An investigation into how animals survive winter months

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Past module on Energy

Introduction

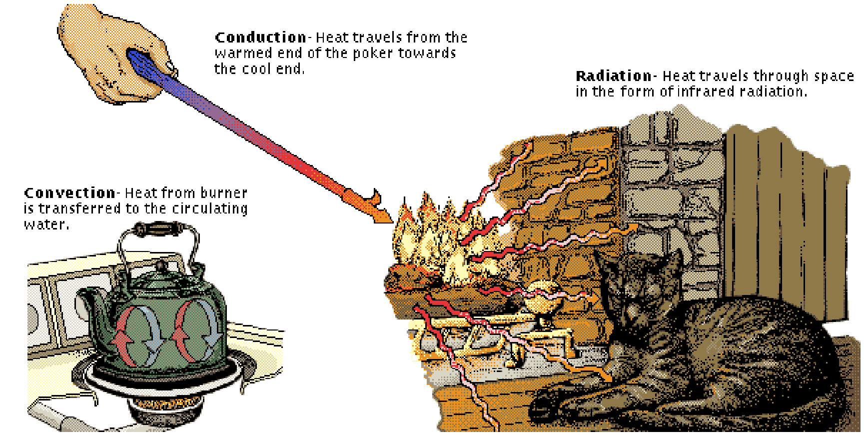
This assessment is all about investigating how animals manage to su rvive the cold winter months. Using some research I have undertaken, I have found out that warm-blooded animals use several ways of surviving the winter. These include the following:

- **Migration**
  Many birds migrate to warmer regions
- **Insulation**
  Many animals are insulated against the cold by means of fur, blubber or feathers
- **Huddling**
  Some animals keep each other warm by huddling together
- **Hibernating**
  Some animals reduce their use of energy by hibernating.

From the factors that I have pointed out above, I have f ound out that it is possible for an animal to survive the cold winter months but which method works best? That is what this investigation is set up to discover, which method of keeping warm is the best for warm-blooded animals. We will do this by using test tubes and hot water instead of real animals, as real animals are hard to find and test on.

I have also found out quite a lot about the different ways that heat can escape, as this will help my investigation if I know some background knowledge. There are three main ways in which heat can escape from bodies these are:

- **Conduction**
  This is the transfer of heat through a substance without it moving because of a difference in temperature. It uses free electrons to travel so that the object doesn't have to move . It requires physical contact between the bodies or portions of bodies exchanging heat.
- **Convection**
  This is the transport of heat in a fluid by the motion of the fluid itself. It occurs through the motion of a liquid or gas in contact with matter at a different temperature.
- **Radiation**
  This is the transfer of infrared heat by waves with no particles of matter being involved. It does not require contact or the presence of any matter between the bodies.



Aim

The aim of this investigation is to investigate how animals keep warm in cold climates. To do this I will compare two different types of insulation, bubble wrap and shredded paper to five different thicknesses, rising by 2cm each time. This will give me a range of thicknesses to conclude and evaluate from. From looking at the separate results, I will then be able to find out which type of insulation works best and which type of animal insulation these are compared to.

Prediction

I think that the bubble wrap will work the best because it has pockets of air in it and air is a good insulator. This is because it offers lots of resistance to heat flow. Insulating properties become poorer if the air space becomes large enough to allow thermal convection, or if moisture seeps in and acts as a conductor so this means that air is a good insulator. Less heat will be lost through the convection currents because the air is trapped in the pockets so it cannot move. This also means that the electrons are colliding into each other with more force due to the smaller surface area so more heat will be conducted.

<u>Test One</u>

For the first test, I will be investigating how much insulation of bubble wrap is needed to give hardly any heat loss. I will do this by increasing the amount of bubble wrap insulation by 2 cm each time so that I build up a range of thicknesses.

Prediction

I think that I will not need that many layers of bubble wrap insulation because bubble wrap has pockets of air inside it. Air is a good insulator as explained in the prediction so therefore as insulators are good at reducing convection currents, less heat will be lost through convection currents so there will be more heat to warm the water (animal).

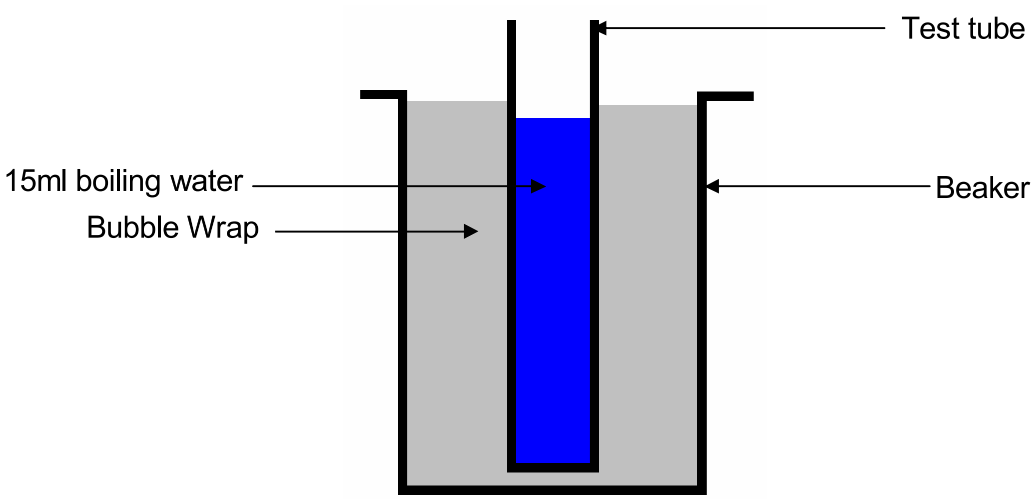
Apparatus List

The apparatus I will use for my testing will be:

- Stop Watch

- Five test tubes
- Five different sized beakers (increasing by 2cm thickness each time)
- Thermometer
- Hot water
- Bubble Wrap
- Measuring cylinder

Diagram



Method

1. Set up the apparatus as shown above.
2. Wrap a thickness of 2cm of bubble wrap before the water has been poured in the test tube (we will do this so we have a variety of different thicknesses) around the test tube and place the thermometer into the tube.
3. Test the temperature of the water, record and start the stopwatch.
4. When 1 minute is over, test the temperature for a second time and record.
5. Repeat for another 9 minutes until 11 temperatures have been recorded.
6. Then, repeat steps 2-7 for the thicknesses of 4cm, 6cm, 8cm and 10cm, recording all of the results.
7. If you need a more accurate result, repeat each of the different thicknesses another two times and then find out the average.

Fair Test

To keep this a fair test I will ensure that the following stay constant:

- The amount of water in the test tube.
- The temperature of the water at the beginning.
- The time the experiment is being timed for.

- The insulation used.
- The angle that the test tube is placed into the beaker. This is so that none of the water spills out of the test tube at an awkward angle as this would disrupt the results.

Results

<u>Test Two</u>

For the second test, I will be investigating how much insulation of shredded paper is needed to give hardly any heat loss. I will do this by increasing the amount of shredded paper insulation by 2cm each time so t hat I build up a range of thicknesses.

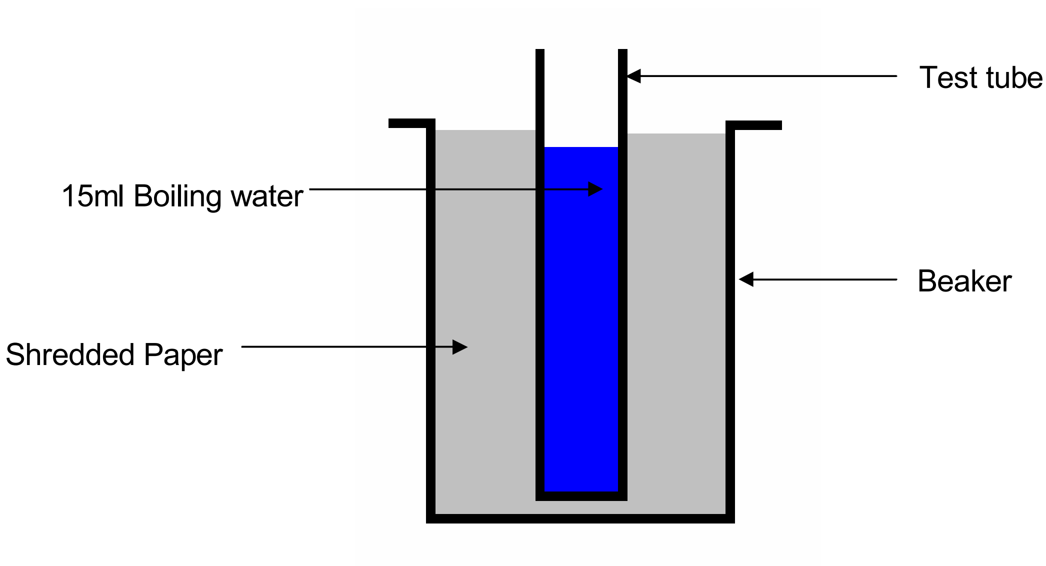
Prediction
I think that I will need quite a few layers of shredded paper insulation because the heat will be able to escape easily from the test tube through the gaps in the paper. Although the shredded paper will not be a good absorber of heat, it will be however a good insulator as they are good thermal insulators the heat is not transmitted so the heat will take longer to pass through the shredded paper.

Apparatus List

The apparatus I will use for my testing w ill be:

- Stop Watch
- Five test tubes
- Five different sized beakers (increasing by 2cm thickness each time)
- Thermometer
- Hot water
- Shredded paper
- Measuring cylinder

Diagram



Method

1. Set up the apparatus as shown above.
2. Wrap a thickness of 2cm of shredded paper before the water has been poured into the test tube (we will do this so we have a variety of different thicknesses) around the test tube and place the thermometer into the tube.
3. Test the temperature of the water, record and star t the stopwatch.
4. When 1 minute is over, test the temperature for a second time and record.
5. Repeat for another 9 minutes until 11 temperatures have been recorded.

6. Then, repeat steps 2-7 for the thicknesses of 4cm, 6cm, 8cm and 10cm, recording all of the results.
7. If you need a more accurate result, repeat each of the different thicknesses another two times and then find out the average.

Fair Test

To keep this a fair test I will ensure that the following stay constant:

- The amount of water in the test tube.
- The temperature of the water at the beginning.
- The time the experiment is being timed for.
- The insulation used.
- The angle that the test tube is placed into the beaker. This is so that none of the water spills out of the test tube at an awkward angle as this would disrupt the results.

Results

Conclusion

Test One - Bubble Wrap

The graphs show that that although there are a few points not connected to the line of best fit, overall my results were very accurate as a show of the average results for each thickness of insulation for bubble wrap. They also show that there is quite a large gap between the points from the thickness of 10cm and the thickness of 8cm. This shows me that there must have been a slight mishap in taking the results; something must have gone slightly wrong in the experiment.

Overall, the graphs show me that the more insulation added, the less heat is lost. It also shows us that if we had carried the experiment on for about 20 minutes, the lines of best fit would h ave eventually not lost any more heat.

This conclusion works because using the idea of, less heat being lost through convection currents because the air is trapped in the pockets so it cannot move, we are able to see that (as the graph shows us) the pock ets of air trapped inside bubble wrap are insulators. This is because air is a good insulator because it offers lots of resistance to heat flow. The graph shows us that the more bubble wrap you have, the more insulator you have which therefore means the less heat lost through convection currents. Although heat is still being lost by radiation and conduction, not much heat is being lost through convection currents apart from through the top of the tube where heat will be lost through radiation.

Test Two - Shredded Paper

The graphs show that although most of the line's of best fit look accurate, either the test with 8cm or the test with 4cm of insulation was tested incorrectly as the lines of best fit intercept each other. Apart from this mishap, most of the other points are plotted correctly according to the lines of best fit. Because of the large gap between 10cm insulation and 8cm insulation, I think that the problem must have happened with the 8cm insulation rather than the 6cm insulation. If I wanted a more accurate show of the results, I would have repeated the experiment for 8cm insulation and plotted the graph again.

Overall, the graphs show me that with the more insulation added, the less heat lost. However, looking at the graph for 10cm insulation, the line of best fit is still very steep so I think that you would need quite a lot of shredded paper to ensure full insulation.

This conclusion works because of the idea that heat can escape by convection currents quickly through the gaps in the paper s o more heat is lost quicker and obviously, the more insulation added, the more the heat has to travel so the less heat is lost.

Evaluation

There were a few things that were not very accurate in my experiment, these included:

- The thermometer was only acc urate to 1°C.
- When 1 minute was over, it took time to take the measurement so we might have lost some of the accuracy.
- The thickness of the insulation wasn't very accurate due to the measuring tools we were allowed.
- The amount of water wasn't measured very accurately due to the measuring tools.
- When measuring out the water, it lost some of the heat and when we held the test tube with our hands, it would have warmed the water up a little bit so the start temperature wasn't 100% accurate.

There were a few anomalous results in my graphs (view the graphs for details on the anomalies) as explained in the conclusion. They were probably caused by a few rogue results knocking the average about so that it became out of sync to the line of best fit. This could have been by not reading the temperature of correctly at any point, forgetting to check what the time was and being late with testing or spilling a bit of water over the side of the test tube so that the water level was lower. Any of these problems could have affected the results that were anomalous.

If I were to repeat the experiment again, I would be sure to change or improve the following things as stated above:

- The thermometer was only accurate to 1°C. I would have preferred to use a more accurate thermometer like a digital one that gave a more accurate reading of the temperature.
- When 1 minute was over, it took time to take the measurement so we might have lost some of the accuracy. I would have preferred to have had several other people so that they could make the experiment quicker or even used a computer to record the measurements from a digital thermometer every 1-minute. This would have been the most accurate way of getting the results.
- The thickness of the insulation wasn't very accurate due to the measuring tools we were allowed. I would have maybe used the mass of the insulation instead of the thickness to see if that improved the results or made them any more accurate.
- The amount of water wasn't measured very accurately due to the measuring tools. I would have used a measuring cylinder with a smaller scale so that I could have read off the measurement easier and more accurately.
- When measuring out the water, it lost some of the heat and when we held the test tube with our hands, it would have warmed the water up a little bit so the start temperature wasn't 100% accurate. I would have heated the water up using a Bunsen burner or alike and then, because it was already measured, I would have easily been able to start timing immediately. It would have also ensured that the start temperature would have been the same the whole way through the experiment.