

Developing Teacher Competencies that Integrate Mathematics, Children's Thinking, and Community-based Funds of Knowledge

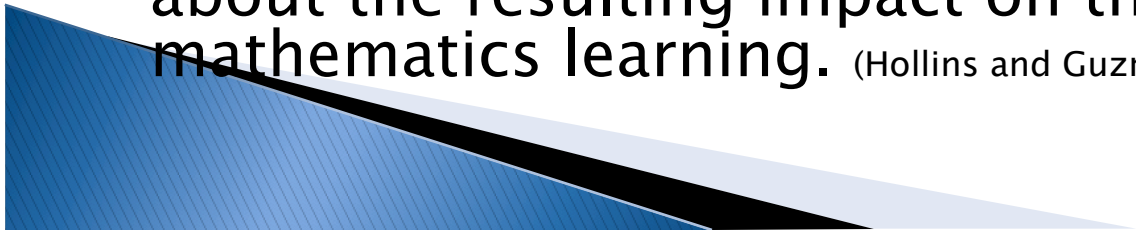
Teachers
Empowered to
Advance
CHange in
MATHematics

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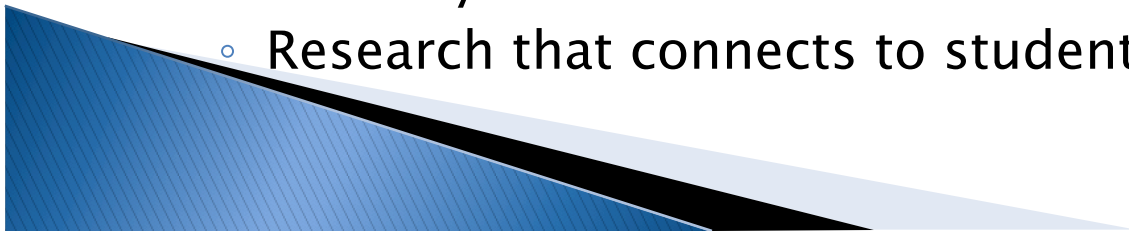
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Key Issues:

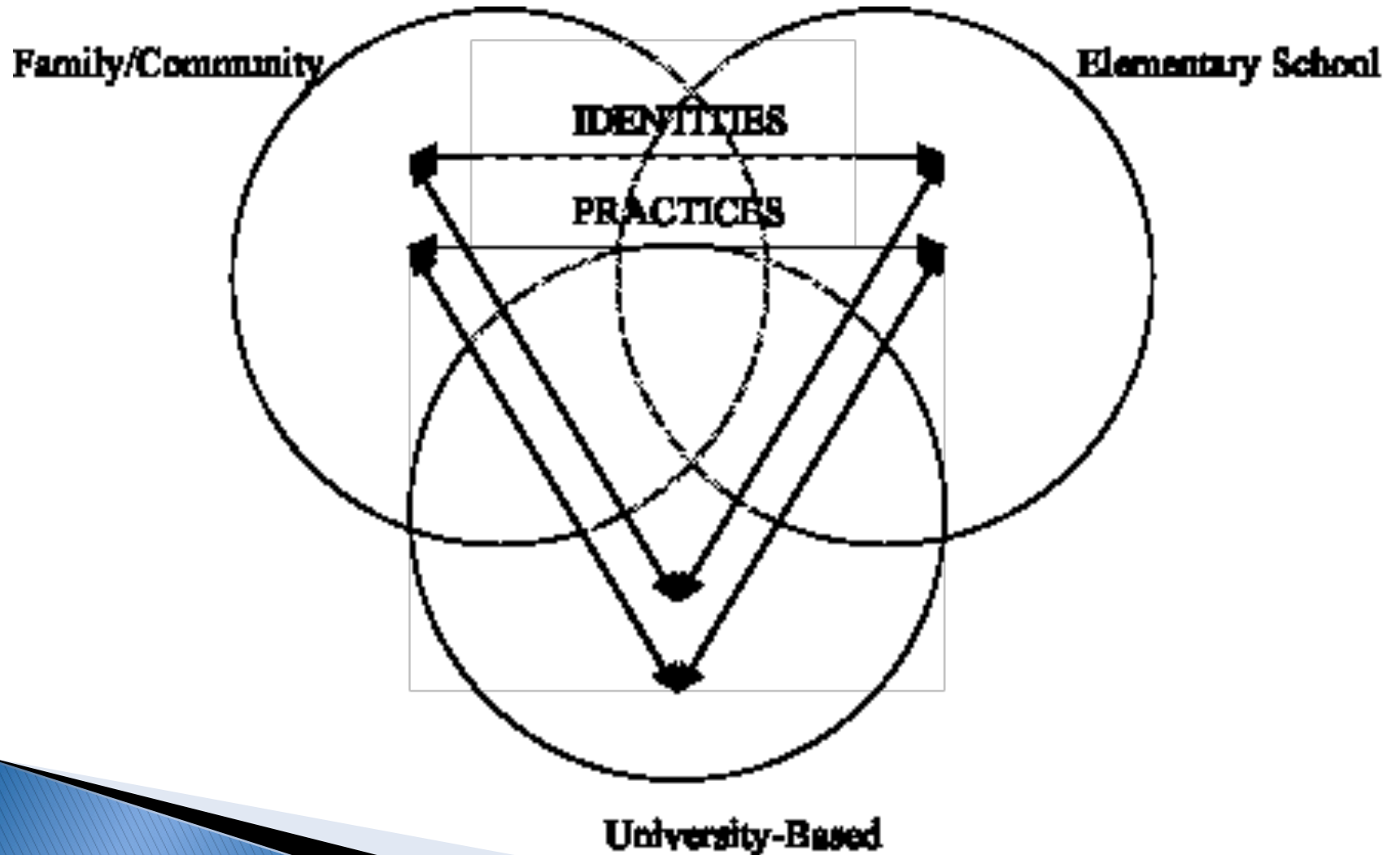
- ▶ **PERSISTENT GAPS:** Persistent gaps in mathematics learning opportunities and achievement between historically underrepresented students and their middle-class White counterparts are cause for concern. (NCES, 2003; NCES, 2007; see also Gutierrez, 2008; Lubienski, 2008)
 - ▶ **TEACHER PREPARATION IN MATHEMATICS:** Teachers are underprepared to teach mathematics effectively in diverse classrooms. (Hollins & Guzman, 2005; Howard, 1999; Nieto, 2004; Rodriguez & Kitchen, 2005; Sleeter, 2001)
 - ▶ **CONNECTION BETWEEN STUDENT MATH LEARNING AND EARLY CAREER TEACHING:** Very little is known about how pre-service teachers transfer new understandings into early teaching experiences, or about the resulting impact on their preK–8 students' mathematics learning. (Hollins and Guzman, 2005)
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TEACH MATH: Prime Directive

- ▶ To design and study ways to support pre-service (PST) and early career teachers in developing teaching competencies that connect rich mathematics, children's mathematical thinking and community/culturally-based funds of knowledge to advance mathematical learning of children.
 - Mathematics Methods course modules
 - Professional development support and on-line networking for early career teachers
 - Research that connects to student learning outcomes



TEACH MATH: Theoretical Framework

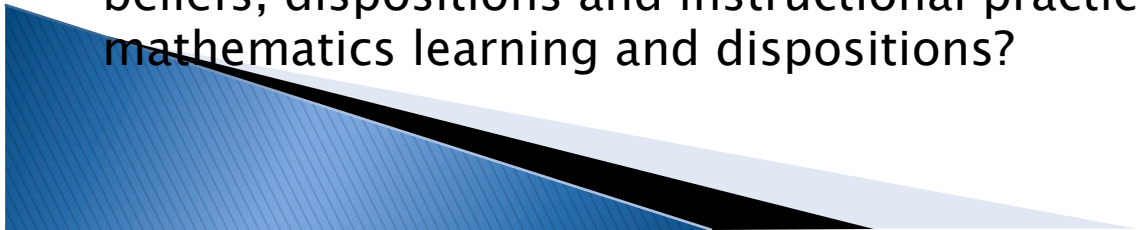


TEACH MATH: Theoretical Perspectives

- ▶ Effectiveness of instruction that focuses on children's mathematical thinking
 - ▶ Carpenter, Fennema, Peterson, Chiang & Loef, 1989; Carpenter, Franke, Jacobs & Fennema, 1998; Fennema, Carpenter, Franke, Levi, Jacobs & Empson, 1996
- ▶ Effectiveness of instruction drawing on students' cultural, linguistic and community-based knowledge
 - ▶ Ladson-Billings, 1994; Lee, 2007; Silver & Stein, 1996; Turner, Celedón-Pattichis & Marshall, 2008
- ▶ Need for teachers to understand how students' home and community-based *funds of knowledge* can support their mathematical learning
 - ▶ Civil, 2002; González, Andrade, Civil, & Moll, 2001; González, Moll & Amanti, 2005; Moll, Amanti, Neff & Gonzalez, 1992

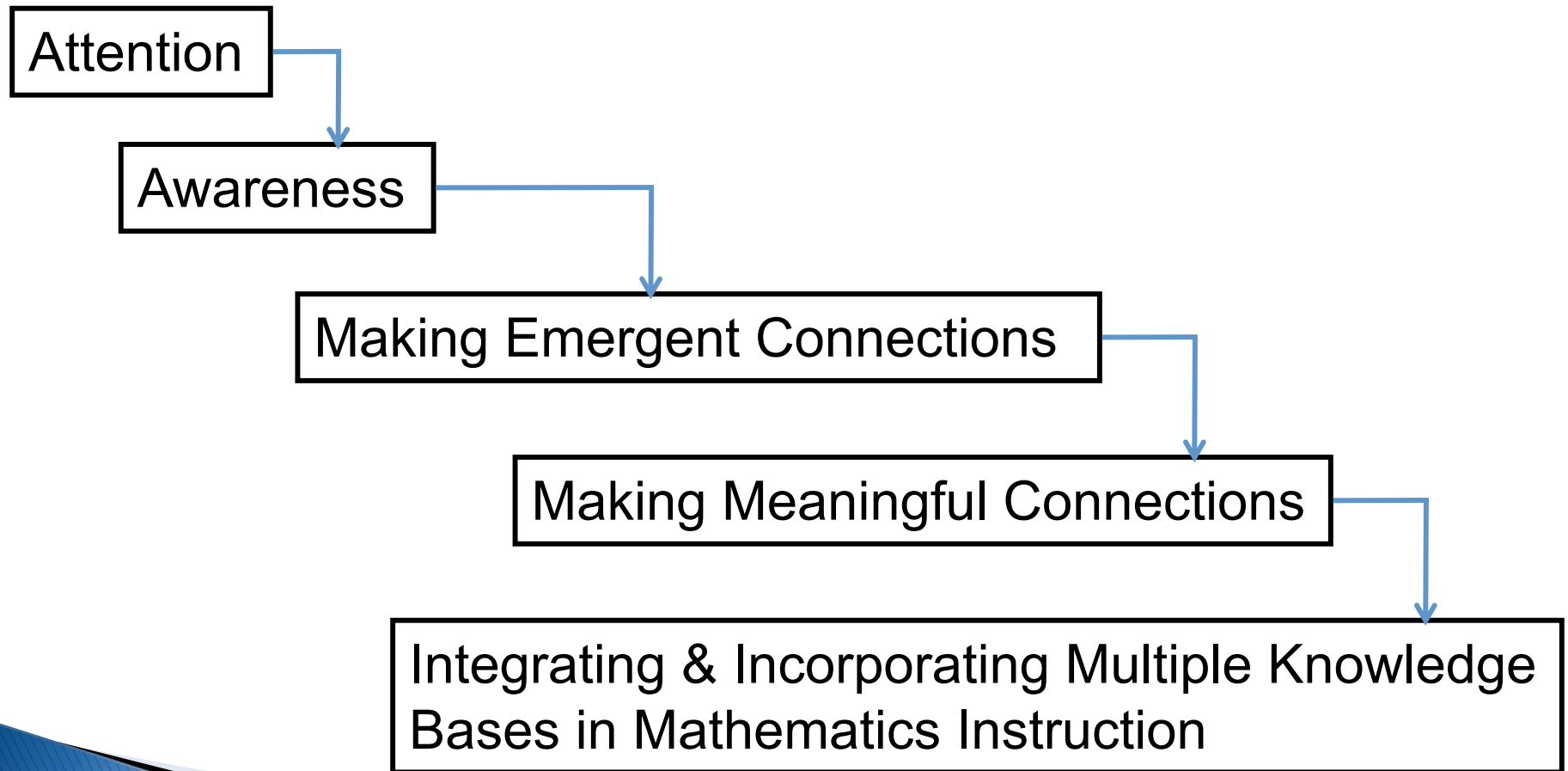


TEACH MATH: Research Questions

- ▶ 1. How do pre-service teachers' knowledge, beliefs, dispositions, and practices related to integrating children's mathematical thinking and children's cultural, linguistic, and community-based funds of knowledge in mathematics instruction *change* as a result of a series of instructional modules for mathematics methods courses?
 - ▶ 2. How do local instructor, course, program, university, and community contexts mediate the implementation of these modules?
 - ▶ 3. What supports and challenges do pre-service and early career teachers face in implementing instructional practices in their preK-8 classrooms that integrate children's mathematical thinking and children's cultural, linguistic, and community-based funds of knowledge, and how do they negotiate these challenges?
 - ▶ 4. What are the relationships between early career teachers' knowledge, beliefs, dispositions and instructional practices and their preK-8 students' mathematics learning and dispositions?
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Conjectured Learning Trajectory for PSTs and Early Career Mathematics Teachers

(Adapted from Mason, 2008)



TEACH MATH: Methods & Data

RESEARCH DESIGN

- ▶ Ongoing cross-sectional study
- ▶ Mathematics methods courses at 6 institutions
- ▶ 540 teacher participants over 3 years
- ▶ Data instruments:
 - Pre-post Belief surveys
 - Pre-post Math knowledge assessment
 - Pre-post Interviews
 - Teacher work samples
 - Instructor Reflections
 - Video/audio tape of methods course & PD sessions
- ▶ Qualitative Analysis: Analytic Induction (Bogdan & Biklin, 1992)

RESEARCH SITES

- ▶ **URBAN:**
 - CUNY: Queens College
 - University of Washington Tacoma
- ▶ **MIX: URBAN, RURAL, SUBURBAN**
 - Iowa State University
