

**Course/Grade Level:        Applied Chemistry and Physics Curriculum  
(10th Grade)**

**APCH.1** Unifying Concepts: The following sections are incorporated throughout the course as appropriate.  
Students will...

APCH.1.1    ▲ develop an understanding of technology as the application of scientific knowledge for functional purposes. (HS.5.1.1)

Additional Specificity:

- a. Technology is driven by the need to meet human needs and solve human problems.
- b. Engineering is the practical application of science to commerce or industry.
- c. Medicine is a practical application of science to human health.
- d. All technological advances contain a potential for both gains and risks for society.

APCH.1.2    ▲ understand natural resources from the lithosphere and ecosystems are required to sustain human populations.

Additional Specificity:

- a. These processes of ecosystems include maintenance of the atmosphere, generation of soils, control of the hydrologic cycle, and recycling of nutrients. Humans are altering many of these processes, and the changes may be detrimental, beneficial, or both to ecosystem function. (HS.6.3.1)
- b. Natural systems can reuse waste, but this capacity is limited. Recycling and environmentally sound decisions improve the quality of human life. (HS.6.3.1)

APCH.1.3    develop an understanding that science is a human endeavor that uses models to describe and explain the physical universe. (HS.7)

APCH.1.4    develop an understanding of the nature of scientific knowledge. (HS.7)

APCH.1.5    view science from historical perspectives. (HS.7)

**APCH.2 Students will apply scientific inquiry processes to investigations.**  
Students will...

APCH.2.1 ▲ actively engage in investigations, including developing questions, gathering and analyzing data, and designing and conducting research.

Additional Specificity:

- a. Formulate a testable hypothesis. (HS.1.1.2a)
- b. Identify and test variables (independent, dependent, and variables to be kept constant). (HS.1.1.2b)
- c. Use methods for gathering data that is observable, measurable, and replicable. (HS.1.1.2c)
- d. analyze and evaluate the results in order to clarify the questions and hypothesis, and to refine methods for further research.

APCH.2.2 ▲ actively engages in using technological tools and mathematics in their own scientific investigations.

Additional Specificity:

- a. Use a variety of technologies, such as hand tools, measuring instruments, calculators, and computers as an integral component of scientific investigations. (HS.1.1.3a)
- b. Use common mathematical functions to analyze and describe data. (HS.1.1.3b)
- c. Use statistical and graphing data analysis techniques. (HS.1.1.3c)
- d. Recognize that the accuracy and precision of the data, and therefore the quality of the investigation, depends on the instruments used. (HS.1.1.3d)

**APCH.3 ▲ Students will use kinetic and potential energy to explain the physical and chemical properties of matter on earth that may exist in any of these three states: solids, liquids, and gases.**

APCH.3.1 describe the states of matter (e.g., solid, liquid, gas, plasma). (HS.2A.2.1a)

APCH.3.2 verify that ionic compounds most commonly exist as solids. (HS.2A.2.1a)

APCH.3.3 relate the intermolecular attraction (attraction between molecules) to the state of the molecule. (HS.2A.2.1b)

APCH.3.4 show how the hydrogen bond is an intermolecular attraction responsible for the properties of water and many biological molecules. (HS.2A.2.1b)

**APCH.4 ▲ Students will describe atoms as the fundamental organizational unit of matter, as well as the subatomic particles.**

- APCH.4.1 identify the number of protons in the nucleus (i.e. the atomic number). (HS.2A.1.1a)
- APCH.4.2 identify the subatomic particles found in the nucleus (protons and neutrons). (HS.2A.1.1.a)
- APCH.4.3 match charges to each subatomic particle. (HS.2A.1.1a, HS.2A.1.1b, HS.2A.1.1c)
- APCH.4.4 describe the location of the electrons and their movement around the atom. (HS.2A.1.1.c)
- APCH.4.5 compare the masses of each subatomic particle. (HS.2A.1.1.a, HS.2A.1.1.b, HS.2A.1.1.c)
- APCH.4.6 determine the atomic mass of an element based on the number of protons and neutrons. (HS.2A.1.1)

**APCH.5 ▲ Students will discover the periodic table lists elements according to increasing atomic number.**

Students will...

