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ODYSSEY Molecular Explorer
— Release 7.0 —

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

   → **C3** *Chemical Matter* "Examples of Elements"
   → **C4** *Chemical Matter* "Types of Compounds"
   → **C5** *Chemical Matter* "Types of Mixtures"
   → **H2** *Liquids & Solids* "Salt Crystals"
   → **K1** *Acids & Bases* "Strong Acids"

c. solids, liquids, and gases

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

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

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

→ **C12** *Chemical Matter* "Types of Properties"

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

→ **G1** *Gases* "Density of Gases and Liquids"

→ **G2** *Gases* "Volume of Gases"

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

→ **K1** *Acids & Bases* "Strong Acids"

→ **K3** *Acids & Bases* "Halogen 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

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

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

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

→ **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. simple compounds (formulas and the nature of bonding)

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

→ **F8** *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

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

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

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

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

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

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

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

    → **L4** *Thermochemistry* "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

    → **G8** *Gases* "Temperature Scales"

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

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

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

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

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

c. mass and charge characteristics of subatomic particles

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

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

d. families or groups

→ **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"

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

→ **D9** *Atoms* "Comparing Helium, Neon, and Argon"

→ **E2** *Periodicity* "Atomic Radii"

g. electron configurations, valence electrons, and oxidation numbers

→ **D4** *Atoms* "Hydrogen Atom"

→ **D8** *Atoms* "Atomic Orbitals"

→ **D9** *Atoms* "Comparing Helium, Neon, and Argon"

→ **D14** *Atoms* "Orbitals of a Krypton Atom"

h. chemical and physical properties

→ **C12** *Chemical Matter* "Types of Properties"

i. historical and quantum models

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

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

→ **C20** *Chemical Matter* "Naming Compounds"

→ **S2** *Organic Chemistry* "Straight-Chain Alkanes"

→ **S5** *Organic Chemistry* "Isomers of the Alkanes"

→ **S9** *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)

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

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

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

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

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

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

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

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

→ **N2** *Equilibria* "Equilibrium and Temperature"

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

→ **G22** *Gases* "Distribution of Kinetic Energies"

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

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

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

c. partial pressure

→ **G21** *Gases* "Partial Pressure"

d. gas laws

→ **G13** *Gases* "Pressure-Volume Relationship"

→ **G14** *Gases* "Boyle's Law"

→ **G16** *Gases* "Pressure and Temperature"

→ **G18** *Gases* "Avogadro's Law"

→ **G19** *Gases* "Universality of the Ideal Gas Law"

e. solution concentrations

→ **I3** *Solutions* "Specifying the Molarity"

→ **I7** *Solutions* "Molarity vs. Molality"

f. chemical equilibrium

→ **N2** *Equilibria* "Equilibrium and Temperature"

→ **N3** *Equilibria* "Equilibrium and Pressure"

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

→ **K1** *Acids & Bases* "Strong Acids"

→ **K3** *Acids & Bases* "Halogen 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

→ **G2** *Gases* "Volume of Gases"

→ **G6** *Gases* "Gas Pressure"

→ **G8** *Gases* "Temperature Scales"

b. vapor pressure

→ **H22** *Liquids & Solids* "Vapor Pressure"

c. phase changes

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

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

e. specific heat capacity

→ **L6** *Thermochemistry* "Specific Heat"