

Chemistry Priority Standards: PHYSICAL SCIENCE (EALR 4)

Revised 6/1/2009

Chemical Reactions (PS2)

- PS2A:** *Atoms* are composed of *protons*, *neutrons*, and *electrons*. The *nucleus* of an *atom* takes up very little of the *atom's* volume but makes up almost all of the *mass*. The *nucleus* contains *protons* and *neutrons*, which are much more massive than the *electrons* surrounding the *nucleus*. *Protons* have a positive charge, *electrons* are negative in charge, and *neutrons* have no net charge.
- PS2B:** *Atoms* of the same element have the same number of *protons*. The number and arrangement of *electrons* determines how the *atom* interacts with other *atoms* to form molecules and ionic *compounds*.
- PS2C:** When *elements* are listed in order according to the number of *protons*, repeating *patterns* of physical and *chemical properties* identify families of *elements* with similar *properties*. This Periodic Table is a consequence of the repeating *pattern* of outermost *electrons*.
- PS2D:** *Ions* are produced when *atoms* or molecules lose or gain *electrons*, thereby gaining a positive or negative electrical charge. *Ions* of opposite charge are attracted to each other, forming *ionic bonds*. Chemical formulas for *ionic compounds* represent the proportion of *ion* of each *element* in the *ionic array*.
- PS2E:** *Compounds* are composed of two or more *elements* bonded together in a fixed proportion by sharing *electrons* between *atoms*, forming *covalent bonds*. Such *compounds* consist of well-defined *molecules*. Formulas of *covalent compounds* represent the types and number of *atoms* of each *element* in each molecule.
- PS2F:** All forms of life are composed of large molecules that contain carbon. Carbon *atoms* bond to one another and other *elements* by sharing, forming *covalent bonds*. Stable molecules of carbon have four *covalent bonds* per carbon *atom*.
- PS2G:** *Chemical reactions* change the arrangement of *atoms* in the molecules of substances. *Chemical reactions* release or acquire energy from their surroundings and result in the formation of new substances.
- PS2H:** *Solutions* are *mixtures* in which particles of one substance are evenly distributed through another substance. *Liquids* are limited in the amount of dissolved *solid* or *gas* that they can contain. *Aqueous solutions* can be described by relative quantities of the dissolved substances and acidity or alkalinity (pH).
- PS2I:** The rate of a physical or *chemical change* may be affected by *factors* such as temperature, surface area, and pressure.
- PS2J:** The number of *neutrons* in the *nucleus* of an *atom* determines the *isotope* of the *element*. Radioactive isotopes are unstable and emit particles and/or *radiation*. Though the timing of a single nuclear decay is unpredictable, a large group of nuclei decay at a predictable rate, making it possible to estimate the age of materials that contain radioactive isotopes.

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PS2K: Nuclear reactions convert *matter* into energy, releasing large amounts of energy compared with *chemical reactions*. *Fission* is the splitting of a large *nucleus* into smaller pieces. *Fusion* is the joining of nuclei and is the process that *generates* energy in the Sun and other stars.

Evolution of the Universe (ES1)

ES1A: Stars have “*life cycles*.” During their active periods, stars produce heavier *elements*, starting with the *fusion* of hydrogen to form helium. The heaviest *elements* are formed when massive stars “*die*” in massive explosions.

Transformation and Conservation of Energy (PS3)

PS3A: Although energy can be *transferred* from one object to another and can be *transformed* from one *form* of energy to another form, the total energy in a *closed system* is constant and can neither be created nor destroyed. (*Conservation of Energy*)

PS3B: *Kinetic energy* is the energy of *motion*. The kinetic energy of an object is defined by the equation: $E_k = \frac{1}{2} mv^2$

PS3C: *Gravitational potential energy* is due to the separation of mutually attracting *masses*. *Transformations* can occur between *gravitational potential energy* and *kinetic energy*, but the total amount of energy remains constant.

PS3D: *Waves* (including sound, seismic, light, and water *waves*) *transfer* energy when they interact with *matter*. *Waves* can have different *wavelengths*, *frequencies*, *amplitudes*, and travel at different *speeds*.

PS3E: *Electromagnetic waves* differ from physical *waves* because they do not require a medium and they all travel at the same *speed* in a vacuum. This is the maximum *speed* that any object or *wave* can travel. Forms of *electromagnetic waves* include X-rays, ultraviolet, visible light, infrared, and radio.

Remember to also address...EALR 1 Systems: Inputs, Outputs, Boundaries and Flows;
EALR 2 Inquiry: Questioning and Investigating;
EALR 3 Application: Science, Technology, and Solving Problems.

Note: Because the state standards are not exhaustive, please see additional important chemistry ideas typically taught in high school chemistry courses by referring to *Chemistry in the National Science Education Standards: Models for Meaningful Learning in the High School Chemistry Classroom* produced and published by the American Chemical Society (ASC).