Labs And Activities

Vocabulary

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Many thanks to...
the teachers and administrators who helped develop and revise the pacing guides.

The Science Pacing Guide is based on the Next Generation Science Standards, and the **I CAN** statements are tailored to the needs of the students in the Lansing School District. For easy access to the actual state standards as well as supporting information and resources visit the official Next Generation Science Standards website at: www.nextgenscience.org.

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Chemistry • First Quarter Pacing Guide

Science

Introduction to Your Science Pacing Guide

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The following tips may be helpful as you begin using the Pacing Guide:

- Introduce 9-week content skills according to the Pacing Guide.
- Once a skill is mastered, continue to practice it.
- Continue to reinforce skills and concepts throughout the year until mastery is achieved.
- Skills can be introduced earlier than listed, but no later, and can be assessed at any point after introduction.
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- Become familiar with sequencing at previous and subsequent grade levels.
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Chemistry — Science — First Quarter

Unit #1
Periodic Table & Properties of Elements

Standard HS PS1.1

- ☐ **I CAN** use the periodic table of elements as a model to predict the relative properties of elements based on the patterns of electrons in the outermost energy level of atoms.
- ☐ **I CAN** describe the reactivity of metals based on their location in the periodic table.
- ☐ **I CAN** describe the types and numbers of bonds formed between different elements.

Use the periodic table as a model to predict the relative properties of elements based on the patterns of electrons in the outermost energy level of atoms.

Clarification: Examples of properties that could be predicted from patterns could include reactivity of metals, types of bonds formed, numbers of bonds formed, and reactions with oxygen. Assessment Boundary: Assessment is limited to main group elements. Assessment does not include quantitative understanding of ionization energy beyond relative trends.

Unit #2
Chemical Reactions & Conservation of Matter

Standard HS PS1.2

- ☐ **I CAN** construct and revise an explanation for the outcome of a simple chemical reaction based on the outermost electron states of atoms, trends in the periodic table, and knowledge of the patterns of chemical properties.
- ☐ **I CAN** identify the products and reactants, including their chemical formulas and the arrangement of their outermost (valence) electrons.
- ☐ **I CAN** demonstrate that the number and types of atoms are the same both before and after a reaction.
- ☐ **I CAN** describe the numbers and types of bonds (i.e., ionic, covalent) in both the reactants and the products.

Construct and revise an explanation for the outcome of a simple chemical reaction based on the outermost electron states of atoms, trends in the periodic table, and knowledge of the patterns of chemical properties.

Clarification: Examples of chemical reactions could include the reaction of sodium and chloride, of carbon and oxygen, or of carbon and hydrogen. Assessment Boundary: Assessment is limited to chemical reactions involving main group elements and combustion reactions.

Standard HS PS1.7

- ☐ **I CAN** use mathematical models to prove that atoms, and therefore mass, are conserved during a chemical reaction.
- ☐ **I CAN** quantify the reactants and products in terms of atoms, moles, and mass.
- ☐ **I CAN** calculate the molar mass of all components of a chemical reaction.
- ☐ **I CAN** describe how the mass of a substance can be used to calculate the number of atoms, molecules, or ions using moles or mole relationships.

Use mathematical representations to support the claim that atoms, and therefore mass, are conserved during a chemical reaction.

Emphasis is on using mathematical ideas to communicate the proportional relationships between masses of atoms in the reactants and the products, and the translation of these relationships to the macroscopic scale using the mole as the conversion from the atomic to the macroscopic scale. Emphasis is on assessing students' use of mathematical thinking and not on memorization and rote application of problem-solving techniques. Assessment Boundary: Assessment does not include complex chemical reactions.

Unit #3
Electrical Forces, Molecular Forces, Energy & Material Properties

Standard HS PS1.3

- ☐ **I CAN** plan and conduct an investigation to gather evidence to compare the structure of substances at the bulk scale to infer the strength of electrical forces between particles.
- ☐ **I CAN** describe the relationship between the measurable properties (e.g., melting point, boiling point, vapor pressure, surface tension) of a substance and the strength of the electrical forces between the particles of the substance.

Plan and conduct an investigation to gather evidence to compare the structure of substances at the bulk scale to infer the strength of electrical forces between particles.

Clarification: Emphasis is on understanding the strength of forces between particles, not on naming specific intermolecular forces (such as dipole-dipole). Examples of particles could include ions, atoms, molecules, and networked materials (such as graphite). Examples of bulk properties of substances could include the melting point and boiling point, vapor pressure, and surface tension. Assessment Boundary: Assessment does not include Raoult's law calculations of vapor pressure.

Standard HS PS2.6

- ☐ **I CAN** explain the relationship between molecular bonding and the physical properties of various materials.

Communicate scientific and technical information about why the molecular-level structure is important in the functioning of designed materials.

Clarification: Emphasis is on the attractive and repulsive forces that determine the functioning of the material. Examples could include why electrically conductive materials are often made of metal, flexible but durable materials are made up of long chained molecules, and pharmaceuticals are designed to interact with specific receptors. Assessment Boundary: Assessment is limited to provided molecular structures of specific designed materials.

Standard HS PS3.2

- ☐ **I CAN** design and use models that illustrate the conservation of energy at the atomic/molecular level.
- ☐ **I CAN** describe the transformation of energy in different chemical reactions and prove that no energy is lost in those transformations.

Develop and use models to illustrate that energy at the macroscopic scale can be accounted for as a combination of energy associated with the motions of particles (objects) and energy associated with the relative position of particles (objects).

Clarification: Examples of phenomena at the macroscopic scale could include the conversion of kinetic energy to thermal energy, the energy stored due to position of an object above the earth, and the energy stored between two electrically-charged plates. Examples of models could include diagrams, drawings, descriptions, and computer simulations.

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Chemistry • Second Quarter

Pacing Guide

Science

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Chemistry — Science — Second Quarter

Unit #4
Chemical Reactions and Thermal Energy

Standard HS PS1.4

- ☐ **I CAN** develop a model to illustrate that the release or absorption of energy from a chemical reaction system depends upon the changes in total bond energy.
- ☐ **I CAN** identify the chemical reaction, the system, and the surroundings under study.
- ☐ **I CAN** identify the chemical bonds that are broken and formed during the chemical reaction.
- ☐ **I CAN** describe the relative potential energies of the reactants and products.

Develop a model to illustrate that the release or absorption of energy from a chemical reaction system depends upon the changes in total bond energy.

Clarification: Emphasis is on the idea that a chemical reaction is a system that affects the energy change. Examples of models could include molecular-level drawings and diagrams of reactions, graphs showing the relative energies of reactants and products, and representations showing energy is conserved. Assessment Boundary: Assessment does not include calculating the total bond energy changes during a chemical reaction from the bond energies of reactants and products.

Standard HS PS3.4

- ☐ **I CAN** explain the second law of thermodynamics in relation to the transfer of thermal energy between objects of different temperatures in a system.
- ☐ **I CAN** describe the energy transformations that occur in endothermic and exothermic reactions of chemical reactions.

Plan and conduct an investigation to provide evidence that the transfer of thermal energy when two components of different temperature are combined within a closed system results in a more uniform energy distribution among the components in the system (second law of thermodynamics).

Clarification: Emphasis is on analyzing data from student investigations and using mathematical thinking to describe the energy changes both quantitatively and conceptually. Examples of investigations could include mixing liquids at different initial temperatures or adding objects at different temperatures to water. Assessment Boundary: Assessment is limited to investigations based on materials and tools provided to students.

Unit #5
Reaction Rates (Temperature/Concentration)

Standard HS PS1.5

- ☐ **I CAN** explain how changing the concentration of reactants will change the reaction rate and formation of products in a chemical reaction.
- ☐ **I CAN** demonstrate how changes in temperature affect the kinetic energy of molecules and their rate of collision in a chemical reaction.

Apply scientific principles and evidence to provide an explanation about the effects of changing the temperature or concentration of the reacting particles on the rate at which a reaction occurs.

Clarification: Emphasis is on student reasoning that focuses on the number and energy of collisions between molecules. Assessment Boundary: Assessment is limited to simple reactions in which there are only two reactants; evidence from temperature, concentration, and rate data; and qualitative relationships between rate and temperature.

Unit #6
Chemical System Products

Standard HS PS1.6

- ☐ **I CAN** describe how changes made at the macroscopic level affect the molecular interactions of a system at equilibrium.
- ☐ **I CAN** apply Le Chatelier's Principle to a chemical reaction system to increase product formation from that system

Refine the design of a chemical system by specifying a change in conditions that would produce increased amounts of products at equilibrium.

Clarification: Emphasis is on the application of Le Chatelier's Principle and on refining designs of chemical reaction systems, including descriptions of the connection between changes made at the macroscopic level and what happens at the molecular level. Examples of designs could include different ways to increase product formation including adding reactants or removing products. Assessment Boundary: Assessment is limited to specifying the change in only one variable at a time. Assessment does not include calculating equilibrium constants and concentrations.

Standard HS ETS1.3

- ☐ **I CAN** refine a given designed system by identifying the constraints and benefits (optimized product formation) of the system and analyzing the tradeoffs of the changes to the system.

Evaluate a solution to a complex real-world problem based on prioritized criteria and trade-offs that account for a range of constraints, including cost, safety, reliability, and aesthetics, as well as possible social, cultural, and environmental impacts.

Unit #7 Fission, Fusion, Radioactive Decay, & Electromagnetic Radiation

Standard HS PS1.8

- ☐ **I CAN** describe the compositional changes of the nucleus of an atom and the energy that is released in the processes of fission, fusion, and radioactive decay. **I CAN** differentiate the scale, or amount, of energy released during nuclear processes relative to other kinds of transformations.
- ☐ **I CAN** differentiate the scale, or amount, of energy released during nuclear processes relative to other kinds of transformations.

Develop models to illustrate the changes in the composition of the nucleus of the atom and the energy released during the processes of fission, fusion, and radioactive decay.

Clarification: Emphasis is on simple qualitative models, such as pictures or diagrams, and on the scale of energy released in nuclear processes relative to other kinds of transformations. Assessment Boundary: Assessment does not include quantitative calculation of energy released. Assessment is limited to alpha, beta, and gamma radioactive decays.

Standard HS PS4.4

- ☐ **I CAN** evaluate the validity and reliability of claims in published materials of the effects that different frequencies of electromagnetic radiation have when absorbed by matter.
- ☐ **I CAN** describe the effects of longer wavelength electromagnetic radiation on matter at the macroscopic and atomic levels.
- ☐ **I CAN** explain the impacts of the absorption of the shorter wavelengths of electromagnetic radiation by atoms and living tissues.

Evaluate the validity and reliability of claims in published materials of the effects that different frequencies of electromagnetic radiation have when absorbed by matter.

Clarification: Emphasis is on the idea that photons associated with different frequencies of light have different energies, and the damage to living tissue from electromagnetic radiation depends on the energy of the radiation. Examples of published materials could include trade books, magazines, web resources, videos, and other passages that may reflect bias. Assessment Boundary: Assessment is limited to qualitative descriptions.