# Definition & Classification of Pisces.

**Fishes** are permanently aquatic vertebrates that has gills for respiration.. They are devoid of the true spine. Fishes may be present in fresh, marine,& brackish water. The organs for locomotion in fishes are fins. However, fins are sometimes paired or unpaired. The study of fishes is **Ichthyology.** Meanwhile, it is believed that they evolved from sea-squirt which is like a primitive fish..

**FISH**: Any of a large group of cold-blooded, finned aquatic vertebrates. Fish are generally scaled and respire by passing water over gills.

**Modern fish are divided into three classes. :**

**I. AGNATHA**, primitive jawless fish.Lampreys and Hagfish. 7

**II. CHONDRICHTHYES**, the jawed fish with cartilaginous skeletons. Sharks, Rays, Rat-Fishes

**III. OSTEICHTHYES,** fish with bony skeletons.Lungfish, Trout, Bass, Salmon, Perch, Parrot Fish

Fish come in all shapes and sizes, some are free swimming, while others rest on the bottom of the sea, some are herbivores and others are carnivores, and some lay eggs while others give live birth and parental care to their young.

## FISHES- Class- Agnatha :

Fish of the class agnatha ("no jaw") are the most "primitive" of the fishes; they lack a jaw and a bony skeleton. The hagfish and the lamprey are the only living representatives of this once large class. As they lack true bones, these fish are very flexible, the hagfish can actually tie itself in a knot to rid itself of a noxious slime it can produce to deter predators. They have a smooth, scale less skin and are soft to the touch. In place of the jaws is an oral sucker in the center of which is the mouth cavity. Many of the agnathas are highly predatory, attaching to other fish by their sucker like mouths, and rasping through the skin into the viscera of their hosts. The juvenile lamprey feeds by sucking up mud containing micro-organisms and organic debris - as did the primitive agnatha. Agnathas are found in both fresh and salt water and some are anadromous [living in both fresh and salt water at different times in its life cycle]. The hagfish has no eyes, while the lamprey has well-developed eyes.

## FISHES-, CHONDRICHTHYES :: Sharks

Chondrichthyes ("cartilage-fish") include the sharks, skates, rays, and ratfish. These fish have a cartilaginous skeleton, but their ancestors were bony animals. These were the first fish to exhibit paired fins. Chondrichthyes lack swim bladders, have spiral valve intestines, exhibit internal fertilization, and posses 5-7 gill arches (most have 5). They have cartilaginous upper and loosely attached lower jaws with a significant array of teeth. Their skin is covered with teethlike denticles.

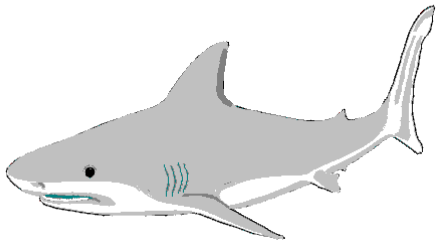
Sharks are animals that are superbly adapted to their environment. Almost all are carnivores or scavengers, although the species that live close to the sea floor feed mostly on invertebrates. Most possess a keen sense of smell, a large brain, good eyesight, and highly specialized mouth and teeth. Their bodies are usually heavier than water, and they do not have an air filled swim bladder for buoyancy like most bony fishes. All sharks have an asymmetric tail fin, with the upper lobe being larger than the lower one. This feature, together with flattened pectoral fins, and an oil-filled liver compensates for the lack of a swim bladder. There are 344 known species of sharks living in all parts of the oceans, from shallow to deep water and from the tropics to the polar regions. A few even venture into fresh water and have been found in rivers and lakes. Contrary to popular belief, most sharks are harmless to humans. Sharks are classified into eight orders:

1. Sawsharks (Pristophoriformes), one family, five sp.Live on the bottom in warm temperate or tropical seas. Easily recognized because of tube, blade like snouts. Bear live young.

2. Dogfish Sharks (Squaliformes), three families, 73 sp. Bottom dwelling deep water sharks, distributed worldwide. Bear live young and eat bony fishes, crustaceans, squid and other sharks. Harmless to humans.

