Real Problem Solving Adventures!

Presented by:
Trena L. Wilkerson, Baylor University
Rachelle Rogers, Baylor University
Keith Kerschen, Baylor University

Department of Curriculum and Instruction
Baylor University School of Education

at the
National Council of Teachers of Mathematics Annual Meeting and Exposition
Nashville, TN
November 2015

Polya

(from a lecture on teaching)

"Mathematics is not a spectator sport. To understand mathematics means to be able to do mathematics. And what does it mean to be doing mathematics? In the first place, it means to be able to solve mathematical problems."

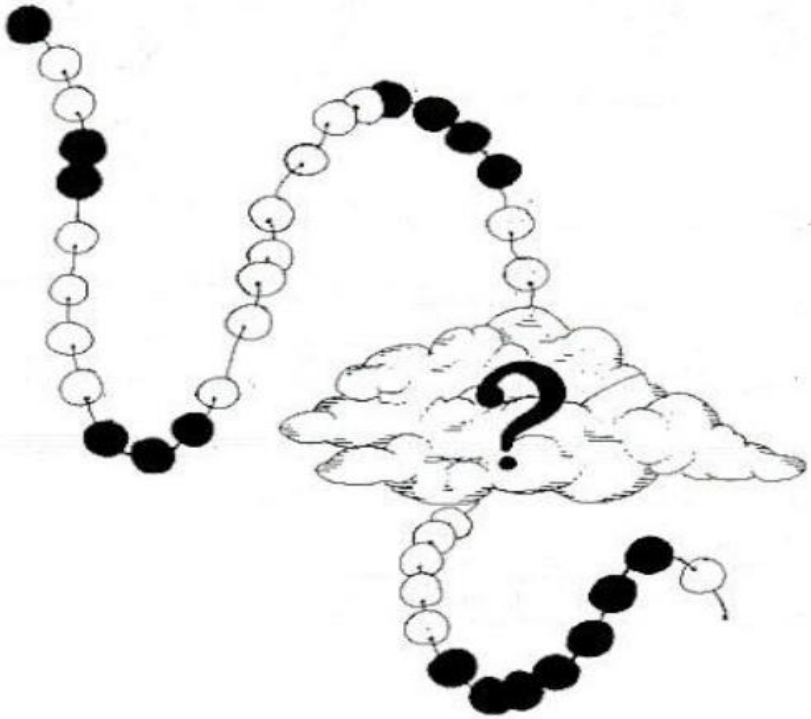
Let's Discuss

- When is solving a problem really problem solving?

- What are characteristics of a 'good' problem solver?

Problem 1: Beads Under the Cloud

How many beads are hidden under the cloud?



NOTE – the cloud is not drawn to scale, and

HINT – remember planes often fly through clouds….

Problem from: Kentucky Department of Education: Secondary Differentiation Resources
http://education.ky.gov/educational/diff/Documents/BeadsUnderTheCloud.pdf

Problem 1: Beads Under the Cloud

How many beads are hidden under the cloud?

NOTE – the cloud is not drawn to scale, and

HINT – remember planes often fly through clouds….

Are there multiple solutions to this problem?

What are some potential student misconceptions?

Is this a good problem solving problem? Why or why not?

Problem from: Kentucky Department of Education: Secondary Differentiation Resources
http://education.ky.gov/educational/diff/Documents/BeadsUnderTheCloud.pdf

Problem 1: Beads Under the Cloud

How many beads are hidden under the cloud?

NOTE – the cloud is not drawn to scale, and

HINT – remember planes often fly through clouds....

Student Example

Problem from: Kentucky Department of Education: Secondary Differentiation Resources
http://education.ky.gov/educational/diff/Documents/BeadsUnderTheCloud.pdf

Common Core State Standards

http://www.corestandards.org/the-standards/mathematics

- Standards for Mathematical Practice
  - Make sense of problems and persevere in solving them.
  - Reason abstractly and quantitatively.
  - Construct viable arguments and critique the reasoning of others.
  - Model with mathematics.
  - Use appropriate tools strategically.
  - Attend to precision.
  - Look for and make use of structure.
  - Look for and express regularity in repeated reasoning.

