COURSE INFORMATION

Chemistry 1

The Chemistry 1 course is for students who have an interest in science, medicine, or engineering and who may be attending college.

Grade Level:	11-12 (10^{th} graders who will be taking Algebra II with approval of instructor)
Length:	1 Year
Period(s) Per Day:	1

ESSENTIAL UNDERSTANDING

Chemistry I is a college preparatory science course. The content of the course includes an overview of major chemistry concepts including but not limited to the following: matter and its properties, atomic theory, chemical bonding, chemical reactions, stoichiometry, solution chemistry, equilibrium, acid-based chemistry, oxidation-reduction, and nuclear chemistry. Laboratory work is an integral part of this course, and students are expected to follow correct lab procedure and safety rules.

The Key Concepts that high school students will continue to develop in Chemistry will include the understanding of the four Physical Science core ideas. These ideas include the most fundamental concepts from chemistry but are intended to leave room for expanded study.

1. HS-PS1 Matter and Its Interactions
2. HS-PS2 Motion and Stability: Forces and Interactions
3. HS-PS3 Energy
4. HS-PS4 Waves and Their Application in Technologies for Information Transfer

COURSE OBJECTIVES AND EXPECTATIONS

This is a college preparatory, laboratory oriented class. It will provide a survey of Introductory Inorganic Chemistry topics. In addition to discussing theoretical aspects of matter and its changes, this course will also focus on Chemistry and its relevance to everyday life. Students will be expected to develop an appreciation of the scientific thought process and its usefulness, develop a logical and critical thinking problem solving approach, manage their time wisely, develop organizational and study skills as well as understand how Chemistry relates to their world.

STUDENT OBJECTIVES

1. Students will build on their previous knowledge and explain more in-depth phenomena central to chemistry.
2. Students will develop and use models.
3. Students will plan and conduct investigations.
4. Students will analyze and interpret data from investigations.
5. Students will use mathematical and computational thinking from investigations and problem sets.
6. Students will construct quality explanations to demonstrate an understanding of the core ideas.

PACING/TIMELINE AND STANDARDS

Pacing	Unit Topic	NGSS Standard	~Disciplinary Core Ideas *Crosscutting Concepts #Science and Engineering Practices
Quarter 1	**Chemistry: An Introduction (about 20 Days)**	**--NGSS HS-PS1: Matter and Its Interaction** ***HS-PS1-3:** Plan and conduct an investigation to gather evidence to compare the structure of substances at the bulk scale to infer the strength of electrical forces between particles. **--NGSS HS-PS2: Motion and Stability: Forces and Interactions** ***HS-PS2-6:** Communicate scientific and technical information about why the molecular-level structure is important in the functioning of designed materials. **--NGSS HS-PS3: Energy** ***HS-PS3-1:** Create a computational model to calculate the change in the energy of one component in a system when the change in energy of the other component(s) and energy flows in and out of the system are known.	**~PS3.A:** Definitions of Energy **~PS3.B:** Conservation of Energy and Energy Transfer **~PS3.D**: Energy in Chemical Processes *Energy and Matter *Systems and System Models *Stability and Change #Planning and Carrying Out Investigations #Using Mathematical and Computational Thinking

Pacing	Unit Topic	NGSS Standard	~Disciplinary Core Ideas *Crosscutting Concepts #Science and Engineering Practices
		***HS-PS3-2:** Develop and use models to illustrate that energy at the macroscopic scale can be accounted for as a combination of energy associated with the motions of particles (objects) and energy associated with the relative position of the particles (objects). ***HS-PS3-3:** Design, build, and refine a device that works within given constraints to convert one form of energy into another form of energy. ***HS-PS3-4:** Plan and conduct an investigation to provide evidence that the transfer of thermal energy when two components of different temperatures are combined within a closed system results in a more uniform energy distribution among the components in the system.	
Quarter 1	**Atomic Theory (about 18 Days)**	**-NGSS HS-PS1 Matter and Its Interaction** ***HS-PS1-1:** Use the periodic table as a model to predict the relative properties of elements based on the patterns of electrons in the outermost energy level of atoms. ***HS-PS1-3:** Plan and conduct an investigation to gather evidence to compare the structure of substances at the bulk scale to infer the strength of electrical forces between particles. **--NGSS HS-PS2: Motion and Stability: Forces and Interactions** ***HS-PS2-6:** Communicate scientific and technical information about why the molecular-level structure is important in the functioning of designed materials.	**~PS1.A:** Structure and Properties of Matter **~PS4.A:** Wave Properties **~PS4.B:** Electromagnetic Radiation *Patterns *Stability and Change *Systems and System Models #Analyzing and Interpreting Data #Obtaining, Evaluating, and Communicating Information #Planning and Carrying Out Investigations #Using Mathematics and Computational Thinking #Engaging in Argument from Evidence

Pacing	Unit Topic	NGSS Standard	~Disciplinary Core Ideas *Crosscutting Concepts #Science and Engineering Practices
		--NGSS HS-PS4: Waves and Their Applications in Technologies for Information Transfer ***HS-PS4-1:** Use mathematical representations to support a claim regarding relationships among the frequency, wavelength, and speed of waves traveling in various media. ***HS-PS4-3:** Evaluate the claims, evidence, and reasoning behind the idea that electromagnetic radiation can be described either by a wave model or a particle model, and that for some situations one model is more useful than the other.	
Quarter 1	**Bonding (about 13 Days)**	**--NGSS HS-PS1 Matter and Its Interactions** ***HS-PS1-1:** Use the periodic table as a model to predict the relative properties of elements based on the patterns of electrons in the outermost energy level of atoms.) Interactions ***HS-PS1-2:** Construct and revise an explanation for the outcome of a simple chemical reaction based on the outermost electron states of atoms, trends in the periodic table, and knowledge of the patterns of chemical properties. ***HS-PS1-3:** Plan and conduct an investigation to gather evidence to compare the structure of substances at the bulk scale to infer the strength of electrical forces between particles. **--NGSS HS-PS2: Motion and Stability: Forces and Interactions**	**~PS1.A:** Structure and Properties of Matter **~PS2.B:** Types of Interactions **~PS3.B:** Relationships between Energy and Forces **~PS3.D:** Energy in Chemical Processes *Patterns *Stability and Change *Energy and Matter *Systems and System Models #Developing and using Models #Engaging in Argument from Evidence

Pacing	Unit Topic	NGSS Standard	~Disciplinary Core Ideas *Crosscutting Concepts #Science and Engineering Practices
		***HS-PS2-4:** Use mathematical representations of Newton's Law of Gravitation and Coulomb's Law to describe and predict the gravitational and electrostatic forces between objects. **--NGSS HS-PS3 Energy** ***HS-PS3-5:** Develop and use a model of two objects interacting through electric or magnetic fields to illustrate the forces between objects and the changes in energy of the objects due to the interaction.	
Quarter 2	**Reactions (about 21 days)**	**--NGSS HS-PS1 Matter and Its Interactions** ***HS-PS1-2:** Construct and revise an explanation for the outcome of a simple chemical reaction based on the outermost electron states of atoms, trends in the periodic table, and knowledge of the patterns of chemical properties. ***HS-PS1-7**: Use mathematical representations to support the claim that atoms, and therefore mass, are conserved during a chemical reaction. **--NGSS HS-PS2: Motion and Stability: Forces and Interactions** ***HS-PS2-6:** Communicate scientific and technical information about why the molecular-level structure is important in the functioning of designed materials.	**~PS1.A:** Structure and Properties of Matter **~PS1.B:** Chemical Reactions **~PS2.B:** Types of Interactions **~PS3.D:** Energy in Chemical Processes *Patterns *Stability and Change *Systems and System Models *Structure and Function *Energy and Matter #Developing and using Models #Constructing Explanations and Designing Solutions

