

High Yield Geometry Routines

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“Consistent use of routines can yield many benefits for students. Such routines offer access to the big ideas of mathematics and allow deep understanding of concepts. In fact, routines can be designed to focus on the desired mathematical content. Mathematical routines also give students opportunities to develop expertise with the eight mathematical practices.....Mathematical routines offer opportunities for students to demonstrate their thinking and for teachers to gain insight into the thinking of their students” (*McCoy, Barnett, & Combs, 2013*).

High-Yield Routines
(available in the NCTM bookstore)



Need for Geometry Routines to help students develop their:

- spatial sense,
- geometric vocabulary,
- understanding of foundational geometric concepts
- develop mathematical habits of mind

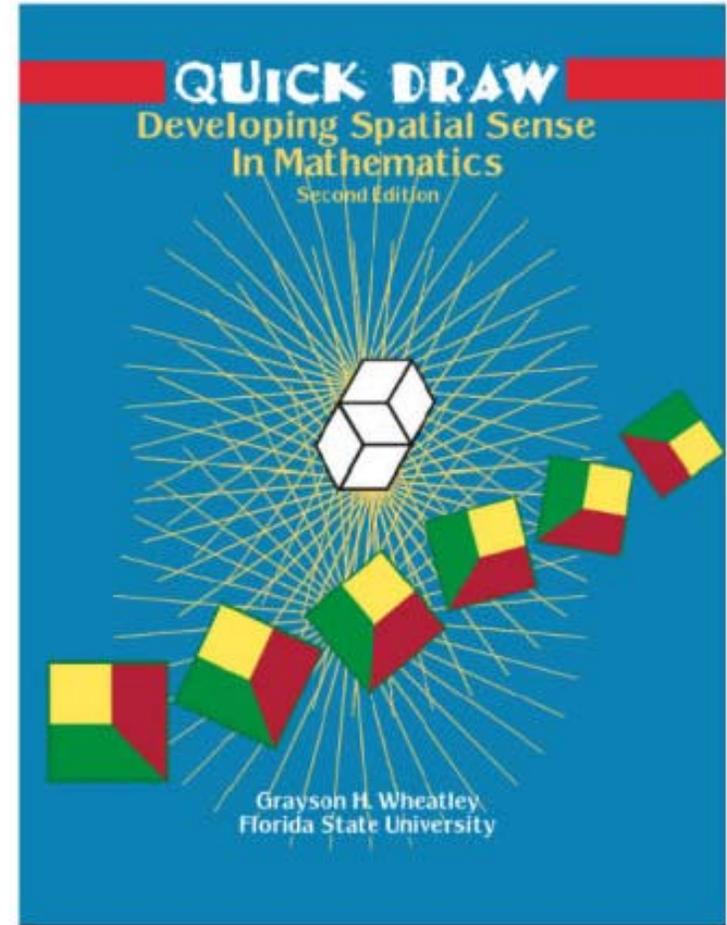


Wheatley & Reynolds (1999) stated “just as it is useful to have a mental map of streets in a city, it is also useful to have mental images of mathematical patterns and relationships. A student who has constructed a network of image-based mathematical meanings can more easily devise solutions to problems.”

“Image Maker”: Developing Spatial Sense
(Article published in Teaching Children Mathematics)



Quick Draw (Quick Images)



<https://mathematicslearning.org>

Quick Draw Teacher Directions

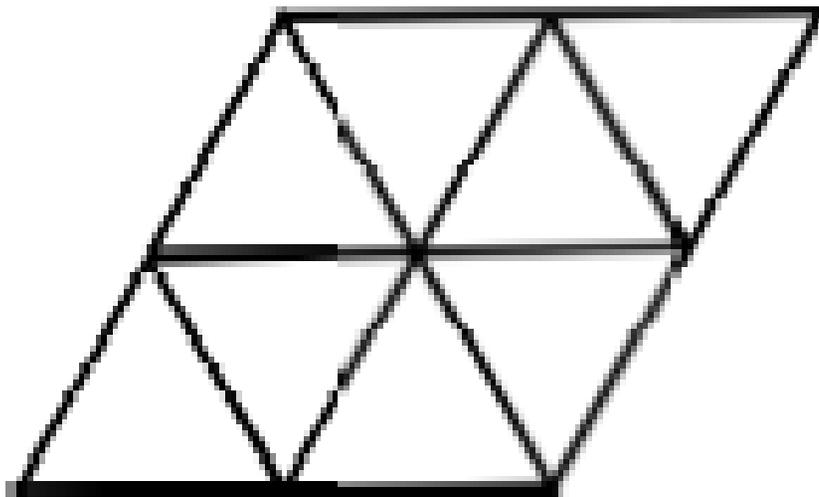
- ▶ To the Whole Class, you will say,
- ▶ “I will show you a shape for only a few seconds. Try to make a mental picture so you can draw it after I turn off the picture. Ready? On the count of three, ONE, TWO, THREE.”
- ▶ Advance the slide to show the picture. It is timed to disappear in 3 seconds.
- ▶ When most people have drawn all they can, click the mouse to show the picture one more time for 3 seconds. When most people have drawn all they can, click the mouse one more time and the picture will remain on the screen until you click the mouse.

- ▶ Whole Class Discussion:
- ▶ The discussion of their drawings is the heart of the activity. “What did you see? How did you draw it?”
- ▶ Encourage students to talk about their drawing. Do not rush the discussion. Some students will be inspired by what others say.
- ▶ Next ask, “What shapes do you see?” As students name shapes, make a list of them.

Grayson Wheatley
www.mathematicslearning.org

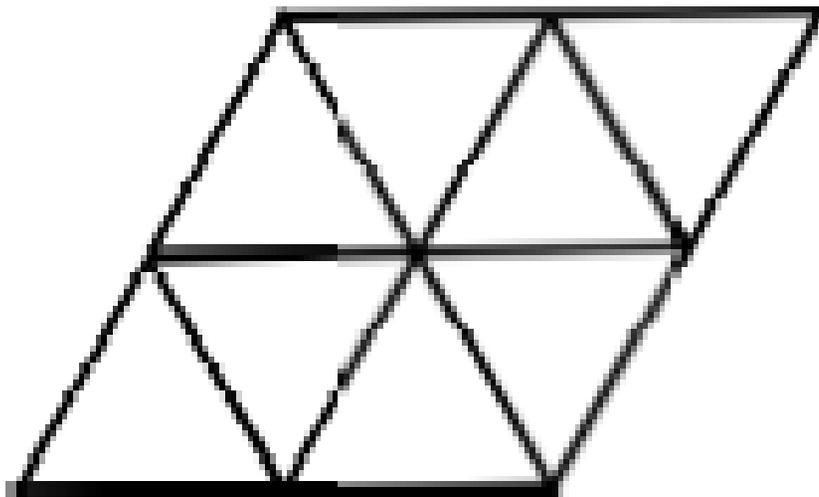
Let's Try a Quick Draw





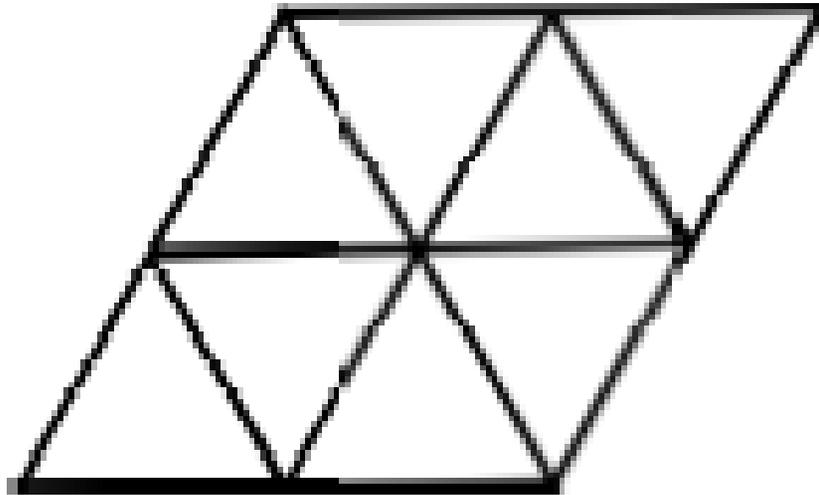
DRAW WHAT YOU SAW





NOW, TRY AGAIN to DRAW MORE
of WHAT YOU SAW





What geometric terms might students generate?

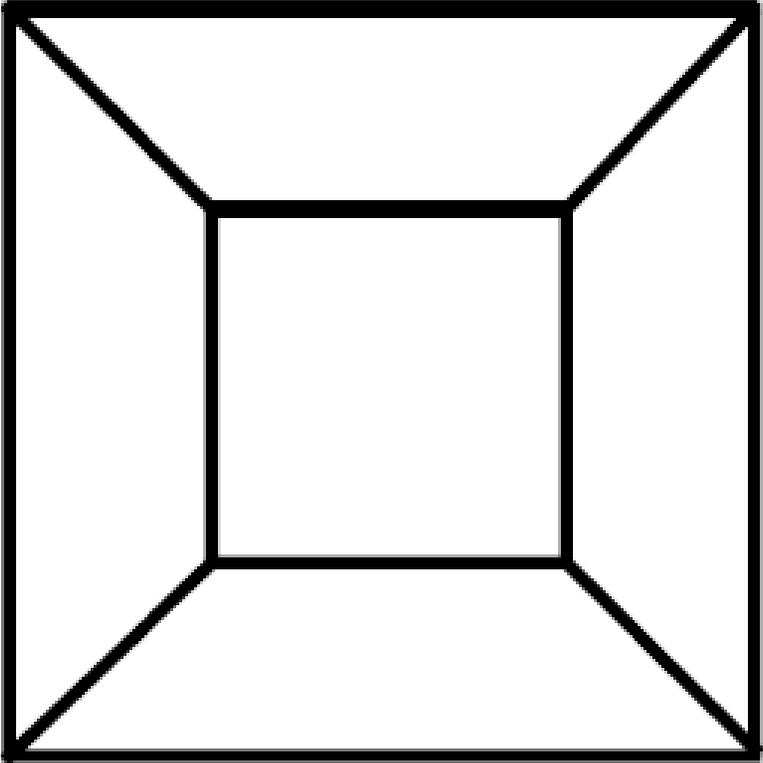
Terms generated by one class:

Rhombus, parallelogram, hexagon, cube,
polygon, trapezoid, triangle, equilateral triangle,
congruent, similar, translation, reflection, rotation



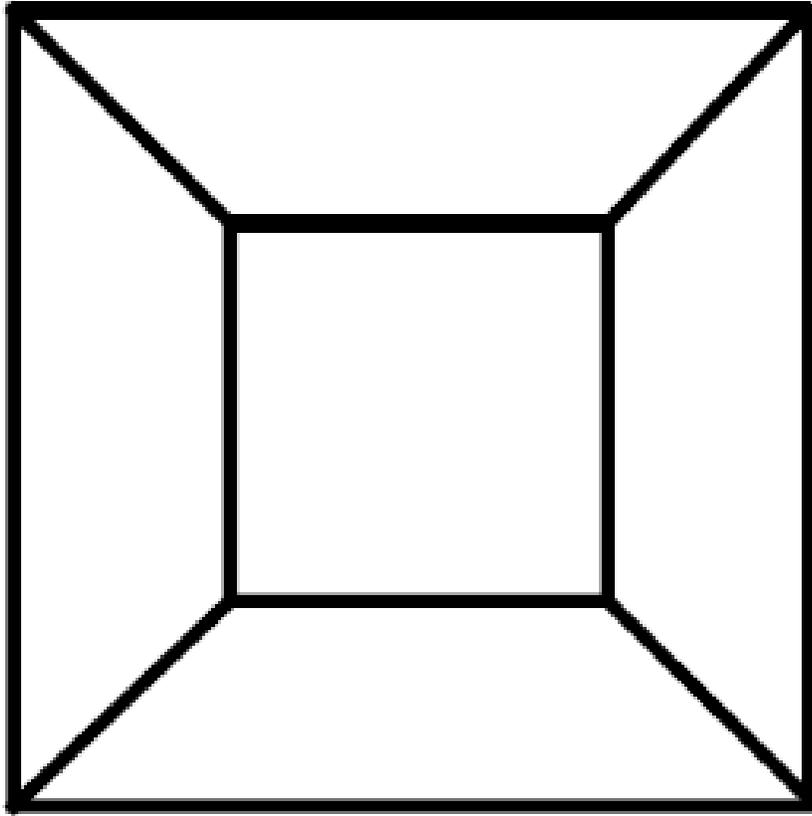
Let's Try a 2nd Figure



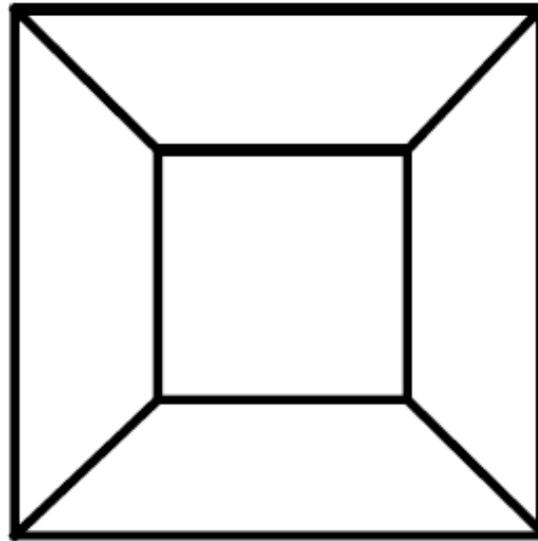


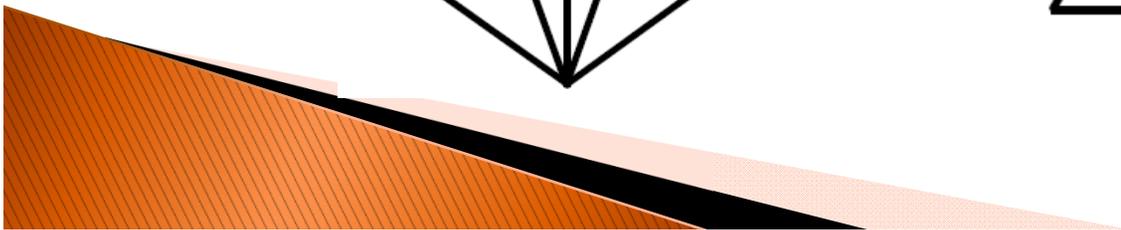
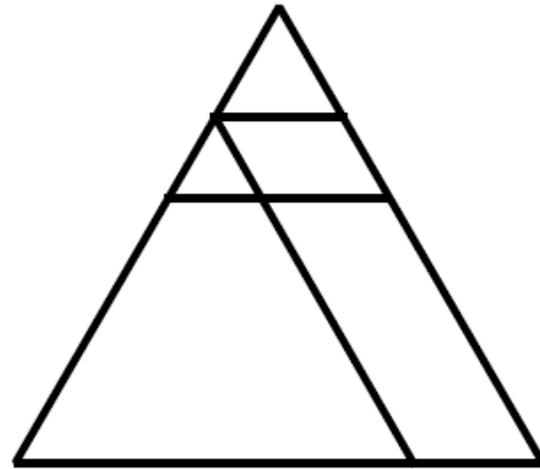
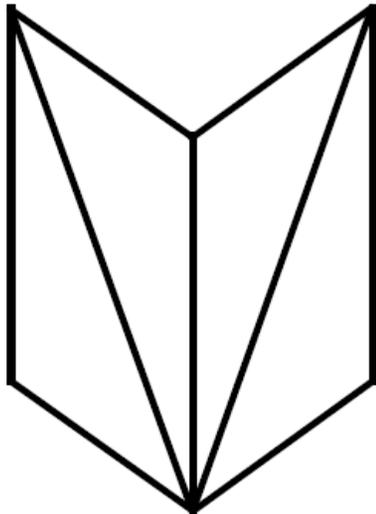
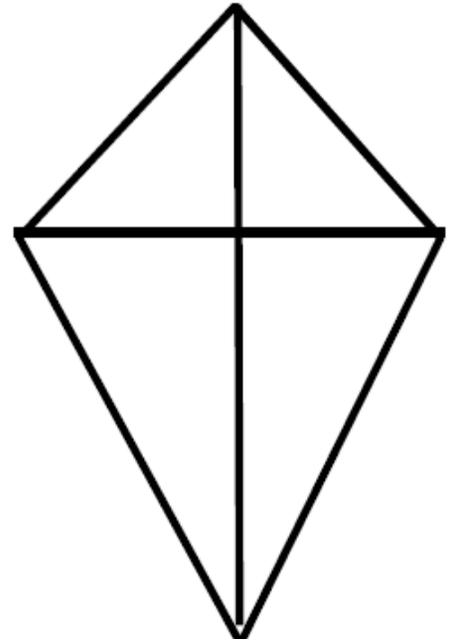
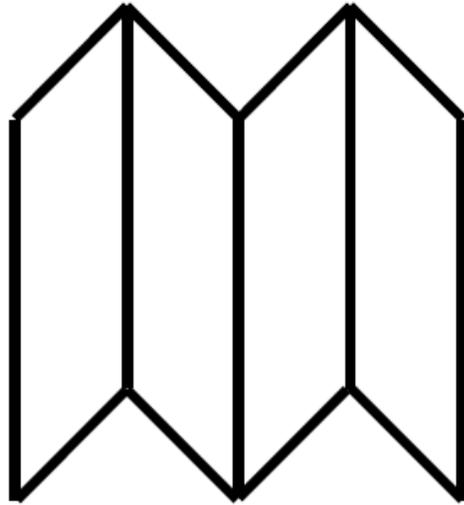
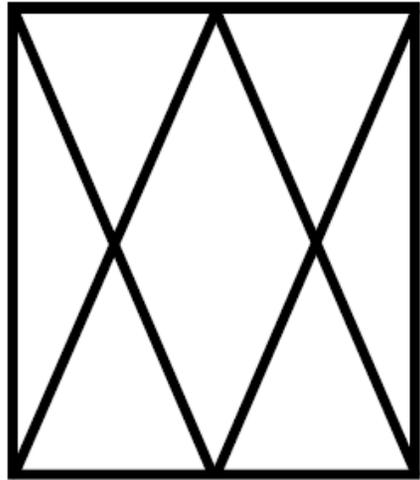
DRAW WHAT YOU SAW