Principles to Actions

Ensuring Mathematical Success for All

Specific, research-based teaching practices that are essential for a high-quality mathematics education for all students are combined with core principles to build a successful mathematics program at all levels.

http://www.nctm.org/PtA/

Principles to Actions offers guidance to teachers, mathematics coaches, administrators, parents, and policymakers.

It includes:

- Eight research-based essential Mathematics Teaching Practices
- Conditions, structures, and policies necessary to support the Effective T
- Implementation strategies for the Common Core State Standards for Ma *Principles and Standards for School Mathematics* and designed to attain of mathematics achievement for all students
- Unproductive and productive beliefs, obstacles, and key actions that mu acknowledged, and addressed by all stakeholders
- Strategies for teachers to engage students in mathematical thinking, rea making to significantly strengthen teaching and learning

Executive Summary Resumen Ejecutivo Overview

Professional Learning Materials

- Exploring Proportional Relationships: Candy Jar (Frasco de dulces)
  - The Case of Mr. Donnelly
  - El caso del profesor Donnelly
  - Effective Teaching Practices
- Exploring Exponential Relationships: Pay It Forward
  - The Case of Ms. Culver
  - Effective Teaching Practices
- Exploring Representations for Multiplication: The Band Concert
  - The Case of Mr. Harris
  - Effective Teaching Practices

Related Resources

Mathematics Teaching Practices

1. Establish mathematics goals to focus learning.
2. Implement tasks that promote reasoning and problem solving.
3. Use and connect mathematical representations.
4. Facilitate meaningful mathematical discourse.
5. Pose purposeful questions.
6. Build procedural fluency from conceptual understanding.
7. Support productive struggle in learning mathematics.
8. Elicit and use evidence of student thinking.

(NCTM, PtA 2014, p. 10)

Problem #2: The Square Pizza Puzzle

The Pizza Palace has started to make square pizzas. This sounds good to Myra, who wants her family to one for dinner.

“No way,” says her brother Kenji. “It costs too much. A 12-inch round pizza with four toppings costs $11.00 at Mondo’s. The Pizza Palace wants $13.00 got their 12-inch square pizza with four toppings.”

Show which pizza company charges more per identical size piece of pizza.

Oregon Department of Education
www.ode.state.or.us

Engage

How would you engage your students with this problem?

I will have a picture of a pizza on the television for the students to see as they walk into the room. I will engage the students by passing around clippings of pizza coupons. We will begin to have a discussion about what they see on the coupons from different pizza companies. I will ask them how they truly know when they are getting the best deal. This will lead into them exploring the pizza puzzle.

What would you think about if I said pizza? I would think about Chicago because I am from Chicago; so when I think of pizza, I think of deep-dish pizza. The #1 deep-dish pizza happens to be from Chicago. Has anyone tried deep-dish pizza? You know deep-dish pizza can be circular or it can be square, which brings me to my problem. My family and I wanted to get some pizza, but we had some disagreements on price because my dad wanted the most pizza for the best price. Here was our problem:

Explore

When students explore, what is the teacher's role/responsibility? What is the student's role/responsibility?

On your own, you will try to figure out the problem. There are many different ways you can solve this problem.
(After 5 minutes)
Now, turn to your partner and discuss how to solve it or if you have already solved it, share your strategy.

Explain

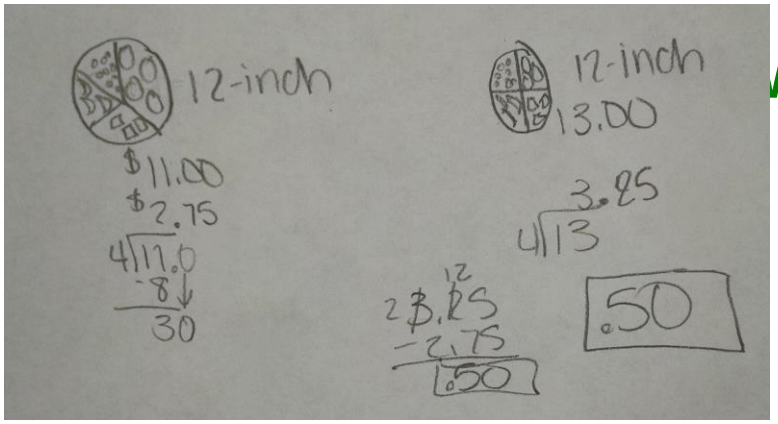
How can we assist students in succeeding as a problem solver?

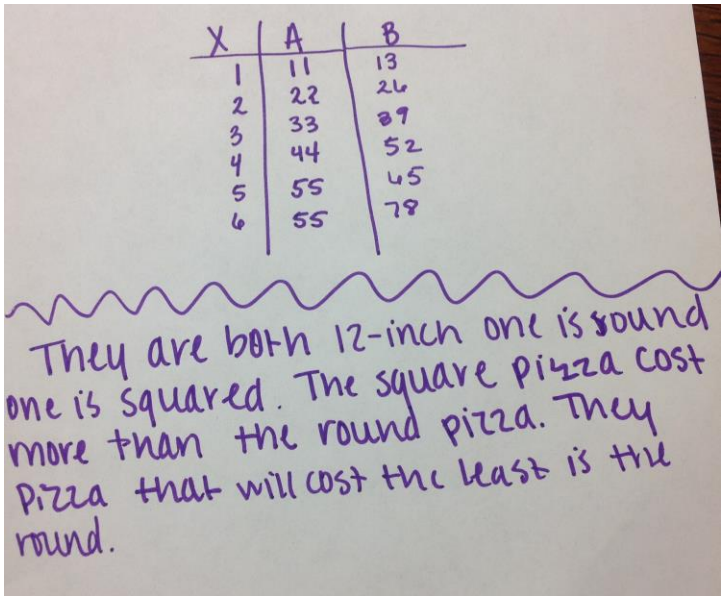
Walk around the classroom and monitor the students as they answer the problem. Pick a few students who solved the problem in different ways and ask them to present to the class how they found the answer.

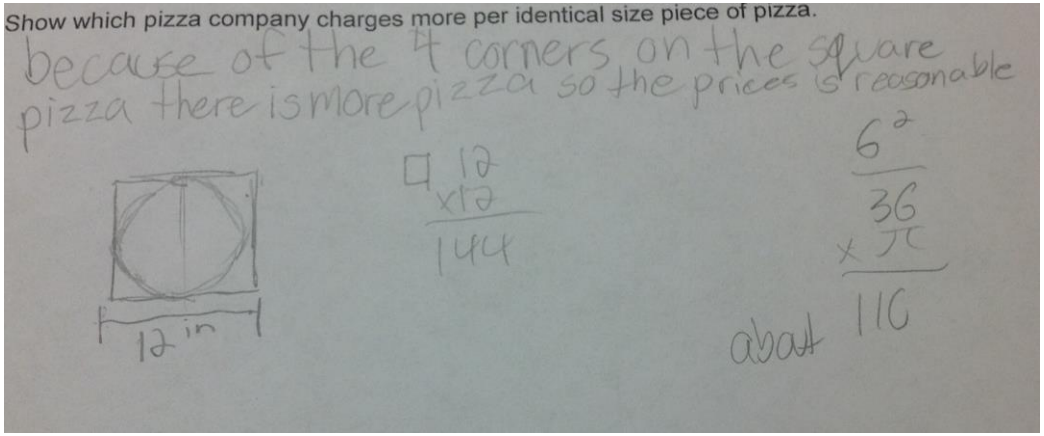
Ask the students who presented how they solved the problem. After each student presents how they found the answer, ask the rest of the class if anyone solved the answer similarly to the student who presented.

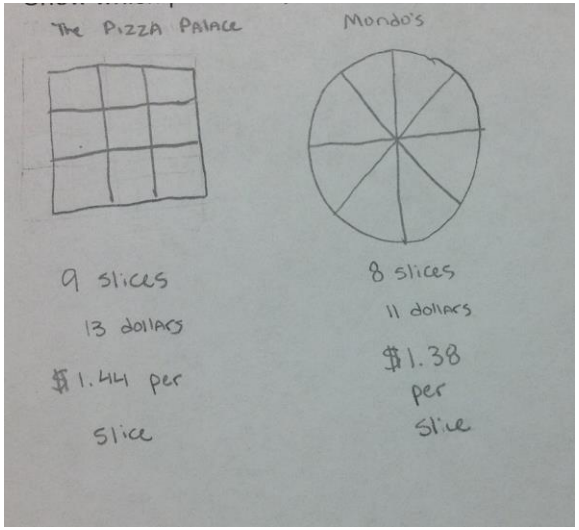
After the students present, I will show how I solved the problem.

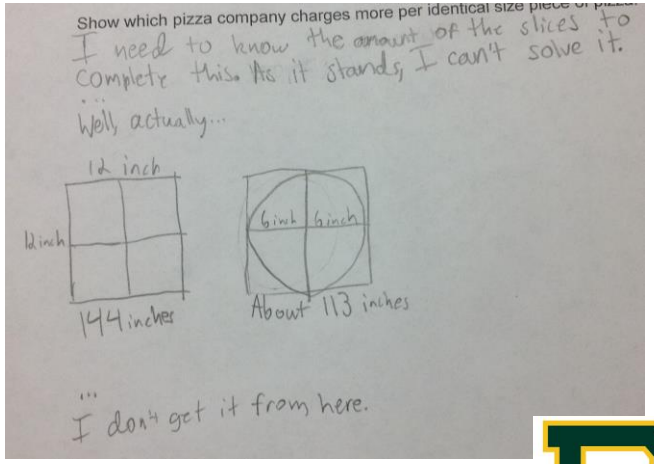
Would Students Do?





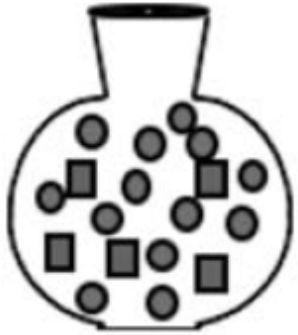






Candy Jar Problem

Suppose you have a new candy jar with the same ratio of Jolly Ranchers (JR) to jawbreakers (JB) as shown in the picture, but it contains 100 Jolly Ranchers.



How many jawbreakers do you have?

Justify your answer.

Note: In the picture, Jolly Ranchers are represented by 5 rectangles, and jawbreakers are shown by 13 circles.

Fig. 12. The Candy Jar task. Adapted from Smith et al. (2005).

Candy Jar Problem-Potential Student answers!

- 260
- 360
- 40
- 26
- 340
- 50
- 240
- 270
- I do not know

- 2600
- 65
- 100
- 38.14
- 82.3
- 30
- 87
- 250
- I do not understand

- 108
- 325
- 35
- 61
- 6.9
- 38
- 160
- 13

- 20
- 36
- 7 R 9
- 50/50
- Less than 78 but more than 65

NCTM Classroom Resources

- http://www.nctm.org/Classroom-Resources/Connect-with-NCTM-Illuminations/

Classroom Resources | Publications | Standards & Positions | Research & Advocacy | Conferences & Professional Developmen

