

Carousel of the Living Sea

Objective:

1. Students will understand the structure and function of specific marine animals.
2. Students will research diversity, behavior and adaptation of specific marine species.
3. Students will explain the food chain as it relates to the ecosystem of marine species.
4. Students will investigate symbiotic and competitive relationships among marine species.

Performance Objectives:

Grade 6: Strand 1: Concept 1 PO 1-3

Strand 4: Concept 1 PO 6; Concept 2 & 4

Grade 7: Strand 4: Concept 3 PO 1-3

Grade 8: Strand 1: Concept 3 PO 3;

Strand 4: Concept 4 PO 1-4

NGSS: MS-LS4-A, B & C

Grade 6-8

Key Vocabulary:

- Vibrissae
- Thermoregulation
- Carapace
- Biome

Related Literature:

Oceans and Sea

Steve Parker

The Discovery

Gordon Korman

*Dolphins, Seals and
other Sea Mammals*

Mary Jo Rhodes

The Secret Life of Sharks

A. Peter Klimley

Background Information: Carousel of the Living Sea

Oceans cover about 70% of the surface of the Earth. The Pacific Ocean is the largest, covering over 60 million square miles, while the Arctic Ocean is the smallest, covering a little over 5 million square miles. In parts, these oceans are thousands of miles deep and house countless “marine” animals. There are other bodies of water on Earth; they are referred to as seas. An example is the Mediterranean Sea, which is over 1 million square miles in size. So the question may be what is the difference between an ocean and a sea?

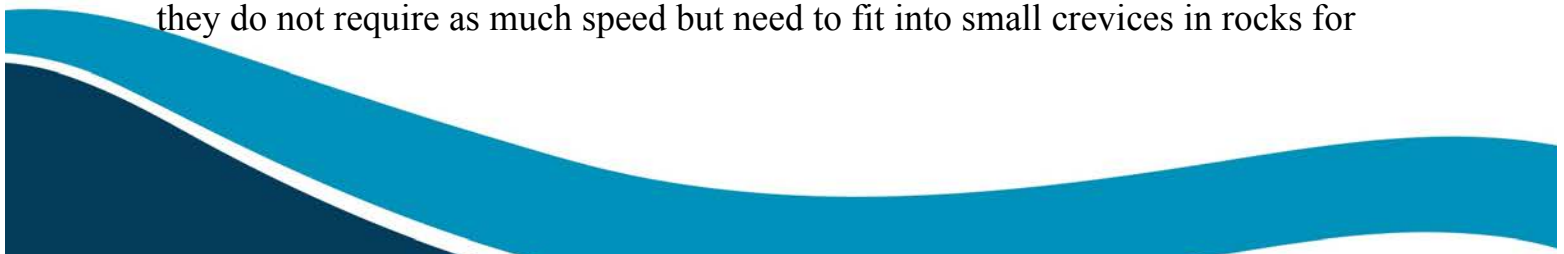
Often people use the terms “ocean” and “sea” interchangeably, to mean a large body of water. While that is a true statement, an ocean is much larger than a sea. Oceans and seas are comprised of salt water. Many of the same type of marine animals and plants are located in both oceans and seas. The main difference is geographic location and size of the body of water.

The largest biome on Earth is the ocean. **Biomes** are large geographic areas that share a common climate and ecology. The ocean is home to a significant percentage of life on Earth. For example, scientists state that 80% of all habitats on Earth are in the depths of the ocean. It is no wonder that a great variety of plant and animal life can be found in the ocean.

Fish and other marine life have learned to co-exist in the salt water regions of the world. Marine animals that live-in ocean and sea biomes have specific traits that allow them to live in the salt water. For example, fish have a rather stream-lined body with fins that allows them to move quickly through the water. Fish have gills for breathing underwater. Some marine animals have adapted to life both in and out of the water. A penguin, for example, spends their time nesting on land but swims and catches its food in the water. Penguins are flightless birds that have adapted to both land and water.

Fish live and breathe in the water. Fish are vertebrates, which mean they have a backbone. Fish have gills, fins, scales and are cold-blooded. There are some fish that can glide across the surface of the water while others can swim to the deepest depths of the ocean. Fish can see well in the water, they can taste their food and fish can even hear. Fish like to eat other fish, fish eggs, mollusks, marine plants, algae.

