
SECRETS
OF THE SEA
ACTIVITY GUIDE

DEAR TEACHERS, PARENTS AND INFORMAL EDUCATORS–

Welcome to the Activity Guide for *Secrets of the Sea*.

As ocean filmmakers, we have spent more than 30 years diving to explore our amazing seas. While we have seen some dramatic acts of predation, what we have observed more often are communities of organisms that live together and that are mutually dependent on each other, helping each other survive and thrive. In our documentary film *Secrets of the Sea*, produced for IMAX® and giant screen theaters, we share some of these stories of incredible mutual partnerships—from cleaning stations where fish eat the parasites off of other organisms, to shrimp that build burrows to share with other fish. With this Activity Guide, learners of all ages can explore these relationships in more detail through interactive and fun activities.

We hope that as you learn even more about these amazing communities, you'll work to help protect our ocean. And perhaps some of our younger viewers will be inspired to explore the 80% of our ocean that is still unexplored, as future marine biologists, oceanographers or even filmmakers when they grow up.

Enjoy these activities at home, school or in youth groups. Keep diving deeper and appreciating communities—on land and in the water.

— The *Secrets of the Sea* Filmmaking Team

For more information about *Secrets of the Sea* and where it is playing, visit **www.SecretsoftheSeaMovie.com**.

OVERVIEW

This Activity Guide provides activities and challenges to inspire a curiosity about the secrets of the sea. It is intended for use by schools, home school groups, informal educators, scout groups, families, and anyone wishing to share a love of nature with others. To encourage life-long learning, this guide will use the terms "learners" and "learning groups" throughout the activities to encompass the learner in all of us. Each activity in this guide includes a **Dive Even Deeper** section with suggestions for follow-up investigations. **Fun Facts**, **Discussion Questions** and **Definitions** will further enhance the experiences. These activities are written for grades 2 through 8, and are adaptable for both younger and older learners. The applicable Next Generation Science Standards (NGSS) are listed in Appendix 3.

ACKNOWLEDGEMENTS

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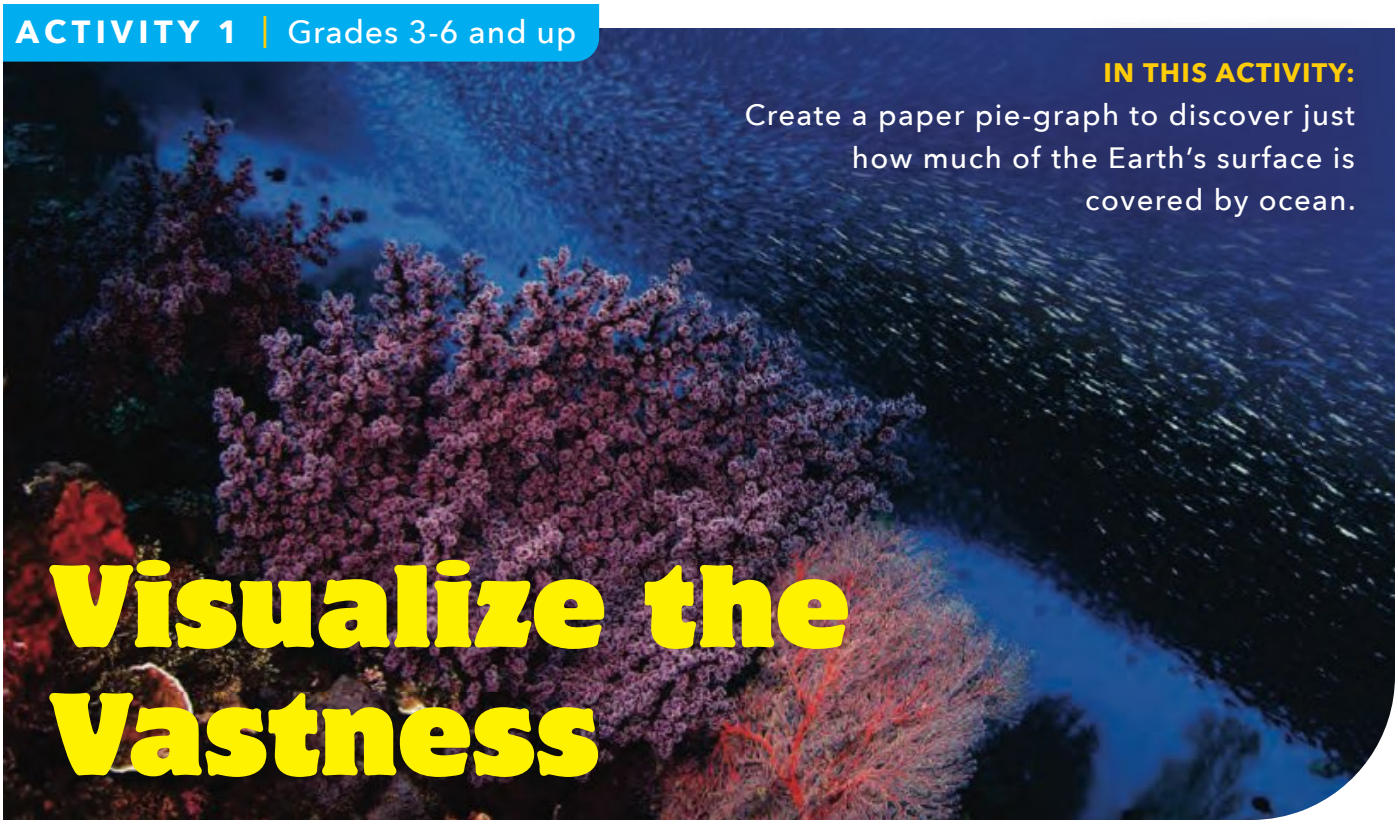
Remora fish clean parasites from the dugong's skin.

ACTIVITY 1 | Grades 3-6 and up



IN THIS ACTIVITY:
Create a paper pie-graph to discover just how much of the Earth's surface is covered by ocean.

Visualize the Vastness

FILMMAKER'S NOTE

We created *Secrets of the Sea* to share our discoveries made while filming our planet's ocean. Join us as we dive deeper into its secrets.

INTRODUCTION

How can we visualize the vastness of this mysterious ocean? This hands-on activity will allow us to create a paper pie-graph representation to discover just how much of the world's surface is land, and how much is ocean with secrets yet to be revealed. Gather paper, scissors, and colored pencils, then follow the instructions and folding methods to explore the unexplored.

DIVE INTO THE ACTIVITY

If you can, go outside. Touch the ground. How much of the planet are you interacting with at this moment in time? Just how big is this planet anyway? It takes most fast walkers 1 hour to walk 5 kilometers (3.11 miles). How long do you think it would take to walk all the way around the planet? Ready for some big numbers? The Earth is about 40,070 kilometers in circumference (24,898 miles). Divide that by a brisk walking speed of 5 km per hour (about 3.11 miles per hour), and you would spend 8,014 hours to circumnavigate our home planet, or nearly a full year of walking full time!

Could you do it? No, partly because you would need to stop to eat and sleep, but mostly because the planet has water in your pathway. How much water? Lots!

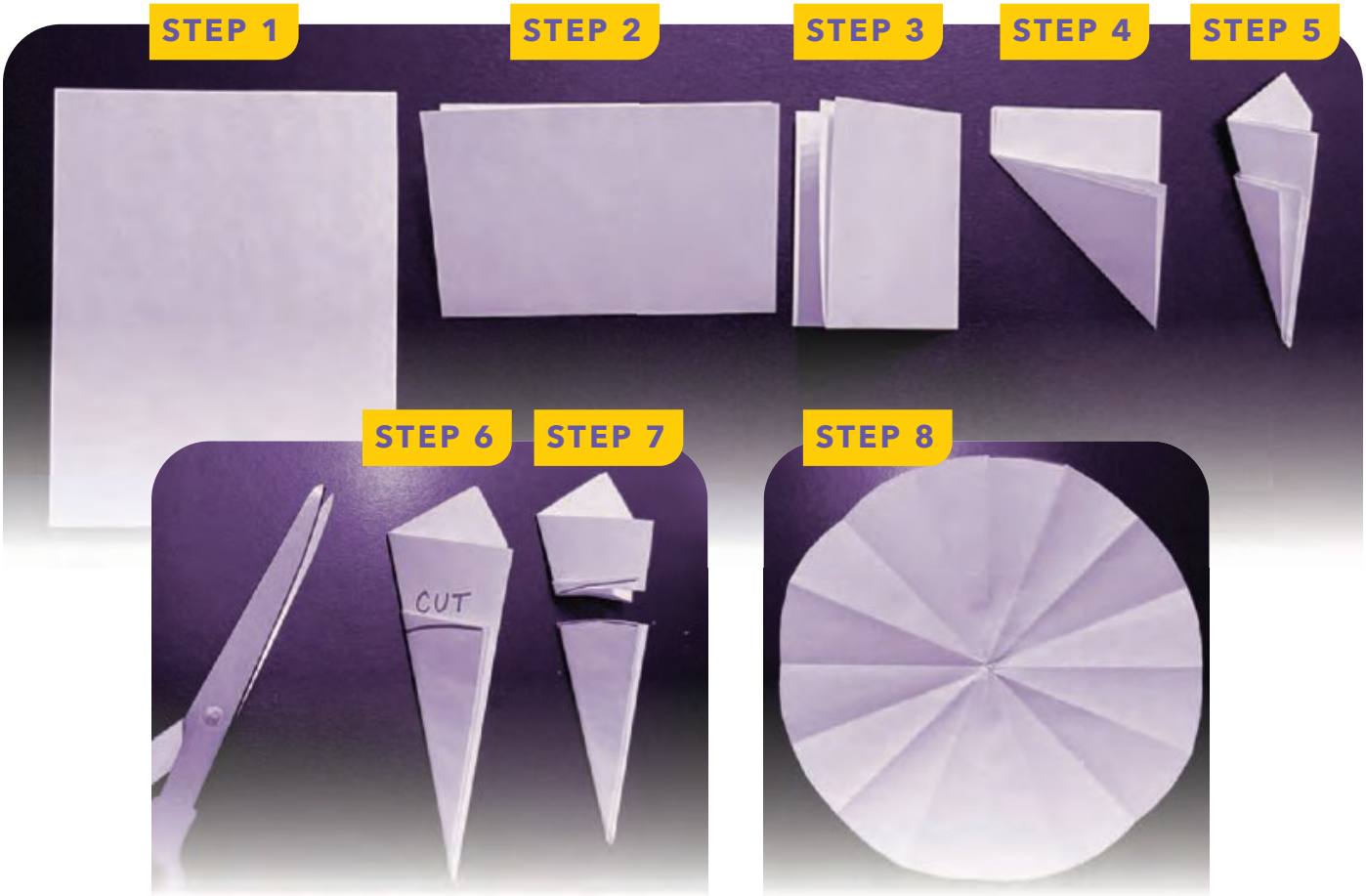
MATERIALS

- [ ] Printer paper (recycled "good on one side" encouraged)
- [ ] Scissors
- [ ] Colored pencils

How much of the Earth's surface is land that you could walk across? And how much is water that you'd need a boat to cross? Additionally, how much of the ocean is regularly used by humans for travel or gathering food to eat, and how much has never been explored, with depths still holding mysteries and surprises for us to uncover?

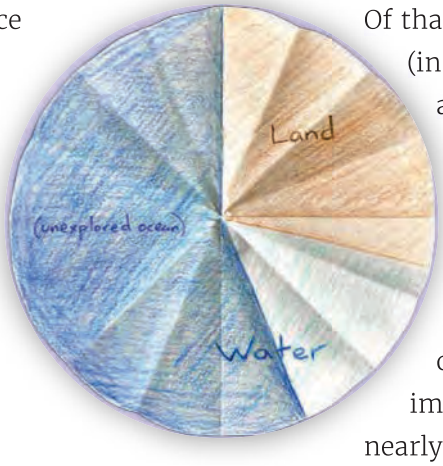
Let's think about the Earth as an orange. Imagine peeling the orange and putting all the bits of Earth's surface peel that are **land** into one part of a round pie, and all the parts that are **water** into the rest of the pie. How much of the pie do you think will be land, and how much will be ocean?

Let's create a learning tool to illustrate. Start with a piece of printer paper. Fold your piece of paper in half bringing the bottom edge to the top, carefully aligning your edges and corners (Steps 1–2), then fold again side to side (3). Now fold it at an angle, bringing the edges with folds together to make a triangle with a border (4). Fold it at an angle one more time, again bringing folds together, keeping the same point at the bottom and keeping the side with the short edge exposed (5). Draw a slightly curved line across the triangle from the shorter corner, as shown in the illustration (6), then cut off the excess (7). Unfold your paper and you should now have a nice round Earth pie, divided into 16 slices! (8)



ACTIVITY 1

This circle represents the entire surface of the planet Earth, flattened out. Our Earth is about 510.1 million square kilometers (196.9 million square miles). That's a big pie!



How much of this big pie is ocean, and how much is land? Using a brown colored pencil to represent land, color one quadrant light brown (4 of the 16 sections, the area from 12 o'clock to 3 o'clock on a clock face) and write the word "Land." Our Earth pie graph shows that one-quarter, or 25%, is land. However, land actually takes up about 29% of our pie graph, so we need to add 4% to our brown area. Each of the sixteen sections is 6.25% of the circle, so extend your brown Land area just over halfway into the adjacent section to total 29% of the Earth pie chart.

You now have a pie chart showing about 29% the Earth's surface covered in land.

What is all the rest? Water! We can now see that 71% of the total surface of the earth is covered in water. Color this area of your pie chart with a light blue, and label it "Water."

Of that watery surface, 3% is freshwater (in lakes, rivers, creeks, and ponds) and 97% is saltwater (the ocean). That's a lot of ocean! Humans travel mostly through the areas near land, and those areas are considered the productive areas of the ocean. That's where most of the fish live. But as you can imagine, with the oceans covering nearly 3/4 of our Earth, a great percentage of that space has never been explored by humans. Eighty percent of our ocean still has surprises for scientists to discover. That means nearly nine of the eleven blue sections of your Earth pie graph are still awaiting inquisitive explorers. Color nine of

HELPFUL HINT: *If pie graphs and percentages are new to you, make a circle using 100 pennies. Think of 1% as one penny out of 100 pennies – one percent (or one cent out of one dollar). Use a pair of pencils extending from the center like hands of a clock. To show 25%, place the pencils at 12 and 3 o'clock, the part of the circle covered by 25 pennies, or one quarter of the circle.*

To imagine the circle you'll need for your pennies, place a 30 cm (12 inch) ruler on a 60 cm (2 foot) wide space, then hold one end of the ruler in place as you scribe a circle with your finger or a pencil at the other end of the ruler. This will give you a rough estimate for the curve of your circle.

DIVE EVEN DEEPER

Travelers talk about the Atlantic Ocean or the Pacific Ocean or the Indian, Arctic or Southern Oceans. If a map shows five oceans, why do we use the singular term "ocean" in this activity guide? If you look carefully at a globe, or even a map, you will see that the water has no dividing lines. Our planet is covered by one continuous world ocean. Examine this simple map, or find a detailed map or globe, to visualize this one world ocean.

your ocean sections in some way to represent the unexplored waters, from the surface to the ocean floor. What would you like to discover?

DISCUSSION CHALLENGES

Guess: What percentage of the land on Earth is uninhabitable by its eight billion citizens? (Answer: 33% of land is desert and 24% is mountainous, leaving 43% for living, farming, and conserving as wild spaces.) Why are many mountains and deserts (and the ocean) considered uninhabitable at this time? Will humans always think this way? Why would harm to the ocean, or help for the ocean, affect the entire planet?

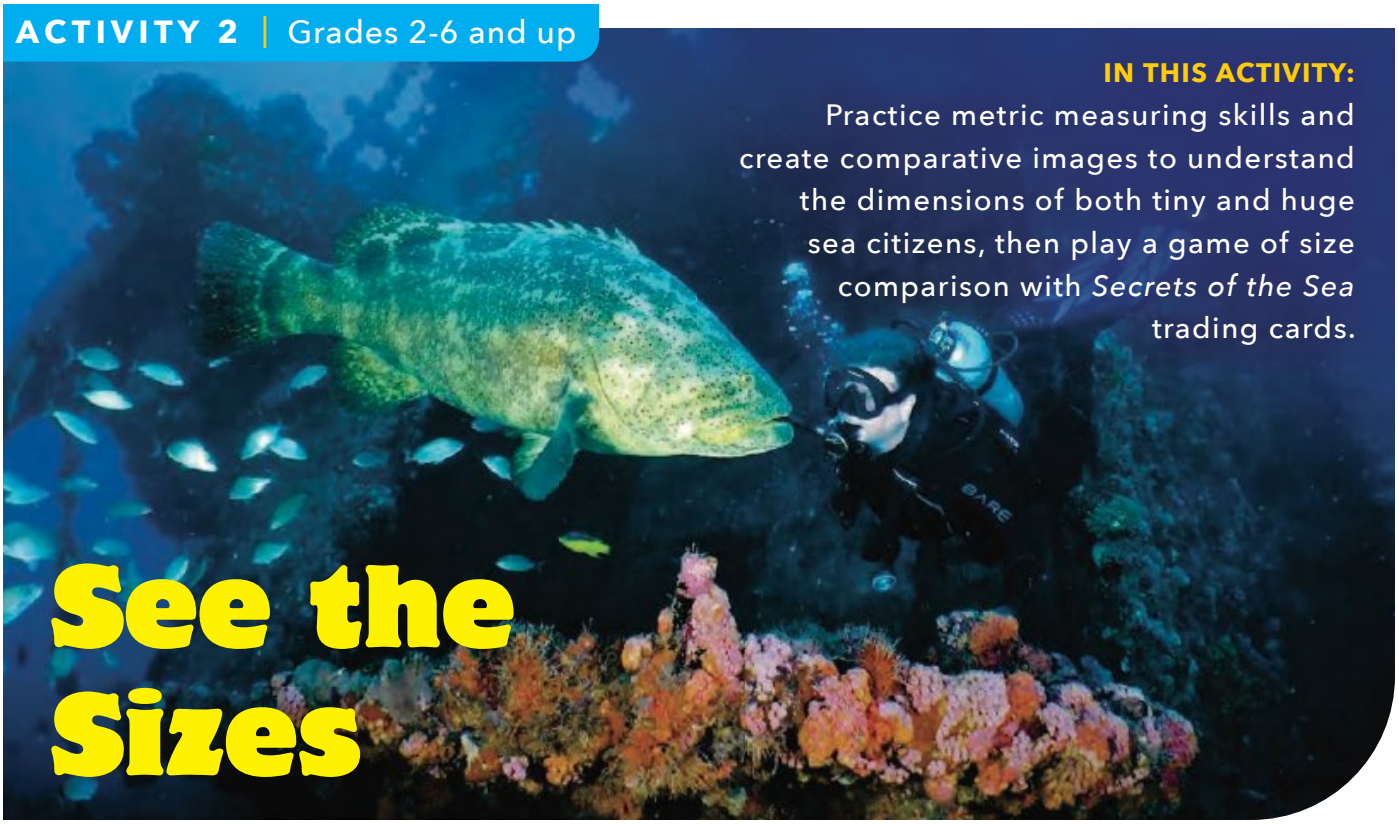
DEFINITIONS

Ocean – the salty water covering 70.9% of the Earth's surface, surrounding the land and islands. There are five geographical areas of Earth's liquid covering (the Atlantic, Pacific, Arctic, Indian and Southern Oceans) that together form the world's ocean.

Sea – the term for a smaller part of the ocean, usually in a protected area where land and ocean meet.

Eighty percent of our ocean is unexplored and still has surprises for scientists to discover.

ACTIVITY 2 | Grades 2-6 and up



IN THIS ACTIVITY:
Practice metric measuring skills and create comparative images to understand the dimensions of both tiny and huge sea citizens, then play a game of size comparison with *Secrets of the Sea* trading cards.

See the Sizes

FILMMAKER'S NOTE

While working under the surface of the water with our underwater cameras, we were challenged by finding and filming some creatures that were smaller than a pencil eraser, while others were larger than a school bus.

INTRODUCTION

In Activity 1, we discovered that Earth has nearly three times as much ocean surface as it does land, so it isn't surprising that the largest creatures on Earth live in the ocean. Also, we learned in *Secrets of the Sea* that these largest creatures survive by eating one of the smallest creatures. What is the size difference between a blue whale and a tiny swimming krill? Let's find out!

MATERIALS

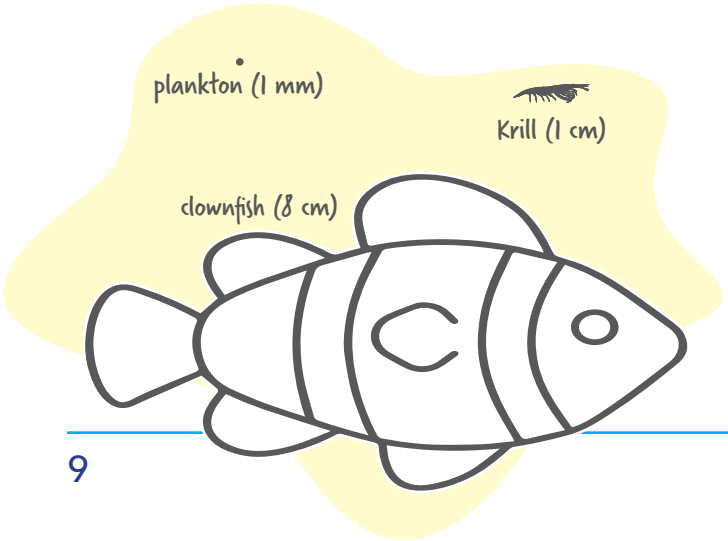
- ☐ Pencil and paper, rulers and meter sticks, chalk or tape for playground or hallway experiences
- ☐ One set of **Sealife Trading Cards** (Appendix 1, with the **Information Backs**) for the measurement activity, printed on both sides and cut apart
- ☐ One set of **Sealife Trading Cards** (Appendix 1, with the **Blank Backs**) per pair of players for the *What's My Size?* game (page 11)

DIVE INTO THE ACTIVITY

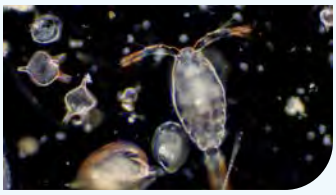
Let's create some comparative images to understand the size differences between the blue whale and the tiny krill, and many of the other inhabitants seen in *Secrets of the Sea*. Use the provided data for your measurements and images, whether on paper or drawn with chalk or tape on a playground. Warning: that blue whale likely won't fit in your

indoor learning space, unless you have access to a basketball court! You might even continue the comparisons to discover the height of Mount Everest compared to the depth of Challenger Deep, the deepest point in the Pacific Ocean's Mariana Trench.

Start by drawing the tiniest dot you can draw with your pencil on a piece of paper. That represents a single-cell zooplankton (animal) or phytoplankton (plant). These are the foods eaten by krill. Label your dot "plankton." With your ruler, draw a line 1 centimeter (3/8 inch) long. That is the size of a typical species of shrimp-like krill. Using the picture of the krill in the **Sealife Trading Cards**, draw a krill near that line. A pygmy seahorse might also grow to be 1 centimeter long. Draw that on your paper. A Goliath grouper, however, might grow to be 2 meters long. With a piece of chalk or tape, draw your Goliath grouper on the floor, sidewalk or playground. If you have lots of room, draw in the whale shark and even the blue whale from the measurements listed in the sidebar. Remember, the whale shark (a fish) and the huge blue whale (a mammal) both survive by eating those tiny 1-centimeter krill. Can you imagine how many krill the whale needs to eat each day to survive? Investigate how scientists have learned about the eating habits of the blue whale. Continue your measurements using the other creatures in the **Sealife Trading Cards**.



MEASUREMENT COMPARISONS



Plankton
Nanoplankton are microscopic, microplankton are less than 1 mm, macroplankton may grow to 1 cm or larger, and megaplankton may grow up to 200 cm.

Krill
1 cm (0.39 inch)

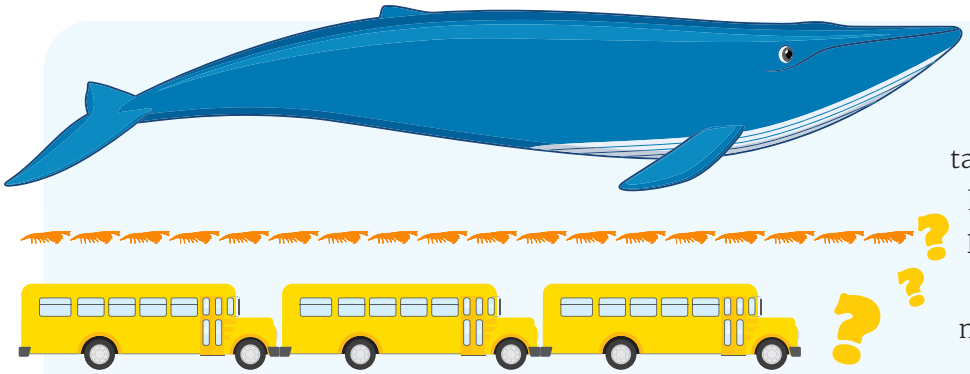
Pygmy Seahorse
1 cm (0.39 inch)

Goliath Grouper
2.5 m (8.2 feet)

Whale Shark
18.8 m for the largest individual discovered (61.68 feet)

Blue Whale
29.9 m for the largest individual discovered (98.1 feet)

School Bus
about 12 meters (40 feet)



MATH CHALLENGE:

How many krill lined up head-to-tail would it take to reach from the head to the tail of the blue whale? How many school buses equal the length of the blue whale? Use the measurements listed on page 9 for your calculations.

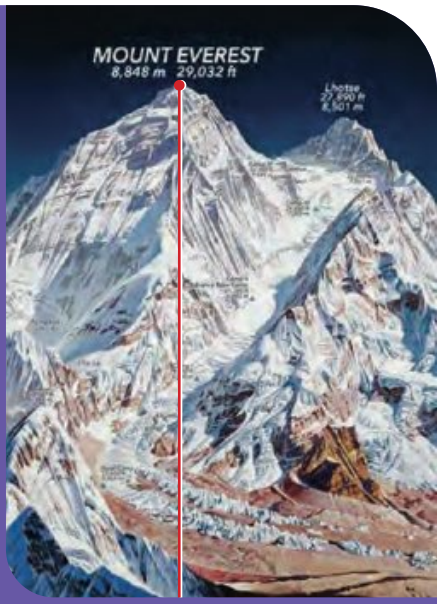
DISCUSSION CHALLENGES

Size makes a difference. How hard would it be to hide a blue whale on land compared to in the ocean? Why?

