JOURNEY INTO THE DEEP

At Kauai Children's Discovery Museum

Teacher's Guide

Dear Teacher,

The Discovery Museum is proud to present Journey into the Deep, a hands-on exhibit featuring world-class Dinamation® robotic whales and undersea creatures. Most of the whale robots have been created to scale, and the whales display movements characteristic of their behavior in the wild.

This learning guide will provide you with background information and activity ideas to help make your class visit to the Museum more interesting and informative. Most of the activities can be conducted before or after your visit. You may also find this guide handy as a reference during your excursion.

To maximize everyone's enjoyment and success, please:

- **Discuss the difference between visiting a museum and visiting a playground.** We ask all teachers and chaperones to make sure their class behaves appropriately, enabling our docents to explain and discuss the exhibits with students.
- **Arrive on time** to make the most of your visit. We cannot go overtime to accommodate a late arrival. Afterwards students, teachers and chaperones can take their time exploring our Discovery Gift Shop with its many science toys, books and other learning tools.

Kauai Children's Discovery Museum reserves the right to videotape/photograph your class visit, to use the images for publicity purposes, and to publish letters and other submissions from participants. This publicity will help us raise funds for the permanent oceanside location we're planning. Attendance will be deemed consent, unless otherwise requested in writing.

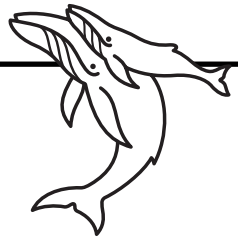
If you haven't already, please **become a member** during your visit, or in preparation for it. Membership supports the museum's ability to continue bringing high quality, hands-on learning experiences to the keiki of Kauai—experiences they would otherwise be unable to enjoy. Membership benefits include free admission to the museum for one year, and a 10% discount on any purchases made at the Discovery Gift Shop.

We look forward to making your visit to Kauai Children's Discovery Museum an exciting learning adventure, and hope you find this guide helpful.

Sincerely,

Robin Mazor

Robin Mazor, Executive Director



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JOURNEY INTO THE DEEP
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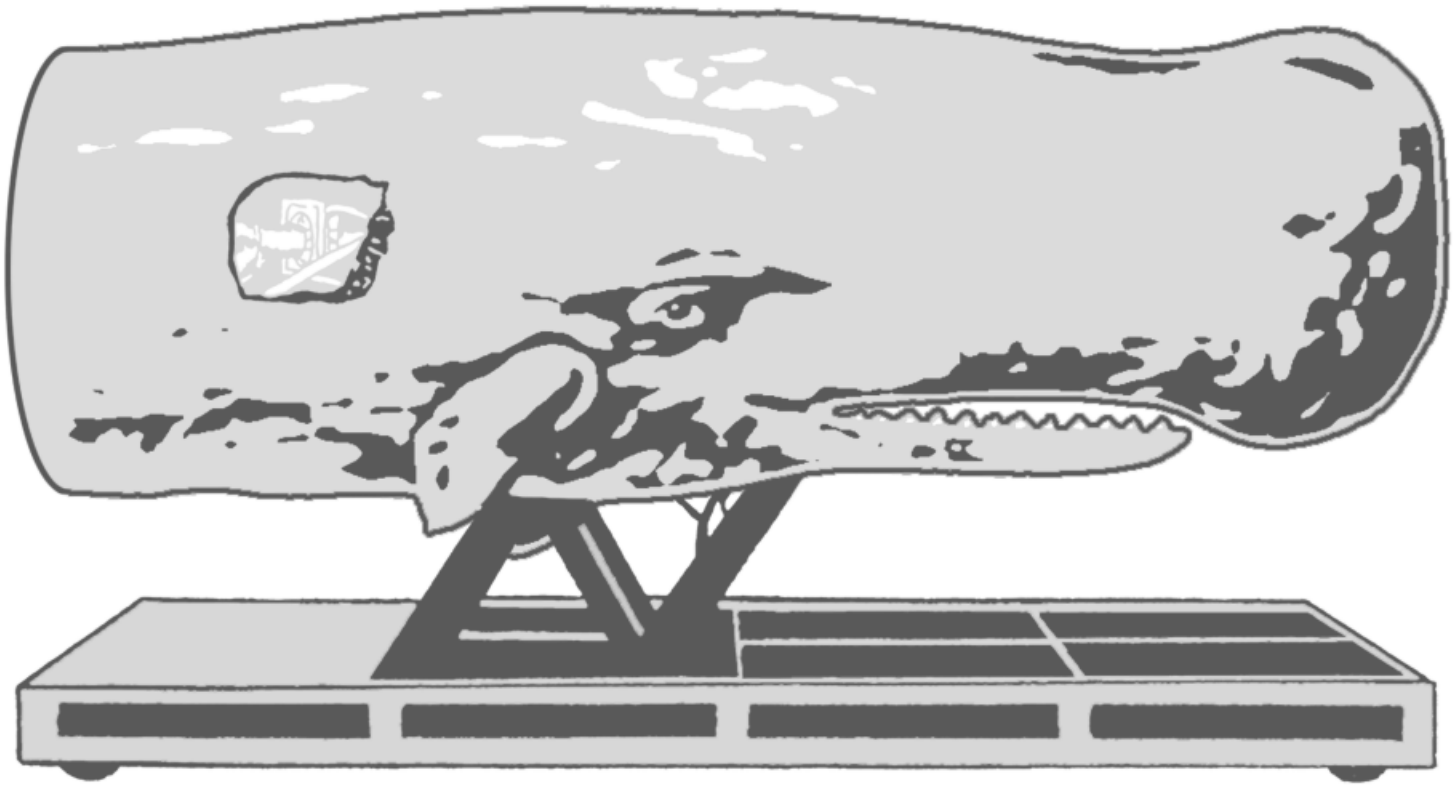
Hawaiian Islands Humpback Whale National Marine Sanctuary offers community programs including a lecture series, an Ocean Count, and a Family Ocean Festival. For more information, visit the Sanctuary website:
<www.hihwnms.nos.noaa.gov>
or call Jean Souza at 808-246-2860

Kauai Children's Discovery Museum is located under the Whale Tower at Kauai Village Shopping Center in Kapaa • Tel. 808-823-8222 • Fax 808-821-2558 • http://www.kcdm.org •

Creating Robotic Sea Creatures

Pre-K to 8th grade, Museum exhibits



COLLABORATION

The unveiling of the *Journey into the Deep* robotics exhibition represents the combined efforts of scientists, artists, sculptors, engineers, welders, mold-makers, computer technicians, and administrators. The outcome is an array of creatures so life-like, we must assure the youngest children that they are not alive.

RESEARCH

The process begins with research. Then detailed drawings are made, and from these a small clay model, or maquette, is produced. From this maquette, engineers design an articulated robotic "skeleton" that will fit inside the creature and bring it to life. While engineers prepare the internal structure, sculptors make a full-size clay model of the creature. During this several-month process, scientists continually check the work for accuracy.

FABRICATION

The completed clay sculpture is handed over to the mold-makers, who cover the sculpture with a liquid paste that hardens and forms a solid shell or mold. The finished mold is then cut into several pieces and reassembled in the "skin" department. A specially developed liquid foam rubber is then poured into the hollow mold, creating the "skin" of the sea-giant replica. After this skin dries, the mold is removed and the skin is wrapped around the finished robotic skeleton.

MECHANICS

Compressed air breathes life into each creature by activating air cylinders inside its fins, head, tail and trunk. An air pump forces air into the cylinders, pushing pistons to create movement. Computer technicians program a small computer to control the amount of air going into each piston. Careful programming and airbrush painting result in a creature that moves, sings, and appears convincingly life-like, to the awe and delight of visitors of all ages.

Featured Creatures—Giant Robotics

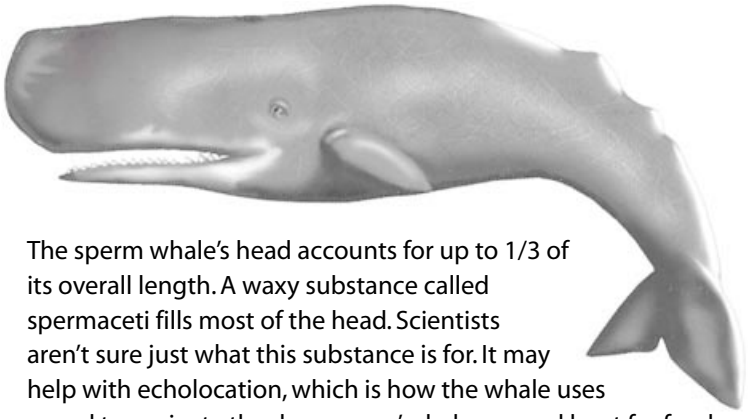
Pre-K and Up

Gray Whale

Scientific Name Eschrichtius robustus
Meaning Named for a 19th-century zoologist
Type Baleen whale
Range Northern Pacific
Length 36–45 feet (12–15m)
Weight 28–35 tons
Diet Bottom-dwelling crustaceans

The gray whale stirs up bottom sediments with its snout to search for food. Like a human who has ukus (head lice), all types of whales carry small "hitch-hiker" animals. Such animals are called parasites. Besides barnacles, a gray whale's skin also carries crustaceans known as whale lice.

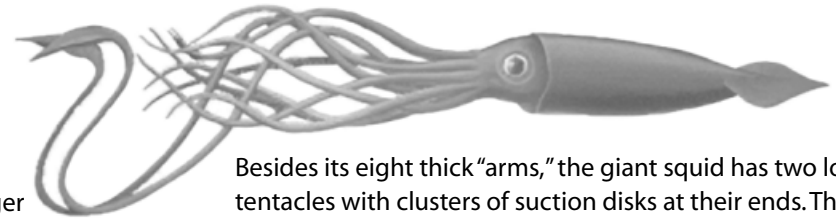
Sperm Whale



Scientific Name Physeter macrocephalus
Meaning Physeter: "blower"
Macrocephalus: "large-headed"
Type Toothed whale
Range Deep waters of all oceans, except polar regions
Length Male: 45–54 feet (15–18m)
Female: 33–39 feet (10–12m)
Weight Male: 35–50 tons
Female: 13–22 tons
Diet Large squid, octopus, cuttlefish, sharks, barracuda and tuna

The sperm whale's head accounts for up to 1/3 of its overall length. A waxy substance called spermaceti fills most of the head. Scientists aren't sure just what this substance is for. It may help with echolocation, which is how the whale uses sound to navigate the deep ocean's darkness, and hunt for food.

