

Norton City Schools Standards-Based Science Course of Study 2003

HIGH SCHOOL ELECTIVE

PHYSICS (USED AS A YEAR-LONG OR BLOCK-SCHEDULED COURSE)

Physical Sciences Standard (PS)

11-12 Benchmarks	Grade Level Indicators and Sub-Objectives	Teaching Strategies/Resources
<p>By the end of the 11-12 program, the student will,</p> <p><u>Physical Sciences</u></p> <ul style="list-style-type: none"> ★ Recognize that some atomic nuclei are unstable and will spontaneously break down. (PS-B) ★ Describe how atoms and molecules can gain or lose energy only in discrete amounts. (PS-C) ★ Apply principles of forces and motion to mathematically analyze, describe and predict the net effects on objects or systems. (PS-D) ★ Summarize the historical development of scientific theories and ideas within the study of physical sciences. (PS-E) 	<p>By the end of Eleventh/Twelfth Grades, the student will:</p> <p><u>Nature of Matter</u></p> <ul style="list-style-type: none"> ★ Explain how all matter tends toward more disorganized states and describe real world examples (e.g., erosion of rocks and expansion of the universe). (PS-12-3) ★ Recognize that at low temperatures some materials become superconducting and offer little or no resistance to the flow of electrons. (PS-12-4) <p><u>Forces and Motion</u></p> <ul style="list-style-type: none"> ★ Describe real world examples showing that all energy transformations tend toward disorganized states (e.g., fossil fuel combustion, food pyramids and electrical use). (PS-11-3) ★ Explain how electric motors and generators work (e.g., relate that electricity and magnetism are two aspects of a single electromagnetic force). Investigate that electric charges in motion produce magnetic fields and a changing magnetic field creates an electric field). (PS-11-4) ★ Use and apply the laws of motion to analyze, describe and predict the effects of forces on the motions of objects mathematically. (PS-12-5) ★ Recognize that the nuclear forces that hold the nucleus of an atom together, at nuclear distances, are stronger than the electric forces that would make it fly apart. (PS-12-6) ★ Recognize that nuclear forces are much stronger than electromagnetic forces, and electromagnetic forces are vastly stronger than gravitational forces. The strength of the nuclear forces explains why 	

Norton City Schools Standards-Based Science Course of Study 2003

	<p>greater amounts of energy are released from nuclear reactions (e.g., from atomic and hydrogen bombs and in the sun and other stars). (PS-12-7)</p> <p>★ Describe how the observed wavelength of a wave depends upon the relative motion of the source and the observer (Doppler effect). If either is moving towards the other, the observed wavelength is shorter; if either is moving away, the observed wavelength is longer (e.g., weather radar, bat echoes and police radar). (PS-12-8)</p> <p>★ Describe how gravitational forces act between all masses and always create a force of attraction. Recognize that the strength of the force is proportional to the masses and weakens rapidly with increasing distance between them. (PS-12-9)</p> <p><u>Nature of Energy</u></p> <p>★ Explain how atoms and molecules can gain or lose energy in particular discrete amounts (quanta or packets); therefore they can only absorb or emit light at the wavelengths corresponding to these amounts. (PS-12-13)</p> <p><u>Historical Perspectives and Scientific Revolutions</u></p> <p>★ Use historical examples to explain how new ideas are limited by the context in which they are conceived; are often initially rejected by the scientific establishment; sometimes spring from unexpected findings; and usually grow slowly through contributions from many different investigators (e.g., nuclear energy, quantum theory and theory of relativity). (PS-12-14)</p> <p>★ Describe concepts/ideas in physical sciences that have important, long-lasting effects on science and society (e.g., quantum theory, theory of relativity, age of the universe). (PS-12-15)</p> <p><u>Sub-Objectives to Meet Indicators:</u></p> <p>Mechanics</p> <ul style="list-style-type: none">• Describe basic units of the metric system.• Convert simple units into each other.• Differentiate among scalar, vector, speed, velocity, displacement, and distance.	
--	--	--

Norton City Schools Standards-Based Science Course of Study 2003

- Plot experimental data on position versus time graphs and use the data to produce speed versus time graphs.
- Solve simple speed problems with equations and then graph the problems.
- Solve simple vector problems involving adding velocity vectors.
- Distinguish between speed and acceleration.
- Describe acceleration of an object from speed versus time graphs and position versus time graphs.
- Apply centripetal acceleration formulas to solve circular motion problems.
- Solve problems with simple equations for accelerated motion.
- Given appropriate data, predict position and velocity for any projectile.
- Convert into and out of scientific notation.
- Find percentage of difference and percentage of error for experimentally derived data.
- Describe mass, weight, and force.
- Distinguish between balanced and unbalanced motion.
- Apply Newton's First Law of Motion (inertia) to explain any motion.
- Discover the relationship between mass and force for an accelerating object using experimental data.
- Use significant figures in calculations correctly.
- Use Newton's Second Law of Motion to define the SI force unit and solve problems.
- Explain the Universal Law of gravitation.
- Apply the Universal Law of Gravitation to explain weight and weightlessness.
- Compare gravitational fields of various planets.
- Distinguish between momentum and impulse.
- Solve problems involving impulse and momentum.
- Analyze motion for objects moving in curved paths.
- Analyze motion of objects in terms of Newton's three laws.
- Analyze actual situations of rocket launches versus a model rocket's situation to explain why prediction can be wrong.
- Describe forces acting on an object that is in equilibrium.
- Determine the resultant and equilibrant of concurrent forces and use them to identify missing forces.
- Find components of vector forces and use to solve problems.
- Analyze force situations and solve vector problems involving resultants

Norton City Schools Standards-Based Science Course of Study 2003

- and component forces.
- Investigate the Law of Torque and use it to describe rotation around any point.
 - Explain center of gravity and explain how to find the center of gravity.
 - Solve problems involving center of gravity and parallel forces.
 - Differentiate among work, power and energy.
 - Solve problems with work, power and energy.
 - Use efficiency to solve simple problems.
 - Describe equivalency of matter and energy.
 - Describe evidence for existence of molecules.
 - Explain what happens to an object as its velocity approaches the speed of light.
 - Apply energy considerations to analyze a trajectory or a roller coaster ride problem.
 - Discuss the particle nature of matter in terms of molecules.

Kinetic Molecular Theory

- Explain phenomena in terms of Kinetic Molecular Theory.
- Discuss origin of forces within fluids and list their effects on fluids.
- Solve simple fluid pressure problems.
- Distinguish among states of matter, including colloids.
- Differentiate between crystalline and amorphous solids.
- Explain how properties of fluids are explained by the Kinetic Molecular Theory.
- Describe intermolecular forces and their effects on solids.
- Distinguish between adhesion and cohesion and describe how they affect matter.
- Recognize the elastic behavior of everyday objects and explain this behavior in terms of intermolecular forces.
- Explain Hooke's Law.
- Predict volume changes brought on by pressure changes and vice versa.
- Differentiate between heat and temperature.
- Discuss the role of kinetic energy in the internal heat energy of matter.
- Explain the operation of thermometers.
- Compare and contrast Kelvin, Fahrenheit, and Celsius temperature scales.
- Describe applications of thermal expansion and problems caused by it.

Norton City Schools Standards-Based Science Course of Study 2003

- | | | |
|--|---|--|
| | <ul style="list-style-type: none">• Discuss some important results caused by the changes in volume when materials melt or freeze.• Distinguish between calories and Joules.• Discuss mechanic equivalent of heat and its relation to the laws of thermodynamics.• Use a calorimeter properly to predict heat transfer.• Using experimental data, generalize the First Law of Thermodynamics.• Explain why it takes so much energy to melt ice and outline some consequences of this.• Solve simple problems involving heat and fusion.• Explain why it takes so much energy to evaporate water and point out consequences.• Solve simple problems involving heat of vaporization.• Provide convincing evidence that there is absolute zero and you can discover it without cooling a gas to any appreciable extent.• Solve simple problems with Charles' Law, Boyle's Law, and the Ideal Gas Law.• Explain the four steps involved in common heat engines and describe ways in which an understanding of heat engines has influenced civilization. <p>Electricity and Magnetism</p> <ul style="list-style-type: none">• Define the concept of charge and state the SI unit for charge.• Explain the basic properties of charge including attraction, repulsion, and conservation.• Distinguish between insulators and conductors.• Differentiate among charging by friction, conduction, and induction.• Explain the concept of electric field, including how to determine its direction.• Explain the concept of electric shielding, that the electric field inside a charged conductor is zero.• Compare and contrast volt, electric current, and electric resistance.• Explain Ohm's Law.• Solve simple problems using Ohm's law.• Calculate equivalent resistances for series and parallel combinations of resistors.• Interpret simple schematic diagrams and be able to distinguish between | |
|--|---|--|

Norton City Schools Standards-Based Science Course of Study 2003

	<p>parallel and series circuits.</p> <ul style="list-style-type: none">• Perform simple circuit analyses on series and parallel circuits.• Explain the Domain Theory of Magnetism.• Determine magnetic field strengths and directions.• Distinguish between an electromagnet and an earth magnet.• Explain what factors determine the strength of an electromagnet.• Determine the direction of a magnetic field around current-carrying conductors.• Calculate an induced EM using Faraday's Law. <p>Sound and Sound Waves</p> <ul style="list-style-type: none">• Distinguish between harmonic and periodic motion.• Compare and contrast amplitude, frequency, and period.• Determine the period of a harmonic oscillating spring.• Determine the period of a pendulum.• Calculate displacement, velocity, and acceleration for harmonic motion.• Distinguish between longitudinal and transverse waves.• Explain the properties and characteristics of waves, including reflection, refraction, diffraction, and interference.• Solve problems incorporating wave speed, frequency, and wavelength.• Explain the relationship between intensity and intensity level (decibels).• Explain the relationship between frequency and pitch.• Solve problems involving intensity levels.• Explain the human hearing thresholds of audibility while incorporating the dependence upon frequency.• Distinguish harmonics from pictorial representations of waves.• Calculate fundamental frequencies and harmonics for both closed and open pipes.• Explain resonance and distinguish between resonance and sympathetic vibrations.• Solve problems involving the Doppler Effect.• Calculate beats and beat frequencies. <p>Light</p> <ul style="list-style-type: none">• Distinguish among reflection, refraction, diffraction, and interference.• Determine when each of the above do or do not occur.• Define angle of incidence and normal.	
--	---	--

Norton City Schools Standards-Based Science Course of Study 2003

	<ul style="list-style-type: none">• Calculate angles of reflection.• Distinguish among plane, concave, and convex mirrors.• Determine the focal length of a curved mirror.• Determine image characteristics using the mirror equation.• Draw ray diagrams for the different types of mirrors.• Explain spherical aberration and explain how to correct for it.• Explain the concept of index or refraction.• Calculate angles of refraction using Snell's Law.• Distinguish between converging and diverging lenses.• Determine the focal length of a thin lens.• Determine image characteristics using the Lens Equation.• Explain chromatic aberration and how to correct it.• Explain the significance of Thomas Young's Double Slit experiment.• Distinguish between polarized and non-polarized light.• Solve problems for single, double, and multiple-slit diffraction patterns.• Explain why thin-film interference occurs.• Solve problems for Brewster's angle.• Explain why the sky appears blue, clouds appear white, and sunsets/sunrises appear red.	
--	---	--