SI Biology - Full Discipline Demo

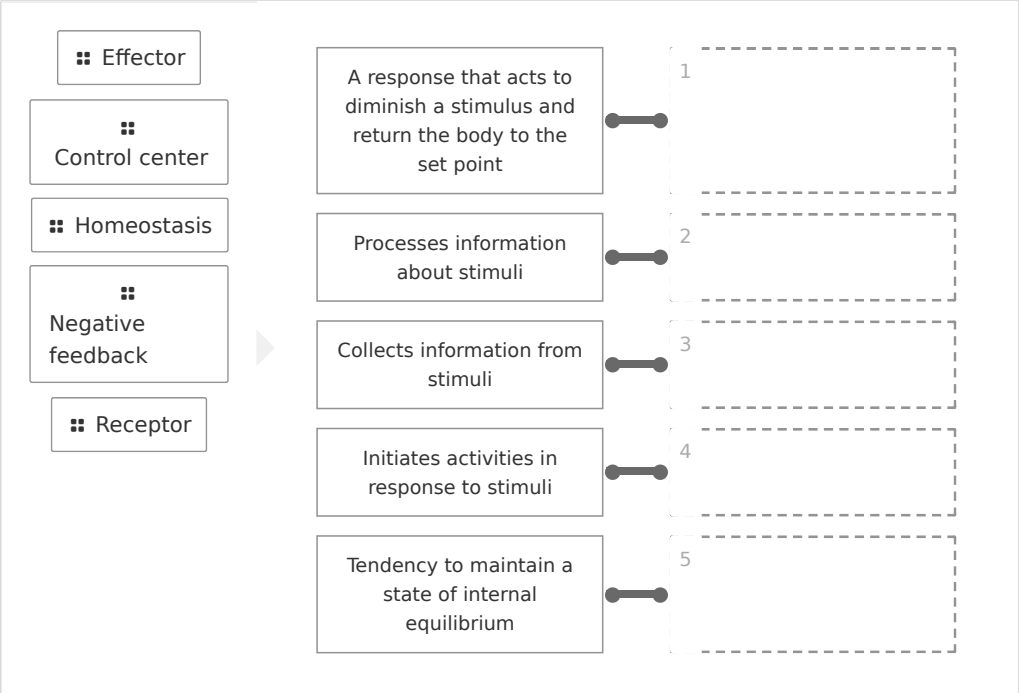
Homeostasis

Final Report - Answer Guide

Institution	Science Interactive University
Session	SI Biology - Full Discipline Demo
Course	SI Biology - Full Discipline Demo
Instructor	Sales SI Demo

Test Your Knowledge

Match each term with the best description.



Correct answers:

1 Negative feedback 2 Control center 3 Receptor 4 Effector

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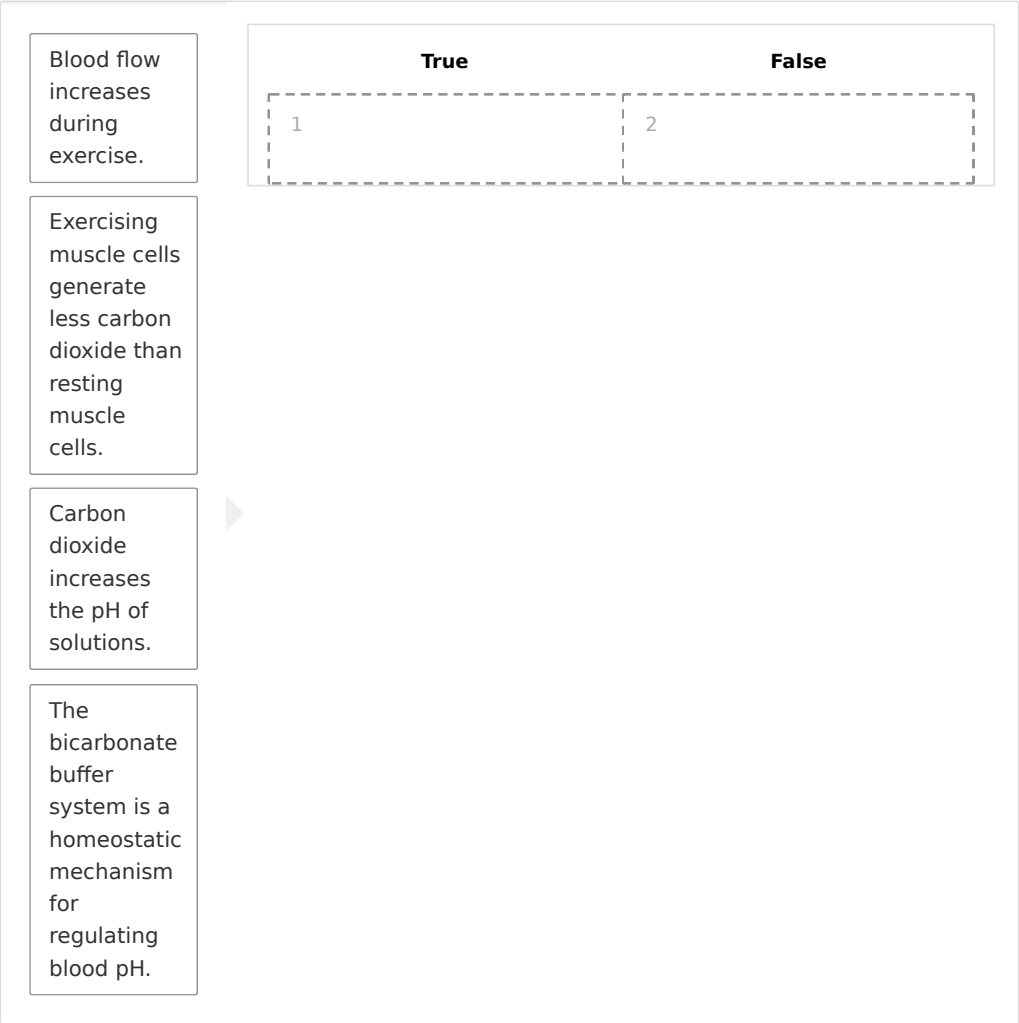
Identify each statement as true or false.



Correct answers:

1 Blood flow increases during exercise.

The bicarbonate buffer system is a homeostatic mechanism for regulating blood pH.

2

Exercising muscle cells generate less carbon dioxide than resting muscle cells.

Carbon dioxide increases the pH of solutions.

Exploration

A homeostatic pathway is composed of receptors, a control center, and effectors.

- [x] True ✔
- [ ] False

A pregnant woman going into labor is an example of positive feedback.

- [x] True ✔
- [ ] False

The brain signals increases in _____ during exercise in order to maintain homeostasis.

- [ ] heart rate
- [ ] respiration rate
- [ ] blood pressure
- [x] All of the above ✔

The bicarbonate buffer system reacts with _____ generated by cells to prevent the blood from becoming acidic.

- [x] carbon dioxide ✔
- [ ] oxygen
- [ ] nutrients
- [ ] effectors

Exercise 1

What is the stimulus, control center, effector, and response for the homeostatic pathway responsible for the relationship between exercise and heart rate observed in this exercise.?

The stimulus is insufficient oxygen and nutrient availability for exercising muscle cells. The control center is the cardiovascular center of the brain stem and the effector is the heart. The response is an increased heart rate to provide increased oxygen and nutrients supplied to cells.

How did heart rate vary with exercise in your results? Reference Data Table 1 and Graph 1 in your explanation.

Heart rate increased as the level of exercise increased as recorded in Data Table 1 and Graph 1. Heart rate at rest was lower than walking heart rate and heart rate while performing jumping jacks was higher than walking heart rate.

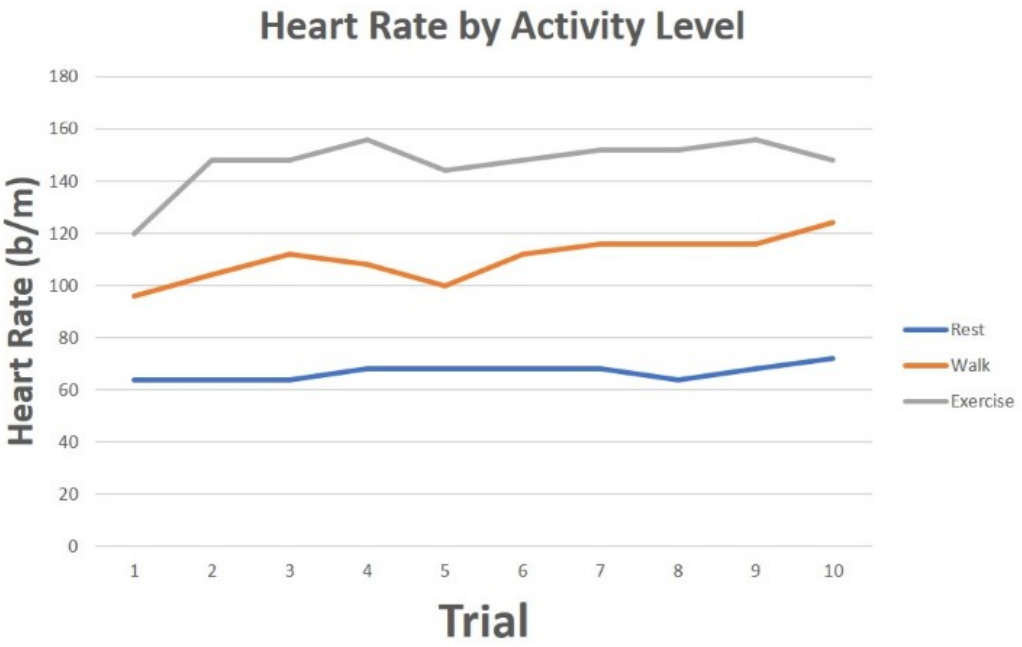
Was the homeostatic pathway investigated in this exercise a positive or negative feedback loop? Explain your answer by referencing the set point for the pathway.

The homeostatic pathway investigated in this exercise was a negative feedback loop as the response was designed to restore the body to the resting heart rate level setpoint.

Data Table 1: Pulse and Heart Rate
(SAMPLE ANSWER BELOW)

	Trial Number									
	1	2	3	4	5	6	7	8	9	10
Resting: Pulses in 15 sec	16	16	16	17	17	17	16	17	18	18
Resting: Heart rate	64	64	64	68	68	68	64	68	72	72
Walking: Pulses in 15 sec	24	26	28	27	25	28	29	29	29	31
Walking: Heart rate	96	104	112	108	100	112	116	116	116	124
Jumping: Pulses in 15 sec	30	37	37	39	36	37	38	38	39	37
Jumping: Heart rate	120	148	148	156	144	148	152	152	156	148

Graph 1: Heart Rate by Activity
(SAMPLE ANSWER BELOW)



Exercise 2

How was the blood buffering system modeled in the procedures of this exercise?

0 Word(s)

Based on your results, what would happen to the human body if the blood did not contain a homeostatic buffering system? Reference Data Table 2 and Graph 2 in your explanation.

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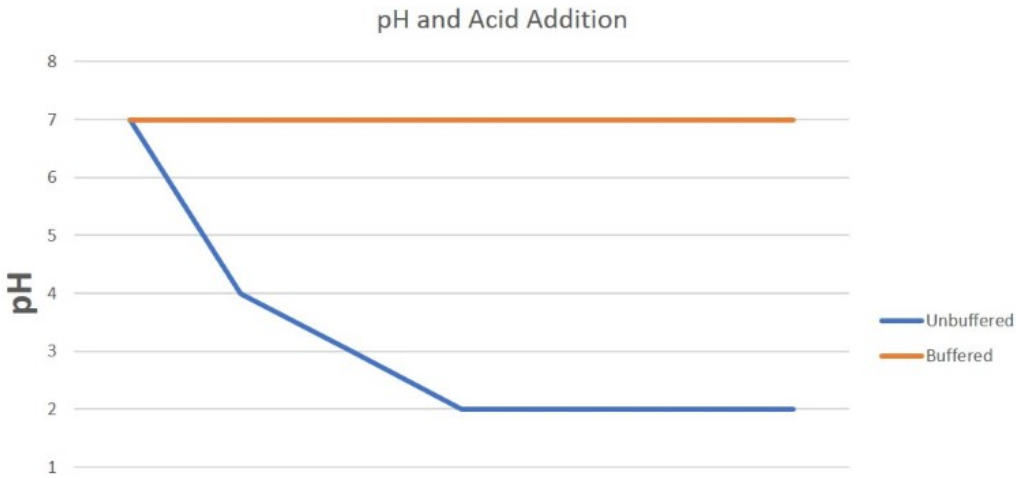
Data Table 2: pH of Buffered and Unbuffered Solutions
(SAMPLE ANSWER BELOW)

HCl Drops	Un-buffered Solution	Buffered Solution
Initial pH	7	7
+3 Drops HCl	4	7
+6 Drops HCl	2	7
+9 Drops HCl	2	7
+12 Drops HCl	2	7
+15 Drops HCl	2	7
+18 Drops HCl	2	7

Graph 2: pH and HCl
(SAMPLE ANSWER BELOW)



Competency Review

In a homeostatic pathway, ____ collect information about stimuli.

