Statement of Teaching Philosophy

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It is difficult to pin down what is most important to hold on to as a teacher. There are obvious necessities: knowledge of all major areas of physics, an awareness of new and exciting developments in the field, and one's sanity; but there is something that is less obvious, yet as important (if not more so). It is crucial to remember not just *what* I am teaching, but *to whom* I am teaching it. It is extremely easy to make the transition from one side of the classroom to the other, from student to professor, and all the while forget what it was like to be on the other side. What now seem like trivial concepts are generally very difficult to understand initially. Add to that the fact that I have only had one experience in learning physics; not everyone will have the same experience as I. Some will find things much more difficult to understand than I did, while at the same time, there can easily be concepts which I found challenging but others wil not. Teaching is a dynamic process, and no matter how much is planned in advance for a given class, adaptation will always be necessary. This adaptation is often needed on the spot, and will change depending on the class and the student, so it is crucial to pay attention to the students as much as possible.

One of the most difficult moments in my teaching career came, not surprisingly, during the first class I was a teaching assistant for (as an undergraduate myself): Basic Ideas of Physics. Non-science majors would take this class to fulfill their physical science requirement. A student asked me why all objects fall with the same acceleration, regardless of their mass, and I thought I answered his question quite well. I was wrong. As he stared at me with a blank face, I realized he didn't understand and I struggled for twenty minutes with him trying to help him understand what was a trivial concept for me. In the end I succeeded in helping him understand, and the difficulties I had to overcome in doing so have not been forgotten.

I realized that I have to always keep in mind that concepts that seem obvious to me now are not necessarily so obvious to others, and also that not everyone understands these concepts in the same way. Thus, when presenting material or answering questions, I have to stay on my toes. I may have fifteen ways to explain a given concept, but it could just be the sixteenth way makes sense to this particular student or group of students. Communication with the students is key, to make sure they are able to understand what I have said by having them actively involved in the class allows me to modify my teaching styles on a case-by-case basis.

Of course, my role as an active educator is not the only issue to worry about. The students also need to play an active role in the learning proces, and I imagine very few people would not say that it is necessary to have the students actually *doing* physics, not just watching me do physics. The majority of learning comes from students solving problems on their own, using the basic principles given to them to discover new things themselves. In essence, they must, with my guidance, rediscover the basic principles that guide how our world and the universe works.

Students need guidance in solving problems, yet it is important to include them in the process during classtime. If I just solve problems and derive formulae, the students can so easily zone out, blindly copy what I am doing, and they won't have to think during class as much as they would if they were expected to help. Making them actively think about the mathematics (much of which is may be new to the students) and physics involved in a given problem will allow them to understand the way one must think when working through the steps, thus allowing them to have a better idea of what they are expected to do for different types of problems. I have found in my experience that although this takes a slightly longer time to work through some problems during classtime, there is often a larger amount of retention when asking the students later about what they have learned.

Probably the best way for students to learn how to do physics is by far for them to become involved in research. For undergraduates (or often even early graduate students), this is often a more difficult task for theoretical physicists than it is for experimentalists, however it is by no means impossible. Numerical simulations of particle interactions, one of my primary research interests, lends itself quite well to only requiring a rudimentary knowledge of computational physics and the concepts a student sees in statistical mechanics, in addition to quantum mechanics, of course. These calculations are completely accessible to many students late in their undergraduate or early in their graduate careers. This can allow students to take an active role in seeing what is happening in the current research community. This is especially necessary since it starts building the bridge between classroom learning, which is needed to build a foundation of physics knowlege, and current research, where one does not know the answer to a given problem.

Since the summer of 2007, I have been working with an undergraduate, Eve, at Columbia University (who had been in my course on particle physics in the spring of 2007) on a small research project. The goal is to study the quantum mechanical harmonic oscillator, and an extension to include a quartic term in the Hamiltonian, in extra dimensions numerically. I have assisted in her edification in lattice techniques to evaluate the path integral numerically and are working to extract out the lowest energy eigenstates, and soon will be able to study how the theory would change while adding in extra compact dimensions. Of course, this problem (without the quartic term) is rather trivial, and solvable, but the program she is generating will be general enough to allow her to study many different potentials, and thus is a useful tool to study how extra dimensions will impact any given theory. Eve has been able to learn quite a bit about how numerical simulations are done, and has definitely gained a sense of how research in a theoretical setting proceeds.

While what I have discussed as important aspects needed for a teacher definitely does not include all of the major issues that arise in a teaching setting, it covers some of the most complicated problems. Every teacher is different, every student is different, every class is different, and every concept is different. When in front of a class, or even a single student, I must figure out on the spot what will be needed from me and from them before I can continue. The best I can do is to do my best to remember the difficulties I had as a student, and remember that this material is not obvious to most people initially. I like to recall especially that day in Basic Ideas of Physics, where it first dawned on me how different everyone is going to be as they learn.