

MS-PS2-1 Motion and Stability: Forces and Interactions

California Science Test—Item Content Specifications

# MS-PS2-1 Motion and Stability: Forces and Interactions

Students who demonstrate understanding can:

Apply Newton’s Third Law to design a solution to a problem involving the motion of two colliding objects.

[Clarification Statement: Examples of practical problems could include the impact of collisions between two cars, between a car and stationary objects, and between a meteor and a space vehicle.] [*Assessment Boundary: Assessment is limited to vertical or horizontal interactions in one dimension.*]

| Science and Engineering Practices | Disciplinary Core Ideas | Crosscutting Concepts |
| --- | --- | --- |
| Constructing Explanations and Designing SolutionsConstructing explanations and designing solutions in 6–8 builds on K–5 experiences and progresses to include constructing explanations and designing solutions supported by multiple sources of evidence consistent with scientific ideas, principles, and theories.Apply scientific ideas or principles to design an object, tool, process or system. | PS2.A: Forces and Motion5. For any pair of interacting objects, the force exerted by the first object on the second object is equal in strength to the force that the second object exerts on the first, but in the opposite direction (Newton’s third law). | Systems and System ModelsModels can be used to represent systems and their interactions—such as inputs, processes and outputs—and energy and matter flows within systems.Connections to Engineering, Technology, and Applications of ScienceInfluence of Science, Engineering, and Technology on Society and the Natural WorldThe uses of technologies and any limitations on their use are driven by individual or societal needs, desires, and values; by the findings of scientific research; and by differences in such factors as climate, natural resources, and economic conditions. |

## 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

6E.2 Ability to evaluate and/or refine solutions to design problems

### 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

6E.2.2 Ability to evaluate and/or refine (optimize) design solutions based on scientific knowledge or evidence

6E.2.3 Ability to optimize performance of a design by prioritizing criteria and considering trade-offs to test, revise, and retest

### Disciplinary Core Idea Assessment Targets

PS2.A.5

* Identify action-reaction pairs of forces and the objects or components involved
* Recognize that the force exerted on a pair of interacting objects is of the same magnitude but opposite in direction regardless of each object’s mass
* Recognize that action-reaction pairs of forces do not cancel each other because they are acting on separate objects
* Recognize that during a collision between two objects, the object with smaller mass has greater acceleration, and the object with greater mass has smaller acceleration, but the action-reaction force between each object is the same magnitude
* Apply the concept of action-reaction pairs of forces to a design problem/solution involving a collision
* Apply the concept of action-reaction pairs of forces involving a collision to a design problem or solution within given criteria or constraints

### Crosscutting Concept Assessment Target(s)

CCC4 Use models to represent systems and their interactions—such as inputs, processes, and outputs—and the flow of energy and matter within the systems

## Examples of Integration of Assessment Targets and Evidence

Note that the list in this section is not exhaustive.

Task provides a description of a physical situation involving a collision between two objects:

* Identifies the action-reaction force pair during collision and the statement regarding the magnitude of the action-reaction forces involved in the collision (6.1.2, PS2.A.5, and CCC4)

Task provides a description of a physical situation involving a collision between two objects and the effectiveness of a given design of an object or process:

* Identifies the scientific principle (e.g., action-reaction forces) that supports the effectiveness of the design (6E.2.2, PS2.A.5, and CCC4)

Task provides a description of a physical situation involving a collision between two objects and a list of multiple designs with given criteria:

* Identifies the best design and provides justification for the selection based on application of Newton’s third law of motion (6E.2.2, PS2.A.5, and CCC4)

Task provides a description of a physical situation involving a collision between two objects and a list of multiple ways to improve the design with given criteria:

* Identifies multiple ways the design can be improved while providing justification for the selection (6E.2.3, PS2.A.5, and CCC4)

## Possible Phenomena or Contexts

Note that the list in this section is not exhaustive.

* Crumple zones in cars to reduce damage in accidents
* Effect of airbag deployment on forces acting on a crash test dummy
* Meteor impact on a satellite in orbit
* Force required to break an object

## Common Misconceptions

Note that the list in this section is not exhaustive.

* Action-reaction forces cancel each other.

## Additional Assessment Boundaries

None listed at this time.

## Additional References

MS-PS2-1 Evidence Statement [https://www.nextgenscience.org/sites/default/files/evidence\_statement/black\_white/MS-PS2-1 Evidence Statements June 2015 asterisks.pdf](https://www.nextgenscience.org/sites/default/files/evidence_statement/black_white/MS-PS2-1%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)