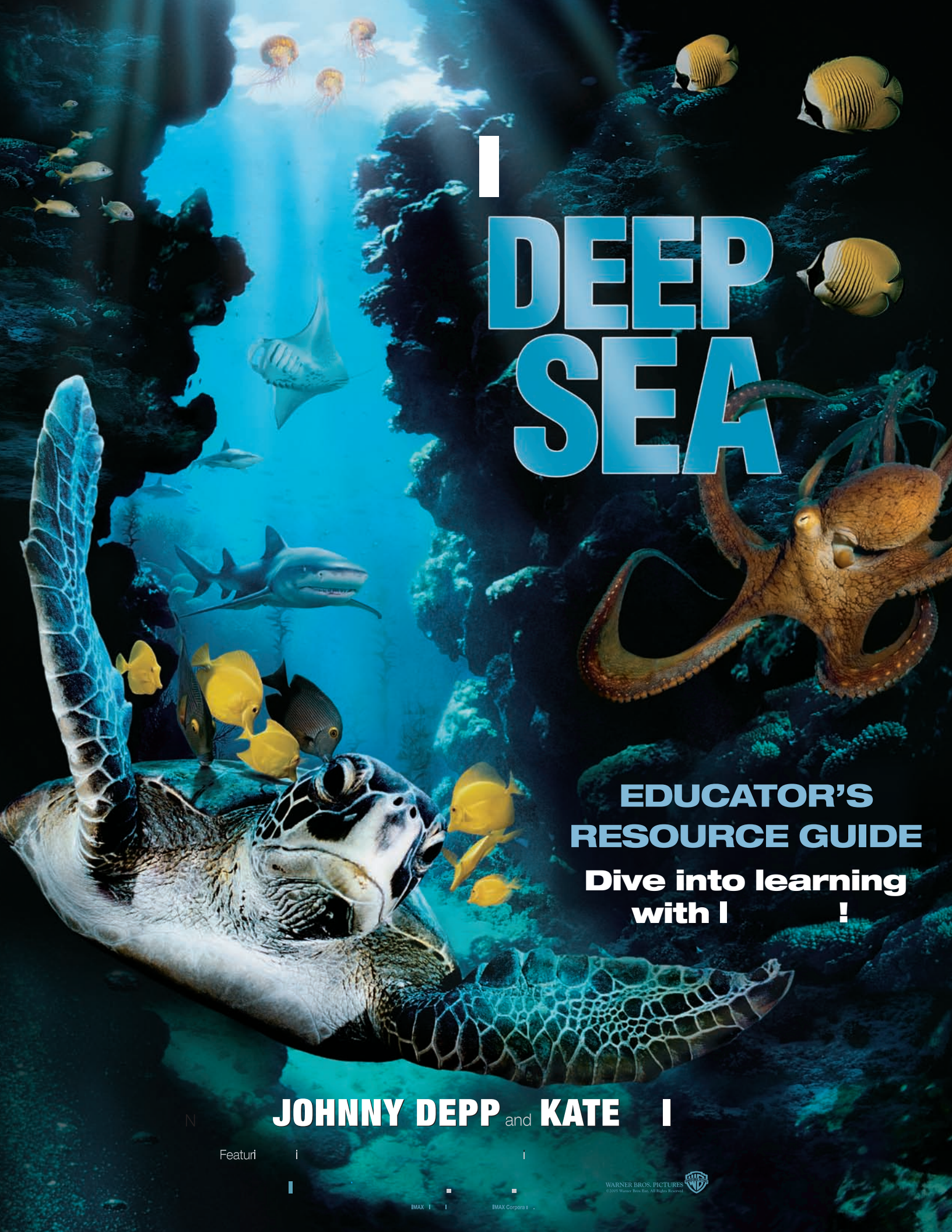
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DEEP
SEA
EDUCATOR'S
RESOURCE GUIDE
Dive into learning
with I !
JOHNNY DEPP and KATE I
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IMAX I I IMAX Corpora i .
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IMAX® DEEP SEA

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Dear Educator,

Thank you for choosing to engage your students and enrich their learning through The IMAX Experience®.

As an educator, you know how well children respond to the use of films in instruction. Classrooms today can have a range of learning styles, and students are recognized as having varied learning styles. With images that provide viewers with a "you are there" feeling and state-of-the-art sound, IMAX® films nourish all learning styles: visual, auditory, and kinesthetic.

Since inception, IMAX has shown its commitment to education by producing learning-based films and providing complementary resources for teachers, such as this Educator's Resource Guide. The guide is filled with activities that will keep students interested in learning about the deep blue sea and the animals that swim, scamper, and float there.

The ocean covers about 70% of the Earth, but for many children, it seems like a vast, unlivable place. Although traveling to the depths of the ocean is not possible for most people, *Deep Sea* provides viewers a unique opportunity to journey through the deep blue sea and uncover the fascinating animals found below.

From the brightly-colored rainbow nudibranch to the giant Pacific octopus, *Deep Sea* captures some of the most beautiful and unusual sea creatures ever seen on the IMAX screen. With this IMAX Educator's Guide, you'll be able to dive right into activities that highlight humorous and peculiar traits of creatures in the ocean.

This Educator's Resource Guide, created by Weekly Reader and IMAX, extends the *Deep Sea* experience into classroom activities that will keep students' interests and help them learn long after the film has ended. Although these materials are copyrighted, they may be reproduced for educational purposes. Please feel free to share this guide with your colleagues and encourage them to book a field trip to an IMAX Theatre.

We look forward to seeing you and your students again at your local IMAX Theatre for the next educational IMAX film.

Sincerely,
Your Friends at IMAX

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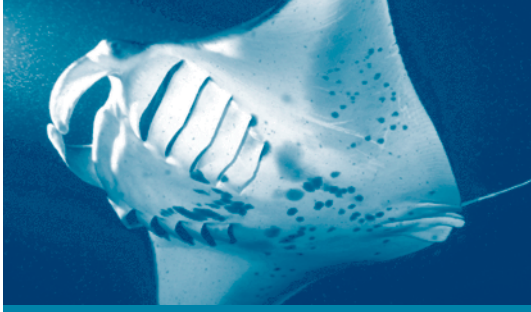


Target Audience:

This program is designed for students in grades 3 through 9. The activities can be adapted to meet the various learning levels of students in this grade range.

Educator's Guide Objectives:

- To spark students' interest in oceanography
- To foster an appreciation of the ocean and sea creatures
- To strengthen students' science, math, and language arts skills with a cross-curricular educational program
- To provide educators with a comprehensive resource for viewing the IMAX film *Deep Sea* and incorporating it into classroom activities

National Education Standards:

Science

- *Earth and Space Sciences*
  Understands the Earth's composition and structure
- *Life Sciences*
  Understands relationships among organisms and their physical environment
- *Physical Sciences*
  - Understands the structure and property of matter
  - Understands the sources of energy
- *Nature of Science*
  Understands the nature of scientific inquiry

nglish Language Arts

Reading

- Uses the general skills and strategies of the reading process
- Uses reading skills and strategies to understand and interpret a variety of informational text

Viewing

Uses viewing skills and strategies to understand and interpret visual media

lathematics

Understands and applies the basic properties of the concepts of measurement

Understands and applies basic concepts of statistics and data analysis

Education and The IMAX Experience

IMAX films are designed to educate and enlighten as much as they are to entertain. They offer educators a powerful teaching tool that extends learning past the classroom and is easily integrated into existing curriculum. IMAX films educate and provide students with unique and exciting opportunities to explore new worlds and new ideas.

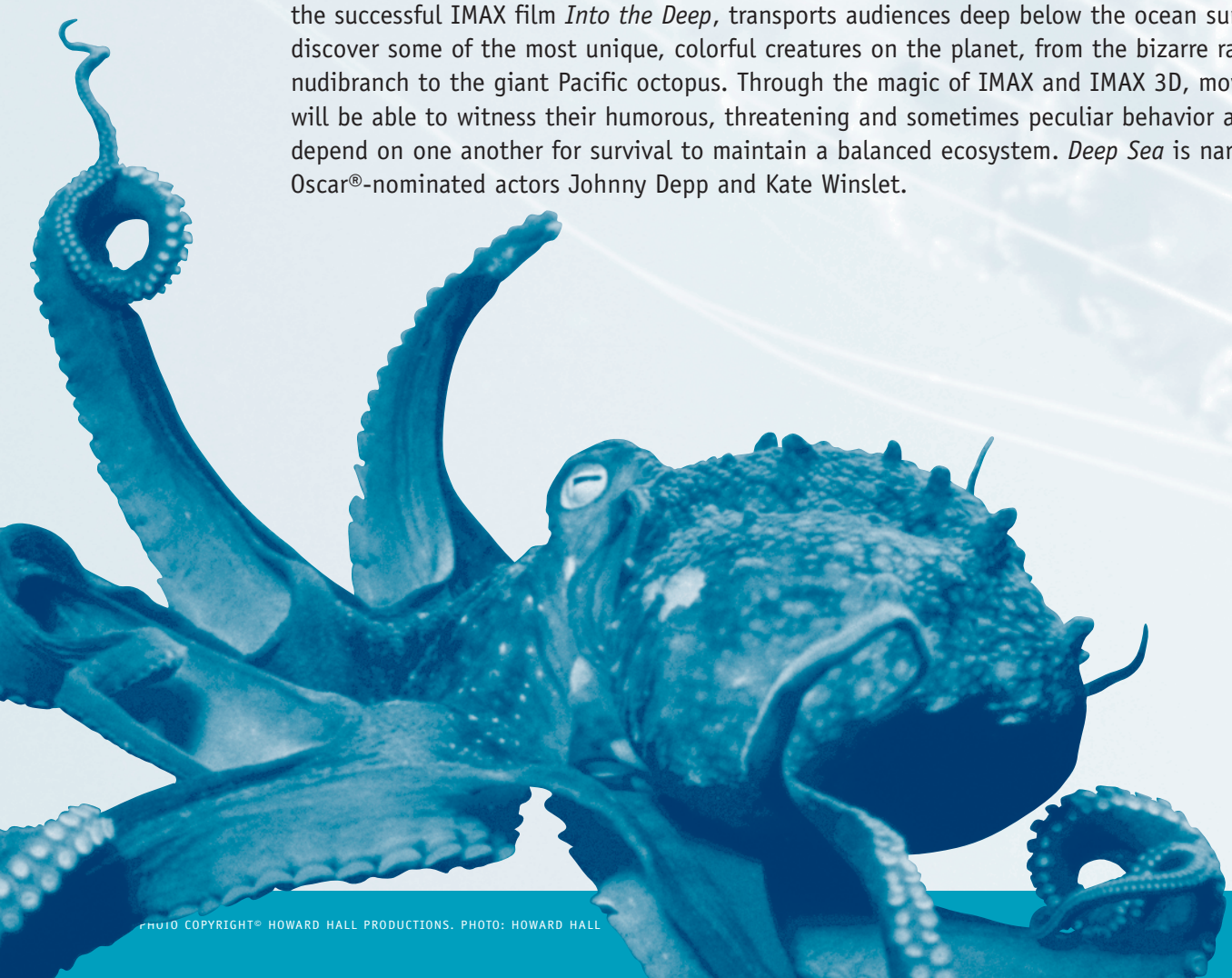
With breathtaking, crystal-clear images on the world's largest screens and digital surround sound, The IMAX Experience takes you to places only imagined. The highly-specialized and precise projectors employ a unique system that ensures outstanding clarity and brightness. The IMAX Experience is completed by a specially-designed sound system, ensuring that each viewer receives the same sound quality. Only IMAX technology lets you feel as if you're really there.

More than 700 million people around the world have been mesmerized and educated by The IMAX Experience. Technically advanced and visually stunning, The IMAX Experience continues to be the world's most immersive theatre entertainment.

IMAX invites your students to think big®.

About the Film

Sea life in a whole new way. Deep Sea, a new underwater adventure from the filmmakers behind the successful IMAX film *Into the Deep*, transports audiences deep below the ocean surface to discover some of the most unique, colorful creatures on the planet, from the bizarre rainbow nudibranch to the giant Pacific octopus. Through the magic of IMAX and IMAX 3D, movie-goers will be able to witness their humorous, threatening and sometimes peculiar behavior as they depend on one another for survival to maintain a balanced ecosystem. *Deep Sea* is narrated by Oscar®-nominated actors Johnny Depp and Kate Winslet.



ABOUT THE EDUCATOR'S GUIDE

Learning should be fun and imaginative. Taking a class trip to an IMAX® Theatre is always an exciting outing, especially a trip to view the IMAX film *Deep Sea*, an underwater adventure that exposes the unique, dangerous, and colorful behaviors of creatures in the ocean. That's why we created the activities and student pages in this guide using a light-hearted and entertaining tone, with an emphasis on educating students about the ocean and its lively inhabitants through humor.

ACTIVITY ONE

The Ocean Diner: Who Eats Whom?

PAGE 10

Grades 3–6

Objective

To analyze an illustration of a Food Web to determine food chains.

In this activity students will read the illustration for meaning and then demonstrate what they learned by completing individual food chains. Before reading, ask students to list foods they ate during the day. As an anticipatory set, create a "food sources" T-chart on chart paper and have students sort their meals into each category appropriately. This anticipatory set will build background and get kids thinking about the sources of their foods. Determine which foods come from the ocean. While you complete the activity, have students add additional animals that live on a coral reef. Encourage students to draw these animals into the illustration and indicate their role in the food web using arrows.

Student Activity Answers:

1. sun → phytoplankton → crab → octopus
2. phytoplankton → ____ → ____ → shark
3. zooplankton → ____ → ____ → sea turtle

Extension Activity:

Prepare this kinesthetic learning activity a few days after your class has completed "THE OCEAN DINER: *Who Eats Whom?*" First write each of the animals in the coral reef food web (sun, phytoplankton, zooplankton, crab, sea anemone, butterfly fish, angelfish, coral, octopus, sea turtle, and shark) on name tag stickers. Then separate students into two groups of twelve. Provide each group with a ball of yarn or string. Have students in each group stand in a circle and then pass out the labeled name tag stickers for students to wear randomly.

Give the student wearing the "sun" the yarn. Then allow students to reconstruct the food web by holding one part of the string and passing the ball to the next appropriate student. This exercise will help you determine students' recall skills and also demonstrate to students how intertwined a food web is.

ACTIVITY TWO

Creature Close-up Plankton: The Snack of the Sea

PAGE 11

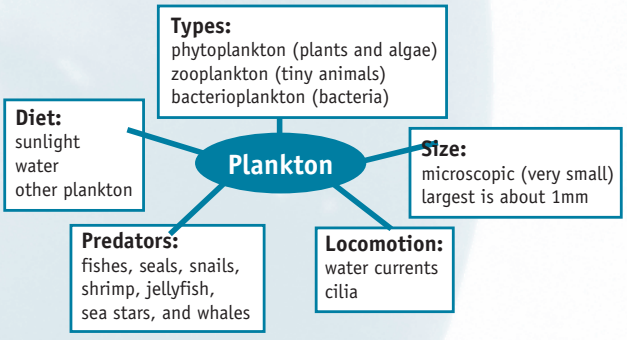
Grades 3–6

Objectives

To identify characteristics of plankton and distinguish between different types. To organize a main idea and supporting details using concept mapping.

Who would eat plankton? Almost every animal in the ocean, that's who! Being at the bottom of the food chain isn't easy. But plankton is an essential part of the ocean ecosystem. Before reading, see if the entire class can agree on one food that everyone likes to eat, such as pizza, hamburgers, or peanut butter. Ask students: *What would happen if your favorite food was not available? How would food choices change if an entire food group was not available to eat?*

Student Activity Answers:



Extension Activity:

The largest phytoplankton is only about 1 millimeter (0.03937 inch) long. Have students measure their desks or the class chalkboard to determine how many phytoplankton could fit there. Here's another quick fact for students: *One teaspoon of sea water can contain as many as one million phytoplankton.*

ACTIVITY THREE

Glow-in-the-Dark: Animals with Bioluminescence

PAGE 12

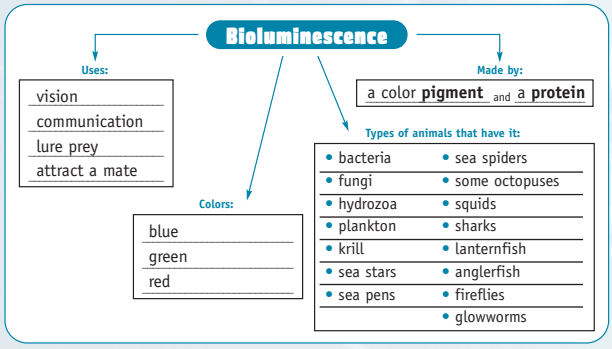
Grades 3–6

Objective

To identify animals that are bioluminescent, and learn about the process. To organize the main idea and supporting details of a passage into a graphic organizer.

Most of your students already know it is hard to see in the dark—and it could be dangerous! To set anticipation for reading about bioluminescence, ask students to completely close their eyes and try to remove their math book (or other items) from their desks. Or, ask the class to remove a notebook and pencil from their desks and then write their name. Tell students that this simulation is sort of what life is like for animals that live in the ocean at depths below 1,000 meters, where there is no sunlight. Discuss the difficulties of trying to live and complete tasks without being able to see. After reading, have groups complete the graphic organizer for the passage they've just read to reinforce reading skills by recalling and organizing information.

Student Activity Answers:



Extension Activity:

Assign students to research the bioluminescent animals (listed in activity) and then write "Bioluminescent Bios" about each. To display students' work, cut out light bulbs from yellow construction paper and label each with the name of a bioluminescent animal.

ACTIVITY FOUR

IMAX Experiment: Swim Bladder: An Under-the-Sea Ladder

PAGE 13

Grades 3-6

Objective

To make a prediction and follow experiment directions to learn and record the results of an experiment.

Swim bladders act just like the balloons in this experiment. When a swim bladder "inflates," or expands, a fish rises to the surface of water. When the bladder is completely deflated, a fish will sink to the ocean floor. A swim bladder is very useful to a fish because it experiences two forces in water: gravity (which pulls it down) and buoyancy (which pushes it up). Fishes without swim bladders, like sharks, have to keep swimming so that they don't sink!

Extension Activity:

Try to add more or less air to the balloons and see if you can make the balloon remain stationary in the water halfway to the top and bottom.

ACTIVITY FIVE

Duos Down Deep

PAGE 14

Grades 6+

Objective

To evaluate and categorize dependent relationships among animals.

In this activity, students will learn about a few ways animals in the ocean coexist. Before completing this activity, pair students and ask the class to move to the back of the classroom in order to perform a task together. Ask one partner to close (or blindfold) their eyes. Have the other partner use directional words (left, right, forward, stop) to safely guide his or her partner to the front of the room or chalkboard. This simulation will build background for reading and demonstrate how working with a partner can benefit each student and complete tasks quicker.

Tell students that animals also work together, but not all of the relationships are beneficial.

Student Activity Answers:

1. [M] Burrowmates
2. [C] Smile Crocodile!
3. [C] Remora Menu
4. [C] Strain in the Stomach
5. [P] Bad Barnacles
6. [M] Clowning Around
7. [C] Coral Bleaching
8. [M] Coral Reef Car Wash

IMAX® Extra!: *(Possible answers)* **Food:** Watchman Goby and snapping shrimp, Nile crocodile and Egyptian plover; remora fish and shark, bacteria and animals, sea anemone and clownfish cleaner wrasse and fishes **Shelter:** Watchman Goby and snapping shrimp **Transportation:** barnacles and turtles **Protection:** sea anemone and clownfish, zooxanthellae and coral polyps

Extension Activity:

Many plants and animals have symbiotic relationships, too. For example: bees disperse pollen from flowering plants *and* the Ant house plant provides shelter for ants that protect it from invader insects. Challenge students to categorize these relationships as mutualism, commensalism, or parasitism.

ACTIVITY SIX

DEBRIS IN THE SEA: The Trash Total

PAGE 15

Grades 6+

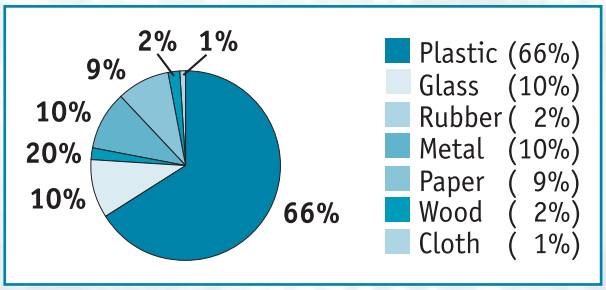
Objective

To compute percentages and organize data from a chart to a circle graph.

Marine debris is more than just "floating litter" and "garbage on the beach." It has a serious impact on wildlife and ecology. Marine mostly affects coastal marine waters. Litter travels over long distances because it is carried by ocean currents and winds. That means it is not only found in populated areas, but also near remote islands and bodies of water. After viewing the film *Deep Sea*, students will naturally be concerned about the ocean and conservation. This activity will allow students to learn more about the staggering statistics involved with marine debris, using a given set of data to create a circle graph that indicates percentages. (Data received from *Cleaning North America's Beaches: 1991 Beach Cleanup Results*, Center for Marine Conservation, 1992.) Be sure to do a mini lesson on finding percents before completing this activity.

Student Activity Answers:

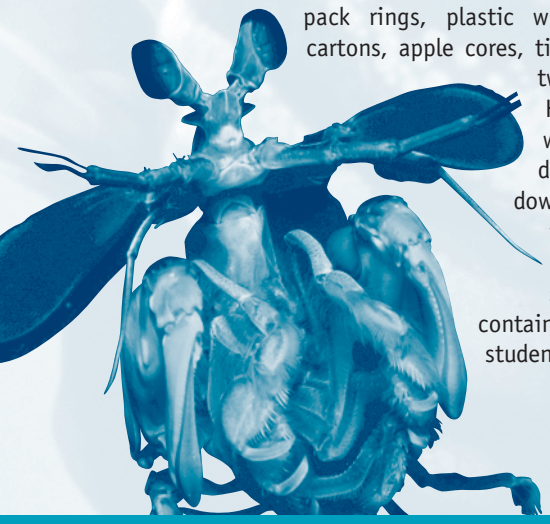
(Numbers are rounded to the nearest ten thousand or one hundred thousand.)



IMAX® Extra! *(answer)*: Sixty-six percent of the items collected during the last national beach clean up were plastics. To find the percent of plastics, divide plastics (3,400,000) by the total number of garbage items collected (5,143,000). The result is: 0.661≈66%.

Extension Activity:

To demonstrate the length of time it takes trash to degrade, set up two containers—one containing water, and the other soil. Collect the following trash items (2 of each): six pack rings, plastic wrappers, cardboard egg cartons, apple cores, tin foil, plastic wrap, and two pages of newspaper. Have students predict in what order the items will degrade, or begin to break down. Place the same items in each container and cover both with a metal screen. Observe the containers regularly and have students record their findings.



ACTIVITY SEVEN

What's Your Ocean I.Q.?

PAGE 16

Grades 6+

Objective

To test students' prior knowledge of the ocean and its features.

Student Activity Answers:

1. **Why is ocean water salty?**
   C. from mineral salts within rocks and soil on land and river beds. Rain and snow run-off on the Earth's land carry mineral salts into the oceans.
2. **What are the deepest parts of the ocean called?**
   A. deep-sea trenches. The deepest place in the ocean is the Mariana Trench in the western Pacific at 35,798.6 feet.
3. **How much of the total water on Earth is in the ocean?**
   C. 97%. Less than 1 percent is fresh water, and 2 to 3 percent is found in glaciers and ice caps.
4. **No light ever reaches the aphotic zone in the ocean.**
   True. The last zone in the ocean is the aphotic or midnight zone. No sunlight reaches this zone.
5. **How much of the Earth's volcanic activity occurs in the oceans?**
   C. 90%. The South Pacific has 1,133 volcanic cones and sea mounts.
6. **Undersea earthquakes create:**
   B. tsunamis. The word means "great waves."
7. **What is the average temperature of the ocean?**
   A. a few degrees above freezing at 39 degrees.
8. **The largest animal in the sea is:**
   C. the blue whale
9. **Fish provide the largest source of protein in the world for humans.**
   True
10. **The largest living structure on Earth is:**
    A. the Great Barrier Reef. Located in Australia, the Great Barrier Reef is 1,234 miles long and is made up of animals, plants and bacteria. It is much like a rainforest on the land.
11. **What causes currents?**
    A. wind
12. **The fastest fish in the ocean is:**
    A. sailfish. It was clocked at 68 miles per hour. The cheetah is the fastest land animal and can travel 60 miles per hour.
13. **Which country has the longest coastline?**
    B. Canada. At 56,453 miles long, Canada has about 15 percent of the world's 372,384 miles of coastline.
14. **Which animals are benthic (live on the ocean floor)?**
    D. all of the above

ACTIVITY EIGHT

So You Want To Be A SCUBA Diver? PAGE 17

Grades 6+

Objective

To read a fictitious job posting for a SCUBA diver and conclude the requirements for the profession.

Poll students to learn how many have been SCUBA diving or snorkeling. Ask volunteers to describe their experiences. Have students describe what they think life is like for professional SCUBA divers.

After reading, develop a class list of maritime careers. Start with: marine biology, oceanographers, meteorology, and ecology. Other careers involve the study of global warming, pollution control, food supplies, medicine, and much more.

Extension Activity:

Jacques-Yves Cousteau was a famous biological oceanographer who developed the Aqua-Lung™, the first open-circuit SCUBA diving equipment, with Emile Gagnan in 1942. Captain Cousteau spent much of his time in or on the ocean. It is estimated that he made more than 30,000 dives in the ocean in his lifetime. Have students research the life and work of Captain Cousteau. In addition, have students make models of SCUBA gear using easy-to-acquire items, such as backpacks, paper towel rolls, and cardboard.

ACTIVITY NINE

IMAX Experiment: Around the Bend: How Objects Look in Water PAGE 18

Grades 6+

Objective

To observe a property of light and alter variables for experimentation.

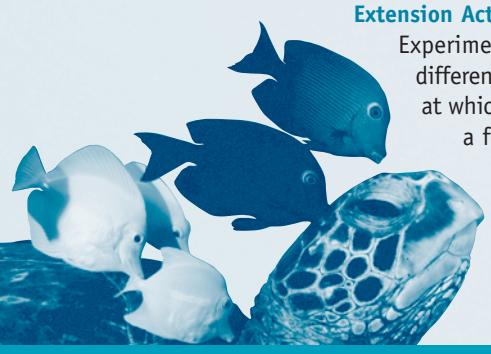
When a ray of light passes through a transparent (clear) material such as water, air, glass, or a film lens, it "breaks" or changes its direction. The bent light makes it seem like the object in the water is broken, too. This is called refraction. Refraction is the bending of a wave when it enters a medium.

The denser the material, the more the light is slowed down. To demonstrate this, alter the experiment by adding a few drops of red food dye. Or, try adding two to three teaspoons of sugar or a few drops of oil to the water. Have students observe how the pencil bends once the water is made more dense (or higher mass).

Reinforce the fact that lenses in glass cameras use refraction to form the images we see in films like *Deep Sea*. The camera lens projects an image of an object onto a screen by gathering rays and bending them back towards the screen.

Extension Activity:

Experiment with the effects of different incident angles (the point at which a pencil looks bent). Hold a flashlight at different angles toward the glass. Have students discuss how much the pencil "bends" each time you change the position of the flashlight.



ACTIVITY TEN

Weirder than Weird: What's Its Name? PAGE 19

All Grades

Objective

To identify animals in context and make inferences about their names.

It may be weird, but this activity provides a fun way to introduce scientific names to students. Before reading, ask volunteers to write their names down on a blank sheet of chart paper. First, use arrows to indicate the first names and surnames (or last names). Ask students to discuss the difference between a first and last name (i.e., last names are used by every member of an animal group). Next, write the scientific name *Canis familiaris*. (Be sure to indicate italics.) Ask students the name of this animal (domesticated dog). Point out that the word "Canis" means "canine" in Latin. Coyotes, dogs, foxes, jackals, and wolves are also members of the Canidae family. Animals have scientific names to show how they are related to one another. Scientists who speak different languages need to use one standard list of names. The scientific naming of all living things is called taxonomy. It was developed in the 1700s by botanist Carolus Linnaeus. (But that's his Latinized name. His Swedish name was Carl von Linné!)

On a lighter note: Some students may think weirdness is a weakness, but in the ocean, weird usually means survival. Reinforce that students shouldn't "judge" a fish by its scales!

Student Activity Answers:

Nicknames
FANGTOOTH *Anoplogaster comuta #2*
SLIME EEL *Myxine glutinosa #5*
GIANT TUBE WORM *Riftia pachyptila #8*
CHAMBERED NAUTILUS *Nautilus popilius #7*
PACIFIC SPOOKFISH *Rhinochimaera pacifica #4*
PORCUPINE PUFFERFISH *Diodon hystrix #6*
UMBRELLAMOUTH GULPER EEL *Eurypharynx pelecanoides #3*
MUSICAL FURRY LOBSTER *Palibythus magnificus #1*

Extension Activity:

Poll students to learn the sea creature your class thinks is the weirdest. Create the tally box below on chart paper and then ask students to transfer the data to create a graph.

VOTE FOR THE WEIRDEST!

Animal	Tallies
Fangtooth	
Musical furry lobster	
Pacific spookfish	
Slime eel	
Porcupine pufferfish	
Chambered nautilus	
Giant tube worm	

ACTIVITY ELEVEN

Ocean Topography:

PAGE 20

Mapping the Sea Floor

All Grades

Objective

To construct a map in order to analyze geographical patterns of the Earth, specifically the ocean.

In this "color-by-number" activity, students will learn how to label, construct, and interpret a map using a physical attribute (elevation). Before reading, challenge students to name the highest point on land (Mount Everest in Nepal-China: 29,035 feet above sea level/8,850 meters). Compare this altitude to the deepest point in the ocean (Challenger Deep, Mariana Trench in the western Pacific Ocean: 35,798.6 ft/10,911.5 m).

Explain that topography is the art or practice of illustrating in detail natural and man-made features of a place or region. Tell students that they will be creating their own map that shows the topography of land and the relief of the ocean floor (which is called bathymetry). These maps show elevations of the area, and their relative positions. A color bathymetry map includes the spectrum of colors. For the map in this activity, black represents the deeper areas of water, with light blue denoting the shallowest areas.

Extension Activity:

Provide large physical and political maps for comparison with the topographic/bathymetric maps.

Ask students to add labels to their colored maps, including continents, oceans, and other bodies of water.

ACTIVITY TWELVE

Home Habitat Home:

PAGE 21

Life on a Coral Reef

All Grades

Objective

To strengthen visual acuity skills.

This is a fun visual-acuity challenge for students in every grade level. Students need to locate sections of the large coral reef illustration. These sections are located inside the small squares along the top. Each section contains a corresponding letter in an alphabet key. Once students locate the small square in the large illustration, they should write the corresponding letter below the square. You'll find that this page is self-assessing, since students will learn the answer to the question, *What do coral polyps use to make a reef?*

Student Activity Answer:

Q: *What do coral polyps use to make a reef?*

A: LIMESTONE

Extension Activity:

There are seven types of coral reefs: apron, fringing, barrier, patch, ribbon, table, and atoll. Assign groups to research these reefs and illustrate each on large pieces of bulletin paper.

Deep Sea Fun Facts

PAGE 22

This page provides fun facts about the production of the film including information on the locations, creatures, filming logistics, and more!

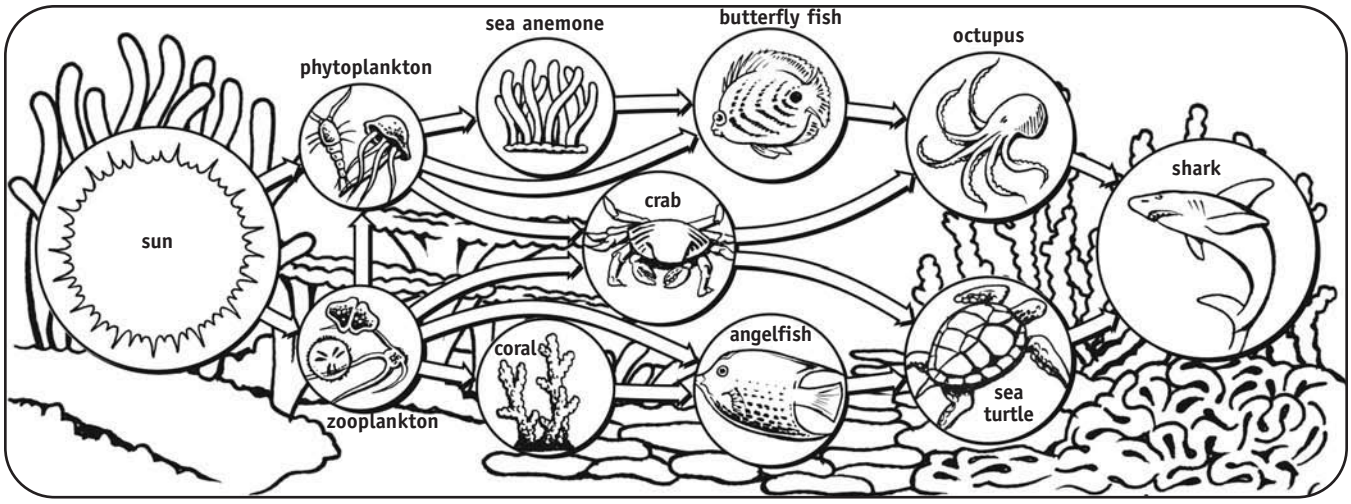
Name _____

Who Eats Whom?

All living things need to eat in order to survive—even you! Eating is the process by which animals get energy. Every plant and animal on Earth can be a source of food. A **food web** is a diagram that shows all the organisms in an environment and what animals eat. Plants and algae are called **producers** since they make their own nourishment using water and energy from the sun. Animals that eat producers and other animals are called **consumers**.

A **food chain** is a model that shows how energy is passed from one animal to another as food. When all the food chains in a habitat are put together, they form a food web. The food web below shows the animals that live on a coral reef—and who eats whom.

WHAT TO DO: This illustration will help you learn about a coral reef food web. Follow the arrows to find out which animal is at the top of the coral reef food web, and those at the very bottom. (The arrows stand for "gets eaten by" or "energy passes to.") Then complete the food chains below.



1. sun → _____ → crab → octopus

2. phytoplankton → butterfly fish → _____ → shark

3. zooplankton → coral → _____ → sea turtle

Use the food web above to write your own chain that includes coral:

4. _____ → _____ → _____ → _____

IMAX® Extra! *Draw a food chain or web for animals that live in your habitat.*

Name _____

Plankton:
The Snack of the Sea

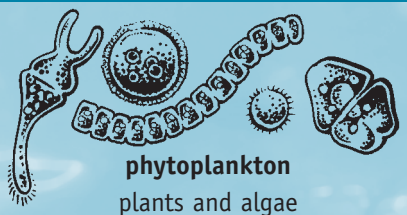
IMAGINE IT: *You're tiny. You're slow. You're stuck in the tide. Everyone wants to eat you.* That's sort of what life is like for plankton—microscopic (very small) plants, algae, and animals that float in freshwater and salt water. How small is plankton? The largest is only about 1 millimeter, or 0.03937 inch. The name plankton comes from a Greek word that means "wanderer" or "drifter." That's a perfect name for the animals since they can't swim well, or in some cases at all! Most tiny plankton animals do not have locomotion body parts (legs, fins, or flippers) like other sea creatures do. But some can move very slowly using cilia (**SI-LEE-ah**)—tiny, hairlike body parts.

Animals don't have to travel far for a microscopic meal—plankton are carried through the water by currents and tides. Plankton are a favorite snack of many animals, including all kinds of fishes, seals, snails, shrimp, jellyfish, sea stars, and especially whales. Blue whales will eat between 2,000 and 9,000 pounds of plankton per day. When Baleen whales see a wave of plankton coming, they swim right towards it with their mouths wide open. (Gulp!)

Plankton may be small, but they provide food for all! So what do plankton eat? Some make a simple, sugary food of their own using sunlight and water. Most plankton just eat other plankton.

WHAT TO DO: After reading the plankton passage above, organize the main ideas into the chart below.

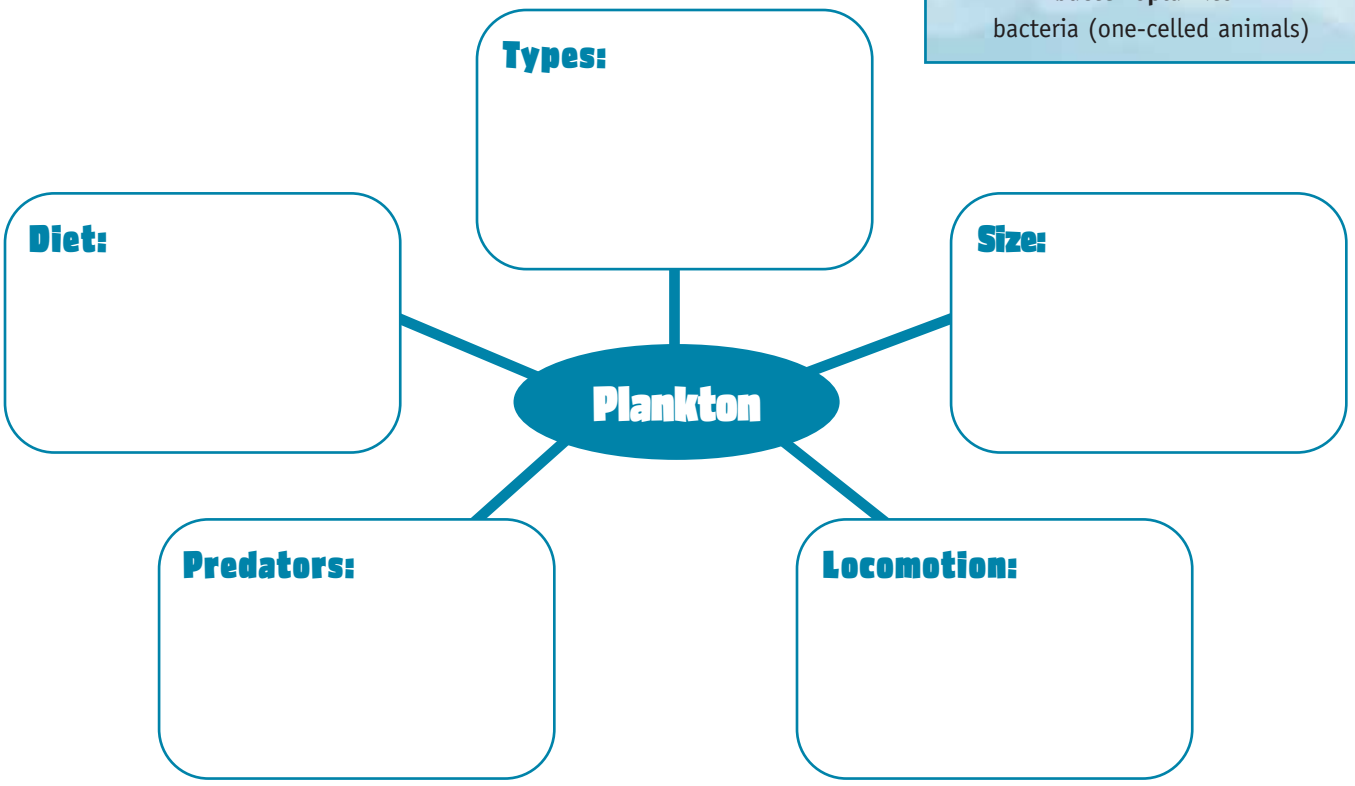
The three types of plankton:



phytoplankton
plants and algae
(animals that look a lot like plants)

zooplankton
very tiny animals
(copepods, diatoms, and krill)

bacterioplankton
bacteria (one-celled animals)



Name _____

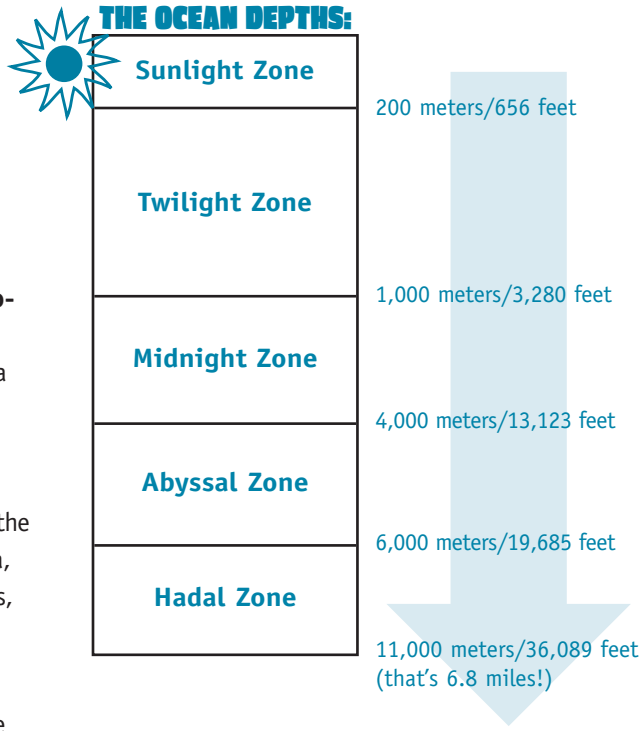
Animals with Bioluminescence

What would you see at the deepest depths of the ocean? Nothing. It is absolutely dark. That's because sunlight does not penetrate (reach) past 1,000 meters (3,280 feet). Beyond that, it is pitch black. So how do animals get around, communicate, lure prey, and attract a mate without light helmets and flashlights? Some make their own light!

The ability to produce light is called bioluminescence (**BY-O-loo-mah-neh-cents**). It's not electrical; it's a chemical. Animals make light through a chemical reaction in their bodies. It happens when a color pigment (luciferin) meets up with a protein (luciferase). The result is: light. Most marine animals produce blue and green lights, but some fishes make red lights.

About 90% of deep sea marine life is bioluminescent. Animals in the ocean that are "living lights" include certain: bacteria, fungi, hydrozoa, plankton, krill, sea stars, sea pens, sea spiders, some octopuses, squids, sharks, lanternfish, and anglerfish. A few land animals are bioluminescent. You know two of them as fireflies and glowworms.

WHAT TO DO: Organize the main ideas about bioluminescence in the chart below.



Bioluminescence

Uses:

_____

_____

_____

_____

Made by:

_____ and _____

Colors:

_____

_____

_____

Types of animals that have it:

_____

_____

_____

_____

Name _____

Swim Bladder:
An Under-the-Sea Ladder

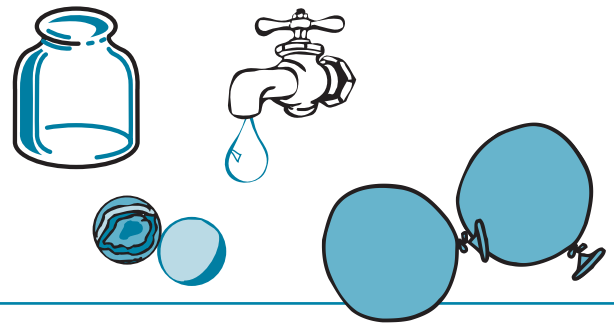
In the ocean, fishes experience "push" and "pull" forces. They are pushed "up" by buoyancy and pulled "down" by gravity. So how does a fish manage to move up and down without having to swim all the time? It has a special body part called a swim bladder (also called a gas bladder) that helps out. A swim bladder is an air sac inside a fish's body that allows it to float.

In this activity, you'll use glass marbles and balloons to figure out how a swim bladder helps a fish move up and down in water.

QUESTION: *How does a swim bladder help a fish move up and down in the water?*

MATERIALS:

- mayonnaise or pickle jar (one quart or 32 oz.)
- tap water
- 2 glass marbles
- two balloons



PROCEDURE:

WHAT TO DO:

1. Clean the jar out with soap and water. Let dry.
2. Fill the jar with 3 cups of water.
3. Stretch out the balloons and push a marble into the opening of each balloon.
4. Tie a knot as close as you can around one of the marbles.
5. Drop that balloon in the jar and see what happens.
6. Ask an adult to blow air into the second balloon.
7. Tie a knot as close to the opening, or end of the balloon, as you can.
8. Drop that balloon in the jar and see what happens.

PREDICTION:

What I think will happen: (circle one for each)

Balloon 1 rise fall **Balloon 2** rise fall

RESULTS:

Draw a picture of your experiment here:

Duos Down Deep

ACTIVITY 5

Name _____

You've heard the phrase, "Two heads are better than one." In the case of animal survival, two is better than one. That's because cooperating with another species can help sea creatures acquire food, shelter, transportation, and protection. When animals interact for these reasons, it is called **symbiosis (sim-BEE-OH-SIS)**. Some interactions are good and others are negative.

Mutualism, commensalism, and parasitism are examples of symbiosis that occurs in nature.

- **Mutualism** is a relationship where both animals benefit from the interaction.
- **Commensalism** is a relationship in which one animal benefits, but the other does not, although it is not harmed in any way. Some relationships are not always good for both animals.
- **Parasitism** occurs between a parasite and a host. In that case, the parasite harms the host in some way.

WHAT TO DO: Read each summary below and then identify the type of animal relationship. Write **"M"** for Mutualism, **"C"** for Commensalism, and **"P"** for Parasitism in the correct box.

☐ **Burrowmates:** Watchman Goby fish and snapping shrimp live together on coral reefs. Snapping shrimp are blind, so they can't see predators. That's okay! Goby fish "lookout" while the shrimp dig (with one antenna on the Goby's tail). The Goby wiggles its tail to warn the shrimp of danger. Then both roommates hide in the burrow.

☐ **Smile Crocodile!:** The Nile crocodile opens its mouth wide and allows the Egyptian plover to eat off leeches that get attached to its gums.

☐ **Remora Menu:** The remora fish attaches itself to a shark using a sucker on its dorsal fin. It eats up stray food scraps as the shark feeds. Fortunately, the shark never interrupts the remora's eating to make *it* into a meal!

☐ **Strain in the Stomach:** Many different strains of tiny bacteria live in the stomachs and large intestines of animals—including humans! These strains don't cause pains. They feed on partly digested foods, and even aid digestion.

PHOTO COPYRIGHT© 2005 WARNER BROS. ENTERTAINMENT INC. PHOTO: PETER KRAGH

☐ **Bad Barnacles:** Barnacles attach themselves in large numbers to docks, boats, rocks, and sea turtles' shells. Because barnacles can't move on their own, boats and sea turtles transport them to new places. Often, too many attach themselves to a sea turtle's shell and cause infections that make it sick.

☐ **Clowning Around:** A sea anemone has nematocyst cells that sting anything that comes close to it—except the clownfish. That may be because these animals have similar slimy coatings on their skins. The clownfish cleans the anemone of algae and the anemone provides a safe place for the clownfish to live and spawn.

☐ **Coral Bleaching:** Algae called zooxanthellae (ZO-ah-zan-THEL-uh) live inside coral polyps—tiny animals that form a coral reef. The algae keep polyps alive by making oxygen. They also give coral their colors. If the water gets too warm, the algae die. The polyps then lose their color and oxygen, which causes the corals to die, too.

☐ **Coral Reef Car Wash:** The cleaner wrasse polishes off dead skin and parasites—from the interior of fishes to the exterior! Fish line up and give the green light to be cleaned by remaining still, spreading their fins and gills, and opening their mouths.

IMAX® Extra!

Sort each of the "duos" above according to their reasons for cooperating. Use these headings: "Food," "Shelter," "Transportation," and "Protection."

Name _____

The Trash Total

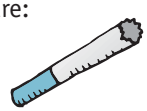
When you think of the ocean, you probably picture a vast deep blue sea full of unique creatures. Unfortunately, you'll have to add garbage to that scene because the ocean is becoming a dumping ground for marine debris. What is marine debris? It's garbage that gets into the ocean. Unfortunately, a lot of waste winds up in the ocean—about seven billion tons each year! About 60% of that waste is made of plastic. Sadly, about 100,000 marine animals die every year due to entanglement and ingestion of garbage.

Marine debris is a serious issue. So be sure to recycle and properly dispose of garbage.

WHAT TO DO: More than 5 million pieces of garbage were collected during the last North American Beach Cleanup. Find out what percent of this total was plastic, glass, rubber, metal, paper, wood, and cloth. (Hint: Add all of the types of items together. To find the percent, divide each item by the total.) Round each number and determine the percent. Then display the results in a circle graph.

