VISUAL DICTIONARIES & GRAPHIC ORGANIZERS

MAKE GEOMETRY STANDARDS STICK

NCTM REGIONAL CONFERENCE: RICHMOND VA NOVEMBER 2014

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ROCKVILLE MD.

BEGIN: WITH AUDIENCE PARTICIPATION

We are going to play….

NAME THAT SHAPE!

GEOMETRY STANDARDS
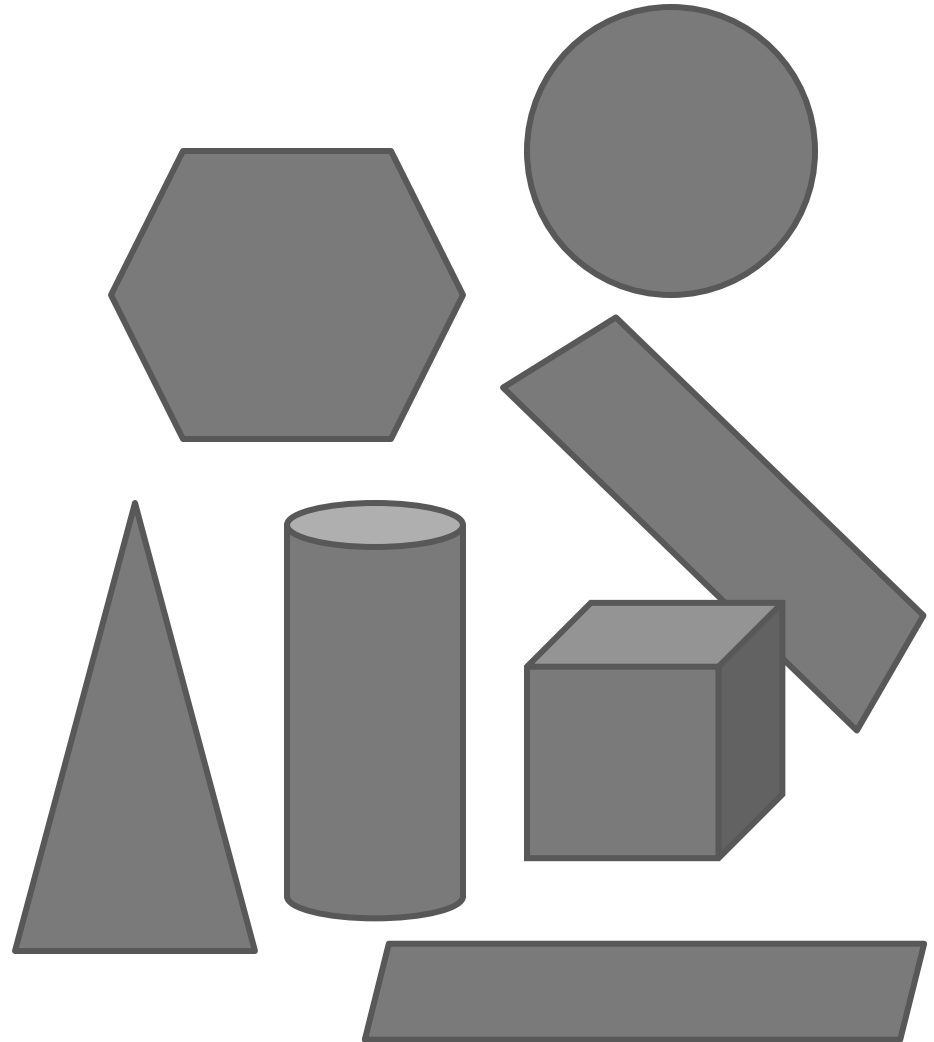
Beginning in early grades students are asked

To reason with shapes

To describe attributes

To use the vocabulary of shapes

To combine

To compute with formulas

WHO STRUGGLES? THOSE WHO STRUGGLE WITH LANGUAGE

Students with language based LD

English Language Learners

Students with spatial and organizational LD

Students with Attention

Students with gaps in knowledge

Students memory deficits

TOO MANY WORDS!

For many students there are just too many words

- Without memorable associations

Students do not receive enough practice with the vocabulary

Representations are bland and described in MORE WORDS

Fill in the Blank

Name the Shape

List the Attributes

Write the Rule

Define the Term

TOO LITTLE INTERACTION

Too little interaction other than to memorize

Too little space to write or draw

Worksheets are cluttered

Students do not interact with attributes other than with words

Too much to a page

Students who have fine motor skill deficits cannot take notes.

Little attention to fine motor skill issues

LETTERS DO NOT AID VISUAL MEMORY

Geometric figures are labeled with letters or numbers which give abstract visual information.

Relationships are difficult to distinguish

Students with figure ground difficulties or working memory issues struggle

a
b
c
d
e
f
g
h
i
j
k
l
m
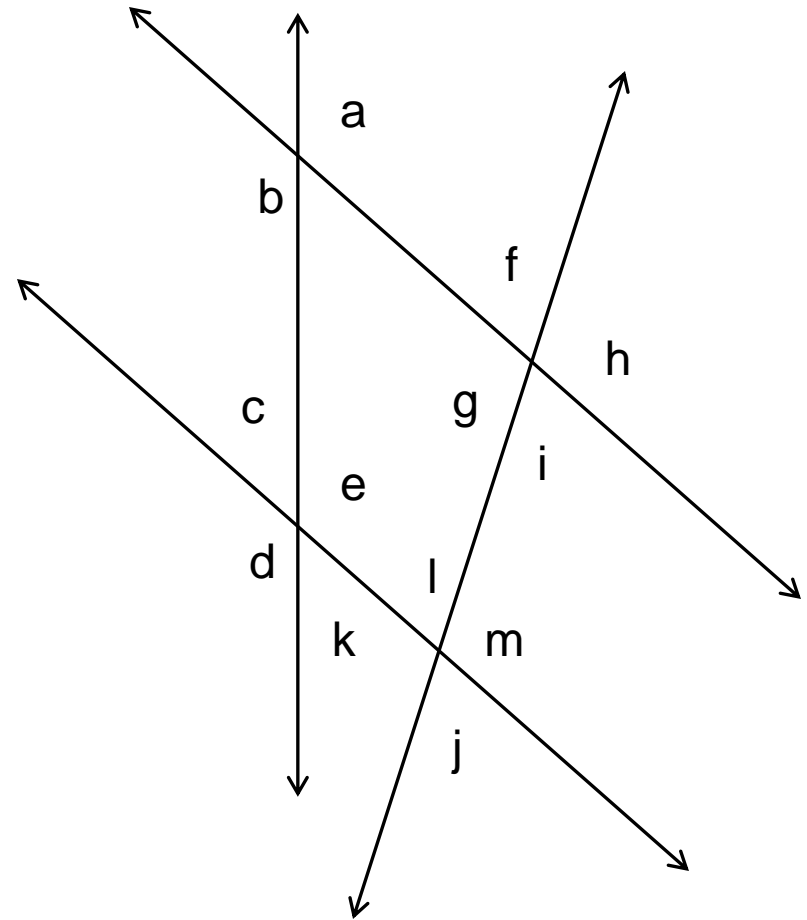
CODING

Coding is a strategy adopted from reading instruction

It means

- Recognizing a pattern
- Labeling it for meaning
- Applying it to a useful purpose

Look at the difference when compared side by side.

Compare the approach to pattern recognition

COMPARE THE APPROACH
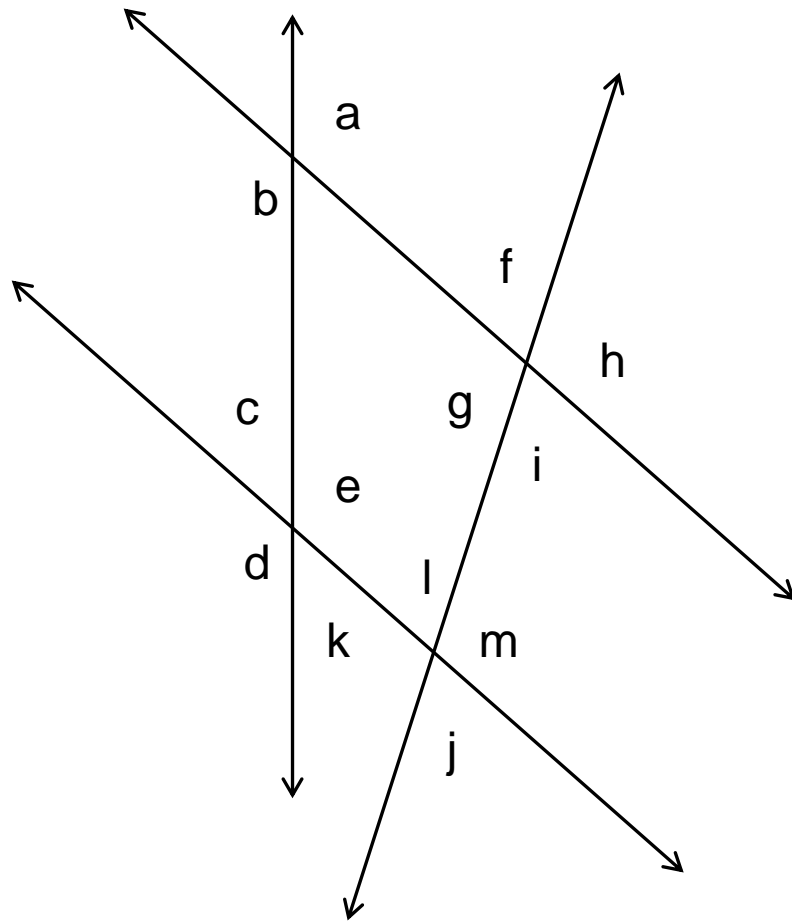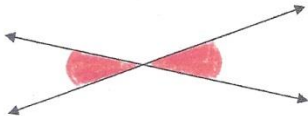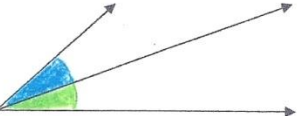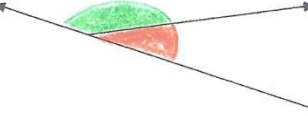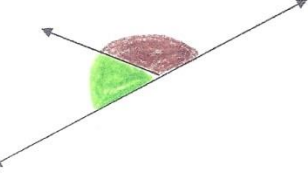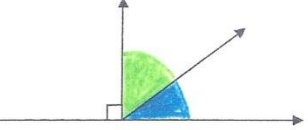
COLORING INSIDE/OUTSIDE AND ON THE LINES

