Building Academic Language in the Secondary Math Classroom

Tami Hicks
Director of Professional Learning, WVEC
WVEC Consortium Coordinator - TITLE III

LEARNING INTENTIONS

Today, we will learn about…...

- Supporting Student Learning by building Academic Language
- The Language of Your Classroom/Content Area
- Three tiers of Vocabulary students learn
- The value of visuals, hands-on/authentic learning and talk!!
- Specialized vocabulary and general academic vocabulary
- Instructional strategies for teaching Academic Language
    - We will investigate our professional book for teaching ideas!
- Investigate & Instructional Supports we are using & possible new ones

SUCCESS CRITERIA

By the end of today, you will:

- Be able to provide background knowledge on the importance of Academic Language, as well as a definition and examples of different types of Academic Language.
- Be able to identify Tier I, II, and III words (and connect to your classroom)
- Be able analyze student work and text for Academic Language.
- Have added several Instructional Strategies to your toolbox

BRAINSTORM: Why do kids struggle in your MATH class?

Choose a way to categorize the problems…

Is it a knowledge issue? Vocabulary? Language? Conceptual? Procedural? Mindset? Other?

PUT a STAR by the top 2 categories that most impact learning in your classroom.

Table Talk

Imagine you are a 10th grade English Learner taking a test and see this question:

- Find the ugloft of a bipkad if the rexnuza is 20.

  Discuss how you would solve this problem.

Table Talk

REFERENCE SHEET

Ugloft = area

Bipkad = circle

Rexnuza= diameter

NOW....SOLVE THE PROBLEM.

WHAT MADE THE DIFFERENCE??

Table Talk -- the language in this slide

Which words might challenge EL's?

REFERENCE SHEET

Ugloft = area

Bipkad = circle

Rexnuza= diameter

NOW....SOLVE THE PROBLEM.

WHAT MADE THE DIFFERENCE??

What is Academic Language?

TABLE TALK

How would you define Academic Language? What does this mean for you as a MATH teacher? Are there math terms/vocabulary that are crucial for students to know and understand to be successful in your classroom? Why or why not?

Definition ACADEMIC LANGUAGE

–Language used in academic settings and for academic purposes to help students acquire and use knowledge (Anstrom, et al., 2010)

–Words and syntactic structures that students are likely to encounter in textbooks and tests, but not in everyday, spoken English (Strategic Education Research Partnership, 2010) (EXAMPLE: QUADRATIC EQUATIONS)

–“The language used in the learning of academic subject matter in a formal schooling context; aspects of language strongly associated with literacy and academic achievement, including specific academic terms or technical language and speech registers related to each field of study.” (TESOL, 2003)

Academic Language DEFINITION...cont’d

Academic Language is the FORMALIZED LANGUAGE OF SCHOOL!!

- The language of the CLASSROOM
- The language of the SUBJECT you are teaching
- The language of the TOPIC you are teaching
- The language of TEXTS students are reading
- The language of PROBLEMS students are solving
- The language students are using to WRITE in formal academic settings

Research - Importance of Academic Language & Vocabulary on Student Achievement

John Hattie: Vocabulary Instruction Effect Size of .67

Students who experienced vocabulary instruction experienced major improvements in reading comprehension and overall reading skills. Most effective vocabulary instruction included providing both definitional and contextual information, involved students in deeper processing, and gave students more than 1 or 2 exposures to the word to be learned.

WIDA RESEARCH

Indiana Academic Standards- Vocabulary

- Math Process Standards
- The Math content standards for your course/classroom
  - Math vocabulary is LEAST likely to be heard in other classes or outside of school
  - Must be cognizant of words that will confuse learning for EL's (as others….)

Two Categories of Academic Language

Specific Content Based Academic Language

Social Studies: democracy, civilization, communism, geography, legislature

Science: photosynthesis, friction, compound, plate tectonics, force

Math: fraction, equation, division, angle, addition, factor

Language Arts: alliteration, plot, genre, author's voice, theme, irony

SPECIFIC CONTENT ACADEMIC LANGUAGE

Specific academic language for each subject area is unique to that subject

Content Academic language increases in difficulty as students progress through grades and subject matter

Provides the building blocks from which conceptual knowledge can be built

“The more a student understands the specific content language of a particular subject matter, then the faster and more efficient they can learn additional knowledge.” - Willingham, 2006

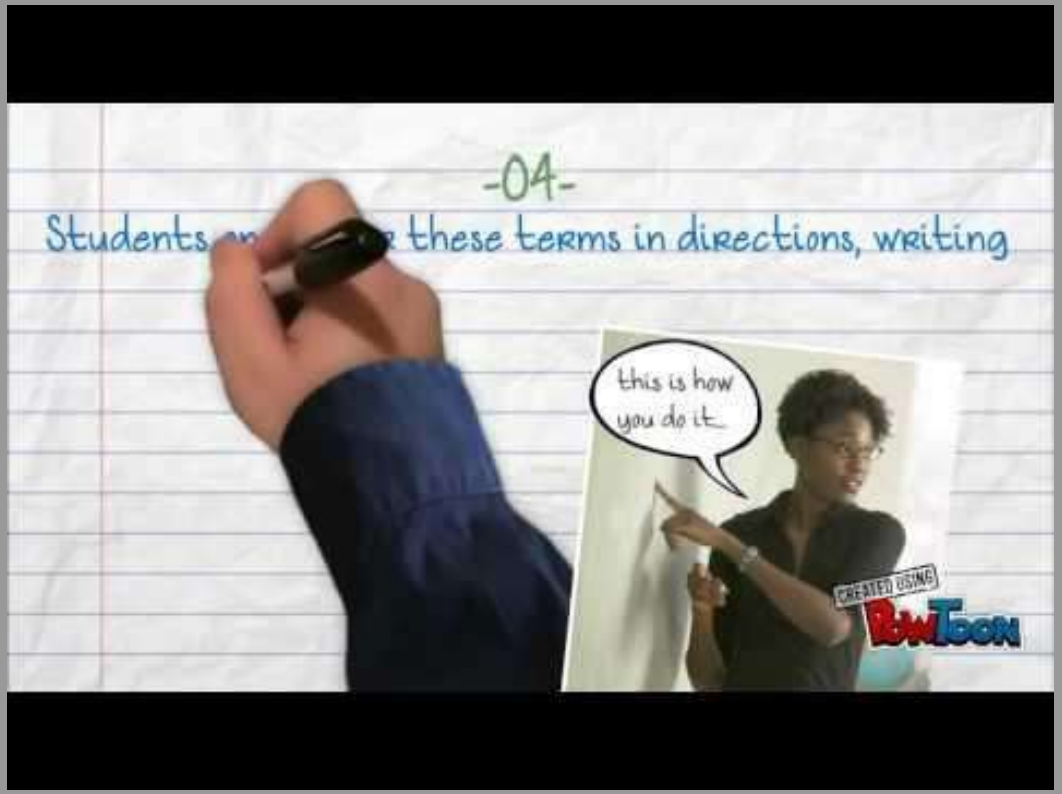
General Academic Language

Provides the foundation for educational success

Includes words that connect concepts, outline transitions, and demonstrate relationships

Brick and Mortar words - critical for EL's

TIER I, II, and III Words!



What is the language of YOUR Classroom?

- Brainstorm all the words you can that are CRITICAL for students to understand in your MATH CLASSROOM.
- What are some words that are CRITICAL that students WON'T SEE ANYWHERE else?
- What are some words that are important for them to know but they MIGHT SEE in ANOTHER classroom also?

WHICH OF YOUR WORDS ARE TIER II? TIER III?

The Language of Math

Specialized Language

Problem areas: Abstract terms, Polysemous Terms, Homonyms, Idioms, Ambiguity

Language & Symbolism

Short cuts & Labels

A number of problems with *NUMBER!!*

The Problem Areas….

Reading Math

- Write out the following math problem in words:
  - $3 < X < 8$
- How might you help EL's visualize/understand this problem?

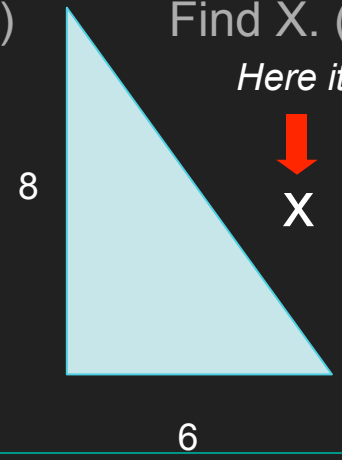
Symbols

- If Y=2, then 5Y=____
  - You notice ALL of your EL's put the answer 52 down.
  - What are the misconceptions?

EXAMPLES

1) REDUCE 6/8
   a) Answer: 6/8
2) Expand (X+3) (X-4)
   a) Answer: (X + 3) (X - 4)
3) Find X. (See student response below)

Here it is!



4) WHICH IS BIGGER?

- 37^5

5) Which number is bigger?

- 37^5

6) Which NUMERAL is bigger?

- 37^5

More NUMBER Issues!

“Numbers” can represent more than a MATH problem!

- 47906
- 765-483-2819
- 3061 Benton Street

Similar terms to number:

- numeral, amount, place value, digit, quantity
    - The opening number was the highlight of the show.
    - His last girlfriend really did a number on him.
    - My finger is number than it was five minutes ago.

Pronunciations!

- How could these two addresses be confused?
  - 3218 Main St
  - 30218 Main St
- Pronounce each of these. What problems might arise for EL's?
  - 2560
  - $25.60
  - 25.6
- How many ways can we say 2632?
- How do we say .2?

ACTIVITY - Analyze a Math Problem

Choose a MATH Problem to analyze:

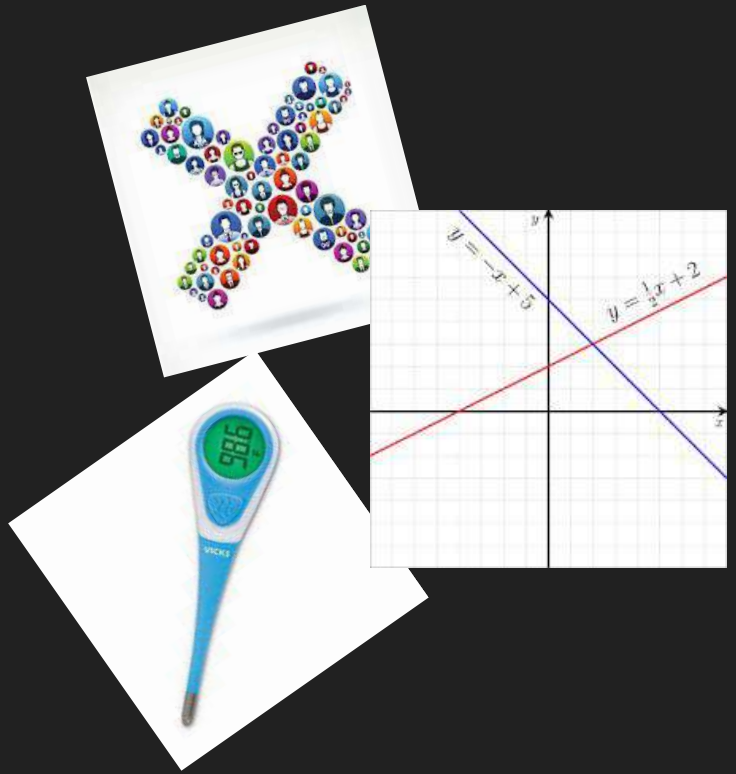
- Choose one of the sample problems on table
- Use one you have or will be using
- Go to a favorite go-to resource and grab a problem!!

What words might challenge EL's?
What other things about the problem might be confusing to EL's?
What would be your next steps if using this question in your classroom to help students understand the LANGUAGE of the problem?

Instructional Strategies & Supports

Instructional Supports for EL’s

- VISUALS
  - Connect symbols to words/phrases/vocabulary
  - Google Images
  - Realia/Manipulatives/Hands-on
- VOCABULARY
  - The Language of Math
  - Academic vocabulary
  - “Problem vocabulary”



Vocabulary

Categorizing Vocab

RESOURCE: http://tactustherapy.com/importance-of-categories/

Categorization *is the process in which ideas and objects are recognized, differentiated, and understood. Categorization implies that objects are grouped into categories, usually for some specific purpose. Ideally, a category illuminates a relationship between objects. Categorization is fundamental in language, prediction, inference, decision-making and in all kinds of environmental interaction. – Wikipedia*

- First step to comprehension
- Formative Assessments
- Reinforce known vocabulary
- Learn new vocabulary/information

Categorizing Vocab

Directions: Review the below list of vocabulary words. Create at least two categories that may be used to group some of the vocabulary words. Write the category and the words that support that category in space provided.

Vocabulary Words:

Absolute Value	Data	Difference	Title
Decimal	Horizontal Axis	Line Plot	Sum
Equation	Fraction	Probability	Product
Frequency Table	Simplify	Vertical Aix	Integers
Percentage	Tally Marks	Stem-and-leaf plot	

Learning the Language of MATH

Teaching Vocabulary

Review text examples, problems and explanations for:

- Important MATH vocabulary
- Important vocabulary needed to understand the question/task
- “Problem Vocabulary”
  - Multiple Meanings, idioms
- Look for any concepts that may be related to first language to build on,
- Look for any areas of possible confusion, especially due to language.
- Attach visuals to vocabulary when possible.
- Be purposeful and regular in using and explaining vocabulary.
- Resource sheets & VOCAB Notebooks are great!

Learning Vocabulary

Vocabulary Journal

- Formal Definition
- Definition in their OWN words*
- Definition outside of MATH
- Examples
- Relationship to Related Terms
- Non-Examples
- Picture/Symbol
- Characteristics including associated symbolism

KNOWING A WORD INVOLVES UNDERSTANDING……

- the core meaning of the word
- Similar forms of the word
- Its spelling and pronunciation
- Its part of speech
- How to use in various forms in sentence
- How to use it for learning in YOUR classroom
- How it relates to other words and concepts

SEE PLANNING STRATEGIES & SAMPLE ACTIVITIES Page 39 (Building Academic Language)

(See examples, page 38 of Building Academic Language in through Content Area Text)

Examples

FOUR levels of Word Knowledge

**Page 76 Academic Language! Academic Literacy!

1) I never saw it before
2) I've heard of it, but I don't know what it means
3) I recognize it in context……it has something to do with……
4) I know it! I understand it well!! I can understand its use when listening, reading, speaking and writing!

Academic Language Awareness

(Page 76)

Students categorize academic words into three categories:

- Actions
  - Action words and verbs can help provide meaning for EL's
- Concepts
  - Key concepts words - important words for learning
- Transitions
  - Words that help them uunderstand text structure

VIDEO

Good video from a group of teachers who all collaborated around teaching the Academic Vocabulary - POINT OF VIEW - and how this is connected and presented in each subject area. Illustrates how they assigned tasks and assessed learning at each level, 1-5.

Link: https://vimeo.com/130650405

Measures of Central Tendency

Mean

- Average
- Sum of the values divided by # of items in data set

Ex ~ 94, 94, 97, 100

$$\frac{94+94+97+100}{4} = \frac{385}{4} = 96.2$$

Median

- Middle
- Middle value when #'s arranged in numerical order
- If # of items in set is odd, median = middle
- If # of items in set is even, add two middle #'s and divide by 2

Ex ~ 94, 94, 97, 100

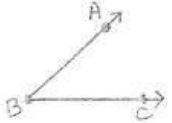
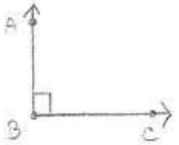
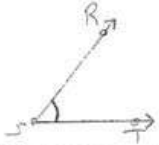
$$94+97 = \frac{191}{2} = 95.5$$

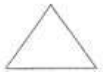
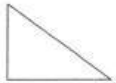
Mode

- Most
- Value that occurs most frequently
- Some sets may not have mode. Some may have more than one mode.

Ex ~ 94, 94, 97, 100

94 = mode

Angle	• Formed by two rays with a common endpoint • The symbol $\angle$ is used to identify an angle  • Labled $\angle ABC$, $\angle CBA$, or $\angle B$ • Measured in degrees (°) using a protractor
Right angle	• Equal to 90° • A small square is often used to identify a right angle 
Acute angle	• Greater than 0° and less than 90° 
Obtuse angle	• Greater than 90° and less than 180° 
Straight angle	• Equal to 180° 

Triangle	• Made up of three line segments called sides • Each pair of sides has a common endpoint, or vertex, and forms an angle
Classified by length of their sides	• Equilateral Triangle – all sides are the same length  • Isosceles Triangle – At least two sides are the same length  • Scalene Triangle – No sides are the same length 
Classified by their angle measures	• Right Triangle – one right angle  • Acute Triangle – all acute angles  • Obtuse Triangle – one obtuse angle 

FRACTIONS and EQUIVALENT FRACTIONS pg 98

NAMING FRACTIONS

- PARTS of a WHOLE
- PARTS are of EQUAL SIZE
- PARTS of a set
- NUMERATOR: number of parts under consideration
- DENOMINATOR: number of parts of a whole set

EQUIVALENT FRACTIONS

- FRACTIONS THAT DESCRIBE THE SAME AMOUNT.
- Example:

$\frac{1}{2} = \frac{2}{4} = \frac{2}{4} = \frac{4}{8} \cdots$

- ANY NUMBER MULTIPLIED BY ONE IS STILL EQUAL TO ORIGINAL NUMBER
- MULTIPLY THE ORIGINAL FRACTION BY A FORM OF ONE TO MAKE AN EQUIVALENT FRACTION
- EXAMPLE:

$\frac{9}{12} = \frac{18}{24}$ $\quad \frac{9}{12} \times \frac{2}{2} = \frac{18}{24}$ $\quad \frac{2}{2} = 1$

GRAPHING A LINE

FIND ORDERED PAIRS

1. choose *x*, find corresponding *y* in equation
2. form 3 ordered pairs
3. make a table

x	y

PLOT ORDERED PAIRS

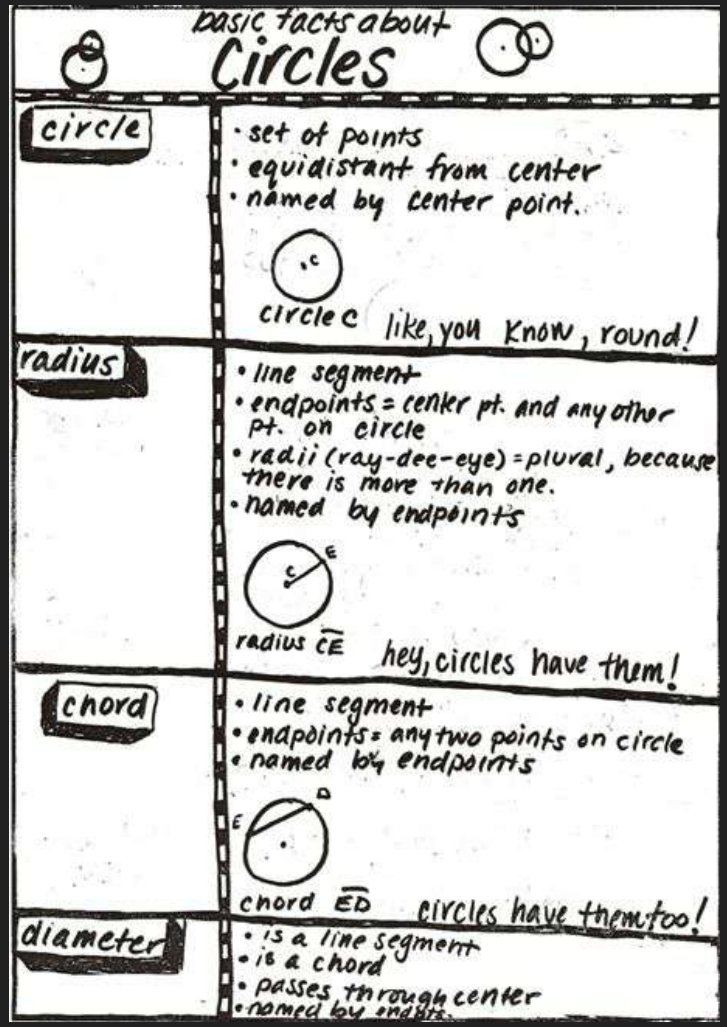
1. draw *x* and *y* axes
2. label *x*-axis and *y*-axis
3. plot points and label ordered pairs

DRAW LINE
(How accurate is your line?)

1. use ruler to draw line through points
2. label line with equation

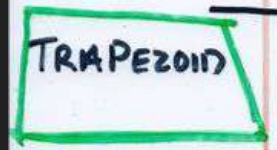
IDENTIFY X AND Y INTERCEPTS
(Will *x* and *y* always be integers (at intercepts)?

1. find where graph intersects *x*-axis, label as ordered pair (*x*,0)
2. find where graph intersects *y*-axis, label as ordered pair (0,*y*)



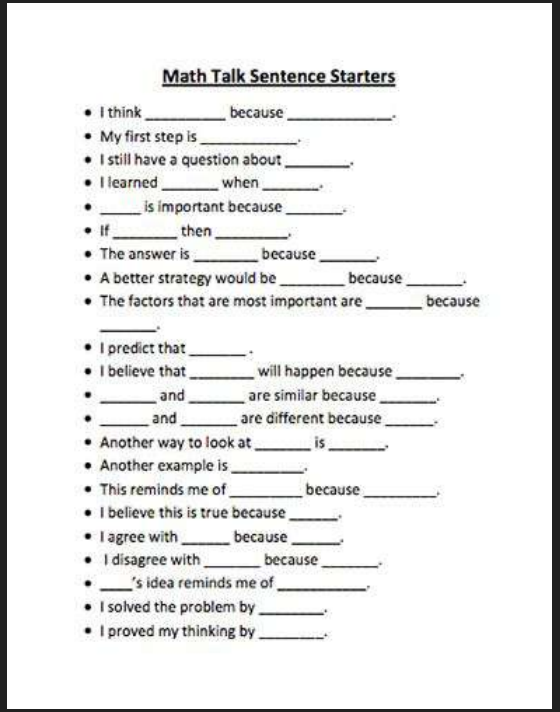
Quadrilaterals

4-sided polygons

main	details
 SQUARE	• 4 right angles (⊾) • 2 sets of parallel sides (∥) • 4 congruent sides (≅)
 RECTANGLE	• 4 right angles (⊾) • 2 sets of parallel sides (∥) • 2 sets of congruent sides (≅)
 RHOMBUS	• 2 sets of parallel sides (∥) • 4 congruent sides (≅) • opposite angles are congruent
 PARALLELOGRAM	• 2 sets of parallel sides (∥) • 2 sets of congruent sides (≅) • opposite angles are congruent
 TRAPEZOID	• 1 set of parallel sides (∥)

EL Students benefit from…..

- Rich Math Discussions
- A lot of “Math Talk” with peers/classmates
- Relatable real Life problems and application
- Visuals
  - Journals
  - Teacher communication
  - Resource sheets
- A “Thinking” Partner
- Looking for errors in solved problems
- Teacher Modeling



Math Talk Sentence Starters

- I think _____ because _____.
- My first step is _____.
- I still have a question about _____.
- I learned _____ when _____.
- _____ is important because _____.
- If _____ then _____.
- The answer is _____ because _____.
- A better strategy would be _____ because _____.
- The factors that are most important are _____ because _____.
- I predict that _____ .
- I believe that _____ will happen because _____.
- _____ and _____ are similar because _____.
- _____ and _____ are different because _____.
- Another way to look at _____ is _____.
- Another example is _____.
- This reminds me of _____ because _____.
- I believe this is true because _____.
- I agree with _____ because _____.
- I disagree with _____ because _____.
- ____'s idea reminds me of _____.
- I solved the problem by _____.
- I proved my thinking by _____.

An example……

Ambiguity to Promote Discussion and Deepen Understanding

ARE A SQUARE AND A RECTANGLE SIMILAR?

Standard English Definition:

https://en.oxforddictionaries.com/definition/similar

STUDENT ERRORS

1) “Add the numbers up”

****

2) Examine the following subtraction problem. What mistake did the student make? Why might she have made this mistake?

8 feet 3 inches

-2 feet 7 inches

5 feet 6 inches

DIGITAL RESOURCES

- www.estimation180.com
- www.openmiddle.com
- www.wodb.ca
- teacher.desmos.com
- www.yummymath.com
- www.robertkaplinsky.com
- Kyle Kline Database of MATH SITES

BOOK CHAT…
A few more things to investigate in Academic Language! Academic Literacy!

NEW iLearn Assessments

- Rely heavily on DOK levels 2 & 3
  - Teachers and administrators need to become familiar with iLearn Blueprints and Item Specifications.
  - Sample problems provided - for DOK practice
  - Smarter Balanced Sample Items
- Students are often getting only 1 out of 2 points due to not being able to do DOK 3 thinking
- Heavy on deep understanding of Tier II & III Academic Vocabulary
- Heavy reading/writing demands in all areas (including Math) - explain reasoning, justify, cite evidence

RESOURCES

The Problem with Math is English

- VIDEO: https://www.youtube.com/watch?v=vf62mAUAKmo
- BOOK: https://www.amazon.com/Problem-Math-English-Language-Focused-Understanding/dp/B00FFBGCG0

English Learners in the Math Classroom

- BOOK

THANKS!

Tami Hicks
thicks@esc5.k12.in.us
765-588-1146

WEBSITE: Wabash Valley Education Center
Follow us on FB (Wabash Valley Education Center) & Twitter (@tamiwvec)

WABASH VALLEY
WVEC
EDUCATION CENTER