



# Honors Physics - Unit 6 - Momentum

## Unit Focus

This unit focuses on Newton's Third Law of Motion, specifically on the resulting change in motion on two objects when they collide, and the effect of an object exploding on the resultant pieces of the object after the explosion. Students will look at the impact of safety features in automobiles (seat belts, air bags, crumple zones) and why they are designed and how their implementation results in less force on the driver. Ultimately, students will apply their understanding of the content to analyze a car crash and present their scientifically-based conclusions in a mock trial.

## Stage 1: Desired Results - Key Understandings

Standard(s)	Transfer	
<p><b>Next Generation Science</b> <i>High School Physical Sciences: 9 - 12</i></p> <ul style="list-style-type: none"> <li>Use mathematical representations to support the claim that the total momentum of a system of objects is conserved when there is no net force on the system. <i>HS-PS2-2</i></li> </ul>	<p><b>T1</b> Analyze qualitative and quantitative data to interpret patterns, draw conclusions, and/or make predictions. <b>T2</b> Communicate effectively based on purpose, task, and audience to promote collective understanding and/or recommend actions.</p>	
<p><b>Next Generation Science Standards (DCI)</b> <i>Science: 12</i></p> <ul style="list-style-type: none"> <li>Momentum is defined for a particular frame of reference; it is the mass times the velocity of the object. <i>PS2.9.A2</i></li> <li>If a system interacts with objects outside itself, the total momentum of the system can change; however, any such change is balanced by changes in the momentum of objects outside the system. <i>PS2.9.A3</i></li> </ul>	Meaning	
	Understanding(s)	Essential Question(s)
<p><b>NGSS/NSTA Science &amp; Engineering Practices</b> <i>NGSS Science &amp; Engineering Practices: 9-12</i></p> <ul style="list-style-type: none"> <li>Construct and revise an explanation based on valid and reliable evidence obtained from a variety of sources (including students' own investigations, models, theories, simulations, peer review) and the assumption that theories and laws that describe the natural world operate today as they did in the past and will continue to do so in the future. <i>SE.9-12.6.2</i></li> </ul>	<p><b>U1</b> While energy within a system is continually changing forms, and being transferred, the total energy of the system is conserved. <b>U2</b> When two objects within a system collide, the total momentum within the system is conserved.</p>	<p><b>Q1</b> What happens when objects collide? <b>Q2</b> What do the results tell me? What patterns do I see or what conclusions can I draw?</p>
	Acquisition of Knowledge and Skill	
	Knowledge	Skill(s)
	<p><b>K1</b> Momentum is a vector <b>K2</b> Momentum is always conserved in a collision between objects ; kinetic energy is not always conserved depending on the nature of the collision <b>K3</b> The momentum of an object can be changed by applying an unbalanced force over a period of time. We call this force acting for a certain time impulse. Impulse is also a vector and has the same units as momentum (kg m/s)</p>	<p><b>S1</b> Calculating the velocity of an object(s) after a collision given initial conditions <b>S2</b> Determining if a collision is completely elastic or inelastic by analyzing the energy of the objects in the collision. <b>S3</b> Applying previous concepts (energy, kinematics, forces) to solve complex problems involving collisions or explosions.</p>

## Stage 1: Desired Results - Key Understandings

- Apply scientific ideas, principles, and/or evidence to provide an explanation of phenomena and solve design problems, taking into account possible unanticipated effects *SE.9-12.6.3*
- Apply scientific reasoning, theory, and/or models to link evidence to the claims to assess the extent to which the reasoning and data support the explanation or conclusion. *SE.9-12.6.4*

### Madison Public Schools Profile of a Graduate

#### *Critical Thinking*

- Analyzing: Examining information/data/evidence from multiple sources to identify possible underlying assumptions, patterns, and relationships in order to make inferences. (POG.1.2)

#### *Creative Thinking*

- Idea Generation: Studying a problem, need or model (mentor text, political piece, documents, art work, etc.) to consider limitations and imagine new solutions/transformations. (POG.2.1)

**K4** Safety devices increase the time of a collision to reduce the force experienced by the object in the collision

**K5** Momentum is the product of mass and velocity.