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TWO WHEELS ON THE CART

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V2.3

LESSONS

WHEELS & AXELS

4th & 5th grade
teacher plan

CREATIVE POWER
PLAY LEARN GROW
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Lesson 3: TWO WHEELS ON THE CART

Students continue designing transportation tools, this time with 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:

Advantage, benefit, mechanical advantage, request, specific, constraint, design, vehicles

Standards

NGSS 3-5 ETS1, ETS1.A, ETS1.B, ETS1.C, ETS1-1, 3-5 ETS1-2, 3-5 ETS1-2, PS3.C, LS1.A, 5-PS2

CCSS-Math MP2, MP3, MP6, MP7, MP8

CCSS-ELA SL.4.1, SL.5.1, SL.4.1c, SL.5.1c, SL.4.1d, SL.5.1d, CCRA.L1, CCRA.L.6, W.4.2, W.5.2, W.4.8, W.5.8

Time needed: 35-45 minutes

Materials and Supplies:

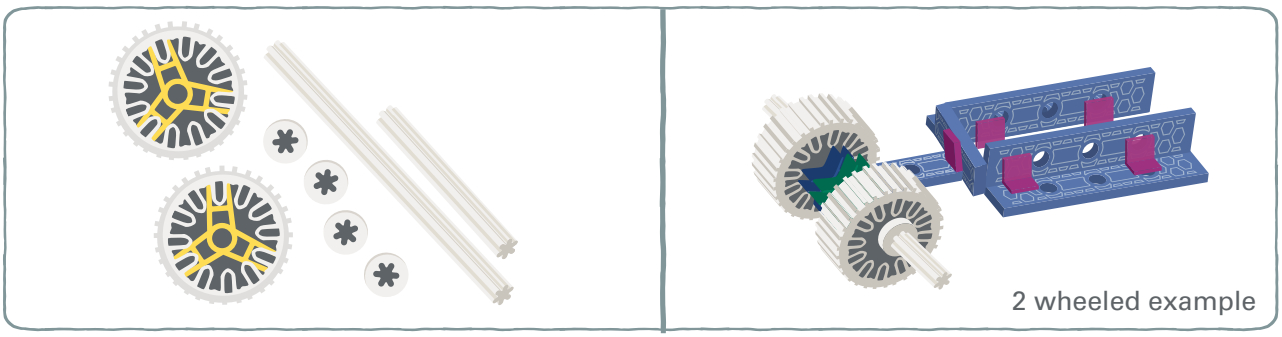
Paper, pencils/crayons, Brackitz planks (1x1 and 1x2), and 3 and 4-way hubs, as well 1-way pivoting hubs. Give out exactly two tires and axle-splines and 4 lock washers to each group.

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.



2 wheeled example

brackitz connecting imaginations

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35-40 minutes

Whole Class — 10 minutes

"Previously, we experimented with moving things ourselves vs. with wheels. Which one was more work? (No wheels was harder.) So, let's think of vehicles we know that make it easier to move things. Let's all write down a vehicle, and what it's moving and send it up front so I can make one list. (Start a chart with the following columns: vehicle name, who uses it, what does it move/carry, and number of wheels. Only ask for information on vehicle and what it carries right now.) Why do we not just walk everywhere? (Vehicles can move more, and move it faster, including people and the things people carry.) So, of these vehicles, which are best for moving people? (Put stars next to those. Bikes, scooter, and skateboards should be on there.) Are the other vehicles best for moving things? (Circle those) Can we even think of special vehicles that are in our school, performing special tasks? (Underline those. Examples include rolling chairs, book carts, rolling trash cans.) Now let's name the number of wheels on everything on our list. (Put in chart.) We use all of these to get a mechanical advantage for moving people and things."

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, busses, etc.) What vehicles are on sidewalks and in parks? (Bikes, scooters, skateboards.) 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 suggestions have. This is a way to get lots of thoughts and offer participation to every student in the class.

Group Exploration — 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 would a small creature 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 to think about, "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 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 working - 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 compare/contrast examples of two-wheeled vehicles: bikes, segues, ripsticks, scooters. Are most of these horizontal or inline placement? Why? Is there a commonality to how/where they are used? 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" and to offer how they would measure/argue for "better than one" (Safety? Balance? Efficiency? Design?)

SIMPLIFY FOR YOUNGER GROUPS

In discussion, review mechanical advantage. "Wheels can help give us a mechanical advantage to use less force. Ask students if they predict more wheels means better vehicles/better mechanical advantage. Then ask them to think of two-wheeled vehicles - bikes, skateboards, scooters. Do these have better mechanical advantage than a wheelbarrow? Why or why not?

In the group challenge, break the build challenge into 2 or 3 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). Second, have them focus on where to put the axles to make their design move smoothly. Last, 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?

_____

_____

_____