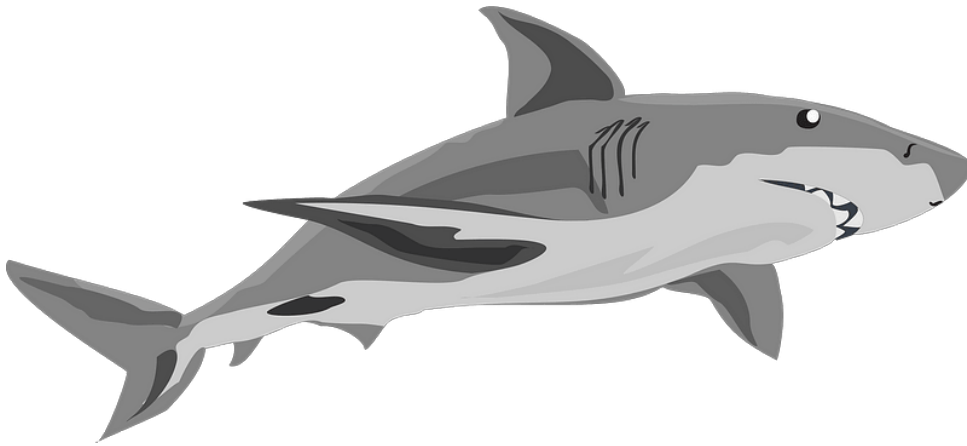


**LET'S INVESTIGATE**  
**SHARKS**  
**TEACHER'S GUIDE**



## **TEACHING GUIDE: LET'S INVESTIGATE SHARKS**

This guide is for use with the *Let's Investigate Sharks PowerPoint*. It provides key points to discuss for each slide as well as vocabulary words (highlighted in RED) that can be incorporated. It is not necessary to discuss each and every one of the key points. Select the points you wish to discuss or the ones that best coincide with your current curriculum.

The PowerPoint is broken down in sections (bold, underlined and lettered). The sections can be used as stand alone curriculum or used as an entire presentation. You may find it beneficial to break the presentation of the material up into smaller sections.

**SQ:** Indicates a question you can ask students to engage them in a discussion (Student Question)

(\*) Indicates a recommended activity to be used in that section or with a particular slide.

### **SLIDES**

#### **A. WHAT IS A SHARK**

##### 3. What is a Shark? (Caribbean Reef Shark)

**SQ:** What is a shark?

-Let students give several guesses.

- Sharks are cartilaginous **FISH**.

**SQ:** Have you ever heard any bad things about sharks?

**SQ:** Do you think they are true?

-Sharks are not monsters and they do not eat people. Yes, accidents happen and people get hurt, but most times it is because the shark has mistaken the person as an animal they eat, like a seal, sea lion, or fish.

\* Ask the students to come up with words they associate with sharks. Make a list on a large piece of paper, so you can save. Do this again after the presentation and see if the words change.

#### 4. Fish Collage

-Sharks are cartilaginous fish meaning their skeleton is made of cartilage.

-Sharks are **COLD BLOODED VERTEBRATES**.

**SQ:** Do you have a pet fish?

#### 5. ”Whoa! Sharks are Fish Too! “

-Yes, sharks are fish, but they are different than some of the other fish that might come to mind.

**SQ:** How are sharks different from other fish?

#### 6. Bones vs. Cartilage

-Sharks do not have bones. Get the students to touch their wrist bones.

-A shark’s skeleton is made entirely of cartilage. Have students touch their nose and wriggle it a bit.

#### 7. Skin vs. Scales

- Sharks do not have scales like other fish.

- Sharks have placoid scales, which are also known as **DERMAL DENTICLES** (more about skin later in the presentation).

-The dermal denticles are razor sharp tooth-like scales that reduce drag (hydrodynamic) and allow the sharks to swim faster.

### **B. WHY ARE SHARKS SO IMPORTANT**

#### 8. Why are Sharks so Important?

**SQ:** Why do you think sharks are important?

## 9. Healthy Ocean Ecosystems

- Scientists believe sharks are critical for maintaining ocean **BIODIVERSITY**.
- Many are **APEX PREDATORS** meaning they are responsible for maintaining the health of ecosystems. They eat old, sick, dead or dying fish and keep the population of fish beneath them on the food chain from overpopulating. It is important for each level of the food chain to be in balance in order for the whole **ECOSYSTEM** to be healthy.
- In some areas where shark populations are declining, scientists have found significant damage to coral reefs. Without sharks, fish species below them on the food chain swell in population and can overeat their food source, making those populations go down. These fish will die off and the next level has a swell in population and so on. It cascades down impacting all levels of the ecosystem.
- Sharks are carnivores meaning they eat other animals.
  - Sharks eat (prey) fish, turtles, **MAMMALS**, birds, sea snakes and even other sharks.

## 10. Biodiversity

- Biodiversity is critical for healthy oceans. Scientists have found a decline in ocean biodiversity and this has consequences on the stability of functioning ecosystems. This system is delicately balanced and when a component or multiple components are affected, the entire system and its interconnected parts feel the impact
- Sharks are not always apex predators, but no matter where in the food chain they exist, they play a critical and necessary role in its balance. They help maintain healthy and sustainable populations of the animals they consume. They also eat injured, sick, dying or dead animals, which keeps the oceans clean and keeps disease from spreading.

## 11. 100 Million

- Approximately 100 million sharks are killed each year. This is a VERY large number and the point of the slide is to get their attention and to think about just how LARGE this number is.

## 12. Sharks are in DEEP Trouble

- Sharks are heavily fished for their livers, meat, cartilage and fins. Their teeth, jaws and fetuses are also sold as souvenirs.
- Shark fins are used to make shark fin soup. A bowl of this soup can cost \$100.00 or more.
- Shark finning is the cruel practice of removing the fins of a live shark, and discarding the rest of the body.
- Sharks are also caught as **BYCATCH** by other fisheries.
- Water pollution and habitat destruction also have a negative impact on the oceans and sharks.
- The **LIFE CYCLE** of sharks is very different from other fish. They are slow growing and do not lay thousands of eggs or give birth to a large quantity of **OFFSPRING**.
- Some shark **POPULATIONS** are declining because they cannot reproduce fast enough to recover from the millions being killed each year.
- Shark biologists believe that some shark species are at risk of extinction due to overfishing, habitat loss, finning and being caught as bycatch.

\* There is a printable poster of this slide

## **C. ECOSYSTEMS AND ADAPTATIONS**

### 13. Where do we Find Sharks?

- SQ:** Do you think there are sharks in the ocean near us? (If near an ocean)
- SQ:** Has anyone ever seen a shark either in the ocean or maybe in an aquarium?
- \* As a class, you can research what shark species can be found in your area.

### 14. Map of the World

- Sharks are found in every ocean around the world.
- Some species of sharks stay in one area while others are highly migratory.
- Shark **MIGRATION** is primarily driven by the need for food, to breed or to give birth.

## 15. Habitat & Ecosystems

- Sharks can be found in lots of different **COMMUNITIES** and **ECOSYSTEMS** including the open ocean, seagrass beds, coral reefs, mangroves and even rivers.
- They can also live in different habitats during different stages of their life, just like you go to different schools as you get older.
- They can be found in cold water, warm water and even in fresh water rivers.
- Bull sharks can actually swim in brackish (fresh and salt water mix) and freshwater. They have been found thousands of miles up rivers around the world; some as far north up the Mississippi River as Illinois.

## 16. Adaptation

-Sharks have some pretty remarkable **ADAPTATIONS** to help them better survive in the environments where they live. These include camouflage, body shape, coloration, fin shape and size, teeth size and shape and their eyes. These can also change over the course of their life as they move into different habitats.

### **JAWESOME Adaptations:**

- Nurse sharks have a tail fin (caudal) that is flat on the bottom because they spend most of the time on or near the bottom of the ocean. ( bottom left image)
- Great hammerheads have a very wide head with more surface area for electroreceptors (**AMPULLAE OF LORENZINI**), which in turn enhances their ability to detect prey. ( bottom right image)
- Thresher sharks actually use their long tail fin to slap prey and stun them, giving the shark a chance to then grab their meal. ( bottom middle)
- Deep-sea lantern sharks have tiny light emitting organs called Photophores, which assist in camouflage and communication. (Check out our DEEP SEA SHARK curriculum packet to learn more) ( top left)
- Wobbegong sharks have amazing camouflage, allowing them to be the ultimate ambush predator. ( top middle)
- **COUNTER SHADING** is an adaptation that helps sharks camouflage themselves either while hiding from predators or hunting their prey. ( top right)

## 17. Reproduction (See Reproductive Fact Sheet for more information)

-The production of offspring is necessary in all living things and sharks have 3 main methods of reproduction.

- Viviparity: (Placental viviparity) Some sharks, like lemon sharks, give birth to live young, which are attached to the mother with an umbilical cord.

- Ovoviviparity: (Aplacental viviparity) Eggs hatch within the mother before the offspring are born alive. They are nourished by a yolk sac rather than an umbilical cord. Nurse, tiger and sand tiger sharks produce offspring this way.

- Oviparity: Chimaeras, skates and some sharks (bamboo, wobbegongs and horn sharks) produce eggs which are encased inside a tough outer shells (an egg case is also known as a mermaid's purse). The mother leaves the egg cases on the sea floor or attached to a corals or seaweed, depending on the species.

- Slide Guide: (Left top) Lemon shark, lemon shark umbilical scar and lemon shark giving birth. (Right top) Nurse shark egg case and juvenile nurse shark. (Bottom left) Cat shark egg cases. (Bottom Right) Horn shark hatching from egg case.

## 18. Traits

Animals are grouped through the process of **CLASSIFICATION** by similar characteristics. Sharks, like all animals, have specific **TRAITS** and these traits are used to break them into different orders. There are 8 different orders of shark. While each of these orders have all the needed traits necessary to be classified as sharks, each group possesses traits that make them different from each other.

**SQ:** What shark traits can you think of? Do all sharks have the same traits?

- Certain traits help a specific species of shark to survey in a particular habitat.
- Offspring **INHERIT** traits from their parents.
- Certain traits like fins and gills slits are found on every species of shark.
- Sharks can also have personality traits just like us. Some sharks are bold while others are shy.
- Cow Sharks (Hexanchiformes) have 6 or 7 gill slits rather than the 5 most other species have. They are also thought to be the oldest living group of sharks and only have a single dorsal fin.
- Sawsharks (Pristiophoriformes) each possess a large rostrum with teeth lining the sides, which is how they have earned their name.

- Eyes can vary in shape and color from species to species.

### 19. Stripes to Spots

-In many species of shark, the parents and offspring look different. In the case of the zebra shark, it is born with stripes like a zebra and as it gets older they turn into spots. This makes the adult look nothing like a zebra, but actually like a leopard.

- It is believed that juvenile zebra sharks are born with zebra like stripes, which look similar to sea snakes found in the same region, as a means of self-defense from possible predators.

## **D. HOW MANY AND HOW LONG**

### 20. How Many Sharks?

**SQ:** How many different types of sharks do you think there are?

**SQ:** Can you name five different sharks? How about ten?

- There are over 500 different **SPECIES** of sharks that we know about. They range in size from 6 inches to 50 feet in length.

### 21. How Long Have Sharks been Around?

- Sharks were around BEFORE the dinosaurs. The first sharks appear around 450 million years ago.

- Fossil records suggest that more than 3,000 types of sharks and related animals lived at one time.

## **E. SHARK PARTS**

### 22. Shark Parts- Just What Have They Got

**SQ:** Which parts of their anatomy are important for surviving in the ocean?

### 23. Let's Dive in and Take a Closer Look



#### 24. Teeth

- Humans have one row of teeth on the top and one row on the bottom (52 teeth total over our lives, 20 baby teeth that we lose, and 32 adult teeth).
- Sharks have several rows of teeth and they are constantly falling out. Most sharks have about 5 rows of teeth.
- Sharks will have thousands of teeth over their lifetime!
- Sharks usually lose at least 1 tooth per week. Imagine losing a tooth every time you ate an apple.

#### 25. Teeth and Jaw Shape

- Different sharks have different shaped teeth depending on what they eat.

#### 26. Gills

- Sharks have 5 to 7 gills slits on each side of their body.
- Even though they live in the ocean they still need oxygen to live.
- Sharks use their gills to pull oxygen from the water.
- Water enters the shark's mouth and is expelled through the gill slits. This is the part of the gills we can see.
- Most sharks have to swim to stay alive, but others can rest on the bottom and pump water over their gills in order to get oxygen. This is called **BUCCAL PUMPING** and is an adaptation some sharks have developed.

#### 27. Lounging

- Lemon sharks ( top) and nurse sharks (bottom) can lie on the bottom and pump water over their gills in order to breathe.

#### 28. Fins

- Sharks have 8 or 9 fins (some have a single dorsal fin)
- They use their fins to swim as well as stay upright while moving through the water.

### 29. Fin shape & function

- The shape of shark fins varies depending on what habitat they spend most of their time in. Example: A nurse shark has a flat caudal (tail fin) because it spends most of its time on the bottom.
- Some sharks like the Thresher shark can use their caudal (tail) fin to slap and stun their prey before eating them.
- The epaulette shark has an increased range of motion in its pelvic and pectoral fins allowing it to walk over the ocean floor or through tide pools.

### 30. Eyes

- Shark eyes are similar to our eyes in how they work.
- Shark eyes vary in size and shape depending on the habitat and depth they spend most of their time in.
- Sharks have eyelids, but they do not close all the way
- Some sharks have nictitating membranes
- Sharks without nictitating membranes can roll their eyes back in order to protect them.

**SQ:** Do any of these eyes look like other animals' eyes?

### 31. Nictitating Membrane

- Many shark species have what is called a **NICTITATING MEMBRANE**. It is a thin membrane similar to our eyelids.
- The membrane protects the eye when a shark is going after prey, they cannot see through this when it is closed, and must use other senses.
- Seals and sea lions have claws and fish have sharp spines, all of which could do damage to the eye of a shark during a feeding event.

\* There is a printable poster of this slide

### 32. Noses

- Sharks have 2 nares (nostrils) on the underside of their snout.
- Each nare has 2 openings: 1 for water to enter and 1 for water to exit.
- Sharks do not use their noses to breathe. They are only used for smelling.

### 33. Skin

- Shark skin is made up of tiny razor like scales called dermal denticles. (See next slide)
- Shark skin is very smooth in one direction (head to tail), but feels like a cat's tongue or sandpaper when you rub it the other way (tail to head).

### 34. Dermal Denticles

- **DERMAL DENTICLES** are V shaped scales that make sharks hydrodynamic, meaning they can move with less resistance through the water allowing them to swim faster, and use less energy.

-Olympic swimsuit designers, and boat builders have modeled material after the skin of sharks.

\* There is a printable poster of this slide

### 35. Prickly Situation

- While most dermal denticles are microscopic in size, the dermal denticles on the Prickly Dogfish are large enough to be seen by our own eyes.

**SQ:** Why would it be important for sharks to be able to swim fast and smoothly through the water?

### 36. Let's Make Sense of Shark Senses: ( 5 slides)

-Sharks have all five of the same senses we do, but they actually have a very special 6<sup>th</sup> sense that helps them detect prey.

#### 37. Sight

-Sharks can see in dark or murky water.

#### 38. Sound

- Sharks have ears, but they are located entirely on the inside of the body. Sound travels faster and farther through water, so often times sharks are able to hear their prey long before they can see it.

#### 39. Smell

-Sharks have an incredible sense of smell.

-Imagine being able to smell a chocolate chip cookie in an area the size of a football field.

-Some sharks can detect a single drop of fish blood within a million drops of seawater or from a quarter of a mile away. A standard track is  $\frac{1}{4}$  mile (1320 feet) in length and  $\frac{1}{4}$  mile is almost 4 football fields (360 feet) in length.

**SQ:** Do you think sharks are attracted to human blood?

\* If you have a space large enough on school property you can measure out  $\frac{1}{4}$  of a mile. Place a marker or half the class at one point and everyone else 1320 feet away. Or you can take the kids onto the track and have them walk/jog a lap around the track, so they can see just how far  $\frac{1}{4}$  mile is.

#### 40. Taste

- Sharks have very sensitive taste buds in their mouth and will do a “test bite” to see if something is edible or part of their normal diet. People are NOT part of the normal diet of sharks.

**SQ:** If you were to bite a crayon or t-shirt (or another item in the classroom the kids would not eat) would it taste good? Would you want to eat it?

-Sharks do not have hands like we do, so they use their mouths to figure out what things are.

-Accidents happen when sharks bite something (people) and then let go because it is not food.

-A candy bar tastes good, but the wrapper it comes in does not. We know the wrapper doesn't taste good because we have learned it is not food. A shark learns by doing a test bite.

-We don't taste good, so they let go, but sharks have a lot of teeth and sometimes the bite can harm a person, but it is not the shark hunting down a human and trying to eat them.

**This is a challenging section, but also a great opportunity to reiterate the fact that humans are not on the menu for sharks. Yes, accidents happen, but sharks do not hunt people and consider them food.**

#### E. Touch

- Sharks have two components to their sense of feeling and touch.

-The first is actually touching an object, including a test bite, where they not only taste, but also feel the potential prey.

-The second is a bit more complex and includes a series of canals known as the lateral line. (See next slide)

41. Lateral Line (see the red line on each shark in the slide)

- The **LATERAL LINE** is a series of interconnected canals that run from the back of the shark's head to its tail.

-Each canal is made up of tiny pores, which allow water to penetrate the skin.

-Tiny hairs line the canal and allow the shark to detect movement in the water.

-The shark does not have to see an animal to know it is there, but can feel it by detecting movement or disturbance in the water.

-If you are in a swimming pool and your friend does a cannon ball you feel the wave, right? Imagine if you were at the opposite end of the pool and your friend wiggled his or her fingers very gently and you were able to feel that.

42. Ampullae of Lorenzini

- Sharks have what is known as a 6<sup>th</sup> sense.

- This 6<sup>th</sup> sense refers to their ability to detect electrical pulses in the water.

- **AMPULLAE OF LORENZINI** (black pores you can see in the image) are sensory organs that can detect these pulses. Every living thing gives off an electrical pulse. This gives sharks another tool for finding food.

-Metal objects such as boat propellers also give off pulses.

- Hammerheads and some other sharks can actually detect the very faint pulse given off by prey hiding motionless while buried in sand on the bottom.

-Sharks that are more active hunters will have more ampullae on their snout than less active species of sharks.

**SQ:** Do you think a healthy fish gives off the same pulse as an injured or dying fish?

\* There is a printable poster of this slide

43. SHARKS NEED YOUR HELP!!!

-Sharks need your help! They are in deep trouble and many species are **ENDANGERED** or critically threatened. 25 % of sharks and rays (their flat cousins) are threatened with extinction.

- Shark **CONSERVATION** involves protecting sharks and their habitats.

**SQ:** What do you think you could do to help sharks?

- Recycle all items you can. Select recyclable items when purchasing goods.

- Don't litter on land or in the water and pick up any litter you see.

- Be a good junior scientist and ask good questions about sharks.

- Be a shark advocate by telling other people how cool sharks really are and that they are NOT man-eating monsters.

- Get mom and dad or other family members to use canvas grocery bags instead of plastic.

- Have a reusable water bottle instead of buying new bottles of water.

- Do a science fair project or report about sharks so you can share some interesting facts about them with other people.

- Take our pledge to Save Sharks (see attached sheet)

44. The End