Giant Squid



Scientific Name Architeuthis
Meaning "Dominant squid"
Range Oceans worldwide
Length 6–100 feet (2–30m) or longer
Weight Up to 2 tons
Diet Fish, mollusks and crustaceans

Besides its eight thick "arms," the giant squid has two longer tentacles with clusters of suction disks at their ends. These are used for capturing prey, and bringing it back to the eight arms. Its huge eyes can be up to 9 inches across (22cm).

Humpback Whale Sanctuary

Grades 4 and up

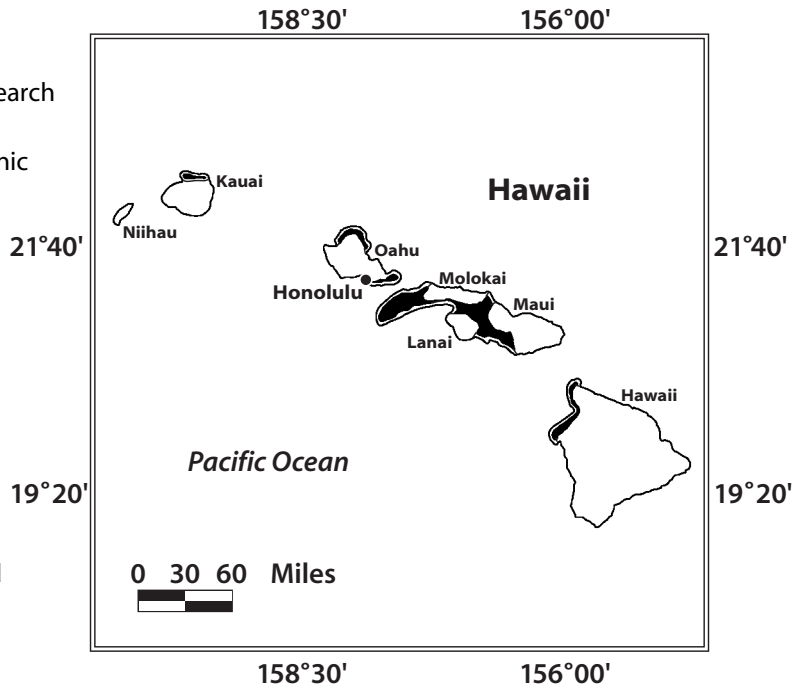
The Hawaiian Islands Humpback Whale National Marine Sanctuary—one of 13 marine sanctuaries created under the U.S. Marine Protection, Research and Sanctuaries Act.

These sanctuaries are overseen by the National Oceanic and Atmospheric Administration (NOAA), which created the **"Blue Refuges" photography exhibit** now on display at the Discovery Museum.

To benefit the endangered humpback whale and its habitat, the sanctuary promotes:

- Research
- Education
- Long-term monitoring
- Comprehensive & coordinated management

For further information about the Hawaiian Humpback Whale National Marine Sanctuary, visit them on the World Wide Web at <www.hihwnms.nos.noaa.gov>, or call Jean Souza at 808-246-2860.



***Sanctuary waters** (in black) border all of Hawaii's populated islands except Niihau.*

Humpback Whale

Scientific Name	Megaptera novaengliae
Meaning	"Great wings of New England"
Type	Baleen whale
Range	Oceans worldwide
Length	40–50 feet
Weight	40 tons
Diet	Krill and small schooling fish

According to scientists, the shallow, warm waters surrounding the main Hawaiian Islands constitute one of the world's most important habitats for the endangered humpback whale.

Nearly two-thirds of the entire North Pacific population of humpback whales migrates from Alaska to Hawaii each winter. Here in Hawaii, they engage in breeding, calving and nursing activities critical to the survival of their species.

Building a Better Sand Castle

Pre-K to 8th grade, pre or post visit exercise

STANDARDS

Doing Scientific Inquiry, Doing Safety, Relating Nature of Technology to Science, Historical Perspective

OBJECTIVES

Children will:

- Experience building sand castles using a variety of techniques & tools
- Design a sand castle and build it using tools provided, and/or discovered or invented tools
- Compare effectiveness of different tools used in building

MATERIALS

- Beach or sand box with fine-grained silty sand and ample supply of water
- Shovels
- Carving tools—examples include popsicle sticks, putty knives, notched trowels, assorted trowels. *TALK ABOUT SAFETY RULES USING WHATEVER TOOLS YOU PROVIDE FOR STUDENTS AHEAD OF TIME, AND SUPERVISE CAREFULLY!*
- Buckets, paper cups, other found containers—to encourage creativity, try not to use prefabricated molds in this activity
- Camera and writing tools to document the process

PROCEDURE

1. After free play in the sand using listed materials, ask a small group of children how they might want to construct a sand castle or similar structure. Facilitate children's development of ideas and strategies. Identify which tools might be most useful for the project.
2. As children create their structure, the teacher acts as a facilitator and resource. The teacher can give input at appropriate times. Children should be the primary designers and problem solvers, changing their tool selection and design as needed.
3. Upon completion of the project, the teacher can photograph students with their creation. Children can dictate stories of how the creation was made, what worked well, what needed to be changed, etc.

FOLLOW-UP

Create a book from the children's photographs and stories, documenting their efforts and what they learned through design & construction.

AMAZING THINGS YOU CAN DO WITH WET SAND

- Build towers, walls and arches out of sand and water!
- Combine those structures to create other structures!
- Carve those structures into recognizable shapes!

Start by digging a hole down to the water table. (If you dig too far from the shoreline, you'll probably have to dig a very deep hole...dig too close, and your structure might get wiped out by waves or incoming tides.) You'll want easy access to water because it's the glue that holds the sand together.

Everyone knows how to dribble! One way is to use large handfuls of very wet sand. Scoop out a large double-handful of very wet sand from the bottom of the hole, pulling the sand towards you. Move the sand fast so you don't lose all the water before you get to your destination. Start building your castle on top of the mound of sand you dug from the hole.

Build a Tower by flattening your handfuls of wet sand into pancakes, by jiggling them with gentle pressure. Do not pound, push, pat, or pack the sand! The goal is to distribute the water consistently through the patty, so it settles down into the patty below.

To make a tower just stack sand patties, one on top of another. As you gain altitude, use smaller handfuls so the tower tapers at the top. That way the tower won't get top-heavy and fall over before you get to carve it.

Build a Wall by connecting towers to other towers, and to create staircases. Also, you can carve your name on a wall, or tunnel through it.

Pull a double-handful of wet sand from the hole. This time, instead of flattening it into a pancake, hold the sides between your flattened hands and jiggle so that the sand takes a brick shape. Keep laying bricks end-to-end for the desired length of the wall, then lay another layer on top, repeating until you reach the desired height. To form a staircase, first carve the wall into a descending ramp, then cut into individual steps.

What's the Beach Made Of?

Pre-K to 8th grade, pre or post visit exercise

STANDARDS

Doing Scientific Inquiry, Relating the Nature of Technology to Science, Unity and Diversity

OBJECTIVES

Children will:

- Hypothesize possible ingredients that make up the beach
- Design a procedure for finding out composition of the beach
- Observe and document their findings
- Compare findings with hypotheses
- Identify ways in which foreign manmade materials affect the composition of sand and impact the environment
- Identify strategies for preserving natural composition of sand and reducing the amount of foreign manmade materials in it

MATERIALS

- Quantity of sand large enough to supply small groups with sufficient samples of equal amount, for sifting and observing
- Variety of sieves (at least 2) with increasingly finer grades of screening
- Catch-basin for sifted sand
- Student Data Sheet for this exercise *(see next page)*
- Magnifying lenses
- Glue

PROCEDURE

1. Ask students what they have seen in the sand when they've been at the beach. List their answers.
2. Ask what they think the sand is composed of. List answers.
3. Have students brainstorm ways of determining what's in the sand. Document their ideas. Work toward a sifting strategy.
4. Slowly pour sand through the largest sieve, and gently shake. Smaller grains of sand will pass through; larger components will remain atop the screen.
5. Observe components using magnifying lenses. Classify components using chart, and glue them to appropriate areas.
6. Repeat steps 4 and 5 until you have used your smallest sieve.
7. Groups can later compare their findings with each other and with their predictions.
8. *(For older students or mixed age groups)*—Take samples from different areas of the beach:

TOP	Where the beach is farthest from the water's edge, it's rarely wet
MIDDLE	Sometimes wet
BOTTOM	Usually wet

Compare what was found in the three different parts of the beach, and draw conclusions.

FOLLOW-UP

1. Ask students what they think will happen if increasing amounts of manmade materials become part of the beach. List answers.
2. Ask students how they could help decrease the amount of manmade materials that get onto the beach. List their answers.

BACKGROUND INFORMATION

Beach composition depends on the beach's origin. Sand can be composed of rock debris, foreign manmade material, driftwood, and/or skeletal remains of living organisms which have been crushed and broken down by feeding sea creatures or wave action. Composition of sand can be analyzed by careful sifting.

What's the Beach Made Of?

STUDENT DATA SHEET

Junk Sea Creatures

Pre-K to 5th grade, post visit exercise

STANDARDS

Historical Perspective, Unity & Diversity

OBJECTIVES

Children will:

- Develop an appreciation for the need to take care of the marine environment, to protect marine life
- Express themselves creatively through 3-dimensional art by designing sea creatures from garbage
- Generate ideas of how to care for the marine environment

MATERIALS

- Garbage that might float out to sea and look like food (milk jugs, plastic wrap, pop cans, wrappers, water bottles etc.)
- Books with photos of sea life (especially jellies, invertebrates, and small fish)
- Scrap construction paper
- Masking tape
- Glue
- *(For 3rd to 8th grade—see column to right)* Each student gets a worksheet: "Find Items that Don't Belong Here!"

PREPARATION

Collect garbage that can be used in collage and sculptures from around your school.

PROCEDURE

Part 1—Look at a sea creature book with students. Have students color the "Things that don't belong" worksheet, and identify those things that don't belong.

Discuss what doesn't belong, how come, how it might have gotten there, and why it shouldn't be there.

Part 2—Show your class the garbage that you collected from school trash.

