

HS-PS1-3 Matter and its Interactions

California Science Test—Item Content Specifications

# **HS-PS1-3 Matter and its Interactions**

Students who demonstrate understanding 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.

[Clarification Statement: Emphasis is on understanding the strengths 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.*]

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 |
| --- | --- | --- |
| Planning and Carrying Out Investigations Planning and carrying out investigations in 9-12 builds on K-8 experiences and progresses to include investigations that provide evidence for and test conceptual, mathematical, physical, and empirical models.  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. | PS1.A: Structure and Properties of Matter  1. The structure and interactions of matter at the bulk scale are determined by electrical forces within and between atoms. | 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.

3.1 Ability to clarify the goal of the investigation and identify the evidence needed to address the purpose of the investigation

3.2 Ability to develop, evaluate, and refine a plan for the investigation

### 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.

3.1.2 Ability to identify relevant independent and dependent variables and to consider possible confounding variables or effects

3.1.3 Ability to describe what and how much data need to be collected to provide sufficient evidence for the purpose of the investigation

3.2.2 Ability to describe a detailed experimental procedure (e.g., number of trials, identify the control) and experimental setup

3.2.3 Ability to compare and evaluate alternative methods to determine which design provides the evidence necessary to address the purpose of the investigation

### Disciplinary Core Idea Assessment Targets

#### PS1.A.15

* Identify bulk properties that are related to the strength of electrical forces of attraction between particles of a substance
* Use the periodic table to predict the properties of elements based on the patterns of valence electrons
* Describe atomic structure and the electrical interactions among subatomic particles
* Recognize that the strength of electrical forces of attraction between particles of a substance is related to the magnitude of and distance between the electrical charges
* Describe how the input of thermal energy affects the spacing between particles of a substance during changes of state
* Infer the strength of the electrical forces of attractions based on the spacing between particles in the different states of matter
* Distinguish between intramolecular and intermolecular forces

### Crosscutting Concept Assessment Target(s)

CCC1 Identify different patterns at each of the scales at which a system is studied and 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 scenario involving an investigation of a bulk property related to the strength of electrical forces between particles in a substance or substances to investigate:

* Identifies variables that need to be controlled to produce reliable data (3.1.2, PS1.A.15, and CCC1)

Task provides a scenario involving an investigation of a bulk property related to the strength of electrical forces between particles in a substance or substances to investigate and a list of variables:

* Identifies the independent and dependent variables (3.1.2, PS1.A.15, and CCC1)

Task provides a scenario that involves determining the relative strengths of electrical forces between particles for a set of substances:

* Identifies what data to collect in an investigation (3.1.3, PS1.A.15, and CCC1)

Task provides a scenario involving a bulk property to investigate and determine the strength of electrical forces between particles of a substance or substances and a list of experimental procedures:

* Identifies the procedure that will produce the most relevant and reliable data (3.2.2, PS1.A.15, and CCC1)

Task provides a flawed experimental plan and/or data generated from an investigation involving the measurement of bulk properties to determine the strength of electrical forces between particles of a substance or substances:

* Identifies the flaws and refines the plan to better address the purpose of the investigation (3.2.3, PS1.A.15, and CCC1)
* Uses the data to evaluate and refine the experimental plan (3.2.3, PS1.A.15, and CCC1)

## Possible Phenomena or Contexts

Note that the list in this section is not exhaustive.

* Inferences about the nature of intermolecular forces based on observed properties (e.g., melting point, boiling point, and surface tension)
* Similarities or differences in the properties of compounds due to intermolecular forces

## Common Misconceptions

Note that the list in this section is not exhaustive.

* There is no empty space between particles in a solid.
* State changes of matter involve chemical changes.
* Ionic compounds have a molecular structure like covalent compounds.
* Breaking bonds releases energy and forming bonds requires energy.

## Additional Assessment Boundaries

None listed at this time.

## Additional References

HS-PS1-3 Evidence Statement [https://www.nextgenscience.org/sites/default/files/evidence\_statement/black\_white/HS-PS1-3 Evidence Statements June 2015 asterisks.pdf](https://www.nextgenscience.org/sites/default/files/evidence_statement/black_white/HS-PS1-3%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)