Critical thinking

Classify living things according to structural features

Why not get a hands on experience with your students at Irukandji Shark and Ray Encounters to learn about the oceans ecosystems from Apex Predators.

This Lesson plan is designed for students to observe and study the marine environment through interactive educational talks on Elasmobranches

Students will be able to

- Identify and describe the structure and function of living things
- classify living things according to structural features and identify that they have patterns of similarities and differences
- Identify a range of plants and animals using simple keys.
- identify the beneficial and harmful effects that microorganisms can have on living things and the environment
- identify that there is a wide range of multicellular organisms ecosystems
- describe the importance of cycles of materials in ecosystems
- describe some impacts of human activities on ecosystems.

Irukandji has over 16 species of marine animals in which students can classify and identify there taxonomy with our marine experts and aquarists. Students will then look at their form and function, as well as their interactions with the marine microorganisms in controlled tank environments. Sharks and Rays are excellent alternative examples to assess various tissues, as they have a unique structure forming part of cartilaginous fish. Students will also observe and learn the reproductive life strategies of sharks and rays, which shows the important differences between k selected life and r selected strategies. It is essential students learn about chondrichthyes physical and biological characteristics of this majestic apex predator as it forms a fundamental part of the world's largest environment.

Learning Environment

Core component is Group Work

- Ray Lagoon
- Tawny Terrian
- Fiddler Flats
- Aqua Nursery

Materials

- Pencil
- Activity sheet
- Ruler and clip board

Steps

Students should have some knowledge of reproductive life strategies of sharks and rays. Irukandji Shark & Ray Encounters has resources to help you pre-teach this information. Please see the section ‚Helpful Information' below for details of pre-teaching material.

Step 1: Briefing approximately 10-15 minutes

Students will be lead to our briefing hut, were they will be taught and explained too about how to interact with Elasmobranches safely by a qualified aquarist.

Step 2: Getting Changed 20 minutes

Students will be given a chance to get changed and store all their valuables

Step 3: Before getting wet Tawny Terrain 10 minutes

This is where students will learn about tropical marine species in particular a 2.7 meter Tawny nurse shark and given a hands on demonstration on what do in the water in the main tanks.

Objectives

- *Observe different species elasmobranches and Teleost*
- *Classify marine animals and their relationships*
- *Discuss animal life history strategies*

Step 4: Getting wet Ray lagoon 25 minutes

This is where students will get a hands on experience feeding, touching and interacting with elasmobranches and teleost within their environment

Objectives

- *identify the beneficial and harmful effects that microorganisms can have on living things and the environment*
- *Effects of humans on rocky coatlines of Australia*
- *Ocean acidification*

Step 5: Getting Change and heading over to Fiddler flats 20 minutes

This is where students will get a hands on experience feeding and observing ray species whilst an aquarist talks about the various types of life strategies employed by elasmobranchs

Objectives

- *Observe various life cycles of Sharks and Rays*
- *Identify, describe and evaluates the interactions between living things and their effects on the environment*
- *Identify current conservation efforts of aquariums and marine parks throughout Australia.*
- *Look at Importance of Chondricthyan fishes (Sharks, Rays and Chimeras) to the marine environment and society, through an insightful look into 6 species life history strategies*

Step 6: Fill out the field work assessment 20 minutes.

Students will be given a chance to wonder the aquarium and obtain the relevant information for their reports

IRUKANDJI
SHARK & RAY ENCOUNTERS
Port Stephens

686 Marsh Road, Bobs Farm

(02) 4982 2476

www.sharkencounters.com.au

Elasmobranchs

Helpful Information

Pre-visit Preparation: Observation is a skill that gets better with pr

Pre- actice. To ensure your students are fully supported in this investigation, we recommend establishing ongoing opportunities for your students to investigate natural phenomena and develop skills of observing and communicating in the classroom. Have the students practice observing: the classroom pet, younger children, insects in the school yard, a clip from a movie with the sound off, etc. Encourage the students to use all of their senses. Observations can take the form of poetry, dialogues, stories, notes, drawings or anything else the students may want to try to get their thoughts on paper. Lessons focused specifically on drawing, descriptive journaling and opportunities for you as the teacher to model journaling will all support the students in their visit to the aquarium.

