

Physics – Standards

Peak to Peak Charter School

Unit 1 Standards

- 1.1 Students can measure quantitative observations, including length, mass, and time.
- 1.2 Students can choose the appropriate instrument and units to measure and record their data.
- 1.3 Students can measure, calculate and report data using SI units and decimal prefixes (micro-, milli-, centi-, kilo-).
- 1.4 Students can create data tables to record measurements and draw meaningful conclusions.
- 1.5 Students can function safely, effectively, efficiently and responsibly in a laboratory or field study setting.
- 1.6 Students can use computer technology, such as a spreadsheet tool, to calculate derived quantities from measured data.
- 1.7 Students can use dimensional analysis to derive units for derived quantities and to check for correct units when solving problems.
- 1.8 Students will understand the history of the experimental scientific method from Aristotle to Galileo.
- 1.9 Students will know the history behind the heliocentric theory of the solar system. Key figures include Aristotle, Ptolemy, Copernicus, Brahe, Kepler, Galileo and Newton.
- 1.10 Students will understand and be able to apply Newton's laws of motion.

Unit 2 Standards

- 2.1 Students will understand Newton's philosophy of scientific research.
- 2.2 Students will understand and be able to apply Newton's Universal law of gravitation.
- 2.3 Students will understand the nature and utility of conservation laws.
- 2.4 Students will understand and be able to apply the law of conservation of momentum.
- 2.5 Students will understand the law of conservation of energy.
- 2.6 Students will be able to recognize situations where mechanical energy is conserved.
- 2.7 Students will be able to use the conservation of mechanical energy in conjunction with Newton's laws of motion and gravity.

Unit 3 Standards

- 3.1 Students will understand that heat is a form of energy.
- 3.2 Students will understand that our understanding of the physics is intimately linked with the development of the steam engine.
- 3.3 Students will understand the terms power and efficiency and will be able to compute the real and ideal efficiency of engines.
- 3.4 Students will understand the Carnot cycle and basic statements about the three laws of thermodynamics.
- 3.5 Students will understand models of matter in the gaseous state including the ideal gas model.
- 3.6 Students will understand the relationship between the kinetic theory of gases and the ideal gas law.
- 3.7 Students will understand the definition, units, and measurement of pressure.
- 3.8 Students will understand the connections between the kinetic theory and the second law of thermodynamics.

Unit 4 Standards

- 4.1 Students will understand that waves transfer energy through space without transferring matter.
- 4.2 Students will understand the types and properties of mechanical waves.
- 4.3 Students will understand the terms longitudinal, transverse, torsional, amplitude, polarization, superposition, propagation, medium, wavelength, frequency, phase.
- 4.4 Students will understand that the speed of a mechanical wave depends on the stiffness and density of its medium.
- 4.5 Students will understand the principle of superposition and be able to add wave amplitudes.
- 4.6 Students will understand the phenomena of diffraction, refraction and reflection.
- 4.7 Students will be able to measure displacement and wavelength from a wave graph.
- 4.8 Students will be able to use the equation relating a wave's wavelength and frequency to its speed.
- 4.9 Students will understand the history of the study of light including the arguments surrounding whether light has a wave or particle nature.
- 4.10 Students will understand that visible light is a part of the electromagnetic spectrum.
- 4.11 Students will understand that white light is composed of light of different frequencies and will understand Newton's discoveries of light's properties.
- 4.12 Students will understand that the mechanical world view coupled with the emerging wave nature of light required the existence of an ether.
- 4.13 Students will understand the experiments that led Einstein to his postulate that light has a constant speed.
- 4.14 Students will understand that Einstein's postulates led to the phenomenon of time dilation, length contraction, and increase of mass.
- 4.15 Students will understand the change in worldview caused by Einstein's theory of relativity.
- 4.16 Students will be able to compute measured changes in time, length and mass for objects in moving reference frames.

Unit 5 Standards

- 5.1 Students will understand the basic nature and history of electric and magnetic forces.
- 5.2 Students will know the three empirical rules of electrostatics.
- 5.3 Students will understand the nature of the electric force and be able to work with Coulomb's electric force law.
- 5.4 Students will understand vector and scalar fields.
- 5.5 Students will understand the nature of the electric field and the forces it exerts on charged particles.
- 5.6 Students will understand the nature of magnets and the nature of forces that magnets exert on each other.
- 5.7 Students will understand the concept of electric potential, electrical potential energy and electric potential difference (voltage).
- 5.8 Students will be able to work with the formulas for electric fields, electric potential and electric potential energy in order to predict the motion of charged particles in electric fields.
- 5.9 Students will understand Ohm's law and be able to understand and design simple circuits.
- 5.10 Students will understand power dissipation in electric circuits.
- 5.11 Students will be able to analyze simple circuits with voltage sources and resistors and predict voltage, current, resistance, or power.
- 5.12 Students will understand the vector nature of the magnetic field.
- 5.13 Students will understand the nature of the force on a charged particle in a magnetic field and be able to calculate properties of its motion.
- 5.14 Students will understand both Direct Current (DC) and Alternating Current (AC) electrical systems and be able to describe their differences.
- 5.15 Students will understand the principles behind the design and use of both electric generators and electric motors. They will be able to recognize a motor or generator and determine whether it is AC or DC.
- 5.16 Students will understand Maxwell's principles of electromagnetism and be able to describe some of the key experiments that confirm the theory.
- 5.17 Students will understand that light is composed of alternating electric and magnetic fields traveling at the speed of light.
- 5.18 Students will be able to use the wave formula relating wavelength, frequency and wave speed and apply it to waves of any type, including light.
- 5.19 Students will be able to describe the different bands of the electromagnetic spectrum and be able to read spectrum charts calibrated in wavelength or in frequency.

Unit 6 Standards

- 6.1 Students will understand the basic nature and history of the discovery of the electron, its mass and its charge.
- 6.2 Students will understand the link between the discovery of the periodic table of the elements and the search for atomic structure.
- 6.3 Students will understand Einstein's theory of the photoelectric effect and will be able to solve qualitative and quantitative problems.
- 6.4 Students will understand the relationships between frequency, energy, momentum and power in electromagnetic radiation.
- 6.5 Students will understand the nature of emission and absorption spectra, their sources and their use in identifying compounds in the laboratory and in the universe.
- 6.6 Students will understand the different atomic models (Thomson, Rutherford, Bohr) and the empirical formulas which were involved in the progression of ideas (Balmer, Rydberg).
- 6.7 Students will be understand de Broglie's hypothesis.
- 6.8 Students will be able to describe the effects of the uncertainty principle on experimental results.