
Coal City Unit District #1
AP Chemistry
Science Curriculum

SC.APC:1 Students will describe how the arrangement of electrons in an atom determine the properties an atom has.

- SC.APC:1-1 Justify the claim that molecules of a pure substance always have the same element ratio. (Law of definite proportions)
- SC.APC:1-2 Determine the composition of a pure substance or mixture.
- SC.APC:1-3 Justify a claim about the composition of a pure substance or mixture using mathematics and data.
- SC.APC:1-4 Relate the amount of mass, number of moles, and volume of a material.
- SC.APC:1-5 Explain the distribution of electrons in an atom or ion using data.
- SC.APC:1-6 Analyze data for patterns or relationships in electron energies.
- SC.APC:1-7 Justify the claim that electrons exist in electron shells in an atom.
- SC.APC:1-8 Justify atomic properties and trends.
- SC.APC:1-9 Explain binary compound compositions using the periodic table.

SC.APC:2 Students will illustrate conservation of matter conceptually and experimentally.

- SC.APC:2-1 Refine an atomic model using data.
- SC.APC:2-2 Evaluate an atomic model using data.
- SC.APC:2-3 Identify the mass of an atom using mass spectrometer data.
- SC.APC:2-4 Justify the type of spectroscopy need to gather desired data.
- SC.APC:2-5 Plan and conduct an experiment to determine the absorbance of an absorbing species.
- SC.APC:2-6 Model the conservation of mass at the macroscopic or atomic level.
- SC.APC:2-7 Use gravimetric or titration data to determine concentration.

SC.APC:3 Students will describe the relationship between physical properties and intermolecular forces.

- SC.APC:3-1 Predict properties of substances based on a chemical formula.
- SC.APC:3-2 Model different phases of matter.
- SC.APC:3-3 Describe properties of real and ideal gasses.
- SC.APC:3-4 Model macroscopic property changes for a gas system.
- SC.APC:3-5 Use gas laws to determine unknowns.
- SC.APC:3-6 Explain the process of chromatography.
- SC.APC:3-7 Model solutions.
- SC.APC:3-8 Design a separation experiment to compare intermolecular forces.
- SC.APC:3-9 Predict the properties of a sample based on London Dispersion Forces.
- SC.APC:3-10 Explain how real gasses are different than ideal gases using intermolecular forces.
- SC.APC:3-11 Describe the relationship between polar molecular shapes and intermolecular forces.
- SC.APC:3-12 Qualitatively describe how charges influence solubility of ions.
- SC.APC:3-13 Modeling the solubility of various substances on the basis of intermolecular interactions and entropic effects.
- SC.APC:3-14 Describe physical properties of compounds in terms of intermolecular forces.
- SC.APC:3-15 Explain the relative strengths of acids and bases using intermolecular forces.

SC.APC:4 Students will be able to differentiate the different types of bonding.

- SC.APC:4-1 Predict the type of bonding in a binary compound.
- SC.APC:4-2 Justify the ranking of bond polarity based on element location in the periodic table.
- SC.APC:4-3 Apply lewis diagrams and the VSEPR model to predict polarity, hybridization, and molecular geometry.
- SC.APC:4-4 Design an experiment to determine the type of chemical bonding that exists in the material.
- SC.APC:4-5 Describe different types of alloys.
- SC.APC:4-6 Determine if and what type of alloy has formed.
- SC.APC:4-7 Compare properties of alloys to the elements that compose them.
- SC.APC:4-8 Make a claim about macroscopic properties of metals or alloys using the electron sea model.

SC.APC:5 Students will illustrate the relationship between atomic structure, types of bonding, and the resulting properties.

- SC.APC:5-1 Model the relationship between atomic structure and bonds to macroscopic physical properties.
- SC.APC:5-2 Model ionic compound structures and properties.
- SC.APC:5-3 Explain how ionic compound structures affect their properties.
- SC.APC:5-4 Model the characteristics of a metal solid using structure and intermolecular forces.
- SC.APC:5-5 Explain how structure and intermolecular forces affect the characteristics of metallic solids.
- SC.APC:5-6 Model the characteristics of a covalent network solid using structure and intermolecular forces.
- SC.APC:5-7 Explain how the structure and intermolecular forces affect the characteristics of covalent network solids.
- SC.APC:5-8 Model the characteristics of a covalent molecular solid using structure and intermolecular forces.
- SC.APC:5-9 Explain how the structure and intermolecular forces affect the characteristics of covalent molecular solids.

SC.APC:6 Students will be able to describe the relationship between chemical reactions and chemical and physical changes.

- SC.APC:6-1 Justify the choice of equation type (molecular, ionic, or net ionic) based on observed chemical changes.
- SC.APC:6-2 Predict the results of performing a reaction in the laboratory.
- SC.APC:6-3 Analyze deviations from the expected results using stoichiometric calculations.
- SC.APC:6-4 Relate quantities (measured mass of substances, volumes of solutions, or volumes and pressures of gases) to identify stoichiometric relationships for a reaction in which the reaction has not gone to completion.
- SC.APC:6-5 Evaluate the classification of a process as a physical change, chemical change, or ambiguous change based on both macroscopic observations and the distinction between rearrangement of covalent interactions and noncovalent interactions.
- SC.APC:6-6 Interpret observations regarding macroscopic energy changes associated with a reaction or process to generate a relevant symbolic and/or graphical representation of the energy changes.
- SC.APC:6-7 Explain galvanic or electrolytic reactions based on half-cell reactions and potentials and/or Faraday's laws qualitatively and quantitatively.
- SC.APC:6-8 Analyze data about galvanic or electrolytic cells to identify properties of the underlying redox reactions.

SC.APC:7 Students will be able to compare reaction types by identifying experimental mechanisms.

- SC.APC:7-1 Design a plan in order to collect data on the synthesis or decomposition of a compound to confirm the conservation of matter and the law of definite proportions.
- SC.APC:7-2 Predict the conservation of matter and the law of definite proportions using data from the synthesis or decomposition of a compound.
- SC.APC:7-3 Identify compounds as Brønsted-Lowry acids, bases, and/or conjugate acid-base pairs, using proton-transfer reactions to justify the identification.
- SC.APC:7-4 Identify redox reactions and justify the identification in terms of electron transfer.
- SC.APC:7-5 Design and/or interpret the results of an experiment involving a redox titration.

SC.APC:8 Students will be able to describe the effect that environmental factors have on reaction rates.

- SC.APC:8-1 Design and interpret the results of an experiment regarding the factors that may influence the rate of a reaction.
- SC.APC:8-2 Describe the rate law for a zeroth-, first-, or second-order reaction.
- SC.APC:8-3 Justify the use of the relation between the half-life of a reaction to the rate constant of a first-order reaction.
- SC.APC:8-4 Interpret graphs of a chemical reaction occurring in the presence and absence of a catalyst.
- SC.APC:8-5 Explain changes in reaction rates arising from the use of catalysts.

SC.APC:9 Students will be able to describe elementary reactions.

- SC.APC:9-1 Explain how the rate law for an elementary reaction is connected to the frequency and success of molecular collisions.
- SC.APC:9-2 Explain the difference between collisions that convert reactants to products and those that do not in terms of energy distributions and molecular orientation.
- SC.APC:9-3 Predict qualitatively the relative temperature dependence of the reaction rate by using representations of the energy diagram for an elementary reaction.
- SC.APC:9-4 Evaluate reaction mechanisms to determine which are consistent with data regarding the overall rate of a reaction.

SC.APC:10 Students will be able to differentiate between the laws of thermodynamics.

- SC.APC:10-1 Compare the magnitudes of the energy changes occurring in two or more interacting systems using conservation of energy.
- SC.APC:10-2 Compare the magnitudes of the energy changes when two nonreacting substances are mixed or brought into contact with one another using conservation of energy.
- SC.APC:10-3 Compare energy changes associated with a change in enthalpy.
- SC.APC:10-4 Design and/or interpret the results of an experiment in which calorimetry is used to determine the change in enthalpy of a chemical process at constant pressure.
- SC.APC:10-5 Predict the sign and relative magnitude of the entropy change associated with chemical or physical processes using representations and models.
- SC.APC:10-6 Predict whether or not a physical or chemical process is thermodynamically favored using Gibbs free energy.
- SC.APC:10-7 Explain how not thermodynamically favorable processes become favorable.
- SC.APC:10-8 Predict qualitatively how systems in which coupled reactions that share a common intermediate form a product using Le Chatelier's principle.
- SC.APC:10-9 Predict quantitatively how systems involving coupled reactions share a common intermediate.
- SC.APC:10-10 Explain why a thermodynamically favored chemical reaction may not produce large amounts of product or why a thermodynamically unfavored chemical reaction can produce large amounts of product for certain sets of initial conditions.

SC.APC:11 Students will be able to describe the relationships between intermolecular forces and bond energy.

- SC.APC:11-1 Model the kinetic energy of particles.
- SC.APC:11-2 Predict how thermal energy transfers between systems due to kinetic energy transfer between systems arising from molecular collisions.
- SC.APC:11-3 Explain qualitatively and quantitatively the connections between the reaction enthalpy and the energies involved in the breaking and formation of chemical bonds.
- SC.APC:11-4 Compare the relative magnitudes of intermolecular forces based on the distribution of electrons within interacting molecules.
- SC.APC:11-5 Explain whether a process is a chemical or physical change based on whether the process involves changes in intramolecular versus intermolecular interactions.
- SC.APC:11-6 Identify the noncovalent interactions within and between large molecules, and connect the shape and function of the large molecule to the presence and magnitude of these interactions.

SC.APC:12 Students will be able to describe the different factors that affect chemical equilibrium within a reaction.

- SC.APC:12-1 Explain observations from reversible processes.
- SC.APC:12-2 Explain the effects of a given manipulation of a chemical reaction or set of reactions on Q or K .
- SC.APC:12-3 Explain the relative rates of a forward and reverse reaction using kinetics and equilibrium.
- SC.APC:12-4 Justify whether a reaction will proceed toward products or reactants as equilibrium is approached.
- SC.APC:12-5 Calculate the equilibrium constant, K , from data.
- SC.APC:12-6 Determine qualitatively or quantitatively the conditions at equilibrium for a system involving a single reversible reaction.
- SC.APC:12-7 Determine concentrations at equilibrium for a reversible reaction that has a large or small K .
- SC. APC:12-8 Predict the direction of the shift resulting from various possible stresses on a system at chemical equilibrium using Le Chatelier's principle.
- SC.APC:12-9 Explain the effects of the stress on Q and K by connecting Le Chatelier's principle to the comparison of Q to K .
- SC.APC:12-10 Express the equilibrium constant in terms of ΔG° and RT and use this relationship to estimate the magnitude of K and the thermodynamic favorability of the process.

SC.APC:13 Students will be able to describe the relationship between acids/bases and equilibrium.

- SC.APC:13-1 Explain the species that will have large versus small concentrations at equilibrium by generating or using a particulate representation of an acid (strong, weak, polyprotic) and a strong base.
- SC.APC:13-2 Reason about the distinction between strong and weak acid solutions with similar values of pH.
- SC.APC:13-3 Interpret titration data for monoprotic or polyprotic acids to determine the concentration of the titrant and the pK_a for a weak acid, or the pK_b for a weak base.
- SC.APC:13-4 Reason that neutrality requires $[H^+] = [OH^-]$ as opposed to requiring $pH=7$.
- SC.APC:13-5 Identify a given solution as containing a mixture of strong acids and/or bases and calculate the pH (and concentrations of all chemical species) in the resulting solution.
- SC.APC:13-6 Identify a given solution as being the solution of a monoprotic weak acid or base, calculate the pH and concentration of all species in the solution, and infer the relative strengths of the weak acids or bases from given equilibrium concentrations.
- SC.APC:13-7 Determine which species will react strongly with one another and what species will be present in large concentrations at equilibrium, given an arbitrary mixture of weak and strong acids and bases.
- SC.APC:13-8 Design a buffer solution with a target pH and buffer capacity.
- SC.APC:13-9 Relate the predominant form of a chemical species involving a protonated/deprotonated form of a weak acid to the pH of a solution and the pK_a associated with the labile protonated/deprotonated form of a weak acid.
- SC.APC:13-10 Identify a solution as being a buffer solution and explain the buffer mechanism in terms of the reactions that would occur on addition of an acid or base.
- SC.APC:13-11 Predict the solubility of a salt given the relevant K_{sp} values.
- SC.APC:13-12 Interpret data regarding solubility of salts.
- SC.APC:13-13 Analyze the enthalpic and entropic changes associated with the dissolution of a salt.