

Big Blowout

A blowhole is an organ found on top of a whale's head, much like a nostril. Unlike a human nose, the blowhole and esophagus are not connected, meaning that the whale's mouth is only used for eating, and its blowhole is only used for breathing. Toothed whales have a single hole, while baleen whales have two. When a whale exhales, it breathes out a mix of warm air and bacteria from inside its respiratory system. As this warm air contacts the cold air outside the whale's body, the water vapour condenses into droplets, creating a spray. The spray can also include seawater resting on top of the blowhole. When the whale dives under the water, muscles around the blowhole close, sealing the blowhole and making it water tight.

Materials:

- 2L plastic bottle
- Balloon
- Straw
- Bowl
- Sticky tack
- Water
- Ruler
- Scissors

Method:

1. Begin by creating a hole 12cm from the bottom of the bottle, just large enough for the straw to fit into.
2. Push the straw into the hole and then place the sticky tack around it to seal the hole.
3. Fill $\frac{3}{4}$ of the bottle with water and place a bowl under the straw to catch any water.
4. With the lid unscrewed, place an inflated balloon over the opening of the bottle.
5. Observe what happens and think about applying this in relation to a whale's blowhole.

What's Going On?

In this experiment, the balloon mimics the whale's lungs, contracting and expanding as the whale breathes in and out. When the whale breathes out, its muscles contract and increase the air pressure inside its lungs. This forces air out of its blowhole, just as water is pushed out of the straw in the experiment.

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Extension:

Scientists initially thought that the blowhole was located atop a whale's head to avoid seawater entering the whale's respiratory system. Research has now shown that some whales dip back into the ocean without closing their blowholes first. This has caused some concern, as scientists have found bacteria in the spray, which has given them important information about diseases and the impact of toxic pollutants.

Oil spills are one form of pollution that can be highly damaging to marine life, including whales, as they could inhale crude oil and toxic oil fumes. In the past, this has decreased the population of whale species in certain areas and even affected birth rates. To reduce the impact of an oil spill, different methods have been attempted to keep whales away from the contaminated area. These include:

- Devices that create a sound that whales likely avoid
- Bringing more boats around the area, creating noise and movement
- Helicopters that make noise and wave movement
- Using fire hoses to spray water at whales

Unfortunately, these methods don't always work.

Materials:

- Container to hold one litre of water
- Salt
- Measuring jug
- Vegetable oil
- Water
- Sponge
- Cotton balls
- Dishwashing liquid
- Spoon
- Images of oil spills

Big Blowout

Extension:

Method:

1. The salinity of seawater is about 35 grams of salt per one litre of water. One litre of water weighs 1000 grams, so salt makes up 3.5% of this. Using this information, fill the container with one litre of water, then add in the correct amount of salt to match the salinity of seawater.
2. Pour some vegetable oil into the container and observe how it interacts with the water. Why does the oil float on top of the water? Imagine a whale was breaching the surface of this water to exhale and inhale. What would happen if the whale's blowhole did not close entirely before going under the water again?
3. Using the sponge, cotton balls and spoon, try to remove the same amount of oil from the water as you added.
4. Then add a squirt of dishwashing liquid. How much oil were you able to remove from the water?

Looking at the images of oil spills, discuss ways that we could reduce the harm to whales in the event of an oil spill.

Hubba Blubber

Blubber is a thick layer of fat underneath the skin of all marine mammals. It covers their entire body except for their fins, flippers and flukes. Blubber has three main functions: insulation, storing nutrients and buoyancy. Storing nutrients and energy in their blubber means that whales can go for a long time without eating, something important during their migration or when mothers nurse calves. Because whales are warm-blooded, their body temperature needs to stay the same, even in the coldest waters. They can live in these cold waters because blubber insulates the whale, keeping the heat inside its body. Buoyancy simply means a whale's ability to float; think of blubber acting like a lifejacket.

Materials:

- Ice cubes
- Big bowl
- Zip-lock bags
- Cold water
- Solid shortening or fat
- Spatula
- Towel
- Duct tape
- Watch or timer

Method:

1. Fill the large bowl with cold water and ice cubes. Place your hand inside the bowl, and time how long it takes before your hand becomes too cold to keep in the water. Record your time.
2. Cover the outside of one ziplock bag with shortening, then place this bag inside a second with both openings in the same direction.
3. Place your hand in the innermost bag, using duct tape to seal around your arm, then put your 'glove' into the ice-cold water. Measure how long it takes before your hand becomes too cold to keep inside.

What's Going On?

Shortening is made of fat and has similar properties to blubber. Fat is an insulator, meaning heat is kept in, and cold is kept out. Blubber doesn't need much blood supply, so the heart can send more blood to parts of a whale's body that aren't protected by blubber, like the fins, flukes and flippers. The shortening acts as a layer of blubber between your hand and the cold 'Antarctic' waters. It insulates your hand, keeping the heat in and the cold out. A whale's layer of blubber is much thicker than the shortening in your glove, making it even better at keeping the whale at the same temperature no matter how cold the water gets.

