Playing It By Ear
The First Year of SCHEMaTC:
South Carolina High Energy Mathematics Teachers Circle

George McNulty [2] Nieves McNulty [1] Douglas Meade[2]
Diana White[3]

[1]Columbia College

[2]University of South Carolina

[3]University of Colorado, Denver

MathFest 2013
Hartford, Connecticut

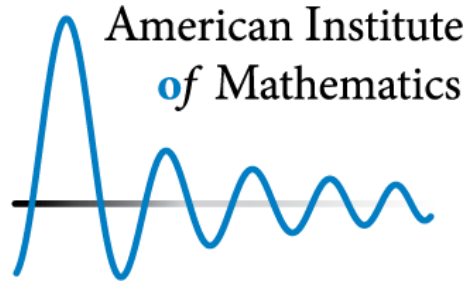
A Bit of History

- Math Circles for school students arose in Russia and Eastern Europe in the 20^{th} century. The Berkeley Math Circle for Students was launched in 1998 under the auspices of the Mathematical Sciences Research Institute. This movement has spread across the country.
- The first Math Teachers' Circle was formed in 2006 in the San Francisco Bay Area. Today there are more than 50 Math Teachers' Circles found all across the country.
- The American Institute of Mathematics in Palo Alto (and soon Morgan Hill) provides workshops for teams of mathematicians and middle school teachers on how to start their own Math Teachers' Circles.

What Is a Math Teachers' Circle?

- A **Math Teachers' Circle** is a community of local middle school math teachers and professional mathematicians.
- The mission of a Circle is to foster **a culture of mathematical problem solving in the middle school classroom** by enhancing each teacher's engagement in and enthusiasm for mathematics through tackling open-ended and mathematically rich problems.

Getting Our Circle Started



We participated in the June 2011 Math Teachers Circle Workshop at the American Institute of Mathematics in Palo Alto. Thanks for the ideas and support! Our special thanks to Brianna Donaldson, Brian Conrey, and all the facilitators at that workshop.

Getting Our Circle Started

During 2011–2012 we hustled funding to support our circle.

We courted deans and provosts at Columbia College and the University of South Carolina.

Sought partnerships with two high need school districts in our area.

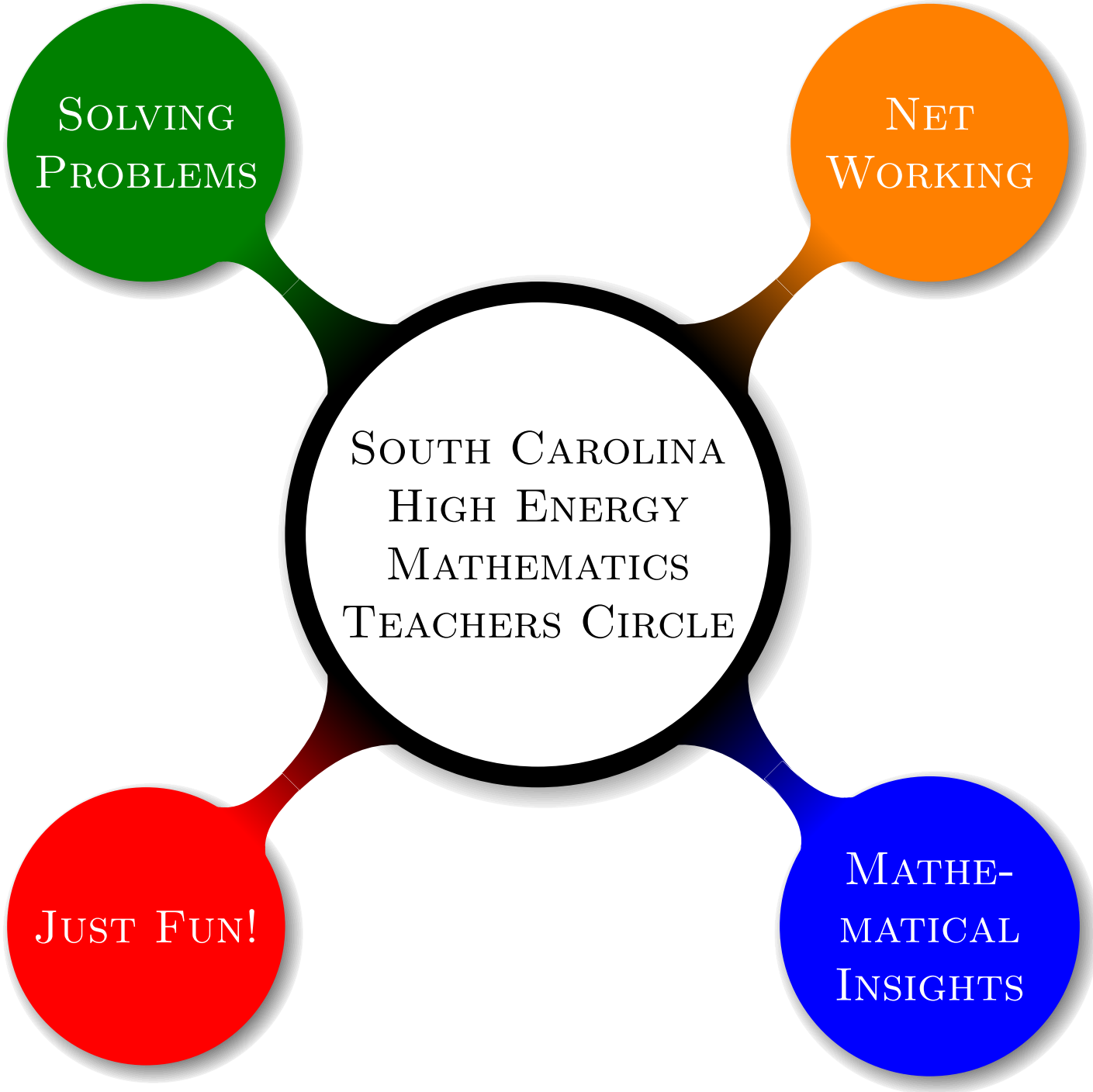
We recruited teachers and college faculty members.

Getting Our Circle Started

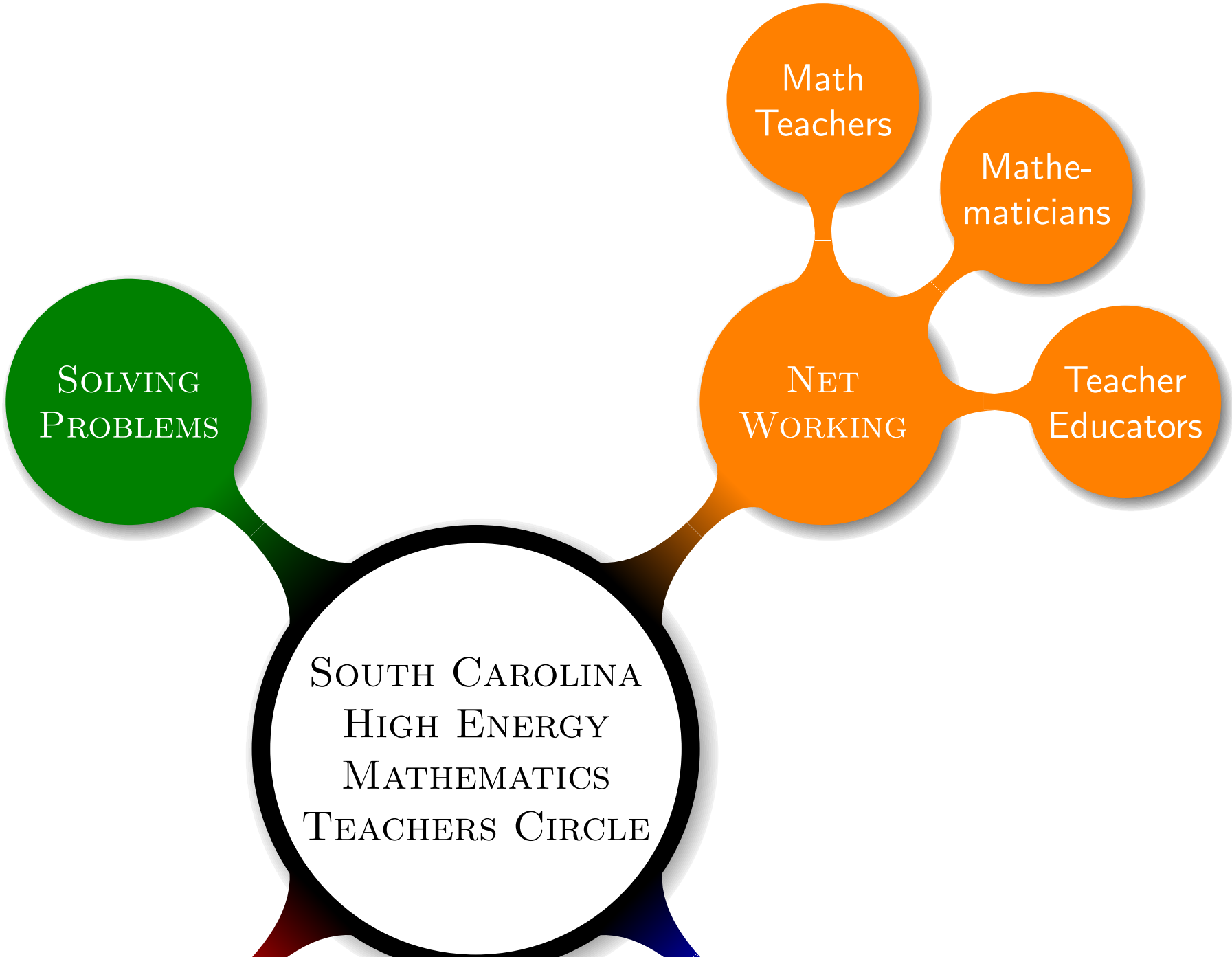
Our Circle is funded by a grant from the South Carolina Commission on Higher Education and the U.S. Department of Education under the auspices of the Improving Teacher Quality Higher Education Grant Program We appreciate this support!

Our First Event

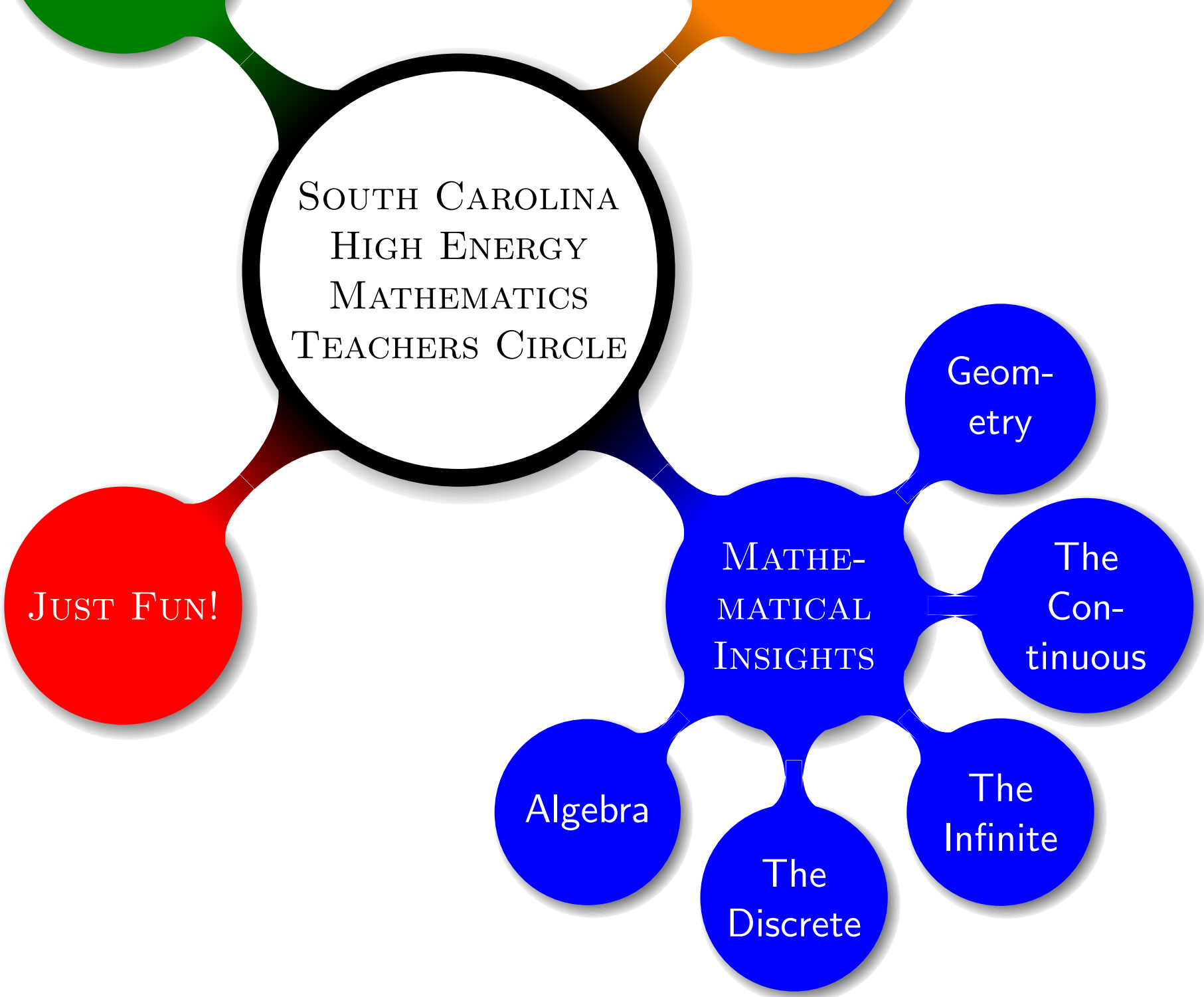
Our First Summer Immersion Workshop was held in July 2012 at Hickory Knob State Resort Park in South Carolina. 16 middle school teachers and 7 college faculty members participated. Several teachers could not attend but expressed strong interest.


Solving Problems
Net Working
South Carolina High Energy Mathematics Teachers Circle
Just Fun!
Mathe-matical Insights


Draw a Picture
Just Try It!
Gen-eralize
Try Some-thing Easier
Solving Problems
Partial Solutions
Sleep on It
Net Working
South Carolina High Energy Mathematics Teachers Circle

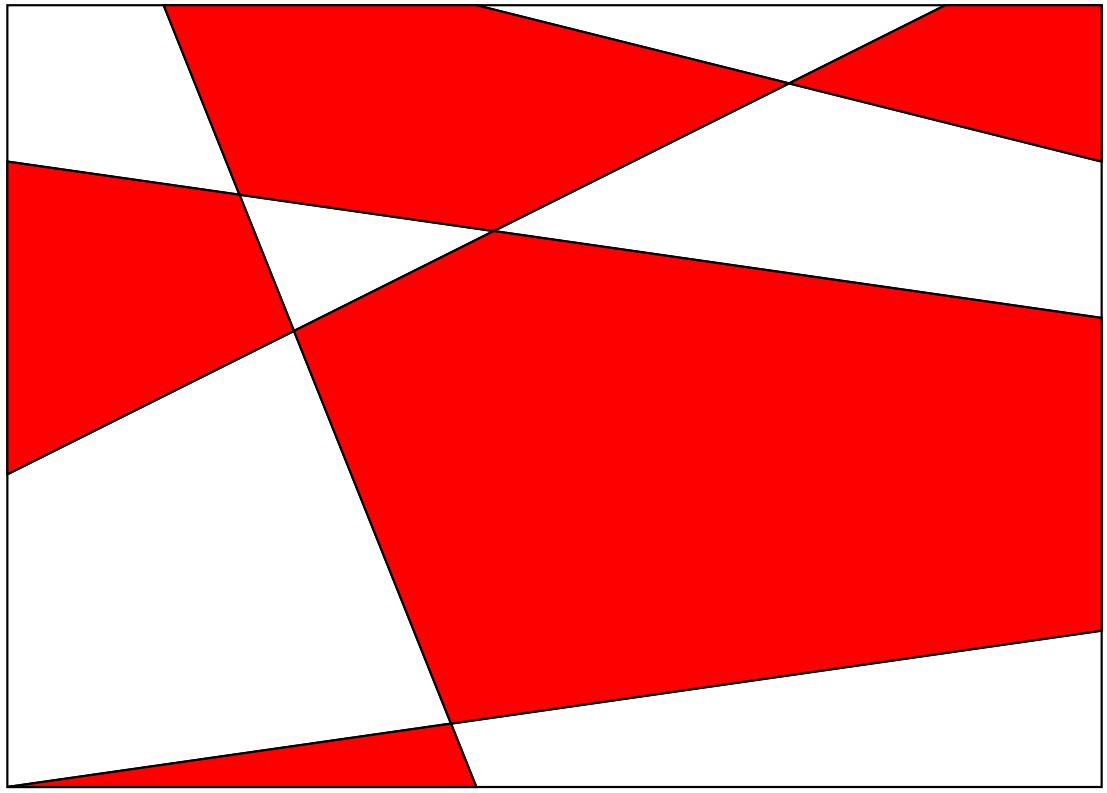

Math Teachers
Mathe-maticians
Net Working
Teacher Educators
Solving Problems
South Carolina High Energy Mathematics Teachers Circle


07/27/2012


South Carolina High Energy Mathematics Teachers Circle
Just Fun!
Mathe-matical Insights
Geom-etry
The Con-tinuous
Algebra
The Discrete
The Infinite

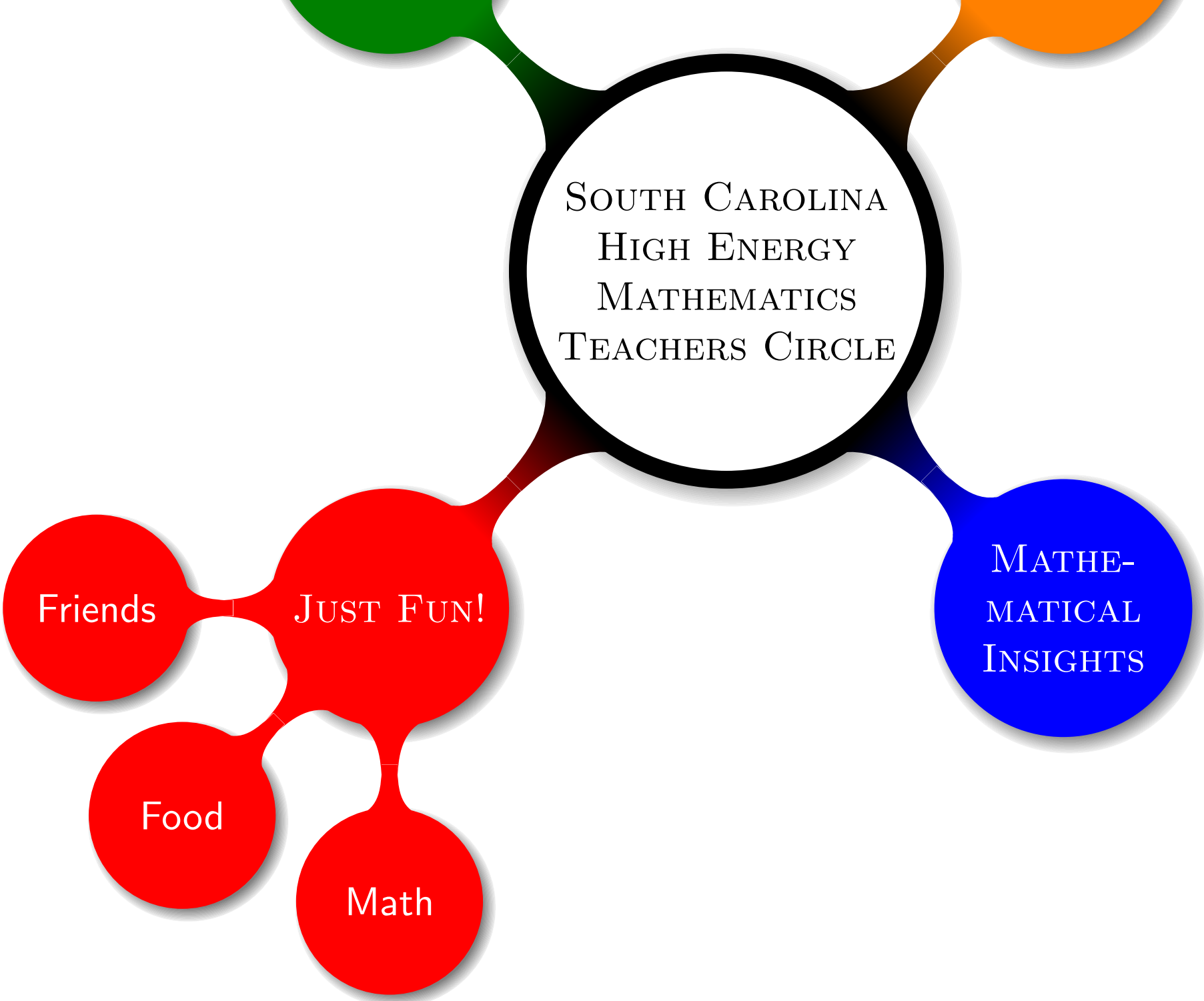
Coloring Maps Led to Induction

Maps with Straight Line Boundaries

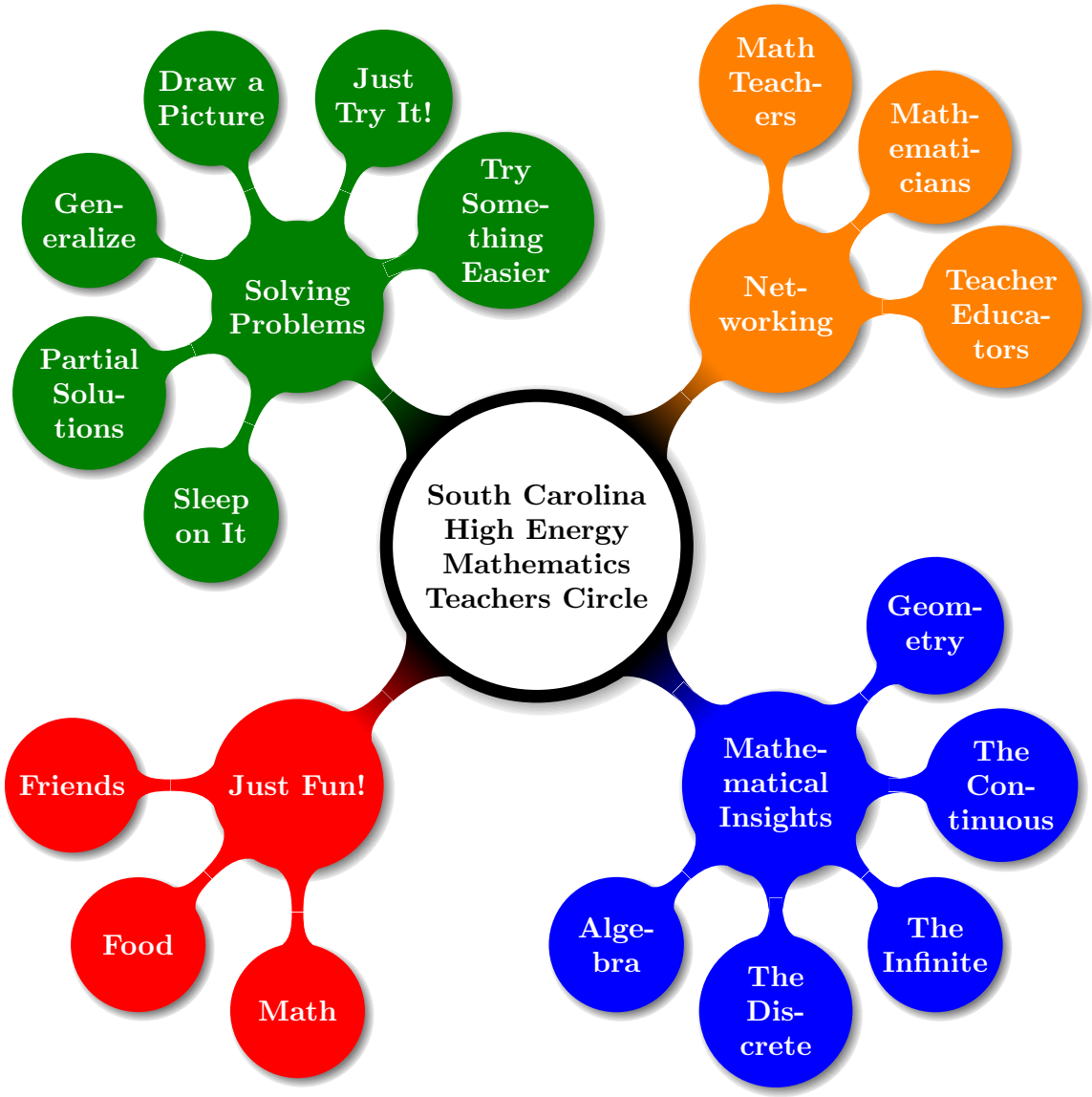


These can always be colored with just two colors!

We convinced ourselves with Mathematical Induction.


South Carolina High Energy Mathematics Teachers Circle
Just Fun!
Friends
Food
Math
Mathe-matical Insights


EXIT
Problem Solving Strategies
Chunking
Make a mistake &
Substitute values into problem
Change to another problem
Work backwards
Guess and check
Trial and Error
Patterns
KERRA


South Carolina High Energy Mathematics Teachers Circle
Solving Problems
Draw a Picture
Just Try It!
Try Some-thing Easier
Gen-eralize
Partial Solu-tions
Sleep on It
Net-working
Math Teach-ers
Math-emati-cians
Teacher Educa-tors
Just Fun!
Friends
Food
Math
Mathe-matical Insights
Geom-etry
The Con-tinuous
The Infinite
The Dis-crete
Alge-bra

During the Academic Year

After the Summer Immersion Workshop. . .

- We met three times in the fall and four times in the spring.
- Our meetings are on Saturday from 9:30 a.m. to 1:30 p.m.
- In June 2013 we had a two-day Emergence Circle Workshop.
- We obtained an extension of our grant to double the size of our Circle.
- Two teachers dropped out of our Circle.

Our Circle Gets in Touch with the Classroom

- Our teachers were eager to put the kind of solving of mathematical problems that is central to our Circle into play in their classrooms.
- Our teachers were intent on implementing the new Common Core Standards of Mathematical Practice.
- These new Common Core Standards are an excellent fit with the philosophy of Math Teachers' Circles!

As the year unfolded we began devoting a significant part of our meetings to discussing how to introduce problem solving into middle school classroom and to exploring the impact of the Common Core.

A Typical Saturday Session

- Present open-ended mathematical problems.
- Circle members work in groups to come up with solutions.
- Share and discuss solutions and different ways to get at the solutions.
- Eat lunch and continue to discuss things.
- Make connections to the middle school classroom environment and to the Common Core.

Our Second Immersion Workshop

- Our Circle Expanded! We have 32 middle and high school math teachers (including 2 of the Circle organizers), three teacher educators, and four mathematicians.
- Our 5-day Summer Immersion Workshop was held at Columbia College last week. About half the sessions were devoted to solving mathematical problems and half were devoted to the Common Core and bringing problem solving into the classroom.

What Our Teachers Say About the Circle

As part of our evaluation process, the teachers where asked to provide comments on how our Circle has impacted their classrooms. Here is a selection:

My classroom is now a **more collaborative environment** that is not so rushed. . . .

It motivates me to **integrate more problem-solving in daily lessons** even to the struggling learners, providing everyone the opportunities to develop their critical thinking skills. . . .

I have been **more thoughtful about the problems** and activities that I give the kids. I purposely choose activities that cause students to think about what they will do to solve the problem, to work collaboratively, to try different approaches, to think about their thinking, and to develop their ability at solving problems. . . .

What Our Teachers Say About the Circle

As part of our evaluation process, the teachers where asked to provide comments on how our Circle has impacted their classrooms. Here is a selection:

It has helped me **prepare more for common core** and use more problem solving skills in my classroom. . . .

Increased Ideas for using critical thinking skills in my class. Improving the amount of **undirected learning** in preparing student for the smarter balance testing process. **Implementing technology within classroom**. Level processing within different classes. Boosting student understand through **peer communication within small groups**.

What Our Teachers Say About the Circle

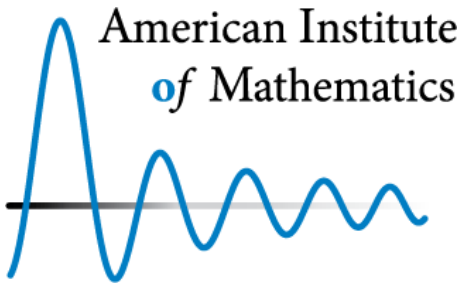
As part of our evaluation process, the teachers where asked to provide comments on how our Circle has impacted their classrooms. Here is a selection:

It has made me seek out more opportunities for my students to **solve open-ended problems**. I would be much more likely to incorporate them if I had time to work through some that are on the level with my students. I realize that it is geared more for older students which is where most of the teachers in the group are teaching.

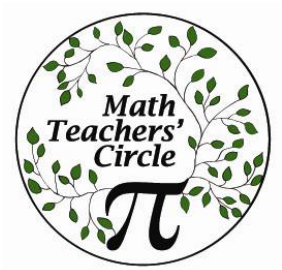
I have **become more of a thinker** and I demand more critical thinking from my students and also more development of the mathematical processes.

Why Not Make A Circle?

Find a couple of mathematical colleagues and a couple of middle school math teachers and think about forming your own Math Teachers Circle! There are a lot of resources to help.
The American Institute of Mathematics holds workshops on setting up a Math Teachers' Circle



http://www.aimath.org



http://www.mathteacherscircle.org

http://www.mathcircles.org

It's a Circle!

http://www.math.sc.edu/schematc

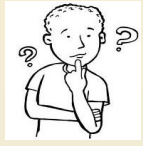
Standards for Mathematical Practice

1. Make sense of problems and persevere in solving them.

Mathematically proficient students start by explaining to themselves the meaning of a problem and looking for entry points to its solution. *"Does this make sense?"*

2. Reason abstractly and quantitatively.

...to make sense of quantities and their relationships in problem situations: students can both:
decontextualize (abstract) and
contextualize (specify).



3. Construct viable arguments and critique the reasoning of others.

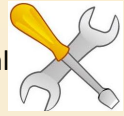
...use stated assumptions, definitions, and previously established results in constructing arguments, *making conjectures and building logical progressions of statements*....

4. Model with mathematics.

...students who can apply what they know are comfortable making assumptions and approximations to simplify a complicated situation, realizing that these may need revision later...

5. Use appropriate tools strategically.

These tools might include pencil and paper, concrete models, a ruler, a protractor, a calculator... able to identify relevant external mathematical resources, such as digital content located on a website, and use them to pose or solve problems...

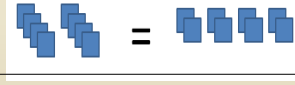


6. Attend to precision.

...try to use clear definitions in discussion with others and in their own reasoning... *careful about specifying units of measure*... express numerical answers with a degree of precision appropriate for the problem context

7. Look for and make use of structure.

...students look closely to discern a pattern or structure... they may sort a collection of shapes according to how many sides the shapes have... can step back for an overview and shift perspective



8. Look for and express regularity in repeated reasoning.

...notice if calculations are repeated, and look both for general methods and for shortcuts... maintain oversight of the process, while attending to the details.

Created by Pierre Sutherland, University of Georgia, psuth@uga.edu