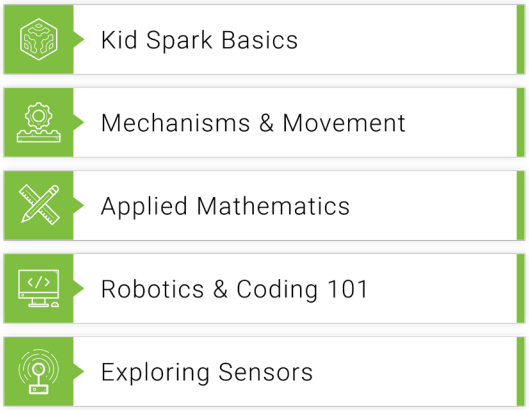
Program Implementation Guide

Grades 2 - 5

In Kid Spark's STEM Program for grades 2 - 5, students jump into the shoes of real engineers as they explore applied mathematics, structural and mechanical engineering, and robotics and coding. 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 five units of instruction included in Kid Spark's 2 - 5 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 2 - 5 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
2	Kid Spark Basics	5 Lessons, 1 Assessment	(7) 60-Minute Sessions
3	Mechanisms & Movement	5 Lessons, 1 Assessment	(11) 60-Minute Sessions
4	Applied Mathematics	5 Lessons, 1 Assessment	(11) 60-Minute Sessions
5	Robotics & Coding 101	5 Lessons, 1 Assessment	(7) 60-Minute Sessions
	Exploring Sensors	5 Lessons, 1 Assessment	(12) 60-Minute Sessions

Plan Your Program

Listed below are the available units of instruction in Kid Spark's 2 - 5 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
	Mechanisms & Movement	5 Lessons, 1 Assessment	(11) 60-Minute Sessions
	Applied Mathematics	5 Lessons, 1 Assessment	(11) 60-Minute Sessions
	Robotics & Coding 101	5 Lessons, 1 Assessment	(7) 60-Minute Sessions
	Exploring Sensors	5 Lessons, 1 Assessment	(12) 60-Minute Sessions

Grade	Instructor	Kid Spark Unit	Implementation Schedule
2	*Mrs. Spark*	*Kid Spark Basics*	*3/5/2021 - 4/23/2021 - 7 (60) minute sessions*
2			
2			
2			
3			
3			
3			
4			
4			
4			
5			
5			
5			

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 - 13.

- [ ] **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 2 - 5 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 2 - 5

  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 learn how to create and convert different types of motion using Kid Spark engineering materials. Throughout each lesson, students will learn how to create a new type of motion and then apply what they have learned through a creative design challenge.

Recommended Grade Level:
2 - 5

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 Spark:bit - Manual Mode (120 Min.) In this lesson, students will learn how to use the manual-mode feature on the Spark:bit to control Motor Modules and Light Modules. This lesson does not require any computers or programming.	Engineering design	Developing & using models	Structure & function	Innovative designer, Creative communicator
Lesson 2: Rotary Motion (120 Min.) In this lesson, students will learn how to create rotary motion. Students will build a simple gear train and observe how it creates rotary motion. Then, students will create a custom design that produces rotary motion.	Engineering design	Asking questions & defining problems	Cause & effect; mechanism & explanation	Innovative designer, Creative communicator
Lesson 3: Linear Motion (120 Min.) In this lesson, students will learn how to create linear motion. Students will build a mechanism that converts rotary motion into linear motion. Then, students will create a custom mechanism that produces linear motion.	Engineering design	Planning & carrying out investigations	Systems & system models	Innovative designer, Creative communicator
Lesson 4: Oscillating Motion (120 Min.) In this lesson, students will build a mechanism that converts rotary motion into oscillating motion. Then, students will create a custom mechanism that produces oscillating motion.	Engineering design	Constructing explanations & designing solutions	Cause & effect; mechanism & explanation	Innovative designer, Creative communicator
Lesson 5: Reciprocating Motion (120 Min.) In this lesson, students will build a mechanism that converts rotary motion into reciprocating motion. Then, students will create a custom mechanism that produces reciprocating motion.	Engineering design	Developing & using models	Scale, proportion, and quantity	Innovative designer, Creative communicator
Unit Assessment: Mechanisms & Movement 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.

Dimensions	Innovation	Motion	Rotary
Gear	Invention	Oscillating	Speed
Gear Train	Linear	Reciprocating	Torque
Infrared	Mechanism	Robot	

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.

