SHARKS 4 KIDS

MIDDLE SCHOOL UNIT 1

www.sharks4kids.com

Note: This unit incorporates many of the NGSS Performance Expectations, Disciplinary Core Ideas, Cross Cutting Concepts, and Science and Engineering Practices. While this unit provides supplemental materials for NGSS, it does not replace core curriculum. By the end of this week long unit, students will not be able to master all of the PEs, DCIs, CCCs, and SEPs listed. They will; however, develop a better schema in these areas.

Here's a great resource for the standards and their various components: https://ngss.sdcoe.net/

UNIT 1:

Performance Expectations
- **MS-LS1-2**
- **MS-LS1-3**
- **MS-LS1-8**
- **MS-LS2-1**
- **MS-LS2-2**
- **MS-LS2-3**
- **MS-LS2-4**
- **MS-PS4-2**

- Other PE's that could connect:
    - MS-LS1-4
    - MS-LS1-5
    - MS-LS1-6
    - MS-LS1-7
    - MS-LS2-5
    - MS-LS3-2
    - MS-LS4-6

Disciplinary Core Ideas - Main focus areas
- LS1.A: Structure and Function
- LS1.D: Information Processing
- LS2.A: Interdependent Relationships in Ecosystems
- LS2.B: Cycles of Matter and Energy Transfer in Ecosystems
- LS2.C: Ecosystem Dynamics, Functioning, and Resilience
- PS4.B: Electromagnetic Radiation

Other DCI Connections:
- LS1.B: Growth and Development of Organisms
- LS1.C: Organization for Matter and Energy Flow in Organisms
- PS3.D: Energy in Chemical Processes and Everyday Life
- LS4.D: Biodiversity and Humans
- LS3.B: Variation of Traits
- LS4.C: Adaptation

Cross Cutting Concepts - Main
- Structure and Function
- Energy & Matter
- Stability & Change

Other CCC Connections

- Systems and System Models
- Cause and Effect
- Patterns

Science and Engineering Practices - If using supplemental materials, will utilize these

- Developing and Using Models
- Engaging in Argument from Evidence

Sections:

- A Whirlwind Tour of the Shark (Anatomy, Senses, Reproduction)
- Ecosystems
- Threats to Sharks

Slides: 1- Intro

Anatomy

2) Skeleton

A shark's skeleton consists of **cartilage**, the same material that is found in human ears and noses. Cartilage is very strong and durable, but much more flexible than bone. This flexibility allows for tight turns, a crucial adaptation for chasing prey.
Cartilage is much lighter than bone, making it easier for a shark to stay afloat and conserve energy.

3 & 4) Skin (3-nurse shark, 4-mako shark)

The skin of a shark consists of millions of placoid scales, modified teeth called **dermal denticles**. The main purpose is to provide streamlining to maximize a shark's efficiency, reducing drag and allowing for faster speeds. In many cases, dermal denticles are shed and replaced by larger ones as a shark grows.

Talk About Being Thick Skinned: Dermal denticles provide a much tougher skin for a shark than the scales of a regular fish. Female sharks tend to have thicker skin than male sharks, particularly around their pectoral fins, and for good reason. Male sharks hold onto the females with their teeth while mating, often inflicting deep wounds.

The pigment found within the skin cells determines the color of a shark's skin. The shade of a shark's skin can be useful for concealing a shark while it is hunting prey as well as concealing the shark from other predators. Many sharks utilize counter shading, dark on the top and lighter on the bottom. This conceals them from above as the darker shade blends in with the darker water. It conceals them from below as the lighter belly will blend in with the lighter surface waters. Other species rely on camouflage for hiding from potential predators and prey.

The second image was created by Dr. George V Lauder using a scanning electron microscope.

5 & 6) Teeth (5- L Top-nurse, R-top- cookie cutter; bottom L & R-lemon sharks)

Sharks are born with a full set of teeth made of hard enamel to give them strength. In fact they're so strong that they are preserved in large numbers as fossils found within rocks that are hundreds of millions of years old.

