Let's Investigate Sharks

Grade Level:
3rd and 4th

Time:
30 minutes (longer if additional options are chosen)

LEARNING OBJECTIVES

1. Define what a shark is.
2. Understand the importance of sharks.
3. Discover where sharks are located.
4. Learn how many shark species exist.
5. Describe various parts of a shark.
6. Recognize how scientists learn about sharks.

SKILLS

analyzing, classifying, comparing and contrasting, defining, describing, evaluating, explaining

BEFORE YOU DIVE IN

Did you know that a shark is classified as a fish and not a mammal? Can you name any special senses that sharks have?

Our educators and scientists have compiled the most important and up to date key facts pertaining to sharks in an easy to follow lesson entitled *Let's Investigate Sharks*.

The *Let's Investigate Sharks* PowerPoint is packed with professional photographs combined with cartoon characters to grab the attention of young learners.

The lesson is broken down into 6 sections including: what is a shark, why are sharks so important, where do we find sharks, how many, shark parts and shark research.

Furthermore, all of the sections include discussion points for each slide. The vocabulary words are highlighted and definitions are included in the packet.

It is not necessary to discuss each and/or every key point. The sections can be used as stand alone curriculum or used as an entire presentation. You have the freedom to personally select the points you wish to discuss or the ones that best coincide with your current curriculum.

ALIGNMENT

Common Core:

CCSS.ELA-LITERACY.SL.1.1; CCSS.ELA-LITERACY.SL.1.2; CCSS.ELA-LITERACY.SL.1.3; CCSS.ELA-LITERACY.SL.2.1; CCSS.ELA-LITERACY.SL.2.2; CCSS.ELA-LITERACY.SL.2.3; CCSS.ELA-LITERACY.L.1.4; CCSS.ELA-LITERACY.L.2.4

Next Generation Science Standards:

LS1.A; LS1.B; LS1.D; LS2.A; LS2.C; LS3; LS4.C; ESS3.C; CCC1; CCC5

Next Generation Sunshine State Standards:

SC.3.L.15.1; SC.3.L.17.1; SC.4.L.16.2; SC.4.L.16.3; SC.4.L.17.1; SC.4.L.17.2; SC.4.L.17.3; SC.4.L.17.4

Ocean Literacy Scope and Sequence:

PSA 1-4; PSB; PSB.1; PSB.2; PSC.3; PSC.5; PSC.6; PSC.7; PT1

VOCABULARY

adaptation, Ampullae of Lorenzini, apex predator, biodiversity, bycatch, buccal pumping, classification, cold-blooded, community, conservation, counter shading, dermal denticles, ecosystem, endangered species, fish, inherent, lateral line, life cycle, mammal, migration, nictitating membrane, offspring, population, species, symbiosis, trait, vertebrate

MATERIALS NEEDED

- *computer/laptop*
- *internet access (optional)*
- *Let's Investigate Sharks PowerPoint*
- *Let's Investigate Sharks teaching guide*
- *Let's Investigate Sharks vocabulary list*
- *large poster board paper (optional)*
- *overhead projector (encouraged but not required)*

EXTENSIONS

Coloring Sheet (multiple species available), Comparing Habitats, Design Your Own Shark, Maze Easy, Sharky Concentration, Shark Cooperation and Sharks Senses activities and more

TEACHING GUIDE: *LET'S INVESTIGATE SHARKS* GRADES 3 & 4

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

Intro:

1. SHARKS4KIDS Logo

2. Let's Investigate Sharks

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 looks 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 6th 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 ¼ mile (1320 feet) in length and ¼ 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 ¼ 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 ¼ 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 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.

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 littler 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

GRADES 3 & 4 Vocabulary

This list of words can be used along with the *Let's Investigate Sharks* PowerPoint

1. **Adaptation:** Change an organism undergoes in order to survive. The change is maintained over time by natural selection. This is a very slow process. Also, an inherited trait that helps a species survive in its environment.

