Nothing Works!

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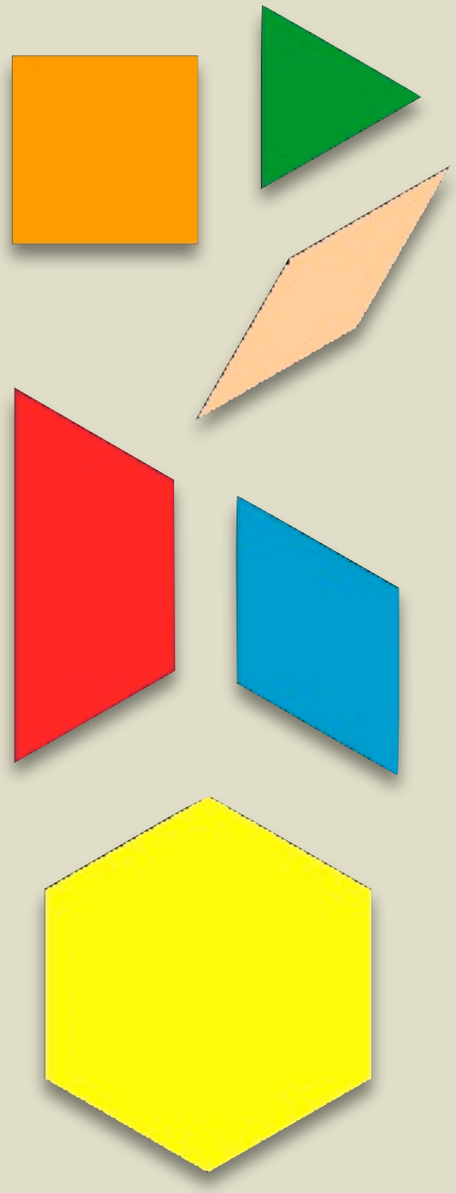
