

HS-PS1-1 Matter and its Interactions

California Science Test—Item Content Specifications

# **HS-PS1-1 Matter and its Interactions**

Students who demonstrate understanding can:

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 Statement: 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.*]

Continue to the next page for the Science and Engineering Practices, Disciplinary Core Ideas, and Crosscutting Concepts.

| Science and Engineering Practices | Disciplinary Core Ideas | Crosscutting Concepts |
| --- | --- | --- |
| Developing and Using Models Modeling in 9–12 builds on K–8 and progresses to using, synthesizing, and developing models to predict and show relationships among variables between systems and their components in the natural and designed world(s).  Use a model to predict the relationships between systems or between components of a system. | PS1.A: Structure and Properties of Matter 13. Each atom has a charged substructure consisting of a nucleus, which is made of protons and neutrons, surrounded by electrons.  14. 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. | Patterns 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. |

## Assessment Targets

Assessment targets describe the focal knowledge, skills, and abilities for a given three-dimensional Performance Expectation. Please refer to the Introduction for a complete description of assessment targets.

### Science and Engineering Subpractice(s)

Please refer to appendix A for a complete list of Science and Engineering Practices (SEP) subpractices. Note that the list in this section is not exhaustive.

2.2 Ability to use models

### Science and Engineering Subpractice Assessment Targets

Please refer to appendix A for a complete list of SEP subpractice assessment targets. Note that the list in this section is not exhaustive.

2.2.2 Ability to use the model to generate explanations and predictions about a scientific phenomenon

### Disciplinary Core Idea Assessment Targets

#### PS1.A.13

* Identify and describe an atom in terms of a substructure consisting of a positively charged nucleus composed of both protons and neutrons, surrounded by negatively charged electrons

#### PS1.A.14

* Explain the arrangement of elements on the periodic table in terms of the number of protons (atomic number) and electron configurations
* Determine the number of valence electrons for a given element or group of elements on the periodic table
* Relate the number of valence electrons to the chemical behavior of an element or group of elements on the periodic table, such as the charge of a stable ion and the number and types of bonds formed (e.g., ionic, covalent, metallic) by an element and between elements
* Describe periodic trends within the main group elements, such as electronegativity, reactivity, metallic character, and atomic size based on electrostatic attractions of electrons to the nucleus
* Use the positions of elements on the periodic table and periodic trends to predict chemical formulas and type of compound (e.g., ionic, covalent)

### Crosscutting Concept Assessment Target(s)

CCC1 Identify different patterns at each of the scales at which a system is studied and can provide evidence for causality in explanations of phenomena

## Examples of Integration of Assessment Targets and Evidence

Note that the list in this section is not exhaustive.

The task provides a periodic table or part of a periodic table and a relevant question/phenomenon:

* Uses the patterns on the periodic table to explain a chemical behavior (2.2.2, PS1.A.14, and CCC1)
* Identifies an element or group of elements based on the chemical behavior (2.2.2, PS1.A.14, and CCC1)
* Predicts the chemical behavior of an element or group of elements based on the position of the element(s) on the periodic table (2.2.2, PS1.A.14, and CCC1)

## Possible Phenomena or Contexts

Note that the list in this section is not exhaustive.

* Identifying an element based on data presented on the periodic table (e.g., group or family, period)
* Identifying an element based on properties (e.g., number of valence electrons, types of bonds it forms with other elements or itself)
* Predicting formulas of ionic compounds based on the ion’s charge or the ion’s valence electrons

## Common Misconceptions

Note that the list in this section is not exhaustive.

* Atomic radii should increase from left to right across a row on the periodic table because the number of protons and electrons increases.
* Atoms that lose electrons during a chemical reaction become anions (i.e., negatively charged ions).

## Additional Assessment Boundaries

None listed at this time.

## Additional References

HS-PS1-1 Evidence Statement [https://www.nextgenscience.org/sites/default/files/evidence\_statement/black\_white/HS-PS1-1 Evidence Statements June 2015 asterisks.pdf](https://www.nextgenscience.org/sites/default/files/evidence_statement/black_white/HS-PS1-1%20Evidence%20Statements%20June%202015%20asterisks.pdf)

The *2016 Science Framework for California Public Schools Kindergarten through Grade 12*

Appendix 1: Progression of the Science and Engineering Practices, Disciplinary Core Ideas, and Crosscutting Concepts in Kindergarten through Grade 12 <https://www.cde.ca.gov/ci/sc/cf/documents/scifwappendix1.pdf>

Posted by the California Department of Education, March 2021 (updated February 2024)