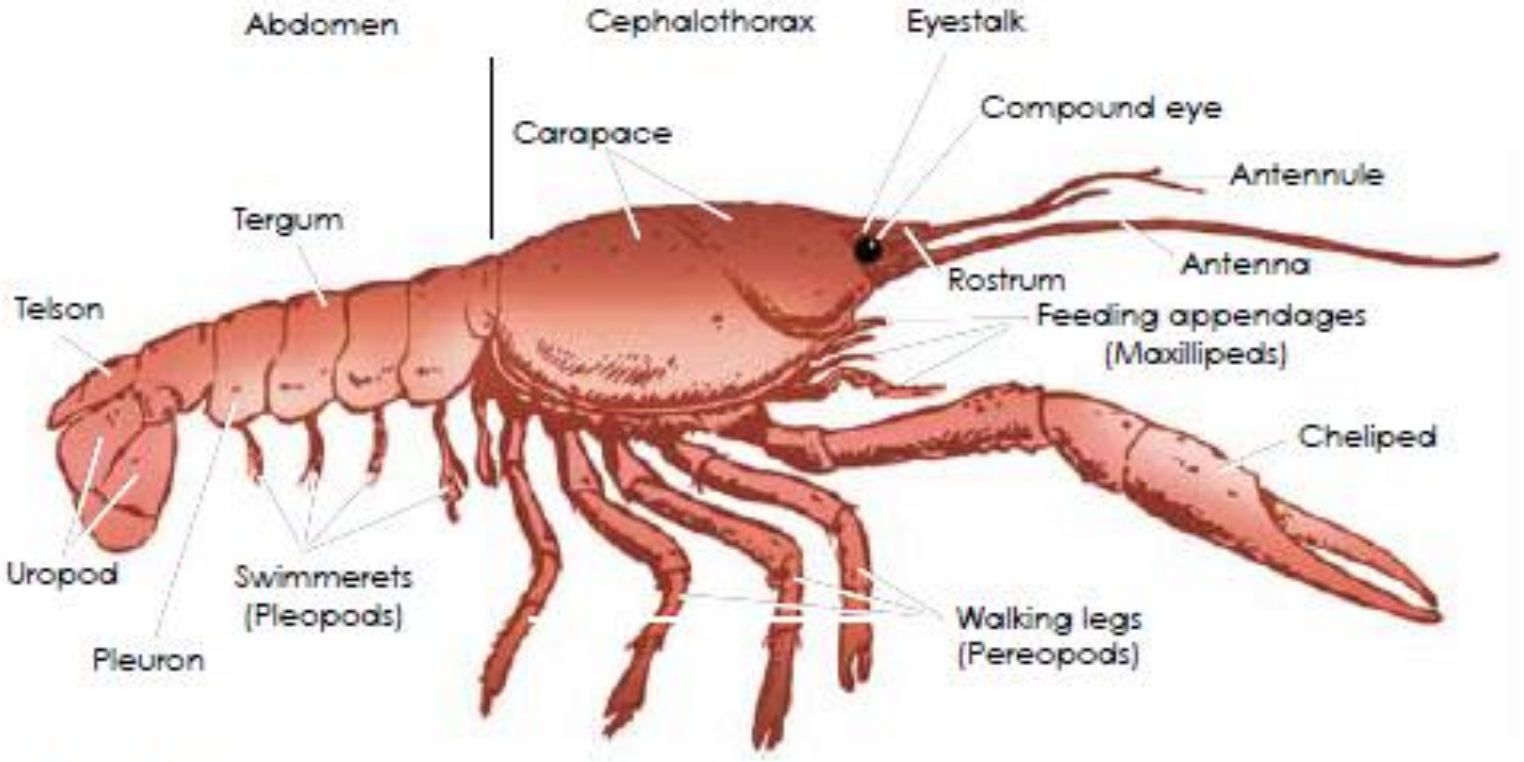


Figure 31.39 A diagram of the crayfish, *Cambarus*.

Phylum Arthropoda – Class Malacostraca

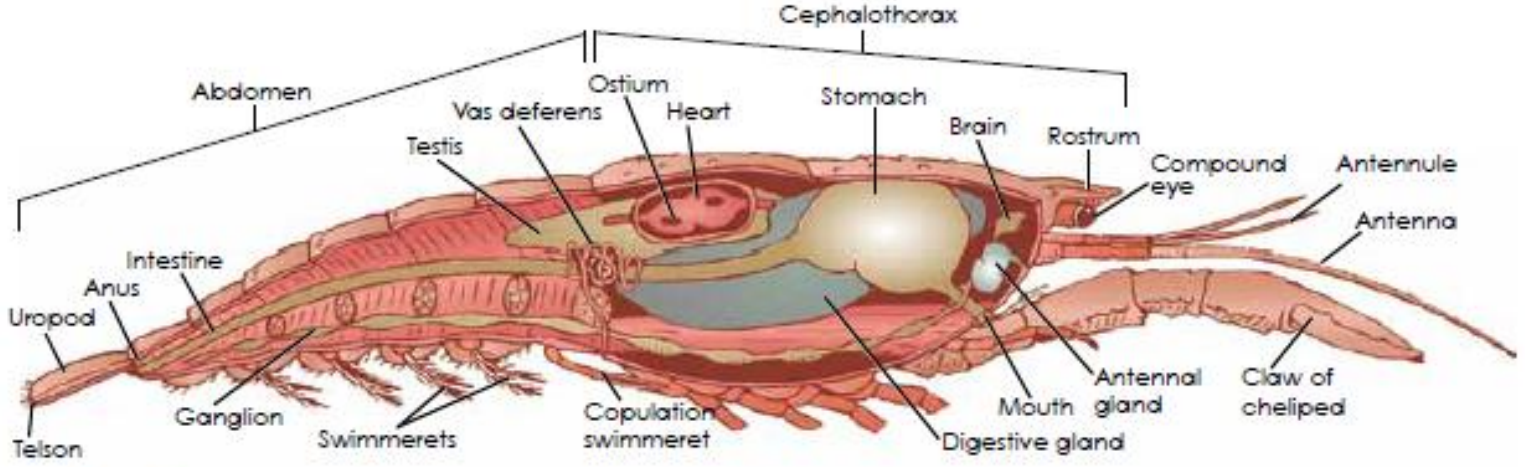
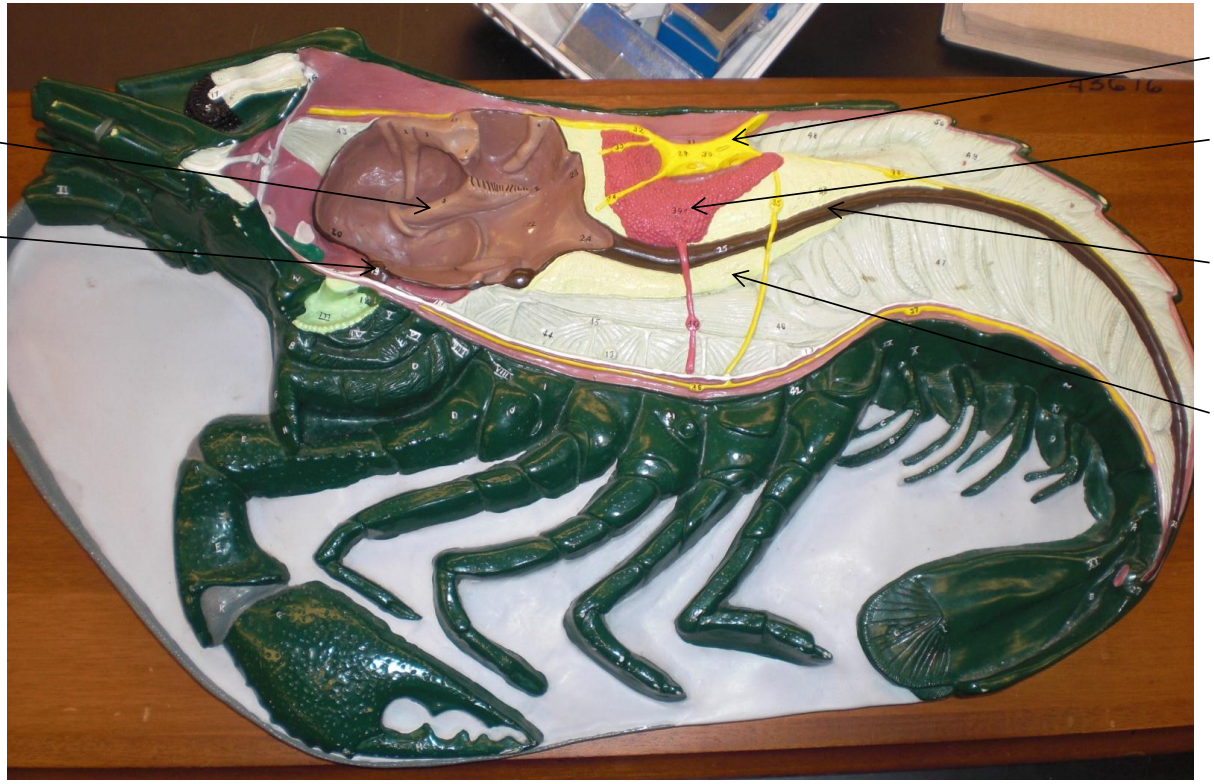


Figure 31.40 The anatomy of a crayfish. A sagittal section of an adult male.

Phylum Arthropoda – Class Malacostraca



Phylum Arthropoda - Class Malacostraca

Phylum Arthropoda – Class Remipedia

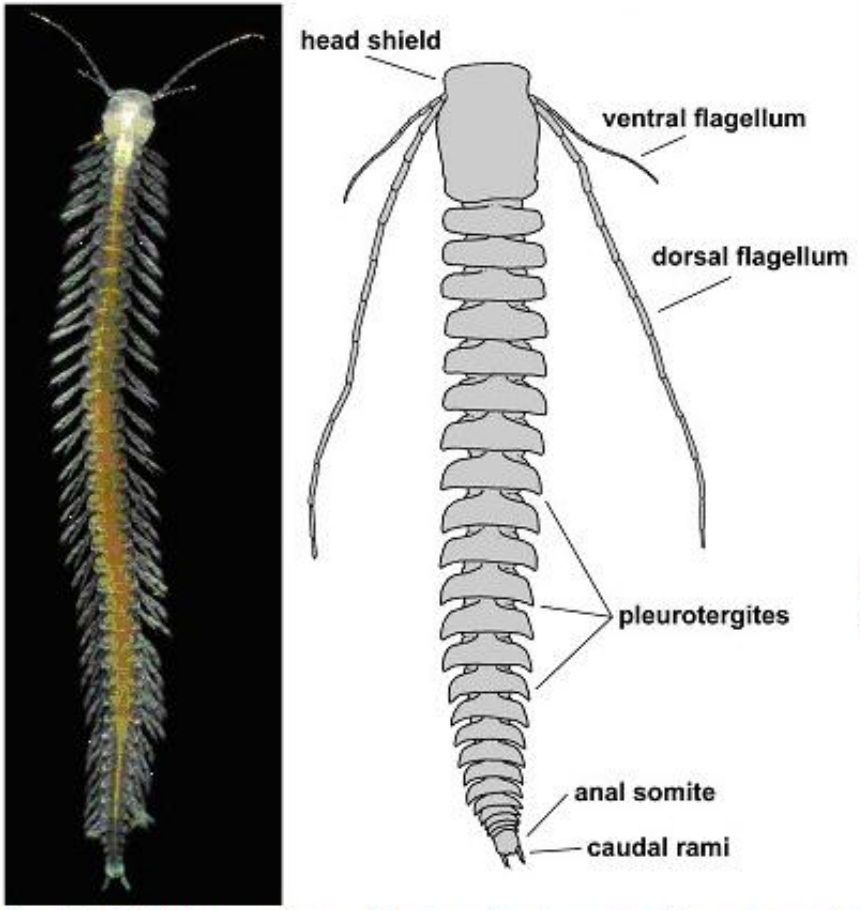


Fig. 1. Left: Living specimen of *Speleonectes tanumekes* Koenemann et al., 2003; photo courtesy of Thomas Iliffe. Right: Habitus drawing of *Speleonectes parabenjamini* (dorsal view); modified from Koenemann et al. 2007a.

Fig. 3. Ventral view of a living specimen of Pleomothra fragilis Koenemann et al., 2008; head region featuring powerful prehensile cephalic limbs. Photo by Thomas Iliffe.

Remipedes

Phylum Arthropoda – Class Cephalocarida

Horseshoe shrimps

Phylum Arthropoda – Class Entognatha

Entognathans – Springtails, Coneheads,

- Wingless
- Mouthparts withdrawn into head
- Absent or small compound eyes

Phylum Arthropoda – Class Insecta

Insects

- Have wings
- Have mouthparts outside of head

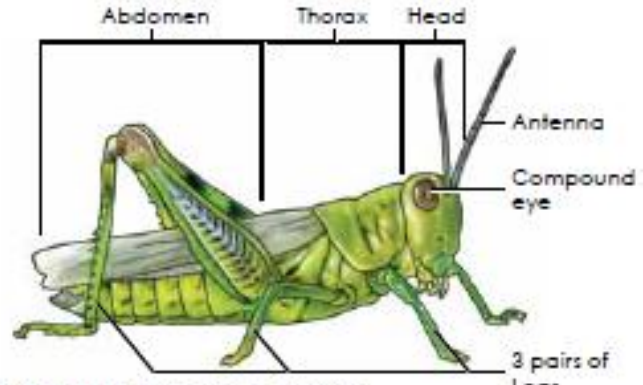


Figure 31.49 Basic insect anatomy.

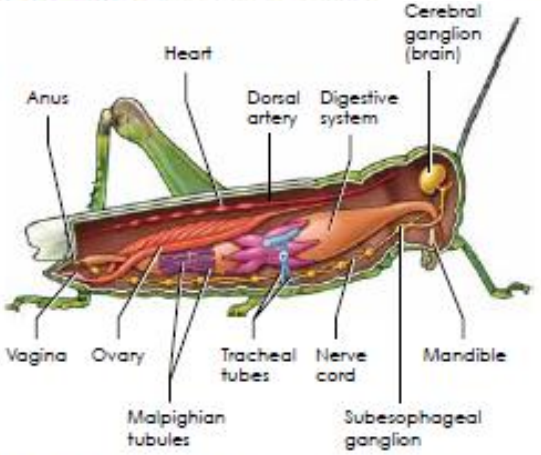


Figure 31.55 The internal anatomy of a grasshopper.

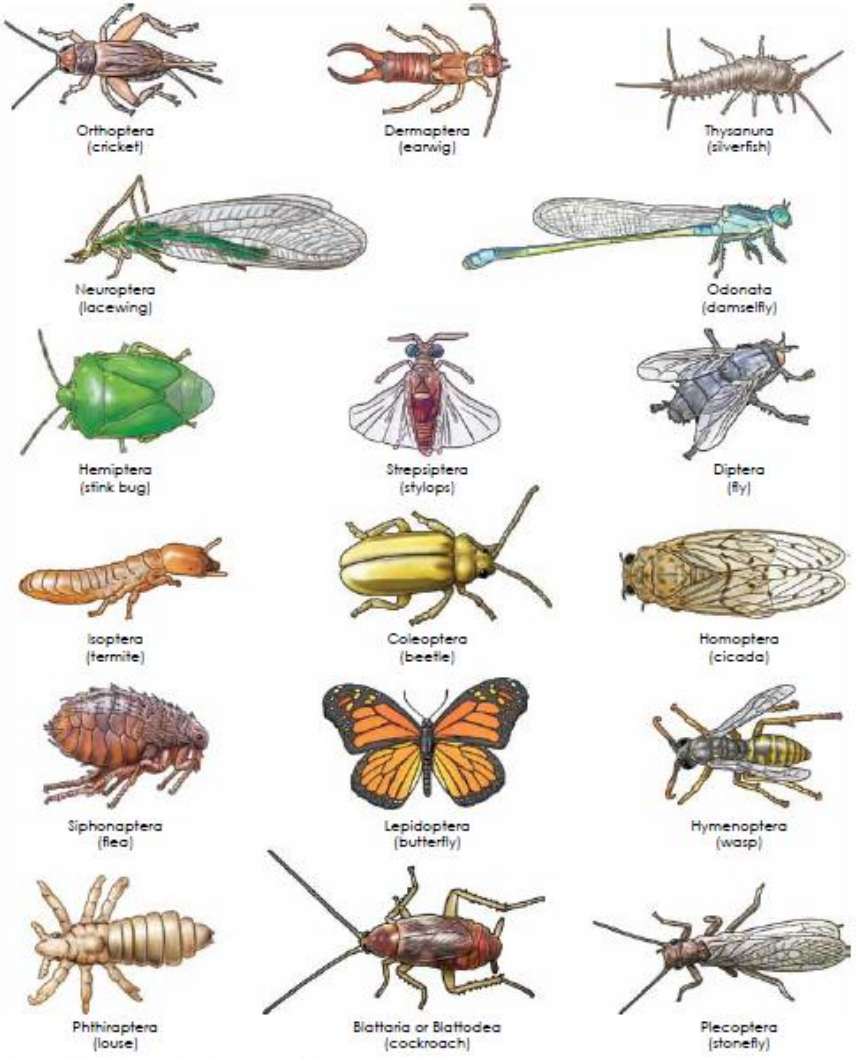


Figure 31.48 Representatives from some of the orders of insects.

Phylum Arthropoda – Class Insecta

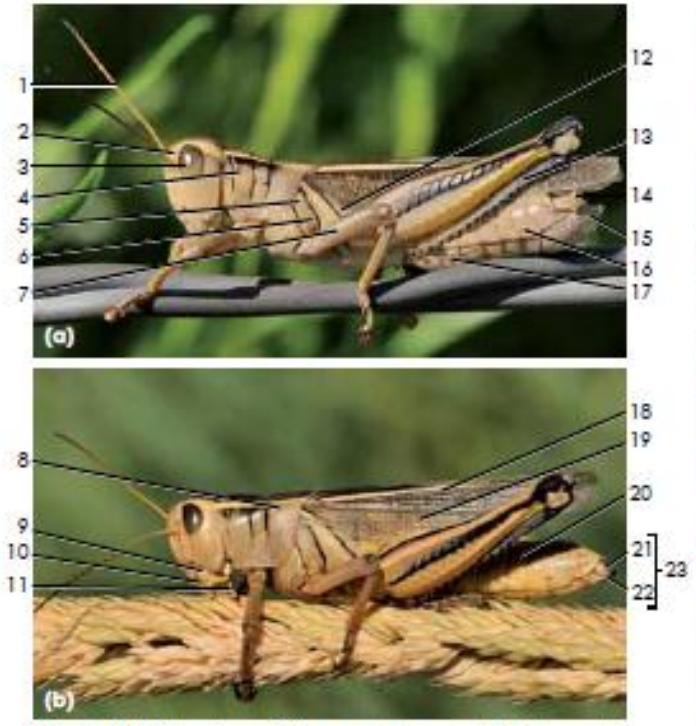


Figure 31.53 Anatomy of the grasshopper. (a) Male and (b) female.

1. Antenna
2. Ocelli
3. Compound eye
4. Prothorax
5. Mesothorax
6. Tympanum
7. Femur
8. Pronotum
9. Mandible
10. Labrum
11. Labial palp
12. Metathorax
13. Tibia
14. Cercus
15. Subgenital plate
16. Spiracle
17. Tarsus
18. Tegmen
19. Wing
20. Abdomen
21. Dorsal valve
22. Ventral valve
23. Ovipositor

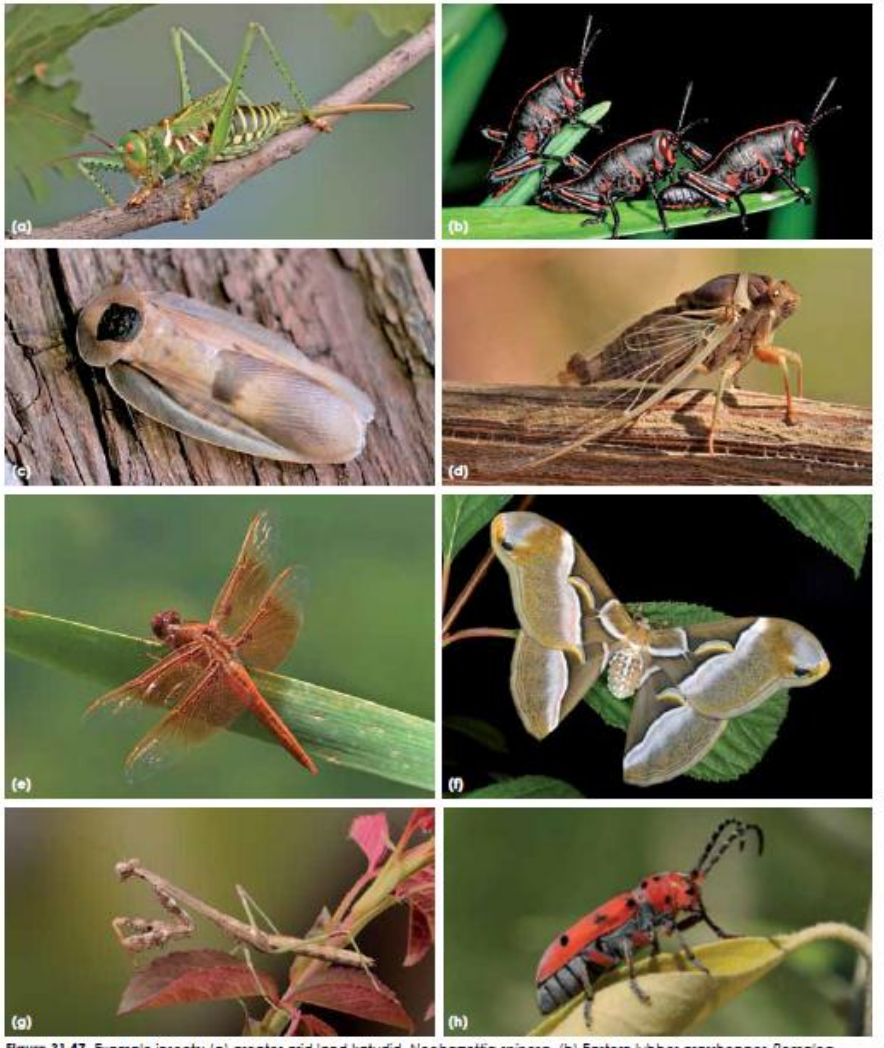


Figure 31.47 Example insects: (a) greater arid-land katydid, *Neobarrettia spinosa*, (b) Eastern lubber grasshopper, *Romalea microptera*, (c) giant cockroach, *Blaberus giganteus*, (d) cicada, *Dioeroprocta apache*, (e) flame skimmer dragonfly, *Libellula saturata*, (f) cynthia moth, *Samia cynthia*, (g) Carolina mantis, *Stagmomantis carolina*, and (h) milkweed beetle, *Tetraopes tetraophthalmus*.

Phylum Arthropoda – Class Insecta

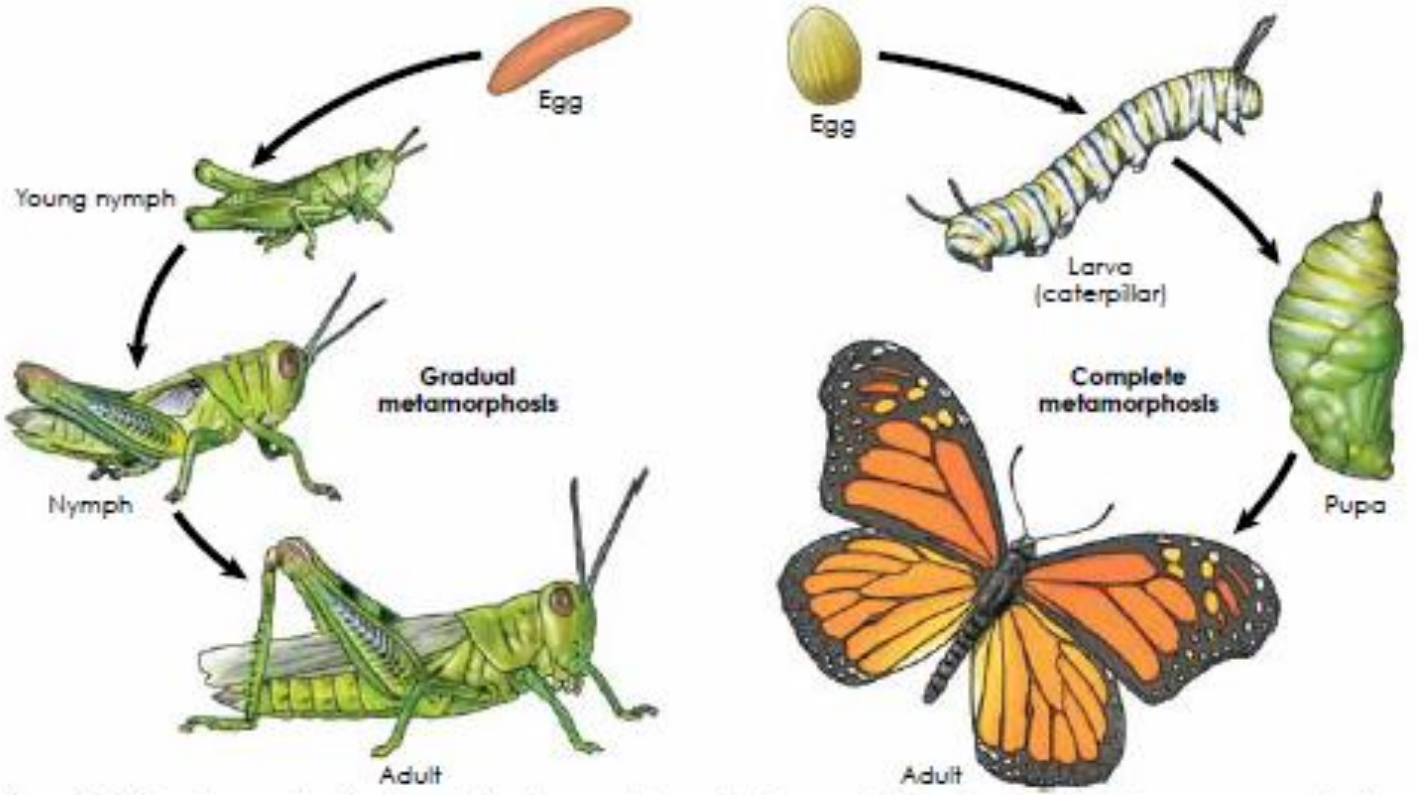
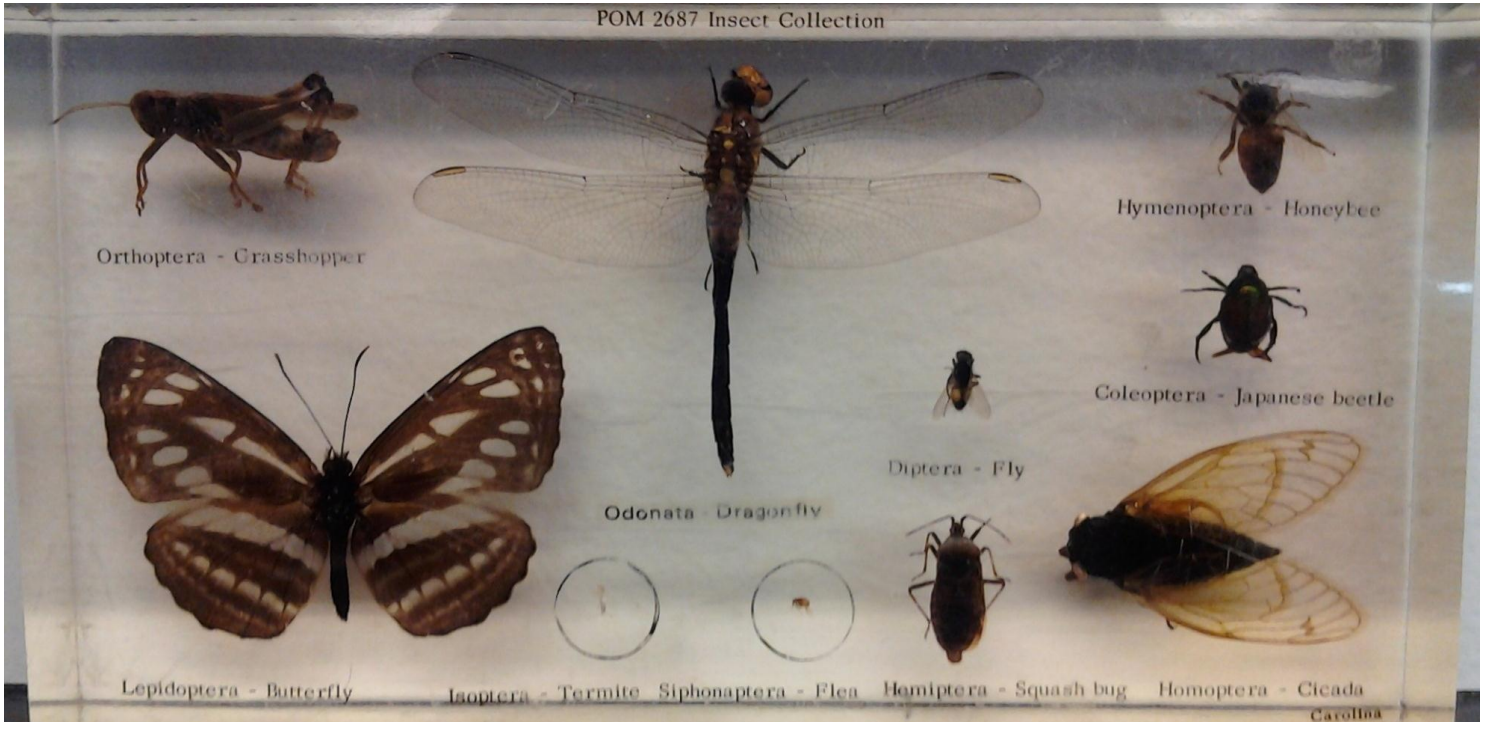
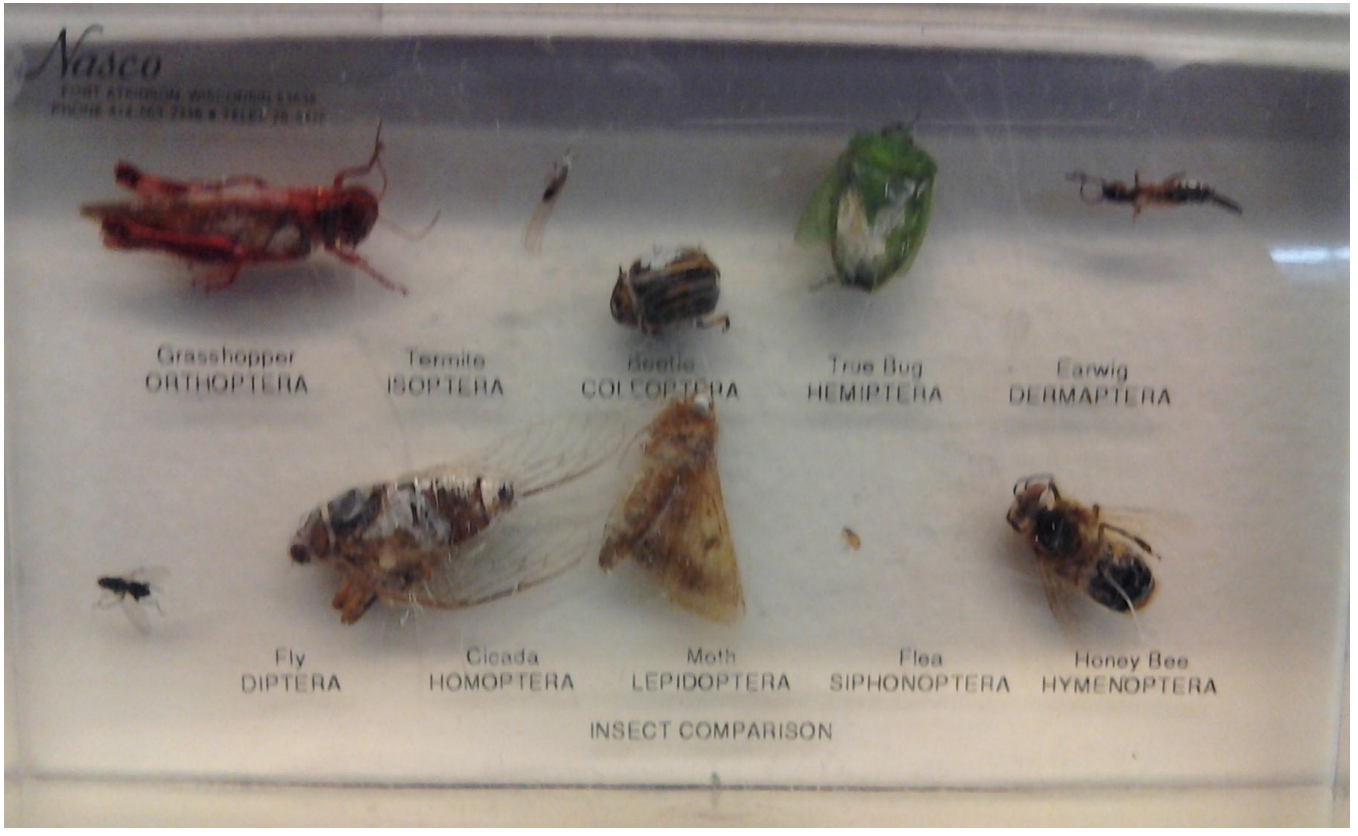


Figure 31.50 A diagram showing insect development. In gradual (incomplete) metamorphosis the young resemble the adults, but they are smaller and have different body proportions. In complete metamorphosis, the larvae look different from the adult and generally have different food requirements.

Phylum Arthropoda - Class Insecta



Phylum Arthropoda – Class Insecta



Phylum Echinodermata

Phylum Echinodermata – Sea stars, sea urchins, sea cucumbers

<u>Echinoderms Have</u>
Bilateral symmetry as larvae, radial symmetry as adults
Endoskeleton of calcium carbonate
Closed circulatory system
Water vascular system
Tube feet
Madreporite (entry/exit to water vascular system)
Deuterostome Development

Phylum Echinodermata

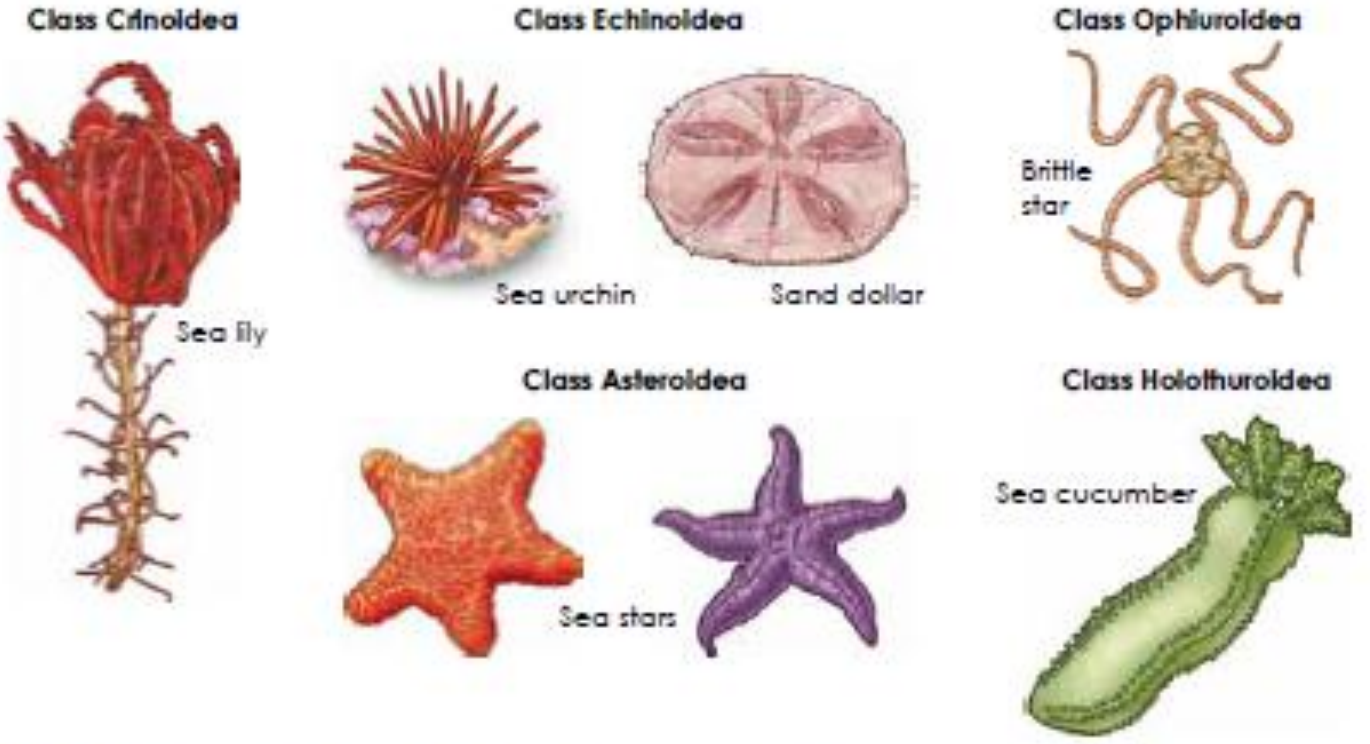


Figure 32.2 A diagram representing each class of echinoderms.

Phylum Echinodermata – Class Crinoidea

Feathers Stars, Sea Lilies

Mostly Sessile

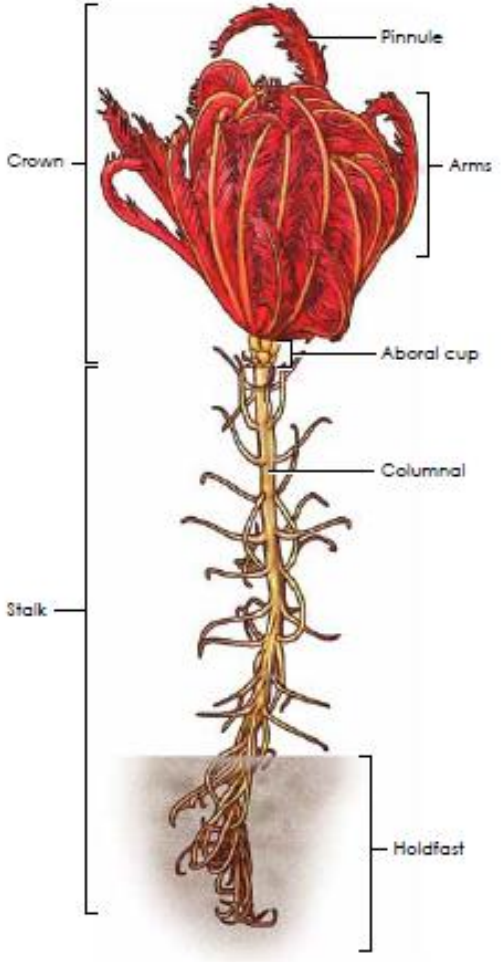


Figure 32.4 Basic crinoid anatomy.

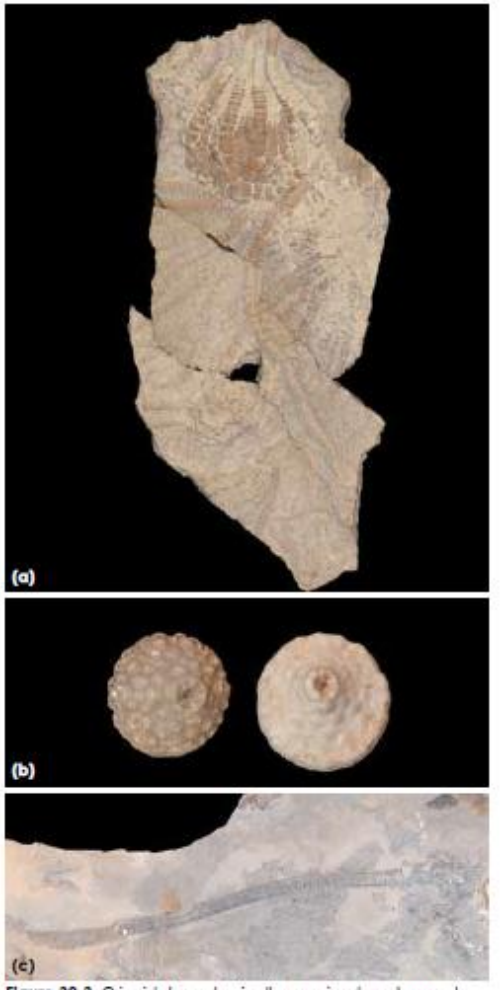


Figure 32.3 Crinoids have basically remained unchanged since the fossil record. (a) A fossil crinoid (b) a partial crown, or aboral cup, and (c) the stalk.

Phylum Echinodermata – Class Asteroidea

Starfish

Figure 32.5 A group of sea stars (starfish), *Asterias*, in a tide pool in Oregon.

Figure 32.6 A sea star (starfish), *Asterias* sp.

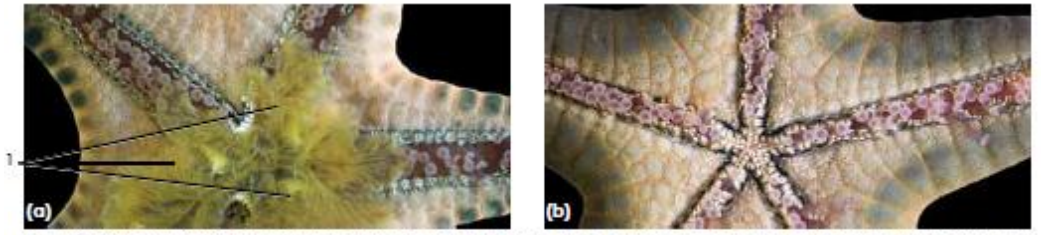


Figure 32.8 An oral view of a sea star (a) showing the cardiac stomach extended through mouth and (b) after retracting the stomach.
1. Cardiac stomach

Phylum Echinodermata - – Class Asteroidea

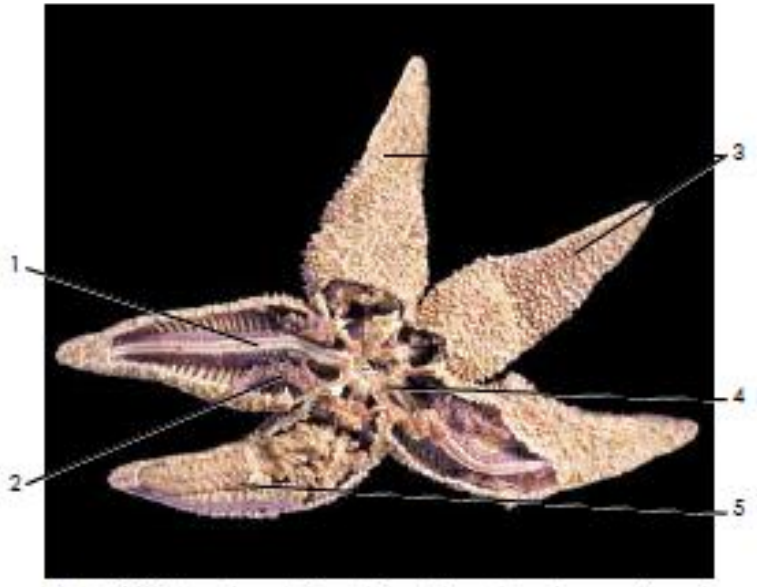


Figure 32.7 An aboral view of the internal anatomy of a sea star.
1. Ambulacral ridge
2. Gonad
3. Spines
4. Ring canal
5. Pyloric caecum (digestive gland)

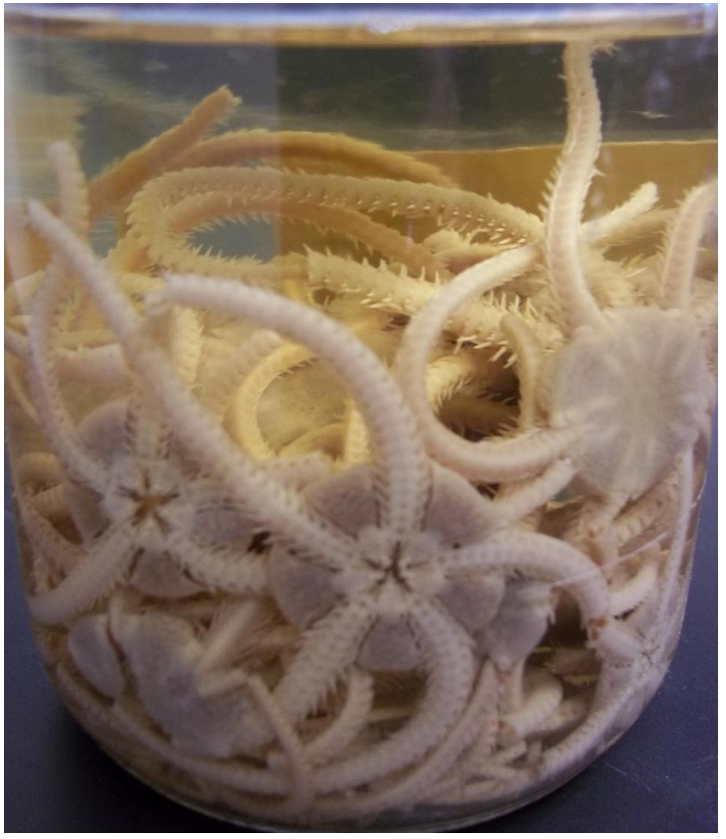
Phylum Echinodermata – Class Asteroidea

Phylum Echinodermata – Class Ophiuroidea

Brittle Stars

Figure 32.9 A brittle star, *Ophioderma* sp.

Figure 32.10 A green brittle star, *Ophiarachna incrassata*.



Phylum Echinodermata – Class Echinoidea

Sea Urchins

Sea Biscuits

Sea Dollars

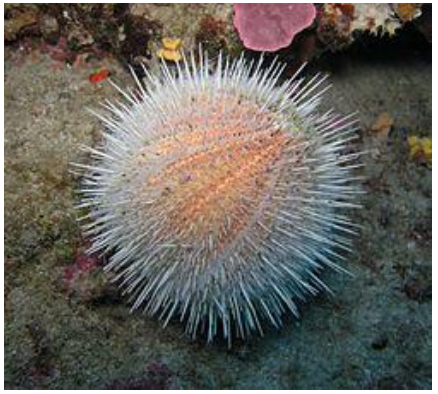


Figure 32.11 Examples of sea urchins: (a) A green sea urchin, *Strongylocentrotus droebachiensis*, (b) A red slate sea urchin, *Heterocentrotus mammillatus*, (c) pencil sea urchin, *Eucidaris*, sp. (d) helmet sea urchin, *Colobocentrotus atratus*, (e) common sand dollars, *Echinarachnius parma*, and (f) sea biscuit skeleton.

