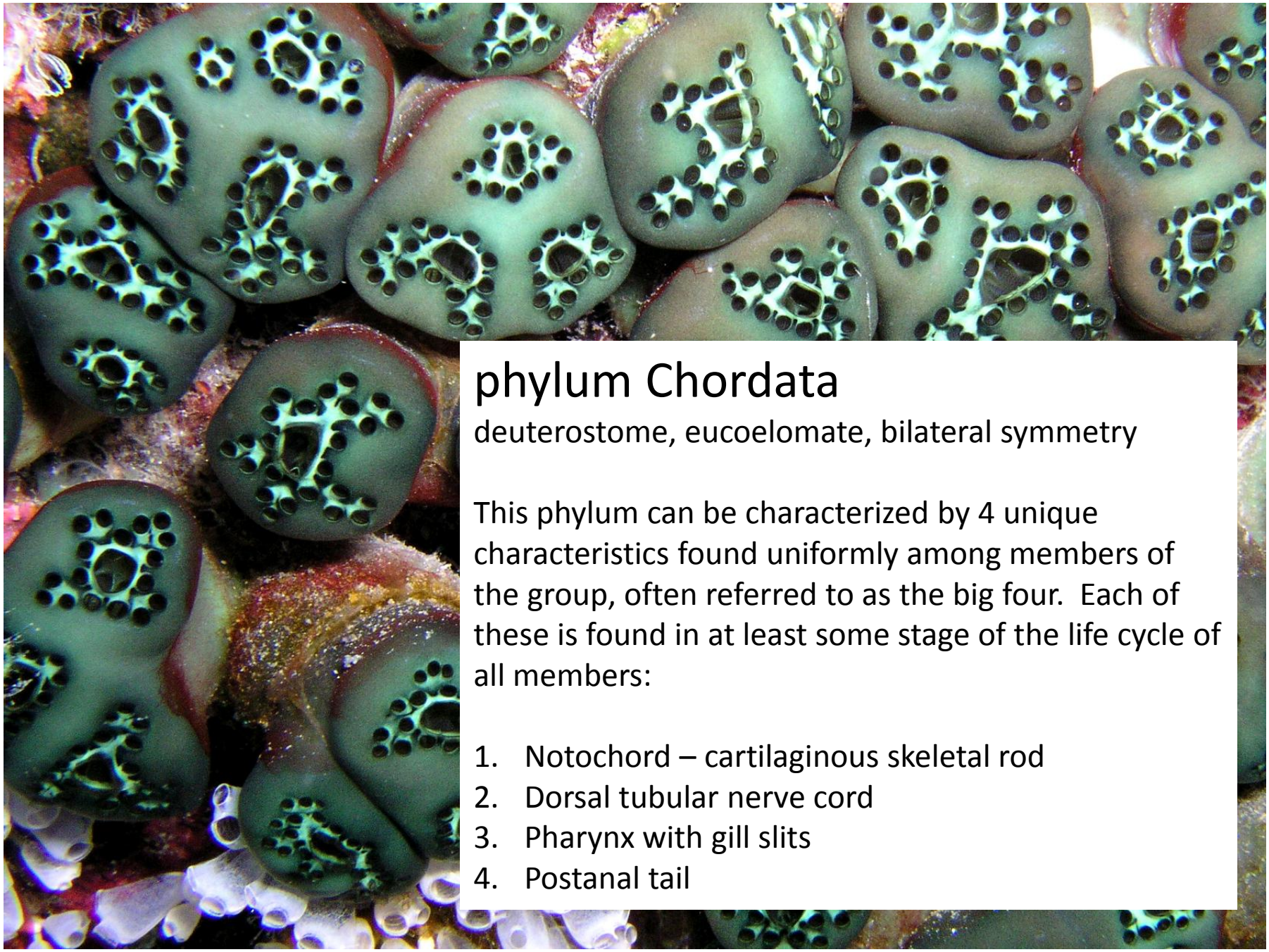


phylum Chordata

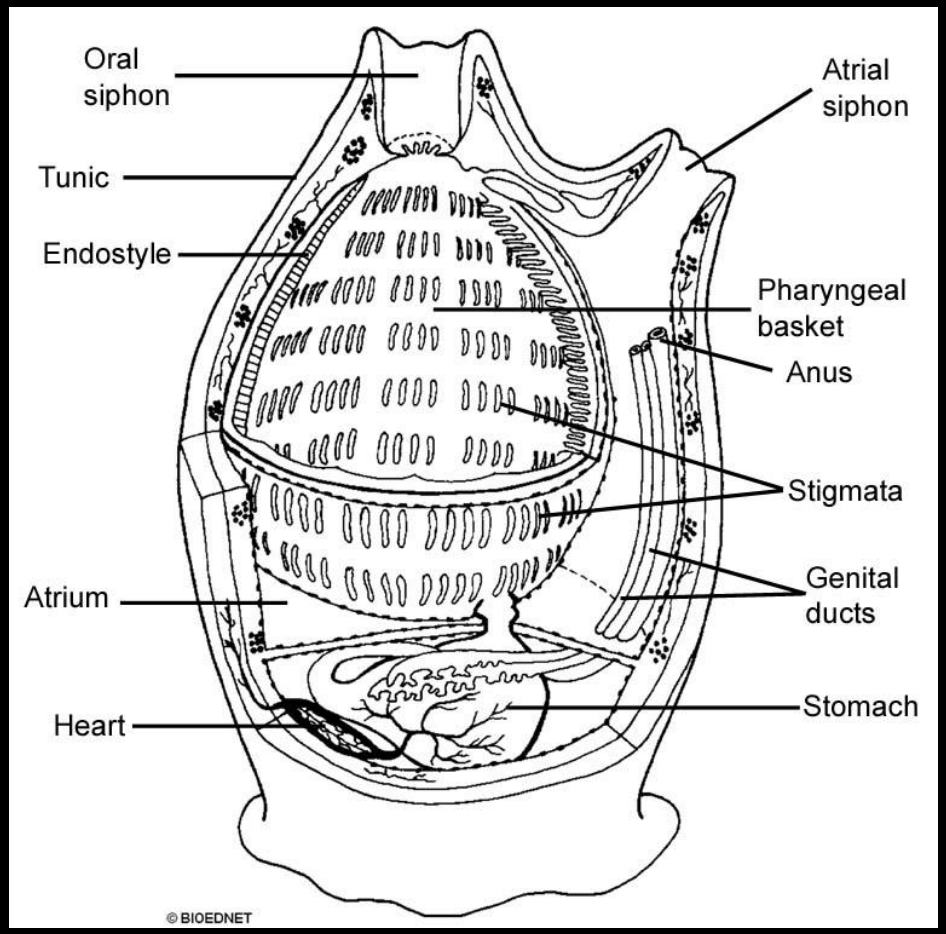
deuterostome, eucoelomate, bilateral symmetry

This phylum can be characterized by 4 unique characteristics found uniformly among members of the group, often referred to as the big four. Each of these is found in at least some stage of the life cycle of all members:

1. Notochord – cartilaginous skeletal rod
2. Dorsal tubular nerve cord
3. Pharynx with gill slits
4. Postanal tail

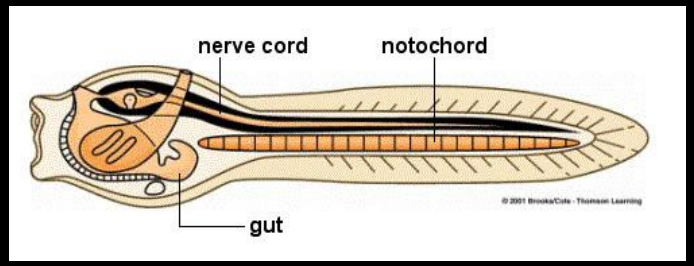
the subphylum UROCHORDATA is named for the fact that the notochord is found only in the tail (and that only goes for the larval form). The sessile adults do not exhibit the 4 chordate characteristics, but are covered with an integument called a tunic (hence they are often called tunicates). They have a water chamber, the atrium, for circulating water through pharyngeal gill slits for filter feeding.

You should know:
incurrent (oral) siphon, excurrent (atrial) siphon
pharynx with gill slits, atrium,
tunic, and coelom



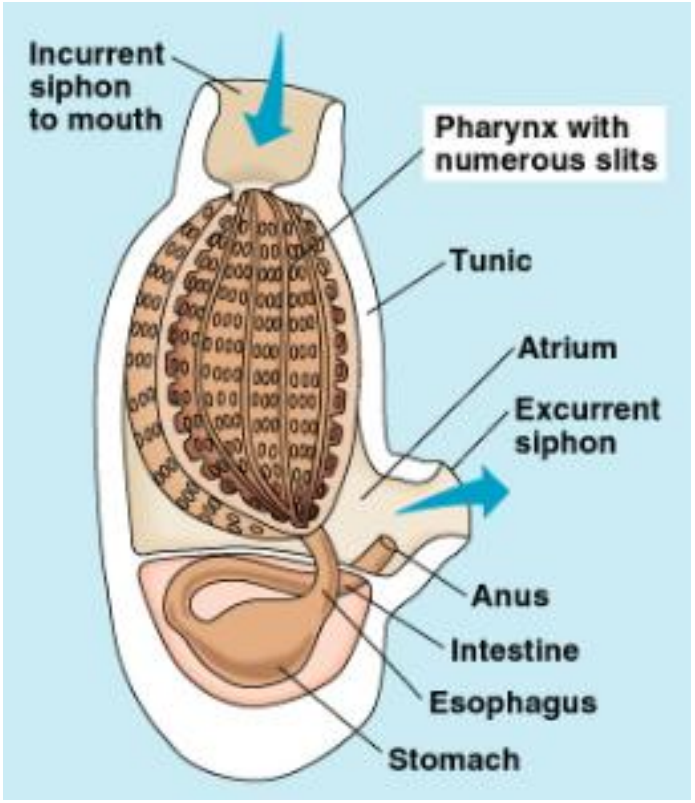
water flows into the pharynx through the mouth and out through gill slits. Tiny food particles are trapped in mucus and moved through the gut (housed in the coelom).

tadpole-like larva

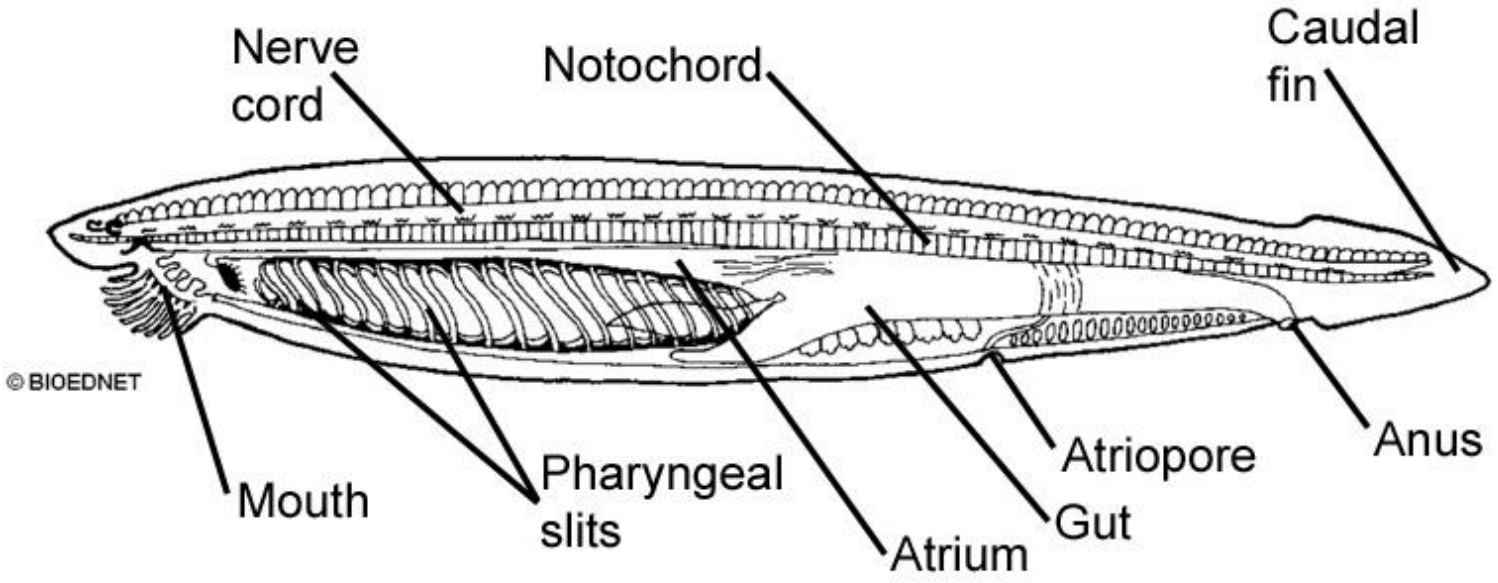


sessile adult

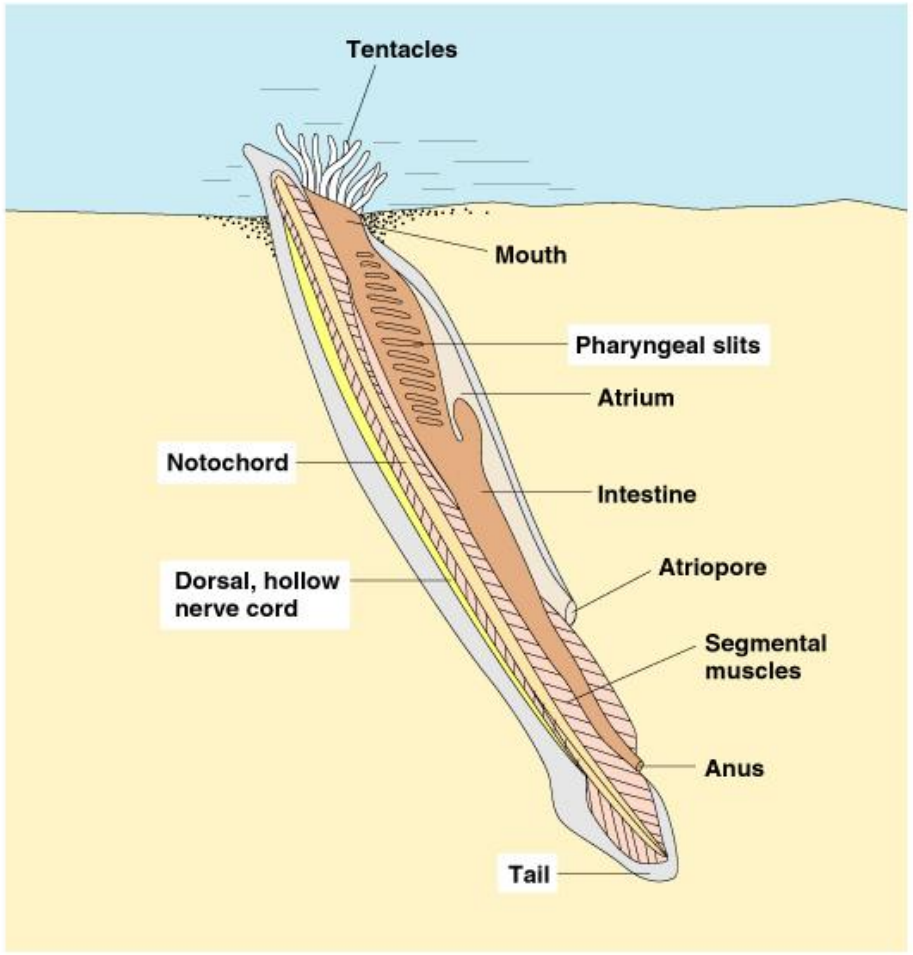
There are many beautiful species!



The subphylum CEPHALOCHORDATA is named for the fact that the notochord is ALSO in the tail. This small group of species is the only group which exhibit all 4 chordate characteristics as adults. Look for all 4 in the diagram below.



Lancelets are members of a single genus, known by the names, *Amphioxus* (double pointed) and *Branchiostoma* (gill mouth). They are better known as *Amphioxus* even though *Branchiostoma* is the older and therefore valid name according to the taxonomic law of priority.



Cephalochordates are called lancelets because They look like small knives. They live in the sediment of shallow marine areas and filter seed on tiny particles in the water. Water flows In the mouth and out the atriopore.

You should know:
mouth, pharynx, atrium, atriopore, anus, postanal tail, notochord, and nerve cord.

The subphylum VERTEBRATA

Includes 3 major groups of fish, as well as amphibians, reptiles, birds, and mammals.

An ancestral group of vertebrates is the superclass AGNATHA.
Members of this group are cartilaginous fish that lack jaws.
All other vertebrates are members of the superclass GNATHOSTOMATA,
named for the presence of jaws.

Among agnathans are lampreys, many of which feed as ectoparasites on other fish. Notice the rings of teeth in the jawless mouth.

Agnathans also include Hagfish which are detritivores of the ocean bottom. They are famous for slime production and for their flexible bodies, with cartilaginous skeletons. They can literally tie their body into a knot and slip the knot forward to push their body away from a carcass they are feeding on. That's one way to live without jaws!

