

**Maryland Science Grades 9-12
Contents Standards Mapping**

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PHYSICS	Boardworks High School Physics Presentation
1. Expectation: The student will know and apply the laws of mechanics to explain the behavior of the physical world.	
1) The student will use analytical techniques appropriate to the study of physics.	
i) Distinguish between scalar and vector quantities (e.g. speed v. velocity; distance v. displacement)	Momentum Vectors and Scalars
ii) Symbolically represent vector quantities (angle for direction, length for magnitude)	Vectors and Scalars
iii) Add vectors (same and opposite directions and at right angles)	Vectors and Scalars
iv) Resolve vectors graphically	Vectors and Scalars
2) The student will use algebraic and geometric concepts to qualitatively and quantitatively describe an object's motion.	
i) Motion with a constant velocity	Speed and Velocity
ii) Motion with a constant acceleration	Acceleration
iii) <i>Linear frames of reference</i>	–
iv) Projectile motion (mathematical solutions limited to initial horizontal velocity only; conceptual questions not restricted)	Projectiles
v) Free fall	Projectiles
3) The student will analyze and explain how Newton's Laws describe changes in an object's motion.	
i) The effect of balanced forces ($f_{net} = 0$) (quantitative and qualitative)	Newton's First Law
ii) The effect of unbalanced forces ($f_{net} \neq 0$) (quantitative and qualitative)	Newton's Second Law
iii) The effect of unbalanced forces ($f_{net} \neq 0$) (quantitative and qualitative)	Newton's First Law
iv) Relationship among force, mass and acceleration (describe qualitative relationships and calculate)	Newton's Second Law
v) Action/reaction (application)	Newton's Third Law
4) The student will analyze the behavior of forces.	
i) Friction (qualitative description of its nature and behavior)	Friction
ii) Inverse square relationship of gravity (describe how the force changes as the distance changes)	Gravity
iii) Relation to work and power (qualitative and quantitative)	Power Work
iv) Relation to impulse and momentum (qualitative and quantitative)	Momentum
5) The student will analyze systems with regard to the conservation laws.	
i) Conservation of momentum (applications and calculation in one dimension)	Conservation of Momentum

ii) Conservation of energy (relationship between potential and kinetic including calculations and conversions)	Conservation of Energy
2. Expectation: The student will know and apply the laws of electricity and magnetism and explain their significant role in nature and technology.	
1) The student will describe the types of electric charges and the forces that exist between them.	
i) <i>Inverse square relationship of electrical forces (describe how the force changes as the distance changes)</i>	–
ii) The attractive/repulsive nature of the forces between charges	Static Electricity
iii) <i>Coulomb's Law (describe qualitative relationships)</i>	–
2) The student will describe the sources and effects of electric and magnetic fields.	
i) <i>Qualitative description of electric field created by a static charge distribution (point charge, line of charge, parallel plates)</i>	–
ii) <i>Qualitative description of magnetic field created by moving charges</i>	–
iii) Qualitative description of the force on a moving charge or on a current carrying wire in a magnetic field	Magnetism, Current and Force
iv) Simple D.C. series and parallel circuits (diagram of series and parallel circuits; use of meters to measure quantities in each circuit; calculations of voltage, current, and resistance using Ohm's Law; and calculations of equivalent resistance and power)	Calculating Resistance Circuit Diagrams Current, Voltage and Resistance Electrical Power Factors Affecting Resistance 1 Factors Affecting Resistance 2 Series and Parallel Circuits Types of Current
v) <i>Practical applications (safety, grounding, circuit breakers, fuses)</i>	–
3) The student will qualitatively describe the applications of electromagnetic induction.	
i) Electromagnetic induction (definition)	Magnetism, Current and Force
ii) Motors (energy transformations)	Energy Transfers Motors
iii) Generators (energy transformations)	Energy Transfers
3. Expectation: The student will recognize and relate the laws of thermodynamics to practical applications.	
1) The student will relate thermodynamics to the balance of energy in a system.	
i) <i>Thermal equilibrium (conditions and definition, differentiate between heat energy and temperature)</i>	–
ii) Heat energy transfer (conduction, convection, radiation)	Conduction and Convection Radiation

iii) Application of heat energy to the Law of Conservation of Energy	Conservation of Energy
iv) Irreversibility of heat energy transformations	Energy Transfers
v) Specific heat and calorimetry (both describe and calculate)	Calorimetry
4. Expectation: The student will explain and demonstrate how vibrations and waves provide a model for our understanding of various physical phenomena.	
1) The student will compare qualitatively how waves are propagated and transmit energy.	
i) Physical v. electromagnetic (transmission media, relative speeds, examples such as sound and light)	Electromagnetic Waves Sound Waves
ii) Longitudinal v. transverse (direction of vibration relative to direction of transmission, examples such as sound and light)	Longitudinal Waves Sound Transverse Waves Waves
2) The student will describe wave characteristics using both diagrams and calculations.	
i) Wavelength	Transverse Waves
ii) Frequency (including relationship to period and energy transmitted)	Transverse Waves
iii) <i>Velocity</i>	–
iv) Amplitude (including relationship to energy transmitted)	Transverse Waves
3) The student will qualitatively describe the physical behaviors of waves.	
i) Reflection (apply the law of reflection, represent image formation for plane and concave surfaces using a ray diagram)	Reflection
ii) Refraction (causes and resultant behavior, which may include ray diagrams for behavior at a plane boundary and for double convex lenses)	Lenses Refraction Refractive Index
iii) Diffraction (causes and relationship between wavelength and size of opening)	Diffraction
iv) Interference (constructive and destructive)	Interference Superposition and Interference
v) Polarization (relation to type of wave, effect on intensity of light)	Polarization
vi) Doppler effect (examples and explanation including frequency shift)	Doppler Effect
5. Expectation: The student will investigate certain topics in modern physics.	
1) The student will cite evidence of the wave/particle duality in the nature of matter.	
i) Wave/particle duality of electromagnetic energy (electron-positron annihilation, conservation of mass and energy/ $E = mc^2$)	Nuclear Fission The Photoelectric Effect Wave Properties of Particles
ii) Photoelectric effect (relationship of current produced to frequency and intensity of wave)	The Photoelectric Effect
2) The student will qualitatively explain the processes associated with nuclear energy and its applications.	

i) Energy and its applications.	Radioactivity
ii) Fission/fusion (distinguish between, compare with other sources of energy)	Nuclear Fission Nuclear Fusion