 - Washington State University Tri Cities
- ▶ **SUBURBAN**
 - University of Delaware
- ▶ **BORDERLANDS**
 - University of Arizona

Current Instructional Modules

A. Critical Case Analysis

PSTs use multiple lenses to critically analyze and evaluate mathematics lessons (video clips and/or written cases).

B. Community Mathematics Exploration

PSTs identify mathematical practices and mathematical funds of knowledge in students' communities and build on them in a standards-based mathematics lesson.

C. Studying Mathematical Competence

PSTs analyze how mathematical competence is evidenced and supported in two settings: a classroom mathematics lesson and an individual problem solving-based interview.

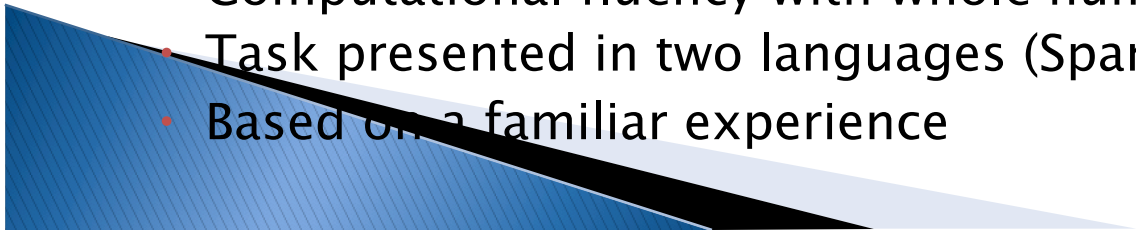
D. Curriculum Spaces (under development)

PSTs analyze mathematics curriculum materials to identify potential opportunities (or spaces) for accessing, building on, and integrating children's mathematical thinking and children's home and community-based mathematical funds of knowledge.



Preliminary Results from Community Mathematics Exploration: *Making meaningful connections*

▶ Lavandería/Laundromat: Overview

- Guided Tour of community by parent
 - “Social hub” of the community
 - Interviewed and observed mothers at the site (math practices, estimation)
 - Developed standards–based Math Lesson
 - High cognitive demand activity
 - Problem–solving
 - Computational fluency with whole numbers and fractions
 - Task presented in two languages (Spanish, English)
 - Based on a familiar experience
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La Lavanderia / The Laundromat

Ud. vive con sus tres hermanos, sus dos padres, y su abeula. Cada semana, su familia tiene muchas ropias sucias para lavar – hoy, de facto, Uds. tienen 10 cargas!

