

# ODYSSEY Molecular Explorer

— Release 6.2 —

Correlation with the

## Montana Essential Learning Expectations for Science Grade Level 9-12

March 2009

### Content Standard 2

Students, through the inquiry process, demonstrate knowledge of properties, forms, changes and interactions of physical and chemical systems.

1. Describe the structure of atoms, including knowledge of (a) subatomic particles and their relative masses, charges, and locations within the atom, (b) the electrical and nuclear forces that hold the atom together, (c) fission and fusion, and (d) radioactive decay.

A. Compare and contrast subatomic particles in relation to their relative masses, charges and location.

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

B. Compare and contrast the number of subatomic particles in different 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"

C. Recognize there is an electrical force of attraction/repulsion.

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

2. Explain how the particulate level structure and properties of matter affect its macroscopic properties, including the effect of (a) valence electrons on the chemical properties of elements and the resulting periodic trends in these properties, (b) chemical bonding, (c) molecular geometry and intermolecular forces, (d) kinetic molecular theory on phases of matter, and (e) carbon-carbon atom bonding on biomolecules.

C. Recognize the repeating patterns of the periodic table of 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"

→ **DEMONSTRATION** *Periodicity* "Are monatomic cations as big as the parent atoms"

E. Describe the significance of electrons in interactions between atoms and why they sometimes form bonds.

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

F. Explain how the chemical bonding of a molecule affects its macroscopic (physical) properties.

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

G. Compare and contrast ionic, covalent and hydrogen bonds.

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

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

→ **MISCELLANEOUS Liquids & Solids** "Elements with Hydrogen Bonding"

H. Explain how the molecular geometry of a molecule (e.g. water) affects polarity and cohesive/adhesive properties.

→ **LAB Chemical Bonding** "VSEPR Theory"

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

→ **MISCELLANEOUS Chemical Bonding** "Dipole Moments"

I. Describe the physical properties of each state of matter: solid, liquid, and gas.

→ **LAB Chemical Matter** "Comparing the States of Matter"

→ **LAB Chemical Matter** "Side-by-Side Comparison of Solids, Liquids, and Gases"

J. Describe, using the kinetic molecular theory, the behavior of particles in each state of matter: solid, liquid, and gas.

→ **LAB Liquids & Solids** "Molecular Motion in the States of Matter"

K. Explain, given a phase change diagram, changes in energy and state.

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

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

L. Explain how electrons are shared in single, double, triple bonds.

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

M. Explain how the variety of carbon-carbon bonds leads to the diversity of biomolecules.

→ **LAB Organic Chem.** "Bonding Characteristics of Carbon"

3. Describe the major features associated with chemical reactions, including (a) giving examples of reactions important to industry and living organisms, (b) energy changes associated with chemical changes, (c) classes of chemical reactions, (d) rates of reactions, and (e) the role of catalysts.

A. Recognize evidence of a chemical change.

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

B. Illustrate a chemical reaction in symbol form.

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

C. Classify the types of chemical reactions.

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

D. Describe the energy changes in an energy releasing and energy consuming reaction.

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

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

E. Describe factors that effect the rate of reactions.

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

→ **LAB** *Thermochemistry* "Energetics of a Chemical Reaction"

4. Identify, measure, calculate, and analyze relationships associated with matter and energy transfer or transformations, and the associated conservation of mass.

A. Explain how energy and mass are conserved given various situations.

→ **DEMONSTRATION** *Thermochemistry* "What is the energy of a vibrating diatomic molecule?"

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

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

6. Explain how energy is stored, transferred, and transformed, including (a) the conservation of energy, (b) kinetic and potential energy and energy contained by a field, (c) heat energy and atomic and molecular motion, and (d) energy tends to change from concentrated to diffuse.

→ **MISCELLANEOUS** *Thermochemistry* "Chemical Energy"

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

→ **MISCELLANEOUS** *Thermochem.* "Rotations and Vibrations"

→ **LAB** *Liquids & Solids* "Energy and the States of Matter"

C. Discuss the conservation of energy.

→ **DEMONSTRATION** *Thermochemistry* "What is the energy of a vibrating diatomic molecule?"

D. Define the kinetic molecular theory and its relationship to heat (thermal energy transfer).

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

E. Recognize heat as a form of energy transfer.

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

F. Explain the relationship between temperature, heat and thermal energy.

→ **LAB Gases** "The Meaning of Temperature"

→ **LAB Thermochemistry** "Thermal Energy"

→ **LAB Chem. Thermodynamics** "Entropy and Temperature"