Fishes

- Aquatic vertebrates that are characterized by:

- Paired fins
  - Used for movement

- Scales
  - Used for protection

- Gills
  - Used for exchanging gases

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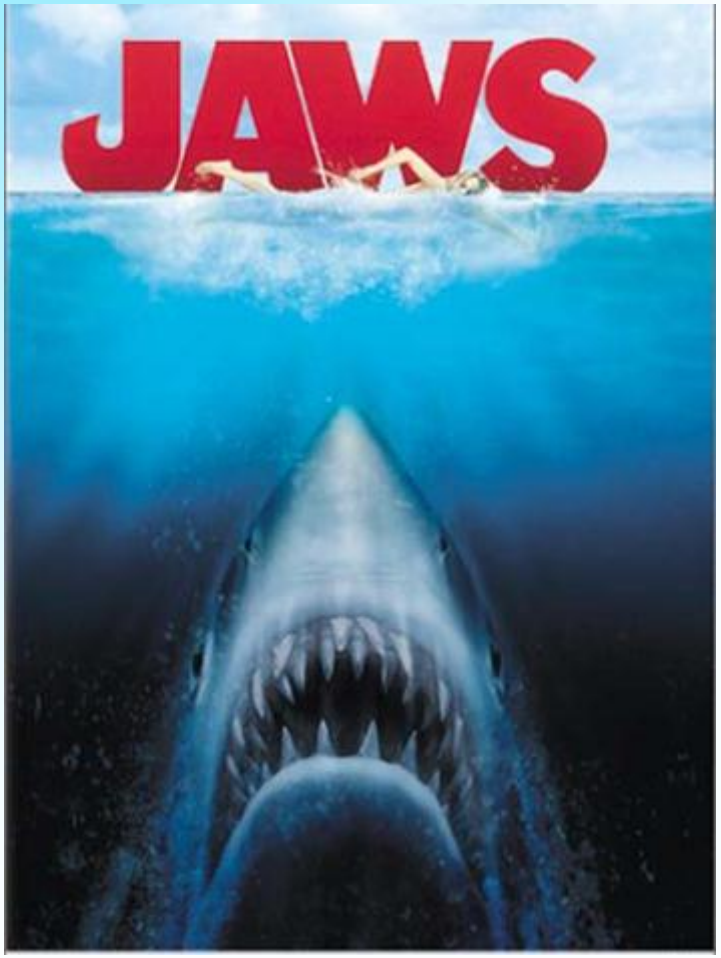
Evolution of Fishes

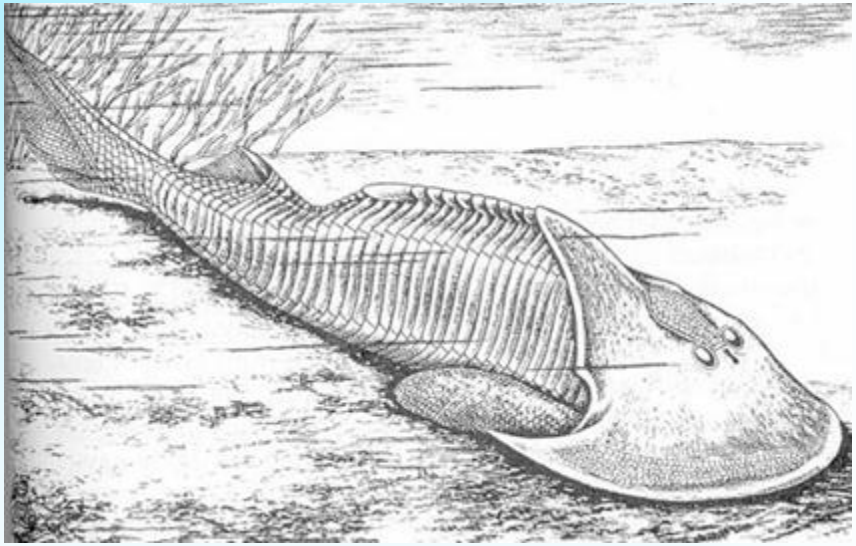
- Fishes were the first vertebrates to evolve

- The evolution of jaws and the evolution of paired fins were important developments during the rise of fishes



The First Fishes

- Jawless creatures whose bodies where armored with bony plates
- Lived in the oceans during the late Cambrian Period, about 510 mya
- Fishes kept this armored, jawless body plan for 100 million years



The Age of Fishes

- Ordovician and Silurian Periods: 505-410 mya, fishes underwent a major adaptive radiation

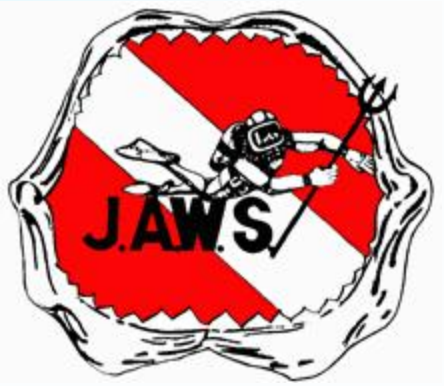
- Devonian Period: “Age of Fishes”
- Some were jawless with little armor
- Ancestors of modern hagfishes and lampreys
- Others were armored and ultimately became extinct about 360 mya

The Arrival of Jaws

- Other ancient fishes kept their bony armor and possessed a feeding adaptation that would revolutionize vertebrate evolution: JAWS

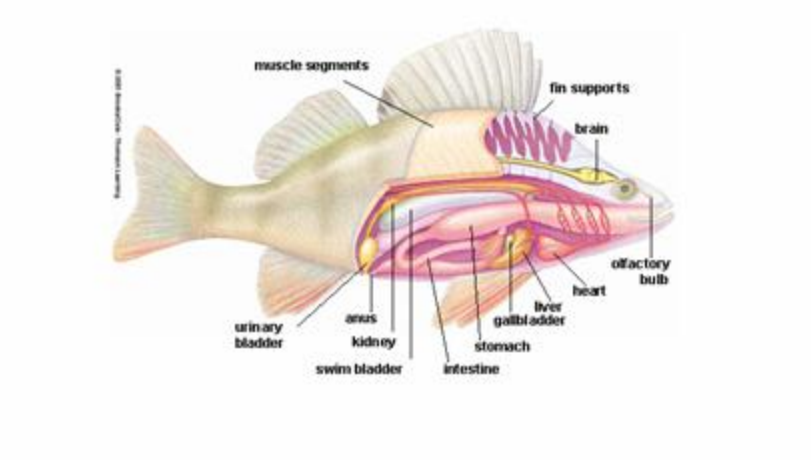
- Jawless fishes
  - Limited to eating small particles of food that they filter out of the water or suck up like a vacuum cleaner

- Jaws can hold teeth and muscles
  - Much wider variety of food
  - Defend themselves by biting



The Arrival of Paired Fins

- More control of body movement
- Fin tails and powerful muscles gave greater thrust when swimming
- Enabled fishes to move in new and varied patterns
- This enabled fishes to use their jaws in complex ways

