Pre/Post Assessment

Use this assessment to discover how much your students already know about math before you begin this unit, and later as a conclusion to your study.

- Describe all the different ways you use math.
- Describe how you might find out what the most popular flavor of ice cream is for students in your class. How would you organize your investigation? If you knew each of your classmate's favorite flavor of ice cream, how could you visually communicate that information?
- Explain how you might find out how big a killer whale is.
- What kind of information might help you predict how many pieces of candy are in one bag?
- If you had 45 fish to feed to five killer whales, how many fish would you feed each whale?
- Make a list of all the different ways you can sort the shoes of everyone in your class.

NATIONAL STANDARDS FOR MATHEMATICS EDUCATION

The National Council of Teachers of Mathematics (NCTM) has adopted national standards for teaching mathematics. The NCTM standards are guidelines for teachers, schools, districts, and states to use in creating high-quality math programs. The SeaWorld ***Splash of Math*** Teacher's Guide activities support the NCTM standards. Among other areas of emphasis, the activities in this Guide strive to do the following:

- Prepare you—the teacher—with the background information you need to lead your students through the activities in a meaningful way.
- Acquaint students with real-life situations that require a contextual use of math skills.
- Require students to solve problems creatively and proficiently.
- Give students practice in estimation, prediction, and computational skills.
- Encourage students to explore mathematical reasoning and connections.
- Give students experience using mathematics as a way to communicate, and to communicate about mathematics.

SeaWorld
ADVENTURE PARKS

Covers

Front *(from left):* polar bear *(Ursus maritimus),* killer whale *(Orcinus orca),* California sea lion *(Zalophus californianus).*

Back *(clockwise from upper left):* SeaWorld trainers periodically measure the parks' killer whales to monitor growth and health. Sea stars come in different sizes and colors, but all have radial symmetry and five arms. To create the SeaWorld tree of lights, SeaWorld electricians attach 24 light strands that hold 2,168 light bulbs to the SeaWorld Skytower. Animal care specialists hand-raise an Asian small-clawed river otter *(Aonyx cinerea)* pup, feeding it a formula that's similar to its mother's milk.

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Splash of Math

K–3 Teacher's Guide

A SEAWORLD PUBLICATION

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To the Teacher

The ***Splash of Math*** Teacher's Guide for grades K–3 was developed at SeaWorld with input from San Diego County Office of Education Math Project Teachers. Our goal is to help you teach your students—in an active, hands-on way—about how mathematical skills relate to real-life situations, specifically marinelife studies and marine zoological park careers. This curriculum supports national standards for mathematics education.

The brief background information in this Guide was written for you, the teacher. It will help you do these activities with your students. As you use this Teacher's Guide, keep in mind that some problems may be solved in more than one way. Answers and problem-solving methods are included for most activities, but in some cases you or your students may find another way to solve a problem—or even other answers that are correct. Also keep in mind your own students' development and experiences. Many of these activities can be customized to fit your classroom and the readiness of your students.

SeaWorld strives to provide teachers with up-to-date information and activities that motivate students to appreciate and conserve wildlife, the oceans, and the natural world.

Do you have comments or suggestions regarding the activities in this Teacher's Guide? We'd love to hear your opinion. Write the SeaWorld San Diego Education Department, email us at *SWC.Education@seaworld.com* or call 1-800-380-3202.

Goal of the Splash of Math Unit

Students will build skills toward becoming mathematical problem solvers.

Objectives

After completing the SeaWorld Splash of Math unit, students will be able to…

1. Demonstrate logic skills by classifying animals according to their attributes.
2. Explore measurements and relationships.
3. Demonstrate basic computational skills.
4. Gather, organize, analyze, and interpret data.
5. Make predictions based on data.
6. Communicate about quantities, measurements, data, logical relationships, and methods for solving problems.
7. Describe how mathematical learning tools help solve real-life problems.
8. Share their learning experience with family and friends.

Vocabulary

attribute — an inherent characteristic that can be used to describe something in terms of physical traits such as size, shape, and color.

blow — the visible exhalation of a whale.

blubber — a layer of fat cells and fibrous connective tissue between the skin and the muscle of most marine mammals.

brackish — describing water that is part salty and part fresh.

data — factual information that can be used as a basis for calculations, reasoning, or decisions.

decimal system — a measurement system in which the basic units increase by powers of ten.

English system — a system of weights and measures, used in the United States, that uses feet, pounds, and gallons.

field guide — a manual for identifying plants or animals in the wild.

gram — in the metric system, the basic unit of mass (weight).

herbivorous — plant-eating.

liter — in the metric system, the basic unit of capacity.

mammal — a member of the class Mammalia; a vertebrate animal that is warm-blooded, has hair, breathes air, bears live young, and has milk-producing glands in the female.

metric system — a system of weights and measures, used throughout most of the world, that uses meters, grams, and liters.

meter — in the metric system, the basic unit of length.

pinniped — a member of the scientific suborder Pinnipedia; a mammal that has all four limbs modified as flippers for an aquatic existence. Pinnipeds include seals, sea lions, and walruses.

vertebrate — an animal with a spinal column of bone or cartilage and a brain enclosed in a skull. Fishes, amphibians, reptiles, birds, and mammals are vertebrates.

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A Splash of Math

Math is a part of our world.

We encounter and use math every day. When we buy groceries, check the mileage on our car, or cook using a recipe, we are using math. When we lay brick for a patio, we use math. When we rearrange the furniture in our house, we use math. In fact, when faced with a problem, we often use math to help us approach and solve the problem.

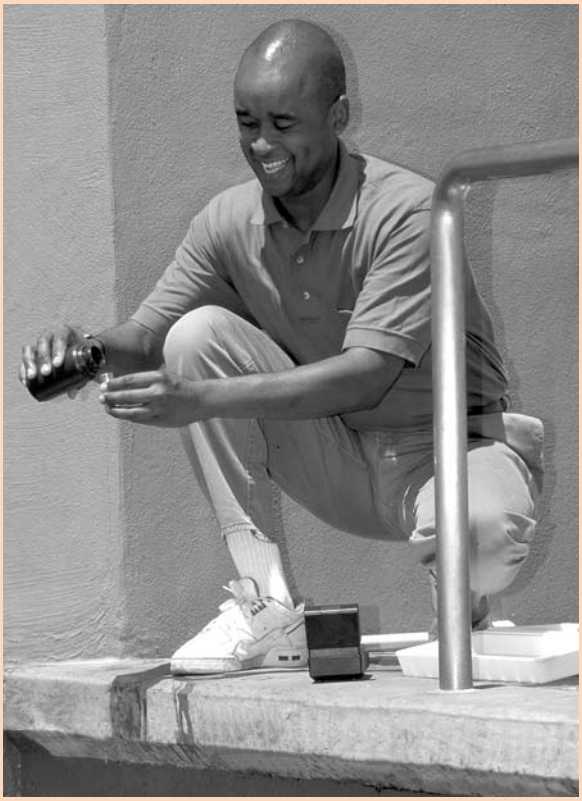
We use math at SeaWorld.

A laboratory technologist analyzing whale blood uses math to help estimate red blood cell count. A business analyst uses math to forecast daily attendance for next year. A food service manager uses math to determine food prices. An animal care specialist uses math to chart a dolphin calf's growth. A water quality expert uses math to determine the amount of chlorine to add to the water in Shamu Stadium. An education department receptionist uses math to schedule school groups for field trips. Exhibit designers use math to help them design and build a new whale pool.

Math is simply of part of our daily work. A clear understanding of math concepts and experience using math skills are important for almost every job at SeaWorld.

Students must become mathematical problem-solvers.

The idea that math is for people with special talents is a myth, as is the idea that some people "can't do math." In our society, everyone needs a useful knowledge of mathematics. A working knowledge of math prepares us not only for science and technical careers, but for a lifetime of analytical problem-solving.



"I remember thinking, 'I'll never use this stuff.' Boy, was I wrong! Calculators help, but you have to understand what you want to know and which numbers to use to find the answer."

Michael Tucker, Manager of Water Quality at SeaWorld San Diego, uses math to do his job every day.

Students must be able to solve problems on a daily basis and to apply mathematics to the real world.

Math skills help us solve routine problems readily. They also help us find ways to reach a solution when no routine path is obvious. Math skills help us to communicate logically and precisely about relationships, quantities, processes, and cause and effect. Math skills also help us gather information, analyze evidence, and make connections among ideas and between mathematics and other disciplines.

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Measurement Systems

Metric System

unit (abbreviation)	*equal to...*
LENGTH	
meter (m)	(basic unit of length)
kilometer (km)	1,000 meters
centimeter (cm)	0.01 meter
millimeter (mm)	0.001 meter
MASS (WEIGHT)	
gram (g)	(basic unit of weight)
kilogram (kg)	1,000 grams
milligram (mg)	0.001 gram
VOLUME	
liter (l)	(basic unit of volume)
milliliter (ml)	0.001 liter

We use the English system.

Most people in the United States are most familiar with the *English system* of weights and measures. We most often use units of pounds and ounces, gallons and quarts, and feet and inches.

Others use the metric system.

Throughout the rest of the world and for scientists everywhere, the *metric system* is most widely used. The metric system is based on units of kilograms and grams, liters and milliliters, and meters and millimeters. The metric system is called a decimal system because the basic units increase by powers of ten.

Because the metric system is used by scientists and because a decimal system is simplest for young students, we have used the metric system in this Teacher's Guide. The table at left shows the most commonly used metric measures, abbreviations, and relationships.

Scientists and medical practitioners use the metric system. Here a SeaWorld medical technologist fills vitamin cups for SeaWorld animals. Each animal is prescribed a specific amount of vitamins and minerals based on the animal's weight. Doses are measured in milligrams.

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Sea Animal Survey

OBJECTIVES

Students gather, organize, display, interpret, and analyze data.

Is a shark the class favorite?

MATERIALS

- ❑ ***Ocean Animals*** cards (pull-out pages)
- ❑ copies of ***Sea Animal Survey*** funsheet (page 7) or paper
- ❑ pencils
- ❑ chalkboard and chalk (or other large writing surface and markers)

For grades 2–3:

- ❑ ***Sea Animal Survey*** graphs, page 8 (Enlarge 130% and photocopy on transparency.)
- ❑ overhead projector

BACKGROUND

To learn about a population, we can survey everyone in the population. Alternatively, we can survey a subgroup of the population and make inferences about the population based on what we learn from the subgroup. In this activity, students survey classmates.

You can turn this into a family-participation activity by having students take the ***Sea Animal Survey*** *funsheet home. They survey their families and/or neighbors, and bring the resulting data back to class to work with, beginning action step #4 at school. Then, students can work with their own data, or they can combine the data they've gathered.*

ACTION

1. Distribute copies of the ***Sea Animal Survey*** funsheet on page 7. Or, if your students can read, you may wish to make a more extensive list on the chalkboard of all the animals on the center insert pages.
2. Using the ***Ocean Animals*** information cards, talk about some of the different kinds of animals that live in the ocean. Which of the animals have students seen before? Ask students to choose their favorite animal from the list.
3. Working individually, in groups, or as a class, students gather data on each student's favorite animals. Students can survey their classmates and mark on their funsheets, or each student can make a tick mark on the chalkboard next to his or her favorite animal. *(Alternatively, have students take home their funsheets and survey their families and/or neighbors.)*
4. How many students chose a sea lion as their favorite? How many chose a killer whale? How many chose a sea turtle? Which animal seems to be the most favorite? Is it possible that this animal is not really the favorite ocean

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animal? *(Do some people have favorite ocean animals that are not on the funsheet or represented in the cards?)* Ask students if they think this data is representative of everyone in their school or neighborhood. Why or why not? Do they think it is representative of everyone in the United States? Of everyone in the world?

5. Ask students to work in groups to create graphs that show how many students picked each animal. Ask a representative from each group to explain to their classmates how they made their graph.
6. *(For grades 2-3)* Re-create on the classroom chalkboard the data from a cooperative learning group in Ms. Potter's second-grade class:

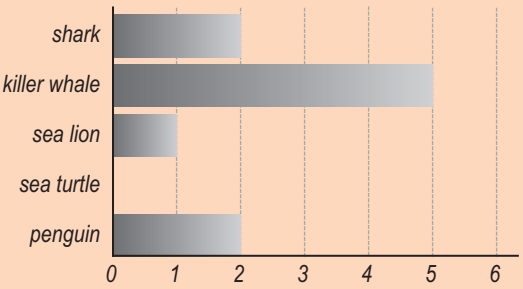
ocean animal	number of students who chose it as their favorite
shark	2
killer whale	5
sea lion	1
sea turtle	0
penguin	2

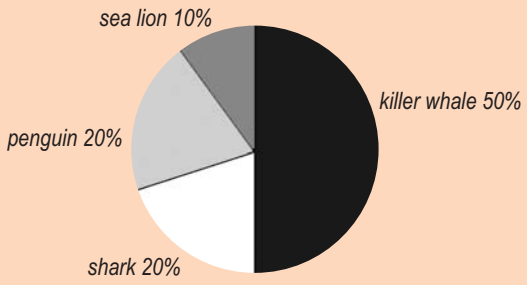
Ask students to create two kinds of graphs with this data. *(Students should be able to create a bar graph and pie graph. To prompt students to create a pie graph, try drawing a circle on the board and dividing it into tenths.)*

7. *(For grades 2-3, show transparencies of or re-create **Sea Animal Survey** graphs A, B, and C on the top of page 8.)* The General Curator at SeaWorld is responsible for the health and well-being of all the animals in the park. If you were the General Curator, which of the following graphs would help you decide what kinds of animals to display in the park? What can you learn from the other two graphs and how could you use that information?
8. *(For grades 2-3, show transparencies of or re-create **Sea Animal Survey** graphs D, E, and F on the top of page 8.)* The Director of Operations at SeaWorld schedules all the shows. If you were the Director of Operations, which graph would help you decide how many Shamu shows to schedule for Saturday? What can you learn from the other two graphs and how could you use that information?

ANSWERS

5. Students should be able to make various kinds of bar graphs from their data.
6. Students should be able to create a bar graph and a pie graph using the data from Ms. Potter's class. Here are two examples:





7. Graph B would help the General Curator decide what animals to display at SeaWorld.
8. Graph F would help the Director of Operations to schedule the Shamu shows.

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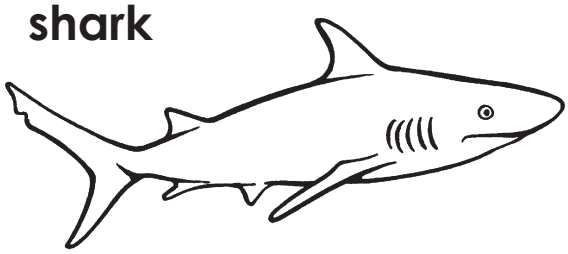
Name _____

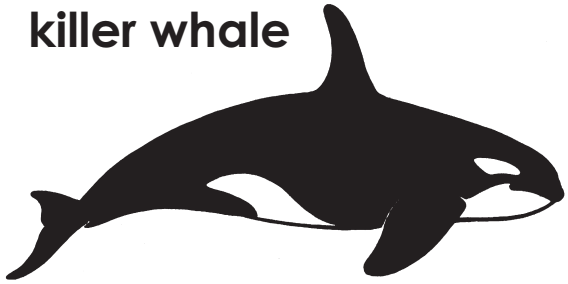
Sea Animal Survey

Which ocean animals are favorites? Survey your classmates. Ask each person which of the animals below he or she likes best. Put a checkmark next to that animal. Continue until you have asked everyone in your class.

shark

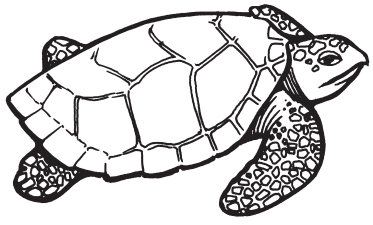


killer whale



sea lion

sea turtle



penguin

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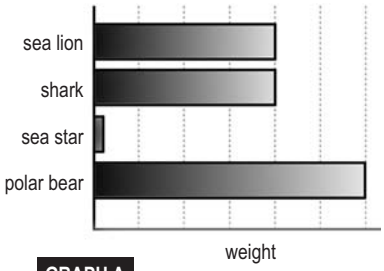
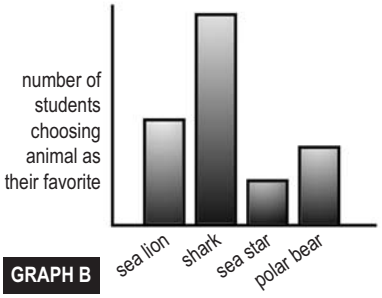
Sea Animal Survey Graphs (Photocopy on transparency at 130%.)

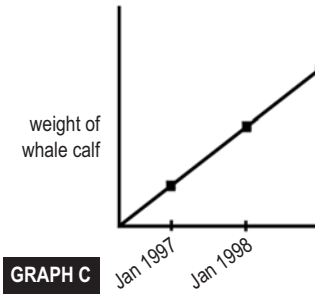
Which graph would help you decide what kinds of animals to display at SeaWorld?



GRAPH A

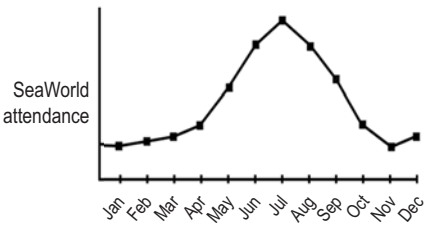


GRAPH B

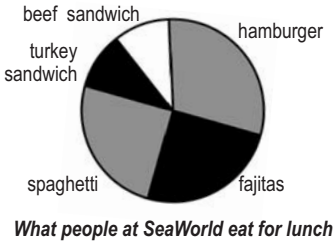


GRAPH C

Which graph would help you decide how many Shamu shows to schedule for Saturday?

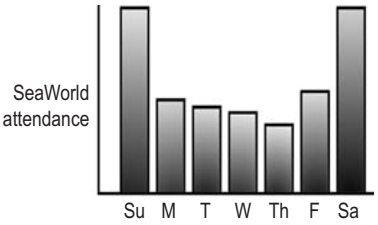


GRAPH D



What people at SeaWorld eat for lunch

GRAPH E



GRAPH F

Sort It Out

OBJECTIVES

Students develop logic skills by investigating various ways to sort by attribute. At the same time, they are exposed to the principles of scientific classification.

