Science
Physics: Honors
Unit 5: Momentum

Essential Understandings	▪ Conceptual: o The reoccurring fundamental principles elaborated in physics have uses and implications in every dimension of modern life. o Physics seeks to analyze and understand every system as a demonstration of the cause-effect relationship. ▪ Computational: o Physics quantifies each variable of a system in order to describe, analyze and understand it. o A variety of problem solving techniques make use of a system's quantities to investigate the conceptual relationships evidenced within the system. o Numerical problem solving is an essential component in developing a clear understanding of the conceptual relationships identified within any system.
Essential Questions	▪ What is the difference between conservative and nonconservative forces? ▪ When is mechanical energy conserved? ▪ What is the difference between impulse and impact? ▪ How are elastic and inelastic collisions the same and how are they different? ▪ How does the center of mass of a complex object move?
Essential Knowledge	▪ Linear momentum is a vector that is the product of mass and velocity. ▪ The total momentum of a system is the vector sum of individual momenta. ▪ Newton's Second Law can be stated as the change in momentum divided by the time interval. ▪ Impulse is the change of momentum and also the average force times the time that the force is applied. ▪ Thrust is the change of mass times the velocity divided by the time interval.
Vocabulary	▪ Terms: o linear momentum, impulse, impact, recoil, inelastic collisions, elastic collisions, center or mass, thrust
Essential Skills	▪ Calculate the total momentum of a system. ▪ Calculate the impulse experienced in a collision. ▪ Find the final velocity of the object that results from a perfectly inelastic collision. ▪ Determine the final velocities of each object after an elastic collision. ▪ Determine the center of mass of a complex object.

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Related Maine Learning Results	Science and Technology A. Unifying Themes A1.Systems Students apply an understanding of systems to explain and analyze man-made and natural phenomena. a. Analyze a system using the principles of boundaries, subsystems, inputs, outputs, feedback, or the system's relation to other systems and design solutions to a system problem. b. Explain and provide examples that illustrate how it may not always be possible to predict the impact of changing some part of a man-made or natural system. B. The Skills and Traits of Scientific Inquiry and Technological Design B2.Skills and Traits of Technological Design Students use a systematic process, tools and techniques, and a variety of materials to design and produce a solution or product that meets new needs or improves existing designs. a. Identify new problems or a current design in need of improvement b. Generate alternative design solutions. c. Select the design that best meets established criteria. d. Use models and simulations as prototypes in the design planning process. e. Implement the proposed design solution. f. Evaluate the solution to a design problem and the consequences of that solution. g. Present the problem, design, process, and solution to a design problem including models, diagrams, and demonstrations. C. The Scientific and Technological Enterprise C4.History and Nature of Science Students describe the human dimensions and traditions of science, the nature of scientific knowledge, and historical episodes in science that impacted science and society. a. Describe the ethical traditions in science including peer review, truthful reporting, and making results public. b. Select and describe one of the major episodes in the history of science including how the scientific knowledge changed over time and any important effects on science and society. c. Give examples that show how societal, cultural, and personal beliefs and ways of viewing the world can bias scientists. d. Provide example of criteria that distinguish scientific explanations from pseudoscientific ones.

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Related Maine Learning Results	D. The Physical Setting D3. Matter and Energy Students describe the structure, behavior, and interactions of matter at the atomic level and the relationship between matter and energy. j. Describe how in energy transformations the total amount of energy remains the same, but because of inefficiencies (heat, sound, and vibrations) useful energy is often lost through radiation or conduction. D4. Force and Motion Students understand that the laws of force and motion are the same across the universe. a. Describe the contribution of Newton to our understanding of force and motion, and give examples of and apply Newton's three laws of motion and his theory of gravitation.
Sample Lessons And Activities	▪ Read the text book and complete the examples presented. ▪ Individually answer conceptual questions and solve problems. ▪ Collectively discuss the answers and solutions in class. ▪ Discuss real world examples of concepts presented in the textbook and encountered in the real world. ▪ Use Pasco data collection system to quantitatively explore elastic and inelastic collisions.
Sample Classroom Assessment Methods	▪ Evaluate homework assignments. ▪ Assess understanding in classroom discussions. ▪ Grade and discuss laboratory reports. ▪ Evaluate written formative and summative assessments with real world conceptual questions and numerical problems.
Sample Resources	▪ Publications: o Physics Second Edition - James S. Walker ▪ Videos: o Mechanical Universe Video Series ▪ Other Resources: o Companion Website: http://physics.prenhall.com/walker o Physics Demonstrations in Mechanics o Pasco's Data Studio program