CHEMISTRY
STANDARDS BASED RUBRIC
ATOMIC STRUCTURE AND BONDING

Essential Standard:
STUDENTS WILL UNDERSTAND THAT THE PROPERTIES OF MATTER AND THEIR INTERACTIONS ARE A CONSEQUENCE OF THE STRUCTURE OF MATTER, INCLUDING NUCLEAR PROCESSES (1,2,11).

First Semester Benchmarks:

FAR BELOW/BELOW BASIC Student is unable to:	**BASIC** Student is inconsistently able to:	**PROFICIENT** Student is able to:	**ADVANCED** Student is able to:
➢ Relate the position of an element in the periodic table to its atomic number and atomic mass	➢ Relate the position of an element in the periodic table to its atomic number and atomic mass	➢ Relate the position of an element in the periodic table to its atomic number and atomic mass	➢ Relate the position of an element in the periodic table to its atomic number, atomic mass, and numbers of protons, neutrons and electrons.
➢ Use the periodic table to identify metals, metalloids, nonmetals, halogens, noble gases, alkali metals, alkaline earth metals and transition metals.	➢ Use the periodic table to identify metals, metalloids, nonmetals, halogens, noble gases, alkali metals, alkaline earth metals and transition metals.	➢ Use the periodic table to identify metals, metalloids, nonmetals, halogens, noble gases, alkali metals, alkaline earth metals and transition metals.	➢ Use the periodic table to identify metals, metalloids, nonmetals, halogens, noble gases, alkali metals, alkaline earth metals and transition metals, and describe at least three of their common chemical and physical properties.
➢ Use the periodic table to identify trends in ionization energy, electronegativity, and the relative sizes of ions and atoms.	➢ Use the periodic table to identify trends in ionization energy, electronegativity, and the relative sizes of ions and atoms.	➢ Use the periodic table to identify trends in ionization energy, electronegativity, and the relative sizes of ions and atoms.	➢ Use the periodic table to identify trends in ionization energy, electronegativity, and the relative sizes of ions and atoms and relate them to reactivity.

FAR BELOW/BELOW BASIC Student is unable to:	**BASIC** Student is inconsistently able to:	**PROFICIENT** Student is able to:	**ADVANCED** Student is able to:
➢ Use the periodic table to determine the number of electrons available for bonding.	➢ Use the periodic table to determine the number of electrons available for bonding.	➢ Use the periodic table to determine the number of electrons available for bonding.	➢ Use the periodic table to determine the number of electrons available for bonding and predict oxidation states for main group elements.
➢ Demonstrate an understanding that the nucleus of the atom is much smaller than the atom yet contains most of its mass.	➢ Demonstrate an understanding that the nucleus of the atom is much smaller than the atom yet contains most of its mass.	➢ Demonstrate an understanding that the nucleus of the atom is much smaller than the atom yet contains most of its mass.	➢ Demonstrate an understanding that the nucleus of the atom is much smaller than the atom yet contains most of its mass, and describe the experimental basis for this understanding.
➢ Explain that protons and neutrons in the nucleus are held together by nuclear forces that overcome the electromagnetic repulsion between the protons.	➢ Explain that protons and neutrons in the nucleus are held together by nuclear forces that overcome the electromagnetic repulsion between the protons.	➢ Explain that protons and neutrons in the nucleus are held together by nuclear forces that overcome the electromagnetic repulsion between the protons.	➢ Explain that protons and neutrons in the nucleus are held together by nuclear forces that overcome the electromagnetic repulsion between the protons, and relate this to the “band of stability.”

FAR BELOW/BELOW BASIC Student is unable to:	BASIC Student is inconsistently able to:	PROFICIENT Student is able to:	ADVANCED Student is able to:
➢ Describe why the energy release per gram of material is much larger in nuclear fusion or fission reactions than in chemical reactions. The change in mass (calculated by $E = mc^2$) is small but significant in nuclear reactions.	➢ Describe why the energy release per gram of material is much larger in nuclear fusion or fission reactions than in chemical reactions. The change in mass (calculated by $E = mc^2$) is small but significant in nuclear reactions.	➢ Describe why the energy release per gram of material is much larger in nuclear fusion or fission reactions than in chemical reactions. The change in mass (calculated by $E = mc^2$) is small but significant in nuclear reactions.	➢ Describe why the energy release per gram of material is much larger in nuclear fusion or fission reactions than in chemical reactions. The change in mass (calculated by $E = mc^2$) is small but significant in nuclear reactions. The student can calculate energy released from a nuclear reaction given the mass defect.
➢ Identify three naturally occurring isotopes of elements that are radioactive, as well as three isotopes formed in nuclear reactions	➢ Identify three naturally occurring isotopes of elements that are radioactive, as well as three isotopes formed in nuclear reactions	➢ Identify three naturally occurring isotopes of elements that are radioactive, as well as three isotopes formed in nuclear reactions	➢ Identify five naturally occurring isotopes of elements that are radioactive, as well as five isotopes formed in nuclear reactions.
➢ Recognize the three most common forms of radioactive decay (alpha, beta, and gamma) and do not know how the nucleus changes in each type of decay.	➢ Recognize the three most common forms of radioactive decay (alpha, beta, and gamma) and inconsistently describe how the nucleus changes in each type of decay.	➢ Recognize the three most common forms of radioactive decay (alpha, beta, and gamma) and know how the nucleus changes in each type of decay.	➢ Students know the three most common forms of radioactive decay (alpha, beta, and gamma) and know how the nucleus changes in each type of decay and can balance a decay reaction.

