Teaching Statement

When I reflect on my greatest influences in pursuing physics, without hesitation I think of my high school physics teacher. Several key aspects of his teaching left an enduring impression on me: his compelling way of presenting the material, drawing on his past experience as an engineer in industry; the way he bolstered our sense of belonging in the field, by welcoming our curiosity and reminding us of our progress along the way; and undoubtedly his spellbinding physics demos, by which he dismantled our assumptions and helped us build new intuitions in their place. Teachers have a profound impact on our perception of a subject and can fuel lasting interest in the field. As a result, I have nurtured a passion for teaching physics since my undergraduate studies, serving as a teaching assistant for both engineering-focused and general introductory physics courses. As a graduate student, I continued to teach introductory physics for students of diverse educational backgrounds. Through these experiences, I have identified a similar set of core values that inform my teaching: (1) promoting an open and engaging learning environment, (2) fostering and practicing metacognitive thinking, and (3) incorporating methodologies to prepare students for long-term scientific inquiry.

The learning environment

To learn and understand physics necessarily requires open-mindedness. Many fundamental concepts contradict one's initial intuition: for instance, that the acceleration of an object in uniform circular motion is directed inward and perpendicular to the object's path. Therefore, I find it important to cultivate a comfortable yet thought-provoking environment that stimulates students' appetite for intellectual challenges without fear of making mistakes. As a graduate student at Harvard University, I had the opportunity to work as a Teaching Fellow for AP 50A/B, an undergraduate sequence in physics developed by Prof. Eric Mazur that emphasizes peer instruction and active learning. At the start of each unit, students complete a pre-reading that introduces a new topic of the course. In class, the students sit in small groups and answer short, conceptual questions in two rounds: an individual round and group discussion round, facilitated by the teaching team. After both rounds, a group member is invited to share the group's solution with the class. There are several appealing aspects of this approach. Students are foremost encouraged to individually formulate their reasoning about a problem. They then vocalize their reasoning in a low-stakes setting within small groups. Finally, they are empowered to participate in class after receiving the affirmation of their peers. I believe this technique is especially successful in encouraging participation among students who have limited prior exposure to physics and may feel hesitant to speak up.

Metacognitive thinking

Central to the success of peer discussion is the opportunity for students to make independent predictions and develop their own problem-solving skills. Thus, through one-on-one interactions with students, I try to instill practices of organizing one's knowledge and critically reflecting on solutions to a problem. For example, during office hours, I typically lay the groundwork for a problem by drawing a diagram on the board. I ask my students to add labels and indicators that can organize all the information we have about the problem on that visual. Often the very act of visualizing information illuminates the approach to a solution: For instance, a free body diagram of a rigid body may reveal an axis about which several forces produce no torque.

When possible, I highlight multiple different approaches to solve the same problem. An example I have demonstrated to my students is how to identify the direction in which a square current-carrying loop will rotate in the presence of a uniform magnetic field. We can approach this problem either by dissecting the forces on each edge to determine the torque, or by coarse-graining our representation of the loop into a single magnetic moment that seeks to align itself with the external field. Arriving at consistent results in two distinct ways is helpful for making broader connections between course concepts and is also a valuable strategy for evaluating one's work. For homework assignments in the same introductory physics course, students are always asked to provide a justification for their answer, which may entail checking units, verifying a conservation law, or making order of magnitude arguments for whether a value seems appropriate.

Attention to one's thought process and organization of knowledge is instructive not only for students; I actively apply metacognitive strategies to guide my own preparation for class. As I review upcoming concepts to cover in class or office hours, I ask myself to articulate exactly *how* I know each step in the process and try to anticipate the possible misconceptions that students may face. During office hours, I candidly discuss my own initial challenges with the material and how my understanding evolved. I believe that nurturing a growth mindset in physics students is invaluable to their sustained perseverance in the course. When grading, I strive to thoroughly understand the students' thought process and identify any sources of confusion, so that I may comment on their successes and provide targeted feedback for improvement.

Skills for continued scientific inquiry

Learning from one's mistakes is integral to conducting research; thus, I have very much appreciated the homework model used in the AP 50 sequence. Students complete assignments independently to the best of their ability, then go over the problems in small groups during class, and finally are provided with solutions in order to make corrections in a different color ink. The grade is based on their initial effort on the assignment and on correctly identifying any misconceptions by the end. Moreover, learning how to validate one's results in a different way and building a repertoire of different problem-solving methods discussed earlier are likewise standard practices in research and can be seamlessly incorporated in teaching. Physics students have genuine curiosity for the applications of their coursework. From my own experience, I vividly remember a discussion with one of my students during office hours when she asked me about my research. She was fascinated when I explained that I model the deformation of thin, elastic materials by applying Hooke's Law to a more complicated arrangement of springs and masses. Thus, I actively pursue opportunities to demonstrate the tangible value of fundamental concepts learned in class.

Teaching interests and concluding remarks

Going forward, I would love to continue exploring nontraditional, flipped classroom approaches to teaching at the undergraduate level. I have likewise gained experience as a Teaching Fellow for a graduate course on scientific computing and numerical methods that connects closely to my research. Given the importance of conducting experiments and collecting data in introductory physics, I believe that preliminary topics in numerical data fitting and error analysis may be a valuable addition to such courses. In addition, I believe that introducing deeper historical context for the topics studied would enrich students' understanding and encourage interest among undergraduates of different educational backgrounds and prior levels of exposure to physics. As diversity in the physics community continues to grow, I hope to emphasize the contributions of underrepresented scientists in our history, and bolster inclusivity and sense of belonging in the discipline among newer generations. Thus, I believe that fostering inclusive, engaging environments, metacognitive thinking, and long-term scientific inquiry are essential practices that will continue to inform my teaching as I pursue my career in academia.