Other cartilaginous fish, with jaws, are members of the superclass Gnathostomata and

class CHONDRICHTHYES.

These are the sharks and rays. They are known for their spiracles, through which water enters to irrigate the gills. Most of them must swim for their entire lives in order to keep water moving over their gills.

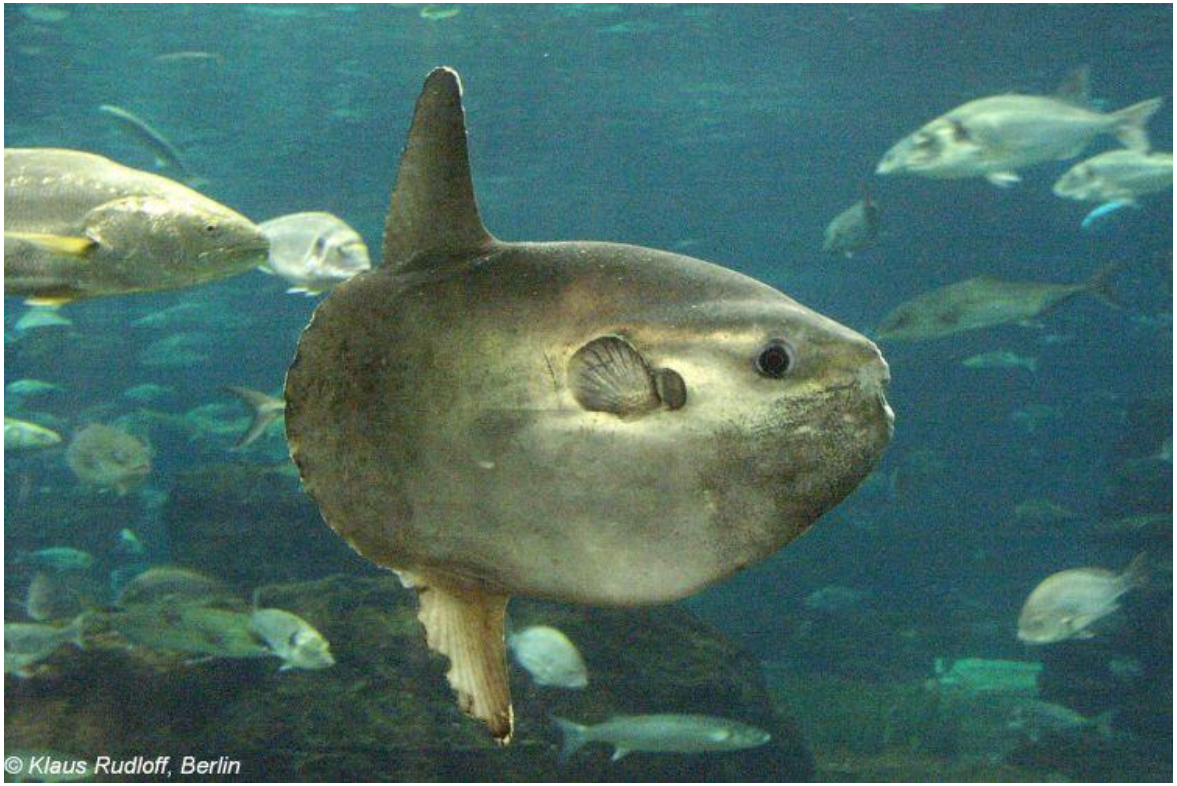
Sharks and rays have unique scales, called placoid scales, or dermal denticles. The seemingly endless supply of teeth in a shark are really modified scales. Most are predaceous, but the largest species, whale shark and basking shark, are filter feeders.

The third group of fish is the class OSTEICHTHYES, or bony fish.

A very primitive fish within this group is the **coelacanth**, belonging to it's own order. It is known as the lobe-finned fish and has muscular elements at the base of fins that are Very much like the muscles in a salamander's leg. Once thought to be extinct, this fish is a descendent of the likely ancestor of all terrestrial vertebrates!

A second order of bony fish includes a few species of **lung fish**.
These amazing species have both gills and lungs. They are able to live in fluctuating habitats and some can survive several years of drought in an underground cocoon.

Most of the 25,000 or more species of bony fish belong to a group known as the **ray-finned fishes.** This group includes most of the familiar fish, many of which are an inch or less in length. It also includes the largest of bony fish, the giant sunfish, shown below.

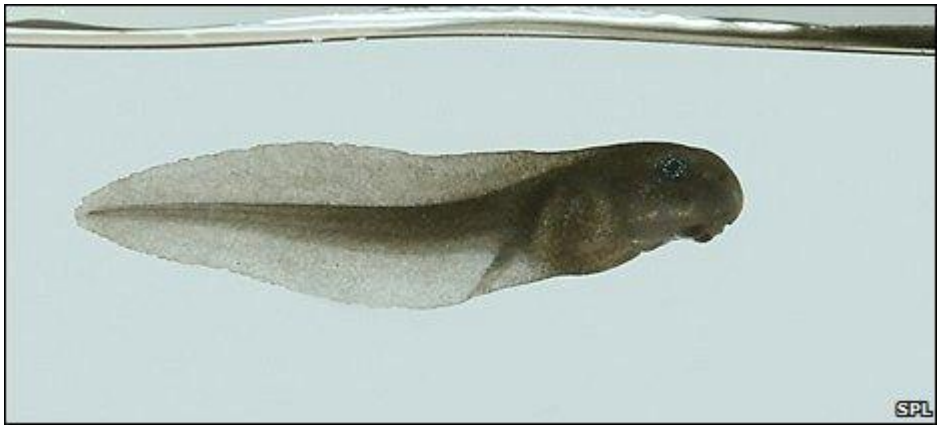


All fish have a single-loop circulatory system and a 2 chambered heart (1 atrium and 1 ventricle. There is no separation between oxygenated and unoxygenated blood.

class AMPHIBIA

Amphibians have moist, glandular skin and a metamorphic life cycle that ties them to the water. They are sometimes referred to as only quasi-terrestrial.
Much of their respiration is cutaneous - through the skin. They have 3-chambered hearts (2 atria and 1 ventricle) and a double-loop circulatory system, but with only partial separation of oxygenated and de-oxygenated blood. They are both ectothermic (external Control of body temperature) and heterothermic (changing body temperature). This Condition can be called poikilothermic.

Orders of amphibians include:
Anura (meaning without a tail) – frogs and toads
Caudata (meaning with a tail) – Salamanders
Gymnophiona – caecilians (legless amphibians)



Frogs have external fertilization. Males sing to attract females to the water. Amplexus results in fertilization of eggs as they are released. Aquatic eggs hatch into tadpoles which eventually sprout legs and absorb their tail to transform into frogs.

Order ANURA

Red-eyed treefrog

Argentine horned frog

Order CAUDATA

tiger salamander

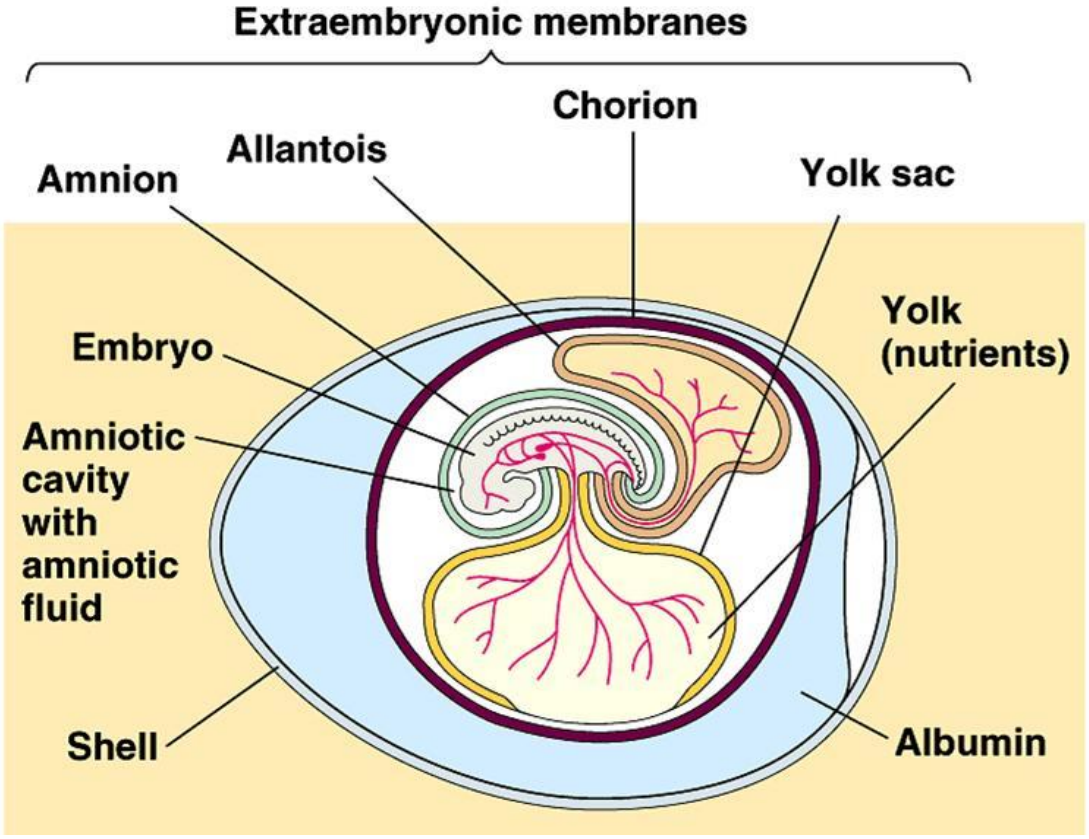
Salamander larvae have external gills.

Order GYMNOPHIONA

The tropical caecilians are legless amphibians. Most of them burrow in moist soil And look much like earthworms.

Class REPTILIA

Reptilians are far more terrestrially adapted than amphibians. They have dry, scaly skin. Their lungs are far more efficient and they rely less on cutaneous respiration. One of the most important terrestrial adaptations seen in reptiles is an egg that can develop and hatch on dry land. It is called the amniotic egg and has the same membranes And fluid compartments that are seen in birds' eggs. Birds may be more famous for their eggs, but reptiles had them first.



Know these membranes and what they surround.

Yolk provides nourishment for Developing embryos while other membrane-bound fluids prevent desiccation and provide physical protection for the embryo.

order TESTUDINES

Turtles are strange animals that have parts of their skeleton (backbone, ribs, and sternum) fused to form a shell, with carapace on top and plastron on the bottom. The shell is covered with skin and epidermal scales. Imagine being able to pull your head, neck, shoulders, arms, hips, and legs inside of your rib cage!

Turtles have no teeth and don't hear very well. They make almost no sounds. Some may live to be well over 100 years old.

giant Galapagos tortoises

Order SQUAMATA

Snakes and lizards belong to the same order. You may think that legs are the obvious difference between them, but look at the legless glass lizard!

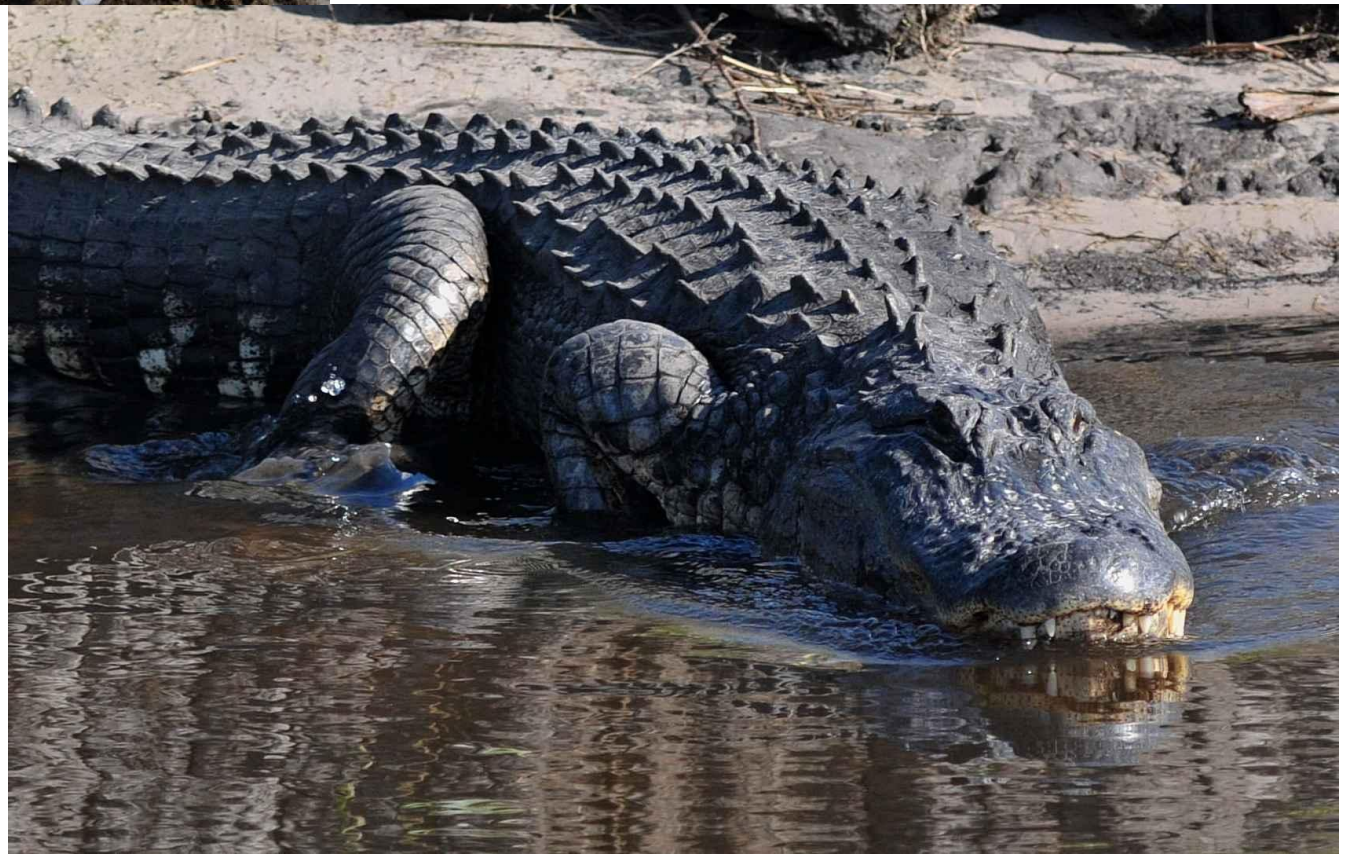
glass lizard

Order SPHENODONTA

The tuatara is a strange, lizard-like animal of New Zealand with a remnant 3rd eye that can be seen on the top of the head of young animals.

Order CROCODILIA

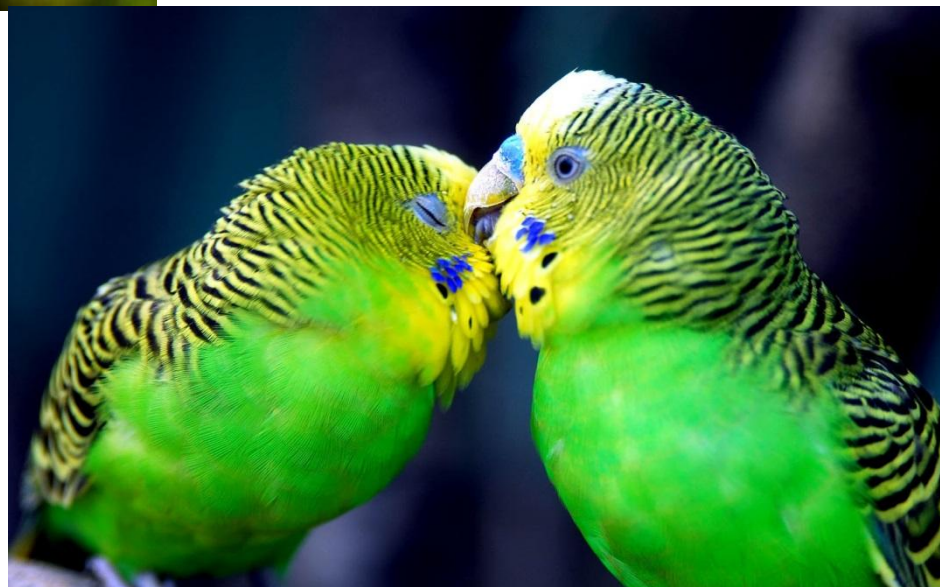
Crocodiles, alligators, caimans, etc. Crocodilians have a 4-chambered heart which efficiently separates oxygenated and de-oxygenated blood. They don't shed their epidermal scales like most reptiles and although highly predaceous, some make very good mothers.



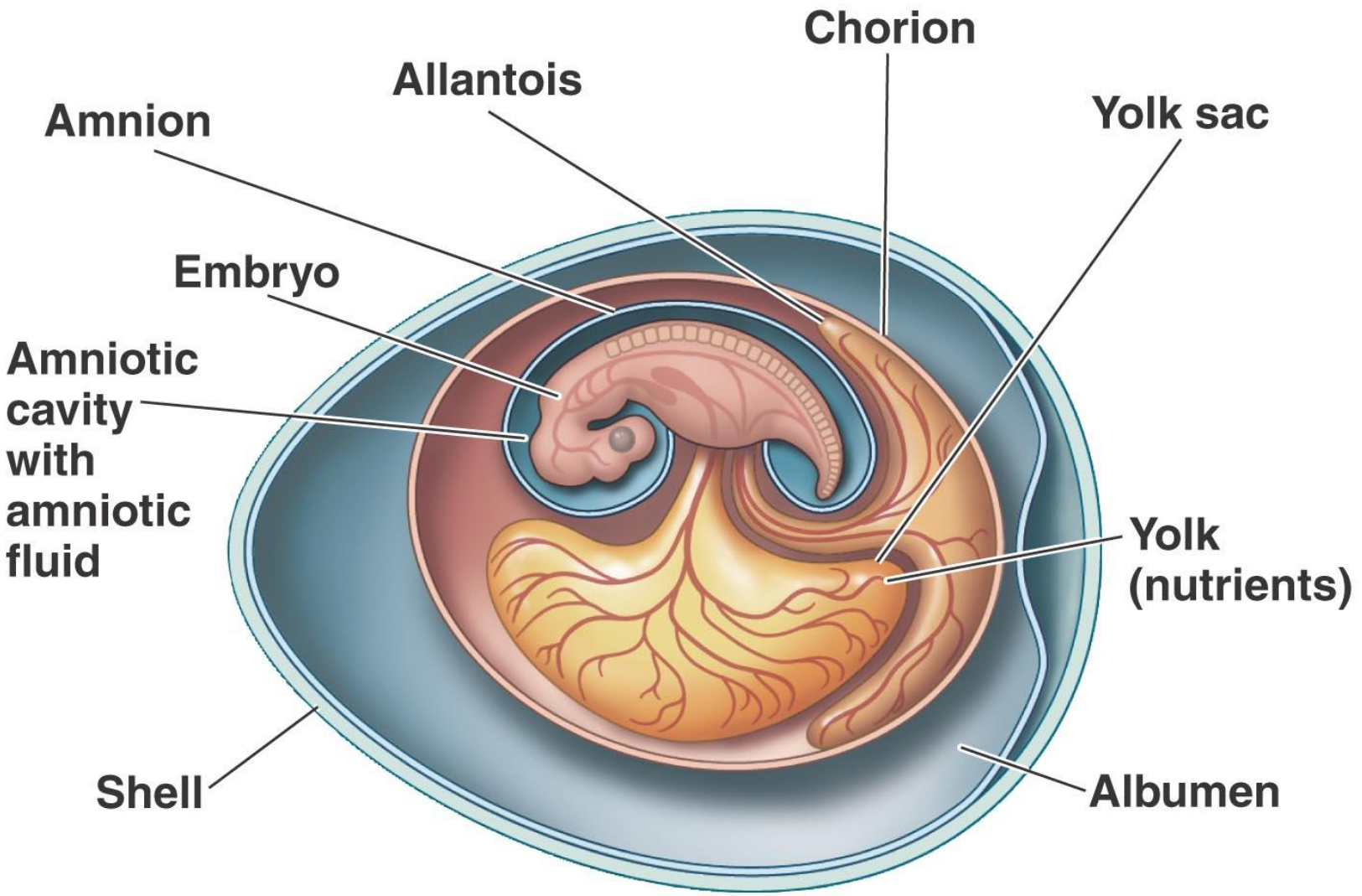
Class AVES

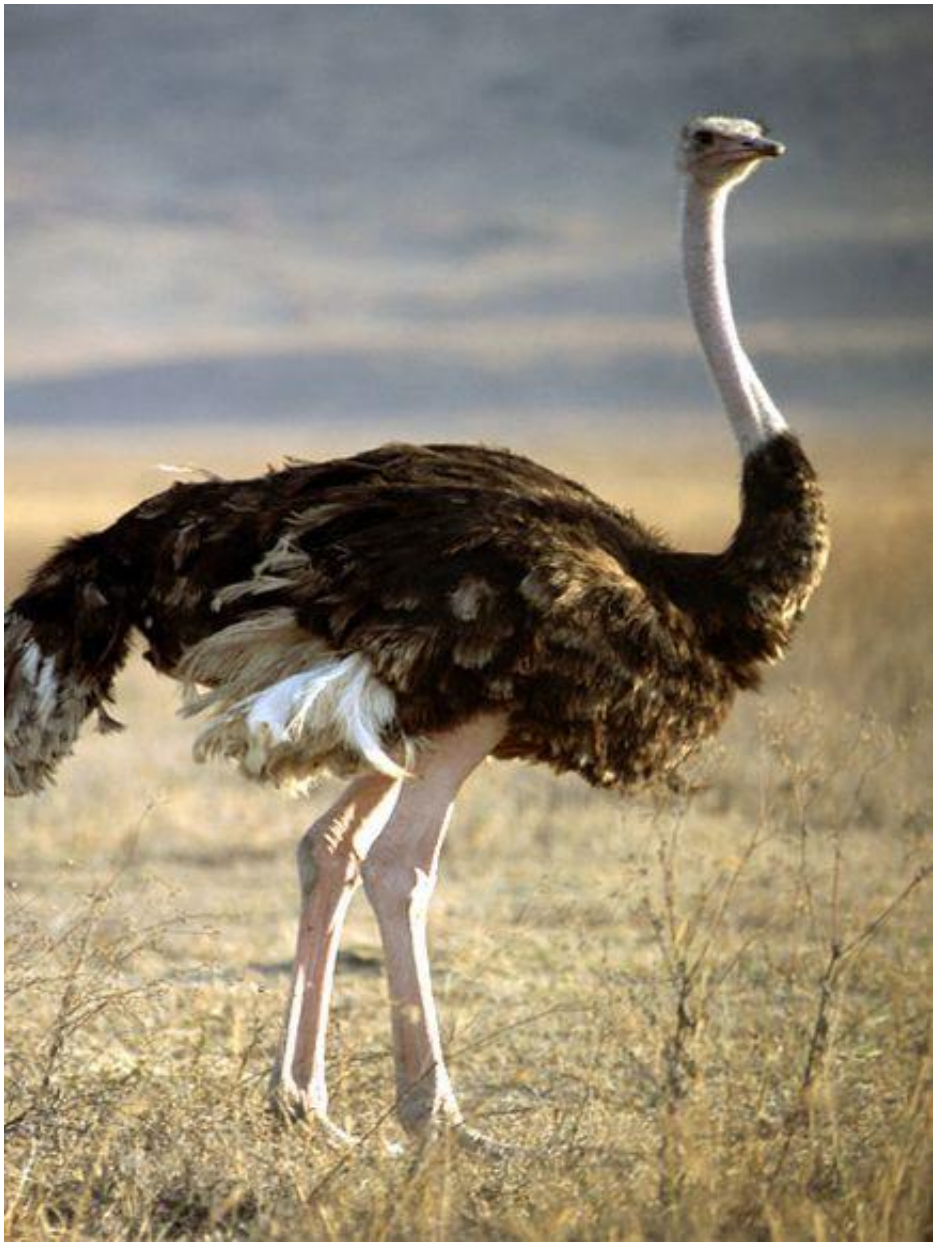
Birds are closely related to reptiles and are considered by some to be reptiles. Their feathers are modified scales. Although feathers first evolved for insulation, they are necessary for flight in birds. Many other adaptations for flight exist in birds, including the lack of a bladder and air spaces inside of their bones.

