When I think about teaching math, my thoughts naturally turn to famous mathematician competitive hot dog eater Joey “Jaws” Chestnut. If our goal is to break Joey’s world record of eating 69 hot dogs in 10 minutes, we can’t expect to do this by watching Joey on TV - rather, we would immediately start eating hot dogs. Mathematics, though less nauseating, works by the same principle. My firmest conviction about learning math, from the rudiments of algebra through the complexities of advanced graph theory, is that we know exactly what we practice. To really learn mathematics it is not enough to take detailed notes in lecture; rather, students absolutely must try problems on their own; this applies from the basics of algebra up Math is an involved discipline, and even the best teacher can impart little to a student who merely observes, and never tries a problem.

During graduate school at Nebraska I taught Intermediate Algebra, which primarily covers properties of polynomials, factoring, and rational functions. By the end of the course students should be able to take a quadratic equation and factor it, graph it, draw it, write a word problem about it, and find its zeros, vertex, intercepts, and social security number. It’s a very skill-specific class, so we spent much of our time doing examples. Usually I would present a topic, and then have the students work problems which illustrated the concepts we were discussing; this emphasized that math is something one does, not something one watches. I often had my students work on harder problems in groups, as this made the problems seem less daunting and the students often have complementary strengths. Working in groups, besides being a vital life skill, gave them peer support and a natural opportunity to understand someone else’s work. They learned to communicate math verbally, and they heard other descriptions of the concept besides mine and the textbook’s.

Though I prefer to have my students actively doing math, I have found that a course based solely around example after example does not work for me as a teacher. I had a chance to try this when I taught Intermediate Algebra under a computer-based format, where students went through an online lesson and did online homework. This was an excellent way for the students to get as many examples as they wished, with instant feedback. However, I found that the benefits of instant feedback were counteracted greatly by the fact that the feedback was identical no matter how one arrived at the answer: a tiny calculation error was exactly as wrong as a major conceptual gap, and I disliked this emphasis on results over process. The valuable habit of writing down steps was lost, so it was difficult to tell where the true misunderstanding might have been. I appreciate computers as a tool, but not as a replacement for a teacher as the source of classroom guidance. Thus, I always do at least some lecturing to provide context, and be sure that the students learn the ‘why’ of the subject as well as the ‘how’.

When it’s possible, I like to extend from short working of examples into presentations and projects, since performing for others is how we turn any knowledge or skill into a profession. In advanced courses with mathematically mature students, having student presentations form the foundation of the class can be exciting and provide them with an invaluable experience. My undergraduate analysis course was entirely student presentation-based and it was undoubtedly the best preparation I received for my mathematical life. I would not have attempted this with my Intermediate Algebra students, as their mathematical compasses were not yet strong, but to give them a smaller version of the same thing, I often had them work on the board, either in groups or alone. Just the fact that they are writing things on the board makes them more vigilant, because things written on the board seem more official and someone else might write it down as correct!
In my final semester at Nebraska, I taught Mathematics Matters, a course for Elementary Education majors. Many of my students in this class, like their counterparts in Intermediate Algebra, suffered serious math anxiety from previous math trauma (and some were just allergic to fractions). They often used phrases like “Ugh, I am so bad at math,” which concerned me greatly, especially coming from those who were going forth to teach math themselves. To help alleviate this sort of mathematical panic, I work particularly hard at the language I use in class. “What are your questions?” gets a better response than “Do you have any questions?” because they do, they always have questions, everyone has questions, and I want them to know that I think these questions are important and not a sign of weakness. Also, I prefer to use “when” as opposed to “if:” When you come to my office hours. When you make mistakes. When you get confused. When you get stuck on a homework problem. These things should sound like a normal part of the mathematical process, not like something that only happens to the mathematically hopeless.

In this vein, I also want to show my students that people exist who care deeply about math and don’t consider it an onerous chore. For this, as for math anxiety, humor is a powerful tool. If I have to do a silly dance or make up a word problem about cats to make integration memorable, then so be it; my dignity is far less important than their education. While teaching induction this year, I used false induction to ‘prove’ that all horses are blue; now they refer to false proofs as ‘blue horse syndrome’ and claim they’ll remember it forever, which to me is a definite win. When I teach factoring, I tell the class how much I adore it because it’s true, and probably there’s a shortage of people in their life who like factoring. I give them stories about mathematicians who loathed one another over theorems and theories, about Fermat and what he wrote in the margins, about Newton hiding in his basement during parties. To put it in literary terms, I try to give them the poetry of math even when they’re working on spelling. Math is a devastatingly beautiful subject and I’m tired of it getting the short end of the stick compared to more generally appreciated disciplines. Everyone knows someone who loves to read, but too few of us know a math enthusiast, and math deserves enthusiasts.

Now that I am teaching at Harvey Mudd, a STEM focused school, I find myself working with students who challenge me in a very different way. They don’t generally suffer from math anxiety when they don’t understand things; rather, they consider a class where they understand everything to be boring. They are astute observers who notice any logical inconsistencies and, in some cases, delight in pointing them out. It is impossible to teach them complacently. This provides a continual push for me to improve my own teaching ability, and for this I try to apply the same methods to myself as I impose on my students. As they would do with a difficult problem, I try different methods and see how they work, discarding those that don’t do well and adding to my repertoire those that do. This year, for example, I’ve found that rushing to finish a proof at the end of class makes my graph theory students frustrated; however, they loved a lecture on the Four Color Theorem which included the historical context and some of the false proofs.

At Harvey Mudd, mentoring is such a part of the culture that nearly every conversation leads to some sort of improvement in my teaching. And just as I evaluate my students with exams and homework, I ask others to evaluate my performance as a teacher. The college has its students write end-of-semester teaching evaluations, but I also like to give mid-semester evaluations of my own so I can benefit my current students as well as future ones. I ask other faculty to sit in on my class and give me their feedback, and then I visit theirs to see how experienced faculty deal with these same issues. To me, improving my teaching is as important a part of my job as writing my lectures or grading homework, since it transfers directly into a better experience for my students. For while I don’t know what the math skills equivalent of eating 69 hot dogs in 10 minutes may be, in the end I simply want my students to feel a deep satisfaction when they, like Joey Chestnut, are true masters of their craft.