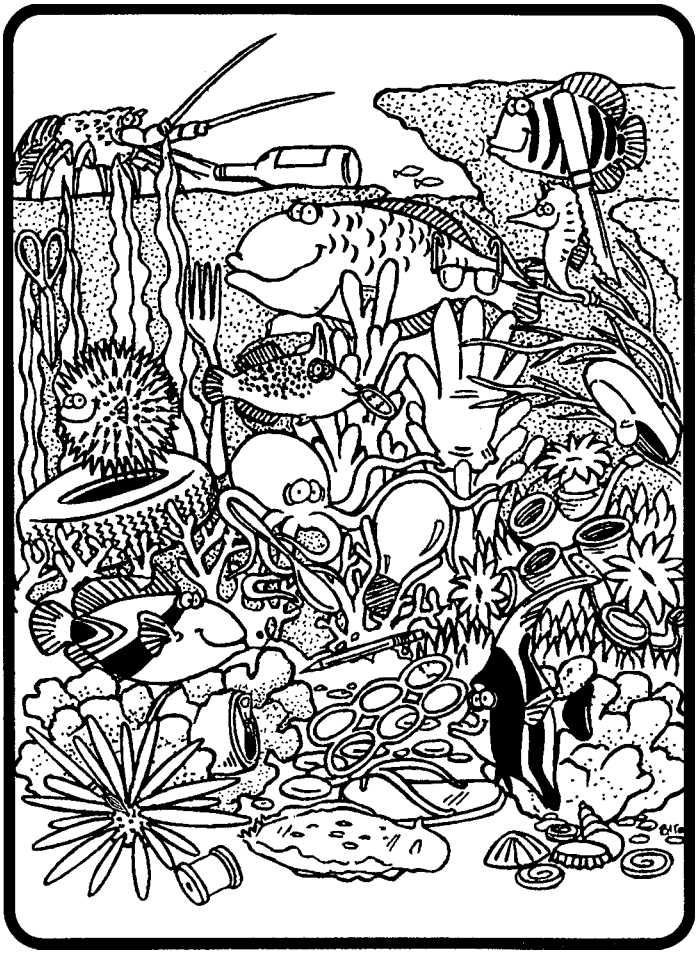
Have students make a creature out of trash—one that a fish or whale might mistake for food. (Bubble wrap, plastic wrap, milk jugs, and pop-can rings make great jellyfish. Bright wrappers, aluminum foil, and cans make great fish.)

Brainstorm ways to keep trash out of the ocean. (Reduce the amount of garbage you make, reuse whatever you can, and recycle things that you can't reuse.)

Part 3—Display your art in a public place at school or in the community, with a poster about keeping our oceans clean.

FIND ITEMS THAT DON'T BELONG HERE!

Color the drawing & help keep our coral reefs clean



List the items you find below:

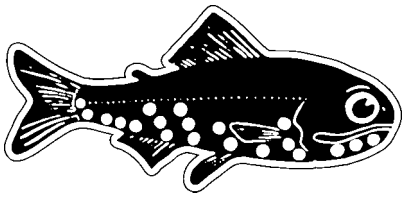
1. _____ 2. _____
3. _____ 4. _____
5. _____ 6. _____
7. _____ 8. _____
9. _____ 10. _____
11. _____ 12. _____
13. _____ 14. _____
15. _____ 16. _____
17. _____ 18. _____
19. _____

Glow-In-The-Dark Fish Puppets

Pre-K to 3rd grade, pre or post visit exercise

STANDARDS

Doing Scientific Inquiry,
Unity and Diversity



OBJECTIVES

Children will:

- Become familiar with bioluminescence as a characteristic of many deep-sea fish
- Experience a simulation of bioluminescence by creating their own lanternfish puppet

MATERIALS

- Lanternfish puppet patterns
- Cardboard for mounting puppet
- Stick or dowel
- Scissors
- Tape and glue
- Glow-in-the-dark paints, markers or crayons
- Flashlight

PROCEDURE

1. Paint matching light spots or photophores on each side of the lanternfish pattern with glow-in-the-dark paint, markers or crayons.
2. Cut out the two sides of the lanternfish pattern. For very young children, patterns may already be pre-cut.
3. Glue *Side One (Right)* of the fish pattern to the cardboard.
4. Trim the cardboard to match the fish's shape.
5. Glue *Side Two (Left)* of the fish pattern to the cardboard.
6. Attach the fish to the stick with tape.
7. Shine a flashlight on the "photophores" before darkening the room.
8. Turn off the lights. Have students make their glowing fish "swim" in the ocean depths.

FOLLOW-UP

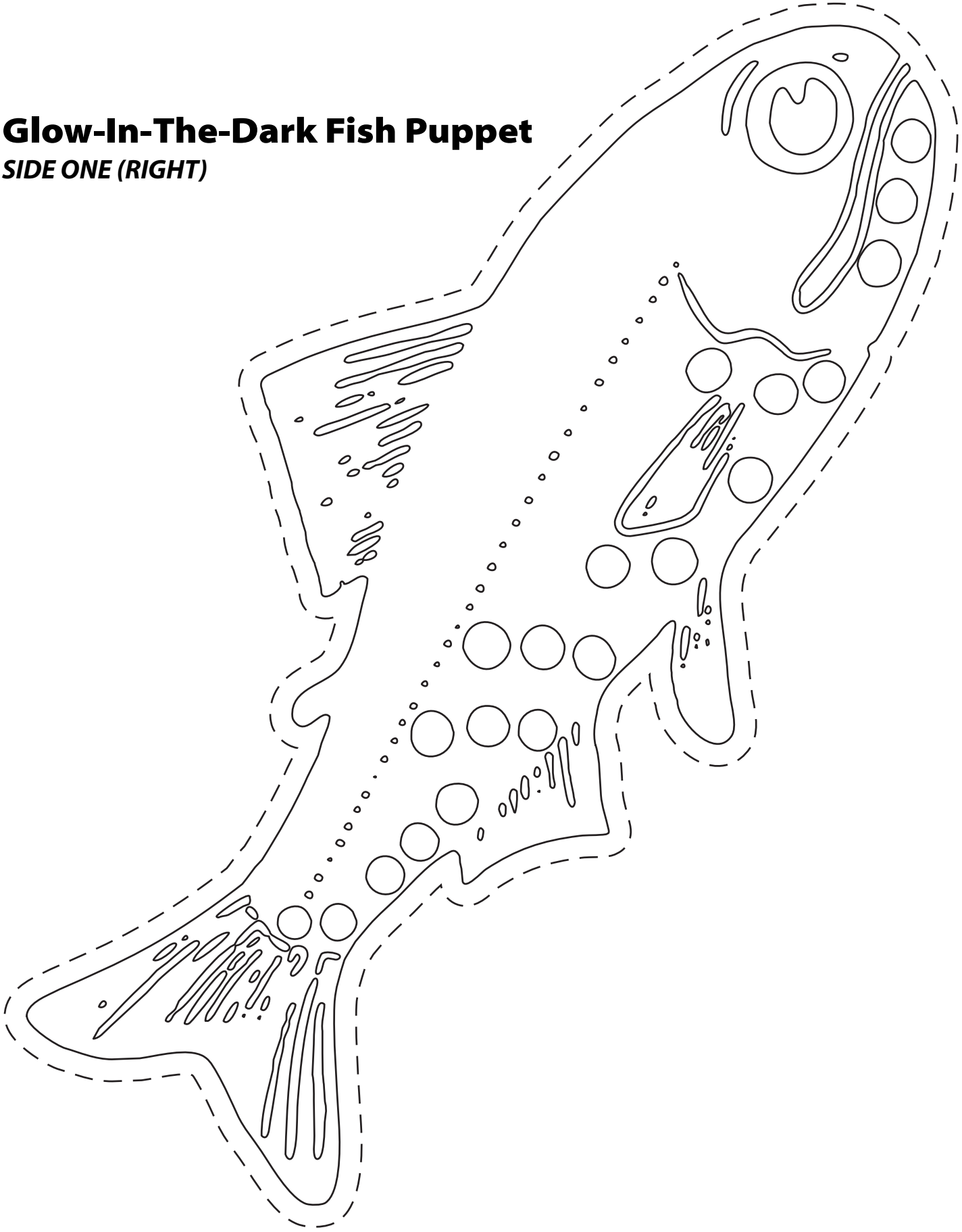
Research other types of deep sea fish with bioluminescence. Children may want to make puppets of other species of fish, or create their own species of deep-sea glowing fish.

BACKGROUND INFORMATION

There are many kinds of lanternfish, each of which glows with its own special pattern of body lights. These lights, called **photophores**, help lanternfish survive in the darkness of the deep sea. Another term for the ability to illuminate one's body is called **bioluminescence**. The pattern of photophores along the side of a lanternfish's body helps it find members of its own species. The photophores on its belly match the dim light that filters down from the ocean's surface, helping the lanternfish hide from hungry fish below.

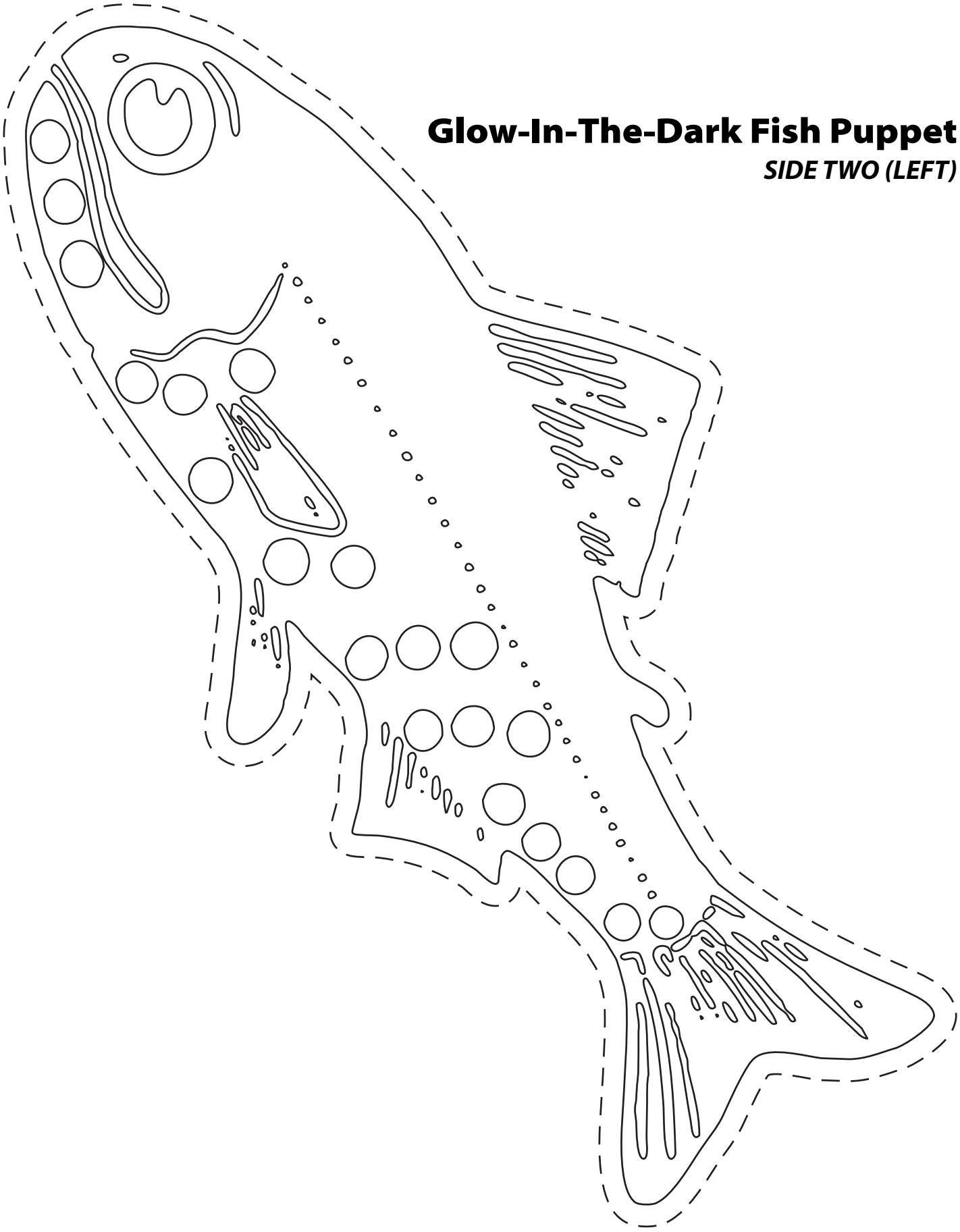
Glow-In-The-Dark Fish Puppet

SIDE ONE (RIGHT)



Glow-In-The-Dark Fish Puppet

SIDE TWO (LEFT)



The Pressure! Water Column Experiment

Pre-K to 4th grade (demonstration), 5th to 8th Grade (experiment), pre or post visit exercise

STANDARDS

Doing Scientific Inquiry, Historical Perspective

OBJECTIVES

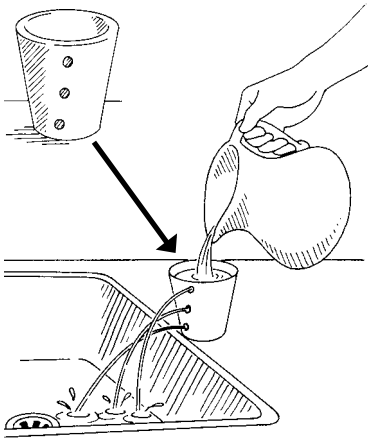
Children will:

- Experience and experiment with water pressure changes at different depths
- Gain an understanding of the increased water pressure at great depths in the ocean, and the need for humans to be protected when visiting those areas.
- Gain an understanding of, and appreciation for, marine creatures that travel at great depths

MATERIALS

- Various cylinders—water bottles, tin cans, milk jugs etc.
- Water container, and a small cup or funnel to fill cylinders
- Scissors or nails for poking holes in cylinders
- Duct tape or masking tape
- Container to collect water
- Paper Towels

PROCEDURE



*For the **experiment** (grades 5 to 8), or to prepare for the **demo** (pre-K to 4th grade)*

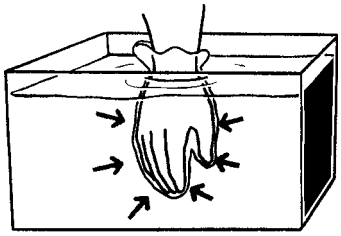
1. Poke holes in each cylinder on the side (an inch from the bottom), in the middle, and toward the top
2. Cover the holes with tape
3. Place the cylinder in the collection container
4. Fill it with water (make sure the water doesn't leak from holes)
5. *(For pre-K to 4th grade demonstration)*—Remove the tape, and observe which stream is strongest

QUESTIONS

1. Can you predict which hole will have the strongest stream when the tape is removed? How come? How will you know which is strongest?
2. Which is the strongest? *(LOWEST)*
3. Which is weakest? *(HIGHEST)*
4. Why is there a difference in water flow?
5. How does difference in pressure affect human divers?
6. How does pressure affect whales?

BACKGROUND INFORMATION

Water has weight. When you're underwater, the more water you have above you, the more it weighs upon you. The water's weight puts your body under pressure. You can demonstrate this by putting on a rubber glove, then immersing your hand in a fish tank or a sink full of water. The weight of the water will make the glove hug your hand from all sides.



In the cylinder with three holes, the lowest hole has the most water above it, so the pressure is highest. The water shoots out forcefully.

The water coming from top hole has the least pressure on it because there's not as much water weighing it down.

Of all the whales, the sperm whale is the deepest diver. It can dive down to 8200 feet below the surface—that's 1.6 miles! And it can hold its breath for over an hour.

Water pressure would crush a human long before they reached the depth of 8200 feet. But a sperm whale is designed to withstand such pressure. Its ribcage and lungs collapse when it dives, and expand when it surfaces.

Humans have developed submersible vehicles so they can visit the ocean's great depths. Like the sperm whale, these submersibles are designed so they won't be crushed by the enormous pressure of the water above them—which can be as high as eight tons per cubic inch.

Despite the enormous pressure at the ocean bottom, a few creatures manage to live there. If these creatures were brought to the surface, they would burst apart because their bodies require great pressure to hold together.

Ocean Divers and Submarines

Pre-K to 8th grade, pre or post visit exercise

STANDARDS

Doing Scientific Inquiry, Convention & Skills

OBJECTIVES

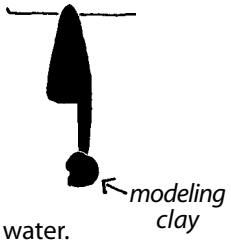
Children will:

- Follow steps to make an ocean diver/submarine to demonstrate for themselves how buoyancy works. To help younger children focus on following the objectives, the "diver" may be readied for them beforehand.
- Learn to control the buoyancy of the ocean diver/submarine by varying their hand-pressure on the bottle
- Explain what causes the ocean diver/submarine to sink or float. *When placed in water, an object pushes some water out of the way—this is called* ***displacement.*** *At the same time, water pushes back on the object. When placed in water, an object floats* ***if*** *its own weight equals the weight of the water it's pushing out of the way. The object will sink if its weight is more than the weight of the water it's pushing out of the way—or "displacing."*

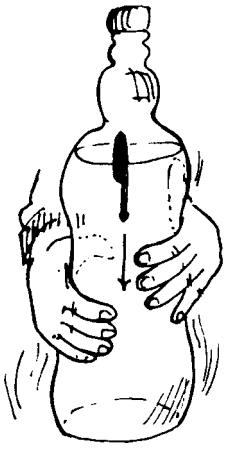
MATERIALS

- Plastic pen cap with modeling clay attached, or use an eye dropper
- Large plastic soft drink bottle
- Water
- Teflon tape (to seal bottle) and electrical or duct tape (to keep the cap secured while it's in the classroom)

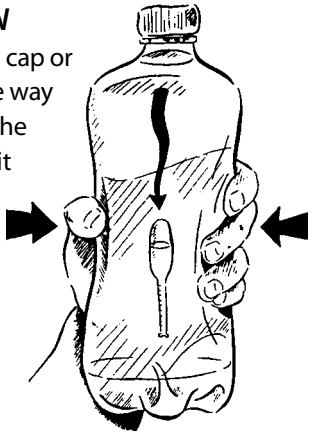
PROCEDURE



1. If you're using a plastic pen cap, put a small lump of modeling clay on the end of the pocket-clip. Experiment with the amount of clay until the pen cap floats, with its tip poking just out of the water.
2. Fill the soft drink bottle to the brim with water.
3. Carefully put pen cap or eye dropper into the water so it floats upright, with an air bubble trapped inside. Seal the bottle cap, using teflon tape over the threads to make a better seal, and electrical or duct tape around and over the bottle cap so it won't come unscrewed.
4. Squeeze the sides of the bottle. What happens to the diver/submarine? It should sink.
5. Students can practice controlling the depth of diver/submarine by varying their squeeze on the bottle.
6. Ask students whether they can explain how they're able to make the diver/submarine float or sink. You may want to document their answers, and check for understanding.



BACKGROUND INFORMATION



Together with its air bubble, the pen cap or eye dropper pushes water out of the way or displaces it. When you squeeze the bottle, the only thing inside inside it that can get squished (compressed) is that little air bubble inside the pen cap or eye dropper. When the air bubble gets squished, it doesn't displace as much water. That's how the diver/submarine becomes more dense than water, so it sinks.

When you stop squeezing, the air bubble grows again (expands). Together with this larger bubble, the pen cap becomes less dense than water, and it floats again.

Just like the bubble in the diver/submarine, fish squeeze or release small bags (sacs) of air in their bodies to move up or down in the water, or to keep a constant depth. Scuba divers and submarines also use air this way to help them float or sink.

FOLLOW-UP

Dissolve sodium bicarbonate in a clear, tall container of water. Place several raisins into the solution. Add some vinegar. Students can observe how the bubbles that form on the raisins will make the raisins float. At the water's surface, the bubbles will soon burst, and the raisins will sink again.

Submarine Coming Up!

Pre-K to 8th grade, pre or post visit exercise

STANDARDS

Doing Scientific Inquiry, Convention & Skills

OBJECTIVES

Children will:

- Follow steps in making a submarine, in order to observe properties of buoyancy (younger children may have submarine prepared for them so they can focus on following objectives)
- Learn to increase the buoyancy of a submarine by adding air and dispelling water
- Explain what causes the submarine to sink or float

MATERIALS

- 2 pennies
- Water resistant tape (duct tape, for example)
- Small narrow-mouthed plastic bottle
- Scissors
- Flexible drinking straws
  MAKE SURE EACH STUDENT USES ONLY HIS OR HER OWN STRAW
- Modeling clay
- Large bowl or basin
- Tap water

PROCEDURE

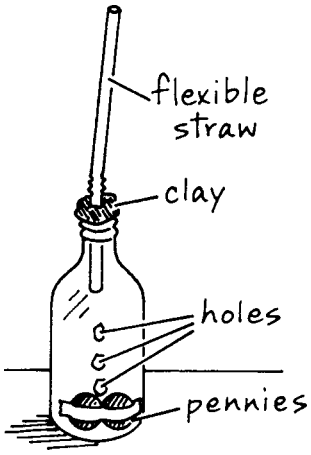
1 Tape pennies side-by-side to the outside bottom of the bottle.

2 With an adult helper or an adult to supervise, use the point of the scissors to make a row of three holes down one side of the bottle.

3 Place the short end of the straw into the mouth of the bottle, and secure it with modeling clay as a stopper.

4 Fill the bowl or basin with water. Place the bottle into the bowl, holes down.

5 Hold the bottle beneath the water until it fills with water and remains on the bottom.
NOTE: If the bottle does not sink, add more coins.



6 Blow into the straw. The bottle should rise to the surface.

FOLLOW-UP

Students can try to make the submarine sink again by adding water through the straw.

BACKGROUND INFORMATION

This activity demonstrates how a submarine can be made to rise.

When an object is placed in water, it pushes some water out of the way—this is called **displacement**. At the same time, water pushes back on the object.

An object floats when placed in water, if it's lighter than the water it pushes out of the way. If the object is heavier than the water it's displacing, the object will sink.

A submarine has special tanks called **ballast tanks** that make it go up or down. When the tanks are filled with water, the submarine gets heavier than the water around it, and it goes down. When the tanks are emptied, the sub grows lighter and goes up to the surface.

Whale Questions from Kids

WHAT DO WHALES EAT?

There are two different types of whales, ones with baleen and ones with teeth.

Baleen whales have a special structure that hangs down from the roof of their mouths that looks like a broom. This baleen is made of the same material as human fingernails. Gray, humpback, blue and minke whales have baleen. When feeding, a baleen whale (such as a gray, humpback, blue or minke) opens its mouth very wide to fill it with water. Then the whale uses its very strong tongue to push the water out, swallowing the small fish and krill from the water.

Toothed whales do not chew their food. Instead they catch and grasp fish and squid in their teeth. Toothed whales such as pilot whales, beaked whales, and dolphins use their tongue to turn the food around head-first, and swallow it. Their small teeth are shaped like tall triangles, except for the killer whale who has large peg-like teeth. The killer whale, also called an orca, eats many kinds of fish.

WHAT EATS WHALES?

Hardly any creatures eat whales because they're so big, but the rather small orca does prey on larger whales. Some orca populations also prey on dolphins and seals. When we think of one type of marine mammal feeding on another, keep in mind that it isn't much different than eating fish.

Orcas have devised specialized hunting and feeding techniques to capture marine mammals. Like a wolf living on land, the orca lives in a family "pod" with a highly developed social structure—orcas hunt, sleep and play together.

When whales die, their flesh becomes food for fish, seals and birds.

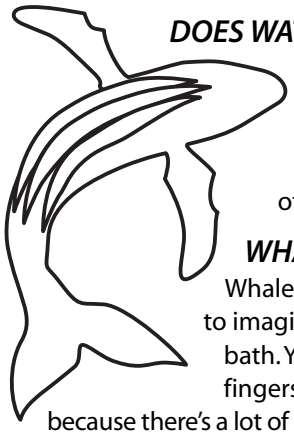
HOW DO WHALES BREATHE?

Whales breathe through a blowhole at the top of their head. This special adaptation helps them take a quick breath of air when they surface. Whales are mammals, and breathe the same air we do.

HOW DO CALVES KNOW HOW TO SWIM & BREATHE?

Scientists aren't sure exactly how baby whales can swim and breathe immediately after birth. Some believe that while the baby grows inside its mother, it feels the movement of the water outside, and can also feel its mother breathing.

When a baby is first born, its mother will help lift it to the surface to take its first breath. The baby immediately begins following close to its mother, imitating her actions.



DOES WATER COME OUT OF THEIR SPOUT?

It looks a lot like water, but it's actually a water vapor. As the whales push the air out of their lungs, that air mixes with surface water, causing the blast of water we call the "blow."

WHAT DOES WHALE SKIN FEEL LIKE?

Whale skin is very soft and tears easily. Try to imagine what your body feels like after a long bath. Your skin is probably wrinkled and your fingers are shriveled up at the ends. That's because there's a lot of water beneath the surface of your skin.

Whales spend their entire lives in water, so they have very delicate skin. Some people say it feels like wet leather, while others say it has more of rubbery feel.

WHERE DO WHALES LIVE?

Whales are found in just about every sea or ocean on the planet. Most baleen whales make seasonal migrations over long distances to find food. In wintertime, some types of baleen whales migrate to warmer climates near the equator to give birth and raise babies. Smaller species of toothed whales and dolphins live where food is plentiful year-round, and don't need to migrate.

Whales who live in colder temperatures have different adaptations to help them survive, such as a thicker layer of blubber, and a highly efficient body temperature system.

HOW MANY SPECIES OF WHALE ARE THERE?

Currently there are about 65 species of toothed whale, and ten species of baleen whale.

WHERE DO WHALES SLEEP?

Cetalogists are still learning about this. Many think that whales don't sleep for long periods of time, but instead take short naps throughout the day.

An animal living in the ocean must constantly be aware of its surroundings. Cetalogists have found species of dolphins that actually sleep with one eye closed while the other is open. This may also be how their brain works—perhaps they rest one side of their brain while the other stays alert.

When pods or groups of whales sleep, they gather in tight formation and take shallow dives of less than 20 feet. This helps protect them from dangers such as predators or boats.

Baleen whales, who are solitary creatures, may simply enter into a rest mode, keeping semi-alert to their surroundings.

Whale Questions from Kids

HOW BIG CAN WHALES GET?

Some whales such as the blue whale may grow to 100 feet in length and weigh up to 100 tons! The blue whale is bigger than any dinosaur that ever lived.

Baleen whales are much larger than toothed whales. The many different species of baleen whales, toothed whales, dolphins and porpoises come in a variety of sizes and weights.

The porpoise, a toothed whale, is the smallest whale of all. Most porpoises average less than 6 feet in length. Dolphins average 7 to 10 feet, except for the orca who grows up to 30 feet. Other toothed whales such as beaked whales, river dolphins, and sperm whales may be 30–40 feet long.

DO WHALES LIKE PEOPLE?

In many ways, whales are curious about people. There are many stories about whales coming up to boats that are on whalewatching trips, and interacting with people by looking at them above the water, eating fish, and letting themselves be touched by the people. Whales are very intelligent. Many are not afraid of the boats or boat sounds.

Whales also seem especially curious about their surroundings. Their survival depends on knowing about everything going on around them, so they must constantly investigate their ocean world.

HOW LONG CAN WHALES STAY UNDERWATER?

Some species of whales, such as the sperm whale, can stay underwater for an hour. This gives them time to dive very deep to feed on giant squid. When whales are searching for food, many can stay underwater for up to 20 minutes.

All species of whales swim very fast. This enables them to dive quickly, find food and swim back to the surface.

Most species of whales are surface-dwelling creatures who stay within 150 feet of the surface because they need to breathe air. Many dolphins stay within 50 feet of the surface. Also, whales mostly eat fish, and the fish feed on creatures found near the surface, in the ocean's sunlit layers.

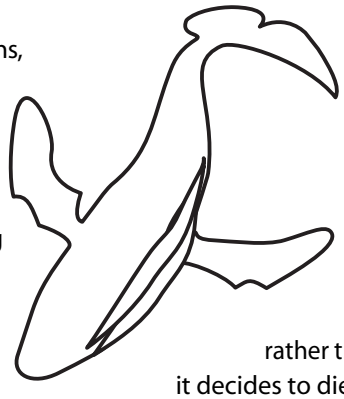
HOW LONG DO WHALES LIVE?

Many species of whales seem to have long life spans. This is important for several reasons.

Whales have long gestation periods, up to 12 months in some cases, and do not reproduce every year. A whale mother spends up to 2 years weaning a calf from her milk, and teaching it how to survive. Because of this, whales must live a long time so that they can produce as many offspring as possible.

Cetalogists have learned that smaller species generally live shorter lives than larger ones. Blue whales may live up to 80 years, while harbor porpoises might live only 15 years.

Whale species with more highly developed social systems tend to live longer.



CAN WHALES GET SICK?

Yes, that's how most whales die. In many cases, whales die from diseases in their organs or infections in their ears.

When a whale is sick, it may purposely swim up to shore and beach itself. This may be because the whale knows it's dying, and rather than sink to the bottom of the ocean, it decides to die on land.

Structurally this is very hard on the whale's skeleton. In water, a whale is weightless. Water provides buoyancy, enabling the whale to float and swim. But on land, their skeleton is very heavy. The body can't hold itself up like humans can—there are no supporting structures. So when a whale beaches itself, the weight of its own body may crush it to death.

ARE WHALES BECOMING EXTINCT?

Because of whaling, many species are currently on the endangered species list.

For 300 years, whales have been hunted for food and oil. Before that, there were hundreds of thousands of every species of whale. In the last 70 years, whaling has been unprofitable, so whales haven't been hunted.

Although several species of whale are beginning to rebound, probably there will never be as many whales as before man started hunting them. Even if all the world's countries stopped whaling today, whales reproduce so slowly that it would take hundreds of years to reach previous numbers. But in time, if they are not hunted, and if food resources are available, there may once again be thousands of whales in the oceans.

