brackitz®

U3 L2
V2.3

GOING UP

LESSONS

PULLEYS & CRANKS

4th & 5th grade
teacher plan

CREATIVE POWER
PLAY LEARN GROW
brackitz
brackitz.com

Lesson 2: GOING UP

Students consider how to solve real world problems using a simple machine to make work easier.

Objectives:

Students will begin to understand simple machines in the context of making work easier. During this lesson, students will interact with and build with pulleys.

Vocabulary used in this activity:

miniature, work, effort, pulley, simple machine, mechanical advantage, situation, mass

Standards

NGSS 5-PS2 Motion and Stability: Forces and Interactions, 3-5 ETS-1 Engineering Design, ETS-1 Designing for a Need, ETS-1.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, pre-built Brackitz Elevator

Resources/Optional Reading:

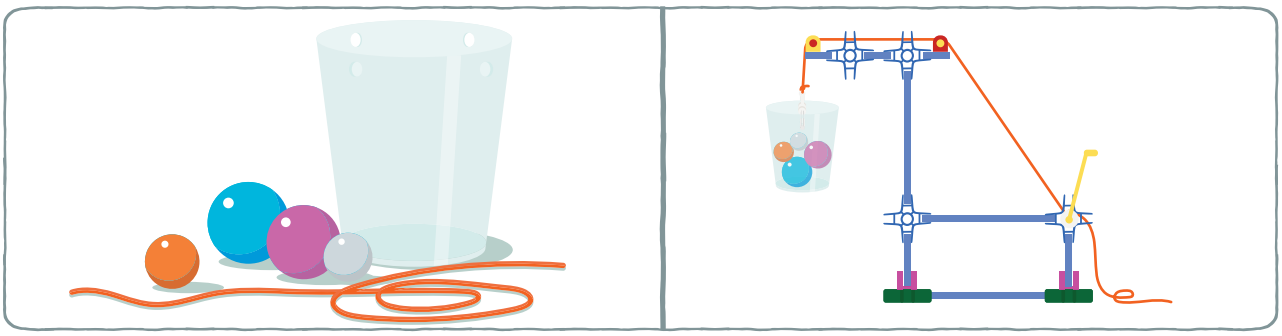
Evan Moor's Simple Machines and John B. Beaver's Simple Machines Grades 6-12 Force, Motion, and Energy.

Set-up and Preparation:

Before class starts, instructor should build the Brackitz Elevator from the Pulleys Kit and make sure it's working. 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 simple machines and mechanical advantage from Unit 2 can be very helpful.



Lesson 2: GOING UP

35-40 minutes

Whole Class 10 minutes

"Sometimes we need to move things up or down where we can't go. Yesterday we talked about elevators. I have a miniature elevator to show you. Do you think using the elevator will help make moving the heavy items up and down easier to do? How will we know it's working the way we want it to?" (Students should suggest testing the elevator you've built.) "Yes, we should test it. Before we do, let's consider if we had to ride up and down in this, what would our criteria be for it being a good solution? Tell me what we would want to happen or not to happen?" (Make a class list of criteria to test against. Demonstrate Brackitz Elevator and ask if this is a good solution.) "Based on our criteria, is this is a good elevator?"

"Let me show you again. Let's list what criteria we would need for this to count as a good solution for our small friend or things s/he needs to go up and down, with less work. If we were in an elevator, what would we want to happen?" (Make a class list.) "And what would we not want to happen?" (Make a class list.)

Goal: Get students to consider moving the same pebbles/marbles used in the cup in Lesson 1 to see if it is easier/smoother/faster.

Instructor Notes and Tips

work/challenge in Lesson 1. How did their hands feel? Their arm muscles?

Ask students to consider what criteria would make this a good solution. Some things you can help steer them towards are:

- Safety: Does this elevator go up and down without tipping or swinging wildly? Most of us would want a stable, safe elevator.
- Mechanical advantage: Does it help lift or lower things without all of the work being done/felt by us?
- Capacity: Can we carry more in it than if we were using just ourselves?
- Reliability: Can we count on this to work over and over?

Group Exploration 10 minutes

"You tried last time to build something using the cup and string and Brackitz. Would it have been a good elevator ride for someone small (safe and comfortable for them)?" (The answer is probably no for most groups. See instructor notes in case some groups had a different build.) "What we were missing was this part of the simple machine - the pulley and crank. The elevator I made works by using the pulley as a simple machine to help us move mass (heavy stuff!) up or down. In real life, we sometimes use a pulley as a way to make work easier, but also to move things to places where we can't go. Can you think of places where we may need to lower things down or lift things up that we wouldn't be able to go to ourselves? Think about it - what ideas does your group have about where we would need this kind of simple machine?"

If some groups built something in the last class that worked well as an elevator without the crank and pulley, it likely had limited range, and may not be a design that could transfer to other locations. Point out the range and location limitations. If one group's design was great, point out what it has in common with your elevator, and point out the successes and issues with the level-based builds as a compare/contrast.

Plan for students to work in small groups, or discuss with you in a large group, for about six to seven minutes on this question.

Great real-life ideas:

- Salvaging a sunken ship
- Dropping off rescue supplies (to canyons or disaster areas)
- Moving items to the top of a building that is being built
- Raising and lowering a flag

Lesson 2: GOING UP

Group Challenge 15 minutes

"I want you to think of a situation where a small creature needed to move things down or up to a place where s/he couldn't go. You can come test out this elevator while you think about a situation that would cause this need. Is this elevator or something like it a good solution? What story would explain why the need arose to move something? Make sure as you think of your story you consider why is s/he moving it to a place s/he can't get to? How will the pulley elevator help?" Record student group stories.

This is a narrative challenge, not a building challenge. Try to guide students to make this relevant to the real world; for example, "Does the small creature you're imagining need to lower supplies to another friend that fell into a hole and is hurt?"

Work with student groups to record their stories either as a quick paragraph that you help write, or as a short video where they narrate the story, or maybe as a storyboard where they quickly sketch a series of pictures showing what happened to create this need/situation. Decide before this step how students should record their stories.

Reflection 5 minutes

"Tell your story, and explain how the pulley in this elevator can help the small creature we have in mind solve the problem s/he is facing in the story." t

Help groups tell their story briefly. If your students struggle to stick to a time limit, ask each group a couple of pointed questions and have them share their ideas as an interview instead of a story. Good questions:

- Why can't our small friend get there herself?
- Why is this a problem for him?
- How does the pulley help get that work done/- make this challenge easier?

CHALLENGE ADVANCED STUDENTS

In the group exploration, ask students to come up with needs for an elevator-like simple machine with a pulley. "_____ needs to _____, and an pulley can help by _____."

In the group challenge, ask students what changes they might make to the elevator design to make it work best for the need in your story?

SIMPLIFY FOR YOUNGER GROUPS

In discussion, remind students where they felt the work in their bodies the other day. Would someone small, who is able to create less force, be able to do that same work without breaking?

In the group challenge, ask for the story one part at a time in four parts: (1) What happened? (2) What is the need? (3) What are the constraints or limitations? (4) How will we know if this design is working and helping (criteria for success)?

Name

Lesson 2: GOING UP

Student Worksheet

Draw at least two or three "places we can't go" but still might want to move things to or from.

1

2

3

brackitz
connecting imaginations

Name

Lesson 2: GOING UP

Draw the story of why there is a need for a pulley-elevator.

What caused this situation?

Why can't the creature go there?

How will the elevator help?

Are there other parts of the story?

brackitz
connecting imaginations