KiDSPARK EDUCATION

Foundational Fluencies

Instructor's Guide

Dear Educator,

We are so excited you have made the decision to incorporate Kid Spark into your educational setting!

Included in this Instructor's Guide you will find teacher preparation materials, lesson plans, and assessments that can be used to help young students develop a strong foundation in STEM. This guide is designed to be used with the Foundational Fluencies Building Plans Booklet and the Foundational Fluencies STEM Lab.

Don't have any prior experience or training in STEM? No problem! Kid Spark's Foundational Fluencies curriculum can be taught in any space, by any caring educator.

Are you getting excited yet? Great, let's get started!

KiDSPARK EDUCATION

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Introduction & Educator Support

What are Foundational Fluencies?

Kid Spark's introductory learning phase, called Foundational Fluencies (Grades Pre-K - 1), focuses on helping young students develop important competencies that are a prerequisite for a lifetime of STEM learning. While many students learn these fluencies at home, this phase helps fill in critical gaps that may exist, especially for underserved students.

All children are natural designers, but they need to learn foundational fluencies in order to think like engineers and scientists. Regardless of their age, all children must acquire these basic fluencies to make sense of more advanced STEM learning opportunities, and to be successful in a technologically-driven world.

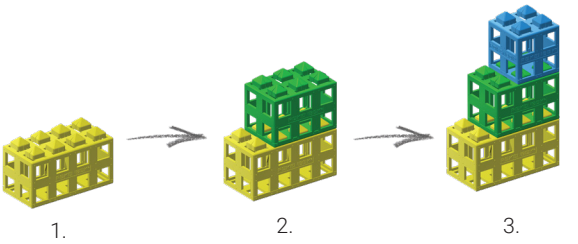
Examples of Foundational STEM Fluencies:

Spatial Reasoning

The ability to envision objects or ideas in three dimensions.

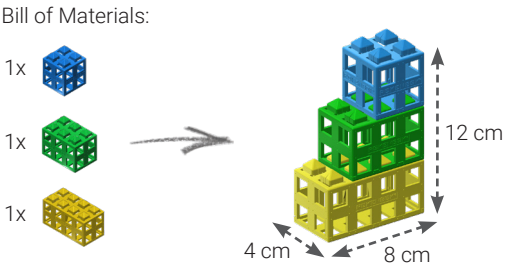
Sequence & Correspondence

The ability to follow steps in order and place objects in a precise way.



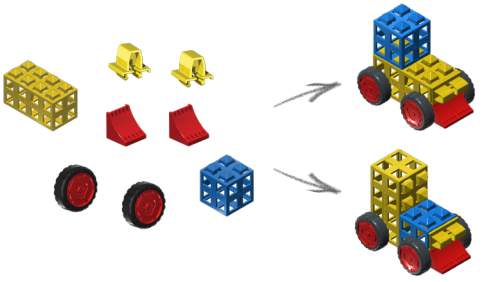
Symbolization

The ability to use symbols to represent ideas or qualities.



Creative Problem Solving

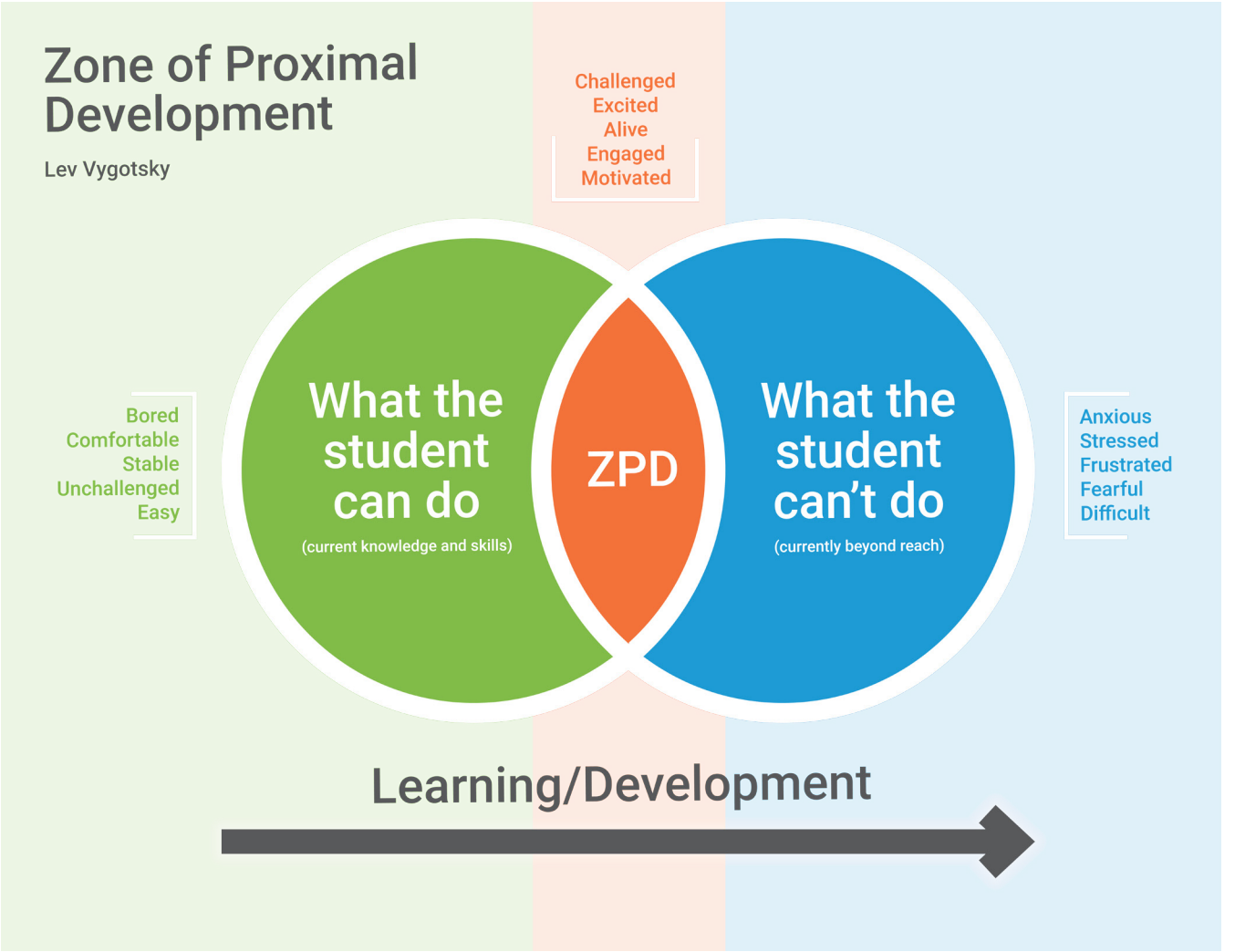
The ability to work through or analyze problems and explore different ways to solve them.



Free Play vs. Mentored Guidance

What makes Kid Spark Foundational Fluencies curriculum especially effective? You do! The role of the mentor is essential in helping students go deeper than they can by themselves. While there is value in letting students “free play”, it will not take children beyond their learning edge (Zone of Proximal Development - see image below).

Kid Spark’s Foundational Fluencies learning phase requires educators to be hands-on with students to ensure they stay engaged and motivated to learn new things. The curriculum guides students through a progressive cycle of learning and ensures students stay within their zone of proximal development.

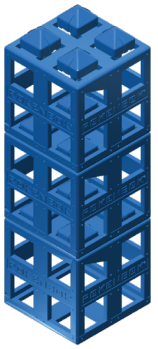


The Zone of Proximal Development (ZPD) refers to what we can learn by ourselves versus what we can learn with a little bit of help. Optimal learning happens when we are presented with tasks that are just out of reach of our current ability level, and supported with a little guidance from a mentor.

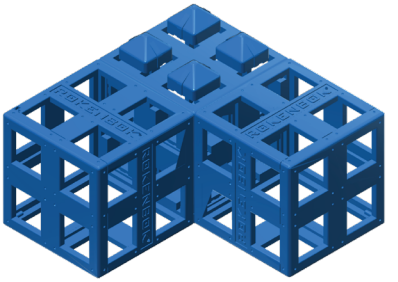
Examples of Mentored Guidance

Example 1:

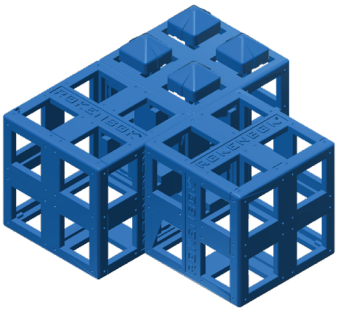
Most students will find it intuitive to stack blocks vertically as shown in Illustration A. A good mentor might demonstrate how blocks can also be connected to the sides of other blocks to build horizontally (Illustration B), or across multiple blocks to add strength (Illustration C).



A.



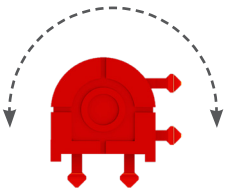
B.



C.

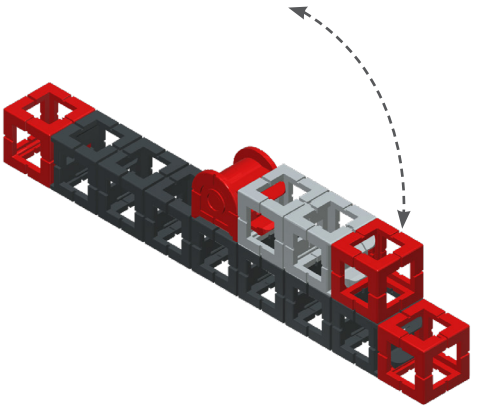
Example 2:

A student might want to add movement to a design but isn't quite sure how to do it. A good mentor might demonstrate how articulating components can be used to create different types of movement in a design.



Hinge Block

Hinge Blocks are used to create rotational movement, but are limited by their range of motion (180°). In the example to the right, the small beam can rotate or "pivot" 180°.



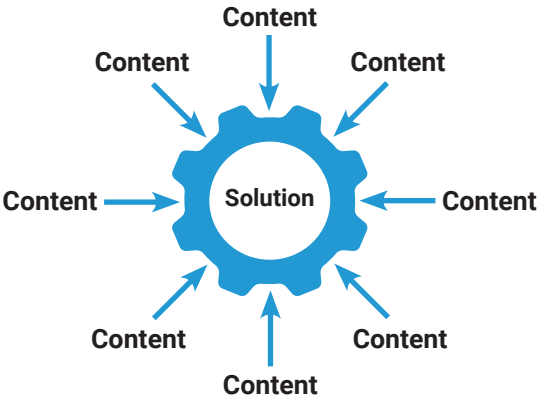
Convergent to Divergent Learning

All Kid Spark curriculum follows a consistent pattern of convergent to divergent learning. Ideally, students are able to absorb critical information as they participate in the convergent part of the lesson, and then creatively apply what they have learned in a divergent challenge. This consistent pattern throughout Kid Spark curriculum gives students the confidence not just to learn and use technology, but to author with technology to solve problems and create new solutions of their own design.

Convergent Learning

Students start out learning key STEM concepts through convergent, step-by-step guided instruction. All students explore the same content, build the same models, and arrive at the same solution.

Example: Students follow step-by-step instructions to build a structure. Then, they learn how different Kid Spark engineering materials can be used to add strength to a design.



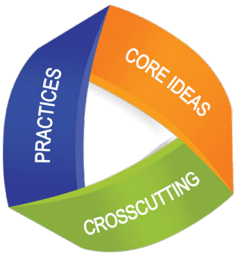
Divergent Learning

After students become familiar with a concept, they are challenged to apply what they have learned through an open-ended challenge. All students are presented with the same challenge, but are free to explore different ways to develop a solution.

Example: Students are challenged to build a custom bridge that can span a certain distance and can withstand a moderate amount of force. Students apply what they learned from the convergent part of the lesson to make sure their bridge is strong and sturdy.

Alignment to NGSS

Kid Spark curriculum follows the Next Generation Science Standards (NGSS) three dimensions of science learning: Scientific and Engineering Practices, Crosscutting Concepts, and Disciplinary Core Ideas.



Scientific & Engineering Practices

Scientific and engineering practices describe what scientists do to investigate the natural world and what engineers do to design and build systems. Kid Spark's Foundational Fluencies curriculum engages students in the following practices:

Asking Questions & Defining Problems

Kid Spark's focus on engineering challenges students to question how the world works and how they might contribute to improve it. Students learn to define problems and develop creative solutions of their own design.

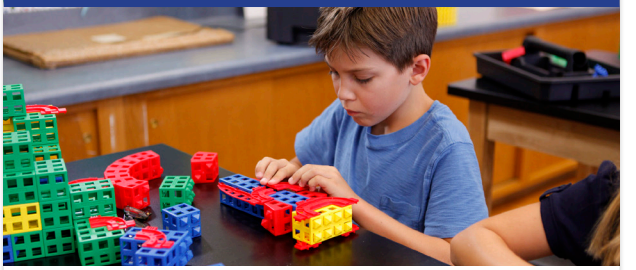
Developing & Using Models

Every student can see like a designer, and learn to think like an engineer. An important component of the Kid Spark learning progression is for students to visualize design solutions and then create physical models that can be tested and improved.

Planning & Carrying Out Investigations

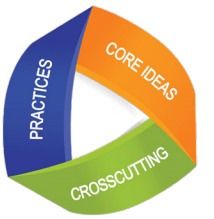
Students are challenged to brainstorm ideas, develop prototypes, and carry out investigations on designs as they develop solutions to problems.

Using Mathematics



Students have an early introduction to applied mathematics with Kid Spark. All engineering materials are designed in metric units of measurement which presents many opportunities for integrating mathematics in lessons and projects.

Alignment to NGSS (continued)



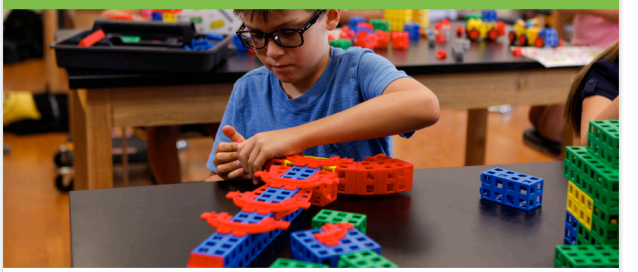
Crosscutting Concepts

Crosscutting concepts help students explore connections across the four domains of science, including physical science, life science, earth and space science, and engineering design. Kid Spark Education encourages students to apply the following crosscutting concepts through the study of engineering:

Patterns

Young students learn basic pattern recognition through classification as they build, test, and analyze different models (e.g. students organize and classify engineering materials based upon their characteristics or function).

Structure & Function



Students explore how different engineering materials can be used in a design (e.g. students learn how to make things strong or make things move). This encourages students to understand the relationship between the structure and function of each component, and how each can be used in developing more complex designs or systems.

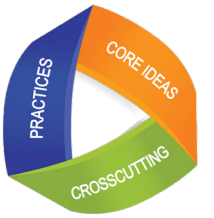
Scale, Proportion, & Quantity

Kid Spark introduces very young students to dimension, scale, quantity, and measurement. Kid Spark builds and projects are often scale models of large, easily relatable, real-world structures. The metric grid inherent in Kid Spark engineering materials is particularly supportive of incorporating mathematics into any lesson.

Cause & Effect; Mechanism & Explanation

Students learn to analyze how and why things work, where they are used in the real world, and how they might be improved or used to create something new.

Alignment to NGSS (continued)



Disciplinary Core Ideas

Disciplinary Core Ideas (DCIs) are the key ideas in science that have broad importance within or across multiple science or engineering disciplines. These core ideas build on each other as students progress through grade levels and are grouped into the following four domains: physical science, life science, earth and space science, and engineering. Kid Spark's Foundational Fluencies curriculum focuses on the following DCIs:

Engineering Design

Students start by learning the structure and function of different engineering materials. As students progress, they explore basic engineering concepts such as how to make things strong, how to make things move, how to measure, and how to develop creative solutions to challenges.

Physical Science

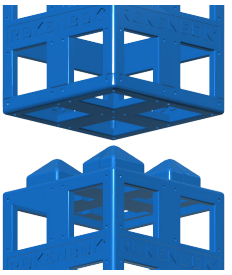
Students explore concepts such as pushes and pulls, gravity, motion, and stability.

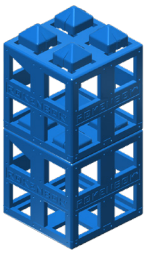
Kid Spark Engineering Materials

Each Foundational Fluencies STEM Lab is equipped with an assortment of engineering materials that students use to complete each lesson. Students start out using the large-scale ROK Blocks and integrate more advanced engineering materials as they progress though the lessons.

ROK Blocks

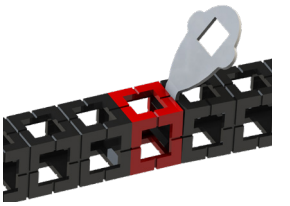
Larger-scale materials use a friction-fit, pyramid and opening system to connect. Simply press pyramids into openings to connect. To separate, pull blocks apart.





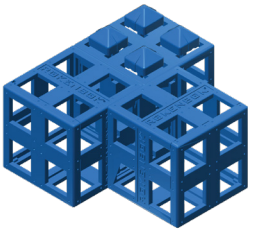
Smaller Engineering Materials

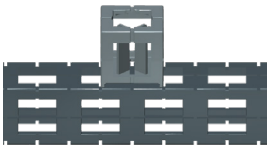
Smaller-scale materials use a tab and opening system to connect. Angle one tab into the opening, and then snap into place. To disconnect, insert the key into the engineered slot and twist.



Snapping Across Openings

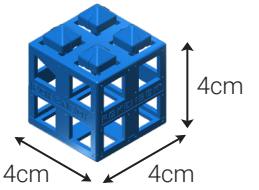
Engineering materials can be snapped directly into openings or across openings.

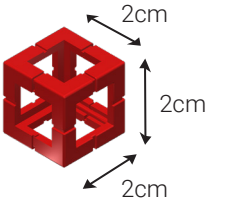


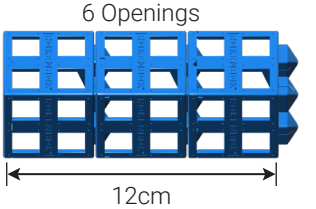


Measurement

All engineering materials are designed in metric units of measurement. To determine the dimensions of a build in centimeters, simply count the number of openings and multiply by 2.







Preparing For Instruction

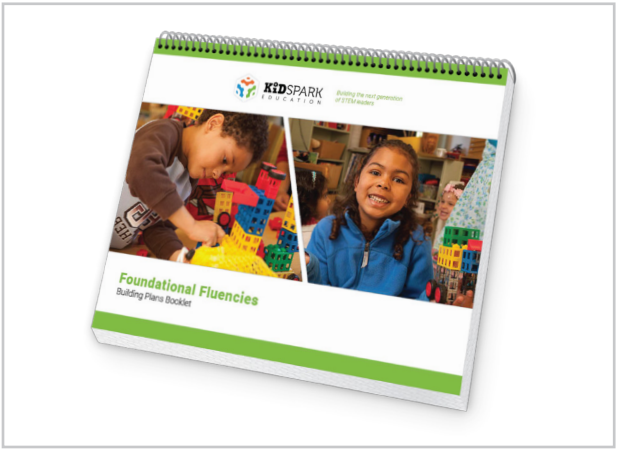
There are a total of four units of instruction included in the Foundational Fluencies learning phase. Each unit of instruction includes a unit overview, four lesson plans, and a unit assessment. Most lessons average 30 - 35 minutes and include opportunities for students to apply what they have learned through creative challenges.

Foundational Fluencies

Units of Instruction

- Unit 1: It's All About The Blocks
- Unit 2: I Am An Engineer
- Unit 3: Making Things Strong
- Unit 4: Making Things Move

The lesson plans and assessments that are included in this Instructor's Guide are designed to be used with the Foundational Fluencies Building Plans Booklet and the Foundational Fluencies STEM Lab. Each lab can accommodate 1 - 2 students. ***Note:*** *To replace missing guides, booklets, or engineering materials, visit:* ***kidsparkeducation.org/replacement-parts***.



Building Plans Booklet

Foundational Fluencies STEM Lab

Questions, Comments, Concerns?

We are committed to helping educators and students get the most out of Kid Spark programs. Please let us know if there are any opportunities to better serve you.

Email: contact@kidsparkeducation.org
Phone: 1.858.259.4433

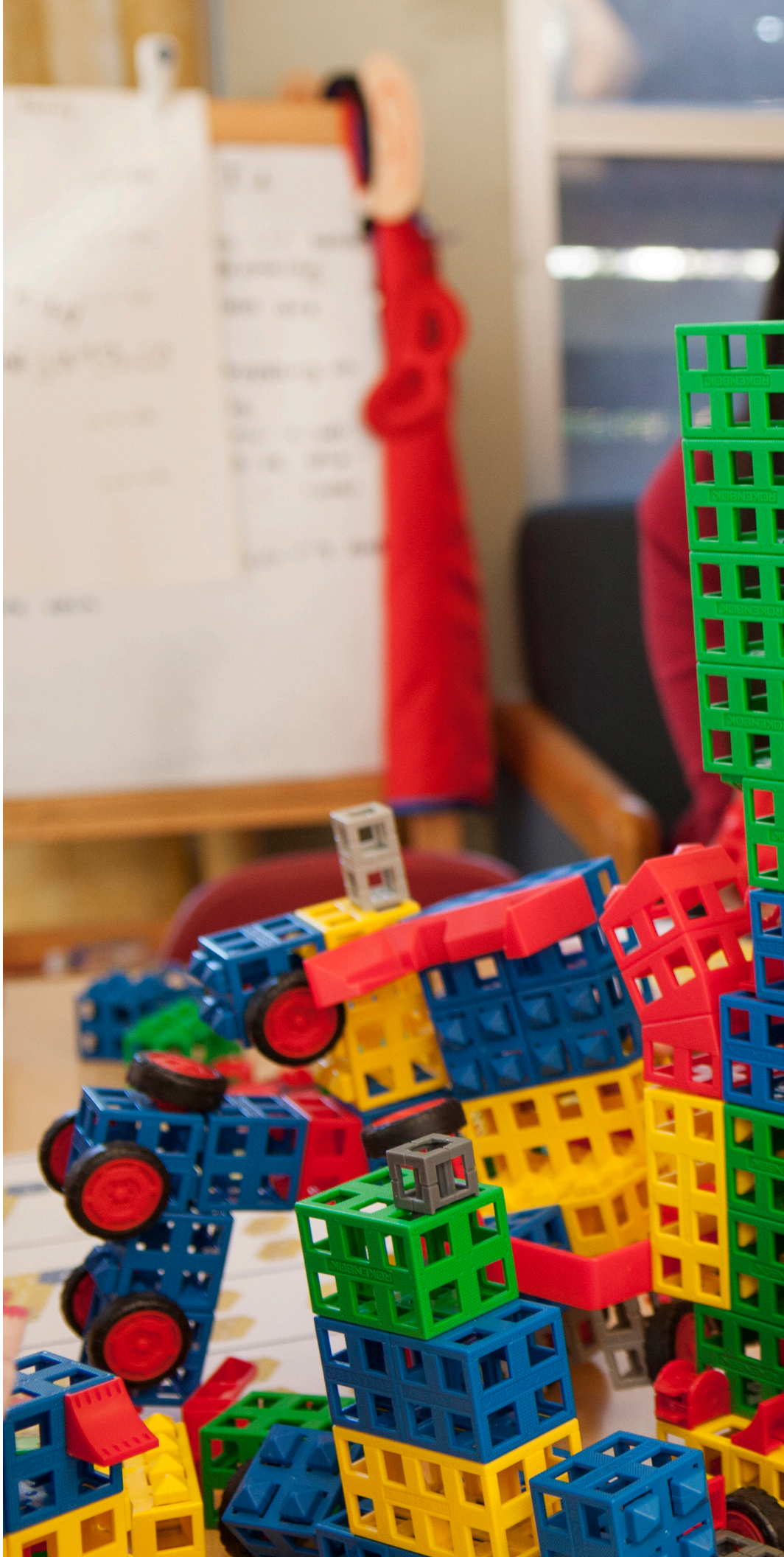
Also, make sure to visit our community page at **kidsparkeducation.org/community** for new project ideas, lesson insights, and to see how other educators are using Kid Spark materials and resources in their classrooms.

You've Got This!

STEM learning requires a culture of experimentation and iteration. While you should do your best to prepare for instruction, it is okay if things don't go as planned or something doesn't work as you intended. Oftentimes failures will present valuable learning experiences for you and your students. Also, don't be afraid to go off script. If you see a learning opportunity, take advantage of it!

Unit 1:

It's All About The Blocks




I'M THE
BIG

It's All About The Blocks

Unit Overview:

This unit is designed to introduce young students to Kid Spark's ROK Blocks during short learning experiences. By focusing their attention on each of the four basic ROK Blocks, students will learn the properties and function of each and be better able to use them in their own creative designs, in future lessons, and free play. The lessons are intended to ensure students experience success immediately.

Recommended Grade Level:
Pre-K - 1

Kid Spark STEM Lab:
Foundational Fluencies

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 (CCS-MA).

- NGSS Disciplinary Core Ideas (DCI) are standards related to content knowledge.
- NGSS Scientific 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 children.
- Common Core Standards in Math help teachers integrate ROK Block experiences with math curriculum and to help build a continuum of engineering learning from preschool to the primary grades.

Lessons	NGSS DCI	NGSS SEP	NGSS CCC	CCS-MA
Lesson 1: The Big Yellow Block (20-30 Min.) In this lesson, students will observe the features and characteristics of the Yellow ROK Block. Students will also practice connecting and disconnecting blocks.	Engineering design	Asking questions & defining problems	Structure & function	Identify & describe shapes
Lesson 2: The Little Blue Block (20-30 Min.) In this lesson, students will observe the characteristics of the Blue ROK Block, compare and contrast blocks of different sizes and shapes, and apply what they have learned to create something new.	Engineering design	Developing & using models	Scale, proportion, & quantity	Count to tell the number of objects
Lesson 3: The Angled Red Block (20-30 Min.) In this lesson, students will observe the features and attributes of the Red ROK Block. Students will also practice connecting the blocks to make curves and arches.	Engineering design	Using mathematics	Structure & function	Compare numbers
Lesson 4: The Medium Green Block (20-30 Min.) In this lesson, students will explore the different features and attributes of the Green ROK Block. Students will compare and contrast the four ROK Blocks, then use the blocks to create something new.	Engineering design	Developing & using models	Scale, proportion, & quantity	Analyze, compare, & compose shapes

Unit Assessment: It's All About The Blocks
In this educator-led assessment, students will get hands-on with Kid Spark engineering materials 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.

Arch	Double	Rectangle	Small(er/est)
Big(ger/gest)	Half	Rectangular Prism	Square
Circle	Large(r/st)	Round	Symmetry
Compare	Long(er/est)	Separate	Tall(er/est)
Cube	Medium	Short(er/est)	Twice
Curve	Pyramid	Size	

Recommended Children's Literature

The following books can be used to support the concepts presented throughout this unit.

"Not a Box" by Antoinette Portis

"Build It! Structures, Systems and You" by Adrienne Mason

"Give Me Half!" by Stuart Murphy

"Shapes Are Everywhere!" by Charles Ghigna

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.

The Big Yellow Block

Foundational Fluencies: It's All About The Blocks | Teacher Lesson Plan

Overview:

In this lesson, students will closely observe the features and attributes of the Yellow ROK Block. Students will practice connecting and disconnecting blocks, then apply what they have learned to create something new.

Learning Objectives & NGSS Alignment:

- Observe the features and attributes of the Yellow ROK Block.
- Practice connecting and disconnecting blocks.
- Use Yellow ROK Blocks to create a large, rectangular prism.

Scientific/Engineering Practice - Asking questions & defining problems

Crosscutting Concept - Structure & function

Lesson Introduction:

Instructor: "Today we are going to start using some special blocks, called ROK Blocks. We can use ROK Blocks to help us learn math and to build things. Today we are going to use the biggest block: The Yellow ROK Block. In the future we will use the other blocks too."

Convergent Learning Activity:

1. Open the Foundational Fluencies - Building Plans Booklet and turn to page 2. Instruct students to locate 1 Yellow ROK Block from the Foundational Fluencies STEM Lab.

2. Instruct students to look closely at the block and share what they notice/observe about it. Use the following questions and the Building Plan for student discussion:

    a. What does the block feel like? ***(Point out texture on sides, openings, pyramids/cones)***
    b. Which side is the longest? What shape is the long side? ***(Rectangle)***
    c. How many openings does a long side have? ***(8)*** How many long sides are there on the block? ***(4)***
    d. Which side is the shortest? What shape is the short side? ***(Square)***
    e. How many openings does a short side have? ***(4)*** How many short sides are there on the block? ***(2)***

3. Explain to students that the Yellow ROK Block is a shape called a rectangular prism. Have students practice saying "rectangular" and "prism".

4. Explain to students that a rectangular prism has twelve edges. Ask students if they know what an edge is. Ask students to touch the edge of their desk. ***Demonstrate touching edge of a desk***. Work with students to count the twelve edges of the block. ***Note:*** *It is okay if students have difficulty counting edges. This activity is designed to introduce them to the 3D shapes.*

Activity Time:

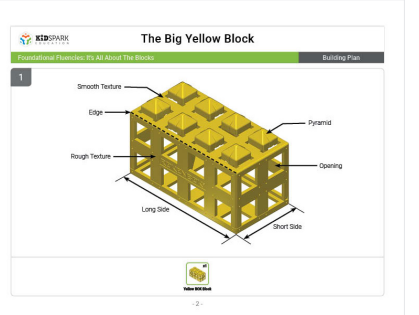
20 - 30 Minutes

Kid Spark STEM Lab:

Foundational Fluencies

Building Plans Booklet:

Pages 2 - 3



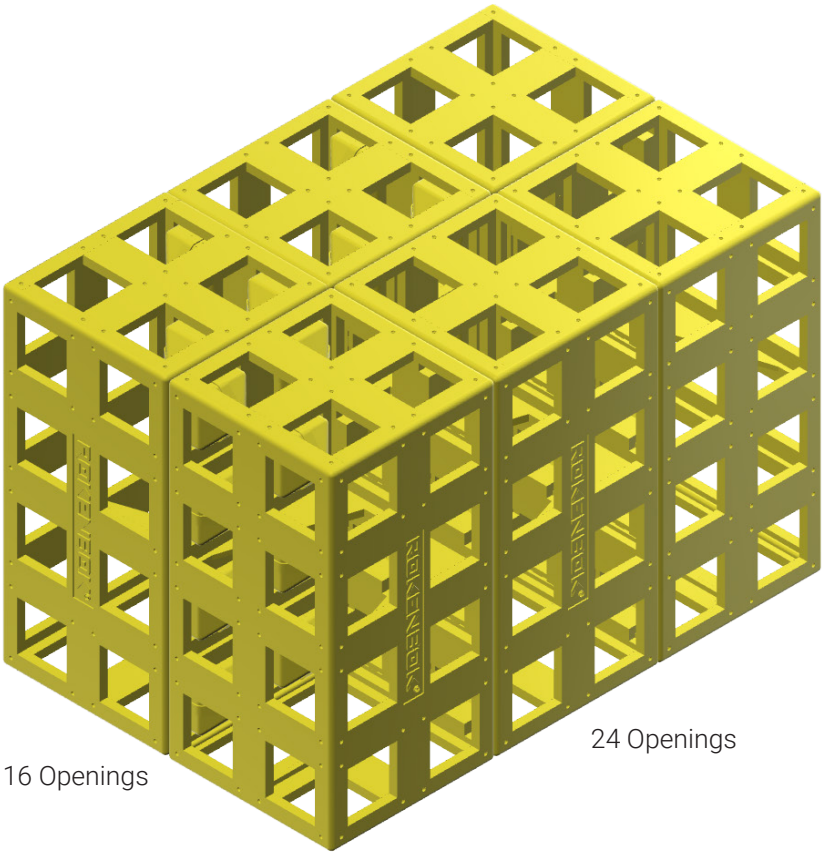
5. Explain to students that a rectangular prism has six sides. Work with students to count all six sides on the Yellow ROK Block.

6. Turn to page 3 in the Foundational Fluencies - Building Plans Booklet. Have students try to match each side of the physical block with the two-dimensional illustrations that are shown on the building plan.

7. Instruct students to locate a second Yellow ROK Block from the Foundational Fluencies STEM Lab. Demonstrate how to connect and disconnect blocks. Allow students some time to practice connecting and disconnecting the blocks. ***Tip:*** *It is easier to pull blocks apart using a bending or twisting motion instead of pulling them straight apart.*

Lesson Challenge: Build a Bigger Rectangular Prism

Instruct students to locate an additional 4 Yellow ROK Blocks from the Foundational Fluencies STEM Lab. Challenge students to build a bigger rectangular prism using the (6) blocks. Ask students to determine how many openings the long and short sides of the rectangular prism has. See example below.



The Little Blue Block

Foundational Fluencies: It's All About The Blocks | Teacher Lesson Plan

Overview:

In this lesson, students will observe the characteristics of the Blue ROK Block, compare and contrast blocks of different sizes and shapes, and apply what they have learned to create something new.

Learning Objectives & NGSS Alignment:

- Observe the characteristics of the Blue ROK Block.
- Compare and contrast blocks of different color, size, and shape.
- Use Blue ROK Blocks to create a large cube.

Scientific/Engineering Practice - Developing & using models

Crosscutting Concept - Scale, proportion, & quantity

Lesson Introduction:

Instructor: "In the previous lesson, we learned about the big Yellow ROK Block. Today we are going to learn about a different block: The Blue ROK Block. The Blue ROK Block is in the shape of a cube. Two Blue ROK Blocks can be put together to be the same size and shape as the big Yellow ROK Block."

Convergent Learning Activity:

1. Open the Foundational Fluencies - Building Plans Booklet and turn to page 4. Instruct students to locate 2 Blue ROK Blocks from the Foundational Fluencies STEM Lab.

2. Instruct students to look closely at the blocks and share what they notice/observe. Use the following questions and the Building Plan for student discussion:

    a. How many sides does the Blue ROK Block have? ***(6)***
    b. How many openings does the Blue ROK Block have on each side? ***(4)***
    c. Which side is different? ***(Pyramid side)*** What makes it different? ***(Pyramids)***
    d. How many pyramids are there? ***(4)***
    e. What are the pyramids for? ***(Connecting to other blocks)***

3. Discuss how all the sides on the Blue ROK Block are the same size. Explain when a shape has six square sides that are all the same size, it is called a "cube". Turn to page 5 in the Foundational Fluencies - Building Plans Booklet. Have students try to match each side of the physical block with the two-dimensional illustrations that are shown on the building plan.

4. Demonstrate how to connect and disconnect the Blue ROK Blocks. Allow students time to practice connecting and disconnecting the blocks.

5. Instruct students to locate a Yellow ROK Block from the Foundational Fluencies STEM Lab. Ask them if they remember what kind of shape it is. ***(Rectangular Prism)***

Activity Time:

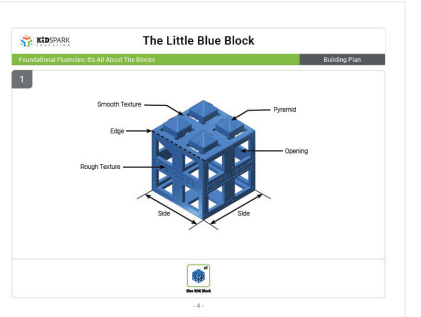
20 - 30 Minutes

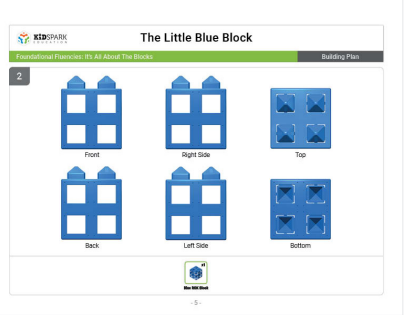
Kid Spark STEM Lab:

Foundational Fluencies

Building Plans Booklet:

Pages 4 - 5





6. Ask students to compare the Blue ROK Block to the Yellow ROK Block. Use the words “half”, “double”, and “twice as large” to compare the sizes of the blocks. Demonstrate how the Blue ROK Blocks can connect to all six sides of the Yellow ROK Block.

7. Ask students to explore the different ways the Blue ROK Blocks and Yellow ROK Block can snap together. Use the following prompt questions with students:

    a. How can you connect the Yellow and Blue ROK Blocks together to make a long shape?
    (Demonstrate how to connect the Blue ROK Blocks to the square end of the Yellow ROK Block)

    b. How can you connect the Yellow and Blue ROK Blocks together to make a square shape?
    (Demonstrate how to connect the Blue ROK Blocks to the Yellow ROK Blocks to form a square)

Learning Extension:

1. Ask students to put a Blue ROK Block and a Yellow ROK Block next to each other on their desks and then stand up behind their chairs.

2. Instruct students to look closely at the Yellow ROK Block and then close their eyes.

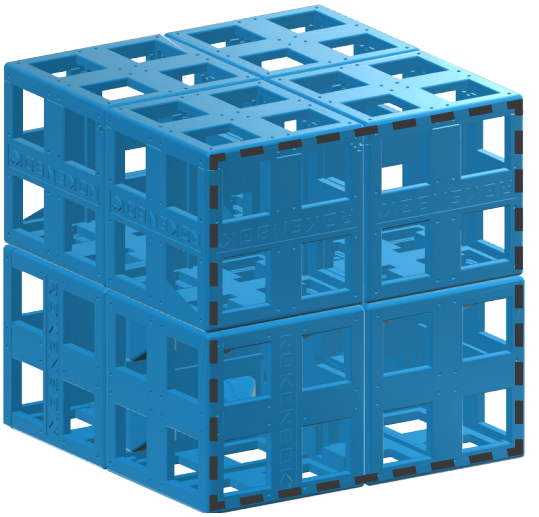
3. Ask students to imagine they are inside a Yellow ROK Block that is big enough for them to stand in. Ask them to reach up and feel the top of the block, then the sides, and then the bottom.

4. Repeat this activity with the Blue ROK Block.

5. Ask students how the Blue ROK Blocks and the Yellow ROK Blocks are the same and different. Ask which is bigger.

Lesson Challenge: Build a Bigger Cube

Instruct students to locate 8 Blue ROK Blocks from the Foundational Fluencies STEM Lab. Then, challenge students to build a bigger cube. Ask students to determine how many openings are on each side of the cube. See example below.



16 Openings

The Angled Red Block

Foundational Fluencies: It's All About The Blocks | Teacher Lesson Plan

Overview:

In this lesson, students will closely observe the characteristics of the Red ROK Block. Students will practice connecting Red ROK Blocks to make curves and arches, then apply what they have learned to create something new.

Learning Objectives & NGSS Alignment:

- Observe the characteristics of the Red ROK Block.
- Build an arch using Red ROK Blocks.
- Create a new design that includes Red ROK Blocks.

Scientific/Engineering Practice - Using mathematics

Crosscutting Concept - Structure & function

Lesson Introduction:

Instructor: "Today we are going to use a ROK Block that is very different from the blocks we have used so far: the Red ROK Block. The Red ROK Block can be used to make curves and arches."

Convergent Learning Activity:

1. Open the Foundational Fluencies - Building Plans Booklet and turn to page 6. Instruct students to locate 1 Yellow ROK Block, 1 Blue ROK Block, and 1 Red ROK Block from the Foundational Fluencies STEM Lab.

2. Instruct students to look closely at the Red ROK Block and share what they notice/observe about it. Use the following questions and the Building Plan for student discussion:

    a. How are the sides different from the other blocks? ***(Two sides are angled. There are pyramids on two sides instead of just one side)***.
    b. How many pyramids are there on the sides with pyramids? ***(2)*** How is this different from the other blocks? ***(On the Blue/Yellow ROK Blocks, the sides with pyramids have only pyramids, and not openings)***.
    c. Why do you think this block is shaped this way? ***(Encourage students to really think about this question. The answer: to make curves/arches/circles)***

3. Turn to page 7 in the Foundational Fluencies - Building Plans Booklet. Have students try to match each side of the physical block with the two-dimensional illustrations that are shown on the building plan.

4. Instruct students to locate a second Red ROK Block from the Foundational Fluencies STEM Lab. Ask them to explore the different ways that the two blocks can be connected.

5. Instruct students to connect the two blocks so that the letters (the logo) are next to each other on top. The bottom of the the two blocks should form a "V".

Activity Time:

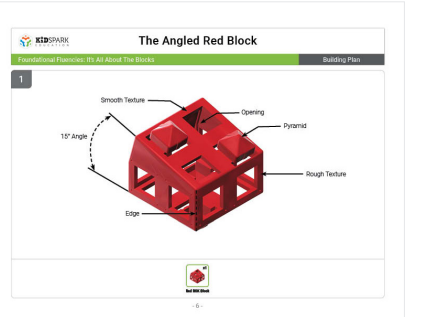
20 - 30 Minutes

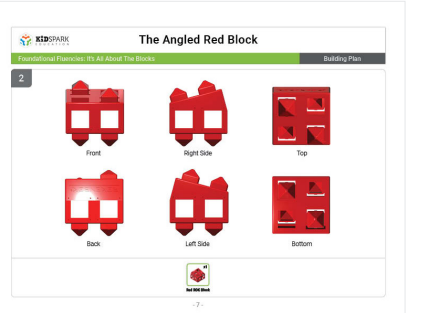
Kid Spark STEM Lab:

Foundational Fluencies

Building Plans Booklet:

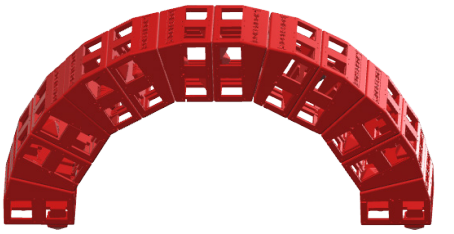
Pages 6 - 7



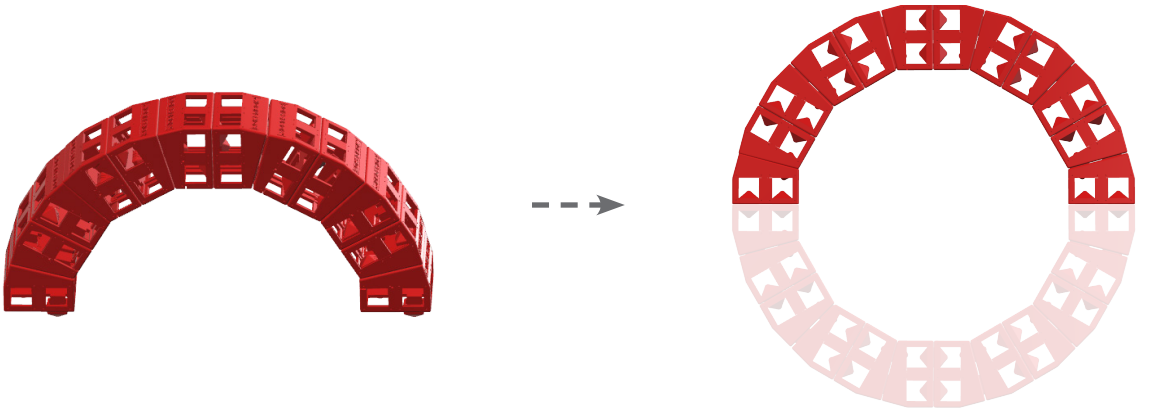


6. Instruct students to locate an additional 10 Red ROK Blocks from the Foundational Fluencies STEM Lab. Have students build an arch using the remaining blocks.

   Note: *The correct way to do this is to make sure all the letters/logos are visible on the top of the arch and there are no letters/logos on the bottom of the arch.*

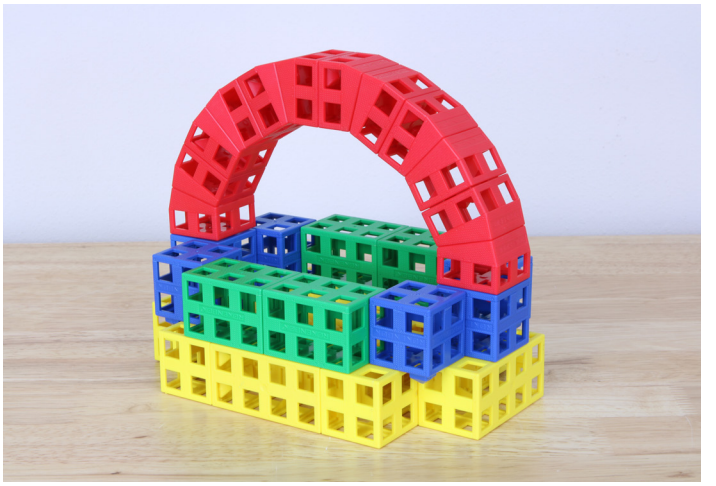


7. Ask students to predict what they think the shape will look like if they kept adding to the arch. ***(Circle)***



Lesson Challenge: Free Build

Instruct students to create a new design that includes Red ROK Blocks. ***Note:*** *For this challenge you may let students access additional blocks from the Foundational Fluencies STEM Lab. Encourage students to try and incorporate curves and arches into their design. See example below.*



Basket

The Medium Green Block

Foundational Fluencies: It's All About The Blocks | Teacher Lesson Plan

Overview:

In this lesson, students will explore the different features and attributes of the Green ROK Block. Students will compare and contrast the four ROK Blocks, then use the blocks to create something new.

Learning Objectives & NGSS Alignment:

- Observe the features and attributes of the Green ROK Block.
- Compare and contrast the Yellow, Blue, Red, and Green ROK Blocks.
- Use ROK Blocks to create something new.

Scientific/Engineering Practice - Developing & using models

Crosscutting Concept - Scale, proportion, & quantity

Lesson Introduction:

Instructor: "So far we have used 3 ROK Blocks. Today we are going to learn about a new block called: the Green ROK Block. The Green ROK Block is bigger than the Blue ROK Block and smaller than the Yellow ROK Block."

Convergent Learning Activity:

1. Open the Foundational Fluencies - Building Plans Booklet and turn to page 8. Instruct students to locate 1 Green ROK Block from the Foundational Fluencies STEM Lab and to observe it closely.

2. Instruct students to look closely at the block and share what they notice/observe about it. Use the following questions and the Building Plan for student discussion:

    a. What does the block feel like? ***(Point out texture on sides, openings, pyramids/cones)***
    b. Which side is the longest? What shape is the long side? ***(Rectangle)***
    c. How many openings does a long side have? ***(6)*** How many long sides are there on the block? ***(4)***
    d. Which side is the shortest? What shape is the short side? ***(Square)***
    e. How many openings does a short side have? ***(4)*** How many short sides are there on the block? ***(2)***

3. Turn to page 9 in the Foundational Fluencies - Building Plans Booklet. Have students try to match each side of the physical block with the two-dimensional illustrations that are shown on the building plan.

4. Instruct students to locate 1 Yellow ROK Block and 1 Blue ROK Block from the Foundational Fluencies STEM Lab.

5. Ask students to hold up the SMALLEST ROK Block! ***(Blue ROK Block)*** For each, hold up the correct block after the students have had a chance to respond.

6. Ask students how many pyramids the Blue ROK Block has. ***(4)*** Have students show with their fingers how many pyramids are on the Blue ROK Block.

Activity Time:

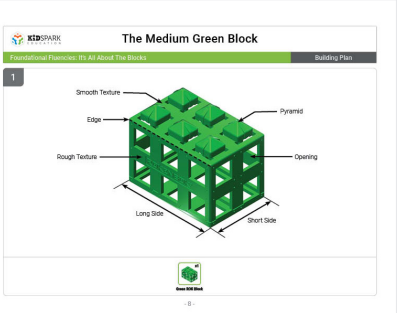
20 - 30 Minutes

Kid Spark STEM Lab:

Foundational Fluencies

Building Plans Booklet:

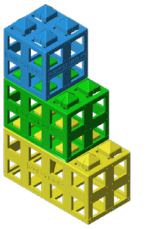
Pages 8 - 9



7. Ask students to find and raise the BIGGEST ROK Block! ***(Yellow ROK Block)*** Ask them how many pyramids are on the block. ***(8)***

8. Ask students to find and raise the MEDIUM-SIZED ROK Block! ***(Green ROK Block)*** Ask them how many pyramids are on this block. ***(6)***

9. Demonstrate how to assemble a set of steps (pictured to the right) using the Yellow, Green, and Blue ROK Blocks.



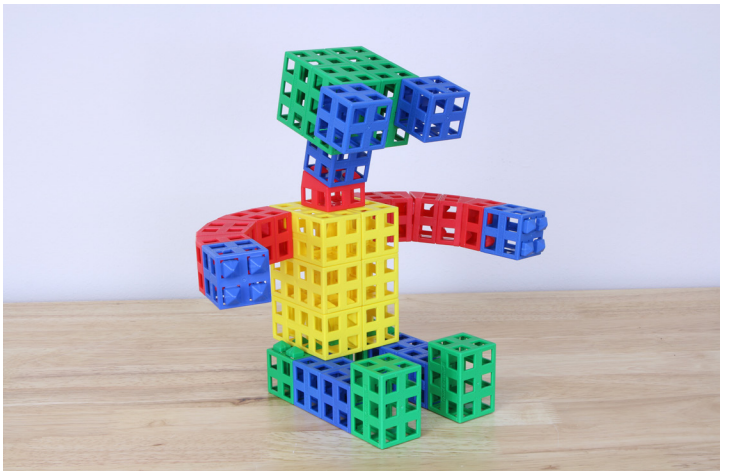
10. Use the following prompt questions for student discussion:

    a. How many more pyramids does the Yellow ROK Block have than the Green ROK Block? ***(2)***
    b. How many more pyramids does the Green ROK Block have than the Blue ROK Block? ***(2)***
    c. How many more pyramids does the Yellow ROK Block have than the Blue ROK Block? ***(4)***

    Note: *You can have students connect the Yellow ROK Blocks and Blue ROK Blocks together to check their answers.*

Lesson Challenge: Free Build

Instruct students to create a new design using only the Yellow, Green, Blue, and Red ROK Blocks from the Foundational Fluencies STEM Lab. Students are free to create whatever they want. After students are finished, have them present their designs. Encourage students to identify the different shapes in their designs (rectangle, square, cube, rectangular prism, arch, etc.). See example below.



Robot

It's All About The Blocks

Foundational Fluencies: It's All About The Blocks | **Unit Assessment**

Student Name: _____

Date: _____

Assessment Score
Total Score: _____ / **15 points**

Instructions:

This assessment can be used to measure student understanding of the core concepts and skills that are covered throughout this unit. The assessment should be facilitated by an instructor that is working directly with an individual student.

Note: A Foundational Fluencies STEM Lab will be required for this assessment.

Question 1

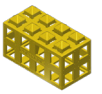
Score
_____ / 2 Points

Place the blocks pictured below in front of the student. Ask the student to identify the smallest block and the largest block.

Correct Answer: Red ROK Block (smallest), Yellow ROK Block (largest).

Lesson Alignment: *The Medium Green Block*
Unit Concepts: *Compare/contrast number, shape, size, and color of basic blocks*

1x
Red ROK Block



1x
Yellow ROK Block

1x
Green ROK Block

Question 2

Score
_____ / 1 Point

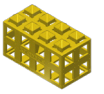
Place the blocks pictured below in front of the student. Ask the student to stack the blocks vertically from the largest (on bottom) to the smallest.

Correct Answer: Yellow (bottom), Green (middle), Blue (top).

Lesson Alignment: *The Medium Green Block*
Unit Concepts: *Compare/contrast number, shape, size, and color of basic blocks*

1x
Blue ROK Block

1x
Green ROK Block



1x
Yellow ROK Block

Question 3

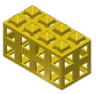
Place the block pictured below in front of the student. Ask the student to identify the two sides on the block that are the shortest. Then, ask the student to describe what 2D shape is represented by the short sides.

Correct Answer: Left and right sides. Square.

Left Side

Right Side

Lesson Alignment: *The Big Yellow Block*
Unit Concepts: *Identify and name 2 and 3 dimensional shapes that comprise ROK Blocks*



1x
Yellow ROK Block

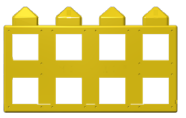
Score

_____ / 2 Points

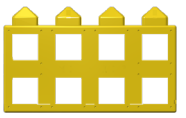
Question 4

Place the block pictured below in front of the student. Ask the student to identify the four sides on the block that are the longest. Then, ask the student to describe what 2D shape is represented by the long sides.

Correct Answer: Front, Back, Top, Bottom. Rectangle.

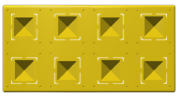


Front Side



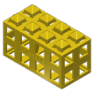
Back Side

Top



Bottom

Lesson Alignment: *The Big Yellow Block*
Unit Concepts: *Identify and name 2 and 3 dimensional shapes that comprise ROK Blocks*



1x
Yellow ROK Block

Score

_____ / 2 Points

Question 5

Place the block pictured below in front of the student. Ask the student to determine how many sides are on the Blue ROK Block.

Correct Answer: Six sides.

Lesson Alignment: *The Little Blue Block*
Unit Concepts: *Observe blocks closely, identifying details and functionality*

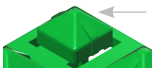
1x
Blue ROK Block

Score

_____ / 1 Point

Question 6

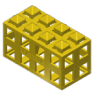
Place the blocks pictured below in front of the student. Ask the student what 3D shapes are on the top of each ROK Block and used to connect the ROK Blocks together.

Correct Answer: Pyramids. 

Lesson Alignment: *The Big Yellow Block, The Little Blue Block*
Unit Concepts: *Identify and name 2 and 3 dimensional shapes that comprise the ROK Blocks*

1x
Blue ROK Block

1x
Green ROK Block



1x
Yellow ROK Block

Score

_____ / 1 Point

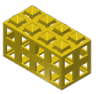
Question 7

Place the blocks pictured below in front of the student. Ask the student to determine how many more pyramids are on the Yellow ROK Block as compared to the Blue ROK Block.

Correct Answer: 4 more pyramids.

Lesson Alignment: *The Medium Green Block*
Unit Concepts: *Compare/contrast number, shape, size, and color of basic blocks*

1x
Blue ROK Block



1x
Yellow ROK Block

Score

_____ / 1 Point

Question 8

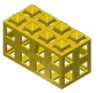
Place the blocks pictured below in front of the student. Ask the student "If two Blue ROK Blocks are placed right next to each other, which of the other two blocks (the Yellow or Green ROK Block) would they closely resemble?"

Correct Answer: Yellow ROK Block.

Lesson Alignment: *The Little Blue Block*
Unit Concepts: *Compare/contrast number, shape, size, and color of basic blocks*

2x
Blue ROK Block

1x
Green ROK Block



1x
Yellow ROK Block

Score
_____ / 1 Point

Question 9

Place the blocks pictured below in front of the student. Ask the student to identify which block represents a cube. Then, ask the student to identify or describe a real-world example of a cube.

Correct Answer: Blue ROK Block, various answers (box, game dice, etc.).

Lesson Alignment: *The Little Blue Block*
Unit Concepts: *Identify and name 2 and 3 dimensional shapes that comprise ROK Blocks*

1x
Blue ROK Block

1x
Red ROK Block

Score
_____ / 2 Points

Question 10

Place the blocks pictured below in front of the student. Ask the student to identify which block represents a rectangular prism. Then, ask the student to identify or describe a real-world example of a rectangular prism.

Correct Answer(s): Yellow ROK Block, various answers (book, door, etc.).

Lesson Alignment: *The Big Yellow Block*
Unit Concepts: *Identify and name 2 and 3 dimensional shapes that comprise ROK Blocks*

1x
Yellow ROK Block

1x
Red ROK Block

Score
_____ / 2 Points

Unit 2:

I Am An Engineer

I Am An Engineer

Foundational Fluencies: I Am An Engineer | **Unit Overview**

Unit Overview:

Some students grow up knowing an engineer. Most do not. Or, the engineers they know are different from them in gender, race, or other demographic characteristics. This unit demonstrates to students that we all use engineering every day, and extends their engineering skills working with Kid Spark engineering materials.

Recommended Grade Level:
Pre-K - 1

Kid Spark STEM Lab:
Foundational Fluencies

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 (CCS-MA).

- NGSS Disciplinary Core Ideas (DCI) are standards related to content knowledge.
- NGSS Scientific 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 children.
- Common Core Standards in Math help teachers integrate ROK Block experiences with math curriculum and to help build a continuum of engineering learning from preschool to the primary grades.

