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MOATS & CASTLES

LESSONS

PULLEYS & CRANKS

CREATIVE POWER
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4th & 5th grade
teacher plan

Lesson 4: MOATS & CASTLES

Students situate their pulleys in a unique setting, continuing to practice needs-based design process.

Objectives:

Students continue building with pulleys to understand how they work and to recognize ways they can practice designing with pulleys.

Vocabulary used in this activity:

Situation, solve/solution, simple machine, pulley, design, drawbridge

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:

Gingerbread friend, paper, pencils/crayons, simulated castle or castle tower set up. Each group will need a tray of Brackitz planks, 3 and 4 way hubs, 1-way pivoting hubs, and access to the pulley, crank, string, and pulley-wheel connectors.

Resources/Optional Reading:

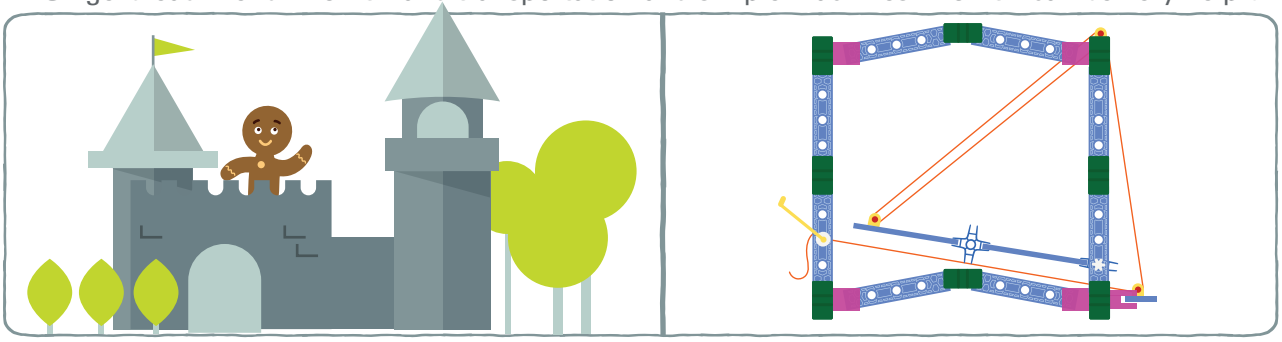
Evan Moor's Simple Machines, John B. Beaver's Simple Machines Grades 6-12 Force, Motion, and Energy, and this Youtube video showing a drawbridge in Chicago letting a sailboat pass: https://www.youtube.com/watch?v=haimlez70fQ. Please see Drawbridges Open and Close by Patrick T. McBriarty

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 simple machines in Unit 2 can be very helpful.



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40 minutes

Whole Class — 10 minutes

"We've imagined the small creature we've been building for in a lot of places, but . . . what if s/he was helping a friend and watching their castle while they were gone. S/he would still want to come to school and need to leave the castle everyday, but . . . the castle is surrounded by water. The water is great for boats, but not great for the small creature we're thinking of. What are the problems of the castle being surrounded by water for a small creature? Let's brainstorm what the problems are together."

Problems:

- Not all creatures can swim!
- Fish and ducks could eat our creature for lunch.
- If water is moving fast, the creature might end up far away.
- Rocks!
- What else?

Instructor Notes and Tips

In previous lessons, students have been involved in coming up with solutions for problems. Here, you are asking them to name the problem. Help students think of real life issues the water presents to small creatures trying to get across.

A picture or model could help them think this through. This suggested video can help students who have never seen a drawbridge understand what it is and why there would be a need for it:

https://www.youtube.com/watch?v=haimlez70fQ

Group Exploration — 10 minutes

"We know the problems of living in a castle surrounded by water. There's only one door, and stepping out of it, you would land right in the water with all the problems we discussed. Most doors open by standing upright and swinging across the floor (demonstrate with classroom door). But what if a door lowered down and then could go back up again? Could a pulley and crank help us build a door that helped? Can we build a special door that stays up most of the time to let boats go by, but lowers down when the small creature wants to leave to take a walk or go to school? Doors and bridges that move up and down are called drawbridges. How could we use a pulley to make this? Draw a basic design."

Students might need to see a picture of a drawbridge to understand what one looks like and how it operates. Try modeling from the suggested reading or video or other pictures. (Try to avoid using Brackitz pieces, as students will just copy the design). Discuss what parts might be used to make the drawbridge and how some of those parts might go together (particularly the pivot part for the drawbridge).

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Group Challenge 15 minutes

"Ok, now build your drawbridge! In order for us to know it's a good design, it needs to be able to lower down for the small creature friend to walk across, but raise up again."

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

"Have you ever seen a drawbridge in real life? Where would it make sense to build a door or bridge that worked like this?"

Drawbridges can have one side that lifts and lowers, or two sides that lift and lower, like this bridge in Chicago. Showing this short video can help students understand how this works in real life.

https://www.youtube.com/watch?v=haimlez70fQ

CHALLENGE ADVANCED STUDENTS

In the group exploration, you may ask students to decide on a drawbridge that lifts and lowers from one side or two sides and to consider the benefits and drawbacks of these choices. "What would be needed to make two sides lift and lower?" (Each drawbridge would need two cranks.)

In the group challenge, instead of supplying students with the criteria, have them brainstorm and agree on the three or four most important criteria.

SIMPLIFY FOR YOUNGER GROUPS

In discussion and group exploration, use the suggested book, Drawbridges Open and Close to help students understand drawbridges.

In the group challenge, if building a drawbridge is too challenging for your students, consider building one before the lesson and having them test it; and then have them "change it to make it work better for the castle!"

Name _____

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Student Worksheet

Pulleys are a simple machine that help us move things: (Circle words that are true.)

Up Down Underneath Between On a road Across

Drawbridges are bridges or walkways that move _____ and _____
(Fill in the blank.)

Draw your drawbridge design: