

JMM 2018

Alliance of Indigenous Math Circles

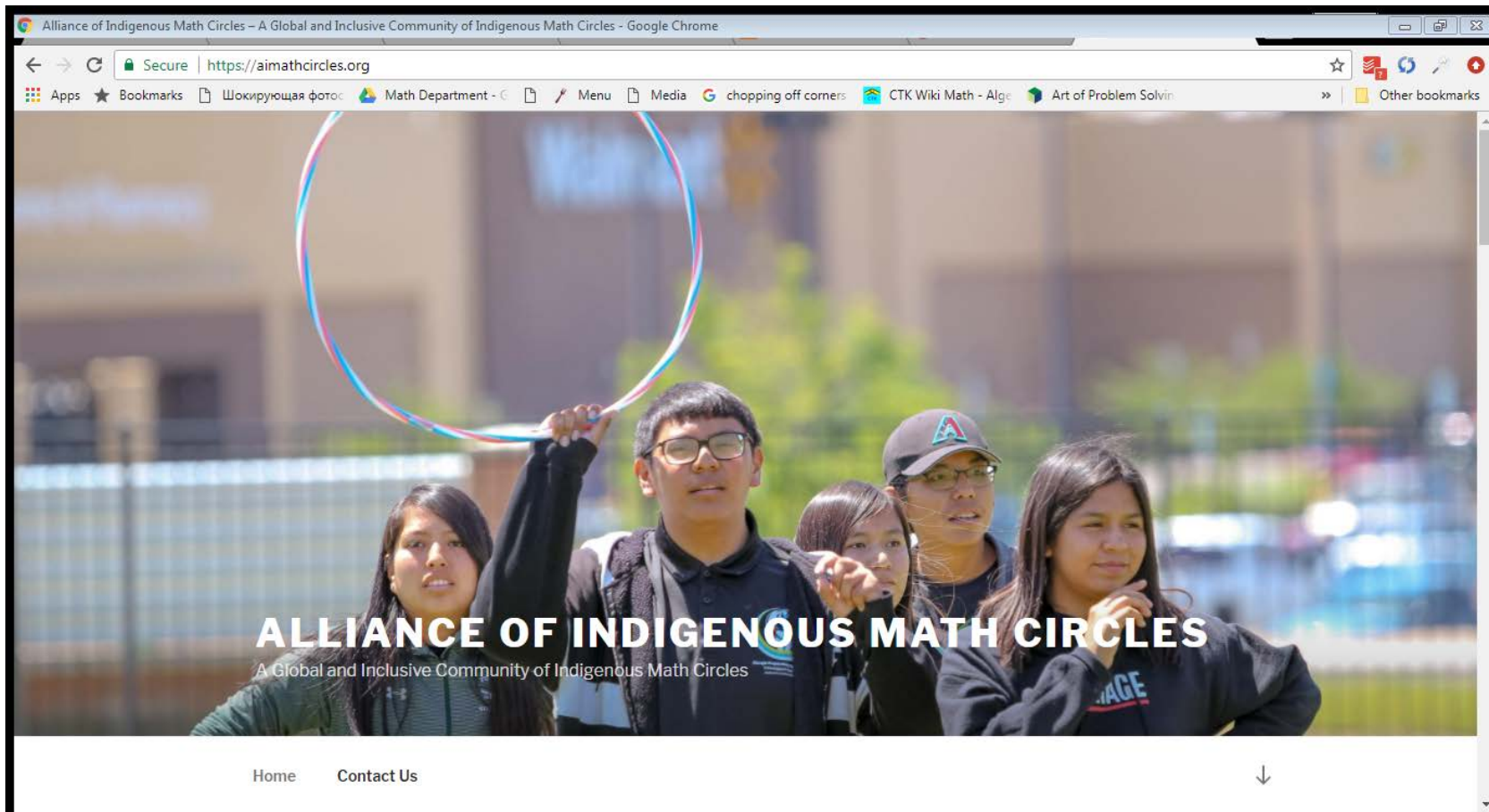
Henry Fowler
Diné College, AZ

Bob Klein
Ohio University, OH

Amanda Serenevy
Riverbend Community Math
Center, IN

Tatiana Shubin
San Jose State University, CA
tatiana.shubin@sjsu.edu

The **Alliance of Indigenous Math Circles** (AIMC <https://aimathcircles.org/>), is an initiative that grows out of the five-year old Navajo Nation Math Circles project.



Navajo Nation Math Circles (NNMC) project launched in 2012 has demonstrated that math circles model can be successfully implemented and used by Native American communities.

In fact, through the years the project has grown in numbers and complexity – now it has many components such as

- math circles for K-12 grade students,
- summer camps for 6-12 grade students,
- professional development workshops and
- mentoring program for K-12 grade teachers



BY THE NUMBERS...

- >40 mathematicians have contributed (thanks!)
- >2000 students impacted
- > 250 teachers impacted
- 15 math majors at Diné College (before NNMC: 0)
- >\$200K support (thanks!)



To learn more about NNMC see the film

Navajo Math Circles

by George Csicsery

<http://www.zalafilms.com/navajo/>

EIGHT COMPONENTS OF THE PROJECT:

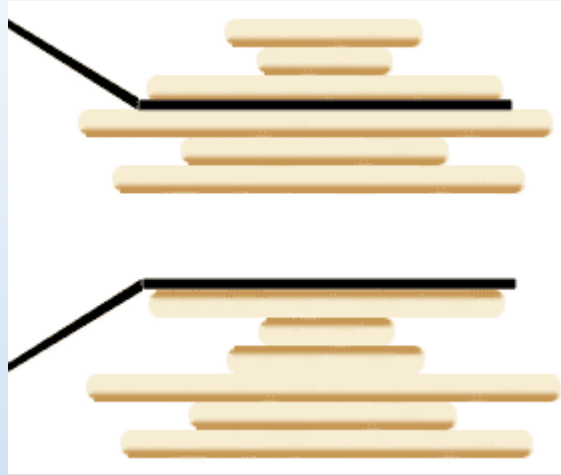
1. Mathematical visitor program
2. Math summer camps
3. Math festivals
4. Teacher PD workshops
5. Teacher mentoring program
6. Teacher development program
7. Math Teachers' Circles
8. Teacher-led math circles for students

Mathematical Circles

are a form of educational enrichment that brings mathematicians and mathematical scientists into direct contact with diverse communities to deepen their understanding and enjoyment of mathematics.

Groups gather to explore challenging mathematical questions in a supportive environment. This form of math enrichment has been around for more than a century in most East European countries and close to 20 years in the US, and *it has a proven record of success.*

When the chef at the MathCircular cafe prepares a stack of pancakes they come out all different sizes and the chef tosses them directly from the griddle onto the plate. The waiter delivering the pancakes tries to rearrange the stacks on his way out of the kitchen, but since he is holding the plate in one hand and the spatula in the other, he is only able to make one type of move in order to adjust the stack: he can stick the spatula somewhere in the stack and flip, in one motion, everything that sits above the spatula. If there are n pancakes, what is the maximum number of flips (as a function $f(n)$ of n) that will ever have to be used to rearrange them?



The spatula is flipping over the top three pancakes, with the result seen below.

This problem is sometimes called the **Pancake Problem**, and it is the subject of the 1979 paper

Bounds for Sorting by Prefix Reversal by **William H. Gates** and **Christos H. Papadimitriou**.

Their paper, which is the only well-known mathematical publication by Microsoft founder Bill Gates.

Sorting pancakes with Bill Gates



$$f(n) \leq (5n + 5)/3;$$

$$(3n/2) - 1 \leq g(n) \leq 2n + 3$$

Since its publication it has received about 300 citations on scholar.google.com

The papers that cite Gates and Papadimitriou include papers on

- **group theory,**
- **electrical engineering,**
- **computer science, and**
- **genomics.**

The problem of finding the exact value of $f(n)$ is still open.

Maybe some of the AIMC students will solve it!

Math Circle sessions provide participants with opportunities to discover mathematical facts and theories, **to ask and answer their own** – sometimes deep and always exciting – **questions.**



Math Summer Camps

2013 – 2017

Dine College, Tsaile, AZ



2017

Navajo Prep, Farmington, NM



LAUNDRY LIST FOR A SUCCESSFUL MATH CAMP:

MATH

TEAM-BUILDING ACTIVITIES:

Cultural sessions

Camping out

Math Wrangle

MORE MATH



Cultural activities





Physical activities



MATH WRANGLE – a new competition type:

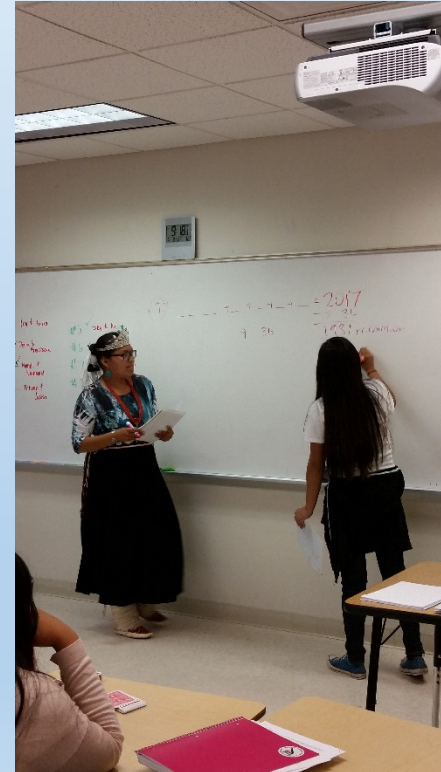
- Solving hard problems
- Team work
- Strategic game
- Presenting solution orally
- Listening other team's presentation and criticizing it
- Theatrical performance

AIMC Math Camp, May 30-June 3, 2017, Navajo Prep School

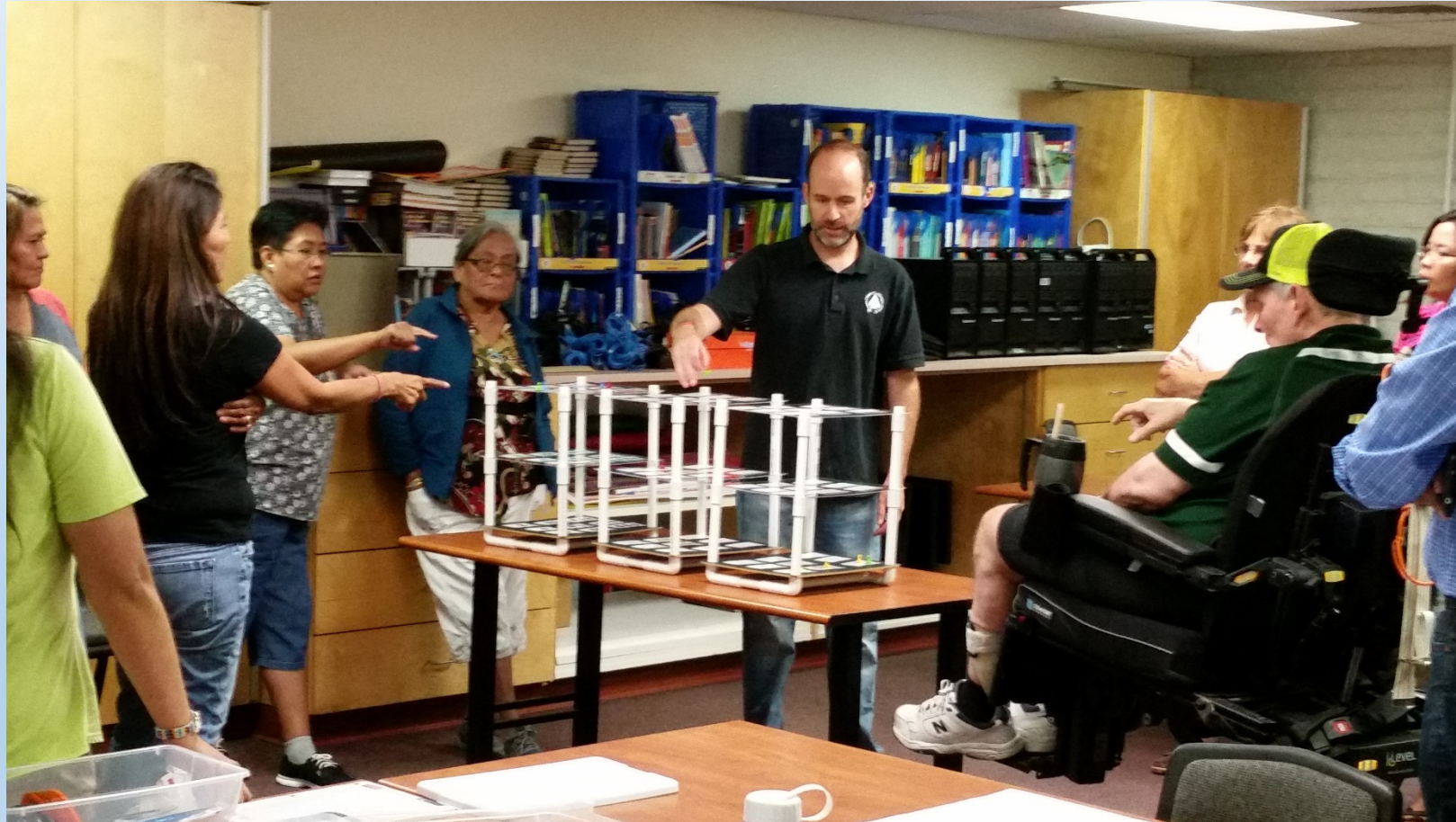
Math Wrangle preparation



Presenting at the Math Wrangle



Math Teachers' Circle (MTC) – same fun for teachers
July 13-15, 2017, Tuba City



“I got to realize that my love for math can take me places.”

Irvilinda Bahe,

Student,
Navajo Prep School,
Farmington, NM



AIMC immediate future sites:

- **Arizona: Hopi Tribe**
- **Oklahoma: Choctaw Nation of Oklahoma
Chickasaw Nation**
- **Montana: Blackfeet Tribe**

AIMC's goal is to help communities to grow and sustain math circles for students and teachers, and to support other related practices such as math summer camps and math festivals.

Contact us at

aimathcircle@gmail.com

Since 2012, we have had many sponsors. The major sponsors include:

- National Science Foundation (has supported NNMC)
- National Security Agency (has supported NNMC)
- AIMC has become possible through the generous support provided by the Carnegie Corporation of New York.

THANK YOU!