EAST PENN SCHOOL DISTRICT

Chemistry 1
July 14, 2025

Chemistry 1 Unit 1 - Atomic Structure and Nuclear Change

STAGE 1 | DESIRED RESULTS
Context and relevance for student learning

Standards

3.2.9-12.B 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.

3.2.9-12A Use the periodic table as a model to predict the relative properties of elements based on the pattern of electrons in the outermost energy levels of atoms.

3.2.9-12N Communicate scientific and technical information about why the molecular level structure is important in the functioning of designed materials.

3.2.9-12.V Evaluate the claims, evidence, and reasoning behind the idea that

Transfer

Students will be able to independently use their learning to consider...

- ☐ How/why stuff works?
- ☐ What are substances made of?
- ☐ How do I solve problems?
- ☐ How does matter interact?

Meaning

UNDERSTANDINGS
Students will understand that...

- ☐ Matter is made of atoms.
- ☐ The properties of a substance are determined by its chemical composition.
- ☐ Scientists use a systematic approach to solving quantitative problems.
- ☐ Nuclear reactions involve changes in the nucleus whereas chemical reactions involve changes in electrons
- ☐ Our understanding of electrons is based on the wave and particle nature of light.
- ☐ Gamma radiation is inherently different from other types of nuclear decay products.

ESSENTIAL QUESTIONS
Students will keep considering...

- ☐ How do we know what we can not see?
- ☐ How does instrumentation determine the quality of the measurement we are making?
- ☐ How are chemical and nuclear reactions fundamentally different?
- ☐ How does one know how to predict what will form when substances react in a nuclear change?
- ☐ What is light? How can one explain the varied effects that involve light? What other forms of electromagnetic radiation are there?

Acquisition(need to align with above and standards)

Students will know...
Disciplinary Core Ideas
PS1.A Structure and Properties of Matter

- ☐ Each atom has a charged substructure consisting of a nucleus, which is made of protons and neutrons, surrounded by electrons.
- ☐ The periodic table orders elements horizontally by the number of protons in the atom's nucleus and

Students will be skilled at...

- ☐ Conduct an investigation to produce data to serve as the basis for evidence of the commonly accepted structure of an atom - including the mass, charge and location of subatomic particles and electron configuration.

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. 3.2.9-12.H 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.	places those with similar properties in columns. The repeating patterns of this table reflect patterns of outer electron states. ☐ The structure and interactions of matter at the bulk scale are determined by electrical forces within and between atoms. PS2.B Types of Interactions ☐ Attraction and repulsion between electric charges at the atomic scale explain the structure, properties, and transformations of matter, as well as the contact forces between material objects. PS1.C Nuclear Reactions ☐ Nuclear processes, including fusion, fission, and radioactive decays of unstable nuclei, involve release or absorption of energy. The total number of neutrons plus protons does not change in any nuclear process. PS4.B Electromagnetic Radiation ☐ Electromagnetic radiation (e.g., radio, microwaves, light) can be modeled as a wave of changing electric and magnetic fields or as particles called photons. The wave model is useful for explaining many features of electromagnetic radiation, and the particle model explains other features. ☐ Shorter wavelength electromagnetic radiation (ultraviolet, X-rays, gamma rays) can ionize atoms and cause damage to living cells.	☐ Develop a model that illustrates a nuclear process, in which atoms are not conserved, but the total number of protons plus neutrons is conserved. ☐ Use multiple types of atomic models based on evidence to illustrate and/or predict the relationships between atoms or components of atoms. ☐ Use patterns to determine the number of protons, electrons, and neutrons in an atom, ion, or isotope. ☐ Explain the developments that led to the modern model of the atom. ☐ Draw models of atoms, including orbital filling diagrams, electron configurations and Lewis Dot Diagrams for the representative elements ☐ Predict the missing components of a nuclear reaction. ☐ Explain the dangers/effects and the appropriate precautions for radioactive exposure. ☐ Model energy changes of nuclear reactions ☐ Use models and data to explain how frequency, energy, and wavelength are related in the electromagnetic spectrum, and describe how these properties help us understand different types of electromagnetic radiation (like visible light, UV, or X-rays). ☐ Explain how light behaves like both a wave and a particle, and use these models to explain chemistry-related phenomena—such as the photoelectric effect, atomic emission spectra, and how photons relate to electron energy levels.

Chemistry 1 Unit 2 - Periodic Table

STAGE 1 | DESIRED RESULTS

Context and relevance for student learning

Standards

3.2.9-12.A 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.(PS1-1)

3.2.9-12.B 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(PS1-3)

3.2.9-12.C 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.(PS1-2)

3.2.9-12.N Communicate scientific and technical information about why the molecular level structure is important in the functioning

Transfer

Students will be able to independently use their learning to consider...

- ☐ How/why stuff works?
- ☐ What are substances made of?
- ☐ How do I solve problems?
- ☐ How does matter interact?

Meaning

UNDERSTANDINGS

Students will understand that...

- ☐ The periodic table is the most important tool in chemistry.
- ☐ Properties and location of elements on the Periodic Table are related.

ESSENTIAL QUESTIONS

Students will keep considering...

- ☐ What is periodic about the table?
- ☐ Why is the Periodic Table so important?
- ☐ How can one explain the structure, properties, and interactions of matter?
- ☐ How does one know how to predict what will form when substances react?

Acquisition(need to align with above and standards)

Students will know...

Disciplinary Core Ideas

PS1.A Structure and Properties of Matter

- ☐ Each atom has a charged substructure consisting of a nucleus, which is made of protons and neutrons, surrounded by electrons.
- ☐ The periodic table orders elements horizontally by the number of protons in the atom's nucleus and places those with similar properties in columns. The repeating patterns of this table reflect patterns of outer electron states.
- ☐ The structure and interactions of matter at the bulk scale are determined by electrical forces within and between atoms.

PS2.B Types of Interactions

- ☐ Attraction and repulsion between electric charges at the atomic scale explain the structure,

Students will be skilled at...

- ☐ Develop and use models of atoms, including orbital filling diagrams, electron configurations and Lewis Dot Diagrams for the representative elements
- ☐ Predict periodic trends and resulting properties due to an element's location on the periodic table and provide an explanation as to why it varies the way it does.

of designed materials.(PS 2-6)	properties, and transformations of matter, as well as the contact forces between material objects. PS1.B Chemical Reactions ☐ The fact that atoms are conserved, together with knowledge of the chemical properties of the elements involved, can be used to describe and predict chemical reactions.	

Chemistry 1 Unit 3 - Bonding and Nomenclature

STAGE 1 | DESIRED RESULTS

Context and relevance for student learning

Standards

3.2.9-12.B 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.

3.2.9-12.C 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.

3.2.9-12.N Communicate scientific and technical information about why the molecular level structure is important in the functioning of designed materials.

Transfer

Students will be able to independently use their learning to...(make purpose-takeaway in 5 years)

- ☐ How/why stuff works?
- ☐ What are substances made of?
- ☐ How do I solve problems?
- ☐ How does matter interact?

Meaning

UNDERSTANDINGS

Students will understand that...

- ☐ New bonds form between atoms to produce new substances.
- ☐ There is a systematic method (IUPAC) for naming chemicals.
- ☐ The properties of a substance are determined by its chemical composition.

ESSENTIAL QUESTIONS

Students will keep considering...

- ☐ How do new substances form?
- ☐ How do we name chemicals?
- ☐ How do we know what we can not see?

Acquisition(need to align with above and standards)

Students will know...

Disciplinary Core Ideas

PS1.A Structure and Properties of Matter

- ☐ The periodic table orders elements horizontally by the number of protons in the atom's nucleus and places those with similar properties in columns. The repeating patterns of this table reflect patterns of outer electron states.
- ☐ The structure and interactions of matter at the bulk scale are determined by electrical forces within and between atoms.

PS2.B Types of Interactions

- ☐ Attraction and repulsion between electric charges at the atomic scale explain the structure, properties, and transformations of matter, as well as the contact forces between material objects.

Students will be skilled at...

- ☐ Develop and use models that illustrate how elements gain, lose or share electrons in the bonding process based on their electron arrangement and attraction resulting in ionic, covalent or metallic bonding.
- ☐ Utilize the pattern of bonding type to recognize its effect on the structure and properties of the resulting substance.
- ☐ Relate a chemical formula to what has occurred in the bonding process between atoms
- ☐ Write the chemical formulas and names of compounds (including polyatomic ions, but not transition metals.).
- ☐ Predict the type of bond that occurs between atoms.
- ☐ Use models to illustrate forces between ions and atoms.

		☐ Determine the number (single, double, or triple) of bonds that will occur between two atoms and the reason why. ☐ Identify a stable electron configuration and how metals and nonmetals obtain them. ☐ Analyze the symmetry of charge within covalent bonds and molecules.

Chemistry 1 Unit 4 - Reaction Writing & Quantities

STAGE 1 | DESIRED RESULTS

Context and relevance for student learning

Standards

3.2.9-12C 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.

3.2.9-12G Use mathematical representation to support the claim that atoms, and therefore mass, are conserved during a chemical reaction.

Transfer

Students will be able to independently use their learning to consider...

- ☐ How/why stuff works?
- ☐ What are substances made of?
- ☐ How do I solve problems?
- ☐ How does matter interact?

Meaning

UNDERSTANDINGS

Students will understand that...

- ☐ Scientists use a systematic approach to solving problems.
- ☐ Scientists have created the mole concept to make quantitative relationships practical.
- ☐ Chemical reactions can be classified by type, which helps to predict products.
- ☐ Chemical reactions can be expressed as reaction equations.
- ☐ A chemical reaction is the breaking and forming of chemical bonds to produce new substances.
- ☐ We can use balanced chemical equations to predict and analyze quantities used and produced in a reaction.

ESSENTIAL QUESTIONS

Students will keep considering...

- ☐ Why is the mole so useful and important?
- ☐ How does one know how to predict what will form when substances react?
- ☐ How can we use stoichiometry to determine the amount of substances used and produced in chemical reactions?

Acquisition(need to align with above and standards)

Students will know...

Disciplinary Core Ideas

PS1.A Structure and Properties of Matter

- ☐ The periodic table orders elements horizontally by the number of protons in the atom's nucleus and places those with similar properties in columns. The repeating patterns of this table reflect patterns of outer electron states.

PS1.B Chemical Reactions

- ☐ The fact that atoms are conserved, together with knowledge of the chemical properties of the elements involved, can be used to describe and predict chemical reactions.

Students will be skilled at...

- ☐ Use mathematical representations of reaction phenomena to support claims involving conversion between mass, mole, and volume of gases. (Dimensional Analysis/Stoichiometric conversions)
- ☐ Use mathematical thinking to calculate the percent composition of the formula of a compound.
- ☐ Use the patterns of reaction types (Synthesis, decomposition, single replacement, double replacement, neutralization and combustion)

		to predict the products of a chemical reaction. ☐ Interpret word equations to write chemical skeletal equations. ☐ Analyze balanced chemical equations according to the law of conservation of mass. ☐ Utilize a chemical equation to communicate relationships of mass, moles of particles, or volume of reactants and products in a reaction.

Chemistry 1 Unit 5 - IMF's and States of Matter

STAGE 1 | DESIRED RESULTS

Context and relevance for student learning

Standards

3.2.9-12A 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.

3.2.9-12B 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.

3.2.9-12E Apply scientific principles and evidence to provide an explanation about

Transfer

Students will be able to independently use their learning to consider...

- ☐ How/why stuff works?
- ☐ What are substances made of?
- ☐ How do I solve problems?
- ☐ How does matter interact?

Meaning

UNDERSTANDINGS

Students will understand that...

- ☐ Substances can be manipulated to obtain varying properties.
- ☐ Solutions play a role in our bodies and environment.
- ☐ Properties of substances, both mixtures and pure, are predictable functions of their intermolecular interactions.

ESSENTIAL QUESTIONS

Students will keep considering...

- ☐ How do the particles in a solution interact to result in the process of dissolving?
- ☐ How does pressure and temperature affect the phase of a substance?

Acquisition(need to align with above and standards)

Students will know...

Disciplinary Core Ideas

PS1.A Structure and Properties of Matter

- ☐ The structure and interactions of matter at the bulk scale are determined by electrical forces within and between atoms.

Students will be skilled at...

