Pennsylvania High School Science

Academic Standards for Science and Technology and Engineering Education 2009

Physical Science	Boardworks High School Physics Presentation
3.2.B. Physics	
3.2.P.B1. Force & Motion of Particles and Rigid Bodies	
Differentiate among translational motion, simple harmonic motion, and rotational motion in terms of position, velocity, and acceleration.	Acceleration Circular Motion Displacement, Velocity and Acceleration Speed and Velocity
Use force and mass to explain translational motion or simple harmonic motion of objects.	–
Relate torque and rotational inertia to explain rotational motion.	–
3.2.10.B1. Grade 10	
Analyze the relationships among the net forces acting on a body, the mass of the body, and the resulting acceleration using Newton's Second Law of Motion.	Newton's Second Law
Apply Newton's Law of Universal Gravitation to the forces between two objects.	–
Use Newton's Third Law to explain forces as interactions between bodies.	Newton's First Law
Describe how interactions between objects conserve momentum.	Conservation of Momentum
3.2.12.B1. Grade 12	
Analyze the principles of rotational motion to solve problems relating to angular momentum and torque.	–
3.2.P.B2.Energy Storage and Transformations: Conservation Laws	
Explain the translation and simple harmonic motion of objects using conservation of energy and conservation of momentum.	Conservation of Energy Conservation of Momentum
Describe the rotational motion of objects using the conservation of energy and conservation of angular momentum.	Conservation of Energy Conservation of Momentum
Explain how gravitational, electrical, and magnetic forces and torques give rise to rotational motion.	–
3.2.10.B2. Grade 10	
Explain how the overall energy flowing through a system remains constant.	Conservation of Energy
Describe the work-energy theorem.	–
Explain the relationships between work and power.	Power Work
3.2.12.B2. Grade 12	
Explain how energy flowing through an open system can be lost.	–
Demonstrate how the law of conservation of momentum and conservation of energy provide alternate approaches to predict and describe the motion of objects.	Conservation of Energy Conservation of Momentum

3.2.P.B2. Heat/Heat Transfer	
Analyze the factors that influence convection, conduction, and radiation between objects or regions that are at different temperatures.	Conduction and Convection Radiation
3.2.10.B3.Grade 10	
Explain how heat energy will move from a higher temperature to a lower temperature until equilibrium is reached.	Conduction and Convection
Analyze the processes of convection, conduction, and radiation between objects or regions that are at different temperatures.	Conduction and Convection Radiation
3.2.12.B3. Grade 12	
Describe the relationship between the average kinetic molecular energy, temperature, and phase changes.	Changing State Particles in Action
3.2.P.B4.Electrical and Magnetic Energy	
Explain how stationary and moving particles result in electricity and magnetism.	Conductors and Insulators Static Electricity
Develop qualitative and quantitative understanding of current, voltage, resistance, and the connections among them.	Calculating Resistance Current and Potential Difference Current, Voltage and Resitance
Explain how electrical induction is applied in technology.	–
3.2.10.B4. Grade 10	
Describe quantitatively the relationships between voltage, current, and resistance to electrical energy and power.	
Describe the relationship between electricity and magnetism as two aspects of a single electromagnetic force.	–
3.2.12.B4.Grade 12	
Describe conceptually the attractive and repulsive forces between objects relative to their charges and the distance between them.	–
3.2.P.B5. Nature of Waves (Sound and Light Energy)	
Explain how waves transfer energy without transferring matter.	Longitudinal Waves Transverse Waves Waves
Explain how waves carry information from remote sources that can be detected and interpreted.	–
Describe the causes of wave frequency, speed, and wave length.	Waves
3.2.10.B5.Grade 10	
Understand that waves transfer energy without transferring matter.	Longitudinal Waves Transverse Waves Waves

Compare and contrast the wave nature of light and sound.	Longitudinal Waves Sound Transverse Waves
Describe the components of the electromagnetic spectrum.	Electromagnetic Waves
Describe the difference between sound and light waves.	Longitudinal Waves Sound Transverse Waves
3.2.12.B5.Grade 12	
Research how principles of wave transmissions are used in a wide range of technologies.	Refraction
Research technologies that incorporate principles of wave transmission.	–
3.2.P.B6.Unifying Themes	
PATTERNS, SCALE, MODELS, CONSTANCY/CHANGE Use Newton's laws of motion and gravitation to describe and predict the motion of objects ranging from atoms to the galaxies.	Newton's First Law Newton's Second Law Newton's Third Law
3.2.10.B6.Grade 10	
PATTERNS, SCALE, MODELS, CONSTANCY/CHANGE Explain how the behavior of matter and energy follow predictable patterns that are defined by laws.	Newton's First Law Newton's Second Law Newton's Third Law
3.2.12.B6.Grade 12	
CONSTANCY/CHANGE Compare and contrast motions of objects using forces and conservation laws.	Conservation of Energy Conservation of Momentum

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Grade 10	
A. Explain concepts about the structure and properties of matter.	
Know that atoms are composed of even smaller sub-atomic structures whose properties are measurable.	Structure of the Atom
Explain the repeating pattern of chemical properties by using the repeating patterns of atomic structure within the periodic table.	*

Predict the behavior of gases through the use of Boyle's, Charles' or the ideal gas law, in everyday situations.	*
Describe phases of matter according to the Kinetic Molecular Theory.	Changing State Particles in Action
Explain the formation of compounds and their resulting properties using bonding theories (ionic and covalent).	*
Recognize formulas for simple inorganic compounds.	*
Describe various types of chemical reactions by applying the laws of conservation of mass and energy.	Conservation of Energy
Apply knowledge of mixtures to appropriate separation techniques.	*
Understand that carbon can form several types of compounds.	*
B. Analyze energy sources and transfers of heat.	
Determine the efficiency of chemical systems by applying mathematical formulas.	*
Use knowledge of chemical reactions to generate an electrical current.	–
Evaluate energy changes in chemical reactions.	*
Use knowledge of conservation of energy and momentum to explain common phenomena (e.g., refrigeration system, rocket propulsion).	Conservation of Energy Conservation of Momentum
Explain resistance, current and electro-motive force (Ohm's Law).	Calculating Resistance Current and Potential Difference
C. Distinguish among the principles of force and motion.	
Identify the relationship of electricity and magnetism as two aspects of a single electromagnetic force.	–
Identify elements of simple machines in compound machines.	–
Explain fluid power systems through the design and construction of appropriate models.	–
Describe sound effects (e.g., Doppler effect, amplitude, frequency, reflection, refraction, absorption, sonar, seismic).	Doppler Effect Longitudinal Waves Reflection Refraction Sound
Describe light effects (e.g., Doppler effect, dispersion, absorption, emission spectra, polarization, interference).	Doppler Effect Interference Polarization Superposition and Interference Transverse Waves Waves
Describe and measure the motion of sound, light and other objects.	Longitundial Waves Sound Transverse Waves Waves

Know Newton's laws of motion (including inertia, action and reaction) and gravity and apply them to solve problems related to forces and mass.	Newton's First Law Newton's Second Law Newton's Third Law
Determine the efficiency of mechanical systems by applying mathematical formulas.	–
D. Explain essential ideas about the composition and structure of the universe.	
Compare the basic structures of the universe (e.g., galaxy types, nova, black holes, neutron stars).	The Solar System
Describe the structure and life cycle of star, using the Hertzsprung- Russell diagram.	The Life Cycle of Stars
Describe the nuclear processes involved in energy production in a star.	The Life Cycle of Stars Nuclear Fusion
Explain the "red-shift" and Hubble's use of it to determine stellar distance and movement.	–
Compare absolute versus apparent star magnitude and their relation to stellar distance.	–
Explain the impact of the Copernican and Newtonian thinking on man's view of the universe.	–
Identify and analyze the findings of several space instruments in regard to the extent and composition of the solar system and universe.	–
Grade 12	
A. Apply concepts about the structure and properties of matter.	
Apply rules of systematic nomenclature and formula writing to chemical substances.	*
Classify and describe, in equation form, types of chemical and nuclear reactions.	*
Explain how radioactive isotopes that are subject to decay can be used to estimate the age of materials.	Radioactivity Radioactive Dating Types of Radiation
Explain how the forces that bind solids, liquids and gases affect their properties.	Particles in Action
Characterize and identify important classes of compounds (e.g., acids, bases, salts).	*
Apply the conservation of energy concept to fields as diverse as mechanics, nuclear particles and studies of the origin of the universe.	Conservation of Energy
Apply the predictability of nuclear decay to estimate the age of materials that contain radioactive isotopes.	Radioactive Dating
Quantify the properties of matter (e.g., density, solubility coefficients) by applying mathematical formulas.	*
B. Apply and analyze energy sources and conversions and their relationship to heat and temperature.	
Determine the heat involved in illustrative chemical reactions.	*
Evaluate mathematical formulas that calculate the efficiency of specific chemical and mechanical systems.	–
Use knowledge of oxidation and reduction to balance complex reactions.	–
Apply appropriate thermodynamic concepts (e.g., conservation, entropy) to solve problems relating to energy and heat.	–

C. Apply the principles of motion and force.	
Evaluate wave properties of frequency, wavelength and speed as applied to sound and light through different media.	Longitudinal Waves Sound Transverse Waves Waves
Propose and produce modifications to specific mechanical power systems that will improve their efficiency.	–
Analyze the principles of translational motion, velocity and acceleration as they relate to free fall and projectile motion.	Acceleration Displacement, Velocity and Acceleration Projectles Speed and Velocity
Analyze the principles of rotational motion to solve problems relating to angular momentum, and torque.	–
Interpret a model that illustrates circular motion and acceleration.	Circular Motion
Describe inertia, motion, equilibrium, and action/reaction concepts through words, models and mathematical symbols.	–
D. Analyze the essential ideas about the composition and structure of the universe.	
Analyze the Big Bang Theory's use of gravitation and nuclear reaction to explain a possible origin of the universe.	The Big Bang Theory
Compare the use of visual, radio and x-ray telescopes to collect data regarding the structure and evolution of the universe.	–
Correlate the use of the special theory of relativity and the life of a star.	The Life Cycle of Stars

* See Boardworks High School Chemistry