Science Graduation Standards (Draft 1)

Graduation Standard #1:

Apply understanding of scientific knowledge and skills to the nature of inquiry and formulate questions, propose hypotheses, and design, conduct, and report on investigations based on research, evidence, and/or scientific numeracy.

Performance Indicators

1. Follow precisely a complex multistep procedure when carrying out experiments, taking measurements, or performing technical tasks, attending to special cases or exceptions defined in the text.
2. Students must be able to write precise descriptions of the step-by-step procedures they use in their investigations or technical work so that others can replicate them and (possibly) reach the same results.
3. Engineering: design, evaluate and/or refine a solution to a real-world problem.
4. Design a controlled experiment.
    a. Identify and manipulate variables and predict their effects.
5. Identify questions that can be answered through scientific investigation and formulate testable hypotheses.
6. Use mathematical operations to analyze and interpret data, and present relationships between variables in appropriate forms.
7. Communicate about science knowledge in different formats, using relevant science vocabulary, supporting evidence and clear logic.

Graduation Standard #2:

Read scientific/technical text closely to determine, evaluate and apply the central ideas and/or conclusions, make logical inferences, and provide specific textual evidence when writing or speaking to support conclusions drawn from the text.

Performance Indicators

1. Evaluate hypotheses, data, analysis or conclusions presented in scientific texts/articles.
2. Using information from the reading, apply the information to novel situations to predict effects.
3. Create a precise summary of the information presented in the text.
4. Articulate arguments focused on discipline-specific content.
5. Gather relevant information from multiple print and digital sources, using advanced searches effectively; assess the usefulness of each source in answering the research question; integrate information into the text selectively to maintain the flow of ideas; avoiding plagiarism and following a standard format for citation.
6. Communicate about science knowledge in different formats, using relevant science vocabulary, supporting evidence and clear logic.

Graduation Standard #3:

Demonstrate an understanding that structure and function are complementary aspects of matter and systems as they apply to different levels of organization.

Performance Indicators:

1. Communicate scientific and technical information about why the molecular-level structure is important in the functioning of natural and designed materials.
    a. Differentiate between the forms of matter based on their structural properties
    b. Analyze the interactions between atoms to form compounds.

c. Hypothesize how compounds will react based on their structure.

d. Describe the function of compounds in the natural and designed world.

e. 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.

f. Design a model of an atom showing the different structural components.

2. Develop and use a model to illustrate the hierarchical organization of interacting systems that provide specific functions within the biosphere.

    a. Organize the levels of organizational hierarchy

    b. Identify the unique interactions that exist within each of the organizational levels.

    c. Explain the connection between each of the organizational levels.

    d. Research a specific system to show the interactions within.

    e. Design a visual representation of this interaction. (model, poster, gallery walk, graphic organizer)

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

    a. 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.

    b. Identify the trends present within the periodic table (atomic size, radius, electronegativity, ionization energy, reactivity)

    c. Determine what type of bond will form based on the number of valence electron(s) present in each atom.

    d. Illustrate simple molecular structures based on the VSEPR theory.

4. Recognize what is relevant at different organizational levels and recognize how changes affect a system’s structure or performance.

    a. Differentiate between organizational levels of size, time and energy.

    b. Compare and contrast between changes in a systems’ scale, proportion and quantity.

Graduation Standard #4:

Apply the law of conservation of energy through analysis of energy transformations within and across systems.

Performance Indicators:

1. Create a computational model that tracks the energy within, into, and out of a system. [HS-PS3-1]
    a. Energy budgets - the supply of energy restricts (limits) the operation of the system
2. Identify areas of energy loss in a system and suggest methods to increase efficiency.
3. Utilize knowledge of energy transformations to evaluate benefits and drawbacks of specific energy sources
    a. Trace energy transformation in biology and chemistry using Hess' Law
4. Design, build, and refine a device that works within given constraints to convert one form of energy into another form of energy. [HS-PS3-3.]
    a. Rube Goldberg devices, wind turbines, solar cells, solar ovens, and generators
5. Use a model to describe how objects acquire energy from interactions with other objects and forces.
6. Develop a logical argument (using specific examples) to prove (illustrate) that entropy is the natural state of the universe.
7. Use mathematical representations to explain the connection between the characteristics of a wave (wavelength, frequency, and energy) and its interactions within a system.
8. Energy is a quantitative property of a system that depends on the motion and interactions of matter and radiation within that system. Forces can transfer energy between objects. [NAS Framework]

Graduation Standard #5:

Understand and analyze the cumulative effect and patterns of human activity on natural and constructed systems.

Performance Indicators/Learning Target

1. Evaluate or refine a technological solution that reduces impacts of human activities on natural systems. (Great Schools Partnerships, Maine Draft, HS-ESS3-3)
    a. I can evaluate the effectiveness of my community's recycling program.
    b. I can propose improvements on the local recycling program.
    c. I can compare and contrast different energy sources and their impact on the environment
    d. I can compare various remediation strategies.
2. Using scientific research, analyze and evaluate the impact of humans on the environment, make predictions, and suggest solutions for regional and/or global change. (Mod. HS-ESS3-5)
    a. I can evaluate population data across a period of time.
    b. I can analyze a population change on the food web.
    c. I can use data to make a connection between nutrient levels and ecosystem health.
3. Evaluate competing design solutions for developing, managing, and utilizing energy and resources based on cost-benefit analysis.
4. Create a product to illustrate the relationships among management of natural resources, the sustainability of human populations, and biodiversity. (HS-ESS3-3)
5. Analyze patterns of resource consumption and the need for sustainable practices.
6. Construct an explanation based on evidence for how the availability of natural resources, occurrence of natural hazards, and changes in climate have influenced human activity.

Graduation Standard #6

Articulate how conditions of stability and determinants of rates of change or evolution of a system are critical elements to both natural and built systems.

Performance Indicators

1. Apply concepts to explain sources of variation and distribution of expressed traits in a population.
2. Evaluate the impact of shifts in equilibrium on the stability of natural and constructed systems.
3. Examine evidence of forces and changes over time to construct explanations of stability and variations in natural and built systems.