

PSI:

PHYSICAL SCIENCE INVESTIGATION



Teacher's Lesson Description

Title	Eggs-treme Impact
Brief Description of the Videos	In this series of videos, Dante will throw a raw egg, in its shell, against a bed sheet. An egg traveling at a high rate of speed should break when it hits, shouldn't it? Dante will try to retrieve the egg, unbroken from the trough at the bottom of the sheet. So why do some things "break" upon collision, and other things don't?
Time Needed	1 class period
Ohio Science Benchmarks Addressed in This Activity	Physical Science, 6-8 Benchmark B Scientific Inquiry, 6-8 Benchmark A, B Scientific Ways of Knowing, 6-8 Benchmark A
Ohio Grade Level Indicators Addressed in This Activity	Physical Science Benchmark B 8 th Grade Forces and Motion Indicator 3 Scientific Inquiry Benchmark A 6 th Grade Procedures in Investigations Indicator 2 7 th Grade Procedures in Investigations Indicator 4 8 th Grade Procedures in Investigations Indicator 1 Scientific Inquiry Benchmark B 7 th Grade Doing Scientific Inquiry Indicator 6 8 th Grade Doing Scientific Inquiry Indicator 4 Scientific Ways of Knowing Benchmark A

Grade 8 Nature of Science Indicator 1	
Concepts Developed	<p>Objects traveling at a high rate of speed have a great deal of energy and are not easily stopped. Commercial goods, people and pets all travel frequently and often at a high rate of speed on streets and interstate highways. Stopping these items safely is very important. The forces that act on objects when they stop rapidly (change in momentum) are sometimes referred to as “impulse”. The Impulse-Momentum Equation describes these changes, and understanding the reduction of force or ways to increase the time of collision will help students grasp the essentials of safety equipment and staying safe.</p>
Lesson Rationale	<p>Demonstrating with simple materials how a fragile object, such as the egg, can be stopped safely will help the students appreciate the physics of forces and how other structures can help safely transport people, pets and goods.</p>
Background Knowledge for Teachers	<p>Review the “teacher video” and student video segments. This segment allows the students to see the extreme conditions of a usually fragile egg traveling at a high rate of speed and then see it emerge unbroken at the end. It dramatizes the fact that if the force can be reduced enough and the time of collision increased as well, the egg will not break. Imagine the often used picnic game of water balloon or egg toss. If we catch either object in our hands, on the softest part and then lengthen the stopping procedure, by moving our hands back with object, we stay dry or clean for the return toss.</p> <p>The Impulse-Momentum Equation says that the product of the force, measured in Newton’s, exerted on the egg by the hand multiplied by the time, in seconds, equals the momentum (which is the product of mass, in Kilograms, and velocity, in meters per second. This is true when the egg is thrown, which we are not concentrating on now. It is equally and more dramatically true when the egg is stopped by the sheet. The force on the egg exerted by the sheet upon impact, in Newton’s, multiplied by the time of collision with the sheet, measured in seconds will equal the Momentum; a product of the mass, in Kilograms multiplied by the velocity, in meters per second as the egg strikes the sheet.</p> <p>This concept can be applied to any accelerating system-speeding up or slowing down. The key to safety is to find the right combination of forces and times, thus the creative packaging, passive</p>

	and active restraints.
Classroom Procedures	<p>Before viewing the video, construct a T-chart with headings of Observation on one column and Inference heading the other column. Remind the students of the definitions and ask them to complete the chart as they watch the video. Allow them to ask questions when the action is stopped and help them clarify where certain information goes. Help them understand the concept and use the vocabulary that is suggested. Show the video again, if needed, to be sure they see what really happened and that their inferences are properly noted. Discuss safety features they observe and why they should be engaged to keep them and pets or cargo safe. Have them write a final explanation at the bottom of the chart to see that they grasp the concepts.</p>
Materials Needed	A raw egg, a fitted bed sheet, brave volunteers with goggles, powerful (and accurate) throwers (in an open area in case the egg goes astray.)
Science Connections	<p>We all read or hear about injuries or deaths when seat belts are not worn. We need students to understand the science behind it. They should understand that seatbelts and air bags will increase the time of stopping as well as reduce the force on the body-avoid the head into the windshield or steering wheel. People have been paralyzed when unrestrained cargo, slides forward in an accident and crushes the driver. Now cargo vans have nets or harnesses that stop the sliding cargo.</p> <p>Many students have had experience with the picnic game, “Water Balloon Catch”. Ask them to discuss how their knowledge of collisions and momentum can be applied to make longer and longer catches in which the balloon doesn’t break. A related, but opposite effect, is that you can throw the balloon so hard that its initial acceleration provides greater force than those holding the balloon together, so it breaks open as you throw it. Have a discussion about how this understanding of physics is useful to a receiver and quarterback in football, or a fielder in baseball.</p>
Additional Web Resources	<p>Here are some other “Collision” activities: http://www.physics.umn.edu/outreach/pforce/circus/collisions.html</p>

<http://serc.carleton.edu/sp/compadre/interactive/examples/19121.html>

A good description of the relationship between momentum and impulse is located here:

<http://www.glenbrook.k12.il.us/gbssci/Phys/Class/momentum/u4l1c.html>

The Science of Airbags

<http://tristanmac.tripod.com/id8.html>

How Stuff Works – How an Airbag Works

<http://www.howstuffworks.com/airbag.htm>

Egg Drop Competition Ideas

http://en.wikipedia.org/wiki/Egg_drop_competition

Crumple Zones – Safety Built Into Your Car:

http://en.wikipedia.org/wiki/Crumple_zone

How to Catch a Football Video (watch and listen for the Physics!)

http://www.ehow.com/video_3991_catch-football.html

Ohio Science Standards Abbreviations:

ES – Earth/Space Science

SI – Scientific Inquiry

LS – Life Sciences

ST – Science and Technology

PS – Physical Sciences

SW – Scientific Ways of Knowing