# Knowing What We "Know" In-forming Policy and Practice: The Case of Mathematics

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Connecting Research, Practice and Policy in Mathematics and Science Education

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# Considering "Knowing" in Policy and Practice

- What is important to know?
- What do we have evidence for and what do we just believe?
- What do we take for granted?
- What do we ignore?

# I. What Do We Think We Know — But Needs To Be Probed And Developed More To Help Improve Mathematics Education?

- "Prescriptive" mathematics curriculum is bad (or good).
- Accountability improves (or interferes with) the effectiveness of mathematics instruction.
- Effective professional development is long-term, collegial, and driven by teachers.

- "Prescriptive" mathematics curriculum is bad (or good).
  - Deskilling versus enabling skillful professional practice
  - Details and elaboration are important in producing complex work, or —
  - Following a script impedes thoughtful work
- Accountability improves (or interferes with) the effectiveness of mathematics instruction.
  - The "tested curriculum" conveys what is valued
  - Testing reduces the curriculum to what is tested, and how, or —
  - Testing expands instructional time so that all students have opportunities to learn crucial content
- Effective professional development is long-term, collegial, and driven by teachers.
  - Evidence of professional development outcomes rely mostly on teachers' expression of satisfaction.

# 2. What Do We Know That Can Help Improve Mathematics Education?

- Teachers' mathematical knowledge matters for the effectiveness of their teaching.
- Much of that mathematical knowledge is *specialized* for the work of teaching.
- "Mathematical knowledge for teaching" can be developed, and can measured reliably and validly.

# What *is* "Mathematical Knowledge for Teaching"?

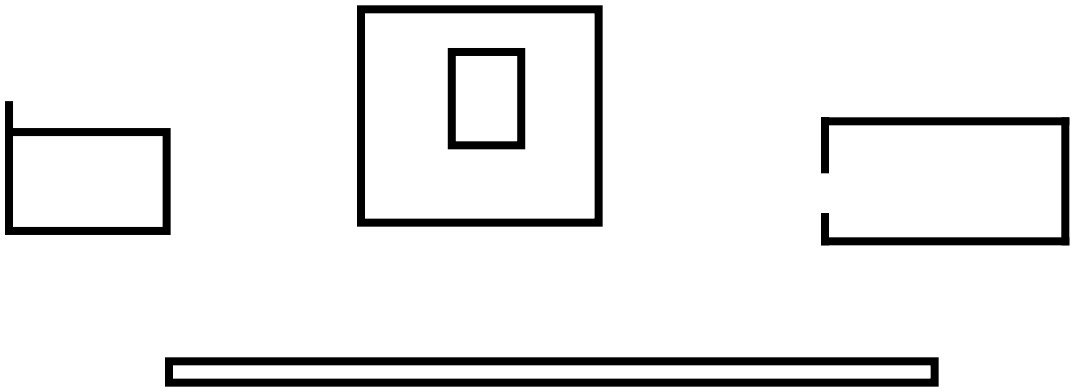
**What is a rectangle?**

**Calculate .3 x .2**

**Is 0 even or odd?**

# "A rectangle is a shape with four straight sides and four right angles."

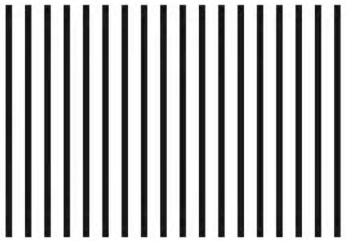
- Is this adequate?



What other shapes would be considered rectangles according to this definition?

# What is a definition of a "rectangle" that is mathematically precise and also usable by fourth graders?

A



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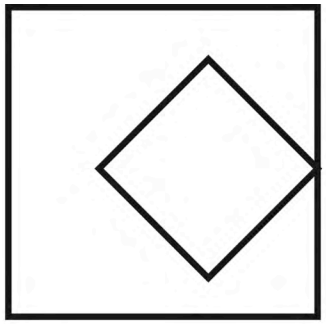

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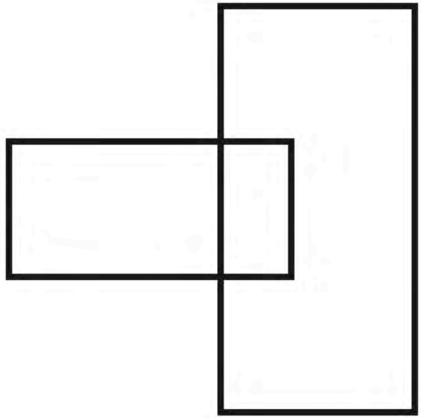

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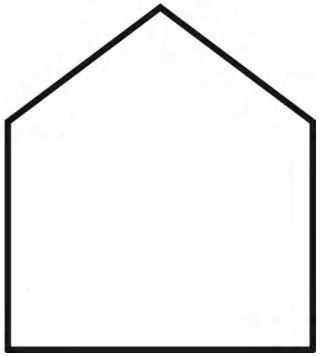
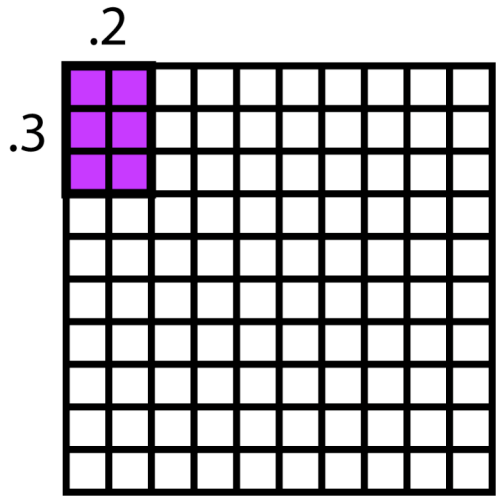


# .3 x .2 = ?

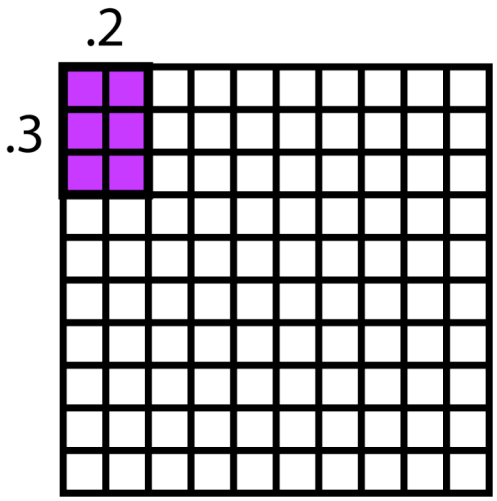
"**.6!**"

How could you explain why .3 x .2 = .06?

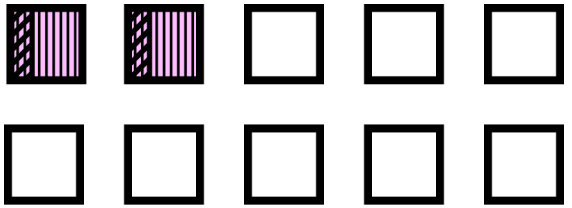


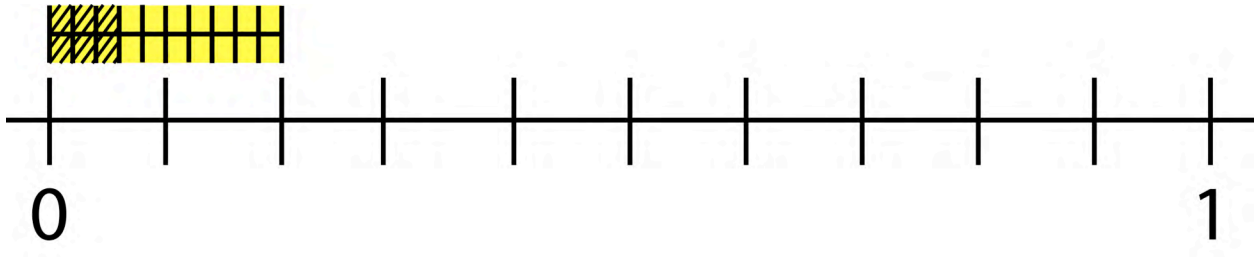

Can you explain or show it a different way? Still another way? What advantages does each way have?

# .3 x .2 = ?




What is 30% of 20 cents?



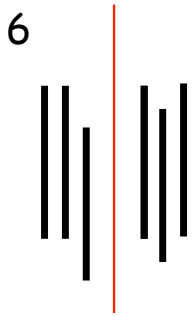


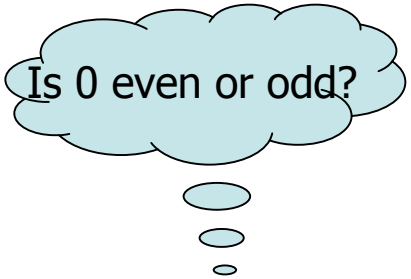
# "Is 0 even or odd?"

# Considering Students' Definitions

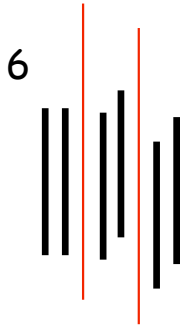
## How well does any of these help to answer the question?

1. An even number is a number you can split in two equal parts without having to break anything in half.

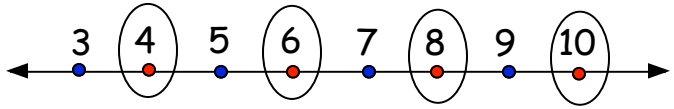



2. An even number is a number that when you group it in twos, there are none left.



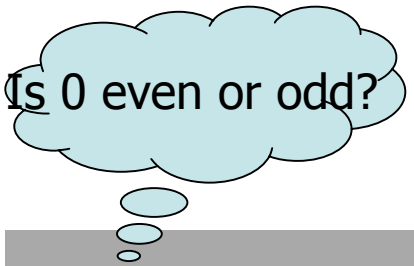

3. The even numbers are every other number on the number line, like 2, 4, 6, and so on.



# Examining Textbook Definitions

How well does any of these help to answer the question?

1. An even number is a number of the form 2k, where k is an integer.
2. An even number is a natural number that is divisible by 2.
3. An even number is any multiple of 2.
4. An even number is a number that has 0, 2, 4, 6, or 8 in the ones place.



# What Don't We Know Yet About Mathematical Knowledge for Teaching?

- Whether these effects are similar at middle and high school levels
- What sorts of learning opportunities contribute most effectively to the development of CKT (content knowledge for teaching)
- Differences in nature of specialized knowledge within mathematical fields or topics
- How knowledge of mathematics and students (KCS) contributes to achievement, or knowledge of mathematics and teaching (KCT)
- How this might inform development of theory about content knowledge for other school subjects (ongoing work on reading)

# 3. What Don't We Know — But Need To — To Help Improve Mathematics Education?

- What it takes to attend effectively to equity in mathematics instruction
- How recruitment, selection, and retention, as well as salary, contribute to teacher quality
- How teachers use teachers' guides and whether they are a source of learning, and what is involved in designing them to be effectively educative
- Whether and how teachers learn from what sorts of uses of practice (video, cases, lesson study)

- What it takes to attend effectively to equity in <u>mathematics instruction</u>
  - Often treated separate from the actual curriculum
  - Inspirational literature low on details
  - Some "good" practice may actually reproduce inequality
- How recruitment, selection, and retention, as well as salary, contribute to teacher quality
  - What can attract different sorts of people to teaching as a short-term engagement in society or as a career?
  - What are valid criteria for selection into teacher education or teaching?
  - How can teacher education programs take advantage of diversity?
  - How does salary affect teacher quality?

- How teachers use teachers' guides and whether they are a source of learning, and what is involved in designing them to be effectively educative
  - Developers invest in building resources for teachers
  - Voluminous
  - Huge value on individualism and creativity
  - Teachers' time and preparation to use guidance in context
- Whether and how teachers learn from what sorts of uses of practice (video, cases, lesson study)
  - Like "manipulatives" for teachers
  - Exemplifying versus studying?
  - Comparison among different forms of harnessing practice

# Conclusions:
# Knowing What We "Know" Informing Policy and Practice:
# The Case of Mathematics

- Use knowledge for the improvement of professional development; evaluate
- Be more cautious about beliefs born of experience that are not subject to disciplined skepticism, testing, and refinement
- Be more clear about nature of knowledge claims
- Target key areas of need for practice-oriented knowledge