Nemeth Code Symbols Used in High School and Strategies for Supporting STEM Learning

Lesson 5:

Materials and Strategies for High School

University of South Carolina Upstate

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Objectives

Participants will be able to:

1. Understand how best to support students in high school math classes.
2. Understand what tools and materials can be used to support high school mathematics learning.
3. Understand which concepts in tactile graphics can be challenging for students who are braille users.

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Review of Tools from Middle School

- Course 4 Lesson 3 and Course 5 Lesson 4 describe tools used by students at the middle school level related to beginning algebra and geometry concepts, including:
  - Tactile Algebra Tiles
  - Graphic Aid for Mathematics
  - Tactile Compass
  - Geometro Sets
- View these lessons if you are not familiar with these tools.

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Supporting High School Students

- Pre-teach students on how to use new tools/manipulatives/materials BEFORE they are used in the classroom.
- Require students to show what they are thinking and not just verbalize what they are thinking.
- Encourage students to advocate for themselves.
- Ensure students have easy access to their own instructional materials.
  - Location of materials (Independent access for the student – not the adult).
  - The student needs to have a braille copy of the same notes as classmates or be actively taking their own notes.

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Methods

- Students find the braillewriter is still an extremely important tool when MANIPULATING the math expressions and THINKING through solving problems.
- Students can submit answers to simpler problems electronically, especially when there aren't many steps involved in solving them.
- Students can submit answers to problems with multiple steps electronically via computer or notetaker once the student has figured out the problems on the braillewriter.

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Algebra

- Simplifying expressions
- Solving equations
- Graphing
- Representations as
  - Ordered pairs
  - Tables
  - Equations
  - Graphs

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Must Haves for Algebra

- Braillewriter
- Graphing tools and materials
- Draftsman or some other drawing board
- Scientific or graphing calculator
  - Ask the math teacher what other students are using

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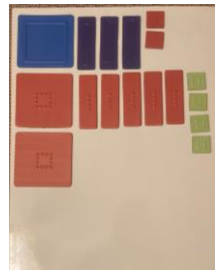
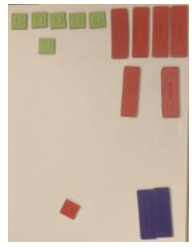
Algebra Tiles

- At the high school level, students are starting to move away from using manipulatives and focusing more on abstract concepts such as manipulating expressions and equations.
- If students are struggling with abstract concepts, Tactile Algebra Tiles are a great tool to connect the two.
  - Add $\left(x^2+3x-2\right)+\left(-2x^2-5x+4\right)=-x^2-2x+2$
  - Subtract $(5-4x)-(2x-1)=6-6x$
  - Factor $x^2+5x+6=(x+2)(x+3)$





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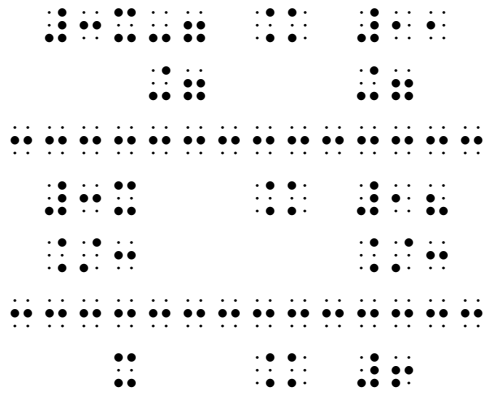
Solving an Equation on a Braillewriter

- Great way to keep track of steps instead of trying to keep everything in their head.

$$\begin{array}{r} 3x - 7 = 11 \\ +7 \quad +7 \\ \hline 3x = 18 \\ \div 3 \quad \div 3 \\ \hline x = 6 \end{array}$$



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Data Tables From a Student's Perspective

- The easiest way for students to make data tables is on the braillewriter.
- Being able to see multiple lines, allows students to see patterns.
- Allow students flexibility in producing the table that works best for them.
- Transcribers may produce data tables differently than students.
- Features that may be included in a braille data table
  - Optional boxed lines - Top (dots 2-3-5-6), Bottom (dots 1-2-4-5)
  - Separation line (dot 5, dots 2-5, dots 2-5, dots 2-5, …)
  - English Letter Indicators are used with x and y

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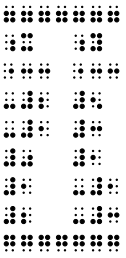
Data Tables

