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U2 L2a
V2.3

ONE WHEEL ON THE CART

LESSONS

WHEELS & AXELS

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

Lesson 2: ONE WHEEL ON THE CART

Students consider designing transportation and including wheels in their designs. This lesson serves as an introduction to the idea of mechanical advantage and to design process with criteria and constraints.

Objectives:

Students will explore the ideas of work, effort, and enhancing transportation with wheels (mechanical advantage). At the close of this lesson, students will be able to describe how wheels help do work.

Vocabulary used in this activity:

objects, work, effort, distance, weight, advantage, benefit, method, constraint, materials

Standards

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, and 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 | **K2 ETS1 and 3-5 ETS1:** Engineering and design | **3 PS2** Forces and motion

CCSS-Math MP1, MP5, MP6, MP7

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:

Gingerbread character, paper, pencils/crayons, cart or wheeled chair, rock or well-built and closed container full of heavy items, Brackitz planks (1x1 and 1x2), and 3 and 4-way hubs. Give out exactly one tire and axle-spline and two lock-washers to each group.

Resources/optional reading:

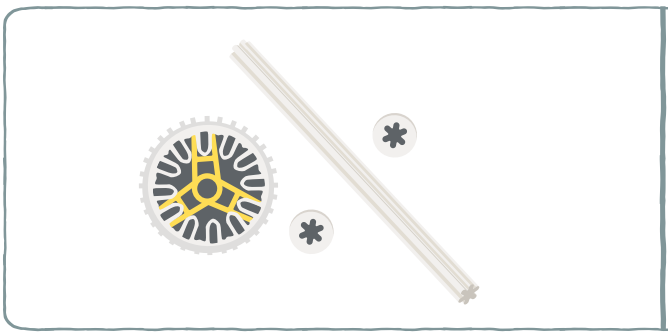
Richard Scarry's Cars and Trucks and Things That Go.

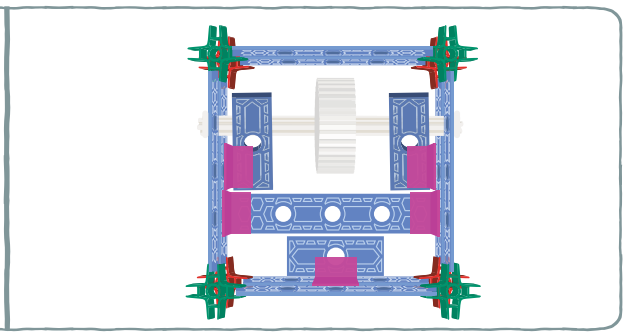
Set-up and Preparation:

Prepare trays of Brackitz building materials so that they are ready to be handed out; 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 from Unit 1 can help them keep a user in mind who will use their designs.





Lesson 2: ONE WHEEL ON THE CART

35-45 minutes

Whole Class - Ways to Get Around

10 minutes

"How do we move things around that need moving? What things do we move in school and how do we move them? What things or people need to move across towns and states and the country? How do we do that moving around? Let's make a list of the ways to move things and people around." Ask students to think of all the ways we move people and objects around: carts, wheelchairs, buses, trains, and more. List on board or chart paper. Then ask "Which of these ways of moving things is easiest? What do all of these ways of moving things/people have in common?"

Instructor Notes and Tips

You may also ask for specific examples:

- How will we change classes/get to the cafeteria? (walking, wheelchairs)
- What are fun ways to move when we are playing (roller skates, scooters)
- If you wanted to go to your friend's house, what are three ways to get there? (car, bike, walking)
- What brings some students to school? (bus, car)

Note how many things that are named have wheels and see if students can be supported to notice this common feature. Try to move the discussion towards "vehicles" as items that help us move things more quickly/easily.

Group Exploration - Force

10 minutes

Feel the work! "Moving something from one place to another is always work, even when we are moving ourselves. Let's see if we can **feel the work** being done. If we want to move this rock from 'Start' to 'X marks the spot,' how can we do the work?

1. Push it.
2. Pull it.
3. Lift and carry it.
4. ROLL IT."

Have students rotate through stations of these options. Then ask, "Which is easiest? Why do wheels help?"

Try to reach this conclusion:

It's easier to move items when it doesn't depend on just us and our muscles. The wheel gives us an advantage. "Advantage means having an edge or better method, like if we got a head start in a race."

Create start and stop spots for each station so that students can line up for this exercise. Have each group take a turn carrying, pushing, pulling, and rolling (with a cart or rolling chair) a rock or heavy container box. Each student's turn should take twenty to thirty seconds or less, and if four or five students are carrying/rolling at once, this means "feeling the work" should take six to seven minutes.

When you ask which is easier, help students consider feeling their muscles. Students may also talk about speed, but help them focus on the wheel allowing the movement of items with less force: "It gives us an advantage of doing work using less force to move the same distance. With the mechanical advantage of wheels, we could go the same distance with **less force coming from us**."

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Group Challenge - Carts and Wheels

15 minutes

"If we want to give our Gingerbread character a way to move things around that will use less force, what do you see on your tray that we should use? (Wheels!)

But what if we had only one wheel? That would be a design constraint. Could we still design something that might help move the books/blocks?

Test it - how do we know if this is helping?"

Pass out trays of planks, connectors, wheels, and axles that are already prepared for groups. This is a chance for students to begin building. Watch to make sure groups are able to share tasks and ideas functionally.

Reflection

5 minutes

"I gave you only one wheel to see if you could build, even if I had a limitation on your building materials. That's called a constraint. Can one wheel still help create an advantage for moving around so you can move things more easily (using less force)? How will we know if it is helping?"

Make sure that before this section of the lesson closes out, students understand the basic idea of doing the same task (moving Gingerbread from A to B or moving books) with less force.

CHALLENGE ADVANCED STUDENTS

In discussion, ask students to name which ways to get from place to place are fastest (cars are faster than bikes), and which ways are safest (planes and trains are fast and safe), and which ways can move the most stuff/people (planes, trains, buses). Which vehicles end up on more than one list? Are these also the most common vehicles? Discuss how this relates to getting work done with an advantage but also how some designs get used more often because they are safer, easier, etc.

In the group challenge, ask students, "With only one wheel, how will this cart have to be used? How are other one-wheeled vehicles used? Can you design it so that it's ideal for the kind of use you are thinking of?"

SIMPLIFY FOR YOUNGER GROUPS

Before the discussion, read Scarry's Cars and Trucks and Things That Go or have students read it.

In discussion, specifically ask for things that may use four wheels (cars, trucks, buses) and things that use fewer than four wheels. Use the book to help students think of different kinds of vehicles. Mention that things using fewer than four wheels often combine human work with wheels.

In the group challenge, direct students to "add a wheel to your container so that it can be pushed smoothly" to prompt a wheelbarrow type cart.

Name

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Student Worksheet

What are some ways we can get around from place to place?
Draw and write the name of at least three!

Name a way to move	Name a way to move	Name a way to move

Think about if you had to move everything in our school to a new school building. Would it be easier to carry them all by hand or to put them in a truck and drive them? (Circle which is easiest.)

Name _____

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Student Worksheet

Who has an advantage in this race? (Circle)

Who has an advantage in this race? (Circle)

Count how many Brackitz pieces you used today: _____

Count how many wheels you got to use in building today: _____

Name

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Student Worksheet

You made something with just one wheel. Draw your design here: