

# Keep It Balanced

**Target Audience:**

*Students, ages 10-15*



**BLOOD  
SUGAR  
DECREASE**



**BLOOD  
SUGAR  
INCREASE**



**Smithsonian**  
Science Education Center





**Yuck! That Tastes Terrible: Discovering a Unique Genetic Trait** is part of the STEM2D Student Activity Series. The content and layout were developed by the Smithsonian Science Education Center as part of Johnson & Johnson's WiSTEM<sup>2</sup>D initiative (Women in Science, Technology, Engineering, Mathematics, Manufacturing, and Design), using a template provided by FHI 360 and JA Worldwide. This series includes a suite of interactive and fun hands-on activities for girls (and boys) ages 5–18, globally.

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# KEEP IT BALANCED

## Challenge

Understand the basic principles of blood sugar homeostasis and model the process by playing a card game.

## Target Population

Students, ages 10–15

## Activity Description

In this activity students will learn about Dr. Bernardo Houssay and the endocrine system. Then they will use their understanding of the endocrine system to play a card game, with the goal of keeping a body at homeostasis to mimic the role of insulin. Students will then write a description of how they played the game and whether that was a successful strategy.

## Materials for Each Student

For the activity leader

- Activity Leader Checklist
- Tell My Story Form

For the class

- Human Body Systems Activity Sheet
- Blood Sugar Homeostasis Activity Sheet
- System to project the activity sheets for the class

For each group of 2 to 4 students

- Endocrine System Activity Sheet
- Blood Sugar Homeostasis Activity Sheet
- Card deck (6 sheets of cards)
- Game Rules Activity Sheet
- Scissors

## Estimated Materials Cost

Paper and printing are the only costs for this activity. The cost of printing should be minimal and scissors should be available in a classroom.

## Activity Leader Preparation

1. Read **Spark WiSTEM<sup>2</sup>D**. This is essential reading for all volunteers interested in working with youth, as it provides important background knowledge about STEM<sup>2</sup>D, strategies for engaging students, and tips for working with groups of students. Download at [STEM2D.org](http://STEM2D.org).
2. Review the **Activity Leader Checklist** for details and specific steps for planning and preparing to implement this activity.

## Background Information

The endocrine system uses hormones to control and coordinate your body's internal metabolism, energy level, reproduction, growth and development, and response to injury, stress, and environmental factors. The endocrine system is made up of glands located throughout the body, hormones that are made by the glands and released into the bloodstream or the fluid surrounding cells, and receptors in various organs and tissues that recognize and respond to the hormones.

When the body's systems are functioning properly and responding to changes as they should, we say the body is in a state of homeostasis. Homeostasis means all the parts of a system are in balance, and the system is operating the way it is supposed to.

Diabetes is a chronic disease that occurs when an organ called the pancreas does not produce enough insulin, or when the body cannot use the insulin it produces. Insulin is a hormone made by the pancreas. Insulin, along with hormones made by the pituitary gland, help your body turn blood sugar (also called glucose) into energy. Insulin

also helps your body store glucose in your liver to use later, when your body needs it.

According to the Centers for Disease Control, more than 30 million Americans suffer from diabetes. Diabetes can lead to other severe health problems. Adults with diabetes have a two to three times higher risk for heart attacks and strokes. Diabetes can lead to reduced blood flow and nerve damage in the feet, which increases the chance of foot ulcers, infections, and limb amputation. Diabetes is the cause of 2.6% of all blindness globally, and is among the leading causes of kidney failure.

For people with type 1 diabetes, a treatment called insulin therapy replaces the insulin their body doesn't produce. For people with type 2 diabetes or gestational diabetes (diabetes that develops when a woman is pregnant), insulin therapy is used if other treatments haven't been able to keep blood glucose levels within the desired range. Insulin therapy helps prevent diabetes complications by keeping the blood sugar within a target range.

Dr. Bernardo Houssay was an Argentine physician and researcher in the early 20th century. He worked in almost every field of physiology, and had a special interest in the endocrine glands. In the early 1940s, Houssay conducted experiments on dogs and toads to study the pituitary gland's role in converting blood sugar to produce energy for the body. In 1947 he won a Nobel Prize for his research on the role of pituitary hormones in regulating blood sugar.



