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Facilitating Quantum Leaps: Reflections on How to Promote Active Student Learning in a Physics Classroom

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FACILITATING QUANTUM LEAPS: REFLECTIONS ON HOW TO PROMOTE ACTIVE STUDENT LEARNING IN A PHYSICS CLASSROOM

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When I was an undergraduate student, my favorite physics course was advanced mechanics. This course is, in many ways, a gateway to upper level physics courses. It's main contribution to the undergraduate curriculum is the introduction of a new formulation of mechanics, called the Lagrangian approach, that provides a way to solve for the motion of complicated mechanical systems without Newton's F = ma. For many students, myself included, Lagrangian Mechanics constitutes a revolutionary twist on physics. It deepens one's appreciation for the Unreasonable Effectiveness of Mathematics in the Natural Sciences.

So I was thrilled to begin my career at Bryn Mawr College by teaching Advanced Mechanics to eleven juniors and seniors from Bryn Mawr and Haverford Colleges. I was also nervous. This was my first time teaching a college course. And my goal was to help foster nothing short of a transformation in my students — to help them take a quantum leap in their appreciation for the reach of physics in the natural world. I was also conscious that not all students wanted to continue in physics after graduation, and that not all students would learn in the same way that I did when I was an undergraduate. This latter point was particularly important when deciding what we would actually *do* in our class meetings.

My undergraduate education consisted of me sitting at a desk while the professor presented a (sometimes) coherent lecture on a topic that was equally well described in our book. I read and went to class religiously, but I also recognized that I did not do most of my learning in the classroom. Rather, my growth came mostly from the manifold more hours spent in small student groups pounding away on problem sets. Much has changed in physics education, even in the fairly short time since my undergraduate days. There is a growing focus on peer instruction, on brains-on activities, and on group work *in* the classroom. I was certainly on board with this shift and wanted to incorporate some of these elements into my teaching. But at the same time, I did not experience this format as a student and so I didn't have much personal experience to draw from.

Fortunately, through the Bryn Mawr TLI program, I was able to work with a talented student consultant named Roselyn throughout the semester. We met weekly to debrief on the past week of classes, to brainstorm ideas for future classes and to reflect on the trajectory of the course so far. Roselyn, who attended all of the lectures, gave invaluable feedback from several perspectives including that of a student and an educator. In each class, Roselyn also took detailed time-indexed notes that described her observations of what I did and how the students responded. Her observations helped me see what techniques were working well and which ones needed work. In particular, Roselyn helped me clarify the physics derivations through "what does it all mean" digestion activities. She also pointed out ways to improve the transition between lecture and group work, and then how to reconvene and repeat.

I have attached Roselyn's observation notes from one class early in the semester. In the margin at right, I have added annotations to describe ways in which her comments impacted my teaching.