MATERIALS

- ❑ students' own shoes
- ❑ copies of ***Sort It Out*** animal sorting cards on page 10 (one set per cooperative learning group)
- ❑ large sheets of paper (one per group)

BACKGROUND

About 1.4 million species of plants and animals have been identified by scientists. More than 2,000 years ago the Greek philosopher Aristotle devised the first classification system with two kingdoms (plants and animals). In the eighteenth century, the Swedish botanist Carolus Linnaeus created a classification system based on similarities and differences among organisms that separate them into categories. Each category includes organisms that share similar characteristics. For instance, all vertebrate animals belong in one of these groups: mammals, birds, reptiles, amphibians, or fishes.

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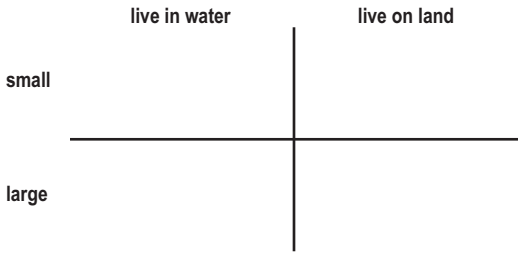
ACTION

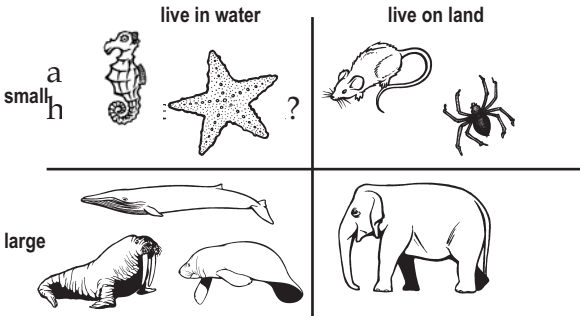
(Note: This exercise works best in cooperative learning groups.)

1. First, ask students to remove one shoe each. Within their groups, students sort their shoes into two groups, based on any characteristic they choose. (For example, they may choose one group of shoes with laces and one group without laces. A different way to sort would be tennis shoes and other shoes. Yet another way to sort would be brown shoes and shoes of other colors.)
2. When they are done, have a representative from each group share with the rest of the class how his or her group sorted their shoes. Once all groups have had a chance to share, discuss whether there may be other ways the shoes could have been sorted. Students put shoes on again.
3. Next, distribute a piece of large-size paper to each group. Have one student from each group draw a vertical line down the middle of the paper from top to bottom.
4. Distribute a set of animal sorting cards to each learning group.
5. Ask students to sort again. This time they will sort the animals into two groups. They choose a characteristic that differentiates the animals into two groups. (For example, they may choose animals that have fur and animals that don't have fur. Another way to sort would be animals bigger than a first-grader or animals smaller than a first-grader.)
6. A representative from each student group shares the way his or her group sorted the animals with the rest of the class. Once all groups have had a chance to share, discuss whether there may be other ways the animals could have been sorted.
7. *(For grades 2-3)* Using the same large sheet of paper, students draw another line in the middle of the paper (perpendicular to the first) across the page, dividing the paper into four quadrants. Sketch and illustrate the diagram below onto the chalkboard and ask students to label their papers the same way:



8. Ask students to sort animals again. This time the animals should fit into the correct category both top or bottom and left or right. Each animal should fall into the quadrant that best describes it.
9. Ask representatives from each group to explain how their group sorted the animals. Are there other ways the

EXAMPLE OF SORTING MATRIX FOR #8



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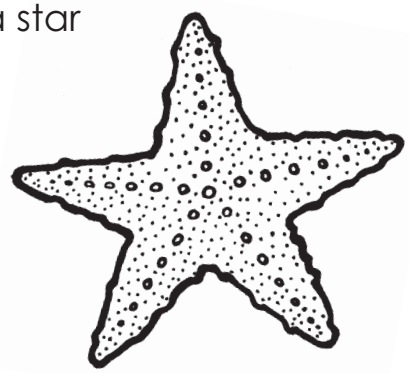
Sort It Out

Animal Sorting Cards

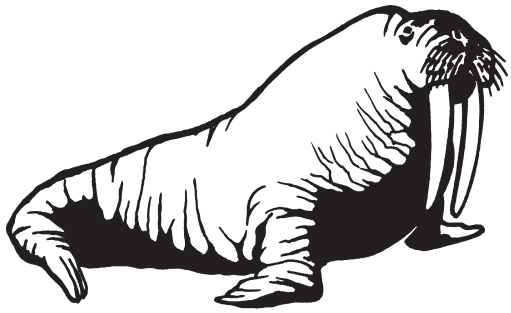
sea star



mouse

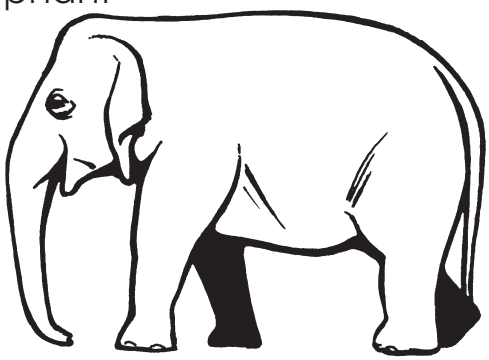
blue whale

walrus

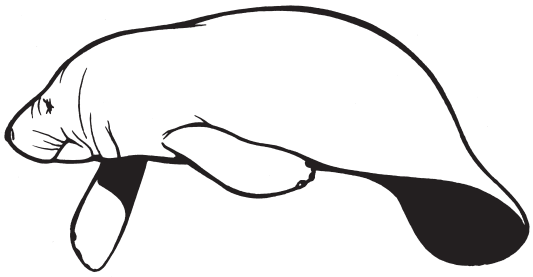


spider

elephant



manatee



seahorse

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Whale Watching Logic

OBJECTIVES

Students develop logic skills by classifying animals by attributes. They practice using logical arguments to reach a conclusion and explain their thinking in their own words.

MATERIALS

- ❑ examples of published field guides with color photos (optional)
- ❑ ***Field Guide*** on insert page in the center of this Guide. (Photocopy at 200% to fit 11-× 17-in. paper.)

BACKGROUND

Many animals share the same habitat. Scientists and wildlife watchers use books called *field guides* to help them identify animals in a particular area. A field guide lists animals found in the area, then describes the animals in terms of their characteristics. Wildlife watchers can look for identifying characteristics to be able to identify an animal.

ACTION

1. Discuss how scientists and wildlife watchers use field guides to help them identify animals. *(Optional: show various field guides.)*
2. Introduce the identifying characteristics of each animal as described in the short ***Field Guide*** included in this Guide (pull-out pages). If your students can read, use the chalkboard to jot down notes under each animal's name. For non-readers, review the animal information including colors.
3. Ask students to pretend they are out at sea on a whale-watching boat. Ask them to use their field guides to try to identify the animals they "see."
4. Read the ***Whale Watching*** scenario on page 12 to your students. Pause after each bullet point to help students reach conclusions.

Both harbor seals *(Phoca vitulina, top)* and common dolphins *(Delphinus* spp., *bottom)* live in the ocean and surface to breathe air.

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Whale Watching

- You are out on a boat to observe wildlife. You are hoping to see a blue whale—the largest animal in the world. Your trip naturalist tells you that you may see other animals, too. You have a field guide that describes the animals living in the area.
- You see a head pop up and an animal take a breath of air. What might it be? *(Sea turtles, sea lions, harbor seals, dolphins, brown pelicans, and blue whales all breathe air.)* What do you know it isn't? *(Sharks don't breathe air.)*
- The head pops up for another breath of air, and this time you notice that the animal is a grayish color. What might it be? *(Harbor seals and common dolphins are both air-breathing animals that can be gray.)* What do you know it isn't? *(Sharks don't breathe air. Sea turtles, sea lions, brown pelicans, and blue whales aren't gray.)*
- The third time the animal lifts its head for a breath it dives down into the water and you spot tail flukes propelling it through the water. What do you think this animal is? *(Common dolphins have tail flukes.)*
- You see another head pop up, and this animal also takes a breath of air. What might it be? *(Sea turtles, sea lions, harbor seals, dolphins, brown pelicans, and blue whales all breathe air.)* What do you know it isn't? *(Sharks don't breathe air.)*
- You notice that this animal has a shell. What might it be? *(Sea turtles have shells.)* What do you know it isn't? *(Sharks, sea lions, harbor seals, common dolphins, brown pelicans, and blue whales don't have shells.)*
- Gazing at the ocean's surface, you see an animal that is gray. What might it be? *(Smoothhound sharks, harbor seals, and common dolphins can be gray.)* What do you know it isn't? *(Olive ridley sea turtles, sea lions, brown pelicans, and blue whales aren't gray.)*
- You notice that the animal doesn't seem to be breathing air, but it is swimming with fins just below the surface of the water. What might it be? *(Sharks don't breathe air. Sharks swim with fins.)* What do you know it isn't? *(Sea turtles, sea lions, harbor seals, dolphins, brown pelicans, and blue whales all breathe air.)*
- You see a brown animal resting on the surface of the water. What might it be? *(California sea lions, harbor seals, and brown pelicans can be brown.)* What do you know it isn't? *(Gray smoothhound sharks, olive ridley sea turtles, common dolphins, and blue whales aren't brown.)*
- Suddenly the animal flies away. What do you think the animal is? *(Brown pelicans can fly.)*
- Just off the boat a blow indicates that a huge animal has taken a breath. What might the animal be? *(Sea turtles, sea lions, harbor seals, dolphins, brown pelicans, and blue whales all breathe air. The breath of a common dolphin or a blue whale can look like a "blow.")*
- As you watch, the animal takes another breath, and you see that the "blow" is much, much taller than you are, and the animal is longer than your whale-watching boat. What do you think it is? *(Blue whales can be as long as 26 meters and can have a "blow" as high as 9 meters.)*

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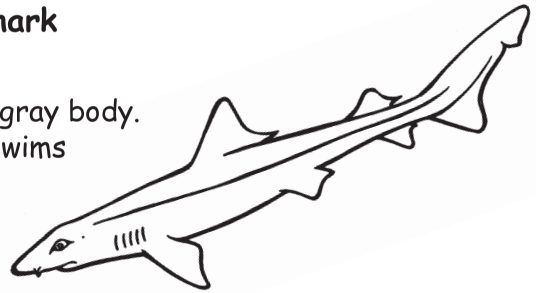
FIELD GUIDE

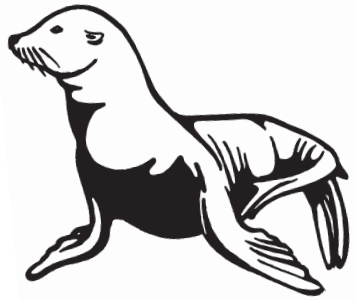
gray smoothhound shark
Mustelus californicus

A shark with a slender gray body. It stays in the water, swims with fins and breathes water—not air.



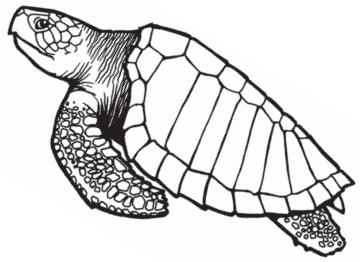
California sea lion
Zalophus californianus

A brown, furry animal that swims in the ocean and walks on land. It breathes air and has small ear flaps —one on each side of its head.



olive ridley sea turtle
Lepidochelys olivacea

A yellow-green ocean turtle with flippers for swimming and a protective shell. It breathes air.



brown pelican
Pelecanus occidentalis

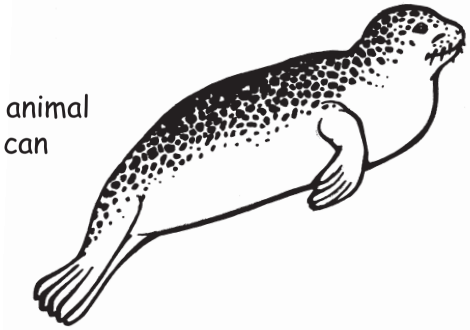
A large brown bird that swims through the air. A large pouch under the beak expands to catch fish.

common dolphin
Delphinus spp.

A gray and beige dolphin that swims in the ocean and breathes air. A common dolphin's exhale can look like a "blow" in the air. It has flippers, a dorsal fin, and tail flukes.

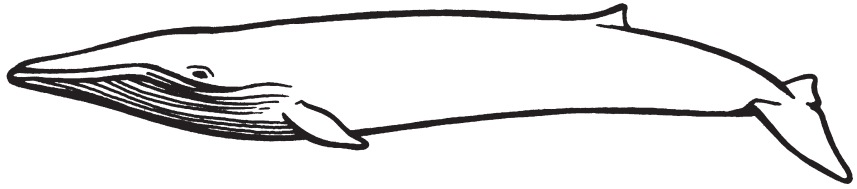
harbor seal
Phoca vitulina

A grayish or brownish furry animal that swims in the ocean and can come on land. Harbor seals have tiny holes that lead to their ears—no ear flaps.



blue whale
Balaenoptera musculus

The largest animal in the world—a whale that can be as long as 26 meters. It creates a "blow" of air and water as high as 9 meters when it breathes. It swims in the water with flippers and and immense tail flukes. It breathes air.



Ocean Animals Math Cards

When we describe ocean animals we often use numbers. Numbers describe how big an animal is, how fast it swims, or how much it eats. These cards use numbers to describe several ocean animals.

So that the numbers are practical for K–3 students to use, cards depict individual animals and are not necessarily representative of the species. *(For most of these species there is a wide range of information regarding size, food intake, etc.)* Some of the activities in this Teacher's Guide use the information in these cards. You may also wish to use these cards in other ways. For example—

- Use this information to help you prepare lessons and lead discussions in class.
- Encourage students to use the information in these cards to develop their own story problems to share with classmates.

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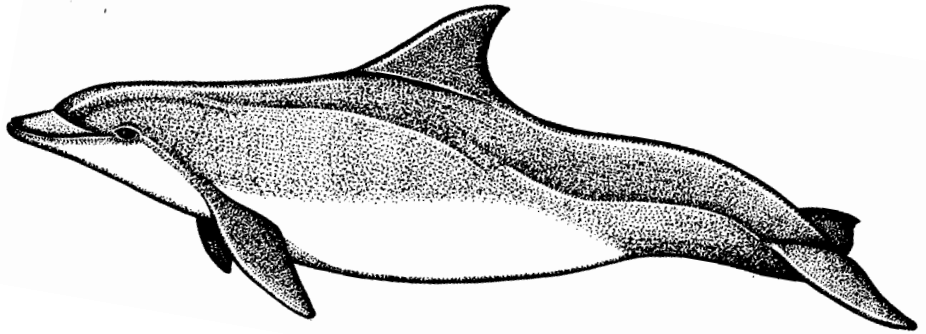
male bottlenose dolphin

Tursiops truncatus



adult size: 3 meters and 400 kilograms

food intake: about 20 kilograms per day

population: unknown, not endangered

speed: usually 5 to 11 kilometers per hour, but as fast as 35 kilometers per hour

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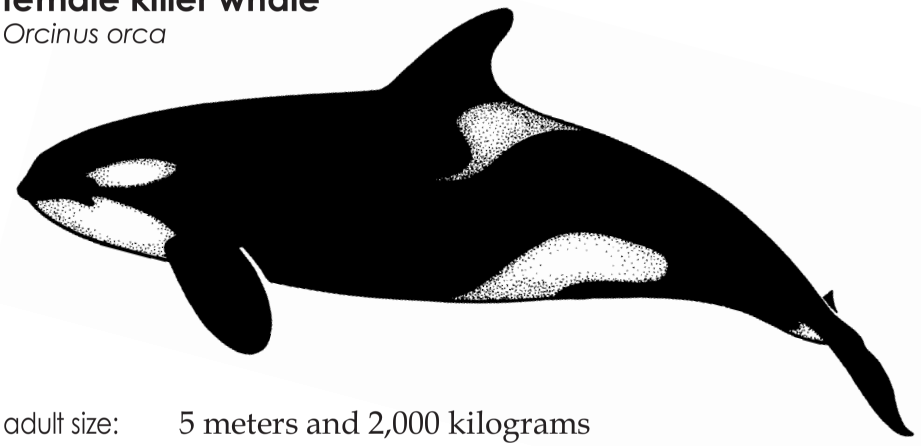
female killer whale

Orcinus orca



adult size: 5 meters and 2,000 kilograms

food intake: about 70 kilograms per day

population: unknown, not endangered

speed: usually 3 to 10 kilometers per hour, but as fast as 48 kilometers per hour

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male blue whale

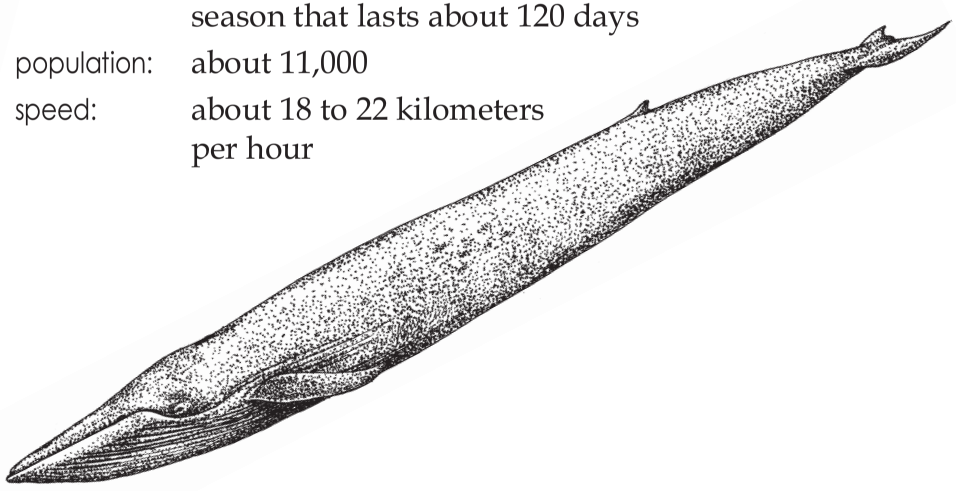
Balaenoptera musculus

adult size: 21 meters and 64,000 kilograms

food intake: about 2,500 kilograms per day during a feeding season that lasts about 120 days

population: about 11,000

speed: about 18 to 22 kilometers per hour



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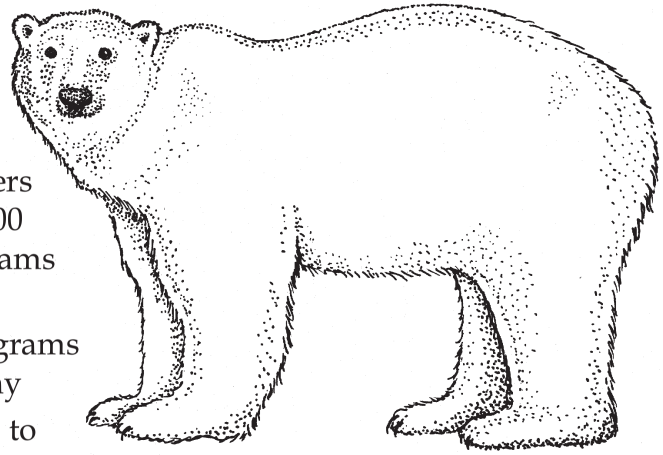
female polar bear

Ursus maritimus



adult size: 2 meters and 200 kilograms

food intake: about 7 kilograms per day

population: 21,000 to 28,000

speed: can swim as fast as 10 kilometers per hour, but usually swims slower

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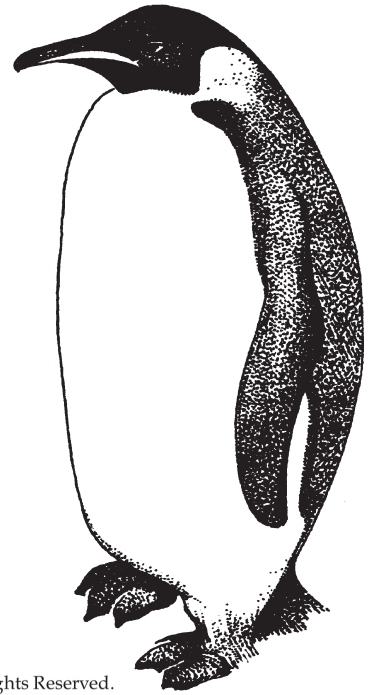
male emperor penguin

Aptenodytes forsteri



adult size: 1 meter and 30 kilograms

food intake: about 1 kilogram per day

population: about 436,200 mature adults

speed: usually swims at speeds of about 10 kilometers per hour or slower

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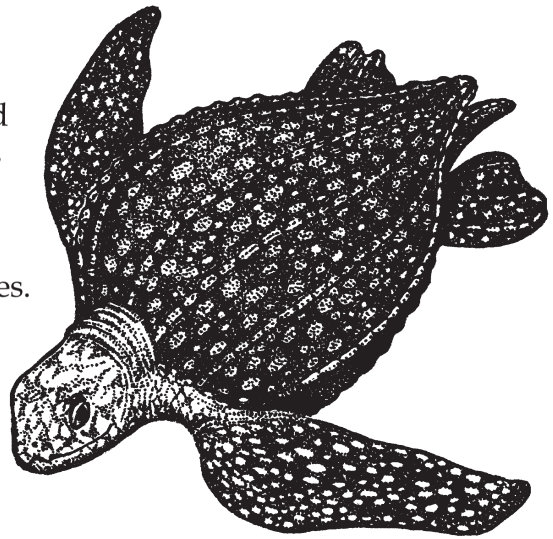
female leatherback sea turtle

Dermochelys coriacea



adult size: 1.6 meters and 450 kilograms

food intake: unknown

population: less than 115,000 females. (Only mature females can be counted, when they come ashore to lay eggs.)

speed: swims at about 1.5 to 9.3 kilometers per hour

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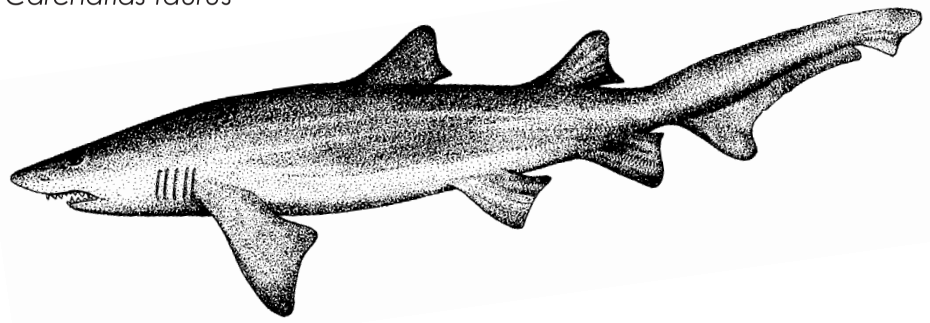
female sandtiger shark

Carcharias taurus



adult size: 3 meters and 140 kilograms

food intake: about 7 kilograms per week

population: unknown

speed: unknown

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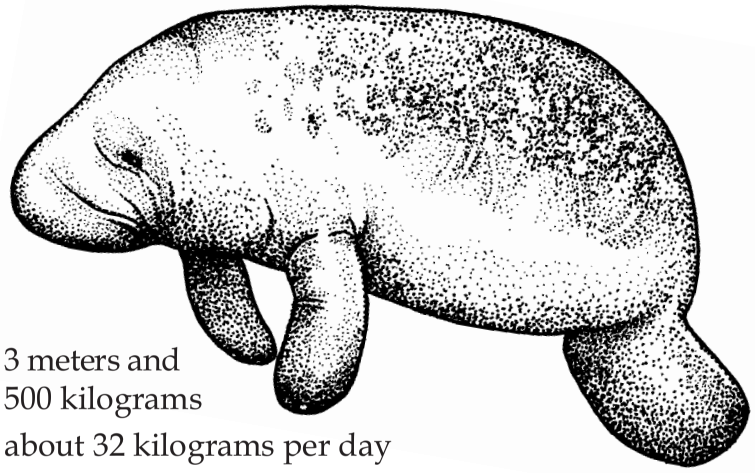
female Florida manatee

Trichechus manatus latirostris



adult size: 3 meters and 500 kilograms
food intake: about 32 kilograms per day
population: endangered, probably less than 3,000
speed: swims about 3 to 10 kilometers per hour, as fast as 24 kilometers per hour in short bursts

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male California sea lion

Zalophus californianus

adult size: 2 meters and 300 kilograms
food intake: about 19 kilograms per day
population: about 200,000
speed: swims as fast as 19 kilometers per hour, usually slower

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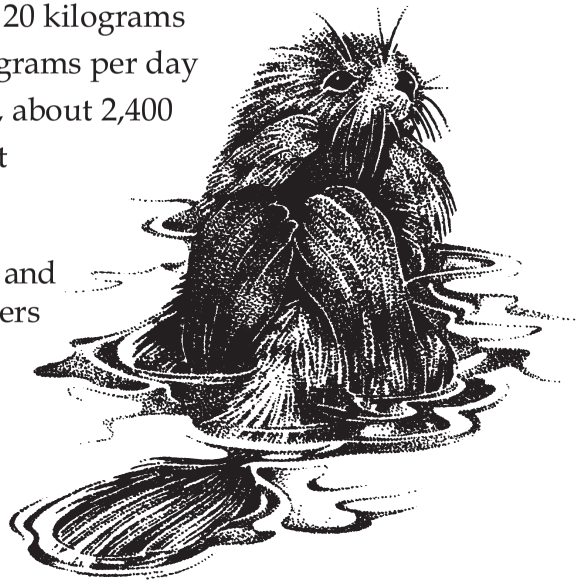
female California sea otter

Enhydra lutris nereis

adult size: 1 meter and 20 kilograms
food intake: about 5 kilograms per day
population: endangered, about 2,400
speed: swims about 9 kilometers per hour under water and 12.5 kilometers per hour at the surface



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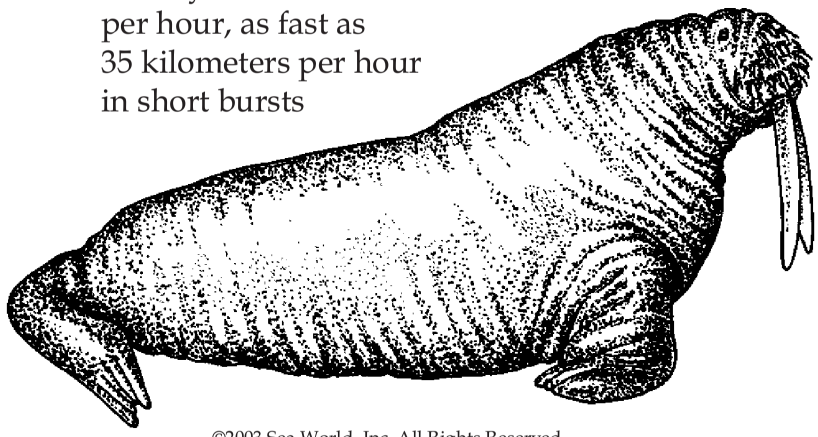
female Pacific walrus

Odobenus rosmarus divergens

adult size: 3 meters and 1,000 kilograms
food intake: about 50 kilograms per day
population: about 200,000
speed: usually swims about 7 kilometers per hour, as fast as 35 kilometers per hour in short bursts



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Shamu Math

OBJECTIVES

Students demonstrate that numbers can be used to describe various quantities and relationships between quantities.

