Introduction to Fish

Fish are finned, aquatic, cold blooded vertebrates with gills. They share a body plan similar to that of humans and other vertebrate (with a backbone) animals. Fish breath oxygen, feed, move, reproduce, and sense their surroundings like other vertebrate animals, but they do so in water. Over 20,000 known species of vertebrates are fish. Ninety percent of these belong to the Class Osteichthyes, or bony fish. Most of the other ten percent belong to the Class Chondrichthyes, or cartilaginous fish, the sharks, rays, and skates, all of which have a skeleton of cartilage. The third class of fish is called the Agnatha ("without a jaw"), a primitive group of mostly extinct fish, with only two living forms, the lampreys and the hagfish.

Fish come in a wide range of sizes and shapes, but most exhibit a basic torpedo-shaped body that is modified according to where in the ocean the fish lives and how it makes its living. The streamlined bodies of fast swimming fish are generally long and thin, with rigid fins that help them zip through the open ocean, the pelagic environment, at speeds of up to 50 m.p.h. for blue fin tuna. Less streamlined fish tend to be shorter and wider, with more flexible fins in order to maneuver in and around reefs and kelp forests to find prey and avoid predators. Flatfish start life as larvae that look like typical fish but as they grow, one eye migrates to the opposite side of the head and its body flattens side to side. When the juvenile transforms into a small version of the adult, the fish settles onto the sea bed where it spends the rest of its life as a benthic animal, lying on one side but with both eyes looking upward for prey. Some fish, like garden eels, live in tubes within the sand, and they have a body form that resembles that of a worm. They hide in their tubes when predators threaten but emerge from the tube, all except the tip of the tail, to feed on zooplankton. Garden eels are somewhat aggressive, and they fight with each other for feeding space, with the result that each eel is just one body length away from its nearest neighbor. When all of the eels are feeding, they look like they have been planted in a garden, in ranks and rows.

Fins give fish mobility, stability, and maneuverability. Fins can be paired or unpaired. The dorsal and anal fins are unpaired fins that act as keels to prevent the fish from rolling. The caudal or tail fin, also unpaired, helps to propel and maneuver the fish. Pelvic and pectoral fins are always paired and these permit the fish to steer, stabilize, and stop. Paired fins that are maneuverable and flexible provide better control at slow speeds, whereas fins that are rigid act as steering planes for fast swimming fish. The fins and the body of bony fish are covered with skin that contains thousands of tiny scales. Growth of a fish is marked in annual rings on each scale, and scales vary in size and shape characteristic of each species of fish. Therefore, examination of a fish scale can tell an investigator not only which species of fish produced the scale but also the age of that particular fish. Mucous covers the skin and scales of bony fish, which is why fish feel slimy, but the mucus is extremely important because it protects the fish from disease, predators, parasites, and sunburn. The skin of cartilaginous fishes, however, is quite different, without mucus but instead thick and tough like armor, covered with tiny impervious scales. The scales of sharks and their relatives are called denticles (like teeth), and the skin feels like sandpaper.

Fish mouths are critical for feeding and breathing. The mouth may be upturned for surface feeding, downturned for feeding on the bottom, or it may be situated midway on the tip of the snout for feeding in midwater. Fish mouths contain a tongue and teeth. Fish breathe by drawing in water through the mouth, across the tongue, over the gills, and then out through openings behind the paired opercula, bony plates on each side of the head that protect the gills and which act as muscular, one-way valves to regulate water flow. Oxygen in the water diffuses through the gill filaments and into the blood where it binds with hemoglobin in the red blood cells for delivery throughout the body of the fish. The gills are

therefore organs for oxygen exchange, but the back portion of the gills, the gill rakers, are also used by some species of fish to filter food out of the water that passes through the mouth and over the gills. Finally, carbon dioxide and nitrogenous wastes are expelled from the blood through the gills and out of the body through openings behind the opercula. Many sharks must swim constantly to maintain a flow of oxygenated water over their gill surfaces, whereas skates and rays lie on the bottom and pump in water across their gills through holes behind the eyes, called spiracles.

Fish gills have an enormous number of blood vessels close to the surface of the gill to permit the exchange of oxygen. These vessels connect to a two-chambered heart, which slowly pumps oxygenated blood throughout the body. Kidneys help regulate blood chemistry and deliver waste products to the urinary tract. The liver stores surplus nutrients and detoxifies substances. In sharks, the liver also contributes to buoyancy because shark livers contain large quantities of oil, which is less dense than water. Because of its role in buoyancy regulation, the liver of sharks is disproportionately larger than livers of bony fish. This is because most bony fish have a swim bladder for buoyancy regulation rather than a fatty liver. The swim bladder is a sac which is gas-filled. Bony fish inflate or deflate the swim bladder to obtain neutral buoyancy, thereby equalizing the fish's weight to that of the surrounding water.

Sight is extremely important to fish. Fish eyes are constantly bathed by the surrounding water, so fish do not need eyelids like those of terrestrial animals to lubricate and protect the delicate cornea. Each fish eye moves and views the world independently of the other eyeball. Fish eyes are not too good at judging distances, but colors are perceived well, and many fish use colors for sexual advertisement and species recognition. Fish can navigate and locate food by using their eyes but they also sense objects using their lateral line sense organs. The lateral line system consists of a series of pores in the skin of the fish, oriented in a line down each side of the body. These pores contain many nerve endings, and they permit the fish to sense slight changes in water pressure. The last major sense is that of hearing. Fish hear very well although they do not have an external ear as do land animals.

Fish have evolved defense mechanisms to deal with predators: poison, camouflage, spines, electricity, and, of course, sharp teeth. Behavioral adaptations also protect fish from predators. Some fish school in large groups to confuse predators. Some hide in plants and rock formations. Flying fish leap out of the water and spread their pectoral fins, like wings, and glide away from their predators, often for distances of up to 100 meters, the length of a football field.

Fish breed using several different methods, with some laying eggs and others bearing live young. Egg-laying styles include egg-scattering, egg-burying, egg-depositing, mouth-brooding, and nest building