

# ODYSSEY Molecular Explorer

— Release 7.0 —

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.

→ **D2** *Atoms "Distribution of Mass in Atoms"*

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

→ **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"*

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

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

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.

→ **E3** *Periodicity* "Size of Monatomic Cations"

→ **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"

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→ **P10** *Main Groups & Transition Metals* "Halogens"

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→ **P12** *Main Groups & Transition Metals* "Elements of the d- and f-Blocks"

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

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

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

→ **H24** *Liquids & Solids* "Types of Bonding in Solids"

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

→ **F11** *Chemical Bonding* "Polar Bonds and Molecules"

→ **F13** *Chemical Bonding* "Classifying by Bond Polarity"

→ **H14** *Liquids & Solids* "Elements with Hydrogen Bonding"

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

→ **F12** *Chemical Bonding* "Dipole Moments"

→ **F14** *Chemical Bonding* "VSEPR Theory"

→ **F15** *Chemical Bonding* "Comparing Shapes"

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

→ **C6** *Chemical Matter* "States of Matter"

→ **C7** *Chemical Matter* "Comparing States Side-by-Side"

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

→ **H9** *Liquids & Solids* "Molecular Motion and Physical States"

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

→ **C13** *Chemical Matter* "Physical Changes"

→ **H20** *Liquids & Solids* "Melting Transition"

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

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

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

→ **S1** *Organic Chemistry* "How Special is 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.

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

B. Illustrate a chemical reaction in symbol form.

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

C. Classify the types of chemical reactions.

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

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

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

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

E. Describe factors that effect the rate of reactions.

→ **L8** *Thermochemistry* "Energetics of a Chemical Reaction"

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

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.

→ **L4** *Thermochemistry* "Vibrating Diatomic Molecule"

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

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

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.

→ **H8** *Liquids & Solids* "Energy and Physical States"

→ **L1** *Thermochemistry* "Chemical Energy"

→ **L2** *Thermochemistry* "Thermal Energy"

→ **L3** *Thermochemistry* "Rotations and Vibrations"

C. Discuss the conservation of energy.

→ **L4** *Thermochemistry* "Vibrating Diatomic Molecule"

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

→ **G12** *Gases* "Mean Speed and Temperature"

E. Recognize heat as a form of energy transfer.

→ **03** *Chemical Thermodynamics* "Heat Conduction"

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

→ **G10** *Gases* "The Meaning of Temperature"

→ **L2** *Thermochemistry* "Thermal Energy"

→ **05** *Chem. Thermodynamics* "Entropy and Temperature"