

Resources for Physics Teachers

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Some Guiding Principles about Student Learning

Taken from: E. F. Redish, *Teaching Physics with the Physics Suite*, (Wiley, 2003)

- **Constructivist principle:** Individuals build their knowledge by connecting to existing knowledge; they use this knowledge by productively creating a response to information they receive.
- **Context principle:** The knowledge individuals construct depends largely on the context.
- **Change principle:** It's reasonably easy to learn something that matches or extends an existing mental model.
 - It's hard to learn something we don't almost already know.
 - It's very difficult to change an existing mental model.

Some Guiding Principles for Effective Teaching

Taken from: L.C. McDermott, "Millikan Lecture 1990: What we teach and what is learned—Closing the gap," *Am. J. Phys.* **59**, 301 – 315 (1991) and L.C. McDermott, "Guest comment: How we teach and how students learn—A mismatch?," *Am. J. Phys.* **61**, 295 – 298 (1993)

- Teaching by telling is an ineffective mode of instruction for most students.
 - Students must be intellectually active to develop a *functional understanding* of the content (*i.e.*, the ability to do the reasoning needed to apply concepts and principles in situations not previously memorized).
- Facility in solving standard quantitative problems is not an adequate criterion for functional understanding.
- Study of advanced topics may not result in a deeper functional understanding of introductory topics.
- Concepts, reasoning ability, and representational skills should be developed together in a coherent body of subject matter.
- The ability to make connections between the formalism of physics and real-world phenomena must be expressly developed.
- Common conceptual and reasoning difficulties that students encounter (*e.g.*, confusing the meanings of a quantity and its rate of change) must be explicitly addressed by multiple challenges in different contexts.
- Questions that require explanations of reasoning are essential for probing student thinking and assessing student progress.

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(continued)

Useful Web Resources

- comPADRE: <http://compadre.org/portal/index.cfm>
 - A modest, but growing, collection of resources for physics teachers.
- Physics Education Technology (PhET) simulations: <http://phet.colorado.edu/>
 - Simulations that can be used for teaching a wide variety of physics topics. There is also a collection of lesson plans and activities to provide you with ideas for how to use the simulations in your class. Everything is free and easily customizable.
- Physics Applets (Physlets): <http://webphysics.davidson.edu/Applets/Applets.html>
 - A large collection of java applets that can be used for teaching a wide variety of physics topics. A large number of problems have already been created, or you can use the open-source materials to create your own.
- Assessing-to-Learn Physics (A2L): <http://a2l.physics.umass.edu/>
 - A collection of high quality multiple-choice assessment items and descriptions of how to use them in formative assessment.
- University of Maryland Physics Education Research Group:
<http://www.physics.umd.edu/perg/>
 - This site has a lot of resources for physics teachers. There are collections of high quality problems, links to some of the latest work in physics education research, as well as the full text of Redish's book, *Teaching Physics with the Physics Suite*.
- Spiral Physics: <http://web.monroecc.edu/spiral/>
 - A set of instructional resources for algebra- and calculus-based introductory physics that includes a large number of student learning activities.
- University of Illinois PER Group: <http://research.physics.uiuc.edu/PER/>
 - Look under the "resources" tab for Interactive Examples (web-based introductory physics problems in which students obtain help that will lead them to the solution) and Introductory Course Materials (links to high quality lecture, exam, discussion resources used in the introductory courses).
- MIT Instructional Materials:
<http://ocw.mit.edu/OcwWeb/web/courses/courses/index.htm#Physics>
 - MIT is now encouraging faculty to post instructional materials online. Many physics faculty have done so. Some are more useful than others.
- University of Minnesota Context-Rich Problems: <http://groups.physics.umn.edu/physed/>
 - A large online collection of context-rich problems as well as descriptions about how to use them for teaching and how to create your own.
- NY State Regents Examinations: <http://www.nysedregents.org/testing/scire/regentphys.html>
 - Ten years of examinations that are designed to test the NY state physics learning standards for a high school physics class. Answer keys also provided.