GED® Math
Grab Bag – A Focus on Key Concepts and Qualitative Reasoning

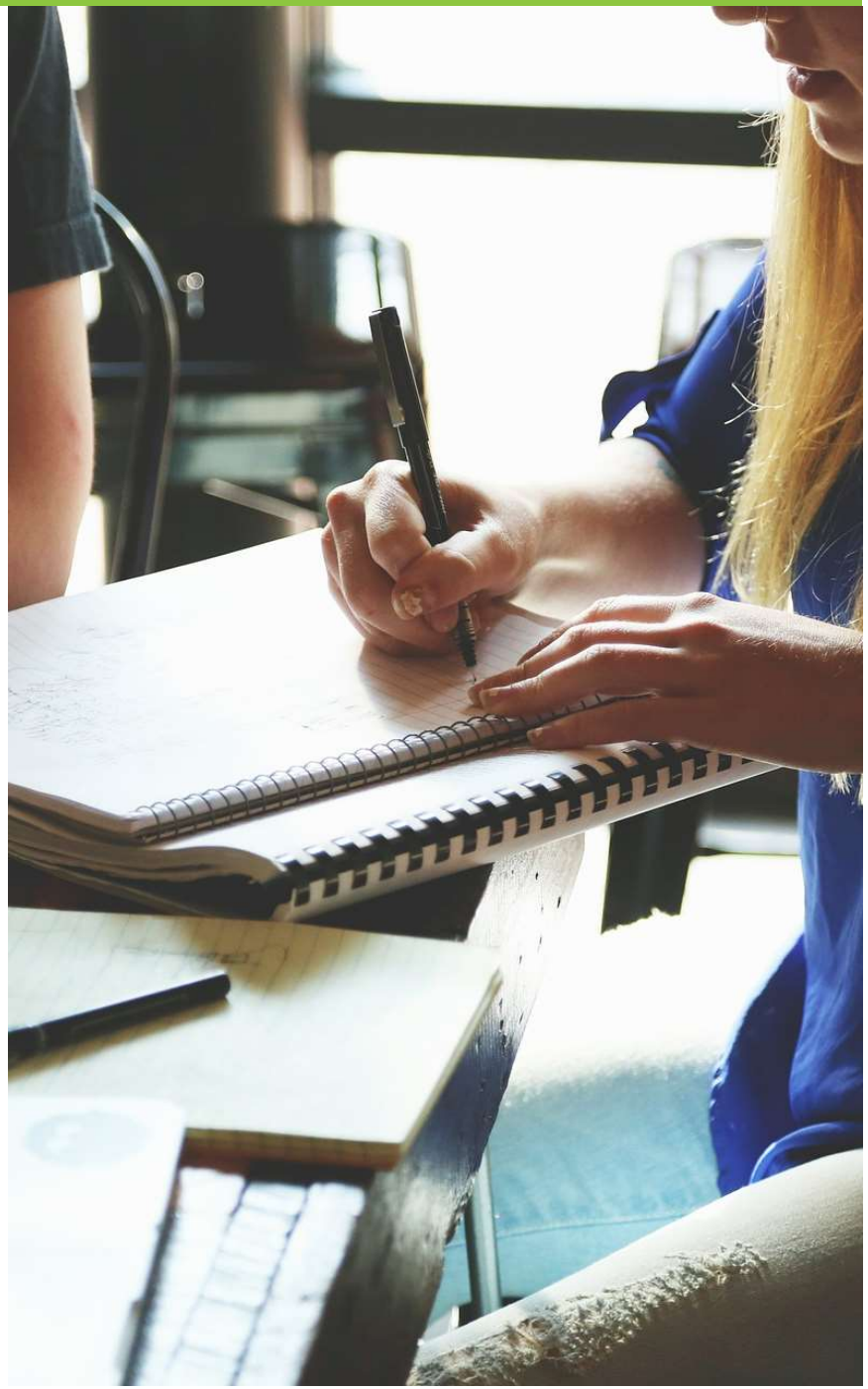
A Workshop by GED Testing Service®

Presented by Thomas Ross

GED TESTING SERVICE®

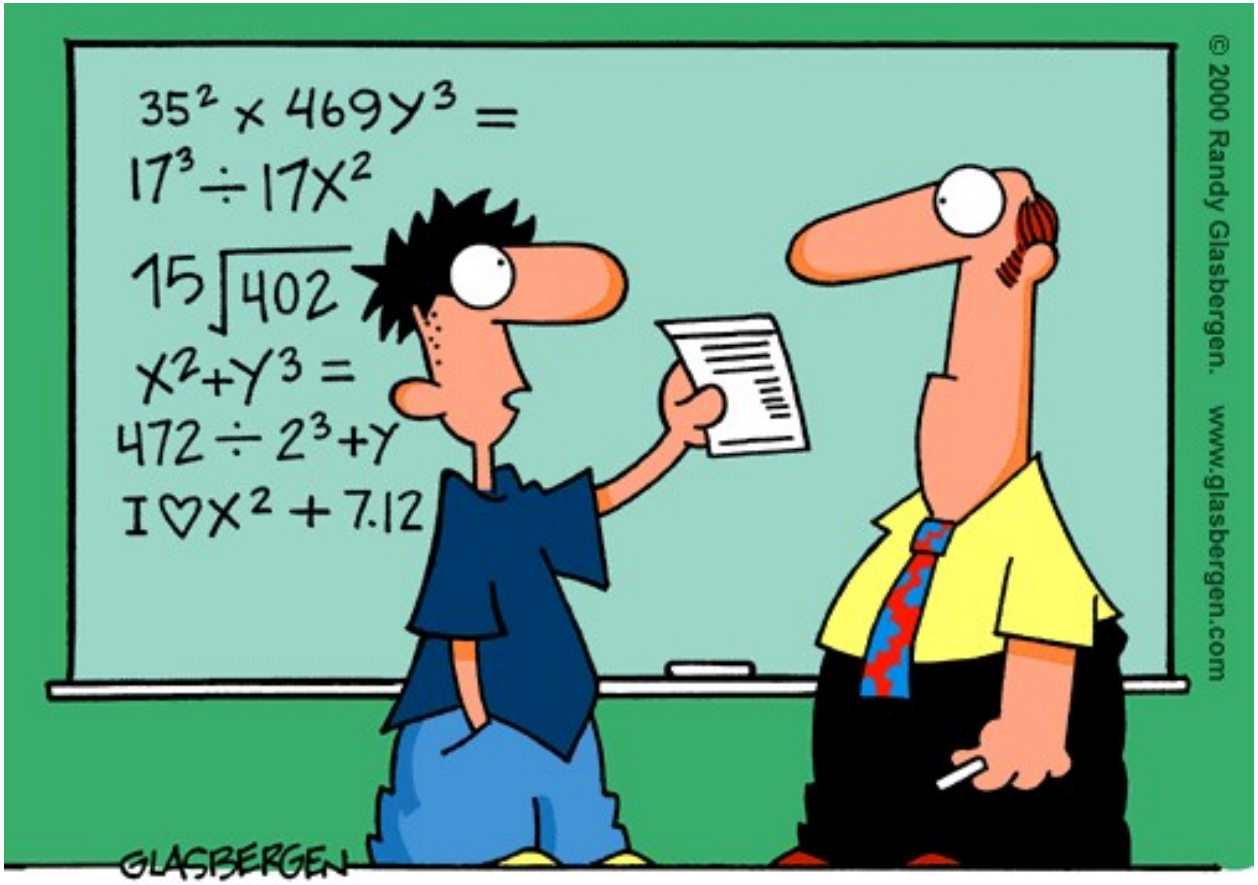
Session Objectives

- Discuss challenges that students face in mathematics
- Review strategies and activities to help students improve their basic math skills
- Share ideas and resources



GED TESTING SERVICE®

It Really Isn't Genetic



"I HAD MY DOCTOR DO A D.N.A. BLOOD ANALYSIS. AS I SUSPECTED, I'M MISSING THE MATH GENE."

GED TESTING SERVICE®

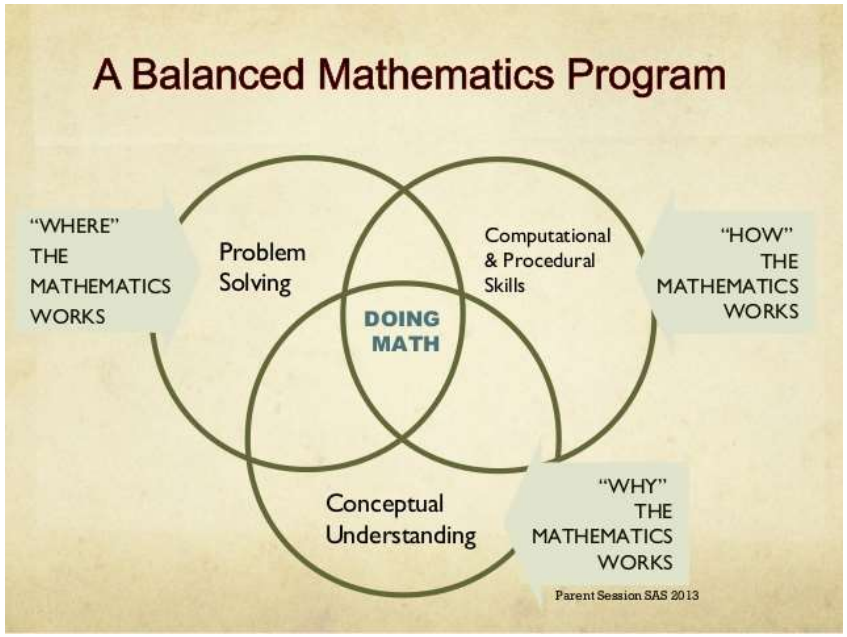
Math Involves…

- Memory
- Language
- Sequencing
- Spatial ordering
- Critical thinking
- Good problem-solving strategies
- Number sense
- Reasoning
- Making connections

In the Classroom, We Often…

- Introduce new concepts too rapidly
- Insufficiently support explanations and activities
- Provide insufficient practice
- Focus on facts versus concepts
- Limit access to manipulatives and
- Limit connection of skills to real-life situations

Our Students Need…



GED TESTING SERVICE®

Overview of the Mathematical Reasoning Test

Overview

- One test with calculator allowed on most items
- Content
  - 45% - Quantitative Problem Solving
  - 55% - Algebraic Problem Solving
- Texas Instruments - TI 30XS Multiview™
- Integration of mathematical practices

Item Types

- Technology-enhanced items
  - Multiple choice
  - Drag-drop
  - Drop-down
  - Fill-in-the-blank

GED TESTING SERVICE®

Understanding Skills Students Have

Low Intermediate Basic Education (4-5.9 GLE)	High Intermediate Basic Education (6-8.9 GLE)	Low Adult Secondary Education (9-10.9 GLE)
Students can perform with high accuracy all four basic math operations using whole numbers up to three digits and can identify and use all basic mathematical symbols.	Students can perform all four basic math operations with whole numbers and fractions; can determine correct math operations for solving narrative math problems and can convert fractions to decimals and decimals to fractions; and can perform basic operations on fractions.	Students can perform all basic math functions with whole numbers, decimals, and fractions; can interpret and solve simple algebraic equations, tables, and graphs and can develop own tables and graphs; and can use math in business transactions.