Read the Fun Fact below. If you walked the distance to the bottom of Challenger Deep or to the top of Mount Everest in a straight line in your neighborhood, how far would you have to walk, and how long would it take you? Is it equal to the distance from your house to your school, or to a park? Check a map to find a location 10.99 km (6.8 miles) from your home for an imaginary journey to the bottom of the ocean.

How many blue whales could stand tip-to-tail from the bottom of Challenger Deep to the ocean surface? Create a scale drawing showing your findings.

FUN FACT



Make a guess. Which do you think is the longer distance: from sea level up to the top of Mount Everest, or from sea level down to the deepest part of the ocean that scientists have discovered? Did you make a guess?

Answer: At the southern end of the Mariana Trench in the Pacific Ocean is Challenger Deep, measuring 10,990 meters from sea level, or 10.99 kilometers (36,056 feet) deep. On land, Mount Everest is the highest Himalayan mountain and the highest point on Earth at 8,850 meters (29,035 feet) tall. If you turned Mount Everest upside down and put the tip into Challenger Deep, how far would the mountain stick out above the water's surface (or would it remain below the surface)?

DIVE EVEN DEEPER

Let's play the "What's My Size?" Game

This is the card game known by many children as "War," where a larger denomination wins over a smaller one.

In the card version of War, the card with the larger face value wins the battle. With **"What's My Size?"** the card with the **largest animal** (the most "size" dots) wins the battle.

To play: Print and cut out the **Sealife Trading Cards** (Appendix 1, with **Blank Backs**), printing one set per pair of players, on cardstock if possible. Shuffle the cards and deal an equal number to each player. Players do not look at their cards but keep them in a pile face down. The object of the game is to win all the cards.

Both players turn their top card face up and put them in the center of the table. Whoever turned the higher card (the larger of the sea creatures) takes both cards and adds them (face down) to the bottom of their own pile. Both players turn up their next card and so on.

If the turned-up cards are equal, there is a **challenge** (not unlike the Sarcastic Fringehead mouth-fighting challenge we see in the film). The equal cards stay on the table and both players play the next three cards of their pile face down, and then another card face-up. Whoever has the higher of the new face-up cards wins the challenge and all the played cards, adding them to the bottom of their pile (yes, you may look at them before adding to your pile). If the new face-up cards are equal as well, the challenge continues. Each player puts another three cards face-down, and one face-up. The player of the higher face-up card wins all the cards in the challenge.

The game continues until one player has all the cards and wins. This can take a long time! Good luck!

SEALIFE TRADING CARDS - SIZE DE-CODER:

Sealife Trading Cards can be found in Appendix 1 of this guide. The number of dots on each card represent the approximate size of the animal. A note on sizes: use a metric ruler to find how your pinkie, hand, and leg compare with the size de-coder measurement hints. This rough estimate for sizes is also provided in the Trading Cards.

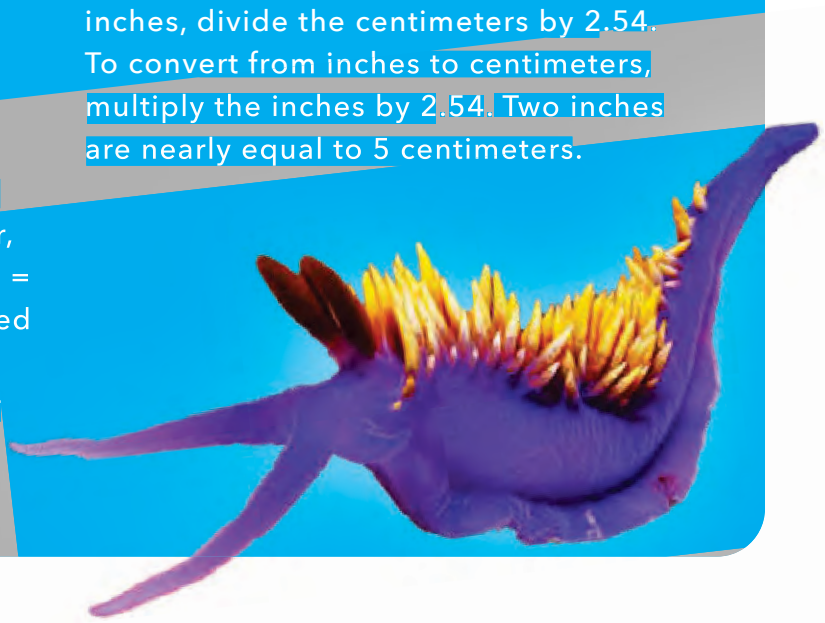
- ● 0 to 1 cm = your pinkie = tiny
- ●● 1 cm to 10 cm = your hand = small
- ●●● 10 cm to 100 cm = your leg = medium
- ●●●● 100 cm to 200 cm (2 m) = your doorway = large
- ●●●●● 200 cm to 1000 cm (2 m - 10 m) = a telephone pole = huge
- ●●●●●● 10 m and up = longer than a telephone pole = enormous!

DEFINITIONS

Plankton – the tiny life of the ocean too small to swim against the currents. Plankton include phytoplankton (plant) and zooplankton (animal), and encompass sizes from nanoplankton, microplankton, macroplankton, and even megaplankton, such as the Portuguese man-o-war sea jelly (formerly called a jellyfish, but not a fish).

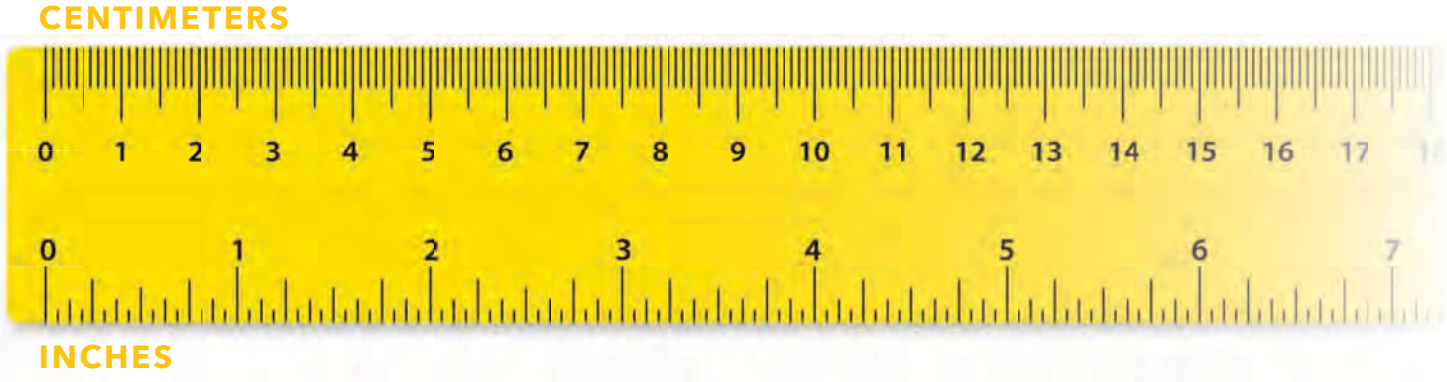
Metric system – the measuring system using the base 10 method of millimeter, centimeter (1 cm = 10 mm), meter (1 m = 100 cm), kilometer (1 km = 1000 m) used by most countries of the world.
A centimeter is about the width of your pinkie. What part of your pinkie? Compare it to the ruler on this page.

Imperial measurements – the measuring system using inches, feet (12 in.), yards (3 ft.), miles (5280 ft or 1760 yards), still used by the U.S. and only two other countries of the world, Myanmar and Liberia. To convert from centimeters to inches, divide the centimeters by 2.54. To convert from inches to centimeters, multiply the inches by 2.54. Two inches are nearly equal to 5 centimeters.

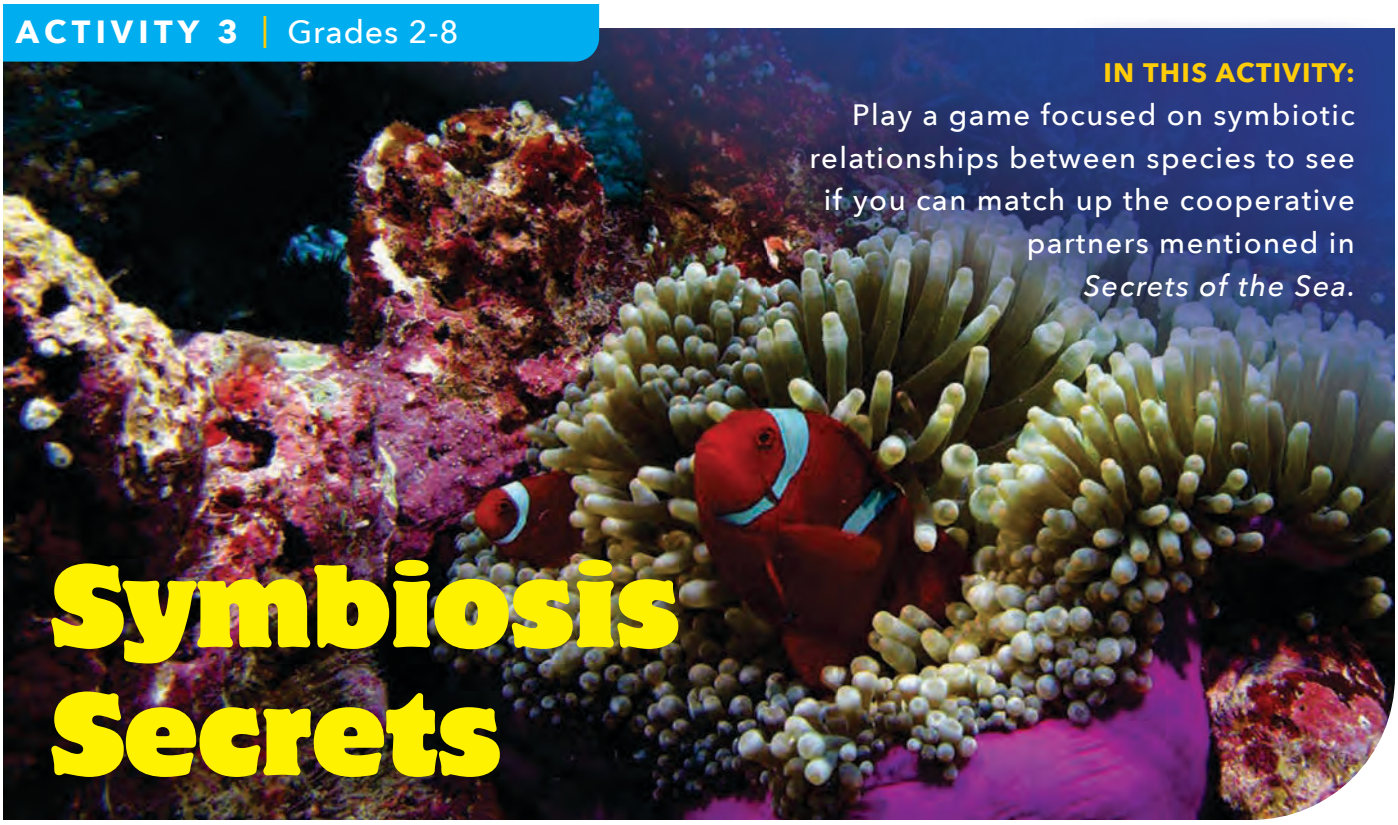


HELPFUL HINT: *Scientists use the metric system of measurement. Challenge students to measure with millimeters, centimeters, meters, and kilometers, rather than the imperial system of inches, feet, yards, and miles, whenever possible. Think like a scientist! Remember, the metric system measures 10 millimeters in a centimeter, 100 centimeters in a meter, and 1,000 meters in a kilometer. To convert from metric to the imperial system, one centimeter = 0.39 inches, and 2 inches nearly equal 5 centimeters.*

See the Definitions in this activity for more.



ACTIVITY 3 | Grades 2-8



IN THIS ACTIVITY:
Play a game focused on symbiotic relationships between species to see if you can match up the cooperative partners mentioned in *Secrets of the Sea*.

Symbiosis Secrets

FILMMAKER'S NOTE

One of the greatest secrets about life in the ocean is that cooperation is far more common than predation. This is contrary to what the casual ocean observer previously believed, and why we created *Secrets of the Sea*. We asked how some animals, such as sea turtles, could live to be 100 years old if the ocean is fraught with the danger of predators constantly gobbling up prey. We discovered instead that many animals, due to unique adaptations, do their part in the community to promote long life for their fellow citizens, while extending theirs as well.

INTRODUCTION

It takes a village. Lean on me. We're all in this together. Humanity has sung the praises of community, but one of the biggest secrets of the sea is that mutualism, or the symbiotic relationship of cooperating, is common among sea creatures.