Visual Dictionaries and Graphic Organizers can help students internalize definitions.

Strategies

- Use COLOR
- REDUCE verbiage
- Restate in Student Friendly Language
- Summarize

Visual Dictionary
Geometry

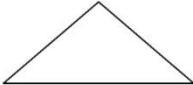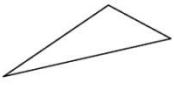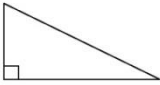|	
	Vertical Angles • Form an hour glass shape • Are congruent
	Adjacent Angles • Share a vertex • Are next to each other
	Linear Pair • Adjacent Angles • Common sides form a line • Are supplementary
	Supplementary • Sum to 180º
	Complementary • Sum to 90º

HOW WOULD YOU COLOR CODE THE PARTS NAMED?

ACTIVITY: USE MARKERS TO "CODE" MEANING

Geometry: Visual Dictionary

	Vertical Angles • Form an hour glass shape • Are congruent
	Adjacent Angles • Share a vertex • Are next to each other
	Linear Pair • Adjacent Angles • Common sides form a line • Are supplementary
	Supplementary • Sum to 180º
	Complementary • Sum to 90º
	Perpendicular Lines • Form 90º angles

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	Co-linear • co-_____ • -line_____ _____
	Equilateral Triangle • _____ _____
	Isosceles Triangle • _____ _____ _____
	Scalene Triangle • _____ _____ _____
	Acute Triangle • _____
	Obtuse Triangle • _____ _____

Created by Marilyn Zecher, M.A. CALT for the Multisensory Math Program©2010

FOR MANY STUDENTS
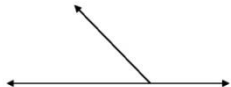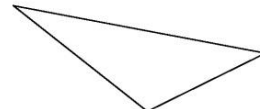
The words get in the way.

Students who learn differently may have difficulties with

- Language retrieval and organization
- Working memory
- Word retrieval
- English itself as English Language Learners

STUDENTS WITH GAPS IN BACKGROUND KNOWLEDGE

May struggle

- With applications
- With math facts
- With spatial relations
- With sequencing
- With directionality

UDL- UNIVERSAL DESIGN FOR LEARNING

Evidence Suggests

- That when all students are taught
- With multiple representations
- With multiple means of engagement
- With multiple means of expression

More students will succeed

Multisensory Instruction is one Tool.

GRAPHIC ORGANIZERS

Organize information into meaningful chunks
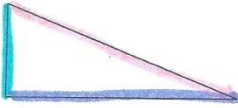
Reduce Verbiage
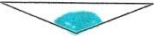
Provide additional

Can be multisensory

Add visual memory input

Enhance memory & retrieval

Geometry Lesson 2: Visual Dictionary Vocabulary and Theorems to Illustrate

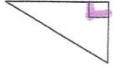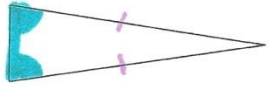| Scalene Triangle	No $\cong$ sides	
Isosceles	2 $\cong$ sides	
Equilateral	3 $\cong$ sides	
Acute Triangle	All $\angle$'s acute (less than 90°)	
Obtuse Triangle	one obtuse angle	
Right Triangle	one right angle	
Equiangular Triangle	all angles $\cong$	
Isosceles base & base angles	sides opposite $\cong$ $\angle$'s and angles opposite $\cong$ sides	
Right Triangle hypotenuse	Side opposite right angle	

USE GRAPHIC ORGANIZERS

To Summarize Content

This set was designed for a student with dyslexia and dysgraphia

His teacher asked that he copy and illustrate

He could not read his own writing or easily draw

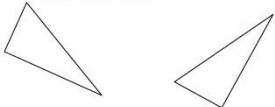**He only had to illustrate with color**

HIS CONJECTURE NOTEBOOK

C-22   Triangle Exterior Angle Conjecture

The measure of an exterior angle of a triangle is
- **equal to the sum** of the opposite interior angles.

