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V2.3

TWO WHEELS ON THE CART

LESSONS

WHEELS & AXELS

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

Lesson 3: TWO WHEELS ON THE CART

Students continue designing transportation tools with wheels. This time they will use two wheels.

Objectives:

Students will practice what they learned about transportation, work, effort, and mechanical advantage with more wheels, while still being challenged with a design constraint.

Vocabulary used in this activity:

Vehicle, example, advantage, benefit, mechanical advantage, request, specific, constraint, design, accommodate

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

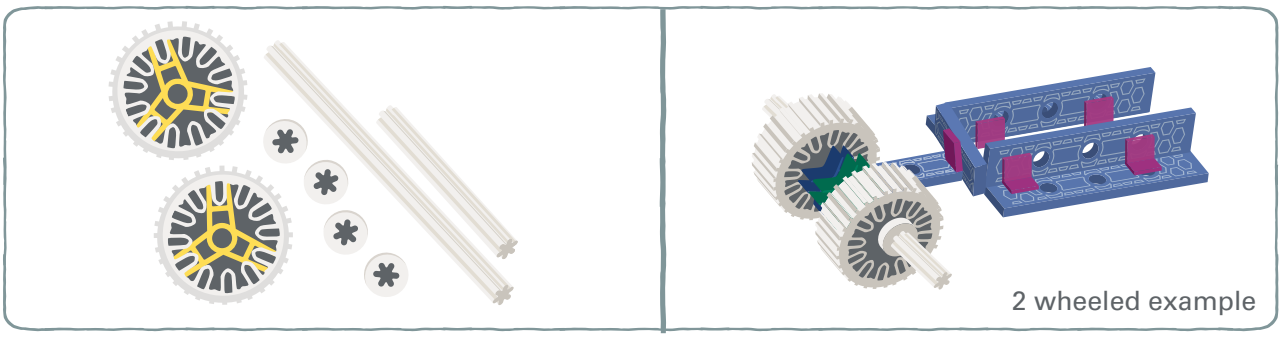
Time needed: 35-45 minutes

Materials and Supplies: Gingerbread friend, paper, pencils/crayons, Brackitz planks (1x1 and 1x2), and 3 and 4-way hubs, as well 1-way pivoting hubs. Give out exactly two tires and axle-splines and 4 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 building materials 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.



2 wheeled example

Lesson 3: TWO WHEELS ON THE CART

35-45 minutes

Whole Class - More Moving

10 minutes

"Previously, we experimented with moving things ourselves vs. with wheels. Which one was harder? (No wheels was harder.) So let's think of examples of designs that use wheels to help move things, and what they carry. Let's see if everyone can share an example. Say the vehicle and what it most often carries. (Write down thoughts in a table with three columns: Vehicle, What it carries, and Number of wheels.) Why do you think we use wheels on so many designs?" (Wheels make it easier to move more, move over distance, and move faster. Review the idea of an advantage/mechanical advantage.)

Instructor Notes and Tips

You can solicit students to consider vehicles in terms of where they get used. What vehicles are on the roads (cars, buses, etc.)? What vehicles are on sidewalks and in parks (bikes, scooters, skate-boards)? What vehicles help move things at schools (wheeled carts, chairs, rolling trash cans, etc.)?

Next, ask them what these vehicles usually carry and then follow up with how many wheels their suggested vehicles have. This is a way to get lots of thoughts and offer participation to every student in the class.

Group Exploration - How Will It Change?

10 minutes

"Who wished we had more wheels yesterday? Well good news: today we get to use TWO wheels, but only two. Take a look at some of your one-wheeled designs. What will change if we add two wheels? Can your group draw a new design with two wheels? Where is the best place for a second wheel?"

After groups have had some time to work, ask, "How will Gingerbread use this and how will we know if your designs are good?" (Build them, test them, and check for safety, stability, and usefulness for your Gingerbread friend.)

Help groups get started by asking them, "If you were adding another wheel, where would it go?" Students may quickly understand that adding a wheel means changing the shape or even the use of their previous design. Ask students, "What will this design help our Gingerbread friend do? Where will this cart or vehicle go/be used, and how will s/he use it?"

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Group Challenge - 2 Wheels

15 minutes

"Build a design with EXACTLY two wheels. You can't have one or three wheels; it has to be two. This is called a design constraint; it means you have to meet a specific request, or not use everything you may want."

This is a chance for students to begin building. Watch to make sure groups are able to share tasks and ideas functionally. Having trays with prepared Brackitz pieces and exactly two wheels and axles will help.

Reflection

5 minutes

"Was a two-wheeled design better than a one-wheeled design? Why or why not? How was it better? What had to change in your one-wheeled designs to accommodate two wheels?"

As you talk to students about their designs, praise what they have gotten to work: perhaps it's a good size or built for a specific use. Ask them about parts of the design that could use improvement: maybe the design needs stability or would present safety concerns for the Gingerbread friend. Referencing things that "may need redesign" or "improvement" is a way to make the reality of redesign in the design cycle less negative.

CHALLENGE ADVANCED STUDENTS

In discussion, ask students to consider vehicles with two wheels and how they are useful. Many are recreational, or are used to create a lighter vehicle or one that is more maneuverable over obstacles or through narrow places. What is the specific design advantage of two wheels?

In the group exploration, have groups draw two designs: one with wheels side by side (horizontally, like on a cart or dolly) and one with wheels placed inline (vertically, like on a scooter). Which is better? How will they pick which design to build?

In the reflection, ask students to decide if two wheels are "better than one" in terms of two considerations: able to do more work with less force, and ease and use of design.

SIMPLIFY FOR YOUNGER GROUPS

In discussion, review mechanical advantage. "Wheels can help give us a mechanical advantage of using less force. Who wanted to use more wheels yesterday? Good news: today we're going to use more wheels, but only two. What are some things that use two wheels?" Ask students if they have ever seen something with two wheels, aside from a bike or scooter. Show them Youtube videos of segues or ripsticks to show them other ways to get around with two wheels.

In the group challenge, break the build challenge into two or three steps. Have students focus first on how and where our Gingerbread friend will use this vehicle (riding at the bike park is different than moving books down a hall). Then have them focus on where to put the axles to make their design move smoothly. Lastly, have them focus on adding wheels.

Name

Lesson 3: TWO WHEELS ON THE CART

Student Worksheet

Draw your two-wheeled design here:

Where will this two-wheeled vehicle get used (school, roads, parks)?
Draw that place.

Name _____

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Student Worksheet

What are some reasons to prefer a two-wheeled design over a one-wheeled design? (Circle or write your own.)

Safety

Balance

Stability

Can make something like real life

Write your own: _____

Write your own: _____

Are there any reasons to prefer a one-wheeled vehicle design over a two-wheeled design? What are they?

_____

_____

_____

Explain how a two-wheeled design is/is not a better vehicle for a small creature to use? (Are there any safety concerns limits on where s/he can use it, or ways it is much better/worse than the one-wheeled vehicle?)

_____

_____

_____

Explain why you think two wheels is more common on vehicles we use than one wheel?

_____

_____

_____