

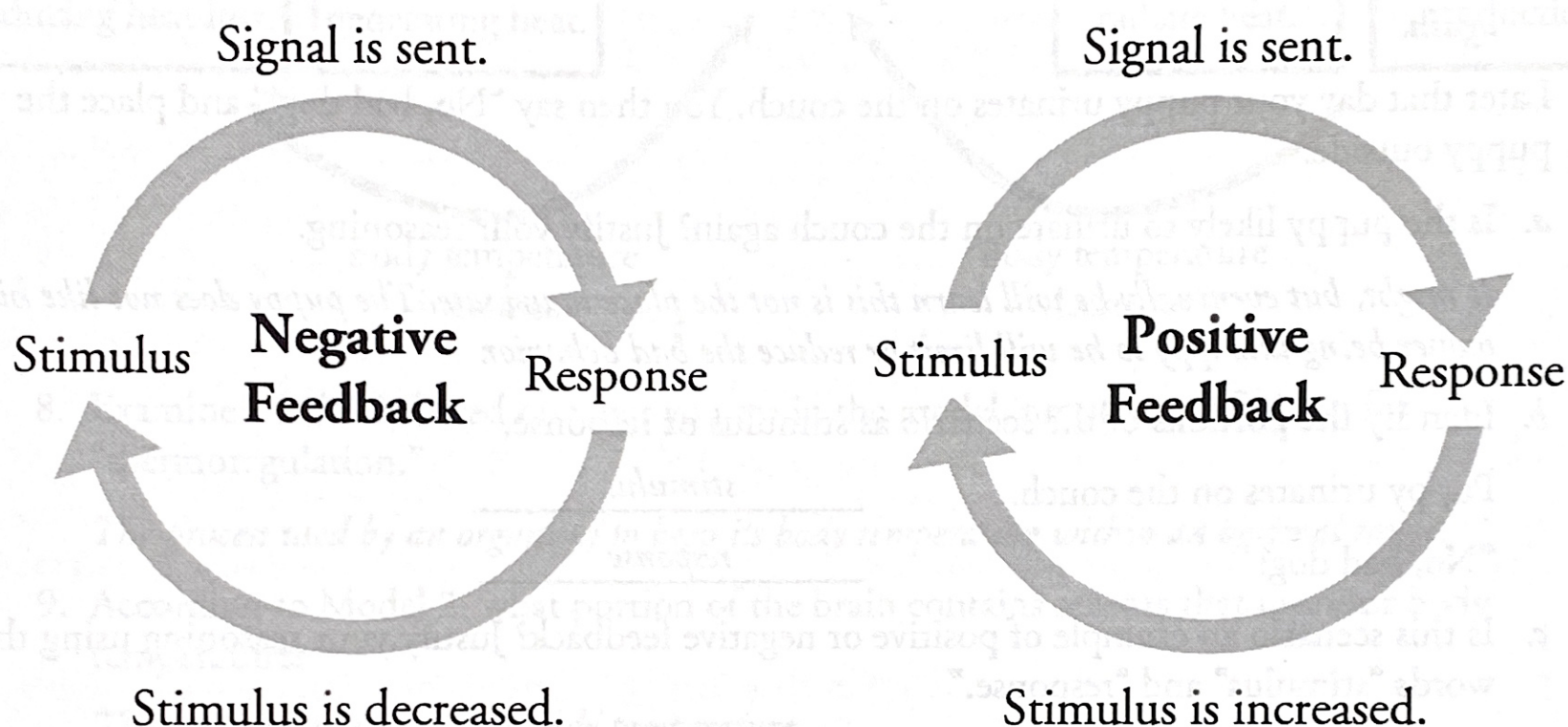
Feedback Mechanisms

How do organisms regulate complex systems through chemical interactions?

Why?

The heating system of a house works to keep the temperature constant. If the house gets too cold, then the heat automatically turns on to warm the house. The heat stops when the preset temperature is reached. This is an example of a **feedback mechanism**. Organisms use many feedback mechanisms to either maintain or amplify important chemical systems. This could happen at a molecular level to coordinate the function of a single enzyme or it could happen throughout the body to regulate the organism's internal temperature.

Model 1 – Positive and Negative Feedback



1. What two types of feedback mechanisms are illustrated in Model 1?

Negative feedback and positive feedback.

2. Define the words below as they are used in everyday language.

Stimulus

Something that triggers or increases an event.

Signal

A method of communicating information between two things.

Response

Something you do after an event.

3. Identify at least three similarities in the two types of feedback mechanisms in Model 1.

Both types of feedback involve a stimulus, a signal, and a response.

12. Consider the feedback loop that heats the body when it is too cold.

- a. Identify the “stimulus” and “response” in the feedback loop.

Stimulus = The body temperature is too low.

Response = Shivering begins and blood vessels in the skin constrict to warm the body.

- b. Is this feedback loop positive or negative feedback? Justify your reasoning.

The feedback loop is negative feedback because the response limits the stimulus. The heating mechanisms of the body bring the temperature back to normal levels. The stimulus is no longer present.

Read This!

Many of the systems in the body are delicate. They function only under a specific range of parameters. Enzymes will denature if they get too hot or cold or if the pH of the solution they are in is too high or too low. Cells will not be able to process glucose for energy if the concentrations of oxygen in the blood are not high enough. Feedback mechanisms are used to keep the body in **homeostasis**. That is, many systems are in place that monitor and regulate important parameters of the body and keep them within normal levels.



13. Consider the state of homeostasis—maintaining conditions within certain limits. The body needs multiple mechanisms to keep all types of systems in check.

- a. Would a positive feedback loop ever be helpful in maintaining homeostasis? Justify your reasoning.

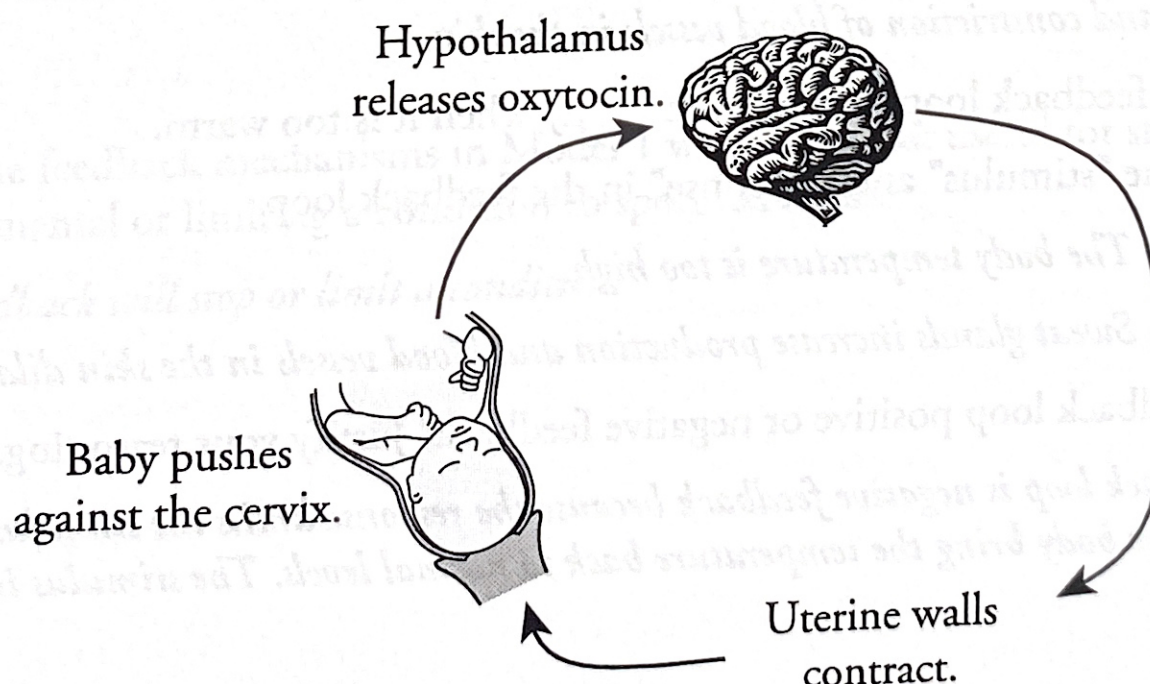
No, positive feedback would not be helpful in maintaining homeostasis because it amplifies a condition. If an organism was not in homeostasis, a positive feedback loop would only take it further from homeostasis.

- b. Would a single negative feedback loop ever be helpful in maintaining homeostasis? Justify your reasoning.

To maintain homeostasis the organism needs a mechanism to adjust for when a condition is too high and also when it is too low. A single negative feedback loop would probably not be sufficient.



Model 3 – Childbirth and Contractions



14. According to Model 3, what is the stimulus and what is the response during childbirth?

Stimulus = Baby's head pushing on the cervix.

Response = Increased contractions.

15. What hormone, released from the hypothalamus, increases the intensity of contractions?

Oxytocin.

16. When the intensity of contractions increases, will the stimulus increase or decrease?

When the contractions increase the pressure on the cervix will also increase. Thus, the stimulus is increased.