Fish are called ectothermic, aquatic vertebrates and are categorized by their type of skeleton. The body temperature of an “ectothermic” animal is regulated by their surroundings, such as water temperature for fish. This means that fish must adapt to the water temperature to survive because they cannot regulate body temperature internally. Being “aquatic” means that they live in the water and process oxygen through the gills. Some fish, for example, are called “bony” fish because they have a skeleton made of bone. Sharks and rays are in a different group because their skeleton is made of cartilage. Generally, fish have skin covered with scales and their limbs are modified into fins for swimming. The scales protect the skin and internal parts of the fish. Even the body shape of the fish tells a story about how it lives. Fish with streamlined bodies are usually fast swimmers and capable of catching prey with great speed. Many tropical fish have a more flattened body as they do not require as much speed but need to fit into small crevices in rocks for



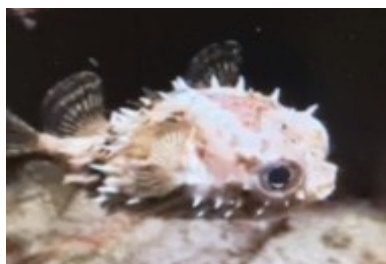
protection. Other types of fish use their color to camouflage themselves for protection.

There are different fins on a fish: pectoral fins, pelvic fins, dorsal fins, caudal (or tail) fins and anal fins. These fins help the fish move in water and provide stability and support for the body of the fish. The tails of fish vary in shape depending on the type of fish and its anatomy. Most fish are visual predators and have fairly large eyes to help them locate food. Bony fish have no eyelids.



The **puffer fish** is a type of fish with very unique characteristics. There are several different species that can be found from the Pacific Ocean to the Red Sea. Puffer fish can range in size from about 4 feet long to only an inch long depending on the type. While the puffer fish is a slow swimmer, it can use a burst of energy to try to escape danger. Puffers can even swim backward!

Puffer fish have tapered bodies with large stomachs. Some have pointed spines for protection. These fish can change their shape in an instant. If the Puffer senses danger, it can gulp water into its large stomach and blow up like a floating balloon. Puffer fish have a toxin in their body that can be deadly to any predator that eats them.



Puffer Fish

Green Sea Turtles are found around the world in warm subtropical and tropical ocean waters. There are 7 species of sea turtles and the green sea turtle can grow 3-4 feet in length and up to 350 pounds. They are marine reptiles, which means they have scales, lay eggs, are cold-blooded (**ectothermic**) and breathe air. Even though

sea turtles spend almost all of their lives at sea (except when females lay their eggs on land) they still need to come to the surface to breathe.

Females lay eggs on sandy beaches in nests on the same beach they were born. Eggs and sea turtle hatchlings face the biggest threats because they are so small and become prey for many animals. Every species of sea turtle is threatened due to beach habitat loss, human development, getting caught as **bycatch** (on accident) and pollution.

The shell of a sea turtle is fused with their skeleton and backbone. The top of their shell is called a **carapace** and the bottom of their shell is called a pastron. The sections on their carapace are called scutes. Unlike other turtles or tortoises, sea turtles do not have the ability to pull their head into their shell for protection. Instead, they have smooth streamlined heads and flippers to help them move through the water gracefully, or for **hydrodynamics**. Their front flippers are their main source of power and movement through the water and their hind flippers assist with steering. Adult males have much longer larger tails than adult females.



Their shell color varies from dark brown to a lighter yellowish brown so, they are not named after the color of their shell. They are named after the food they eat as an adult and the color of their insides! As juveniles, green sea turtles are omnivorous eating both seagrasses and small fish, but as adults, they are strictly herbivores and eat seagrasses. They have a mouth called a beak with a serrated jaw to assist with eating seagrasses. The internal organs and fat of green sea turtles are green due to their adult diet. (<https://www.nwf.org/Wildlife/Wildlife-Library/Amphibians-Reptiles-and-Fish/Sea-Turtles/Green-Sea-Turtle.aspx>)

California sea lions can be found all up and down the Pacific coast, as far North as British Columbia and as far south as Mexico. The average lifespan of a California sea lion is approximately 15-25 years. Lifespan can exceed 30 years under human care because of the opportunity for consistent food supply and veterinary care, as well as the absence of predators, pollution, and habitat destruction. Adult California sea lion females weigh between 110-220lb on average; males weigh between 440-880lb when full grown. Sea lions typically cruise at speeds of around 12 miles per hour, but can reach bursting speeds around 20mph.

Females typically have the appearance of a flat head, whereas adult male sea lions have a raised forehead on the center of their skull, caused by a ridge of bone, called

a sagittal crest. This can be about 1-2 inches high when fully developed. Sagittal crests tend to be present on the skulls of adult animals that rely on powerful biting and clenching of the teeth, such as carnivores. Male California sea lions can also ‘flex’ the muscles on top of this crest, causing the crest to rise, when posturing aggressively or defensively toward other male sea lions.



Male sealion displaying his Sagittal crest.

Sea lions can hold their breath for up to 20 minutes and can dive to depths of around 900ft, although they typically don't because their food source is in much more shallow waters. Sea lions are voluntary breathers, which means they consciously have to think about every breath they take. Their nostrils are naturally closed, but sea lions have specific muscles in their cheeks called **myastacial muscles** that flex to open their nostrils when they want to take a breath.

On the front of their face, or muzzle, they have whisker like appendages called **vibrissae**. They have 20-30 per side, or 40-60 total. They are made up of keratin, like our fingernails, but are highly sensitive to motion because they have nerve endings and muscle tissue in them. In dark, murky waters they use their vibrissae to detect schools of fish and changes in currents. Vibrissae feel much like uncooked spaghetti!





Close up of vibrissae.

Sea lions use **thermoregulation** to help cool or warm their bodies. Their flippers are highly vascular, with lots of capillaries close to the surface of the skin, and can easily distribute warmth or cold to other parts of the body. When a sea lion is cold, it will float on the surface of the water and hold its flipper(s) up to absorb the sun's rays. This flipper will absorb the heat, which is circulated to the rest of the body. When a sea lion is too warm, the process is reversed as they lay on land and hold up their flipper(s) to absorb a cool breeze or dip their flippers in the cool waters, which helps to cool the blood and distribute it to the rest of the body.

Pacific harbor seals are found north of the equator in both the Atlantic and Pacific Oceans. In the northeast Pacific, they range from Alaska to Baja California, Mexico. They favor near-shore coastal waters and are often seen on rocky islands, sandy beaches, mudflats, bays, and estuaries. They are the most widely distributed species of **pinniped** (walruses, eared seals, and true seals). They are true or crawling seals, having no external ear flaps. True seals have small flippers and must move on land by flopping along on their bellies. An adult can attain a length of 6 ft. and a weigh 290 lb. Blubber under the seal's skin helps to maintain body temperature. Females outlive males (30–35 years versus 20–25 years).





Pacific harbor seals spend about half their time on land and half in water. They can dive to 1,500 feet for up to 40 minutes, although their average dive lasts three to seven minutes and is typically shallow, and they sometimes sleep in the water. They are opportunistic feeders, eating sole, flounder, sculpin, hake, cod, herring, octopus, and squid. While harbor seals swim safely in the surf, they will often curiously watch humans walking on beaches. However, they are wary of people while on land and will rush into the water if approached too closely or disturbed. In fact, if disturbed too often, they have been known to abandon favorite haul-out sites or their pups.

Both courtship and mating occur underwater. The mating system is not known, but thought to be polygamous. Females give birth once per year, with a gestation period of approximately nine months. Birthing of pups occurs annually on shore. The timing of the pupping season varies with location, occurring in February for populations in lower latitudes, and as late as July in the subarctic zone. The mothers are the sole providers of care, with lactation lasting four to six weeks.

SEA LIONS vs. SEALS

- California sea lions have external ear flaps, while seals have only small holes that are the opening of an internal ear. Sea lion ears are similar to our external earlobes, but folded tightly to protect from water entering the ear canal.
- Sea lions have long foreflippers to hold their weight, and can rotate their hind flippers to walk on land. Seals have short, stubby foreflippers and cannot walk on land, but instead undulate, much like an inchworm. Sea lions use their foreflippers to propel them through water, whereas seals use their hind flippers as their main power source.
- Sea lions have nails on the middle three digits of their hind flippers. Their foreflippers have no nails or hair. Seals have nails on both hind and foreflippers.
- Sea lion vocalizations sound like a bark or roar, which is how they got their name. Seals demonstrate sounds such as wheezes, wretches, and blows.

Interesting fact there are 5 million living organisms in 1 tea spoon of ocean water. Imagine what is in a bucket of ocean water!

Additional Resources:

Pufferfish Inflating: <https://www.youtube.com/watch?v=rAGWO5i2C5M>

Green Sea Turtle Feeding on Jellyfish:

<https://www.youtube.com/watch?v=DmNOsOm0JiE>

Baby Turtles Entering the Ocean:

<https://www.youtube.com/watch?v=t1kFiehGh9s>

Sea Lions Barking: https://www.youtube.com/watch?v=ds6Qcrf_Gks

Seals vs Sealion Video: https://www.youtube.com/watch?v=wJ-F4n_XjTM

Sources: NOAA; National Geographic; World Wildlife Federation; National Aquarium; Encyclopedia of Earth; Fish Channel; Florida Museum of Natural History. Photos: OdySea Aquarium or public domain.

Procedures and Activities:

1. State the learning objectives. Review previous instruction as it relates to the topic and objectives.
2. Review vocabulary.
3. Read related literature. Follow-up with discussion and open-ended questioning. Ask student to hypothesize about the conditions of the ocean waters around the planet and the marine life survival. Consider natural and man-made disasters that impact the largest biome on Earth.
4. Discuss populations of marine life in an ecosystem. Review the food chain and where examples of marine life fit on the food chain.
5. Instruct and discuss marine life relationships and the impact on the ocean biome. (Symbiosis, competition, parasitism, etc.)
6. Review adaptation of species to the environment and community.
7. Discuss biodiversity and ecosystems. Include climate, genetic variation within species, varieties of species within an area and communities.



Indicates 'take along' activity.

Activity: Pre and post activity. Before the field trip, ask them what they think they know about the oceans or ocean animals. Following the field trip, ask students what they learned during the field trip. In small groups or as a class, discuss the students' responses.

Activity: Students do the activity sheet, 'Describe the Biome.' This activity is designed to engage students in comparing and contrasting different biomes. They should discuss the pros and cons of each and how life survives in each biome. This activity can be individual, small, or large group.

Activity: Pre or post activity. Students select two of the biomes and write an essay that compares and contrasts the biomes. The draft can be part of a peer editing activity prior to the final essay.

Activity: Beach in a bottle is an activity that any age group will enjoy and is engaging students in creating a specific environment.

Materials needed: Clear plastic bottles; sand and sea shells (from a craft store); small, plastic marine plants and animals (craft store).

Each student uses the plastic bottle to create a beach. The activity can be expanded by creating an ocean in a bottle using water. This activity can be an individual or small group activity. The verbal or written description of the bottle contents and their relationship to the environment can be presented to the class.

Activity: Post activity. Students create the project called "Ocean Utopia." This project meets the STEM standards involving engineering principles, planning and design. (This activity can be modified for specific grade levels.)

Activity: Follow-up activity. Students complete the seals vs. sea lions Venn diagram. Students draw conclusions and communicate the information to the class.



Activity: OdySea Aquarium Ethogram is a chance for students to observe one exhibit for two minutes and record various behaviors from one animal.



Activity: OdySea Aquarium Scavenger Hunt is an aquarium-wide take-along activity that students can complete during their visit to the aquarium.

Reflections and Assessments: Students are assessed on varied levels depending on the activity. Participation, grade standards, and percentages may be applied to each activity. Activities are designed for flexibility and use either pre - or post - fieldtrips.

Depending on the level of instruction prior to the field trip, many activities may be used as a pre-visit or as a follow-up to the visit.

Activities meet the STEM education guidelines involving problem solving, investigation, gathering data, analysis, using technology, application of math, integration of interdisciplinary instruction and inquiry.

Describe the Biome

Biome	Geographic Area	Climate	Plants & Animals
Tundra			

Tropical Rainforest			
Deserts			

Grasslands			
Oceans			



Compare and Contrast

Introduction

Introduces the two subjects A and B, which are being compared or contrasted and includes an overview

Thesis statement _____
Point #1 _____
Point #2 _____
Point #3 _____

Body

More detailed explanation of the points with alternating discussions of Subject A and Subject B

Subject A — Point #1 _____
Supporting detail _____
Example _____

Subject B — Point #1 _____
Supporting detail _____
Example _____

Subject A — Point #2 _____
Supporting detail _____
Example _____

Subject B — Point #2 _____
Supporting detail _____
Example _____

Subject A — Point #3 _____
Supporting detail _____
Example _____

Subject B — Point #3 _____
Supporting detail _____

Example _____

Conclusion

Summary of main points _____

Restatement of thesis statement _____



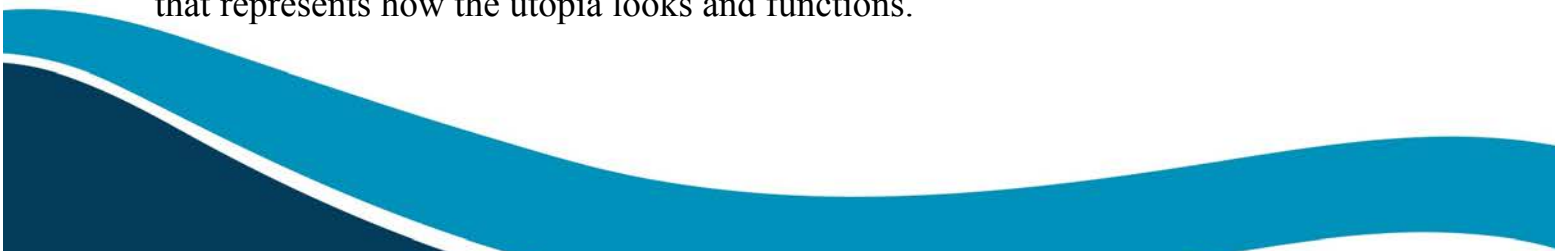
OCEAN UTOPIA

The term, utopia, can be defined as a state of things in which everything is perfect. In your project, you will create an Ocean Utopia that can support both marine life and human life. This underwater utopia must include all of the mechanisms that are needed for survival underwater.

Consider the following:

- The structure that houses human life
- Control of the environment
- Air and sunlight
- Fresh water (filtering)
- Food sources
- Disposal of waste products
- Protection from severe temperatures and water currents
- Activities for humans
- Job responsibilities
- Management system
- Rules and regulations
- Living areas (homes?)
- Locomotion within the utopia

You are to engineer the utopia to specifications that best fit the environment and can support generations of life within the structure. Since you will live there, create the utopia to include a few things that are part of your lifestyle. In addition to describing the Ocean Utopia in written form, you will design a poster that represents how the utopia looks and functions.



Assessment: Your project will be evaluated on the detailed consideration of the functions of the utopia, addressing life support systems, written description, and the visual (poster) appearance.

