

## 22. REGULATION OF BODY HEAT

How does the body maintain a constant internal temperature despite constant temperature changes outside the body?

### Objectives

- Describe the body's response to changes in external skin temperature.

### Materials and Equipment

- Data collection system
- Wireless temperature links with fast response temperature probes (2)
- Standard alcohol thermometer
- Large bowl or shallow pan
- Adhesive bandages (2) or medical tape (4 cm)
- Fan
- Ice
- Paper towels

### Safety

Follow these important safety precautions in addition to your regular classroom procedures:

- If you experience severe discomfort, remove your hand from the ice bath. While there will be some discomfort, most students can tolerate the cold water for 1-2 minutes without issue.
- Do not submerge your hand in ice water for more than 2 minutes. The risk of frostbite is minimal, but prolonged numbness in the hand could occur if left in the ice bath for too long.

### Procedure

1. Work in pairs. One partner will collect data and keep track of time while the other partner will be the subject, or the person whose data will be recorded. The subject should be comfortable with submerging their hand in ice water for up to two minutes.
2. Select Sensor Data in SPARKvue.
3. Make sure the temperature probes are securely plugged in to the temperature links. Connect both temperature links in SPARKvue.
4. Find the Quick Start Experiments menu on the right and choose Two Temperature Probes. When the graph appears, locate the temperature probe associated with the y-axis on the left by matching the 6-digit ID number. Place this probe near the subject's left hand. Place the probe associated with the y-axis on the right near the subject's right hand.
5. Use a small bandage or a 2-cm piece of medical tape to secure the first temperature probe to the pointer finger on the left hand as shown in Figure 1.
6. Secure the probe from Sensor 2 to the pointer finger on the right hand.
7. Have the test subject sit comfortably in a chair and relax, resting both hands on the table or lab bench surface.

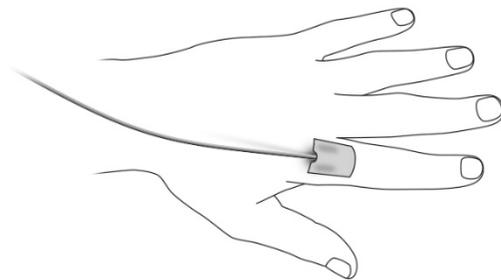


Figure 1: Probe position on left hand

**Part 1 – Control Skin Temperature**

1. Remind the subject to sit quietly with both hands resting on the table, relax, and avoid looking at data during data collection.
2. Select Start to begin collecting data.
3. Allow data collection to continue for 6 minutes, then stop collecting data.
4. Sketch your results in Graph 1. Include numbers, labels, and units on the x- and y-axes. Add a key to identify the temperature data for each hand.

**Part 2 – Skin Temperature in Moving Air**

1. Position a fan near the subject so air will blow across their right hand but not their left hand.
2. Remind the subject to sit quietly with both hands resting on the table, relax, and avoid looking at data during data collection.
3. Start collecting data. After about 10 seconds, turn on the fan.
4. Turn off the fan after 2 minutes and allow data collection to continue for 4 additional minutes.
5. Stop collecting data. Sketch your results in Graph 2. Include numbers, labels, and units on the x- and y-axes. Add a key to identify the temperature data for each hand.

**Part 3 – Skin Temperature in Ice Water**

1. Prepare an ice bath by filling a bowl or pan with water about 3 cm deep. Add several pieces of ice.
2. Test the water height to make sure the subject's right hand can be covered by ice water just past the first set of knuckles without getting the probe wet as shown in Figure 2. The palm should be completely submerged in the ice bath. Dry the hand after testing.

*Note: Avoid getting any part of either sensor wet.*

3. Set a thermometer in the ice bath and let it stand for 5 minutes, then check the thermometer to make sure the ice bath temperature is between 4 °C and 8 °C. Add or remove ice as needed.
4. Remind the subject to sit quietly with both hands resting on the table, relax, and avoid looking at data during data collection.
5. Start collecting data. After about 10 seconds, have the subject place their right hand in the ice water bath as shown in Figure 2. The subject's hand must remain in the ice bath for 2 minutes.

*NOTE: It is expected that the subject will experience discomfort. However, if the cold becomes too painful, the subject may withdraw their hand and continue with the next step.*

6. After 2 minutes, remove the right hand from the ice water bath. Gently blot the hand dry while data collection continues, taking care not to disturb the temperature probe.

