

MODELING THEORY AND MODELING INSTRUCTION FOR STEM EDUCATION

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Cognitive Theory: All humans create mental models to plan and guide their interactions with the physical world. Science has greatly refined and extended this ability by creating and validating formal scientific models of physical things and processes. Research in physics education has found that mental models created from everyday experience are largely incompatible with scientific models (Hestenes, Wells & Swackhamer, 1992). This supports a view that the fundamental problem in learning and understanding science is coordinating mental models with scientific models. Modeling Theory (Hestenes, 2008a; Hestenes, 2008b) has drawn on resources of cognitive science to work out extensive implications of this view and guide development of an approach to science pedagogy and curriculum design called Modeling Instruction (Hestenes, 1997).

Science Pedagogy: Modeling Instruction is centered on making and using scientific models of the physical world as the core of scientific knowledge and practice. Modeling pedagogy and instructional materials were first developed and thoroughly tested for high school physics. Exemplary outcomes and enthusiastic teacher response to summer Modeling Workshops have driven continued growth of the program and extension to chemistry and biology.

Delivery and Support: Intensive 3-week summer Modeling Workshops have proven to be an ideal mechanism to upgrade knowledge and skills in science and pedagogy for in-service teachers. The Workshops were developed and widely offered across the United State with fifteen years of support from the National Science Foundation. The program was so popular among teachers that, when NSF funding ceased in 2005, to sustain it they created their own organization to sustain it, the American Modeling Teachers Association (AMTA). The AMTA now has nearly 2000 members. More than 7000 teachers have taken at least one Modeling Workshop, and more than 50 Workshops are offered each year. This makes Modeling the largest coherent STEM education program in the United States.

Education Reform: Over the last two decades, Modeling Instruction has evolved into a promising program to drive rapid, deep and sustained STEM education reform on a national scale (Hestenes, 2015).

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American Modeling Teachers Association (AMTA). Website <<http://modelinginstruction.org>>

[Most of these articles and other materials can be downloaded from < <http://modeling.asu.edu>>]