

CLASSIFICATION OF FISHES
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A fish is a type of animal that has a backbone, lives in the water, and has fins. Most fish have scales covering their bodies. Most fish breathe with gills. Fish belong to a very large group! Nearly half of all vertebrates (animals with backbones) are fish. Fishes have been swimming in Earth's waters for more than five hundred million years. That's longer than any other kind of vertebrate has been on Earth. Fish were the first vertebrate animals to evolve.

Scientists group fish into three main types. They are divided into these groups because of the structure of their mouths and the types of skeletons they have. There are jawless fishes, cartilaginous (cart uhl AJ uh nuhs) fishes, and bony fishes. All three types are "cold-blooded," or ectotherms. This means that they can't control their body temperature internally. Their body temperature is similar to the temperature of their outside environment.

The jawless fishes were the earliest vertebrates. Today there are only about sixty species still living. These fish have no scales. Their skeletons are made of cartilage, a firm, flexible material like the end of your nose. They also do not have pairs of fins like most fish. But the most remarkable thing about these fish is that they do not have jaws! Instead, the mouths of these fishes have structures for scraping, stabbing, and sucking.

Hagfishes and lampreys are the only living kinds of jawless fishes. Hagfishes look like big slimy worms! They crawl into the bodies of dead or dying fish and use their sandpapery tongue to scrape the tissues.

Lampreys have a mouth like a suction cup with many tiny, but sharp, teeth. Many of them are parasites that feed on other fish. A parasite is an organism that lives off another organism without helping the host organism in any way. Lampreys attach their mouths to a healthy fish and then suck the tissues and blood out of the healthy fish. There are many lampreys in the Great Lakes.

The second type of fish is the cartilaginous fishes. These include sharks, rays, and skates. Their skeletons are made of cartilage, just like the skeletons of the jawless fishes. However, they do have jaws and pairs of fins. Their bodies are covered with

pointed, toothlike scales. This gives their bodies a texture rougher than sandpaper. All cartilaginous fishes are carnivores. Rays, like sting rays and manta rays, live on the ocean floor. Sting rays hunt mollusks, crustaceans, and small fishes. Manta rays are filter-feeders. As they swim with their mouths open, water containing plankton, very small animals, comes into their mouths. They filter out the food from the water.

Most sharks are active predators, eating mostly fish. The great white shark also preys upon ocean mammals like seals. The largest shark, the whale shark, may grow to be forty feet long. It feeds like a filter-feeder, swimming along with its mouth open to catch small fish and plankton.

The third type is the bony fishes. These are the most familiar fish. Bony fish make up about ninety-five percent of all fish species. Trout, goldfish, tuna, clownfish, and catfish are all kinds of bony fishes. They live in both salt and fresh water. Their bodies are covered with scales. Their gills are inside a pocket on the sides of their head. Each gill pocket is covered with a flap that opens to release water.

Bony fish have scales that overlap like the shingles on a roof. Scales are made from a substance like your fingernails. Mucus covers and protects the scales. This slimy coating is important because it protects the fish from parasites, infections, and diseases. It helps wounds heal and even helps the fish move easily through the water. The paired fins help the fish stay balanced and upright in the water. Fins are used for swimming. Fins are thin membranes stretched across a framework of bones. Like a wide boat paddle, a fin provides a large surface to push against the water.

Most all fish breathe with gills. As a fish swims, it automatically opens its mouth. It continuously gulps water, even when it sleeps. The water, which contains oxygen, moves through openings in the fish's throat that lead to the gills. Gills, which look like tiny feathers, are red because of the many blood vessels in them. As water flows over the gills, oxygen moves from the water into the fish's blood. Carbon dioxide, a waste product, moves out of the blood into the water. After flowing over the gills, water leaves the fish through slits beneath the gill flaps.

From the gills, the blood travels through the fish's body. Blood is pumped from the heart to the gills, from the gills to the rest of the body, and back again to the heart. Each cell of the fish's body receives oxygen from the blood and releases its carbon dioxide into the blood. Interestingly, a fish's heart has only two chambers.

Fish come in all shapes, colors, and sizes. Scientists estimate that there are more than 20,000 different species of fish! Fish have lived on Earth before the dinosaurs. Fish have adapted to almost every watery environment and type of food.

UPERCLASS AGNATHA (jawless fishes)

Vertebrates with a suctorial or filter-feeding mouth; no true jaws; 2 (possibly 1 sometimes) semicircular canals; pelvic fins lacking; pectoral finlike structures, when present, lacking fin rays; persistent notochord, without bone or cartilage; bony skeleton, when present, formed in skin; true gill arches absent, gill basket present. Habitat of fossil groups uncertain; earliest probably in fresh water. About 113 living species.

Class Myxini

Order Myxiniformes(hagfishes)

Without dermal ossification of any sort; pectoral appendages absent; eyes poorly developed; 1–16 pairs of external gill openings; tail more or less diphyercal. Primarily bottom-dwelling fishes, but suctorial, rasping and feeding on flesh of dead or dying fishes; horny teeth present. Length about 15–110 cm (roughly 6–43 inches). About 70 species. Marine. Pennsylvanian to present.

Class Cephalaspidomorphi (Monorhina)

Order Petromyzontiformes(lampreys)

Without dermal ossification of any sort; pectoral appendages absent; eyes more or less lateral or dorsal; 7 pairs of external gill openings; tail more or less diphyercal. Primarily bottom-dwelling fishes, but suctorial, feeding on blood and juices of live fishes; horny teeth present. Species are either parasitic or nonparasitic. Length about 15–100 cm (roughly 6–39 inches). About 43 species. Freshwater and marine, breeding in fresh water. Pennsylvanian and present.

CLASS CHONDRICHTHYES (OR SELACHII) (cartilaginous fishes)

Cartilaginous fishes. Lacks true bone (except in the roots of teeth). Gill clefts: 5–7 in Selachii, 5 gill openings occur on the lower surface of Batoidei, and only 1 in Chimaeriformes. Dorsal fin, fins, and fin spines rigid, not erectile, if present. Approximately 940 species.

Subclass Elasmobranchii

Chondrichthians with 5–7 pairs of gill clefts not covered by a fold of skin, opening separately to the exterior.

Order Selachii (sharks)

Elasmobranchs with gill clefts opening at least partly on the side of the body. More than 400 species.

Order Batoidei (rays, sawfishes, guitarfishes, skates, and stingrays)

5 gill openings, wholly on ventral surface; pectoral fins united with sides of head forward past the gill opening. Differ from all sharks in lacking upper free eyelid. More than 500 species. Jurassic to present.

Subclass Holocephali

Jaws holostylic (the palatoquadrate) supporting the upper jaw completely fused to cranium; hyoid arch complete, unmodified; branchial arches below cranium; internal skeleton of cartilage, often calcified but never of bone; dermal skeleton of dentine or dentinelike tissue (placoid scales), never with true bone; scales do not continue to grow once fully formed; pelvic and cephalic claspers in males of some groups. About 40 species.

Order Chimaeriformes (chimaeras)

Teeth in a single series of a few tooth plates along each jaw ramus (half); pectoral with 2, and pelvic fins with 1 basal element; pelvic fin claspers present; dermal armour frequently present on head; primitive forms with placoid scales covering body, lost in certain advanced forms; scales specialized in some; dorsal fin spine present or absent; cephalic clasper present in some. Marine. Late Devonian to present.

SUPERCLASS OSTEICHTHYES(bony fishes)

Class Actinopterygii (ray-finned fishes)

Fins supported by rays of dermal bone rather than by cartilage. A group of jawed fishes so diverse that no single definition for them can be derived; better understood by determining the distinctive characters of the primitive members and then tracing their various lines of evolution. Primitive actinopterygians can be separated from the sarcopterygians by the following characteristics: scales ganoid; single dorsal fin; pectoral fins with a series of thin radial bones, rather than basal plates and fleshy lobes; no internal nares. Other important characters: skeleton

usually well ossified; scales grow throughout life; swim bladder present (occasionally modified to a lunglike structure). More than 27,000 living species.

Subclass Chondrostei

A mixed group that has undergone many evolutionary diversifications. The remaining orders of the Chondrostei are specialized, often for special habitats and ways of life, but many of the groups show trends toward the holostean level of organization, especially in median fin structure and the development of hemiheterocercal tail, in which externally at least the tail appears nearly homocercal. About 40 living species.

Order Acipenseriformes (sturgeons and paddlefishes)

Almost no internal ossification; scales as large scutes in isolated rows (Acipenseridae); snout enlarged and tactile (Polyodontidae); median fins chondrosteian in having more fin rays than basal elements; tail heterocercal. Length (sturgeons) up to 6 metres (roughly 20 feet), weight to 3,200 kg (roughly 7,000 pounds). Marine and freshwater, bottom suctional feeders (sturgeons, Acipenseridae; Europe, Asia, North America) carnivores and plankton feeders (paddlefishes, Polyodontidae; China and North America). Middle Jurassic to present.

Order Polypteriformes (bichirs and reedfish)

Relationships controversial, placed in own subclass by some and thought related to crossopterygians by others. Typical chondrosteian characters, such as ganoid scales and a paleoniscoid type of preopercle. Fins modified into long continuous dorsal, tail diphyercal. Freshwater, Africa. Late Cretaceous to present.

Infraclass Holostei

Paraphyletic group. Tail hemiheterocercal; maxillary scale free of preopercle; rays of median fins about equal basal elements in number; spiracle lost; vertebral column tended to increasing ossification; trend toward thinning scales and loss of ganoid layer. Preoperculum intimately bound to and supporting the posterior border of the palate. About 8 species.

Order Amiiformes (bowfins and fossil relatives)

Relatively conservative holosteans with typical holostean characters as given above; some specialized in body shape (elongate); most typical fusiform holosteans. 1 living member of the family Amiidae, with 1 species, *Amia calva* (bowfin), of North America. Marine and freshwater, almost worldwide. Middle Jurassic to present.

Order Semionotiformes (gar and fossil relatives)

3 (2 extinct and 1 living) families of widely divergent fishes; probably independent of the Amiiformes but with typical holostean characters; length to about 3 metres (roughly 10 feet). Late Permian to present.

Infraclass Teleostei(advanced bony fishes)

Tail homocercal; caudal skeleton with perichordally (around the spinal cord) ossified centra; neural arches modified into elongate uroneurals extending forward onto the preural centra, “stiffening” the joints between the terminal 4 or 5 vertebrae. 2 hypural bones supporting the lower caudal fin lobe. Teleosts never have ganoid scales; typically, their scales when present are thin, overlapping plates of bone that continue to grow throughout life; their lower jaws lack certain bones found in many chondrosteans or at least have some of these bones fused to single elements. 26,840 living species.