Phylum Echinodermata – Class Holothuroidea

Sea Cucumbers

Figure 32.15 California sea cucumber, *Parastichopus californicus*.

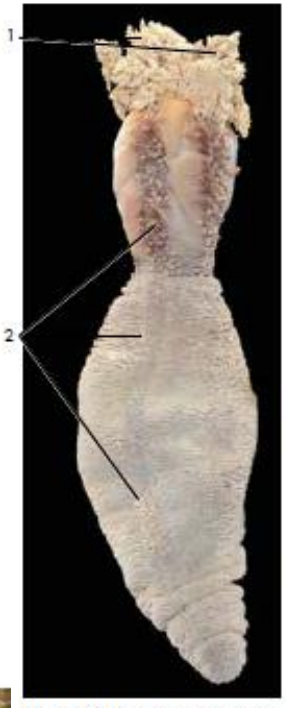


Figure 32.12 A sea cucumber, *Cucumaria*.
1. Tentacles
2. Tube feet

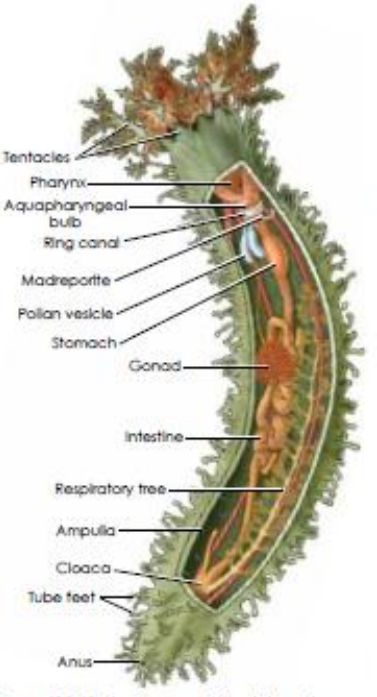


Figure 32.13 A diagram of the internal anatomy of a sea cucumber.

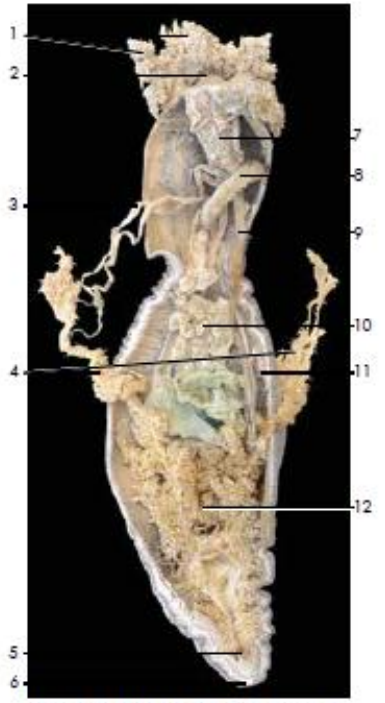
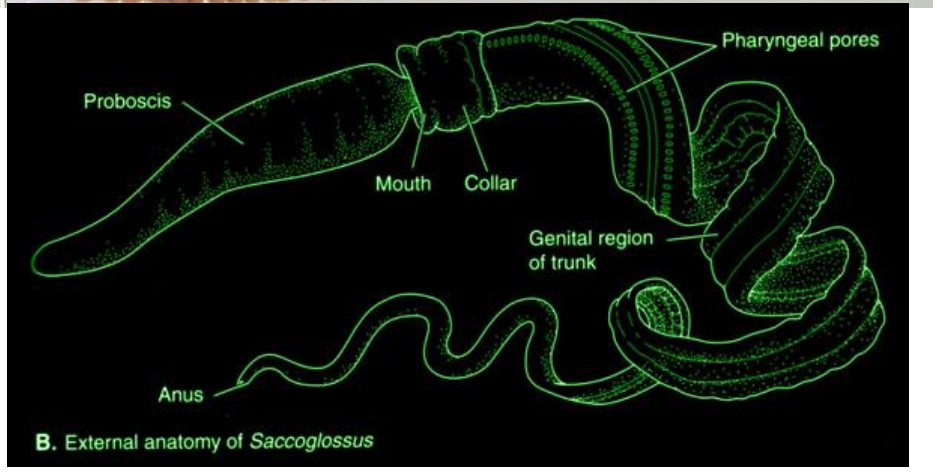


Figure 32.14 The internal anatomy of a sea cucumber.
1. Tentacles
2. Mouth
3. Polian vesicle
4. Respiratory tree
5. Cloaca
6. Anus
7. Aquapharyngeal bulb
8. Esophagus
9. Retractor muscle
10. Intestine
11. Ampulla
12. Gonad

Phylum Hemichordata



Hemichordates – Acorn worms and Pterobranchs

<u>Hemichordates</u>

Rare

Deuterostomes

Three Body Regions

- Proboscis
- Collar
- Trunk

Marine Organisms

Pharyngeal Gill Slits

Class Enteropneustra
Acorn Worms

Phylum Chordata

Phylum Chordata – All chordates, including tunicates, lancelets, hagfish, lamprey, sharks, fish, amphibians, reptiles, and mammals
Everything after this slide is in Phylum Chordata

<u>All Chordates Have</u>
Bilateral symmetry
Closed circulatory system
Complete digestive tract
True Coelom
Deuterostome Development
A hollow dorsal nerve cord
A notochord
Pharyngeal gill slits
Post anal tail

Subphylum Urochordata

Sub-Phylum Urochordata –

Sea Squirt, Tunicates

Lose post-anal tail and notochord in adulthood

Classes include

Asicidiacea – sea squirts

Thaliacea – salps

Appendicularia - larvaceans

Subphylum Cephalochordata

Sub-phylum Cephalochordata – Lancelets

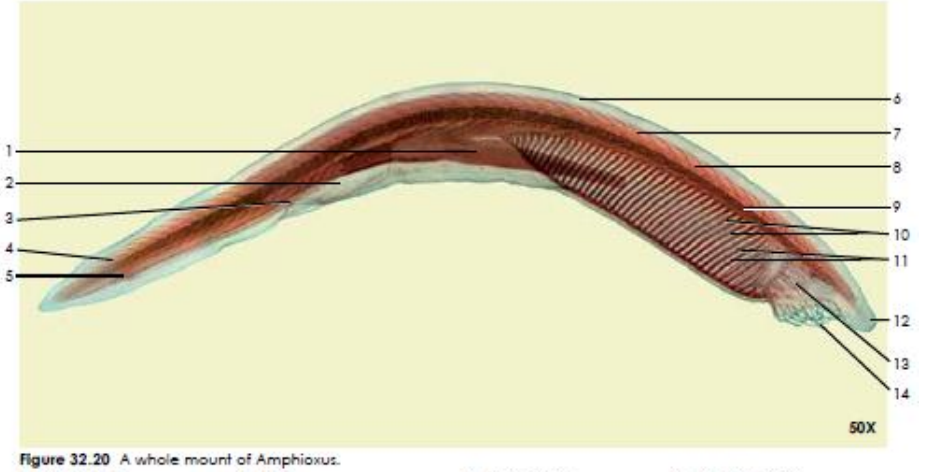
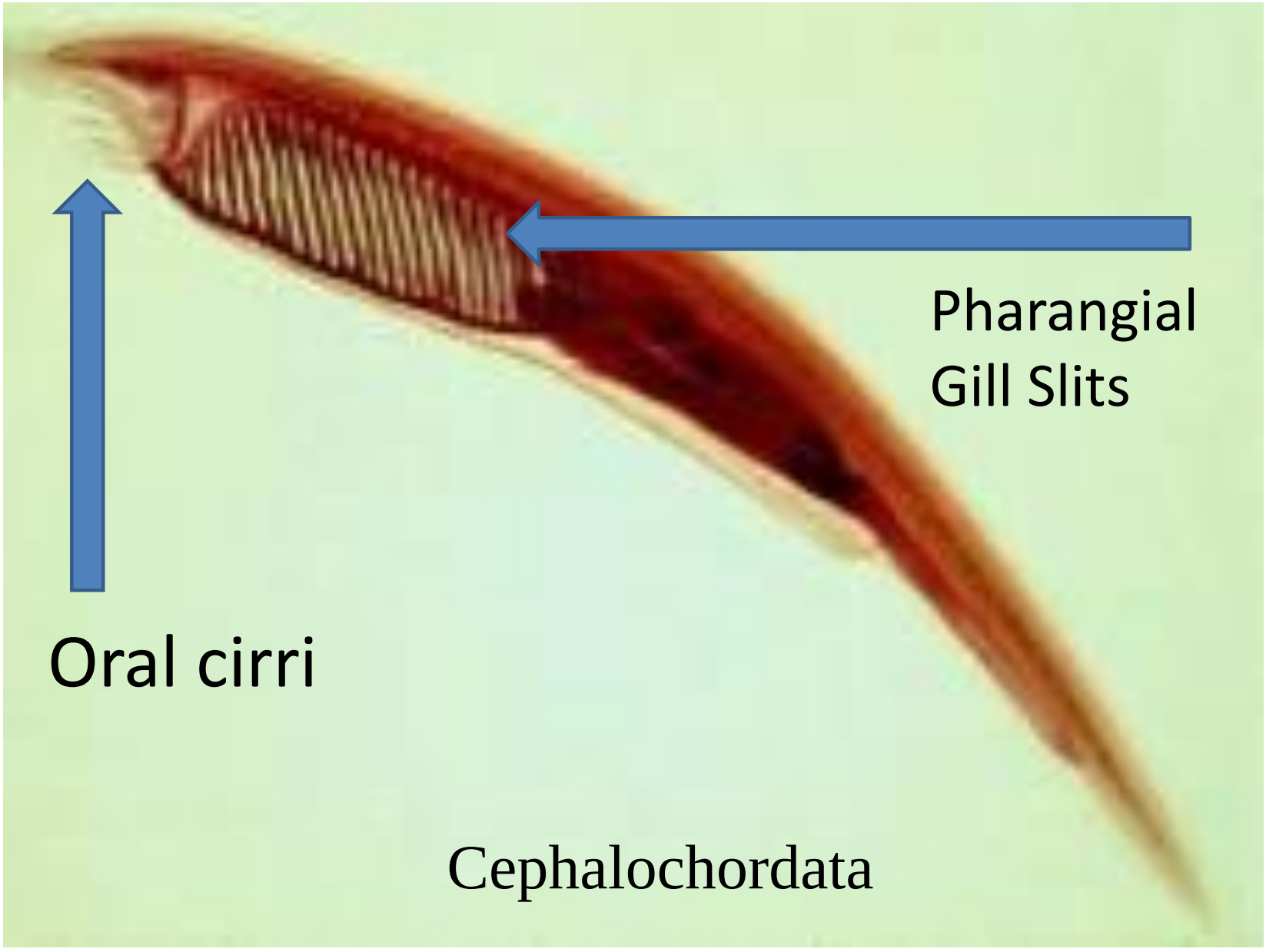


Figure 32.20 A whole mount of Amphioxus.

1. Esophagus
2. Atrium
3. Atriopore
4. Caudal fin
5. Anus
6. Fin rays
7. Myomeres
8. Dorsal nerve cord
9. Notochord
10. Gill slits
11. Gill bars
12. Rostrum
13. Wheel organ
14. Oral cirri


Pharangial
Gill Slits
Oral cirri
Cephalochordata

Subphylum Vertebrata (Craniata)

Agnatha

- Myxini (Craniate not Vertebrate)
- Cephalapidomorphi

All VERTEBRATES have a backbone, in addition to all the characteristics of chordates.

Gnathostomata

- Chondrichthyes
- Osteichthyes
  - Actinopterygii
  - Sarcopterygii
    - Actinista
    - Dipnoi
- Amphibia
- Reptilia
  - Aves
- Mammalia

Subphylum Vertebrata (Craniata)

Table 32.2 Representatives of the Subphylum Vertebrata	
Taxa and Representative Kinds	**Characteristics**
Superclass Agnatha	Eel-like and aquatic; sucking mouth (some parasitic); lack jaws and paired appendages
Class Myxini — hagfishes	Terminal mouth with buccal funnel absent; nasal sac connected to pharynx; 4 pairs of tentacles; 5 to 10 pairs pharyngeal pouches
Class Cephalaspidomorphi (Petromyzontida) — lampreys	Suctorial mouth with rasping teeth; nasal sac not connected to buccal cavity; 7 pairs of pharyngeal pouches
Superclass Gnathostomata	Jawed vertebrates; most with paired appendages
Class Chondrichthyes — sharks, rays, and skates	Cartilaginous skeleton; placoid scales; most have spiracle; spiral valve in digestive tract
Class Osteichthyes	Bony fishes; Gills covered by bony operculum; most have swim bladder
Subclass Sarcopterygii	Bony skeleton; lobe-finned; paired pectoral and pelvic fins;
Subclass Actinopterygii	Bony skeleton; most have dermal scales; ray-finned
Class Amphibia — salamanders, frogs, and toads	Larvae have gills and adults have lungs; scaleless skin (except apoda); an incomplete double circulation; three–chambered heart
Class Reptilia (Sauropsida) — turtles, snakes, and lizards	Amniotic egg; epidermal scales; three- or four-chambered heart; lungs
Class Aves — birds	Homeothermic (warm-blooded); feathers; toothless; air sacs; four-chambered heart with right aortic arch
Class Mammalia — mammals	Homeothermic; hair; mammary glands; most have seven cervical vertebrae; muscular diaphragm; three auditory ossicles; four–chambered heart with left aortic arch

Class Myxini

Class Myxini – Hagfish

<u>Hagfish have</u>
Cephalization, but no backbone
Are not true vertebrates
Craniates

Class Cephalaspidomorphi (Petromyzontida)

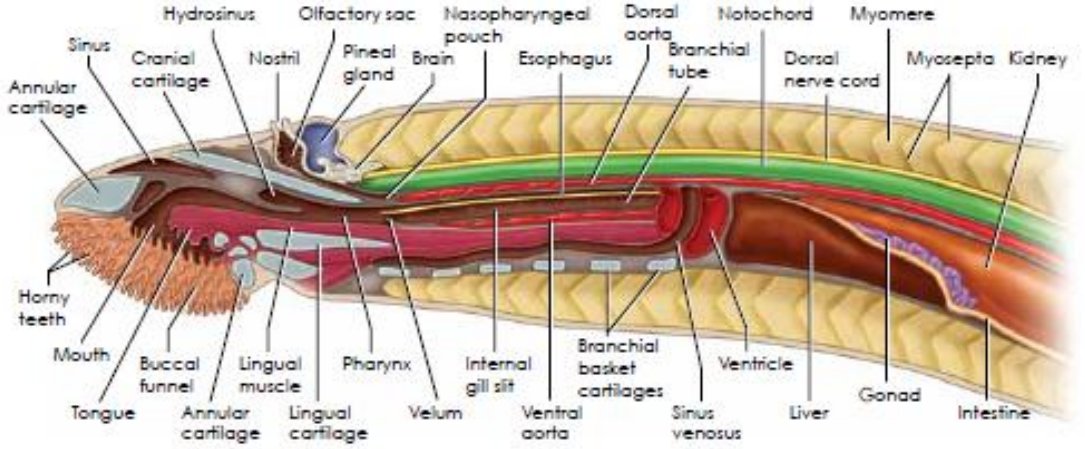
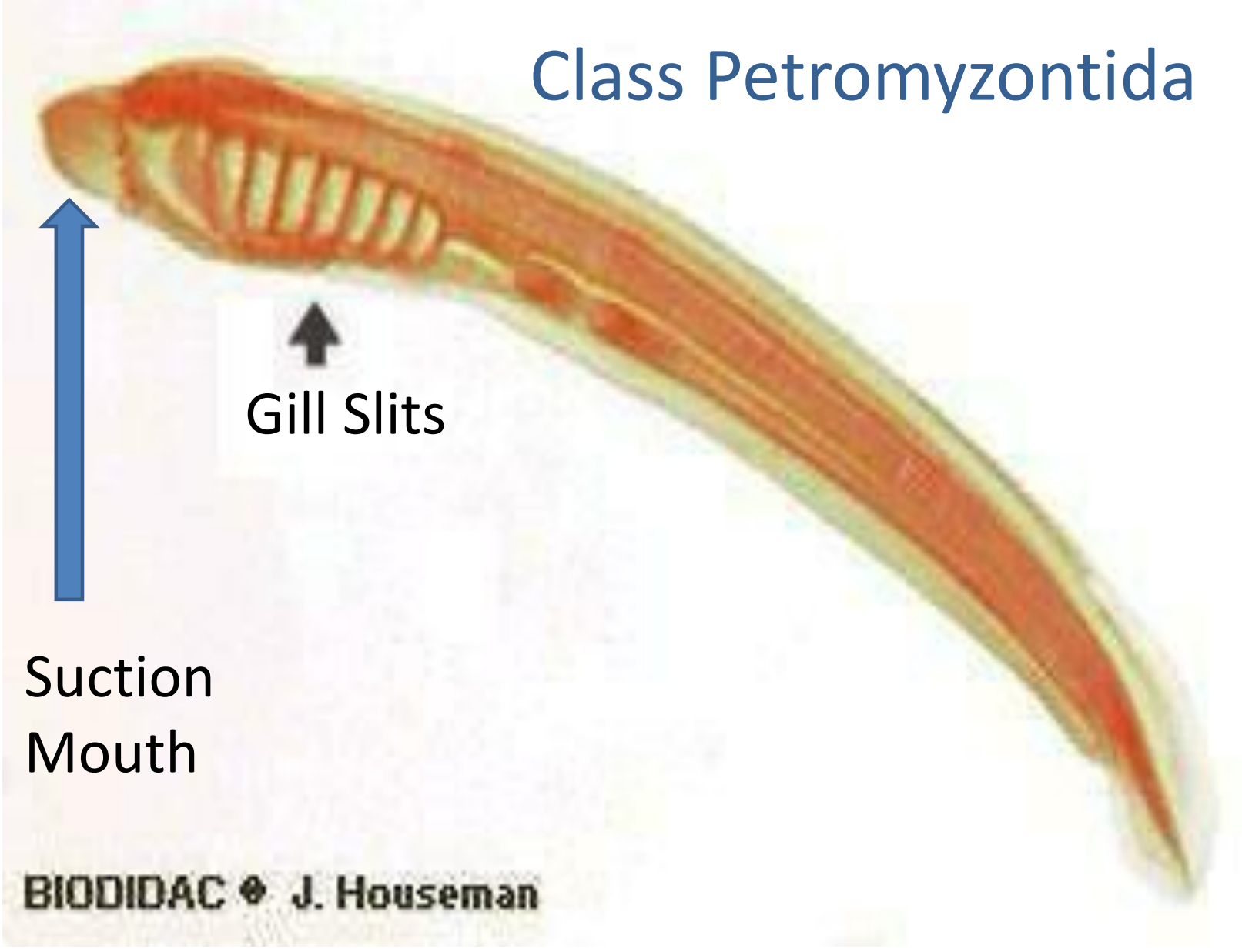


Figure 32.30 A diagram of a sagittal section of a marine lamprey.

Class Petromyzontida – Lampreys

<u>Lampreys Have</u>
Teeth
True Backbone, no jaw

Class Petromyzontida



Class Chondrichthyes

Class Chondrichthyes – Sharks, skates and rays

<u>Chondrichthyans Have</u>

Living Skeleton made entirely of cartilage

Ancient chondrichthyans had bone skeletons

Fins for swimming

Class Chondrichthyes

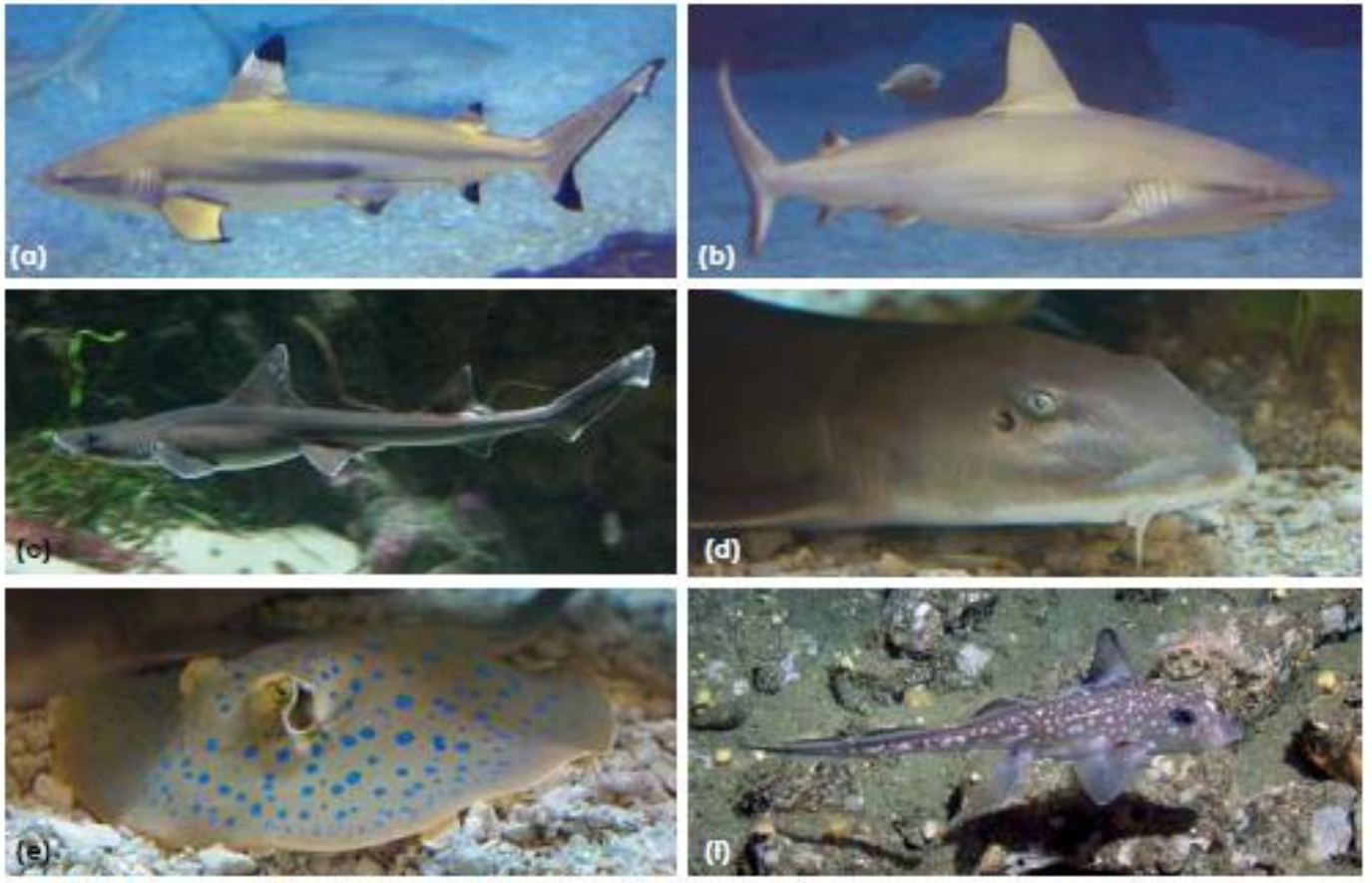


Figure 32.31 Examples of chondrichthyes: (a) black tip reef shark, *Carcharhinus melanopterus*, (b) gray reef shark, *Carcharhinus amblyrhynchos*, (c) gray smoothhound shark, *Mustelus californious*, (d) nurse shark, *Gingiymostoma cirratum*, (e) blue spotted stingray, *Taeniura lymma*, and (f) chimaera, *Hydrolagus colliei*.

Class Chondrichthyes

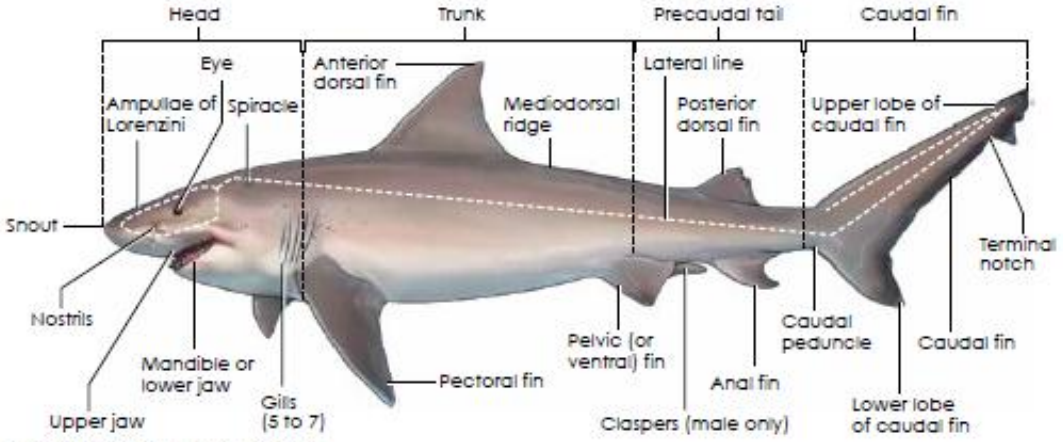


Figure 32.35 The anatomy of a shark.

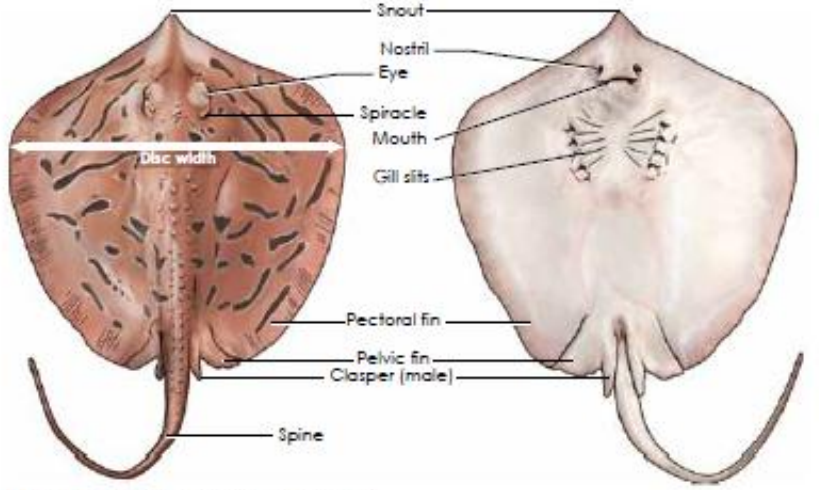
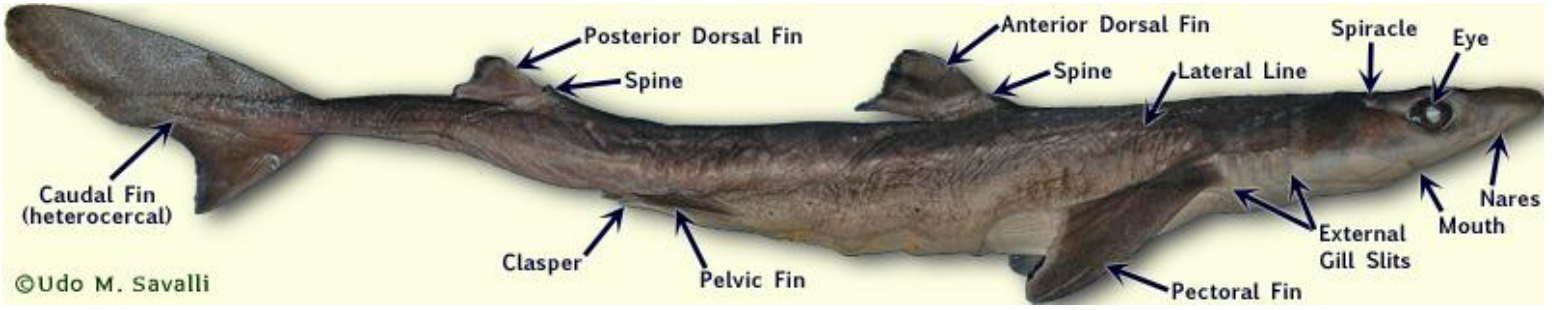
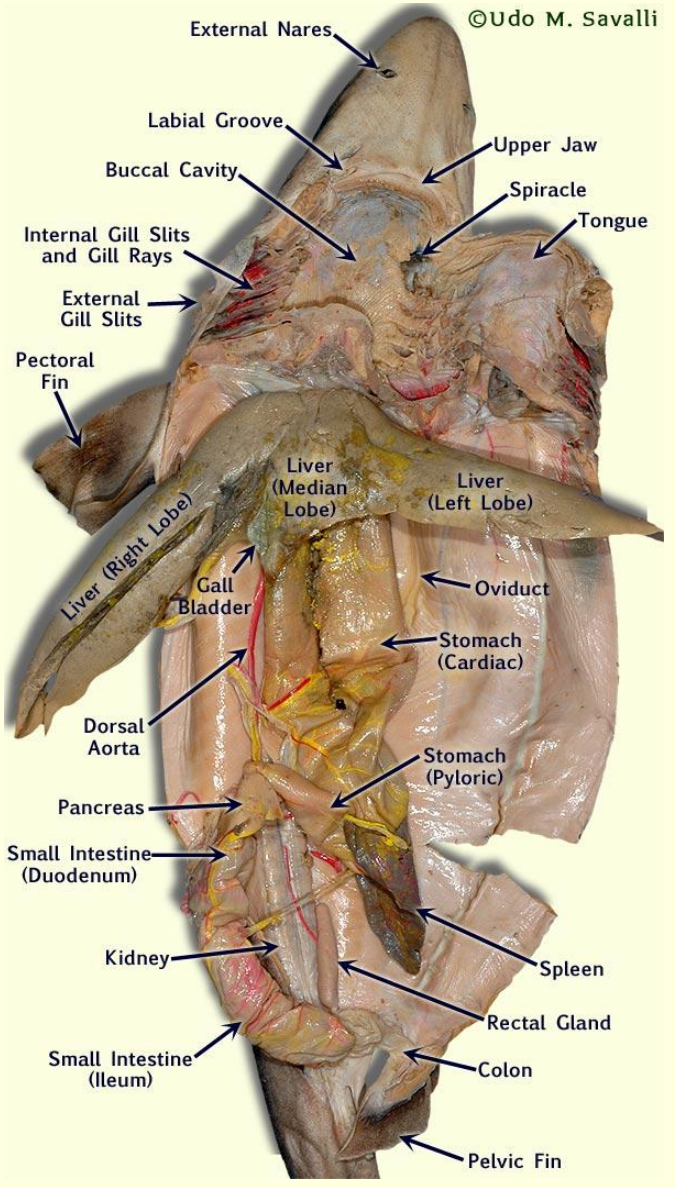


Figure 32.36 The external anatomy of a stingray.

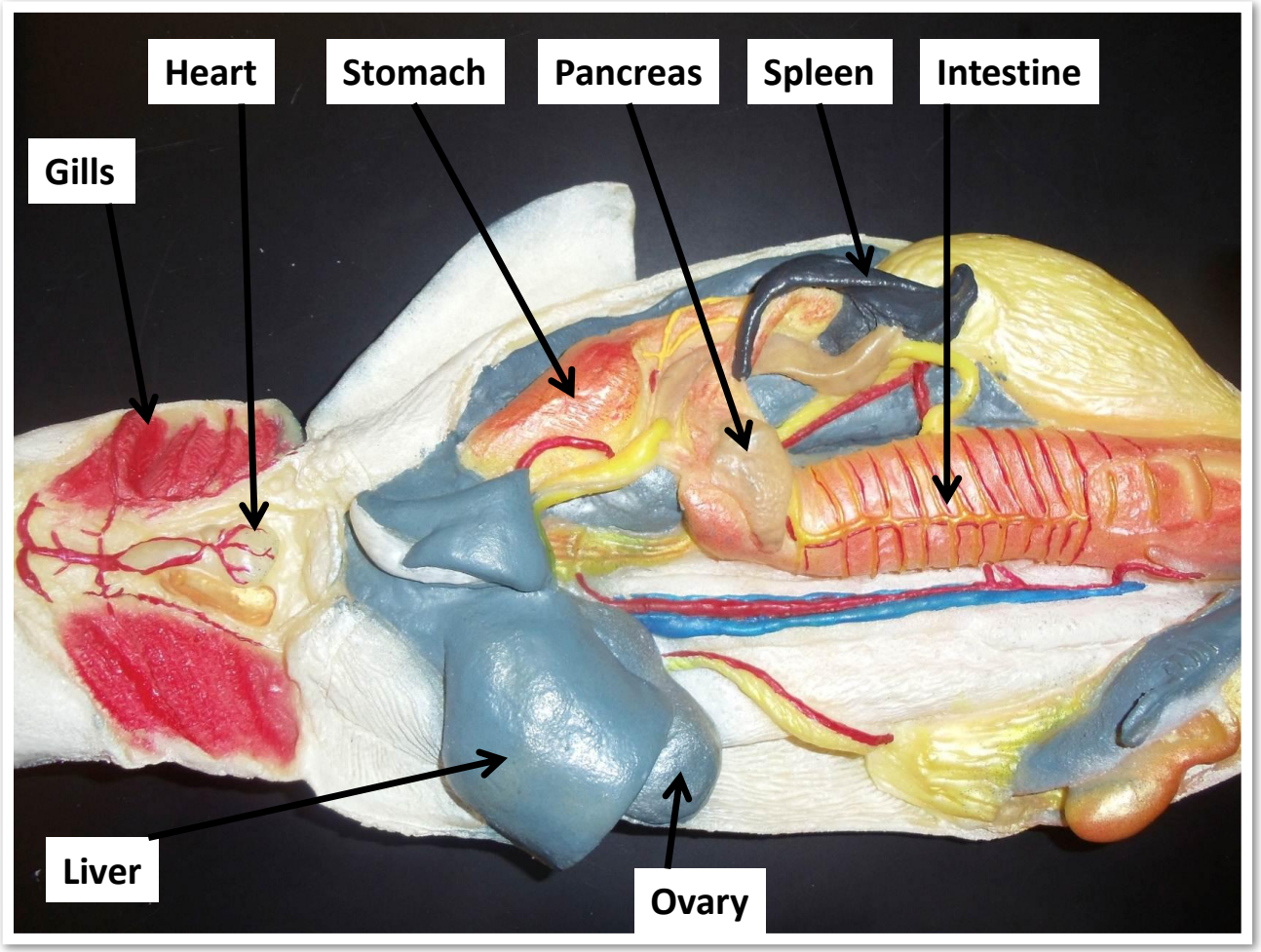
Spiny Dogfish Shark



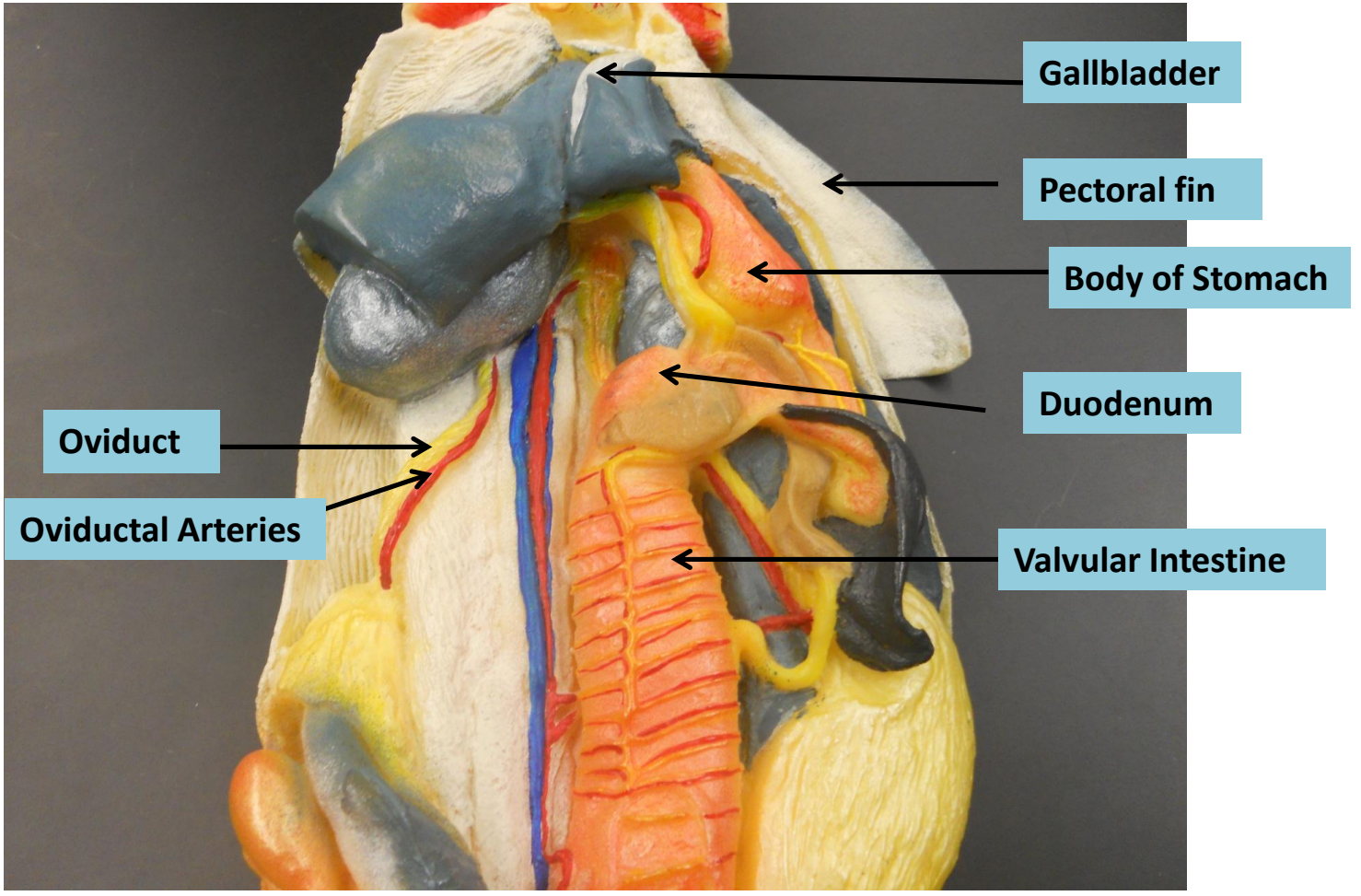
Spiny Dogfish Shark



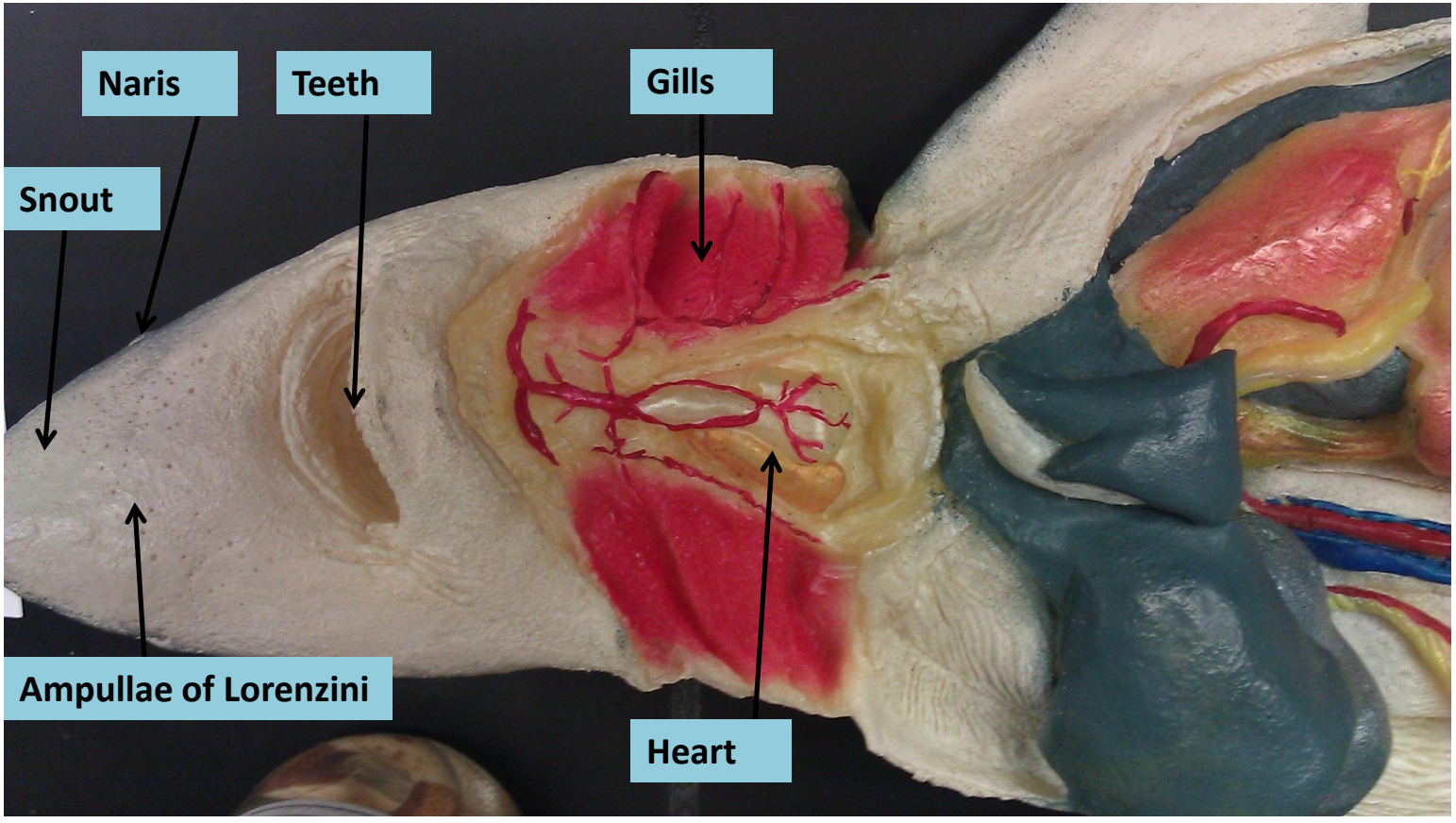
Spiny Dogfish Shark



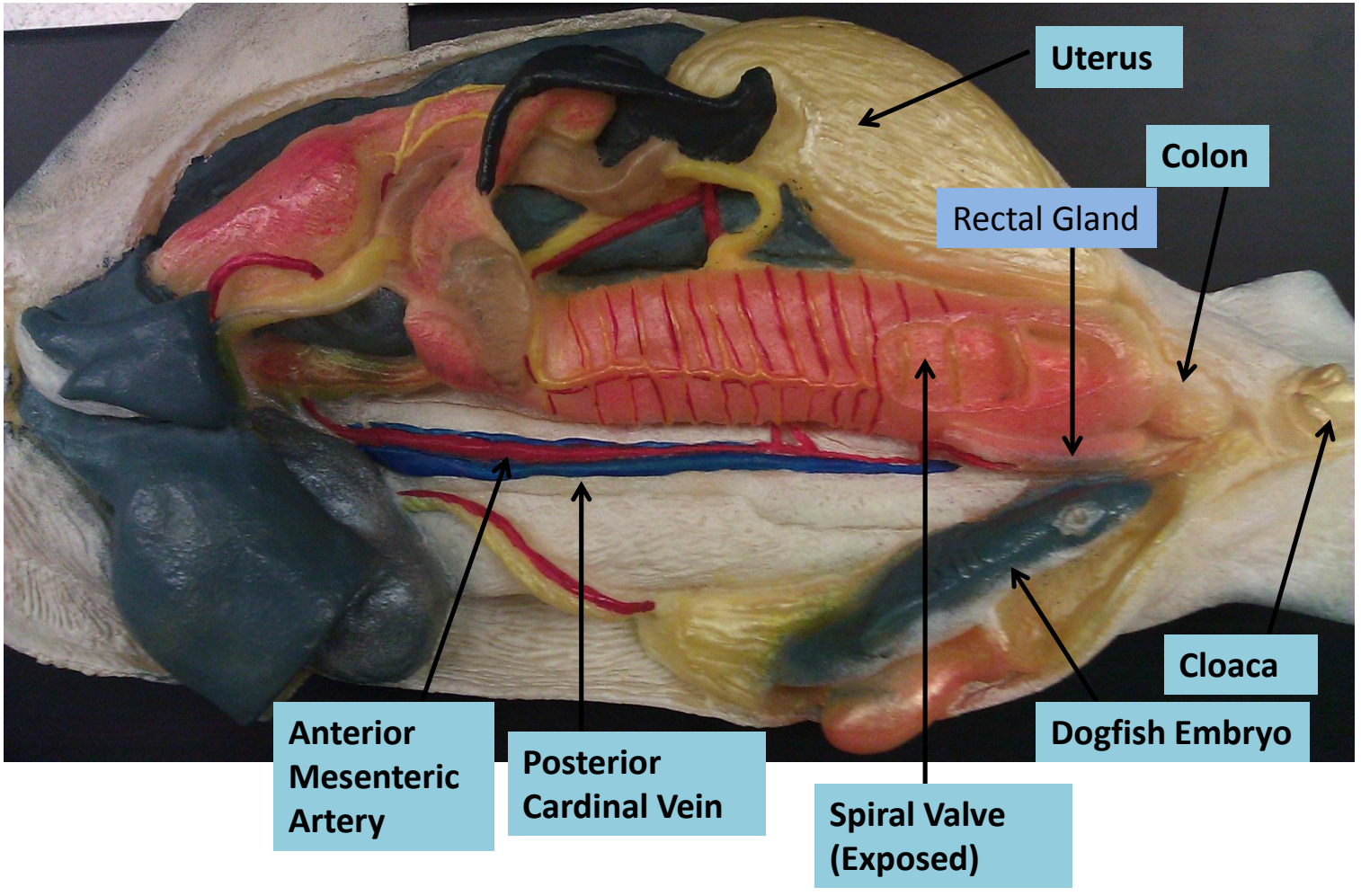
Spiny Dogfish Shark



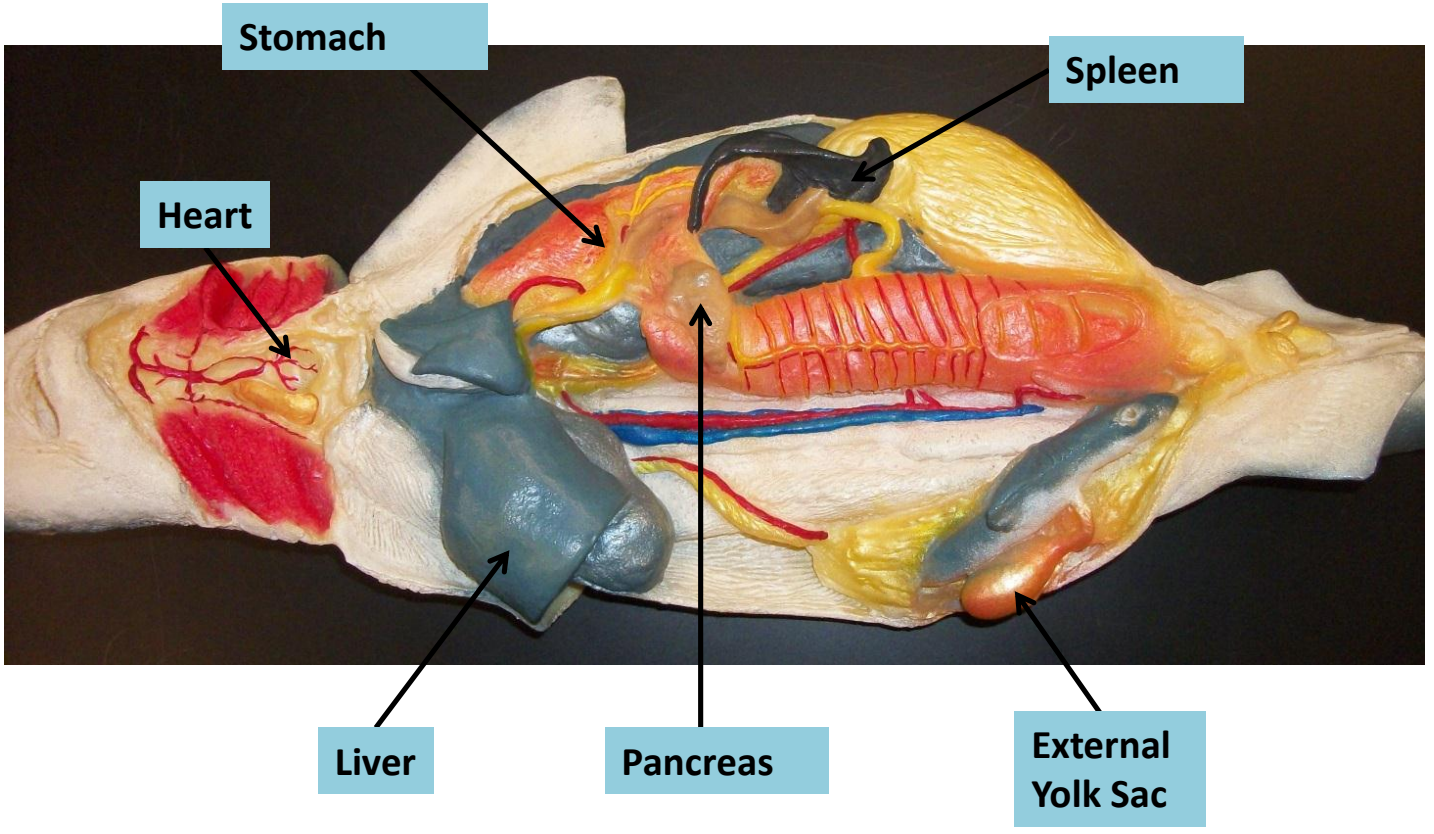
Spiny Dogfish Shark



Spiny Dogfish Shark



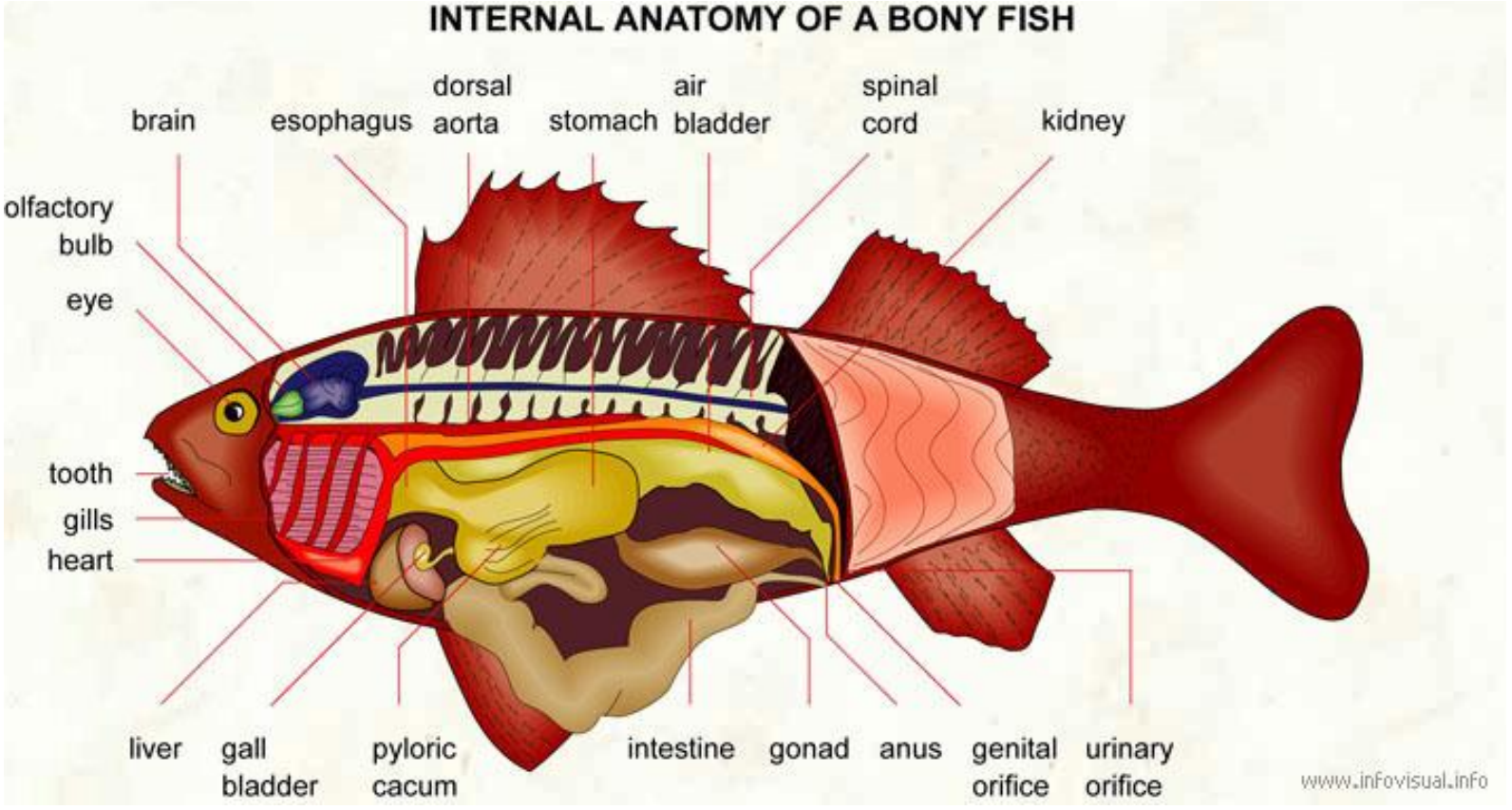
Spiny Dogfish Shark

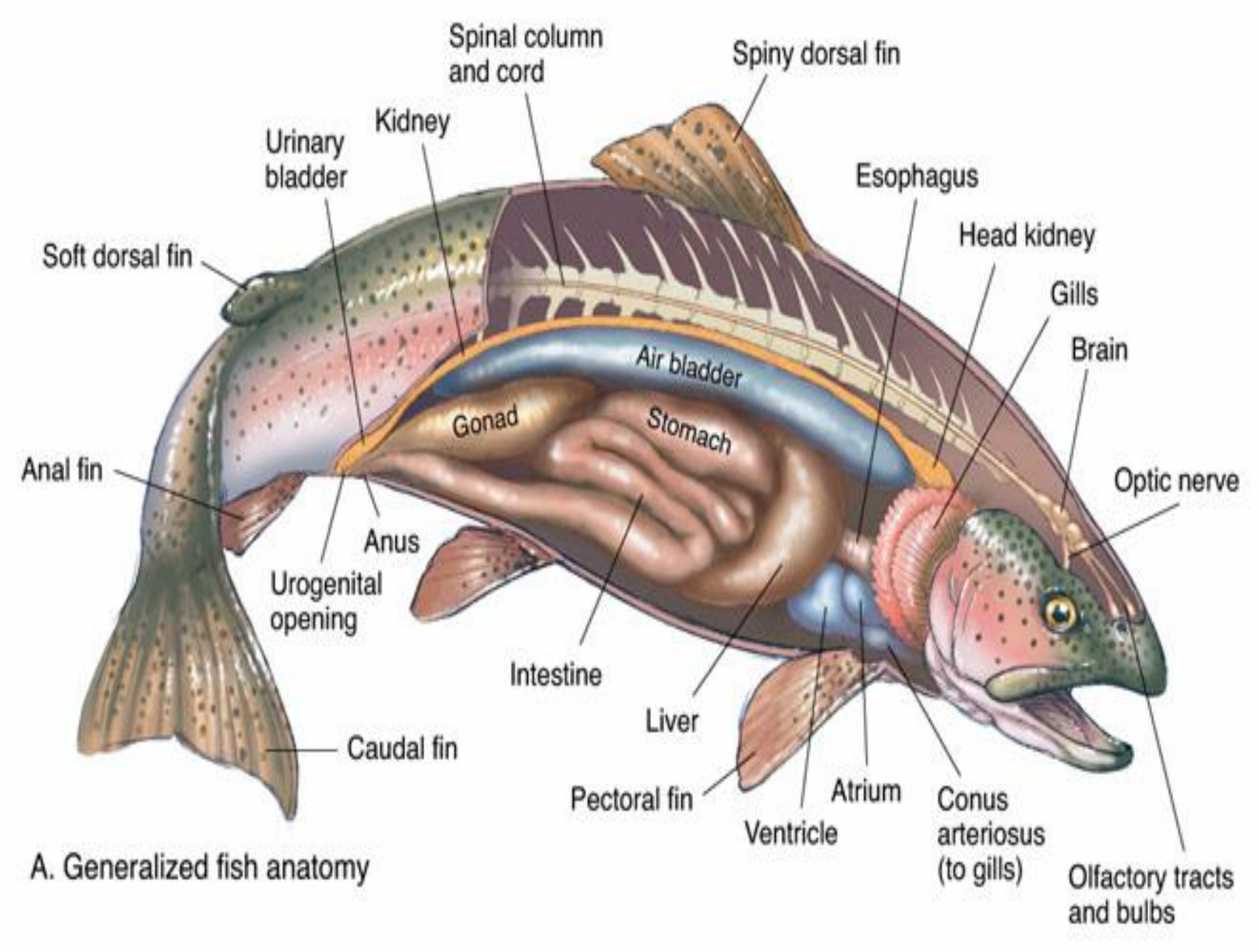


Superclass Osteichthyes

- Comprised of 3 classes
  - Actinopterygii : Rayfin fish
  - Actinista : Lobefin fish
  - Dipnoi : Lung fish
- All Osteichthyans have a bony, living skeleton
- Have Scales
- Are cold-blooded

Superclass Osteichtyes





A. Generalized fish anatomy

Class Actinopterygii

Rayfin Fish

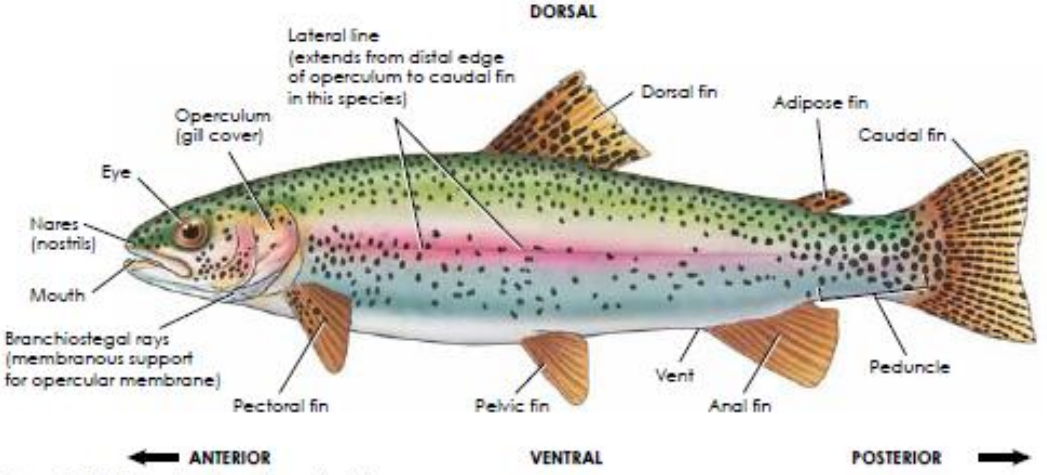


Figure 32.41 The external anatomy of a fish.

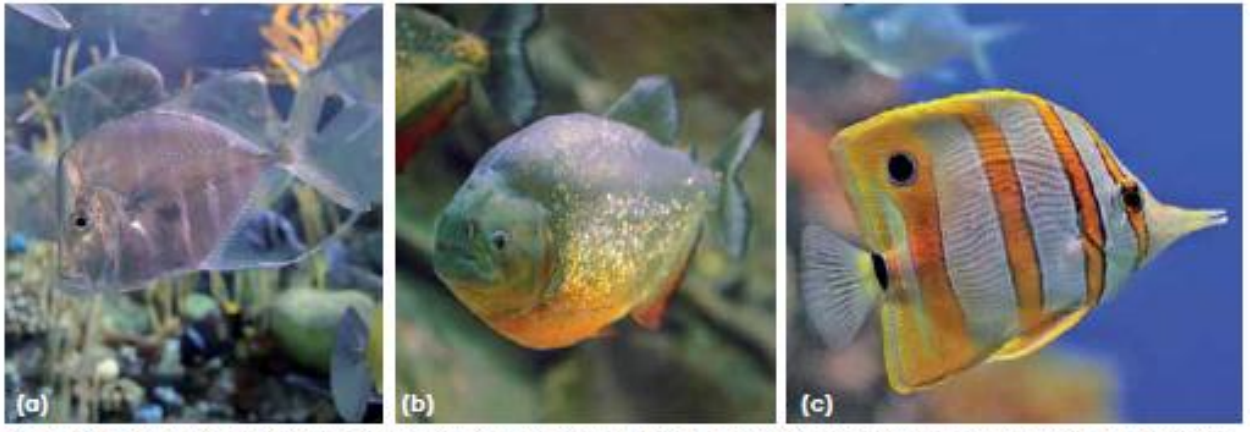
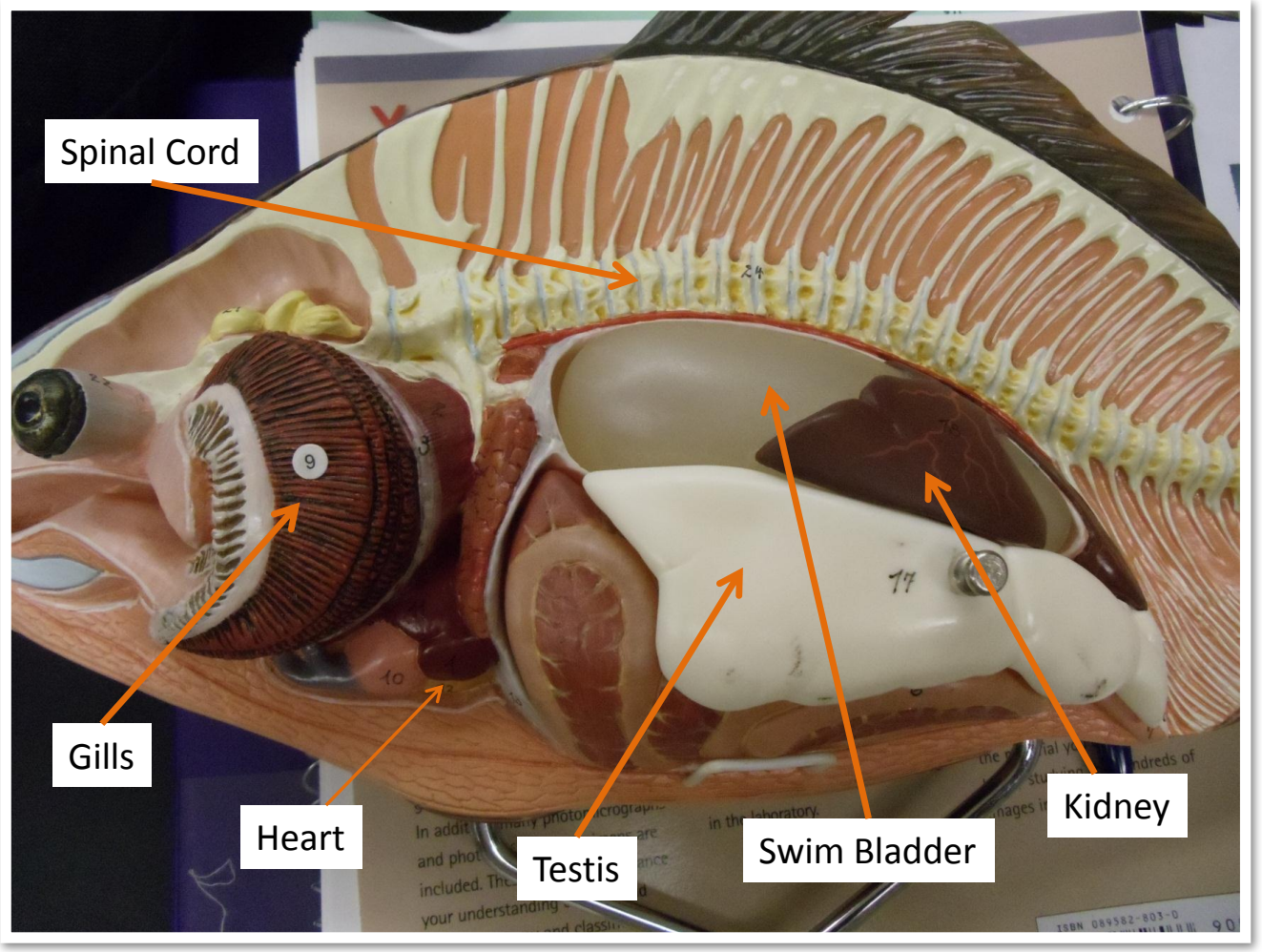
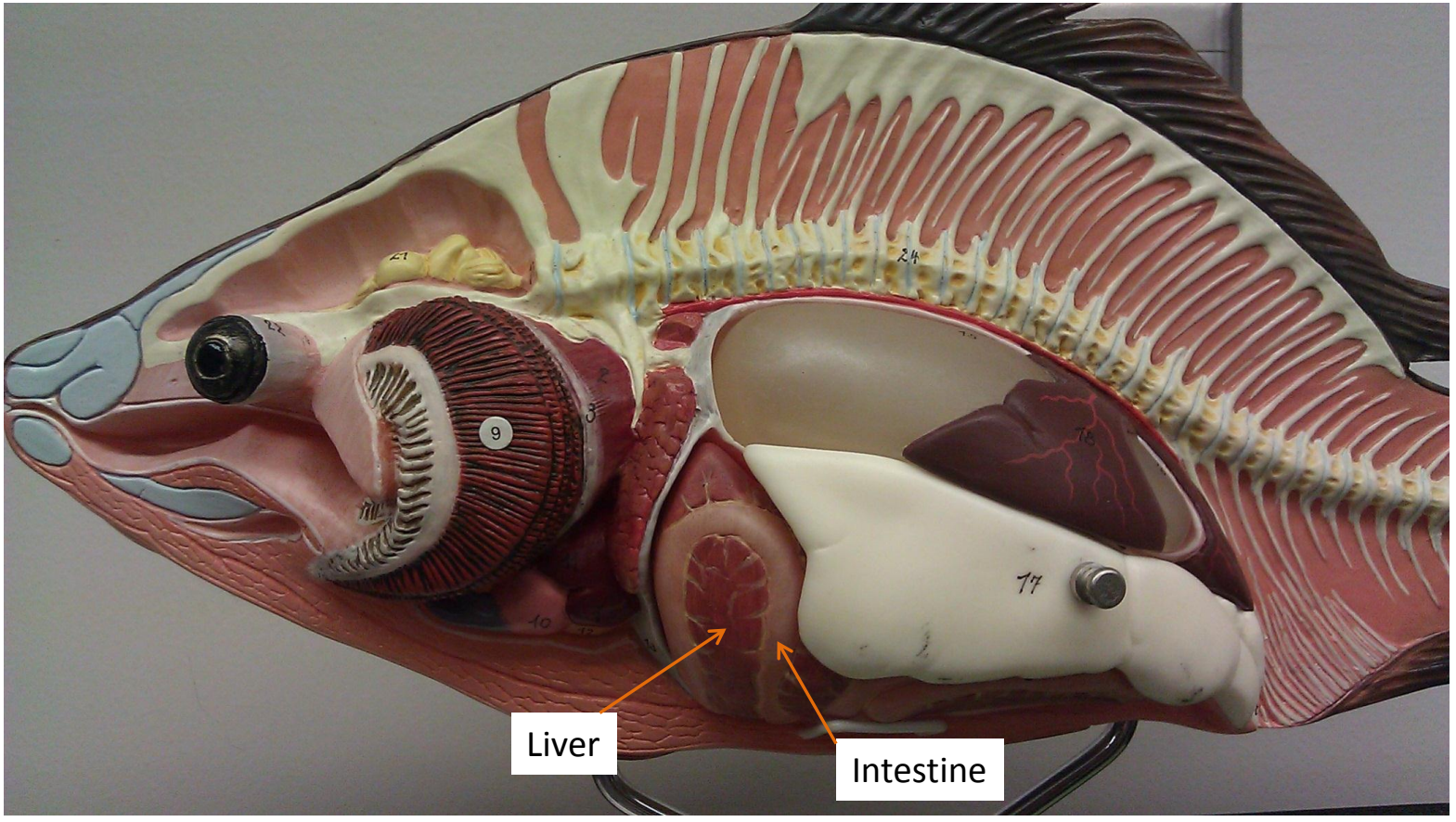


Figure 32.37 Ray-finned fishes: (a) lookdown fish, *Selene vomer*, (b) piranha, *Pygocentrus nattereri*, (c) copper band butterfly fish, *Chelmon rostratus*.

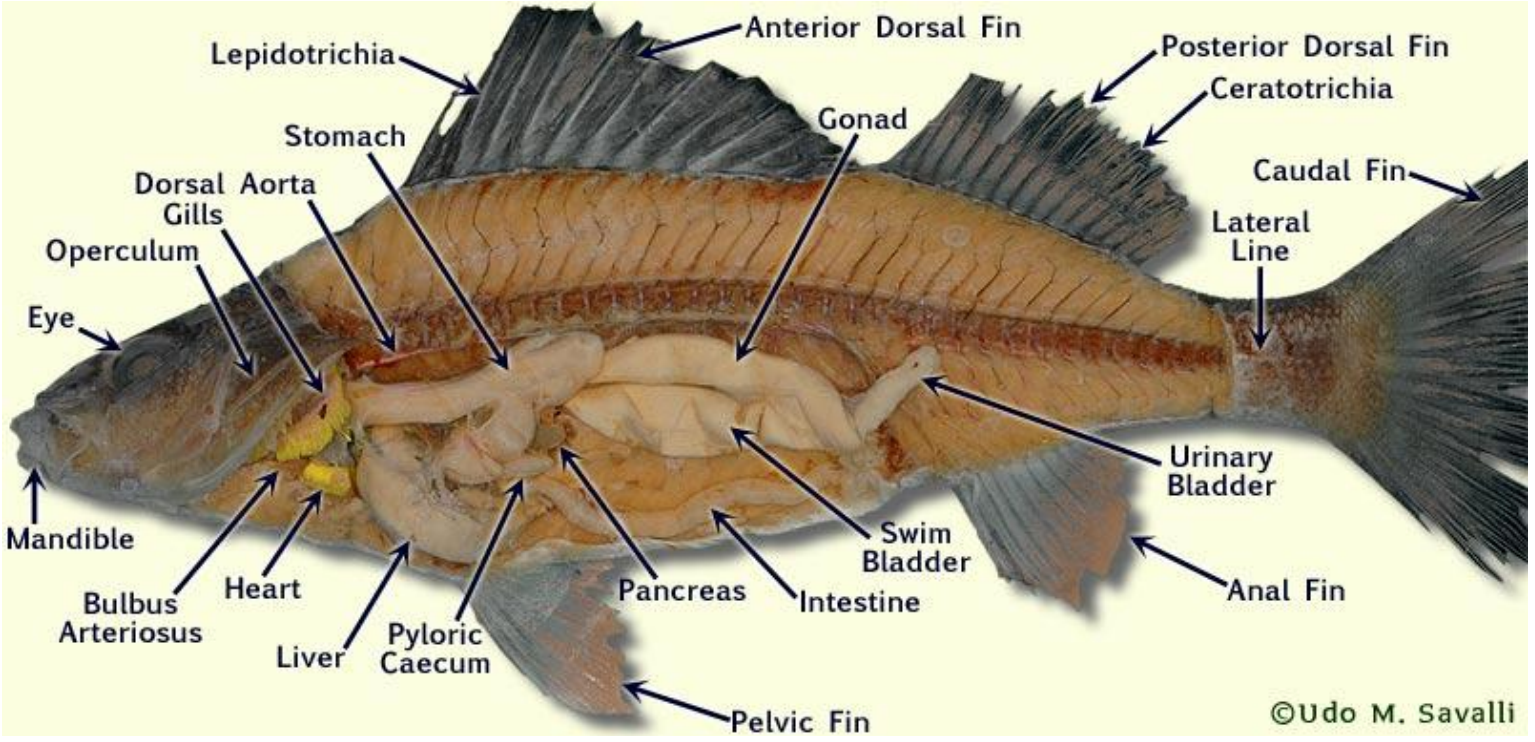
Carp – Class Actinopterygii



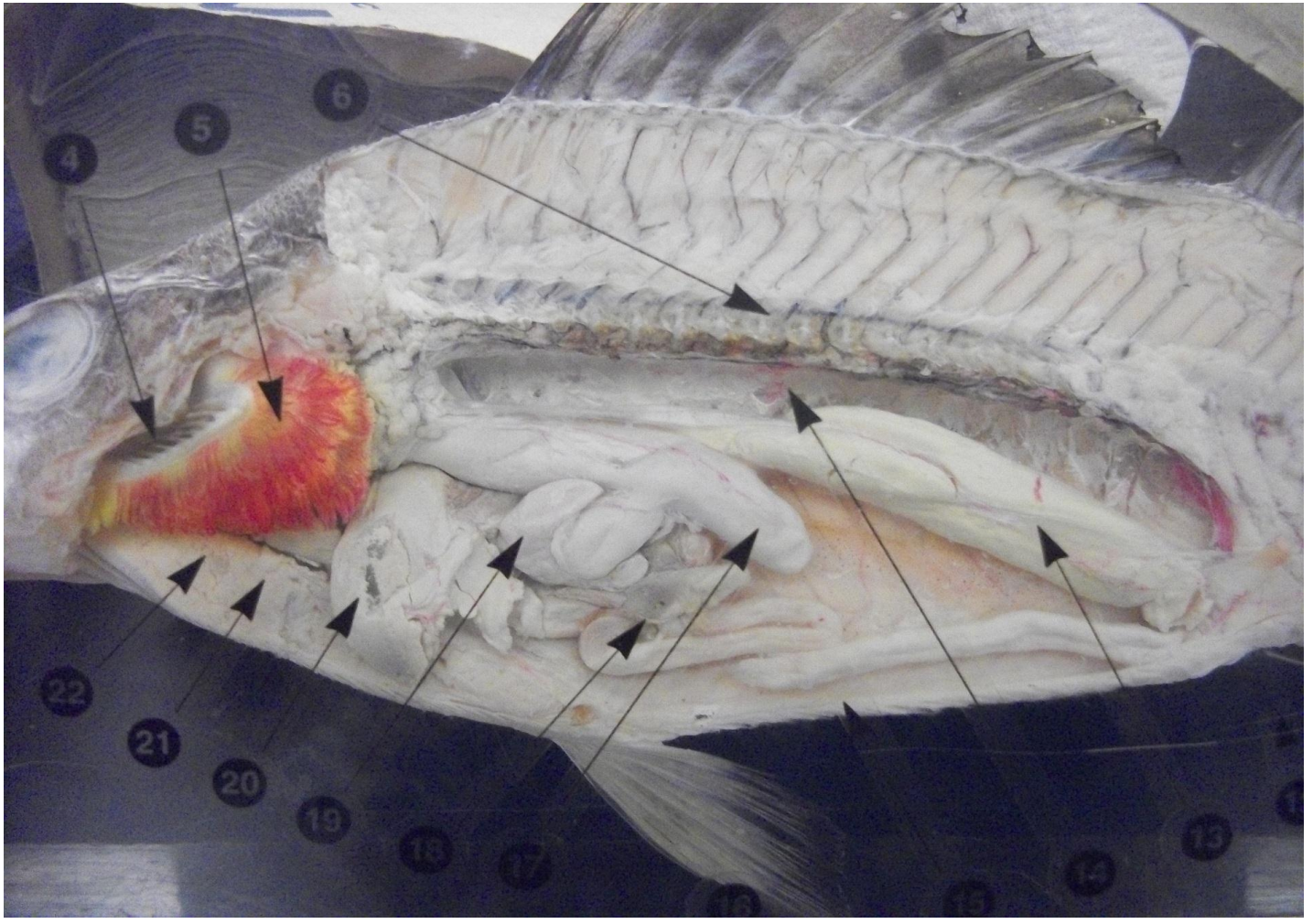
Carp – Class Actinopterygii



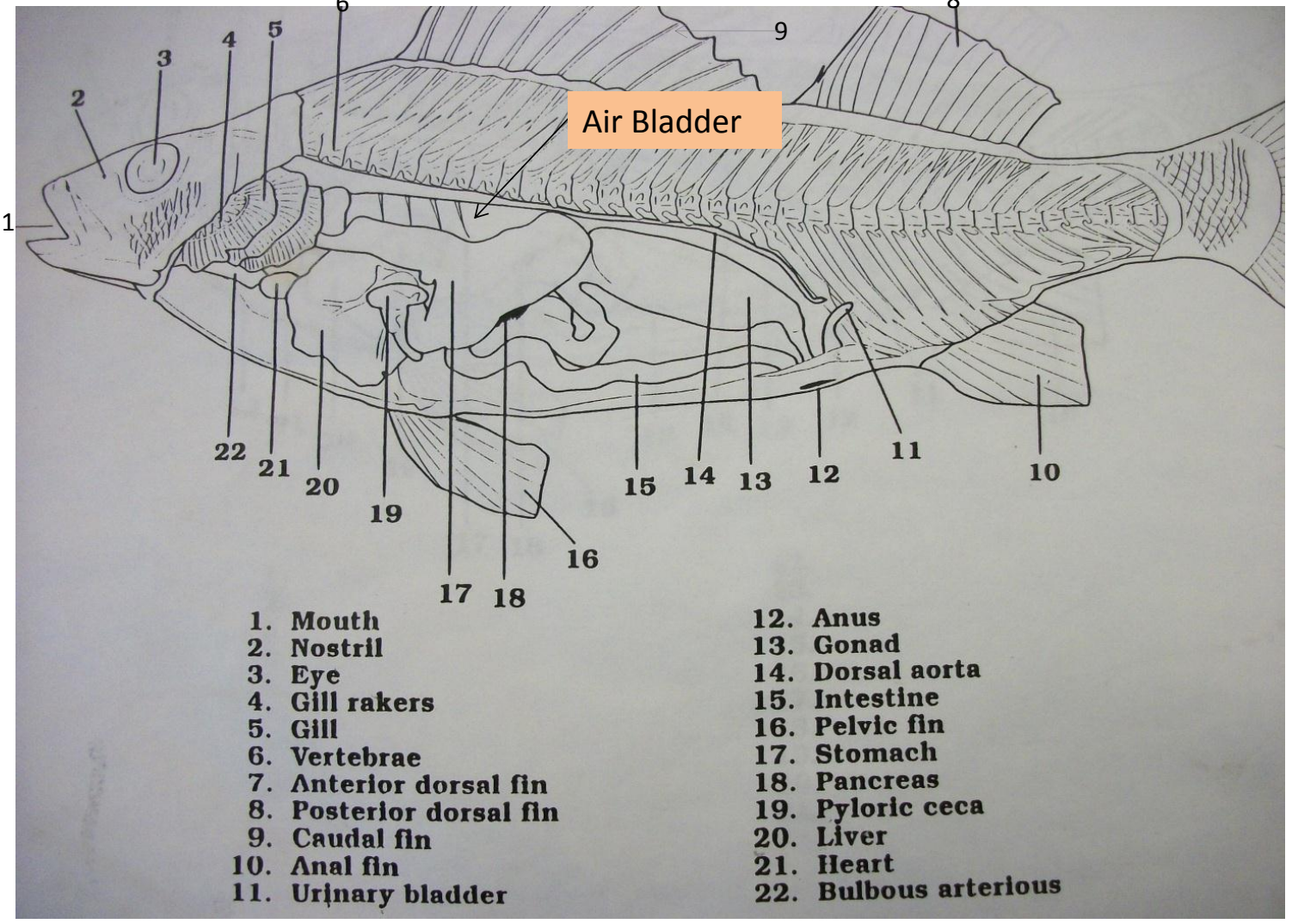
Yellow Perch – Class Actinoptrygii



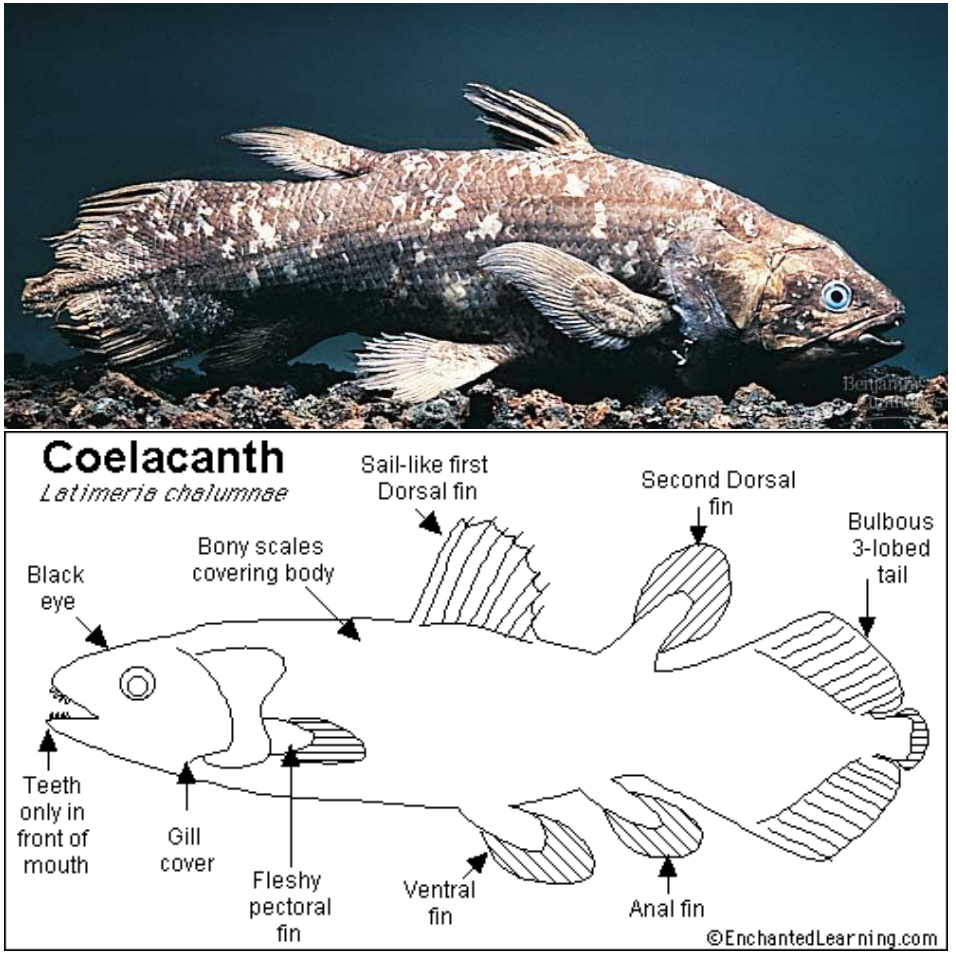
Yellow Perch – Class Actinoptrygii



Yellow Perch – Class Actinopterygii



Class Actinista



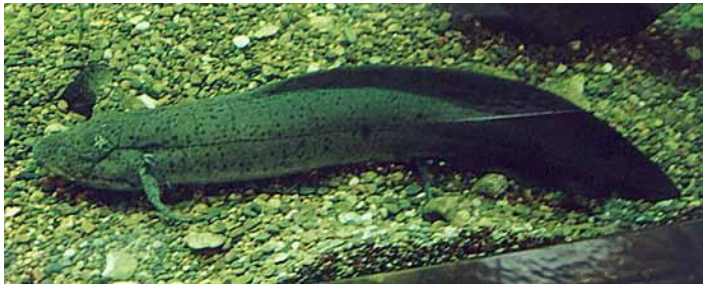
Class Actinista – Lobe finned fish
Only remaining genus is Latimeria (coelacanths)

<u>Have</u>
Muscular bony fins
Vestigial lung

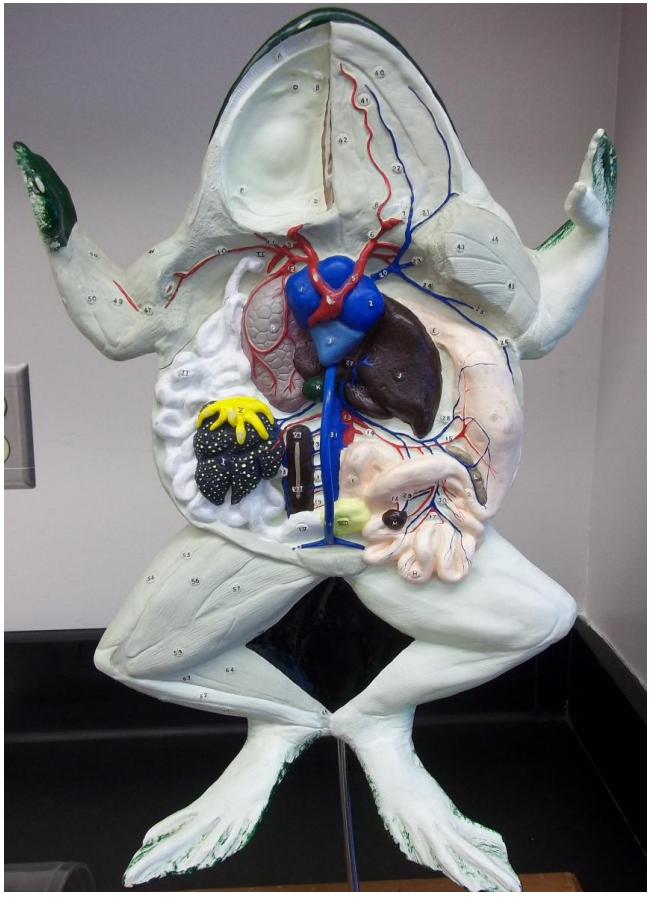
Class Dipnoi

Class Dipnoi – Lungfish

<u>Lungfish Have</u>
Functional Lungs (modified swim bladder)
Modified fins



Class Amphibia

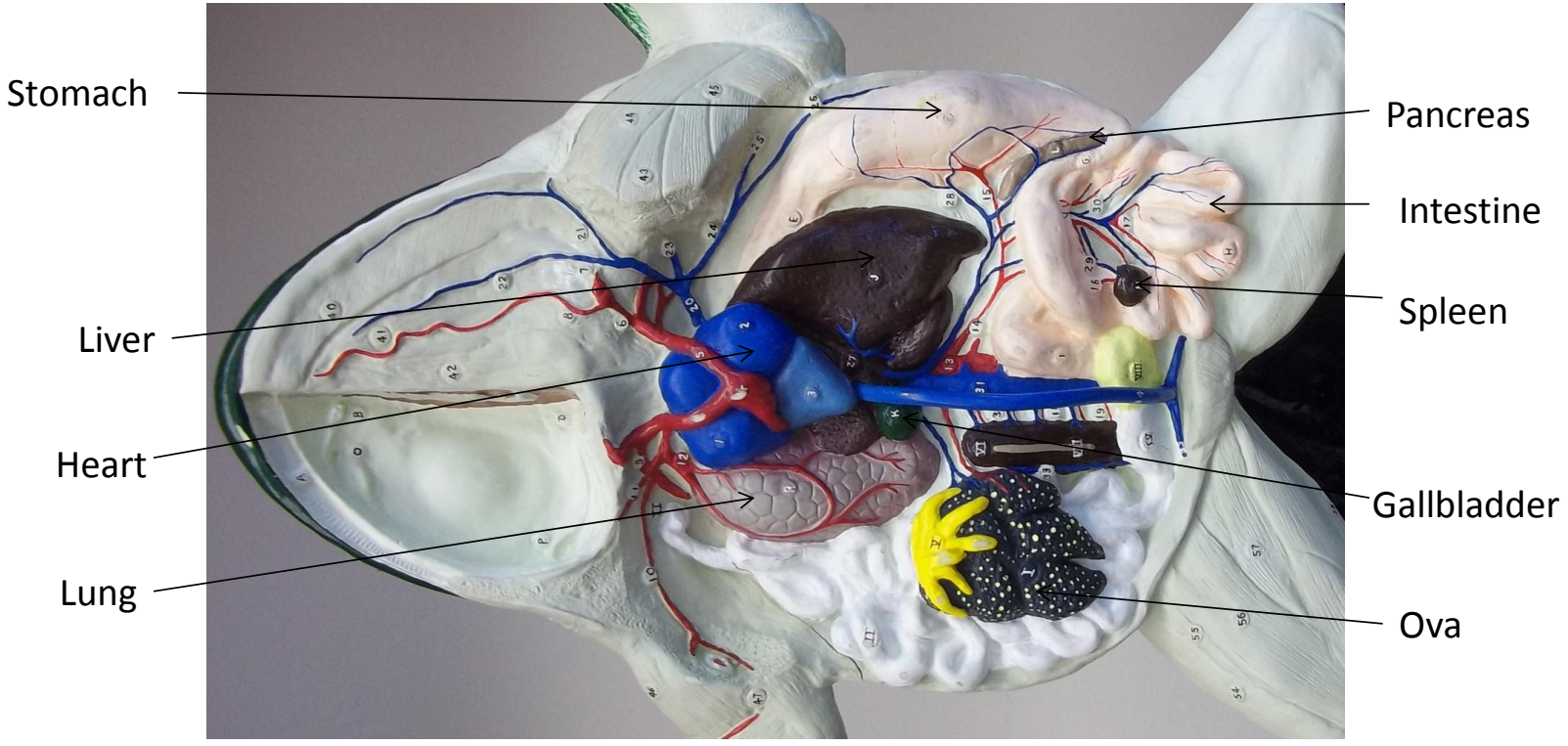


Class Amphibia - Frogs, Salamanders, Newts

<u>Amphibians Have</u>
Legs
Lungs – in adult
Gills – in tadpole
Breathe through skin
3 Chambered heart
Cold-Blooded

Figure 32.63 An American bullfrog, *Rana catesbeiana*.

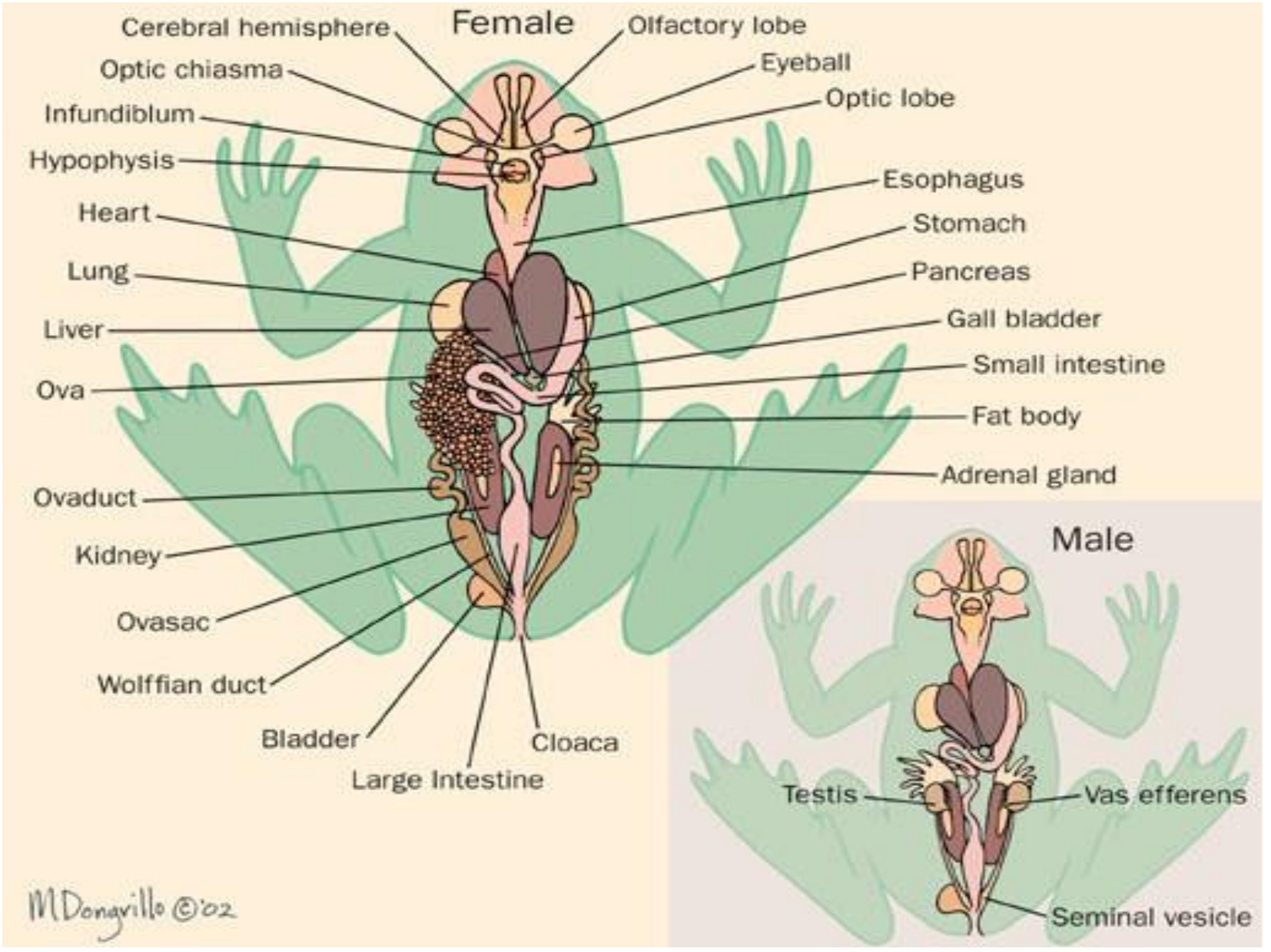
Class Amphibia



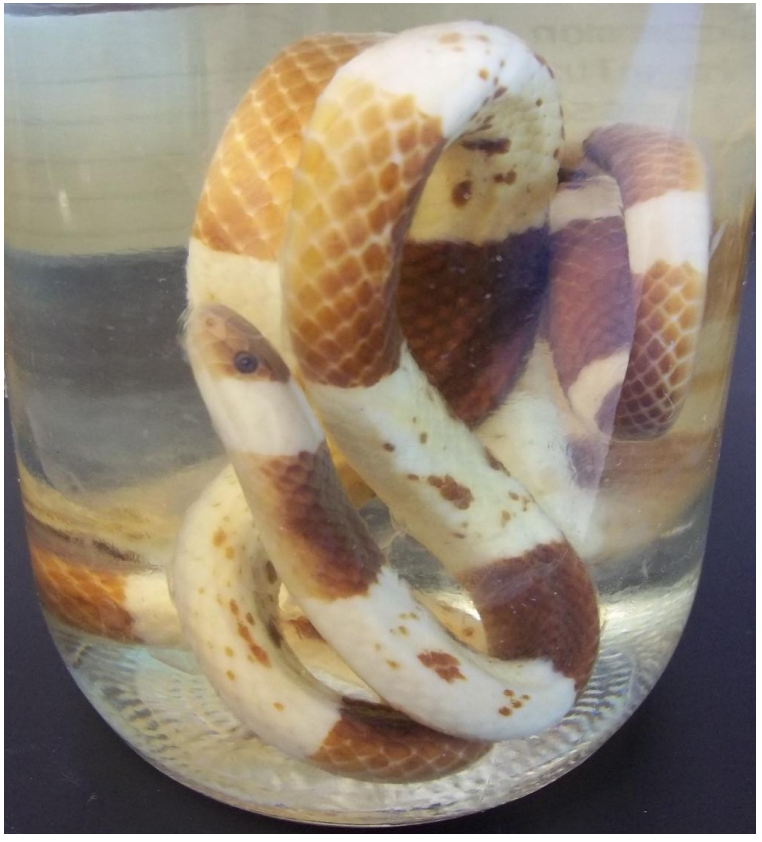
Class Amphibia

Figure 32.50 A lesser siren, *Siren intermedia*.

Figure 32.48 Representatives from the three orders of amphibians: (a) blue-webbed gliding tree frog, *Rhacophorus reinwardtii*, from the order Anura, (b) spotted salamander, *Ambystoma maculatum*, from the order Caudata, and (c) Cameroon caecilian, *Crotaphatrema bornmuelleri*, from the order Gymnophiona.


Female
Cerebral hemisphere
Optic chiasma
Infundiblum
Hypophysis
Heart
Lung
Liver
Ova
Ovaduct
Kidney
Ovasac
Wolffian duct
Bladder
Large Intestine
Cloaca
Olfactory lobe
Eyeball
Optic lobe
Esophagus
Stomach
Pancreas
Gall bladder
Small intestine
Fat body
Adrenal gland
Male
Testis
Vas efferens
Seminal vesicle
M Dongvillo ©'02

Class Reptilia



Class Reptilia – Snakes, lizards, turtles, dinosaurs (extinct), *birds*

<u>Reptiles have</u>
Scales
3 chambered heart with partial septum (complete in crocodilians and birds)
Cold-blooded (except for birds)

Class Reptilia

Figure 32.80 Members of the class Reptilia: (a) a star tortoise, *Geochelone elegans*, (b) a green basilisk, *Basiliscus plumifrons*, (c) kingsnake, *Lampropeltis getulus*, (d) a tuatara, *Sphenodon punctatus*, and (e) American alligator, *Alligator mississippiensis*.

Class Reptilia

Subclass Aves

Sub-Class Aves – Birds, are part of reptilia, but are distinct from other reptiles

<u>Birds Have</u>
Feathers (modified scales)
4 Chambered Heart
Warm Blooded
Hollow Bones

Subclass Aves

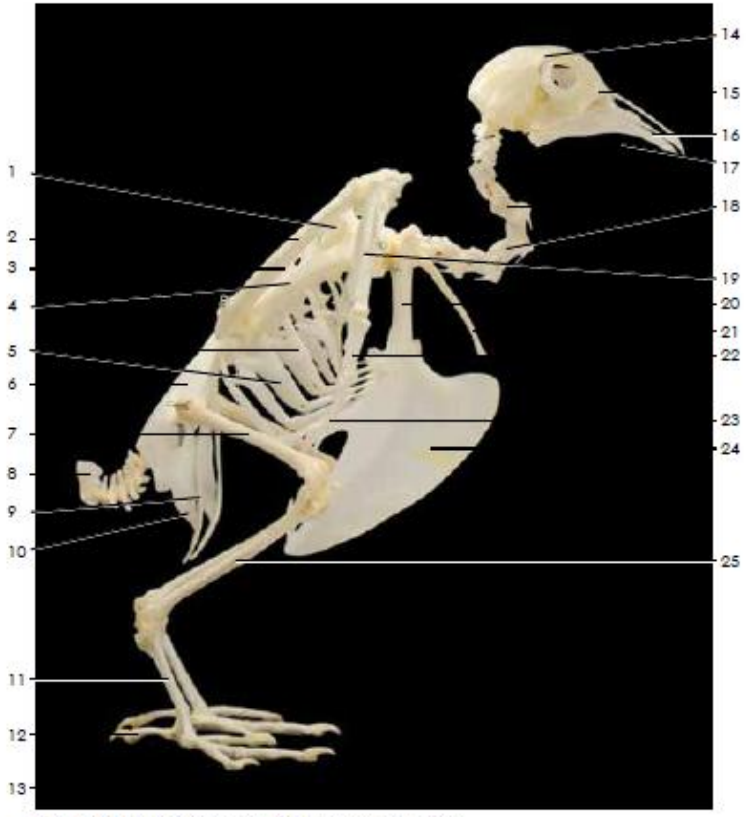


Figure 32.96 The skeleton of a pigeon, *Columba*.

1. Scapula
2. Ulna
3. Radius (behind ulna)
4. Humerus
5. Ribs
6. Ilium
7. Femur
8. Pygostyle
9. Pubis
10. Ischium
11. Tarsometatarsal bone
12. Digit 1
13. Phalanges
14. Cranium
15. Sclerotic bone
16. Premaxilla
17. Dentary
18. Cervical vertebrae
19. Carpometacarpal bones
20. Coracoid bone
21. Furcula
22. Phalanges
23. Phalanx of third digit
24. Keel of sternum
25. Tibiotarsal bone

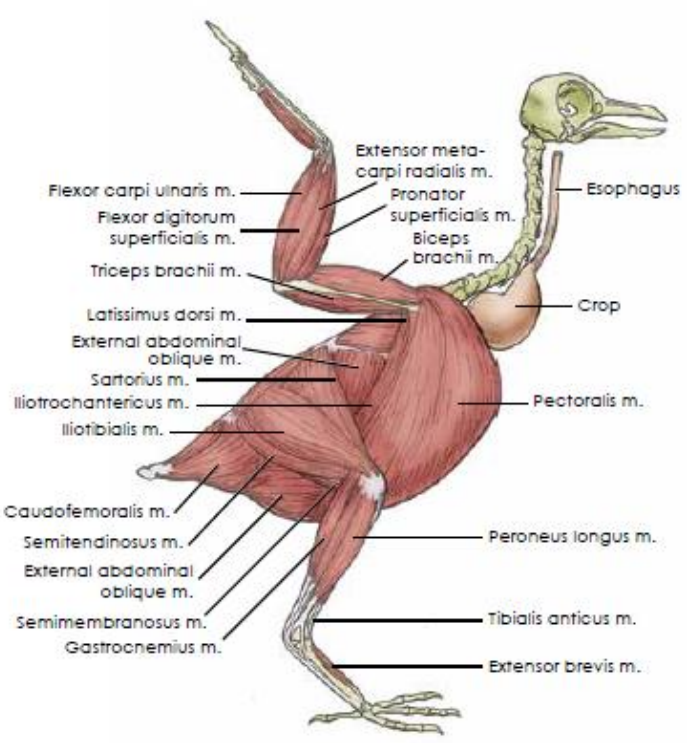


Figure 32.97 The superficial muscles of a pigeon. (m. = muscle)

Subclass Aves

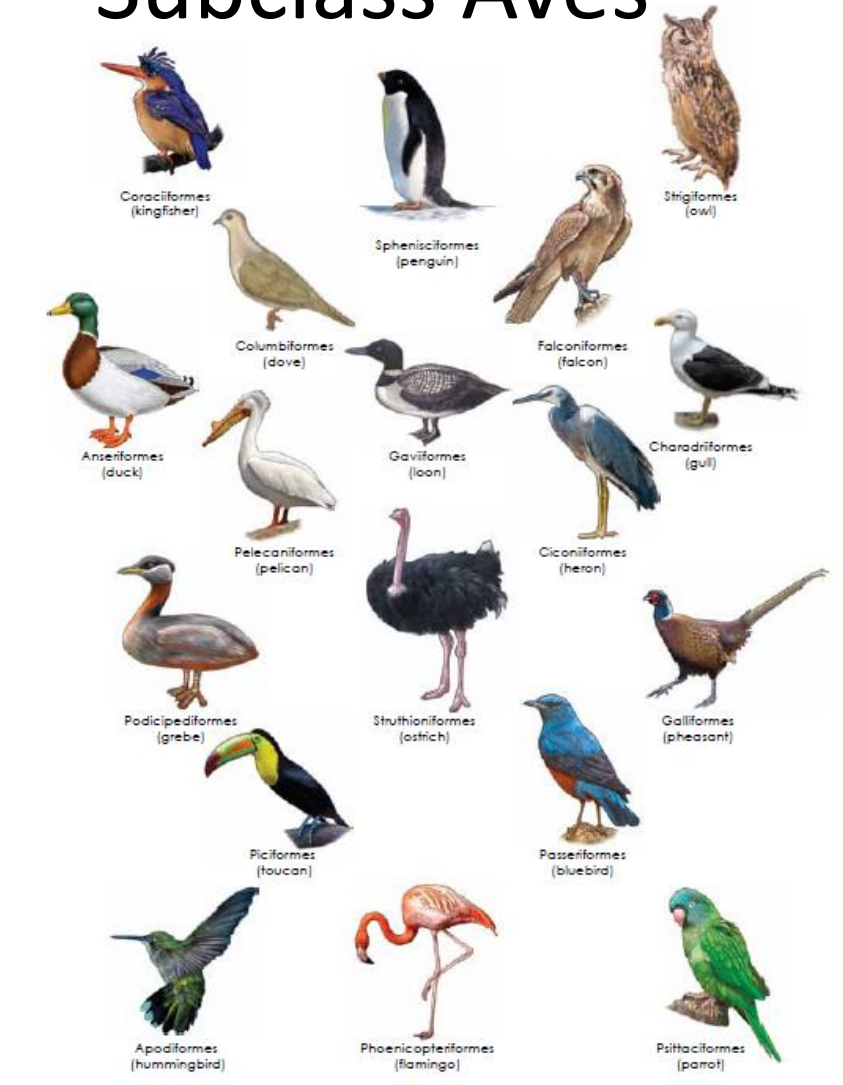
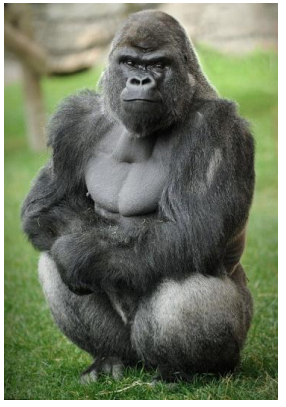


Figure 32.100 Representative bird orders.

Class Mammalia

Class Mammalia - Canines, Primates, Humans, Rhinos, etc.

<u>Mammals Have</u>
Hair
4 chambered heart
Milk
Warm-Blooded



Class Mammalia

Figure 32.101 Examples of mammals: (a) echidna, *Tachyglossus aculeatus*, (b) Eastern grey kangaroo, *Macropus giganteus*, (c) bottlenose dolphin, *Tursiops truncatus*, (d) lion, *Panthera leo*, (e) meerkat, *Suricata suricatta*, and (f) gorilla, *Gorilla gorilla gorilla*.

Class Mammalia

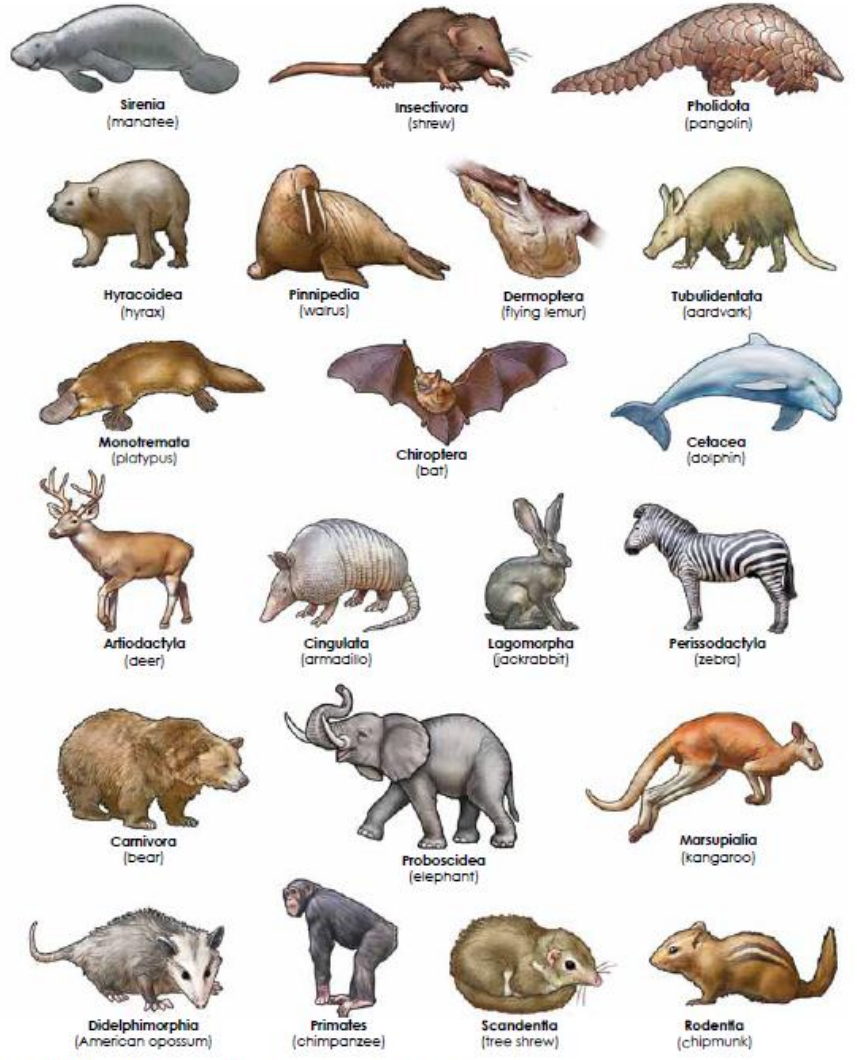


Figure 32.102 Representatives from some of the orders of mammals.

Class Mammalia

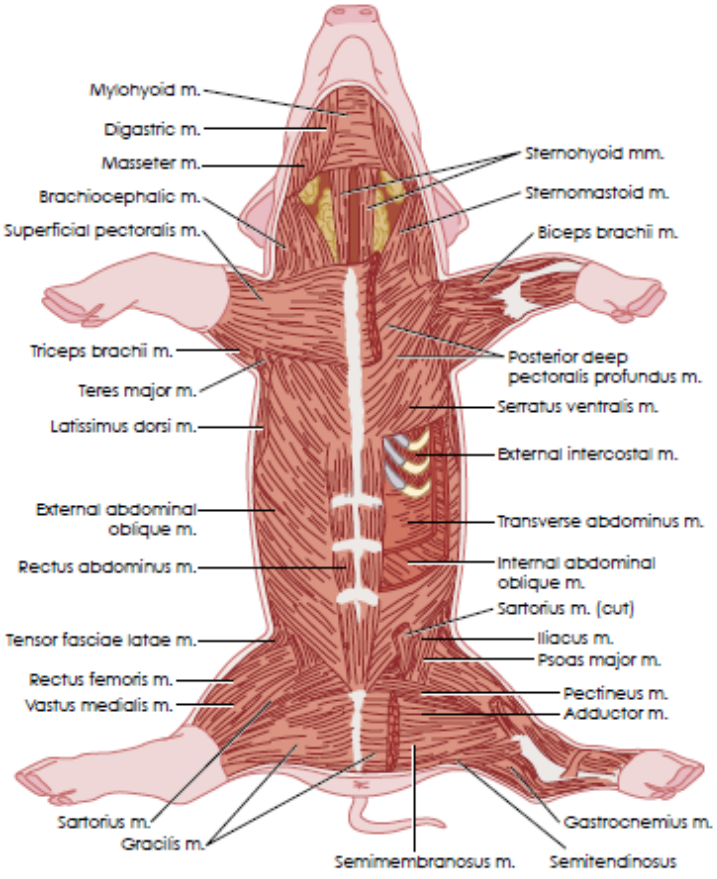


Figure 32.106 A ventral view of the muscles of the fetal pig.

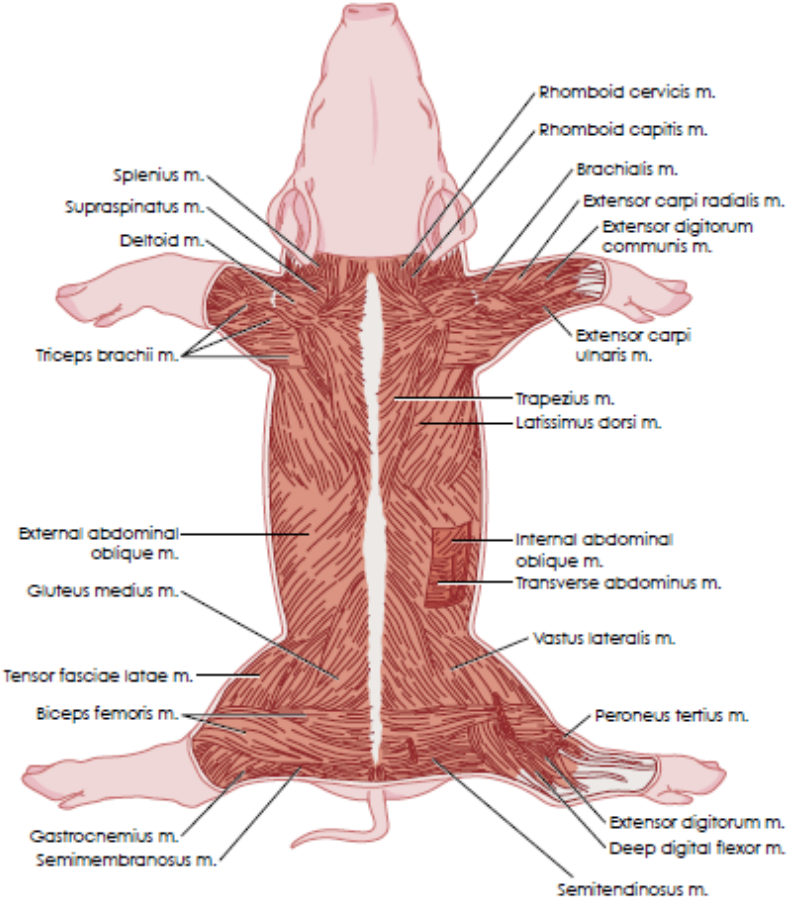
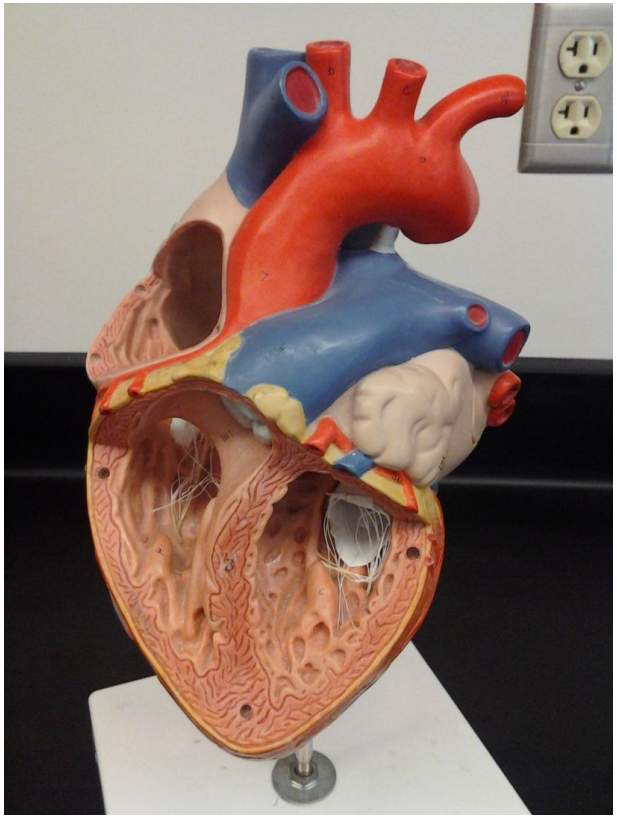


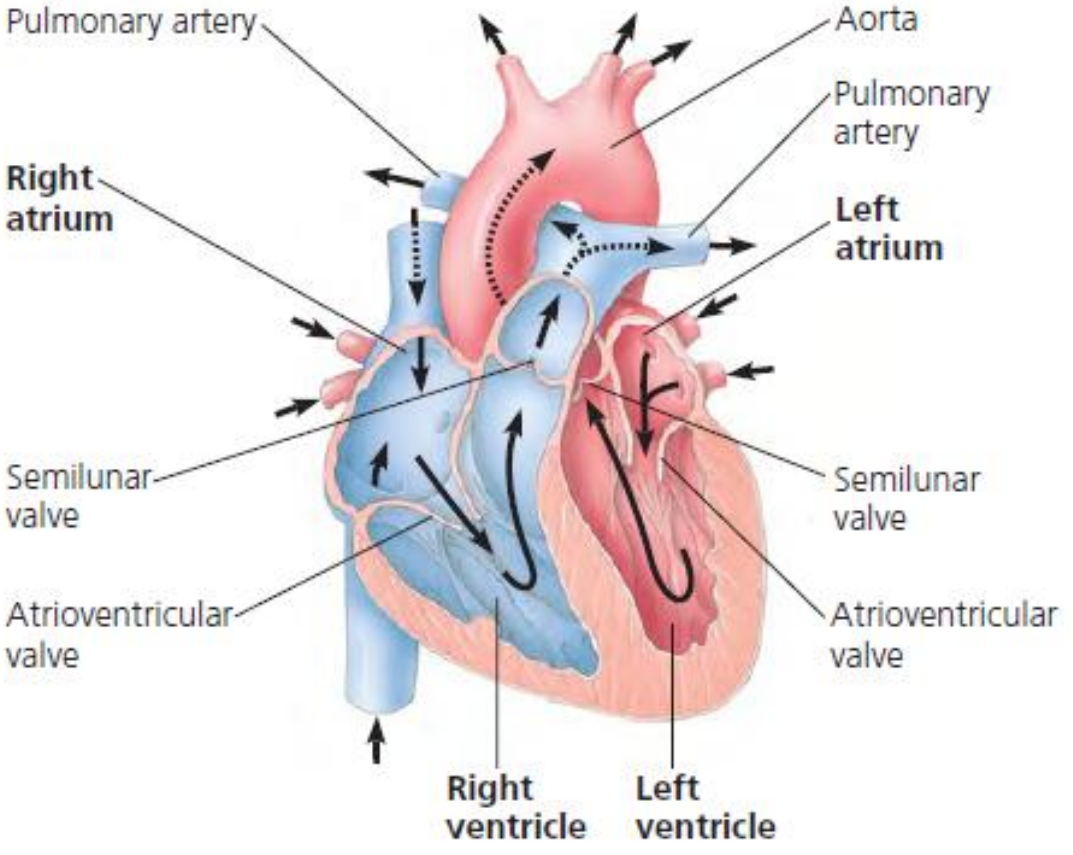
Figure 32.107 A dorsal view of the muscles of the fetal pig.