MATERIALS

- ☐ One set of **Sealife Trading Cards** (Appendix 1, with the **Information Backs**) per group, printed on both sides and cut apart
- ☐ One set of **Symbiotic Partners Challenge Cards** (page 15) per group (or one set to be read aloud to all groups), printed and cut apart
- ☐ Scissors or paper cutter for cutting the Trading Cards apart

DIVE INTO THE ACTIVITY

Use the **Sealife Trading Cards** listed in these instructions and challenge your learning group to complete the **Symbiotic Partners Challenge**. Can you match these cooperative partners mentioned in the movie? How do they cooperate with one another?

To play, each pair or group of players gets a set of the **Symbiotic Partners Challenge Cards** (or one person reads aloud to all groups), plus one of each of the following **Sealife Trading Cards** from the **Symbiosis List** below.

SYMBIOSIS LIST: *Anemonefish, Carrier Crab, Dugong, Gorgonian Sea Fan, Hammerhead Shark, Pygmy Seahorse, Remora, Sea Anemone, Sea Urchin, Snapping Shrimp, Shrimp Goby*

Place the Trading Cards with the picture side up on the table. Player #1 of the pair reads the first challenge. Player #2 chooses two cards that they think are the cooperating partners described by the challenge. Check your guess with the information on the reverse side of the Trading Cards to see if the correct partners were selected. An answer key is found on page 16. Switch roles for the second challenge, and continue to play for all challenges.

DIVE EVEN DEEPER

Play a symbiosis game of imaginative pairings (with a bit of a punny play on words).

FOR INSTANCE:

- How might a seahorse form a symbiotic relationship with a dugong, the sea cow?
- How might a seastar (starfish) form a symbiotic relationship with a sunfish?
- What other pairings can you imagine?

DISCUSSION CHALLENGES

Why is it advantageous to have cooperative relationships between animal species?

DEFINITIONS

Predation – the preying (catching and eating) of one animal by another animal (note: predation is not considered a symbiotic relationship)

Cooperation – the process of working together for a mutual goal

Symbiosis – the interaction between living things in one of four ways: mutualism, commensalism, parasitism, and competition

Mutualism – a symbiotic relationship where both living things are mutually dependent upon each other

Commensalism – a symbiotic relationship where one living thing benefits from another, who receives neither benefit nor harm

Parasitism – a symbiotic relationship where one organism benefits while inflicting harm on another

Competition – a symbiotic relationship where organisms compete for resources

SYMBIOTIC PARTNERS CHALLENGE CARDS

SYMBIOTIC PARTNERS CHALLENGE CARD

This organism has stinging tentacles to capture prey. Its partner has developed an immunity to the venom and can live protected among the tentacles. When the partner eats, it drops food bits to the organism.

1

SYMBIOTIC PARTNERS CHALLENGE CARD

This organism has very poor eyesight and cannot see oncoming predators, but it can use its claws to dig and maintain burrows in the sand. Its partner needs a protective burrow in the sand to hide from predators, and it warns the organism of any predators nearby.

2

SYMBIOTIC PARTNERS CHALLENGE CARD

This organism is excellent at finding a meal of bothersome parasites on the skin of a variety of animals. Its partner enjoys the grooming and the removal of the annoying parasites.

3

SYMBIOTIC PARTNERS CHALLENGE CARD

This organism follows its partner and awaits for an episode of defecation (pooping) for a snack of any undigested bits. Its partner does not appear to benefit from this bothersome attention, instead rolling in the sand to dislodge the hangers-on. This is a symbiotic relationship of commensalism, where one benefits but the other does not.

4

SYMBIOTIC PARTNERS CHALLENGE CARD

This organism is capable of carrying another organism on its back. Its partner is covered with stinging spines, providing protection to the organism while also receiving a free ride to areas with food.

5

SYMBIOTIC PARTNERS CHALLENGE CARD

This tiny organism is camouflaged to hide among the branches of its partner. The partner provides protection and receives bits of dropped food from the tiny organism.

6

Answer key is on page 16.

These golden jack fish benefit from their relationship with the dugong. As the dugong gobbles up sea grass, she disturbs small shrimp that are gobbled up by the jacks.

FUN FACT

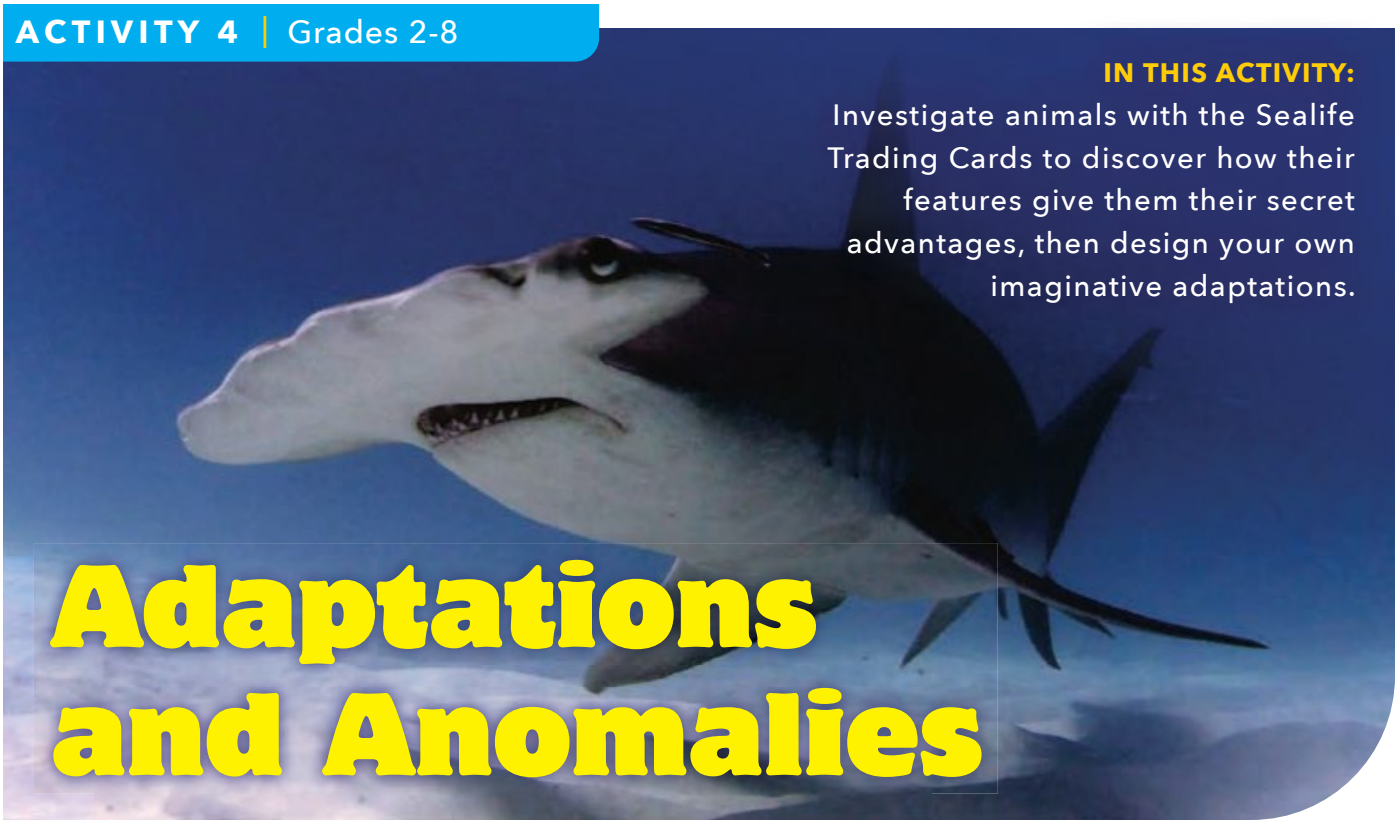
Scientists prefer the terms sea star and sea jelly over starfish and jellyfish because neither of those animals are fish!

ANSWER KEY

for the Symbiotic Partners Challenge Cards:

1 – sea anemone and anemonefish
2 – snapping shrimp and shrimp goby
3 – remora and hammerhead shark or dugong
4 – remora and dugong
5 – carrier crab and sea urchin
6 – pygmy seahorse and gorgonian sea fan

ACTIVITY 4 | Grades 2-8



IN THIS ACTIVITY:
Investigate animals with the Sealife Trading Cards to discover how their features give them their secret advantages, then design your own imaginative adaptations.

Adaptations and Anomalies

FILMMAKER'S NOTE

We filmed many cooperative communities during our filming expeditions and noted that cooperation is often based on the adaptations of each animal. Other adaptations allow animals to live surprisingly long lives. Scientists are discovering more and more adaptations that allow species to survive, thrive and reproduce.

INTRODUCTION

How is each animal species best adapted for its environment? How is it adapted for a cooperative relationship with other species? First, explore the adaptations of cooperative couples from the Symbiotic Partners Challenge game in Activity 3. Then examine other species such as the frogfish, the angel shark, the garden eel and more to discover how their features give them their "secret" special advantages to thrive or promote cooperation in the community. Adaptations generally include body shapes, sizes, senses, colors, or behavior. For more on body coloring, see Activity 5: Colorful Camouflage.

MATERIALS

- ☐ One set of **Sealife Trading Cards** (Appendix 1, with the **Information Backs**) per team, printed on both sides and cut apart

DIVE INTO THE ACTIVITY

If you have not yet played the Symbiotic Partners Challenge game in Activity 3, your group might want to do that first. Next, divide the learning group into two teams. Allow each team a few minutes to read both sides of each of the **Sealife Trading Cards**. Collect all of the cards, then show the front of the first card to one team and have someone call out a body adaptation that might allow it to cooperate with a partner organism or to survive in its environment. Challenge the other team with the second card. Continue through the deck of cards, giving helpful hints and encouraging teams to cooperate so that everyone wins! For instance, what is a barnacle blenny's special behavioral adaptation for survival? The barnacle blenny seeks out empty barnacle shells for a protective home to avoid predators. How does a sarcastic fringehead fish protect its territory? These fish engage in mouthfighting, where the fish with the biggest mouth retains rights to feed in a certain territory. Having the best territory will give advantages when seeking a mate, so the larger mouth adaptation will likely be passed down to future generations through DNA.

Sarcastic fringehead fish use mouth displays to fight for territory.

IMAGINARY ADAPTATION EXAMPLES

Next, design an animal with imaginary adaptations uniquely suited to live in an environment of your choosing. Consider eyes and other sensory organs, mouthparts, coloring, and methods of locomotion. Draw a picture of your imaginary animal, make a computer image or animation of the animal, or even create a sculpture of your imaginary animal.

Consider how each adaptation, anomaly, or mutation might help the individual to survive, thrive, and reproduce.

DISCUSSION CHALLENGES

Play a creative thinking game with your learning group. Challenge everyone to come up with a variety of "What-if" situations and solutions. You may keep your ideas to life in the ocean, or even extend it to humans.

"WHAT-IF..." STARTER QUESTIONS:

What if a fish was born with huge eyes. In what way would it excel? (A fish with huge eyes might be better adapted to see in the dark areas of the ocean, allowing it to catch more food and evade predators and thus thrive because it has more light-collecting space on its retina.)

What if a fish was born with a really big tail? (That fish might be able to evade predators by swimming fast, allowing it to thrive, reproduce, and possibly pass this new trait on to offspring. Conversely, it might be more easily caught because of the big tail, in which case it would not be able to thrive and reproduce, nor pass on this adaptation or anomaly to offspring.)

What if a human was born with really long fingers? (That human might be extremely good at playing the piano, or possibly catching fish with their hands in a stream. Prior to the profession of commercial fishing, excelling in catching fish would allow the human to thrive.)

HELPFUL HINT: *For some animals, an adaptation has been passed down for generations through genetics. Anomalies and mutations also occur during development or due to an accident in the DNA. Only mutations that involve DNA can be passed on to offspring.*

DEFINITIONS

Adaptation - a characteristic, such as body shape, senses, colors, or behavior, that helps an animal survive and reproduce in its habitat

Anomaly - a deviation or mutation from standard characteristics for an animal, such as a fish that hatches without a tail

Evolve - to change, such as an alteration in the characteristics of a species over many generations through changes in the DNA

Mutation - a change or variant, such as an alteration to a gene in the DNA of a living thing, possibly causing a deviation from standard characteristics

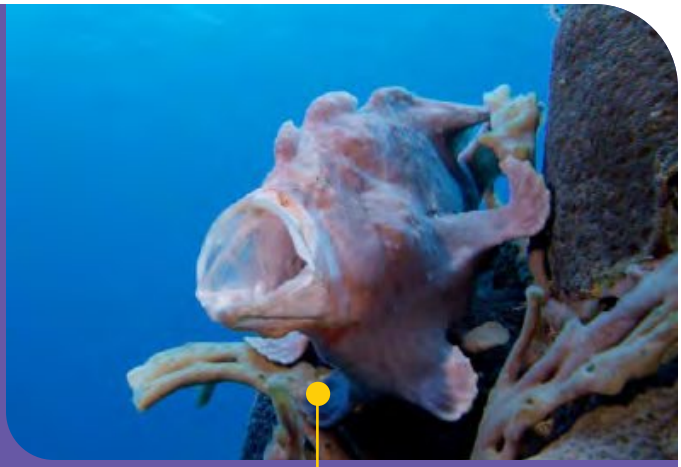
DIVE EVEN DEEPER

Explore creatures in your own community to find their special adaptations. How do adaptations give local animals advantages to survive, such as squirrels, crows, or web-spinning spiders?

(Squirrels can climb trees to evade predators, crows can fly to find food in many environments, and spiders can spin webs to catch flying prey.)

FUN FACTS

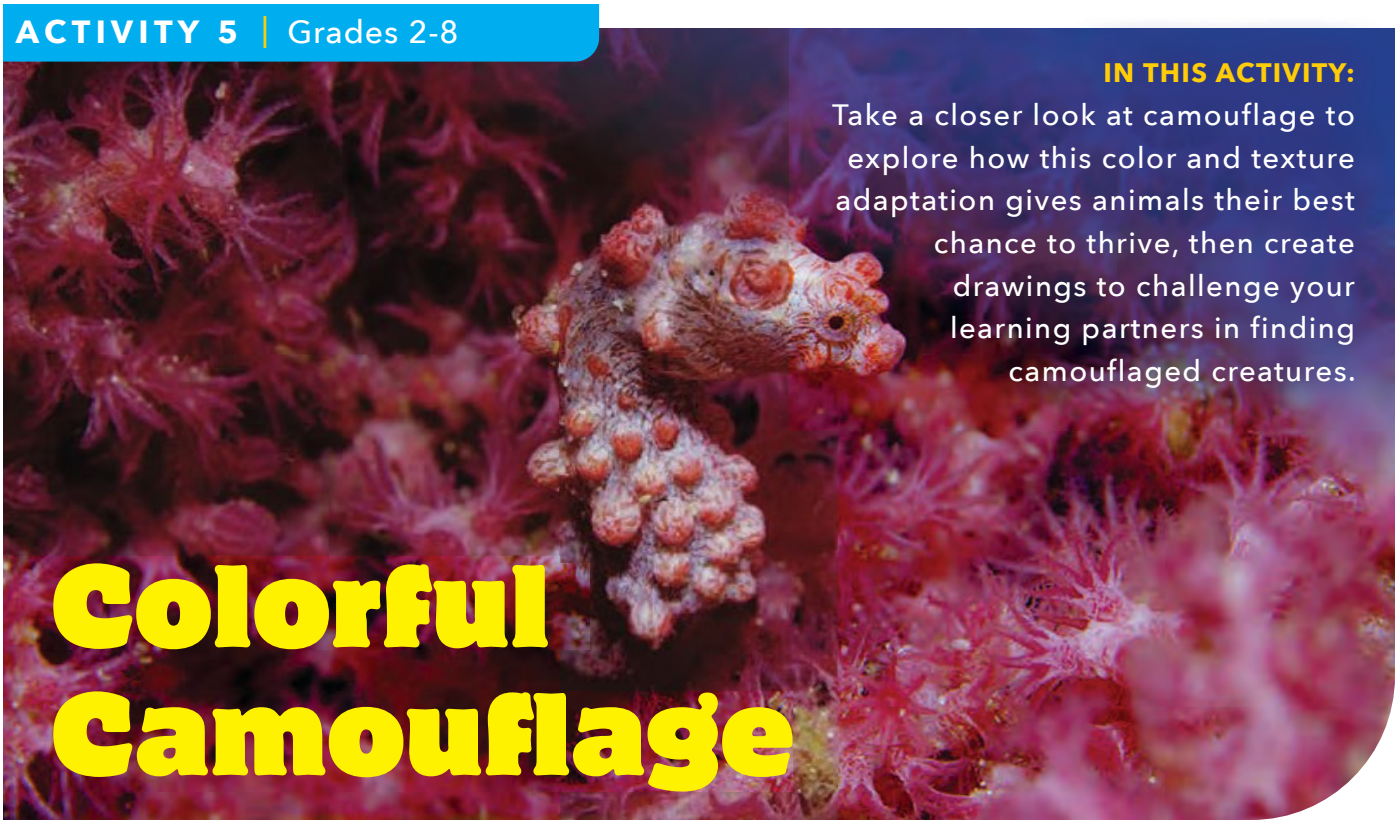
Hammerhead sharks have the oddest shark adaptations in the ocean. Their head has extremely wide-set eyes for excellent depth perception, the area under the wide head has electroreceptors which detect nerve activity of prey animals even under the sand, and the shape of the head, like a special airplane wing, likely increases maneuverability and swimming ability.



Frogfish are the masters of adaptations in the ocean. Their front dorsal fin has changed into a fleshy fishing lure that can grow back if nibbled off, and their pectoral fins have changed into walking legs because their lumpy, camouflaged body is no longer streamlined for efficient swimming.

The **snapping shrimp** has a special adaptation in its claws. One claw is larger than the other, and the shrimp is capable of closing that claw so quickly it produces a percussive snap due to the rapid movement of water. The shockwave can both stun prey and deter a predator.

ACTIVITY 5 | Grades 2-8



IN THIS ACTIVITY:
Take a closer look at camouflage to explore how this color and texture adaptation gives animals their best chance to thrive, then create drawings to challenge your learning partners in finding camouflaged creatures.

Colorful Camouflage

FILMMAKER'S NOTE

Filming the creatures of the sea can be especially challenging when many of them have adapted to their environment by completely blending in with their surroundings. We found this to be another wonderful secret of the sea.

INTRODUCTION

The adaptation of camouflage, or hiding in plain sight, involves coloring, shape, texture, and movement. Take a closer look at camouflage to explore how this adaptation gives animals their best chance to survive, thrive and reproduce in their environment. Create drawings to challenge your learning partners, including your friends and family members, in finding camouflaged creatures in a variety of environments.

MATERIALS

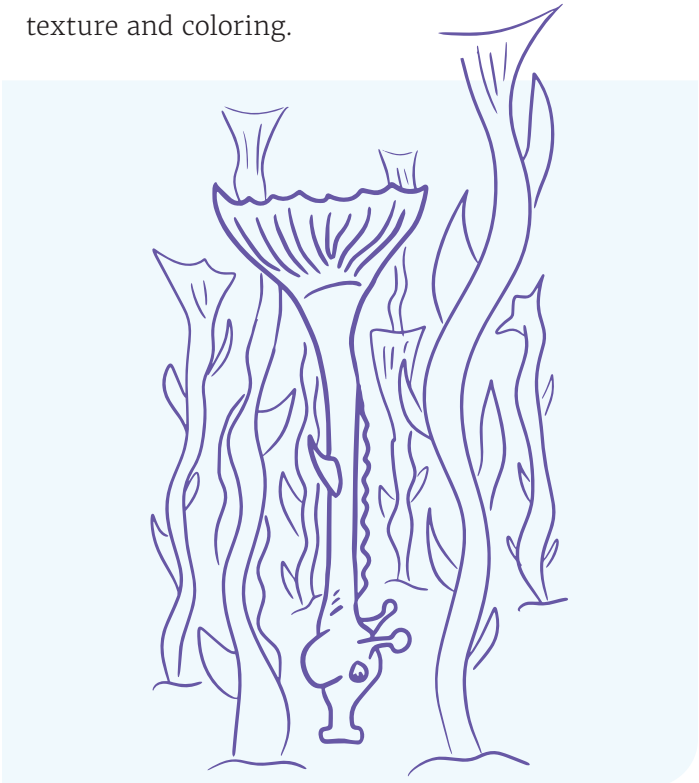
- [ ] One set of **Sealife Trading Cards** (Appendix 1, with the **Information Backs**), printed on both sides and cut apart
- [ ] Paper and drawing materials

DIVE INTO THE ACTIVITY

Take a close look at the **Sealife Trading Cards** images of the animals in the **Camouflage List** below. How does their coloring help them hide from both their prey and their predators? Read their information card, then research their environment to discover how they hide in plain sight. If you and your learning group are computer-savvy, create digital images to hide and then reveal your chosen creatures.

CAMOUFLAGE LIST: *Angel Shark, Coconut Octopus, Comb Jelly, Flamboyant Cuttlefish, Frogfish, Manta Ray, Opalescent Squid, Pygmy Seahorse, Spinner Dolphin.*

Next, explore adaptations and camouflage in an imaginative way and create imaginary sea creatures that would have an advantage in various environments. Draw pictures, design digital images, and create 3-D art to share your imaginary animals with a focus on shape, texture and coloring.



DISCUSSION CHALLENGES

If you wanted to find and study well-camouflaged animals in the wild, how would you use technology to help you locate the animal?

DIVE EVEN DEEPER

Explore in your own community for animals employing the adaptation of camouflage, such as moths, or those with warning colors, such as yellow jacket wasps. Warning colors are the reds, oranges, and yellows that many insects adapt to indicate a defense mechanism – a "don't eat me!" message. How can camouflage, or warning coloration, provide an advantage for survival?

DEFINITIONS

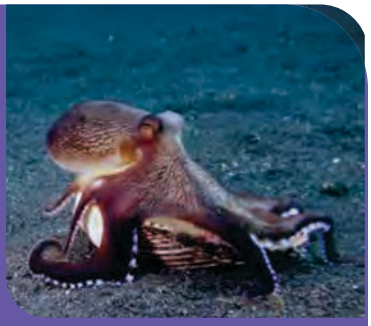
Camouflage – coloring or body shape that allows an animal to hide in plain sight by blending in with the surroundings

Warning Coloration – bright red, orange, yellow or white colors on an animal that warn a predator of a defense method such as a sting (yellow jackets), a foul taste (monarch butterflies), or a poison (poison dart frogs)

Predator – an animal that hunts and eats another animal

Prey – an animal that is eaten by another animal

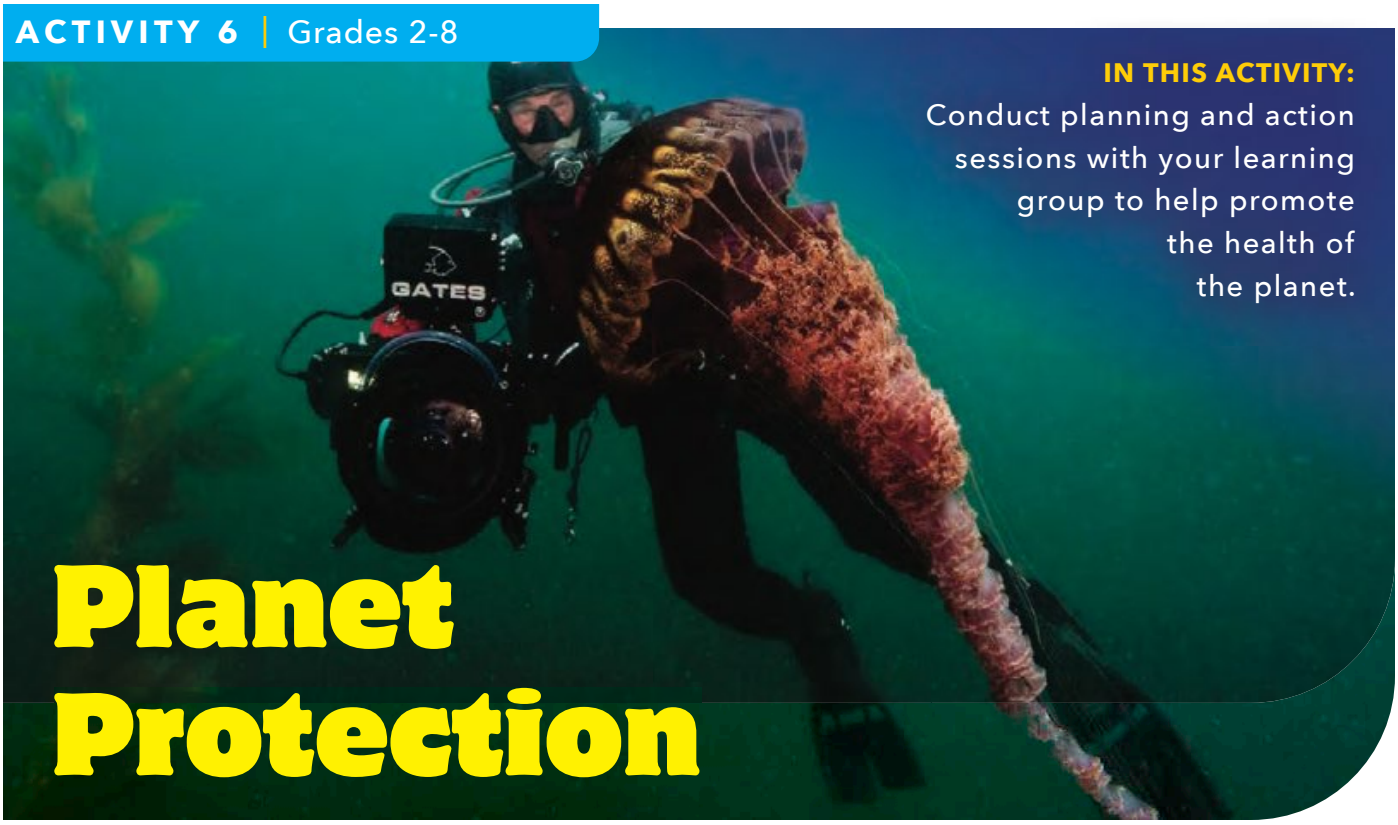
FUN FACTS



Some land animals and insects, such as yellow jackets or skunks, display warning colors in red, orange, yellow or white to alert predators to their defenses. Other land animals, such as peacocks, and many sea creatures, such as the anemonefish or barnacle blenny, use bright colors to attract a mate.

Some sea creatures, such as angel sharks, are permanently colored with their camouflage markings, while others, such as octopus, cuttlefish, and squid, have skin cells called chromatophores that can change colors in an instant to provide protective camouflage.

ACTIVITY 6 | Grades 2-8



IN THIS ACTIVITY:
Conduct planning and action sessions with your learning group to help promote the health of the planet.

Planet Protection

FILMMAKER'S NOTE

The plants and animals of our planet, whether on land or water, all depend on community and cooperation. Humans are a species capable of both stewardship and destruction. We need to be cooperative stewards of our planet because the ocean is resilient, but it needs our help.

INTRODUCTION

What can we do to ensure that our actions protect and preserve, rather than harm, the natural areas of our neighborhoods, both near and far? Find ways to work in your community to practice good stewardship for our small blue planet.

DIVE INTO THE ACTIVITY

Conduct a planning session with your learning group to determine ways you can help protect the health of the planet with a **Planet Protector Challenge**. Create multiple teams of Planet

MATERIALS

- [ ] Paper and drawing materials for making a poster

Protectors and conduct your own **Earth Day Competition Challenge** (or Ocean Day, or Wetlands Day, or even Desert Day) on any day of the year. How much litter or trash can each group gather from the outdoors? How can you help with recycling efforts in your community? How many single-use plastics can you avoid using? How many harsh cleaning chemicals can you replace with environmentally friendly ones? How can you help others see the benefits of planet stewardship and conservation efforts? Create posters to alert your community to your efforts. For the computer artists, create digital images, infographics, or storyboards for videos to share your creative ideas about protecting the planet.

DISCUSSION CHALLENGES

What aspect of protecting the planet or wildlife conservation is most important to you, and why?

DIVE EVEN DEEPER

Make something beautiful from your Planet Protector trash collecting or reduce-reuse-recycle efforts. Create art, perhaps a 3-D rendering of your imaginary animal designs from **Activity 4: Adaptations and Anomalies** and **Activity 5: Colorful Camouflage** using parts gathered in your Planet Protector Challenge. Check out the examples from Washed Ashore, an artistic group known for sculptures created from ocean trash (www.washedashore.org).

Then write a creative piece, perhaps a nature haiku, based on your thoughts and nature observations. What can you create? Also, encourage your learning group to explore the wide world of marine and nature careers, and investigate other ways to preserve and protect our fragile Planet Earth and all her secrets and surprises. How will you contribute?

A swordfish sculpture created by Washed Ashore from trash collected during beach cleanup activities. Image: Washed Ashore

GET IN TOUCH WITH NATURE THROUGH CREATIVE WRITING:

Write a nature haiku! This one describes the *Secrets of the Sea* filmmakers.

Ocean observers

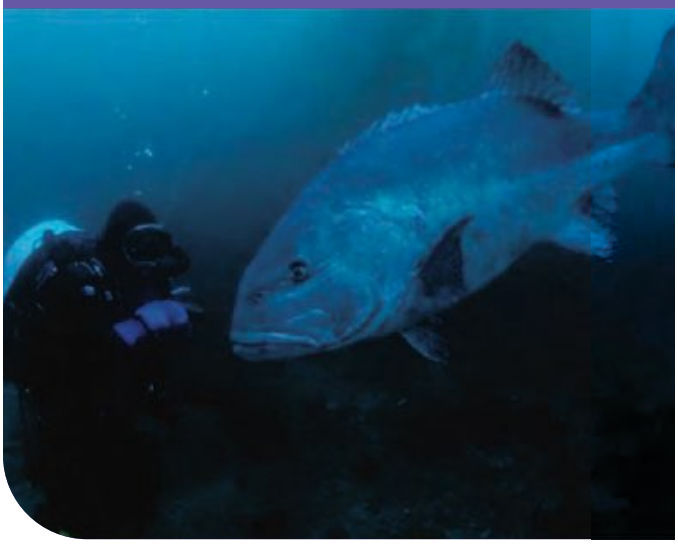
Filming secrets undersea

Striving to protect

Filmmaker Howard Hall filming a tiger shark in the Bahamas.

FUN FACT

Global conservation efforts have helped animals such as the giant sea bass, the goliath grouper, and the sea turtle come back from the threat of extinction.



DEFINITIONS

Conservation – acting with care to avoid wasting Earth's resources or damaging the environment

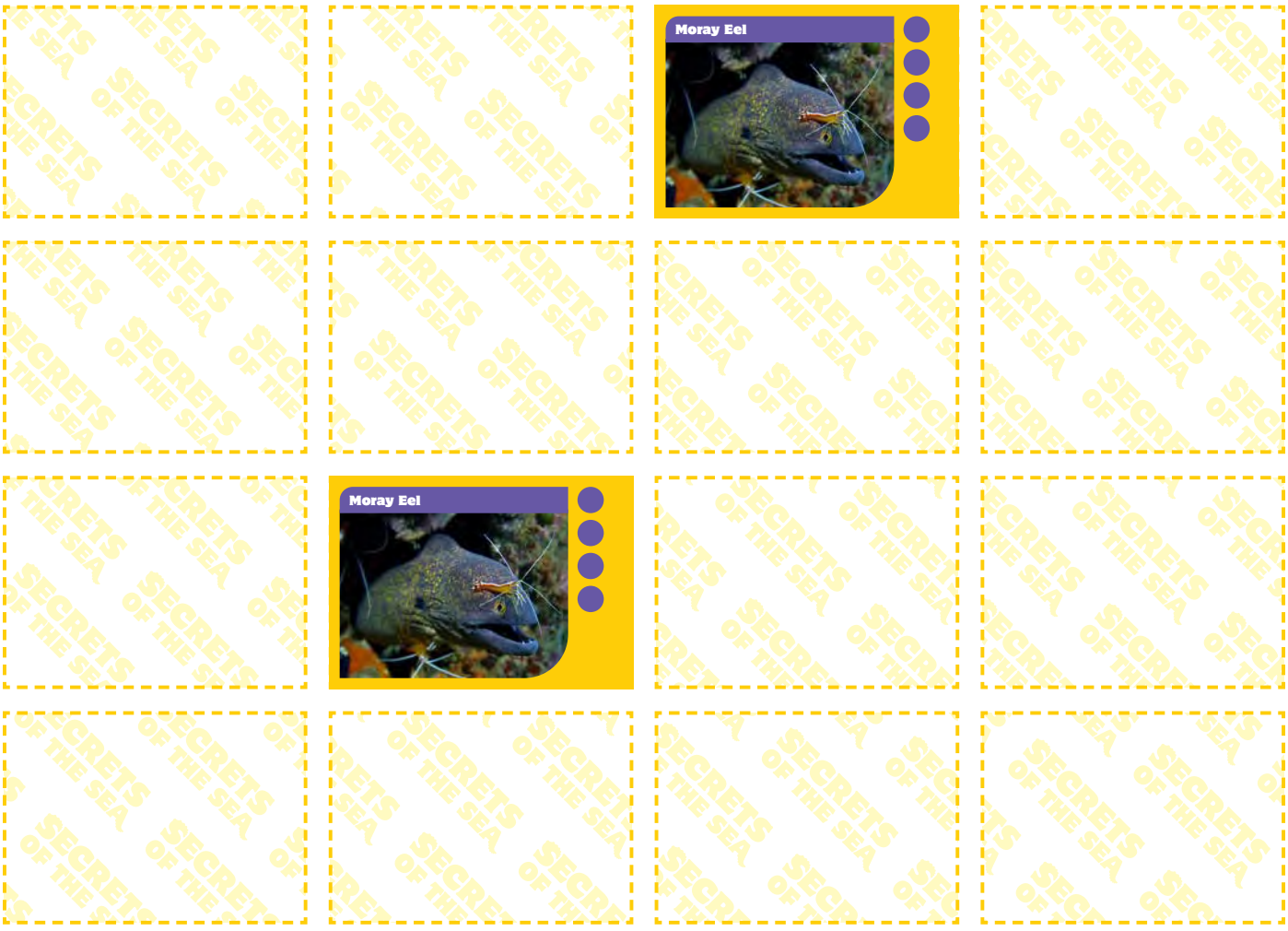
Stewardship – the job of caring for resources, such as for the environment

Reduce-Reuse-Recycle – minimize waste (such as single-use plastics), find new uses for products rather than throwing them into the landfill, and place clean items into the recycling bin to be processed into new products

Use the **Sealife Trading Cards** to play these additional games that encourage an appreciation of our ocean communities.

SEALIFE MEMORY GAME

Play the **Sealife Memory Game** using the **Sealife Trading Cards** (Appendix 1, with the **Blank Backs**). Make two sets of a single page of 12 cards, such as two copies of Card Set 3. Arrange the 24 cards (or fewer pairs for younger players, perhaps 8 pairs), in straight rows and columns. The first player turns over two cards, one at a time. If the cards match, the player gets to keep the cards and the next player takes a turn. (Some players may choose to have a player take another turn if their two cards match, but this rule may frustrate younger players.) If the cards don't match, they are turned back over in their same locations and the next player takes a turn. Players should try to use their memory to locate pairs. Play until all the matches have been found. The player with the most pairs wins. Then shuffle the cards and play again!



Players flip over two cards to see if they match. The goal is to find as many matches as possible.

SEALIFE BINGO

Play **Sealife Bingo** with your learning group! Print out one set of **Sealife Trading Cards** (with the **Information Backs**), then put the following 24 cards into a choosing bowl: Anemonefish, Barnacle Blenny, Blue Whale, Carrier Crab, Coconut Octopus, Comb Jelly, Dugong, Flamboyant Cuttlefish, Frogfish, Garden Eel, Goliath Grouper, Hammerhead Shark, Humpback Whale, Manta Ray, Moray Eel, Pygmy Seahorse, Remora, Sarcastic Fringehead, Sea Anemone, Sea Lion, Sea Otter, Sea Turtle, Sea Urchin, Spinner Dolphin.

Print as many of the **Sealife Bingo Cards** (Appendix 2) as needed for your group. One square on each Bingo Card page is blank. Have players fill in the blank square with an animal from the list on their page to ensure each player's card is unique.

The Bingo Caller will choose a **Sealife Trading Card** from the choosing bowl (players should be familiar with the cards by participating in the previous activities in this Guide). Hiding the name on the front of the card, the Caller will read the clue on the back. The Caller then chooses a player to guess the name of the animal described in the Clue and named on the front of the card. When the correct animal is guessed, all players with that animal on their Bingo card will mark the animal's square with a checkmark in the small box. Use pencil so the mark can be erased for subsequent games. Players call out "Bingo!" when they have a straight row, column, or diagonal of four marked squares. An alternative to the pencil checkmark is a marker, such as a penny or paperclip, placed on each called square. Have fun with this!

Card Set 1

Card Fronts

I am a small fish and a good recycler. I reuse empty barnacle shells for a home and a place to hide from predators. I am usually less than 6 centimeters long.

I am a shark, but I look more like my relative the manta ray. Instead of stiff bones, my skeleton is made of cartilage. My large flat head and flat wing-like pectoral fins allow me to cover myself with sand so I can hide from my prey. I am typically about 2 meters long.

I am a fish. Unlike most fish, I am immune to sea anemone venom, so I can swim among their stinging tentacles and stay safe from predators. We share a mutual symbiotic relationship. I am typically about 8 centimeters long.

I am a very intelligent boneless animal related to squid and cuttlefish. I can use my eight arms to close myself into clam shells or coconut shells for protection, and I can change my colors with skin cells called chromatophores. I am about 15 centimeters long.

I am a crustacean with long legs and strong pinchers, related to lobsters. I have a mutual symbiotic relationship with the spiny sea urchin. I can carry one around for my own protection. I am typically 20 centimeters wide.

I am the largest animal on the earth, the length of two volleyball courts, but I survive on food smaller than your fingertip. I am an ocean mammal with baleen instead of teeth for straining the tiny krill from the water. The longest of my kind is 29.9 meters long.

I am a huge community made of tiny polyps which form hard limestone shapes. I provide a neighborhood for a very diverse group of animals and plants. The longest community is about 2,500 kilometers (1,553 miles) long, about the distance from Kansas City to Los Angeles!

I am one of the tiny individuals that builds hard limestone reefs. I come out of my shell to eat, then retract to hide from predators. I form a symbiotic relationship with algae, which give me my beautiful colors. When I am stressed due to pollution or warming ocean water, I kick out the algae, and I may get sick and die. Conservation efforts are helping me recover. I am typically 0.5 centimeter across.

I am a boneless animal. I have bioluminescent algae inside me in a symbiotic relationship. The algae make me glow, so predators cannot see my silhouette at night. If the predators swim below me and look up, they think they are seeing the night sky. I am typically 10 centimeters long.

Dugong

Flamboyant Cuttlefish

Frogfish

Garden Eel

Goliath Grouper

Gorgonian Sea Fan

Hammerhead Shark

Humpback Whale

Kelp

I am a fish with a wormy-looking knob on my forehead that I use as bait to catch smaller fish. My colors and texture give me great camouflage, and I walk or hop on my front pectoral fins. I can grow to 38 centimeters long.

I am an animal related to squid and octopus, but I have a bone in my head and squid and octopus do not. I can hide from my predators with my amazing color-changing chromatophore-cell camouflage. I am typically about 10 centimeters long.

I am considered the cow of the sea. I graze on sea grasses. I have a mutual symbiotic relationship with remoras. They keep me free of parasites, but they bug me when they just want to eat my poop. I am typically about 3 meters long.

