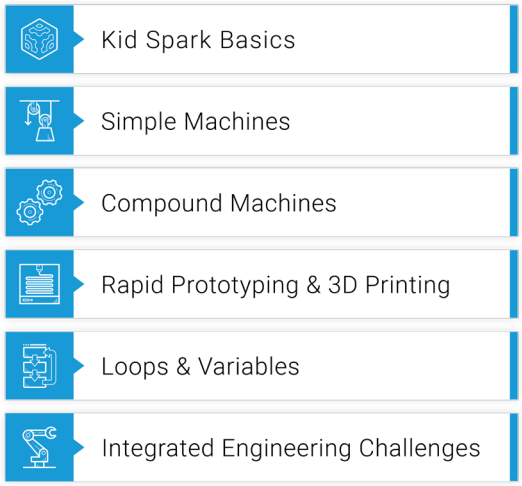
Program Implementation Guide

Grades 6 - 8

In Kid Spark's 6 - 8 STEM Program, students explore challenging STEM concepts from their everyday world, authoring with technology to solve problems and create new solutions. Students explore concepts in structural & mechanical engineering, physics, rapid prototyping & 3D printing, computer science, and robotics. We recommend schools implement at least one (1) Kid Spark unit of instruction per grade level so students can continue to develop a lasting interest in STEM.

Units of Instruction

There are a total of six units of instruction included in Kid Spark's 6 - 8 STEM program. Each unit of instruction includes a unit overview, multiple hands-on lessons, and a unit assessment.



Sample Implementation Plan

Below is an example of how Kid Spark's 6 - 8 STEM Program might be implemented across grade levels. Ultimately, each school can decide which units of instruction to offer at certain grades. Kid Spark units are progressive which means educators have the ability to meet the needs of any student regardless of age or skill level.

Grade	Kid Spark Unit	Lessons & Assessments	Minimum Time Required
6	Kid Spark Basics	5 Lessons, 1 Assessment	(7) 60-Minute Sessions
	Simple Machines	6 Lessons, 1 Assessment	(13) 60-Minute Sessions
7	Compound Machines	5 Lessons, 1 Assessment	(11) 60-Minute Sessions
	Rapid Prototyping & 3D Printing	5 Lessons, 1 Assessment	(9) 60-Minute Sessions
8	Loops & Variables	5 Lessons, 1 Assessment	(11) 60-Minute Sessions
	Integrated Engineering Challenges	5 Lessons, 0 Assessments	(11) 60-Minute Sessions

Plan Your Program

Listed below are the available units of instruction in Kid Spark's 6 - 8 STEM Program. Determine which units of instruction will be offered at each grade level and the dates in which they will be implemented.

	Kid Spark Basics	5 Lessons, 1 Assessment	(7) 60-Minute Sessions
	Simple Machines	6 Lessons, 1 Assessment	(13) 60-Minute Sessions
	Compound Machines	5 Lessons, 1 Assessment	(11) 60-Minute Sessions
	Rapid Prototyping & 3D Printing	5 Lessons, 1 Assessment	(9) 60-Minute Sessions
	Loops & Variables	5 Lessons, 1 Assessment	(11) 60-Minute Sessions
	Integrated Engineering Challenges	5 Lessons, 1 Assessment	(11) 60-Minute Sessions

Grade	Instructor	Kid Spark Unit	Implementation Schedule
6	*Mrs. Spark*	*Kid Spark Basics*	*3/5/2021 - 4/23/2021 - 7 (60) minute sessions*
6			
6			
6			
7			
7			
7			
8			
8			
8			

Preparing For Instruction

We recommend educators complete the following steps prior to instruction:

- [ ] **Determine which Kid Spark units of instruction will be offered at each grade level.**

  See page 1 for sample implementation plan and minimum time requirement for each unit. Complete the Plan Your Program worksheet on page 2.

- [ ] **Review the unit overview(s) for all of the units you will be responsible for teaching.**

  Unit Overviews can be found on pages 4 - 11.

- [ ] **Review lesson content.**

  We highly recommend educators get hands-on with the lessons they will be responsible for teaching. All of the curriculum for Kid Spark's 6 - 8 STEM Program can be found online at kidsparkeducation.org/curriculum.

- [ ] **Review unit assessments.**

  Each Kid Spark unit includes a unit assessment that can be used to evaluate student learning. Unit assessments can be found online at kidsparkeducation.org/curriculum.

- [ ] **Complete the following online professional learning courses:**

  - Kid Spark Program Orientation
  - Grades 6 - 8

  Note: After successfully completing all of these courses, educators will receive their Kid Spark Grades 2 - 5 program certification. All courses can be found online by visiting: kidsparkeducation.org/professional-learning.

- [ ] **Make sure all STEM Labs are inventoried and ready to go.**

Kid Spark Basics

v3.0

Unit Overview:

In this unit, students will learn the basics of how to use Kid Spark resources in the classroom. Students will get hands-on as they explore different building materials and engineering processes that are used throughout Kid Spark learning experiences.

Recommended Grade Level:
2 - 8

Kid Spark STEM Lab:
STEM Pathways

Alignment to STEM Standards:

The table below highlights how this unit is aligned to the Next Generation Science Standards (NGSS).

- NGSS Disciplinary Core Ideas (DCI) are standards related to content knowledge.
- NGSS Science and Engineering Practices (SEP) and Crosscutting Concepts (CCC) provide a foundation for all scientific and engineering disciplines and are particularly important to develop in young students.

Lessons & Assessment	NGSS DCI	NGSS SEP	NGSS CCC
Lesson 1: Basic Building Components (60 Min.) In this lesson, students will become familiar with the basic building components that are included in Kid Spark STEM Labs. Students will learn how to connect and disconnect building components, and how to add strength to a design.	Engineering Design	Asking questions & defining problems	Structure & function
Lesson 2: Articulating Components (60 Min.) In this lesson, students will learn how Kid Spark engineering materials can be used to create movement. Then, students will create a custom design that moves.	Engineering Design	Asking questions & defining problems	Structure & function
Lesson 3: Dimensions, Perspectives, & Measurement (60 Min.) In this lesson, students will learn how Kid Spark engineering materials can be used to determine the dimensions of different objects. Then, students will create a simple measuring device to determine the dimensions of several objects in the room.	Engineering Design	Using mathematics	Scale, proportion, & quantity
Lesson 4: The Design & Engineering Process (120 Min.) In this lesson, students will learn how to use a design and engineering process to develop solutions to problems or challenges. Students will learn how each step in the process is essential to developing creative, collaborative solutions to STEM challenges.	Engineering Design	Planning & carrying out investigations	Stability & change
Lesson 5: Free Build Challenge (60 Min.) In this lesson, students will apply the knowledge and skills they have acquired throughout the Kid Spark Basics Unit to develop a solution to a challenge. Students will work in teams to design, engineer, and present a custom design.	Engineering Design	Constructing explanations & designing solutions	Systems & system models
Unit Assessment: Kid Spark Basics In this assessment, students will answer a series of questions to demonstrate an understanding of the core ideas and concepts that were covered throughout this unit.			

Target Vocabulary

The following key terms will be used throughout this unit. It may be helpful to explain these terms as they show up in lessons and challenges.

Articulating	Dimension	Invention	Perspective
Brainstorm	Empathy	Iteration	Prototype
Collaboration	Engineer	Length	Rotational
Depth	Height	Measurement	Specification
Design	Innovation	Movement	Teamwork

Teaching Lessons Over Multiple Class Periods

Each lesson in this unit follows Kid Spark's convergent to divergent lesson format. Lessons can easily be taught over the course of two class periods.

Class Period 1 - Convergent Learning Activity

Students building the same models, learning the same content.

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Class Period 2 - Divergent Learning Activity

Students applying their knowledge through open-ended design challenges.

Get Engaged!

Visit our community page at **KidSparkEducation.org/Community** for new project ideas, lesson insights, and to see how other educators are using Kid Spark materials and resources in their classrooms.

Unit Overview:

In this unit, students will develop a conceptual understanding of how simple machines work and how they can be used to improve our lives.

Recommended Grade Level:
6 - 8

Kid Spark STEM Lab:
STEM Pathways

Alignment to STEM Standards:

The table below highlights how this unit is aligned to the Next Generation Science Standards (NGSS) and the International Society for Technology in Education Standards (ISTE).

- NGSS Disciplinary Core Ideas (DCI) are standards related to content knowledge.
- NGSS Science and Engineering Practices (SEP) and Crosscutting Concepts (CCC) provide a foundation for all scientific and engineering disciplines and are particularly important to develop in young students.
- ISTE standards are designed to prepare students to thrive in a constantly evolving technological landscape. Click here to view ISTE standards.

