Mini-Map for SCI.EE.12.PS.Matter-4

Subject: Science
Physical Science (PS)
Grade band: 9–12

Grade-Level Expectation

DLM Essential Element	DLM Disciplinary Core Idea Family[1]	Framework Disciplinary Core Ideas
SCI.EE.12.PS.Matter-4 Use a model to support the law of the conservation of matter during chemical reactions.	Physical Science – Matter and Chemical Reactions	PS1.A: Structure and Properties of Matter PS1.B: Chemical Reactions

[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]
Match a visual, tactile, or symbolic representation of an object (i.e., a model) to the real object, based on the objects' shared characteristics and functions.	Use representations to understand that matter is made of very small particles that can break apart when dissolved (i.e., when soluble solids are mixed with liquid water).	Use representations to understand that compounds and molecules are made of specific types and numbers of atoms.	Use a model as evidence to make and support claims about the conservation of matter during a chemical reaction (i.e., equal types, numbers, and mass of atoms before and after a reaction) in a closed system.

[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	**Developing and Using Models:** Modeling in grades 9–12 builds on K–8 experiences and progresses to developing, using, and evaluating models (e.g., maps, diagram, drawing, physical replica, diorama, graphs, dramatization, storyboard) that represent relationships, events, and systems in the natural world. • Develop, use, and evaluate models to describe relationships between variables and components of a system. • Use models to construct and evaluate explanations in the natural world. **Using Mathematics and Computational Thinking:** Mathematical and computational thinking in grades 9–12 builds on K–8 experiences and progresses to analyzing and interpreting data and mathematical concepts to construct meaning about systems in the natural and designed world • Use mathematical reasoning to construct and support claims about the relationships between variables. • Analyze and interpret data to investigate the relationships and characteristics of the components of a system. **Engaging in Argument from Evidence:** Engaging in argument from evidence in grades 9–12 builds on K–8 experiences and progresses to evaluating information to construct arguments about the natural world. • Use observations, information, data, models, and mathematical reasoning to develop and evaluate claims. • Use information to construct an argument.

Disciplinary Core Ideas	Matter and Chemical Reactions

	Matter and Chemical Reactions
	• A molecule or compound is a substance composed of groupings of atoms with specific types and numbers of atoms.
	  o Limit to very simple and common compounds such as sodium chloride (NaCl, salt), carbon dioxide (CO_2), oxygen (O_2), and water (H_2O).
	• An atom is the smallest particle of matter that comprises a substance (i.e., molecule, compound).
	• A chemical reaction occurs when the atoms comprising substances are rearranged or regrouped to form new substances (i.e., the groupings of atoms in starting substances are different than in the ending substances).
	• The rearrangement of atoms that occurs during chemical reactions results from particle collisions.
	  o The atoms or molecules involved in the reaction move about and collide with each other.
	  o When they collide, the original groupings or arrangements of atoms change.
	  o The faster the atoms or molecules move (i.e., the higher the kinetic energy), the more they collide.
	  o The higher the temperature, the faster the atoms or molecules move and the more they collide.
	  o The greater the amount of atoms or molecules, the more they collide.
	  o The more the atoms or molecules collide, the faster new substances are produced (i.e., the faster the atom rearrangement occurs).
	• The same types and numbers of atoms are present at the beginning and end of a chemical reaction in a closed system.
	  o The total mass of beginning substances is equal to the total mass of ending substances in a closed system.
	  o Limit to counting atoms in a provided model or image or measuring the mass of starting and ending substances in a closed system.
	• Evidence of conservation of matter includes the types and numbers of atoms as well as the masses of the substances involved in the reaction.
	• Models can include mathematical representations such as mass data, chemical equations, and physical models such as ball and stick models.

