brackitz®

RESCUE!

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V2.3

LESSONS

PULLEYS & CRANKS

CREATIVE POWER
PLAY LEARN GROW
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4th & 5th grade
teacher plan

Lesson 3: RESCUE!

Students consider how to use pulleys to complete a rescue!

Objectives:

Students will build with pulleys to better understand using simple machines to make work easier in a vertical direction. Students also practice design thinking with a need and some specific design criteria.

Vocabulary used in this activity:

situation, solve/solution, simple machine, pulley, design, model

Standards

NGSS 5-PS2 Motion and Stability: Forces and Interactions, 3-5 ETS-1 Engineering Design, ETS-1 Designing for a Need, ETS1.A Defining Engineering Problems, ETS-1.B Design Solutions

CCSS-Math MP2, MP3, MP5, MP7

CCSS-ELA CCRA.W.3, CCRA.W.5.3, CCRA.W.5.3b,CCRA.W.5.2, L.4.1, L.4.3, CCRA.L.6,

Time needed: 35-45 minutes

Materials and Supplies:

Paper, pencils/crayons, simulated canyon or hole (box) set up on the floor below a counter/table/book-shelf edge. Each group will need a tray of Brackitz planks, 3, 4 and 1-way pivoting hubs, access to the pulley, crank, string, and pulley-wheel connectors, and simulated rescue items (small toys, marbles, or pebbles).

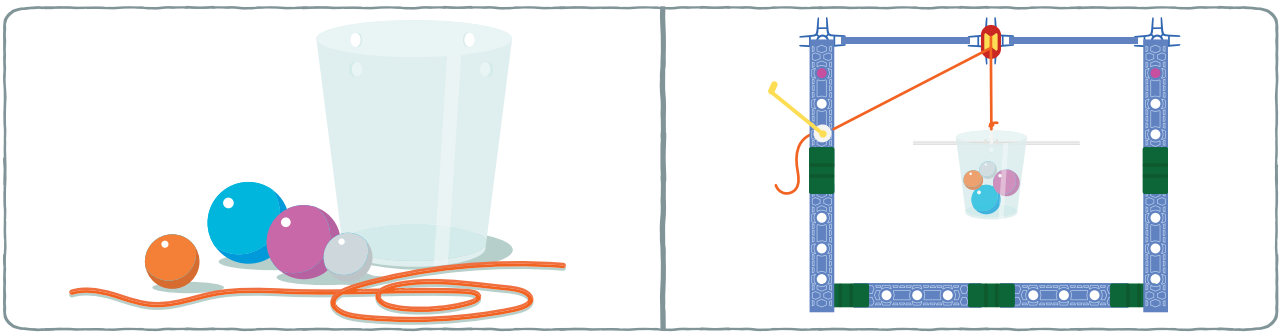
Resources/Optional Reading:

Evan Moor's Simple Machines and John B. Beaver's Simple Machines Grades 6-12 Force, Motion, and Energy.

Set-up and Preparation: Help students cooperatively form groups of 2-3 to work together.

Background Knowledge:

Prior to this lesson, students do not need special background knowledge. Introducing students to the ideas of simple machines and mechanical advantage from Unit 2 can be helpful.



Lesson 3: RESCUE!

35-45 minutes

Whole Class 10 minutes

"In the last lesson, we thought about what situation would cause a small creature to need a pulley and crank to get things where s/he couldn't go.

Today I'm going to model a situation that we need to help the same small creature solve. That creature's best friend has fallen down into a deep hole. Rescuers will be figuring out how to dig her out, but it will take several days, and the friend will need some things while she waits. What does the fallen friend need while the rescuers figure out how to get her out?" (Food, water, blankets.)

"What are the safety concerns we have to be aware of when thinking how to get things to her?" (Can't climb down. Can't get too close to the edge.)

"How can a pulley and crank help?" (Lower things down, come back up for the next load, keep friends away from edge.)

Instructor Notes and Tips

If student ideas tend towards the fanciful, ask specifically, "How can we use the pulley to help get this friend what she needs safely?"

Invite students to use the Brackitz pulley pieces to act out ideas of how to lower items into the hole, without building a structure to operate it at this point.

Lead students to the idea of something that can be operated that also maintains some distance from the edge. **Crane!**

Group Exploration 10 minutes

"In real life, we use cranes to lower supplies into canyons and holes during rescues.

Design on paper what it would look like to use the Brackitz pieces to make a crane to help with this rescue. In order for your design to help, what are the criteria for this design?" (It has to keep other small creatures away from the edge, and be able to lower some things down to the friend in the hole safely.)

You may want to find a youtube video of cranes to help show them how a pulley can work in a crane in real life.

Remind students that pulleys are simple machines that make it possible to move things up and down smoothly. Try to arrive at the criteria that the small creature cannot go down to the hole to help in person. S/he has to stay away from the edge during this rescue.

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Group Challenge 15 minutes

"Ok, now build your crane! In order for us to know it's a good design, it needs to be able to lower these (model) rescue items, and keep us and other creatures away from the edge when s/he is using it to help the friend in a hole. After you build, test your design! This table/desk can be our ledge and lowering things down the side can simulate the hole or cavern."

Building with and using the pulley takes some fine-motor control and practice. Be prepared to guide students and groups to practice this until they achieve success.

Reflection 5 minutes

"Do you know where cranes are used in real life? Do you know any real life rescue stories? Could cranes have helped?"

You can share stories about disaster areas that people wanted to send help to, but couldn't risk being in, or the story of trapped miners who needed weeks of supplies before they could safely be rescued.

CHALLENGE ADVANCED STUDENTS

In the group challenge, give students a challenge criteria of building their crane a certain number of inches from the edge. Then ask them how their design will need to change if the criteria changes and they can move closer or farther away. Ask them to estimate how many new pieces they will need (or how many pieces will leave their design) and how long it will take to rebuild. Then time them and have them keep count of pieces. Do a "redesign debrief" so they can discuss the redesign process and how it may have unfolded differently than they expected. What would this mean if a team was redesigning an existing crane for a real rescue? If you have time, they can rebuild with new distance criteria.

SIMPLIFY FOR YOUNGER GROUPS

In discussion, use the suggested book, Cranes! (Mighty Machines) to help guide students to real world solutions.

In the group challenge, any crank and pulley assembly will do, even if it looks a lot like the elevator from previous lessons. Help students identify the minimum viable product that will lift and lower to help with this rescue operation.

Name

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Student Worksheet

Draw how your crane will help lower supplies to the small creature's trapped friend:

Name

Lesson 3: RESCUE!

Student Worksheet

Draw a place where cranes are used in real life: