For years I have considered myself an “aspiring math inspirer,” and I am excited to take the next step to realize this dream. I believe anyone can be successful in a course when they are excited and engaged in the material. I aim to bring a contagious enthusiasm to class every day and to structure my courses in a way that challenges students to work hard both in and out of class, piques their interest and excitement, and encourages them to take advantage of the available resources. As a former student put it, “He made the class engaging and even fun. He was understanding of the students and really went above and beyond to make calculus as interesting as possible.” [1]

Math is often best learned when it is *seen*. When I taught Riemann sums, (after letting my students put on their “Newton Hats” to devise their own approximation strategy) I projected up an applet which *shows* their strategy’s limiting behavior; this took them from “Yeah, I pretty much get it” to “Ah, I see!” Weeks later when we revolved these same regions about an axis, I showed them another applet which draws the resulting solid. When we found the volume of a hemisphere by slicing, I brought a sliced apple to class to show them the disc-like cross sections. Not only are these moments fun and memorable, but the students can then better see, understand and remember the solution. This, in turn, presents a satisfying moment for a professor: “Ah, I can see my students learning!”

To get the most out of these experiences, I found that it is helpful to have built a relationship of friendliness, respect and trust with my students. With this foundation, and by explaining the reasoning behind these activities, the students buy into the pedagogy and it works.

To further engage my students, I often take time to let them think about the next step on their own, or discuss it with a partner. As my student described it, “He would also kind of make us figure out what to do, use our brains for once; it’s normally so easy to zombie out in class or not realize you actually don’t get what’s going on, you’re just watching. Everything was explained in a way I could understand…so I actually learn.” [2]

I, myself, have fallen prey to the bleary, timeless state of “math class zombie,” so I work to combat this as the instructor. My calculus class was particularly susceptible since it was a summer class, and therefore had two-hour lectures. Halfway through class I gave my students a five-minute break which concluded with what I called “The Curious and Interesting Facts of the Day.” Each day I gave them two facts—one math, one non-math—to re-engage their interest and energy. These ranged from Goldbach’s Conjecture, to ant super-colonies, to a proof that there are at least 6 non-balding San Diegans who have exactly the same number of hairs on their head, to a U.S. Army study that found that the most important quality to succeed in the Army (or to succeed in calculus, I argued) was *grit*. In all, my students found these facts to be “fun”[3] and “a nice change of pace.” [4] Furthermore, despite the following outcome being unplanned, this short segment again displayed my passion for math, teaching, and learning in general: “I enjoyed his interesting facts of the day, which further proved how much he was into his field and loved spreading knowledge.” [2] I aim to spread this love and passion to my students, and am excited when my students note on a personal shift: “For once math is fun.” [5]

I conceived the idea for this segment during my sophomore year of college when I mentored a gifted 5th grader who was a year ahead in math; I taught him the 6th grade material. I often stole a few minutes at the end to work on a fun, advanced math problem. I loved to see his face light up at the sight of another cool idea; he was enjoying math, and that was exciting to see. Years later I returned to tutoring young kids, this time for the Art of Problem Solving program, and have continued this tradition.

I enjoyed these mentoring experiences and have since sought out other such opportunities. In my second year at UCSD I took part in our department’s Graduate-Undergraduate Learning Program (GULP)
during which I worked with a group of undergrads as a research mentor. I found an open problem in Ramsey theory, taught them the basics of the theory, and then worked with them weekly as they attempted to answer the questions. It was a wonderful experience that taught me much. I have taken part in GULP every year since and have also kept in contact with several of these students, advising them on their math education and graduate school opportunities. In my fourth year my dedication to GULP was recognized when I was asked to organize and run the program during my final two years at UCSD, which I happily accepted.

I also mentored undergrads during an informal follow-up to the 2014 Clemson Math REU. I worked with three students on another Ramsey theory problem, which produced a paper. I again had a wonderful time in this role and hope to continue to mentor undergrads.

I work to have a “well-structured” course. Twice a week my students had to complete a short pre-class quiz through UCSD’s course-management website. These “were short, regular, and friendly. They really help [the students] stay on top of the material.” Typically I asked two questions: the first reviewed our previous lesson and the second prepared them for the next. I also began each class with a brief summary of our previous lecture (and in the future I also plan to write a sentence or two about what we will be covering that day). A day or two after each class I typed up lecture notes and posted them to my website, along with many other helpful documents. The notes topped off at 130 pages, which many students commented were “very helpful” and “clearer” than the textbook.

I have twice been recognized by my department or university for my teaching. First, our department selected me as one of two nominees to be a 2014 UCSD Graduate Teaching Scholar. I, along with several others, won this honor and received an award to attend the 8-week course “The College Classroom” and work on a teaching research project, both run by UCSD’s Center for Teaching Development. This class, as well as several more that I took as an undergrad when I considered double majoring in education, have provided me with a nice foundation of college education classes. Second, based on my teaching evaluations, I was selected to be the math department’s Senior MATLAB TA. Our linear algebra and differential equations classes have a MATLAB component, and it is my job to coordinate these.

I think technology can be a valuable resource in education. In my own class, not only did I use technology to draw Riemann sums, visualize solids of revolution and provide course notes, but also to make YouTube videos and create an in-class integration game. I recorded some example problems and posted them to my YouTube channel so that students could review some of the more difficult concepts at their own pace to “gain deeper understanding of the problems.” I had the idea for the game while tutoring six years ago, as a way to teach antiderivatives. The students at this point can read the question ‘What is the derivative of $f(x)$?’ and answer ‘$f'(x)$.’ The idea of antiderivatives is not to memorize a bunch of new rules, but to flip around the rules that they already know. For an antiderivative problem they are essentially given the “answer” of $f'(x)$ and are asked to come up with the “question” (or, at least the $f(x)$ part of it). This is exactly the setup of the game Jeopardy!, so for one hour I let my students reapply old knowledge to discover antiderivatives on their own through a modified version of Jeopardy!. Based on my experiences and from student comments, I believe that having a few special lectures, like a well-planned game, can excite my students and help them “understand [the material] better.”

I still consider myself an “aspiring math inspirer,” and a professorship in mathematics is the next step to continue this goal. As an undergrad I TAed 7 of my 8 semesters – calculus each time. When I entered UCSD I set a goal to TA as many different classes as possible, particularly upper-division classes. So far I have taught Calculus II, Calculus III, Linear Algebra, Geometry for Secondary Teachers, Combinatorics, Probability, Graph Theory, Analysis I, Analysis II, Topology and Mathematical Reasoning, and I am currently TAing Group Theory. As a professor I hope to continue this tradition and teach as many different classes as I can. Working in diverse situations with diverse students provides challenges and opportunities that I am excited to meet.
– Addendum: Community Education –

As a professor I will engage in the education of more than just my students; I will serve my department, my university and my community. For the past couple years I have been writing a book on applications of math to the “real world”; so far I have written 180 pages. I believe the public wants to see more applications of mathematics. I’ve seen this both on the big stage in Wall Street Journal articles, political blogs, sports debates, and evening talk shows, as well as in my local community.

I have served my community to this end. In 2008 and 2009 I wrote, administered, and graded the exams for the Fermi Questions event at the Nebraska State Science Olympiad Competition. I paused only when the Fermi Questions event was rotated out of the active events, but last year I returned to Science Olympiad when a friend and I wrote, administered and graded the exams for the Crave the Wave event at the 2014 Southern California Invitational. Also in my community, I recently gave the plenary talk at the San Diego Fleet Science Center’s special event “Circus Feats and Science Geeks,” which I helped promote beforehand on a local TV program. Several hundred people attended my talk which was about the math behind juggling and was entitled *Throwing on Beats with Math Techniques as Circus Feats for Science Geeks*. I had a wonderful time and hope to give more public talks in the future.

