Sharks4Kids Deep-Sea Sharks

1. Powerpoint Guide
2. Vocabulary
3. Activities

Deep-sea Shark Teacher Material (matched to the slides)

Most people are familiar with great whites or tiger sharks, but have you ever heard of a frilled shark or a velvet belly lantern shark? In this packet you will learn about deep-sea sharks, the challenges scientists face in studying them and why they deserve more attention. Several species of deep-sea sharks will be highlighted to show a better understanding of the diversity of sharks and the adaptations needed to survive in a very inhospitable environment.

1) <u>The Deep Sea</u>

Student Question: what come to mind when you think of the deep-sea?

"Over 60% of our planet is covered by water more than a mile deep. The deep-sea is the largest habitat on earth and is largely unexplored. More people have traveled into space than have traveled to the deep ocean realm..." - The Blue Planet Seas of Life

- The deep-sea is the largest environment on the planet.
- It begins at the edge of continental shelf at about 200m, and extends down to almost 11,000m.
- It is thought that life may have originated in the deep-sea and was restricted to the oceans for the first 3 billion years of evolution.
- Because of how difficult it is to see things in the deep-sea, we have only recently begun to appreciate and understand the great diversity of animals that live down there.

2) <u>Ocean Realms</u>

The ocean is divided into 2 main realms:

1) Benthic – bottom sediments and surface of the ocean. The organisms that live here are collectively called the benthos, and can be permanently attached, burrowed within or swimming just above the bottom.

2) Pelagic – the open water of the ocean. The organisms living here are called pelagos, swimming or floating freely within the open water.

The pelagic can be further divided into depth zones. From shallowest to deepest: the epipelagic (0-200m), mesopelagic (200-1,000m), bathypelagic (1,000-4,000m), abyssopelagic (4,000-6,000m) and the hadopelagic (6,000-11,000m).

3) Epipelagic Zone

This is the surface layer of the ocean, stretching to 200m in depth. Sunlight penetrates throughout this depth, making photosynthesis possible. Phytoplankton flourish and this is where most of the fish, marine mammals and marine invertebrates that we are most familiar with are found. It is often referred to as the Euphotic (light) zone as well.

Lesser spotted dogfish is an example of shark found in the Euphotic zone.
Note light colour and camouflage speckles.

4) Mesopelagic Zone

This region of the ocean is often referred to as the twilight zone as there is not enough light for photosynthesis to occur, but marine animals can still detect light from above. It stretches from a depth of 200-1,000m. In this zone we start to see adaptations such as larger mouths and eyes, as well as bioluminescence on all sorts of animals. From this point on down, food becomes something of a scarcity.

Velvet belly lantern shark is an example of shark found in the twilight zone.
Note counter shading, this shark uses bioluminescence. The black areas are home to thousands of glow in the dark cells known as photophores.

5) Bathypelagic Zone

This ocean region extends down from 1,000-4,000m. We've entered a realm of total darkness, the only light is from bioluminescent organisms. The only food is what trickles down from above, or from eating other animals that have travelled down from above. Many representatives of fish, molluscs, jellies, and crustaceans can still be found at this depth.

Portuguese shark is an example of shark found in the midnight zone.
Note uniform dark coloration and small dorsal fins.

6) Abyssopelagic Zone

This ocean region extends from 4000m to the sea floor at approximately 6,000m. It has pretty inhospitable living conditions, which include near freezing temperatures and crushing pressures. Very few fish live at this depth, most animals are invertebrates such as sea cucumbers and squid. A full 75% of the ocean lies within this depth range.

Hydrothermal vents are underwater volcanoes that can be found at spreading or converging plate boundaries. They are the result of seawater percolating down through fissures in the ocean crust and being heated by hot magma. The water reemerges to form the vents, reaching temperatures of over 340°C (700°F). Scientists also found that the hydrothermal vents were surrounded by large numbers of organisms, whole biological communities depending upon chemical processes for energy rather than sunlight.

7) Hadopelagic Zone

This is the deepest region of the oceans, 6000m to as deep as 11000m. The deepest parts of our oceans are in huge cracks or trenches in the sea floor. Very little life is found here but you do get some biodiversity hotspots around hydrothermal vents, some of which are like underwater volcanoes. Many of the animals that live here are chemotrophic, meaning that they get a lot of their energy directly from the chemicals released from the volcanoes.

The Mariana Trench is located around the Mariana Islands in the Pacific Ocean, and is the deepest part of the world's oceans. The deepest point in the trench, known as Challenger Deep, lies some 11,000 metres (nearly 7 miles) below the surface. Only 3 people have ever reached the deepest point in our oceans. On January 23, 1960, Jacques Piccard and Don Walsh boarded the Bathyscaphe Trieste sea vessel and descended to the deepest part of the ocean. On March 26, 2012, Filmmaker James Cameron successfully piloted the DEEPSEA CHALLENGER—outfitted for scientific exploration—to the ocean's deepest point.

Bathymetric Categories used for deep-sea sharks

These categories describe the depth at which various shark species can be found.

- paraprofundic: "shallow-water" species 200 m

- mesoprofundic: moderately deep dwelling species, typically inhabiting depths of 200-600 m
- holoprofundic: deep dwelling species, typically inhabiting depths of 600 m or greater
- metaprofundic: species utilizing a wide range of depths including at least 2 categories.