FAR BELOW/BELOW BASIC Student is unable to:	BASIC Student is inconsistently able to:	PROFICIENT Student is able to:	ADVANCED Student is able to:
➢ Describe the various types of damage and penetration related to alpha, beta, and gamma radiation.	➢ Describe the various types of damage and penetration related to alpha, beta, and gamma radiation.	➢ Describe the various types of damage and penetration related to alpha, beta, and gamma radiation.	➢ Describe the various types of damage and penetration related to alpha, beta, and gamma radiation and relate the longevity of radioactive isotopes in the environment to their half-lives.
➢ Differentiate that, ionic bonding is the result of transfer of electrons and covalent bonding is the result of sharing of electrons.	➢ Differentiate that, ionic bonding is the result of transfer of electrons and covalent bonding is the result of sharing of electrons.	➢ Differentiate that, ionic bonding is the result of transfer of electrons and covalent bonding is the result of sharing of electrons.	➢ Differentiate that, ionic bonding is the result of transfer of electrons and covalent bonding is the result of sharing of electrons and metallic bonding is the result of delocalized electrons.
➢ Classify bonds between nonmetals as covalent, and bonds between metals and nonmetals as primarily ionic.	➢ Classify bonds between nonmetals as covalent, and bonds between metals and nonmetals as primarily ionic.	➢ Classify bonds between nonmetals as covalent, and bonds between metals and nonmetals as primarily ionic.	➢ Classify bonds between nonmetals as covalent, and bonds between metals and nonmetals as primarily ionic.
➢ Organize a model of a salt crystal, such as NaCl, into repeating patterns of positive and negative ions held together by electrostatic attraction.	➢ Organize a model of a salt crystal, such as NaCl, into repeating patterns of positive and negative ions held together by electrostatic attraction.	➢ Organize a model of a salt crystal, such as NaCl, into repeating patterns of positive and negative ions held together by electrostatic attraction.	➢ Organize a model of a salt crystal, such as NaCl, into repeating patterns of positive and negative ions held together by electrostatic attraction and explain how the fundamental structure is related to the size and charge of the ions in the salt.
➢ Draw Lewis dot structures.	➢ Draw Lewis dot structures.	➢ Draw Lewis dot structures.	➢ Draw Lewis dot structures and use them to predict the molecule's three-dimensional geometry.

CHEMISTRY
STANDARDS BASED RUBRIC
CONSERVATION OF MATTER/STOICHIOMETRY

Essential Standards:
STUDENTS WILL DEMONSTRATE THE QUALITATIVE AND QUANTITATIVE RELATIONSHIPS OF MATTER IN CHEMISTRY PROCESSES (3).

First Semester Benchmarks:

FAR BELOW/BELOW BASIC Students are unable to:	**BASIC** Students are inconsistently able to:	**PROFICIENT** Students are able to:	**ADVANCED** Students are able to:
➢ Write balanced equations.	➢ Write balanced equations.	➢ Write balanced equations.	➢ Predict the products of a reaction from the names of the reactants, and write a balanced chemical equation of the overall reaction.
➢ Identify carbon-12 as the standard for determining the number of atoms in one mole and that one mole is 6.02×10^{23}, Avogadro's number.	➢ Identify carbon-12 as the standard for determining the number of atoms in one mole and that one mole is 6.02×10^{23}, Avogadro's number.	➢ Identify carbon-12 as the standard for determining the number of atoms in one mole and that one mole is 6.02×10^{23}, Avogadro's number.	➢ Identify carbon-12 as the standard for determining the number of atoms in one mole and that one mole is 6.02×10^{23}, Avogadro's number. Relate Avogadro's number to a real-life quantity or application.
➢ Determine the molar mass of a molecule from its chemical formula and a table of atomic masses be able to convert the mass of a molecular substance to moles, number of particles.	➢ Determine the molar mass of a molecule from its chemical formula and a table of atomic masses be able to convert the mass of a molecular substance to moles, number of particles.	➢ Determine the molar mass of a molecule from its chemical formula and a table of atomic masses, and be able to convert the mass of a molecular substance to moles, number of particles.	➢ Determine the molar mass of a molecule from its chemical formula and a table of atomic masses, and be able to convert the mass of a molecular substance to moles, number of particles. Determine percentage composition of a chemical compound.

FAR BELOW/BELOW BASIC Students are unable to:	**BASIC** Students are inconsistently able to:	**PROFICIENT** Students are able to:	**ADVANCED** Students are able to:
➢ Calculate the masses of reactants and products in a chemical reaction from the mass of one of the reactants or products and the relevant atomic masses.	➢ Calculate the masses of reactants and products in a chemical reaction from the mass of one of the reactants or products and the relevant atomic masses.	➢ Calculate the masses of reactants and products in a chemical reaction from the mass of one of the reactants or products and the relevant atomic masses.	➢ Calculate the masses of reactants and products in a chemical reaction from the mass of one of the reactants or products and the relevant atomic masses. Determine limiting reactant and calculate percent yield.

CHEMISTRY
STANDARDS BASED RUBRIC
STATES OF MATTER

Essential Standard:
STUDENTS WILL UNDERSTAND THE PROPERTIES AND BEHAVIOR OF SOLIDS, LIQUIDS, GASES AND MIXTURES (4, 5, 6).

Second Semester Benchmarks:

FAR BELOW/ BELOW BASIC Students are unable to:	**BASIC** Students are inconsistently able to:	**PROFICIENT** Students are able to:	**ADVANCED** Students are able to:
➢ Recognize that random motion of molecules and their collisions with a surface create the observable pressure on that surface.	➢ Recognize that random motion of molecules and their collisions with a surface create the observable pressure on that surface.	➢ Recognize that random motion of molecules and their collisions with a surface create the observable pressure on that surface.	➢ Recognize that random motion of molecules and their collisions with a surface create the observable pressure on that surface and can relate the random motion to changes in temperature.
➢ Describe how the random motion of molecules explains the diffusion of gases.	➢ Describe how the random motion of molecules explains the diffusion of gases.	➢ Describe how the random motion of molecules explains the diffusion of gases.	➢ Describe how the random motion of molecules explains the diffusion of gases and apply Graham's Law to solve for relative rates of effusion and diffusion.
➢ Apply the gas laws to relations between the pressure, temperature, and volume of any amount of an ideal gas or any mixture of ideal gases.	➢ Apply the gas laws to relations between the pressure, temperature, and volume of any amount of an ideal gas or any mixture of ideal gases.	➢ Apply the gas laws to relations between the pressure, temperature, and volume of any amount of an ideal gas or any mixture of ideal gases.	➢ Apply the gas laws to relations between the pressure, temperature, and volume of any amount of an ideal gas or any mixture of ideal gases, including the application of Dalton's Law.

FAR BELOW/ BELOW BASIC Students are unable to:	**BASIC** Students are inconsistently able to:	**PROFICIENT** Students are able to:	**ADVANCED** Students are able to:
➢ Recall the values and definitions of standard temperature and pressure (STP).	➢ Recall the values and definitions of standard temperature and pressure (STP).	➢ Recall the values and definitions of standard temperature and pressure (STP).	➢ Recall the values and definitions of standard temperature and pressure (STP), and be able to convert between different systems of measurement.
➢ Perform stoichiometric calculations on reactions involving gases, applying the Standard Molar Volume at STP, 22.4 L.	➢ Perform stoichiometric calculations on reactions involving gases, applying the Standard Molar Volume at STP, 22.4 L.	➢ Perform stoichiometric calculations on reactions involving gases, applying the Standard Molar Volume at STP, 22.4 L.	➢ Perform stoichiometric calculations on reactions involving gases, applying the Standard Molar Volume at STP, 22.4 L. The student also performs calculations at conditions other than STP.
➢ Convert between the Celsius and Kelvin temperature scales.	➢ Convert between the Celsius and Kelvin temperature scales.	➢ Convert between the Celsius and Kelvin temperature scales.	➢ Convert between the Celsius, Kelvin and Fahrenheit temperature scales.
➢ Identify 0 Kelvin as the lowest possible temperature.	➢ Identify 0 Kelvin as the lowest possible temperature.	➢ Identify 0 Kelvin as the lowest possible temperature.	➢ Identify 0 Kelvin as the lowest possible temperature and describe the condition in terms of kinetic energy.
➢ State the definitions of solute and solvent.	➢ State the definitions of solute and solvent.	➢ State the definitions of solute and solvent.	➢ State the definitions of solute and solvent and give examples of each in gaseous and liquid solutions.
➢ Describe the dissolving process at the molecular level by using the concept of random molecular motion.	➢ Describe the dissolving process at the molecular level by using the concept of random molecular motion.	➢ Describe the dissolving process at the molecular level by using the concept of random molecular motion.	➢ Describe the dissolving process at the molecular level by using the concept of random molecular motion and intermolecular attraction.

