

Wavefunction, Inc.

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## **ODYSSEY Molecular Explorer**

— Release 7.0 —

*Correlation with the*

### **Ohio Academic Content Standards, K-12 Science**

Adopted December 10, 2002

## **Physical Sciences**

Students demonstrate an understanding of the composition of physical systems and the concepts and principles that describe and predict physical interactions and events in the natural world. This includes demonstrating an understanding of the structure and properties of matter, the properties of materials and objects, chemical reactions and the conservation of matter. In addition, it includes understanding the nature, transfer and conservation of energy; motion and the forces affecting motion; and the nature of waves and interactions of matter and energy. Students demonstrate an understanding of the historical perspectives, scientific approaches and emerging scientific issues associated with the physical sciences.

### **Benchmarks, Grades 9-10**

**A.** Describe that matter is made of minute particles called atoms and atoms are comprised of even smaller components. Explain the structure and properties of atoms.

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

**B.** Explain how atoms react with each other to form other substances and how molecules react with each other or other atoms to form even different substances.

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

→ **M2 Kinetics** "Reactive Collisions"

**C.** Describe the identifiable physical properties of substances (e.g., color, hardness, conductivity, density, concentration and ductility). Explain how changes in these properties can occur without changing the chemical nature of the substance.

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

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

**E.** Demonstrate that energy can be considered to be either kinetic (motion) or potential (stored).

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

**F.** Explain how energy may change, form or be redistributed but the total quantity of energy is conserved.

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

## **Benchmarks, Grades 11-12**

**A.** Explain how variations in the arrangement and motion of atoms and molecules form the basis of a variety of biological, chemical and physical phenomena.

→ **Most Labs**

## **Indicators, Grade Nine**

### *Nature of Matter*

**2.** Illustrate that atoms with the same number of positively charged protons and negatively charged electrons are electrically neutral.

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

**6.** Explain that the electric force between the nucleus and the electrons hold an atom together. Relate that on a larger scale, electric forces hold solid and liquid materials together (e.g., salt crystals and water).

→ **H2 Liquids & Solids** "Salt Crystals"

**7.** Show how atoms may be bonded together by losing, gaining or sharing electrons and that in a chemical reaction, the number, type of atoms and total mass must be the same before and after the reaction (e.g., writing correct chemical formulas and writing balanced chemical equations).

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

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

**9.** Investigate the properties of pure substances and mixtures (e.g., density, conductivity, hardness, properties of alloys, superconductors and semiconductors).

→ **C5 Chemical Matter** "Types of Mixtures"

### *Nature of Energy*

**11.** Explain how thermal energy exists in the random motion and vibrations of atoms and molecules. Recognize that the higher the temperature, the greater the average atomic or molecular motion, and during changes of state the temperature remains constant.

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

**16.** Illustrate that chemical reactions are either endothermic or exothermic (e.g., cold packs, hot packs and the burning of fossil fuels).

- **M2 Kinetics** "Reactive Collisions"
- **M3 Kinetics** "Mechanism of a Reaction"
- **N2 Equilibria** "Equilibrium and Temperature"

## Indicators, Grade Eleven

### *Nature of Matter*

**2.** Explain that humans have used unique bonding of carbon atoms to make a variety of molecules (e.g., plastics).

- **S1 Organic Chemistry** "How Special is Carbon?"
- **Stockroom Organic** "Polyolefins"

### *Forces and Motion*

**3.** Describe real world examples showing that all energy transformations tend toward disorganized states (e.g., fossil fuel combustion, food pyramids and electrical use).

- **01 Chemical Thermodynamics** "Gas Expansions"
- **03 Chemical Thermodynamics** "Heat Conduction"

## Indicators, Grade Twelve

### *Nature of Matter*

**1.** Explain how atoms join with one another in various combinations in distinct molecules or in repeating crystal patterns.

- **C4 Chemical Matter** "Types of Compounds"
- **H2 Liquids & Solids** "Salt Crystals"

**3.** Explain how all matter tends toward more disorganized states and describe real world examples (e.g., erosion of rocks and expansion of the universe).

- **01 Chemical Thermodynamics** "Gas Expansions"
- **03 Chemical Thermodynamics** "Heat Conduction"

### *Nature of Energy*

**12.** Describe how different atomic energy levels are associated with the electron configurations of atoms and electron configurations (and/or conformations) of molecules.

→ **D4 Atoms** "Hydrogen Atom"

→ **D8 Atoms** "Atomic Orbitals"

→ **D10 Atoms** "s-Orbitals"

→ **D11 Atoms** "p-Orbitals"