Lessons & Assessment	NGSS DCI	NGSS SEP	NGSS CCC	ISTE
Lesson 1: Inclined Plane (120 Min.) In this lesson, students will assemble an inclined plane and learn how it's used to multiply force. Then, students will design and engineer a custom inclined plane to solve a challenge.	Engineering design	Developing & using models	Cause & effect; mechanism & explanation	Innovative designer, Creative communicator
Lesson 2: Wedge (120 Min.) In this lesson, students will assemble a wedge and learn how to calculate its mechanical advantage. Then, students will develop a custom design that includes a wedge.	Engineering design	Planning & carrying out investigations	Scale, proportion, & quantity	Innovative designer, Creative communicator
Lesson 3: Lever (120 Min.) In this lesson, students will assemble three different types of levers and learn how to calculate the mechanical advantage of each. Then, students will work as a team to design and engineer a custom catapult that includes a lever.	Engineering design	Constructing explanations & designing solutions	Patterns	Innovative designer, Creative communicator
Lesson 4: Wheel & Axle (120 Min.) In this lesson, students will assemble a wheel and axle and learn how it is used to increase speed or create mechanical advantage. Then, students will work as a team to create a design that includes a wheel and axle.	Engineering design	Obtaining, evaluating, & communicating information	Scale, proportion, & quantity	Innovative designer, Creative communicator
Lesson 5: Screw (120 Min.) In this lesson, students will assemble a screw and learn how to calculate its mechanical advantage. Then, students will work as a team to design and engineer a custom design that includes a screw.	Engineering design	Using mathematics	Cause & effect; mechanism & explanation	Innovative designer, Creative communicator
Lesson 6: Pulley (120 Min.) In this lesson, students will explore how fixed and movable pulleys can be used to make work easier. Then, students will design and engineer a custom pulley system to solve a challenge.	Engineering design	Asking questions & defining problems	Systems & system models	Innovative designer, Creative communicator
Unit Assessment: Simple Machines In this assessment, students will answer a series of questions to demonstrate an understanding of the core ideas and concepts that were covered throughout this unit.				

Target Vocabulary

The following key terms will be used throughout this unit. It may be helpful to explain these terms as they show up in lessons and challenges.

Axle	Fulcrum	Pi	Screw thread
Circumference	Inclined plane	Pulley	Separate
Diameter	Lever	Radius	Simple machine
Effort	Leverage	Rise	Wedge
Force	Load	Screw	Wheel
Friction	Mechanical advantage	Screw pitch	Work

Teaching Lessons Over Multiple Class Periods

Each lesson in this unit follows Kid Spark's convergent to divergent lesson format. Lessons can easily be taught over the course of two class periods.

Class Period 1 - Convergent Learning Activity

Students building the same models, learning the same content.

Class Period 2 - Divergent Learning Activity

Students applying their knowledge through open-ended design challenges.

Prerequisite Kid Spark Units

We highly recommend students complete the following Kid Spark units prior to starting this unit.

Elementary Program Units

Applied Mathematics

Students should demonstrate an understanding of metric measurement, dimensions, ratios, and proportions.

Middle School Program Units

Kid Spark Basics

Students should demonstrate a basic understanding of how to use Kid Spark engineering materials, as well as the Kid Spark Design & Engineering Process.

Unit Overview:

In this unit, students will explore how mechanisms and machines can be used to create and convert motion, increase speed, increase torque, and create mechanical advantage.

Recommended Grade Level:
6 - 8

Kid Spark STEM Lab:
STEM Pathways

Alignment to STEM Standards:

The table below highlights how this unit is aligned to the Next Generation Science Standards (NGSS) and the International Society for Technology in Education Standards (ISTE).

- NGSS Disciplinary Core Ideas (DCI) are standards related to content knowledge.
- NGSS Science and Engineering Practices (SEP) and Crosscutting Concepts (CCC) provide a foundation for all scientific and engineering disciplines and are particularly important to develop in young students.
- ISTE standards are designed to prepare students to thrive in a constantly evolving technological landscape. Click here to view ISTE standards.

Lessons & Assessment	NGSS DCI	NGSS SEP	NGSS CCC	ISTE
Lesson 1: The Maker ROK-Bot (120 Min.) In this lesson, students will learn how to create different types of robots using the remote-controlled Maker ROK-Bot and various Kid Spark engineering materials.	Engineering design	Developing & using models	Structure & function	Innovative designer, Creative communicator
Lesson 2: Creating & Converting Motion (120 Min.) In this lesson, students will learn how to create and convert different types of motion using Kid Spark engineering materials. Then, students work as a team to create a custom design that converts motion.	Engineering design	Asking questions & defining problems	Cause & effect; mechanism & explanation	Innovative designer, Creative communicator
Lesson 3: Links & Linkages (120 Min.) In this lesson, students will learn how different types of linkages can be used to redirect or convert motion. Students will build a series of mechanisms and then work as a team to create a custom design that includes a linkage.	Engineering design	Developing & using models	Systems & system models	Innovative designer, Creative communicator
Lesson 4: Gears & Gear Trains (120 Min.) In this lesson, students will learn how gears can be used to increase torque or speed. Students will build, modify, and analyze a simple gear train and then work as a team to create a custom design.	Engineering design	Using mathematics	Scale, proportion, & quantity	Innovative designer, Creative communicator
Lesson 5: Compound Machines (120 Min.) In this lesson, students will build a compound machine and determine its total mechanical advantage. Then, students will work as a team to design and create a custom compound machine.	Engineering design	Constructing explanations & designing solutions	Systems & system models	Innovative designer, Creative communicator
Unit Assessment: Compound Machines In this performance-based assessment, students will complete a series of tasks as they demonstrate their understanding of the core ideas and concepts that were covered throughout this unit.				

Target Vocabulary

The following key terms will be used throughout this unit. It may be helpful to explain these terms as they show up in lessons and challenges.

Dimensions	Innovation	Mechanical advantage	Robot
Force	Invention	Mechanism	Rotary
Gear	Linear	Motion	Speed
Gear Ratio	Linkages	Oscillating	Torque
Gear Train	Links	Power	
Infrared	Machine	Reciprocating	

Teaching Lessons Over Multiple Class Periods

Each lesson in this unit follows Kid Spark's convergent to divergent lesson format. Lessons can easily be taught over the course of two class periods.

Class Period 1 - Convergent Learning Activity

Students building the same models, learning the same content.

.

Class Period 2 - Divergent Learning Activity

Students applying their knowledge through open-ended design challenges.

Prerequisite Kid Spark Units

We highly recommend students complete the following Kid Spark units prior to starting this unit.

Elementary Program Units

Applied Mathematics

Students should demonstrate an understanding of the following concepts:

- Metric Measurement
- Dimensions
- Ratios
- Proportions

Middle School Program Units

Kid Spark Basics

Simple Machines

Students should demonstrate an understanding of the following concepts:

- Simple Machines
- Mechanical Advantage

Unit Overview:

In this unit, students will learn the basics of how to create custom, 3D printed components using Tinkercad. Students will gain confidence as they design and print a custom airplane propeller that snaps onto a model airplane. Then, students will have an opportunity to apply what they have learned throughout the unit as they participate in a fun free build challenge.

Recommended Grade Level:
6 - 8

Kid Spark STEM Lab:
STEM Pathways

Alignment to STEM Standards:

The table below highlights how this unit is aligned to the Next Generation Science Standards (NGSS) and the International Society for Technology in Education Standards (ISTE).

- NGSS Disciplinary Core Ideas (DCI) are standards related to content knowledge.
- NGSS Science and Engineering Practices (SEP) and Crosscutting Concepts (CCC) provide a foundation for all scientific and engineering disciplines and are particularly important to develop in young students.
- ISTE standards are designed to prepare students to thrive in a constantly evolving technological landscape. Click here to view ISTE standards.

