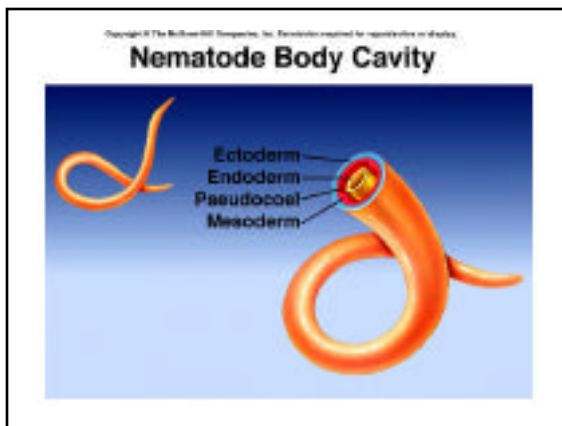


## Animalia

Chapter 32  
Ecdysozoans: The molding animals

## Nematoda (roundworms)

- ✓ Cylindrical worms, bilateral symmetry
- ✓ Fluid filled pseudocoel (hydrostatic skeleton)
- ✓ sense organs, primitive brain, no circulatory system
- ✓ Male and female usually separate
- ✓ Some parthenogenic (females reproduce without males)
- ✓ *Caenorhabditis elegans* - genetic development
- ✓ *Trichinella* - trichinosis from eating undercooked pork and bear



## Nematoda (*C. elegans*)



## Ascaris (roundworm)



## Nematophora

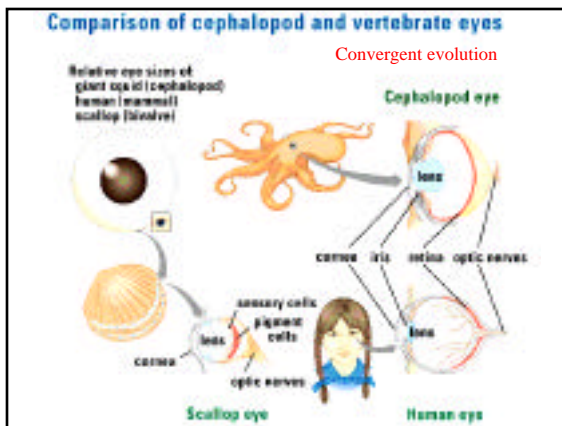
- ✓ 230 species
- ✓ Millimeters to a meter
- ✓ Horsehair worms
- ✓ Aquatic
- ✓ Larva are parasites (insects and crabs)
- ✓ No mouth, food (probably) by absorption

## Cycliophora

- ✓ Discovered in 1995
- ✓ Attached to the mouth of lobsters
- ✓ *Symbion pandora*
- ✓ Unusual sexual reproduction associated with the shedding of the lobster's exoskeleton
  - Dwarf males emerge
    - Brains and reproductive organs
  - Fertilize a female's eggs
  - Free swimming offspring seek out new lobsters

## Gastrotricha

- ✓ Microscopic bottle-shaped animals
- ✓ Freshwater to marine

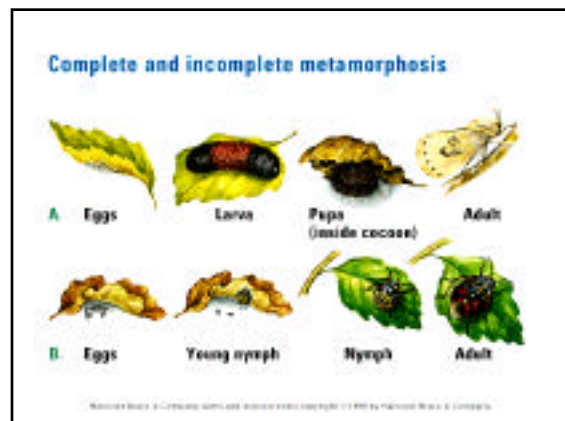


## Arthropoda

- ✓ Exoskeleton - chitin and protein
  - Support, protection, slows water loss
    - molting
- ✓ Jointed limbs
- ✓ Segmented
- ✓ Tagmata - Fused segments
- ✓ Thorax
- ✓ Abdomen
- ✓ Some metamorphosis

## Arthropoda

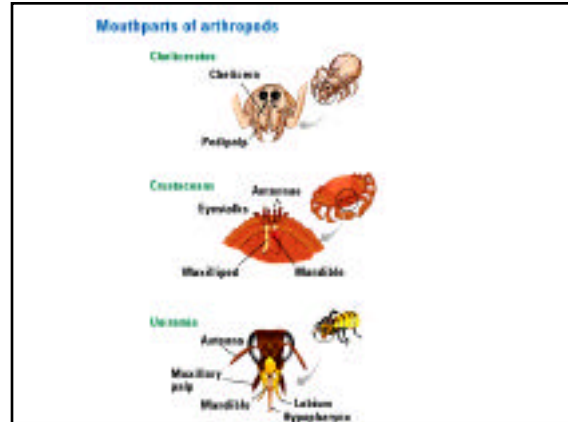
- ✓ Internal anatomy similar to annelids
  - Open circulatory system - one way valves
  - Gills or book lungs or spiracles (tracheae)
  - Sexual reproduction
  - Male and female separate
  - Terrestrial arthropods - internal fertilization
  - Malpighian tubules - eliminate or excrete waste from blood
  - Well developed nervous system
    - Compound eyes
      - Ommatidia