Journal Preparation: Spend time preparing your journals for your visit to the aquarium. Get students to copy the observation questions (below) onto individual pages in their books [greener option] or copy, cut and paste into their books.

Why Study Elasmobranches?

Elasmobranches are one of the most amazing species on this planet from the mysterious sharks all the way through to majestic rays and little known chimeras.

Yes is it's a fact despite travelling into outer space we still haven't touch the surface in the terms of knowledge of the world's oceans.Yet without sharks, the entire ocean would be out of balance.

Today people don't really know a lot about sharks. And it's not just the average person - it's the researchers too.

If we walked up to an average Joe off the street and asked, "Where in the world do great white sharks breed?" That person would probably say, "I have no idea. And how did you know my name was Joe?" On the other hand, if we asked a Ph.D shark biologist that same question, we'd get the same answer: "Nobody knows!" How exciting is that?! One of the world's most famous predators, a giant 7m shark, still holds a few giant mysteries.

We know little about Elasmobranches because they are especially hard to monitor and frequently move around the globe even diving to incredible depths and therefore making it difficult for researches to monitor them successfully.

Elasmobranches are a very diverse group from the small pygmy ribbontail catshark can practically fit in your hand, while the largest sharks for example whale sharks could not …unless your hand was over 21 m long.

Elasmobranches come in a wide variety of colors – grays, blues, browns, greens, whites, stripes and spots. The lantern shark even glows in the dark!

They also have an array shapes too. The saw shark has a head shaped like a saw. The angelsharks are flattened like angelic pancakes. Thresher sharks can have extensively long slender tails.

This booklet will identify the key impacts current day human life is having on our World oceans and how our impacts have drastically reduced shark populations

ELASMOBRANCH EXTREMES

BIGGEST LIVING SHARKS
The biggest shark is the whale shark (Rhincodon or Rhiniodon typus), which can be up to 21 m long. It is a filter feeder and sieves enormous amounts of plankton to eat through its gills as it swims. It is also the biggest fish.

SMALLEST
Spined pygmy shark The smallest sharks are: •Dwarf Lanternfish (Etmopterus perryi), which is about to 19 - 20 cm long for fully-grown females and 6 to 7 inches 16 - 17.5 cm long for adult males. Spined pygmy shark (Squaliolus laticaudus), which is about 21 cm long for fully-grown females and 18 cm long for males. pygmy ribbontail catshark (Eridacnis radcliffei) , which is about 15 - 16 cm long for fully-grown females and 18 - 19 cm long for males.

FASTEST
The fastest swimming sharks are the mako sharks and blue sharks, which can even leap out of the water. They are also among the fastest fish. Estimates of their speed varies; some say that they can swim at about 97 kph, while more conservative estimates are about 35 kph. There hasn't been enough observation of their speeds to have a definitive answer.

BIGGEST MOUTH
The whale shark has the biggest mouth among sharks.

LONGEST TAIL
The thresher sharks have the longest tail among sharks; the upper lobe of their tails are about the same length as their bodies.

STRONGEST SHARK BITE
The strongest shark bite belongs to the dusky shark (Carcharhinus obscurus); its jaws have been measured to exert 132 pounds (60 kg) of force per tooth.

MOST COMMON SHARK
The piked dogfish shark (Squalus acanthias) is very abundant, especially in the North Atlantic Ocean. It is a small shark, about 1.6 m long.

LARGEST EGGS
Whale shark The whale shark was long thought to be oviparous (an egg 14 inches (36 cm) long was found in the Gulf of Mexico in 1953; this would be the largest egg in the world). Recently, pregnant females have been found containing hundreds of pups. Whale sharks are viviparous, giving birth to live young. Newborns are over 2 feet (60 cm) long.

LONGEST MIGRATION
Blue shark had been known to migrate from 2000-3000 km in a seasonal journey.

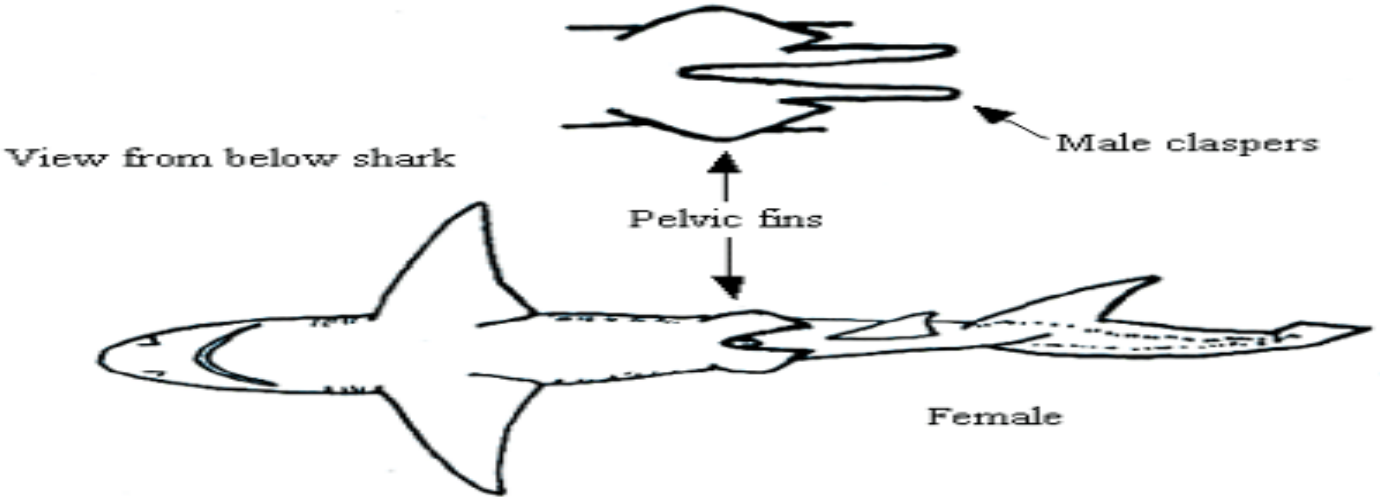
LARGEST LITTER
Blue shark was found with 135 pups in her uterus.

Life History and Reproduction

How do sharks and rays have babies?

Unlike most bony fish, shark's and rays eggs are fertilized inside the female's body. As you can see on the diagram below male sharks have claspers, which are extensions of the pelvic fins that are used to transfer sperm to the female and fertilize her eggs.

Most sharks give birth to live young, but some release eggs that hatch later. Baby sharks and



rays are called pups are born with a full set of teeth and are fully ready to take care of themselves. They quickly swim away, even from their mothers who might eat them. Some sharks have one or two pups and some have over 100.

There are different types of shark and rays reproduction:

•Viviparity- The eggs hatch inside the female's body and the babies are fed by a placenta which transfers nourishment from the mother to the babies via an umbilical cord which is connected to the baby shark behind the between the pectoral fins.

•Oviparity- These sharks deposit eggs in the ocean which will hatch later if they are not eaten by predators. The eggs are not guarded by either parent. Shark eggs (sometimes called "mermaid's purses") are covered by a tough, leathery membrane.

•Aplacental Viviparity (Ovoviviparous)- In these animals, the eggs hatch and the babies develop inside the female's body but there is no placenta to nourish the pups. The pups eat any unfertilized eggs and each other.

QUICK QUIZ

True or False

All sharks must swim continuously to respire or else they drown.

A) True

B) False

Most cartilaginous fishes have smooth skin.

A) True

B) False

Stingrays swim by undulating their bodies like a wave, others flap their pectoral fin like wings.

A) True

B) False

The dark spots on Ray's and Sharks snout and lower jaw are pores that mark the opening of the ampullae of Lorenzini, jelly-filled canals that allow the rays and sharks to pick up weak electrical fields.

A) True

B) False

There is evidence that plastic in our oceans is been ingested by coral.

A) True

B) False

Sharks were the first fully jawed vertebrates.

A) True

B) False

Special organs called claspers are used for internal fertilization in cartilaginous fishes.