Students gain experience adding, subtracting, multiplying, and dividing —building their understanding of how numbers are put together and taken apart.

Students connect what they know to symbolic representation using number sentences.

MATERIALS

- ❑ copies of ***Shamu Math*** funsheet, page 15 (one per cooperative learning group)
- ❑ pencils and paper

It's showtime! SeaWorld animal trainers send whales into the main pool to start the show.

BACKGROUND

The Animal Welfare Act establishes habitat requirements for all oceanariums including SeaWorld. SeaWorld's killer whale facility exceeds these required guidelines. One of the largest zoological killer whale habitats in the world, the Shamu Stadium complex at SeaWorld San Diego holds about 26.5 million liters of continuously filtered sea water. It includes the four pools shown in the diagrams on the Shamu Math funsheet, plus a fifth breeding and research pool. Gates between the pools can be opened or closed.

There are ten killer whales at SeaWorld San Diego: Corky, Orkid, Kasatka, Ulises, Takara, Splash, Nakai, Keet, Sumar, and Kohana. Each day, animal trainers feed the whales about 580 kg of fish and squid.

ANSWERS TO PAGE 14

Exercise #1

Number sentences:

0 + 6 = 6	1 + 5 = 6	2 + 4 = 6
3 + 3 = 6	4 + 2 = 6	5 + 1 = 6
6 + 0 = 6		

Exercise #2

Two killer whales go into the main show pool: 6 - 2 = 4 left in holding pools

One more killer whale swims into the show pool: 2 + 1 = 3 now in the show pool

The number of killer whales left in the holding pools: 4 - 1 = 3

Exercise #3

If the same number of people are sitting in each row, 22 ÷ 2 = 11 people in each row

Orkid splashes 6 × 11 = 66 wet people

Ulises splashes 9 × 11 = 99 wet people

Exercise #4

Six buckets of fish per show, three shows per day: 6 × 3 = 18 buckets of fish

In kilograms, 18 × 14 = 252 kg during shows

Food eaten while not doing shows:
580 kg - 252 kg = 328 kg

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ACTION

1. Distribute ***Shamu Math*** funsheets.
2. Read the exercises below to students. Work through the problems either as a class or in cooperative learning groups. Students use the funsheet to do Exercise 1.
3. After each exercise, ask student volunteers to explain to the class how they worked out an answer.

Shamu Math exercises

Exercise #1

About a half-hour before the Shamu show is about to start, trainers move Nakai, Keet, Sumar, and Kohana to the research and breeding pool and all the other whales to holding pools A and B, then close the gates. How many different ways can the trainers place the six whales in pools A and B? Use X's to represent killer whales, and mark the whale pool diagrams to show all the various possibilities of where the six whales might go.

How can you communicate how many killer whales are in each pool using numbers and symbols? *(Show students how they can write number sentences that describe how many whales are in each pool.)*

Exercise #2

To start the show, Orkid and Ulises go into the main show pool to do bows. Now how many killer whales are left in the holding pools?

Next, Takara swims into the show pool to splash the audience. Now how many killer whales are in the show pool? In the holding pools?

Can students create a number sentence to show each of these situations?

Exercise #3

During the Shamu show, Orkid splashed six rows, Takara splashed two rows, and Ulises splashed nine rows. If the same number of people are sitting in each row, which whale got the most people wet?

(For grades 2-3) Takara got 22 people wet.

- If the same number of people are sitting in each row, how many people does one row hold?
- How many people did Orkid get wet? How many people did Ulises get wet?
- Can students create number sentences for each situation?

Exercise #4 *(For grades 2-3)*

The whales are fed throughout the day, including during shows. During the first show the trainers feed the whales six buckets of fish. Each bucket holds about 14 kilograms of fish. If there are two more shows today (a total of three shows), how many buckets of fish will the whales eat during all three shows? How many kilograms of fish is that?

Can students create a number sentence to communicate how many kilograms of fish the whales eat during three shows?

In one day the killer whales eat about 580 kilograms of fish. How much fish will they eat while they are not doing shows? Create a number sentence that shows how much fish the killer whales eat while they are not doing shows.

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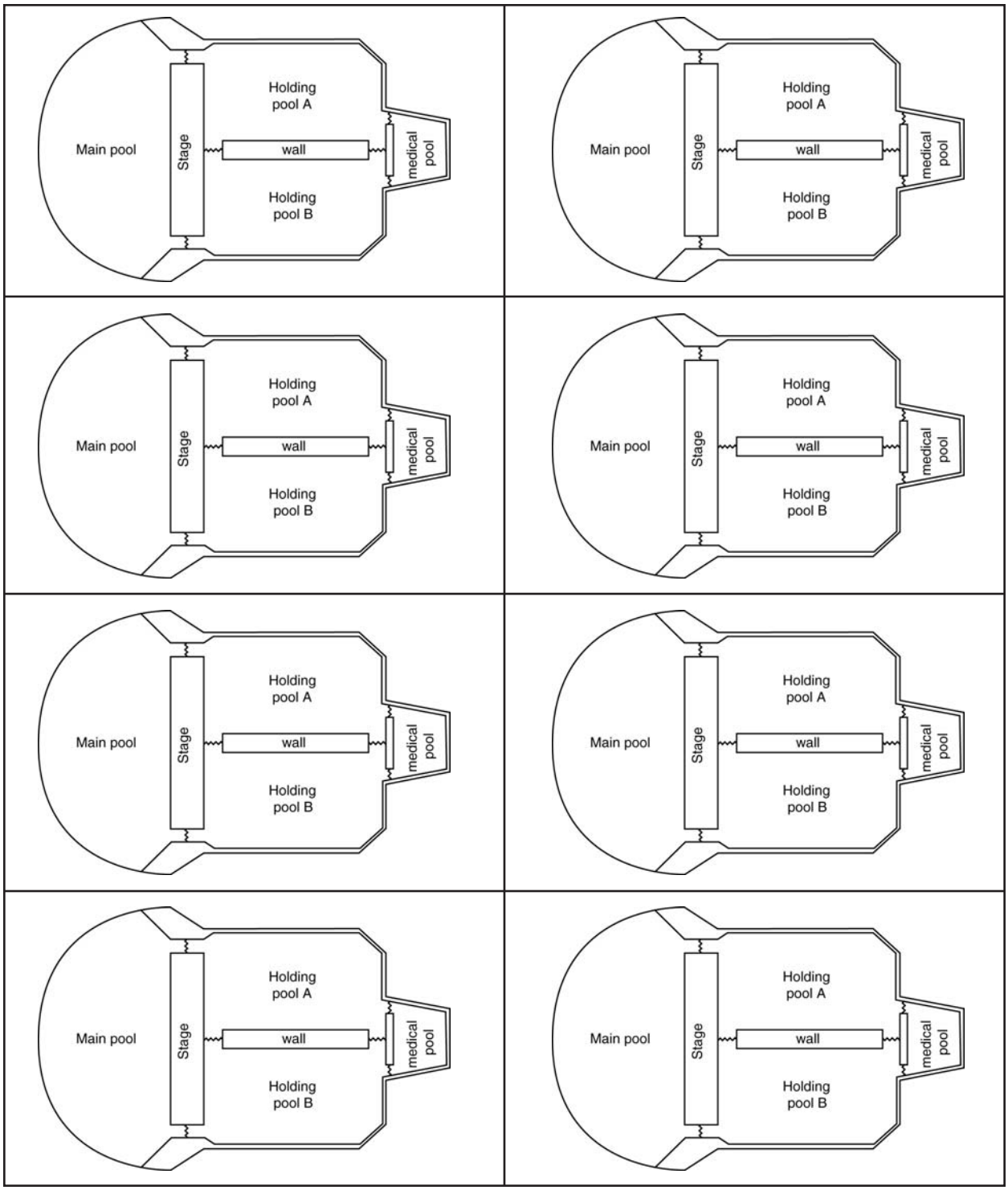
Name _____

Shamu Math

About a half-hour before the Shamu show starts, trainers move six killer whales to holding pools A and B. How many different ways can trainers place the whales? Use X's to represent killer whales and mark the whale pool diagrams to show all the possibilities of where six whales might go.



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Manatee Feeding Time

OBJECTIVES

Students explore how numbers are put together and taken apart. They experiment with division, connecting what they know to symbolic representations.

In the wild, manatees eat a variety of aquatic and shoreline plants. At SeaWorld *(above)*, manatees eat lots of romaine lettuce and other healthy vegetables.

MATERIALS

- ❑ copies of ***Manatee Feeding Time*** cut-outs, page 17 (one per student)
- ❑ scissors
- ❑ tape or glue
- ❑ pencils and paper

BACKGROUND

Manatees are large, herbivorous marine mammals that live in fresh water, sea water, and brackish water. In the wild, they eat a wide variety of aquatic and shoreline plants.

The manatees at SeaWorld eat romaine, greenleaf, and iceberg lettuce; spinach; and cabbage. The immense mammals devour nearly 227 kg of greens every day. For special treats, they nibble grapes, carrots, apples, and sweet potatoes.

ACTION

1. Discuss manatees and what they eat. In this exercise, students will pretend they are animal care specialists at SeaWorld who are responsible for caring for and feeding the manatees.
2. Distribute ***Manatee Feeding Time*** cut-outs page. Explain to pre-readers that their job is to distribute the food to the manatees. They must decide how much of each kind of food each manatee gets for this feeding. Each manatee eats the same amount of food: romaine lettuce, cabbage, carrots, and grapes.
3. Students use scissors to cut apart food items and tape or glue them to the bottom of the manatee drawings.
4. When finished, discuss the exercise with students. Ask them to explain how they decided how many of each food item to give each manatee.
5. *(For grades 2-3)* Students write number sentences that describe how they divided the food.

ANSWERS

Students should suggest the following number sentences:

45 ÷ 5 = 9	(romaine lettuce)
15 ÷ 5 = 3	(cabbage)
10 ÷ 5 = 2	(grapes)
5 ÷ 5 = 1	(carrots)

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Manatee Feeding Time cutouts

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Field Trip Fun

OBJECTIVES

Students develop their understanding of quantities and their relationships. They experiment with strategies that help them be efficient rather than counting by ones.

Students gather, organize, and analyze data of a representative sample and explore probability by making predictions based on their data.

MATERIALS

- ❑ one candy bar (optional)
- ❑ juice boxes—one per student (optional)
- ❑ individual-size boxes or bags of crackers or cookies—one per student
- ❑ ice chest or cardboard box (large enough to hold all or most of the juice boxes)
- ❑ pencils and paper

BACKGROUND

In this exercise, students help prepare for an imaginary field trip. (Or, use this exercise next time you have a class field trip planned.) Depending on the developmental level of your students, you can lead the class in problem solving, form cooperative learning groups to complete the exercises, or ask students to complete exercises independently. Ask students or cooperative learning groups to report back to the class on how they came up with their answers to each question.

ACTION

A student counts the number of crackers in a bag.

1. Tell students you are going to pretend that your class is going on a whale-watching field trip. Before you go, you need to raise money to pay for the field trip. You also need to pack snacks and drinks for the class.
2. Read the exercises on pages 19–20 aloud to your students. Do the exercises with your students, either as a class or in cooperative learning groups.
3. After each exercise, ask a representative from each group to share with the rest of the class how they worked out an answer.

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Field Trip Fun exercises

Exercise #1

To raise money for the trip, we'll sell candy bars. *(SHOW CANDY BAR.)* For each candy bar we sell, we earn $1. The whale-watching boat costs $3 per student. How many candy bars does our class need to sell?

(FOR GRADES 2-3) The bus to go to the whale-watching boat costs $200. How many candy bars does the class have to sell to be able to hire the bus? How many candy bars per person is that?

Exercise #2

We'll brings snacks and drinks on our field trip. How many juice boxes do we need to bring so that everyone has one?

Can you organize the juice boxes in some way so that your friends can tell how many juice boxes there are without counting by ones?

PLACE ONE LEVEL OF JUICE BOXES IN THE ICE CHEST, COUNTING THEM WITH STUDENTS. WHEN THE FIRST LAYER IS IN THE ICE CHEST, ASK –

Can you estimate how many juice boxes the ice chest will hold when full? Do we need a bigger ice chest or a smaller ice chest to bring drinks for the class?

(FOR GRADES 2-3, USE THE JUICE BOXES AS MANIPULATIVES.) Sketch various shapes of ice chests that would hold the right number of juice boxes for our class. Use number sentences to communicate how many juice boxes are in the ice chest.

Exercise #3

DISTRIBUTE INDIVIDUAL-SIZE BAGS OF CRACKERS TO STUDENTS. We'll also bring bring bags of crackers for a snack. *SELECT A STUDENT TO OPEN A BAG AND COUNT THE NUMBER OF CRACKERS INSIDE. ASK THE OTHER STUDENTS –* Predict how many crackers are inside your own bag. *WRITE THEIR PREDICTIONS ON THE BOARD.*

SELECT ANOTHER STUDENT TO OPEN A BAG AND COUNT THE CRACKERS INSIDE. Is this number greater than, less than, or the same as the first student's number of crackers? Does anyone want to change their prediction? *(IF SO, MAKE CHANGES TO THE NUMBERS YOU HAVE RECORDED ON THE BOARD.)*

REPEAT WITH A THIRD AND FOURTH STUDENT – EACH TIME ALLOWING STUDENTS TO REVISE THEIR PREDICTIONS. What is the range of actual numbers of crackers inside the four bags? What is the range of predictions?

FINALLY, ALL STUDENTS OPEN THEIR BAGS AND COUNT THE CRACKERS INSIDE. RECORD THE ACTUAL NUMBERS NEXT TO EACH STUDENT'S PREDICTION. How many predictions were higher than the actual number? How many were lower?

Were you able to predict better after four bags were open than after just one bag? Why?

(FOR GRADES 2-3, RECORD IN A FREQUENCY DIAGRAM HOW MANY CRACKERS WERE IN EACH BAG. FINALLY, SHOW STUDENTS ONE MORE BAG OF CRACKERS.) Based on what you know about the other bags of crackers, how many crackers do you think might be in this bag? What would some reasonable guesses be? What would some unreasonable guesses be? *OPEN THE BAG AND COUNT THE CRACKERS.* How well did you predict?

Exercise #4

WRITE THE FOLLOWING NUMBERS ON THE BOARD: 3, 30, ½, 200.

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Field Trip Fun exercises continued

ASK STUDENTS TO CONSIDER THE FOLLOWING:

- Which of these numbers might describe the number of seats on a school bus?
- Which might describe the number of hours we will spend driving to the whale-watching boat?
- Which might describe the number of hours we will be on the whale-watching boat?
- Which might describe the number of cars we will see on our drive to the whale-watching boat?

ANSWERS

Exercise #1

How many candy bars does the class need to sell?
3 X (number of students)

How many candy bars does the class have to sell to be able to hire the bus?
If the whale-watching boat costs $200, your class must sell 200 candy bars.

How many candy bars per person is that?
That's 200 ÷ (number of students) = ? candy bars per person.

Exercise #2

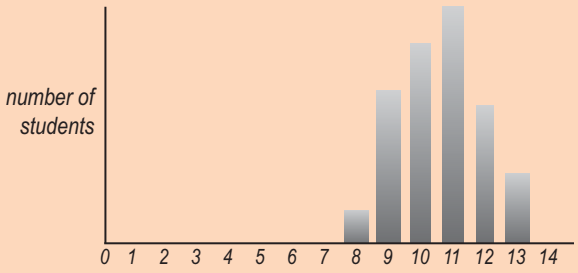
How many juice boxes do we need to bring?
1 X (number of students)

Can you organize the juice boxes in some way so that your friends can tell how many juice boxes there are without counting by ones?
Students may suggest you organize the juice boxes in stacks of two's, five's or ten's. For example, if you need to bring 20 juice boxes, students may design boxes that hold —
1 × 20 = 20, 2 × 10 = 20, 5 × 4 = 20

Exercise #3

Were the students able to predict better after four bags were open than after just one bag?
Students should be able to predict better with more data (more bags of crackers opened).

Record in a frequency diagram how many crackers were in each bag.
See example below. For this example , reasonable guesses would be 8, 9, 10, 11, 12, or 13 crackers. Unreasonable guesses would be any guess less than 8 or greater than 13.



sample frequency diagram
(Your data will be different.)

Exercise #4

Which of these numbers might describe the number of seats on a school bus?
30 seats on a school bus

Which of these numbers might describe the number of hours we will spend driving to the whale-watching boat?
½ hour driving to the boat

Which of these numbers might describe the number of hours we will be on the whale-watching boat?
3 hours on a whale-watching boat

Which of these numbers might describe the number of cars we will see on our drive to the whale-watching boat?
200 cars on the road

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Growing Whales

OBJECTIVES

Students explore measurement and relationships

BACKGROUND

Killer whale trainers periodically weigh and measure the whales to see how they are growing. Other animals at SeaWorld are weighed and measured, too.

MATERIALS

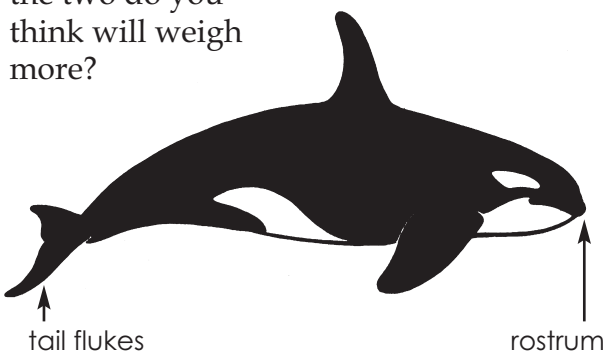
- ❑ balance scale
- ❑ manipulative cubes
- ❑ plush or plastic Shamu toy (or other ocean animal toy)
- ❑ measuring tapes (enough for students to use with partners)
- ❑ bathroom scales

ACTION

1. Do the following exercises with your students, either as a class or in cooperative learning groups.
2. After each problem, ask students to share with the class how they worked out an answer.