Lessons	NGSS DCI	NGSS SEP	NGSS CCC	CCS-MA
Lesson 1: What Is An Engineer?(30-35 Min.) In this lesson, students will learn about engineers and what they do. Students will create measurement tools to help their instructor solve a challenge.	Engineering design	Using mathematics	Scale, proportion, & quantity	Describe & compare measurable objects
Lesson 2: Patterns & Pyramids (30-35 Min.) In this lesson, students learn how to think like an engineer. Students will explore patterns and symmetry as they build different structures and designs.	Engineering design	Developing & using models	Patterns	Count to tell the number of objects
Lesson 3: What's In The Lab? (30-35 Min.) In this lesson, students will explore the engineering materials that are included in the ROK Blocks Mobile STEM Lab and become familiar with the name and function of each component.	Engineering design	Asking questions & defining problems	Structure & function	Compare numbers
Lesson 4: Free Build (30-35 Min.) In this lesson, students are free to create something of their own design. Students can use the skills they have learned throughout previous lessons to build and improve a custom design.	Engineering design	Developing & using models	Structure & function	Analyze, compare, & compose shapes

Unit Assessment: I Am An Engineer
In this educator-led assessment, students will get hands-on with Kid Spark engineering materials 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.

Build	Left	Problem	Symmetry
Design	Make	Pyramid	Tool
Engineer	Measure	Right	Vehicle
Equivalent	Pattern	Solve	
Inventory	Persistence	Symmetrical	

Recommended Children's Literature

The following books can be used to support the concepts presented throughout this unit.

"What Do You Do With A Problem?" by Kobi Yamada

"Is it Symmetrical?" by Nancy Allen

"Seeing Symmetry" by Loreen Leedy

"What is Symmetry in Nature?" by Bobbie Kalman

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.

What Is An Engineer?

Foundational Fluencies: I Am An Engineer | Teacher Lesson Plan

Overview:

In this lesson, students will learn about engineers and what they do. Students will create measurement tools to help their instructor solve a challenge.

Learning Objectives & NGSS Alignment:

- Define the role and purpose of an engineer.
- Create a measuring tool using ROK Blocks.
- Use a measuring tool to determine the dimensions of different objects.

Scientific/Engineering Practice - Using mathematics

Crosscutting Concept - Scale, proportion, & quantity

Pre-Lesson Preparation:

Prepare a "measuring tool" using 8 Blue ROK Blocks. See *Building Plans Booklet - Page 11*

Activity Time:

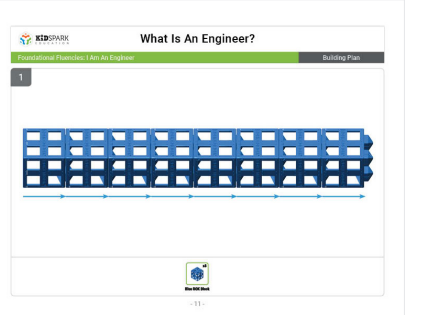
30 - 35 Minutes

Kid Spark STEM Lab:

Foundational Fluencies

Building Plans Booklet:

Page 11



Lesson Introduction:

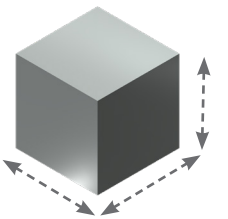
Instructor: "Today we are going to learn what it means to be an Engineer. Engineers are people who solve problems. They often design or make things to help them solve a problem. Think about what the word "problem" means. A problem is something that you need to figure out. Sometimes problems can be frustrating or keep us from doing something we want to do. Most problems are like puzzles that we need to figure out. Tools can help us solve these puzzles."

Convergent Learning Activity:

1. Explain to students that you would like to have their help in solving a problem. Tell students that you are thinking about rearranging the classroom, but you aren't sure how big a lot of the objects in the room are. Explain how you would like for them to help you create some measuring tools to measure different objects in the room. Tell students, "This is exactly what engineers do. They make things that help solve problems. Let's think like an engineer."

2. Show the class the tool you made using the Blue ROK Blocks (Pre-Lesson Preparation). Explain why you made your measuring tool the way you did. (***Ex.- "I made it straight because most of what I want to measure is straight. I made it long because I want to measure long things, but not too long because it might fall apart."***)

3. Demonstrate measuring an object such as a book or a desk using your tool. For the unit of measurement, count each block. This means your object will be "X" number of Blue ROK Blocks long, "X" number of Blue ROK Blocks deep, and "X" number of Blue ROK Blocks tall.

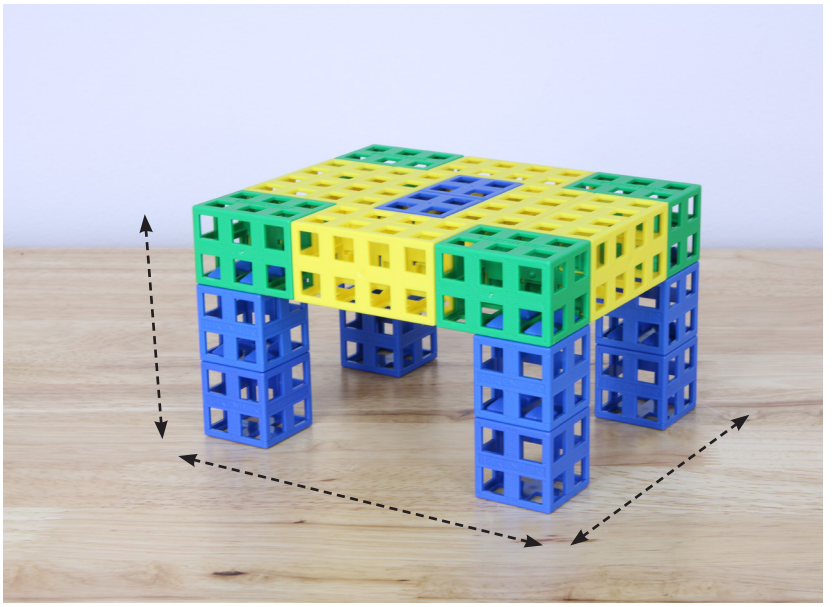


4. Open the Foundational Fluencies - Building Plans Booklet and turn to page 11. Instruct students to assemble a measuring tool using 8 Blue ROK Blocks.

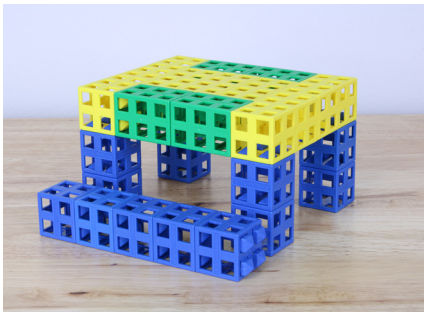
5. Ask students to measure their desks or other objects in the room (e.g., white boards, cabinets, tables, or chairs). Students can also measure things like their arms, legs, or feet, etc.

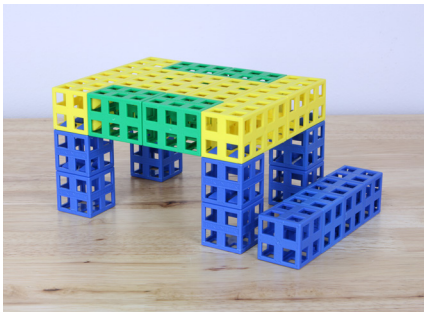
Lesson Challenge: Build a Custom Piece of Classroom Furniture

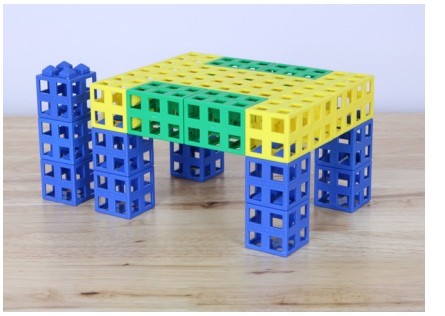
Instructions: Challenge students to build a piece of classroom furniture using only Yellow and Green ROK Blocks from the Foundational Fluencies STEM Lab. Once they are finished, have students create a measuring tool using Blue ROK Blocks to measure the length, depth, and height of the design. See example below.



Desk/Table







Patterns & Pyramids

Foundational Fluencies: I Am An Engineer | Teacher Lesson Plan

Overview:

In this lesson, students will learn how to think like an engineer. Students will explore patterns and symmetry as they build different structures and designs.

Learning Objectives & NGSS Alignment:

- Create a simple pattern using ROK Blocks.
- Assemble a pyramid and observe the differences between the two halves.
- Create a custom, symmetrical pyramid.

Scientific/Engineering Practice - Developing & using models

Crosscutting Concept - Patterns

Lesson Introduction:

Instructor: "Today we are going to learn how to think like an engineer. Engineers love patterns. Patterns are things that repeat. We can make a pattern by clapping." Clap a simple pattern like slow, fast-fast, slow, fast-fast. Have the students repeat after you. Then change the pattern, like slow, slow, fast-fast-fast, slow, slow, fast-fast-fast. Discuss with students how patterns are all around us. Ask students to point out patterns they see in the classroom. If they're having difficulty, point out some patterns for them (like patterns on the wall, ceiling, etc.).

Activity Time:

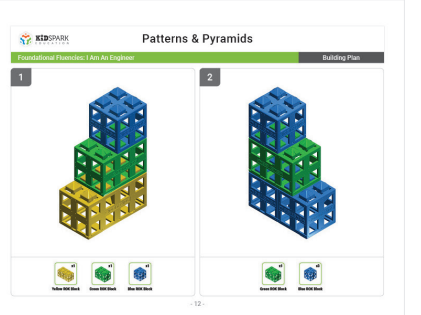
30 - 35 Minutes

Kid Spark STEM Lab:

Foundational Fluencies

Building Plans Booklet:

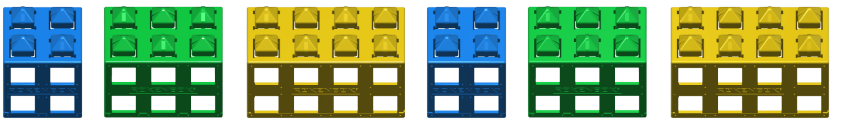
Page 12



Convergent Learning Activity:

1. Instruct students to locate 2 Yellow ROK Blocks, 2 Green ROK Blocks, and 2 Blue ROK Blocks from the Foundational Fluencies STEM Lab.

2. Demonstrate how a pattern can be created using ROK Blocks. Make the pattern: blue, green, yellow; blue, green, yellow. ***Instructor: As you place the blocks say: "I'm putting the blocks down in this sequence: blue, green, yellow. A sequence tells us the order of a pattern. It tells us what comes first, and second, and third."***



3. Instruct the students to copy your pattern. Ask them to share what they notice about the pattern using these prompt questions:

    a. What else do you notice about this sequence? ***(It goes small, medium, large. Four pyramids, six pyramids, eight pyramids.)***

    b. Can you make a different pattern with these 6 blocks? ***(Such as B, B, G, G, Y, Y).*** Ask students to talk you through their pattern.

4. Open the Foundational Fluencies - Building Plans Booklet and turn to page 12. Instruct students to assemble the two sides of the pyramid that are shown on the building plan.

5. Ask students to share what they notice about the two sides of the pyramid. Use the following prompt questions to initiate discussion:
    a. How are the sides the same? ***(Same size/shape)***
    b. How are they different? ***(Different block colors, different number of blocks)***
    c. How is it possible that the two sides are the same size but use a different number of blocks? ***(Yellow ROK Blocks are twice as big as Blue ROK Blocks)***
    d. **Instructor:** "Walk" your fingers up the angled side of the pyramid and ask the students what it reminds them of? ***(Stairs)***

6. ***Instructor: "Sometimes patterns can be symmetrical. Does anyone know what symmetrical means? A shape or pattern is symmetrical if a central dividing line (a mirror line) can be drawn on it, to show that both sides are exactly the same (or mirror each other)."*** Instruct students to stack their two pyramids next to each other, as shown below in Figure 1. Ask students if the pyramids are symmetrical. ***(They show symmetry in shape, but not in color.)*** Point out how the two pyramids are the same shape, but different in color.

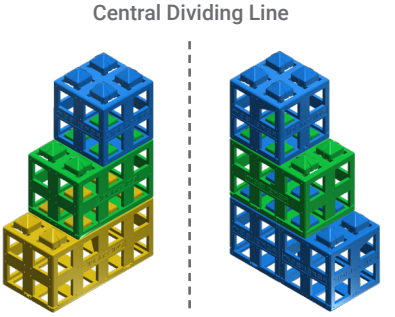
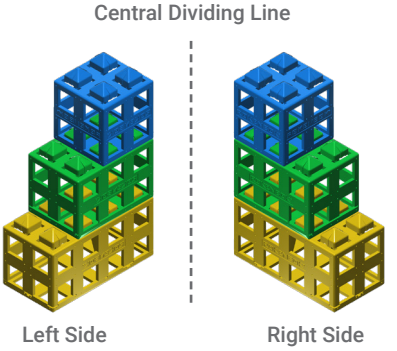
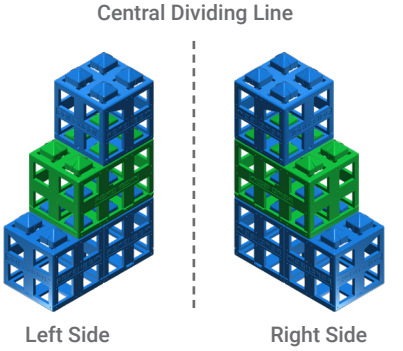


Figure 1

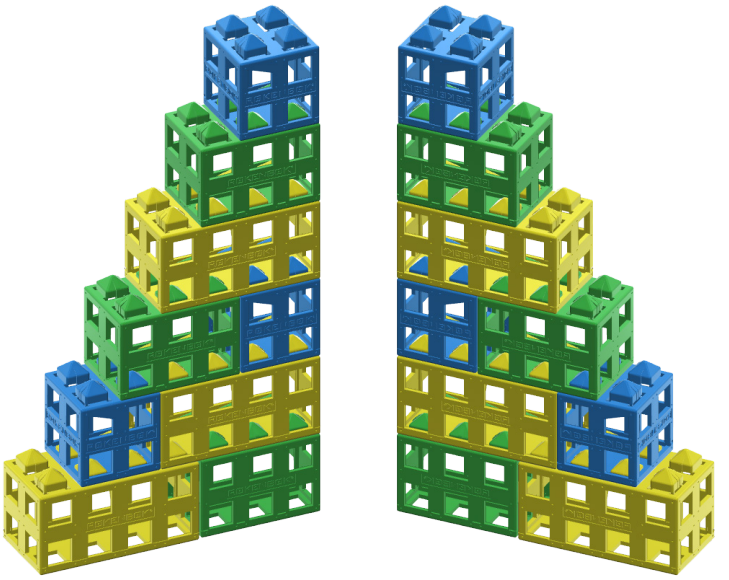
7. ***Instructor: "Now let's make a pattern with our pyramids that is symmetrical in shape and color."*** Instruct students to use blocks from the Foundational Fluencies STEM Lab to modify one of the pyramids so both are symmetrical in shape and color (see examples below). Give them a few minutes to try and rearrange their pyramids so they are symmetrical. Help students if necessary.





Lesson Challenge: Build a Large, Symmetrical Pyramid

Using only ROK Blocks from the Foundational Fluencies STEM Lab, challenge students to create a large, symmetrical pyramid. The pyramid can be symmetrical in shape, color, or both. See example below.



Symmetrical Pyramid

What's In The Lab?

Foundational Fluencies: I Am An Engineer | **Teacher Lesson Plan**

Overview:

In this lesson, students will explore the engineering materials that are included in the ROK Blocks Mobile STEM Lab and become familiar with the name and function of each.

Learning Objectives & NGSS Alignment:

- Locate and observe each component in a Foundational Fluencies STEM Lab.
- Practice connecting and disconnecting engineering materials.
- Build a car using Kid Spark engineering materials.

Scientific/Engineering Practice - Asking questions & defining problems

Crosscutting Concept - Structure & function

Pre-Lesson Preparation:

This lesson introduces students to some of the smaller engineering materials that are included in the Foundational Fluencies STEM Lab. Smaller engineering materials can be more difficult for little hands to connect and disconnect. They are easier to disconnect if you pull at an angle or use the provided key, rather than trying to pull them straight out. Smaller materials snap together in two different ways. Prior to instruction, make sure to review page 10 (Kid Spark Engineering Materials) to become familiar with how to easily connect and disconnect components.

Lesson Introduction:

Instructor: "So far we've used just the 'large' ROK Blocks, but there are a lot more engineering materials in the lab that we can use to build fun and useful things. Engineers always want to know what tools and materials they have to work with, so today we're going to see what is in the Foundational Fluencies Lab."

Activity Time:

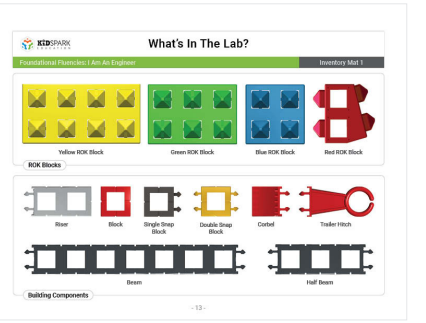
30 - 35 Minutes

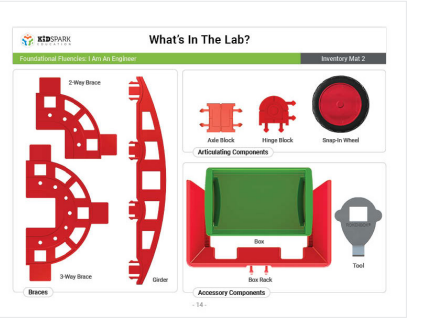
Kid Spark STEM Lab:

Foundational Fluencies

Building Plans Booklet:

Pages 13 - 14



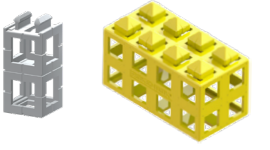


Convergent Learning Activity:

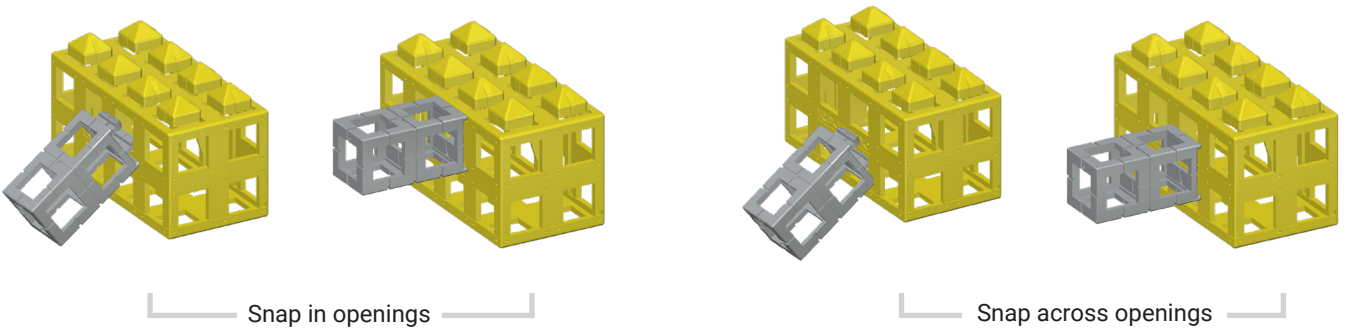
1. Open the Foundational Fluencies - Building Plans Booklet and turn to page 13. Instruct students to locate all of the engineering materials that are displayed on the Inventory Mat. Have students match each physical block with the two-dimensional illustrations that are shown.

2. Once students have correctly identified and placed all engineering materials in their appropriate spot, explore how several of the smaller components work. Start by showing the students how the smaller components connect differently than the larger ROK Blocks.

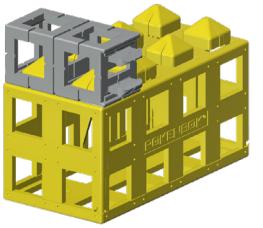
Instructor: "Everyone get a Riser and a Yellow ROK Block. The Riser is light gray and is two squares long. Smaller components are special because they can fit together with other blocks in three ways." Hold up the Riser so the connectors are at the top. ***Instructor: "See those two tabs at the top? They can snap in to the openings on the Yellow ROK Block in two ways. Watch me while I show you."***



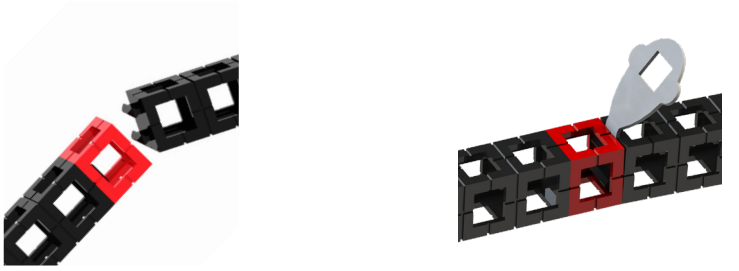
3. Demonstrate how to connect the Riser into the openings of the Yellow ROK Block, and how to snap across the "bridge" points (the solid part between the openings). Demonstrate how it is easier to connect smaller components by angling one tab into an opening, and then snapping into place. ***Note:*** *Point out to students how snapping across openings is easier than snapping directly into openings, but it is also less strong.*



4. Demonstrate how the Riser fits on the pyramids. Allow students time to practice connecting and disconnecting.



5. Demonstrate how to connect and disconnect smaller engineering materials to each other. Show students how the tool can be used to disconnect smaller engineering materials. Allow students time to practice connecting and disconnecting.



6. Instruct students to place all of the engineering materials that are on the Inventory Mat back in the Foundational Fluencies Lab.

7. Turn to page 14 in the Foundational Fluencies - Building Plans Booklet. Instruct students to locate all of the engineering materials that are displayed on the Inventory Mat. Have students match each physical block with the two-dimensional illustrations that are shown.

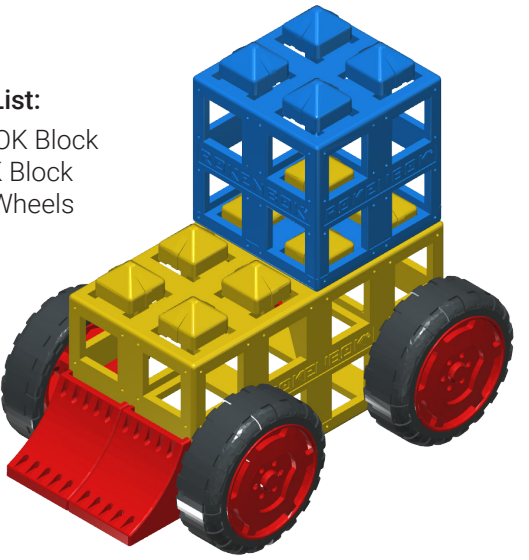
8. Have students observe all of the new engineering materials on the mat and share how they think each component can be used.

Lesson Challenge: Build a Car

Challenge students to build a car using the larger ROK Blocks and the smaller engineering materials. Have students create an inventory list of all of the engineering materials that are used to build the car. See example below.

Inventory List:

1 Yellow ROK Block
1 Blue ROK Block
4 Snap-In Wheels
2 Corbels



Car

Free Build

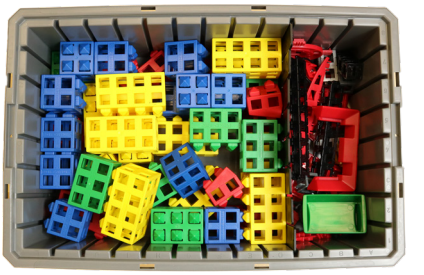
Foundational Fluencies: I Am An Engineer | Teacher Lesson Plan

Overview:

In this lesson, students will apply what they have learned throughout this unit to create something new. Students will look for opportunities to improve the design as they build and test it.

Activity Time:
30 - 35 Minutes

Kid Spark STEM Lab:
Foundational Fluencies



Learning Objectives & NGSS Alignment:

- Apply concepts from this unit to create a custom design.
- Identify opportunities to improve a design.
- Explain the design to others.

Scientific/Engineering Practice - Developing & using models
Crosscutting Concept - Structure & function

Lesson Introduction:

Instructor: "So far you've been given ideas about what to build and how to use ROK Blocks to make things. The best thing about ROK Blocks is getting to think up something ourselves and then figure out how to build it."

Divergent Learning Activity:

1. Inform students they are free to create any design of their choosing. Encourage students to try and think about what they learned throughout previous lessons as they are building.

2. Circulate among the students or build your own design, or both. As you interact with students ask them to tell you about their creation using these potential prompt questions:

    a. What are you making? What do you want your design to do?
    b. Can you show me with your hands what you're trying to make?
    c. Where are the patterns in what you're making?
    d. How tall will it be? How many [color] blocks do you think you'll need to make it that tall?
    e. What could you do to make it roll?
    f. What could you do to make it stronger?

3. Encourage students to look for opportunities to test and improve their designs.

4. After students are finished, have them share their design with others.

Learning Extensions:

a. If time permits, you can extend children's learning before they build by having them draw/sketch or describe what they intend to build.

b. Students can practice writing skills by taking a picture or drawing their build in their class journals and writing or dictating a few sentences about it. Children can connect to their environment or community by identifying similar objects in their home, school, or neighborhood.

I Am An Engineer

Foundational Fluencies: I Am An Engineer | **Unit Assessment**

Student Name: _____

Date: _____

Assessment Score

Total Score: _____ / **11 points**

Instructions:

This assessment can be used to measure student understanding of the core concepts and skills that are covered throughout this unit. The assessment should be facilitated by an instructor that is working directly with an individual student.

Note: A Foundational Fluencies STEM Lab and Building Plans Booklet will be required for this assessment.

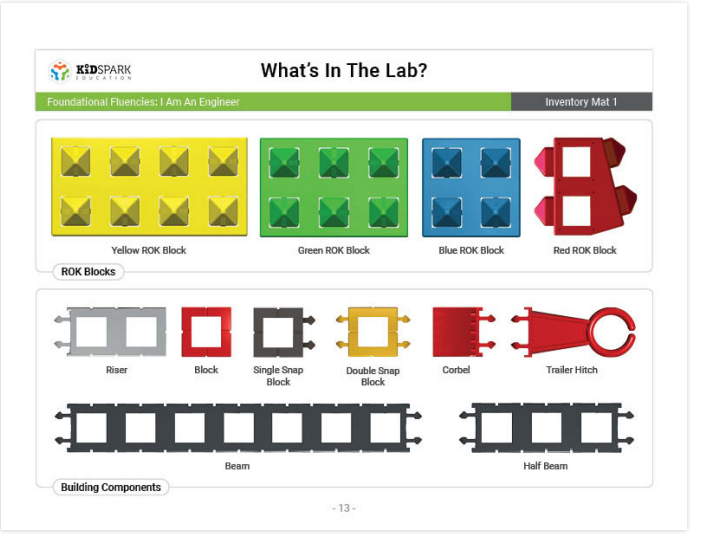
Question 1

Score

_____ / 4 Points

Place the blocks pictured below in front of the student. Open the Building Plans Booklet and turn to page 13. Ask the student to correctly match each physical block with the 2-dimensional image on the mat.

Correct Answer: Student correctly places blocks on the inventory mat.



Lesson Alignment: *What's In The Lab*

Unit Concepts: *Match 3-dimensional objects to 2-dimensional pictures*

1x
Yellow ROK Block

1x
Green ROK Block

1x
Blue ROK Block

1x
Red ROK Block

Question 2

Assemble a measuring device that is 8 Blue ROK Blocks in length. Place the measuring stick in front of the student and ask them to determine its length (in Blue ROK Block units of measurement).

Correct Answer: 8 Blue ROK Blocks in length.

Length

Lesson Alignment: *I Am An Engineer*
Unit Concepts: *Compare and contrast size and shape of objects*

8x
Blue ROK Block

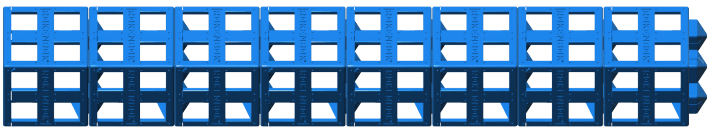
Score

_____ / 1 Point

Question 3

Using the measuring stick from the previous question, ask the student to determine the length of a random object (book, desk, etc.) in Blue ROK Block units of measurement.

Correct Answer: Length of random object in Blue ROK Block units.



Length

Lesson Alignment: *I Am An Engineer*
Unit Concepts: *Compare and contrast size and shape of objects*

8x
Blue ROK Block

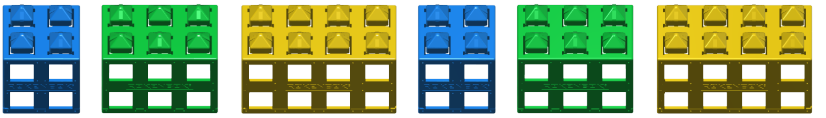
Score

_____ / 1 Point

Question 4

Place the blocks pictured below in front of the student. Ask the student to create a repeating pattern by arranging the blocks in a straight line.

Correct Answer: Various answers. See example below.



Lesson Alignment: *Patterns & Pyramids*
Unit Concepts: *Create and analyze patterns*

2x
Yellow ROK Block

2x
Green ROK Block

2x
Blue ROK Block

Score

_____ / 1 Point

Question 5

Assemble the two pyramids shown below. Place the pyramids in front of the student and ask the following questions. How are the two sides of the pyramid the same? How are the two sides of the pyramid different? Are the two sides symmetrical in shape? Are the two sides symmetrical in color?

Correct Answers: The two sides are the same size and shape. The two sides are made up of different colors and number of blocks. The two sides are symmetrical in terms of shape. The two sides are not symmetrical in terms of color.

Lesson Alignment: *I Am An Engineer*
Unit Concepts: *Compare and contrast size and shape of objects; recognize symmetry*

1x
Yellow ROK Block

2x
Green ROK Block

4x
Blue ROK Block

Score

_____ / 4 Points

Unit 3:

Making Things Strong

Making Things Strong

Foundational Fluencies: Making Things Strong | Unit Overview

Unit Overview:

In this unit, students expand on their growing understanding of engineering and what it means to be an engineer. The activities engage them with a real-life problem that often faces engineers: how to make things strong. Students also learn part of the design cycle by testing their designs and improving them.

Recommended Grade Level:
Pre-K - 1

Kid Spark STEM Lab:
Foundational Fluencies

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 (CCS-MA).

- NGSS Disciplinary Core Ideas (DCI) are standards related to content knowledge.
- NGSS Scientific 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 children.
- Common Core Standards in Math help teachers integrate ROK Block experiences with math curriculum and to help build a continuum of engineering learning from preschool to the primary grades.

Lessons	NGSS DCI	NGSS SEP	NGSS CCC	CCS-MA
Lesson 1: How Much Load Can It Hold? (30-40 Min.) In this lesson, students will learn what it means for something to be strong. Students will build a bridge and learn about the relationships between weight, strength, load, and reinforcement.	Engineering design	Developing & using models	Structure & function	Describe & compare measurable attributes
Lesson 2: The Long Haul (30-40 Min.) In this lesson, students will build a truck and explore different ways to make it stronger. Then, students will create their own truck and look for opportunities to strengthen it.	Engineering design	Asking questions & defining problems	Scale, proportion, & quantity	Analyze, create, & compose shapes
Lesson 3: Make Your Castle Strong (30-40 Min.) In this lesson, students will assemble a castle wall and explore different ways to make it stronger. Then, students will build a custom structure and look for opportunities to strengthen it.	Engineering design	Planning & carrying out investigations	Cause & effect; mechanism & explanation	Identify & describe shapes
Lesson 4: Free Build (30-40 Min.) In this lesson, students will apply what they have learned throughout this unit to create something new. Students will look for opportunities to improve the design as they build and test it.	Engineering design	Developing & using models	Scale, proportion, & quantity	Reason with shapes & their attributes.

Unit Assessment: Making Things Strong
In this educator-led assessment, students will get hands-on with Kid Spark engineering materials 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.

Beam	Joint	Push	Vehicle
Bridge	Load	Reinforce	Work
Energy	Machine	Reinforcement	
Force	Pull	Strong(er) Test	

Recommended Children's Literature

The following books can be used to support the concepts presented throughout this unit.

"Building Bridges (Young Engineers)" by Tammy Enz

"Go! Go! Go! Stop!" by Charise Mericle Harper

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.

How Much Load Can It Hold?

Foundational Fluencies: Making Things Strong | Teacher Lesson Plan

Overview:

In this lesson, students will learn what it means for something to be strong. Students will build a bridge and learn about the relationships between weight, strength, load, and reinforcement.

Learning Objectives & NGSS Alignment:

- Discuss bridge design and structure.
- Build a sample of a Beam Bridge and then make it stronger.
- Use force to determine how strong the bridge is.

Scientific/Engineering Practice - Developing & using models
Crosscutting Concept - Structure & function

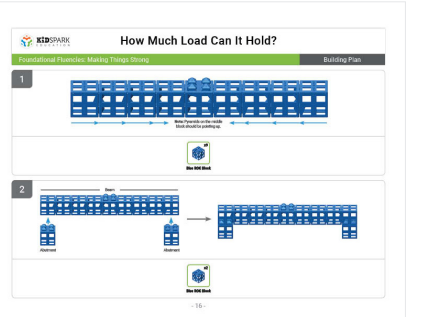
Lesson Introduction:

Instructor: "One of the most common problems engineers solve is how to make things stronger. Adding reinforcements that can help distribute the weight or load is one way engineers make things strong."

Activity Time:
30 - 40 Minutes

Kid Spark STEM Lab:
Foundational Fluencies

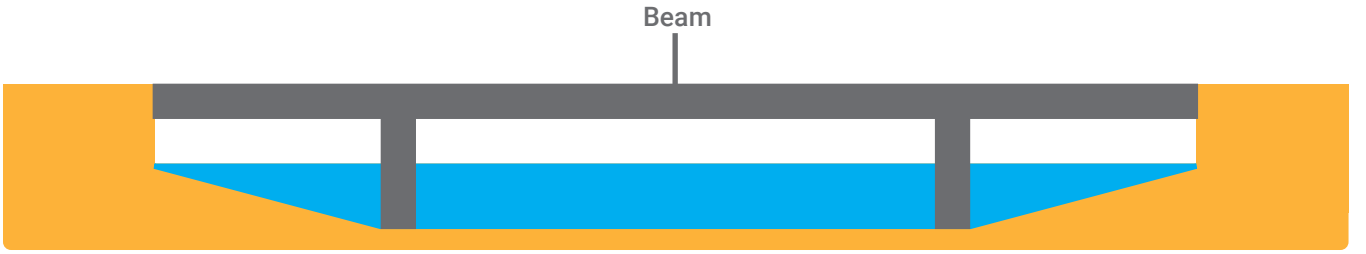
Building Plans Booklet:
Page 16



Convergent Learning Activity:

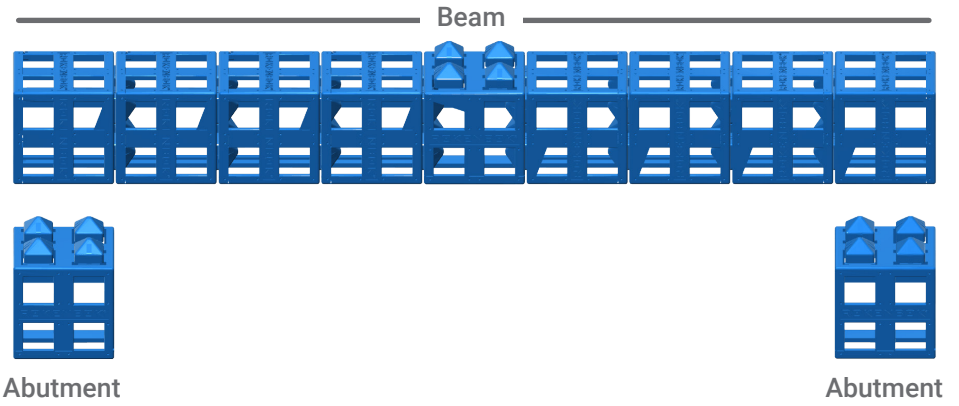
1. Start by engaging students in a discussion about bridges. Ask students to raise their hands if they have traveled over a bridge lately. If there are bridges in the local neighborhood, ask if any of the children live near them, or cross them frequently. Ask them what bridges do and why we need them.

   Instructor: "Today we're going to build bridges. We're going to build the most common type of bridge. It's called a beam bridge." Draw a simple beam bridge on the whiteboard/chalkboard or paper (see image below). ***Instructor: "The long part in the middle is called a beam."***



2. Open the Foundational Fluencies - Building Plans Booklet and turn to page 16. Instruct students to follow the step-by-step instructions to assemble a bridge.

3. As students are building their bridges, point out how the beam of the bridge is supported by two "abutments".

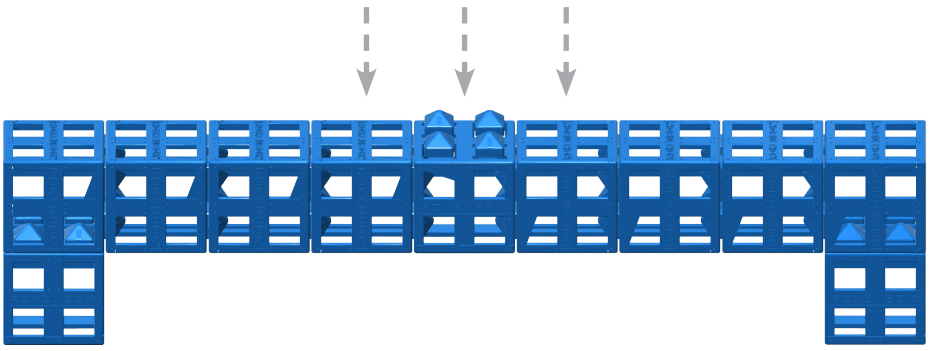


4. As students finish building their bridges, ask the following prompt questions:

    a. Are both sides of the bridge symmetrical?
    b. Is the bridge long and thin, or short and wide?
    c. What do you notice about the middle of the bridge?

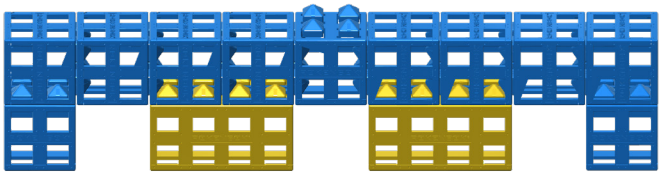
5. ***Instructor: "Let's test our bridges to see how strong they are. Put your bridge on the table. "Testing" means we're trying out the bridge to see if it works. Think about this question: What do you predict will happen if you walked on the bridge? (It would break.) What do you predict would happen if you were to put pressure on it?"***

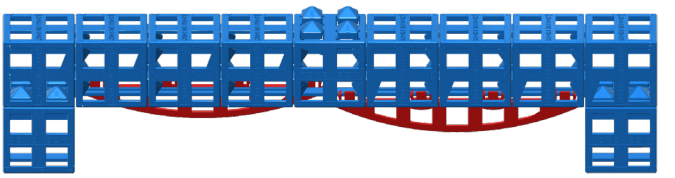
6. After making their predictions, have each student put gentle pressure on their bridge until it fails. Make sure every student has the chance to put pressure on their bridge until it fails. Feeling their own body's force against the bridge can help them understand the relationship between load and strength.



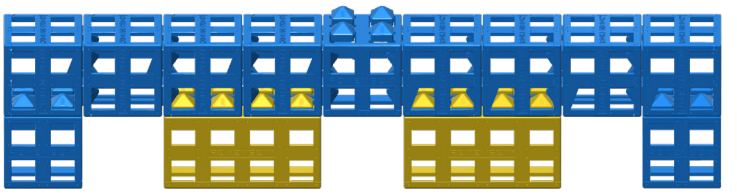
7. ***Instructor: "When we put pressure on the bridges, we're putting our "weight" on them. Weight on a bridge is called a "load." When have you heard the word "load" before? (A load of laundry, picking up a load of garden soil, etc.). Our bridges are not strong enough for us to put pressure on them. How could we make them stronger?" (Make the beam shorter, use supports, or braces.)***

8. Ask students to locate 2 Yellow ROK Blocks and 2 Girders from the Foundational Fluencies STEM Lab. Let them experiment with different ways to make their bridge stronger. (See examples below) ***Note:*** *Girders may be too difficult for some students to snap into openings. Demonstrate how to easily connect girders by snapping one end of the girder into an opening, and then pressing down on the remaining tabs to snap into place.*



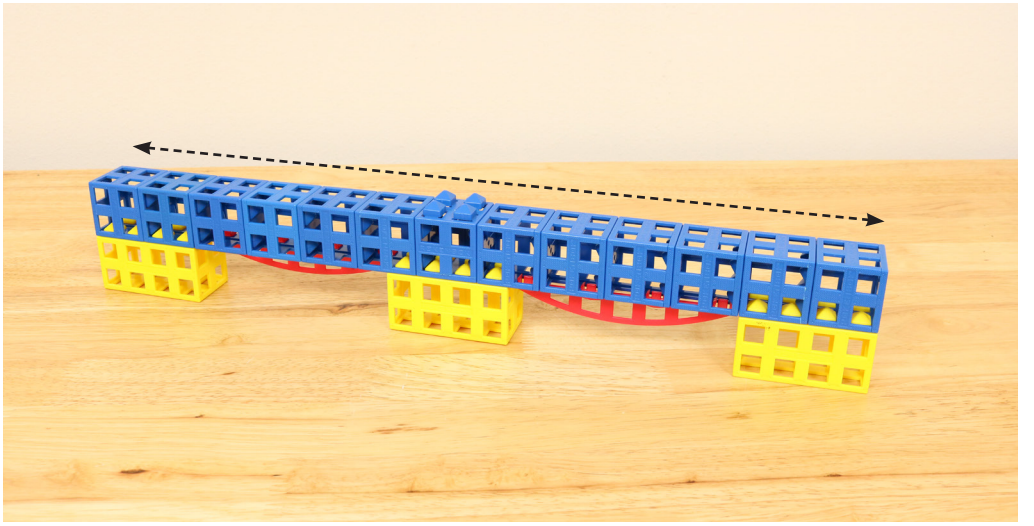


9. After students have tested various configurations to add strength to their bridges, add 2 Yellow ROK Blocks to the bottom of your bridge (see image below). ***Instructor: "I reinforced my bridge by connecting 2 Yellow ROK Blocks underneath it. The word "reinforce" means to strengthen something. We can reinforce our creations by adding materials in certain places. Some places are better than others for reinforcement. I put the Yellow ROK Blocks towards the middle of the bridge where it is often very weak. Next time we work with ROK Blocks we will build something designed to move heavy things."***



Lesson Challenge: Build a Large Bridge

Challenge students to build a strong bridge that is at least 12 Blue ROK Blocks in length. The bridge should include abutments on each end. Have students demonstrate and explain how they reinforced the bridge to make it stronger. See example below.



Bridge

The Long Haul

Foundational Fluencies: Making Things Strong | **Teacher Lesson Plan**

Overview:

In this lesson, students will build a truck and explore different ways to make it stronger. Then, students will create their own truck and look for opportunities to make it stronger.

Lesson Concepts & NGSS Alignment:

- Discuss the concept of work.
- Build a truck and explore different ways to make it stronger.
- Create a custom vehicle that is strong.

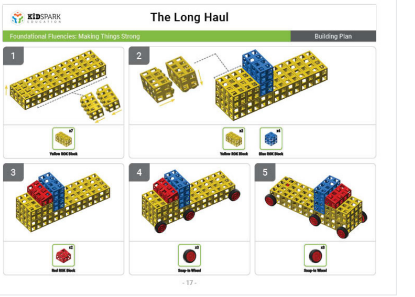
Scientific/Engineering Practice - Asking questions & defining problems

Crosscutting Concept - Scale, proportion, & quantity

Activity Time:
30 - 40 Minutes

Kid Spark STEM Lab:
Foundational Fluencies

Building Plans Booklet:
Page 17



Lesson Introduction:

Instructor: "In the previous lesson we learned about making a bridge strong. Engineers design a lot of different things to be strong. Today, we're going to learn how to make a truck strong, but first, please tell me what you think of when you hear the word 'work'." To further the discussion, you could use some potential prompts such as:

a. Do you hear your parents or neighbors or brothers/sisters talk about going to work? What does that mean?
b. Do you do work here at school?

Convergent Learning Activity:

1. ***Instructor: "Engineers and scientists have a special way they think about work. Work is the amount of energy it takes to make something move, change directions, or stop moving."*** Engage the students in a discussion of how they do this. (Examples: Running, riding a bike, skates/skateboard, etc.)

2. ***Instructor: "When you or your parents need to move something heavy, what do you use to move it? (Use a shopping cart, wheelbarrow, truck/car, hand truck/dolly.) What do shopping carts, cars, and wheelbarrows all include that make it easier to move something heavy? (They all have wheels.) Wheels make work easier. They make it easier to move something heavy."*** *Note: If students ask or if you are doing an extended lesson on simple machines, you may wish to say, "Wheels make work easier because they reduce friction."*

3. ***Instructor: "Today we are going to build a truck."*** Open the Foundational Fluencies - Building Plans Booklet and turn to page 17. Instruct students to follow the step-by-step instructions to assemble a truck.

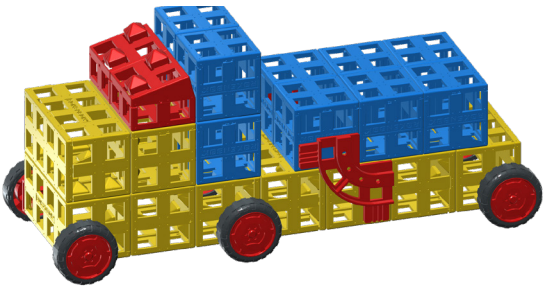
4. ***Instructor: "Let's look at what we've built. What do you notice about the truck?"*** To further the discussion, you could use some potential prompts such as:

a. Is it symmetrical? **(Side to side, yes; front to back, no)** How do you know?
b. Does the bed of the truck (point to bed) have any reinforcement? ***(No)***

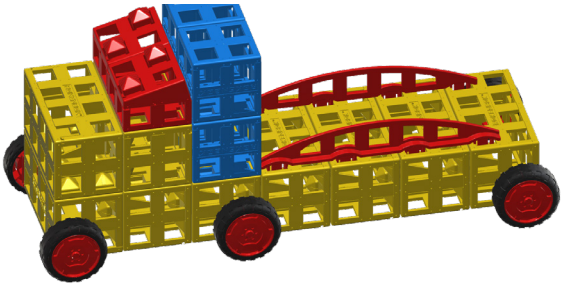
5. ***Instructor: "This truck is supposed to make work easier by moving heavy things. Now, let's test it for strength."*** Put the truck on the table and put gentle pressure on the middle of the truck bed until it fails (see image below). What happens? ***(It fails.)***

6. ***Instructor: "How do you think we can make our truck bed stronger so that it can hold more weight?"***

7. Instruct students to use some of the extra materials to try and make the bed of the truck stronger (add braces, use materials across joints....see examples below). Once they are finished, have students put pressure on the truck bed to see if it is stronger than the original design. ***Note:*** *Girders work great but may be too difficult for some students to snap into openings. Demonstrate how to easily connect girders by snapping one end of the girder into an opening, and then pressing down on the remaining tabs to snap into place.*



Example 1: Using ROK Blocks and Braces



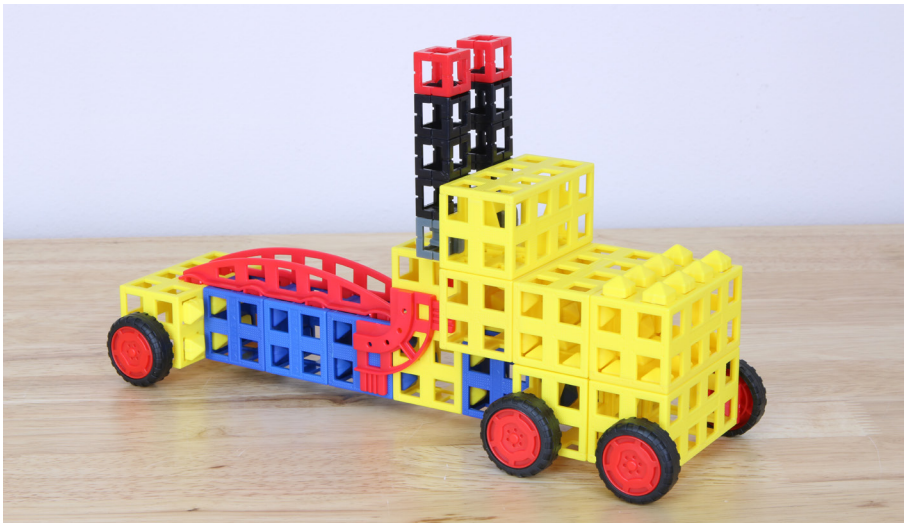
Example 2: Using Girders

8. Have students put small objects on their trucks and move them around their desks or the floor. Point out that when the truck is moving objects it is doing work, and that when they make their truck move, they are doing "work" too.

9. ***Instructor: "Today we built a truck and explored ways to make it stronger. We also learned that engineers have a special meaning for the word 'work.' To an engineer, work means the energy it takes to move something, change directions, or stop something that is moving."***

Lesson Challenge: Build a New Truck

Challenge students to build a custom, new truck that can be used to transport heavy loads. Have students demonstrate and explain how they reinforced the truck to make it stronger. See example below.



Custom Truck

Make Your Castle Strong

Foundational Fluencies: Making Things Strong | Teacher Lesson Plan

Overview:

In this lesson, students will assemble a castle wall and explore different ways to make it stronger. Then, students will build a custom structure and look for opportunities to strengthen it.

Lesson Objectives & NGSS Alignment:

- Assemble a castle wall and test it for strength.
- Use Kid Spark engineering materials to make the castle wall stronger.
- Create a custom structure and look for opportunities to strengthen it.

Scientific/Engineering Practice - Planning & carrying out investigations

Crosscutting Concept - Cause & effect; mechanism & explanation

Lesson Introduction:

Instructor: "Engineers design machines, vehicles, tools, furniture - you name it! If we use it, an engineer designed it. Engineers also design buildings. We're in a building right now. Some engineers specialize in designing schools. Others design houses or shopping malls or restaurants. Buildings need to be strong enough to hold up their own weight because they are heavy and strong enough not to be knocked down."

Activity Time:

30 - 40 Minutes

Kid Spark STEM Lab:

Foundational Fluencies

Building Plans Booklet:

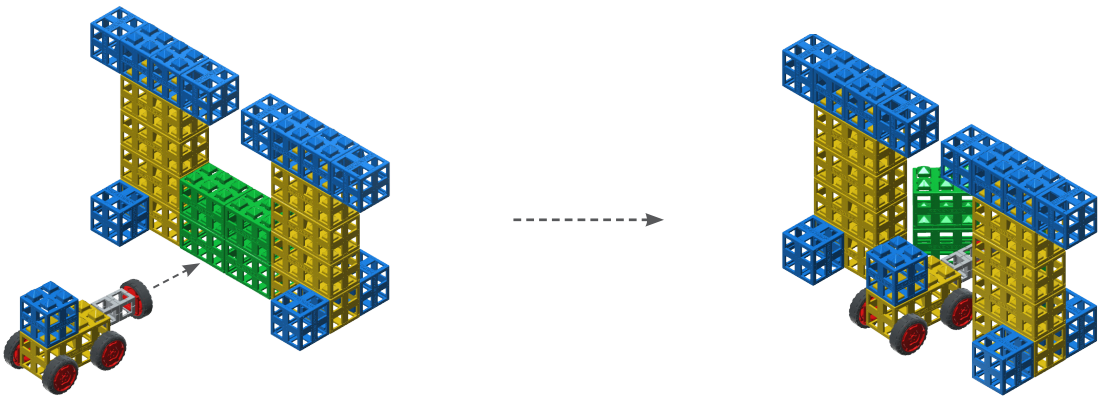
Page 18

Convergent Learning Activity:

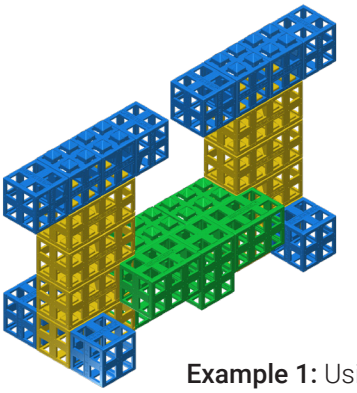
1. ***Instructor: "Buildings need to be strong to hold themselves up because they are heavy. Buildings also need to be strong so they don't fall down in a storm or an earthquake. Today we're going to build part of a building and try to knock it down."***

2. Open the Foundational Fluencies - Building Plans Booklet and turn to page 18. Instruct students to follow the step-by-step instructions to assemble a castle wall and battering ram vehicle.

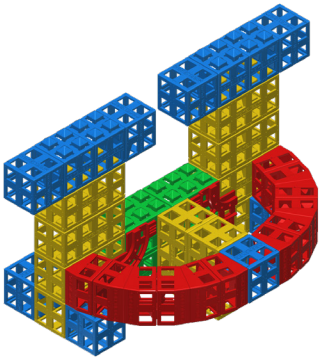
3. Once students are finished assembling their builds, instruct them to roll the battering ram car into the green blocks on the castle wall. Use the word "test" and remind students of what it means to test something. The battering ram car will easily push through the green blocks because they aren't actually connected to the wall.



4. ***Instructor: "Now that we've tested our castle walls, let's think about what we can do to make them strong. What could we do to reinforce the castle walls?"*** Work with students to explore different ways to reinforce the castle wall to make it stronger. Have students test out the improved walls using the battering ram vehicle. See examples below.



Example 1: Using ROK Blocks

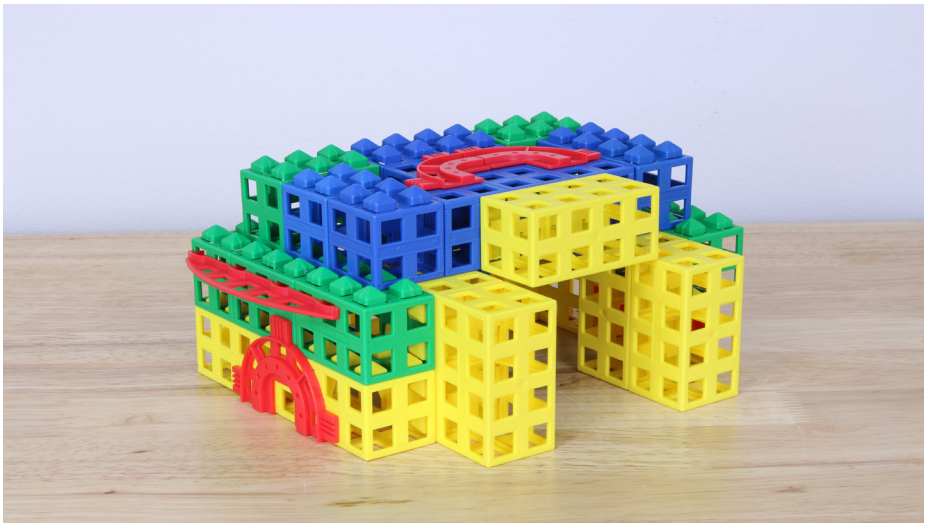


Example 2: Using ROK Blocks and Braces

5. ***Instructor: "Today we learned that engineers design buildings and structures, and that it is important for structures to be strong and stable. We built a castle wall and then explored different ways to make it stronger; just like real engineers."***

Lesson Challenge: Build a New Structure

Challenge students to create a new building or structure. Have students demonstrate and explain how they reinforced the structure to make it stronger. See example below.



Custom Building/Structure

Free Build

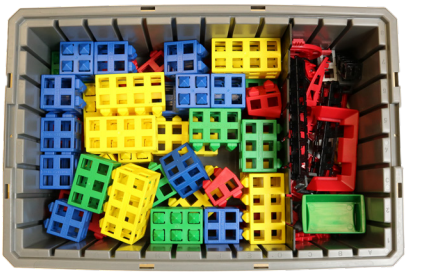
Foundational Fluencies: Making Things Strong | Teacher Lesson Plan

Overview:

In this lesson, students will apply what they have learned throughout this unit to create something new. Students will look for opportunities to improve the design as they build and test it.

Activity Time:
30 - 40 Minutes

Kid Spark STEM Lab:
Foundational Fluencies



Learning Objectives & NGSS Alignment:

- Apply concepts from this unit to create a custom design.
- Identify opportunities to make the design stronger.
- Explain the design to others.

Scientific/Engineering Practice - Developing & using models
Crosscutting Concept - Scale, proportion, & quantity

Lesson Introduction:

Instructor: "Throughout this unit, we have learned how to add strength to different types of buildings, structures, and vehicles. In this lesson, you are going to have the opportunity to use your imagination to create your very own design that is strong and stable."

Divergent Learning Activity:

1. Inform students they are free to create any design of their choosing. Encourage students to try and think about what they learned throughout previous lessons as they are building.

2. Circulate among the students or build your own design, or both. As you interact with students ask them to tell you about their creation using these potential prompt questions:

    a. What are you making? What do you want your design to do?
    b. Can you show me with your hands what you're trying to make?
    c. How have you made your design strong? What could you do to make it stronger?
    d. Is it symmetrical? How do you know?
    e. Where are the joints in what you're building? How could you reinforce them?

3. Encourage students to look for opportunities to add strength to their designs.

4. After students are finished, have them share their design with others.

Learning Extensions:

a. If time permits, you can extend children's learning before they build by having them draw/sketch or describe what they intend to build.

b. Students can practice writing skills by taking a picture or drawing their build in their class journals and writing or dictating a few sentences about it. Children can connect to their environment or community by identifying similar objects in their home, school, or neighborhood.

Making Things Strong

Foundational Fluencies: Making Things Strong | **Unit Assessment**

Student Name: _____

Date: _____

Assessment Score

Total Score: _____ / **6 points**

Instructions:

This assessment can be used to measure student understanding of the core concepts and skills that are covered throughout this unit. The assessment should be facilitated by an instructor that is working directly with an individual student.

Note: A Foundational Fluencies STEM Lab and Building Plans Booklet will be required for this assessment.

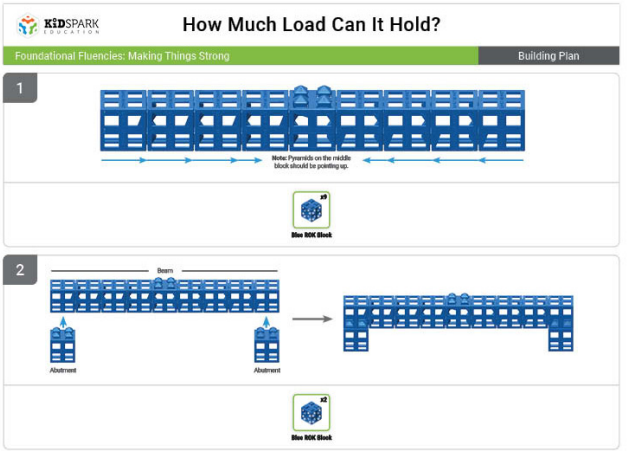
Question 1

Score

_____ / 1 Point

Place the blocks pictured below in front of the student. Open the Building Plans Booklet and turn to page 16. Ask the student to correctly assemble the bridge as shown on the mat.

Correct Answer: Student correctly assembles the bridge as shown.



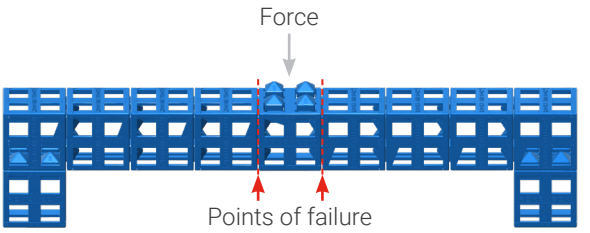
Lesson Alignment: *How Much Load Can It Hold?*
Unit Concepts: *Manipulate ROK Blocks to build increasingly complicated structures*

11x
Blue ROK Block

Question 2

Place the bridge that was assembled in Question 1 in front of the student. Ask the student to identify where the bridge would fail if a downward force was directly applied to the top of the bridge.

Correct Answer: Student correctly identifies the points of failure.



Lesson Alignment: *How Much Load Can It Hold?*
Unit Concepts: *Test structures for strength*

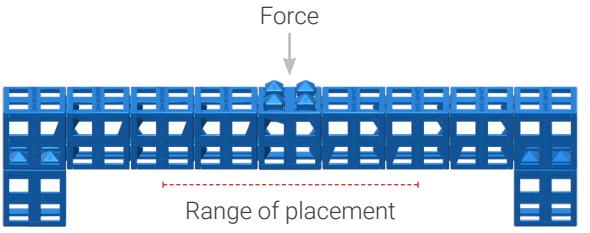
Score

_____ / 1 Point

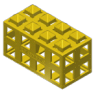
Question 3

Place the bridge and the block pictured below in front of the student. Ask the student to use the block to strengthen the bridge so it can withstand a moderate amount of pressure.

Correct Answer: Student places block within range to add strength.



Lesson Alignment: *How Much Load Can It Hold?*
Unit Concepts: *Explore a specific problem engineers face (how to make things stronger)*



1x
Yellow ROK Block

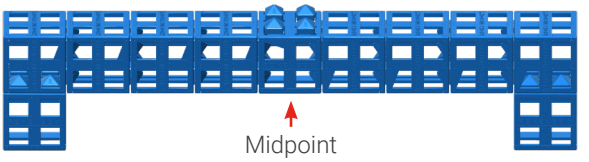
Score

_____ / 1 Point

Question 4

Place the bridge in front of the student. Ask the student to determine if the bridge is symmetrical. Ask the student to explain their answer.

Correct Answer: Yes, the bridge is symmetrical because the left and right sides of the bridge are the same and they mirror each other.



Lesson Alignment: *How Much Load Can It Hold?*
Unit Concepts: *Recognize symmetry*

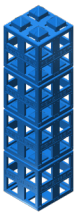
Score

_____ / 2 Points

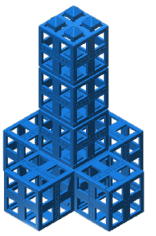
Question 5

Build a tower that is 4 ROK Blocks tall. Place the tower in front of the student and knock it over. Give the student 4 additional ROK Blocks and ask them to add strength/stability to the tower to prevent it from falling.

Correct Solution: Student builds a tower that can withstand impact.



Unstable Tower



Stable Tower (example)

Unit Alignment: *Making Things Strong*
Unit Concepts: *Testing design for strength; Try to improve strength/stability in a design*

8x
Blue ROK Block

Score

_____ / 1 Point



Unit 4:

Making Things Move


Camera

Making Things Move

Foundational Fluencies: Making Things Move | **Unit Overview**

Unit Overview:

In this unit, students will learn about the physics of movement as they explore force, gravity, pushes and pulls, and more. Students will learn how to use Kid Spark engineering materials to create different types of movement in a design.

Recommended Grade Level:
Pre-K - 1

Kid Spark STEM Lab:
Foundational Fluencies

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 (CCS-MA).

- NGSS Disciplinary Core Ideas (DCI) are standards related to content knowledge.
- NGSS Scientific 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 children.
- Common Core Standards in Math help teachers integrate ROK Block experiences with math curriculum and to help build a continuum of engineering learning from preschool to the primary grades.

Lessons	NGSS DCI	NGSS SEP	NGSS CCC	CCS-MA
Lesson 1: Pushes & Pulls (30-40 Min.) In this lesson, students will build a tractor and explore how different forces, like pushes and pulls, can be used to move objects. Then, students will apply what they have learned to create something new.	Engineering design	Asking questions & defining problems	Cause & effect; mechanism & explanation	Identify & describe shapes
Lesson 2: Exploring Gravity (30-40 Min.) In this lesson, students will build a helicopter and explore the concept of gravity. Then, students will create a model aircraft of their own design.	Engineering design	Developing & Using models	Cause & effect; mechanism & explanation	Common Core
Lesson 3: Make Your Castle Move (30-40 Min.) In this lesson, students will build a castle wall and explore different ways to make a door open and close. Then, students will create a locking mechanism to secure the castle door.	Engineering design	Developing & Using models	Structure & function	Analyze, create, & compose shapes.
Lesson 4: Free Build (30-40 Min.) In this lesson, students will apply what they have learned throughout this unit to create something new. Students will look for opportunities to improve the design as they build and test it.	Engineering design	Planning & carrying out investigations	Scale, proportion, & quantity	Reason with shapes & their attributes.

Unit Assessment: Making Things Move
In this educator-led assessment, students will get hands-on with Kid Spark engineering materials 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.

Curve	Gravity	Pull	Vehicle
Direction	Helicopter	Rotate	Wheel
Drag	Movement	Rotor	Work
Estimate	Pivot	Round	
Force	Push	Transport	

Recommended Children's Literature

The following books can be used to support the concepts presented throughout this unit.

"Motion: Push and Pull, Fast and Slow" by Darlene Stille and Sheree Boyd

"Pushes and Pulls" by Helen Gregory

"Push and Pull" by Charlotte Guillain

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.

Pushes & Pulls

Foundational Fluencies: Making Things Move | Teacher Lesson Plan

Overview:

In this lesson, students will build a tractor and explore how different forces, like pushes and pulls, can be used to move objects. Then, students will apply what they have learned to create something new.

Activity Time:

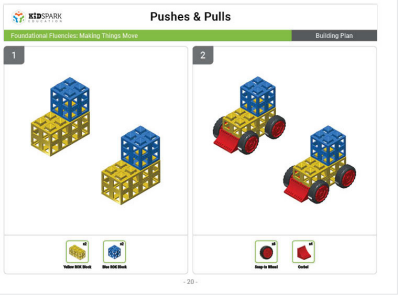
30 - 40 Minutes

Kid Spark STEM Lab:

Foundational Fluencies

Building Plans Booklet:

Page 20



Lesson Objectives & NGSS Alignment:

- Assemble two tractors using Kid Spark engineering materials.
- Demonstrate push and pull forces on an object.
- Create a new vehicle that can be used to push or pull objects.

Scientific/Engineering Practice - Asking questions & defining problems

Crosscutting Concept - Cause & effect; mechanism & explanation

Lesson Introduction:

Instructor: "A vehicle is used for transporting people or things. Today we are going to build a tractor and explore how it can be used to move objects."

Convergent Learning Activity:

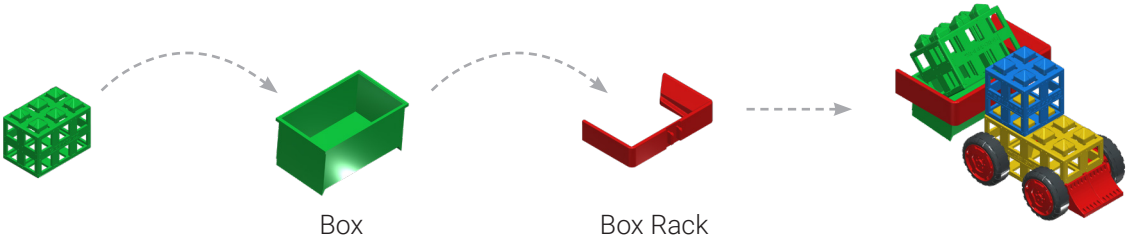
1. Open the Foundational Fluencies - Building Plans Booklet and turn to page 20. Instruct students to follow the step-by-step instructions to assemble two tractors.

2. ***Instructor: "This vehicle can move because it has wheels. Imagine if we needed to transport something that was heavy using the tractor. How could you do that?" (Put things on top of the tractor, use the tractor to push and pull.)***

3. ***Instructor: "We can put objects on top of the tractor."*** Place a Green ROK Block on the top of the tractor, but don't actually connect it. ***Instructor: "If we just put objects loosely on top of the tractor, when the tractor moves, the vibrations will make the object fall off."*** Show how the Green ROK Block falls off the tractor when it is moved back and forth. Students can also experiment by putting a Green ROK Block on their tractors and driving them around.

4. ***Instructor: "How could we make sure things don't fall off?" (Tie them down, brace them, or cover them.)***

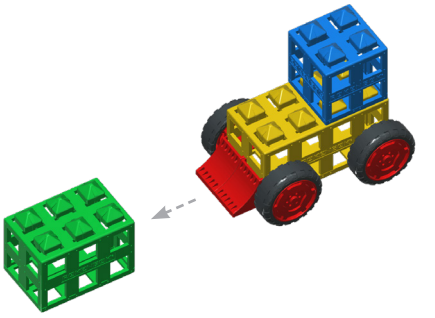
5. ***Instructor: "In your ROK Blocks Lab, you have a component designed by engineers called a box rack."*** Show the Box Rack and the Box. ***Instructor: "You can connect the Box and the Box Rack to the tractor and then transport the Green ROK Block safely."*** Instruct students to attach a Box and a Box Rack to one of the tractors they built. Once they have everything connected, instruct them to place a Green ROK Block in the box and practice driving the tractor around.



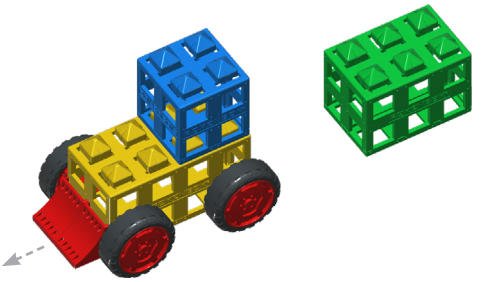
6. ***Instructor: "Did the Box and Box Rack do a good job at transporting the Green ROK Block safely?"*** Instruct students to remove the Box and the Box Rack from the tractor when they are finished.

7. ***Instructor: "Vehicles can do work by pushing and pulling things."*** Ask students if they can think of any examples of things they "push" to make them move ***(shopping cart, throwing a ball)*** and examples of things they "pull" to make them move ***(a wheeled backpack, cart, or cooler)***. Bring student's attention to the fact that you have to hold/grab something to be able to pull it.

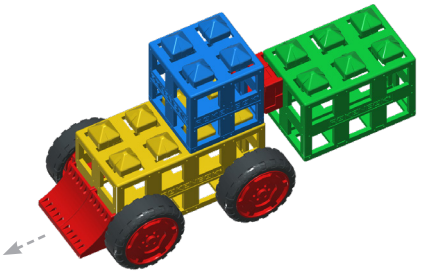
8. ***Instructor: "Let's try to push an object with our tractor."*** Demonstrate with a Green ROK Block. ***Instructor: "We are using a push force on the Green ROK Block to do the work of moving it."*** Instruct students to use their tractors to practice pushing the Green ROK Block around.



9. ***Instructor: "Now, let's try to pull an object with our tractor. Can our tractors use a pull force to move something? Let's try."*** Place the Green ROK Block behind the tractor and show the students that the block is not moving (because it is not connected to the Green ROK Block).

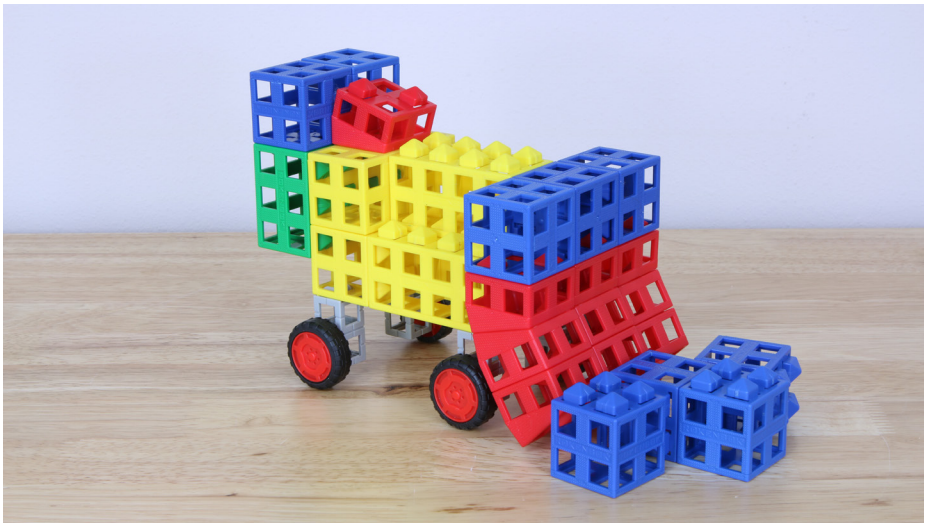


10. ***Instructor: "Why is the tractor not pulling the Green ROK Block?"*** Discuss with students that in order pull something you have to grab it or connect to it. Demonstrate how to connect the Green ROK Block to the back of the tractor using an Axle Block. Instruct students to practice pulling the Green ROK Block using the tractor.



Lesson Challenge: Build a Push/Pull Vehicle

Challenge students to create a machine or vehicle that can be used to push or pull objects. Have students demonstrate and explain how their design works. See example below.



Dozer

Exploring Gravity

Foundational Fluencies: Making Things Move | **Teacher Lesson Plan**

Overview:

In this lesson, students will build a helicopter and explore the concept of gravity. Then, students will create a model aircraft of their own design.

Lesson Objectives & NGSS Alignment:

- Drop an object and observe the force of gravity.
- Assemble a helicopter and discuss how it creates "lift".
- Create a new aircraft of your own design.

Scientific/Engineering Practice - Developing & using models
Crosscutting Concept - Cause & effect; mechanism & explanation

Pre-Lesson Preparation:

Before class, build the helicopter that is featured in this lesson and show it during the lesson introduction. This will get students excited about the lesson and give them an example of what they are going to build. You can find instructions to assemble the helicopter on page 21 in the Foundational Fluencies - Building Plans Booklet.

Activity Time:

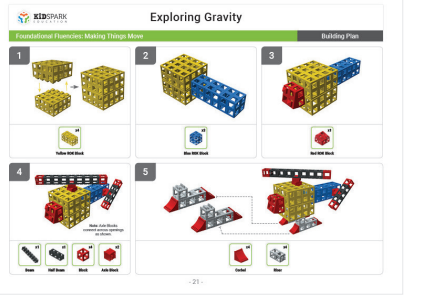
30 - 40 Minutes

Kid Spark STEM Lab:

Foundational Fluencies

Building Plans Booklet:

Page 21

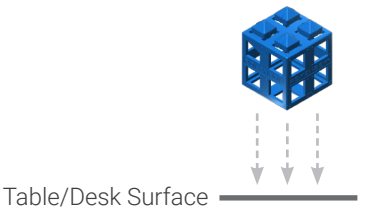


Lesson Introduction:

Instructor: "Today we are going to build this cool helicopter and explore something called "Gravity". Are you ready to learn? Great, let's get started!"

Convergent Learning Activity:

1. ***Instructor: "In the previous lesson, we talked about different ways that we can make objects move by pushing or pulling them. When a push or a pull moves an object we call that "force". Now, watch me drop this block."*** Hold up a Blue ROK Block and drop it to the ground. Pick up the block and repeat, then have students try it out for themselves.



2. ***Instructor: "What is making this block move (fall to the ground)?"*** Some students will likely say "gravity" - if so, acknowledge that is right and follow up by asking is gravity a push or a pull? Discuss how the Earth pulls objects towards its center. ***Instructor: "That force, that pull, is called gravity. Gravity is the reason none of us or the objects around us go floating away."***

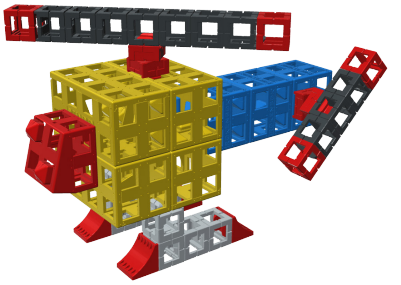
3. ***Instructor: "In previous lessons we have built a lot of vehicles. Can you remember what kind of vehicles we have built?"*** (cars, tractors, trucks) ***"Today, we are going to take the role of an aircraft engineer to build a new kind of vehicle. Does anyone know what aircraft engineers design and build?"*** (planes, helicopters)

4. ***Instructor: "What do planes and helicopters do?"*** (Transport people and things in the air/they fly in the air.) ***"That's right! Aircraft engineers design planes and helicopters to move against the force of gravity and not fall on the ground like our block did."***

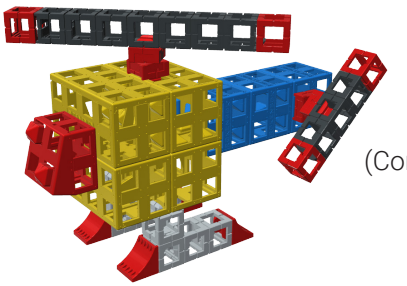
5. Open the Foundational Fluencies - Building Plans Booklet and turn to page 21. Instruct students to follow the step-by-step instructions to assemble a helicopter.

