Indiana Academic Standards for Chemistry
Standards Resource Guide Document

This Teacher Resource Guide has been developed to provide supporting materials to help educators successfully implement the Indiana Academic Standards for Chemistry 1. These resources are provided to help you in your work to ensure all students meet the rigorous learning expectations set by the Academic Standards. Use of these resources is optional – teachers should decide which resource will work best in their school for their students.
This resource document is a living document and will be frequently updated.
Please send any suggested links and report broken links to:

Jarred Corwin
Secondary Science Specialist
jcorwin@doe.in.gov

The resources, clarifying statements, and vocabulary in this document are for illustrative purposes only, to promote a base of clarity and common understanding. Each item illustrates a standard but please note that the resources, clarifying statements, and vocabulary are not intended to limit interpretation or classroom applications of the standards.

The links compiled and posted in this Resource Guide have been provided by the Department of Education and other sources. The DOE has not attempted to evaluate any posted materials. They are offered as samples for your reference only and are not intended to represent the best or only approach to any particular issue. The DOE does not control or guarantee the accuracy, relevance, timeliness, or completeness of information contained on a linked website; does not endorse the views expressed or services offered by the sponsor of a linked website; and cannot authorize the use of copyrighted materials contained in linked websites. Users must request such authorization from the sponsor of the linked website.

POSSIBLE WEBSITES FOR SCIENCE:
https://phet.colorado.edu/
http://www.nclark.net/
http://www.rose-prism.org/moodle/
http://www.ck12.org/teacher/
https://www.youtube.com/user/crashcourse
https://www.youtube.com/user/ParrMr
http://www.bozemanscience.com/

http://www.ptable.com/
http://www.sciencegeek.net/

Standard	Course specific content/vocabulary	Possible Resources/Labs/Activities
SEPS.1 Asking questions (for science) and defining problems (for engineering).	Writing hypothesis, researching background knowledge	
SEPS.2 Developing and using models and tools.	Identifying and developing models (visual depictions, online simulations, lab experiments, and physical manipulatives) to represent complex ideals. Using laboratory equipment and techniques properly.	
SEPS.3 Planning and carrying out investigations.	Developing detailed procedures for carrying out laboratory investigations. Identifying dependent and independent variables.	
SEPS.4 Analyzing and interpreting data.	**Accuracy, Precision, Percent Yield, Error, Significant Figures**, organizing data and observations in tables, graphs, and in lab reports.	
SEPS.5 Using mathematics and computational thinking.	Computing, extrapolating, and graphing using laboratory data.	
SEPS.6 Constructing explanations (for science) and designing solutions (for engineering).	Using laboratory data, calculations, extrapolations, and background research to explain complex scientific occurrences and apply their results to new situations/summarize	
SEPS.7 Engaging in argument from evidence.	Use data/research/observations to justify conclusions and argue/discuss various	

	options/explanations that refer to the same topic.	
SEPS.8 Obtaining, evaluating, and communicating information.	Write scientifically (detailed and concise) explanations of thinking, observations, and conclusions to lab experiments. Use scientific writing styles. Cite and identify credible resources	

Standard	**Highlighted Vocabulary Words from the Standard Defined**	**Clarifying Statement**	**Specific Resource/Activity for the Standard**	**Crosscutting Concept**
Standard 1: Properties and States of Matter				

Standard	Highlighted Vocabulary Words from the Standard Defined	Clarifying Statement	Specific Resource/Activity for the Standard	Crosscutting Concept
C.1.1 Differentiate between pure substances and mixtures based on physical and chemical properties.	**Pure substance** – composed of only one type of particle (compound or element) **Mixture** – sample of two or more pure substances where each material maintains its own properties **Physical property** – aspect of matter that can be observed or measured without changing the chemical composition of the sample **Chemical property** – any property of matter that may only be observed and measured by performing a chemical change or chemical reaction.	Identify and explain why a sample that has multiple elements (water) can be pure (depending on the sample, not tap water). Students are able to identify physical and chemical properties in the laboratory. Separate mixtures using physical and chemical properties.		Patterns Structure and Function

Standard	Highlighted Vocabulary Words from the Standard Defined	Clarifying Statement	Specific Resource/Activity for the Standard	Crosscutting Concept
C.1.2 Use chemical properties, extensive, and intensive physical properties to identify substances.	**Chemical properties** – any property of matter that may only be observed and measured by performing a chemical change or chemical reaction. **Extensive properties** – dependent on the amount of matter that is present in a sample **Intensive properties** – do not depend on the amount of matter present in a sample **Physical properties** – aspect of matter that can be observed or measured without changing the chemical composition of the sample **Substances** – a material with a definite chemical composition	Identifying various compounds and elements based on their chemical properties (flammable, oxidizer, etc.) extensive (mass, volume, etc.) and intensive physical properties (density, hardness, color, melting point, odor, etc.). Extensive properties of mass and volume can be used to calculate density (intensive) to help identify the substance. Extensive properties alone are not useful in the identification of a substance.	Identifying an unknown substance in the lab based on chemical and physical properties http://swc2.hccs.edu/pahlavan/intro_labs/Exp_3_Identification_of_Substances_by_Physical_Properties.pdf	Patterns Structure and Function

Standard	Highlighted Vocabulary Words from the Standard Defined	Clarifying Statement	Specific Resource/Activity for the Standard	Crosscutting Concept
C.1.3 Recognize observable macroscopic indicators of chemical changes.	**macroscopic indicators** – observations made by the naked eye **chemical changes** – the making and/or breaking of chemical bonds resulting in the formation of new chemical substances	Use the indicators of energy released/absorbed during a reaction(heat, light, sound), gas production, precipitate formation, or color change to justify whether a chemical reaction occurred or if there was just a physical change.		Energy and matter
C.1.4 Describe physical and chemical changes at the particle level.	**Physical changes** – any change that does not change the chemical identity of a substance **Chemical changes** – the making and/or breaking of chemical bonds resulting in the formation of new chemical substances **Particle** – smallest individual units of a sample (formula units, molecules, atoms)	Students examine and build models of what samples look like at the microscopic level. Manipulate atoms/particles to see that chemical changes rearrange particles and break/form new bonds.	Chemical and physical changes: http://www.glencoe.com/sites/common_assets/science/virtual_labs/E03/E03.html	Structure and function Energy and Matter

Standard	Highlighted Vocabulary Words from the Standard Defined	Clarifying Statement	Specific Resource/Activity for the Standard	Crosscutting Concept
C.1.5 Describe the characteristics of solids, liquids, and gases and changes in state at the macroscopic and microscopic levels.	**Solid** – state of matter characterized by structural rigidity and resistance to changes of shape or volume **Liquid** – state of matter characterized by nearly constant volume independent of pressure and conforms to the shape of its container. **Gas** – state of matter that expands freely to fill any space available **Change in state** – transition from one state of matter to another state of matter **Macroscopic** – visible to the naked eye/large scale **Microscopic** – visible only with a microscope or various technology/small scale/particle level	Students look at defining characteristic of each state of matter. Students make/examine models of particles at the microscopic/macroscopic levels and how these particles behave in each of the states of matter.	States of matter: http://www.bgfl.org/bgfl/custom/resources_ftp/client_ftp/ks3/science/changing_matter/index.htm http://www.pbs.org/wgbh/nova/physics/states-of-matter.html http://science.k12flash.com/statesofmatter.html	Cause and Effect Scale, proportion, and quantity Energy and Matter

Standard	Highlighted Vocabulary Words from the Standard Defined	Clarifying Statement	Specific Resource/Activity for the Standard	Crosscutting Concept
C.1.6 Demonstrate an understanding of the law of conservation of mass through the use of particle diagrams and mathematical models.	**Law of conservation of mass** – matter can be changed from one form into another, but the total amount of mass remains the same **Particle diagrams** – visual depiction in which atoms and molecules are drawn as dots/circles **Mathematical models** – description of a system using equations	Modeling a chemical reaction through diagrams, manipulatives so that as a chemical reaction occurs, the matter/atoms that make the reactants equal that in the final products, just rearranged and bonds formed/broke		Patterns Scale, Proportion, and Quantity
C.1.7 Perform calculations involving density and distinguish among materials based on densities.	**Density** – mass per unit volume **Material** – sample of matter.	Identify density as an intensive property derived from two extensive properties. Identify unknown substance by calculating density and comparing to known values of various samples. Identify and use correct units for density. Calculate volume, mass, and density when two of the three values are known.	Density: http://phet.colorado.edu/en/search?q=density	Scale, Proportion, and Quantity

Standard	Highlighted Vocabulary Words from the Standard Defined	Clarifying Statement	Specific Resource/Activity for the Standard	Crosscutting Concept
Standard 2: Atomic Structure and the Periodic Table				
C.2.1 Using available experimental data, explain how and why models of atomic structure have changed over time.	**Experimental data** – quantities obtained through laboratory investigations **Model** – representation of a more complex item/relationship **Atomic structure** – the particles, amounts, and position of particles within an atom		Atomic models: http://wps.pearsoned.com.au/cc2/63/16285/4169026.cw/content/index.html http://www.pbslearningmedia.org/asset/lsps07_int_theatom/ http://www.bbc.co.uk/schools/gcsebitesize/science/add_ocr_gateway/periodic_table/atomstrucact.shtml	Systems and System Models Structure and Function Stability and Change

Standard	Highlighted Vocabulary Words from the Standard Defined	Clarifying Statement	Specific Resource/Activity for the Standard	Crosscutting Concept
C.2.2 Determine the number of protons, neutrons, and electrons in isotopes and calculate the average atomic mass from isotopic abundance data.	**Protons** – an elementary particle that is identical with the nucleus of the hydrogen atom, that along with the neutron is a constituent of all other atomic nuclei, that carries a positive charge numerically equal to the charge of an electron **Neutron** – an uncharged elementary particle that has a mass nearly equal to that of the proton and is present in all known atomic nuclei except the hydrogen nucleus **Electron** – a very small particle of matter that has a negative charge of electricity and that travels around the nucleus of an atom **Isotopes** – any of two or more species of atoms of a chemical element with the same atomic number and nearly identical chemical behavior but with differing atomic mass or mass number and different physical properties			Structure and Function Scale, proportion, and quantity

Standard	Highlighted Vocabulary Words from the Standard Defined	Clarifying Statement	Specific Resource/Activity for the Standard	Crosscutting Concept
C.2.3 Write the full and noble gas electron configuration of an element, determine its valence electrons, and relate this to its position on the periodic table.	**Full electron configuration** – distribution of electrons of a neutral atom **Noble gas electron configuration** – the loss or gain of electrons to achieve the stable electron configuration of a noble gas **Element** – smallest unit of matter that maintains its unique properties **Valence electrons** – electrons in the outer shell of an atom that often are involved in bonding. **Periodic table** – arrangement of all known elements in order of atomic number so that elements with similar atomic structure and properties appear in vertical columns		Electron Orbital Builder http://www.learner.org/interactives/periodic/elementary_interactive.html	Pattern Cause and Effect System and system models

Standard	Highlighted Vocabulary Words from the Standard Defined	Clarifying Statement	Specific Resource/Activity for the Standard	Crosscutting Concept
C.2.4 Use the periodic table as a model to predict the relative properties of elements based on the pattern of valence electrons and periodic trends.	**Periodic table** – arrangement of all known elements in order of atomic number so that elements with similar atomic structure and properties appear in vertical columns **Model** – representation of a more complex item/relationship **Properties** – an attribute, quality, or characteristic of something **Element** – smallest unit of matter that maintains its unique properties **Valence electrons** – electrons in the outer shell of an atom that often are involved in bonding. **Periodic trends** – specific patterns that are present in the periodic table that illustrate different properties.	Examples of properties that could be predicted from patterns could include reactivity of metals, types of bonds formed, numbers of bonds formed, electronegativity, atomic radius, ionization energy, and reactions with oxygen	Octet Rule Song - YouTube http://www.google.com/url?sa=t&rct=j&q=octet%20rule%20activities&source=web&cd=4&cad=rja&uact=8&ved=0CDYQFjAD&url=http%3A%2F%2Fwww.youtube.com%2Fwatch%3Fv%3DWzWk-mx_14E&ei=XNkIVM-MMY7hsAT5j4DABw&usg=AFQjCNFFO6Pu8sYPc9OyfFdIWBaIxVoWkg&sig2=gP_oFujFJGt_3NLLm1w8cw http://www.rsc.org/periodic-table/trends	Pattern Cause and effect Structure and Function

Standard	Highlighted Vocabulary Words from the Standard Defined	Clarifying Statement	Specific Resource/Activity for the Standard	Crosscutting Concept
C.2.5 Compare and contrast nuclear reactions with chemical reactions	**Nuclear reactions** – change in the energy or structure of an atomic nucleus (fission, fusion, or radioactive decay) **Chemical reactions** – process of rearrangement of the molecular or ionic structure of a substance (making or breaking chemical bonds), as opposed to change in physical form or a nuclear reaction	Emphasis is on simple qualitative models, such as pictures or diagrams, and on the scale of energy released in nuclear processes relative to other kinds of transformations.		Energy and Matter Stability and change

Standard	Highlighted Vocabulary Words from the Standard Defined	Clarifying Statement	Specific Resource/Activity for the Standard	Crosscutting Concept
C.2.6 Describe nuclear changes in matter, including fission, fusion, transmutations, and decays.	**Nuclear changes** – change in the number of protons or neutrons in the nucleus of an atom **Matter** – thing that has mass and takes up space **Fission** – splitting of a nucleus of an atom into two nuclei of lighter atoms and the release of energy **Fusion** – nuclei of light atoms join to form nuclei of heavier atoms **Transmutation** – the conversion of one element or nucleide into another either naturally or artificially **Decay** – nucleus of an unstable atom loses energy by emitting radiation			Energy and matter Stability and change Structure and function

Standard	Highlighted Vocabulary Words from the Standard Defined	Clarifying Statement	Specific Resource/Activity for the Standard	Crosscutting Concept
C.2.7 Perform half-life calculations when given the appropriate information about the isotope.	**Half-life** – the time it takes for half of a radioactive sample to decay to a more stable isotope **Isotope** – any of two or more species of atoms of a chemical element with the same atomic number and nearly identical chemical behavior but with differing atomic mass or mass number and different physical properties	Perform sample calculations and graph half-life to find time that has passed, original mass, final mass, and calculate half-life based on experimental data.	Radioactive decay: http://phet.colorado.edu/en/simulation/alpha-decay http://www.colorado.edu/physics/2000/isotopes/radioactive_decay3.html	Patterns Scale, proportion, and quantity
Standard 3: Bonding and Molecular Structure				

Standard	Highlighted Vocabulary Words from the Standard Defined	Clarifying Statement	Specific Resource/Activity for the Standard	Crosscutting Concept
C.3.1 Investigate the observable characteristics of elements, ionic, and covalent compounds.	**Elements** – smallest unit of matter that maintains its unique properties **Ionic compounds** – chemical compound comprised of ions held together by electrostatic forces **Covalent compounds** – two or more nonmetal atoms bonded by sharing valence electrons	Examine conductivity, solubility, melting point, boiling point, etc. using lab data and observations	Covalent Bonding webquest http://www.millcreekhs.com/attachments/article/673/Covalent-Bonding-Lewis-Structure-Webquest.pdf	Patterns Structure and function

Standard	Highlighted Vocabulary Words from the Standard Defined	Clarifying Statement	Specific Resource/Activity for the Standard	Crosscutting Concept
C.3.2 Compare and contrast how ionic and covalent compounds form.	**Ionic compounds** – chemical compound comprised of ions held together by electrostatic forces **Covalent compounds** – two or more nonmetal atoms bonded by sharing valence electrons		Ionic Bond Builder http://www.learner.org/interactives/periodic/groups_interactive.html Ions/Atoms review video http://www.bbc.co.uk/schools/gcsebitesize/science/add_aqa/bonding/ionic_bondingact.shtml Covalent Bonding review video http://www.bbc.co.uk/schools/gcsebitesize/science/add_aqa_pre_2011/atomic/covalentbond.shtml Octet Rule Video and Quiz http://education-portal.com/academy/lesson/understanding-ions-and-drawing-lewis-structures.html#lesson	Structure and function Systems and system models

Standard	Highlighted Vocabulary Words from the Standard Defined	Clarifying Statement	Specific Resource/Activity for the Standard	Crosscutting Concept
C.3.3 Draw structural formulas for simple molecules and determine their molecular shape.	**Structural formulas** – a formula that shows the arrangement of atoms in the molecule of a compound **Molecules** – group of atoms held together by chemical bonds **Molecular shape** – three dimensional arrangement of the atoms bonded in a molecule	Introduction to drawing structural formulas and simple molecular shapes emphasizing three dimensional molecules (water is bent because of lone pairs of electrons)	VSPER theory http://www.pbslearningmedia.org/resource/lsps07.sci.phys.matter.molecularshp/molecular-shapes/ Molecular Geometry simulation https://phet.colorado.edu/en/simulation/molecule-shapes	System and system models
C.3.4 Write chemical formulas for ionic compounds and covalent compounds given their names and vice versa.	**Chemical formula** – set of chemical symbols showing the elements present in a compound and their relative proportions	Writing formulas and naming compounds for simple binary ionic and binary covalent compounds	Ionic Formula Naming (Who wants to be a millionaire?) http://www.quia.com/rr/180365.html	Patterns System and system models

Standard	Highlighted Vocabulary Words from the Standard Defined	Clarifying Statement	Specific Resource/Activity for the Standard	Crosscutting Concept
C.3.5 Use laboratory observations and data to compare and contrast ionic, covalent, network, metallic, polar, and non-polar substances with respect to constituent particles, strength of bonds, melting and boiling points, and conductivity; provide examples of each type.	**Data** – facts and statistics collected together for reference and analysis **Ionic** – **Covalent** – **Network** – **Metallic** – attraction between positively charged atomic nuclei of metal atoms and delocalized electrons **Polar substances**– compound in which the electric charge is not symmetrically distributed to where there is a separation of charge or partial charge **Non-polar substances** – compound composed of molecules that possess symmetric distribution of charge **Constituent particles** – **Strength of bonds** – strength with which a chemical bond holds two atoms together, measured in the amount of energy, kilocalories/mole, required to break the	Emphasis is on understanding the strengths of forces between particles, not on naming specific intermolecular forces (such as dipole-dipole). Examples of particles could include ions, atoms, molecules, and networked materials (such as graphite). Examples of bulk properties of substances could include the melting point and boiling point, vapor pressure, and surface tension.]	Ionic/Covalent/Polar/Nonpolar bonding power point http://www.google.com/url?sa=t&rct=j&q=properties%20of%20ionic%20and%20covalent%20compounds%20activities&source=web&cd=35&ved=0CD8QFjAEOB4&url=http%3A%2F%2Fhsscience-chemoise2010.wikispaces.com%2Ffile%2Fview%2FConcept%2BPresentation%2Bon%2BChemical%2BBonding%2B(Iris%2BLo).ppt&ei=TdwIVMTKJvLisATLtYLwBg&usg=AFQjCNH-mibAKHB874l2bxzyR8O2e-UzSA&sig2=dNfAVoRIeXuZRe7zmjPfFg	Cause and effect Structure and function Stability and change

Standard	Highlighted Vocabulary Words from the Standard Defined	Clarifying Statement	Specific Resource/Activity for the Standard	Crosscutting Concept
C.3.6 Use structural formulas of hydrocarbons to illustrate carbon's ability to form single and multiple bonds within a molecule.	**Structural formulas** - – a formula that shows the arrangement of atoms in the molecule of a compound **Hydrocarbons –** simplest organic compounds containing only carbon and hydrogen **Single bonds –** a chemical bond in which one pair of electrons is shared between two atoms. **Multiple bonds –** a chemical bond in which two or more pairs of electrons are shared between two atoms **Molecule** - group of atoms held together by chemical bonds	Introducing organic compounds and the formation of long chains, rings, double, and triple bonding between carbon	http://www.murrieta.k12.ca.us/cms/lib5/CA01000508/Centricity/Domain/1506/bio_ch02-3.pdf	Structure and function System and system model
Standard 4: Reactions and Stoichiometry				

Standard	Highlighted Vocabulary Words from the Standard Defined	Clarifying Statement	Specific Resource/Activity for the Standard	Crosscutting Concept
C.4.1 Describe, classify, and give examples of various kinds of reactions: synthesis (i.e., combination), decomposition, single displacement, double displacement, acid/base, and combustion.	**Synthesis –** two or more simple substances combine to form a more complex product **Decomposition –** separation of a chemical compound into elements or simpler compounds **Single displacement –** an element or ion moves out of one compound and replaced by another **Double displacement –** two compounds react and the cation and anion of the two reactants switch to form two new compounds **Acid/base –** exchange of one or more hydrogen ions between species **Combustion –** oxygen reacts with another compound, usually a hydrocarbon	Extension: Electrochemistry	**Chemical equations.** http://education.jlab.org/elementbalancing/ https://phet.colorado.edu/en/simulations/category/chemistry http://sciencespot.net/Pages/kdzchem.html http://www.jdenuno.com/Chemistry/ChemBalance.htm	Patterns Cause and effect System and system models Energy and matter

Standard	Highlighted Vocabulary Words from the Standard Defined	Clarifying Statement	Specific Resource/Activity for the Standard	Crosscutting Concept
C.4.2 Predict products of simple reactions as listed in C.4.1.	**Products** – new compounds formed in a chemical reaction	When given two compounds/reactants, students can predict products by classifying the type of reaction		Stability and change Patterns
C.4.3 Balance chemical equations and use the law of conservation of mass to explain why this must be true.	**Balance** – using coefficients to ensure that each type of atom and the total charge of reactants matches the total number of atoms and charge of products. **Law of conservation of mass** – mass in an isolated system is neither created nor destroyed by chemical reactions or physical transformations.	Extension: Identify REDOX reactions/Balance REDOX reactions		Scale, proportion, and quantity

Standard	Highlighted Vocabulary Words from the Standard Defined	Clarifying Statement	Specific Resource/Activity for the Standard	Crosscutting Concept
C.4.4 Apply the mole concept to determine the mass, moles, number of particles or volume of a gas at STP, in any given sample, for an element or compound.	**Mole** – a chemical unit defined to be 6.022 x 10^23 molecules, atoms, or some other unit **Mass** – measure of the amount of matter in an object **Number of particles** – molecules, formula units, atoms **Volume** – quantity of three-dimensional space occupied by a solid, liquid, or gas **STP** – standard temperature and pressure, 273.15 K and a pressure of 1 atm **Element** – atoms that all have the same number of protons **Compound** – two or more elements chemically bonded together	Emphasis is on using mathematical ideas to communicate the proportional relationships between masses of atoms in the reactants and the products, and the translation of these relationships to the macroscopic scale using the mole as the conversion from the atomic to the macroscopic scale	**Mole Calculations** http://sciencegeek.net/Chemistry/Video/index.shtml http://www.lsua.us/chem1001/stoichiometry/stoichiometry.html	Scale, proportion, and quantity Energy and matter

Standard	Highlighted Vocabulary Words from the Standard Defined	Clarifying Statement	Specific Resource/Activity for the Standard	Crosscutting Concept
C.4.5 Use a balanced chemical equation to calculate the quantities of reactants needed and products made in a chemical reaction that goes to completion.	**Balanced chemical equation** – using coefficients to ensure that each type of atom and the total charge of reactants matches the total number of atoms and charge of products to reflect the law of conservation of mass **Reactant** – substances initially present in a chemical reaction **Product** – new compounds formed in a chemical reaction **Chemical reaction** – process of rearrangement of the molecular or ionic structure of a substance (making or breaking chemical bonds), as opposed to change in physical form or a nuclear reaction **Completion** – a reaction in which essentially all of the reactants react to form products	Examining limiting reagents, excess reagents, and left-over materials. Extension can be when the reaction does not go to equilibrium(examining equilibrium constants)		Scale, proportion, and quantity

Standard	Highlighted Vocabulary Words from the Standard Defined	Clarifying Statement	Specific Resource/Activity for the Standard	Crosscutting Concept
C.4.6 Perform calculations to determine the composition of a compound or mixture when given the necessary information.	**Composition** – proportions of various elements/compounds in a sample **Compound** – substance formed when two or more elements are chemically bonded together **Mixture** – sample of two or more pure substances where each material maintains its own properties	% composition by mass for each element in a compound when given the formula, % composition by mass of various compounds/elements in a mixture		Scale, proportion, and quantity Structure and function

Standard	Highlighted Vocabulary Words from the Standard Defined	Clarifying Statement	Specific Resource/Activity for the Standard	Crosscutting Concept
C.4.7 Apply lab data to determine the empirical and molecular formula of a compound.	**Empirical formula**– simplest whole number ratio of a chemical formula **Molecular formula**– expression of the number and type of atoms that are present in a molecule of a substance (can be a multiple of an empirical formula) **Compound** – substance formed when two or more elements are chemically bonded together	Use percent composition data to calculate the empirical formula and with the molar mass, find the molecular formula		Scale, proportion, and quantity Structure and function
Standard 5: Behavior of Gases				

Standard	Highlighted Vocabulary Words from the Standard Defined	Clarifying Statement	Specific Resource/Activity for the Standard	Crosscutting Concept
C.5.1 Use the kinetic molecular theory with the combined and ideal gas laws to explain changes in volume, pressure, moles and temperature of a gas.	**Kinetic molecular theory** – individual gas particles interact with one another and relates microscopic gas to macroscopic gas behavior **Combined gas law** – combination of Charles's, Boyle's, and Gay-Lussac's law relating pressure, volume, and temperature **Ideal gas law** – relationship of variables in a hypothetical ideal gas, combination of Boyle's, Charles's, and Avogadro's law. **Volume** – quantity of three-dimensional space occupied by a solid, liquid, or gas **Pressure** – force exerted by the substance per unit area on another substance **Moles** - a chemical unit defined to be 6.022 x 10^23 molecules, atoms, or some other unit **Temperature** - measure of thermal energy		Kinetic Molecular Theory http://preparatorychemistry.com/KMT_flash.htm http://www.classzone.com/books/ml_science_share/vis_sim/mem05_pg101_kintheory/mem05_pg101_kintheory.html	Scale, proportion, and quantity Cause and effect

Standard	Highlighted Vocabulary Words from the Standard Defined	Clarifying Statement	Specific Resource/Activity for the Standard	Crosscutting Concept
C.5.2 Apply the ideal gas equation (PV = nRT) to calculate the change in one variable when another variable is changed and the others are held constant.	**Ideal gas equation** – equation that equates the product of the pressure and the volume of a gas to the product of the number of moles of gas, the temperature, and gas constant **Variable** – factor, trait, or condition that can exist in differing amounts or types **Constant** – a fixed value, non-varying		Gas Laws http://phet.colorado.edu/en/simulation/gas-properties http://create.nyu.edu/mm/simulations.php?btn_simsDirect=Take+me+to+the+Simulations... http://www.nclark.net/GasLaws http://www.chemicool.com/idealgas.html Gas Laws Unit. http://marric.us/files/HS_Chem_Unit5_Gases_Interactive_Notebook_final_121613.pdf	Scale, proportion, and quantity Cause and effect

Standard	Highlighted Vocabulary Words from the Standard Defined	Clarifying Statement	Specific Resource/Activity for the Standard	Crosscutting Concept
C.5.3 Use lab data and a balanced chemical equation to calculate volume of a gas at STP and non STP conditions, assuming that the reaction goes to completion and the ideal gas law holds.	**Balanced chemical equation** – using coefficients to ensure that each type of atom and the total charge of reactants matches the total number of atoms and charge of products to reflect the law of conservation of mass			Scale, proportion, and quantity Systems and system models
Standard 6: Thermochemistry				
C.6.1 Explain that atoms and molecules are in constant motion and that this motion increases as thermal energy increases.	**Motion** –moving or changing place or position **Thermal energy** – internal energy of an object due to kinetic energy of its atoms and/or molecules			Scale, proportion, and quantity Cause and effect

Standard	Highlighted Vocabulary Words from the Standard Defined	Clarifying Statement	Specific Resource/Activity for the Standard	Crosscutting Concept
C.6.2 Distinguish between the concepts of temperature and heat flow in macroscopic and microscopic terms.	**Temperature** – measure of thermal energy **Heat flow** – process whereby heat moves from one body or substance to another by radiation, conduction, convection, or a combination of these methods **Macroscopic** – visible to the naked eye/large scale **Microscopic** – visible only with a microscope or various technology/small scale/particle level			Scale, proportion, and quantity Energy and matter

Standard	Highlighted Vocabulary Words from the Standard Defined	Clarifying Statement	Specific Resource/Activity for the Standard	Crosscutting Concept
C.6.3 Classify chemical reactions and phase changes as exothermic or endothermic based on enthalpy values. Use a graphical representation to illustrate the energy changes involved	**Phase changes** – transition between solid, liquid, and gaseous phases **Exothermic** – accompanied by the release of heat **Endothermic** – accompanied by or requiring the absorption of heat **Enthalpy** – measure of energy in a thermodynamic system	Emphasis is on the idea that a chemical reaction is a system that affects the energy change. Examples of models could include molecular-level drawings and diagrams of reactions, graphs showing the relative energies of reactants and products, and representations showing energy is conserved		Energy and matter

Standard	Highlighted Vocabulary Words from the Standard Defined	Clarifying Statement	Specific Resource/Activity for the Standard	Crosscutting Concept
C.6.4 Perform calculations involving heat flow, temperature changes, and phase changes by using known values of specific heat, phase change constants, or both.	**Specific heat** – thermal energy required to raise the temperature of one gram of a given substance by one degree Celsius **Phase change constants** – rate of energy required to change a mass of sample from one state to another(heat of fusion, heat of vaporization)		Specific heat http://www.chem.uiuc.edu/webfunchem/specificheat/specificheat.htm https://sites.google.com/a/northgwinnett.com/rstroud/gifted-chemistry/gifted-spring-semester/gifted-unit-4-thermochemistry/thermochemistry-virtual-lab http://www.algebralab.org/practice/practice.aspx?file=Algebra_SpecificHeatCapacity.xml	Scale, proportion, and quantity Energy and matter
Standard 7: Solutions				

