

TEACHING STATEMENT — CHRISTOPHER KEYES

christopher.keyes@kcl.ac.uk
<https://c-keyes.github.io/>

Overview. My goal in communicating mathematics is to make it accessible and relatable to students. I believe that math should resonate with their experiences and feel relevant to their lives. To achieve this, I prioritize active learning, incorporate diverse and meaningful examples, and bring genuine enthusiasm into every lesson. This teaching philosophy has been shaped by my experience as an instructor of record for two semesters of Calculus I and as a teaching assistant for two semesters of Linear Algebra at Emory University. It has also been informed by my activities outside the classroom, as an Math Circle instructor in the Atlanta community and as an organizer and mentor for Emory's Directed Reading Program. I am eager to return to the classroom in my next position, where I will improve my instruction through teaching and developing a broader range of courses, and to contribute to my new community as a mentor and a leader.

In the classroom. I incorporate **active learning techniques** as a key part of my instructional style. In a typical lesson, I like to 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 response to the Covid-19 pandemic, I had to transition my approach to the virtual classroom. This came with challenges, especially since I was preparing to teach Calculus I as an instructor of record for the first time. Like many faculty during this time, I experimented with different virtual features and used student feedback to help determine what was most effective. Initially, I frequently used Zoom breakout rooms to simulate small group problem solving discussions. As I learned from mid- and end-of-semester surveys I sent the students, these were polarizing, with some students finding them highly effective and others least effective. Zoom's poll functionality proved universally popular, which I used both to review previous material and for warm up questions at the start of each class. Having regular, anonymous formative assessments helped me to see where my students were at, and students shared that they appreciated the instant feedback they received. While I'm not eager to go back to the uncertain times of the pandemic, it made me a more effective instructor by forcing me to adapt and respond to promptly to student feedback.

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 for 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). The full evaluations for [Fall 2020](#) and [Spring 2021](#) are available on my website. Also available is [sample asynchronous content](#) I created as well as [selected recorded synchronous sessions](#) at the linked YouTube playlists.

Math circle influence. My outreach experience as a **math circle instructor** at Emory has also helped to shape my approach to teaching. Over eight semesters spanning Fall 2018 – Spring 2023, 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 possessed by the students. 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, [available on my website](#), begins with students playing 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 then used their answer to devise an optimal strategy for the game and investigated how rule changes would impact their strategies. I particularly enjoyed this lesson, because it exemplifies the active participation and accessibility for a variety of backgrounds that I seek to incorporate, both my math circle sessions and undergraduate classes.

Directed reading and mentorship. In Spring 2021, I founded a Directed Reading Program (DRP) at Emory University, which brings undergraduate students together with graduate mentors to learn an advanced topic. In addition, it provides the undergraduates 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 my graduation in Spring 2023, the program served 46 students in total, and it continues to this day. 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 envision using this experience to develop and teach a course on sabermetrics, intended to serve as an introduction to the applicability of mathematics to everyday life.

Future goals. I am eager to expand my teaching portfolio and to broaden the range of courses I can offer. To that end, I am preparing to lead an advanced graduate topics course in Arithmetic Statistics for the London Taught Course Center in Spring 2025. I am excited about the challenge of connecting to a different type of student and tailoring a course to match their specific interests. This experience will be invaluable to me as I move forward in my career, where I will continue to find opportunities to teach a wide variety of courses and students.

I am also enthusiastic about mentoring students who are seeking to engage with research and scholarship. My research interests in number theory and arithmetic geometry are broad and offer several accessible points of entry for undergraduates (please see my [research statement](#) for specifics). Drawing on my one-on-one mentoring experience through the Directed Reading Program, I will find projects to challenge them and further accelerate their growth as problem solvers, opening the door to the exciting possibilities of mathematical research.