Riley Children's Health
Indiana University Health

SPORTS LEGENDS EXPERIENCE

SPORTS SCIENCE AND WELLNESS

A UNIT OF STUDY FOR GRADES 4–8

CHILDREN'S MUSEUM INDIANAPOLIS

ACKNOWLEDGMENTS

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**deceased*

CHILDREN'S MUSEUM INDIANAPOLIS

The Children's Museum of Indianapolis is a nonprofit institution dedicated to creating extraordinary learning experiences across the arts, sciences, and humanities that have the power to transform the lives of children and families. It is the largest children's museum in the world and serves more than 1 million people across Indiana as well as visitors from other states and nations.

The museum provides special programs and experiences for students as well as teaching materials and professional development opportunities for teachers. To plan a visit or learn more about educational programs and resources, visit the Teacher section of the museum's website at **childrensmuseum.org**.

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INTRODUCTION

Legendary athletes at the youth, amateur, and professional levels all share common experiences. Learning and practicing sports fundamentals, sportsmanship, and teamwork are essential to an enjoyable and rewarding sports experience. When we have fun participating in physical activities with other people, we are more likely to want to continue those activities in our daily lives. Eating right, being active, and playing together with our family, friends, and teammates motivates us to improve our overall health.

ENDURING IDEA

The stories of outstanding Sports Legends from around the world and throughout history shared within an immersive and engaging sports environment can inspire children and their families to achieve their own health and fitness goals and live a healthy life style.

THE SPORTS LEGENDS EXPERIENCE

At the **Riley Children's Health Sports Legends Experience**, located at The Children's Museum of Indianapolis, children and families explore health and fitness through interactive experiences. In the *Sports Legends Pavilion*, visitors participate in the training zone, learn about important skills needed for sports, and explore art works from the *National Art Museum of Sport*. In the outdoor area, students participate in a range of sports activities with the assistance of the museum interpretation team. Here, visitors complete physical activities while learning about key historical moments and the fundamentals of sports such as football, tennis, soccer, baseball, hockey, and golf.

WHAT'S AHEAD?

This unit of study contains three lessons, each with three experiences that may be taught together or individually. Each lesson will connect to science and/or math standards, along with a health standard or sports connection. Sidebars throughout the unit feature **Riley Children's Health Messages**. These messages include quotes and support information from Riley physicians as well as links to the Riley Children's Health "Change the Play" program.

In the culminating experience for the unit, students create a family learning night for members of their school community about the benefit of sports and active lifestyles. To prepare for the family night, students will learn how to improve their physical well-being through healthy behaviors that prepare them to participate in sports. Students will learn how the human body is designed for physical activity and how the brain interacts with the body when we participate in sports. In addition, students will explore the effect of healthy behaviors on the body's performance.

GETTING STARTED

In preparation for these experiences, each student should be given a composition notebook or materials to make a **sports science journal**. Each student should take time to personalize their journal with sports-themed stickers, artwork, or other decorations.

WHAT WILL STUDENTS BE ABLE TO DO? UNIT GOALS

Students will

- Explore how structures within the body support participation in athletics
- Examine how different parts of the body work together
- Learn how a healthy body helps athletes perform at their best
- Discover how understanding the connection between physics and sports helps an athlete on the field

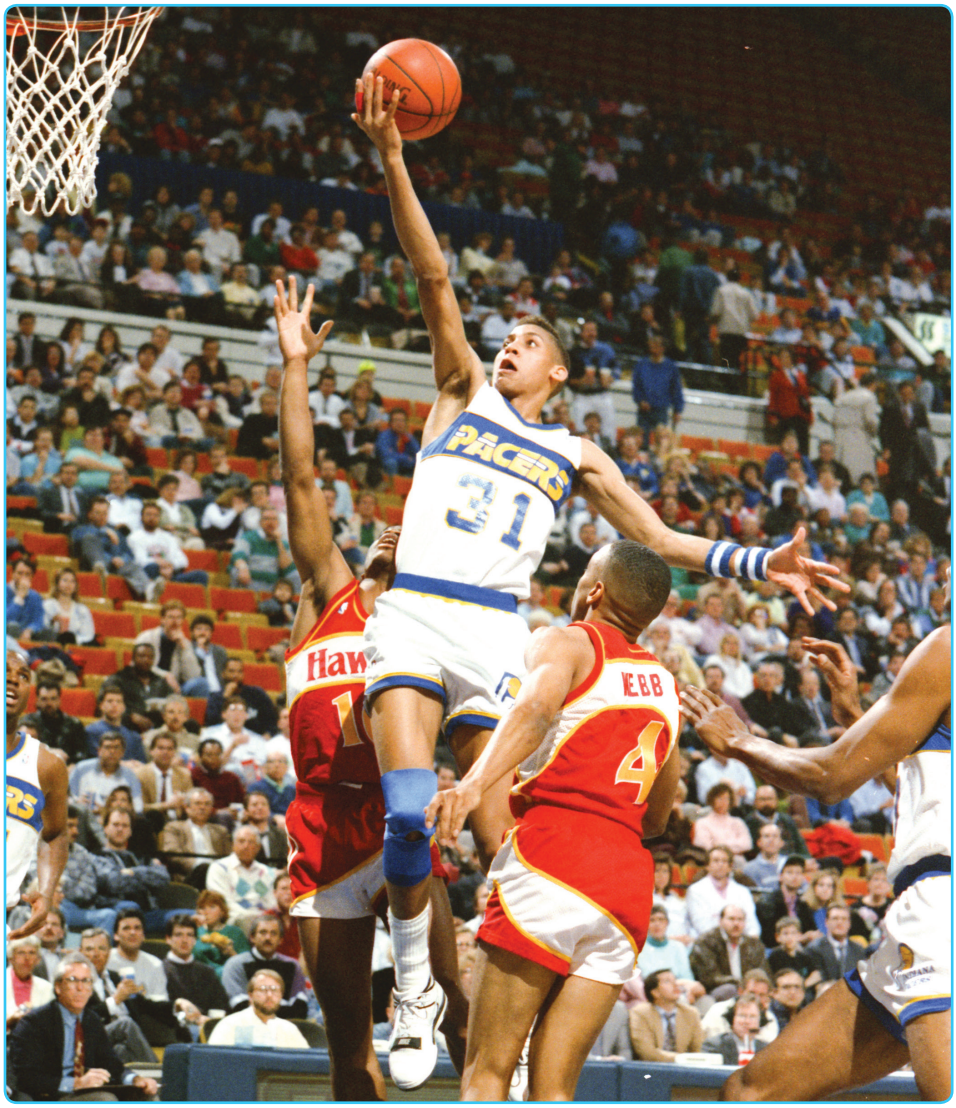

PHOTO COURTESY OF PACERS SPORTS AND ENTERTAINMENT

LESSON 1
YOUR BODY IN MOTION

In this lesson, students learn how different parts of the body enable movement and how the body responds to physical activity. They explore how the muscles and other parts of the body interact with the brain and begin to understand why practice is important in improving physical performance in sports featured in the **Riley Children's Sports Legends Experience**, such as football, baseball, soccer, and tennis.

Above: Reggie Miller, playing for the Pacers, flies to the basket and scores against the Hawks.

OBJECTIVES

Students will

- Develop a model of a muscle to demonstrate how the body moves
- Complete a simulation of the cardiovascular system
- Test and graph their heart rate during physical activity
- Experiment with reaction time
- Practice a task to explore how the brain sends messages to the body

FOCUS QUESTIONS

- How does a healthy lifestyle support your body?
- How do bones and muscles work together to enable movement?
- How do the heart and lungs work together to help your body move?
- How does your brain send messages to the rest of your body?
- Why do athletes practice physical movements many times?

VOCABULARY

blood
brain
cancellous bone
cardiovascular system
cortical or compact bone
digestive system
heart
joint
ligament
limbs
lungs
motion
muscle
musculoskeletal system
nutrients
oxygen
reaction time
skeleton
skull
tendon

YOU WILL NEED . . .

TIME: 4 CLASS PERIODS

MATERIALS

EXPERIENCE 1

- Skeleton – either a 3D model or a diagram
- Flexible straws – 1 for each student
- Recycled materials such as cardboard, egg cartons, cereal boxes
- Craft supplies such as balloons, pipe cleaners, felt, rubber bands
- Tape, glue
- Sticky notes, index cards
- Student journals for recording data and observations

EXPERIENCE 2

- Blue and red balloons or small foam balls
- Gym, large room, or large space outdoors
- Stopwatch or timer
- Student data sheets
- Physical activity equipment such as balls or jump ropes
- Graph paper or access to spreadsheet software

EXPERIENCE 3

- Meter sticks – 1 per every 2 students
- Student handout
- Small foam balls or beach balls
- Activity cards on page
- Model or diagram of the nervous system

EXPERIENCE 1: THE MUSCULOSKELETAL SYSTEM

In this experience students learn how various parts of the body work together to enable us to move and perform a variety of activities, including sports.

ACADEMIC STANDARDS

Indiana Science 4.LS.3

Next Generation Science 4-LS1-1, 4-LS1-2; MS-LS1-6

PROCEDURES

- To begin the lesson, invite students to stand in an open space in the classroom and complete a set of jumping jacks. After they have finished, have them sit down in groups of two or three students.
- In the small groups, have students draw an outline of a person on a large piece of poster paper. Then have students diagram the parts of the body that allowed them to complete the jumping jacks. If students are struggling, suggest that they think about specific movements they made, such as raising an arm.
- After students have completed their sketches, invite them to share their ideas with the class. Record each response where students can read them, asking students for their reasoning in selecting each body part. This could include responses such as "bones give you structure to hold up your arms."
- Ask students: What parts of the body are needed for any physical movement? Help students come to the conclusion that all parts of the body, including the **muscles**, **bones**, **heart**, **lungs**, and even the **digestive system**, are involved in movement. Explain to students that during this lesson, they will learn the different ways the body allows humans to complete physical activities.
- Share with students that bones and muscles are the part of a body that provide the structures to support movement. This is called the **musculoskeletal system** and includes the structure of the bones (such as the arm) and a mechanism for moving the bones (muscles).
- To illustrate how the muscles and bones work together to create **motion**, provide each student with a bendable soda straw. Explain that the straw represents two bones that are meeting at the bend in the straw. Give them time to compare the bend in the straw to the bend in an elbow or knee. Share with students that bones provide the structure in the body, and muscles are what move the bones. Explain to students that muscles work in pairs to move bones because they can only pull bones.
- Have students hold their straws so the short part above the bend is straight up. Instruct students to move the straw back and forth by only pulling on the straw. These means students will either have to alternate hands or move their hand back and forth to only pull. Explain to students that they created a simple model of how muscles move bones.
- Tell students that there is one more part of the system that allows bones and muscles to move. Point to the bend in the straw and ask students if they know what allows the two bones in the model to move. If students aren't sure, explain that any place in the body where there is movement between bones is called a **joint**. Have students identify different joints in their hands, arms, and legs.
- Explain to students that they will use the simple model as inspiration, and use additional sources such as books or websites to create a model of muscles or joints. Students will work in groups and choose to construct a model of either joints or muscles, or the teacher can assign group projects. Ideas for models to be created by students might include: muscle fibers working together to move bones, demonstrating how **tendons** attach muscles to bones, or the function of **ligaments** in different types of joints.
- Provide student groups with recycled materials and craft supplies to make their models. This would include items such as cardboard boxes, rubber bands, craft sticks, pipe cleaners, balloons, string, and tape or glue. Groups can use the planning handout, *Musculoskeletal System*, on page 8 to help guide them in their model development.
- Share with students how much time they will have to create their model. During the build time, make sure students have access to web resources or books for research.

- After students have created their models, display them in the classroom for a gallery walk or student presentations. As students view other models, they can record bullet points about how bones and muscles work together in their sports science journals.

EXTENDING EXPERIENCE

- Using what students have learned about bones, muscles, and joints, have students dissect a physical movement from a common sport. This could include throwing or kicking a ball or hitting a ball with a bat or racquet.
- Demonstrate a flip-book to students, either with an online flip-book or hard copy toy flip-book. Share with students that when pages are moved in rapid succession, the drawings appear to move. Explain to students that they will apply what they have learned about how bones and muscles move to design a flip-book, or a series of drawings that illustrates a movement in sports, such as throwing a football.
- Have students use notecards stapled together or a pack of sticky notes as the basis for a flip-book. You may also choose to have students use animation software for this purpose.
- Have students create a series of drawings using stick figures, with small changes in movements between pictures. Encourage students to think about which parts of the arm or leg are moving, and where joints need to be placed.
- Encourage students to test their flip-books and make changes as necessary.

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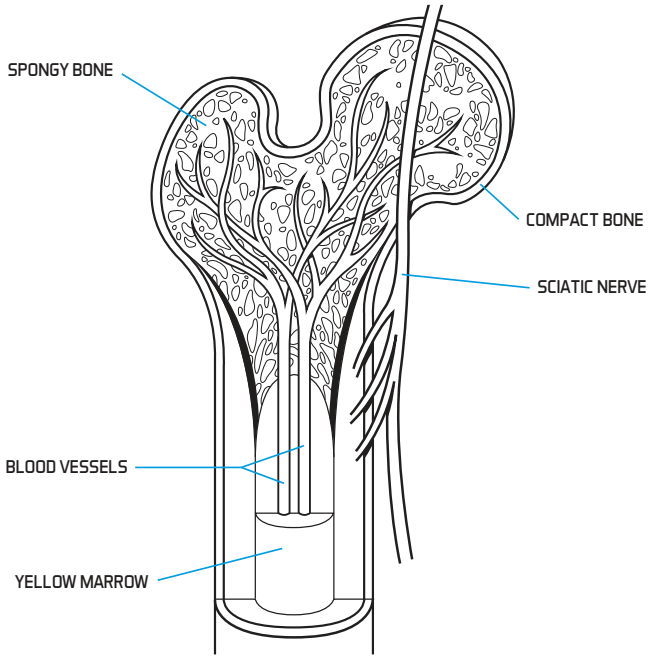
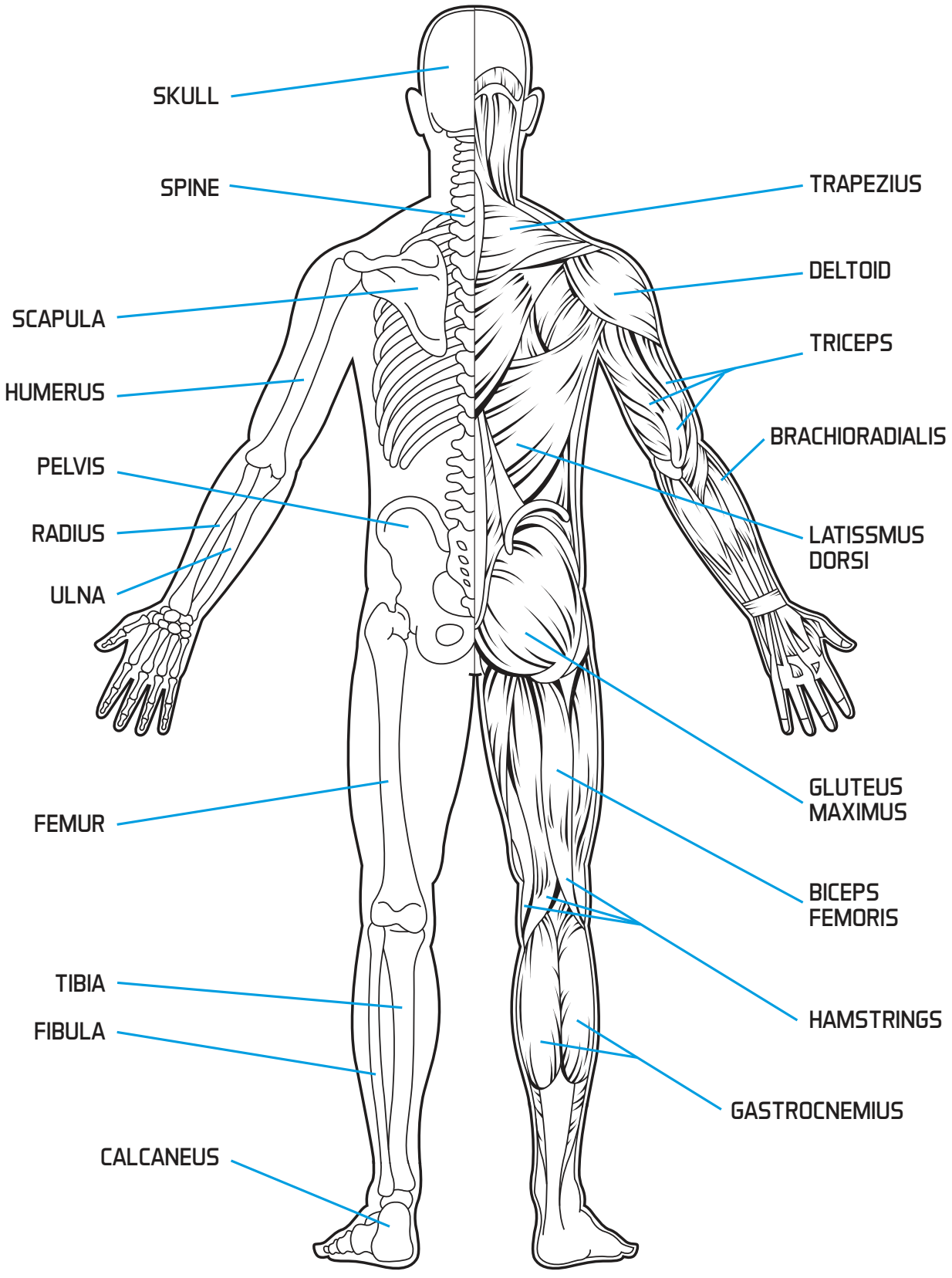
HOW TO KEEP BONES HEALTHY

Your bones, also known as the **skeleton**, form the structure of your body. You may think of bones in the body like fossilized dinosaur bones or leftover chicken bones. While the bones in the human body are hard, just like a fossil, they are living organs as well.

