Lesson 9.2	Stimulus/ Response and Feedback Loops	**Name** **Date** **Period**

Key Terms	
stimulus	
response	
voluntary	
involuntary	
feedback loop	

Engage The Horse that Could Do Math

Clever Hans was a horse in Germany in the early 1900s that was believed to be capable of arithmetic and other intelligent tasks. His owner, Mr. von Osten, was a high school math teacher and horse trainer who traveled with Hans to show the public his many abilities. These abilities included telling time, keeping track of the calendar, reading, spelling, and understanding German. Hans could also add, subtract, multiply, divide, and work with fractions. When asked a question such as, "if the fifth day of the month comes on a Sunday, what is the date of the following Wednesday," Clever Hans would tap is hoof eight times in response. Clever Hans could answer correctly when questions were asked verbally or written down. Mr. von Osten never charged admission to observe Hans and he eventually became so famous that he appeared on the front page of the New York Times.

1. Do you think Hans could really read and solve math problems? Explain why or why not.

2. It was believed that Hans needed the individual asking the question to be in the room with him. Why would someone believe this?

3. If you think he could solve these problems, how did he learn to do this? If you don't think he could solve the problems, how do you think he was getting the correct answer? Explain your thinking.

Explore I: Read the remainder of the story of Hans and answer the following questions.

4. Summarize in your own words what the psychologist concluded about Hans.

5. Define stimulus.

6. Define response.

7. Explain why a dog would ignore the sounds coming from the television.

Explore II

The teacher is going to show you a video clip of people responding to a variety of environmental conditions.

- Invent titles for each situation.
- Record your observations of behavioral (voluntary) and physiological (involuntary) responses to these environmental stimuli.

	Situation 1	Situation 2	Situation 3	Situation 4
Observed Behavioral Responses				
Observed Physiological Responses				

Read the following descriptions. Match these descriptions to your observed situations. Share your ideas in the lab group.

Description	Situation
A. The pancreas releases chemicals into the blood that increase the tendency of cells in the body (especially liver cells and fat cells) to store sugars and other nutrients. Blood vessels leading to the brain constrict, reducing blood flow and general alertness. Blood vessels leading to the digestive system expand, increasing blood flow.	**1**
B. Pulse and breathing rates increase slightly. Blood vessels at the surface of the body constrict, reducing blood flow to the skin. Involuntary, rhythmic muscle tremors occur. Hairs on the surface of the skin raise and bumps appear on the skin. Body responses occur that have the general effect of reducing the amount of surface area exposed to the environment	**2**
C. Pulse, breathing rates, and blood pressure increase significantly. Heart contractions are stronger, and clotting capacity of the blood increases. Blood vessels leading to the brain and to the muscles of the legs and arms expand, increasing blood flow and general alertness and readiness. Blood vessels leading to the digestive system, the urinary system, and to the skin constrict. The liver releases sugars and other nutrients into the blood. The pupils dilate and the lenses of the eyes flatten, improving vision for distance.	**3**
D. Heart rate and breathing rate are elevated. Both liver and muscle glycogen stores are depleted. Blood glucose levels are low and brain function is impaired, producing depression and making it difficult to concentrate. Pain due to extreme fatigue and muscle damage is present, and the body is dehydrated.	**4**

Explain II

8. What information was most helpful in matching the description to the video segment?

9. How did the internal responses benefit the people involved?

Explore III

Imagine that you placed your hand in a bath of ice water.

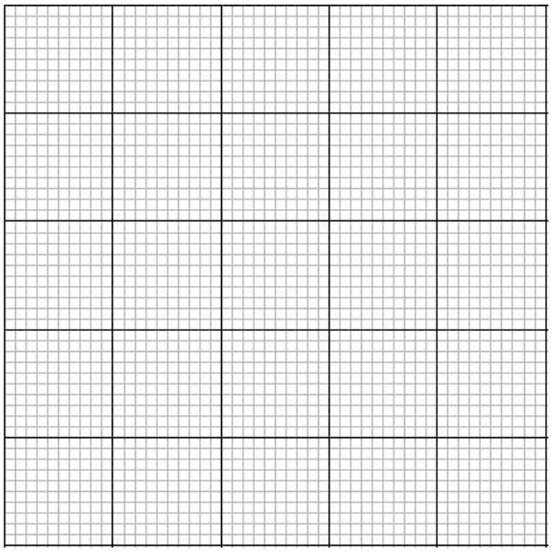
10. What physiological results might you observe?

11. What do you predict will happen to the temperature of your hand?

The teacher will select a volunteer from the class. The volunteer will hold one temperature probe in his or her hand, and one temperature probe under the armpit.

Record the temperature over 10 second intervals. Graph the temperature on the provided grid

Time (sec)	Hand Temperature (°C)	Armpit Temperature (°C)
0		
10		
20		
30		
40		
50		
60		
70		
80		
90		
100		
110		
120		



12. The test subject will describe his or her experiences of the test. Record those experiences in the space below.

13. Describe the changes in the temperature of the extremity (hand). Describe the changes in the core temperature (armpit).