- Lesson Plans
- Interactives & Mobile Apps
- Problems
- Student Explorations in Mathematics
- Browse All Classroom Resources
- Share and Review Resources
- Success Stories

- http://www.nctm.org/Classroom-Resources/Core-Math-Tools/Core-Math-Tools/
- Hirsch, Martin, Hopfensperger, Zbiek (AMTE 2013)

NCTM | NATIONAL COUNCIL OF TEACHERS OF MATHEMATICS

Classroom Resources | Publications | Standards & Positions | Research & Advocacy | Conferences & Professional Develop

Core Math Tools

0

- Core Math Tools
- General Purpose Tools
- Custom Apps
- Advanced Apps
- Sample Lessons
- Data Sets
- How-To Pages

Core Math Tools is a downloadable suite of interactive software tools for algebra and functions, geometry and trigonometry, and statistics and probability. The tools are appropriate for use with any high school mathematics curriculum and compatible with the Common Core State Standards for Mathematics in terms of content and mathematical practices. Java required.

General Purpose Tools CAS, Spreadsheet, Geometry, Data Analysis, and Simulation	Custom Apps Focused explorations of specific topics	Advanced Apps Focused explorations of advanced topics
Sample Lessons Problem-based lessons that employ *Core Math Tools*	Data Sets Wealth of data sets organized by data type	How-To Pages Help, hints and steps to do basic tasks

NCTM Supporting Resources

- http://www.nctm.org/Conferences-and-Professional-Development/Professional-Development-Resources/

Professional Development Resources

Principles to Actions Toolkit	This toolkit consists of a series of grade-band specific modules that are focused on a subset of the effective teaching practices as well as professional learning resources that support implementation of the five guiding principles in the publication, Principles to Actions: Ensuring Mathematical Success for All, other than Teaching and Learning: Access and Equity, Curriculum, Tools and Technology, Assessment, and Professionalism.
Professional Development Guides	NCTM school journals and other publications are a rich resource for professional development. Professional Development Guides are detailed guides for using journal articles and books as professional development experiences.

Sample NCTM Resources

www.nctm.org

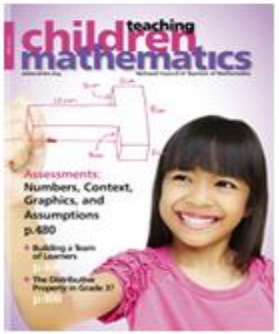
- *Implementing the CCSS though Mathematical Problem Solving: For various grade bands*
- *Connecting the NCTM Process Standards and the CCSSM Practices*
- *5 Practices for Orchestrating Productive Mathematics Discussions*
- *Principles to Action: Ensuring Mathematical Success for All*
- *Essential Understandings*

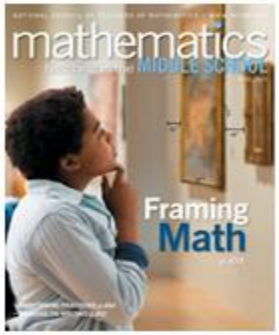
National Council of Teachers of Mathematics
www.nctm.org

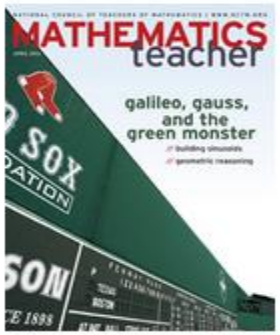
Full Individual Membership and E-Membership

For $84 per year, Full Individual Members get a FREE print subscription to one of the following award-winning school journals, which includes full online access to that journal. For $72 per year, E-Members get a FREE digital edition to one of the following award-winning school journals.

- *Teaching Children Mathematics* (Pre-K-6)
- *Mathematics Teaching in the Middle School* (5-9)
- *Mathematics Teacher* (8-14)







National Council of Teachers of Mathematics
www.nctm.org

About | Affiliates | News & Calendar | Career Center | Get Involved | Support Us | View Cart | NCTM Store

NCTM | NATIONAL COUNCIL OF TEACHERS OF MATHEMATICS

Classroom Resources | Publications | Standards & Positions | Research & Advocacy | Conferences & Professional Development | Grants & Awards | Membership

PreK-8 School Membership

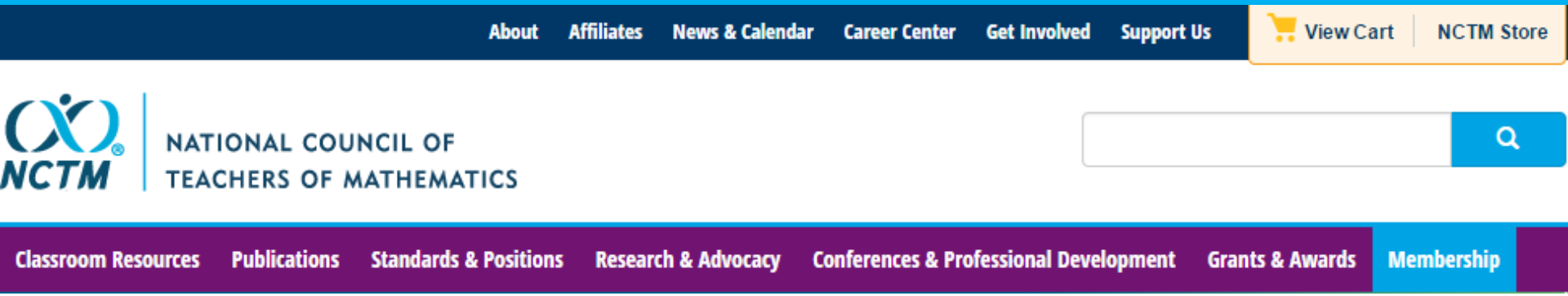
For $144 per year, your school will get a FREE print-only subscription to one of the follow

- *Teaching Children Mathematics* (PreK–6)
- *Mathematics Teaching in the Middle School* (5–9)

Five FREE E-Memberships for teachers in your school
All the benefits of an e-membership including full access to the digital edition of *Teaching Children Mathematics* or *Mathematics Teaching in the Middle School* (a $72 value!) FREE!

To involve more teachers, additional e-memberships can be added for just $10 each.

National Council of Teachers of Mathematics
www.nctm.org



New Member Discount

$20 off for full membership
$10 off e-membership
$5 off student membership

Use Code: **BDB0616**

BTW0616	Trena Wilkerson campaign/discount- $20 off full individual membership or $10 off e-membership, $5 for students for lapsed or never members

NCTM Regional Conferences

www.nctm.org

Atlantic City
October 21-23
Minneapolis
November 11-13
Nashville
November 18-20

NCTM Interactive Institutes
www.nctm.org

Grades PK-5, 6-8, High School,and Administrators
February 5–6, 2016
Dallas

NCTM Conferences
www.nctm.org

2016 Annual Meeting and Exposition

April 13–16, 2016
San Francisco

TODOS 2016 Conference

Ensuring Equity and Excellence in Mathematics For ALL

June 23-25, 2016

Scottsdale Plaza Resort, Phoenix, AZ

Participants will leave with important tools, strategies, ideas, and models for their own settings so they can advocate for and enact mathematics teaching that increases Equity, Access, and Achievement for ALL students through rigorous and coherent mathematics.
http://www.todos-math.org

Classroom Teacher Scholarships Available!

TODOS 2016 Conference is co-sponsored by NSF-funded Arizona Master Teachers of Mathematics (AZ-MTM), award #1035330,administered by the Department of Mathematics at The University of Arizona.

Thank you!

Contact Information

Trena_Wilkerson@baylor.edu
Rachelle_Rogers@baylor.edu
Keith_Kerschen@baylor.edu