17. Is childbirth an example of a positive or negative feedback system? Justify your answer.

Childbirth is a positive feedback system because the response escalates the stimulus.

18. What will eventually stop the stimulus and thus stop the childbirth feedback loop?

When the child is born and leaves the birth canal, the pressure on the cervix will stop and that will stop the feedback loop.



19. Below are several descriptions of processes that occur in the human body. For each one identify the stimulus and the response and state whether the process is positive or negative feedback.

a. When human tissue, such as skin or a blood vessel, is torn or cut, the cells near the damage send out a signal that activates platelets in the vicinity. As the platelets begin to form a plug, they release more chemical signals to attract more platelets and other clotting factors until the bleeding is stopped.

Stimulus = A cut in a blood vessel.

Response = Increased platelets and clotting factors.

This is an example of positive feedback.

b. When a person has not taken in sufficient water they become dehydrated. This may cause a loss of blood pressure, which will trigger the release of antidiuretic hormone (ADH) from the hypothalamus and pituitary glands. This hormone signals the kidney to allow reabsorption of water by the blood vessels to bring the blood pressure back to normal conditions.

Stimulus = Loss of blood pressure.

Response = Reabsorption of water.

This is an example of negative feedback.

c. When a human increases physical activity, the amount of fuel burned in its cells also increases, which in turn increases the concentration of dissolved CO_2 in the blood. The CO_2 reacts with water in the blood to make a weak acid, which lowers the pH of the blood. Sensory cells in the medulla of the brain register this drop in pH and send signals to the diaphragm and heart to increase respiration. This will clear the CO_2 from the bloodstream.

Stimulus = Low pH in blood (high CO_2 concentration).

Response = Increased respiration.

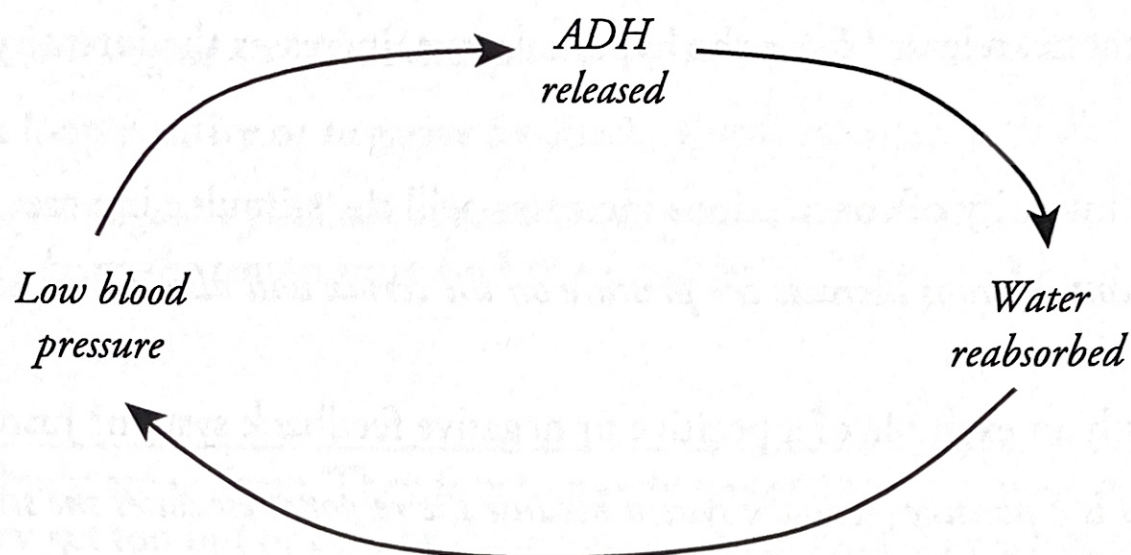
This is an example of negative feedback.



Extension Questions

20. Draw a diagram similar to Models 2 and 3 for one of the feedback mechanisms in Question 19.

Answers will vary.



21. Relate the common phrase “a vicious cycle” to feedback loops.

The phrase “vicious cycle” refers to a positive feedback loop where the response increases the stimulus and the response is increased.

22. Choose one of the following feedback mechanisms found in nature.

Terrestrial plants and their water supply.

The hormones epinephrine and norepinephrine and responses to stress.

Hormones and ovulation.

Lactation in mammals.

- a. Research the mechanism to determine the stimulus and the response.

Answers will vary.

- b. Diagram the feedback loop(s) involved.

Answers will vary.

- c. Be prepared to present your findings to the rest of the class.

Answers will vary.