Exercise #1

Corky measures about 6 m from the tip of her rostrum (beak) to the tip of her tail. Takara measures about 4 m from the tip of her rostrum to the tip of her tail. Who is bigger? Next, the trainers are going to weigh the whales. Which of the two do you think will weigh more?



Exercise #2

Using manipulatives, help students balance a scale to investigate the weight of a plastic Shamu or other toy animal.

Exercise #3

Who do you think is bigger, a baby killer whale or you? What are some different ways we could we find out for sure?

What is bigger, SeaWorld or your school playground? What are some ways we could find out for sure?

Exercise #4

Students measure and weigh each other. Repeat this exercise in several months. Who has grown?

(For grades 2-3) Measurement in the U.S. is usually in feet or inches and in pounds, rather than meters and kilograms. Scientists, however, use the metric system. Help students convert their weight to kilograms. *(Two pounds equals roughly 1 kilogram.)* Help them convert their height to centimeters. *(Two inches equals roughly 5 centimeters.)*

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Seals and Sea Lions: Venn Diagram

OBJECTIVES

Students will create a Venn diagram showing sets of the characteristics of seals and sea lions.

MATERIALS

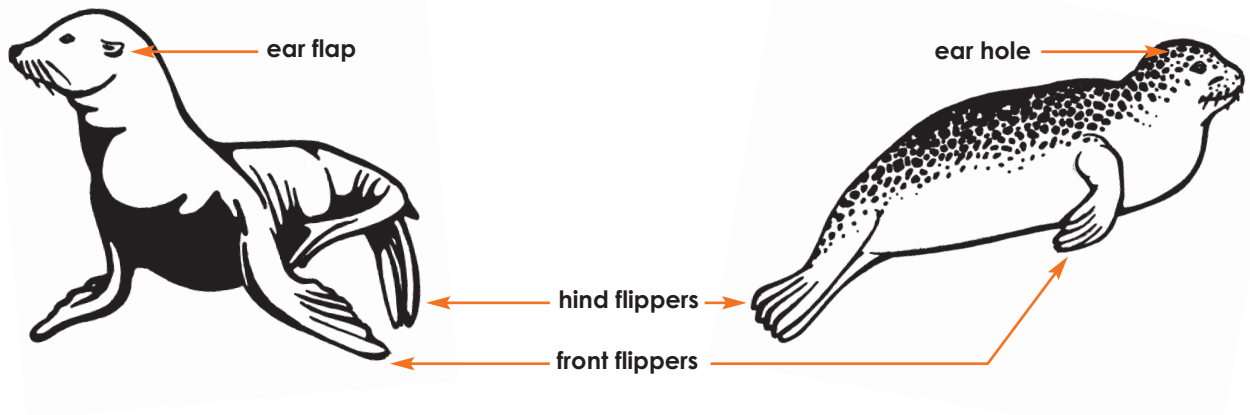
- ❑ list of seal and sea lion characteristics as described below

BACKGROUND

Seals, sea lions, and walruses all belong to a group of animals known as pinnipeds. Scientists categorize pinnipeds as true seals, sea lions, or walruses based on characteristics such as body shape. The information and illustrations below show some of the differences between true seals and sea lions. *(Note: Fur seals are grouped with sea lions.)*

Like other mammals, pinnipeds are warm-blooded, give live birth, nurse their young, breathe air, and have hair. Pinnipeds also have blubber and sensitive whiskers called vibrissae. Although most of their lives are spent in the water, pinnipeds are dependent on land. They come ashore periodically to rest and bask in the sun, and at least once a year—during their breeding season—most species congregate on beaches or sea ice to give birth and breed.

How can you tell the difference between a seal and a sea lion?



	sea lions and fur seals	true seals
HEAD	♦ small, slim, external ear flaps	♦ tiny ear holes, no ear flaps
FRONT FLIPPERS	♦ short and blunt, usually hairless; short nails	♦ covered with hair; clawlike nails
HIND FLIPPERS	♦ hairless, large and paddlelike ♦ webbed digits; nails on middle three digits ♦ turn forward to walk on land	♦ covered with hair, short and paddlelike ♦ webbed digits; nails on all digits ♦ can't turn forward
MOVEMENT ON LAND	♦ "walks" on all fours	♦ "bounces" or undulates

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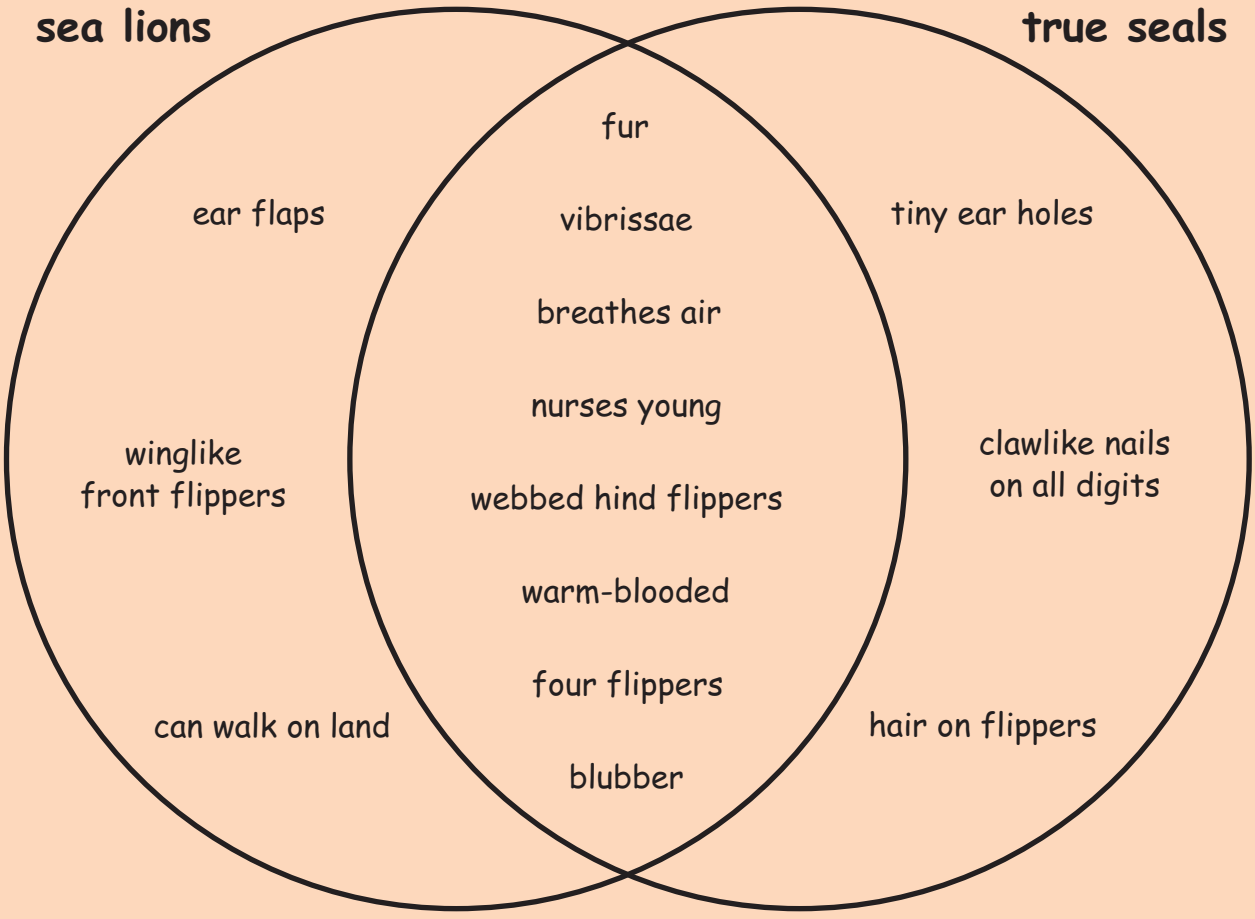
ACTION

1. Share the description of true seals and sea lions with your students. Ask them how they would be able to tell the difference between true seals and sea lions.
2. Ask students to create a Venn diagram showing the characteristics of seals and sea lions. Which characteristics are common to both kinds of animals? Which are only characteristics of true seals? Which are only characteristics of sea lions?

California sea lions *(Zalophus californianus)* have small external ear flaps and winglike front flippers.

POSSIBLE ANSWER



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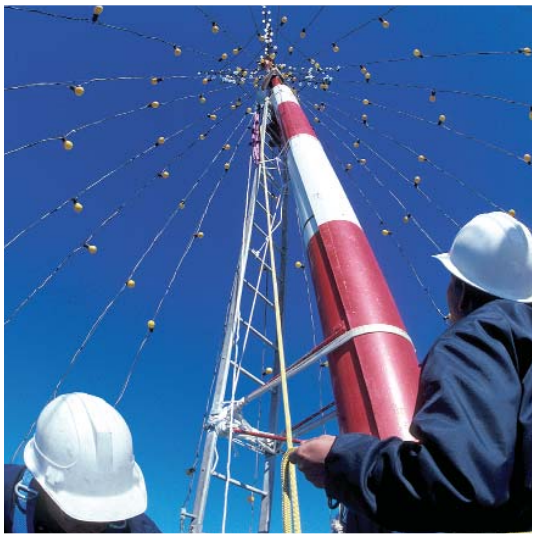

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