What did you see?





Can all students in your class be successful?

Quick Draw helps students develop
Productive Disposition

“Research has shown that students who are good at Quick Draw have the potential to reason mathematically.”

Quick Draw
Wheatley, 2010, p. 3



Quick Draw helps students:

- ▶ Develop mental imagery
- ▶ Recognize and name geometric shapes
- ▶ Analyze mental images
- ▶ Improve spatial memory
- ▶ Develop concepts of congruence & symmetry
- ▶ Build geometric vocabulary
- ▶ Learn to talk mathematics
- ▶ Negotiate social norms

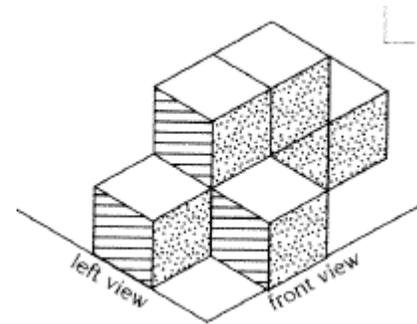
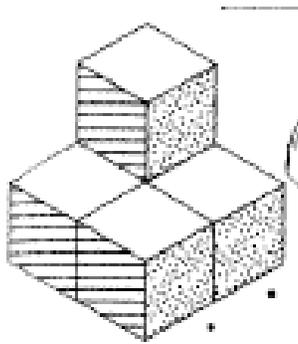
Fold-n-Cut



Let's Try one

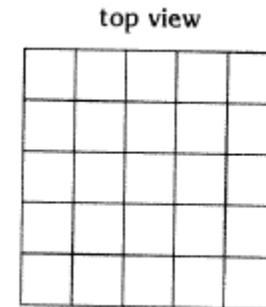


Quick Build



What is the Volume?

What is the Surface Area?



Fold-n-Cut

- ▶ Spatial Sense
- ▶ Mental Imagery
- ▶ Reflectional Symmetry
- ▶ Part to Whole Relationships Instead of Whole to Part



“Communication is an essential part of mathematics and mathematics education. It is a way of sharing ideas and clarifying understanding. Through communication, ideas become objects of reflection, refinement, discussion, and amendment.....Because mathematics is so often conveyed in symbols, oral and written communication about mathematical ideas is not always recognized as an important part of mathematics education.”

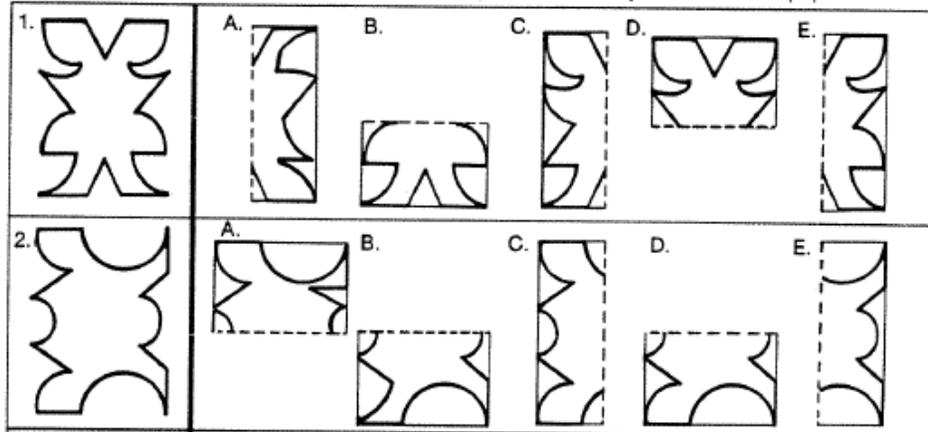
Principles and Standards of School Mathematics
(NCTM, 2000, p. 59)



Fold-n-Cut: Related Activities

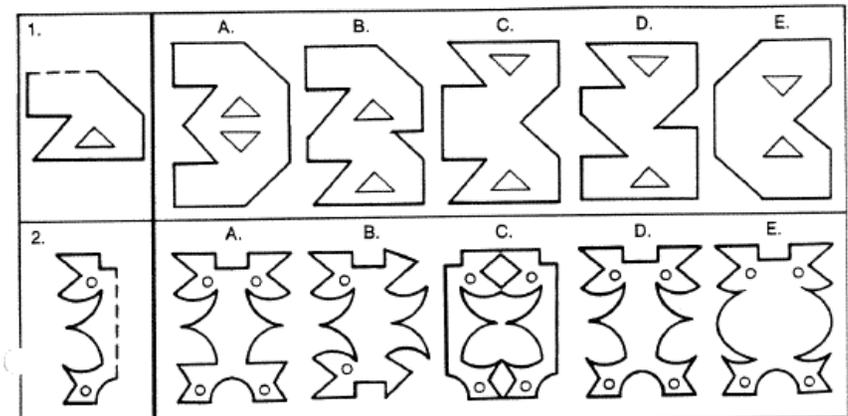
MATCHING A GIVEN DESIGN AND ITS FOLDED PIECE

Each design in the left hand column can be cut from a folded piece of paper. Which of the five drawings on the right is the correct folded piece for the design on the left? Circle the letter for the correct piece.
 Caution: Note that the folded piece has to be placed correctly on the folded paper!



UNFOLDING A CUT-OUT PIECE

The left hand column are pieces that have been cut from a folded sheet of paper with the fold line indicated. Which of the five drawings on the right shows the design that will result from unfolding the cut-out piece? Circle the letter above the correct design.

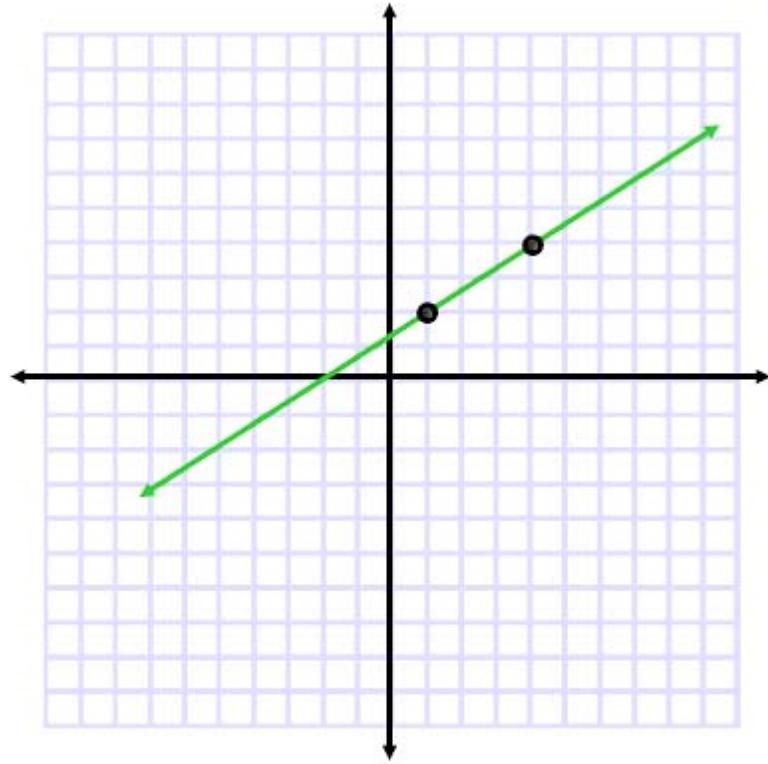


Spatial Problem Solving with Paper Folding and Cutting
 Davidson & Willcutt, 1984, Cuisenaire Company