The outside of a bone is a membrane that contains blood vessels and nerves. This provides the bone cells with the **nutrients** and **oxygen** needed for repair and growth. Underneath the membrane is **compact bone**, a hard and dense layer that is often what is seen on a skeleton. The **cancellous bone** is found in the center of bones and is sometimes called spongy bone. The holes and spaces within cancellous bone reduce the weight of our bones. While this layer looks like a sponge, it is quite hard. Some bones, particularly the bones in legs and arms, contain bone marrow. This jelly-like material is the factory that produces the cells for our blood, like red blood cells and immune cells.

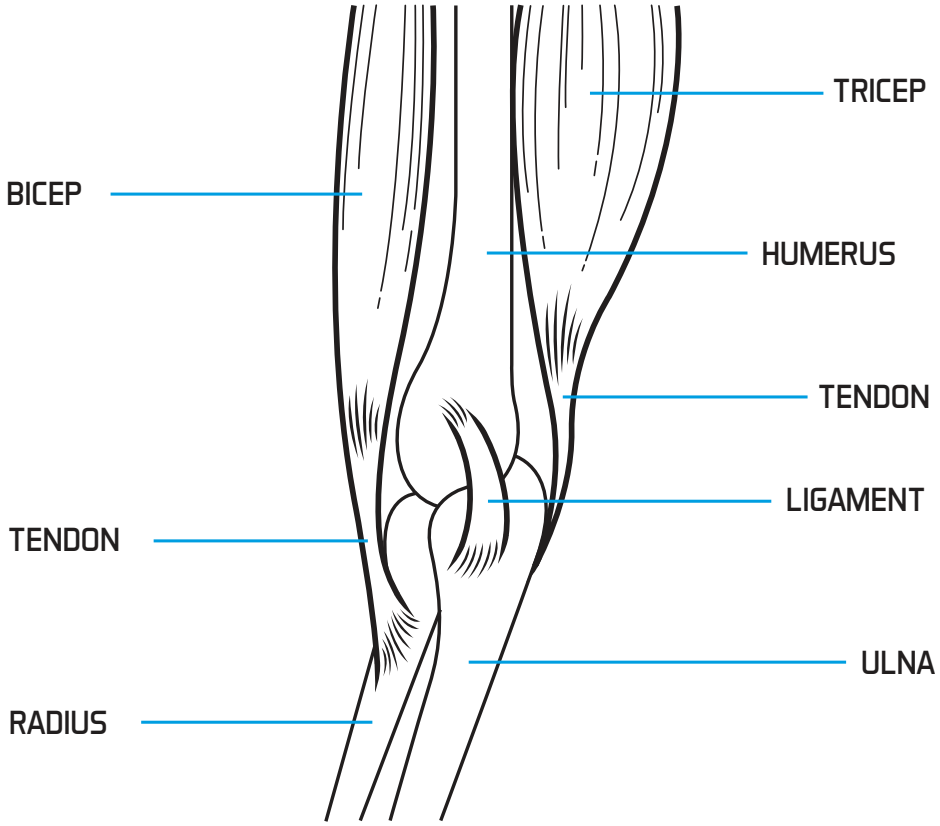
Calcium is a key ingredient for bone strength. Maintaining a diet rich in calcium is a way to keep the bones strong. Calcium is found in dairy products, like milk, and also in leafy green vegetables. While bones are very hard, they can still break when not protected. Wearing a helmet during sports protects the **skull**, and pads can reduce the chance of bone breaks in contact sports. Most of all, staying active and getting plenty of exercise, like running or walking, are important ways to keep bones healthy.

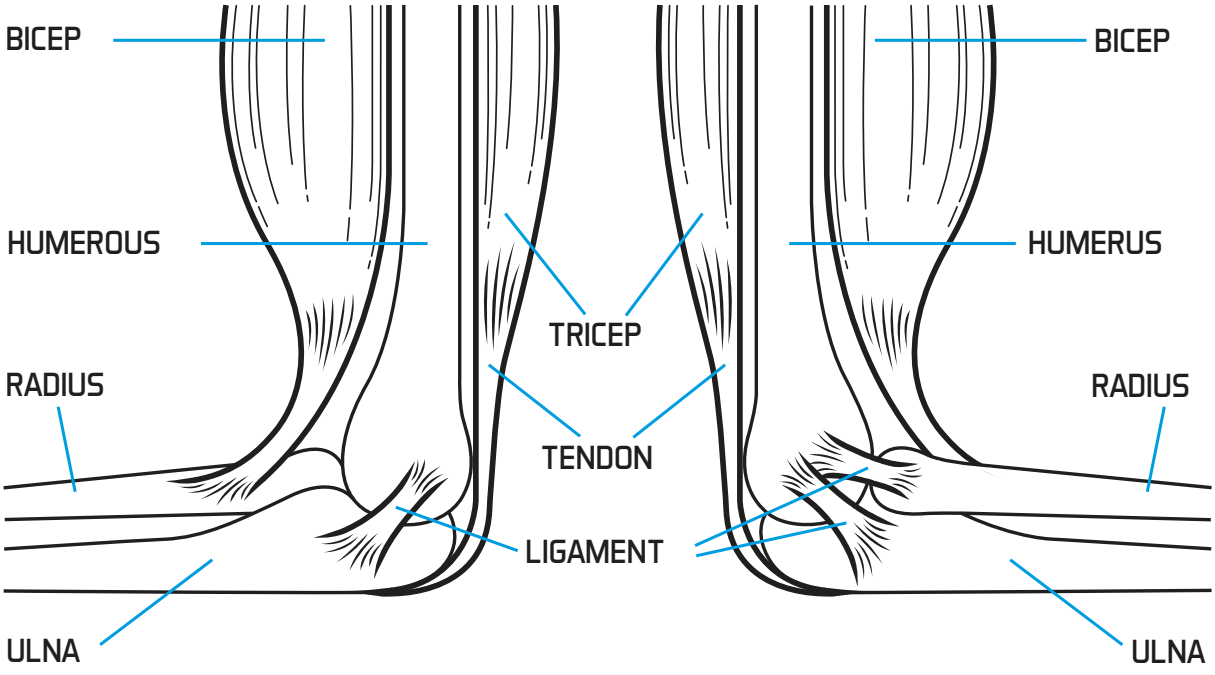




MUSCULOSKELETAL SYSTEM

MEDIAL VIEW





MEDIAL VIEW **LATERAL VIEW**

UPPER ARM AND ELBOW

STUDENT HANDOUT
MUSCULOSKELETAL MODEL

TEAM MEMBERS: _____

_____

_____

_____

Our group will create a model of: _____

_____

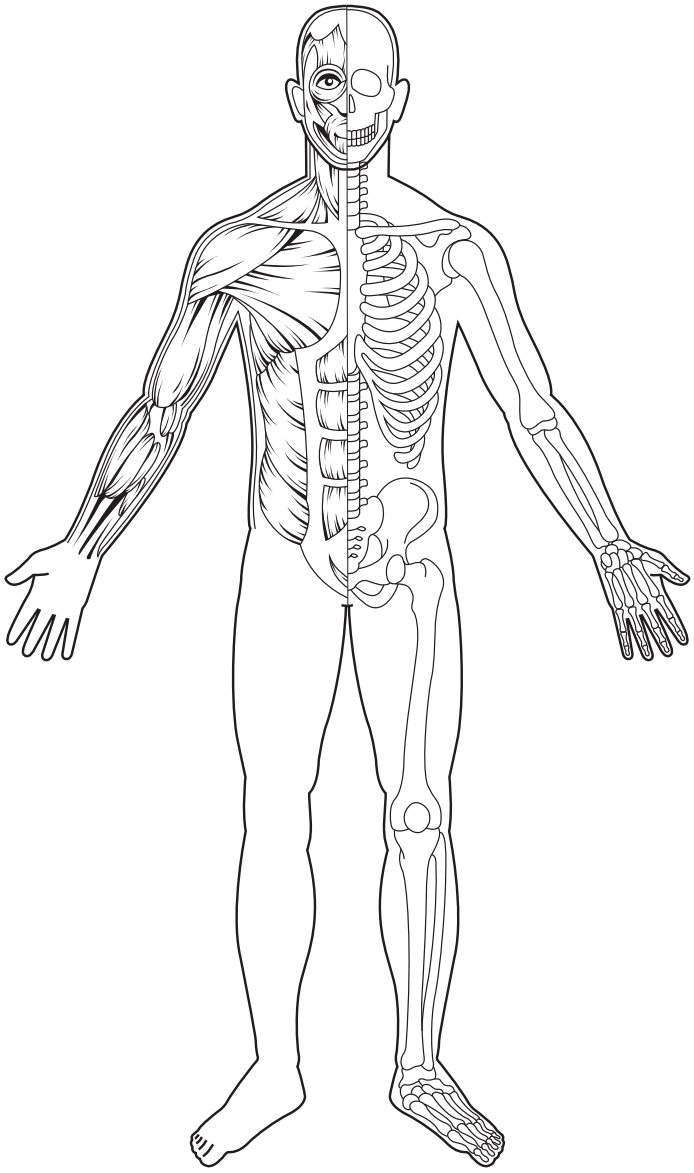


Diagram of our model

Materials needed: _____

_____

_____

_____

_____

Brief description of how the muscles or joints allow the body to move:

_____

_____

_____

_____

_____

EXPERIENCE 2: THE CARDIOVASCULAR SYSTEM

In Experience 2, students learn how blood flows through the body to transport oxygen and nutrients that the body needs to move and function. They measure their own heart rate during physical activity to determine that exercise increases the heart rate and the flow of blood. They also learn that regular exercise helps the cardiovascular system become more efficient.

ACADEMIC STANDARDS

Indiana Science SEPS.3; 4.LS.3
Indiana Health and Wellness 4.1.1, 4.7.1, 4.7.2; 5.1.1; 6.1.1, 6.1.7
Next Generation Science 4-LS1-1

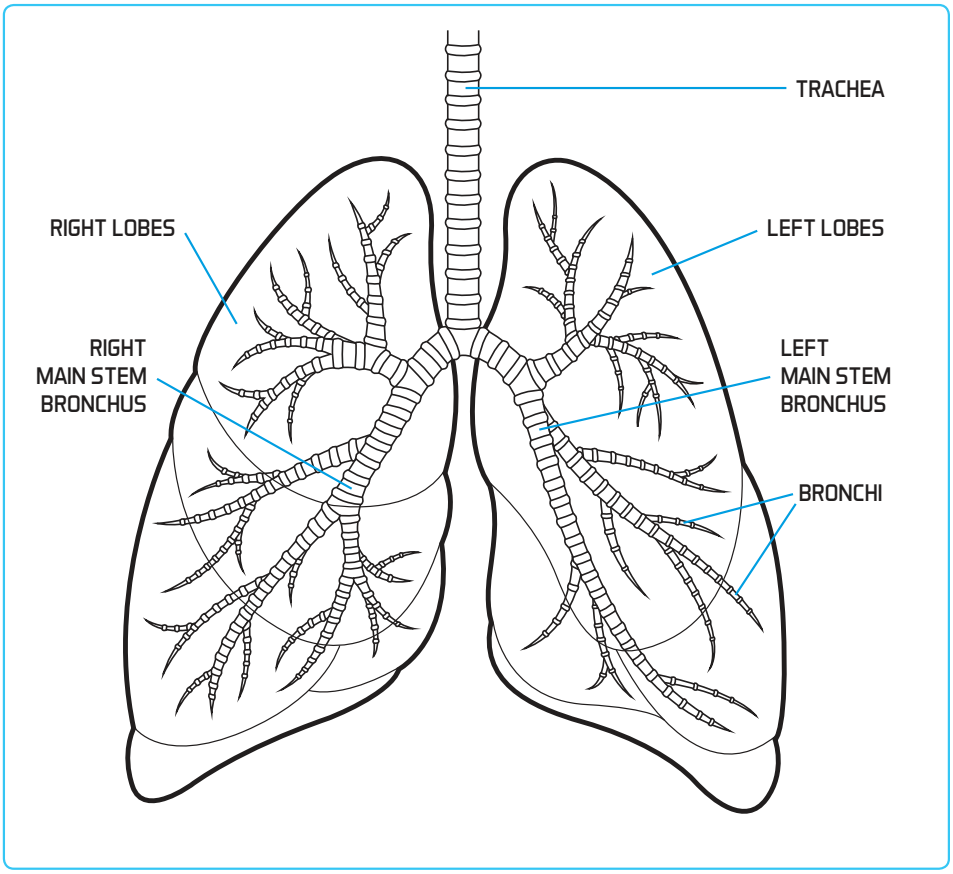
PROCEDURES—PART 1

- Prior to the class, set up the cardiovascular system model in a large room or outside. Create three signs: heart, lungs and **limbs**. Using the diagram on page 10 as your model, place the lungs, heart, and limbs signs on the floor or ground. They should be spaced at least 6 feet apart. Place collection bins at the limbs and lungs. To start the model, red balls should be placed at the lungs and blue at the limbs.
- Review with students what they learned about how bones and muscles provide the body with the ability to move.
- Explain that another system in the body, the **cardiovascular system**, transports the energy needed for bones and muscles to move.
- Tell students that they will model how **blood** flows through the body in a specific path through the heart, lungs, organs, and limbs in the body.
- Take students to the model of the cardiovascular system that has been set up outside or in a large room. You may want to diagram the model on the board and review the path before going outside.
- Have all students stand near the lungs in the model. Explain that in the model, students will start at the lungs, and they will represent blood cells. Share that in the lungs, all blood cells pick up oxygen, which is needed by cells in the rest of the body.
- Demonstrate to students that they will pick up a red ball, to signify they are oxygenated blood.
- After leaving the lungs, the blood goes to the heart to be pumped to other parts of the body. Demonstrate for students that they will walk to the heart, touching the heart label on the floor.
- Older students may add two pairs of valves to the heart. Each pair of students should face each other with their arms outstretched to make a gate or a door. Explain that valves in the heart stop and start the flow of blood, to regulate how much blood is going through the system. Explain that as the students acting as blood cells move through the heart, the valves will act as gates, letting one student through at a time.
- Direct students leaving the heart to the sign that says limbs and organs. Explain that when the blood cells reach other parts of the body, they deposit the oxygen and pick up carbon dioxide, a waste product of cells. Have students leave their red ball and pick up a blue one.
- Explain to students that they will need to return to the heart (going through a different valve if you are using them) to be pumped back to the lungs.
- While at the lungs, students will need to swap their blue ball for a red one, to demonstrate they have left carbon dioxide in the lungs, and picked up more oxygen.
- Allow students to circulate through the model several times. You may need to redirect students along the path.
- After all students have performed the role of blood cells, and moved through the heart and lungs, complete a short debriefing session. You may choose to have students record answers in their sports science journals before doing a class discussion to provide all students with a change to process these questions:
  - Describe in your own words the path of blood through the body.
  - In our model, oxygen was already in the lungs. How do you think oxygen gets into our lungs? How would you change our model to show how oxygen gets into the lungs? (Student responses should relate to breathing in and out. If desired, you could return to the model and have students add oxygen to the lungs and remove carbon dioxide.
  - In our model, the blood carried oxygen only. What else do you think blood may carry and deliver to the rest of the body?

PART 2

- For Part 2, you may choose to partner with the physical education or health teacher. This could include having the students collect data on heart rates during the physical education period. The students may already track their heart rate during PE, so using the same method will make the lesson easier for students. Before the lesson, talk with the PE teacher or school nurse to make sure you are aware of any students who have medical issues such as asthma that may be affected by the activity.
- Explain to students that as the body increases the amount of movement it completes, the body will need more oxygen and energy cells throughout the **musculoskeletal system** and **cardiovascular system**.
- To demonstrate to students how the body responds, explain that they will complete a series of physical activity exercises and monitor their heart rate.

- Demonstrate to students how to feel their pulse. Share with students that what they are feeling is the blood pulsing through their arteries. You may want to refer back to the walking model of the heart that students completed. The pulse occurs when the heart pushes the blood through the body.
- Provide each student with a data sheet, or have students create one in their sports science journals. Explain that they will be completing a series of activities and taking their pulse or heart rate after each activity.



- Explain to students that it is important to collect a control, or baseline, heart rate. This is how fast the heart is beating while a person is relaxed and seated, and is called the resting heart rate. Instruct the students to take their resting heart rate, and record it on their data sheet or in their journal. Students should sit quietly at their desks for 30 seconds, and then measure their heart rate. You may need to repeat this activity several times to make sure all students have accurately recorded their heart rates.
- To learn how heart rates increase with activity, students will need to complete 3 or 4 different activities for a sustained time. This could include running outside or in place, jumping rope, playing basketball, or other high-energy activities. For a more student-centered experience, allow students to choose the activities they would like to complete. Students should choose a variety of activities. The physical activities could be completed over several days, such as just after recess or at the start of a class period. Depending on time in the classroom, students could also complete an activity of choice at home and record their heart rate. At-home activities could include playing video games to demonstrate the heart rate difference during active and sedentary activities.

- Have students record their resting heart rate before the activity, and then again directly after the activity. They will also need to record the length of time they were doing the activity.

- Make sure students are recording all the data they collect on their data sheets. Walk students through how to find the change in heart rate, if they haven't completed this already. Ask students why they will be comparing the change in heart rate, rather than the actual heart rate after an activity. Help students understand that this is because they may not have always started with the same resting heart rate.
- Provide students with access to a spreadsheet program or graph paper and have them create bar graphs to show the change in heart rate. You may choose to work with the technology teacher to show the students how to use a spreadsheet program, such as Excel, to create graphs.
- After students have completed their graphs, have them respond to the following prompts regarding physical activity.
  - What changes occurred in your heart rate after physical activity?
  - What are the similarities between activities that raised your heart rate the most?
  - The best types of physical activities are ones that raise your heart rate. What recommendations would you make to other kids about physical activity?

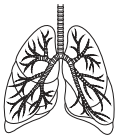
Riley Children's Health
Indiana University Health

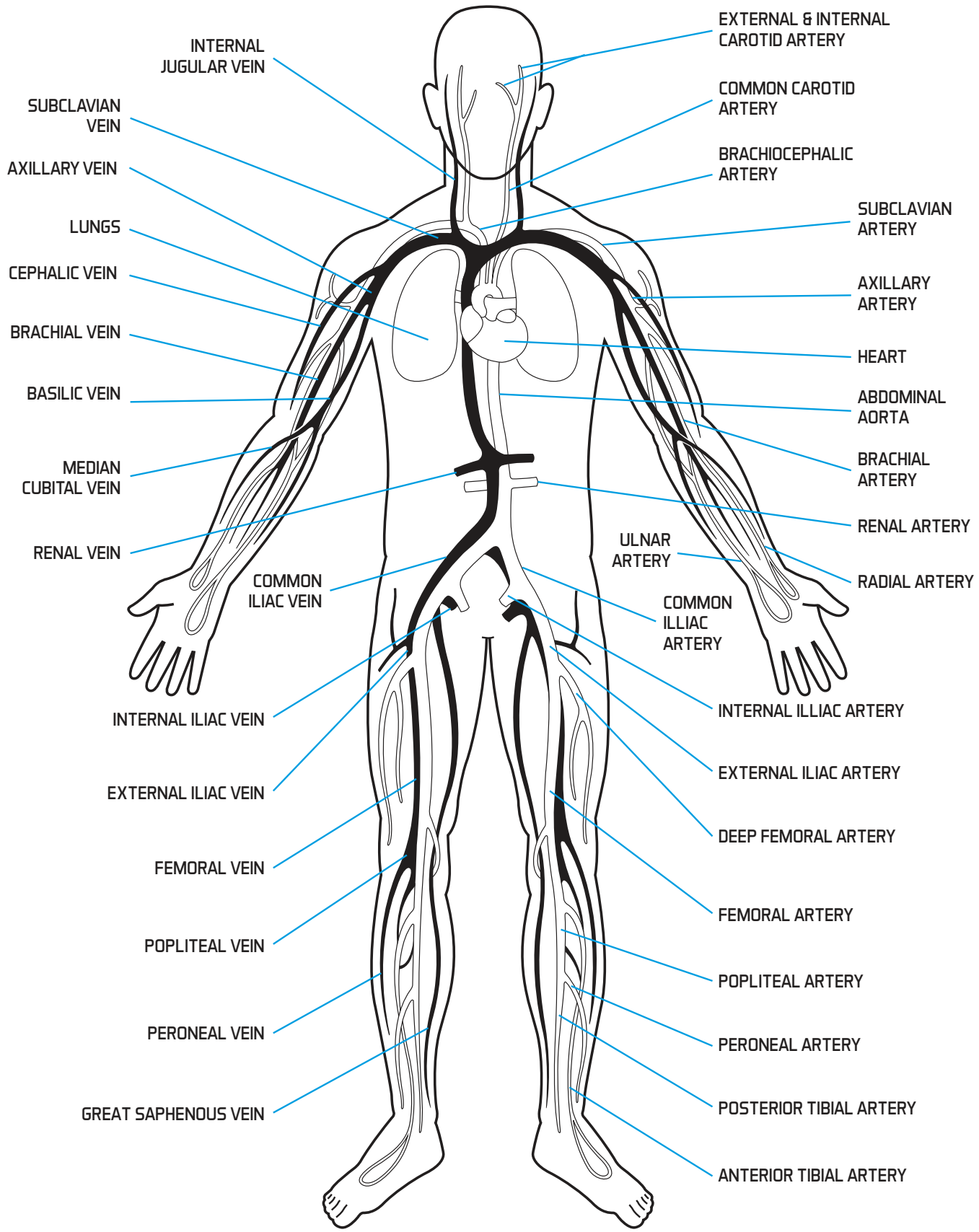
HEALTHY LUNGS

All of your cells need oxygen to perform their jobs within your body, and your lungs play a crucial role in providing your body with oxygen. Much like filling balloons, your lungs fill with air as you breathe in through your nose and sometimes your mouth. Tiny sacs within the lungs fill with air and transport oxygen into your bloodstream. For your lungs to work efficiently, the passages in your lungs need to be healthy, meaning they are free of blockages or inflammation.

While everyone may get an occasional cold or infection that blocks the lungs, there are several things you can do to keep your lungs in great working order. Tobacco or illicit drug use significantly damages lung tissues. Tar from cigarettes clogs up passageways, and the chemicals found within drugs can irritate or harm the lung tissues. This makes it harder for lungs to fill with air. Not smoking and not using drugs are important ways to keep your lungs healthy. Reducing exposure to secondhand smoke helps keep the lungs of nonsmokers healthy as well.

Like the muscles in your arms and legs, your lungs need exercise too. Moderate exercise, such as a brisk walk or a bike ride, helps your lungs become stronger and more efficient. People with chronic illnesses, such as asthma, should always consult a physician before starting an exercise program.





CARDIOVASCULAR SYSTEM

PHOTO COURTESY OF INDIANAPOLIS COLTS

EXPERIENCE 3: REACT AND RESPOND

This experience enables students to examine the brain–body connection by monitoring their own performance as they do physical activities. They study how repeating their motions decreases reaction time and begin to understand why athletes repeat training drills many times to increase their skills.

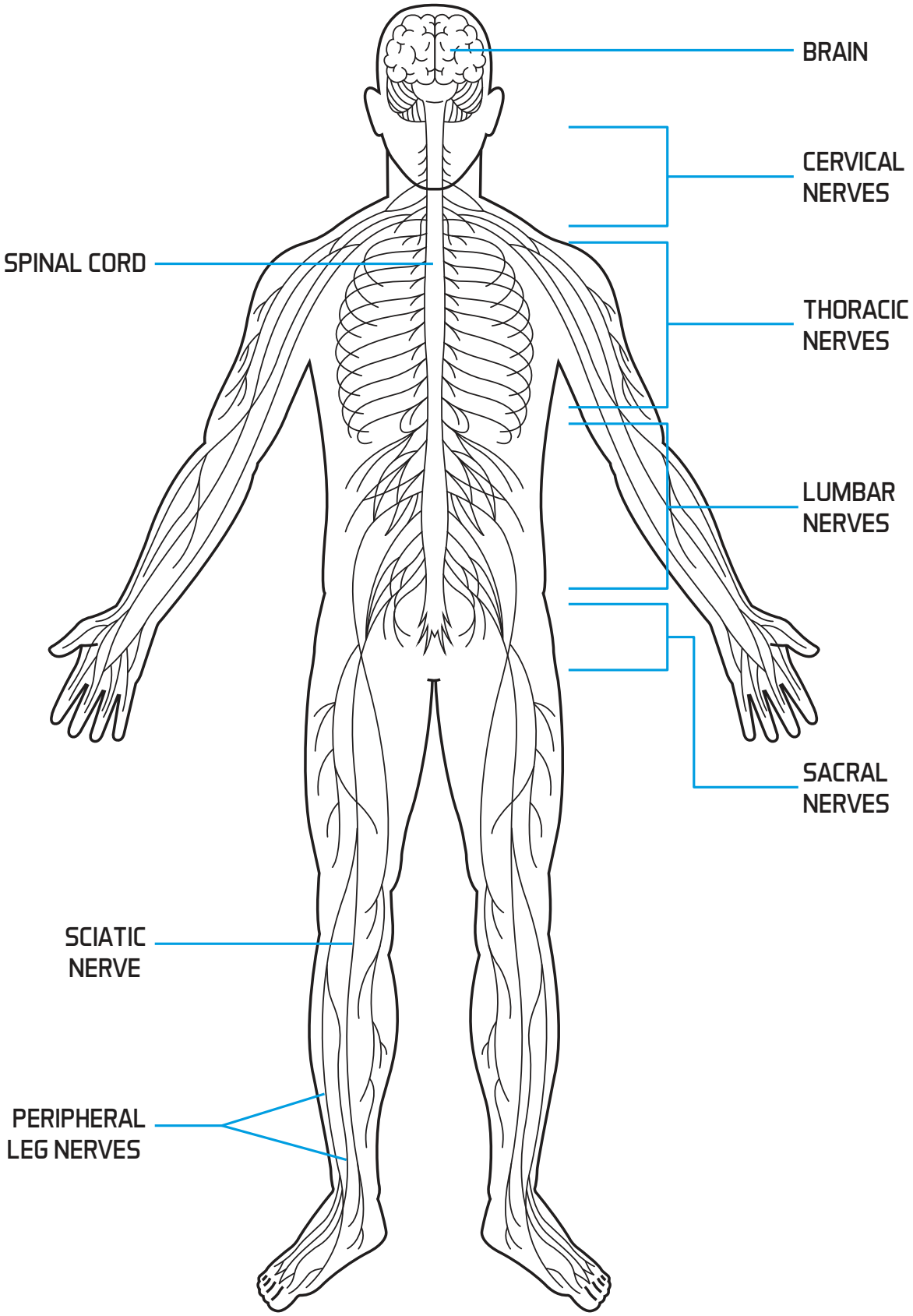
Above: Reggie Wayne catches a critical pass in a hard-fought game.

ACADEMIC STANDARDS

Indiana Science SEPS.3; 5.LS.3
Indiana Health and Wellness 4.1.1, 4.7.3; 5.1.1; 6.1.1, 6.1.7, 6.7.2; 7.7.2
Next Generation Science 4-LS1-2

PROCEDURES—PART 1

- Prior to the lesson, cut out the **Reaction Time** instruction cards found on page 18 and have them ready to hand out to students.
- To introduce the lesson, clear a space in the front of a classroom large enough to safely throw a beach ball or soft foam ball. Share with students that an important component of being able to play a sport is how effectively the **brain** sends messages to the arms or legs, telling them to respond with a specific movement. For example, when a tennis ball is headed toward a player, the brain sends a message to the arm to swing the racquet.
- Invite two students to come to the front of the classroom and gently toss the ball back and forth. As they are doing this, ask the other students to think about the information the brain is taking in and the messages it is sending to the rest of the body.
- After several rounds of catch, have students complete a think-pair-share. Have students record in their journals all of the information they believe the brain is taking in and the messages it is sending during the game of catch. Encourage students to use drawings as needed.
- Provide students with 3 to 4 minutes to record their own thoughts on paper.
- Place students into groups of two or three to share ideas. Students should add new ideas to their own individual lists.
- After groups have been able to work together for 5 to 7 minutes, initiate a whole-class discussion. Ask groups to share their ideas of the messages begin sent and received, encouraging them to describe ideas that haven't already been mentioned. Record ideas from students as they are shared.
- After students have shared ideas, ask them how they think the brain knows how to respond to catching the ball. Explain that many responses related to sports have to be learned. While the body instantly reacts to having something fly nearby, knowing how to catch in a certain way has to be learned, and it is the brain that learns the appropriate actions.
- Explain to students that the brain sends this learned information through the nervous system. Show students a picture or model of a brain and nervous system. Explain that the brain uses pathways to communicate movements to muscles about how to respond.
- To demonstrate how the nervous system works, have students line their chairs in rows, with one student seated at a desk at the end of each row. If the students' seats or desks are already organized in rows have them stay in that configuration. Make sure there are least four students in each row.
- Ask the first two students in each row to act as the brain, and decide which directions will be sent in a specific order. The directions will be sent down the row and the person at the desk will have to execute the action. Only the first two students will know the reason for the action.
- When students have finished the game, explain that this was a model for how the brain sends messages throughout the body. Short bits of information are sent to the muscles and they respond. A key difference is speed. Our body responds much faster than the model. In the demonstration, messages weren't sent back to the brain, but this is also an important function of the nervous system.



NERVOUS SYSTEM

PART 2

- Discuss with students that the body's ability to react and respond to stimuli is called **reaction time**. In sports, athletes need to work on their reaction time, making it as fast as possible in order to complete an action.
- Invite students to name actions in a game or sport where an athlete might need to have quick reaction time. If students are having difficulty, share the list below, based upon the museum's **Sports Legends**.

MARK KAUFFMAN, THE LIFE PICTURE COLLECTION, GETTY IMAGES

DaMarcus Beasley shows his skills in maneuvering the ball.

  - **DaMarcus Beasley**, soccer player: Notice a soccer pass and react quickly to kick a ball.
  - **Reggie Wayne**, football player: Anticipate the path of a football and respond by intercepting it.
  - **Barbara Wynne**, tennis player: Observe the direction a tennis ball is moving, and respond with a specific swing or by moving closer to where the ball will be flying.
  - **Oscar Robertson**, basketball player: Observe the path of a ball to catch a pass.
- Explain to students that one of the ways reaction times can be decreased is through practice, which trains the brain and muscles how to respond faster. This is one of the reasons athletes spend so much time completing drills.
- Provide students with the **Reaction Time** handout and walk them through the directions. Place students in pairs to complete a test of reaction time.
- After students have completed 10 trials for their reaction time, have them respond to the reflection questions. This could also be something that students complete as homework.
- Debrief with students after they have been able to complete their reflection questions. Ask students to share their evidence for how their reaction time improved.