- receptors ✔
- set points
- effectors
- All of the above

A set point is the ideal condition at which the body exists.

- True ✔
- False

Sweating and shivering to maintain internal body temperatures are examples of _____ feedback loops.

- negative ✔
- positive
- equilateral
- multiplicative

Muscle cells require more _____ and produce more _____ during exercise than at rest.

- carbon dioxide; nutrients
- oxygen; nutrients
- oxygen; carbon dioxide ✔
- nutrients; oxygen

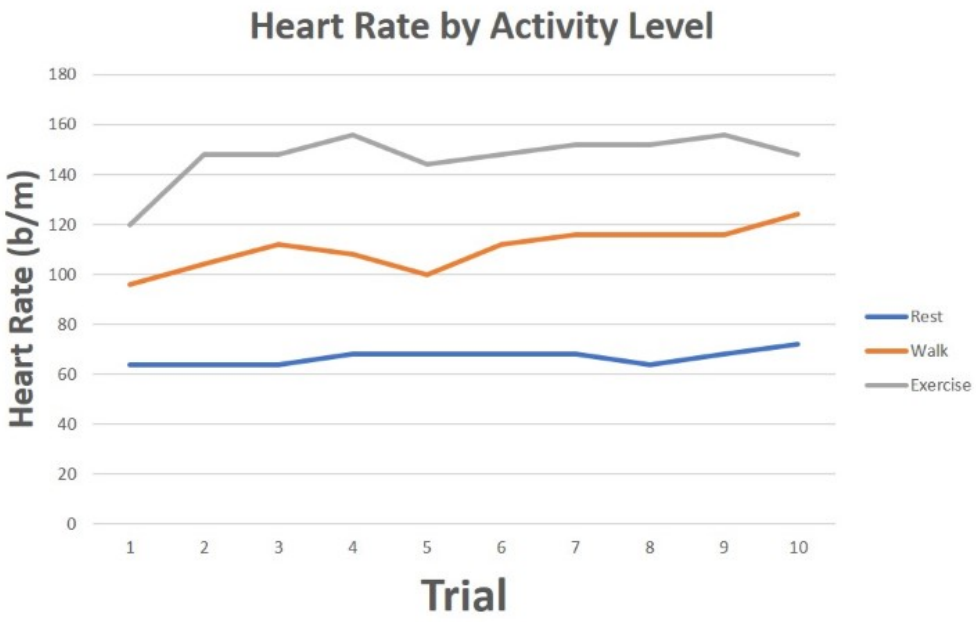
The bicarbonate buffer system is used by the human body to maintain blood pH between 7.35 - 7.45.

- True ✔
- False

Resting heart rate should be measured when the individual is _____.

- standing
- walking
- jumping
- sitting ✔

The graph below indicates that heart rate decreases as a result of exercise.



- True
- False ✔

The homeostatic buffering system of the blood can be modeled by adding _____ to distilled water.

- carbon dioxide
- oxygen
- sodium bicarbonate ✔
- nutrients

Extension Questions

Diabetes is a disease resulting from elevated glucose levels in the bloodstream due to a disrupted feedback loop. In healthy individuals, the pancreas maintains the set point for blood glucose levels by secreting the hormone insulin. Following a meal, digestion and absorption result in elevated glucose levels in the blood. Elevated glucose levels are detected by pancreatic beta cells which then release insulin stored within vesicles of the beta cells. The secreted insulin enters the bloodstream and facilitates the transport of glucose into cells of the body where it is stored or used as energy for cellular work.

Apply your knowledge of homeostatic pathways to classify the feedback loop as positive or negative. How is the feedback disrupted by diabetes? Explain your answer by referencing the roles of pancreatic beta cells within the homeostatic pathway.

(SAMPLE ANSWER BELOW)

Insulin secretion by beta cells is an example of a negative feedback loop. The cells function to return blood glucose levels to a setpoint by decreasing the effects of the high blood sugar stimulus. The beta cells function as receptors of blood sugar level stimuli, control centers, and effectors of insulin release. Diabetes disrupts the negative feedback loop such that beta cells no longer signal insulin release in response to elevated glucose levels in the blood resulting in an inability to return glucose levels to a setpoint.