G-TEAMS: Graduate Students and Teachers Engaging in Mathematical Sciences

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

**Chantel Blackburn**

**Teacher Partner**: Janet Liston at Cholla High Magnet School

**Challenge:** Truthfully representing mathematics to high school students without being too technical

**Solution:** Connect the mathematics to something tangible and introduce ideas in small pieces

**Example:** Deriving a discrete Ricker population model with survival from assumptions about flour beetle populations.

**Outcome:** Students think about assumptions and how parameters affect function behavior for exponential growth/day word problems instead of "just knowing how to start."

**Matt Thomas**

**Teacher Partner**: John Willy at Tucson High Magnet School

**Challenge:** Show students how mathematics is a current and growing field

**Solution:** Exploring the idea of conjecture

**Example:** The Collatz conjecture. Define $a_{n+1} = \begin{cases} \frac{a_n}{2} & \text{if } a_n \text{ is even} \\ 3a_n + 1 & \text{if } a_n \text{ is odd} \end{cases}$, if $a_1$ is odd, the sequence generated eventually winds up in a pattern of $4 \rightarrow 2 \rightarrow 1$. If $a_1$ is even, it may take more steps. We discussed what would be needed to show the conjecture false, or what would be needed to show the conjecture true. Following this, we discussed Polya's conjecture. It was shown to be false in 1996. The smallest counterexample, however, is 9,018,537.

**Outcome:** This illustrated to many of the students just how transformative intuition and experimental evidence can be when making general claims. I learned from this process how difficult these kinds of lessons can be.

**Victor Piercey**

**Teacher Partner:** Connie Dolalez at Casa Grande Union High School

**Challenge:** Have disinterested students thinking mathematically

**Solution:** Brief question during otherwise "ordinary" discussion

**Example:** The question "why" following definition:

**Outcome:** A brief, surprisingly lively discussion

**Megan Alexander**

**Teacher Partners:** Christy Erickson and Briana Gryzynier at Gale Elementary School

**Challenge:** Engaging 25 first graders for any length of time, addressing greatly varying levels of ability

**Solution:** Keeping to a minimum, incorporate a hands-on activity or exciting interaction with every math lesson; have the highest level learners help others when they finish early

**Example:** Use toy fishing rods with magnets and paperclips on the fish to allow the students to actually "go fishing", then measure each fish to fill "keepers."

**Outcome:** Students adapting examples to solve unfamiliar problems

**Brenae Bailey**

**Teacher Partner:** Amruto Velásquez at Wakefield Middle School

**Challenge:** Engage low-achieving students in Math Intervention classes

**Solution:** Do hands-on activities in small groups

**Examples:**

- Making patterns with sets of tiles—exploring symmetry, comparing areas in terms of simple fractions
- Drawing Poisson stars—understanding combinations and statistics, connections to the art of M. C. Escher
- Solving probability problems

**Outcome:** Most students are interested and engaged in the activities for at least half of the class period. While I have one group, Mr. Velásquez can work more effectively on the regular/union with the rest of the students in the class. I hope that these activities will provide some "mental Vitamin" to help the students remember the related math concepts when they see them again in more formal lessons.

**Grant Peterson**

**Teacher Partner**: Mark Sommers at Mansfield Middle School

**Challenge:** Classroom discipline and getting eighth grade students to be engaged

**Solution:** Design as many hands-on, moving around, doing something activities as we can

**Example:** Calculate the height of a lamp post or flagpole by using similar triangles. Students measure their own height, the length of their shadow and the length of the shadow of the flagpole.

**Outcome:** The students were genuinely engaged. They did what we asked of them and seemed to enjoy and care about the problem. It is our hope that in a future lesson, linking our discussion to the memory of this activity will bring the idea of congruent and similar triangles back into focus.