Carousel of the Living Sea

Objective:

1. Students will explain environmental factors related to specific marine creatures.
2. Students will demonstrate an understanding of adaptive behavior in specific marine animals.
3. Students will make predictions using science-based methods.
4. Students will analyze data, consider variables and draw conclusions related to survival of marine life.

Grades 3 – 5

Key Vocabulary:

- **Adaptation**
- **Hydrodynamic**
- **Ectothermic**

Related Literature:

The Discovery
Gordon Korman
Dolphins, Seals, and Other Sea Mammals
Mary Jo Rhodes
1001 Things to Spot in the Sea
Katie Daynes
Ocean and Sea
Steve Parker

Performance Objectives:

Grade 3: Strand 1: Concept 1 – PO 1; Strand 4: Concept 4 – PO 1-3
NGSS: 3-LS2-1; LS4-2&3
Grade 4: Strand 1: Concept 1 – PO 3; Concept 1 – PO 3; Strand 4: Concept 1 – PO 1-2; Concept 3 – PO 1; Concept 4 – PO 1-2
NGSS: 4-LS1-1 & 2
Grade 5: Strand 1: Concept 1 – PO 2; Concept 3: PO 1-5; Concept 4 – PO 1-3
NGSS: 5-LS2-1-A

Background Information:

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 contain countless water or “marine” animals. There are other bodies of water on Earth; they are referred to as seas. An example is the

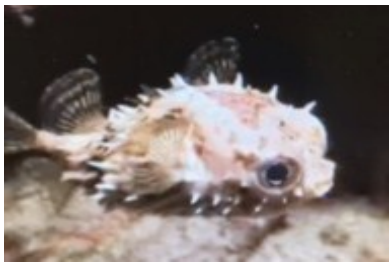
Mediterranean Sea, which is over 1 million square miles in size. So the question may be what is the difference between an ocean and a sea?
Often people use both terms “ocean” and “sea” to mean a large body of water. While that is a true statement, an ocean is much larger than a sea. Oceans and seas are 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 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, spend 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 and 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 ocean creature 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 also 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

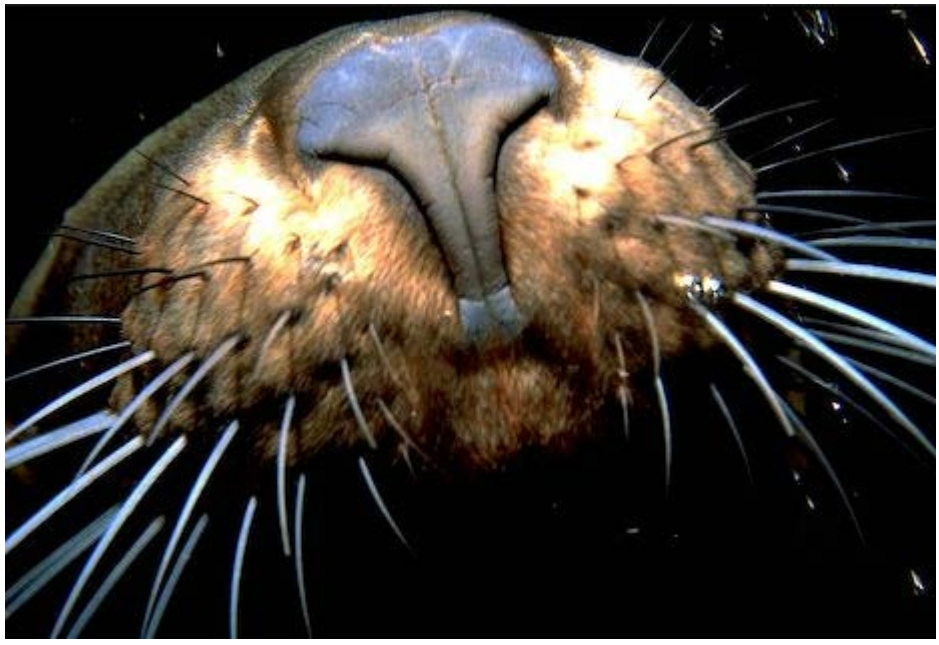
care because of the opportunity for consistent food supply and veterinary care, as well as the absence of predators, pollution, and habitat destruction. Adult California sea lion females weigh between 110-220lb on average; males weigh between 440-880lb when full grown. Sea lions typically cruise at speeds 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 nosrils 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 one teaspoon 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; U.S. Department of Natural Resources.

Procedures and Activities:

1. State the learning objectives.
2. Read related literature and discuss the general topic. Discuss the ocean as a biome. Relate environments, habitats and communities to the topic.
3. Review the vocabulary as words relate to the topic.
4. Discuss physical and behavioral adaptations specific to marine animals and plants. Explain how adaptations develop and help animals survive in their environment.
5. Use technology for students to research a favorite marine animal. (See activity)
6. Review the concepts of scientific inquiry, characteristics of organisms, life cycles, populations in an ecosystem, diversity, adaptations of organisms, types of resources and human interactions with marine animals.

 **Indicates 'take along' activity.**

Activity: Pre and post field trip 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: Pre or post activity.

Materials: 3x5 cards

Give a 3x5 note cards to each student. Ask students to think of their favorite marine animal. (Suggest animals such as sea turtles, whales, seals, sting rays, and dolphins.) Students use computers to do a short research on the animal. Students use the 3x5 card to write all of the interesting facts about the chosen animal. Explain that they should write only the most important facts due to space and this is just a note card. In groups or as a class, each student gives a brief summary of their marine animal.

Activity: 'Label the Fish' can be an activity or quiz. Students learn about the uses of the fins as structure/function.

 **Activity:** Students take the Aquarium Ethogram sheet with them to the aquarium. Students complete the observation activity and bring it back to class. In class, following the fieldtrip, students discuss their observations and inferences.

Optional Activity: Divide students into small groups (3-5). Give each group a 3x5 index card. In groups, students discuss the external anatomy of the fish and the patterns of movement within the aquariums. On the 3x5 card, each group lists 5 significant observations that they recall from viewing the fish in the aquariums. They should consider:

Physical Structure and Function
Fins and Movement
Habitat Variations
Compatibility of species in tanks

Upon completion of the task, each group presents one or two observations to the class. Class discussion follows the presentations.

Quiz: Students complete the quiz titled: Label the parts of the fish.

Activity: Students will demonstrate their knowledge of vertebrates and invertebrates as they relate to the lesson. Discuss the topic, then hand out the sheet, 'Got Bones?' and ask them to complete the activity.

Activity: Following the field trip, students can use computers to look up a favorite marine animal that is on the endangered species list. Students research

the animal and take notes about the species, characteristics, physical and behavioral adaptations, location of existence and reason for being placed on the endangered species list. Using notes, students write an expository essay about the chosen species. Additionally, students may include steps being taken to protect the species, and students can predict the future of the species based on their research. Students may make a presentation to the class as part of the speaking and listening standard.

Activity: The classification grid is a higher level thinking activity. Students make comparisons, analyze data, and create graphs in 'Classifying Ocean Animals'.

Activity: "Plankton Lab"

Materials: Microscopes, Petri dishes, pipettes, water from local sources, phytoplankton and zooplankton pictures and examples

Students use microscopes to investigate what is in local sources of water. As students look at the plankton, consider how a microscope helps an oceanographer look at a drop of ocean water. In addition, students use computers to investigate what else could be in a drop of water. Have students work in pairs and discuss what the research and photos show. Provide the activity handout and ask students to identify what is in their water.

Activity: 'Seals vs. Sea Lions' is an activity that challenges students to look beyond the basics of similarities. Using a Venn diagram, students can visualize characteristics that are shared by seals and sea lions.