$$\angle = \angle + \angle$$
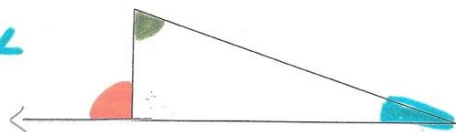
C-23   SSS Congruence Conjecture

If **three sides** of one triangle are congruent to the three sides of another triangle then
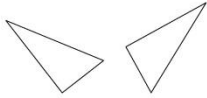- the triangles are congruent by **SSS**
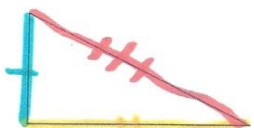
C-24   SAS Congruence Conjecture

If **two sides** and **the included angle** of one triangle are congruent to the two sides and the included angle of another triangle then
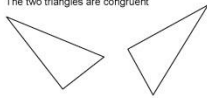- the triangles are congruent

C-25   ASA Congruence Conjecture

If **two angles** and the **included side** of one triangle are congruent to two angles and the included side of another triangle then
- the two triangles are congruent

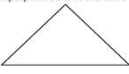## C-26   SAA Congruence Conjecture

If **two angles and a non-included side** of one triangle are congruent to the corresponding two angles and non-included side of another triangle then
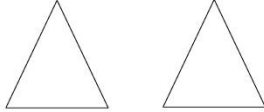- The two triangles are congruent

SIMULTANEOUS PROCESSING

Students

- Touch and say
- Color and say
- Create a visual memory of the link between the language and the image
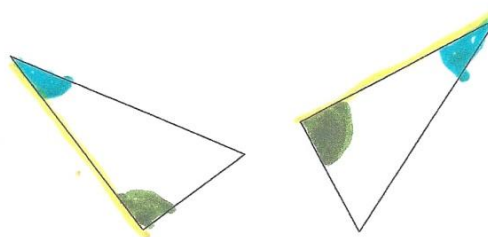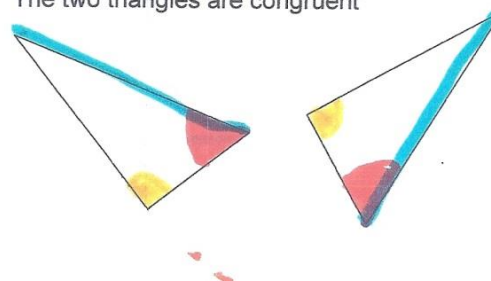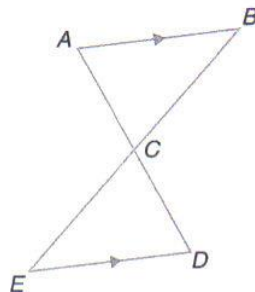
Pg. 209   4-4

9. Supply the reason for each step in the two-column proof.

Given: $\overline{AD}$ bisects $\overline{BE}$.
$\overline{AB} \parallel \overline{DE}$

Prove: $\triangle ABC \cong \triangle DEC$

Proof:

Statements	Reasons
1. $\overline{AD}$ bisects $\overline{BE}$.	1. _?_ Given
2. $\overline{BC} \cong \overline{EC}$	2. _?_ Def. Bisector
3. $\overline{AB} \parallel \overline{DE}$	3. _?_ Given
4. $\angle B \cong \angle E$	4. _?_ Based on Given: Alt. Int. ∠'s
5. $\angle BCA \cong \angle ECD$	5. _?_ "Hidden Given" Vertical ∠'s
6. $\triangle ABC \cong \triangle DEC$	6. _?_ ASA

Color Code ALL "Givens"
From Each "Given" think "what I know" & Why you know it.
Color code the "Hidden Givens"
  - These are what you know about relationships like:
    - vertical angles
    - reflexive property
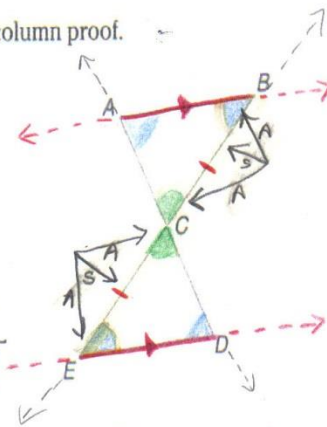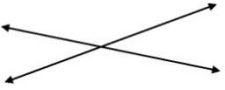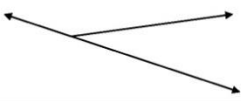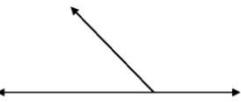Based on what you know of the "Givens" and the Hidden Givens" what can you prove?
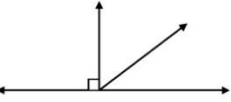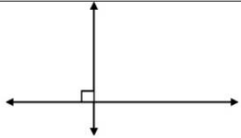
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1. $\overline{AD}$ bisects $\overline{BE}$.	1. _?_
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3. $\overline{AB} \parallel \overline{DE}$	3. _?_
4. $\angle B \cong \angle E$	4. _?_
5. $\angle BCA \cong \angle ECD$	5. _?_
6. $\triangle ABC \cong \triangle DEC$	6. _?_
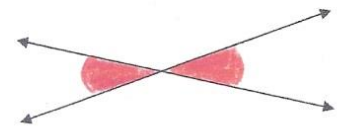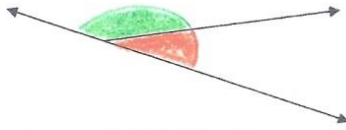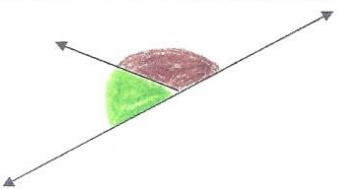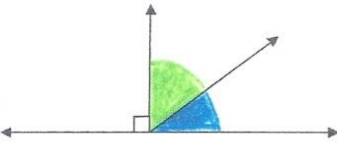
ANGLE RELATIONSHIPS: VISUAL AIDS

MULTISENSORY MATH

Geometry: Visual Dictionary

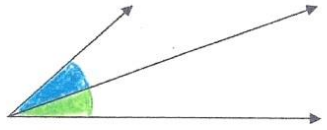|	
	Vertical Angles • Form an hour glass shape • Are congruent
	Adjacent Angles • Share a vertex • Are next to each other
	Linear Pair • Adjacent Angles • Common sides form a line • Are supplementary
	Supplementary • Sum to 180º
	Complementary • Sum to 90º
	Perpendicular Lines • Form 90º angles

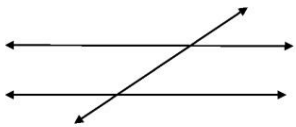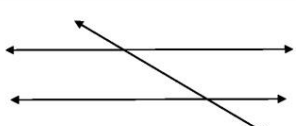Created by Marilyn Zecher, M.A. CALT for the Multisensory Math Program©2010

Visual Dictionary
Geometry

	Vertical Angles • Form an hour glass shape • Are congruent
	Adjacent Angles • Share a vertex • Are next to each other
	Linear Pair • Adjacent Angles • Common sides form a line • Are supplementary
	Supplementary • Sum to 180º
	Complementary • Sum to 90º

PARALLEL LINES CREATE ANGLE RELATIONSHIPS

Angle Relationships
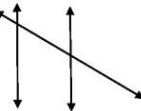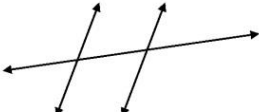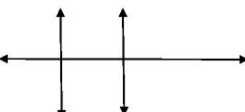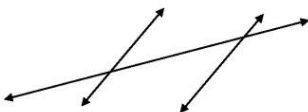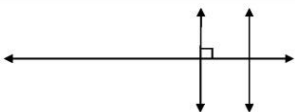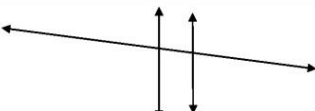
	Alternate Interior Angles • _____
	Alternate Exterior Angles • _____
	Corresponding Angles • _____
	Vertical Angles • _____
	Supplementary Angles • _____
	Complementary Angles • _____

Can You Recognize Angle Relationships When Parallel Lines Are In A Different Position?

Color code an angle pair. State the relationship name. State the relationship.
Ex. Alternate Interior Angles are congruent.

LINKING THE LANGUAGE

Morphology- meaning bearing parts of words

trans- **across**

- transversal

para- **beside**

- Parallel, parabola

bi- **two**

sec, sect – **to cut**

- Bisect, secant

vers-/vert-   **to turn**

tan- **to touch**

- Tangent,

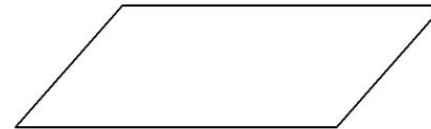**C-44 Parallelogram Opposite Angles Conjecture**
The opposite angles of a parallelogram are congruent.

C-45 Parallelogram Consecutive Angles Conjecture
The consecutive angles of a parallelogram are supplementary .

C-46 Parallelogram Opposite Sides conjecture
The opposite sides of a parallelogram are congruent.

DIFFICULT CONCEPTS W/ MANY VARIATIONS

Geometry standards include some difficult concepts with many variations

These include distinguishing quadrilaterals and concepts related to circles

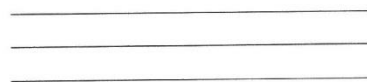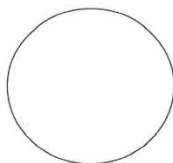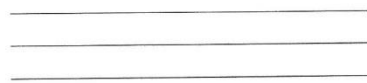For older students one can require greater effort by the student.