- ☐ Using mathematical, computation, and or algorithmic representations of gas phenomena to describe and support explanations of gas behavior.

the effects of changing the temperature or concentration of the reacting particles on the rate at which a reaction occurs. 3.2.9-12N. Communicate scientific and technical information about why the molecular level structure is important in the functioning of designed materials. 3.2.9-12O. 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.	PS2.B Types of Interactions ☐ Attraction and repulsion between electric charges at the atomic scale explain the structure, properties, and transformations of matter, as well as the contact forces between material objects. PS3.A Definitions of Energy ☐ Energy is a quantitative property of a system that depends on the motion and interactions of matter and radiation within that system. PS3.B Conservation of Energy and Energy Transfer ☐ Mathematical expressions, which quantify how the stored energy in a system depends on its configuration (e.g. relative positions of charged particles, compression of a spring) and how kinetic energy depends on mass and speed, allow the concept of conservation of energy to be used to predict and describe system behavior.	☐ Analyze and interpret data to predict the response of a gas to changes in pressure, volume and/or temperature, using the appropriate gas law. ☐ Utilize mathematics and computation thinking to solve the Ideal Gas Law equation. ☐ Explain the cause and effect on the colligative properties of a solvent due to the addition of a solute. ☐ Describe the relationship between bulk properties of a substance and the strength of its intermolecular forces. ☐ Use mathematics and computational thinking to calculate the concentration (Molarity), volume and/or number of moles of particles in a solution. ☐ Interpret a phase diagram appropriately. ☐ Model the three states of matter. ☐ Experiment with the effects of intermolecular forces. ☐ Use Solubility Curves to determine the saturation of a particular solute and solvent. ☐ Interpret a heating or cooling curve appropriately.

Chemistry 1 Unit 6 - Applications of Chemical Concepts

STAGE 1 | DESIRED RESULTS Context and relevance for student learning		
Standards	**Transfer**	
3.2.9-12.C 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	*Students will be able to independently use their learning to consider...* ☐ How/why stuff works? ☐ What are substances made of? ☐ How do I solve problems? ☐ How does matter interact?	
	Meaning	
	UNDERSTANDINGS *Students will understand that...*	ESSENTIAL QUESTIONS *Students will keep considering...*

knowledge of the patterns of chemical properties. 3.2.9-12.E 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. 3.2.9-12.F Refine the design of a chemical system by specifying a change in conditions that would produce increased amounts of products at equilibrium. 3.2.9-12.G Use mathematical representations to support the claim that atoms, and therefore mass, are conserved during a chemical reaction.	☐ Chemical equilibrium is reached when the rate of a forward reaction equals the rate of a reverse reaction. ☐ The equilibrium of a chemical reaction can be manipulated to maximize the amount of products made. ☐ Reactions are driven by energy changes and therefore always involve them.	☐ What is chemical equilibrium? ☐ How is equilibrium affected by temperature, pressure and the concentration of reactants and products? ☐ How is energy involved in a chemical reaction?
	Acquisition(need to align with above and standards)	
	Students will know... Disciplinary Core Ideas PS1.A Structure and Properties of Matter ☐ The repeating patterns of this table reflect patterns of outer electron states. PS1.B Chemical Reactions ☐ Chemical processes, their rates, and whether or not energy is stored or released can be understood in terms of the collisions of molecules and the rearrangements of atoms into new molecules, with consequent changes in the sum of all bond energies in the set of molecules that are matched by changes in kinetic energy. ☐ In many situations, a dynamic and condition-dependent balance between a reaction and the reverse reaction determines the numbers of all types of molecules present. ☐ The fact that atoms are conserved, together with knowledge of the chemical properties of the elements involved, can be used to describe and predict chemical reactions.	*Students will be skilled at...* ☐ Construct explanations of how things change and how they remain stable within a system at equilibrium ☐ Carry out investigations on how the addition of a stress will affect an equilibrium. ☐ Use models of equilibrium reactions to Predict the effect of a catalyst on a reaction (both at and not at equilibrium). ☐ Use Le Chatelier's principle to predict the response of a system at equilibrium. ☐ Use algorithmic thinking to approximate the pH of a substance based on the exponent of the hydrogen ion concentration. ☐ Evaluate the acidity or basicity of a solution through the analysis of hydrogen ion concentration and pH data. ☐ *Identify when an acid or base has been neutralized.*