Timeline for the project: _____

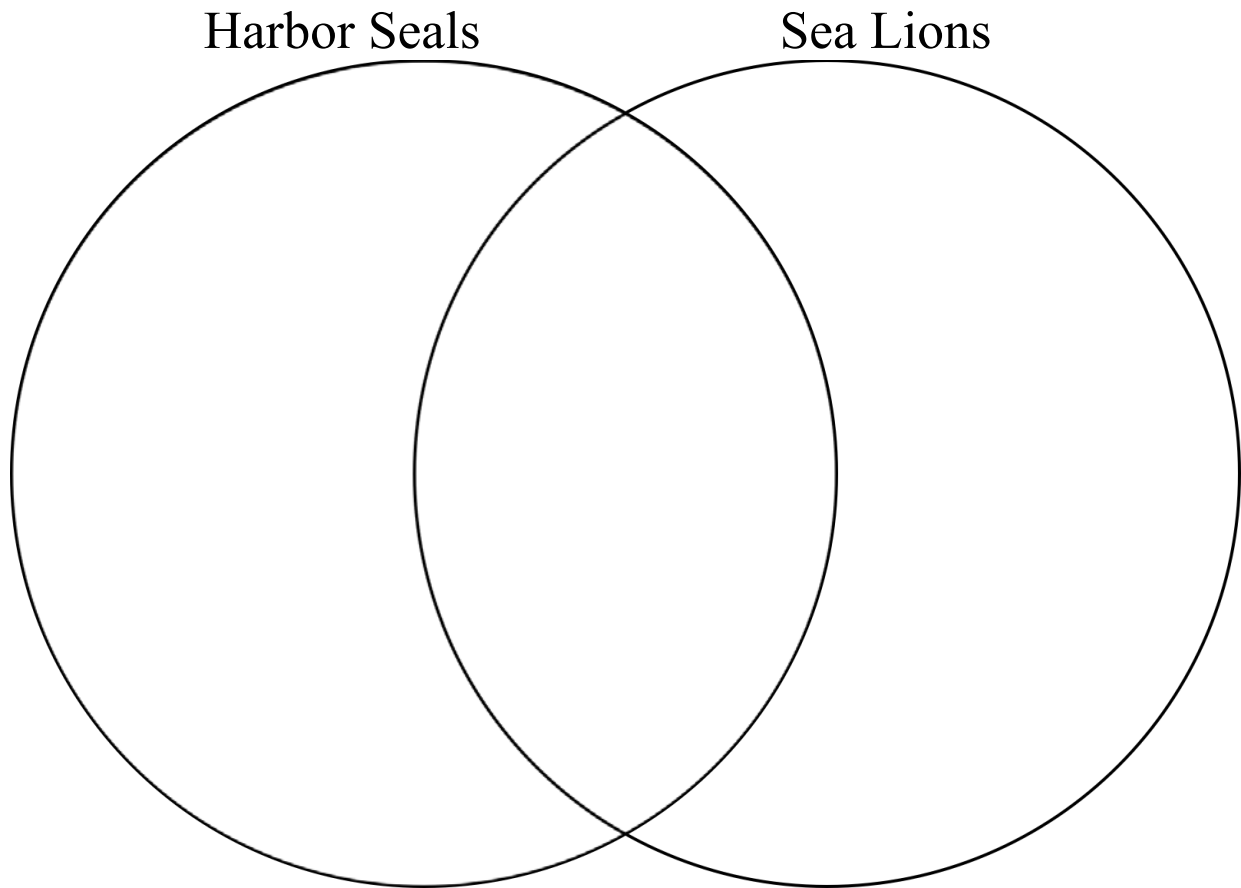
Due date: _____

* Design your Ocean Utopia on poster board. Be creative!



Seals vs. Sea Lions

Compare and contrast characteristics of Harbor Seals and California Sea Lions.



What can you conclude about the similarities and differences between harbor seals and sea lions?





OdySea Aquarium Ethogram

Practice what it is like to be a behavioral biologist and study one animal at OdySea Aquarium for two minutes.

An Ethogram is a way we can record the behavior of an animal over time in order to make inferences, or assumptions, about how an animal generally spends its time.

Every 15 seconds, mark what behavior the animal is exhibiting.

Species: _____

OdySea Aquarium Ethogram					
	Resting	Moving	Hiding	Eating	Other
0:15					
0:30					
0:45					
1:00					
1:15					
1:30					
1:45					
2:00					

Inference about animal's behavior:





OdySea Aquarium Scavenger Hunt

1. What species of trout found in Arizona is OdySea Aquarium and Arizona Fish and Game trying to conserve? _____
2. What do American Paddlefish eat and how can their rostrum (nose) help them find their food?

3. What fish spits water into the air to catch their prey? _____
4. What fish nicknamed “monkey fish” jumps out of the water to catch their prey?

5. What type of predator are Asian Small Clawed Otters? _____
6. What oceans are most of the fish in SeaTREK’s Stingray Bay found?

7. What is special about the spots on an African Penguin’s chest?

8. What is the invasive, venomous fish in Bizarre and Beautiful? _____
9. How large can Scalloped Hammerheads grow? _____
10. When did Nautili first appear in natural history? _____
11. What type of camouflage do clownfish exhibit? _____
12. What species of wrasse is found in the Great Barrier Reef tunnel?

13. What are the 5 species of shark in the Shark Waters exhibit?

14. What bottom-dwelling shark is named after how it sucks animals out of rock crevices?

15. How is the Hepatus (blue) Tang beneficial to coral reefs?





OdySea Aquarium Scavenger Hunt Key

1. What species of trout found in Arizona is OdySea Aquarium and Arizona Fish and Game trying to conserve?
Apache Trout.
2. What do American Paddlefish eat and how can their rostrum (nose) help them find their prey? **They eat zooplankton and their rostrum helps them sense electromagnetic pulses to find their prey.**
3. What fish spits water into the air to catch their prey? **Archer Fish.**
4. What fish nicknamed “monkey fish” jumps out of the water to catch their prey? **Silver Arrowana.**
5. What type of predator are Asian Small Clawed Otters? **Apex Predators.**
6. What oceans are most of the fish in SeaTREK’s Stingray Bay found? **The Indo-pacific.**
7. What is special about the spots on an African Penguin’s chest? **They are different for every penguin- like a human’s fingerprint.**
8. What is the invasive, venomous fish in Bizarre and Beautiful? **Lionfish.**
9. How large can Scalloped Hammerheads grow? **6 feet (males) 8 feet (females).**
10. When did Nautili first appear in natural history? **500 million years ago.**
11. What type of camouflage do clownfish exhibit? **Disruptive Coloration.**
12. What species of wrasse is found in the Great Barrier Reef tunnel? **Napoleon Wrasse.**
13. What are the 5 species of shark in the Shark Waters exhibit? **Nurse Shark, Lemon Shark, Blacktip Reef Shark, Sand Tiger shark and Sand Bar Shark.**
14. What bottom-dwelling shark is named after how it sucks animals out of rock crevices? **Nurse Shark.**
15. How is the Hepatus (blue) Tang beneficial to coral reefs? **They eat plankton and algae that could smother coral.**