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ODYSSEY Molecular Explorer

— Release 6.2 —

Correlation with the
Science Standards of Learning for Virginia Public Schools
Adopted January 2003

Physical Science

1. The student will plan and conduct investigations in which

   b. length, mass, volume, density, temperature, weight, and force are accurately measured and reported using metric units (SI—International System of Units)

   c. conversions are made among metric units, applying appropriate prefixes

   e. numbers are expressed in scientific notation where appropriate

   f. research skills are utilized using a variety of resources

   g. independent and dependent variables, constants, controls, and repeated trials are identified

   j. frequency distributions, scattergrams, line plots, and histograms are constructed and interpreted

   k. valid conclusions are made after analyzing data

   n. an understanding of the nature of science is developed and reinforced

   → *Most Labs*

2. The student will investigate and understand the basic nature of matter. Key concepts include

   a. the particle theory of matter

   → *All Labs*

   b. elements, compounds, mixtures, acids, bases, and salts

   → **MISCELLANEOUS** *Chemical Matter* "Examples of Chemical Elements"

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

   → **MISCELLANEOUS** *Chemical Matter* "The Types of Mixtures"

   → **LAB** *Liquids & Solids* "Comparing Salt Crystals"

   → **LAB** *Acids & Bases* "Strong Acids"

c. solids, liquids, and gases

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

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

d. characteristics of types of matter based on physical and chemical properties

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

e. physical properties (shape, density, solubility, odor, melting point, boiling point, color)

→ **Demonstration** *Gases* "Do gases have a definite volume?"

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

f. chemical properties (acidity, basicity, combustibility, reactivity)

→ **Lab** *Acids & Bases* "Strong Acids"

→ **Miscellaneous** *Acids & Bases* "Oxoacids"

3. The student will investigate and understand the modern and historical models of atomic structure. Key concepts include

b. the modern model of atomic structure

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

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

4. The student will investigate and understand the organization and use of the periodic table of elements to obtain information. Key concepts include

a. symbols, atomic number, atomic mass, chemical families (groups), and periods

→ **Miscellaneous** *Main Groups* "Alkali Metals"

→ **Miscellaneous** *Main Groups* "Alkaline Earth Metals"

→ **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"

→ **Miscellaneous** *Transition Metals* "Elements of the d- and f-Blocks"

c. simple compounds (formulas and the nature of bonding)

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

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

5. The student will investigate and understand changes in matter and the relationship of these changes to the Law of Conservation of Matter and Energy. Key concepts include

    a. physical changes

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

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

    c. chemical changes (types of reactions, reactants, and products; and balanced equations)

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

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

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

6. The student will investigate and understand states and forms of energy and how energy is transferred and transformed. Key concepts include

    a. potential and kinetic energy

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

7. The student will investigate and understand temperature scales, heat, and heat transfer. Key concepts include

    a. Celsius and Kelvin temperature scales and absolute zero

    → **Lab** *Gases* "Temperature Scales in Chemistry"

    b. phase change, freezing point, melting point, boiling point, vaporization, and condensation

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

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

Chemistry

1. The student will investigate and understand that experiments in which variables are measured, analyzed, and evaluated produce observations and verifiable data. Key concepts include

    d. manipulation of multiple variables, using repeated trials

    e. accurate recording, organization, and analysis of data through repeated trials

    f. mathematical and procedural error analysis

g. mathematical manipulations (SI units, scientific notation, linear equations, graphing, ratio and proportion, significant digits, dimensional analysis)

h. use of appropriate technology including computers, graphing calculators, and probeware, for gathering data and communicating results

i. construction and defense of a scientific viewpoint (the nature of science)

→ *Most Labs*

2. The student will investigate and understand that the placement of elements on the periodic table is a function of their atomic structure. The periodic table is a tool used for the investigations of

a. average atomic mass, mass number, and atomic number

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

c. mass and charge characteristics of subatomic particles

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

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

d. families or groups

→ **Miscellaneous** *Main Groups* "Alkali Metals"

→ **Miscellaneous** *Main Groups* "Alkaline Earth Metals"

→ **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"

→ **Miscellaneous** *Transition Metals* "Elements of the d- and f-Blocks"

f. trends including atomic radii, electronegativity, shielding effect, and ionization energy

→ **Lab** *Atoms* "s- and p-Orbitals"

→ **Lab** *Periodicity* "Atomic Radii"

g. electron configurations, valence electrons, and oxidation numbers

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

→ **Lab** *Atoms* "Atomic Orbitals"

→ **Lab** *Atoms* "s- and p-Orbitals"

→ **Lab** *Atoms* "d-Orbitals"

h. chemical and physical properties

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

i. historical and quantum models

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

3. The student will investigate and understand how conservation of energy and matter is expressed in chemical formulas and balanced equations. Key concepts include

a. nomenclature

→ **Lab** *Chemical Matter* "Naming Molecular Compounds"

→ **Lab** *Organic Chemistry* "Straight-Chain Alkanes"

→ **Lab** *Organic Chemistry* "Isomers of the Alkanes"

→ **Lab** *Organic Chemistry* "Isomers of Alkenes and Alkynes"

c. writing chemical formulas (molecular, structural, and empirical; and Lewis diagrams)

→ *Many Stockroom Pages*

d. bonding types (ionic and covalent)

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

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

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

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

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

e. reaction types (synthesis, decomposition, single and double replacement, oxidation-reduction, neutralization, exothermic, and endothermic)

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

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

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

f. reaction rates and kinetics (activation energy, catalysis, and degree of randomness)

→ **Lab** *Gases* "The Distribution of Kinetic Energies"

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

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

4. The student will investigate and understand that quantities in a chemical reaction are based on molar relationships. Key concepts include

c. partial pressure

→ **Lab** *Gases* "Partial Pressure"

d. gas laws

→ **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"

e. solution concentrations

→ **Lab** *Solutions* "Specifying the Molarity"

→ **Miscellaneous** *Solutions* "Molarity vs. Molality"

f. chemical equilibrium

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

→ **Lab** *Equilibria* "Equilibrium and Pressure"

g. acid/base theory: strong electrolytes, weak electrolytes, and nonelectrolytes; dissociation and ionization; pH and pOH; and the titration process

→ **Lab** *Acids & Bases* "Strong Acids"

→ **Miscellaneous** *Acids & Bases* "Oxoacids"

5. The student will investigate and understand that the phases of matter are explained by kinetic theory and forces of attraction between particles. Key concepts include

a. pressure, temperature, and volume

→ **Demonstration** *Gases* "Do gases have a definite volume?"

→ **Lab** *Gases* "Gas Pressure"

→ **Lab** *Gases* "Temperature Scales in Chemistry"

b. vapor pressure

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

c. phase changes

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

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

e. specific heat capacity

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