**HS-PS2 Motion and Stability: Forces and Interactions**

**HS-PS2-1 Analyze data to support the claim that Newton’s second law of motion describes the mathematical relationship among the net force on a macroscopic object, its mass, and its acceleration.**

Further explanation: Examples of data could include tables or graphs of position or velocity as a function of time for objects subject to a net unbalanced force, such as a falling object, an object rolling down a ramp, or moving object being pulled by a constant force. Examples could include the acceleration of a snowmobile in different gears (same mass with different forces creating different accelerations) or the comparison of gas mileage between a truck vs a truck hauling a boat (same acceleration with different masses).

Analyzing and Interpreting Data, Types of Interactions, Forces and Motion, Cause and Effect

**HS-PS2-2 Use mathematical representations to support the claim that the total momentum of a system of objects is conserved when there is no net force on the system.**

Further explanation: Emphasis is on the quantitative conservation of momentum in interactions and the qualitative meaning of this principle. Examples could include jumping off a boat or canoe and the total momenta of all the various pieces exploding from fireworks.

Using Mathematics and Computational Thinking, Forces and Motion, Systems and System Models

**HS-PS2-3 Apply scientific and engineering ideas to design, evaluate, and refine a device that minimizes the force on a macroscopic object during a collision.**

Further explanation: Examples of evaluation and refinement could include determining the success of a device at protecting an object from damage and modifying the design to improve it. Examples of a device could include a football helmet or a parachute. Examples could also include the barriers on the sides of NASCAR tracks, truck safety hills on the sides of highways, bike helmets or car bumpers.

Constructing Explanations and Designing Solutions, structure and properties of matter, Forces and Motion, Defining and Delimiting Engineering Problems, Optimizing the Design Solution, types of interactions, Cause and Effects

**HS-PS2-4 Use mathematical representations of Newton’s Law of Gravitation and Coulomb’s Law to describe and predict the gravitational and electrostatic forces between objects.**

Further explanation: Emphasis is on both quantitative and conceptual descriptions of gravitational and electrical fields.

Using Mathematics and Computational Thinking, Types of Interactions, Patterns

**HS-PS2-5 Plan and conduct an investigation to provide evidence that an electric current can produce a magnetic field and that a changing magnetic field can produce an electric current.**

Further explanation: Examples could include wind turbines or generators along with any DC motorized toy.

Planning and Carrying out an Investigation, Types of Interactions, Definitions of Energy, Cause and Effect

**HS-PS2-6 Communicate scientific and technical information about why the molecular-level structure is important in the functioning of designed materials.**

Further explanation: Emphasis is on the attractive and repulsive forces that determine the functioning of the material. Examples could include why electrically conductive materials are often made of metal, flexible but durable materials are made up of long chained molecules, and pharmaceuticals are designed to interact with specific receptors. Examples could also include composite material substitutes for wood and the structure of solar cells along with how they work.

Obtaining, Evaluating, and Communicating Information, Structure and Property of Matter, Types of Interactions, Structure and Function