Great Problems, 
Great Sessions, 
Great Circles

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Key Questions

• What makes a great problem?
• What makes a great session?
• How do you go from a great problem to a great session?
What is a problem?

- Exercise: Something that can be easy or hard, but that you know how to do
- Problem: Something challenging that you don’t already know how to do
Problem

"cognitive dissonance" connects to

Rich - different approach
No obvious method
understandable

Multiple paths to solution
Clarity

Variety of topics / levels
WANT to know answer!
Related to "old" material

Possibility to leave with
Think about it

Different levels of understanding
Incomplete closure, good for "open-ended"

Connects to other areas
New way of seeing
Grounded in simplicity
Scalability

Connects to other topics

Varied entry points and exit points
Instigate questions

Enticing

Some closure possible
Session

- relates to curric.
- shows human process
- leads to lotsa discussion
- facilitator vs instructor
- on task
- End with "mess"
- prepared facilitator
- "appropriately" paced
- enthusiastic participants
- progress at each step
- team-building activities

Leave with things you can use
- Bridging/Acids
- good & posed
- lotsa reflection
- feedback
- willingness to sacrifice plan/ prep

Safe environment
- everyone contributes
- multiple strategies
- tables & desks

Enthusiastic leader
- integrated
- take/ encourage struggle w/o NOT too much frustration
- Name tags
- participants at demand
- own background/review etc
- reward risk w/ respect

A culture-setting facilitator

Sensitivity re: "wayward" participants
- relaxed
- no one leaves early/disconnected
What makes a good problem?

What makes a good session?

Great problems are...

- Perplexing
During the long days and evenings of challenging math, we coined a new word "funstration" — it was fun but frustrating because of the complexity of the problems and solutions. The North-
Theme Song of the Heartland MTC (Olathe, KS)

If you’re in a math circle,
You’re bound to feel frustration!
Even though the answer sets
Are proved by demonstration.
Don’t worry, you won’t work alone
You’ll find cooperation.
If you’re in a math circle,
You’re bound to feel frustration!
Great problems are...

- Perplexing
- Swimming pools
Grid Power
Tatiana Shubin

View the playlist...

Synopsis: In this session, led by Tatiana Shubin (San Jose State University), a sheet of grid paper and a simple counting question reveal some deep mathematical surprises.

Length: 1 hour, 17 minutes

Session materials:
• Grid Luck, Tatiana Shubin

Middle school curriculum materials:
• Grid Paper Exploration, by Randy Lomas (Harvest Park Middle School; AIM MTC). Published in the California Mathematics Council Communique, 40(4), June 2016.

Resources and session video available at
http://www.mathteacherscircle.org/resources/videos/
Great problems are...

• Perplexing
• Swimming pools
• Gateways to mathematical landscapes
Exploding Dots

Resources and videos available at [www.globalmathproject.org](http://www.globalmathproject.org) (and sign up for Global Math Week while you are there!)
Great sessions...

- Give participants time to think
Great sessions...

• Give participants time to think
• Have landmarks along the way
An Introduction to Problem Solving

Joshua Zucker

View the playlist...

Synopsis: Joshua Zucker (Julia Robinson Math Festivals) leads a session on the 1-to-100 problem. Along the way, many problem-solving strategies are revealed, including trying a smaller problem.

Length: 1 hour, 54 minutes

Session materials:
- The 1 to 100 Problem, Tom Davis and Joshua Zucker
- An Introduction to Problem Solving, Joshua Zucker

Resources and session video available at
http://www.mathteacherscircle.org/resources/videos/
Great sessions...

• Give participants time to think
• Have landmarks along the way
• Have a little magic
Conway's Rational Tangles

Tom Davis

View the playlist...

Synopsis: Tom Davis (AIM Math Teachers' Circle) presents a mathematical rope dance with two moves: twist and rotate. Given that “untwist” and “unrotate” aren’t legal moves, is it always possible to return to an untangled state?

Length: 1 hour, 35 minutes

Session materials:

- Conway's Rational Tangles, Tom Davis
- Understanding Rational Tangles, James Tanton
- Slides from a presentation by Altha Rodin (MTC Austin) on Rational Tangles using individual tabletop tangle cards

Middle school curriculum materials:

- Blog post by middle school math teacher Fawn Nguyen (Thousand Oaks MTC) on doing “Rational Tangles” with middle grades students

Resources and session video available at
http://www.mathteacherscircle.org/resources/videos/
The Evolution of a Session: SET

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The Original SET Contraption
In the beginning...

• Didn’t allow enough time for people to play the game
• Focused on our own questions and interests (e.g., how many cards can you have without having a Set?)
• Also spent a lot of time coordinatizing the cards and using that to explore characteristics of sets (lines), planes, etc.
Over time...

- Built in more time to play
- Provided a chance toward the beginning of the session for participants to brainstorm questions
- Focused on the most magical part: the geometry!
Major Changes

• Respect the need for participants to play.
• Provide time for problem posing.
• Focus on the magic!
Thank you!

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