Three Score Level Indicators on GED Ready®

Not Likely to Pass	Too Close to Call	Likely to Pass
100-133	134-144	145-200

GED TESTING SERVICE®

Test-taker Scoring Too Close to Call

The Student's performance

- Is typically based on a test-taker's consistency in demonstrating skills, or
- May be based on the level of complexity of materials that a test-taker can handle
  - Lower-performing students may be
    - Successful with simpler materials and
    - Less successful with those that are more complex

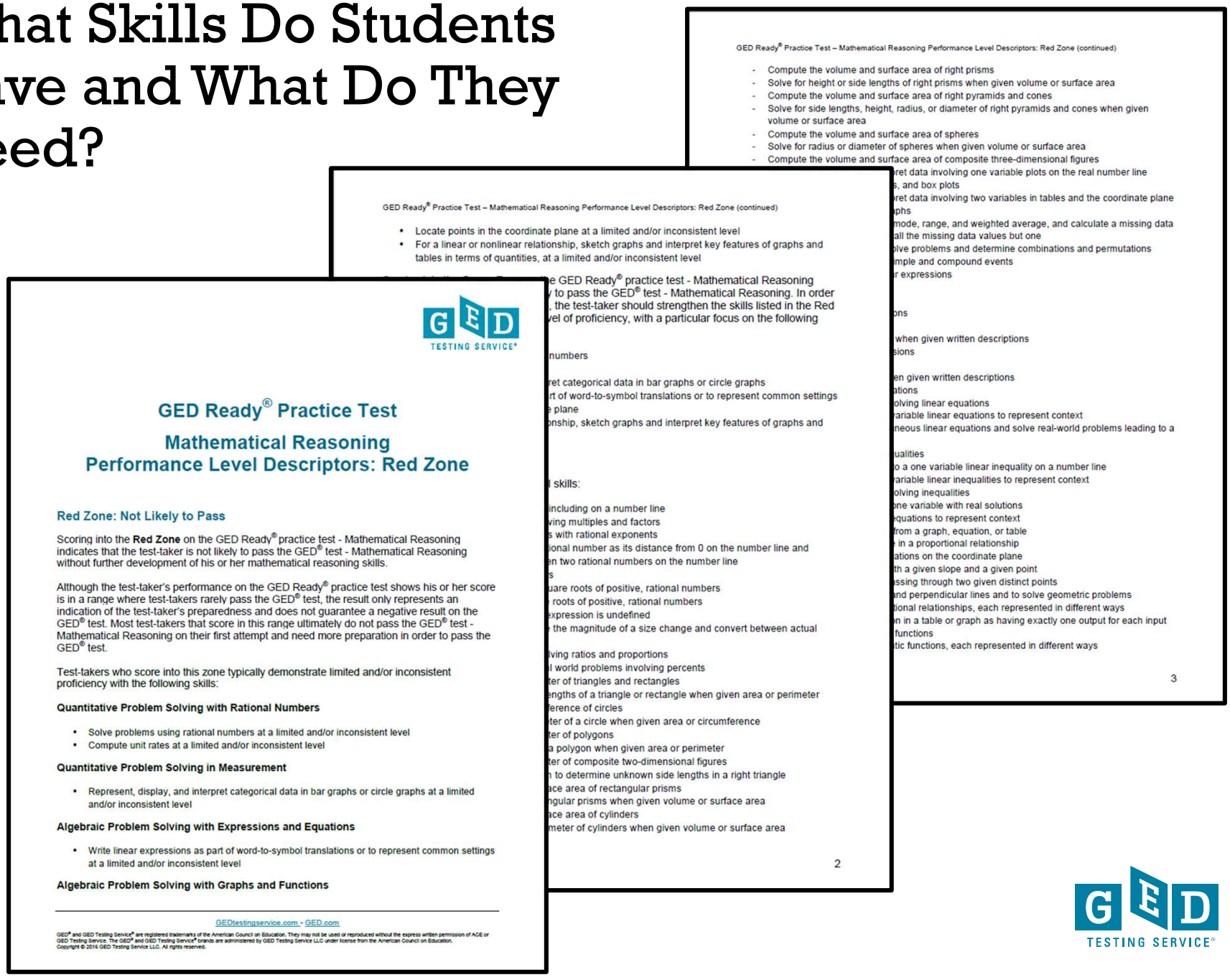
GED TESTING SERVICE®

Level of Consistency in Demonstrating Skills

Not Likely to Pass	Too Close to Call	Likely to Pass
Quite Inconsistent	Perform about 50% - 70%	Above 70%

GED TESTING SERVICE®

What Skills Do Students Have and What Do They Need?



GED Ready® Practice Test – Mathematical Reasoning Performance Level Descriptors: Red Zone (continued)

- Compute the volume and surface area of right prisms
- Solve for height or side lengths of right prisms when given volume or surface area
- Compute the volume and surface area of right pyramids and cones
- Solve for side lengths, height, radius, or diameter of right pyramids and cones when given volume or surface area
- Compute the volume and surface area of spheres
- Solve for radius or diameter of spheres when given volume or surface area
- Compute the volume and surface area of composite three-dimensional figures

3

GED Ready® Practice Test – Mathematical Reasoning Performance Level Descriptors: Red Zone (continued)

- Locate points in the coordinate plane at a limited and/or inconsistent level
- For a linear or nonlinear relationship, sketch graphs and interpret key features of graphs and tables in terms of quantities, at a limited and/or inconsistent level

2

GED TESTING SERVICE®

GED Ready® Practice Test

Mathematical Reasoning Performance Level Descriptors: Red Zone

Red Zone: Not Likely to Pass

Scoring into the **Red Zone** on the GED Ready® practice test - Mathematical Reasoning indicates that the test-taker is not likely to pass the GED® test - Mathematical Reasoning without further development of his or her mathematical reasoning skills.

Although the test-taker's performance on the GED Ready® practice test shows his or her score is in a range where test-takers rarely pass the GED® test, the result only represents an indication of the test-taker's preparedness and does not guarantee a negative result on the GED® test. Most test-takers that score in this range ultimately do not pass the GED® test - Mathematical Reasoning on their first attempt and need more preparation in order to pass the GED® test.

Test-takers who score into this zone typically demonstrate limited and/or inconsistent proficiency with the following skills:

Quantitative Problem Solving with Rational Numbers

- Solve problems using rational numbers at a limited and/or inconsistent level
- Compute unit rates at a limited and/or inconsistent level

Quantitative Problem Solving in Measurement

- Represent, display, and interpret categorical data in bar graphs or circle graphs at a limited and/or inconsistent level

Algebraic Problem Solving with Expressions and Equations

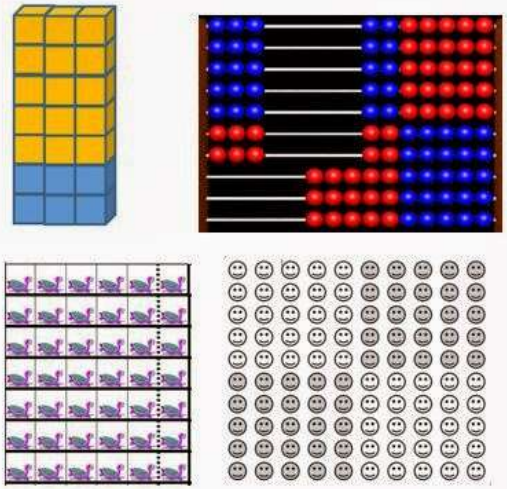
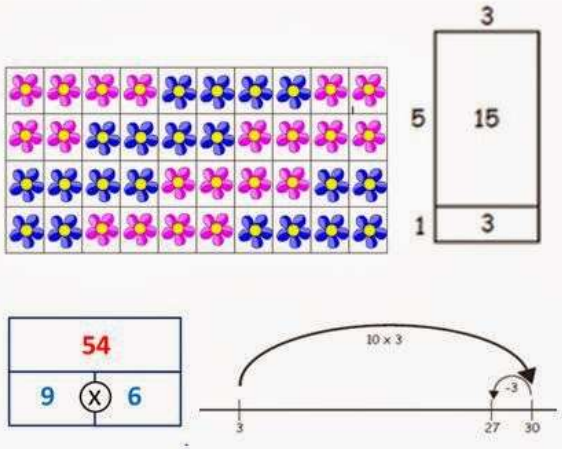
- Write linear expressions as part of word-to-symbol translations or to represent common settings at a limited and/or inconsistent level

Algebraic Problem Solving with Graphs and Functions

GEDtestingservice.com • GED.com

GED TESTING SERVICE®

C-R-A – Essential for Understanding

Concrete	Representational	Abstract
Students manipulate hands-on, concrete materials	Students draw and observe diagrams, or watch the teacher touching and moving hands-on materials	Numbers and mathematical symbols
		x 4 Patterns: 4, 8, 12, 16, 20 / 24, 28, 32, 36, 40 8 x 5 (4 x 2) x 5 4 x (2 x 5) 4 x 10 40 45 ÷ 5 (50-5) ÷ 5 (50÷5) - (5÷5) 10-1 9

So…How Can You Help Students "Build" Math Skills and Become a GED® Test Passer?

Reinforce the Basics

.

GED TESTING SERVICE®

GED Calculator-Prohibited Indicators

https://www.gedtestingservice.com/uploads/files/09738c12fe4e4accd9a16bab7cb99a3c.pdf

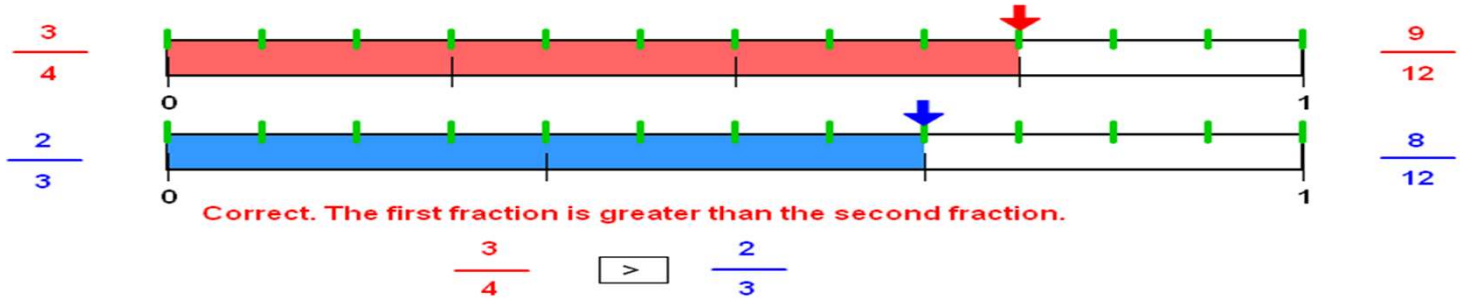
TEST-TAKER RECOMMENDATIONS FOR CALCULATOR-PROHIBITED INDICATORS

The first several questions of the GED® Mathematical Reasoning test assess eight indicators covering various concepts in number sense and computation (Q.1.a through Q.1.d and Q.2.a through Q.2.d) that prohibit the use of the calculator. GED Testing Service has analyzed data on these calculator-prohibited items, resulting in the following comments and recommendations:

Indicator	Background	Recommendations for Test-takers
Q.1.a Order fractions and decimals, including on a number line.	These questions may require • comparing or ordering positive numbers, or negative numbers, or both, • with or without a number line. Test takers generally do very well on this indicator, with the exception of questions that require test takers to compare or order a set consisting entirely of ***negative*** numbers.	• Leverage skills in comparing and ordering ***positive*** fractions and decimals toward similar skills comparing and ordering ***negative*** fractions and decimals. • Understand the difference in how negative numbers are compared and ordered: o For instance, while 0.7 is greater than 0.2, -0.7 is actually *less than* -0.2. o Since positives and negatives are essentially opposites, the rules for ordering each type of number are applied in a similarly opposite manner.
Q.1.b Apply number properties involving multiples and factors, such as using the least common multiple, greatest common factor, or distributive property to rewrite numeric expressions.	Test takers generally perform very well on this indicator, which includes questions that include both context or pure computation (no context) and which test factors of a number, multiples of a number, least common multiple, greatest common factor, etc.	No specific recommendations are provided, as the general population of GED® test takers performs well on this indicator.

Make Sure Students Can Use a Number Line

The fractions 3/4 and 2/3 are pictured with number lines below:

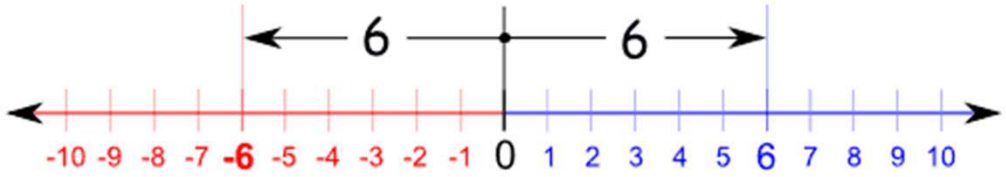


Check Students Understanding of Absolute Value

Absolute Value indicates how far a number is from 0.

- Remove any negative sign and think of all numbers as positive **|-5| = 5**

- Recognize symbol used to represent absolute value **|7| = 7**

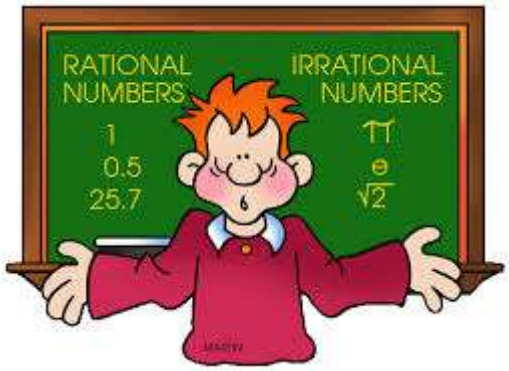


"6" is 6 away from zero,
and "−6" is **also** 6 away from zero.