Sharks are abundant up to a depth of 2500m, with very few below that depth. It's just too far removed from primary production (energy produced by sunlight through photosynthesis). Rarely do we get sharks deeper than 2000m although some have been recorded at nearly 4000m. The most abundance and diverse depths are found between 800-1200m.

8) Continental Slope

At the margins of the continents are flat, shallow plains called continental shelves, averaging in depth of about 100-200m. At the edge of the shelves, the ocean floor begins to descend at an average angle of 4 degrees. This is the continental slope, and the descent continues to the abyssal plain at about 3,000m. Most Deep-sea life is found on or near the sea floor of the continental slope.

9) Characteristics of the Deep-sea

SQ: What characteristics would you use to describe the deep-sea environment?

Dark – sunlight is lost within the first 1,000m and there is no longer enough light for photosynthesis. Most animals found here are either black or red.

Cold – Relatively constant 3○C (varies between about 4○C and -1○C)

Pressure – Very high pressure, at 1000m the pressure is 100 times that of the surface.

Oxygen - waters of much of the deep sea have adequate oxygen. This is because cold water can dissolve more oxygen than warm water. The zone habituated by sharks (500-2500m) tends to have quite low oxygen content in relation to surface waters. Sluggish circulation and the decay of sinking organic matter consumes so much oxygen that the middle depths contain dramatically less of the gas than water above or below.

Stable – Unlike shallower waters that are subject to varying levels of temperature, light, pressure (tides), salinity and nutrients, the deep-sea is actually very stable, providing a challenging but constant environment to live in.

Energy Source – most energy in deep-sea comes from the sinking particles from the surface known as marine snow. The dead bodies of other animals and poop supply a lot of energy to life in deep. Vertically migrating animals also provide a nutrient source for deep-sea predators.

10) Marine Snow

Most of the nutrients that reach the deep-sea come from the surface. There is a steady 'rain' of waste products and the decaying remains of microbes, algae, plants and animals from the upper zones of the ocean. Marine snow supports a diverse range of animals from sea cucumbers, crustaceans, squids, fish and sharks. It is the fuel for many of the deep-sea food webs.

There are infrequent times of feast as well, whale falls (when a whale dies and slowly sinks to the ocean floor) provide a great source of food for all sorts of animals in the deep for a short period of time.

11) Studying the Deep-sea

SQ: Can you think of some reasons why it would be difficult to study the deep-sea?

The large area of the deep-sea as well as the extreme depth, pressure and temperature combine to make this environment very challenging to study and explore. Humans can't dive to these depths without submersibles and it isn't possible to tag and track deep-sea shark species. Most specimens collected are dead or only live for a few hours when removed from their deep-sea habitat. Animals in the deep sea are relatively understudied as it is so difficult and expensive to explore.

Certain species of deep-sea sharks have only been seen a few times. The deep-sea megamouth shark was only discovered in 1976 and has only been seen about 60 times. The pocket shark as only been seen twice.

If you look at the picture, these sharks could easily be mistaken for being members of the same species. In reality, they are all members of different species of deep-sea shark. A great example of just how tough it is to study these species.

SQ: How do you think scientists study the marine life living in the deep-sea?

A few ways to study the deep include:

- Deep-sea fishing lines and nets
- Baited underwater cameras
- Remote controlled submarines (ROVs)
- Manned submarine.

12) Deep-sea Fishing Lines and Nets

To obtain samples of deep-sea life and gauge population sizes, scientists can use deep-sea fishing gear to capture a small amount of specimens and bring them to the surface. Scientists can also work closely with fisheries in order to obtain specimens. Most specimens will not survive as the change in pressure and temperature can be too much for them to cope with.

13) Baited Underwater Cameras

Cameras with bait and lights can be used to attract deep-sea marine life and provide excellent opportunities to view living organisms. They have many benefits such as not killing the marine life and allowing the viewing of species that don't take the fishing line bait or are strong enough to free themselves from the lines.

The following image was taken at Baited Remote Underwater Video Stations (BRUVS). The photos are courtesy of Andrew Gates from the SERPENT project at the National Oceanography Centre, Southampton. The species of shark is the Leafscale gulper shark (Centrophorus squamosus). As part of the work, Andrew deployed several cameras in the Indian Ocean and left them on the seabed for 24 hours and recorded everything that came along to eat. Find out more about his work at www.serpentproject.com.

14) Manned Deep-sea Submersibles

Small submarines that can carry 1-3 scientists to explore the dark depths. They are outfitted with cameras and mechanical arms that allow scientists to explore the deep. They have to be built from strengthened materials to cope with the great pressures at depth. Whilst they provide incredible insights for scientist that are directly viewing the environment, they can be very dangerous because if something goes wrong, it takes a long time to get back to the surface.

15) Remotely Operated Vehicles (ROVs)

Remotely operated vehicles (ROVs) have been used underwater since the 1950s and are increasingly becoming more popular. They are unmanned submarine robots with umbilical cables used to transmit data between the vehicle and researcher. ROVs are often fitted with video and still cameras as well as with mechanical tools such as mechanical arms for specimen retrieval and measurements. They are much safer than manned submersibles and footage can be sent to scientist all around the world, instantly.

16) Groups of Sharks

SQ: How many species of shark can you identify in this photo?
L-R: *Oceanic Whitetip, Horn shark, Blue shark,*
Whale shark, Broadnose Seven Gill, Thresher shark
Wobbegong shark, Great white sharks, Hammerhead shark.

There are over 500 species of shark in the world and they are divided into 2 main groups, the galeomorphs and the squalomorphs.

17) Galeomorphs

Typically galeomorphs are found in shallow waters and they include most of the well-known species like the great white, tiger and lemon sharks. Many species that live in shallower waters do make regular dives into the deep-sea.

18) Squalomorphs

Typically squalomorphs are found in the deep-sea and include lesser-known species like the dogfish, six-gill sharks and lantern sharks. The deep-sea is a huge environment with a large variety of different shark species.

There are always exceptions, as some squalomorphs are found in shallow water and some galeomorphs are found in the deep.

19) Catsharks

Cat sharks are galeomorphs. They are generally small sharks, most species being less than 3 feet long with cylindrical bodies, tapered at the ends. They have 2 small dorsal fins located far back on the body. Their elongated eyes give them a cat-like appearance. Over 90% reproduce by laying eggs known as 'mermaids' purses. The cat sharks include one of the largest groups of shark, the *Apristurus*, with anywhere from 24-47 species. Catsharks can be found in both shallow and deep-sea environments. Scientists are still unsure how many species exist.

20) Dogfish

The dogfish are squalomorphs. They are the most common group of shark found in the deep-sea. They are the one of the largest order of sharks, with 119 species identified so far. They come in all sizes, shapes and colours, ranging from tiny Dwarf Lantern sharks reaching 6 inches to Greenland sharks exceeding 20 feet. They can be found at extreme depths with many species exhibiting characteristics such as fin spines or bioluminescence.

21) Greenland Shark (*Somniosus microcephalus)*

- A type of sleeper shark
- Found in the cold waters of the North Atlantic, from the surface to as deep as 1200m.
- Only Arctic shark that can tolerate such cold waters, as low as 1°C.
- Second largest carnivorous shark, after the white shark, and grow up to 4.5m in length.
- Opportunistic predators – known to feed on fish, seals, polar bears, reindeer and even husky dogs.

- Very slow swimmers, with large spiracles on top of their head to help them breath and conserve energy is such cold waters.
- Estimated to live over 100 years.
- The majority are blind because of a parasite that lives in its eye.

22) Bluntnose Sixgill Shark (*Hexanchus griseus)*

- Primitive sharks with six pairs of long gill slits on each side of their blunt, rounded head, a single dorsal fin located closer to a long tail and translucent eyelids.
- One of the world's largest sharks, averaging lengths of 4.8m and exceeding 1,000lbs.
- It ranges widely in temperate and tropical seas around the world preferring deep-water habitats, below 91 m (300 ft), though it can be found from the surface down to at least 2,000 m deep (about 6,500 ft).
- The sixgill shark is a slow but strong swimmer.
- They are generalists, feeding on a great variety of prey items. Their diet includes other sharks, skates and rays, many kinds of large bony fish, and invertebrates including squid, crabs, sea cucumbers and shrimp.

23) Arrowhead dogfish (*Deania profundorom)*

- A type of gulper shark
- Found at depths between 300-1800m.
- A mysterious shark with a patchy distribution across the globe.
- Feed mainly on fish and squid.
- Elongated rostrum (nose) with a large number of ampullae of lorenzini, allows shark to increase foraging efficiency in the deep.
- They have large dorsal fin spines that they use to stop predators from eating them.
- Some deep-sea squid have been found to feed upon this shark.
- In this picture, both are mature but notice how much bigger the top female shark is to the lower male shark. This is a common trait found throughout the shark kingdom and is linked with females needing to be bigger to support reproduction.
- This shark is often missed in catch records due to its striking similarities to the shark on the following slide.

24) Birdbeak dogfish (*Deania calcea*)

- Note how similar this shark looks to the one on the previous slide. It occurs much shallower than its close relative the Arrowhead dogfish.
- This shark can be distinguished from the Arrowhead dogfish due it having much rougher skin and being slightly bigger.
- We still know very little about how these shark may be biologically different.

25) Velvet Belly Lantern Shark (*Etmopterus spinax)*

- Found between depths of 200-1000m.
- Shark is able to glow in the dark, using this ability mainly for camouflage in a process termed counter-illumination (see later slides).
- They are able to make their defensive dorsal fin spines glow in the dark so they look like light sabers and warn predators off.
- They get their velvet name because unlike most sharks, their denticles are bristle like. This helps their light cells (photophores) emit light, but also gives them a furry texture.
- Velvet bellys are preyed upon by deep-sea rays.

26) Cookiecutter Shark *(Isistius brasiliensis)*

- A type of kitefin shark.
- Cookie cutter sharks latch onto their prey with specialized suction lips.
- They are then able to remove circular (or cookie shaped) pieces of flesh from their prey, usually whales, dolphins and large fish such as tuna.
- They have a glow in the dark belly (bioluminescence), which helps them remain camouflaged in twilight zone.
- Have a dog collar section on their underside, which is a dark area that has no glowing cells. Some scientists think the dog collar is used to attract prey closer for it to latch onto them. Others think it may be used to help cookie cutter sharks recognize each other.

