

SCED 542

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Standards Analysis

In examining three relevant standard systems that apply to a seventh-grade science course in Alabama, many standards were found that related to problem solving and engineering design. The standards chosen for analysis were ALCOS (Alabama Course of Study) grade 7 science, ALCOS grade 7 math, and ITEA (International Technology Education Association) technological literacy standards grades 6 through 8. Engineering design was frequently found in both the science and technology standards. In the math standards, design was mentioned once. Problem solving was directly referred to in the math standards more frequently than in the science and technology standards.

The grade 7 math standards for the state of Alabama, while not directly referring to engineering design, does list solving real-life or real-world problems five times. These standards are 7.NS.3 (number system) *Solve real-world and mathematical problems involving the four operations with rational numbers*, 7.EE (expressions and equations) *Solve real-life and mathematical problems using numerical and algebraic expressions and equations*, 7.EE.4 *Use variables to represent quantities in a real-world or mathematical problem, and construct simple equations and inequalities to solve problems by reasoning about the quantities*, 7.G (geometry) *Solve real-life and mathematical problems involving angle measure, area, surface area, and volume*, and 7.G.6 *Solve real-world and mathematical problems involving area, volume and surface area of two-and three-dimensional*

*objects composed of triangles, quadrilaterals, polygons, and right prisms. The very last standard listed could be interpreted to refer to the engineering design process. 7.SP.8.c (statistics and probability) Design and use a simulation to generate frequencies for compound events.*

Grade 7 science standards for the state of Alabama have been unpacked to coordinate with the National Research Council's *Framework for K-12 Science Education*. Each standard is organized by its disciplinary core ideas, crosscutting concepts, and scientific and engineering practices. Focusing on the last category, scientific and engineering practices, constructing explanations and designing solutions appears six times in the eighteen total standards for grade seven science. These standards are *7.3 Construct an explanation of the function of specific cell structures for maintaining a stable environment, 7.5 Examine the cycling of matter between abiotic and biotic parts of ecosystems to explain the flow of energy and the conservation of matter, 7.13 Construct an explanation from evidence to describe how genetic mutations result in harmful, beneficial, or neutral effects to the structure and function of an organism, 7.16 Construct an explanation based on evidence for the anatomical similarities and differences among modern organisms and between modern and fossil organisms, including living organisms, 7.17 Obtain and evaluate pictorial data to compare patterns in the embryological development across multiple species to identify relationships not evident in the adult anatomy, and 7.18 Construct an explanation from evidence that natural selection acting over generations may lead to the predominance of certain traits that support successful survival and reproduction of a population and to the suppression of other traits.* Standard 7.9 was the only one that has direct reference to design solution: *Engage*

*in argument to defend the effectiveness of a design solution that maintains biodiversity and ecosystem services.*

The international standards for technological literacy (grades 6-8) lists fourteen sub-standards broken from 4 encompassing broad standards that directly engage with the design process. These four broad areas are standard 7 *The influence of technology on history*, standard 8 *The attributes of design*, standard 11 *Apply the design*, and standard 13 *Assess the impact of products and systems*. Problem solving shows up in standard 1 *Scope of technology* and in standard 10 *The role of trouble shooting, research and development, invention and innovation, and experimentation in problem solving*.

Based on this analysis of these three different standard systems, Alabama grade seven science, grade seven math, and the International technological standards for middle school, a pattern was noted. The math standards leaned more toward the problem-solving category and the science standards toward the engineering design category. The technological standards had more representation of both categories, albeit slightly more in the design category.

From a science teacher's point of view, engineering design and problem solving are unifying concepts for seventy grade students. Employing engineering design and problem-solving skills could likely facilitate more encompassing lessons that would be inquiry based and full of real life applications. These types of 'complete' lessons are those that students remember and apply in their adult lives.