During my eleven years at the University of Southern California I have taught courses for all the undergraduate target audiences served by our Department of Physics and Astronomy. In this statement I would like to address my contributions to the development of our department’s course in Conceptual Physics for non–science majors.

The University of Southern California offers undergraduate degrees in a broad spectrum of disciplines ranging from the traditional arts and sciences to pre–professional specializations. The University’s recently revised general education curriculum mandates a common core program for all undergraduates. This program includes two required science courses, the first within a broadly–based “Foundations” category and the second within a more narrowly focused “Case Studies” category. Over the last two years I have been involved in the development of a course in Conceptual Physics to meet the Foundations requirement.

The pedagogical goals of such a course are quite distinct from those in the traditional physics curriculum. In my view the principal goals of a conceptual course are as follows: (i) appreciation of physics as an intellectual pursuit or liberal art, in the sense of the subject’s earlier name “natural philosophy”; (ii) understanding of reductionism and the search for simplicity as unifying principles in physical theory; (iii) appreciation of the benefits and limitations of applications which arise from physics; and (iv) development of logical reasoning to form answers to new questions based on pre–existing principles.

The last goal is particularly difficult to achieve in a framework which does not rely on mathematics. Indeed there is a tendency for the authors of physics textbooks for the non–science major to produce mathematically scaled–down versions of the traditional texts for science majors. I believe this is exactly the wrong approach. Rather than developing mathematical solution techniques of increasing complexity, it is far more useful to develop the subject as a series of qualitative thought experiments and “what if” questions. The mental effort required of the student is different, but no less demanding, than that involved in the solution of mathematics problems. Furthermore, this approach proves far more engaging and less intimidating for students in subject areas far from the sciences.

My typical “lecture” in Conceptual Physics begins with a carefully posed thought experiment with several plausible outcomes. I take an initial poll of opinions and ask for students to explain their answers. [This technique has been advocated by Eric Mazur in his book Peer Instruction (Prentice Hall, Saddle River, NJ, 1997).] I have found it possible to get wide student participation in such thought experiments in classes as large as one hundred. My intent is to create an atmosphere more akin to a humanities discussion section than a science lecture.

Whenever possible, the outcome of a thought experiment is illustrated by a live demonstration. My hour–and–a–half lectures always contain four or more demonstrations, and in some cases as many as eight. Over the course of a semester these demonstrations include breaking a drinking glass with a high–pitched note; yanking a tablecloth from beneath a service of dinnerware; and lying inside a sandwich–board of nails while a cinder block is broken on top. Highlights of the semester include a videotape of myself and two students on a bungee–jump ride at a local theme park; and my live firewalk across red–hot wood coals. Each of these demonstrations provides a vivid illustration of one or more physical concepts. The sense of immediacy and excitement imparted to the students could not possibly be achieved in a conventional lecture setting. I believe, however, that there need
be no sacrifice of academic rigor when unconventional methods such as these are brought into the classroom. On the contrary I have found that students are in many cases more willing to work hard and master difficult subjects when they are “brought to life” in the classroom.

I have also worked with our laboratory director to develop a series of student lab exercises which are challenging and engaging, but fall within the same conceptual framework described above. Again the emphasis has been on developing exercises which require careful logical reasoning, but eliminate the more technical mathematics required in courses for science majors.

The response to our revised Conceptual Physics course has been extremely strong. Whereas the course consistently ranked among the lowest general education science courses on student evaluations before the revisions, it has recently been ranked the highest. This has been achieved without a decline in grading standards. Further, in my opinion, the appreciation of non-science students for physics as a vital and intellectually rewarding area of study has been markedly increased.