

Overview:

In this lesson, students will build a castle wall that includes a door. Students will explore how to use different engineering materials to make the castle door open and close.

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Unit Concepts & NGSS Alignment:

- Manipulate ROK Blocks to build objects that move
- Explore a specific problem engineers often face (making things move)
- Understand that pushes/pulls on objects can have different strengths and that bigger pushes/pulls cause bigger changes in the object
- Match 3-dimensional objects to 2-dimensional pictures
- Compare and contrast vehicle types and how different vehicles do work by moving

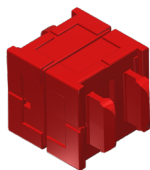
Scientific/Engineering Practice - Asking questions and defining problems
Crosscutting Concept - Structure and function

Lesson Introduction:

Instructor: "In the previous unit, we learned how to make designs that were strong and stable. Do you remember building a castle wall and exploring different ways to make it strong? In today's lesson, we are going to build another castle wall that includes a door. We are going to explore different ways to make the door open and close."

Core Learning Activity:

1. Give each team of two students a Make Your Castle Move Construction Mat and the correct assortment of engineering materials listed.
2. **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."
3. **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

Activity Time:

30 - 40 Minutes

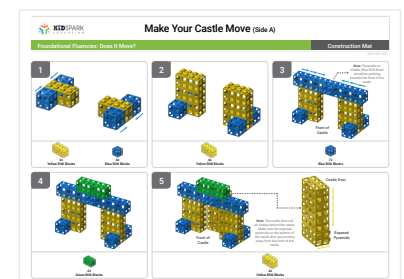
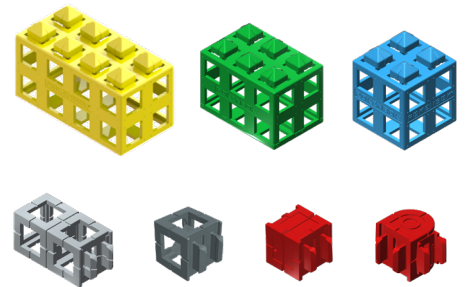
Kid Spark Mobile STEM Lab:

ROK Blocks

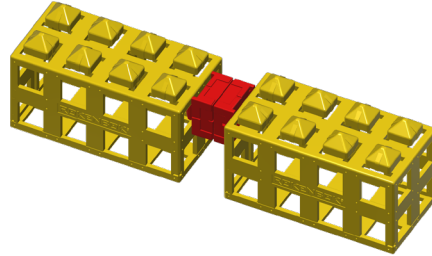
Materials Per Team:

Group students in teams of 2.

- 10 Yellow ROK Blocks
- 2 Green ROK Blocks
- 11 Blue ROK Blocks
- 4 Risers
- 2 Single Snap Blocks
- 2 Axle Blocks
- 2 Hinge Blocks
- 1 Construction Mat



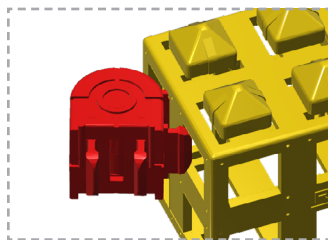
4. Instruct each student to pick up an axle block. **Instructor, "The axle block is used to create rotational movement. Does anyone remember what "rotational" movement is?** (movement that turns round in a circle). **Let's connect the axle block to a couple of Yellow ROK Blocks and see what happens."**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



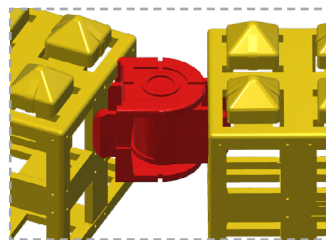
5. After students have the axle block connected, demonstrate how you can independently rotate either of the Yellow ROK Blocks 360°. Let students fidget with the design for a few seconds. **Instructor, "Can anyone think of a real world example of something that creates movement like the axle?"** (car wheel, bicycle wheel, ferris wheel) After students are done, instruct them to disconnect the axle block from the Yellow ROK Blocks.
6. 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 axle block in between the two Yellow ROK Blocks as shown below. **Note:** The axle 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 axle block as shown below.



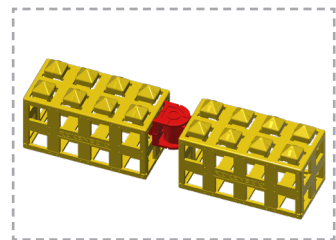
Step 1: Rotate hinge completely to one side.



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.



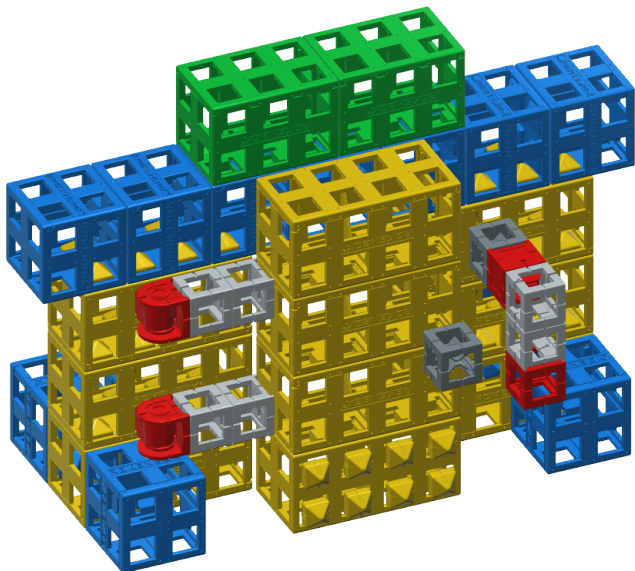
Completed Assembly

7. After students have the hinge block connected, 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, teeter totter) After students are done, instruct them to disconnect the axle block from the Yellow ROK Blocks.
8. **Instructor, "Now we are going to build a castle wall and explore different ways to make a door open and close."** Make sure all students locate the Make Your Castle Move Construction Mat and are on **Side A**. Instruct students to follow the 5 steps on the mat to assemble the castle wall and door.
9. Once teams have their castle wall and door assembled, 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 flip the mat over to **Side B**. Instruct students to try out the three ideas. As students are trying out the ideas, circulate around the room to make sure they aren't having trouble connecting any of the materials.

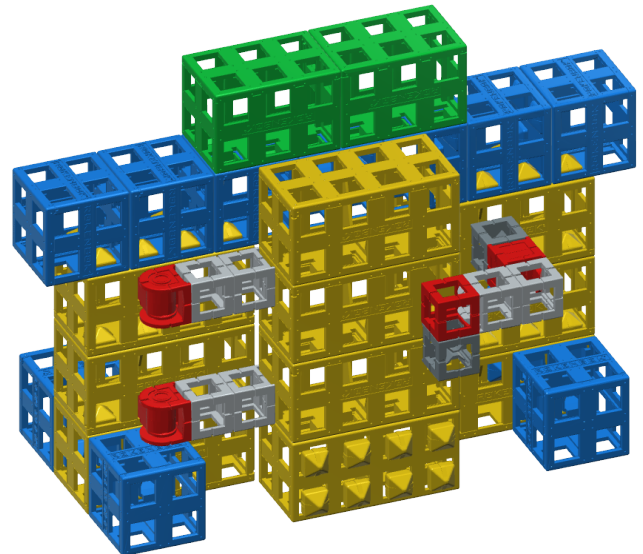
10. After teams have tried out all three ideas, ask students if they have any of their own ideas about how to make the door open and close. If you wish, you can let students try out a new idea with the provided engineering materials. Encourage students to share their ideas with the class, even if they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

Learning Extension Activity

Instructions: Challenge teams to build a locking mechanism that can be attached to their castle door (see example below). Students may need to access additional engineering materials in the ROK Blocks Mobile STEM Lab to complete their design. If a team comes up with an innovative or creative design, we encourage you to take a picture of it and share it on twitter using the hashtag **#KidSparkEdu**.



Door Unlocked



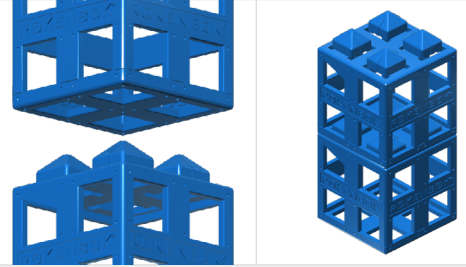
Door Locked

Building Basics

The following tips will be helpful when using Kid Spark engineering materials.

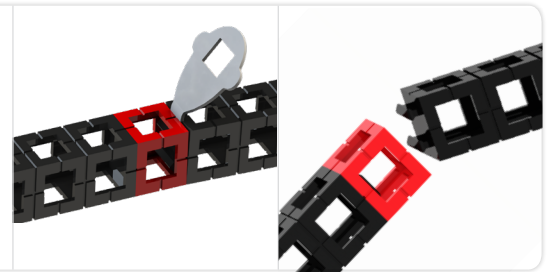
Connecting/Separating ROK Blocks:

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



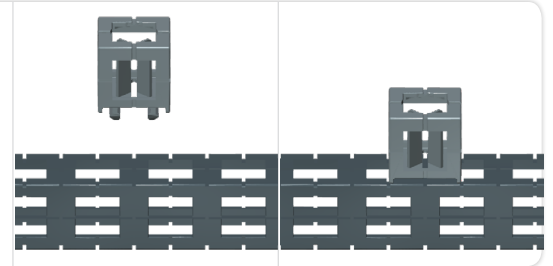
Connecting/Disconnect Smaller Engineering Materials:

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



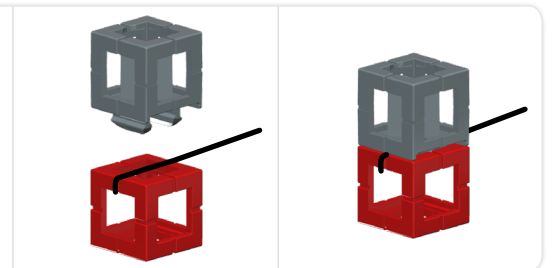
Snapping Across Openings:

Materials can be snapped directly into openings or across openings to provide structural support to a design. This will also allow certain designs to function correctly.



Attaching String:

In some instances, string may be needed in a design. Lay string across the opening and snap any component with tabs or pyramids into that opening. Be sure that the tabs are perpendicular to the string to create a tight fit.



Measuring:

The outside dimensions of a basic connector block are 2 cm on each edge. This means the length, depth, and height are each 2 cm. To determine the size of a project or build in centimeters, simply count the number of openings and multiply by two. Repeat this process for length, depth, and height.