## Explaining the Problem Conversation Starters

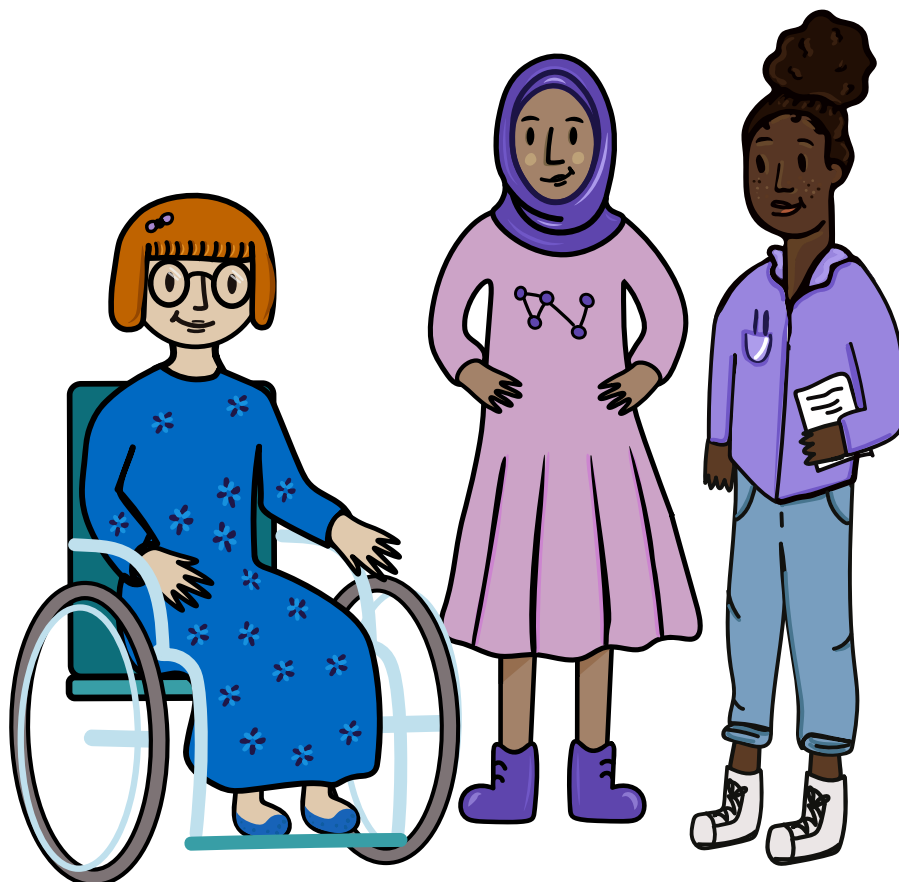
- Why do you think it is important to keep blood sugar in homeostasis?
- How do you think diet can play a role in blood sugar homeostasis?

## Step-by-Step Instructions

1. Greet the students.
2. Tell the students your name and your organization/company. Talk about your educational and career path. Use the Tell My Story Form as a starting point for your remarks. Be prepared to describe your job or a typical day, and provide information about your background, including:
  - Your education (focus on secondary and post-secondary classes and courses)
  - Current work projects
  - Interests and hobbies
  - Why you love STEM2D and how your work is connected
3. Ask the students and any volunteers helping today to introduce themselves.
4. Inform the class that this activity will discuss human body systems and that body systems, such as respiration, serve important roles within the body.
5. Ask the students as a class to list as many human body systems or important jobs the body does that they can think of.
6. Project the Human Body Systems Activity Sheet and discuss the body systems that students identified and the ones they missed.
7. Tell the class that they will now be focusing on the endocrine system. Divide the class into groups of 2 or 4 students.
8. Give a copy of the Endocrine System Activity Sheet to each group. Review with the class the organs and glands of the endocrine system and their basic functions.
9. Now project the Blood Sugar Homeostasis Activity Sheet and give

a copy to each group. Review the graphic and definitions with the class. This should remain projected during the card game.

10. Hand out a card deck (6 sheets) and Game Rules Activity Sheet to each group.
11. Have the students review the headings on the cards to make sure they understand what each heading means.
12. Ask the students to cut out the cards to create a deck.
13. Instruct the class to follow the Game Rules Activity Sheet to play the card game.
14. Give the students 20 minutes to play as many rounds of the game as they can.
15. Gather the class back together and discuss how the card game went. Ask the class:
  - What was easy about using the cards to create homeostasis? What was difficult?
  - What did students learn? What do the students want to learn more about?



## Vocabulary

**Blood sugar:** The main sugar found in your blood. It comes from the food you eat and is your body's main source of energy.

**Diabetes:** A long-lasting health condition that affects how your body turns food into energy—which requires a hormone called insulin. If you have diabetes, your body either doesn't make enough insulin or can't use the insulin it makes as well as it should.

**Endocrine system:** A complex network of glands and organs. It uses hormones to control and coordinate your body's metabolism, energy level, reproduction, growth and development, and response to injury, stress, and mood.

**Gland:** An organ that produces and releases substances that perform a specific function in the body.

**Homeostasis:** The state of steady and balanced internal, physical, and chemical conditions maintained by living systems.

**Hormones:** Your body's chemical messengers.

**Human body system:** A group of organs that work together to perform a specific function in the body.

**Metabolism:** The chemical reactions in the body's cells that change food into energy.

**Receptor:** A part of a cell that receives a signal.



# ACTIVITY LEADER CHECKLIST

## DID YOU . . .

- ☐ Read Spark WiSTEM2D? This is essential reading for all volunteers interested in working with youth. It defines the STEM2D principles and philosophy and provides research-based strategies and tips for engaging and interacting with female students. Download at [www.STEM2D.org](http://www.STEM2D.org).
- ☐ Visit the implementation site and observe the young people (optional)? If you do visit, take note of the following:
  - ☐ How does the site encourage orderly participation? For example, do the young people raise their hands when responding to questions or during discussions? How are interruptions handled? Do you see any potential problems with managing a class of young people?
  - ☐ What does the site do to make each student feel important and at ease?
  - ☐ How is the room arranged? Will you need to move desks or chairs for any part of your presentation?
  - ☐ How can you engage the site representative in your presentation?
- ☐ Meet with and finalize the logistics with the Site Representative?
  - ☐ Confirm the date, time, and location of the activity?
  - ☐ Confirm the number of students attending? Knowing this will help you decide how to group the students into teams, as well as the appropriate materials to purchase.
- ☐ Recruit additional volunteers, if needed?
- ☐ Prepare for the activity:
  - ☐ Read the entire activity text prior to implementation?
  - ☐ Customize the activity, if desired, to reflect your background and experiences, as well as the cultural norms and language of the students in your community?
  - ☐ Complete the Tell My Story Form, which will prepare you to talk about your educational and career path with the students?
  - ☐ If teams are needed for this activity, please ask the teacher in advance to organize the students into teams.
- ☐ Practice your presentation, including the hands-on, minds-on activity? Be sure to:
  - ☐ Do the activity; make sure you can explain the concepts to students, if needed, and that you know the correct answers.
- ☐ Obtain the required materials (see the Materials and Estimated Materials Costs sections) and, if asked for in the Getting Ready section, photocopy the Student Handouts and Materials Testing Sheets. In addition:
  - ☐ Organize the materials to ensure each team has everything listed in the Materials section—keep in mind some materials are shared among the teams.
- ☐ Prepare the space? Specifically:
  - ☐ Make sure tables and chairs are arranged to accommodate teams of students.
  - ☐ Bring a camera, if desired, to take photographs.
- ☐ Obtain and collect permission slips and photo release forms for conducting the activity if applicable?
- ☐ Have fun!

# “Tell My Story” Form

*This form will help volunteers serving as activity leaders prepare to talk about their STEM<sup>2</sup>D interests, education, and career path.*

## ABOUT YOU

Name: \_\_\_\_\_

Job Title: \_\_\_\_\_

Company: \_\_\_\_\_

When/Why did you become interested in STEM<sup>2</sup>D? \_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

What do you hope young people, especially girls, will get out of this activity? \_\_\_\_\_

\_\_\_\_\_

## FUN FACT

Share a little about your background. Ideas:

- Share a memory from childhood where you first had your “spark” or “interest” in STEM.
- Detail your journey; highlight what you have tried, what you learned, steps to success, etc.
- Failures or set backs are also great to talk about—difficulties, and/or challenges and how you overcame them.

## EDUCATION AND CAREER PATH

What classes/courses did you take in secondary school and in college that helped or interested you most? \_\_\_\_\_

How did you know you wanted to pursue a STEM<sup>2</sup>D career? \_\_\_\_\_

\_\_\_\_\_

What was your postsecondary path, including the institution you attended and your degree? *If you switched disciplines, make sure you explain why to the students.*

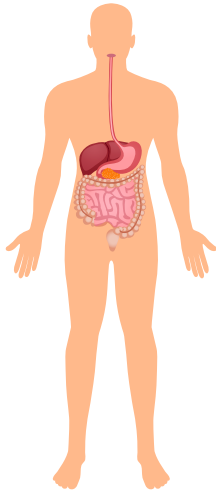
\_\_\_\_\_

What your current position entails. *Be sure to include how you use STEM<sup>2</sup>D on a typical work day.*

\_\_\_\_\_

\_\_\_\_\_

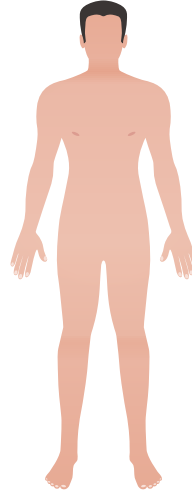
# Human Body Systems Activity Sheet



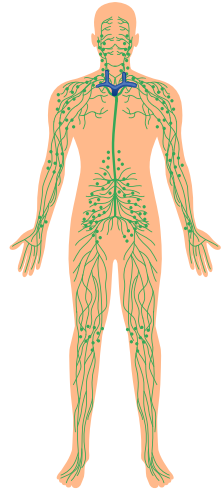
Digestive System



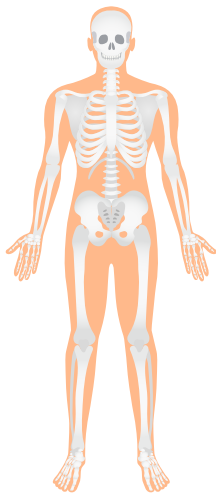
Muscular System



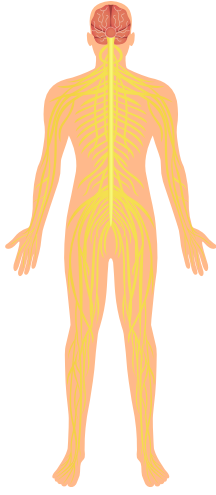
Integumentary System



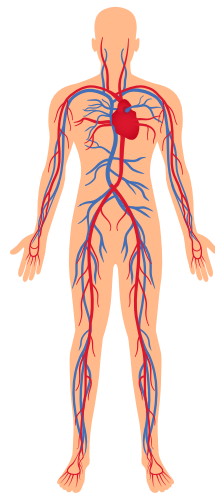
Lymphatic System



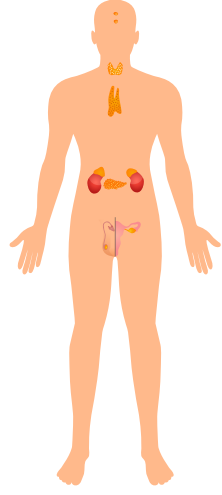
Skeletal system



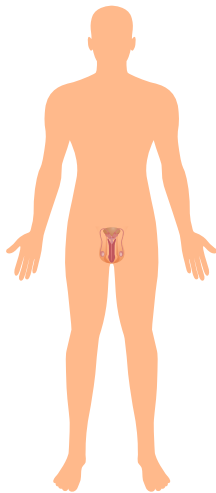
Nervous System



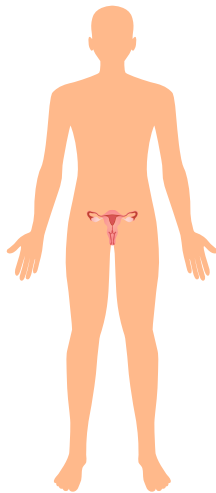
Circulatory system



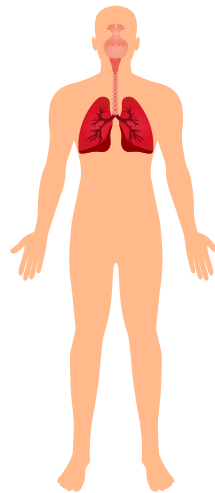
Endocrine System



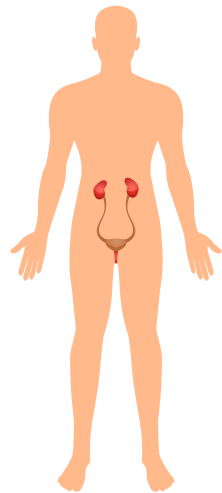
Male Reproductive System



Female Reproductive System



Respiratory system