- APCH.5.1 justify that elements in the same group have the same number of valence electrons. (HS.2A.2.2a)
- APCH.5.2 use valence electrons to predict similar physical and chemical properties. (HS.2A.2.2a)
- APCH.5.3 group elements by similar ground state valence electron configurations. (HS.2A.2.2a)
- APCH.5.4 correlate the increase in period to the principle energy levels of the outermost (valence) electrons. (HS.2A.2.2b)
- APCH.5.5 change from one energy level to another. (HS.2A.2.2b)
- APCH.5.6 describe the regions such as metal, non-metals, and transition elements on the periodic table. (HS.2A.2.2c)
- APCH.5.7 compare the different physical and chemical properties between nonmetals and metals. (HS.2A.2.2c)

**APCH.6 ▲ Students will recognize chemical bonds result when valence electrons are transferred or shared between atoms.**

Students will...

- APCH.6.1 correlate energy changes associated with breaking and forming a chemical bond. (HS.2A.2.3)
- APCH.6.2 distinguish between ionic compounds and molecular compounds based on the behavior of the electrons. (HS.2A.2.3)
- APCH.6.3 recognize branched network and metallic solids that also result from bonding. (HS.2A.2.3)
- APCH.6.4 use valence electron configurations to determine whether an atom gains, loses or shares electrons to achieve a more stable electron configuration similar to the noble gases. (HS.2A.2.3a)
- APCH.6.5 name ions according to their charges (e.g., cation, anion). (HS.2A.2.3b)
- APCH.6.6 recognize most anions are nonmetals and cations are metals. (HS.2A.2.3)
- APCH.6.7 describe the behavior of cations when in the vicinity of anions (opposite charges attract). (HS.2A.2.3b)
- APCH.6.8 support that in stable ionic compounds, the sum of the charges is zero. (HS.2A.2.3b)
- APCH.6.9 describe the behavior of an atom's electrons when a covalent bond forms. (HS.2A.2.3c)
- APCH.6.10 distinguish between nonpolar and polar covalent bonds. (HS.2A.2.3c)
- APCH.6.11 use two atoms' electronegativity difference to determine the polarity of the bond. (HS.2A.2.3c)

**APCH.7 ▲ Students will demonstrate a chemical reaction occurs when one or more substances (reactants) react to form a different chemical substance(s) (products).**

Students will...

- APCH.7.1 identify the different types of chemical reactions (synthesis, decomposition, combustion, single and double replacement). (HS.2A.3.1a, HS.2A.3.1b)
- APCH.7.2 write balanced chemical equations according to the Law of Conservation of Matter and Energy. (HS.2A.3.1a)
- APCH.7.3 identify chemical reactions using the following criteria: physical property change, effervescence, mass change, precipitation, light emission, and heat exchange. (HS.2A.3.1c)
- APCH.7.4 change the rate of a chemical reaction using parameters such as temperatures, concentration, catalysts, inhibitors, surface area, and reaction type. (HS.2A.3.1d)

***B Trimester***

**APCH.8 ▲ Students will describe the position and motion of particles using Newton's Laws.**

Students will...

- APCH.8.1 **NOTHING IS WRITTEN except the std code.** (HS.2B.1.1a)
- APCH.8.2 use velocity to describe how position changes. (HS.2B.1.1b)
- APCH.8.3 use acceleration to describe how velocity changes. (HS.2B.1.1b)
- APCH.8.4 derive equations that relate the kinematic variables. (HS.2B.1.1.c)
- APCH.8.5 describe the direction of acceleration of an object moving in a circle. (HS.2B.1.1.d)
- APCH.8.6 **NOTHING IS WRITTEN except the std code.** (HS.2B.1.1d)
- APCH.8.7 describe the velocity change of an object in the absence of a net force. (HS.2B.1.1e)
- APCH.8.8 diagram the velocity change of an object in the presence of a net force by using Newton's second law. (HS.2B.1.1f)
- APCH.8.9 compare the force exerted of an object by another object according to Newton's first law. (HS.2B.1.1g)

## **APCH.9 Students will use conservation laws to analyze the motion of objects.**

Students will...

- APCH.9.1 evaluate mechanical energy conservation when no non-conservative forces (such as friction) do work. (HS.2B.1.2a)
- APCH.9.2 determine the momentum of an object by using its mass and velocity. (HS.2B.1.2b)
- APCH.9.3 relate an objects momentum change when there are no external forces on the system. (HS.2B.1.2b)
- APCH.9.4 identify situations in which momentum is conserved but mechanical energy is not. (HS.2B.1.2c)
- APCH.9.5 show how external forces can change the system's momentum. (HS.2B.1.2c)
- APCH.9.6 describe the angular momentum of an object when external torques work on the system. (HS.2B.1.2d)

## **APCH.10 ▲ Students will state the laws of thermodynamics.**

Students will...