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Unit Overview:

This unit is designed to introduce students to basic mathematics concepts such as perimeter, area, volume, ratios, proportions, and scale drawings. As students progress through the unit, they will become confident in their ability to use and apply mathematics concepts to real-world situations and challenges.

Recommended Grade Level:
3 - 5

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 Common Core Standards in Math.

- 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.
- Common Core Standards in Math (CCS-MA) help teachers integrate math concepts to Kid Spark curriculum. Click on the common core standards listed below for a brief overview of each standard.

Lessons & Assessment	NGSS DCI	NGSS SEP	NGSS CCC	CCS-MA
Lesson 1: Dimensions & Measurement (120 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 work in teams to create a custom design and determine its dimensions.	Engineering design	Constructing explanations & designing solutions	Scale, proportion, & quantity	CCSS.MATH.CONTENT.4.MD.A.1
Lesson 2: Perimeter (120 Min.) In this lesson, students will learn how to determine the perimeters (inside and outside dimensions) of square, rectangular, and circular three-dimensional objects.	Engineering design	Developing & using models	Scale, proportion, & quantity	CCSS.MATH.CONTENT.3.MD.D.8
Lesson 3: Area (120 Min.) In this lesson, students will learn how to determine the area of square, rectangular, and circular three-dimensional objects. Then, students will work in teams to build a custom structure and determine its area.	Engineering design	Planning & carrying out investigations	Scale, proportion, & quantity	CCSS.MATH.CONTENT.3.MD.C.6
Lesson 4: Volume (120 Min.) In this lesson, students will learn how to determine the volume of rectangular prisms and cylinders. Then, students will work in teams to build a custom structure and determine its volume.	Engineering design	Obtaining, evaluating, & communicating information	Scale, proportion, & quantity	CCSS.MATH.CONTENT.5.MD.C.3
Lesson 5: Ratios, Proportions, & Scale Drawings (120 Min.) In this lesson, students will learn about ratios, proportions, and scaled drawings using Kid Spark engineering materials. Then, students apply what they have learned to complete a fun design and engineering challenge.	Engineering design	Asking questions & defining problems	Scale, proportion, & quantity	CCSS.MATH.CONTENT.7.RP.A.2
Unit Assessment: Applied Mathematics 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.

Area	Dimension	Perimeter	Rectangular prism
Circle	Equivalent ratio	Perspective	Scale drawing
Circumference	Height	Pi	Scale ratio
Cube	Length	Proportion	Square
Cylinder	Measurement	Radius	Volume
Depth	Metric	Ratio	
Diameter	Orthographic projection	Rectangle	

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.

Online Video Resources

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

Mathantics - Perimeter (Video):
https://youtu.be/AAY1bsazcgM

Mathantics - Area (Video):
https://youtu.be/xCdxURXMdFY

Mathantics - Volume (Video):
https://youtu.be/qJwecTgce6c

Mathantics - Ratios (Video):
https://youtu.be/RQ2nYUBVvqI

Mathantics - Proportions & Scale Drawings (Video):
https://youtu.be/USmit5zUGas

Unit Overview:

In this unit, students will get familiar with the Spark:bit robotics controller and the software (Makecode) that is used to program it. Students will gain confidence in their ability to write simple programs that can be uploaded to the Spark:bit.

Recommended Grade Level:
3 - 8

Kid Spark STEM Lab:
STEM Pathways

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: The Spark:bit (60 Min.) In this lesson, students will learn how the Spark:bit works and how it can be used to control a simple mechanism. Students will upload an example program to the Spark:bit and test and observe the connected inputs and outputs.	**1B-CS-01** Describe how internal and external parts of computing devices function to form a system. **Concept:** Computing Systems | **Subconcept:** Devices	Engineering Design
Lesson 2: Introduction to Makecode (60 Min.) In this lesson, students will learn how to use Makecode software to create a series of simple programs that can be uploaded to the Spark:bit. Students will learn how to program the Spark:bit to control connected output modules.	**1B-CS-02** Model how computer hardware and software work together as a system to accomplish tasks. **Concept:** Computing Systems | **Subconcept:** Hardware & Software	Engineering Design
Lesson 3: Pauses (60 Min.) In this lesson, students will create a series of programs in Makecode that utilize pauses. Then, students will develop and program a custom design that utilizes pauses to function as intended.	**1B-AP-10** Create programs that include sequences, events, loops, and conditionals. **Concept:** Algorithms & Programming | **Subconcept:** Control	Engineering Design
Lesson 4: Functions (60 Min.) In this lesson, students will learn how to create custom functions in Makecode. Students will assemble a fun ball maze that can be controlled using the built-in accelerometer in the Spark:bit.	**1B-AP-10** Create programs that include sequences, events, loops, and 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 Robotics & Coding 101 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: Robotics & Coding 101 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.

