

Marine Mammal Adaptations Learning Centre

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Introduction

The marine mammal adaptations learning centre introduces students to what a marine mammal is and what kinds of adaptations marine mammals have to help them survive in the ocean. The centre includes many local species including pinnipeds (seals, sea lions, etc.), sea otters, toothed whales, and baleen whales; as well as species found elsewhere in the world such as polar bears and manatees. In this centre, students experience hands-on activities that range from looking at a whale bone, measuring the various body sizes of marine mammals, and learning about the evolutionary history of marine mammals, to experimenting with insulation, learning facts through a trivia game or crossword puzzle, and creating a bar chart.

While this centre may be suitable for any grade in middle school, from 6th grade to 8th grade, it was created with the Grade 7 curriculum in mind. This centre specifically addresses the following items in the Grade 7 B.C. curriculum:

- **Big Idea:** Evolution by natural selection provides an explanation for the diversity and survival of living things
- **Curricular Content:**
 - Organisms have evolved over time - change in traits of populations over time
 - Survival needs - all organisms need space, food, water, and access to resources in order to survive
 - Natural selection - the natural process by which certain traits that have a greater fitness for their environment lead to a reproductive advantage; this process happens within a population over time because of genetic variation.

Rationale for the Centre

Marine mammals make for a great lesson in evolution as they are a prime example of adaptation and natural selection over time. This centre would fit well in a classroom when beginning a unit on how different environments can cause selection pressure on animals, leading to evolution and diversity. Learning about marine mammals specifically can aid in introducing the concept of *convergent evolution*. Choosing this particular grouping of animals also allows for *place-based education* as we, on Vancouver Island, are quite exposed to the ocean and it is probable that the majority of the students here would have come across at least a couple of these animals in their lifetime. The topic of marine mammals, therefore, falls in line with keeping material relevant and authentic for students, and that is one of the goals with education. If any students express that they have not experienced these animals in the wild, teachers should consider organizing a field trip to one of the local marinas where seals live.

The activities in this centre promote science as they provide a variety of entry points for discovering marine mammals and their adaptations. The number of activities included in the

centre provides students with choice in terms of how they want to approach this lesson. In terms of cross-curricular connections, this centre mainly provides opportunities to integrate science concepts with *math*. This is done through activities that involve the creation of bar charts, calculating how many times one number is larger than another, and estimating sizes. This connection is important for students to experience as it is a good portrayal of how math and science are very integrated with one another in the research world.

Activities in this Centre

1. What Do You Know About Marine Mammals?
2. How Big???
3. Seals vs. Sea lions
4. Can You Handle the Cold Like a Marine Mammal?
5. Adaptation & Marine Mammal Trivia
6. Can You Beat a Marine Mammal in a Breath-Holding Competition?
7. Mystery Bone

Supplies Required

- Tri-fold, cardboard poster board (cut into 4 quadrants)
- See <https://www.youtube.com/watch?v=nDqP7kcr-sc> for whale sounds to accompany learning centres
- See appendix for photos that can be included throughout the centre
- “Mystery Bone” activity:
 - Whale bone
 - Cards with simple questions and answers on the back (see Appendix)
 - Magnifying glass
 - Photos of gray whales
- “What do you know about marine mammals?” activity:
 - Marine Mammal tree with velcro pieces (see photo in appendix)
 - Answer key (see appendix)
- “Can you beat a marine mammal in a breath-holding competition?” activity:
 - Stopwatch
 - Table describing how long various marine mammals can hold their breath (see appendix)
 - Graph paper (see template)
- “Marine Mammal & Adaptation Trivia” activity:
 - Trivia cards (see appendix)
 - See appendix for “Quiz Master” photo you can include in this station
- “Can you handle the cold like a marine mammal?” activity:
 - Table to record times (see appendix)
 - 1 pair of neoprene gloves

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- Stopwatch (1 or 2)
- Bin
- Ice water
- “Seals vs. Sea Lions” activity:
 - Sea lion and seal crossword puzzle PDF (see appendix)
- “How Big???” activity:
 - Cards with pictures of animal on one side and size on the reverse side (see appendix)
 - 30 m Transect tape

How to Design the Centre

Cut a tri-fold display into four pieces, and paint it to look like the ocean. With the aid of binder clips, nest the four pieces together to create four small cubby sections (it should look like a “+” sign from an aerial view). Use one entire section for the “Can You Handle the Cold?” activity (as it requires room for a large bin of ice water) and use the other three sections for two activities each. Cut up file folders and affix them to the walls of the centre to create pockets for the activity information and worksheets. Leave the boards and pockets generic so the same set-up can be used for other science centres.

Safety & Other Concerns

This centre has seven different activities and relies on a couple specialized items. Teachers should consider the following before attempting to carry this out:

- Access to a whale bone is not always possible, but one might be surprised to discover what people can offer by simply asking around the school and surrounding community.
- As neoprene gloves can be expensive, there is another way to simulate blubber using vegetable shortening. It is important to note that this method is messier and may be difficult to leave with students to carry out independently. See the following link for more information: <https://kids.nationalgeographic.com/explore/science/blubber-gloves/>
- The blubber glove requires a large amount of ice and this requires some prior planning.
- It is important to encourage students to pull their hands out of the ice water if in pain.
- Transect tape that measures up to 30 m is ideal for visualizing the size of a large Blue Whale, but this could be substituted with pre-marked rope or paper tape if necessary.
- Measuring the size of some marine mammals will require space larger than a classroom. Discuss with the students where they should go for this activity - hallway, gymnasium, outside, etc. - before starting the centre.
- One might consider assessing this centre with an “exit slip” type of assessment. This slip can include questions focused around the main teaching points from each of the activities in the centre.

References & Resources

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Appendix

Seals vs. Sea Lions

Use the information about pinnipeds to complete the crossword puzzle

Let's learn about Pinnipeds!

Seals, sea lions and walrus are a special group of marine mammals called pinnipeds. The word “pinniped” refers to them being “fin-footed” or “wing-footed”. There are 33 different species of pinnipeds. The closest living land relative to pinnipeds are bears!

California sea lions, the most commonly known species of sea lion, can be found all the way from Alaska to Mexico. Harbour seals are found in temperate and arctic water of the northern hemisphere as far north as Greenland.

Sea lions spend much of the year at sea, but come ashore from May to August when the males establish territories and the animals mate. They are very social animals. Male sea lions are much larger than females. They also have a special fatty bump on their foreheads called a sagittal crest. Females choose their mates, and avoid males that are too aggressive or energetic. Babies, known as pups are born in June or July and mothers nurse their pups between foraging trips.

Seals spend most of their time at sea but breed and give birth on land or pack ice. After giving birth, females are often very far from their feeding grounds and must fast while nursing, relying on built up fat stores to sustain themselves.

Differences

There are many differences between seals and sea lions. One of these is their ears - sea lions are sometimes called “eared seals” because they have external ears. Seals have internal ears, making their heads look much more sleek. Sea lions can also walk on their four flippers by rotating the back ones forward towards their body. Seals are much less mobile on land because their front flippers are small and their rear flippers don’t rotate forward.

Feeding

Pinnipeds are opportunistic feeders which means they eat almost anything they can catch. This includes fish, krill, plankton, squid, molluscs and crustaceans, other marine mammals, and even birds. And they can eat a lot! Male sea lions eat about 45 pounds of fish each day. Pinniped whiskers have special nerve endings to help them detect vibrations of fish and other prey in dark and murky waters. Their conical teeth are perfect for catching and holding slippery fish and squid. They eat small fish whole, and come to the surface to take bite sized chunks, so they don’t need to have grinding and chewing teeth like many land mammals.

Pinnipeds are great swimmers and divers. The deepest recorded dive was by an elephant seal at 4,125 feet!

Warmth

Like whales and polar bears, pinnipeds have blubber. This is a layer of specialized fat under their skin that acts as an insulator. An insulator is something that is a poor conductor of heat, which means that the body heat of the animal doesn’t pass into the cold ocean water easily.

Can You Beat a Marine Mammal in a Breath-Holding Competition?

Marine mammals don't have gills, so they can't breathe underwater like fish. They have to come to the surface of the ocean to get oxygen, like humans! But they can stay underwater longer than we can because they can hold their breath for a long time.

1. Check out how long the mammals below can hold their breath underwater.
2. Choose 5 mammals and use the graph paper provided to create a bar chart of how long they can hold their breath.
3. Use the timer to see how long you can hold your breath.
4. Add your time to your bar chart.
5. Calculate how many times longer a Curvier's beaked whale can hold their breath than you. Record this on your graph.

Mammal	Time
Elephant Seal	2 hours
Fin Whale	20 minutes
Weddell Seal	70 minutes
Humpback Whale	45 minutes
Dolphin	10 minutes
Orca	15 minutes
Sperm Whale	90 minutes
Curvier's beaked whale	2 hours and 20 minutes

Mystery Bone

Do you know what kind of bone this is?

What kind of animal do you think it is from?

A vertebrae from a Gray whale

What do you notice about the vertebrae?

Can you see anything interesting when you look up close?

How Big???

There are many different types of marine mammals in the Pacific ocean and therefore a variety of sizes! Some marine mammals, like whales, have evolved to be quite large to aid in minimizing heat loss! Each of the species you will find on these cards have evolved to be a size that is well-suited to their lifestyle in terms of how they mate, how they find their food, how far they migrate, how they stay warm, etc.

Can you guess how big the marine mammals on these cards can get?

Instructions:

- Go through the following cards containing pictures and names of various marine mammals and, using the tape measure, visualize how big you imagine that mammal to be
- Once you've made your guess, turn the card over and discover the actual size - measure that out with the tape measure and see how accurate your guess was!

Answer key:

Marine mammals and their sizes (*retrieved from The Marine Mammal Center, 2020*):

- Sea Otter: 1.5 m
- Harbour Seal: 1.9 m
- Steller Sea lion: 3.25 m
- Male Elephant Seal: 4 m
- Female Elephant Seal: 3 m
- Gray Whale: 14 m
- Blue Whale: 27 m

Can You Handle the Cold Like a Marine Mammal?

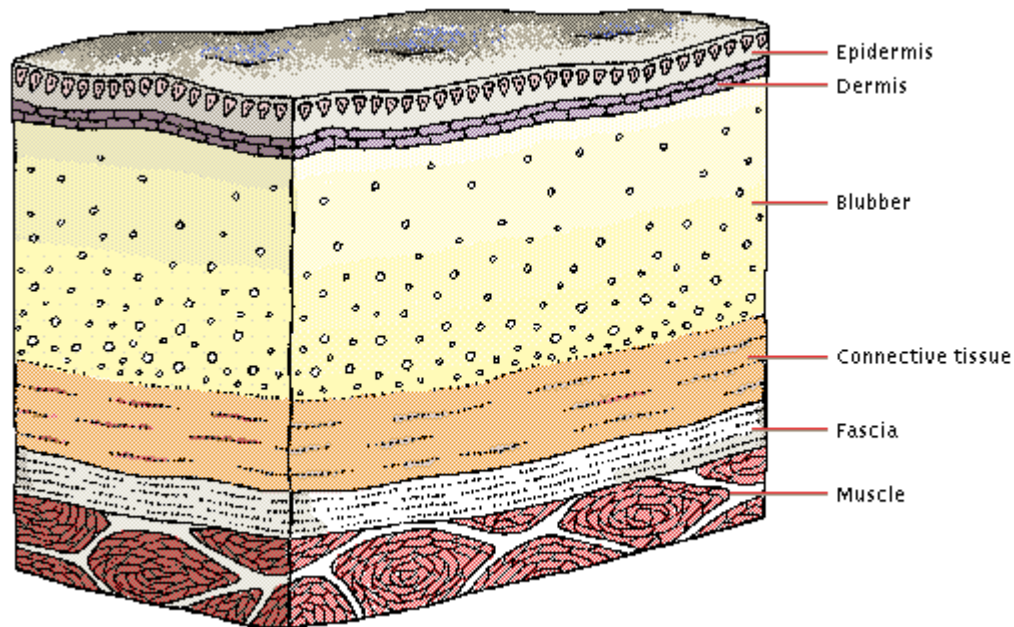
One of the challenges that comes with living in the ocean is that it is quite chilly!!

Brrrr...

So, how do marine mammals spend their entire lives in this environment? There are quite a few ways in which marine mammals have evolved to conserve heat in their bodies, and one of these ways includes something called *blubber*.

What is blubber?

Blubber is a specialized layer of fat found beneath the skin layer. It is *only* found in marine mammals! It is different than other body fat tissue in that it is adapted to serve as an adjustable thermal insulator. Furthermore, blubber affects buoyancy and acts as a body streamliner and elastic spring for efficient movement in water!
(Retrieved from Science Direct, 2020)



http://www.lausd.k12.ca.us/Figueroa_EL/images/Survival/Blubber.gif

Fun Fact:

Not every marine mammal has blubber. Can you think of one that might use another tactic to stay warm? (Hint: they were very popular during the *fur trade*) If you guessed **sea otters**, you would be correct! Instead of using a layer of blubber, sea otters use their dense *fur* to stay warm. Sea otters have the thickest fur of any mammal with up to 1 million hairs per *square inch*!! That is more hairs than there are on your whole head! If you were to observe sea otters, you may catch them grooming their hair and “scratching” their heads. As they do this, they are actually fluffing up their fur, filling the spaces between the hairs with air in order to keep their bodies better insulated from the cold.

Instructions:

Place a neoprene glove on only one of your hands, the other hand should be bare. Have your partner start the stopwatch as you place both hands in the bucket of ice water. Record how long you can keep each hand in the ice water in the table provided. You and your partner may carry this out at the same time, however, in this case you would need to find a third person to be in charge of the stopwatch and recording time.

Caution: Use your better judgment! If your hand is in a lot of pain, remove it from the ice water.

Discuss the following questions: Which hand lasted longer? Did the neoprene glove help? What do you think the glove was representing in this activity?

What do you know about Marine Mammals?

We know you've learned a lot about marine mammals in school, so can you tell a friend what makes a mammal a *marine* mammal? Take a minute to discuss with your partner/group what defines a marine mammal.

Next, can you think of any marine mammals that spend most of their lives on land? Discuss.

Ok, now that you've had the chance to talk these questions over, flip up this page and look under the flap for the answers.

Next, we know that because marine mammals are mammals that they evolved from terrestrial animals. Some ancestors of marine mammals never moved to the ocean. Can you correctly fill in the blanks on this chart showing the 3 groups of marine mammals and their closest living land relatives by sticking on the appropriate mammal names?

Answer: Marine mammals are aquatic mammals that rely on the ocean and other marine ecosystems for their existence. They include animals such as seals, whales, manatees, sea otters and one species that spends most of their lives on land: polar bears! They all rely on marine environments for *feeding*.

Answer Key for Marine Mammal Tree

Marine Mammals:

Line 1: Whales - Porpoises - Dolphins

Line 2: Dugongs - Manatees

Line 3: Seals - Sea Lions - Walruses

Closest Living Relatives:

Line 1: Hippopotamus , then - Deer - Sheep - Cows

Line 2: Elephants - Hyraxes

Line 3: Bears - Weasels - Dogs - Skunks

Pictured: Marine Mammal Tree

There are *three* groups of marine mammals:

The cetaceans

- they have evolved to become the dominant group of marine mammals, with the highest levels of taxonomic and ecological diversity, as well as the widest geographic range. They evolved from a group of hoofed terrestrial ancestors within the order Artiodactyla more than 50 million years ago during the Eocene period.

The sirenians

- they are the only herbivorous marine mammals, and appear to have originated during the same period as the cetaceans. They also evolved from a primitive group of hoofed animals.

The pinnipeds

- they are the youngest group of marine mammals, and still have adaptations to some extent for both land and marine living. They are Arctoid carnivores within the order Carnivora, originated about 25 million years ago during the late Oligocene period.

Marine Mammals

Porpoises

, then

Sheep

Closest Living Relatives (land)

Dugongs

Walruses

Weasels

Marine Mammal & Adaptation Trivia

Alright scientists, let's test your general knowledge about marine mammals. Pick one person to be the Quiz Master and have your partner/group attempt to answer these brain busters. Once a few questions have been posed, have someone else take a turn at being the Quiz Master!