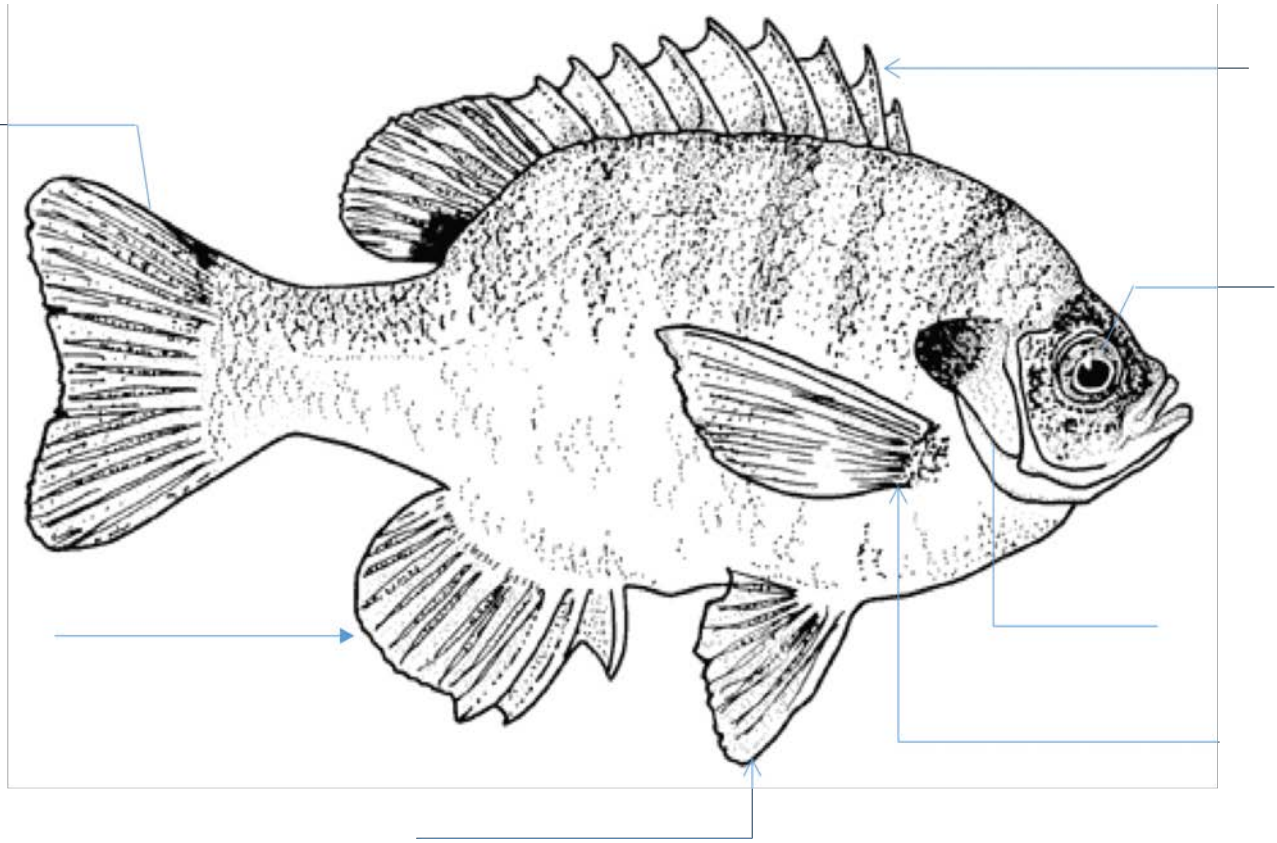
Activity: 'Scavenger Hunt' is a take-along activity that students can complete during their visit to the aquarium.

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

Reflections and Assessments: Students can be evaluated on the basis of participation. In addition, some activities may be used as a quiz or test.

Most activities meet the STEM guidelines.

Label the Fish



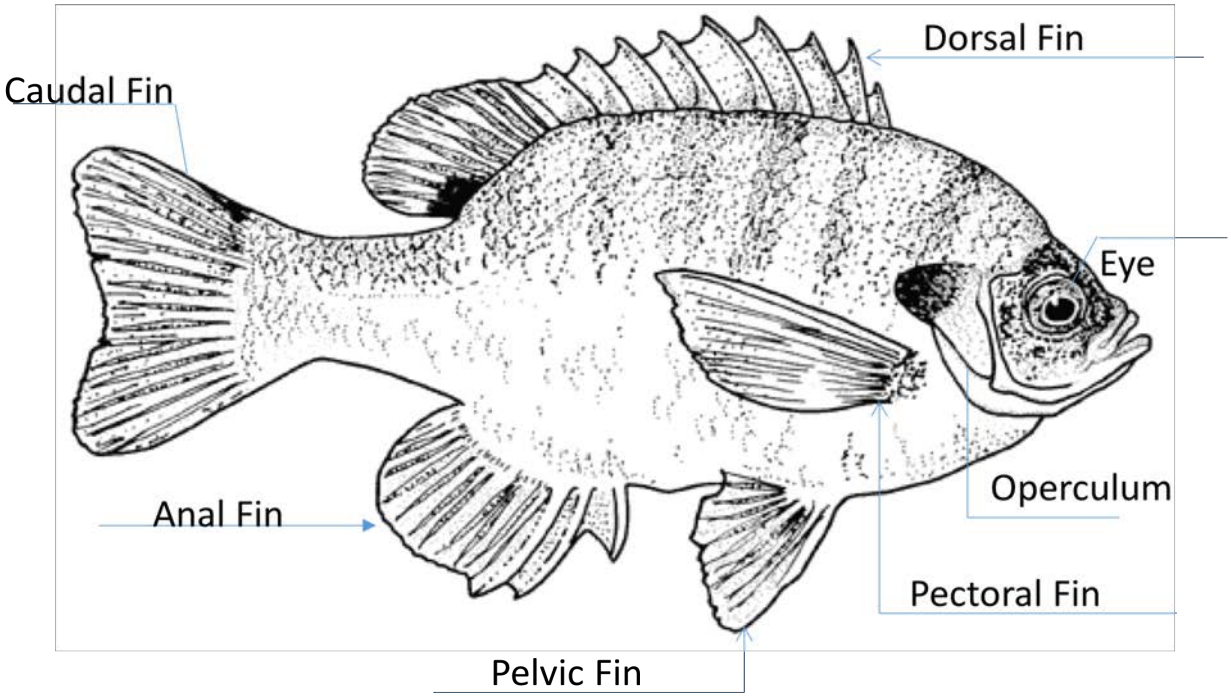
Word Bank: Caudal Fin Operculum Eye Anal Fin

Dorsal Fin Pelvic Fin Pectoral Fin

How do the different fins help fish swim?

Caudal: _____
Dorsal: _____
Pectoral: _____
Pelvic/anal: _____

Label the Fish Key



Word Bank: Caudal Fin Operculum Eye Anal Fin Dorsal Fin Pelvic Fin Pectoral Fin

How do the different fins help fish swim?

Caudal: Propels fish forward
Dorsal: stability- balance and stay upright in water
Pectoral: Steering left and right
Pelvic/anal: brakes- slow down and stop

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:

_____

_____

_____

_____

Got Bones?

A *vertebrate* is an animal _____ bones.

An *invertebrate* is an animal _____ bones.