So the absolute value of 6 is **6**,
and the absolute value of −6 is also **6**

GED TESTING SERVICE®

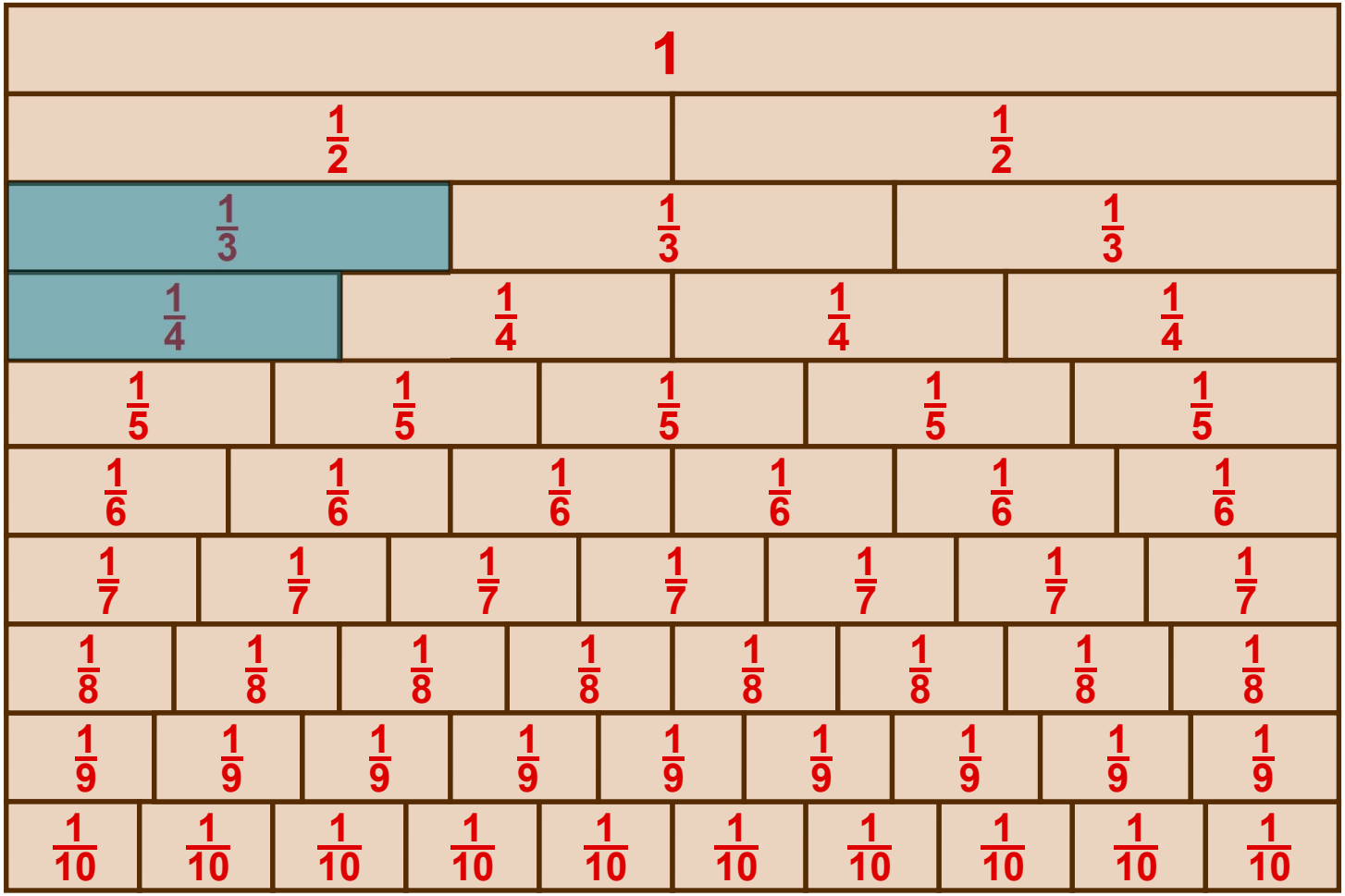
Operations on Rational Numbers



Recommendations for Test-Takers

- Be able to:
  - Multiply and divide with decimals
- Compute
  - With fractions, mixed numbers, and negative numbers
  - Using order of operations

Fraction Tiles



What is more, 1/4 or 1/3? What is more, 1/9 or 1/10?

GED TESTING SERVICE®

Rules of Exponents

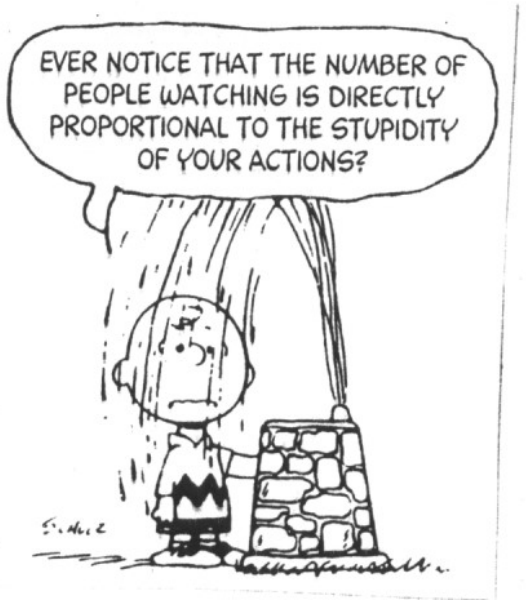
	Rule	Example
1	$x^1 = x$	$5^1 = 5$
2	$x^0 = 1$	$5^0 = 1$
3	$x^{-1} = \frac{1}{x^1}$	$5^{-1} = \frac{1}{5}$
4	$(x^m)(x^n) = x^{m+n}$	$(x^2)(x^3) = x^{2+3} = x^5$
5	$\frac{x^m}{x^n} = x^{m-n}$	$\frac{x^3}{x^2} = x^{3-2} = x^1$
6	$(x^m)^n = x^{(m)(n)}$	$(x^3)^2 = x^{(3)(2)} = x^6$
7	$(xy)^n = x^n y^n$	$(xy)^3 = x^3 y^3$
8	$(\frac{x}{y})^n = \frac{x^n}{y^n}$	$(\frac{x}{y})^3 = \frac{x^3}{y^3}$
9	$x^{-n} = \frac{1}{x^n}$	$x^{-2} = \frac{1}{x^2}$

Percents, Ratios, and Proportions – What's the Problem?

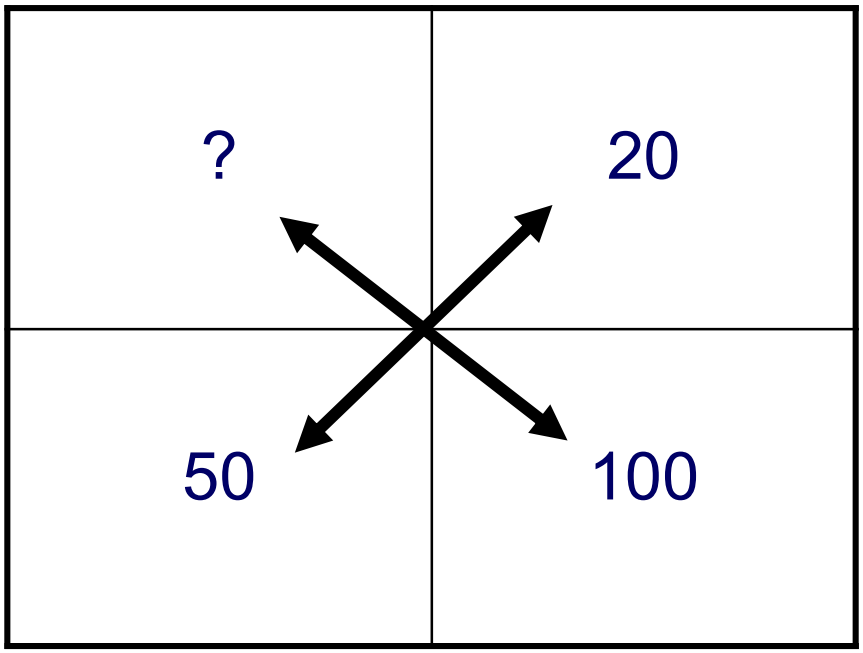
- Percent means "out of 100"

4:3

- Ratio describes the part to part relationship
- Proportion describes the part to whole relationship



Calculating Percents

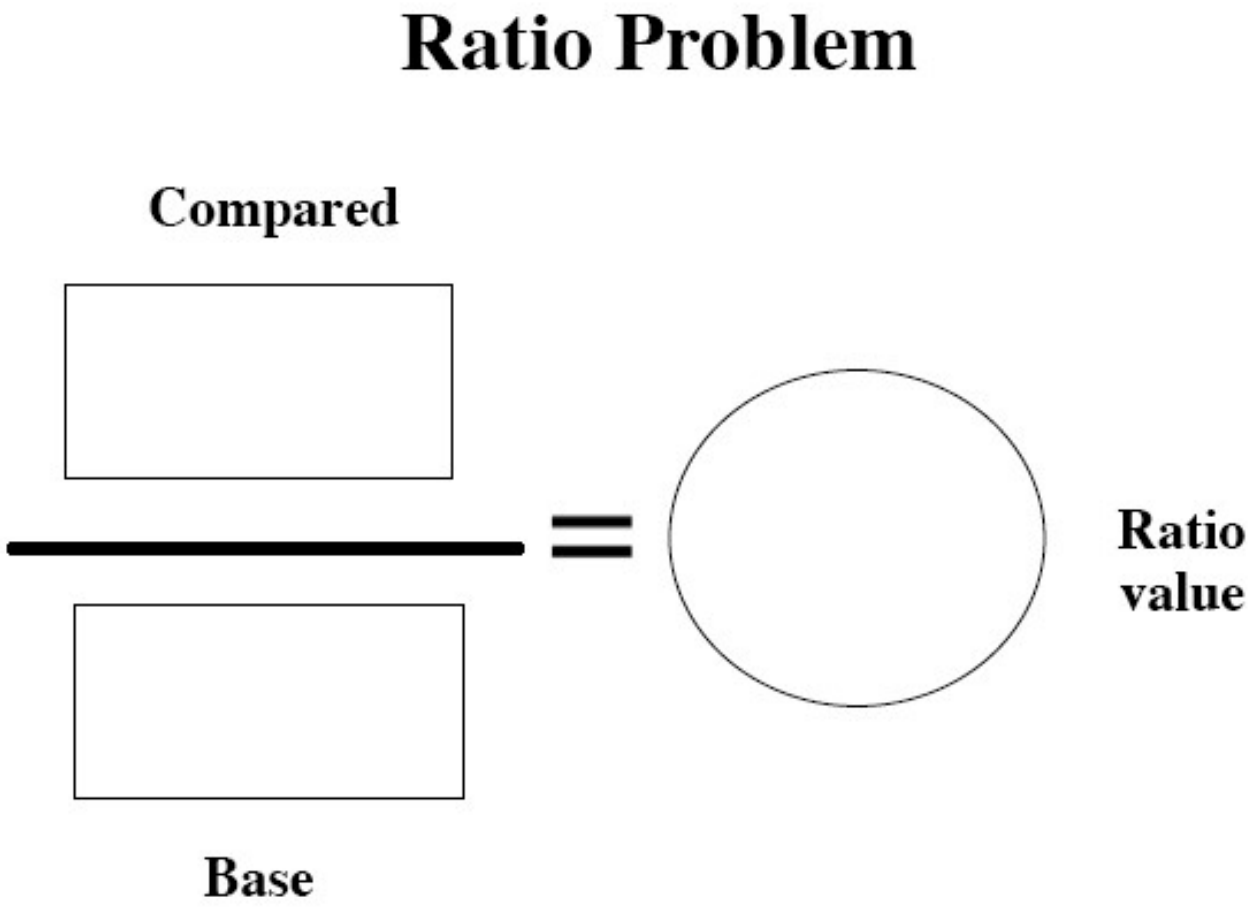


What is 20% of 50?

- 20 x 50 = 1000
- 1000 ÷ 100 = 10
- 20% of 50 = 10

GED TESTING SERVICE®

Ratio and Proportion – Use Graphic Organizers



Provide a "Concrete" Example

Ratios can have **more than two numbers**!

For example concrete is made by mixing cement, sand, stones and water.

A typical mix of cement, sand and stones is written as a ratio, such as 1:2:6.

We can multiply all values by the same amount and still have the same ratio.

10:20:60 is the same as 1:2:6

So when we use 10 buckets of cement, we should use 20 of sand and 60 of stones.

https://www.mathsisfun.com/algebra/proportions.html

Misconceptions about Order of Operations

Misconception 1 - All multiplication should happen before division.

Incorrect	Correct
$12 \div 3 \times 4$	$12 \div 3 \times 4$
$12 \div 12$	4×4
1	16

Misconception 2 – All addition comes before subtraction.

Incorrect	Correct
$4+10-5+8$	$4+10-5+8$
$14-13$	$14-5+8$
1	$9+8$
	17

GROUPINGS ( ) { } [ ]
EXPONENTS N^2
MULTIPLY/DIVIDE ÷/×
(LEFT TO RIGHT)
SUBTRACT/ADD +/−
(LEFT TO RIGHT)

Parenthesis
Exponents
Multiply / **D**ivide
Add + **S**ubtract

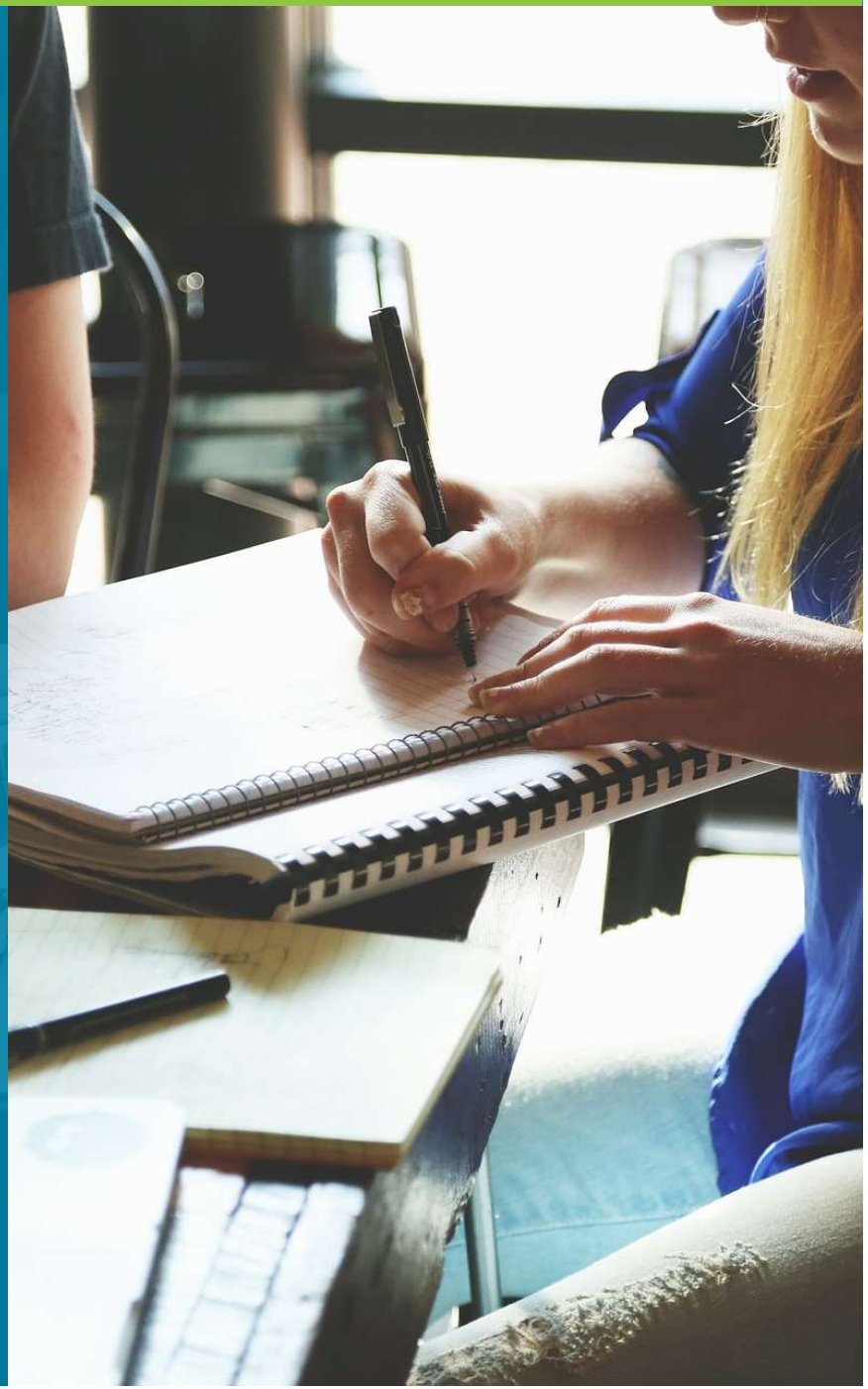
The Challenge

- Increase instruction on problem-solving strategies
- Incorporate close-reading strategies into the math classroom
- Increase emphasis on geometric and algebraic thinking
- Provide instruction in higher-order mathematics
- Shift focus from “rules or processes” of mathematics to deeper understanding of “why”
- Have high expectations of all students

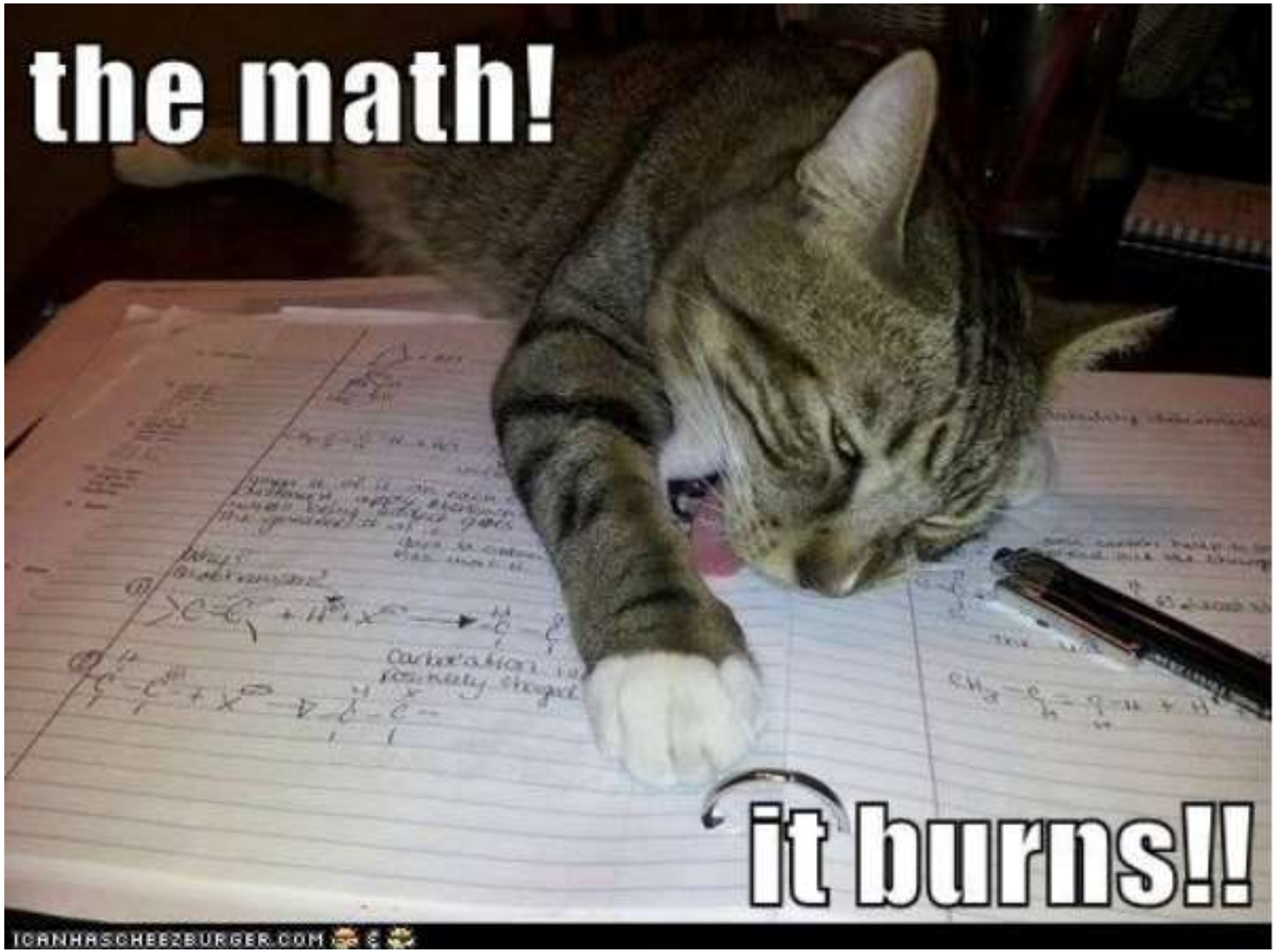
GED TESTING SERVICE®

Reading and Reasoning in Mathematics

Steps to Success



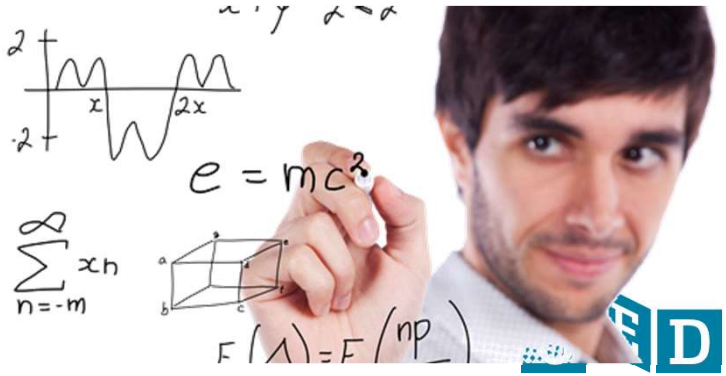
GED TESTING SERVICE®


the math!
it burns!!
ICANHASCHEEZBURGER.COM

Analysis of Math Challenges

In Mathematical Reasoning, items require:

- Application and development of quantitative and algebraic reasoning skills
  - Grounded in real-world examples
  - Beyond rote application of formulas and/or procedural steps
  - The “why” and “how” of math
- Strong critical reading and thinking skills
  - What is the question asking?
  - What heuristics can I use?
  - Is the answer reasonable?



Two Essential Strategies

Helping students learn *how to learn* is critical to aiding the development of higher-order thinking skills

- **Modeling** is one way to teach students how to learn
- **Scaffolding** allows students to practice with diminishing support—to build confidence and competence

Reading and Reasoning Process

First Read: Read for Understanding

Second Read: Identify a Problem-Solving Process

Third Read: Solve the Problem and Check for Reasonableness

Miller, P. and Koesling, D. “Mathematics Teaching for Understanding: Reasoning, Reading, and Formative Assessment. Danvers, MA

First Read: Read for Understanding

- Read through the problem aloud – noting your reactions to what you're reading.
- What vocabulary do you not know?
- What's the real-world context of the problem?
- Is there a picture that can help you visualize the problem?
- What questions are being asked?

Miller, P. and Koesling, D. "Mathematics Teaching for Understanding: Reasoning, Reading, and Formative Assessment." Danvers, MA