Spark:bit - A robotics controller that can be programmed to detect information from sensors that are connected to the input ports, process that information into relevant commands, then send the commands to modules connected to the output ports.

Makecode - An online programming environment that can be used to create custom programs for the Spark:bit.

Pause - A delay in the execution of a program for a specified amount of time.

Function - A named section of a program that performs a specific task.

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Exploring Sensors

v3.0

Unit Overview:

In this unit, students will learn how to incorporate digital and analog sensors to robotic builds and projects. Students will learn how to write custom programs that include conditional statements such as **if statements** and **if/then statements**.

Recommended Grade Level:
3 - 8

Kid Spark STEM Lab:
STEM Pathways

Prerequisite Kid Spark Units:
1. Robotics & Coding 101

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: Digital vs. Analog Sensors (60 Min.) In this lesson, students will learn the difference between digital and analog sensors. Students will also learn how to use the serial function in Makecode to observe data from sensors that are connected to the Spark:bit.	**1B-CS-01** Describe how internal and external parts of computing devices function to form a system. **Concept:** Computing Systems | **Subconcept:** Devices	Engineering Design
Lesson 2: If Statements (120 Min.) In this lesson, students will learn how to create a sketch that utilizes if statements. Then, students will build and program a custom design that relies on an if statement to function correctly.	**1B-AP-10** Create programs that include sequences, events, loops, and conditionals. **Concept:** Algorithms & Programming | **Subconcept:** Control	Engineering Design
Lesson 3: If/Else Statements (120 Min.) In this lesson, students will learn how to develop a sketch that uses if/else statements. Students will observe how if/else statements can be used with digital and analog sensors to control a simple design.	**1B-AP-10** Create programs that include sequences, events, loops, and conditionals. **Concept:** Algorithms & Programming | **Subconcept:** Control	Engineering Design
Lesson 4: Creating a Light Gate (120 Min.) In this lesson, students will learn how transmitters and receivers can be used to create light gates. Students will build a simple mechanism and create a series of new sketches to control the design.	**1B-AP-10** Create programs that include sequences, events, loops, and conditionals. **Concept:** Algorithms & Programming | **Subconcept:** Control	Engineering Design
Lesson 5: Creating a Proximity Sensor (120 Min.) In this lesson, students will learn how transmitters and receivers can be used to create a proximity sensor. Students will build and test a simple proximity-sensing device, then create a custom build of their own design.	**1B-AP-10** Create programs that include sequences, events, loops, and conditionals. **Concept:** Algorithms & Programming | **Subconcept:** Control	Engineering Design
Lesson 6: Free Build Challenge (60 - 120 Min.) In this lesson, students will apply the knowledge and skills they have acquired throughout the Exploring Sensors unit to develop a custom design or invention.	**1B-AP-17** Describe choices made during program development using code comments, presentations, and demonstrations. **Concept:** Algorithms & Programming | **Subconcept:** Program Dev.	Engineering Design
Unit Assessment: Exploring Sensors 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.

Analog Sensors - A sensor that can produce or convey a range of values.

Digital Sensor - A sensor that has only two states: on (true) or off (false).

Serial Monitor - A visual monitoring tool within Makecode that allows you to view data being sent from the Spark:bit.

If Statement - A conditional statement that is used to execute a set of commands if a condition or test is true.

If/Else Statement - A conditional statement that is used to execute a set of commands if a condition or test is true. If the condition or test is false, another set of commands is executed.

Light Gate - A digital sensor that uses a transmitter to "transmit" a constant infrared (IR) signal to a receiver. When objects interrupt the signal, the sensor returns a value of 0 (off, false). When no objects are interrupting the signal, the sensor returns a value of 1023 (on, true).

Proximity Sensor - A digital sensor that uses a transmitter and a receiver to detect or "sense" nearby objects. When an object is detected, the sensor returns a value of 1023 (on, true). When no objects are detected, the sensor returns a value of 0 (off, false).

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