



IGNITE MY FUTURE

SUBJECTS

Science
Health
Physical Education

COMPUTATIONAL THINKING PRACTICE

Fostering an Inclusive
Computing Culture

Collaborating Around
Computing

Communicating
About Computing

COMPUTATIONAL THINKING STRATEGIES

Find Patterns

Build Models

MATERIALS

[User Profile Student Prompt](#)

[User Profile](#)
Student Capture Sheet

[Body Systems](#)
Student Capture Sheet

[Exercise Research](#)
Student Capture Sheet

[Shoe Prototype Design](#)
Student Capture Sheet

[Model Exercise Plan](#)
Student Capture Sheet

Computers with access
to the internet (optional)

LESSON TITLE

The Science of Sports

Guiding Question: What Does Happiness Mean?

Ignite Curiosity

- What feelings do you experience when you are exercising? How about afterwards?
- Are our physical and emotional states more connected than we might think?
- Can the clothes we wear increase our happiness?

In this lesson, students use the computational thinking strategies of finding patterns and building models to investigate how physical activity affects emotional health. Students will simulate the role of sports scientists working for an apparel company that is developing a shoe that can improve both physical and emotional health. The company will market the shoes with an exercise program that the wearer can follow to increase their happiness. In **THINK**, students will understand how different systems within the body affect one another—from muscles to bones, from hormones to cells. In **SOLVE**, they will identify patterns between physical activity and emotional well-being. They will then use the patterns they have identified to **CREATE** a prototype of a shoe with identifiable features that will help the wearer experience more happiness. Students will then design an adjoining exercise program based in exercise science that capitalizes on the design features of the shoes. In **CONNECT**, students will explore careers in health and exercise science.

Students will be able to:

- **Analyze** the anatomy of the human body in order to understand how physical and emotional health are linked,
- **Create** a prototype and complementary exercise plan based on anatomical research, and
- **Evaluate** how exercise impacts physical health and feelings of happiness.



Students act as sports scientists who are challenged with developing a new shoe and adjoining exercise routine that can help the user experience more happiness.

1 Read the following to students:

Imagine that you are a scientist working for an athletic apparel company. Recent studies have shown that exercise and movement have a profound impact on emotional health as well as physical health. Your company wants to design a new shoe that can help the wearer experience greater happiness. In addition, they want to market the shoe with a movement routine designed to maximize the function of the shoe and increase happiness. Can you think like a computer to design a shoe that increases happiness?

2 Explain to students that when product developers begin designing a new product, they have to think about the end user first. Divide students into groups of 4 or 5 and provide each group with a user profile from the [User Profile student prompt](#). Each student group should provide a visual and written profile for their assigned end user that includes age, athletic ability, overall level of health and interests/hobbies.

3 Once each group has created their end user, write the following body systems on the board in a chart, leaving space underneath each body system for students to write (you may also choose to complete this exercise using large-scale notepads and markers):

- The skeletal system
- The muscular system
- The circulatory system
- The respiratory system
- The endocrine system
- The immune system
- The digestive system
- The nervous system

4 Assign one or two body systems to each student group. Provide students with up to 10 minutes to complete the Body Systems student capture sheet. Students may use a variety of resources to complete their capture sheets. If your classroom is equipped with computers and access to the internet, provide each student group with 1-3 laptops so that they can use the linked resources on the Body Systems capture sheet to complete their research. If not, you can print out the linked resources ahead of time and distribute to the student groups.

5 When each group has completed their research, ask one representative to come up to the board and list one way that the body system they have been assigned impacts physical health.

6 Next, have another representative come up to the board and write how their assigned body system affects mental well-being.



- 7 Finally**, have another representative come up to the board and write which systems operate closely with the system they have been assigned.

Optional extension: Provide students with an in-depth understanding of how body systems work together during exercise with this [lesson plan on exercise science](#) from The American Physiological Society.

- 8 Summarize and check** for understanding by asking students to respond to the following critical thinking questions, either out loud or within their group setting:
- What surprising connections exist between different body systems?
 - What happens when we focus too much on one body system without thinking of others?
 - Are there any body systems that are not impacted when we exercise?
 - What patterns do you see between body systems? How can you use those patterns to develop a shoe that improves physical and emotional health?



Students explore the mental health benefits of different types of exercise.

- 1 Divide** students into new groups, making sure to diversify so that each new group contains students who researched different body systems in the “Think” section.
- 2 Instruct** groups to review the [Exercise Research](#) student capture sheet and choose three or four types of exercises to research. They will complete the first column, Type of Exercise, with their choices. Students will study their selected exercises in order to find the following:
 - Repetitive motions and patterns
 - Impact on different body systems during and after activity
 - How accessible the activity is for individuals from a variety of physical, environmental and socioeconomic backgrounds
- 3 Provide** groups with ample time to complete their capture sheets, circulating amongst groups in order to answer any questions that arise.
- 4 When groups have completed their capture sheets**, ask them to assign a “happiness score” to each of the activities they have researched, based on the levels of fun and accessibility of the activity.
- 5 Show** students this [short video](#) about how chemicals are transmitted throughout the brain and how they impact different brain functions. When the video is over, ask students to review their “happiness” scores and see if they would revise them based off of what they have learned about endorphins, serotonin and other chemicals in the brain.
- 6 Summarize and check** for understanding by asking students to respond to the following critical thinking questions, either out loud or within their group setting:
 - How are our emotions linked to exercise?
 - Does an exercise have to be strenuous in order to improve our physical and emotional well-being? Why or why not?
 - Think back to the user profiles that you developed at the beginning of this lesson. What are the similarities and differences between users? Can you design a shoe that would work for all of them? Why or why not?
 - How does the computational thinking strategy of finding patterns help us to understand our bodies? How can we use the strategy of finding patterns to design an athletic shoe?



Students develop a model of an athletic shoe and an adjoining physical activity plan designed to help the wearer experience better physical and emotional health.

- 1 Distribute** students into new groups. Hand out the [Shoe Prototype Design](#) student capture sheet. Instruct students that they will be working in these groups to compile what they have learned into a prototype design for an athletic shoe and adjoining exercise program that increase physical and emotional well-being.
- 2 Instruct** each group to select the following:
 - One user from the User Profile student capture sheet that will serve as the end user of their shoe and exercise plan.
 - One body system that the shoe will be specifically designed to support.
 - The 3 activities from the Exercise Research student capture sheet with the highest “happiness score”. Their shoe design and adjoining exercise plan should take these activities into account.

- 3 Provide** each group with time to review their selections and begin designing their shoe with these selections in mind. Students can use paper, markers and other art supplies to design their prototype in the space provided on the [Shoe Prototype Design](#) student capture sheet.

Optional extension: if your classroom has computers with access to the internet, you can have students design their prototype using the online application [TinkerCAD](#) and modify an existing CAD design on the website (viewable in the gallery).

- 4 Once groups have designed** their shoe prototype, instruct them to create an adjoining exercise plan to market with the shoe on the [Model Exercise Plan](#) student capture sheet.
- 5 Have each student group briefly present** their shoe design and exercise plan to the class. When each group has presented, check for understanding by asking the following summarizing questions:
 - What similarities and differences did you notice between the different shoe designs and exercise plans?
 - If you were going to design this shoe in real life, what would your next step be? Why?
 - How does building models help us create better products? How can thinking like computers help us develop smarter technology?



Select one of the strategies listed below to help students answer these questions:

- How do this problem and solution connect to me?
- How do this problem and solution connect to real-world careers?
- How do this problem and solution connect to our world?

- 1 Write** the three questions on PowerPoint or flip chart slides and invite students to share out responses.
- 2 Display** chart paper around the room, each with one question written on it. Ask students to write down their ideas on each sheet.
- 3 Assign** one of the questions to three different student groups to brainstorm or research, and then share out responses.
- 4 Invite** students to write down responses to each question on a sticky note, and collect them to create an affinity diagram of ideas.

How does this connect to students?

Students will gain insight into the many health benefits of different types of exercise and how to use technology to communicate these effects. They will understand the scientific foundations of health and identify how to improve both physical and mental well-being. Students can apply their research from this lesson to many real-world applications, such as after-school sports, clubs and other physical activities. Students will understand that while socioeconomic and health factors might impact a person's ability to lead an active lifestyle, there are steps that everyone can take to improve their health.

How does this connect to careers?

Health Educators teach people about behaviors that promote wellness. They develop and implement strategies to improve the health of individuals and communities.

Personal Trainers and Fitness Instructors lead, instruct, and motivate individuals or groups in exercise activities, including cardiovascular exercises (exercises for the heart and blood circulation), strength training, and stretching. They work with people of all ages and skill levels.

Neuroscientists conduct research aimed at improving overall human brain and nervous system health. They often use clinical trials and other investigative methods to reach their findings.

Psychologists study cognitive, emotional, and social processes and behavior by observing, interpreting, and recording how people relate to one another and their environments.

How does this connect to our world?

In an increasingly stressful world, people need to find moments of calmness to recharge, and research has shown that exercise has benefits beyond physical conditioning. Everyone can find a restorative state through exercise. But with so many different types of exercise, what types are best for each person? Using computational thinking harnesses the power of technology to bring the health benefits of exercise to everyone, no matter what that exercise might be.

National Standards

NEXT GENERATION SCIENCE STANDARDS

Science and Engineering Practices

Asking Questions and Defining Problems

Asking questions and defining problems in grades 6–8 builds on grades K–5 experiences and progresses to specifying relationships between variables, and clarifying arguments and models.

Analyzing and Interpreting Data

Analyzing data in 6–8 builds on K–5 experiences and progresses to extending quantitative analysis to investigations, distinguishing between correlation and causation, and basic statistical techniques of data and error analysis.

Disciplinary Core Ideas

LS1.D: Information Processing

Each sense receptor responds to different inputs (electromagnetic, mechanical, chemical), transmitting them as signals that travel along nerve cells to the brain. The signals are then processed in the brain, resulting in immediate behaviors or memories.

In multicellular organisms, the body is a system of multiple interacting subsystems. These subsystems are groups of cells that work together to form tissues and organs that are specialized for particular body functions.

ETS1.A: Defining and Delimiting Engineering Problems

The more precisely a design task's criteria and constraints can be defined, the more likely it is that the designed solution will be successful. Specification of constraints includes consideration of scientific principles and other relevant knowledge that are likely to limit possible solutions.

ETS1.C: Optimizing the Design Solution

Although one design may not perform the best across all tests, identifying the characteristics of the design that performed the best in each test can provide useful information for the redesign process—that is, some of those characteristics may be incorporated into the new design.

Crosscutting Concepts

MS-ETS1-2

Critical thinking using the tools of mathematical analysis is combined with strong computational thinking principles of reuse and verification of outcomes.

National Standards

K-12 COMPUTER SCIENCE FRAMEWORK

Practice 2. Collaborating Around Computing

Collaborative computing is the process of performing a computational task by working in pairs and on teams. Because it involves asking for the contributions and feedback of others, effective collaboration can lead to better outcomes than working independently. Collaboration requires individuals to navigate and incorporate diverse perspectives, conflicting ideas, disparate skills, and distinct personalities. Students should use collaborative tools to effectively work together and to create complex artifacts.

NATIONAL HEALTH EDUCATION STANDARDS

Standard 3

Students will demonstrate the ability to access valid information, products, and services to enhance health.

Standard 4

Students will demonstrate the ability to use interpersonal communication skills to enhance health and avoid or reduce health risks.

Standard 5

Students will demonstrate the ability to use decision-making skills to enhance health.

Standard 7

Students will demonstrate the ability to practice health-enhancing behaviors and avoid or reduce health risks.

User Profiles Prompts

- 1 **Dahlia** is a 14-year old student who likes to play a wide variety of sports. She lives in a rural area and has been active her whole life. Her favorite activities include horseback riding, soccer and playing with her dogs. Dahlia has asthma and seasonal allergies.

- 2 **Fred** is a 73 year-old retired male who is recovering from a stroke. Fred is learning to walk again with the help of his physical therapist. Prior to his stroke, Fred liked to go for walks around the neighborhood with his wife. Fred lives in a suburban neighborhood with lots of public transit options.

- 3 **Molly** is a 32 year-old woman with two young children. She works full time as a lawyer and lives in a busy city. Between her young children and her stressful job, Molly does not have a lot of time to work out. She is frequently tired and experiences a lot of stress.

- 4 **David** is a 45 year-old male. David is a truck driver and spends long hours on the road without stopping. He spends most of his days sitting and driving. David recently visited the doctor to complain about a pain in his leg and was diagnosed with Type 2 diabetes. David knows he has to improve his physical health, but he doesn't know where to start.

- 5 **Juan** is a 25 year-old chef who spends a lot of time in the kitchen. He works long hours, often late at night, and sleeps during the day. The hard floors of the kitchen have caused him to have some hip pain and he wants to find a way to continue his passion of cooking while improving his physical health. Juan lives in the suburbs and commutes into the city every day.

- 6 **Gloria** is a 55 year-old nurse practitioner who works in a busy hospital. She recently lost her mother and is going through a hard time. She has begun seeing a therapist who suggested that spending more time in nature might help her mental health. Gloria lives in an urban setting and wants to make an effort to get out to the country more. She has two dogs and likes to swim and hike. She was on the cross country team in college but has not consistently since graduating.

User Profiles Capture Sheet

User Name:

User Age:

User Gender:

User Living Environment:

User Occupation:

User Interests and Hobbies:

User Health Concerns:

Based on the above data, what do you think this user is looking for in an athletic shoe?

How can you help this person improve their mental and physical health?

**What special considerations might this person have that separate them from other users?
How can you design a product specifically for them?**

Exercise Brainstorm and Research

Type of Exercise	Level of Ability Needed	Indoors, Outdoors, or Both?	Required Equipment	Useful Across Diverse Population?	Correlates to Happiness?

Additional Notes:

Shoe Prototype Design

User Name:

User Bio:

Special Considerations:

Body System(s) the Shoe will Support:

Three Activities the Shoe will be Designed For:

Draw your shoe prototype in the space below, making sure to identify any key design features.

Model Exercise Plan

User Name:

Type of Exercise	Level of Ability Needed	Indoors, Outdoors, or Both?	Required Equipment	Why is this exercise a good choice for this individual?

Additional Notes: