How is your heart rate affected by diving?

When marine mammals dive they stay under water for a long time. To do this they need to make the oxygen in their body last the length of the dive. Oxygen is carried around a mammal's body through its blood. When mammals dive they need to change their heart rate to reduce the blood flowing through the body. By doing this they will use less oxygen. Today we will see if a mammal's heart rate will increase or decrease when diving in cold water.

Set a hypothesis: What will happen to your pulse when you dip your head into the water? Will it increase or decrease?

Required materials: Basin, cold water (approx. 10 °C), thermometer, fingertip pulse, stopwatch, paper towel.

Method:

1. Record the water temperature.
2. Begin by making a reference measurement.
   a. Put the pulse oximeter on your finger and measure your heart rate.
   b. Record the result.
3. Dip your head into a basin of cold water.
   a. Put the pulse oximeter on your finger and measure your heart rate for 2 minutes.
   b. Record your result.

Results

<table>
<thead>
<tr>
<th>Name</th>
<th>1. Water Temperature</th>
<th>2. Reference Heart Rate</th>
<th>3. Heart Rate after head in cold water</th>
</tr>
</thead>
<tbody>
<tr>
<td>Elephant seal</td>
<td>0</td>
<td>120 bbm</td>
<td>40 bbm</td>
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</table>
Summary: What happened to your pulse when you dipped your head in the water? What do you think this means?

All mammals breathe in oxygen from the air. Mammals store oxygen in their blood and muscles. The diving reflex happens when mammals dive in cold water and their bodies use their oxygen supply as little as possible. Using less oxygen means they do not have to come to the surface for air too often and so can stay underwater longer. Today we will investigate one part of the diving reflex. We will see what happens to a human’s heart rate when our face is in contact with cold water. The heart rate will be reduced and so the diving reflex has been activated. This means less blood is moving around the body and therefore less oxygen will be used when diving. The reflex is stronger in marine mammals, which allows them to stay under water for a longer period of time.
Pressure underwater

What happens to your lungs when pressure increases?

On land the weight on air above our heads is pushing down on us, this is called atmospheric pressure. In the oceans this pressure increases because water is heavier than air. It increases the deeper one dives in the ocean. When pressure increases it compresses the air in a body, so the air will shrink. The opposite will happen when pressure is reduced, the amount of air in a body will expand. When air is compressed by high pressure the gases in it become toxic and can enter different parts of the body. If the pressure is reduced the toxic gases will expand and can cause a sickness. Marine mammals avoid this by getting rid of all the air in the lungs before they dive.

Set a hypothesis: When you go deeper below the surface of the water, the pressure will increase. What happens to the lungs when pressure increases?

Required materials: Basin, cold water (approx. 10 °C), thermometer, fingertip pulse, stopwatch, paper towel.

Method:
1. Blow the balloon up inside the bottle.
2. Study the balloon that is in the bottle.
3. Record what it looks like.
4. Increase the pressure in the bottle by pumping in more air.
5. Record what it looks like.

Results: Balloon before increasing the pressure:

Balloon after increasing the pressure:

Summary: What happened to the balloon? What do you think this means?
Pressure underwater

Water has a greater density than air, which means it is heavier. This means when mammals dive underwater there is more pressure pressing on their bodies, this pressure squeezes the body. We measure this pressure in atmospheres. When a mammal is on land the pressure on the body is 1 atmosphere. When a mammal dives the pressure pressing onto the body increases. At 10m the pressure is 2 atmospheres, at 20m the pressure is 3 atmospheres etc. This pressure causes any air in the body to be compressed when diving down into deep water. When air is compressed the gases in the air can enter the body. When the pressure is reduced the gases expand and can become toxic in the body. If this happens a mammal may suffer so-called decompression sickness. Many marine mammals avoid this by getting rid of most of the air in their lungs before a dive.
Thermoregulation and insulation

How is your strength affected in cold water?

Heat is lost 20 times faster in water than in air and the temperature in the ocean is much colder than air temperature. When mammals dive they need to stay warm and avoid getting too cold. One of the ways they do this is with a thick layer of insulation called blubber or fur covering their body. The blubber and or fur avoids heat lost from the body to the water. The mammals need to stay warm to be able to use their muscles and swim deep in the ocean. Today we will investigate how cold water can affect our muscles.

