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U2 L4a
V2.3

LESSONS

WHEELS & AXELS

THREE WHEELS ON THE CART.:

CREATIVE POWER
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K & 1st grade
teacher plan

Lesson 4: THREE WHEELS ON THE CART..:

This lesson invites students to add one more wheel and explore how the mechanical advantage of wheels, plus the added stability of more wheels, offers more design choices.

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. At the end of this lesson, students will better understand that creating stability/safety when enabling speed is desirable.

Vocabulary used in this activity:

advantage, benefit, mechanical advantage, request, specific, constraint, environment

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.CC.C.6, K.MD.A2, K.G.A.1, K.G.B.4, 1. MD.A.1, 1.MD.A.2, 1.G.A.1, 1.G.B.5

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.1.5.C

Time needed: 35-40 minutes

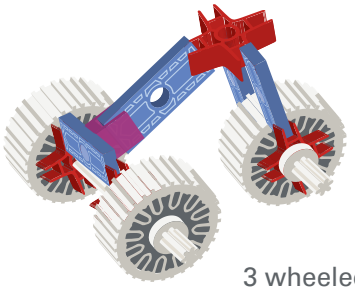
Materials and Supplies: Gingerbread friend, paper, pencils/crayons, Brackitz planks (1x1 and 1x2), and 3 and 4-way hubs, as well 1-way pivoting hubs. Give out exactly three tires and axle-splines and lock washers to each group.

Resources/Optional Reading: Richard Scarry's Cars and Trucks and Things That Go and Gail Gibbons' Transportation: How People Get Around.

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.



3 wheeled example

Lesson 4: THREE WHEELS ON THE CART..

35-40 minutes

Whole Class — 10 minutes

"We've been adding a wheel every day. On the first day we used NO wheels, then did one wheel, then we built with two wheels. How many wheels do you think we'll build with today? (Three!) When we build something to help our Gingerbread get from place to place, that's called a vehicle. Today we will think about 3-wheeled vehicles - have you ever seen 3-wheeled vehicles? What were they? (wheelbarrows, certain ATVs, dune buggies, some bike trailers, and some baby strollers) How/where were they used?" (If you need a vehicle that can be a bit flexible or get through rough, narrow, or twisty spots, having three wheels can provide some stability while also making a vehicle that's a bit adjustable - off road baby strollers or bike trailers are a good example of this.)

Instructor Notes and Tips

Three wheels is not as common. Help students consider that these vehicles may be used for special circumstances like hiking with a baby stroller or moving rocks with a wheelbarrow.

Asking what is the advantage of three wheels is the right question, but students may not be able to think this over until the end of the lesson.

Group Exploration — 10 minutes

"You're going to keep practicing your design constraint - but today you get three wheels. You can't get one or two wheels - it has to be three. Design a 3-wheeled vehicle for our Gingerbread friend. Where will this vehicle be most useful to the Gingerbread?"

Many students will design something that looks a lot like their Lesson 2 wheelbarrows. This is because they had one-wheel and assumed in the design that the two legs of the user would balance. Now, with three wheels, those 2 legs can be replaced with two wheels. **Point this out and discuss the similarities and reasons for this!**

You can ask students to think about a place Gingerbread would like to have a vehicle - where would s/he like to go and what would s/he like to do? (Driving around a beach, moving our toys out of the way to make a new Gingerbread building in the classroom, etc.) Then ask how three wheels can help us design something that's the right size for the Gingerbread friend and will work in that environment.

Lesson 4: THREE WHEELS ON THE CART.

Group Challenge 15 minutes

"Build a vehicle design with EXACTLY three wheels as the design constraint. How and where will Gingerbread use it? How will we know if it's a vehicle that's good for our Gingerbread friend?" (right size, is useful, is safe/stable)

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

"Getting feedback, or the thoughts of others, can make our designs better. Let's give two pieces of feedback for each group's 3-wheeled design. I will model saying, 'I really like this design _____, and 'I wonder if one way to improve this vehicle could be _____.' Let's try using those sentences when we talk to others about their designs."

As you model giving feedback, make sure to ask what the group thought the design was for or where it could be best used. This will inform what praise and suggestions make the most sense.

Preserve the 3-wheeled vehicles for the final lesson in the unit, if you can.

CHALLENGE ADVANCED STUDENTS

In discussion, ask if there are any similarities between having a three wheel constraint and a one wheel constraint (as we had in lesson 2). You may also discuss how having an odd number of wheels (1 or 3) causes the designer to have to think about vehicle shape and balance differently than having 2 wheels.

SIMPLIFY FOR YOUNGER GROUPS

In discussion, bring up the lesson 2, "One wheel on the cart" constraint.

In the group exploration, show students pictures of their one-wheeled designs; ask if this gives them ideas on building something with three wheels.

Name

Lesson 4: THREE WHEELS ON THE CART.

Student Worksheet

Draw your 3-wheeled design here:

Where will this 3-wheeled vehicle get used (school, roads, parks)?
Draw that place.

Count how many Brackitz pieces you used today: _____

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

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