

# Effects of Exercise on Body Systems

## INTRODUCTION

Use this document to facilitate student work as they complete this Project-Based Learning (PBL) Pack. Students will complete the *PBL Project Organizer* sheets as they progress through the project. See the *PBL Overview* for more in-depth instructional tips for teaching with Project-Based Learning Packs.

### PBL Topic: Effects of Exercise on Body Systems

This PBL Pack is part of The Human Body unit (grades 3–4) and focuses on designing a series of exercises to improve the fitness of several body systems.

**Driving Question:** How can you design exercises that will improve your fitness level over time?

**! Safety:** Ensure that all students are cleared to perform fitness exercises prior to allowing them to participate in the physically exerting portions of this PBL Pack. If any student is unable to participate in physical activity, have him or her contribute to the project in a different way.

## PROJECT OBJECTIVES

- Students will learn about the respiratory, circulatory, and muscular systems.
- Each team will design a series of exercises intended to improve their level of fitness.
- Each team will design tests to measure their fitness before, during, and after completing the exercises.
- Students will perform the exercises over a period of time and collect data to measure the effects on the body's systems.
- At the culmination of the project, teams will prepare and deliver a presentation, including a demonstration of the exercises, to share the outcome of their project with the class. The presentation will ideally incorporate technology and the arts.

## CONNECTIONS TO NEXT GENERATION SCIENCE STANDARDS\*

Below is a list of key national science standards supported by this pack.

### Performance Expectations

3-LS3-2. Use evidence to support the explanation that traits can be influenced by the environment.

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

### Science and Engineering Practices

Analyzing and Interpreting Data

Developing and Using Models

Obtaining, Evaluating, and Communicating Information

### Disciplinary Core Ideas

LS1.A: Structure and Function

Plants and animals have both internal and external structures that serve various functions in growth, survival, behavior, and reproduction.

### Crosscutting Concepts

**Cause and Effect** (exercise causes short-term and long-term effects in body systems)

**Systems and System Models** (the human body is made up of multiple systems that interact during exercise)

## CONNECTIONS TO COMMON CORE STATE STANDARDS

Below is a list of selected key ELA/Literacy standards supported by this pack.

- RI.3.4 Determine the meaning of general academic and domain-specific words and phrases in a text relevant to a grade 3 topic or subject area.
- W.4.8 Recall relevant information from experiences or gather relevant information from print and digital sources; take notes and categorize information, and provide a list of sources.
- SL.4.5 Engage effectively in a range of collaborative discussions (one-on-one, in groups, and teacher-led) with diverse partners on grade 4 topics and texts, building on others' ideas and expressing their own clearly.

## CONNECTIONS TO 21ST CENTURY SKILLS†

- Health Literacy:** Understanding preventive physical and mental health measures, including proper diet, nutrition, exercise, risk avoidance and stress reduction
- Make Judgments and Decisions:** Reflect critically on learning experiences and processes
- Work Independently:** Monitor, define, prioritize and complete tasks without direct oversight
- Manage Projects:** Prioritize, plan and manage work to achieve the intended result

\* Next Generation Science Standards is a registered trademark of Achieve. Neither Achieve nor the lead states and partners that developed the Next Generation Science Standards was involved in the production of, and does not endorse, this product. † From the Partnership of 21st Century Skills

**PROJECT TIMELINE**

The following timeline is a guide to help prepare for and schedule this Project-Based Learning Pack. It is meant to be used as an approximate guide and can be adapted to meet the needs of the class. The project timeline will vary, depending on the number of Science A–Z resources used to build background and the time allocated for students to develop their project.

Activity	Estimated Time	Date(s)
<b>GETTING STARTED</b>		
Introduce the Topic (p. 3)	1 day	
Conduct an Entry Event (p. 3)	1–2 days	
Preteach Vocabulary (p. 3)	1 day	
Build Background Knowledge (p. 4)	5–15 days	
<b>PLAN AND CREATE</b>		
Plan the Project (p. 7)	1–2 days	
Pitch the Project (p. 7)	1 day	
Develop and Conduct the Project (p. 8)	5–15 days	
<b>PRESENT, ASSESS, AND EXTEND</b>		
Practice the Presentation and Complete Peer Review (p. 8)	1–2 days	
Present and Assess the Final Project (p. 9)	2–3 days	
Extensions and Variations (p. 9)	0–5 days	
<b>ESTIMATED TOTAL SCHEDULE</b>		
<b>4–8 weeks</b>		

**BACKGROUND AND MISCONCEPTIONS**

Use this section as a resource for more background knowledge about fitness and body systems and to clarify the content for students if misconceptions arise. The *Unit Guide* from the Human Body unit provides additional background information for this PBL Pack.

**Q:** *Do the body systems we use during exercise help us do more than just move?*

**A:** Certainly! Each body system has several important jobs. For example, the skeletal system provides structure and support for the body during exercise, but it also protects internal organs. The nervous system coordinates body movements during exercise, but it is also responsible for all of a person's senses and thoughts.

**Q:** *Does each human body system work by itself?*

**A:** No. Each system does have specific components and functions, but no system could work without the others. For example, the respiratory system brings oxygen into the body. The circulatory system transports blood containing that oxygen throughout the body, including to muscles. Those muscles are attached to the skeletal system, and

the interconnections go on and on. This is why it is so crucial to keep the entire body healthy.

**Q:** *Do muscles push and pull?*

**A:** Not exactly. Muscles work only by contracting (or shortening) and relaxing (or lengthening). Sometimes there are opposing muscles such that one muscle contracts in one direction while the other relaxes, but then the second muscle can contract while the first relaxes.

**Q:** *Why does my heart beat faster when I exercise?*

**A:** The circulatory system is responsible for moving blood throughout your body. Your heartbeat is the rhythm of your heart pumping blood through your arteries and veins. Your heart pumps oxygen-rich blood from your lungs to the cells in the rest of your body. After the blood provides cells with oxygen, it carries away carbon dioxide and other waste. When you exercise, the muscles in your body need more oxygen and must get rid of waste more quickly. Your heart increases the rate at which it pumps blood through your body during this time.

## GETTING STARTED

### Introduce the Topic

Place students in teams. They will remain in these teams for the duration of the project. Having an odd number of students on each team will help avoid split votes when decisions need to be made.

Give each team a copy of the entire Human Body *PBL Project Organizer*. Explain to students that they will fill in different pages as they complete this project. Consider also printing out an enlarged version of *PBL Sheet 1: Project Outline* to display in the classroom for the duration of this PBL Pack.

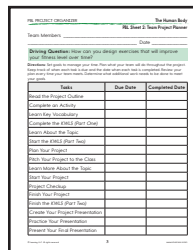


Prepare each team's *PBL Project Organizer* by printing it and placing it in a folder or binder. It may be useful to hand out these folders at the beginning of each class session and collect them for storage each day.

Begin by asking teams to read *PBL Sheet 1: Project Outline*. Explain to students that as they work on this project, they will learn how a series of exercises designed to improve fitness affect body systems. This information will help students complete their project and ultimately answer the Driving Question.



Introduce *PBL Sheet 2: Team Project Planner*, which students can use to track milestones and be sure the project remains on schedule. Assign due dates and have students fill in the due date for each task. As each team finishes a task, have students record the date in the last column.



## Conduct an Entry Event

Lead an entry event that supports the Driving Question: How can you design exercises that will improve your fitness level over time?

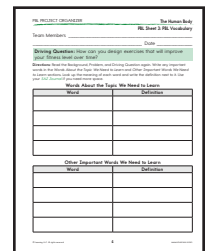
### Sample Entry Events

Select one or more entry events to help students start thinking about the PBL Pack topic. Encourage students to use key vocabulary related to the topic (see Preteach Vocabulary).

- **Process Activity:** Complete the *Lung Capacity* and/or the *Changing Pulse Rates* *Process Activity* from the Inside Living Things unit (grades 5–6). Set up stations in the classroom with the materials needed to complete each activity. In the first experiment, students will measure their lung capacity and compare it with the lung capacity of classmates. In the second investigation, students will observe how their pulse rate changes by doing different activities. Both of these lessons will help prepare students to develop their PBL project in order to better design their fitness exercises.
- **Science Diagrams:** Print or display the *Science Diagrams* from the Human Body unit that illustrate the important components of each major body system. Have students share their prior knowledge and observations about each body system. Then ask students to compare the systems in various ways.
- **Debate:** Complete the *One Recess or Two?* *Debate*. Divide students into equal teams. Ask students to prepare Pro and Con cards to support their position. Then conduct the debate and discuss how it might relate to this project.

## Preteach Vocabulary

Refer students to *PBL Sheet 3: PBL Vocabulary*. Have them read the Background, Problem, and Driving Question again. Ask students to identify any important or unfamiliar words related to the topic. Have them write the words in the *Words About the Topic We Need to Learn* section. Ask students to identify any other important or unfamiliar words, including academic vocabulary, and write them in the *Other Important Words We Need to Learn* section. Ask teams to look up each word's definition and write the meaning next to it.



The terms listed below appear in one or more of the Recommended and Supplemental Resources. Have students add these terms to their vocabulary sheet or *SAZ Journal*. You may also choose to display key vocabulary on a Word Wall for ongoing access during the Entry Event and throughout the entire project.



Use the Human Body *Vocabulary Cards* and *Image Cards* to teach related content vocabulary in multiple ways.

<b>carbon dioxide</b>	an invisible gas that is given off as a waste product during breathing
<b>circulatory system</b>	the body system that moves blood throughout the body
<b>muscular system</b>	the body system that allows body parts to move
<b>oxygen</b>	the invisible, odorless gas that makes up part of the air and that humans must breathe in order to live
<b>respiratory system</b>	the body system that controls breathing by inhaling oxygen and exhaling carbon dioxide

<b>benefit</b>	an advantage gained from something
<b>cause</b>	to make something happen
<b>modify</b>	to make changes
<b>sequence</b>	a group of things that are in a certain order; the order in which things happen
<b>task</b>	a piece of work that needs to be done

The other recommended resources listed below will provide additional information and practice for students before they begin their project. In addition, consider using the supplemental resources listed in the chart to further develop students' understanding of and experience with the content.

The *PBL Project Organizer* used by student teams contains a similar list of resources on *PBL Sheet 5: Recommended Reading*. As students plan their project, they may need to conduct more research or may come up with new questions that can be answered by selecting from these additional resources. Some resources listed below do not appear on the student list, since they require teacher management.

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To view a list of all the resources from the the Human Body unit, use the [Unit Resource List](#) or visit the unit page on the Science A–Z website.



**Science A-Z**

THE SCIENCE INDEX (2014)

Science is a field of systematic study in the Natural World, using the scientific method to generate knowledge about the natural world, and to make other claims. Researchers are grouped by research category.

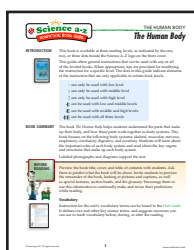
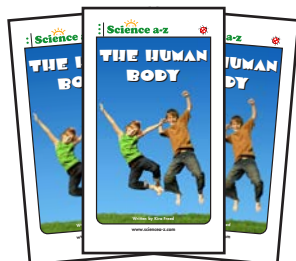
Research Category	Researcher Name	Researcher Name	Researcher Name
1. <b>Biological Sciences</b>	1. <b>Botany</b>	1. <b>Botany</b>	1. <b>Botany</b>
2. <b>Chemical Sciences</b>	2. <b>Chemical Sciences</b>	2. <b>Chemical Sciences</b>	2. <b>Chemical Sciences</b>
3. <b>Earth and Planetary Sciences</b>	3. <b>Earth and Planetary Sciences</b>	3. <b>Earth and Planetary Sciences</b>	3. <b>Earth and Planetary Sciences</b>
4. <b>Environmental Sciences</b>	4. <b>Environmental Sciences</b>	4. <b>Environmental Sciences</b>	4. <b>Environmental Sciences</b>
5. <b>Health Sciences</b>	5. <b>Health Sciences</b>	5. <b>Health Sciences</b>	5. <b>Health Sciences</b>
6. <b>Life Sciences</b>	6. <b>Life Sciences</b>	6. <b>Life Sciences</b>	6. <b>Life Sciences</b>
7. <b>Physical Sciences</b>	7. <b>Physical Sciences</b>	7. <b>Physical Sciences</b>	7. <b>Physical Sciences</b>
8. <b>Social Sciences</b>	8. <b>Social Sciences</b>	8. <b>Social Sciences</b>	8. <b>Social Sciences</b>
9. <b>Technical Sciences</b>	9. <b>Technical Sciences</b>	9. <b>Technical Sciences</b>	9. <b>Technical Sciences</b>
10. <b>Unnatural Sciences</b>	10. <b>Unnatural Sciences</b>	10. <b>Unnatural Sciences</b>	10. <b>Unnatural Sciences</b>

## Build Background Knowledge

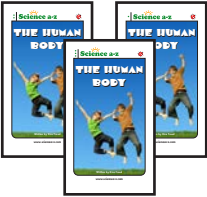

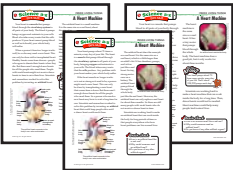

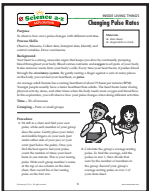
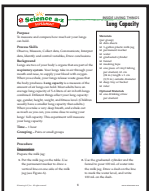
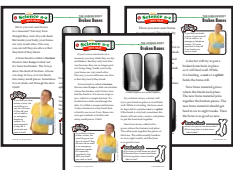
Before students begin research, introduce *PBL Sheet 4: KWLS (Part One)* and explain the purpose of its sections. Have students write what they already *know* about the topic (*K* section) and what they still *want* to know (*W* section).

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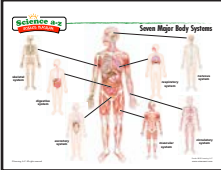


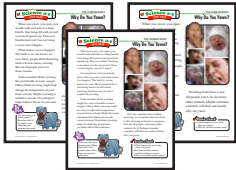

Begin by having students read the *Nonfiction Book* titled *The Human Body* to provide a foundation of understanding about the science content. Select the most appropriate reading level—high, mid, or low—for each student. The *Nonfiction Book Teacher's Guide* provides a guided reading lesson plan to accompany the books, including vocabulary support and a set of discussion questions differentiated by reading level.



## Recommended and Supplemental Resources – Teacher's List

Recommended			
Resource Type	Title	Summary	Preview
Nonfiction Book	<i>The Human Body</i>	This book addresses the parts of the human body and how these parts work together as systems. It is offered at three reading levels.	
Vocabulary Cards	<i>The Human Body Vocabulary Cards</i>	Unit vocabulary terms are defined on clippable cards, along with parts of speech and the levels of reading materials in which each term appears.	
Quick Read	<i>A Heart Machine</i> (Grades 5–6 Inside Living Things Unit)	This Quick Read describes the human heart and explains how an artificial heart can take its place. It is offered at three reading levels.	
Reading A–Z Book	<i>Get Moving!</i> <i>All About Muscles</i>	This Reading A–Z book describes muscles and their multiple functions in the human body.	
Process Activity	<i>Changing Pulse Rates</i> (Grades 5–6 Inside Living Things Unit)	In this exploration, students measure their pulse rates before and after physical activity.	
Process Activity	<i>Lung Capacity</i> (Grades 5–6 Inside Living Things Unit)	In this experiment, students learn how to measure lung capacity. Then they compare their own lung capacity with that of their classmates.	
Quick Read	<i>Broken Bones</i>	This Quick Read explains that bones are alive and heal when broken. It is offered at three reading levels.	



Supplemental			
Resource Type	Title	Summary	Preview
Nonfiction Book	<i>Inside Living Things</i> (Grades 5–6 Inside Living Things Unit)	This book explains the common features of body systems shared by many types of organisms. It is offered at three reading levels.	
Science Diagram	<i>Seven Major Body Systems</i>	This one-page diagram illustrates seven major body systems.	
Career Files	<i>Personal Trainer; Nurse; Choreographer</i>	These single-page files describe careers that require knowledge of body systems.	
Debate	<i>One Recess or Two?</i>	In this activity, students debate whether one or two recesses would be more beneficial.	
Quick Read	<i>Why Do You Yawn?</i>	This Quick Read describes yawning and its connection to the respiratory system. It is offered at three reading levels.	
Quick Read	<i>Sweat (Grades 3–4 Heat Energy Unit)</i>	This Quick Read explains the purpose of sweating during exercise. It is offered at three reading levels.	

### Additional Research

Students may need to conduct additional research before planning their project and while working on the project as a team. Some of this research can be done in a library, and some can be done online during a supervised search. The following are examples of websites that may be useful resources for students as they complete this PBL Pack:

- <http://kidshealth.org/kid>  
Explore the Kids section for information, quizzes, and games about how the body works.
- [www.sciencekids.co.nz/videos/humanbody.html](http://www.sciencekids.co.nz/videos/humanbody.html)  
View science videos on the different body parts and systems.

### What Have We Learned?

After teams conduct research, have them fill in *PBL Sheet 6: KWLS (Part Two)* by writing what they have *learned* about the topic (L section) and what they *still* want to learn (S section). Encourage students to refer back to this list of questions as they complete the project, and have them conduct additional research if needed.

## PLAN AND CREATE

### Plan the Project

Facilitate a class discussion to summarize what students have learned so far and discuss how this information will help them answer the Driving Question. Refer to *PBL Sheet 1: Project Outline*.

Using the information students learned during the Getting Started activities, encourage each team to brainstorm at least three project ideas that would solve the Problem while meeting all the project constraints. Teams should discuss how they would complete each project, including the materials they would need. Have students record all ideas in the table on *PBL Sheet 7: Project Ideas* without rejecting any student's ideas.

Next, challenge each team to evaluate its list of ideas to determine which will make the best project. Teams may find certain project ideas fun or appealing, but remind them that the best project will satisfy all requirements in the Project Outline. Review the project guidelines, including requirements regarding materials, time, cost, and any other constraints. Have teams circle their project selection and explain their decision at the bottom of the sheet.

Introduce *PBL Sheet 8: Project Description*. Instruct teams to describe the project they have chosen. They should give their PBL project a name that describes what they will do or learn. Then have students briefly explain what they plan to do and how they expect to do it. Finally, have them list the materials they think they will need. Explain that the list may change as they work on the project.

### Pitch the Project

Have each team present its Project Plan to the class for review (refer to *PBL Sheet 8: Project Description*). One team at a time should explain to the class how it plans to complete the project and what materials it will use. Students should describe how their project will help answer the Driving Question while working within the project constraints.

Invite other students in the class to provide constructive feedback to the team presenting its project idea. The other students should make suggestions on how to improve portions of the project. The presenting team should record comments from classmates on *PBL Sheet 9: Pitch Your Project*. Allow each team to present its plan and record peer feedback.

Next, have each team review the comments it received and discuss how these ideas might affect the project plan. Once students agree on any changes, have them record their revised plan at the bottom of *PBL Sheet 9*. Before each team begins project development, review each team's plan. Ensure that the activities are safe, can be completed within the allotted time frame, are of suitable complexity, adhere to any project constraints, and are designed so that all team members will contribute.

### Additional Research

If new questions arise, students may need to conduct additional research on their project topic. Consider using Science A–Z resources listed in the supplemental section of the Recommended and Supplemental Resources chart. Also help students locate resources in a library, online, or in the community.

## Develop and Conduct the Project

Refer to the *PBL Overview* for management tips to help teams get their project started and how best to facilitate their work as they develop their project.

Review *PBL Sheet 2: Team Project Planner* to help students stay on track with project milestones.

Encourage students to use their *SAZ Journal* to record notes, draw sketches, and revise project plans.

### Project

During this project, each team will design a series of exercises that can be used to improve their physical fitness. Then they will design several tests to measure the effects of these exercises on various human body systems, including circulatory, muscular, and respiratory. Students will perform these exercises several times over a defined period of time and collect data before and after the exercises. Some examples include:

- Completing jumping jacks to develop cardio strength and measuring heartbeat before and after
- Lifting weights to develop muscle strength and measuring the number of repetitions in one minute
- Running around a track to develop endurance and measuring breathing rate before and after exercise

**! Safety:** Ensure that all students are cleared to perform physical fitness exercises prior to allowing them to participate in the physically exerting portions of this PBL Pack. Be sure that any weights are not too heavy, that exercise bands offer only light resistance, and that students are using proper form.

### Materials

Listed below are materials that students may need during the course of this project. Teams may propose different or additional materials they need to complete their projects based on their unique plans.

- |   |                                       |
|---|---------------------------------------|
| <input type="checkbox"/> small hand weights | <input type="checkbox"/> exercise mat |
| <input type="checkbox"/> exercise bands     | <input type="checkbox"/> stopwatch    |
| <input type="checkbox"/> jump rope          | <input type="checkbox"/> clipboard    |

## Project Checkup

Facilitate a touch-base meeting with each team partway through the project to ensure that the team is on track to successfully complete the project on time. Introduce *PBL Sheet 10: Project Checkup* and have each team complete the form.

## What Have We Learned?

During and after the project, have students update *PBL Sheet 6: KWLS (Part Two)* by writing additional facts they have *learned* about the topic (L section) and what they *still* want to learn about the topic (S section).

## PRESENT, ASSESS, AND EXTEND

### Practice the Presentation and Complete Peer Review

Once teams have completed work on their project, they will get ready to present it to the class. First, have them plan their presentation as a team. Have them refer to *PBL Sheet 11: Presentation Rubric* and *PBL Sheet 12: Practice Presentation and Peer Review* as guides so they are aware of the expectations and elements of a good presentation. Provide time for preparation and practice.

Discuss various options that teams might choose from to prepare a presentation, such as:

- Leading a talk with visual aids (display board, posters, dioramas, digital artwork, data, and so on)
- Producing a digital slideshow using presentation software
- Presenting a physical model and explaining its structure and function
- Producing a video and playing it for the class
- Performing a role-play or skit
- Writing a report and discussing it with the class



Teams should include the following in their presentation:

- Description of the project
- How they addressed the Driving Question
- How well they worked within the project constraints
- Materials used
- Steps followed
- Challenges faced
- How they dealt with challenges
- How well they worked as a team
- What they learned during the project
- What new investigable questions they have

### Peer Review

The purpose of the peer review is to allow teams to practice and improve their presentations before speaking to the whole class. Pair each team with another team and ask the two teams to practice presenting to each other. Each team should complete *PBL Sheet 12: Practice Presentation and Peer Review* after receiving feedback from the other team.

### Present and Assess the Final Project

#### Final Presentations

After practicing, each team will deliver its final presentation to the class. Allow teams time to review the peer-review suggestions from their practice presentation and incorporate this feedback into their planning for the final presentation.

Give each team between 5 and 10 minutes per team to deliver its final presentation. Encourage the audience to ask questions of the team after the presentation.



Consider inviting guests to observe the presentations and provide feedback. These may include content-area experts, scientists, engineers, community members, parents, or students from other classes.

### Team and Individual Self-Assessment

After the final presentations, have teams complete *PBL Sheet 13: Student Rubric-Team* and *PBL Sheet 14: Team Reflection*. Also distribute a copy of *PBL Sheet 15: Student Rubric-Individual* to each student. Have students evaluate their team's performance and their own contributions to the project.

Collect each team's completed *PBL Project Organizer* sheets to assess how well students met the objectives of this Project-Based Learning Pack. Also collect each student's *SAB Journal* to evaluate his or her note-taking skills and individual contributions to the team.

### Teacher Rubrics

In addition to the assessments completed by students, use the *Teacher Rubric-Team* and *Teacher Rubric-Individual* to complete your own evaluation of each team and student.

### Extensions and Variations

Extension activities are an important way for students to continue learning about a topic and to understand how it relates to the real world beyond the classroom. As each PBL experience concludes, new questions may lead to new project ideas. Unused ideas from the Sample Entry Events section above may be used to extend the learning. In addition to the following extensions and variations, also see the Extensions and Variations section in the *PBL Overview* for ideas that can be used with any PBL Pack.

- **Research:** In this PBL Pack, students designed their own fitness regimen and recorded data. Help students conduct a monitored search online to investigate existing fitness programs and have them report to the class on which body systems each exercise targets. Also ask them to judge how well they feel the fitness program would work to improve health in various body systems and whether the exercises pose any safety risks.
- **Math:** Have students apply math skills to interpret the data they recorded during this project. They might graph data over time, calculate averages, evaluate patterns, and predict future results.

- Field Trip: Bring students to a local gym for a tour of the facilities and equipment. Have each student select one apparatus to draw and describe, with a focus on which muscle groups the equipment targets and what other body systems would be engaged by performing that type of exercise. Back in class, invite students to share their observations.
- ELL: Build a class Word Wall with key terms from this PBL Pack, including words related to exercise and fitness. Invite English language learners to share the translations for these words in their first language, and add these words to the Word Wall for the class to learn.
- Writing: Ask students to write a short story or acting scene in which a character has some sort of motivation to be in better physical shape, so he or she participates in a fitness regimen. Students might include obstacles or setbacks the character must overcome. See [Writing A-Z](#) for extensive writing instruction.