**Name:** **Date:**

HANDS-ON ACTIVITY

# Negative and Positive Feedback

Negative and positive feedback loops control many physiological functions. In a negative feedback loop, physiological mechanisms work to counteract changes that move internal conditions above or below set values.

In contrast, in a positive feedback loop, physiological mechanisms work to increase change away from set values until a particular result is achieved, and homeostasis is restored.

Whether or not a process is controlled by negative or positive feedback loops can often be determined by examining graphs of relevant data. In this exercise, you will make graphs using various sets of data. You can then use the graphs to determine whether a positive or negative feedback loop is at work.

### MATERIALS

- pencil
- ruler

## PROCEDURE

1. First, you will graph a function controlled by negative feedback, in this case the release of an animal hormone. Make a line graph in your Evidence Notebook of the data in Data Table 1. In this example, the presence of hormone A can cause the release of hormone B into the blood. The rise in hormone B levels then will decrease the amount of hormone A. This is a negative feedback loop. Time should be on the $x$-axis. Label both axes and give your graph a title.

### DATA TABLE 1: HORMONE A LEVELS IN THE BLOOD

| HORMONE A CONCENTRATION (ng/mL) | TIME (min) |
|---|---|
| 1 | 0 |
| 1 | 15 |
| 2 | 30 |
| 4 | 45 |
| 6 | 60 |
| 3 | 75 |
| 2 | 90 |
| 1 | 105 |
| 1 | 120 |
| 2 | 135 |
| 5 | 150 |
| 2 | 175 |
| 1 | 190 |

2. Look at your graph. Notice there is a pattern of how the hormone level rises and falls. This is characteristic of negative feedback.

3. Make a new line graph of the data in Data Table 2 that shows a positive feedback system. When you get a cut or scrape, clotting factors in the blood are activated so that they can seal the wound. The activation of some clotting factors increases the amount of other clotting factors. Plot time on the $x$-axis and label both axes. Title your graph.

### DATA TABLE 2: BLOOD LEVELS OF CLOTTING FACTOR X FOLLOWING A WOUND

| FACTOR X CONCENTRATION (μg/ml) | TIME AFTER CUT (min) |
|---|---|
| 0.1 | 0.0 |
| 0.2 | 0.5 |
| 0.3 | 1.0 |
| 0.9 | 2.0 |
| 1.2 | 3.0 |
| 1.8 | 4.0 |
| 1.9 | 5.0 |

4. Compare this graph to the negative feedback graph.

5. Construct two new graphs from Data Tables 3 and 4. Use them to determine whether the situations described below are controlled by negative or positive feedback loops.

6. **Graph 3:** After a meal, the concentration of glucose in a person's blood will start to change from its baseline value, as shown in Data Table 3. Make another line graph using this data. Plot time on the $x$-axis. Label the axes and give your graph an appropriate title.

### DATA TABLE 3: GLUCOSE LEVELS IN THE BLOOD AFTER EATING

| BLOOD GLUCOSE CONCENTRATION (ng/ml) | TIME AFTER EATING (min) |
|---|---|
| 80 | 0 |
| 130 | 15 |
| 175 | 30 |
| 162 | 45 |
| 150 | 60 |
| 145 | 75 |
| 140 | 90 |
| 119 | 120 |
| 100 | 150 |
| 80 | 180 |

7. **Graph 4:** In females, the levels of the hormone estrogen in the blood peak just prior to ovulation, the release of an egg from the ovary. A rise in estrogen causes the release of a hormone from the brain (luteinizing hormone), which leads to additional increases in estrogen levels. Make another line graph using the data in Data Table 4. Again, the $x$-axis should be time; label the axes and give your graph a title.

## DATA TABLE 4: BLOOD ESTROGEN LEVELS IN THE DAYS BEFORE OVULATION

| ESTROGEN CONCENTRATION (pg/ml) | TIME (days) |
|---|---|
| 50 | 0 |
| 70 | 1 |
| 90 | 2 |
| 120 | 3 |
| 150 | 4 |
| 180 | 5 |
| 190 | 6 |

Compare your graphs made using Data Table 3 and Data Table 4 data. Decide whether positive or negative feedback loops control blood glucose levels. Then decide which type of feedback controls estrogen concentration. Label each graph as positive or negative feedback.

## ANALYZE AND CONCLUDE

1. How are the graphs of a body chemical controlled by negative feedback and a chemical controlled by positive feedback similar? How are they different?

2. Which is controlled by a negative feedback loop: blood glucose levels after eating or estrogen levels in the days prior to ovulation? Which is controlled by a positive feedback loop? Explain your answers.

**3.** It's around lunchtime and you are feeling hungry, so you eat a sandwich. When the food passes through your stomach and into your small intestine during digestion, your brain receives a signal causing you to feel full. Consequently, you do not eat any more food. Is this an example of negative or positive feedback? Explain your answer.

**4.** Mitochondria, the organelles involved in cellular respiration, can also generate chemicals called reactive oxygen species (ROSs). ROSs can damage mitochondria. Damaged mitochondria generate more ROSs than healthy mitochondria. Is this an example of negative or positive feedback? Explain your answer.

**5.** How is negative feedback related to homeostasis?