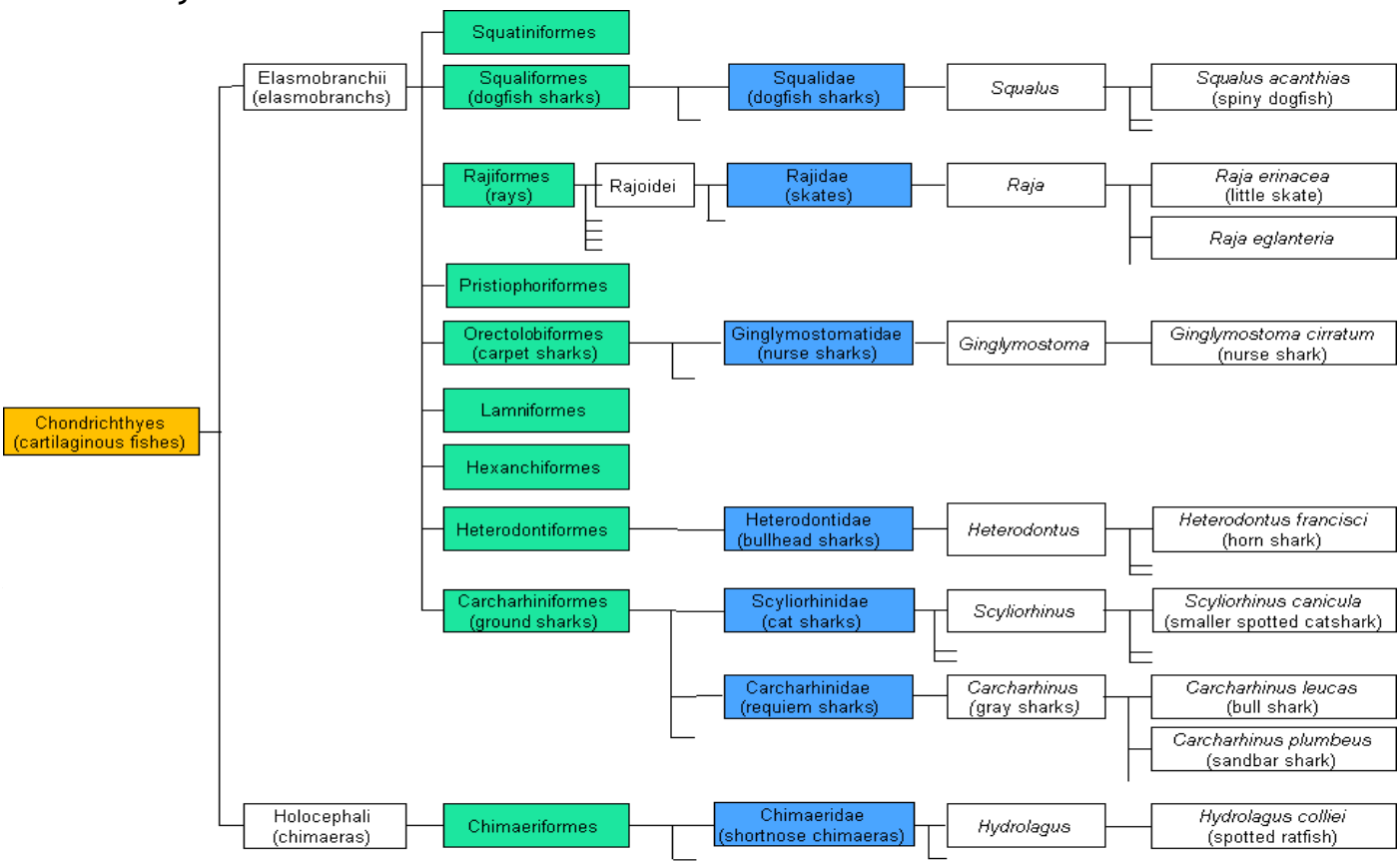
A) True

B) False

Chondrichthyes have been evolving for about 400 million years. Some of the early sharks looked very different from the ones we see now.Of the shark families alive today, the cow sharks (six and seven gilled sharks) are believed to be the oldest and most primitive. The youngest family are the strange looking hammerhead sharks.What is so amazing is that the development of their streamlined shape and powerful muscles has made them so successful as predators, yet it doesn't appear that they have had to evolve to survive as much as other creatures. In fact, it is believed that they have evolved very little over the past 150 million years!

Shark Classification

Kingdom: Animalia
Phylum: Chordata
SubPhylum: Vertebrata
Class: Chondrichthyes (cartilaginous fish)
Subclass: Plagiostomi (sharks and rays: upper jaw hung from skulls and different kind of blood)
Superorder: Selachimorpha (sharks: free upper eyelids, gill openings on the head, and pectoral fins separate from the side of the head)
Subclass: Elasmobranchii (upper jaw that is not fused to the braincase, no swim bladder, advanced electroreceptive system, a spiracle, skin with placoid scales, teeth modified placoid scales, and 5-7 separate slit-like gill openings on each side of the body.



