

The ARKive Darwin education materials cover a number of science subjects, such as variation, classification and keys, using Darwin and the voyage of the Beagle as the exploratory vehicle.

Included within the package are: an ARKive themed classroom presentation, classroom activities and links to additional ARKive internet multi-media resources. All the resources provided can be used alongside your existing teaching material, individually or as a complete set.

In addition, the ARKive website contains a wealth of multi-media that teachers can tailor to the specific needs of their individual teaching group. The educational material ARKive has put together is intended to give an idea of how ARKive can be used to help teach a variety of subjects.

The components of the ARKive sharks and rays education materials for 11-14 year olds are detailed below:

- **Class presentation**
 - 11-14 year olds Classroom presentation – Darwin's Observations.ppt
 - MyARKive scrapbook of images: Darwin's observations: www.arkive.org/darwins-observations
- **Sharks and rays**
 - 11-14 year olds Activity - Sharks and rays - classroom materials.ppt
 - 11-14 year olds Activity - Sharks and rays - handout.pdf
 - MyARKive scrapbook: Sharks and rays: <http://www.arkive.org/sharks-and-rays>
 - 11-14 year olds Activity – Sharks and rays – teacher's notes: see below

11-14 year olds Activity – Sharks and rays – teacher's notes: see below

Part 1 – Answers

1. *Cetorhinidae* - Basking shark
2. *Chlamdoselachidae* - Frilled shark
3. *Dasyatidae* - Blue-spotted stingray
4. *Sphyrnidae* - Great hammerhead
5. *Lamnidae* - Great white shark
6. *Stegostomatidae* - Leopard shark
7. *Rhincodontidae* - Whale shark
8. *Rajidae* - Big skate
9. *Hexanchidae* - Broadnose sevengill shark

Part 2 – Answers

Fish - scales, gills, fins, endoskeleton, lateral line and lid less eyes, adapted for life in water - streamlined body, cold blooded

Could explain that all these features are not unique to fish, it is the combination of several features which unites the group. It is important to look at both the similarities and the differences between groups of organisms.

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Morphology

Basking shark – the second largest fish in the sea after the whale shark. A filter-feeder the basking shark filters plankton through the five massive gill slits that almost encircle the head. Inside its massive mouth are thousands of fine, bristle-like 'gill rakers' on the gill arches within the gill slits.

Friiled shark – a slow-moving deep-water shark which lives on the ocean floor. Feeds on other sharks, squid and bony fish.

Blue-spotted stingray – a bottom dweller, the snout is rounded and the mouth is found on the underside of the body, along with the gills, perfect for scooping up animals hiding in the sand.

Great hammerhead - the eyes are at either end of the hammer and the mouth is positioned on the underside in line with the trail edge of the hammer. The body is counter-shaded with dark grey above fading to light grey below – thus, when viewed from below the light belly blends in with the sunny waters above and when viewed from above, the darker back blends in with the dark ocean floor below. Feeding mainly at dusk, the great hammerhead uses an electro-sensory system to locate prey; sensing the weak electric field produced by all living organisms.

Great white shark - is streamlined for efficient movement through the water, and has a pointed snout. At the top of the marine food chain these sharks are skilled predators with a mouth armed with an array of sharply pointed, serrated teeth. They feed predominately on fish but will also consume turtles, molluscs, and crustaceans, and are active hunters of small cetaceans such as dolphins and porpoises, and of other marine mammals such as seals and sea lions.

Leopard shark - believed to be a nocturnal hunter, they spend most of the day lazily swimming and resting on the bottom, becoming active at night when they hunt for sleeping fish, molluscs and crustaceans. A slow but powerful swimmer, leopard sharks have unusually flexible bodies that are used to squirm into tiny crevices in search of food.

Whale shark - the largest fish in the world; with its vast size it resembles the whales from which its common name is derived. The head is flattened and the wide mouth, positioned at the tip of the snout, stretches almost as wide as the body. Whale sharks feed on planktonic organisms and small fish by suction filter-feeding. This species is thought to be a more dynamic filter-feeder than, for example, the basking shark, actively sucking food in through their vast mouths and passing the water over the gill arches, where prey are retained and then swallowed.

Big skate - as with all skates, the body is flattened and disc-shaped, with the pectoral fins broadly expanded and joined to the head and body. The big skate feeds on marine invertebrates such as shrimps, worms and clams, as well as on crustaceans and fish. The positioning of the mouth on the underside of the body is perfect for sucking up animals hiding in the sand.

Broadnose sevengill shark – often found in deep water this shark swims slowly along the bottom. It is an opportunistic predator, and will feed on almost anything including sharks, rays, chimaeras, and marine mammals such as dolphins, porpoises, and seals. This species is again counter-shaded, an adaptation that allows the shark to blend in with its environment

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when viewed both from above or below.

Part 3 - Answers

1. Sharks can't move their fins as freely as other fish do. Their skeleton is more rigid, and the whole body of the shark moves, giving their distinctive movement patterns.

2. Yes. Sharks that spend most of their time near the bottom of the oceans generally have a much smaller lower lobe of their caudal fin. Those that swim in the mid-water have a larger lower lobe of their caudal fin – allowing greater propulsion through the water.

Rays have evolved without pelvic or anal fins, which allows them to lie flat on the bottom substrate.

3. Cartilaginous skeleton

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