Wavefunction, Inc.
www.wavefun.com

ODYSSEY Molecular Explorer

— Release 6.2 —

Correlation with

Florida's Student Performance Science Standards

Grade 9-12

Adopted February 19, 2008

Physical Science Body of Knowledge

Standard 8: *Matter*

A. A working definition of matter is that it takes up space, has mass, and has measurable properties. Matter is comprised of atomic, subatomic, and elementary particles.

B. Electrons are key to defining chemical and some physical properties, reactivity, and molecular structures. Repeating (periodic) patterns of physical and chemical properties occur among elements that define groups of elements with similar properties. The periodic table displays the repeating patterns, which are related to the atom's outermost electrons. Atoms bond with each other to form compounds.

C. In a chemical reaction, one or more reactants are transformed into one or more new products. Many factors shape the nature of products and the rates of reaction.

D. Carbon-based compounds are building-blocks of known life forms on earth and numerous useful natural and synthetic products.

Benchmarks:

1. Differentiate among the four states of matter.

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

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

   → **LAB** *Gases* "The Density of Liquids and Gases"

   → **MISCELLANEOUS** *Liquids & Solids* "Compressibility"

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

2. Differentiate between physical and chemical properties and physical and chemical changes of matter.

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

4. Explore the scientific theory of atoms (also known as atomic theory) by describing the structure of atoms in terms of protons, neutrons and electrons, and differentiate among these particles in terms of their mass, electrical charges and locations within the atom.

    → **Lab** *Atoms* "Nuclei and Electrons"

    → **Lab** *Atoms* "Isotopes"

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

6. Distinguish between bonding forces holding compounds together and other attractive forces, including hydrogen bonding and van der Waals forces.

    → **Lab** *Liquids & Solids* "Intermolecular Forces"

    → **Miscellaneous** *Liquids & Solids* "Elements with HydrogenBonding"

    → **Demonstration** *Liquids & Solids* "How different are ice and liquid water?"

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

12. Describe the properties of the carbon atom that make the diversity of carbon compounds possible.

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

13. Identify selected functional groups and relate how they contribute to properties of carbon compounds.

    → **Lab** *Organic Chemistry* "Functional Groups"

    → **Lab** *Organic Chemistry* "Comparing and Identifying Organic Compounds"

Standard 10: *Energy*

A. Energy is involved in all physical and chemical processes. It is conserved, and can be transformed from one form to another and into work. At the atomic and nuclear levels energy is not continuous but exists in discrete amounts. Energy and mass are related through Einstein's equation $E=mc^2$.

B. The properties of atomic nuclei are responsible for energy-related phenomena such as radioactivity, fission and fusion.

C. Changes in entropy and energy that accompany chemical reactions influence reaction paths. Chemical reactions result in the release or absorption of energy.

D. The theory of electromagnetism explains that electricity and magnetism are closely related. Electric charges are the source of electric fields. Moving charges generate magnetic fields.

E. Waves are the propagation of a disturbance. They transport energy and momentum but do not transport matter.

Benchmarks:

1. Differentiate among the various forms of energy and recognize that they can be transformed from one form to others.

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

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

2. Explore the Law of Conservation of Energy by differentiating among open, closed, and isolated systems and explain that the total energy in an isolated system is a conserved quantity.

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

4. Describe heat as the energy transferred by convection, conduction, and radiation, and explain the connection of heat to change in temperature or states of matter.

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

5. Relate temperature to the average molecular kinetic energy.

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

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

6. Create and interpret potential energy diagrams, for example: chemical reactions, orbits around a central body, motion of a pendulum.

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

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

7. Distinguish between endothermic and exothermic chemical processes.

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

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

Standard 12: *Motion*

A. Motion can be measured and described qualitatively and quantitatively. Net forces create a change in motion. When objects travel at speeds comparable to the speed of light, Einstein's special theory of relativity applies.

B. Momentum is conserved under well-defined conditions. A change in momentum occurs when a net force is applied to an object over a time interval.

C. The Law of Universal Gravitation states that gravitational forces act on all objects irrespective of their size and position.

D. Gases consist of great numbers of molecules moving in all directions. The behavior of gases can be modeled by the kinetic molecular theory.

E. Chemical reaction rates change with conditions under which they occur. Chemical equilibrium is a dynamic state in which forward and reverse processes occur at the same rates.

Benchmarks:

10. Interpret the behavior of ideal gases in terms of kinetic molecular theory.

→ **Lab** *Gases* "Gas Pressure"

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

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

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

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

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

11. Describe phase transitions in terms of kinetic molecular theory.

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

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

13. Explain the concept of dynamic equilibrium in terms of reversible processes occurring at the same rates.

→ **Demonstration** *Liquids & Solids* "How does temperature affect the vapor pressure?"

→ **Miscellaneous** *Equilibria* "The Dynamic Nature of Equilibria"