

Going Beyond the Basics Mathematics and the Workplace

Developed and Presented by:

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“ We should be educating all students according to a common expectation, one that prepares them for both postsecondary education and the workforce.”

ACT (2006)

Going Beyond the Basics

- 41% of graduates currently in the workforce stated that there are gaps in their mathematical preparation for what is expected of them in their current job.
- 40% of employers state that recent high school graduates do not have adequate mathematics skills for the level of work required.

Rising to the Challenge (2006)

Going Beyond the Basics

“Mathematics is the key to opportunity. No longer just the language of science, mathematics now contributes in direct and fundamental ways to business, finance, health, and defense. For students, it opens doors to careers. For citizens, it enables informed decisions. For nations, it provides knowledge to compete in a technological community. To participate fully in the world of the future, America must tap the power of mathematics”. (National Research Council, 1989)

Make the Connection

***How do you use the math skills
that you learned in school?***



Quick Review

- Most people learn best in a concrete manner that includes personal participation, hands-on activities, and opportunities for personal discovery.
- Learning is enhanced when concepts are presented in a context that is familiar to the learner.
- Most learners relate better to concrete examples rather than abstract conceptual models.
- Most students learn best when they have a opportunity to interact with other students.
- Rote memorization of isolated skills is relatively inefficient and ineffective for most students.

What We Know About the Learning Process, CORD, <http://www.cord.org>

Quick Review

**You May Be More
Contextualized Than
You Think . . .**



You Can Provide More Contextualized Instruction If You . . .

- Ask what the learner would like to learn
- Target learner needs
 - Transportation
 - Housing
 - Job
- Use authentic materials
 - Maps, bus schedules
 - Receipts, coupons, ads
 - Memos, pay stubs, benefits information

Mathematics

Where are the problems now?

- Graphic Literacy
- Multi-Step Problems
- Percents
- Ratio and Proportion
- Elapsed Time
- Geometric Concepts
 - Lines and Angles
 - Triangles
- Algebra and Functions
 - Expressions, Equations, and Inequalities
 - Linear Equations
 - Functions

Going Beyond the Basics

You have a five-gallon jug and a three-gallon jug. You must obtain exactly four gallons of water to add to your cement mix. How will you do it?

What mathematical equation would be used to set up this problem?

Going Beyond the Basics

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Going Beyond the Basics

What Is Workplace Readiness and What Do Employers Want?

- Algebra and algebraic thinking
- Geometry and geometric thinking
- Data representation and statistical thinking

Going Beyond the Basics

**What Do You Mean?
I Have to Know Math
to be a . . .**

Going Beyond the Basics

**You need math -
even before you begin work!**

Going Beyond the Basics

Which Job Should Sandra Choose?

- What mathematical skills will Sandra need?
- What problem solving skills will Sandra need?
- Will Sandra need any additional information to make her decision?
- What are the pros/cons of each job?
- Which job is best for Sandra?



Just the Basics

Number Operations & Number Sense

Number Operations and Number Sense

- Analyze, explain and apply ratios, proportions and percents
- Relate operations to each other
- Compute with whole numbers, fractions, decimals and integers
- Use estimations to solve problems and assess for reasonableness of answers



Math in the Workplace

Computational fluency--having and using efficient and accurate methods for computing--is essential.

Students should be able to perform computations in different ways, including

- mental calculations,
- estimation, and
- paper-and-pencil calculations using mathematically sound algorithms.

Going Beyond the Basics

**Oh no – I have to do
an expense report!**

Data, Statistics, and Probability

Data Analysis, Statistics and Probability

- Construct, interpret and infer from tables, charts and graphs
- Make inferences based on data analysis
- Apply measures of central tendency
- Apply and recognize sampling and bias in statistical claims
- Compare and contrast different sets of data

Charts and Graphs in the Workplace

- Charts and graphs are essential in the workplace.
- Data from charts and graph are used to make decisions.
 - Graphs are useful tools in that they organize data so the information becomes clearer.
 - This organized information can then be used to draw conclusions, to make decisions, or to influence others.

Charts and Graphs in the Workplace

Students should be able to

- Collect data
- Construct tables
- Construct graphs
- Interpret information from graphs
- Recognize biased or distorted graphs
- Draw conclusions and make decisions based on the information provided in tables, charts, and graphs

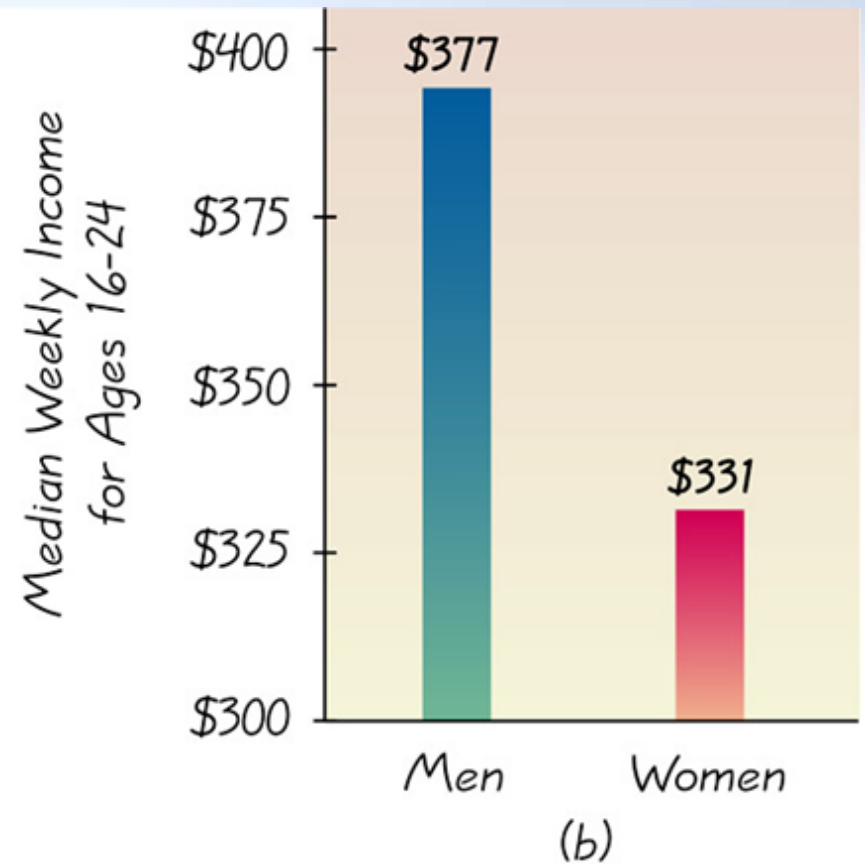
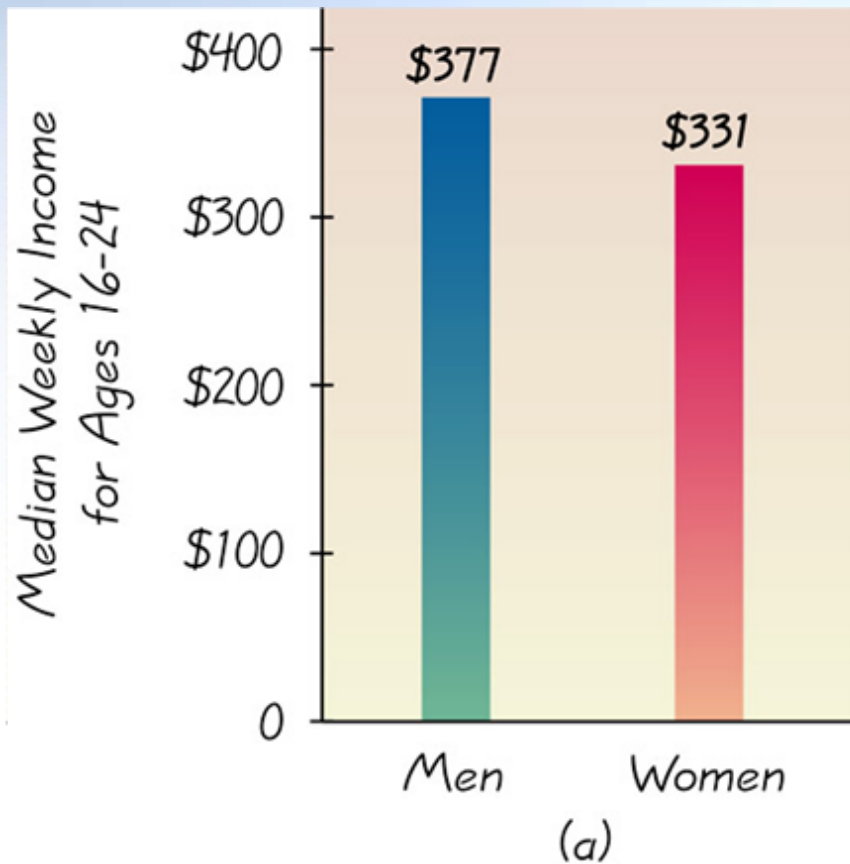
Charts and Graphs in the Workplace

