



TEACHING GUIDE: LET'S INVESTIGATE SHARKS GRADE 5

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. (Ecology, Conservation& Anatomy)

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

Intro:

1. SHARKS4KIDS Logo

A. WHAT IS A SHARK

2. 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, bites happen, but they are very rare. (On average 5 people die from shark bites in the world each year-ONLY 5)

* 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.

3. Fish Collage

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

-Sharks are **COLD BLOODED** vertebrates.

SQ: In what ways are sharks different from other fish? In what ways are they similar?

4. 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.

-Cartilage is lighter (less dense) than bone, so it helps sharks maintain neutral buoyancy (keeps them from sinking to the bottom)

5. Skin vs. Scales (Slides 5 & 6)

- Sharks do not have flat 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.

-In most species of shark, the dermal denticles are microscopic.

7. Reproduction

-Fish spawn, producing thousands of eggs which are fertilized externally.

- Sharks use internal fertilization and produce egg cases or give birth to live young

Slide: Top left- lemon shark giving birth to live pup. The pup is attached to the mother with an umbilical cord, leaving a shark "belly button" when it's born.

Top right: Nurse sharks hatch from an egg case inside the mother and then are born alive. (no umbilical cord).

Bottom left: Cat shark egg cases

Bottom right: A horn shark hatching from an egg case.

B. WHY ARE SHARKS SO IMPORTANT

8. Why are Sharks so Important?

SQ: Why do you think sharks are important?

9. Food Pyramid

- In a balanced ecosystem, the food pyramid shows the quantity of organisms on each level (number of animals) of the food chain. There are more **PRODUCERS** (base) than there are **CONSUMERS** (upper levels). This is necessary to keep the whole system in balance.
- In the ocean **PHYTOPLANKTON** and **PLANKTON** are at the base of the pyramid.
- Producers make their own food using **PHOTOSYNTHESIS**, a form of **PRIMARY PRODUCTION**.
- Many shark species are at the top of the food chain (food pyramid) in almost every part of the world's oceans.
- This means sharks play a critical role in the largest **BIOME** on the planet, the marine biome, which covers 71% of the Earth's surface.
- Scientists believe sharks are critical for maintaining ocean **BIODIVERSITY**.
- Some sharks **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.
- A healthy ecosystem is one in which multiple species (of different kinds) are each able to meet their needs in a relatively stable web of life.
- 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 can cascade down, impacting all levels of the ecosystem.

- Sharks eat (prey) fish, turtles, mammals, birds, sea snakes and even other sharks.

10. Food Web

- **FOOD WEBS** show the interacting food chains in a community.

- This food is in the Bahamas and the tiger shark is the apex predator at the top. This is a basic food web.

- Animals in this food web: tiger shark, loggerhead turtle, barracuda, juvenile lemon shark (center bubble) silversides (far left bubble), juvenile mangrove snapper, blue crab and Caribbean spiny lobster. Left Image: Sea grass bed. Right Image: Mangrove forest. These are all **BIOTIC** parts of this ecosystem.

- Tiger sharks eat turtles, other smaller sharks and barracudas.

- Loggerhead turtles eat blue crabs and lobster.

- Juvenile lemon sharks eat small fish and crabs.

- Barracudas eat snapper and juvenile lemon sharks. They are **TERTIARY CONSUMERS**.

- Mangrove snapper eat silversides & small crustaceans (crabs & lobster). They are **SECONDARY CONSUMERS**.

- The crabs eat small critters found in the seagrass like snails and fish. They also eat dead and decaying matter.

- The silversides are **PRIMARY CONSUMERS**.

- The seagrass and mangroves make their own food (photosynthesis) using **ABIOTIC** elements of the ecosystem. (Sunlight)

- Understanding food webs and food pyramids is very important and is a major component of **ECOLOGY**.

11. Human Impact: Sharks are in DEEP Trouble

SQ: Do you think humans make an impact on sharks? How?

12. 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.
- Sharks are heavily fished for their meat and fins, as well as their cartilage, skin and livers.
- -Sharks are also caught as **BYCATCH** by other fisheries.
- Water pollution and habitat destruction 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.
- 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

13. Shark Fins & Finning

- SHARK FINNING** is the cruel practice of removing the fins of a live shark, and discarding the rest of the body.
- Shark fins are used to make shark fin soup. A bowl of this soup can cost \$100.00 or more.
- It is widespread and represents one of the largest threats to shark populations on a global scale.
- Shark fin soup is popular in Asian cultures, but can be found around the world.