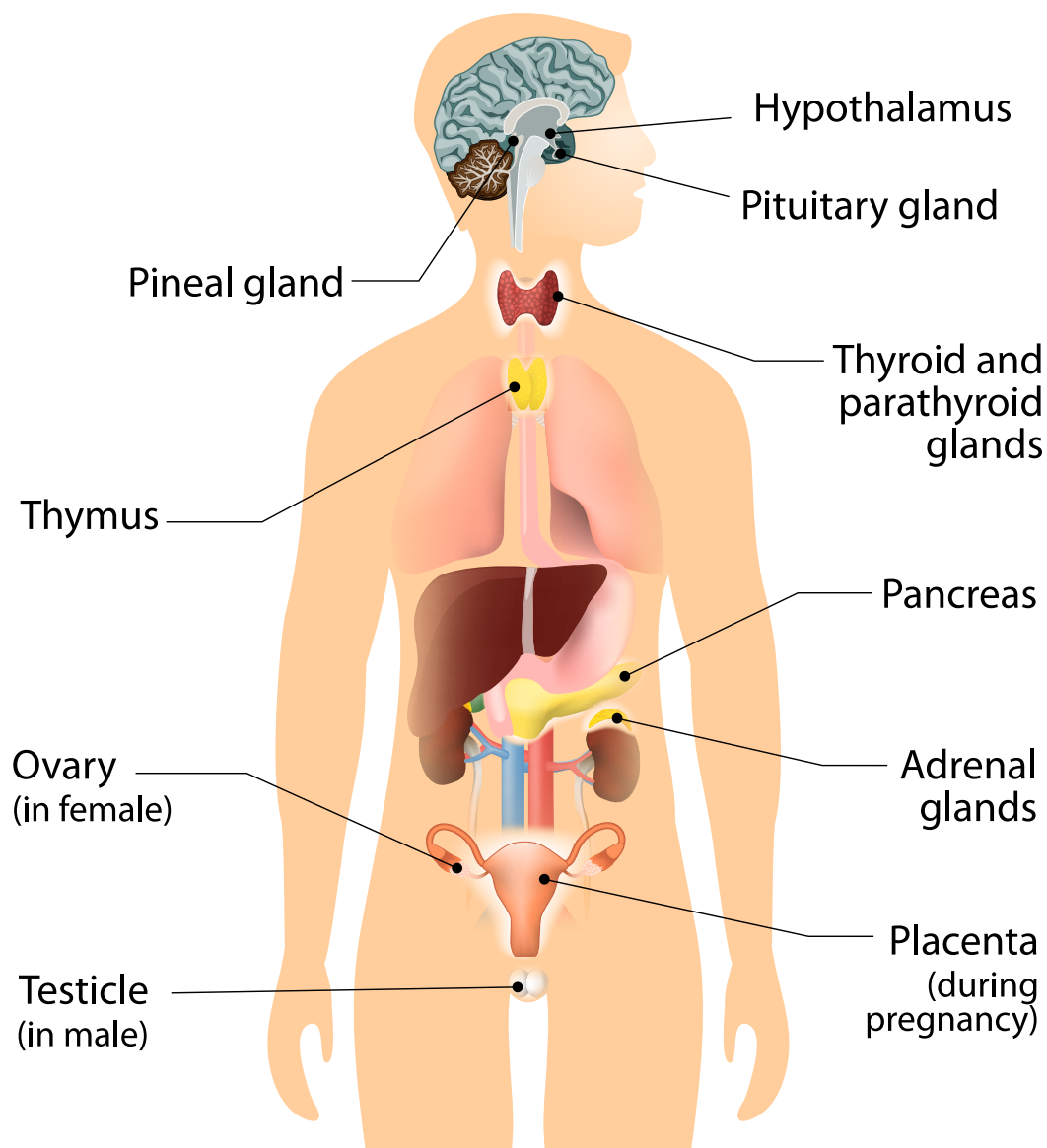


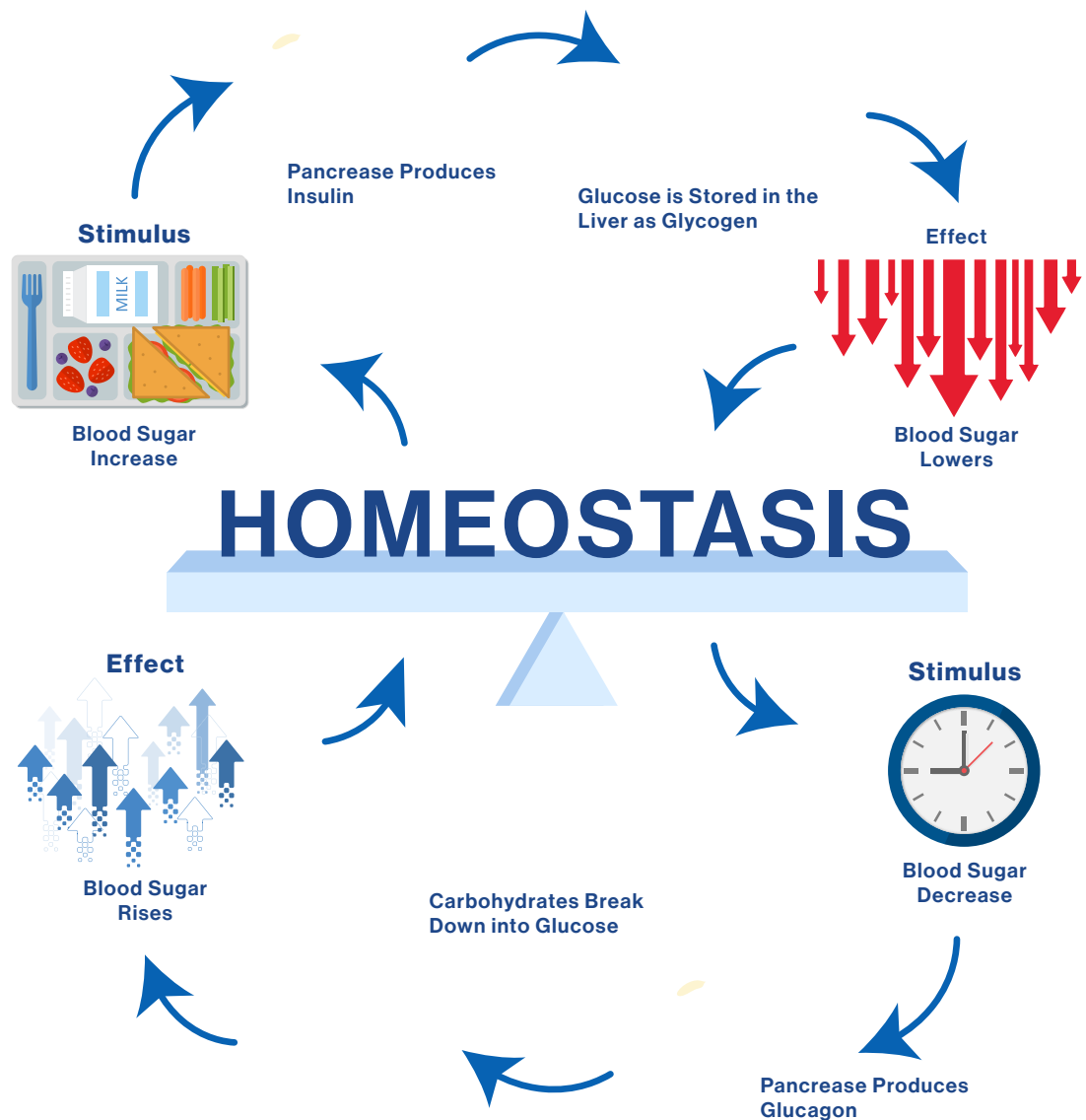
Urinary System

# Human Body Systems Activity Sheet

The endocrine system uses hormones to control and coordinate your body's internal metabolism (the processes of burning fuel to power the body), energy level, reproduction, growth and development, and response to injury, stress, and environmental factors. This system is made up of:

- Glands located throughout the body. These include the pituitary, pineal, thyroid, parathyroid, and adrenal glands.
- Hormones that are made by the glands and released into the blood stream or the fluid surrounding cells.
- Receptors in various organs and tissues that recognize and respond to the hormones.





**Blood sugar homeostasis:** The balance of insulin and glucagon needed to maintain the proper levels of blood glucose.

**Carbohydrates:** The main source of energy for the human body. They are found in food in the form of sugars, fibers, and starches.

**Glucagon:** A hormone produced in the pancreas to maintain glucose levels in the bloodstream when you're not eating and to raise very low glucose levels.

**Glycogen:** A substance deposited in bodily tissues as a store of carbohydrates for energy.

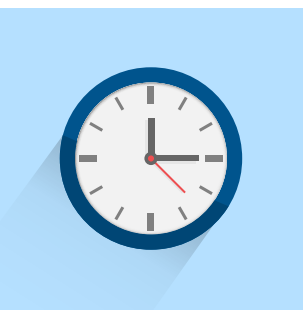
**Insulin:** A hormone produced by the pancreas in response to a rise in blood glucose following a meal. Insulin lowers blood glucose by increasing glucose uptake in muscle and fat tissue and by promoting formation of glycogen in the liver and the muscles.

**Stimulus**



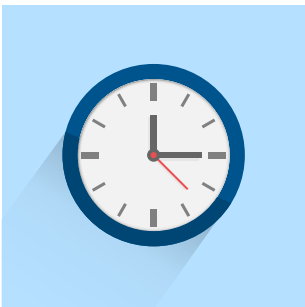
**Blood Sugar  
Decrease**

**Stimulus**



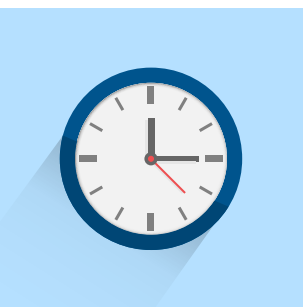
**Blood Sugar  
Decrease**

**Stimulus**



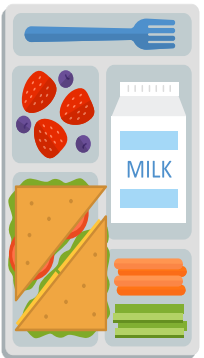
**Blood Sugar  
Decrease**

**Stimulus**



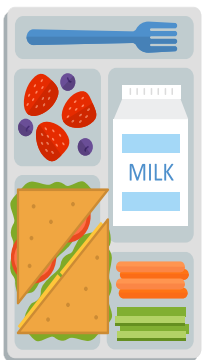
**Blood Sugar  
Decrease**

**Stimulus**



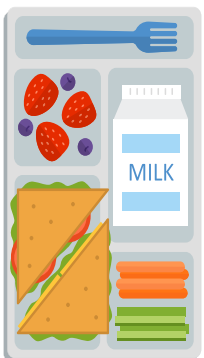
**Blood Sugar  
Increase**

**Stimulus**



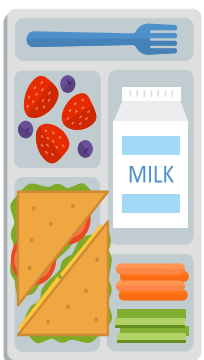
**Blood Sugar  
Increase**

**Stimulus**



**Blood Sugar  
Increase**

**Stimulus**



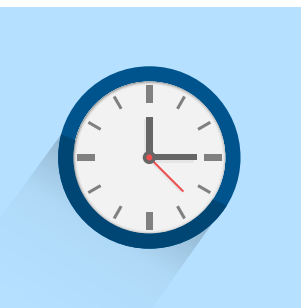
**Blood Sugar  
Increase**

**Stimulus**



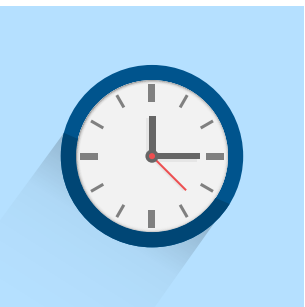
**Blood Sugar  
Decrease**

**Stimulus**



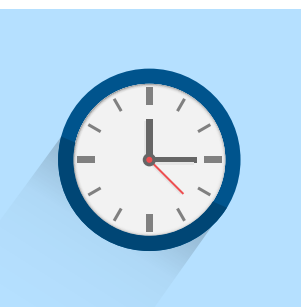
**Blood Sugar  
Decrease**

**Stimulus**



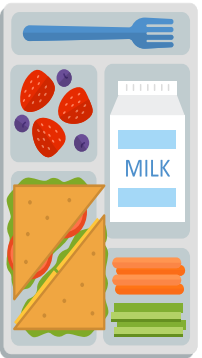
**Blood Sugar  
Decrease**

**Stimulus**



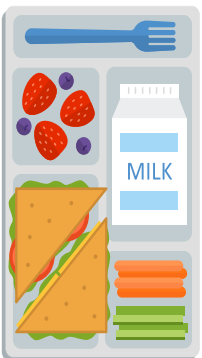
**Blood Sugar  
Decrease**

**Stimulus**



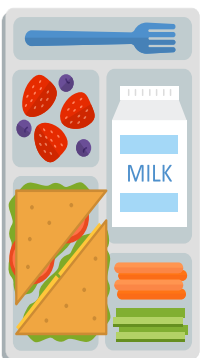
**Blood Sugar  
Increase**

**Stimulus**



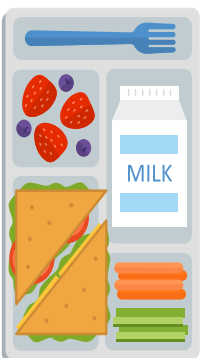
**Blood Sugar  
Increase**

**Stimulus**



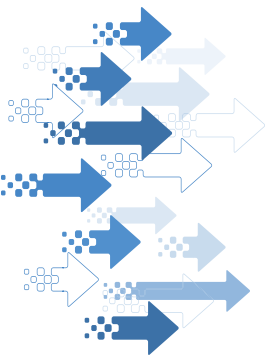
**Blood Sugar  
Increase**

**Stimulus**



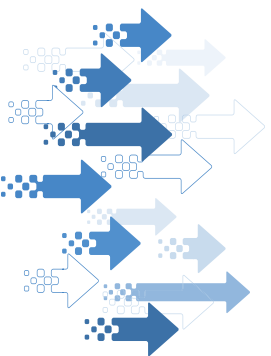
**Blood Sugar  
Increase**

**Effect**



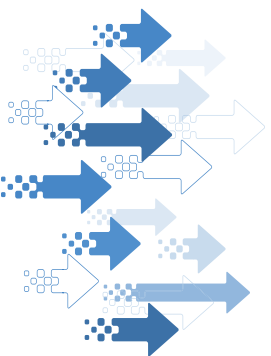
**Blood Sugar  
Rises**

**Effect**



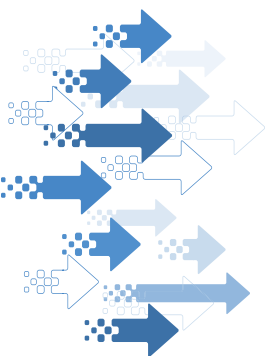
**Blood Sugar  
Rises**

**Effect**



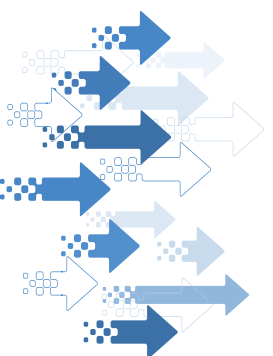
**Blood Sugar  
Rises**

**Effect**



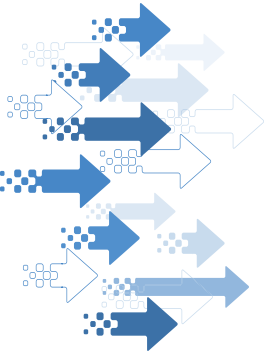
**Blood Sugar  
Rises**

**Effect**



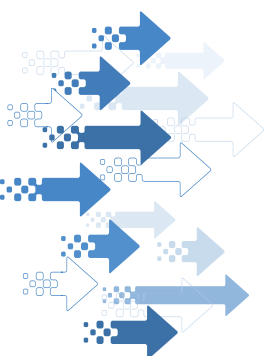
**Blood Sugar  
Rises**

**Effect**



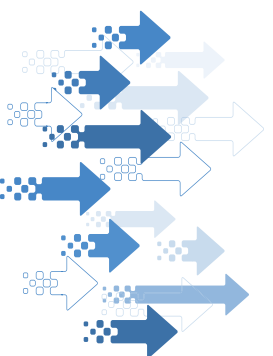
**Blood Sugar  
Rises**

**Effect**



**Blood Sugar  
Rises**

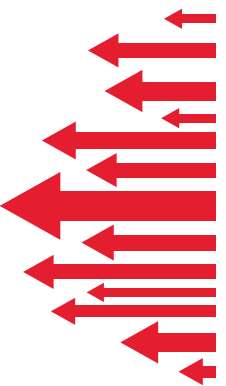
**Effect**



**Blood Sugar  
Rises**

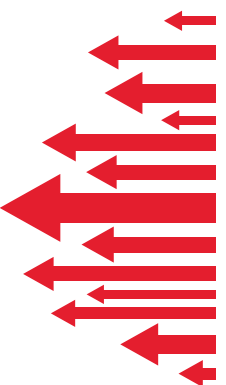


**Effect**



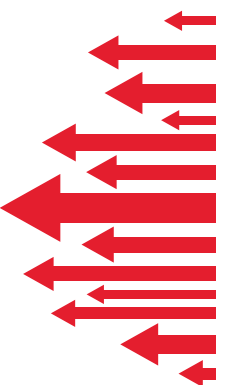
**Blood Sugar  
Lowers**

**Effect**



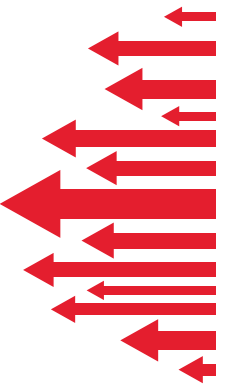
**Blood Sugar  
Lowers**

**Effect**



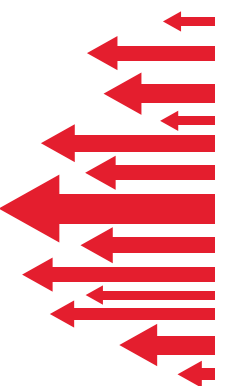
**Blood Sugar  
Lowers**

**Effect**



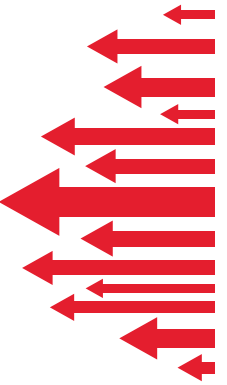
**Blood Sugar  
Lowers**

**Effect**



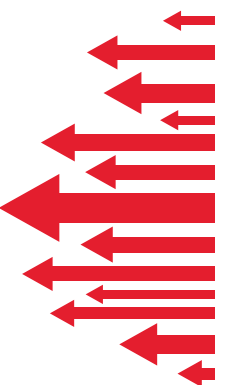
**Blood Sugar  
Lowers**

**Effect**



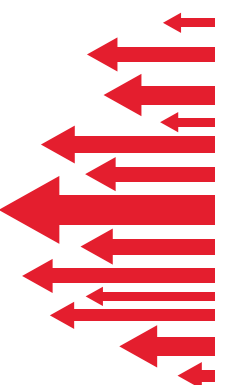
**Blood Sugar  
Lowers**

**Effect**



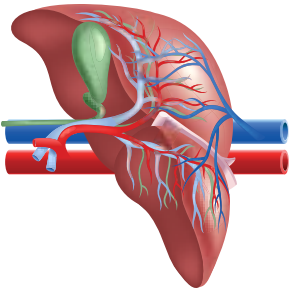
**Blood Sugar  
Lowers**

**Effect**



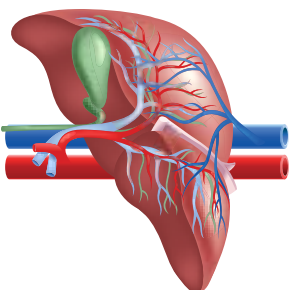
**Blood Sugar  
Lowers**

## **Body Action**



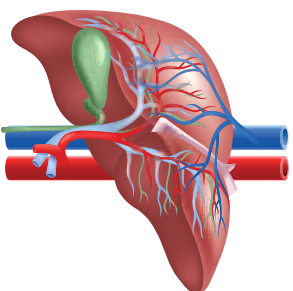
**Carbohydrates  
Break Down into  
Glucose**

## **Body Action**



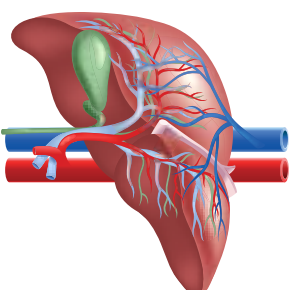
**Carbohydrates  
Break Down into  
Glucose**

## **Body Action**



**Carbohydrates  
Break Down into  
Glucose**

## **Body Action**



**Carbohydrates  
Break Down into  
Glucose**

## **Body Action**



**Pancreas  
Produces Insulin**

## **Body Action**



**Pancreas  
Produces Insulin**

## **Body Action**



**Pancreas  
Produces Insulin**

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**Pancreas  
Produces Insulin**

## Body Action



Pancreas  
Produces  
Glucagon

## Body Action



Pancreas  
Produces  
Glucagon

## Body Action



Pancreas  
Produces  
Glucagon

## Body Action



Pancreas  
Produces  
Glucagon

## Body Action



Glucose Stored  
in Liver as  
Glycogen

## Body Action



Glucose Stored  
in Liver as  
Glycogen

## Body Action



Glucose Stored  
in Liver as  
Glycogen

## Body Action



Glucose Stored  
in Liver as  
Glycogen

# Game Rules Activity Sheet

## The Objective

The goal is to be the first player to get rid of all your cards. You get rid of cards by creating chains of three cards that represent the normal functioning of the endocrine system. Each chain must include a stimulus, a body action, and an effect. An example of a chain is a stimulus card of "blood sugar increase," a body action of "pancreas produces insulin," and an effect card of "blood sugar lowers."

## The Deal

1. Deal seven cards face down, one at a time, to each player, beginning with the player to the left of the dealer.
2. Place the remaining cards face down in the center of the table to form the stock.
3. The dealer turns over the top card from the stock and places it face up next to the stock. This is the discard pile.

## The Play

1. Beginning with the player to the left of the dealer, players either draw the top card of the stock or take the top face-up card in the discard pile and add it to their hand. The player may also lay down on the table, face up, any completed chain. If the player does not wish to lay down a chain, they discard one card, face up, onto the discard pile. If the player has drawn from the discard pile, they may not discard the same card on that turn.
2. Play continues until one player gets rid of all of their cards by laying them down in complete chains of three cards.
3. If the stock pile runs out before that happens, leave the top card from the discard pile on the table and reshuffle the rest of the discard pile to make a new stock pile. Continue playing until one player lays down all of their cards.
4. All players then score their hands as described below. Use a piece of paper to keep track of your scores.
5. Play another round.
6. After the desired number of rounds are played, add up the total score for each player. The player with the lowest total score is the winner.

## The Scoring

The player who is the first to get rid of all their cards ends the round and gets zero points for that round. The other players in that round count the total number of cards remaining in their hand, and get one point for each card.



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