



This lesson leads students to add a fourth wheel as they continue to experiment with mechanical advantage, transportation, and designing with constraints and criteria.

Objectives:

As students add a fourth wheel, new design choices are available. At the end of this lesson, students will design vehicles that are more related to their everyday experiences, and consider the mechanical and design advantages of four wheels.

Vocabulary used in this activity:

Prediction, advantage, benefit, stability, balance, mechanical advantage, request, specific, constraint

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, 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 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: Preserved three-wheeled vehicles from the previous lesson, Gingerbread friend, paper, pencils/crayons, Brackitz planks (1x1 and 1x2) and 3 and 4-way hubs, as well 1-way pivoting hubs. In the last lesson, students received exactly three tires and axle-splines, and six lock washers for each group. If you preserved their three-wheeled vehicles, each group now needs only one additional tire and axle and two additional lock washers.

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

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.



*Lesson 5: FOUR WHEELS!

35-45 minutes

Whole Class - Vehicles with 4 Wheels

"What's your prediction of how many wheels we'll build with today? (4!) We've added a wheel with each lesson. How do more wheels help us?" (Students may think that more wheels equals work done more easily. Actually, more wheels often equals more balance/stability.) Discuss, "What vehicles do we know of that have four wheels?" Make a class list, working to get every student to participate. If several students contribute the same idea, tally how many times it came up as a show of how common these vehicles are.

"What do you think the advantage of having four wheels is? Is there a reason we have so many commonly used vehicles with 4 wheels?"

10 minutes

Instructor Notes and Tips

Four wheels is VERY common. In this brainstorm, help each student contribute, even if they are naming something another student has mentioned. "What do you know that has four wheels?" Examples:

- Cars
- Trucks
- Busses (ignore for now that many have added wheels)
- Golf carts
- Tractors
- Wagons
- Construction vehicles
- Batmobile

Group Exploration - 3 vs 4

"Think about your three-wheeled vehicles from the last class. I have them here on display. What was challenging about building with three wheels? What was better about three wheels than two wheels? Predict what could be easier about four wheels? Do you think anything will be harder? Make a plan for four wheels and draw it. Think about where this vehicle will be used. Will it be used differently than a three-wheeled vehicle?"

10 minutes

Asking "what worked/what could be better" on the three-wheeled vehicles can help. "Can Gingerbread use this vehicle everywhere? Where would this work best? Where would this not work? Why not?"

Ask students to name what will improve, using ONE WORD if they can. Possible answers:

- Safety
- Stable/Stability
- Balance

If your students don't know those words, you may hear "less wobbly" or "not falling over;" and you can share how one word can help express that and practice vocabulary.



*Lesson 5: FOUR WHEELS!

Group Challenge - 4 Wheels

"Build a vehicle design with EXACTLY four 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.)

15 minutes

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.

Students may elect to use their previous three-wheeled vehicles and do a redesign from there to create the space for a fourth wheel.

Reflection

"Can each group show us their four-wheeled design. Tell us four things about it.

1. How will Gingerbread use it?

2. What's working well on your design?

3. What is not working yet or needs improvement?

4. How is this use different from the three-wheeled vehicle's use?"

CHALLENGE ADVANCED STUDENTS

In discussion, ask students to consider WHY four-wheeled vehicles are so common. Help them think about how a vehicle that has balance may be functional in more kinds of locations. Why is it good if a vehicle works in more than one environment?

In the group exploration, introduce the word criteria and ask students to name their criteria for success before building their vehicle.

In the group challenge, ask students to design something other than a car since cars are so prevalent.

5 minutes

Encourage groups to share in 30-60 seconds only and to be open about giving self-feedback. "It's ok to notice that something isn't working the way you want it to. That helps make plans for what to work on next."

SIMPLIFY FOR YOUNGER GROUPS

In discussion, revisit the suggested books so that students have pictures from the pages to help them brainstorm four-wheeled vehicles. Ask "who came to school today in a car or bus? How many wheels brought you here on those vehicles?"

In the group exploration, remind students what was challenging about their three-wheeled vehicles, as a way to prime them to consider what could be easier/better/different in their four-wheeled designs.

In the group challenge, let students make whatever vehicle with four wheels that they have in mind, but give practical help in making sure it is balanced.



Name

*Lesson 5: FOUR WHEELS

Student Worksheet

Why do you think four wheels is more common than three wheels?

Is there a specific advantage to having four wheels on a vehicle?

Draw your 4-wheeled design here:





*Lesson 5: FOUR WHEELS

Student Worksheet

Can this vehicle be used in more than one place? (Circle)

YES

NO

Tell us four things about your design today:

1. How will a small creature use this vehicle?

2. What's working well on your design?

3. What is not working yet or needs improvement?

4. How is this use different than the three-wheeled vehicle?

