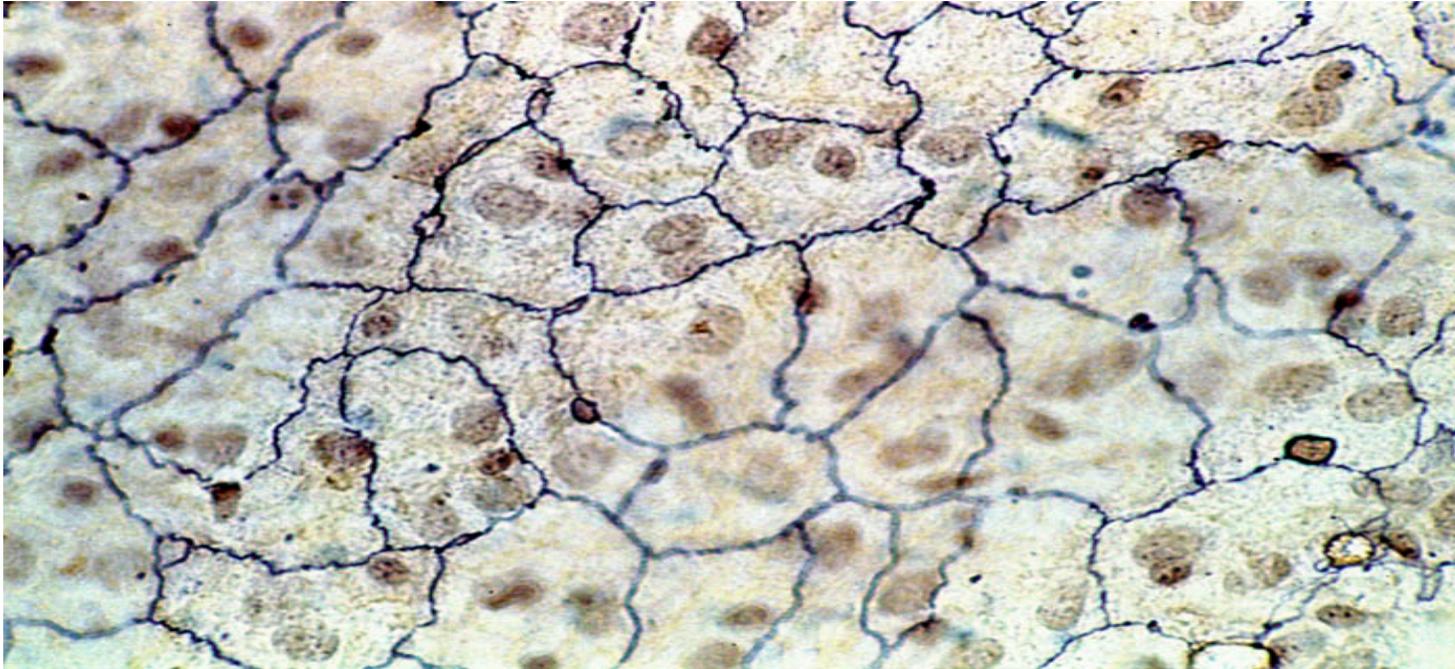


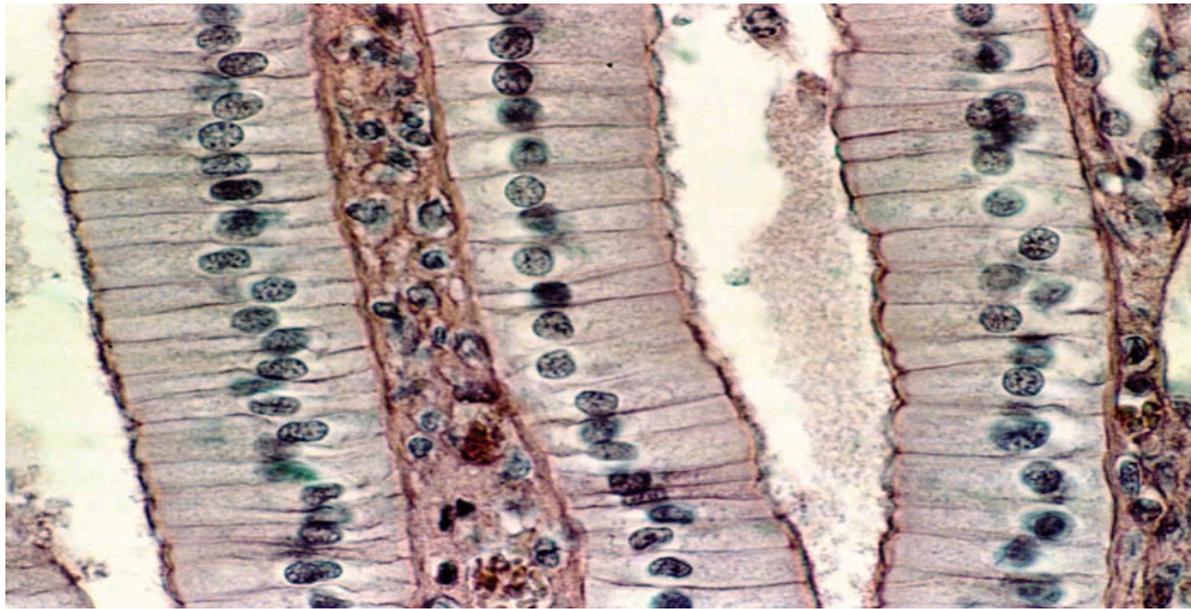
Simple Squamous



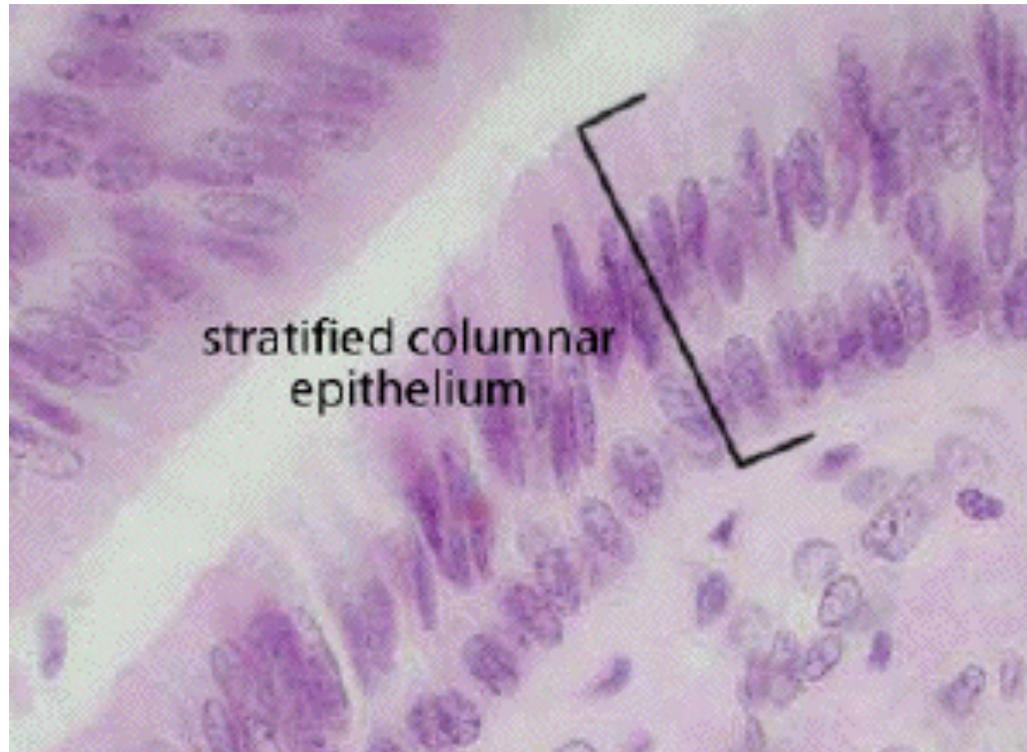
Simple Cuboidal



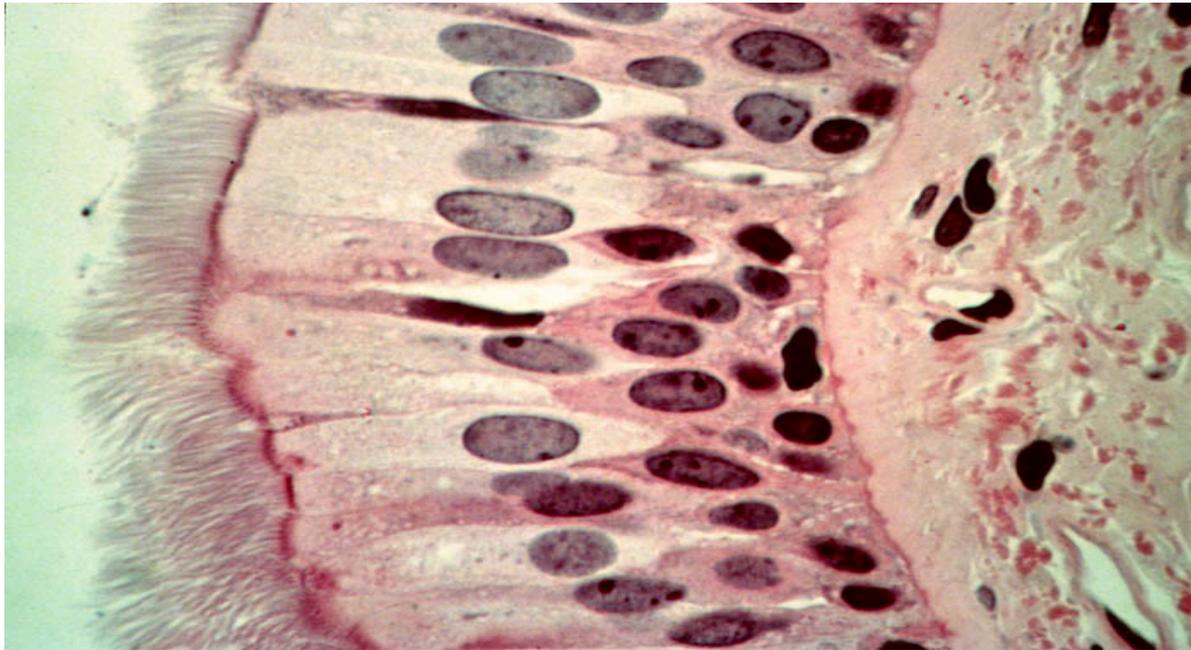
Simple Columnar



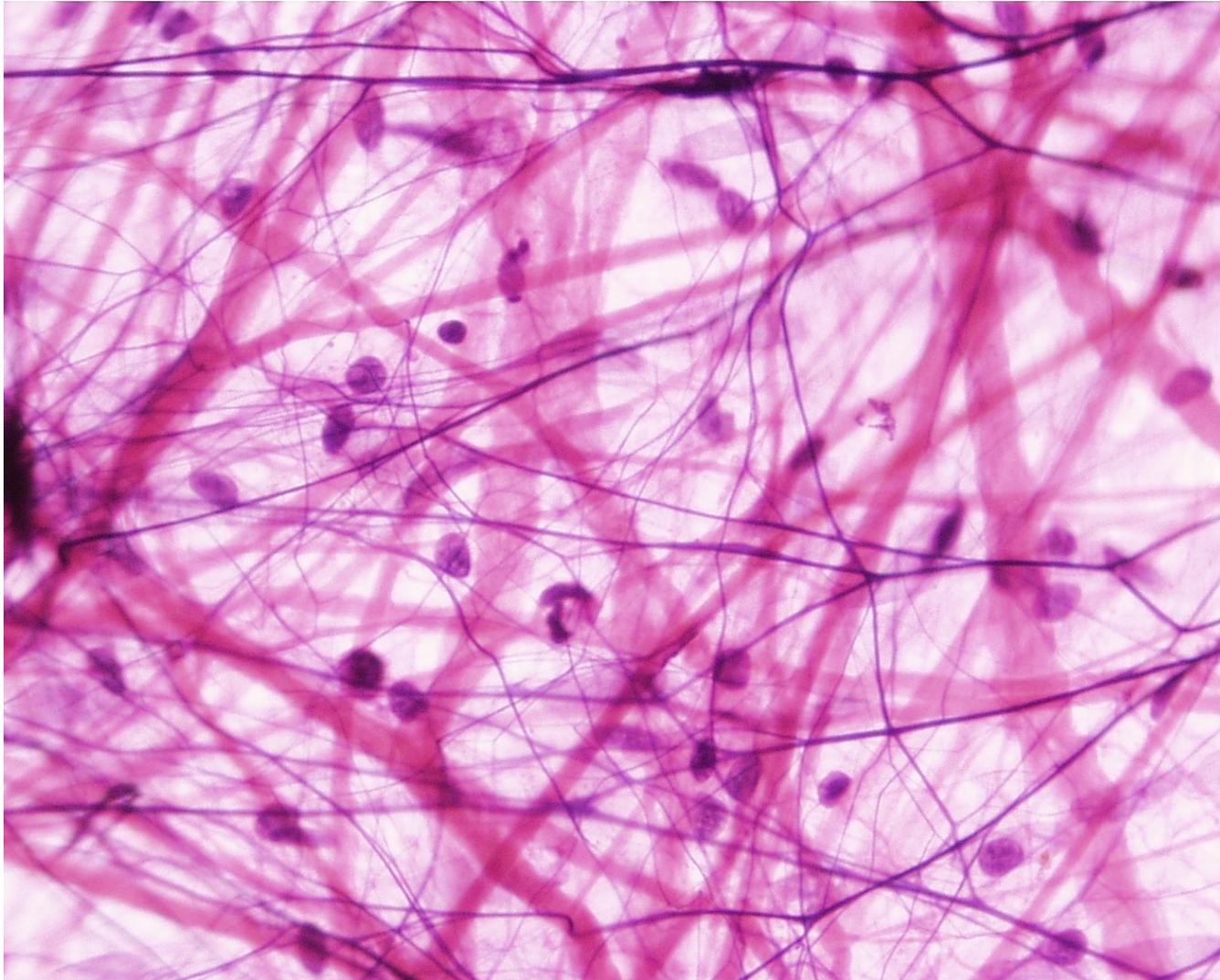
Stratified Columnar



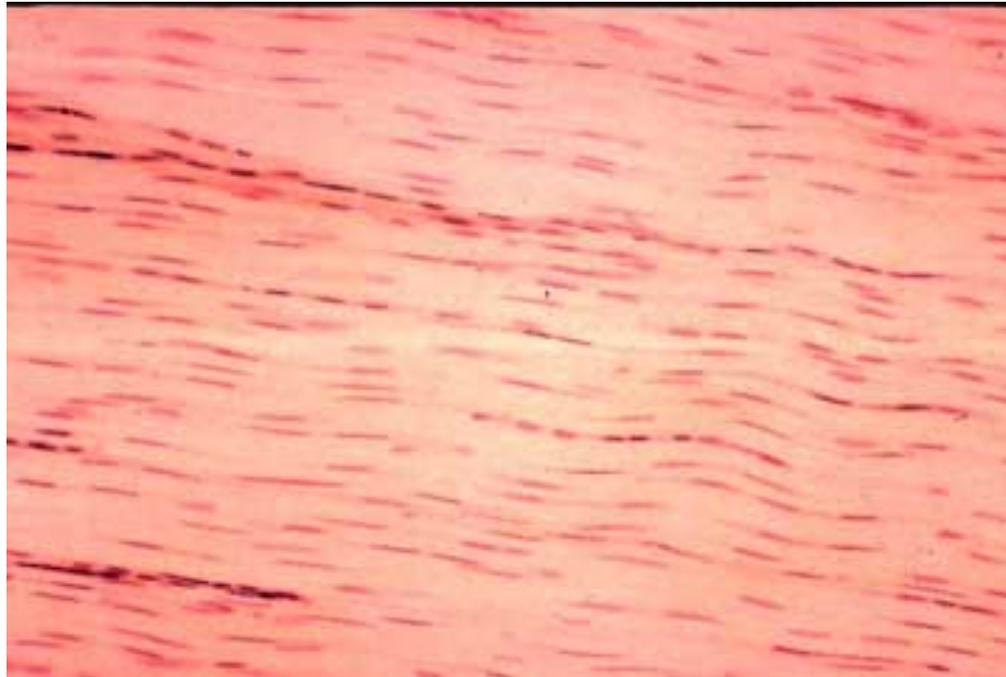
Pseudostratified Columnar



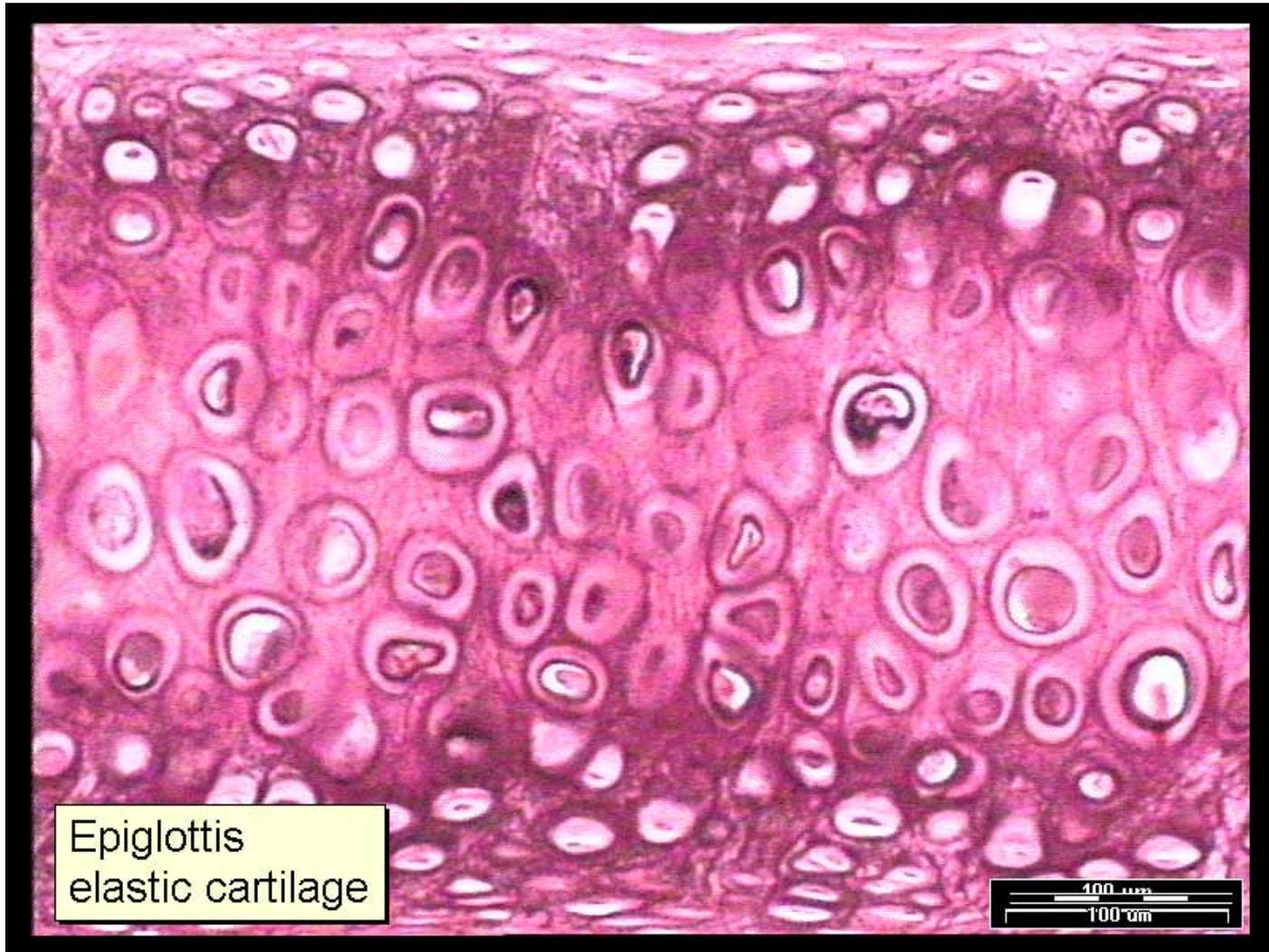
Loose Connective Tissue



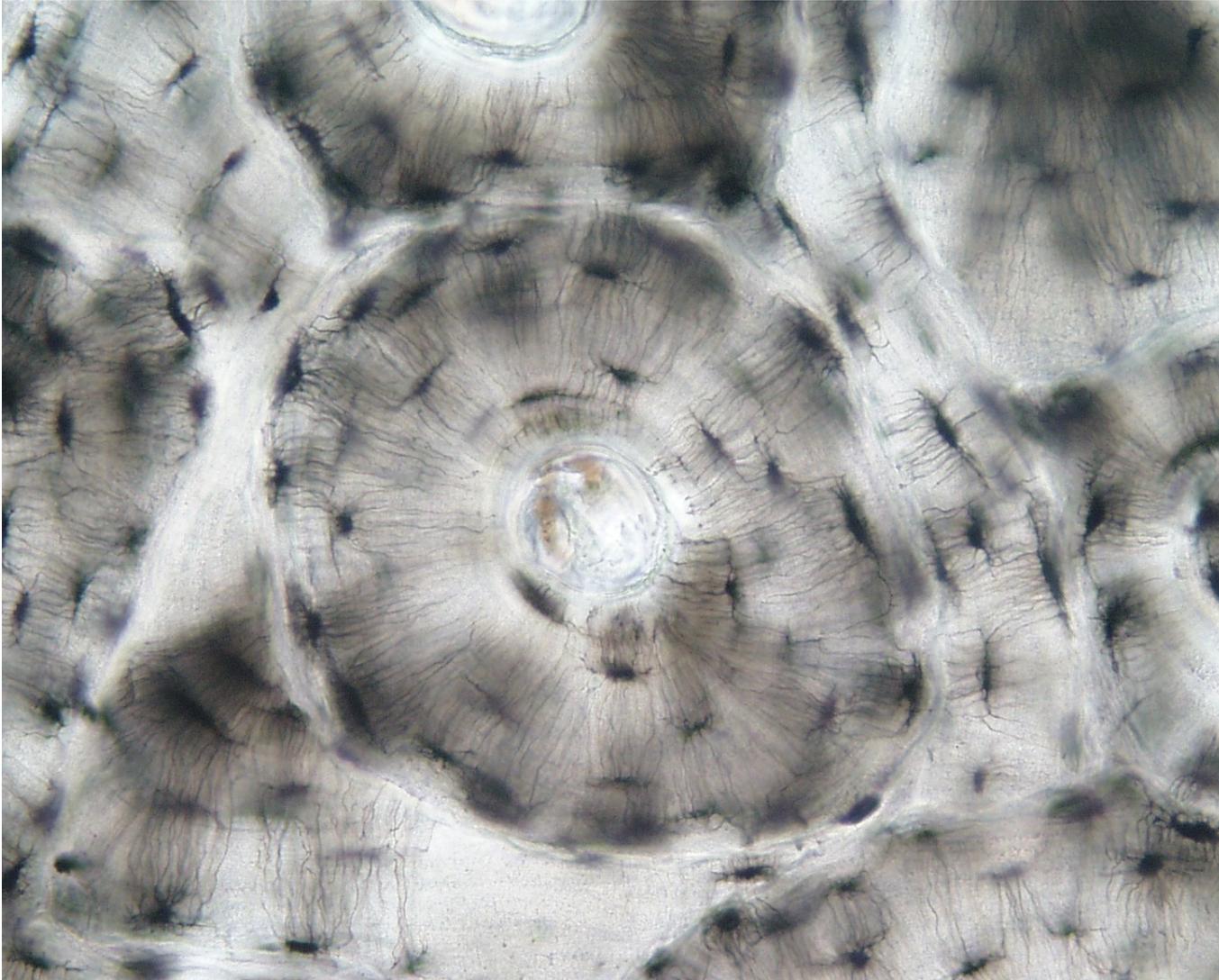
Fibrous Connective Tissue



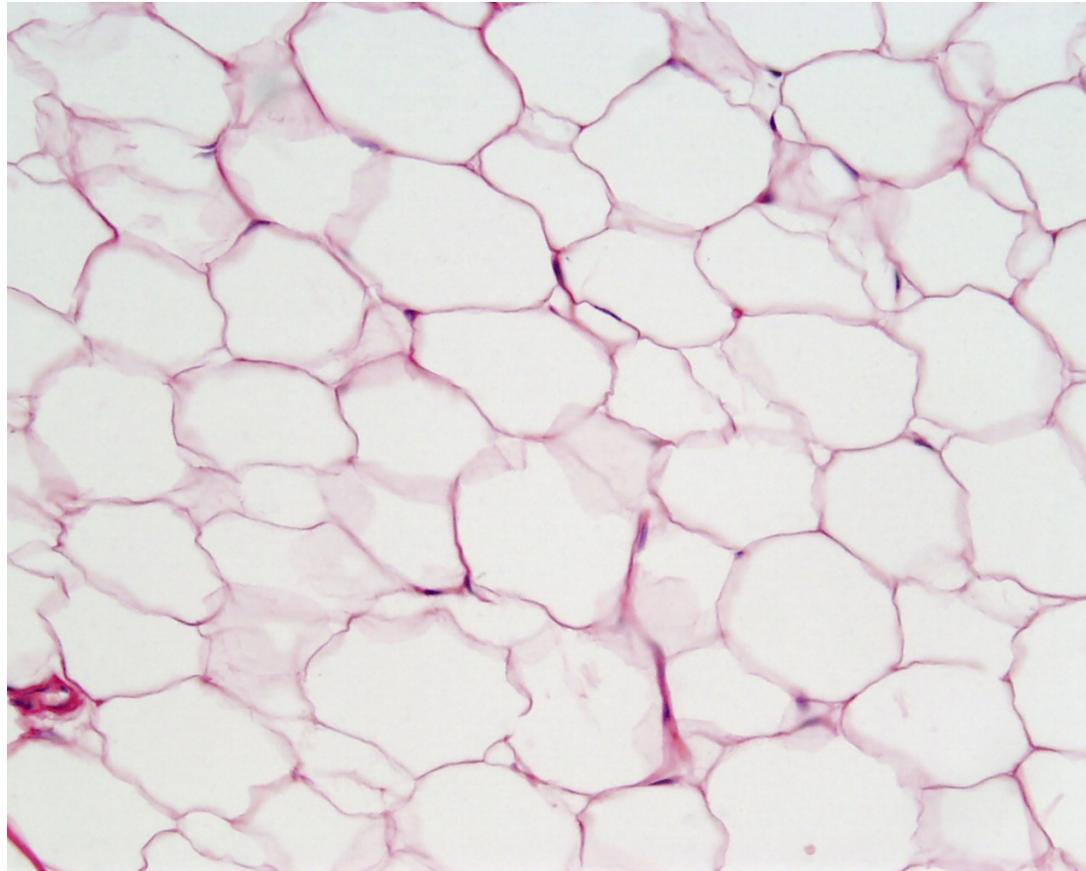
Cartilage



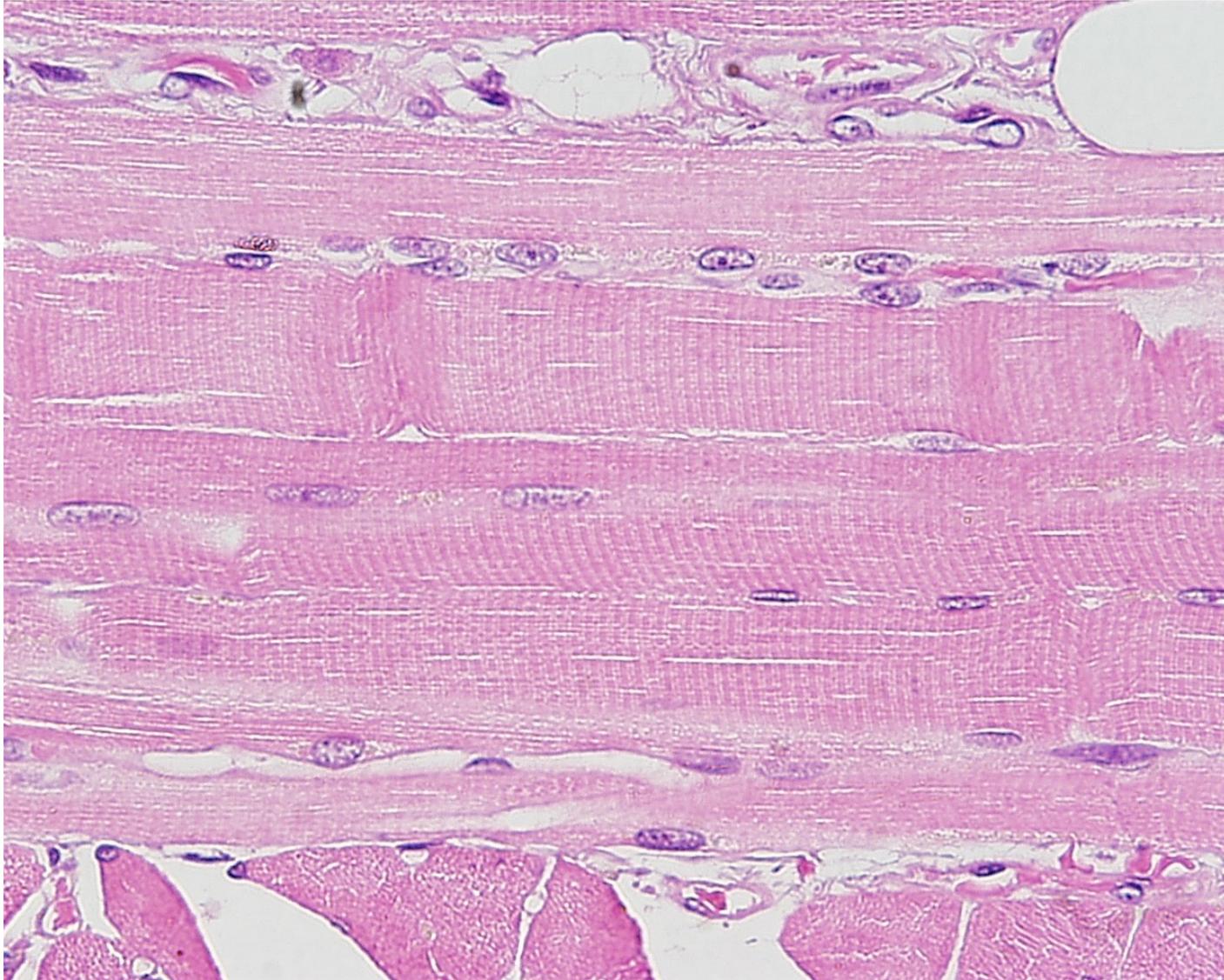
Bone



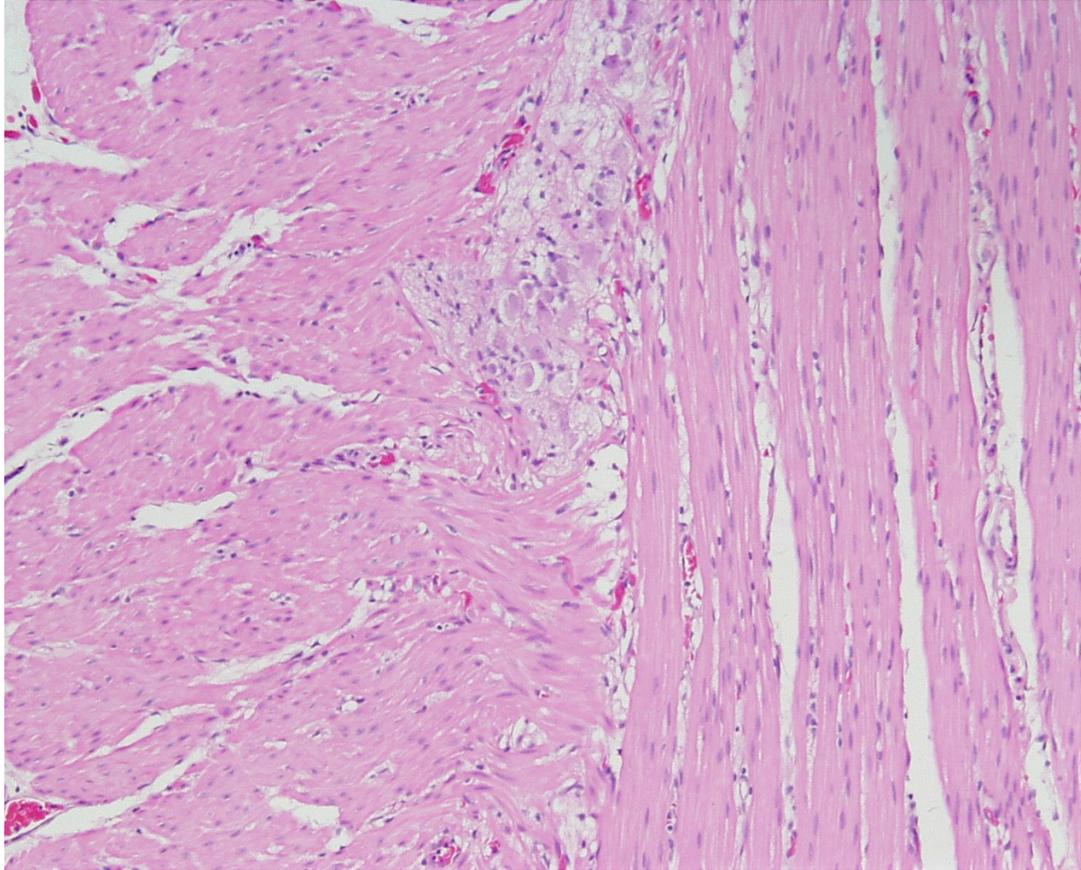
Adipose



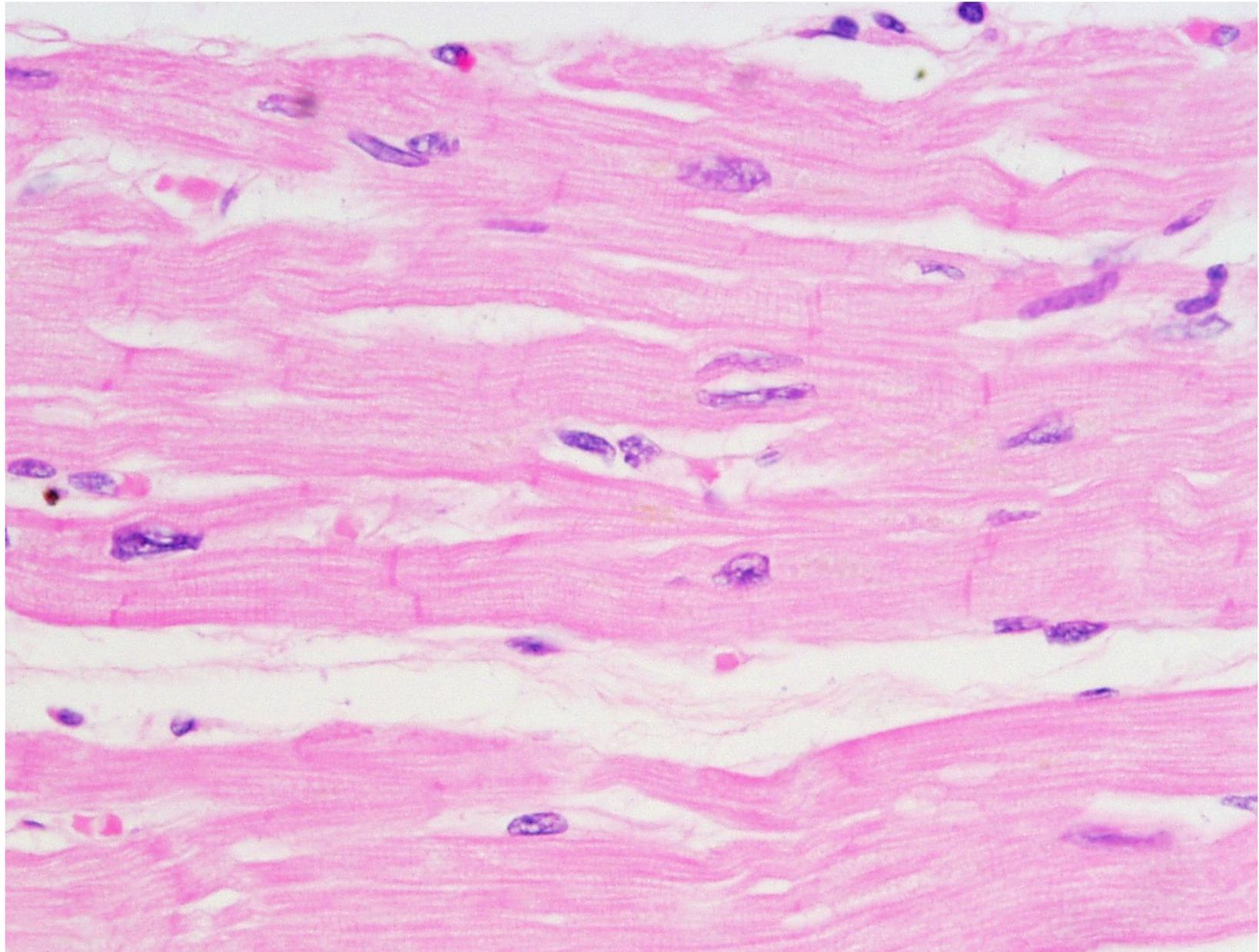
Skeletal Muscle



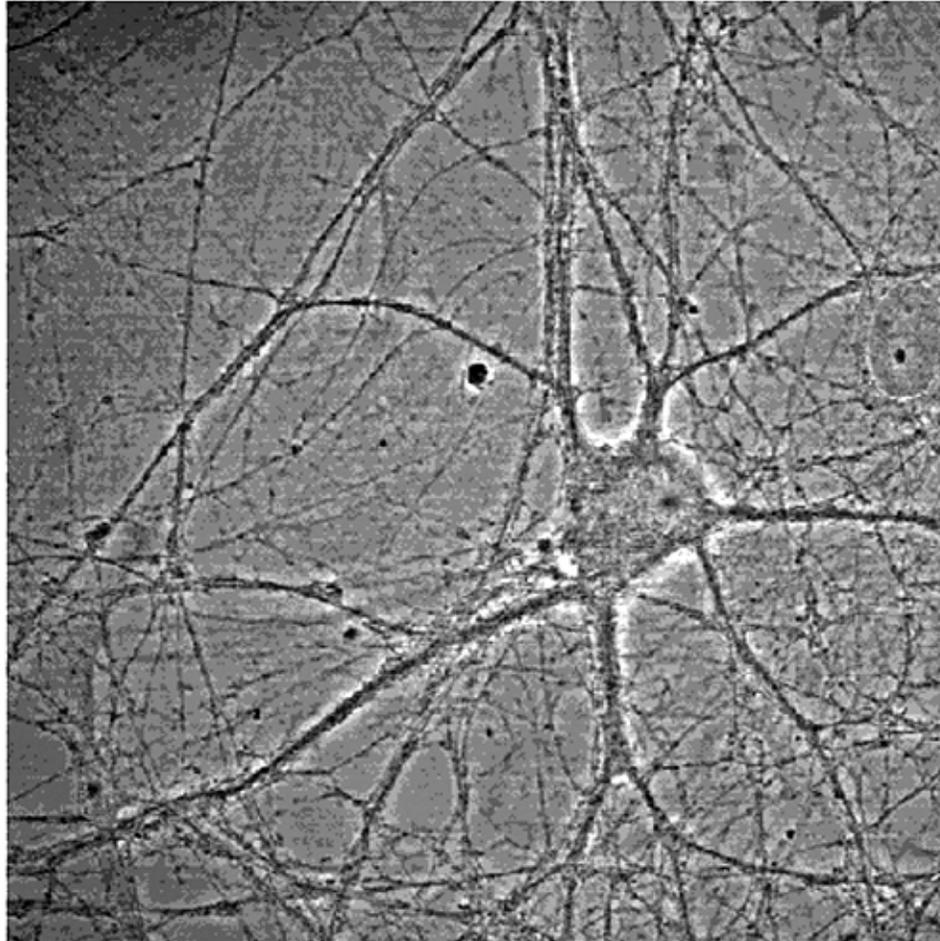
Smooth Muscle



Cardiac Muscle



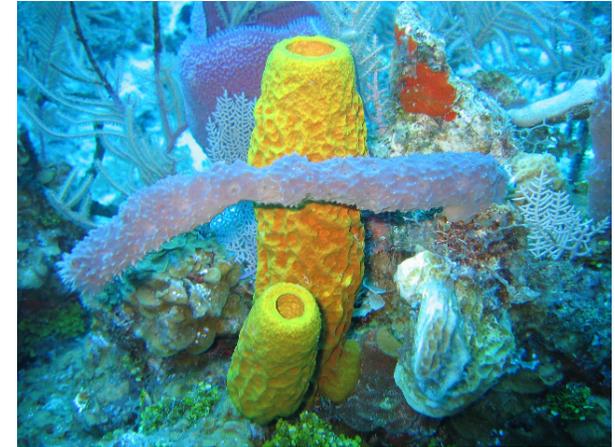
Neuron



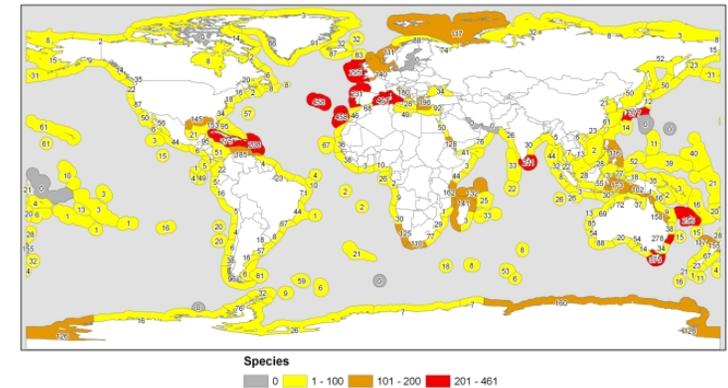
Phylum: Sponges

- General Characteristics and structures** –Sponges are a clade of sessile animals that are made up of a loose aggregate of cells which means they are different from other animals because they have no true tissues. They have a **cellular-level of organization** and the individual cells retain a large degree of independence. The word porifera means “**pore-bearers**” because a sponge is basically a sac that is full of holes. Sponges are **usually classified by their canal systems (with flagellated cells called choanocytes) and the type of skeletal structures they possess.**
- Evolutionary History** – The earliest fossils of sponges have shown up in the **Cambrian period** although biomarkers and molecular clocks suggest they appeared in the **Precambrian**.
- Biogeography** – Sponges are **worldwide in their distribution, living in a wide range of ocean habitats, from the polar regions to the tropics**

Era	System & Period	Series & Epoch
CENOZOIC	Quaternary	Recent
		Pleistocene
	Tertiary	Pliocene
		Miocene
		Oligocene
		Eocene
Paleocene		
MESOZOIC	Cretaceous	
	Jurassic	
	Triassic	
PALEOZOIC	Permian	
	Carboniferous	Pennsylvanian
		Mississippian
	Devonian	
	Silurian	
	Ordovician	
Cambrian		
	Precambrian	



Various sponge types



Global Diversity of Sponges

Porifera

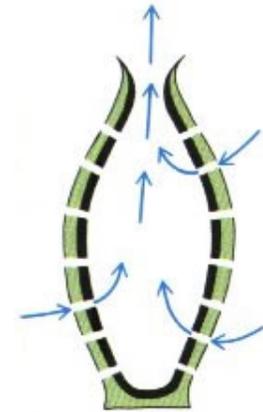
Level of Organization	Cellular
Tissue Layers	None
Digestive System	None, Intracellular
Excretory System	None
Circulatory System	None
Respiratory System	None
Nervous System	None, local
Body Cavity	None
Asexual Reproduction	Budding
Sexual Reproduction	Egg and Sperm

Porifera: Sponges – General Characteristics

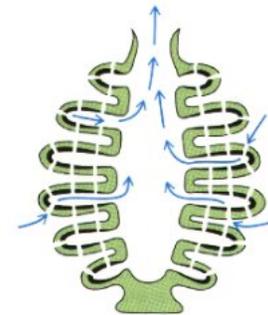
Body types - Sponges have a large central cavity called a **spongocoel**. This cavity opens to the outside by a large opening called an **osculum**. Sponges have three body types depending on the location of their choanocytes:

1. **Asconoid**: flagellated spongocoel
2. **Syconoid**: flagellated canals
3. **Leuconoid**: flagellated chambers

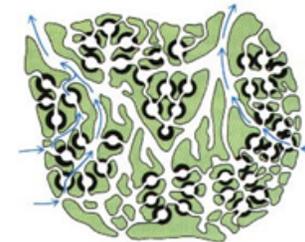
Skeletal Structures - The skeletal structures in sponges are called **spicules** (made of calcium carbonate or silica) and/or **spongin** (made up of protein).



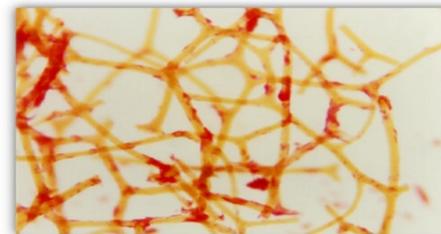
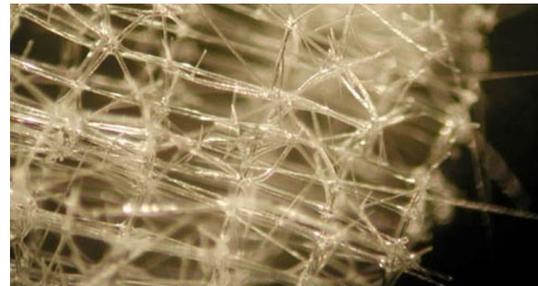
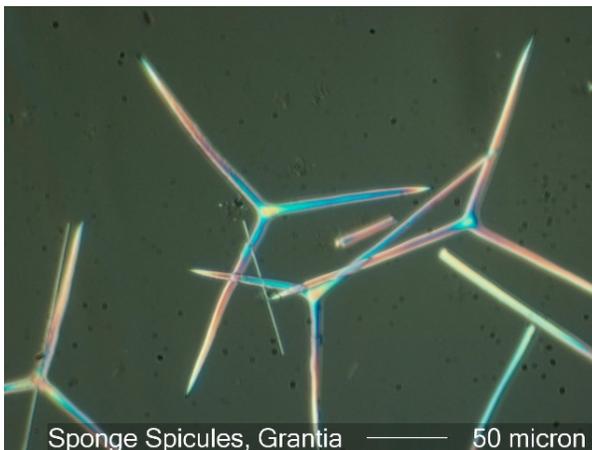
Asconoid



Syconoid



Leuconoid



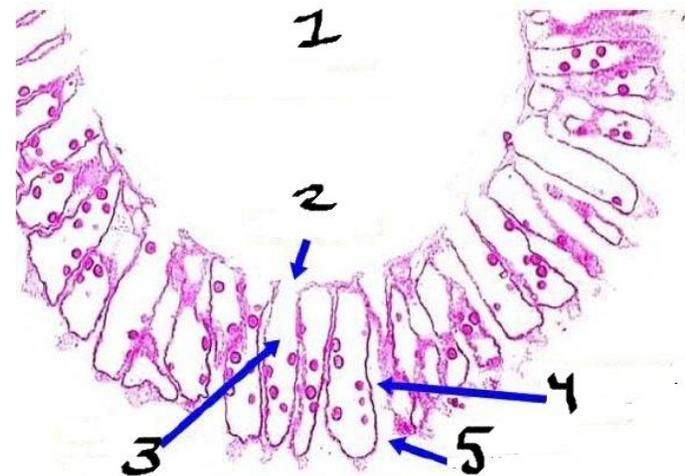
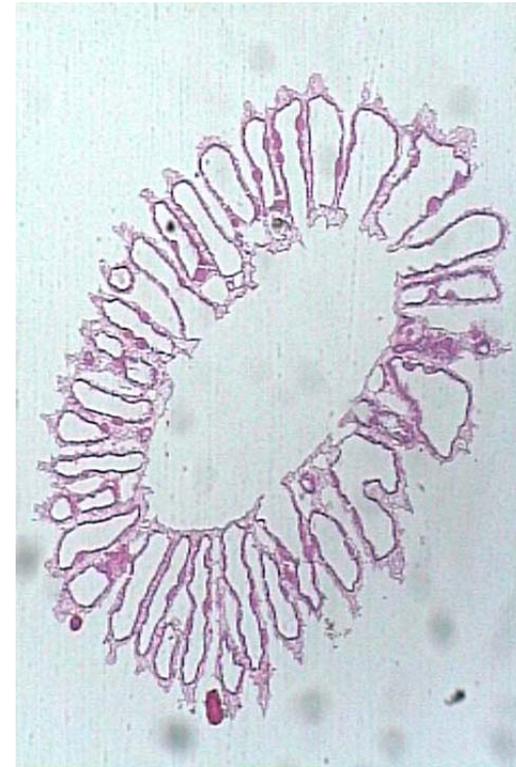
Sponge Anatomy

Be able to identify the following structures under the microscope:

1. Spongocoel
2. Apopyle
3. Radial Canal
4. Incurrent Canal
5. Ostia

Not Labeled

- Prosopyle - Opening between canals
- Osculum – Large opening at top of sponge



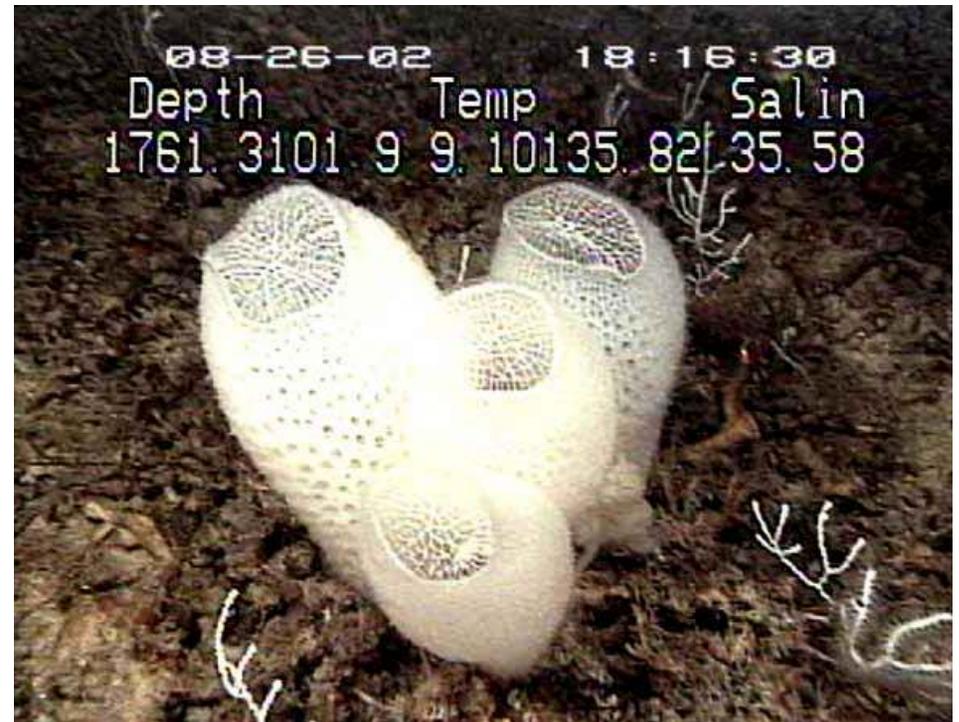
Class: Calcarea

- 1. General Characteristics.** Like all other sponges, they are sedentary filter feeders. Calcareous sponges vary from **radially symmetrical vase-shaped body types to colonies made up of a meshwork of thin tubes, or irregular massive forms.** The skeleton has either a mesh or honeycomb structure. Of the 15,000 or so species of Porifera that exist, only 400 of those are calcareans.
- 2. Unique Characteristics**
 - A. Body Types – Asconoid, Syconoid, Leuconoid**
 - B. Skeletal Types – Calcium carbonate spicules**
- 3. Biogeography –** All sponges in this class are **strictly marine and they are distributed worldwide.**
- 4. Habitat -** Most are **found in shallow tropical waters**



Class: Hexactinellidae

1. **General Characteristics.** Like all other sponges, they are sedentary filter feeders. Hexactinellidae sponges are sponges with a skeleton made of four- and/or six-pointed siliceous spicules, often referred to as **glass sponges**.
2. **Unique Characteristics**
 - A. **Body Types** – Syconoid, Leuconoid
 - B. **Skeletal Types** – Six-sided Silica spicules
3. **Biogeography** – They are found in all oceans of the world, although they are particularly common in **Antarctic and Northern Pacific waters**.
4. **Habitat** - Most are Glass sponges are relatively uncommon and are mostly found at depths from 450 to 900 meters (1,480 to 2,950 ft)



Class: Demospongiae

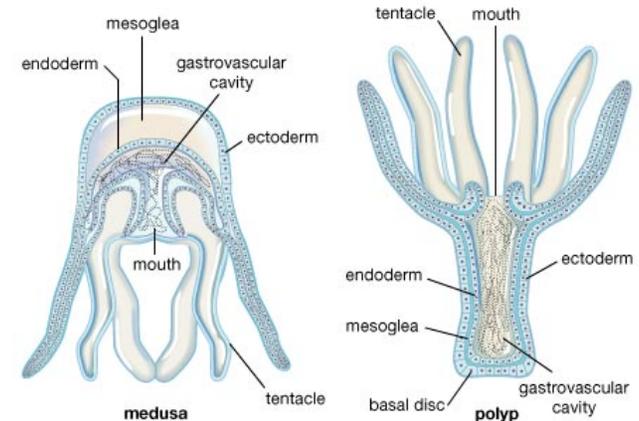
1. **General Characteristics** – The Demospongiae are the largest class in the phylum Porifera. In fact, the demospongia include 81% of all species of sponges with nearly 7,000 species worldwide. The most economically important group is this class to humans are the bath sponges. These are harvested by divers and can also be grown commercially.
2. **Unique Characteristics**
 - A. Body Types – Leuconoid
 - B. Skeletal Types – Silica spicules and/or spongin
3. **Biogeography** – Worldwide
4. **Habitat** - Most are marine dwellers, but one order (Spongillida) live in freshwater environments



Phylum: Cnidaria

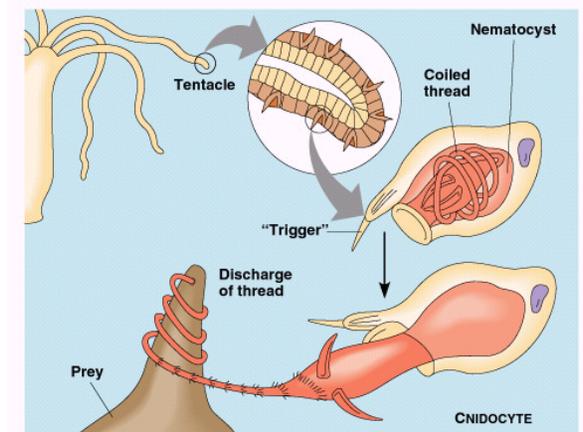
- General Characteristics and structures** – Cnidarians are separated from other animals because of their **radial symmetry**. These animals are said to have a **tissue-level of organization**. They are said to be **diploblastic** because they have a true outer **epidermis** and an inner **endodermis** separated by **mesoglea**. The body plan for this group is a sac that surrounds a **gastrovascular cavity**. These organisms are **polymorphic** and demonstrate two body types in their life cycles (**the polyp and the medusa**). These organisms all possess **nematocysts (stinging cells)** that are used to capture prey and for protection).
- Evolutionary History** – Fossil cnidarians have been found in rocks formed about **580 million years ago in the Precambrian**.
- Biogeography** – Cnidarians are a phylum containing over 10,000 species of animals **found exclusively in aquatic (freshwater and marine) environments: they are predominantly marine species.**

Era	System & Period	Series & Epoch
CENOZOIC	Quaternary	Recent
		Pleistocene
	Tertiary	Pliocene
		Miocene
		Oligocene
		Eocene
Paleocene		
MESOZOIC	Cretaceous	
	Jurassic	
	Triassic	
PALEOZOIC	Permian	
	Carboniferous	Pennsylvanian
		Mississippian
	Devonian	
	Silurian	
	Ordovician	
Cambrian		
	Precambrian	



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Body Types



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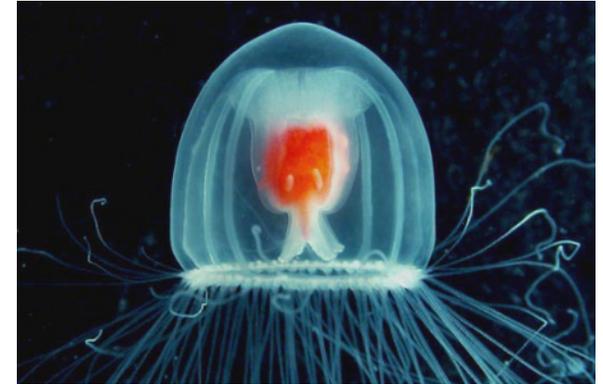
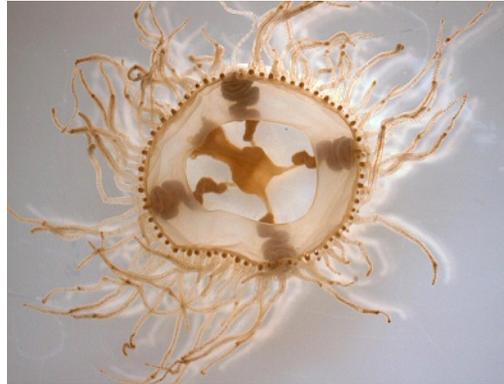
Nematocyst

Cnidaria

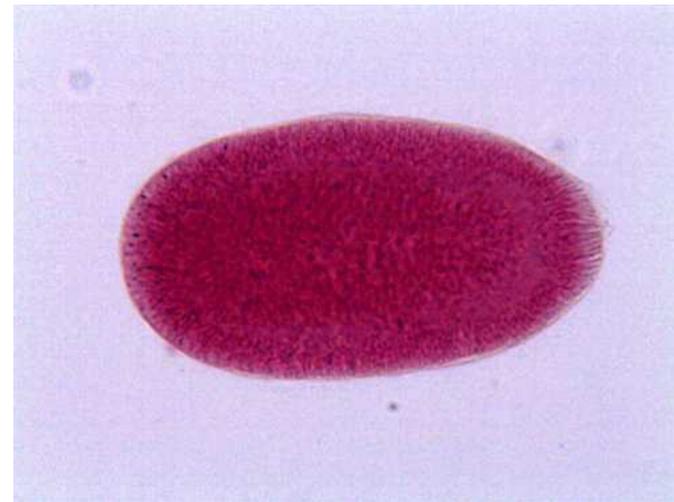
Level of Organization	Tissue
Tissue Layers	Diploblastic with a mesoglea
Digestive System	Gastrovascular cavity, extra- and Intracellular
Excretory System	None
Circulatory System	None
Respiratory System	Dermal branchiae
Nervous System	Nerve Net
Body Cavity	None
Asexual Reproduction	Budding
Sexual Reproduction	Egg and Sperm

Class: Hydrozoa

1. **General Characteristics** – .Hydrozoans are a taxonomic class of individually **very small, predatory animals, some solitary and some colonial**, The colonies of the colonial species can be large, and in some cases the specialized individual animals cannot survive outside the colony.
2. **Body forms** – **Most species contain both a polyp and medusa stage.** The medusa is usually small with a **velum** (small shelf). The polyp stage is often **colonial**. The life cycle usually contains a **planula larvae**.
3. **Biogeography** – **Mostly found in salt water but a few genera within this class live in fresh water.**



Medusa with Velum

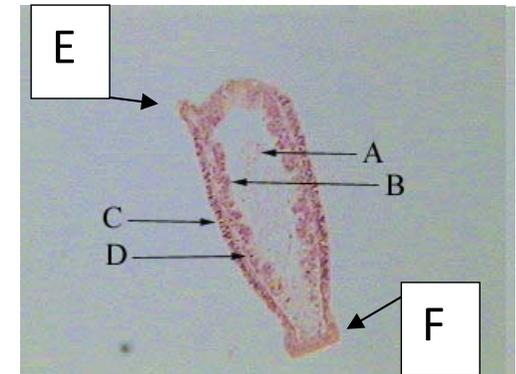
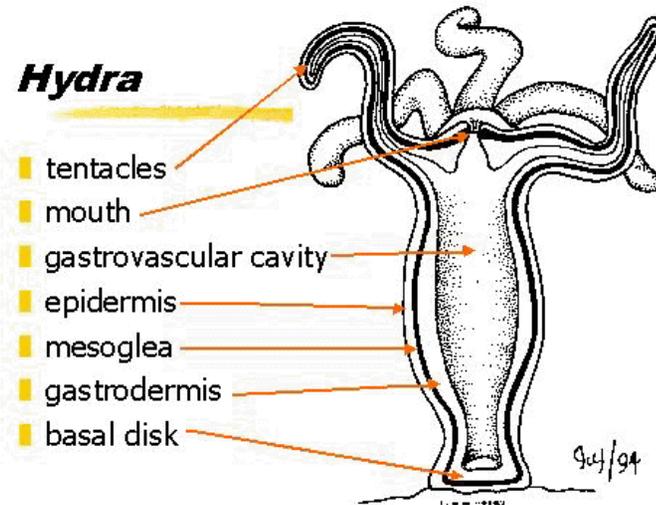


Planula Larvae

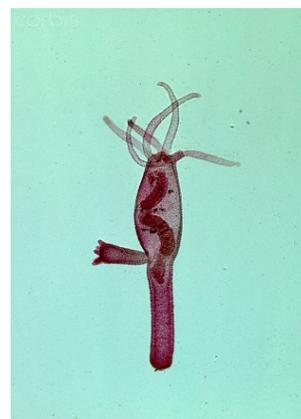
Hydra

(*Hydra sp.*)

- General Characteristics** – Hydra have **only a polyp body form**. They can reproduce asexually by **budding** and have **both males and females with testes or ovaries**.
- Unique Characteristics** – Biologists are especially interested in *Hydra* because of **their regenerative ability** – they appear not to age or die of old age.
- Biogeography** – **Native to the temperate and tropical regions**
- Habitat** - **Fresh-water animals**
- Diet** – **Aquatic Invertebrates**



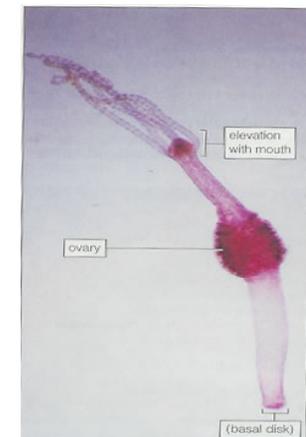
You need to be able to identify the following structures: E) tentacles, mouth, A) gastrovascular cavity, C) epidermis, B) gastrodermis, D) mesoglea and F) basal disc, Bud, Testes, and Ovary.



Budding



Testes

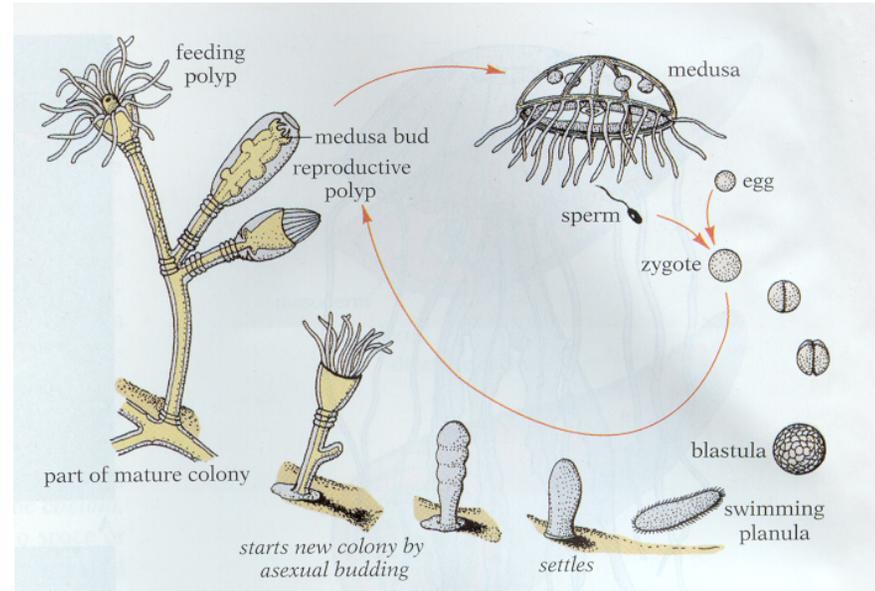


Ovaries

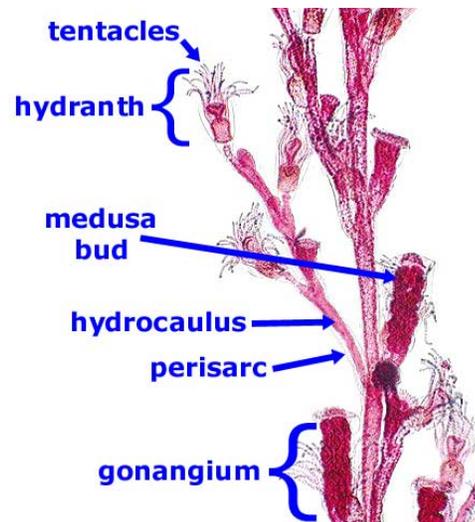
Obelia

(*Obelia sp.*)

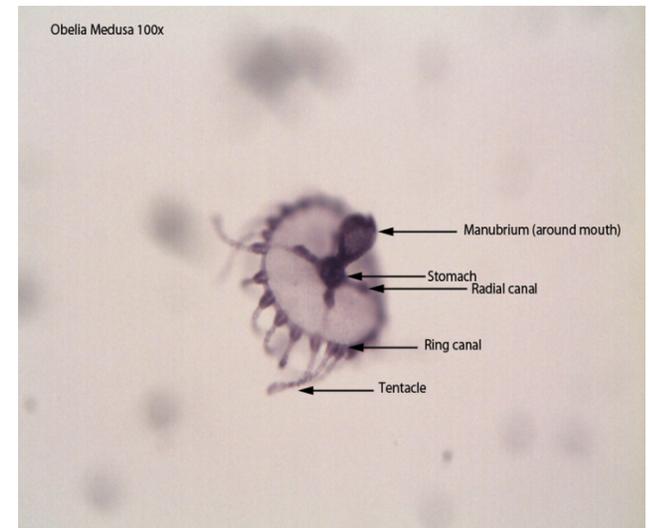
- General Characteristics** – These species have **both the polyp and medusa stages** in their life cycle.
- Unique Characteristics** – The polyp stage has **specialized structures for feeding (hydranth) and for reproduction (gonangium)**
- Biogeography** – *Obelia* has **a worldwide distribution except the high-arctic and Antarctic seas**
- Habitat** – This genus consists of mainly **marine and some freshwater animal species**. The medusa stage of *Obelia* species are common in **coastal and offshore plankton**
- Diet** – Zooplankton, worms and crustaceans.



Obelia Life Cycle



Polyp



Medusa

Portuguese Man of War

(*Physalia sp.*)

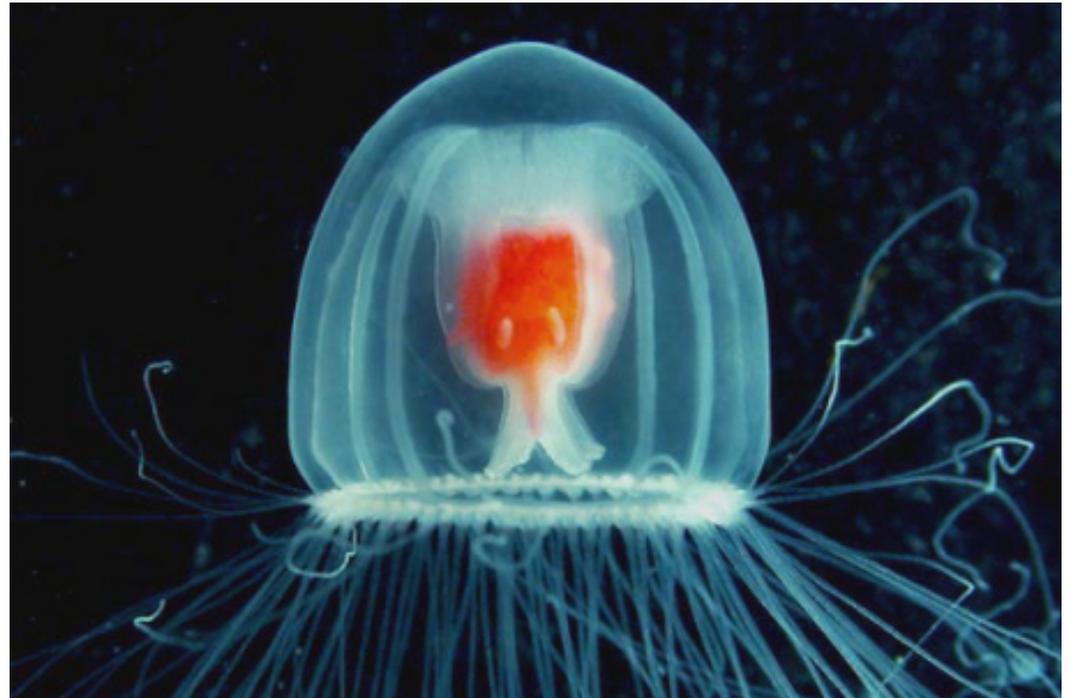
1. **General Characteristics** – is not a jelly but a **siphonophore** which is a colonial organism made up of specialized minute individual organisms called **zooids**. The float on top is not a medusa but a modified structure from the planula larvae called a **pneumatophore**.
2. **Unique Characteristics** – Stings usually cause **severe pain to humans, leaving whip-like, red welts on the skin that normally last two or three days after the initial sting, though the pain should subside after about 1 to 3 hours (depending on the person).**
3. **Biogeography** – They live in the **warm waters of the seas around the world. They seem to thrive in the tropical and subtropical areas.**
4. **Habitat** – They are often found **floating on the top of the oceans.**
5. **Diet** – They will **consume small fish, plankton and crustaceans.** They use their venom to paralyze them so that they are able to prevent their meals from escaping.



Gonionemus

(Gonionemus sp.)

1. **General Characteristics** – A small jelly with colorful gonads and a manubrium which hangs down. Tentacles are bent on the ends
2. **Unique Characteristics** – Called the Clinging Jelly, its range is being expanded and was probably introduced to California
3. **Biogeography** – Most *Gonionemus* species are widely distributed in the warmer regions of the Atlantic and Indo-Pacific oceans
4. **Habitat** – *Gonionemus* attach to eelgrass, sea lettuce or various types of algae.
5. **Diet** – Small fish and zooplankton



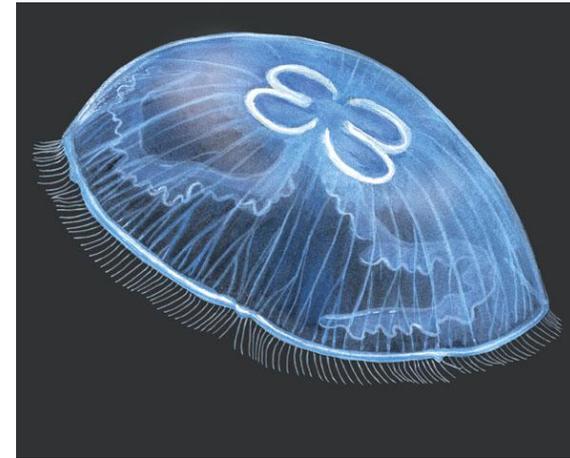
Class: Scyphozoa

1. **General Characteristics** - The Scyphozoa are an exclusively marine class sometimes referred to as the “true jellies”.
2. **Unique Characteristics** – Unlike the small hydrozoa jellies, they usually lack a vellum.
3. **Biogeography** – Scyphozoans inhabit every ocean in the world.
4. **Habitat** – They are exclusively marine. They are most commonly found close to shore in shallow waters, and usually thrive in eutrophic conditions.

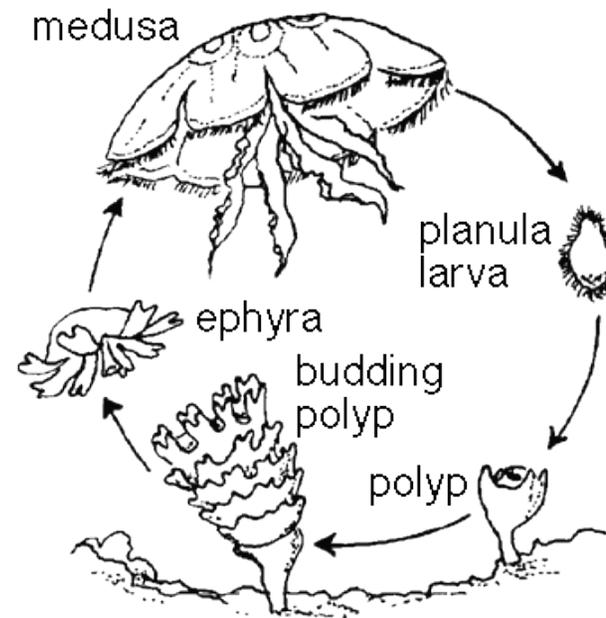


Moon Jellies (*Aurelia aurita*)

1. **General Characteristics** – The jellyfish is translucent, usually about 25–40 cm (10–16 in) in diameter, and can be recognized by its **four horseshoe-shaped gonads**, easily seen through the top of the bell
2. **Unique Characteristics** – It is capable of **only limited motion, and drifts with the current, even when swimming.**
3. **Biogeography** – It is found in **most of the world's oceans**
4. **Habitat** – In general, *Aurelia* is an inshore genus that can be **found in estuaries and harbors**
5. **Diet** –. It feeds on **medusae, plankton, and mollusks**



Jellyfish Life Cycle



Class: Anthozoa

- 1. General Characteristics** - Unlike other cnidarians, anthozoans **do not have a medusa stage in their development**. Instead, they release sperm and eggs that form a planula, which attaches to some substrate on which the cnidarian grows into a polyp. They include sea anemones, coral, sea fans and sea pens.
- 2. Unique Characteristics** – Their name is from the Greek that **means “flower animal”**. They are **solitary or found in large colonies**.
- 3. Biogeography** – They are found **worldwide in all oceans, from the Arctic to the Antarctic**.
- 4. Habitat** – **Sessile on the ocean floor or rocky shores**.



Sea Anemone (*Anthopleura sp.*)

1. **General Characteristics** – Anemones have many tentacles that radiate out from the mouth area located at the top of the central body. The body is roughly cylindrical with the mouth (oral disc) at the top and a foot (pedal disc) at the bottom. The pedal disc is used by the animal to securely attach to the rock.
2. **Unique Characteristics** – Sea anemones can range from a deep green color to a light yellowish and grey color depending on location and species.
3. **Biogeography** – Intertidal Zones
4. **Habitat** – Low Tide Zone in calmer waters
5. **Diet** – Anemones will feed on small fish, snails, limpets, crabs and other marine life



Coral

1. **General Characteristics** – A coral "group" is a colony of myriad genetically identical polyps. Each polyp is a sac-like animal typically only a few millimeters in diameter and a few centimeters in length. A set of tentacles surround a central mouth opening. An exoskeleton is excreted near the base.
2. **Unique Characteristics** – Over many generations, the colony creates a large exoskeleton that is characteristic of these species.
3. **Biogeography** – Worldwide, most occur in tropical and subtropical seas
4. **Habitat** – shallow to deeper waters depending on species
5. **Diet** – small fish, plankton, food from symbiotic algae called zooxanthellae



Sea Fans

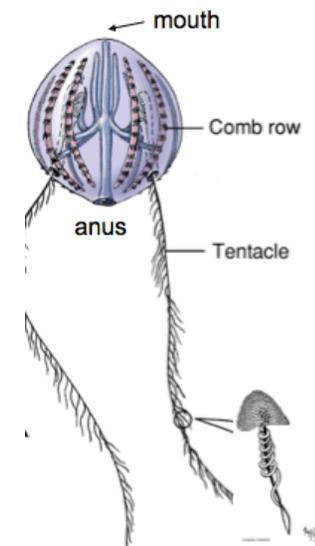
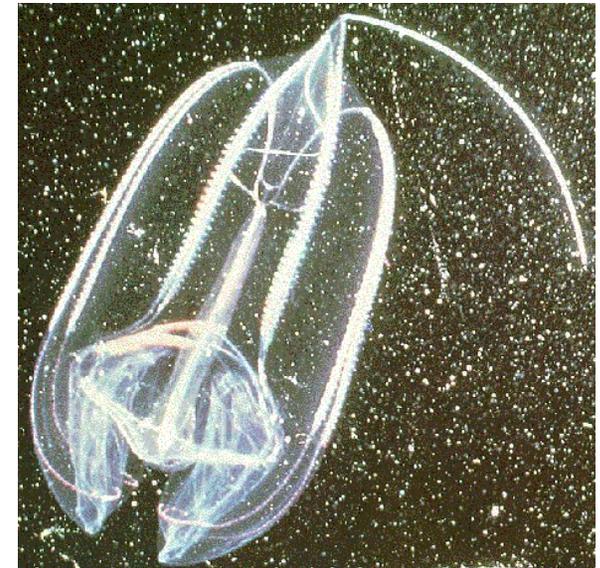
1. **General Characteristics** – Individual tiny polyps form colonies that are **normally erect, flattened, branching, and reminiscent of a fan.**
2. **Unique Characteristics** – Gorgonians produce unusual organic compounds in their tissues, particularly **diterpenes, for protection and some of these are important candidates for new drugs**
3. **Biogeography** – Cnidarians found **throughout the oceans of the world, especially in the tropics and subtropics**
4. **Habitat** – **Typically shallow waters**
5. **Diet** – **Plankton**



Phylum: Ctenophora

- General Characteristics and structures** – Ctenophores, like cnidarians are separated from other animals because of their **radial symmetry**. These animals are said to have a **tissue-level of organization**. The body plan for this group is a sac that surrounds a **gastrovascular cavity**. The word Ctenophora means “**comb-bearer**”. They contain **comb plates with cilia** for movement and tentacles that contain **coloblasts** to capture their prey. They are also the largest animals to move by cilia found on their combs.
- Evolutionary History** – Fossil ctenophores have been found **about 510 million years ago in the early Cambrian**.
- Biogeography** – Ctenophores **live in marine habitats world wide**.

Era	System & Period	Series & Epoch
CENOZOIC	Quaternary	Recent
		Pleistocene
	Tertiary	Pliocene
		Miocene
		Oligocene
		Eocene Paleocene
MESOZOIC	Cretaceous	
	Jurassic	
	Triassic	
PALEOZOIC	Permian	
	Carboniferous	Pennsylvanian
		Mississippian
	Devonian	
	Silurian	
	Ordovician	
Cambrian		
	Precambrian	



Lophotrochozoans

The **Lophotrochozoans** are a major grouping of protostome animals. The taxon was discovered based on molecular data. **Molecular evidence** (rRNA) supports the monophyly of the phyla listed below.

Platyhelminthes

Nemertea

Rotifera

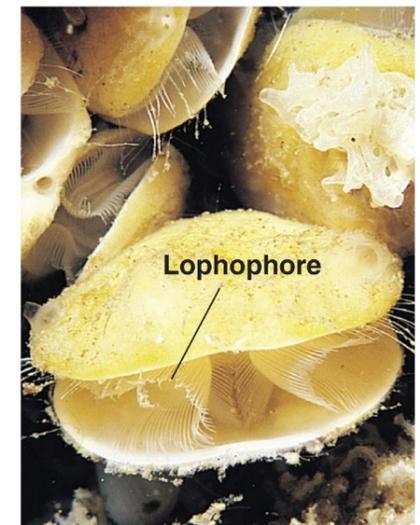
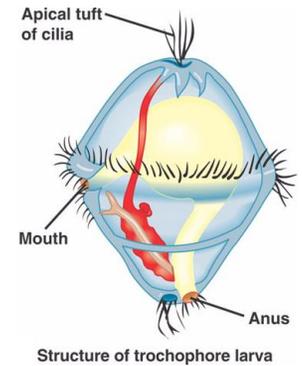
Mollusca

Ectoprocta

Annelida

Brachiopoda

The Lophotrochozoa comprise two groups, the trochozoans and the lophophorates. The exact relationships between the different phyla are not entirely certain.



The Trochozoans have a larvae form with a ring of cilia around its middle.

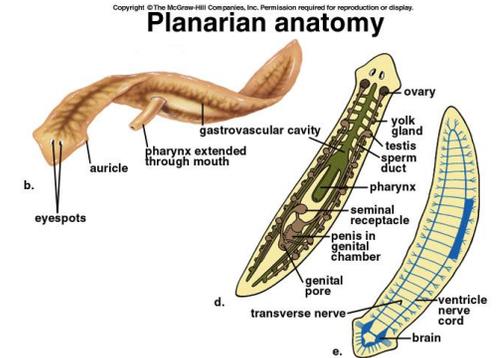
The Lophophorates have a horse-shoe shaped structure covered with ciliated tentacles.

Phylum: Platyhelminthes

- General Characteristics and structures** – Platyhelminthes are different from other animals because of there is no space between the gastrovascular cavity and the muscles so they are said to be **acoelomates**. They are also the first animals that demonstrate **bilateral symmetry**, which allows these organisms to develop a head with specialized sense organs. These animals are said to have an **organ system level of organization**. They are said to be **triploblastic** because they have a true outer **epidermis** and an inner **endodermis** separated by a third layer called the **mesodermis**. The body plan for this group is a solid mass of tissue that surrounds that surrounds a **gastrovascular cavity**.
- Evolutionary History** – Fossil records for this group are very minimal at best. (**unknown**)
- Biogeography** – There are free-living and parasitic species worldwide.

? ? ?

Era	System & Period	Series & Epoch
CENOZOIC	Quaternary	Recent
		Pleistocene
	Tertiary	Pliocene
		Miocene
		Oligocene
		Paleocene
MESOZOIC	Cretaceous	
	Jurassic	
	Triassic	
PALEOZOIC	Permian	
	Carboniferous	Pennsylvanian
		Mississippian
	Devonian	
	Silurian	
	Ordovician	
Cambrian		
	Precambrian	



A large tapeworm & close-up view

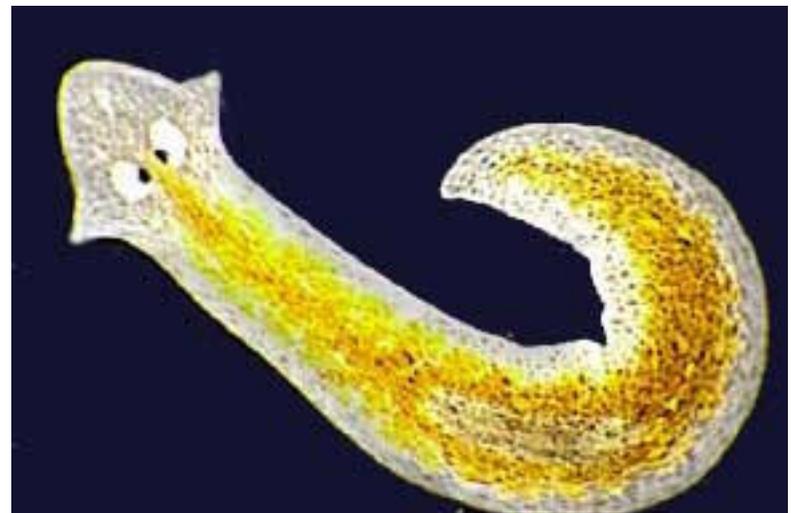
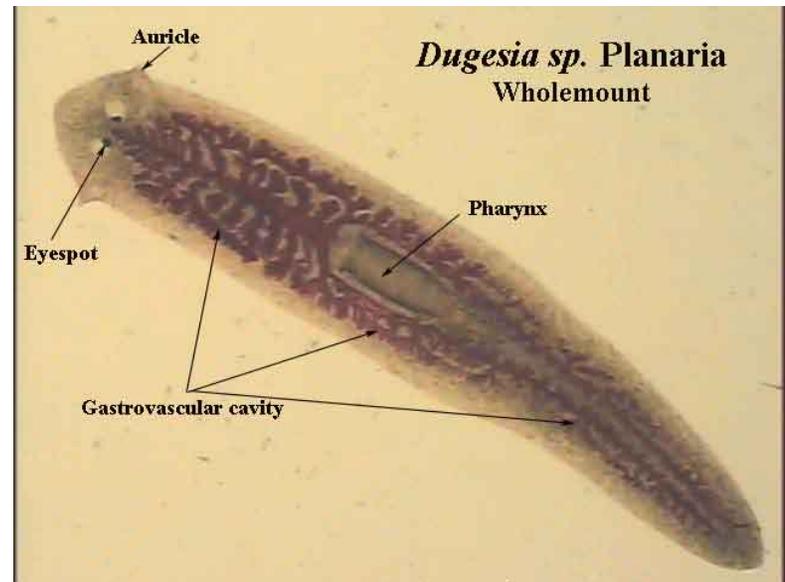


Platyhelminthes

Level of Organization	Organ-system
Tissue Layers	Triploblastic
Digestive System	Gastrovascular cavity, extra- and Intracellular
Excretory System	Protonephridia for osmoregulation
Circulatory System	None
Respiratory System	None, body surface
Nervous System	Pair of cerebral ganglia with long nerve cords
Body Cavity	None
Asexual Reproduction	Regeneration
Sexual Reproduction	Egg and Sperm

Class: Turbellaria

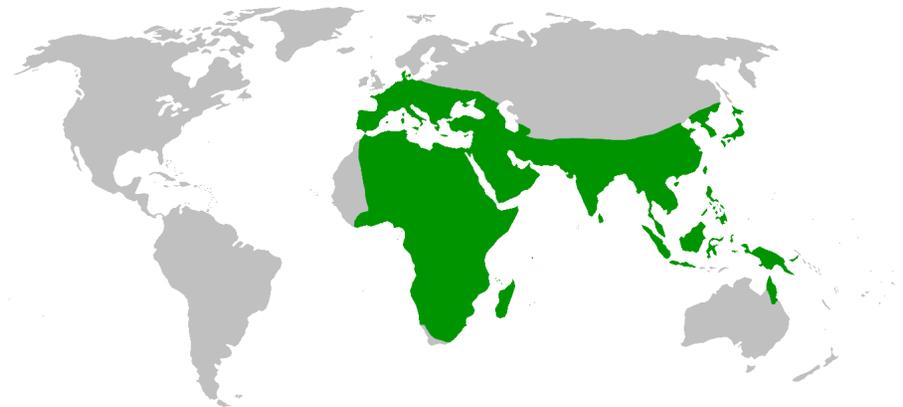
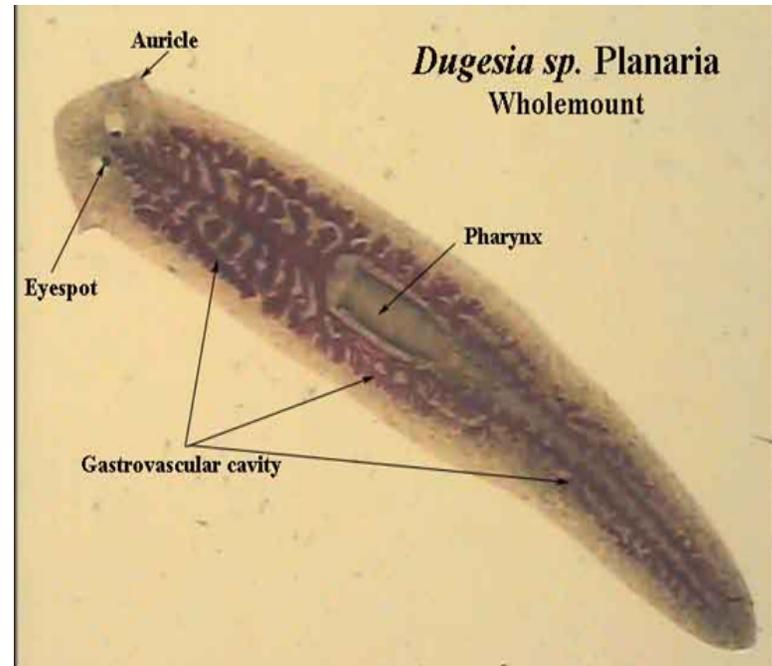
- 1. General Characteristics** – This class includes all the sub-groups that are not exclusively parasitic. There are about 4,500 species, which range from 1 mm long to large freshwater forms more than 500 mm (20 in) long. Platyhelminthes are bilaterally symmetrical animals, in other words their left and right sides are mirror images of each other; this also implies that they have distinct top and bottom surfaces and distinct head and tail ends. Like other bilaterians they are triploblastic, having three main cell layers.
- 2. Unique Characteristics** – They are known for the regenerative skills.
- 3. Biogeography** – Worldwide
- 4. Habitat** – Marine and freshwater; and moist terrestrial environments such as leaf litter or between grains of soil.



Planaria

(*Dugesia sp.*)

1. **General Characteristics** – They have an elongated body with a slightly triangle-shaped head. These flatworms have eyespots called **ocelli** that are used for **light detection**. They have **bumps on the side of their head called auricles used as a chemical detectors**.
2. **Unique Characteristics** – . They are known for their **regeneration properties**
3. **Biogeography** – **Africa, Europe, Middle East, Asia and Australia**
4. **Habitat** – **Freshwater**
5. **Diet** – **Carnivorous of small invertebrates**



Class: Turbellaria

Know the following structures:

Ocelli

Auricles

Mouth

Gastrovascular Cavity

Pharynx

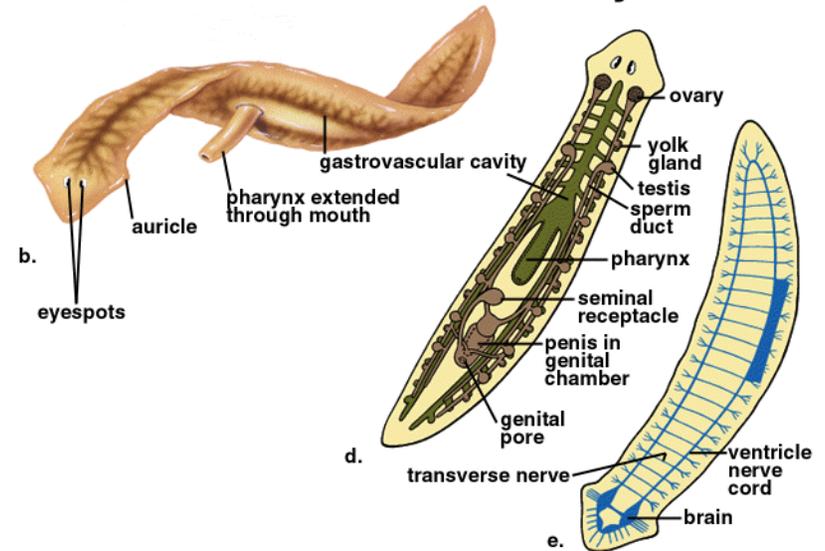
Intestines

Anterior

Posterior

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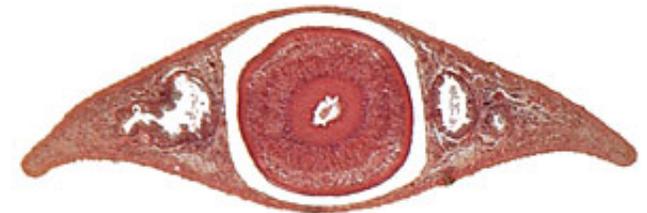
Planarian anatomy



Anterior



Pharyngeal



Posterior



Class: Trematoda

1. **General Characteristics** –They are internal parasites of mollusks and vertebrates. Most trematodes have a complex life cycle with at least two hosts. The primary host, where the flukes sexually reproduce, is a vertebrate. Many species spend part of their life cycle in invertebrates and vertebrates such as [snails](#), [crabs](#), [fish](#), [birds](#), [etc.](#)
2. **Unique Characteristics** – The body surface of trematodes comprises a tough syncitial **tegument**, which helps protect against digestive enzymes in those species that inhabit the gut of larger animals
3. **Biogeography** – [Worldwide](#)
4. **Habitat** – [Internal Parasites](#)



BIODIDAC, © Houseman, Univ of Ottawa

Class: Trematoda

Know the following structures:

A: Oral Sucker

B: Ventral Sucker

C: Esophagus

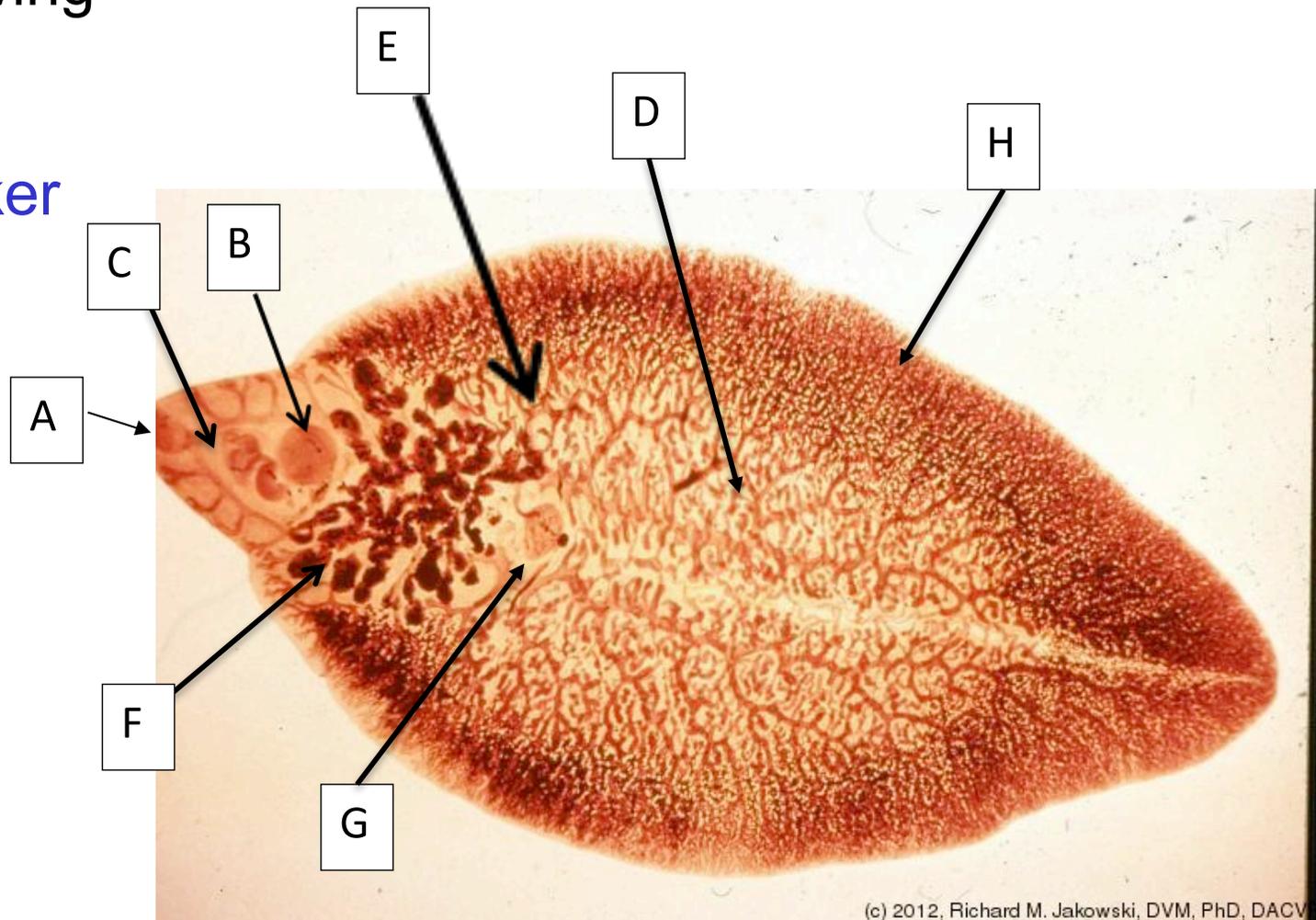
D: Testes

E: Ovaries

F: Uterus

G: Shell Gland

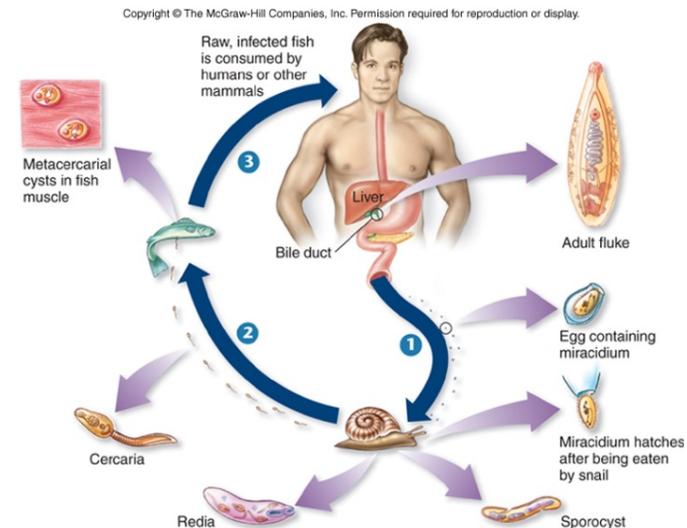
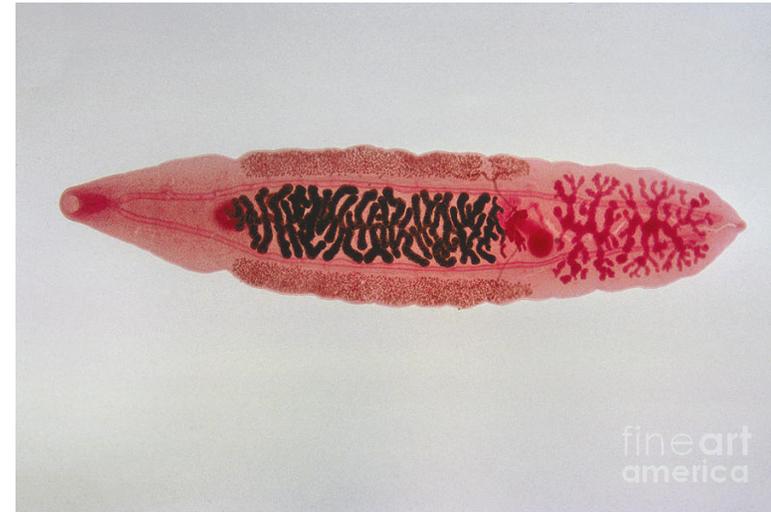
H: Yolk Gland



Human Liver Fluke

(*Clonorchis sp.*)

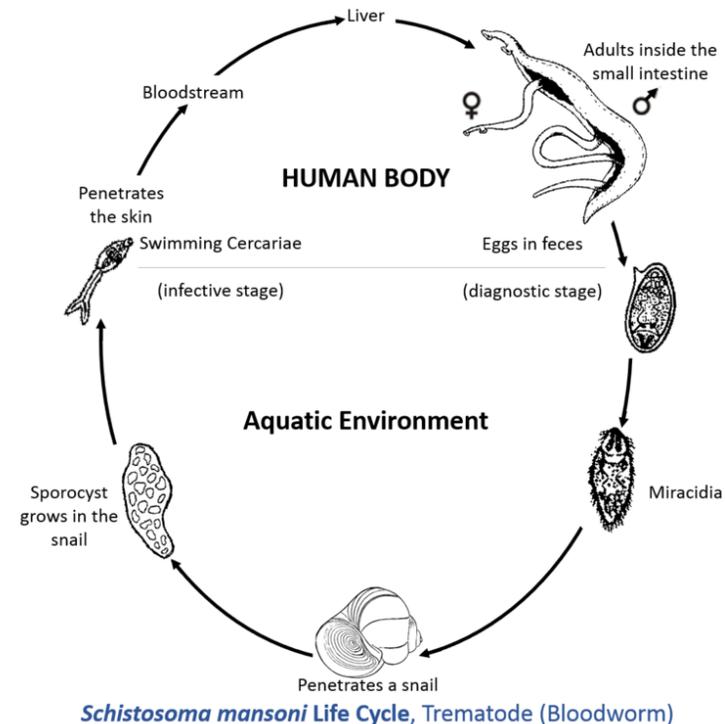
- 1. General Characteristics –**
The human liver fluke is a parasite that lives in the liver of humans, and is found **mainly in the common bile duct and gall bladder, feeding on bile**. As an adult, it is a very narrow fluke, 10-25 mm. in length, flattened dorsal-ventrally, with an oral and a ventral sucker. The fluke is tapered at the anterior end and rounded at the posterior end .
- 2. Unique Characteristics –**
These animals, which are believed to be the third most prevalent worm parasite in the world currently infecting an **estimated 30,000,000 humans..**
- 3. Biogeography –. 85% of cases are found in China.**
- 4. Life Cycle –** The fluke begins in **freshwater snails** and a larval form burrows out of the snail and into a **fish**. **Humans are infected when eating the fish**.



Bloodworm Fluke

(*Schistosoma mansoni*)

- 1. General Characteristics –** Schistosomes are long, slim worms with a tegument that bears a large number of small tubercles. When the larvae recognize human skin, they burrow into the skin heading for the lungs and then migrate to the heart which carries them through the circulatory system.
- 2. Unique Characteristics –** Schistosomes are atypical trematodes in that the adult stages have two sexes (dioecious) and are located in blood vessels humans.
- 3. Biogeography –** *S. mansoni* is the most widespread of the human-infecting schistosomes, and are present in 54 countries. These countries are predominantly in South America and the Caribbean, Africa and the Middle East.
- 4. Life Cycle –** The lifecycle of schistosomes includes two hosts: humans where the parasite undergoes sexual reproduction, and a single intermediate snail host where there are a number of asexual reproductive stages.

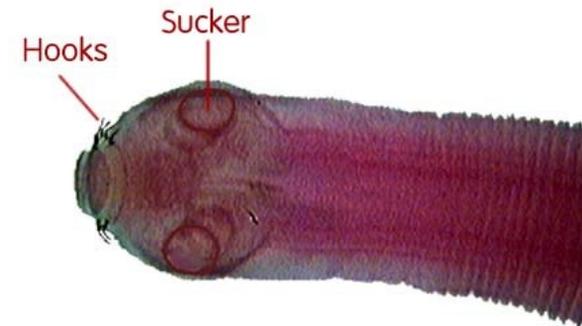


Class: Cestoidea

- 1. General Characteristics** – These animals are commonly called **tapeworms**. All tapeworms are parasitic and their life histories vary, **but typically they live in the digestive tracts of vertebrates as adults, and often in the bodies of other species of animals as juveniles**. Over a thousand species have been described, and all vertebrate species may be parasitized by at least one species of tapeworm. Humans are subject to infection by several species of **tapeworms if they eat undercooked meat such as pork, beef, and fish, or if they live in, or eat food prepared in, conditions of poor hygiene**.
- 2. Unique Characteristics** – These flatworms are endoparasitic parasites called tapeworms. They have specialized body parts: **a head called a scolex** and **body segments called proglottids**.
- 3. Biogeography** – **Worldwide**
- 4. Habitat** – **Internal Parasites**

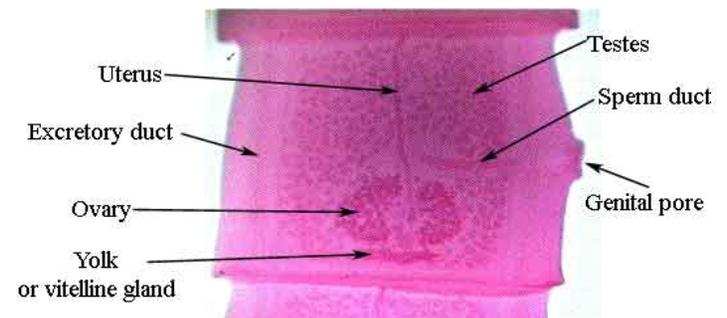
Tapeworm

Scolex



Taenia pisiformis Dog tapeworm

40x



Mature proglottid

Class: Cestoidea

Know the following structures:

Scolex

Hooks

Rostellum

Suckers

Proglottids

Uterus

Ovary

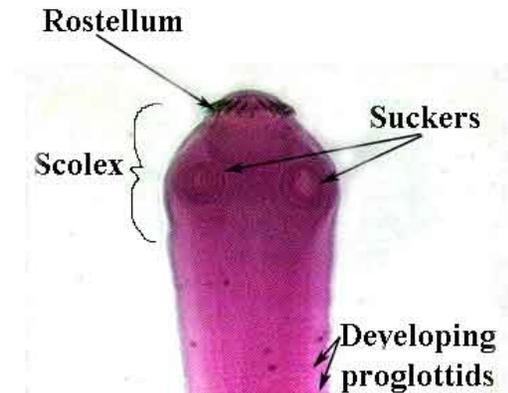
Yolk (Vitelline) Gland

Testes

Ductus deferens (sperm duct)

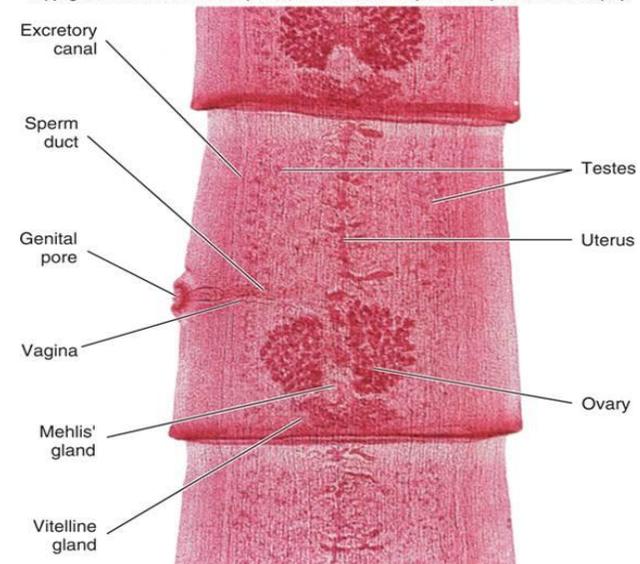
Genital Pore

Vagina



Taenia pisiformis - dog tapeworm - 40x

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Phylum: Rotifera

- General Characteristics and structures** –The rotifers are animals that exhibit a pseudocoelomate body plan. They are one of the early animals to exhibit an alimentary canal (which has both a mouth and an anus). They exhibit an organ-system level of organization and they are triploblastic. The word rotifer means wheel bearer because they have jaws and a crown of cilia.
- Evolutionary History** – Fossils have been found in the early Eocene although they probably have been around much longer
- Biogeography** – Freshwater animals around the world.

Era	System & Period	Series & Epoch
CENOZOIC	Quaternary	Recent
		Pleistocene
	Tertiary	Pliocene
		Miocene
		Oligocene
		Eocene Paleocene
MESOZOIC	Cretaceous	
	Jurassic	
	Triassic	
PALEOZOIC	Permian	
	Carboniferous	Pennsylvanian
		Mississippian
	Devonian	
	Silurian	
	Ordovician	
Cambrian		
	Precambrian	

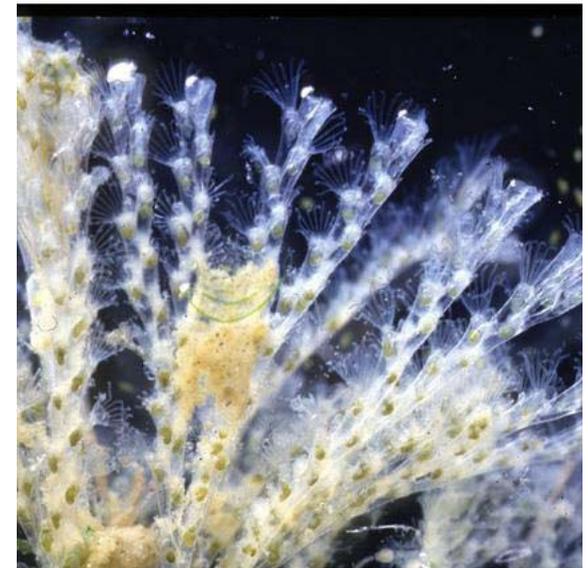


Phylum: Ectoprocta

- General Characteristics and structures** – The word ectoproct means outside anus. They are often called bryozoans because they resemble mosses and are therefore called moss animals.
- Evolutionary History** – Fossils have been found in the late Jurassic although they probably have been around much longer.
- Biogeography** – They are normally found in the sea in colonies encased in a hard exoskeleton associated with coral reefs but are also found in lakes and rivers.



Era	System & Period	Series & Epoch
CENOZOIC	Quaternary	Recent
		Pleistocene
	Tertiary	Pliocene
		Miocene
		Oligocene
		Paleocene
MESOZOIC	Cretaceous	
	Jurassic	
	Triassic	
PALEOZOIC	Permian	
	Carboniferous	Pennsylvanian
		Mississippian
	Devonian	
	Silurian	
	Ordovician	
Cambrian		
	Precambrian	



Phylum: Brachiopoda

- General Characteristics and structures** – Brachiopods or lamp shells are different than clams because although similar in appearance to the bivalves, their valves (shells) are dorsal and ventral rather than lateral.
- Evolutionary History** – Fossils have been found in the Cambrian.
- Biogeography** – They are found only in the marine environment usually attached to the sea floor.

Era	System & Period	Series & Epoch
CENOZOIC	Quaternary	Recent
		Pleistocene
	Tertiary	Pliocene
		Miocene
		Oligocene
		Eocene Paleocene
MESOZOIC	Cretaceous	
	Jurassic	
	Triassic	
PALEOZOIC	Permian	
	Carboniferous	Pennsylvanian
		Mississippian
	Devonian	
	Silurian	
	Ordovician	
Cambrian		
	Precambrian	



Phylum: Nemertea

- General Characteristics and structures** – The ribbon or proboscis worms are animals that are different from other animals because they exhibit an acoelomate body plan but have a fluid sac that some suggest may be an early coelom. They have an alimentary canal, closed circulatory system and the fluid sac mentioned above that makes them different than flatworms
- Evolutionary History** – Fossils have been found in the mid Cambrian but confirmation of these fossils being ribbon worms is still pending.
- Biogeography** – Tropics and subtropics.
- Habitat** A few live in the open ocean while the rest find or make hiding places on the bottom. About a dozen species inhabit freshwater, and another dozen species live on land in cool, damp places



Era	System & Period	Series & Epoch
CENOZOIC	Quaternary	Recent
		Pleistocene
	Tertiary	Pliocene
		Miocene
		Oligocene
		Eocene
Paleocene		
MESOZOIC	Cretaceous	
	Jurassic	
	Triassic	
PALEOZOIC	Permian	
	Carboniferous	Pennsylvanian
		Mississippian
	Devonian	
	Silurian	
	Ordovician	
	Cambrian	
Precambrian		



Phylum: Annelida

- General Characteristics and structures** – Annelids are eucoelomates that have a true coelom lined with mesoderm and they are soft bodied and segmented which makes them different from other animals. They have an organ system level of organization and are triploblastic. They are worms whose bodies are divided into segments with bristles called setae and false feet called parapodia. Body segmentation is this phylum's greatest advancement and leads to more highly specialized segmentation in animals like the arthropods
- Evolutionary History** – The first confirmed fossil of Annelids are dated 516 million years ago in the early Cambrian.
- Biogeography** – Annelids have a worldwide distribution and occur in marine and fresh water along with terrestrial soils.



Era	System & Period	Series & Epoch
CENOZOIC	Quaternary	Recent
		Pleistocene
	Tertiary	Pliocene
		Miocene
		Oligocene
		Eocene
Paleocene		
MESOZOIC	Cretaceous	
	Jurassic	
	Triassic	
PALEOZOIC	Permian	
	Carboniferous	Pennsylvanian
		Mississippian
	Devonian	
	Silurian	
	Ordovician	
	Cambrian	
Precambrian		



Annelida

Level of Organization	Organ-system
Tissue Layers	Triploblastic
Digestive System	Alimentary Canal
Excretory System	Metanephridia
Circulatory System	Closed system
Respiratory System	Skin, Gills, or parapodia
Nervous System	Pair of cerebral ganglia with double ventral nerve cords
Body Cavity	True
Asexual Reproduction	Budding in some
Sexual Reproduction	Monecious or dioecious

Class: Clitellata

1. **General Characteristics** – The “old” classification of annelids has been determined to be paraphyletic. There is still uncertainty of what should occur with the old classes. **The best evidence suggests that the oligochaeta and the hirudinidea are now grouped together in a class Clitellata** with the two former classes placed into subgroups or clades
2. **Unique Characteristics** – **These have few or no setae per segment, and no parapodia.** However, they have a unique reproductive organ, the ring-shaped **clitellum around their bodies, which produces a cocoon** that stores and nourishes fertilized eggs until they hatch.
3. **Biogeography** – Annelids are found **throughout the world, from deep ocean bottoms to high mountain glaciers.**
4. **Evolutionary History** – It is now suggested this is a clade found under the polychaete worms. They are soft bodied and don't fossilize well but the **earliest known fossil burrow of clitellata are known from the Triassic period 250 mya.**
5. **Habitat** – These species exist in and have adapted to various ecologies - some in **marine environments as distinct as tidal zones and hydrothermal vents, others in fresh water, and yet others in moist terrestrial environments.**



Clade: Oligochaeta

1. **General Characteristics** – This clade which includes earthworms have a sticky pad in the roof of the mouth.
2. **Habitat** - Most are burrowers but some are aquatic and marine found all over the world.
3. **Diet** - They feed on wholly or partly decomposed organic materials



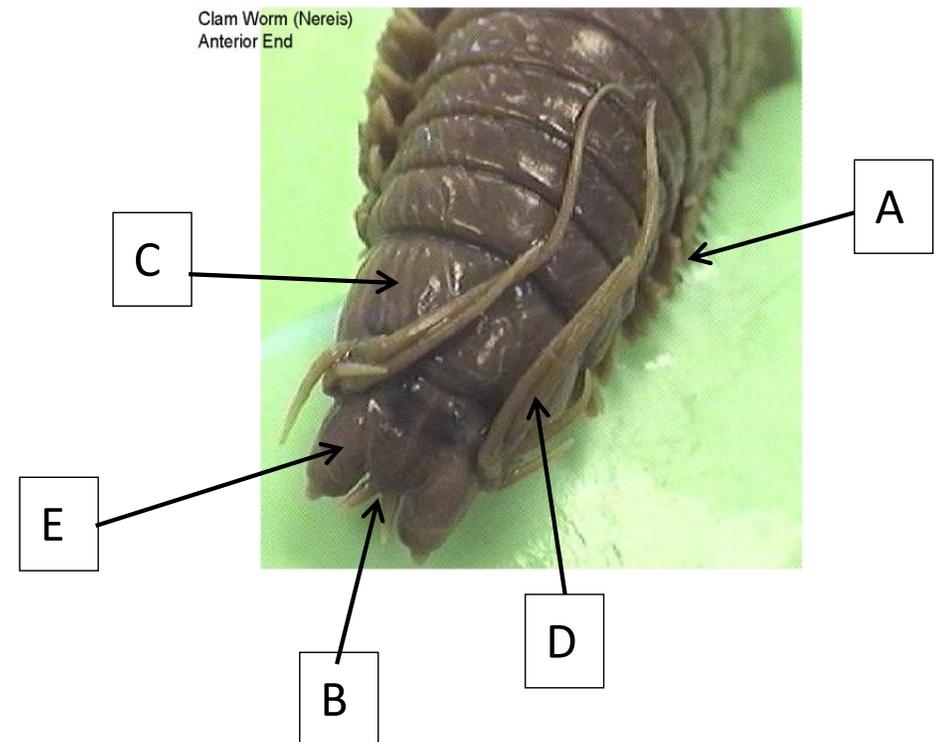
Clade: **Hiurinidea**

1. **General Characteristics** – The name means "leech-shaped" and whose best known members are leeches. They have suckers at both ends of their bodies, and use these to move rather like inchworms.
2. **Habitat** – **Marine and fresh water**
3. **Diet** - Marine species are mostly blood-sucking parasites, mainly on fish, while most freshwater species are predators.

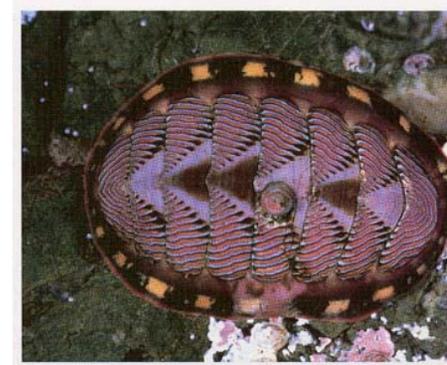


Class: Polycheta

- 1. General Characteristics** – As their name suggests, they have **multiple setae** ("hairs") per segment. Polychaetes have **parapodia that function as limbs, and they are thought to be chemosensors.**
- 2. Unique Characteristics – Structures - Be able to recognize the following structures:**
 - A. Parapodia with setae
 - B. Mouth
 - C. Prostomium
 - D. Tentacles
 - E. Palps
- 3. Evolutionary History** – The earliest polychetes are known from their jaws found in the **early Cambrian (516 mya)**
- 4. Biogeography** – **Worldwide**
- 5. Habitat** – **Most are marine animals, although a few species live in fresh water and even fewer on land. They can be free-living or live in tubes they secrete**



Phylum: Mollusca



- General Characteristics and structures** – Mollusca differ from other animals because they are **coelomates that are soft bodied and unsegmented**. This phylum is the second largest and probably one of the most familiar invertebrate groups. They have an **organ system level of organization** and are **triploblastic**. Mollusks are soft-bodied animals but many are protected by a hard, **calcium carbonate shell**. Despite their apparent differences, all mollusks have a similar body plan, **which consists of a muscular foot for movement, a visceral mass containing the internal organs, and a mantle that may secrete a shell**. Most mollusks also contain a rasping organ called a **radula (except bivalves)**.
- Evolutionary History** – Fossil records are plentiful but the origin is still in question due to arguments on whether these early fossils are actually mollusks. They are sure they showed up at least in the early Cambrian.
- Biogeography** – Mollusks are the largest marine phylum, comprising about 23% of all the named marine organisms. Numerous mollusks also live in freshwater and terrestrial habitats around the world.

Era	System & Period	Series & Epoch
CENOZOIC	Quaternary	Recent
		Pleistocene
	Tertiary	Pliocene
		Miocene
		Oligocene
		Eocene
MESOZOIC	Cretaceous	
	Jurassic	
	Triassic	
PALEOZOIC	Permian	
	Carboniferous	Pennsylvanian
		Mississippian
	Devonian	
	Silurian	
	Ordovician	
Cambrian		
	Precambrian	



Mollusca

Level of Organization	Organ-system
Tissue Layers	Triploblastic
Digestive System	Alimentary Canal
Excretory System	Metanephridia
Circulatory System	Open system with heart
Respiratory System	Gills, lungs or body
Nervous System	Pair of cerebral ganglia with nerve cords
Body Cavity	True
Asexual Reproduction	None
Sexual Reproduction	Most are dioecious

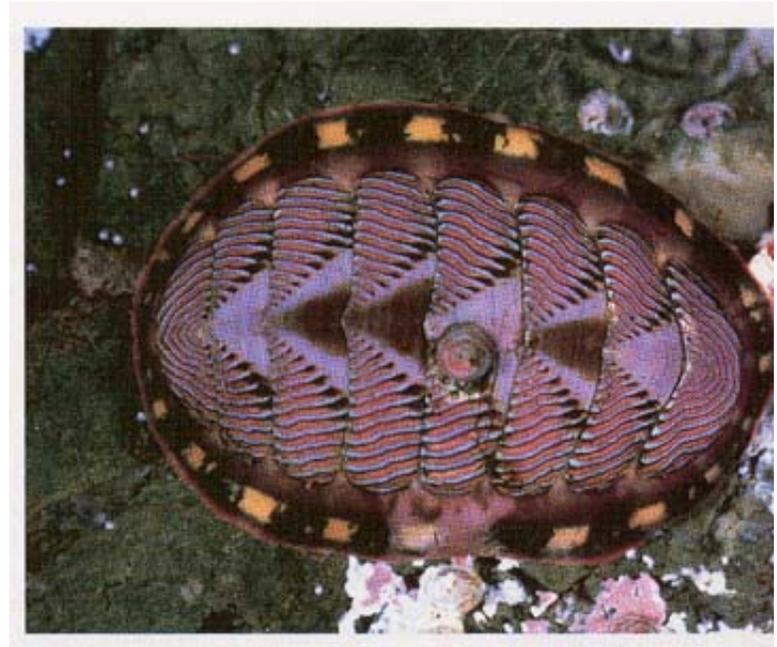
Class: Monoplacophora

- 1. General Characteristics –** Monoplacophorans are **singled shelled animals** that their body (unlike other molluscans) are **segmented**. They have **foot for locomotion, a reduced head and a radula**.
- 2. Unique Characteristics –** They were thought to be extinct until **1952** when living individuals were discovered.
- 3. Biogeography – Deep marine environments of the world.**
- 4. Habitat – Continental shelves and slopes**



Class: Polyplacophora

1. **General Characteristics** – Chiton are species where they have an external shell made of 8 plates. The foot is used for locomotion. They have a reduced head that contains a radula.
2. **Unique Characteristics** – They have a shell with 8 overlapping plates.
3. **Biogeography** – Worldwide in cold water, warm water, and in the tropics. Most chiton species inhabit intertidal or subtidal zones, and do not extend beyond the photic zone.
4. **Habitat** – They live on hard surfaces, such as on or under rocks, or in rock crevices. Some species live quite high in the intertidal zone and are exposed to the air and light for long periods. Others live subtidally. A few species live in deep water.



Class: Gastropoda

1. **General Characteristics** – The **Gastropoda**, more commonly known as **snails and slugs**, are a large taxonomic class. They have a distinct head and The shell is coiled, reduced or absent in some) and the foot is used for locomotion. They have a radula for feeding.
2. **Unique Characteristics:** Most shelled species are asymmetrical and spiral to the right (dextral) but some spiral to the left (sinistral). This is called torsion. Unshelled gastropods may appear normal but have gone through a process called detorsion.
3. **Biogeography** – **Worldwide**
4. **Habitat** – The class Gastropoda has an extraordinary diversification of habitats. Representatives live in gardens, woodland, deserts, and on mountains; in small ditches, great rivers and lakes; in estuaries, mudflats, the rocky intertidal, the sandy subtidal, in the abyssal depths of the oceans including the hydrothermal vents, and numerous other ecological niches, including parasitic ones.



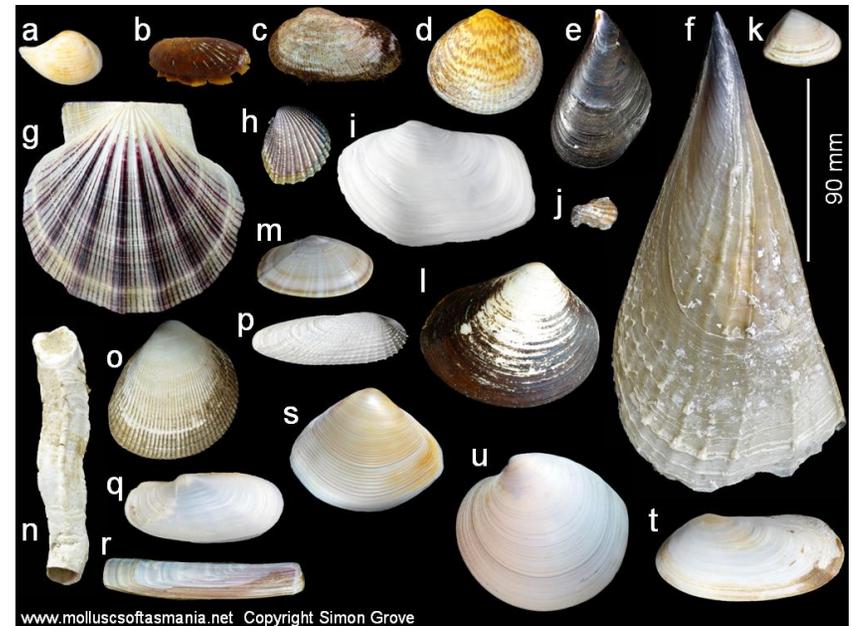
Class: Scaphopoda

1. **General Characteristics** – They have a shell shaped like a tooth or tusk therefore they are called a tooth or tusk shells. They are filter feeders that use their foot to burrow into the sand. They have a reduced head.
2. **Unique Characteristics** – The radula is used to move food into the gizzard.
3. **Biogeography** – Worldwide
4. **Habitat** – Benthic Species buried in the sand



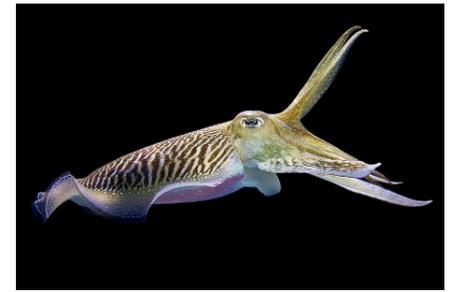
Class: Bivalvia (Pelecypoda)

- 1. General Characteristics** – They are mollusks that have laterally compressed bodies enclosed by a shell consisting of two hinged parts.. They include clams, oysters, cockles, mussels, scallops, and numerous other families that live in saltwater, as well as a number of families that live in freshwater. The majority are filter feeders. Most bivalves bury themselves in sediment, where they are relatively safe from predation. Others lie on the sea floor or attach themselves to rocks or other hard surfaces. A few bore into wood, clay, or stone and live inside these substances.
- 2. Unique Characteristics** – Bivalves have no distinct head, and they also lack a radula. The foot is used for locomotion and burrowing.
- 3. Biogeography** – Aquatic habitats around the world.
- 4. Habitat** – Marine and freshwater



Class: Cephalopoda

1. **General Characteristics** – These marine animals are characterized by bilateral body symmetry, a prominent head, and a set of arms or tentacles modified from the primitive molluscan foot used to move over surfaces and steer when swimming. This class includes octopus, squid, cuttlefish and Nautilus. The shell is external, internal or absent. They have a mouth with a radula. Their locomotion is by a siphon (made from the mantle).
2. **Unique Characteristics** – Cephalopods are widely regarded as the most intelligent of the invertebrates, and have well developed senses and large brains.
3. **Biogeography** – Cephalopods are found in all the oceans of Earth
4. **Habitat** – Exclusively Marine



Ecdysozoa

The **Ecdysozoans** are a grouping of protostome animals including **Arthropoda, nematoda, and several smaller phyla**. The taxon was discovered based on molecular data. **Molecular evidence** (rRNA) supports the monophyly of the phyla.

The group is also supported by morphological characters, and includes all animals that **shed their exoskeleton**. This shedding process is called **ecdysis**.



Phylum: Onychophora

- General Characteristics and structures** – This animal has raised questions in taxonomy in the past. Often called the **walking or velvet worm**, these animals **were once thought to be a link between annelids and arthropods**. The reason they were considered a link between the two phyla is **they are segmented like annelids but they have appendages like arthropods**. Unlike arthropods, the appendages are unjointed. **This animal is probably most closely related to the arthropods.**
- Evolutionary History** – Fossils from the **early Cambrian** bear a striking resemblance to the velvet worms
- Biogeography** – **Most common in tropical regions of the Southern Hemisphere**



Era	System & Period	Series & Epoch
CENOZOIC	Quaternary	Recent
		Pleistocene
	Tertiary	Pliocene
		Miocene
		Oligocene
		Paleocene
MESOZOIC	Cretaceous	
	Jurassic	
	Triassic	
PALEOZOIC	Permian	
	Carboniferous	Pennsylvanian
		Mississippian
	Devonian	
	Silurian	
	Ordovician	
Cambrian		
	Precambrian	



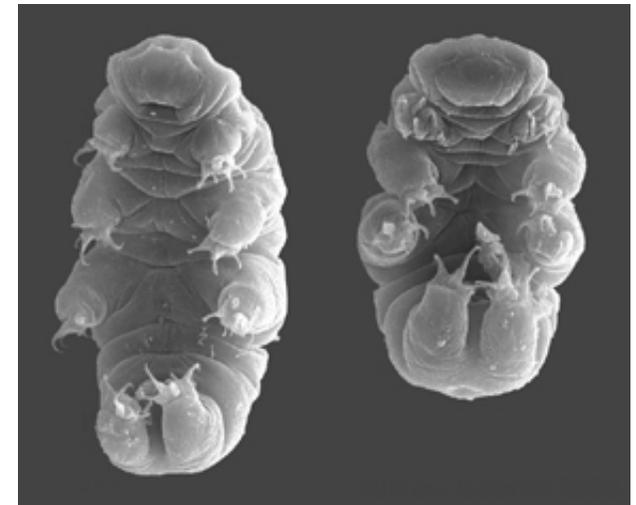
Phylum: Tardigrada



- General Characteristics and structures** – The tardigrades are animals that are commonly called water bears. Tardigrades are classified as extremophiles, organisms that can thrive in extreme conditions. Tardigrades can withstand temperatures from just above absolute zero to well above the boiling point of water, pressures about six times greater than those found in the deepest ocean trenches, and ionizing radiation at doses hundreds of times higher than the lethal dose for a human. They can go without food or water for more than 10 years, drying out to the point where they are 3% or less water, only to rehydrate, forage, and reproduce.
- Evolutionary History** – The earliest fossils come from the mid Cambrian
- Biogeography** – Tardigrades are most common in moist environments, but can stay active wherever they can retain at least some moisture.



Era	System & Period	Series & Epoch
CENOZOIC	Quaternary	Recent
		Pleistocene
	Tertiary	Pliocene
		Miocene
		Oligocene
		Eocene
Paleocene		
MESOZOIC	Cretaceous	
	Jurassic	
	Triassic	
PALEOZOIC	Permian	
	Carboniferous	Pennsylvanian
		Mississippian
	Devonian	
	Silurian	
	Ordovician	
Cambrian		
	Precambrian	



Phylum: Nematoda



- General Characteristics and structures** – The nematodes are animals that exhibit a pseudocoelomate body plan. They are one of the first animals to have an alimentary canal (which has both a mouth and an anus). They exhibit an organ-system level of organization and they are triploblastic. The muscles of nematodes are all longitudinal so they demonstrate a snake-like movement.
- Evolutionary History** – The earliest fossils come from the Precambrian
- Biogeography** – They are found worldwide with over half of them being parasitic. Nematodes have successfully adapted to nearly every ecosystem from marine (salt water) to fresh water, to soils, and from the polar regions to the tropics, as well as the highest to the lowest of elevations

Era	System & Period	Series & Epoch
CENOZOIC	Quaternary	Recent
		Pleistocene
	Tertiary	Pliocene
		Miocene
		Paleocene
MESOZOIC	Cretaceous	
	Jurassic	
	Triassic	
PALEOZOIC	Permian	
	Carboniferous	Pennsylvanian
		Mississippian
	Devonian	
	Silurian	
	Ordovician	
Cambrian		
	Precambrian	



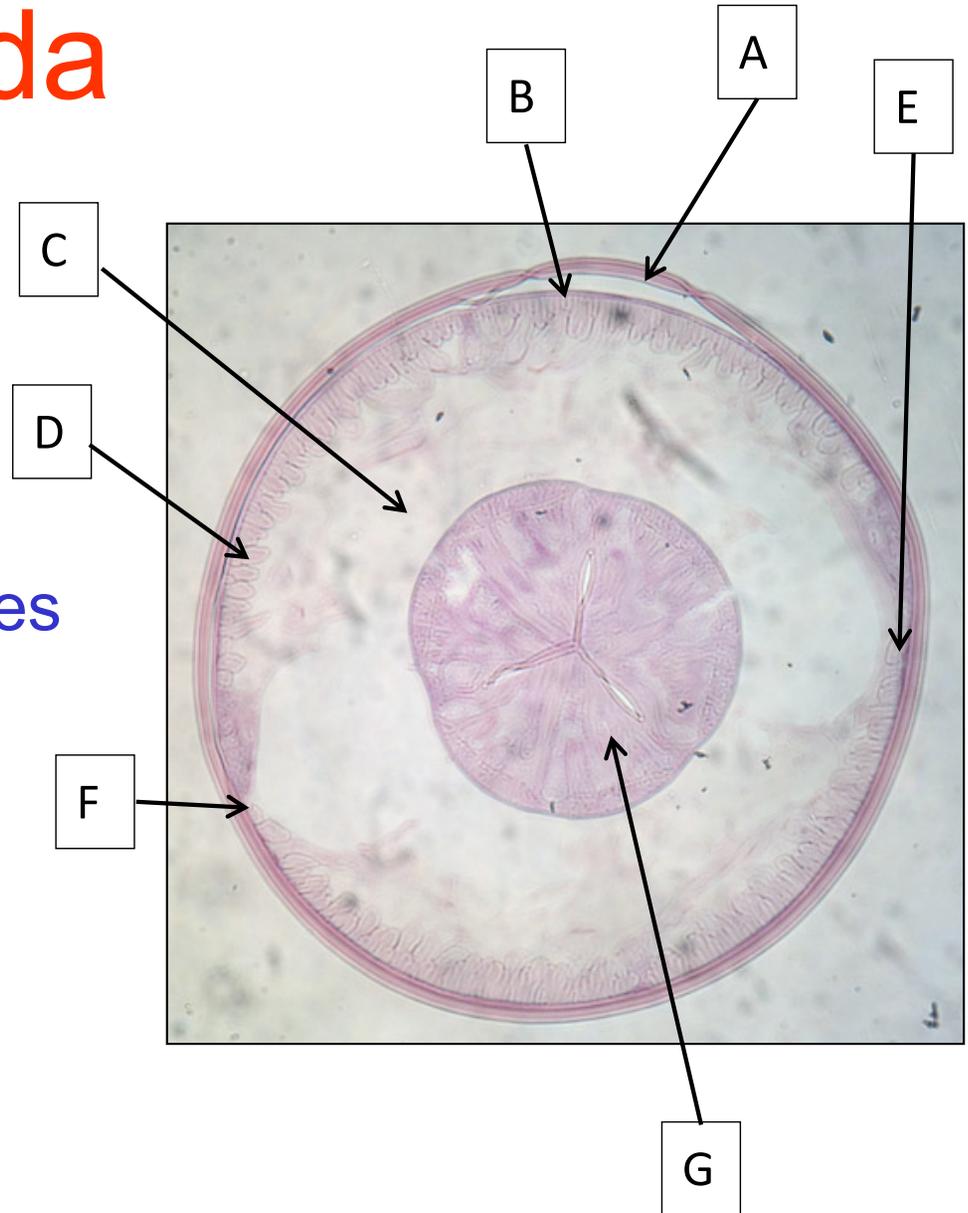
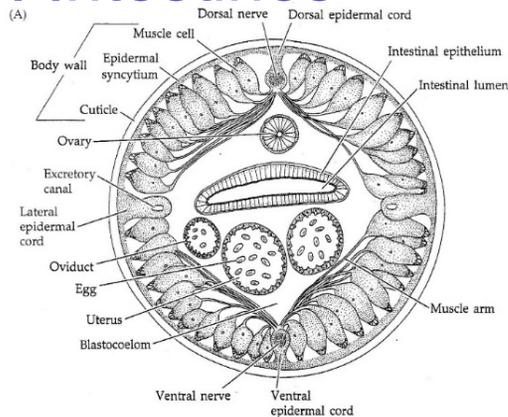
Nematoda

Level of Organization	Organ-system
Tissue Layers	Triploblastic
Digestive System	Alimentary Canal
Excretory System	Protonephridia or absent
Circulatory System	None
Respiratory System	None, body surface
Nervous System	Pair of cerebral ganglia with long nerve cords
Body Cavity	False (not completely lined with mesoderm)
Asexual Reproduction	None
Sexual Reproduction	Complicated life cycles

Class: Nematoda

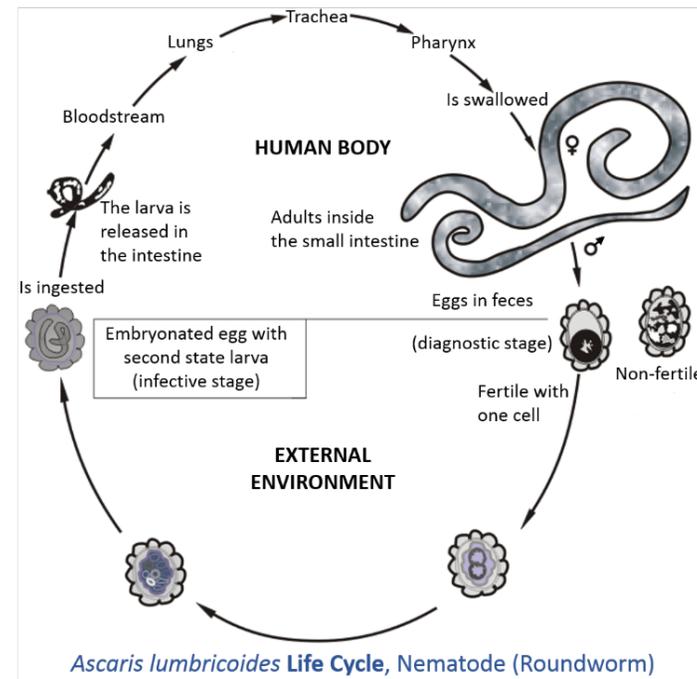
Know the following structures:

- A. Cuticle
- B. Epidermis
- C. Pseudocoel
- D. Longitudinal Muscles
- E. Dorsal Nerve Cord
- F. Ventral Nerve Cord
- G. Intestines



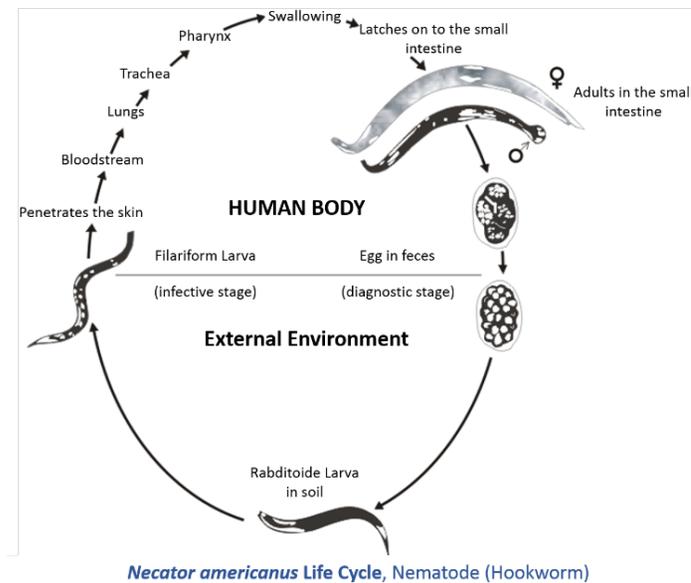
Ascaris lumbricoides

- 1. General Characteristics –** The body is long, slender, smooth, unsegmented and pointed at both ends and lives in the **hosts small intestine**.
- 2. Unique Characteristics –** The males of this species are about 6 to 10 inches long and have a curved posterior end that bears bristle-like copulatory spicules near the genital pore. The females are about 12 to 14 inches long are not curved near the genital pore.
- 3. Biogeography –** Ascariasis is common in Africa and in Southeast Asia. It also occurs in the United States including Gulf Coast
- 4. Hosts -** The human intestinal roundworm may actually be found living as a **parasite in the small intestines of horses, pigs, and humans**.
- 5. Infection mode–** Children that play in the dirt often **ingest the eggs**



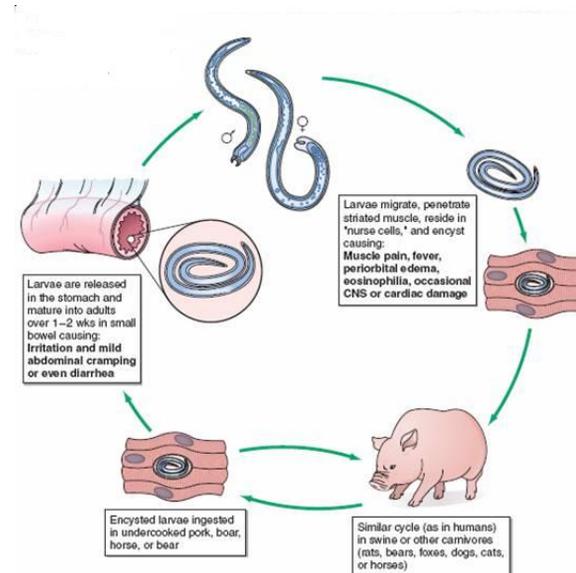
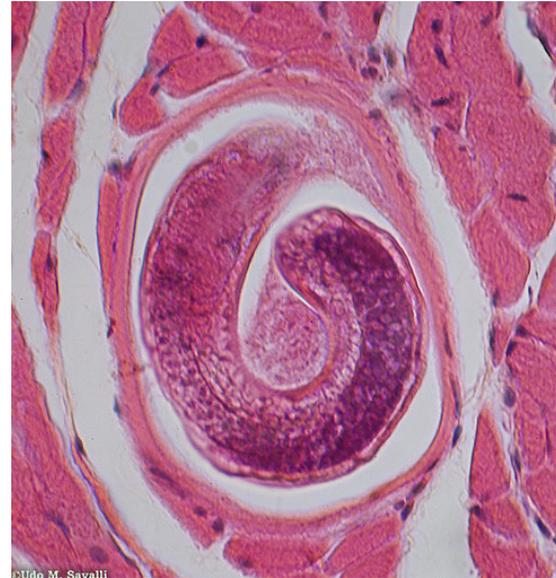
Necator americanus

- 1. General Characteristics –**
The American hookworm lives in warm climates because the **larvae form is found in the soil** and can't survive colder climates. The adult male is 7-9mm long and the female adult is 9 – 11 mm long. **The adult is found in the small intestines of the host.** Heavy infestations can cause anemia or death.
- 2. Unique Characteristics –**
Males have conspicuous copulatory bursa supported by fleshy rays.
- 3. Biogeography –** New World
- 4. Hosts –** Humans
- 5. Infection mode–** The eggs are passed in the feces and the juveniles live in the soil until they can burrow into the skin of the host and work their way back into the intestines via the lungs



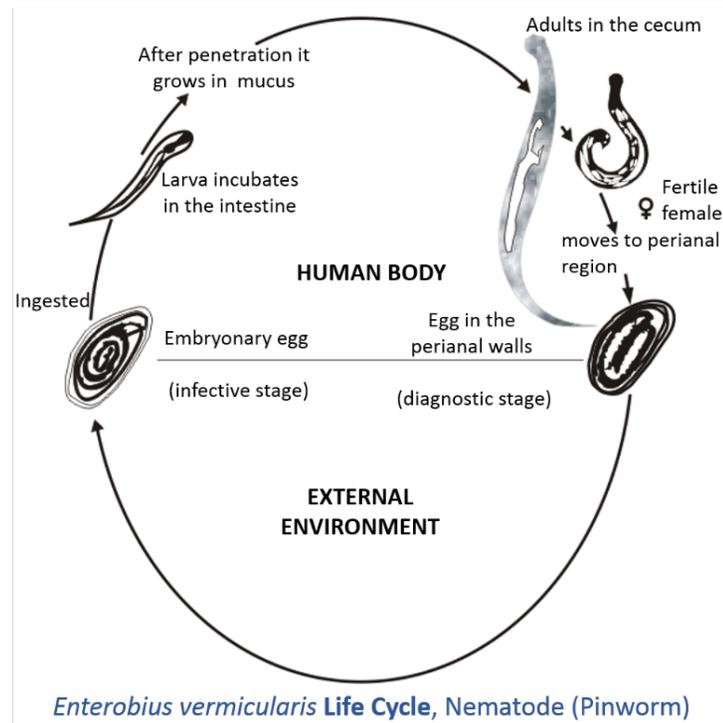
Trichinella spiralis

1. **General Characteristics** – Adult worms penetrate the small intestine where the adult female produces living young. The juveniles burrow into the circulatory system and are carried throughout the body and eventually burrow their way into skeletal muscle and form a cyst.
2. **Unique Characteristics** – It causes the lethal disease **trichinosis**
3. **Biogeography** – All continents except Antarctica
4. **Hosts** – The pork roundworm is a parasite that infects **pigs, rats, humans, and other mammals that are carnivorous.**
5. **Infection mode** – The organism enters the host when a host ingests **raw or undercooked meat.**



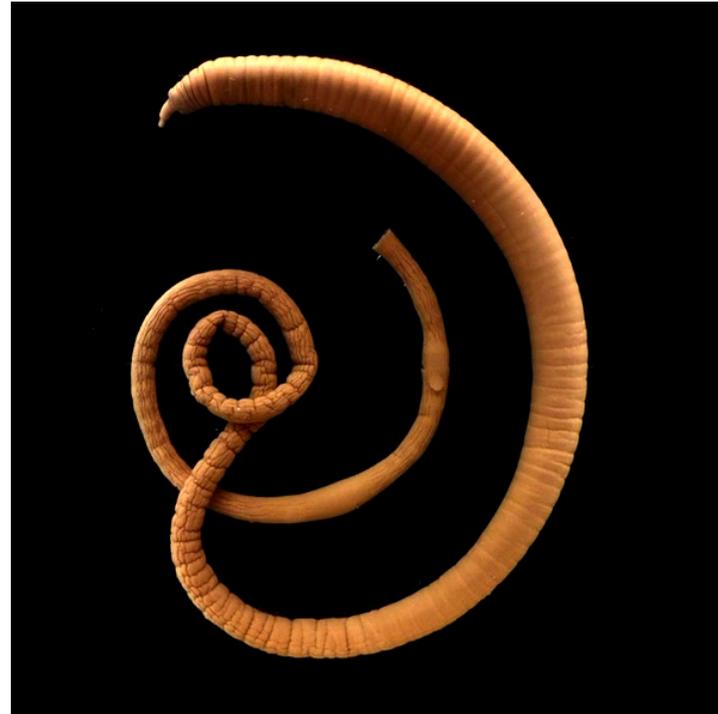
Enterobius vermicularis

- 1. General Characteristics** – The pinworm is a common **intestinal parasite** that infects **children of all nations and social classes**. The **female worm migrates to the anal region at night and deposits her eggs**. This causes an **irritation around the anus causing it to itch**. **Scratching the area, may transfer the eggs to the hands which can then be swallowed and a person then is reinfected**.
- 2. Unique Characteristics** – Be able to recognize this species (It has a clear tail with the anus at the end of the worm).
- 3. Biogeography** – Worldwide
- 4. Hosts** – Humans
- 5. Infection mode** – Ingestion of eggs



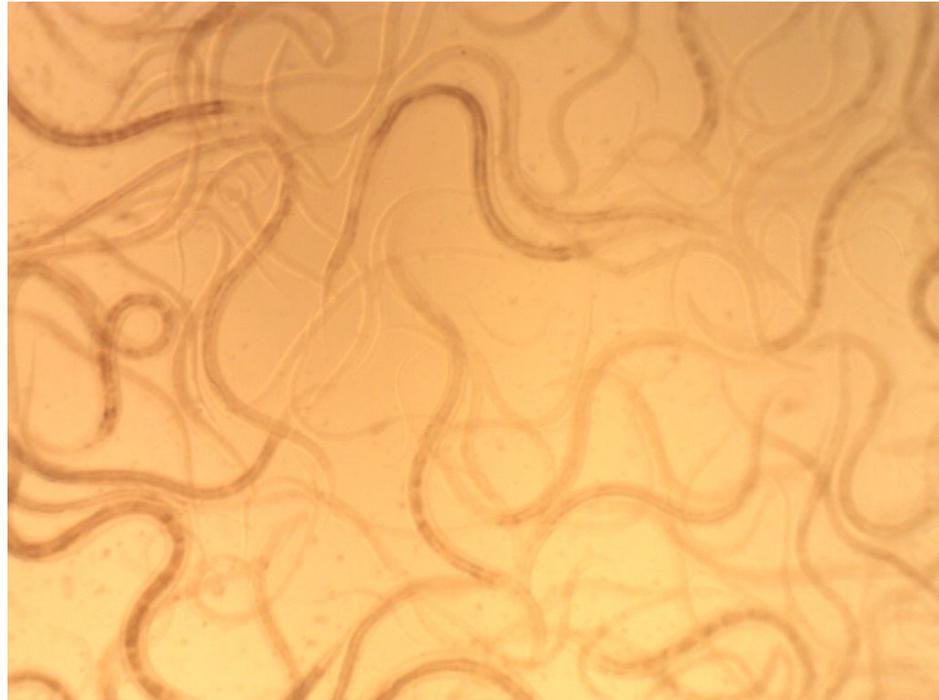
Macracanthorhynchus hirudinaceus

1. **General Characteristics** – This species is known as a spiny-headed worm and is often placed in the phylum Acanthocephala
2. **Unique Characteristics** – . It is an **endoparasite** entering the small intestines by a spiny proboscis.
3. **Biogeography** – They are found in both temperate and tropical climates.
4. **Hosts** – It is usually found in pigs but can sometimes be found in humans.
5. **Infection mode** – The larvae of this species is found in beetle larvae (gubs) and can be taken into the body by eating the grubs.



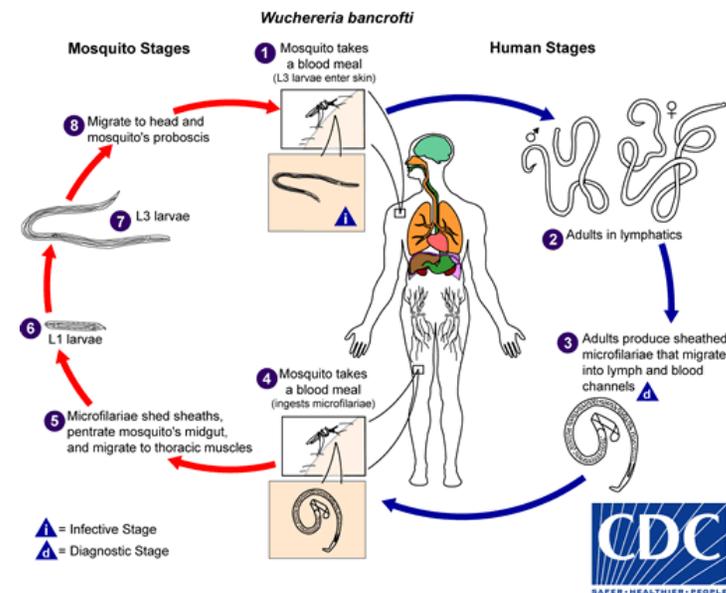
Tubatrix aceti

1. **General Characteristics** –
The vinegar eel is a tiny, **free-living nematode** sometime found in vinegar.
2. **Unique Characteristics** –
The worms are most abundant in the bottom sediments of unpasteurized vinegar and other fermented fruit juices. Vinegar eels thrive in such acid conditions, and feed on the yeast and bacteria growing in the sediment. .
3. **Biogeography** – Worldwide
4. **Hosts** – None
5. **Infection mode** – None



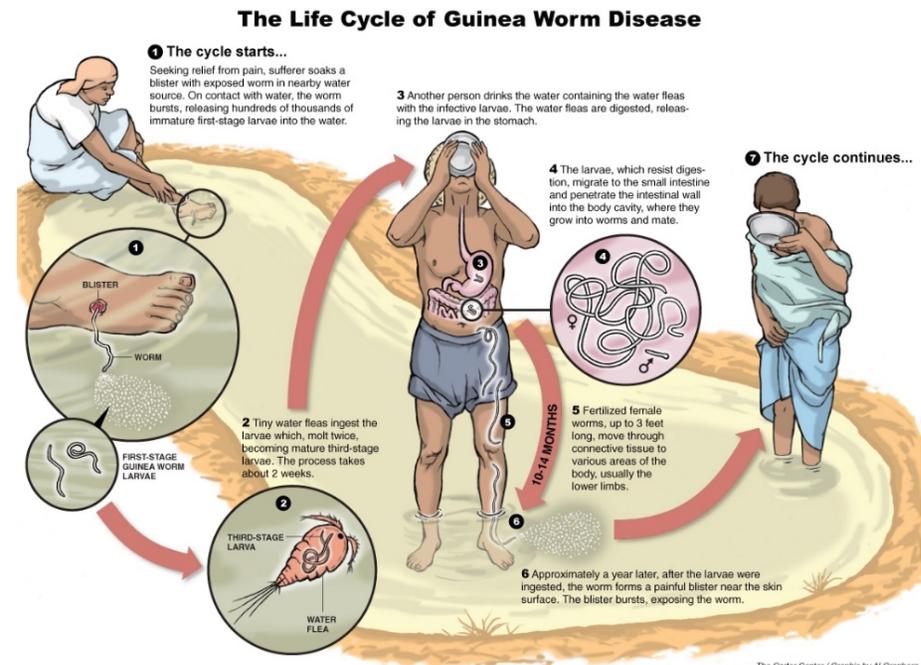
Wuchereria bancrofti

- 1. General Characteristics** – This worm is a human parasitic roundworm. It **infects the lymphatic system to cause lymphatic filariasis.**
- 2. Unique Characteristics** – If the infection is left untreated, it can develop into a chronic disease called **elephantiasis.**
- 3. Biogeography** – Found primarily in Central Africa and the Nile delta, South and Central America, and the tropical regions of Asia including southern China and the Pacific
- 4. Hosts** – Humans
- 5. Infection mode** – These filarial worms are spread by a **mosquito vector** and affects over 120 million people



Dracunculiasis sp.

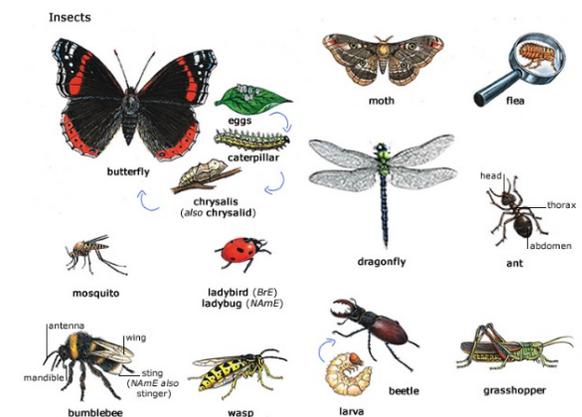
1. **General Characteristics** – This worm is also called the **guinea worm**. Initially there are no symptoms. About one year later, the person develop a painful burning feeling as the **female worm forms a blister in the skin, usually on the lower limb**. The worm then comes out of the skin over a few weeks. During this time it may be difficult to walk or work
2. **Unique Characteristics** – To extract the worm, a person must wrap the live worm around a piece of gauze or a stick. The process can be long, taking anywhere from hours to a week.
3. **Biogeography** – Asia and Africa
4. **Hosts** – **Humans** are the only known animal that guinea worms infect.
5. **Infection mode** – A person becomes infected **when he drinks water that contains water fleas infected with guinea worm larvae**



Phylum: Arthropoda

- General Characteristics and structures** – Arthropods are different from all other animals because they are eucoelomates with a hard, segmented body. The phylum Arthropoda (jointed-foot) consists of most of the known animals and many are enormously abundant as individuals. The general characteristics of the arthropods include a hard exoskeleton called a cuticle made up of chitin and proteins. This hard exoskeleton gives the organism's segmented body protection and a place for muscle attachment. Arthropods also have jointed appendages that allow for specialized functions. They have an organ system level or organization and they are triploblastic. There are five subphyla: Trilobita, Checlicerata, Crustacea, Myriapoda, and Hexapoda.
- Evolutionary History** – The earliest fossils come from the Precambrian
- Biogeography** – Worldwide

Era	System & Period	Series & Epoch
CENOZOIC	Quaternary	Recent
		Pleistocene
	Tertiary	Pliocene
		Miocene
		Oligocene
		Paleocene
MESOZOIC	Cretaceous	
	Jurassic	
	Triassic	
PALEOZOIC	Permian	
	Carboniferous	Pennsylvanian
		Mississippian
	Devonian	
	Silurian	
Ordovician		
Cambrian		
	Precambrian	



Arthropoda

Level of Organization	Organ-system
Tissue Layers	Triploblastic
Digestive System	Alimentary Canal with modified mouth parts
Excretory System	Nephridia
Circulatory System	Open system with heart
Respiratory System	Skin, gills, tracheae or book lungs
Nervous System	Dorsal brain with ring connected to ventral cords
Body Cavity	True
Asexual Reproduction	Budding in some
Sexual Reproduction	Usually Dioecious

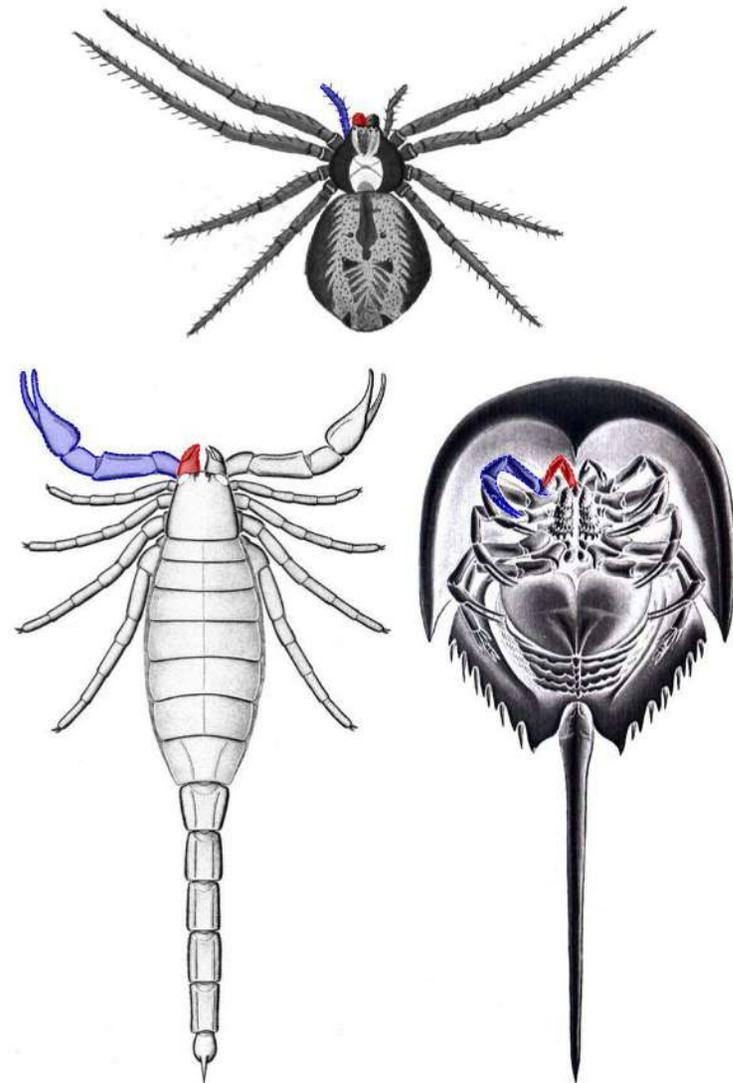
Subphylum: Trilobita

1. **General Characteristics** – This subphylum (like other arthropods) **have paired appendages..**
2. **Unique characteristics** – **They are different from other arthropods because they are segmented without any specialization.**
3. **Biogeography** - **This subphylum are all extinct (Permian era – 250 mya)**



Subphylum: Chelicerata

1. **General Characteristics** – Chelicerata all have 6 pairs of appendages. The first pair is modified into chelicerae. The next pair are modified into pedipalps. The last 4 pairs are walking legs. These animals have one or two body regions (cephalothorax and abdomen).
2. **Unique characteristics** – These animals do not have a mandible or any antennae.



Class:

Eurypterids

1. **General Characteristics** - The Eurypterids or water scorpions are animals that are now extinct. They were normally marine and freshwater predators.
2. **Unique Characteristics** – This class includes the largest known arthropod to ever live.
3. **Biogeography** – Extinct



Class:

Merostomata

1. **General Characteristics** – The first pair of appendages are modified into chelicerae but the second pair is not modified into pedipalps like other chelicerates.
2. **Unique Characteristics** – The Horseshoe crab's larvae look similar to the extinct trilobites.
3. **Biogeography** – Eastern U.S. and Eastern Asia
4. **Habitat** - These organisms (horseshoe crabs) are found in shallow coastal waters.



Class:

Pycnogonida

1. **General Characteristics** – These animals (sea spiders) often have eight legs (like true spiders) but they are not a spider.
2. **Unique Characteristics** – They may have extra legs from their segments being duplicated
3. **Biogeography** - Worldwide
4. **Habitat** – These organisms (sea spiders) are usually found in shallow coastal waters and many polar oceans..



Class:

Arachnida

1. **General Characteristics** – These organisms include **spiders, scorpions, ticks, and mites**. They have a special gland that can produce silk used for webs, eggs, escape, and courtship.
2. **Unique Characteristics** – Spiders contain modified chelicerae which are used as fangs to inject poison. **Scorpions** are the first terrestrial invertebrates. Their pedipalps are modified into pinchers and their tail is modified into a stinger. Ticks and mites are shaped for their parasitic lifestyle..
3. **Biogeography** – **Worldwide**
4. **Habitat** - **Almost all extant arachnids are terrestrial.** However, some inhabit freshwater environments and, with the exception of the pelagic zone, marine environments as well. Some are parasitic.



Subphylum: Crustacea

1. **General Characteristics** – Crustacea have **two pair of antennae**. Each appendage is **biramous** (two main branches). **They have mandibles**. These animals have **two or three body regions** (cephalothorax and abdomen or head, thorax, and abdomen).
2. **Unique characteristics** – **These animals are mostly marine**.
3. **Biogeography** - **Worldwide**



Group: Isopoda

1. **General Characteristics** – The isopods are the most diverse group of crustaceans. They have two pairs of antennae, seven pairs of jointed limbs on the thorax, and five pairs of branching appendages on the abdomen.
2. **Habitat** - These animals are found in terrestrial, freshwater, and saltwater habitats.
3. **Diet** - Isopods have various feeding methods: some eat dead or decaying plant and animal matter, others are grazers or strain food particles from the water around them, a few are predators, and some are internal or external parasites, mostly of fishes



Group: Decapoda

1. **General Characteristics** – The decapods include many of the familiar crustaceans. all decapods have ten legs, in the form of five pairs of thoracic appendages on the last five thoracic segments. The front three pairs function as mouthparts and are generally referred to as maxillipeds;
2. **Habitat** – They are mostly aquatic species.
3. **Diet** - Most decapods are scavengers



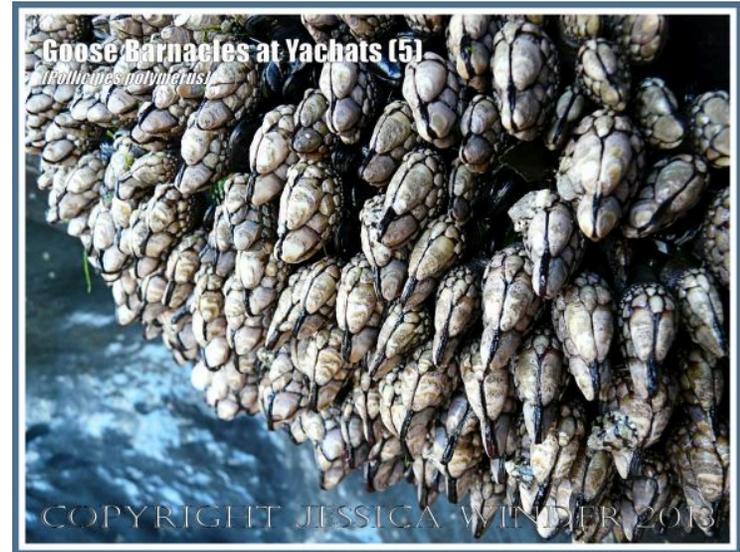
Group: Copepoda

1. **General Characteristics** – The copepods are animals that are among the most numerous members of the marine and freshwater plankton community.
2. **Habitat** – Copepods are a group of small crustaceans found in the sea and nearly every freshwater habitat.
3. **Diet** – Phytoplankton



Group: Cirripedia

- 1. General Characteristics –**
They are encrusters which attach themselves to the rocks. Inside the carapace, the animal lies on its back, with its limbs projecting upwards. Segmentation is usually indistinct, and the body is more or less evenly divided between the head and thorax, with little, if any, abdomen. Adult barnacles have few appendages on their heads, with only a single, vestigial pair of antennae, attached to the cement gland. The six pairs of thoracic limbs are referred to as "cirri", which are feathery and very long, being used to filter food, such as plankton, from the water and move it towards the mouth.
- 2. Habitat –** Barnacles are exclusively marine, and tend to live in shallow and tidal waters, typically in erosive settings.
- 3. Diet –** Suspension feeders



Subphylum: Myriapoda

1. **General Characteristics** – Myriapods all have appendages that are uniramous (one main branch). The body is long with a distinct head. They have one pair of antennae. These animals also have a mandible.
2. **Unique characteristics** – This subphylum includes millipedes and centipedes.
3. **Biogeography** - Worldwide



Class:

Chilopoda

1. **General Characteristics** – These organisms are centipedes. They have one pair of jointed legs per segment.
2. **Unique Characteristics** – They have poison claws and are predators
3. **Biogeography** – Worldwide
4. **Habitat** - They are found in an array of terrestrial habitats from tropical rainforests to deserts. Accordingly, they are found in soil and leaf litter, under stones and dead wood, and inside logs.



Class:

Diplopoda

- 1. General Characteristics –** These organisms are millipedes. They have two pair or jointed legs per segment. (Two segments have fused together).
- 2. Unique Characteristics –** Most millipedes are slow-moving detritivores, eating decaying leaves and other dead plant matter. Some eat fungi or suck plant fluids, and a small minority are predatory
- 3. Biogeography –** Millipedes occur on all continents except Antarctica, and occupy almost all terrestrial habitats
- 4. Habitat -** Millipedes are typically forest floor dwellers, occurring in leaf litter, dead wood, or soil, with a preference for humid conditions



Subphylum: Hexapoda

1. **General Characteristics** – Hexapods all have 6 appendages, each pair are attached to a segment of the thorax. The body consists of a distinct head, thorax, and abdomen. They have one pair of antennae. These animals also have a mandible.
2. **Unique characteristics** – *Hexapods* are named for their most distinctive feature: a consolidated thorax with three pairs of legs. Most other arthropods have more than three pairs of legs. This subphylum includes the insects.
3. **Biogeography** - Worldwide



Class:

Insecta

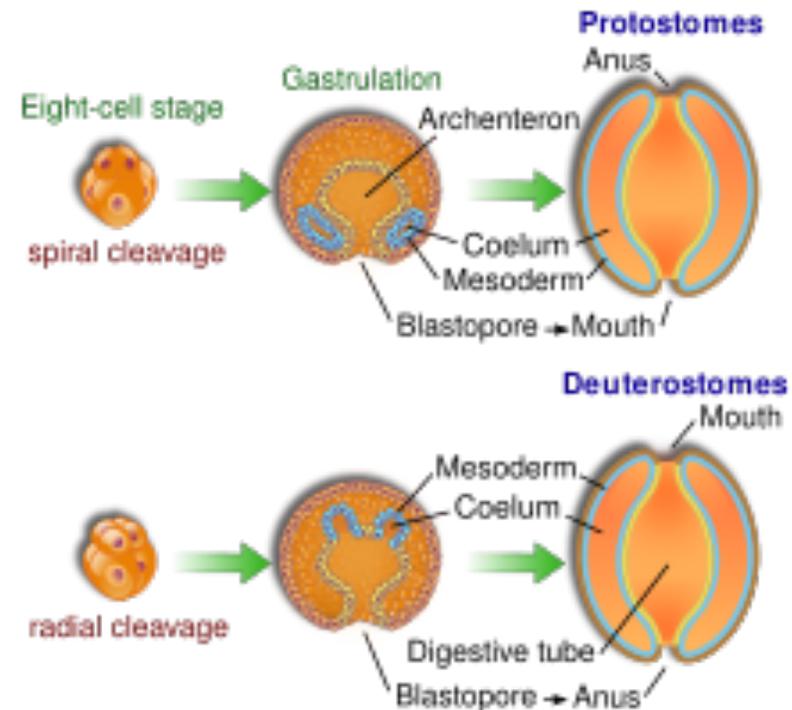
- 1. General Characteristics –**
They are invertebrates within the that have a [chitinous](#) exoskeleton, a three-part body (head, thorax and abdomen), three pairs of jointed legs, compound eyes and one pair of antennae
- 2. Unique Characteristics –**
[Insects are the most diverse of all arthropods. They may have been the cause of angiosperm diversity.](#)
- 3. Biogeography –** Worldwide
- 4. Habitat –** They may be found in every environment.



Deuterostomia

The **Deuterostomia** are a grouping of deuterostome animals including the Echinoderms and the Chordates.

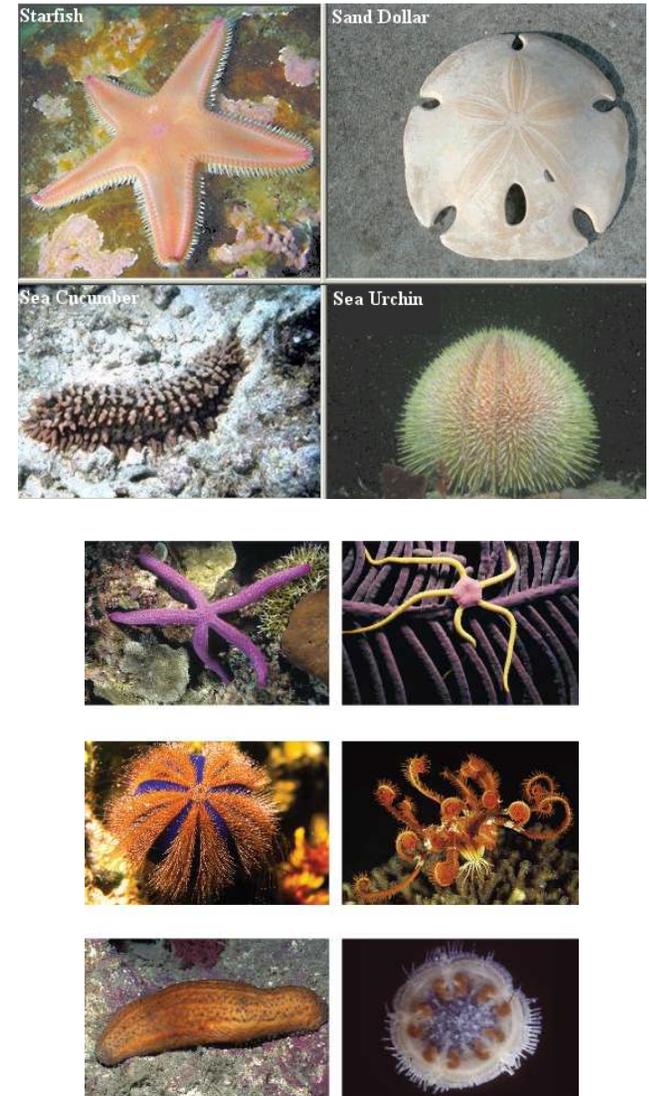
The defining characteristic of the deuterostome is the fact that the blastopore (the opening at the bottom of the forming gastrula) becomes the anus, whereas in protostomes the blastopore becomes the mouth.



Phylum: Echinodermata

- General Characteristics and structures** – The word Echinodermata means “**spiny skin**”. These animals demonstrate **secondary radial symmetry** as adults (evolved from bilateral symmetry back to radial symmetry) while the larvae stage still exhibits bilateral symmetry. They are probably more closely related to the vertebrates because of their **deuterostome** development. Unique to echinoderms is the **water vascular system** used for locomotion, feeding and food exchange.
- Evolutionary History** – Fossils have been found in the **Pre-cambrium**.
- Biogeography** – All echinoderms are marine and most are benthic.

Era	System & Period	Series & Epoch
CENOZOIC	Quaternary	Recent
		Pleistocene
	Tertiary	Pliocene
		Miocene
		Oligocene
		Paleocene
MESOZOIC	Cretaceous	
	Jurassic	
	Triassic	
PALEOZOIC	Permian	
	Carboniferous	Pennsylvanian
		Mississippian
	Devonian	
	Silurian	
	Ordovician	
Cambrian		
	Precambrian	



Echinodermata

Level of Organization	Organ-system
Tissue Layers	Triploblastic
Digestive System	Alimentary canal
Excretory System	Absent
Circulatory System	Reduced if at all
Respiratory System	Dermal branchia, tube feet, respiratory tree
Nervous System	No brain, nerve ring with radial nerves
Body Cavity	True
Asexual Reproduction	Regeneration
Sexual Reproduction	Dioecious

Phylum: Echinodermata

1. Structures –

Oral Side: Side with mouth

Aboral Side: side without mouth

Madreporite: opening into water vascular system

Ambulacral Grooves:
Radiating grooves that contain tube feet

Pedicellariae: pincer-like organs on surface (see compound microscope)

Dermal Branchiae: skin gills

- ## 2. Larvae -
- The larvae form is evidence that this phyla has evolved radial symmetry from a bilateral ancestor. The larvae form is used for dispersal.



Class:

Asteroidea

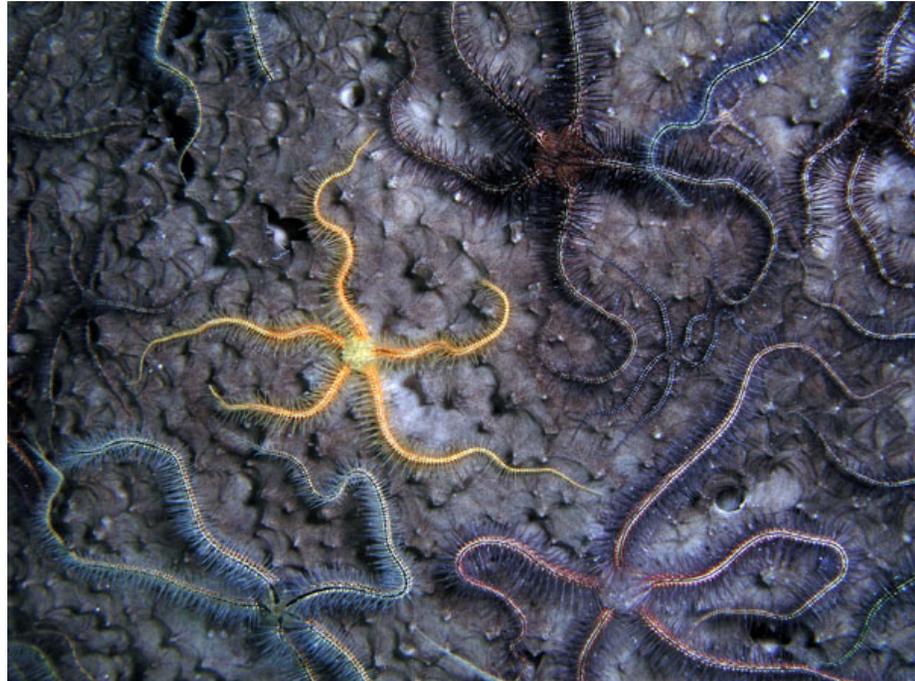
1. **General Characteristics** – Sea stars have five arms that radiate from a central disc. They have an **open** ambulacral groove. The madreporite is on the **aboral** side. They **contain** both pedicellariae and dermal branchiae
2. **Unique Characteristics** – This class includes the sea stars. **The are known for their regenerative abilities.**
3. **Biogeography** – **World oceans**
4. **Habitat** - These species inhabit all of the world's oceans. **Habitats range from tropical coral reefs rocky shores, tidal pools, mud, and sand to kelp forests, seagrass meadows and the deep-sea floor. The greatest diversity of species occurs in coastal areas**



Class:

Ophiuroidea

1. **General Characteristics** – They have five thin arms radiating from a central disc. They have a closed ambulacral groove. The madreporite is on the oral side. They do not have pedicellariae or dermal branchiae.
2. **Unique Characteristics** – This class includes brittle stars which are known for their breaking arms when disturbed.
3. **Biogeography** – World oceans
4. **Habitat** – They live from the low tide zone to the benthic zone.



Class:

Echinodea

1. **General Characteristics** – The Sea urchins and Sand dollars have no arms but have five rows of tube feet. They contain moveable spines. They have closed ambulacral grooves. Their madreporite is on the aboral side. They contain pedicellariae and dermal branchiae.
2. **Unique Characteristics** – The sea urchins have specialized jaw-like structures called an Aristotle's lantern.
3. **Biogeography** – World oceans
4. **Habitat** – Rocky intertidal zones or sandy bottoms



Class:

Holothuroidea

1. **General Characteristics** – Sea cucumbers are soft bodied animals with ambulacral areas (closed) with tube feet. They have an **internal** madreporite. They have **no** pedicellariae or dermal branchiae
2. **Unique Characteristics** – This class includes the sea cucumbers. **Some species are known to eviscerate themselves when threatened**
3. **Biogeography** – **World oceans**
4. **Habitat** – **Sea floor**



Class:

Crinoidea

1. **General Characteristics** – The sea lilies are attached to the substrate with many branched arms. They have open ambulacral grooves. They have no madreporite, pedicellariae or dermal branchiae
2. **Unique Characteristics** – This includes the sea lilies. They are substrate feeders which produce mucus on their tube feet to capture food which floats by.
3. **Biogeography** – World oceans
4. **Habitat** – Shallow and deep water on the sea floor.

