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ODYSSEY Molecular Explorer

— Release 6.2 —

Correlation with the

North Carolina Science Standards

Revised 2004

PHYSICAL SCIENCE

Grades 9-12

COMPETENCY GOAL 3

The learner will analyze energy and its conservation.

3.01 Investigate and analyze storage of energy:

- Kinetic energy.
- Potential energies: gravitational, chemical, electrical, elastic, nuclear.
- Thermal energy.

→ **LAB** *Gases* "Mean Speed and Temperature"

→ **LAB** *Thermochemistry* "Thermal Energy"

COMPETENCY GOAL 5

The learner will build an understanding of the structure and properties of matter.

5.01 Develop an understanding of how scientific processes have led to the current atomic theory.

- Dalton's atomic theory.
- J.J. Thomson's model of the atom.
- Rutherford's gold foil experiment
- Bohr's planetary model.
- Electron cloud model.

→ **LAB** *Atoms* "Nuclei and Electrons"

→ **LAB** *Atoms* "The Electron Cloud of an Argon Atom"

5.02 Examine the nature of atomic structure:

- Protons.

- Neutrons.
- Electrons.
- Atomic mass.
- Atomic number.
- Isotopes.

→ **LAB** *Atoms* "Nuclei and Electrons"

→ **LAB** *Atoms* "s- and p-Orbitals"

→ **LAB** *Atoms* "The Electron Cloud of an Argon Atom"

→ **LAB** *Atoms* "d-Orbitals"

5.03 Identify substances through the investigation of physical properties:

- Density.
- Melting point.
- Boiling point.

→ **LAB** *Chemical Matter* "Chemical and Physical Properties"

COMPETENCY GOAL 6
The learner will build an understanding of regularities in chemistry.

6.01 Analyze the periodic trends in the physical and chemical properties of elements.

- Groups (families).
- Periods.

→ **MISCELLANEOUS** *Chemical Matter* "Examples of Chemical Elements"

→ **MISCELLANEOUS** *Main Groups* "Alkali Metals"

→ **MISCELLANEOUS** *Main Groups* "Alkaline Earth Metals"

→ **MISCELLANEOUS** *Transition Metals* "Elements of the d- and f-Blocks"

→ **MISCELLANEOUS** *Main Groups* "Boron Group"

→ **MISCELLANEOUS** *Main Groups* "Carbon Group"

→ **MISCELLANEOUS** *Main Groups* "Nitrogen Group"

→ **MISCELLANEOUS** *Main Groups* "Oxygen Group"

→ **MISCELLANEOUS** *Main Groups* "Halogens"

→ **MISCELLANEOUS** *Main Groups* "Noble Gases"

6.02 Investigate and analyze the formation and nomenclature of simple inorganic compounds.

- Ionic bonds (including oxidation numbers).
- Covalent bonds.
- Metallic bonds.

→ **LAB** *Chemical Matter* "Naming Molecular Compounds"

→ **LAB** *Chemical Bonding* "Exploring Ionic Interactions"

→ **LAB** *Chemical Bonding* "Electron Sharing in Molecules"

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

→ **LAB** *Chemical Bonding* "Polar Bonds and Molecules"

→ **LAB** *Chemical Bonding* "Classifying by Bond Polarity"

6.03 Identify the reactants and products of chemical reactions and balance simple equations of various types:

- Single replacement.
- Double replacement.
- Decomposition.
- Synthesis.

→ **DEMONSTRATION** *Solutions* "How do salts dissolve in water?"

→ **DEMONSTRATION** *Kinetics* "What does a chemical reaction look like at the molecular level?"

→ **LAB** *Kinetics* "Examining a Reaction Mechanism"

6.05 Investigate and analyze the properties and composition of solutions:

- Solubility curves.
- Concentration.
- Polarity.
- pH scale.
- Electrical conductivity.

→ **MISCELLANEOUS** *Solutions* "Energetics of Solutions"

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

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

CHEMISTRY

Grades 9-12

COMPETENCY GOAL 2
The learner will build an understanding of the structure and properties of matter.

2.02 Examine the nature of atomic structure.

- Subatomic particles: protons, neutrons, and electrons.
- Mass number.

- Atomic number.
- Isotopes.

→ **LAB** *Atoms* "Nuclei and Electrons"

→ **LAB** *Atoms* "The Electron Cloud of an Argon Atom"

2.03 Apply the language and symbols of chemistry.

- Name compounds using the IUPAC conventions.
- Write formulas of simple compounds from their names.

→ **LAB** *Chemical Matter* "Naming Molecular Compounds"

→ **LAB** *Organic Chemistry* "Isomers of the Alkanes"

→ **LAB** *Organic Chemistry* "Straight-Chain Alkanes"

→ **LAB** *Organic Chemistry* "Isomers of Alkenes and Alkynes"

→ **LAB** *Organic Chemistry* "Cyclic Hydrocarbons"

2.04 Identify substances using their physical properties:

- Melting points.
- Boiling points.
- Density.
- Solubility.

→ **LAB** *Chemical Matter* "Chemical and Physical Properties"

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

2.05 Analyze the basic assumptions of kinetic molecular theory and its applications:

- Ideal Gas Equation.
- Combined Gas Law.
- Dalton's Law of Partial Pressures.

→ **LAB** *Gases* "The Pressure-Volume Relationship"

→ **LAB** *Gases* "The Pressure-Temperature Relationship"

→ **DEMONSTRATION** *Gases* "What is Boyle's Law?"

→ **DEMONSTRATION** *Gases* "What is Avogadro's Law?"

→ **MISCELLANEOUS** *Gases* "The Universality of the Ideal Gas Law"

2.06 Assess bonding in metals and ionic compounds as related to chemical and physical properties.

→ **LAB** *Chemical Bonding* "Exploring Ionic Interactions"

→ **LAB** *Liquids & Solids* "Bonding in Crystalline Solids"

2.07 Assess covalent bonding in molecular compounds as related to molecular geometry and chemical and physical properties.

- Molecular.

- Macromolecular.
- Hydrogen bonding and other intermolecular forces (dipole/dipole interaction, dispersion).
- VSEPR theory.

⟶ **LAB** *Chemical Bonding* "Comparing Conceivable Shapes for a Molecule"

⟶ **LAB** *Liquids & Solids* "Structure and Dynamics of Liquid Water"

⟶ **LAB** *Liquids & Solids* "Intermolecular Forces"

⟶ **MISCELLANEOUS** *Liquids & Solids* "Elements with HydrogenBonding"

2.08 Assess the dynamics of physical equilibria.

- Interpret phase diagrams.
- Factors that affect phase changes.

⟶ **LAB** *Liquids & Solids* "The Melting Transition"

⟶ **DEMONSTRATION** *Chemical Matter* "Do physical changes affect the amount of matter?"

COMPETENCY GOAL 3
The learner will build an understanding of regularities in chemistry.

3.01 Analyze periodic trends in chemical properties and use the periodic table to predict properties of elements.

- Groups (families).
- Periods.
- Representative elements (main group) and transition elements.
- Electron configuration and energy levels.
- Ionization energy.
- Atomic and ionic radii.
- Electronegativity.

⟶ **LAB** *Atoms* "s- and p-Orbitals"

⟶ **MISCELLANEOUS** *Main Groups* "Alkali Metals"

⟶ **MISCELLANEOUS** *Main Groups* "Alkaline Earth Metals"

⟶ **MISCELLANEOUS** *Transition Metals* "Elements of the d- and f-Blocks"

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⟶ **MISCELLANEOUS** *Main Groups* "Oxygen Group"

⟶ **MISCELLANEOUS** *Main Groups* "Halogens"

⟶ **MISCELLANEOUS** *Main Groups* "Noble Gases"

3.02 Apply the mole concept, Avogadro's number and conversion factors to chemical calculations.

- Particles to moles.
- Mass to moles.
- Volume of a gas to moles.
- Molarity of solutions.
- Empirical and molecular formula.
- Percent composition.

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

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

COMPETENCY GOAL 4
The learner will build an understanding of energy changes in chemistry.

4.02 Analyze the law of conservation of energy, energy transformation, and various forms of energy involved in chemical and physical processes.

- Differentiate between heat and temperature.
- Analyze heating and cooling curves.
- Calorimetry, heat of fusion and heat of vaporization calculations.
- Endothermic and exothermic processes including interpretation of potential energy.
- Diagrams (energy vs reaction pathway), enthalpy and activation energy.

→ **Lab** *Thermochemistry* "Specific Heat"

→ **Lab** *Thermochemistry* "Thermal Energy"

→ **Lab** *Kinetics* "Reactive Collisions Between Molecules"

→ **Lab** *Kinetics* "Examining a Reaction Mechanism"

→ **Lab** *Equilibria* "Equilibrium and Temperature"

4.03 Analyze the relationship between entropy and disorder in the universe.

→ **Demonstration** *Chemical Thermodynamics* "Are gas expansions irreversible?"

→ **Demonstration** *Chem. Thermodyn.* "Do all spontaneous processes involve a visible increase of disorder?"

→ **Lab** *Chemical Thermodynamics* "Entropy and the States of Matter"

COMPETENCY GOAL 5
The learner will develop an understanding of chemical reactions.

5.04 Identify the physical and chemical behaviors of acids and bases.

- General properties of acids and bases.
- Concentration and dilution of acids and bases.
- Ionization and the degree of dissociation (strengths) of acids and bases.
- Indicators.
- Acid-base titration.

- pH and pOH.

→ **Demonstration** *Solutions* "How do salts dissolve in water?"

→ **Lab** *Acids & Bases* "Strong Acids"

→ **Lab** *Acids & Bases* "Structure and Acidity"

5.06 Assess the factors that affect the rates of chemical reactions.

- The nature of the reactants.
- Temperature.
- Concentration.
- Surface area.
- Catalyst.

→ **Lab** *Kinetics* "Reactive Collisions Between Molecules"