2. **Apex Predator**: An animal at the top of the food chain with no natural predators. If removed from an ecosystem, can have large cascading effects on many other species within that system.

3. **Ampullae of Lorenzini:** Tiny pores filled with a jelly like substance that can detect electrical fields traveling through the water. There are more of them on the head of the shark (around the snout) than anywhere else.

4. **Biodiversity**: The variety of different species within an ecosystem. Coral reefs are one of the most diverse ecosystems on the planet.

5. **Bycatch:** Certain fish or other animals (dolphin, sea turtles) that are caught unintentionally while fishing for a specific fish species.

6. **Buccal Pumping:** Named the 'buccal' (cheek) muscles used to pull water into the mouth and over the gills.

7. **Classification:** The action or process of grouping animals together according to shared qualities or characteristics.

8. **Cold Blooded:** Animals like reptiles, amphibians, and fish that become hotter and colder, depending on the temperature around them (can not regulate their internal temperature). For most shark species, their body temperature will be the same as the water it is swimming in. Some species like the Great White Shark and Mako sharks can warm parts of their body to be able to swim faster.

9. **Community:** A group of different species in one location that interact with each other.

10. **Conservation:** The protection of plants, animals and their habitats.

11. **Counter Shading:** Countershading is a type of coloration in animals where dorsal side (back) is dark while its ventral side (underside/belly) is light.

12. **Dermal Denticles**: Tiny tooth shaped scales that cover a shark's body (also called placoid scales). They reduced resistance as the shark moves through the water (hydrodynamic), allowing it to swim faster while using less energy.

13. **Ecosystem:** Animals, plants and nonliving things that make up an environment and impact one another.

14. **Endangered Species:** A species that is in danger of becoming extinct if actions are not taken to protect it.

15. **Fish:** These are vertebrates (have backbones) that live in water. They breathe using special organs called gills.

16. **Inherit:** A trait passed from one generation to the next.

17. **Lateral Line:** A row of sensory cells along the side of a shark that allow it to detect vibrations in the water.

18. **Life Cycle:** A series of changes that happen to an organism over the course of its life.

19. **Mammal:** A warm-blooded vertebrate that has hair and nourishes its young with milk produced in mammary glands.

20. **Migration**: Relatively long distance movement of animals from one area to another and then returning to the original area, usually on a seasonal basis. The reason for migration is usually to mate, find food or because of a change in water temperature or climate.

21. **Nictitating Membrane:** A thin membrane similar to our eyelids that sharks have and can use to protect their eyes when attacking prey.

22. **Offspring:** The young of a plant, animal or person.

23. **Population:** All of the individuals of the same species living within a given area.

24. **Species:** A group of similar living things that ranks below the genus in scientific classification and is made up of individuals able to produce offspring with one another.

25. **Trait:** A distinguishing characteristics of an organism

26. **Vertebrate:** An animal with a backbone (spinal cord).

Sharks4Kids
JAWSOME ADAPTATIONS
Grade 3-4 Activity

NGSS:3-LS4 Biological Evolution: Unity and Diversity
LS4.C: Adaptations
4-LSI Form Molecules to Organism: Structures and Processes
LS1.A: Structure and Function

Introduction:
Sharks have some pretty JAWsome adaptations to help them survive in different habitats including, camouflage, fin size and shape and counter-shading.