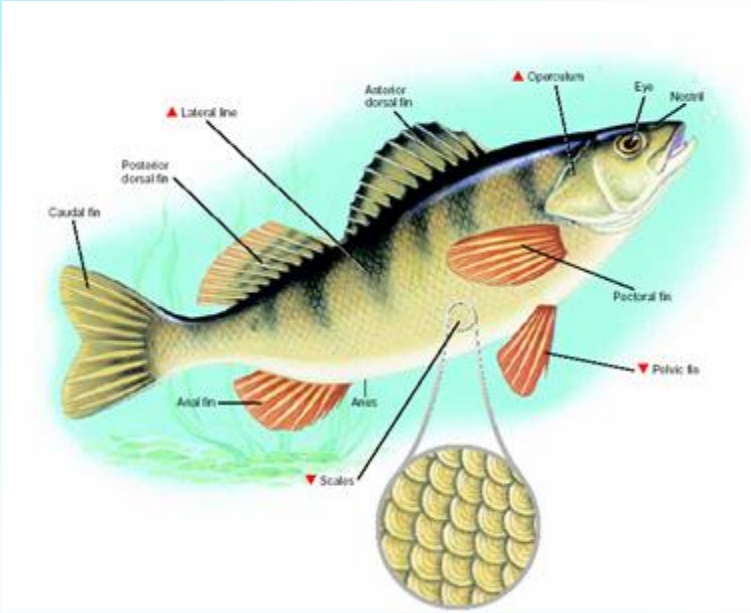


The Rise of Modern Fishes

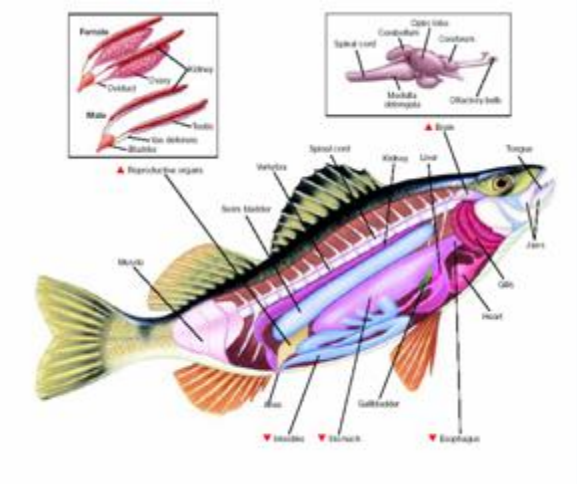
- Although the early jawed fishes soon disappeared, they left behind two major groups that continued to evolve and still survive today
  - Ancestors of modern sharks and rays: skeletons made of resilient cartilage
  - Group that evolved skeletons made of true bone

Form and Function in Fishes

- Adaptations to aquatic life include:
  - Various modes of feeding
  - Specialized structures for gas exchange
  - Paired fins for locomotion



Feeding



- Herbivores, carnivores, parasites, filter feeders, detritus feeders

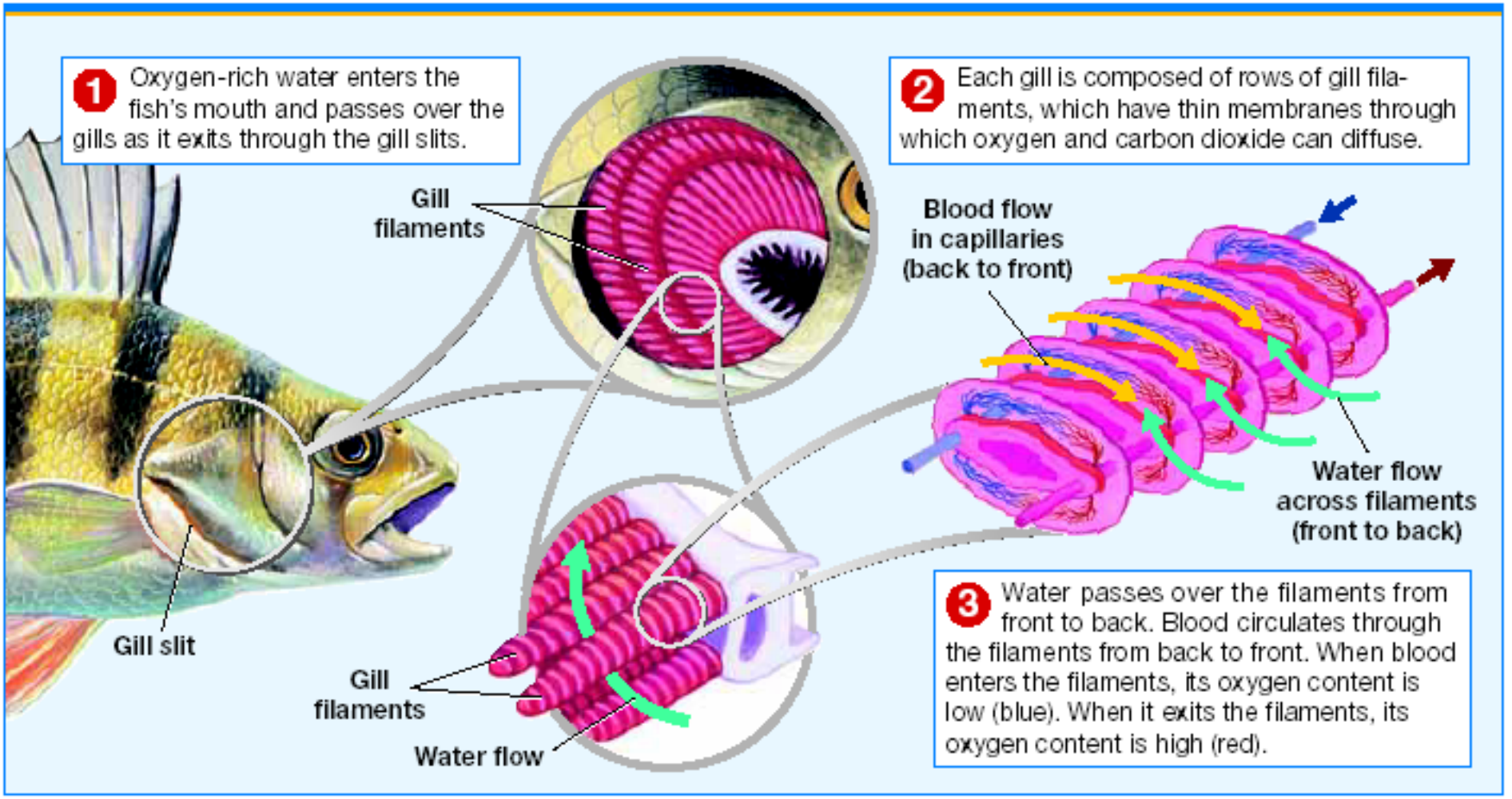
- A single fish may exhibit several modes of feeding (carp: eat what is available) while others are very specialized (barracuda: carnivore)

