# HS. Structure and Properties of Matter



## A Performance Expectations HS.PS1.SPM

1 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. HS.PS1.1

2 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. HS.PS1.3

3 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. HS.PS1.8

4 Communicate scientific and technical information about why the particulate-level structure is important in the functioning of designed materials. HS.PS2.6

6 Analyze data to support the claim that the combined gas law describes the relationships among volume, pressure, and temperature for a sample of an ideal gas. HS.PS1.9

7 Use evidence to support claims regarding the formation, properties and behaviors of solutions at bulk scales. HS.PS1.10

## B Science and Engineering Practices HS.SPM.SEP

1 Developing and Using Models HS.SPM.SEP.1

- a Develop a model based on evidence to illustrate the relationships between systems or between components of a system. (HS-PS1-8) HS.SPM.SEP.1A
- b Use a model to predict the relationships between systems or between components of a system. (HS-PS1-1) HS.SPM.SEP.1B

2 Planning and Carrying Out Investigations HS.SPM.SEP.2

- a Plan and conduct an investigation individually and collaboratively to produce data to serve as the basis for evidence, and in the design: decide on types, how much, and accuracy of data needed to produce reliable measurements and consider limitations on the precision of the data (e.g., number of trials, cost, risk, time), and refine the design accordingly. (HS-PS1-3) HS.SPM.SEP.2A

3 Analyzing and Interpreting Data HS.SPM.SEP.3

- a Analyze data using tools, technologies, and/or models (e.g., computational, mathematical) in order to make valid and reliable scientific claims or determine an optimal design solution. (HS-PS1-9) HS.SPM.SEP.3A

4 Engaging in Argument from Evidence HS.SPM.SEP.4

- a Evaluate the claims, evidence, and reasoning behind currently accepted explanations or solutions to determine the merits of arguments. (HS-PS1-10) HS.SPM.SEP.4A

5 Obtaining, Evaluating, and Communicating Information HS.SPM.SEP.5

- a Communicate scientific and technical information (e.g. about the process of development and the design and performance of a proposed process or system) in multiple formats (including orally, graphically, textually, and mathematically). (HS-PS2-6) HS.SPM.SEP.5A

## C Disciplinary Core Ideas HS.SPM.DCI

1. PS1.A: Structure and Properties of Matter HS.SPM.DCI.PS1.A
   a. Each atom has a charged substructure consisting of a nucleus, which is made of protons and neutrons, surrounded by electrons. (HS-PS1-1) HS.SPM.DCI.PS1.A.1
   b. The periodic table orders elements horizontally by the number of protons in the atom's nucleus and places those with similar chemical properties in columns. The repeating patterns of this table reflect patterns of outer electron states. (HS-PS1-1) HS.SPM.DCI.PS1.A.2
   c. The structure and interactions of matter at the bulk scale are determined by electrical forces within and between atoms.(HS-PS1-3),(secondary toHS-PS2-6) HS.SPM.DCI.PS1.A.3
   d. (NYSED) The concept of an ideal gas is a model to explain behavior of gases. A real gas is most like an ideal gas when the real gas is at low pressure and high temperature. (HS-PS1-9) HS.SPM.DCI.PS1.A.4
   e. (NYSED) Solutions possess characteristic properties that can be described qualitatively and quantitatively. (HS-PS1- 10) HS.SPM.DCI.PS1.A.5
2. PS1.C: Nuclear Processes HS.SPM.DCI.PS1.C
   a. Nuclear processes, including fusion, fission, and radioactive decays of unstable nuclei, involve release or absorption of energy. The total number of neutrons plus protons does not change in any nuclear process. (HS-PS1-8) HS.SPM.DCI.PS1.C.1
3. PS2.B: Types of Interactions HS.SPM.DCI.PS2.B
   a. Attraction and repulsion between electric charges at the atomic scale explain the structure, properties, and transformations of matter, as well as the contact forces between material objects. (secondary to HS-PS1- 1),(secondary to HS-PS1-3),(HS-PS2-6). HS.SPM.DCI.PS2.B.1

## D Crosscutting Concepts HS.SPM.CC

1. Patterns HS.SPM.CC.1
   a. Different patterns may be observed at each of the scales at which a system is studied and can provide evidence for causality in explanations of phenomena. (HS-PS1-1),(HS-PS1-3),(HS-PS1-10) HS.SPM.CC.1A
   b. Mathematical representations can be used to identify certain patterns. (HS-PS1-9) HS.SPM.CC.1B
2. Energy and Matter HS.SPM.CC.2
   a. In nuclear processes, atoms are not conserved, but the total number of protons plus neutrons is conserved. (HSPS1-8) HS.SPM.CC.2A
3. Structure and Function HS.SPM.CC.3
   a. Investigating or designing new systems or structures requires a detailed examination of the properties of different materials, the structures of different components, and connections of components to reveal its function and/or solve a problem. (HSPS2-6) HS.SPM.CC.3A