Baleen versus Teeth

Pre-K to 8th grade, pre or post visit exercise

STANDARDS

Doing Scientific Inquiry, Unity and Diversity

OBJECTIVES

Children will:

- Experience the difference between whales' food-collecting methods, using a toothbrush to represent baleen, and a comb to represent teeth
- Analyze which method is more effective for gathering krill (represented by ground pepper) or meat (torn paper)

MATERIALS (PER GROUP)

- A pile of paper torn in pieces the size of a nickel
- A wide-toothed comb (Teeth)
- A toothbrush (Baleen)
- Two bowls of water
- Ground pepper

PROCEDURE

1. Cover the water of one bowl with pepper, the other with paper.
2. Run the toothbrush through the pepper.
3. Note how much is removed (a lot, a little, half, a third—the description will depend on the age of your students)
4. Cover the surface with pepper again.
5. Repeat with the wide toothed comb.
6. Compare. Which picked up more pepper?
7. Repeat this process with the bowl of paper.

QUESTION

Do baleen or toothed whales eat small krill?

BACKGROUND INFORMATION

Baleen whales take in large mouthfuls of water and then use their large tongues to push it out, trapping their dinner of krill and small fish in their baleen.

Baleen is like the bristles on a toothbrush hanging from the upper jaw of the whale. Baleen is made of the same material as our fingernails, keratin.

Toothed whales have cone-shaped teeth in their mouths for catching food. The most common foods for these whales are fish and squid.

Instead of chewing their food, toothed whales use their teeth to catch and grasp their prey. Then they use their tongue to turn the food around head-first and swallow it.

Fluke Art

Pre-K to 5th grade, pre or post visit exercise

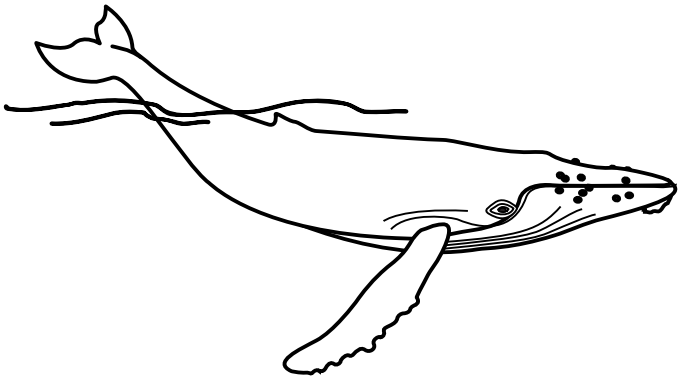
STANDARDS

Communication Process

OBJECTIVES

Children will:

- Learn the concept of identifying whales by the unique patterns on each one's fluke
- Use their creative expression to design a unique pattern on a fluke shape



MATERIAL

Black or Gray Construction Paper
White chalk or paint
Finger paint or stamp pad

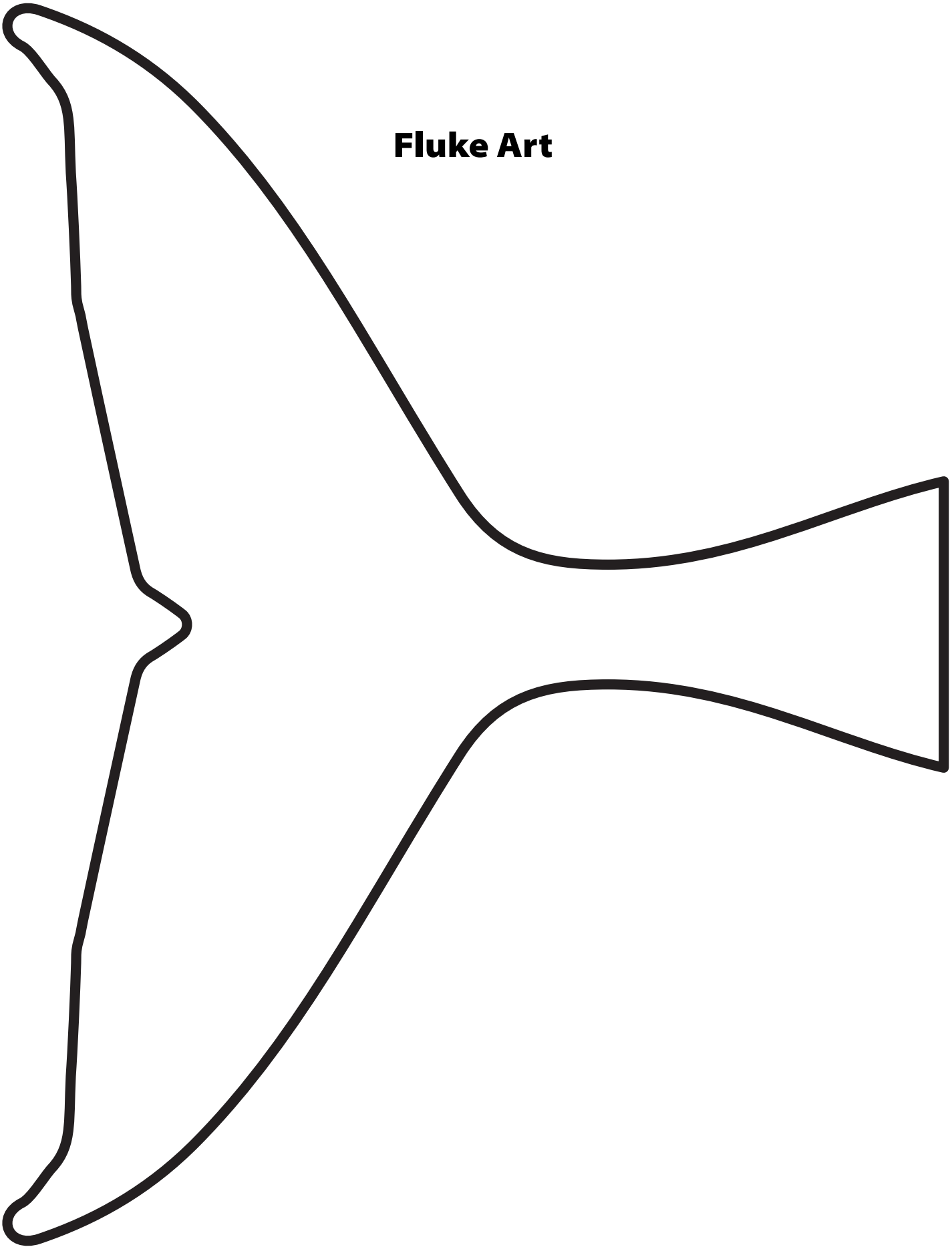
PREPARATION

Cut out fluke shapes *(see next page)*

PROCEDURE

1 Explain that each Humpback whale has a unique fluke just like each child has a unique fingerprint, and a whale can be identified by its fluke pattern
2 Give each student an outline
3 Have each student paint or color a fluke design
4 Let them name their whales
5 Have students autograph their art with their thumb print
6 Display the flukes and names in the hall or the classroom

Fluke Art



Blubber Glove

Pre-K to 4th grade (demonstration), 5th to 8th grade (experiment), pre or post visit exercise

STANDARDS

Doing Scientific Inquiry, Unity and Diversity

OBJECTIVES

By experiencing the insulating effects of blubber (represented by Crisco shortening), children will learn why marine mammals need blubber.

MATERIALS

- Gallon-size Ziploc plastic bags
- Crisco shortening
- Ice and water
- Bucket or large bowl
- Insulating materials (such as cotton balls to represent fur, or wet cotton for wet fur)

PREPARATION

To make an insulating glove, you can pair one Ziploc bag with an identical one that's turned inside-out:

1. Turn a Ziploc bag inside-out, and put it into a regular one so the lips match up.
2. Zip the lips of the inner bag onto the lips of the outer bag. This forms a double-layered pocket to surround your hand like a glove. The glove will keep your hand dry and clean, while you experiment with various insulating materials held between the double-layers of plastic.

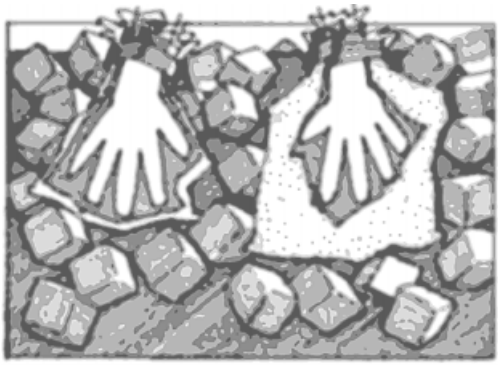
Each student will be testing the properties of insulation by dipping a glove-covered hand into icy water. During this exercise it's important to keep cold water from leaking into the glove, so advise your students not to put their gloved hand too far into the water. (You can also wrap duct tape around the "cuff" of the glove to help keep water out—see the picture.)

For younger students, have the gloves already made. Have older students vary the thickness of Crisco or insulating material.

PROCEDURE

For each group of four:

1. Make a bowl or bucket of icy water.
2. Smear Crisco into a Ziploc bag.
3. Turn another Ziploc bag inside-out, and put it inside the first bag to form a Crisco glove.
4. Seal the lips of the inside bag to the lips of the outer bag.
5. Have each student put one hand into the Crisco glove, then immerse both hands in the icy water. Which hand gets cold faster? How come?



6. Repeat this process by making gloves that contain other materials. Compare the insulating effectiveness of bare hands…Ziploc bags alone…Crisco gloves… and gloves containing other insulating materials.

QUESTIONS

- Why aren't whales furry?
- Do humans use insulation in water?

BACKGROUND INFORMATION

Marine mammals need to keep their body warm in their cold surroundings. Most have a thick layer of blubber (fat) under their skin to help insulate their body.

Did you know that swimmers in cold water, such as those who swim the English Channel, cover their bodies in Crisco or other fatty materials? It's true!

Name that Sound

Pre-K to 8th grade, pre or post visit exercise

STANDARDS

Doing Science, Communication Process

OBJECTIVES

Children will:

- Develop and/or practice auditory discrimination skills, identifying various sounds and their locations
- Develop an understanding of how some whales use echolocation to search for food, and to find their way when they can't see (such as in the deep sea's darkness)

MATERIALS

- Blindfolds
- Noisemakers, whistles, horns, bells, things to tap on
- Paper & pencils for older students

PROCEDURE 1

1. Blindfold two students and have them sit in the middle of the room.
2. Have another student walk quietly around the room, tapping on objects.
3. Ask the blindfolded students to point to where the sound came from, then name the object making the sound. (Does a single object sound different, depending on where it's located? Why are there differences?)

PROCEDURE 2

Stand behind the class and make noises using various items, while students record the items they think they heard.

PROCEDURE 3 (OLDER STUDENTS)

1. Divide the class into groups of four.
2. Select a leader for each group.
3. Give each leader a noisemaker, and have them demonstrate its particular sound.
4. Have the groups spread out and mix with other groups.
5. Blindfold everyone but the leaders.
6. Then using only the noisemakers as signals, have each group member try to find their group leader.

BACKGROUND INFORMATION

Some whales use echolocation to gather information about their surroundings. They make sounds underwater—vibrations such as clicks or chirps. These vibrations bounce off nearby objects, and return to the whales as echoes.

By listening to the echoes, whales can determine the size, distance, and location of undersea objects and terrain.

FOLLOW-UP

Students can feel the vibration of their voices by talking directly in front of an inflated balloon while holding it in their hands. This simulates the vibrations whales make when using echolocation.

NOTE: SUPERVISE USE OF BALLOONS VERY CAREFULLY WHEN WORKING WITH YOUNGER CHILDREN, TO AVOID SUFFOCATION FROM BROKEN PIECES OF BALLOON.

QUESTION

Could you find your way, or find food or friends, in the deep sea without using your eyes?

Deep Sea Hunt

Pre-K to 8th grade, pre or post visit exercise

STANDARDS

Doing Scientific Inquiry, Unity and Diversity, Convention and Skills

OBJECTIVES

Children will experience what it might be like for a whale to catch its prey using echolocation.

MATERIALS

- One blindfold
- Two film canisters with coins in them
- An area of flat ground or floor, free of obstacles

GAME SETUP

The object of the game is for the whale (played by one student) to catch the squid (played by another student). The whale navigates only by the sound of coins shaking in canisters.

Explain that the whale shakes its canister to simulate its outgoing vocalization sounds—then the squid's canister simulates the echo of the whale's vocalizations, as they return to the whale. When the whale hears its own sounds bouncing back from the squid as echoes, it can determine where the squid is located. This is called echolocation.

1. Divide class into groups of 10-15.
2. Each group makes a circle, which serves as the boundary for the game.
3. Select a student in each group to stand within the circle and be the *squid* (prey or lunch!). The squid gets a film canister.
4. Pick a second student in each group to stand inside the circle and be the *sperm whale* (predator or hunter). The sperm whale gets blindfolded, and receives the second film canister.

GAME PLAY

- The whale tries to find and tag the squid using echolocation.
- The whale and squid can move within the circle, but cannot leave the circle. (As an alternative, the squid may be allowed to escape the circle.)
- Whenever the whale shakes its canister, the squid must stop moving for a moment and shake its canister in reply.
- The round is over when the squid gets tagged, or the teacher calls time.
- Pick a new whale and squid, and keep playing.
- Remember, in the deep sea it's very quiet and dark, so our circle must stay still and silent. Students in the circle have the most important job, keeping the whale and squid safe.

BACKGROUND INFORMATION

Toothed whales have great rounded foreheads called melons. The melon is used as a "second-sight" sense, much like the sonar that ships use for locating underwater objects. In the above exercise, blindfolding makes the students focus on the world of sound.

Sperm whale "sonar" is called echolocation. The sounds are like pocket-change rattling in an empty clothes dryer. These sounds bounce off undersea objects and back to the whale, helping it determine where the objects are located, how far away, what shape and how big they are. That's how they find their way in the deep ocean, where there's no light.

Sperm whales also use sound to confuse or stun their prey and make them easier to catch.

A Whale of a Tale Trivia

4th to 8th grade, post visit exercise

STANDARDS

Doing Scientific Inquiry, Understanding Scientific Inquiry & the Character of Scientific Knowledge, Communication Process, Convention & Skills

OBJECTIVES

Children will:

- Develop a deeper understanding of marine mammals
- Increase research skills by collecting information about marine life
- Develop communication skills by preparing questions and answers about marine life they researched

MATERIALS

Students will need access to information from the Internet and/or the library.

GAME SETUP (PART 1)

1. Divide the class into groups of four.
2. Assign each group a mammal found in the ocean around Hawaii.
3. Have students research information about their mammal in specific categories such as its anatomy, where it lives, what it eats, how it raises its young, its adaptations, and any strange facts about it.
4. Research should be presented in the form of trivia questions, mounted on colored paper. Each category needs its own paper color. Questions should be mounted on one side of the paper, with answers on the other.

GAME SETUP (PART 2)

1. On the chalkboard list the categories in a horizontal line.
2. Write 6 different point values under each category (such as 10, 20, 30…60).
3. Divide the class into teams, making sure to divide up the research groups.

GAME PLAY

- The first team picks a category and number of points. Ask them a question from this category.
- *If they answer correctly,* they get the points and the next team selects a new category and points.
- *If they answer incorrectly,* repeat the question for the next team.
- The team that answers correctly gets the points.

Higher grades could introduce incorrect statements, requiring the discrimination and higher thinking skills of their classmates.

Higher grades could also create activities such as this game, for the younger audience.

Deep Sea Legends

K to 8th grade, pre visit exercise

STANDARDS

Convention & Skills, Communication Process

OBJECTIVES

Children will:

- Listen to descriptions of sea creatures, and create their own imaginative, artistic representations of these creatures
- Compare their own interpretations with other people's pictures or models of the same creatures

MATERIALS

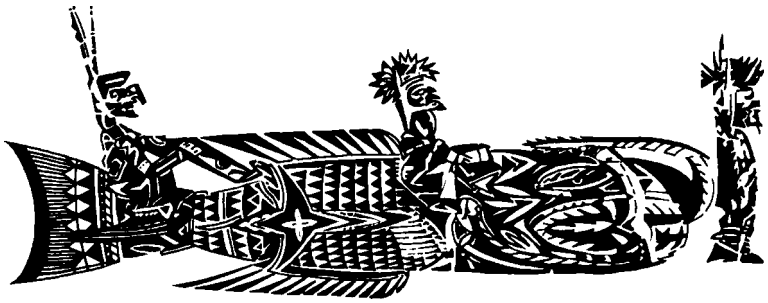
- Deep Sea Giant descriptions
- Crayons, markers, pastels or paints
- Paper

PROCEDURE

1. Read the description of each Deep Sea Giant that your students will see on display at the Museum *(see previous page)*. *IMPORTANT:* Avoid naming or showing pictures of the creatures you'll be describing.
2. Have the students draw what they expect to see at the Museum, based only on your verbal descriptions.
3. Have students name the creature they drew. To extend the activity, have them write a story about their creature's life or adventures.
4. Have students share their drawings and stories. Each student will have pictured a different animal based on your description.

BACKGROUND INFORMATION

Many legends about mythical sea creatures are based on observation of living animals.



To help inspire your class, find and share books from your local library about mythical creatures and sea adventures.

SPECIAL OPPORTUNITY

Your trip to the Museum can include a planetarium show exploring a story of the constellation Cetus the Whale. This connects astronomy to your Journey into the Deep. To schedule this program as part of your tour, please reserve at least one week in advance.

Classification of Whales

BACKGROUND INFORMATION (PART 1)

Although they may not look it at first glance, whales and their close relatives are all mammals. Mammals are characterized by the following features:

- Mammals breathe air with lungs.
- Mammals maintain a constant high body temperature independent of their surroundings.
- Mammals have a four-chambered heart.
- Mammals bear live young (except the duck-billed platypus and the spiny anteater who both lay eggs).
- Mammals nurse their young with milk.
- Mammals have hair, at least at some stage in their development.

BACKGROUND INFORMATION (PART 2)

Whales belong to the scientific order **Cetacea.** Other well-known members of this order are the dolphin, porpoise, orca (killer whale) and narwhal. The *order* Cetacea (from the Greek *cetus,* meaning whale) is divided into three *suborders:*

Odontoceti
"Toothed whales" include the orca, dolphin, porpoise, beluga whale and sperm whale

Mysticeti
"Baleen whales" include the blue whale, gray whale and right whale

Archaeoceti
These whales are extinct

All members of the suborder **Odontoceti**, the toothed whales, have peg-like teeth. These teeth are vestigial, or limited to just the lower jaws in some species. The name **Odontoceti** is from the Greek *odontos,* meaning tooth. Orcas have 10 to 15 teeth on both sides of the upper and lower jaws.

"Baleen whale" is the common name for the suborder **Mysticeti**. The word Mysticeti is derived from the Greek word for mustache, *mystax.* This may refer to the hairy appearance of the whale's baleen plates, which hang from the roof of its mouth, and are used for straining food from the water. Baleen whales (sometimes known as "great whales") have 2 external blowholes, no teeth, and are larger in size than most toothed whales.

Orders and *suborders* are divided into *families.* Among the suborders of Cetacea are eleven families. The Odontoceti suborder includes the families Physeteridae (sperm whales) and Delphinidae (dolphins, porpoises and orcas). The Mysticeti suborder contains the family Eschrichtiidae (gray whales, often seen along the Oregon coast) and Balaenopteridae (the blue whale, largest of all whales).

Glossary *p1*

Terms found in the Journey Into the Deep exhibit (words in *italics* are defined within this glossary)

Abyss	The great depths of the ocean floor, averaging about 15,000 feet deep (4,500 m).
Abyssal plains	The flat surface of the abyss.
Baleen	Sheets of bony material hanging down from the upper jaw of a baleen whale, used instead of teeth to capture and eat fish.
Baleen whale	A common name for whales in the scientific suborder, *Mysticeti*. See *baleen*.
Ballast tanks	Special tanks in a submarine that make it go up or down. The tanks can fill with water to sink the sub, or release water to make the sub rise.
Beach	1. A shore with a smooth, sloping stretch of sand and pebbles. 2. A whale is said to beach itself when it swims onto shore, or gets washed to the shore.
Beached [animal]	Refers to a marine animal washed up on shore.
Bioluminescence	The process by which living organisms produce light.
Blow	Refers to the visible exhaled air of a whale. When the whale exhales, the warm moist air from its lungs condenses in the cool sea air, forming a steam-like vapor.
Blowhole	A nostril on top of a whale's head. Some whales have one blowhole, some have two.
Blubber	Oil-filled threadlike tissue under a whale's skin, that keeps the animal warm.
Breaching	The act of a whale leaping out of the water.
Calf	A baby whale. Whale calves are born in the water, and may be born head or tail first. Although twins are possible, usually only one calf is born at a time.
Cetacea	All *whales* belong to this scientific order, which includes three suborders: 1. Archaeoceti are prehistoric whales, now extinct. 2. Mysticeti are *baleen whales.* 3. Odontoceti are *toothed whales.* All cetaceans live in the water, have *blowholes,* pectoral (chest) flippers, and tail *flukes.*
Cetacean	Refers to an animal in the scientific order *Cetacea* (see).
Class	In the *Linnaean* classification system, this level is below Phylum and above Order. Humans are members of the *class* Mammalia.
Crustacean	An invertebrate animal that usually lives in the water and has a segmented body with pairs of jointed limbs, and a shell-like skeleton that wraps around its outside. Lobsters, crabs, shrimps and barnacles are all crustaceans.
Deep-sea zone	The area of the ocean floor lying beneath the waters of the open ocean.
Density	The "heaviness" of an object, based on a comparison between its mass and its *volume.*
Echolocation	A method of determining distance by bouncing sounds off an object, and listening for echoes.
Endangered species	A species in immediate danger of becoming *extinct* (see).
Endangered Species Act of 1973	A law established by the United States government to stop extinction of wild animals & plants in the United States. Under this law, the US Fish & Wildlife Service and the National Marine Fisheries Service each protect certain animals.

Glossary *p2*

Terms found in the Journey Into the Deep exhibit (words in *italics* are defined within this glossary)

Entanglement Refers to an animal trapped or tangled in fishing gear, trash, nets, or other obstacles.

Environment The surroundings of living things.

Extinction The dying out or disappearance of a *species*.

Family A level of classification that ranks below Order and above Genus.

Flipper-slapping Refers to a whale slapping its flipper on the surface of the water.

Fluke A fin at the end of a whale's tail. Each side of the tail is called a fluke. Whales have two flukes, one right and one left. The whale swims by moving its flukes up & down.

Genus A group of closely related species. In the *Linnaean* classification system, Genus is the category below Family and above Species.

Insulator Any material that slows down the transfer of heat energy.

Invertebrate Having no backbone or spinal column.

Kingdom The highest category in the *Linnaean* classification system.

Krill A small shrimp-like *zooplankton*.

Linnaean Refers to the classification system in use today by the biological sciences to classify all living things. It was invented by Carolus Linnaeus (1707-1778). Its groupings include Kingdom, Phylum, Class, Order (and Suborder), Family, Genus and Species.

Lob-tail The behavior of a whale when it slaps the surface of the water with its tail flukes.

Mammal Any of various warm-blooded vertebrate animals of the *class* Mammalia, including humans, characterized by a covering of hair on the skin and, in the female, milk-producing glands for nourishing the young.

Marine Having to do with the ocean.

Marine animal An animal that lives in or depends upon the ocean to survive. Examples of marine animals includes shrimp, whales, seals and squid.

Marine biology The study of ocean life.

Marine mammal A mammal that lives most or all of its life in the ocean, and/or depends on the ocean for its survival. Marine mammals include whales, seals and polar bears.

Mass 1. The amount of material in an object.

2. Carried out on a large scale, as in *mass stranding*.

Mass stranding When a group of whales strand or *beach* together. Scientists are unsure what causes this. Mass strandings may be caused by illness, impaired *echolocation* ability, or errors in following the earth's magnetic field or the contours of the shore.

Melon The fat-filled region in the forehead of a toothed whale, used to produce *sound waves*. The melon directs or focuses sounds into a beam. The whale may use this sound-beam for communication and *echolocation*.

Microscopic organisms Living beings too small to see with the naked eye.

Midnight zone The bottom layer of the ocean, which extends from the bottom of the *twilight zone* to the ocean floor, and where light is produced only by *bioluminescence*.

Glossary *p3*

Terms found in the Journey Into the Deep exhibit (words in *italics* are defined within this glossary)

Migration When an animal or group of animals travels long distances to take advantage of food sources or weather, or to find a mate or give birth. *Baleen whales* generally migrate.

Mysticeti A scientific *suborder (see order)* of whales known as *baleen whales* or mysticetes. All baleen whales have *baleen* and two *blowholes*. In general, the adult females are larger than the males. Different types of baleen whales depend on different diets, but they all eat plankton and/or small fish. Examples of mysticetes include humpback whales, blue whales and gray whales.

Ocean The entire body of saltwater that covers about three-fourths of the earth's surface.

Oceanographer A scientist who studies the ocean.

Oceanography The branch of science investigating all aspects of the ocean's physical features and creatures.

Odontoceti A scientific suborder *(see order)* of whales known as *toothed whales* or odontocetes. Toothed whales have one blowhole and—you got it—teeth. Different types of toothed whale vary in the size and shape of their teeth, in their diet, and in where they live. Many toothed whales eat fish, squid and *crustaceans.* Some may also eat seals, sea lions, penguins, sharks, and seabirds. Odontocetes include sperm whales, dolphins, and beaked whales.

Order The level of classification below *class* and above *family*. An order can contain suborders.

Parasite An animal that lives in or on another animal. A parasite feeds upon this *host* animal without helping the host survive.

Photophores These body lights on lanternfish form a special pattern. The lights help the lanternfish survive in the darkness of the deep sea.

Photosynthesis The process that plants use to make food out of carbon dioxide, water, and sunlight.

Phylum The level of classification just below *kingdom* and above *class.* At this level, animals are grouped according to their similarities in basic body plan or organization.

Phytoplankton Plantlike *plankton* that are capable of producing food by *photosynthesis.* Phytoplankton are the most important producers in the ocean.

Plankton Small, often *microscopic organisms* drifting with the current or tide, at or near the ocean surface.

Pollutant A substance that makes air, water, or land impure.

Porpoising Refers to a fast-moving marine animal leaping from the water repeatedly, in a series of small bows.

Predator An animal that hunts, kills and eats other animals.

Pressure A force applied over a certain area.

ROV Remotely Operated Vehicle, such as an unmanned submarine.

Scuba Short for Self-Contained Underwater Breathing Apparatus.

Sonar Short for Sound Navigation And Ranging. A method or device used to determine ocean depth or distances, by calculating the time needed to send *ultrasound* through the water, and pick up its reflection.

Sound 1. A form of energy that causes wave motion in materials as it passes through them. 2. Also *sounding*. When a whale dives deep, or when it jumps out of the water.

Glossary *p4*

Terms found in the Journey Into the Deep exhibit (words in *italics* are defined within this glossary)

Sound wave — A wave of pressure that can pass through substances such as water or air, or bounce off materials such as coral. You hear sound waves when they vibrate your eardrums.

Species — The level of classification below *genus*. The largest natural population of organisms with the potential to interbreed and produce fertile offspring.

Spyhop — A behavior of a whale when it "stands" vertically in the water, with its head and sometimes its eyes above the water's surface.

Submarine — A *submersible* vehicle designed to operate underwater for long periods of time.

Submersible — A vessel capable of going under water.

Sunlight zone — The top layer of the ocean, having the most light and the most plant life, and averaging 300 feet in depth (90m).

Swim bladder — An air-filled sac inside a fish's body that allows the fish to float.

Taxonomy — The branch of science concerned with naming, describing, and classifying organisms, and assigning them categories based on their evolutionary relationships. The biological sciences primarily use the *Linnaean* classification system for this.

Toothed whale — A nickname for whales in the scientific suborder *Odontoceti*.

Twilight zone — The middle layer of the ocean, descending from the bottom of the *sunlight zone* to a depth of about 3,000 feet (900m), where there's little light, no plants, and few animals.

Ultrasound — Sounds of such high pitch that humans cannot hear them.

Vibrate — To move back and forth repeatedly.

Vocalizations — Voice sounds that an animal makes. Depending on species, a whale's vocalizations may be used to communicate and/or *echolocate*. The whale may produce these sounds in the nasal passages below the *blowhole*. Whales have neither vocal cords nor language.

Volume — The amount of space that an object takes up.

Warm-blooded — Maintaining a relatively constant and warm body temperature independent of environmental temperature. Sea and land *mammals* are all warm-blooded.

Whale — Whales are *marine mammals* that spend their entire lives in the water—usually in the ocean, but some live in freshwater rivers. There are about 80 different kinds of whale found throughout the world.

Whale louse (plural *lice*) — An external *parasite* that attaches to and lives on a whale. The whale louse is a *crustacean* that feeds on the skin of the whale.

Zooplankton — The animal form of *plankton*.

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We welcome your suggestions for additional resources!

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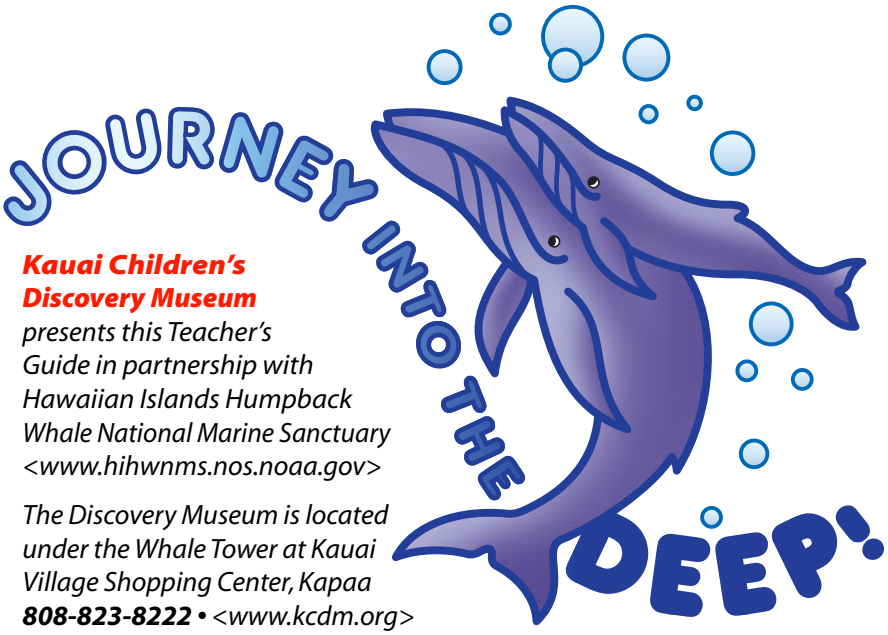

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The Discovery Museum is located under the Whale Tower at Kauai Village Shopping Center, Kapaa
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