- Pyloric ceca: finger-like pouches found in many species of fish that secrete digestive enzymes to help digest food

Respiration

- Most fishes exchange gases using gills located on either side of the pharynx
- The gills are made up of feathery filaments
- Lampreys and sharks have several gill openings on the side of the body
- A number of fishes, such as the lungfish, have an adaptation that allows them to survive in oxygen-poor water or in areas where bodies of water often dry up

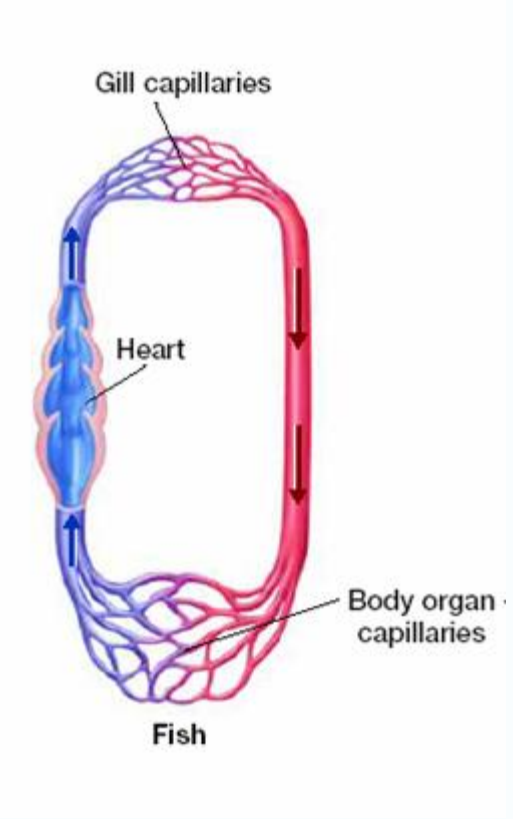
Respiration



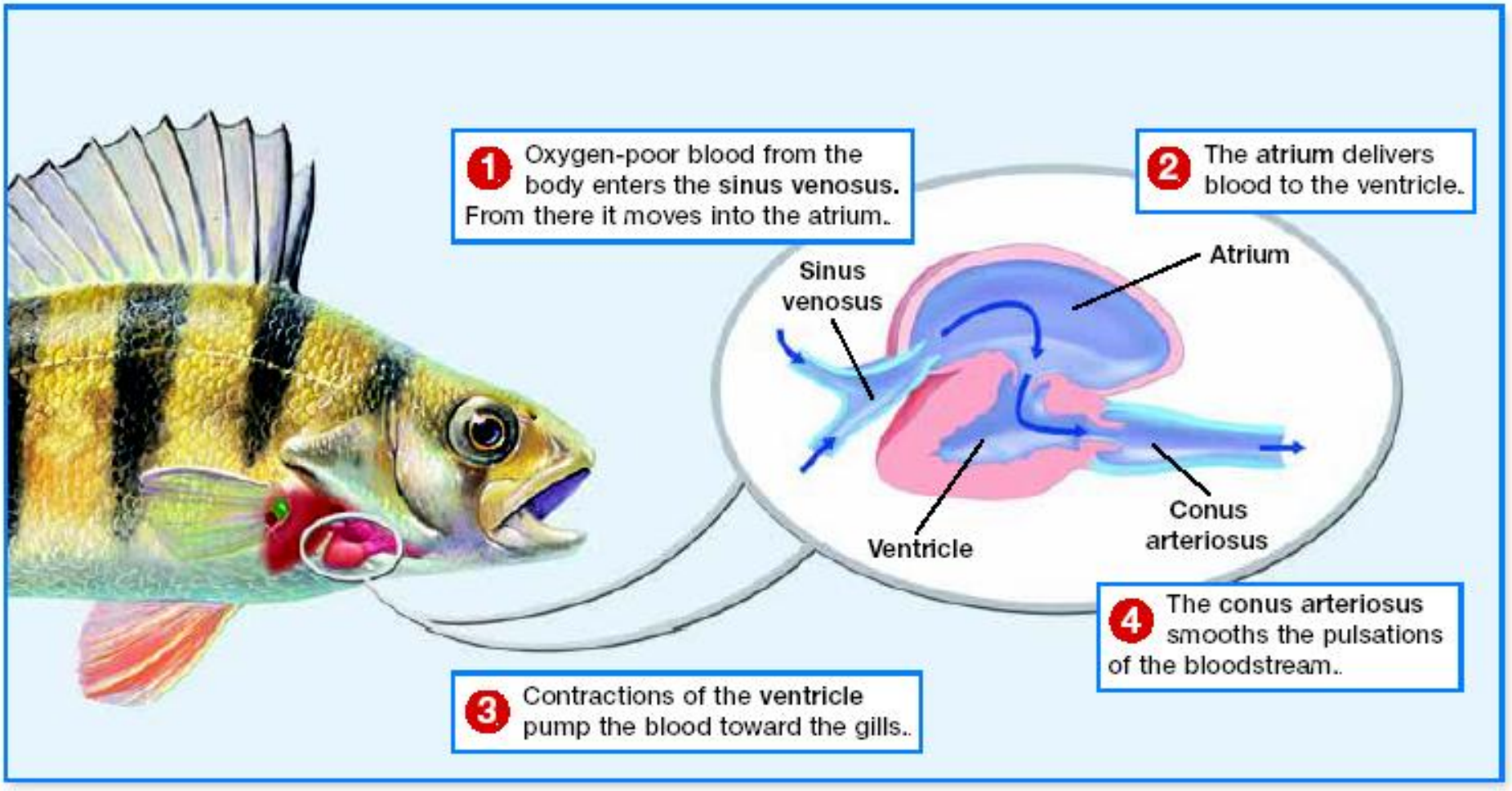
Circulation

- Closed circulatory systems with a heart that pumps blood around the body in a single loop

- Heart consists of 4 parts:
  - Sinus venosus: thin-walled sac that collects blood from the fish's veins
  - Atrium: a large muscular chamber that serves as a one-way compartment for blood
  - Ventricle: thick-walled muscular chamber; pumping portion of the heart
  - Bulbus arteriosus: connects to a large blood vessel called the aorta, which moves blood to the fish's gills



Circulation



Excretion

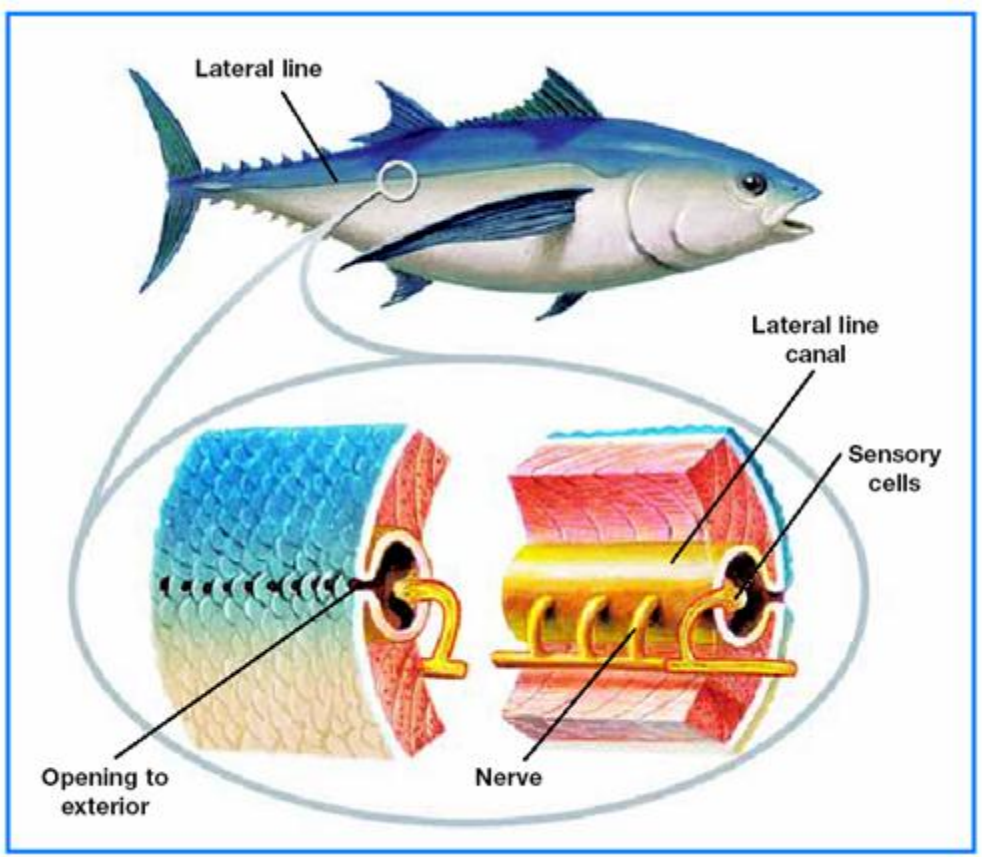
- Most fishes rid themselves of nitrogenous wastes in the form of ammonia
- Gills, kidneys
  - Saltwater fishes
    - Lose water by osmosis: kidneys return as much water to the body as possible
  - Freshwater fishes
    - Gain water by osmosis: kidneys pump out plenty of dilute urine

Response

- Well-developed nervous systems organized around a brain
- Cerebrum: area of the brain responsible for all voluntary activities of the body
- Cerebellum: region of the brain that coordinates body movements
- Medulla oblongata: area of the brain that controls the functioning of many internal organs

Response

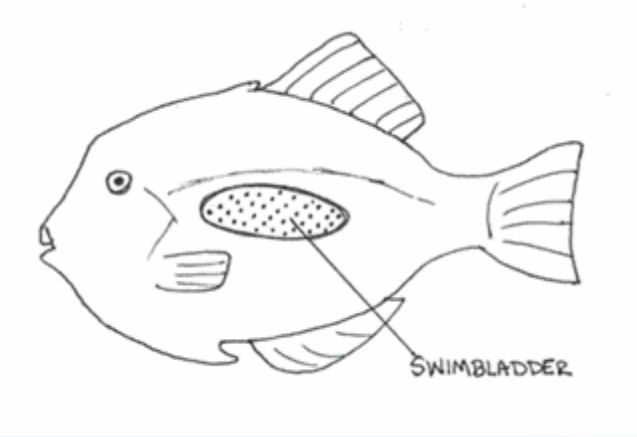
- Lateral line system: sensitive receptor system that enables fish to detect gentle currents and vibrations in the water (the 6th sense)



Movement

- Most move by alternately contracting paired sets of muscles on either side of the backbone

- Because their body tissues are more dense than the water they swim in, sinking is an issue for fishes



- Swim bladder: gas-filled organ found in many bony fishes that adjusts their buoyancy

Reproduction

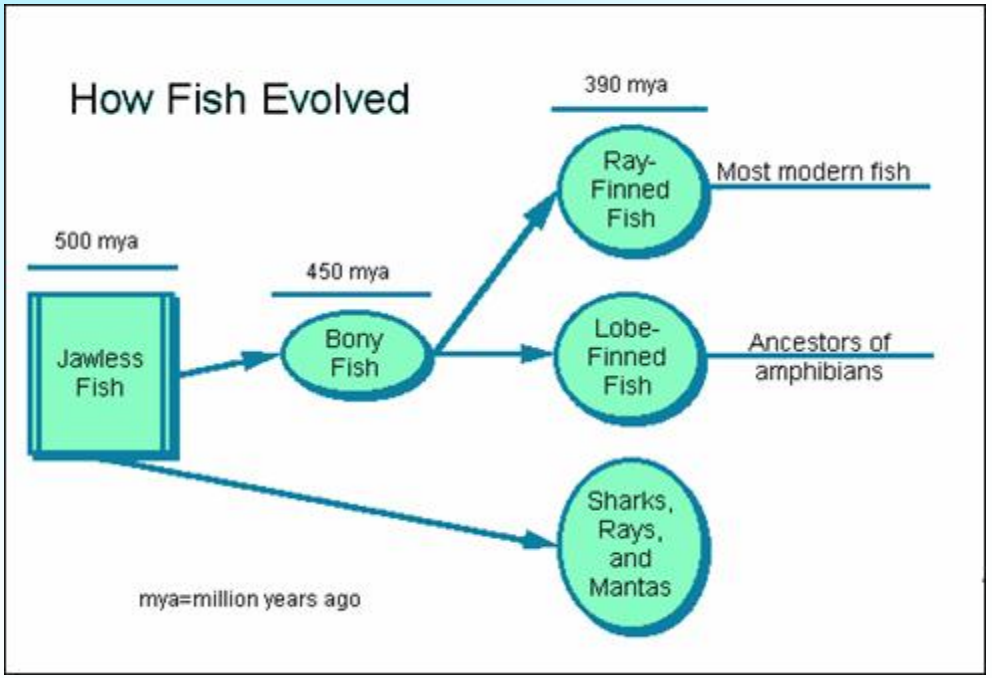
- Oviparous: term used to refer to animals whose eggs hatch outside the mother's body

- Ovoviviparous: term used to refer to animals whose young are born alive after developing in eggs inside the mother's body

- Viviparous: term used to refer to animals that bear live young that are nourished directly by the mother's body as they develop

Groups of Fishes

- Over 24,000 living species that are extremely diverse
- Jawless fishes
- Cartilaginous fishes
- Bony fishes

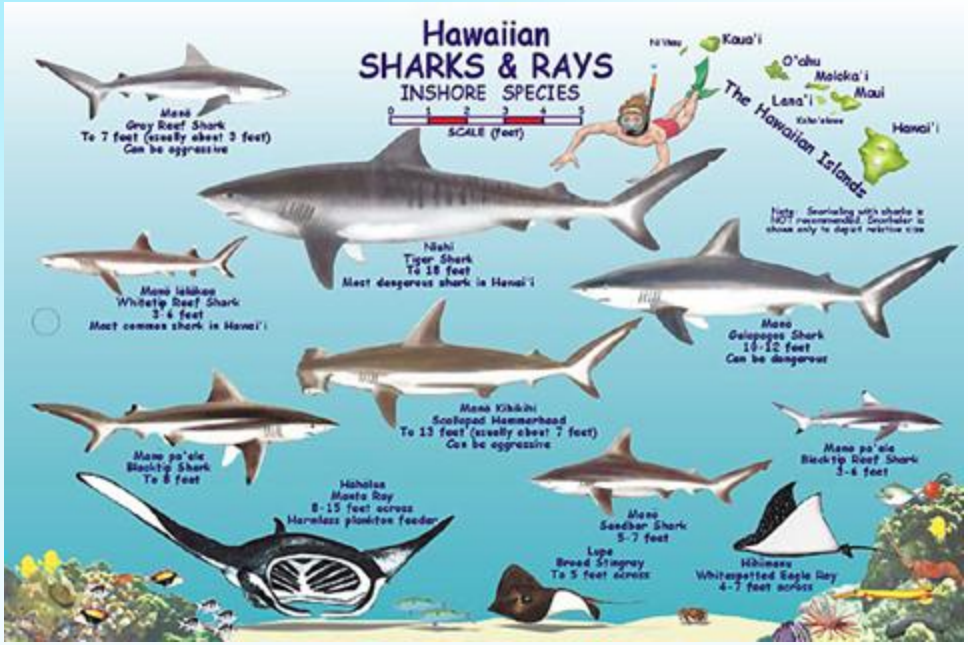


Jawless Fishes

- Have no true teeth or jaws
- Skeletons are made of fibers and cartilage
- Lack vertebrae; keep notochords as adults
- Two main classes:
  - Lamprey
  - Hagfishes

