Dynamic Design: Launch and Propulsion

Pop Goes Newton

TEACHER GUIDE

BACKGROUND INFORMATION

In this activity, students continue to study the concept of variables in relation to launching pop rockets. The lesson has the students applying each of Newton's laws of motion to the "Pop Rocket Variables" activity.

The activity demonstrated each of Newton's Laws of Motion. The film canister sat on the floor before lift off, demonstrating that objects at rest remain at rest unless acted on by an unbalanced force (first law). The lift off demonstrated that the pressure of the gas generated by the water-antacid reaction caused an unbalanced force resulting in upward movement. This movement continued until the force of gravity caused the canister to move downward, demonstrating that objects in motion remain in motion unless acted upon by an unbalanced force (first law). The force of the floor or ground pushing up on the canister at rest and the canister pushing on the ground demonstrated that for every action there is an equal and opposite reaction (third law). Also, the canister traveled upward with a force that is equal and opposite to the downward force propelling the water, bubbles, and lid. The acceleration of the canister is directly proportional to the amount of force on the canister, and inversely proportional to the mass of the water, gas, and canister, demonstrating a=f/m. Students will analyze each step in the "Pop Rocket Variable" activity and match this with the appropriate law of motion.

The National Science Education Standards call for students to develop descriptions, explanations, predictions, and models using evidence. "Students should base their explanations on what they observed, and as they develop cognitive skills, they should be able to differentiate explanation from descriptions-providing causes for effects and establishing relationships based on evidence and logical argument." (NRC, 1996) In this activity students make detailed descriptions of events from the "Pop Rocket Variable" activity. Then they state the Law that corresponds with the description followed by an explanation.

NATIONAL SCIENCE STANDARDS ADDRESSED

Grades 5-8

Science As Inquiry

Abilities Necessary to do scientific inquiry

Physical Science

Motion and Forces

Science and Technology

Understandings about science and technology

Science in Personal and Social Perspectives

Science technology and society

History and Nature of Science

History of science

Teaching Tip

An image of teaching force and motion using essential features of inquiry is presented in *Inquiry and the National Science Education Standards.* The lesson detailed could preceed this activity and provide students with experience relating to fundamental concepts of force and motion.

Grades 9-12

Science As Inquiry

Abilities Necessary to do scientific inquiry

Physical Science

Motion and Forces

Science and Technology

Understandings about science and technology

History and Nature of Science

Historical Perspectives

(View a full text of the National Science Education Standards.)

MATERIALS

For each group of three to four students:

- Student Activity, "Pop Goes Newton"
- Student Text, "Newton's Laws of Motion"
- (Optional) *Newton In Space* Liftoff to Learning Video

Alternate Strategy Tip

Before the students read the student text, show them the short (12 minute) NASA video *Newton In Space* . This short video shows Newtons Laws of Motion in an everyday fun context.

PROCEDURE

1. Distribute the Student Text "Newton's Laws of Motion" and assign this to be read before the students begin the student activity. Review the concepts in the text by having students explain Newton's three laws using their own words and examples from their everyday lives.

2. Distribute the Student Activity, "Pop Goes Newton" to each person in the class. You may choose to have students work on this activity in groups or individually. Review the background information and explain that they are going to be taking another look at the "Pop Rocket Variable" activity and applying what they have read about Newton's Laws to that activity.

3. Show students the procedure on the student activity and point out the example item that has been done for them. Ask if there are any questions. Allow students time to complete the activity. Circulate around the room offering assistance to those who have questions or need help.

4. Once everyone has finished the activity, have student volunteers read their descriptions, laws, and explanations. During this time, challenge students to listen to the descriptions and explanations, allowing those who are listening to ask questions, or seek clarification on what has been read.

5. Conclude the activity by having students write in their journals about what they have learned today. Instruct them to use their activity sheets to summarize Newton's three laws of motion in their own words.

TEACHER RESOURCES

Publications

National Aeronautics and Space Administration. (1996). Rockets: A Teacher's Guide with Activities in Science Mathematics, and Technology. Office of Human Resources and Education. Washington, DC.

National Research Council. (2000). *Inquiry and the National Science Education Standards.* National Academy Press. Washington, D.C.

Web sites

http://spacelink.nasa.gov/Instructional.Materials/NASA.Educational.Products/Newton.In.Space/

NASA Video and Resource Guide for *Newton In Space*

http://www-groups.dcs.st-and.ac.uk/~history//Mathematicians/Newton.html

Newton biography

http://www.maths.tcd.ie/pub/HistMath/People/Newton/RouseBall/RB_Newton.html
Newton biography from A Short Account of the History of Mathematics' (4th edition, 1908) by W. W. Rouse Ball.

http://www.newton.cam.ac.uk/newton.html
Isaac Newton Resources, includes many Web links