6. ***Instructor: "Does our helicopter have wheels?"*** (no) ***"That's right, this helicopter does not have wheels. How is our helicopter going to move without wheels?"*** Draw student's attention to the helicopter's top rotor and note that even though the helicopter doesn't have wheels, it still has a part that moves in a circle called the "rotor". ***"The rotor goes around, or rotates, very, very quickly. When it rotates quickly it creates a force called "lift". The lift the rotor creates is stronger than the force of gravity, so the helicopter can fly and do the work of transporting whatever is in the helicopter."*** Demonstrate how this works using one of the helicopters. Since these helicopters obviously won't fly, you will have to tell students that we are using our imaginations.

Top Rotor
(Creates lift)



7. ***Instructor: "Do you notice any more rotors on our helicopters?"*** (on the tail) ***"That's right, there is also a rotor on the tail of the helicopter. If the top rotor is used create lift (to raise the helicopter off of the ground/fly), what do you think the tail rotor is used for?"*** (To prevent the helicopter from turning in circles/To control the helicopter's direction.) Hold up an Axle Block and point out how both rotors are able to rotate because of the Axle Block that is used. Have students observe how one end of the Axle Block stays secure to the helicopter while the other end, that is connected to the rotor, can rotate freely.

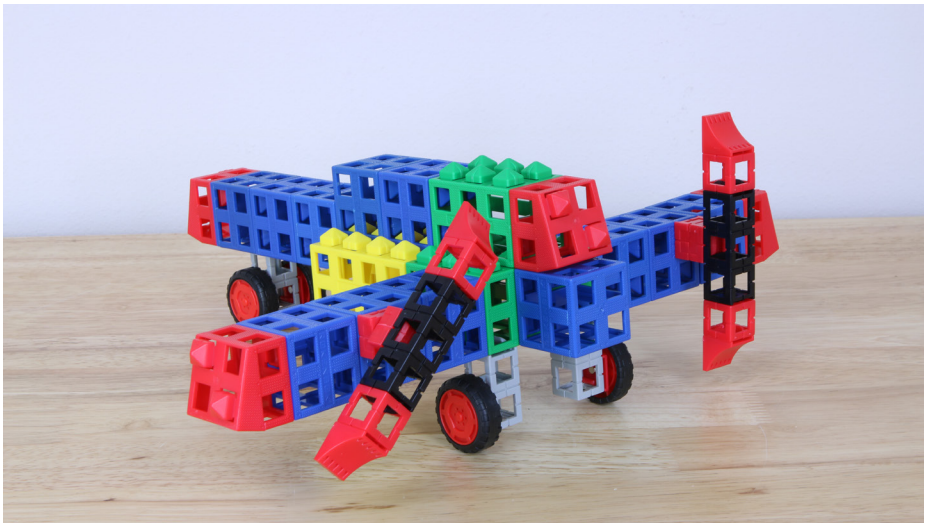


Tail Rotor
(Controls direction)

8. ***Instructor: "If a helicopter's rotors stopped working mid-flight, what would happen?"*** (It would fall to ground/ Crash) "***Why?"*** (If the rotors stopped working they would no longer create lift and gravity would cause the helicopter to fall to the ground.) "***What can helicopters do that planes can't?"*** (Fly straight up/Hover in one place) ***Why?*** (The rotor creates lift.)

Lesson Challenge: Build a Custom Aircraft

Challenge students to create a custom aircraft of their own design (another helicopter, an airplane, hot-air balloon, etc.). Have students demonstrate and explain their new design to others. See example below.



Airplane

Make Your Castle Move

Foundational Fluencies: Making Things Move | Teacher Lesson Plan

Overview:

In this lesson, students will build a castle wall and explore different ways to make a door open and close. Then, students will create a locking mechanism to secure the castle door.

Lesson Objectives & NGSS Alignment:

- Observe how Kid Spark engineering materials can be used to create movement.
- Build a castle and explore different ways to make the castle door open and close.
- Create a custom locking mechanism to secure the castle door.

Scientific/Engineering Practice - Developing & using models

Crosscutting Concept - Structure & function

Pre-Lesson Preparation:

Before class, build the castle wall and door that is featured in this lesson and show it during the lesson introduction. This will get students excited about the lesson and give them an example of what they are going to build. You can find instructions to assemble the castle wall and door on page 22 - 23 in the Foundational Fluencies - Building Plans Booklet.

Lesson Introduction:

"In today's lesson, we are going to build a castle wall that includes a door. We are going to explore different ways to make the door open and close."

Activity Time:

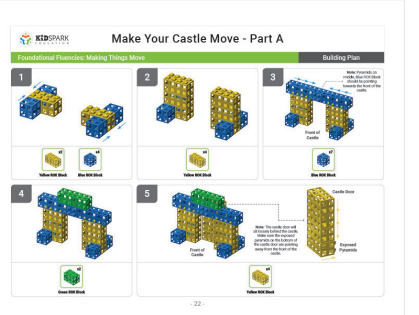
30 - 35 Minutes

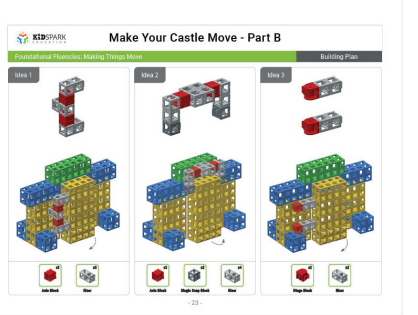
Kid Spark STEM Lab:

Foundational Fluencies

Building Plans Booklet:

Pages 22 - 23

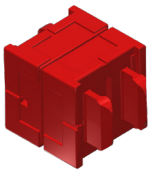




Convergent Learning Activity:

1. ***Instructor: "In the real world, engineers are challenged to figure out how to create different types of movement in order for a design to work correctly. These type of engineers are typically called "mechanical engineers". Mechanical engineers design, create, and test any type of equipment or machinery that is meant to move."***

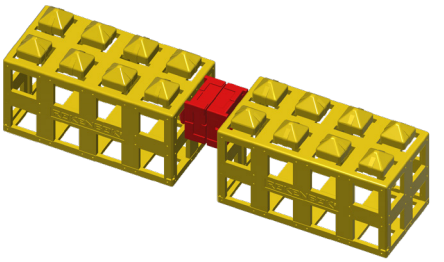
2. ***Instructor: "In today's lesson, we are going to build a castle that includes a door. Then, we are going to explore different ways to make the door open and close. Before we get started, let's take a look at a couple of engineering materials that we will be using."*** Instruct students to locate (1) Axle Block and (1) Hinge Block.



Axle Block

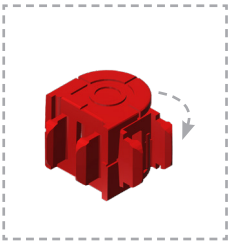
Hinge Block

3. Instruct each student to pick up an Axle Block. ***Instructor: "The Axle Block is used to create rotational movement. Does anyone remember what "rotational" movement is?"*** (Movement that turns round in a circle). ***Let's connect the Axle Block to a couple of Yellow ROK Blocks and see what happens."*** Instruct students to connect the Axle Block in between two Yellow ROK Blocks as shown below.

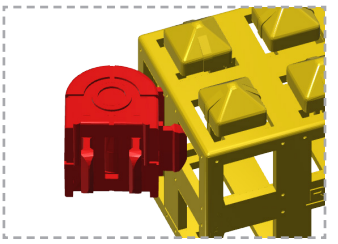


4. After students have the Axle Block connected, demonstrate how either Yellow ROK Block can freely rotate 360°. Let students fidget with the design for a few seconds. ***Instructor: "Can anyone think of a real world example of something that creates movement like the axle?"*** (car wheel, bicycle wheel, Ferris wheel) After students are done, instruct them to disconnect the Axle Block from the Yellow ROK Blocks.

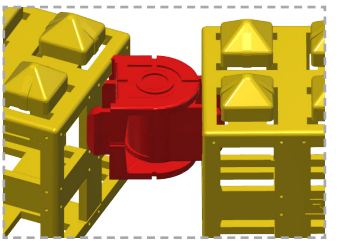
5. Instruct each student to pick up a Hinge Block. ***Instructor: "The Hinge Block also creates rotational movement, but is limited by its range of motion."*** Have students observe how the hinge can only rotate 180°. "***Let's connect the Hinge Block to the Yellow ROK Blocks and see what happens."*** Instruct students to connect the Hinge Block in between the two Yellow ROK Blocks as shown below. ***Note:*** *The Hinge Block is one of the more difficult engineering materials to use, especially for very young students. Make sure to demonstrate the easiest way to connect the Hinge Block as shown below.*



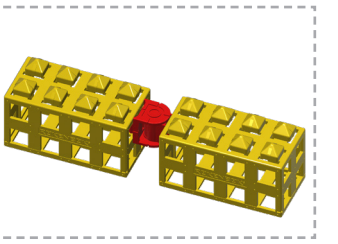
Step 1: Rotate hinge completely to one side.



Step 2: Angle one tab of the hinge across the opening and snap into place.



Step 3: Rotate the hinge assembly towards the second Yellow ROK Block. Angle one tab of the hinge across the opening and snap into place.



Completed Assembly

6. After students have connected the Hinge Block, demonstrate how you can independently rotate or "pivot" either of the Yellow ROK Blocks, but the range of motion is limited (in this case the Yellow ROK Blocks are limiting the range of the hinge even more because they touch together). Let students fidget with the design for a few seconds. ***Instructor: "Can anyone think of a real-world example of something that creates movement like the hinge?"*** (doors, ladders, seesaw) After students are done, instruct them to disconnect the Hinge Block from the Yellow ROK Blocks.

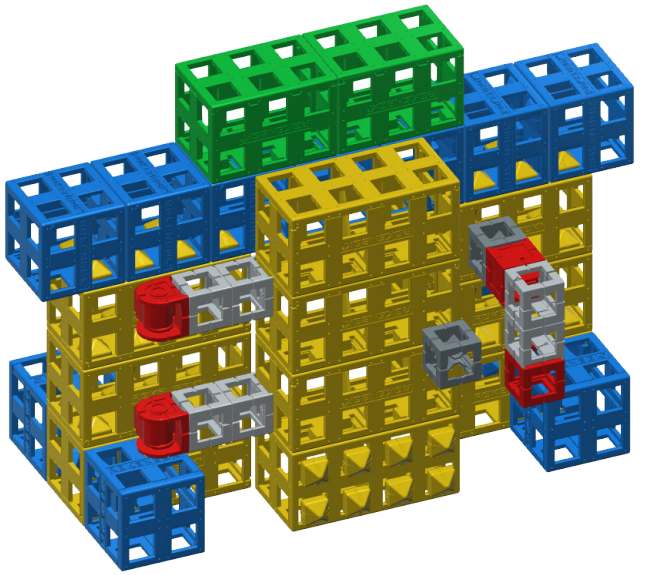
7. ***Instructor: "Now we are going to build a castle wall and explore different ways to make a door open and close."*** Open the Foundational Fluencies - Building Plans Booklet and turn to page 22. Instruct students to follow the step-by-step instructions to assemble the castle wall and door.

8. Point out how the castle has a door, but it is not connected to the castle. Ask students if they have any ideas about how they could connect the door to the castle that would allow it to open and close. After a few students have shared their ideas, instruct students to turn to page 23 in the Foundational Fluencies - Building Plans Booklet. Instruct students to try out the three ideas that are shown. As students are trying out the ideas, circulate around the room to make sure they aren't having trouble connecting any of the materials.

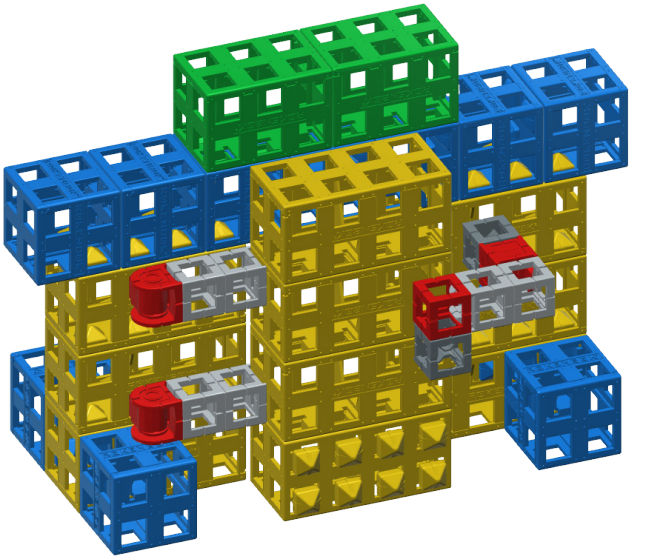
9. After students have tried out all three ideas, ask students if they have any of their own ideas about how to make the door open and close. If you wish, you can let students try out a new idea. Encourage students to share their ideas, even if they aren't able to get them to work correctly.

Lesson Challenge: Create a Locking Mechanism

Challenge students to create a locking mechanism to secure their castle door in place. Encourage students to use Axle or Hinge Blocks in their design. Have students demonstrate and explain their new design to others. See example below.



Door Unlocked



Door Locked

Free Build

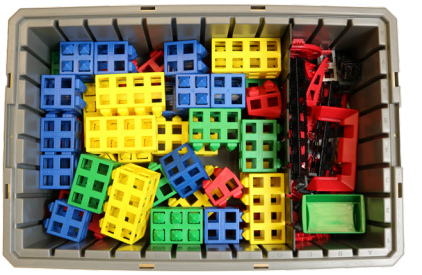
Foundational Fluencies: Making Things Move | **Teacher Lesson Plan**

Overview:

In this lesson, students will apply what they have learned throughout this unit to create something new. Students will look for opportunities to improve the design as they build and test it.

Activity Time:
30 - 40 Minutes

Kid Spark STEM Lab:
Foundational Fluencies



Learning Objectives & NGSS Alignment:

- Apply concepts from this unit to create a custom design.
- Identify opportunities to add movement to the design.
- Explain the design to others.

Scientific/Engineering Practice - Planning & carrying out investigations
Crosscutting Concept - Scale, proportion, & quantity

Lesson Introduction:

Instructor: "Throughout this unit, we have explored different types of forces and movement. We have used different engineering materials to create doors that open and close, vehicles that move, and helicopters that fly! In today's lesson, you get to build your very own design that moves."

Divergent Learning Activity:

1. Inform students they are free to create any design of their choosing. Encourage students to try and think about what they learned throughout previous lessons as they are building.

2. Circulate among the students or build your own design, or both. As you interact with students ask them to tell you about their creation using these potential prompt questions:

    a. What are you making? What do you want your design to do?
    b. Can you show me with your hands what you're trying to make?
    c. How have you made your design strong? What could you do to make it stronger?
    d. Is it symmetrical? How do you know?
    e. How are you planning on adding movement to your design?

3. Encourage students to look for opportunities to create different types of movement in their design.

4. After students are finished, have them share their design with others.

Learning Extensions:

a. If time permits, you can extend children's learning before they build by having them draw/sketch or describe what they intend to build.

b. Students can practice writing skills by taking a picture or drawing their build in their class journals and writing or dictating a few sentences about it. Children can connect to their environment or community by identifying similar objects in their home, school, or neighborhood.

Making Things Move

Foundational Fluencies: Making Things Move | **Unit Assessment**

Student Name: _____

Date: _____

Assessment Score
Total Score: _____ / **7 points**

Instructions:

This assessment can be used to measure student understanding of the core concepts and skills that are covered throughout this unit. The assessment should be facilitated by an instructor that is working directly with an individual student.

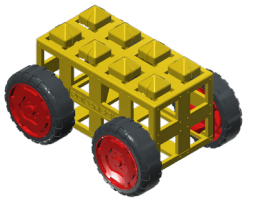
Note: A Foundational Fluencies STEM Lab will be required for this assessment.

Question 1

Score
_____ / 2 Points

Assemble a simple car using the components listed below. Place the car in front of the student. Ask the student to move the car using a "push" and then a "pull".

Correct Answer: Student correctly moves the car using a push and a pull.



Lesson Alignment: *Pushes & Pulls*
Unit Concepts: *Understand the difference between a push and a pull*

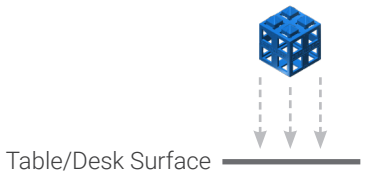
1x
Yellow ROK Block

4x
Snap-In Wheel

Question 2

Hold up a Blue ROK Block in front of the student, then drop the block to the surface of the table or desk. Ask the student what force causes the block to fall instead of floating in mid-air. Then, ask them to identify if the force is a push or a pull.

Correct Answers: Gravity. Pull.



Lesson Alignment: *Exploring Gravity*
Unit Concepts: *Understand the difference between a push and a pull*

1x
Blue ROK Block

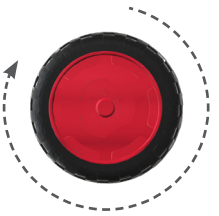
Score

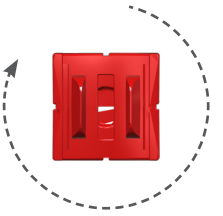
_____ / 2 Points

Question 3

Place the components listed below in front of the student. Ask the student to describe what type of movement the components are used to create.

Correct Answer: Rotational Movement (movement that turns in a circle).





Lesson Alignment: *Make Your Castle Move*
Unit Concepts: *Manipulate components to build objects that move*

1x
Snap-In Wheel

1x
Axle Block

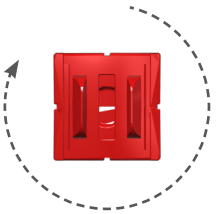
Score

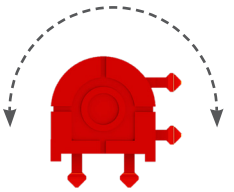
_____ / 1 Point

Question 4

Place the components listed below in front of the student. Ask the student to describe the difference in the range of motion of the two components.

Correct Answer: The Axle Block can freely rotate 360°, while the Hinge Block can only rotate 180°.





Lesson Alignment: *Make Your Castle Move*
Unit Concepts: *Manipulate components to build objects that move*

1x
Axle Block

1x
Hinge Block

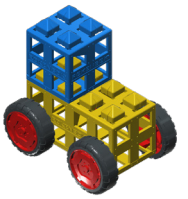
Score

_____ / 1 Point

Question 5

Place the components listed below in front of the student. Ask the student to build a simple small car that moves.

Correct Solution: Student creates a car that moves.



Example Solution

Lesson Alignment: *Make Your Castle Move*
Unit Concepts: *Manipulate ROK Blocks to build objects that move*

1x
Yellow ROK Block

1x
Blue ROK Block

4x
Snap-In Wheel

Score

_____ / 1 Point

Kid Spark Education is a
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