Staying Alive

Teachers
This unit of work has been designed to support your class visit for the 'Staying Alive' programme at the National Aquarium of New Zealand. Students will participate in a range of level-specific interactive activities.

The primary focus of this programme is the Living World Strand of the Science Curriculum, however when planning your unit of work, links can be made to other essential learning areas. Similarly, different essential skills can be emphasised depending on the needs of your students.

Programme Overview
The staying alive programme teaches students about the different adaptations found in a variety of animals, including fish. Students will examine and discover what special features the animals have to successfully live in certain environments and why each animal has adapted to live in its environment.

Essential Learning Area: Science

Strand: Living World

Achievement Aim 2 and 3: Investigate and understand relationships between structure and function in living organisms. Investigate and understand how organisms grow, reproduce and change over generations.

Level	Essential Learning Area	Strand	Achievement Aim	Achievement Objective
1	Science	Living World	Structure and Function Interdependence of living organisms	Observe and identify parts of common animals.
2	Science	Living World	Structure and Function Interdependence of living organisms	Investigate and understand the general functions of the main parts of animals and plants.
3	Science	Living World	Structure and Function Interdependence of living organisms	Investigate special features of common animals and describe how these help them to stay alive.
4	Science	Living World	Structure and Function Interdependence of living organisms	Investigate and describe special features of animals or plants which help survival into the next generation.

Scientific Skills and Attitudes
- Focusing and Planning
- Information Gathering
- Processing and Interpreting
- Reporting

The 'Staying Alive' programme at the National Aquarium of New Zealand lays the foundations for developing the above investigative skills and attitudes.

Specific Learning Outcomes

- To understand why a particular type of animal lives in certain habitats.
- To understand, describe and identify examples of structural, functional and behavioural adaptations which help animals survive into the next generation.
- To become aware of the environmental factors affecting aquatic organisms and discuss how certain factors affect their survival.

Major topics covered by this booklet:

1) Patterns, colours and shapes
2) Teeth, jaws and guts
3) Survival on the land

Fabulous Facts .... What do you know about evolution?

The theory of evolution discusses how certain characteristics of organisms have come about using the ideas of natural selection and mutation. Darwin and Wallace in the 19th Century both* came up with an idea to explain why there are so many different animals in the world and how organisms change over time.

Natural selection and survival of the fittest

Darwin suggested that certain organisms have characteristics that better suited them to their environment. These organisms would tend to reproduce more prolifically than other organisms. Therefore their characteristics could be passed on in higher proportion to future generations. In some cases, new characteristics formed due to a mutation. If this mutation was beneficial to the organism in its environment, the mutation would be passed on to future generations. Over time, populations could continually improve their adaptations to the environment to which they were subjected, and those with inadequate adaptations would become extinct.

**Charles Darwin is usually recognised as the first person to come up with a generally accepted scientific explanation for evolution. However, Alfred Wallace who also carried out large voyages around the world came up with an explanation for evolution, possibly even before Darwin but his theory was not published before Darwin's theory of evolution (Origin of Species) and therefore is not well recognised.*

Staying Alive
Pre and post-visit activities

Pre - visit activities

Many features of animals and plants can help them to adapt to their surrounding environment, some are more obvious than others. Adaptations of animals can be divided into structural or behavioural adaptations – both are addressed in this booklet.

Patterns, colours and shapes

Spot the difference?

Look at the pictures of 'adaptations' in a variety of animals (see pictures provided at the back of the booklet). Discuss with the class how the patterns differ on the animals, what do the shapes and patterns on the animals look like? Could the patterns, spots and shapes be useful?

Fabulous Facts .... What do you know about mimicry?

Mimicry is used by some animals as a way of protecting themselves. The animal mimics/resembles another animal which is usually poisonous or has some nasty habits when being attacked (e.g. skunks)!

Monarch and viceroy butterflies

By eating and storing toxic compounds that are found in milkweed, the monarch caterpillar and butterfly are poisonous to many birds. The bright orange and black colours of the butterfly wings are a warning to birds. The viceroy butterfly mimics the monarch butterfly in wing shape and colouring and so escapes being preyed upon by many birds!

Viceroy Butterfly (mimic)

Monarch Butterfly

Can you tell the difference between the butterfly species?

Eye-spots and mimicry?

Brainstorm the words 'eye-spots', 'camouflage' and 'mimicry' – what do they mean?
Check the class definitions with dictionary definitions.

Your own 'adapted' animal

Draw a picture of an animal (use the sheet found at the back of the booklet) with different patterns, colours and shapes. Once the students have drawn the 'adapted' animal ask the students to present their drawing, explaining what features the animal has and how it is adapted to a particular environment. For example, does it have eyespots? Does it have spines or spikes? Is it camouflaged?

Camouflage mural
Create sheets with different patterns (e.g. zebra stripes or leaf patterns). Ask the students to design an animal which uses camouflage. Cut and paste the different camouflage animals to the mural.

Tall tails and fins
Have a class discussion about the different shaped tails (see picture at back of the booklet). What are the different tail shapes likely to be used for? Balance, speed or manoeuvrability?

Fabulous Facts .... Are all tails and fins the same?

Tails depending on their shape and size have very different uses…
Kangaroo and kangaroo rats have very long tails which are used for **balance** while they are hopping along at high speed. Can you think of any other animals that use their tails for balance while running?

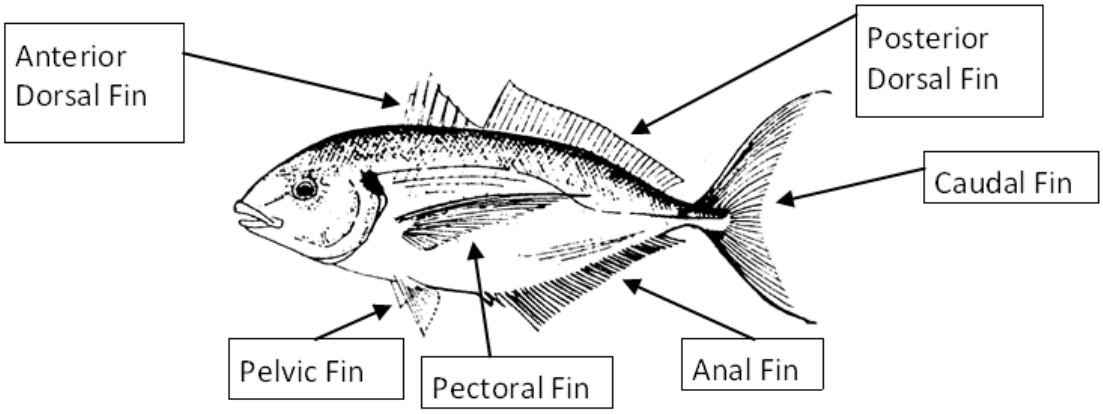
New world monkeys (e.g. howler monkeys and spider monkeys) use their tails as a **5th prehensile limb** (used for hanging in trees, or moving from tree to tree). Old world monkeys (e.g. rhesus monkeys and baboons) use their tails for **balance** rather than as a prehensile organ.

Fishes have many different fins that are used in many different ways…
Pelvic fins are often found on the bottom side (ventral) of fish. Pelvic fins are usually used as stabilisers and in bottom dwelling fish the pelvic fin is modified to help hold onto substrates.

Pectoral fins are usually located high up on the sides of fishes. The shape of the fins will be long and pointed in fast swimming fish (e.g. Tuna) and rounded in slower moving fish (e.g. Groper).

Dorsal and anal fins are used for stability in fish which need to manoeuvre quickly and are shaped as small finlets in fast swimming fish. The finlets are often folded up when swimming fast.

The caudal fin is often a very good indicator of a fish's ability to swim fast. Fast swimming fish have a 'stiff quarter moon' shaped tail whereas fish that swim at a constant speed over long distances have forked shaped tails. Fish that swim slowly but need to manoeuvre quickly have square or rounded tails.



Teeth, jaws and guts

Small teeth and large teeth

Look at pictures of carnivore and herbivore teeth or bring along animal skulls (with teeth) to aid your class discussions. Discuss with the class the function of teeth. What do we use teeth for? What type/shape of teeth do carnivores have? What type/shape teeth do herbivores have? Do humans have both carnivore and herbivore type teeth?

Hint: You may need to do a prior brainstorm about the words carnivore, herbivore and omnivore. Definitions and associated tasks can be found in the Rocky Shore pre- and post - visit activity booklet, in the food web section.

The basic pattern of teeth in mammals (upper jaw, from front to back) is four incisors, two canines, eight premolars and six molars. However there are modifications to the basic teeth pattern which often reflect the dietary habits of the animal. Large predatory carnivores (e.g. lions) have canines adapted for stabbing and slicing and large sharp molars which can crush bones. Herbivores have incisors and canines modified for clipping grass and large flat molars for grinding tough fibrous food. Elephant tusks are a form of modified incisors and in the case of a walrus, modified canines!

Invite a tooth authority

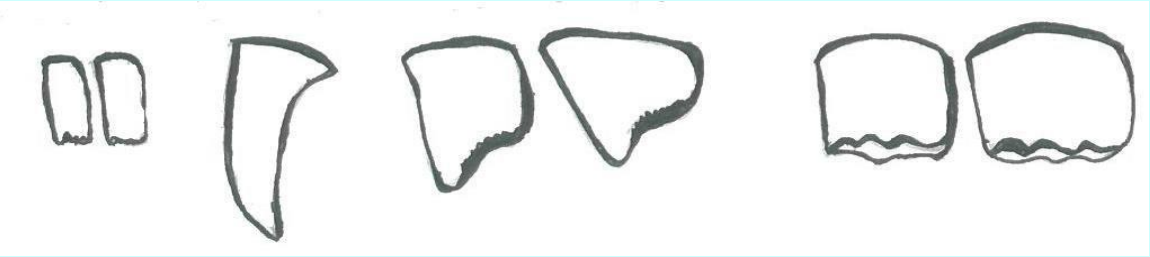
Invite the dental nurse or a dentist to come along to the school to talk about human teeth.

Fabulous Facts .... What do you know about your teeth?

Humans are usually omnivores (eat both meat and veggies) and therefore we need a range of teeth for different jobs. Humans have four different types of teeth; canines, incisors, premolars and molars.

The teeth in the front of the mouth are flat chisel like teeth (incisors) used for nipping and cutting. Back from the incisors is a set of canines (four in total).

Canines are sharp pointed teeth used for stabbing and tearing. Carnivores have many canine-like teeth. Behind the canines are the pre-molars, and further back again are molars (molars don't usually grow through until humans are in their late teens). Pre-molars and molars are used for grinding.



incisors **canine** **premolars** **molars**

The tooth rap
Make a song or rap about teeth, jaws and guts. For example….

Jiggle, jiggle
Chatter, chatter the teeth go…
It's a bit chillllly out there
Gnaw, grind, chew
Use those jaws
Chomp, champ, chip the teeth go on a bit of old steak
Tear, shread, pull these are the actions your teeth make
When you are chewing your food.

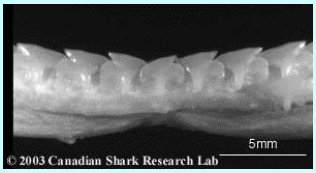
Say 'cheese'
Make a classroom 'tooth' poster. Put a characteristic shaped tooth beside pictures of different animals. Can you identify the type of animal (i.e. carnivore or herbivore) by the shape of the tooth?

Fabulous Facts …. What do you know about specialised teeth?

Most sharks are predators and have very sharp teeth.
However, different sharks eat different prey and used different methods of attack and biting so the tooth shape does vary slightly. For example mako shark teeth are designed to hold, pierce and rip flesh (a bit like a set of very sharp needles) whereas the seven gill shark and spiny dogfish teeth are designed to cut flesh (a bit like a serrated knife!).

Mako Shark Tooth

Sevengill Shark Tooth



Spiny Dogfish Tooth

Survival on the land

What helps this animal survive?
Look at the different animal pictures (see pictures in the back of the booklet) with the class. Discuss with the class if there are any features that the animals may have that might help its survival on land. Hint: For most animals, the move to land was associated with ways of combating desiccation (i.e. drying out). Feathers, scales and efficient water retaining devices such as kidneys all helped animals make the move to land.

What would you do if….?
Role-play behavioural adaptations with the class. Ask the class to act, mime or discuss what they would do under different scenarios. Ask the children to identify the different behavioural adaptations in each of the scenarios. Here are some examples of scenarios to role-play; make up some of your own too!

Pretend you are a slug or a snail and you are on a footpath and… the sun has just come out! What would you do?

You are outside and it is cold and windy! What would you do?
Pretend you are a small bird pecking at food on the lawn. Out of the corner of your eye you see a cat! What would you do?

Pretend you are a hedgehog out in broad daylight and some children come along! What would you do?

After the role-plays, sit the class down and discuss the difference between behavioural adaptations and structural adaptations. For example a hedgehog curls into a ball when frightened (behavioural adaptation) and has spines (structural adaptation).

Fabulous Facts …. Did you know?

Herbivores can only give limited protection to their newly born offspring. As a behavioural adaptation to avoid predation, many newly born herbivores (e.g. zebra, sheep and goats) are able to get to their feet and run with their parents less than an hour after their birth.