**There's Got to
Be A Better Way!**

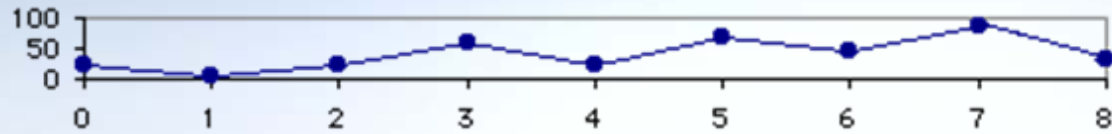
Charts and Graphs in the Workplace

Is this right?

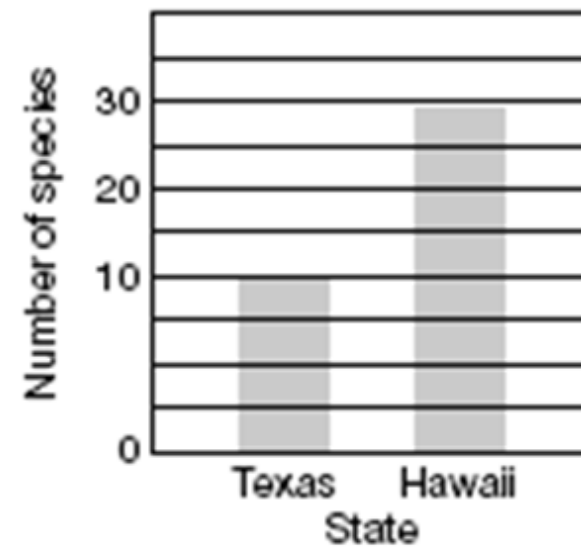
Misleading Graphics – Distorted Scale



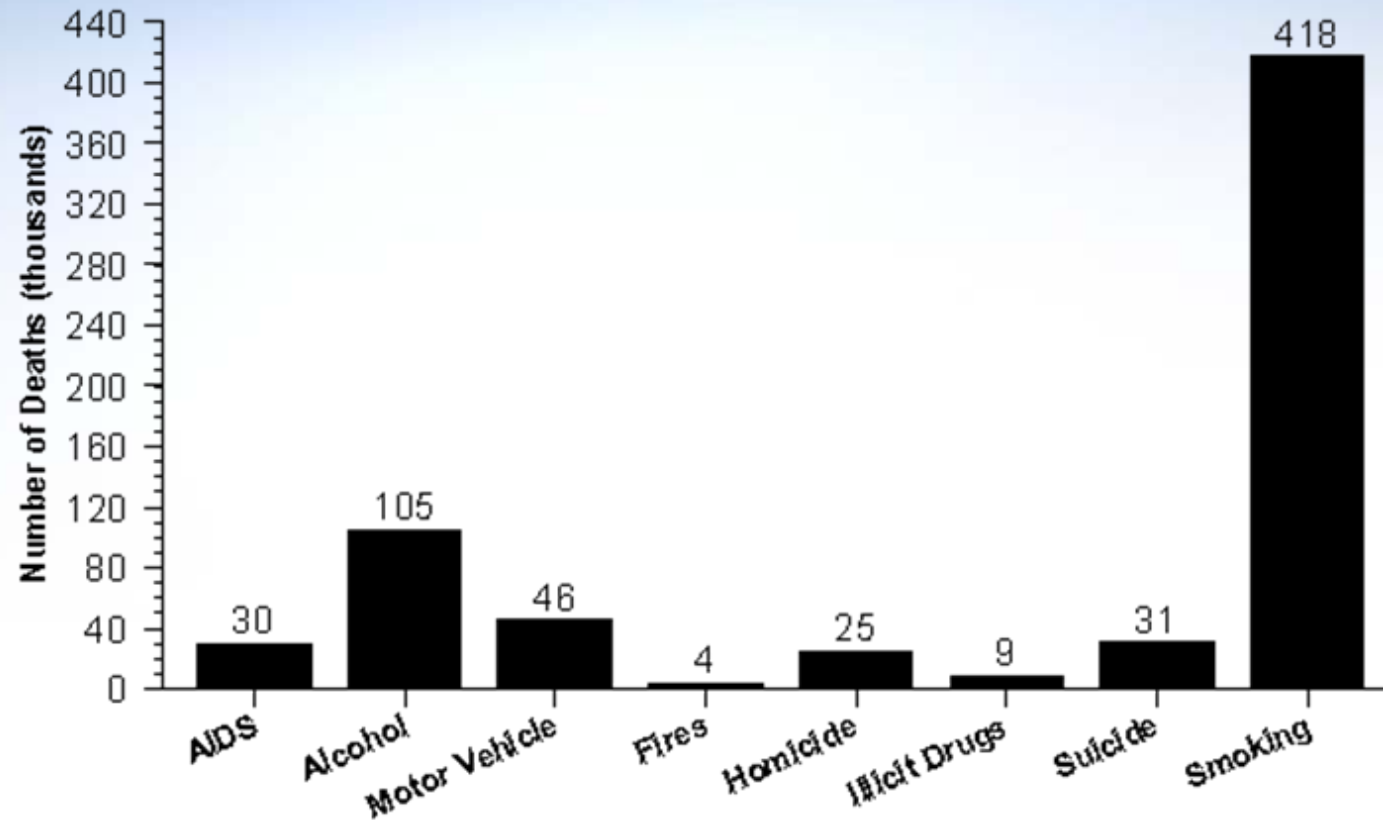
Misleading Graphics – Distorted Scale



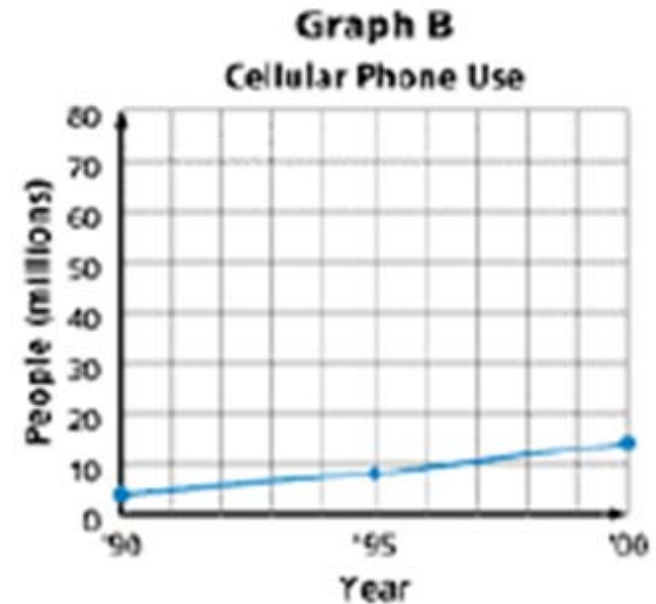
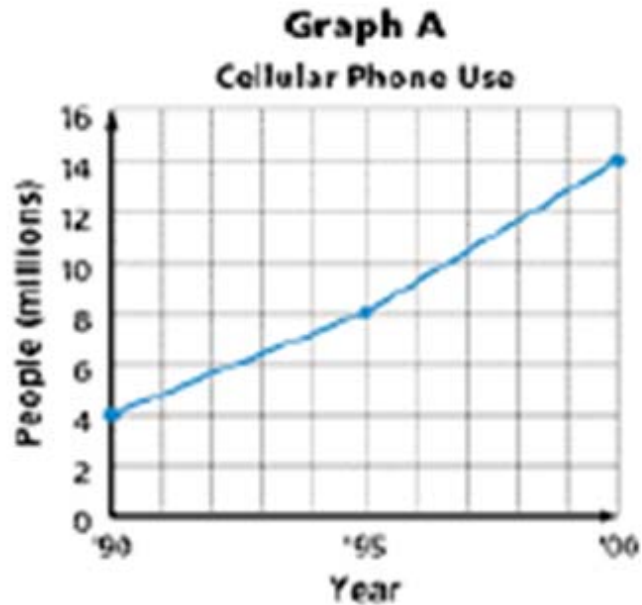
Endangered Birds



Misleading Graphics – Missing Categories



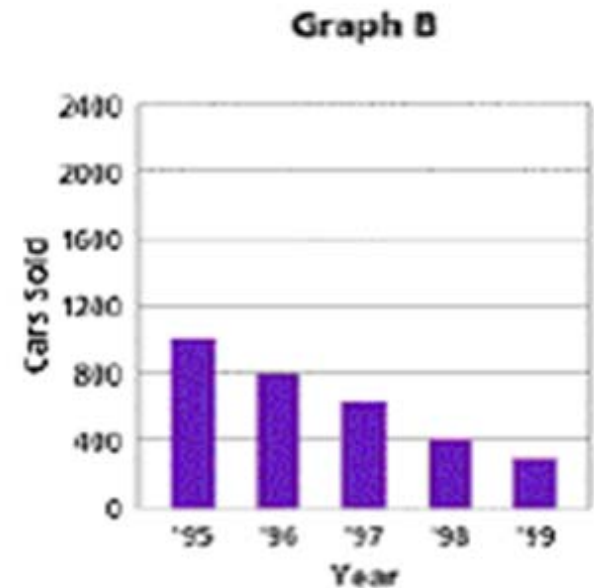
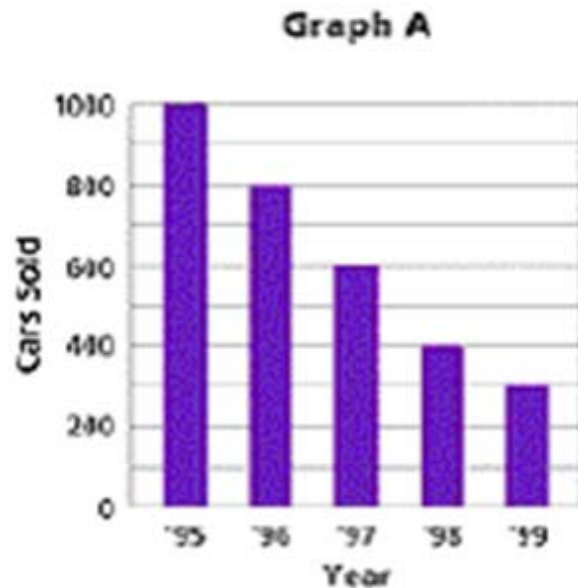
Misleading Statistics – Looks Like a Bias



Why do the graphs look different?

Which graph appears to show a greater increase in the use of cellular phones?

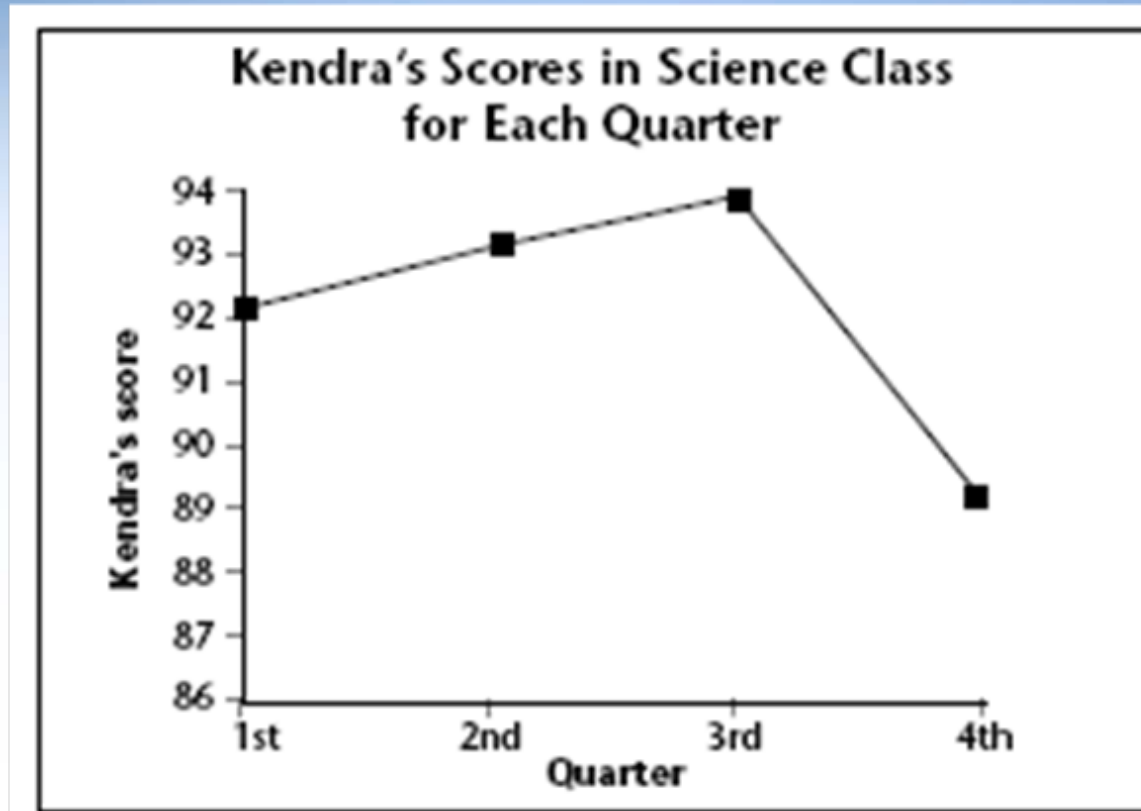
Misleading Statistics – Looks Like a Bias



Why do the graphs look different?

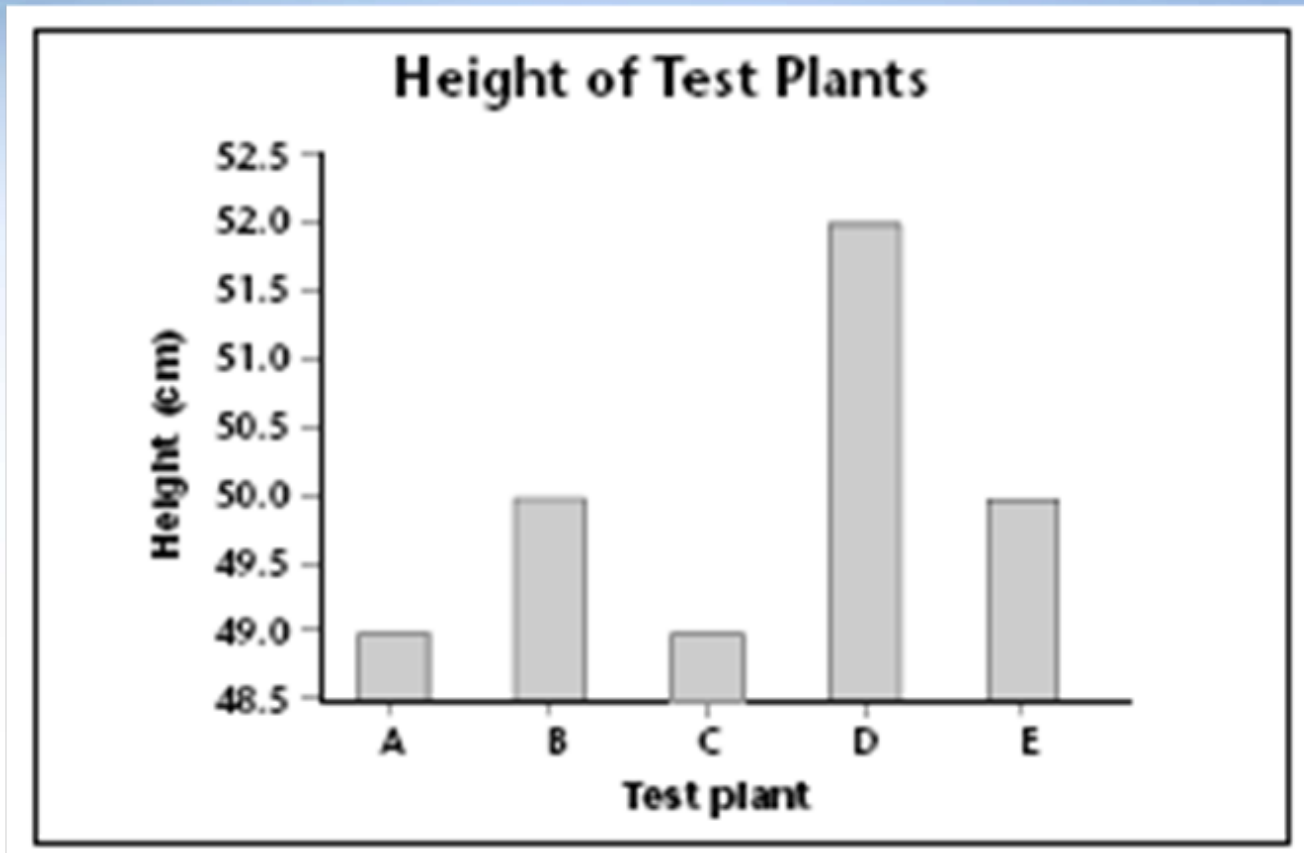
Which graph would be most effective in negative advertisement by a competing car company? Why?

Misleading Statistics – Looks Like a Bias



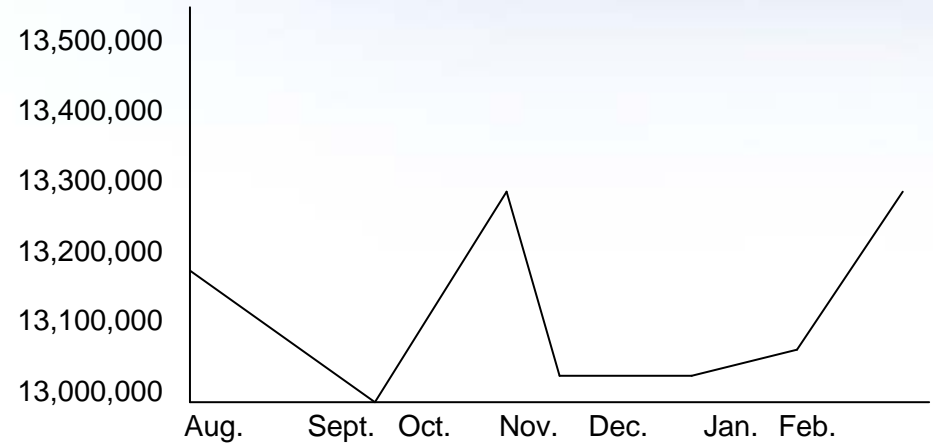
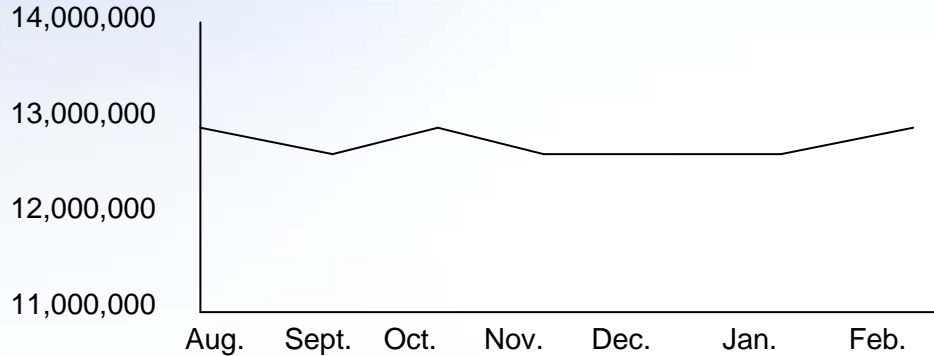
This graph shows that Kendra received a much lower grade in science class during the fourth quarter. Do you think what appears to be such a large drop in her grades should worry Kendra? Explain your reasoning.

Misleading Statistics – Looks Like a Bias



This graph shows that test plant D grew much taller than the other plants. How is this information misleading?

Going Beyond the Basics



Unemployment Numbers

If you were campaigning for office, which one would you want to use? Why?

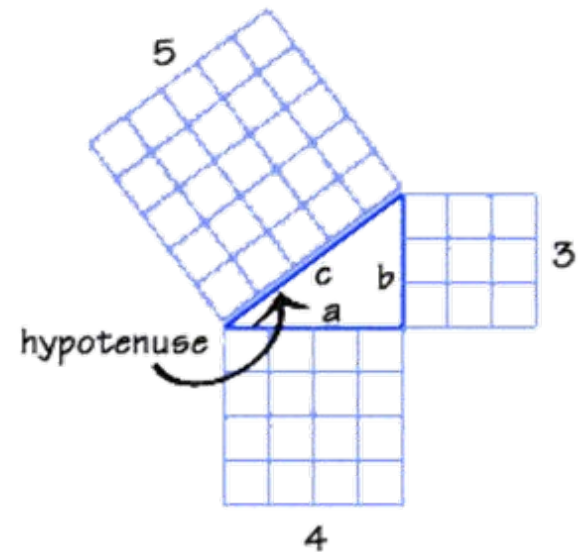
Put Your Skills to Work

**A Really Sweet
Assignment!**

What Does This Have to Do with Anything?

The Pythagorean theorem states that:
The sum of the squares of the lengths of the legs of a right triangle ('a' and 'b' in the triangle shown below) is equal to the square of the length of the hypotenuse ('c').

$$a^2 + b^2 = c^2$$



$$a^2 + b^2 = c^2$$

Mathematics

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National Research Council, 1989

Still Struggling

With Geometry?

Measurement and Geometry

Measurement and Geometry Skills

- Use concepts
- Use spatial visualization
- Select appropriate units of measure
- Read and interpret scales, meters, and gauges
- Predict impact of change on perimeter, area and volume of figures

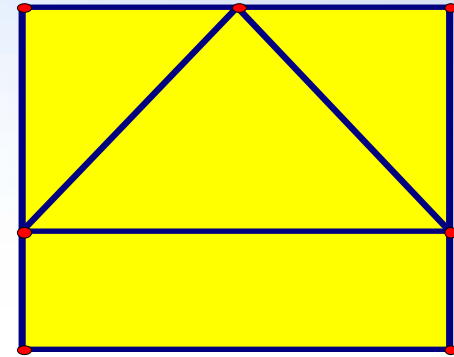
Geometry and Measurement

The Van Hiele Theory

- Level 1: Visualization
- Level 2: Analysis
- Level 3: Informal deduction
- Level 4: Formal deduction
- Level 5: Rigor

Implications for Instruction All Levels

- Use the levels to diagnose where your students are
- It is important that students have lots of experiences at the appropriate level
- Levels are not age dependent, so you can move students along the continuum at any age



Geometry and Measurement

Level 1: Visualization

- Students can name and recognize shapes by their appearance, but cannot specifically identify properties of shapes. Although they may be able to recognize characteristics, they do not use them for recognition and sorting.
- Students manipulate physical models, e.g., lay one shape on top of another.

Geometry and Measurement

Level 2: Analysis

- Students begin to identify attributes of shapes and learn to use appropriate vocabulary related to attributes, but do not make connections between different shapes and their properties.
- In the example of the area of a rectangle, students can count the component square units.

Geometry and Measurement

Level 3: Informal Deduction

- Students are able to recognize relationships between and among properties of shapes or classes of shapes and are able to follow logical arguments using such properties.
- See the relationship between length, width, and area for all rectangles.

Geometry and Measurement

Level 4: Formal Deduction

- Students can go beyond just identifying characteristics of shapes and are able to construct proofs using postulates or axioms and definitions. A typical high school geometry course should be taught at this level.

Geometry and Measurement

Level 5: Rigor

- Students at this level can work in different geometric or axiomatic systems and would most likely be enrolled in a college-level course in geometry.



Visualizing The First Step in Geometric Reasoning

Geometry and Measurement

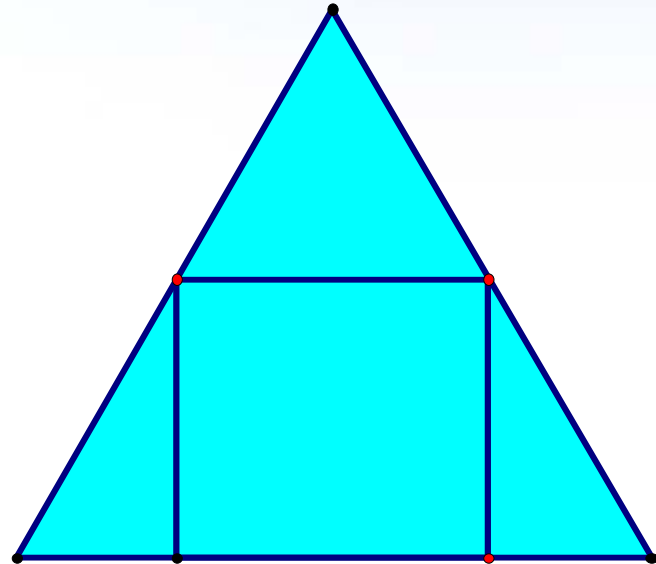
Visualize – the ability to produce mental images

- An object
- A shape
- An operation
- A formula



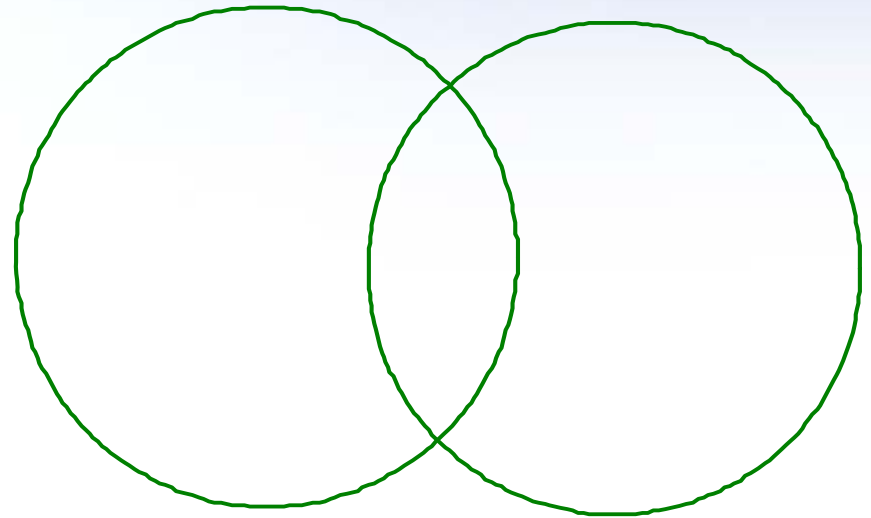
Implications for Instruction - Visualization

- Make sure students see shapes in different orientations
- Make sure students see different sizes of each shape
- Instruction should be informal



Implications for Instruction - Visualization

- Provide activities that have students sort shapes, identify and describe shapes (e.g., Venn diagrams)
- Have students use manipulatives
- Build and draw shapes
- Put together and take apart shapes



Try This!

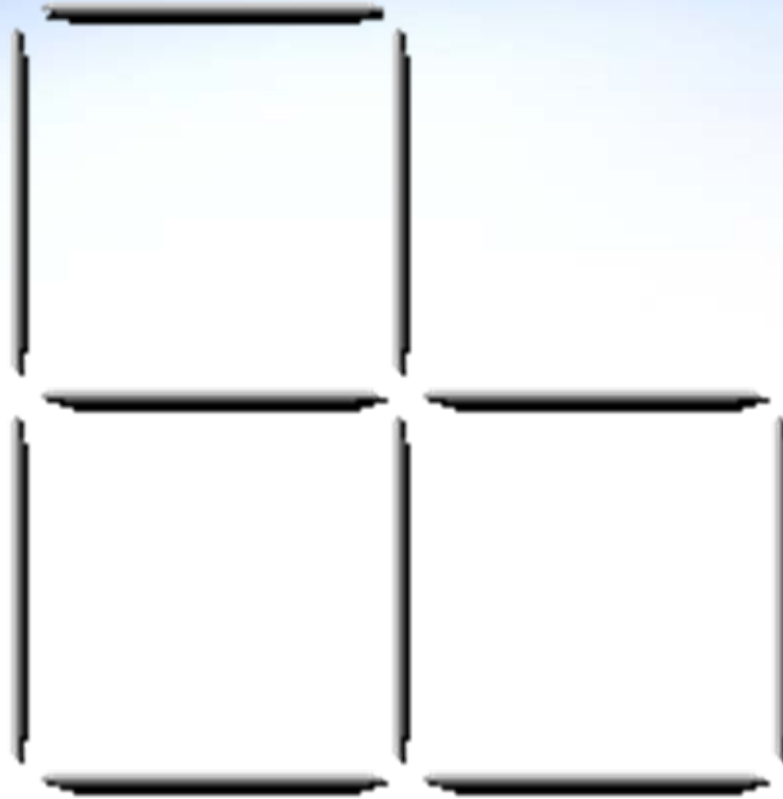
Three Triangles to Two



**Move two toothpicks to make
two triangles**

Try This!

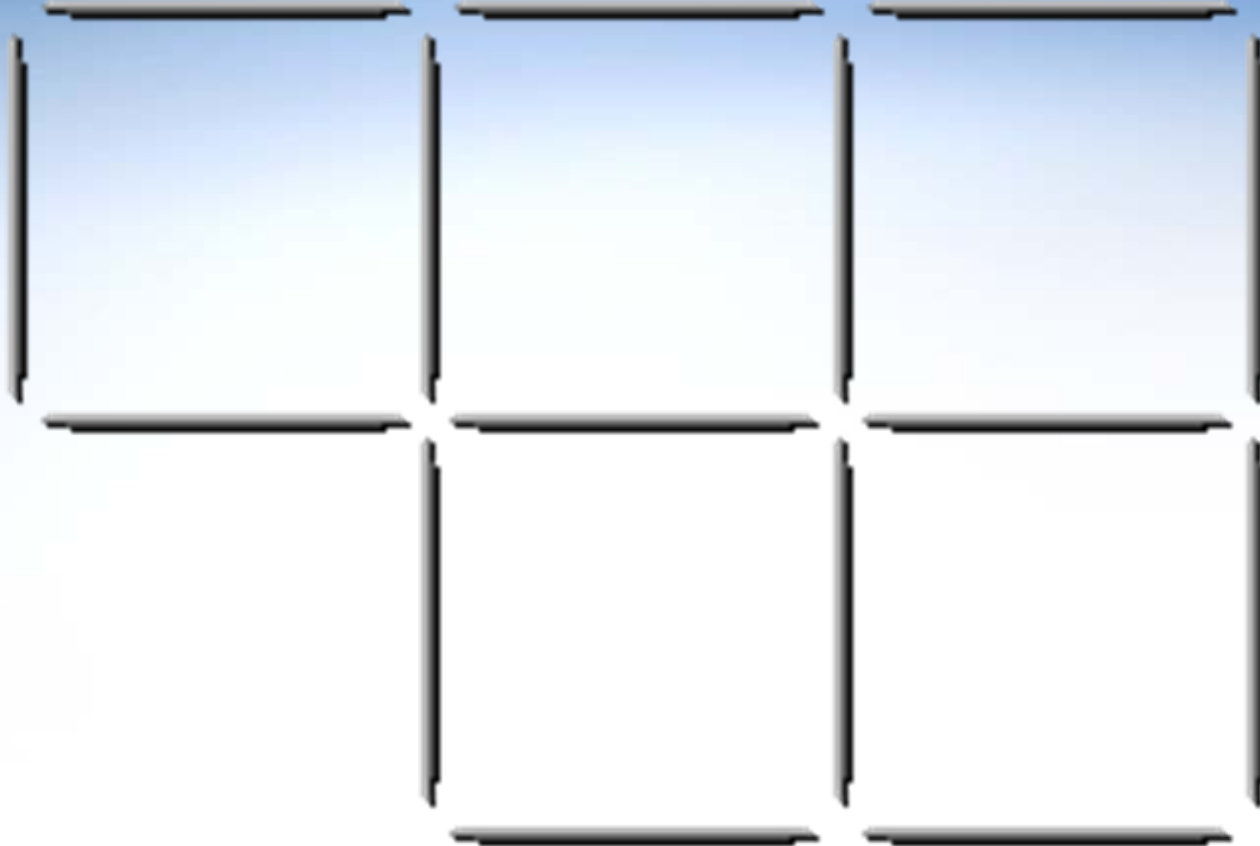
The Upside Down L



**Move only two toothpicks to
turn the L upside down**

Try This!

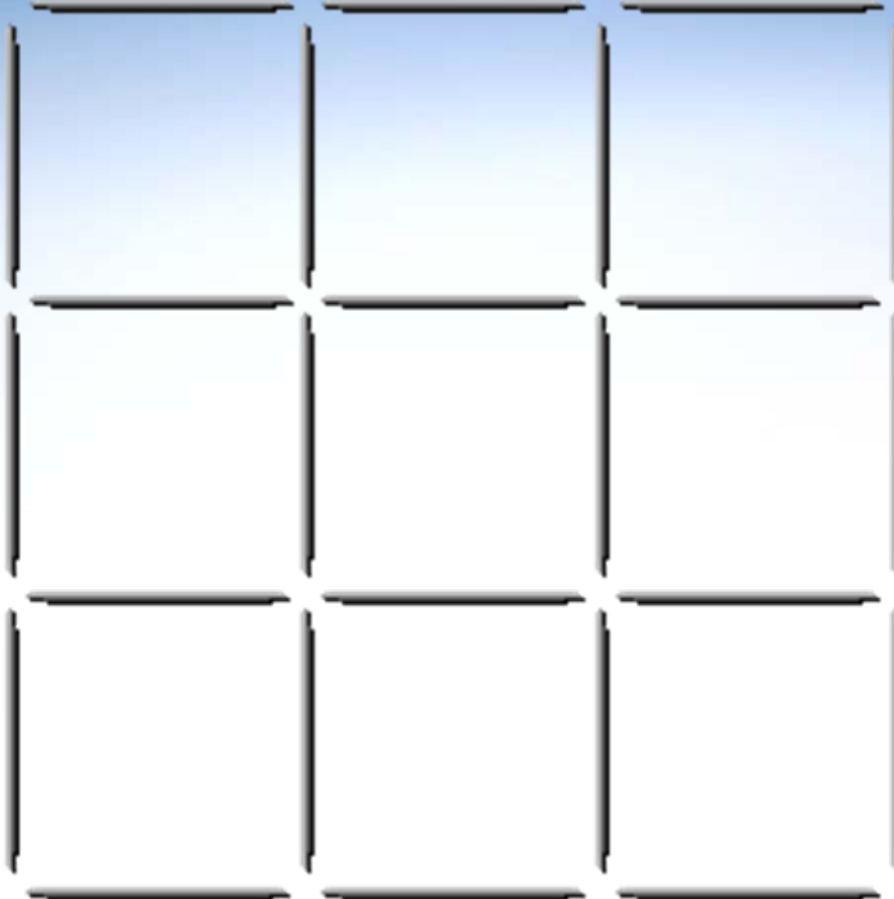
Five to Three



**Remove three toothpicks to make
three squares**

Try This!