## Arthropoda

### ✓ Subphylum

- Trilobites - extinct
- Chelicerates
  - ↳ First pair of appendages are mouth parts with chelicerae (fangs or pincers)
- Uniramia
  - ↳ First pair of appendages are antennae, next are mandibles. Mostly terrestrial with unbranched appendages
- Crustacea
  - ↳ First pair of appendages are antennae, next are mandibles. Mostly aquatic with branched appendages



## Arthropods

### ✓ Chelicerates

- No antennae, jaws,
- Chelicerae, pedipalps

### ✓ Horseshoe crabs,

### ✓ spiders (arachnids)

- Four pairs of legs + 2 appendages above
- Scorpions
- Daddy longlegs
- Mites (ticks)

## Arthropods

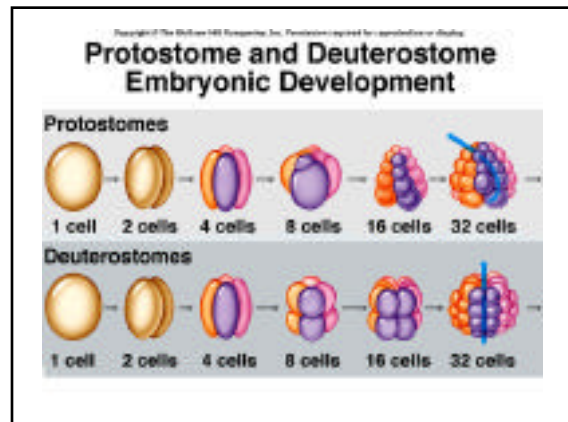
### ✓ Crustaceans

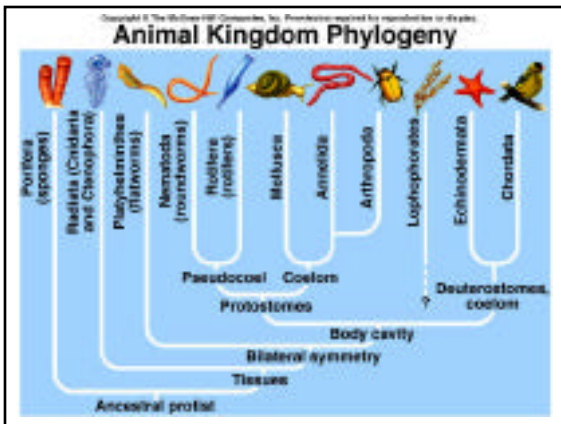
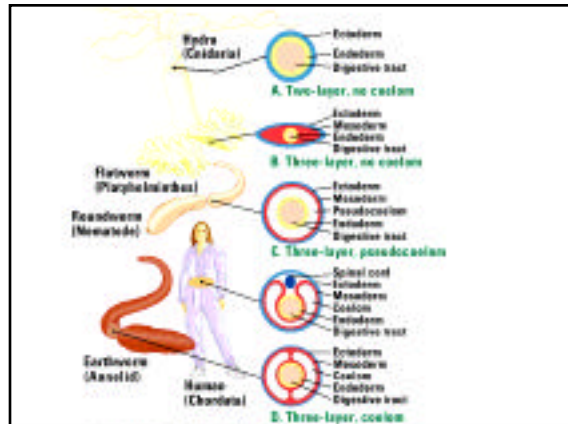
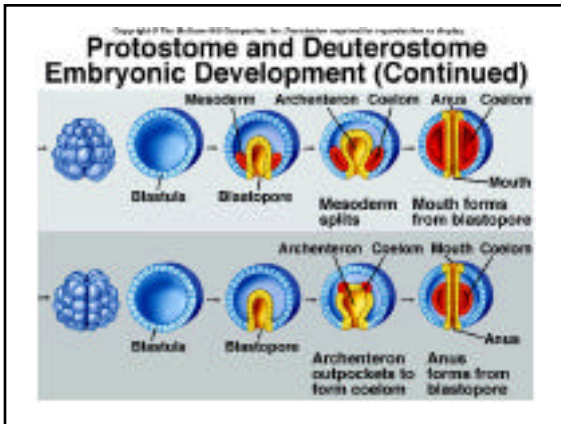
- Lobsters, crabs, shrimps, barnacles, crayfish, water fleas, fairy shrimp, pillbugs, copepods
- 3 pair of chewing appendages and many pairs of legs
- Legs are biramous (split apart at the tip)
- 2 pair of antennae

## Arthropods

### ✓ Uniramia

- Tracheae, Malpighian tubules, uniramous appendages
- Myriapods - millipedes and centipedes
- Insects
  - ↳ Three tagmata
    - Head
    - Thorax
      - ↳ 3 Segments, one pair of legs on each
      - ↳ One or two wings on most
    - Abdomen
      - ↳ 12 or fewer segments, no legs or wings





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### Major Animal Phyla (1)

Phylum	Typical Examples
Arthropoda (arthropods)	Beetles, other insects, crabs, spiders
Mollusca (mollusks)	Snails, oysters, octopuses, nudibranchs
Chordata (chordates)	Mammals, fish, reptiles, birds, amphibians

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### Major Animal Phyla (2)

Phylum	Typical Examples
Platyhelminthes (flatworms)	Planaria, tapeworms, liver flukes
Nematoda (roundworms)	Ascaris, pinworms, hookworms, <i>Filaria</i>
Annelida (segmented worms)	Earthworms, polychaetes, beach tube worms, leeches

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### Major Animal Phyla (3)

Phylum	Typical Examples
Cnidaria (cnidarians)	Jellyfish, hydra, corals, sea anemones
Echinodermata (echinoderms)	Sea stars, sea urchins, sand dollars, sea cucumbers

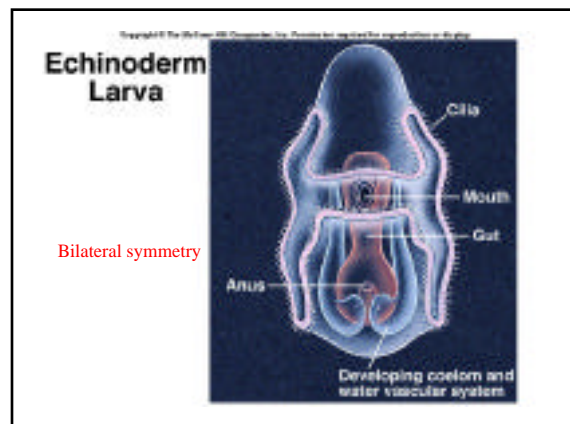
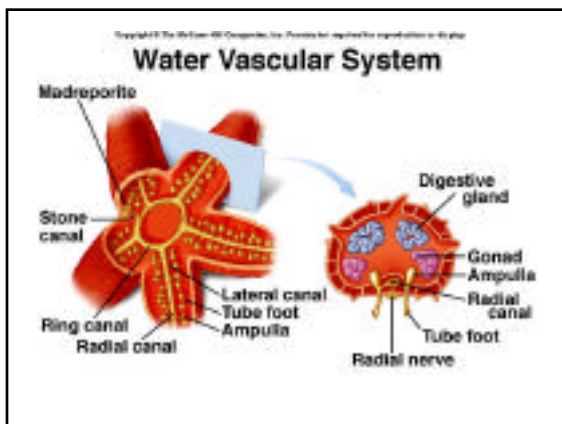
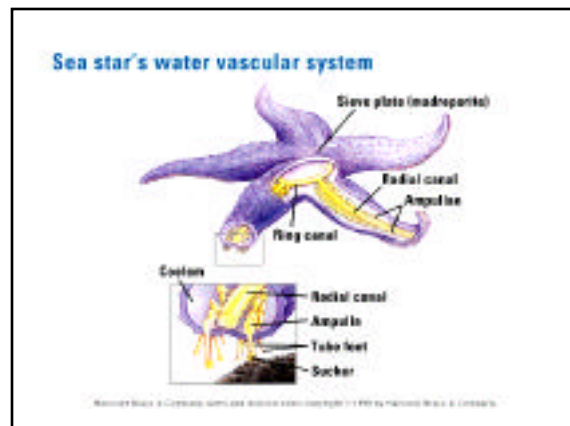
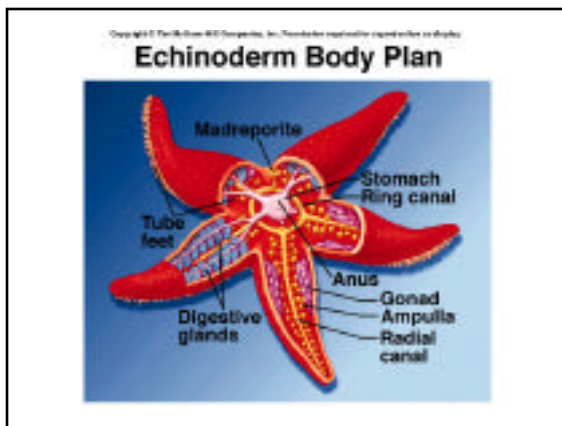


## Echinoderms

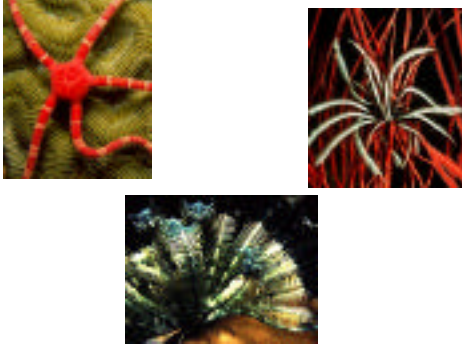
- ✓ Sea stars, sea urchins, sea lilies, feather stars, sea cucumbers
  - Calcium rich spines
  - Adults - radial symmetry
    - Larva - bilateral symmetry
  - Sexes are separate
  - Fertilization is external - many eggs (2 million)

## Sea stars

- ✓ Mouth in the center
  - Feed on corals, mollusks, worms, oysters
- ✓ Radiating arms
  - Bend and twist
  - Canals, water vascular system
  - Primitive skeleton - calcium rich plates
  - Reproduce asexually and sexually



## Echinoderms



## Arrow and Acorn worms

- ✓ Chaetognatha - Arrow worms
  - Feed on small marine animals
  - Moveable hooks
  - ?Tail formation? Body beyond anus
  - Vertebrate ancestor?
- ✓ Hemichordates - Acorn worms
  - U-shaped burrows at the bottom of the sea
  - 1. Gill slits
  - 2. Beginnings of a dorsal nerve cord