FAR BELOW/ BELOW BASIC Students are unable to:	**BASIC** Students are inconsistently able to:	**PROFICIENT** Students are able to:	**ADVANCED** Students are able to:
➢ Describe how temperature, pressure, and surface area affect the dissolving process.	➢ Describe how temperature, pressure, and surface area affect the dissolving process.	➢ Describe how temperature, pressure, and surface area affect the dissolving process.	➢ Describe how temperature, pressure, and surface area affect the dissolving process and explain differences in solubility between solids and gases.
➢ Calculate the concentration of a solute in terms of grams per liter, molarity and molality	➢ Calculate the concentration of a solute in terms of grams per liter, molarity and molality	➢ Calculate the concentration of a solute in terms of grams per liter, molarity and molality	➢ Calculate the concentration of a solute in terms of grams per liter, molarity and molality, parts per million and percent composition.
➢ List the observable properties of acids, bases, and salt solutions.	➢ List the observable properties of acids, bases, and salt solutions.	➢ List the observable properties of acids, bases, and salt solutions.	➢ List the observable properties of acids, bases, and salt solutions and use those properties to identify unknowns.
➢ Characterize acids as hydrogen-ion-donating and bases as hydrogen-ion accepting substances.	➢ Characterize acids as hydrogen-ion-donating and bases as hydrogen-ion accepting substances.	➢ Characterize acids as hydrogen-ion-donating and bases as hydrogen-ion accepting substances.	➢ Characterize acids as hydrogen-ion-donating and bases as hydrogen-ion accepting substances and give three examples of each.
➢ Define strong acids and bases as fully dissociated and weak acids and bases as partially dissociated	➢ Define strong acids and bases as fully dissociated and weak acids and bases as partially dissociated	➢ Define strong acids and bases as fully dissociated and weak acids and bases as partially dissociated	➢ Define strong acids and bases as fully dissociated and weak acids and bases as partially dissociated, and identify the state of dissociation as an equilibrium state.
➢ Use the pH scale to characterize acid and base solutions.	➢ Use the pH scale to characterize acid and base solutions.	➢ Use the pH scale to characterize acid and base solutions.	➢ Use the pH scale to characterize acid and base solutions and calculate pH from hydrogen ion concentration.

CHEMISTRY
STANDARDS BASED RUBRIC
KINETICS AND THERMODYNAMICS

Essential Standard:
STUDENTS WILL DESCRIBE THE DYNAMICS OF CHEMICAL PROCESSES, INCLUDING ENERGY CHANGE, REACTION RATES AND EQUILIBRIUM.

Second Semester Benchmarks:

FAR BELOW/ BELOW BASIC Student is unable to:	**BASIC** Student is inconsistently able to:	**PROFICIENT** Student is able to:	**ADVANCED** Student is able to:
➢ Describe temperature and heat flow in terms of the motion of molecules (or atoms).	➢ Describe temperature and heat flow in terms of the motion of molecules (or atoms).	➢ Describe temperature and heat flow in terms of the motion of molecules (or atoms).	➢ Describe and quantify temperature and heat flow in terms of the motion of molecules (or atoms).
➢ Identify chemical processes that either release (exothermic) or absorb (endothermic) thermal energy.	➢ Identify chemical processes that either release (exothermic) or absorb (endothermic) thermal energy.	➢ Identify chemical processes that either release (exothermic) or absorb (endothermic) thermal energy.	➢ Identify chemical processes that either release (exothermic) or absorb (endothermic) thermal energy. Illustrate each in an energy diagram.
➢ Recognize that energy is released when a material condenses or freezes and is absorbed when a material evaporates or melts.	➢ Recognize that energy is released when a material condenses or freezes and is absorbed when a material evaporates or melts.	➢ Recognize that energy is released when a material condenses or freezes and is absorbed when a material evaporates or melts.	➢ Recognize that energy is released when a material condenses or freezes and is absorbed when a material evaporates or melts. Describe in terms of the system and surroundings.
➢ Solve problems involving heat flow and temperature changes, using known values of specific heat and latent heat of phase change.	➢ Solve problems involving heat flow and temperature changes, using known values of specific heat and latent heat of phase change.	➢ Solve problems involving heat flow and temperature changes, using known values of specific heat and latent heat of phase change.	➢ Solve problems involving heat flow and temperature changes, using known values of specific heat and latent heat of phase change. In addition, the student can draw a phase change diagram and identify key points.

FAR BELOW/ BELOW BASIC Student is unable to:	BASIC Student is inconsistently able to:	PROFICIENT Student is able to:	ADVANCED Student is able to:
➢ Define rate of reaction as the decrease in concentration of reactants or the increase in concentration of products with time.	➢ Define rate of reaction as the decrease in concentration of reactants or the increase in concentration of products with time.	➢ Define rate of reaction as the decrease in concentration of reactants or the increase in concentration of products with time.	➢ Define rate of reaction as the decrease in concentration of reactants or the increase in concentration of products with time. Recognize a general rate law.
➢ Recognize that reaction rates depend on such factors as concentration, temperature, and pressure.	➢ Recognize that reaction rates depend on such factors as concentration, temperature, and pressure.	➢ Recognize that reaction rates depend on such factors as concentration, temperature, and pressure.	➢ Recognize that reaction rates depend on such factors as concentration, temperature, and pressure and predict their individual effects.
➢ Define the role a catalyst plays in increasing the reaction rate	➢ Define the role a catalyst plays in increasing the reaction rate	➢ Define the role a catalyst plays in increasing the reaction rate	➢ Define the role a catalyst plays in increasing the reaction rate and its effects on activation energy.
➢ Use LeChatelier's principle to predict the effect of changes in concentration, temperature, and pressure.	➢ Use LeChatelier's principle to predict the effect of changes in concentration, temperature, and pressure.	➢ Use LeChatelier's principle to predict the effect of changes in concentration, temperature, and pressure.	➢ Use LeChatelier's principle to predict the effect of changes in concentration, temperature, and pressure, individually and in combination
➢ State that equilibrium is established when forward and reverse reaction rates are equal.	➢ State that equilibrium is established when forward and reverse reaction rates are equal.equal.	➢ State that equilibrium is established when forward and reverse reaction rates are equal.equal.	➢ State that equilibrium is established when forward and reverse reaction rates are equal and can write an equilibrium expression.

CHEMISTRY
STANDARDS BASED RUBRIC
ORGANIC AND BIOCHEMISTRY

Essential Standard:
STUDENTS WILL UNDERST AND THE BONDING CHARACTERISTICS AND CHEMICAL PROPERTIES OF ORGANIC AND BIOMOLECULES.

Second Semester Benchmarks:

FAR BELOW/ BELOW BASIC Student is unable to:	**BASIC** Students is inconsistently able to:	**PROFICIENT** Student is able to:	**ADVANCED** Student is able to:
➢ Describe large molecules (polymers), such as proteins, nucleic acids, and starch, as being formed by repetitive combinations of simple subunits.	➢ Describe large molecules (polymers), such as proteins, nucleic acids, and starch, as being formed by repetitive combinations of simple subunits.	➢ Describe large molecules (polymers), such as proteins, nucleic acids, and starch, as being formed by repetitive combinations of simple subunits.	➢ Describe large molecules (polymers), such as proteins, nucleic acids, and starch, as being formed by repetitive combinations of simple subunits. In addition, the student can describe the subunit of each.
➢ Identify the bonding characteristics of carbon that result in the formation of a large variety of structures ranging from simple hydrocarbons to complex polymers and biological molecules.	➢ Identify the bonding characteristics of carbon that result in the formation of a large variety of structures ranging from simple hydrocarbons to complex polymers and biological molecules	➢ Identify the bonding characteristics of carbon that result in the formation of a large variety of structures ranging from simple hydrocarbons to complex polymers and biological molecules.	➢ Identify the bonding characteristics of carbon that result in the formation of a large variety of structures ranging from simple hydrocarbons to complex polymers and biological molecules. In addition, the student can name the 10 simplest linear hydrocarbons.
➢ Identify amino acids as the building blocks of proteins.	➢ Identify amino acids as the building blocks of proteins.	➢ Identify amino acids as the building blocks of proteins.	➢ Identify amino acids as the building blocks of proteins and recognize their general structure.