Elaboration and Unpacking of the DCIs

Grade 5, Measurement Target 1	Students are able to investigate and interpret data to draw or support conclusions about the structure and properties of matter, including whether or not matter is conserved, and to identify materials and mixtures based upon their properties or results of a reaction.	
	PS1.A: Structure and Properties of Matter	**PS1.B: Chemical Reactions**
DCIs	• Matter of any type can be subdivided into particles that are too small to see, but even then, the matter still exists and can be detected by other means. A model showing that gases are made from matter particles that are too small to see and are moving freely around in space can explain many observations, including the inflation and shape of a balloon and the effects of air on larger particles or objects. **(5-PS1-1)** • The amount (weight) of matter is conserved when it changes form, even in transitions in which it seems to vanish. **(5-PS1-2)** • Measurements of a variety of properties can be used to identify materials. (Boundary: At this grade level, mass and weight are not distinguished, and no attempt is made to define the unseen particles or explain the atomic-scale mechanism of evaporation and condensation.) **(5-PS1-3)**	• No matter what reaction or change in properties occurs, the total weight of the substances does not change. (Boundary: Mass and weight are not distinguished at this grade level.) **(5-PS1-2)** • When two or more different substances are mixed, a new substance with different properties may be formed. **(5-PS1-4)**
Elaboration of the DCIs	**5-PS1A.a** • Everything around us (matter) is made up of particles that are too small to be seen. • Matter that cannot be seen can be detected in other ways. • Gas (air) has mass and takes up space. • Gas (air) particles, which are too small to be seen, can affect larger particles and objects. • Gas particles freely move around in space, until they hit a material that keeps them from moving further, thus trapping the gas (e.g., air inflating a basketball, an expanding balloon). **5-PS1A.b** • Matter can change in different ways. • Regardless of the type of change, none of the particles are lost, and the total mass of the system is the same. • The mass of substances is the same before and after they change form (e.g., heating, cooling, or mixing).	**5-PS1B.a** • When substances are mixed, the change can result in a new substance. • Substances change during a chemical reaction. • A new substance may have different properties than the individual substances from which it was made. **5-PS1B.b** • In a closed system, the total mass will not change. • The total mass of matter is conserved after heating, cooling, or mixing substances. • During a physical or chemical change, the total mass of the substances does not change. • After a change, the total mass of the new substance(s) will be the same as the total mass of the beginning substances.

Elaboration of the DCIs Cont'd	**5-PS1A.c** • Properties can be used to identify materials. • Properties can be measured. • Materials can be identified based on their observable and measurable properties. • Properties of materials may include color, hardness, reflectivity, electrical conductivity, thermal conductivity, response to magnetic forces, and solubility.	
Proficiency Boundaries	• Assessment does not include the atomic-scale mechanism of evaporation and condensation or defining the unseen particles. • Assessment does not include density or distinguishing mass and weight. • Students should know that tools are used to measure properties, but they might not know about some tools. • Tasks should focus on heating, cooling, or mixing simple substances.	
Prior Knowledge	• Matter is anything that occupies space and has weight/mass. • Different kinds of materials can be classified by their observable properties such as color, texture, hardness, and flexibility. • Various materials have properties (i.e., strength, flexibility, hardness, texture, and absorbency) that are best suited to different purposes. • Heating or cooling a substance may cause changes that can be observed. • Sometimes these changes are reversible and sometimes they are not.	
Student Misconceptions	• Lower elementary school students fail to conserve weight and volume of objects that change shape. When an object's appearance changes in several dimensions, they focus on only one. They cannot imagine a reversed or restored condition and focus mostly on the object's present appearance. [1] The ability to conserve develops gradually. Students typically understand conservation of number between the ages of 6 and 7, of length and amount (solid and liquid) between 7 and 8, of area between 8 and 10, of weight between 9 and 11, and of displaced volume between 13 and 14. These ages will vary when different children are tested, or the same children are tested in different contexts. [2] • Many students cannot discern weight conservation in some tasks until they are 15 years old. The ability to conserve weight in a task involving transformation from liquid to gas or solid to gas may rise from 5% in 9-year-old children to about 70% in 14- to 15-year-old children. [3] More complex changes, such as chemical reactions, especially those where gas is absorbed or released, are still more difficult to grasp as instances of weight conservation. [4]	
Articulation of DCIs Across Grade Levels	**2.PS1.A** (5-PS1-1), (5-PS1-2), (5-PS1-3) **MS.PS1.A** (5-PS1-1), (5-PS1-2), (5-PS1-3), (5-PS1-4)	**2.PS1.B** (5-PS1-2), (5-PS1-4) **MS.PS1.B** (5-PS1-2), (5-PS1-4)

[1] Gega, P. (1986). *Science in elementary education*. New York: Macmillan Publishing Company.

[2] Donaldson, M. (1978). *Children's minds*. New York: W.W. Norton.

[3] Stavy, R. (1990). Children's conceptions of changes in the state of matter: From liquid (or solid) to gas. *Journal of Research in Science Teaching, 27*, 247-266.

[4] Stavy, R. (1990). Children's conceptions of changes in the state of matter: From liquid (or solid) to gas. *Journal of Research in Science Teaching, 27*, 247-266.