# Ocean Scientists & Ocean Champions

## Educator's Guide

Aquarium Pyramid at Moody Gardens®
Education Department

MOODY GARDENS
Education Department

# Ocean Scientists & Ocean Champions

## Educator's Guide

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# Contents

# Introduction

**Moody Gardens® is a public, non-profit educational destination utilizing nature in the advancement of rehabilitation, conservation, recreation and research.**

Moody Gardens® was founded in Galveston, Texas, in 1986 as a horse barn and riding arena to offer equine-assisted therapy for people with head injuries. Today, Moody Gardens® is one of the premier education recreational facilities in the southern United States.

The Education Department at Moody Gardens® strives to provide learning experiences for our guests that instill enthusiasm, appreciation and stewardship for the natural world and its inhabitants. From teacher workshops and field trips to sleepovers and birthday parties, kids of all ages will have an experience like no other!

For more information, contact Education at 1-800-582-4673, ext. 4290, or at http://www.moodygardens.org/education/

We'd love to see you at Moody Gardens® in one of our education programs.

Moody Gardens
Education Department


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# Acknowledgments

We'd like to acknowledge and thank those responsible for developing and contributing to this Educator's Guide.

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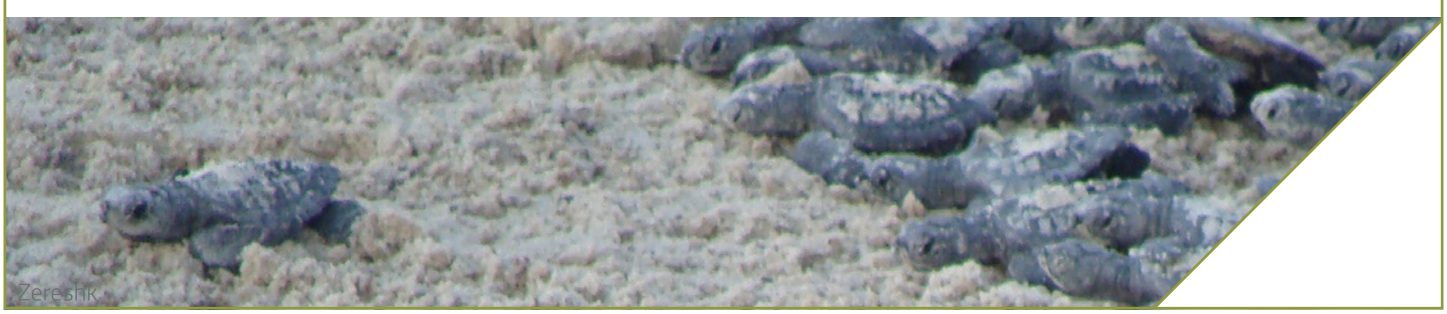


# Your Field *Trip*

## Field Trip Preparation

We're looking forward to welcoming you to an exciting educational trip to the Aquarium Pyramid at Moody Gardens®. We've developed this Educator's Guide and the activities within to support a great field trip experience.

During your field trip we would like your students to experience being ocean scientists and becoming ocean champions. This Educator's Guide is organized by grade bands (K-2, 3-5, 6-8, 9-12) with each band focusing on a particular aspect of oceanography and ocean conservation. Within each grade band are four activities:

- The pre-visit activity will ready your students to be ocean scientists studying the marine worlds on display at the Aquarium.
- The Aquarium activity will help your students conduct observational studies during their field trip, just as ocean scientists would study the ocean.
- The post-visit activity will aid your students with analyzing and sharing the data they gathered at the Aquarium.
- The final activity is to encourage your students to become ocean champions in their community, working to understand and protect local environments.

# Your Field *Trip* (continued)

## The Aquarium Pyramid®

The Aquarium exhibits showcase aspects of Earth's ocean that will inspire your students with awe and spark their imaginations. Each exhibit gallery highlights our relationship with the ocean, which covers about 70% of our blue planet. Within our planet's single interconnected ocean are many unique ocean regions and basins, each with its own geological, chemical, physical, biological and cultural properties. You'll see that each exhibit gallery is full of wonder and adventure.

During your visit you will travel from the Gulf of Mexico to the South Atlantic, the South and North Pacific, and the Caribbean. In addition, you'll view special exhibits on jellies (jellyfish), penguins, corals and ocean conservation. You can learn more at http://www.moodygardens.org. Here's a preview of the areas you can explore.

### Gulf of Mexico

***Thematic Focus: A Bountiful Basin***

Gulf of Mexico water lapping the Texas shoreline is likely the most familiar ocean region to you. Yet the vast, warm, bountiful Gulf is as complex as its 250 million-year history. It's bounded by the United States to the north and east, by Mexico to the west, and by Cuba to the south. Because of its bounty, it's the engine that drives Texas' climate and economy.

- Area: 615,000 square miles (1.6 million km$^2$) covering 0.3% of the Earth's surface
- Average depth: 4,874 feet (1486 m)
- Aquarium Habitats: Open waters, coral reefs and rigs-to-reefs platforms.

### South Atlantic

***Thematic Focus: Extreme Icy Wilderness***

Monster waves, wild wind, icy conditions and the remote location make the South Atlantic a tough place to live. The South Atlantic and North Atlantic are close to the same size, separated by currents and countercurrents along the equator. In the cold, harsh environments of the South Atlantic live almost all of the world's penguin species.

- Area: 15.5 million square miles (40.2 million km$^2$) covering about 11% of Earth's surface
- Greatest depth: South Sandwich Trench at 27,650 feet (8428 m)
- Aquarium Habitats: Rugged rocky islands, icy open waters and dark seafloor.

# Your Field *Trip* (continued)

## South Pacific
***Thematic Focus: Center of Coral Diversity***

The South Pacific is exotic and dreamy with warm, crystal-clear waters and stunningly beautiful islands. This is where the richest coral reefs grow — more coral species than any other ocean region. It's also the location of the deepest trench: the Challenger Deep on the southern end of the Mariana Trench at almost 36,000 feet (11000 m) below the surface. That's over a mile deeper than Mount Everest is high!

- Aquarium Habitats: Open waters, coral reefs and lagoons.

## North Pacific
***Thematic Focus: Vast and In Danger***

Imagine a mighty, majestic and moody body of water that covers more of the Earth's surface than any other ocean region and contains the world's most beautiful and diverse underwater kelp forests. The North and South Pacific together blanket 30% of the Earth's surface (60 million square miles or 155 million km$^2$).

- Aquarium Habitats: Rocky shores, kelp forests and deep reefs.

## Caribbean Sea
***Thematic Focus: Diversity & Mosaic of Habitats***

The Caribbean Sea is a tropical arm of the Atlantic Ocean. It's home to the world's second largest coral reef system. That's due to a land-to-sea ecosystem that combines flooded mangrove forests, swaying seagrass meadows and vibrant corals. It's surrounded by Mexico's Yucatan Peninsula, Central America, South America and the Greater and Lesser Antilles.

- Area: 1.06 million square miles (2.75 million km$^2$) covering 0.5% of Earth's surface
- Average depth: 8,685 feet (2647 m)
- Aquarium Habitats: Coral reefs, seagrass meadows and mangrove forests.

Even though most of the Earth's surface is ocean, about 95% of the ocean is unexplored. What does that mean for the future? There's a place for everyone who is interested in studying or caring for the ocean.

# Your Field *Trip* (continued)

## Field Trip Theme: Ocean Scientists & Ocean Champions

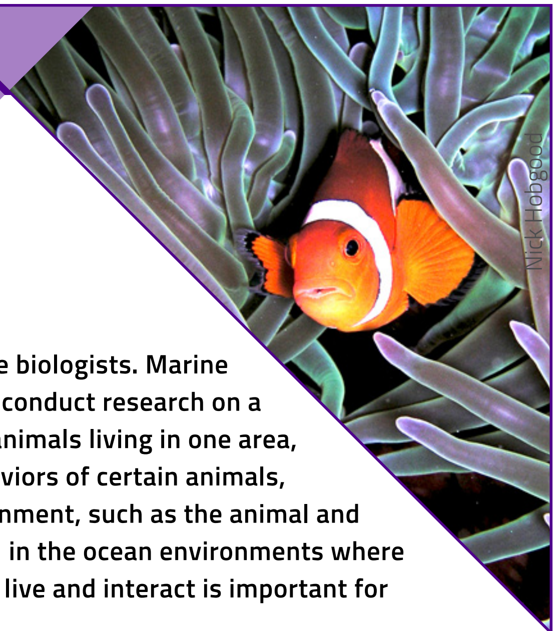
An ocean scientist or oceanographer, in the broadest sense, is someone who studies the ocean. Ocean scientists base their studies on data gathered by observations, measurements, samples or models. Oceanography specialties are as vast as the ocean itself — physics, chemistry, geology and biology primarily — but also working in oceanography are ecologists, archaeologists, engineers, lawyers and policy makers, medical professionals and more. With only about 5% of the world's ocean explored, ocean-related careers await just about any professional.

And, you don't have to be a scientist to get involved with the ocean. Anyone can be an ocean champion by advocating for the health and well being of the ocean, everything that lives in it and everyone who relies on it. This includes teachers and students who recycle at school and home to keep trash out of the Gulf, to the people who work with and for Moody Gardens®: veterinarians and animal caretakers, technicians, educators, managers, marketers, accountants and maintenance staff. For our planet, everyone can and should be an ocean champion.

Throughout the Aquarium you'll find information about ocean scientists and ocean champions, as well as the conservation status of many animals and tips on how you can help the ocean every day.

# Teacher Overview

K–2




**Grades K–2**

## Ocean *Homes*

**Scientists who study ocean organisms (ocean life) are called marine biologists. Marine biologists approach their research in a variety of ways. They might conduct research on a particular group of animals, for example sea turtles, or a group of animals living in one area, such as all the shrimp species in the Gulf. They may study the behaviors of certain animals, such as whales, or how animals interact with others in their environment, such as the animal and plant life on a coral reef. Marine biologists work in offices, labs and in the ocean environments where the organisms are. Knowing the nature of organisms and how they live and interact is important for understanding how the ocean works and how healthy it is.**

**For your Aquarium field trip, students will take on the role of marine biologists by investigating the shapes of ocean animals and how their shapes help them where they live. This lesson consists of four activities that work together: one at school before your trip, one during the field trip, one for reflection back at school, and a culminating session in your community.**

### Lesson Objectives

As a result of your field trip and these activities, students will...

- experience what it's like to be a marine biologist working on a research project
- observe, describe and classify ocean animals based on their external physical characteristics, in particular their body shapes, and practice identifying two-dimensional shapes and three-dimensional solids
- create animal models and place them in the proper ocean habitat (home) based on their Aquarium observations
- apply what they learned to organisms in their schoolyard or neighborhood.

### Lesson Scope & Sequence

In pairs at school, students will investigate two-dimensional shapes (circle, triangle, square, rectangle, rhombus, hexagon, oval and star), or three-dimensional solids (cylinder, cube, sphere, triangular pyramid, rectangular prism, cone, fusiform and sinusoid) as they relate to the basic body plans (shapes) of ocean animals. During the field trip, students will identify and match a variety of ocean animals to the shapes they studied in class, and gather data on where the animals live and how the shape might help the animals in their habitats (homes).

Then, back at school students will make 3-D models of the animals they observed and place those animals in their habitats. They will then describe in their own words why the shape helps the animal live where it lives. Finally, students will apply their new understanding by looking for organisms (animals or plants) in their schoolyard or local park, and then drawing what they find with a shape as the foundation for the drawing. To wrap-up they will discuss how shapes help organisms live in their homes.

# Teacher Overview

## Table 1. Shapes and Animal Examples at the Aquarium

**Teacher Key**

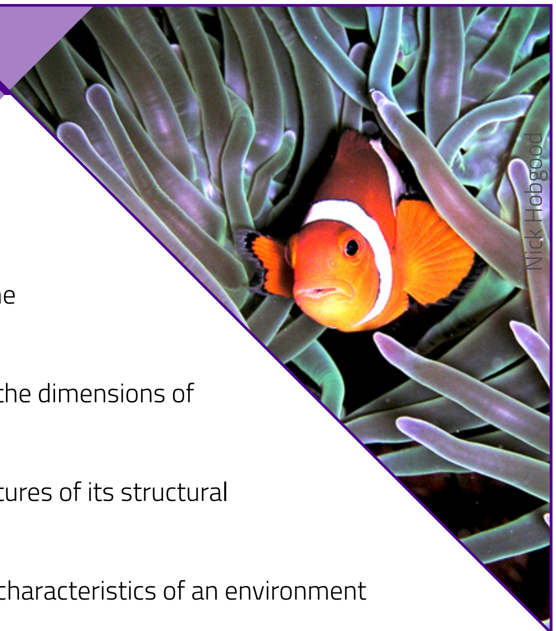
| 2-D | Animal Example | Ocean Home | Shape for... | Aquarium Location |
|---|---|---|---|---|
| circle* | moon jelly | open water | moving through open water | Jellies Gallery |
| hexagon* | Kemp's ridley sea turtle | open water | swimming in water and moving on land | South Pacific |
| oval | blue tang | coral reef or platform reef | swimming | Gulf of Mexico, Caribbean, South Pacific |
| rectangle* | rock beauty | coral reef | swimming | Gulf of Mexico |
| rhombus* | cownose ray | sandy bottom | hiding on the seafloor | Caribbean |
| square* | smooth trunkfish | coral reef | body armor for protection | Gulf of Mexico |
| star | bat star | rocky bottom | 5 arms for feeding & moving | North Pacific |
| triangle* | French angelfish | around reef or platform | swimming | Gulf of Mexico, Caribbean |

| 3-D | Animal Example | Ocean Home | Shape for... | Aquarium Location |
|---|---|---|---|---|
| cone | penguin | open water & on land | flying through water | South Atlantic |
| cube* | sharpnose puffer | around reef | for protection | Gulf of Mexico |
| cylinder* | giant green anemone or plumose anemone | bottom | sitting on bottom and catching food in water | North Pacific |
| fusiform | reef shark | reef lagoon | fast swimming | Caribbean, South Pacific |
| rectangular prism* | balloonfish | coral reef | for protection | Gulf of Mexico, Caribbean, South Pacific |
| sinusoid | moray eel | rock or coral cave | hiding in caves and swimming | Caribbean, South Pacific |
| sphere* | purple sea urchin | rocky bottom | sitting on the bottom | North Pacific |
| triangular pyramid* | purple ringed topsnail | bottom or on kelp | protection of body inside shell | North Pacific |

** indicates shapes or solids listed in the TEKS*

# Teacher Overview

K-2




## Vocabulary List

**2-D** abbreviation for two-dimensional: having the dimensions of width and length (or height)

**3-D** abbreviation for three-dimensional: having the dimensions of width, length (or height) and depth

**body plan** the architecture of an animal, the major features of its structural and functional design

**ecosystem** the sum total of the biological and physical characteristics of an environment

**fusiform** shaped like a spindle or rocket with a rounded middle tapering at each end, such as a shark or tuna

**habitat** a specific type of environment, the place where an animal or plant lives, such as a sandy shore or rocky reef

**marine biologist** a scientist who studies marine (ocean) organisms, e.g., whales, shrimps or fishes, as well as their habitats (homes where they live). Also called a biological oceanographer.

**ocean** there's one global ocean, that is, an interconnected body of salt water that covers most (70%) of the Earth's surface and within which are several regional oceans

**ocean region** the term we're using in this packet to distinguish between a single global ocean and various regional oceans (identified based on history, culture, geography and science), such as the Gulf of Mexico or the South Pacific

**organism** a single living thing, such as an animal, plant, fungus or bacterium

**sinusoid** shaped like a sine curve or sine wave, such as a snake or eel

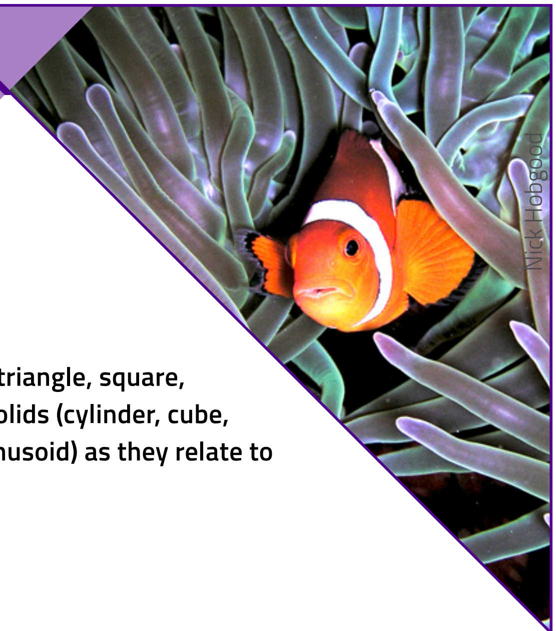
**species** the same type of living things that can mate and produce other living things of the same type, e.g., the red drum is a species of fish that mates with and produces other red drums only

**three-dimensional** an object or solid shape having (or appearing to have) the dimensions of width, length (or height) and depth; abbreviated as 3-D

**two-dimensional** a shape that has the dimensions of width and length (or height); abbreviated as 2-D

# Activity 1

K-2




AT SCHOOL

## What's my Shape?

**At school, students will investigate two-dimensional shapes (circle, triangle, square, rectangle, rhombus, hexagon, oval and star), or three-dimensional solids (cylinder, cube, sphere, triangular pyramid, rectangular prism, cone, fusiform and sinusoid) as they relate to the basic body plans (shapes) of ocean animals.**

### Time & Materials

- This activity could take a class period (30 to 60 minutes).
- Students could work in pairs for this activity.
- Each student pair will need
  - crayons, pencils, colored paper, scissors, tape or glue.

### Activity Instructions

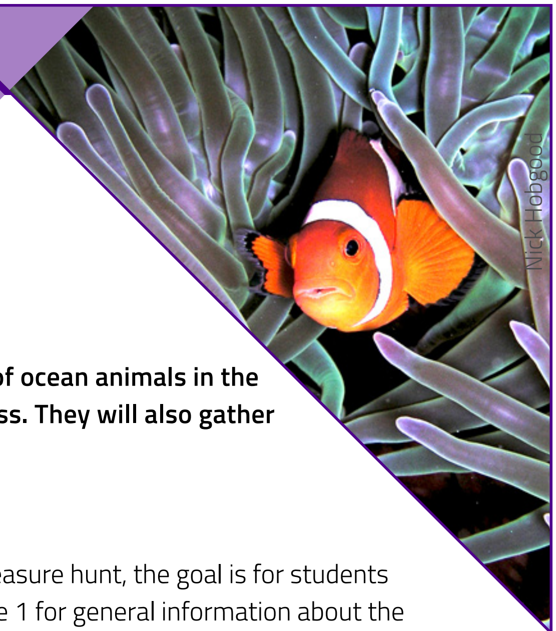
Introduce your students to these 2-D shapes (if they don't know them already): circle, hexagon, oval, rectangle, rhombus, square, star and triangle. Or, if they're already familiar with those shapes, you can introduce them to these 3-D solids: cone, cube, cylinder, fusiform, rectangular prism, sinusoid, sphere and triangular pyramid.

Give each student pair a set of animal cards and the matching shape or solid cards (see pages 16 to 23) that you decided to focus on for this activity and their Aquarium visit. Have students work together to match each shape with an ocean organism (see Table 1 for a list of ocean animal examples that most closely match each shape).

Then have student pairs make a booklet that shows each shape or solid next to the matching ocean animal. They will carry this with them during their Aquarium visit and use these booklets to identify Aquarium animals and observe them in their homes.

# Activity 2

K-2




**AT MOODY GARDENS®**

## Find Me at Home

**During the field trip, students will work together to find the variety of ocean animals in the Aquarium in their booklets and match the shapes they studied in class. They will also gather data on where each animal lives, that is, its ocean habitat (home).**

### Time & Materials

- This activity can be done throughout your Aquarium visit, and like a treasure hunt, the goal is for students to find as many of the animals in their booklets as they can. (Use Table 1 for general information about the locations of the animals.)
- Have students work together in pairs or in small groups with chaperones.
- Each student pair (or student group) will need

  -the booklets they made at school

  -help from an adult identifying and writing in the booklets an ocean home for each animal.

### Activity Instructions

Instruct students and chaperones to use the booklets to find in the Aquarium the ocean animals matching the shapes they studied in class. (Use Table 1 to find the general location of each animal.)

Have students observe the animal for a minute or two and decide where each animal lives: What's its habitat (home)? Some ocean habitats are: open water, deep sea, reef lagoon, sandy bottom, rocky bottom, rock caves, a coral reef, a kelp forest, or an oil platform. Students may also be able to place an animal in a specific place in the habitat, such as resting on the sand, or swimming around a reef, or hiding in a reef cave. With the help of chaperones, have students write each animal's home in their booklets. (Use Table 1 to find the habitat of each animal.)

# Activity 3

K-2


BACK AT SCHOOL

## Shapes in the Ocean

**Now it's time to have students analyze the data (shapes, species and habitats) they collected at the Aquarium.**

### Time & Materials

- This activity could take one class period of up to 60 minutes.
- Students could work in pairs for this activity.
- Each student pair will need
  - materials to construct or draw their model animal such as paper, crayons, pencils, scissors, tape or glue.

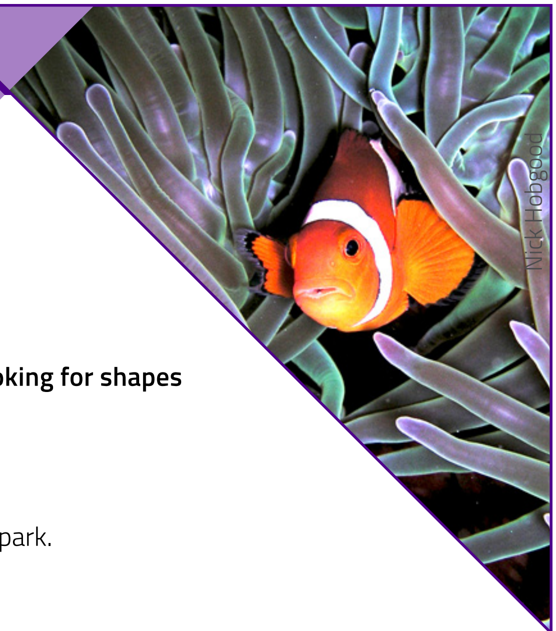
### Activity Instructions

Back at school student pairs will select a favorite ocean animal they observed at the Aquarium and make a 3-D model of the animal and its habitat using their booklet information. (Students could also draw their animal within its habitat instead.)

Then have students describe in their own words (either verbally to the class or written with their model) why they think the animal's shape helps it survive where it lives. (Use Table 1 to help with ideas of how shapes and homes match for each animal.)

# Activity 4

K-2


Nick Hobgood

IN THE COMMUNITY

## Shapes near Me

**Finally, students will apply their new understanding of shapes by looking for shapes in their schoolyard or local park.**

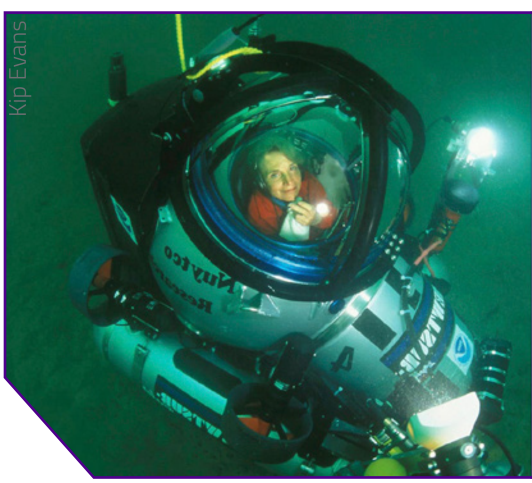
### Time & Materials

- This activity could take one or more class periods in the schoolyard or park.
- Students could work in pairs for this activity.
- Each student will need paper, crayons or pencils for making drawings.

### Activity Instructions

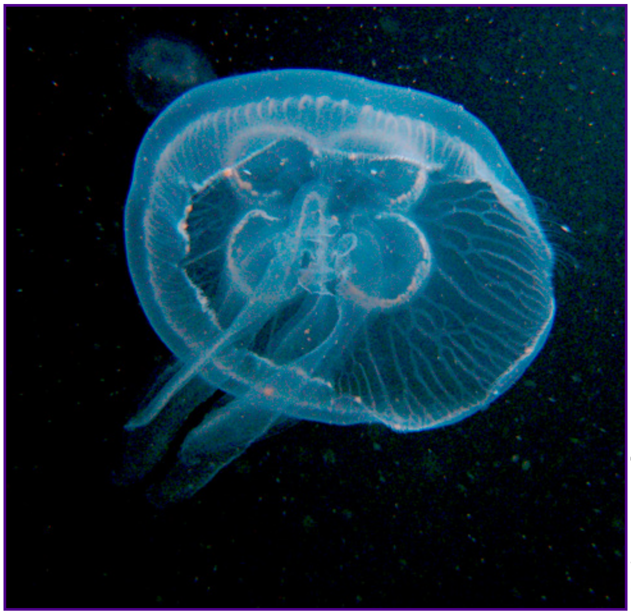
Have students look for shapes in the schoolyard or a local park. These could be shapes of organisms (animals and plants), but also human-made objects (such as baseball or basketball). Have students draw the organisms or objects they find using a particular shape as a foundation.

Discuss with students how particular shapes help things. Ask students: Why is a ball round? What if you took a ball away from a playground and put it in the water? Could it swim? What if you took a fish out of the water and put it on land? Could it walk? Talk about why it's important to let animals live in the homes that best fit their shapes.


Kip Evans

### Ocean Champion: Sylvia Earle

Dr. Sylvia Earle is a marine biologist and ocean explorer. Her favorite shape might be a sphere. She has spent much of her career under the water in sphere-shaped submersibles and other underwater vehicles, such as the *Deep Rover*. She has also lived underwater in an aqualab in the Caribbean. Her job today is as an ocean champion. In 2012, she launched Mission Blue with the goal to establish a global network of marine protected areas she calls "Hope Spots."



BS Thurner Hof

Moon jelly
Ocean home: ________________________

U.S. Fish and Wildlife Service

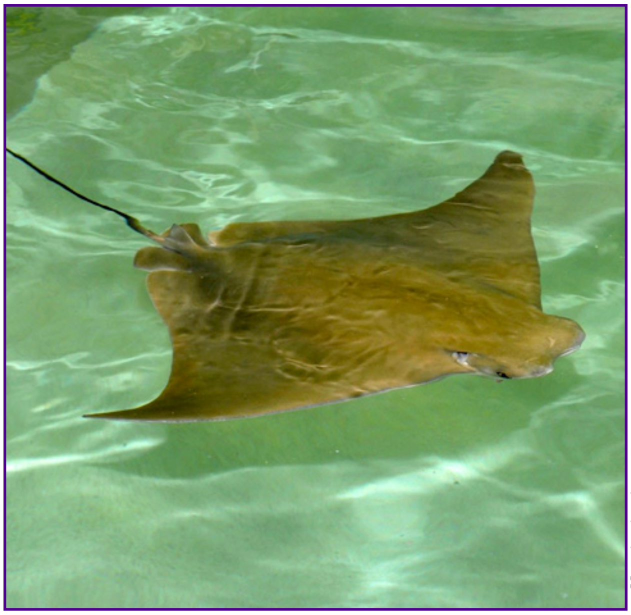
Kemp's ridley sea turtle
Ocean home: ________________________

Brian Gratwicke

Blue tang
Ocean home: ________________________

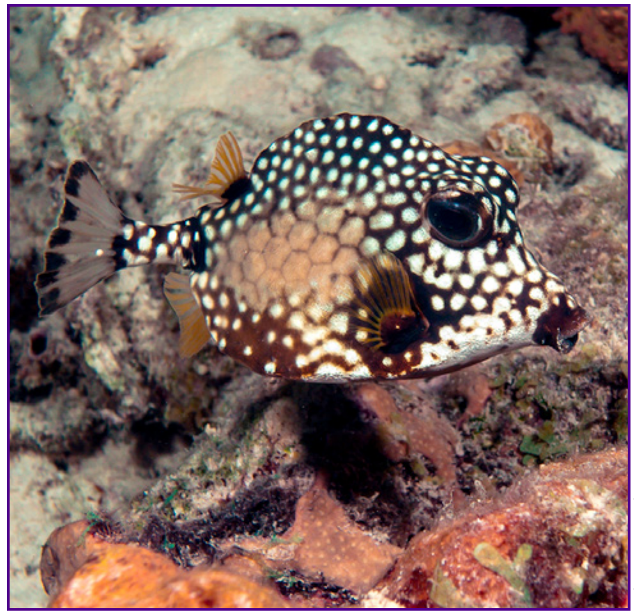
Laszlo Ilyes

Rock beauty
Ocean home: ________________________



Jeff Whitlock

Cownose ray
Ocean home: ____________________



John A. Anderson

Smooth trunkfish
Ocean home: ____________________

Jerry Kirkhart

Bat star
Ocean home: ____________________

Reese, OAR/National Undersea Research Program (NURP)

French angelfish
Ocean home: ____________________


Ben Tubby

Penguin
Ocean home: ___________________________


flowergarden@noaa.gov

Sharpnose puffer
Ocean home: ___________________________


Tim Sheerman-Chase

Plumose anemone
Ocean home: ___________________________


Stefan Pircher

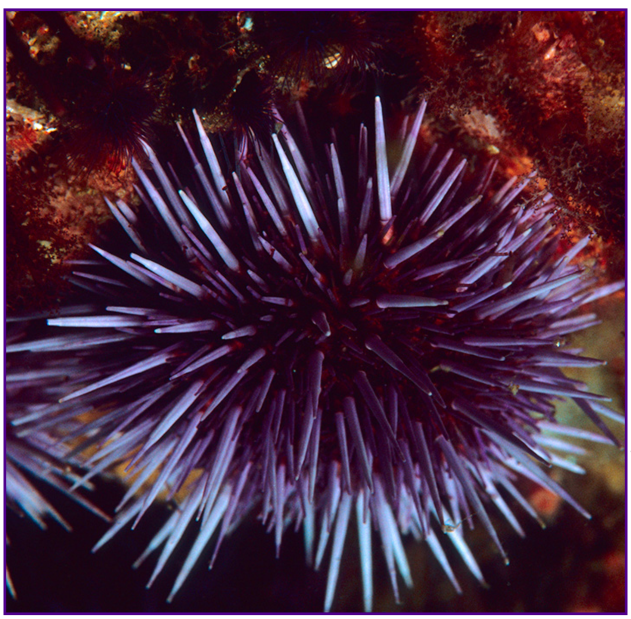
Reef shark
Ocean home: ___________________________

Rich Carey

Balloonfish
Ocean home: ____________________

Laszlo Ilyes

Moray eel
Ocean home: ____________________



Dr. Dwayne Meadows, NOAA/NMFS/OPR

Purple sea urchin
Ocean home: ____________________

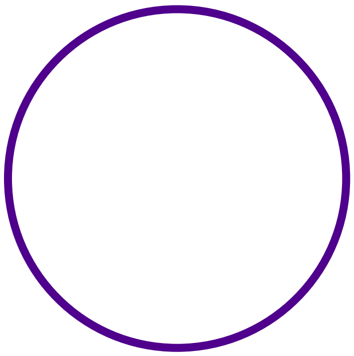
Steve Lonhart (SIMoN / MBNMS)

Purple ringed topsnail
Ocean home: ____________________

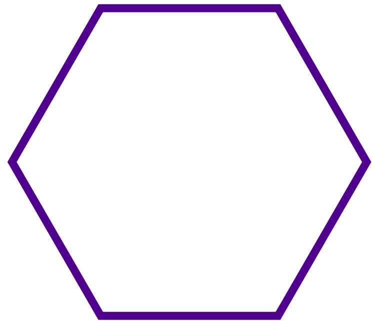
# 2D Shape Cards for Animals

K-2

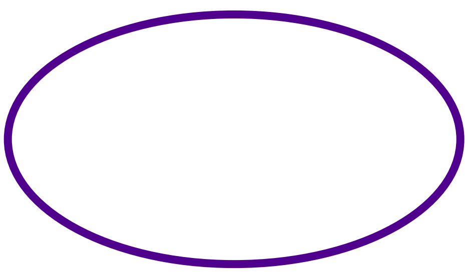
## Set 1



Circle

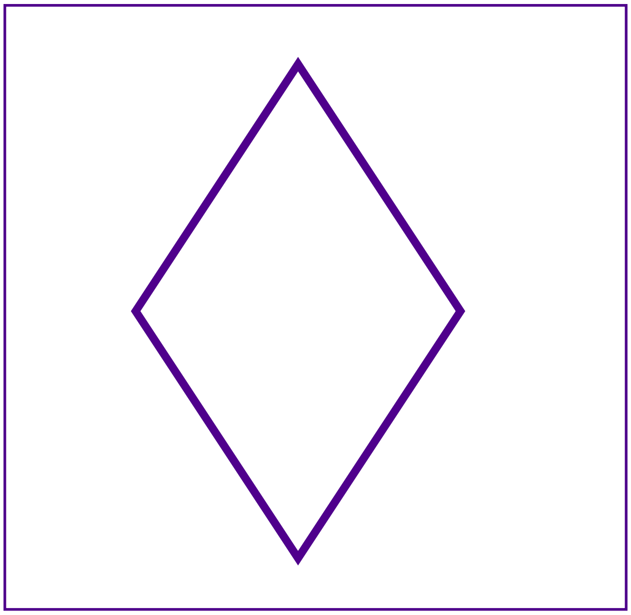


Hexagon

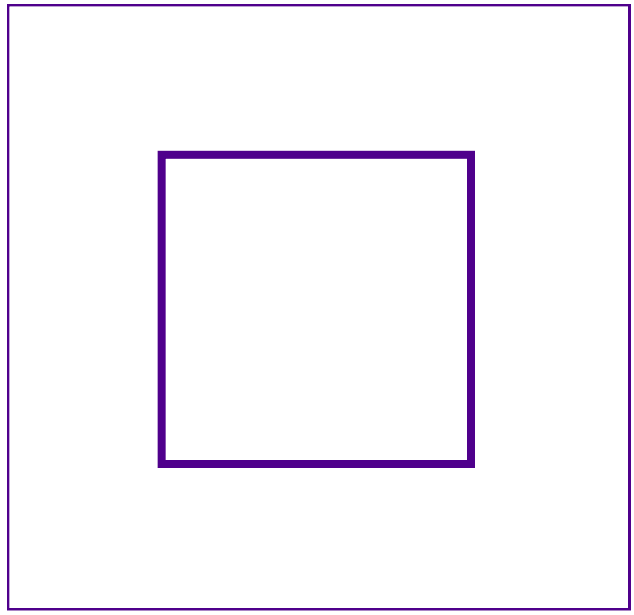


Oval

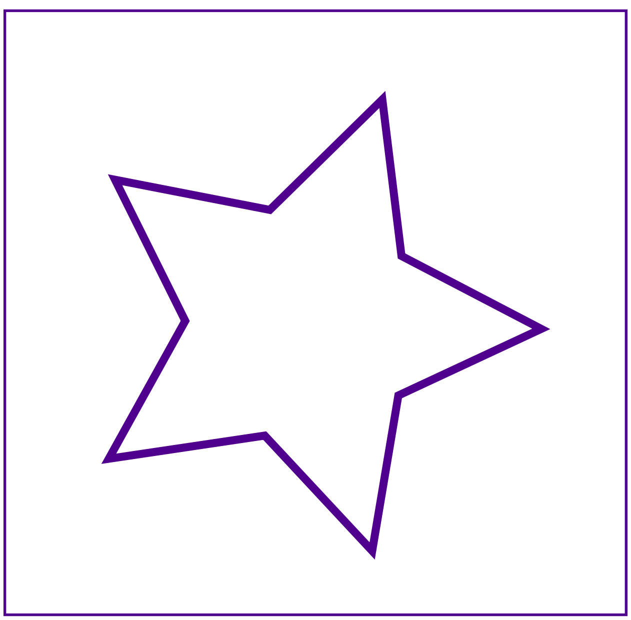
Rectangle



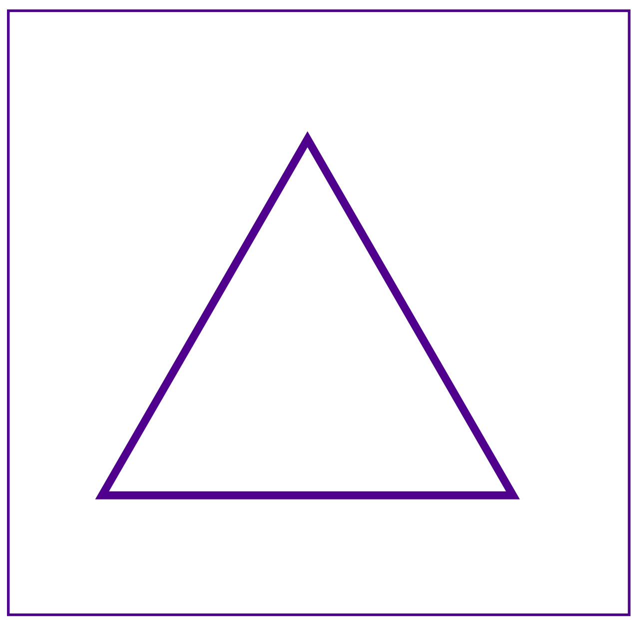
Rhombus



Square



Star

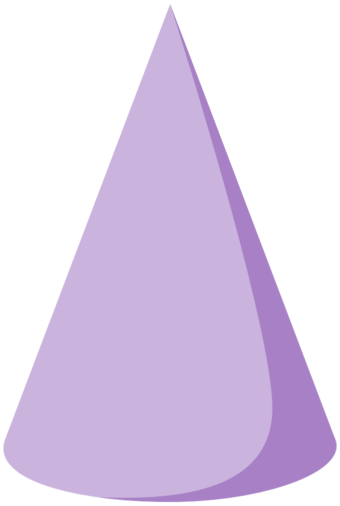


Triangle

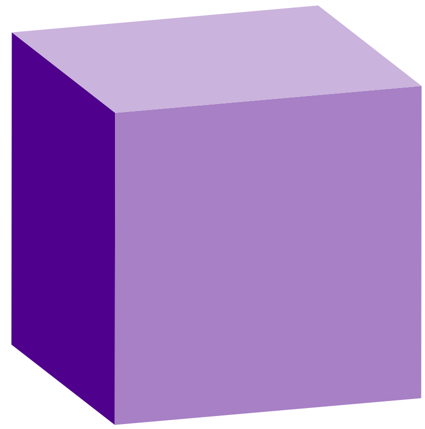
# 3D Shape Cards for Animals

K-2

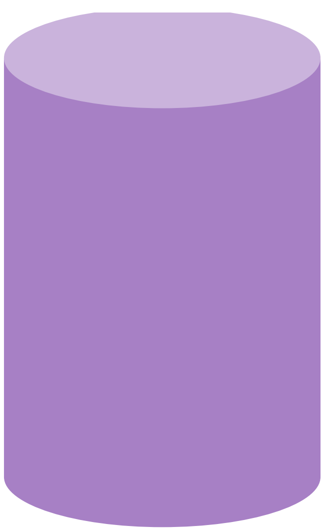
Set 2



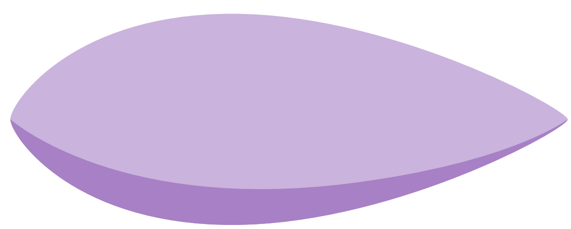
Cone



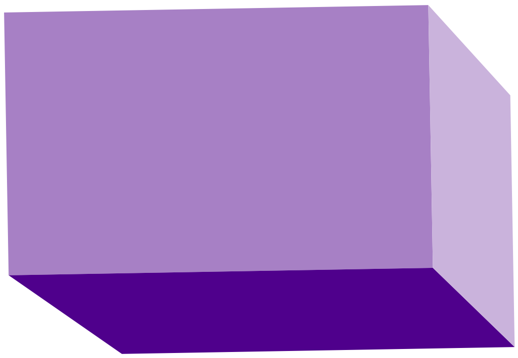
Cube



Cylinder

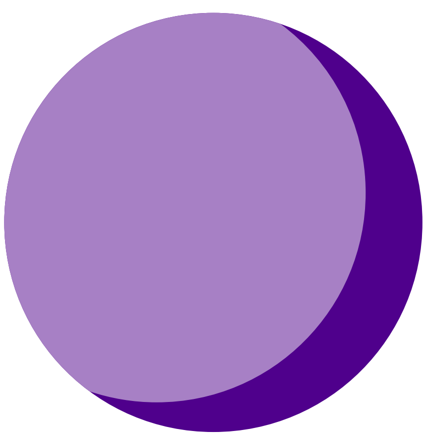


Fusiform

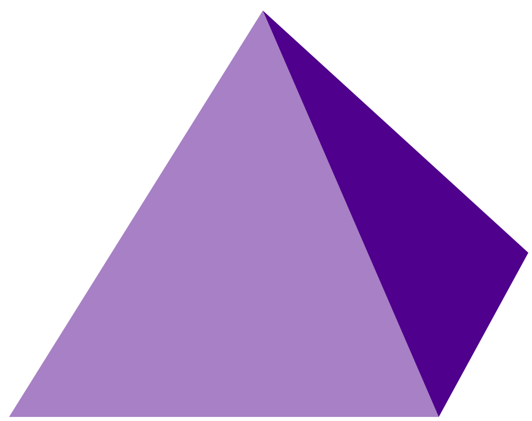


Rectangular prism

Sinusoid



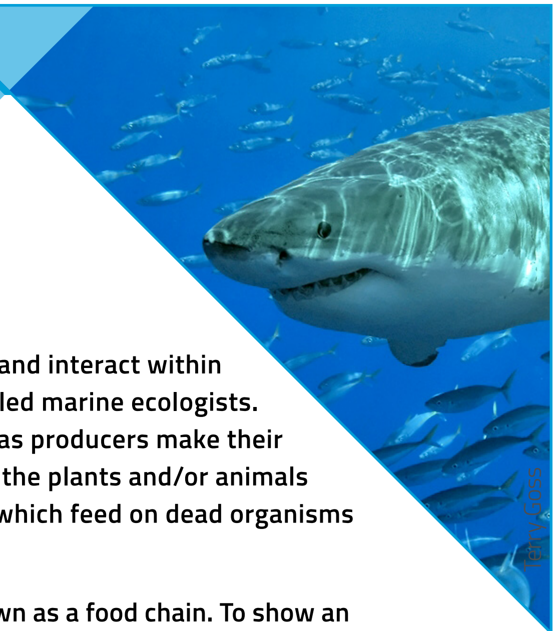
Sphere



Triangular pyramid

# Teacher Overview

3–5



Grades 3–5

# Ocean *Dining*

**Some ocean scientists study how animals and plants live together and interact within their particular environment or ecosystem. These scientists are called marine ecologists. Ecologists know that all life needs energy to live. Plants and algae as producers make their energy from sunlight. Animals as consumers get their energy from the plants and/or animals they eat or consume. In addition, in this system are decomposers, which feed on dead organisms and waste material.**

**A simple feeding diagram from producers to consumers is often drawn as a food chain. To show an ecosystem's complex feeding interactions with many different kinds of consumers (herbivores, carnivores and omnivores), a food web is drawn. (See References & Resources for more about food webs and food chains.) In even a very complex food web there are usually only three or four feeding levels (called trophic levels). To show the transfer of energy through those levels from producers to consumers to decomposers, a pyramid is often used. For an ecosystem to be balanced and work well, there must be more producers at the bottom and only a few carnivores at the top of a trophic (feeding) pyramid (see Figure 1).**

**For your Aquarium field trip, students will take on the role of marine ecologists and investigate ocean animals and how they fit within their ecosystem's food pyramid. This lesson consists of four activities that work together: one at school before your trip, one during the field trip, one for reflection back at school, and a culminating session in your community.**

## Lesson Objectives

As a result of your field trip and these activities, students will...

- experience what it's like to be a marine ecologist working on a research project
- observe, describe and classify ocean animals based on what they eat and the feeding role they play in an ecosystem
- role-play a chosen animal and create a class feeding structure (trophic pyramid) to determine if their ecosystem would work (is balanced), and if not, make changes for balancing the ecosystem
- apply what they learned to be ocean champions.

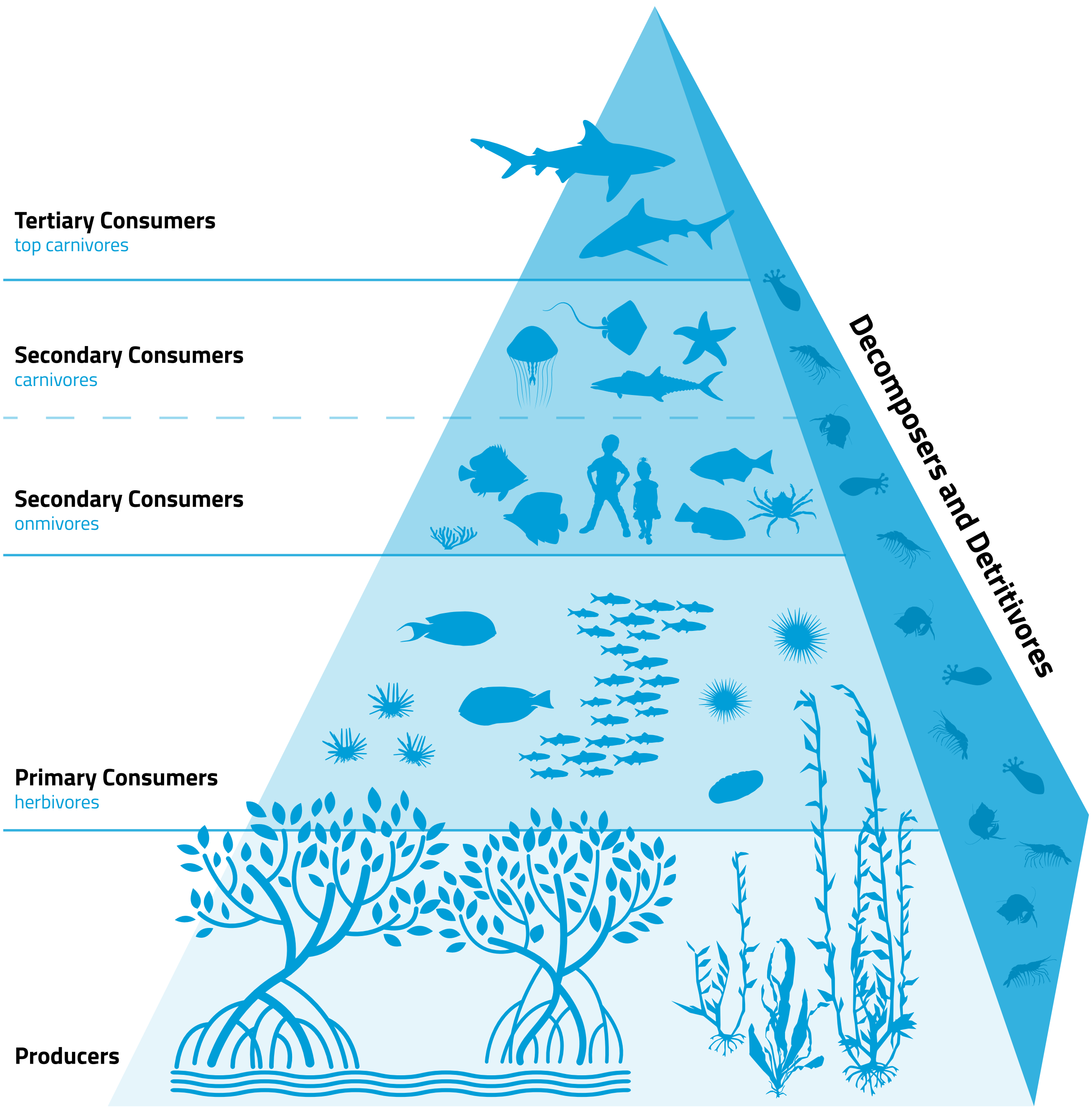
## Lesson Scope & Sequence

In teams at school, students will research animals in the food webs and at different trophic levels in a kelp forest ecosystem (North Pacific) or coral reef ecosystem (South Pacific or Caribbean). During the field trip, students will identify at least one organism at each trophic level and gather data on where it gets its energy to determine if it's a producer, consumer or decomposer.

Back at school students will choose an animal to role-play, and then as a class organize by trophic levels to determine if their ecosystem works or not, and how to fix it if it doesn't work. Finally, students will apply their new understanding by starting an ecology study or habitat improvement project in their community.

# Teacher Overview

## Figure 1: Food Pyramid



# Teacher Overview

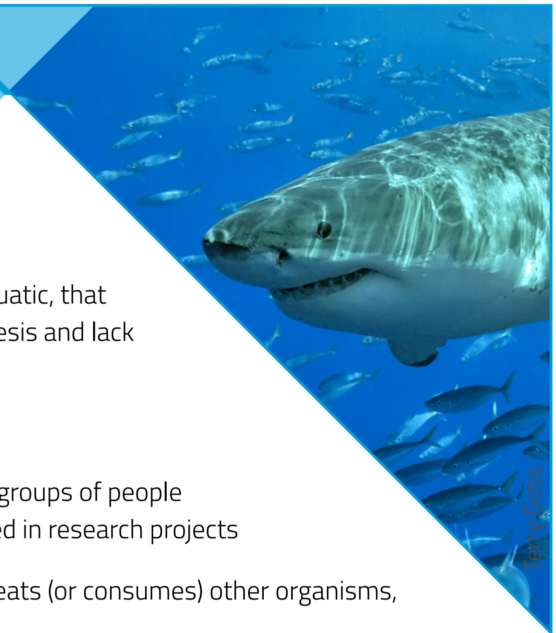
## Table 1. Aquarium Organisms and Trophic (Feeding) Levels

Teacher Key

| Trophic (Feeding) Level | Animal Examples | Food | Aquarium Location & Habitat |
|---|---|---|---|
| Tertiary Consumers (top carnivores) | | | |
| | sharks (large) | mammals, fishes | Caribbean (coral reefs) |
| | whales<br>sea otters | fishes, invertebrates<br>invertebrates | Not in the Aquarium |
| Secondary Consumers (carnivores) | | | |
| | sharks & rays<br>other fishes | fishes, invertebrates | North Pacific (kelp forest), South Pacific, Caribbean (coral reefs) |
| | jellies (jellyfish) | fishes, other jellies, invertebrates | Jellies Gallery |
| | sea stars | mussels, clams, snails | North Pacific (kelp forest), South Pacific (coral reefs) |
| | California sea lions and harbor seals | fishes | North Pacific (kelp forest) |
| Secondary Consumers (omnivores) | | | |
| | damselfishes | crustaceans, sponges, plankton, algae | Gulf of Mexico, South Pacific (coral reefs) |
| | butterflyfishes | crustaceans, worms, plankton | Gulf of Mexico, South Pacific (coral reefs) |
| | corals | plankton<br>with partner algae | North Pacific (deep sea), South Pacific (coral reefs) |
| | humans | most everything | throughout the Aquarium |
| Primary Consumers (herbivores) | | | |
| | surgeonfishes, doctorfishes and tangs | algae | Gulf of Mexico, South Pacific (coral reefs) |
| | sea urchins | algae | North Pacific (kelp forest), South Pacific (coral reefs) |
| | gumboot chiton | algae | North Pacific (kelp forest) |
| Producers | | | |
| | alga (giant kelp) | sunlight | North Pacific (kelp forest) |
| | plants (mangroves) | sunlight | Caribbean (coral reefs) |
| Decomposers and Detritivores | | | |
| | sea cucumbers | detritus (decaying material) | North Pacific (kelp forest) |
| | shrimps | detritus (decaying material) | Gulf of Mexico, South Pacific (coral reefs), North Pacific (kelp forest) |

# Teacher Overview

3-5




## Vocabulary List

**alga (pl. algae)** a variety of plant-like organisms, mostly aquatic, that typically contain chlorophyll for photosynthesis and lack true roots, stems or leaves

**carnivore** an animal that eats other animals

**citizen science** science conducted by non-scientists, often groups of people collecting or analyzing data that may be used in research projects

**consumer** in a food chain or food web, an animal that eats (or consumes) other organisms, either plant and/or animal

**crustaceans** a group of animals that includes shrimps, lobsters, crabs, barnacles, isopods and pill bugs

**decomposer** an organism that consumes dead or dying animals, plants and/or the waste material they produce

**detritivore** an animal that eats organic matter that's dead or decaying (called detritus)

**detritus** bits of dead and decaying organic matter from decomposing plants and animals

**ecosystem** the sum total of the biological and physical characteristics of an environment

**food pyramid** a diagram that shows the transfer of energy through feeding levels (called trophic levels) in a food web

**food web** a diagram that shows the complex feeding interactions of producers, consumers and decomposers within an ecosystem

**habitat** a specific type of environment, the place where an animal or plant lives, such as a sandy shore or rocky reef

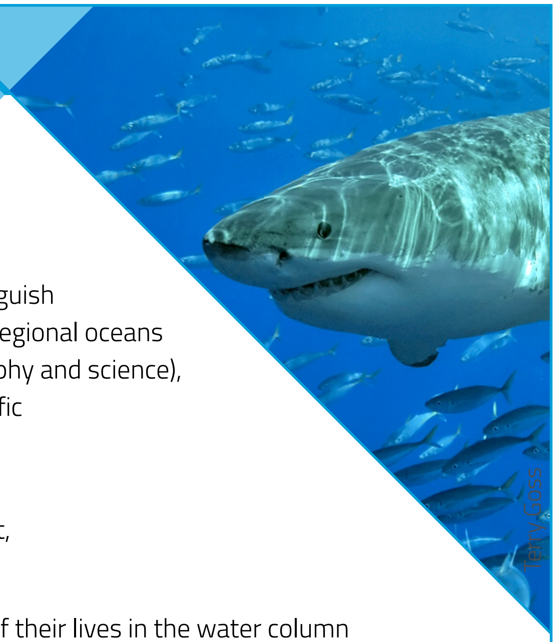
**herbivore** an animal that eats plants or algae

**invertebrate** an animal that lacks a spinal column (backbone), such as sea stars, jellies, molluscs and crustaceans

**marine ecologist** a scientist who studies the relationships of marine (ocean) organisms and their interactions with their environment.

**molluscs** a group of animals that includes snails, clams, mussels, chitons, octopus & kin

**ocean** there's one global ocean, that is, an interconnected body of salt water that covers most (70%) of the Earth's surface and within which are several regional oceans



## Vocabulary List (continued)

**ocean region** the term we're using in this packet to distinguish between a single global ocean and various regional oceans (identified based on history, culture, geography and science), such as the Gulf of Mexico or the South Pacific

**omnivore** an animal that eats animals and plants

**organism** a single living thing, such as an animal, plant, fungus or bacterium

**plankton** tiny plants and animals that live all or part of their lives in the water column

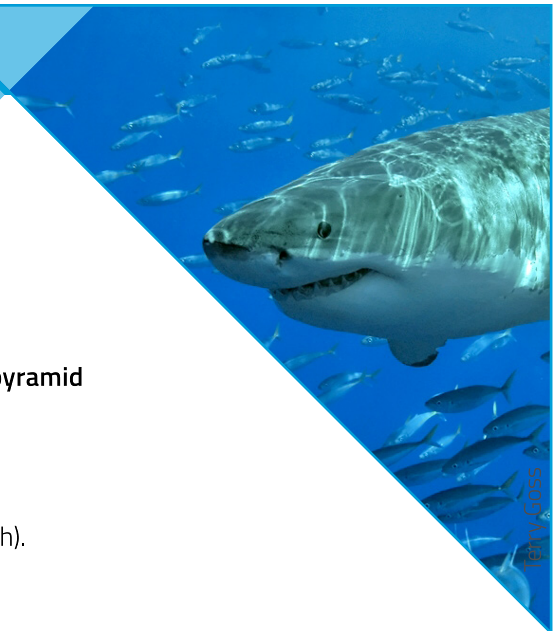
**producer** in a food chain or food web, an organism (e.g., a plant or alga) that makes the food it needs from sunlight (or in deep-sea environments from chemicals)

**species** the same type of living things that can mate and produce other living things of the same type, e.g., the red drum is a species of fish that mates and produces other red drums only

**trophic level** a feeding or energy transfer level within an ecosystem

# Activity 1

3-5



AT SCHOOL

## What's my Role?

**At school, students will investigate the roles of animals in the food pyramid of a kelp forest or coral reef ecosystem.**

### Time & Materials

- This activity could take one or two class periods (up to 60 minutes each).
- Students could work in pairs or in small groups.
- Each student pair or group will need drawing materials, such as paper (or the Workbook page), pens and/or pencils.

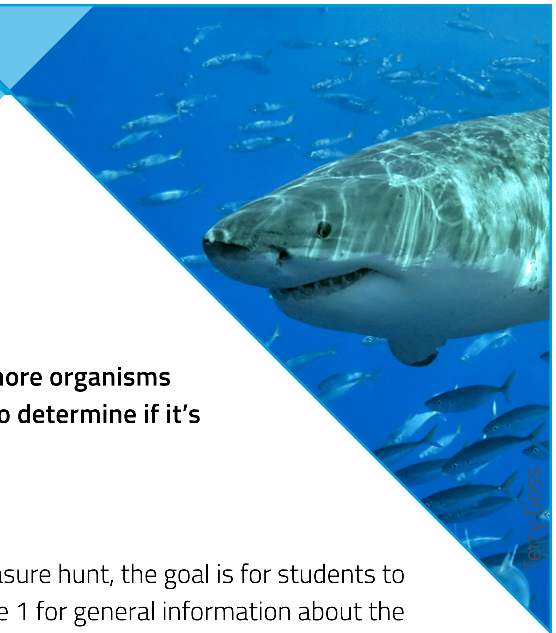
### Activity Instructions

Working in small groups or teams, have students research, draw and label a kelp forest food pyramid or a coral reef food pyramid using Worksheet 1 (see pages 33 or the References & Resources list for online resources). Encourage them to include producers, consumers (herbivores, omnivores and carnivores) and decomposers in their diagram and link them to show what eats what. You can also provide them with the list of animals in Table 1 that live in the ecosystem they're drawing and they might find during their visit to the Aquarium.

Next have them make a booklet with the cards on pages 34-36 to take on their field trip to help them identify animals. In the Aquarium the kelp forest ecosystem is displayed in the North Pacific gallery and coral reef ecosystems are on display in the Caribbean and South Pacific galleries. You may want to collect the booklets at the end of this activity and return them to students at the start of their Aquarium field trip.

# Activity 2

3-5



AT MOODY GARDENS®

## What's my Trophic Level?

**During the field trip, students will work together to identify one or more organisms at each feeding level of a food web and gather data on what it eats to determine if it's a producer, consumer or decomposer.**

### Time & Materials

- This activity can be done throughout the Aquarium visit, and like a treasure hunt, the goal is for students to find as many of the organisms in their booklets as they can. (Use Table 1 for general information about the locations of the organisms.)
- Have students work together in pairs or in small groups with chaperones.
- Each student (or each student group) will need
  - the food web or food pyramid diagram they made at school
  - the booklet they made at school
  - help from chaperones to identify organisms and write in the booklets the trophic (feeding) level for each organism
  - blank pages to add organisms to their booklets.

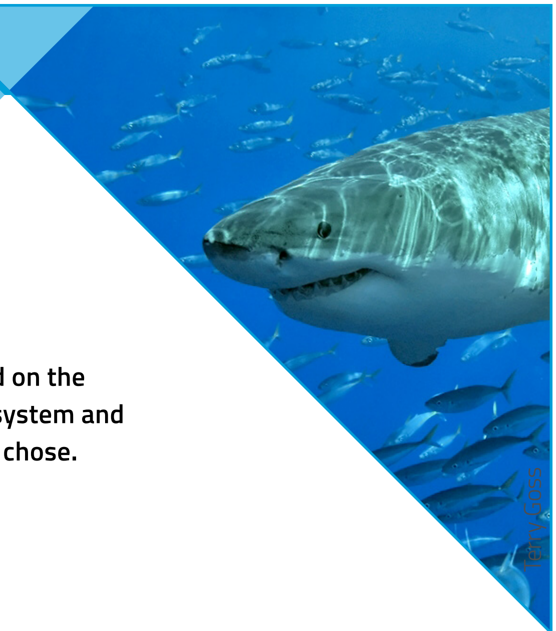
### Activity Instructions

Return students' booklets before entering the Aquarium. Instruct students and chaperones to use the booklets to locate the ocean organisms in the diagram that students drew and especially those in their booklets. (Provide chaperones with Table 1 to find the Aquarium locations for each animal or organism.) Have students watch each animal for a few minutes to observe whether or not it's eating, and what it's eating. They can also read signage or the ID monitors to collect data on how each organism gets its food.

With the help of chaperones, have students write the specific name of each animal and its trophic (feeding) level into their booklets. (Use Table 1 to find the Aquarium locations and trophic levels of each organism.)

# Activity 3

3-5



BACK AT SCHOOL

## Does my Ecosystem Work?

**Back at school each student will choose an animal to role-play based on the data collected at the Aquarium and the class will organize as an ecosystem and determine if their ecosystem works based on the roles each student chose.**

### Time & Materials

- This activity might take one class period (up to 60 minutes).
- Students will work individually and then as a class.
- A digital camera or computer for taking photos and projecting onto a whiteboard or screen.

### Activity Instructions

Have students choose an ocean animal to role-play based on the data collected at the Aquarium. They should know what they are, where they fit in the food web (what they eat and what eats them) and what their trophic level is.

In a large open room or the schoolyard have students organize themselves as a trophic levels pyramid (standing on the floor or ground, not stacked on top of one another) with producers at the base and carnivores at the apex of a pyramid (see figure1). *(Note: If you have enough students and variety of animals to role-play, you could role-play a kelp forest and coral reef ecosystem separately. However, since the focus is on trophic levels, you could combine ecosystems for this activity.)* Take a picture of the shape of the class food pyramid from above. Back in the classroom project the image to analyze its shape. Is the group shape structured like a trophic pyramid? (Ideally the shape should be close to a pyramid, with primary producers at the base and few top predators at the apex like Figure 1.)

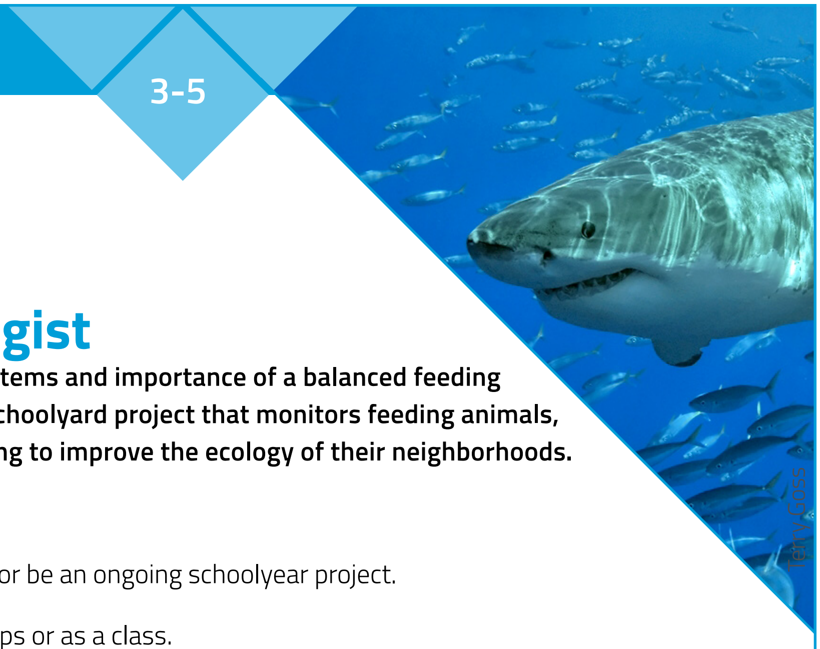
Have students discuss in small groups and then share whether or not this shape (and the food pyramid) works. If they think it doesn't work, have them discuss why: What about the pyramid is off balance? Are there too many producers or too many predators? What changes must they make to balance the ecosystem?

Have students change their animal choices based on trophic levels, then go out and make a new trophic pyramid and take a new photo. Again, review the image data and discuss if they were successful in rebalancing the ecosystem.

For the final discussion, have students answer the question: What can a marine ecologist do if a research study shows that an ecosystem is out of balance?

# Activity 4

3-5




IN THE COMMUNITY

## Be a Community Ecologist

**Finally, now that students understand ecosystems and importance of a balanced feeding structure, they can learn more by starting a schoolyard project that monitors feeding animals, such as birds, or apply their new understanding to improve the ecology of their neighborhoods.**

### Time & Materials

- This activity could take several class sessions or be an ongoing schoolyear project.
- Students could work individually, in small groups or as a class.

### Activity Instructions

Have students decide if they want to learn more about feeding animals or work to improve their neighborhood ecology. Here are some suggestions on projects they could get involved in. There are many other possibilities online.

- Instead of watching fish, have students watch birds and their feeding habits through Project Feeder Watch. They can even try different feeders to attract and study birds at different trophic levels. Visit http://feederwatch.org for more information.
- Habitat Network is a citizen science project where students can engage in improving their schoolyard or neighborhood by mapping and managing local landscapes for wildlife. Visit Yardmap.org for more information.
- Develop a mini ecosystem by planting a schoolyard garden with plants native to your area. Over the school year have students observe the organisms that visit the garden and note what they're feeding on. At the end of the year, diagram the food chain for your schoolyard garden. For ideas about schoolyard gardens, visit Texas Parks & Wildlife: Wildscapes at http://tpwd.texas.gov/huntwild/wild/wildlife_diversity/wildscapes/ or National Wildlife Federation's Gardens for Wildlife at https://www.nwf.org/Garden-For-Wildlife/Create/Schoolyards.aspx


### Ocean Champion: Dee Boersma

Dr. Dee Boersma is an ocean researcher who studies penguins and other seabirds. She has been watching and gathering data about penguins on the Galapagos Islands and Argentina coast for over four decades. Penguins have taught her that pollution, overfishing and climate change threaten all ocean life. Because she cares about the environment, she founded Penguin Sentinels. This conservation group brings together scientists, governments and local people to protect the ocean.

Team Name: ______________________

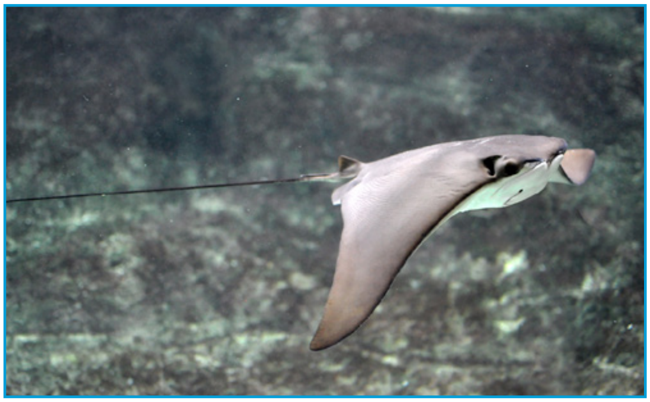
# Ocean *Dining*

Research, draw and label a kelp forest food pyramid or a coral reef food pyramid. Be sure to include producers, consumers (herbivores, omnivores and carnivores) and decomposers. Then link them to show what eats what. Also, add any specific animals that you might find during your Aquarium visit.

# Ocean Dining Cards

3-5

Citron / CC BY-SA 3.0



Shark or Ray Name: ______________________________

Feeding Level: ______________________________

Jerry Kirkhart

Sea Star Name: ______________________________

Feeding Level: ______________________________

Mark William Penny

Jelly (Jellyfish) Name: ______________________________

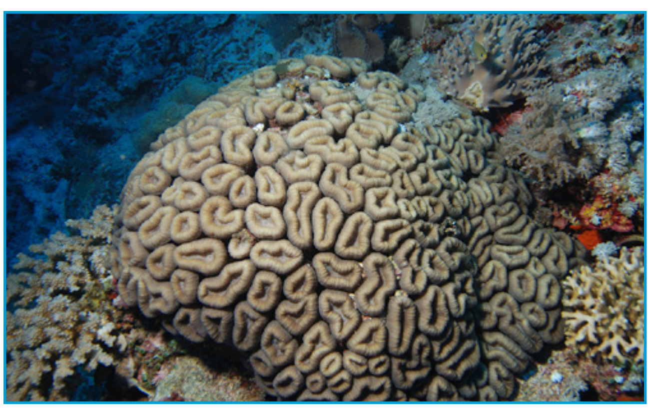
Feeding Level: ______________________________

Brocken Inaglory

Damselfish or Butterflyfish Name: ______________________________

Feeding Level: ______________________________

Albert Kok



Coral Name: ______________________________

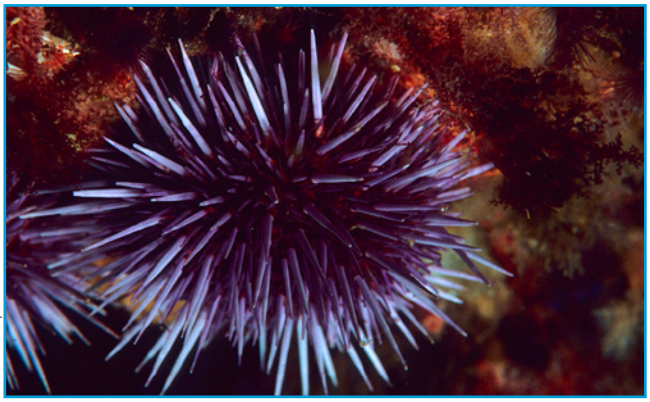
Feeding Level: ______________________________

Brian Gratwicke

Tang Name: ______________________________

Feeding Level: ______________________________

Dr. Dwayne Meadows, NOAA/NMFS/OPR



Sea Urchin Name: ___________________________________

Feeding Level: ______________________________________

National Park of American Samoa

Surgeonfish or Doctorfish Name: ____________________

Feeding Level: ______________________________________

Claire Fackler, CINMS, NOAA

Alga Name: _________________________________________

Feeding Level: ______________________________________

Boricuaeddie

Plant Name: ________________________________________

Feeding Level: ______________________________________

Dr. Bradley Stevens & Eric Munk, NOAA

Sea Cucumber Name: __________________________________

Feeding Level: ______________________________________

Tim

Shrimp Name: _______________________________________

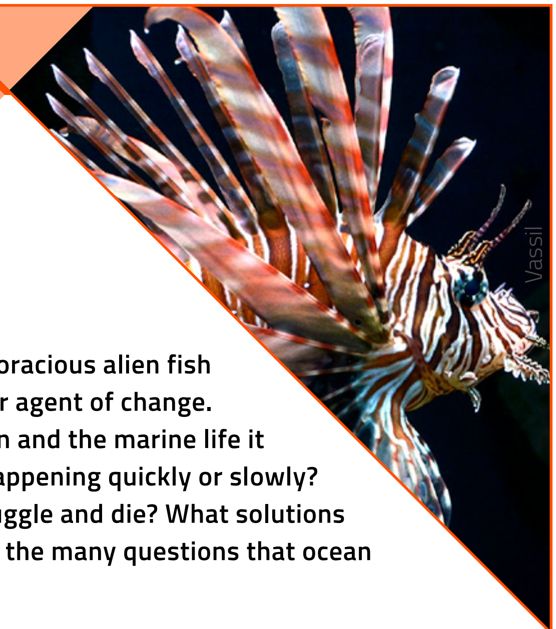
Feeding Level: ______________________________________

# Ocean Dining Cards

3-5

(continued)

| | |
|---|---|
| Organism Name: ____________________<br>Feeding Level: ____________________ | Organism Name: ____________________<br>Feeding Level: ____________________ |
| Organism Name: ____________________<br>Feeding Level: ____________________ | Organism Name: ____________________<br>Feeding Level: ____________________ |
| Organism Name: ____________________<br>Feeding Level: ____________________ | Organism Name: ____________________<br>Feeding Level: ____________________ |




Grades 6–8

# Agents of *Change*

**What do colorless corals, disappearing penguins, plastic nurdles, voracious alien fish and towering oil platforms have in common? Each is an indicator, or agent of change. Ocean scientists often study how agents of change affect the ocean and the marine life it sustains. They ask: Are the changes helpful or harmful? Are they happening quickly or slowly? Will marine life be able to adapt to the changes and survive, or struggle and die? What solutions could ease the impact of negative changes? These are just a few of the many questions that ocean scientists are working on today.**

**For your Aquarium field trip, students will take on the role of ocean scientists and investigate some of the changes that are occurring in today's ocean. This lesson consists of four activities that work together: one at school before your trip, one during the field trip, one for reflection back at school, and a culminating ocean champion session in your community.**

## Lesson Objectives

As a result of your field trip and these activities, students will...

- practice using the scientific method to explore and investigate agents of change in five of the world's ocean regions
- experience what it's like to be ocean scientists and collaborate on researching ocean issues
- be an ocean champion to combat negative changes or facilitate positive changes to help the ocean.

## Lesson Scope & Sequence

In teams at school, students will work as ocean scientists to familiarize themselves with the five ocean regions exhibited in the Aquarium: Gulf of Mexico, South Atlantic, North Pacific, South Pacific or Caribbean Sea (for exhibit gallery details, see page 38). In addition to learning generally about each area, they'll also learn about the major agents of change that each is facing. Their pre-trip research will culminate in each team posing a hypothesis about changes and the agents of change occurring in their ocean region. During the field trip, students will learn more about their ocean region and investigate their hypothesis by observing and recording clues to the area's agents of change.

Back at school, they'll evaluate their data and draw conclusions regarding their hypothesis and whether they should accept or reject it. They will also develop suggestions for what could be done to help mitigate any negative changes. Then, teams will share results during an "oceanography conference" held in class. By viewing each team's research, students will see the interconnectedness of the various ocean regions and the similarities and differences in the changes the ocean and its inhabitants face. Finally, students will apply their new understanding by participating in a citizen science activity and becoming positive agents of change themselves.


# Agents of *Change* (continued)

**Here are some agents of change that students could investigate for each ocean region.**

## Gulf of Mexico

The Gulf of Mexico is dotted with thousands of oil platforms. Before humans built these, the Gulf's offshore habitats consisted primarily of open waters over a silty soft bottom. How has the installation of oil platforms altered bottom and water column ecosystems in the Gulf of Mexico? Have they increased or reduced native species? Have new species moved into the area? If so, where did they originate and how did they arrive? What changes occur when oil platforms are no longer useful for oil production? What can people do to support positive changes and mitigate negative changes?

## South Atlantic

In the South Atlantic penguin populations are in flux. Warmer water temperatures are affecting penguin food sources, mainly tiny shrimplike organisms called krill, as well as fishes. They're also impacting penguin nesting sites on land. How are penguins adapted to their cold, harsh environment? How is their life cycle related to seasonal changes on land and in the water? What's the relationship between temperatures in the ocean and on land in the South Atlantic? Will penguins be able to adapt to a changing ocean? Why or why not? What can people do to support positive changes and mitigate negative changes?

## South Pacific

Over the last century, sea surface temperatures have been rising, indicating global changes. When water temperatures exceed normal range limits, even for just a few weeks, hard corals, which are the primary architects of coral reefs, become stressed. Stressed corals expel the symbiotic algae (zooxanthellae) living within their tissues. This is called coral bleaching, and it often results in the widespread death of corals and coral reefs. What role do zooxanthellae play in the health of corals? What changes occur on the coral reef during bleaching events? How are other coral reef organisms affected? Can corals and coral reefs recover? If so, how quickly or slowly? What can people do to support positive changes and mitigate negative changes?

## North Pacific

Concentrated in the center of the North Pacific by circling currents (gyre) is what's called the "The Great Pacific Garbage Patch" — a collection of debris hundreds of miles wide. Most of the garbage consists of nurdles (plastic pellets) and plastic products that slowly break into smaller and smaller fragments. These bits float in the water column like rice in soup. Fish, sea birds, sea turtles and marine mammals mistakenly eat the plastic as food. Where does the plastic come from? How has this plastic in the North Pacific impacted the animals in the open ocean and their food chain? Does it affect people? Is the North Pacific the only place with a gyre and a "garbage patch"? What can people do to support positive changes and mitigate negative changes?

## Caribbean Sea

In the 1990s (mostly likely) the predatory lionfish (*Pterois* spp.) showed up off Florida and in the Caribbean. This native to the Indo-Pacific is having a catastrophic effect on Caribbean marine life. How is the arrival of this predator changing the Caribbean's ecosystem? What is the lionfish's native habitat like and why isn't it a problem there? Are any Caribbean native species at risk and are any species benefitting? What can people do to support positive changes and mitigate negative changes?

# Teacher Overview

6–8


Vassil

## Vocabulary List

**biological oceanographer** a scientist who studies life in the ocean

**citizen science** science conducted by non-scientists, often groups of people collecting or analyzing data that may be used in research projects

**chemical oceanographer** a scientist who studies the chemistry and chemical interactions in the ocean

**coral bleaching** a phenomenon that occurs when corals are stressed, often by overly warm water, causing them to expel their zooxanthellae

**ecosystem** the sum total of the biological and physical characteristics of an environment

**geological oceanographer** a scientist who studies land forms beneath the ocean, such as volcanoes, plate tectonics, seafloor spreading areas, petrology (crude oil and natural gas deposits), seamounts, trenches, etc.

**gyre** a large system of circular ocean currents formed in part by wind patterns

**hypothesis** a testable scientific idea, statement or question

**introduced species** a species that does not naturally belong in an area but was put or added there either accidentally or on purpose

**invasive species** an introduced species that overtakes an ecosystem

**krill** a type of shrimplike plankton that many species of penguin (as well as some fishes and marine mammals) rely on wholly or in part for food

**mitigate** to moderate a force or activity to make it less serious or destructive

**native species** a species that naturally belongs in an area

**nurdle** a plastic pellet used in manufacturing and packaging

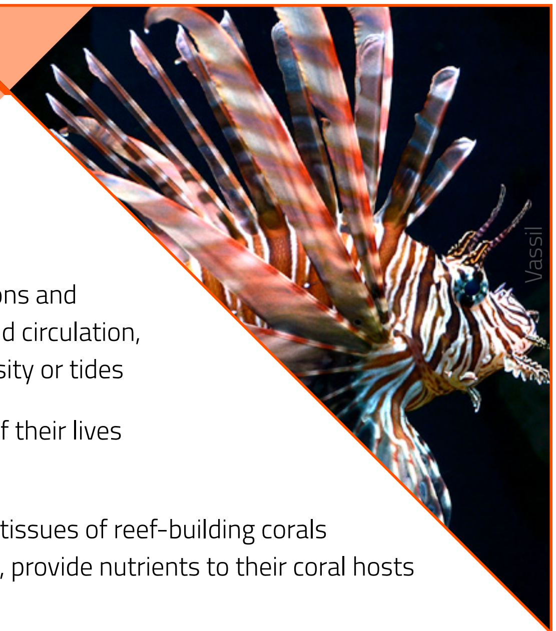
**ocean** there's one global ocean, that is, an interconnected body of salt water that covers most (70%) of the Earth's surface and within which are several regional oceans

**ocean basin** an area of land covered by sea water and defined by its geology or geological processes

**ocean current** a continuous flow of water in the ocean, like a river in the sea

**ocean region** the term we're using in this packet to distinguish between a single global ocean and various regional oceans (identified based on history, culture, geography and science), such as the Gulf of Mexico or the South Pacific

**oceanographer** someone who studies the ocean through data gathered by observations, measurements, samples or models




## Vocabulary List (continued)

**physical oceanographer** a scientist who studies the physical conditions and properties of the ocean, such as currents and circulation, temperature and heat storage, salinity, density or tides

**plankton** tiny plants and animals that live all or part of their lives in the water column

**zooxanthellae** tiny plantlike organisms that live within the tissues of reef-building corals and, through the process of photosynthesis, provide nutrients to their coral hosts

# Activity 1

6–8


AT SCHOOL

## Be a Researcher

**Have your students imagine they are ocean scientists or oceanographers, and a global citizen science group has approached them regarding changes to five ocean regions: Gulf of Mexico, South Atlantic, North Pacific, South Pacific and Caribbean Sea. The global group would like your students to investigate and report back if there's evidence for concern, what that evidence is, and what could be done to help mitigate any negative changes.**

### Time & Materials

- This activity should take 60 minutes over 1 to 2 class periods.
- Have students work in teams or small groups.
- Each team will need
  - Worksheet (in this packet) with questions
  - Pens/pencils, or computer app for drawing
  - Computer with Internet access or access to a library.

### Activity Instructions

Begin by explaining the premise of this activity as described above. As a class, locate each of the five ocean regions on a world map, and then divide the class into at least five research teams. Assign one or more teams to each region so that all five are studied. Then, instruct students to perform basic research about their assigned ocean region. Have them use Worksheet 1 at the end of this lesson to help guide their research. If students need more prompting, provide them with the agents of change information for their ocean region at the beginning of this lesson (page38).

Once students have completed their research, instruct each team to formulate a hypothesis that they will investigate further during their field trip to the Aquarium. The hypothesis should be a testable statement about a change they believe may be occurring in their ocean region. *(Sample hypothesis: A lionfish invasion is leading to significant loss of native fish species in the Caribbean.)* Teams can share their hypotheses with the class. If needed, you and the other students can ask questions to help each team fine-tune the hypothesis to make it as specific (and testable) as possible.

# Activity 2

6–8


AT MOODY GARDENS®

## Test your Hypothesis

**During the field trip to the Aquarium student teams will make observations and collect data pertaining to their hypothesis. In addition to making observations in the gallery that's exhibiting their ocean region, they'll also look for clues that their hypothesized change is or is not occurring in other ocean regions.**

### Time & Materials

- This activity should take at least 10 to 15 minutes in each gallery pertaining to assigned ocean regions.
- Have students work in teams or small groups.
- Each team will need
  - Worksheet 2 with guiding questions and pens/pencils
  - Camera or voice recorder (optional).

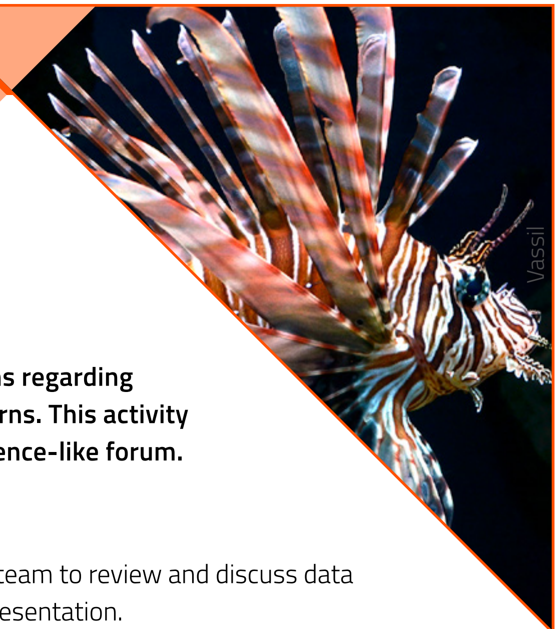
### Activity Instructions

Instruct student teams (and chaperones) to spend 10 to 15 minutes observing the Aquarium exhibits pertaining to their ocean region. Have students record any clues they find about agents of change in that area. They can take notes or draw in a journal, take photos or video, or make voice notes. Encourage students to read the information signs/labels and Aquarist Notes or Keeper Notes for clues. Students can use Worksheet 2 at the end of this lesson to guide their work.

As students visit other parts of the Aquarium, have them note evidence of agents of change they discover in other ocean regions that are similar to those in their region.

# Activity 3

6–8




BACK AT SCHOOL

## Analyze your Data

**Now it's time for students to analyze their data and draw conclusions regarding recommendations to the global citizen science group that had concerns. This activity culminates with student teams presenting their findings in a conference-like forum.**

### Time & Materials

- This activity should take multiple class sessions: 30 minutes for each team to review and discuss data and about 2 hours to make a poster or infographic (or other media) presentation.

- Have students work in their teams.

- Each team/group will need

  - Notes, photos, video or voice notes from the Aquarium field trip

  - Poster board, pens and markers, or computer and printer (for making posters), or

  - Computer and app to create an infographic or other digital presentation.

### Activity Instructions

Begin by having teams meet to review the data they collected at the Aquarium. Use Worksheet 3 to guide them. Encourage teams to be creative with visual aids such as infographics and images or videos, or perform a song or poem to present their data and conclusions. (See References and Resources on page 67 for helpful links.)

Finish this activity by holding a class oceanography conference where each team will present its hypothesis and results, and make recommendations regarding solutions.

# Activity 4

6–8


IN THE COMMUNITY

## Be an Agent of Change

**Agents of change can be positive or negative, and sometimes both. For this culminating activity, students apply their new knowledge to become positive agents of change, that is, ocean champions. Anyone can be an ocean champion by contributing to a local citizen science project. Your students can do this individually, in teams, or as a class.**

### Time & Materials

- This activity could take several class sessions or be an ongoing schoolyear project.
- Students could work individually, in small groups or as a class.

### Activity Instructions

Have students decide what kind of citizen scientists they would like to be. They can choose to focus on their ocean region or on local issues. Here are some suggestions. There are many other possibilities online.

- Research local organizations that are working to combat invasive lionfish, such as Guide to Invasive Species of the Galveston Bay Area or Texas Lionfish Control Unit. Start a blog about this issue and how to deal with it, such as listing restaurants serving lionfish (or other invasive species) in your area. Dine on lionfish with your family, or host a lionfish potluck, or publish a lionfish recipe online.
- Participate in a local beach clean up, and post your results online: How much was plastic (by weight, volume or number of pieces)? How much was recyclable?
- Help scientists map penguin colonies in the Antarctic at http://www.penguinmap.com.
- Go birdwatching at a local beach, marsh or mangrove. Learn about how those habitats are changing, and report the bird species you saw at http://www.tamug.edu/armitage/citizenscience.html or Ebird.


### Ocean Champion: Charles Moore

Captain Charles Moore is making waves in the North Pacific. Trained as a sailor, he's traded his racing sails for a research vessel. Why? On a sailing trip from Hawaii to California, he noticed large and small bits of plastic floating in the water — a plastic soup extending for hundreds of miles. Concerned, he started investigating ocean plastic and its affect on the ocean and ocean life. Today, he runs a research organization called Algalita that focuses on combating the plastics-at-sea problem throughout the ocean.

# Agents of *Change*

Team Name: ______________________

Ocean Region: ______________________

Draw your ocean region and label major water and land features below, including continents or islands. Add to your drawing:

- the main characteristics or features of your ocean region, including size, depth, average and minimum and maximum temperatures, currents
- the main ecosystems or habitats
- seasonal changes or patterns that would be important for you to understand, such as temperature changes, daylight hours, animal migrations, food availability, etc.

*Continue by answering questions on the back of this page*

(continued)

Have any new or unexpected environmental changes developed over the last 50 years that are raising concerns? What are the changes? How quickly are they occurring? What is or are the causes?

State a testable one-sentence hypothesis about change(s) that may be occurring in your ocean region.
*(During your Aquarium visit you will be looking for clues, which you'll analyze to help you accept or reject your hypothesis.)*

In your own words, write a narrative or essay below about your ocean region and explain your hypothesis.
*(Feel free to add diagrams, illustrations or images.)*

# Agents of Change

Team Name: ______________________

Ocean Region: ______________________

*Throughout your Aquarium visit, write notes, take photos/videos, draw sketches and/or record voice notes about what you observe related to your hypothesis.*

What is your hypothesis?

Spend 10–15 minutes observing your ocean region at the Aquarium. Record and describe the physical characteristics in the exhibit gallery: Is it light and bright? Or dark? Is it colorful? Busy? Quiet or calm? Anything else you notice about the environment?

What are the main plants and animals you find? What behaviors or interactions do you observe?

Read the information labels/signs for clues that support or make you question your hypothesis. Also, check the Aquarist Notes or Keeper Notes to see if they mention anything about ocean changes related to your hypothesis.

Do your observations in the Aquarium provide you with any other information about agents of change throughout our world's ocean?

# Agents of Change

Team Name: ______________________

Ocean Region: ______________________

*Work with your team to answer these questions. They will help you develop your presentation on the strength of your hypothesis and mitigating agents of change in your ocean region.*

What data on agent(s) of change did you identify for your ocean region at the Aquarium?
Was this the same agent of change that you stated in your hypothesis?

Given what you learned at the Aquarium, do you accept or reject your hypothesis? And, why?

What is the source of the agent(s) of change in your ocean? Is it a natural or human-caused change, or both?
Is it happening relatively quickly or slowly?

What impact are the agents of change having in that ocean region?

Are the changes unique to your ocean region or are they also found in other ocean regions?

*Continue by answering questions on the back of this page*

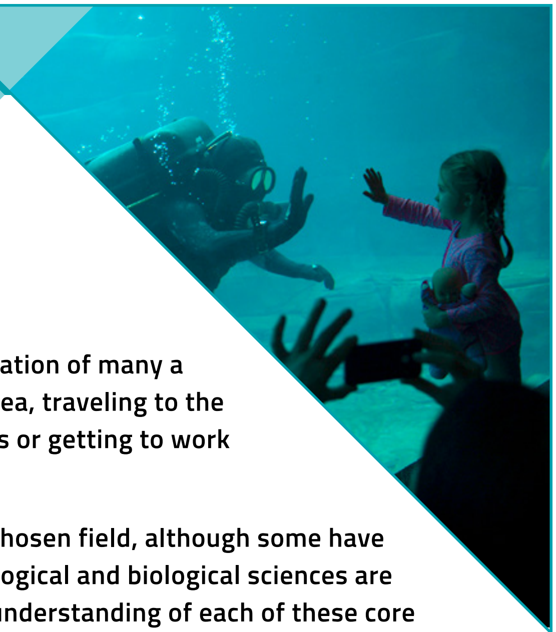
(continued)

What are your recommendations to the global citizen science group that approached you with this question? Should they be concerned about changes in your ocean region? If yes, what are some solutions you would recommend?

If you wanted to study more about this change issue, would you say you needed to be a biological, physical, chemical or geological oceanographer? During your research would you need to collaborate with other types of researchers? Which ones? Why?

# Teacher Overview

9-12



**Grades 9-12**

# Chart your Course

**The dream of becoming an ocean scientist has captured the imagination of many a student. They're lured by the mystique of joining an expedition at sea, traveling to the bottom of the ocean in a submarine, visiting remote tropical islands or getting to work with animals.**

**Most ocean scientists have a Ph.D. (Doctor of Philosophy) in their chosen field, although some have a master's degree or multiple degrees. The physical, chemical, geological and biological sciences are key to understanding the ocean and oceanographers need a basic understanding of each of these core fields. However, all these fields are intertwined and ocean science has become multi-disciplinary, as has the focus of science education with a combined emphasis on science, technology, engineering and mathematics (STEM).**

**Due to the complexity of today's ocean issues, ocean scientists must collaborate and communicate in teams with varied expertise. Some of the valuable experts in other disciplines include engineers, computer modelers, economists and social scientists who have chosen to apply themselves to the study of the ocean and how people interact with it.**

**Many ocean scientists have come to champion a cause related to their research. It may be saving an endangered species, contributing to the body of evidence about global climate change, or working to protect local habitats. Ocean champions, however, don't have to be scientists. People in a variety of careers, from art to media to fashion, have taken up the challenge of protecting the ocean.**

**For your Aquarium field trip, your students will learn about the many avenues they can follow to become an ocean scientist or ocean champion. This lesson consists of four activities that work together: one at school before your trip, one during the field trip, one for reflection back at school, and a culminating session in your community.**

## Lesson Objectives

As a result of your field trip and these activities, students will...

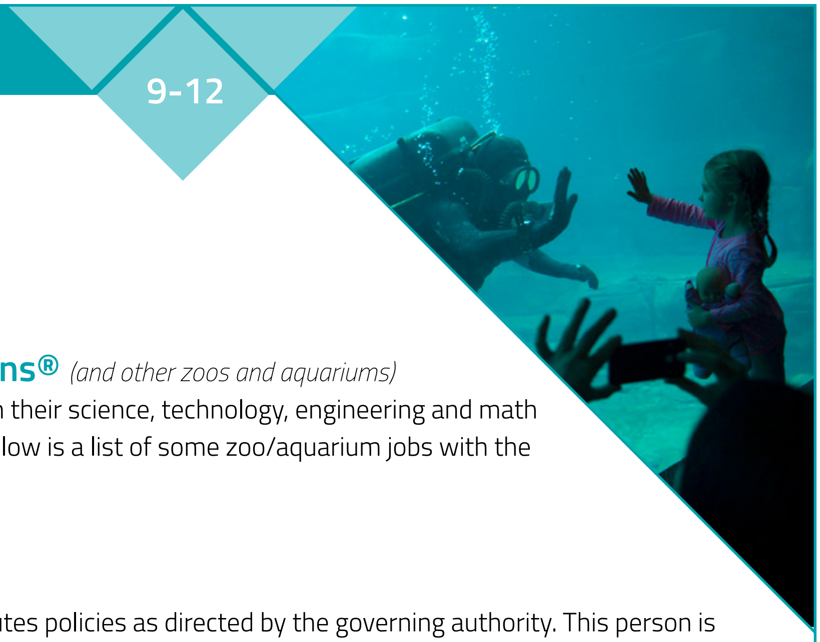
- gain an understanding of what an ocean scientist does
- learn the skills and requirements necessary to pursue an ocean-related career
- develop an action plan for charting a course toward an ocean scientist or ocean-related career.

# Chart your Course (continued)

## Lesson Scope & Sequence

In preparation for their field trip, students will begin by brainstorming what they already know about ocean scientists' or other ocean-related careers and then they'll research one notable person in their career of interest. During the field trip, students will observe aquarists and keepers taking care of the marine life in the exhibits, as well as other staff performing the many different jobs related to operating the Aquarium that might interest students.

Back at school, students will identify an ocean-sciences or ocean-related career path that appeals to them and develop an action plan to prepare for success. They'll finish by applying what they've learned to preparing and conducting an informational interview with someone working for an ocean-related business or organization.



# Chart your *Course*

## Jobs and Careers at Moody Gardens® *(and other zoos and aquariums)*

Employees throughout Moody Gardens® rely on their science, technology, engineering and math (STEM) knowledge and skills on a daily basis. Below is a list of some zoo/aquarium jobs with the STEM subjects essential to each job.

### ADMINISTRATION

**President** The president executes policies as directed by the governing authority. This person is responsible for the institution's operation and plans for future development. (math)

**General Manager** The general manager assists the director and assumes charge in the director's absence. (math)

**Comptroller** The comptroller manages the institution's finances, including payment of bills, purchasing, investments, and the preparation of financial statements. (math)

**Marketing Director** This position is responsible for all marketing and advertising campaigns for upcoming events and also deals with public relations. (math)

**IT Support Technician** IT support technicians are responsible for hardware, software, and preventative maintenance of computer systems. (engineering, math, tech)

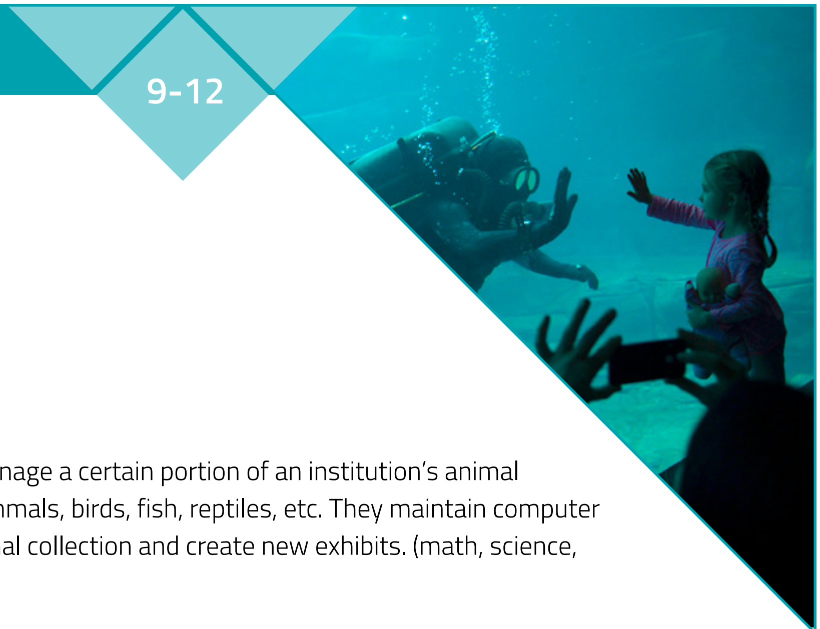
**Safety Officer** The safety officer is responsible for CPR and first aid training for staff and maintains all safety equipment. This position monitors activity around the property to ensure jobs are being performed under proper safety guidelines. (science, tech, engineering)

**Education Curator** The education curator oversees the operations of the Education Department, including implementing educational graphics, programs, and developing the annual budget for the department. (math, science, tech)

**Theater Technicians** Theater technicians oversee the Giant Screen 3D theater, 4D theater, and ride-film theater. They must perform routine maintenance on the projectors and equipment to keep them in working condition. (science, tech, math, engineering)

### ANIMAL CARE

**Animal Husbandry Manager** The animal husbandry manager oversees an institution's entire animal collection and animal management staff. They are responsible for creating a strategic collection plan, applying for permits and licenses to hold or transport animals, and supervising research projects. They also oversee the institution's conservation activities, including field projects. (math, science, tech, engineering)



# Chart your *Course*

## ANIMAL CARE (continued)

**Animal Curator** Animal curators manage a certain portion of an institution's animal collection, e.g., mammals, birds, fish, reptiles, etc. They maintain computer records on the animal collection and create new exhibits. (math, science, tech, engineering)

**Biologist** Biologists (including aquarists and keepers) are responsible for the day-to-day care of animals within exhibits. Most are skilled in either aquarium or tropical animal care. They maintain animal behavior records, prepare animal diets, provide enrichment and training, and clean animal exhibits and holding areas. (math, science, tech, engineering)

**Veterinary Technician** The veterinary technician assists the veterinarian and provides care to the animals under the supervision of the veterinarian. (math, science, tech)

## MAINTENANCE

**Director of Facilities** The director of facilities oversees all maintenance staff and projects for all property buildings, vehicles and equipment. (math, science, tech, engineering)

**Life Support Systems Operator** Life support systems operators maintain exhibit pumps, motors, electrical and plumbing systems for animals. (math, science, tech, engineering)

**Mechanic** The mechanics are responsible for the care and maintenance of all vehicles on property. (math, tech, engineering, science)

**Gardener** The gardeners are responsible for plotting and maintaining the plant life around property, whether in exhibits, buildings, or around the grounds. (science, tech, math)

**Master Electrician** Master electricians are responsible for electrical components of electrical equipment in buildings, vehicles and equipment. (science, tech, engineering, math)

# Teacher Overview

9-12

## Vocabulary List

**action plan** a specific step-by-step plan with stated timelines in order to achieve a stated goal

**aquarist** a person who cares for fish and other marine life kept at public aquariums

**biological oceanographer** a scientist who studies life in the ocean

**chemical oceanographer** a scientist who studies the chemical composition, processes and cycles of sea water, and their interaction with the atmosphere and sea floor

**ecosystem** the sum total of the biological and physical characteristics of an environment

**geological oceanographer** a scientist who studies the earth beneath the ocean, such as volcanoes, plate tectonics, seafloor spreading areas, petrology (crude oil and natural gas deposits), seamounts, trenches, etc.

**husbandry** the field of management and care of animals

**informational interview** a meeting where someone interested in a particular job or career seeks advice from a professional in that field on career path, the business practices and culture, and requirements for working in that field

**internship** paid or unpaid positions in which students work to gain experience in their chosen field; usually temporary and/or short term

**keeper** a person at a zoo or aquarium who cares for reptiles, snakes, birds, mammals and other non-aquatic animals

**ocean** there's one global ocean, that is, an interconnected body of salt water that covers most (70%) of the Earth's surface and within which are several regional oceans

**ocean basin** an area of land covered by sea water and defined by its geology or geological processes

**ocean region** the term we're using in this packet to distinguish between a single global ocean and various regional oceans (identified based on history, culture, geography and science), such as the Gulf of Mexico or the South Pacific

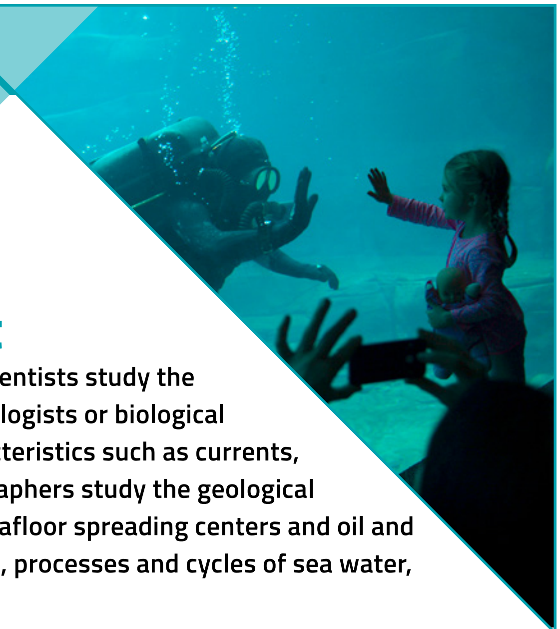
**oceanographer** someone who studies the ocean through data gathered by observations, measurements, samples or models

**Ph.D.** an advanced degree, called a Doctorate of Philosophy, and one of the highest-level degrees conferred by universities

**physical oceanographer** a scientist who studies the physical conditions and properties of the ocean such as currents and circulation, temperature and heat storage, salinity, density or tides

# Activity 1

9-12



AT SCHOOL

## Learning to be an Ocean Scientist

**An ocean scientist is anyone who studies the ocean. Some ocean scientists study the marine life and how they interact in the ocean. These are marine biologists or biological oceanographers. Physical oceanographers study the physical characteristics such as currents, tides, salinity, temperature and heat retention. Geological oceanographers study the geological characteristics of the seafloor, from volcanoes and seamounts to seafloor spreading centers and oil and gas deposits. Chemical oceanographers study chemical composition, processes and cycles of sea water, and their interaction with the atmosphere and sea floor.**

**The variety of routes to becoming an ocean scientist is unlimited. If your students are interested in biology, chemistry, geology, meteorology, computer modeling, environmental science, electrical or mechanical engineering, art or media, there could be an ocean career in their future.**

### Time & Materials

- This activity could take 60 – 90 minutes in 1 or 2 class sessions.
- Students could work individually or in small groups.
- Each student or group will need Worksheet 1, and access to the Internet or library.

### Activity Instructions

Begin by brainstorming as a class: What is an ocean scientist? What does an ocean scientist study? Are there different types of ocean scientists? Can you name any famous ones? What did or does that person do? Why is that person's work important? Have students research an ocean scientist or someone in an ocean-related career. Instruct them to make notes on where that person works, what they study, and why their work is important to them or others. Also have students investigate that person's career path, including how they got interested in a career related to the ocean and their schooling. Students can use Worksheet 1 (page 59) to guide their research and see the References section for helpful links.

Students could research scientists highlighted in the Aquarium or who've worked in the Gulf.

- Robert Ballard
- William Beebe
- P . Dee Boersma
- Eugenie Clark
- Jack Corliss
- Jacques-Yves Cousteau and other Cousteau family members
- Quenton Dokken
- Sylvia Earle
- Ashanti Johnson

Once students have completed their research, have them share with the class what they found. Ask follow-up questions such as: Which job or career did you find most interesting? What's the most interesting part of the job? What's a negative or difficult aspect of the job?

## Activity 2

9-12

AT MOODY GARDENS®

# Working at Moody Gardens®

**During the field trip to the Aquarium, students will observe husbandry staff (aquarists and keepers) at work caring for the marine life in the exhibits. They'll also observe other staff at work and learn about the many jobs it takes to run the Aquarium Pyramid at Moody Gardens®. They'll also have the opportunity to interview staff about their jobs.**

## Time & Materials

- This activity could take about one class period (60 minutes) to prepare and 10–15 minutes for observing and interviewing Aquarium staff at work.
- Students could work individually or with a partner.
- Each student or pair will need
  - Worksheet (paper or digital)
  - Pens/pencils (optional)
  - Voice recorder and/or camera (photo or video).

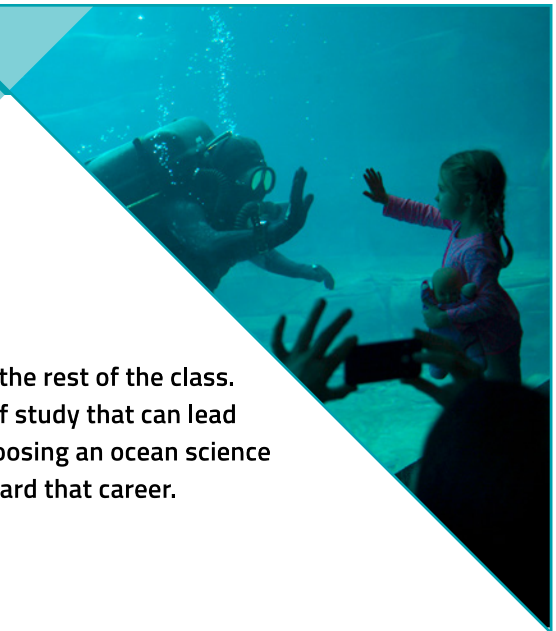
## Activity Instructions

Tell your students that while they are at the Aquarium, they are to interview one staff member (aquarist, keeper or other staff working at a job that interests them). Instruct students to begin by asking politely if the staff person has time for a three- to five-minute interview. Then have students ask the questions on the Investigation at the Aquarium Worksheet (see page 60). If students think of additional questions, they can ask those as well.

To record their data, students may use voice recorders for short interviews, take photos of staff at work (with their permission) and make notes and/or sketches on the Investigation Worksheet. Once they've finished this part of their assignment, instruct them to identify as many different additional ocean-related careers they can spot as they tour the rest of the Aquarium.

# Activity 3

9-12



BACK AT SCHOOL

## Present your Research

**Back at school, students will share their job/career discoveries with the rest of the class. Through the class discussion, they'll see that many different fields of study that can lead to an ocean-related career. This lesson culminates with students choosing an ocean science or ocean- related career and then writing an action plan to work toward that career.**

### Time & Materials

- This activity could take two 30 – 45 minute class sessions.
- Students could work individually or with a partner.
- Each student will need the Action Plan Worksheet, and access to the Internet or library.

### Activity Instructions

Begin by holding a class discussion in which each student (or team) presents what they learned from their interviews of staff at the Aquarium. Follow up by having students share other jobs they noticed at the Aquarium. Ask students: Are you surprised to find that so many different ocean-related jobs are possible? What would be your top job choice? Why?

Finish with students using the Action Plan Worksheet (see pages 61-62) to chart a path toward their career choice. A good action plan includes specific tasks and deadlines to complete each step. To help them, they can go online to the Moody Gardens® employment web page at http://www.moodygardens.com/employment/, to the websites of other institutions to see job postings, or job boards to research job requirements and salary ranges.

# Activity 4

9-12

IN THE COMMUNITY

## Working for the Ocean

**Each student will contact a local person (by email or phone) who works in an ocean-related field that interests them for an informational interview.**

### Time & Materials

- This activity could take one 30 – 45 minute class period for interview preparation, a 45-minute session outside of class for the interview plus travel time (if interviewing in person) and one 45-minute class period for everyone's presentations.
- Students could work individually or with a partner.
- Each student or pair will need
  - Computer or pens/pencils & notebook for taking notes
  - Digital camera for photos/video (optional)
  - Digital voice recorder (optional)

### Activity Instructions

Have each student contact a local person (by email or phone) who works in an ocean-related field that interests them. It can be an ocean scientist, ocean educator, museum or nature center staff person, human resources manager, ocean engineer, etc.

Call and set up an appointment for a 30-minute informational interview (preferably in person) about the career path, the business practices and culture, and requirements for working in your field of interest, as well as volunteer or internship opportunities. Before the interview, research that person's background, field of study and current work. (Students might try a search on LinkedIn or Facebook or the professional organization for this field.) Write a list of questions to ask during the interview (see Worksheet 4 for help). After the interview, summarize your conversation and make a short presentation to the class about a community job, volunteer position or internship of interest.


### Ocean Champion: Quenton Dokken

Dr. Quenton Dokken has been an ocean champion most of his oceanography career. He started by studying local Gulf of Mexico reefs and marine life and advanced to finding ways to protect and promote the Gulf's valuable resources. As President/CEO of the Gulf of Mexico Foundation, he brought together government agencies, the energy industry, communities and individuals to work toward improving ocean health. In 2016, he became Executive Director of the Texas Institute for Applied Environmental Research (TIAER) at Tarleton State University. Education, leadership programs and science-based research are just a few areas he has championed and had a positive impact on worldwide.

# Chart your Course

Student or
Team Name: ___________________________

Which ocean scientist did you research?

Where does this person work?

What is this person's main field of study/work? Describe what this person does.

How did this person prepare for their career (internships, schools, degrees, work experience)?
Are any special skills required for this career?

What's the salary range for this job?

Would you want this person's job or career? Why or why not?

# Chart your Course

Student or
Team Name: _______________________

Find an aquarist, keeper or other staff person working in the Aquarium and ask if they have three to five minutes to answer a few of questions about their job. With their permission, take photos, video or voice recordings of them at work explaining their job. When finished, be sure to thank them for their time.

Write down the person's name, job title and exhibit gallery or area where this person is working.

*Ask the following questions:*

What's your main responsibility at the Aquarium?

What training or schooling did you complete to qualify for this job?

What's the best part of your job? Is there any part you don't like?

What advice would you give to someone who wanted to follow the same career path?

Other questions:

*Thank them for their time.*

During the rest of your visit, be on the lookout for other jobs people are doing at the Aquarium and write them down in the space below.

# Chart your Course

Student Name:________________________

1. What motivates and inspires you?
   *Example: I love animals*

2. How does this relate to a career related to the ocean?
   *Example: I can become a marine biologist and help save endangered species*

## Start to Chart Your Career Course

| Action | Specific Steps | By when | Outcome |
|---|---|---|---|
| **Example:** Step 1: Work at an animal rescue facility | Apply to be summer volunteer at [name a local animal rescue organization] | May 1 | Gain 3 mo. experience in sea turtle rescue and care |
| **Example:** Step 2: Get B.S. degree in marine biology | Apply to Texas A&M, Univ. of Texas and U.C. San Diego. | Oct. 1 my Senior year | Get accepted at all three then choose the best one. |
| **Step 1** | | | |
| **Step 2** | | | |
| **Step 3** | | | |
| **Step 4** | | | |
| **Step 5** | | | |

*continue on back...*

Student Name:________________________

# Chart your Course (continued)

| Action | Specific Steps | By when | Outcome |
|---|---|---|---|
| Step 6 | | | |
| Step 7 | | | |
| Step 8 | | | |
| Step 9 | | | |
| Step 10 | | | |

# Chart your Course

Student or
Team Name: ___________________________

Contact a local person working in an ocean-related field or job that interests you.

Name of Person ________________________________________________

Profession ___________________________________________________

Job Title and Business or Organization ______________________________

______________________________

*Ask the following questions:*

What's your main job or responsibility?

What training or schooling did you complete to qualify for this job?

What advice would you give me if I wanted to start on this career path?

Are there internships or volunteer opportunities so that I can learn more about this job? If yes, how do I apply?

Other questions: If you have other questions, write them on the back before the interview and be sure to ask them.

*Thank them for their time.*

# Alignment to TEKS by Grades

| | | | | |
|---|---|---|---|---|
| Grades K-2 | 111.2 Grade K<br>111.3 Grade 1<br>111.4 Grade 2 | (b)<br>Knowledge<br>& Skills | (6) | **Geometry and measurement.**<br>The student applies mathematical process standards to analyze attributes of two-dimensional shapes and three-dimensional solids to develop generalizations about their properties. |
| | 112.11 Grade K<br>112.12 Grade 1<br>112.13 Grade 2 | (b)<br>Knowledge<br>& Skills | (2)(3)(4)<br>(2)(3)(4)<br>(2)(4) | **Scientific investigation and reasoning.**<br>(2) The student develops abilities to ask questions and seek answers in classroom and outdoor investigations.<br>(3) The student knows that information and critical thinking are used in scientific problem solving.<br>(4) The student uses age-appropriate tools and models to investigate the natural world. |
| | 112.13 Grade 2 | (b)<br>Knowledge<br>& Skills | (3) | **Scientific investigation and reasoning.**<br>(3) The student knows that information and critical thinking, scientific problem solving, and the contributions of scientists are used in making decisions. |
| | 112.11 Grade K<br>112.12 Grade 1<br>112.13 Grade 2 | (b)<br>Knowledge<br>& Skills | (9) | **Organisms and environments.**<br>The student knows that plants and animals have basic needs and depend on the living and nonliving things around them for survival. |
| | 112.11 Grade K<br>112.12 Grade 1<br>112.13 Grade 2 | (b)<br>Knowledge<br>& Skills | (10) | **Organisms and environments.**<br>The student knows that organisms resemble their parents and have structures and processes that help them survive within their environments. |

| | | | | |
|---|---|---|---|---|
| Grades 3-5 | 112.14 Grade 3<br>112.15 Grade 4<br>112.16 Grade 5 | (b)<br>Knowledge<br>& Skills | (2) | **Scientific investigation and reasoning.**<br>The student uses scientific inquiry methods during laboratory and outdoor investigations. |
| | 112.14 Grade 3<br>112.15 Grade 4<br>112.16 Grade 5 | (b)<br>Knowledge<br>& Skills | (3) | **Scientific investigation and reasoning.**<br>(3) The student knows that information, critical thinking, scientific problem solving, and the contributions of scientists are used in making decisions.<br>(3) The student uses critical thinking and scientific problem solving to make informed decisions. |
| | 112.14 Grade 3<br>112.15 Grade 4<br>112.16 Grade 5 | (b)<br>Knowledge<br>& Skills | (9) | **Organisms and environments.**<br>(9) The student knows that organisms have characteristics that help them survive and can describe patterns, cycles, systems, and relationships within the environments.<br>(9) The student knows and understands that living organisms within an ecosystem interact with one another and with their environment.<br>(9) The student knows that there are relationships, systems, and cycles within environments. |

| | | | | |
|---|---|---|---|---|
| Grades 6-8 | 112.18 Grade 6<br>112.19 Grade 7<br>112.20 Grade 8 | (b)<br>Knowledge<br>& Skills | (2) | **Scientific investigation and reasoning.**<br>The student uses scientific inquiry methods during laboratory and field investigations. |
| | 112.18 Grade 6<br>112.19 Grade 7<br>112.20 Grade 8 | (b)<br>Knowledge<br>& Skills | (3) | **Scientific investigation and reasoning.**<br>The student uses critical thinking, scientific reasoning, and problem solving to make informed decisions and knows the contributions of relevant scientists. |
| | 112.18 Grade 6<br>112.19 Grade 7<br>112.20 Grade 8 | (b)<br>Knowledge<br>& Skills | (12)<br>(10)<br>(11) | **Organisms and environments.**<br>(12) The student knows that organisms...within taxonomic groups share similar characteristics which allow them to interact with the living and nonliving parts of their ecosystem.<br>(10) The student knows that there is a relationship between organisms and the environment.<br>(11) The student knows that interdependence occurs among living systems and the environment and that human activities can affect these systems. |

| | | | | |
|---|---|---|---|---|
| Grades 9-12* | 112.32<br>Aquatic Systems<br><br>112.37<br>Environmental<br>Systems | (c)<br>Knowledge<br>& Skills | (3) | **Scientific processes.**<br>The student uses critical thinking, scientific reasoning, and problem solving to make informed decisions within and outside the classroom. The student is expected to:<br>(E) describe the connection between aquatic science and future careers.<br>(E) describe the connection between environmental science and future careers. |
| | 112.36<br>Earth & Space<br>Science | (c)<br>Knowledge<br>& Skills | (3) | **Scientific processes.**<br>The student uses critical thinking, scientific reasoning, and problem solving to make informed decisions within and outside the classroom. The student is expected to:<br>(E) explore careers and collaboration among scientists in Earth and space sciences. |

*Also see Chapter 130. Texas Essential Knowledge and Skills for Career and Technical Education

# References & Resources by Grades


## General Ocean & Ocean Basins

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## Grades K – 2: Ocean Homes

New Hampshire Sea Grant: Marine Careers. (2017). *Marine Biology.* Accessed Aug. 2017 at http://www.marinecareers.net/marine-biology

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## Grades 3 – 5: Ocean Dining

**For food chains/food webs**

California Academy of Sciences. (2016). *Exploring Ecosystems: Coastal Food Webs* [kelp forest]. Accessed Aug. 2017 at https://www.youtube.com/watch?v=LVJ5BKcAhAg

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# References & Resources by Grades (continued)

## Grades 3 – 5: Ocean Dining (continued)

**For local ecology projects**


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## Grades 6 – 8: Agents of Change

**For information or citizen science projects on invasive species and habitats**


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Texas General Land Office: Texas Adopt a Beach. (n.d.). Accessed Aug. 2017 at http://www.glo.texas.gov/adopt-a-beach/

The Galveston Bay Estuary Program. (2010). *The Quiet Invasion: A guide to invasive species of the Galveston Bay Area*. Accessed Aug. 2017 at http://www.galvbayinvasives.org/www.galvbayinvasives.org/index.html


**For developing infographics or a blog**


McConnell, C. (2013). *5 Tools for Creating Your Own Infographics.* Accessed Aug. 2017 at http://readwrite.com/2013/06/10/5-tools-for-creating-your-own-infographics/

Piktochart: https://piktochart.com

Platforms for Student Blogs: edublogs.org or Education.Weebly.com


## Grades 9 – 12: Chart Your Course

*Note: To find ocean scientists to research, Google "famous oceanographers"*


EnvironmentalScience.org. (2017). *What is an Oceanographer.* Accessed Aug. 2017 at http://www.environmentalscience.org/career/oceanographer

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Scripps Institution of Oceanography. (2017). *Careers in Oceanography.* Accessed Aug. 2017 at https://scripps.ucsd.edu/education/careers

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