Match the animal as an invertebrate or a vertebrate

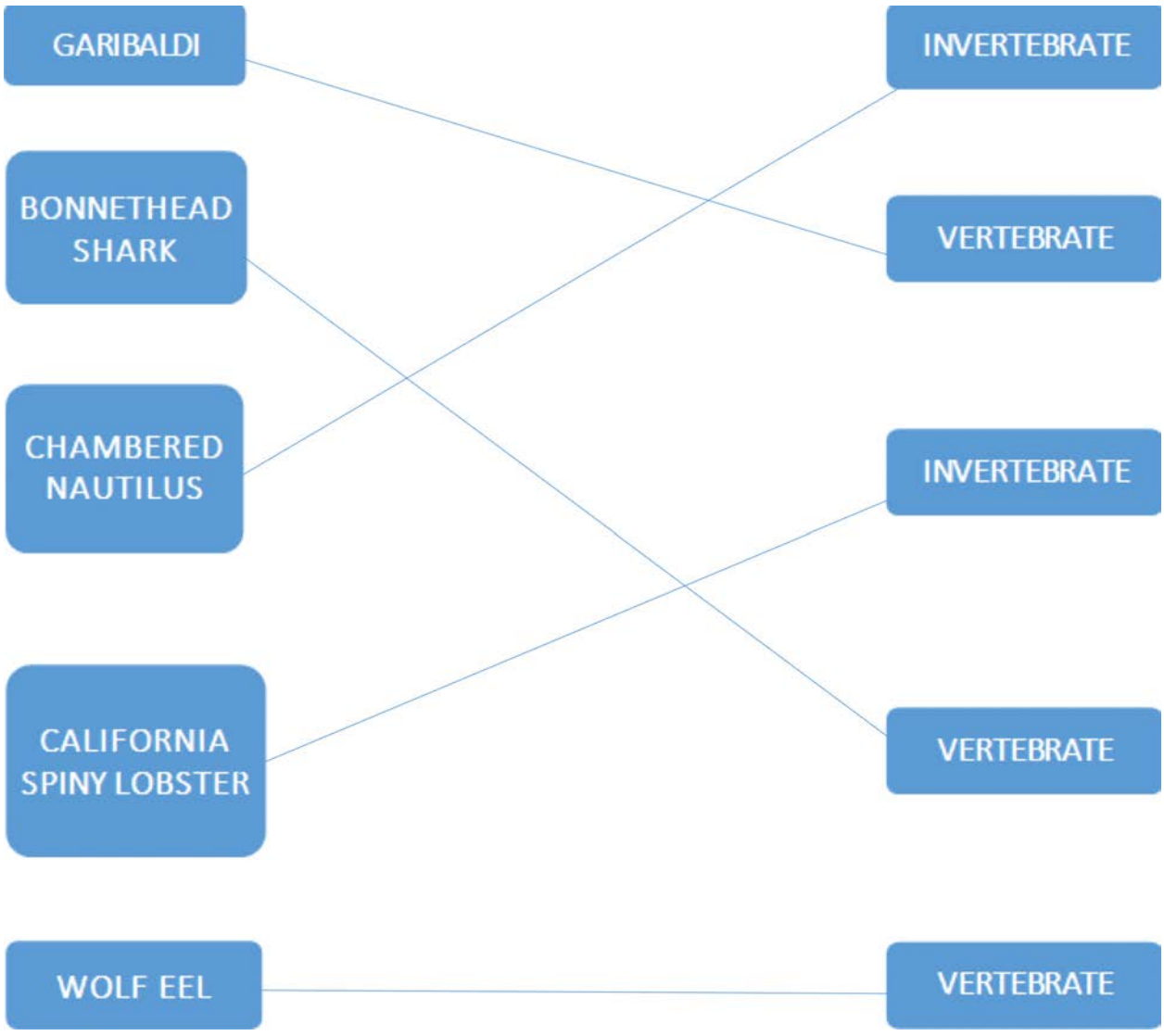
GARIBALDI	INVERTEBRATE
BONNETHEAD SHARK	VERTEBRATE
CHAMBERED NAUTILUS	INVERTEBRATE
CALIFORNIA SPINY LOBSTER	VERTEBRATE
WOLF EEL	VERTEBRATE

Got Bones? (Key)

A *vertebrate* is an animal _____WITH_____ bones.

An *invertebrate* is an animal _____WITHOUT_____ bones.

Match the animal as an invertebrate or a vertebrate



Writing an Expository Essay

Paragraph #1 – Introduction

Topic Sentence: _____

_____

_____

Major Idea #1: _____

Major Idea #2: _____

Major Idea #3: _____

Closing Sentence: _____

_____

_____

Paragraph #2 – Major Idea #1 is discussed completely and with evidence

Topic Sentence: _____

_____

_____

Major Idea #1: _____

Major Idea #2: _____

Major Idea #3: _____

Closing Sentence: _____

_____

_____

Paragraph #3 – Major Idea #2 is discussed completely and with evidence

Topic Sentence: _____

_____

_____

Major Idea #1: _____

Major Idea #2: _____

Major Idea #3: _____

Closing Sentence: _____

_____

_____

Classifying Ocean Animals

Place an X in the box that matches with the animal's characteristics.

Ocean Animal	Fins	No Skeleton	Breathes Air	Swims	Lay Eggs	Flippers
Sea Urchin						
Fish						
Crab						
Sea Turtle						
Sea Anemone						
Sharks						
Jellyfish						
Sea Lion						

Total:

Tally up the total number of X's from each category and create a bar graph of your findings.

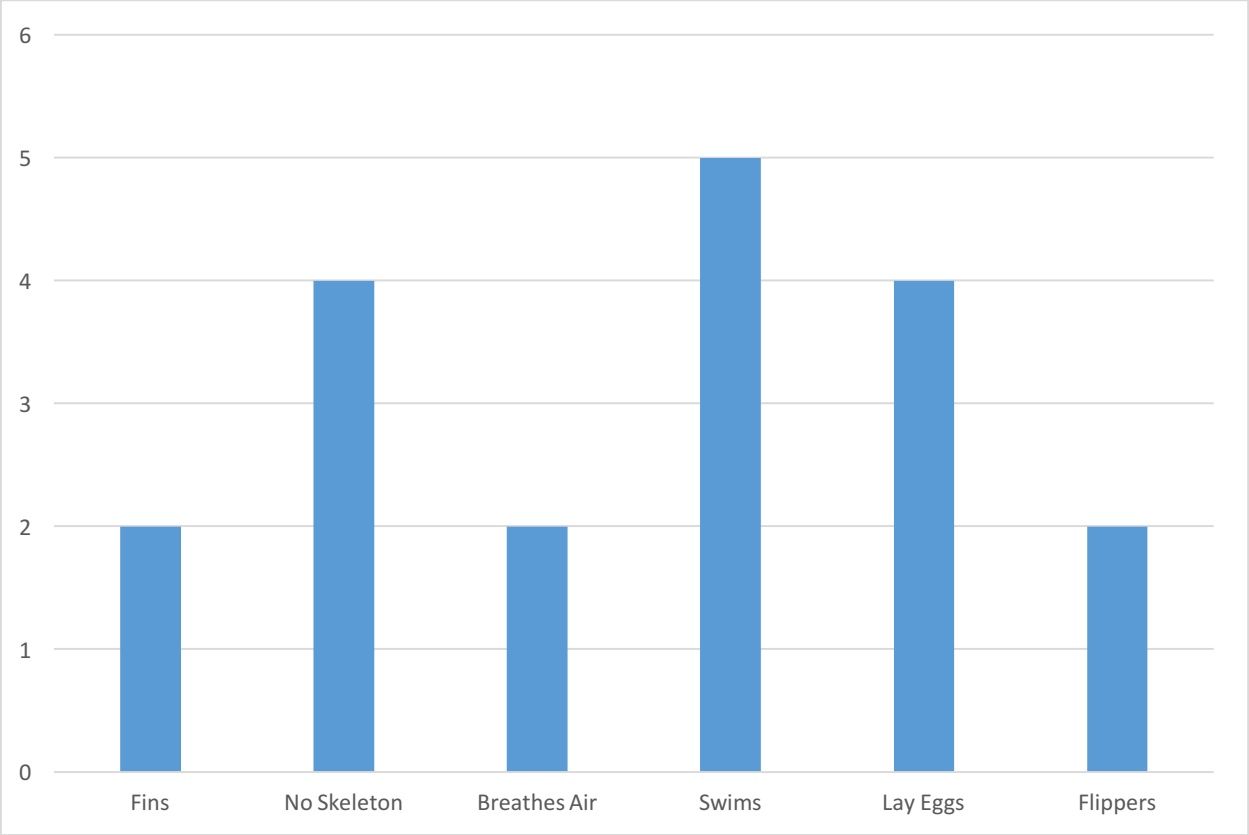
Classifying Ocean Animals Key

Place an X in the box that matches with the animal's characteristics.

Ocean Animal	Fins	No Skeleton	Breathes Air	Swims	Lay Eggs	Flippers
Sea Urchin		X				
Fish	X			X	X	
Crab		X			X	
Sea Turtle			X	X	X	X
Sea Anemone		X				
Sharks	X			X	X	
Jellyfish				X		
Sea Lion			X	X		X
Total:	II	III	II	(5)	IIII	II

Tally up the total number of X's from each category and create a bar graph of your findings.

Classifying Ocean Animals Key

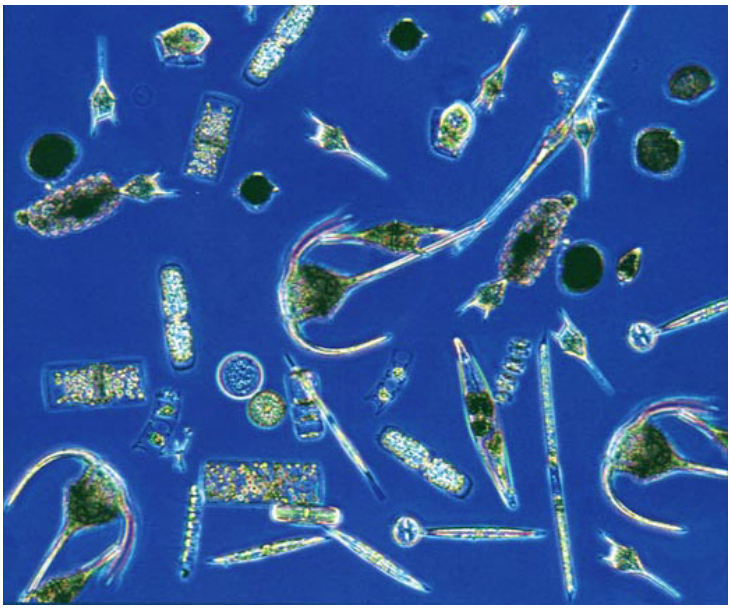


Plankton Lab

In a drop of water, there are countless microorganisms called plankton! Plankton is microscopic plants or animals. Plankton that is similar to animals is called zooplankton and plankton that is similar to plants is called phytoplankton. Collect water from a local lake or other source and use a microscope at school to identify your plankton.

Zooplankton

Phytoplankton

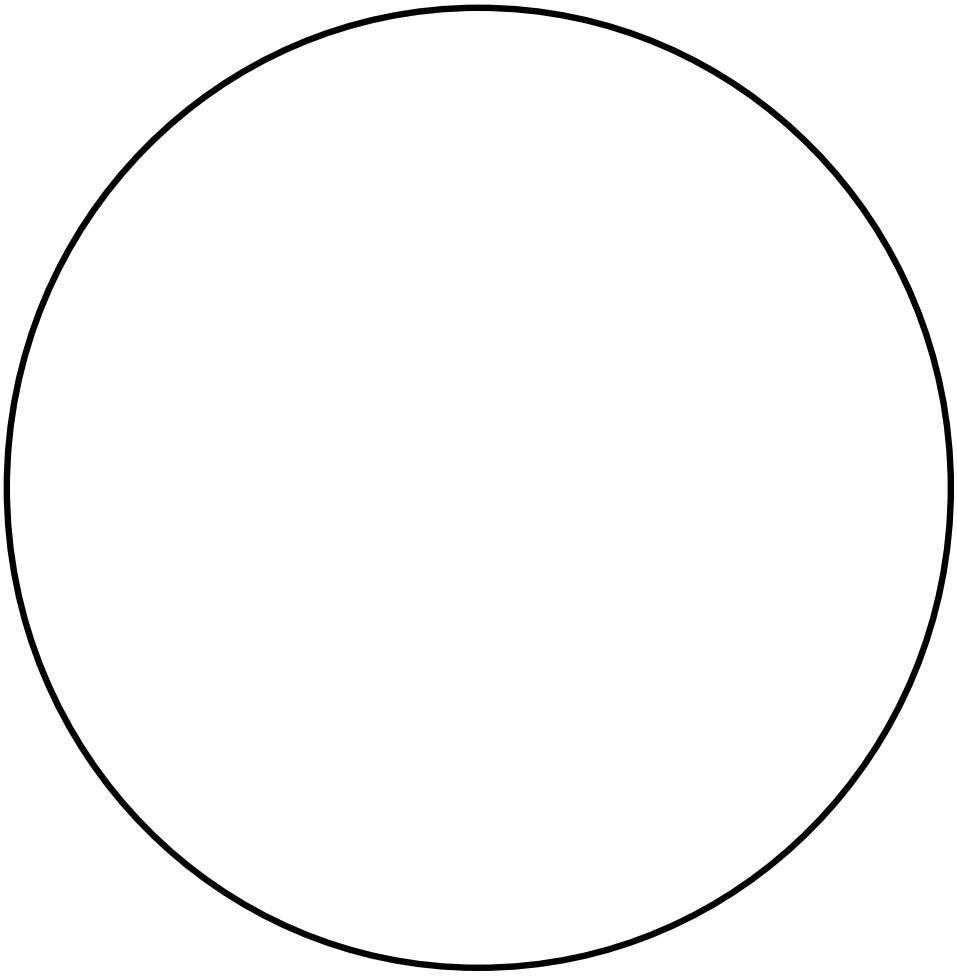


Zooplankton typically has many feather-like appendages to help with movement and a mouth to eat phytoplankton.

Phytoplankton is usually shaped simply and is slightly green due to the photosynthetic properties it has- it uses the sun to make its own food like a plant.

Plankton Lab

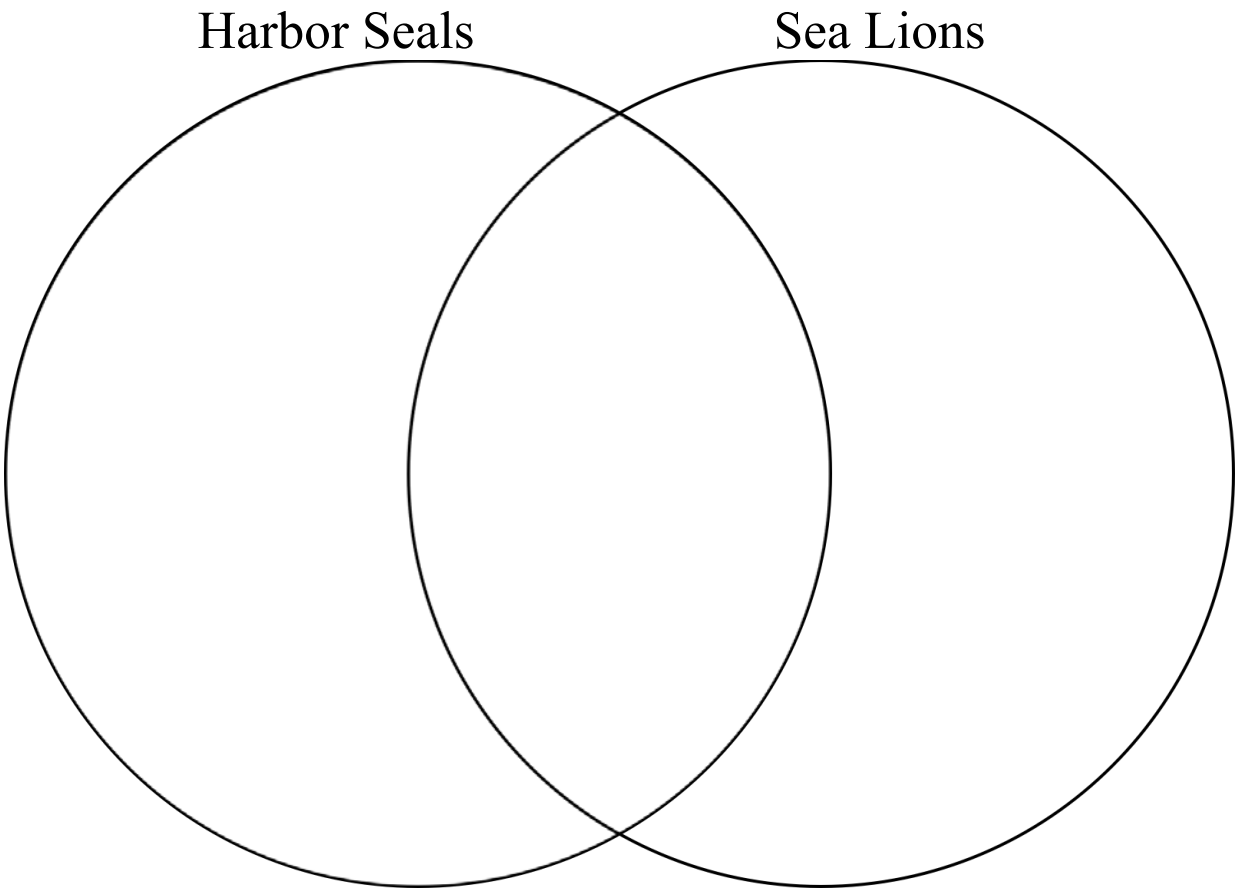
View your sample of water and draw the plankton you see. Circle your favorite plankton and write if it is zooplankton or phytoplankton and why.



My Plankton: _____

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?

_____

_____

_____

_____

_____

Scavenger Hunt

How long can Green Moray Eels grow?

What habitat do Yellow Head Jaw fish live?

What species of Sea Turtle live at OdySea Aquarium?

How many Sea Lions live at OdySea Aquarium?

How much can Goliath Groupers weigh?

What is the Conservation Status of Butterfly Pyramid fish?

Scavenger Hunt Key

How long can Green Moray Eels grow? 8 feet

What habitat do Yellow Head Jaw fish live? They make their own burrows of coral and sand.

What species of Sea Turtle live at OdySea Aquarium? Green Sea Turtles

How many Sea Lions live at OdySea Aquarium? 6 sea lions

How much can Goliath Groupers weigh? 680 pounds

What is the Conservation Status of Butterfly Pyramid fish? Endangered