**President’s Column**

By Jim Barta, NASGEm President

“One Small Thing”

Yearly I travel to the rural village of Santa Avelina in the highlands of Guatemala to partake in professional development with teachers at the William Botnan School. A team of math consultants expert in coaching accompany me for the week long in-service. This summer’s trip was the eighth in a series of continuing efforts to enhance mathematics education at the K – 6 school. It is gratifying to see that the teachers are incorporating what they are learning in their instruction and according to national assessment results, the students at the school are out-performing their peers in non-immersion public schools. I have written before about the school but its uniqueness lies in the fact that it is a “Mayan” immersion school where local students begin their educations in their home language (IXIL) and each year increasingly learn more Spanish. Their language and culture are respected and utilized throughout this orientation to education.

Our math efforts focus on research-based efforts and a heavy emphasis is placed on the relationship between math and culture from a community perspective. In the past weaving and the planting of corn have been two connections used to contextualize the math lessons taught. Making math applicable is a central theme throughout our in-service. Each year I have been fortunate to gather an exemplary team of consultants to accompany me. All consultants are volunteer and self-supporting for the cost of the trip. The living conditions in the village are basic, and consultants usually quickly learn to better appreciate boundless clean water they enjoy back home, quick access to inexpensive and healthy foods, and a high standard of public sanitation.
Team members this year included Linda Gojak, Jennifer Bay-Williams, Susana Davidenko, Jessica Hundson, Daniel Battey, Sandy Hepworth, Luisa Quintana, Kathy Davin, and Julie Barta. Consultants modeled lessons of best practice aligned with the particular curricular needs of the specific teacher with whom they collaborated. They also cooperatively planned, team taught, and participated in a daily activity where consultants and teachers collaboratively worked to solve a rich problem of the day when students were dismissed.

Jennifer shared an insight that grew to become a key part of the theme for our work this summer illustrated in the phrase, “One small thing!” So often when we work to enhance our practice or that of others it seems we think we need to ‘move the mountain’ to show an impact. I know I have been guilty of this kind of thinking. Instead, Jennifer suggested we all agree to strive to do ‘just one small thing’ to change and hopefully improve our teaching. All welcomed this small-scale concept and its effects upon reflection seem powerful. Many felt liberated by the fact that they need not change the (math) world in a week for themselves and rather could try to affect one small component.

In my situation, Luisa and I worked with Orfa who teaches Kindergarten and helped her develop a number of small centers where students could investigate the manipulatives she presented or complete simple tasks she arranged. Students then circulated from center to center investigating activity concepts. Previously Orfa believed the only way to instruct a group was with teacher-led whole group instruction. This did not allow her any time for individual teaching or assessment. Orfa indicated this ‘one small step’ was transformative for her. She could now meaningful engage her students yet call single students or small groups over to work with her individually or to access them.

Dan helped his teacher learn to employ manipulatives more frequently during instruction and engage students in dialogue about what they were learning. One activity had the students estimating how much corn was in a container. Linda used the context of tortillas in her lessons as she and Juan Castro worked with division and decimals as well as the decimal fraction connections. Sandy also incorporated partitioning tortillas in her interactions and Susana included weaving and measurement of fabric. Jennifer focused on the distance traveled to school as students walked to integrate the work she did on fractions.

Evident in each illustration is the use of developing a context so that the math that is being taught has a place and purpose. Consultants agreed that such a seemingly small step as having a context for the math provided a bridge for students to better comprehend its value and utility in their lives. The teachers of Santa Avelina appreciated this insight and several began to infuse a context in what they were planning and teaching.

In this endeavor, I learned sometimes we never really have an impact because I either try to do too much or simply never start because of how daunting a task may seem. Doing ‘one small thing’ is possible for us all. I set a challenge for everyone reading this to consider what ‘small thing’ they may do to enhance their math practice or collaborate with others so that children and their teachers grow to better understand the role of culture and language in teaching and learning.
Yours Truly,
Jim Barta
NASGEm President
Star Quilt Math (Part 2 of 3)
Jennifer Rodin
Oglala Lakota College

We can use art, music and artifacts from cultures all over the world throughout history to explore mathematical concepts. One of my favorite activities is to delve into functions and group theory with a concrete object with which students identify strongly. I will use a Lakota Star Quilt for my example here, but any images that resonate with students will work perfectly.

Examine our image:

This is a finite figure in the plane. A finite figure is any figure that can be contained in some circle of finite radius. Every finite figure has a set of symmetries or isometries, which preserve distance and orientation of the figure. Essentially, “a symmetry is a rigid motion which leaves the figure looking exactly the way it started” (Farmer, 1996). If we were pursuing this investigation in a classroom setting, we would each have a cardboard cutout version of this image, a small mirror, a ruler, a brad or pin, a few colored pencils, some cardstock for mappings and notes, and a protractor. Another term is also used to describe geometric symmetry. Ascher and many text books describe an isometry as a structure preserving mapping; a transformation of the plane which for all points X and Y, the distance between their images X’ and Y’ is equal to the distance between X and Y. “iso-” means “the same”; “-metry” means “measure.” In the case of this finite figure, we also need every point on the original star to be mapped to a corresponding point within the bounds of the image. The isometries of a finite figure such as this star quilt image are reflective (or mirror) symmetry and rotational symmetry.

At this point, we discuss and play with the mirror lines, counting them up, using the mirrors to check them, and convincing each other that there are 8 lines of reflective symmetry. One convention is to label these lines as \( m_1 \) through \( m_8 \), beginning with \( m_1 \) as the vertical line of reflective symmetry, and moving clockwise from there. We discuss the orientation of these lines of symmetry and their relationships with the other mirror lines. We can also calculate and explore the slopes of these lines, check which ones are perpendicular, etc.

To internalize the definition of an isometry, place any two points X and Y on the star. Measure the distance \( XY \). Next, fold your star along mirror line \( m_1 \) and mark with X’ and Y’ the exact points where X and Y get mapped. Measure the distance \( X’Y’ \) to verify that it is equal to the distance \( XY \). It is a good idea to try this activity several times with different mirror lines and with new X and Y points to map. Note that in my previous article in this series, I showed how to overlay a Cartesian grid on an image like this star quilt, in order
to practice using Cartesian Coordinates and the distance formula or the slope formula. As we practice reflecting our images, we discuss whether or not every single mirror line of symmetry will bring us to an image of the star quilt that maintains its original position. This can be a fairly abstract concept, depending on the students’ background in spatial/visual reasoning. A good way to reinforce the concept is to label every point of the star, create a function table where the operation is, for example $m_3$: a reflection across the line $y=x$, and complete the table as a group. Many students are surprised to find that this is in fact a function! We can recall that a function is any relation between two sets, the domain and the codomain, in which every element of the domain has exactly one image in the codomain.

Notice that this table can lead easily to an examination of a closed group, discovery of inverses and the identity element, as well as many other rich and wonderfully advanced topics. In addition, once the topic of single reflections has been sufficiently explored, we can practice creating compositions of reflections such as “First do $m_2$, then do $m_5$.” This is a good opportunity to explore whether or not all compositions of reflections will bring us back to a star which maintains an image of its original orientation. If it does not, then we will fail to maintain closure. The composition of transformations will still be an isometry, by definition, but our finite figure is not mapped to itself on the plane, and thus the set will no longer be closed under this specific operation. The abstract concept of closure of a set under an operation is often difficult for students to grasp; the patient use of concrete images in motion and the creation of tables and mapping diagrams can aid in mastery of the concept.

Similar activities can be carried out with rotational symmetry of a finite figure in the plane. The star quilt has eight angles of rotation which will preserve its structure and map it back onto itself. The first angle is usually called $r_0$, a rotation of $0^\circ$, or the identity element. As a class, we would calculate what the next angle would be. $360^\circ + 8 = 45^\circ$, so together we would find the rotocenter or axis of rotation for our star, and then we would perform a 45 degree rotation in the counterclockwise direction. (Direction is not really important, and varies from text to text, but it is essential to maintain consistency.) We would call this 45 degree rotation $r_1$, and have a discussion to make sure we were convinced that our finite figures looked exactly the way they had originally looked. Sometimes a before and after tracing is a great idea. Here is a table of the mappings of $r_1$ on our star with labels on the previous page:
As a class, we would calculate the degrees of rotation for \( r_2, r_3, r_4, \ldots \) until we arrive at the discovery that \( r_8 \) has the same exact effect as the identity or \( r_0 \). This concept can lead to in depth studies of the identity element, its effect on a set, and topics in modular arithmetic.

We can combine rotations and explore the outcomes. For example, if we perform the transformation of \( r_1 \), and then follow it with \( r_3 \), we will have the same outcome as the single operation of \( r_4 \). We can also clearly see the effect of following a transformation with its inverse, or with the identity. We would try using our stars, with points labeled and a brad to attach the rotocenter to a piece of card stock, to create compositions such as \( r_3 \) followed by \( r_3^{-1} \), or more clearly rotate 45 degrees counterclockwise, and then follow that with a 45 degree clockwise turn. When our star is returned to its exact original position, we get a firm grasp of the linked concepts of inverse and identity.

Rotational symmetry lends itself well to discussions of modular, cyclic or “clock” arithmetic as well as to more explorations of closure and group behavior. A group is a set that is closed under a binary operation and has associativity, an identity, and an inverse for all elements of the group. Familiarity with this area of mathematical thinking will boost students’ confidence and capabilities when they come upon functions, properties, and group theory in their future math travels. Use of concrete familiar images and physical manipulations of objects will enhance meaning for students and provide a platform for further exploration into different images and concepts and three-dimensional reasoning as well. The study of symmetries and behaviors of three dimensional solids is quite complex, leading to applications in fields within Chemistry, Geology, Mathematical Crystallography, and Art, to name a few.

Because it has eight lines of reflective symmetry and eight orders of rotational symmetry, this particular star quilt could be classified as having dihedral symmetry order 8, or more simply, \( D_8 \). However, if time for further investigation allows, we discover that some compositions of mirror and rotational transformations will return us to our originally oriented star, while other will not. This study can become quite complex and deep, a great introduction to abstract algebra. We can build a function multiplication table to display all the combinations of symmetries for the star quilt.

This fairly advanced exploration is best developed gradually by first delving into the symmetries of a monochromatic equilateral triangle. This is the function multiplication table for all the symmetries of the \( D_3 \) equilateral triangle (from Fraleigh, p. 97).

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Think about what the function multiplication table for our \( D_8 \) star quilt would look like! Encouraging students to work out a table for a more sophisticated figure is a good opportunity for enrichment. Another exciting field of study is the research of images from all over the world and then a comparison of their symmetry types. The fact that many Amish quilts have \( D_8 \) symmetry like the Lakota Star Quilts gives rise to an often rousing student discussion about possible reasons why this might be so, what kinds of cultural comparisons or history might
lead to such similarities, and also how, without further analysis, it may just be a coincidence; no grand anthropological or scientific conclusions can be drawn without extensive evidence!

Notice that star quilts may have different color schemes, which will alter their isometries. Now, we can see that a 45-degree rotation will not leave the star looking exactly as it did when it started. Color has an enormous effect on the underlying symmetries of a figure. Numerous further activities can be developed when color plays a role.

Students can explore sophisticated concepts in traditional mathematical fields using images from indigenous or popular culture as vehicles. If students discover or create their own images with which to perform these investigations, the effectiveness of the teaching is likely to have greater impact than it otherwise would have had because of the personal connection the students achieve with the mathematics in context. The ethnomathematics and the academic mathematics complement each other to benefit student learning. Just last week, I asked my Intermediate Algebra class at Oglala Lakota College to email me five photographs or sketches, each portraying math in their immediate surroundings. The images are delightfully diverse! Some people sent me photos of places on their ranches, geometric objects in their homes, tools they work with in their shops, art, beadwork, and children doing math problems in schools where they work. We will view the images in a slide show while discussing their mathematical findings, and then we will return to the images throughout the remainder of the semester, to help us review concepts such as slope, perimeter, area, symmetry, volume, distance, division, perpendicular bisectors, scientific notation, and mental math. Perhaps if the students are willing, we will write a future article together about the mathematics in their images. Relevant images capture people’s attention and help us all see the vivid connections between math, art, design, and culture.

References


Note: Dorothy Washburn and Donald Crowe have a newer book that further develops topics in symmetry and culture, published in 2004, which I just discovered! I’d highly recommend it to anyone who is interested in this subject. The title is Symmetry Comes of Age: The Role of Pattern in Culture.
Fascinating patterns can arise out of arrays of numbers defined by simple rules. The set of numbers immediately below is now widely known as Pascal’s triangle, named for French philosopher and mathematician Blaise Pascal (1623-1662), who studied it intensively. Here are the first six rows of Pascal’s Triangle:

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1
1 1
1 2 1
1 3 3 1
1 4 6 4 1
1 5 10 10 5 1
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Pascal, however, was not the first to identify this pattern. The mathematician, astronomer, and poet Omar Khayyam (1048-1122) described this number triangle in his writings. It was also well-known to the Chinese. A nine-row version was featured prominently in the introduction to the old Chinese book *Precious Mirror of the Four Elements*, which appeared in 1303. The book’s author refers to the triangle as a “diagram of the old method for finding eighth and lower powers.”

This same set of numbers arises in a very different way in the Iñupiat counting system, when the spoken-number grid is extended in order to explore the mathematical realm of the 2-dimensional, Iñupiat counting system. These same numbers occur on diagonals, representing fractal iterations, as one splits the number(s) on one diagonal into constituent parts. The value of each box on the grid is indicated at the bottom of that box. Although the spoken Iñupiat system is generally limited to the horizontal band, shaded in gray, in Greenland, Inuit peoples use a base-five counting system for special purposes, such as when hunting birds in a kayak. A kayak, fully loaded safely, will hold 25 birds (five groups of five), tied together and distributed to balance the kayak.

25 is shown in the green box below (position of the Greenlandic base-5 “25”) whose box represents the value 25 as one single unit of 25, or (1 x 25). 25 is shown on the gray diagonal as one unit of twenty plus one unit of five, or (1 x 20) + (1 x 5). This is the usual way of expressing the number in spoken Iñupiaq. This “splitting” pattern will be applied to produce each subsequent iteration on the next diagonal below. On the yellow diagonal, 25 is represented as (1 x 16) + (2 x 4) + (1 x 1). On the next diagonal, in purple, 25 is shown by (1 x 12.8) + (3 x 3.2) + (3 x 0.8) + (1 x .2). The rose diagonal then represents twenty-five as (1 x 10.24) + (4 x 2.56) + (6 x 0.64) + (4 x 0.16) + (1 x 0.04). The teal diagonal expresses the very same twenty-five as (1 x 8.192) + (5 x 2.048) + (10 x 0.512) + (10 x 0.128) + (5 x 0.032) + (1 x 0.008).
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Fractal Representation of

Structural Iterations in the Iñupiat Counting System

References


Dear Editor:

The article on "Vedic Mathematics" by Blidi Stemn (NASGEm News, Summer 2011) makes many incorrect statements about "Vedic" mathematics, presumably because it relies on unreliable tertiary sources like Joseph.  

First of all, the methods described have nothing to do with the Veda. This is acknowledged up front in the book by Bharti Krishna Tirtha, that they are not based on the Veda. Stemn should at least have carefully read that source available in English, and should have noticed that there are no references to any Vedic hymns. As I have been pointing out since 1998, and in a widely circulated paper of 2001, the book *Vedic Mathematics* acknowledges on its first page (p v) that the (elementary arithmetic) algorithms expounded in the book have nothing to do with any recension of Atharvaveda. ‘Obviously these formulas are not to be found in the present recensions of Atharvaveda.’ As described in passing in my book *Cultural Foundations of Mathematics* (Pearson Longman, 2007, pp. 130-31), the mathematics that one does find in the Yajurveda (xvii.2) is quite different, and consists of arithmetic progression, decimal place value system, etc.

Various astika systems of Indian philosophy accepted the Veda as reliable testimony, but this has been misunderstood to mean that all knowledge is in the Veda, and that is the justification given for the use of the term "Vedic" in the title of the book by Bharti Krishna Tirtha.

Secondly, it is incorrect to describe the Vedas as the main scriptural texts of Hinduism. The term "Hindu" is one used by foreigners to describe people on the other side of the Indus (Hindukush) and does not fit the Indian tradition. For example, the nastika (=non-astika) Lokayata, who do not accept the Veda as authoritative, would still be classified as Hindus today from the viewpoint of the census or the tax laws or inheritance law etc. So, the label "Hindu" is being used somewhat indiscriminately.

Further, even astika Hinduism is not a *scriptural* religion, and the Vedas are not *texts*, but an oral tradition. They were not written down for long after writing was known in India. This tendency to mould everything into the church tradition (which promoted scriptural testimony as gospel truth) should be avoided.

The metre is an important reason for retaining the oral tradition. The Vedic hymns are intended to be sung. Witzel from Harvard, who claims to be an expert on the Vedas, recently made a bloomer (among several others) when in his attack on me in H-VASMA, it emerged that he was ignorant that the theory of permutations and combinations is built into the theory of the Vedic metre (as in the theory of Indian music), and the metre is used as a way to check the accuracy of the content, so writing it down can compromise its contents.

The debate in H-VASMA related to my paper on "Probability in Ancient India" which refers to and gives a correct translation of the hymn on dice (aksa sukta) in the Rgveda, and, apart from the issue of permutations and combinations, it explains how sampling theory was used in the Mahabharata epic to count the number of nuts in a tree. The paper also looks at other issues of contemporary significance, such as frequentist interpretation of probability and quantum probabilities (and quantum computing) related to Buddhist logic. The point of bringing in these contemporary applications is to show situations where European ethnomathematics and its ethnophilosophy has failed, and other systems can do better. The paper was recently published in the Elsevier *Handbook of Philosophy of Science* vol. 7, *Philosophy of Statistics*. The debate, together with a link to the paper is archived on my blog (http://ckraju.net/blog/?p=56 and the previous entry). Such contemporary applications of the mathematics in early Indian tradition get sidelined by various incorrect claims about "Vedic" mathematics.
To summarize, "Vedic mathematics" is an invention of Bharti Krishna Tirtha based on certain mental arithmetic algorithms in common use in India. He wrongly thought that the usual arithmetic algorithms used today are Western, in origin. In fact, the very name "algorithm" originates from al Khwarizmi (known in Latin as Algorismus) whose book Hisab al Hind, on Indian arithmetic, started the algorismus tradition in Europe, which still used the abacus (and stopped doing so for the exchequer only in the 18th c.). So, this bad story of "Vedic mathematics" ends up denying the more serious achievements about mathematics in Indian tradition. By all means teach the mental arithmetic used by Indian artisans, but don't incorrectly call it "Vedic".

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New Publications


*Abstract:* Working with Navajo Indian informants in Arizona, USA we became aware of the capabilities of children and adults to find their way in vast and clearly ‘chaotic’ canyons. One thing we did was describe what people actually did and said about their ways to find the way back home in such contexts. A second one was to use these data in order to build a curriculum book for a bicultural school on the Navajo reservation. We start from this example to ask what the political choices are, which we confront when working with such material: how much mathematics (or is it Mathematics) is needed in daily life? And what mathematics should we promote or develop, without becoming colonialist again? In section 2 we discuss the meaning and the status of ethnomathematics, proposing that it would be the generic category, which allows for a more systematic and comparative study of the whole domain of mathematical practices. In section 3 we introduce the concept of multimathemacy (after multiliteracy) to discuss the political agenda of ethnomathematics. We argue that multimathemacy should be the basis of the curriculum in order to guarantee optimal survival value for every learner.


*Abstract:* The implementation of a culturally relevant pedagogy in the school curriculum helps to develop students’ intellectual, social, emotional, and political learning by using their own cultural referents to impart their knowledge, skills, and attitudes. A culturally relevant pedagogy provides ways for students to maintain their identity while succeeding academically. In the context of culturally relevant pedagogy, there is a need to examine the embeddings of mathematics in culture, drawing from an ethnomathematical perspective that takes on the cultural nature of knowledge production into the mathematics curriculum. Ethnomathematics and culturally relevant pedagogy-based approaches to mathematics curriculum are intended to make school mathematics relevant and meaningful as well as to promote the overall quality of students’ educational experience. In this perspective, the theoretical framework used in this article is Culturally Relevant Education Theory. Since Culturally Relevant Pedagogy and the Cultural Aspects of Ethnomathematics are interrelated to Culturally Relevant Education, this article is also framed by applying these theoretical approaches.
Announcements

Call For Papers:
Special Issue of MERJ (Mathematics Education Research Journal): Mathematics Education with/for Indigenous Peoples
Editors: Robyn Jorgensen, Griffith University, and David Wagner, University of New Brunswick

Description:
Indigenous education has gone through many iterations with the focus changing dramatically over the past few decades where the emphasis has shifted from researching “on” Indigenous people to researching “with” Indigenous people. While there are a multiplicity of approaches and ideologies that underpin various research projects, there are some common denominators that guide research. This special issue will represent a collection of research projects conducted in Australia and internationally where the intent has been to work with Indigenous people/communities/schools and/or educators to enhance the mathematics/numeracy learning for Indigenous students. We would envisage that the Special Issue will make a significant contribution to Indigenous Mathematics Education.

The Editors invite researchers to submit their manuscripts for this special issue through the online MERJ Springer website. The editors will give preference to publishing manuscripts where:
   a) The research is with and/or by, rather than on, Indigenous people
   b) The authors do not approach their work through the exoticising of Indigenous people
   c) The research projects attempt to push learning rather than rely on deficit models
   d) The research pushes boundaries and challenges some of the existing orthodoxies that perpetuate differences in learning and outcomes.

Graduate Fellowships in Science and Technology Studies:
The NSF Triple Helix project in the department of Science and Technology Studies at Rensselaer has funding for new Graduate Fellows beginning in AY2012 (starting August 2012). Graduate funding (tuition and stipend) is guaranteed for a minimum of 4 years.

Overview:
Graduate fellows accepted for the program will explore how cutting-edge science and technology research might be adapted to address the problems encountered by low-income communities (health, environment, poverty, crime, information access, etc.). They will also teach in inner city middle school classrooms to apply these social/technical connections to education in communities affected by these challenges. Additional travel funding will be available for fellows interested in extending this research to low-income communities in Africa or Latin America, or among U.S. Native American populations. The Fellow must be a US citizen or permanent resident.

Current grads in the program come from a variety of backgrounds, including sociology, media arts, and urban development. Their projects include the use of cell phones for low-income health information, working with software developers to create new culture-based educational technologies, and deploying pollution sensors for both rural and urban communities. For further information see the Triple Helix website.

To apply send email describing your interests to:
Dr. Ron Eglash, Professor, Science and Technology Studies,
Sage Labs 5502, Rensselaer Polytechnic Institute, 110 8th St, Troy, NY 12180-3590
eglash@rpi.edu Work: 518-276-2048 fax: 518-276-2659
Museum Exhibit:

**Feed Your Head: The African Origins of the Scientific Aesthetic**

Artists: Pamela Phatsimo Sunstrum, Sylvester James Gates, Jr., Tanea Richardson and Ron Eglash

Curated by Kalia Brooks, Director of Exhibitions

MoCADA 80 Hanson Pl. Brooklyn, NY 11217

November 17, 2011 – February 25, 2012

**Overview:**

The exhibition focuses on teaching about science through the visual arts, as well as configurations of the world that are grounded in African-based visual systems. *Feed Your Head* make for an intriguing collaboration in the arts and sciences through the rubric of the African Diaspora. The point is to bring these fields together in a shared aesthetic purpose. In addition, this project seeks to encourage partnerships by creating the potential for curriculum building that connects the work of the museum with other people and places engaged in creative learning. [http://mocada.org/2011/11/03/feed-your-head-the-african-origin-of-the-scientific-aesthetic/](http://mocada.org/2011/11/03/feed-your-head-the-african-origin-of-the-scientific-aesthetic/)

**Blog: ICTworks by inveneo (2011)**


**Overview:**

In a National Science Foundation research project, Dr. Ron Eglash and a group of professors and students from Rensselaer Polytechnic Institute (RPI) are changing attitudes that mathematics does not apply to lives and culture of indigenous people in developing countries by creating software based on ethnomathematics: a study of the interaction of math and culture. The software, known as *Culturally Situated Design Tools*, illustrates mathematical concepts to students by having them develop virtual designs based on artifacts in their culture. The website includes a TED (Ideas Worth Spreading) video of Ron Eglash talking about the virtual designs of Original African Artifacts.

Here is a sample Culturally Situated Design Tool:

*African Fractals Culture 2: Logone-Birni*

[ri.edu/african/African_Fractals/culture2.html](http://rpi.edu/african/African_Fractals/culture2.html)

**Address Change:**

Daniel Clark Orey has moved from Sacramento, California to Ouro Preto, Minas Gerais Brazil

Dr. Orey requests that you do not use the old address orey@csus.edu, but instead use his new contact information:

Daniel Clark Orey, Ph.D.
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Professor, Centro de Educação Aberta e a Distância
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Address Change:
Milton Rosa has moved from Sacramento, California to Ouro Preto, Minas Gerais, Brazil.
His new contact information is:

Milton Rosa, EdD
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A Final Word from Claudette Engblom-Bradley and Rick Silverman

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