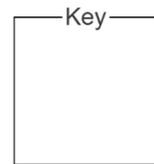
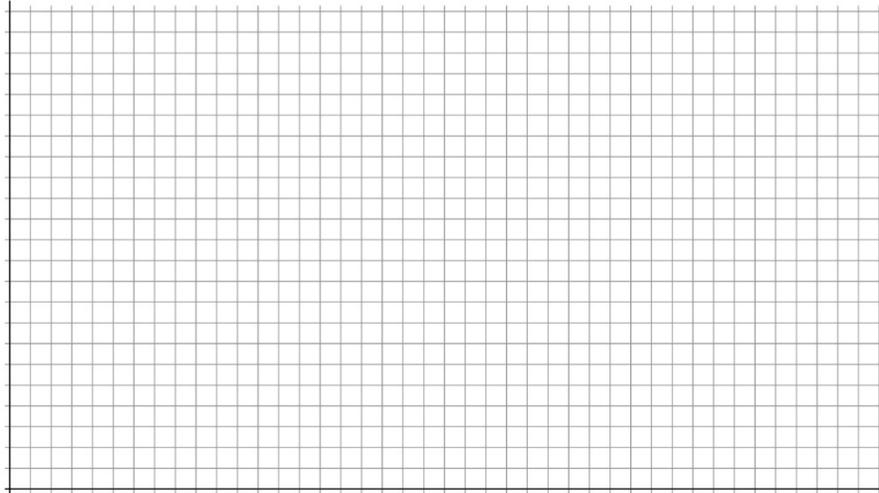


Figure 2: Right hand in ice bath, probe above water line

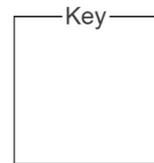
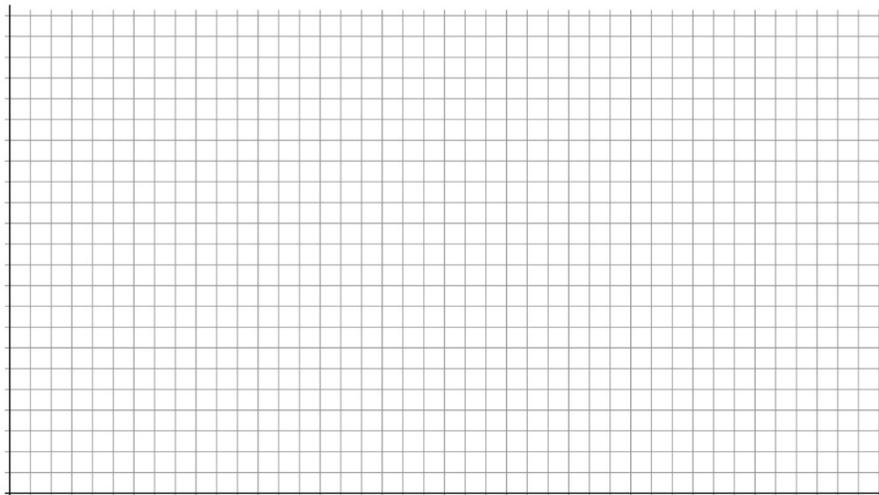
8. Have the subject rest both hands on the table while data collection continues for 4 additional minutes (or a total of six minutes), then stop collecting data.
9. Sketch your results in Graph 3. Include numbers, labels, and units on the x- and y-axes. Add a key to identify the temperature data for each hand.

### Data Collection

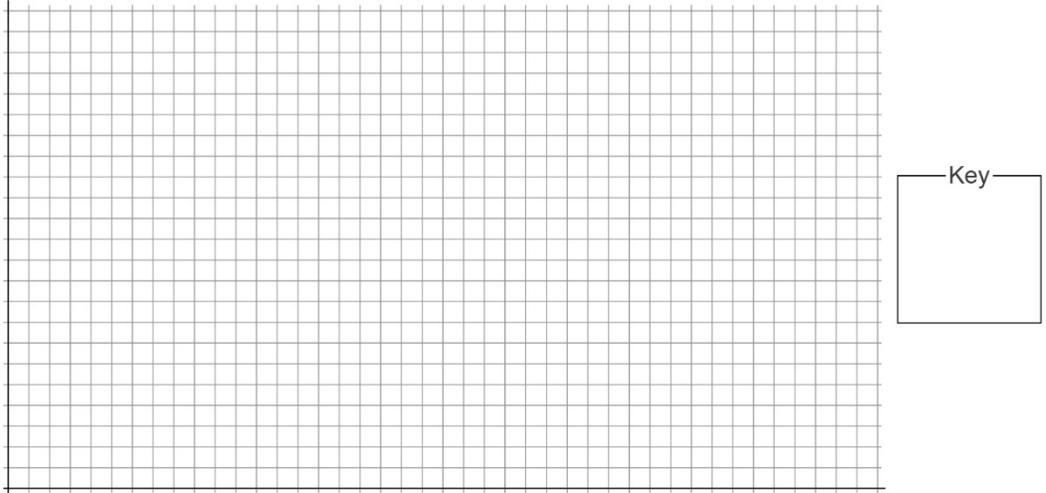
Graph 1: Control skin temperature



Graph 2: Skin temperature in moving air



Graph 1: Skin temperature in ice bath



### Questions and Analysis

1. What happens to the skin temperature of each hand when one hand is exposed to moving air? Why did the fan have this effect?
  
2. What happens to the skin temperature of each hand when one hand is exposed to water that is much colder than air? Support your answer with data.
  
3. Do the results of this experiment show evidence of homeostasis? Why or why not?
  
4. Explain how a person may get frostbite on their fingers and toes, but their core body temperature may remain relatively constant.