Nine Square No4



**Remove eight toothpicks to make
two squares
(can you find two different solutions?)**



Analysis

The Second Step

in Geometric Reasoning

Geometry and Measurement

Description 1:

The design looks like a bird with

- a hexagon body;
- a square for the head;
- triangles for the beak and tail; and
- triangles for the feet.

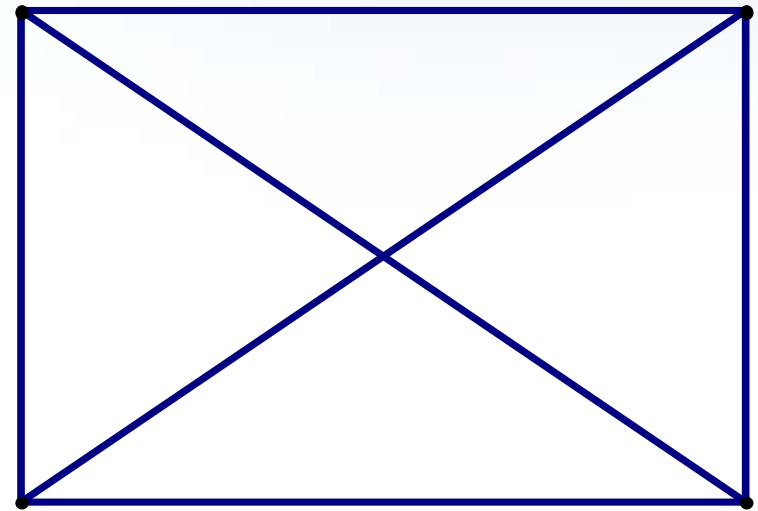
Geometry and Measurement

Description 2:

- Start with a hexagon.
- On each of the two topmost sides of the hexagon, attach a triangle.
- On the bottom side of the hexagon, attach a square.
- Below the square, attach two more triangles with their vertices touching.

Implications for Instruction - Analysis

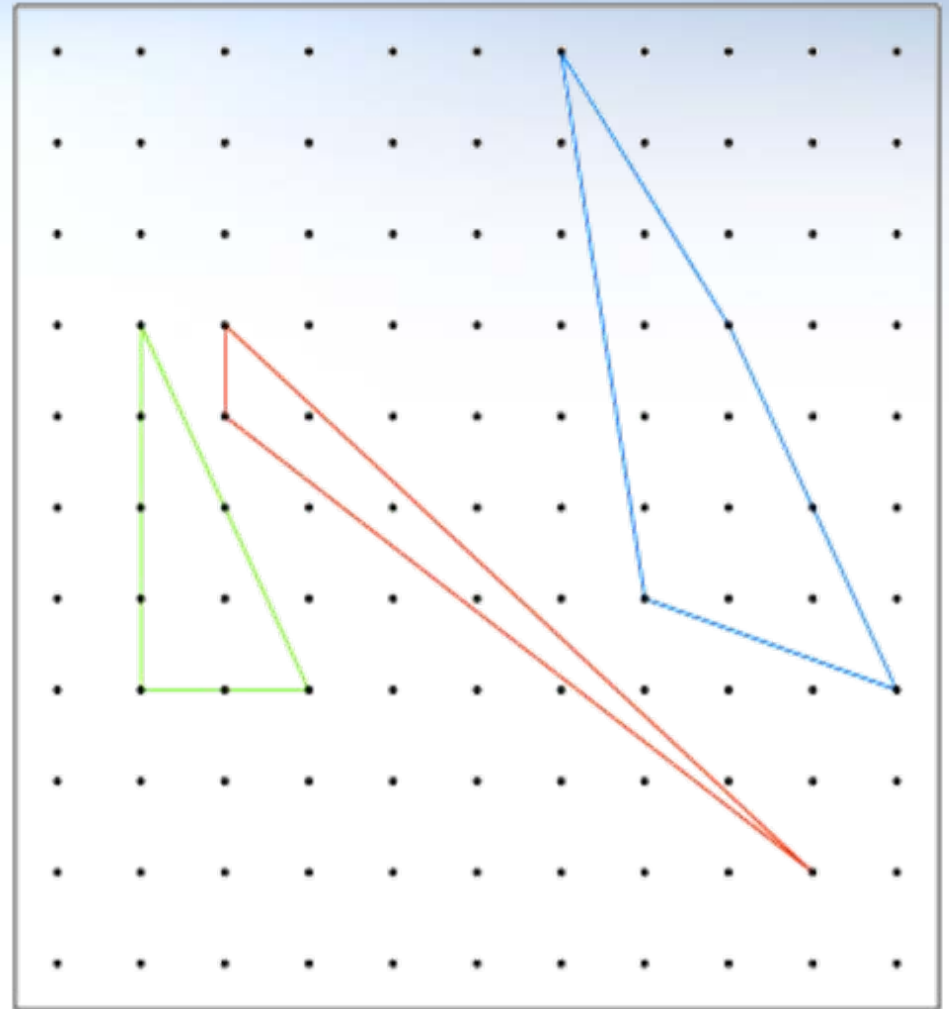
- Work with concrete or virtual manipulatives
- Define properties, make measurements and look for patterns
- Explore what happens if a measurement or property is changed
- Discuss what is sufficient to define a shape (e.g., rectangle)



Geometry and Measurement

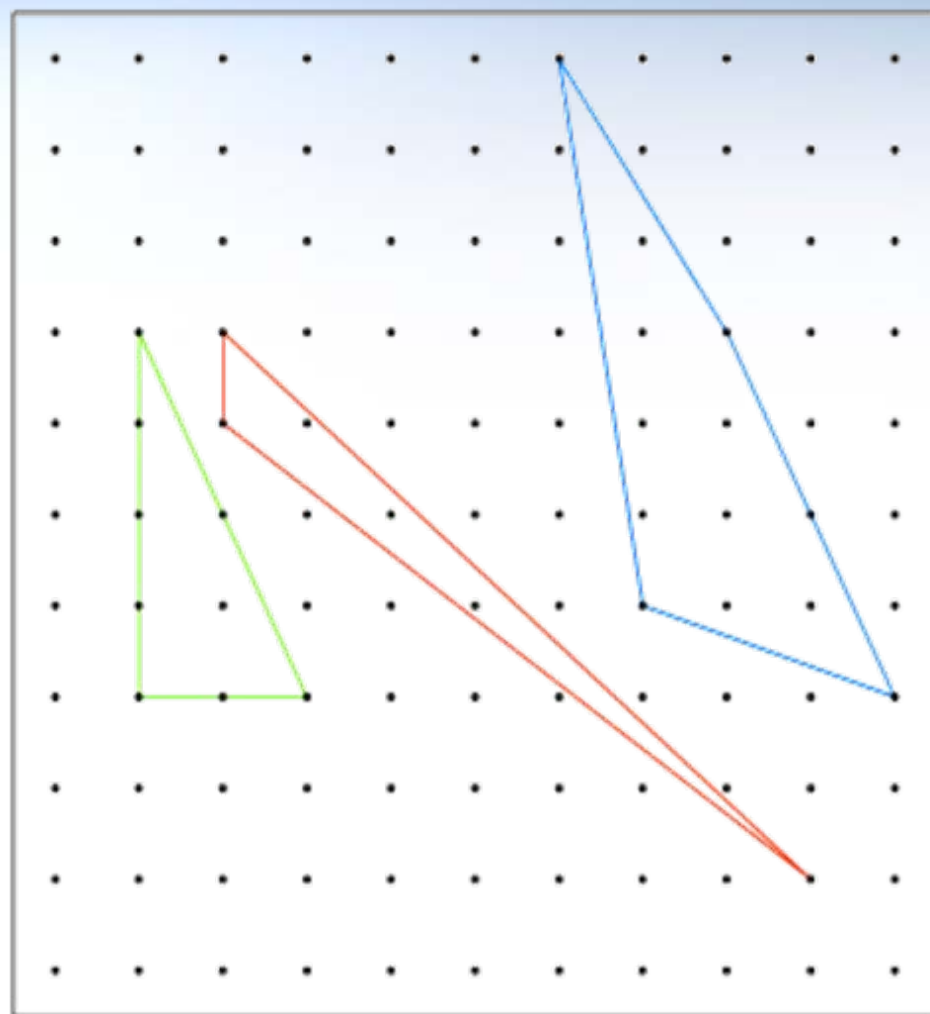
What is a geoboard?