Encourage students to look for patterns

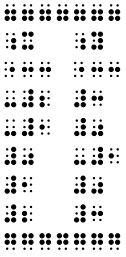
Linear

x	y
-2	5
-1	3
0	1
1	-1
2	-3



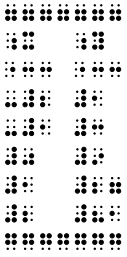
Quadratic

x	y
-2	3
-1	0
0	-1
1	0
2	3



Exponential

x	y
-2	1
-1	3
0	9
1	27
2	81



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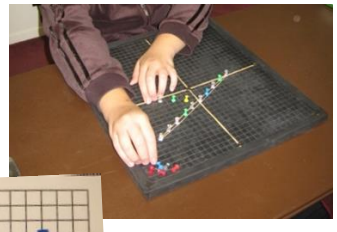
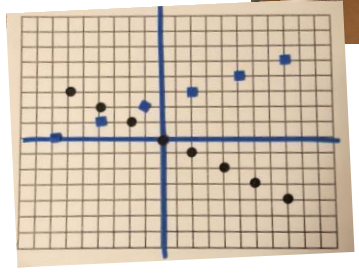
Graphing

- Graphing is a huge part of algebra at the high school level.
- Students begin graphing by hand and then later move to electronic tools once basic skills are mastered.
- Tactile dots
  - Push pins on a corkboard
  - APH Graph Benders
  - Brass fasteners
  - Sticky foam sheets (hole punch)
  - Exceptional Teaching
  - Maxi-Aids
  - Craft stores





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Identifying Whether Relations Are Functions

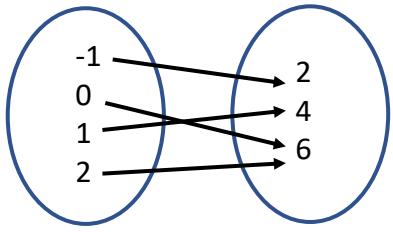
- Points (x's are different, so function)

{(1,1), (2,3), (3,2), (4, 0)}

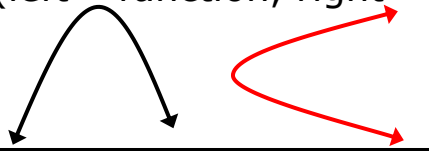
- Data Table (x's are the same for two points, so not a function)

x	y
1	-2
1	3
2	5
3	5

- Mapping (x's are different, so function)



- Graph - Vertical Line Test (left – function, right - not)



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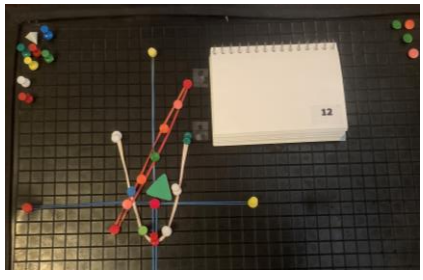
Graphing Inequalities and Curves

- Use two types of pins/dots for more than one line/curve on a single graph.
- Solid vs. Dotted – use an "s" or a "d" by the line
  - Solid for ≤ or ≥
  - Dotted for < or >
- Shading – place something in the shaded area
- Student can take a picture and send it to the teacher before moving to the next problem.

$y \geq x^2 - 3$

$y < 2x + 4$



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Geometry

- Characteristics of shapes (triangles, quadrilaterals, etc.)
- 2-D and 3-D figures
- Area, perimeter, surface area, and volume
- Constructions
- Proofs (depending on the class)
- Trigonometry (depending on the class)

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Must Haves for Geometry

- Braillewriter
- Graphing tools and materials
- Draftsman or some other drawing board
- Shape stencils
- Protractor and ruler
- Lots of tactile materials such as APH's Graphic Art Tape, Graph Benders, and Feel 'n Peel stickers (see resource list).
- Scientific or graphing calculator
  - Ask the math teacher what other students are using.

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Key Parts and Symbols in a Tactile Graphic

- Title
- Key
- Labels
- Lead lines for labeling
- Right angles
- Tick marks for congruence
- Arrows for parallel lines
- Dotted lines for lines that are hidden

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3D figures

- Cube/Prism:

  Draw two overlapping squares, triangles, rectangles, etc. and then connecting the corners.
- Pyramid:

  Draw a shape and then connect all vertices to the same point above the shape.
- Cone:

  Draw a circle and then connect the left and right side of the circle to a point above the circle.
- Cylinder:

  Draw 2 ellipses and connect the sides.

