



Chemistry - Unit 2 - Atomic Structure and Electron Structure

Unit Focus

Students explore the Periodic Table as an organizing framework for the fundamentals of chemical behavior. Students take a deeper dive into their understanding of subatomic particles, the relationship between the particles and their relevance to atomic mass and isotopes. Students will describe the quantum mechanical model of the atom and an in depth study of the electromagnetic spectrum as the anchoring phenomenon will lead students to develop a model for the electronic structure of the atom. By evaluating electron configuration and orbital diagrams, students will explain Periodic Law. Students will apply their understanding of periodic law to interpret and predict properties of elements including ionization energy, electronegativity, and atomic radius and their relationship to the electron structure of each element.

Stage 1: Desired Results - Key Understandings

Standard(s)	Transfer	
NGSS/NSTA Science & Engineering Practices NGSS Science & Engineering Practices: 9-12 - Analyze data using tools, technologies, and/or models (e.g., computational, mathematical) in order to make valid and reliable scientific claims or determine an optimal design solution. (SE.9-12.4.1) - Use mathematical, computational, and/or algorithmic representations of phenomena or design solutions to describe and/or support claims and/or explanations. (SE.9-12.5.3) - Apply scientific ideas, principles, and/or evidence to provide an explanation of phenomena and solve design problems, taking into account possible unanticipated effects (SE.9-12.6.3) Next Generation Science Standards Performance Expectations: High School Physical Sciences - 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-PS1-1) - Use mathematical representations to support a claim regarding relationships among the frequency, wavelength, and speed of waves traveling in various media. (HS-PS4-1) - 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. (HS-PS4-3) Next Generation Science Standards (DCI) Science: 11	<i>Students will be able to independently use their learning to...</i> T1 Analyze qualitative and quantitative data to interpret patterns, draw conclusions, and/or make predictions. T2 Evaluate scientific claims and analyze issues to verify the credibility of the source, data, and/or approach.	
	Meaning	
	Understanding(s)	Essential Question(s)
	<i>Students will understand that...</i> U1 Scientific numeracy includes the ability to use universal mathematical operations and procedures to calculate, analyze and present scientific data and ideas. U2 Matter of any type can be subdivided into particles that are too small to see. U3 Wavelength, frequency, and amplitude are properties of a wave that determine its characteristics such as pitch, color, sound and energy. U4 Electric and magnetic forces can be attractive or repulsive and are dependent on the strength of the charge or magnetic strengths and the distance between them. U5 Frequency of electromagnetic waves is directly proportional to its energy which can affect how it interacts with matter. U6 Atoms are comprised of subatomic particles held together by fundamental forces and their quantity and	<i>Students will keep considering...</i> Q1 How does understanding the organization of the periodic table allow scientists to make predictions? Q2 What information do you need to predict the property of an element? Q3 How can we use models to represent structure of matter? Q4 How does structure relate to function?

Stage 1: Desired Results - Key Understandings

- Each atom has a charged substructure consisting of a nucleus, which is made of protons and neutrons, surrounded by electrons. (PS1.9.A1)
- The periodic table orders elements horizontally by the number of protons in the atom's nucleus and places those with similar chemical properties in columns. The repeating patterns of this table reflect patterns of outer electron states. (PS1.9.A3)
- These relationships are better understood at the microscopic scale, at which all of the different manifestations of energy can be modeled as a combination of energy associated with the motion of particles and energy associated with the configuration (relative position of the particles). In some cases the relative position energy can be thought of as stored in fields (which mediate interactions between particles). This last concept includes radiation, a phenomenon in which energy stored in fields moves across space. (PS3.9.A4)
- The wavelength and frequency of a wave are related to one another by the speed of travel of the wave, which depends on the type of wave and the medium through which it is passing. (PS4.9.A1)
- 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. (PS4.9.B1)
- Atoms of each element emit and absorb characteristic frequencies of light. These characteristics allow identification of the presence of an element, even in microscopic quantities. (PS4.9.B2)

Madison Public Schools Profile of a Graduate

- Analyzing: Examining information/data/ evidence from multiple sources to identify possible underlying assumptions, patterns, and relationships in order to make inferences. (POG.1.2)
- Collective Intelligence: Working respectfully and responsibly with others, exchanging and evaluating ideas to achieve a common objective. (POG.3.1)
- Self-Awareness: Examining current performance critically to identify steps/ strategies to persist. (POG.4.1)

arrangement determines the atom's properties, identity, and behavior.

U7 The organization of elements in the periodic table based on atomic structure facilitates predictions about their characteristics.

U8 Wavelength, frequency, and amplitude are properties of a wave that determine its characteristics such as pitch, color, sound and energy.

U9 Electrons are arranged in energy levels, sublevels, and orbitals. The arrangement of the outermost electrons determines the properties and chemical behaviors of the element.

Acquisition of Knowledge and Skill

Knowledge

Students will know...

K1 The metric system is used for scientific investigations.

K2 Vocabulary: atom, molecule, ion, valence electron, metal, nonmetal, transition metal, metalloid, isotope, atomic mass, noble gases, halogens, alkali metals, alkaline earth metals, wave, wavelength, frequency, photon, quantum, atomic emission spectrum, electron configuration, principal energy level, sublevel, orbital, periods, groups, valence electrons, ionization energy, atomic radius, and electronegativity.

K3 Electrons can display energy changes as movements between energy levels.

K4 Electron configurations describe how electrons spaces themselves apart from one another and from the nucleus of an atom.

K5 Electron configurations explain the properties of elements.

K6 Elements can be classified a metals, nonmetals, or metalloids with general properties specific to each classification.

Skill(s)

Students will be skilled at...

S1 Apply both precision and accuracy in recording experimental data.

S2 Draw a model of a given atom.

S3 Describe and calculate wavelength, frequency, and energy of a photon.

S4 Describe and calculate the energy change that happens during an absorption spectrum.

S5 Identify electron configuration of a given element from its position on the periodic table.

S6 Calculate the number of electrons, protons, and neutrons in atoms, ions and isotopes.

S7 Identify groups and periods on the Periodic Table and describe the general properties of each group.