Riley Children's Health
Indiana University Health

PROTECTING THE BRAIN

Your brain is the control center for your body. In addition to controlling voluntary movement, your brain tells your body how to complete involuntary movements such as breathing, helping your body respond when you are playing sports, and also holding your knowledge and memories. Keeping your brain protected is a very important part of being healthy.

Your brain is made of specialized soft tissue. Protecting this tissue is your skull, or several plates of bone that surround the brain. Just like the bones in arms and legs, with enough force the skull can crack or break. This can happen during a fall, or when something strikes the head. In sports such as hockey, football, and baseball, where balls or equipment may strike a skull with great force, wearing a helmet is necessary. A helmet is designed to absorb some of the force when struck. Helmets are also important in sports such as bicycling, where falls may be common.

Concussions are another concern when playing sports. When brain tissues are damaged in a concussion, symptoms such as headaches or even loss of function can result. The brain is surrounded by fluid that, along with the skull, protects it from small impacts. In hard or severe impacts, the fluid may not provide enough protection. Some concussions occur when the brain accelerates quickly into the skull.

If a concussion is suspected, it is important to contact a medical professional for guidance on treatment. In sports, it is imperative for athletes to follow the advice of a doctor on when it is safe to engage in sports again, to prevent further damage.

STUDENT HANDOUT
REACTION TIME

NAME: _____

INSTRUCTIONS:

1. With your partner, decide who will catch the meter stick and who will drop it.
2. The catcher should sit in a chair with arms extended straight outward, palms forward, and fingers extended to catch the meter stick between thumb and fingers.
3. While standing, the dropper should hold the meter stick so the zero end is even with the top of the catcher's hand.
4. Without saying anything, the dropper should let go of the meter stick, and the catcher should try to catch and hold on to the stick as soon as it begins to drop.
5. On the record sheet, record the centimeters mark where the catcher caught the meter stick.
6. Complete 10 trials for each person, with the dropper varying the amount of time before dropping the meter stick in each trial.

DATA TABLE

TRIAL		cm
1		
2		
3		
4		
5		
6		
7		
8		
9		
10		

LESSON 2
SPORTS AND YOU

In this lesson, students focus on why athletes practice skills, use equipment to improve their performance, and learn why statistics and math are so important when communicating about and analyzing sports. Students will work on improving their ability to throw and kick a ball, conduct experiments with bouncing balls, and finally conduct a whole-class experience where they play sports and calculate and share their own statistics. At the Museum's **Riley Children's Health Sports Legends Experience,** students and their families can participate in the training zone and reinforce the importance of practicing skills as they test and improve their own performance. At the same time they learn how dedication to their sport and years of practice led legendary athletes to record-breaking achievements.

OBJECTIVES

Students will

- Discuss why practicing sports is important for athletes
- Throw a variety of balls and diagram their paths from hand to landing
- Investigate how physical differences in balls affect their path
- Create a guide for athletes to explain how a ball will move during a game
- Conduct experiments on a variety of bouncing balls
- Play a variety of sports activities and record data on successful and unsuccessful sports actions
- Graph and/or calculate statistics on how successful they were at the sports actions

FOCUS QUESTIONS

- Why do athletes practice skills such as throwing and kicking?
- How does the equipment used by athletes support their ability to play?
- Why do we use statistics and math to communicate about sports?

VOCABULARY

elasticity
energy transfer
gravity
Newton's laws of motion
statistics
velocity

YOU WILL NEED . . .

EXPERIENCE 1
TIME: 2 CLASS PERIODS

EXPERIENCE 2
TIME: 1 CLASS PERIOD

EXPERIENCE 3
TIME: 1 CLASS PERIOD

MATERIALS

For each group

- Sports science journals for recording observations and activities
- Pencils
- 1 or 2 pieces of graph paper per group
- A variety of sports balls (such as soccer ball, basketball, tennis ball, football, golf ball, volleyball, racquetball, or squash ball).
- Air pump to change pressure in inflated balls
- Stopwatch or timer on a phone

PHOTO COURTESY OF NEGRO LEAGUES BASEBALL MUSEUM, INC.

Above: Mamie Johnson stretches for a catch. Nicknamed "Peanut," she was one of two women members of the Indianapolis Clowns, 1953–1955.

EXPERIENCE 1: THE PATH OF THE BALL

Students throw a variety of balls used in sports and diagram their path from the thrower's hand to landing. During this investigation, students will discuss how to control variables such as always using the same ball. Students will construct an argument, using their data, to explain similarities in how a ball moves after it has been thrown or kicked. Then, students will create a short guide for athletes to explain how a ball will move during a game.

At the museum's **Sports Legends Experience** students and families can learn how to further refine their abilities in controlling the path of a ball. In the outdoor experience students and families can work together as a team in a range of sports activities where movement of the ball can be the key to success.

Above: Playing for the Indiana Fever, Tamika Catchings uses her skills to control the ball.

PHOTO COURTESY OF PACERS SPORTS AND ENTERTAINMENT.

ACADEMIC STANDARDS

Indiana Science SEPS.3, SEPS.4; 4.PS.2; 6.PS.2, 6.PS.3; 7.PS.4, 7.PS.5

Next Generation Science 4-PS3-1, MS-PS3-5; 5-PS2-1

PREPARATION

Before teaching Experience 1, preview the gym or outdoor area you will use. Each student group will need enough space to throw or kick a ball without interfering with another group. There should be room to the side of where the object is kicked or thrown where students can sit or stand to observe the path of the ball.

PROCEDURES—DAY 1

- Explain that students will explore connections between science and sports.
- Ask students to share information they know about sports and forces in sports. Guide the discussion by describing how athletes work to understand how they can use forces to their advantage. For example, soccer players know how to kick a ball to cause it to spin and curve in the air so it is harder for defenders to know where the ball is going. Basketball players know how to use angles on the backboard to improve the chances of making their shot. A quarterback knows how to throw a ball to increase its **velocity**, or directional speed.
- Point out that there is an area of study called sports science, where people who aren't athletes have careers thinking about how athletes can improve their performance using science.
- Assign students to groups of three or four. Provide each group with a copy of The Path of the Ball worksheet (page 21).Have them record the date and time and instruct them to make detailed observations in their journals about how changing how a ball is thrown or kicked will change its path. Explain that they are now sports scientists examining how variables impact the movement of objects.
- Give the students 2 to 3 minutes to brainstorm about questions they can test in their experiments and have them record their best ideas in their journals. Ask them to experiment on how balls move in different paths depending on forces applied to them. Sample questions may include:
  - What happens to a soccer ball if I kick it mostly from underneath versus mostly from the top?
  - How far will a football go if I throw it at a 60-degree angle and a 30-degree angle with the same force?
  - If I'm shooting a basketball from the side of the goal, should I shoot a bank shot using the backboard or should I shoot straight at the rim?
- Circulate to guide their ideas and then allow them to begin testing. Inform them that their goal will be a presentation or brochure for athletes to help them understand how they can improve their game based on what students learn from their experiments.
- Explain to the students that each of them will have a role for the experiment: the thrower/kicker, the recorder, and the observer. They should rotate roles so everyone gets a chance to throw or kick a ball in a variety of ways, record the path of the ball, and observe how the ball moves from the side.
- Provide students with time to complete the experiments, allowing for 10 minutes at the end of class for a class discussion. Help students manage their experimentation time by giving a warning when 5 minutes remain.
- Ask students to share with the whole class what they tested and to give a brief explanation of their initial results.

STUDENT HANDOUT
THE PATH OF THE BALL WORKSHEET

NAME: _____

INSTRUCTIONS:

1. With your partners, decide who will by the thrower/kicker, the observer, and the recorder.
2. Brainstorm and then conduct a minimum of three tests with three trials (repeats) of each test. After a test is complete, rotate the roles you are playing on the team for the next test.
3. Have the thrower/kicker use the same motion for all three trials and record the path of the ball in the boxes below. If you are trying to move the ball left/right observe and record the test from a top-down, or aerial, view. If you are trying to change how high or how far the ball will go, observe and record the test from a side view.
4. After each test is completed, write a brief reflection of your observations below and answer the reflection questions.

Test Number 1: _____

Variable: _____

View: _____

REFLECTION QUESTIONS:

How did the path of the ball change with each test? Why? _____

_____

Was the path of the ball the same for each trial? _____

Why or why not? _____

_____

Test Number 2: _____

Variable: _____

View: _____

REFLECTION QUESTIONS:

How did the path of the ball change with each test? Why? _____

_____

Was the path of the ball the same for each trial? _____

Why or why not? _____

_____

Test Number 3: _____

Variable: _____

View: _____

REFLECTION QUESTIONS:

How did the path of the ball change with each test? Why? _____

_____

Was the path of the ball the same for each trial? _____

Why or why not? _____

_____

Test Number 4: _____

Variable: _____

View: _____

REFLECTION QUESTIONS:

How did the path of the ball change with each test? Why? _____

_____

Was the path of the ball the same for each trial? _____

Why or why not? _____

_____

DAY 2

- Give the students 5 to 10 minutes to reflect on what they learned from their experiments. Ask: How can you turn your observations into advice for athletes?
- Instruct the students to create a product that will describe what they learned about how forces affect the paths of balls and how athletes might use this to their advantage.
- Circulate among the students and guide them on transforming their experimental results into phrases to help athletes. Encourage the students to create a product that matches their creative abilities. The product could be a verbal presentation, a trifold brochure, a small cheat card to keep in a back pocket, a poster for hanging in a locker room, etc.
- Allow the students to have 15 to 20 minutes to create their products. Meet with each group to discuss their initial ideas and provide guidance on how they could improve their final product. Be sure to emphasize that they need to include science in the explanations they put into their product and to provide athletes with at least three helpful messages.
- With the remaining class time, have the students present their final products and ask for brief feedback on the best message and on ways one message could be improved.

FORCES IN SPORTS

Forces are one of the most important factors in sports. Athletes and scientists work very hard to maximize the benefits and minimize the negatives of forces, with a special emphasis on avoiding injury or death of athletes. Just how much force is involved in sports? It depends on the sport.

In baseball, a 95 mph fastball generates about 2,400 lbs. of force at impact on an unprotected head. A professional helmet reduces the force by about 30%, reducing the impact below the critical level of 1,800 lbs. that typically leads to skull fractures.

Remember Newton's second law of motion: Force = mass x acceleration (F = ma).

During IndyCar races, drivers push their cars to around 240 mph. Since an IndyCar weighs approximately 1,800 lbs. (816 kg) with a driver inside, it can produce an astonishing almost 20,000 lbs. (89,000 newtons) of force at the point of impact. Preventing this force from injuring the driver requires a mix of protective gear, engineered crumple zones in the car to absorb some of the impact force, and even the crash barriers themselves. The Indianapolis Motor Speedway now uses Steel and Foam Energy Reduction (SAFER) barrier, which uses a combination of steel and foam supports to reduce the force of impact by up to 50%, decreasing the crash severity by 30% to 80% and the chance the driver will have a serious injury from the impact.

The rapid pace of technological development means that sports scientists and engineers are constantly looking for new ways to prevent dangerous situations caused by force in sports, while at the same time athletes are pushing the envelope to look for a unique advantage over their competitors.

EXPERIENCE 2: WHY BALLS BOUNCE

Student groups will explore a series of stations that explore the variables that affect how a ball bounces. While there are many factors that affect how a ball bounces, there are a few that can be tested easily by your students, such as the characteristics of the ball, the type of surface the ball bounces off of, the height from which the ball is dropped, and the angle at which the ball hits the surface. Students will complete multiple tests of the same experiment, called trials or repeats, through a series of three stations.

ACADEMIC STANDARDS

Indiana Science SEPS.3, SEPS.4; 4.PS.4; 6.PS.3
Indiana Math 5.NS.2, 5.DS.2
Next Generation Science 4-PS3-1, 4-PS3-3, MS-PS3-5; 5-PS2-1, MS-PS2-1, MS-PS2-2

PROCEDURES

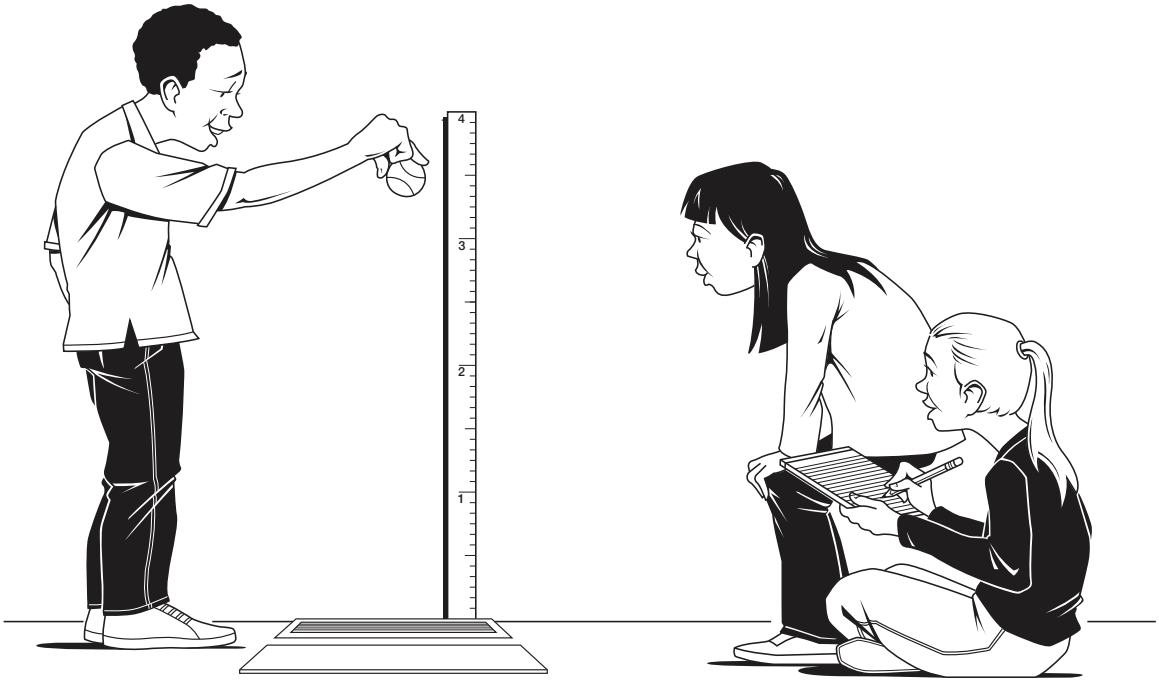
- Before the lesson begins, review the setup needs for each station. Set up stations around the room that will allow groups of three or four students to rotate around the room and test different variables that affect a bouncing ball. You may need to set up multiples of stations so that all students can remain engaged. Provide students instructions for each station to help them complete the investigation.
- Ask students what happens when you hold a ball up and let it go. Ask: What force causes the ball to drop? Help students identify **gravity**, which gives weight to the ball and causes it to fall.
- Ask: What makes a ball bounce the way it does? Give the students a few minutes to brainstorm on what causes a ball to bounce. Have the students record their group's answers in their sports science journals. Then have the students circle ideas they think they can test.
- Explain to the class that they will work as groups to test different factors that affect how a ball bounces. Each student will have an opportunity to be the dropper, the observer, and the recorder. Explain how each group should conduct at least three trials of each test and record their data each time. You can give the students a handout that can be glued into their journals to save time. Remind them to read the instructions for each station to be sure they are performing the experiment correctly.
- Have the students rotate between each of the first two stations. This should take approximately 30 minutes. After the students have completed the first three stations, have them check with you briefly on their results and observations. Then instruct them to go to Station 3 to begin designing their own experiment. Circulate around the classroom and provide guidance as students conduct their trials.

STATION 1: DROP HEIGHT

- Setup
  - Clear an area near a wall or vertical surface where you can tape or secure a tape measure or ruler to the vertical surface with the zero end of the ruler/tape even with the surface the ball will bounce on. The observer student will need room to watch the ball drop from directly in front of the ruler to see how high the ball is released from and how high it bounces on the first rebound.
  - Place at least two of each kind of ball at the station (suggestions include tennis and golf balls), so students can test multiples of the same kind of ball.
  - Tape the instructions for the station (see page 24 for Drop Height Instruction Sheet) in a place where it is easy for students to read. Be sure the surface the balls are dropped on will allow for good bounce.
- Instruct the students to follow the instructions and conduct at least 3 tests from each height while rotating their roles. The recorder should note the results in the sports science journal as each trial is conducted. The observer should watch the ball carefully and call out the number that is visible beneath the bottom of the ball when it bounces back up. Have the students discuss the results as a group and write down their explanation for their observations.
- This station is about how doubling the potential energy of an object will increase the amount of kinetic energy that the ball has at the moment of impact. Ask students: How much higher did the ball bounce when dropped from twice the height?
- To extend the experience with math integration, ask students to calculate the average of the three trials.

STUDENT HANDOUT

DROP HEIGHT INSTRUCTION SHEET



INSTRUCTIONS			
1	With your partners, decide who will be the dropper, the observer, and the recorder.	5	**Dropper:** Release the ball by pulling your thumb and forefinger away from the ball at the same time and do not add any downward force to the ball.
2	Brainstorm and then conduct a minimum of three tests (using a different ball for each test) with three trials (repeats) of each test. After a test is complete, rotate the roles you are playing on the team for the next test.	6	**Observer:** Watch the tests from a position 3 to 4 feet in front of the ruler, where you can clearly see the measurement marks. When the ball is dropped you should have your eyes roughly level with where the ball bounces back up. The team may have to do a test drop first so the observer can get in the proper position.
3	Each test should involve dropping the ball from the heights of 20" and 40" (50 cm and 100 cm). The bottom of the ball should be lined up with the measurement mark. Your team may choose to drop from additional different heights if time permits, but everyone should drop from 20" and 40" first to ensure all teams get to use the station.	7	**Observer:** When the ball bounces back up, watch for the largest number that appears below the bottom of the ball and announce that as the bounce height.
4	For each drop select the ball to be used. Use the same ball for each trial of a test. Hold it with your thumb and forefinger, just slightly in front of the tape measure or ruler on the wall. Make sure the bottom of the ball is even with the drop height on the tape measure or ruler.	8	**Recorder:** Repeat the bounce height out loud before writing it down so the observer can confirm that the correct bounce height is recorded on the Drop Height Worksheet (page 25).
		9	After all tests for the first surface are complete, either move to the next bounce surface station or move the new bounce surface into place and repeat the test.

STUDENT HANDOUT
DROP HEIGHT WORKSHEET

NAME: _____

INSTRUCTIONS:

1. Read the Station Instructions Sheet.
2. With your partners, decide who will be the dropper, the observer, and the recorder.
3. Brainstorm and then conduct a minimum of three tests (using a different ball for each test) with three trials (repeats) of each test. After a test is complete, rotate the roles you are playing on the team for the next test.
4. Each test should involve dropping the ball from heights of 20" and 40" (50 cm and 100 cm). The bottom of the ball should be lined up with the measurement mark. Your team may choose to drop from additional different heights if time permits, but everyone should drop from 20" and 40" first to ensure all teams get to use the station.
5. After each test is completed and the data are recorded, answer the reflection questions below.

DATA TABLE

	TRIAL	DROP HEIGHT (cm)	BOUNCE HEIGHT (cm)
1			
2			
3			
4			
5			
6			
7			
8			
9			
10			
11			
12			

REFLECTION QUESTIONS:

Did dropping the ball from twice the height make every ball bounce twice as high? Why or why not? _____

_____

Did two of the same type of ball both bounce a similar amount? Why or why not? _____

_____

Did two different types of balls both bounce a similar amount? Why or why not? _____

_____

_____

Golf courses are carefully planned and maintained. This helps skillful golfers predict how the ball will behave when it lands in dirt, grass, or sand.

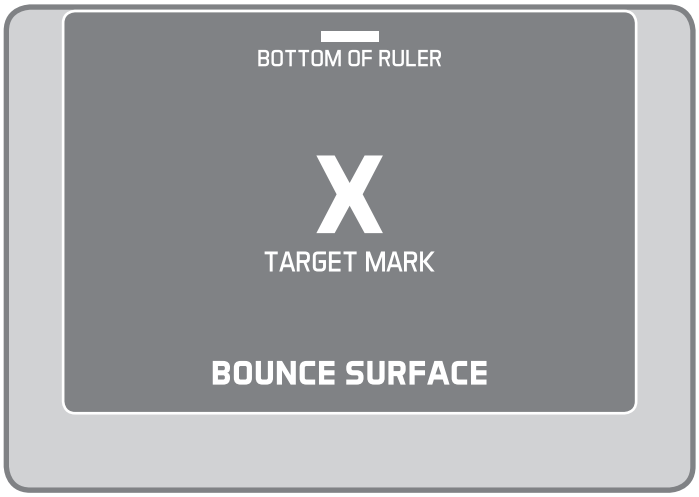
STATION 2: BOUNCE SURFACE PROPERTIES

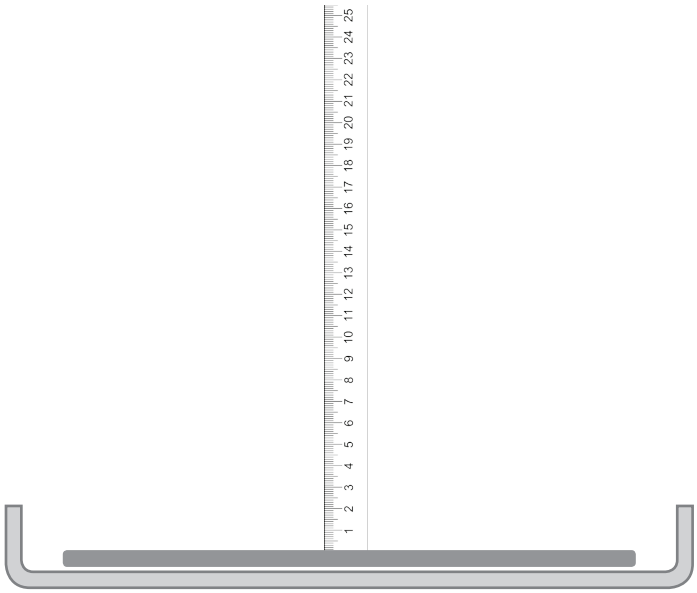
- Setup
  - Clear an area near a wall or vertical surface to tape or secure a tape measure or ruler to the vertical surface with the zero end of the ruler/tape even with the bounce surface. The observer student will need room to watch the ball drop directly in front of the ruler to see how high the ball is released from and how high it bounces on the first rebound.
  - Place at least two of each kind of ball at the station so students can test the performance of more than one ball in each type.
  - Tape the instructions sheet for the station (see page 27 for Bounce Surface Properties Instructions Sheet) in a place where it is easy for students to read.
  - Set up two (or more) bounce surface trays (see Bounce Surface Handout) that will allow students to quickly switch out the bounce surface the ball will hit. Be sure to set up the trays so that the height of the surface does not change when the trays are switched out. As an alternative to the bounce surface trays, you may set up multiple stations around the room with rulers already prepared and resting on the top of the bounce surface so drop heights are the same regardless of bounce surface thickness.
  - Suggested surfaces for testing include wood, metal, sponge, artificial turf, plastic, etc. You can tailor this station to the abilities of and time you have to work with your students. If time allows, you could test three or four surfaces or test multiple kinds of balls on just one surface. A good suggestion for materials here is to have two balls of roughly the same mass and size but with differing elasticities. For example you can have a golf ball and a golf-ball-size Super Ball. The difference in elasticity in the balls can yield interesting results for different surfaces.
- Following the Bounce Surface Properties Instructions Sheet, the students will conduct at least 3 tests, where they drop a ball from the same height onto two or more different surfaces. Have the students discuss the results as a group and write down their explanation for what they saw.
- This station is about how the surface that the ball strikes changes how much the ball bounces back upward. There are two variables at play here: the **elasticity** of the ball and the amount of energy the surface absorbs when the ball hits it, or **energy transfer**. Assuming the students keep the elasticity of the ball the same, the amount of energy the surface is absorbing will be the primary factor in determining the height of the bounce. Concrete absorbs little energy compared to grass or sponge, meaning most balls will bounce better on concrete.

Athletes and sports scientists spend significant time learning how balls bounce on different surfaces in order to improve performance. Golfers know to avoid sand traps and areas of high rough (vegetation) that will reduce or eliminate bounce that would allow their ball to travel further. Sports surface companies carefully design basketball courts to eliminate or reduce dead spots where too much flexibility in the floor reduces the height a ball bounces back from the floor. Basketball players sometimes test floors before games to locate dead spots to be avoided.

STUDENT HANDOUT

BOUNCE SURFACE PROPERTIES INSTRUCTION SHEET





INSTRUCTIONS			
1	With your partners, decide who will be the dropper, the observer, and the recorder.	6	The observer should be positioned directly in front of the ruler about 3 to 4 feet away. When the ball is dropped, the observer's eyes should be roughly level with where the ball bounces back up. The team may have to do a test drop first so the observer can get in the proper position.
2	Brainstorm and then conduct a minimum of three tests with three trials (repeats) of each test. After a test is complete, rotate the roles you are playing on the team for the next test.		
3	Position the first bounce surface with the end of the ruler/tape measure resting on the top of the bounce surface. Make sure the ruler or tape measure is still vertical after adjusting the height.	7	When the ball bounces back up, the observer should watch for the largest number that appears below the bottom of the ball and announce that as the bounce height.
4	For each drop, select the ball to be used (it should be the same ball for each trial of a test) and hold it with your thumb and forefinger, just slightly in front of the ruler. Make sure the bottom of the ball is even with the drop height.	8	The recorder should repeat the bounce height out loud before writing it down so the observer can confirm that the correct bounce height is recorded.
5	Release the ball by pulling your thumb and forefinger away from the ball at the same time and do not add any downward force to the ball.	9	After all tests for the first surface are complete, either move to the next bounce surface station or move the new bounce surface into place and repeat the test.

STUDENT HANDOUT
BOUNCE SURFACE PROPERTIES WORKSHEET

NAME: _____

INSTRUCTIONS:

1. Read the Station Instructions Sheet.
2. With your partners, decide who will be the dropper, the observer, and the recorder.
3. Brainstorm and then conduct a minimum of three tests. Make sure to change the roles you play after each test.
4. After each test is completed and the data are recorded, answer the reflection questions below.
5. Change the bounce surface to be ready for the next test.

DATA TABLE

TRIAL		DROP HEIGHT (cm)	BOUNCE HEIGHT (cm)
1			
2			
3			
4			
5			
6			
7			
8			
9			
10			
11			
12			

REFLECTION QUESTIONS:

If you tested one ball on multiple surfaces, which surface did the ball bounce the best on? Why? _____

_____

If you tested multiple balls on the same surface, did the balls all bounce the same amount? Why or why not? _____

_____

_____

What makes a ball bounce well on one surface and not on another? _____

_____

_____

STATION 3: THE EXPERIMENTATION STATION

- **Setup**

Create another station with a variety of balls, tape measures/rulers/yardsticks and bounce surfaces. You may want to set up multiple replicas of this station to prevent overcrowding as students transition to designing their own experiments.

- At this station, students can investigate dropping balls from larger heights or testing a variety of balls that were not available at stations 1 and 2.
- To extend the activity, provide fresh tennis or racquet balls (labeled A) and older used ones (labeled B) and have students test how well Ball A bounces compared to Ball B. Ask students to come up with an explanation for why the B balls do not bounce as well. The reason older balls do not bounce as well is that they have lost some of their firmness and have become more elastic. This makes more of the energy go into changing the shape of the ball (flexing or deformation) than into the bounce.

After students have completed their own experiments at Station 3, you can have them briefly report to the rest of the class what they experimented on (what variable they manipulated), what their results were, and how they explain their results.

EXTENDING EXPERIENCE

Depending on the grade level of your students and their familiarity with experiments, you may want to extend this experience into two days.

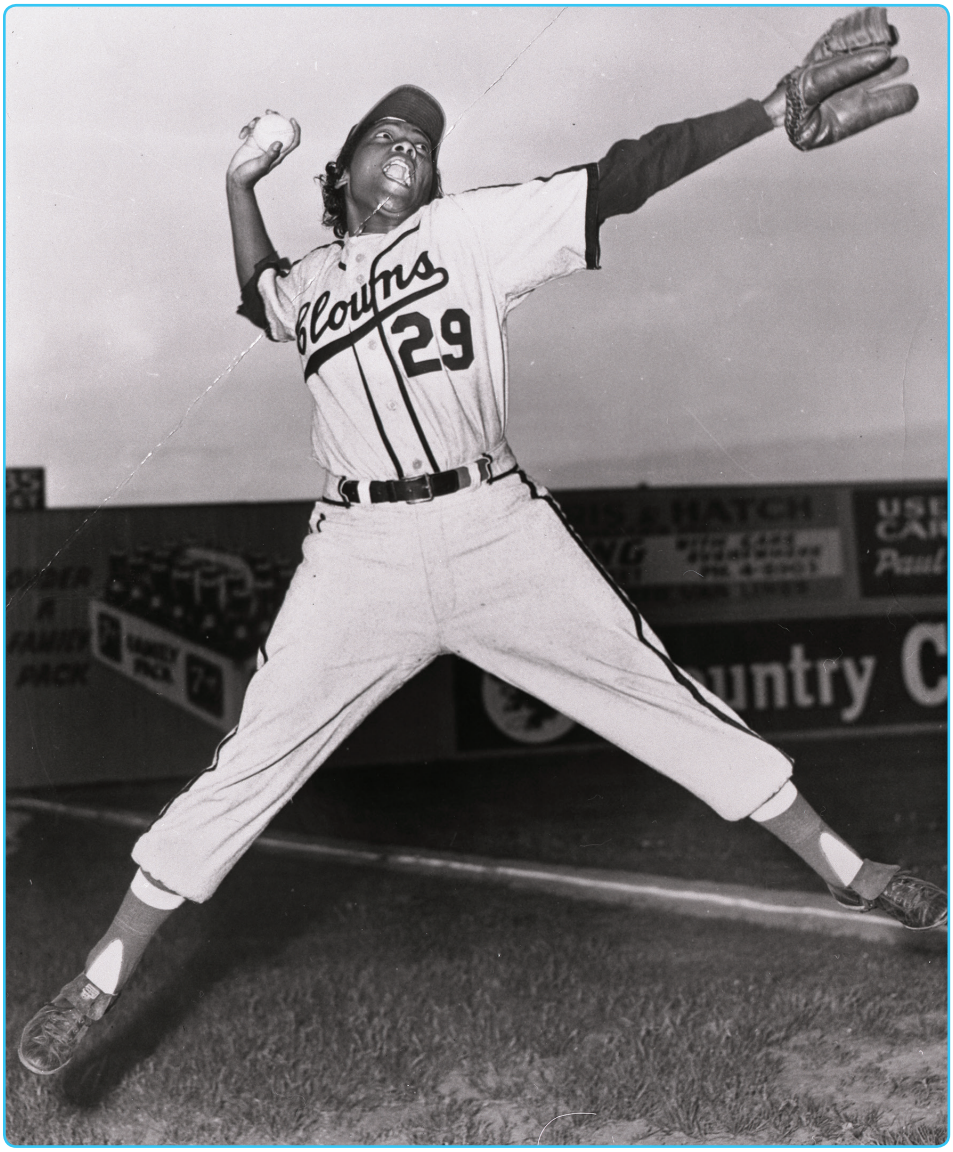
- Day 1: Focus on completing the first two stations and initial experimentation with Station 3.
- Day 2: Shift the focus to purposeful planning for conducting multiple experiments at Station 3. This will allow you extra time for reviewing their experiment plans at the beginning of class and then letting them explore experiments at Station 3 for 20 to 25 minutes before the class comes back together for a longer debrief on the results of their efforts.
- Some higher-performing students may have enough time in two days to perform two or three experiments and you can have them focus on reporting on their most interesting or best experiment.

STUDENT HANDOUT
EXPERIMENTATION INSTRUCTIONS SHEET

In the first two stations you focused on a specific test already designed for you to show how manipulating variables affects how a ball bounces. Now it is your turn to design experiments that research how other variables will affect how a ball bounces. Each experiment you perform should focus on changing only one variable at a time and include a minimum of three trials of each setup being tested.

For example, if you want to test how changing the angle of a bounce pass in basketball affects the height it bounces you should release the bounce pass from the same distance and angle from the bounce target at least three times. Try to use a similar amount of force when you release the ball each time.

	INSTRUCTIONS
1	With your partners, decide who will be the thrower/kicker, the observer, and the recorder.
2	Brainstorm and then conduct a minimum of three tests with three trials (repeats) of each test. After a test is complete, rotate the roles you are playing on the team for the next test.
3	Before conducting your test, ask yourself the following questions: Am I changing only one thing in this test? Is there anything I should consider doing the same for each test (for example, using the same force when passing the ball)? Do I have my datasheet set up properly to record the results of the tests?
4	The observer will need to be positioned at the best angle to see the results of the test.
5	Release/pass/kick the ball with the same amount of force for each trial.
6	When the ball bounces back up, the observer should watch for the largest number that appears below the bottom of the ball and announce that as the bounce height or distance.
7	The recorder should repeat the measurement out loud before writing it down so the observer can confirm that the correct measurement is recorded.



EXPERIENCE 3: SPORTS STATISTICS

Visitors of the **Riley Children's Health Sports Legends Experience** learn how numbers and calculations are used in sports. In Experience 3, students investigate sports statistics. They participate in a sports activity and calculate the statistics on their own performance. Students explore multiple examples of statistics and determine which statistics are most useful for specific sports.

Above: "Toni" (Marcenia Lyle) Stone puts muscle into a pitch. She was a member of the Indianapolis Clowns from 1953 to 1954. PHOTO COURTESY OF NEGRO LEAGUES BASEBALL MUSEUM, INC

ACADEMIC STANDARDS

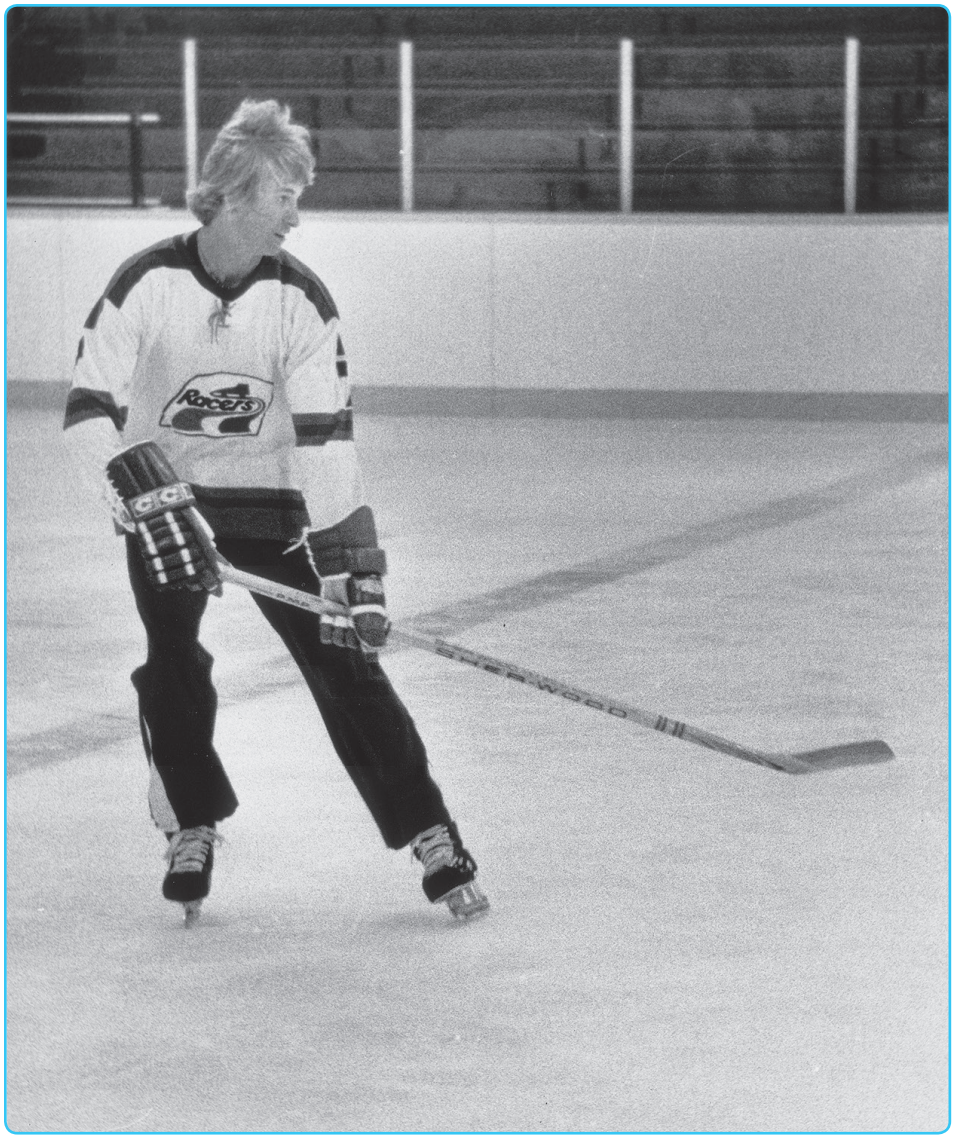
Indiana Math 4.NS.6, 4.DA.1; 5.NS.6, 5.AT.5, 5.DS.1, 5.DS.2; 6.NS.5, 6.NS.8, 6.NS.9, 6.NS.10, 6.C.3, 6.DS.1, 6.DS.2, 6.DS.3; 7.C.5, 7.C.6, 7.C.8, 7.DSP.3

TIME: 1 CLASS PERIOD

PROCEDURES

- Gather your students together in the gym or in an outdoor space and ask the question: "How are numbers and calculations used in sports?" Collect six to 10 responses and record them on your board or butcher paper.
- Divide the class into groups of two or three students and ask them to discuss how numbers are used and calculated. Instruct the students to focus on numbers that indicate a success rate at a sports activity. Their answers may include batting averages, free throw percentages, shots on goal, and pass completion rates. Alternatively, the students could focus on numbers that indicate the ability to break a record, such as records for Olympic events including the long jump, the high jump, or any of the speed events. Ask the students to think about what sports activity they would like to test to come up with their own numbers table or statistics.
- Have each group select three sports activities they would like to experiment with and collect statistics for. Combine groups with similar ideas together so they can gather more numbers while conducting their activity. Depending on the length of your class period, you may want to limit the number of groups to three to five so that each group will have time to record their data, perform calculations, and report their findings at the end of class.
- Have the students perform their sports activity, with each student in the group taking a turn at doing the sports activity, observing others, and recording numbers on their data sheet.
- Younger students may focus on simple numbers collection or doing activities that yield numbers about breaking a record. Older students can do this as well and then extend their experience by calculating an appropriate percentage or rate for their activity.
- After the students have finished conducting their activities, give them a few minutes to prepare a brief presentation on their numbers or calculations. Encourage them to focus on not only who had the best percentage but also on comparing the best percentage to the average percentage for the group conducting the activity.
- Circulate among the groups to offer help. When everyone is ready to present, have each group present to the class how they used numbers and calculations to evaluate their group's activity.

SPORTS LEGENDS STATS



Above: Playing for the Indianapolis Racers in 1978, Canadian hockey player Wayne Gretzky shows the early talent that led to record-breaking statistics. PHOTO COURTESY OF INDYSTAR.

One of the most interesting mathematical concepts for sports is **statistics**. If you ask a roomful of people the question, "Who was the best sports athlete who has ever lived?" you will get a wide variety of answers, including some reasons that can't be measured. This can sometimes end up being a popularity contest. So putting emotion and opinion aside, how can we tell who was the best ever? What separates a Sports Legend from just the average professional athlete?

Sometimes it is emotion and opinion, but sometimes statistics can show with numbers how a Legend was simply better. It is more difficult to argue with numbers. So who was the Indiana Pacers' greatest player? This can be a matter of personal opinion, but Reggie Miller has some impressive stats his supporters can use. Most games played for the Pacers? Reggie played 1,389; next in line is Rik Smits with 867. Minutes played? Reggie Miller 47,619; Rik Smits 23,100. Three-point field goals? Reggie Miller 2,560; Danny Granger 964. The Pacers' leader in free throws made, assists, steals, points, and true shooting percentage? You may have guessed it: Reggie Miller.

Wayne Gretzky was a dominant Sports Legend in hockey. Although he retired in 1999, Gretzky still holds 40 regular season, 15 playoff, and 6 All-Star hockey records. These records—including most goals in a career, most playoff goals, most goals in one season including the playoffs, most game-winning goals in the playoffs, most assists, and most points—all continue to belong to Wayne Gretzky.

WAYNE GRETZKY

- MOST GOALS IN A CAREER
- MOST PLAYOFF GOALS
- MOST GOALS IN ONE SEASON INCLUDING THE PLAYOFFS
- MOST GAME-WINNING GOALS IN THE PLAYOFFS
- MOST ASSISTS
- MOST POINTS

In addition to documenting outstanding individual performance, statistics also help coaches to rate players and determine how to put together the best team to use against a particular opponent. In hockey, if a team is struggling to score goals, the coach can look at goals and assists to see who is weaker in those categories and replace them with players with better statistics. In baseball, if the star starting pitcher has an Earned Run Average (ERA, the number of earned runs given up per nine innings pitched) of 1.09 overall, but 5.75 against a particular opponent, a savvy manager will use another pitcher against that opponent to improve his team's chances of winning.

STUDENT HANDOUT
SPORTS STATISTICS WORKSHEET

What statistics would you like to examine today?
While there are many uses of statistics in sports, two of the most common are to calculate success rates and to indicate if an established record has been broken (for example, Olympic records). What sports do you like? How do you calculate their statistics? See below for some guidance.

SUCCESS STATISTICS DATA TABLE

	SPORT	STATISTIC	SUCCESSFUL ACTIONS	TOTAL ACTIONS	SUCCESSFUL PERCENTAGE
1					
2					
3					
4					
5					
6					
7					
8					

RECORDS DATA TABLE

	SPORT	ACTIVITY TESTED	ATTEMPT 1	ATTEMPT 2	ATTEMPT 3	ATTEMPT 4	RECORD
1							
2							
3							
4							
5							
6							
7							
8							

LESSON 3
YOUR HEALTHY BODY

After studying how the body works in sports activities and how athletes perform, students will begin to understand the need for good physical health. In this lesson, students focus on how to maintain a healthy body. Students work to discover why healthy eating is so important to a healthy body, how water is critical to health, and how to protect the body to keep it healthy during sports activity.

OBJECTIVES

Students will

- Brainstorm examples of energy and how it is created
- Review how the digestive process works and how it provides energy to the body
- Think-pair-share on what kinds of energy is in food and drinks and how food and drinks could affect the body
- Calculate the calories and nutrients in a meal and discuss how those may affect the body
- Explore the role of water in maintaining a healthy body
- Understand the danger of dehydration and how to avoid it
- Create a 3D visual on water volume and loss in adults and kids
- Investigate the purpose of protective gear
- Design protective gear for an "apple athlete" and test its effectiveness

FOCUS QUESTIONS

- Why are healthy foods important to a healthy body?
- What is the role of water in a healthy lifestyle?
- How do you protect your body to keep it healthy during sports?

YOU WILL NEED . . .

EXPERIENCE 1
TIME: 1 – 2 CLASS PERIODS

EXPERIENCE 2 & 3
TIME: 1 CLASS PERIOD

EXPERIENCE 3
TIME: 1 CLASS PERIOD

MATERIALS FOR EACH GROUP

EXPERIENCE 1

- A computer, tablet, or phone allowing students to research calorie and nutrient content of foods and drinks
- Youth Nutrition Needs worksheet, page 36
- Digestive process infographic, page 38

EXPERIENCE 2

- Water card sort game, pages 42–43
- Paper and pencils, markers, or colored pencils to create a 3D visual
- Paper to create a dehydration worksheet

EXPERIENCE 3

- Apples (2 or 3 per student group)
- Plastic tablecloth
- Tape
- Recycled or craft materials such as foam, cardstock, paper
- Student handout or student notebooks

VOCABULARY

calorie
dehydration
health
hydration
protective gear
wellness

EXPERIENCE 1: YOU ARE WHAT YOU EAT

Students examine what a healthy body is and why the body requires us to eat healthy foods. Students work to understand different forms of energy and how they are created. Then students explore how they get energy into their bodies. Students examine the key components of the digestive process and how food and water are used in it. They calculate calorie and nutrient content of a meal and understand how that meal could affect the body.

ACADEMIC STANDARDS

Indiana Science 4.PS.4; 7.LS.4

Indiana Health and Wellness 4.1.1, 4.7.1, 4.7.3; 5.1.1, 5.1.4, 5.2.4, 5.7.1, 5.7.2, 5.8.2; 6.1.5, 6.1.7, 6.2.9, 6.7.1, 6.7.2; 7.1.1, 7.7.2, 7.7.3; 8.1.1, 8.7.2, 8.8.1

Next Generation Science MS-LS1-7

PROCEDURES

- Divide the class into groups of three or four students. Ask students to brainstorm examples of energy and record in their sports science journals how each one is created. Some examples could include the lights in the classroom or batteries in their calculators or phones. After they have recorded their ideas in their journals, have students share their answers with the class. Then hold up an apple (or another piece of food) and ask: Is this energy? After the class agrees that it is indeed energy, ask your students how their bodies use that energy.

- Distribute the Digestive Process handout on page 38 and ask students to review the information. Have them write down a brief explanation in their journals on how food and drinks provide energy to the body. Also ask them to write a brief response to the question: How could consuming too much food or sugary drinks be bad for your body? Question your students on their responses. When you are satisfied they understand the digestive process, move on to the next step.
- Pass out the Youth Nutrition Needs worksheet on page 36 and ask students to review the information summary at the top of the sheet. After a brief review with the class, ask the students to think about one of their favorite meals. Ask: What is in your favorite meal? Which foods? What drinks? How will this favorite meal affect your body? Then give the students 10 to 15 minutes to research the **calorie** and nutrient information of their favorite meals. Alternatively, you can ask your students to turn this into a homework assignment.
- Once the students have filled out the Youth Nutrition Needs worksheet, have them share within their small group on their choice. Have them write on the sheet or in their journals about how their choice either meets the needs of a healthy body or could potentially cause problems.
- If time permits, extend the experience by having the students fill out the back side of the worksheet, which asks them to calculate the amount of time spent doing various exercises that would be needed to burn off the calorie or fat content of their favorite meal.

STUDENT HANDOUT

YOUTH NUTRITION NEEDS WORKSHEET

INTRODUCTION

Youth nutrition needs are unique and depend on the activities you participate in, but some general guidelines apply for the types of food and drinks you put into your body.

NUTRITION RECOMMENDATION FOR STUDENTS 9–13 YEARS OLD	MALE	FEMALE
Calories	1,800 kcal/day	1,600 kcal/day
Fat	25% to 35% of calories	25% to 35% of calories
Milk/Dairy	3 cups	3 cups
Lean Meat/ Beans	5 ounces	5 ounces
Fruits and Vegetables	4 cups	3.5 cups
Grains	6 ounces	5 ounces
Sugars (total)	6 to 9 teaspoons (25–37.5 grams)	6 to 9 teaspoons (25–37.5 grams)

DATA TABLE

	NUTRITION	QUANTITY	NOTES
1			
2			
3			
4			
5			
6			
7			
8			
9			
10			

What is your favorite meal? _____

_____

How does your meal compare to the recommended daily allowances? _____

_____

Where does it have too much of something or not enough of something? _____

_____

Do any of the amounts from this single meal exceed your daily allowance? _____

STUDENT HANDOUT
STUDENT NUTRITION WORKSHEET

Everyone enjoys eating their favorite meal but remember: Your food choices impact your body!
How long would you need to exercise to burn off the calories in your favorite meal?
Use the table below to learn how many calories you can burn by doing common exercises.
You can research the calories in your favorite meal and your favorite exercises online.

EXERCISE AND CALORIES TABLE

EXERCISE	TIME	CALORIES BURNED	EXERCISE	TIME	CALORIES BURNED
WALKING	30 MIN.	126	WEIGHT LIFTING	35 MIN.	126
HIKING	20 MIN.	126	GOLF	20 MIN.	126
DANCING	23 MIN.	126	RUNNING – 5 MPH	13 MIN.	126

MY EXERCISE PLAN

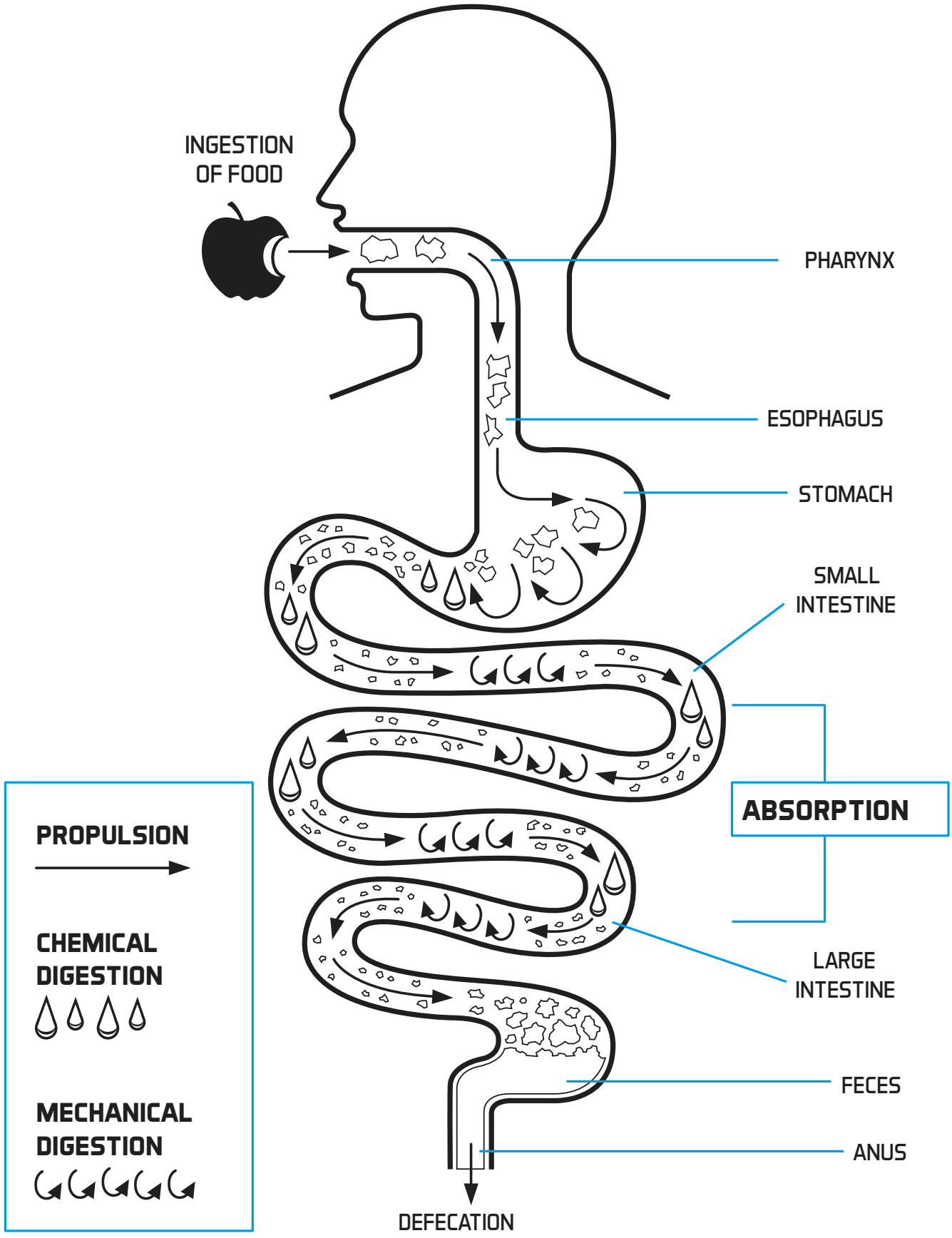
Use this chart to plan how you will exercise to burn the calories from your favorite meal.
Remember: 1 gram of dietary fat = 9 calories

FAVORITE MEAL: _____ TOTAL CALORIES: _____

MY EXERCISES TO BURN OFF THE CALORIES FROM MY FAVORITE MEAL:

EXERCISE	TIME	CALORIES BURNED
EXERCISE 1:		
EXERCISE 2:		
EXERCISE 3:		
EXERCISE 4:		

TOTAL TIME SPENT EXERCISING : _____ TOTAL CALORIES BURNED: _____



DIGESTIVE PROCESS

Riley Children's Health
Indiana University Health

CHANGE the PLAY

SCHOOL CHALLENGE

Physical education classes and time spent at recess have declined for many elementary and middle schools over the last 20 years. Schools have been dropping PE class and recess in favor of more time for studying for standardized tests. The intention of this change was to have students better prepared for exams, but the opposite has been occurring. The lack of physical activity and time to relax from the stressful educational environment has led to poorer performance on tests. Following the passage of the Healthy, Hunger-Free Kids Act of 2010, schools were mandated to implement School-Wide Wellness policies. This has resulted in some schools giving time back to physical education and recess as part of their **wellness** plan.

In response to the increasing call for school-wide wellness, Riley Children's Health partnered with Indianapolis Colts quarterback Andrew Luck to create a new wellness program called *Change the Play*. Change the play provides eight weeks of challenges to keep kids active and eating healthy. Each week is a themed challenge highlighting different areas of wellness and fitness.

CHANGE THE PLAY	
WEEKLY CHALLENGES	THEME
Ready, Set, Stretch	Teaches kids the importance of flexibility and the positive impact it can have on their body.
Mindful Mornings	Pairs simple morning activities with nutritional tips that help increase something we all want more of—brainpower.
H_2GO	Reveals the importance of hydration and how important drinking the right amount of water can be.
Power Up	Helps kids learn the value of building and maintaining strength in healthy, age-appropriate ways.
Chill Out	Provides kids with great activities and nutritional tips that can help them deal with everyday stresses.
Dart & Dash	Showcases the fun of learning how to improve quickness, coordination, balance, and overall agility.
Game Changer	Encourages kids to get out there and try a new sport, activity, or food in the name of health and fun.
Be the QB	Pushes kids to take charge of their own health at home, in the classroom, and out on the playing field.

For more information visit
rileychildrens.org/changetheplay

EXPERIENCE 2: A BODY OF WATER

In this experience the students will explore the role of water in maintaining a healthy body. Students will examine the different roles that water plays in their bodies through a card sort. Students will create a 3D visual to show the volume of water in an average adult or child and how much is lost every day. Included in the visual will be messages on the importance of hydration and how to replace water in the body.

ACADEMIC STANDARDS

Indiana Science 4.P.4; 6.PS.2; 7.PS.4, 7.PS.6, 7.LS.4
Indiana Health and Wellness 4.1.1, 4.1.4, 4.7.1, 4.7.2, 4.7.3; 5.1.1, 5.7.1, 5.7.2; 6.1.7, 6.7.1, 6.7.2; 7.1.1, 7.7.2, 7.7.3, 7.8.1; 8.1.1, 8.7.2, 8.8.1, 8.8.2
Next Generation Science MS-LS1-7

PROCEDURES

- As a class discuss the role of water in the body and share some statistics (see sidebar).
- Ask: How does water help maintain a healthy body?
- Record answers and ask students to elaborate. When there are six to 10 answers, place students in groups of three or four and begin the card sort experience.
- Hand out a set of the Body of Water cards to each group. Ask them to sort the role cards into the Blood and Water role groups and to match the How Much and Percentage cards.
- Once the students have sorted the cards, they should use classroom computers, tablets, phones, or print resources to research how much water common activities require. Ask: What process in the human body consumes the most water? What takes the least amount of water but is still important?
- Encourage students to research how much water activities use, including activities that are not featured on the How Much cards. Ask: How are blood and water similar and different in the body? What process in the human body consumes the most water? What takes the least amount of water but is still important?
- After their research is completed students should create a 3D visual of the volume of water in an average adult or child and show how much water is needed to balance the water demands of their bodies.

HOW MUCH OF A NEWBORN BABY'S BODY IS WATER?

How much of a school student's body is water?
65%

How much of an adult's body is water?
55%-60%

How much of your bone is water?
25%

How much of your skin is water?
60%-70%

How much of your brain is water?
75%

How much of your blood is water?
85%

Riley Children's Health
Indiana University Health

WHAT IS DEHYDRATION?

Dehydration is a condition that occurs when the amount of water available in your body has dropped below the level of water needed to maintain normal body functions. You know that as soon as you feel thirsty you should drink water to restore your body's balance. But thirst is **not** an early indicator of dehydration. It takes only about a 1% loss of body water for dehydration to begin. Many people do not feel thirsty until they have lost 2% to 3% of their body water. Some other signs that you may already be dehydrated include feeling dizzy or lightheaded, having a dry or sticky mouth, or urinating less than usual or having darker urine. How soon these symptoms set in varies by individual, so these aren't always reliable indicators of dehydration.

How can you maintain good **hydration**? Drink as much water and other liquids as you can at regular intervals throughout the day to offset loss of body water. Always drink water during and immediately after strenuous exercise or time outside. Depending on your level of activity and the humidity outside, you can lose a significant amount of water just by sweating. You can get some water back into your body from foods and beverages, but drinking clean water is always the best option.

STUDENT HANDOUT
WATER AND BLOOD CARD SORT GAME

TEACHER INSTRUCTIONS

Print out a full set of cards and withhold the answer cards. Share with your students that you will now be playing a Water and Blood Card sort game where they will be examining each card and determining if roles are fulfilled by water or blood or how much of a body part is made up of water. Allow the students 5-10 minutes to sort and match their cards. Circulate around the groups playing the game to answer questions or provide clarifications.

After all groups have completed their selections hand out the answer cards and ask the groups to examine their answers. When they correctly sorted a blood or water role card they should turn that card over. If they correctly matched a how much card to the corresponding percentage both of those cards should be turned over. Circulate around the room and ask students questions about cards they did not correctly sort. If desired a large group discussion can be held to address commonly missed cards.

Make one card from each of the following:

Instructions Card — Blood or Water Role:		Instructions Card — Blood or Water Role:	
If the card is a role, sort the cards into two groups. One group will be cards about water's role in the body. The second group will be cards about blood's role in the body.		Cards that ask a how much question should be matched to the correct percentage card. Create a group of cards where each how much question card is matched to a percentage card that you think is the correct answer.	
Role Card: Major part of saliva	**Role Card:** Removes waste materials from cells	**Role Card:** Transports oxygen around your body	**Role Card:** Helps prevent damage to your body
Role Card: Helps seal wounds and cuts	**Role Card:** Helps keep body tissues moist	**Role Card:** Helps protect your spinal cord	**Role Card:** Helps you digest food, especially fiber
Role Card: Helps regulate your body temperature	**Role Card:** Removes waste materials from the kidneys and bladder	**Role Card:** Lubricates joints	**Role Card:** Moves hormones around the body

STUDENT HANDOUT
WATER AND BLOOD CARD SORT GAME

Role Card: Moves immune system (white) cells around the body	How Much: … of your bones are made up of water?	How Much: … of your saliva is water?	How Much: … of your blood is water?
How Much: … of your organs are water (on average)?	How Much: … of your body fat is water?	Percentage Card: 25%	Percentage Card: 99.5%
Percentage Card: 83%	Percentage Card: 70%	Percentage Card: 10%	

Answer Card: Blood Roles Removes waste products from cells Transports oxygen Helps seal wounds and cuts Moves hormones around the body Moves immune system (white) cells around the body	Answer Card: Water Roles Major part of saliva Helps: prevent damage keep body tissues moist protect your spinal cord digest food regulate body temperature Removes waste materials from the kidneys and bladder Lubricates joints	Answer Card: How Much Bones: 25% Saliva: 99.5% Blood: 83% Organs: 70% Body fat: 10%

EXPERIENCE 3: SPORTS GEAR—PROTECT YOURSELF

In this experience students learn that another way to maintain good health is to "play smart" by using appropriate sports equipment. Protective sports gear is essential to prevent injuries and help an athlete achieve his or her personal best.

ACADEMIC STANDARDS

Indiana Science SEPS.3, SEPS.4; 4.P.4; 6.PS.2, 6.PS.3; 7.PS.4, 7.PS.6

Indiana Health and Wellness 4.1.1, 4.7.1, 4.7.2, 4.7.3; 5.1.4, 5.7.1, 5.7.2; 6.1.1, 6.1.5, 6.1.7, 6.7.1, 6.7.2; 7.1.1, 7.7.2, 7.7.3; 8.1.1, 8.7.2, 8.8.1, 8.8.2

Next Generation Science 4-PS3-3; MS-LS1-3, MS-LS1-6, MS-LS1-7; MS-PS2-1

PROCEDURES

- Ask students to share the types of **protective gear** they often wear during sports or athletic events. Responses from students might include a helmet and pads while skateboarding, a bike helmet, or shin guards in soccer.
- Share with students that they are going to focus on helmets, and explore how forces and Newton's laws of motion make wearing a helmet during sports very important.
- Hold up an apple and a soft foam ball, and ask students to predict what might happen when each item is dropped. You may choose to go ahead and drop the items for students to see the differences between the two items.
- Ask students to share why they believe the two items behaved differently when dropped. Share with students that they are seeing the effects of Newton's third law of motion. The action of the ball and apple hitting the floor causes a reaction: the floor pushes back. Due to the material of the apple, the reaction is too much force on the apple, and it is damaged or even broken apart.
- Invite students to share ideas about why the foam ball does not break apart. As students provide answers, reinforce that the ball is made of a flexible material, so as the floor pushes back, the foam is able to bend and stretch, rather than break.
- Share with students that the purpose of safety equipment is either to prevent injury or, in some cases, make an injury less severe. This is often accomplished by controlling the reaction when someone falls.
- Share with students they will be completing an engineering design challenge to create a helmet for an apple. (Water balloons could be used instead of apples if you are concerned about using food in the classroom).
- Prior to giving students the handout, draw an apple on the board, and hold up an apple for the students to see.
- Provide students with the engineering handout and review the following parameters.
  - The helmet must prevent the apple from splitting open, and reduce bruising.
  - The helmet must stay on the apple throughout the test.
  - There must be space left for a face; the helmet cannot completely surround the apple.
- Make sure each group has an engineering handout, or instruct students to document their designs and modifications in their sports science journals.
- Provide a variety of materials, such as paper, foam, tape, fabric, or other recycled materials for students to create their helmets. You may decide to let students bring in their own supplies. For a more realistic experience, limit the variety and amount of materials that students may use.
- For the testing, lay out a tarp or plastic tablecloth. This will be the drop zone. Apples should be dropped from a height of 4 feet. Explain to students that apples are not being dropped from a huge height, just as cyclists, for example, don't fall from a huge height compared to the size of their heads. Instruct students to drop the apple so the helmet is directed toward the ground.
- Provide each group with at least 2 apples or balloons so students can create a prototype to test, and then modify the design based upon their tests. As students complete their testing, have them record the outcomes of the tests and sketch the modifications of their helmets on their handout or in their sports science journals.
- After students have completed all of their tests, provide them time to create a short presentation to their classmates. They will need to show their final design, the outcome, and how they reduced the effect of the reaction force of the apple.
- Once students have completed their presentations, ask students to answer the following questions in their journals or through an oral discussion.
  - What were similarities in the helmet designs? What was different?
  - After learning about other designs, what additional modifications would you like to make to your helmet design?

STUDENT HANDOUT
DESIGN FOR SAFETY

TEAM MEMBERS: _____

Engineering Objective: To create a helmet prototype to protect an apple during a fall from 4 feet.

Helmet Brainstorm: List materials and features you will include in your first helmet design.

Helmet Design #1: Sketch your helmet design before its first test. Label the features and materials used.

Condition of Apple: Following the first test, describe the condition of your apple.

What design modifications do you plan to make for the second test?

Helmet Design #2: Sketch your helmet design after its modifications. Label the materials used.

Condition of Apple: Following the second test, describe the condition of your apple.

What design modifications would you make for additional tests?

Helmet Discoveries: Describe the features your group believes worked best to protect your apple.






CULMINATING EVENT

Prior to introducing the **Sports Health and Wellness Fair** to students, identify a large location such as the school cafeteria or gym to host the event. Work with your administrator to determine if the fair will be held during school hours or if it could be an evening event. You may also consider partnering with the school's parent organization to include the health fair as part of a larger event.

You may choose to partner with the health or physical education teacher to develop content. In addition, the technology teacher at your school may be able to help students create items such as promotional flyers or presentation.

PROCEDURES

- Share with students that they will have an opportunity to present what they have learned about **health**, **wellness**, sports, and the human body to the families at their school. Explain that they will work in groups to create displays and activities for their peers and their families.
- Explain that students will work in groups of 3 or 4, and each group will be responsible for 2 stations. One station will be a physical activity, and the second will be health and wellness. (If you have multiple classes, you may want to have students work on one physical activity or health station, rather than doing two.)
- Provide students with expectations for what should be included in their display. The Student Brainstorming Handout on page 47 is a template. You may choose to modify the expectations to fit the space available for your fair.
- Share the timeline and dates for completion with students. Provide them with time to research their topic and develop the student activity. The Health & Wellness Fair Activity Plan on page 48 can be a guide for students to develop their table.
- After students have shared their plans with the teacher, have them begin to develop their display and presentation. You may want to have students write out what they will say to kids and adults at their station.
- Several days prior to the fair have the students complete a dry run of their stations for their peers. This will help them practice their presentations and test their activities.
- On the day of the event, provide students with the location for their set-up and a schedule for when they will be at their station.
- During the event, circulate through all of the stations, assisting students as needed.
- After the event, have students complete the following statements as a self-reflection.
  - The parts of our display and activity I am most proud of are:
  - If I were to do my station again I would change:

STUDENT HANDOUT
STUDENT BRAINSTORMING

HEALTH AND WELLNESS FAIR

TEAM MEMBERS: _____

_____

_____

Your team will be responsible for creating two displays or activities for our school health and wellness fair. One will be on physical activity, and the second will be on health stations. Your displays should include the following elements.

- **Activity or Interactive Station:** For sports, this should include having families complete a physical movement or activity. Health and wellness displays should have something for families to do that is more than reading a poster.
- **Visual Display:** Your stations should include a poster, trifold, or another type of display to explain what is going to happen at the station and 3 or 4 bullet points about why the activity is important.

STATION BRAINSTORM

Ideas for a Physical Activity Display *(Circle your final idea)*	Ideas for a Health Display *(Circle your final idea)*

IMPORTANT DATES

Ideas to teacher due by: _____ Presentation due by: _____

Activity plan due by: _____ Wellness Fair date: _____

STUDENT HANDOUT
HEALTH AND WELLNESS FAIR ACTIVITY PLAN

HEALTH AND WELLNESS FAIR

TEAM MEMBERS: _____

Activity Topic: _____

In 2 or 3 sentences, describe what kids and adults will do at your station.

At our station, children will learn:

At our station each participant will do the following steps:

We will need the following materials:

Describe what you will include in your display:

GLOSSARY

blood: The red fluid that circulates in the heart, arteries, capillaries, and veins and that brings nourishment and oxygen to and carries away waste products from all parts of the body.

brain: The part of the nervous system that is inside the skull, consists of grayish nerve cells and whitish nerve fibers, and is the organ of thought and the central control point for the nervous system.

calorie: The energy it takes to raise the temperature of 1 gram of water 1 degree Celsius; the unit often used to measure the energy value of foods.

cancellous bone: Spongy tissue of mature adult bone typically found at the core of vertebral bones in the spine and the ends of the long bones (such as the femur, or thigh bone). It is important for producing red blood cells.

cardiovascular system: The heart and blood vessels (arteries, veins, and capillaries), which deliver oxygen and nutrients to the body's tissues and carry waste products to the organs responsible for elimination. Also called the circulatory system.

cartilage: A tough, elastic, fibrous connective tissue common in very young children that is converted largely to bone as they mature, and is found in various parts of the adult body, such as the joints.

cortical or compact bone: The dense outer surface of bone that forms a protective layer around the internal cavity. It supports the body's structure and ability to bear weight.

dehydration: A harmful reduction in the amount of water in the body, such as from sweating, vomiting, or diarrhea.

digestive system: The organs and glands that take food into and out of the body and that make use of food to keep the body healthy.

energy transfer: The conversion of one type of energy into another, or the movement of energy from one place to another.

gravity: The force of attraction by which all things with mass tend to move toward one another. On Earth, gravity gives weight to physical objects, including people, so that they are pulled toward the center of the planet.

health: The condition of a person's body; the state of being free from illness or injury; a state of complete physical, mental, and social well-being.

heart: The muscular organ that pumps blood through the vessels of the circulatory system.

hydration: The process of causing something to absorb water. Hydration helps maintain body temperature, remove waste from the body, and lubricate the joints.

joint: The point at which two bones are joined in the body, such as the hip joint.

ligament: A band of tough, flexible fibrous tissue that connects two bones or holds a joint together.

limbs: A person's arms and legs.

lungs: Two sponge-like organs inside the chest that expand with air to enable breathing. The lungs transfer oxygen from the air into the blood on inhale, and remove carbon dioxide from the blood into the air on exhale.

motion: The act or process of moving or changing position.

muscle: A band or bundle of fibrous tissue that has the ability to contract, allowing or preventing motion.

musculoskeletal system: A combination of muscles, bones, cartilage, and tendons working together to give people the ability to move.

Newton's laws of motion: 1) An object at rest stays at rest and an object in motion stays in motion at the same speed and in the same direction unless acted upon by an unbalanced force. Also called the *law of inertia*. 2) The force acting on an object is equal to the mass of that object times its acceleration. 3) For every action there is an equal and opposite reaction.

nutrients: Molecules in food that provide nourishment needed for growth and life maintenance.

oxygen: A chemical necessary for life that is found in the air as a colorless, odorless, tasteless gas.

protective gear: Helmets, goggles, gloves, padding, and other garments and equipment designed to protect the wearer's body from harm.

reaction time: The speed at which a person is able to respond mentally and physically to external stimuli.

skeleton: The protective structure of an organism, especially the framework made of bones and cartilage that supports the soft tissues and protects the internal organs of a person or other vertebrate.

skull: A framework of bone or cartilage enclosing a person's head to protect the brain.

statistics: The practice or science of collecting and analyzing numerical data in large quantities. In sports, "stats" often refers to information based on the frequency of some achievement, such as the player with the most goals in soccer history.

tendon: A flexible but inelastic cord of strong fibrous collagen tissue attaching a muscle to a bone, such as the hamstring.

velocity: A measure of displacement that describes the speed of an object or a person in a given direction.

wellness: The state of being in good physical and mental health.

NONFICTION BOOKS

Adamson, Thomas K. *Baseball: The Math of the Game.* North Mankato, MN: Capstone Press, 2011.

Balkan, Gabrielle. *Book of Bones: 10 Record-Breaking Animals.* New York, NY: Phaidon Press, 2017.

Bazemore, Suzanne. *Soccer: How It Works.* North Mankato, MN: Capstone Press, 2010.

Biskup, Agnieszka. *Football: How It Works.* North Mankato, MN: Capstone Press, 2010.

Bodden, Valerie. *Golf.* Mankato, MN: Creative Education, 2016.

Coffland, Jack A. *Math Soccer: Solving Problems From the Pitch for Grades 4–8.* Culver City, CA: Good Year Books, 2012.

Dreier, David. *Baseball: How It Works.* North Mankato, MN: Capstone Press, 2010.

Frederick, Shane. *Football: The Math of the Game.* North Mankato, MN: Capstone Press, 2012.

Gutelle, Andrew. *Baseball's Best: Five True Stories.* New York, NY: Random House, 2009.

Mahaney, Ian F. *The Math of NASCAR.* New York, NY: PowerKids Press, 2011.

Morgan, Ben, and Steve Parker. *The Skeleton Book.* New York, NY: DK Publishing, 2016.

Savage, Jeff. *Auto Racing Super Stats.* Minneapolis, MN: Lerner Publications, 2017.

Slade, Suzanne. *Basketball: How It Works.* North Mankato, MN: Capstone Press, 2010.

Vizard, Frank. *Why a Curveball Curves: The Incredible Science of Sports.* New York, NY: Hearst Books, 2009.

Wunderlich, Richard. *Math on the Job: Working in Sports.* New York, NY: Crabtree Publishing, 2016.

WEBSITES

Human Body Explorer

http://www.innerbody.com/

The Human Body

https://www.nationalgeographic.com/science/health-and-human-body/human-body/

KidsHealth

- **Your Bones**
  http://kidshealth.org/en/kids/bones.html
- **Bones, Muscles, and Joints**
  http://kidshealth.org/en/parents/bones-muscles-joints.html
- **Heart and Circulatory System**
  http://kidshealth.org/en/teens/heart.html
- **Your Digestive System**
  http://kidshealth.org/en/kids/digestive-system.html
- **Your Brain & Nervous System**
  http://kidshealth.org/en/kids/brain.html
- **Eating for Sports**
  http://kidshealth.org/en/kids/sports.html
- **Sports and Exercise Safety**
  http://kidshealth.org/en/teens/sport-safety.html

Kids Discover How STEM Influences the Sports They Love

http://www.chevronstemzone.com/

Newton's Laws of Motion

http://www.physics4kids.com/files/motion_laws.html

Physics for Kids: Laws of Motion

http://www.ducksters.com/science/laws_of_motion.php

Data & Statistics

https://www.learninggamesforkids.com/4th-grade-math/data-statistics-4th.html

Statistics for Kids

https://www.neok12.com/Statistics.htm

Indiana Academic Standards – Science

Science and Engineering Process

SEPS.3 Constructing and performing investigations

SEPS.4 Analyzing and interpreting data

Physical Science

4.PS.2 Investigate the relationship of the speed of an object to the energy of that object.

4.PS.4 Describe and investigate the different ways in which energy can be generated and/or converted from one form of energy to another.

6.PS.2 Describe the motion of an object, graphically showing the relationship between time and position.

6.PS.3 Describe how potential and kinetic energy can be transferred from one form to another.

7.PS.4 Investigate Newton's first law of motion (law of inertia) and how different forces (gravity, friction, push, and pull) affect the velocity of an object.

7.PS.5 Investigate Newton's second law of motion to show the relationship between force, mass, and acceleration.

7.PS.6 Investigate Newton's third law of motion to show the relationship between action and reaction forces.

Life Science

4.LS.3 Construct an argument that plants and animals have internal and external structures that function to support survival, growth, behavior and reproduction in different ecosystems.

5.LS.3 Use a model to describe that animals receive different types of information through their senses, process the information in their brain, and respond to the information in different ways.

7.LS.4 Research and describe the functions and relationship between various cell types, tissues, and organs in the immune system, circulatory system and digestive system of the human body.

Indiana Academic Standards – Health and Wellness

4.1.1 Explain the connection between behaviors and personal health.

4.1.4 Explain ways to prevent common health problems.

4.7.1 Describe positive health behaviors.

4.7.2 Describe a healthy behavior to improve personal health and wellness.

4.7.3 Describe behaviors to reduce health risks.

5.1.1 Describe the relationship between healthy behaviors and personal health.

5.1.4 Describe ways to prevent common childhood injuries and health problems.

5.2.4 Describe how the school and community can support personal health practices and behaviors.

5.7.1 Identify responsible personal health behaviors.

5.7.2 Demonstrate a variety of healthy practices and behaviors to maintain or improve personal health.

6.1.1 Compare how healthy behaviors and personal health are linked.

6.1.5 List ways to reduce or prevent injuries.

6.1.7 Identify the benefits of practicing healthy behaviors.

6.2.4 Identify how the community can affect personal health practices and behaviors.

6.7.1 Identify the importance of being responsible for health behaviors.

6.7.2 Indicate healthy behaviors that will maintain or improve the health of self and others.

7.1.1 Examine how healthy behaviors influence personal health.

7.7.2 Describe healthy practices and behaviors that will maintain or improve the health of self and others.

7.7.3 Describe behaviors to avoid or reduce health risks to self and others.

7.8.1 Select a health enhancing position and support it with accurate information.

7.8.3 Work with others to advocate for healthy individuals and families

7.8.4 Explain ways that health messages can be altered for different audiences.

8.1.1 Analyze the relationship between healthy behaviors and personal health.

8.7.2 Demonstrate healthy practices and behaviors that will maintain or improve the health of self and others.

8.8.1 State a health-enhancing position on a topic and support it with accurate information.

8.8.2 Demonstrate how to influence and support others to make positive health choices.

8.8.3 Work cooperatively to advocate for healthy individuals, families and schools.

8.8.4 Identify ways that health messages and communication techniques can be altered for different audiences.

Indiana Academic Standards – Math

Number Sense

4.NS.6 Write tenths and hundredths in decimal and fraction notations. Use words, models, standard form, and expanded form to represent decimal numbers to hundredths. Know the fraction and decimal equivalents for halves and fourths (e.g., 1/2 = 0.5 = 0.50, 7/4 = 1 3/4 = 1.75).

5.NS.2 Explain different interpretations of fractions, including: as parts of a whole, parts of a set, and division of whole numbers by whole numbers.

5.NS.6 Understand, interpret, and model percentages as part of a hundred (e.g. by using pictures, diagrams, and other visual models).

6.NS.5 Know commonly used fractions (halves, thirds, fourths, fifths, eighths, tenths) and their decimal and percent equivalents. Convert between any two representations (fractions, decimals, percentages) of positive rational numbers without the use of a calculator.

6.NS.8 Interpret, model, and use ratios to show the relative sizes of two quantities. Describe how a ratio shows the relationship between two quantities. Use the following notations: a/b, a to b, a:b.

6.NS.9 Understand the concept of a unit rate and use terms related to rate in the context of a ratio relationship.

6.NS.10 Use reasoning involving rates and ratios to model real-world and other mathematical problems (e.g., by reasoning about tables of equivalent ratios, tape diagrams, double number line diagrams, or equations).

Computation

6.C.3 Solve real-world problems with positive fractions and decimals by using one or two operations.

7.C.5 Compute unit rates associated with ratios of fractions, including ratios of lengths, areas, and other quantities measured in like or different units.

7.C.6 Use proportional relationships to solve ratio and percent problems with multiple operations, such as the following: simple interest, tax, markups, markdowns, gratuities, commissions, fees, conversions within and across measurement systems, percent increase and decrease, and percent error.

7.C.8 Solve real-world problems with rational numbers by using one or two operations

Algebraic Thinking

5.AT.5 Solve real-world problems involving addition, subtraction, multiplication, and division with decimals to hundredths, including problems that involve money in decimal notation (e.g., by using equations to represent the problem).

Data Analysis

4.DA.1 Formulate questions that can be addressed with data. Use observations, surveys, and experiments to collect, represent, and interpret the data using tables (including frequency tables), line plots, and bar graphs.

Data Analysis and Statistics

5.DS.1 Formulate questions that can be addressed with data and make predictions about the data. Use observations, surveys, and experiments to collect, represent, and interpret the data using tables (including frequency tables), line plots, bar graphs, and line graphs. Recognize the differences in representing categorical and numerical data.

5.DS.2 Understand and use measures of center (mean and median) and frequency (mode) to describe a data set.

6.DS.1 Recognize a statistical question as one that anticipates variability in the data related to the question and accounts for the variability in the answers. Understand that a set of data collected to answer a statistical question has a distribution that can be described by its center, spread, and overall shape.

6.DS.2 Select, create, and interpret graphical representations of numerical data, including line plots, histograms, and box plots.

6.DS.3 Formulate statistical questions; collect and organize the data (e.g., using technology); display and interpret the data with graphical representations (e.g., using technology).

Data Analysis, Statistics, and Probability

7.DSP.3 Find, use, and interpret measures of center (mean and median) and measures of spread (range, interquartile range, and mean absolute deviation) for numerical data from random samples to draw comparative inferences about two populations.

Next Generation Science Standards

Energy

4-PS3-1 Use evidence to construct an explanation relating the speed of an object to the energy of that object.

4-PS3-3 Ask questions and predict outcomes about the changes in energy that occur when objects collide.

MS-PS3-5 Construct, use, and present arguments to support the claim that when the kinetic energy of an object changes, energy is transferred to or from the object.

From Molecules to Organisms: Structures and Processes

4-LS1-1 Construct an argument that plants and animals have internal and external structures that function to support survival, growth, behavior and reproduction.

4-LS1-2 Use a model to describe that animals receive different types of information through their senses, process the information in their brain, and respond to the information in different ways.

MS-LS1-6 Gather and synthesize information that sensory receptors respond to stimuli by sending messages to the brain for immediate behavior or storage as memories.

MS-LS1-7 Develop a model to describe how food is rearranged through chemical reactions forming new molecules that support growth and/or release energy as this matter moves through an organism.

Motion and Stability: Forces and Interactions

5-PS2-1 Support an argument that the gravitational force exerted by Earth on objects is directed down.

MS-PS2-1 Apply Newton's third law to design a solution to a problem involving the motion of two colliding objects.

MS-PS2-2 Plan an investigation to provide evidence that the change in an object's motion depends on the sum of the forces and the mass of the object.