Pacing	Unit Topic	NGSS Standard	~Disciplinary Core Ideas *Crosscutting Concepts #Science and Engineering Practices
Quarter 2	**Mole (about 9 days)**	**--NGSS HS-PS1 Matter and Its Interactions** ***HS-PS1-1:** Construct and revise an explanation for the outcome of a simple chemical reaction based on the outermost electron states of atoms, trends in the periodic table, and knowledge of the patterns of chemical properties.	**~PS1.A:** Structure and Properties of Matter *Patterns #Planning and Carrying Out Investigations #Using Mathematics and Computational Thinking #Engaging in Argument from Evidence
Quarter 2	**Stoichiometry (about 5 days)**	**--NGSS HS-PS1 Matter and Its Interactions** ***HS-PS1-1:** Construct and revise an explanation for the outcome of a simple chemical reaction based on the outermost electron states of atoms, trends in the periodic table, and knowledge of the patterns of chemical properties. ***HS-PS1-7:** Use mathematical representations to support the claim that atoms, and therefore mass, are conserved during a chemical reaction.	**~PS1.A:** Structure and Properties of Matter **~PS1.B:** Chemical Reactions *Patterns #Planning and Carrying Out Investigations #Using Mathematics and Computational Thinking #Developing and using Models #Constructing Explanations and Designing Solutions #Engaging in Argument from Evidence
Quarter 3	**Gases and Gas Laws (about 14 days)**	**--NGSS HS-PS1 Matter and Its Interactions** ***HS-PS1-1:** Construct and revise an explanation for the outcome of a simple chemical reaction based on the outermost electron states of atoms, trends in the periodic table, and knowledge of the patterns of chemical properties. ***HS-PS1-3:** Plan and conduct an investigation to gather evidence to compare the structure of substances at the bulk scale	**~PS1.A:** Structure and Properties of Matter **~PS1.B:** Chemical Reactions **~PS2.B:** Types of Interactions **~PS3.B:** Conservation of Energy and Energy Transfer **~PS3.C:** Relationship Between Energy and Forces **~PS3.D:** Energy in Chemical Processes

Pacing	Unit Topic	NGSS Standard	~Disciplinary Core Ideas *Crosscutting Concepts #Science and Engineering Practices
		to infer the strength of electrical forces between particles. ***HS-PS1-5:** Apply scientific principles and evidence to provide an explanation about the effects of changing the temperature or concentration of the reacting particles on the rate at which a reaction occurs. **--NGSS HS-PS2: Motion and Stability: Forces and Interactions** ***HS-PS2-6:** Communicate scientific and technical information about why the molecular-level structure is important in the functioning of designed materials. **--NGSS HS-PS3: Energy** ***HS-PS3-2:** Develop and use models to illustrate that energy at the macroscopic scale can be accounted for as a combination of energy associated with the motions of particles (objects) and energy associated with the relative position of the particles (objects).	*Patterns *Stability and Change *Systems and System Models *Structure and Function *Energy and Matter #Planning and Carrying Out Investigations #Using Mathematics and Computational Thinking #Developing and using Models #Constructing Explanations and Designing Solutions #Engaging in Argument from Evidence
Quarter 3	**Liquids and Solids (about 9 days)**	**--NGSS HS-PS1 Matter and Its Interactions** ***HS-PS1-1:** Construct and revise an explanation for the outcome of a simple chemical reaction based on the outermost electron states of atoms, trends in the periodic table, and knowledge of the patterns of chemical properties. ***HS-PS1-3:** Plan and conduct an investigation to gather evidence to compare the structure of substances at the bulk scale to infer the strength of electrical forces between particles. ***HS-PS1-4:** Develop a model to illustrate that the release or absorption of energy from	**~PS1.A:** Structure and Properties of Matter **~PS1.B:** Chemical Reactions **~PS2.B:** Types of Interactions **~PS3.B:** Conservation of Energy and Energy Transfer **~PS3.C:** Relationship Between Energy and Forces **~PS3.D:** Energy in Chemical Processes *Patterns *Stability and Change *Systems and System Models *Energy and Matter

Pacing	Unit Topic	NGSS Standard	~Disciplinary Core Ideas *Crosscutting Concepts #Science and Engineering Practices
		a chemical reaction system depends upon the changes in total bond energy. ***HS-PS1-5:** Apply scientific principles and evidence to provide an explanation about the effects of changing the temperature or concentration of the reacting particles on the rate at which a reaction occurs. **--NGSS HS-PS2: Motion and Stability: Forces and Interactions** ***HS-PS2-6:** Communicate scientific and technical information about why the molecular-level structure is important in the functioning of designed materials. **--NGSS HS-PS3: Energy** ***HS-PS3-2:** Develop and use models to illustrate that energy at the macroscopic scale can be accounted for as a combination of energy associated with the motions of particles (objects) and energy associated with the relative position of the particles (objects).	#Planning and Carrying Out Investigations #Using Mathematics and Computational Thinking #Developing and using Models #Constructing Explanations and Designing Solutions #Engaging in Argument from Evidence
Quarter 3	**Solutions (about 15 days)**	**--NGSS HS-PS1 Matter and Its Interactions** **HS-PS1-1:** Construct and revise an explanation for the outcome of a simple chemical reaction based on the outermost electron states of atoms, trends in the periodic table, and knowledge of the patterns of chemical properties. **HS-PS1-3:** Plan and conduct an investigation to gather evidence to compare the structure of substances at the bulk scale to infer the strength of electrical forces between particles. **HS-PS1-5:** Apply scientific principles and evidence to provide an explanation about the	**~PS1.A:** Structure and Properties of Matter **~PS1.B:** Chemical Reactions **~PS2.B:** Types of Interactions **~PS3.B:** Conservation of Energy and Energy Transfer **~PS3.C:** Relationship Between Energy and Forces **~PS3.D:** Energy in Chemical Processes *Patterns *Stability and Change *Systems and System Models *Energy and Matter

Pacing	Unit Topic	NGSS Standard	~Disciplinary Core Ideas *Crosscutting Concepts #Science and Engineering Practices
		effects of changing the temperature or concentration of the reacting particles on the rate at which a reaction occurs. **--NGSS HS-PS2: Motion and Stability: Forces and Interactions** ***HS-PS2-6:** Communicate scientific and technical information about why the molecular-level structure is important in the functioning of designed materials. **--NGSS HS-PS3: Energy** ***HS-PS3-2:** Develop and use models to illustrate that energy at the macroscopic scale can be accounted for as a combination of energy associated with the motions of particles (objects) and energy associated with the relative position of the particles (objects).	#Planning and Carrying Out Investigations #Using Mathematics and Computational Thinking #Developing and using Models #Constructing Explanations and Designing Solutions #Engaging in Argument from Evidence
Quarter 4	**Equilibrium (about 15 days)**	**--NGSS HS-PS1 Matter and Its Interactions** ***HS-PS1-1:** Construct and revise an explanation for the outcome of a simple chemical reaction based on the outermost electron states of atoms, trends in the periodic table, and knowledge of the patterns of chemical properties. ***HS-PS1-3:** Plan and conduct an investigation to gather evidence to compare the structure of substances at the bulk scale to infer the strength of electrical forces between particles. ***HS-PS1-4:** Develop a model to illustrate that the release or absorption of energy from a chemical reaction system depends upon the changes in total bond energy. ***HS-PS1-5:** Apply scientific principles and evidence to provide an explanation about the	**~PS1.A:** Structure and Properties of Matter **~PS1.B:** Chemical Reactions **~PS2.B:** Types of Interactions **~PS3.B:** Conservation of Energy and Energy Transfer **~PS3.C:** Relationship Between Energy and Forces *Patterns *Stability and Change *Systems and System Models *Energy and Matter #Planning and Carrying Out Investigations #Using Mathematics and Computational Thinking #Developing and using Models

Pacing	Unit Topic	NGSS Standard	~Disciplinary Core Ideas *Crosscutting Concepts #Science and Engineering Practices
		effects of changing the temperature or concentration of the reacting particles on the rate at which a reaction occurs ***HS-PS1-6:** Refine the design of a chemical system by specifying a change in conditions that would produce increased amounts of products at equilibrium. **--NGSS HS-PS3: Energy** ***HS-PS3-2:** Develop and use models to illustrate that energy at the macroscopic scale can be accounted for as a combination of energy associated with the motions of particles (objects) and energy associated with the relative position of the particles (objects).	#Constructing Explanations and Designing Solutions #Engaging in Argument from Evidence
Quarter 4	**Acids/Bases (about 11 days)**	**--NGSS HS-PS1 Matter and Its Interactions** ***HS-PS1-1:** Construct and revise an explanation for the outcome of a simple chemical reaction based on the outermost electron states of atoms, trends in the periodic table, and knowledge of the patterns of chemical properties. ***HS-PS1-3:** Plan and conduct an investigation to gather evidence to compare the structure of substances at the bulk scale to infer the strength of electrical forces between particles. ***HS-PS1-5:** Apply scientific principles and evidence to provide an explanation about the effects of changing the temperature or concentration of the reacting particles on the rate at which a reaction occurs ***HS-PS1-6:** Refine the design of a chemical system by specifying a change in conditions that would produce increased amounts of products at equilibrium.	**~PS1.A:** Structure and Properties of Matter **~PS1.B:** Chemical Reactions **~PS2.B:** Types of Interactions **~PS3.B:** Conservation of Energy and Energy Transfer **~PS3.C:** Relationship Between Energy and Forces *Patterns *Stability and Change *Systems and System Models *Energy and Matter #Planning and Carrying Out Investigations #Using Mathematics and Computational Thinking #Developing and using Models #Constructing Explanations and Designing Solutions #Engaging in Argument from Evidence

Pacing	Unit Topic	NGSS Standard	~Disciplinary Core Ideas *Crosscutting Concepts #Science and Engineering Practices
Quarter 4	**Redox (about 16 days)**	**--NGSS HS-PS1 Matter and Its Interactions** ***HS-PS1-7:** Use mathematical representations to support the claim that atoms, and therefore mass, are conserved during a chemical reaction. **--NGSS HS-PS3: Energy** ***HS-PS3-2:** Develop and use models to illustrate that energy at the macroscopic scale can be accounted for as either motions of particles or energy stored in fields. ***HS-PS2-6:** Communicate scientific and technical information about why the molecular-level structure is important in the functioning of designed materials. HS-PS2-7. Use mathematical representations to support the claim that atoms, and therefore mass, are conserved during a chemical reaction.	~**PS1.A:** Structure and Properties of Matter ~**PS1.B:** Chemical Reactions ~**PS2.B:** Types of Interactions ~**PS3.B:** Conservation of Energy and Energy Transfer ~**PS3.C:** Relationship Between Energy and Forces *Patterns *Stability and Change *Systems and System Models *Energy and Matter #Planning and Carrying Out Investigations #Using Mathematics and Computational Thinking #Developing and using Models #Constructing Explanations and Designing Solutions #Engaging in Argument from Evidence
Quarter 4	**Nuclear Chemistry (about 3 days)**	**--NGSS HS-PS1 Matter and Its Interactions** ***HS-PS1-8.** Develop models to illustrate the changes in the composition of the nucleus of the atom and the energy released during the processes of fission, fusion, and radioactive decay. **--NGSS HS-PS3: Energy** ***HS-PS3-2:** Develop and use models to illustrate that energy at the macroscopic scale can be accounted for as either motions of particles or energy stored in fields.	~**PS1.C** Nuclear Processes ~**PS2.B:** Types of Interactions ~**PS3.A:** Definitions of Energy ~**PS3.C:** Relationship Between Energy and Forces *Patterns *Stability and Change *Systems and System Models *Energy and Matter #Using Mathematics and Computational Thinking #Developing and using Models #Constructing Explanations and Designing Solutions

Pacing	Unit Topic	NGSS Standard	~Disciplinary Core Ideas *Crosscutting Concepts #Science and Engineering Practices
			#Engaging in Argument from Evidence

Resources

"Next Generation Science Standards Home Page." Accessed January 21, 2019. https://www.nextgenscience.org/

"Montana Standards Model and Curriculum Guide." OPI. Accessed January 21, 2019. https://opi.mt.gov/LinkClick.aspx?fileticket=FSVC2_o8RZU%3d&portalid=182

Zumdahl, Steven S., and DeCoste, Donald J. Introductory Chemistry: A Foundation. 8th ed. Cengage Learning.