- APCH.10.1 decide that in any physical interaction, the total energy in the universe is conserved.
- APCH.10.2 identify different manifestations of energy (e.g., kinetic, potential, gravitational, electric).
- APCH.10.3 use temperature differences to observe internal heat exchanges between systems spontaneously from hot objects to cooler objects. (HS.2B.2.2b)
- APCH.10.4 observe that work done can cause heat to flow from cooler objects to warmer objects. (HS.2B.2.2b)
- APCH.10.5 describe the types of heat transport including radiation, convection, and conduction. (HS.2B2.2.b)
- APCH.10.6 predict the direction of motion of an object by measuring a force acting on the object. (HS.2B.2.2c)
- APCH.10.7 distinguish between positive and negative work done on an object. (HS.2B.2.2c)
- APCH.10.8 describe an object's energy when positive work is done on an object, and when negative work is done on an object. (HS.2B.2.2d)
- APCH.10.9 applies the second law of thermodynamics to the entropy of the universe. (HS.2B.2.3)

**APCH.11 ▲ Students will illustrate waves' energy interaction with matter.**

Students will...

- APCH.11.1 relate a wave's energy transport to the motion of matter in which it travels. (HS.2B.3.2a)
- APCH.11.2 describe the disturbance of transverse and longitudinal waves to the direction of travel. (HS.2B.3.2a)
- APCH.11.3 give examples of different types of waves (e.g., water, sound, and electromagnetic). (HS.2B.3.2b)
- APCH.11.4 describe periodic waves in terms of wavelength, frequency, period, and amplitude. (HS.2B.3.2b)
- APCH.11.5 describe waves in terms of velocities. (HS.2B.3.2c)
- APCH.11.6 relate the velocity of a wave to the medium in which it is traveling.
- APCH.11.7 relate the speed, wavelength, and frequency of a periodic wave. (HS.2B.3.2c)
- APCH.11.8 relate the frequency of a sound wave to the pitch we perceive. (HS.2B.3.2c)
- APCH.11.9 relate the different wavelengths of visible light to different colors. (HS.2B.3.2c)

**APCH.12 Students will describe how waves interact with other waves.**

Students will...

- APCH.12.1 diagram the result of two waves colliding when the crests (or troughs) align (e.g., constructive interference). (HS.2B.3.3a)
- APCH.12.2 diagram the result of two waves colliding when the crests (or troughs) do not align (e.g., destructive interference). (HS.2B.3.3a)
- APCH.12.3 construct a standing wave. (HS.2B.3.3a)
- APCH.12.4 define diffraction as the bending of wave around an obstacle or an edge. (HS.2B.3.3b)
- APCH.12.5 predict the different intensities of a wave that are observed on the other side of an object due to the wave interfering with itself. (HS.2B.3.3b)

### **APCH.13 Students will observe the principles of reflection and refraction**

Students will...

- APCH.13.1 determine the law of reflection. (HS.2B.3.4a)
- APCH.13.2 observe light moving from one transparent medium to another, as it bends (refracts) at the interface in a manner given by Snell's law. (HS.2B.3.4a)
- APCH.13.3 trace rays to predict the properties of images produced by mirrors (e.g., flat, convex, concave). (HS.2B.3.4a)
- APCH.13.4 trace rays to predict the properties of images produced by lenses (e.g., converging, diverging). (HS.2B.3.4a)

### **APCH.14 ▲ Students will define electromagnetic waves as the result of a charged particle that is **STATEMENT NOT COMPLETE****

Students will...

- APCH.14.1 differentiate between electromagnetic waves, including radio waves, microwaves, infrared radiation, visible light, ultraviolet radiation, X-rays, and gamma rays. (HS.2B.3.5a)
- APCH.14.2 describe the energy of an electromagnetic wave according to its wavelength. (HS.2B.3.5a)
- APCH.14.3 realize some particles, such as protons and electrons, have a physical property known as charge. (HS.2B.3.5b)
- APCH.14.4 describe the force on charged particles given by Coulomb's law. (HS.2B.3.5c)
- APCH.14.5 predict the electric force between two charges of the opposite sign, and two charges of the same sign. (HS.2B.3.5c)
- APCH.14.6 describe the inverse relationship between the force between charges to the square of the distance between them. (HS.2B.3.5c)
- APCH.14.7 relate the magnitude of the magnetic force on a particle in a magnetic field to the particle's charge and speed, and to the magnitude of the magnetic field. (HS.2B.3.5d)
- APCH.14.8 predict the force on a particle within a magnetic field when the particle's velocity is parallel to the magnetic field. (HS.2B.3.5d)
- APCH.14.9 ▲ predict the force on a particle within a magnetic field when the particle's velocity is perpendicular to the magnetic field. (HS.2B.3.5d)