Hubba Blubber

Extension:

One of the reasons a whale may not survive a stranding event is overheating. Blubber keeps a whale warm even in the coldest Antarctic waters, but when they are out of the water for long periods of time, they become at risk of heatstroke. For this reason, it is vital to keep a whale's body wet and cool while volunteers are trying to refloat a whale.

Materials:

- Four large sponges
- Two light-coloured, thin sheets of fabric, large enough to cover a sponge
- Water
- A shady area
- An area in direct sunlight
- Four bowls/containers

Method:

1. Soak the four large sponges with water, then place two in a shady area and two in an area with direct sunlight.
2. Soak the fabric with water, and place one piece over a sponge in the shade and the other over one sponge in the sun.
3. Depending on the day's heat, check the sponges every 30 minutes to an hour to see how much water has evaporated. Every time the sponges are inspected, re-soak the fabrics and place them back over the same sponges.
4. Towards the end of the school day, remove the fabric sheets and squeeze the remaining water from each sponge into a separate container. Measure the amount of water from each sponge.

Hubba Blubber

Extension:

Discussion Points

What do you notice about the amount of water left in each sponge? Which one had the most amount of water left?

What does 'warm-blooded' mean? How does the human body keep its core body temperature stable?

What factors would contribute to a whale suffering heatstroke on land? E.g. types of weather, wind.

Think about the process of evaporation. Can you explain how the sponges went from being completely wet to dry?

What is the connection between how wet the sponge was and the temperature?

Feeding Frenzy

Whales can be put into two categories; baleen whales and toothed whales. Baleen whales have plates of keratin instead of teeth. Keratin is the same material that our hair and nails are made of. These plates look like a comb and hang down from the top of the whale's mouth. When the whale takes a mouthful of water, it closes its mouth and pushes the water out between the plates, trapping prey inside its mouth. Think of it as a giant sieve. This process is called **filter feeding**.

Materials:

- Crisp rice cereal
- Plastic comb or a brush
- Chopsticks
- Plastic tub, just large enough for the cereal to float
- Hand towel
- Water

Method:

1. Fill the plastic tub with water, enough so the cereal will float but not so much that it spills out the top.
2. Sprinkle some crisp rice cereal onto the surface of the water.
3. Pull the comb across the top of the water, observing how much cereal you scoop up.
4. Remove the cereal from the comb and place it onto a paper towel, counting how many pieces you have collected.
5. Think about how the comb traps the cereal against the bristles while allowing water to pass through.

Think on This

Using what you know about how different whales eat, do you think a toothed whale or a baleen whale consumes more food? Why is that? What does this generally tell you about the size of the whale?

How much control do you think a baleen whale has on what is present in the mouthful of water it takes? Might there be things in the water other than prey?

Feeding Frenzy

Extension:

When we think of plastic pollution in the ocean, it's easy to imagine plastic bags floating through the water or old plastic bottles. Did you know that the biggest plastic problem is so small we can barely see it? Over time, large pieces of plastic break down into much smaller pieces, even less than 1mm long. We call these small pieces microplastics. Scientists estimate there are 14 million tonnes of plastic just sitting on the ocean floor – that doesn't include the stuff floating in the water! Microplastics can create health problems for whales, whether this is because their prey has ingested the microplastics first or because they are present in the mouthfuls of water taken when baleen whales filter feed. Microplastics are not what they should be feeding on!

Materials:

- Gloves for each student handling rubbish
 - One day's worth of waste in the classroom rubbish bin
 - Tarpaulin
 - Hand soap and towel
 - Well-ventilated space
 - Paper or whiteboard to record findings on
 - Pen or whiteboard marker
 - Bags
- Put gloves on before beginning, and lay the tarpaulin out flat onto the floor of your space.
 - Empty the classroom rubbish bin onto the tarpaulin and discuss which categories the items could be put in. As we are looking at plastics, think specifically about material types.
 - Sort the items into the agreed categories and count the pieces of rubbish in each.
 - How much plastic material did you find? How much is food waste and could be composted instead?

Feeding Frenzy

Extension:

- Record findings on a piece of paper or whiteboard. Your class might like to do this over a while and actively try to reduce plastic usage. By recording your data on the whiteboard, you can compare the changes you see over that period.
- Return the items to the rubbish bin.
- At another time, take a walk around the school. Using the same categories agreed on in the first part of the activity, collect items of rubbish found around the school into separate bags.
- Analyse the contents of each bag on the tarpaulin laid out in the previous activity and re-record your findings.

Discussion Points

Which material did you find the most in your classroom rubbish bin? Around the school? Does this material go in the landfill, recycling or compost?

Think about the plastic items found in your classroom rubbish bin and around the school. What changes could you make to reduce the amount used?

What would have happened to the rubbish found around the school if you had not picked it up?