STUDENT GUIDE
EXPLAIN 2 LESSON 12

Food and Agriculture Center for Science Education

Part 1: Our Motivation

Record what we are now trying to explain about the Module Phenomenon for this module.

We have figured out that many changes happen to the amount of water in the body to make you sweaty, thirsty, and make your urine color change during exercise, so we will try to explain how this process happens.

Part 2: Developing an Explanation of Sweat, Thirst, and Urine Color Change After Exercise

Using the evidence gathered throughout this module, construct an explanation of the Module Questions, *Why do we get sweaty and thirsty after exercise? Why does the color of our urine change? How does milk help us recover from these effects?* In your explanation, be sure to describe:

- Cite at least two different sources of evidence, including data sets and/or the Science Theater models from Module 2.
- Describe how you think exercise changes the conditions of the body, including temperature change, sweat, thirst, and urine color change.
- Describe how a negative feedback mechanism responds to water and temperature changes in the body and brings them back to a stable state.
- Students describe how specialized cells in each organ contribute to the function of the system or organ.

After a person works out, they typically get hot. We observed the changes in body temperature due to exercise in the scientific study from Lesson 9 Part 2. Before exercise, the body temperature starts at a normal, stable state at about 36.5° C. When exercising, body temperature increases by about 0.5 - 1.0° C. Then, after exercise, body temperature returns to about 36.6° C (Lesson 9 Part 2 Analyzing Changes in Body Temperature).

The body has multiple ways in which it tries to cool down. First, thermoreceptors in the skin and muscles detect a change in temperature. They send a nerve signal to the hypothalamus in the brain, which then sends a signal via nerves to the sweat glands to produce sweat to cool the body. The hypothalamus also signals the vasodilation nerves to expand the blood vessels, allowing blood to bring heat from the body to the surroundings. This is one example of a feedback mechanism the body has to respond to the increase in temperature of the body to bring the temperature back to its stable state.

The loss of water in sweat occurs because water moves from the bloodstream to the skin in sweat. In our graph of water volume in the bloodstream, we saw that blood volume decreased during two instances of exercise. First, during the moderate effort exercise, it decreased by about 10%. Then, during the max effort exercise, it decreased by 10-20% (Lesson 11 Part 3: Analyzing Data About the Water Content of Blood During Exercise).

Osmoreceptors detect the decrease in water in the blood and send a signal to the brain. The hypothalamus in the brain receives the signal from the osmoreceptors. This results in the sensation of thirst and an increased production of ADH from the pituitary gland in the brain. The pituitary region of the brain sends ADH to the kidney via the bloodstream to absorb less water from the blood, leading to less water moving to the bladder, where it is stored as urine. The urine color becomes darker. This process is also a negative feedback loop and is how the body prevents additional water loss (observed in Science Theater).

In recovery, when someone stops exercising, they cool down. The temperature change is detected by thermoreceptors, which send a signal to the hypothalamus, which then signals the sweat glands to stop sweating. When someone drinks milk, the water in the milk moves through digestion into the bloodstream, which brings the amount of water in the blood back to its stable state. The osmoreceptors detect this change, cease the sensation of thirst, and send less ADH to the kidneys. The kidneys can now absorb more water from the bloodstream, passing it on to the bladder as urine. Urine is a lighter color as a result (observed in Science Theater).

Part 3: Updating the Effects of Exercise and Recovery Models

As a class, we will update the Effects of Exercise Model and the Recovery Models. List 3-4 additions you would make to the class model in the space below. These may be:

- Organs and their function

- Specialized cells and their function
- Signals or molecules and where they move

- Add the kidneys that function to filter the blood and pull water out of the blood into the urine.
- Add the bladder and its urothelial cells that hold urine.
- Add ADH that signals the kidneys to hold more water from entering the urine and hold it in the blood during exercise

Part 4: Asking New Questions

Record any new questions that you have that might help you:

- Find additional information about sweat, thirst, urine, and exercise recovery.
- "Fill in a gap" in your explanation or our class explanation.
- Settle an area of disagreement that we've identified in our explanations.

- What happens in the body when too much water is lost?
- What happens if you drink too much water?
- What happens to the electrolytes from milk? Do they help with hydration?