New teeth form in a deep groove just inside the mouth, making up a series of replacement teeth behind every front (functional or working) tooth. The front or working row of teeth is considered series 1. The series of replacement teeth behind each front tooth (most sharks have 20-30, but whale sharks have more than 300) move forward in a conveyer belt manner. The teeth are not attached to the gum with a root like our teeth, making it easier for them to come loose. Rate of replacement varies between species and depends on factors like diet and water temperature and can range from a single day to approximately 70 days. Most species only replace a few teeth at a time, but the cookie-cutter shark replaces the entire set all at once. Some sharks can have up to 30,000 teeth over the course of their lives.

Tooth size and shape varies based on primary diet:

- Sharks like the nurse shark have flat, crushing teeth for dealing with hard shelled prey like shellfish and crabs.

- Fish eating sharks like the grey reef shark have pointed teeth for hanging onto their prey.

- Sharks that handle large prey items like tiger sharks and great whites have sharp, serrated cutting teeth.

- Filter feeding sharks like the basking and whale shark still have rows of hundreds of tiny teeth along the top and bottom jaws. There is a debate as to their purpose, with some scientist believing that they are **vestigial**, meaning that they serve no purpose anymore. While others think they could play a role in mating.

7-10) Fins

Unlike bony fish that can tuck their fins tight against their bodies, shark fins are always rigid. The fins of a shark provide balance and stability when moving through the water.

Dorsal Fin – the most recognizable fin on a shark, triangular shaped and located on the top of the body. Plays a role in balance, with some sharks having a second one closer to the tail.

Pectoral Fin – a shark has two pectoral fins, located on either side of the body. They play an important role in balance and generating lift when the shark moves through the water. Some sharks, like the bamboo shark, can use their pectoral fins to 'walk' across the sea floor.

Pelvic Fin – located behind the pectoral fins, they are often associated with claspers in male sharks, an important part of reproduction.

Anal Fin – although absent in many species, it is believed to play a role in balance.

Caudal Fin – the tail of a shark varies in size depending on species. It tends to be asymmetrical, with the top lobe being larger than the bottom lobe.

11) Gills

Most sharks have 5 gill slits, while sharks from the family Hexanchiformes have 6 or 7 (6 gill shark, Greenland shark, etc.). As sharks swim, water passes over their gills. Dissolved oxygen diffuses from the water into their blood, where it is carried throughout the shark's body.

Pelagic (open ocean sharks) need to keep moving to have water move over the gills. This is called ram-ventilation. If the shark is unable to swim for any reason it can suffocate and die.

Not all species need to keep moving. Some sharks like the nurse and zebra shark can sit on the bottom for extended periods of time. They can actively pump water over their gills by sucking it in through their mouths and squeezing it over their gills. This is called buccal-pumping. Some sharks, like tiger sharks, can do both.

12) The Wobbegong or carpet shark uses **spiracle** holes behind their eyes to pump in water and push it over their gills. This is the same process used by skates and rays. (Top southern stingray, bottom ornate wobbegong)

13) Neutral Buoyancy

Neutral buoyancy is resisting the downward force of gravity and the upward force of buoyancy. Bony fish have a **swim bladder** that can utilize oxygen from the gills to inflate and deflate, altering their position in the water.

The cartilage of a shark's skeleton reduces their weight which reduces the amount of energy needed to maintain neutral buoyancy. Sharks can use their fins to adjust their position in the water. Water flowing under the pectoral fins can generate some lift.

Another adaptation is the shark's liver. It is very large and full of low-density oil. The liver can provide buoyancy in the same manner a swim bladder does in bony fish. The liver can account for 25% of a shark's body weight, compared to our livers accounting for about 5% of our body weight.

Sand tiger sharks can hover in the water column. They accomplish this feat by gulping air and using their stomach as primitive swim bladder.

14) Muscle

Sharks have 2 types of muscle:

The first is a thin layer of red muscle beneath the skin. It has a good blood supply and allows the shark to swim slowly for long periods of time. Its energy comes from breaking down fat.

The second type is white muscle, found beneath the red muscle. White muscle is poorly supplied with blood and breaks down glycogen (sugar) for energy. White muscle is utilized in short sprints to catch prey or escape danger.

15) Temperature Control

Most fish are cold blooded, or **ectothermic**, meaning their body temperature is the same as the surrounding water. Most sharks lose their heat almost immediately as heated blood from their muscles passes through the blood vessels in the gills to pick up oxygen from the colder sea water.

Sharks from the Lamnidae family (great whites, mako. salmon sharks) are warm blooded or endothermic. Their body temperature can be as much as 10 degrees higher than the surrounding water. This adaptation allows them to be more efficient predators. The large surface area of gills leads to heat loss as the blood passes near the cold, oxygenated water. To counteract this and maintain an increased body temperature, there is a network of tiny capillaries called rete mirabile. Blood vessels traveling to the gills carrying warm, deoxygenated blood pass alongside cold oxygenated blood that is going to the body and as a result heat is passed to the colder blood.

16) Senses (Intro- slide 16- distances and strength of shark sensory systems)

17) Smell

Smell is a very important sense to a shark; in fact two-thirds of the total weight of a shark's brain is made up of olfactory lobes, which analyze smell. Shark's sensitivity to smell plays a role in finding prey, recognizing potential predators and finding a mate. When a shark swims, water flows through their nostrils into nasal sacs full of sensory cells that send signals to the brain.

A shark's sense of smell is directional, so a smell coming from the left side of the shark will reach the left nasal cavity before the right, allowing them to determine the direction of whatever is producing the smell. They home in on it by repeatedly changing direction so the smell is equally distributed between their nostrils.

Their smell is so sensitive that some sharks can detect blood from prey at great distance, recognizing it in quantities of one part of blood per one million parts of water (like a teaspoon in a swimming pool).

18) Sight

The eyes of a shark are located on either side of its head, giving them a field of vision that extends in all directions. They are very similar to mammalian eyes, consisting of an iris that surrounds the pupil. The iris adjusts the amount of light that enters the pupil. In low light, the pupil is open wide to maximize the amount of light entering, while in bright light the pupil is much smaller to limit the amount of light coming in. The lens focuses the images on the retina, which contains rods (light and dark) and cones (color).

The **tapetum lucidium** is a reflective layer of cells that lie behind the retina and improve vision in low light conditions, a crucial adaptation for nocturnal and deep-water shark species. This can make a shark's eye up to ten times more sensitive to light than ours.

Sharks have two eyelids per eye, but they don't fully close. Sharks in the family Requiem have a third eyelid called the **nictitating membrane** that serves as protection by completely covering the eye. Shark species without this membrane can roll their eyes to protect them when attacking prey.

19) Sound

Sharks have inner ears that are only visible from the outside as two small holes. They have a very good sense of hearing, especially sensitive to the distress sounds of wounded prey.

The ear of a shark consists of three cartilage tubes that are lined with sensory cells and filled with fluid. Sound waves vibrate the tiny hairs, sending signals to be interpreted by the brain. A small area of the ear called the **otoliths** enables a shark to sense gravity and its orientation in the water.

20) Touch

Touch can be actual contact or distance touch related to the lateral line (more below). Below the surface of a shark's skin are multiple nerve endings that detect touch. Sharks obviously don't have hands to touch objects, so they use their teeth. The teeth contain multiple pressure sensitive nerves that can test objects to attempt them. Each tooth is also able to rock back and forth up to 10 degrees due to jaws that aren't fully fixed to the skull. A bite can be exploratory and is both touch and taste.

21) Taste

Taste is a sense that doesn't help a shark locate prey, so it isn't as highly developed as their other senses. They have taste buds that send signals to the brain to determine whether something that has been bitten is worth eating. Sharks will often give a test bite to determine if something is palatable, if it doesn't like the taste, the item will be spat out. This may be the reason why there is such a high level of survival from shark bites. The shark's sense of taste may recognize that humans aren't a usual food source and leave them after a single 'accidental' bite.