Standard	Highlighted Vocabulary Words from the Standard Defined	Clarifying Statement	Specific Resource/Activity for the Standard	Crosscutting Concept
C.7.1 Describe the composition and properties of solutions.	**Composition** – proportions of various elements/compounds in a sample **Property** – characteristic of a substance **Solution**- homogenous mixture composed of two or more substances		**Solutions / molarity** http://www.occc.edu/kmbailey/Chem1115Tutorials/Molarity.htm http://www.oneonta.edu/faculty/kotzjc/POWERPOINT/Ch5_D_Solutions.pdf http://phet.colorado.edu/en/simulation/molarity http://www.sciencegeek.net/Chemistry/taters/Unit6SolutionConcentrationA.htm http://www.physiologyweb.com/calculators/molar_solution_concentration_calculator.html	Scale, proportion, and quantity

Standard	Highlighted Vocabulary Words from the Standard Defined	Clarifying Statement	Specific Resource/Activity for the Standard	Crosscutting Concept
C.7.2 Explain how temperature, pressure, and polarity of the solvent affect the solubility of a solute.	**Pressure** – force exerted by the substance per unit area on another substance **Polarity** – separation of electric charge leading to a molecule having a electric dipole or multipole moment **Solubility** – chemical property referring to the ability for a given substance, solute, to dissolve in a solvent **Solute** – substance dissolved in another substance, known as a solvent			Cause and effect
C.7.3 Describe the concentration of solutes in a solution in terms of molarity. Perform calculations using molarity, mass, and volume. Prepare a sample of given molarity provided a known solute.	**Concentration** – ratio of solute per total volume of a mixture **Molarity** – moles of solute per liter of solution			Scale, proportion, and quantity

Standard	Highlighted Vocabulary Words from the Standard Defined	Clarifying Statement	Specific Resource/Activity for the Standard	Crosscutting Concept
Standard 8: Acids and Bases				
C.8.1 Classify solutions as acids or bases and describe their characteristic properties.	**Acid** – chemical substance whose aqueous solutions are characterized by a sour taste, turn blue litmus red, and react with bases to form salts **Base** – chemical substance that in aqueous solution are slippery to the touch, taste bitter, change red litmus paper blue, and react with acids to form salts **Characteristic properties** – chemical or physical property that helps identify and classify substances		http://www.harcourtschool.com/activity/acids/ http://chemcollective.org/acid-base http://users.wfu.edu/ylwong/chem/titrationsimulator/	Patterns Systems and system models
C.8.2 Compare and contrast the strength of acids and bases in solutions.	**Strength** – concentration of ions in solution	Examine household chemicals and a variety of stock laboratory chemicals		Structure and function

Standard	Highlighted Vocabulary Words from the Standard Defined	Clarifying Statement	Specific Resource/Activity for the Standard	Crosscutting Concept
C.8.3 Given the hydronium ion and/or the hydroxide ion concentration, calculate the pH and/or the pOH of a solution. Explain the meanings of these values.	**Hydronium ion** – hydrogen ion bonded to a molecule of water found in aqueous systems **Hydroxide ion** – diatomic anion with an oxygen and hydrogen covalently bonded and carries a negative charge **pH** – figure expressing the acidity or alkalinity based on hydrogen ion concentration of a solution on a logarithmic scale on which 7 is neutral, lower acidic, and higher basic **pOH** – figure expressing the acidity or alkalinity based on hydroxide ion concentration of a solution on a logarithmic scale on which 7 is neutral, higher acidic, and lower basic	Extension: Titrations, finding the concentration/molarity of an unknown acid/base Extension: Buffers		Scale, proportion, and quantity Stability and change

Crosscutting Concepts

1. *Patterns.* Observed patterns of forms and events guide organization and classification, and they prompt questions about relationships and the factors that influence them.
2. *Cause and effect: Mechanism and explanation*. Events have causes, sometimes simple, sometimes multifaceted. A major activity of science is investigating and explaining causal relationships and the mechanisms by which they are mediated. Such mechanisms can then be tested across given contexts and used to predict and explain events in new contexts.
3. *Scale, proportion, and quantity.* In considering phenomena, it is critical to recognize what is relevant at different measures of size, time, and energy and to recognize how changes in scale, proportion, or quantity affect a system's structure or performance.
4. *Systems and system models.* Defining the system under study—specifying its boundaries and making explicit a model of that system—provides tools for understanding and testing ideas that are applicable throughout science and engineering.
5. *Energy and matter: Flows, cycles, and conservation.* Tracking fluxes of energy and matter into, out of, and within systems helps one understand the systems' possibilities and limitations.
6. *Structure and function.* The way in which an object or living thing is shaped and its substructure determine many of its properties and functions.
7. *Stability and change.* For natural and built systems alike, conditions of stability and determinants of rates of change or evolution of a system are critical elements of study.