Self-Guided Exploration of the Sant Ocean Hall for Educators

Target audience: Students in grades 6-12
Estimated time: 30-60 minutes
User tip: For the best user experience, download this file to your desktop or right-click or Ctrl-click the link at the top of each "Stop" page to open it on a separate tab.

Goal

Through guided inquiry of Sant Ocean Hall objects during this virtual tour, students will make observations and connections in order to explore the themes of a global ocean, marine biodiversity, and human impacts on the natural world. They will use modern marine collections objects and evidence of past life to discover how studying the past and present helps to better understand and preserve our ocean.

Learning Objectives

In this self-guided exploration, students will:

- Independently navigate the NMNH website's virtual tour to explore the Sant Ocean Hall
- Use close looking to connect with exhibit objects and extend those observations into predictions about the natural world
- Answer questions relating to key concepts in ocean science

Student Outcomes

After participating in this self-guided exploration, students will be better able to:

- Experience the Sant Ocean Hall as a space with meaning and connection to themselves or people/places/things they care about
- Appreciate that the ocean is a global system essential to all life, impacted by and impacting human communities
- Demonstrate understanding of ocean terms and concepts

- Cultivate interest in the museum space and understand the stories museums can tell with collections objects

Central Questions

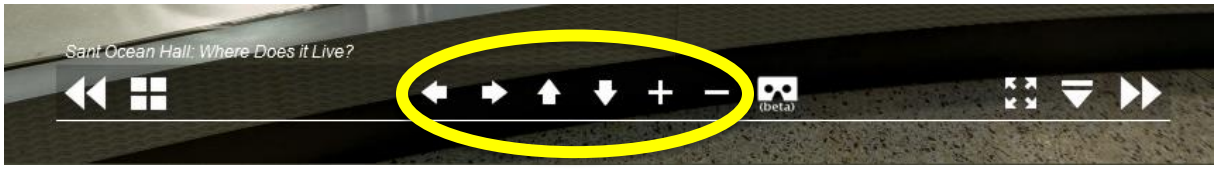
- What are some of the unique specimens featured in the Sant Ocean Hall?
- What can we learn about the ocean by exploring collections objects?
- What can we learn about organisms' adaptations by observing and comparing different specimens?
- What can museum specimens teach us about how humans are connected to the natural world?

The following text is the same information that is in the student guide.

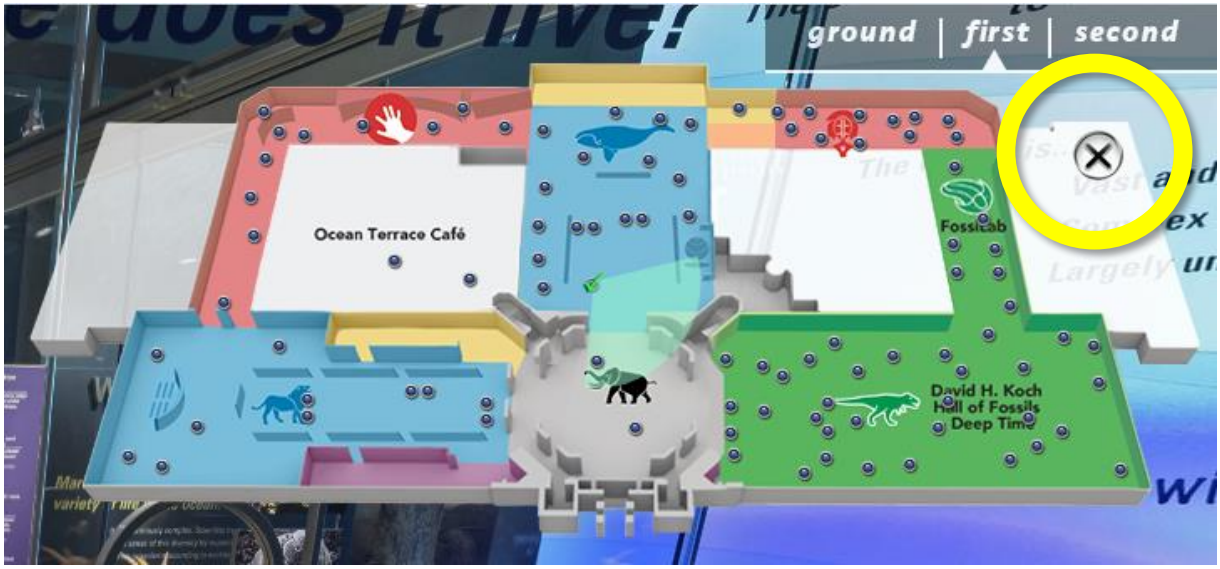
Welcome to the Sant Ocean Hall at the Smithsonian's National Museum of Natural History! During this virtual exploration of the Hall, you will be introduced to some of our most fascinating specimens and will answer a few questions about these exhibits.

At each stop, click the links to take you to specific spots in the virtual tour. Once there, use the arrows at the bottom of your screen to navigate, and zoom in and out using the plus and minus buttons. The map in the corner shows you where you are in the museum. You can click the X to close the map. Let's get started!

Navigation Tools



Closing the Map



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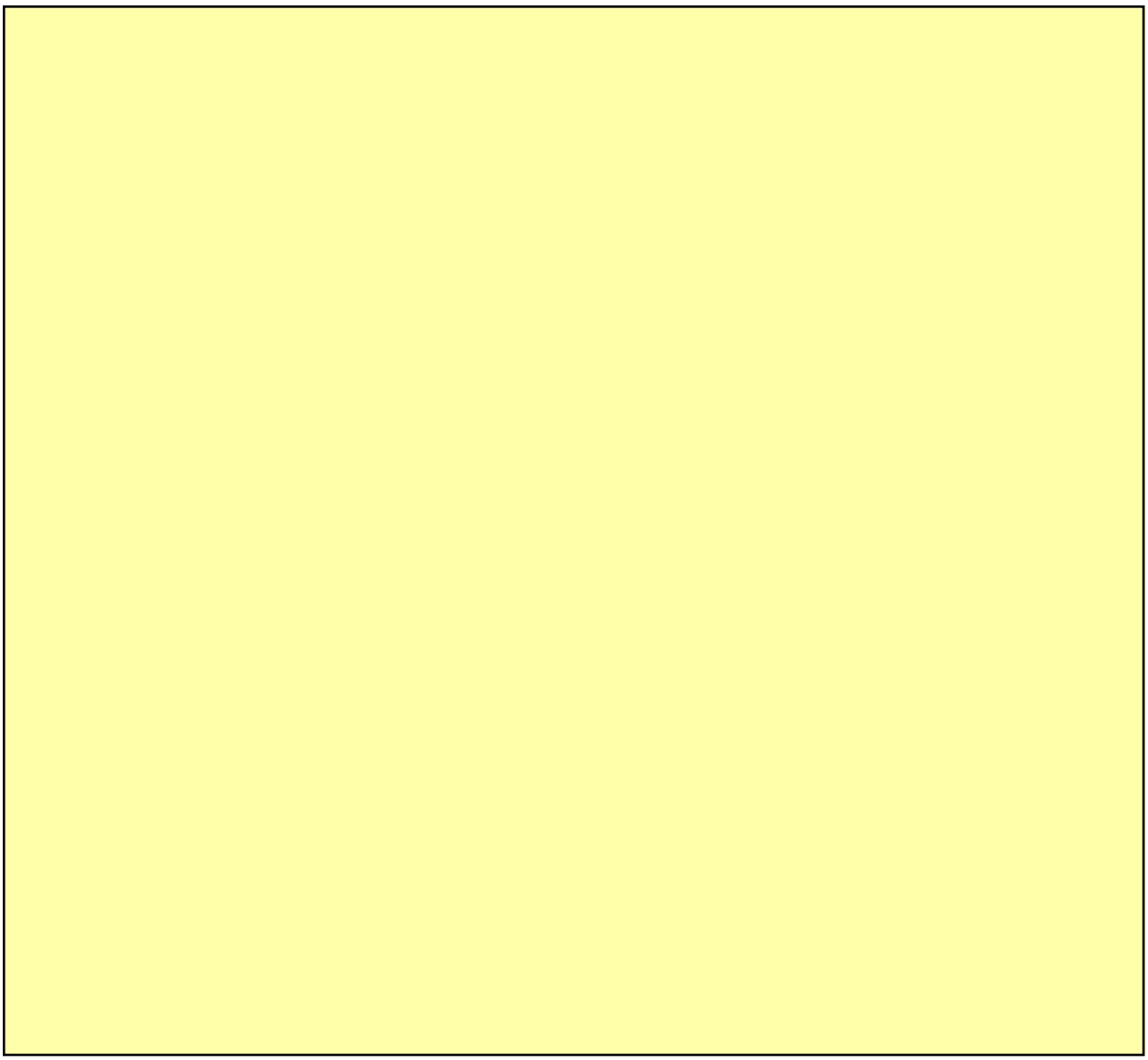
Stop 1: An Abundance of Life

Our ocean is home to the most species, or the highest **biodiversity**, on the planet. More life, and more kinds of life, are found here than in any place on land! These cases at the entrance to the Sant Ocean Hall contain a representative of every major group of life found in the ocean, from single-celled plants to complex animals. Life in the ocean comes in many sizes and shapes, all uniquely evolved to survive in their habitats. ***Click the left arrow*** to move across the case. Observe the different body plans and sizes, and think about how their differences help these species survive in different places.

At the next case to the left, ***click the up arrow*** to look up. Here, you'll see two of the largest living things found in the ocean– a giant kelp and a lion's mane jellyfish. Lion's mane jellyfish grow up to 120 feet long, and giant kelp grow up to 175 feet high!

Now ***click on the camera icon directly below the giant kelp (labeled 52c)***. This display introduces some of the smallest living things in the ocean, **dinoflagellates**, a type of microscopic plant-like organisms known as **phytoplankton.** Although these creatures are tiny, they are absolutely vital to the health of our ocean. Phytoplankton supply up to half of the oxygen on our planet and form the base of the marine food web, supporting many of the larger species, like fish. As humans change the ocean, however, phytoplankton are growing in different places and at different times of the year.

How do you think these changes in phytoplankton growth affect other creatures in the food web? How might these food web changes affect humans?



Stop 2: Phoenix the North Atlantic Right Whale

At the center of the Sant Ocean Hall is our largest resident - a North Atlantic right whale. Check out the large bumps on its head and jaw. These are called **callosities** and are rough patches of skin unique to each whale. Scientists use these callosities to identify individuals in the wild.

This life-sized model is 45 feet long and is based on a real whale named Phoenix. ***Click the plus button to zoom in*** on the exhibit panel on the right to see how a North Atlantic right whale's size measures up to other whales (in this image, the North Atlantic right whale is the whale furthest to the right in the top blue circle).

The North Atlantic right whale was chosen to be the centerpiece of the Sant Ocean Hall because Phoenix represents the stories of hundreds of other marine creatures threatened by human impacts on the ocean. North Atlantic right whales were hunted to near extinction during commercial whaling until right whale hunting was made illegal in 1935. Unfortunately, these whale populations continue to decline due to entanglements with fishing gear and collisions with boats. Scientists and environmental managers are working hard to protect the population, but as of 2019 it is estimated that only 356 individuals remain.

If you were an environmental manager, what are two actions YOU would suggest to protect North Atlantic right whales?

Click here to get a closer look at Phoenix.

Zoom in on Phoenix's mouth. Rather than teeth, North Atlantic right whales have long sheets of **baleen** that hang from the top of their jaw. Baleen is made of keratin, the same material that makes up your hair and fingernails. When the whale takes in a gulp of water, the baleen plates act like a sieve. Water passes through it and small marine organisms—**zooplankton** like krill and copepods—get stuck in the hairs. In a single day, a North Atlantic right whale may consume up to 2600 pounds of food!

Take a look at this scientific drawing of an orca whale skull from our collection:

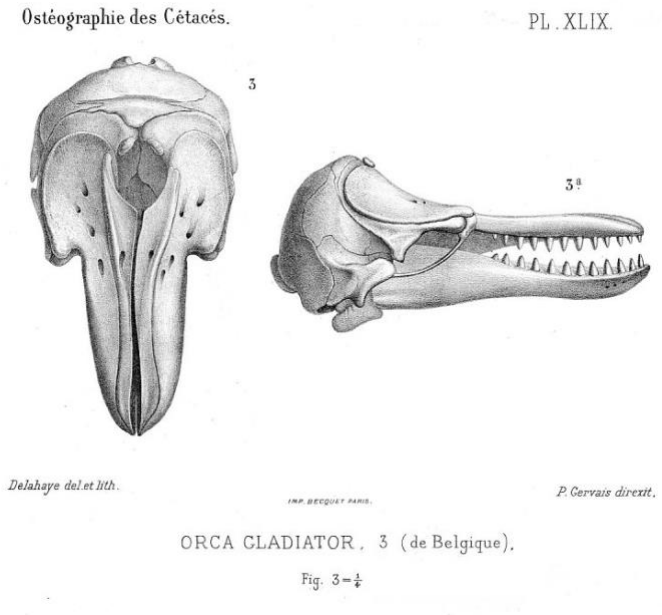


Image reference

How does this orca's mouth look different from the mouth of the North Atlantic right whale? Compare Phoenix's diet with what you think this whale might eat.

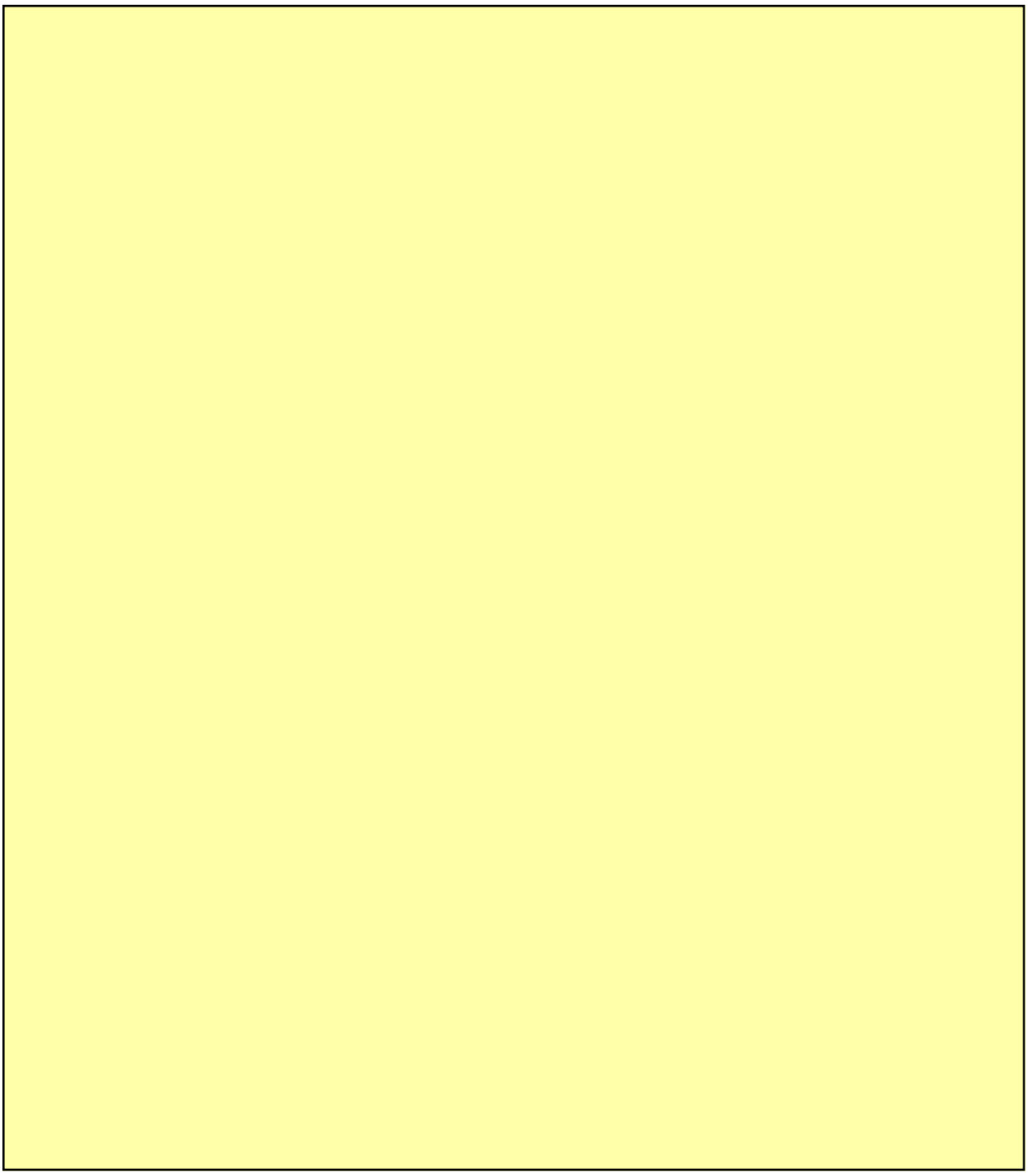
Stop 3: A Coral Community

Welcome to one of the few living exhibits in the museum! This large tank represents a coral reef community from the Indo-Pacific, an area of ocean just north of Australia that is home to over 500 species of reef-building coral. Coral reefs only cover about 1% of the Earth's surface, but support about 25% of marine biodiversity, making them hugely important!

Click the plus button to zoom in to take a closer look at the tank and some of the amazing creatures that call this exhibit home. While they may look a bit like rocks, corals are actually animals! Living coral reefs are made up of hundreds of tiny **polyps** that build their skeletons out of a mineral called **calcium carbonate**. ***Click the left arrow*** to look to the left of the tank and ***zoom in*** on the exhibit called 'What Is Coral?'. There you can see a coral skeleton and diagram of a polyp which has a cup-like shape with tentacles all around it.

Within the coral skeleton, tiny plants called **zooxanthellae** live in a symbiotic relationship with the corals. These zooxanthellae make their own food via photosynthesis and provide up to 90% of the energy needs of the corals, while the coral skeleton provides space for the zooxanthellae to live. This relationship is very fragile, however. When ocean temperatures quickly get warmer (even by a few degrees), corals become stressed and expel these tiny plants from their tissues, causing the corals to appear white. This phenomenon is known as **coral bleaching**. If conditions do not improve, bleached corals without zooxanthellae will eventually die. As climate change impacts our ocean, ocean heat waves are becoming more common and more severe, but scientists at the Smithsonian and around the world are researching ways to better understand and protect our world's corals.

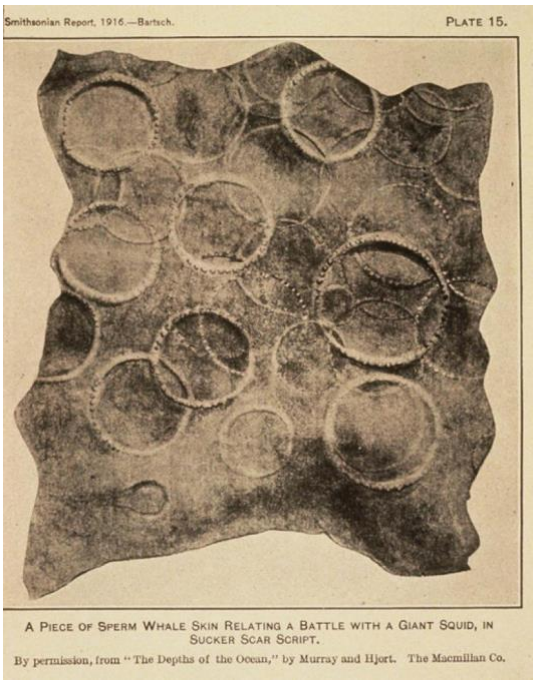
What is another example of a symbiotic relationship in the ocean?



Stop 4: Giant Squid

Starting at our coral reef tank, ***click the left arrow*** until you see the first blue arrow on the floor, then ***click the plus button to zoom in***. On the wall above this arrow is a giant squid! This individual male squid is 9 feet long and weighs about 100 pounds, but giant squid can grow over 40 feet long and weigh nearly one ton. Giant squid are deep sea creatures, living in the cold dark ocean 1650 feet (500 meters) to 3300 feet (1000 meters) below the surface. This makes them quite hard to find. It wasn't until 2012 that scientists were able to film a giant squid in its natural habitat for the first time.

Giant squid belong to the group **cephalopods**, which contains octopus, cuttlefish, and other squid. The National Museum of Natural History has one of the most diverse **collections** of cephalopods in the world, with 200,000 preserved specimens. Scientists often act like detectives, piecing together clues to better understand the natural world, and because these squid are so difficult to study in their deep-sea habitat, much of what we know about them comes from museum collections like ours. For example, one of the giant squid's predators is the sperm whale. No one has ever seen the fierce battle between a sperm whale and a giant squid, but scientists have found parts of giant squid in the stomachs of sperm whales, and some sperm whales have been found with circular battle scars so large they can only be caused by the sharp-toothed suckers on a giant squid's tentacles.



A PIECE OF SPERM WHALE SKIN RELATING A BATTLE WITH A GIANT SQUID, IN SUCKER SCAR SCRIPT.
By permission, from "The Depths of the Ocean," by Murray and Hjort. The Macmillan Co.

Image reference

200,000 specimens is a whole lot of cephalopods! Why do you think it's important that museums like NMNH collect so many examples of the same thing?

Stop 5: Megalodon: Ancient Predator

For a long time, life in the ocean existed only in the form of simple, single-celled organisms. Yet over the course of billions of years, new living things evolved and died out and life on our planet changed dramatically. We can look to the fossil record for evidence of this diversity of ocean life. One of the most striking prehistoric marine creatures was megalodon, the largest shark to have ever lived!

Above our Ocean Terrace Cafe, a life-sized model of a megalodon hangs hungrily over visitors as they enjoy their lunch. Megalodon lived roughly 23 to 3.6 million years ago and grew to be approximately 60 feet long, about three times larger than a modern great white shark! When it ruled the seas, the megalodon lived in every corner of the ocean; however, changes in habitat and prey availability likely caused the megalodon to go extinct while smaller sharks flourished. Today, the closest living relative of the megalodon is the mako shark. ***Click the plus button to zoom in*** to see the details on this model.

Today, the mako shark population is declining. How does understanding why some sharks went extinct in the past help us protect modern sharks?

An impressive set of megalodon jaws about 5 feet tall and 3 feet wide welcomes visitors to our “Journey Through Time” gallery.

Zoom in on the teeth and check out the serrated edges. The largest of these teeth are 7 inches long! With these fearsome teeth, the megalodon could tear chunks of flesh from almost any prey, including whales, seals, sea turtles, fish, and even other megalodon. It has been estimated that the bite force of the megalodon was up to 40,000 pounds - that’s 100 times greater than the bite force of a great white shark! Like modern sharks, megalodon grew and shed thousands of teeth over the course of their lives - these fossilized teeth have been found all over the world and give scientists important clues to understanding these creatures.

Think about another extinct animal that you know. What is one fossil clue that could help paleontologists learn about that animal AND what might that clue tell them about how it behaved?

Stop 6: Life in the Deep Sea

Scientists used to think that very little life was found in the deepest, darkest parts of the ocean. But as we have explored the deep sea, we've learned that life there is just as diverse as it is at the surface, supported by food sinking down from the above, or creatures able to convert chemicals in the deep ocean into food through a process called **chemosynthesis**.

These models of deep sea corals are an excellent example of the complex life found in the deep sea. Remember, though corals do not move, they are animals like anemones or sponges. ***Click the plus button to zoom in*** and examine these models: the larger coral on the left is a **bubblegum coral**, and the smaller one on the right is a **bamboo coral**. Compare these two species – look at their size, shapes, structures, and colors**.**

What are two ways in which these two corals look similar and what are two ways in which they look different? What do you think these similarities and differences can tell scientists about the roles these corals play in their ecosystem?

Now ***click the right arrow*** to rotate your view to face the display titled “Being on an Ocean Planet” and ***click the up arrow*** to look up. The robot suspended from the ceiling is a remotely operated vehicle, or ROV. Tools like this help scientists explore deep ocean habitats like deep sea corals using video and photography.

Stop 7: Mosasaur Fossils of Angola

Between 250 and 66 million years ago, while dinosaurs were thriving on land, marine reptiles were at the top of the food chain, or the **apex predators**, in the ocean. This gallery features the fossilized remains of mosasaurs, a type of marine reptile that dominated the seas at this time. These fossils were collected by paleontologists in Angola, a country on the west coast of the African continent.

Click the plus button to zoom in on the mosasaur skeleton. Throughout history, some living things with similar lifestyles or habitats have adapted to have very similar body structures, even if they are found in different places or in completely different time periods! This is called **convergent evolution**. Scientific evidence shows that mosasaurs and modern whales are an example of convergent evolution due to their similar body plans.

Carefully examine the mosasaur skeleton's tail, fins, and skull. What body parts do you notice that look similar to what you would see on a modern whale or dolphin?

Now take a look at this other area of our mosasaur exhibit. This fossil structure contains a fossilized mosasaur AND its fossilized stomach contents! Paleontologists can use fossils to not only learn what extinct animals looked liked, but also how they behaved. Because of fossil structures like this one, we know that mosasaurs ate turtles, bony fish, and even other mosasaurs!

Stop 8: From Pole to Pole

At the northernmost and southernmost points on our planet, ocean life still thrives. ***Click the plus button to zoom in*** to get a close at this polar bear and notice its teeth and fur. Do you see what the bear is standing on? Polar bears are marine mammals that rely on the ocean and sea ice for prey and habitat. They have evolved many adaptations that help them be successful in the Arctic - thick white fur to withstand the cold, sharp teeth for hunting seals, the ability to swim over 30 miles, and the ability to smell prey up to a kilometer away. But, because of climate change, the Arctic is changing fast – sea ice is melting, and ocean and air temperatures are rising.

Think about one of these adaptations that the polar bear has – how will it help or hurt polar bears' chance of survival as the Arctic warms?

Click the down arrow to take a look at some of the animals that make their home in the poles, including the Adelie penguin in the South Pole and the Arctic tern, which makes the longest migration of any bird on Earth! ***Click the right arrow*** and ***zoom in*** on the panel that reads "What's for Dinner?". These diagrams show Arctic and Antarctic food webs. Though the North and South Poles are both cold year-round and dominated by ice, life at each pole is actually quite different. In the north, the **Arctic Ocean** is a

largely enclosed body of water with many rivers flowing into it, surrounded by land that is home to many people. At the South Pole, the **Southern Ocean** circulates around the uninhabited Antarctic continent.

Other than melting ice, how do you think these two polar ecosystems are feeling the effects of climate change and human impact?