HiTemp Temperature Sensor

for the LogIT Microsense® system

Overview

HiTemp is a general purpose temperature sensor supplied individually and in several of the LogIT starter packs.

In Use

Hi Temp is designed for measuring air, liquid and skin temperature within the range of -10 ^{O}C to +110 ^{O}C with a 1^{O}C accuracy and 0.1 ^{O}C resolution. Due to its low thermal mass it has a fast response time and the senor cable is both lightweight and waterproof making it suitable for suspending in air or liquid and ideal for measuring low surface or skin temperatures with it's small tip.

As with any sensor if you need to measure with accuracy and repeatability, you must carefully conrol the experiment conditions and consider the effect of where and how the sensor is positioned. For example, if it is put into a beaker the sensor should not touch the glass and the liquid should be repeatedly agitated to maintain even heat transfer around the sensor.

Specifications

Range:	-10 to +110^{O}C maximum
Resolution:	0.1 ^{O}C
Accuracy:	Nominal +/- 1^{O}C @ -10 to +50^{O}C

Care

This is a general purpose sensor which must not be exposed to temperaures outside the quoted range or to any toxic substances which could damage its casing. Do not pull or strain the sensor's lightweight cable. We recommend it is not extended beyond a single 3m Microsense extension cable.

Special Care Instructions

- Do not pull the sensor out of the data logger by it's cable.
- Never expose the sensor to temperatures outside of its range.
- Take care measuring in kettles as the element is at a higher temperature than the water.
- Only the sensor tip and cable are waterproof, the connection plug/socket is not.
- Never expose to flames as this will damage the sensor and melt the cable.
- Do not excessively twist the cable/sensor ie. between the hands.
- Do not pull the sesnor out of hard substances (eg. soil) by the cable.
- Do not expose to toxic substances or strong acid/alkaline.
- Take care when storing the sensor - do not wrap up or twist the cable tightly.

Instructions & Resources

The resources shown overleaf are also available in PDF form at www.logitworld.com

Waste electrical and electronic products must not be disposed of with household waste.
Please recycle where facilities exist.
Check with your Local Authority or Retailer for recycling advice.

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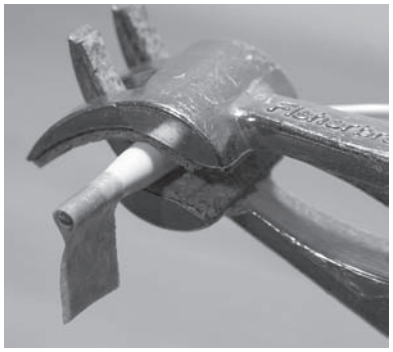
Cooling by evaporation

Subject: Physics

Physics

Overview:
Latent heat is the heat absorbed or released by a substance as it changes state ie. liquid to gas at a constant temperature and pressure. The latent heat needed for evaporation is taken from the liquid itself which subsequently cools and as a result cools its surroundings.
The method provides scope for pupils to expand their thinking about heat absorption, evaporation and how the body might keep cool.



Equipment required: LogIT Datalogger
HiTemp Temperature sensor
Clamp stand or similar
Paper towels, pipettes drip tray or mat
Distilled water
Methylated spirit/alcohol/mineral spirit

Hazards:
Children should be supervised at all times.
Ensure the datalogger cannot come into contact with water or damp.
Goggles should be worn and avoid skin contact with samples.
Always check your local regulations or a school advisory service such as CLEAPSS or SSERC for guidance on the use of any hazardous material.

Setup:
1. Cut strips of a paper towel about 3 cm long and the width of the temperature sensors stainless tip. (About 7 mm)
2. Mount the temperature sensor horizontally in the clamp stand.
3. Fold the strip of paper in half and by slightly squashing it, place it onto the end of the mounted temperature sensor. (see picture)
4. Connect the temperature sensor to Voyager and connect Voyager to the computer.
5. Start the datalogging software and if necessary set the time span to 3 minutes.

Note: If using a clamp stand to hold the temperature sensor, do not clamp too tightly.
You can use cotton wool instead of paper but be aware that placing the cotton wool on the temperature sensor is difficult and if covered in methylated spirit can be a handling hazard. By tightly squeezing the paper you should find it sits securely on the probe tip.

Method:
1. Start logging.
2. Using a pipette, drop water onto the paper wrapped around the sensor until saturated.
3. Continue logging the temperature for about 3 minutes and then stop logging.
4. Remove the paper from the probe and wipe dry using a paper towel.
5. Allow the temperature of the probe to reach the starting temperature of the water sample.
6. Fold another strip of paper in half and place it onto the end of the mounted temperature sensor as before.
7. Start the datalogging software again and use the 'overlay' function to plot over the top of the previous graph.
8. Repeat the steps above using spirit in place of water.

Results:
What do the results show?
How do the two traces differ?
What can be concluded about the latent heat of the two samples?

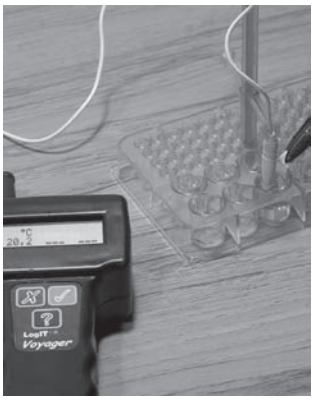
Going further:
What other liquid could you try?
What would happen to the latent heat if a fan was used to blow air continuously over the sample?
This can also make an interesting demonstration:
On a sunny day, invert a clay plant pot. Insert a temperature probe into the middle of the pot and place a temperature sensor outside the pot. Pour water onto the pot until it is fairly well saturated and log the temperature over a few hours, direct sunlight is best. What might be found? You can also place a few ice cubes inside the pot and a few outside the pot.