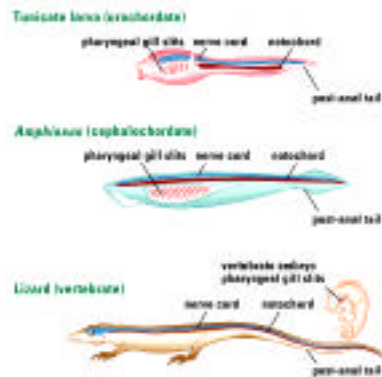
## hemichordata



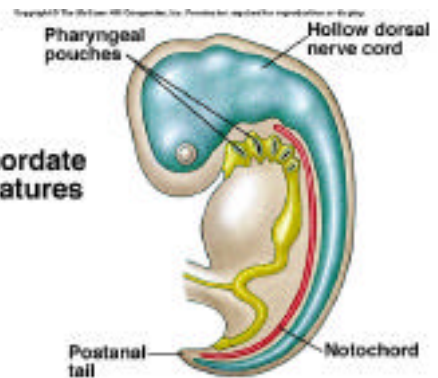
## Chordata

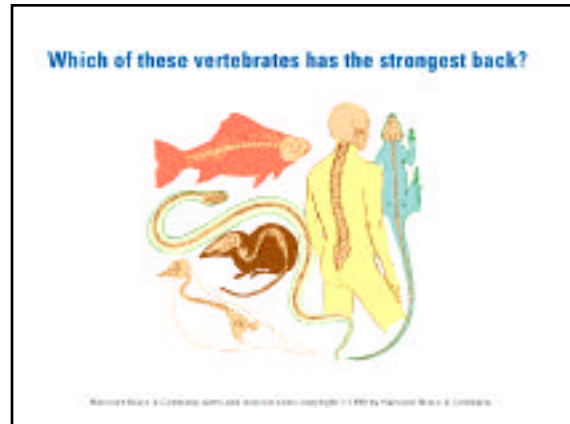
- ✓ Notochord
  - Flexible rod running along the dorsal surface
- ✓ Dorsal hollow nerve cord
  - Along the surface of the notochord
- ✓ Pharyngeal slits
  - Gill slits
- ✓ Segmented body and post-anal tail

### Four features of chordates

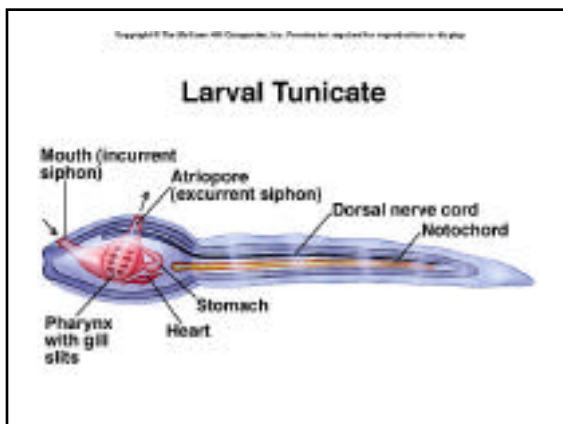
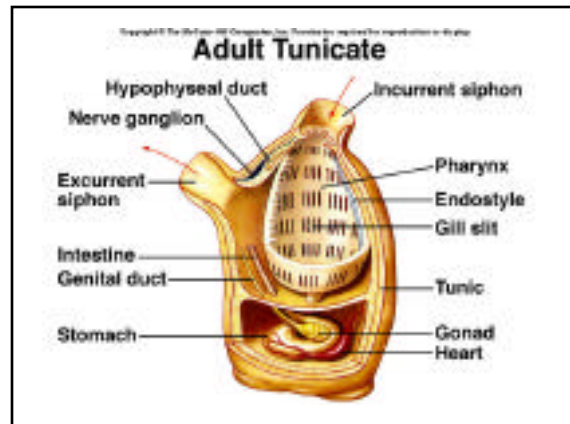


### Chordate Features

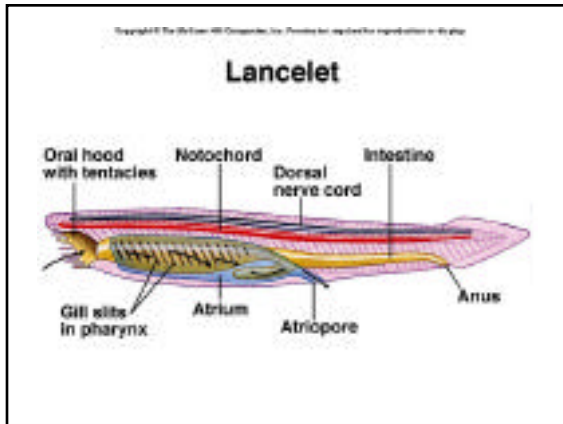




- ### Truncates
- ✓ Sessile
  - ✓ Cellulose covering
  - ✓ Pharyngeal gill slits
  - ✓ Larva have most chordate characteristics
    - Notochord
    - Dorsal hollow nerve cord
    - Pharyngeal gill slits
    - Post-anal tail

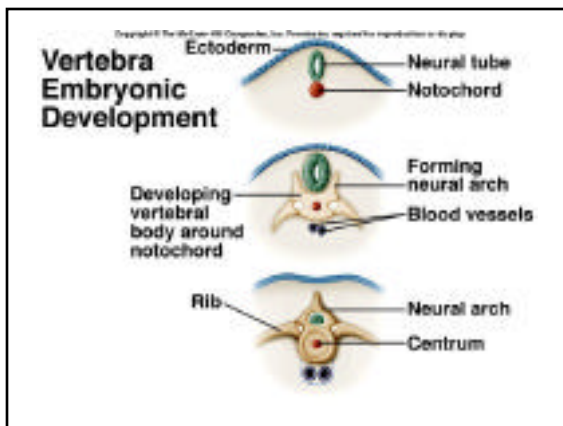


- ### Cephalochordates
- ✓ Lancelets
    - Fish-like animals - Branchiostoma (amphioxus)
    - Notochords as both larva and adults
    - Segmented muscles