Materials: Paper, pencils, crayons

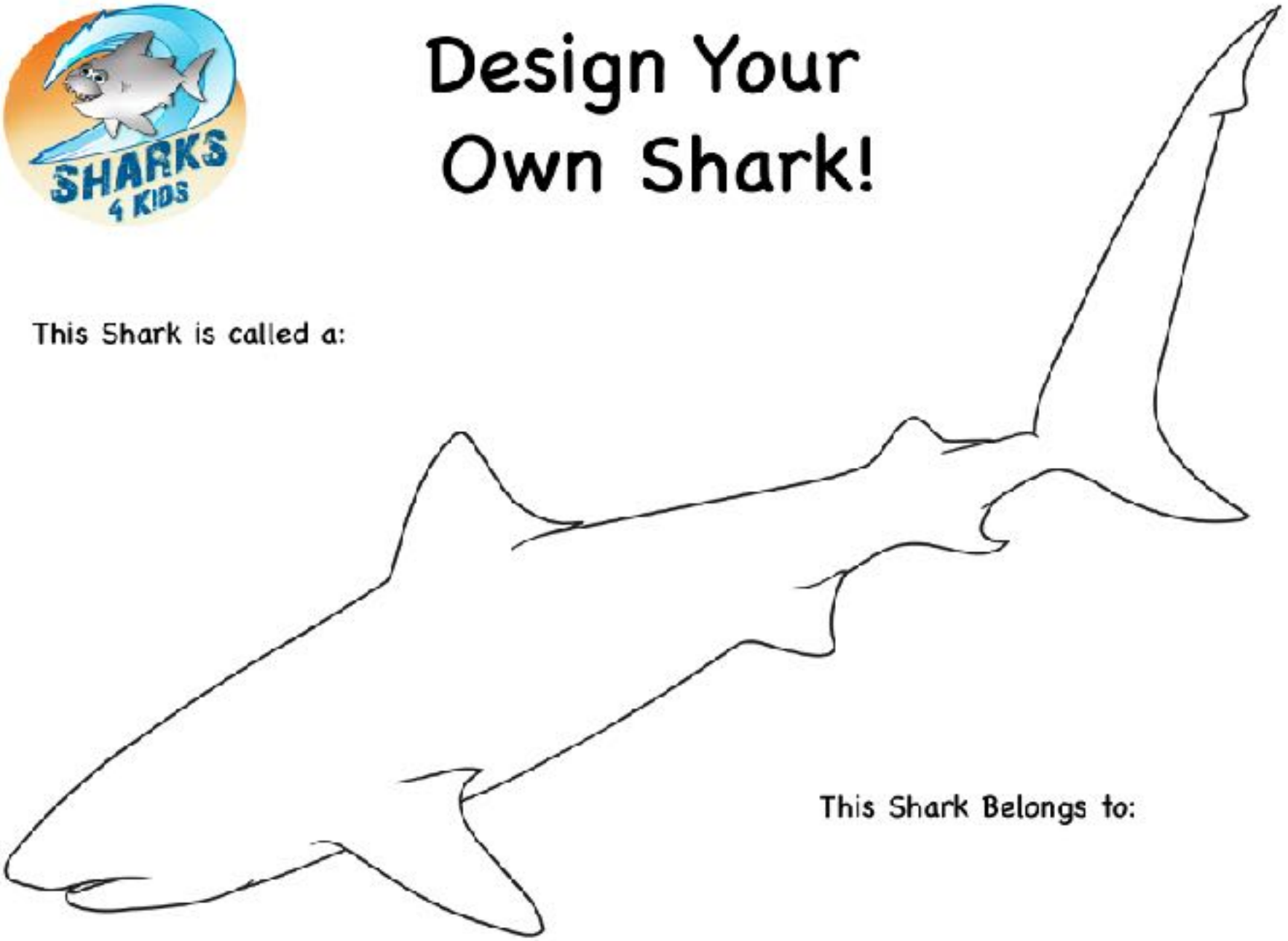
Time: 20-30 minutes

Procedure:
1. Print shark outline for each student.
2. Ask them to create their own species of shark.
3. They must name the shark and explain why they chose that name.
4. The shark must have 3-4 adaptations to help it survive in a specific habitat. (Ex: Eye shape, coloration, fin shape and size)
5. Which habitat does the shark live in? How does each adaptation help them survive.

Discussion:
Discuss the importance of adaptations for the survival of species. How do adaptations allow different species to survive in different habitats.

Design Your Own Shark!