I have also served my department as the co-organizer of our graduate student colloquium and by giving talks at our university (including at that colloquium). More broadly, I have served the mathematical community by refereeing a number of papers for the Journal of Combinatorics and the Electronic Journal of Linear Algebra. I believe service should be an important component of one’s life and I am excited to enter a profession where it is encouraged.
Referenced comments from my student evaluations

[1] “Jay was a fabulous instructor. He made the class engaging and even fun. He was understanding of the students and really went above and beyond to make calculus as interesting as possible. He even made a Jeopardy game for the class, in addition to daily fun facts. He explained the material carefully and thoroughly, and always answered questions. He was efficient and very knowledgeable, but more importantly very good at articulating the concepts and explaining things. He had a lot of office hours and was very willing to help students. I went to his office hours weekly and found that his office hours were more helpful than the TA’s sections. The weekly quizzes we had were very helpful. It seems that Jay put a lot of effort into this class and successfully managed to make it an enjoyable course to take! Definitely the best math class I’ve ever taken. He also made Youtube videos for us and explained problems on there right before the exams. I would highly recommend taking his class.”

[2] “You can tell he really loves teaching, particularly from all the extra note typing and outside office hours he held. I enjoyed his interesting facts of the day, which further proved how much he was into his field and loved spreading knowledge. I found him to be a lot more engaging than any prof I’ve ever had, considering every example he helped us through he would also kind of make us figure out what to do, use our brains for once; it’s normally so easy to zombie out in class or not realize you actually don’t get what’s going on, you’re just watching. Everything was explained in a way I could understand (math isn’t my strong suit), so I hope if I ever have to take 10C he can just be the professor, so I actually learn. Also, this was in double-time 5wks so kudos!”

[3] “Jonathan is really a great instructor. He is always prepared to the class that he can always finish the topic he prepared on time. In the break time, he always have a section called ‘Interesting and curious facts of the day’, during which he will tell us many curious and interesting facts that involves mathematics so that we can experience the fun parts of mathematics. Also, I believe that he is a very patient man. He treats every question very seriously and patiently, even though some questions don’t seem like they deserve that much patience. Overall, I definitely will recommend him to everyone that need to take Calculus. BTW actually the reason why I select this course is also because one of my undergraduate friend recommended him.”

[4] “Great lectures and explanations of the material. He does an optional segment during the 5-minute break called “Curious and interesting facts of the day”, which is a pretty nice change of pace after an hour of math.”

[5] “Exceptional professor with a great attitude. For once math is fun.”

[6] “The course is well structured, as we move through the material from easier concepts to harder ones. The course is challenging but it is presented in a way that the material we learn builds on itself progressively and allows an easier flow through the course.”

[7] “Great exams and quizzes. I liked how the quizzes were short, regular, and friendly. They really help me stay on top of the material. The exams were fair too.”

[8] “He seems very passionate about the subject. I can tell how much he loves teaching math. His notes are very helpful and overall he is an awesome instructor who cares about his students’ learning and understanding. I would take his classes again if he teaches other classes.”

[9] “The textbook is good, but Jonathan Cummings’s notes are clearer.”
“Cummings is an excellent instructor. He has been my best math lecturer. He is always prepared for class and succeeds at making calculus clear (brings an apple to serve as a visual for teaching volumes of spheres). He also uses his free time to make youtube videos to help us gain deeper understanding of the problems. He is simply the best!”

“He is, by far, one of the best professors I’ve had at UCSD. He is amazing. He is very good at teaching the material, and has a unique way of making math be very interesting. He is very straightforward with the material and goes out of his way to make sure all of the students understand the material to the fullest. He also incorporate various techniques (extra worksheets, games) so we can practice the material and understand it better. I honestly think he spent every second of his day trying to figure out how to make the class better and the material easier to understand. For example, he typed up notes on the lecture material and even recorded youtube videos further explaining the material, with lots of detail, so we understood it better. I’ve never had a professor put so much effort to make sure his/her students learn the material. I was truly amazed by how great he was. He even had examples about how we could use the material in our real life - for instance, how to calculate how long will it take for the thanksgiving turkey to cook. A.M.A.Z.I.N.G.”

Note: The above comments were all from my time as an instructor of record. The rest of those evaluations can be viewed here:


My TA evaluations can be viewed here:

http://www.math.ucsd.edu/~jjcummings/CummingsUCSDTAEvals.pdf