

Mapping Concepts and Ideas to Research Findings

Topic: Conservation of Matter

Science Concepts and Ideas	Research Findings
Objects can be described in terms of the materials they are made of (clay, cloth, paper, etc.) and their physical properties (color, size shape, weight, texture, flexibility, etc.). (<i>BSL K-2 p. 76</i>)	Students cannot understand conservation of matter and weight if they do not understand what matter is, or accept weight as an intrinsic property of matter, or distinguish between weight and density. (<i>BSL pp.336-337</i>)
No matter how parts of an object are assembled, the weight of the whole object made is always the same as the sum of its parts; and when a thing is broken into parts, the parts have the same total weight as the original thing. (<i>BSL 3-5 p. 77</i>)	Mass often became associated with the phonetically similar word ‘massive’ and was conflated with size or volume. (<i>Driver, p. 78</i>)
No matter how substances within a closed system interact with one another, or how they combine or break apart, the total weight of the system remains the same. (<i>BSL 6-8 p. 78</i>)	(Some students) do not understand that substances can be formed by the recombination of atoms in the original substance. (<i>BSL p. 337</i>)
Substances react chemically in characteristic ways with other substances to form new substances (compounds) with different characteristic properties. In chemical reactions, the total mass is conserved. (<i>NSES, p. 154</i>)	Chemical or physical change may determine whether students regard mass as being conserved. (<i>Driver, p. 77</i>)
All matter is made up of atoms which are far too small to see directly through a microscope. (<i>BSL 6-8 p. 78</i>)	Some students think that when something is burned in a closed container, it will weigh more because they see the smoke that was produced. (<i>BSL p. 337</i>)
The idea of atoms explains conservation of matter: If the number of atoms stays the same no matter how they are rearranged, then their total mass stays the same. (<i>BSL 6-8 p. 78</i>)	For chemical reactions, especially those that evolve or absorb gas, weight conservation is more difficult for students to grasp. (<i>BSL p. 337</i>)
WA State EALR Component 1.3: Changes: Understand how interactions within and among systems cause changes in matter and energy. GLE 1.3.3 (grade 7): Understand that matter is conserved during physical and chemical changes.	If (pupils) regard gases as weightless, then they are unlikely to conserve overall weight or mass in reactions that involve gases. (<i>Driver, p. 77</i>)

Adapted from CTS and the Maine Mathematics and Science Alliance (<http://www.mmsa.org>).

BSL: *Benchmarks for science literacy*. American Association for the Advancement of Science (AAAS). (1993). New York: Oxford University Press.
 CTS: *Curriculum topic study: Bridging the gap between standards and practice*. Keeley, P. (2005). Thousand Oaks, CA: Corwin Press.
 Driver: Driver, R., Squires, A., Rushworth, P., & Wood-Robinson, V. (1994). *Making Sense of Secondary Science*. New York, NY: Routledge.
 NSES: National Research Council. (1996). *National Science Education Standards*. Washington, DC: National Academy Press.