



SPRINGFIELD PUBLIC SCHOOLS
ENGAGING STUDENTS • FOSTERING ACHIEVEMENT • CULTIVATING 21ST CENTURY GLOBAL SKILLS

Springfield Public Schools
Springfield, New Jersey 07081

PLTW Launch
Grade 3

Curriculum Guide

2024

This curriculum may be modified through varying materials, techniques, and strategies as per an individual student's IEP.

Springfield Board of Education
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Springfield Public Schools Springfield, New Jersey

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New Jersey Student Learning Standards

Science

- 3-PS2-1 Plan and conduct an investigation to provide evidence of the effects of balanced and unbalanced forces on the motion of an object.
- 3-PS2-2 Make observations and/or measurements of an object's motion to provide evidence that a pattern can be used to predict future motion.
- 3-PS2-3 Ask questions to determine cause and effect relationships of electric or magnetic interactions between two objects not in contact with each other.
- 3-PS2-4 Define a simple design problem that can be solved by applying scientific ideas about magnets.
- 3-LS1-1 Develop models to describe that organisms have unique and diverse life cycles but all have in common birth, growth, reproduction, and death.
- 3-LS2-1 Construct an argument that some animals form groups that help members survive.
- 3-LS3-1 Analyze and interpret data to provide evidence that plants and animals have traits inherited from parents and that variation of these traits exists in a group of similar organisms.
- 3-LS3-2 Use evidence to support the explanation that traits can be influenced by the environment.
- 3-LS4-1 Analyze and interpret data from fossils to provide evidence of the organisms and the environments in which they lived long ago.
- 3-LS4-2 Use evidence to construct an explanation for how the variations in characteristics among individuals of the same species may provide advantages in surviving, finding mates, and reproducing.
- 3-LS4-3 Construct an argument with evidence that in a particular habitat some organisms can survive well, some survive less well, and some cannot survive at all.
- 3-LS4-4 Make a claim about the merit of a solution to a problem caused when the environment changes and the types of plants and animals that live there may change.
- 3-ESS2-1 Represent data in tables and graphical displays to describe typical weather conditions expected during a particular season.
- 3-ESS2-2 Obtain and combine information to describe climates in different regions of the world.
- 3-ESS3-1 Make a claim about the merit of a design solution that reduces the impacts of a weather-related hazard.
-
- 3-5-ETS1-1 Define a simple design problem reflecting a need or a want that includes specified criteria for success and constraints on materials, time, or cost.
- 3-5-ETS1-2 Generate and compare multiple possible solutions to a problem based on how well each is likely to meet the criteria and constraints of the problem.
- 3-5-ETS1-3 Plan and carry out fair tests in which variables are controlled and failure points are considered to identify aspects of a model or prototype that can be improved.

Science and Engineering Practices

Asking Questions and Defining Problems

- Asking questions and defining problems in 3–5 builds on K–2 experiences and progresses to specifying qualitative relationships.



Developing and Using Models

- Modeling in 3–5 builds on K–2 experiences and progresses to building and revising simple models and using models to represent events and design solutions.

Planning and Carrying Out Investigations

- Planning and carrying out investigations to answer questions or test solutions to problems in 3–5 builds on K–2 experiences and progresses to include investigations that control variables and provide evidence to support explanations or design solutions.

Analyzing and Interpreting Data

- Analyzing data in 3–5 builds on K–2 experiences and progresses to introducing quantitative approaches to collecting data and conducting multiple trials of qualitative observations. When possible and feasible, digital tools should be used.

Using Mathematics and Computational Thinking

- Mathematical and computational thinking in 3–5 builds on K–2 experiences and progresses to extending quantitative measurements to a variety of physical properties and using computation and mathematics to analyze data and compare alternative design solutions.

Constructing Explanations and Designing Solutions

- Constructing explanations and designing solutions in 3–5 builds on K–2 experiences and progresses to the use of evidence in constructing explanations that specify variables that describe and predict phenomena and in designing multiple solutions to design problems.

Engaging in Argument from Evidence

- Engaging in argument from evidence in 3–5 builds on K–2 experiences and progresses to critiquing the scientific explanations or solutions proposed by peers by citing relevant evidence about the natural and designed world(s).

Obtaining, Evaluating, and Communicating Information

- Obtaining, evaluating, and communicating information in 3–5 builds on K–2 experiences and progresses to evaluating the merit and accuracy of ideas and methods.

Disciplinary Core Ideas (DCIs)

LS1.B Growth and Development of Organisms

- Reproduction is essential to the continued existence of every kind of organism. Plants and animals have unique diverse life cycles.

LS2.C Ecosystem Dynamics, Functioning, and Resilience

- When the environment changes in ways that affect a place's physical characteristics, temperature, or availability of resources, some organisms survive and reproduce, others move to new locations, yet others move into the transformed environment, and some die.

LS2.D Social Interactions and Group Behavior

- Being part of a group helps animals obtain food, defend themselves, and cope with changes. Groups may



serve different functions and vary dramatically in size.

LS3.A Inheritance of Traits

- Many characteristics of organisms are inherited from their parents.
- Other characteristics result from individuals' interactions with the environment, which can range from diet to learning. Many characteristics involve both inheritance and environment.

LS3.B Variation of Traits

- Different organisms vary in how they look and function because they have different inherited information.
- The environment also affects the traits that an organism develops.

LS4.A Evidence of Common Ancestry and Diversity

- Some kinds of plants and animals that once lived on Earth are no longer found anywhere.
- Fossils provide evidence about the types of organisms that lived long ago and also about the nature of their environments.

LS4.B Natural Selection

- Sometimes the differences in characteristics between individuals of the same species provide advantages in surviving, finding mates, and reproducing.

LS4.C Adaptation

- For any particular environment, some kinds of organisms survive well, some survive less well, and some cannot survive at all.

LS4.D Biodiversity and Humans

- Populations live in a variety of habitats, and change in those habitats affects the organisms living there.

ESS2.D Weather and Climate

- Scientists record patterns of the weather across different times and areas so that they can make predictions about what kind of weather might happen next.
- Climate describes a range of an area's typical weather conditions and the extent to which those conditions vary over years.

ESS3.B Natural Hazards

- A variety of natural hazards result from natural processes. Humans cannot eliminate natural hazards but can take steps to reduce their impacts.

ETS1.A Defining and Delimiting Engineering Problems

- Possible solutions to a problem are limited by available materials and resources (constraints). The success of a designed solution is determined by considering the desired features of a solution (criteria). Different proposals for solutions can be compared on the basis of how well each one meets the specified criteria for success or how well each takes the constraints into account.

ETS1.B Developing Possible Solutions

- Research on a problem should be carried out before beginning to design a solution.



- At whatever stage, communicating with peers about proposed solutions is an important part of the design process, and shared ideas can lead to improved designs.
- Tests are often designed to identify failure points or difficulties, which suggest the elements of the design that need to be improved.
- Testing a solution involves investigating how well it performs under a range of likely conditions.

ETS1.C Optimizing the Design Solution

- Different solutions need to be tested in order to determine which of them best solves the problem, given the criteria and the constraints.

PS2.A Forces and Motion

- Each force acts on one particular object and has both strength and a direction. An object at rest typically has multiple forces acting on it, but they add to give zero net force on the object. Forces that do not sum to zero can cause changes in the object's speed or direction of motion.
- The patterns of an object's motion in various situations can be observed and measured; when that past motion exhibits a regular pattern, future motion can be predicted from it.

PS2.B Types of Interactions

- Objects in contact exert forces on each other.
- Electric and magnetic forces between a pair of objects do not require that the objects be in contact. The sizes of the forces in each situation depend on the properties of the objects and their distances apart and, for forces between two magnets, on their orientation relative to each other.

Crosscutting Concepts

Patterns – Observed patterns in nature guide organization and classification and prompt questions about relationships and causes underlying them.

- Patterns of change can be used to make predictions.

Cause and Effect: Mechanism and Prediction – Events have causes, sometimes simple, sometimes multifaceted. Deciphering causal relationships, and the mechanisms by which they are mediated, is a major activity of science and engineering.

- Cause and effect relationships are routinely identified, tested, and used to explain change.

Scale, Proportion, and Quantity – In considering phenomena, it is critical to recognize what is relevant at different size, time, and energy scales, and to recognize proportional relationships between different quantities as scales change.

- Observable phenomena exist from very short to very long time periods.

Systems and System Models – A system is an organized group of related objects or components; models can be used for understanding and predicting the behavior of systems.

- A system can be described in terms of its components and their interactions.



Connections to Engineering, Technology, and Applications of Science

Influence of Science, Engineering and Technology on Society and the Natural World

- Engineers improve existing technologies or develop new ones to increase their benefits, to decrease known risks, and to meet societal demands.
- People's needs and wants change over time, as do their demands for new and improved technologies.

Interdependence of Science, Engineering, and Technology

- Scientific discoveries about the natural world can often lead to new and improved technologies, which are developed through the engineering design process.

Connections to the Nature of Science

Science is a Human Endeavor

- Science affects everyday life.

Scientific Knowledge Assumes an Order and Consistency in Natural Systems

- Science assumes consistent patterns in natural systems.

Scientific Knowledge is Based on Empirical Evidence

- Science findings are based on recognizing patterns.

Scientific Investigations Use a Variety of Methods

- Science investigations use a variety of methods, tools, and techniques.

Computer Science and Design Thinking (Standard 8)

- 8.1.5.CS.1: Model how computing devices connect to other components to form a system.
- 8.1.5.CS.2: Model how computer software and hardware work together as a system to accomplish tasks.
- 8.1.5.CS.3: Identify potential solutions for simple hardware and software problems using common troubleshooting strategies.
- 8.1.5.NI.1: Develop models that successfully transmit and receive information using both wired and wireless methods.
- 8.1.5.NI.2: Describe physical and digital security measures for protecting sensitive personal information.
- 8.1.5.IC.1: Identify computing technologies that have impacted how individuals live and work and describe the factors that influenced the changes.
- 8.1.5.IC.2: Identify possible ways to improve the accessibility and usability of computing technologies to address the diverse needs and wants of users.
- 8.1.5.DA.1: Collect, organize, and display data in order to highlight relationships or support a claim.
- 8.1.5.DA.2: Compare the amount of storage space required for different types of data.
- 8.1.5.DA.3: Organize and present collected data visually to communicate insights gained from different views of the data.
- 8.1.5.DA.4: Organize and present climate change data visually to highlight relationships or support a claim.
- 8.1.5.DA.5: Propose cause and effect relationships, predict outcomes, or communicate ideas using data.
- 8.1.5.AP.1: Compare and refine multiple algorithms for the same task and determine which is the most



appropriate.

- 8.1.5.AP.2: Create programs that use clearly named variables to store and modify data.
- 8.1.5.AP.3: Create programs that include sequences, events, loops, and conditionals.
- 8.1.5.AP.4: Break down problems into smaller, manageable sub-problems to facilitate program development.
- 8.1.5.AP.5: Modify, remix, or incorporate pieces of existing programs into one's own work to add additional features or create a new program.
- 8.1.5.AP.6: Develop programs using an iterative process, implement the program design, and test the program to ensure it works as intended.
- 8.2.5.ED.1: Explain the functions of a system and its subsystems.
- 8.2.5.ED.2: Collaborate with peers to collect information, brainstorm to solve a problem, and evaluate all possible solutions to provide the best results with supporting sketches or models.
- 8.2.5.ED.3: Follow step by step directions to assemble a product or solve a problem, using appropriate tools to accomplish the task.
- 8.2.5.ED.4: Explain factors that influence the development and function of products and systems (e.g., resources, criteria, desired features, constraints).
- 8.2.5.ED.5: Describe how specifications and limitations impact the engineering design process.
- 8.2.5.ED.6: Evaluate and test alternative solutions to a problem using the constraints and tradeoffs identified in the design process.
- 8.2.5.ITH.1: Explain how societal needs and wants influence the development and function of a product and a system.
- 8.2.5.ITH.2: Evaluate how well a new tool has met its intended purpose and identify any shortcomings it might have.
- 8.2.5.ITH.3: Analyze the effectiveness of a new product or system and identify the positive and/or negative consequences resulting from its use.
- 8.2.5.ITH.4: Describe a technology/tool that has made the way people live easier or has led to a new business or career.
- 8.2.5.NT.1: Troubleshoot a product that has stopped working and brainstorm ideas to correct the problem.
- 8.2.5.NT.2: Identify new technologies resulting from the demands, values, and interests of individuals, businesses, industries, and societies.
- 8.2.5.NT.3: Redesign an existing product for a different purpose in a collaborative team.
- 8.2.5.ETW.1: Describe how resources such as material, energy, information, time, tools, people, and capital are used in products or systems.
- 8.2.5.NT.4: Identify how improvement in the understanding of materials science impacts technologies.
- 8.2.5.ETW.1: Describe how resources such as material, energy, information, time, tools, people, and capital are used in products or systems.
- 8.2.5.ETW.2: Describe ways that various technologies are used to reduce improper use of resources.
- 8.2.5.ETW.3: Explain why human-designed systems, products, and environments need to be constantly monitored, maintained, and improved.
- 8.2.5.ETW.4: Explain the impact that resources, such as energy and materials used to develop technology, have on the environment.
- 8.2.5.ETW.5: Identify the impact of a specific technology on the environment and determine what can be done to increase positive effects and to reduce any negative effects, such as climate change.
- 8.2.5.EC.1: Analyze how technology has contributed to or reduced inequities in local and global communities and determine its short- and long-term effects



Career Readiness, Life Literacies, and Key Skills (Standard 9)

- 9.2.5.CAP.1: Evaluate personal likes and dislikes and identify careers that might be suited to personal likes.
- 9.2.5.CAP.3: Identify qualifications needed to pursue traditional and non-traditional careers and occupations.
- 9.2.5.CAP.4: Explain the reasons why some jobs and careers require specific training, skills, and certification (e.g., life guards, child care, medicine, education) and examples of these requirements.
- 9.2.5.CAP.6: Compare the characteristics of a successful entrepreneur with the traits of successful employees.
- 9.4.5.CI.2: Investigate a persistent local or global issue, such as climate change, and collaborate with individuals with diverse perspectives to improve upon current actions designed to address the issue (e.g., 6.3.5.CivicsPD.3, W.5.7).
- 9.4.5.CI.3: Participate in a brainstorming session with individuals with diverse perspectives to expand one's thinking about a topic of curiosity (e.g., 8.2.5.ED.2, 1.5.5.CR1a).
- 9.4.5.CI.4: Research the development process of a product and identify the role of failure as a part of the creative process (e.g., W.4.7, 8.2.5.ED.6).
- 9.4.5.CT.1: Identify and gather relevant data that will aid in the problem-solving process (e.g., 2.1.5.EH.4, 4-ESS3-1, 6.3.5.CivicsPD.2).
- 9.4.5.CT.2: Identify a problem and list the types of individuals and resources (e.g., school, community agencies, governmental, online) that can aid in solving the problem (e.g., 2.1.5.CHSS.1, 4-ESS3-1).
- 9.4.5.CT.3: Describe how digital tools and technology may be used to solve problems.
- 9.4.5.CT.4: Apply critical thinking and problem-solving strategies to different types of problems such as personal, academic, community and global (e.g., 6.1.5.CivicsCM.3).
- 9.4.5.DC.4: Model safe, legal, and ethical behavior when using online or offline technology (e.g., 8.1.5.NI.2).
- 9.4.5.IML.2: Create a visual representation to organize information about a problem or issue (e.g., 4.MD.B.4, 8.1.5.DA.3).
- 9.4.5.IML.3: Represent the same data in multiple visual formats in order to tell a story about the data.
- 9.4.5.TL.1: Compare the common uses of at least two different digital tools and identify the advantages and disadvantages of using each.
- 9.4.5.TL.2: Sort and filter data in a spreadsheet to analyze findings.
- 9.4.5.TL.4: Compare and contrast artifacts produced individually to those developed collaboratively (e.g., 1.5.5.CR3a).
- 9.4.5.TL.5: Collaborate digitally to produce an artifact (e.g., 1.2.5.CR1d).



Introduction to the Module

Environmental Changes

Teacher Resources



Distance Learning Support

For information about PLTW's distance learning support and online learning guides, jump to Distance Learning Support in [PLTW Launch Module-specific PD Resources](#).

For distance learning support for facilitating this module, jump to [Distance Learning Support: Environmental Changes Teacher Guide](#).

PREFACE

Time: 10 instructional hours

In this module, students learn about Earth's habitats and how these habitats support life. Students examine fossils and investigate what fossils reveal about how organisms and habitats adapt and change over time. Students identify factors that cause environmental changes and simulate the effect the environmental changes have on living things.

After students establish an understanding of environmental change and possible consequences to habitats and organisms, they take a deeper look at specific examples of environmental changes in their own habitat. Students use the design process to explore one problem caused by environmental change and develop an action plan to reduce or stop future damage.

RESOURCES



Device Specifications



Application List

R



Preparation

Are you ready to teach this module? Hold it right there! As you may remember from PLTW Launch Classroom Teacher Training, to create an engaging learning experience for your students, planning is essential.

This Teacher Guide includes resources you need for both planning and facilitation. The following outline lists the general resources designed to help you prepare to teach this module to your students.

Spanish Language Resources: Printable resources in Spanish are available in the Teacher Guide (Español) for this module.

Connections to Standards and Curriculum Framework

Math Connections

Professional Development

Community

Rostering Students

Family and Community Relationships

PLTW Launch Logs

Developing Vocabulary

Icon Legend

Additional Instructional Resources

Curriculum Revisions



Activity 1

What Is a Habitat?

Teacher Resources

[View Student Course](#)

EQUIPMENT

This list is based on a class of 30 students.

Included in Equipment Kit	Not Included in Equipment Kit	Device Applications
• <i>Habitats</i> by William B. Rice	• PLTW Launch Logs (1 per student) • Digital devices • Pencils or colored pencils for sketching • Chart paper • Markers	• Inking or my.pltw.org • Camera • Presentation app, such as: ◦ Popplet Lite ◦ Mindomo ◦ ShowMe Interactive Whiteboard ◦ Zoho Show

ESSENTIAL QUESTIONS

EQ

- EQ1 How does an animal's habitat affect its survival?
- EQ2 How do environmental changes affect organisms?
- EQ3 How can a step-by-step process help you design or improve a solution to a problem?



Introduction

In this activity, students take an outdoor walk to observe *organisms* around their school. They gain an understanding of *habitats* and the *basic needs* of organisms through literature. Then, the students apply what they have learned to identify the basic needs of local organisms.

Finally, students explore eight different habitats on Earth and create a digital presentation to share with the class.

Preparation

Professional Development

Before you facilitate Activity 1, access the [Launchpad](#) to review the resource, Unpacking PLTW Launch Curriculum Frameworks.

Part 1. Local Habitat

1. Become familiar with the vocabulary terms used in this activity. Plan how you will help students use these terms as part of their vocabulary.

basic needs	The resources and conditions that an organism needs to survive.
climate	The average weather conditions in a particular region over a period of years.
habitat	The resources and conditions that promote survival in a certain area.
organism	A living thing.

2. Review the Learning Objectives and Knowledge and Skills in Stage 1 of the [Curriculum Framework](#). Use the Evidence (Stage 2) and Learning Plan (Stage 3) content to plan how you will formatively and summatively assess students throughout this activity.
3. Determine ways you can support the development of transportable skills in this module. Examples include calling out ways students demonstrate the skills, asking questions that allow students to reflect on their development of the skills, and integrating books listed in the Transportable Skills: Literature Connections resource.
4. Review the [Additional Instructional Resources](#). This list includes books that offer diverse perspectives that can expand student understanding. Using these resources provides a sense of inclusion and belonging, and helps students make connections if the content is new to them.
5. To access a printable version of the Launch Log, go to [PLTW Launch Logs](#).
6. Before you begin Activity 1, read the [Introduction Story: The Missing Animals](#) with students.
7. Review the external resources used in this activity. External resources can include:
 - Apps for digital devices
 - Web-based apps
 - Websites



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For each resource, determine if translations in other languages are available to meet the needs of multilingual learners (ML).

8. As students engage in learning experiences throughout the module, they may experience technical problems. Encourage them to find potential solutions by following basic troubleshooting strategies, such as:
 - a. Check the Wi-Fi connection.
 - b. Close the application or tab and reopen it.
 - c. Use a different web browser.
 - d. Shut down the digital device and reboot it.



Teacher Tip: Encourage your students to use accurate terminology while troubleshooting. They should be able to identify and describe the basic hardware and software.

9. Take a walk around the school to determine the best route for students to identify local organisms. Consider a route where students can observe local plant life, animal life, water sources, and land.
10. Consider the best day and time to take an outdoor walk with students to identify local organisms. Students will use the cameras on their devices to take photographs of what they find.

Note: If the weather does not allow for students to take an outdoor walk, or if there is a lack of organisms around your school, consider the following alternatives:

- Search for a virtual field trip that is similar to your local area.
- Prepare in advance to take a walk outdoors in a local habitat and record your walk, being sure to capture a variety of organisms. Have students watch your video in place of the outdoor walk.

11. Read the book *Habitats* to become familiar with the content. Review the discussion questions in the Procedure.
12. Optional: Consider whether you will facilitate [Internet Safety](#). During this experience, students will become familiar with the importance of making safe choices in a digital world.

Part 2. Habitats Around the World

Before you begin Part 2, review the habitat presentations in the student course to become familiar with the content students explore.



Possible Student Misconceptions

- **An animal's habitat and home are the same thing.** An animal's habitat is more than its home. A habitat is the resources and conditions present in an area that promote survival. For example, a squirrel's home or shelter is in a tree, but its habitat is the larger area of the forest where it finds food and water and collects the materials necessary for its home.
- **A city or suburban area is a natural habitat.** Cities and other areas where humans live and build homes are created by humans and do not occur naturally on Earth. Many plants and animals have adapted to live in cities, but the building of cities and homes often destroys the natural habitats of plants and animals.

Procedure

Optional: Internet Safety

During the [Internet Safety](#) learning experience, students learn about the importance of making safe choices in the digital world. They explore strategies to keep personal information secure and learn how to use the internet safely and responsibly.



Time: 100 Minutes

Part 1. Local Habitat

- 1 Direct students to access Activity 1 in the student course and have them read the Introduction.
- 2 Students use PLTW Launch Logs to keep a record of their work as they progress through the module. Distribute a Grades 3–5 Launch Log to each student. In the notebook, they may take notes as they research, create sketches, and answer conclusion questions.
- 3 Introduce the outdoor walk to students. On this walk, students work in groups of three or four students to observe local plant life, animal life, water sources, and land. Guide students to use digital devices and PLTW Launch Logs to:
 - Take photographs
 - Sketch pictures
 - Write down observations
- 4 Throughout the walk, ask students questions about their discoveries. Prompts:
 - Describe the characteristics of the living things you see.
 - What do you notice about the land around you?
 - Have you found any water in the area?



- 5 Lead a discussion about the outdoor walk. Prompts:
 - What plant and animal life did you observe?
 - What type of water sources are available for the plants and animals?
 - How would you describe your local area?
 - Are there areas around the world that are the same as our local area? Are there areas around the world that are different from our local area? Why do you think this?
- 6 Read aloud *Habitats Are Found in Ecosystems* in the student course.
- 7 Direct students to access the flashcard example as you introduce the vocabulary term *habitat*.
- 8 Read the book *Habitats* aloud for students. You may choose to use a document viewer to project an image of the book.
- 9 Lead a discussion about the book. Prompts:
 - What is a habitat?
 - A habitat is more than just a home. It includes what animals and plants need to survive. What do animals need to survive? What do plants need to survive? Direct students to access the flashcard example as you introduce the vocabulary term *basic needs*.
 - Why are some plants and animals not able to live in all habitats?
 - A habitat must have the right climate. Direct students to access the flashcard example as you introduce the vocabulary term *climate*. How would you describe your local climate?
- 10 Choose one plant or animal that several groups observed while on the outdoor walk. Write the name of that organism in the middle of a piece of chart paper. Direct students to access the flashcard example as you introduce the vocabulary term *organism*.
- 11 Guide students to work with a partner to identify the basic needs of the organism. Have students share their thoughts with the class.
- 12 Record the basic needs of the organism on the chart paper. Connect these needs to the organism's name to create a concept map.

Note: If students are not familiar with a concept map, explain their purpose and how they are used/created, because students will create their own concept map in the Conclusion Questions at the end of the module.

- 13 Lead a discussion about the concept map. Prompts:
 - Why do you think this organism lives in our habitat?
 - How are the basic needs of the organism met within its habitat?
 - What do you think would happen if its basic needs were not met?

Part 2. Habitats Around the World

- 14 Guide students to work in a group of three or four to learn more about a specific habitat. Assign each group a different habitat to ensure each habitat is represented:
 - Desert



- Temperate grassland
- Temperate forest
- Tundra
- Rain forest
- Wetland
- Ocean
- Tropical grassland

- 15 Direct groups to view the presentation about their assigned habitat found in the student course. Have students take notes in their Launch Logs while they view the presentation.
- 16 Guide students to create a presentation using ShowMe Interactive Whiteboard, Popplet Lite, Mindomo, or Zoho Show. The presentation should demonstrate students' understanding of the habitat. Presentations should include information, such as:
 - Name of the habitat
 - Description of the habitat
 - Animal life
 - Plant life
 - Climate
- 17 Provide time for groups to share their presentations.
- 18 Lead a discussion about what students learned during the presentations. Prompts:
 - How are the habitats similar and different from each other?
 - How are the basic needs of different organisms met within each habitat?
 - How would you describe the habitat of your local area?
- 19 When students explore careers, they can see connections between what they are learning and how it is applied in the real world. Guide students to read about marine botanist Dr. Isabella Alona Abbott. As an option, you can read this aloud to students.
- 20 Lead a discussion for students to consider what organism they would study if they could choose an organism from any habitat.
- 21 Guide students to answer the Conclusion Questions. Lead a discussion for students to share their thoughts.

Conclusion Questions Answer Key

Note: Conclusion Questions offer an opportunity for formative assessment. You may use them as a whole-class discussion or you may have students record ideas in their Launch Logs.

- 1 Think of one organism you observed on the outdoor walk. Create a concept map of that organism's basic needs.

Student responses will vary. Student responses should demonstrate an understanding of basic needs.



- 2** If you could live in any habitat, where would you choose to live? Why would you live there? What would you need to survive in this habitat?

Student responses will vary. Student responses should demonstrate an understanding of habitats.

A large, empty rectangular box for student responses.



Activity 2

Long Ago

Teacher Resources

[View Student Course](#)

EQUIPMENT

The list below is based on a class of 30 students.

Included in the Equipment Kit	Not Included in Equipment Kit	Device Application
• <i>Figuring Out Fossils</i> by Sally M. Walker • Fossil sorting kit (2) • Dual magnifiers (30) • Resealable plastic bags (8) • Paper towels • Plastic drainage bin (8) • Scrub brushes (8)	• PLTW Launch Logs (1 per student) • Digital devices • Pencils or colored pencils for sketching • Water • Chart paper • Markers	• Inking or my.pltw.org

ESSENTIAL QUESTIONS

EQ

- EQ1** How does an animal's habitat affect its survival?
- EQ2** How do environmental changes affect organisms?
- EQ3** How can a step-by-step process help you design or improve a solution to a problem?



Introduction

Many students think that *fossils* are just a bunch of old bones. In fact they are not bones at all but an ancient record of plants and animals that once lived on earth. Some fossils are imprints of animals and plants, while others are created when minerals replace and take the shape of animal and plant parts. Although the plants and animals themselves are long gone, their fossils leave *paleontologists* a lot of information about the *habitat* in which the fossils are found. Each fossil tells a story about the habitat that *organism* once lived in and helps us understand how the world around us has changed.

In this activity, students observe and categorize fossils to infer which habitat they once lived in.

Preparation

Part 1. Introduction to Fossils

1. Become familiar with the vocabulary terms used in this activity. Plan how you will help students use these terms as part of their vocabulary.

adaptation	A change that an organism develops to better survive in its habitat.
fossil	Any remains, impression, or trace of an ancient living thing.
habitat	The resources and conditions that promote survival in a certain area.
organism	A living thing.
paleontologist	A scientist who studies plant and animal fossils from long ago.

2. Review the Learning Objectives and Knowledge and Skills in Stage 1 of the [Curriculum Framework](#). Use the Evidence (Stage 2) and Learning Plan (Stage 3) content to plan how you will formatively and summatively assess students throughout this activity.
3. Review the [Additional Instructional Resources](#). This list includes books that offer diverse perspectives that can expand student understanding. Using these resources provides a sense of inclusion and belonging, and helps students make connections if the content is new to them.
4. Review the external resources used in this activity. External resources can include:
 - Apps for digital devices
 - Web-based apps
 - WebsitesFor each resource, determine if translations in other languages are available to meet the needs of multilingual learners (ML).
5. Read the book *Figuring Out Fossils* to become familiar with the content. Review the discussion questions provided in the Procedure.

Part 2. Observing Fossils



1. Before you begin Part 2, do a preliminary sort and examination of the fossil sorting kits so that you can assist students and predict their misconceptions.
2. Divide the fossils into eight sets and place each set in a plastic bag.
 - Make sure each bag has at least three types of fossils. Use the Fossil Sorting Guide that came with your fossils as a reference. If you did not receive a Fossil Sorting Guide, use the images on [Fossil Groups](#).
3. Plan how you will distribute the materials to each group.
 - One plastic drainage bin with water
 - One bag of fossils
 - One scrub brush
 - Paper towels
4. Prepare a piece of chart paper titled "Fossil Questions".
5. Another option is to create the chart using a digital device and project the chart for students to view.

Fossil Questions

Possible Student Misconceptions

- **Fossils are pieces of dead animals and plants.** Some fossils are actually imprints of animals and plants. Others are created when minerals replace and take the shape of animal and plant parts. The animal or plant is long gone!
- **Fossils represent only extinct animals and plants.** Most fossils represent extinct animals and plants. However, some organisms are considered living fossils. A living fossil is an organism that has remained relatively unchanged over time, and whose close relatives are usually extinct. Examples include the horseshoe crab, the ginkgo tree, and the elephant shark.

Procedure

Time: 90 Minutes

Part 1. Introduction to Fossils

- 1 Direct students to access Activity 2 in the student course and have them read the Introduction.
- 2 Have students prepare their PLTW Launch Logs for Activity 2.
- 3 Read the book *Figuring Out Fossils* aloud for students. You may choose to use a document viewer to project an image of the book.



- 4 Lead a discussion about the book. Prompts:
 - In your own words, what is a fossil? Direct students to access the flashcard example as you introduce the vocabulary term *fossil*.
 - What things can become a fossil? Direct students to access the flashcard example as you review the vocabulary term *organism*.
 - Do all organisms from long ago become fossils? Why or why not?
 - If we were scientists, what could we discover by looking at fossils? Direct students to access the flashcard example as you introduce the vocabulary term *paleontologist*.
- 5 Introduce the Introduction to Fossils video. Guide students to work with a partner or small group to view the video. Students may take notes in their Launch Logs while they view the video.

)



Introduction to Fossils video

- 6 Lead a discussion about the video. Prompts:
 - How do fossils form?
 - What do fossils tell us about organisms that lived long ago?
 - What is an adaptation? Direct students to access the flashcard example as you introduce the vocabulary term *adaptation*.
 - How do adaptations help organisms survive in their habitat? Direct students to access the flashcard example as you review the vocabulary term *habitat*.
- 7 Introduce the [Mystery Fossils](#) presentation. Guide students to work with a partner or small group to view the presentation. Have students record written responses in their Launch Logs while they view the presentation.
- 8 Lead a discussion about the presentation. Prompts:
 - How do fossils of organisms provide clues about the habitat in which they lived?
 - What type of clues do paleontologists look for?
 - What surprised you about the four mystery fossils? Why did that surprise you?
- 9 Guide students to read A Fossil's Story. Prompt students to examine the images of the mastodon and bison and respond to the reflection prompt.



Compare the mastodon and bison images. Why do you think people of the Delaware and Shawnee nations believed that the mastodon fossils belonged to an ancestor of the bison?

Part 2. Observing Fossils

- 10 Tell students that now they get to act like paleontologists as they observe fossils. Explain that paleontologists ask questions about fossils and then use their observations to try to answer them.
- 11 Guide students to brainstorm with a partner what questions they could ask about a fossil. Questions might include:
 - Does this fossil look like any organism that is alive today? If so, what organisms does it look like?
 - What characteristics does the fossil have?
 - What habitat could these fossils have lived in?
 - What might have caused this organism's death?
- 12 Gather students together and have them share their questions. Record the questions on the chart paper titled, "Fossil Questions".
- 13 Model for students how to observe and sort the fossils. You may choose to use a document viewer to project an image of the fossil. Alternately, have students gather around a table.
 - Gently scrub each fossil to remove dirt and place the clean fossil on a paper towel.
 - Use the dual magnifier to observe the fossil.
 - Sort fossils into groups with similar characteristics. For more information, see [Fossil Groups](#).

Note: Students should sort the fossils based on how they look. Some students may struggle with how to group the fossils. Explain that there are many ways to group them, but it is important that they use evidence from their observations.

 - Make a sketch of one fossil from each group in your Launch Logs.
 - Discuss the characteristics of each fossil group and document them in your Launch Logs.
 - Use your observations and background knowledge to make an inference about what type of habitat these organisms once lived in.
- 14 Guide students to work in groups of three or four students to observe and sort the fossils.
- 15 Distribute the materials to each group or have the students collect the materials from a central location. Each group needs:
 - One plastic drainage bin with water
 - One bag of fossils
 - One scrub brush
 - Paper towels
- 16 Lead a discussion about the fossils. Prompts:



- How did you group your fossils? Why did you group them that way?
- Do the fossils look similar to anything you have seen before? Why do you think this?
- What do you know about other organisms that look like these fossils?
- What habitat might the fossils have once lived in? Why do you think this?

- 17 Explain that many of the fossils are marine fossils. These organisms lived in the ocean habitat. Complete a Think-Pair-Share on these questions:

- What do you remember or know about the ocean habitat?
- How do you think oceans might change over time?
- If a habitat changes, what might happen to the organisms that live there?

Note: Think-Pair-Share is a strategy where students think individually, discuss ideas with a partner, and then share with the whole class. It increases participation and focus.

- 18 Guide students to answer the Conclusion Questions. Lead a discussion for students to share their thoughts.

Conclusion Questions Answer Key

- 1 Describe one adaptation of an organism that helps it survive in its habitat.

Student responses should demonstrate an understanding of adaptations. Example response:
Whale's hearing has adapted over time. Their excellent hearing allows them to communicate with other whales over a long distance.

- 2 Take a look at this photograph of a fossil. Describe the fossil's characteristics. What habitat do you think it lived in? Support your answer with evidence.

Student responses should demonstrate an understanding of the fossils and habitats. Example response:
This fossil seems to be bumpy on the front and have multiple colors. It is brown on the outside and has ridges. I think the fossil lived in a temperate forest habitat because it appears to be part of a tree.



Activity 3

Environmental Change

Teacher Resources

[View Student Course](#)

EQUIPMENT

The list below is based on a class of 30 students.

Not Included in Equipment Kit	Device Application
• PLTW Launch Logs (1 per student) • Digital devices • Pencils or colored pencils for sketching • Chart paper • Markers • Tape • White butcher paper • Items to represent food, such as: ◦ Small, colored pieces of paper ◦ Plastic blocks ◦ Plastic game chips	• Inking or my.pltw.org

ESSENTIAL QUESTIONS

EQ

- EQ1 How does an animal's habitat affect its survival?
- EQ2 How do environmental changes affect organisms?
- EQ3 How can a step-by-step process help you design or improve a solution to a problem?



Introduction

The world around us is always changing. There are naturally occurring events, such as volcanic eruptions, storms, and earthquakes. *Environmental change* is also caused by human activity, such as the removal of forests, pollution, and construction of roads, dams, and houses.

In this activity, students get a firsthand experience of environmental change by participating in a *simulation* about polar bears and melting ice. This helps students see the impact of environmental change on the arctic *habitat* and one animal that lives there.

Preparation

Professional Development

Before you facilitate Activity 3, access the [Environmental Changes Module-specific PD Resources](#) to review Building Your Understanding: What Is Climate Change?

Part 1. Environmental Change

1. Become familiar with the vocabulary terms used in this activity. Plan how you will help students use these terms as part of their vocabulary.

adaptation	A change that an organism develops to better survive in its habitat.
basic needs	The resources and conditions that an organism needs to survive.
climate change	Long-term change in temperature and weather patterns in an area.
environment	The living things, nonliving things, and conditions in an area.
environmental change	A change to the surroundings caused by human activity or natural event.
habitat	The resources and conditions that promote survival in a certain area.
organism	A living thing.
simulation	Something that is made to look, feel, or behave like something else, especially so it can be studied or used to train people.
trend	A pattern found in data.

2. Review the Learning Objectives and Knowledge and Skills in Stage 1 of the [Curriculum Framework](#). Use the Evidence (Stage 2) and Learning Plan (Stage 3) content to plan how you will formatively and summatively assess students throughout this activity.
3. Review the [Additional Instructional Resources](#). This list includes books that offer diverse perspectives that can expand student understanding. Using these resources provides a sense of inclusion and belonging, and helps students make connections if the content is new to them.



4. Review the external resources used in this activity. External resources can include:

- Apps for digital devices
- Web-based apps
- Websites

For each resource, determine if translations in other languages are available to meet the needs of multilingual learners (ML).

5. Prepare four pieces of chart paper with the questions:

- When you hear the word “environment”, what do you think of?
- What do you think an environmental change is?
- What are some examples of environmental changes?
- What or who causes environmental changes?

6. Hang the charts around the room.

Part 2. Melting Sea Ice

1. Review the directions and complete the preparation for the [Polar Bear Simulation](#).

2. Prepare a piece of chart paper titled “Polar Bear Simulation”.

3. Another option is to create the chart using a digital device and project the chart for students to view.

Polar Bear Simulation			
Round	Amount of Ice Melted (Removed)	Amount of Ice Remaining	Number of Polar Bears in Danger
1	0	35 pieces	0
2			
3			
4			
5			



Possible Student Misconceptions

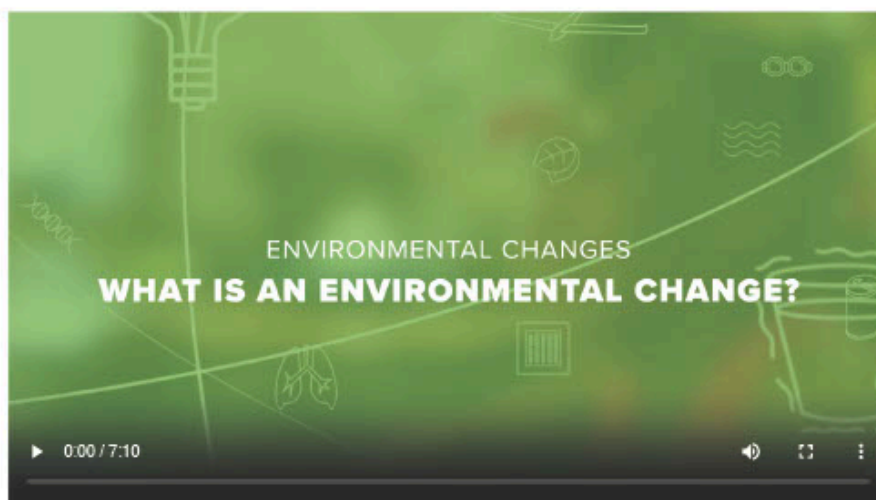
- **Habitats do not change, or change little, over time.** Habitats are constantly changing due to natural events (such as severe weather), natural changes within a habitat, climate change, and human activity.
- **The plants and animals in a habitat do not change.** If the resources that support life in a habitat change, the types and number of plants and animals that live there change. Plants can adapt or die off. Animals can adapt, die off, or leave a habitat.
- **A few degrees warmer on Earth is not really that much.** With every degree warmer our Earth gets, there are greater impacts on the environment: oceans warm, more of our glaciers and ice caps melt, water levels rise, habitats shrink or grow, and severe weather events increase.
- **Environmental change is just what nature does.** While some changes are the impact of severe weather or natural changes to Earth, a large number of environmental changes are the result of human impact.

Procedure

Time: 75 Minutes

Part 1. Environmental Change

- 1 Direct students to access Activity 3 in the student course and have them read the Introduction.
- 2 Have students prepare their PLTW Launch Logs for Activity 3.
- 3 Guide students to work in a small group to discuss four questions:
 - When you hear the word environment, what do you think of?
 - What do you think an “environmental change” is?
 - What are some examples of environmental changes?
 - What or who causes environmental changes?
- 4 Have each group select a recorder to write the group’s responses on the corresponding piece of chart paper.
- 5 Lead a class discussion about their responses. Direct the students to access the flashcard examples to introduce the vocabulary terms *environment* and *environmental change*.
- 6 Introduce the What Is an Environmental Change? presentation. Guide students to work with a partner or small group to view the presentation. Have students record written responses in their Launch Logs while they view the presentation.



What is an Environmental Change? video

7

Lead a discussion about the presentation. Prompts:

- What are some of the causes of environmental change?
- What are some of the effects that environmental change has on habitats and organisms in that habitat? Direct students to access the flashcard examples as you review the vocabulary terms *habitat* and *organism*.
- How do growing human communities affect the environment?
- What do you think humans can do after a natural disaster to help a habitat and the plants and animals in it recover?
- What can you or others do to make a difference in places where human activity is causing environmental change?
- Where have you seen this phenomenon in your community? Tell me more.

Part 2. Melting Sea Ice

8

Lead students in a review of the tundra habitat from Activity 1. Prompts:

- How would you describe the tundra habitat?
- What types of organisms live there?
- How have they adapted to survive in this environment? Direct students to access the flashcard example as you review the vocabulary term *adaptation*.

9

Guide students to complete a Think-Pair-Share on these questions:

- What environmental changes might occur in the tundra?
- What animals in the tundra do you think are affected by environmental change? Why do you think this?
- How do you think the polar bear is affected by environmental change?

10

Introduce the [Polar Bear](#) presentation. Guide students to work with a partner or small group to view the presentation. Students can take notes in their Launch Logs while they view the presentation.



- 11 Lead a discussion about the presentation. Prompts:
- Why are icebergs important to the polar bears?
 - What is the trend in the amount of arctic sea ice over time? How did you arrive at that conclusion? Direct the students to access the flashcard example to introduce the vocabulary term *trend*.
 - Based on what you know about polar bears' basic needs, what do you think could happen to polar bears if this trend continues? Direct students to access the flashcard example as you review the vocabulary term *basic needs*.
 - What environmental change causes the sea ice to melt? Direct the students to access the flashcard example to introduce the vocabulary term *climate change*.

- 12 Introduce the polar bear simulation. See [Polar Bear Simulation](#) for step-by-step directions. Explain to the students that they will model what scientists think could happen to polar bears as the sea ice continues to decrease. Direct the students to access the flashcard example to introduce the vocabulary term *simulation*.

Notes:

- Polar bears are in danger if they are stuck on an iceberg with no food, or if they have no space on the icebergs and need to stay in the water (the floor). Students will probably make the connection that being in danger most likely leads to death. Consider whether this might be a sensitive subject for any of your students.
- If you feel students will struggle with being a polar bear in the simulation, assign them a special role. They can help you remove the icebergs, or record observations and data on the Polar Bear Simulation chart.

- 13 Complete multiple rounds of the simulation to see the effect of melting sea ice.
- 14 Lead a discussion about the simulation. Prompts:
- How do icebergs help polar bears meet their basic needs?
 - What happened when the icebergs melted?
 - Describe the trend of the polar bear population as more ice melted.
- 15 Guide students to answer the Conclusion Questions. Lead a discussion for students to share their thoughts.

Conclusion Questions Answer Key

- 1 Describe one environmental change that you want to learn more about. How does this environmental change affect the organisms that live in the habitat?

Student responses should demonstrate an understanding of the environmental change.

Example response:

I want to learn more about deforestation in rain forests. When trees are cut down, many animals lose their homes. This might cause animals to become endangered or extinct.



- 2** What might eventually happen to polar bears if the trend of melting sea ice due to climate change continues?

Student responses should demonstrate an understanding of the environmental change.

Example response:

Due to melting ice from climate change, polar bears can lose their home and food source. Without food, they will die, and the species may become extinct.



Introduction to the Module

Life Cycles and Survival

Teacher Resources



Distance Learning Support

For information about PLTW's distance learning support and online learning guides, jump to Distance Learning Support in [PLTW Launch Module-specific PD Resources](#).

For distance learning support for facilitating this module, jump to [Distance Learning Support: Life Cycles and Survival Teacher Guide](#).

PREFACE

Time: 10 instructional hours

In this module, students are introduced to life cycles. Students compare and contrast different animal life cycles to identify common features and specific differences. Students deepen their understanding of life cycles as they investigate the life cycle of honeybees. They learn that worker bees have an important relationship with flowering plants that connects their life cycles.

Students analyze the benefits and disadvantages of solitary animal life versus group life. They investigate whether living in a group makes honeybees more or less susceptible to hazards. Applying skills and knowledge learned from the activities and project, students design a bee habitat that promotes the survival of bees. They create a public service campaign to share their designs to raise awareness of the importance of bees.

RESOURCES

 [Device Specifications](#)

 [Application List](#)

R



Preparation

Are you ready to teach this module? Hold it right there! As you may remember from PLTW Launch Classroom Teacher Training, to create an engaging learning experience for your students, planning is essential.

This Teacher Guide includes resources you need for both planning and facilitation. The following outline lists the general resources designed to help you prepare to teach this module to your students.

Spanish Language Resources: Printable resources in Spanish are available in the Teacher Guide (Español) for this module.

Connections to Standards and Curriculum Framework

Math Connections

Professional Development

Community

Rostering Students

Family and Community Relationships

PLTW Launch Logs

Developing Vocabulary

Icon Legend

Additional Instructional Resources

Curriculum Revisions



Activity 1

Animal Life Cycles

Teacher Resources

[View Student Course](#)

EQUIPMENT

The list below is based on a class of 30 students.

Included in Equipment Kit	Not Included in Equipment Kit	Device Application
• by Bobbie Kalman and Jacqueline Langille	• PLTW Launch Logs (1 per student) • Digital devices • Chart paper • Markers	• linking or my.pltw.org

RESOURCE

R

 [Animal Life Cycle Cards](#)

ESSENTIAL QUESTIONS

EQ

- EQ1** Why are life cycles of organisms important for life on Earth?
- EQ2** How do bees impact our world?
- EQ3** How can a step-by-step process help you design or improve a solution to a problem?



Introduction

In this activity, students learn about . They connect the definition of cycle to a . Students learn about a basic life cycle as well as life cycles of different animals. Students compare and contrast the life cycles and draw in their Launch Logs.

Preparation

Professional Development

Before you facilitate Activity 1, review the professional development resources.

- Access the [Launchpad](#) to review the resource, Unpacking PLTW Launch Curriculum Frameworks.
- Access the [Life Cycles and Survival Module-specific PD Resources](#) to review Building Your Understanding: Pollination and Pollinators Part 1.

Part 1. What Is a Cycle?

1. Become familiar with the vocabulary terms used in this activity. Plan how you will help students use these terms as part of their vocabulary.

cycle	A set of events or actions that happen again and again in the same order.
life cycle	The stages an organism goes through from the start of its life through adulthood when it produces offspring.
metamorphosis	A major change in an organism's form between life cycle stages.
model	A representation of a process or system that can be presented through drawings or diagrams.
organism	A living thing.

2. Review the Learning Objectives and Knowledge and Skills in Stage 1 of the [Curriculum Framework](#). Use the Evidence (Stage 2) and Learning Plan (Stage 3) content to plan how you will formatively and summatively assess students throughout this activity.
3. Determine ways you can support the development of transportable skills in this module. Examples include calling out ways students demonstrate the skills, asking questions that allow students to reflect on their development of the skills, and integrating books listed in the Transportable Skills: Literature Connections resource.
4. Review the [Additional Instructional Resources](#). This list includes books that offer diverse perspectives that can expand student understanding. Using these resources provides a sense of inclusion and belonging, and helps students make connections if the content is new to them.
5. Review the external resources used in this activity. External resources can include:
 - Apps for digital devices
 - Web-based apps
 - Websites



For each resource, determine if translations in other languages are available to meet the needs of multilingual learners (ML).

6. To access a printable version of the Launch Log, go to [PLTW Launch Logs](#).
7. Before you begin Activity 1, read the [Introduction Story](#): _____ with students.
8. As students engage in learning experiences throughout the module, they may experience technical problems. Encourage them to find potential solutions by following basic troubleshooting strategies, such as:
 - a. Check the Wi-Fi connection.
 - b. Close the application or tab and reopen it.
 - c. Use a different web browser.
 - d. Shut down the digital device and reboot it.



Teacher Tip: Encourage your students to use accurate terminology while troubleshooting. They should be able to identify and describe the basic hardware and software.

9. Optional: Consider whether you will facilitate [Internet Safety](#). During this experience, students will become familiar with the importance of making safe choices in a digital world.

Part 2. Animal Life Cycles

1. Use a piece of chart paper to prepare a KWL chart titled "Animal Life Cycles".

Animal Life Cycles		
K	W	L
What do you know?	What do you want to learn?	What did you learn?

2. Print and cut out the [Animal Life Cycle Cards](#). There are 17 unique cards. If you have 17 students or less in your class, you only need to print one set of cards. For class sizes 17 or above, print two copies of the Animal Life Cycle Cards.

Part 3. Read and Reflect

Pre-read _____ as it contains information about animal reproduction. Pages 26-29 have been left out of the read aloud in Part 3. If desired, you may read these pages.



Possible Student Misconception

All animals' life cycles are the same. Different classes of animals have different life cycles. Students might be most familiar with mammals that have live births. Most animals do not have live births.

Procedure

Optional: Internet Safety

During the [Internet Safety](#) learning experience, students learn about the importance of making safe choices in the digital world. They explore strategies to keep personal information secure and learn how to use the internet safely and responsibly.

Time: 80 Minutes

Part 1. What Is a Cycle?

- 1 Direct students to access Activity 1 in the student course and have them read the Introduction.
- 2 Students use PLTW Launch Logs to keep a record of their work as they progress through the module. Distribute the Grades 3–5 Launch Log to each student. In the notebook, they may take notes as they research, create sketches, and answer Conclusion Questions.
- 3 Direct students to access the flashcard example as you introduce the vocabulary term [cycle](#). Ask students to think of a cycle, such as morning routines, school routines, the four seasons, the water cycle, or the design process. Prompts:
 - What is something that you do over and over again?
 - Does the last step of the cycle start a new cycle over again?
 - What is something that occurs in nature that happens again and again in the same order?
 - What types of cycles do we, as humans, depend on and benefit from? Explain your thinking.
- 4 Direct students to access the flashcard example as you introduce the vocabulary term [cycle](#). Prompts:
 - Do you think all organisms experience cycles?
 - Can you provide an example of a cycle that involves an organism?
- 5 Direct students to work with a partner. Have them choose one cycle and document the cycle as a series of steps in their Launch Logs.
- 6 Lead a discussion about the cycle the students documented in their Launch Logs. Prompts:
 - What cycle did you choose?
 - What was the first step of the cycle?



- Did the cycle start over at the first step or event?
- Do the cycles in our daily routines change over time? If so, how do they change?

Note: As you work through this activity, continue to ask questions to determine whether students' misconceptions are being addressed.

Part 2. Animal Life Cycles

- 7 Introduce the students to the KWL graphic organizer. This graphic organizer provides an opportunity for you to formatively assess your students as they share what they already know about life cycles, what they hope to learn, and later, what they do learn from this module.
- 8 Guide students to create a KWL chart in their Launch Logs.
- 9 Have students work individually, with a partner, or in a small group to complete the first two columns in the KWL chart with their responses about life cycles. All students, whether working individually or with a partner or group, should create the chart and record the responses in their own Launch Logs.
- 10 Monitor student groups as they fill out the KWL chart. Allow time for groups to share their responses in the first two columns.
- 11 Record the student responses in the class KWL chart.
- 12 Introduce the Animal Life Cycles presentation. Guide students to work with a partner or small group to view the presentation. Have students take notes in the "L" column of their KWL chart in their Launch Logs while they view the presentation.



Animal Life Cycles video

- 13 Lead a discussion about the presentation. Add responses to the class KWL chart. Prompts:
 - What are the stages of a life cycle? Direct students to access the flashcard example as you introduce the vocabulary term



- In the presentation, students learned that some animals experience metamorphosis during their lives. Direct students to access the flashcard example as you introduce the vocabulary term . Name some animals that go through a metamorphosis.
- How are the life cycles of animals similar? How are the life cycles of animals different?

- 14 Direct students to access the flashcard example as you introduce the vocabulary term . Guide students to draw a model of an animal life cycle in their Launch Logs.

- 15 Guide students to play the Animal Life Cycle game.

Notes:

- The images on the Animal Life Cycle cards are the same as those in the Animal Life Cycle presentation.
- There are 17 unique cards. You may need to give some students two cards so all stages of the life cycles are represented. Make sure students with two cards have cards from the same animal.

- For class sizes larger than 17, divide the class into two groups.
- Provide one Animal Life Cycle card to each student.
- Guide students to walk around and find others who have a card with an image of a stage of their animal's life cycle. Instruct students to use their cards to create a cycle.
- Monitor student groups as they place the cards in order to show their animal's life cycle.

- 16 Lead a discussion about the game. Prompts:
- How did you know what order to put the cards in?
 - What specific similarities and differences do you notice in the animal life cycles?

Part 3. Read and Reflect

- 17 Read aloud pages 4–5 and 8–11 from . You may choose to use a document viewer to project an image of the book.

Note: This book contains valuable information about the life cycles of different animals. Consider reading one or two additional sections of the book each day. Alternatively, read the remaining pages during your language arts time.

- 18 Lead a discussion that focuses on life cycles. Prompts:
- How do organisms grow and change during their life cycles?
 - How do life cycles help keep species alive?
 - How do different animals treat their eggs differently?
 - Do all species go through a metamorphosis? How do you know?

- 19 Ask the students: Have you ever used a model outside of school? What was it for?



- 20 Guide students to draw a model of the newt life cycle in their Launch Logs. If possible, use a document viewer to project page 10 of the book.
- 21 Guide students to answer the Conclusion Questions. Lead a discussion for students to share their thoughts.

Conclusion Questions Answer Key

Note: Conclusion Questions offer an opportunity for formative assessment. You may use them as a whole-class discussion, or you may have students record ideas in their Launch Logs.

- 1 Animal life cycles have many similarities and differences. Describe one similarity and one difference.

Student responses should demonstrate an understanding of life cycles. Example responses:

- 2 Why is it important that animals' lives are a cycle?

Student responses should demonstrate an understanding of how animals continue to exist through a process that is a cycle.

Example response:



Activity 2

The Life of the Bee

Teacher Resources

[View Student Course](#)

EQUIPMENT

The list below is based on a class of 30 students.

Included in the Equipment Kit	Not Included in Equipment Kit	Device Applications
• <i>The Life Cycle of a Honeybee</i> by Bobbie Kalman	• PLTW Launch Logs (1 per student) • Digital devices • Life Cycles chart from Activity 1	• Inking or my.pltw.org • Chrome

ESSENTIAL QUESTIONS

EQ

- EQ1** Why are life cycles of organisms important for life on Earth?
- EQ2** How do bees impact our world?
- EQ3** How can a step-by-step process help you design or improve a solution to a problem?



Introduction

In this activity, students learn about the *life cycle* of bees. They compare and contrast the life cycle of the honeybee to that of other animals. Students learn about the *basic needs* of bees, which include food, water, air, and shelter. To meet their basic needs, bees in a colony have three specific roles: queen, worker, and drone. Students categorize the different roles and responsibilities of the bees.

Students explore the relationship between bees and flowering plants. They learn that their life cycles are connected.

Preparation

Professional Development

Before you facilitate Activity 2, access the [Life Cycles and Survival Module-specific PD Resources](#) to review:

- Building Your Understanding: Pollination and Pollinators Part 2
- Building Your Understanding: Honeybees

Part 1. Read and Reflect

1. Become familiar with the vocabulary terms used in this activity. Plan how you will help students use these terms as part of their vocabulary.

basic needs	The resources and conditions that an organism needs to survive.
habitat	The resources and conditions that promote survival in a certain area.
life cycle	The stages an organism goes through from the start of its life through adulthood when it produces offspring.
pollination	The transfer of pollen from the male part of a flower to the female part of the flower.

2. Review the Learning Objectives and Knowledge and Skills in Stage 1 of the [Curriculum Framework](#). Use the Evidence (Stage 2) and Learning Plan (Stage 3) content to plan how you will formatively and summatively assess students throughout this activity.
3. Review the [Additional Instructional Resources](#). This list includes books that offer diverse perspectives that can expand student understanding. Using these resources provides a sense of inclusion and belonging, and helps students make connections if the content is new to them.
4. Review the external resources used in this activity. External resources can include:

- Apps for digital devices
- Web-based apps
- Websites

For each resource, determine if translations in other languages are available to meet the needs of multilingual learners (ML).



5. Read the book *The Life Cycle of the Honeybee* to become familiar with the content. Review the discussion questions in the Procedure.

Part 2. Roles and Needs of Honeybees

Before you begin Part 2, review the presentations in the student course to become familiar with the content students explore.

Part 3. Honeybees and Flowering Plants

Before you begin Part 3, review the [Honeybees and Flowering Plants](#) presentation to become familiar with the content students explore. Review the presentation on a student device to make sure it works.

Note for iPad Users: This resource works best in the Chrome browser. If your students use iPads with Safari as the default browser, show them how to open the resource in the Chrome app. To learn how, view [How to Open an Asset in Chrome on an iPad](#).

Possible Student Misconceptions

- **All bees sting.** Only female bees of certain species can sting. Most bees will not sting unless provoked or threatened.
- **Honeybees can sting their victim repeatedly.** Honeybee workers can sting other insects repeatedly. However, barbs in their stingers get caught in the skin of some animals they sting, especially mammals with thick skin like humans.
- **Bees gather honey from flowers.** Flowers do not contain honey; they contain nectar. Honeybees convert that nectar, which is a complex sugar, into honey. Bees forage on flowers, storing nectar in a special "honey stomach" and then carrying it back to the hive. There, other bees take the regurgitated nectar and break it down into simple sugars using digestive enzymes. The modified nectar is then packed into the cells of the honeycomb. Bees in the hive fan their wings on the honeycomb to evaporate water out of the nectar, resulting in honey.

Procedure

Time: 75 Minutes

Part 1. Read and Reflect

- 1 Direct students to access Activity 2 and have them read the Introduction.



- 2 Have students prepare their PLTW Launch Logs for Activity 2.
- 3 Read aloud pages 10–21 from *The Life Cycle of a Honeybee*. You may choose to use a document viewer to project an image of the book.
- 4 Guide students to view the image of the honeybee life cycle in the student course. Lead a discussion about the book and the image. Prompts:
 - How is a life span different from a life cycle? Direct students to access the flashcard example as you review the vocabulary term *life cycle*.
 - What do you notice about this life cycle that is different from the life cycles you explored in Activity 1?
 - How is the life cycle of a honeybee similar to and different from that of a dog? A frog?
 - What are the three roles of honeybees in a colony? Why do you think each of these roles is important?

Note: Students will learn more about the specific roles of the honeybees in Part 2.

Part 2. Roles and Needs of Honeybees

- 5 Complete a Think-Pair-Share for these questions:
 - What do animals need to survive? Direct students to access the flashcard example as you introduce the vocabulary term *basic needs*.
 - What do honeybees need to survive?
 - How do honeybees meet their basic needs? Direct students to access the flashcard example as you introduce the vocabulary term *habitat*.

Note: Think-Pair-Share is a strategy where students think individually, discuss ideas with a partner, and then share with the whole class. It increases participation and focus.

- 6 Guide students to create a Bee Classifying Chart in their Launch Logs. Students categorize the roles and responsibilities of bees as they view the Roles of Honeybees presentations.

Queen	Worker	Drone

- 7 Direct students to view the Roles of Honeybees presentations in the student course with a partner or small group.
- 8 Lead a discussion about the roles of honeybees. Prompts:
 - What are the primary roles of the different adult honeybees?
 - How do the roles of honeybees support their survival?
 - Which role do you consider to be the most important?



Part 3. Honeybees and Flowering Plants

- 9 Lead a discussion to activate students' prior knowledge regarding the relationship between honeybees and flowering plants. Prompts:
 - Do you think honeybees and flowering plants need one another? Why do you think this?
 - What do you think would happen if bees did not have access to any flowers?
 - What do you think would happen to flowering plants if there were no honeybees?
- 10 Introduce the [Honeybees and Flowering Plants](#) presentation. Guide students to work with a partner or small group to view the presentation. Students take notes in the "L" column of their KWL chart in their Launch Logs while they view the presentation.
- 11 Lead a discussion about the presentation. Add responses to the class KWL chart titled "Life Cycles". Prompts:
 - What are the stages in a flowering plant life cycle?
 - How are the life cycles of the honeybee and apple tree related?
 - Which bee pollinates an apple tree's flowers? Direct students to access the flashcard example as you introduce the vocabulary term *pollination*.
 - How does this connect to your life?
- 12 Guide students to answer the Conclusion Questions. Lead a discussion for students to share their thoughts.

Conclusion Questions Answer Key

- 1 What roles do bees have that are necessary for the survival of the colony?

Student responses should demonstrate an understanding of life cycles. Example response:
Worker bees collect the food and water, feed the queen and drones, and build and maintain the hive. Drones mate with the queen. The queen mates with drones and lays eggs.

- 2 How are life cycles of plants and animals connected?

Student responses should demonstrate an understanding of the connection of life cycles. Example responses:
Bees and flowering plants are connected. Bees pollinate flowers, and flowers provide pollen and nectar to bees.
Other connections include that many animals depend on the plants for food and shelter which are basic needs. Without plants, those animals could not survive.



Activity 3

Animal Behavior

Teacher Resources

[View Student Course](#)

EQUIPMENT

The list below is based on a class of 30 students.

Included in the Equipment Kit	Not Included in Equipment Kit	Device Application
• <i>The Life Cycle of a Honeybee</i> by Bobbie Kalman • Pom-poms (blue, red, yellow, and green)	• PLTW Launch Logs (1 per student) • Digital devices • Pencils or colored pencils for sketching	• Inking or my.pltw.org

RESOURCES

R

- Animal Survival Chart
- Animal Survival Simulation Roles
- Animal Survival Simulation

ESSENTIAL QUESTIONS

EQ

- EQ1** Why are life cycles of organisms important for life on Earth?
- EQ2** How do bees impact our world?
- EQ3** How can a step-by-step process help you design or improve a solution to a problem?



Introduction

In this activity, students are introduced to animal behavior with a focus on animal survival and *basic needs*. They explore the benefits and disadvantages of living a *solitary* life versus living in a group. Students participate in a *simulation* where they take on a specific role within the honeybee hierarchy. Then, students simulate life as a carpenter bee.

Preparation

Part 1. Solitary and Group Life

1. Become familiar with the vocabulary terms used in this activity. Plan how you will help students use these terms as part of their vocabulary.

basic needs	The resources and conditions that an organism needs to survive.
simulation	Something that is made to look, feel, or behave like something else, especially so it can be studied or used to train people.
solitary	Living alone.

2. Review the Learning Objectives and Knowledge and Skills in Stage 1 of the [Curriculum Framework](#). Use the Evidence (Stage 2) and Learning Plan (Stage 3) content to plan how you will formatively and summatively assess students throughout this activity.
3. Review the [Additional Instructional Resources](#). This list includes books that offer diverse perspectives that can expand student understanding. Using these resources provides a sense of inclusion and belonging, and helps students make connections if the content is new to them.
4. Review the external resources used in this activity. External resources can include:
 - Apps for digital devices
 - Web-based apps
 - WebsitesFor each resource, determine if translations in other languages are available to meet the needs of multilingual learners (ML).
5. Print one copy of the Animal Survival Chart for each student. If desired, students can recreate this chart in their Launch Logs. These charts are used here in Activity 3 and later, in the Project.
6. Prepare a piece of chart paper titled "Animal Survival" to share students' notes with the whole class.
7. Another option for sharing students' notes is to create the chart using a digital device and project it for students to view.



Animal Survival				
What impacts survival?	Advantages of Solitary Life	Disadvantages of Solitary Life	Advantages of Group Life	Disadvantages of Group Life
Food				
Safety or Defense				

Part 2. Animal Simulation

1. Review the directions for the [Animal Survival Simulation](#).
2. Complete the preparation for the simulation. Consider moving some of the desks or tables to the perimeter of the room so that you have an open space for students to move around. Or use an existing open space, such as a lobby, gymnasium, or cafeteria.

Possible Student Misconception

All bees live in hives. Only a small percentage of bees build hives. These bees live in groups and are called “social bees”. Most bees are solitary, living in individual nests tunneled in the soil or in tree trunks.

Procedure

Time: 85 Minutes

Part 1. Solitary and Group Life

- 1 Direct students to access Activity 3 in the student course and have them read the Introduction.
- 2 Have students prepare their PLTW Launch Logs for Activity 3.
- 3 Hand out one Animal Survival Chart to each student. If desired, have students recreate this chart in their Launch Logs. Explain to students that the chart organizes their ideas about the advantages and disadvantages of solitary and group living.
- 4 Introduce the [Solitary and Group Living](#) presentation. Direct students to access the flashcard example as you introduce the vocabulary term *solitary*. Guide students to work with a partner or small group to view the presentation. While they view the presentation, students take notes on the Animal Survival chart in the rows labeled “Food” and “Safety or Defense”.



- 5 Lead a discussion about the presentation. Prompts:
- What are some advantages and disadvantages related to finding food when an animal is solitary? When an animal lives in a group?
 - What are some ways to stay safe or defend itself when an animal is solitary? When an animal lives in a group?

Part 2. Animal Simulation

- 6 Read aloud pages 22–26 from *The Life Cycle of a Honeybee*. You may choose to use a document viewer to project an image of the book.
- 7 Lead a discussion about how bees find food. Prompts:
- Which bees find food for the colony?
 - How do they collect the pollen and nectar?
 - How do bees communicate with each other?
 - Which bee performs the most work in the colony? Why do you think that?
- 8 Introduce the Animal Survival simulation. See [Animal Survival Simulation](#) for details. Direct students to access the flashcard example as you introduce the vocabulary term *simulation*.
- 9 Complete the simulation.
- 10 Lead a discussion about the simulation. Students can add their responses to the Animal Survival Chart from Part 1. Prompts:
- What are the benefits of honeybees living in groups? Why do you think this?
 - What are the disadvantages of honeybees living in groups? Why do you think this?
 - What are the benefits of the carpenter bee living a solitary life? Why do you think this?
 - What are the disadvantages of the carpenter bee living a solitary life? Why do you think this?
 - How were the basic needs of the honeybee met in the simulation? Direct students to access the flashcard example as you review the vocabulary term *basic needs*.
 - How were the basic needs of the carpenter bee met in the simulation?
- 11 Guide students to answer the Conclusion Questions. Lead a discussion for students to share their thoughts.

Conclusion Questions Answer Key

- 1 How does living in a group help animals survive?

Student responses should demonstrate an understanding of group life. Example response:
Living in a group can help animals get food. It can also help them defend themselves.

- 2 If you had to pick, would you choose to be an animal that lives alone or in a group? Why would you choose that life?

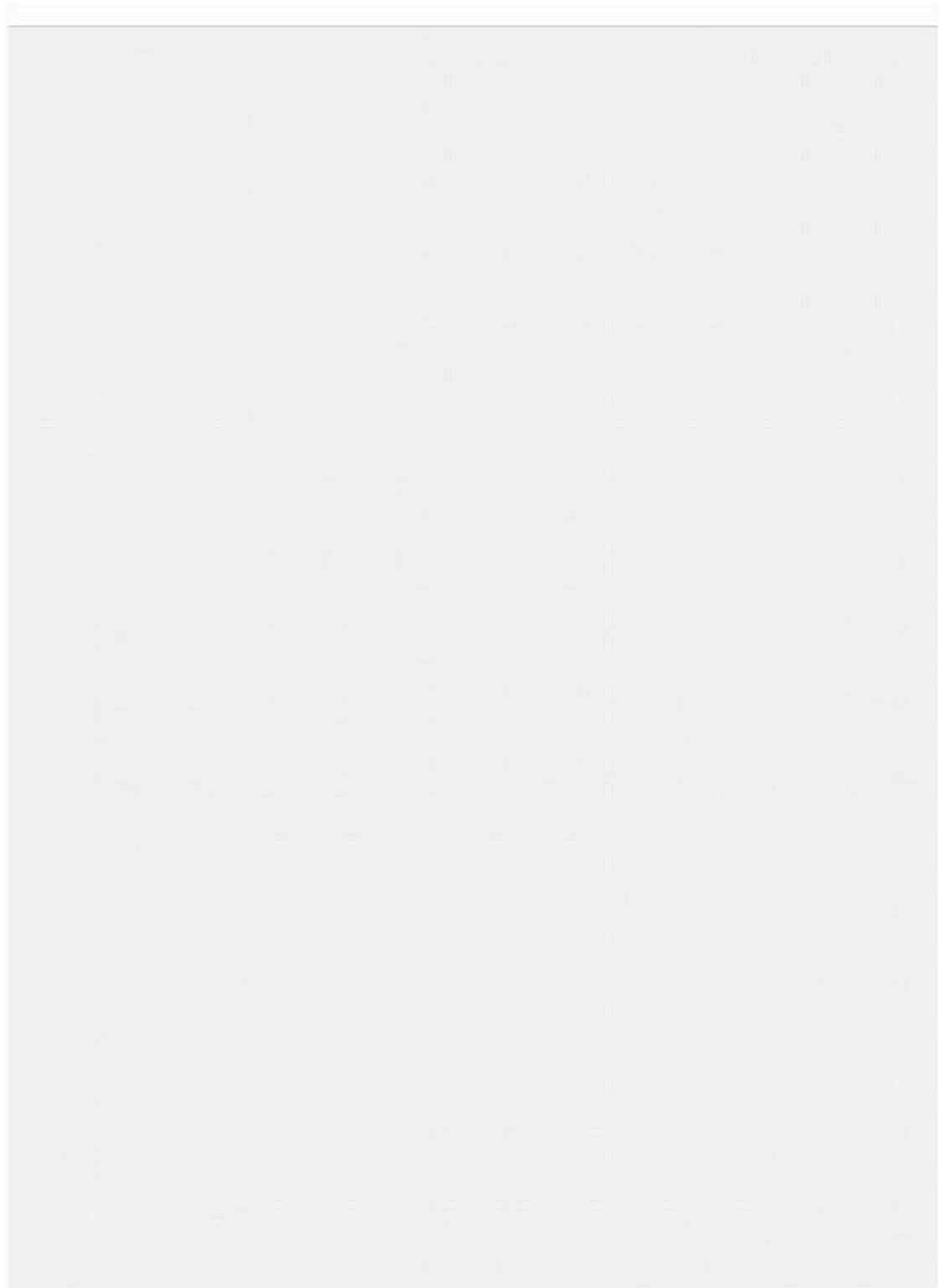
Student responses will vary.



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Introduction to the Module

Programming Patterns

Teacher Resources



Distance Learning Support

For information about PLTW's distance learning support and online learning guides, jump to Distance Learning Support in [PLTW Launch Module-specific PD Resources](#).

For distance learning support for facilitating this module, jump to [Distance Learning Support: Programming Patterns Teacher Guide](#).

PREFACE

Time: 10 instructional hours

This module introduces important computer science concepts, such as abstraction and modularization, which means breaking down problems into smaller ones. Throughout the module, students exhibit confidence in dealing with complexity, persistence in working with difficult problems, and the ability to communicate and collaborate with others to achieve a common objective.

In this module, students create digital interactive stories using events, loops, and conditional statements. Through hands-on activities both with and without a computer, students explore the sequential nature of computer programs. Applying skills and knowledge learned from the activities and project, students work together to design and program a digital interactive story with multiple plot lines.

RESOURCES



Device Specifications



Application List

R



Preparation

Are you ready to teach this module? Hold it right there! As you may remember from PLTW Launch Classroom Teacher Training, to create an engaging learning experience for your students, planning is essential.

This Teacher Guide includes resources you need for both planning and facilitation. The following outline lists the general resources designed to help you prepare to teach this module to your students.

Spanish Language Resources: Printable resources in Spanish are available in the Teacher Guide (Español) for this module.

Connections to Standards and Curriculum Framework

Math Connections

Professional Development

Community

Rostering Students

Family and Community Relationships

PLTW Launch Logs

Developing Vocabulary

Icon Legend

Additional Instructional Resources

Curriculum Revisions



Activity 1

Story Factory

Teacher Resources

[View Student Course](#)

EQUIPMENT

The list below is based on a class of 30 students.

Included in Equipment Kit	Not Included in Equipment Kit	Device Application
• Index cards, 3 × 5-inch (30 per class) • Envelopes (15 per class)	• Launch Logs (one per student) • Digital devices • Markers • Pencils	• Inking or my.pltw.org

RESOURCES

R

-  Story Factory Inbox/Outbox
-  Story Factory Fill-in Stories
-  Story Factory Programs

ESSENTIAL QUESTIONS

EQ

- EQ1** How does technology impact our lives?
- EQ2** How can a step-by-step process help you design or improve a solution to a problem?



Introduction

In this activity, students break into small groups to write a silly story with each group having a specific task to perform. One group assembles the main story while the other groups produce their assigned part of speech (noun, verb, or adjective). This serves as an example of how a computer programmer breaks down a problem into smaller tasks.

Preparation

Professional Development

Before you facilitate Activity 1, review the professional development resources.

- Access the [Launchpad](#) to review the resource, Unpacking PLTW Launch Curriculum Frameworks.
- Access the [Programming Patterns Module-specific PD Resources](#) to review:
 - Computational Thinking
 - Building Computational Thinking with Young Children
 - Use-Modify-Create Framework

Activity

1. Become familiar with the vocabulary terms used in this activity. Plan how you will help students use these terms as part of their vocabulary.

bug	An error in a computer program that causes the program to run incorrectly.
debug	To find and fix errors in a program.
program	A set of code given to a computer to accomplish a task.
sequence	The step-by-step order in which instructions are followed.

2. Review the Learning Objectives and Knowledge and Skills in Stage 1 of the [Curriculum Framework](#). Use the Evidence (Stage 2) and Learning Plan (Stage 3) content to plan how you will formatively and summatively assess students throughout this activity.
3. Determine ways you can support the development of transportable skills in this module. Examples include calling out ways students demonstrate the skills, asking questions that allow students to reflect on their development of the skills, and integrating books listed in the Transportable Skills: Literature Connections resource.
4. Review the [Additional Instructional Resources](#). This list includes books that offer diverse perspectives that can expand student understanding. Using these resources provides a sense of inclusion and belonging, and helps students make connections if the content is new to them.
5. Review the external resources used in this activity. External resources can include:
 - Apps for digital devices
 - Web-based apps
 - Websites



For each resource, determine if translations in other languages are available to meet the needs of multilingual learners (ML).

6. To access a printable version of the Launch Log, go to [PLTW Launch Logs](#).
7. As students engage in learning experiences throughout the module, they may experience technical problems. Encourage them to find potential solutions by following basic troubleshooting strategies, such as:
 - a. Check the Wi-Fi connection.
 - b. Close the application or tab and reopen it.
 - c. Use a different web browser.
 - d. Shut down the digital device and reboot it.



Teacher Tip: Encourage your students to use accurate terminology while troubleshooting. They should be able to identify and describe the basic hardware and software.

8. Prepare one set of envelopes for the class as follows:
 - Gather three colors of markers
 - Use a different colored marker to label the envelopes for each part of speech:
 - noun1, noun2, noun3, noun4, and noun5
 - verb1, verb2, verb3, and verb4
 - adj1, adj2, adj3, adj4, adj5, and adj6
9. Prepare the classroom with four stations: Main Story, Noun, Verb, and Adjective. Each station needs an inbox and outbox. You can print four copies of the Story Factory Inbox/Outbox found in the Resources section or create your own. Also, print the Story Factory Programs resource to place at each station.
10. Print two or three copies of the Story Factory Fill-in Stories for students to complete.
11. Before you begin Activity 1, read the [Introduction Story](#) with students.
12. Optional: Consider whether you will facilitate [Internet Safety](#). During this experience, students will become familiar with the importance of making safe choices in a digital world.

Procedure

Optional: Internet Safety

During the [Internet Safety](#) learning experience, students learn about the importance of making safe choices in the digital world. They explore strategies to keep personal information secure and learn how to use the internet safely and responsibly.



Time: 60 Minutes

1

Direct students to access Activity 1 in the student course and have them read the Introduction.



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- 2 Distribute the Grades 3–5 Launch Log to each student. Students use Launch Logs to keep a record of their work as they progress through the module. In this notebook, they can take notes as they research, create sketches, and answer conclusion questions.
- 3 Introduce the Story Factory activity—a fill-in-the-blank story game. Show a phrasal template, such as a page from Mad Libs®, as an example of a fill-in-the-blank story game.
- 4 Review the parts of speech with students. Focus on nouns, verbs, and adjectives.
- 5 Divide the class into three equal groups to represent nouns, verbs, and adjectives.
- 6 Provide 10 index cards and the designated color of marker to each group. Be sure each group receives the same color of marker as that used on their envelopes.
- 7 Guide the groups to write one noun, verb, or adjective on each card. When all cards are complete, place the cards at the corresponding station.
- 8 Explain to the class that one group of students simulates, or acts out, a program inside a computer as they create a silly story. The other students act as software engineers. They check to see how the program runs and to make sure there aren't any bugs.
- 9 Direct students to access the flashcard example as you introduce the vocabulary terms and .
- 10 Assign students to their Story Factory role. Guide students to access and review their program directions now. Roles include:
 - Main story (two or three students)
 - Messenger (two students)
 - Noun (two or three students)
 - Verb (two or three students)
 - Adjective (two or three students)
 - Software engineers (remaining students)
- 11 Facilitate the creation of the first program, Reading Contest.
- 12 After the first simulation, guide the software engineers to share their feedback. Sample prompts:
 - From your perspective, how did the program run?
 - Did you see any bugs? If so, how did the students debug the program? Direct students to access the flashcard example as you introduce the vocabulary term .
 - Do you have any recommendations to improve the program?
- 13 Lead a discussion with the programmers. Sample prompts:
 - What was the easiest part of your program? Why do you think that?
 - What was the most difficult part of your program? Why do you think that?
 - In your role, you had to follow a specific series of steps in order. Direct students to access the flashcard example as you introduce the vocabulary term . Why was it important to follow the steps in order?
- 14 Choose a new set of students to run the next program, Field Trip. Debrief with the software engineers and programmers when the program is complete.



- 15 Run the remaining programs so all students experience a role.
- 16 Lead a discussion about the simulation. Sample prompts:
 - What did you learn about how a computer operates? Did this surprise you? Why or why not?
 - What was the most difficult part of this simulation? Why do you think that was difficult?
 - Did you notice any changes in the groups as you continued creating the programs? Why do you think this?
 - To write the stories, each group had a role. This represents how a computer programmer breaks down problems into smaller problems. How would this activity have been different if one group had to complete all the programs? Why do you think this?
 - How does this connect to your life?
- 17 Guide students to answer the Conclusion Questions. Lead a discussion for students to share their thoughts.

Conclusion Questions Answer Key

Note: Conclusion questions offer an opportunity for formative assessment. You may use them as a whole-class discussion, or you may have students record ideas in their Launch Logs.

- 1 In Story Factory, each group followed a specific sequence in their program. Think of an everyday activity you perform that uses a sequence. Identify the activity and list the steps of the sequence.

Student responses will vary. Example response:

- a.
- b.
- c.
- d.
- e.
- f.

- 2 Why is it important to follow a sequence in the example above?

Student responses should demonstrate an understanding of sequences. Example response:



Activity 2

Rosie's Path

Teacher Resources

[View Student Course](#)

EQUIPMENT

The list below is based on a class of 30 students.

Included in the Equipment Kit	Not Included in Equipment Kit	Device Application
• Rosie's Runtime card game • Rosie's Runtime game tiles • Rosie's Runtime Loop folders • Rosie's Runtime Run Function cards • Rosie's Runtime Run Function folders • Rosie's Runtime If folders • Floor markers • Dog ears	• Launch Logs (one per student) • Digital devices • 2 × 2-inch self-stick notes (60 per class) • Pencils • Chart paper • Markers	• Inking or my.pitw.org

RESOURCES

R

-  Rosie's Path Instructions
-  Optional: Rosie's Runtime Instructions
-  Computer Science Background

ESSENTIAL QUESTIONS

EQ

- EQ1** How does technology impact our lives?
- EQ2** How can a step-by-step process help you design or improve a solution to a problem?



Introduction

In this activity, students build a *program* using *code cards* to direct Rosie the robotic dog along a path. In this version of the unplugged activity, students use *loops*, *functions*, and *conditional statements*.

Preparation

Professional Development

Before you facilitate Activity 2, access the [Programming Patterns Module-specific PD Resources](#) to review Building Your Understanding: Algorithms.

Part 1. Challenge 1

1. Become familiar with the vocabulary terms used in this activity. Plan how you will help students use these terms as part of their vocabulary.

algorithm	A set of instructions to accomplish a task.
bug	An error in a computer program that causes the program to run incorrectly.
code	The instructions for a program.
conditional statement	A programming element that performs different actions depending on whether a condition is true or false.
debug	To find and fix errors in a program.
function	A named code block that accomplishes a task.
loop	A programming element that repeats a set of code.
program	A set of code given to a computer to accomplish a task.
test	An action taken to check whether a program is working properly.

2. Review the Learning Objectives and Knowledge and Skills in Stage 1 of the [Curriculum Framework](#). Use the Evidence (Stage 2) and Learning Plan (Stage 3) content to plan how you will formatively and summatively assess students throughout this activity.
3. Review the [Additional Instructional Resources](#). This list includes books that offer diverse perspectives that can expand student understanding. Using these resources provides a sense of inclusion and belonging, and helps students make connections if the content is new to them.
4. Review the external resources used in this activity. External resources can include:
 - Apps for digital devices
 - Web-based apps
 - Websites

For each resource, determine if translations in other languages are available to meet the needs of multilingual learners (ML).



5. If your students haven't played Rosie's Runtime in a previous grade, consider beginning with this game. See [Optional Activity: Rosie's Runtime](#).
6. Read [Rosie's Path Instructions](#) to understand how to play the game.
7. Find an open spot in the classroom to place the floor markers.
8. Arrange the floor markers and game tiles for Challenge 1 in [Rosie's Path Instructions](#).
9. Review the [Computer Science Background](#) resource for additional guidance on computer programming concepts.

Possible Student Misconception

A computer can think for itself. Computers can only do what you program them to do. Nothing more, nothing less!

Procedure

Time: 80 Minutes

Part 1. Challenge 1

- 1 Direct students to access Activity 2 and have them read the Introduction.
- 2 Introduce the game, Rosie's Path. Explain to the students that they must create a program for Rosie in which she follows a path to her doghouse. Along the way, Rosie must pick up her bones and avoid the mud puddles. If there are bugs in the program, students must work together to debug it.
- 3 Direct students to access the flashcard examples to review the vocabulary terms *program*, *bug*, and *debug*.
- 4 Share the Rosie's Runtime code cards with the students. Explain how students use these code cards to create their program. See [Rosie's Path Instructions](#) for step-by-step directions. Direct students to access the flashcard example as you introduce the vocabulary term *code*.
- 5 Explain to students how they'll test their programs. Direct students to access the flashcard example as you introduce the vocabulary term *test*.
- 6 Divide the class into groups.
- 7 Guide each group to complete Challenge 1.
- 8 After all groups finish Challenge 1, lead a discussion. Sample prompts:
 - What did you learn about the way Rosie executes code? Did this surprise you? Why or why not?
 - What was the most difficult part of this challenge? Why do you think this?



- Select one group's program and write the code in words on chart paper. Direct students to access the flashcard example as you introduce the vocabulary term *algorithm*. An algorithm is a set of instructions to accomplish a task. It's written for humans to understand. A program is written in a way that computers understand. Guide students to compare and contrast the algorithm and the program.
- Look at the algorithm on the chart paper. Do you see any code that repeats? Do you think there is a better way to write the program? Introduce the Rosie's Runtime loop folders. Direct students to access the flashcard example as you introduce the vocabulary term *loop*. Guide students to look at their program for any code that repeats.

9 Have students rewrite their program for Challenge 1 to include loops. Facilitate the testing of these solutions.

10 After all groups finish Challenge 1, lead a discussion about how loops improve a program.

Part 2. Challenges 2 and 3

11 Guide each group to complete Challenge 2.

- 12 After all groups finish Challenge 2, lead a discussion. Sample prompts:
- Did you use any loops in your program? If so, where were the loops? How did using loops impact what Rosie did in the program? If not, where could you add loops?
 - How did you program Rosie to dance? How might you modify or change your program to use fewer cards? Explain your thinking.
 - Introduce the Rosie's Runtime function cards and function folders. Direct students to access the flashcard example as you introduce the vocabulary term *function*.

13 Have students rewrite their program for Challenge 2 so it contains loops and functions.

14 Guide students to complete Challenge 3.

15 After all groups finish Challenge 3, lead a discussion about the programs created using loops and functions.

Part 3. Challenges 4 and 5

16 Guide students to complete Challenge 4.

- 17 After all groups finish Challenge 4, lead a discussion. Sample prompts:
- How did you use loops and functions in your program?
 - Do you think you could write a program with fewer "jump over" cards? Why do you think this?
 - Introduce the Rosie's Runtime if folders. Direct students to access the flashcard example as you introduce the vocabulary term *conditional statement*. In computer programming, if/then statements are known as conditional statements.

18 Have students rewrite their program for Challenge 4 so it contains conditional statements.

19 Guide students to complete Challenge 5 and discuss the programs as a class.



- 20 Optional: Encourage students to create their own path for Rosie to follow. Have students create the rules for each colored floor marker. Allow time for students to solve each other's challenges.

Note: After students have experience in using and then modifying in computer programming, it's a natural step for them to be able to create. Modeling this in the unplugged activity can illustrate the process used when working with technology.

- 21 Guide students to answer the Conclusion Questions. Lead a discussion for students to share their thoughts.

Conclusion Questions Answer Key

- 1 In Rosie's Path, you used a loop folder to hold the repetitive code. How do loops help improve the program? Support your answer with evidence.

Student responses should demonstrate an understanding of loops. Example response:
With a loop, we wrote a shorter program. For example, if we wanted Rosie to turn left, turn left, turn left, and turn left, we put a turn left card in the folder and wrote a number 4 on the attached sticky note. With fewer cards, the program was completed faster.

- 2 An if/then statement in programming is called a conditional. The program does the steps in the conditional statement only if the condition is true. We use conditions all the time in our daily lives. For example, "If it's raining, we'll have indoor recess." Think of two more conditional statements you use every day.

Student responses should demonstrate an understanding of conditional statements. Example responses:

- *If the fire alarm sounds, we leave the school.*
- *If it's Saturday, I don't go to school.*
- *If I'm hungry, I fix myself a snack.*



Activity 3

Let's Dance!

Teacher Resources

[View Student Course](#)

EQUIPMENT

The list below is based on a class of 30 students.

Not Included in Equipment Kit	Device Applications
• Launch Logs (one per student) • Digital devices • Pencils	• Inklings or my.pltw.org • Scratch (Before signing in, see Preparation for registration information.)

ESSENTIAL QUESTIONS

EQ

EQ1 How does technology impact our lives?

EQ2 How can a step-by-step process help you design or improve a solution to a problem?



Introduction

In this activity, students use *pair programming* to create multiple *programs* in Scratch. They explore the Scratch interface to become familiar with its components. Students view short tutorials to learn more about this web-based application. Then, they use their creativity to program a sprite to dance.

Preparation

Professional Development

Before you facilitate Activity 3, access the [Launchpad](#) to review Integrating Technology and Promoting Online Safety.

Part 1. Introduction to Scratch

Note: Scratch is a project of the Scratch Foundation, in collaboration with the Lifelong Kindergarten Group at the MIT Media Lab. It is available for free at <https://scratch.mit.edu>.

1. Become familiar with the vocabulary terms used in this activity. Plan how you will help students use these terms as part of their vocabulary.

driver	The person who controls the device during pair programming.
navigator	The person who watches closely, makes suggestions, and asks or answers questions during pair programming.
pair programming	When two people work together to create a computer program.

2. Review the Learning Objectives and Knowledge and Skills in Stage 1 of the [Curriculum Framework](#). Use the Evidence (Stage 2) and Learning Plan (Stage 3) content to plan how you will formatively and summatively assess students throughout this activity.
3. Review the [Additional Instructional Resources](#). This list includes books that offer diverse perspectives that can expand student understanding. Using these resources provides a sense of inclusion and belonging, and helps students make connections if the content is new to them.
4. Review the external resources used in this activity. External resources can include:
 - Apps for digital devices
 - Web-based apps
 - WebsitesFor each resource, determine if translations in other languages are available to meet the needs of multilingual learners (ML).
5. At least 24 hours before you start this activity, [register](#) for a Scratch teacher account.
6. After you receive confirmation from Scratch about your teacher account, set up your student accounts. These accounts allow students to save their programs.



Note: When students first access their account, they are asked to share their birth month, birth year, gender, and country. Scratch uses this information for verification and to aggregate usage statistics.

If you would like your students to build projects without submitting personal information to Scratch, download the [Scratch app](#), which is available for Windows, macOS, ChromeOS, and Android operating systems.

Because projects students create in the Scratch app are saved locally, the Scratch Team cannot access them unless students upload projects to the Scratch online community. For more information, see Scratch's [Frequently Asked Questions](#).

7. When using the web-based version of Scratch, direct students to save their projects to their Scratch account to protect student data and privacy. It is recommended that students not share their projects. If students choose to share their projects, they are visible to the entire Scratch community.
8. Decide how you want to divide the class into groups. We recommend that students work with a partner. However, if there are not enough devices, students may work in groups of two to four. Consider borrowing devices from other classrooms to complete the activity.

Optional: If you prefer to have students work in groups of two, but do not have enough devices, consider having half of the class pair program while the other half works in another area of study.

9. Preview the Scratch [tutorials](#). Decide which ones are appropriate for your students based on their previous experience in computer science. Suggested tutorials for students new to Scratch include:
 - Getting Started
 - Add a Backdrop
 - Add a Sprite
 - Animate a Sprite
 - Change Size
10. Become familiar with the Scratch interface or the programming environment. Have fun! Create a few sample programs with the given criteria so you can better facilitate this activity with students.

Possible Student Misconception

Computer programmers work alone all the time. Computer programmers might work alone for a portion of their day. However, they often work together to solve problems. It's important for programmers to communicate and collaborate with others.



Procedure

Time: 90 Minutes

Part 1. Introduction to Scratch

- 1 Direct students to access Activity 3 in the student course and have them read the Introduction.
- 2 Guide students to watch the Pair Programming video in the student course.

Note: In software development, it's common practice to have two programmers work together at the same workstation. The driver writes the code, while the navigator reviews it. This technique is called Pair Programming.

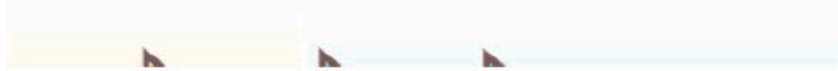
- 3 Direct the students to use the flashcard examples to review the vocabulary terms *pair programming*, *driver*, and *navigator*. Lead a discussion about pair programming:
 - How do you approach learning something new?
 - Why is it important to use pair programming? Why do you think this?
 - How are the roles of driver and navigator different?
 - Even though the navigator is not touching the device, why is their role important? Why do you think this?
- 4 Guide students to label their Launch Log for this activity and reflect on pair programming. Refer to the reflection questions in the student course.
- 5 Divide the class into partners or small groups. (See the note in the Preparation section about grouping strategies.) Remind them of the following:
 - Students take turns in the roles of driver and navigator. The driver controls the device interface and is the only one who touches or clicks the screen. The navigator watches closely, makes suggestions, and asks/answers questions. Students switch roles during the activity.
 - Remind students of the rules of pair programming: Talk to each other about the work, explain what you are doing or thinking, be respectful of each other, and never grab the device from the driver.
- 6 Provide students with their usernames and passwords so they can log in to [Scratch](#).
- 7 After students log in, direct them to click **Create**. When students go to the website, the tutorial screen automatically opens. For now, have the students close the tutorial window.
- 8 Allow the students 10 minutes to explore the Scratch interface. During this time, walk around and view student progress on the basic understanding of the programming environment.
- 9 At the end of 10 minutes, have groups share what they learned.



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- 10 Introduce the Use-Modify-Create Framework to students. Guide students to view the graphic in the student course.



Use-Modify-Create Framework

- 11 Explain to students that they will follow these steps to learn more about programming.
- Use: Interact with tutorials.
 - Modify: Change the sprite, the sprite's action, or backdrop in a program.
 - Create: Write their own programs.
- Use the graphic to help students understand the progression from "Not Mine" to "Mine" as they apply this framework.
- 12 To provide a guided learning experience, direct students to watch a few of the short tutorials. To view the tutorials, guide students to click **Tutorials** on the menu bar. There are many tutorials for students to view. Select the ones that are most appropriate for your students based on their previous experience in computer science. Suggested tutorials for students who are new to Scratch include:
- Getting Started
 - Add a Backdrop
 - Add a Sprite
 - Animate a Sprite
 - Change Size



Notes:

- These tutorials are interactive. Each tutorial has a video and slide presentation. Guide students to view the annotated image in the student procedure.
- Encourage students to view the videos first. Then, have them use the slides to drag out code blocks and test the code.
- Remind the students to test their code incrementally (in small pieces) as they build their programs. Waiting until the program is complete to test it, makes it difficult for students to debug issues in their code and causes frustration.
- Encourage students to remix or modify the program they create in the tutorial. This helps them learn more about programming. They could modify the:
 - Sprite
 - Sprite's action(s)
 - The size of the sprite
 - Backdrop
- Students can refer back to these tutorials at any time throughout the module.
- If you feel your students need a more guided experience, you may walk them through how to add a backdrop, add a sprite, animate a sprite, and change its size.
- You may also allow student groups to collaborate so they can teach each other how to add a backdrop, add a sprite, animate a sprite, and change its size.

13

Lead a discussion about the Scratch programming environment. Sample prompts:

- If you could create any program, what would you create?
- What would you want your sprite to do? How could you use code to program your sprite to do that?
- How well did your team communicate? Share some examples.

Part 2. Dancing Sprites

14

Guide students to work with their group to write a program to make a sprite dance. Encourage students to use what they learned in the tutorials to create a new program.

15

Programs may include:

- Sprite of their choice
- Backdrop of their choice
- Music

Note: There are different ways to add music. Students can add music through the Sound category, or they can enable the music extension. To do this, students need to click **Add Extension** and select **Music**.

16

Allow students about 15 minutes to write a program to make a sprite dance.



Note: It is normal and expected that programs do not work exactly as intended at first. Encourage students to iterate and debug while programming.

- 17 Guide students to give their program a meaningful name. An example might be Dancing Sprite Group 1.



- 18 Have students type the program name in the box and select **File**. Then click **Save Now**.

- 19 At the end of this time, have students share their programs with the class. Display the programs with a projector so all students can view them. Guide students to discuss which blocks they chose to get their sprite to dance.

- 20 Lead a discussion about the programs. Sample prompts:
- What were the similarities in how everyone programmed their sprites to dance? What were the differences?
 - What were the similarities in how everyone added music? What were the differences?
 - What was the biggest challenge you faced? How did you address it?
 - What did you learn from viewing other programs that you'd like to include in a future program?
 - Think about the members of your team. Are all the team members alike? How do you think having team members with different qualities impacts your work?

- 21 Guide students to answer the Conclusion Questions. Lead a discussion for students to share their thoughts.

Conclusion Questions Answer Key

- 1 What did you learn about programming from viewing other students' programs? What would you like to include in future programs?

Responses will vary.

- 2 While testing your program, you probably experienced bugs. How did you debug your program?

Responses will vary.

- 3 How does working in a group help you with programming?

Responses will vary.



Introduction to the Module

Stability and Motion: Forces and Interactions

Teacher Resources



Distance Learning Support

For information about PLTW's distance learning support and online learning guides, jump to Distance Learning Support in [PLTW Launch Module-specific PD Resources](#).

For distance learning support for facilitating this module, jump to [Distance Learning Support: Stability and Motion: Forces and Interactions Teacher Guide](#).

PREFACE

Time: 10 instructional hours

Forces and interactions are at work all around us. We experience pushes and pulls, resistance forces, gravity, and friction in our daily routines.

Students explore, design, sketch, and build both simple and compound machines that demonstrate the use of forces. They test the force of magnets and explore the interaction of the magnetic poles. Students use the skills and knowledge gained in the module to solve an open-ended, real-world problem.

As students work through this module on Stability and Motion: Forces and Interactions, they engage in hands-on experiences and use a step-by-step process to solve problems.

RESOURCES



Device Specifications



Application List

R



Preparation

Are you ready to teach this module? Hold it right there! As you may remember from PLTW Launch Classroom Teacher Training, to create an engaging learning experience for your students, planning is essential.

This Teacher Guide includes resources you need for both planning and facilitation. The following outline lists the general resources designed to help you prepare to teach this module to your students.

Spanish Language Resources: Printable resources in Spanish are available in the Teacher Guide (Español) for this module.

Connections to Standards and Curriculum Framework

Math Connections

Using VEX IQ or VEX GO Components

Professional Development

Community

Rostering Students

Family and Community Relationships

PLTW Launch Logs

Developing Vocabulary

Icon Legend

Additional Instructional Resources

Curriculum Revisions



Activity 1

Introduction to Forces

Teacher Resources

[View Student Course](#)

EQUIPMENT

The list below is based on a class of 30 students.

Included in Equipment Kit	Not Included in Equipment Kit	Device Applications
E. Wells by Robert	- Launch Logs (one per student) - Digital devices - Pencils or colored pencils for sketching - Right triangles made from paper (one per group) - VEX® GO Kit with Storage Case or VEX® IQ Construction Kit (one per group)	- Inking or my.plt.w.org - Chrome

ESSENTIAL QUESTIONS

EQ

- EQ1** In what ways do forces impact your daily life?
- EQ2** How do machines make life easier?
- EQ3** How can a step-by-step process help you design or improve a solution to a problem?



Introduction

In this activity, interactive presentations and literature introduce students to **forces** as a type of **interaction**. Students learn that interactions may occur anywhere, but this module's focus is on the interactions of forces in **the physical world**. After being introduced to simple machines, students build a model with a **simple machine** to move a load.

Preparation

Professional Development

Before you facilitate Activity 1, review the professional development resources.

- Access the [Launchpad](#) to review the resource, Unpacking PLTW Launch Curriculum Frameworks.
- Access the [Stability and Motion: Forces and Interactions Module-specific PD Resources](#) to review:
 - Building Your Understanding: Motion and Forces Part 1
 - Building Your Understanding: Motion and Forces Part 2
 - Simple Machines Infographic
 - Building Your Understanding: Simple Machines Part 1—Inclined Plane and Lever
 - Building Your Understanding: Simple Machines Part 2—Pulley and Wheel and Axle
 - Building Your Understanding: Simple Machines Part 3—Wedge and Screw

Part 1. Forces

1. Become familiar with the vocabulary terms used in this activity. Plan how you will help students use these terms as part of their vocabulary.

effort force	A force applied to move an object over a distance.
force	A push or pull that can make an object move, stop moving, or change direction.
friction	A force that resists the movement of an object. Friction acts in the opposite direction of movement, causing objects to slow down.
interact	To come together and have an effect on each other. When objects push or pull, they interact.
lever	A simple machine that includes a stiff bar that rests on a support called the fulcrum.
pulley	A simple machine that uses grooved wheels and a rope, cable, or chain to raise or lower a load.
resistance force	A force that opposes the direction of motion.
simple machine	A device that changes the direction or magnitude of a force. Simple machines include levers, inclined planes, pulleys, wheels and axles, wedges, and screws.
wheel and axle	A simple machine made of a wheel with a rod (called an axle) through its center.



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2. Review the Learning Objectives and Knowledge and Skills in Stage 1 of the [Curriculum Framework](#). Use the Evidence (Stage 2) and Learning Plan (Stage 3) content to plan how you will formatively and summatively assess students throughout this activity.
3. Determine ways you can support the development of transportable skills in this module. Examples include calling out ways students demonstrate the skills, asking questions that allow students to reflect on their development of the skills, and integrating books listed in the Transportable Skills: Literature Connections resource.
4. Review the [Additional Instructional Resources](#). This list includes books that offer diverse perspectives that can expand student understanding. Using these resources provides a sense of inclusion and belonging, and helps students make connections if the content is new to them.
5. Review the external resources used in this activity. External resources can include:
 - Apps for digital devices
 - Web-based apps
 - WebsitesFor each resource, determine if translations in other languages are available to meet the needs of multilingual learners (ML).
6. To access a printable version of the Launch Log, go to [PLTW Launch Logs](#).
7. Before you begin Activity 1, read the [Introduction Story](#): _____ with students.
8. Review the [Introduction to Forces](#) and [Effort and Resistance Force](#) presentations to become familiar with the content. Review the presentations on a student device to make sure they work.

Note for iPad Users: These resources work best in the Chrome browser. If your students use iPads with Safari as the default browser, show them how to open the resources in the Chrome app. To learn how, view [How to Open an Asset in Chrome on an iPad](#).

9. As students engage in learning experiences throughout the module, they may experience technical problems. Encourage them to find potential solutions by following basic troubleshooting strategies, such as:
 - a. Check the Wi-Fi connection.
 - b. Close the application or tab and reopen it.
 - c. Use a different web browser.
 - d. Shut down the digital device and reboot it.



Teacher Tip: Encourage your students to use accurate terminology while troubleshooting. They should be able to identify and describe the basic hardware and software.

10. Optional: Consider whether you will facilitate [Internet Safety](#). During this experience, students will become familiar with the importance of making safe choices in a digital world.

Part 2. Simple Machines

1. Cut right triangles out of paper. You need one right triangle for each partner group.
2. Using a standard piece of paper, cut the paper in half width-wise.
3. Cut each half diagonally to make four right triangles.



Part 3. Wheel and Axle

1. Before you begin Part 3, organize the VEX kits. These kits may be organized in multiple ways. If you are sharing materials, be sure to organize them in a way that works for you and your school. If you need more support, collaborate with other teachers in the Community tool at myPLTW.org to see how they organize their VEX kits.
2. Consider developing guidelines for how students will use the kits, clean up, and store the materials.
3. Decide how you'll divide your class into groups. Students may be in groups of two to four students. Since this is the first build, it may be best to work in smaller groups.

Possible Student Misconceptions

- **An object is hard to push because it is big.** The size of an object does not indicate the amount of force needed to push or move it. For example, a large, empty cardboard box doesn't take much force to push or pull. Whereas, a brick would take more force to push or pull.
- **If an object is not moving, no force is acting on it. For example, some believe that a stationary object has no forces acting on it at all.** Objects with balanced forces acting on them may not move. Balanced forces are equal in magnitude and opposite in direction, so an object that is at rest continues to have forces acting upon it.
- **Moving objects stop because the "force runs out".** A moving object's force gradually fades and eventually stops because no force is acting upon it. This fact is known as the Impetus Theory.
- **Only living things can cause movement of objects.** Nonliving objects can apply force to other objects as well. For example, a spring exerts a force in a Jack-in-the-box toy.

Procedure

Optional: Internet Safety

During the [Internet Safety](#) learning experience, students learn about the importance of making safe choices in the digital world. They explore strategies to keep personal information secure and learn how to use the internet safely and responsibly.



Time: 80 Minutes



Part 1. Forces

- 1 Direct students to access Activity 1 in the student course and have them read the Introduction.
- 2 Distribute the Grades 3–5 Launch Log to each student. Students use Launch Logs to keep a record of their work as they progress through the module. They may take notes as they research, create sketches, and answer conclusion questions in this notebook.
- 3 Guide students to label a new page in their Launch Logs with the heading, “Forces”.
- 4 Introduce the [Introduction to Forces](#) presentation. Guide students to work with a partner or small group to view the presentation. While viewing the presentation, students complete drag and drop activities and record written responses in their Launch Logs.
- 5 Lead a discussion about the presentation. Sample prompts:
 - What is a force? Direct students to access the flashcard example as you introduce the vocabulary term . What is an example of a push or a pull you used today?
 - What is an interaction? Direct student to access the flashcard example as you introduce the vocabulary term . How do magnets interact with each other?
 - What is friction? Direct students to access the flashcard example as you introduce the vocabulary term . When have you experienced friction?
 - On the images of the slide and the sled, how was friction at work? How did friction resist the movement of the objects or people?
 - To demonstrate a force on a chair, push or pull it across the floor. Ask students to identify the force (push or pull), explain how gravity affects the chair, and identify friction while moving the chair.
 - Where have you seen the phenomena before? Tell me more.
- 6 Introduce the [Effort and Resistance Force](#) presentation. Guide students to work with a partner or small group to view the presentation. While viewing the presentation, students complete drag-and-drop activities and record written responses in their Launch Logs.
 - What were some of the ways you recorded in your Launch Log to move the heavy box? Direct students to access the flashcard examples as you introduce the vocabulary terms and . Identify the effort force and resistance force when moving a heavy box.
 - Present other scenarios such as:
 - If I try to lift several large books off the table, what is the effort force and what is the resistance force?
 - When I pick up a backpack, what is the effort force and what is the resistance force?

Part 2. Simple Machines

- 7 Read the book aloud for students. You may choose to use a document viewer to project an image of the book.
- 8 Direct students to access the flashcard examples as you introduce the vocabulary terms , , and .



- 9 Using the information from _____, lead a discussion about forces and simple machines. Sample prompts:
- How does a lever help you to lift a heavy weight?
 - A lever has a force side and a load side. Which side represents the effort force? Which side represents the resistance force?
 - How does a wheel and axle system make it easier to move a load?
 - How does a pulley system make it easier to move a load?
 - Where have you seen the phenomena in your community? Tell me more.
 - How can you apply what you have learned to your life?
- 10 Guide students to view the [Simple Machines](#) presentation to learn more about the six types of simple machines. Hand out to each group a piece of paper precut in the shape of a right triangle. Students will use the paper and a pencil to make a model of a screw.
- 11 Lead students in a discussion about the presentation. Sample prompts:
- We have learned that it takes an effort force to move a load. What simple machine can be used to make the work seem easier?
 - What are the six types of simple machines?
 - What are some common examples of simple machines?
 - Can you identify a simple machine in our classroom?
- 12 When learning is connected to the real world, students can make meaning of the concepts they learn in school. To help students make this connection for the screw and wedge, direct students to watch the Simple Machines: Screw and Simple Machines: Wedge videos.

Part 3. Wheel and Axle

Note: This may be the first time your students have worked with the VEX kits. You may want to provide time for them to explore how the pieces fit together or the organization of the kits. Be sure to set expectations for how to use the materials, how to put everything away, and what to do with pieces found on the floor. If you need more support, collaborate with other teachers in the Community group at myPLTW.org.

- 13 Guide students to work in their small groups to build a model that uses a wheel and axle to move a load. Students may create the load using VEX components, or they may use other materials you provide. Set a time limit for this build and make students aware of it before they begin working.
- 14 Direct students to share their wheel and axle models with the class and discuss how the models help to move a load.
- 15 Have students disassemble their models.
- 16 To help students connect the concepts of the wheel and axle to the real world, direct students to watch the Simple Machines: Wheel and Axle video.



- 17 Guide students to answer the Conclusion Questions. Lead a discussion for students to share their thoughts.

Conclusion Questions Answer Key

Note: Conclusion questions offer an opportunity for formative assessment. You may use them as a whole-class discussion or you may have students record ideas in their Launch Logs.

- 1 Describe an action that shows two forces you used as you got ready for school today. Answer these questions:

- Were you using a push or a pull in each interaction?
- What was the effort force?
- What was the resistance force?

Student responses should demonstrate an understanding of forces. Example response:

- 2 Name an object found on a playground that uses a simple machine to make it work. What kind of simple machine is used? How would the playground be different if there were no simple machines there?

Student responses should demonstrate an understanding of simple machines. Example response:



Activity 2

Simple Machines and Forces

Teacher Resources

[View Student Course](#)

EQUIPMENT

The list below is based on a class of 30 students.

Included in Equipment Kit	Not Included in Equipment Kit	Device Applications
String (one 12-inch length per group)	- Launch Logs (one per student) - Digital devices - Pencils or colored pencils for sketching - VEX® GO Kit with Storage Case or VEX® IQ Construction Kit (one per group) - Ramp, such as: - Plywood - Cardboard - Box lid	- Inking or my.pltw.org - Camera - Presentation app, such as: - ShowMe Interactive Whiteboard - Popplet Lite - Mindomo - Zoho Show

RESOURCES

R

- [VEX GO Inclined Plane Build Instructions](#)
- [VEX GO Lever Build Instructions](#)
- [VEX GO Pulley Build Instructions](#)
- [VEX IQ Inclined Plane Build Instructions](#)
- [VEX IQ Lever Build Instructions](#)
- [VEX IQ Pulley Build Instructions](#)

ESSENTIAL QUESTIONS

EQ

- EQ1** In what ways do forces impact your daily life?
- EQ2** How do machines make life easier?
- EQ3** How can a step-by-step process help you design or improve a solution to a problem?



Introduction

In this activity, students explore three *simple machines*—the *inclined plane*, *lever*, and *pulley*. Students use the VEX® GO or VEX® IQ components to build each machine. After building, they sketch and interact with each machine, focusing on the reduction in force or the change in direction that each simple machine causes.

Preparation

Before you begin Activity 2, assemble the three simple machines to become familiar with the builds. The directions for building each model are in the [student course](#).

Notes

- Build instructions are available for VEX GO and VEX IQ components. Guide students to use the build instructions for their VEX components.
- You can access the build files required to work with the VEX GO or VEX IQ components in multiple ways. Please refer to [Using VEX GO or VEX IQ Components](#) to decide which option to use.
- With the 3D build instructions, students can:
 - Advance the animation step-by-step, view all steps, or jump to a specific step.
 - To view the animation step-by-step, select the Play button.
 - To view all steps or jump to a specific step, select the down arrow.
 - View the name of a component by selecting it.
 - Zoom in or zoom out to get a better view of the model.
 - Rotate the model to see all sides of it.
- If your students need additional support identifying the VEX IQ components, provide a printed copy of the [VEX IQ Equipment Lists](#) to each group.

Part 1. Inclined Plane

1. Become familiar with the vocabulary terms used in this activity. Plan how you will help students use these terms as part of their vocabulary.



effort force	A force applied to move an object over a distance.
inclined plane	A simple machine that is a sloping (or slanted) surface that can be used to raise or lower a load.
lever	A simple machine that includes a stiff bar that rests on a support called the fulcrum.
pulley	A simple machine that uses grooved wheels and a rope, cable, or chain to raise or lower a load.
resistance force	A force that opposes the direction of motion.
simple machine	A device that changes the direction or magnitude of a force. Simple machines include levers, inclined planes, pulleys, wheels and axles, wedges, and screws.

2. Review the Learning Objectives and Knowledge and Skills in Stage 1 of the [Curriculum Framework](#). Use the Evidence (Stage 2) and Learning Plan (Stage 3) content to plan how you will formatively and summatively assess students throughout this activity.
3. Review the [Additional Instructional Resources](#). This list includes books that offer diverse perspectives that can expand student understanding. Using these resources provides a sense of inclusion and belonging, and helps students make connections if the content is new to them.
4. Review the external resources used in this activity. External resources can include:
 - Apps for digital devices
 - Web-based apps
 - Websites

For each resource, determine if translations in other languages are available to meet the needs of multilingual learners (ML).

5. Construct a simple ramp in the classroom using a board, piece of cardboard, or box lid.

Possible Student Misconception

All machines require power. Simple machines and many other machines can be powered by humans.

Procedure

Time: 140 Minutes

Part 1. Inclined Plane

- 1 Direct students to access Activity 2 in the student course and have them read the Introduction.
- 2 Direct students to access the flashcard examples to review the vocabulary terms *simple machine*, *effort force*, and *resistance force*.



3 Direct students to access the flashcard example as you introduce the vocabulary term *inclined plane*.

4 Guide students to work with their small group to build the inclined plane. Direct them to use the VEX GO or VEX IQ Inclined Plane 3D Build Instructions in the student course.

Note: If needed, students can follow the directions in the [VEX GO Inclined Plane Build Instructions](#) or [VEX IQ Inclined Plane Build Instructions](#) to build the model.

5 To facilitate the creation of the inclined planes, walk around the room and monitor group work.

6 As students complete the build, have them take a photo of the inclined plane. Guide students to interact with the inclined plane as indicated in the student procedure.

7 Because VEX® components are very light, it's difficult to feel the reduction in force that occurs when an object is pushed up a ramp versus when it's picked straight up. To better demonstrate this concept, have students pick up a heavy book from the floor and feel the force required. Then, have them push the heavy book up the ramp you created in preparation to compare the amount of force needed.

8 After all groups have interacted with the inclined plane, lead students in a discussion. Sample prompts:

- When pushing the load up the inclined plane, did it take more or less force than picking up the load?
- Which distance was greater—the height of the inclined plane or the length of the inclined plane?

Note: The length of the inclined plane will always be greater than the height. When the length of the inclined plane is longer, it reduces the amount of effort force required.

- What is the effort force and the resistance force? Why do you think that?
- Where have you seen other examples of inclined planes? How did those inclined planes help reduce the amount of force required? Explain your thinking.
- Direct students to access the flashcard example as you introduce the vocabulary term *friction*.
 - Where did you experience friction in the inclined plane?
 - How did friction affect the force required to move the load?

9 To help students connect the concepts of the inclined plane to the real world, direct students to watch the Simple Machines: Inclined Plane video.

10 If students are using VEX GO components, guide them to take apart the inclined plane and return the parts to the appropriate kit.



- 11 Direct students to access the flashcard example as you introduce the vocabulary term *lever*.
- 12 Guide students to work with their small group to build the lever. Direct them to use the VEX GO or VEX IQ Lever 3D Build Instructions in the student course.

Note: If needed, students can follow the directions in the [VEX GO Lever Build Instructions](#) or [VEX IQ Lever Build Instructions](#) to build the model.

- 13 To facilitate the creation of the levers, walk around the room and monitor group work.
- 14 As students complete the build, have them take a photo of the lever. Guide students to interact with the lever as indicated in the student procedure.
- 15 After all groups have interacted with the lever, lead students in a discussion. Sample prompts:
 - What are the effort force and the resistance force? Why do you think that?
 - How did the placement of the fulcrum affect the amount of force required to move the load?
 - How did the placement of the fulcrum affect the distance that the force side moved?

Note: Students should conclude that the force required to move a load is reduced when the fulcrum is closer to the load. Due to the fulcrum being closer to the load, the force side moved a greater distance.

- 16 To help students connect the concepts of the lever to the real world, direct students to watch the Simple Machines: Lever video.
- 17 If students are using VEX GO components, guide them to take apart the inclined plane and return the parts to the appropriate kit.

Part 3. Pulley

- 18 Direct students to access the flashcard example as you introduce the vocabulary term *pulley*.
- 19 Guide students to work with their small group to build the pulley. Direct them to use the VEX GO or VEX IQ Pulley 3D Build Instructions in the student course.

Note: If needed, students can follow the directions in the [VEX GO Pulley Build Instructions](#) or [VEX IQ Pulley Build Instructions](#) to build the model.

- 20 To facilitate the creation of the pulleys, walk around the room and monitor group work.
- 21 As students complete the build, have them take a photo of the pulley. Guide students to interact with the pulley as indicated in the student procedure.



- 22 After all groups have interacted with the pulley, lead students in a discussion. Sample prompts:
- What are the effort force and the resistance force? Why do you think that?
 - How does a pulley change the direction of force needed to move a load? Why do you think that?

Note: There are different types of pulley systems. In this activity, students build a fixed pulley. With a fixed pulley, the amount of force needed to move a load is the same as that required to pick up the load from the ground. However, the fixed pulley changes the direction of the force.

- 23 To help students connect the concepts of the pulley to the real world, direct students to watch the Simple Machines: Pulley video.
- 24 Instruct students to disassemble all simple machines and return the components to the appropriate kits.

Part 4. Reflection

- 25 Guide students to read Simple Machines to the Rescue! in the student course.
- Prompt students to explore the slideshow and make observations about the simple machines the first responders are using in each photograph.
 - Use the reflection question to guide student discussion.



If a disaster were to occur in your community, what support or resources do you think you might need? What might you do to prepare for an event like this?

Optional Extension: Research and share with students some ways that FEMA has provided support in your community, region, or state. Consider inviting a first responder to share about what motivates them to do this work.

- 26 Guide students to create a presentation using ShowMe Interactive Whiteboard, Popplet Lite, Mindomo, or Zoho Show. The presentation should include:
- A picture of each simple machine
 - Everyday examples of the simple machines
 - Benefits of the simple machines
- 27 Allow students to share their presentations with the class.
- 28 Guide students to answer the Conclusion Questions. Lead a discussion for students to share their thoughts.



Conclusion Questions Answer Key

- 1 Describe one common simple machine in your life and explain how it reduces the amount of force required or changes the direction of the force.

Student responses should demonstrate an understanding of simple machines. Example response:

My water bottle cap is actually a type of screw because of its threads. The threads reduce the amount of force by making it easier to open and close the bottle with a simple turn. The threads also change the direction of force from an up and down movement to a turning movement to remove the cap.

- 2 How would the world be different if there were no simple machines? Why do you think that?

Student responses should demonstrate an understanding of simple machines. Example response:

Without simple machines, many tasks would be more difficult. For example, raising the flag up the flag pole would be much harder without a pulley. You would need to use a ladder to climb to the top of the pole to attach the flag.

- 3 Think about a task you do at school, at home, or in your community that requires you to use force. How could you use a simple machine to change the amount of force or direction of force needed to complete the task?

Student responses should demonstrate an understanding of simple machines. Example response:

Sometimes my backpack gets very heavy because of all the books inside. If my backpack had wheels, it wouldn't take as much force to move it.



Activity 3

Forces and Interactions in Compound Machines

Teacher Resources

[View Student Course](#)

EQUIPMENT

The list below is based on a class of 30 students.

Included in Equipment Kit	Not Included in Equipment Kit	Device Applications
• String	• Launch Logs (one per student) • Digital devices • Pencils or colored pencils for sketching • VEX® GO Kit with Storage Case or VEX® IQ Construction Kit (one per group)	• Inking or my.pltw.org • Camera

ESSENTIAL QUESTIONS

EQ

EQ1 In what ways do forces impact your daily life?

EQ2 How do machines make life easier?

EQ3 How can a step-by-step process help you design or improve a solution to a problem?



Introduction

In this activity, students expand their understanding of simple machines to learn about *compound machines*. Using the *design process*, students combine two or more of the simple machines they explored previously to solve a problem.

Preparation

Professional Development

Before you facilitate Activity 3, review the professional development resources.

- Access the [Launchpad](#) to review the resource, Thinking Like an Engineer.
- Access the [Stability and Motion: Forces and Interactions Module-specific PD Resources](#) to review Building Your Understanding: Compound Machines.

Activity 3

1. Become familiar with the vocabulary terms used in this activity. Plan how you will help students use these terms as part of their vocabulary.

design process A step-by-step way to solve problems.

compound machine A device made of two or more simple machines.

2. Review the Learning Objectives and Knowledge and Skills in Stage 1 of the [Curriculum Framework](#). Use the Evidence (Stage 2) and Learning Plan (Stage 3) content to plan how you will formatively and summatively assess students throughout this activity.
3. Review the [Additional Instructional Resources](#). This list includes books that offer diverse perspectives that can expand student understanding. Using these resources provides a sense of inclusion and belonging, and helps students make connections if the content is new to them.
4. Review the external resources used in this activity. External resources can include:
 - Apps for digital devices
 - Web-based apps
 - Websites

For each resource, determine if translations in other languages are available to meet the needs of multilingual learners (ML).

5. During the Explore step of the design process, students are encouraged to research compound machines. Visit your school or local library to gather age-appropriate books about compound machines. As an alternative, you may use age-appropriate websites or device applications for students to explore to gather research.



Possible Student Misconception

Machines produce more work than we put into them. Many machines have energy sources, meaning they are powered by electricity or they burn fuel. Taking this into account, the energy the machines use up is greater than the work they do. Regarding simple machines, the work put into the machine is the work you get out, assuming there is no friction.

Procedure

Time: 120 Minutes

- 1 Direct students to access Activity 3 in the student course and have them read the Introduction.
- 2 Guide students to look at the photographs of the skateboard, hand pruners, and fishing rod in the student course. Have students think about what these objects have in common.

Students should notice that all of these objects include two or more simple machines.

- The skateboard includes a lever (the board and upturned ends) and wheel and axle (the wheels). These simple machines work together to enable the rider to perform tricks on the skateboard.
- The hand pruners include a lever (the handles) and wedge (the blades). These simple machines work together to make cutting easier.
- The fishing rod and reel include a lever (the rod), pulley (the reel), and wedge (the hook). These simple machines work together to make it easier to catch and reel in a fish.

Share with students that these objects are compound machines. Direct students to access the flashcard example as you introduce the vocabulary term *compound machine*.

- 3 Explain to students that they are going to use the design process to build a model of a compound machine. The compound machine should include two or more simple machines that work together.
 - Ask students to share examples of how they've used a step-by-step process to complete a task. Examples include:
 - Getting ready for school
 - Brushing their teeth
 - Solving a math problem
 - Making a snack
 - Explain to the students that they are going to use the same steps engineers use to design new items and improve existing items.



- 4 Present the Design Process video as an introduction to engineers and the design process.



Design Process video

- 5 Lead a discussion about what students learned from the Design Process video.
- Ask students the following questions:
 - Why do engineers use the design process? Direct students to access the flashcard example as you introduce the vocabulary term *design process*.
 - How do you think the design process helps engineers in their work?
 - Why is it important to ask questions as you work through the design process? Why do you think that?
 - In the video, we learned that, "it is important to understand the problem before looking for a solution."
 - Have you ever identified a problem and then looked for a solution? Allow students to share their thoughts.

- 6 The first step in the design process is **Ask**.
- Guide a discussion where students ask questions to gather information that will help them define the problem.

Note: This is an open-ended problem. Students may design any compound machine. This compound machine may be in existence today, or it may be something that does not yet exist. To make a community connection, feel free to pose a local problem to the students and have them design a compound machine that solves the problem.

- With support and guidance, the students define the problem, "How can we design a compound machine using at least two simple machines?"
- Tell students that their model:
 - Must include two or more different simple machines
 - Must be constructed using VEX components
 - May use string if desired
 - Must be completed within a given time limit



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7

The second step in the design process is **Explore**.

- Encourage students to research common compound machines. Students can also view the Compound Machines flashcards in the student course.
- Allow students to explore ideas by brainstorming in small groups about ideas for their compound machines.
- Guide students to sketch ideas for their compound machine design in their Launch Logs. Direct them to label their sketches.

8

The third step in the design process is **Model**.

- Ask the students to circle their best design, if they drew more than one idea.
- Guide students to share their ideas and sketches with the group. Encourage students to be open minded to all ideas. Guide students to select the design that best meets the criteria discussed in the Ask step of the design process.
- To facilitate creation of the compound machines, circle around the room and assess student progress. Ask students to share their ideas and their thinking with you as they work.
- Have students add a drawing or a photograph of their model in their Launch Logs.

9

The fourth step in the design process is **Evaluate**.

- Explain to students how they will conduct a fair test to determine how well their model solves the design problem. Use the following steps:
 - Conduct three trials
 - Use a camera to record the trials
 - Document the results of the trials in the Launch Logs
- Encourage students to discuss the results to determine if their model solved the problem.
- Guide students to reflect on strengths and weaknesses of their designs and record this in their Launch Logs.

10

The fifth step in the design process is **Explain**.

- Direct students to share their compound machines with the class and discuss why they built them the way they did. Lead a discussion about the features, strengths, and weaknesses of the different compound machine designs.
 - Did your final model look like your sketch? Why or why not?
 - What simple machines did you incorporate in your compound machine?
 - Identify the effort force and resistance force within the compound machine.
 - What was the task of your compound machine? Was it able to accomplish this task?
 - If you could improve anything in your compound machine, what would you improve? Why would you improve that?
 - What was the most challenging part of the design process? Why do you think that?
 - How did you contribute to the success of your team's design?
 - How did your team members contribute to the success of the design?



Notes

- Students may not be able to move their compound machines to one central location for sharing with the class. Feel free to move around the room as a class to observe the compound machines in action.
- If the compound machines have been disassembled before sharing with the class, have students share their video recording of one trial.

- 11 When students explore careers, they can see connections between what they are learning and how it is applied in the real world. Guide students to read about heavy equipment operators. As an option, you can read this aloud to students. Remind students that these compound machines are made up of simple machines that work together to perform tasks. Help students identify the simple machines that work together on these compound machines.
- 12 Lead a discussion for students to consider how the construction industry would be different without compound machines.
- 13 Guide students to answer the Conclusion Questions. Lead a discussion for students to share their thoughts.

Conclusion Questions Answer Key

- 1 Now that you've seen other compound machine designs and how other students used the materials, what would you do differently if you could start all over? Why would you make these changes?

Student responses will vary.

- 2 Describe a common compound machine. How do you know that it's a compound machine? Support your answer with evidence.

Student responses should demonstrate an understanding of compound machines. Example response:

Scissors are a common compound machine. I know scissors are a compound machine because they contain two levers (the handles) and two wedges (the blades). These simple machines work together as a compound machine to make it easier to cut through material.



Introduction to the Module

Stability and Motion: Science of Flight

Teacher Resources



Distance Learning Support

For information about PLTW's distance learning support and online learning guides, jump to Distance Learning Support in [PLTW Launch Module-specific PD Resources](#).

For distance learning support for facilitating this module, jump to [Distance Learning Support: Stability and Motion: Science of Flight Teacher Guide](#).

PREFACE

Time: 10 instructional hours

Air is all around us. We know that air can hold up heavier-than-air objects, such as kites, gliders, and airplanes, but how does it do that? What forces act on an airplane or glider? Students use aerodynamic concepts to explain how the motion of air and other forces act on gliders and other aircraft.

Gliders and other aircraft use wings to develop the lift needed to fly. Wing shapes, sometimes called airfoils, provide lift. Wings must have the proper angle of attack—the angle at which a wing meets the flow of air. Because of their design, the airfoils can overcome gravity acting on the aircraft. Research and testing has shown that a wing with a streamlined shape and a body or fuselage that is streamlined can help overcome drag.

In this module, students design, build, and test an experimental model glider as they learn about the forces involved in flight. In addition, students apply the engineering design process to the problem of airlifting supplies to a remote area.



RESOURCES

R

-  Device Specifications
-  Application List

Preparation

Are you ready to teach this module? Hold it right there! As you may remember from PLTW Launch Classroom Teacher Training, to create an engaging learning experience for your students, planning is essential.

This Teacher Guide includes resources you need for both planning and facilitation. The following outline lists the general resources designed to help you prepare to teach this module to your students.

Spanish Language Resources: Printable resources in Spanish are available in the Teacher Guide (Español) for this module.

Connections to Standards and Curriculum Framework

Math Connections

Professional Development

Community

Rostering Students

Family and Community Relationships

PLTW Launch Logs

Developing Vocabulary

Icon Legend

Additional Instructional Resources

Curriculum Revisions



Activity 1

Balanced and Unbalanced Forces

Teacher Resources

[View Student Course](#)

EQUIPMENT

The list below is based on a class of 30 students.

Included in Equipment Kit	Not Included in Equipment Kit	Device Application
• Binder clips (three per group) • Large paper clips (six per group) • Small paper clips (six per group)	• Launch Logs (one per student) • Digital devices • Pencils or colored pencils for sketching • Ruler, 12-inch (one per group) • Ball (one per class), such as: ◦ Soccer ball ◦ Basketball ◦ Softball	• Inking or my.pltw.org

ESSENTIAL QUESTIONS

EQ

- EQ1** In what ways do forces impact our world?
- EQ2** How do balanced and unbalanced forces affect aircraft flight?
- EQ3** How can a step-by-step process help you design or improve a solution to a problem?



Introduction

In this activity, students build a teeter-totter to learn about *balanced* and *unbalanced* forces. They add weight to their teeter-totter and explore the causes of motion and stability.

Exploring forces and recognizing whether they are balanced or unbalanced helps students gain an understanding of the science of flight.

Preparation

Professional Development

Before you facilitate Activity 1, review the professional development resources.

- Access the [Launchpad](#) to review the resource, Unpacking PLTW Launch Curriculum Frameworks.
- Access the [Stability and Motion: Science of Flight Module-specific PD Resources](#) to review:
 - Building Your Understanding: Motion and Forces Part 1
 - Building Your Understanding: Motion and Forces Part 2
 - Building Your Understanding: Gliders and Flight

Part 1. Teeter-Totter

1. Become familiar with the vocabulary terms used in this activity. Plan how you will help students use these terms as part of their vocabulary.

aircraft	All types of vehicles that fly or move through the air.
balanced forces	Two forces that are equal in size acting in opposite directions on an object.
force	A push or pull that can make an object move, stop moving, or change direction.
gravity	A force that pulls two objects toward one another.
unbalanced forces	Two forces that are not equal in size acting in opposite directions on an object.

2. Review the Learning Objectives and Knowledge and Skills in Stage 1 of the [Curriculum Framework](#). Use the Evidence (Stage 2) and Learning Plan (Stage 3) content to plan how you will formatively and summatively assess students throughout this activity.
3. Determine ways you can support the development of transportable skills in this module. Examples include calling out ways students demonstrate the skills, asking questions that allow students to reflect on their development of the skills, and integrating books listed in the Transportable Skills: Literature Connections resource.
4. Review the [Additional Instructional Resources](#). This list includes books that offer diverse perspectives that can expand student understanding. Using these resources provides a sense of inclusion and belonging, and helps students make connections if the content is new to them.
5. To access a printable version of the Launch Log, go to [PLTW Launch Logs](#).
6. Review the external resources used in this activity. External resources can include:



- Apps for digital devices
- Web-based apps
- Websites

For each resource, determine if translations in other languages are available to meet the needs of multilingual learners (ML).

7. Before you begin Activity 1, read Chapter 1: Helping Others of the [Introduction Story](#): _____ with students. This story involves a scenario where the United States National Guard delivers aid to a remote area. Students may need some background on the National Guard. The National Guard was founded in 1636, and much has changed since then. National Guard Soldiers hold civilian jobs or attend college while maintaining their military training part time. They must always be ready to respond in the event of an emergency. National Guard Soldiers may serve overseas combat missions, but their primary area of operation is their home state. If a natural disaster strikes at home, the National Guard is there to respond.
8. As students engage in learning experiences throughout the module, they may experience technical problems. Encourage them to find potential solutions by following basic troubleshooting strategies, such as:
- a. Check the Wi-Fi connection.
 - b. Close the application or tab and reopen it.
 - c. Use a different web browser.
 - d. Shut down the digital device and reboot it.



Teacher Tip: Encourage your students to use accurate terminology while troubleshooting. They should be able to identify and describe the basic hardware and software.

9. Place equipment on a table for students to use while building the teeter-totter. If you do not have a designated supply table, you may divide up the materials to place them at each table.
10. Optional: Consider whether you will facilitate [Internet Safety](#). During this experience, students will become familiar with the importance of making safe choices in a digital world.

Part 2. Experimenting with Forces

Before you begin Part 2, get a ball to use for the demonstration. Choose a ball that's large enough for all students can see, such as a soccer ball, basketball, or softball.



Possible Student Misconceptions

- **An object is hard to push because it is big.** The size of an object does not indicate the amount of force needed to push or move it. The weight of the object is important. For example, a large, empty cardboard box doesn't take much force to push or pull, whereas, a brick would take more force to push or pull.
- **If an object is not moving, no force is acting on it. For example, a stationary object has no forces acting on it.** Objects with balanced forces acting on them might not be moving. Balanced forces are equal in size and opposite in direction, so the forces cancel out and do not cause an object to move.
- **Moving objects stop because the "force runs out".** Forces do not run out, they are counteracted by other forces. Friction is typically the cause of a moving object gradually coming to a stop. Friction is a force that acts opposite to the direction of motion.

Procedure

Optional: Internet Safety

During the [Internet Safety](#) learning experience, students learn about the importance of making safe choices in the digital world. They explore strategies to keep personal information secure and learn how to use the internet safely and responsibly.



Time: 60 Minutes

Part 1. Teeter-Totter

- 1 Direct students to access Activity 1 in the student course and have them read the Introduction.
- 2 Lead a discussion of the questions found in the Introduction. This discussion provides an opportunity for formative assessment as students share their conceptions about flight and forces. As you work through this activity, continue to ask questions to determine whether students' misconceptions are being addressed through the hands-on activities.
 - What objects fly?
 - How do you think airplanes and other aircraft fly? Direct students to access the flashcard example as you introduce the vocabulary term *aircraft*.
 - What is a force? Direct students to access the flashcard example as you introduce the vocabulary term *force*. What is an example of a push or a pull you used today?
- 3 Students use Launch Logs to keep a record of their work as they progress through the module. Distribute a Grades 3–5 Launch Log to each student. They may take notes as they research,



create sketches, and answer conclusion questions in the notebook.

- 4 Introduce the teeter-totter to the students. Have students work with a partner to complete this using the [Teeter-Totter](#) presentation or the written procedure in the student course.
- 5 Distribute materials or have students gather materials from a designated supply table.
- 6 Facilitate the creation of the teeter-totter by circling around the room, monitoring group work, and asking questions.

Part 2. Experimenting with Forces

- 7 Place a ball on the floor or on a table so that it doesn't roll. Lead a discussion about the ball. Sample prompts:
 - How would you describe the movement of the ball?
 - Are any forces acting on the ball? Direct students to access the flashcard example as you introduce the vocabulary term *gravity*.
 - Explain that two forces are acting on the ball—the force of gravity and the force of the table (or floor) pushing back on the ball. These forces are equal and opposite. Therefore, they are balanced. Direct students to access the flashcard example as you introduce the vocabulary term *balanced forces*.
 - Can you identify other objects in the room with balanced forces?

Note: Any object in the room that's not moving has balanced forces acting on it.

- 8 Push the ball so that it rolls across the table or floor. Lead a discussion about the ball. Sample prompts:
 - What did you observe?
 - What do you wonder?
 - What caused the ball to move?
 - While the ball was moving, were the forces balanced? Why do you think this? Direct students to access the flashcard example as you introduce the vocabulary term *unbalanced forces*.
 - Now that the ball has come to a stop, are the forces balanced or unbalanced? Why do you think this?
- 9 Display one of the groups' teeter-totter. Ask students whether the ruler is in a level position, meaning it's parallel or level with the floor. Direct students to access the flashcard example as you introduce the vocabulary term *stable*.
- 10 Guide students to follow the procedure in the student course to experiment with their teeter-totter by adding different weights in the form of paper clips.
- 11 When the students are finished experimenting, gather everyone together to discuss the results. Sample prompts:
 - When you added paper clips to one side of your teeter-totter, what happened? Why do you think your teeter-totter moved?
 - Were the forces balanced or unbalanced? Why do you think this?



- When the teeter-totter stopped moving again, what provided the balancing force? What did you observe? Was the ruler horizontal?
- How did you achieve horizontal stability? While the teeter-totter was in a position of stability, were the forces balanced or unbalanced? Why do you think this?
- How well did your team collaborate? Share some examples.

12 Have students disassemble their teeter-totter.

13 Guide students to answer the Conclusion Questions. Lead a discussion for students to share their thoughts.

Conclusion Questions Answer Key

Note: Conclusion questions offer an opportunity for formative assessment. You may use them as a whole-class discussion or you may have students record ideas in their Launch Logs.

1 When your teeter-totter was moving, what caused the motion? Describe how force was involved.

Student responses should demonstrate an understanding of forces. Example response:
The teeter-totter moved when we added the paper clips. This extra weight caused the motion. While the teeter-totter was moving, the forces were unbalanced. When the forces were balanced, the teeter-totter stopped moving.

2 Describe what must be true of the forces for your teeter-totter to achieve stability in a level position. How do you know this?

Student responses should demonstrate an understanding of forces. Example response:
For my teeter-totter to achieve stability in a level position, the forces must be balanced. If the forces are unbalanced, the teeter-totter moved.



Activity 2

Forces: Lift, Drag, Thrust, and Weight

Teacher Resources

[View Student Course](#)

EQUIPMENT

The list below is based on a class of 30 students.

Included in the Equipment Kit	Not Included in Equipment Kit	Device Application
Measuring tapes (three per class)	- Launch Logs (one per student) - Digital devices - Pencils or colored pencils for sketching - Paper (8.5 × 11-inch, one per student) - Masking tape - Boxes (one per group) - Balls (one per group) - Books (one per group)	Inklings or my.pltw.org

ESSENTIAL QUESTIONS

EQ

- EQ1** In what ways do forces impact our world?
- EQ2** How do balanced and unbalanced forces affect aircraft flight?
- EQ3** How can a step-by-step process help you design or improve a solution to a problem?



Introduction

In this activity, students explore how planes fly and how *forces* push and pull an *aircraft* through the sky. They create a paper airplane and identify the forces at work. Also, students are introduced to Newton's Laws of Motion.

Preparation

Part 1. Forces of Flight

1. Become familiar with the vocabulary terms used in this activity. Plan how you will help students use these terms as part of their vocabulary.

aircraft	All types of vehicles that fly or move through the air.
balanced forces	Two forces that are equal in size acting in opposite directions on an object.
drag	Resistance that slows an object down in the air.
force	A push or pull that can make an object move, stop moving, or change direction.
lift	A force that pushes objects upward.
thrust	The force or push that comes from a power source, such as a propeller, jet engine, or a launcher, in the case of a glider.
unbalanced forces	Two forces that are not equal in size acting in opposite directions on an object.
weight	The force of gravity that pulls objects downward.

2. Review the Learning Objectives and Knowledge and Skills in Stage 1 of the [Curriculum Framework](#). Use the Evidence (Stage 2) and Learning Plan (Stage 3) content to plan how you will formatively and summatively assess students throughout this activity.
3. Review the [Additional Instructional Resources](#). This list includes books that offer diverse perspectives that can expand student understanding. Using these resources provides a sense of inclusion and belonging, and helps students make connections if the content is new to them.
4. Review the external resources used in this activity. External resources can include:
 - Apps for digital devices
 - Web-based apps
 - Websites

For each resource, determine if translations in other languages are available to meet the needs of multilingual learners (ML).

Part 2. Paper Airplanes

1. Before you begin Part 2, decide where students will throw their paper airplanes. Students will need a large area, such as the hallway or gym.



2. Create a start line for the students to release their paper airplanes.
3. Lay out the measuring tapes for students to measure the distance flown.
4. Review the "How to Create a Paper Airplane" resource located in the student course. Make a paper airplane so you are familiar with the instructions and able to assist students.

Part 3. Newton's Laws of Motion

Before you begin Part 3, decide whether students will complete the hands-on activities in small groups or as a whole class. This determines how many additional materials you'll need. The additional materials include boxes, balls, and books.

Possible Student Misconception

Weight and gravity are the same on Earth and are sometimes used interchangeably. Weight is a response of mass to the pull of gravity. It acts downward against lift. Gravity is the force that pulls down on objects and gives them weight.

Procedure

Time: 100 Minutes

Part 1. Forces of Flight

- 1 Review Chapter 1: Helping Others from the Introduction Story: *Gliders to the Rescue*.
- 2 Direct students to access the Introduction Story: *Gliders to the Rescue* in the student course and read Chapter 2: Forces and Flight. Lead students in a discussion of this chapter to gain insight into their thinking about the concepts. Remember that this is a great time to uncover misconceptions that can be addressed as you work through the activity. Sample prompts:
 - What are the forces of flight the students are learning about?
 - How do you think these forces allow airplanes to fly?
 - Have you ever seen a glider? How is it different than an airplane?
 - Would you like to sketch and build a model of a glider? What would your glider look like?
- 3 Direct students to access Activity 2 and have them read the Introduction.
- 4 Direct students to access the flashcard examples to review the vocabulary terms *aircraft*, *force*, *balanced forces*, and *unbalanced forces*.
- 5 Introduce the [Forces of Flight](#) presentation. Guide students to work with a partner or small group to view the presentation. While viewing the presentation, students record sketches and written responses in their Launch Logs.



- 6 Lead a discussion about the presentation. Sample prompts:
- What are the four forces of flight? Direct students to access the flashcard examples as you introduce the vocabulary terms *lift*, *weight*, *thrust*, and *drag*.
 - Which forces are opposites of each other?
 - How is an airplane able to land? Are the forces balanced or unbalanced during landing? How do you know?
 - When are the forces balanced during flight? How do you know?

Part 2. Paper Airplanes

- 7 Guide students to read the Making Paper Airplanes scenario. As an option, you may read the scenario to students or have them listen to the audio recording.
- 8 Provide one piece of paper to each student.
- 9 Allow each student to make a paper airplane. Students may make an airplane of their own design or follow the steps in How to Make a Paper Airplane located in the student course.
- 10 Go to a large open area such as a hallway or gym to fly the planes. Allow the students to release their planes at least two times from the start line. Direct students to measure the distance their paper airplanes flew and record the data in their Launch Logs.
- 11 Lead a discussion focused on the forces of flight. Sample prompts:
- What forces of flight were acting on the paper airplanes? How did you arrive at that conclusion?

Note: Students should identify three forces acting on their paper airplanes—lift, weight, and drag. Since the paper airplane does not provide its own power, it does not have thrust. The drag comes from the design of the paper airplane. Some student airplanes have more drag than others. As the planes flew, the wings provided lift. The weight of the plane eventually brought the plane to the ground.

- What would you change about your design? Why would you make this change? Explain how the change would impact the forces of flight acting on your plane.
- 12 Guide students to read Origami Art and Engineering. As an option, you may read this aloud to students.

Did You Know?

Engineers from Brigham Young University were inspired by origami when they built solar panels bound for space. To save room during shuttle transport, engineers designed the solar panels to fold in a geometric origami pattern called a Miura fold.





- 13 Lead a discussion with students. Encourage students to share what inspires them when they create new things.



- Can you think of a problem you might solve with origami?
- If you could try origami, what would you create?

- 14 Optional: Provide time for students to test additional designs or airplanes they created out of different types of paper.

Part 3. Newton's Laws of Motion

- 15 Introduce Sir Isaac Newton and his three laws of motion.
- 16 Guide students to work with a partner or small group to view the Newton's Laws presentation. During the presentation, students take notes in their Launch Log and complete hands-on activities.

/



Newton's Laws video

- 17 If desired, you may project this presentation and work through the hands-on activities with the students as a class. The activity requires a pencil, a box, and some objects to place in the box to demonstrate forces on an object.
- 18 Lead a discussion of the presentation. Sample prompts:
- Who was Sir Isaac Newton?
 - What science concept were his three laws about?
 - What was Newton's first law of motion? Use the pencil demonstration to help students understand this law.
 - What was Newton's second law of motion? Use the box demonstration to help students understand this law.
 - What was Newton's third law of motion? Use the ball demonstration to help students understand this law.
 - Where have you seen these laws of motion in action?



- How does this connect to your life?

19

Guide students to answer the Conclusion Questions. Lead a discussion for students to share their thoughts.

Conclusion Questions Answer Key

- 1 Which forces must be increased to cause an airplane to take off? Support your answer with evidence.

Student responses should demonstrate an understanding of the forces of flight. Example response:

For an airplane to take off, thrust must be increased to be greater than drag, and lift must be increased to be greater than weight.

- 2 When an aircraft is cruising, are the forces balanced or unbalanced? Support your answer with evidence.

Student responses should demonstrate an understanding of the forces of flight. Example response:

When an aircraft is cruising, the forces are balanced. Lift is equal to weight, and thrust is equal to drag.



Activity 3

Gliders and Other Aircraft

Teacher Resources

[View Student Course](#)

EQUIPMENT

The list below is based on a class of 30 students.

Included in the Equipment Kit	Not Included in Equipment Kit	Device Application
• PLTW glider kits • Optional: Hand-launched propellers	• Launch Logs (one per student) • Digital devices • Pencils or colored pencils for sketching	• Inking or my.pltw.org

ESSENTIAL QUESTIONS

EQ

- EQ1** In what ways do forces impact our world?
- EQ2** How do balanced and unbalanced forces affect aircraft flight?
- EQ3** How can a step-by-step process help you design or improve a solution to a problem?



Introduction

In this activity, students expand their understanding of *aircraft* to learn about *gliders*. Students learn about the basic parts of a glider—the *fuselage*, the *wings*, and the *horizontal stabilizer*. Students use this knowledge to sketch glider designs in their Launch Log.

Preparation

Activity 3

1. Become familiar with the vocabulary terms used in this activity. Plan how you will help students use these terms as part of their vocabulary.

aircraft	All types of vehicles that fly or move through the air.
drag	Resistance that slows an object down in the air.
fuselage	The body of an aircraft.
glider	An aircraft that is designed to fly without an engine.
horizontal stabilizer	The structure on an aircraft that prevents up and down motion of the aircraft nose.
lift	A force that pushes objects upward.
thrust	The force or push that comes from a power source, such as a propeller, jet engine, or a launcher, in the case of a glider.
weight	The force of gravity that pulls objects downward.
wings	The parts of an aircraft that provide lift. Wings are also called airfoils.

2. Review the Learning Objectives and Knowledge and Skills in Stage 1 of the [Curriculum Framework](#). Use the Evidence (Stage 2) and Learning Plan (Stage 3) content to plan how you will formatively and summatively assess students throughout this activity.
3. Review the [Additional Instructional Resources](#). This list includes books that offer diverse perspectives that can expand student understanding. Using these resources provides a sense of inclusion and belonging, and helps students make connections if the content is new to them.
4. Review the external resources used in this activity. External resources can include:
 - Apps for digital devices
 - Web-based apps
 - WebsitesFor each resource, determine if translations in other languages are available to meet the needs of multilingual learners (ML).
5. Decide how you'll prepare the glider parts. Students may punch out the glider parts while sketching, or you may punch out the parts ahead of time.



6. Place glider parts on a table for students to access while sketching. If you don't have a designated supply table, you may divide up the parts to place them at each table.

Possible Student Misconception

All aircraft have engines. Aircraft are all types of vehicles that fly or move through the air. Airplanes, helicopters, gliders, and hot air balloons are all considered aircraft. Aircraft may be powered or unpowered.

Procedure

Time: 60 Minutes

- 1 Direct students to access Activity 3 in the student course and have them read the Introduction.
- 2 Direct the students to access the flashcard examples to review the vocabulary terms *aircraft*, *lift*, *weight*, *thrust*, and *drag*.
- 3 Lead students in a discussion of gliders to gain insight into their thinking.
 - How is a glider different than an airplane?
 - Can you think of other objects that fly without an engine?
 - Direct students to access the flashcard example to introduce the vocabulary term *glider*.
- 4 Introduce the [Glanders and Other Aircraft](#) presentation. Guide students to work with a partner or small group to view the presentation.
- 5 Lead a discussion about the presentation. Sample prompts:
 - Other than gliders and airplanes, what are some examples of aircraft?
 - How is a spacecraft different than an aircraft?
 - Many fixed-wing aircraft have similarities. What are the similarities? Direct the students to access the flashcard examples to introduce the vocabulary terms *fuselage*, *wings*, and *horizontal stabilizer*.
 - Since gliders do not generate their own thrust, how do they fly without an engine?
- 6 When students explore careers, they can see connections between what they are learning and how it is applied in the real world. Guide students to read about astronaut John Herrington. As an option, you can read this aloud to students.
- 7 Use the flashcard examples to introduce the different types of gliders parts.
- 8 Guide students to reflect on the glider design they think would fly the farthest distance. Have them consider the:
 - wing shape
 - wing location



- horizontal stabilizer shape

- 9 Direct students to trace the glider parts and label them in their Launch Logs.
- 10 Have students circle the type of wings and horizontal stabilizer they think would cause the glider to fly the farthest.
- 11 If you received the hand-launched propellers in your kit, consider allowing time for students to launch these in an open area. Guide students to identify the forces of flight acting on the propellers.
- 12 Guide students to answer the Conclusion Questions. Lead a discussion for students to share their thoughts.

OPTIONAL EXTENSION

OE

Now that students have learned about the forces of flight and different types of aircraft, allow time for them to explore the [Science of Flight](#) game. In this game, students pilot a remote-controlled aircraft to learn more about forces.

NOTE: This game requires the use of a keyboard. If your students use tablets, consider options for how students can play the game.

Conclusion Questions Answer Key

- 1 What is a glider? How is it different from powered aircraft?

Student responses should demonstrate an understanding of aircraft. Example response:
A glider is an aircraft that is designed to fly without an engine. It is different than a powered aircraft in that it does not provide its own thrust.

- 2 How are the forces of flight at work on a glider? When are the forces balanced? When are the forces unbalanced?

Student responses should demonstrate an understanding of the forces of flight. Example responses:
Three forces of flight are at work on a glider—drag, lift, and weight. Since a glider does not have an engine, it does not produce its own thrust.

The forces are balanced when the glider is cruising. The forces are unbalanced when the glider is landing.



Introduction to the Module

Variation of Traits

Teacher Resources



Distance Learning Support

For information about PLTW's distance learning support and online learning guides, jump to Distance Learning Support in [PLTW Launch Module-specific PD Resources](#).

For distance learning support for facilitating this module, jump to [Distance Learning Support: Variation of Traits Teacher Guide](#).

PREFACE

Time: 10 instructional hours

In this module, students investigate the differences between genetic traits that are inherited and traits that are influenced by the environment. Students learn about dominant and recessive alleles, as they explore the phenomenon that offspring may express different traits than parents. Students apply this knowledge as they use a Punnett square to document possible genotypes and phenotypes of offspring.

In the problem, students select four inherited traits for two fictitious parent animals. Students follow the design process to explore, sketch, build, and evaluate an offspring of the parent animals that's able to survive in a specific environment. Students use data to support their explanation of the inherited traits passed from the parents to the offspring.

RESOURCES



Device Specifications



Application List

R



Preparation

Are you ready to teach this module? Hold it right there! As you may remember from PLTW Launch Classroom Teacher Training, to create an engaging learning experience for your students, planning is essential.

This Teacher Guide includes resources you need for both planning and facilitation. The following outline lists the general resources designed to help you prepare to teach this module to your students.

Spanish Language Resources: Printable resources in Spanish are available in the Teacher Guide (Español) for this module.

Connections to Standards and Curriculum Framework

Math Connections

Professional Development

Community

Rostering Students

Family and Community Relationships

PLTW Launch Logs

Developing Vocabulary

Icon Legend

Additional Instructional Resources

Curriculum Revisions



Activity 1

Inventory of Traits

Teacher Resources

[View Student Course](#)

EQUIPMENT

The list below is based on a class of 30 students.

Included in Equipment Kit	Not Included in Equipment Kit	Device Applications
• by Jennifer Boothroyd	• PLTW Launch Logs (1 per student) • Digital devices • Chart paper • Markers • Pencils or colored pencils for sketching	• Inking or my.pltw.org • Camera • Presentation app, such as: ◦ Popplet Lite ◦ Mindomo ◦ ShowMe Interactive Whiteboard ◦ Zoho Show

RESOURCE

 Traits Survey

R

ESSENTIAL QUESTIONS

EQ

- EQ1** Why do some offspring look like their parents while others do not?
- EQ2** How are traits of one generation passed to the next?
- EQ3** How can a step-by-step process help you design or improve a solution to a problem?



Introduction

In this activity, students take a personal inventory of their [traits](#). Then, they compile classroom data for some of these traits. Students use the [classroom data](#) to answer a question about the distribution of traits among their classmates. This investigation helps students appreciate the [value of traits](#) in the class.

Preparation

Professional Development **PD**

Before you facilitate Activity 1, review the professional development resources.

- Access the [Launchpad](#) to review the resource, Unpacking PLTW Launch Curriculum Frameworks.
- Access the [Variation of Traits Module-specific PD Resources](#) to review Building Your Understanding: Variation of Traits.

Part 1. Traits Survey

Sensitively Addressing Traits in Your Class

Activity 1: Inventory of Traits introduces traits to students. The focus of this activity is identification of traits, not inheritance of human traits. Students are introduced to inheritance in the book, [The Tale of Two Cities](#). However, students do not reflect on how their traits are similar or different than their parents. When students examine traits passed from parents to offspring, the focus is on plants and animals.

As you progress through this module, be sensitive to students who may not live with their biological parents.

1. Become familiar with the vocabulary terms used in this activity. Plan how you will help students use these terms as part of their vocabulary.

organism	A living thing.
scientific inquiry process	A process that scientists use to explore observations and answer questions.
trait	A quality or characteristic of an organism.
variation	A change or difference in something.

2. Review the Learning Objectives and Knowledge and Skills in Stage 1 of the [Curriculum Framework](#). Use the Evidence (Stage 2) and Learning Plan (Stage 3) content to plan how you will formatively and summatively assess students throughout this activity.



3. Determine ways you can support the development of transportable skills in this module. Examples include calling out ways students demonstrate the skills, asking questions that allow students to reflect on their development of the skills, and integrating books listed in the Transportable Skills: Literature Connections resource.

4. Review the [Additional Instructional Resources](#). This list includes books that offer diverse perspectives that can expand student understanding. Using these resources provides a sense of inclusion and belonging, and helps students make connections if the content is new to them.

5. Review the external resources used in this activity. External resources can include:

- Apps for digital devices
- Web-based apps
- Websites

For each resource, determine if translations in other languages are available to meet the needs of multilingual learners (ML).

6. To access a printable version of the Launch Log, go to [PLTW Launch Logs](#).

7. Before you begin Activity 1, read the [Introduction Story](#):_____ with students.

8. As students engage in learning experiences throughout the module, they may experience technical problems. Encourage them to find potential solutions by following basic troubleshooting strategies, such as:

- a. Check the Wi-Fi connection.
- b. Close the application or tab and reopen it.
- c. Use a different web browser.
- d. Shut down the digital device and reboot it.



Teacher Tip: Encourage your students to use accurate terminology while troubleshooting. They should be able to identify and describe the basic hardware and software.

9. Decide how your students will take the Traits Survey: on paper or on a digital device. If your students will take it on paper, print out one copy of the survey for each student. If your students will take it digitally, each student needs a device.

10. Optional: Consider whether you will facilitate [Internet Safety](#). During this experience, students will become familiar with the importance of making safe choices in a digital world.

Part 2. Traits Investigation

Use a piece of chart paper to prepare a class data table titled "Traits". Adjust the number of rows based on the students in your class.

	Dimples	Freckles	Cleft Chin	Tongue Rolling	Attached Ear Lobes	Finger Hair	Bent Little Finger
Student 1							
Student 2							
Student 3							
Student 4							



Possible Student Misconceptions

- **All our traits come from our parents.** We get our inherited traits from our ancestors. However, some traits are multifactorial. Multifactorial traits are controlled by multiple factors, such as our genes and our environment. Examples of multifactorial traits are height, weight, skin color, and intelligence.
- **Sons take after their fathers, and daughters take after their mothers.** All organisms produced by sexual reproduction contain genetic material from both parents. The offspring receive an equal number of chromosomes from each parent. The offspring may display physical characteristics from both the mother and the father.

Procedure

Optional: Internet Safety

During the [Internet Safety](#) learning experience, students learn about the importance of making safe choices in the digital world. They explore strategies to keep personal information secure and learn how to use the internet safely and responsibly.

Time: 100 Minutes

Part 1. Traits Survey

- 1 Direct students to access Activity 1 in the student course and have them read the Introduction.
- 2 Students use PLTW Launch Logs to keep a record of their work as they progress through the module. Distribute the Grades 3–5 Launch Log to each student. They may take notes as they research, create sketches, and answer conclusion questions in the notebook.
- 3 Introduce the Traits Survey. This survey allows the students to inventory some of their unique characteristics.
- 4 Guide students to complete the Traits Survey in the student course on a digital device or on the printed version you provide.
- 5 After they complete the survey, have students share their results with a partner. Guide students to consider:
 - How many traits do they have in common?
 - How many traits are different?
- 6 Lead a discussion about the Traits Survey.



- What characteristics did you share with your partner? Direct students to access the flashcard example as you introduce the vocabulary term .
- Which traits were different? Direct students to access the flashcard example as you introduce the vocabulary term .
- What are some other examples of traits that are not included on this survey?

Example responses:

-
-
-

Note: Students may think of different behavioral traits, such as happiness, kindness, or honesty. If so, share the difference between a behavioral trait and a physical trait.

- A trait is a quality or characteristic of an organism.
 - What is an organism? Why do you think that?
 - Direct students to access the flashcard example as you introduce the vocabulary term .

Part 2. Traits Investigation

- 7 Guide students to label a new page in their Launch Logs with the heading, "Traits Investigation".
- 8 Ask students what they think scientists do. Discuss that scientists are people who ask questions, make observations, and investigate ideas, to acquire knowledge and/or solve problems. Tell students that they are now going to act as scientists as they investigate traits.
- 9 Guide students to view the Scientific Inquiry Process video as an introduction to scientists and the scientific inquiry process.



Scientific Inquiry Process video

- 10 Lead a discussion about what students learned from the Scientific Inquiry Process video.
 - Why do scientists use the scientific inquiry process? Direct students to access the flashcard example as you review the vocabulary term
 - How do you think the scientific inquiry process helps scientists in their work?
 - Why is it important to ask questions as you work through the scientific inquiry process? Why do you think that?
- 11 Guide students to work with a partner to investigate a class trait.
- 12 **Ask:** Lead a discussion about the following questions.
 - Based upon the Traits Survey, which trait could we investigate further?
 - How would we write a testable question? For example, "Which trait is more common in our class: free or attached ear lobes?"
 - Guide students to write their question in their Launch Logs.
- 13 **Predict:** Have students predict an answer to their question. Guide them to record their predictions in their Launch Logs.
- 14 **Investigate:** Introduce the "Traits" class data table. Have students add their name and place a check mark in the column if they exhibit that trait.
- 15 **Observe:** Guide students to collect the data related to their investigation. Have students create a data table and a bar graph in their Launch Logs to display the data.
- 16 **Explain:** Guide students to explain the results of their investigation.
 - Have students compare their prediction to the actual results and document the findings in their Launch Logs.
 - Guide students to create a presentation using ShowMe Interactive Whiteboard, Popplet Lite, Mindomo, or Zoho Show. The presentation should include all aspects of the scientific inquiry process, such as:
 - Testable question
 - Prediction
 - Photograph of data table



- Photograph of bar graph
- Explanation of the results
- Provide time for groups to share their presentations.
- Lead a discussion about what students learned during their investigations. Ask students to explain their thinking as they share their thoughts. Be sure to address misconceptions.
 - Were the results of your investigation what you expected? Explain your thinking.
 - If you could complete this investigation with the whole school, how would your results vary? Why do you think this?
 - If you could investigate another trait, what would you choose? Why would choose that?
 - How well did your team collaborate? Share some examples.

Part 3. Read and Reflect

- 17 Read aloud the book for students.
You may choose to use a document viewer to project an image of the book.
- 18 Lead a discussion about the book. Sample prompts:
 - Where do some of our traits come from?
 - Do we know where all of our traits come from? Why do you think that?
 - What is an example of another trait that is not shared in the book? (Possible answers include hair type, face shape, and skin color.)
 - Why do you think a variation of traits is important? Why do you think that?
- 19 Guide students to answer the Conclusion Questions. Lead a discussion for students to share their thoughts.

Conclusion Questions Answer Key

Note: Conclusion questions offer an opportunity for formative assessment. You may use them as a whole-class discussion or you may have students record ideas in their Launch Logs.

- 1 When you think about yourself, what traits make you unique, or one of a kind?
Student responses will vary.
- 2 If you had access to all of the students in your school, what question about traits would you like to investigate? Why would you investigate that? How might you investigate this question?
Student responses will vary.



Activity 2

Types of Traits

Teacher Resources

[View Student Course](#)

EQUIPMENT

The list below is based on a class of 30 students.

Included in Equipment Kit	Not Included in Equipment Kit	Device Applications
• <i>Facial Features: Freckles, Earlobes, Noses, and More</i> by Jennifer Boothroyd • Traits Simulation Game • Dry-erase markers (1 per group)	• PLTW Launch Logs (1 per student) • Digital devices • Pencils or colored pencils for sketching • Dry-erase board eraser	• Inking or my.pltw.org • Presentation app, such as: ◦ Popplet Lite ◦ Mindomo ◦ ShowMe Interactive Whiteboard ◦ Zoho Show

RESOURCES

R

-  Traits Simulation Game
-  Inherited Traits Game Board
-  Traits Influenced by the Environment Game Board
-  Scenario Cards

ESSENTIAL QUESTIONS

EQ

- EQ1** Why do some offspring look like their parents, while others do not?
- EQ2** How are traits of one generation passed to the next?
- EQ3** How can a step-by-step process help you design or improve a solution to a problem?



Introduction

In this activity, students explore *inherited traits*. They learn that some inherited traits are *multifactorial*. Students identify these *traits* in both humans and animals. They apply what they have learned as they select traits for the plutow, a fictitious animal. The selected traits must help the plutow survive in its environment.

Preparation

Professional Development

Before you facilitate Activity 2, review the professional development resources.

- Access the [Launchpad](#) to review the resource, Enhancing Learning Through Centers.
- Access the [Variation of Traits Module-specific PD Resources](#) to review:
 - Building Your Understanding: Variation of Traits
 - Building Your Understanding: Parents and Offspring

Part 1. Inherited Traits

1. Become familiar with the vocabulary terms used in this activity. Plan how you will help students use these terms as part of their vocabulary.

genes	Information in your cells that helps determine some of your traits.
inherited trait	A quality or characteristic passed on to offspring through genes.
multifactorial trait	A quality or characteristic controlled by multiple factors.
trait	A quality or characteristic of an organism.
variation	A change or difference in something.

2. Review the Learning Objectives and Knowledge and Skills in Stage 1 of the [Curriculum Framework](#). Use the Evidence (Stage 2) and Learning Plan (Stage 3) content to plan how you will formatively and summatively assess students throughout this activity.
3. Review the [Additional Instructional Resources](#). This list includes books that offer diverse perspectives that can expand student understanding. Using these resources provides a sense of inclusion and belonging, and helps students make connections if the content is new to them.
4. Review the external resources used in this activity. External resources can include:
 - Apps for digital devices
 - Web-based apps
 - WebsitesFor each resource, determine if translations in other languages are available to meet the needs of multilingual learners (ML).
5. Prepare a piece of chart paper titled "Traits".
6. Another option is to create the chart using a digital device and project the chart for students to view.



Traits

Part 3. Simulation

1. Review how to play the traits simulation game. See [Traits Simulation Game](#) for details.
2. Place the following materials at each center:
 - One inherited traits game board
 - One traits influenced by the environment game board
 - One scenario card
 - One dry-erase marker
 - One dry-erase board eraser

Possible Student Misconception

A dog looks different than a cat. This is an example of variation. Variation is a change or difference in something. Scientifically speaking, only differences between individuals of the same species count as variation.

Procedure

Time: 90 Minutes

Part 1. Inherited Traits

- 1 To review the concept of variation of traits, ask students to clasp their hands. Guide students to look at their hands to see whether their right thumb is over their left thumb or their left thumb is over their right thumb.



How does observing how we clasp our hands demonstrate variation of traits? Direct students to access the flashcard examples to review the vocabulary terms *trait* and *variation*.

- 2 Lead a discussion to review Activity 1.



- What traits did we inventory in Activity 1?
- How are our traits similar? How are our traits different?
- Where do you think our traits come from? Why do you think this?
- Which traits do you think were passed to you? Which traits on the survey were learned traits?

Note: Students should recognize that playing video games, art, sports, and music are learned.

- 3 Direct students to access Activity 2 in the student course and have them read the Introduction.
- 4 Have students prepare their PLTW Launch Logs for Activity 2.
- 5 Introduce the [All About Traits](#) presentation. Guide students to work with a partner or small group to view the presentation. While viewing the presentation, students may take notes in their Launch Logs.
- 6 Lead a discussion about the presentation. Sample prompts:
 - Some traits are inherited. How are inherited traits passed to offspring? Direct students to access the flashcard example as you introduce the vocabulary terms *inherited trait* and *genes*.

Example response:

Traits are passed to the offspring through genes.

- How does the environment influence traits? Direct students to access the flashcard example as you introduce the vocabulary term *multifactorial trait*.

Example response:

Some traits are multifactorial. This means they are influenced by the environment. If you have two plants from the same species, they may grow differently due to sunlight, water, or soil conditions.

- 7 Direct students to work with a small group and brainstorm examples of inherited traits in organisms. Have students document those traits in their Launch Logs.
- 8 Guide students to share the inherited traits. Document the traits on the “Traits” chart. Use the book, *Facial Features: Freckles, Earlobes, Noses, and More*, to identify additional inherited traits.
- 9 When students explore careers, they can see connections between what they are learning and how it is applied in the real world. Guide students to read about Dr. Lap-Chee Tsui, a geneticist. As an option, you can read this aloud to students.



Part 2. Animal Traits

- 10 Lead students in a discussion of animal traits. Sample prompts:
 - What are some common animal traits?
 - Do all animals share the same traits? Why do you think that?
- 11 Guide students to work in small groups to identify observable animal traits. Assign each group a specific animal image from the student course. Have students record their animal's traits in their Launch Logs. Guide students to reflect on how the traits help the animal survive in its environment.
- 12 Guide students to create a presentation on their animal's traits using ShowMe Interactive Whiteboard, Popplet Lite, Mindomo, or Zoho Show.
- 13 Provide time for each group to share their animal's traits.

Part 3. Simulation

- 14 Introduce the traits simulation game. See [Traits Simulation Game](#) for details.



Teacher Tip: Encourage your students to use accurate terminology while troubleshooting. They should be able to identify and describe the basic hardware and software.

- 15 Lead a discussion about what students learned from the traits simulation game. Sample prompts:
 - How did the inherited traits you selected help your plutow to survive?
 - How did the traits influenced by the environment help your plutow to survive?
 - Did you select the same traits for each scenario? Why or why not?
 - Are there any animal traits you feel would benefit the plutow that were not included on the game boards? Why do you think this?
- 16 Guide students to answer the Conclusion Questions. Lead a discussion for students to share their thoughts.

Conclusion Questions Answer Key

- 1 Take a look at Angelina and Suzi. Describe three of their traits.

Student responses should demonstrate an understanding of traits. Example response:

- *Angelina and Suzi have many traits. One of their inherited traits is hair color. Angelina has dark brown hair, and Suzi has black hair.*
- *Another trait is skin color. Angelina has light brown skin, and Suzi has tan skin.*
- *A third inherited trait is attached earlobes. Angelina has attached earlobes.*



- 2** Some animals understand commands, such as verbal commands or hand signals. How has their environment influenced their traits?

Student responses should demonstrate an understanding of multifactorial traits. Example responses:

- *Animals can do things on command, but they must be taught. If someone trains an animal, it can learn basic commands, such as sit or stay. Animals can also learn more difficult commands, like turning on a light switch or jumping through a hoop.*
- *Intelligence is a multifactorial trait. Animals are smart, but someone in their environment must train them to follow the commands.*



Activity 3

Traits Exploration

Teacher Resources

[View Student Course](#)

EQUIPMENT

The list below is based on a class of 30 students.

Not Included in Equipment Kit	Device Application
• PLTW Launch Logs (1 per student) • Digital devices • Chart paper • Markers • Pencils or colored pencils for sketching	• Inking or my.pltw.org

ESSENTIAL QUESTIONS

EQ

- EQ1** Why do some offspring look like their parents, while others do not?
- EQ2** How are traits of one generation passed to the next?
- EQ3** How can a step-by-step process help you design or improve a solution to a problem?



Introduction

In this activity, students expand their understanding of *inherited traits*. They learn that *organisms* have two copies of their *genes*. These copies, or *alleles*, can be *dominant* or *recessive*. Students apply their understanding of dominant and recessive alleles to create *Punnett squares*.

Preparation

Professional Development

Before you facilitate Activity 3, review the professional development resources.

- Access the [Launchpad](#) to review the resource, Enhancing Learning Through Centers.
- Access the [Variation of Traits Module-specific PD Resources](#) to review:
 - Building Your Understanding: Variation of Traits
 - Building Your Understanding: Gregor Mendel

Part 1. Understanding Inheritance

1. Become familiar with the vocabulary terms used in this activity. Plan how you will help students use these terms as part of their vocabulary.

allele	The different forms of a gene.
dominant allele	The form of a gene that shows its phenotype whenever present.
gene	Information in your cells that helps determine some of your traits.
genotype	The genetic structure of an organism.
inherited trait	A quality or characteristic passed on to offspring through genes.
multifactorial trait	A quality or characteristic controlled by multiple factors.
phenotype	The visible traits or abilities of an organism.
Punnett square	A square diagram used to predict genetic outcomes.
recessive allele	The form of a gene that shows its phenotype when a dominant allele is not present.

2. Review the Learning Objectives and Knowledge and Skills in Stage 1 of the [Curriculum Framework](#). Use the Evidence (Stage 2) and Learning Plan (Stage 3) content to plan how you will formatively and summatively assess students throughout this activity.
3. Review the [Additional Instructional Resources](#). This list includes books that offer diverse perspectives that can expand student understanding. Using these resources provides a sense of inclusion and belonging, and helps students make connections if the content is new to them.
4. Review the external resources used in this activity. External resources can include:



- Apps for digital devices
- Web-based apps
- Websites

For each resource, determine if translations in other languages are available to meet the needs of multilingual learners (ML).

Part 3. Punnett Squares

1. Review Building Your Understanding: Gregor Mendel for additional information about Mendel's life and studies. Prepare to facilitate a discussion about The First Geneticist.
2. Prepare eight Punnett squares on chart paper with one Punnett square per piece. Each Punnett square represents one pea trait studied by Gregor Mendel.

Note: The letters on the Punnett squares are arbitrary. You may change any of these letters.

Plant Height (T = tall, t = short)	
T	t
T	
t	

Seed Color (S = yellow, s = green)	
S	s
S	
s	



Pod Color
(G = yellow, g = green)

	G	G
G		
g		

Pod Color
(G = yellow, g = green)

	G	g
G		
g		

Seed Shape
(R = round, r = wrinkled)

	R	R
r		
r		

Flower Color
(F = purple, f = white)

	F	f
F		
f		

Flower Position
(M = middle, m = top)

	M	m
M		
M		

Pod Shape
(I = inflated, i = constricted)

	i	i
I		
i		



Possible Student Misconceptions

- **Dominant traits are the most common traits in a population.** The term “dominant” does not mean the majority of the population has that trait. Dominant refers to one allele’s expression over the other. For example, the presence of extra fingers and/or toes is a dominant trait. However, it is rare for people to have extra fingers and/or toes.
- **All traits have two alleles.** Traits are divided into two categories—simple and complex.
Simple traits, or Mendelian traits, are controlled by two alleles. Examples of Mendelian traits are the ability to taste PTC, albinism, and color blindness.
Polygenic traits and multifactorial traits are complex traits. Polygenic traits are traits controlled by more than two alleles. Multifactorial traits are traits influenced by a combination of genetic and environmental factors. The majority of human traits are complex traits.

Procedure

Time: 120 Minutes

Part 1. Understanding Inheritance

- 1 Direct students to access Activity 3 in the student course and have them read the Introduction.
- 2 Have students prepare their PLTW Launch Logs for Activity 3.
- 3 Direct students to access the flashcard examples as you review the vocabulary terms *gene*, *inherited trait*, and *multifactorial trait*.
- 4 Introduce the [Understanding Inheritance](#) presentation. Guide students to work with a partner or small group to view the presentation. While viewing the presentation, students record sketches and written responses in their Launch Logs.
- 5 Lead a discussion about the presentation. Sample prompts:
 - Where does an offspring get its genes?
 - We have two copies of our genes. What are those copies called? Direct students to access the flashcard example as you review the vocabulary term *allele*.
 - Each allele is either dominant or recessive. What does that mean? Direct students to access the flashcard examples as you review the vocabulary terms *dominant allele* and *recessive allele*.
 - Let’s think about hair color. I can see your hair color. What do we call this visible trait? Direct students to access the flashcard example as you review the vocabulary term *phenotype*.



- Hair color has multiple alleles that make up its genetic code. What do we call the genetic code? Direct students to access the flashcard example as you review the vocabulary term *genotype*.

Note: Most of our traits are controlled by several alleles. Those traits are considered complex traits. Multifactorial traits are complex traits. The ability to taste PTC is considered a simple trait, or Mendelian trait. Simple traits are controlled by two alleles.

- 6 Introduce the [Introduction to Punnett Squares](#) presentation. Guide students to work with a partner or small group to view the presentation. While viewing the presentation, students record sketches and written responses in their Launch Logs.
- 7 Lead a discussion about the presentation. Sample prompts:
 - How can we predict the possible genotypes and phenotypes of a trait? Direct students to access the flashcard example as you review the vocabulary term *Punnett square*.
 - Draw a Punnett square with the genotypes Tt and tt. Complete the Punnett square and discuss the possible outcomes.

Part 2. Allele Patterns

- 8 Guide students to work with a partner to complete the Knowledge Check in the student course. In the Knowledge Check, one answer is not like the others. Students must find the item that does not belong.

Note: Use this knowledge check as a formative assessment on alleles, genotypes, and phenotypes. This way, you can see whether students are ready to move on to Part 3.

- 9 Lead students in a discussion about the Knowledge Check. Be sure they support their answers with evidence.



Question 1: What does not belong?

- a. **dominant allele** (Dominant allele does not belong. Choices b, c, and d are all recessive alleles.)
- b. g
- c. recessive allele
- d. b

Question 2: What does not belong?

- a. T
- b. dominant allele
- c. **r** (The lowercase r does not belong, because lowercase letters represent recessive alleles. Choices a, b, and d are all dominant alleles.)
- d. S

Question 3: What does not belong?

- a. phenotype
- b. **genotype** (Genotype does not belong because it is the genetic structure of the organism. Green eyes and blond hair are phenotypes.)
- c. green eyes
- d. blond hair

Question 4: What does not belong?

- a. Aa
- b. Nn
- c. the genetic structure of an organism
- d. **phenotype** (Phenotype does not belong because it refers to the visible traits or abilities of an organism. Aa and Nn are genotypes.)

Question 5: What does not belong?

- a. rr
- b. **dominant allele** (Dominant allele does not belong. Choices a, c, and d are all recessive alleles.)
- c. recessive allele
- d. tt

Part 3. Punnett Squares

10

Guide students to read The First Geneticist to learn about discoveries made by Gregor Mendel, a scientist in the mid-1800s. As an option, you may read this content aloud to students.

11

Lead a discussion with students.



- Why was it important for Mendel to record his observations?

Example response:

Mendel needed to record what he noticed about the parents so that he could compare the parent pea plants to the offspring pea plants.

- If you were a geneticist, what would you want to learn more about?

- 12 Guide students to rotate around the room in small groups to visit the eight Punnett squares.
- 13 At each center, direct students to:
 - Copy the Punnett square in the Launch Logs.
 - Discuss how to complete the Punnett square with their group.
 - Complete the Punnett square in their Launch Logs.
- 14 Lead students in a discussion to share their completed Punnett squares. Be sure to have students support their answers with evidence. As students share, fill out the blank Punnett squares on chart paper.
- 15 Guide students to answer the Conclusion Questions. Lead a discussion for students to share their thoughts.

Conclusion Questions Answer Key

- 1 Two dogs from the same litter are different colors. How can they have different fur color if they share the same parents?

Student responses should demonstrate an understanding of inheritance. Example response:
Dogs in the same litter do not have to be the same color. Each offspring has multiple chances of being a certain color. Let's say one of the dogs is the dominant color, brown. That means that one of the parents passed on the dominant allele. Let's say another dog is the recessive color, white. For the dog to be white, both parents passed on the recessive allele.

- 2 Draw a Punnett square for pea plant height. Use the following information where T represents a tall plant, and t represents a short plant:
 - Parent plant 1: TT
 - Parent plant 2: Tt

What will the offspring's phenotype be? Support your answer with evidence.

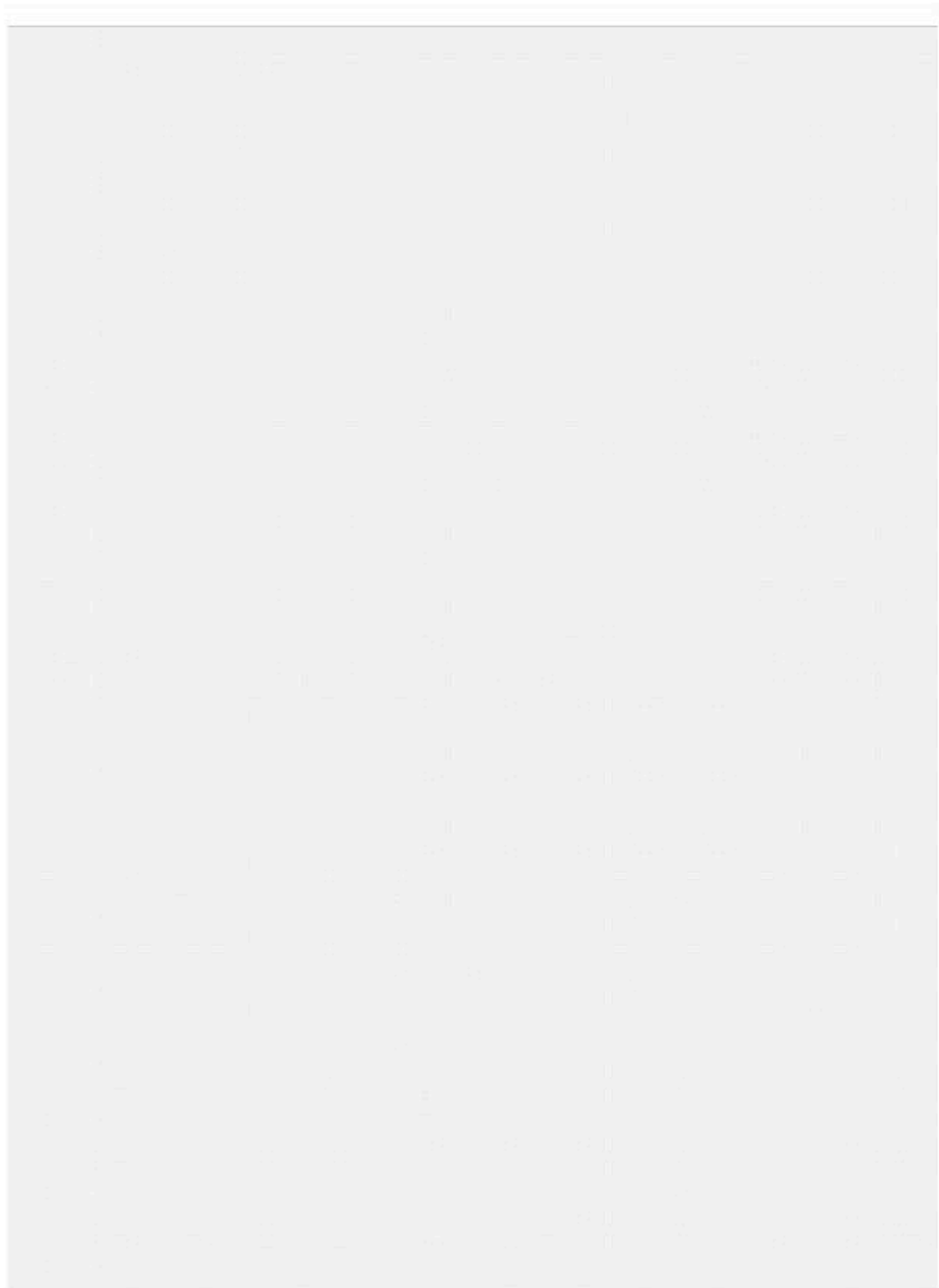
Student responses should demonstrate an understanding of Punnett squares. Example response:
The offspring's phenotype will be "tall plant". I know the plant will be tall because when I made the Punnett square, the genotypes were TT, TT, Tt, and Tt. Since every genotype has a T, the dominant allele, the dominant trait will show itself in the phenotype.



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Introduction to the Module

Weather: Factors and Hazards

Teacher Resources



Distance Learning Support

For information about PLTW's distance learning support and online learning guides, jump to Distance Learning Support in [PLTW Launch Module-specific PD Resources](#).

For distance learning support for facilitating this module, jump to [Distance Learning Support: Weather: Factors and Hazards Teacher Guide](#).

PREFACE

Time: 10 instructional hours

In this module, students explore, collect, and classify data related to three factors that affect weather: precipitation, temperature, and wind. They contrast weather and climate, relying on the three factors in their descriptions. Students explore different types of weather hazards, including those in their region. They design a solution that reduces the impact of a flood.

RESOURCES

R

 [Device Specifications](#)

 [Application List](#)



Preparation

Are you ready to teach this module? Hold it right there! As you may remember from PLTW Launch Classroom Teacher Training, to create an engaging learning experience for your students, planning is essential.

This Teacher Guide includes resources you need for both planning and facilitation. The following outline lists the general resources designed to help you prepare to teach this module to your students.

Spanish Language Resources: Printable resources in Spanish are available in the Teacher Guide (Español) for this module.

Connections to Standards and Curriculum Framework

Math Connections

Professional Development

Community

Rostering Students

Family and Community Relationships

PLTW Launch Logs

Developing Vocabulary

Icon Legend

Additional Instructional Resources

Curriculum Revisions



Activity 1

Weather Factors

Teacher Resources

[View Student Course](#)

EQUIPMENT

The list below is based on a class of 30 students.

Included in Equipment Kit	Not Included in Equipment Kit	Device Application
• Rain gauge • Thermometers (1 per group)	• PLTW Launch Logs (1 per student) • Digital devices • Pencils or colored pencils for sketching • Chart paper • Markers	• Inking or my.pltw.org

ESSENTIAL QUESTIONS

EQ

EQ1 How does weather affect our lives?

EQ2 How can a step-by-step process help you design or improve a solution to a problem?



Introduction

In this activity, students explore the three factors that affect *weather*: *precipitation*, *temperature*, and *wind*. Students learn how meteorologists use weather tools to collect data. They learn how to measure precipitation with a *rain gauge* and how to measure temperature with a *thermometer*.

Preparation

Professional Development

Before you facilitate Activity 1, review the professional development resources.

- Access the [Launchpad](#) to review the resource, Unpacking PLTW Launch Curriculum Frameworks.
- Access the [Weather: Factors and Hazards Module-specific PD Resources](#) to review Building Your Understanding: Computer Models and Simulations.

Part 1. What Is Weather?

1. Become familiar with the vocabulary terms used in this activity. Plan how you will help students use these terms as part of their vocabulary.

meteorologist	A scientist who studies weather.
precipitation	Water that falls to the ground as rain, snow, sleet or hail.
rain gauge	A tool that measures the amount of precipitation.
temperature	A measurement that indicates how hot or cold something is.
thermometer	A tool that measures temperature.
weather	The state of the atmosphere, or air, at a particular place.
wind	The natural movement of air outside.

2. Review the Learning Objectives and Knowledge and Skills in Stage 1 of the [Curriculum Framework](#). Use the Evidence (Stage 2) and Learning Plan (Stage 3) content to plan how you will formatively and summatively assess students throughout this activity.
3. Determine ways you can support the development of transportable skills in this module. Examples include calling out ways students demonstrate the skills, asking questions that allow students to reflect on their development of the skills, and integrating books listed in the Transportable Skills: Literature Connections resource.
4. Review the [Additional Instructional Resources](#). This list includes books that offer diverse perspectives that can expand student understanding. Using these resources provides a sense of inclusion and belonging, and helps students make connections if the content is new to them.
5. To access a printable version of the Launch Log, go to [PLTW Launch Logs](#).
6. Review the external resources used in this activity. External resources can include:
 - Apps for digital devices



- Web-based apps
- Websites

For each resource, determine if translations in other languages are available to meet the needs of multilingual learners (ML).

7. Before you begin Activity 1, read the [Introduction Story: Weather Worries](#) with students.
8. As students engage in learning experiences throughout the module, they may experience technical problems. Encourage them to find potential solutions by following basic troubleshooting strategies, such as:
 - a. Check the Wi-Fi connection.
 - b. Close the application or tab and reopen it.
 - c. Use a different web browser.
 - d. Shut down the digital device and reboot it.



Teacher Tip: Encourage your students to use accurate terminology while troubleshooting. They should be able to identify and describe the basic hardware and software.

9. Use a piece of chart paper to prepare a KWL chart titled “Weather”.

Weather		
K	W	L
What do you know?	What do you want to learn?	What did you learn?

10. Optional: Consider whether you will facilitate [Internet Safety](#). During this experience, students will become familiar with the importance of making safe choices in a digital world.

Part 2. Weather Tools

Review the steps in the Procedure to become familiar with how to use the rain gauge and thermometer.



Possible Student Misconceptions

- **Clouds move when we move.** Clouds move when wind blows them.
- **Rain falls out of the sky when the clouds evaporate, or rain comes from clouds sweating.** Rain begins to fall when water drops in the cloud are too heavy to remain airborne.
- **Frost is frozen dew.** Frost forms when water vapor comes in contact with very cold surfaces. The water vapor freezes directly to create frost in a process called deposition, instead of first condensing to liquid dew.

Procedure

Optional: Internet Safety

During the [Internet Safety](#) learning experience, students learn about the importance of making safe choices in the digital world. They explore strategies to keep personal information secure and learn how to use the internet safely and responsibly.



Time: 80 Minutes

Part 1. What Is Weather?

- 1 Direct students to access Activity 1 in the student course and have them read the Introduction.
- 2 Students use PLTW Launch Logs to keep a record of their work as they progress through the module. Distribute a Grades 3–5 Launch Log to each student. In the notebook, they may take notes as they research, create sketches, and answer conclusion questions.
- 3 Have students prepare their PLTW Launch Logs for Activity 1.
- 4 Introduce the students to a KWL graphic organizer. This graphic organizer will be used to record what the students already know about weather, what they want to learn, and what they learn from this module.
- 5 Guide students to create a KWL chart in their Launch Logs titled “Weather”.
- 6 Have students work individually, with a partner, or in a small group to complete the first two columns in the KWL chart to record their responses about weather. All students, whether working individually or with a partner or group, should create the chart and record the responses in their own Launch Logs.



- 7 Monitor student groups as they fill out the KWL chart. Allow time for groups to share their responses in the first two columns.
- 8 Record the student responses in the class KWL chart titled "Weather".
- 9 Introduce the [Introduction to Weather](#) presentation.
 - Guide students to work with a partner or small group to view the presentation to build an understanding of weather and its three factors.
 - While they view the presentation, direct students to record responses in the "L" column of the KWL chart in their Launch Logs.
- 10 Lead a discussion about the presentation. Prompts:
 - Why is paying attention to the weather important? Direct students to access the flashcard example as you introduce the vocabulary term *weather*.
 - How does this connect to your life?
 - What are the three weather factors? What weather factors have you experienced? Direct students to access the flashcard examples as you introduce the vocabulary terms *precipitation*, *temperature*, and *wind*.
 - What tools do meteorologists use to measure weather factors? How do these tools help them? Direct students to access the flashcard examples as you introduce the vocabulary terms *meteorologist*, *rain gauge*, and *thermometer*.

Part 2. Weather Tools

- 11 Build on the discussion at the end of Part 1. Prompts:
 - How do meteorologists measure weather factors?
 - Do they use the same tools to measure each factor? Why do you think it is important for them to use different tools?
 - Can two people measure different amounts of rainfall from the same rain storm? Can wind speed and wind direction vary depending on where they are measured? Why do you think this?

Note: Technologies for collecting weather data continue to evolve, though many existing weather tools use the same principles to measure weather factors as the tools in this activity.

- 12 Show the rain gauge. Ask if anyone has captured rain in a container during a rainstorm.
 - Discuss how the rain gauge measures rain by capturing the water that falls through the opening.
 - The rain gauge must be placed in an open space so that the rain is not blocked.
- 13 Model the correct way to collect data with a rain gauge. Determine whether you will use the millimeter or inch scale to record volume.
 - Fill the rain gauge half full with water.
 - Hold the rain gauge at eye level.
 - Read the volume of water.



- 14 Guide students to view the photographs of the rain gauge in the student course. Have students record the measurements in their Launch Logs.
- 15 Distribute one thermometer to each partner group. Ask students whether they have used a thermometer before.
 - Demonstrate how to accurately read a thermometer. The liquid in the thermometer and the scale need to be viewed at eye level, not at an angle from above or below.
 - Determine whether you will use the Fahrenheit or Celsius scale to record temperature.
- 16 Guide students to work with their partner to practice reading temperatures at different locations. Examples include:
 - Classroom
 - Hallway
 - Bathroom
 - A sunny location
- 17 Lead a discussion about using a rain gauge and a thermometer. Prompts:
 - What measurements did you record from the photographs of the rain gauges? How did you know your measurement was accurate?

Note: A black line was added to the photographs of the rain gauge to help students see the top of the water. Measurements may vary slightly.

Rain Gauge 1

The rain gauge displays 30 millimeters or 1.2 inches of water. I know this because the top of the water is right on the 30 and 1.2 mark.

Rain Gauge 2

The rain gauge displays about 51 millimeters or 2.05 inches of water. I know this because the top of the water is above 50 but below 52. Also, it is slightly above the 2 mark.

Rain Gauge 3

The rain gauge measures about 75 millimeters or 2.95 inches of water. I know this because the top of the water is slightly above the 74 and 2.9 mark.

- How is reading a rain gauge similar to reading a thermometer? How is it different?
- What temperatures did you record around school? Were they all the same? Explain why you think the temperatures were the same or different.
- What effect did sunlight have on the temperature?
- Did you and your group members record different measurements on the rain gauge or the thermometer? How did you resolve it?
- How might you use data to make decisions in your life?



- 18 Guide students to answer the Conclusion Questions. Lead a discussion for students to share their thoughts.

Note: At the end of Activity 1, find an outside location for the rain gauge where rain is not blocked from falling into its opening. Mount the rain gauge so it can collect rain prior to Activity 2.

Conclusion Questions Answer Key

Note: Conclusion questions offer an opportunity for formative assessment. You can use them as a whole-class discussion, or you can have students record ideas in their Launch Logs.

- 1 How do the three weather factors impact your local area?

Student responses will vary. Student responses should demonstrate an understanding of the weather factors: precipitation, wind, and temperature.

- 2 Why is it important for meteorologists to collect weather data? Support your claim with evidence.

Student responses should demonstrate an understanding of weather. Example response: *It is important for meteorologists to collect weather data so they can present the weather accurately. Also, meteorologists use the weather data to help forecast future weather.*



Activity 2

Weather and Climate

Teacher Resources

[View Student Course](#)

EQUIPMENT

The list below is based on a class of 30 students.

Included in Equipment Kit	Not Included in Equipment Kit	Device Applications
• Rain gauge • Digital anemometer (2) • Thermometers (3) • Wind sock (2) • Pole (2) • Compass	• PLTW Launch Logs (1 per student) • Digital devices • Pencils or colored pencils for sketching	• Inking or my.pltw.org • Weather website or app of teacher's choice • Compass (iPad®) • SmartCompass (Android™)

RESOURCE

R

 [Weather Data Calendar](#)

ESSENTIAL QUESTIONS

EQ

EQ1 How does weather affect our lives?

EQ2 How can a step-by-step process help you design or improve a solution to a problem?



Introduction

In this activity, students continue their exploration of *weather*. They learn about two new weather tools—a *wind sock* and an *anemometer*. With all four tools, students collect daily weather data in their Launch Logs.

Why do we need to collect weather data? Data gathered over a period of time helps us understand the *climate*. Students explore five climate zones and learn how those climate zones are different. Students learn how to interpret climate normals, or averages over a 30-year period, and use this information to make a claim about the climate zone.

Preparation

Part 1. Weather Collection

1. Become familiar with the vocabulary terms used in this activity. Plan how you will help students use these terms as part of their vocabulary.

anemometer	A tool that measures the speed of the wind.
climate	The average weather conditions in a particular region over a period of years.
meteorologist	A scientist who studies weather.
precipitation	Water that falls to the ground as rain, snow, sleet, or hail.
rain gauge	A tool that measures the amount of precipitation.
temperature	A measurement that indicates how hot or cold something is.
thermometer	A tool that measures temperature.
weather	The state of the atmosphere, or air, at a particular place.
wind	The natural movement of air outside.
wind sock	A tool that shows the direction of the wind.

2. Review the Learning Objectives and Knowledge and Skills in Stage 1 of the [Curriculum Framework](#). Use the Evidence (Stage 2) and Learning Plan (Stage 3) content to plan how you will formatively and summatively assess students throughout this activity.
3. Review the [Additional Instructional Resources](#). This list includes books that offer diverse perspectives that can expand student understanding. Using these resources provides a sense of inclusion and belonging, and helps students make connections if the content is new to them.
4. Review the external resources used in this activity. External resources can include:
 - Apps for digital devices
 - Web-based apps
 - Websites



For each resource, determine if translations in other languages are available to meet the needs of multilingual learners (ML).

5. Before you begin Part 1, print the [Weather Data Calendar](#) for each student.
6. Find a weather website or app that you can use to get local weather conditions. Students will collect weather data throughout the module, including on weekends, and you will need a source to verify the data they collect or to provide the data to them. Your students will refer to the data on their calendars throughout the module.
7. Review the steps in the Procedure to become familiar with how to use the wind sock.
8. Review the manufacturer's instructions on how to use the digital anemometer.

Part 2. What Is Climate?

1. Preview the Climate Zones presentation to become familiar with its content. Review the discussion questions in the Procedure.
2. In this activity, students create a graphic organizer in their Launch Logs to record notes about five different climate zones. If students are not familiar with using graphic organizers, consider creating an example to use as you introduce this idea to students. Possible graphic organizers:
 - a. Turn the Launch Log to landscape orientation. Divide a page into five sections.
 - b. Fold two side-by-side pages in half vertically toward the spine of the Launch Log. On one page, make two cuts on the flap so it is divided into thirds. Do not cut past the fold. On the second page, make one cut on the flap so it is divided in half.
3. Prepare a piece of chart paper titled, "Climate Zones". Another option is to create the chart using a digital device and project the chart for students to view.

Climate Zones				
Tropical	Dry	Temperate	Continental	Polar

Part 3. Climate Data

Consider how you will assign a set of climate data to each partner group. There are five sets of data in the student course. Assign duplicate sets as needed.



Possible Student Misconceptions

- **Cold days are caused by the clouds covering the sun.** The temperature of a given day is dependent upon many different things including time of year, location, altitude, and prevailing winds.
- **Snow and ice make it cold.** The snow and ice are the result of cold temperatures, not the cause of them.
- **Climate and weather are synonymous.** Weather is the state of the air and atmosphere at a particular time and place. Climate is the pattern of weather over a long period.
- **Winter weather can be predicted by studying the thickness of the fur on some animals.** It is difficult to make accurate, long-term weather predictions. Predictions are based on a variety of factors in the atmosphere, not on fur thickness nor a ground hog's shadow.

Procedure

Time: 100 Minutes

Part 1. Weather Collection

- 1 Direct students to access Activity 2 in the student course and have them read the Introduction.
- 2 Have students prepare their PLTW Launch Logs for Activity 2.
- 3 Lead a discussion to review Activity 1. Students can refer to the KWL graphic organizer from Activity 1 if needed. Prompts:
 - What is weather? Direct students to access the flashcard example as you review the vocabulary term *weather*.
 - What are the three factors that affect weather? Direct students to access the flashcard examples as you review the vocabulary terms *precipitation*, *temperature*, and *wind*.
 - How do meteorologists measure the factors? Direct students to access the flashcard examples as you review the vocabulary terms *meteorologist*, *rain gauge*, and *thermometer*.
 - How does weather impact your daily life?
- 4 Lead a discussion about how to measure the wind speed and direction.

Note: Changes in the wind can be a sign of changing weather or an approaching storm. Wind speed often is measured by a system that rotates in the wind. The wind's speed determines the number of rotations per minute. You can visualize wind direction with a wind sock or a weather vane, devices that turn to align to the wind's direction.



Prompts:

- How can you tell when the wind is blowing? What do you observe? Direct students to access the flashcard example as you introduce the vocabulary term *wind sock*.
- How do you think wind speed can be measured? Direct students to access the flashcard example as you introduce the vocabulary term *anemometer*.
- When would it be important to know the wind speed and wind direction?

5 Show the wind sock and digital anemometer. Explain how to use each tool.

- Wind sock
 - Ask: Where have you seen this before?
 - Demonstrate how to extend the telescopic pole.
 - Clip the wind sock to the end of the pole.
 - Use a compass or compass app to locate true north for your location.
 - Face true north and hold up the pole.

Note: The best place to use a wind sock is an open area outside. Wind blows through the wind sock, which indicates the direction the wind is coming from.

- Digital anemometer
 - Demonstrate how to turn on and off.
 - Demonstrate how to collect wind data.

6 Distribute the Weather Calendar template to each student.

7 Guide students to record the month and dates on the calendar, and attach the calendar to their PLTW Launch Logs.

Note: The weather calendar template allows data collection for one month. If desired, continue daily weather collection for the duration of the module and beyond. While day-to-day weather conditions are important, there is value in understanding trends in weather data over longer periods, such as months or longer. For example, two inches of rain in isolation may not cause flooding, but two inches after several days of continuous rainfall can cause a river to overflow.

8 Divide the class into eight groups. Assign groups based on the weather tools:

- Rain gauge (one group)
- Thermometer (three groups)
- Digital anemometer (two groups)
- Wind sock (two groups)

9 Take the class outside to collect daily weather information. Guide students in the thermometer groups, digital anemometer groups, and wind sock groups to compare their data for accuracy.

10 In the classroom, have each group share their weather data. Guide students to record the precipitation, temperature, wind direction, and wind speed on the weather calendar in their PLTW



Launch Logs. Collecting and analyzing weather data over many days grounds students' understanding of weather trends over time.

- 11 Throughout the time that students collect data, compare the students' weather data to current weather conditions. Use a weather website or an app of your choice to view local weather conditions. Lead a discussion about the data collected. Prompts:
 - What direction is the wind blowing from? How do you know?
 - How would you describe the wind? Why do you think this? Discuss the wind speed from the digital anemometer.
 - How did the temperature feel outside? What was the actual measurement?
 - How does the student-recorded data compare to the weather app or website data?
 - Is there a weather condition that consistently varies? Why do you think this weather factor varies compared to the other weather factors?
- 12 Continue to record weather observations daily, even if you are not teaching PLTW Launch on a daily basis. Daily weather data is the foundation for understanding trends in weather. Ultimately, the averages of precipitation and temperature data over 30-year periods or longer, establish the climate for a region.

Note: Be sure to rotate groups daily so all students experience each weather tool.

Part 2. What Is Climate?

- 13 Lead a discussion to gather students' preconceptions about climate. Prompts:
 - Why do you think it is important to gather weather data over a long period?
 - What do you think the term *climate* means? Why do you think that?
 - How do you think climate and weather are related?
- 14 Introduce the Climate Zones video. Guide students to view the video with a partner or small group to build an understanding of climate. In their PLTW Launch Logs, have students create a graphic organizer to record important information about the five climate zones.



Climate Zones video

- 15** Lead a discussion about the video. Sample prompts:
- How is climate different from weather? Direct students to access the flashcard example as you review the vocabulary term *climate*.
 - What are the five climate zones? Guide students to describe each zone. Record this information on the chart titled "Climate Zones".
 - What climate zone do we live in? What evidence do you have that this zone fits where we live?
 - How would your life change if you lived in a different climate zone?

Part 3. Climate Data

- 16** Model for students how to make a claim and support it with evidence. Direct students to view the climate normals for Istanbul, Turkey. These climate normals represent three-decade averages of temperature and precipitation. Use these climate normals to determine Istanbul's climate zone.

Istanbul, Turkey

	January	February	March	April	May	June	July	August	September	October	November
Average temperature (°F)	42	42	45	53	61	69	74	74	68	60	
Average precipitation (inches)	4.0	2.8	2.8	2.0	1.3	1.2	0.9	1.3	1.8	2.9	

Claim: Istanbul, Turkey is in the temperate climate zone.

Evidence: Based on the temperature and precipitation, they have four seasons. It is cold December to March (winter). It starts to warm up in April (spring). It is warm July to August



(summer), and it starts to cool down in September (autumn). Also, the temperature in the coldest month is 42 °F. In a temperate climate zone, the coldest month ranges between 26–64 °F.

- 17 Direct students to work with a partner to review one of the climate normals found in the student course.

- 18 Guide students to:
- Analyze the data for both temperature and precipitation.
 - Make a claim about which climate zone the country is in. Support this claim with evidence.
 - Record the claim and evidence statements in their Launch Logs.

Student responses should demonstrate an understanding of climate zones. Example responses:

- *Toronto, Canada is in the continental climate zone. I think this because they have hot summers and cold winters. Also, their coldest month is below 26 °F.*
- *Cairo, Egypt is in the dry climate zone. I think this because Cairo gets very little precipitation. They have six months without any precipitation, and the other months never get above 5 millimeters.*
- *Nuuk, Greenland is in the polar climate zone. I think this because they have cold winters and cool summers. The average temperature never exceeds 45 °F.*
- *Shanghai, China is in the temperate climate zone. I think this because the climate appears to be mild. In the winter, the average temperature does not drop below 40 °F. In the summer, the average temperature is in the 70s and 80s.*
- *Cumanda, Ecuador is in the tropical climate zone. I think this because they have wet and dry seasons. Their wettest months average 352 to 480 millimeters of rain. The other months average 29 to 178 millimeters of rain.*

- 19 Lead students in a discussion about the climate normals. For each city, use the prompts:

- What do you think this climate zone is?
- What evidence do you have for your thinking?
- How is this climate different from the other climates?

- 20 Guide students to answer the Conclusion Questions. Lead a discussion for students to share their thoughts.

Conclusion Questions Answer Key

- 1 Describe how weather and climate are connected.

Student responses should demonstrate an understanding of weather and climate. Example response:

Weather is the state of the atmosphere, or air, at a particular place over a short period, while climate is the average weather conditions in a particular region over a period of years.

- 2 If you could live in any climate zone, which climate zone would you choose? Why would you choose this climate zone?



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Responses will vary. Student responses should demonstrate an understanding of climate zones.



Activity 3

Weather Hazards

Teacher Resources

[View Student Course](#)

EQUIPMENT

The list below is based on a class of 30 students.

Included in Equipment Kit	Not Included in Equipment Kit	Device Applications
• Rain gauge • Thermometer (3) • Wind sock (2) • Pole (2) • Digital anemometer (2) • Compass	• PLTW Launch Logs (1 per student) • Digital devices • Pencils or colored pencils for sketching • KWL chart from Activity 1	• Inking or my.pltw.org • Weather website or app of teacher's choice • Compass (iPad®) • SmartCompass (Android™) • SciLinks Hurricane Simulation • SciLinks Tornado Simulator

RESOURCE

R

[Three-Circle Venn Diagram](#)

ESSENTIAL QUESTIONS

EQ

EQ1 How does weather affect our lives?

EQ2 How can a step-by-step process help you design or improve a solution to a problem?



Introduction

In this activity, students expand their understanding of *weather* to learn about *weather-related hazards*. They identify which weather factor(s) are present in a specific hazard. Students deepen their understanding of weather-related hazards through simulations.

Preparation

Professional Development

Before you facilitate Activity 3, access the [Weather: Factors and Hazards Module-specific PD Resources](#) to review Building Your Understanding: Disaster Relief.

Part 1. Weather Collection

1. Become familiar with the vocabulary terms used in this activity. Plan how you will help students use these terms as part of their vocabulary.

climate	The average weather conditions in a particular region over a period of years.
meteorologist	A scientist who studies weather.
trend	A pattern found in data.
weather	The state of the atmosphere, or air, at a particular place.
weather-related hazard	An extreme weather event that occurs naturally.

2. Review the Learning Objectives and Knowledge and Skills in Stage 1 of the [Curriculum Framework](#). Use the Evidence (Stage 2) and Learning Plan (Stage 3) content to plan how you will formatively and summatively assess students throughout this activity.
3. Review the [Additional Instructional Resources](#). This list includes books that offer diverse perspectives that can expand student understanding. Using these resources provides a sense of inclusion and belonging, and helps students make connections if the content is new to them.
4. Review the external resources used in this activity. External resources can include:
 - Apps for digital devices
 - Web-based apps
 - Websites

For each resource, determine if translations in other languages are available to meet the needs of multilingual learners (ML).

Part 2. Weather-related Hazards



1. View the Weather-related Hazards presentation before you facilitate the activity.
2. Be prepared to provide examples of weather-related hazards that relate to your community, state, or region.
3. Print the [Three-Circle Venn Diagram](#) for each student.

Part 3. Weather-Related Hazard Simulations

1. Preview the ScJinks Hurricane Simulation and ScJinks Tornado Simulator to better facilitate this part with students.
2. Review the full content of both pages. There are some additional resources you may want to share, such as "How Does a Hurricane Form?" and "Learn More About Tornadoes".

Possible Student Misconceptions

- **Lightning never strikes in the same place twice.** Lightning tends to strike the highest points in a given area, as a result, such locations are likely to be struck more than once.
- **Thunder occurs when two clouds collide.** Thunder and lightning are the auditory and visible effects of a massive charge transfer between clouds.
- **Seasons are caused by Earth's distance from the sun.** Seasonal variation is a result of Earth's alignment on its axis.

Procedure

Time: 100 Minutes

Part 1. Weather Collection

- 1 Lead a discussion to review Activity 2. Prompts:
 - What kind of weather data do meteorologists collect? How do they collect this data? Direct students to access the flashcard examples as you review the vocabulary terms *weather* and *meteorologist*.
 - Why do you think people collect weather data?
 - How are weather and climate different? Direct students to access the flashcard example as you review the vocabulary term *climate*.
 - How can you apply what you have learned to your life?
- 2 Divide the class into eight groups. Distribute the wind socks and poles, digital anemometers, and thermometers to the groups. Be sure that each group uses a different tool than they did in Activity 2.
- 3 Take the class outside to gather weather data.



- 4 In the classroom, have each group share their weather data. Guide students to record the precipitation, temperature, wind direction, and wind speed on the weather calendar in their Launch Logs.
- 5 Discuss any observations about the data that has been collected. Prompts:
 - Do you notice any trends in the weather data? If so, what trends do you see? Direct students to access the flashcard example as you introduce the vocabulary term *trend*.
 - How can weather patterns help to predict the weather?
 - What do you think the weather will be tomorrow? Why do you think that?

Part 2. Weather-related Hazards

- 6 Direct students to access Activity 3 in the student course and have them read the Introduction.
- 7 Have students prepare their PLTW Launch Logs for Activity 3.
- 8 Lead a discussion to gather students' preconceptions about weather-related hazards. Prompts:
 - What do you think the term hazard means? Why do you think that?
 - What do you think the term weather-related hazard means? Why do you think that?
 - What are some examples of weather-related hazards? How do you know that?
- 9 Introduce students to the [Weather-related Hazards](#) presentation.
 - Guide students to work with a partner or small group to view the presentation to learn about weather-related hazards.
 - While viewing the presentation, students take notes in their Launch Logs, focusing on the weather factors of each weather-related hazard.
 - Use the presentation as a first step in overcoming misconceptions about weather-related hazards.
- 10 Reflect on the presentation. Guide students to use the KWL chart they created in their Launch Logs to record their reflections. Direct them to consider what new information they learned related to weather. Add new information under the "L" column and new questions under the "W" column.
- 11 Lead a discussion about the presentation. Prompts:
 - What types of weather-related hazards have you experienced? Direct students to access the flashcard example as you introduce the vocabulary term *weather-related hazard*.
 - Why do you think these weather-related hazards are common in our local area?
 - What warning did you receive before the weather-related hazard happened? Why are warnings important?
 - What types of weather-related hazards are not typical in our area?
- 12 Record the student responses in the class KWL chart titled "Weather".
- 13 Introduce students to a three-circle Venn diagram. Distribute the Three-Circle Venn Diagram template to each student. Explain how this diagram compares three items. The areas that overlap represent similarities. The areas with no overlap represent differences.

Venn Diagram



Note: If students need more practice in using a Venn diagram, consider modeling how to use a Venn diagram with a familiar topic.

- 14 Direct students to make a claim about the eight weather-related hazards by placing them on the Venn diagram. The placement serves as their claim about the connections among the weather-related hazards and the three weather factors. The eight weather-related hazards are:

- Flooding
- Drought
- Tornado
- Blizzard
- Lightning
- Mudslides
- Dust storms
- Hurricane

Student responses may vary.

- Flooding (precipitation)
- Drought (temperature and/or lack of precipitation)
- Tornado (wind)
- Blizzard (precipitation, temperature, and wind)
- Lightning (precipitation and/or temperature)
- Mudslide (precipitation)
- Dust storms (lack of precipitation and/or temperature)
- Hurricane (precipitation and wind)

- 15 Guide students to consider the weather factors that contribute to each weather-related hazard. For help, students can refer to the notes in their Launch Logs or the Weather-related Hazards presentation.

Note: Support students in considering all of the potential weather factors for a weather-related hazard. For example, students might make an accurate connection between hurricanes and high winds. However, because a hurricane is typically accompanied by rain, hurricane should be placed in the overlap of the Wind circle and Precipitation circle.

- 16 Lead a discussion about each group's Venn diagram. Prompts:
- How did you decide where to place the weather-related hazards?
 - Share the weather-related hazards that have only one weather factor. What evidence do you have to support your claim that these hazards have one weather factor?
 - Share the weather-related hazards that have two weather factors. What evidence do you have to support your claim that these hazards have two weather factors?
 - Share the weather-related hazards that have three weather factors. What evidence do you have to support your claim that these hazards have three weather factors?



- 17 When students explore careers, they can see connections between what they are learning and how it is applied in the real world. Guide students to read about Lisa Kriederman, an incident meteorologist. As an option, you can read this aloud to students.

Part 3. Weather-related Hazard Simulations

- 18 To learn more about hurricanes, guide students to complete the [SciJinks Hurricane Simulation](#). In this simulation, students explore the relationship between sea surface temperature (SST) and hurricane strength.
- 19 Have students read the content of the page so they understand the different hurricane categories before they explore the simulation.
- 20 In this simulation, students:
- Drag the hurricane around to see the effect surface temperature has on the hurricane.
 - Drag the grey high pressure area around to see how pressure and winds influence hurricane paths.
 - Click the season name to rotate through seasons. Ocean temperatures change with each season.
 - Click Reset to start over.
- 21 To learn more about tornadoes, guide students to complete the [SciJinks Tornado Simulator](#). In this simulation, students explore a tornado's destructive force by adjusting the funnel width and the core pressure difference.
- 22 Have students read "What do these measurements mean?" and "How do we measure tornadoes?" before they explore the simulation.
- 23 Lead a discussion about the simulations. Prompts:
- How did the sea surface temperature affect the hurricane?
 - How did the seasons affect the temperatures?
 - How did the funnel width affect the destruction?
 - How did the core pressure and speed affect the destruction?
- 24 Guide students to answer the Conclusion Questions. Lead a discussion for students to share their thoughts.

Conclusion Questions Answer Key

- 1 What weather-related hazards are common in your local area? Which of the three weather factors are involved with those weather-related hazards?

Student responses will vary. Student responses should demonstrate an understanding of weather-related hazards.

- 2 How do weather-related hazards impact the world?



Student responses should demonstrate an understanding of weather-related hazards.

Example response:

Because weather-related hazards are extreme weather events, they bring large amounts of precipitation, extreme temperatures, and high winds. These factors can cause damage to buildings and homes.



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GLOBAL SKILLS

IEP AND 504 ACCOMMODATIONS AND MODIFICATIONS FOR EARLY CHILDHOOD AND ELEMENTARY SCHOOL STUDENTS:

Large print textbooks
Textbooks for at-home use
Additional time for assignments
Review of directions
Use of mnemonics
Have student restate information
Concrete examples
Adaptive writing utensils
Support auditory presentations with visuals
Use of a study carrel
Assistance in maintaining uncluttered space
Weekly home-school communication tools (notebook, daily log, phone calls or email messages)
Space for movement or breaks
Study sheets and teacher outlines
Extra visual and verbal cues and prompts
Math sheets with highlighted instructions
Graph paper to assist in organizing or lining up math problems
Use of computers and calculators
Books on tape
Graphic organizers
Quiet corner or room to calm down and relax when anxious
Preferential seating
Alteration of the classroom arrangement
Reduction of distractions
Answers to be dictated
Hands-on activities
Use of manipulatives
No penalty for spelling errors or sloppy handwriting
Follow a routine/schedule
Alternate quiet and active time
Teach time management skills
Rest breaks
Verbal and visual cues regarding directions and staying on task
Agenda book and checklists
Adjusted assignment timelines
Visual daily schedule



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**ENGAGING STUDENTS • FOSTERING ACHIEVEMENT • CULTIVATING 21ST CENTURY
GLOBAL SKILLS**

Varied reinforcement procedures
Immediate feedback
Work-in-progress check
Personalized examples

TESTING AND ASSESSMENT ACCOMMODATIONS AND MODIFICATIONS:

Answers to be dictated
Frequent rest breaks
Additional time
Oral testing
Untimed tests
Choice of test format (multiple-choice, essay, true-false)
Alternate ways to evaluate (projects or oral presentations instead of written tests)
Accept short answers
Open-book tests
Read test and directions to student
Provide study outline prior to tests
Highlight key directions
Test in alternative site
Use of calculator
Extra credit option
Preview test procedures
Simplified test wording; rephrased test questions and/or directions

GENERAL ACCOMMODATIONS AND MODIFICATIONS:

Use of alternative books or materials on the topic being studied
Computerized spell-check support
Word bank of choices for answers to test questions
Provision of calculator and/or number line for math tests
Reworded questions in simpler language
Projects instead of written reports
Highlighting important words or phrases in reading assignments
Modified workload or length of assignments/tests
Modified time demands
Modified grades based on IEP

BEHAVIOR ACCOMMODATIONS MODIFICATIONS:



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GLOBAL SKILLS**

Breaks between tasks
Cue expected behavior
Daily feedback to student
Have contingency plans
Use de-escalating strategies
Use positive reinforcement
Use proximity/touch control
Use peer supports and mentoring
Model expected behavior by adults
Have parent sign homework
Have parent sign behavior chart
Set and post class rules
Chart progress and maintain data



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GLOBAL SKILLS

IEP AND 504 ACCOMODATIONS AND MODIFICATIONS FOR MIDDLE AND HIGH SCHOOL STUDENTS:

Large print textbooks
Textbooks for at-home use
Additional time for assignments
A locker with adapted lock
Review of directions
Review sessions
Use of mnemonics
Have student restate information
Provision of notes or outlines
Concrete examples
Adaptive writing utensils
Support auditory presentations with visuals
Weekly or bi-weekly home-school communication
Space for movement or breaks
Study sheets and teacher outlines
Extra visual and verbal cues and prompts
Lab and math sheets with highlighted instructions
Graph paper to assist in organizing or lining up math problems
Use of tape recorder for lectures
Use of Interactive notebook
Use of a scribe
Use of computers and calculators
Books on tape
Graphic organizers
Quiet corner or room to calm down and relax when anxious
Preferential seating
Alteration of the classroom arrangement
Reduction of distractions
Answers to be dictated
Hands-on activities
Ability to type all assignments
Follow a routine/schedule
Teach time management and organizational skills
Rest breaks
Verbal and visual cues regarding directions and staying on task
Agenda book and checklists
Daily check-in with case manager or special education teacher
Adjusted assignment timelines
Visual daily schedule



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**ENGAGING STUDENTS • FOSTERING ACHIEVEMENT • CULTIVATING 21ST CENTURY
GLOBAL SKILLS**

Varied reinforcement procedures
Immediate feedback
Work-in-progress check
Personalized examples

TESTING AND ASSESSMENT ACCOMMODATIONS AND MODIFICATIONS:

Answers to be dictated
Frequent rest breaks
Additional time
Oral testing
Choice of test format (multiple-choice, essay, true-false)
Alternate ways to evaluate (projects or oral presentations instead of written tests)
Accept short answers
Open-book or open-note tests
Read test and directions to student
Provide study guides prior to tests
Highlight key directions
Test in alternative site
Use of calculator
Extra credit option
Pace long-term projects
Preview test procedures
Simplified test wording; rephrased test questions and/or directions

GENERAL ACCOMMODATIONS AND MODIFICATIONS:

Allow outlining, instead of writing for an essay or major project
Use of alternative books or materials on the topic being studied
Computerized spell-check support
Word bank of choices for answers to test questions
Provision of calculator for math tests
Film or video supplements in place of reading text
Reworded questions in simpler language
Projects instead of written reports
Highlighting important words or phrases in reading assignments
Modified workload or length of assignments/tests
Modified time demands



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**ENGAGING STUDENTS • FOSTERING ACHIEVEMENT • CULTIVATING 21ST CENTURY
GLOBAL SKILLS**

Pass/no pass option
Modified grades based on IEP

BEHAVIOR ACCOMMODATIONS FOR STUDENTS:

- Breaks between tasks
- Cue expected behavior
- Daily feedback to student
- Have contingency plans
- Use de-escalating strategies
- Use positive reinforcement
- Use proximity/touch control
- Use peer supports and mentoring
- Model expected behavior by adults
- Have parent sign homework
- Set and post class rules
- Chart progress and maintain data



SPRINGFIELD PUBLIC SCHOOLS

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GLOBAL SKILLS

Accommodations and Modifications for ESL Students

- Give tests orally
- Give instructions/directions in writing and orally
- Assign a peer tutor, same language or English speaking
- Allow use of bilingual/translation dictionary
- Provide summaries of text or study guides of particular chapters
- Allow errors in speaking
- Allow errors in writing
- Accept writing in first language
- Highlight key vocabulary
- Reduce amount of work required
- Assess comprehension through demonstration or other alternative means (gestures, drawings)
- Rephrase questions, directions, and explanations
- Reduce multiple choices on assessments
- Provide study guides and/ or outlines
- Shorten reading assignments
- Allow extended time for test/project completion
- Use of audio books
- Use of graphic organizers
- Use reduced text, so that print is not dense
- Use visuals/pictures throughout lesson/unit/assignment
- Adapt homework to reflect language proficiency/home support
- Adapt homework to reflect home support
- Provide hands-on activities and explanations
- Allow extended time to answer questions, and permit drawing, as an explanation
- Use of translation dictionaries to locate words in the native language
- Use anecdotal records and portfolio of work as forms of assessment
- Use story retellings to assess comprehension

What Does the Gifted and Talented Experience Look Like? *Springfield Public Schools*

Mission Statement

The Gifted and Talented Program of the Springfield Public Schools aims to provide a meaningful and rigorous education that instills the value of lifelong learning and empowers all students to reach their full potential and become self-fulfilled creative leaders in accordance with the comprehensive standards of our state. We accomplish this by offering challenging, real-world experiences in a student-centered environment.

We recognize that students come from diverse socioeconomic, cultural, and ethnic backgrounds, and the mission of the gifted and talented program is to provide opportunities for students to explore their intellectual, creative, and artistic gifts and talents within the classroom and with beyond-the-classroom experiences. It is essential to provide diverse, appropriate, and ongoing learning experiences and environments that incorporate students' academic, psychological, and social needs. Our responsibility is to provide students with educational alternatives that teach, challenge, and expand their knowledge, while simultaneously stressing the development of independent and self-directed learners who continuously generate questions, analyze, synthesize, and evaluate information and ideas.

New Jersey Administrative Code 6A:8-3.1 defines students who are gifted and talented as those students who possess or demonstrate high levels of ability in one or more content areas when compared to their chronological peers in the local district and who require modification of their educational program if they are to achieve in accordance with their capabilities.

Goals:

To support our mission, we have established the following goals to guide our work:

- To infuse into the general education program a broad range of activities for high-level learning that will challenge all students to perform at advanced levels, and provide extended opportunities, resources, and support in particular areas where student interest or talent is demonstrated.
- To provide a continuum of gifted education services that will strengthen the total school program, offer enriching and challenging learning opportunities for all students, and provide specialized learning experiences
- To promote achievement of students' best potentials and increased ability.

Through a productive and collaborative relationship among the building principals, classroom teachers, and the Gifted and Talented teacher, our schools can create programming that will enhance the learning experience for every student and serve the unique and specialized needs of students currently demonstrating gifted behaviors.

Elements of the Schoolwide Enrichment Model, W.I.N (What I Need), differentiated instruction, advanced classes, or individual programs into a student's regular instruction program are integral to this overarching framework for gifted education in the Springfield School District.

Reference Board Policy and Regulation 2464 – Gifted and Talented Pupils (M)

Early Childhood Center **Edward V. Walton**

Schoolwide Virtual Enrichment

All first and second grade students have access to the [Gifted and Talented Virtual Classroom](#). This virtual classroom is a space for students to complete various challenges and enrichment opportunities at their own pace. Students can receive feedback and additional adaptable resources to meet their individual learning needs. The virtual classroom design expands accessibility to enrichment resources and allows students to choose learning activities according to their unique interests and abilities. The purpose of the activities is to encourage problem-solving, develop critical thinking

skills, and expand curiosity and imagination. Activities are aligned to the New Jersey Student Learning Standards.

Gifted and Talented Teacher as a Resource

The Gifted and Talented teacher serves as a resource to all teachers within Edward V. Walton School. Teachers seeking resources for their high-ability learners will receive additional support from the Gifted and Talented teacher in various ways. This support may include additional units of study, challenging resources, and student projects.

Elementary Schools **James Caldwell** **Thelma L. Sandmeier**

The goal is to engage small groups of students in intensive learning experiences through standards-based, rigorous, and relevant units of study that supplement, not supplant, the grade-level curriculum and support students' unique learning needs.

Enrichment Experience Grade 3

Beginning in third grade, the G&T teacher will cycle through all classrooms to work on problem-solving and enrichment tasks with students. Driven by assessment data, academic performance, student interest, and teacher observation, small groups of students will meet with the G&T teacher during W.I.N. (What I Need) periods throughout the week that the teacher is assigned to their classroom teacher. Groupings will be flexible and monitored to best meet each student's needs throughout the school year. Activities will include brain teasers, puzzles, strategic thinking, problem-solving, and STEM challenges.

Targeted Gifted and Talented Programing Grades 4-5

Students may become identified as Gifted and Talented in fourth grade. Students that are identified may receive support from the G&T Teacher for up to five periods (200 minutes) a week during W.I.N. (What I Need) periods. Identified students will meet to explore grade-level content while incorporating depth and complexity in a student-centered, problem-based environment. The Gifted and Talented Program aims to provide students with various advanced and challenging learning experiences across content areas to promote independent thinking skills, refine critical thinking and communication skills, cultivate joy in learning, and expand student interests through problem-solving. The instruction that students receive incorporates 21st Century Skills and advanced content that is challenging, hands-on, and relevant to the real world.

Strategies and Practices that Support Gifted and Talented Students

- Adjusted Pace of Lessons
- Inquiry-Based Instruction
- Higher-Order Thinking Activities
- Interest-Based Content
- Real World Problem Solving/Problem Based Learning
- Independent Study/Passion Projects
- Units of Study with Like-Minded Peers

Schoolwide Virtual Enrichment

All JCS and TLS students have access to grade level-specific [Gifted and Talented Virtual Classrooms](#). These virtual classrooms are a space for students to complete various challenges and enrichment opportunities at their own pace. Students are able to receive feedback and additional opportunities based on their needs. The virtual classrooms have expanded the accessibility of enrichment resources directly to the students and allows for students to choose opportunities according to their interests and abilities. The purpose of the activities is to encourage problem solving, develop critical thinking skills, and expand curiosity and imagination in conjunction with the New Jersey Student Learning Standards.

Gifted and Talented Teacher as a Resource

In addition to classroom support, the Gifted and Talented teacher also serves as a resource to all teachers in the building. Teachers that are seeking resources for their high ability learners will receive additional support from the Gifted and Talented teacher in various ways. This may include additional units of study, challenging resources, student projects, and meeting with the G&T teacher as needed.

Additional Enrichment Opportunities

Across all grade levels 3-5, as recommended by the classroom teacher, students exhibiting a need for additional enrichment may have the opportunity to meet with the G&T teacher as the schedule allows. Groupings will be flexible and monitored to best meet the students' needs throughout the school year. Activities will include, brain teasers, puzzles, strategic thinking activities, problem-solving challenges, and STEM challenges. Students engage in an extended process of asking questions, using resources, and developing answers that lead to thinking about what and how they are learning. Students are held accountable for how they work and use their time by demonstrating their learning through products or presentations.

Students self-select to participate in individual and/or group projects based on interest and commitment. The classroom teacher and/or the enrichment teacher will help guide and monitor student exploration of chosen topics, facilitating their learning with resources and teaching of needed skills.

Secondary Schools
Florence M. Gaudineer Middle School
Jonathan Dayton High School

Grades 6-12: Access to specific content programs with higher levels of academic challenges (i.e. Pre-Algebra, Accelerated Communication Arts, and Advanced Placement Classes)

Dual Credit Courses provide students the opportunity to obtain high school credit, and college credit, simultaneously through partnerships with several institutions.

Project Lead the Way (PLTW) students become builders of technology by engaging in real world activities. Students are empowered as design thinkers collaborating on real world projects.

Gifted and Talented Identification Criteria

The Springfield Schools Gifted and Talented Program recognizes that students require differentiated learning experiences beyond the core curriculum being taught because of their advanced abilities in one or more content areas. These students may also have other cognitive qualities such as curiosity, creativity, motivation, leadership, and passion that require modifications to their academic experience.

Multiple Measures of Eligibility

Kindergarten through grade twelve identification process for gifted and talented students includes multiple measures. Multiple measures may include but are not limited to: achievement test scores; grades; student performance or products; intelligence testing; parent, student, and/or teacher recommendation; and other appropriate measures. The identification methodology is developmentally appropriate, non-discriminatory, and related to the programs and services offered by the Springfield School District. The identification procedures are reviewed annually.

According to N.J.A.C. 6A:8-3.1, all public school districts must have a board-approved gifted and talented identification process and provide services for identified students enrolled in the grades of that school district. The regulations require that identification and services be made available to students in grades K-12.

When students are recommended for the Gifted and Talented Program there are multiple measures that are considered to determine if services are necessary and appropriate. The assessments used are as follows:

- Cognitive Abilities Test (CogAT)
- Classroom Performance/Student Portfolios
- DRA2 Level
- iReady Diagnostic Scores
- Gifted Indicators Checklist
- Start Strong/NJSLA Assessment Data

The N.J.A.C. requires that students be compared to their chronological peers in the local school district. The New Jersey Department of Education has not established state-level criteria for identifying students who are gifted, such as mandated tests or assessments, grade point averages, or IQ scores. Local school districts must use multiple measures to identify students.

Procedures

<https://www.straussesmay.com/seportal/Public/DistrictPolicy.aspx?policyid=2464&id=b8a33a9f505e4998a6db3fb8e1de778b>

Gifted and Talented Program Identification Matrix

Minimum Score Required for Consideration: 14 Points

1 Point	2 Points	3 Points
Cogat Assessment Overall Stanine Score of a 7	Cogat Assessment Overall Stanine Score of an 8	Cogat Assessment Overall Stanine Score of a 9
iReady Math Assessment Just Below Current Grade Level	iReady Math Assessment On Grade Level	iReady Math Assessment ½ Year + Above Current Level
iReady ELA On Grade Level	iReady ELA ½ Year Above Current Level	iReady ELA One Full Grade Level + Above Current Level
NJSLA Math Approaching Expectations	NJSLA Math Met Expectations	NJSLA Math Exceed Expectations
NJSLA ELA Approaching Expectations	NJSLA ELA Met Expectations	NJSLA ELA Exceed Expectations
HOPE Teacher Rating Scale Raw Score: 11 - 29	HOPE Teacher Rating Scale Raw Score: 30 - 49	HOPE Teacher Rating Scale Raw Score: 50-66

Team meetings present the opportunity to review data and assess the educational needs of all students. Teacher provides examples of student work exhibiting above and beyond grade level expectations, creativity, leadership, critical and abstract thinking. Programs for gifted and talented students will be periodically evaluated for their continuing efficacy and adjusted accordingly. The parent of any student identified as gifted or talented shall be consulted regarding any program designed to address the student's particular needs.

Resource Links

https://riversideinsights.com/cognitive_abilities_test

<https://www.curriculumassociates.com/programs/i-ready-learning>

<https://www.nj.gov/education/assessment/resources/>

<https://www.routledge.com/HOPE-Teacher-Rating-Scale-Involving-Teachers-in-Equitable-Identification/Gentry-Pereira-Peters-McIntosh-Fugate/p/book/9781618214522#:~:text=The%20HOPE%20Teacher%20Rating%20Scale,making%20it%20easy%20to%20use.>

Gifted and talented student: The “*[Strengthening Gifted and Talented Education Act](#)*” defines a gifted and talented student as a “student who possesses or demonstrates a high level of ability in one or more content areas when compared to their chronological peers in the school district and who require modifications of their educational program if they are to achieve in accordance with their capabilities.”

Twice-exceptional (2E) students: A twice-exceptional (2E) student is defined as “a student who is both gifted and a student with a disability. These students may also be referred to as having dual exceptionalities or as being gifted with learning disabilities (GT/LD). This also applies to students who are gifted with ADHD or gifted with autism” (New Jersey Association for Gifted Children, www.nagc.org).

Instructional adaptation: An adjustment or modification to instruction enabling a student who is gifted and talented to participate in, benefit from, and demonstrate knowledge and application of the New Jersey Student Learning Standards in one or more content areas at the instructional level of the student, not just the student's grade level.

Identifying gifted and talented students: The focus of identification is to provide programming and services in which students' specific learning needs and potential are appropriately addressed and met. In every New Jersey school district, there are students who require modifications to the general education curriculum if they are to achieve in accordance with their abilities. By identifying a student's general intellectual ability, creativity, or specific academic area aptitudes, we are acknowledging that they need programming and services outside of the general education/grade level curriculum to advance their learning.

NJDOE Fast Facts

<https://www.nj.gov/education/standards/gifted/>

<https://www.nj.gov/education/standards/gifted/legislation.shtml>

Supplemental Resources/Programming for Gifted Students

Edward V. Walton

- PETS Program – Primary Education Thinking Skills
- Group Solutions/Group Solutions 2 – Cooperative Logic Activities
- Lollipop Logic
- Beginning Thinking Skills
- AIMS Education Programming

James Caldwell and Thelma L. Sandmeier

Math/ELA

- Project M3: Mentoring Mathematical Minds
- Junior Great Books
- AIMS Education Programming
- Borenson Hands on Equations
- BizWorld
- Perplexors
- Advanced Math Explorations grade 3-5
- Challenging Units for Gifted Learners (ELA and Math)
- Creative Curriculum Extenders
- Differentiated Lessons & Projects
- Challenge Math Grades 4+
- Differentiating Instruction with Menus (All Content Areas)
- Jacob's Ladder
- Genius Hour/Passion Project
- Spatial Reasoning
- Logic Puzzles, Brain Games, Analogies

STEM

- Engineering is Elementary
- Engineer Throughout the Year
- PBS Design Squad
- DefinedSTEM
- Project Lead the Way (PLTW)

Enrichment Events

Experience for all students to be enriched through events related to the curricular or extracurricular activities. Examples include after school clubs, PTA-sponsored events, leadership opportunities, visual and performing arts, and community service opportunities.