Five Short Stories on Teaching

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In thinking about this activity called teaching, the following has occurred to me: The best we can do - either as individuals or as a university - is create the learning environment and then offer the opportunity for an education to those who choose to acquire it. But ultimately, the emphasis has to be on learning and not on teaching.

Consider the following five short stories - personal vignettes, actually - that are loosely related to this peculiar enterprise we call education.

- In 1972, Richard Feynman was awarded the Oersted Medal for his outstanding contributions to physics teaching at a national meeting of the American Physical Society. He had been asked to talk about what makes a good teacher. He began by saying that while thinking about the talk, he decided that he didn't know how to teach. So instead of talking about teaching, he would talk about physics - the structure of the proton - to this audience of a thousand physicists. And he gave one of the best research talks I have ever heard - stripping away the details in order to focus on the essential elements of the line of reasoning. He was, as usual, exuberant and supremely clear in his presentation, developing the arguments, speculating on the outcomes of the work and on the possible implications. Although I am not an elementary particle theorist, I could follow the essential arguments and came away enriched by the insights into that discipline and his work. And the particle theorists undoubtedly saw connections or conclusions or possible future lines of inquiry they had not previously seen. It was so very clear why he was awarded the Oersted Medal.

- I saw Richard Feynman again fifteen years later - only three months before his death, and obviously very ill. The occasion was a physics teachers conference - his last professional meeting. He was a panelist in a discussion on physics teaching. What made the event so very special, however, was the discussion <u>after</u> the meeting. There were a dozen or more of us gathered around Feynman reviewing some of the day's discussion when someone handed him a long copper tube and a small object to be dropped down the tube. And once dropped, it fell ...s o s l o w l y.... not at all what one might have expected. "It must be magnetic," said Feynman of the object being dropped. Of course it was, we all knew, since that was a fairly standard lecture demonstration of how a moving magnet can stimulate eddy currents in the copper tube and hence dissipate some energy which in turn slows the magnet's fall. What was magic was the almost childlike way he played with the magnet and tube. He was clearly delighted by the interplay of physical concepts involved. Then someone asked what would have happened had the tube been one of the “new” superconductors instead of copper [Note: this was in 1987, just after the discovery of the high-temperature superconductors.]! The mood of the group suddenly changed from light to serious - a *new* physics question had just been raised - one none of us had considered before. In the animated discussion that followed a variety of speculations were offered - with supporting arguments and counter-arguments. What <u>fun</u>! Then David Goodstein, also of Caltech, made a pivotal observation – and the answer became clear. "Of course!", said Feynman - with that great excitement that comes with new insight into an interesting question.

- I had lunch with a friend and colleague just prior to the birth of his first child. He told me he was very excited about the prospect of becoming a father but that he hoped that he would not "do a number" on his kid. I said that *of course* he would do a number on his kid (*all* parents do) - it's just a question of which number.

- When my son was about five, we were walking along the cliffs overlooking the ocean. "Dad, can you tell me what makes the waves?", he asked. I told him I didn't know if I could explain it to him - that it was quite complicated. "But will you try?", he responded - as if the limitation were mine and not his.

- Finally, during a physics class last year in which I was describing the motion of some object (a projectile, if I recall correctly) by first demonstrating the motion, then drawing the force diagram, writing the equations of motion - and their solution, and sketching the graphs of the position as a function of time and of the trajectory, a student asked what would have happened if the problem were changed in some way (maybe by including air resistance, or something). I proceeded to show the effect of the change in the problem - in the diagram, in the equations and the solution, and in the graphs of the motion. I looked around and the class was both attentive and very anxious! I think my students were rather concerned that they were expected to be able to quickly go from problem statement to description, solution, graphs, and interpretation just as I had done. So I stopped and asked how many of them enjoyed music. They all raised their hands (but had no idea why I asked). I then followed by asking how many played musical instruments...fewer hands. Then how many could read music ... still fewer hands. And how many could sight read the music and play it on their instrument ... fewer still. Finally, I asked how many could read a musical score and *hear* the music. One hand remained. Interpreting physics problems and reading music are very much alike in that they are both learned skills - and you can learn anything you want to learn. What you learn depends ultimately on you.

There are a number of lessons in these stories: You teach best what you understand deeply – and are passionate about. You should teach the principles and the lines of reasoning, the goals and the possible outcomes and implications. Don't underestimate your audience. Expect a lot from your students - the best of them deserve to be challenged – and each can learn anything he or she *wants* to learn. Expect a lot from yourself as well. Teaching excellence requires that you remain a student - learning, stretching, questioning and remaining "childlike" in your curiosity and enthusiasm for learning. Learning about one's universe is a lifelong endeavor – and there will continue to be surprises and new insights for teacher and student alike. We as teachers are very much like parents in that we have influence on our students ... the only question being what kind of influence that will be. Finally, all knowledge, like all education, is ultimately driven by the questions asked. Our task is to pose the right questions – and help our students learn to ask the right questions.

Excellence in teaching ultimately has little to do with the mechanics of the process - it isn't algorithmic, or the number of students we have, or whether we hand out course syllabi or how many tests we give or how we grade. It has to do with creating the desire to learn and then establishing the environment in which the learning can flourish.

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