<table>
<tr><td>Crosscutting Concepts</td><td>Energy and Matter: Flows, Cycles, and Conservation: Tracking energy and matter flows, into, out of, and within systems helps one understand their system’s behavior.
The total amount of energy and matter in closed systems is conserved.
Changes of energy and matter in a system can be described in terms of energy and matter flows into, out of, and within that system.
Energy cannot be created or destroyed—only moves between one place and another place, between objects and/or fields, or between systems.
Energy drives the cycling of matter within and between systems.
In nuclear processes, atoms are not conserved, but the total number of protons plus neutrons is conserved.
Stability and Change: For both designed and natural systems, conditions that affect stability and factors that control rates of change are critical elements to consider and understand
Much of science deals with constructing explanations of how things change and how they remain stable.
Change and rates of change can be quantified and modeled over very short or very long periods of time. Some system changes are irreversible.
Feedback (negative or positive) can stabilize or destabilize a system.
Systems can be designed for greater or lesser stability.</td></tr>
<tr><td>How three dimensions support instruction for this Essential Element</td><td>Students can use models to learn that the total amount of energy and matter is conserved in a closed system and that changes of energy and matter can be described in terms of how each flows in and out of the system. They can provide evidence for the conservation of matter through comparisons of mass, the number of atoms, and the types of atoms before and after physical and chemical reactions.
The concepts of stability and change can be incorporated as students analyze how things change versus remain stable and how change can be quantified and modeled over time. Both physical and chemical reactions result in changes to matter. Understanding conservation of matter includes demonstrating how substances are stable (mass and the number and types of atoms don’t change over time unless they interact with other substances in their environment).</td></tr>
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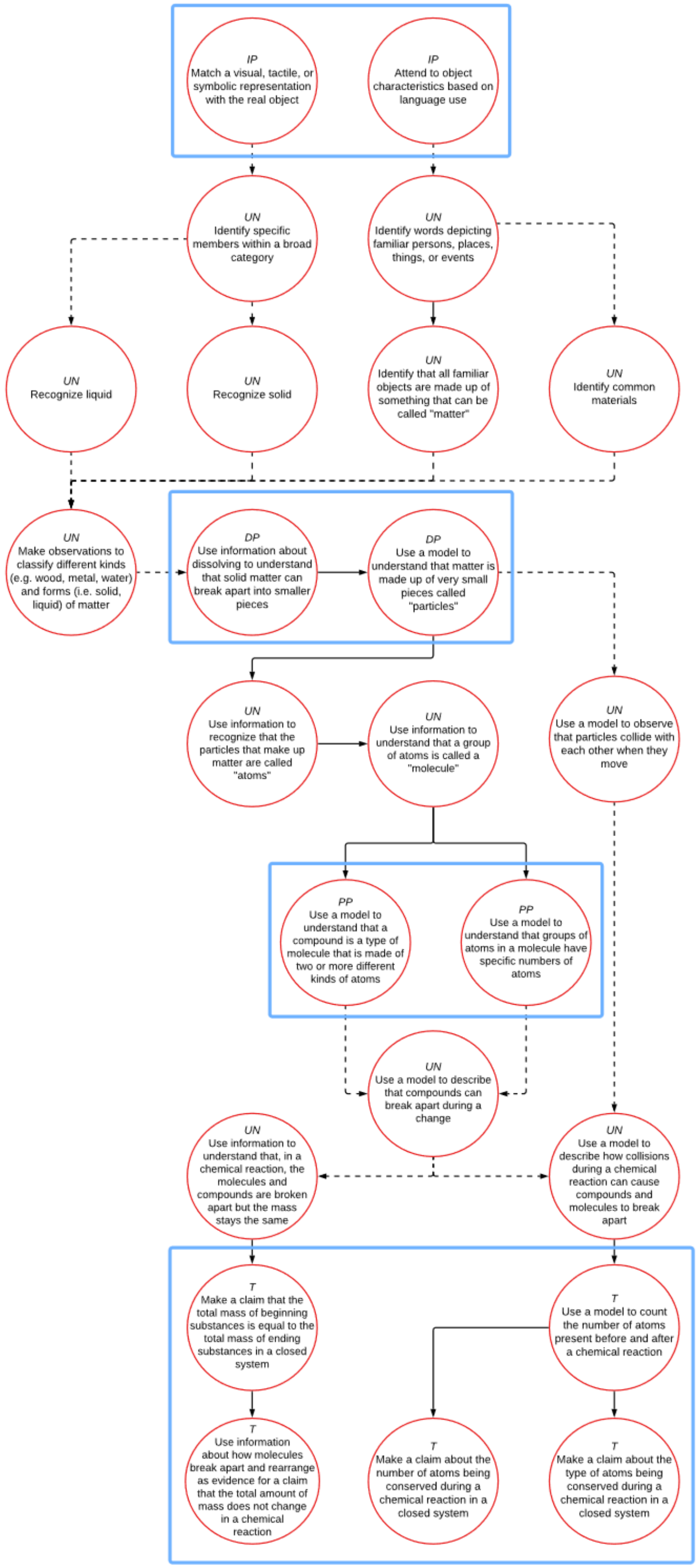
Instructional Resources

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

SCI.EE.12.PS.Matter-4 Use a model to support the law of the conservation of matter during chemical reactions.



Map Key	
IP	Initial Precursor
DP	Distal Precursor
PP	Proximal Precursor
T	Target
UN	Untested
───▶	Direct Connection
- - -▶	Indirect Connection that omits intervening node(s)

Boxes show nodes in each linkage level