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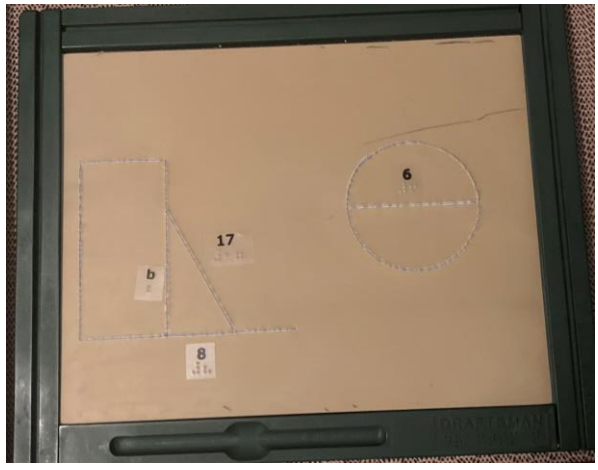
Approaches for Illustrating Word Problems

- It is important that students have a method for creating their own pictures to represent a problem.
- They need to have methods for
  - Creating straight lines
  - Creating curved lines
  - Adding labels



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Tactile Graphics

- Geometry Tactile Graphics Kit (APH)
  - Has both early and more advanced concepts
  - Includes common graphics used in geometry class
- Student's textbook
  - Pre-teaching the student how to read tactile graphics efficiently is important.
  - Encouraging the student to look ahead at graphics before they are needed in class is essential.

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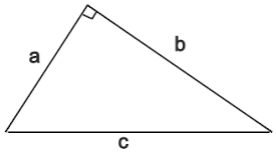
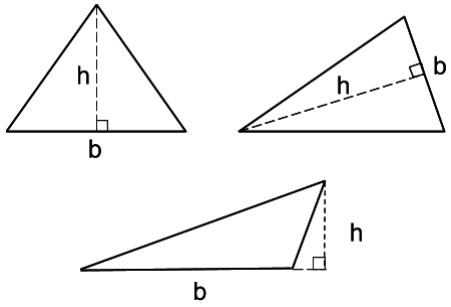
Altitude (height) on Triangles

- Look for the right angle
- Find the two sides that connect to the right angle
- One side is the height
- The other side is the base





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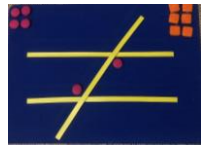
Angles Formed by Intersecting Lines

- Vertical angles and a linear pair (A): The opposite angles at an intersection.
- When parallel lines are cut by a transversal
  - Corresponding angles (B): Angles on the same part of the intersection. For example, both are top right.
  - Alternate interior angles (C): Between the parallel lines, but opposite sides of the transversal.
  - Alternate exterior angles (D): Outside of the parallel lines, but opposite sides of the transversal.

A 

B 

C 

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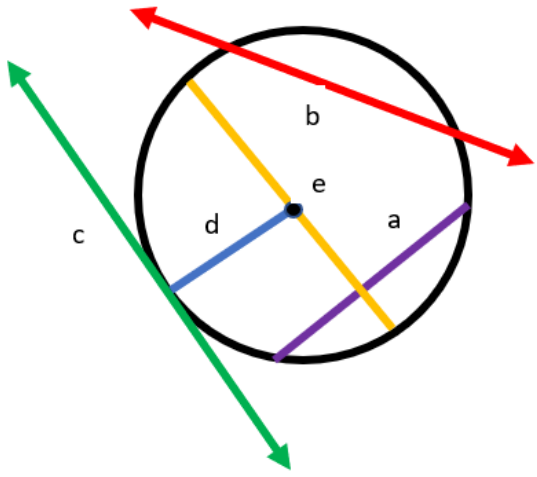
Lines in a Circle

- Chord (a): segment that connects 2 points on a circle
- Secant (b): line that intersects the circle twice
- Tangent (c): line that intersects the circle once
- Radius (d): segment that connects the center and a point on the circle
- Diameter (e): chord that goes through the center of the circle



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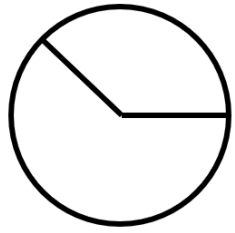
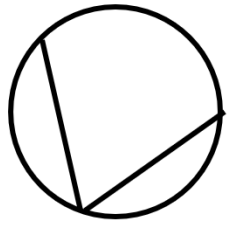
Angles in a Circle

- Central angle: angle with its vertex at the center of the circle



- Inscribed angle: angle with its vertex on the circle



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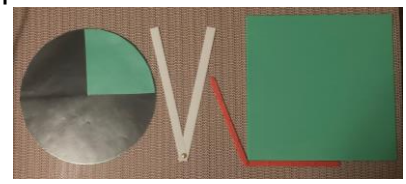
Student Engagement with Acute, Right, and Obtuse Angles

- Create a math journal – have students create a page for each angle, describe the angle, and create a picture.
  - Acute – smaller than a right angle ("it's a cute, little angle")
  - Obtuse – larger than a right angle
- Use
  - Brads and strips of cardboard or heavy paper
  - Students' folding canes
  - Craft sticks with Velcro on the ends
  - A small carpenters L
  - The corner of an index card or piece of cardboard to compare the angles to a right angle



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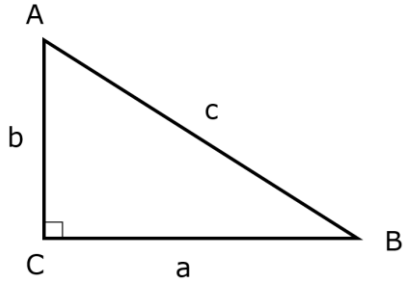
Sides of a Right Triangle and Trigonometry

- Hypotenuse (opposite the right angle)
- Leg (adjacent to the right angle)
- Leg opposite angle A
- Leg adjacent to angle A
- SOH CAH TOA
  - Sine equals Opposite over Hypotenuse
  - Cosine equals Adjacent over Hypotenuse
  - Tangent equals Opposite over Adjacent



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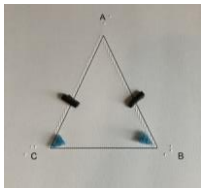
Using Graphics When Doing Proofs

- As students are doing proofs, it is helpful to mark congruent sides and angles on a graphic.
- Consider just using the following because they can be easily removed when the proof is complete.
  - Graph Benders
  - WikkiStix
  - Graphic Art Tape
  - Tactile dots



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Lead Line (from component to label)

- Looks different than the lines of the actual graphic
- Is the least significant line in the graphic, with a preferred minimum length of 3/4 inch and a preferred maximum length of 1-1/2 inches
- Doesn’t have an arrowhead at the end
- Is straight, if at all possible
- Touches the component it identifies at one end
- Is at least 1/8 inch from the beginning or end of the braille label at the other end

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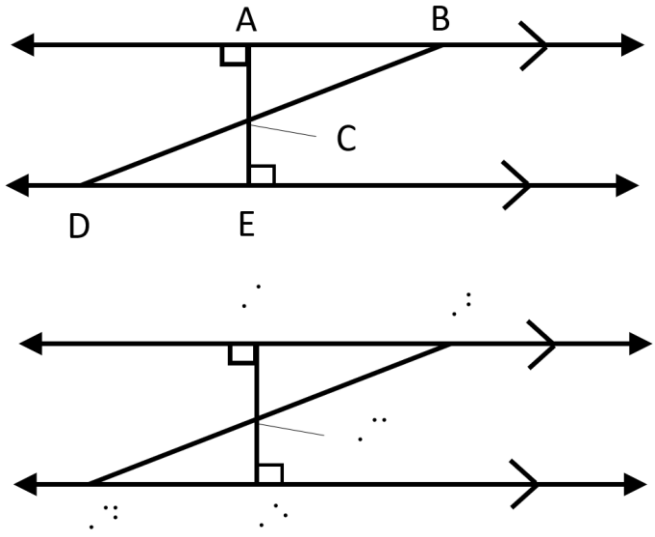
Example of Drawings with Lead Lines



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Example of a Proof

Given: $\overline{BC} \cong \overline{DC}, \overline{AB} \parallel \overline{DE}$

Prove: $\triangle ABC \cong \triangle EDC$

Statement	Reason
1. $\overline{BC} \cong \overline{DC}, \overline{AB} \parallel \overline{DE}$	1. Given
2. $\angle ACB \cong \angle ECD$	2. Vertical angles are congruent
3. $\angle ABC \cong \angle EDC$	3. If parallel, alternate interior angles are congruent
4. $\triangle ABC \cong \triangle EDC$	4. ASA

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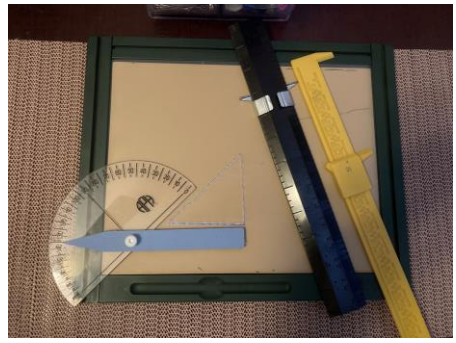
Constructing Triangles with Specific Measurements

- Drawing boards with the Braille/Print Protractor
  - Use of blue wand on the protractor
- SAS – Side AB is 3”, Angle ABC 45°, Side BC is 4”



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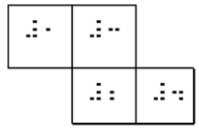
3-D Figures and Mat Plans

- Mat Plan – top view of a solid, with the number of cubes appearing in each vertical column displayed in the corresponding box.
- 2-D to 3-D: Student uses the mat plan to build the 3-D figure with Omnifix cube.
- 3-D to 2-D: Student uses 1” graph paper and the braillewriter to make a mat plan for a given 3-D figure.
- Help students who struggle with the abstract concept.



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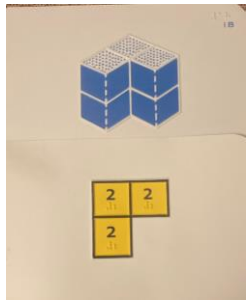
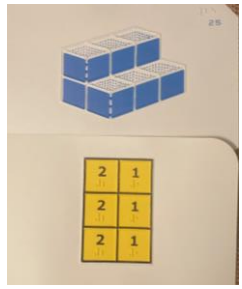
Orthographic Views

- 3 Orthographic views
  - Top view
  - Front view
  - Right view
- StackUps Kit includes:
  - Velcro cubes
  - Mat plan cards
  - 3-D figure cards
  - Grids and Velcro squares for orthographic views





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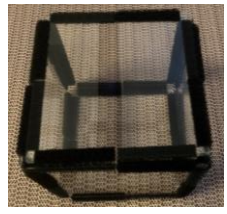
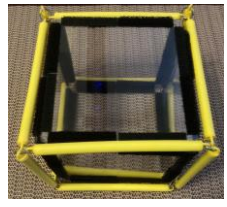
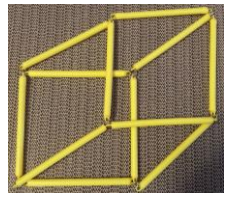
Geometro

- Student Workbook Kit
  - Student Workbook
  - Magnetic Tiles and Board
  - Rod Models (square prism, triangular prism, square pyramid, triangular pyramid)
- Mini and medium sets often do not have enough shapes
- When the student uses the yellow rods and removes them from the shape, the rods that lay underneath other rods are the hidden ones that become dotted in a picture.







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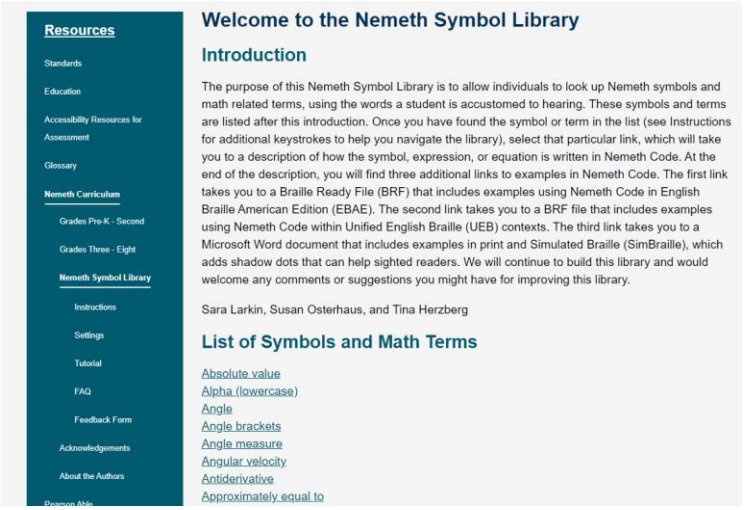
Nemeth Symbol Library Webpage

- Works with any screenreader
- Use a braille display or emboss to look at braille examples



https://accessibility.pearson.com/resources/nemeth-curriculum/nemeth-symbol-library/index.php

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Nemeth Symbol Library

- Glossary of terms used in math which are linked to a description of how to write each in Nemeth code related to that content.
  - 240 terms, 136 definitions
- Several terms land you on the same description so if your terminology is slightly different, you still get the same description.
- Over 600 examples from easy first to more complex later in the file.
  - Nemeth in EBAE as a brf file for students
  - Nemeth within UEB contexts as a brf file for students
  - Nemeth in Print and SimBraille for teachers

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Tutorial

- Students must learn how the library is structured.
- Students need to learn keystrokes for navigating to a webpage and around a webpage within the context of the library.
- Students need to learn to use Insert-F7 to open the link list and find the term they are needing.
- Students need opportunities to practice looking up definitions and examples.

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