## Vertebrates

- ✓ 1. Segmented vertebral column
  - Vertebrae
- ✓ 2. A distinct head
  - Cranium (skull) and a brain
- Closed circulatory system
- Internal organs,
  - Liver, kidneys, hormone secreting (endocrine) glands
- Bony skeletons
  - Except sharks and other cartilaginous fishes



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Class	Typical Examples	Major Classes of Fishes (1)
Acanthodii	Spiny fishes	
Placodermi	Armored fishes	
Osteichthyes	Ray-finned fishes	
	Lobe-finned fishes	

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Class	Typical Examples	Major Classes of Fishes (2)
Chondrichthyes	Sharks, skates, rays	
Myxini	Hagfishes	
Cephalaspidomorphi	Lampreys	

## Agnatha

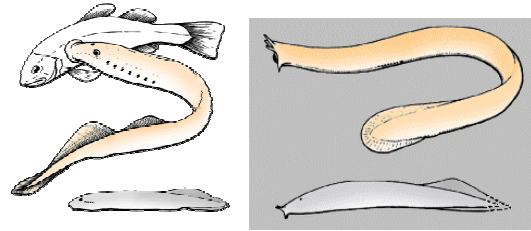
- ✓ Most are extinct
- ✓ Ostracoderms are extinct
  - Shelled or bony plates
- ✓ Cyclostomes - living members
  - Lamprey, hagfish

## Agnatha

### Jawless fishes

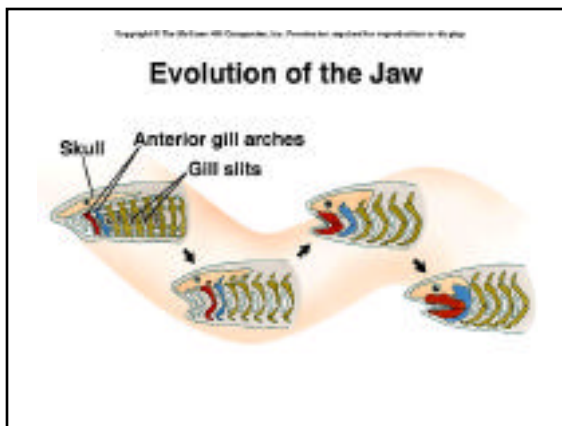


## Agnatha



lampreys

hagfishes



## Placoderms

✓ Extinct armored fish with jaws

## Chondrichthyes

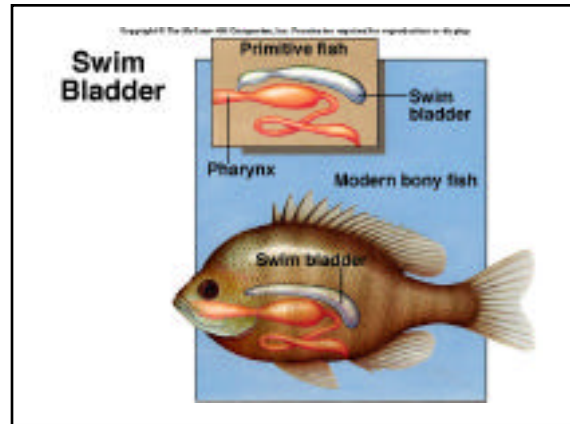
✓ Fish with cartilaginous skeleton

- Sharks, skates, and rays
- Lack swim bladders
- Denticles (sandpaper skin)
- Teeth (derived from scales)
- Vision
- Lateral line system

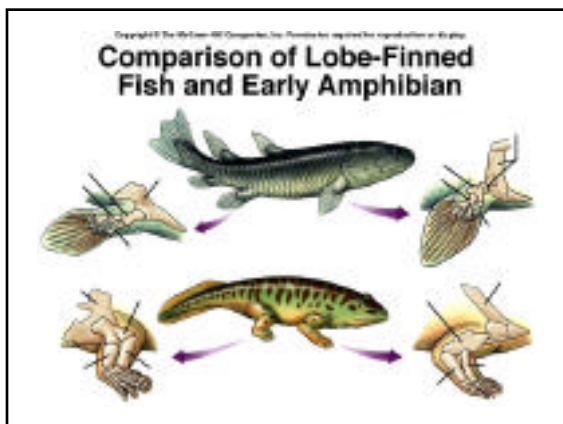
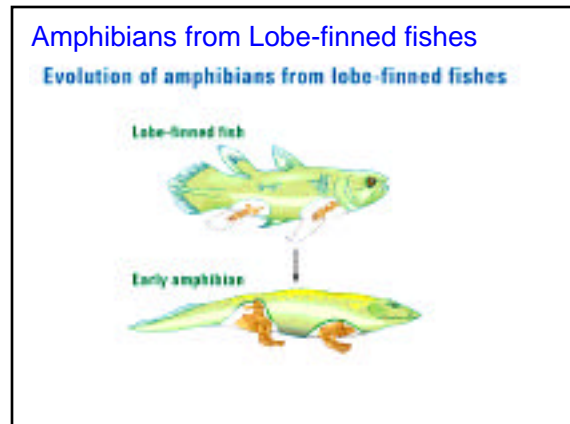
## Osteichthyes

✓ Bony fish

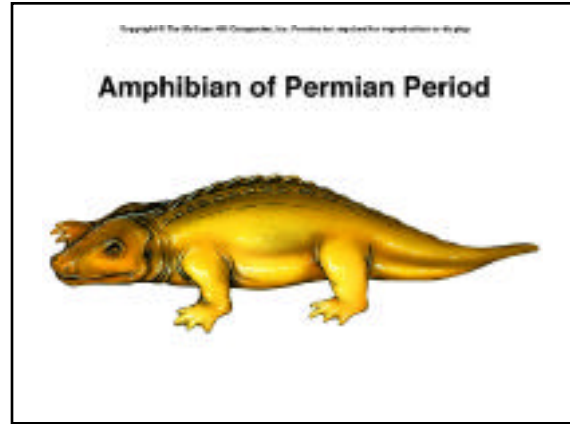
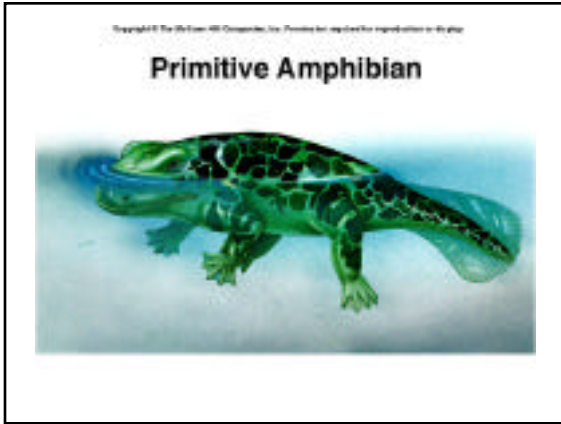
- Bony skeletons
- Bony scales
- Swim bladder
- Paired fins
- Lobed finned
  - lungfishes, coelacanth
- ray-finned
  - Swimming fishes



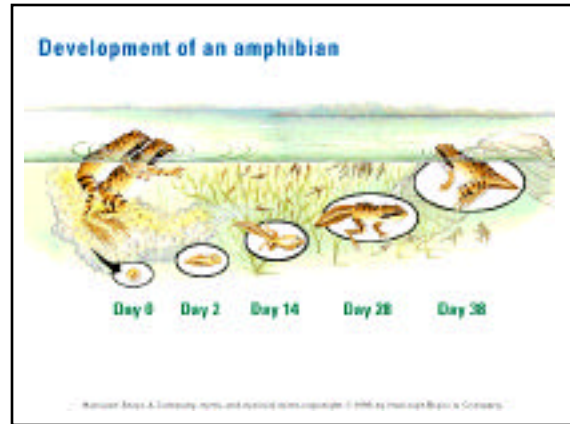
- Movement to land**
- ✓ Conserve water
  - ✓ Extract oxygen from air
  - ✓ Strong skeletons
  - ✓ Control body temperature
  - ✓ Needed a watery environment for fertilization and early development



- Amphibians**
- ✓ Devonian period
    - Double circulation
      - Heart - lung, heart to body
    - Legs

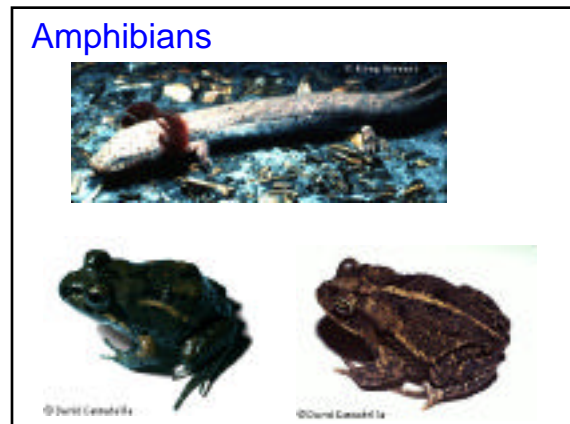


- ## Amphibians
- ✓ Classes
- Urodela
    - ↳ Salamanders
      - tails
  - Anura
    - ↳ Frogs and toads
      - No tails
  - Gymnophiona
    - ↳ Caecilians
      - No legs



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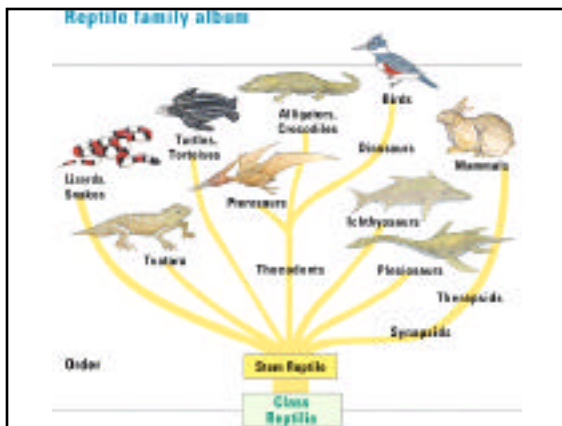
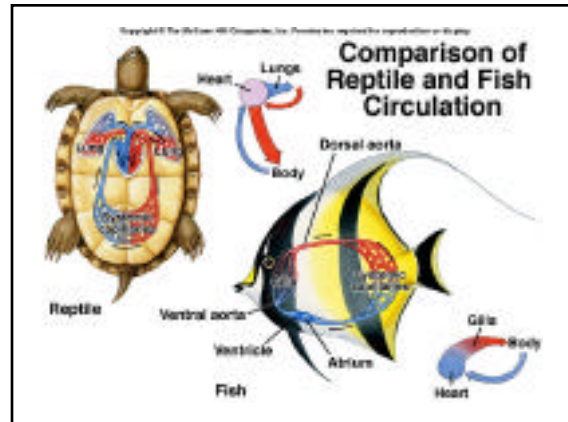
Order	Typical Examples	Orders of Amphibians
Anura	Frogs, toads	
Caudata	Salamanders, newts	
Apoda (Gymnophiona)	Caecilians	