Post visit activities

Bill shapes and guts

Bird bills are a good example of a structural adaptation for collecting food. Take a class trip to an estuary, the beach or wildlife sanctuary. Observe the different birds, their bill shape and feeding habits. Fill in the provided field sheet (see back of booklet) or adapt your own for the field trip. Make sure you take binoculars along with you!

Have a class discussion about the different bill types (see provided pictures at back of booklet). Can you suggest what food the birds may eat by looking at their bill shape? Do a class research project on the differences between herbivore and carnivore stomachs. How many stomachs does a herbivore have? Why? *Hint:* The functional adaptation may have something to do with the type of food they eat! Discuss with the class why humans have an appendix?? Note most biology text books will have diagrams of animal anatomy .

Styles of running

There are many different running styles found in two or four legged animals. Here are a few to give you an appreciation of what they are and why the different running styles are useful:

Most mammals show examples of cursorial locomotion (running design). A full cycle of running motion is called a stride. Animals are able to increase their speed by increasing the *length* of the stride or the number of times they complete a stride in a set time (i.e. the *rate* of the stride).
The length of the stride can be maximised by increasing the gait (time in which the animal's feet are off the ground). The gait is increased in a number of ways;

1) Lengthening of limbs, many herbivores such as horses and giraffes have long leg bones.
2) Running on your toes! The bone structure, particularly in herbivores (e.g. horses) has been modified in such a way that these animals are really only running on a single digit.
3) Flexing of the spine, many carnivores such as cats and dogs are able to flex their spines while running. Cheetahs are an extreme example of spine flexing!

Animals can be grouped into *weakly cursorial*, *highly developed cursors* or *richochetal* animals. *Weakly cursorial* animals usually have at least one foot on the ground at any one time. *Highly developed cursors* have extended periods in their stride where they are unsupported. *Richochetal* animals spend most of the time off the ground during their stride! Richochetal locomotion is used by smaller animals as an escape mechanism (e.g. kangaroo mouse).
Cursorial locomotion can also be grouped according to speed and distance covered.
Animals that use *spring - like movements* can move very fast but only for short durations (e.g. antelope and cheetahs). Animals that use *pendulum - like movements* can move quickly over long distances (e.g. wolves and horses).

Discuss different running styles (use the above information or the web sites: **Animal diversity** (look up special topics, mammal anatomy) and **anatomical adaptation for cursorial locomotion**). Once you have discussed different running styles, look at videos of animals (e.g. wildlife documentaries, big game animals in Africa) – see if you can identify the different running styles or specialisation in running styles.
Discuss why different animals have different running styles. Is it for catching prey? To avoid being caught? For speed (running short distances)? For endurance (running long distances)?
An extension task may be to look at some athletics sports, e.g. the 2016 Olympics. Is there a difference in running style between sprinters and long distance runners?

Eye position

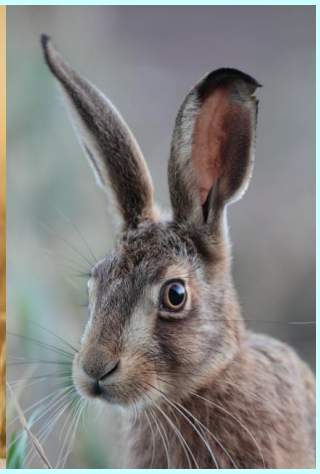
Get the children to bring in a picture of their favourite animal (the picture must show the head clearly) to class. Discuss with the class differences in eye position (see fact box). Ask the children to discuss the eye position of their favourite animal. Can you tell whether it is likely to be a herbivore or carnivore?

Fabulous Facts .... Did you know?

The position of eyes can often indicate whether the animal is a predator or prey.

Predatory animals tend to have eyes positioned in the front of the head. This leads to 'stereoscopic vision' which allows distances ahead to be judged while moving. Animals which are preyed upon (e.g. rabbits and other herbivores) have eyes positioned on the side of the head, giving a wide total visual field both in front of them and behind them.

The size of the eye can also give clues as to whether an animal is nocturnal (night dwelling) or not. For example owls and possums have large eyes.



Some useful references:

Discovering Life on Earth. David Attenborough. (1981), Collins, London.

Biology, 5th Edition. Curtis and Barnes. (1989), Worth Publishers, New York.

Evolution – a New Zealand perspective. Secondary Education programmes, National Aquarium of New Zealand.

The Life of Birds. David Attenborough (1998). BBC Books, London.

Videos:

Survival: A Wild South Video

Mutation: Science of Survival: A Wild South Video