JOHNS HOPKINS
SCHOOL *of* EDUCATION

**CENTER FOR SOCIAL
ORGANIZATION OF SCHOOLS**

Working with
Rich Mathematical Tasks

"…being good at mathematics involves many different ways of working…it involves asking questions, drawing pictures and graphs, rephrasing problems, justifying methods, and representing ideas *in addition to* calculating with procedures."

-Jo Boaler, Professor of Mathematics Education, Stanford University

the task is inquiry based. *Why does this work? Would doing _____ help address _____? What would happen if I _____?*

the problem is reconceptualized in way that facilitates understanding

the task is multidimensional, requiring fluid representations of the mathematics in different ways *(visually, algebraically, in writing, organized in a table, using colors, etc.).*

Does the task entail…?

☐ asking questions

☐ drawing/creating pictures and graphs

☐ rephrasing problems

☐ justifying methods

☐ representing ideas/concepts/patterns

☐ calculating with procedures

a chart/graph/visual is created in order to communicate or make sense of the mathematics,
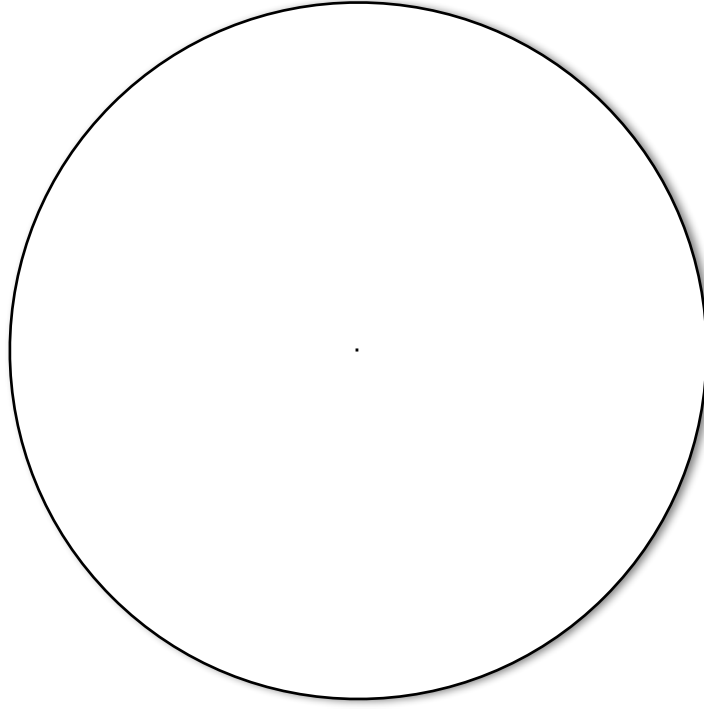
the need to apply mathematical reasoning and provide justification is embedded within the task

the use of skills, computations, procedures, and algorithms.

Rich mathematical tasks

Create a pie chart that reflects **your ideal balance** between the six different mathematical competencies indicative of a successful doer of mathematics, according to Boaler.

	asking questions
	drawing/creating pictures and graphs
	rephrasing problems
	justifying methods
	representing ideas/concepts/patterns
	calculating with procedures
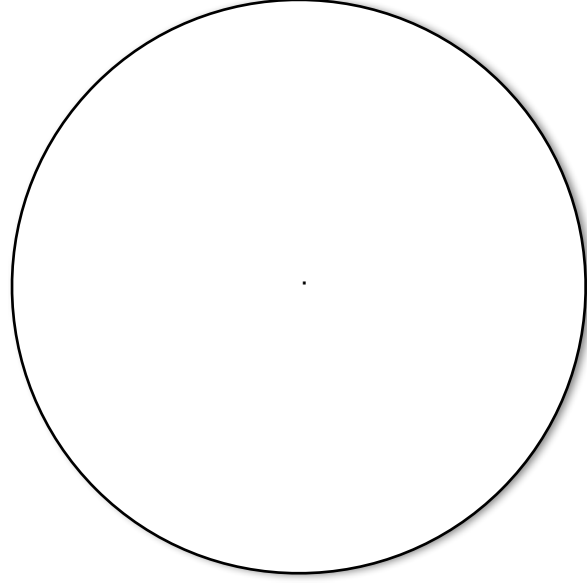
Friday the 13th

This month there is no Friday the thirteenth, but this year there was one. Can you explain why every year **must** contain at least one Friday the thirteenth?

What's the greatest number of Friday the thirteenths that can fall in one year?

Nrich Mathematics
http://nrich.maths.org/610

JANUARY								FEBRUARY								MARCH								APRIL								MAY								JUNE						
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Group Roles

Facilitator/Includer

Make sure your group reads all the way through the task before you begin. *"Does everyone get what to do?"*

Keep your group together. Make sure everyone's ideas are heard.

"Did anyone see it a different way?"

"Are we ready to move on?"

Resource Manager

Get and manage materials/ resources for your team.

Make sure all questions are team questions; everyone has been tapped as a resource before you call the teacher.

Be prepared to join the teacher for a huddle and debrief your group.

Reporter

Your group needs to organize your group's results.

Your results need to be well organized, and use color, arrows, and/or other math tools to communicate your mathematics, reasons, and connections.

"How do we want to show that idea?"

Organizer

Remind your team to justify each mathematical statement

Search for connections among the different statements.

"How do you know that for sure?"

"How does that relate to…?"

Boaler, J. (2015). From Tracking to Growth Mindset Grouping. In *Mathematical Mindsets: Unleashing Students' Potential through Creative Math, Inspiring Messages and Innovative Teaching* (First edition). San Francisco, CA: Jossey-Bass.

Teacher Roles

- assign competence to all students
    - raise 'status' of students who think they may be of lower status in a group

- teach students to be responsible for each other's learning
    - establish group norms of respect, listening, and collaboration
    - encourage students to build off of each other's ideas

- teach broad, open, multidimensional mathematics
    - math is so much more than executing procedures!

- ensure students are in mixed-ability groupings

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Ice Cream Scoop

This is a really nice task as it is open to everyone, can be solved in different ways and can also extend to work in combinatorics – a nice way of organizing counting. Ask students to work on this task in groups, and to display their results on posters. Often we name students' different approaches and strategies.

Task Instruction

In shops with lots of ice-cream flavors there are many different flavor combinations, even with only a 2-scoop cone. With 1 ice-cream flavor there is 1 kind of 2-scoop ice cream, but with 2 flavors there are 3 possible combinations (eg vanilla/vanilla, chocolate/chocolate, and vanilla/chocolate).

- How many kinds of 2-scoop cones are there with 10 flavors?
- What about "n" flavors?
- Create a poster that represents your group's thinking.

Does this task entail…?

- [ ] asking questions
- [ ] drawing/creating pictures and graphs
- [ ] rephrasing problems
- [ ] justifying methods
- [ ] representing ideas/concepts/patterns
- [ ] calculating with procedures

The Four 4's

Task Instruction

Can you find every number between 1 and 20 using only four 4's and any operation?

Or

Can we as a class find every number between 1 and 20 using only four 4's and any operation?

Here's an example √4 + √4 + 4⁄4 =

Give this challenge to students and write all the numbers from 1 to 20 on the board. Then ask students to come to the board and write a solution any time they have one. The more solutions you get for each number the better.

Going beyond…

Can you find more than one way to make each number with four 4s?

Can you go beyond 20?

Can you use four 4s to find negative integers?

Does this task entail…?

☐ asking questions

☐ drawing/creating pictures and graphs

☐ rephrasing problems

☐ justifying methods

☐ representing ideas/concepts/patterns

☐ calculating with procedures

Route to Infinity
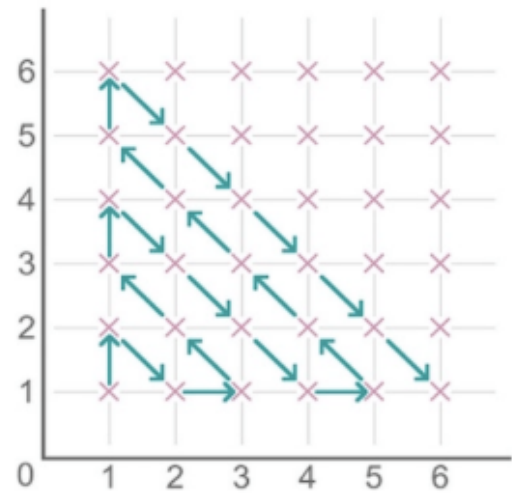
Take some time to look at the route the arrows follow in the diagram.

Try to describe their path.

Will the route pass through the point (18,17)?

If so, which point will be visited next?

Through how many points does the route pass before it reaches the point (9,4)?

nrich.maths.org

Task Instruction

Have you ever wanted to journey to infinity? Can you find the route?

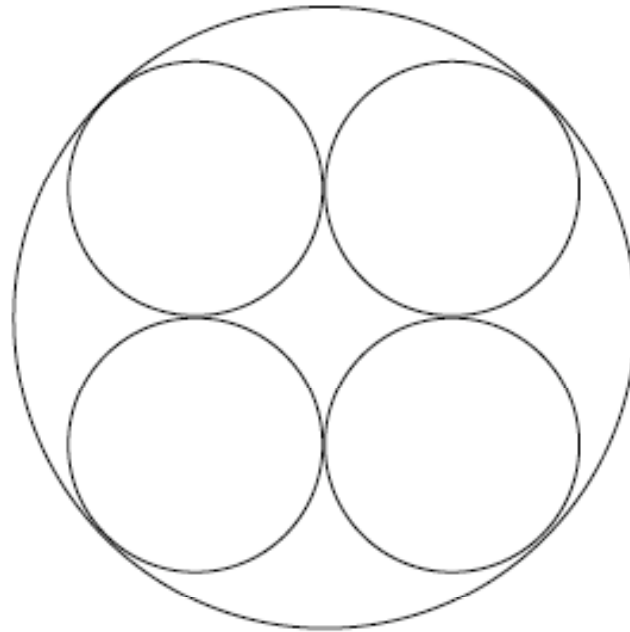Does this task entail…?

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Pipes

This problem gives you the chance to:
• use the Pythagorean Rule
• calculate distances between circles

Four small circular pipes are placed inside a large circular pipe as shown above.
Each of the four small pipes has a radius of 6 inches.

Find the radius of the large pipe. Show how you figured it out.

(Hint: Join the centers of the 4 small circles and find the length of the diagonal of the square obtained.)

Does this task entail…?

☐ asking questions

☐ drawing/creating pictures and graphs

☐ rephrasing problems

☐ justifying methods

☐ representing ideas/concepts/patterns

☐ calculating with procedures

Designing Rich Mathematical Tasks

- Can you open the task to encourage multiple methods, representations, and pathways?

- Can you make it inquiry based?

- Can you present the task before teaching the method?

- Can you make it visual?

- Can you make it "Low Floor" and "High Ceiling"?

- Can you add requirement for students to convince, reason, and justify?

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