Endothermic Reactions

Subject: Chemistry

Overview:
There are a few reactions in Chemistry where energy is absorbed from the surroundings during the reaction. When this happens, the temperature of the reactants drops and an endothermic reaction has taken place. The experiment is also a simple rate of reaction experiment in that you can vary the starting temperature of the water, size or shape of the antacid.

Equipment required: LogIT Datalogger
HiTemp Temperature sensor
Small vessel, beaker or boiling tube
Antacid such as Alka-seltzer® (Sodium Bicarbonate and Citric Acid)
Water



Hazards:

If using warm water, make sure the water is not too hot for the ability of the pupils. Water temperature above 55°C will scold children.
Care must be taken if using kettles to heat the water.
Place the tubes over a tray to catch any spilt water.
Always check your local regulations or the school advisory service such as CLEAPSS or SSERC for guidance on the use of any hazardous material.

Setup:

1. Connect the Temperature sensor to the datalogger.
2. You can use a clamp stand to hold the sensor if required.
3. Place the water into the small vessel, beaker or boiling tube.

Note: In the picture we have used a Micro Science kit with the Alka-Seltzer® about to be introduced to the water. This allows for the use of small amounts of water and Alka-Seltzer® (2.0 ml of water and 0.3 g of Alka-Seltzer® in this example). You can use boiling tubes, about 10ml of water and half a tablet which is about 1.5 g.
Be careful of using too much water as this will cause only a small drop in temperature due to the volume of water being reacted with the tablet.

Method:

1. Switch on your datalogger or setup your software ready to start taking readings.
2. When the temperature has reached a stable value start logging.
3. Add the Alka-Seltzer® tablet. (You can add a marker to the graph either by pressing the Red button if logging remotely, or selecting the down arrow from the icons at the top of LogIT Lab)
4. Record until the temperature no longer falls.
5. Stop logging.
6. Repeat for different temperatures of water, different size or different shape of Alka-Seltzer.

Note: If you are varying the temperature of the water, you could use more channels and record the temperature changes on the same graph. This could also be achieved by using the 'Overlay' feature found in some datalogging software. You may need to use the zoom facility of the software to show the results more clearly. You can use the smoothing function to produce a cleaner curve from the gathered results.

Results:

How much of a temperature change was there?
How does this show that a reaction has taken place?

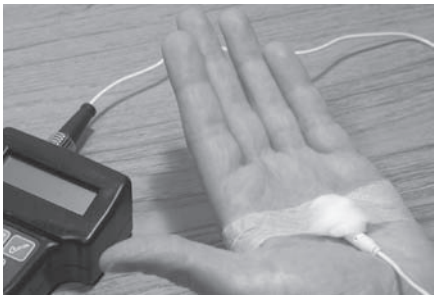
Going further:

How would the shape and size of the Alka-Seltzer affect the graph?
Try using vinegar instead of water. What might happen to the speed of the reaction and shape of graph this time?
How might the investigation be changed to calculate the rate of reaction?
What other factors could you investigate using this method?

Simple Physiology (temperature)

Subject: Biology/Environmental studies

Overview:
This simple procedure can be used to discuss how the body keeps cool during exercise or simply a method to show how exercise effects the skin temperature on different parts of the body. For this example, we measured the skin temperature of the hand of a volunteer who was painting a large room but this procedure can easily be adapted for other forms of exercise. The human body regulates its temperature by allowing water (sweat) to evaporate from the surface of the skin carrying away heat.



Equipment required: LogIT remote Datalogger
HiTemp Temperature sensor
Surgical tape to fix the sensor to the skin
Small piece of cotton wool

Hazards:
DO NOT CONNECT THE DATALOGGER TO THE COMPUTER.
If an exercise is being performed, make sure it is appropriate for the student.
Check that the tape used will not cause any allergic reactions to the user.
Ensure the datalogger cannot come into contact with water or damp.
Always check your local regulations or the school advisory service such as CLEAPSS or SSERC for guidance on the use of any hazardous material.

Setup:
1. If necessary, run the temperature sensor cable down the sleeve of the users top.
2. Plug the sensor into Voyager.
3. Leaving enough slack in the sensor's cable, attach the sensor to the skin using surgical tape.

Note: If you are performing a fairly rigorous exercise and the skin becomes damp with perspiration, it is a good idea to wrap the tape around the hand completely to prevent the tape sliding off. Remember to do this lightly to prevent cutting off circulation as the sensor should stick to the underside of the tape preventing it from coming away. The photo shows the sensor attached to the palm of the hand.

Method:
1. Switch on the datalogger by pressing any button.
2. Start the datalogger logging by pressing the 'Green' button.
3. Begin exercising.
4. When the exercise is finished, press the 'Red' button to stop logging.
5. Upload the results to a computer and view the graph.

Hint: It was found that the best results were obtained by using surgical tape and a small piece of cotton wool under the tape on top of the sensor. If too much cotton wool is used this tends to insulate the skin rather than letting the heat naturally escape and can affect the results as the hand will heat up more than it should giving an artificially high reading.

Results:
Did the temperature of the skin go up or down?
Are the results a surprise?
What difference might there be with the temperature of the blood compared to the skin?
How might you change the procedure to obtain a more accurate result?

Going further:
Try different exercises. Which might give the highest increase in skin temperature?
Try using a pulse monitor to monitor heart rate along with temperature.
Try different parts of the body. For example the leg or forearm.
What other factors could you investigate to obtain a true physiological profile when exercising?