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U3 L1
V2.3

WHAT GOES UP
MUST COME DOWN

LESSONS

PULLEYS & CRANKS

CREATIVE POWER
PLAY LEARN GROW
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2nd & 3rd grade
teacher plan

Lesson 1: WHAT GOES UP MUST COME DOWN

Students consider the challenges of moving things and people up and down, and revisit the idea of how simple machines can do the work of moving more effectively.

Objectives:

Students will consider that getting from one place to another can involve moving objects and materials, and can require up and down movement. At the end of this lesson students will have started to think of using simple machines, like pulleys, to create movement in another direction.

Vocabulary used in this activity:

fragile, work, effort, weight, heavy, advantage, disadvantage

Standards

NGSS K-2-ETS1-1 Ask questions, make observations, and gather information about a situation people want to change by defining a simple problem that can be solved through the development of a new or improved object or tool. K2 ETS1 and 3-5 ETS1: Engineering and design. 3 PS2, PS2.A Forces and motion.

CCSS-Math MP2, MP3, MP5

CCSS-ELA SL.2.1, SL.2.1.A, L.2.1, L.2.2, L.2.3, W.3.8, W.3.1b, CCRA.I.6, RF.3a.4a

Time needed: 35-45 minutes

Materials and Supplies:

Brackitz Pulley, Gingerbread Friend, paper, pencils/crayons, Brackitz Pulley Bucket, string, and weighted objects (pebbles, marbles, or pennies). **Important: do not supply the pulley and crank in this lesson.**

Resources/Optional Reading:

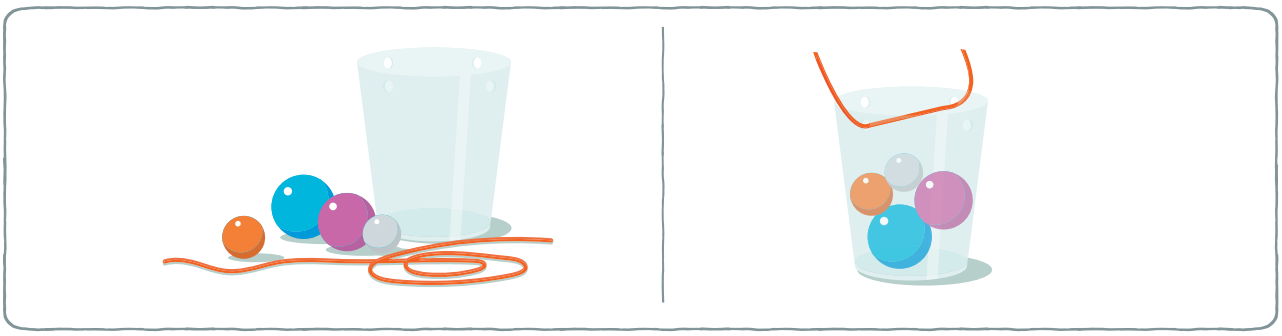
Monica Kulling's Going up!, Elisha Otis's Trip to the Top, and Amanda Askew's Cranes (Mighty Machines)

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 Gingerbread Friend in Unit 1 and simple machines and mechanical advantage in Unit 2 can be very helpful.



Lesson 1: WHAT GOES UP MUST COME DOWN

35-45 minutes

Ways to Move 10 minutes

"When we think about ways to move, which ones can get us to places most efficiently or with the least work?" (Students should easily think of vehicles from the previous unit: bikes, scooters, skateboards, cars, busses.) "Yes, vehicles and things with wheels come to mind easily, not only because we learned about them in the last unit but because most of us interact with vehicles everyday. One thing that most vehicles have in common, aside from wheels, is that they help move people and things across (across roads, paths, and sidewalks.) What helps move us up and down?"

Discuss, with the goal of arriving at the idea that most machines that can move us or objects up and down are not vehicles. Try to help students think of examples of machines we use to move up and down. (Elevators, and pulleys in both flagpoles and wells are great examples.)

Instructor Notes and Tips

If the brainstorm needs some assistance, consider asking for specific examples. "What are all the ways we can get from . . .?"

- Home to school (walking, bikes, bus, car)
- Class to playground (walking, scooter, wheelchair)
- First floor of a building to the second floor (walking + stairs, ramp, or an **elevator**)

Pulleys can also move things horizontally, but vertically is more common and may be easier to focus on for now.

Group Exploration 10 minutes

"If we want to move something up and down using a machine, how can we tell that work is being done? I've set up stations. You can pull something heavy (like a pulley cup filled) up from the floor onto your tables. You have to use just your muscles and this rope. What are things that would help you know work is being done?"

Ask students what they felt, observed, and noticed.

Fill your pulley cups enough so that work can be felt, but not so much that it's a hazard (marbles and pebbles work well). If you can throw your rope over something a bit higher, like a bookshelf, that will help make this point.

Have each child in each group take a turn.

Prime them with ways to experience the work - muscles or string on hands. Students may mention that lifting with their hands is imprecise or "can spill," and you can help them understand that this is a design-based reason to rethink lowering and lifting everything by hand.

Lesson 1: WHAT GOES UP MUST COME DOWN

Group Challenge 15 minutes

"Did you feel the work in your arms, hands, and fingers? That was just up and down from a table to the floor, and you are bigger than the table. What if Gingerbread needed to move up and down something that was five Brackitz planks taller than s/he is? That would be like if you had to pull all of your stuff up from the ground to the top of a two or three story roof! Would your hands feel that?
What could happen if Gingerbread tried to do that with fragile, cookie hands?" (Discuss that the work they felt could mean cookie breaks!) "What if our Gingerbread lived at the top of a tower and needed to get down to go to school every day? How could we help by making something so that s/he could easily get up and down? Draw a design to add to the tower that will help move Gingerbread or the things s/he needs up and down safely. "

This is a draw and design challenge, not a build challenge. Try to set some limitations and make this more real-world with guidelines, like Gingerbread can't do the following:

- Fly
- Jump
- Do rock climbing up and down every day

Try to steer students back to "in-real-life" examples, like installing an elevator or lift system.

Reflection 5 minutes

"If Gingerbread has to get down to the ground floor every day, how will s/he do that? If s/he couldn't fly or jump super high, and if we couldn't have stairs in the tower, what could we do instead? What did each of your groups think of?"

Before this lesson completes, help students consider that there is a way to facilitate changing the direction of force to move things up and down. Refresh them on the idea of using machines to make work easier/smoother from Unit 2.

CHALLENGE ADVANCED STUDENTS

In discussion, ask if they have thought about or noticed that there are places that bikes, cars, and scooters can't go. Talk about dimensions and directions: "A vehicle is most likely to help us in a horizontal direction, but gravity prevents it from climbing a wall and moving vertically." Do they think there are other machines that can help with up and down? If they think of planes, direct them to the tall building example. If they think of elevators, ask if they think a simple machine could be part of that solution.
In the group exploration, mention that simple machines make work easier with a mechanical advantage. "One simple machine is a pulley."
In the group challenge, have students consider the pulley cup, without the thread guide and crank. Ask them if they could use it to take things up and down with Brackitz planks and hubs. What are the benefits? What are the drawbacks, especially for Gingerbread Friend?

SIMPLIFY FOR YOUNGER GROUPS

Before this lesson, try to read Going Up!, as recommended in the resources section. This will help prime your class.
In discussion, remind students about simple machines and ask, "What machines have you seen that move people or things up and down?" Although pulleys can also move things across, for now, help students think in just one more dimension.
In the group challenge, help groups who are stuck by asking them explicitly if they scale buildings to go to a top floor or if there are machines that help get them to a top floor. Ask also, "What about someone who can't use their legs (someone older or someone who uses a wheelchair, for instance) to go up stairs? How do they go up and down in a building?"

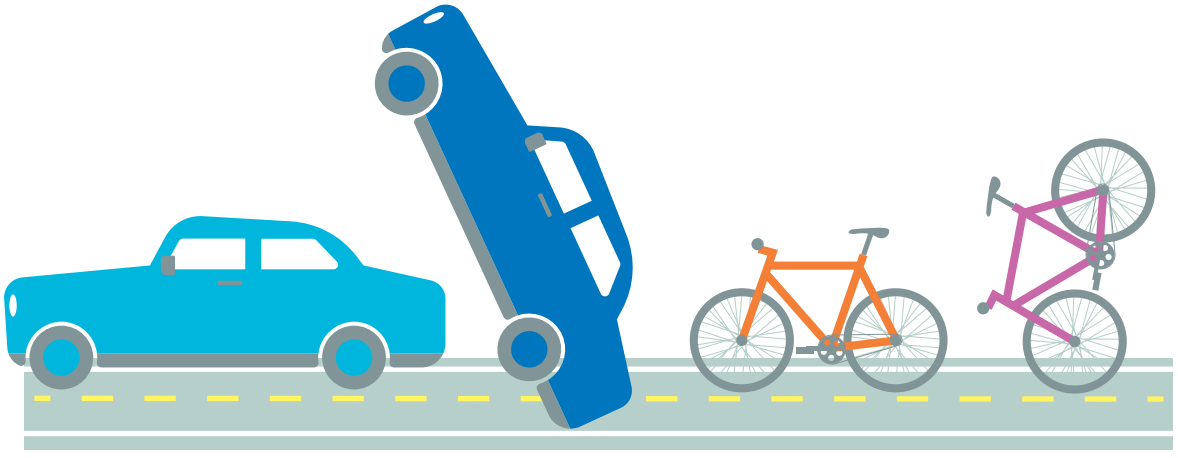
Name

Lesson 1: WHAT GOES UP MUST COME DOWN

Student Worksheet

One way to get somewhere is in a vehicle. Here is a road:

Circle the pictures that show how vehicles are used in real life on a road like this:



Name _____

Lesson 1: WHAT GOES UP MUST COME DOWN

Vehicles are very good at moving across or back and forth, but not as good at moving us

_____ and _____.

What are some places vehicles can't take us? _____

_____

Who does the work walking up and down stairs? How is riding in an elevator easier for us than walking up stairs?

_____

What are some other places that may need people or things to be moved up and down. Can you think of any?

_____

Draw your design for how to move Gingerbread up and down here: