



Physics

Rocket Races

5E Lesson Plan

Source Material: [STEMonstrations: Newton's Third Law](#)
Mission Focused Area: [Aeronautics and Flight](#)

Lesson Overview

In this lesson, students conduct a hands-on activity to investigate Newton's Third Law. Working individually or in pairs, students complete the "Rocket Races" activity found on pages 3-6 of the source material. Students construct "rocket racers" powered with inflated balloons. Instructions for building a basic racer are provided on pages 5-6. Students can modify this basic design or come up with their own unique designs using other materials (optional). Using results from the activity, students explain how it demonstrated Newton's Third Law.

NASA Connection

NASA uses [rockets](#) to launch astronauts and supplies to the International Space Station. Launching a rocket relies on Newton's Third Law of Motion. A rocket engine produces thrust through action and reaction. The engine produces hot exhaust gases which flow out of the back of the engine. A thrusting force is produced in the opposite reaction.

Objectives

- Students predict and make observations about the nature of forces and motion
- Students explain Newton's Third Law of Motion and apply examples to everyday life
- Students investigate Newton's Third Law of Motion by designing and constructing rocket-powered racing cars

Guiding Questions

- What are some other examples of force pairs?
- Did the racer go as far as expected?
- Which direction did the force of the balloon point? Which direction did the racer travel?
- How does this rocket racer demonstrate Newton's Third Law?
- How might the added weight of additional fuel and rockets affect the overall ability of a spacecraft to fly?

Materials

- Styrofoam food trays (like the trays grocery stores use for poultry)
- Small plastic stirrers (round cross section) – 2 per student
- Flexi-straws – 3 per student
- 4- or 5-inch round balloons
- Balloon pump (recommend having at least 4-5 so students can do testing)
- Masking Tape
- Pencils
- Scissors
- Rulers
- Meter stick or measuring tape
- Sandpaper (optional)
- Additional supplies for modifications to cars (rubber bands, cardboard, CDs, etc.)

National STEM Standards

NGSS

- **MS-PS2-1** Apply Newton's Third Law to design a solution to a problem involving the motion of two colliding objects.

5E Instructional Mode



Teacher Action

Engage - [STEMonstrations Video](#)

- Play STEMonstrations video
- Discuss video with student and ask CFU questions

Scripted CFU questions

- What are some other examples of force pairs?

Explore - Design and Build the Rocket Racer

- Prior to lesson, lay out a course in a large open space, preferably on a smooth floor. Stretch out a straight, 10-meter-long line of masking tape, and make a mark at 10 cm intervals (this will help students calculate their distance quickly).

Scripted CFU questions

- Did the racer go as far as expected?
- Which direction did the force of the balloon point? Which direction did the racer travel?

Explain - Analyze Results

- Circulate and observe student answers to the analysis questions
- Show-call exemplary answers and clear up misconceptions students might have about the content

Scripted CFU questions

- How could your design be improved?
- How does this rocket racer demonstrate Newton's Third Law?

Elaborate - Improve Design, Race Cars, Add Thrust

- Hold Rocket Racer drag races. Lay out a 3-meter-long course. The fastest car is the one that crosses the finish line first. Calculate racer average speed by timing start to finish with a stopwatch.

Scripted CFU questions

- How might the added weight of additional fuel and rockets affect the overall ability of a spacecraft to fly?
- Would it be a good idea for automobiles to be powered by rocket engines?
- How are the wheels on a rocket racer similar to and different from wheels on a regular automobile?
- What types of modifications would students like to make that weren't available to them?

Evaluate - Draw a Diagram of Forces Acting on the Rocket Racer

- Discuss results with students; ask for results from different student groups
- Facilitate formative assessment where students draw diagrams of the physics of the rocket racers

Student Action

Engage - [STEMonstrations Video](#)

- Watch STEMonstrations video
- Respond to teacher discussion questions

Explore - Design and Build the Rocket Racer

- Follow procedures on page 4 to design and build a rocket racer with the provided materials
- Conduct tests of the rocket racer and record data in the provided data table



Explain - Analyze Results

- Students answer analysis questions on student handout
- Discuss possible design improvements based on the results



Elaborate - Improve Design, Race Cars, Add Thrust

- Decide on improvements and implement
- Participate in a competition with classmates racing the rocket cars with improvements
- Record results of rocket drag races and other competitions



Evaluate - Draw a Diagram of Forces Acting on the Rocket Racer

- Share and discuss results
- Create a labeled diagram on all forces acting on the rocket along with a written explanation of how the model demonstrates Newton's Third Law

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