



# Body in Balance

Based on Body System Interaction Board and Cart Sort Activity  
By Crystal Taylor & Kristi Swiderski

## Focus on Inquiry

The student will create explanations that fit evidence in science relating to how the human body maintains homeostasis.

## Lesson Content Overview

Students will discover body system interactions and how the organ systems work together to maintain homeostasis.

<b>Duration</b> 95 minutes	<b>Setting</b> Classroom	<b>Grouping</b> 2 students per group	<b>PTI Inquiry Subskills</b> 5.3, 3.3, 3.4, 5.2, 3.7, 5.4, 7.3
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Lesson Components	Estimated Time	Inquiry Subskills Used	Technology Used	Level of Student Engagement	Brief Description
<i>Engage</i>	5 min	5.3	Laptop/ Video clip	2	Students will watch a short video of a man performing a balancing act on a trapeze and make connections between the video and balance within the human body.
<i>Explore</i>	40 mins	3.3, 3.4	Projector/ Elmo	3	Students will cut-out statements that show organ system interactions. With a partner, students will match a statement with two body systems interacting. Once students have correct answers, the statements will be glued onto a placemat for further notes and reference.
<i>Explain</i>	20 mins	5.2	Projector/ Elmo	2	The class will read a scenario, then answer questions relating to the body maintaining homeostasis. Students will answer questions, then justify their answer with a partner. The class will discuss answers and dispel any misconceptions.
<i>Expand/Elaborate</i>	20 mins	3.7, 5.2, 5.4	Projector/ Elmo	3	Body movement activity to relate to homeostasis. Students will complete a series of physical activities, record data and observations, then answer questions to make connections between the organ systems and homeostasis.
<i>Evaluate</i>	10 min	7.3	Gradecam	1	Students will complete a short quiz (Gradecam optional) to evaluate their understanding of homeostasis. \

### Level of Student Engagement

1	Low	Listen to lecture, observe the teacher, individual reading, teacher demonstration, teacher-centered instruction
2	Moderate	Raise questions, lecture with discussion, record data, make predictions, technology interaction with assistance
3	High	Hands-on activity or inquiry; critique others, draw conclusions, make connections, problem-solve, student-centered

### Next Generation Science Standards – Inquiry

NGSS Practice 3: Planning and Carrying Out Investigations  
NGSS Practice 6: Constructing explanations  
NGSS Practice 8: Obtaining, Evaluating and Communicating Information



### Next Generation Science Standards – Life Science

**MS-LS-3:** Use argument supported by evidence for how the body is a system of interacting subsystems composed of groups of cells.



### Florida Science Standards – Nature of Science

**SC.6.N.1.5:** Recognize that science involves creativity, not just in designing experiments, but also in creating explanations that fit evidence.



### Florida Science Standards – Life Science

**SC.6.L.14.5:** Identify and investigate the general functions of the major systems of the human body (digestive, respiratory, circulatory, reproductive, excretory, immune, nervous, and musculoskeletal) and describe ways these systems interact with each other to maintain homeostasis.



## Materials and Advance Preparation

### Materials List

Class set:

- Scissors
- Glue

### Blackline Masters

1. **Blackline Master #1:** Body System Statements – one per student
2. **Blackline Master #2:** Body System Placemat – one per student
3. **Blackline Master #3:** Body System Placemat Answer Key – one for teacher
4. **Blackline Master #4:** Scenario and Discussion Question – one copy displayed for the class
5. **Blackline Master #5:** Activity Data Chart – one per student (2 charts on one page, cut in half)
6. **Blackline Master #6:** Quiz Homeostasis – one class set

### Advance Preparation

1. Teacher should get video ready before class.
2. Copies of all blackline masters should be made.
3. The teacher will need a timer.

## Lesson Information

### Learning Objectives

1. The student will be able to identify how different body systems work together to attempt to keep the body in homeostasis. (SC.6.L.14.5)
2. The student will be able to explain homeostasis and the interactions of body systems in relation to evidence collected. (SC.6.N.1.5)

### Prior Knowledge Needed by the Students

- Students should be able to identify organs in the human body and/or describe their functions (SC.5.L.14.1).
- Students should also have a general knowledge of the body systems, including the major organs of each system and the general function of each body system (SC.6.L.14.5).