Anatomy

Although Elasmobranches are part of the fish family they are very different, sharks have no bones because their skeleton is made of cartilage, like your ears and your nose. Sharks also have no swim which means they cannot float in the water like bony fish they sink as soon as they stop moving.

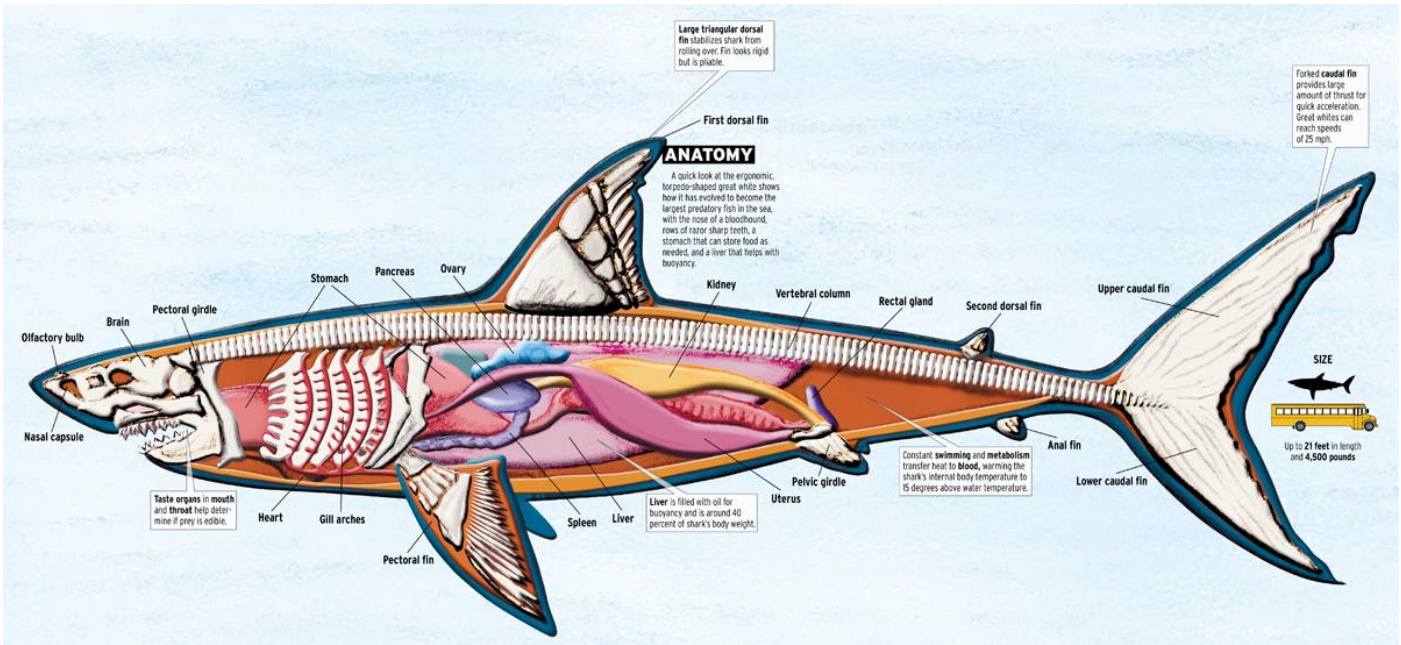


Figure 1.1.1 This diagram highlights the biology of sharks

Breathing

To breathe, water comes in through the shark's mouth. As they swallow, water passes over the gills and out through the gill slits. This filters the air and then the oxygen is absorbed.

Skin

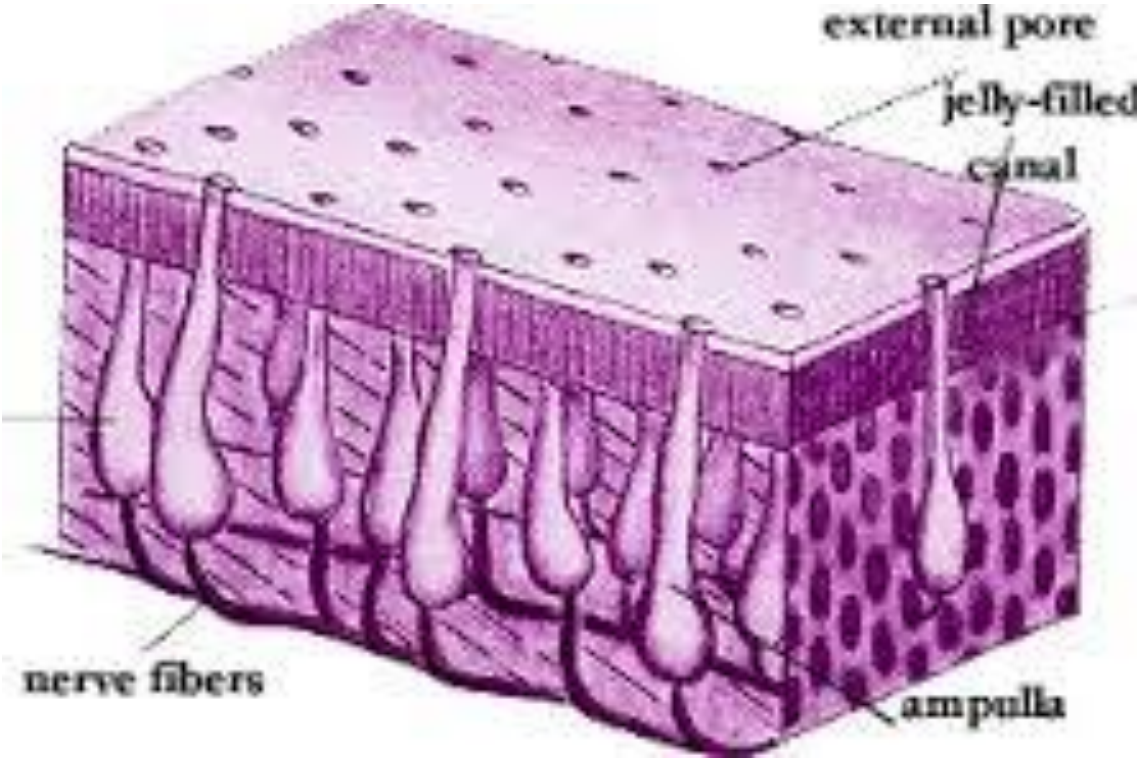
Sharks skin consists of very small scales known as Dermal Denticles (skin teeth). Like their teeth, if damaged dermal denticles soon grow back. Dermal denticles help sharks swim by making the water flow better over the body without creating turbulence. The skin feels very rough one way and when stroked the other is very smooth. Human swimmers can be badly cut by the skin of a shark! Below are images of Mangnified dermal denticles

Super Senses

Sharks have been evolving 100 times longer than humans, which is why they have such highly developed senses. They have an incredible 7 senses compared to our 5 (sight, touch, smell, taste and hearing).

Sharks 6th sense is the detection of electricity, which is emitted in small amounts by every living animal. They have a special network of jelly-filled canals in their head called the ampullae of Lorenzini that detect electric fields (rays also have this).

The 7th sense sharks have allows them to detect vibrations in the water (the lateral line). These extra senses can lead sharks to injured fish (easy prey) that are thrashing around in the water and have helped them to become one of the best hunters in the wild!



Why are Sharks Important

Sharks' Role in the Oceans

Sharks play a very important role in the oceans in a way that an average fish does not. Sharks are at the top of the food chain in virtually every part of every ocean. In that role, they keep populations of other fish healthy and in proper proportion for their ecosystem. How do sharks keep the oceans healthy?

Sharks keep food webs in balance

Sharks have evolved in a tight inter-dependency with their ecosystem. They tend to eat very efficiently, going after the old, sick, or slower fish in a population that they prey upon, keeping that population healthier. Sharks groom many populations of marine life to the right size so that those prey species don't cause harm to the ecosystem by becoming too populous.

The ocean ecosystem is made up of very intricate food webs. Sharks are at the top of these webs and are considered by scientists to be "keystone" species, meaning that removing them causes the whole structure to collapse. For this reason, the prospect of a food chain minus its apex predators may mean the end of the line for many more species. A number of scientific studies demonstrate that depletion of sharks results in the loss of commercially important fish and shellfish species down the food chain, including key fisheries such as tuna, that maintain the health of coral reefs

Sharks keep prey populations healthy

Predatory sharks prey on the sick and the weak members of their prey populations, and some also scavenge the sea floor to feed on dead carcasses. By removing the sick and the weak, they prevent the spread of disease and prevent outbreaks that could be devastating. Preying on the weakest individuals also strengthens the gene pools of the prey species. Since the largest, strongest, and healthiest fish generally reproduce in greater numbers, the outcome is larger numbers of healthier fish.

Sharks keep sea grass beds and other vital habitats healthy

Through intimidation, sharks regulate the behavior of prey species, and prevent them from overgrazing vital habitats. Some shark scientists believe that this intimidation factor may actually have more of an impact on the ecosystem than what sharks eat. For example, scientists in Hawaii found that tiger sharks had a positive impact on the health of sea grass beds. Turtles, which are the tiger sharks' prey, graze on sea grass. In the absence of tiger sharks, the turtles spent all of their time grazing on the best quality, most nutritious sea grass, and these habitats were soon destroyed. When tiger sharks are in the area, however, turtles graze over a broader area and do not overgraze one region.

An important lesson: we need sharks!

Where sharks are eliminated, the marine ecosystem loses its balance.

In the parts of the ocean where sharks have been fished out of existence, we can see the dangerous result of removing the top predator from an ecosystem.

The lesson is important. Sharks are being killed for their fins for shark fin soup, a food that has assumed cultural value but is not important for human survival or health. However, removing the sharks can result in the loss of important foods that we do depend upon for survival.

Sharks have survived for 450 million years, but may be gone within the next decades. Life within the oceans, covering 2/3rds of our planet, has enjoyed a relationship with sharks for about 450 million years. Our growing demand for shark fin soup has increased the slaughter of sharks to such a great extent that many shark species are already nearing extinction.

What will the health of oceans be like when such an important group of animals have been destroyed? Do we want the destruction of sharks and the oceans to be the legacy we leave for our children?

Observations at the Irukandji

My Chosen Animal at the Irukandji:
1. Common name:

2. Scientific (latin) name:

3. Location in the Aquarium:

4. Origin:
- Which country/continent is it from?

- Which climate is it from? Eg) Temperate, tropical, arctic

Movement:
How does my animal move? Which parts of its body does it use? What shape are its fins/arms/feet?
Sketch the swim/movement pattern of your animal….
(you may want to use blank paper and a pencil to trace movement as you watch for a certain period of time)

Adaptations:
What special features (adaptations) does my animal have to help it to survive?
a. From looking at its mouth – what might it eat?
b. How does it protect itself?

A sketch of your animal and labeling of anatomy…

A “zoomed-in” sketch of the body covering of your animal…
Interactions: Does my animal interact with any living or non-living things in its habitat? How? A pastel/pencil crayon artistic scene of your animal and its habitat…
Food chain: Where in the food chain might my animal be? Does it have the features of a predator, prey or both? Is there evidence of food remnants? Do humans use my animal in any way? Is it sustainable? (Will it be around for future generations?)
Oxygen: What organ does my animal use to breathe? Are there gill slits? Does it breathe in the air with lungs? Can I see it take a breath? How many times per minute does it happen?
Locomotion: How long does it take my animal to move (swim, crawl, walk) 1 metre?
Vocabulary Bank…. (Write new, unfamiliar and words related to your animal here)
Impacts: Are there any threats to my animal in the wild?
Questions about my animal….

Sharkie Guardian Pledge:

Because I want to help the ocean and all the creatures that live in it and around its shores, I pledge today to do these things and accept membership into the Sharkies:

- Conserve water.
- Reduce waste and dispose of trash properly.
- Reuse or repurpose products to extend their usable life.
- Recycle disposable items and use products made of recycled materials.
- Be considerate of ocean wildlife and seabirds.
- Clean up the beach, park, or river and leave it better than I found it.
- Devote time every year to community service to benefit and beautify the environment.
- Increase my own awareness of the effects that I have on the ocean and our environment.
- Learn all I can about the environment, including special ocean areas like national marine sanctuaries.
- Promote ocean awareness and pass on my knowledge to friends and family.
- Encourage my family and friends to protect the ocean and our environment.

Signature

Print Your Name

Date