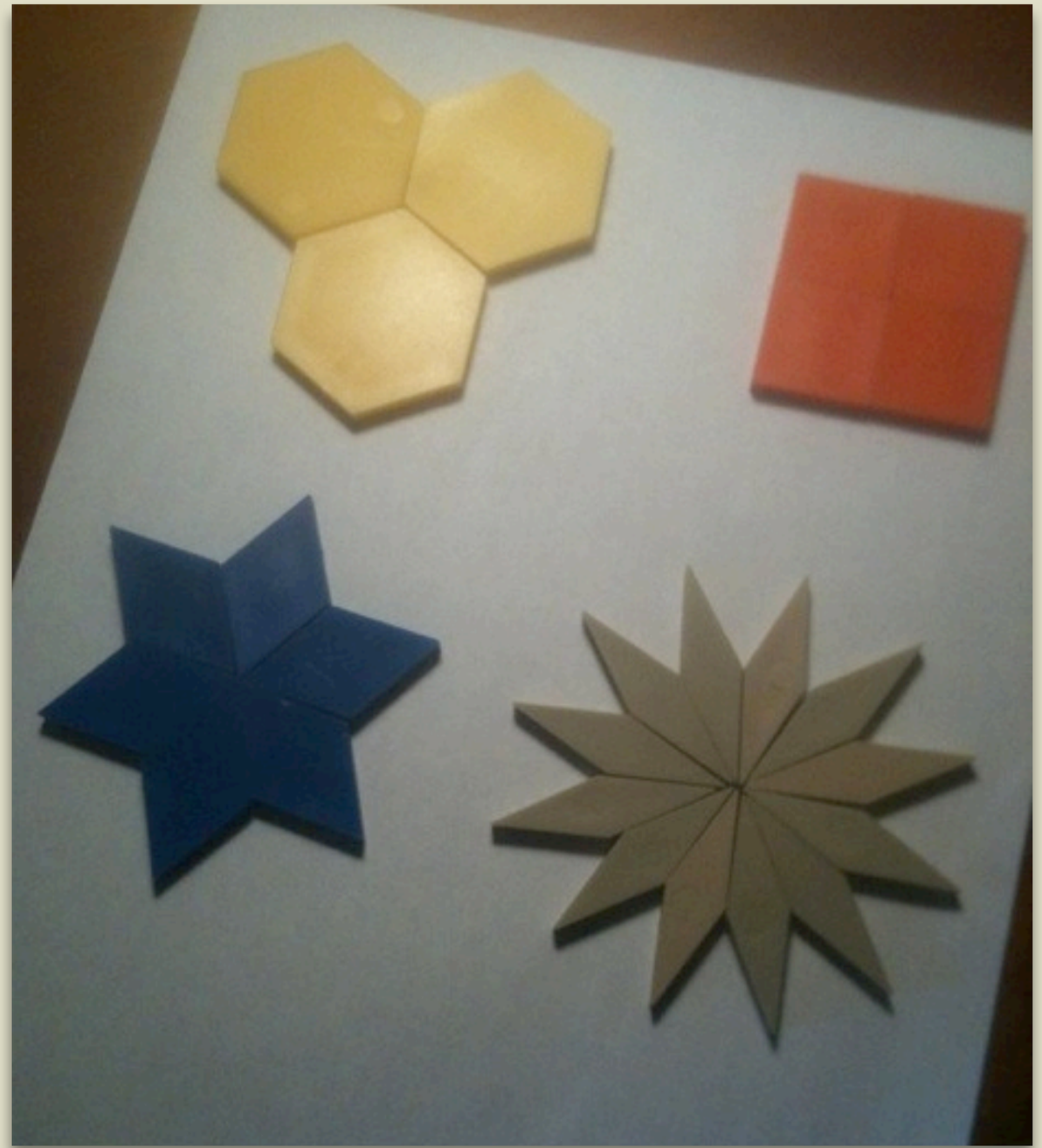
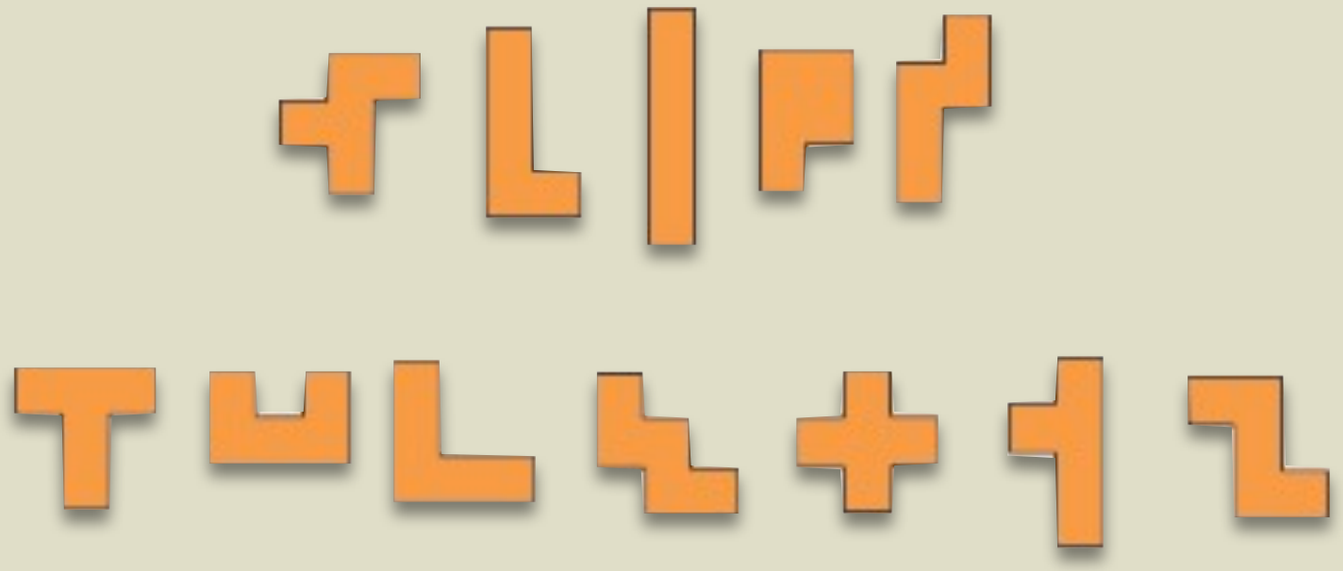
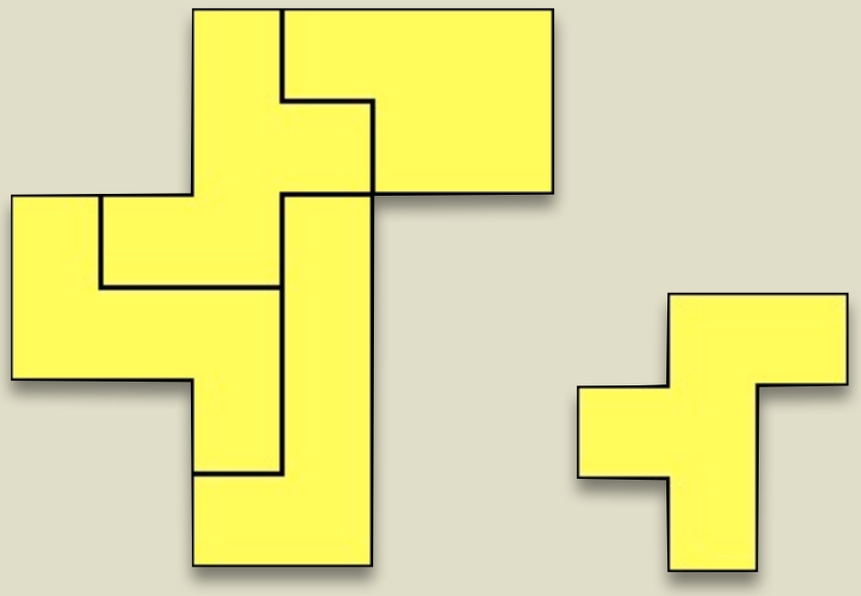
Tools: Manipulatives

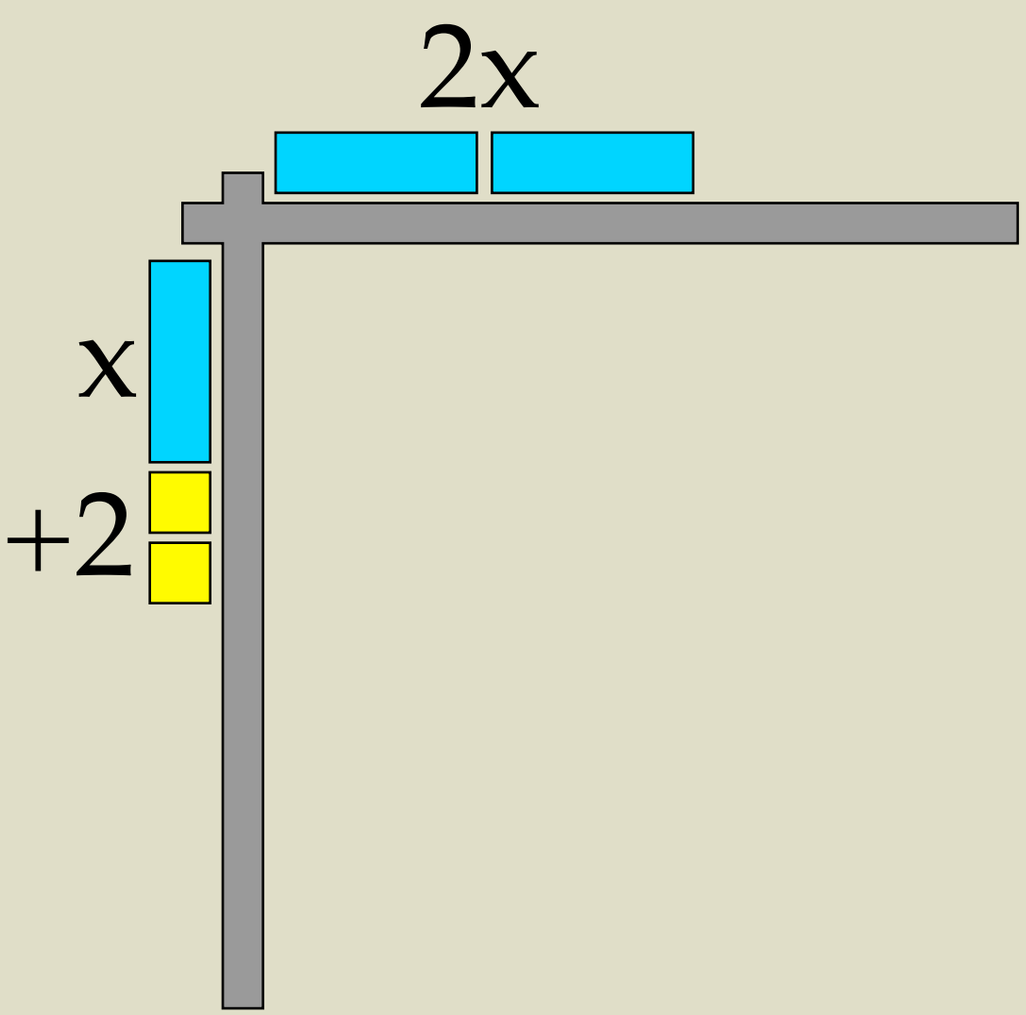




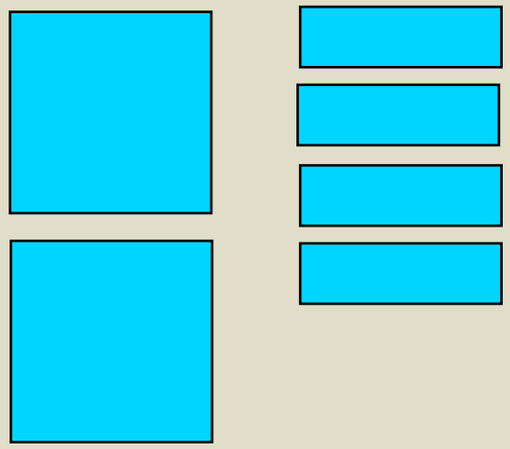




Make a Rectangle

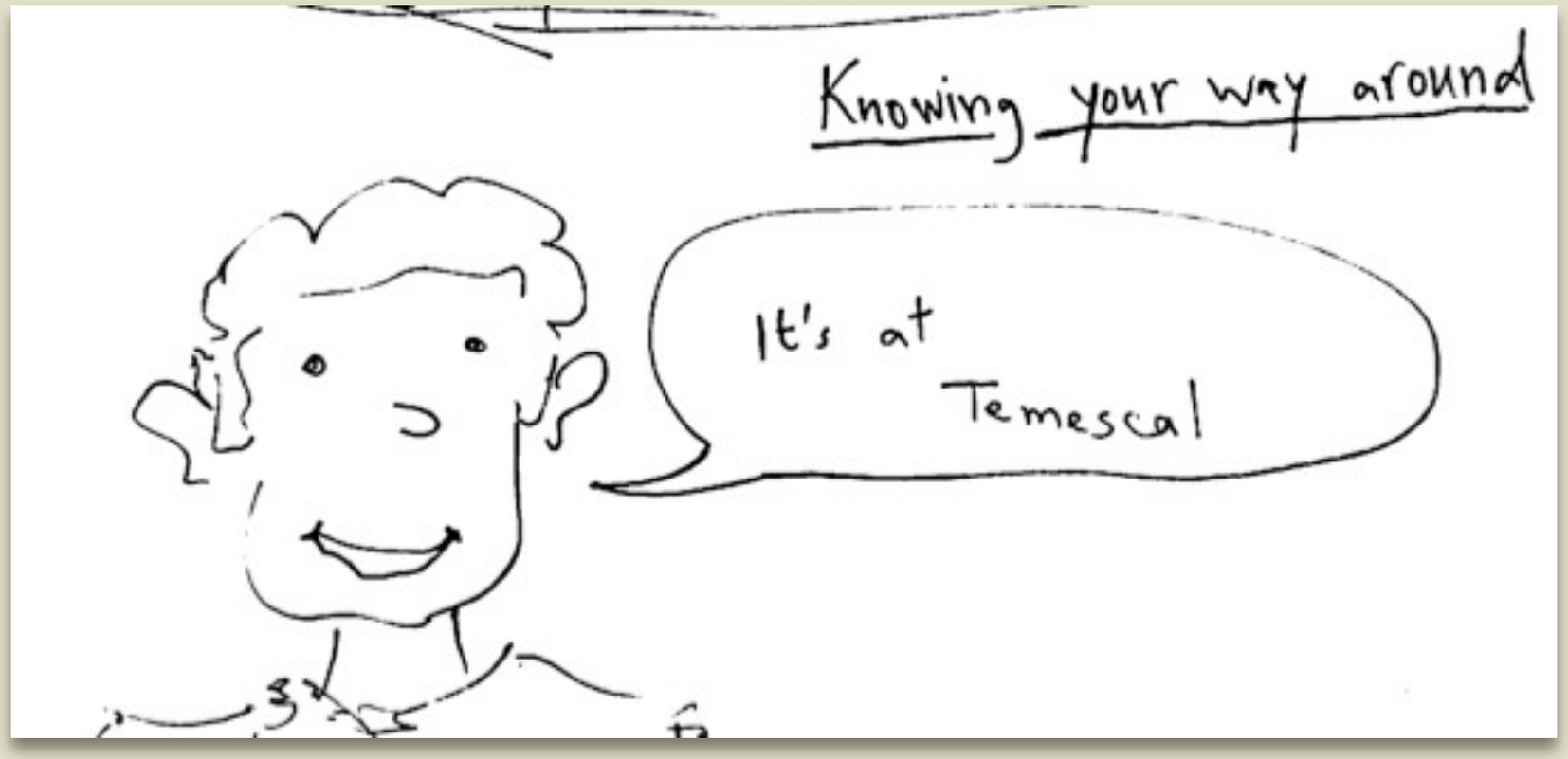


$$2x^2 + 4x = 2x \cdot (x+2)$$



He said:
"Go South on Martin Luther King Junior Way (Old Grove Street). Left on Alcatraz. Right on College. Left on Keith. You'll get to a Stop sign; then a stop light. Make a left onto Broadway, but get into the right lane. When you see the overpass"... er..."when you see the freeway... um... What did he say?