14. a) Predict what would happen to the temperature of the extremity if there is long-term exposure to cold temperature.

b) What happens to the extremity and how does this relate to the temperature of the core?

15. How might the changes that you observed in the core and the surface temperatures help you to maintain homeostasis?

Explain III

16. Complete the table below. In addition to temperature, name two other stressors that the human body might encounter and adjust to automatically. Give two examples of behavioral and physiological responses to this stressor.

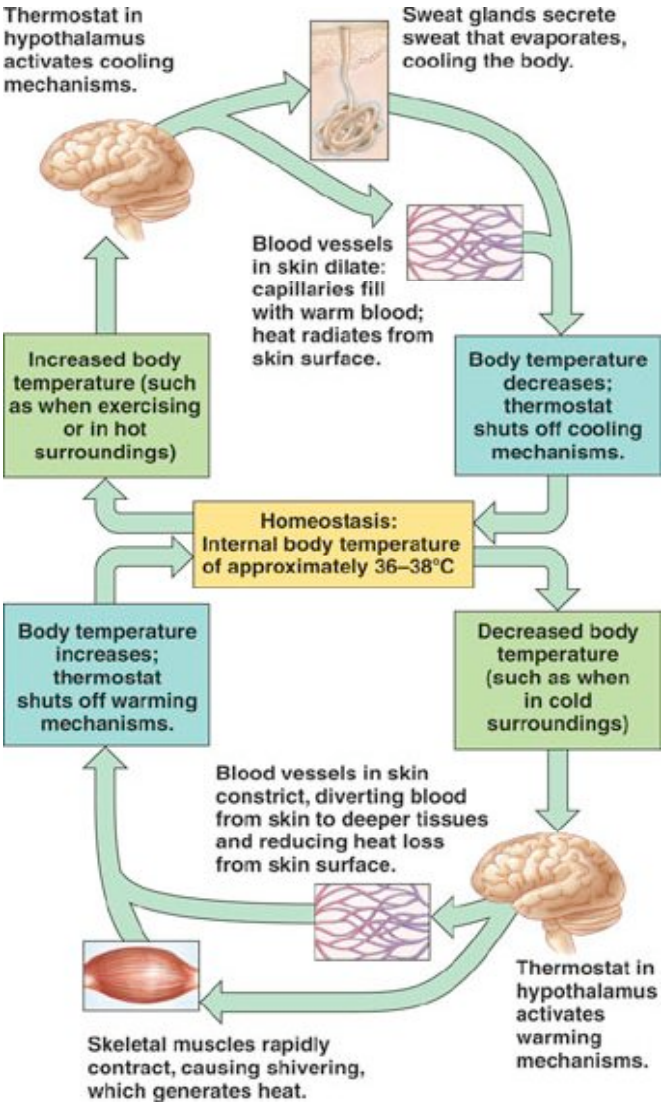
External Stressor	Behavioral Response	Automatic Physiological Response
1. Low Temperature	1. 2.	1. 2.
2.	1. 2.	1. 2.
3.	1. 2.	1. 2.

17. Explain whether regulation to maintain homeostasis is a random or specific activity of the body?

Explore IV Feedback Control

Most of the control mechanisms of homeostasis are based on negative feedback. A simple example of a negative feedback control not in our bodies can be observed in room temperature control by a thermostat. A thermostat is the control center for regulating the temperature of a room. When the room temperature falls below a set point (68°F), a sensor (thermometer) turns on a switch which sends a signal to turn on the heater. The room is then warmed. When the sensor then registers that the temperature is above a set point, a signal is sent to turn the heater off. You could say that the sensor is triggered by a stimulus (room temperature) and the heater would be an effector to produce a response (heat).

This is called negative feedback because a change in one condition triggers the control mechanism to counteract further change in the same direction. As seen in the figure, we also use feedback control to regulate our body temperature. Healthy human bodies can have a temperature between 97°F -100°F.



Starting at the arrow that moves upward on the left from homeostasis, we see that when the temperature is too hot, the control center (brain) sends signals to the skin to increase the activity of its sweat glands and for the blood vessels to dilate. These activities cause the skin to release heat energy from the body and the body begins to cool. Once it has cooled off to a temperature between the normal body temperature range, a signal is sent to stop these signals.

The same feedback mechanism is involved when blood temperature drops below normal temperatures. Signals from the brain's control center shut off the sweat glands and constrict the skin's blood vessels. These actions reduce heat loss. When the body heats back up to normal temperatures, these signals are shut off.

Explain IV

18. What is negative feedback?

19. Describe how our bodies use negative feedback when body temperature increases.

20. Describe how our bodies use negative feedback when body temperature decreases.