27) Life History Traits

SQ: Can you name some adaptations that sharks might have to survive in the deep-sea environment?

- Like other deep-sea fish, deep-sea sharks have a low metabolism. This may be due to lack of food, cold temperatures or different hunting techniques because of lack of light.
- A slow metabolism also leads to slow growth and long lives (some maybe 75-100 years old).
- Small number of offspring (some species only have 1-10 pups).
- Long pregnancies (pregnancies can take up to 1-2 year).
- Long periods of rest between pregnancies. (some take 1-2 years between pregnancies).
- Late age of maturity (some don't reach maturity until 35).

28) <u>Fin Spines</u>

Many species of deep-sea shark have dorsal fin spines. These defensive spikes are usually found on both first and second dorsal fin spines. As many deep-sea sharks live close to the sea bed, the spines protect the sharks from attacks from above by other sharks, whales and squid.

29) <u>Bioluminescence</u>

Bioluminescence is a process in which an animal is able to produce its own light. Some deep-sea animals are able to glow by eating/engulfing bioluminescent microbes. Sharks have a different technique. Using a mixture of chemicals that are controlled by hormones, some sharks are produce light in specialized organs called photophores or simply light cells.

Two types of deep-sea sharks have the ability to glow in the dark, Lantern sharks and 2 species of Kitefin shark. The light is produced by an organ called a photophore. Thousands of photophores are located mainly on the underside of the shark but can be found at other locations on the shark.

SQ: How might sharks use bioluminescence?

The function varies between species but can be used to recognize each other, ward off predators and as camouflage.

30-32) Counter-illumination

Counter-illumination is a type of camouflage in which an animal produces light to match an illuminated background, such as the ocean surface. Thousands of photophores on the underbelly of the shark, match the intensity of light that comes down from the surface. Lantern sharks migrate vertically in the water column throughout the day and can alter the light pattern of their photophores, ensuring that they match the intensity of the light above. This obliterates their silhouette, thus rendering them invisible to predators from below.

The next 2 slides feature illustrations of a velvet belly lantern shark silhouetted against the sky, how it would appear to a predator from below. Without photophores, it is clearly visible. With photophores its outline blends in with the light from above, an excellent demonstration of counter-illumination!

33) Additional Roles of Bioluminescence

Recognition – each species of lantern shark has a unique glowing pattern on its side that allow members of same species to recognize each other.

Warning – some species of lantern shark have photophores behind their fin spines on their back, which make their spikes glow….LIGHTSABERS!!!

Reproduction – allowing males and females to distinguish each other by highlighting reproductive organs.

34) Vision

Deep-sea sharks have very large eyes to absorb as much available light as possible. Many species have a reflective layer in their eye called a tapetum lucidum. This tissue of mirrored crystals located behind the retina reflects light back to the retina, allowing a shark better visibility in the darkness of the deep ocean. It works much like a cats eye and allows sharks to absorb twice as much light. When exposed to light on the surface, this makes shark's

eyes look like they are glowing. Many deep-sea sharks have eyes that can detect the bioluminescence of other animals. They really do have the ultimate night vision goggles.

35) Liver

Deep-sea sharks use their large livers for buoyancy and nutrient storage. To control buoyancy, sharks have a very oily liver that they use to stop them sinking. To maintain such a large liver, sharks must eat regularly to maintain it. Sharks are rarely found any deeper than about 3,000m and this may be because food is to scarce to allow for the maintenance of such a large liver. They also have high levels of TMAO enzyme to aid buoyancy. A compound called squalene found in deep-sea shark liver oil is in high demand for dietary supplements.

36) Skin

Shallow sharks use their skin for streamlining, their dermal denticles forming a smooth surface, allowing them to move easily through the water.

37) Deep-sea sharks tend to have think skin that provides protections and also aids in the prevention of parasites. Even though the skin may be thinker, it still allows for the passage of light from photophores.

The photo in this slide is the skin of a birdbeak dogfish under the microscope. You can see the individual dermal denticles, which are actually modified teeth!

38) Brain Size

Deep-sea sharks tend to have smaller brains than shallower species, however larger portions are dedicated to their sense of smell and ampullae of lorenzini as these senses are very important in an environment lacking light.

39) Threats

SQ: Deep-sea sharks live in environments that are hard for us to reach and explore, yet they still face many threats. What might some of these threats be?

Due to the life history of deep-sea sharks they are the most vulnerable group of sharks to fishing. Having a small number of offspring and long periods of time between pregnancies, as well as slow rates of growth and maturity, translates to a long period of time to replaces sharks removed by fishing. Because deep-sea sharks rely on food from surface waters, any decrease in fish stocks or primary production could have cascading effects on deep-sea shark populations.

40) Deep-sea Fisheries

Sharks are the target of many deep-sea fisheries. They have large, muscular bodies that are sold for meat. Their large, oily livers are prized for many products such as dietary supplements and make-ups. The leftover parts are also sometimes used as food in fish farms. Many sharks are also caught accidently as bycatch in other fisheries.

41) Longline Fishing

Longlining is a method where thousands of hooks are attached to a very long fishing line, which can then be sank to the sea floor. Some of these fishing lines can stretch for over 150km. These target large numbers of mainly predatory fish. They can be set out specifically for sharks, but even if targeting other species, many sharks fall victim as bycatch.

42) Deep-sea Trawling

Trawling is a process in which a large, heavy net is dragged across the seabed for miles at a time. It captures a lot of different species and does a tremendous amount of damage to the seafloor. These are large nets, some easily able to fit 13 jumbo jets inside. Many species caught can be sold, but any bycatch that isn't wanted is thrown back into the ocean. Unfortunately, by this stage many species are already dead. The act of bringing many species of deep-sea shark to the surface is enough to kill them due to pressure and temperature changes.

43) Shark Liver Oil

As already mentioned, the livers of deep-sea sharks are very large and very oily. The oils contain a versatile and highly sought after compound called squalene. It can be used as:

- Dietary supplement
- Medicines – vaccines and other remedies
- Cosmetics - face creams

Squalene is also sold as a means to help prevent heart disease and cancer, as well as an immune system booster.
Deep-sea sharks are typically targeted for their large livers and will often be discarded once the liver has been removed, a large waste of protein.

SQ: What do you think we can do to protect deep-sea shark species?

44) <u>Future Studies</u>

There are many aspects of the deep-sea shark world to be discovered and studied:

- There are still many new species of deep-sea shark to be discovered.
- Very little is known about the population size of many deep-sea shark species.
- In Europe, very rarely are juvenile sharks seen. Scientists simply don't know where they are.
- Not much is known much about migrations or movements of these sharks.
- The role these sharks play in the ecosystem isn't fully understood.

Meet Chris Bird, a deep-sea shark scientist whose research aims to uncover some of these mysteries. Learn about some of his trips in the field in our 'Deep-sea Shark Science In Action' package.

Deep-sea Sharks Vocabulary

This list of words can be used along with the Deep-sea Sharks PowerPoint and Prezi

Abyssal Plain – underwater plain on the deep ocean floor, found at depths between 3000 and 6000 m. Abyssal plains cover more than 50% of the Earth's surface.

Abyssopelagic – this ocean region extends from 4000m to the sea floor. It has pretty inhospitable living conditions, which include near freezing temperatures and crushing pressures.

Adaptation - Change an organism undergoes in order to survive. The change is maintained over time by natural selection. This is a very slow process.

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.

Bathypelagic – this ocean region extends down from 1000m to 4000m. The only light is from bioluminescent organisms, and the only food is what trickles down from above, or from eating other animals. Many representatives of fish, molluscs, jellies, and crustaceans can be found at this depth.

Bioluminescence - the production and emission of light by a living organism.

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

Continental Shelf - broad, gently sloping plains covered by relatively shallow water. Water depth over the continental shelves averages about 60 m (200 feet).

Continental Slope - connects the flat continental shelf at about 200m to the abyssal plains at about 3000m.

Counter-illumination - a method of camouflage in which an animal produces light to match an illuminated background, such as the ocean surface.

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

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

Epipelagic - The surface layer of the ocean that is penetrated by sunlight, stretching to 200m. Phytoplankton flourish and it is where the fish, marine mammals, and marine invertebrates that most people are familiar with are found.

Evolution - Through the process of descent with modification, the common ancestor of life on Earth gave rise to the fantastic diversity that we see documented in the fossil record and around us today.

Galeomorphs – shark species found in shallow waters and include familiar species like great white sharks, tiger sharks and lemon sharks.

Hadopelagic – the deepest regions of the ocean, which includes areas found in deep sea trenches and canyons.

Hydrothermal Vents – cracks or fissures in the seafloor pouring hot, mineral-rich fluids from beneath the ocean floor. They are found along volcanically active areas of the ocean floor.

Life History - using biological evolution to explain aspects of an organism's anatomy and behavior.

Marine Snow - a shower of organic material falling from upper waters to the deep ocean. It includes includes waste, such as dead and decomposing animals, poop, silt and other organic items washed into the ocean from land.

Mesopelagic – this ocean region extends from 200m – 1000m and is sometimes called the twilight zone. It's bordered by the epipelagic zone above and the darkness below. In this zone we start to see bioluminescence on all sorts of animals and from this point on down, food becomes something of a scarcity .

Metabolism – all of the chemical processes that go on continuously inside of the bodies of living things.

Photophores - light-emitting organ which appears as luminous (glowing) spots on various marine animals.

Photosynthesis - The process by which plants make their own food. They use carbon dioxide, water and sunlight (energy) to produce sugar (food) and oxygen.

Population - All of the individuals of the same species living within a given area.

Primary Production - The conversion of light or chemical energy into organic matter. Photosynthesis is an example of this.

Rostrum – pointed snout at the front of a shark's head.

Spiracles - found in some sharks and all rays. They are a pair of openings just behind the fish's eyes that allow it to draw oxygenated water in from above.

Squalene – a compound found in large quantities in the livers of deep-sea sharks. Used as a supplement, in medicines and cosmetics.

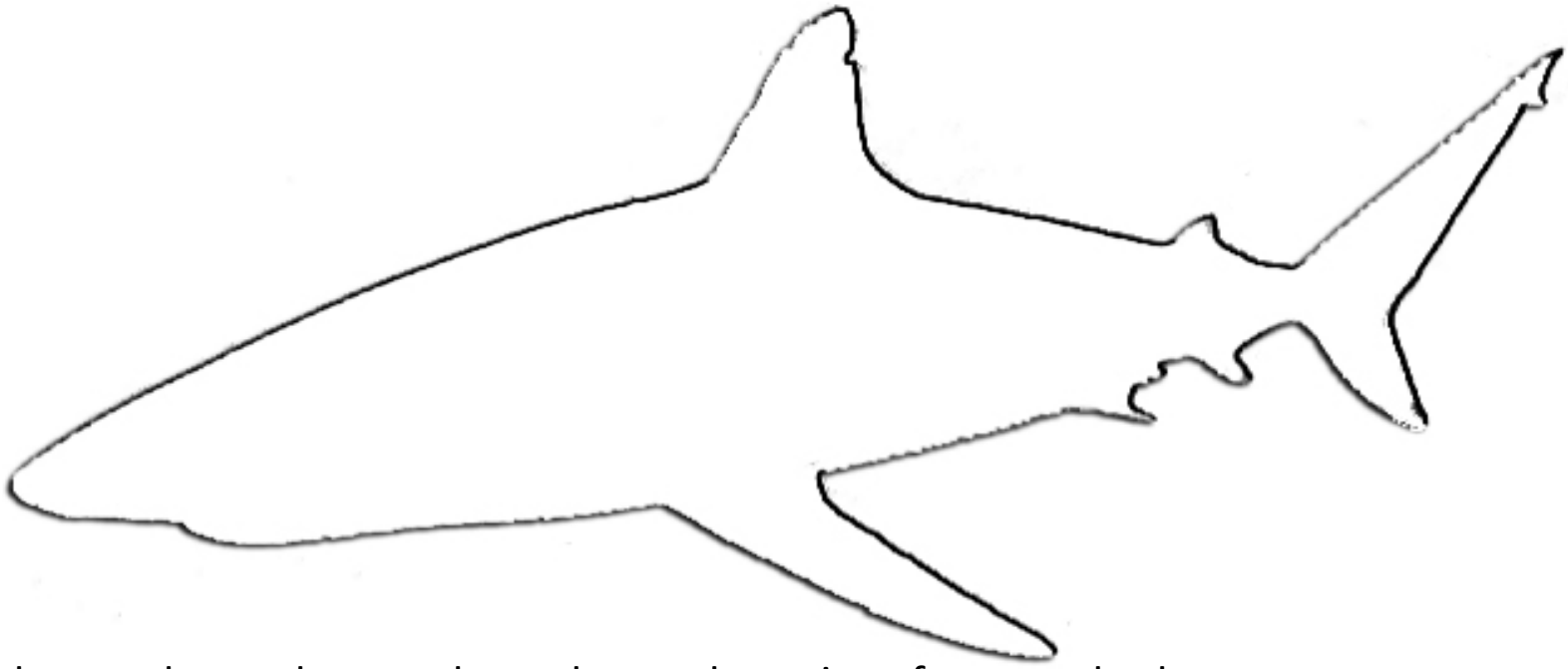
Squalomorphs – species typically found in the deep sea and include the dogfish, six-gill sharks and lantern sharks.

Tapetum Lucidum – tissue of mirrored crystals located behind the retina that reflects light back to the retina, allowing a shark better visibility in the darkness of the deep ocean.

Vertical Migration – movement up and down in the water column in response to daily and seasonal changes.

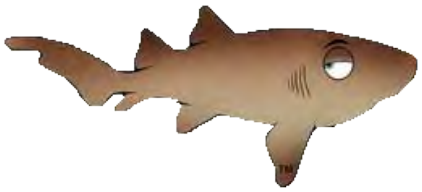
Deep-sea Shark Adaptations

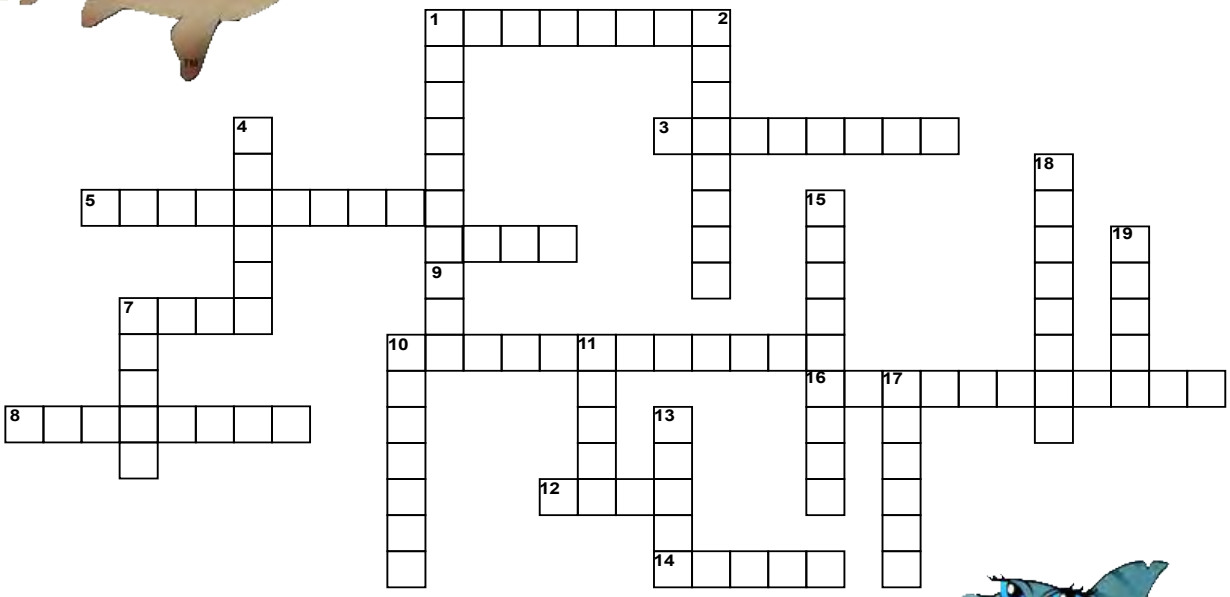
It's not easy making a living in the deep-sea, but the jawesome shark species you've learned about have special adaptations that allow them to survive and thrive. Using the outline of the shark below, illustrate some adaptations to prepare your shark for life in the deep!



Use the box to share why you chose these adaptations for your shark:

Deep-sea Shark Crossword





Clues

ACROSS

1 The deepest area of the ocean in which sharks are able to live
3 The area of water between 200m and 100m where some light is still visible
5 A cell that is able to make light in some species of shark
7 Deep sea sharks tend to mature this stage
8 Fishing method where thousands of hooks are sunk to the sea floor to catch fish
9 Growth rates of deep-sea sharks
10 The smallest shark in the world
12 A camera that has bait attached to it and is used to film animals in deep-sea
14 The time of day when many deep-sea sharks move to shallower waters
16 What the glowing fin spines on the back of lantern sharks look like

DOWN

1 The falling particles of other animals and poop that fuel deep-sea ecosystems
2 Fishing method that scrapes the ocean floor with a big net to catch fish
4 This shark leaves circular wounds on its prey of whales, dolphins and large fish
7 The size of deep-sea shark eyes
10 Squaliformes common name
11 The organ that sharks use to control buoyancy and is targeted by deep-sea shark fisheries
12 The number of dogfish families
13 Number of different dogfish families
15 The largest deep-sea shark species
17 The birdbeak dogfish and leafscale shark are types of this shark family
18 This shark has an elongated nose covered in ampullae of Lorenzini
19 The continental area of seafloor where majority of deep-sea sharks live

Sharks4Kids Deep-sea Shark Activity Answers

Word Search Answers

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+ B I O L U M I N E S C E N C E Y M D +
G + E + + + S + + K + M + + + L + A O +
H A + S + C + Q A + E + + + L + + R G +
P + L + O + I E U T + + + E + + + I F +
R + + E + N B G A A + + B + + + + N I +
O + + + O D T B A + L T + + B + + E S +
M D + A R M O N + L E E + + A + + S H +
O N + I B L O + U V E C N + T + + N + +
L A B + I Y + R L L O P + E H + + O + +
A L + S + + S E P O B + O + Y + + W + +
U N M + + + V S K H + + + S P + + + + +
Q E + + + + + I O C I G A L E P O D A H
S E + + + + E + + P + + + + L M + + + +
+ R + + + C + + + + E + + + A + + + + +
+ G + + U + + + + + + L + + G + + + + +
+ + + T + + E P I P E L A G I C + + + +
+ + T E R O H P O T O H P G C + + + + +
+ E + + + + + + + + + + + + I + + + + +
R + + + + + + + + + + + + + C + + + + +
+ + + + + + + + + C A T S H A R K + + +
```

Shark Sort Answers:

Epipelagic

Lesser Spotted Dogfish
Gulper Shark

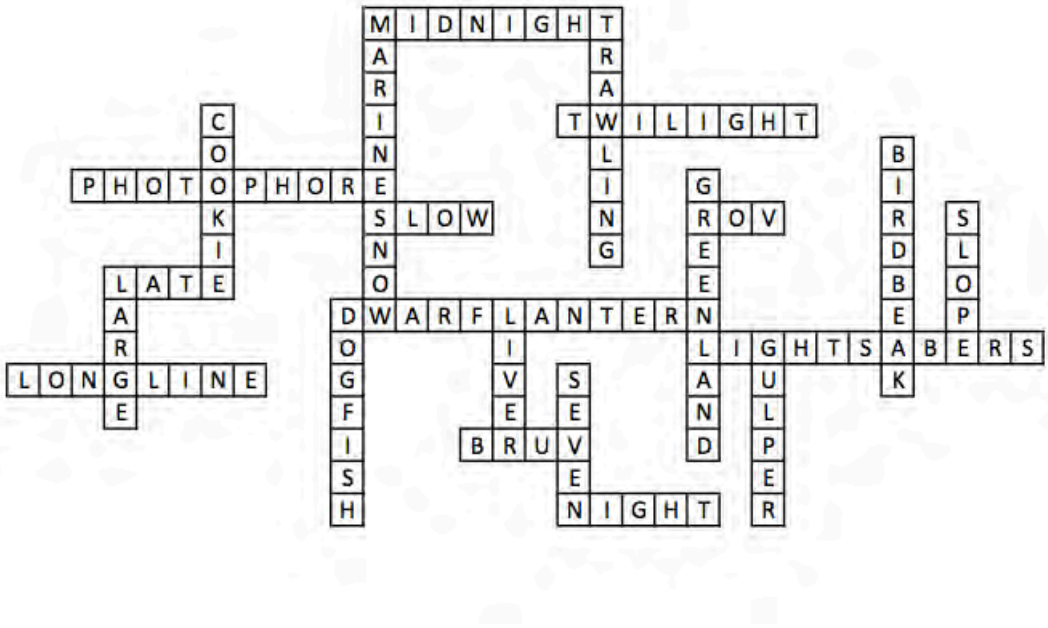
Mesopelagic

Velvet Belly Lanternshark
Greenland Shark
Arrowhead Dogfish

Bathypelagic

Portuguese Shark
Cookiecutter Shark

Crossword Answers



Deep-Sea Shark Word Search

C B I O L U M I N E S C E N C E Y M D E
G J E J L I S S D K C M Q H C L E A O V
H A G S V C M Q A Z E X S U L K V R G O
P Q L C O H I E U T A Z A E T Z J I F L
R E U E S N B G A A F O B Z P Q K N I C
O H O Z O D T B A Y L T O L B E V E S M
M D C A R M O N H L E E K I A I O S H G
O N D I B L O X U V E C N B T K D N Y A
L A B J I Y Q R L L O P J E H I C O B R
A L Z S P I S E P O B Y O J Y F J W C E
U N M C B M V S K H B P D S P M G L S U
Q E M Q S J H I O C I G A L E P O D A H
S E Z T E H E T F P X E K P L M W I Z A
L R H G D C N A M F E D U J A J T Z Z F
H G I K U T S L E F V L K J G T J V M Q
B X C T K G E P I P E L A G I C C I R U
P U T E R O H P O T O H P G C S V L S U
Q E J F Y Q S F B C F L M S I A L K L K
R N T D J T Z A M L A T C P R C O S W Z
V P J C Q T J H X C A T S H A R K W O C

Abyssopelagic
Bathypelagic
Bioluminescence
Birdbeak
Bluntnose
Catshark
Cookiecutter
Dogfish
Epipelagic
Hadopelagic
Galeomorph
Greenland
Marine snow
Mesopelagic
Metabolism
Photophore
Squalene
Squalomorph
Velvet Belly

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Deep-Sea Shark Article Summary

A lot of articles about deep-sea sharks have been appearing in the news lately, sometimes they are washing ashore or being pulled up in fishing nets. Search the internet for an article about deep-sea sharks and summarize it below. Include a picture in the space at the bottom that relates to the article, you can print a picture or draw one.

Deep-Sea Shark Sort

Label the 5 depth zones and then draw lines to place each deep-sea shark at the depth it can usually be found.

200m

1000m

Greenland Shark

Portuguese Shark

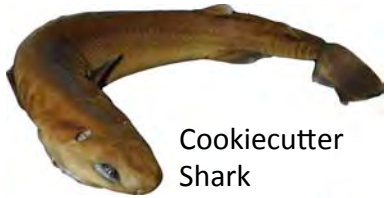
Gulper Shark

4000m

Lesser Spotted Dogfish

Arrowhead Dogfish

6000m

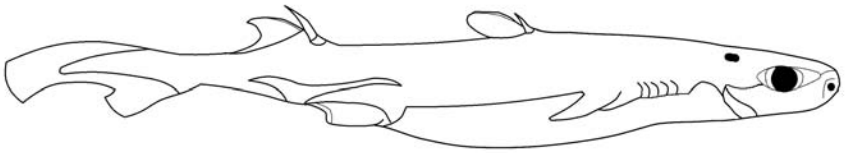


Cookiecutter Shark

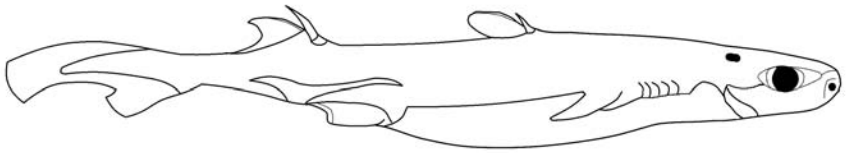
Velvet Belly Lanternshark

Bioluminescence in Velvet Belly Lantern Sharks Worksheet

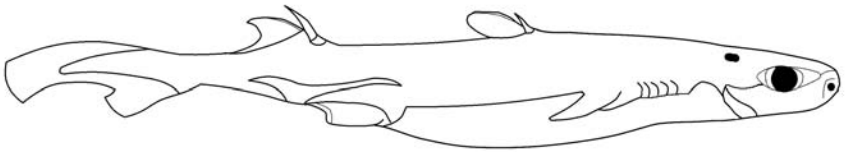
Vinnie uses bioluminescence to communicate in the deep-sea with other lantern sharks as well as with other deep-sea marine life. Shade in the parts of Vinnie that would be illuminated in the situations below:



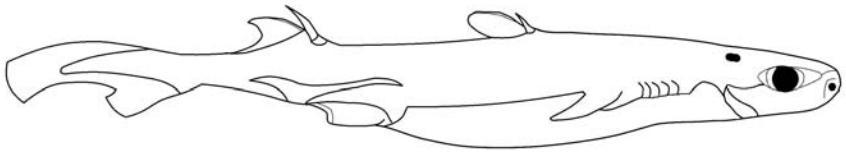
Deterring Predators



Counter-Illumination (camouflage)



Attracting a Mate



Identifying himself to other lantern sharks

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