Haddon Township High School
Course Overview

Subject Area: Science
Course Name: Physics

Summary: This year-long laboratory course is designed for juniors and seniors who wish to continue their study of the most fundamental subject of all physical sciences. Topics to be examined include motion, mechanics, energy, astronomy, and waves. There is a focus on the relationship between these concepts and the practical application of mathematics. Mathematics (algebra, geometry, and basic trigonometry) plays a major role in helping to define the relationships describing physical phenomena. In addition, historical and social implications will be addressed as they become relevant. Students taking this course will be well prepared to take an introductory college physics course.

Unit Title	Student Learning Target	Standards	Resources	Assessments
Measurements and Tools	*Students will ...* • Identify activities and fields that involve the major areas within physics. • Describe and apply the processes of the scientific method. • Describe the role of models and diagrams in physics. • List basic SI units and the quantities they describe. • Convert measurements into scientific notation. • Distinguish between accuracy and precision. • Use significant figures in measurements and calculations. • Interpret data in tables and graphs, and recognize equations that summarize data. • Distinguish between	5.1 Science Practices: Science is both a body of knowledge and an evidence-based, model-building enterprise that continually extends, refines, and revises knowledge. The four Science Practices strands encompass the knowledge and reasoning skills that students must acquire to be proficient in science. 9.1 21st Century Life & Career Skills: All students will demonstrate the creative, critical thinking, collaboration, and problem-solving skills needed to function successfully as both global citizens and workers in diverse ethnic and organizational cultures.	Serway, R.A. & Faughn, J.S. *Holt Physics*, 2006. Holt, Rinehart, and Winston Computers, poster board or paper, markers, colored pencils, rulers, magazines, glue	Imagine you are employed by a science supply company to design science posters for the classroom. You must create a poster depicting the possible ranges of measurement for a dimension, such as distance, time, temperature, speed, or mass. Depict examples from the very large to the very small, using the appropriate SI units and prefixes. Also include several examples involving the English system of measurement that are typical of your own experiences.

	conventions for abbreviating units and quantities. Use dimensional analysis to convert from one measurement unit to another.			
Motion and Vectors	*Students will ...* • Describe motion in terms of frame of reference, displacement, time, and velocity. • Calculate the displacement of an object traveling at a known velocity for a specific time interval. • Construct and interpret graphs of position versus time. • Apply kinematic equations to calculate distance, time or velocity under conditions of constant acceleration. • Calculate displacement, time, and velocity at various points in the motion of a free falling object. • Compare the motions of different objects in free fall. • Distinguish between a vector and scalar. • Add and subtract vectors using the graphical method. • Apply the Pythagorean	5.1 Science Practices: Science is both a body of knowledge and an evidence-based, model-building enterprise that continually extends, refines, and revises knowledge. The four Science Practices strands encompass the knowledge and reasoning skills that students must acquire to be proficient in science. 5.2 Physical Science: Physical science principles, including fundamental ideas about matter, energy, and motion, are powerful conceptual tools for making sense of phenomena in physical, living, and Earth systems science. 9.1 21st Century Life & Career Skills: All students will demonstrate the creative, critical thinking, collaboration, and problem-solving skills needed to function successfully as both global citizens and workers in diverse ethnic and organizational cultures.	Serway, R.A. & Faughn, J.S. *Holt Physics*, 2006. Holt, Rinehart, and Winston Lancor, R. 2009. *Wiffle Ball Physics*, The Science Teacher, Sept. 2009. Wiffle balls and bats, stopwatches, meter sticks or trundle wheels	The following problem is presented: What information is needed to calculate the initial velocity of a ball as it is hit by a batter? The necessary equations will be identified and a diagram drawn. Students in groups of four will then use a wiffle ball and bat to measure the variables and calculate the initial velocity. Additional investigative questions will be answered. *Alternative choice*: You are helping NASA engineers design a basketball court for a colony on the moon. How do you anticipate the ball's motion compared with its motion on Earth? What changes will there be for the players – how they move, how they throw the ball? What changes would you recommend for the size of the court, the basket height, and other regulations in order to adapt the sport to the moon's low gravity? Create

	theorem and trigonometry functions to the solutions of vector problems. • Describe the path of a projectile as a parabola. • Resolve vectors into their components and apply kinematic equations to solve problems involving projectile motion. Describe relative velocity situations in terms of frame of reference.			a presentation with your suggestions and include the physics concepts behind your recommendations.
Forces	*Students will:* • Describe how force affects the motion of an object. • Explain the relationship between the motion of an object and the net external force acting on the object. • Calculate the net external force on an object. • Describe an object's acceleration in terms of its mass and the net force acting on it. • Predict the direction and magnitude of the acceleration caused by a known net force. • Identify action-reaction pairs. • Explain the difference between mass and weight.	5.1 Science Practices: Science is both a body of knowledge and an evidence-based, model-building enterprise that continually extends, refines, and revises knowledge. The four Science Practices strands encompass the knowledge and reasoning skills that students must acquire to be proficient in science. 5.2 Physical Science: Physical science principles, including fundamental ideas about matter, energy, and motion, are powerful conceptual tools for making sense of phenomena in physical, living, and Earth systems science. 9.1 21st Century Life & Career Skills: All students will demonstrate the	Serway, R.A. & Faughn, J.S. *Holt Physics*, 2006. Holt, Rinehart, and Winston Dynamics carts, hooked masses, string, pulleys, clamps, balances, recording timers and tape, stopwatches, graph paper	With the use of a dynamic cart, students will compare the accelerations of a mass acted on by different forces, and compare the accelerations of different masses acted on by the same force. The data will be organized in a table and then graphed. The relationships between mass, force, acceleration and Newton's laws of motion will be analyzed.

	• Use coefficients of friction to calculate frictional force. • Apply Newton's law of universal gravitation to solve gravitational force problems.	creative, critical thinking, collaboration, and problem-solving skills needed to function successfully as both global citizens and workers in diverse ethnic and organizational cultures.		
Work and Energy	*Students will:* • Recognize the difference between the scientific and ordinary definitions of work. • Calculate net amount of work done when one force or many forces are applied to an object. • Calculate the kinetic energy of an object. • Classify different types of potential energy. • Calculate the potential energy associated with an object's position. • Identify situations in which conservation of mechanical energy is valid. • Solve problems using conservation of mechanical energy. • Relate the concepts of energy, time, and power. Calculate power given work or velocity.	5.1 Science Practices: Science is both a body of knowledge and an evidence-based, model-building enterprise that continually extends, refines, and revises knowledge. The four Science Practices strands encompass the knowledge and reasoning skills that students must acquire to be proficient in science. 5.2 Physical Science: Physical science principles, including fundamental ideas about matter, energy, and motion, are powerful conceptual tools for making sense of phenomena in physical, living, and Earth systems science. 9.1 21st Century Life & Career Skills: All students will demonstrate the creative, critical thinking, collaboration, and problem-solving skills needed to function successfully as both global citizens and workers in diverse ethnic	Serway, R.A. & Faughn, J.S. *Holt Physics*, 2006. Holt, Rinehart, and Winston PSEG electric meter model, information charts, sample data tables Internet web sources that are appropriate references	Students will complete a home energy audit. Electric and natural gas meters will be monitored for at least a two-week period. Electrical appliance use will also be monitored and related to meter readings so that a more complete understanding of reliance on electric power and need for energy conservation will be reached.

		and organizational cultures.		
Momentum and Collisions	*Students will:* • Compare the momentum of different moving objects. • Identify examples of change in the momentum of an object. • Describe changes in momentum in terms of force and time. • Compare the total momentum of two objects before and after they interact. • State the law of conservation of momentum. • Calculate the final velocities of objects after collisions, given the initial velocities. • Identify different types of collisions. Compare conservation of momentum and conservation of kinetic energy in perfectly inelastic and elastic collisions.	5.1 Science Practices: Science is both a body of knowledge and an evidence-based, model-building enterprise that continually extends, refines, and revises knowledge. The four Science Practices strands encompass the knowledge and reasoning skills that students must acquire to be proficient in science. 5.2 Physical Science: Physical science principles, including fundamental ideas about matter, energy, and motion, are powerful conceptual tools for making sense of phenomena in physical, living, and Earth systems science. 9.1 21st Century Life & Career Skills: All students will demonstrate the creative, critical thinking, collaboration, and problem-solving skills needed to function successfully as both global citizens and workers in diverse ethnic and organizational cultures.	Serway, R.A. & Faughn, J.S. *Holt Physics*, 2006. Holt, Rinehart, and Winston The Physics Classroom. 1996-2010. Internet site. Understanding Car Crashes video, 2000. Insurance Institute for Highway Safety. Sample police accident report and accident forms, graph paper, protractors, metric rulers, "Understanding Car Crashes" video.	Students will investigate an automobile accident from a police accident report. From report information and measurements, students will draw diagrams and discern the drivers' actions and the resulting collision damage and injury to drivers and passengers.
Circular and Rotational Motion	*Students will:* • Solve problems involving centripetal acceleration. • Solve problems involving centripetal force. • Explain how the apparent	5.1 Science Practices: Science is both a body of knowledge and an evidence-based, model-building enterprise that continually extends,	Serway, R.A. & Faughn, J.S. *Holt Physics*, 2006. Holt, Rinehart, and Winston Fay, Glenn, Jr. "Using a	Working in small teams of 3 or 4, students will select a toddler or child toy that displays at least two of the three motions: translational, vibrating, and

	existence of an outward force in circular motion can be explained as inertia resisting the centripetal force. • Distinguish between torque and force. • Calculate the magnitude of a torque on an object. Recognize an example of an object with translational, vibrating, and rotational motions.	refines, and revises knowledge. The four Science Practices strands encompass the knowledge and reasoning skills that students must acquire to be proficient in science. 5.2 Physical Science: Physical science principles, including fundamental ideas about matter, energy, and motion, are powerful conceptual tools for making sense of phenomena in physical, living, and Earth systems science. 9.1 21st Century Life & Career Skills: All students will demonstrate the creative, critical thinking, collaboration, and problem-solving skills needed to function successfully as both global citizens and workers in diverse ethnic and organizational cultures.	Cycle to Find Solutions: Thayer Model Engineering." *The Science Teacher*. November 1, 2006. Fay, Glenn, Jr Poster board or construction paper, markers, colored pencils, metric rulers, and glue; students will supply the toys.	rotational. The toy may be battery-operated or wind-up, but must move on its own once started. The motion of the toy must be quantified (measured). A poster depicting the toy will be prepared, and the motion components will be identified and explained.
Subatomic Physics	*Students will:* • Identify the properties of the nucleus of an atom. • Explain why some nuclei are unstable. • Calculate the binding energy of various nuclei. • Describe the three modes of nuclear decay. • Predict the products of nuclear decay. • Calculate the decay	5.1 Science Practices: Science is both a body of knowledge and an evidence-based, model-building enterprise that continually extends, refines, and revises knowledge. The four Science Practices strands encompass the knowledge and reasoning skills that students must acquire to be proficient in science.	Serway, R.A. & Faughn, J.S. *Holt Physics*, 2006. Holt, Rinehart, and Winston Appropriate internet background research	Students will be presented with the following scenario: You are designing a nuclear power plant for a space station to be established on Mars. Fuel Choice A is radioactive and has a half-life of two years. Fuel Choice B is also radioactive with a half-life of one year. Atoms of B have one half the mass of atoms of A. Decide what

	constant and the half-life of a radioactive substance. • Distinguish between nuclear fission and nuclear fusion. • Explain how a chain reaction is utilized by nuclear reactors. • Define the four fundamental interactions of nature. • Classify the elementary particles that make up matter. Use the Standard Model details to explain the early universe.	5.2 Physical Science: Physical science principles, including fundamental ideas about matter, energy, and motion, are powerful conceptual tools for making sense of phenomena in physical, living, and Earth systems science. 9.1 21st Century Life & Career Skills: All students will demonstrate the creative, critical thinking, collaboration, and problem-solving skills needed to function successfully as both global citizens and workers in diverse ethnic and organizational cultures.		the benefits and drawbacks involved with each of these fuels would be. Choose a disposal option that seems most appropriate. Write a position paper that includes information about all options and reasons for choices.
Vibrations and Waves	*Students will ...* • Identify the conditions of simple harmonic motion. • Identify the amplitude of vibration. • Relate and calculate period and frequency of an object vibrating with simple harmonic motion. • Interpret waveforms of transverse and longitudinal waves. • Apply the relationship among wave speed, frequency, and wavelength to solve problems. • Differentiate between constructive and	5.1 Science Practices: Science is both a body of knowledge and an evidence-based, model-building enterprise that continually extends, refines, and revises knowledge. The four Science Practices strands encompass the knowledge and reasoning skills that students must acquire to be proficient in science. 5.2 Physical Science: Physical science principles, including fundamental ideas about matter, energy, and motion, are powerful conceptual tools for making sense of	Serway, R.A. & Faughn, J.S. *Holt Physics*, 2006. Holt, Rinehart, and Winston Resonance apparatus and resonance boxes for demonstration, set of tuning forks, large graduated cylinder, resonance tube, metric ruler, thermometer, tuning fork mallet, water, calculators	The speed of sound can be determined by using a resonance apparatus. Students will use appropriate materials, diagrams and directions to calculate the speed of sound in various temperatures. Values for absolute and relative errors will also be determined.

	destructive interference. • Relate frequency to pitch. • Compare the speed of sound in various media. • Recognize the Doppler effect, and determine the direction of a frequency shift when there is a relative motion between a source and an observer. • Calculate the intensity of sound waves. • Relate intensity, decibel level, and perceived loudness. Explain why resonance occurs.	phenomena in physical, living, and Earth systems science. 9.1 21st Century Life & Career Skills: All students will demonstrate the creative, critical thinking, collaboration, and problem-solving skills needed to function successfully as both global citizens and workers in diverse ethnic and organizational cultures.		