Quick Slope

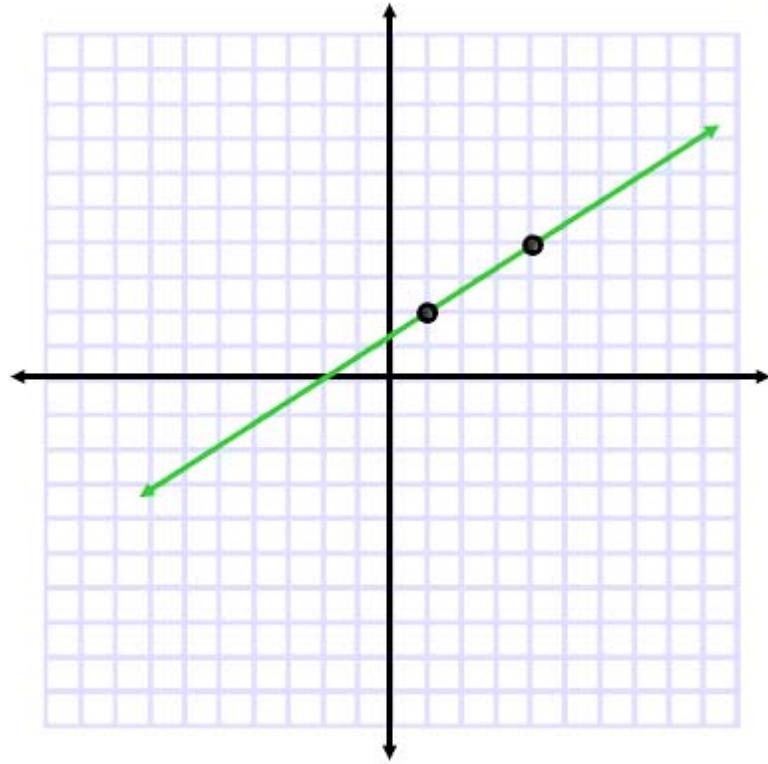




Anyone need another look?

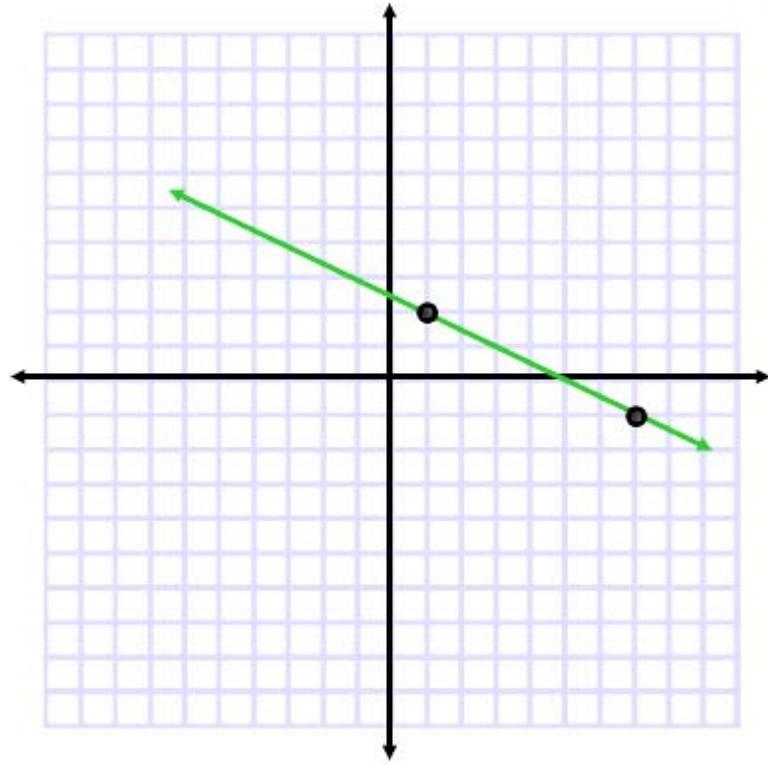
What was the slope?





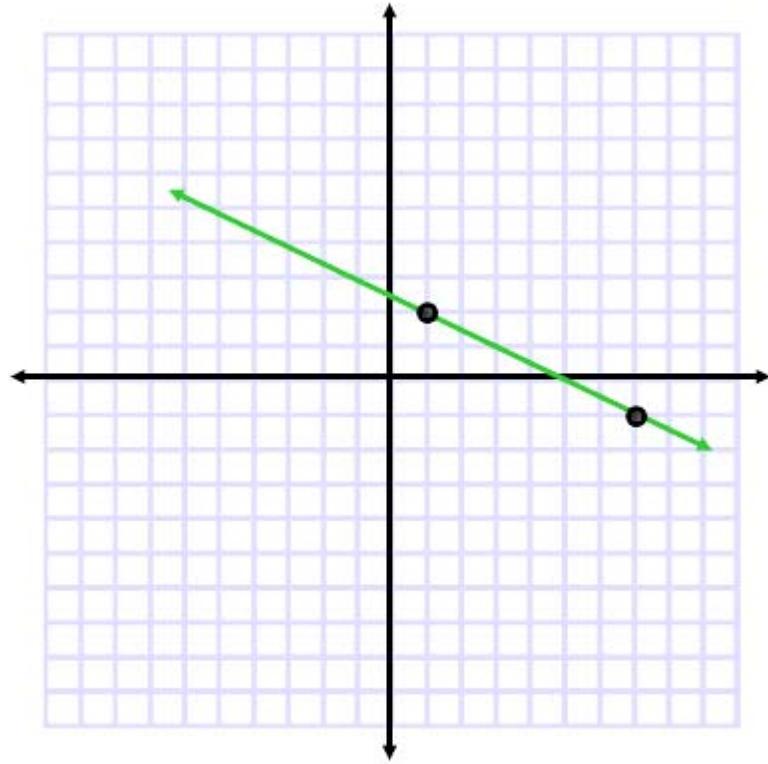
Let's Try Another one

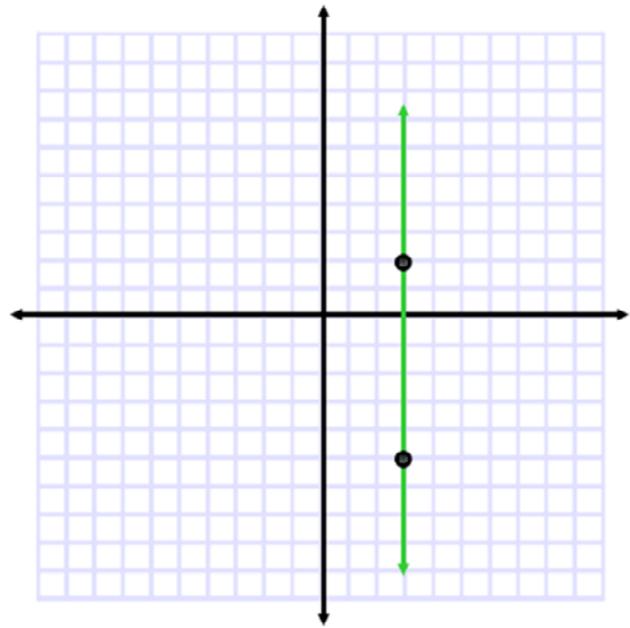
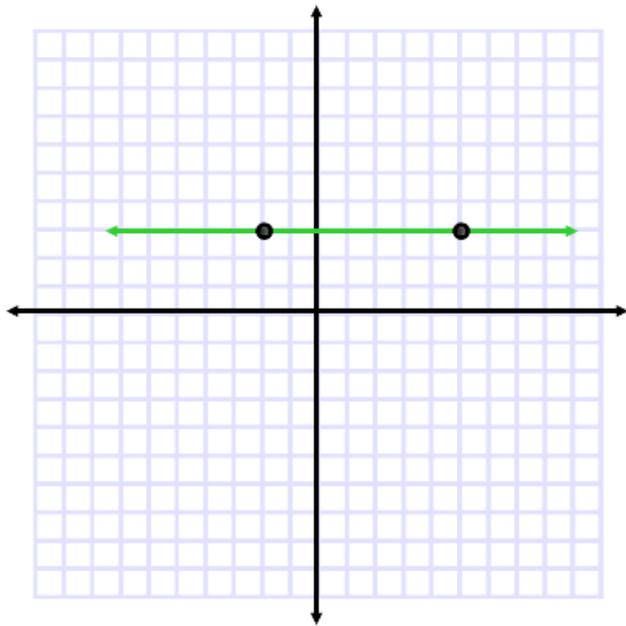




Slope???







Construct and Describe – CD Problems

Every CD problem consists of two parts:

1. Construction

- Doing the construction in the appropriate context

2. Description

- Most important part
- Sometimes difficult or uncomfortable for students at the beginning
- Narrative: Step by step description of how the construction was done



Aichele, D. B. and Wolfe, J. (2008). *Geometric Structures: An Inquiry-Based Approach for Prospective Elementary and Middle School Teachers*. Upper Saddle River, NJ: Pearson Prentice Hall.

Basic Constructions

Using paper folding construct the perpendicular bisector of line segment CD and describe your process.