22 & 23) Electroreception

Located on a shark's head and snout are small pores housing receptors called **ampullae of Lorenzini**. They are jelly-filled sensory organs that allow a shark to detect the faintest electrical fields.

They can detect the Earth's **geomagnetic field**, which may help them orient themselves and navigate large distances in the oceans during migrations. They can also help detect prey because muscle contractions of a living thing give off small electrical fields. Hammerhead sharks are extremely good at picking up these fields and are able to detect prey like stingrays that are buried completely under the sand.
The black dots on the snout of the shark are the ampullae. The magnified image shows dermal denticles and the ampullae (circled). It was created by Dr. George V Lauder using a scanning electron microscope.

24) Lateral Line

Running along both sides of a shark's body, just below the skin, are a series of small pores leading to a fluid-filled canal system. These are called the **lateral lines** and they can detect changes in pressure. Water flows through the pores and along the canals that are lined with sensory hairs connected to sensory cells called neuromasts. When a fish displaces the water through movement, small waves radiate outwards and are detected by the neuromasts, which react by sending a signal to the brain. The more erratic the movement, the more interesting it is to the shark as it could signal a wounded prey item.

Sharks can also create pressure maps of the environment around them. As the swim, their own body movement creates waves that bounce off objects in the marine environment and return to the shark.

Reproduction

25) Male Reproductive Organs

Like humans, male sharks have paired testes that are the site of sperm production. The testes are also involved in the production and secretion of some **hormones**.

Male sharks are easily identifiable by their **claspers**, paired organs that form the edge of the pelvic fins. They transport the sperm from the male to the female. Immature claspers are small and flexible, but become somewhat calcified as they mature.

25) Female Reproductive Organs

Primitive female sharks tend to have paired ovaries, but in some species only the right ovary works. More advanced forms of sharks only have a single ovary. Ovaries can be considered external or internal. External ovaries are compact and produce a small quantity of large eggs, while internal ovaries produce countless small eggs.

The ova (eggs) are usually large with lots of yolk, taking a lot of energy to produce, which is why they aren't numerous. In species with large numbers of eggs, the extras are used to feed the developing embryos.

26) Mating

Little is known about the act of mating in a lot of shark species. Prior to mating there can be complex activities where females can be selective, rejecting many males. Females reject male sharks by refusing, avoiding, arching or shielding. They show acceptances by flaring or cupping their pelvic fins.

Most bony fish practice external fertilization, producing a lot of eggs and sperm and releasing them in the water, a very primitive form of reproduction. The survival rate is low, but it is balanced out by the large number of eggs produced. All sharks practice internal fertilization. This results in fewer, but larger young and provides a safer area to develop, enhancing chances of survival.

During mating the male must grip the female somehow to line up the clasper for insertion. Since sharks lack hands, using their mouths is really their only option. Female sharks tend to have thicker skin (especially around the pectoral region) to protect themselves from these mating bites. The female blue shark's skin is twice as thick as the males. Even so, many female sharks bear the scars of past mating encounters.

Some species of female sharks can store sperm, from several months to a year.

27) Development and Birth

Shark reproductive strategies have more in common with birds and mammals than they do with most bony fishes. For the most part sharks only produce a small number of relatively large young, giving them a better chance for survival.

Sharks either deposit eggs (**oviparity**) or they give birth to live young (**vivparity**). The fecundity of a shark ranges from 1-2 young a year up to 300 in the case of a whale shark. Studies have shown that **fecundity** of a shark or a fish increases with their size. This is why the fishing practice of taking the largest members of a species has a tremendous impact on their reproductive success. If only the smaller members of a species are left, the amount of young produced will be fewer.

Oviparous form of reproduction is practiced by 40% of sharks. A tough egg case is laid on the ocean floor or attached to a surface. Embryos within the egg case are nourished by yolk sacs, but since there is a finite amount of yolk, the young sharks emerge small. Incubation period can last from a few months to over a year. The egg remains oxygenated through slits on either side of the egg and the embryo can fan its tail to increase water flow.

There are 2 forms of viviparity: aplacental and placental. In aplacental the eggs remain in the female until they hatch and then she gives birth to fully developed live you. In placental viviparity, which is the most advanced form of reproduction in sharks, there is a placental cord which delivers nutrients from the mother to the pup. Once they are fully developed the female gives birth to live young and each pup must break free of the umbilical cord before being entirely on its own. The young are born larger as they have had more access to nutrients. No matter what form of reproduction occurs, there is no parental care once the egg case has been laid or live birth has occurred.

Speaking of nutrients, the young of some shark species (thresher, mako, porbeagle) practice **oophagy**. The female shark produces a lot of eggs, most of which are destined to be nourishment for the developing young. The extra nutrients allow the embryos to grow very large before birth, up to 5 kg. In some shark species **intrauterine cannibalism** occurs. A developing embryo will bite and kill another, ingesting it during development. In the case of the sandtiger shark, the pups can be born up to one third of the size of an adult due to the large amount of extra nutrients acquired.

(Slide description: left top: lemon shark umbilical scar- live birth. Right top: juvenile nurse shark and egg case (shed from female). Bottom left: Egg cases. Bottom Right: Horn shark hatching from egg case)

<u>Ecosystems</u>

28) Ecosystems

Everything in the natural world is connected. An **ecosystem** is a community of living and non-living things that work together in a way that energy is exchanged. Ecosystems have no set size. An ecosystem can be as large as a rainforest or a lake or as small as a tree or a puddle. All the parts work together to make a balanced system.

A healthy ecosystem has lots of species diversity (**biodiversity**) and is less likely to be seriously damaged by human interaction, natural disasters and climate change. Every species has a niche in its ecosystem that helps keep the system healthy. Ecosystems are interconnected systems that have evolved over millions of years, remove one piece and the whole thing can collapse.

29) Abiotic vs Biotic

Marine ecosystems are comprised of the living organisms that have adapted to the **abiotic** (non-living) factors and physical processes that characterize each ecosystem. Abiotic factors include sunlight, temperature, moisture, wind or water currents, soil type, and nutrient availability. Ocean ecosystems are impacted by abiotic factors in ways that may be different from terrestrial ecosystems. **Biotic** factors include plants, animals, fungi, algae, and bacteria. Humans are biotic components of marine ecosystems and have a significant impact on the maintenance of healthy, well-balanced ocean ecosystems.

30) Producers (seagrass)

No organism exists in isolation, individual organisms live together and depend on one another. There are different categories of interactions. One category is the different ways that organisms obtain food and energy.

Autotrophs or producers are organisms that have the ability to make (produce) their own energy from sunlight and simple chemicals. In the ocean environment plants, algae, and microscopic organisms such as phytoplankton and some bacteria, make energy-rich molecules from sunlight, water, and carbon dioxide during a process called **photosynthesis**.

Some producers are **chemosynthesizers**, using chemicals to make food. Some species of bacteria use simple chemicals as their source of energy. They live in places with no sunlight, such as along oceanic vents at great depths on the ocean floor.

30) Consumers (Same slide- top left image)

Heterotrophs or consumers must obtain nutrients by eating other organisms. All marine animals and some bacteria are consumers, using energy from other organisms to grow, reproduce and carry out all of their life activities.

Carnivores are the meat-eaters, sharks fall under this category. They are predators, having to hunt, catch and kill other marine animals. Their prey tries to avoid being eaten using various adaptations and strategies. Sharks have shaped the evolutionary defenses of their prey over hundreds of millions of years. If the shark is successful it acquires energy. If it fails, it has to expend precious energy to continue to hunt elsewhere.

Herbivores are the plant eaters.

Omnivores eat both other animals and plants.

All consumers depend on the energy-rich food molecules made by producers, either directly by eating producers, or indirectly by eating organisms that have eaten producers. A **primary consumer** eats producers (fish feeding on phyotplankton); a **secondary consumer** eats primary consumers (e.g., a larger fish feeding on a smaller fish); a **tertiary consumer** eats secondary consumers (a shark eating the larger fish).

30) Scavengers, Detritivores and Decomposers (Same slide- crab image)

All organisms produce waste and eventually die. This is where **scavengers, detritivores,** and **decomposers** come in. They play a critical role that often goes unnoticed when observing the workings of an ecosystem. They break down carcasses, body parts and waste products, returning to the ecosystem the nutrients and minerals stored within them. This interaction is critical for our health and the health of the entire planet; without them we would be literally buried in dead stuff. Crabs and bacteria are examples of these important clean-up specialists in the ocean environment. Many shark species, even the great white, are **opportunistic**, meaning they won't turn down free energy in the form of a scavenged meal. A fascinating example is when sharks find the carcass of a large whale that has died. As many as 40 sharks have been documented as feeding on a single whale carcass over the course of a day.

31) Energy Cycle

The interactions of the autotrophs, heterotrophs and the scavengers**,** detritivores**,** and decomposers, along with the abiotic factors, make up a continuous cycle of nutrients and energy in an ecosystem. Autotrophs, like phytoplankton, utilize the energy from the sun along with water and carbon dioxide to produce their own energy. They are consumed by heterotrophs, more specifically the primary consumers who are in turn consumed by secondary consumers. The waste as well as the bodies of producers and consumers are broken down by scavengers**,** detritivores**,** and decomposers, releasing nutrients and minerals back into the ecosystem they can be utilized by autotrophs, beginning the cycle anew.

32) Carrying Capacity

Carrying capacity is the population that can be supported indefinitely by the available resources and services of an ecosystem. The limits of an ecosystem
depends on three factors:

- the amount of resources available in the ecosystem
- the size of the population
- the amount of resources each individual is consuming.

A simple example of carrying capacity is the number of people who could survive in a lifeboat after a shipwreck. Their survival depends on how much food and water they have, how much each person eats and drinks each day, and how many days they are afloat. If the lifeboat made it to an island, how long the people survived would depend upon the food and water supply on the island and how wisely they used it. A small desert island will support far fewer people than a large continent with abundant water and good soil for growing crops.

33) Threats Facing Sharks (Deep Trouble)

34) Finning

Shark finning is the practice of removing the fins of a shark. The sharks are dumped back into the ocean, often times still alive. Unable to swim the shark slowly suffocates because of the lack of water flowing over their gills. Shark finning is widespread and represents the largest threat to shark populations on a global scale. Each year, approximately 100 million sharks are killed by humans, a large number due to the fin trade. It's highly lucrative practice, with fins retailing at $181/lb ($400/kg).

So what's driving the market for these fins? They are used to make shark fin soup, which is very popular in Asian cultures but can be found around the world. It is seen as a status symbol, with a bowl of shark fin soup selling for $100 or more. Eating shark fin soup is actually a health concern. Chemicals like mercury that humans have been dumping into the oceans **bioaccumulate** in sharks because they are at the top of the food chain. The more contaminated fish a shark eats, the more toxic their flesh becomes. Studies have found high levels of **neurotoxins** linked to diseases like Parkinson's and Alzheimer's disease in shark fins.

35) Bycatch

The term **bycatch** refers to marine species that our caught unintentionally in a fishery designated to catch other species of fish. Many fisheries use gear that isn't very selective, resulting in catching and discarding of millions of tons of marine species. It is estimated that over 40% of marine species caught are non-target species. Longline fishing is typically used to catch tuna, lines up to 93 miles (150km) long and consisting of thousands of hooks are set in the ocean. They indiscriminately catch sharks and other species such as turtles and seabirds. Large trawling nets, some the size of 13 jumbo jets, are pulled behind boats, catching whatever is unable to get out of the way. An estimated 50 million sharks are caught as bycatch in commercial fisheries.

In the past sharks were considered a nuisance and thrown overboard, sometimes still alive. Now with shark fins being so valuable there is little incentive to implement measures to reduce bycatch. Instead, the fins can be removed for a large profit.

36) Meat Consumption

Global data shows that the trade in shark meat has been expanding over the last decade. Most likely due to the increase in demand for seafood globally. Brazil and Italy are the two largest importers of shark meat. Dogfish is the preferred species in the US and many European nations. This image shows dogfish caught in the fishery based in Chatham, Massachusetts. Markets for shark much are more diverse and geographically dispersed than those for shark fins.

37) Supplements

There are several shark products that are sold as nutritional supplements. Most are derived from shark cartilage and liver oil. Shark cartilage has been touted as a remedy for a variety of ailments including arthritis, inflammation and even anti-cancer properties. A very false belief that sharks don't get cancer has been circulated for years. There is absolutely no evidence that shark cartilage has any cancer fighting properties. The use of shark liver oil, also called **squalene**, is gaining in popularity as it is being marketed as having the ability to enhance your immune system and has anti-cancer properties. The oil from shark liver has been utilized throughout human history in food, cosmetics, textiles, lubricants and fuels. With this new demand, it is placing a greater strain on shark populations that are already in trouble. Sharks living at extreme depths maintain neutral buoyancy by the oil in their large livers (up to 30% of their body weight), making them a prime target for exploitation. However, these sharks are particularly vulnerable to overexploitation and population decreases because of extremely low reproductive rates. Again, there is no scientific evidence to support any claims about shark liver.

38) Habitat Loss

Development along our coastlines is increasing each year, altering habitats and increasing levels of pollution entering the marine environment. Coastal areas such as mangroves and estuaries are utilized by sharks as a safe place to find food and give birth. These areas also afford protection for young sharks, isolating them from predators and competition.

Mangrove forests are naturally resilient, having withstood severe storms and changing tides for thousands of years. They literally live in two worlds at once. Growing in the intertidal areas and estuaries between land and sea, mangroves have specially adapted aerial and salt-filtering roots, and salt-excreting leaves which enable them to occupy the saline wetlands where other plant life cannot survive.

For some time, mangrove forests had been classified by many governments and industries alike as "wastelands," or useless swamps. This mistaken view has made it easier to exploit mangrove forests as cheap and unprotected sources of land and water. An example of how the loss of these habitats can effect shark populations is occurring in the Bahamas. Dredging has resulted in a 25% decline in juvenile lemon shark survival. Already half of the world's mangroves have been lost.

39) Souvenirs

In some parts of the world, including the United States, shark parts are sold as souvenirs. Some recreational fishermen target large sharks to make a trophy from the jaws, which can sell for hundreds of dollars. Since the meat from these large sharks is not edible, the rest of the shark is wasted. In Florida, souvenir jaws from all sizes and types of sharks, including baby sharks, can be found in tourist shops. Shark teeth are another popular item found at souvenir shops, as well as small or baby sharks in jars of formaldehyde.

40) Importance of Sharks

The marine ecosystem is an intricate food web with sharks at the top as apex predators. They are considered **keystone species**, meaning that if they are removed the whole ecosystem could collapse. How could this happen? Sharks eat the old, sick and slower fish of a **population**, keeping the population healthy by preventing the spread of disease and keeping the **gene pool** strong. They also keep population levels in check, too many fish can put a strain on other marine animal populations. If sharks are removed, the populations of their prey will increase, putting a strain on the food sources they rely on. It can have a cascading effect down the entire food chain.

References:

Carrier, J.C., M. Heithaus, and J. Musick. 2012. Biology of Sharks and Their Relatives Second Edition. CRC Press: Boca Raton, Florida.

Compagno, L., D. Ebert, and S. Fowler.2013. Sharks of the World: A Fully Illustrated Guide. Wild Nature Press: Plymouth, England.

State of the global market for shark products – FAO

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