

brackitz®

U2 L5a
V2.3

LESSONS

FOUR WHEELS!

WHEELS & AXELS



★ Lesson 5: FOUR WHEELS! ★

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 will 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 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:

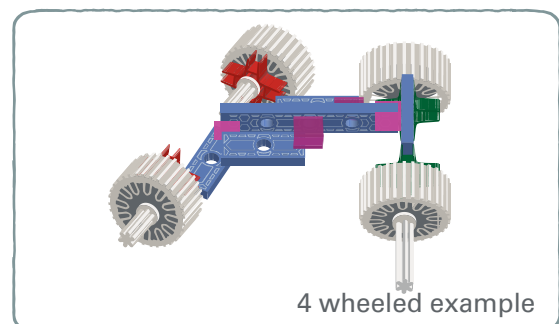
Preserved three-wheeled vehicles from the previous lesson, paper, pencils/crayons, Brackitz planks (1x1 and 1x2) and 3 and 4-way hubs, as well 1-way pivoting hubs. In the last lesson, students received exactly three tires and axle-splines, and six lock washers for each group. If you preserved their three-wheeled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

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.



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35-40 minutes

Whole Class

10 minutes



Instructor Notes and Tips

"What's your prediction of how many wheels we'll build with today? (4!) We've added a wheel with each lesson. Do more wheels equal the ability to do more work and move more things easily?" 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 four wheels?"

Four wheels is VERY common. In this brain-storm, 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

10 minutes



"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. Write down what criteria will determine if your designs are a success. Think too, how will it be used differently than a three-wheeled vehicle?"

Asking "what worked/what could be better" on the three-wheeled vehicles can help start thoughts on what kind of four-wheeled vehicle would be useful.

Ask students to name what will improve with ONE WORD if they can. Possibly:

- 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.

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Group Challenge

15 minutes



"Build a vehicle design with EXACTLY four wheels as the design constraint. How and where could someone small use it? How will we know if it's a vehicle that can be used successfully? What should we test 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.

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



5 minutes



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

1. How will someone 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 than the three-wheeled vehicle?
5. What is the advantage of four wheels?"

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. That helps us make plans for what to work on next."

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 reflection, ask students why we don't see many or any four-wheeled vehicles with in-line wheels. Point out the designs that have maximized balance on four corners and what it will mean not to have that.

SIMPLIFY FOR YOUNGER GROUPS

In discussion, start the brainstorm: "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.

Name

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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?

Compare and contrast three wheels and four wheels on vehicles.
What similarities do you notice?

What differences do you notice?

Name

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Student Worksheet

Compare and contrast two wheels and four wheels on vehicles
What similarities do you notice?

What differences do you notice?

Draw your 4-wheeled design here:

Name

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Student Worksheet

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

YES

NO

Name the place or places it can be used:

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?