Each member of my community is tiny, but together we build a fan-like structure of limestone that is the favorite hiding place of the tiny pygmy seahorse, my mutual symbiosis partner. My individual community members are 0.5 centimeter across, but our colony can grow to be about a meter tall.

I am a huge fish, longer than a basketball player is tall. I was nearly extinct, but conservation efforts and protection of my mangrove tree nursery habitats have helped my numbers rebound. I am typically 2.5 meters long.

I am a very long, slender animal. I hide in a deep burrow under the sand. When my neighbors and I come out to feed on plankton, we look like a garden of swaying plants. I am typically about 60 centimeters long.

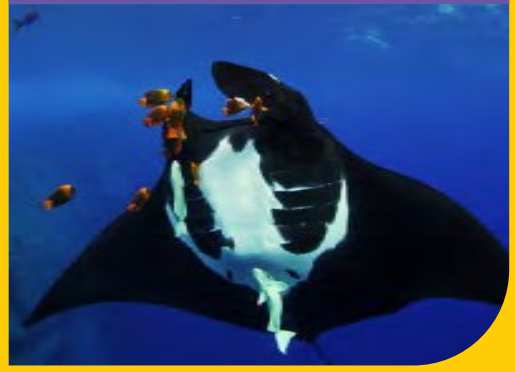
I am an ocean plant. Like all plants, I convert sunlight to nutrients. When I am part of an ocean forest, I provide habitat to many ocean animals. I am typically 30 meters tall.

I am a mammal bigger than a school bus, but I am nimble enough to dance and breach out of the ocean. I have baleen instead of teeth, a very humpy-bumpy head, and a very expressive language. I can grow to 17 meters long.

I have a head that allows me to locate prey through wide-set eyes and nostrils and special electroreceptors. My unique head shape also increases my maneuverability and swimming function. Like other sharks, I have a mutual symbiotic relationship with remoras. I can grow to 6 meters long.

Krill

Manta Ray



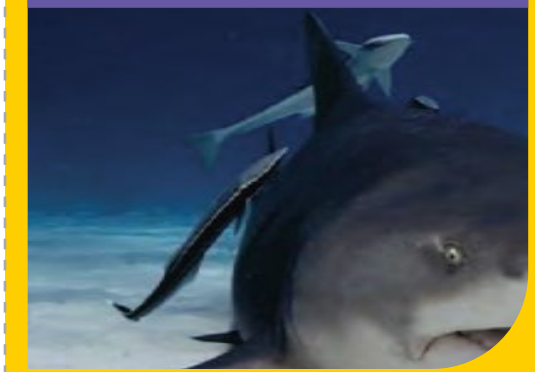
Moray Eel

Opalescent Squid

Plankton

Pygmy Seahorse

Remora



Sarcastic Fringehead

Sea Anemone

I am a long, slender, flexible fish. I swim by wiggling my body because I lack swim fins. I hide in holes in coral reefs and gobble unsuspecting prey with my powerful jaws and sharp teeth. I am typically 1.5 meters long.

I look more like a black-and-white kite than a fish, and I can hide under the sand because of my flat shape. I have a mutual symbiotic relationship with remoras, who keep me free of parasites and whom I will not eat while they provide their service. I am related to sharks. I can grow to be 7 meters wide.

I am a tiny animal, but the most important food source for the largest animals of the ocean. I am unable to swim against ocean currents, so I am in the group called plankton (unless I am the largest of my kind). I am typically 1 centimeter long.

I am a tiny sea creature with a head that resembles a horse. I have a symbiotic relationship with gorgonian sea fan corals, and my resemblance to their branches allows perfect camouflage. I am less than two centimeters tall.

My name refers to a group of sea life that includes both plants and animals. If I am a plant, I convert sunlight to food. If I am an animal, I survive on even tinier animals such as diatoms, which are also part of this group. I am in this group if I am unable to swim against ocean currents. I am microscopic, typically smaller than a millimeter.

I am an animal related to cuttlefish and octopus. My hot-dog shape is similar to a cuttlefish, but unlike the cuttlefish I have no bones in my entire body. My skin contains cells called chromatophores, which allow me to change color. I especially do this to attract a mate. I am typically 30 centimeters long, including my tentacles.

I may look like a plant, but I am an animal related to coral and sea jellies. I have stinging tentacles that I use to stun prey. I have a mutual symbiotic relationship with one type of fish, who is immune to my sting, and who protects me and rids me of parasites. Some members of my family grow to be 5 centimeters in diameter, while others can grow to be nearly 1 meter. I am typically about 20 centimeters in diameter.

I am a fish known for my huge mouth and my very civil way of settling territory disputes. The one with the biggest mouth wins! My jaws flair open for the challenge. I am typically 30 centimeters long.

I am the spa treatment fish of the sea. Other animals, such as sharks, come to me for relief from their pesky parasites. We form a mutual symbiotic relationship. I groom them, and they refrain from eating me. I am also known to pester dugongs for their poop. I am typically less than 100 centimeters long.

Sea Lion

Sea Otter

Sea Turtle

Sea Urchin

Shrimp Goby

Snapping Shrimp

Spinner Dolphin

Whale Shark

SEALIFE TRADING CARDS - SIZE INFORMATION:

- ● 0 to 1 cm = your pinkie = tiny
- ●● 1 cm to 10 cm = your hand = small
- ●●● 10 cm to 100 cm = your leg = medium
- ●●●● 100 cm to 200 cm (2 m) = your doorway = large
- ●●●●● 200 cm to 1000 cm (2 m to 10 m) = a telephone pole = huge
- ●●●●●● 10 m and up = enormous

I am a sea reptile. I hatch from an egg on the beach and must make my way to the ocean waters where I gracefully swim with my flippers. My numbers have been in danger, but conservation efforts have helped me to survive. I am typically under 2 meters in length.

I am a sleek, slender, flexible mammal, known for my playfulness. I lounge on my back on the surface of the ocean in the kelp forests, grooming my thick fur and crushing shells with a rock on my belly. I am typically 1.5 meters long.

I am a fish-eating mammal well-known for my bright eyes and little ears, and for my boisterous gatherings off the coast of California in the United States. I am playful and curious. I can grow to be 2.5 meters long.

I am a crustacean related to krill, crabs, lobsters, and even roly-poly pillbugs. I have strong pinchers, which I use to dig burrows, or snap to stun and capture prey. I am nearly blind, so goby fish protect me from predators and share my burrow in a symbiotic relationship. I am typically 5 centimeters long.

I am a fish known for my mutual symbiotic relationship with snapping shrimp. I live with the shrimp in their burrow, and I protect them from predators that they cannot see with their poor eyesight. I am typically 10 centimeters in length.

I look like a round pincushion covered by spines that I use for protection and to spear prey. I have a symbiotic relationship with the carrier crab, who carries me to places with food and uses me for protection. I am related to sea stars. I am typically smaller than 10 centimeters in diameter.

SEALIFE TRADING CARDS - SIZE INFORMATION:

- ● 0 to 1 cm = your pinkie = tiny
- ●● 1 cm to 10 cm = your hand = small
- ●●● 10 cm to 100 cm = your leg = medium
- ●●●● 100 cm to 200 cm (2 m) = your doorway = large
- ●●●●● 200 cm to 1000 cm (2 m to 10 m) = a telephone pole = huge
- ●●●●●● 10 m and up = enormous

I am the largest fish in the ocean, but I use my huge mouth to eat tiny krill. Unlike my relative the great white shark, I am known to be gentle. I have grown to 18.8 meters in length.

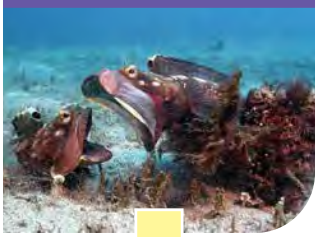
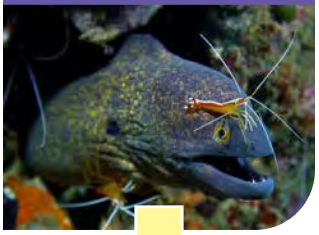
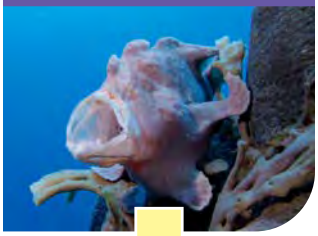
I am a sea mammal with a face that looks like I'm smiling, and a dorsal fin that makes me look like a shark. I am known for my acrobatic spinning leaps and my chattering voice. My species is small compared to my relatives. I am typically about 2 meters long.

SECRETS OF THE SEA

Sealife Bingo!

There are 24 sea creatures in the Bingo game. Fifteen are on your card. Choose one more animal from the following list to add to the blank space on your card. This will make your card unique from other cards! When the Bingo Caller calls one of your animals, mark it with a ✔ in the ❒. Look for 4 in a row for a Bingo!

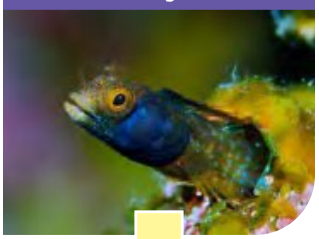
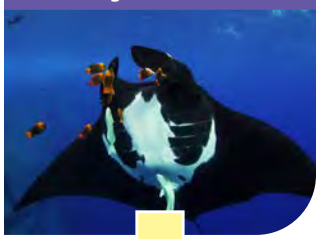
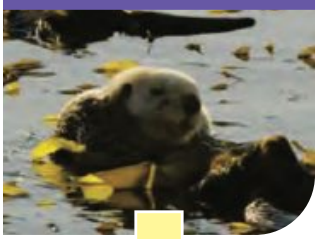
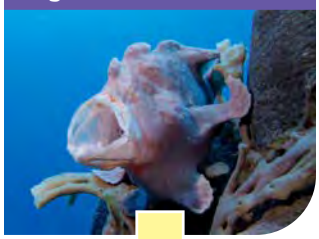
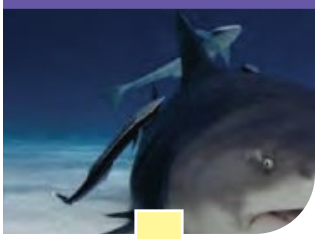
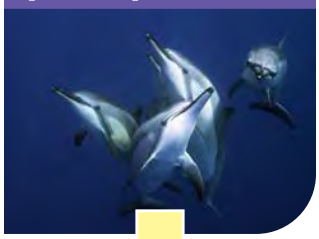
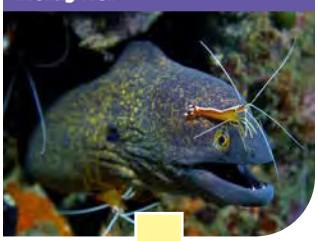
Choose one of these animals for the blank square: *Barnacle Blenny, Blue Whale, Coconut Octopus, Flamboyant Cuttlefish, Goliath Grouper, Manta Ray, Remora, Sea Lion, Sea Urchin.*

Anemonefish aka Clownfish 	**Hammerhead Shark** 	**Sarcastic Fringehead** 	**Garden Eel** 
Humpback Whale 	**Sea Turtle** 	**Carrier Crab** 	**Pygmy Seahorse** 
Moray Eel 	**Dugong** 	**Spinner Dolphin** 	**Sea Anemone** 
Comb Jelly 	**Sea Otter** 	**Frogfish** 	**Choose your own animal from the list!**

Sealife Bingo!

There are 24 sea creatures in the Bingo game. Fifteen are on your card. Choose one more animal from the following list to add to the blank space on your card. This will make your card unique from other cards! When the Bingo Caller calls one of your animals, mark it with a ✔ in the ❒. Look for 4 in a row for a Bingo!

Choose one of these animals for the blank square: *Anemonefish, Carrier Crab, Dugong, Garden Eel, Humpback Whale, Pygmy Seahorse, Sea Anemone, Sea Lion, Sea Turtle.*

Barnacle Blenny 	Manta Ray 	Sea Otter 	Frogfish 
Goliath Grouper 	Comb Jelly 	Sea Urchin 	Flamboyant Cuttlefish 
Remora 	Spinner Dolphin 	Hammerhead Shark 	Blue Whale 
Coconut Octopus 	Sarcastic Fringehead 	Moray Eel 	Choose your own animal from the list!

Sealife Bingo!

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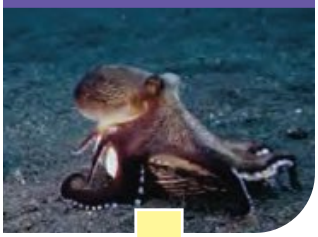
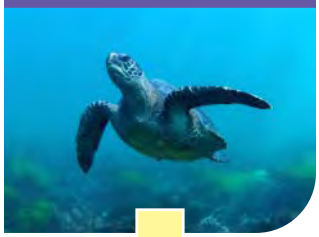
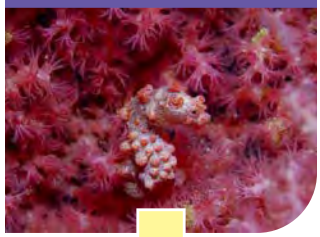
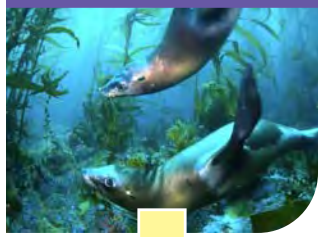
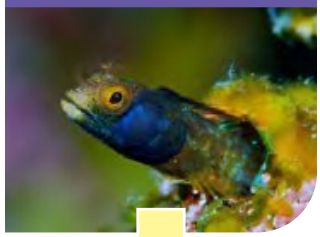
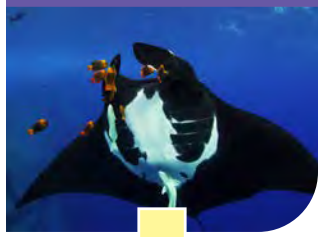
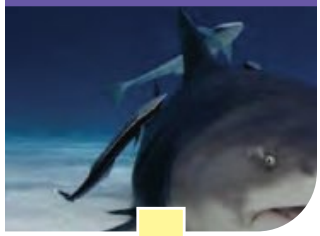
Choose one of these animals for the blank square: *Blue Whale, Carrier Crab, Comb Jelly, Frogfish, Hammerhead Shark, Moray Eel, Sarcastic Fringehead, Sea Otter, Spinner Dolphin.*

Coconut Octopus 	**Sea Turtle** 	**Pygmy Seahorse** 	**Sea Lion** 
Garden Eel 	**Anemonefish aka Clownfish** 	**Barnacle Blenny** 	**Sea Urchin** 
Dugong 	**Sea Anemone** 	**Goliath Grouper** 	**Manta Ray** 
Humpback Whale 	**Flamboyant Cuttlefish** 	**Remora** 	**Choose your own animal from the list!**

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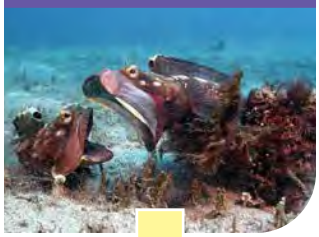
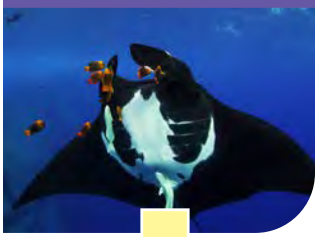
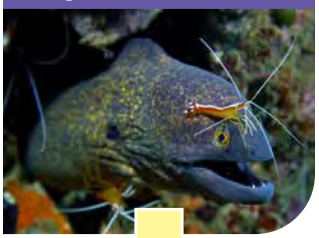
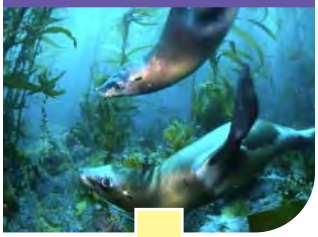
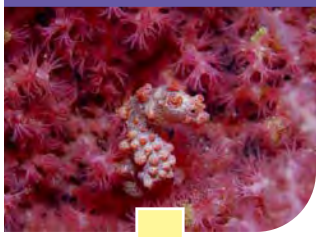
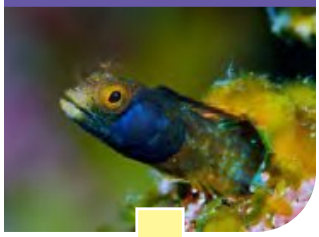
Dugong 	**Sarcastic Fringehead** 	**Carrier Crab** 	**Manta Ray** 
Moray Eel 	**Blue Whale** 	**Sea Lion** 	**Sea Anemone** 
Goliath Grouper 	**Pygmy Seahorse** 	**Sea Otter** 	**Barnacle Blenny** 
Comb Jelly 	**Hammerhead Shark** 	**Garden Eel** 	**Choose your own animal from the list!**

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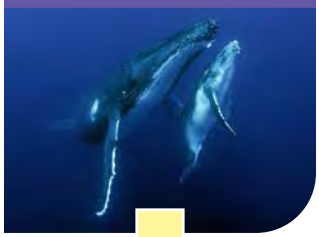
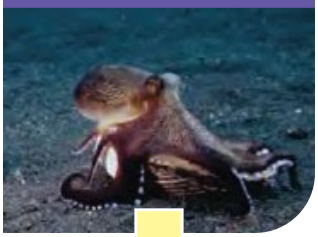
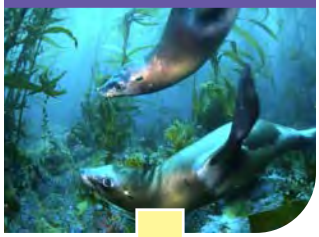
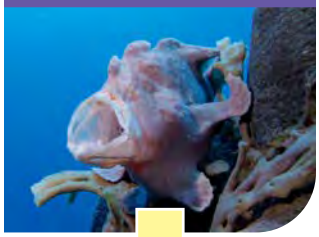
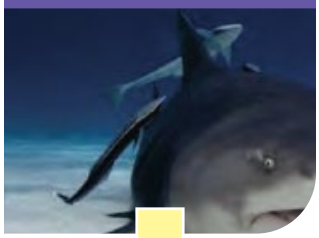
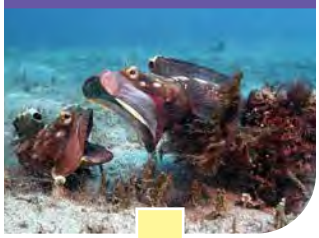
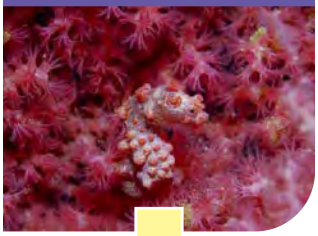
Flamboyant Cuttlefish 	**Humpback Whale** 	**Coconut Octopus** 	**Sea Lion** 
Hammerhead Shark 	**Frogfish** 	**Spinner Dolphin** 	**Carrier Crab** 
Blue Whale 	**Remora** 	**Sea Otter** 	**Sarcastic Fringehead** 
Pygmy Seahorse 	**Sea Turtle** 	**Anemonefish aka Clownfish** 	**Choose your own animal from the list!**

Next Generation Science Standards and Common Core Math Standards

ACTIVITY 1: Visualize the Vastness

2-ESS2-3 Earth's Systems: Obtain information to identify where water is found on Earth and that it can be solid or liquid.

5-ESS2-2 Earth's Systems: Describe and graph the amounts and percentages of water and fresh water in various reservoirs to provide evidence about the distribution of water on Earth.

ACTIVITY 2: See the Sizes

Common Core Math Standards for Measuring and Data:
Measure the length of an object by selecting and using appropriate tools such as rulers, meter sticks, and measuring tapes.
Measure to determine how much longer one object is than another, expressing the length difference in terms of a standard-length unit.

ACTIVITIES 3, 4 and 5: Symbiosis Secrets, Adaptations and Anomalies, and Colorful Camouflage

3-LS2-1. Ecosystems: Interactions, Energy, and Dynamics. Construct an argument that some animals form groups that help members survive.

3-LS3-2. Heredity: Inheritance and Variation of Traits. Use evidence to support the explanation that traits can be influenced by the environment. *(Examples of the environment affecting a trait could include: normally tall plants grown with insufficient water are stunted.)*

3-LS4-2. Biological Evolution: Unity and Diversity. Use evidence to construct an explanation for how the variations in characteristics among individuals of the same species may provide advantages in surviving, finding mates, and reproducing. *(Examples of cause-and-effect relationships could include animals that have better camouflage coloration than other animals may be more likely to survive and therefore more likely to leave offspring.)*

3-LS4-3. Biological Evolution: Unity and Diversity. Construct an argument with evidence that in a particular habitat some organisms can survive well, some survive less well, and some cannot survive at all. *(Examples of evidence could include needs and characteristics of the organisms and habitats involved. The organisms and their habitat make up a system in which the parts depend on each other.)*

4-LS1-1. From Molecules to Organisms: Structures and Processes. Construct an argument that plants and animals have internal and external structures that function to support survival, growth, behavior, and reproduction.

MS-LS2-2. Ecosystems: Interactions, Energy, and Dynamics. Construct an explanation that predicts patterns of interactions among organisms across multiple ecosystems. *(Examples of types of interactions could include competitive, predatory, and mutually beneficial.)*

MS-LS4-4. Biological Evolution: Unity and Diversity. Construct an explanation based on evidence that describes how genetic variations of traits in a population increase some individuals' probability of surviving and reproducing in a specific environment.

ACTIVITY 6: Planet Protection

MS-LS2-4. Ecosystems: Interactions, Energy, and Dynamics. Construct an argument supported by empirical evidence that changes to physical or biological components of an ecosystem affect populations.

Use these references and resources for further explorations.

ACTIVITY 1: Visualize the Vastness

USGS – How Much Water is There on Earth? | U.S. Geological Survey
https://www.usgs.gov/special-topics/water-science-school/science/how-much-water-there-earth

NOAA – How much of the ocean have we explored?
https://oceanservice.noaa.gov/facts/exploration.html

NOAA's printable globe – ETOPO2 Icosahedron for Print.ai
https://ngdc.noaa.gov/mgg/global/relief/ETOPO2/etopo2icosahedron_smaller.pdf

NASA – The Water Cycle*
https://earthobservatory.nasa.gov/features/Water

ACTIVITY 2: See the Sizes

American Museum of Natural History – How Does a Blue Whale Feed
https://www.amnh.org/explore/videos/oceans/blue-whale-feeding-in-ocean

American Museum of Natural History – YouTube for whale videos
https://www.youtube.com/@AmericanMuseumofNaturalHistory/videos

FloridaOcean – plankton.PDF
https://www.floridaocean.org/sites/default/files/images/plankton-final.pdf

ACTIVITY 3: Symbiosis Secrets

National Geographic Society – Symbiosis: The Art of Living Together
https://education.nationalgeographic.org/resource/symbiosis-art-living-together

ACTIVITY 4: Adaptations and Anomalies

Discover Magazine – 8 Marine Creatures that Light Up the Sea
https://www.discovermagazine.com/planet-earth/8-marine-creatures-that-light-up-the-sea

U of Hawaii – Adaptations | manoa.hawaii.edu/ExploringOurFluidEarth
https://manoa.hawaii.edu/exploringourfluidearth/biological/fish/adaptations-fish

Shark Trust – A-ZOfSharksA3_with_facts_2018.indd
https://www.sharktrust.org/Handlers/Download.ashx?IDMF=66cf6bdc-51c6-4a9f-9086-03c4d9843e78

ReefQuest Centre for Shark Research – Functions of the Hammer
http://www.elasmo-research.org/education/topics/d_functions_of_hammer.htm

Monterey Bay Aquarium – Animals A to Z
https://www.montereybayaquarium.org/animals/animals-a-to-z/?filterBy=animaltype:Fishes:240

BBC – Sarcastic Fringehead Fights For Territory | Life | BBC Earth - YouTube
https://www.youtube.com/watch?v=vewtmQ5xrtU

Woods Hole Oceanographic Institution – How does bioluminescence work?
https://www.whoi.edu/know-your-ocean/did-you-know/how-does-bioluminescence-work/

ACTIVITY 5: Colorful Camouflage

Khao Lake Explorer – Frogfish Masters of Camouflage | Frogfish Marine Life Guide of Similan Islands
https://www.khaolakexplorer.com/marine-life-guide/frogfish/

Ocean Conservancy – An Ode to the Flamboyant Cuttlefish
https://oceanconservancy.org/blog/2019/06/21/ode-flamboyant-cuttlefish/

Ocean Conservancy – Hide-and-Seek: Ocean Animals with Top-Notch Camouflage
https://oceanconservancy.org/blog/2022/09/27/ocean-animals-with-top-notch-camouflage/

BBC – Can Cuttlefish camouflage in a living room? | Richard Hammond's Miracles of Nature - YouTube
https://www.youtube.com/watch?v=pgDE2DOICuc

Real Science – The Insane Biology of: The Octopus - YouTube Stephanie Sammann curiositystream.com/realscience
https://www.youtube.com/watch?v=mFP_AjJeP-M

ACTIVITY 6: Planet Protection

Washed Ashore – Tennessee Aquarium
https://tnaqua.org/washed-ashore/

Washed Ashore – Art to save the sea
https://www.washedashore.org/

National Geographic – Coral reefs in the Philippines are some of the world's most vibrant—but in peril
https://www.nationalgeographic.com/magazine/article/philippines-reefs-are-some-of-the-most-vibrant-but-in-peril-feature?rid=0E7111FBB67358049641726EA9186CB8&cmpid=org=ngp::mc=crm-email::src=ngp::cmp=editorial::add=Daily_NL_Saturday_Photography_20221203

PRINT RESOURCES FOR CHILDREN:

Cousteau, Philippe, and Hopkinson, Deborah. *Follow the Moon Home: A Tale of One Idea, Twenty Kids, and a Hundred Sea Turtles*. Chronicle Books, California 2016.

Knowlton, Nancy. *Citizens of the Sea: Wondrous Creatures from the Census of Marine Life*. National Geographic, Washington, DC 2010.

PRINT RESOURCES FOR ADULTS: Symbiosis and Adaptation

Ohlson, Kristin. *Sweet in Tooth and Claw: Stories of Generosity and Cooperation in the Natural World*. Patagonia Works, Florida 2022.

Shubin, Neil. *Your Inner Fish: A Journey into the 3.5-Billion-Year History of the Human Body*. Pantheon Books, New York 2008.