Newton's First Law:
Inertia and Unbalanced Forces

Duration:
1-2 class periods

Essential Questions:

What are the properties of inertia?

How do common experiences with unbalanced forces help us to understand Newton's First Law?

Objectives: Students will…

see that an object at rest remains at rest unless an unbalanced force acts on it

see that an object in motion will remain in motion unless acted upon by an unbalanced force

see that an object in motion will change that motion if acted upon by an unbalanced force

Science Concept:

Newton's First Law of motion states that a body at rest will remain at rest unless acted upon by an unbalanced force. It also states that a body in motion will maintain that motion, in the same direction and with the same speed, unless acted upon by an unbalanced force.

About this Poster

The Swift Gamma-Ray Burst Explorer is a NASA mission which is observing the highest energy explosions in the Universe: gamma-ray bursts (GRBs). Launched in November, 2004, Swift is detecting and observing hundreds of these explosions, vastly increasing scientists' knowledge of these enigmatic events. Education and public outreach (E/PO) is one of the goals of the mission. The NASA E/PO Group at Sonoma State University develops classroom activities inspired by the science and technology of the Swift mission, which are aligned with the national standards. The front of the poster illustrates Newton's First Law. Descriptions of the drawings can be found on the next page. This poster and activity are part of a set of four educational wallsheets aimed at grades 6-9; they can be displayed as a set or separately in the classroom.

The activity provides a simple illustration of Newton's First Law. The activity is complete and ready to use in your classroom; the only extra materials you need are listed on page 6. The activity is designed and laid out so that you can easily make copies of the student worksheet and the other handouts.

The NASA E/PO Group at Sonoma State University is:
• Prof. Lynn Cominsky - Project Director,
• Dr. Phil Plait - Education Resource Director,
• Sarah Silva - Program Manager,
• Tim Graves - Information Technology Consultant,
• Aurore Simonnet - Scientific Illustrator,
• Laura Dilbeck - Project Assistant,

We gratefully acknowledge the advice and assistance of Dr. Kevin McLin, the NASA Astrophysics division Educator Ambassador (EA) team, and the West Ed educator review panel. This poster set represents an extensive revision of the materials created in 2000 by Dr. Laura Whitlock and Kara Granger for the Swift E/PO program.

The Swift Education and Public Outreach website is
http://swift.sonoma.edu
This poster and other Swift educational materials can be found at: *http://swift.sonoma.edu/education/*
National Science Education Standards and Mathematics Standards for the set of four Newton's Law wallsheets can be found at:
http://swift.sonoma.edu/education/newton/standards.html

Description of the Front of the Poster:

Figure skater: To begin moving, a figure skater must apply a force using her skates. Once in motion, she'll continue to glide along the ice in a straight line for a long time unless she applies another force.

Hands pulling on rope: When each end of a rope is pulled, the rope will move in the direction of whoever is pulling harder – whoever is applying more force. In this case, the magnitude or strength of A (on the right) is greater than that of B (on the left), so the rope accelerates to the right.

Snowboarder: A snowboarder experiences a force due to gravity which pulls her down. She will move in a straight line unless she applies a force to the board, changing direction.

Train: A train is a very massive object, and therefore has a lot of inertia. Once in motion, it is very difficult to stop, requiring a very large force to slow it.

Jogger: A jogger experiences many forces while running: gravity, the push of her feet, the friction of her shoes on the ground, and air resistance. Her legs, together with the friction of her shoes, overcomes her inertia to propel her forward.

Car hitting the wall: A car rolling down a hill is being moved by the force of gravity. When the car hits the wall, the greater inertia of the wall stops it. But anything not attached to the car will still move forward, so the man running after the car will lose his coffee, his lunch, and his briefcase.

Background Information for Teachers:

Sir Isaac Newton (1642-1727) established the scientific laws that govern 99% or more of our everyday experiences – from how the Moon orbits the Earth and the planets orbit the Sun to how a hockey puck slides over ice, a person rides a bicycle, or a rocket launches a satellite into space. Newton's Laws are considered by many to be the most important laws of all physical science. They are also a great way to introduce students to the concepts, applications, vocabulary, and methods of science.

Newton's Laws are related to the concept of motion: Why does an object move the way it does? How does the object accelerate or decelerate? To understand these things, we need to understand the relationship between force and motion.

Forces can cause motion. But what exactly is a force? We can think of a force as a push or a pull. A force has a direction as well as a magnitude; such quantities are called vectors. In a diagram, a force can be represented by an arrow indicating its two qualities: The direction of the arrow shows the direction of the force (push or pull). The length of the arrow is proportional to the magnitude (or strength) of the force.

Swift Satellite - *http://swift.gsfc.nasa.gov*

• NASA Education Resources:
The Space Place - *http://spaceplace.nasa.gov*
Imagine the Universe! - *http://imagine.gsfc.nasa.gov*

• NASA's Central Operation of Resources for Educators (CORE):
http://education.nasa.gov/edprograms/core/home/index.html
Check out these videos:
"Liftoff to Learning: Newton in Space" (1992), $15.00
"Flight Testing Newton's Laws" (1999), $24.00

• NASA's Space Science Education Resource Directory:
http://teachspacescience.org

• Newton's Laws of Motion:
http://www-istp.gsfc.nasa.gov/stargaze/Snewton.htm
http://www.grc.nasa.gov/WWW/K-12/airplane/newton.html

• Newton's Law of Gravitation:
http://csep10.phys.utk.edu/astr161/lect/history/newtongrav.html

• Newton in the Classroom:
http://www.physicsclassroom.com/Class/newtlaws/newtltoc.html
http://www.glenbrook.k12.il.us/gbssci/phys/Class/newtlaws/u2l1a.html

• The Nine Planets:
http://seds.lpl.arizona.edu/nineplanets/nineplanets/nineplanets.html
http://seds.lpl.arizona.edu/nineplanets/nineplanets/data1.html