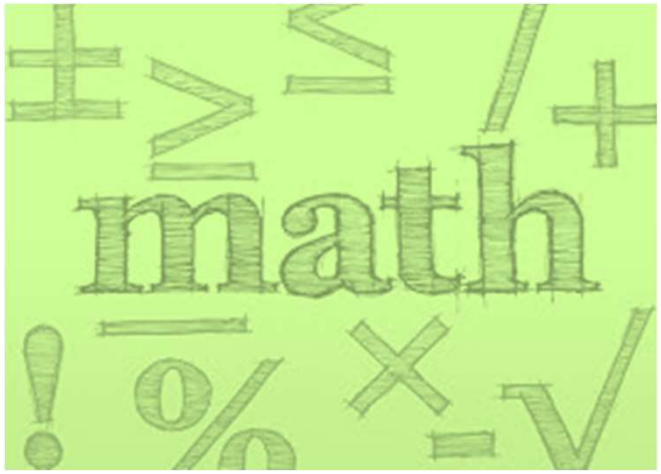
GED TESTING SERVICE®

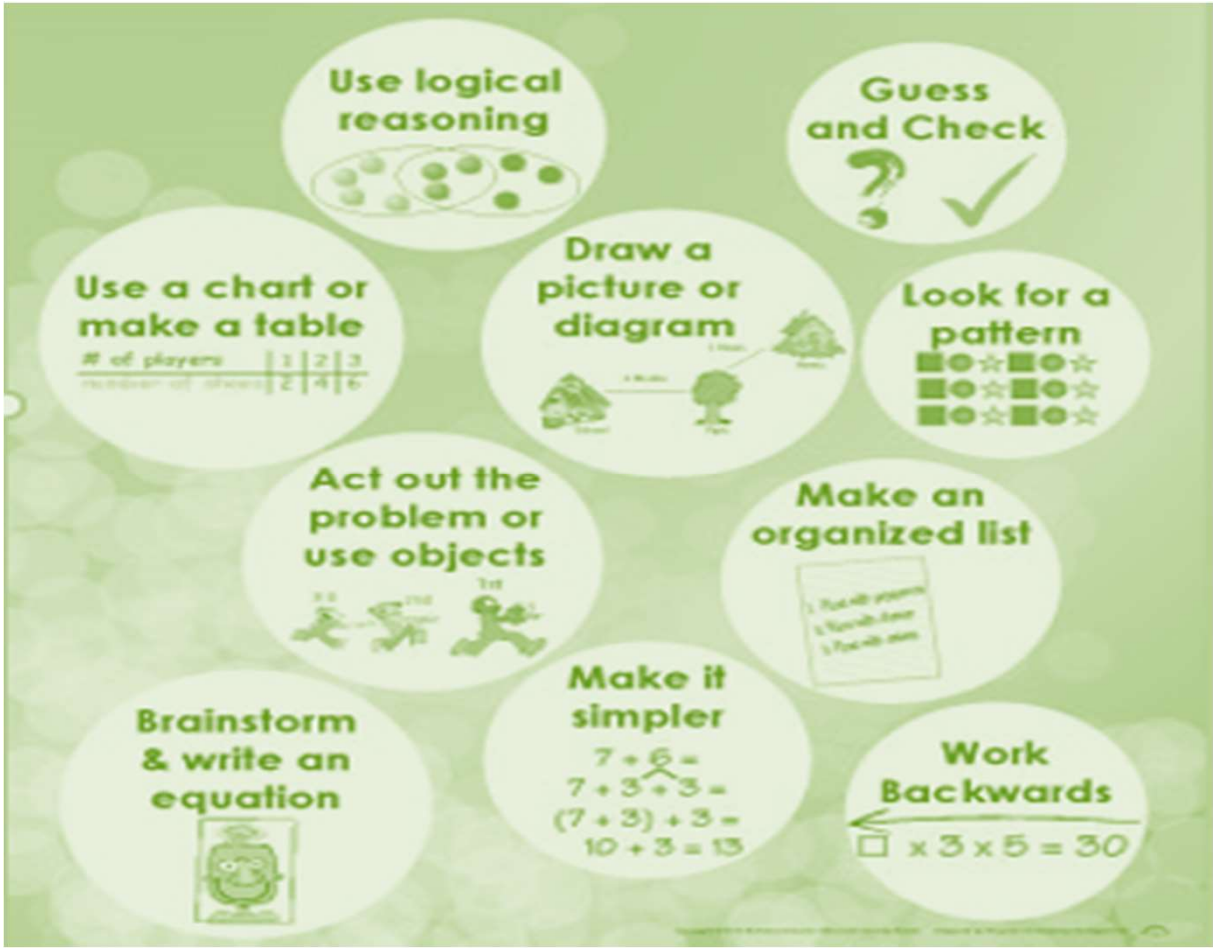
Second Read: Identify a Problem-Solving Process

- What is the pertinent information in this problem?
- What problem-solving strategies could I use?
- Which of those problem-solving strategies is best suited for this problem?
- How will I represent the problem in the symbolic language of mathematics?
- What mathematical details will I select as I reason and solve this problem?

Miller, P. and Koesling, D. “Mathematics Teaching for Understanding: Reasoning, Reading, and Formative Assessment.” Danvers, MA

Second Read: Identify a Problem-Solving Process



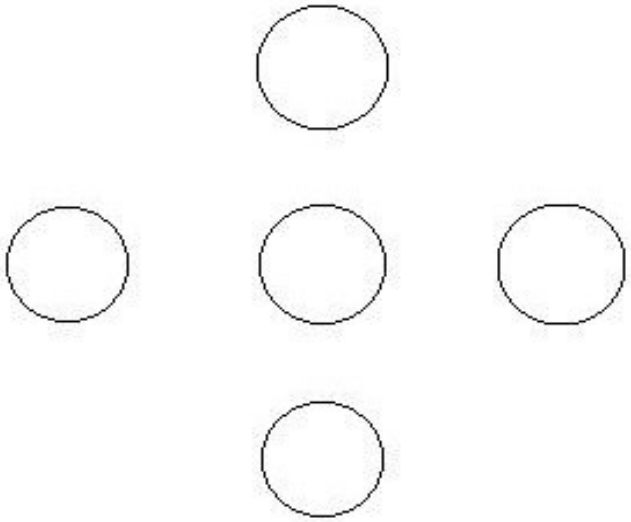


Miller, P. and Koesling, D. “Mathematics Teaching for Understanding: Reasoning, Reading, and Formative Assessment.” Danvers, MA

GED TESTING SERVICE®

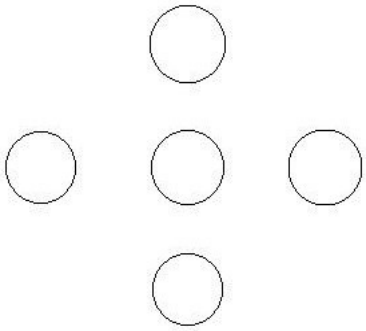
Strategy – Guess and Check

Copy the figure below and place the digits 1, 2, 3, 4, and 5 in the circles so that sums across (horizontally) and down (vertically) are the same.



Guess and Check

Copy the figure below and place the digits 1, 2, 3, 4, and 5 in the circles so that sums across (horizontally) and down (vertically) are the same.



Possible solutions:

		2				3				2		
1		3		5		1		5		5		4
		4				4				3		

Strategy – Draw a Diagram

In a stock car race, the first five finishers in some order were a Ford, a Pontiac, a Chevrolet, a Buick, and a Dodge.

- The Ford finished seven seconds before the Chevrolet.
- The Pontiac finished six seconds after the Buick.
- The Dodge finished eight seconds after the Buick.
- The Chevrolet finished two seconds before the Pontiac.

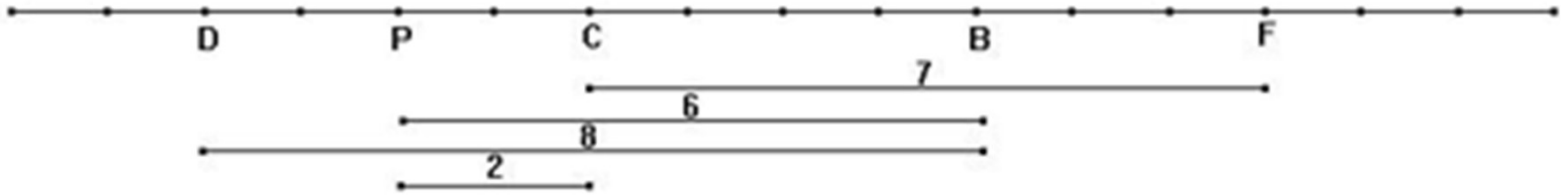
In what order did the cars finish the race? What strategy did you use?

Draw a Diagram

In a stock car race, the first five finishers in some order were a Ford, a Pontiac, a Chevrolet, a Buick, and a Dodge.

- The Ford finished seven seconds before the Chevrolet.
- The Pontiac finished six seconds after the Buick.
- The Dodge finished eight seconds after the Buick.
- The Chevrolet finished two seconds before the Pontiac.

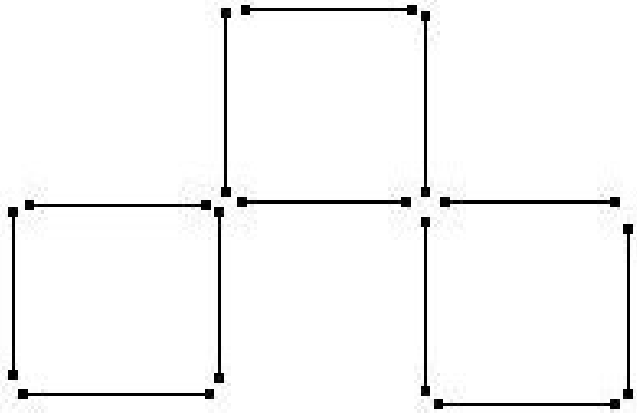
In what order did the cars finish the race? What strategy did you use?



The order is: Ford, Buick, Chevrolet, Pontiac, Dodge.

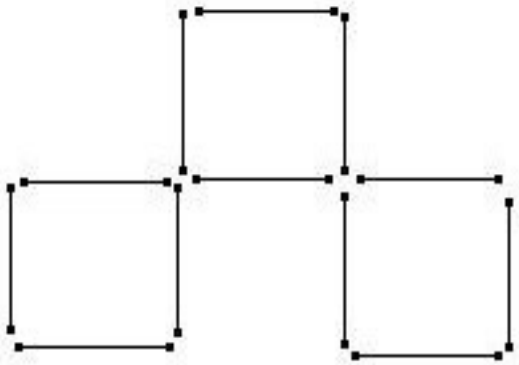
Strategy – Act It Out or Use Objects

The figure shows twelve toothpicks arranged to form three squares. How can you form five squares by moving only three toothpicks?

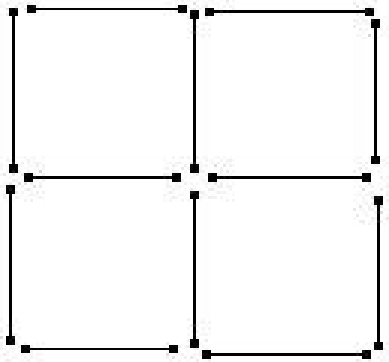


Act It Out or Use Objects

The figure shows twelve toothpicks arranged to form three squares. How can you form five squares by moving only three toothpicks?



Answer: One of the squares is formed by the outer boundary of the arrangement. There was no requirement that each of the five squares must be congruent to each of the others.



GED TESTING SERVICE®

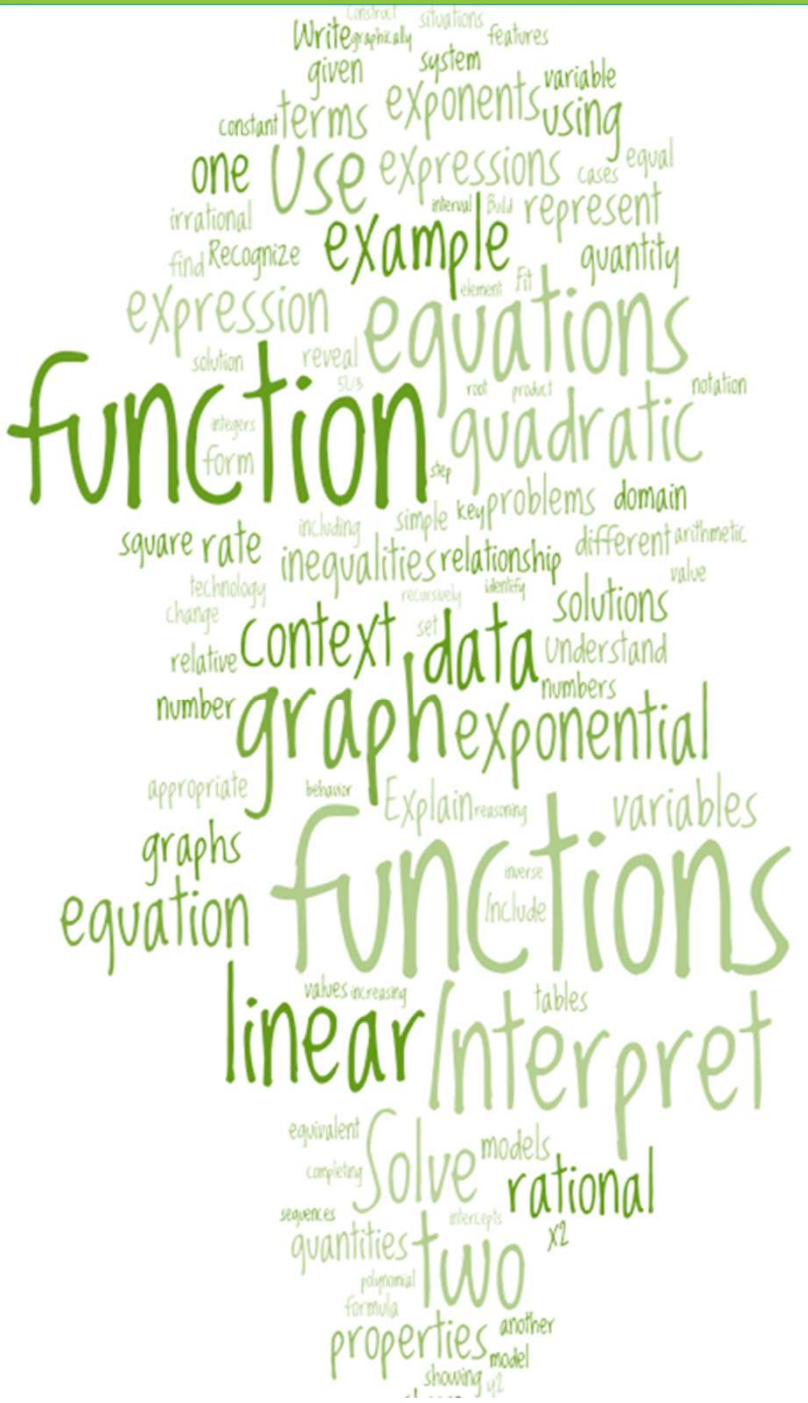
Third Read: Solve the Problem and Check for Reasonableness

- Now that I understand the problem's content, how can I best use my math skills to solve the problem?
- Am I answering the right question?
- How should the answer to the question be expressed?

