

Educational Resources from *Phenomenon Science Education*

Student Proficiency Goals for **NGSS MS-PS2-2**



Information about MS-PS2-2

NGSS Performance Expectation MS-PS2-2.

Plan an investigation to provide evidence that the change in an object's motion depends on the sum of the forces on the object and the mass of the object.

Clarification Statement.

Emphasis is on balanced (Newton's First Law) and unbalanced forces in a system, qualitative comparisons of forces, mass and changes in motion (Newton's Second Law), frame of reference, and specification of units.

Assessment Limits.

Assessment is limited to forces and changes in motion in one-dimension in an inertial reference frame and to change in one variable at a time.

Assessment does not include the use of trigonometry.

Science and Engineering Practice (Planning and Carrying Out Investigations)

- Plan an investigation individually and collaboratively, and in the design: identify independent and dependent variables and controls, what tools are needed to do the gathering, how measurements will be recorded, and how many data are needed to support a claim.

Disciplinary Core Idea (PS2.A: Forces and Motion)

- The motion of an object is determined by the sum of the forces acting on it; if the total force on the object is not zero, its motion will change. The greater the mass of the object, the greater the force needed to achieve the same change in motion. For any given object, a larger force causes a larger change in motion.
- All positions of objects and the directions of forces and motions must be described in an arbitrarily chosen reference frame and arbitrarily chosen units of size. In order to share information with other people, these choices must also be shared.

Crosscutting Concept (Stability and Change)

- Explanations of stability and change in natural or designed systems can be constructed by examining the changes over time and forces at different scales.

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Student Proficiency Goals

SEP (Planning and Carrying Out Investigations):

- Students plan investigations, individually and in collaboration with peers, to provide evidence about the effects of forces and the mass of an object on that object's motion in one dimension.
- Students determine what data and how many data are required to be used as evidence to support the claim that the change in an object's motion depends on the sum of the forces on the object and the mass of the object.
- Students identify independent, dependent, and control variables as part of their investigation planning.
- Students identify the tools needed to measure changes in an object's motion in one direction, the sum of forces on an object, and the mass of the object.
- Students determine how measurements and units will be recorded within their investigations.
- Students conduct investigations, individually or in collaboration with peers, to collect evidence that the change in an object's motion in one dimension depends on the sum of the forces on the object.
- Students conduct investigations, individually or in collaboration with peers, to collect evidence that the change in an object's motion in one dimension depends on the mass of the object.

DCI (PS2.A Forces and Motion):

- Students know that the motion of an object depends on the sum of the forces acting on that object.
- Students know that if the sum of the forces exerted on an object is zero, then the object will not change its motion.
- Students know that if the sum of the forces exerted on an object is not zero, then the object will change its motion.
- Students know that it requires more force to change the motion of an object with more mass and less force to change the motion of an object with less mass.

CCC (Stability and Change):

- Students consider the conditions required for the motion of an object to remain constant.
- Students consider the conditions required for the motion of an object to change.
- Students consider the changes in motion of objects within natural and designed systems over time.
- Students consider the forces applied to objects within natural and designed systems over time and at different scales.

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| <ul style="list-style-type: none">• Students know that for a specific object, the larger the force acting on the object, the more the object's motion will change.• Students know that position and direction are described through the context of an arbitrarily determined frame of reference.• Students know that units represent an agreed upon system of measurement.• Students know that when sharing information with others, units of measurement and frames of reference provide needed context and magnitude. | |
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