SQ: Have you been to a restaurant with shark fin soup on the menu?

- Mercury **BIOACCUMULATES** in ocean animals and because sharks are at or near the top of the food chain they can have toxic levels in their systems.

- Studies have found high levels of neurotoxins linked to diseases such as Alzheimer's and Parkinson's disease, in shark fins.

C. WHERE DO WE FIND SHARKS

14. 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.

A: Sharks are found in every ocean around the world.

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 be found in cold water, warm water and even in fresh water rivers.

SQ: If you were a shark, which habitat would you want to live in and why?

16. Adaptation

-Different species of sharks have adapted to better survive in the environments where they live. This includes camouflage, tail shape or head shape. (Top middle wobbegong with camouflage).

-The great diversity of ecosystems in the ocean provides opportunities for sharks to develop a great diversity of adaptations, many of which are unique to sharks and other organisms living in the ocean.

-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).

- The velvet belly lantern shark (top left) is a deep-sea shark which has light emitting photophores, which make its belly glow.

- Counter shading is seen in many species (great white shark top right). It's a method of camouflage where the upper region of the body is dark, and the underneath is light.

- 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) .
- It is believed that thresher sharks actually use their long tail fins to slap prey and stun them, giving the shark a chance to then grab their meal. (Bottom middle image)

D. RELATIONSHIPS AND BEHAVIORS

17. Migration:

- Some species of sharks stay in one area while others are highly migratory.
- **MIGRATION** can be vertical (moving from **MESOPELAGIC ZONE** to **EPIPELAGIC ZONE** at night- up and down movement) or horizontal (moving across great expanses of ocean or from one ocean to another).
- Migration is a strategy sharks and other organisms use in response to daily and seasonal changes in ecosystems, including temperature, tides, availability of food and potential mates.
- This slide shows the migration path of a tiger shark equipped with a SPOT satellite tag. Each dot shows when the shark's fin came to the surface and the tag transmitted a location to a satellite.

18. Sharks & Remoras

- Adaptation can occur with behaviors as well. Check out the fish that are attached to or swimming next to the nurse shark. These are remoras and this is a **SYMBIOTIC** relationship that is **MUTALISTIC**. The remoras clean parasites off the shark and in turn they get bits of food from whatever the shark eats.

19. Being Social Butterflies (or sharks, if you will)

- Some sharks are solitary, while others are social.
- Juvenile lemon sharks have friends and learn from each other (seen in image).
- Spiny dogfish hunt together like a pack of dogs, which is how they earned their common name.

E. HOW MANY

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 types of sharks that we know about. They range in size from 6 inches to 50 feet in length.

Slide: Top (L to R) Salmon, Common Angel, Great Hammerhead

Middle (L to R) Gulper, Greenland, Zebra

Bottom (L to R) Puffadder Shy, Bull, Blacktip

F. SHARK PARTS

21. Shark Parts

22. 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.

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

Slide: Top (L to R) Nurse, Cookiecutter

Bottom (L to R) Tiger, lemon

23. 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.

24. Buccal Pumping

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

- Sharks can rest different parts of their brain at different times in order to get some rest. They do not sleep like we do.

- Some species of sharks, like the nurse sharks, are primarily nocturnal, so they will rest during the day and hunt for food at night.

25 & 26. Fins (2 slides)

- Sharks have 8-9 fins (pectoral, pelvic, caudal, anal and dorsal).

-They use their fins to swim as well as stay upright while moving through the water.

Second slide (26)

- 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 (bottom right).

- Some sharks like the Thresher shark can use their caudal (tail) fin to slap and stun their prey before eating them (top left).

- 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 tidepools (middle).

27. 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, which protect their eyes when they are going after prey. (Tiger shark top left image)

-Sharks without nictitating membranes can roll their eyes back in order to protect them.

Top right-great hammerhead

Bottom left-nurse, right-zebra

SQ: Do any of these eyes look like other animal eyes?

. 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 predation event.

VIDEO RESOURCE (shows nictitating membrane)

<https://www.sharks4kids.com/shark-videos>

(scroll down to Shark Anatomy)

28. 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.

(top left – nurse shark, large center-tiger, left middle- great hammerhead)

29. 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).

30 & 31. 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.

-Prickly dogfish dermal denticles are large enough to be seen by the human eye. (slide 31)

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

32. Let's Make Sense of Shark Senses:

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

33. Sight

-Sharks can see in dark or murky water

Top: Lemon

Bottom: (L) Nurse (R) Bull

34. 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.