Following Directions


Knowing your way around
It's at
Temescal


Oh, here's another route...
Oakland
Reading a map

Tools: Technology

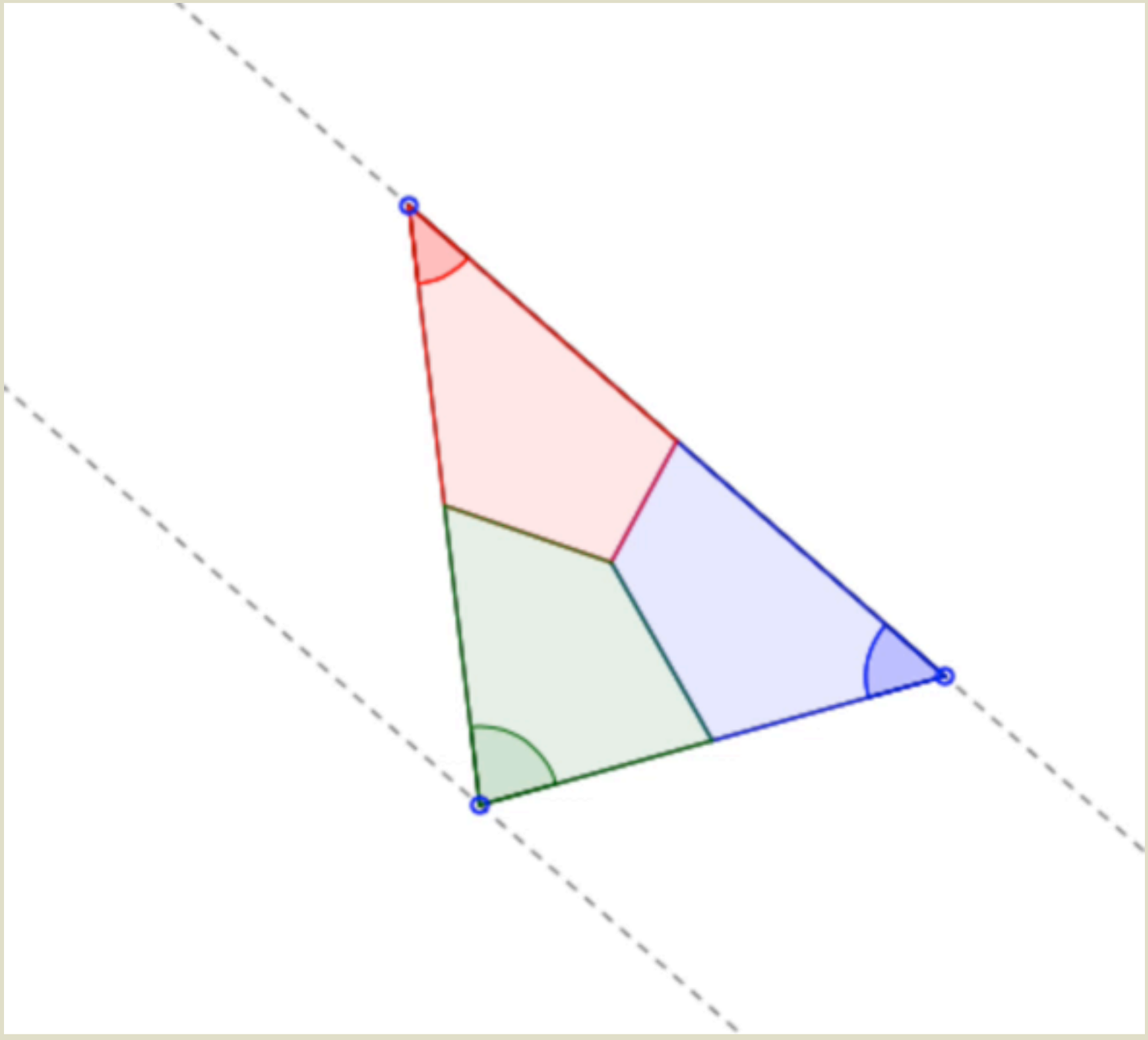
http://www.wolframalpha.com/

Speed and accuracy in computation are no longer legitimate priorities for math education.

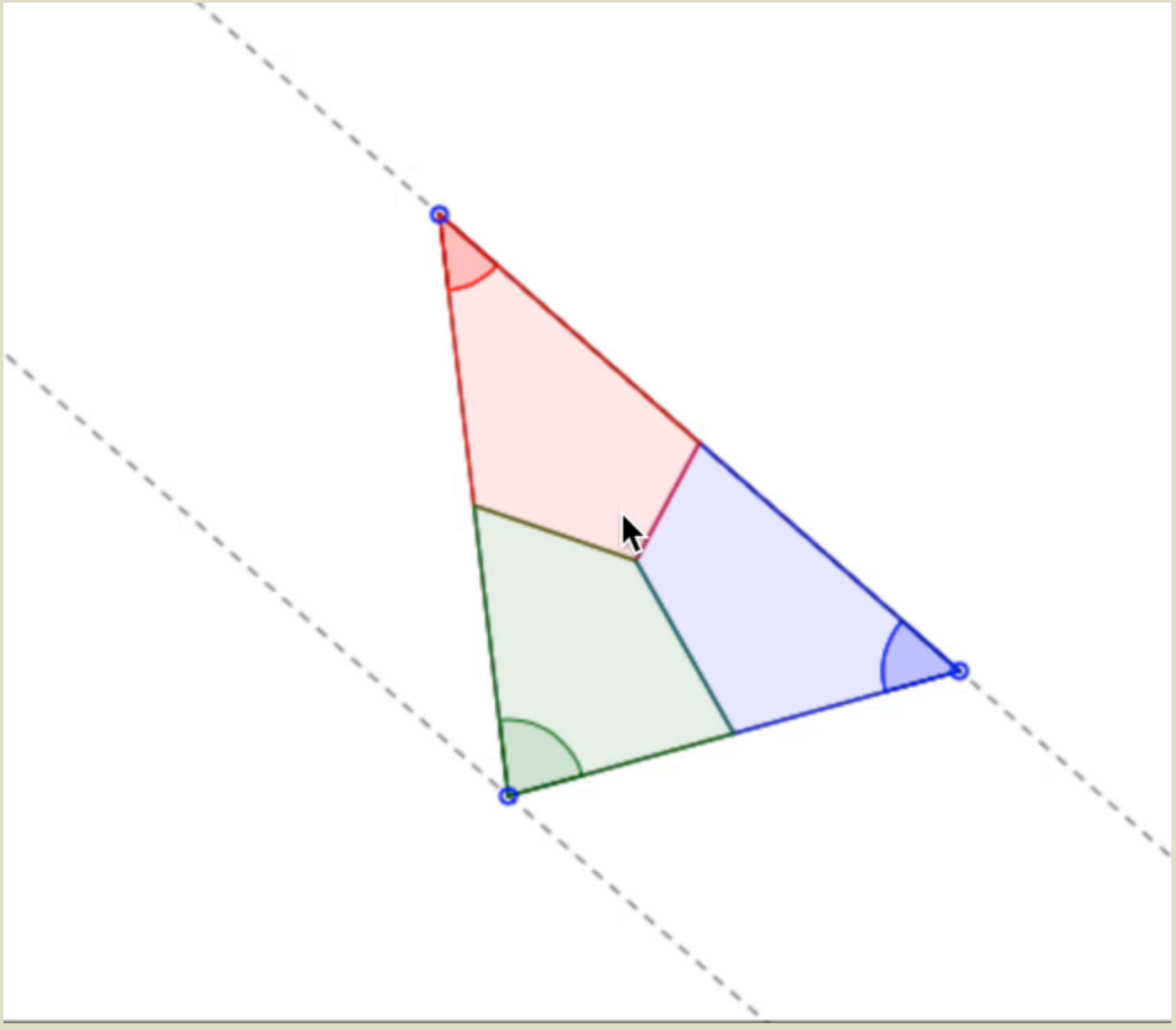
Technology can help make math

- ◊ visual
- ◊ interactive
- ◊ creative

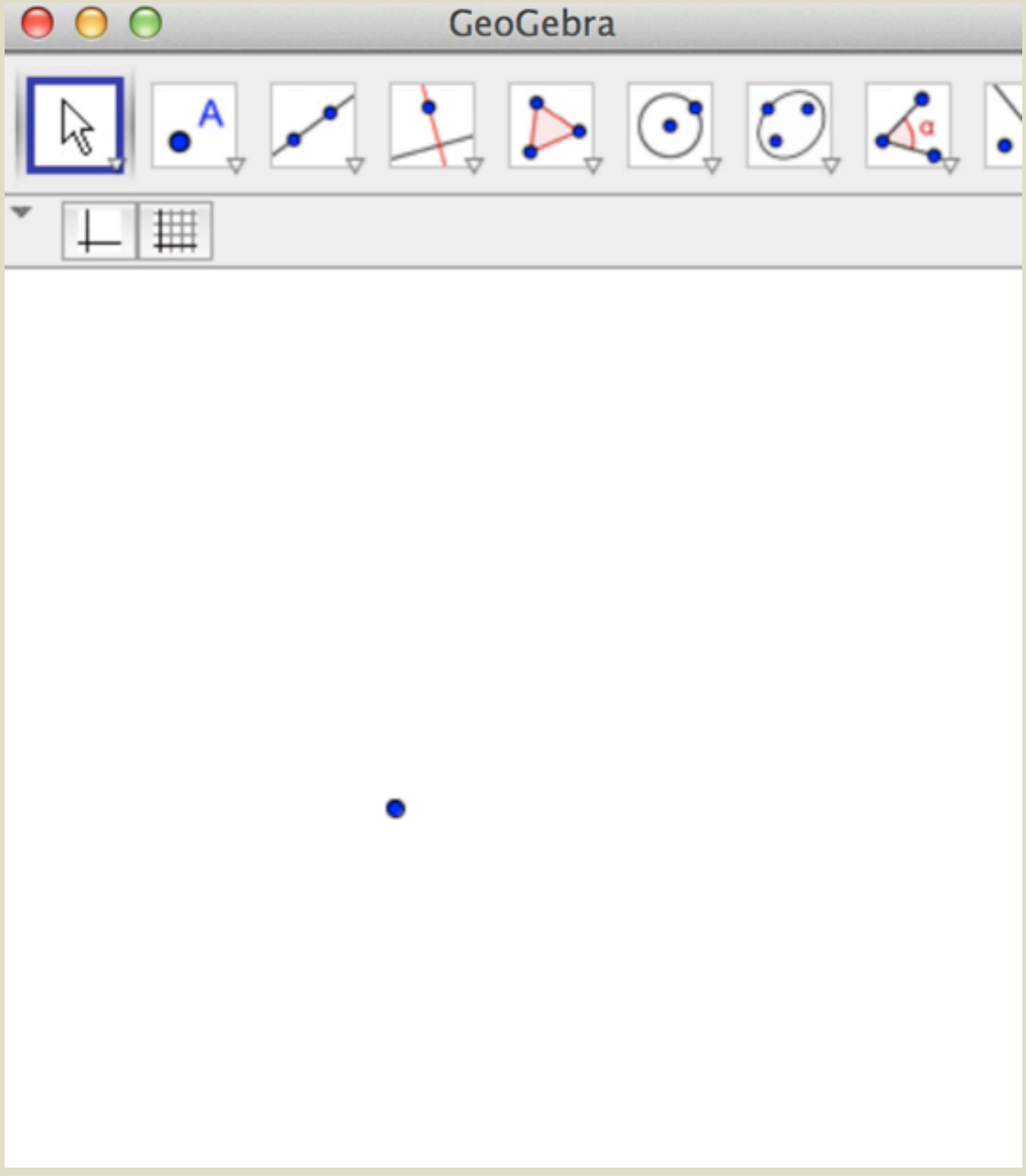
Make Math Visual



Make Math Interactive



Make Math Creative



Technology complements...
...does not replace hands-on and paper-pencil work

Unfortunately:

Tools are not magic!

A Tool-Rich Pedagogy

◊ Student-centered classroom
◊ Discussion and reflection,verbalizing
◊ Cooperative learning, group work
◊ Visual bridges to concepts
◊ Microworlds

Classroom Choices

Group Work

◊ Random groups
  - new groups every 2 weeks

◊ Students mostly work independently
  - are expected to help each other

◊ If a group does not function well
  - intervene directly to get the behaviors you want

◊ If more than one group is stuck
  - stop them all for a class discussion

More on group work:
Complex Instruction

◊ Prof. Elizabeth Cohen (Stanford)

◊ *Mathematics for Equity*
(Carlos Cabana and other Bay Area public school teachers)

◊ Also search my blog for more titles

Verbalizing

Putting things in words is crucial to understanding

◊ Encourage talking

◊ Require writing

Don’t answer questions they don’t have

They cannot hear you!

- Seed with questions, problems, discussion
- Lecture in small doses when appropriate

Class Discussion

True discussion vs. interactive lecture

Use of open-ended questions

Creating a safe environment

◊ No putdowns

◊ "Tell your neighbor..."

◊ "Can you restate what X said?"

Growth Mindset

◊ Praise participation and risk-taking

- rather than correct answers

◊ Backed by research: Prof. Carol Dweck, Stanford

Handling wrong answers

◊write down many answers

◊poker face vs. telling

◊"Choose someone to help you"

◊making 'mistakes' myself

Feedback from all

◊votes

◊gestures

◊writing

Variety

- Fanfare vs. total silence
- New problems, not same as on paper
- Move around the room
- Give the right answer, or a probably popular wrong answer up front

Heterogeneous Classes

All classes are heterogeneous

Alliance with the strongest students

Support for the weakest

The Goldilocks Strategy

◊ Something too difficult

◊ Something too easy

◊ Something "just right"

Curricular Choices

Sequencing within a course

Tackle important and/or difficult topics early

Sequencing within a course

Separate related topics:

- ◊ Proportional relationships / Dilations
- ◊ Linear functions / Systems
- ◊ Exponents / Scientific Notation

Navigating a Topic

Concrete to abstract, and back

positive whole numbers to rational numbers

numbers to variables

discrete to continuous

Example:
the Pythagorean theorem on the geoboard

Navigating a Topic

Difficult to easy, and back.

Assessment Choices

Assessment: Purpose

1. To improve learning

Let students know where they are

Provide learning opportunities

Assessment: Purpose

2. To improve teaching

Diagnose student understanding and skills

Figure out next steps

Fine-tune the course

Assessment: Purpose

3. Also…

Manipulate student motivation

Prepare students for future assessments (!)

Rank students / assign grades

Justify the grades

Satisfy parents, administrators, and politicians

Assessment Alternatives

◊ Participation quiz
◊ Quiz / test corrections
◊ "Recycle extra"
◊ Other take-home assignments
- projects
- reports
- problem sets

Equity concerns

Reasoning and Sense-Making

“Be less helpful” — Dan Meyer

but keep it interactive

Discovery vs. Direct Instruction

◊ A false choice:
neither works well without the other

◊ After exploration, "institutionalization"

- Make key concepts explicit

- Clarify what is important and worth remembering and thus worth writing down

Skills vs. concepts

Another false choice

Memorization

◊ as a substitute for understanding, ***does not work***

◊ as a complement to understanding, can help

Teach for understanding!

Understanding…

◊ is difficult to encapsulate in a checklist

◊ cannot be easily conferred by explanations

◊ is difficult to assess

◊ is not always valued by students, parents, and administrators

◊ is the most important part of our job

Nothing Works

for every student

every class

every teacher

every day

Be skeptical and eclectic

Do not believe claims that some particular approach or curriculum is “the answer”.

Constantly broaden your repertoire

Our Own Learning

...about math,

about learning and teaching,

is what makes the job interesting in the long haul

The Art of Teaching

◊ Don't blame the students

◊ Learn from your successes and mistakes

◊ Teacher collaboration is key

There is no one way

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