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ODYSSEY Molecular Explorer
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Correlation with the
South Dakota Science Content Standards
High School
Board Approved March 22, 2005

PHYSICAL SCIENCE STANDARDS 9-12

Indicator 1

Describe structures and properties of, and changes in, matter.

Core HS Standards

9-12.P.1.1. (Analysis)
Use the Periodic Table to determine the atomic structure of elements, valence number, family relationships, and regions (metals, nonmetals, and metalloids).

- Determine protons, neutrons, electrons, mass number, and atomic number from the Periodic Table.
- Determine the number of valence electrons for elements in the main (s&p) blocks of the Periodic Table.
- Identify the relative metallic character of an element based on its location on the Periodic Table.

→ **P1** *Main Groups & Transition Metals* "Alkali Metals"
→ **P2** *Main Groups & Transition Metals* "Alkaline Earth Metals"
→ **P3** *Main Groups & Transition Metals* "Boron Group"
→ **P4** *Main Groups & Transition Metals* "Carbon Group"
→ **P6** *Main Groups & Transition Metals* "Nitrogen Group"
→ **P7** *Main Groups & Transition Metals* "Oxygen Group"
→ **P10** *Main Groups & Transition Metals* "Halogens"
→ **P11** *Main Groups & Transition Metals* "Noble Gases"
→ **P12** *Main Groups & Transition Metals* "Elements of the d- and f-Blocks"

9-12.P.1.2. (Comprehension)

Describe ways that atoms combine.

- Name and write formulas for binary ionic and covalent compounds. Example: sodium chloride (NaCl), carbon dioxide (CO_2)
- Compare the roles of electrons in covalent, ionic, and metallic bonding.
- Discuss the special nature of carbon covalent bonds.

→ **C20** *Chemical Matter* "Naming Compounds"

→ **F1** *Chemical Bonding* "The Attraction Between Ions"

→ **F7** *Chemical Bonding* "Electron Sharing"

→ **F8** *Chemical Bonding* "Energetics of Covalent Bonding"

→ **S1** *Organic Chemistry* "How Special is Carbon?"

9-12.P.1.3. (Application)
Predict whether reactions will speed up or slow down as conditions change.

- Examples: temperature, concentration, surface area, and catalysts

→ **M2** *Kinetics* "Reactive Collisions"

9-12.P.1.4. (Application)
Balance chemical equations by applying the Law of Conservation of Matter.

- Trace number of particles in diagrams and pictures of balanced equations. Example: Write out an equation with symbols: $Mg + 2HCl \rightarrow MgCl_2 + 2H_2$

→ **M1** *Kinetics* "Observing a Reaction"

→ **M3** *Kinetics* "Mechanism of a Reaction"

9-12.P.1.5. (Comprehension)
Distinguish among chemical, physical, and nuclear changes.

- Differentiate between physical and chemical properties used to describe matter.
- Identify key indicators of chemical and physical changes.
- Describe the effects of changing pressure, volume, or temperature upon gases.
- Identify characteristics of a solution and factors that affect the rate of solution formation.
- Explain the differences among nuclear, chemical, and physical changes at the atomic level.
- Examples: solute, solvent, concentrated, dilute, saturated, unsaturated, supersaturated
- Factors affecting rate: agitation, heating, particle size, pictures of particles

→ **C12** *Chemical Matter* "Types of Properties"

→ **G13** *Gases* "Pressure-Volume Relationship"

→ **G16** *Gases* "Pressure and Temperature"

→ **I2** *Solutions* "Process of Dissolving"

→ **I7** *Solutions* "Molarity vs. Molality"

→ **I11** *Solutions* "Energetics of Solution Formation"

Advanced HS Standards

9-12.P.1.1A. (Analysis)
Distinguish between the changing models of the atom using the historical experimental evidence.

- Examples: Dalton, Thompson, Rutherford, Bohr, wavemechanical models

→ **D5** *Atoms* "Electron Cloud of Argon"

9-12.P.1.2A. (Synthesis)
Predict electron configuration, ion formation, reactivity, compound formation, periodic trends, and types of compounds formed based on location on the Periodic Table.

- Examples: periodic trends including ionization, energy, electronegativity, atomic and ionic size, and shielding effect.

→ **Stockroom** Many Examples of Ionic and Molecular Compounds

9-12.P.1.3A. (Synthesis)
Identify five basic types of chemical reactions and predict the products.

- Single replacement, double replacement, synthesis, decomposition, and combustion reactions
- Describe the properties and interactions of acids, bases, and salts.
- Calculate pH, pOH, $[H_3O^+]$, $[OH^-]$.
- Distinguish between Arrhenius, Bronsted-Lowry, and Lewis definitions of acids and bases.

→ **K1** *Acids & Bases* "Strong Acids"

→ **K2** *Acids & Bases* "Comparing Oxoacids"

→ **M1** *Kinetics* "Observing a Reaction"

→ **M3** *Kinetics* "Mechanism of a Reaction"

9-12.P.1.4A. (Synthesis)
Describe factors that affect solution interactions.

- Calculate concentration of solutions.
- “Like dissolves like”
- Van der Waals forces

→ **I6** *Solutions* "Concentration of a Dissolved Pesticide"

→ **I7** *Solutions* "Molarity vs. Molality"

→ **I17** *Solutions* "Miscible and Nonmiscible Liquids"

9-12.P.1.5A. (Application)
Examine energy transfer as matter changes.

Examples:

- Determine ΔH, ΔG, ΔS for thermo-chemical equations.
- Calculate energy involved in phase changes.
- Compare the specific heats of various substances.
- Describe physical and chemical processes that result in endothermic and exothermic changes.
- Describe energy transfer as matter changes from one phase to another.

→ **C13** *Chemical Matter* "Physical Changes"
→ **H20** *Liquids & Solids* "Melting Transition"
→ **I11** *Solutions* "Energetics of Solution Formation"
→ **L6** *Thermochemistry* "Specific Heat"

9-12.P.1.7A. (Application)
Apply the kinetic molecular theory to solve quantitative problems involving pressure, volume, temperature, and number of moles of gas.

- Apply Boyle's Law, Charles' Law, Gay-Lussac's Law, Combined Gas Law, and Ideal Gas Law.

→ **G6** *Gases* "Gas Pressure"
→ **G14** *Gases* "Boyle's Law"
→ **G19** *Gases* "Universality of the Ideal Gas Law"

9-12.P.1.8A. (Synthesis)
Use models to make predictions about molecular structure, chemical bonds, chemical reactivity, and polarity of molecules.

- Create Lewis structures for molecules and polyatomic ions.
- Determine molecular shape using VSEPR theory.
- Determine the polarity of a molecule.

→ **F10** *Chemical Bonding* "Polyatomic Ions"
→ **F11** *Chemical Bonding* "Polar Bonds and Molecules"
→ **F12** *Chemical Bonding* "Dipole Moments"
→ **F14** *Chemical Bonding* "VSEPR Theory"
→ **F15** *Chemical Bonding* "Comparing Shapes"

9-12.P.1.9A. (Analysis)
Describe the characteristics of equilibria.

- Apply Le Chatelier's principle to equilibrium reactions.
- Identify factors that drive reactions toward completion.
- Calculate K_{eq} values for equilibrium reactions.

→ **N1** *Equilibria* "Dynamics of Equilibria"

→ **N2** *Equilibria* "Equilibrium and Temperature"

→ **N3** *Equilibria* "Equilibrium and Pressure"