Lessons & Assessment	NGSS DCI	NGSS SEP	NGSS CCC	ISTE
Lesson 1: Taking Flight, Part 1 (30 - 40 Min.) In this lesson, students will start out using Kid Spark engineering materials to assemble an airplane model that is missing a propeller. Then, students will set up a Tinkercad account and explore the Tinkercad workspace.	Engineering design	Developing & using models	Systems & system models	Innovative designer
Lesson 2: Taking Flight, Part 2 (30 - 40 Min.) In this lesson, students will explore Kid Spark's 3D virtual parts library. Students will also learn how to import and manipulate objects in Tinkercad as they prepare to create a new propeller for the airplane they built in Part 1.	Engineering design	Asking questions & defining problems	Structure & function	Innovative designer
Lesson 3: Taking Flight, Part 3 (40 - 60 Min.) In this lesson, students will learn how to use some of the basic tools in Tinkercad as they create a custom propeller for their airplane. Students will create a 3D, virtual propeller and prepare it for 3D printing.	Engineering design	Using mathematics	Scale, proportion, & quantity	Innovative designer
Lesson 4: Taking Flight, Part 4 (120 Min.) In this lesson, students will learn how to 3D print the custom airplane propeller they designed throughout the previous lessons. After the propeller has successfully printed, students will clean it and snap it on the airplane.	Engineering design	Developing & using models	Systems & system models	Innovative designer
Lesson 5: Free Build Challenge (120 - 180 Min.) In this lesson, students will be challenged to design a custom, 3D printed component that can be integrated into a Kid Spark project or build.	Engineering design	Planning & carrying out investigations	Stability & change	Innovative designer
Unit Assessment: Rapid Prototyping & 3D Printing In this performance-based assessment, students will complete a series of tasks as they demonstrate their understanding of the core ideas and concepts that were covered throughout this unit.				

Target Vocabulary

The following key terms will be used throughout this unit. It may be helpful to explain these terms as they show up in lessons and challenges.

Align	Group	Paraboloid	Shell thickness
CAD	Layer height	Print speed	Support type
Duplicate	Navigate	Prototyping	Tinkercad
Filament	Nozzle size	Rotate	Workplane

Additional Unit Resources

The following videos and articles are a great resource when teaching the concepts that are covered throughout this unit.

Kid Spark 3D virtual parts library:
kidsparkeducation.org/downloads

Print quality troubleshooting guide:
simplify3d.com/support/print-quality-troubleshooting/

Using 3D printing to teach math and science (article):
weareteachers.com/3d-printing-math-science/

How to use 3D printers in the classroom (article):
resourced.prometheanworld.com/use-3d-printers-classroom/

Unit Overview:

In this unit, students will build upon previous Kid Spark robotics and coding experiences as they explore how to use different types of loops and variables in a program.

Recommended Grade Level:
6 - 8

Kid Spark STEM Lab:
STEM Pathways

Prerequisite Kid Spark Units:
1. Robotics & Coding 101
2. Exploring Sensors

Alignment to STEM Standards:

The table below highlights how this unit is aligned to the Computer Science Teachers Association (CSTA) K-12 Computer Science Standards and the Next Generation Science Standards (NGSS).

- CSTA K-12 CS standards introduce the fundamental concepts of computer science to all students, beginning at the elementary level. Click here to view the standards.
- NGSS Disciplinary Core Ideas (DCI) are standards related to content knowledge.

Lessons & Assessment	CSTA	NGSS-DCI
Lesson 1: While Loops (120 Min.) In this lesson, students will learn how to use **while loops** to control a simple mechanism. Then, students will build and program a custom design that utilizes a **while loop**.	**1B-AP-10** Create programs that include sequences, events, loops, and conditionals. **Concept:** Algorithms & Programming | **Subconcept:** Control	Engineering Design
Lesson 2: Repeat Loops (120 Min.) In this lesson, students will learn how **repeat loops** can be used to repeat a set of commands in a sketch. Then, students will build and program a custom design that utilizes a **repeat loop**.	**1B-AP-10** Create programs that include sequences, events, loops, and conditionals. **Concept:** Algorithms & Programming | **Subconcept:** Control	Engineering Design
Lesson 3: Integer Variables (120 Min.) In this lesson, students will learn how integer variables can be used in a sketch as they create a simple counting device. Then, students will build and program a custom design that includes an integer variable.	**2-AP-11** Create clearly named variables that represent different data types and perform operations on their values. **Concept:** Algorithms & Programming | **Subconcept:** Variables	Engineering Design
Lesson 4: Digital Variables (120 Min.) In this lesson, students will learn how to use digital variables in a sketch to create a toggle switch. Then, students will build and program a custom design that includes a digital variable and a toggle switch.	**2-AP-12** Design and iteratively develop programs that combine control structures, including nested loops and compound conditionals. **Concept:** Algorithms & Programming | **Subconcept:** Control	Engineering Design
Lesson 5: Free Build Challenge (60 - 120 Min.) In this lesson, students will apply the knowledge and skills they have acquired throughout the Loops & Variables unit to develop a custom design or invention.	**1B-AP-13** Use an iterative process to plan the development of a program by including others' perspectives and considering user preferences. **Concept:** Algorithms & Programming | **Subconcept:** Program Dev.	Engineering Design
Unit Assessment: Loops & Variables In this performance-based assessment, students will complete a series of tasks as they demonstrate their understanding of the core ideas and concepts that were covered throughout this unit.		