This Shark is called a:



This Shark Belongs to:

www.sharks4kids.com

Sharks4Kids
Human vs. Shark Senses
Grade 3-4 Activities/Crafts

4-LS1-2 From Molecules to Organisms: Structure and Processes

These activities can be used with the *Let's Investigate Sharks PowerPoint*. Vocabulary is highlighted in red and a full vocabulary list for the PowerPoint can be found within the curriculum packet.

SQ: Indicates questions you can ask the students to engage them in a discussion.

Introduction:
Sharks have the same senses we do plus an extra sense! Scientists discovered this sixth sense by blocking out the other five senses of a shark, and he/she STILL found the hidden food. Could you find your food if you even one sense blocked out? These crafts/activities explore shark senses and compare them to our senses.

Time: Each sense may take up to an hour. One/two senses can be done each day to make a full week of learning about shark senses.

1)Hearing

Introduction:

Sharks have excellent hearing. They have internal ears that can pick up which direction a sound is coming from. We can do this too, but once we get underwater, it can be very difficult to tell where a sound is coming from. This is because sound travels much faster in water. Water is denser than air so the molecules are closer together and can bounce off each other more easily.

Materials per group:

- Bucket/container to be filled with water
- Solid objects that can be safely tapped against the bucket, or in the water, to make sounds
- Empty soda bottle
- Scissors

Procedure:

1. Each group will start by cutting off the bottom of the soda bottle. Take the top of the soda bottle and remove the cap.
2. Students will take turns holding the bottle top over the empty bucket while putting their ear up to the cap. At the same time, another student will create a sound on the outside of the bucket and then on the inside.
3. On a scale of 1-10, note how loud the sound was.
4. Now fill the bucket with water and repeat the experiment with the bottom of the bottle top submerged in the water. Note how loud this sound was compared to the first trial.

SQ:

1. On a scale of 1-10, how loud was the sound in the empty bucket?
2. On a scale of 1-10, how loud was the sound when the bucket had water?
3. Which one was louder? (If there is no noticeable difference then you may need to consider using different materials for either making the noise or the bucket.)
4. What are the natural sounds a shark might hear in the ocean?
5. What are the unnatural sounds a shark might hear in the ocean? Could any of these unnatural sounds cause them harm? If so, how?

Human vs. Shark Hearing Challenge

Procedure:
As a class, listen to the "frequencies sharks can hear" video on Sharks4kids.com. Have the students close their eyes and raise their hands when they hear something. As the teacher, record the earliest time the students start hearing the sound.

SQ and discussion:
Sharks are able to hear sounds at much lower frequencies than we can. Discuss why this would be helpful. What natural and unnatural things may make sounds at lower frequencies?

Sharks have great hearing. However, if we could give sharks earplugs, they would still find their food because they have 6 other senses to use! Could you find your food without hearing it?

2.) Sight & Smell

Introduction:
How well a shark can see depends on the SPECIES of shark and where he/she lives. The Greenland Shark *(Somniosus microcephalus)* lives in arctic waters as deep as 3,937 feet (1,200 meters). Having good eyesight in these dark waters is

not very useful so this shark is practically blind! However lemon sharks (*Negaprion Brevirostris)* are considered to have very good eyesight since they live in shallow waters in the Gulf of Mexico, Caribbean, and Pacific from Baja California to Ecuador. Studies have shown they have rod and cones cells and can even see color! From this, we can hypothesize that eyesight is important to the lemon shark. Therefore, they have to protect their eyes! They do this with a second eyelid called a NICTITATING MEMBRANE.

Sharks have a great sense of smell too. As they swim and swing their head side to side, their nostrils allow them to tell which direction a smell is coming from. For example, if a smell is coming from the right, their right nostril will pick up the scent before their left nostril! Our nostrils are so close together that we cannot tell if one nostril picks up a smell before the other one.

How far away sharks can hear, see, or smell something depends on a few environmental factors. These factors may include the frequency of the sound, the clarity of the water, and the strength and direction of water currents.

Human vs. Shark Sight and Smell Challenge

Procedure:

Sharks and people can find food without hearing it by using other senses. But what if we could give a shark ear plugs AND a blindfold? Could a shark still find food? Yes, because they can smell their food. Is your sense of smell strong enough to guide you without being able to hear or see?

Materials:

- Earmuffs (students can bring their own or they can cover their ears with their hands)
- Blindfold
- measuring tapes/rulers/meter sticks
- smelly markers
- paper fans

Procedure:

1. Give each group 2-3 different smelly markers, one measuring tape/ ruler/meter stick, and a piece of paper to fold into a fan.
2. Taking turns, have one student in each group put on the blindfold and cover his/her ears. Another student can stand 10 steps away with the smelly marker. This student will take single steps towards the blindfolded student until he/she can smell the marker. Mark this distance and measure it.
3. Repeat the process but use the paper fan to waft the smell towards the blindfolded student. Did this help the student smell the marker sooner?

SQ & Discussion:

1. How far away could you smell the marker with no fan?
2. How far away could you smell the marker with the fan?
3. What are some natural and unnatural smells a shark might detect in the ocean?
4. How would smelling these odors be helpful/harmful to sharks?

3.) Touch

Sharks can feel when something touches them just as we can. However, since they don't have hands, they do not use touch the same way we do. Sharks can also feel their environment without anything touching them! They do this by using their LATERAL LINE. This sense is not unique to just sharks, all FISH have a lateral line as well.

If your ears, nose and eyes are covered, what is the next sense you will use? Touch! As soon as people are blindfolded, they will put their arms out in front of them to feel for what is around. Sharks do not have arms to feel things but they might use their head! If a shark is trying to figure out what something is, they might headbutt the object. (This helps them to use their extra sense which we'll talk about later.)

Activity One

Materials:

- Blindfold
- Earmuffs
- Random objects from your classroom

Procedure:
Have students pair up in small groups. Taking turns, blindfold one student and give them an object from the room. Using only their sense of touch, have the blindfolded student try to figure out what the object is. As an extra step, try figuring out what the object is without your hands.

SQ & Discussion:

1. Which of these five senses is most used by humans?
2. Which sense do you think is most important to sharks and why? (Think about a type of shark and its habitat for this question)
3. Could a shark find its food without these five senses?

Activity Two (Lateral line)

Materials:

- Paper fan
- Blindfold

- Earmuffs

Procedure:
Have students sit in a circle with one student in the middle blindfolded with earmuffs on. Pick a few students at a time to make small, silent movements. (you may need to add music so the student in the middle cannot hear the movements from other students.) When the student in the middle thinks he/she can feel movement in the room, he/she can point in the direction of the movement. (As an option, one student can keep score of how many times a classmate moves vs. how many times the student raised his/her hand.)

Next have a new student stand in the middle with the blindfold and earmuffs. Another student will stand as far away as possible with a fan and slowly take single steps towards the first student until he/she can feel the breeze from the fan. Measure how far away this is. To make it more difficult there can be students with fans coming from different angles at different times.

SQ & Discussion:

We can feel movements that do not touch us if the movement is strong enough to push the air around. However, the movement has to be close enough so that the air does not disperse in another direction. Air and water molecules act very differently. For example, air molecules are compressible. Water molecules do not compress very well and instead, they push into nearby water molecules. In this way, water can carry vibrations much further away than air can. Next time you go swimming, see if you can feel your neighbor kicking next to you under water. This is similar to how a lateral line works except the sense is much more sensitive! Think about a school of fish. Ever wonder how they can all change directions at almost the exact same time? It's because of their lateral line! They can feel each other moving. How is this helpful to sharks and bony fish?

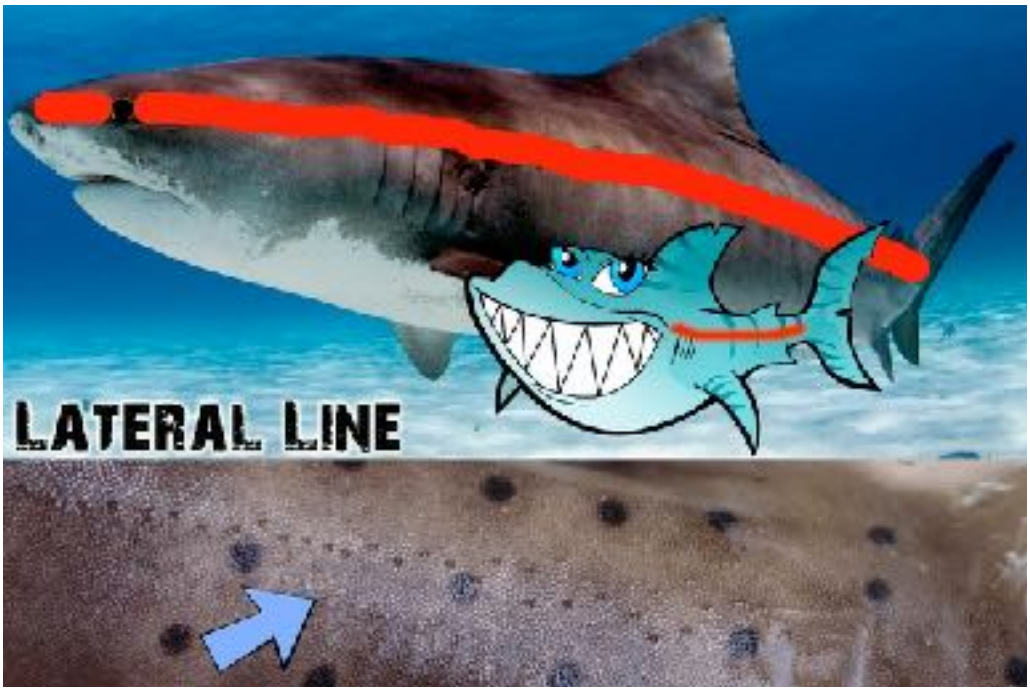
Additional Craft

Materials:

- Jello Packets/cleaned tops from individual portions
- Hole puncher
- Yarn
- Streamers
- Tape

Procedure:

1. Take Jell-O packets and punch holes near the top of each one.



2. Cut a piece of yarn that is twice as long as the student and run it through each hole of the Jello packets with a tie to hold each one in place. Spacing between the Jell-O packets may be determined by how many packets each student has.
3. Next cut small, skinny, strips of streamers and tape them to the back of the Jell-O packets.
4. Drape the finished lateral line over the student's head so it runs down both sides of their body-just like a shark!

Extra optional step:
Go back and try the lateral line activity again. This time, measure the distance at which the streamers start moving from the breeze of the fan.

5.) Ampullae of Lorenzini:

Introduction:

Sharks have one last sense which is called the AMPULLAE OF LORENZINI. This sense detects electrical pulses given off by a fish's heartbeat. This sense is made up of gel filled pores in the shark's head. (This is why sharks sometimes headbutt things!) The hammerhead has a large head called a cephalofoil that is covered with Ampullae of Lorenzini. Hammerheads love to eat stingrays and when one is buried in the sand this may be the only sense the shark can use to find the sting ray.

Materials:

- Small, thin magnets
- Compass
- Blanket

Procedure:

1. Before the class enters the room, spread the magnets out on the floor in a small area that your blanket can cover. Place the blanket over the magnets in a way that they are completely visually concealed.
2. Once the students are in the classroom, ask a volunteer to find the magnets under the blanket by using all their senses except touch with their hands (because sharks do not have hands.)
3. Once the volunteer(s) have tried finding them give them the compass and ask them to use it to scan over the blanket. Watch the compass for any unusual pointing.

SQ & Discussion:

1. What did the compass do when it was near a magnet?
2. When would a shark use this sense?
3. Do you think this sense can work from a long distance away? (No, this is usually the last sense a shark uses because they have to be in very close range to feel the electrical pulses.)