3. Angel Sharks (Squatiniformes), one family, 13 sp. Flattened, bottom dwelling sharks. Found on continental shelves and upper slopes of cold temperate and tropical seas. Have very sharp, awl-like teeth that are used to impale small fish and crustaceans.

4. Bullhead Sharks (Heterodontiformes), one family, 8 sp. Live on rocky reefs where there are plenty of cracks and crevices. Found in Pacific and Indian Ocean. Eat invertebrates.



5. Gilled Sharks (Hexanchiformes), two families, five sp. Deep-water, bottom-dwelling sharks. Worldwide distribution. Only shark with six or seven gill slits. Bear live young and eat bony fish, crustaceans, and other sharks.

6. Mackerel Sharks (Lamniformes), seven families, 16 sp. Small, highly diverse order. Found in tropical to cold temperate or even Arctic waters. Oceanic and coastal. Most very large, eat bony fish, other sharks, squid, and marine mammals. Includes the Mako and Great White and the plankton eating Megamouth and Basking Sharks.

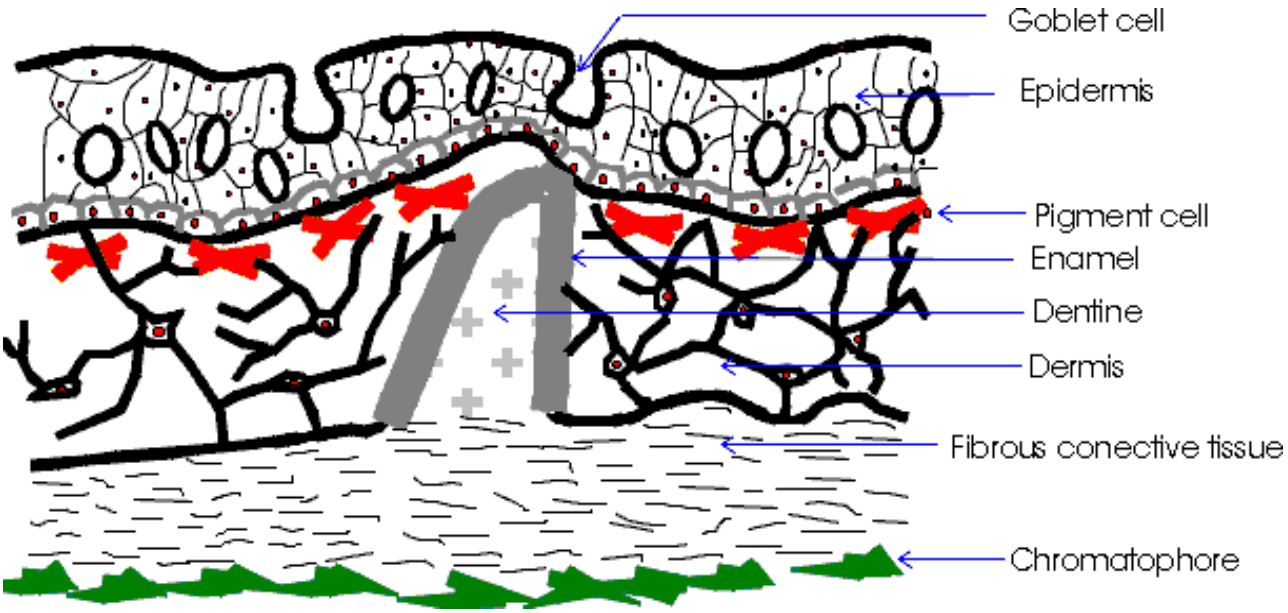
7. Carpet Sharks (Otectolobiformes) seven families, 31 sp. Warm tropical to temperate waters. All members except whale shark live on bottom.

Flattened. Most eat small fishes and invertebrates. Whale shark is plankton feeder. Some bear live young and others lay eggs.

8. Ground Sharks (Carcharhiniformes) 8 families, 193 sp. Largest order of sharks. Worldwide distribution, temperate and tropical waters. Most live near coast, although some found in deeper waters. Eat bony fishes, other sharks, squid, and small invertebrates. Includes the dangerous Tiger shark.

**Shark Anatomy**

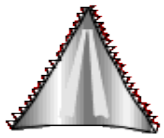
Sharks have numerous structural and physiological features that make them unique among the fishes. They have a simple cartilaginous skeleton with no ribs, and a cartilaginous jaw, backbone, and cranium.