Target Vocabulary

The following key terms will be used throughout this unit. It may be helpful to explain these terms as they show up in lessons and challenges.

While Loop - Executes (or loops) a set of commands until the condition of the test is false.

Repeat Loop - Repeats a set of commands a specified amount of times.

Variable - Used to store data that may change during the course of a program. Variables include a name, data type, and a value.

Integer Variable - A variable that includes an integer data type (whole numbers which may or may not include negative numbers).

Digital Variable - A variable that includes a digital data type (true or false).

Prerequisite Kid Spark Units

We highly recommend students complete the following Kid Spark units prior to starting this unit.

Elementary Program Units

- Robotics & Coding 101
- Exploring Sensors

Integrated Engineering Challenges

v3.0

Unit Overview:

In this unit, students will apply the knowledge they have gained from previous Kid Spark learning experiences as they develop creative solutions to a series of robotics and coding challenges.

Recommended Grade Level:
6 - 8

Kid Spark STEM Lab:
STEM Pathways

Prerequisite Kid Spark Units:
1. Robotics & Coding 101
2. Exploring Sensors
3. Loops & Variables

Alignment to STEM Standards:

The table below highlights how this unit is aligned to the Computer Science Teachers Association (CSTA) K-12 Computer Science Standards and the Next Generation Science Standards (NGSS).

- CSTA K-12 CS standards introduce the fundamental concepts of computer science to all students, beginning at the elementary level. Click here to view the standards.
- NGSS Disciplinary Core Ideas (DCI) are standards related to content knowledge.

Lessons & Assessment	CSTA	NGSS-DCI
Challenge 1: Automated Gate Challenge (120+ Min.) In this challenge, teams will develop an automated gate that is controlled using the ROKduino programmable robotics controller and a Bump Sensor.	**1A-CS-01** Describe how internal and external parts of computing devices function to form a system. **1B-CS-02** Model how computer hardware and software work together as a system to accomplish tasks. **1B-AP-08** Compare and refine multiple algorithms for the same task and determine which is the most appropriate. **1B-AP-10** Create programs that include sequences, events, loops, and conditionals. **1B-AP-13** Use an iterative process to plan the development of a program by including others' perspectives and considering user preferences. **2-AP-11** Create clearly named variables that represent different data types and perform operations on their values. **2-AP-12** Design and iteratively develop programs that combine control structures, including nested loops and compound conditionals. **Concepts:** Computing Systems, Algorithms & Programming **Subconcepts:** Devices, Hardware & Software, Troubleshooting, Algorithms, Variables, Control, Program Development	Engineering Design
Challenge 2: Roadway Redirect Challenge (120+ Min.) In this challenge, teams will develop a section of bridge roadway that can rotate 90° on command. Teams will utilize the Angle Sensor and serial monitor to observe real-time data that will be directly applied to the challenge.		
Challenge 3: Retractable Field Challenge (120+ Min.) In this challenge, teams will create a retractable sports field that can move inside and outside of a stadium on command. Teams will utilize Light Sensors to position the field inside or outside of the stadium.		
Challenge 4: Movable Bridge Challenge (120+ Min.) In this challenge, teams will create an automated, movable bridge. Teams will be required to utilize a pair of light gates (using transmitters and receivers) to complete the challenge.		
Challenge 5: Smart Vault Challenge (120+ Min.) In this challenge, teams will develop an automated smart vault that is used to protect valuable items on display in the city museum.		

Prerequisite Kid Spark Units

We highly recommend students complete the following Kid Spark units prior to starting this unit.

Elementary Program Units

- Applied Mathematics
- Robotics & Coding 101
- Exploring Sensors

Middle School Program Units

- Kid Spark Basics
- Simple Machines
- Compound Machines
- Loops & Variables

Note: Make sure students can access prior Kid Spark units/lessons. Students may need to re-visit past learning experiences or utilize example programs/sketches they can apply to new robotics challenges and projects.

Get Engaged!

Visit our community page at **KidSparkEducation.org/Community** for new project ideas, lesson insights, and to see how other educators are using Kid Spark materials and resources in their classrooms.