G-TEAMS: Perspectives on Secondary Mathematics

Department of Mathematics, University of Arizona, Tucson, Arizona

Institute for Mathematics & Education

THE UNIVERSITY OF ARIZONA.

G-TEAMS fellows bring their mathematical expertise into K-12 classrooms in a year-long partnership with local mathematics teachers. The goals of the program include: (i) introducing mathematical thinking to K-12 students; (ii) enriching curriculum possibilities for K-12 teachers; (iii) strengthening fellows' ability to communicate mathematical ideas to non-mathematician audiences; and (iv) introducing mathematical modeling techniques to K-12 students in order to enhance their appreciation for the role of mathematics in other disciplines.

In striving to achieve these goals, fellows have to overcome several challenges, such as: (i) discussing abstract mathematical research using limited mathematical content while still remaining faithful to the key ideas; (ii) engaging high school upperclassmen in original problem solving and changing their mindset about learning and exploring mathematics; and (iii) capturing and maintaining the attention of middle school students, particularly in math intervention classes for low achieving students.

The nine G-TEAMS fellows, whose research interests vary from applied mathematics to abstract algebra, are working in partnerships in Tucson and Casa Grande, Arizona at three elementary schools, two middle schools, and four high schools.

Matthew Lafferty, PhD Student in Mathematics
Jennifer Gould, 6th through 8th Grade Math Teacher

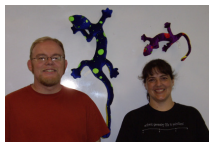
Matt's Research Interests: Number Theory

School: St. Michael's Parish Day School, Tucson, AZ

G-Teams Goals: Mrs. Gould and I are hoping to introduce concepts and lessons that will challenge mathematically inclined students, pique the curiosity of students that were previously uninterested in mathematics, and expand the students overall idea of what mathematics is.

What Matt Learned	What Jennifer Learned
•How to build off the intuitions of the student when introducing a new concept. • How to create and maintain interest when presenting mathematics to a non-mathematician audience. • How to structure a lesson so that the students can, as much as possible, discover the concepts for themselves. • How to better answer questions on the fly, by first asking them to clarify where their misunderstanding is occurring and then having the patience to guide them through the problem while injecting as little as possible. • Many creative and interesting ways of looking at mathematical concepts I had long since taken for granted.	•The importance of weaving real-world math applications into the curriculum • I have also learned a lot during math circles. Allowing the students' questions to lead each session has been eye-opening. Math Club has shown me that it is often more meaningful to allow them to struggle with the math and to reach their own understanding before presenting them with a set of steps to follow • I have discovered how excited the kids are to hear about mathematicians. I will continue to place some names and faces with the work that we do. I love that my 6th graders will say that they are "Gaussing" a problem as if the word is a verb. When they say that they've "Gaussed", it means that they have been creative and thought outside of the box to solve a problem without "brute force."

Michael Bishop, PhD Student in Mathematics
Lisette Eckman, Geometry and College Algebra Teacher



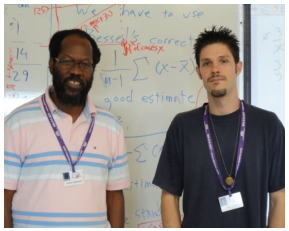
Michaael's Research Interests: Probability, Mathematical Physics

School: Tucson High School, Tucson, AZ

G-Teams Goals: Our goals are to present mathematical ideas and problems in a way that piques the student's interest in the topic and challenges him or her to work hard in understanding the problem, solving the problem, and sharing the solution with others.

What Michael Learned	What Lisette Learned
•Students need activities and real-world settings to help connect abstract concepts to their tangible experiences. •Teaching in small groups and one-on-one is much more helpful for the students and gives instructors much better feedback on students abilities. Being able to help students while Ms. Eckman taught was extremely productive. •No matter what is being taught, students need ready access to earlier mathematical skills and ideas to succeed in more advanced courses. When students lack basic skills with fractions and algebra, later courses become much more difficult. •Bad attitudes about education impede and prevent effective teaching and learning. This proved to be a larger obstacle than I first anticipated.	•There are many practical ways to bring real-world applications into the classroom. We all know that students become more engaged in the lessons if they are real-world orientated, and having Michael around has created an opportunity to do more with that. •How to work effectively with a co-teacher. Creating a 'tag-team' teaching environment has helped the students develop their own skills in group work. •Being able to brainstorm ideas on the best way to approach a topic is easier when there is someone to bounce the ideas off of. •My students seem to respond better to the lessons when we are teaching together, as opposed to when there is a single teacher in the room.

Jordan Schettler, PhD Student in Mathematics
Charles Collingwood, Pre-Calculus and Statistics Teacher



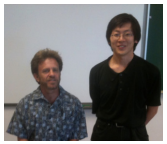
Jordan's Research Interests: Iwasawa Theory

School: Rincon High School , Tucson, AZ

G-Teams Goals: We have a deeply motivated interest in improving math and science education in a wonderful country which is woefully behind other developed nations in those areas. The common themes we'll try to incorporate are social justice, environmental responsibility, current scientific research (particularly involving mathematical modeling), and those things in life which are just inherently interesting (like black holes or transcendental numbers, for example). Generally speaking, the culture of math in this country is troubling. There is fear, dislike, and an attitude of accepting mediocrity. We'd like to be part of changing perceptions of what math is and how math should be taught.

What Jordan Learned	What Charles Learned
•I've learned a ton from Charles about communication, community, and commitment. •Talking to students and developing a relationship conducive to a healthy classroom is a non-trivial task. Charles pulls it off brilliantly: he lets students be themselves but also holds them accountable for their assignments. •He also communicates on a personal level very well. This makes lesson planning and collaboration very smooth. •Charles has a very grounded teaching style. He runs project based classes which emphasize real world applications that study social justice and environmental responsibility.	•Jordan is able to expound on very important concepts in the classroom to deepen mathematical understanding. •He gives an extra pair of eyes and ears to the teaching environment. •Jordan helps in creating awesome lessons and projects like our Dyson Air-Blade lab, the Cygnus X-1 black holes lab, using the binomial distribution to study over/under-representation. •Together, we spend Thursdays after school holding problem sessions for our AP calculus class. We bring pizza and work on problems from previous years' exam. We even made T-shirts for our calc students.

Qiyam Tung, PhD Student in Computer Science
Michael Herzog, High/Middle School Math Teacher



Qiyam's Research Interests: Computer Science with a focus on Computer Vision applications

School: St. Gregory College Preparatory School, Tucson, AZ

G-Teams Goals: To teach students how to think logically and coherently and to be able to model real world phenomena.

What Qiyam Learned	What Michael Learned
• Being bold in trying a new idea (i.e. programming in classes) • Using every possible tool to teach the student. • Creating useful activities/projects that gives the students' the ability to really test their knowledge of mathematics.	• How valuable it is to have another adult in the classroom to be a critical eye on both our teaching and the students attention and their learning. • The importance of teaching for deeper understanding. • Making connections with the students interests.

Part of learning mathematics is learning how to convert a vague notion or idea into a concrete statement that can be evaluated. Learning to program on a computer can help students practice this skill.

Chantel C. Blackburn, PhD Student in Mathematics
Lorraine Kaldman, 7th Grade Math Teacher

Valentine's Day provided a nice opportunity to learn together: Lorraine used her creativity to engage students in a Valentine's themed activity while Chantel helped to refine the mathematical investigation about ratios and proportions.

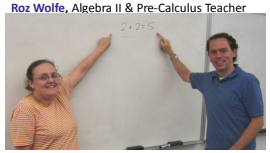
Chantel's Research Interests: Mathematics Education, Computational Group Theory

School: Safford Middle School, Tucson, AZ

G-TEAMS Goals: Develop positive attitudes in students toward mathematics. Develop mathematical thinking and reasoning in students. Broaden students' understanding of just what mathematics is: it is more about a way of thinking than doing calculations and that most of all it is just plain fun!

What Chantel Learned	What Lorraine Learned
•Working with an experienced teacher has been a very valuable experience for me. I've learned a lot about interacting with students as I see her skill at engaging students and asking questions in ways that students understand. • I've learned that what I think is fun is pretty different from what is fun for a 7th grader! • I have realized that sometimes hearing students complain about the mathematics being hard doesn't mean that they aren't working. Sometimes they are, and when they conquer the challenge, they can actually get excited! • Sometimes when students "don't know where to start" it is because their focus is on the parts of a problem they don't understand and not the parts they do.	•Having a graduate student in the classroom has been double rewarding one for myself and the other for the students. The knowledge possessed by the graduate student and the ability to transfer it to the students and myself has enhanced the curriculum in a way that normally would not have happened. • Connections are being made from one concept to another. • Topics are being introduced in a way that expresses the "why" of certain algorithms such as why we move the decimal two places when we find 10% of something. • One of the most important ideas being expressed is that math is like a game with rules to follow.

David Love , PhD Student in Applied Mathematics
Roz Wolfe, Algebra II & Pre-Calculus Teacher



David's Research Interests: Stochastic Programming

School: City High School, Tucson, AZ

G-Teams Goals: Our team goal is to present mathematics as a human enterprise that we have engaged in since the dawn of civilization. We aspire to include discussions of the origin and evolution of as many topics as possible, and consider their historical uses when devising student activities.

What David Learned	What Roz Learned
•Having students apply techniques to their own questions, problems, or data sets greatly promotes learning and retention. •Teachers can bring research into the classroom simply by presenting the students with a problem they don't know how to handle and giving them to freedom to go somewhere with it. •Sometimes, a grad student's ideas about mathematics, acquired over many years of school fall apart when examined.	•One thing that I've learned is how high school math needs reform. There have been a few times we look at each other and wonder why a particular skill is taught but we can't find a real life application or use in upper level mathematics for that skill. •G-TEAMS has allowed me to gain perspective. Watching David teach helps me see other ways to present a problem that I wouldn't have thought of before. •I also like the insight into the history and rationale for some content that David brings to the classroom. This allows the students to gain understanding and appreciation for mathematics.

The most striking (and thrilling) aspect of working with uncertainty is how often our intuition fails us. I bring this into the classroom by showing how our intuition can fail, and thus the need for a rigorous study of uncertainty.