# SCIENCE THEATER EXPLORE 2 LESSON 11



## **Science Theater Teacher Directions**

## **Key Outcomes**

- Students experience the model from two points of view: an observer and a participant assigned to the role of an organ and/or specialized cell within an organ.
- Students cooperate to combine information about individual organs and cells to make sense of the processes by which water balance in the body changes during exercise and during recovery.
- Students physically transport and manipulate molecules and nutrients simulating the movement of matter in a feedback mechanism that regulates changes in water levels in the body.

## **Materials**

The following is a list of the printed materials which are located in the student handout. There you will find:

**Table Tents** for each organ that depict the structure of the organ and the specialized cells it is composed of.



**Tokens** represent relevant nutrients, stimuli, processes, and responses that occur during the mechanism being modeled.

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#### TOKENS



Fold along solid lines marked "FOLD" (applies to M1 only)



**Role Cards** for each organ (including any specialized cells) that describe the function of each organ and its specialized cells as well as instructions for how students will engage in the model.

**ROLE CARD** 



## **Physical Classroom Setup**

Set up and label the layout of the classroom as shown below so that a table (or grouping of desks) represents each organ. Ensure each organ has the corresponding visual poster where it is visible. Students will stand or sit at each table as they represent the cells of each organ. Molecule cards will be "moving" from one organ to another.



Below is a table listing the initial locations for each token:

Organ	Act 1 Tokens	Act 2 Tokens
Brain	<ul><li>Thirst sensation</li><li>Signal - low water in blood</li></ul>	<ul> <li>No longer thirsty</li> <li>Signal - increased water in blood</li> </ul>
Blood Vessels	<ul> <li>Lower water levels in blood</li> <li>Filter water and wastes</li> <li>Detect low water in blood</li> <li>Signal - low water in blood</li> </ul>	<ul> <li>Higher water levels in blood</li> <li>Filter water and wastes out to make urine</li> <li>Signal increased water in blood</li> </ul>
Kidneys	<ul> <li>Increased amount of ADH</li> <li>Decreased absorption of water</li> </ul>	<ul> <li>Decreased amount of ADH</li> </ul>
Bladder	<ul> <li>Decreased urine volume</li> <li>Water (1)</li> <li>Low-volume, dark-colored urine</li> </ul>	<ul> <li>Increased urine volume</li> <li>Filter water and waste out to make urine</li> <li>High-volume, light-colored urine</li> <li>Water (5)</li> </ul>
Facilitator	• Exercise begins	Recovery with milk begins

## **Science Theater Actions By Role**

- Brain: Hypothalamus Neurons and Pituitary Neurons
  - Exercise: Receive the Low Water in Blood Nerve Signal token from the osmoreceptors. In response, activate the Sensation of Thirst token.
  - Exercise: Activate the Increased amount of ADH token and send it to the bloodstream.
  - Recovery: Receive the Increased Water in the Blood Nerve Signal token from the osmoreceptors. In response, activate the No Longer Thirsty token.
  - Recovery: Activate the Decreased Amount of ADH token. Send it into the bloodstream.
- Brain: Osmoreceptors Neurons
  - Exercise: Osmoreceptors detect a reduction in the amount of water in the bloodstream.
     Activate the Low Water in Blood Nerve Signal token. Send the Low Water in Blood Nerve Signal token to the hypothalamus and pituitary neurons in the brain.
  - Recovery: Osmoreceptors detect an increase in the amount of water in the bloodstream.
     Activate the Increased Water in the Blood Nerve Signal token. Send the Increased Water in Blood Nerve Signal token to the hypothalamus and pituitary neurons in the brain.
- Blood Vessels
  - Exercise: Deactivate two water tokens.
  - Exercise: Receive the Increased Amount of ADH token and deliver it to the epithelial cells of the kidney.
  - Recovery: Activate all five water tokens.
  - Recovery: Receive the Decreased Amounts of ADH token from the pituitary gland and deliver to the epithelial cells of the kidney.
- Kidney: Epithelial cells
  - Exercise: Receive the Increased Amount of ADH token and activate the Filter Water and Wastes Out of Blood to Make Urine token. In response to lower water levels in the blood, activate the Decreased Absorption of Water token. Receive one water token from the bloodstream and pass it to the Bladder.
  - Recovery: Receive the Decreased Amounts of ADH token from the bloodstream and activate the Filter Water and Wastes Out of Blood to Make Urine token. In response to higher water levels in the blood, activate the Increased Absorption of Water token. Receive three water tokens from the Bloodstream and pass them to the Bladder.
- Bladder: Urothelial cells
  - Exercise: with only one water token, activate the Decreased Urine Volume token and
  - Recovery: With three water tokens, activate the Increased Urine Volume Token and the Release the High Volume, Light-Colored Urine token.

## **Science Theater Actions in Sequence**

Act 1 - During Exercise

- 1. (Facilitator) Exercise begins. Recall that the body is sweating during exercise, and water moves from the bloodstream out of the body via sweat glands. The bloodstream has less water in it than it does at the stable state.
- 2. (Blood vessels) Deactivate two water tokens.
- 3. (Osmoreceptors) Osmoreceptors detect a reduction in the amount of water in the bloodstream. Activate the Low Water in Blood Nerve Signal token. Send the Low Water in Blood Nerve Signal token to the hypothalamus and pituitary neurons in the brain.
- 4. (Brain Hypothalamus Neurons) Receive the Low Water in Blood Nerve Signal token from the osmoreceptors. In response, activate the Sensation of Thirst token.
  - a. (Facilitator) I feel thirsty now! I might go drink some milk later!
- 5. (Brain Pituitary Gland Neurons) Activate the Increased amount of ADH token and send it to the bloodstream.
- 6. (Blood vessels) Receive the Increased Amount of ADH token and deliver it to the epithelial cells of the kidney
- 7. (Kidney) Receive the Increased Amount of ADH token and activate the Filter Water and Wastes Out of Blood to Make Urine token. In response to lower water levels in the blood, activate the Decreased Absorption of Water token. Receive one water token from the bloodstream and pass it to the Bladder.
- 8. (Bladder) With only one water token, activate the Decreased Urine Volume token and the Release the Low Volume, Dark-Colored Urine token.
- Act 2 Recovery With Milk
  - 1. (Facilitator) Exercise stops. Athlete drinks milk, making more water available in the bloodstream.
  - 2. (Blood Vessels) Activate all five water tokens.
  - 3. (Osmoreceptors) Osmoreceptors detect an increase in the amount of water in the bloodstream. Activate the Increased Water in the Blood Nerve Signal token. Send the Increased Water in Blood Nerve Signal token to the hypothalamus and pituitary neurons in the brain.
  - 4. (Brain Hypothalamus) Receive the Increased Water in the Blood Nerve Signal token from the osmoreceptors. In response, activate the No Longer Thirsty token.
    - a. (Facilitator) I don't feel thirsty anymore!
  - 5. (Brain Pituitary gland neurons) Activate the Decreased Amount of ADH token. Send it into the bloodstream.
  - 6. (Blood Vessels) Receive the Decreased Amounts of ADH token from pituitary gland and deliver to the epithelial cells of the kidney.
  - 7. (Kidney) Receive the Decreased Amounts of ADH token from the bloodstream and activate the Filter Water and Wastes Out of Blood to Make Urine token. In response to higher water levels in the blood, activate the Increased Absorption of Water token. Receive three water tokens from the Bloodstream and pass them to the Bladder.
  - 8. (Bladder) With three water tokens, activate the Increased Urine Volume Token and the Release the High Volume, Light-Colored Urine token.