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BONY FISH AND SHARK: COMPARISON OF STRUCTURE

The previous six plates dealt with the variety of forms found in the bony fishes. Before venturing forward in a study of the cartilaginous sharks and rays, a comparison of these two groups is in order. The major organs and systems, with special emphasis on the difference between the sharks and rays (elasmobranch fishes), and the bony fishes, are reviewed here.

This plate presents a highly diagrammatic comparison between the internal anatomy of a bony fish and that of a shark. Locate and color each organ or system in both illustrations as it is discussed in the text. Only those structures labeled and outlined with dark lines are to be colored.

Starting from the anterior, or mouth end of each fish, note the relatively small *brain*, which continues posteriorly as the *spinal cord*. The large *olfactory lobe* of the brain gives evidence of the importance of an acute sense of smell in both groups of fishes. The olfactory lobe terminates near the base of a blind sac, which opens at the *nostril*. Since the nostrils do not open to the throat—as they do in mammals for instance—most fishes must take in their respiratory water current through the mouth. Rays and other bottom-dwelling elasmobranch fishes take in water through an opening called the *spiracle*. Contraction of the throat musculature pumps water over the *tongue* and across the *gills*, which take up the sides of the throat. This oxygen-laden water passes over *gill filaments*, oxygenating the blood supply. *Gill rakers,* located on the inner face of the gill support (gill arch), prevent foreign matter from clogging the gills. Water is pumped out of the gill chamber past the operculum in bony fishes, or through the gill slits in sharks.

The relatively small *heart* is located near the base of the gills. It pumps blood through the gills and from there to the head and the rest of the body. *Kidneys* help regulate blood chemistry and deliver waste products to the exterior through the urogenital opening (not shown). The *gonads* (sex organs) also empty through this opening.

Another large organ linked to the circulatory system is the *liver*, whose main functions are to store surplus nutrients and to detoxify certain substances. In sharks and their relatives, the liver has an additional function: to contribute buoyancy to the body. This is because the liver stores oil which is considerably less dense than water. The presence of the oil in the shark liver is responsible for the latter being much larger in size than the liver of the bony fish. Most bony fish utilize a more efficient adaptation for buoyancy: the gas-filled *swim bladder*. Air is either gulped at the surface or secreted from the bloodstream into the swim bladder. Delicate regulation of the gas content in this organ allows a fish to maintain its position in the water column with a minimum expenditure of energy. By contrast, elasmobranchs function similarly to airplanes, requiring forward motion to keep from sinking.

The length and complexity of the gut has more to do with the diet of any particular species than with that species' relation to the bony fishes or shark group. The *spiral valve* is one gut structure found almost exclusively in sharks and their relatives. It serves to increase the surface area of the *intestine* for more efficient absorption of nutrients.

The characteristic difference between the two major groups, by which they are most commonly named, is the skeletal material. Elasmobranchs are cartilaginous fishes. Their skeletons are made of a relatively flexible material, but the skeletal structure is much less elaborately articulated than in bony fishes. The result is that the bodies of elasmobranchs are on the whole less maneuverable and adaptable than those of bony fishes. This is especially apparent in the structure and utilization of the fins.

Most fishes are covered by a protective layer of scales. In elasmobranchs, these are *placoid scales*, also called denticles. The word "denticle" indicates a relation to teeth, and sharks' teeth indeed originate from the skin layer, as do the scales. Placoid scales seen under a microscope have a sharp tooth-shaped projection, and collectively these scales give a sandpaper texture to the shark's skin. Bony fishes possess, as a group, several types of scales. The *ctenoid scales* shown here are thin and translucent. They lack the enamel and dentine layers of placoid scales, and instead have an outer surface marked with bony ridges that alternate with depressions. Ctenoid scales overlap to provide both protection and suppleness.

Name/Period/Date

Bony Fish and Shark: Comparison of Structure

1. What is a major difference between elasmobranchs and bony fishes?
2. What is the spiracle used for?
3. How do sharks use their liver differently than you do?
4. Describe shark scales.
5. Color!

COMPARISON OF STRUCTURE

BRAIN$_a$
OLFACTORY LOBE$_{a^1}$
SPINAL CORD$_{a^2}$
NOSTRIL$_b$
TONGUE$_c$
GILL$_{(d)}$
GILL FILAMENT$_{d^1}$
GILL RAKER$_{d^2}$
HEART$_e$
KIDNEY$_f$
GONADS$_g$
LIVER$_h$
STOMACH$_i$
INTESTINE$_j$
MUSCLE$_k$
BONY FISH✡
SWIM BLADDER$_l$
BONE$_m$
VERTEBRA$_{m^1}$
RIB$_{m^2}$
FIN SUPPORT$_{m^3}$
CTENOID SCALE$_n$
SHARK✡
SPIRACLE$_o$
SPIRAL VALVE$_p$
CARTILAGE$_{(q)}$
VERTEBRA$_{q^1}$
PLACOID SCALE$_r$