Ud. se va a la lavandería con su madre para ayudarla. Ella quiere saber cuánto costaría para lavar (no sacar) toda la ropa. Le puedes ayudar? Cuántas soluciones hay? Cuánto es lo máximo y lo mínimo que Uds. van a pagar? (Ya tienen detergente).

Después de lavar...ahora Ud. y su madre tienen 10 cargas de ropa mojada. Cuánto costaría secar la ropa? (Por lo medio, cada carga necesitaría 45 minutos de secar).

Use números, palabras, dibujos, manipulativos, etc. para mostrar sus trabajos y soluciones de su grupo.

You live with your three siblings, your two parents, and your grandmother. Every week, your family has lots of dirty laundry that needs to be washed – today, in fact, you have 10 loads of laundry!

You go to the laundromat to help your mother. She wants to know how much it will cost to wash (not dry) all the clothes. Can you help her? How many solutions are there? What is the maximum and minimum that you might pay? (You already have the detergent).

After the washing...now you and your mother have 10 loads of wet laundry. How much will it cost to dry all the loads? (On average, each load of laundry will need 45 minutes to dry).

Use numbers, words, drawings, manipulatives, etc. to show your group's work and solutions.

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Extension Possible:

Cada persona en su familia hace 1 ½ cargas de ropa sucia por semana, y Ud. no tiene detergente. Cuántas cargas necesitas lavar? Cuánto es lo mínimo y lo máximo que pagarías por lavar y secar toda la ropa?

Possible Extension:

Each person in your family makes 1 ½ loads of dirty laundry per week, and you don't have any laundry detergent. How many loads of laundry do you need to wash? What is the minimum and maximum amounts that you will pay to wash and dry all the clothes?

Enviro Safe Coin Lavandería



Precios de Lavar (Washing Prices)

La máquina de una carga / Single load washer: \$1.75/load
Las máquinas de dos cargas / Double load washer: \$3.00/load
Las máquinas de tres cargas / Triple load washer: \$4.00/load

Precio de Secar (Drying Price)

\$.25/15 min.

Precio de Detergente (Detergent Price)

\$.75/carga (\$.75/load)

PSTs making meaningful connections to challenge deficit views

- ▶ “When one of the resource room teachers heard about our Community Math lesson project, she exclaimed that it was a great opportunity to “show them how to fix some of their problems. Maybe you can somehow make a lesson that will make parents care about their kids.” We felt passionately that this bias against the community was unfair – clearly parents in the Sunny Hill community care deeply about their children. As such, we wanted our lesson to be a tiny step in the opposite direction; we wanted our project to recognize (and even celebrate) students’ families and values rather than criticize them.”



Preliminary Results from Community Mathematics Exploration: *Attention (superficial)*

- ▶ “Johnny was saving money for a toy he really wanted. His mom decided to bring him to the supermarket to empty his piggy bank in the coin machine. He has 75 quarters, 40 dimes, 26 nickels, and 175 pennies. How much money does he have for his toy?”
 - Connection made to money, local supermarket context, and going to a coin machine
 - Mathematics: low cognitive demand, computation



Benefits for PSTs' Learning

- ▶ “seeing math everywhere”
- ▶ New and more nuanced views of the community
 - as a math resource
 - complex spaces
- ▶ Enhanced view of students' math funds of knowledge
- ▶ Strengthening relationships with students and the community



Challenges for PSTs

- ▶ Tensions:
 - Access to the community
 - Perceived community resistance
 - Hard to connect to math or children's mathematical thinking
 - Hard to pose “important” math problems




Benefits for Teacher Educators

- ▶ Leverages key progress toward project goals of developing an integrated teaching knowledge base and set of practices that privilege mathematics and community-based funds of knowledge.
- ▶ Produces transformative experiences in mathematics instruction
 - Expanding PSTs' views about mathematics and mathematical practice
 - Challenging deficit views of students/communities
 - Making meaningful connections



Challenges for Teacher Educators

- ▶ Logistics
 - Community access, physical location
 - ▶ Pre-preparation
 - ▶ Explicit connections to mathematics and children's mathematical thinking
 - ▶ Supporting PSTs movement toward making meaningful connections
 - Challenging deficit views
 - Challenging uncritical reflection
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For More Information...

- ▶ <http://mathconnect.hs.iastate.edu>

- ▶ This project was launched in May 2008 at the Math Funds of Knowledge Conference funded by the National Science Foundation (DRL#0736964)

