

Physics – Momentum and Impulse – Car Safety Engineering (egg drop)

	Intro to Momentum	Conservation of Momentum	Impulse
Student Experience	<p>Students brainstorm the meaning of momentum.</p> <p>Students use different balls to investigate what the factors are in momentum.</p>	<p>Students qualitatively experiment with elastic collisions to construct the conservation of momentum.</p> <p>Teacher leads a demonstration of elastic and inelastic collisions with a Newton's Pendulum.</p>	<p>Students design and carry out an investigation to identify the differences between when a ball is dropped on a book versus a ball dropped on a foam pad. Then, students identify the factors involved in the difference.</p> <p>Students participate in a water balloon toss. They write about how the toss relates to the impulse equation.</p>
T4T Material	Golf balls. Also needed, ping pong balls and marbles.	1 Clear tube, tube cut in half or some other channel, 1 Golf ball, 1 ping pong ball, 1 marble per group. A Newton's Pendulum for a demo.	One golf ball, a book and a foam pad per group. Additionally, one water balloon per pair.
Big Idea	Momentum = mass x velocity	Momentum is conserved. Elastic and Inelastic collisions have similar but different equations.	$Ft = \Delta mv$ A cushioned landing takes more time.
Connection to Culminating Activity	Definition and equation of momentum	Momentum can be changed.	This is the central concept for the Culminating Activity.
CA Standards	PH2. d; IE1. j	PH2. g; IE1. j	PH2. f; IE1. j
Next Generation Science Standards	HS-PS2-2 Asking questions and defining problems. Analyzing and interpreting data. Constructing explanations and designing solutions.	HS-PS2-2, 3 Asking questions and defining problems. Analyzing and interpreting data. Constructing explanations and designing solutions.	HS-PS2-1 Asking questions and defining problems. Analyzing and interpreting data. Constructing explanations and designing solutions.
Time	One 55 min period	Two 55 min periods	One 55 min period

Culminating Activity – Car Safety Engineering

	Force to Break Egg Test	Materials Test	The Drop and Write up
Student Experience	Students are introduced to the Culminating Activity (if not done at the beginning of unit)	Students design and carry out a test to determine which material will best help their egg survive.	Students design and build a device (vehicle) that minimizes the force on an egg, after the device is dropped from a height to collide with the ground.
T4T Material	Students design and carry out a test to determine the force required to break an egg. One egg per pair, in a baggie. Mass, spring scales or house scales, meter sticks, stop watches. *Water balloons can be used as an alternative.	The Cart	One egg per pair. The Cart. *Water balloons can be used as an alternative.
Big Idea	How much force can an egg withstand?	Designing a controlled experiment. Thinking about how the testing of materials helps students understand the Impulse Equation better.	$Ft = \Delta mv$
CA Standards	-----	-----	PH2. f
Next Generation Science Standards	HS-PS2-1, 3 Asking questions and defining problems. Analyzing and interpreting data. Constructing explanations and designing solutions.	HS-PS2-1, 3 Asking questions and defining problems. Analyzing and interpreting data. Constructing explanations and designing solutions. Engaging in Argument from Evidence	HS-PS2-1, 2, 3 Asking questions and defining problems. Analyzing and interpreting data. Constructing explanations and designing solutions. Engaging in Argument from Evidence
Time	One 55 min period	One 55 min period	Two 55 min periods

Total Time: about eight 55-min periods.

These lessons are not intended to be a complete unit, but, rather a learning activity guide for concept attainment. Teachers should supplement these lessons with appropriate reading material and problem sets.