

# How do we teach our Introductory Physics Courses?

How does one learn physics, or any new subject or skill for that matter? By doing it!! By practicing the skill, in a series of exercises intended to develop that skill to the fullest extent. Swimmers do not learn by watching the coach sketch the mechanics of swimming strokes on the blackboard — they learn by jumping in the pool and trying it for themselves. So it is with physics as well. You must get directly involved — you must “jump in the pool” — you must *think* about the concepts, *work* through the problems, and *practice* this new skill.

Current research in the now-established field of Physics Education has very clearly demonstrated the need for students to be actively engaged in the learning process. In the Department of Physics at GW, we have adopted and implemented several recent pedagogical innovations which are designed to enhance the educational environment and to increase student interaction.

In the classroom, we have installed an electronic response system (Respondex), which enables each student to respond individually to conceptual questions posed in class. These probing questions are asked throughout the class period and are openly discussed by the students in class, thus encouraging close interaction and exchange of ideas. The activities based on these in-class questions greatly enliven the discussion and help illuminate concepts that might be troublesome.



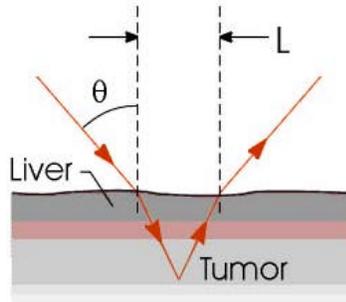
*Respondex keypad used by students in the main Physics lecture hall.*

Homework is of course an important component of the physics courses. In this case, we have adopted a web-based system (CAPA) that delivers individualized problems to each student. Because all of the problems are numerically different, students are encouraged to work together to develop their problem-solving skills. The CAPA system provides immediate feedback (correct/incorrect) and permits multiple attempts per problem, enabling students to identify and correct their mistakes. Hints can also be offered to help guide the students in the right direction.

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16. [1pt]

A narrow beam of ultrasonic waves reflects off the liver tumor in the figure t



If the speed of the wave is 10.5% less in the liver than in the surrounding m

**Answer:** 6.14e+00 cm

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17. [1pt]

A certain kind of glass has an index of refraction of 1.659 for blue light of w  
beam containing these two colors is incident at an angle of  $30.7^\circ$  on a piece

**Answer:** 4.47e-01 deg

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*Example of two homework problems  
using the CAPA web-based system.*

A focal point of the introductory physics courses is the Physics Help Room. This is a room equipped with networked computer terminals (accessible to CAPA) that is open to all students. During Help Room hours, there is a professor or a teaching assistant available for assistance, but the main advantage is the gathering of students who work together closely on their homework assignments. The Help Room is quite active during its open hours and has proven to be an invaluable resource throughout the academic semester.

Overall, the objective of the introductory courses is to promote basic skills in critical thinking, analytical reasoning and problem solving. This requires lots of practice (which we provide!) and plenty of interaction between the students and the instructor and also amongst the students themselves. The challenging academic environment offering a multitude of opportunities to think about physics in both a qualitative and quantitative manner, coupled with a high degree of interactivity, make the introductory courses stimulating and satisfying to the students who seriously desire to benefit from the educational experience.



*View of the Physics Help Room,  
equipped with networked computers.*