### Background Information

- Homeostasis is the process by which the internal environment of the body is kept relatively stable despite changes in the external environment. Typically, we understand that our body's ability to regulate temperature is very important. Our body has a normal "set point" for its temperature, which varies slightly from person to person. We often forget that the body regulates its internal environment in many ways. The body senses changes in the environment and responds by making changes in functions. This is a dynamic process that keeps the internal conditions of the body relatively stable. The body can adapt to many changing conditions, but there are limits to these conditions. The body's cells will not function well if they are too cold or too hot, our heart rates cannot endlessly increase and we cannot lose excessive water without putting our cells, tissues and organs at risk. As a result, reaching or exceeding these limits can be dangerous, so our body tends to function within certain normal ranges. Using temperature as an example, we know that the hypothalamus in the brain can act as a thermostat and control the body's functioning to regulate temperature to keep us from overheating or getting too cold. The hypothalamus causes changes in the size of blood vessels in the skin, which then has a direct impact on the amount of heat lost or retained by the body. Most systems of the body maintain homeostasis by means of negative feedback mechanisms, which reverse a response back to a normal state.

## Lesson Procedure

### *Engage*

1. Teacher will play this video and ask students to think what the concept of balance has to do with the human body.
2. Video found at: <https://youtu.be/JPwtw8sEK0g>  
**NOTE:** Make sure to fast forward if there are any advertisements. And display the video "whole screen" so that the web page advertisements located on the right-hand side and underneath the

video will not be seen. In addition, please be on the lookout for “pop up” ads while the video is playing.

3. After viewing the video clip, the teacher will ask the following question:
  - a. What is **one** word you would use to describe this video clip?
4. Teacher will give students think time. Then teacher will ask the students to turn to their shoulder partner and share their answer to the prior question. Each partner will take a turn sharing their one word.

*Student responses will vary but you are looking for the word “balance” to lead into a conversation about homeostasis.*
5. Teacher will start a short class discussion for students to share the word they chose and lead into the following questions.
  - a. What was he doing to maintain balance? What interactions do you see him using to help get back to balance? *Student responses will include: The man had to rely on different parts of his body to help him maintain balance. The man had to make sure all the pieces of equipment he was using in his act work well together. The body and equipment had to work together to help the man maintain balance.*
  - b. What do you think balance has to do with the human body? *Student responses will include: The man had to make sure that all body parts (such as legs, arms, head, and core) was aligned properly to help keep balance. The man had to make sure he was focused (using his mind) on the job at hand. The man used the muscles in his body for strength to balance himself.*
  - c. What do you think balance has to do with the human body? *Student responses will include: The body functions have to be balanced in the human body. If not, the body will not function properly and the organism could get very sick and/or die. As certain things change in the body, outside the norm, our body has to adjust or change continually to be at or near the normal range. Different parts within the body (physical and/or chemical) have to work together to maintain equilibrium and allow the human body to survive.*

### **Explore**

1. Have students cut out the body system statements (Blackline Master #1). Or the teacher can pre-cut out the statements.
2. Provide students with a body system placemat (Blackline Master #2).
3. Students will work with a partner to match the body system statements to the correct location on the placemat.
4. Each statement describes how two body systems interact. Students will align the statement with the two systems that are interacting on the placemat.
5. Once each pair of students matches the statements on the placemat, the teacher will check the placemat for correct answers (Blackline Master #3).
6. If student’s answers are not correct, remove the statements that are incorrect and have students continue to work.
7. Once all answers are correct, have students glue down the correct answers onto the placemat.

### **Explain**

1. Display the scenario for the class to see (Blackline Master #4).
2. Read the scenario as a class, and mark the text as a class.
3. Display and read each question one at a time.
4. Give students think time, then allow students to discuss their answer with a partner/group.
5. Have students justify their answers using a whiteboard or piece of paper.
6. Then as a class discuss answers, and dispel misconceptions that students might have.

### **Scenario:**

A millionaire named forest Fenn has hidden a treasure chest deep into the Rocky Mountains, in hopes to spark adventure and get people off the couch to seek fortune in the great outdoors. The treasure chest is known in the Rocky Mountains as the “Bronze Box”, which is filled with gold and precious gems. Fenn tells us the box is hidden somewhere between Santa Fe, New Mexico and the Canadian border at an elevation above 5,000 feet right in the middle of a rapidly changing climate. In this area where the treasure resides, temperatures can vary from day to evening; it’s not uncommon in summer months to drop below freezing, particularly at higher elevations which gives risk to frost bite or worse. Frost bite causes the body to divert blood flow from the surface as the temperature drops so the more important body parts stay warm the longest. This process utilizes several body systems and allows the body’s core to stay protected for as long as possible. Randy Bilyeu, a 54-year old retired mechanic who had moved

from Florida to Colorado to seek out the treasure, was last seen on January 5<sup>th</sup> 2016. His belongings were found near the Rio Grande river, south of Santa Fe, New Mexico. Severe frost bite has been concluded as his probable death. Investigators are still in debate regarding the true cause of his death.

**Discussion Questions (correct answers are highlighted):**

- 1.) When blood flow is gone from the extremities for too long, the cells start to die. Depending on the severity of the damage, new cells will either replace the old or that part of the body that is lost to frost bite. Which system was MOST responsible for Randy's frostbite?
  - A. Nervous
  - B. Circulatory**
  - C. Musculoskeletal
  - D. Respiratory
  
- 2.) Those that knew Randy stated he should not have gone treasure hunting because he had a premedical breathing condition known as asthma from a long life of smoking. Asthma causes severe difficulties in breathing when under stress or mild exercise and can lead to death or serious injury without treatment. If Asthma was indeed the reason for Randy's death instead of frost bite, which system would be MOST responsible?
  - A. Nervous
  - B. Circulatory
  - C. Musculoskeletal
  - D. Respiratory**
  
- 3.) Blood pressure typically rises during the winter due to constrictions in blood flow, which can lead to an increase in heart attacks, strokes, and other circulatory causes of death. Scientists at the Oregon University have uncovered a system that tells the body when to perform one of its most basic defenses against the cold: Shivering. The scientists have discovered the brains wiring system, which take temperature information from the skin which tells the brain when the musculoskeletal system should start shivering. Which system was primarily responsible for initiating Randy's shivering if frostbite was his cause of death?
  - A.) Nervous**
  - B.) Circulatory
  - C.) Musculoskeletal
  - D.) Respiratory
  
- 4.) The \_\_\_\_\_ system was triggered when Randy's blood flow was limited in response to the severe cold temperatures, this led to his brain to send impulses through the \_\_\_\_\_ system to constrict blood vessels in the circulatory system and cause shivering. This is the body's first line of defense in response to Frost bite.
  - A.) Nervous, Circulatory
  - B.) Nervous, Musculoskeletal
  - C.) Musculoskeletal, Nervous**
  - D.) Circulatory, Respiratory

**Expand**

Students will be going through a series of physical activities to see how their body systems work together to maintain homeostasis.

1. Have students balance on one foot for one minute. (teacher timed)
2. Have students fill in the chart with their observations by explaining what they experienced while attempting to maintain balance (Blackline Master #5).
3. Lead a class discussion, by examining which body systems were affected and how the body systems work together.
4. After discussing, have student's record notes into the chart. Students can write a summary, provide bullet points or draw a picture to explain the concept.
5. Students take their initial heart rate.

6. Students will take their pulse, while the teacher times the class for 10 seconds. Students will count how many beats during the 10 seconds. Then multiply the number of beats by 6, to calculate the beats per minute  

$$\text{_____} \times 6 = \text{_____} \text{ BPM}$$
7. Then have students run in place or do jumping jacks for 90 seconds. (make sure students are moving with purpose)
8. Students will take their new heart rate after activity (same as before). Time for 10 seconds, and calculate the heartrate.
9. Students will record their data and make observations to explain what they experienced.
10. Lead a class discussion, by examining which body systems were affected and how the body systems work together.
11. After discussing, have student's record notes into the chart. Students can write a summary, provide bullet points or draw a picture to explain the concept.

Class questions that can lead into a discussion might include:

- *What is happening to your body?*
- *What body systems do you think are affected?*
- *Why do you think they are affected?*
- *What will make the systems return to normal?*
- *Discuss the word homeostasis – (homeo = same, stasis = state of)*

Class answers from the discussion might include:

*The body systems are working together to maintain balance. When jumping, the nervous, muscular, and skeletal systems are working, when running, the respiratory system is working with the circulatory system – more oxygen is needed in the body, causing the heart rate in increase. For the systems to return to normal, rest is needed. In order for the body to maintain homeostasis systems must work in conjunction so that one is not overloaded.*

## **Evaluate**

### **FORMAL EVALUATION**

1. Students will complete the Quiz: 5 multiple choice questions (Blackline Master #6), to evaluate students' understanding.
2. **Quiz Key: 1. B 2. D 3. B 4. A 5. B**

### **INFORMAL or OPTIONAL EVALUATIONS**

1. Teacher will check the placemat for correct answers to show understanding of body system interactions.
2. The scenario discussion questions will show student understanding of the body maintaining homeostasis.
3. The activity data chart will show data, observations and notes that the teacher can evaluate.
4. Teacher will also use quiz results to assess student mastery of the standard and remediate/enrich as appropriate.

### **WRAP UP.**

- Bring the lesson to a conclusion by having students brainstorm other ways that the body works to maintain homeostasis and have them take turns sharing ideas with a partner one at a time.

## **Supplementary Resources**

### **Teachers**

This reading passage from the CK-12 Foundation provides a great deal of background information that teachers may find useful in preparing themselves as well as students:

<http://www.ck12.org/biology/Homeostasis/lesson/Homeostasis-BIO/>

Multimedia Resources (virtual labs, video clip, etc.)

[http://www.pbslearningmedia.org/resource/tdc02.sci.life.reg.lp\\_humanreg/human-body-regulation/](http://www.pbslearningmedia.org/resource/tdc02.sci.life.reg.lp_humanreg/human-body-regulation/)

### **Students**

- Students can review and watch a video clip, then quiz themselves on homeostasis:  
<https://www.brainpop.com/health/bodysystems/homeostasis/>
- This interactive gives student's information on homeostasis while also letting them explore the impacts of certain activities on the body.

<http://www.think-bank.com/iwb/flash/homeostasis.html>

#### CITATION OF SOURCES.

Dobrovolny, M. (n.d.). Body System Interactions Board and Card Sort Activity. Retrieved from <https://www.teacherspayteachers.com/Product/Body-System-Interactions-Board-and-Card-Sort-Activity-372128>

Nelson, B. (2017, June 21). \$2 million treasure buried in the Rocky Mountains has yet to be found. Retrieved from <https://www.mnn.com/lifestyle/arts-culture/stories/2-million-treasure-buried-rocky-mountains-has-yet-be-foun>

Yes, I cited all materials and resources used in this lesson.

*Crystal Taylor, Kristi Swiderski, Jennifer Purnell, Shane Miller,  
Kathleen Yates*

## Body System Statements

Oxygen is inhaled and is then distributed throughout the bloodstream	Blood carries digested nutrients to body cells	Oxygen is inhaled and helps provide energy to the stomach muscles for digestion	Oxygen is passed through to the fetus	The brain monitors respiratory volume and gas levels	Nutrients diffuse through the placenta and are carried to the embryo through blood vessels in the umbilical cord	The brain stem controls heart rate
Chemical signals are carried through the body to help the speed of digestion	Oxygen is delivered to muscles to aid in digestion	Carbon dioxide is released from the body	Nutrients absorbed from food are essential in meeting the developmental needs of the embryo	The medulla located inside the brain stem controls involuntary muscle movement which aids in the breakdown of food	Vitamins found in food are essential to the developing fetus	Calcium that we ingest can be used to strengthen bones.
The bloodstream carries oxygen to the reproductive organs	Oxygen is provided to the sex organs to keep the tissues healthy	Cellular waste from food and liquid consumption are removed from the body	The diaphragm allows involuntary breathing to occur	The brain controls mating behavior	Waste products from a developing fetus are eliminated by the mother	The kidneys clean the blood and control the amount of salt, water, and other substances in the blood
The brain controls circulation	The brain regulates the respiratory rate	The digestive system sends signals to the brain when the stomach is full	Hormones effect brain development	Oxygen is carried to the muscles	The brain controls urination	The brain regulates the position of bones by controlling muscles
The heart pumps blood to the kidneys	Lungs are used to remove waste gases	Work together after eating remove waste from the body	Waste products are absorbed from the fetus to the mother and are excreted in urine	The bladder sends sensory information to the brain	The pelvis protects a developing fetus from injury	Carbon dioxide is removed from bone marrow
Blood is pumped through the heart	The ribcage protects the lungs	Involuntary muscles help move food through the digestive track	Supports reproductive organs and are active during childbirth	The skull protects the brain from injury	Waste produced in muscle cells is removed from the body	Oxygen is delivered to the cells in the body

# Body System Placemat

	Circulatory	Respiratory	Digestive	Reproductive	Nervous	Excretory	Musculoskeletal
Circulatory							
Respiratory							
Digestive							
Reproductive							
Nervous							
Excretory							
Musculoskeletal							

### Body System Placement Answer Key

There are two possible answers for every body system interaction. They can be interchanged on the student chart. Interchangeable answers are highlighted the same color

	Circulatory	Respiratory	Digestive	Reproductive	Nervous	Excretory	Musculoskeletal
Circulatory		Oxygen is inhaled and is then distributed throughout the bloodstream	Blood carries digested nutrients to body cells	Nutrients diffuse through the placenta and are carried to the embryo through blood vessels in the umbilical cord	The brain stem controls heart rate	The kidneys clean the blood and control the amount of salt, water, and other substances in the blood	Oxygen is carried to the muscles
Respiratory	Oxygen is delivered to the cells in the body		Oxygen is inhaled and helps provide energy to the stomach muscles for digestion	Oxygen is passed through to the fetus	The brain monitors respiratory volume and gas levels	Carbon dioxide is released from the body	The diaphragm allows involuntary breathing to occur
Digestive	Chemical signals are carried through the body to help the speed of digestion	Oxygen is delivered to muscles to aid in digestion		Nutrients absorbed from food are essential in meeting the developmental needs of the embryo	The medulla located inside the brain stem controls involuntary muscle movement which aids in the breakdown of food	Cellular waste from food and liquid consumption are removed from the body	Calcium that we ingest can be used to strengthen bones.
Reproductive	The bloodstream carries oxygen to the reproductive organs	Oxygen is provided to the sex organs to keep the tissues healthy	Vitamins found in food are essential to the developing fetus		The brain controls mating behavior	Waste products from a developing fetus are eliminated by the mother	The pelvis protects a developing fetus from injury
Nervous	The brain controls circulation	The brain regulates the respiratory rate	The digestive system sends signals to the brain when the stomach is full	Hormones effect brain development		The brain controls urination	The brain regulates the position of bones by controlling muscles
Excretory	The heart pumps blood to the kidneys	Lungs are used to remove waste gases	Work together after eating remove waste from the body	Waste products are absorbed from the fetus to the mother and are excreted in urine	The bladder sends sensory information to the brain		Carbon dioxide is removed from bone marrow
Musculoskeletal	Blood is pumped through the heart	The ribcage protects the lungs	Involuntary muscles help move food through the digestive track	Supports reproductive organs and are active during childbirth	The skull protects the brain from injury	Waste produced in muscle cells is removed from the body	

## Scenario & Discussion Questions

A millionaire named forest Fenn has hidden a treasure chest deep into the Rocky Mountains, in hopes to spark adventure and get people off the couch to seek fortune in the great outdoors. The treasure chest is known in the Rocky Mountains as the “Bronze Box”, which is filled with gold and precious gems. Fenn tells us the box is hidden somewhere between Santa Fe, New Mexico and the Canadian border at an elevation above 5,000 feet right in the middle of a rapidly changing climate. In this area where the treasure resides, temperatures can vary from day to evening; it’s not uncommon in summer months to drop below freezing, particularly at higher elevations which gives risk to frost bite or worse. Frost bite causes the body to divert blood flow from the surface as the temperature drops so the more important body parts stay warm the longest. This process utilizes several body systems and allows the body’s core to stay protected for as long as possible. Randy Bilyeu, a 54-year old retired mechanic who had moved from Florida to Colorado to seek out the treasure, was last seen on January 5<sup>th</sup> 2016. His belongings were found near the Rio Grande river, south of Santa Fe, New Mexico. Severe frost bite has been concluded as his probable death. Investigators are still in debate regarding the true cause of his death.

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- 2.) Those that knew Randy stated he should not have gone treasure hunting because he had a premedical breathing condition known as asthma from a long life of smoking. Asthma causes severe difficulties in breathing when under stress or mild exercise and can lead to death or serious injury without treatment. If Asthma was indeed the reason for Randy’s death instead of frost bite, which system would be MOST responsible?
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  - A. Nervous, Circulatory
  - B. Nervous, Musculoskeletal
  - C. Musculoskeletal, Nervous
  - D. Circulatory, Respiratory

## Activity Data Chart

Task	Time	Observations (what did you experience)	Notes from class discussion
Balancing on one foot	1 min		
Run in place Initial heart rate _____ BPM Final heart rate _____ BPM	1 min		

Task	Time	Observations (what did you experience)	Notes from class discussion
Balancing on one foot	1 min		
Run in place Initial heart rate _____ BPM Final heart rate _____ BPM	1 min		

## Homeostasis Quiz

1. You and your classmate are discussing different organs and organ systems within the human body. Your friend states that the excretory system includes multiple organs, and one of those organs is the lungs. You argue that the lungs can't possibly be in the excretory system since it is part of the respiratory system. Which of the following choices would be the **best statement** that your friend would use to justify why the lungs help keep homeostasis for the excretory system? (SC.6.L.14.5)
  - a. The lungs bring in oxygen, which is a vital gas to keep our cells alive and healthy.
  - b. The lungs exhale carbon dioxide, which is a waste gas and needs to be removed from the body.
  - c. The lungs provide cells with a gas that is important for the cell process of respiration.
  - d. The lungs remove waste in the forms of solids, liquids, and gases that could be harmful for the body.
2. How do your respiratory and circulatory systems attempt to maintain homeostasis during exercise? (SC.6.L.14.5)
  - a. Your body produces more red blood cells to help provide energy to cells.
  - b. Your lungs produce more oxygen which is then delivered to the cells through the blood.
  - c. You experience an increase in blood flow which provides nutrients to cells to increase energy and remove wastes.
  - d. You experience an increase in breathing rate to obtain more oxygen which is delivered to cells through the blood stream.
3. Food gives the body energy, which helps the body maintain homeostasis. In the morning, an athlete eats a nutritious breakfast to get energy to exercise. What are the main organ systems involved in the process of food from the athlete's breakfast being broken down into nutrients and then delivered to the cells? (SC.6.L.14.5)
  - a. Digestive and excretory systems.
  - b. Digestive and circulatory systems.
  - c. Nervous and excretory systems.
  - d. Respiratory and circulatory systems.
4. The skin helps regulate body temperature by perspiration, which allows excess heat to leave the body. If you lost the ability to sweat, what could happen to you if you were running a marathon? (SC.6.L.14.5)
  - a. The body would overheat.
  - b. The body would react slowly.
  - c. The body would start to shiver.
  - d. The body would need more energy.
5. In order to maintain homeostasis, the systems of the human body work together to keep a constant internal temperature. Which of the following best describes how the human body responds in a cold environment? (SC.6.L.14.5)
  - a. The digestive system produces more hormones to warm the body.
  - b. The nervous system signals the muscles of the muscular system to contract and warm the body.
  - c. The circulatory system delivers less carbon dioxide to the muscular system, resulting in stiffening of the muscles.
  - d. The skeletal system produces more blood cells that circulate through the blood vessels, increasing the warmth of the body.