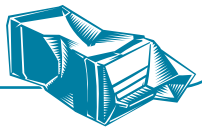
Dirty Dozen

The twelve most frequently found items in the ocean are:



1. cigarette butts
2. paper
3. plastic

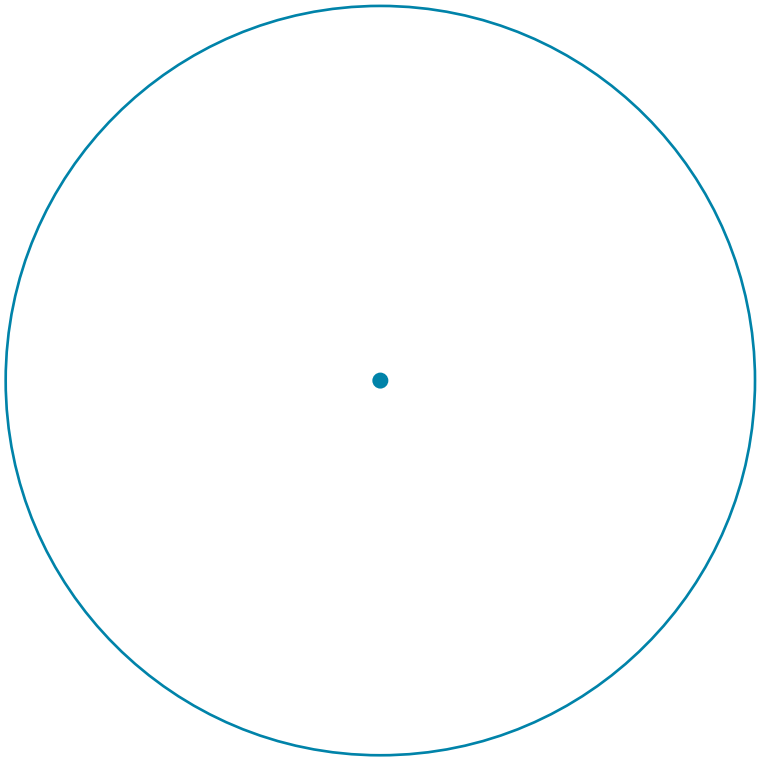
4. foam
5. glass
6. plastic food bags
7. plastic caps and lids
8. metal beverage cans
9. plastic straws
10. glass beverage bottles
11. plastic beverage bottles
12. foam cups



FIND THE TOTAL:

Item	Collected
Plastic	3,400,000
Glass	500,000
Rubber	100,000
Metal	500,000
Paper	470,000
Wood	120,000
Cloth	53,000
TOTAL	

DISPLAY THE RESULTS:



IMAX® Extra!

What percent of the results of the beach clean up was plastics? Is the value more or less than 60%?

What's Your Ocean I.Q.?

ACTIVITY 7

Name _____

How much of the Earth's surface is covered by oceans? If you know the answer is almost 71%, then you scored a point! This quick quiz will test your "Ocean Intelligence Quotient," or "I.Q." And you can always improve your personal Ocean I.Q. by seeing the IMAX film *Deep Sea* and learning all you can about our water planet.

1. Why is ocean water salty?
   - **A.** decomposing sea creatures
   - **B.** from rainfall into the water
   - **C.** from mineral salts within rocks and soil on land and river beds

2. What are the deepest parts of the ocean called?
   - **A.** deep-sea trenches
   - **B.** ridges
   - **C.** abyssal plains

3. How much of the total water on Earth is in the ocean?
   - **A.** 55%
   - **B.** 12%
   - **C.** 97%

4. No light ever reaches the aphotic zone in the ocean.
   True **False**

5. How much of the Earth's volcanic activity occurs in the oceans?
   - **A.** 32%
   - **B.** 61%
   - **C.** 90%

6. Undersea earthquakes create:
   - **A.** smog.
   - **B.** tsunamis.
   - **C.** reverse currents.

7. What is the average temperature of the ocean?
   - **A.** a few degrees above freezing at 39 degrees
   - **B.** 75 degrees which is great for swimming
   - **C.** 62 degrees which isn't fun for swimming

8. The largest animal in the sea is:
   - **A.** the giant squid.
   - **B.** the Great White Shark.
   - **C.** the blue whale.

9. Fish provide the greatest percentage of protein eaten by humans on Earth.
   True **False**

10. The largest living structure on Earth is:
    - **A.** the Great Barrier Reef
    - **B.** the San Juan Islands
    - **C.** an undersea mountain range in the Pacific Ocean

11. What causes currents?
    - **A.** wind
    - **B.** gravity
    - **C.** tides
    - **D.** all of the above

12. The fastest fish in the ocean are:
    - **A.** sailfish.
    - **B.** swordfish.
    - **C.** tuna.

13. Which country has the longest coastline?
    - **A.** Brazil
    - **B.** Canada
    - **C.** Australia

14. Which animals are benthic (live on the ocean floor)?
    - **A.** crayfish
    - **B.** mussels
    - **C.** shrimp
    - **D.** all of the above

Name _____

If you don't mind wearing tight goggles and rubber clothes or strapping on 50 pounds or more of compressed air and other gear, then you'll love SCUBA diving! Read this want ad for SCUBA divers and decide if you have what it takes to be a diver.

WHAT TO DO: Read this want ad for a SCUBA diver and then write a cover letter from a potential candidate.

WANTED:
Professional SCUBA Divers

JOB TITLE: SCUBA Diver
TYPE: Full Time
COMPANY: Divers 'R Us
LOCATIONS: Worldwide (including lakes, shipwrecks, and reefs)
SALARY: Competitive
DESCRIPTION: Divers 'R Us, the premier diving school, is looking for an experienced SCUBA diver and avid undersea sightseer to dive with us. We offer a dream job and a unique work environment.

ABILITIES:

All candidates should:

- be able to swim
- like fishes
- be comfortable being in water for hours at a time
- enjoy salt water
- have ability to breathe through mouth
- be averse to sea sickness
- be physically fit
- be an experienced "equalizer" (able to "pop" your ears to relieve pressure)
- have no allergies
- work well with others (all divers have buddies)
- be unafraid of jellyfish, stingrays, octopuses, and turtles (to name a few)

REQUIRED CERTIFICATION:

- **Basic:** open water certification courses from Professional Association of Diving Instructors (PADI) or National Association of Underwater Instructors (NAUI)
- **Academic:** courses on diving physiology and hazards, SCUBA equipment, safety, use of dive tables, planning and emergency procedures

EQUIPMENT NEEDED:

A diver candidate should have:

- a comfortable mask (lens should be made of tempered safety glass)
- snorkel breathing tube with one-way valves (gets water out through only one exit)
- full-foot fins for warm-water diving
- booties and open-heel fins for cold-water diving
- a regulator (to reduce pressure from the tank to a safe level for you to inhale)
- buoyancy compensation device (a weighted backpack that inflates and deflates)
- cold and wet water wet suits
- air tanks
- dive light

TESTING:

All employees must be able to perform the following before hire:

- skill training
- clear a mask that's filled with water
- recover a regulator after it has come out of your mouth
- put on and take off equipment in the water
- perform neutral-buoyancy techniques
- establish proper weighting
- do a controlled emergency ascent
- breathe from a buddy's air supply

IMAX® Extra! *Work with a group to develop a list of careers in marine science.*

Name _____

Around The Bend:
How Objects Look in Water

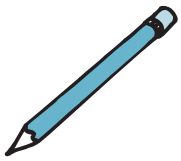
You may have noticed that when you dangle your legs into a pool, it looks like they bend in a different direction. If you put a stick obliquely (on a slant) into a body of water, it appears to bend (or break) where it enters the water. So why does this happen? It's called **refraction**. The word refraction comes from a Latin word that means "to break up."

QUESTION: *Does light bend in water?*

MATERIALS:

- mayonnaise or pickle jar (one quart or 32 oz.)

- a new pencil



- red food dye

PROCEDURE:

WHAT TO DO:

1. Fill the jar two-thirds of the way with water.
2. Hold the pencil in the jar standing straight and observe.
3. Place the pencil at an angle (leaning against the side of the glass.)
4. Find the spot where the pencil is "bent."
5. Observe and draw the pencil from the side, and from above.
6. Add one drop of red food dye.
7. Add another drop, and then observe.

OBSERVATION:

Draw the glass and pencil from the side:

Draw the glass and pencil from above:

RESULTS:

Write about what you saw after you added one to two drops of red food dye:

IMAX® Extra!

Try changing the point at which the pencil looks bent.
(Hint: Change something about one of the experiment materials.)

Name _____

What's Its Name?

A cricket-like crustacean? A fish with fangs? A squid in a shell? What could be weirder than that? There are a lot of strange-looking creatures in the ocean. And some have the weirdest names!

The science of naming living things is called taxonomy. Most animals have a scientific name and a common name (or nickname). A scientific name has two words. The first word, or genus (family name), tells who the animal is related to. The second word names the species, or specific kind. A common name is sort of a nickname. It usually describes what the animal looks like, how it acts, or where it lives.

WHAT TO DO: Read about a "weird" sea creature under its scientific name. After reading the descriptions, try to match each scientific name with the correct nickname.

Scientific Names

1. ***Palibythus magnificus***
   This crustacean is completely covered in short hairs. But it hardly comes up short. What makes it unusual is its ability to make music—short "chirping" sounds like a cricket.
2. ***Anoplogaster comuta***
   Picture it: a fish covered with small, prickly scales that has sharp fangs hanging out of its over-sized mouth. When it closes its mouth, the lower jaw fangs slide into "pockets" on the roof of its mouth.
3. ***Eurypharynx pelecanoides***
   Talk about a big gulp! This fish can stretch its mouth almost as wide as an opened umbrella. It has a glowing red light on the end of its tail that attracts fishes and shrimp.
4. ***Rhinochimaera pacifica***
   Imagine if you had a body part that detected electricity. This long-nosed fish does! It uses its snout to sense the electrical currents of its prey under the sand, sort of like a metal detector.
5. ***Myxine glutinosa***
   This animal has glands that can produce enough slime at one time to fill a milk jug. It doesn't make "ooey-gooey" slime, just one with very strong fibers. It covers its body with the slime to suffocate predators.
6. ***Diodon hystrix***
   Huff, puff, and blow! That's what this fish does when danger is near. It can inflate itself by filling its very stretchable stomach with water or air until it looks like a balloon (three times its normal size). It's also covered in prickly spines.
7. ***Nautilus popilius***
   This sea creature has tentacles (up to ninety) just like its relatives, the squid, octopus, and cuttlefish. But, it has hung on to its shell! The calcium-rich shell is divided into spiraled chambers. It lives in the last—and largest—of the chambers.
8. ***Riftia pachyptila***
   Hot! Hot! Hot! These eight-foot long, tube-shaped animals can tolerate the hottest temperatures of any living thing on Earth. They don't even need sunlight or oxygen to survive.

Nicknames

Write the number of the matching scientific name on the line next to the nickname (common name).

FANGTOOTH ____

SLIME EEL ____

GIANT TUBE WORM ____

CHAMBERED NAUTILUS ____

PACIFIC SPOOKFISH ____

PORCUPINE PUFFERFISH ____

UMBRELLAMOUTH GULPER EEL ____

MUSICAL FURRY LOBSTER ____

IMAX® Extra!

Balaenoptera musculus *is the probably the largest animal ever to have lived on Earth (including dinosaurs). Unscramble these words to learn its nickname (common name):* LUBE LEWAH

Ocean Topography

Name _____

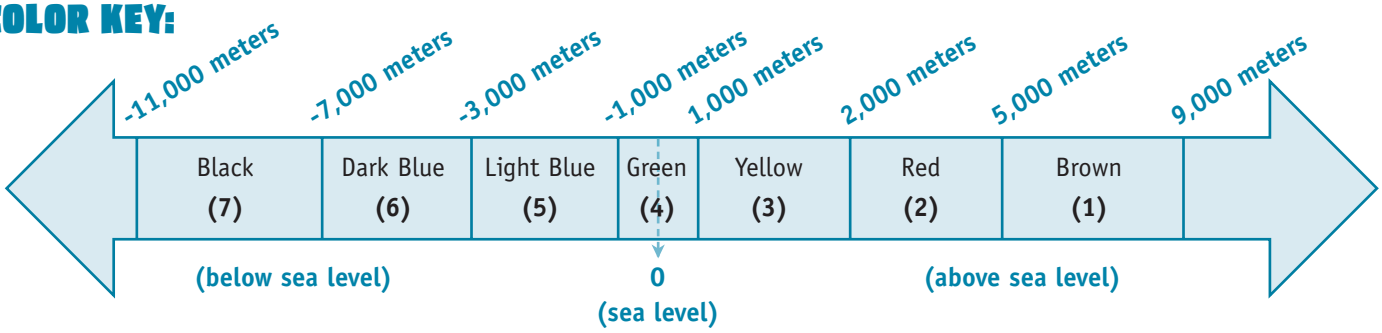
Mapping the Sea Floor

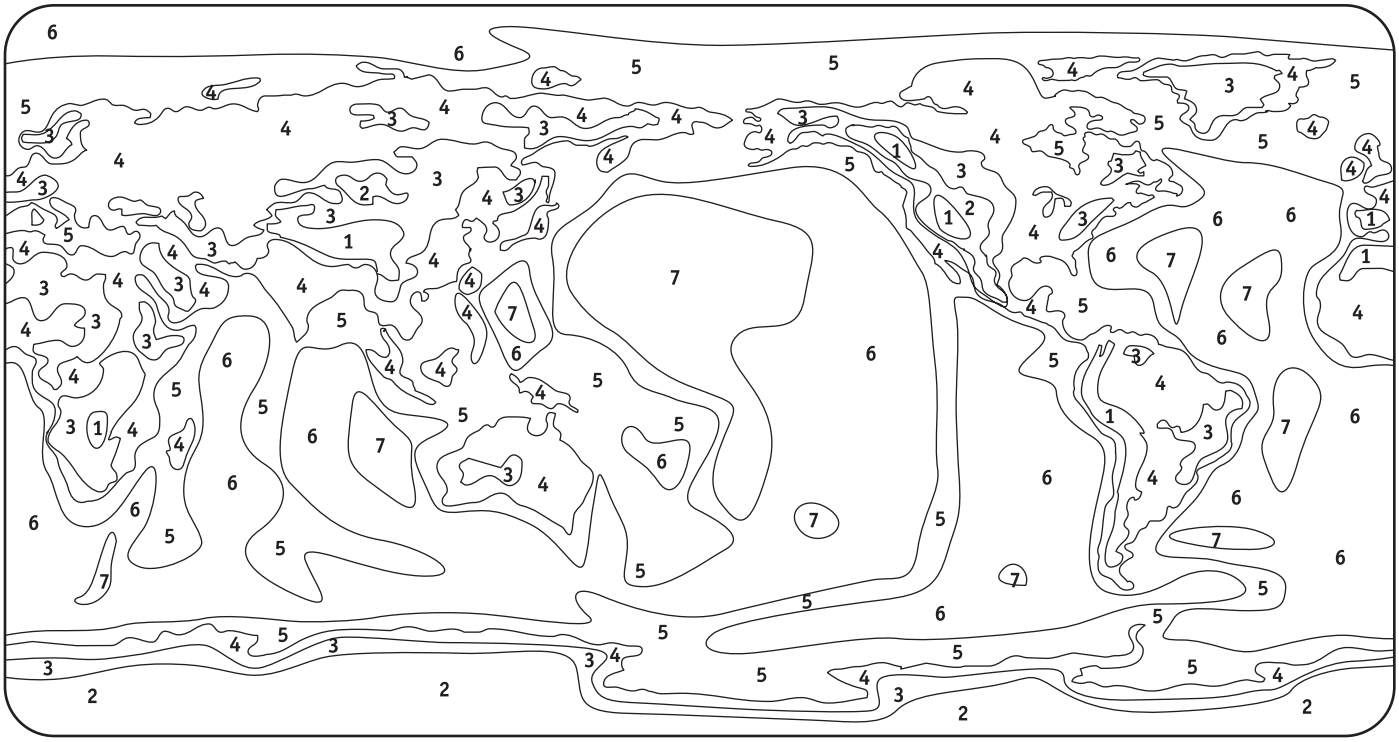
How can you tell how deep the ocean is? You can read a map! A bathymetric map illustrates the heights and depths of formations under the sea, just like a topographical map (called a "topo" map) shows elevations on land. Some maps show the different elevations using colors.

The first maps of the sea floor were made by attaching a weight to a line and dropping it from a ship. When the weight hit the bottom, the line was measured. This was a very slow method that left room for a lot of mistakes. Today, bathymetric maps are made using Sonar (Sound Navigation Range). Special devices send sound waves to the sea floor and measure the time it takes for the sound to be reflected back to the surface. The time is used to figure out the depth of an area.

WHAT TO DO: Be a cartographer and color in your own bathymetric map. The map below has the numbers 1-7 on it. Find each number and its matching color in the key. Wherever you see these numbers on the map, shade them in using the right crayon or marker colors. (You can also figure out how high above or below sea level a place on Earth is by using the key.)

COLOR KEY:





IMAX® Extra! *Find the difference between the highest and lowest elevations on the map.*

Home Habitat Home

ACTIVITY 12

Name _____

Life on a Coral Reef

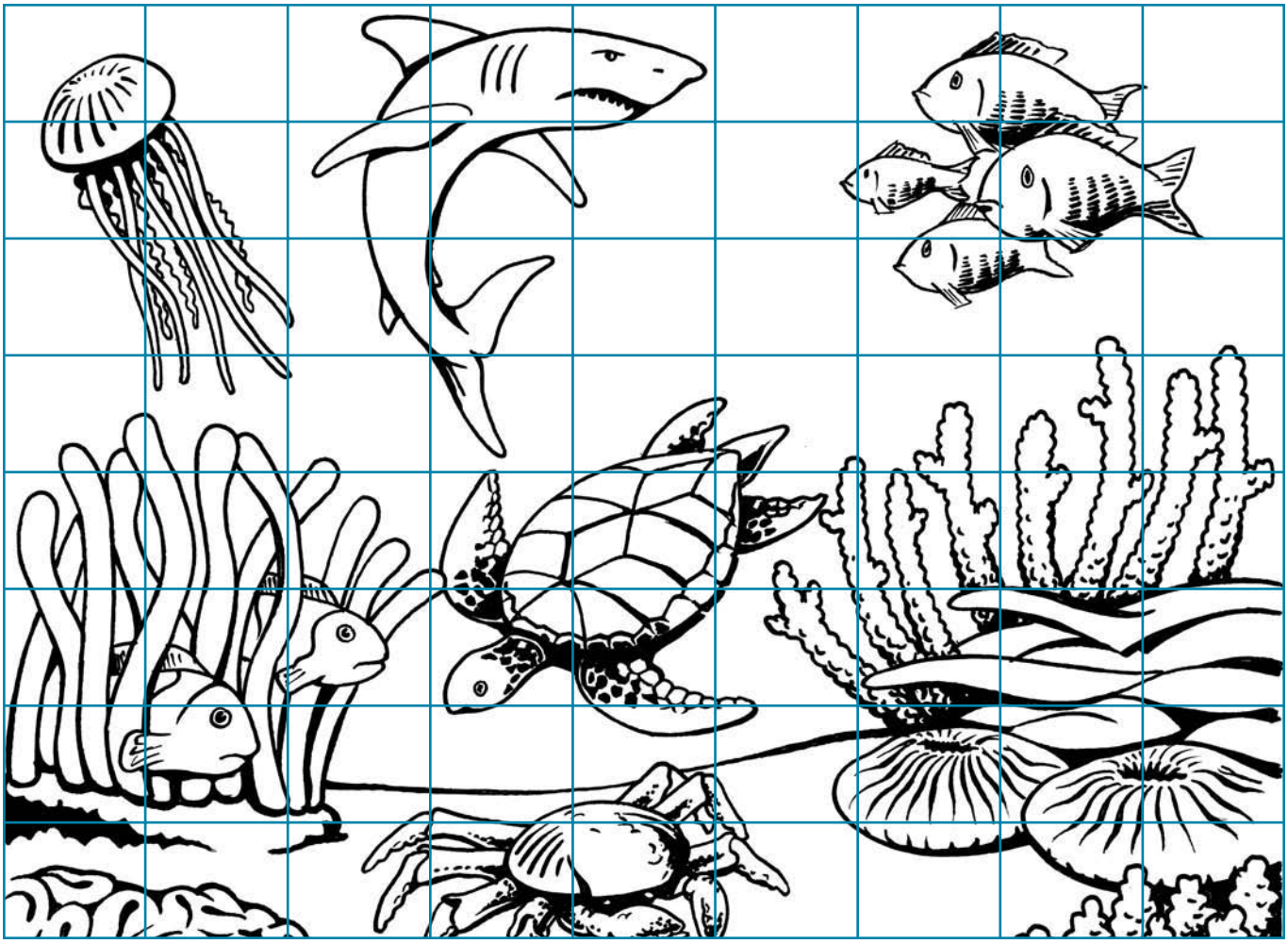
It's easy to get lost in the crowd on a coral reef. Coral reefs provide a natural habitat and protection for many species of animals, including sponges, nudibranchs, fishes, sharks, sea turtles, jellyfish, sea anemones, sea stars, crustaceans, of coral polyps—of course!

WHAT TO DO: Find each of the small squares in the large illustration below. Count which row and square the scene is in. Find the matching square in the alphabet grid. Write the letter in that square below the small square. Find all the small squares to learn the answer to this question:
Q: What do coral polyps use to make a reef?

A: _____

I	P	O	L	F	O	F	L	U
A	U	J	F	A	J	Z	Y	D
S	E	S	J	J	A	I	J	A
A	G	V	O	B	T	S	M	B
K	P	H	P	A	K	T	A	K
N	H	N	R	Y	H	Q	C	W
S	Y	F	A	D	G	I	F	Q
E	H	E	X	S	E	M	S	M

L								



The Shoot:

- The film crew shot in nine different locations: Sea of Cortez; The Channel Islands, CA; Monterey, CA; La Jolla, CA; Kona, Hawaii; Outer Banks, NC; Gulf of Mexico; Bahamas; British Columbia.
- The coldest water the filmmakers dove in was 46°F in British Columbia.
- The film crew's scariest encounter was with Tiger Sharks in the Bahamas. One of the sharks was nearly 14 feet long, and they are one of the few shark species that actually prey on humans!
- 379,120 feet of 15/70 film was used to shoot Deep Sea, which translates into about 73 miles of film.
- At least 67 unique species of sea creatures were profiled in *Deep Sea*, with many being featured in IMAX 3D for the first time EVER!
- During the filming of *Deep Sea*, the crew encountered a school of juvenile mola molas—an occurrence never before seen by any of the crew members, nor believed to be captured on film ever before.
- The longest dive the filmmakers embarked on was 4 hours, 30 minutes in North Carolina—2 hours of which was decompression.
- The IMAX 3D camera, in its underwater housing, weighs more than 1,000 pounds.
- It typically required six divers to shoot underwater with the IMAX 3D camera: two camera operators, two gear handlers (lights, cables, etc.), and another two divers to retrieve the camera and gear once the shoot was complete. The retrievers were necessary because the camera operators and gear handlers often required decompression, so they weren't able to surface with the equipment.
- Though seven-minute rolls of IMAX 3D film can be specially ordered, a typical roll runs for only three minutes before the camera must be returned to the surface for reloading. Reloading takes about 30 minutes, then it can be sent back down to shoot another roll of film.
- The *Deep Sea* filmmakers communicated with each other, as well as the surface crew, via OTS (Ocean Technology Systems) microphones that were built into their regulator mouthpieces.
- During coral spawning in the Gulf of Mexico, an event that takes place for only about an hour on a particular night each year, a barracuda bit through the light cable just prior to filming. Thankfully the crew brought a spare light, because if they hadn't been so prepared, the filmmakers would have missed their chance to capture this spectacular event.

The Nu

- 1,850—total number of hours the crew spent underwater for filming
- 92—total number of nights the film crew spent on the boat
- 84—number of days spent diving
- 73—total miles of film shot
- 21—total number of crew members (although only 8 went on every expedition)
- 17—number of consecutive days spent diving
- 9—number of different shooting locations
- 2—number of hurricanes encountered while shooting

The Creatures:

- The mantis shrimp uses its appendages to spear or smash their prey. The force of a strike from a large Californian species approaches that of a 22-caliber bullet, capable of breaking double layered safety glass.
- The giant Pacific octopus can reach more than 25 feet tentacle-to-tentacle and weigh over 200 pounds.
- The wolf eel crushes and eats spiny sea urchins—spines and all!
- For every human killed by sharks, more than two million sharks are killed by humans.
- Some nudibranchs 'steal' their venomous stinging cells from sea anemones. When the nudibranch eats the anemone's tentacles, they pass through the gut and are deposited in its gills to serve as protection. The anemone's tentacles grow back.
- Octopuses can change their size to maneuver through the tiniest hole. As long as their beak can get through, they can squeeze the rest of their body through a tight spot.
- Barracuda and other fish change color to signal cleaner fish that they are willing to be cleaned of the parasites that live on their skin.
- Scientists have been observing corals spawning in the Gulf of Mexico so closely for so many years that they are able to predict within moments when a species of coral will spawn.

IMAX® DEEP SEA

Resources

Glossary

Bathymetric map: a map that illustrates the heights and depths of formations under the sea

Bioluminescence: the ability to produce light through a chemical reaction in the body

Buoyancy: the tendency of a body or object to float or rise when submerged in a fluid

Cartographer: a person that makes maps

Cilia: tiny, hairlike body parts that animals use for locomotion

Commensalism: a relationship between animals in which one animal benefits, but the other does not, although it is not harmed in any way

Food chain: a single model that shows how energy is passed from one animal to another in the form of food

Food web: a diagram or illustration that shows all the animals in a habitat and what they eat

Gravity: the force with which a body is attracted or "pulled" towards the center of the Earth, or other celestial body by gravitation

Luciferase: a protein in the body that helps produce light

Luciferin: a color pigment in the body that helps produce light

Mutualism: a relationship where both animals benefit from interaction

Parasitism: a relationship that occurs between a parasite and a host. The parasite harms the host in some way.

Plankton: microscopic (tiny) plants and animals that float in freshwater and salt water

Producer: plants animals that make their own food using water and energy from the sun

Refraction: the bending or turning of a ray of light or energy wave from its straight path as it passes from one medium (as air) into another (as glass)

Symbiosis: when animals interact to acquire food, shelter, transportation, and protection

Taxonomy: the science of naming living things

Topographical map: a map that illustrates land elevations

Print

The Story of Plankton (Bang on the Door Series)
by Jackie Robb

Sea Soup: Zooplankton (Hardcover)
by Mary M. Cerullo

Sea Soup: Phytoplankton (Hardcover)
by Mary M. Cerullo

Diminutive Drifters: Microscopic Aquatic Life (Life in Strange Places)
by Harry Breidahl

Winking Blinking Sea: All About Bioluminescence
by Mary Batten

Glow In The Dark Animals
by Kris Hirschmann

Creatures That Glow (Creatures of the Sea)
by Kris Hirschmann

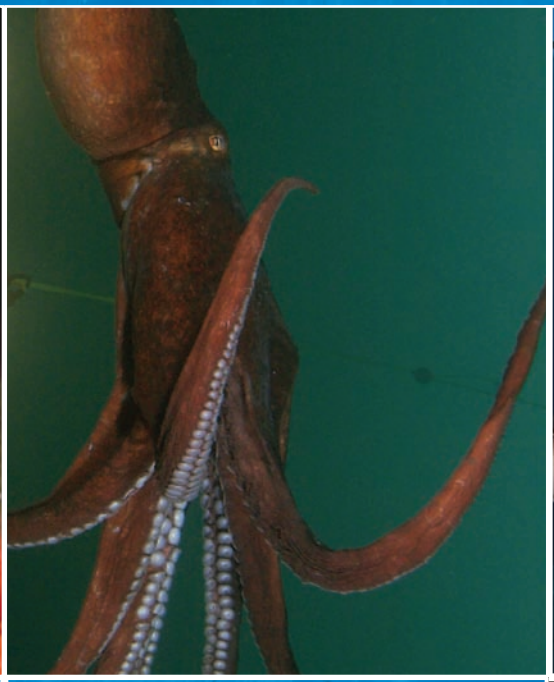
In The Deep Sea (Sneed B. Collard Science Adventures)
by Sneed B. Collard

Venturing The Deep Sea (Science on the Edge)
by Laurie Lindop

Web Sites

- The Ultimate Movie Experience online **www.IMAX.com**
- To learn more about the film **www.IMAX.com/deepsea**
- In depth information about the ocean and the wonders of the universe **www.seasky.org**
- The National Oceanic & Atmospheric Administration's Kid's Corner **www.nmfs.noaa.gov/kids.htm**
- Monterey Bay Aquarium Kid's Corner and Teacher's Place **www.mbayaq.org/lc**
- An interactive educational resource about Earth, oceans, and the environment **http://earthguide.ucsd.edu**

Sea life in a whole new way.



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