Experiment B-9
Thermoregulation and Perspiration

Objectives

- To learn about homeostasis and thermoregulation.
- To learn about the importance of perspiration.
- To understand the relationship between perspiration and relative humidity by using a relative humidity sensor.

Modules and Sensors

- PC + NeuLog application
- USB-200 module
- NUL-207 Relative humidity logger sensor

Materials

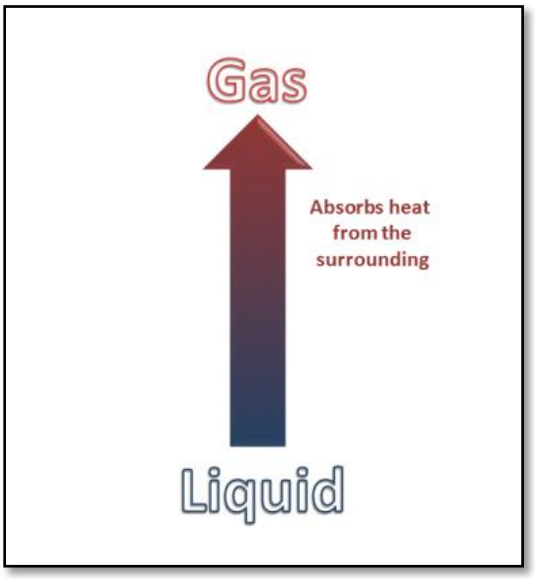
- Plastic bag

Introduction

Living organisms adapt to external environmental fluctuations in order to maintain a relatively steady internal environment. The tendency of an organism or a cell to regulate its internal conditions is called homeostasis. Homeostatic mechanisms regulate many different parameters (pH, dissolved oxygen, glucose concentration, etc). Homeostatic control of an organism's body temperature is called thermoregulation. Internal temperature changes affect enzyme function, muscle activity, metabolism and more physiological aspects.

The two primary responses to external temperature changes exhibited by animals are poikilothermy and homeothermy. Poikilotherms regulate their body temperature by selecting an appropriate external environment. Homeotherms also rely on physiological mechanisms, in which they produce or dissipate heat.
As ambient temperature increases, homeotherms cool down by the dilation of blood vessels. When these vessels dilate, warmed blood from the core of the body is carried to the skin and heat is lost to the environment. Some homeotherms also use sweating and/or panting in order to lose heat.

The evaporation of sweat (perspiration) has a cooling effect. The energy required for evaporation is absorbed from the skin. The sweat will sufficiently evaporate if the environmental air has a relatively low humidity.



Actually a small amount of perspiration is continuously excreted by sweat glands in the skin. Frequently, the sweat evaporates before it may be observed.

In this experiment, the palm of your hand and a relative humidity sensor will be placed inside a plastic bag. You will observe the changes of relative humidity throughout the measurement.

Procedure

Experiment setup

1. Set up the experiment as shown in the picture below.

2. Make sure you have a plastic bag that is big enough to contain the palm of your hand and also the sensor connected to the USB module. The bag should not be too big (it would increase the necessary measurement time).

3. It is preferred to keep the air conditioner off during the measurement.

4. Place the relative humidity sensor connected to the USB module in the plastic bag. Keep the bag open and flat.

Sensor setup

5. Connect the USB-200 module to the PC.

6. Check that the relative humidity sensor is connected to the USB-200 module.

Note:

The following application functions are explained in short. It is recommended to practice the NeuLog application functions (as described in the user manual) beforehand.

7. Run the NeuLog application and check that the relative humidity sensor is identified.

Settings

8. Click on the **Run Experiment** icon and set the:

   Experiment duration to 10 minutes
   Sampling rate to 1 per second

Testing and measurements

9. We want to measure the relative humidity in the room and establish a baseline.

   Click on the **Record** icon  to start the measurement.

10. Click on the **Arrows** icon  in order to see the sensor's values during the measurement.

11. To see the entire graph after one minute, use the mouse's scroll wheel.

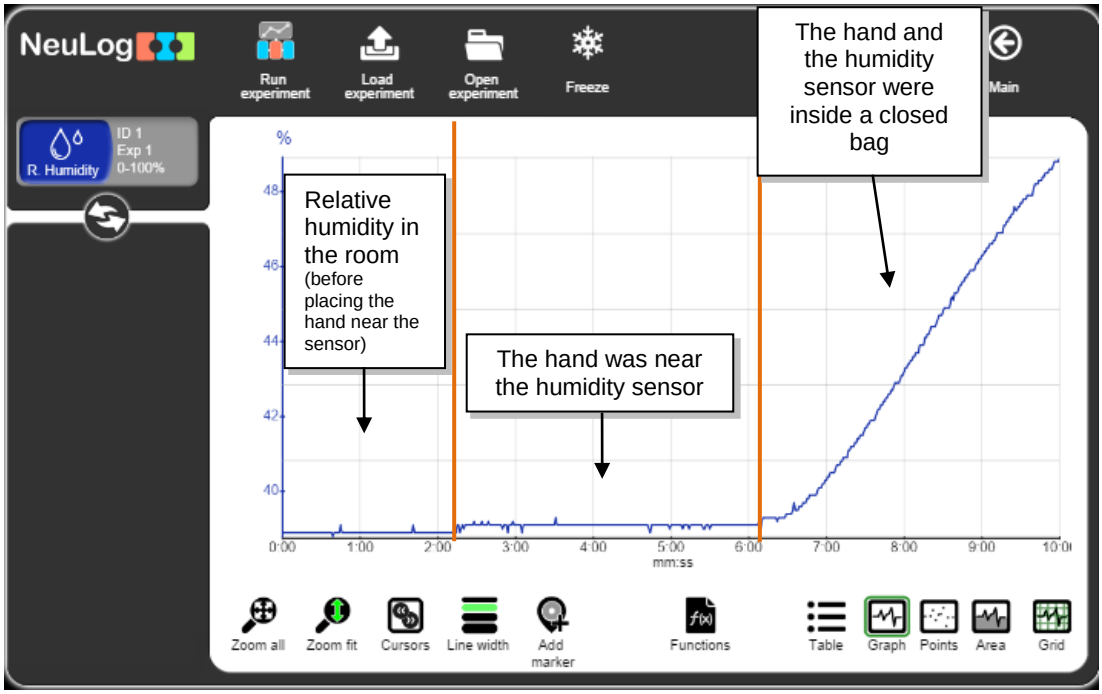
12. After two minutes, place your hand close to the relative humidity sensor without closing the bag.

13. Six minutes after the beginning of the measurement (four minutes after placing your hand near the sensor), ask another student to tie the bag around your hand.

14. Follow the relative humidity changes until the end of the measurement.

15. Click on the **Zoom fit** icon .

16. Your graph should be similar to the following:



17. We can see that after placing the hand near the relative humidity sensor, the relative humidity slightly increased (from 38.9% to 39.1%). The sensor reacted to the vaporized sweat produced by the hand's sweat glands.

    After tying the bag around the hand (with the sensor inside the bag), the relative humidity increased. The bag blocked the air flow in and out of it, therefore the vaporized sweat accumulated inside.

Challenge experiment

18. Change the experiment duration to 15 minutes.

    This measurement is longer so you can observe the relative humidity changes over a larger period of time.

19. Put the sensor inside the bag but keep the bag open as in the beginning of the first experiment. Wait until the relative

humidity value is the same or close to the one measured in the beginning of the first experiment (the baseline part).

20. Click on the **Record** icon  to start the measurement.

21. After one minute insert your hand into the bag and tie it again. Keep your palm in the bag for the rest of the measurement.

Summary questions

1. Give an example of another homeostatic mechanism (different than thermoregulation) and explain how the body regulates its internal condition by using this mechanism.

2. An abnormal lack of sweat in response to heat is called anhidrosis. Why is this condition harmful? What can a person with this condition do in order to improve the situation?

3. Describe how the relative humidity changed throughout the second measurement (the challenge experiment). Explain your results.