

# Engineering Stomp Rockets

## Educator Guide



### ACTIVITY: ENGINEERING STOMP ROCKETS

#### Big Idea

A stomp rocket works based on Newton's Third Law of Motion (for every action, there is an equal and opposite reaction). The rocket is a projectile. Changing the design of the rocket can improve the horizontal distance over which it travels.

#### Guiding Question

How does Newton's Third Law of Motion explain the launch of a stomp rocket? What is a projectile and how can that knowledge be used to improve the distance that the stomp rocket travels?

#### Note to Classroom Educator

We are so glad you have chosen to welcome a content expert into your teaching environment to share excitement about engineering and STEM careers with your students. Use the resources provided in this guide to prepare your students before the visit, to assist the content expert during the visit, and for follow-up with your students after the visit to make this experience as impactful and productive as possible.

Be sure to have a conversation with your classroom visitor at least one week in advance of the scheduled visit to discuss the timing for arrival, including security and general visitor protocol for your school or teaching environment. Let the visitor know how much time will be available (if any) in your educational environment to set up before the instructional period begins. Let the content expert know how many students are in your class and inform him or her about the technology availability and capabilities in your classroom. For example: Do you have a way to show a streaming video? Do you have a projector or a smart board? Is your classroom set up for Mac or PC use?

Share any classroom management techniques you use during instruction so your classroom visitor can communicate effectively with your students. Example: "I clap three times to refocus my students' attention when they get off task." "I whisper directions as a signal for my students to quiet down." The content expert will be interacting with the whole group of students at times and will also want them to work in small groups during his or her visit. Please divide the classroom into well-thought-out working groups of three to four students each before the classroom visit. Let the classroom visitor know how many small groups there will be so enough supplies are brought for each group.

#### Prepare Your Students for the Classroom Visit

Visit [www.classroomengineers.org](http://www.classroomengineers.org) and open the Engineering Stomp Rockets activity, to see the classroom visitor's detailed instructions for using this activity with your students.

Use all or some of the following pre-visit resources to engage your students with Newton's Laws of Motion and projectiles.

#### Background Information for the Classroom Educator

Newton's First Law of Motion states that an object at rest will remain at rest and an object in motion will remain in motion at the same speed and direction unless acted on by a force. Newton's Third Law of Motion states that for every action there is an equal and opposite reaction. Newton's Third Law of Motion plays a part in how a rocket lifts off. As a rocket burns fuel, a hot gas is created and forced out of the back of the rocket. As the gas is expelled, the rocket is propelled with equal force in the opposite direction, once the force exceeds the weight of the rocket.

## Engineering Stomp Rockets

## Educator Guide

Stomp rockets are also launched by expelling a gas (air). However, unlike actual rockets, which continue to expel propellant for a time after launch, this force only acts on the stomp rocket at the moment of its launch. After that, gravity is the only force acting on the rocket. That makes the stomp rocket a projectile. Due to inertia (Newton's First Law of Motion), the rocket will continue to travel in the same direction and at the same speed of its launch until another force (gravity) acts on it. This combination of inertia from the initial launch and the force of gravity gives projectiles an arced trajectory, or path.

Air resistance can also affect the flight of a projectile within Earth's atmosphere. Rockets are shaped aerodynamically with a cone at the leading end to help minimize the effect of air resistance on the rocket's motion. Fins are also included on a rocket to help stabilize the rocket during flight. With a stomp rocket projectile, minimizing air resistance and keeping the rocket stable allow the rocket to travel farther before the force of gravity causes it to fall to Earth.

### Pre-Visit Resources and Activities

- Use the following resources to review Newton's Laws of Motion with students:
  - Simple explanation: Website: TeacherTech-Newton's Laws of Motion  
<http://teachertech.rice.edu/Participants/louviere/Newton/>
  - More advanced explanation: Video: NASA-Newton in Space  
<http://quest.nasa.gov/space/teachers/liftoff/newton.html>
- Use these resources to review projectile motion:
  - Simple explanation: Article: cK-1-Projectile Motion  
<http://www.ck12.org/physics/Projectile-Motion/lesson/Projectile-Motion-Middle-School/r25/>
  - More advanced explanation: Article: NCSEC-Projectile Motion  
[http://www.ncsec.org/cadre2/team1\\_2/pm.htm](http://www.ncsec.org/cadre2/team1_2/pm.htm)
- Pre-teach relevant vocabulary: air resistance, gravity, Newton's Third Law of Motion, projectile

### Post-Visit Resources and Activities

- Have each group choose one of the factors it identified in the wrap-up discussion to improve its rocket design. As a follow-up to the activity, have the groups remake their rocket, adjusting only the factor they selected. Have students design a way to test whether their adjustment improves the performance of their rocket.
- Learn more about rockets and find other rocket activities on NASA-Brief History of Rockets  
[http://exploration.grc.nasa.gov/education/rocket/TRCRocket/history\\_of\\_rockets.html](http://exploration.grc.nasa.gov/education/rocket/TRCRocket/history_of_rockets.html)
- Use the game Angry Birds for more exploration of projectiles, as described in this article:
  - PBS-Teaching Physics with Angry Birds: Projectile Motion  
<http://www.pbs.org/wgbh/nova/blogs/education/2011/02/teaching-physics-with-angry-birds-projectile-motion/>
- Review relevant vocabulary/concepts: air resistance, gravity, Newton's Third Law of Motion, projectile

### For Further Exploration

- Article: NASA-Projectile Flight  
[http://www.nasa.gov/pdf/544893main\\_PS2\\_Projectile\\_Flight\\_C4.pdf](http://www.nasa.gov/pdf/544893main_PS2_Projectile_Flight_C4.pdf)
- Article: Education.com-Projectiles Launched at an Angle  
<http://www.education.com/science-fair/article/aim-shooting-projectile-target/>
- Extension Activity: Try Engineering-Lesson Plans (use keyword "materials")  
<http://www.tryengineering.org/lesson-plans>
- Interactive: Phet-Projectile Motion  
<http://phet.colorado.edu/en/simulation/projectile-motion>

## Engineering Stomp Rockets

## Educator Guide

### National Standards Alignment

- (5-8) Standard A-1: Abilities necessary to do scientific inquiry
- (5-8) Standard B-4: Motions and forces

### Next Generation Science Standards Alignment

- PS2.A: Forces and Motion
- Science and Engineering Practices: Constructing Explanations and Designing Solutions
- Science and Engineering Practices: Developing and Using Models

©2014 National Geographic Society. All rights reserved.