35. Smell

-Sharks have an incredible sense of smell.

- They can detect smells between one part per 25 million and one part per 10 billion, depending on the substance, and the species of shark.

- This is the equivalent of a drop of blood in a small swimming pool.

36. 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.

37. 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)

Slide- tiger shark touching the camera with its snout.

38. Lateral Line (see the red line on 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.

39. Ampullae of Lorenzini

- Sharks have what is known as a 6th sense.

- This 6th 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.

40. Ampullae of Lorenzini Continued....

- This image shows the dermal denticles and the ampulla look like balls of yarn). Created using a scanning electron microscope.

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

41. How Do We Learn About Sharks?

SQ: How do you think people learn about sharks?

SQ: How could you learn about sharks?

42. Scuba Diving & Snorkeling

-In order to study sharks sometimes we need to dive in and get a closer look.

-Scuba Diving: SCUBA stands for self-contained underwater breathing apparatus. Divers use special equipment to be able to stay underwater, including an air tank they can breathe from.

-Snorkeling: People can use a snorkel, which looks like a pipe sticking up out of the water, to get air from the surface without having to lift their face out of the water.

SQ: Has anyone here been snorkeling? Do you have family members or friends who have been snorkeling or scuba diving?

SQ: How do you think snorkeling or scuba diving would allow people to learn about sharks?

Scuba diving and snorkeling lets people observe sharks and study them in their natural habitat. People can learn how they swim, what they eat and where they go.

43. Underwater Photo & Video

A great way to learn about any animal is by taking photos and videos.

SQ: What could we learn from looking at photos and videos of different animals?

- What they eat.
- How they move.
- Where they hide or spend time.
- How they play.
- How they act with other animals .

SQ: Has anyone here ever watched an animal show on television? Were the animals underwater?

SQ: What do you think would happen if you took a regular camera underwater?

-There are special housings made for cameras, so they can go in the water. The housings keep the cameras safe and dry.

44. Science & Research

SQ: How do you think scientists learn about sharks?

SQ: If you were a shark scientist, what would you want to learn about sharks?

- There are lots of ways scientists can learn about sharks.
- Scientists and researchers can come up with a **HYPOTHESIS** and then determine whether it is true by studying sharks in various ways.
- They can observe sharks in their natural environment and take notes.
- Catch the sharks and see how long they are and how much they weigh (just like when you go to the doctor). This is called a scientific workup.
- They can take a DNA sample or a blood sample.
- They can study the DNA to figure out a shark family tree just like people can research their family trees.

Slide: Top (Left to right) – Measuring the length of a bull shark, taking a tissue (DNA) sample from a shark.

Bottom (Left to right)- PIT tag scanner, measuring the length.

45. Shark Tagging

- A really cool tool that scientists can use is to put tags on sharks. There are lots of different tags and they can do different things.

- A simple tag might just give the shark an ID or “name.” If they catch the shark again, they will know it has already been caught and they can take measurements again to see if it has grown.

- Acoustic tags can be used for tracking animal movements over a long time period.

- There are larger tags that are actually miniature computers. They record a lot of information while attached to the shark. (SPOT and PSAT)

 - Location

 - Water temperature

 - Depth

 - Speed

- The tags do not hurt the animals, but probably feel like getting a shot or your ears pierced. Sharks also heal incredibly fast.

Slide: Top (Left to right) SPOT tag on a tiger shark, PSAT on a great hammerhead, roto tags and temperature tag on a nurse shark.

Bottom (Left to right)- Casey tag on a nurse, roto and acoustic tag on a nurse, SPOT tag on a tiger and small PIT tag on card.

(See full tag description under the science section of our website)

* Shark Tracker Website: Students can follow different tagged sharks and see where they go. As a class you can select a shark and see where it goes for a week or 2 weeks or even a month. This is a great way for students to see real life science in action. <http://www.nova.edu/ocean/ghri/tracking/>

46. We need your help

-Sharks need your help! They are in deep trouble and many species are **ENDANGERED** or critically **THREATENED**

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

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

- Recycle

- Don't litter on land or in the water.

- Be a 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.

- Lots of things YOU can do and every little bit helps.

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

- You could ask your parents, family and friends NOT to eat at restaurants that serve shark fin soup.

- Take our OFFICIAL SHARKS4KIDS PLEDGE TO SAVE SHARKS!

