## Progression of Instruction -- Topic: "Matter" -- Example: Virginia Standards of Learning

K.4 The student will investigate and understand that the position, motion, and physical 1.3 The student will investigate and understand how different common materials properties of an object can be described. Key concepts include interact with water. Key concepts include a) colors (red, orange, vellow, green, blue, purple), white, and black; a) some liquids will separate when mixed with water, but others will not; b) shapes (circle, triangle, square, and rectangle) and forms (flexible/stiff, b) some common solids will dissolve in water, but others will not; and straight/curved); c) some substances will dissolve more readily in hot water than in cold water. c) textures (rough/smooth) and feel (hard/soft); d) relative size and weight (big/little, large/small, heavy/light, wide/thin, long/short); and e) position (over/under, in/out, above/below, left/right) and speed (fast/slow). K.5 The student will investigate and understand that water flows and has properties that can be observed and tested. Key concepts include 2.3 The student will investigate and understand basic properties of solids, liquids, a) water occurs in different states (solid, liquid, gas); and gases. Key concepts include b) the natural flow of water is downhill; and a) mass and volume: and c) some materials float in water, while others sink. b) processes involved with changes in matter from one state to another (condensation, evaporation, melting, and freezing). 3.3 The student will investigate and understand that objects are made of materials 5.4 The student will investigate and understand that matter is anything that has mass, that can be described by their physical properties. Key concepts include takes up space, and occurs as a solid, liquid, or gas. Key concepts include a) objects are made of one or more materials; a) atoms, elements, molecules, and compounds; b) materials are composed of parts that are too small to be seen without magnification; b) mixtures including solutions; and c) physical properties remain the same as the material is reduced in size. c) the effect of heat on the states of matter. Middle School physical science 6.4 The student will investigate and understand that all matter is made up of atoms. PS.2 The student will investigate and understand the basic nature of matter. Key con-Key concepts include cepts include a) atoms are made up of electrons, protons, and neutrons; a) the particle theory of matter; b) atoms of any element are alike but are different from atoms of other elements; b) elements, compounds, mixtures, acids, bases, and salts; c) elements may be represented by chemical symbols; c) solids, liquids, and gases; d) two or more atoms may be chemically combined; d) characteristics of types of matter based on physical and chemical properties; e) compounds may be represented by chemical formulas; e) physical properties (shape, density, solubility, odor, melting point, boiling point, color); f) chemical equations can be used to model chemical changes; and f) chemical properties (acidity, basicity, combustibility, reactivity). g) a limited number of elements comprise the largest portion of the solid Earth, living matter, the oceans, and the atmosphere. PS.3 The student will investigate and understand the modern and historical models of atomic structure. Key concepts include a) the contributions of Dalton, Thomson, Rutherford, and Bohr in understanding the atom: and b) the modern model of atomic structure. High School chemistry CH.2 The student will investigate and understand that the placement of elements on PS.4 The student will investigate and understand the organization and use of the periodthe periodic table is ic table of elements to obtain information. Key concepts include a function of their atomic structure. The periodic table is a tool used for the investigaa) symbols, atomic number, atomic mass, chemical families (groups), and periods; tions of b) classification of elements as metals, metalloids, and nonmetals; and a) average atomic mass, mass number, and atomic number; c) simple compounds (formulas and the nature of bonding). b) isotopes, half lives, and radioactive decay; c) mass and charge characteristics of subatomic particles; PS.5 The student will investigate and understand changes in matter and the relationship d) families or groups; of these changes to the Law of Conservation of Matter and Energy. Key concepts e) series and periods; f) trends including atomic radii, electronegativity, shielding effect, and ionization enera) physical changes; b) nuclear reactions (products of fusion and fission and the effect of these products on g) electron configurations, valence electrons, and oxidation numbers; humans and the environment); and h) chemical and physical properties; and c) chemical changes (types of reactions, reactants, and products; and balanced

CH.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;
- b) balancing chemical equations;

i) historical and quantum models.

- c) writing chemical formulas (molecular, structural, and empirical; and Lewis diagrams);
- d) bonding types (ionic and covalent);
- e) reaction types (synthesis, decomposition, single and double replacement, oxidation-reduction, neutralization, exothermic, and endothermic); and
- f) reaction rates and kinetics (activation energy, catalysis, and degree of randomness).
- CH.4 The student will investigate and understand that quantities in a chemical reaction are based on molar relationships. Key concepts include
- a) Avogadro's principle and molar volume;
- b) stoichiometric relationships;
- c) partial pressure;
- d) gas laws;
- e) solution concentrations;
- f) chemical equilibrium; and
- g) acid/base theory: strong electrolytes, weak electrolytes, and nonelectrolytes; dissociation and ionization; pH and pOH; and the titration process.
- CH.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
- a) pressure, temperature, and volume;
- b) vapor pressure;
- c) phase changes;
- d) molar heats of fusion and vaporization;
- e) specific heat capacity; and
- f) colligative properties.

High School physics

equations).

PH.14 The student will investigate and understand that extremely large and extremely small quantities are not necessarily described by the same laws as those studied in Newtonian physics. Key concepts include

- a) wave/particle duality;
- b) wave properties of matter;
- c) matter/energy equivalence;
- d) quantum mechanics and uncertainty;
- e) relativity;
- f) nuclear physics;
- g) solid state physics;
- h) superconductivity; and i) radioactivity.

Analysis by the STEM Education Center http://www.StemEd.info