- A geoboard is a board covered in a grid of pegs which can be used to construct shapes using geo bands.
- It is used as a manipulative tool for teaching geometry on an elementary level.



Geometry and Measurement

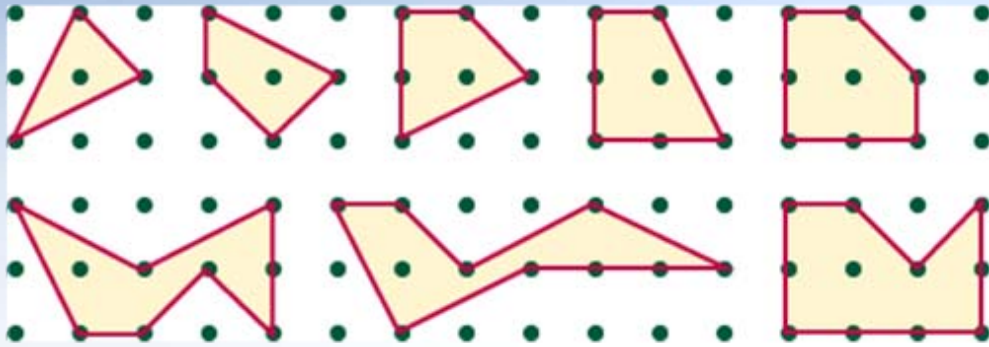
Geoboards help students identify simple geometric shapes, describe their properties, and develop spatial sense.



Geometry and Measurement

- Give specific assignment to the students.
- Make a shape with three sides.
- Make a two point shape.
- Make a shape of something that can fly.
- Make a shape that touches four pegs with two pegs inside.
- Students record their shapes on geoboard dot paper for display.

Geometry and Measurement



- Create figures on the geoboard.
- Find the perimeter of the created figures.
- Measure the length of the unit as the space between consecutive pegs.
- Find the area of the created figures.
- Compare perimeter and area.

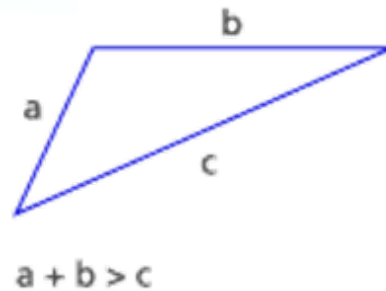
Implications for Instruction Analysis

- Use technology (e.g., Geometer's Sketchpad, National Library of Manipulatives) to explore properties
- Classify shapes based on lists of properties
- Solve problems involving properties of shapes

Putting Geometry to Work!

Triangles

- Theorem: The measure of any side of a triangle must be LESS THAN the sum of the measures of the other two sides. (This same concept forms the basis for other questions in the domain of Geometry.)



- The triangle inequality is the mathematical statement of the old adage, "The shortest distance between two points is a straight line." If you don't travel along the straight line, you travel two sides of a triangle, and that trip takes longer.

**Why do I need
to know this?**

Authentic Tasks and Materials

Going Beyond the Basics

Measurement: It's Important

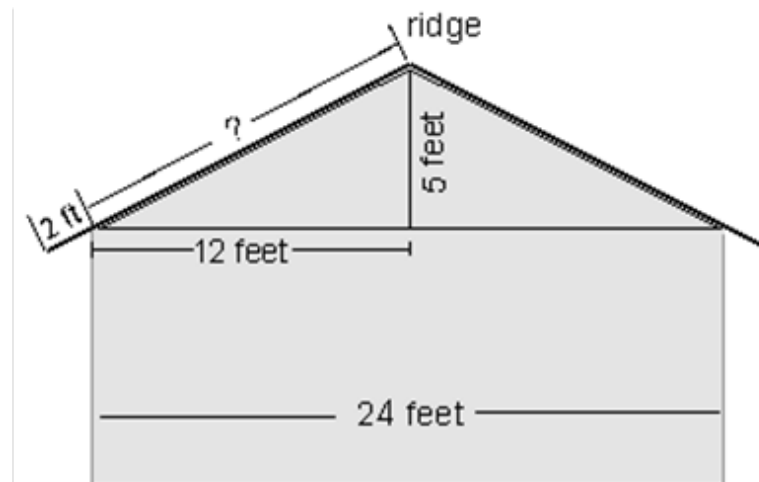
- What formula(s) will Danielle need to calculate the cost of the fabric?
- What problem solving skills will Danielle need?
- What is likely error that your students would make in solving this problem?
- What else will Danielle need to add to the fabric cost before she can give the quote to her client?

Geometry in Real-Life

Problem:

A customer would like a bonus room to be added to an existing home. The new room is to be 26' x 24' with an 8' ceiling and a 2' roof overhang. The ridge of the roof is to be centered over the 24 foot wall and 5 feet above the top of the wall of the bonus room. Assuming the builder uses standard 4' x 8' plywood sheets, determine the following:

1. How many plywood sheets will be needed to cover the walls of the bonus room (not accounting for doors or windows)?
2. How many plywood sheets will be necessary to cover the roof over the bonus room?



Math = Experiences

*One picture tells a thousand words;
one experience tells a thousand
pictures.*



Going Beyond the Basics

- Connect learners' prior knowledge and the new concept
- Present authentic information from a problem-solving perspective
- Demonstrate problems at concrete (e.g., manipulatives), pictorial, & abstract levels
- Teach algebraic thinking
- Teach geometric thinking
- Use the tools (technology) of math for application

Going Beyond the Basics

Math Lesson Plans

1. Just a Part of Everyday Life!
2. Estimation
3. Rate/Time/Distance: Where Do We Go From Here?
4. Measurement: It's Important!
5. Does It Fit? Pythagorean in the Workplace
6. Statistics in the Workplace
7. Interpreting Workplace Graphics
8. Graphics Credibility in the Workplace

Going Beyond the Basics

Strategies for Incorporating Mathematics in the Workplace into the GED Curriculum

- Use authentic tasks
- Start lessons with workplace situations
- Teach and apply problem-solving skills
- Use graphic organizers
- Use project based learning
- Teach algebraic thinking (Try C-S-A and STAR)

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