

Student Information Sheet 1

General Biology of Sharks and Rays

The scientific name for the group of animals that includes the sharks and rays is called the **Chondrichthyes**. This group form only a small proportion of all living fishes.

Sharks and rays share many features with other fish — known as bony fish — but they also have several features that separate them from bony fish.

Skeletal Structure

One key feature of the sharks and rays that separate them from the bony fishes and other **vertebrates** (amphibians, reptiles, birds and mammals) is their skeleton. Most vertebrates have a skeleton made of hard, dense bone. Sharks and rays have a skeleton made of **cartilage**, which is softer and more flexible.

Sometimes the cartilaginous skeleton of sharks and rays can be made harder and stronger by a process called **calcification** or **mineralisation**. In this process various types of salts, such as calcium, are deposited into the cartilage while it is growing.

The basic design of sharks and rays includes a skull, jaws with teeth, a backbone and fins. Unlike the bony fish, they do not have ribs. Sharks and rays come in many different sizes and shapes.

The backbone of sharks and rays is made up of a series of **vertebrae** held in place by connective tissue, and provides the animal with a flexible body. Mineralisation in these vertebrae often forms bands, like tree rings, which are used to estimate the age of sharks and rays.

Teeth

The teeth of sharks and rays also vary in size and shape. Both the upper and lower jaws of sharks and rays have teeth that are embedded in the gums, rather than attached to the jaw. This means they can be continually replaced.

Some sharks have small sharp teeth for grasping prey, and more flattened back teeth for crushing hard shells. Other sharks may have large sharp teeth, more suited to cutting their prey. The whale shark, basking shark and manta ray do not have teeth at all. Instead, they have evolved **gill rakers**, and use these to strain out plankton from the water as the shark breathes.

Fins and Movement

Generally, sharks and rays have three types of unpaired fins (**dorsal**, **anal** and **caudal**) and two types of paired fins (**pectoral** and **pelvic**). However, some groups do not have all of these features, or the features have been modified (over millions of years) to form long tails or flattened body discs. Body shape and locomotion vary between different animals in the group.



Scientist capturing a shark.
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Gills and Spiracles

In common with the bony fishes, sharks and rays have gills to extract oxygen from the water in which they live. Most shark species have five pairs of gill openings, but there are several species that have six or seven pairs of gill openings. Rays have either five or six pairs, located on the underside of the body.

The rays and many of the bottom-dwelling sharks have **spiracles** behind the eyes. Spiracles are holes that allow the rays and sharks to take in water for breathing while they rest on the sea floor. Fast-swimming sharks lack spiracles and depend on water entering the mouth and passing through the gill openings to breathe, so they must swim continuously to breathe.



Gummy shark (*Mustelus antarcticus*).

Note: spiracle behind the eye
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Skin

Another feature of sharks and rays is that the outer skin has **denticles**. Formed in the skin, they are usually less than a millimetre wide. Denticles are made of the same materials as your teeth: they have a soft pulp cavity inside; this is covered by dentine; and finally a layer of hard enamel on the outside. These denticles reduce drag during swimming and provide some protection from injury.

Some sharks and rays possess other hard structures, which are developed in the same way as denticles. These can be in the form of teeth, thorns and venomous spines.

Sensory Systems

Chondrichthyans have at least eight well-developed sensory systems.

- 1) The paired eyes provide an excellent field of vision, are able to see colour and are good in low light.
- 2) An excellent sense of smell is provided by the two **olfactory** sacs under the snout, which are associated with the large front section of the brain.
- 3) Taste-receptor cells occur on taste buds, which cover small bumps in the mouth and determine whether prey tastes good.
- 4) Touch-receptor cells occurring near the skin's surface respond to contact and smaller capsules deeper in the skin respond to the bending of the body and fins through muscle movement.
- 5) Senses of balance, orientation and movement depend on a complex system of organs inside the ear.
- 6) Sound is channelled through a series of cartilaginous tubes to the ear canals, and hearing is very good even though sharks and rays lack external ear structures.
- 7) Clusters of sensory hair cells detect water movement or vibrations. These are situated both on the surface of the skin (pit organs) and also just below the surface of the skin (lateral lines), which run across each side of the head and body.
- 8) **Electrosense** is present in all sharks and rays, but is uncommon among other groups in the animal kingdom. The electrosensory organs (**Ampullae of Lorenzini**) are able to detect weak electric fields generated by the movement of prey, predators and water in the Earth's magnetic fields.

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Reproduction



School shark (*Galeorhinus galeus*)
in utero
(© Terence I. Walker)

Sharks and rays have separate sexes for reproduction. They can be either egg laying or live bearing, and there are four different modes of reproduction for live-bearing conditions, depending on the source of nutrition for the developing embryo (yolk, **uterine** milk, other eggs/siblings or placenta).



Developmental stages of the
gummy shark (*Mustelus antarcticus*)
– egg to juvenile
(© Terence I. Walker)

The number of eggs laid or number of young born varies widely with species and size of the mother. The **gestation** period can vary from several months to well over one year.

Kate Sputore (Rottnest Island Authority) adapted this information sheet (which is suitable for primary and lower secondary school students) from the information sheet compiled for the general public by © Terence Walker (Terry.Walker@dpi.vic.gov.au).

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