

MS-PS2-3 Motion and Stability: Forces and Interactions

California Science Test—Item Content Specifications

# MS-PS2-3 Motion and Stability: Forces and Interactions

Students who demonstrate understanding can:

Ask questions about data to determine the factors that affect the strength of electric and magnetic forces.

[Clarification Statement: Examples of devices that use electric and magnetic forces could include electromagnets, electric motors, or generators. Examples of data could include the effect of the number of turns of wire on the strength of an electromagnet, or the effect of increasing the number or strength of magnets on the speed of an electric motor.] [*Assessment Boundary: Assessment about questions that require quantitative answers is limited to proportional reasoning and algebraic thinking.*]

| Science and Engineering Practices | Disciplinary Core Ideas | Crosscutting Concepts |
| --- | --- | --- |
| Asking Questions and Defining ProblemsAsking questions and defining problems in grades 6–8 builds from grades K–5 experiences and progresses to specifying relationships between variables, and clarifying arguments and models.Ask questions that can be investigated within the scope of the classroom, outdoor environment, and museums and other public facilities with available resources and, when appropriate, frame a hypothesis based on observations and scientific principles. | PS2.B: Types of Interactions5. Electric and magnetic (electromagnetic) forces can be attractive or repulsive, and their sizes depend on the magnitudes of the charges, currents, or magnetic strengths involved and on the distances between the interacting objects. | Cause and EffectCause and effect relationships may be used to predict phenomena in natural or designed systems. |

## 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.

1.3 Ability to ask and evaluate questions that can be investigated

### 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.

1.3.1 Ability to ask questions that can be investigated within the scope of the school laboratory, research facilities, or field (e.g., outdoor environment) with available resources

1.3.2 Ability to ask questions that can frame a hypothesis based on an observation, model, or theory

### Disciplinary Core Idea Assessment Targets

#### PS2.B.5

* Describe how the magnetic interactions between two objects are affected by the strength of the magnetic force, taking into consideration the distance and relative orientation of the objects
* Identify the relationship between the circuit features (such as magnitude of an electric current or the number of turns of wire in a coil) and the resulting magnetic forces that arise
* Identify the effect of distance between two electric charges, their magnitude and sign, or nearby magnetic forces on the resulting electric forces acting upon those charges
* Describe patterns in data that correspond to proportional relationships between factors that affect the magnitude and direction of electromagnetic force experienced by two interacting objects
* Distinguish between instances in which observed interactions match predictions and instances in which observations are unexpected
* Distinguish between investigations which are and are not possible within a particular scope (e.g., in the classroom, in informal learning settings, in museums, or in a laboratory)

### Crosscutting Concept Assessment Target(s)

CCC2 Use cause and effect relationships to predict phenomena in natural or designed systems

## Examples of Integration of Assessment Targets and Evidence

Note that the list in this section is not exhaustive.

Task describes a classroom investigating the interaction of two magnets and a model for that interaction (can be a force diagram or a picture of the results of putting iron filings around a magnet):

* Identifies a question that can be used to expand the model considering the investigation (1.3.1, PS2.B.5, and CCC2)

Task provides a model showing the distribution of iron filings around a coil of wire experiencing a fixed current:

* Identifies which, in a set of questions, would provide the evidence a student needs to include information about poles in the model (1.3.1, PS2.B.5, and CCC2)

Task provides an interactive investigation into how the strength of an electromagnet may be controlled:

* Selects a hypothesis that would include a factor known to affect the strength of an electromagnet (1.3.1, PS2.B.5, and CCC2)

Task provides a picture of the electric field generated from a charged point-source that incudes arrows tracking the paths of various test particles of different charges (positive or negative) of varying magnitudes:

* Generates/identifies questions about the results of an experiment that would clarify the relationship between charge magnitude and resulting force (linear), distance and resulting force (nonlinear), and the sign of the interacting charges and the resulting forces (directional) (1.3.1, PS2.B.5, and CCC2)

Task provides a model for the interaction between two electric charges that indicates that two like charges repel with a magnitude that increases in a nonlinear relationship with the distance between them:

* Selects between two students’ questions regarding a potential investigation based on which question is empirically testable with the materials available in a classroom (1.3.2, PS2.B.5, and CCC2)

## Possible Phenomena or Contexts

Note that the list in this section is not exhaustive.

* Two electrically charged objects of various charge intensities at various distances
* Two electrically charged objects of similar or different polarities at various distances
* Two identical magnets at various distances and relative orientations
* Two magnets of different strength, size, shape, or material
* A magnet and another object that may or may not be ferromagnetic

## Common Misconceptions

Note that the list in this section is not exhaustive.

* Magnetic forces only act between objects when they are in contact.
* The separation of a magnet into two halves creates two monopoles; one north and one south.

## Additional Assessment Boundaries

None listed at this time.

## Additional References

MS-PS2-3 Evidence Statement [https://www.nextgenscience.org/sites/default/files/evidence\_statement/black\_white/MS-PS2-3 Evidence Statements June 2015 asterisks.pdf](https://www.nextgenscience.org/sites/default/files/evidence_statement/black_white/MS-PS2-3%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)