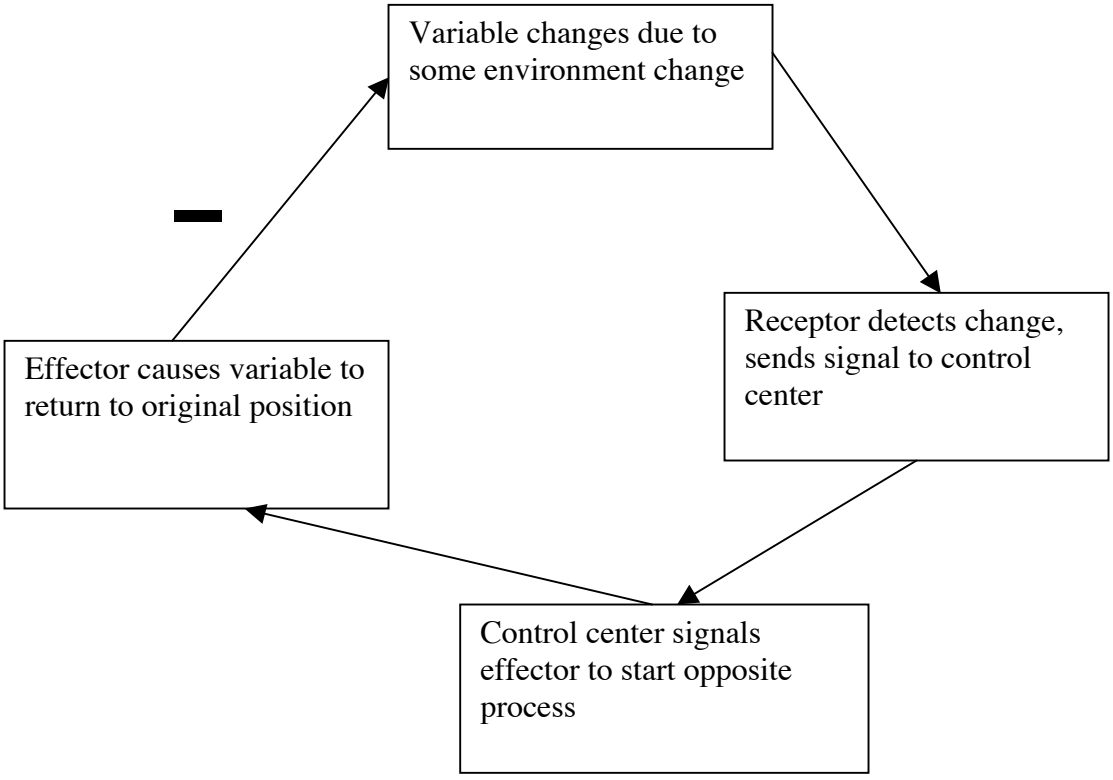
CSM Introductory Physiology
Homeostasis Activity Fall 2009

Homeostasis is a term that refers to the dynamic balance within the human body. The body regulates all sorts of processes in order to keep the individual alive and healthy. These processes maintain the body's equilibrium, making sure the body is functioning correctly. In this lab we will measure some characteristics of the body that are regulated. We will see how the changes in the characteristics may be constantly occurring, but the changes all happen within a normal range.

The mechanisms that regulate the processes of homeostasis may be simple or complex. They all have a few key features in common. One, they all require receptors or sensors to monitor the variable, two, the receptor must send its information to a control center which processes the information and sends out an output signal to the third part of the system which is an effector. Effectors actually do the adjusting to the parameter. Some homeostatically controlled variables may have more than one effector that act on them. Remember the autonomic nervous system? This system, with its opposing sympathetic and parasympathetic pathways, controls most of the physiological variables that are homeostatically controlled.

Most regulated activities in the body are controlled using a negative feedback mechanism. This means that as a variable changes, the receptor picks up that information and relays it to the control center. The control center sends a signal to the effector that tells the effector to change the variable back to its original spot, known as the setpoint. Because the effector has the effect of changing the variable back in the opposite direction as the original change, we call this negative feedback. This mechanism is often visualized as a loop, shown here in this flow chart or concept map:



For example, the body usually has about a small amount of carbon dioxide (CO_2) circulating in the bloodstream. If the environment changes - the person receives a fright or something, they might breathe faster for a few moments. This would decrease the amount of CO_2 in their blood. CO_2 receptors in the walls of the blood vessels would detect the change and send the information to the brain. The brain (pons and medulla) would process the information and send a signal to the diaphragm and other ventilatory muscles to reduce breathing rate. Thus the breathing rate would be reduced for a few moments until the CO_2 levels came back up to normal, then the whole process would come to a stop.

In this activity, you will explore an easily measured variable, heartrate (HR) that is homeostatically regulated. You will take measurements over time and with various environmental conditions. You will be the subject for these measurements.

Activity Guidelines:

Observe your heartrate. What blood vessel did you choose to monitor your pulse? What do you think heartrate will do under various environmental conditions? Make a prediction about what you think heartrate will do when you change your environment. Some examples of variables might be rest vs. exercise, indoors (room temperature) vs. outdoors (colder or warmer temperatures), presence or absence of drugs in your system (like caffeine or nicotine), time of day. Do some testing of your predictions. One thing to remember is that heartrate is NOT tightly controlled. It tends to go up and down within a range in any one setting. So… it would be prudent to take several measurements under each condition and take an average of your findings. State your findings and discuss why this occurs using your understanding of the physiology of heartrate and its control.
Hints:

1. Think about how often to **take measurements** (in other words, how long might it take to see the heartrate change after you put yourself into the new environment? Will the heartrate stay changed in this environment, or will it go back to normal range? You also need to measure to establish a baseline of normal range. Take several readings in this "baseline" condition.
2. Other ideas for environmental conditions that might change the heartrate include: immersion of face into cold water, relaxation with meditation, etc.
3. **Take multiple measurements** after introducing the environmental change. Does the body will establish a new setpoint if the conditions stay different? Or will HR return to the initial setpoint if the environmental change only was temporary. Record data in table format. And show the data in graphical form

Table 1 example

Time	HR (beats per minute bpm)	Comments/Condition

Questions/Lab Report

1. What blood vessel did you palpate to take your pulse? What other ones might you have used?

2. What was your prediction regarding your heartrate in various conditions?

3. What was your finding of the actual heartrate in two conditions.

4. What is the function of the heartbeat?

5. Why would the heart speed up or slow down, from the standpoint of its function? In your tests, what physiological needs account for any changes seen?

6. Draw a concept map of the negative feedback mechanisms that control heartrate, using your book as a guide. Be sure to put the descriptive comments in your own words, not the textbook authors'.