

HS-PS1-2 Matter and its Interactions

California Science Test—Item Content Specifications

# **HS-PS1-2 Matter and its Interactions**

Students who demonstrate understanding 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.

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

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 |
| --- | --- | --- |
| Constructing Explanations and Designing Solutions Constructing explanations and designing solutions in 9–12 builds on K–8 experiences and progresses to explanations and designs that are supported by multiple and independent student-generated sources of evidence consistent with scientific ideas, principles, and theories.  Construct and revise an explanation based on valid and reliable evidence obtained from a variety of sources (including students’ own investigations, models, theories, simulations, and peer review) and the assumption that theories and laws that describe the natural world operate today as they did in the past and will continue to do so in the future. | PS1.A: Structure and Properties of Matter 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. PS1.B: Chemical Reactions 9. The fact that atoms are conserved, together with knowledge of the chemical properties of the elements involved, can be used to describe and predict chemical reactions. | 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.

6.1 Ability to construct explanations of phenomena

6.2 Ability to evaluate explanations of phenomena

### 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.

6.1.2 Ability to apply scientific concepts, principles, theories, and big ideas to construct an explanation of a real-world phenomenon

6.1.3 Ability to use models and representations in scientific explanations

6.2.1 Ability to evaluate and revise a given explanation based on an accepted scientific theory and/or data provided

### Disciplinary Core Idea Assessment Targets

#### PS1.A.14

* Use the periodic table to determine the number of valence electrons in an atom of an element
* 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, and metallic character that are 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 types of compounds (e.g., ionic, covalent)

#### PS1.B.9

* Identify the components of a chemical reaction (i.e., reactants and products) represented in a chemical equation or description
* Describe how conservation principles (of atoms and mass) can help to explain or predict the outcome of a chemical reaction
* Use periodic trends to describe and predict the outcome of a chemical reaction

### 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.

Task provides a description of a simple chemical reaction:

* Uses scientific concepts, principles, theories, and big ideas (e.g., conservation of atoms and mass, Lewis theory of bonding, and periodic trends) to explain the outcome of the chemical reaction (6.1.2, PS1.A.14, PS1.B.9, and CCC1)

Task provides a description and an incomplete chemical equation of a simple chemical reaction (e.g., the equation is missing a necessary reactant or product). The task also includes a selection of ways to complete the equation:

* Explains the best way to complete the equation by using the periodic table as a model to predict the product(s) of the reaction (6.1.3, PS1.A.14, PS1.B.9, and CCC1)

Task provides a description of a simple chemical reaction that includes the outcome and a choice of models that may represent the reaction:

* Selects the model that best represents the correct explanation for the outcome of the reaction (6.1.3, PS1.A.14, PS1.B.9, and CCC1)

Task provides a flawed explanation for the outcome of a simple chemical reaction. Potential flaws include, but are not limited to, incorrect predictions of the outcome, incorrect application of scientific theories, or use of irrelevant evidence:

* Identifies the flaw in the reasoning and/or predictions described in the provided explanation of the reaction (6.2.1, PS1.A.14, PS1.B.9, and CCC1)
* Amends the flawed features of the provided explanation (6.2.1, PS1.A.14, PS1.B.9, and CCC1)

## Possible Phenomena or Contexts

Note that the list in this section is not exhaustive.

* The formation and structure of binary ionic compounds when metallic and nonmetallic elements react
* The formation and structure of covalent compounds when two nonmetallic elements react
* Use of Lewis electron-dot structures to show the formation of simple compounds from elements, limited to elements that obey the octet rule

## Common Misconceptions

Note that the list in this section is not exhaustive.

* The octet rule can be used for all elements.
* When metallic and nonmetallic elements react to form a compound, they share electrons.

## Additional Assessment Boundaries

None listed at this time.

## Additional References

HS-PS1-2 Evidence Statement [https://www.nextgenscience.org/sites/default/files/evidence\_statement/black\_white/HS-PS1-2 Evidence Statements June 2015 asterisks.pdf](https://www.nextgenscience.org/sites/default/files/evidence_statement/black_white/HS-PS1-2%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)