## Reptiles

✓ Adapted to land

- Some have gone back to water
  - Crocodiles and sea turtles
  - Breath air



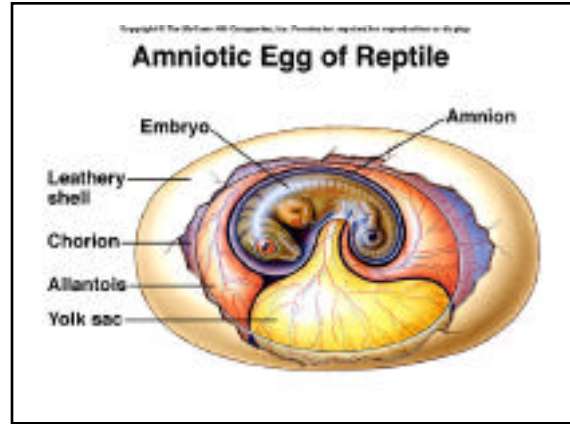
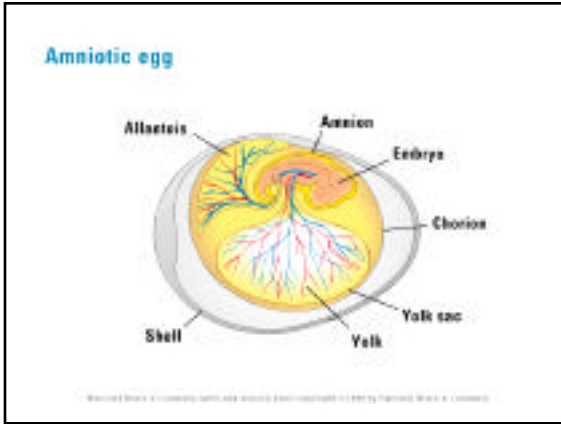
Order	Typical Examples	Orders of Reptiles (1)
Ornithischia	Stegosaur	
Saurischia	Tyrannosaur	
Pterosauria	Pterosaur	
Plesiosauro	Plesiosaur	
Ichthyosauria	Ichthyosaur	

Order	Typical Examples	Orders of Reptiles (2)
Squamata, suborder Sauria	Lizards	
Squamata, suborder Serpentes	Snakes	
Chelonia	Turtles, tortoises, sea turtles	
Crocodylia	Crocodiles, alligators, gavials, caimans	
Rhynchocephalia	Tuatara	

## Reptiles

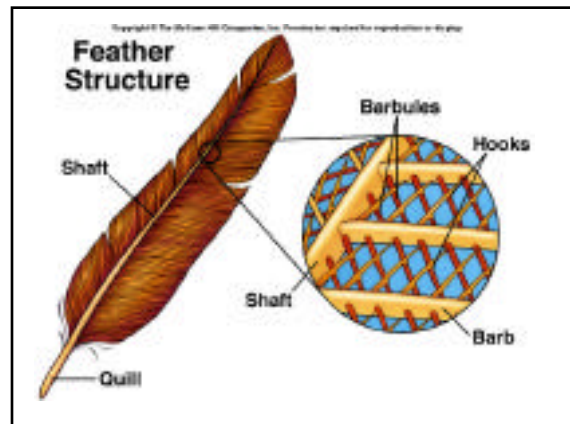
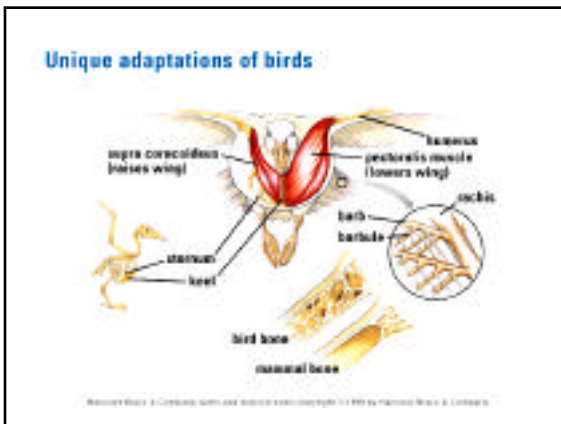
✓ Free of water

- Dry water tight skin
- Lungs
- Efficient kidney
  - Conserve water
- Legs
- Amniotic egg
  - Amnion - membrane - encloses the embryo in water
  - Chorion - membrane - encloses the embryo, yolk, and allantois - regulated oxygen and CO<sub>2</sub> exchange
  - Allantois - membrane - outhouse
  - Yolk - food supply
  - Yolk sac - membrane
- Internal fertilization
- Cloaca - common entrance & exit of the reproductive, urinary and digestive system








- Temperature Regulation**
- ✓ Ectotherms
    - External sources for heat
    - Basking in the sun
  - ✓ Endotherms
    - Heat from metabolism
    - Evaporation






- Birds**
- ✓ Differences from reptiles
    - Feathers
      - Keratin
    - Flight
      - Loss of teeth
      - hollowing of bones
      - Reshaping the breastbone (keel)
    - Endothermy









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Order	Typical Examples	Major Orders of Birds (1)
Passeriformes	Crows, mockingbirds, robins, sparrows, starlings, warblers	
Apodiformes	Hummingbirds, swifts	
Piciformes	Honeyguides, toucans, woodpeckers	
Psittaciformes	Cockatoos, parrots	
Charadriiformes	Auks, gulls, plovers, sandpipers, terns	

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Order	Typical Examples	Major Orders of Birds (2)
Columbiformes	Doves, pigeons	
Falconiformes	Eagles, falcons, hawks, vultures	
Galliformes	Chickens, grouse, pheasants, quail	
Gruiformes	Bitterns, coots, cranes, rails	
Anseriformes	Ducks, geese, swans	

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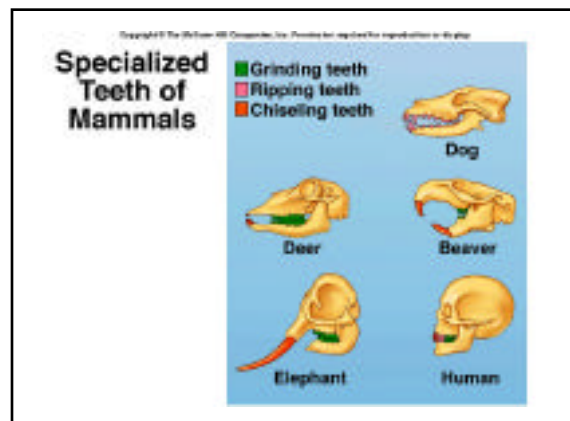
Order	Typical Examples	Major Orders of Birds (3)
Strigiformes	Barn owls, screech owls	
Ciconiiformes	Herons, ibises, storks	
Procellariiformes	Albatrosses, petrels	
Sphenisciformes	Emperor penguins, crested penguins	
Dinornithiformes	Kiwis	
Struthioniformes	Ostriches	

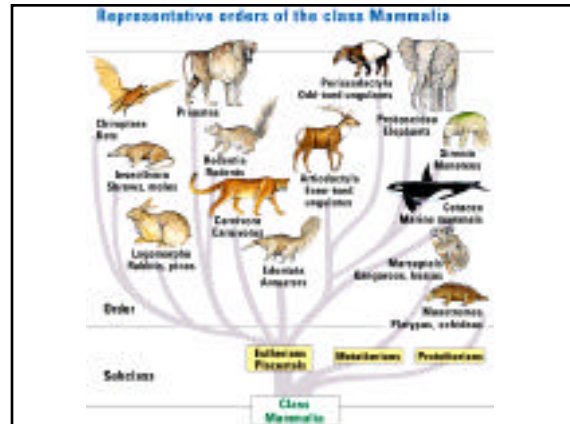
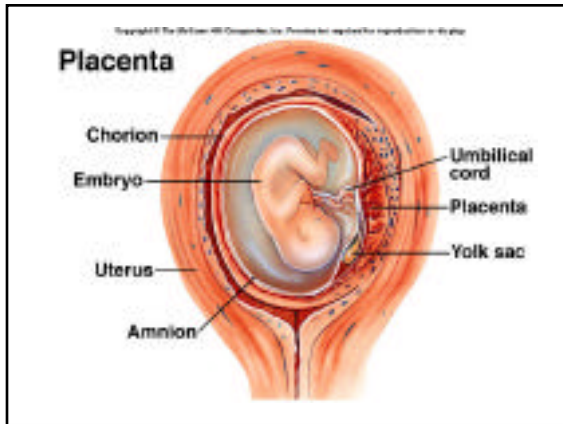
## Mammals

- ✓ Mammary glands
- ✓ Hair
  - warmth
- ✓ Two sets of teeth
  - Baby and adult
    - Specialized for grinding, shearing flesh, breaking bones, seizing fish

## Mammals

- ✓ 3 subclasses
  - Placentals
  - Metatherians or marsupials
  - Prototherians or monotremes





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Group	Extinct Mammals
Cave bears	
Irish elk	
Mammoths	
Giant ground sloths	
Sabertooth cats	

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Order	Typical Examples	Major Orders of Mammals (1)
Rodentia	Beavers, mice, porcupines, rats	
Chiroptera	Bats	
Insectivora	Moles, shrews	
Marsupialia	Kangaroos, koalas	

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Order	Typical Examples	Major Orders of Mammals (2)
Carnivora	Bears, cats, raccoons, weasels, dogs	
Primates	Apes, humans, lemurs, monkeys	
Artiodactyla	Cattle, deer, giraffes, pigs	
Cetacea	Dolphins, porpoises, whales	
Lagomorpha	Rabbits, hares, pikas	

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Order	Typical Examples	Major Orders of Mammals (3)
Pinnipedia	Sea lions, seals, walruses	
Edentata	Armadillos, sloths	
Perissodactyla	Horses, rhinoceroses, zebras	
Proboscidea	Elephants	