Birds have a beak, or bill, instead of teeth. Their heart is 4-chambered and they have very efficient respiratory and circulatory systems. They are the only animals besides mammals that uniformly control their body temperature from within (metabolically). They are endothermic and therefore usually homeothermic as well.



Bird eggs have the same membranes and compartments as reptilian eggs.





The flightless ostrich is the largest bird.

The bee hummingbird is the smallest bird. Most hummingbirds drop their body temperature while sleeping at night in order to save energy. They are so small that their surface area to volume ratio is high and results in rapid heat loss.

class MAMMALIA

All mammals have hair and mammary glands. Hair is made of keratin like reptilian scales and bird feathers. They also have 4-chambered hearts and are endothermic and homeothermic. Some are oviparous (egg layers), some are marsupial (young develop in a pouch called a marsupium) or pouch and some are truly viviparous or placental (young are nourished through the mother's blood stream.

Infraclass with single order

order MONOTREMATA

duckbill or platypus

and

Spiny anteater or Echidna

eggs are released from the cloaca (single opening for reproductive, excretory, and digestive systems).

Young lap milk from the mother's fur. These animals have no nipples and no lips.

Koalas only eat eucalyptus.

Baby wombat in marsupium

Koalas, wombats and kangaroos belong to order MARSUPIALIA (the only order in it's infraclass. They have a very short gestation and the young are born when only slightly developed. They immediately migrate to the marsupium and attach to a nipple. They will stay in the pouch until they are ready to live on their own.

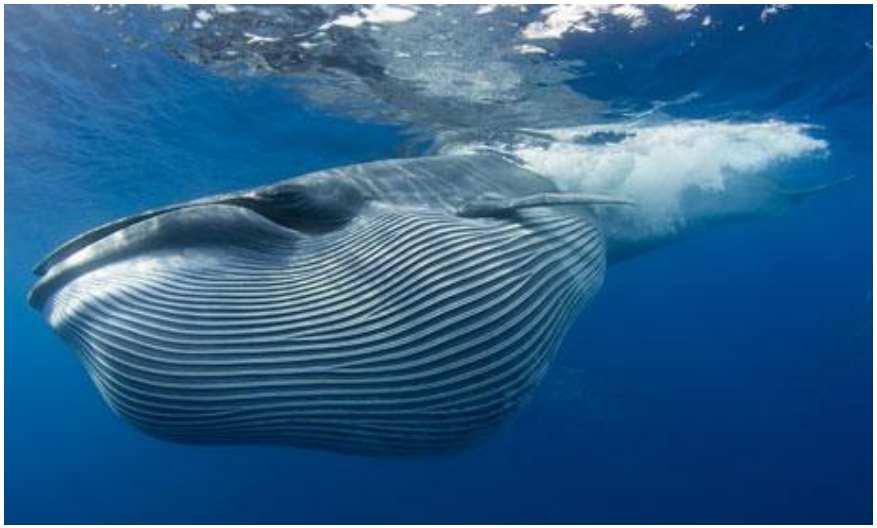
Most marsupials live in Australia.
The virginia opossum is the only North American marsupial.

All other mammals (19 orders) belong to the infraclass EUTHERIA. They are the placental mammals.

Order RODENTIA (gnawing mammals with evergrowing incisors, like mice and squirrels) is the largest class of mammals.

The capybara is the world's largest rodent.

An entirely marine group, the order CETACEA includes the whales and dolphins. Some are predaceous like the dophins and others are filter-feeders like the humpback whale. The world's largest animal is the great blue whale



beluga

order CHIROPTERA, bats, includes the smallest mammal. They are well adapted for flight. Notice the hand bones in the wing. Hands and legs are connected by a patagium.

Zebras, horses, and rhinos are members of the order PERISSODACTYLA, the odd-toed hoofed mammals. Did you know that horses walk on a single toe?

order CARNIVORA includes cats and dogs as well as bears, weasels and sea lions.

Siberian tiger

We, monkeys, apes, tarsiers, and lemurs belong to the order PRIMATES.
Primates have binocular vision, opposable thumbs, and fingernails.

Most of the world's primates are critically endangered, except for us.