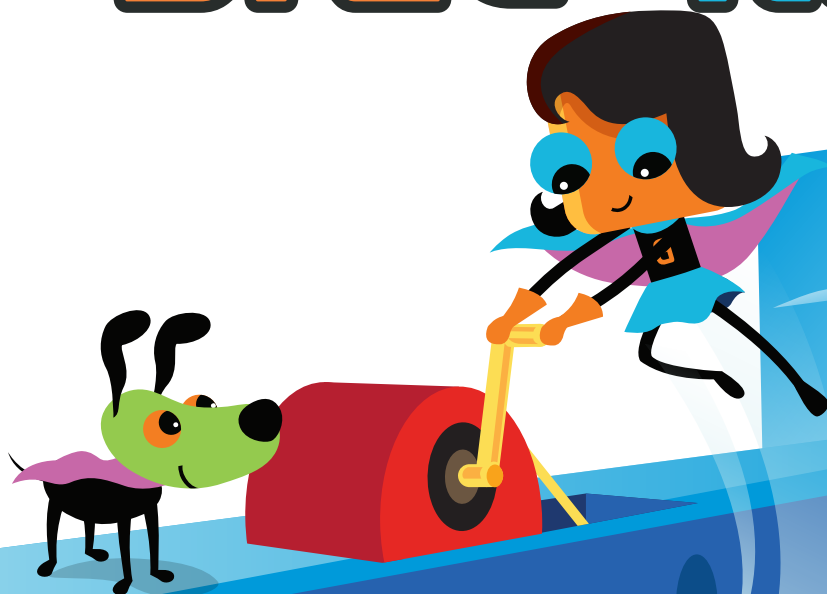


# brackitz®

U3 L1  
V2.3



LESSONS

## PULLEYS & CRANKS



# 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

**ECERS-R** Language-Reasoning: Books and pictures, Encouraging children to communicate Using language to develop reasoning skills | **Activities:** Fine Motor, Art, Math/Numbers | **Program Structure:** Group time

**NGSS** **K-2nd Engineering Design:** K-2-ETS1-2 Develop a simple sketch, drawing, or physical model to illustrate how the shape of an object helps it function as needed to solve a given problem. K-2-ETS1-1 Ask questions, make observations, gather information about a situation people want to change to define a simple problem that can be solved through the development of a new or improved object or tool.

**CCSS-Math** K Practice.MP5, K Practice. MP7, 1. MD.A.1, 1.MD.A.2, 1. MP8, 1.MP5

**CCSS-ELA** SL.K.1, SL.K.1.A, SL.K.1.B, SL.K.5, W.K.3, CCRA.L.6, SL.1.1, SL.1.1.A, SL.1.1.B, SL.1.5, L.1.1i

**Time needed:** 35-40 minutes

## Materials and Supplies:

Brackitz Pulley, Gingerbread friend, paper, pencils/crayons, Brackitz Pulley Bucket, string, and weighted objects (pebbles, marbles, or pennies).

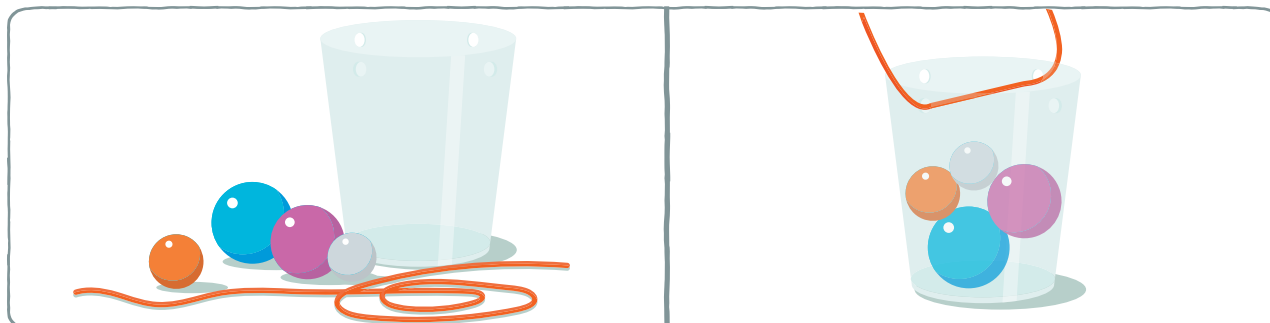
## Resources/Optional Reading:

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 transportation and mechanical advantage in Unit 2 can be very helpful.





# Lesson 1: WHAT GOES UP MUST COME DOWN



35-40 minutes

## Whole Class

10 minutes



"When we think about ways to move, things with wheels come to mind easily! In the last unit we worked with vehicles and made carts, bikes, cars, and more - mostly things that move us across roadways, paths, and the ground - but what other ways are there to move?"

**Goal:** Get students to consider moving things up and down (and, if it comes up, across) using machines that will change direction, but aren't vehicles. (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, wheel-chair)
- 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 (pulley cup filled) up from the floor onto your tables. You have to use just your muscles and this rope. What are some of the things that let you know how much work it is?"

Ask students what they felt - how did their hands feel? And their arms? Did they have to use muscles or feel the string cutting into their hands? These would be disadvantages or ways to experience higher effort.

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, 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



"The Gingerbread friend is small and a little fragile. Would it make sense if s/he lifted heavy things up and down with her/his cookie hands? What if our Gingerbread lived somewhere high up, like a tower, but 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."

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

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

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

## Reflection



5 minutes



"If Gingerbread has to climb down 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?"

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/smoothen from Unit 2.

## CHALLENGE ADVANCED STUDENTS

In discussion, talk about the idea that vehicles move us, but 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. For this, we need a different kind of solution.

In the group exploration, mention that simple machines can make work easier with a mechanical advantage. "One simple machine is a pulley."

## 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, "Can we use a machine or tool to move things up and down?" Although pulleys can also move things across, for now help students think in just one more dimension.

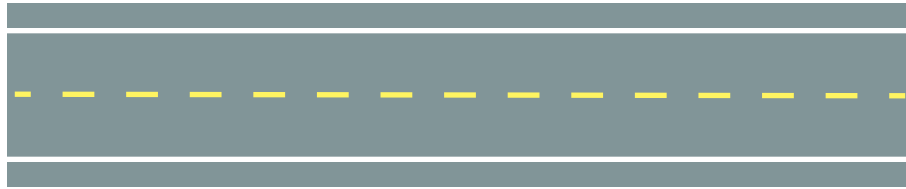
In the group challenge, help groups who are stuck by asking them explicitly what the pulley cup reminds them of in real life or asking them if they think this is similar to a well, an elevator, or raising a flag up a pole.

Name \_\_\_\_\_

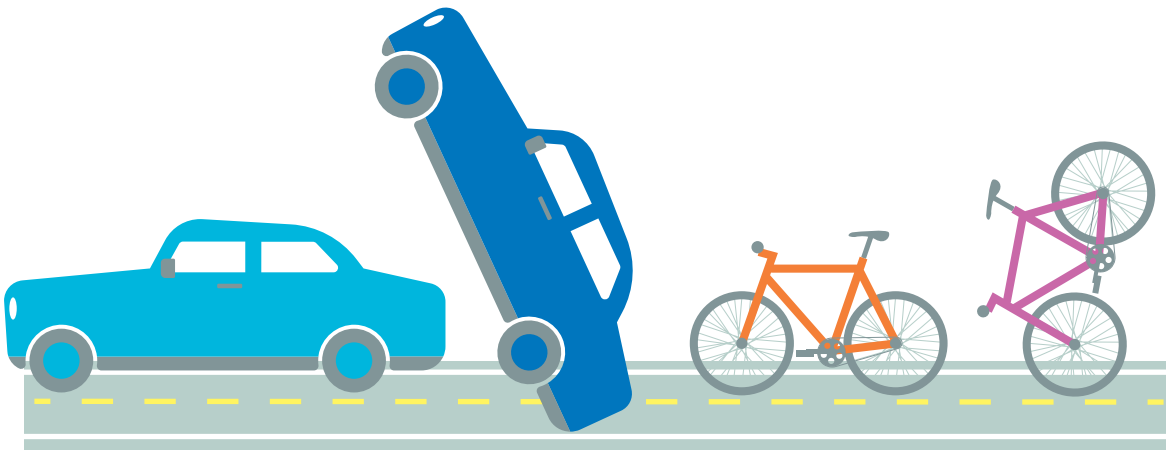
# ★ Lesson 1: WHAT GOES UP ★ MUST COME DOWN

## 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:



Count how many Brackitz pieces you used today: \_\_\_\_\_

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 \_\_\_\_\_.

Who does the work walking up and down stairs? \_\_\_\_\_

And who does the work if we go up and down in an elevator? \_\_\_\_\_

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