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**Research on physics learning and research-based instructional strategies<sup>1</sup>**

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For over 100 years, physicists have strived to develop effective methods of helping students at all levels learn the concepts and methods of physics. A long-favored strategy has been to guide students to synthesize physics concepts by engaging in gently guided laboratory-based investigations in which the outcome is not known in advance; in recent times these have often been called "active-learning" methods. [D. Meltzer and V. Otero, AJP 83, 447 (2015).] However, it has only been since the 1970s that systematic research on teaching and learning physics at the university level has been carried out. This "physics education research" (PER) has proved to be valuable in generating productive insights into physics learning that help guide development of instructional materials and methods. In addition, this research has provided persuasive evidence of the effectiveness of research-based active-learning instruction by documenting improvements in students' ability to understand and apply physics ideas. [D. Meltzer and R. Thornton, AJP 80, 478 (2012).] I will provide a brief overview of these developments and give some examples of PER and of PER-based instructional strategies.

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