

Ocean Discovery

Adventures in Education



6-12

Thank you for choosing SeaWorld Orlando!

SeaWorld is pleased to present you with this educational guide to help you plan a rewarding and positive field trip experience. Contained in this guide are activities and lesson plans designed to help you and your students make the most of your visit by emphasizing the vast educational potential housed in the attractions and animals you'll encounter while visiting us. Also included are numerous pre- and post-activities designed to supplement your trip to create a well-rounded and pertinent educational experience. Our activities support Sunshine State Standards, National Standards in Language Arts, Math, Science, Social Studies and the Arts, and also support essential principles of the Ocean Literacy project. SeaWorld Educators are located at many of the animal attractions throughout the park and can provide valuable information and insight to your students during your visit as well. It is our goal to ensure your experience with us is as enriching and informative as possible!

In the table of contents, you will find grade specific benchmarks/standards and the activities that accompany those standards. As you review the activities in the booklet, we are confident you will find a variety of ways to incorporate them to complement your own lesson plans. A glossary of word definitions and an answer key for all activities have also been provided in the back of this guide. Finally, we have included two FCAT practice exercises.

We sincerely hope you will find this booklet to be a valuable educational tool and encourage you to use the activities and information as you prepare for your trip to SeaWorld. Visit us online at SeaWorld.org for even more activities, lesson plans and detailed animal information.



Visit SeaWorld.org/education-programs/swf for important information and helpful tips to make your visit with us as easy possible. You'll find confirmation materials, payment options and information to share with all the chaperones and adults on your field trip.

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Goals of the SeaWorld Education & Conservation Department

Based on a long-term commitment to education, SeaWorld Orlando strives to provide an enthusiastic, imaginative and intellectually stimulating atmosphere to help students and guests develop a lifelong appreciation, understanding and stewardship for our marine and aquatic resources. Specifically, our goals are...

- To instill in students and guests of all ages an appreciation for science and a respect for all living creatures and natural resources.
- To conserve our valuable natural resources by increasing awareness of the interrelationships of humans and the marine and other aquatic environments.
- To increase students' and guests' basic competencies in science, math and other disciplines.
- To provide an educational resource to the world.

“For in the end we will conserve only what we love. We will love only what we understand. We will understand only what we are taught.” – B. Dioum

Ocean Discovery: SeaWorld Adventures in Education
6 - 12 Teachers Guide
Part of the SeaWorld Education Series

Advisory Staff
Geni Wright
Josh Kennedy
David Schindler

Layout/Design
Dennis Jones

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7007 SeaWorld Drive, Orlando, Florida 32821
800-406-2244

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Threatened or Endangered

The chart below reflects animals listed as endangered or threatened by the United States Fish and Wildlife Department. Several boxes within the chart have been left blank. Use the information provided to calculate the numbers needed to complete the chart. Answers given as a percent should be rounded to the nearest tenth.

Group	Endangered Species		Threatened Species		Total	% of all threatened and endangered animals listed
	United States	Foreign	United States	Foreign		
mammals	70	256		20	360	
birds	75		15	6	275	
reptiles		66	24	16	119	
amphibians	14	8	11	1		
fishes	74	11	65		151	
snails	24		11	0	36	
clams		2	8	0	72	
crustaceans	19		3		22	
insects	47	4	10	0		
arachnids	12				12	
TOTALS						

Answer the following questions based upon the information provided within the chart:

- According to the chart, how many species of animals are endangered throughout the world?

- Which group of animals has the most number of endangered species in the United States?

- Which group of animals has the most number of endangered species outside of the United States?

- Which group of animals has the most number of threatened species throughout the world?

- Which group of animals has more threatened species than endangered species in the United States?

- Which groups of animals include more than 100 endangered species?

- Which groups of animals are listed as threatened only in the United States?

- Which groups of animals are listed as endangered only in the United States?

- What percentage of all of the animals listed are considered endangered? _____
- What percentage of all of the animals listed are considered to be threatened? _____

Diet Composition, Distribution and Analysis

SeaWorld Orlando distributes approximately 5,000 pounds of restaurant-quality food to its animals every day. Daily observations and periodic physicals help determine proper growth and development rates. Biological sampling can also give clues about how quickly and efficiently different animals assimilate various food items. This information can be utilized to more accurately determine the normal caloric requirements of each individual species. The dietary elements can then be adjusted and altered to reflect changes in regard to commercial availability and to maximize cost effectiveness.

Using the following information, determine the daily intake requirements of the following animals:

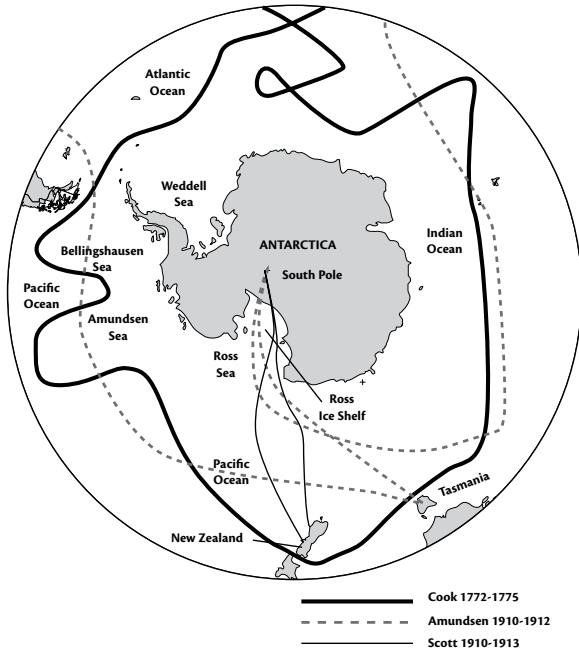
1. If the killer whale below weighs 5,000 pounds (lb.), what percentage of its body weight does it require each day? _____
2. If a dolphin requires 4% of its body weight each day, and has the dietary intake indicated above, how much would this individual weigh? _____

Type of Food	Killer Whale	California Sea Lion	Pacific Walrus	Bottlenose Dolphin	Bull Shark
Herring	50 lb.	7 lb.	15 lb.	10 lb.	1.0 lb.
Squid	15 lb.	2 lb.	10 lb.	3 lb.	0.5 lb.
Salmon	15 lb.	*	*	*	*
Smelt	70 lb.	11 lb.	15 lb.	17 lb.	*
Clams	*	*	20 lb.	*	*
Total					

3. If the bull shark above weighs 300 pounds (lb.), what percentage of its body weight does it require on a weekly basis? _____
4. Why do you think that the killer whale has a higher caloric intake than the bull shark? _____

5. What food item does the walrus seem to prefer? _____
6. What percentage of the walrus diet consists of this one food item? _____
7. Assuming that the sea lion above weighs 250 pounds (lb.) and the killer whale weighs 5,000 pounds (lb.), which animal requires a higher percentage of its body weight? _____
8. If the walrus weighs 2,500 pounds (lb.) and you compare its daily intake to the sea lion above, which animal requires a higher percentage of its body weight? _____

Exploring Polar Regions



Part I

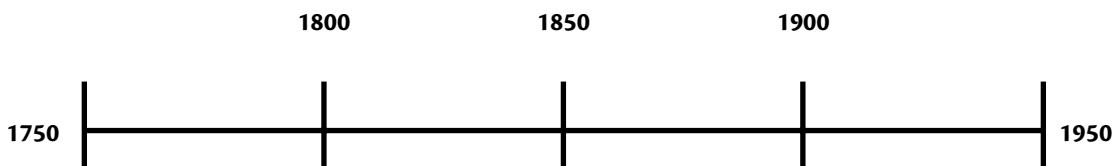
Directions: Based upon the information above, answer the following questions about polar exploration.

- Which explorer traveled to both the Arctic and Antarctic? _____
- To circumnavigate means to go completely around. Which explorer circumnavigated the continent of Antarctica?

- The Northwest Passage enabled early explorers to travel from the Atlantic Ocean to the Pacific Ocean along the coast of North America.
 - Which explorer successfully traveled through the Northwest Passage? _____
 - Which explorer attempting to travel the Northwest Passage never completed his journey? _____
- Which explorer(s) reached the South Pole? _____
 - Which explorer(s) reached the North Pole? _____
- Early explorers traveling to the South Pole chose to come ashore the continent of Antarctica near the Ross Ice Shelf. Why do you think they chose this location? _____

Part II

Directions: Use the information above to plot each polar expedition on the timeline below. Place Arctic expeditions above the timeline and Antarctic expeditions below the timeline. Note: You will need to approximate where each expedition should be placed on the timeline.



Part III

Directions: Complete the following exercises. Be sure to use complete sentences and proper grammar.

Hint: Referring to the maps on the previous page will be helpful in completing this section.

1. A continent is defined as one large continuous stretch of land. Explain why Antarctica is considered to be a continent, but the Arctic is not.

2. The primary intent of early expeditions to the Arctic was to find safe passage through this region by boat. Why do you think this was so important to people living in Europe, North America and Asia?

3. To be isolated means to be alone or separate. Which of the polar regions appears most isolated from the rest of the world? (explain your answer)

4. a) Next to each item listed below write either Arctic or Antarctic to identify which region is being described.
- _____ is land surrounded by water. _____ is water mostly surrounded by land.
- _____ is located in the Northern Hemisphere. _____ is located in the Southern Hemisphere.
- _____ is isolated from the rest of the world. _____ is a continent.
- _____ includes portions of the continents of North America, Europe, and Asia, but is not itself a continent.

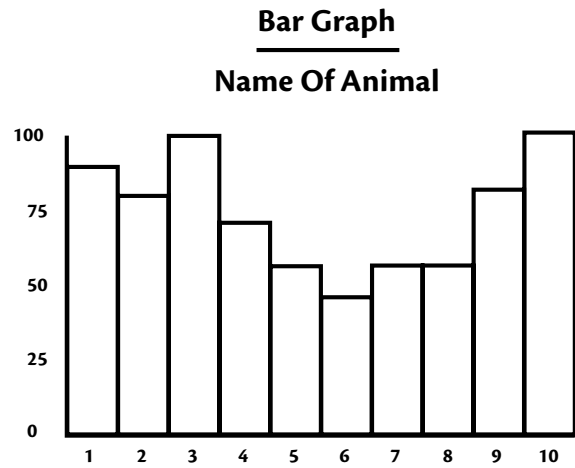
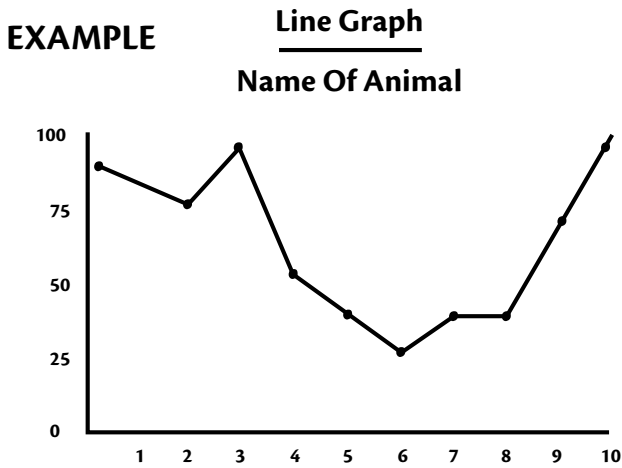
- b) Use the information in part "a" to write a brief paragraph which describes the differences between the Arctic and the Antarctic.

Lending a Helping Hand

Directions: Below is a statistical chart which reflects various animal rescues at SeaWorld during a 10 year period. Use this information to answer the questions and complete the graphs at the bottom of the page.

Year	Birds	Cetaceans	Manatees	Otters	Pinnipeds	Turtles	TOTALS
10	632	7	26	0	60	29	754
9	474	4	9	2	182	32	703
8	591	6	24	0	144	35	800
7	524	4	23	0	127	38	716
6	732	21	14	0	157	20	944
5	462	17	22	1	168	10	680
4	517	6	12	0	229	49	813
3	645	10	18	1	58	28	760
2	813	4	13	0	38	73	941
1	872	9	12	0	69	43	1005

- On a separate sheet of graph paper, create a line graph and a bar graph to reflect the number of rescues for each group of animals for this 10 year period. Place the year along the horizontal axis and the number of rescues along the vertical axis. Label each graph with the name of the animal group it represents.



- On a separate sheet of graph paper create a bar graph to compare the total number of cetacean, manatee, pinniped and turtle rescues for the ten year period. Place the names of the animals along the horizontal axis and the total number of rescues along the vertical axis.

- Answer the following questions: (Round answers to two decimal places.)

a. What percentage of all animal rescues for the ten year period were each of the following:

birds = _____ cetaceans = _____ manatees = _____

otters = _____ pinnipeds = _____ turtles = _____

b. What percentage of all animal rescues took place each year: (Round answers to two decimal places.)

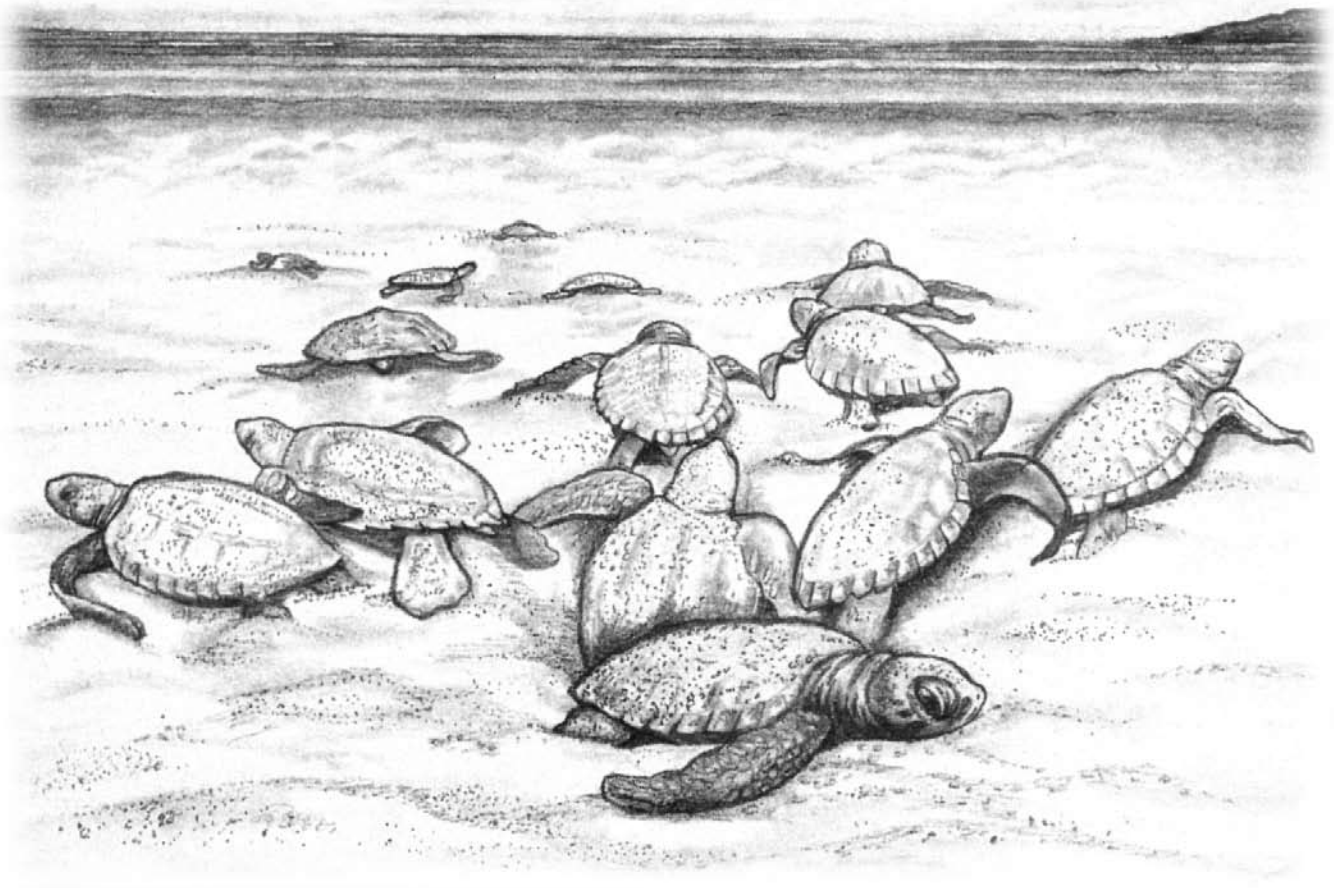
1: _____ 2: _____ 3: _____ 4: _____ 5: _____

6: _____ 7: _____ 8: _____ 9: _____ 10: _____

Sea Turtles: Race for Survival

Sea turtles face a variety of environmental obstacles. Most of the problems that directly affect them can be attributed to human encroachment. While at Turtle Point, listen to the educational presentation and visit the sea turtle kiosk to learn about these ancient creatures. Circle the entries that adversely affect sea turtle populations.

- | | | |
|--------------------|------------------|----------------------|
| Hunting for Meat | Sea Walls | Beach Replenishment |
| Boating Collisions | Shrimp Trawling | Crab Fishing |
| Drift Nets | Beach Lighting | Hunting for Leather |
| Beach Traffic | Hunting for Eggs | Ocean Dredging |
| Beach Development | Foot Traffic | Agricultural Run-off |
| Heavy Metals | Oil Drilling | Recreational Fishing |
| Noise | Beach Erosion | Curio Industry |

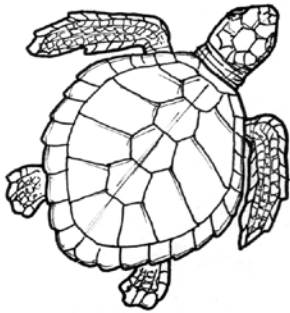


If you examine all of the answers carefully, you will find that all of the items are adversely affecting sea turtles to varying degrees. However, persistent environmental protection has demonstrated some early success. Sea turtle nest sites on the east coast of Florida have nearly tripled in the last decade.

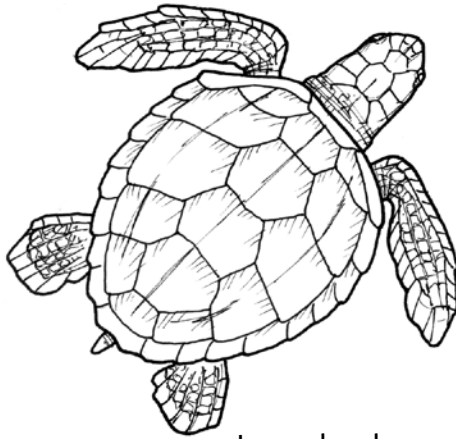
Sea Turtles of Florida

Currently, there are eight species of sea turtles. All eight species are listed as endangered or threatened. Five species can be found in the waters off the coast of Florida. The east coast of Florida, specifically south Brevard County, is one of the most significant nesting beaches for loggerhead and green sea turtles in the entire Western Hemisphere. To the casual observer, it may seem difficult to distinguish one turtle from another. The color of the skin and shell is not always reliable because the animals display a high degree of variability within each species. In some cases, leucistic or light phase individuals may occur. Sea turtles also exhibit variability from population to population according to geographic location. However, the scute (scale) pattern on the turtle's carapace (top part of shell) appears to be species specific.

