Chemistry Summary

In Chemistry, instructional time should focus on five unifying themes: (1) approaching science as a reliable and tentative way of knowing and explaining the natural world; (2) weighing evidence and use scientific approaches to ask questions, investigate, and make informed decisions; (3) making and use observations to analyze relationships and patterns in order to explain phenomena, develop models, and make predictions; (4) evaluating systems, in order to connect how form determines function and how any change to one component affects the entire system; (5) explaining how the natural and designed worlds are interrelated and the application of scientific knowledge and technology can have beneficial, detrimental, or unintended consequences.

Big Ideas in Science

1. Develop and use system models.
2. Observe patterns to guide organization and classification and prompt questions which lead to investigations.
3. Investigate flow of energy and matter into, out of, and within systems.
4. Evaluate structures of living things and objects as they relate to their properties and functions.
5. Investigate cause and effect relationships to make predictions and explain events.
6. Design models to explore stability and change in systems.

Atomic Structure and the Periodic Table

- Describe the evolution of the atomic theory; the evolution includes models by John Dalton, J.J. Thomson, Ernest Rutherford, and Niels Bohr.
- Differentiate between the mass number of an isotope and the average atomic mass of an element; the mass number of an isotope is determined by the addition of the number of protons and neutrons within the nucleus of each isotope; the average atomic mass is the product of the relative abundance of an isotope and its atomic mass.
- Predict and describe the characteristics and behavior of an atom or ion based on its location on the periodic table and known trends; characteristics include metallic or nonmetallic nature which influence its conductivity, number of valence electrons and ion formation, which influence its ability to bond with other atoms.
- Explain how the periodic trends and the properties of atoms allow for the prediction of physical and chemical properties; periodic trends include electron affinity, ionization energy, atomic radius; physical properties include boiling point, melting point and density and chemical properties include reactivity and flammability.

The Mole and Chemical Bonding

- Use the concept of a mole to determine the mass of atoms, ions, and compounds; the mole is determined by dividing the quantity of substance by its atomic mass.
- Use the concept of a mole to investigate the composition of matter; composition can include determining the number of particles of a substance using Avogadro's number (6.02×10^{23} units).
- Describe and classify chemical bonds and use illustrations to predict a molecule's polarity; chemical bonds can be classified as ionic, covalent or metallic and are determined by the action of the valence electrons when joining two elements.
- Use different types of models to represent and predict chemical bonding in simple compounds; models include atomic diagrams that indicate the number of valence electrons and their attraction to valence electrons in other atoms.

Diagnostic Category Skills List

Properties and Classification of Matter

- Use observable (qualitative and quantitative) and measurable properties to classify and describe changes to matter and energy in a system; observable properties include shape, color and luster; measureable properties include mass, temperature, density and volume; changes can be physical or chemical and include states of matter (solid, liquid, gas) due to the addition or removal of energy to a system and the movement of particles in matter in response to the energy of a system.
- Compare and contrast the properties of solutions and other mixtures; properties of solutions include concentration, increased boiling point or decreased freezing point (colligative properties), and the distribution of solute in the solvent to produce heterogeneous or homogenous solutions.

Chemical Relationships and Reactions

- Analyze chemical reactions to describe the roles of limiting and excess reactants, classify reactions, predict products, and balance chemical equations; chemical reactions include those classified as synthesis, decomposition, single replacement, double replacement and combustion; limiting and excess reactants are determined using balanced equations for a chemical reaction.
- Explain how the kinetic molecular theory relates to the behavior of gases and predict changes to variables in a gaseous system using mathematical relationships; the kinetic molecular theory is based on assumption about the interaction and collision of particles and is the basis for the laws investigating the behavior of gases under specified conditions.

Additional Materials and Resources can be found at:

http://www.pdesas.org/

or

https://pa.drcedirect.com/

October 2014

CLASSROOM DIAGNOSTIC TOOLS

Chemistry Course Summary and Diagnostic Category Skills List

The Chemistry summary describes the unifying themes upon which instructional time should be focused. The Big Ideas in Science describe practices that students should engage in throughout their learning in Science. The Diagnostic Category Skills List provides descriptions of skills that students can be expected to demonstrate within each Diagnostic Category while taking the Classroom Diagnostic Tools for Chemistry. While this list does not include every possible skill that students may encounter within the CDT, it does provide a representative sample for each diagnostic category. Additionally, science instruction should not address these as discrete skills but rather incorporate them with the Big Ideas in Science as a part of an integrated curriculum.

pennsylvania DEPARTMENT OF EDUCATION

SAS Standards Aligned System