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Development of Active-Learning Curricular Materials in Thermodynamics

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Abstract

Physics (13) This project is creating new active-learning curricular materials for the study of thermodynamics, which would have a direct impact on instruction both in physics and chemistry at the introductory and intermediate juniors level. The motivation for the creation of these new materials is research on student learning which suggests that instruction utilizing only lecture classes and standard recitations and labs results in relatively small increases in most students' understanding of fundamental concepts in physics and chemistry. The materials being developed can be described as guided-inquiry problem sets. They are carefully designed both to elicit common student difficulties regarding the subjects under study, and then to lead students to confront these difficulties head-on with a tightly focused and strategically sequenced series of questions and exercises. An integral feature of these exercises is to require students to explain their reasoning process with short written statements. In the course of working through these questions and exercises, students are guided to resolve their difficulties and confusion and to attain a firm grasp on the targeted concepts. The material consists of a tightly linked set of (1) brief textual expositions in highly "interactive" format, (2) multiple-choice, concept-oriented questions for use with classroom communication systems in large classes, (3) structured series of questions that

lead students to elicit and then resolve conceptual difficulties, and finally (4) exercises to strengthen understanding. The emphasis throughout will be on qualitative reasoning and mastery of fundamental concepts. A great deal of pictorial, diagrammatic, and graphical material is incorporated. The effectiveness of the materials being rigorously assessed by continual in-class use and redesign, in conjunction with evaluation of student learning gains. Undergraduate students who plan to become high-school teachers are involved in the design and testing process, thereby gaining valuable preparation for their future professional activities.

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