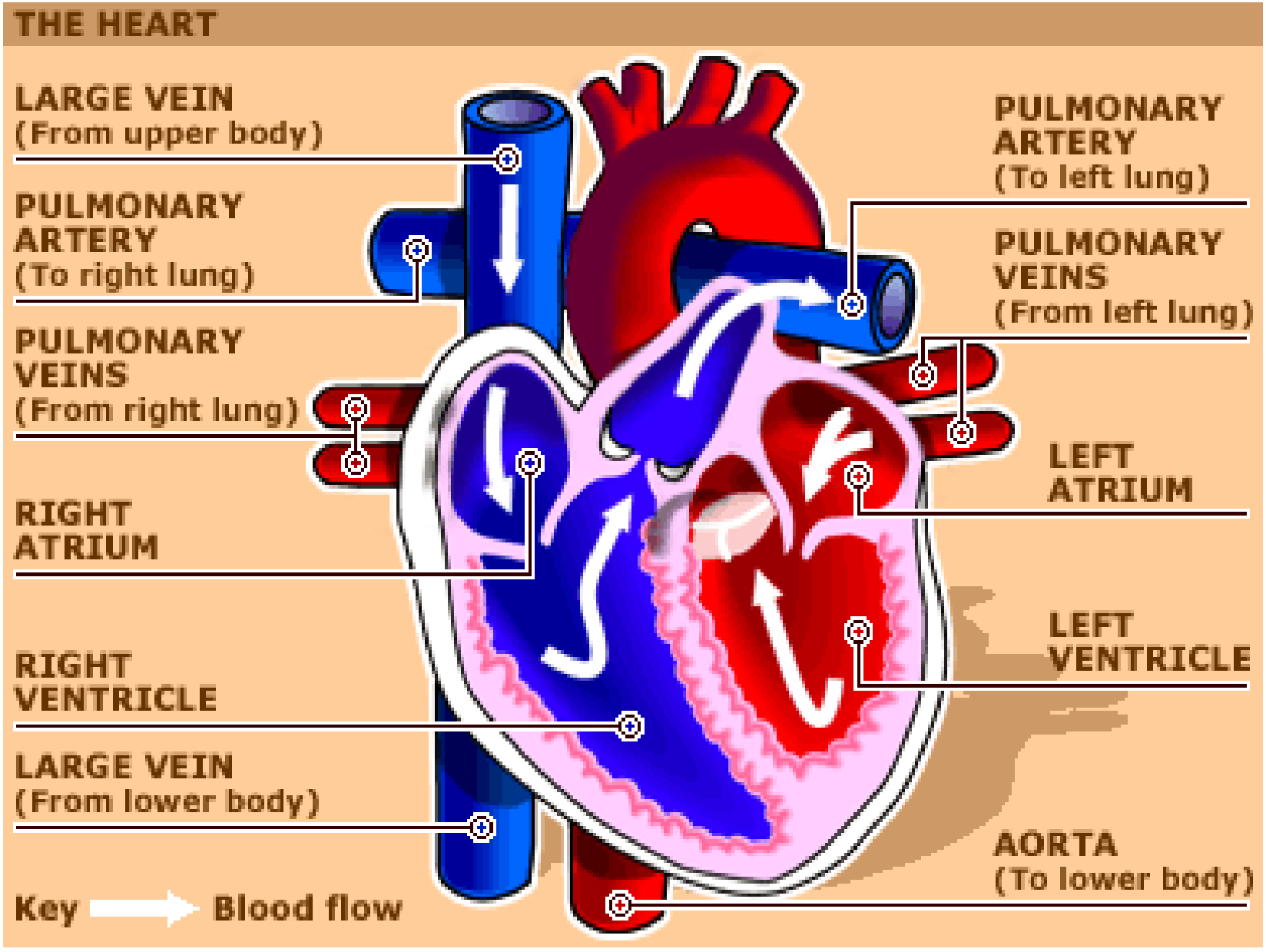
Circulation – The Heart

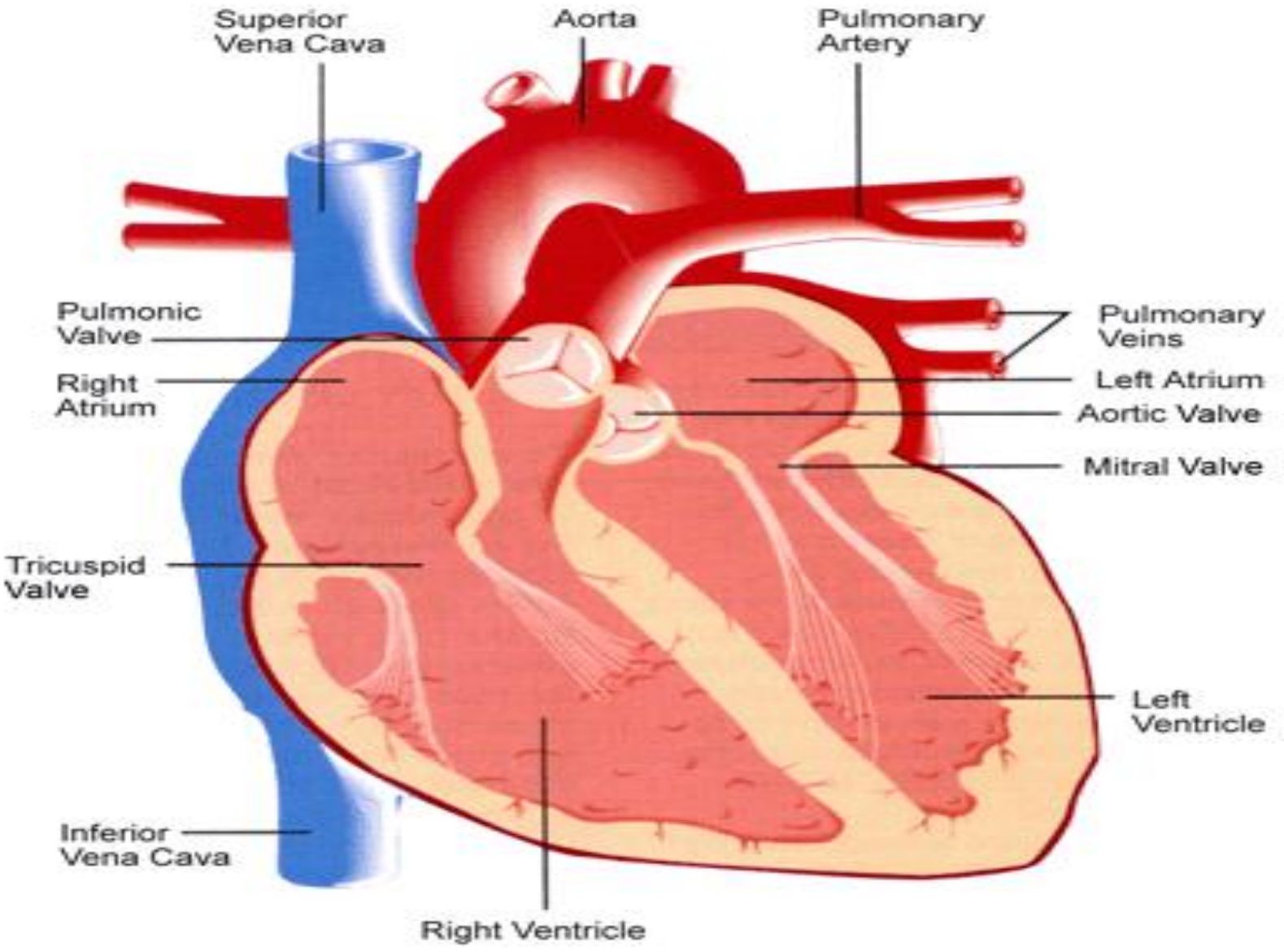


<u>The Mammalian Heart</u>
Four Chambers – Right and left Atrium and right and left ventricles
Two Atrioventricular Valves – Tricuspid and Bicuspid
Two Semilunar Valves – Aortic and Pulmonary

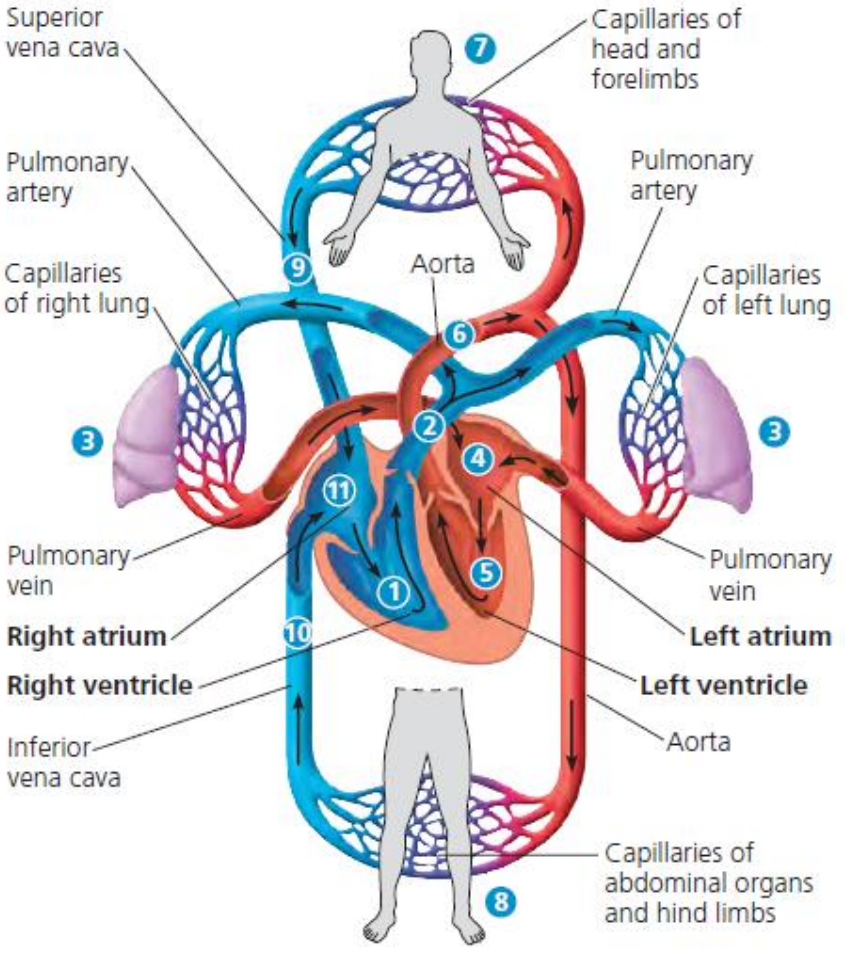
Circulation



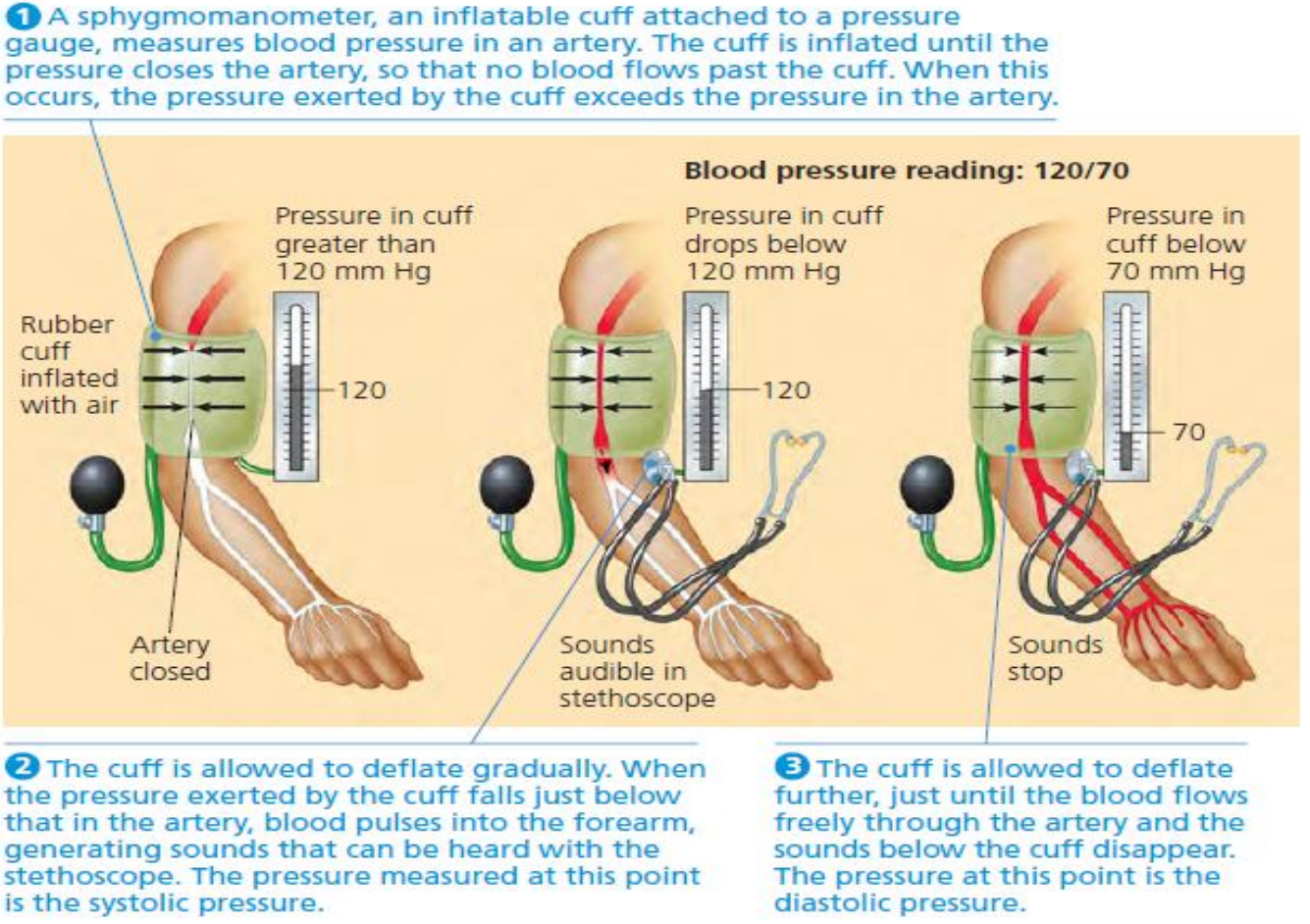

THE HEART
LARGE VEIN
(From upper body)
PULMONARY
ARTERY
(To right lung)
PULMONARY
VEINS
(From right lung)
RIGHT
ATRIUM
RIGHT
VENTRICLE
LARGE VEIN
(From lower body)
Key
Blood flow
PULMONARY
ARTERY
(To left lung)
PULMONARY
VEINS
(From left lung)
LEFT
ATRIUM
LEFT
VENTRICLE
AORTA
(To lower body)


Superior Vena Cava
Aorta
Pulmonary Artery
Pulmonic Valve
Right Atrium
Pulmonary Veins
Left Atrium
Aortic Valve
Mitral Valve
Tricuspid Valve
Left Ventricle
Inferior Vena Cava
Right Ventricle

Circulation



Blood Pressure

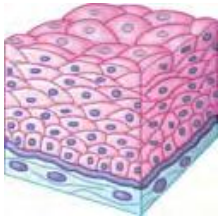


Tissue Types

- Epithelial Tissue
  - Covers the outside of the body and lines organs and body cavities
  - Squamous, Cuboidal, Columnar
  - Simple, Stratified, Pseudostratified
- Connective Tissue
  - Sparse population of cells scattered through extracellular matrix
  - Bone, Blood, Cartilage, Fibrous, Loose, Adipose,
- Muscle Tissue
  - Contracts
  - Skeletal, Smooth, Cardiac
- Nervous Tissue
  - Receive, process and transfer information
  - Neurons, Glia

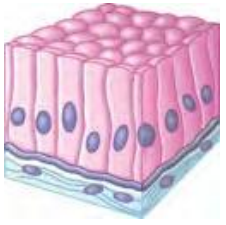
Epithelial Tissue

Stratified Squamous – multilayered, regenerates rapidly, found in harsh environments in/on the body

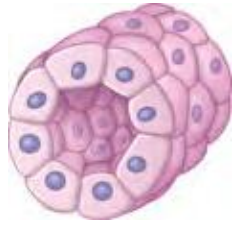


Simple Squamous – single layer of flat cells, found in capillaries

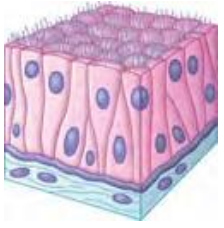
Simple Columnar – single layer of tall column-like cells, found in intestines



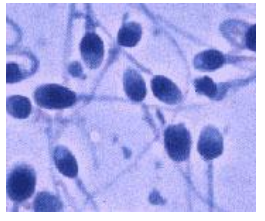
Simple Cuboidal – single layer of cube-shaped cells, found in kidneys and glands



Pseudostratified Columnar – squished and abnormally shaped columnar cells, usually ciliated, found in upper respiratory tract

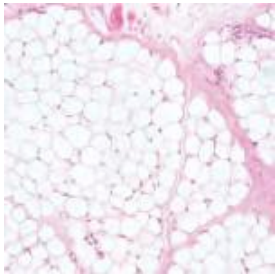


Reproductive Cells – sperm and egg cells are haploid gametes

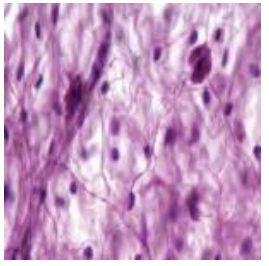


Connective Tissue

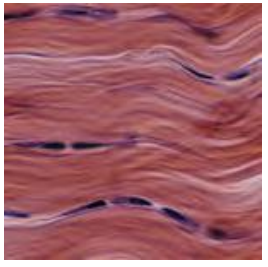
Adipose – Cells contain a large fat droplet, used for energy storage



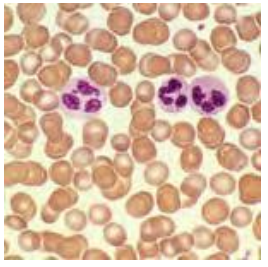
Loose/Areolar - binds epithelia and organs in place, has loosely connected fibers



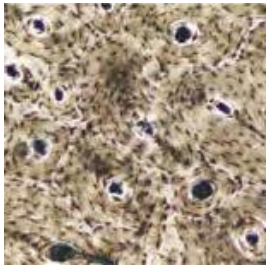
Fibrous – dense with collagenous fibers, found in tendons and ligaments



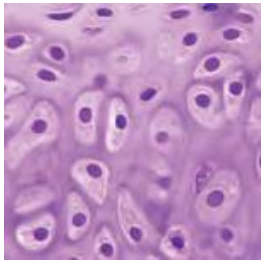
Blood – made up of plasma, erythrocytes, leukocytes and platelets, carries nutrients and wastes



Bone – Osteocytes, osteoblasts, and osteoclasts suspended in an extracellular matrix of hard calcium

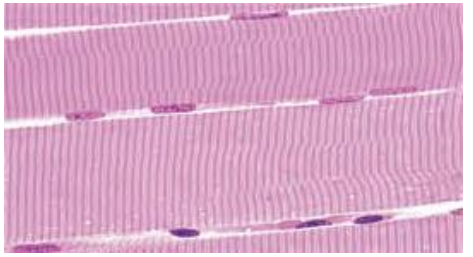


Cartilage – chondrocytes secrete a rubbery matrix of collagen and chondroitin sulfate, found in joints

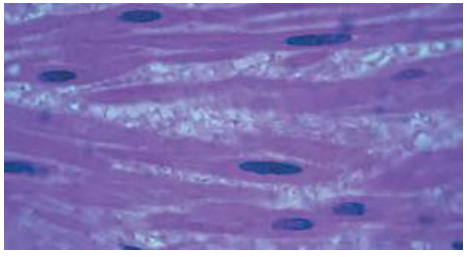


Muscle Tissue

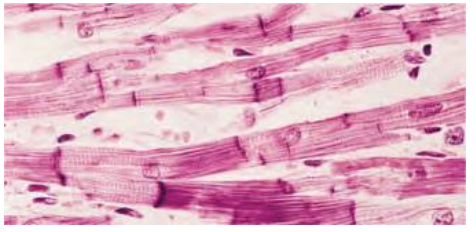
Skeletal Muscle – Bundles of long, un-branched, striated cells, responsible for voluntary movement, made up of sarcomeres



Smooth Muscle – non-striated and spindle shaped, responsible for involuntary activity of things like the stomach and constriction/dilation of arteries



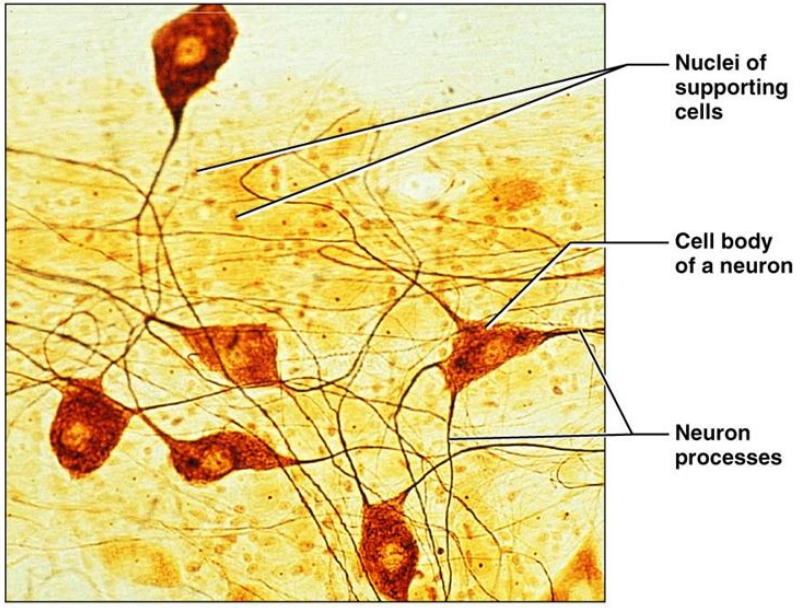
Cardiac Muscle – branched and striated, has intercalated disks to help transfer of electrical signals, found only in the heart, responsible for contraction of the walls of the heart



Nervous Tissue

Neurons – Receive and transmit signal throughout the body via the nervous system. Have dendrites for receiving impulses from other nerve cells and axons for sending out impulses to other cells

Glia – cells that support, nourish, and insulate the neurons



Photomicrograph: Neurons (100×)

DAYTONA STATE COLLEGE

Questions

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