Set a hypothesis: What will happen your strength when you put your hand in cold water? Will your strength be affected? Will you get stronger or weaker?

Required materials: Basin, cold water (approx. 10 °C), thermometer, fingertip pulse, stopwatch, paper towel.

Method:

1. Record the temperature of the water.
2. Begin by making a reference measurement.
   a. Pick up your hand and squeeze the hand dynamometer as hard as you can.
   b. Record your strength and record the results in the table.
3. Now put on cotton glove and a thin plastic glove.
   a. Dip your hand in a bucket of cold water for 60 seconds.
   b. Pick up your hand and squeeze the hand dynamometer as hard as you can.
   c. Record your strength in the table.
4. Then remove the glove and dip your hand in the cold water for 60 seconds.
   a. Pick up your hand and squeeze the hand dynamometer as hard as you can.
   b. Record your strength in the table.

Results:

Summary:
Is there any difference between the different situations when you dip in your hand in the water? What does this mean?

Thermoregulation is when an organism is able to keep its body warm even if its surroundings are colder. Insulation prevents the loss of heat from a body. When marine mammals dive into cold water they need to keep their bodies warm. One way they do this is by having an extra thick skin layer called blubber or fur. This blubber helps insulate the body and allows the animal to stay in the water without getting hypothermia. Today we will investigate what would happen to the muscle strength of a mammal with or without insulation in cold water.
Thermoregulation and insulation

Results:

<table>
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<tr>
<th>Name</th>
<th>1. Water Temp (°C)</th>
<th>2. Reference (kg)</th>
<th>3. Hand in water with glove (kg)</th>
<th>3. Hand in water no with glove (kg)</th>
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Summary: Is there any difference between the different situations when you dip in your hand in the water? What does this mean?

Thermoregulation is when an organism is able to keep its body warm even if its surroundings are colder. Insulation prevents the loss of heat from a body. When marine mammals dive into cold water they need to keep their bodies warm. One way they do this is by having an extra thick skin layer called blubber or fur. This blubber helps insulate the body and allows the animal to stay in the water without getting hypothermia. Today we will investigate what would happen to the muscle strength of a mammal with or without insulation in cold water.
The diving reflex

Set a hypothesis: What will happen to your pulse when you dip your head under the water? Will it increase or decrease? The heart rate will decrease because mammals needs to use less oxygen when they dive deep under water.

Summary: What happened to your pulse when you dipped your head in the water? What do you think this means? For example: My heart rate went down. When mammals go diving their heart rate decreases. This happens so they can use less oxygen around the body. By doing this the mammals can stay underwater for a longer period. Mammals breathe oxygen through the air. By decreasing the oxygen used in their bodies means they do not need to come back to the surface for air too often and can dive deeper. The elephant seal has a bigger change in heart rate so it can stay under water longer than humans.

Pressure underwater

Set a hypothesis: When you go deeper below the surface of the water, the pressure will increase. What happens to the lungs when pressure increases? The air inside the lung will shrink.

Results: Balloon before increasing the pressure: The balloon is inflated. Balloon after increasing the pressure: The balloon is deflated.

Summary: What happened to the balloon? What do you think this means? For example: The air in the balloon was compressed. This happened because the pressure around the balloon increased. When pressure increases in a closed area the volume in the closed area will decrease in direct proportion. If mammals did not collapse their lungs before diving deep when they resurface they could become ill because the gasses in the air expand and become toxic.

Thermoregulation and insulation

Set a hypothesis: What will happen your strength when you put your hand in cold water? Will your strength be affected? Will you get stronger or weaker? My strength will be weaker after it has been in cold water without insulation (the glove). There should be no change when my hand has insulation (the glove) around it.

Summary: Is there any difference between the different situations when you dip in your hand in the water? What does this mean? For example: The strength in my warm was weaker after leaving my hand in the cold water with no glove on. This means my arm lost heat in the water faster when it had no insulation. My muscles have less strength when they were cold. If marine mammals did not have insulation they would not be able to swim in cold water because their muscles would not be able to work properly.