

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

California Science Test—Item Content Specifications

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

Students who demonstrate understanding can:

Plan and conduct an investigation to provide evidence of the effects of balanced and unbalanced forces on the motion of an object.

[Clarification Statement: Examples could include an unbalanced force on one side of a ball can make it start moving; and, balanced forces pushing on a box from both sides will not produce any motion at all.] [*Assessment Boundary: Assessment is limited to one variable at a time: number, size, or direction of forces. Assessment does not include quantitative force size, only qualitative and relative. Assessment is limited to gravity being addressed as a force that pulls objects down.*]

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 InvestigationsPlanning and carrying out investigations to answer questions or test solutions to problems in 3–5 builds on K–2 experiences and progresses to include investigations that control variables and provide evidence to support explanations or design solutions.Plan and conduct an investigation collaboratively to produce data to serve as the basis for evidence, using fair tests in which variables are controlled and the number of trials considered.Connections to Nature of ScienceScientific Investigations Use a Variety of MethodsScience investigations use a variety of methods, tools, and techniques. | PS2.A: Forces and Motion3. Each force acts on one particular object and has both strength and a direction. An object at rest typically has multiple forces acting on it, but they add to give zero net force on the object. Forces that do not sum to zero can cause changes in the object’s speed or direction of motion. (Boundary: Qualitative and conceptual, but not quantitative addition of forces are used at this level.)PS2.B: Types of Interactions2. Objects in contact exert forces on each other. | Cause and EffectCause and effect relationships are routinely identified. |

## 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

3.3 Ability to collect the data 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.

3.1.4 Ability to describe how the observations and/or collected data can be used as evidence for the phenomenon under 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

3.3.2 Ability to make observations according to the investigation plan

3.3.3 Ability to evaluate the quality of data to determine if the evidence meets the goals of the investigation

### Disciplinary Core Idea Assessment Targets

#### PS2.A.3

* Describe forces acting on objects in terms of both strength and direction
* Describe that unbalanced forces acting on an object result in a change of motion – in either speed or direction
* Identify forces even when an object is at rest and infer that forces at play are balanced
* Predict future motion based on observed patterns of motion and presence of balanced or unbalanced forces

#### PS2.B.2

* Recognize that objects in physical contact exert forces on each other
* Recognize that some forces act on objects without physical contact
* Recognize that the gravitational force of Earth pulls objects (near Earth’s surface) towards the planet’s center

### Crosscutting Concept Assessment Target(s)

CCC2 Identify cause and effect relationships

## Examples of Integration of Assessment Targets and Evidence

Note that the list in this section is not exhaustive.

Task provides observations and/or data from an investigation that sought to measure (qualitatively) the effects of balanced and unbalanced forces on the motion of an object:

* Evaluates whether the data provide sufficient evidence to meet the goal of the investigation (3.1.4, PS2.A.3, and CCC2)
* Selects a subset of the data that best support the goal of the investigation (3.1.4, PS2.A.3, and CCC2)

Task provides a list of experimental plans to answer a question about the effects of balanced and unbalanced forces on the motion of an object:

* Selects the plan that will best provide data to answer the question (3.2.2, PS2.A.3, and CCC2)

Task provides a list of variables in an experiment to answer a question about the effects of balanced and unbalanced forces on the motion of an object:

* Identifies the control, independent, and/or dependent variables (3.2.2, PS2.A.3, and CCC2)

Task provides a flawed experimental plan and/or data generated from an experiment about the effects of balanced and unbalanced forces on the motion of an object:

* Identifies the flaws and refines the plan to better address the purpose of the investigation (3.2.3 and PS2.A.3)
* Uses the data to evaluate and refine the experimental plan (3.2.3 and PS2.A.3)

Task provides an animation of an investigation about the effects of balanced and unbalanced forces on the motion of an object:

* Identifies the observations that provide evidence to support the hypothesis under investigation (3.3.2, PS2.A.3, and CCC2)

Task provides a simulation about the effects of balanced and unbalanced forces on the motion of an object:

* Interacts with the simulation to generate data to support the hypothesis under investigation (3.3.2, PS2.A.3, and CCC2)

Task presents a set of data from an investigation about the effects of balanced and unbalanced forces on the motion of an object:

* Evaluates whether the amount of data (i.e., number of trials) is sufficient to answer the question under investigation (3.3.3, PS2.A.3, and CCC2)

## Possible Phenomena or Contexts

Note that the list in this section is not exhaustive.

* A force acting on an object initially at rest (e.g., kicking a ball)
* A force acting on an object already in motion (e.g., tapping a rolling marble)
* Combinations of push and pull forces acting on an object initially at rest (e.g., two students pushing on a desk)
* Evaluating the appropriateness of measuring tools, measurements made, and/or data collected during an investigation of unbalanced forces

## Common Misconceptions

Note that the list in this section is not exhaustive.

* If a force is acting on an object, the object will move unless it is immovable.
* No forces act on objects at rest.
* There is a constant force acting on an object in motion.
* A force is something that can be carried with an object and may be used up over time.
* Force is an internal property of objects.
* Objects cannot move in the absence of friction.

## Additional Assessment Boundaries

None listed at this time.

## Additional References

3-PS2-1 Evidence Statement [https://www.nextgenscience.org/sites/default/files/evidence\_statement/black\_white/3-PS2-1 Evidence Statements June 2015 asterisks.pdf](https://www.nextgenscience.org/sites/default/files/evidence_statement/black_white/3-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