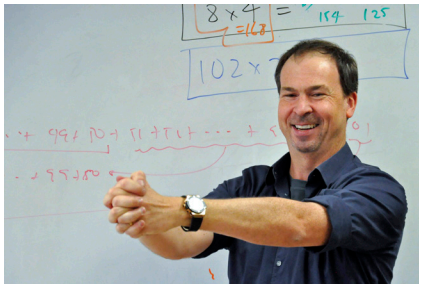
NAVAJO MATH CIRCLES

VIEWER DISCUSSION GUIDE



Top: James Tanton leads a math circle for teachers at a Diné College workshop.

Above: Irvilinda Bahe and Charmayne Seaton work together on a math problem at a Math Camp session held at Diné College in Tsaile, Arizona.

Right: Irvilinda Bahe, Natanii Yazzie, and Charmayne Seaton are on the same team during the Math Wrangle at the end of the week. Photos by George Csicsery

Program Synopsis

Navajo Math Circles follows Navajo students in a lively collaboration with mathematicians. Using a model called math circles, the students stay late after school and assemble over the summer at Diné College in Tsaile, Arizona, to study mathematics. The math circles approach emphasizes open-ended problems, where students are encouraged to explore questions in mathematics to their own joy and satisfaction.

The documentary reveals the challenges in education on the Navajo Nation and looks at the benefits—both in student skills and in student attitudes—of this way of teaching mathematics. The Navajo Math Circles project also summons applications of math in Native culture to provide tools for increasing math literacy and highlights the special connections between Navajo culture, natural beauty and mathematics. The film shows how math circles help raise the hopes of parents, students and teachers for a brighter future.

The producer, George Csicsery, has been a writer and independent filmmaker since 1968. He has directed 32 films—dramatic shorts, performance films and documentaries. Csicsery received the 2009 Joint Policy Board for Mathematics (JPBM) Communications Award for bringing mathematics to non-mathematical audiences.

In Their Words

"Mathematics is very close to Navajo culture. Both things are deeply rooted in the love of beauty."

— Tatiana Shubin

The Navajo Nation extends into the states of Utah, Arizona and New Mexico, covering 27,000 square miles (larger than the size of West Virginia).

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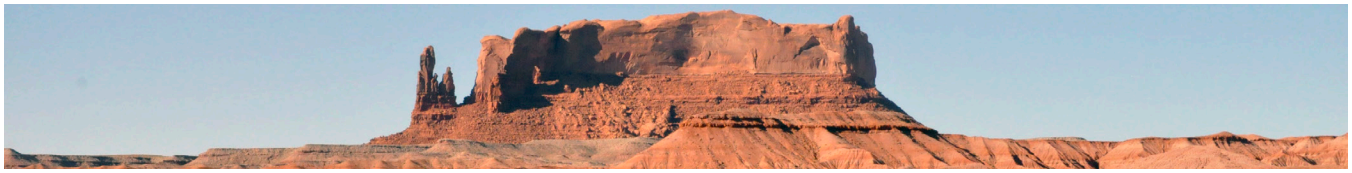
Educator's Comment

Henry Fowler

"I became a teacher first at Red Mesa Unified School District in the Navajo Nation near the Four Corners. Walking into a real classroom was different than how you're trained in a teacher program. There were absolutely no math textbooks available for me to use. I had to adjust as quickly as I could because these students, they dislike math. That's when I started creating my own cultural math stories for them, designing my own cultural math curriculum for them, to engage them. The more I looked, I said, we want to promote math literacy across Navajo Nation because I care for my Navajo people. I want them to do better in life than me. I want them to go higher than me."

Dawnlei Ben is in charge of the traditional Navajo cultural side of the Math Camp, organizing sessions on Navajo arts, games, language and folklore. Photo by George Csicsery

By the Numbers



Round Rock

1. The concept of math circles was first developed from an Eastern European/Soviet model and was later adapted for use in America, most notably in the San Francisco Bay Area. The model was then brought to the Navajo Nation.

2. The Navajo Nation Math Circles (NNMC) was funded and began in the fall of 2012. The organization is comprised of mathematicians, teachers, students and consultants—all bringing fun and culturally-based mathematics to students.

3. Every summer NNMC holds a two-week nonresidential summer camp for grades 6-12 called Baa Hózhó Summer Camp.

4. The Navajo Math Circles program continues to grow. In the 2014-2015 academic year, it reached 1,800 Navajo students and 250 Navajo teachers, and involved about 40 mathematicians from across the United States.

5. Its impact is felt directly at Diné College. In the fall of 2013, the college offered one section of pre-calculus, with 23 enrolled students. By 2015, it offered pre-calculus to 35 students, calculus to 32 students, linear algebra to six students, and had introduced its first degree program in mathematics education.

6. The Navajo Nation stretches into the states of Utah, New Mexico and Arizona covering 27,000 square miles—an area larger than 10 of the 50 states in America. The population of the Navajo Nation is approximately 250,000.

7. Formerly known as the Navajo Indian Reservation, the tribe was able to officially change their name to Navajo Nation on April 15, 1969.

8. Diné College, a community college, was founded in 1968 and was the first tribally controlled college in the United States. It now includes seven satellite campuses throughout Navajo Nation that serve over 1,800 students.

9. The word "Navajo" can be traced back to the Tewa word "Navahu." "Nava" is believed to be an ancient word for cultivated field and "hu" meaning the mouths of canyons. However, the people refer to themselves as Diné, which means "The People" in their language.

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Michael Begay (center) and teammates huddle for the 2015 Math Wrangle at Math Camp. Photo by George Csicsery

Discussion Questions

1. In the film, *Navajo Math Circles*, careful planning went into how to reconnect math concepts with the natural world. Identify several examples that you recall from watching the film. Then explore and discuss your own thoughts and ideas about how math and nature are connected. Use specific examples when possible.

2. Cultural thinking, worldview and experience are woven into the math circles through the activites, challenges and language exposure. Based on what you heard and saw in the film, how do you think a deep understanding of the Navajo culture supports math learning and vice versa—how can learning math help keep a culture strong?

3. Besides helping students learn and understand mathematics, what other skills did you see the students in Math Camp gain over the course of the camp?

4. School performance is often considered a yardstick that predicts later life outcomes. Based on the student reports within this film, how do you think involvement in the math circles contributes to the students' performance in the regular classroom? What did you observe? Do you think math circles would help students in other cultures improve student learning?

5. Many of the students must travel great distances or overcome other barriers to attend Math Camp. Explore and discuss what you observed or what you think motivates students to attend camp year after year. How do students benefit from the experience?

Suggested Activities

1. A film like *Navajo Math Circles* gives us new insight and understanding about how others within our human family live. Name some of the differences in how life is lived within the Navajo communities and compare and contrast them with your own cultural or social group. How are they the same? How are they different?

2. All cultures of the world have their own religious or mythological cosmology—an understanding of our universe and how we came to be within it. Do research on the Internet or in the library to learn more about the cosmology and the creation story of the Navajo Nation.

3. Choose two to four different cultures that you live within or that are near you. Do similar research into the cosmological beliefs, legends and creation stories of each culture. Then compare and contrast them to the Navajo view or your own cultural cosmology.

4. Achieving high levels of educational competency is an issue nationwide, and Native American students sometimes face even bigger barriers. On the Internet or in the library, discover more about these barriers and student performance within Native American communities. What are the graduation rates? How many go to college? How many drop out? Then identify three different approaches that schools are using to close the gap successfully. What strategies are being developed? How are they working?

5. One segment of the film focuses on the efforts being made to train other teachers to conduct math circles in their schools. Examine how the open-ended structure of the math circle differs from traditional classroom approaches. Be specific and compare and contrast either from your own experience or from what you see happening in our own schools. Then explore the guidelines and steps to starting a math circle within your own community available at http://www.mathcircles.org/content/getting-started-math-circles. In what environment would math circles work best? Who would need to be involved? How would you begin? Who would you bring into your planning group? What resources would you need to offer math circles to students?

The Mittens

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Resources

About the film

www.navajomathcirclesfilm.com

About the math circles

Navajo Nation Math Circles https://navajomathcircles.org

New York Times Problem Sample

http://wordplay.blogs.nytimes.com/2014/11/17/navajo/?_r=0

Tatiana Shubin introduced math circles to schools in the Navajo Nations in 2012. She has organized numerous mathematical events and math camps for Navajo children and teachers ever since. Photo by George Csicsery

About the Navajo Nation

http://www.dinecollege.edu/

http://www.navajo-nsn.gov/

http://navajopeople.org/navajo-history.htm

Navajo Nation - http://www.navajo-nsn.gov

At a 2015 math circle session at Diné College, mathematician Joe Buhler works with Dawnae Etsitty on a problem derived from the Pythagorean theorem. Photo by George Csicsery

About Science and Math

American Indian Science and Engineering Society (AISES): http://www.aises.org

Society for Advancement of Hispanics/Chicanos and Native Americans in Science: http://sacnas.org

Mathematical Sciences Research Institute: http://www.msri.org

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This Viewer Discussion Guide was developed by Jamie Lee, an author and former instructor at the Oglala Lakota College, where she taught for five years. Lee has a Master's in Human Development and has been a communications trainer and an educator for the past 30 years. Her stories and articles have appeared in *The South Dakota Review, Winds of Change Magazine* and several other anthologies. She has published three non-fiction books along with one novel and a collection of writings from Oglala Lakota College students. Her first novel, *Washaka: The Bear Dreamer,* was a PEN USA finalist in 2007. Lee has written over 70 documentary programs including Public Radio's landmark 52-part Native music series, *Oyate Ta Olowan: The Songs of the People.*

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Educational resources for this film are available at www.visionmakermedia.org/educators/navajo-math-circles.

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