DEVELOPING MATHEMATICS TEACHERS' MATHEMATICAL PROBLEM SOLVING THROUGH A MATH TEACHERS' CIRCLE FRAMEWORK

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DISCUSSION POINTS

- Origins of the Central VA MTC
- Background of Central VA MTC
- Snapshot of MTC Problem-Solving Sessions
- Unique Perspectives of Our MTC

CENTRAL VA MTC ORIGINS

- NEW MTC – FIRST SESSION FALL 2015
- DESIRE TO START A “CLUB” FOR LOCAL MATHEMATICS TEACHERS
- UNDERSTAND THAT MTC WOULD NOT LOOK LIKE THE TRADITIONAL PD
- PLAN, PLAN, PLAN
- STUDY/INVESTIGATE SUCCESSFUL MTCs IN THE COUNTRY
- IDENTIFY AND USE AVAILABLE RESOURCES
- SEEK SUPPORT OF DEPARTMENT, COLLEGE, AND UNIVERSITY

UNDERSTANDING THE DIFFERENCE BETWEEN TRADITIONAL PD AND THE PHILOSOPHY OF THE MTC

Traditional PD

- Mandated in schools
- Time consuming
- Information may not always be relevant or applicable

MTC

- Hands on
- Teachers are students
- Fun learning environment
- Teachers ideas are taken into consideration

PLAN, PLAN, PLAN

- Implementation of Central VA MTC was Fall 2015
- Engaged in 1 year planning effort prior to implementation
  - Study other MTCs throughout the country
  - Communication with AIM
    - Circle mentor and visit to sister circle
  - Form Leadership Development Team
  - Develop Circle Goals and Objectives
  - Create Budget for MTC and Explore Funding Options
  - Recruit teachers from different districts
    - Sell the product
    - Invitations and word of mouth
  - Create a calendar for the year

EXPLORING OTHER MTC RESOURCES

JMM 2014

- Attended MTC sessions, where we made contact with several colleagues with current MTC
- Left with bank of possible problems for MTC use
- Explored meaningful ways to couple our MTC implementation with VSU's NSF Noyce grant model and VDOE Innovative Mathematics Partnership for Rural Elementary Schools model

AIM Guidance

- Initial phone conference
- Helpful with Circle Organization
- Provide Circle Mentors
- Provide opportunities to visit other MTC
- Math problems resources online

MSRI NAMC

- Participated in August 2015 workshop for MTC organizers in all phases of Math Circle planning process
- Build math circle Networks – Listserv and Ongoing Webinars
- Problem solving approach thoroughly investigated
- Opportunity to see a MTC
- Participation in Julia Robinson Math Festival

BACKGROUND INFORMATION

- 13 secondary mathematics teacher participants
- 4 M.S. and 9 H.S. teachers
- 3 participants on Leadership Development Team, along with 3 mathematics university faculty
- 5 of teachers are involved in other University projects/grants
- 5 school districts represented
- Blended mix of certified, lateral entry, novice, and veteran teachers
- Funding (for meals and supplies) from AIM

SNAPSHOT OF CENTRAL VA MTC SESSION

Agenda for MTC Session #2
Thursday, November 12th
5 – 7 pm

1. Welcome/Dinner
2. MTC Teacher Led Problem
3. MTC Problem Solving Activity
4. Activity Debrief
5. Closing Remarks/Announcements
6. Submission of Session Evaluations

- Sessions take place every 2nd Thursday
- 2 Hour Session
- Dinner is provided
- Door prizes are given
- **“it’s okay not to know the answer!”**
- Problem solving skills needed/developed
- Hands on learning
- Always debrief
- Evaluations are important

SAMPLE PROBLEM #1 : COLORING CUBES

Julia Robinson Mathematics Festival

Directed by Joshua Zucker
Castilleja School

Coloring Cubes, or Painting Permutations

Part 1: Paint, then cut.

We'll take a cube whose edges are n units long; paint its surface completely; cut it into unit cubes, whose edges are 1 unit long; and then ask how many unit cubes are painted in which way. Clearly, if you start with a 1-unit cube, you end up with 1 unit cube painted on all 6 sides, and that's it.

1. If you start with a 2-unit cube, how many of the resulting unit cubes are completely unpainted? Painted on just 1 side? Two sides? Three sides?

2. Starting with a 3-unit cube, answer the same questions.

3. Repeat for a 4-unit cube.

4. Repeat for an n unit cube. Can you find the pattern?

Part 2: Cut, then paint.

Now we're going to first cut the cube into unit cubes, paint them, and then put them back together. But there's a little catch! We want to paint it with several different colors, in fact as many as possible, so that it can be reassembled to make a cube whose outside is all one color. With a 1-unit cube, this problem is a bit too easy. Paint the cube one color, and it's already back together.

5. With a 2-unit cube, you can cut it into 8 1-unit cubes, and paint them with two colors in such a way that you could put them back together into a 2-unit cube of either color. How should you paint them?

6. With a 3-unit cube, cut into 27 1-unit cubes, can you paint them with three colors in such a way that they can be put back together into a 3-unit cube of any of the three colors? If so, how? If not, why not?

7. Does this generalize? Starting with an n-unit cube, can you cut it into 1-unit cubes and paint them with n colors in such a way that they can be reassembled into an n-unit cube of any one of the colors?

SAMPLE PROBLEM #2 : CANDY SHARING GAME

Candy Sharing Game Rules

The players should sit in a circle. Each circle will have a leader who starts the game by distributing wrapped candies among participants. The distribution of candy will not necessarily be even (some players will start out with more and some players may start out with none).

During the game, players should keep their candy in front of them. When the leader says “Share!", everyone who has two or more pieces of candy in front of them gives one piece to the person on their right and one piece to the person on their left. They should use both arms to do this at the same time.

Players with one or zero pieces of candy do nothing. After the appropriate players have shared candy, the leader will say “Share!" again. This process repeats until the group sees a pattern emerge in the game.

Several things might happen with the game.

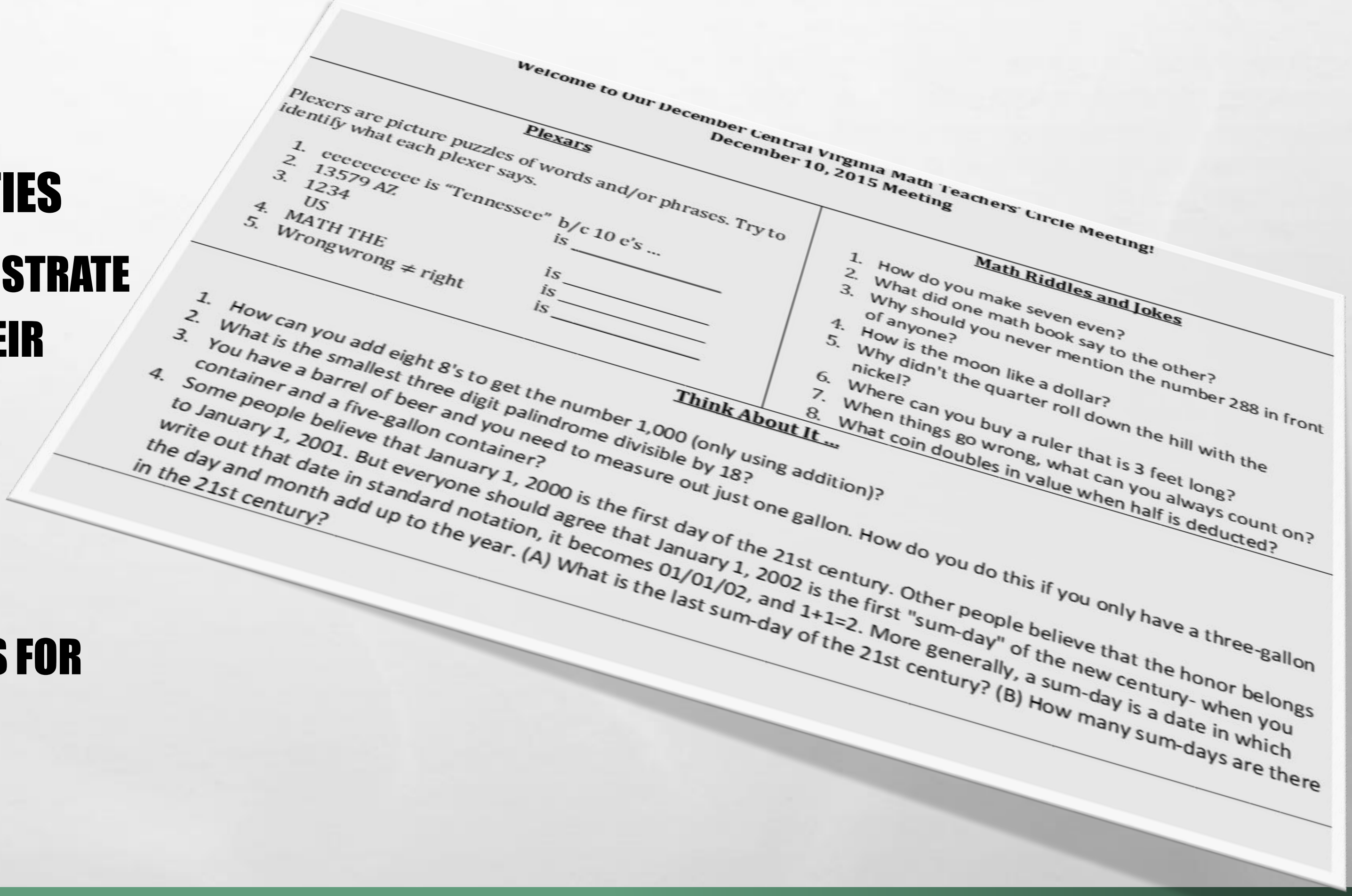
1. The game might stop because no one is passing candy any more.
2. The game might settle down so that even though everyone passes candy every time, the amount of candy that each player has is always the same. This is called a fixed point.
3. A repeating pattern might emerge in the way that the candy is shared. This is called a cycle.

Candy Sharing Activity Challenges

- Find an initial distribution of candy that eventually causes the game to stop.
- Find an initial distribution of candy that leads to a fixed point.
- Find an initial distribution of candy that leads to a cycle.
- What is the smallest amount of candy that you can use to design a game that never stops?
- What is the smallest amount of candy that you can use if you want to guarantee that the game will never stop no matter how the leader distributes the candy.
- What is the largest amount of candy that you can use if you want a game that leads to a cycle instead of a fixed point? Smallest amount?
- What is the smallest amount of candy that you can use if you want to guarantee that the game will lead to a fixed point no matter how the leader distributes the candy?

UNIQUE PERSPECTIVES OF OUR MTC

- INCORPORATE TIME FOR TEACHER LED ACTIVITIES
  - ALLOW 30 MINUTES FOR TEACHERS TO DEMONSTRATE COOL ACTIVITIES THAT THEY ARE DOING IN THEIR CLASSROOM
- DIFFERENT MEETING LOCATIONS AND THEMES
  - DECEMBER HOLIDAY SOCIAL
  - ALLOW TEACHER TO OPEN THEIR CLASSROOMS FOR FUTURE MEETINGS


Welcome to Our December Central Virginia Math Teachers' Circle Meeting!
December 10, 2015 Meeting

Plexars

Plexers are picture puzzles of words and/or phrases. Try to identify what each plexer says.

1. eeeeeeeeee is "Tennessee" b/c 10 e's ...
2. 13579 AZ is ____________
3. 1234 US is ____________
4. MATH THE is ____________
5. Wrongwrong ≠ right is ____________

Math Riddles and Jokes

1. How do you make seven even?
2. What did one math book say to the other?
3. Why should you never mention the number 288 in front of anyone?
4. How is the moon like a dollar?
5. Why didn't the quarter roll down the hill with the nickel?
6. Where can you buy a ruler that is 3 feet long?
7. When things go wrong, what can you always count on?
8. What coin doubles in value when half is deducted?

Think About It ...

1. How can you add eight 8's to get the number 1,000 (only using addition)?
2. What is the smallest three digit palindrome divisible by 18?
3. You have a barrel of beer and you need to measure out just one gallon. How do you do this if you only have a three-gallon container and a five-gallon container?
4. Some people believe that January 1, 2000 is the first day of the 21st century. Other people believe that the honor belongs to January 1, 2001. But everyone should agree that January 1, 2002 is the first "sum-day" of the new century- when you write out that date in standard notation, it becomes 01/01/02, and 1+1=2. More generally, a sum-day is a date in which the day and month add up to the year. (A) What is the last sum-day of the 21st century? (B) How many sum-days are there in the 21st century?

QUESTIONS?