

TEACHING STATEMENT — CHRISTOPHER KEYES

christopher.keyes@emory.edu
www.math.emory.edu/~ckeyes3

Overview. My primary goal when teaching undergraduate mathematics is to make math accessible to the student audience and relatable to their experiences. To that end, I strive to promote student engagement in and out of the classroom through active learning techniques, a wide range of examples, and a healthy dose of enthusiasm. This philosophy is informed by my experiences as an instructor of record for two semesters of Calculus I and a teaching assistant for two semesters of Linear Algebra at Emory University, in addition to organizing a Directed Reading Program at Emory and serving as one of its mentors, and participating in community outreach with Emory's Math Circle. I look forward to bringing my experience to a new department, where I will improve my instruction through teaching and developing a broader range of courses, continue to be involved in undergraduate mentorship and research, and engage in sharing mathematics with my new community.

In the (virtual) classroom. I incorporate **active learning techniques** as a key part of my instructional style. In a typical lesson, I alternate between modeling problem solving at the board and active components, namely independent and group work followed by a discussion of the students' solutions and the challenges they faced. This approach allows students to receive rapid feedback from myself and each other, helping them identify what they should be focusing on when working outside of class.

When courses moved online in the 2020 – 2021 academic year, transitioning this approach to the virtual setting came with challenges. Zoom breakout rooms, which I initially employed frequently to simulate group problem solving discussions, were polarizing among the students, as I learned from the mid- and end-semester surveys I sent out to determine which techniques they found most effective for their learning. I also made use of Zoom polls, both to review previous material and for warm up questions at the start of each class. Having these regular, anonymous formative assessments helped me to see where my students were at, and students shared that they appreciated the instant feedback they received.

Essential to my teaching style are **thoughtfully chosen examples**. When selecting problems to work out in class and crafting worksheets, I deliberately choose a diverse selection of topics and problem types in order to maximize the ability for each student to relate to the content. I also consider that my students may have a different background than mine or one another, and aim to avoid problems that assume specific contextual knowledge that students may lack. For one calculus lesson on viewing the derivative as a function, I presented a topic relevant to all college students: university tuition costs. From an exponential model, which I built from actual data, I asked students to compute and reason with the derivative. I then had them brainstorm further examples on their own and share them with the class, offering an opportunity for them to take ownership of their own examples, while adding to my ever-expanding list to present to future students.

My view that mathematics can and should be accessible to everyone manifests in my enthusiastic teaching style. Especially at the entry undergraduate level, I want to exemplify to my students that math can be as exciting and joyful as it can be useful. This extends beyond classroom demeanor, to making myself available outside of class for one-on-one discussion and conversation, where I learn more about their individual motivations and background, tailoring my strategy accordingly. I received some of my highest average marks on enthusiasm and accessibility outside of class in end-of-semester student evaluations; for Calculus I in Fall 2020 and Spring 2021, I received **8.26 out of 9 for enthusiasm** and **8.39 out of 9 for accessibility for individual discussion** (averaging over 44 student responses). My overall average instructor score was 7.73 out of 9 over these two semesters. You may view some [example asynchronous content](#) I created as well as [selected recorded synchronous sessions](#) at the linked YouTube playlists.

Directed reading program. I am involved in teaching activities outside of the classroom, namely through Emory's directed reading program (DRP). This program, which I started in Spring 2021, brings undergraduate students together with graduate mentors to learn an advanced topic in a more tailored one-on-one or small group setting. In addition, it provides the undergrads with insight into the day-to-day experience of graduate school while cultivating a mentor-mentee relationship that endures beyond the conclusion of the semester. From Spring 2021 through Fall 2022, we have served 35 students in total, covering a wide array of topics, which can be found on [the Emory DRP website](#). I have personally mentored 8 students in reading courses on p -adic numbers, elliptic curves, and sabermetrics — the mathematics of baseball.

My favorite part about mentoring a student in a DRP is the level of personalized guidance I can provide — the entire course can be shaped to the interests of the student. No more is this exemplified than by Ezra, a student who reached out to the DRP wishing to study sports analytics. Since I had little prior experience mentoring this topic, I began the semester by sitting down with Ezra to get an idea of his background and goals for the DRP. We found that we shared a lifelong interest in baseball and a desire to understand how events, players, and teams are valued, and he hoped to land a job in sports data analysis. I was then able to find an online university course that included the basics of expected run values and team winning percentage estimators that helped us answer many of our baseball questions. It also covered technical skills like SQL database management that would help to make Ezra more competitive in this field. This experience spurred my own interest in the mathematics of baseball, leading me to write several expository and investigative articles on the subject, which are [available on my website](#). I hope to someday use this experience to develop and teach a special topics or seminar course on the subject.

Math outreach. My outreach experience as a **math circle instructor** at Emory has also helped to shape my approach to teaching. Over seven semesters spanning Fall 2018 – Fall 2022, I served a total of 199 middle and high school students, developing and leading biweekly math exploration activities with my class, and assisting other instructors with their sessions. In August 2022, I also co-organized a [Julia Robinson Math Festival](#). For this one day event attended by about 150 area students and their families, I worked to select and prepare engaging activities, then recruited and trained 15 volunteers to lead them.

A major challenge when designing a lesson for this audience is the variability in abilities and prior knowledge the students possess. In a given class, we might have a student trying math circle for the first time alongside one who excels in math competitions and has already had exposure to algebra and trigonometry at school. To make sure my lesson is maximally impactful for both of those students, I strive to include multiple “jumping in” and “jumping off” points. That is, I shape the lesson so that a student with minimal experience could get started and make meaningful progress, while a more advanced or quicker student will stay engaged throughout the lesson and be challenged by plenty of follow up questions.

One of my favorite lessons I developed for high school math circle students is based on the TV game show *Press Your Luck*. The lesson plan is [available on my website](#). We began by having students play a toy version of the game in small groups with dice, to get a feel for the rules and start building some intuition about strategy. Then, students worked on a worksheet with questions getting at some of the basic probability principles behind the game. For some students this proved a sufficient challenge, and I was happy to see them come out of the lesson understanding that the likelihood of something happening at least once is complementary to it never happening at all. For the others, we encouraged them to go further, for example by considering how to calculate the expected value of each roll when the outcomes depend on the player’s starting conditions. Students could then use this to devise an optimal strategy when starting with a fixed number of rolls, or investigating how rule changes impact this strategy. I particularly enjoyed this lesson, because it exemplifies the active participation and accessibility for a variety of backgrounds that I seek to incorporate in both my math circle sessions and undergraduate classes.

Future goals. In my next position, I look forward to gathering a wider range of teaching experience, expanding my repertoire of courses taught beyond calculus. In particular, I am eager for the challenge of teaching a first course in proofs, with the goal of guiding students from being technicians, knowledgeable in the manipulations of (differential, integral, or matrix) equations, to becoming effective communicators of mathematics. I would also enjoy the opportunity to develop a topics course on the mathematics of baseball, building on my DRP experience to deliver a fun and engaging class at a level appropriate for math majors and non-majors alike.

Outside of the classroom, I hope to continue finding opportunities to mentor undergraduates through reading courses and by supervising research, whether independent or through an REU. My one-on-one mentoring experience through the DRP will help me to be an effective leader and my broad [research program](#) offers several opportunities for undergraduate involvement; see §5 of my [research statement](#) for examples.

In addition, I plan to further my demonstrated commitment to the community at my home institution and beyond. This could look like participating in existing mathematics outreach programs, such as math circles, or if no such opportunities exist, organizing them myself.