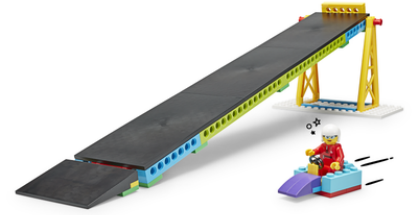


Gravity Car Derby

Build your car, find a hill, and off you go! Remember to stay safe out there.



🕒 30–45 min. 📦 Advanced 🎓 Grades 3–5

Teacher Support

Key objectives

Students will:

- Conduct an investigation to collect evidence of the effects of balanced and unbalanced forces on the motion of a gravity-powered car.
- Design, build, and test a safe gravity-powered car

Things you will need

- LEGO® Education BricQ_Motion Essential Set (one for every two students)

Additional resources

[Building instructions book "B," pages 88 - 102](#)

[Student Worksheet](#)

[Assessment Rubric](#)

Educational standards

- NGSS 3-PS2-1
 - ISTE: 4c
 - CCSS.ELA-LITERACY.SL.3.1
- Lesson extension
- CCSS.ELA-LITERACY.W.3.2

Prepare

- Review the online student material. Use a projector to share this material with your students during the lesson.
 - Make sure that you've covered balanced and unbalanced forces in an earlier lesson.
 - Consider the abilities and backgrounds of all of your students. Differentiate the lesson to make it accessible to everyone. See the *Differentiation* section below for suggestions.
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Engage

(Whole Class, 5 Minutes)

- Watch the student video here or access it via the online student material.
 - Facilitate a quick discussion about the forces that are at work in a downhill go-cart or soapbox car race.
 - Ask questions, like:
 - What's a soapbox car race? (*It's a downhill car race using a car without an engine.*)
 - Have you watched one on TV?
 - Which force makes the car roll down the hill? (*Gravity*)
 - Which force makes the car slow down? (*Friction*)
 - What do you think gives winning cars a competitive advantage?
 - Tell the students that they're going to build a ramp and a gravity-powered car, and then experiment to recognize a pattern in the car's motion.
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Explore

(Small Groups, 25 Minutes)

- Have the students work in pairs to build the Gravity Car Derby model. Tell them to take turns, one partner searching for the bricks while the other builds, switching roles after each step has been done.
- You can find support for building in the *Tips* section below.

Experiment 1:

- Have the students place the car chassis without wheels at the top of the ramp, let it go, and observe what happens (*they might need to give it a little push*).

Experiment 2:

- Now ask the students to design and build their own simple car model.
- Direct them to:
 - Include a safety device to keep the Minifigure driver in the slippery seat. You can't win the race if you fall out before the finish line!
 - Use a brick to mark where they predict their car will stop after they let it go from the top of the ramp, measure the predicted distance, and record it on their Student Worksheets.
 - Measure the actual distance it traveled, and mark it on their Student Worksheets (Teacher Support – Additional Resources).

- Encourage them to experiment with different wheel sizes, the weighted brick, and any other variables they can think of to find out what will make their car travel the farthest.
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Explain

(Whole Class, 5 Minutes)

- Gather your students together to review and discuss what they've learned.
 - Ask questions, like:
 - How did the car move down the ramp without wheels? *(It slid down the ramp at a constant speed, which was controlled by the friction between the car and the ramp.)*
 - Sometimes, the driver falls out of the car when it suddenly stops. Why does the driver keep moving even when the car has stopped? *(This force is called "inertia." It can be explained by Newton's first law of motion, which states that an object in motion will stay in motion in the same direction and speed until other forces act upon it.)*
 - What difference did it make when you attached larger wheels to your car? *(less rolling resistance friction, heavier car/more mass)*
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Elaborate

(Whole Class, 10 minutes)

- Allow the students to continue building and experimenting for another 5 minutes to find out whose car goes the farthest, and why.
 - If time allows, ask them to try adding the weighted brick to their cars. Have them predict how far the car will travel, recording their predictions and results on their Student Worksheets.
 - Allow time for the students to disassemble their models, sort the bricks back into the trays, and clean up their workstations.
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Evaluate

(Ongoing Throughout the Lesson)

- Ask guiding questions to encourage them to "think aloud" and explain their thought processes and reasoning in the problem-solving decisions they've made when building their models.

Observation Checklist

- Measure your students' proficiency in describing the effects of balanced and unbalanced forces on the motion of the gravity-powered car.
- Create a scale that matches your needs. For example:
 1. Needs additional support
 2. Can work Independently
 3. Can teach others

Self-Assessment

Have each student choose the brick that they feel best represents their performance:

- Green: I think I can understand the effects of balanced and unbalanced forces on the car's motion.

- Blue: I know I can understand the effects of balanced and unbalanced forces on the car's motion.

- Purple: I can provide evidence of the effects of balanced and unbalanced forces on the motion of a gravity-powered car.

Peer-Feedback

- In their teams, have the students discuss their experiences working together.
- Encourage them to use statements like:
 - I liked it when you...
 - I'd like to hear more about how you...

Tips

Model Tips

- Highlight that the building instructions start with the students building the ramp with the bricks upside down (*pages 88 to 96*).
- When the students finish the building instructions, their cars won't have wheels. They should first test their models without wheels to observe the effects of friction and possibly inertia if the Minifigure driver falls out of the car.
- Squeezing the wheels tightly on an axle against a chassis will add friction and slow the car down. Wiggling the wheels to be just a hair looser will make it roll much farther.

Differentiation

Simplify this lesson by:

- Having your students start by getting their cars to travel as far as possible without the Minifigure (*encourage them to keep their ideas simple*)

Increase the difficulty by:

- Having the students remove the small ramp at the base of the larger ramp to see what happens
 - If time allows, have them reattach the smaller ramp, raising it into a small jump
 - If needed, they can place some bricks on the underside to support it
 - Encourage them to redesign their cars to safely ride over the jump and still travel as far as possible.
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Extensions

(Note: This will require additional time.)

To incorporate language arts skills development, ask your students to create a report or a short video describing the effects of balanced and unbalanced forces on the motion of their gravity-powered cars.

CCSS.ELA-LITERACY.W.3.2