

MS-PS2-5 Motion and Stability: Forces and Interactions

Students who demonstrate understanding can:

- MS-PS2-5. Conduct an investigation and evaluate the experimental design to provide evidence that fields exist between objects exerting forces on each other even though the objects are not in contact.** [Clarification Statement: Examples of this phenomenon could include the interactions of magnets, electrically-charged strips of tape, and electrically-charged pith balls. Examples of investigations could include first-hand experiences or simulations.] [Assessment Boundary: Assessment is limited to electric and magnetic fields, and limited to qualitative evidence for the existence of fields.]

The performance expectation above was developed using the following elements from the NRC document *A Framework for K-12 Science Education*:

Science and Engineering Practices

Planning and Carrying Out Investigations

Planning and carrying out investigations to answer questions or test solutions to problems in 6–8 builds on K–5 experiences and progresses to include investigations that use multiple variables and provide evidence to support explanations or design solutions.

- Conduct an investigation and evaluate the experimental design to produce data to serve as the basis for evidence that can meet the goals of the investigation.

Disciplinary Core Ideas

PS2.B: Types of Interactions

- Forces that act at a distance (electric, magnetic, and gravitational) can be explained by fields that extend through space and can be mapped by their effect on a test object (a charged object, or a ball, respectively).

Crosscutting Concepts

Cause and Effect

- Cause and effect relationships may be used to predict phenomena in natural or designed systems.

Observable features of the student performance by the end of the course:

1	Identifying the phenomenon to be investigated
a	From the given investigation plan, students identify the phenomenon under investigation, which includes the idea that objects can interact at a distance.
b	Students identify the purpose of the investigation, which includes providing evidence that fields exist between objects exerting forces on each other even though the objects are not in contact.
2	Identifying evidence to address the purpose of the investigation
a	From the given plan, students identify and describe* the data that will be collected to provide evidence for each of the following:
i.	Evidence that two interacting objects can exert forces on each other even though the two interacting objects are not in contact with each other.
ii.	Evidence that distinguishes between electric and magnetic forces.
iii.	Evidence that the cause of a force on one object is the interaction with the second object (e.g., evidence for the presence of force disappears when the second object is removed from the vicinity of the first).
3	Planning the investigation
a	Students describe* the rationale for why the given investigation plan includes:
i.	Changing the distance between objects.
ii.	Changing the charge or magnetic orientation of objects.
iii.	Changing the magnitude of the charge on an object or the strength of the magnetic field.
iv.	A means to indicate or measure the presence of electric or magnetic forces.
4	Collecting the data
a	Students make and record observations according to the given plan. The data recorded may include observations of:
i.	Motion of objects.
ii.	Suspension of objects.
iii.	Simulations of objects that produce either electric or magnetic fields through space and the effects of moving those objects closer to or farther away from each other.
iv.	A push or pull exerted on the hand of an observer holding an object.

5	Evaluation of the design
a	Students evaluate the experimental design by assessing whether or not the data produced by the investigation can provide evidence that fields exist between objects that act on each other even though the objects are not in contact.