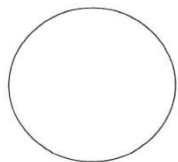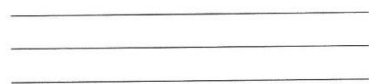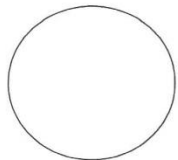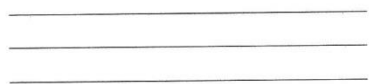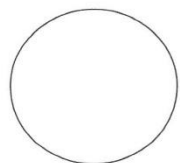Or, one can present the template for coding.

Either way, a model must be provided and the concept explored in class.

MORE COMPLEX CONCEPTS

MULTISENSORY MATH

Circles: What I Need To Know

Give a basic template

Ask students to use a straight edge to add tangents, secants, chords, etc

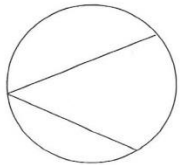**Ask them to code relationships and state theorems.**

ALTERNATIVELY, GIVE ORGANIZERS TO CODE

ALTERNATIVELY, OFFER IMAGES TO CODE

MULTISENSORY MATH

Circles: What I Need To Know

MULTISENSORY MATH

Circles: What I Need To Know

$$m\angle = \frac{1}{2}\left(\begin{matrix}\text{major} \\ \text{arc}\end{matrix} - \begin{matrix}\text{minor} \\ \text{arc}\end{matrix}\right)$$

$$m\angle = \frac{1}{2}\left(\quad - \quad \right)$$

$$m\angle = \frac{1}{2} \text{ intersected arc}$$
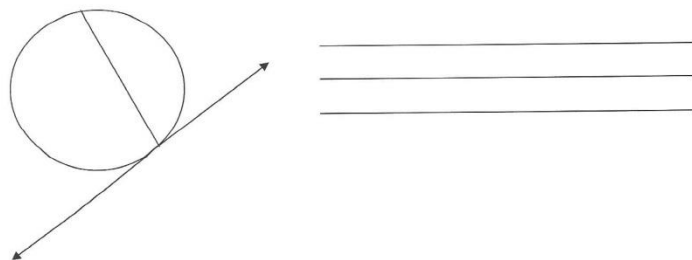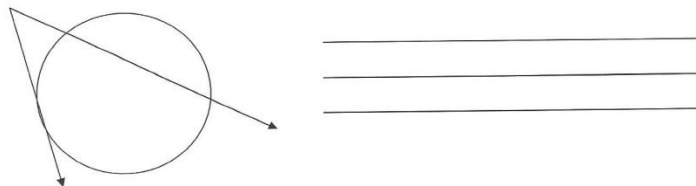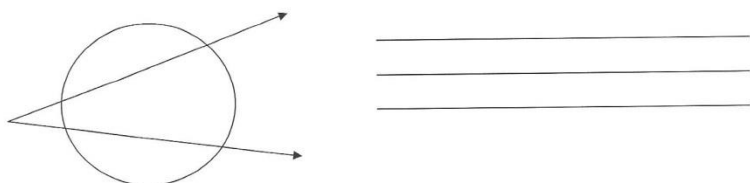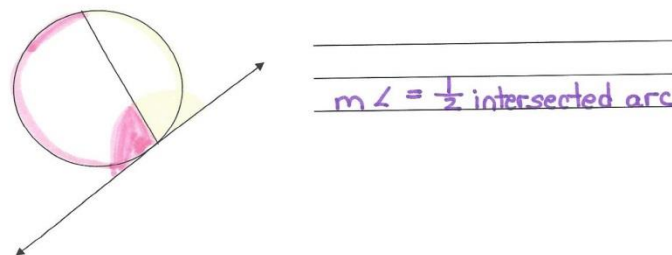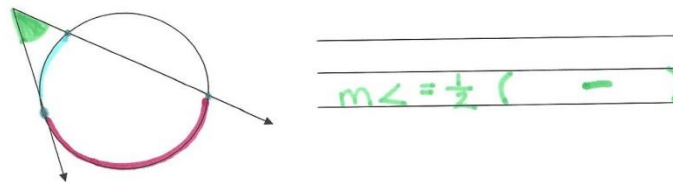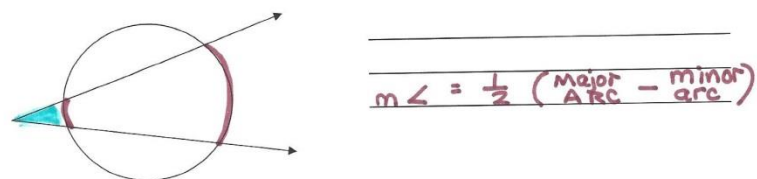
CREATING SUMMARY ORGANIZERS

Study Skills- How to Study

MS Word

Insert Table

Insert Shape

Create shapes and group objects

Formulas I Know

P =

A =

V =
Name: _____
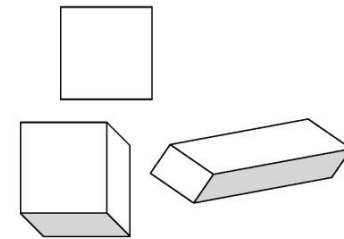
Name: _____
P =

A =

C =

A =

V =

Name: _____

Name: _____   Name: _____

Copyright 2014 MZecher
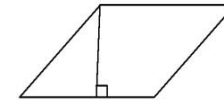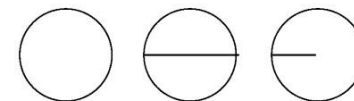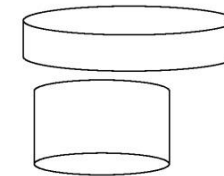
DIFFERENTIATION: TEACHER MADE LINKAGES

21

Arc Length

$$\frac{\text{arc } L}{C} = \frac{\text{arc } M}{360}$$

Remember $C = \pi d$ or $C = 2\pi r$

$P = 2b + 2h$ $A = b \cdot h$ $V = B \cdot h$
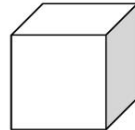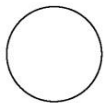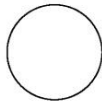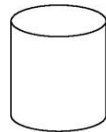
$C = \pi d$ $A = \pi r^2$ $A = Bh$
$C = 2\pi r$ $A = (\pi r^2)h$
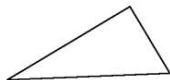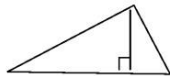
$P = s + s + s$ $A = \frac{1}{2} b \cdot h$
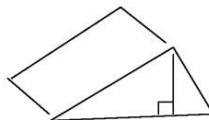
$V = B \cdot h$
$V = (\frac{1}{2} b \cdot h) h$

Prisms

Name: _____

V =

or

V =

B stands for the AREA of the Base

Isosceles Triangular Prism

$\frac{\text{Surface}}{\text{Area}}$ $A = bh + 2ls + lb$

Volume $V = \frac{1}{2}(bh)l$

9 cm
12 cm
18 cm
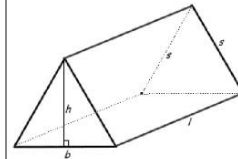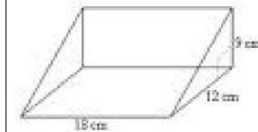
Name: _____
Highlight the B and identify the formula for its area.
Highlight the height or length
V =
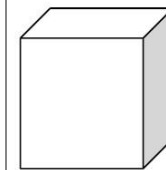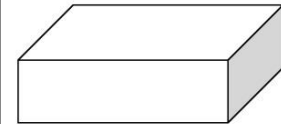
Volume is in Units^2

GRAPHIC ORGANIZERS & VISUAL DICTIONARIES

Elementary

- Illustrate vocabulary of shapes and attributes

Middle School

- Illustrate applications such as area, perimeter
- The use of formulas for problem solving
- Reference pages for hands on projects

High School

- Compile a reference library of theorems and postulates
- Each unit's core concepts can be summarized, illustrated and kept for exam review
- Memory is enhanced by using words, visuals, and tactile strategies for applications.

ESSENTIAL INSTRUCTOR SKILLS & TECHNOLOGY

Word processing program such as MS Word

Insert Table

Insert Shape

Knowledge of Grouping function (Format)

Formatting: "tight" or "text wrapping" features

Students may refer to organizers for homework

Or, fill them in from memory as a study strategy

Teachers may use portions as warm ups.

Non-verbal, multisensory, differentiated and fun.

SAMPLES
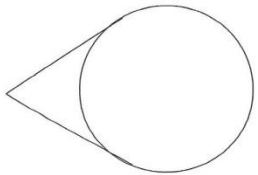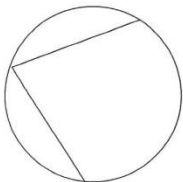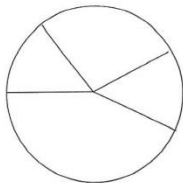
Circles: What I Need To Know

Circles: What I Need To Know
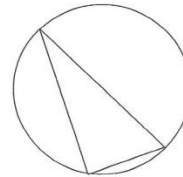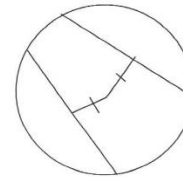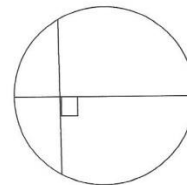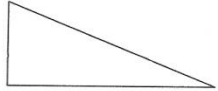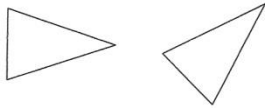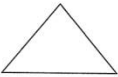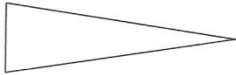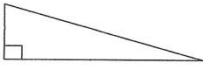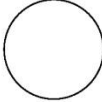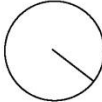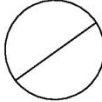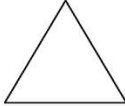
SAMPLES

Geometry Lesson 2: Visual Dictionary Vocabulary and Theorems to Illustrate

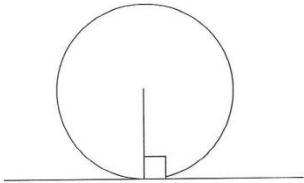| Scalene Triangle	No ≅ sides	
Isosceles	2 ≅ sides	
Equilateral	3 ≅ sides	
Acute Triangle	All ∠'s acute	
Obtuse Triangle	one obtuse angle	
Right Triangle	one right angle	
Equiangular Triangle	all angles ≅	
Isosceles base & base angles	sides opposite ≅ ∠'s and angles opposite ≅ sides	
Right Triangle hypotenuse	Side opposite right angle	

Geometry: Visual Dictionary

	Square Attributes: _____ _____ _____
	Rectangle Attributes: _____ _____ _____
	Circle Attributes: _____ _____ _____
	Radius _____ _____ _____
	Diameter _____ _____ _____
	Equilateral Triangle Attributes: _____ _____ _____

Theorems, Postulates & Corollaries

SAMPLES

Reason Bank for Proofs: Geometry

- Given

- Addition Property of Equality
- Subtraction Property of Equality
- Multiplication Property of Equality
- Division Property of Equality

- Identity Property of Addition
- Identity Property of Subtraction
- Identity Property of Multiplication
- Identity Property of Division

- Reflexive Property
- Symmetric Property
- Transitive Property
- Substitution

- Angle Addition Postulate
- Segment Addition Postulate
- Linear Pair Postulate

- Angle Congruence Postulate
- Segment Congruence Postulate

- Definition of supplementary
- Definition of complementary
- Definition of Right Angle

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The Atlantic Seaboard DYSLEXIA EDUCATION CENTER, Rockville, MD

MULTISENSORY MATH

Visual Dictionary for Algebraic Properties of Equality

Word or Property	In my own words + pictures	Example
equality	Same, Equal	same amount or quantity, same measurement
Addition property of equality	If I **add** the same amount to **both** sides, the sides will STILL be equal	If a = c then a+ **b** = c + **b**
Subtraction Property of Equality	If I **subtract** the same thing from *both* sides of an equation they will still be equal	If a = c then a- **b** = c - **b**
Multiplication Property of Equality	If you **multiply** both SIDES by the same thing, they will still be equal.	If a=c Then **d**(a) = **d**(c)
Division Property of Equality	DUH!	If a = c Then a/d = c/d *As long as none of the terms = 0*
Substitution Property of Equality	You can "substitute" the ten dollar bill for the two 5's b/c...	If a = c AND c + 10 = 30 You can substitute "a" for c and the equation is still true! 7 + 3 =10 (7+3)-29 =10-29

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The Atlantic Seaboard DYSLEXIA EDUCATION CENTER, Rockville, MD

MULTISENSORY MATH

Other Properties:

Reflexive Property	It is itself	
Transitive Property	Transfer equality from one thing or expression to another that is equal! Logical assumption.	For all real #'s A= B and B=C You can transfer the equality from A to C b/c they BOTH = B
Symmetric Property	Then Order can reverse b/c they are equal.	For all real #'s A = B then B = A

Proofs:

Color Code the "GIVENS"
- These are gifts
- They tell you things that you don't have to figure out.

Look for the "**HIDDEN GIVENS**"
- Based on the "givens" what do you know must be true?

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MULTISENSORY MATH

The Multisensory Training Institute of ASDEC in Rockville MD www.asdec.org

The Multisensory Math Program offers two graduate level courses in Mathematics Instructional Methods, both on site and through distance learning.

MSM courses emphasize a conceptual approach to teaching math for all learners and inclusion classes using the Concrete-Representational-Abstract instructional sequence & evidence based instructional methods

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Email: multisensorymath@gmail.com

The Multisensory Training Institute of

The Atlantic Seaboard Dyslexia Education Center, Rockville MD

REFERENCES & RESOURCES

The Learning Brain, Blakemore & Frith

The Number Sense, Stanislas Dehaene

The What Works Clearinghouse, US Department of Education Practice Guides

http://ies.ed.gov/ncee/wwc/Publications_Reviews.aspx?f=All%20Publication%20and%20Review%20Types,3;#pubsearch

Universal Design for Learning, UDL

http://www.cast.org/udl/

Common Core State Standards: Math

http://www.corestandards.org/Math/Practice/