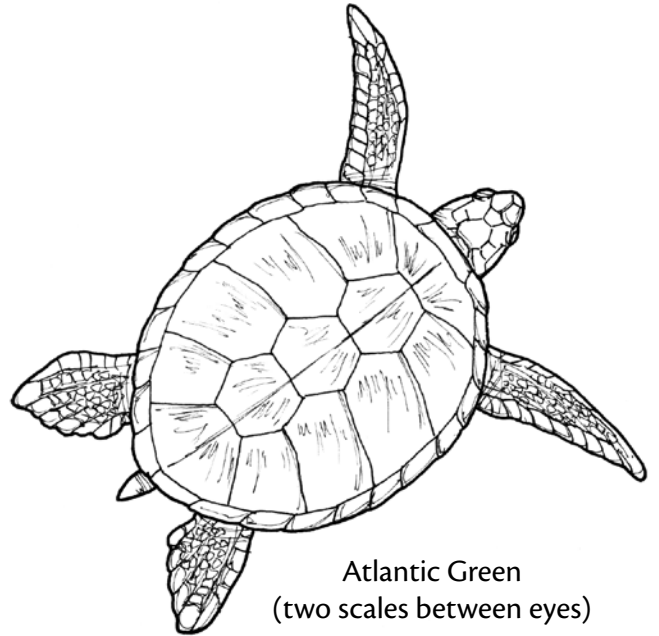
Please look at the diagrams below and see if you can identify the different sea turtles at Turtle Point.



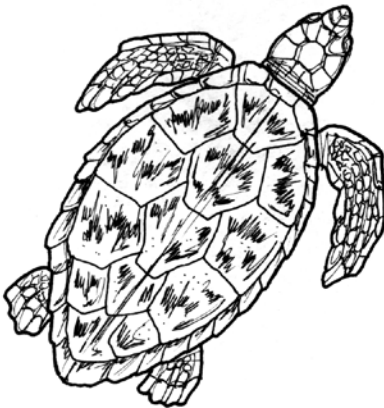
Kemp's Ridley
(light blond color)



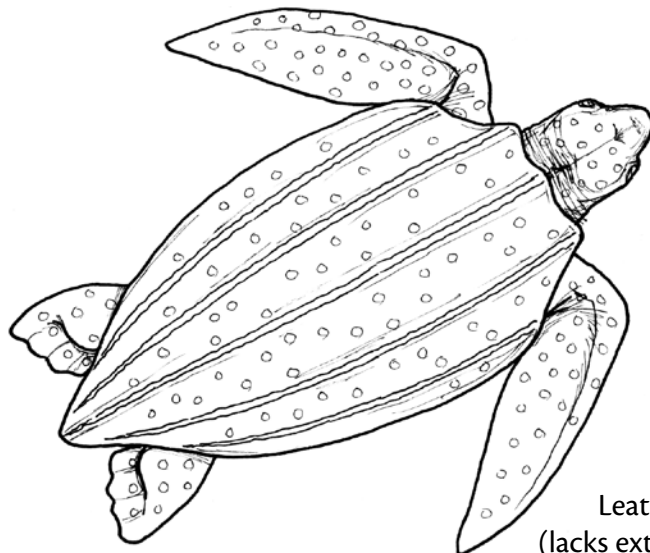
Loggerhead
(wide neck and head)



Atlantic Green
(two scales between eyes)



Hawksbill
(has overlapping scutes)



Leatherback
(lacks external scutes)

Sea Turtles of Florida

1. What species are currently present at Turtle Point? _____

2. At Turtle Point, the male and female turtles are separated. Do you notice any physical differences between the two sexes? _____

3. What color do the loggerheads tend to be? _____
4. What color are the green sea turtles? _____
5. Why do you think they are named green sea turtles if they are not green? _____

6. What species appears to be the smallest? _____

7. Which species has scales that appear to be loosely attached? _____

8. Which species appears to be the most active swimmer? _____

Visit the small museum at Turtle Point to answer the following questions.

9. About how deep does the female dig to lay her eggs? _____
10. How does beach lighting adversely affect sea turtles? _____

11. What species has the most prized shell? _____
12. What products have sea turtles been harvested for? _____
13. What is the name of the special netting equipment that allows sea turtles to escape from the nets of shrimp trawlers? _____

All About Animal Training

Teachers Note: This activity is recommended as a post-activity to be completed following your educational field trip experience.

People have been training animals for thousands of years. Through the use of various techniques, animal trainers have learned how to modify and shape the behaviors of many animals. To be a successful animal trainer there are several important concepts and training techniques that need to be understood.

Directions: Below are explanations of several key concepts and training techniques that relate to training animals. Below each explanation are three examples. Circle the example that best demonstrates the explanation that has been provided.

1. Learned Behavior

An action or response that is learned through experience is referred to as a learned behavior. For the most part, learning such behaviors occurs gradually and in steps.

- a) After being born a dolphin calf surfaces to take its first breath of air.
- b) After several months in the ocean a dolphin begins to make daily visits to a nearby coral reef in search of food.
- c) A group of dolphins, spend their entire lives together swimming through the ocean.

2. Innate Behavior

Actions that animals are born knowing how to perform are referred to as innate behaviors. These types of behaviors do not need to be learned in order to be performed. Innate behaviors are sometimes referred to as instincts.

- a) A sea lion eats a fish that is given to it by its trainer.
- b) A sea lion barks after the trainer blows his whistle.
- c) A sea lion swims through the water while waving a flipper in the air.

3. Conditioned Response

A specific behavior that an animal learns to perform in response to a specific stimulus is referred to as a conditioned response. Conditioned responses are behaviors that are learned through repetition.

- a) A dog sits down and lifts its paw.
- b) A dog rolls over then is given a treat by its trainer.
- c) A dog fetches a stick that is thrown by its trainer.

4. Positive Reinforcement

A type of reward that is given to an animal to increase the likelihood of a behavior being performed is referred to as positive reinforcement. Positive reinforcement is given to an animal immediately after it successfully performs a behavior as a means to encourage the animal to perform the behavior again in the future.

- a) The crowd cheers as a killer whale jumps up out of the water.
- b) A trainer gently pets a dog after it lifts its paw.
- c) A sea lion successfully performs several behaviors and later that day is given a whole bucket of fish.

5. Bridge Signal

It is not always possible to immediately provide an animal with positive reinforcement for performing a behavior. In such instances, a trainer will use a bridge signal. A bridge signal is a visual or auditory signal that lets the animal know they have successfully completed a behavior and will receive reinforcement. A bridge signal is important because it allows trainers to bridge the gap of time between when a behavior is performed and when the reinforcement is provided.

- a) A trainer blows a whistle to signal a dolphin to jump out of the water then gives the dolphin a fish.
- b) After a dolphin jumps out of the water, the trainer throws the dolphin a fish and blows a whistle.
- c) After a dolphin jumps out of the water, the trainer blows a whistle and will give the dolphin a fish as soon as it swims over to the side of the pool.

6. Approximation

Complex behaviors must be learned through a step by step process. Each step in the learning process is referred to as an approximation. By reinforcing an animal for each successful approximation toward the final goal, the animal will gradually learn the desired complex behavior.

- a) A cat learns how to jump through a hoop; then learns to roll over; then learns to climb a ladder.
- b) A sea lion learns to bark on command, swim through the water and wave one flipper in the air.
- c) A dolphin first learns to swim above a piece of rope held underwater; then learns to swim over the rope as it is held at the surface of the water; then finally to jump over it as it is held a few feet above the water.

7. Chain

When a series of individual behaviors are performed in sequence, this is referred to as a chain. An animal is first trained to perform each individual behavior separately, then to perform all of these behaviors in a specific sequence. Reinforcement is given only after all of the behaviors in a chain have been completed successfully.

- a) A cat jumps through a hoop, rolls over, then climbs up a ladder before being reinforced.
- b) A sea lion is reinforced for barking on command, then reinforced again for waving its flipper in the air.
- c) A dolphin first learns to swim above a piece of rope held underwater; then learns to swim over the rope as it is held at the surface of the water; then finally to jump over it as it is held a few feet above the water.

8. Least Reinforcing Stimulus

If a trainer requests a particular behavior and the animal does not respond, or the animal responds with undesired behavior, the trainer must be careful not to reinforce the response. A least reinforcing stimulus is a technique used by trainers whereby no response - positive or negative - is given to an animal following an undesired behavior, or failure to perform a behavior that is desired. Through repetition of this technique an animal will cease to perform undesirable behaviors that are not reinforced.

- a) A trainer responds to an undesirable behavior by standing motionless and in silence for several seconds before continuing with the training session.
- b) A trainer responds to an undesirable behavior by turning away from the animal and standing in silence for at least one minute.
- c) A trainer responds to an undesirable behavior by ending the training session.

Cetacean Photo Identification Study

Photo identification is an important research tool that allows scientists to examine various aspects of cetacean biology, zoogeography and population dynamics. Researchers record the individual members of a region by taking photographs as a whale reaches the highest point out of the water. The size, shape and condition of the dorsal fin and the saddle patch can enable astute observers to identify individual animals within a population. This allows for longitudinal studies over several years and even successive generations. New insight can be gained with respect to seasonal migrations, pod composition as well as physical and social development. Close observation can also give us clues about the social hierarchy that exists in each pod and how that information is related to breeding success.

SeaWorld Orlando normally maintains between five and eight killer whales at the Shamu Stadium facility. This complex is one of the largest marine mammal habitats in the world. Assume that you are conducting a photo-identification study on killer whales in their natural environment. Instead of a camera however, you will attempt to sketch the dorsal fins of all the killer whales in our care. Attempt to focus on small details that would enable another person to identify the whales using your information. Keep in mind that male killer whales have very tall and triangular dorsal fins, while females are smaller and tend to lean back towards the tail. Draw the individual dorsal fins in the boxes below and create a name for each whale.

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NAME

NAME

NAME

NAME

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NAME

NAME

NAME

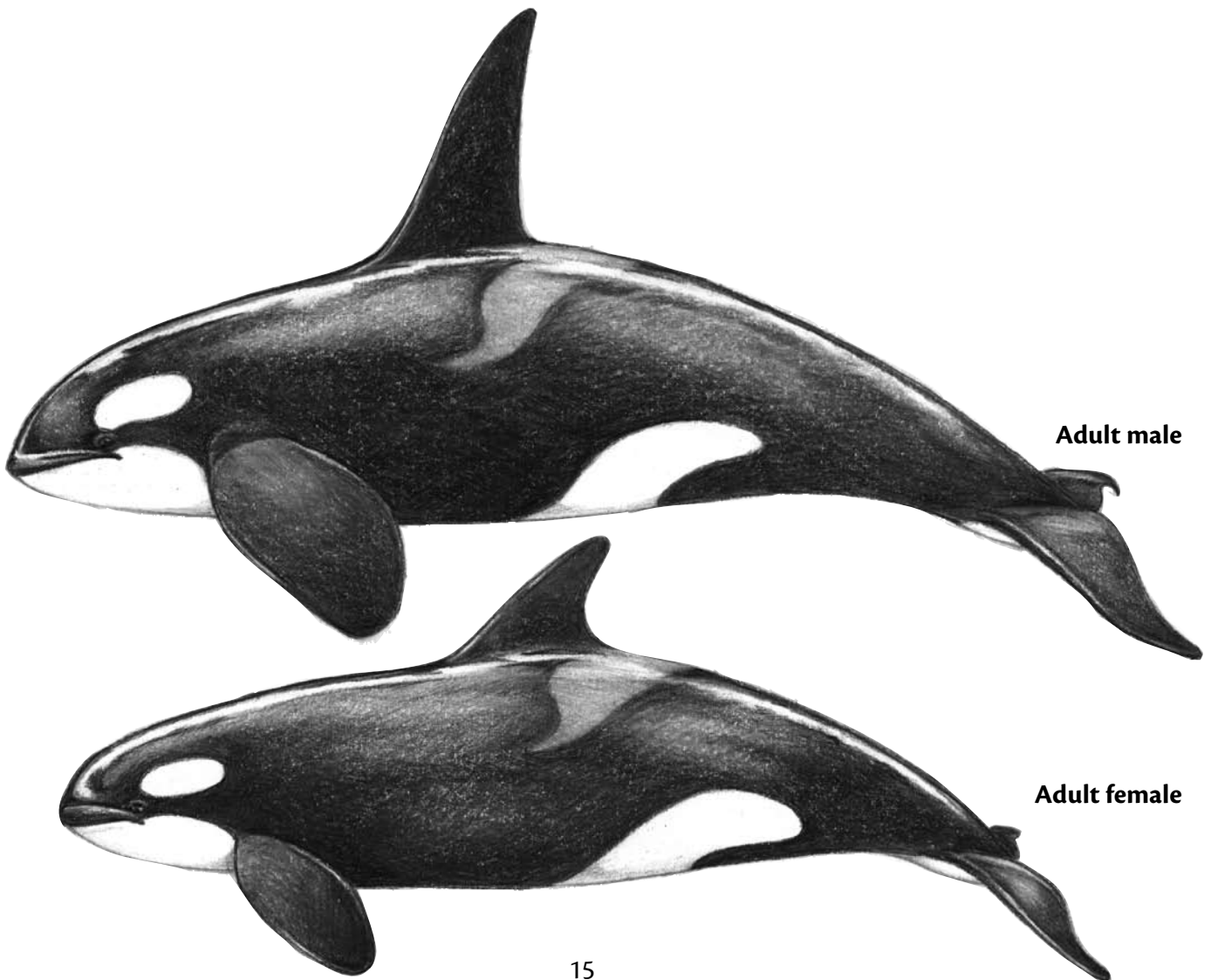
NAME

Cetacean Photo Identification Activity

1. What do you think are the two primary functions of the dorsal fin? _____

2. How many male killer whales are present? _____
3. Aside from the dorsal fin, does there appear to be any other way to distinguish the males from the females? _____

4. What gender appears to dominate socially? _____
5. Can you tell what female is the matriarch? _____
6. How many calves are present? _____
7. Have you witnessed any nursing behavior? _____
8. What is the largest number of individuals that you see traveling together at one time? _____
9. What animal spends the most time alone? _____
10. What other anatomical features would be useful for identification purposes? _____



Much to do About Marine Mammals

Directions: Below is some general information about several species of marine mammals. Sections 1 and 2 contain several grammatical errors and misspelled words. On a separate sheet of paper make the necessary corrections and rewrite each paragraph.

1. Manatees

There are three species of manatees: the West Indian manatee, the West African manatee, and the Amazonian manatee. The Florida manatee and the Antillean manatee are subspecies of the West Indian manatee. The West Indian and West African manatees inhabit rivers, bays, canals, estuaries, and coastal areas rich in seagrass and other vegetation. Amazonian manatees are restricted to fresh water. They are most common in floodplain lakes and channels. All manatees are grayish-brown in color. Amazonian manatees usually have white or pink patches on their belly and chest. All manatees have a large flexible upper lip and long whiskers called vibrissae. They do not have external ear flaps, but do have a very small opening to the ear canal. They use their flippers and paddle-like tail to propel them through the water. Manatees are nonaggressive, nonterritorial herbivores who spend most of their time feeding and resting. They will eat up to 100 pounds of vegetation each day and rest from two to twelve hours.

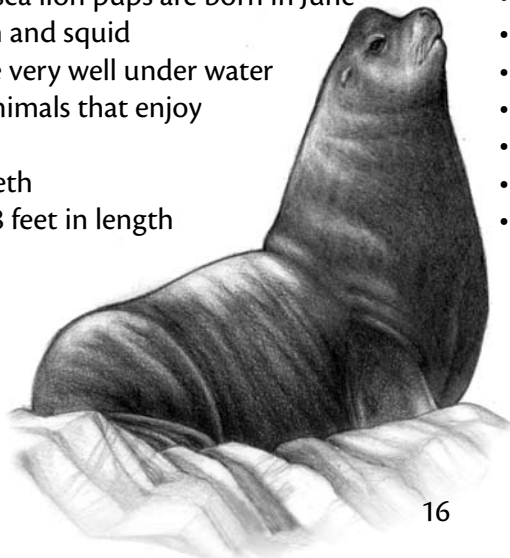
2. Killer Whales

Growing to lengths of over twenty-five feet, killer whales are the largest members of the dolphin family. They inhabit all oceans in the world, but are most numerous in the Arctic, the Antarctic, and areas of coldwater upwelling. Killer whales are found in both the open ocean and coastal waters. They travel together in groups called "pods." Though the worldwide population of killer whales is unknown, specific populations in a few areas have been estimated. For instance, in some areas of the Antarctic alone, their numbers are estimated at about 180,000. Researchers have recently learned to identify killer whales by photographing and comparing their dorsal fins. Photo-identification promises to be an important new research tool for studying various aspects of killer whale biology, reproduction, behavior, and population dynamics.

Directions: Sections 3 and 4 list various facts about California sea lions and harbor seals. On a separate sheet of paper use the facts provided to write a few paragraphs describing the similarities and differences between these animals.

3. California Sea Lions

- live along the west coast of North America
- inhabit rocky and sandy beaches
- babies are called "pups"
- are excellent swimmers
- have visible ear flaps
- are kept warm by their thick coat of blubber
- are very vocal animals
- most California sea lion pups are born in June
- primarily eat fish and squid
- can hear and see very well under water
- are very social animals that enjoy interaction
- have 34 to 38 teeth
- can grow up to 8 feet in length
- are pinnipeds



4. Harbor Seals

- are excellent swimmers
- live in the North Atlantic and North Pacific
- inhabit shallow water along the coastline
- can reach approximately 6.5 feet in length
- are pinnipeds
- have a well developed sense of hearing
- can see well underwater
- a thick coat of blubber helps keep them warm
- do not have visible ear flaps
- primarily eat fish and squid
- have 34 to 36 teeth
- are not very vocal
- rarely interact with other animals
- most pups are born February through July



5. Answer questions “a-e” using the information provided on the previous page and in the chart below. Round answers to the nearest tenth.



Measurement Conversion Chart

1 foot = 12 inches

feet x .305 = meters

1 pound = 16 ounces

pounds x .45 = kilograms

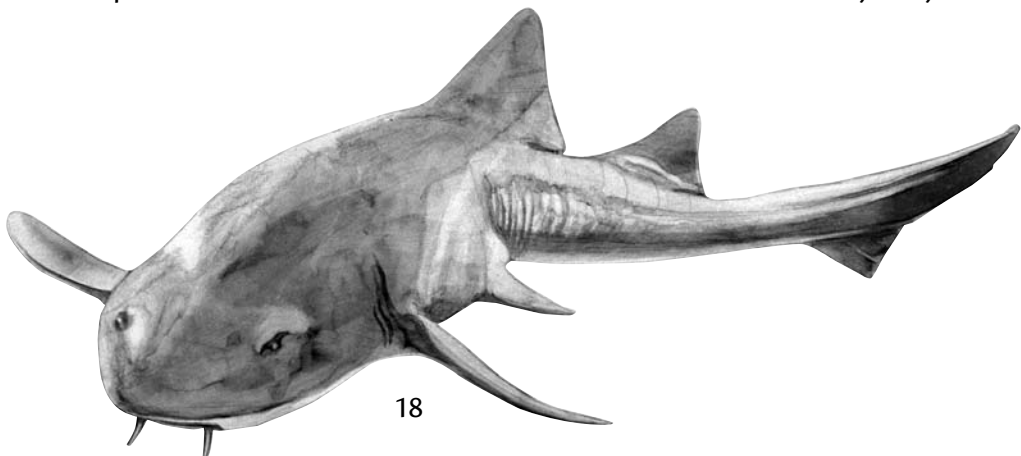
1 yard = 3 feet

- a) Approximately how many kilograms of vegetation does a manatee eat each day? _____
- b) Approximately how many inches in length is an adult harbor seal? _____
- c) Approximately how many meters in length is an adult killer whale? _____
- d) A California sea lion is approximately how many meters smaller than a killer whale? _____
- e) Approximately how many ounces of food can a manatee eat in one week? _____
6. Based upon sections 1-5, answer the following questions by placing the word “bigger” or “smaller” in the space provided within each statement.
- a) A killer whale measuring 22.75 feet is _____ than a killer whale measuring $22 \frac{7}{8}$ feet.
- b) A sea lion measuring 6.25 feet is _____ than a seal measuring 73 inches.
- c) A seal measuring 71 inches in length is _____ than a sea lion measuring $6 \frac{1}{4}$ feet.
- d) A killer whale measuring 6.71 meters is _____ than a killer whale measuring 23 feet.
- e) A manatee measuring 98 inches is _____ than a manatee measuring $2 \frac{1}{4}$ meters.
7. Answer the following questions “True” or “False” based upon the information in sections 1-6:
- a) Both California sea lions and harbor seals have visible ear flaps. _____
- b) The current global killer whale population is 180,000. _____
- c) The Florida manatee is a subspecies of the West Indian manatee. _____
- d) Killer whales and manatees prefer the same type of ocean habitat. _____
- e) California sea lions are more vocal and more social than harbor seals. _____
- f) A manatee that weighs 800 pounds is heavier than one that weighs 365 kilograms. _____
- g) A killer whale measuring eight yards is larger than 8 meters. _____
- h) A sea lion that measures $7 \frac{1}{4}$ feet is bigger than a seal which measures 86.5 inches. _____
- i) The total weight of three killer whales with an average weight of 10,000 pounds each is 13,500 kilograms. _____
- j) One yard is longer than one meter. _____

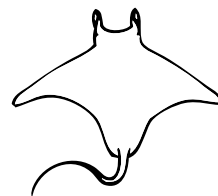
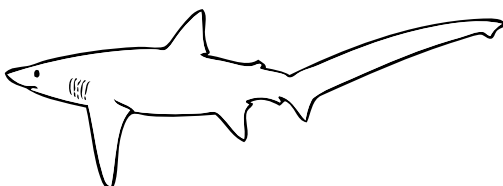
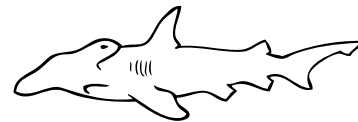
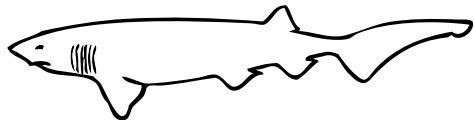
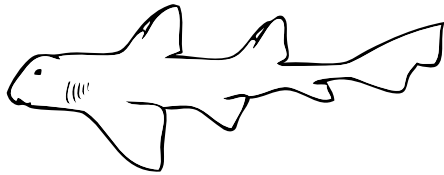
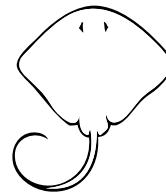
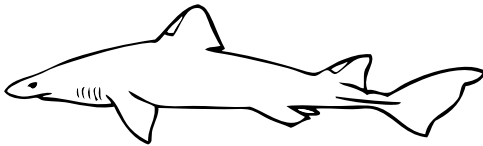
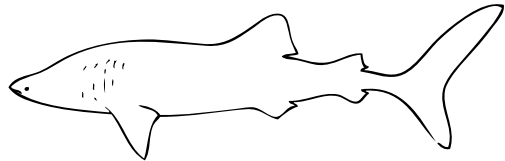
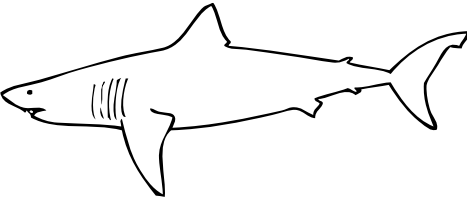
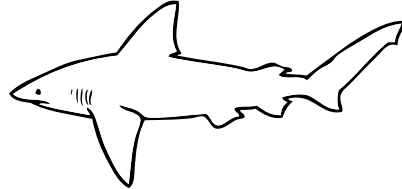
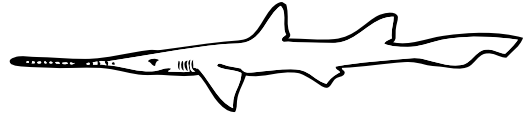
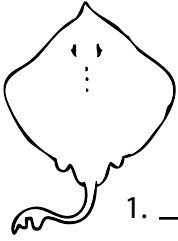
Classification with Dichotomous Keys

Classify the sharks on the following page into their respective scientific families using the dichotomous key below. Remember, you should start at the beginning for each specimen. Historically, these keys have been utilized to quickly identify organisms in the field. With the advent of DNA technology and protein analysis, scientists are able to identify previously unknown phylogenetic relationships.

1. a) Body shaped like a kite if viewed from above.....Go to 12
b) Body not kite-like if viewed from above.....Go to 2
2. a) Anal fin absent.....Go to 11
b) Anal fin present.....Go to 3
3. a) Six gill slits presentFamily Hexanchidae
b) Five gill slits present.....Go to 4
4. a) Dorsal fin with spinesFamily Heterodontidae
b) No spines on dorsal fins.....Go to 5
5. a) Terminal mouth (front of snout).....Family Rhiniodontidae
b) Mouth on underside of head.....Go to 6
6. a) Head expanded with eyes at ends of expansion.....Family Sphyrnidae
b) Head not expanded.....Go to 7
7. a) Homocercal tail (lobes symmetrical).....Family Lamnidae
b) Heterocercal tail (lobes asymmetrical).....Go to 8
8. a) First dorsal fin is nearly half of body length.....Family Pseudotriakidae
b) First dorsal fin regular lengthGo to 9
9. A) Caudal fin nearly as long as entire body.....Family Alopiidae
B) Caudal fin regular length.....Go to 10
10. a) Base of first dorsal fin behind pelvic finsFamily Scyliorhinidae
b) Base of first dorsal fin in front of pelvic fins.....Family Carcharhinidae
11. a) Long, pointed snout.....Family Pristiophoridae
b) Snout without long point.....Family Squalidae
12. a) Animal has anterior horn-like appendages.....Family Mobulidae
b) No horn-like appendages.....Go to 13
13. a) Small dorsal fin present near tip of tail.....Family Rajidae
b) No dorsal fin present near tip of tail.....Family Dasyatidae



Classification with Dichotomous Keys

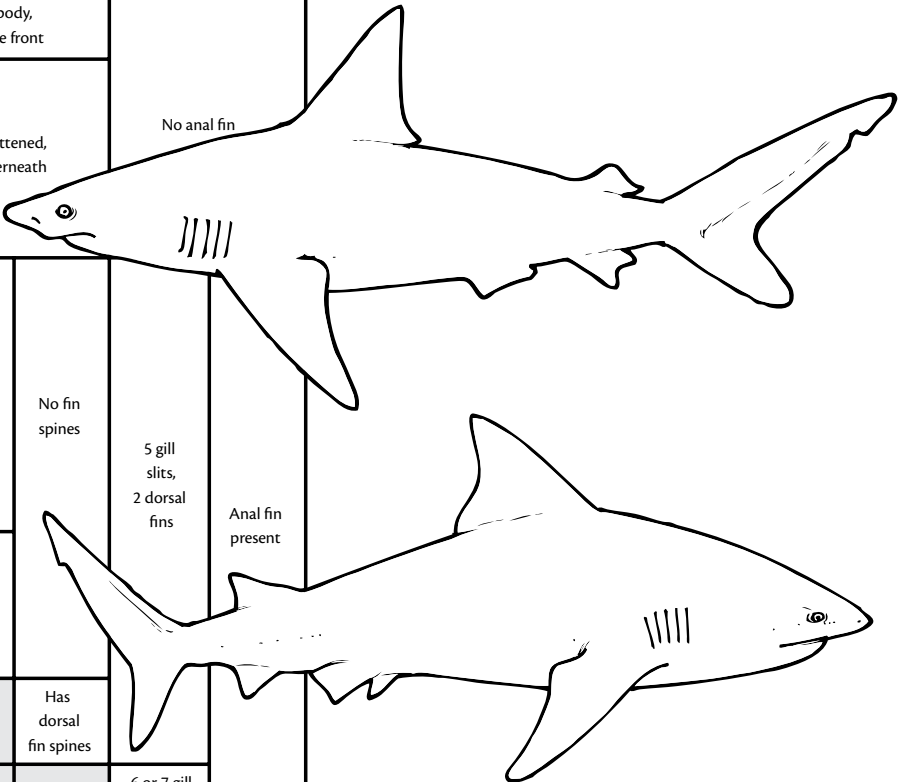


Sharks: They're Not Just One of a Kind

As one of the top predators of the ocean, sharks play an important role in helping to maintain healthy and stable populations among other marine animals. It is estimated that there are over 350 known species of sharks throughout the world. These sharks can generally be divided into eight groups, referred to as "orders."

In **boldface type** are the orders into which all sharks can be divided. Beneath each order are some examples of the types of sharks belonging to the order. To the right are the characteristics that help to distinguish these sharks from each other.

Squaliformes angelsharks		Flattened body, mouth at the front	No anal fin		
Pristiophoroformes sawsharks	Snout long and saw like	Body not flattened, mouth underneath			
Squaliformes dogfishes bramble sharks rough sharks	Short snout				
Carcharhiniformes hammerhead sharks requiem sharks catsharks	Nictitating eyelids (protective inner eyelid)	Mouth extends behind the eyes	No fin spines	5 gill slits, 2 dorsal fins	Anal fin present
Lamniformes thresher sharks sand tiger sharks mackerel sharks	No nictitating eyelids				
Orectolobiformes bamboo sharks nurse sharks carpet sharks		Mouth extends in front of eyes			
Heterodontiformes hornsharks			Has dorsal fin spines		
Hexanchiformes cowsharks frilled sharks				6 or 7 gill slits, 1 dorsal fin	



Directions: Use the chart to answer the following questions.