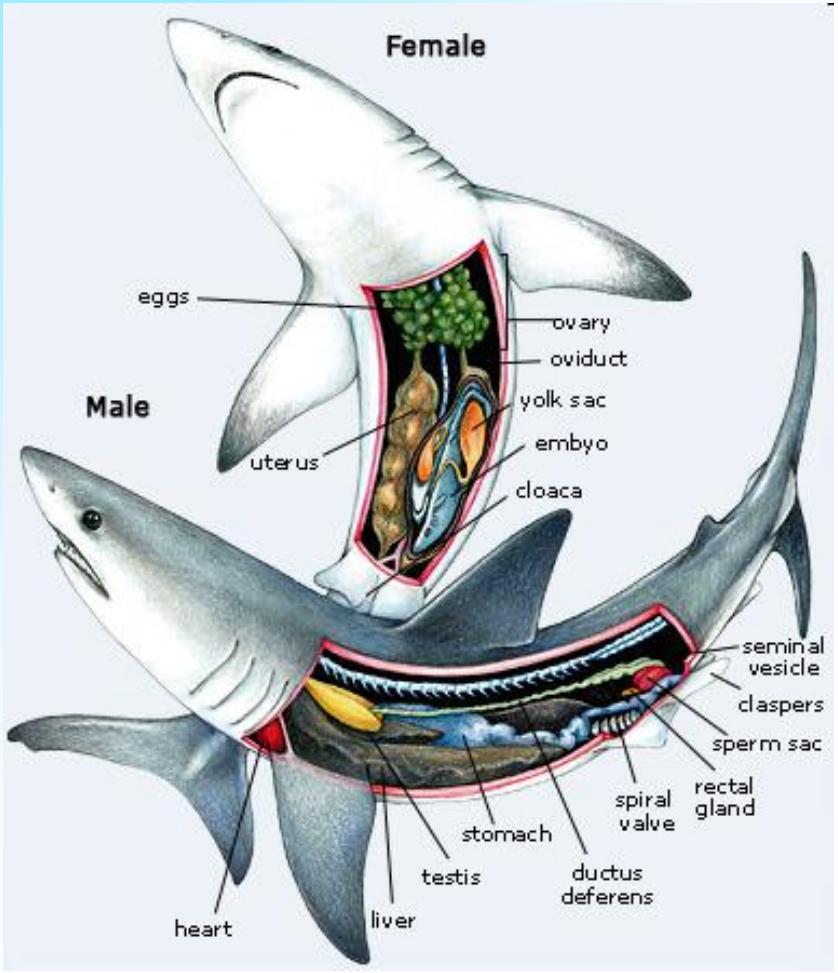
Sharks and Their Relatives

- Class Chondrichthyes
- Sharks, rays, skates,
- Also: sawfishes and chimaeras
- Cartilage, not bone



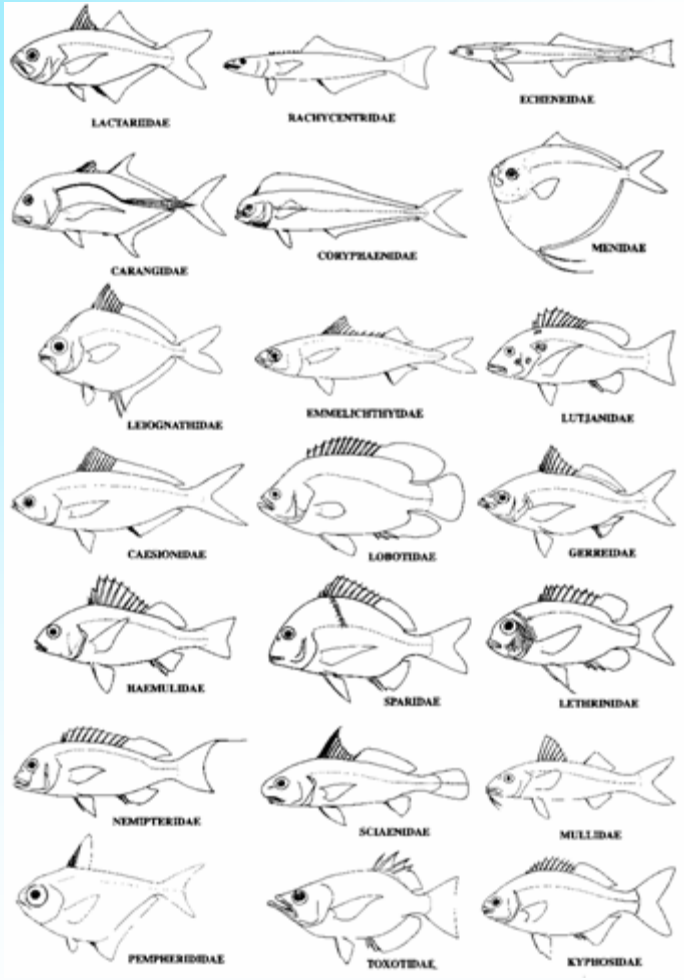
350 Living Species

- Curved tails
- Torpedo-shaped bodies
- Pointed snouts
- Mouth underneath
- Enormous number of teeth
- Always exceptions!



Bony Fishes

- Class Osteichthyes
- Skeletons made of hard, calcified tissue: bone
- Ray-finned fishes
  - Rays or spines that support the fins
  - Only 7 living species of bony fish are not ray-finned
- Lobe-finned fishes



Ecology of Fishes

- Anadromous: fishes that spend most of their lives in the ocean but migrate to fresh water to breed
  - Examples: lampreys, sturgeons, and salmon
- Catadromous: fishes that spend most of their lives in fresh water but migrate to the ocean to breed
  - Example: European eel, American eel

References

- www.smackslide.com