The Early Career Section offers information and suggestions for graduate students, job seekers, early career academics of all types, and those who mentor them. Angela Gibney serves as the editor of this section. Next month's theme will be dealing with challenging issues.

Communicating Mathematics

Math Under a Minute

Izzet Coskun

The party was rowdy, lousy with graduate students. I found myself in a corner next to a guy from the business school and his somewhat silent sidekick. He asked me what I do. You know how it goes: "I'm in math." "What kind of math?" "Algebraic geometry—I solve polynomial equations using geometry and symmetry." "Is that useful for anything?" After mention of physics, economics, computer science, … "Yes, but what do you study?" he demanded.

I didn't think about this at the time, but of course a person you meet at a party in grad school may end up with a job where they play a role in deciding on funding for the National Science Foundation, or have an impact on mathematics in some other capacity. Maybe they'll have a talented kid and think about encouraging them to study mathematics.

I tried to get through it. I told him that I study the geometry of spaces with lots of symmetries. That a good example is the sphere. Under rotation, any point on the sphere looks like any other point. I pantomimed rotating a sphere. "Homogeneous spaces are higher dimensional analogues that similarly have a large symmetry group so that every point looks like every other point. I study the geometry of these spaces." He leaned closer. I could smell the alcohol on his breath. "What do you want to know about these spaces?" I continued with my account: "I count spheres on these spaces that satisfy constraints like passing through a set of points." He didn't really believe me—he asked me why I wouldn't tell him what I really do. "Do you think I won't understand?" I gave in, admitting the truth: "I study the genus zero Gromov-Witten invariants of homogeneous varieties like Grassmannians using degenerations of scrolls." I could see his arm muscles tense, fists ball up. I thought he would lunge at me. His sidekick, quiet before, intervened to suggest they go and get a beer, ending my misery.

It turned out OK that night; I didn't get punched. There is, of course, no irony in that years later I find myself giving advice on how to communicate mathematics quickly in informal settings.

Whether before a promotion committee, at a party where one might meet future politicians or future parents of future colleagues, in the elevator on the way up to tea, or in the dean's office at a job interview, we often have the opportunity to explain our work to a general audience. The time we have is usually short (even my parents will edge their way to the dance floor after listening to me for fifteen minutes on higher codimension cycles). Our audience will not be familiar with our terminology. Communicating mathematics in such settings is challenging.

Try to be engaging and present your material at an accessible level. Avoid jargon and give the basic ideas with technical details appropriate to the situation. To explain specializations in algebraic geometry at a holiday party at my wife's law firm, I might say something like

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"Specialization is the art of simplifying a problem until you solve it." If pressed I may add that you can vary polynomial systems by changing the coefficients of the defining polynomials. "The system might be easier to solve for some special coefficients—for example, if many of the terms of the polynomials are zero. I study how geometric properties of a complicated system can be deduced by studying simpler systems." I avoid any mention of flatness or schemes.

A simple example often conveys what we do more effectively than our latest technical progress. I once gave a one-minute presentation on my work at a Kavli Symposium of the National Academy of Sciences to a group of accomplished young scientists. I spoke about the problem of using specialization to find the number of lines intersecting four general lines in space. I asked the audience to visualize the problem and then I showed them a movie of the specialization. When two of four lines intersect, finding the two solutions is relatively easy and the audience was comfortable with it. By the time I said that I study higher dimensional analogues of this problem, my minute was up.

Pictures are potent communication devices. We can all be envious of colleagues who study complex dynamics and can show beautiful renditions of Mandelbrot or Julia sets, especially ones with names like Basilica, Rabbit, Airplane...

Catchy phrases can be effective in describing one's work. These evoke the main idea of the proof or the essence of an object at hand. "The dog on the leash theorem" or "train tracks" are good examples. Such slogans call to mind an idea, avoiding the accompanying long explanation.

Even if we find it hard to describe our most recent results, we can try alternatives that convey aspects of it. Applications, even if not implied directly by our own work, can be illustrative. We can explain a simple toy problem, even when this problem does not exhibit the main technical difficulties we face.

It can be fun to bring up certain problems, especially those you know may elicit strong reactions or whose solutions are counterintuitive. I have had spirited arguments over the Monty Hall problem. When people get upset, try not to lose your cool, acknowledge the solution may appear unreasonable at first glance, discuss more intuitive variants.

It is of course always important to be respectful of people. Most will have had a brief and often fraught exposure to mathematics. Nevertheless, they are often genuinely interested in hearing about the work that we do and will make a good faith effort to understand what we tell them.

Do not appear arrogant, condescending, or not willing to try. While sometimes we find ourselves at a party with a drunk jerk who isn't going to remember what we tell them anyway, most of the time there is an opportunity for honest communication. With some forethought, there is no need to switch to physics to do a reasonable job!

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Credit

Author photo is by Micah Block Weiss.

Communicating Mathematics Using Social Media

David Richeson

In the June/July 2019 Early Career column, Holly Krieger wrote about the importance of creating a high-quality online presence before entering the academic job market ([Kri19]). I agree wholeheartedly with her recommendations, but she focused mainly on what once was described as "Web 1.0." Approximately two decades ago, "Web 2.0," the participatory web, was born. In this article, I argue that mathematicians should take advantage of the interactive nature of the web and build an online network of colleagues, collaborators, mentors, and friends.

Social media sites are ubiquitous on the internet. We share photos of our kids on Facebook. Our pets and our food look great on Instagram. We argue about the day's political news on Twitter. We comment on how to fix a broken dishwasher on YouTube. But we can also use social media to communicate about mathematics and the profession.

Like many mathematicians, I find social media to be an essential part of my career. I have a blog, `divisbyzero.com`, and I am active on Twitter, where I am @divbyzero (see [Ric17]). I use social media for professional networking, for learning new mathematics, for improving my teaching, for learning about the pressing social issues in academia, and for having fun.

When I was asked to write this piece on communicating mathematics via social media, I knew exactly what I had to do: ask my Twitter followers what I should include in the article. Within moments, replies flooded in. What follows are my impressions of the benefits of having a professional

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