1. What do bamboo sharks and thresher sharks have in common? _____
2. How do sand tiger sharks differ from hammerhead sharks? _____
3. What type of shark has a flattened body? _____
4. How are cowsharks and frilled sharks different from all other sharks listed above? _____
5. Which sharks have a mouth that extends behind the eyes and a protective inner eyelid? _____
6. Which sharks have 5 gill slits, 2 dorsal fins and dorsal fin spines? _____
7. Where is the mouth located on a dogfish? _____
8. How many gill slits does a nurse shark have? _____
9. How are catsharks, mackerel sharks and hornsharks alike? _____
10. How are angelsharks, sawsharks and bramble sharks alike? _____

SeaWorld Field Notes

SeaWorld Orlando has an extremely diverse collection of animals. Encourage your students to find the following information on five SeaWorld animals of their choice. To expand their field guides, simply make additional copies of this page.

Common Name:

Scientific Name:

Endangered Status: Appendix I II III Species of Special Concern

Environmental Perils:

Distribution:

Gestation/Incubation Period:

Size at Birth:

Age of Maturity:

Size at Maturity:

Sexual Dimorphism:

Diet:

Life Span:

Interesting Facts:

Common Name:

Scientific Name:

Endangered Status: Appendix I II III Species of Special Concern

Environmental Perils:

Distribution:

Gestation/Incubation Period:

Size at Birth:

Age of Maturity:

Size at Maturity:

Sexual Dimorphism:

Diet:

Life Span:

Interesting Facts:

Common Name:

Scientific Name:

Endangered Status: Appendix I II III Species of Special Concern

Environmental Perils:

Distribution:

Gestation/Incubation Period:

Size at Birth:

Age of Maturity:

Size at Maturity:

Sexual Dimorphism:

Diet:

Life Span:

Interesting Facts:

Common Name:

Scientific Name:

Endangered Status: Appendix I II III Species of Special Concern

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Distribution:

Gestation/Incubation Period:

Size at Birth:

Age of Maturity:

Size at Maturity:

Sexual Dimorphism:

Diet:

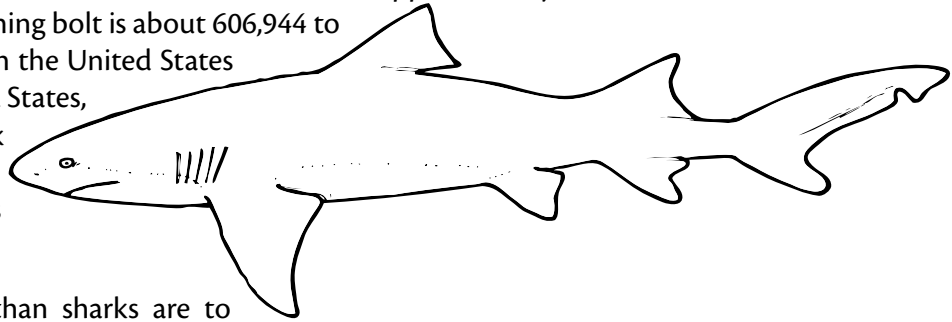
Life Span:

Interesting Facts:

FCAT Practice

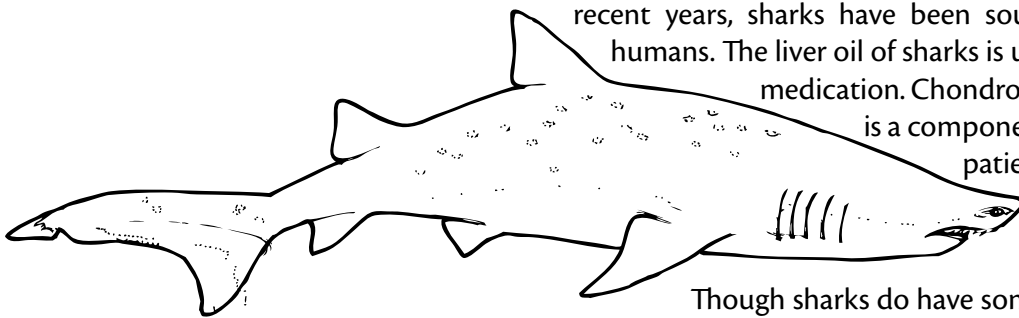
Sharks Under Attack

Just how dangerous are sharks to people? As hard as it is to believe, more humans are killed each year by bees, elephants, dogs and pigs than sharks. In the United States, the animal that causes the most human deaths is deer! People get into an estimated 1,500,000 car accidents each year with deer, which result in approximately 150 human fatalities. The percentage chance of being struck by a lightning bolt is about 606,944 to one and about 100 to 200 people are killed in the United States every year by lightning. For the entire United States, there may be one or two reported shark fatalities in an entire year. This represents approximately 10% to 15% of all shark attacks reported annually within the United States.



People are far more dangerous to sharks than sharks are to people. Every year, humans kill as many as 100 million sharks. Many of these sharks are harvested for their meat. One particularly wasteful type of shark fishing is known as finning. Only the fins of the sharks, which will be sold for use in shark fin soup, are removed. The rest of the shark is simply discarded. In Asia, where shark fin soup is very popular, shark fins are worth \$25 per pound. A bowl of shark fin soup is worth \$150 a bowl. Each year millions of sharks are slaughtered just for their fins.

In addition to being harvested, some sharks are taken unintentionally in nets set out to catch other types of fish. One study shows that for every shark intentionally harvested, at least one other shark is killed by accident. In one study of 400,000 sharks caught in the western North Atlantic, 80% were bycatch and therefore wasted.



In recent years, sharks have been sought after for their medicinal value to humans. The liver oil of sharks is used in making vitamin supplements and medication. Chondroitin, a substance found in shark cartilage, is a component of artificial skin used for treating burn patients and for acne medication. In some instances, even shark corneas have been used as replacement corneas in people.

Though sharks do have some legitimate medicinal uses, they are often harvested for unproven purposes. For example, shark cartilage pills have been touted as a miracle cure for cancer. This claim is dubious to say the least. Research has only just begun, so little is known about how, or even if, shark cartilage can reduce tumors.

The rate at which sharks are currently being harvested is particularly alarming since they mature and reproduce slowly. Whereas fish that are low on the food chain lay millions of eggs at one time, sharks (which are among the top predators of the ocean) typically produce litters of no more than 100 pups. In fact, most species of shark produce far fewer, leaving them vulnerable to the threat of overfishing. Since shark populations vary greatly and are largely unknown, it is difficult for countries to enact comprehensive fishing laws to protect them. Only the United States, Canada, and New Zealand have started shark management plans in an attempt to help protect sharks from being overharvested.

1. Which of the following statements best summarizes the passage above?
 - a) Sharks are amazing animals that can be very useful to people.
 - b) Sharks really are not as dangerous as they seem.
 - c) People pose more of a threat to sharks than sharks do to people.
 - d) There are many ways in which people can protect sharks.

2. Which of the following statements is not accurate?
- a) In the United States more people are struck by lightning each year than attacked by sharks.
 - b) Sharks are responsible for fewer human fatalities than deer.
 - c) According to the author of this article, pigs pose more of a threat to people than sharks.
 - d) In the United States there are usually no more than two reported cases of shark attacks each year.
3. What important point is the author trying to make about the practice of finning sharks?
- a) Shark finning occurs more in Asia than any other place in the world.
 - b) Finning sharks is wasteful and has led to a large decline in the shark population.
 - c) Because there is so little meat on a shark's fin, it is very expensive.
 - d) It is okay to harvest sharks for their meat, but not just for their fins.
4. Which of the following does the author suggest is not an appropriate use for sharks?
- a) using shark cartilage pills to treat cancer
 - b) using shark cartilage in creating artificial skin for burn victims
 - c) using shark corneas as replacement corneas for people
 - d) using their liver oil to make medicine
5. In the second paragraph the author states: "People are far more dangerous to sharks than sharks are to people". Based upon the information provided within the article, do you agree with this statement? Use details from the article to support your answer.

6. Shark populations are vulnerable because
- a) Sharks swim close to the surface.
 - b) Sharks do have some legitimate medicinal uses.
 - c) Sharks typically produce litters of no more than 100 pups.
 - d) Sharks are slaughtered just for their fins.
7. Which of the following statements best summarizes how the author feels about the future of the shark population?
- a) The author is concerned that the shark population will continue to decline because it is difficult to enact laws to protect sharks from overharvesting.
 - b) The author is concerned because sharks are harvested for unproven purposes.
 - c) The author is not concerned because the United States has a shark management plan.
 - d) The author is not concerned since shark populations vary greatly.
8. The author of this article uses the word "wasteful" to describe the manner in which people use sharks. Explain what is wasteful about the manner in which sharks are used. Use details and information from the article to support your answer.

FCAT Practice

Downfall of an Ocean Titan

It began in November of 1741, when a Russian brig, the Saint Peter, wrecked off a barren island chain between Alaska and Russia. The arctic winter was fast approaching and the crew lacked enough clothing, food and supplies to last until the spring. Among the seemingly doomed crew was Captain Vitas Jonassen Bering and the German naturalist George Wilhelm Steller. Soon the crew began to catch glimpses of a humongous creature swimming in the bitter cold sea. Sometimes the behemoths came close enough to touch. These beasts appeared to have no fear of man. Steller recognized them as a manatee relative, but they were unlike any he had ever heard about. While stranded on the island, Steller dedicated much of his time studying these animals which eventually were named in his honor.

Steller's sea cows, as they are now known, had thick skin which was uneven at sections and felt like tree bark. They often measured more than 20 feet in length and weighed more than six tons. In need of food, the crew of the Saint Peter would eventually hunt these animals. The first attempt to kill one failed since the iron hooks used could not penetrate the animal's tough hide. It took teamwork and determination for the crew to eventually kill a Steller's sea cow, but once they did, all of their prayers were answered. They had a source of food that could last them throughout the winter, plus leather for shoes and strong hides for boat repairs.

During the time they were stranded on the island, several members of the crew had perished due to illness. Among those who perished was Captain Bering - after whom the island and surrounding body of water would be named.

In August of 1742, Steller and the other surviving members of the crew escaped their prison island and returned to the Russian mainland. When the crew arrived in Russia, they spread stories of the magnificent animal they had found. Soon after, people who sought an opportunity to profit from these animals set out to hunt them. The Steller's sea cows were helpless against these hunters, for they were so buoyant from blubber that they could not dive to escape being harpooned and dragged to shore.

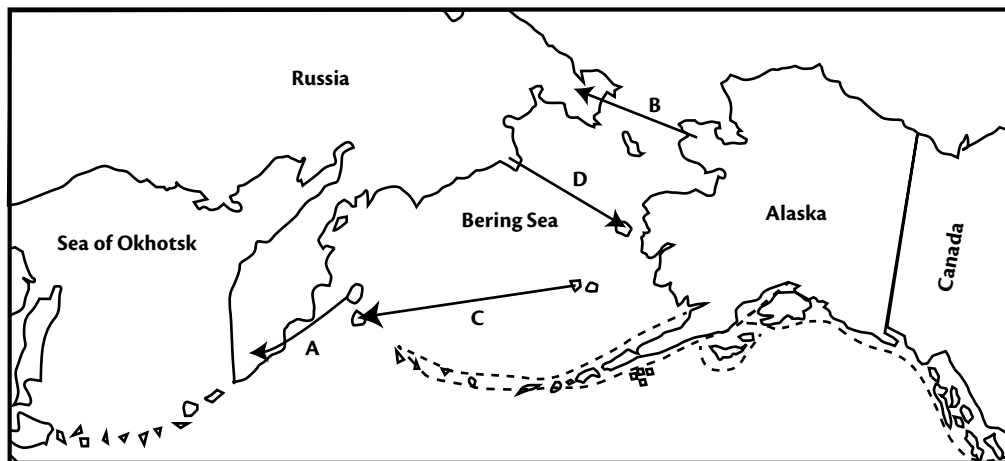
It is estimated that when first discovered by the crew of the Saint Peter, there were approximately 2,000 sea cows alive. By 1768, a mere 27 years later, Steller's sea cows had disappeared. Like the mythological Loch Ness Monster, there are sailors who claim to have seen Steller's sea cows alive today. Sadly, all that is truly left is about ten complete skeletons, various bones scattered across a few museums and a story which highlights mans indifference and ignorance to this one-time gentle giant of the sea.

1. In the story above, Saint Peter is
 - a) the Captain of the crew
 - b) the name of a crew member
 - c) the name of a boat
 - d) the name of an island
2. Which of the following words is not used by the author to describe the animals encountered by the crew of the ship?
 - a) behemoths
 - b) beasts
 - c) humongous
 - d) doomed
3. Why was it so difficult for the crew members to kill the sea cows?
 - a) They were so large.
 - b) Their skin was very thick and tough.
 - c) They lived in the cold water.
 - d) They could swim very fast.

4. The name of the island on which the crew was stranded would likely appear on a map today as
- Bering Island
 - Steller's Island
 - Prison Island
 - Saint Peter Island
5. In paragraph number five, the author states that people sought to profit from sea cows. In what ways could people profit from these animals? Use details and information from the story to support your answer.

6. Which of the routes on the map did the crew most likely take when returning home from their exploration?

- route "A"
- route "B"
- route "C"
- route "D"



7. The Steller's sea cow was
- a type of manatee
 - closely related to the manatee
 - a type of cow
 - closely related to a cow

8. The word "titan" means "one that is gigantic in size or power". What do you think the title, "Downfall of an Ocean Titan," refers to? Use details and information from the story to support your answer.

FCAT Practice

Diversity of Life

About 1.7 million species of plants and animals have been identified. Some scientists estimate that there may be as many as 100 million species! How do we keep track of them all?

More than 2000 years ago, Aristotle, a Greek philosopher, devised the first classification system with two kingdoms. For many years anything alive was thought to be either a plant or an animal. If it stayed in one place and made its own food, it was a plant. If it moved about freely and ate other living things, it was an animal. Then with the help of the microscope, scientists discovered one-celled living things with traits similar to both plants and animals. These living things were classified into a third kingdom called Protista. Yet, upon further research, scientists also discovered differences in the cells of living things and how they would get their food. Based upon these findings, all living things were classified according to their similarities and differences into one of five kingdoms: Animalia (animals), Plantae (plants), Protista (single-celled organisms with a defined nucleus), Monera (single-celled organisms without a defined nucleus) and Fungi (multicellular organisms that obtain food by absorbing nutrients from their surroundings).

In the 18th century, a Swedish botanist, Carolus Linnaeus, began to classify all living things into smaller groups. Using the the Latin or Greek language, Linnaeus began to identify all living things using two names. The first name, referred to as a genus, would identify what group of similar species a living thing belonged to. The second name would identify the specific species within the genus. For example, the scientific name for a bottlenose dolphin is *Tursiops truncatus*. This system of naming living things using two words is referred to as binomial nomenclature.

You may wonder why Linnaeus did not simply use the common names with which people are familiar with when classifying all living things. For one thing, the same living thing may be called by different names in different places. A large member of the cat family is called a cougar, mountain lion or panther, depending on where people live. For another thing, the same common name may be used for different living things, such as several species of birds being referred to as robins. There is also a problem with misleading names. For example, a jellyfish is not a fish nor is it made of jelly.

Although Linnaeus is responsible for a great deal of the progress which has been made in classifying all living things, there still remains a great deal of work to be done. Every year more than 6,000 new species of plants, animals, protists, monerans or fungi are found, identified and named. Sometimes scientists are not always in complete agreement and have differing opinions as to how a particular species should be classified. For example, there is some disagreement within the scientific community over whether or not a virus is actually living. Though a virus can reproduce when inside of a living cell, it has no cell parts and does not grow. For these reasons some scientists believe a virus is a nonliving molecule. In contrast, other scientists believe that since a virus can replicate itself it should be considered living.

As scientists discover new organisms and change their views about what characteristics are important in classifying organisms, our classification system continues to change. For this reason, the classification of all living things remains an ongoing evolution.

1. What is the main purpose of this passage?
 - a) to explain how the classification of all living things has evolved over time
 - b) to explain binomial nomenclature
 - c) to acknowledge the individuals responsible for developing a system of classification
 - d) to identify the five kingdoms into which all living things are classified
2. Which of the following is an example of binomial nomenclature?
 - a) sea turtle
 - b) *Lepidochelys*
 - c) *Lepidochelys kempii*
 - d) *Lepidochelys* sea turtle

3. Which best explains why Aristotle only used a two kingdom classification system?
- a) Organisms later classified into other kingdoms did not yet exist 2,000 years ago.
 - b) Aristotle's classification system was developed using limited technology and was based upon limited research.
 - c) Aristotle only classified a small percentage of all living organisms during his lifetime.
 - d) Aristotle was a Greek philosopher and was not as educated as most scientists.

4. What point is the author trying to make when pointing out that some scientists believe a virus is a living organism, yet other scientists classify a virus as nonliving?
- a) our current system of classification is very impractical and must be improved
 - b) an organism can be both living and nonliving
 - c) classification is an inexact science and sometimes scientists have differing opinions
 - d) we need to create a sixth kingdom by which living organisms can be classified

5. How did Carolus Linnaeus improve the system by which we classify all living things? Use details and information from the passage.

6. Prior to the use of the five kingdom classification system, organisms today referred to as Monera would have been classified as which of the following?
- a) Protista
 - b) Plantae
 - c) Animalia
 - d) Fungi

7. Why does the author state "the classification of all living things remains an on going evolution?" Use details and information from the passage to explain.

8. The main purpose of this passage is to:
- a) entertain the reader
 - b) educate and inform the reader
 - c) debate an important issue
 - d) provide data which supports a theory

Glossary

approximation – each step in the process to shape the behavior of an animal.

biodiversity – the variety of living organisms that share our planet.

bycatch – nontargeted animals caught during a fishing operation (usually becoming entangled in a net).

cetacean – order of marine mammals consisting of all whale species.

circumnavigate – to go or travel completely around.

conditioned response – a specific action or behavior that is performed in response to a stimulus.

echolocation – the ability to locate objects by emitting sound waves and interpreting the resulting echo.

endangered – decreasing in numbers at an alarming rate; in danger of becoming extinct.

genus – grouping or classification of species that are closely related.

herbivore – an animal that primarily eats plants and vegetation.

innate behavior – actions or behaviors that animals are born knowing how to perform.

learned behavior – actions or behaviors that are learned through experience.

marine mammals – various species of mammals that feed on food sources primarily found in rivers, lakes, or oceans; includes animals such as whales, manatees, polar bears, sea lions, and seals.

nictitating eyelids – a membrane under the outer eyelid which provides additional protection to the eye in some species of sharks; this membrane covers the eye as these sharks feed.

pinniped – any of a number of “feather-footed” mammals including sea lions, seals, and walrus.

pod – a group of whales or dolphins that travel together.

predator – an animal that actively hunts and eats other animals.

prey – an animal upon which a predator feeds.

species – a group of genetically similar living organisms able to breed and reproduce with each other.

stimulus – an action or change in the environment that brings about a response.

Answer Key

Teacher’s Note: Only answers to questions with specific answers have been provided below. Answers that are subject to interpretation, opinion, or analysis may vary and have been omitted.

Threatened or Endangered? (Pg. 4)

Group	Endangered Species		Threatened Species		Total	% of all threatened and endangered animals listed
	United States	Foreign	United States	Foreign		
mammals	70	256	14	20	360	31.5%
birds	75	179	15	6	275	24.1%
reptiles	13	66	24	16	119	10.4%
amphibians	14	8	11	1	34	3.0%
fishes	74	11	65	1	151	13.2%
snails	24	1	11	0	36	3.2%
clams	62	2	8	0	72	6.3%
crustaceans	19	0	3	0	22	1.9%
insects	47	4	10	0	61	5.3%
arachnids	12	0	0	0	12	1.1%
TOTALS	410	527	161	44	1142	

Answers in the chart above appear in bold type.

- 937
- birds
- mammals
- fishes
- reptiles
- mammals and birds
- snails, clams, crustaceans, insects
- crustaceans and arachnids
- 82.05%
- 17.95%

Diet Composition, Distribution and Analysis (Pg. 5)

Total Diets: Killer Whale – 150 lb.; California Sea Lion – 20 lb.; Pacific Walrus – 60 lb.;
Bottlenose Dolphin – 30 lb.; Bull Shark – 1.5 lb.

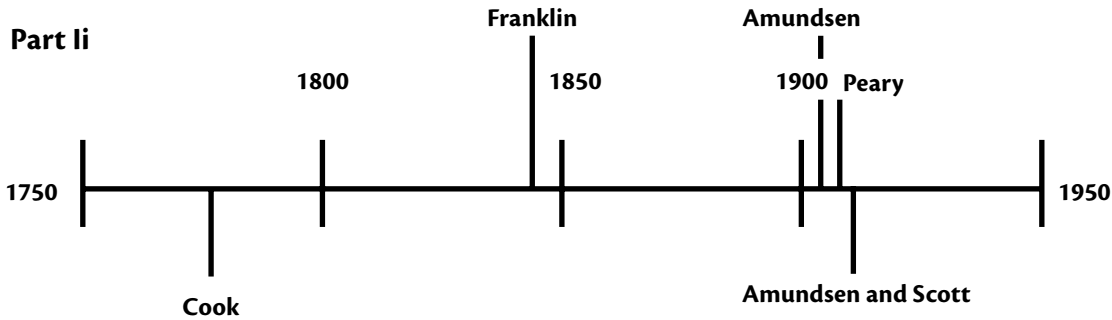
- 3%
- 750 lb.
- 3.5%
- Larger size, killer whale is warm-blooded
- Clams
- 33.3%
- Sea Lion; requires up to 8% of body weight per day.
- The Walrus has a slower metabolism, only requiring about 2.4% of its body weight per day. The Walrus has an advantage because of its thick layer of blubber (up to 6 inches thick) and also has a smaller surface area to volume ratio. This allows them to retain more of their body heat, which allows them to have a slower metabolism.

Exploring Polar Regions (Pgs. 6-7)

Part I

- Amundsen
- Cook
- a) Amundsen b) Franklin
- a) Amundsen and Scott b) Peary
- This offered the shortest distance to travel by foot from the shoreline of Antarctica to the South Pole.

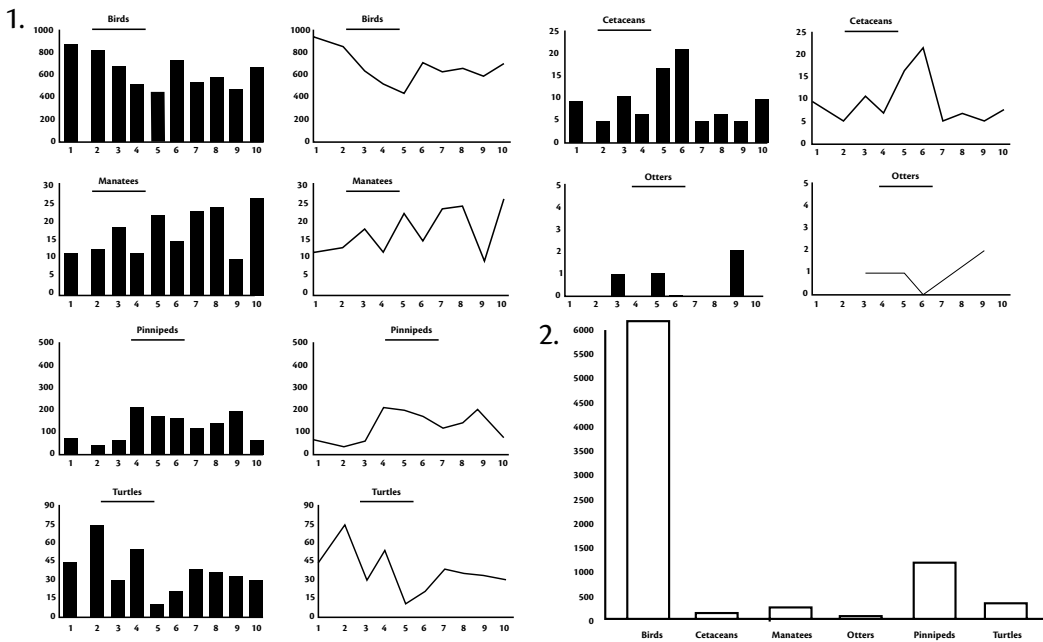
Part II



Part III

- The arctic is primarily frozen water surrounded by land. Antarctica is one large continuous stretch of land that is surrounded by water.
- It would greatly reduce the time and distance traveled between continents.
- Antarctic. It is separated from all other major land masses by large bodies of water. In contrast, the Arctic includes portions of North America, Europe, and Asia.
- a) Antarctic; Arctic; Arctic; Antarctic; Antarctic; Antarctic; Arctic

Lending a Helping Hand (Pg. 8)



- a) birds = 77.16%;
cetaceans = 1.08%;
manatees = 2.13%;
otters = .05%;
pinnipeds = 15.18%;
turtles = 4.4%
- b) 1 = 12.38%; 2 = 11.59%;
3 = 9.36%; 4 = 10.02%;
5 = 8.38%; 6 = 11.63%;
7 = 8.82%; 8 = 9.86%;
9 = 8.66%; 10 = 9.29%

Sea Turtles: Race for Survival (Pg. 9)

All of the items adversely affect sea turtles to varying degrees

Sea Turtles of Florida (Pgs. 10-11)

- Loggerhead, Green, Kemp's Ridley, Hawksbill
- Males have larger tails to encase the genitalia.
- Reddish-brown
- Gray to tan
- The color of their body fat is green due to their herbivorous diet.
- Kemp's Ridley
- Hawksbill
- Hawksbill and Green
- 18 inches
- The lights can disorient the hatchlings.
- Hawksbill
- Food, eggs, leather, chopsticks, eyeglass frames, tortoise shell jewelry
- Turtle Excluder Device (TED)

All About Animal Training (Pgs. 12-13)

1. b 2. a 3. c 4. b 5. c 6. c 7. a 8. a

Cetacean Photo Identification Activity (Pg. 15)

1. Hydrodynamic stability and thermoregulation
2. Answers will vary
3. Broader tail flukes and pectoral flippers; adult males are much larger in size
4. Females tend to dominate the pods socially.
5. Answers will vary
6. Answers will vary
7. Yes or no depending on observations
8. Normally groups of 2-5, but some killer whale pods may exceed 20 individuals.
9. Answers will vary, but the adult males tend to be more solitary.
10. Saddle patch (light area behind dorsal fin), scratch marks or abnormalities, color patterns, characteristics of tail flukes

Much to do About Marine Mammals (Pgs. 16-17)

1. There are three species of manatees: the West Indian manatee, the West African manatee, and the Amazonian manatee. The Florida manatee and the Antillean manatee are subspecies of the West Indian manatee. The West Indian and West African manatees inhabit rivers, bays, canals, estuaries, and coastal areas rich in seagrass and other vegetation. Amazonian manatees are restricted to fresh water. They are most common in floodplain lakes and channels. All manatees are grayish-brown in color. Amazonian manatees usually have white or pink patches on their belly and chest. All manatees have a large flexible upper lip and long whiskers called vibrissae. They don't have external ear flaps, but do have a very small opening to the ear canal. They use their flippers and paddle-like tail to propel them through the water. Manatees are nonaggressive, nonterritorial herbivores that spend most of their time feeding and resting. They will eat up to 100 pounds of vegetation each day and rest from two to twelve hours.
2. Growing to lengths of over twenty-five feet, killer whales are the largest members of the dolphin family. They inhabit all oceans of the world, but are most numerous in the Arctic, the Antarctic, and areas of cold water upwelling. Killer whales are found in both the open ocean and coastal waters. They travel together in groups called "pods." Though the worldwide population of killer whales is unknown, specific populations in a few areas have been

estimated. For instance, in some areas of the Antarctic alone, their numbers are estimated at about 180,000. Researchers have recently learned to identify killer whales by photographing and comparing their dorsal fins. Photo-identification promises to be an important new research tool for studying various aspects of killer whale biology, reproduction, behavior, and population dynamics.

5. a) 45 b) 78 c) 7.6 d) 5.2 e) 11,200
6. a) smaller b) bigger c) smaller d) smaller e) bigger
7. a) false b) false c) true d) false e) true f) false g) false h) true i) true j) false

Classification with Dichotomous Keys (Pgs. 18-19)

- | | |
|-------------------|---------------------|
| 1. Rajidae | 8. Pristiophoridae |
| 2. Scyliorhinidae | 9. Carcharhinidae |
| 3. Lamnidae | 10. Rhiniodontidae |
| 4. Squalidae | 11. Dasyatidae |
| 5. Heterodontidae | 12. Pseudotriakidae |
| 6. Hexanchidae | 13. Sphyrnidae |
| 7. Alopiidae | 14. Mobulidae |

Sharks: They're Not Just One of a Kind (Pg. 20)

1. no fin spines, 5 gill slits and 2 dorsal fins, anal fin is present
2. hammerhead sharks have nictitating eyelids, sand tiger sharks do not
3. angel shark
4. They have six or seven gill slits
5. carcharhiniformes
6. heterodontiformes
7. underneath its body
8. five
9. 5 gill slits and 2 dorsal fins, anal fin is present
10. no anal fin

FCAT Practice Exercise 1– Sharks Under Attack (Pgs. 23-24)

1. c 2. d 3. b 4. a 6. c 7. a

FCAT Practice Exercise 2– Downfall of an Ocean Titan (Pgs. 25-26)

1. c 2. d 3. b 4. a 6. a 7. b

FCAT Practice Exercise 3–Diversity of Life (Pgs. 27-28)

1. a 2. c 3. b 4. c 6. a 8. b

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