Miller, P. and Koesling, D. "Mathematics Teaching for Understanding: Reasoning, Reading, and Formative Assessment." Danvers, MA

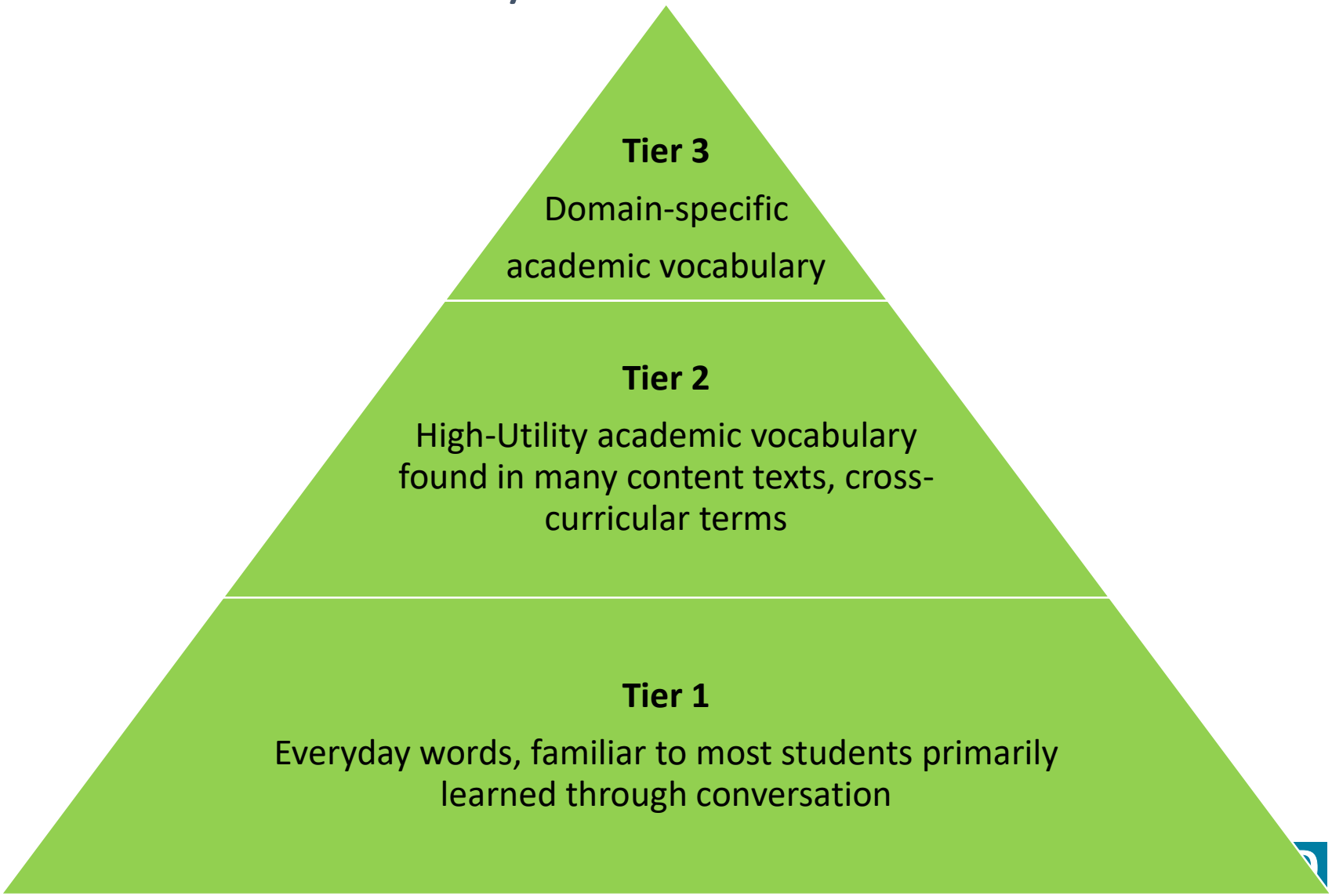
Help Students Build Math Vocabulary

.



GED TESTING SERVICE®

Tiered Vocabulary



TESTING SERVICE®

Do Your Students Know These Words?

Tier 2 Vocabulary Words for Math

Analyze	Compare	Contrast
Demonstrate	Describe	Argument
Conclusions	Evidence	Determine
Develop	Evaluate	Explain
Identify	Infer	Draw
Distinguish	Suggest	Interpret
Organize	Illustrations	Predict

http://soltreemrls3.s3-website-us-west-2.amazonaws.com/marzanoresearch.com/media/documents/reproducibles/vocab-common-core/sourcelistforpartIIandIIIterms.pdf

GED TESTING SERVICE®

How About These Words?

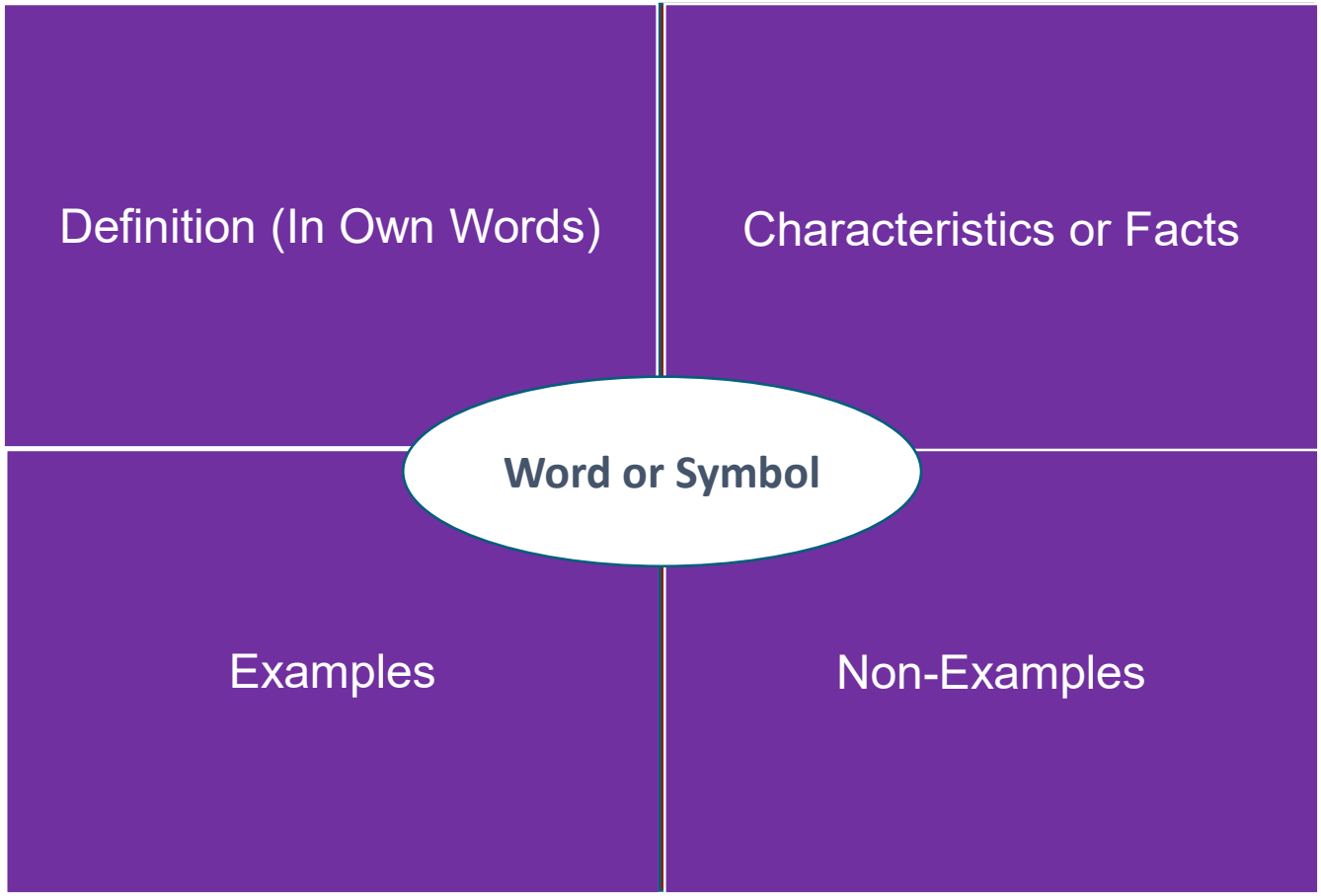
Tier 3 Vocabulary Words for Math

Absolute value	Additive inverse	Algorithm
Attribute	Constant	Distance formula
Exponent	Function	Dependent variable
Independent variable	Linear	Numerical expression
Profit	Property	Proportional gain
Rate of change	Strategy	Value

http://soltreemrls3.s3-website-us-west-2.amazonaws.com/marzanoresearch.com/media/documents/reproducibles/vocab-common-core/sourcelistforpartIIandIIIterms.pdf

GED TESTING SERVICE®

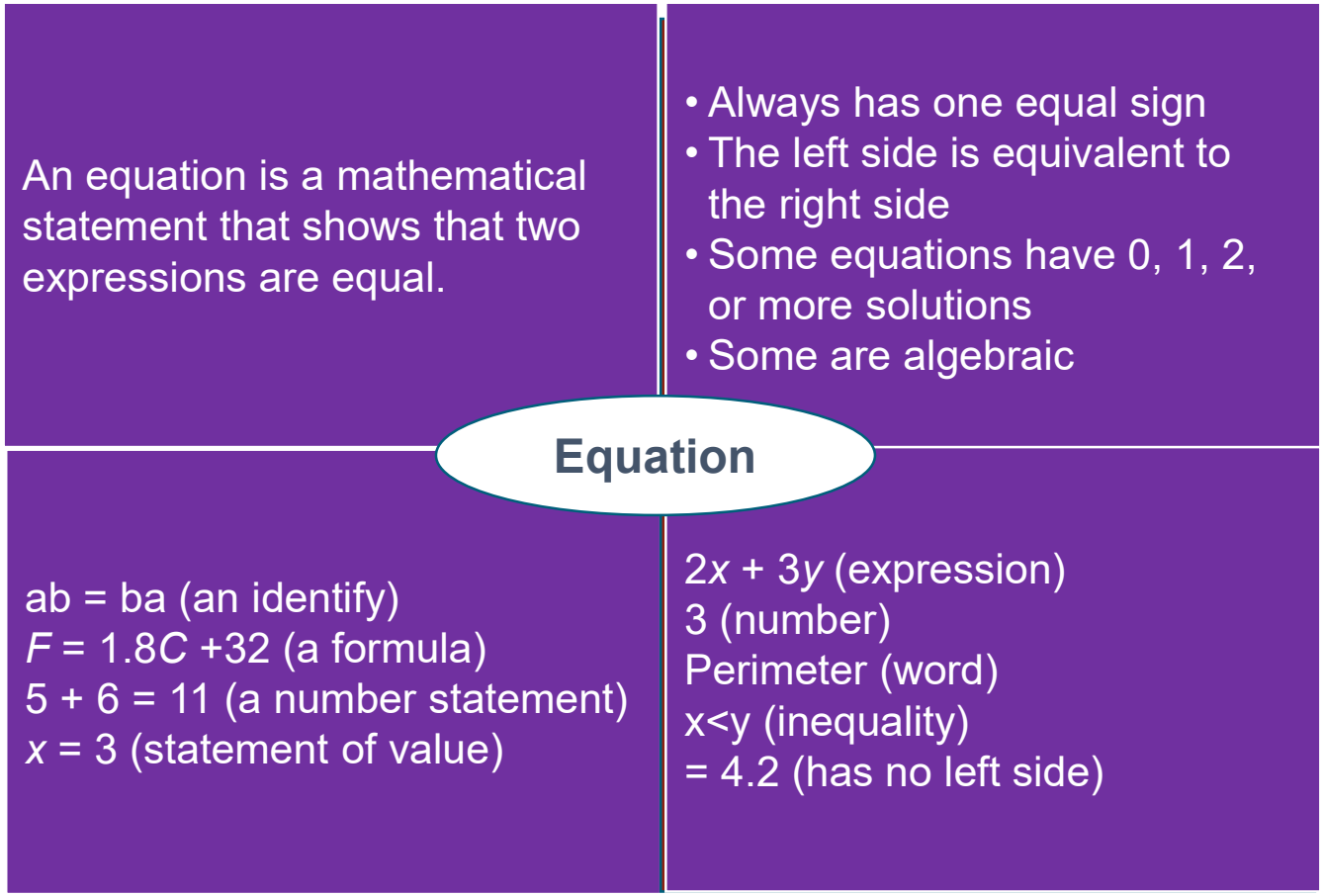
Building Vocabulary



Frayer Model – (Barton and Heidema, 2002)

GED TESTING SERVICE®

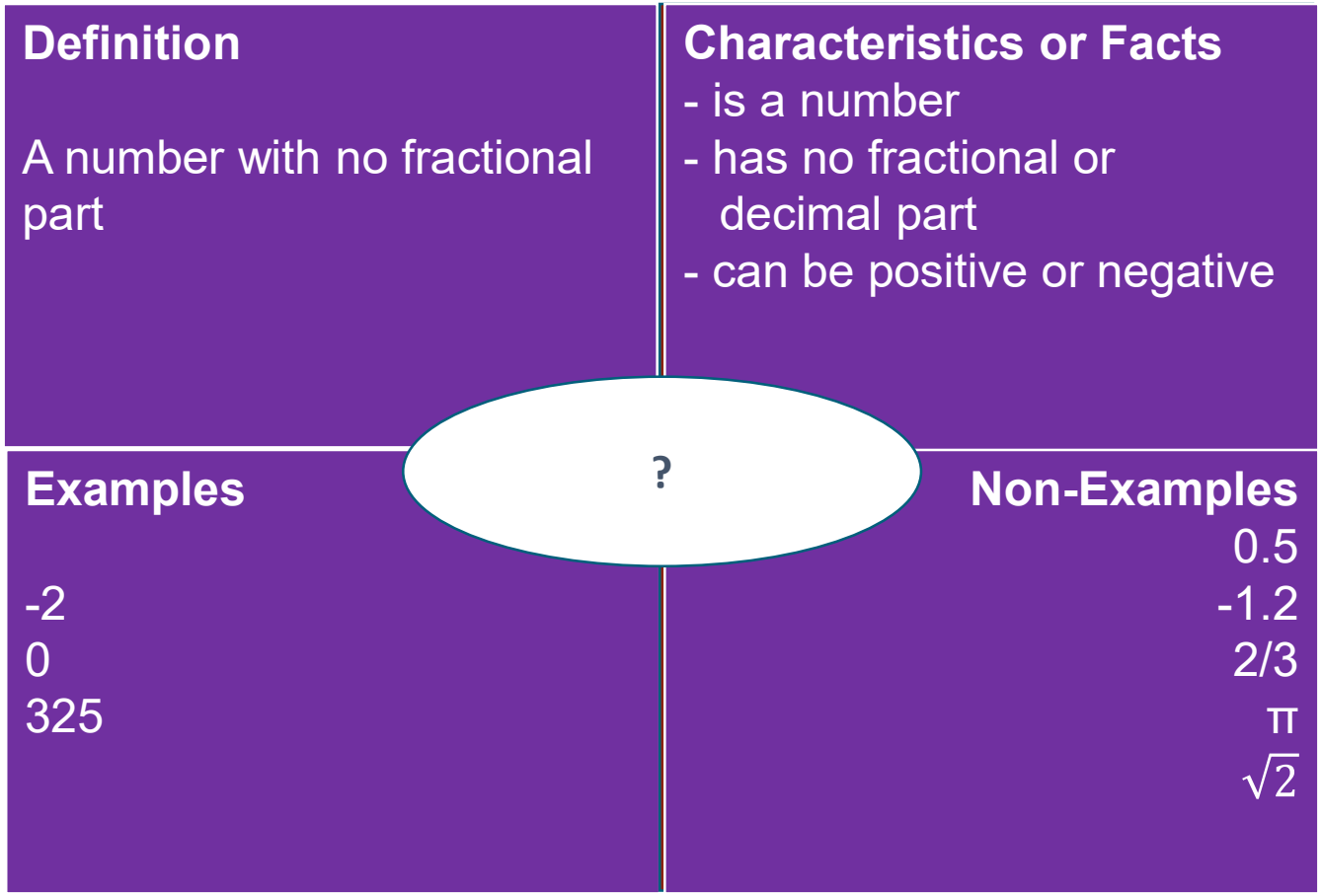
Tools for Building Vocabulary



Frayer Model – (Barton and Heidema, 2002)

GED TESTING SERVICE®

What is it?



Frayer Model – (Barton and Heidema, 2002)

GED TESTING SERVICE®

Advice

Watch for Obstacles and Opportunities

.

GED TESTING SERVICE®

Math Misconceptions

1. A number with three digits is always bigger than one with two

2. When you multiply two numbers together, the answer is always bigger than both the original numbers

3. Which fraction is bigger: 1/3 or 1/6?

4. Common regular shapes aren't recognized for what they are unless they're upright

5. The diagonal of a square is the same length as the side?

More Math Misconceptions

6. To multiply by 10, just add a zero

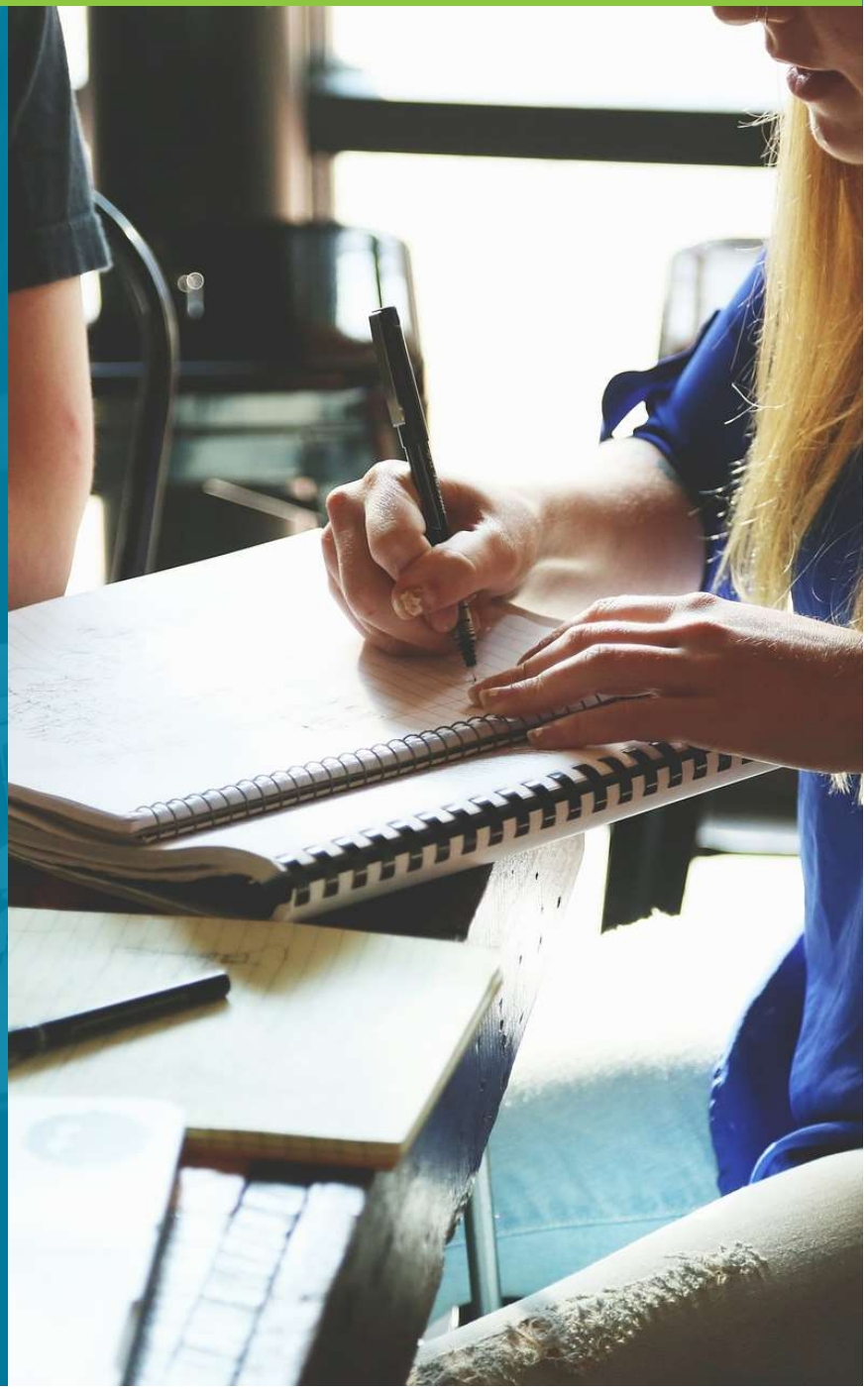
7. Proportion: three red sweets and two blue

8. Percentages can never be bigger than 100

9. Misreading scales

10. An exponent requires that you multiply the base by the exponent (example: $2^3 = 3^2$)

Getting Down to Basics with Algebraic Reasoning



GED TESTING SERVICE®

What About Algebra?

Key Differences Between Likely to Pass and the Red Zone

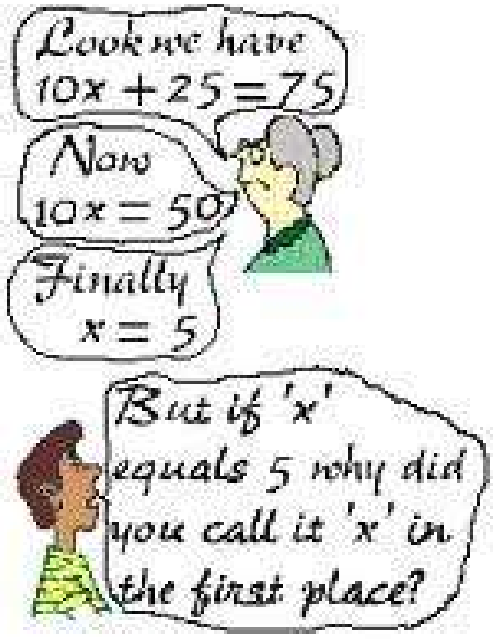
Students

- Have a much smaller skill repertoire, e.g.
  - Tend to be able to work with equalities but not inequalities
  - Tend to have very weak graphing skills
- Are far less able to apply math skills to real-world situations or interpret real-world skills mathematically
- Are far less consistent in their performance (likely to be “hit or miss”)

Remember . . .

- Arithmetic is doing something to numbers to get an answer.

- Algebra is exploring the relationships between numbers.



Symbolic Notation

Sign	Arithmetic	Algebra
= (equal)	. . . And the answer is	Equivalence between two quantities
+	Addition operation	Positive number
-	Subtraction operation	Negative number

Algebraic Misconceptions

1) $a + a + a + a = \mathbf{4a}$

2) $3a \times 2b = \mathbf{5ab}$

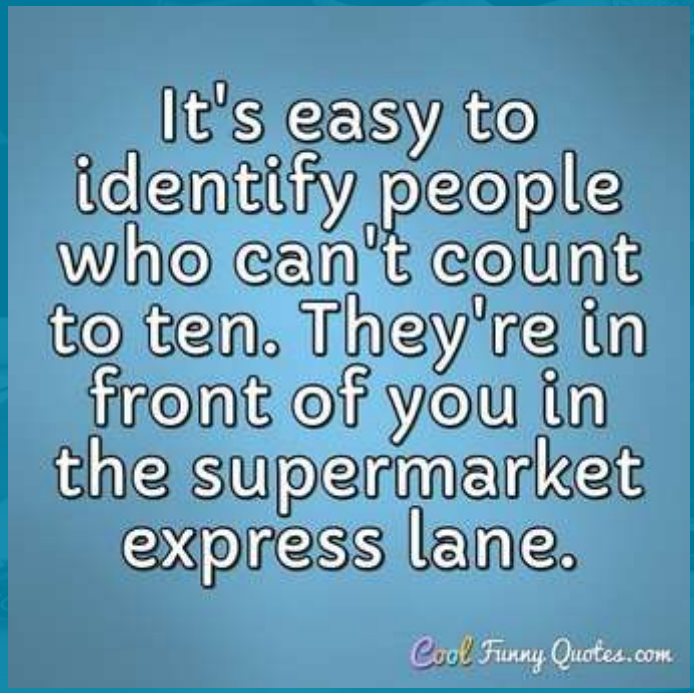
3) $c \times c = \mathbf{2c}$

4) $5y - y = \mathbf{5}$

5) $3(2k + 3) = \mathbf{6k + 6}$

GED TESTING SERVICE®

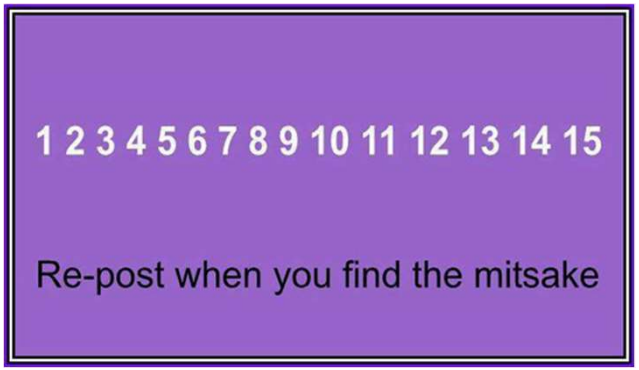
Have Fun!



GED TESTING SERVICE®

Use Brainteasers to Develop Reasoning Ability

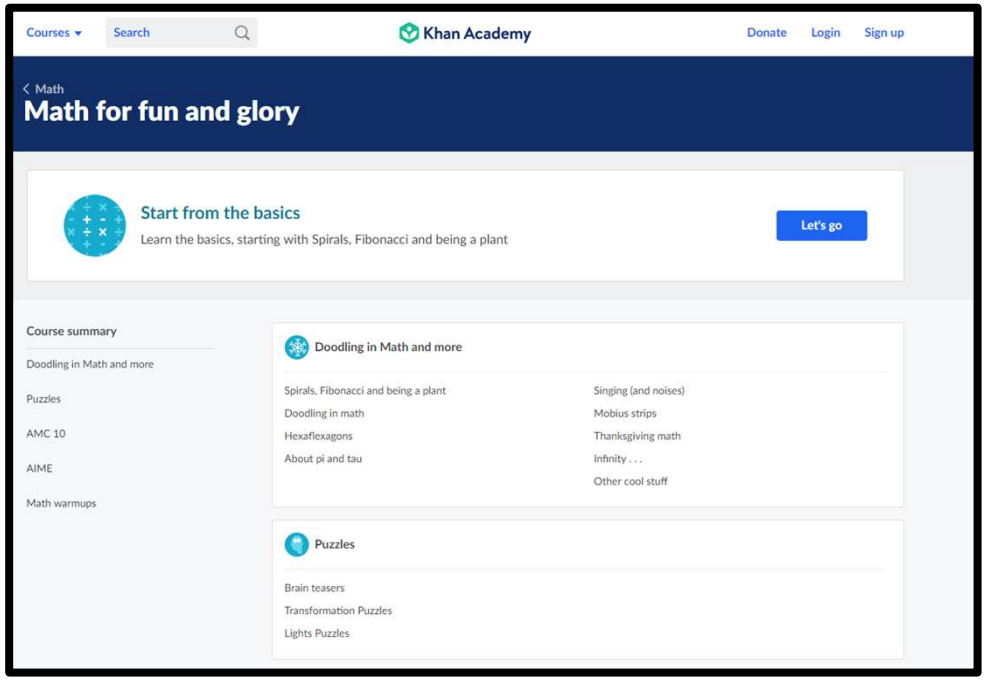
- Engages students' minds in a reasoning process
- Encourages students to play and have fun
- Uses humor to increase interest and motivation
- Decreases math anxiety
- Focuses on reasoning – not just the answer

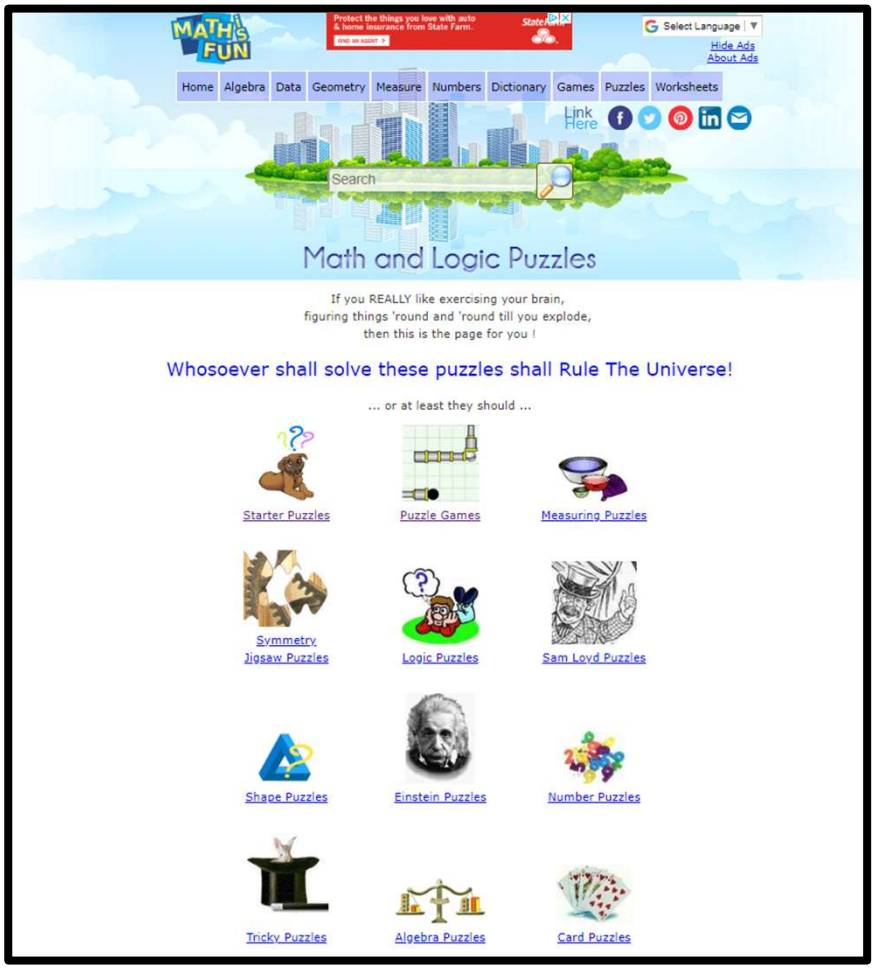


"Brainteasers are therapy for the mind."

Stogsdill, Gary. "Being Reasonable: Using Brainteasers to Develop Reasoning Ability in Humanistic Mathematics courses," Journal of Humanistic Mathematics, Volume 4 Issue 2 (July 2014).

GED TESTING SERVICE®


Courses
Search
Khan Academy
Donate
Login
Sign up
Math
Math for fun and glory
Start from the basics
Learn the basics, starting with Spirals, Fibonacci and being a plant
Let's go
Course summary
Doodling in Math and more
Puzzles
AMC 10
AIME
Math warmups
Doodling in Math and more
Spirals, Fibonacci and being a plant
Doodling in math
Hexaflexagons
About pi and tau
Singing (and noises)
Mobius strips
Thanksgiving math
Infinity . . .
Other cool stuff
Puzzles
Brain teasers
Transformation Puzzles
Lights Puzzles


MATH is FUN
Select Language
Hide Ads
About Ads
Home
Algebra
Data
Geometry
Measure
Numbers
Dictionary
Games
Puzzles
Worksheets
Search
Math and Logic Puzzles
If you REALLY like exercising your brain,
figuring things 'round and 'round till you explode,
then this is the page for you !
Whosoever shall solve these puzzles shall Rule The Universe!
... or at least they should ...
Starter Puzzles
Puzzle Games
Measuring Puzzles
Symmetry Jigsaw Puzzles
Logic Puzzles
Sam Loyd Puzzles
Shape Puzzles
Einstein Puzzles
Number Puzzles
Tricky Puzzles
Algebra Puzzles
Card Puzzles

It's Your Turn!

A little boy goes shopping and purchases 12 tomatoes. On the way home, all but 9 get mushed and ruined. How many tomatoes are left in a good condition?

Nine

Eggs are $0.12 a dozen. How many eggs can you get for a dollar?

100 eggs, at one penny each

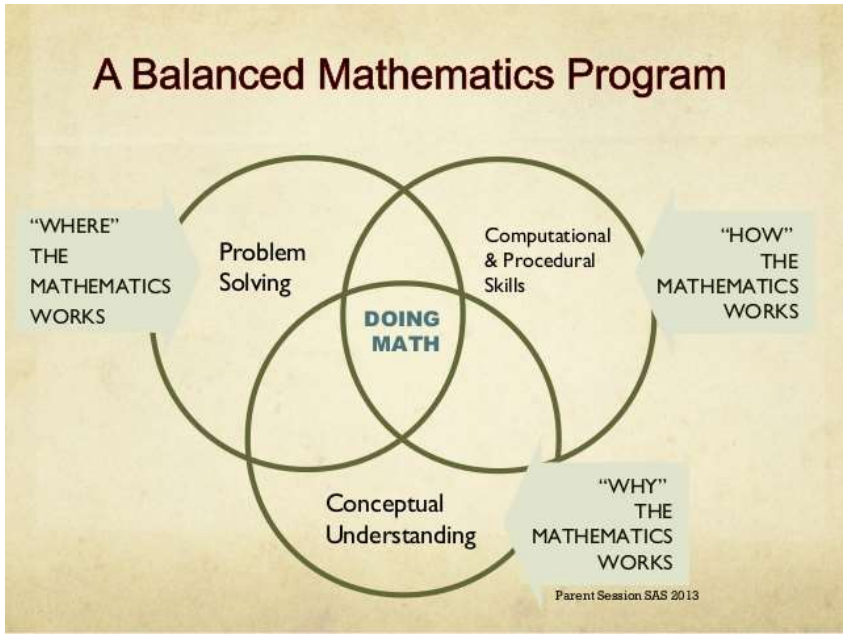
GED TESTING SERVICE®

Math Bender Time!

There are 6 pails, 3 of the pails are filled with water. Can you move only one pail and make a pattern of: full pail, empty pail, full pail, empty pail, full pail, empty pail?

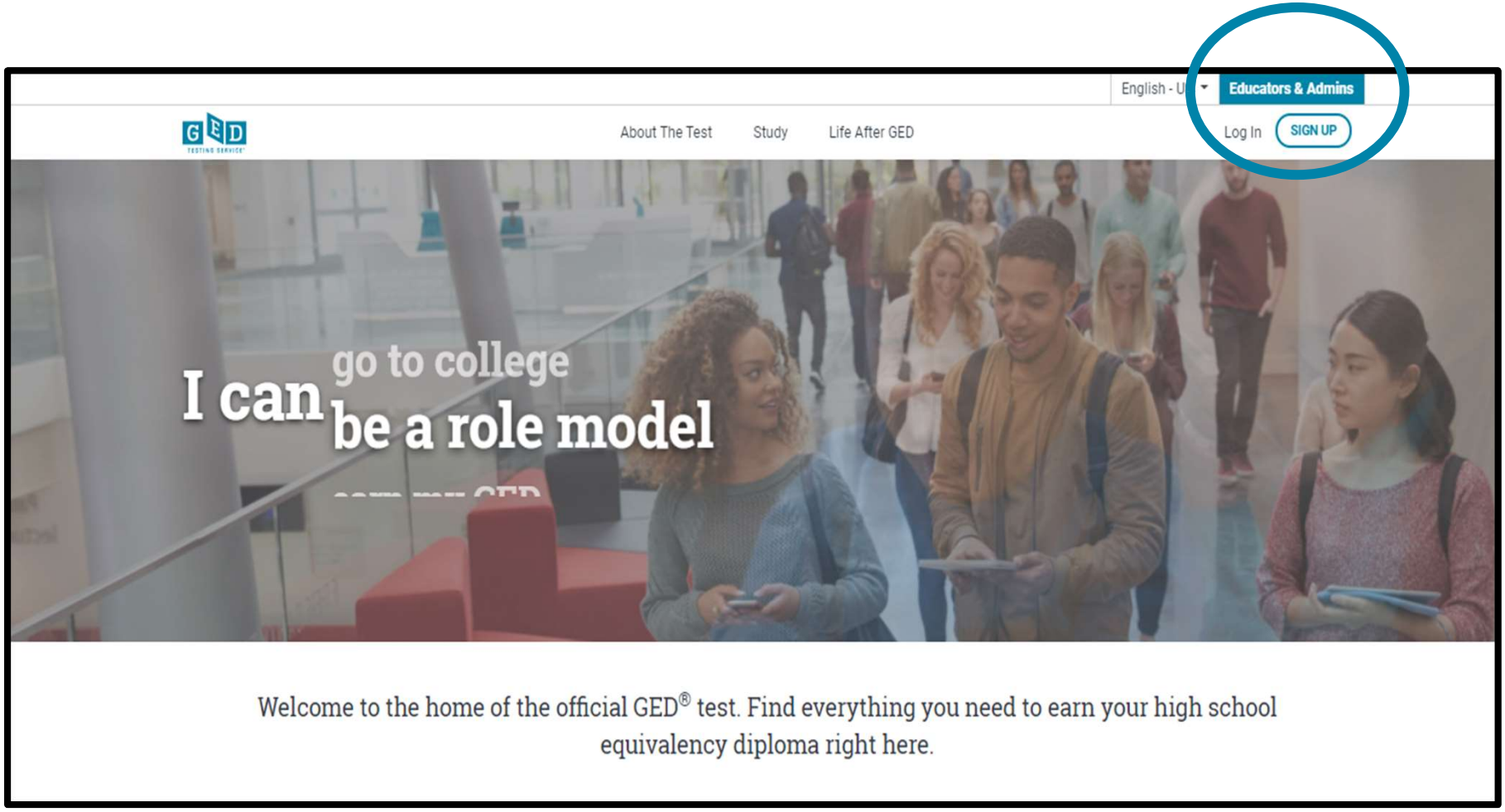
GED TESTING SERVICE®

Our Students Need…



GED TESTING SERVICE®

https://ged.com




which
which ?
about ?
help
why
what
HOW
?
who
Q
answers
&
A
WHERE
when
Where
?
why
WHO
WHEN
WHY
FAQ
which
how

Thank you!

Communicate with GED Testing Service®
communications@ged.com