Mini-Map for SCI.EE.8.PS.Forces-1

Subject: Science
Physical Science (PS)
Grade band: 6–8

Grade-Level Expectation

DLM Essential Element	DLM Disciplinary Core Idea Family[1]	Framework Disciplinary Core Ideas
SCI.EE.8.PS.Forces-1 Use observations and measurements to determine how an object's mass affects the force needed to change its motion.	Physical Science – Interacting Forces	PS2.A: Forces and Motion PS2.B: Types of Interactions PS2.C: Stability and Instability in Physical Systems PS3.C: Relationship Between Energy and Forces

[1] DLM Science Essential Elements organize Disciplinary Core Ideas (defined in the *Framework for K-12 Science Education*) into DCI families. By combining similar concepts within a domain, science content from the general education standards is reduced in depth, breadth, and complexity to provide access for students that qualify for the DLM alternate assessment.

Linkage Level Descriptions

Initial Precursor	Distal Precursor	Proximal Precursor	Target[2]
Recognize when specific attribute values of objects' physical characteristics are similar to or different from each other.	Observe the values of two attributes (i.e., motion of an object and force applied to the object) to identify that a force (i.e., push/pull) can cause a stationary object to move and the direction of the motion is related to the direction of the force.	Compare observations of two variables (i.e., motion of an object and force applied to the object) to determine how differing directions and magnitudes (i.e., strengths) of forces (i.e., pushes and pulls) applied to an object changes its motion (i.e., direction of motion, distance traveled, and speed of motion).	Use relative measurements from tests to determine the relationships between objects' masses, the strength of forces applied to them, and their resulting motion (i.e., speed of motion, direction of motion, and distance traveled).

[2] The target linkage level description is a measurement target that describes the expectations (content and performance) of the Essential Element for assessment purposes.

Essential Element Three Dimensions

Each Essential Element is defined in the three dimensions described in the *Framework for K-12 Science Education*: disciplinary core ideas (DCIs), science and engineering practices (SEPs), and crosscutting concepts (CCCs). The table below lists the details of each dimension from the individual DLM Essential Element descriptions, with color-coding of dimensions corresponding to the Next Generation Science Standards (NGSS). The first row (in blue) lists the SEP(s) used to construct the Essential Element and describes ways each SEP could be incorporated. The second row (in orange) describes the science concepts within the DCI family related to this Essential Element. The third row (in green) lists the CCC(s) associated with the Essential Element and explains how each might be incorporated in the grade band (quoted from NSTA, 2013, matrix of CCCs). Note that the SEP is presented first here (rather than second, as it is in the full list of Essential Elements) to reflect the emphasis on practices in instruction and across the linkage levels. The final row (in white) includes examples of how the three dimensions could work together to support instruction for the Essential Element. These examples provide ideas for integrating the dimensions and are not exhaustive, nor are they intended to limit instruction.

Science and Engineering Practices	**Analyzing and Interpreting Data:** Analyzing data in grades 6–8 builds on K–5 experiences and progresses to representing and evaluating data to support explanations about relationships and solutions to problems in the natural world. • Gather and represent data to determine and describe patterns. • Evaluate data to construct and support explanations. • Analyze data to evaluate solutions to problems. **Planning and Carrying Out Investigations:** Planning and carrying out investigations in grades 6–8 builds on K–5 experiences and progresses to collecting data during investigations to examine and support claims. • Gather and use data to determine answers to scientific questions. o Use observations and measurements to determine and support relationships between variables. **Using Mathematics and Computational Thinking:** Mathematical and computational thinking in grades 6–8 builds on K–5 experiences and progresses to using and applying data and mathematical concepts to understand relationships in the natural and designed world. • Apply mathematical concepts and processes to determine and describe relationships between variables. • Use mathematical representations and reasoning to compare characteristics of components of a system.

Disciplinary Core Ideas	**Interacting Forces** • The motion of an object depends on the total forces acting on that object (see SCI.EE.5.PS.Forces-1). • Newton's third law of motion: For any pair of interacting objects, the forces exerted by each object on the other are equal and opposite. In other words, the force exerted by the first object on the second object is equal to the force that the second object exerts on the first but in the opposite direction.
Crosscutting Concepts	**Patterns**: Observed patterns in nature guide organization and classification and prompt questions about relationships and causes underlying them. • Macroscopic patterns are related to the nature of microscopic and atomic-level structure. • Patterns in rates of change and other numerical relationships can provide information about natural and human designed systems. • Patterns can be used to identify cause and effect relationships. • Graphs, charts, and images can be used to identify patterns in data. **Cause and Effect: Mechanism and Explanation**: Events have causes, sometimes simple, sometimes multifaceted. Deciphering causal relationships, and the mechanisms by which they are mediated, is a major activity of science and engineering. • Relationships can be classified as causal or correlational, and correlation does not necessarily imply causation. • Cause and effect relationships may be used to predict phenomena in natural or designed systems. • Phenomena may have more than one cause, and some cause and effect relationships in systems can only be described using probability.
How three dimensions support instruction for this Essential Element	Students can identify patterns in relationships between an object's mass and the force needed to change motion by using measurement and observations. They learn the general principle that an object's mass affects the force needed to change its motion in systematic ways. Through investigations, students can record the relationships between forces with different directions and magnitudes acting on an object (causes) and the resulting speed, direction, and distance the object travels (effects). This can help students understand that the total force acting on an object, not just individual forces, is the key factor in determining its motion.

Instructional Resources

Resources
Learning modules and additional science instructional resources can be found at https://www.dlmpd.com/science/
A glossary defining key science terms found in the Essential Elements can be found at DLM Glossary for Science Learning Maps.

Link to Text-Only Map

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