Shark Designer

TOPIC C: FORM AND FUNCTION
TEACHER RESOURCE

THE AQUARIUM OF WESTERN AUSTRALIA
SEA FOR YOURSELF

Curriculum Links

Design, presentations, art, form and function, label diagram, maths.

Ancient vs modern changes over time.

Background Notes

This booklet provides the background information needed to conduct AQWA's Shark Designer activity in your classroom.

In this activity, you will explore the most amazing and extreme designs of sharks that have ever lived so that your students can then 'create a creature' and design a shark of their own.

- Sharks have existed for more than 400 million years.
- There are about 170 species of sharks in Australia and they live in different areas of the ocean.
- Their bodies are designed to help them hide and catch the food available in their environment.

TEETH

Sharks don't just have one row of teeth – but several – and their rows of teeth work like a conveyor belt. If one falls out the one behind simply moves up into place.

Megalodon (ancient shark)

- The name megalodon means 'big tooth' – teeth over 18 cm in size have been found.
- Most of the teeth found are 10–12 cm in size (about the size of an adult hand).
- The megalodon grew to over 18 m in length and its jaw would have opened 1.8 m wide (an adult human could stand up in it!). This is so large that a great white – the largest of today's predatory sharks – could swim right through it.
- They had triangular teeth with serration along the sides. These serrations meant that each tooth could cut like a knife and helped them rip and tear at their food.
- Modern sharks with this tooth design are great white sharks and whaler sharks.
- The megalodon is thought to have had the most powerful bite of any known animal. Scientists think its bite force was 6–10 times as powerful as today's crocodiles and great whites and 2–3 times as powerful as a T-Rex. So powerful that it could bite a small whale in half!
- The megalodon had about 276 teeth in five rows. Like modern sharks, the megalodon discarded its teeth frequently as they became worn. The vast majority of fossil megalodon teeth that are collected show significant feeding wear to the tip, sometimes with the tips completely sheared off due to hitting bone or other teeth during feeding.

Cookiecutter shark (modern shark)

- To bite it sticks its teeth in then twists its body to cut out a circular chunk of food.
- Each of its teeth are pretty small but the cookiecutter is also small so, comparative to its size, the cookiecutter shark actually has the largest teeth of all known sharks.
- The cookiecutter doesn't replace one tooth at a time – it replaces the whole row! Making teeth takes a bit of investment so the cookiecutter shark swallows its old teeth and eats them so to reuse the calcium!

Helicoprion (ancient shark)

- The Helicoprion lived 250 million years ago and instead of replacing teeth in rows it had a spiral whorl of teeth that worked like a circular saw.
- This whorl fitted between the tips of the two halves of the lower jaw. Its upper jaw had two half whorls – one on either side – when its jaw closed they met and created a perfect 'can opener' to crush through the hard shells of floating marine snails, such as ancestors of the nautilus.

Tiger shark (modern shark)

Its tooth has a pointed section to pierce and a serrated edge to cut so it can get through hard things like a turtle shell.

Grey nurse shark (modern shark on exhibit at AQWA)

Pointy dagger-like teeth are great for grabbing slippery fish and swallowing them whole.

Port Jackson shark (modern shark)

Not all shark teeth are sharp – the Port Jackson shark has flat teeth like we have at the back.

HEAD SHAPE

Blue shark

The standard shark design. The blue shark is slightly oval and the head is pointed – just like the design of a rocket, an aeroplane or a bullet. This design helps a shark to pierce its way through the water and move fast.

Cookiecutter shark

The cookiecutter shark has thick rubbery lips around its mouth which work like a suction cup to attach to the side of their prey.

Hammerhead shark

- Plank–like head which acts like the wings on a fighter plane, helping with manoeuvrability.
- Having their eyes right on the edge helps them to see below as well as up, behind and in front.
- Underneath a shark's head are small pits housing sensory cells that can pick up on the small pulses of electricity that all animals give off. This ability is called electroreception and is also known as a shark's sixth sense.

- By spreading their electrical sense organs across the width of the hammer they can sense a wider area, making it easier to find food even if it is buried in the sand.

SIZE

Scale on Student Diagrams

When students are thinking of the size of their shark here are a few things to consider:

- Sharks range in size from the pygmy shark that grows to just 15 cm to the whale shark – the world's largest living fish and the largest of today's sharks, growing to an amazing 15 m.
- A shark with huge teeth might need a big head to fit them all in and then a huge body to hold all the enormous muscles needed to open and close its giant jaws.
- Size can relate to the part of the ocean that a shark lives in and the food that they will find there.
- Bigger sharks will generally live further from shore and swim around in the open ocean, while smaller sharks can swim through caves or navigate through all the tight corners of a coral reef.

TAIL DESIGN

- Sharks have been around for about 400 million years but most of the early sharks were coastal predators that chased slow-moving food. As sharks started chasing faster food, like fish, they needed to get faster.
- Most sharks can't accelerate quickly because of their tail shape, which is designed to push them towards the ocean floor as they hunt. A few species have enough power to launch themselves out of the water. Some species, such as thresher sharks, employ their speed and agility in unusual methods of attack.
- The fastest shark today is the shortfin mako, which can swim at 50 km/hour with bursts of up to 74 km/hour. It has a sleek streamlined body and to make its swimming muscles work harder it stores heat in its body. This keeps them up to 7 degrees warmer than the rest of their body and warm muscles work faster.
- The mako and the great white shark have the same tail design – crescent-shaped with the upper and lower lobes of equal size. This is the perfect design for producing propulsion, so much so that the great white can generate enough speed to propel its whole body out of the ocean, as can the mako.
- If we look at the tail of the grey nurse shark they have a different design. It suits slower-moving sharks capable of quick bursts of speed, not constant fast swimming. As the tail is larger on top, it can also help a shark to swim towards the bottom.
- The thresher shark takes this to a whole other level – using its long tail to herd, thwack and stun its food.

BODY SHAPE

- Sharks that swim through the open ocean have a rounded body.
- Sharks which rest on the bottom will have a flat tummy so they can lie flat on the sand.

CAMOUFLAGE

All sharks have a basic form of camouflage known as countershading. They are darker on top and lighter underneath which helps them to blend in. If you are up the top looking down you will see the dark of their back against the deep dark ocean below and if you are down below looking up you will see the light of its belly up against the light of the sun or the moon on top of the ocean.

Wobbegong

- The wobbegong has a very flat body to help it blend in with the seafloor.
- Its blotchy sand coloured patterns act as camouflage

Port Jackson shark

The harness-like stripes on a Port Jackson shark break up its image and look like the shadow of seaweed falling on the seafloor. Tiger sharks also have stripes, while the whale shark has dots.

Cookiecutter shark

- The cookiecutter shark takes countershading to the extreme.
- It swims in such deep water (over 3,000 m) that even with a white belly when you look up you would see it as a silhouette. To stop this from happening, it glows in the dark!
- Two chemicals in the cells of its underbelly react to produce a light that is bright enough to read by. You might think that would make them easier to see but it doesn't as, seen from below, it makes it easier for them to hide in the light from the surface.
- Their clever camouflage doesn't stop there, as there is one part of their belly that doesn't glow, creating a dark patch under their throat that looks like a small and potentially tasty fish.
- This attracts big fish such as tuna. They dart towards the dark patch thinking it's food, then 'bang' – the cookiecutter bites and turns around using the speed of the tuna to help cut out a perfectly round golf ball sized chunk of flesh. This sneaky ambush technique enables them to feed on animals much bigger than them and attack prey which should be able to outswim them.

FINS

- Most sharks have side (pectoral) fins for steering;
- Two sets of fins underneath for stability (anal and pelvic fins); and
- Dorsal fins on top for stability at high speed – so the bigger the first dorsal fin – the faster the shark!

Make sure your name is on top and you can even create a name for your shark.

EYES

- Big eye means visual predator as they rely on them more. Position of eye can also link to where they are searching for their food – above, below, all around.

DISCUSSION

For discussion after students present their shark designs:

- They are all perfectly designed for what you want them to do, so whose do we think would survive for the most millions of years?
- It is possible that the design that would last the longest would be the simplest and plainest.
- What we think are the coolest features are often the most extreme – this makes them perfect at doing one thing – a specialist. But you never know, it might be better to be ready for anything rather than one set thing.

Notes: