

Jessica Bruck- Fund for Teachers Proposal (Peru- July/ August 2011)

Summary:

Travel to Peru for Spanish Language immersion and to explore Pre-Columbian Peru's mathematical achievements and the Geometric patterns of its textiles

Fellowship Rationale and Purpose: When thinking about your teaching practice, what would you like to learn? What are the key questions you want to explore? What challenge or passion inspires your proposed fellowship? *

I will research the importance of mathematics to the cultural heritage of the Inca and Nazca Civilizations as well as to Peruvian textiles. I know it will be used to inspire my geometry, algebra, and art and architecture students to make connections, build mathematical models and communicate using mathematics. I want my students to ponder would the Incas have been as well known without their mathematical and engineering accomplishments? Taking this one step further, what are the implications of strong foundations in mathematical thinking for any society's accomplishments?

The desire for my students to ponder these questions is rooted in my own personal awe at the monumental architectural accomplishment of Machu Pichu, which I first experienced when I too was just a high school student. A family friend introduced me to the Incas and Nazcas through pictures from their own trip and shortly afterwards, I watched a television program about the mathematical marvels of the Inca and Nazca Civilizations and I was hooked. In addition to the architectural feat of Machu Pichu, I was amazed and fascinated that a culture could dominate and communicate with no written language but only a mathematical record keeping system, such as the knots and strings of the Inca *quipu*. Dreaming of embarking on this journey and awestruck ever since, I have so many questions:

How is it possible for a culture to dominate as the Incan Empire did without a written language but only a mathematical system? What does geometry have to do with the integrity of the structural engineering of the Machu Pichu? What are the geometric patterns of the Nazca lines? Are these drawings really mathematical? What is the geometry of the patterns found in Peruvian textiles? In present times, is there a connection between the patterns of the Nazca lines and those patterns found in the textiles of the Peruvian Highlands? What are the economic implications of the tourist industry in regards to Machu Pichu, textiles, and artisan craft products?

I am also inspired to make this trip because it has been inherently challenging to naturally integrate mathematics in my school's cross-curricular model. I am excited to use this fellowship opportunity to create an experience for my students which is cross-curricular yet driven by mathematics. To be specific, my school follows the curricular model of Expeditions Learning. A good Learning

Expedition gives students an active role in seeking the deeper connections among content areas through the lens of compelling real world contexts and big ideas. Because of this fellowship, for the first time in our school, mathematics will be able to drive a Learning Expedition, that can connect to a topic in Global History: Ancient Civilizations.

In addition to an ethno-mathematical study, there are two other areas I want to pursue during my time in Peru: the life cycle of wool from alpacas to yarn used in knitting and textiles and the improvement of my Spanish Language skills. Both of these topics are relevant to my school. Twice a year, we have students participate in special weeks called Intensives, where teacher and students explore passions that not necessarily related to a core content area. For the past two years, I have taught a knitting Intensive. As the students have become more experienced, we have gone from simply learning how to knit to exploring other means of creating fabrics such as through using a loom to weave their own piece of cloth. Exploring Peru's textile tradition will allow the Intensive to grow in new directions. Finally, taking a Spanish language course and immersing myself in the Spanish speaking country of Peru will not only enable me to navigate and gain information critical to my fellowship, but more importantly, it will help me with the fluency and confidence in my language abilities necessary to communicate with many of my students' parents, 37% of which are known to be Spanish speaking English Language Learners or Former English Language Learners.

Project Description: Describe and outline in detail your proposed fellowship. What key activities will you pursue, and why are they important? What is the time frame for achieving the goals outlined in the rationale and purpose? *

Week One:

My four week journey through Peru during July and August 2011 will begin in the Peru's capital city of Lima, where I will spend one to two days to visit several historical sites and museums. I will learn about artifacts such as the oldest mathematical texts in Peru, the Incan mathematical records keeping system of *quipus* and Peru's cultural history. From Lima I will journey by bus to Nazca to learn about the Nazca lines, a mysterious group of geoglyphs, from the 5th-7th centuries that can span up to 890ft. Unlike like the Nazca, I will be able to fly over the lines and see them in their entirety. I will explore how and why these huge lines were made and the meaning of the geometric shapes found in the figures. This will insightful perspective as well as photographic artifacts when exploring the geometry of these mysterious shapes with my students.

Week Two:

Although I studied Spanish in college I need a structured environment to improve my fluency. By the end of my first week in Peru, I will arrive in Arequipa for small group instruction courses. Working on these skills towards the beginning of my fellowship will aid me to communicate directly with Peruvians, facilitate logistics and most importantly, provide access to learn more while I am in Peru. Arequipa is also in the vicinity of Colca Canyon, a site known for its terraced farms, which will provide me connections to algebra and engineering that I will encounter at Machu Pichu.

Week Three:

From Arequipa, I will travel to Puno (Lake Titicaca), and then, Cuzco and the Sacred Valley. I am excited to spend time at these centers of Peru's textiles and fiber arts, gaining ideas and experiences to share with my Knitting Intensive classes. I will also use this part of my journey to photograph and document the geometric patterns in Peruvian textiles, which will be explored in my geometry and algebra classes.

Week Four +:

I will base myself out of Cuzco for the final ten days of my journey in order to participate in a four day trek to Choquequirao, the "other Machu Pichu." A trek is the only way to gain access to this second marvel of Inca architecture. In the days following my trek to Choquequirao, I will tour Machu Pichu itself, returning perhaps even a second day. This will provide me with multiple opportunities to explore the architectural and engineering accomplishments of the Inca Civilizations as well as compare the two sites. I would like to take measurements along with photos of various dwelling and structures at both Choquequirao and Machu Pichu as a part of a plan for a Learning Expedition upon my return to my classroom. Throughout my journey, I will be researching and making inquiries into the economic implications of the tourism industry in regards to eco-tourism, textiles and artisan crafts. After one or two more days in Cuzco, exploring various cultural centers of textile art in the Sacred Valley, a flight back to the United States, connecting through Lima, completes my journey.

Teacher Growth and Learning: How will your fellowship help you address your key questions and/or learning goals? How will this fellowship help you grow as a teacher? *

Every city and cultural or historical site I have included in my itinerary has been purposely chosen for its mathematical, architectural, or economic significance and as a means of exploring one or more of my key questions. I will not only go and see the amazing architecture and designs that originally captured my attention when I was fifteen, but also use my increasingly fluent Spanish to find the answers to the questions born from those first images.

I am excited at the thought of leading a Learning Expedition in which I really feel like an expert because of the real life experiences and contact with the topic that I would be able to bring to it. The growth of my knowledge about the Nazca, Incas, and geometric patterns in textiles will help me to be able to better articulate and show my students with clear, concrete examples and documentation, mathematics and architecture in a way I hope fills them with a sense of wonder. I have had success with being a part of cross-curricular Learning Expeditions in the past, but have never had the curricular materials and life experience to lead one as I feel this journey through Peru will afford me.

While I am passionate about knitting, I know little about the process through which animal hair becomes the beautiful yarn I love working with. I am excited to learn and see for myself the processing and dying of alpaca wool as I spend time in the textile regions of Puno, the Sacred Valley and Cuzco. As an extension, I also want to learn about the economics of various cooperatives located in this area, which help local women sell their textiles and wool to people around the world.

Finally, I really want to improve both my level of competency in Spanish and the extent to which parents are involved in our school community. I will gain confidence in my speaking skills so I am more comfortable communicating with the mostly Spanish speaking parents of more than one-third of my school's population, not to mention our large student populations of Spanish speaking English Language Learner.

Student Growth and Learning: How will students benefit from your proposed fellowship? What meaningful additions will this experience bring to your classroom? *

As described earlier, a Learning Expedition based on the fellowship will be one of the key benefits for my students. Learning Expeditions emphasize depth instead of breadth and we will conduct an intensive study of Pre-Columbian accomplishments based on mathematics. Moreover, one special aspect of our relatively small school is that each Spring I know exactly who my students will be the following Fall term. As a supplement to traditional summer reading, my students will be expected to follow a tumblr blog that I create and update with photos, reflections and discoveries while on my journey. I am working to build a culture of turning the simple into the extraordinary in my math classes as geometry, formulas, figures, logic, data and statistical trends are revealed in the light of "I didn't know they used math to do *that!*" It is important to make connections between seemingly unrelated topics in and out of pure mathematics content. Following my blog, it is my hope students will also begin to ask "Wow! *How* did they do that?" Thus, creating a "need to know" by which the mathematics will be discovered and investigated. Taking the time to address and answer students' questions in the Fall after my journey to Peru and to really dive deeply into the mathematics behind the construction of Machu

Pichu and Choquequirao, the Nazca lines, terraced gardens, the economics of the textile industry and geometric patterns will drive further conversations and studies revolving around the premise that high levels of mathematical thinking provides the foundations for a culture to be successful.

It is also my goal that students will benefit from my own enthusiasm for completing a life-long dream and the idea that they too should explore the world around them. A gain of multicultural appreciation is a more subtle effect of placing mathematics in a cross-culture context. My fellowship will ensure that the curriculum I will ultimately design after completing my research of Peru's mathematical achievements is founded in experience and deep understanding of the topic I am teaching. The physical artifacts of photographic evidence and textiles will make the more abstract content mathematical real and useful.

My knitting students will be awed and inspired by the textiles, pictures and stories I will bring to them from Peru. These students are hungry for any and all information and experiences relating to the subject. In fact, it was a student's question of just how was yarn made that first made me pause and reflect for a moment as to my own knowledge base of the topic.

My ability to communicate with and understand my Spanish speaking beginning English Language Learner students will improve exponentially after my time in Peru. Often, my students are able to understand English, but have great difficulty speaking it. My gained Spanish vocabulary of mathematical terms and general comprehension and speaking skills will help these new students make the transition to the United States that much easier.

Benefits to School Community: How will your fellowship experience contribute to your school community's efforts to engage students and improve learning? How will you share the fellowship learning with colleagues? *

Through carefully planned "Expeditions" our school is constantly looking for meaningful ways to engage students in interesting and complexly connected topics. This fellowship will provide me with the best foundation any teacher can have for planning curriculum and a Learning Expedition: real life experience. Mathematics is particularly challenging to include many of the current Learning Expeditions and this fellowship would provide me with the expertise necessary to lead a Mathematics-Global History Expedition that highlights mathematical thinking, instead of simply adding data and graphs to another content area's curriculum as is usually the case. If accepted for the fellowship, I will meet with the Global History teacher at my grade level before the end of the school year, outlining my journey, but also offering an opportunity for additional suggestions and points of interest to this teacher. During the last two weeks of August, when all teachers at my school have common planning prior to the beginning of the

school year, I would share the documentation and insights gained from my travels in Peru in with all teachers on my grade level in order to complete the planning process for a Learning Expedition next Fall semester.

Currently, as a part of a school leadership team that guides and helps teachers to create strong Learning Expeditions, my journey through Peru would provide the ultimate case study for how Learning Expeditions can be researched and designed. Ultimately, my experience and the creation and implementation of the Learning Expedition itself will be proposed for the Expeditionary Learning Schools 2012 National Conference as an exemplar to teach new Expeditionary Learning School's teachers one way of integrating seemingly contrasting content areas, thereby reaching teachers far beyond my school community but in my network of schools as well

A knitting and crocheting group for parents who have already expressed a desire to learn these crafts could be started after school to provide a context for parents in our school community to learn more about what their child is learning in our school. In so doing, I would be helping the school to improve its communication with our parent community and also give an access point for our parents to have conversations with their children about what they are learning.

My improved Spanish skills will no doubt help with communication in the context of the parent knitting group, but also, I know that it will provide me the freedom and confidence to call parents with more frequency. Currently, I hesitate to call many of my students' parents because we do not speak the same language. I am excited to break down this barrier as it benefits both the child and school community as a whole when there is a greater level of communication and involvement.

Plan For Implementation of Fellowship Learning

Please outline a plan for implementing learning from your proposed fellowship. Unintended learning experiences may constitute powerful aspects of your fellowship. Not all learning and transfer can be predicted. Planning a clear structure for bringing fellowship learning back to students contributes to a more focused experience in the field.

Your plan may be (1) an outline of a newly created or enhanced curricular unit/project; or (2) an action plan for new classroom or school-wide structures.

(1) Curricular Unit/Project Outline: Focus on goals, student skills, general content, teaching methods, and assessment ideas.

(2) Action Plan: Focus on the goals, strategy, and outcomes for new classroom or school-wide structures.

The ultimate goal for what I want to bring back to my school community is a strong knowledge base and collection of pictorial artifacts and notes to design and execute a Learning Expedition that explores the connections between mathematics and Ancient Civilizations. The breadth of Global History is challenging and often inaccessible to my students. Additionally, mathematics content is often forgotten in cross-curricular planning. This Learning Expedition would aim to draw deep connections between the two, while also make the topic of Ancient Civilizations more distinct and accessible.

Mathematics and Ancient Civilizations Learning Expedition:

Student Learning Targets (Learning Objectives written in student friendly language):

- ✓ I can articulate how a deep understanding of mathematics and Geometry led to the prominence of Ancient Civilizations, and the Incas and Nazca in particular.
- ✓ I can make and use a *quipu* to explore the Incan mathematical record keeping, taxation and trade system.
- ✓ I can make connections between mathematical innovative thinking and dominance of civilizations.
- ✓ I can investigate the characteristics of polygons and geometric patterns through a careful study of patterns in the Nazca Lines of Ancient Peru in juxtaposition to patterns in the textiles of present day Peru,

Products/ Evidence of Learning:

Geometry/ Art and Architecture classes:

-students will create scale models of the city of Machu Pichu itself, thereby exploring area, characteristics of polygons, architectural structures as well as systems of measurement.

- students will use transformations and geometric patterns to design pattern charts to be woven as textiles.

Algebra:

- students will explore slope by investigating the terrace farms of Colca Canyon and the terrace foundations of Machu Pichu as well as the advanced water and irrigation systems of the lost city.

-students will solve Linear Programming problems in the context of textile, eco-tourism and agriculture.

- students will make their own *quipus*, which will be used as part of a unit designed to strengthen student skills in numeracy.

In addition to the creation of curriculum for this Learning Expedition, my time in Peru will benefit my school and its community through my improved Spanish language communication skills. Inspiration and a better understanding of the life cycle of wool and textiles will enrich my week long Intensive knitting class, which are extremely popular with the students.