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ODYSSEY Molecular Explorer
— Release 6.2 —

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.

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

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.

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

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

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.

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

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

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

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

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

→ **Demonstration *Thermochemistry*** "What is the energy of a 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.

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

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).

→ **Lab *Liquids & Solids*** "Comparing 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).

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

→ **Lab *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).

→ **Miscellaneous *Chemical Matter*** "The 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.

→ **Lab *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).

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

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

→ **Lab *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).

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

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

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

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.

→ **Miscellaneous *Chemical Matter*** "The Types of Compounds"

→ **Lab *Liquids & Solids*** "Comparing 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).

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

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

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.

→ **Demonstration *Atoms*** "What does a hydrogen atom look like?"

→ **Lab *Atoms*** "Atomic Orbitals"

→ **Demonstration *Atoms*** "Is an s-orbital the same for all elements?"

→ **Demonstration *Atoms*** "How do p-orbitals differ from each other?"