Thick skin supports the flimsy skeleton. The skin is elastic and aids in movement; when the tail is arched, it pulls on the skin, which pulls back like a rubber band. The jaws are not connected to the skull and become unhinged, protruding forward from the skull allowing for a wider gape when

feeding. The teeth are ossified with minerals known as 'apatite'. They form a conveyer belt with as many as eight teeth in a row. When a shark looses a tooth, another one just pops up. Sharks go through up to 2,400 teeth a year.

Tiger shark
-feeds on turtles



Great White
-feeds on marine mammals



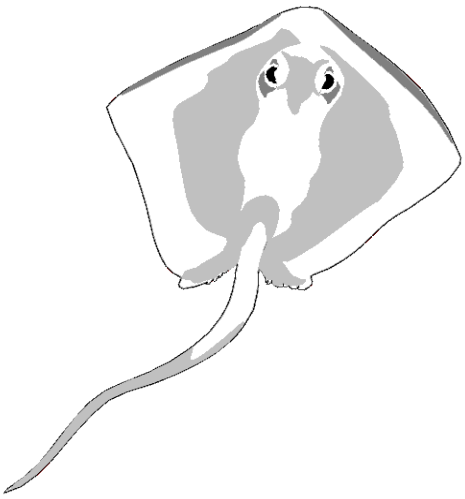
Sharks have placoid scales which are fixed, slightly ossified and layered. They are smooth to the touch in one direction and extremely course in another. Just rubbing a shark the wrong way can inflict serious wounds.

All sharks, rays, and skates are carnivores. They have normal sensory modalities, a small brain (most of which is dedicated to the olfactory lobes giving them an acute sense of smell) and well developed eyes with color vision and adaptation to low light levels.

Some sharks lay eggs (all skates and ratfish do), but most are ovoviviparous (all rays are). The young develop with their yolk sacks within the mother, but without a placenta or umbilical cord. Some sharks (the Great White) are oviphagous; the young eat the other developing young and embryos inside their mother and only the fiercest is born! A few sharks (hammerheads and reef sharks) are viviparous; like mammals, the young are nourished with a placenta within the mother. The gestation period is around 22 months and 2-80 pups are born per litter. Because most sharks are ovoviviparous or

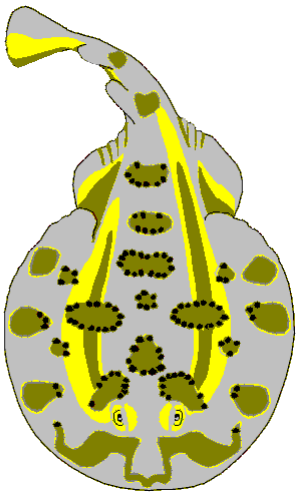
viviparous, they do not produce mass numbers of young like other fish do. They are slow to develop and for this reason shark population numbers have been decreasing rapidly due to the recent popularity of shark fin soup. Fishermen are taking many more sharks than the maximum sustainable yield will allow. Some sharks will soon be endangered species. Rays

Rays in general are physiologically exactly like sharks except the rays pectoral fins are fussed to their heads. Their gills are ventrally located. They swim with their ventral fins, like wings. Their eyes are dorsally [top] located and have spericules behind them. The spericules are used to breathe in with.



Rays are modified as bottom feeders, feeding on invertebrates found in the sand. Sometimes you can watch a ray making quite a ruckus on the sand bottom in search of the invertebrates.

Manta rays are planktivores and cruise the open water filter feeding out small animals. Mantas are the largest of the rays.



Electric rays swim with their caudal fin and use their modified pectoral fins to electrically shock and stun their prey.

Sawfish look like sharks but have true fused pectoral fins and gills on the ventral surface.

Stingrays have a toxin filled spine at the base of their tail. Stingrays are not the mean creatures roaming the waters to hurt swimmers, as many people believe them to be. Stingrays are actually very approachable and can be hand fed and petted, just don't step on them!

## FISHES- The BONY FISH, OSTIEICTHYES

The bony fish comprise the largest section of the vertebrates, with over 20,000 species worldwide. They are called bony fish because their skeletons are calcified, making them much harder than the cartilage bones of the chondrichthyes. The bony fishes have great maneuverability and speed, highly specialized mouths equipped with protrusible jaws, and a swim bladder to control buoyancy.

The bony fish have evolved to be of almost every imaginable shape and size, and exploit most marine and freshwater habitats on earth. Many of them have complex, recently evolved physiologies, organs, and behaviors for dealing with their environment in a sophisticated manner.

Eels -Anguilliformes 597 spp

Tarpon -Elopiformes 11spp

Salmon -salmoniformes 350 spp

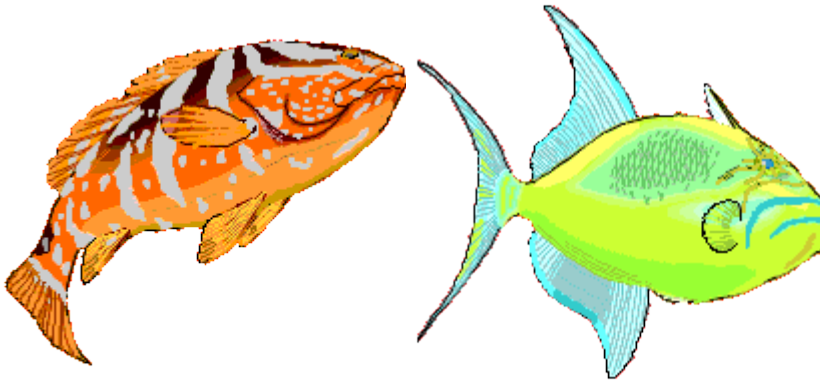
Deep Sea Fish - Stomiiformes 250 spp

Gobies - Gobiesociformes 114 spp

Trumpetfish - Syngnathiformes 257 spp

Silversides - Atheriniformes 235 spp

Squirrelfishes - Beryciformes 164 spp



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|---|---|
| Perch Like -Perciformes 7791 spp, largest order | Triggerfish - Tetraodontiformes 329 spp |

Fish have come up with three modes of reproduction depending on the method they care for their eggs.

## Modes of Reproduction

**In fishes,** oviparity is most common; the eggs are inexpensive to produce, and as eggs are in the water, they do not

- **Oviparity**-- Lay undeveloped eggs, External fertilization (90% of bony fish), Internal fertilization (some sharks and rays)
- **Ovoviviparity**- Internal development- without direct maternal nourishment-Advanced at birth (most sharks + rays)-Larval birth (some scorpeaniforms-rockfish)
- **Viviparity**- Internal development- direct nourishment from mother-Fully advanced at birth (some sharks, surf perches)

dry out (oxygen, nutrients are not scarce). The adult can produce many offspring, which they broadcast into the plankton column. When the offspring settle out of the plankton, they may be in totally new environments, allowing for a great area in which the young may survive. This mode also comes with its disadvantages; when born, the fish must first go through a larval stage for growth before they transform into the adult stage. In this larval stage, they must fend for themselves in obtaining food and avoiding predation. They may not find a suitable environment when they settle out of the plankton column. The survival of individual eggs is very low, so millions of eggs must be produced in order for the parent to successfully produce offspring. The other modes have their advantages, the eggs are much less prone to predation when carried within the mother, and the young are born fully advanced and ready to deal with the environment as miniature adults. These advantages come with a price-tag also; the adult must supply nutrients to its offspring and can only produce a few eggs at a time. The young are limited to the

environment that their parents were in, and if this environment is deteriorating, they are stuck with it.

Parental care: In fishes, parental care is very rare as most fish are broadcast spawners, but there are a few instances of parental care. Male gobies guard the eggs in a nest until they are born. The male yellowhead jawfish actually guards the eggs by holding them in his mouth! Weird Fish Sex!

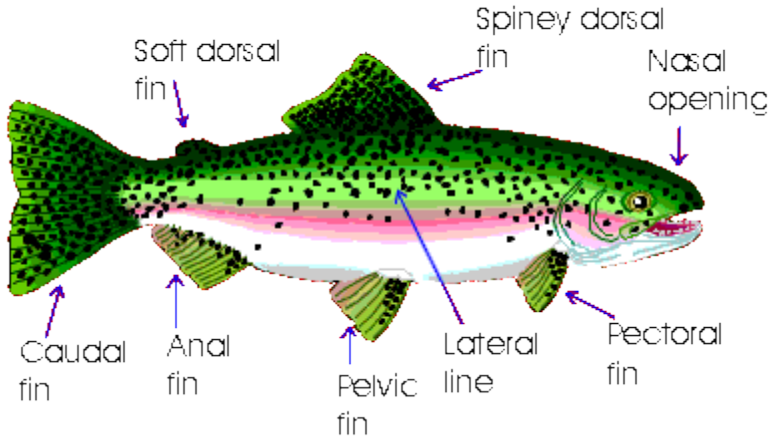
Some fish are very kinky creatures by human standards, displaying behavior that would probably get a human incarcerated for a long time.

# FISH- how fish swim

The density of water makes it very difficult to move in, but fish can move very smoothly and quickly.

A swimming fish is relying on its skeleton for framework, its muscles for power, and its fins for thrust and direction.

The skeleton of a fish is the most complex in all vertebrates. The skull acts as a fulcrum, the relatively stable part of the fish. The vertebral column acts as levers that operate for the movement of the fish.




The muscles provide the power for swimming and constitute up to 80% of the fish itself. The muscles are arranged in multiple directions (myomeres) that allow the fish to move in any direction. A sinusoidal wave passes down from the head to the tail. The fins provide a platform to exert the thrust from the muscles onto the water.

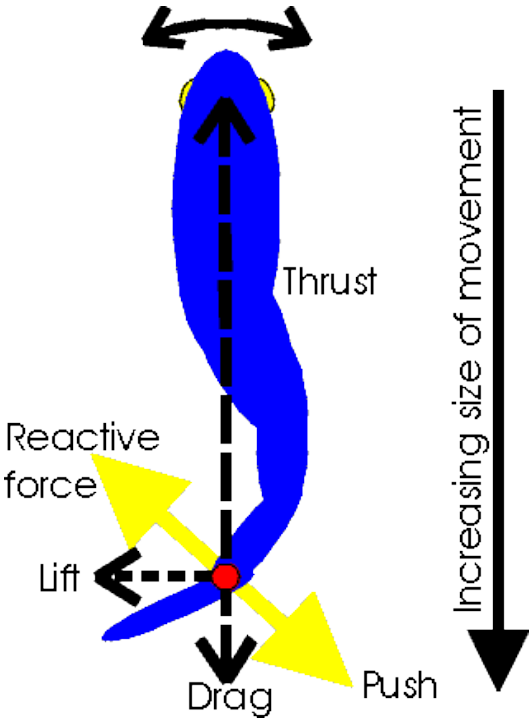



**Diagram of forces when a fish swims.**

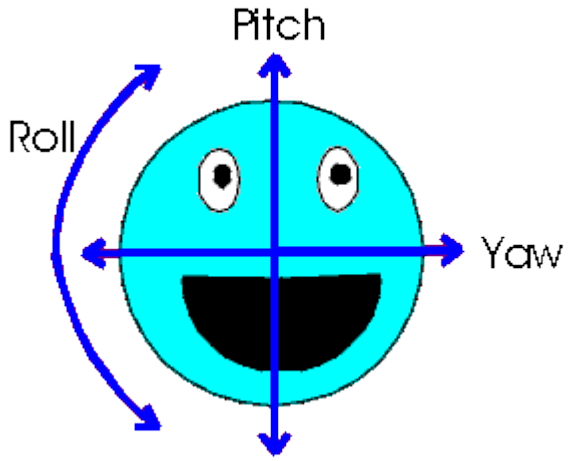
Thrust- force in animal's direction

Lift- force opposite in right angles to the thrust

Drag- force opposite the direction of movement

** All lift forces cancel out over one complete tail stroke.

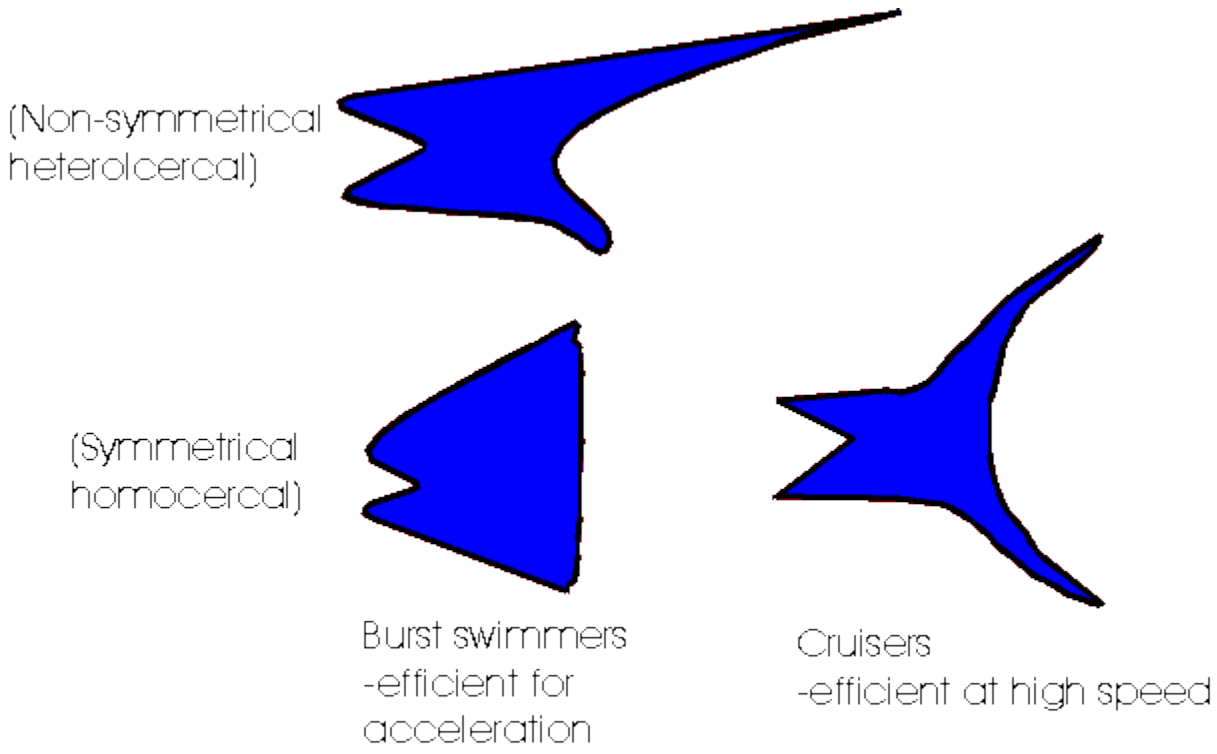
**Fins**- fins give a fish control over its movements by directing thrust, supplying lift and even acting as brakes. A fish must control its pitch, yaw, and roll.




- Caudal fin-- provides thrust, and control the fishes direction
- Pectorals-- act mostly as rudders and hydroplanes to control yaw and pitch. Also act as very important brakes by causing drag.

- Pelvic fins-- mostly controls pitch
- Dorsal/anal-- control roll

**Caudal Fins**



# Fishes- How Fish Breathe

When we go under water, we have to bring air with us to survive. Whales and dolphins have lungs that store air from the surface. Fish don't have lungs, and they rarely ever venture into the air, so how do they survive. We all know it has something to do with gills, but what exactly.

The water surrounding a fish contains a small percentage of dissolved oxygen. In the surface waters there can be about 5 ml. of oxygen per liter of water. This is much less than the 210 ml. of oxygen per liter of air that we breath, so the fish must use a special system for concentrating the oxygen in the water to meet their physiological needs. Here it comes again, a counter current exchange system, similar to the one we found in the fish's swim bladder and in the tuna's muscles.

The circulation of blood in fish is simple. The heart only has two chambers, in contrast to our heart which has four. This is because the fish heart only pumps blood in one direction. The blood enters the heart through a vein and exits through a vein on its way to the gills. In the gills, the blood picks up oxygen from the surrounding water and leaves the gills in arteries, which go to the body. The oxygen is used in the body and goes back to the heart. A very simple closed-circle circulatory system.

The gills: the gills are composed of a gill arch (which gives the gill rigid support), gill filaments (always paired), and secondary lamellae, (where gas exchange takes place)..