Tools and Best Practices for Teaching Higher Level Mathematics

Sponsored by:

National Organization of Parents of Blind Children Division (NOPBC)

NFB Convention

ORLANDO, FLORIDA

July 3, 2018

Presented by
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Outreach Programs

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www.tsbvi.edu/math

www.tsbvi.edu/videos-webinars/mathematics

Agenda

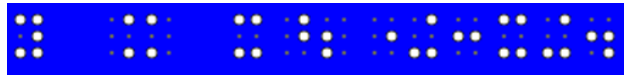
- Math Materials (Including Graphics)
  - Blind Learner
  - Low Vision Learner
  - Auditory Learner
- Accessible Math Tools and Technology
  - Basic
  - Number and Quantity
  - Measurement
  - Algebra and Statistics and Probability
  - Geometry

The Learning of Mathematics

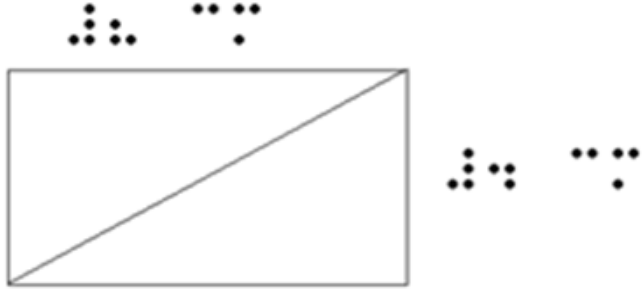
- Highest level of math achieved in high school was shown to be linked with successful completion of a college degree in any field of study (Adelman, 1999 and Hill, 2006)
- **higher level of high school math = higher likelihood of completing college degree**

Math Materials
Braille Reader

- High Quality Braille Textbooks & Assessments (including released tests)
  - Nemeth Code
  - Tactile Graphics



- Teacher-Made Materials
  - Worksheets
  - Quizzes
  - Tests



Nemeth Translation Packages

- Duxbury: ≥ DBT WIN 10.3

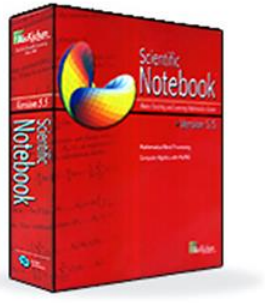
  www.duxburysystems.com

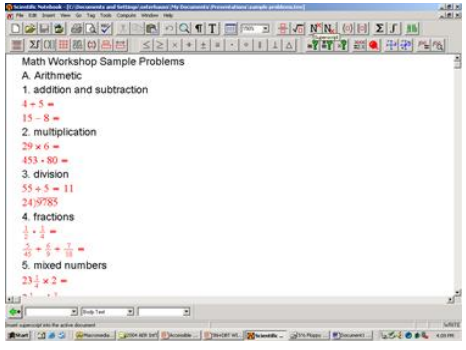
- MacKichan: Scientific Notebook

  www.mackichan.com

- Design Science: MathType

  www.dessci.com





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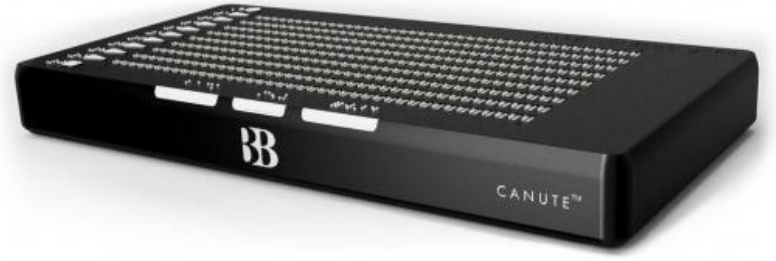
Nemeth to Print Back Translators

- Humanware KeySoft 9.5 Upgrade for the BrailleNote Apex
  http://support.humanware.com/en-usa/support/braillenote_apex/software/keysoft_95 4
  Humanware Key Math with the Braille Note Touch
  http://support.humanware.com/en-usa/support/braillenote_touch/video_tutorials#a15

- Braille Sense Notetaker v8.6 Firmware Update with BookShare fix, new Tablet Viewer feature and Math Symbol Select.
  https://www.hims-inc.com/news/?mod=document&uid=128
- Duxbury Systems www.duxburysystems.com
  Now Translating from Braille Math to Inkprint Math via Word*
  *Requires Microsoft Word and MathType

Bristol Braille Canute: Multi-line Refreshable Braille http://www.bristolbraille.co.uk/

- The *Canute 360* is a nine line, 360-cell standalone braille e-reader.
- Entering final testing period with release later in 2018
- Single line braille displays and talking books can never fully replace braille in the STEM fields.



Understanding in these subjects requires information to be rendered *in context:* math problems, data tables, equations, etc. require information to be presented over a series of lines, not a single line of text.

Resources for Learning Nemeth Code

- **Publications Available to Learn Nemeth Code**
  www.tsbvi.edu/component/content/article/1523-publications-available-to-learn-nemeth-code

- **Other Ways to Learn Nemeth Code**
  www.tsbvi.edu/component/content/article/1522-other-ways-to-learn-nemeth-code

- **Nemeth Code Reference Sheets**
  www.tsbvi.edu/resources-math/1524-nemeth-code-reference-sheets

- **Nemeth Updates**
  www.brailleauthority.org/mathscience/math-science.html

What's New with Learning Nemeth!

- *Guidance for Transcription Using the Nemeth Code within UEB Context*, Approved June 2016 (Revised 2018)

  www.brailleauthority.org/mathscience/math-science.html
- *Nemeth at a Glance: A Math Resource, Grade Level Chart, and Evaluation Tool*
  www.tsbvi.edu/store/ecom/index.php?action=ecom.pdetails&mode=nemeth

Online Nemeth

- APH Nemeth Tutorial
  https://tech.aph.org/nemeth/

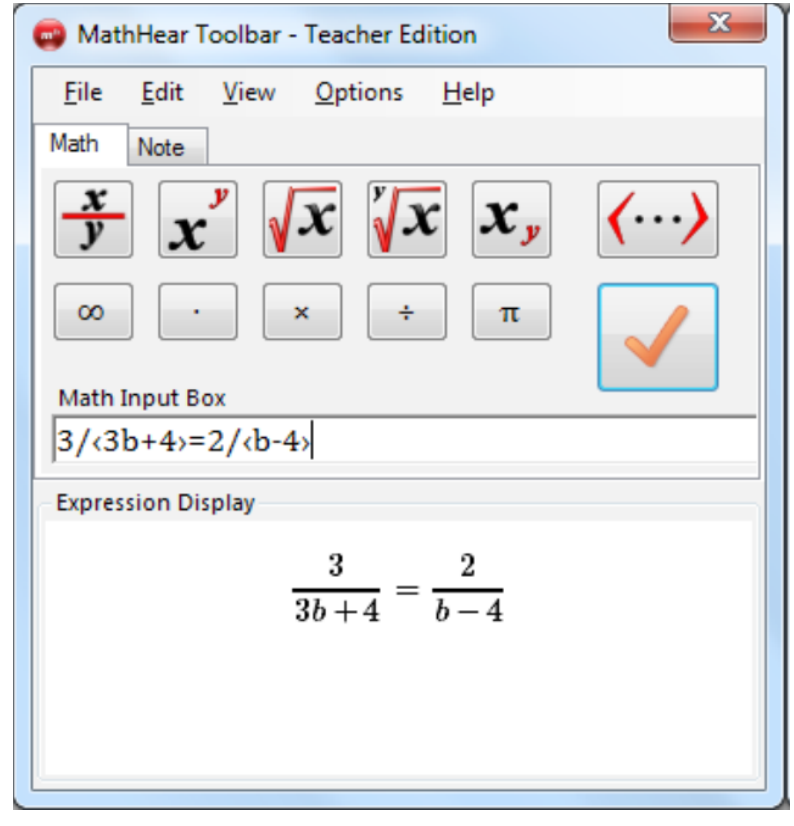
- Nemeth Braille Searchable Database
  http://accessibility.pearson.com/nemethdatabase

- TSBVI Online Nemeth Tutorial (coming soon)

MathHear for Windows

www.gh-accessibility.com/software/mathhear

- MathHear provides simple and accurate math access to teachers and students via a keyboard-accessible interface. Full voicing provides blind and visually impaired users with complete access to both basic and advanced math expressions, enabling all students to participate equally in online learning activities.



Math Speech and Braille Display

- Math Player + MathType + NVDA

  www.dessci.com/en/reference/ies-ets/instructional_material/default.htm#navigation_guide

- JAWS

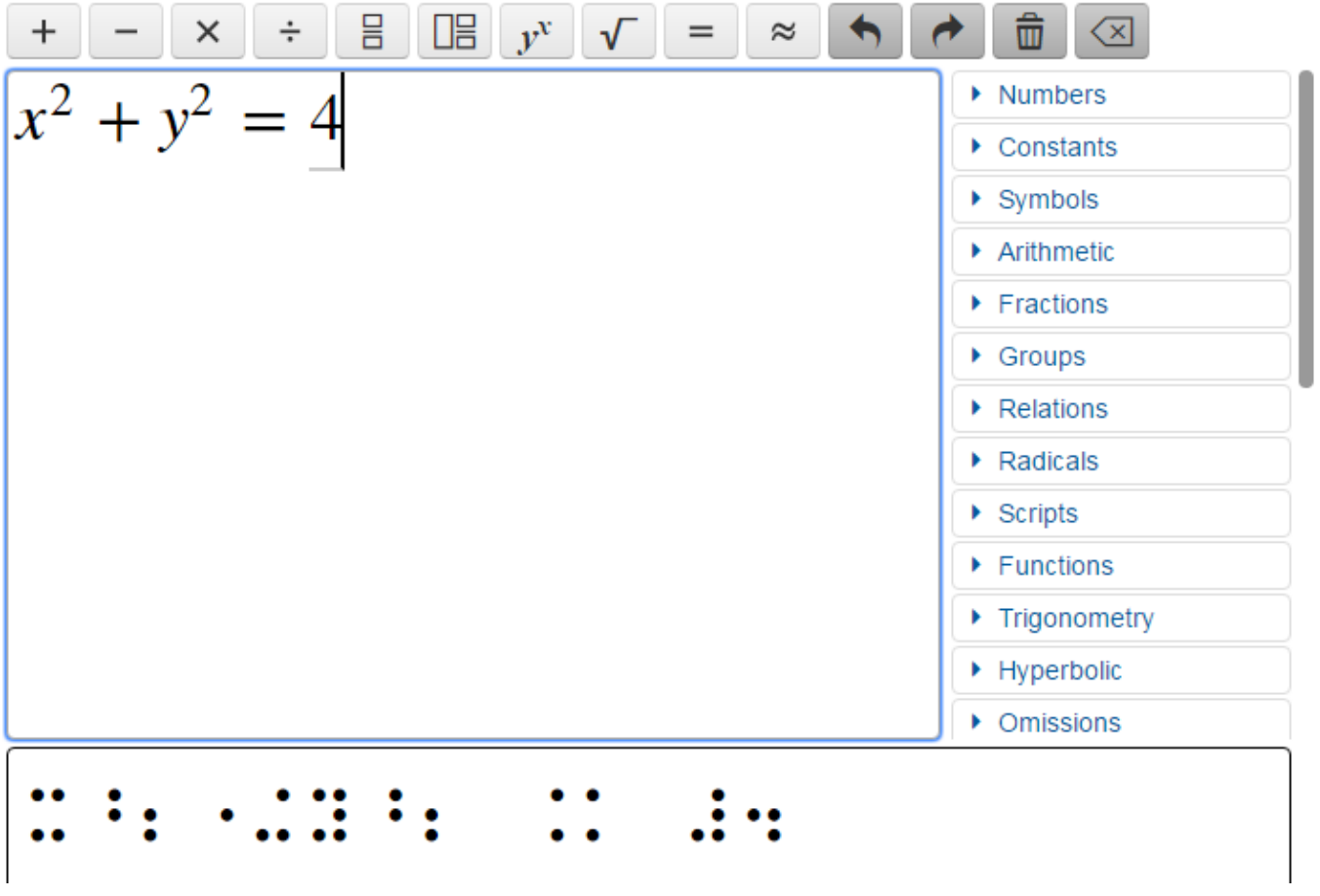
  www.freedomscientific.com/JAWSHQ/JAWSHeadquarters01

  www.freedomscientific.com/content/html/jawshq/MathML-Samples.html

  http://podcast.freedomscientific.com/FSCast/episodes/FSCast128-Conference_Specials,MathML,Mike_Wood.mp3

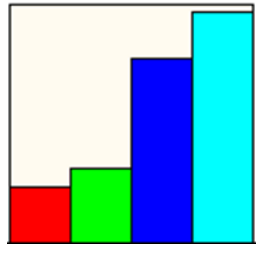
Accessible Equation Editor

http://accessibility.pearson.com/mathex-app/



Math Materials
Large Print Reader

- Large Print Textbook
- Enlarged Materials
- Regular Print with Magnification
- Be Alert for Color-Keyed Graphics



Accessible Math Graphics

- Tactile Graphics
- Large Print Graphics
- Universally Designed Math Graphics for both the Student Who is Blind or Who Has Low Vision

Guidelines and Standards for Tactile Graphics, 2010

from the Braille Authority of North America (BANA) and Canadian Braille Authority (CBA)

www.brailleauthority.org/

Available for purchase from APH…

Print: 7-35935-00 Braille: 5-35935-00

Guidelines and Standards for Tactile Graphics
Supplement: Examples 1 - 35

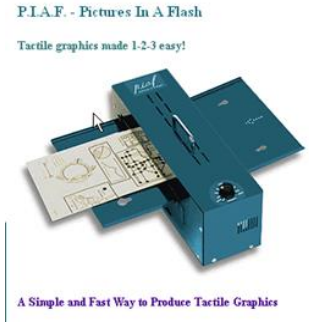
The tactile graphics examples illustrated in this supplement have been designed to accompany the *Guidelines and Standards for Tactile Graphics 2010*. Each tactile graphic is preceded by a brief summary of the important design techniques and braille formats used in each example.

Available for purchase from APH…

Print: 7-35936-00 Braille: 5-35936-00

Tactile Imaging Machine and Swell Touch Paper

- Pictures in a Flash (PIAF)
  www.humanware.com



- Swell-Form Graphics Machine
  www.americanthermoform.com

ViewPlus Braille Embossers are all Powered by Tiger®

www.viewplus.com

- **Braille production made flexible and easy:**
  Braille is translated and embossed from MS Word in one touch and graphics are produced from any PC software including Illustrator & CorelDraw.
- **Braille and Ink:**
  Prints Braille and ink on the same page in a single pass.
- **Tactile graphics embossed in fine detail:**
  Tiger tactile graphics are the highest-resolution of any embosser.
- **Braille & graphics software included:**
  TSS incorporates braille software, tactile graphic studio, and more. It is also compatible with Duxbury and other braille software.

Phoenix Braille and Tactile Graphics Embosser

http://brailler.com/products/phoenix

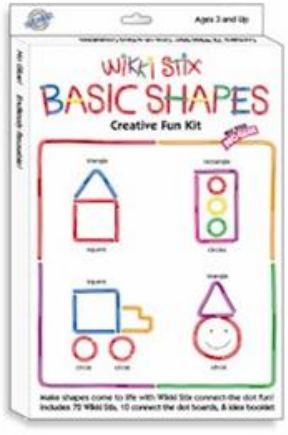
- Introducing Phoenix, the World's first multi-function Braille and Tactile Graphics System.

- Imagine the ability to scan your pictures, graphs and charts into your computer and with a few clicks of the mouse, emboss those images in high definition tactile graphics without compromising the quality of your Braille text.

Quick/Instant Tactile Graphics

- APH Picture Maker: Wheatly Tactile Diagramming Kit

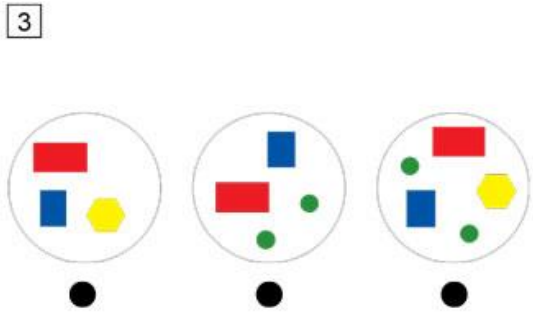
- WikkiStix
  www.wikkistix.com



More Quick Tactile Graphics

- APH Draftsman
- E.A.S.Y. inTACT Sketchpad
- Sewell Raised Line Drawing Board
- Sensational Blackboard

TTT: Talking Tactile Tablet



- www.touchgraphics.com TTT Math

TTP: Talking Tactile Pen

- www.touchgraphics.com

IVEO® Touchpad

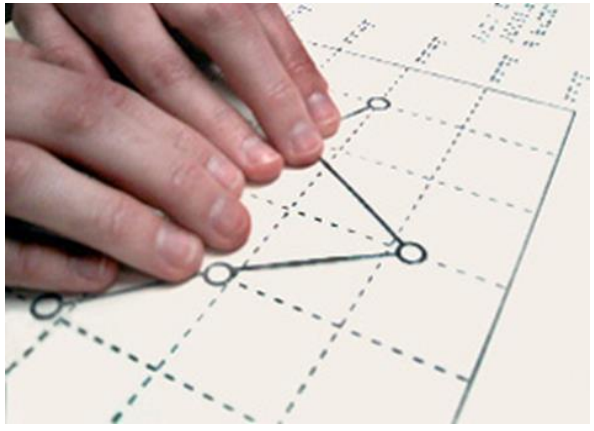
- www.viewplus.com

Math Graphics
Made to Order by Others

- gh, LLC

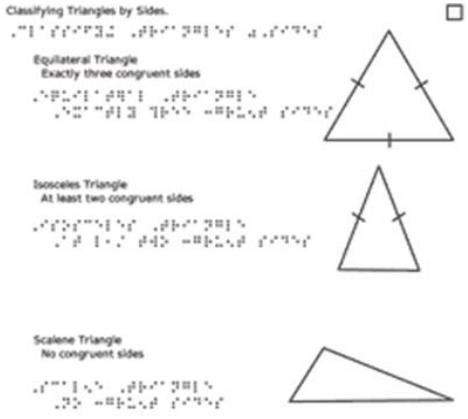
  LaserLine™ Graphics

  www.gh-accessibility.com



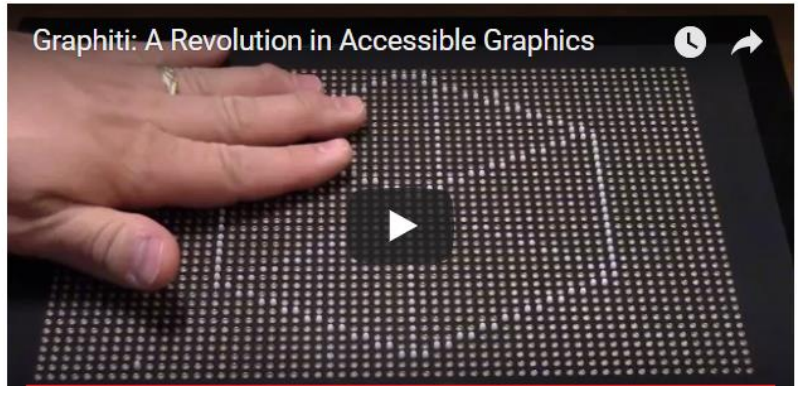
- Tactile Vision Graphics

  http://tactilevisiongraphics.com

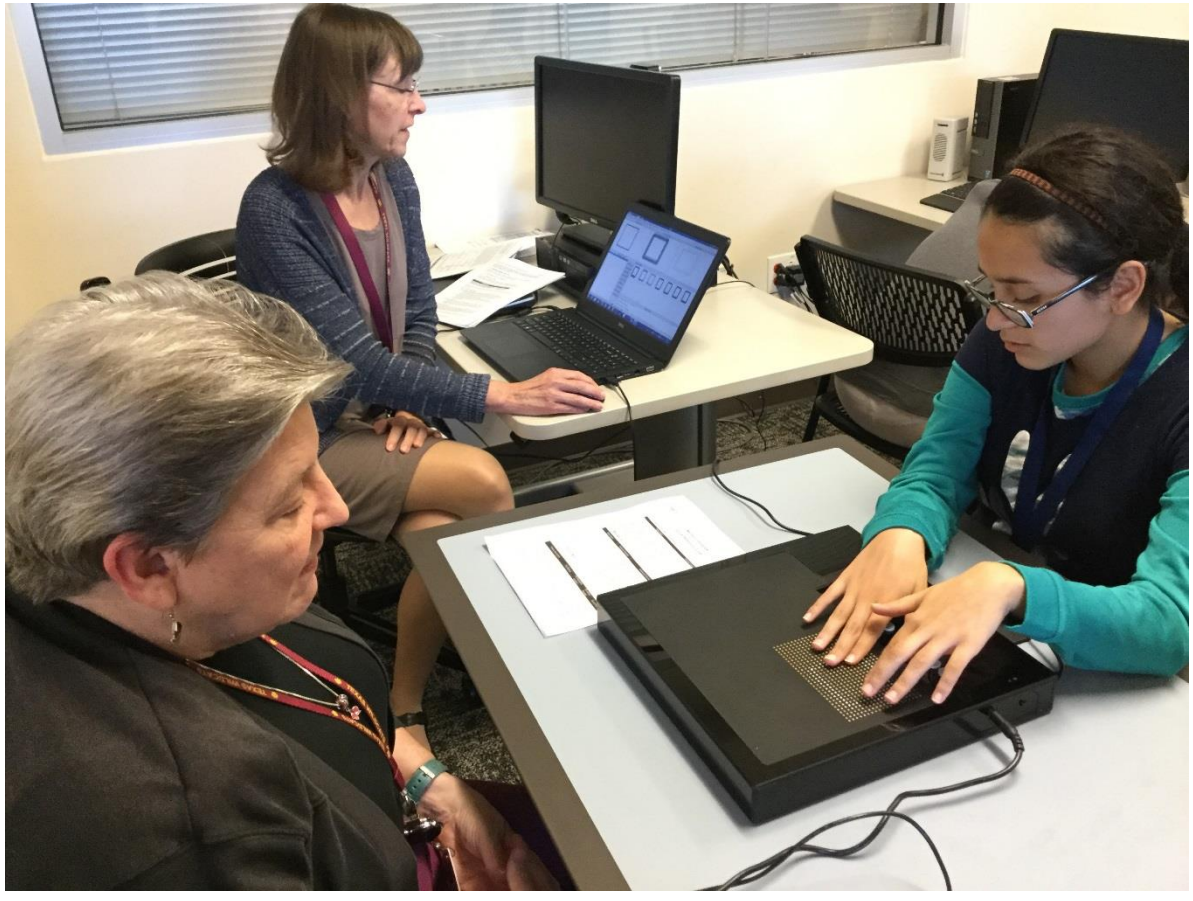


Graphiti www.aph.org

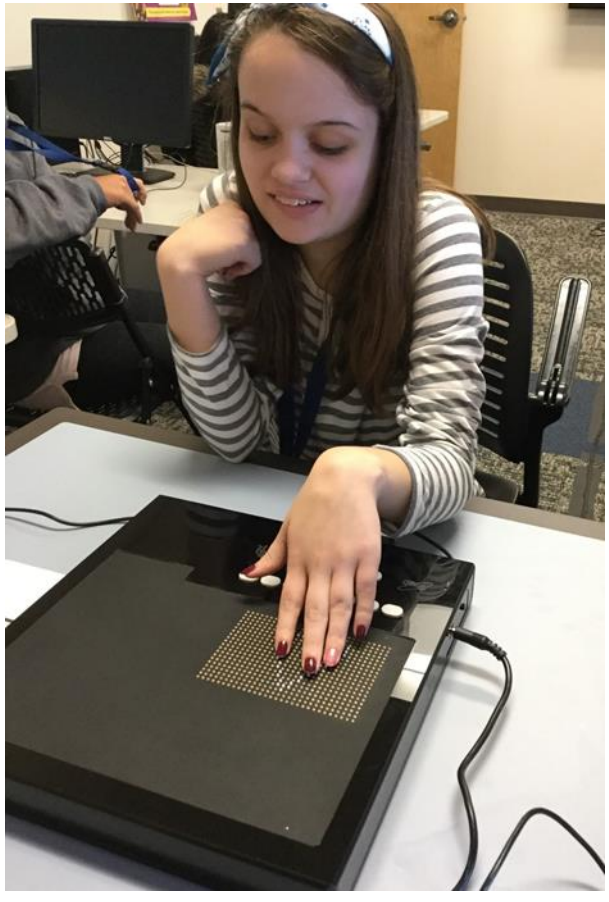
- **Graphiti is a dynamic multilevel tactile touch display** developed by Orbit Research and the American Printing House for the Blind. Graphiti allows students and adults to access a wide variety of on-screen graphics by touch.

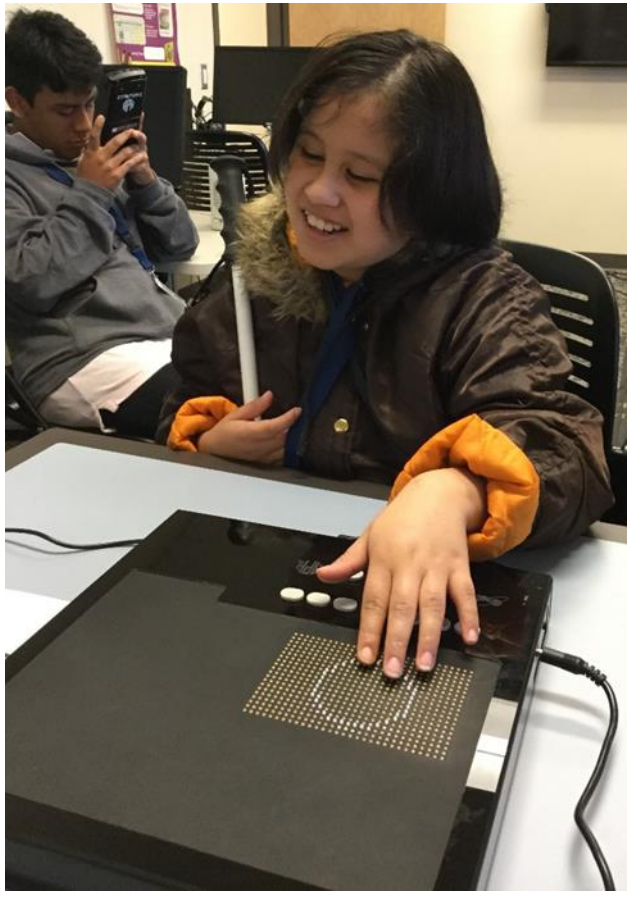


Graphiti – Short Term Programs' Math Tools Class - Guess the Shape

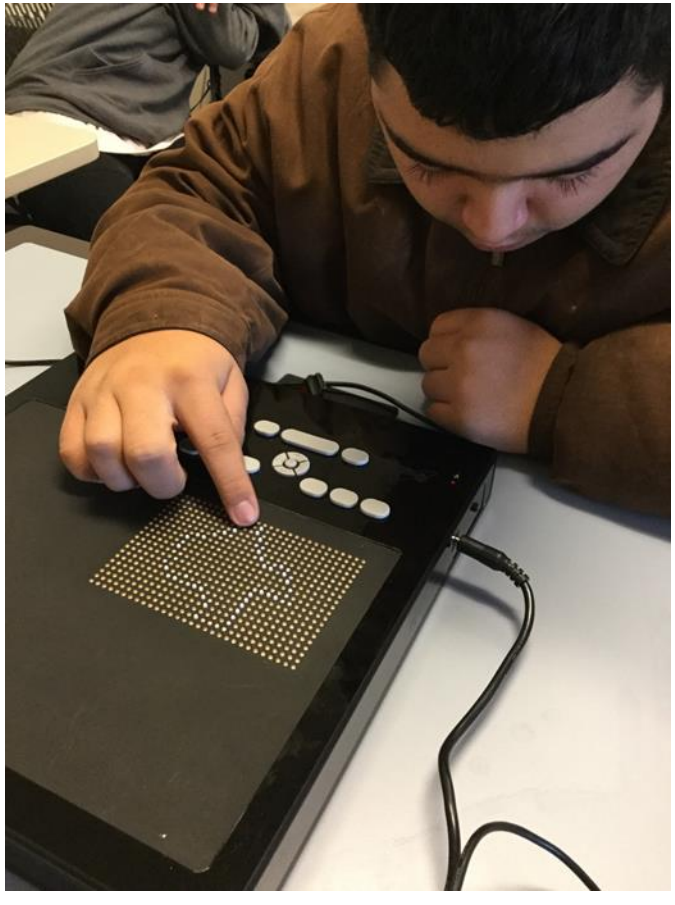


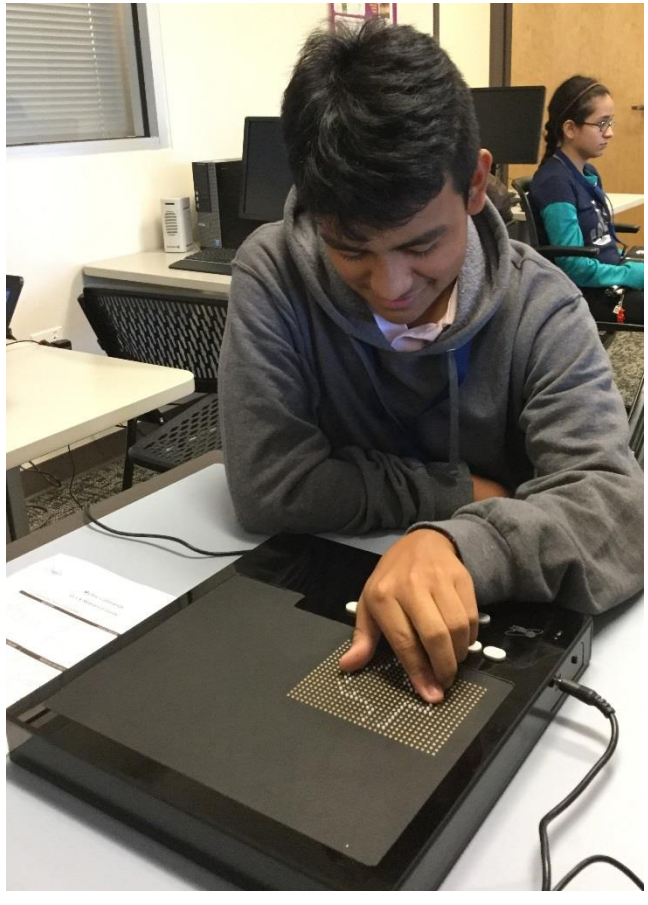
Graphiti – Triangle and Circle



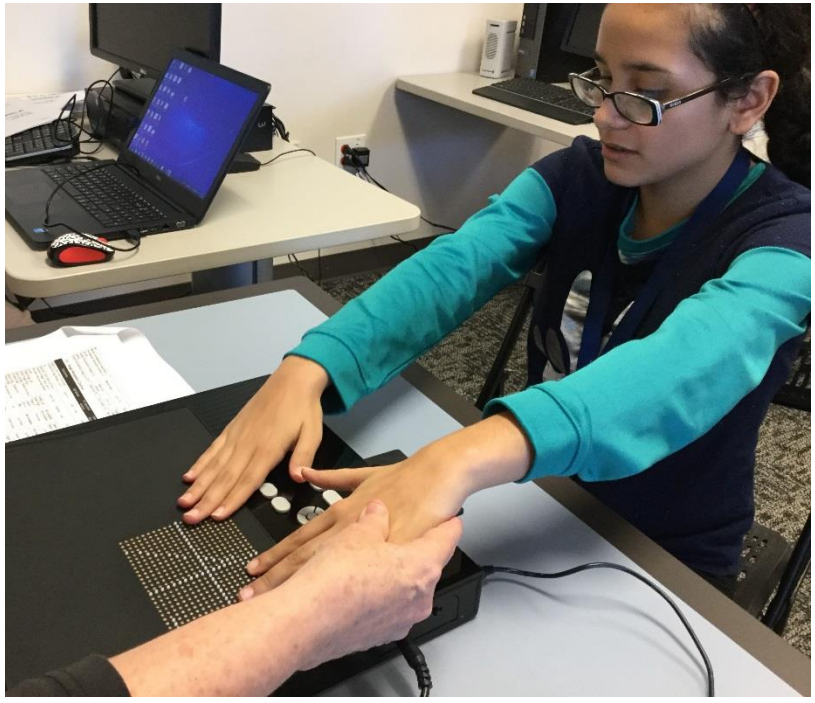


Graphiti – Is that Texas?

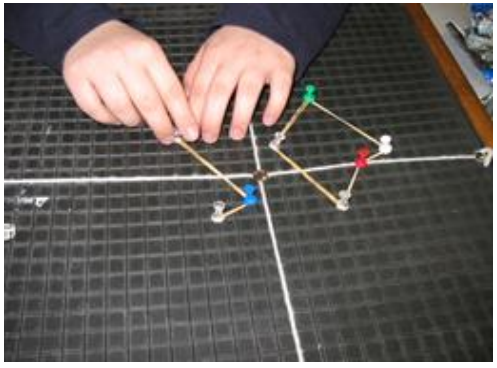


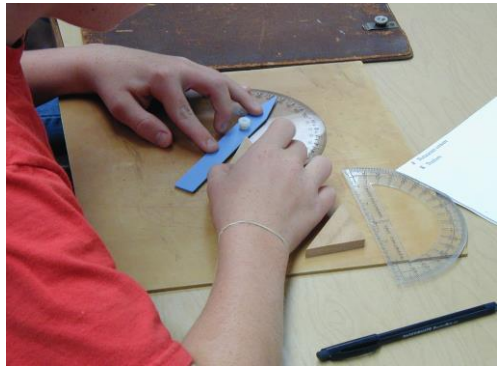


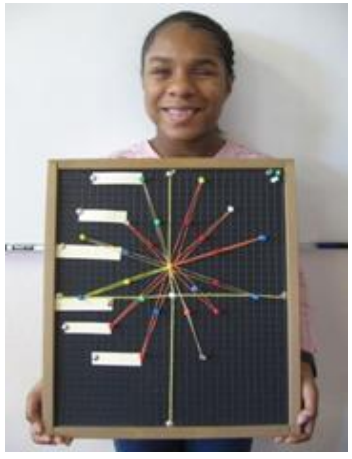
Graphiti with the Orion TI-84+ Talking Graphing Calculator

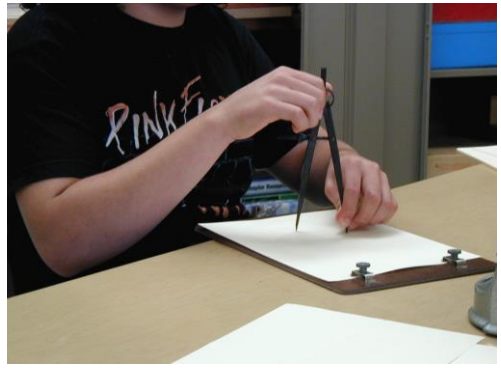


Accessible Math Tools and Technology





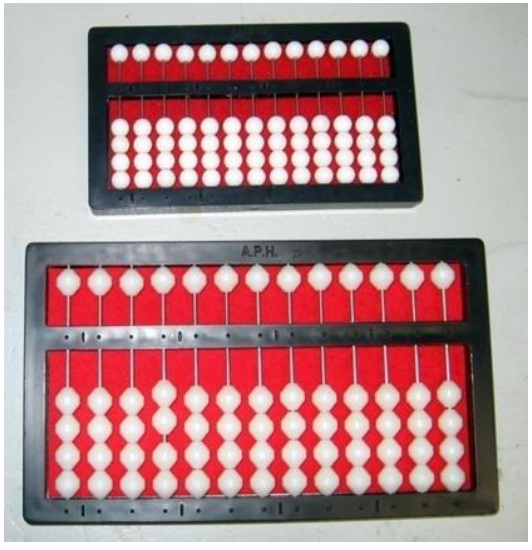




Number and Quantity

Abaci from APH www.aph.org

- Cranmer Abacus

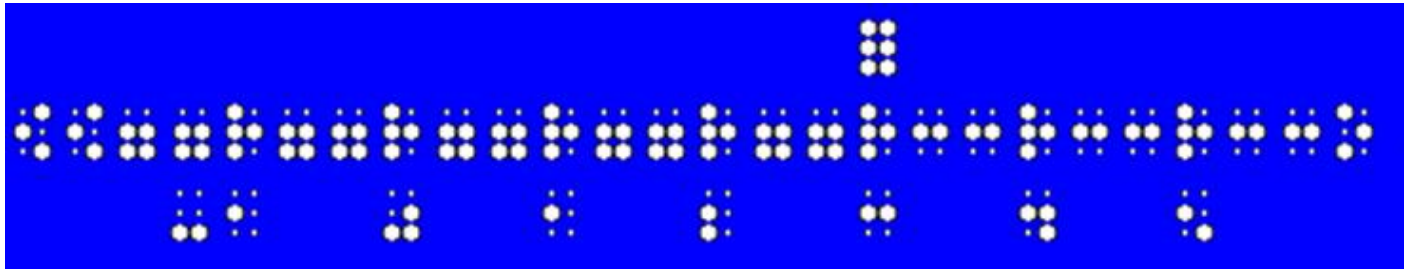


Student-Generated Graphics on a Number Line

- APH Number Line Device
- APH Consumable Number Lines

- Desktop Stick-On Number Lines

- Student-Made Number Lines



Publications and Videos

- Prime Factorization on the Abacus
  www.tsbvi.edu/videos-webinars/mathematics

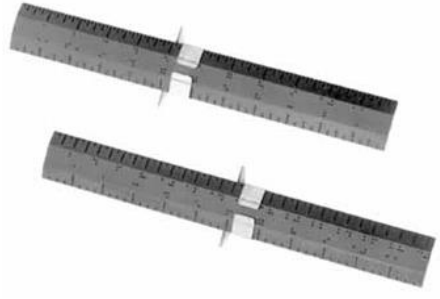
- Osterhaus, S.A. (2003). *Susan's Math Technology Corner: Standardized Braille Number Lines. Division on Visual Impairments Quarterly*, 48(2), 9-11
  www.tsbvi.edu/resources/2316-susans-math-technology-corner-standardized-braille-number-lines

Measurement

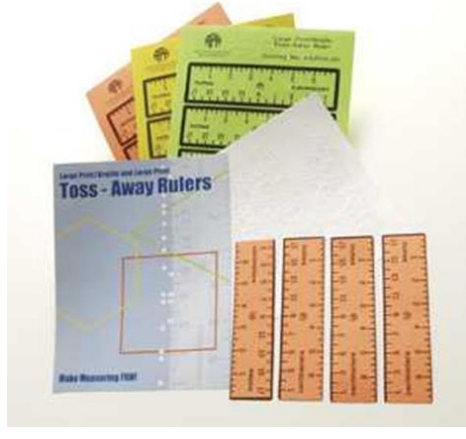
Linear and Angle Measurement

www.tsbvi.edu/tools/2181-math-tools#equipment

- Ruler



- Yardstick and Meter Stick
- Toss-Away Rulers
- Protractor

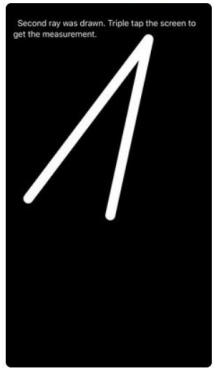


Draw2Measure Protractor App

http://www.aph.org/products/mobile-apps/

- Draw2Measure Protractor App for iOS® devices allows blind and visually impaired students to measure angles in two ways!

  First, students can place an angle over the screen of a device, such as a phone or tablet, and trace along the sides of the angle with a fingertip or stylus. The app records the locations of the sides and then calculates the angle.



Tactile Caliper – 1/16 inch precision

www.squirreldevices.com

www.youtube.com/watch?v=JOi8zTI9TwY

- The caliper is accurate to 1/16”. There are subtle audible cues when it is operating. The caliper is 12 inches long, the size of a standard ruler. The caliper's design allows for small objects to be inserted into the caliper’s opening. This eliminates some common problems for students including holding the ruler steady and lining up the ruler to begin measuring.

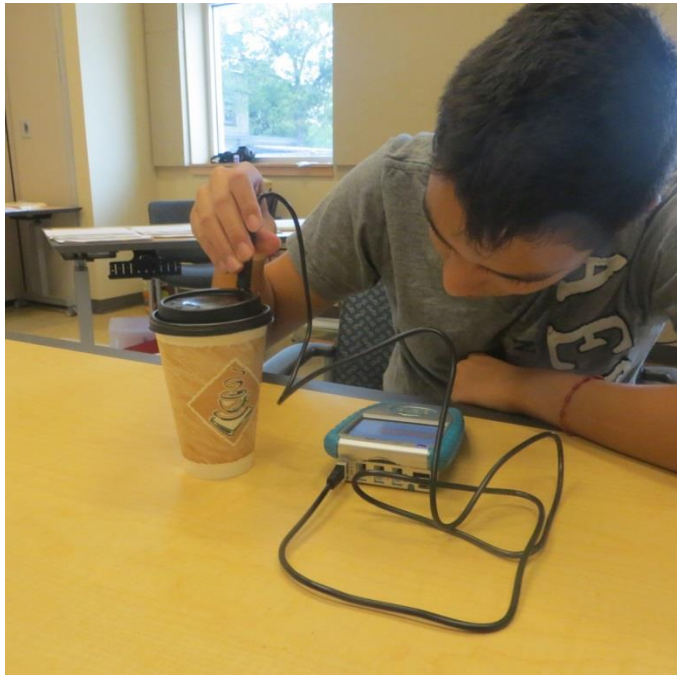
The caliper is available from the online store at National Braille Press.
www.nbp.org/ic/nbp/CALIPER.html

Tactile Caliper – 1 mm Precision

- This metric caliper is brand new and currently being field tested by APH.
- Should be available soon, along with the English measurement tactile caliper, from APH on federal quota funds.

Temperature

Tactile Demonstration Thermometer
www.aph.org



Talking Lab Quest
http://www.independencescience.com

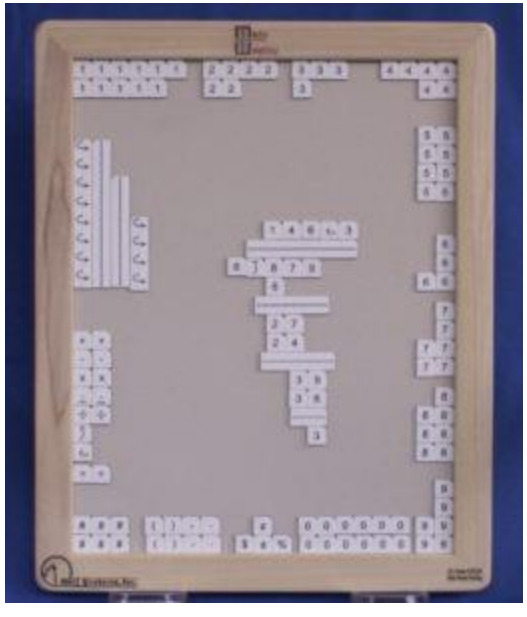
Measurement Resources

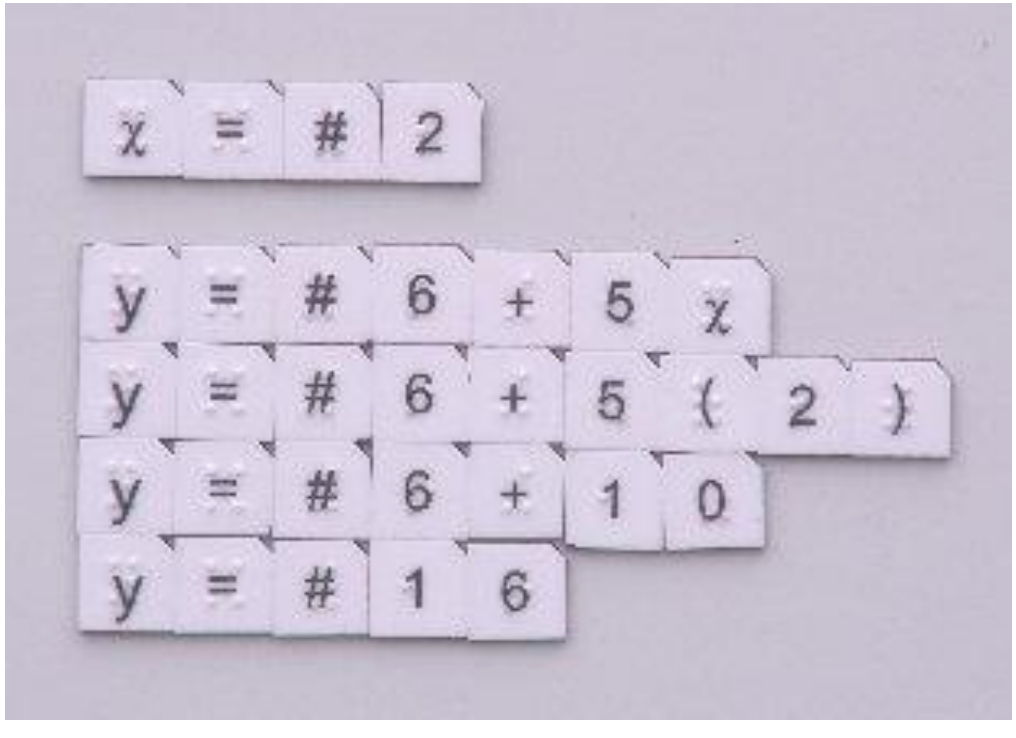
- Linear Measure, Perimeter, Area
  www.tsbvi.edu/resources-math/3237-teaching-strategies#Linear
- APH Braille/Print Protractor
  www.tsbvi.edu/videos-webinars/mathematics
- Perkins School for the Blind
  www.perkinselearning.org/accessible-science
- Independence Science
  www.independencescience.com

Algebra
and
Statistics and Probability

Math Window Algebra Add-On

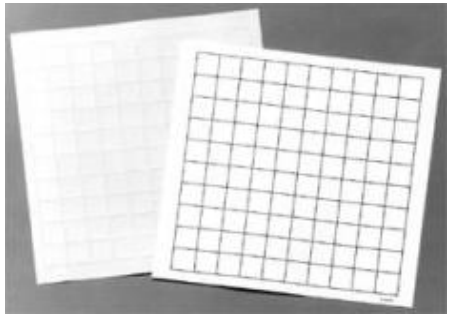
www.mathwindow.com

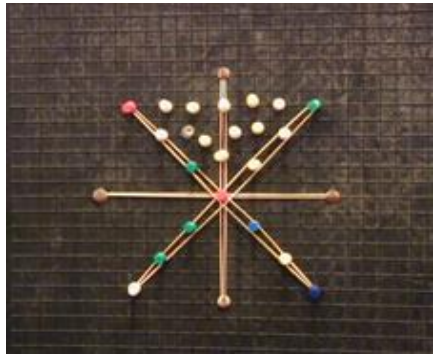




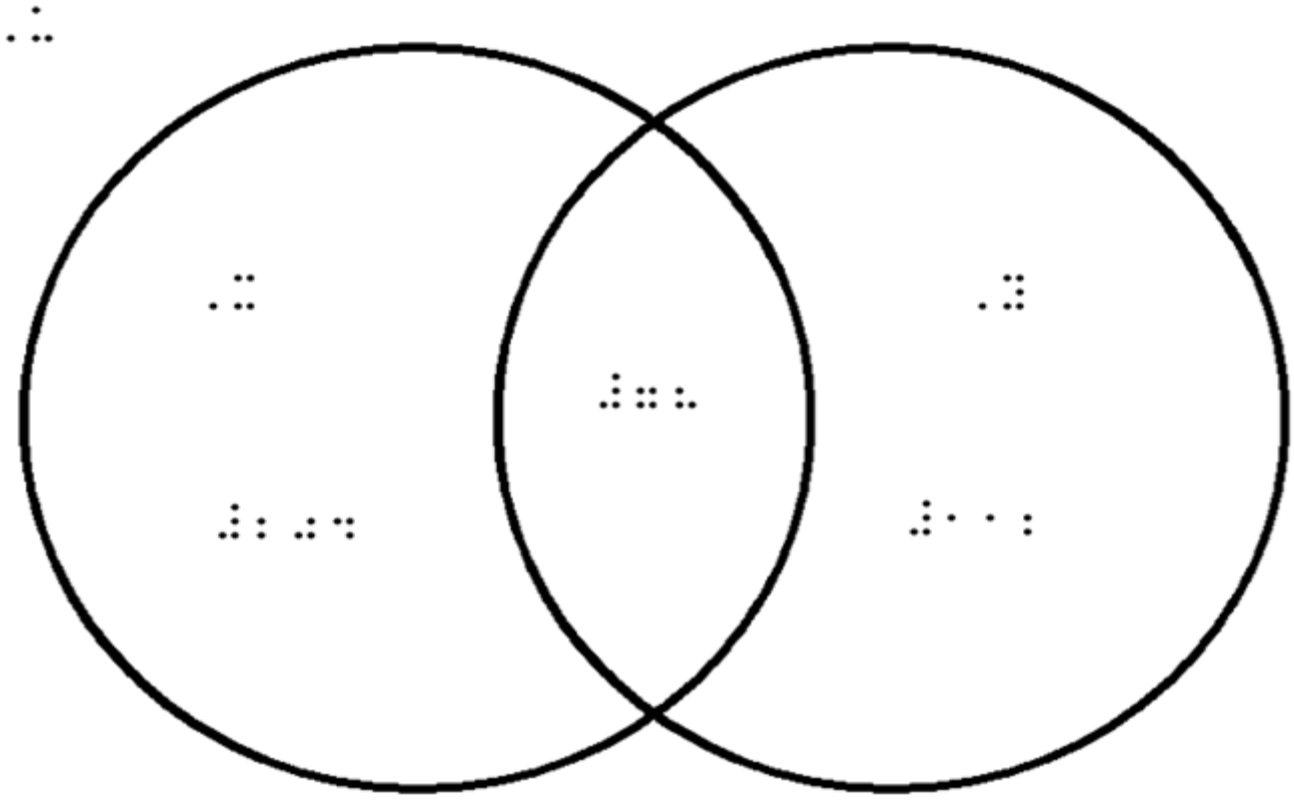
Student-Generated Graphics on a Coordinate Plane

- APH Graphic Aid for Mathematics
- Graph Paper



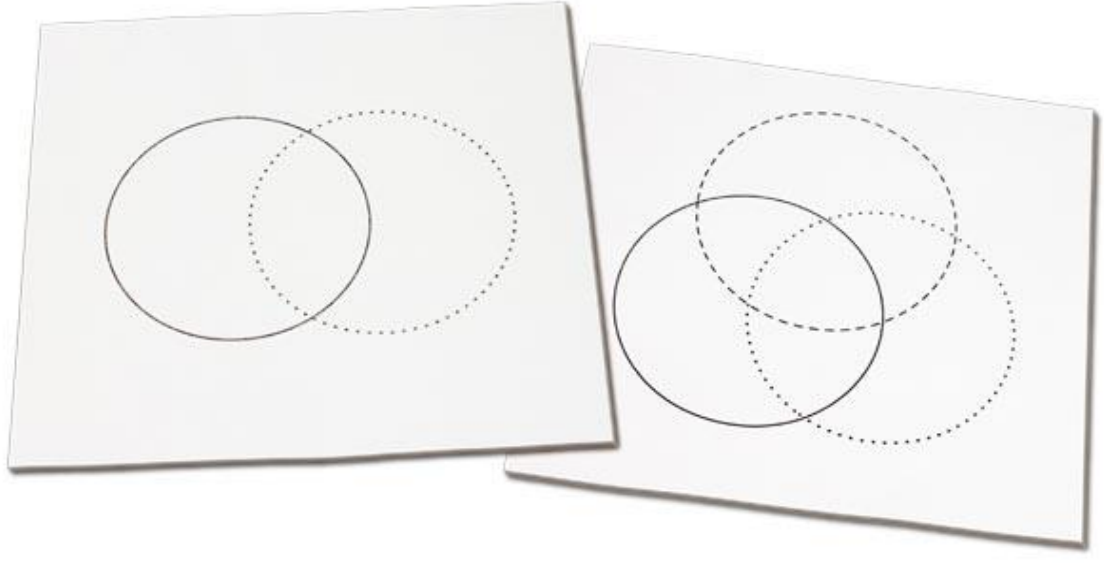


Student- or Teacher-Generated Venn Diagram



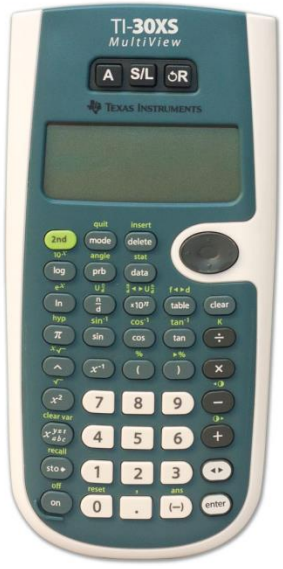
Venn Diagram Template Kit

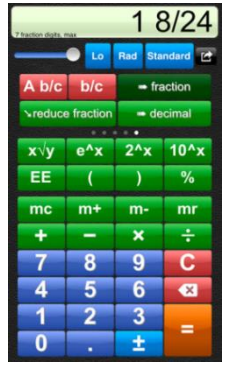
www.aph.org



Talking Scientific Calculators

- ORION TI-36X
  www.orbitresearch.com
- ORION TI-30XS
  www.aph.org (available on federal quota money)
- SciPlus-2300 Scientific Calculator with speech
  www.sightenhancement.com
- Talking Scientific Calculator
  By Adam Croser
  https://itunes.apple.com/us/app/talking-scientific-calculator/id411433609?mt=8





Notetaker Scientific Calculators

PAC Mate (BX or QX)

- Talking Scientific Calculator with refreshable braille
- www.freedomscientific.com/

BrailleNote Apex (BT or QT)

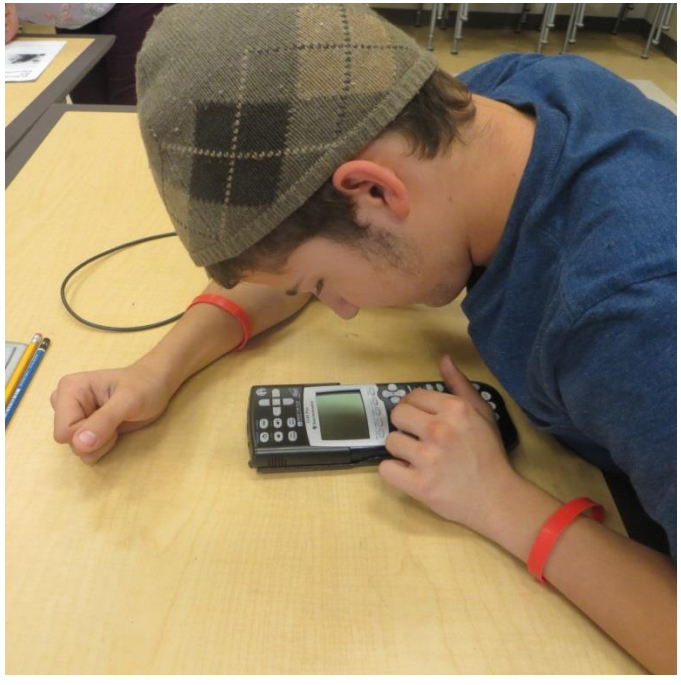
- Talking Scientific Calculator with refreshable braille
- www.humanware.com

Braille Sense U2 or QWERTY

- Talking Scientific Calculator with refreshable braille
- http://hims-inc.com

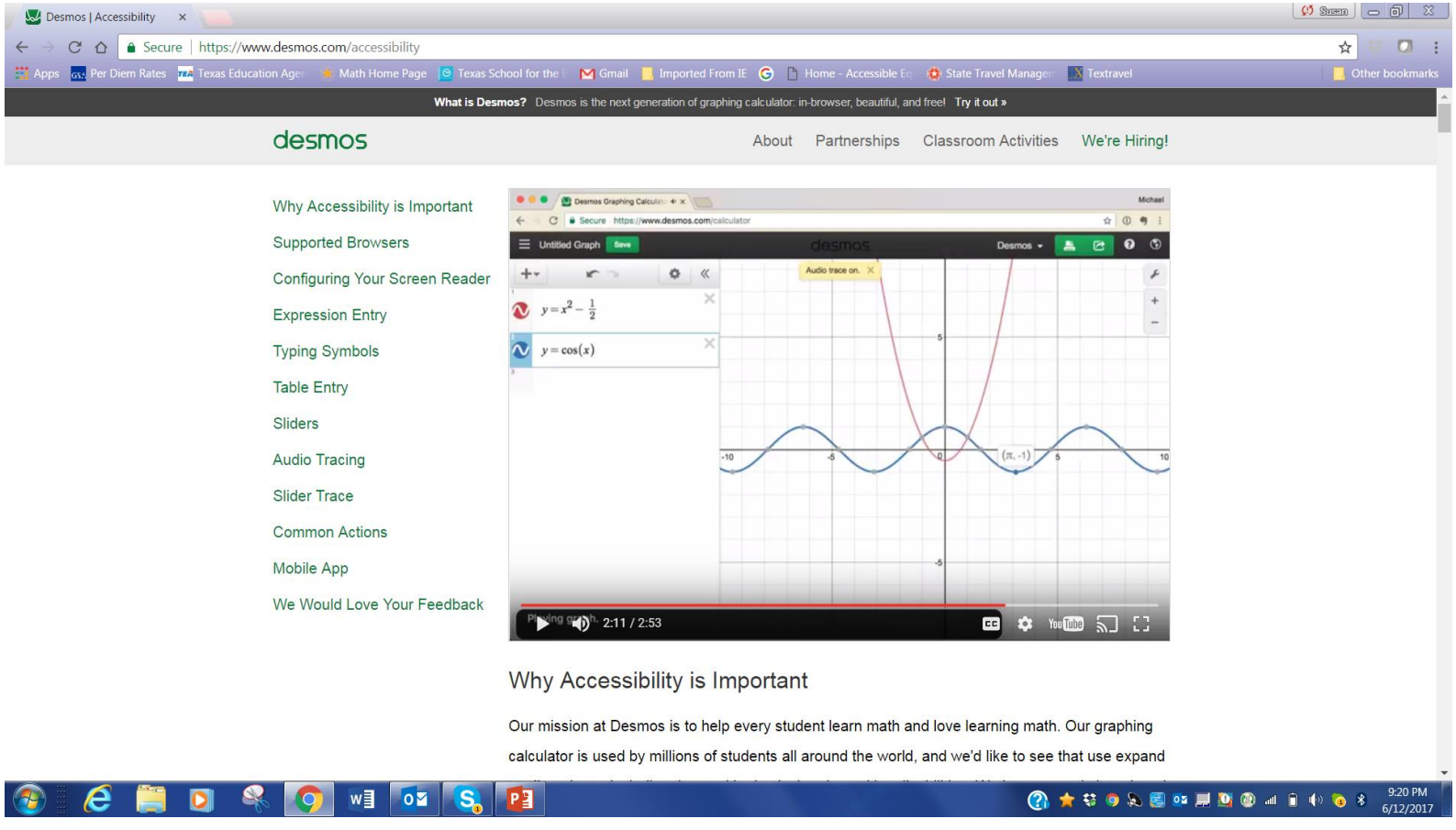
ORION TI-84+ Talking Graphing Calculator

- Now available from APH www.aph.org/



DESMOS

www.desmos.com/accessibility

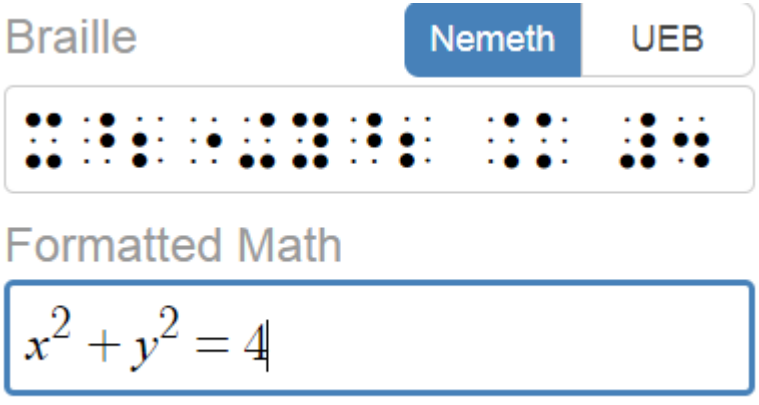


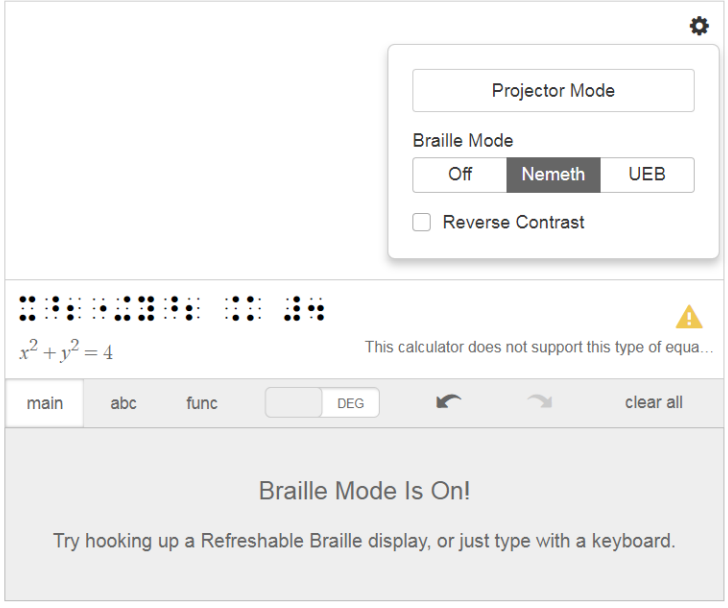
DESMOS

https://www.desmos.com/accessibility

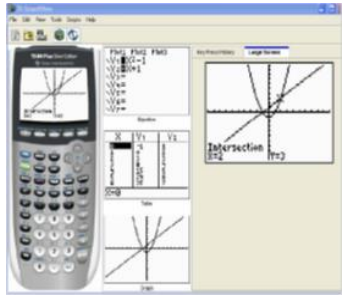
https://www.desmos.com/braille-demo/index.html

https://www.desmos.com/scientific?braille





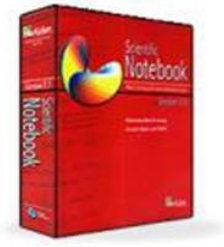
Large Display Scientific/ Graphing Calculator Solutions



- TI-Smart View 2.0
  The Emulator Software Package for the TI-84+
  http://education.ti.com/educationportal/

- TI-NSpire (or TI-NSpire CAS+)
  http://education.ti.com/en/us/nspire-family/cx-handheldsl

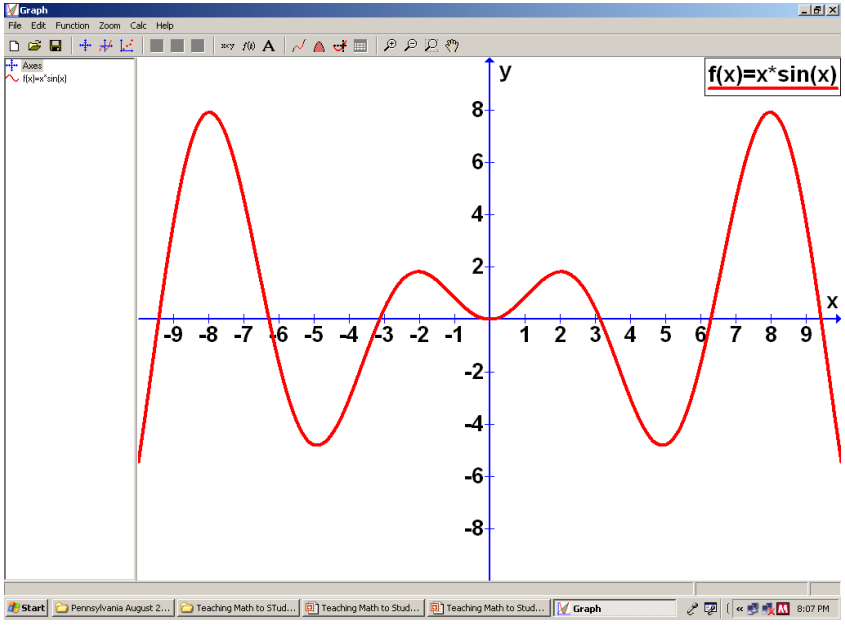
- SciPlus-2200 Scientific Calculator
  www.sightenhancement.com/

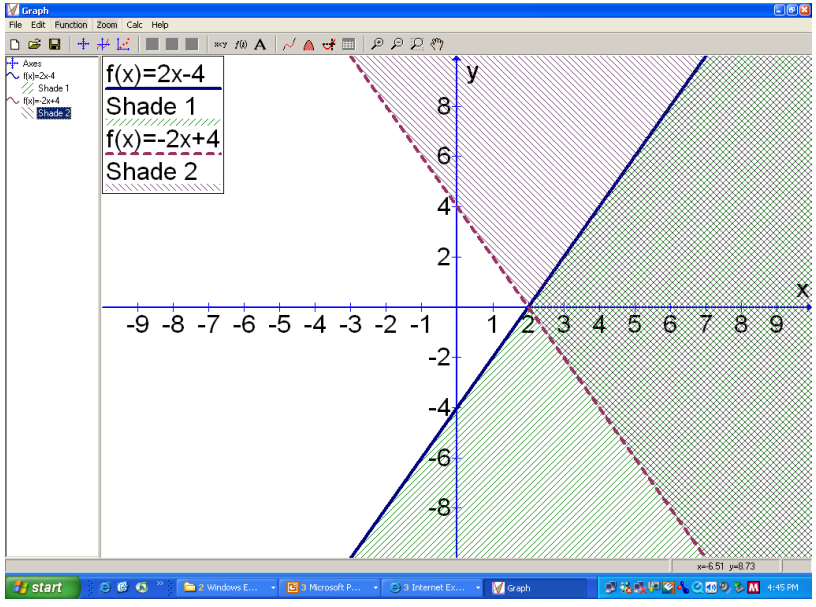


- Scientific Notebook
  www.mackichan.com

Large Print Graphs by *Graph*

www.padowan.dk





Large Display Graphing Calculator Solutions on a Tablet

- Desmos Graphing Calculator (available for iPad and Android)

- Free Graphing Calculator by William Jockusch (available for iPad and Android)

Publications and Videos (Algebra)

- Osterhaus, S.A. (2002). Susan's Math Technology Corner: Teaching A Blind Student How to Graph on a Coordinate Plane: No Tech, Low Tech, and High Tech Tools. *Division on Visual Impairments Quarterly, 47*(3), 23-26

  www.tsbvi.edu/index.php?option=com_content&view=article&id=3619:coordinate-plane&catid=54

  www.tsbvi.edu/videos-webinars/mathematics

- Solving Quadratic Equations Graphically, by Factoring, and by Using the Quadratic Formula

  www.tsbvi.edu/resources-math/3237-teaching-strategies#Quadratic

Videos

www.tsbvi.edu/videos-webinars/mathematics

- Orion TI-36X Talking Scientific Calculator
- Orion TI-84 Tutorials
  - Graphing Simple Functions and Gathering Information
  - Plotting Points and the Line of Best Fit
  - Working with Matrices
- Using the Orion TI-84 Plus in the Classroom

Geometry

Hands-on System for Learning Three-Dimensional Geometry www.geometro.net

Geometro Sets Now Available from APH

www.aph.org

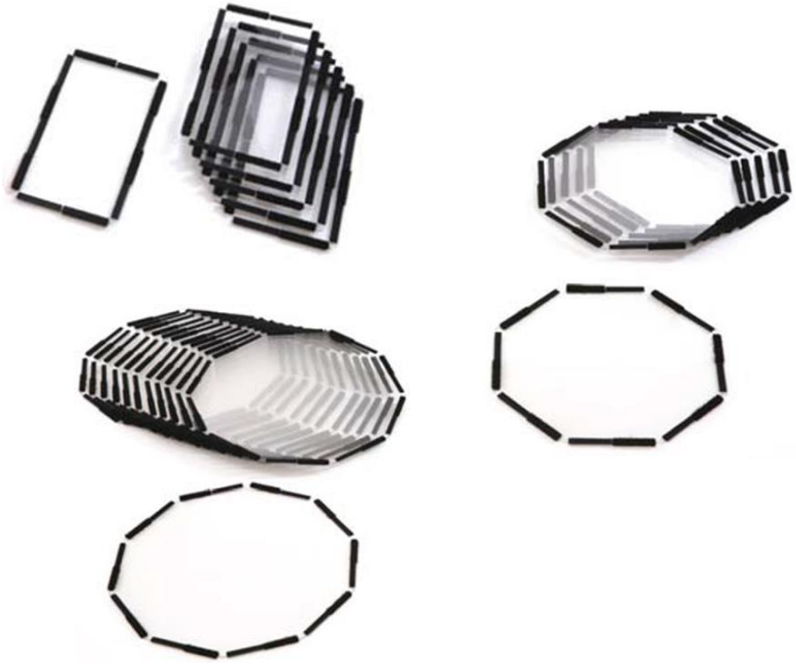
Mini

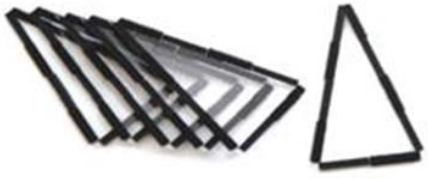
Medium

Large

More Geometro Shapes

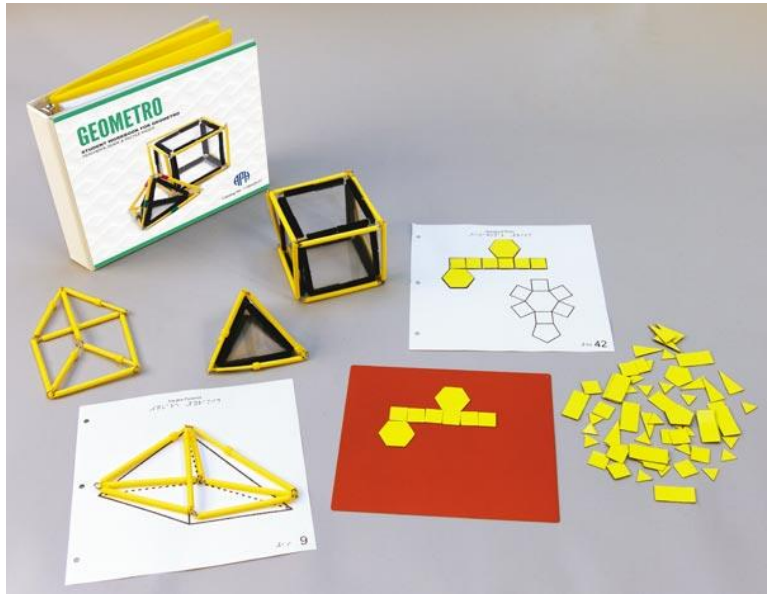
- Rectangles
- Octagons
- Decagons
- Isoceles Triangles
- Hook Material Rods





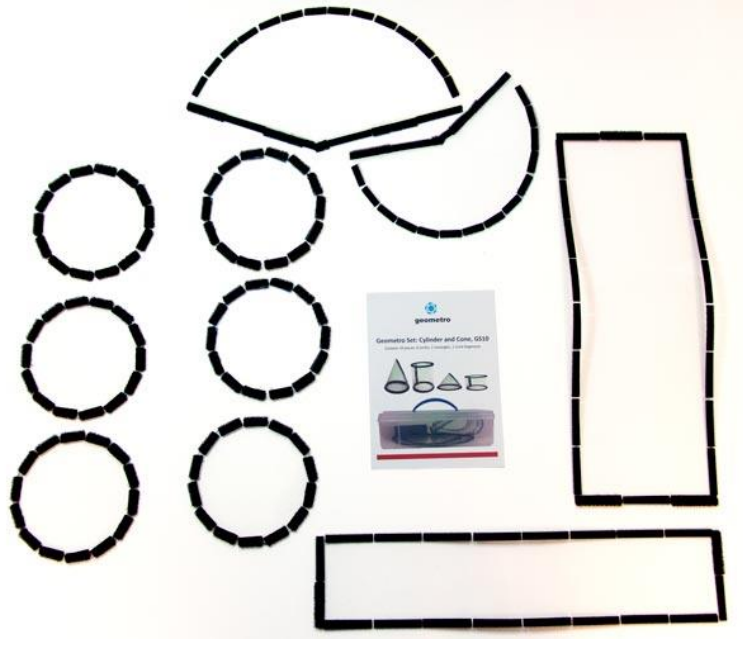
Geometro: Student Workbook Kit

- Familiarize students with various 3-D solids and their general properties
- Help students grasp the difficult concepts of how 3-D solids relate to their 2-D representations
- Help students understand how 3-D objects are made with 2-D objects



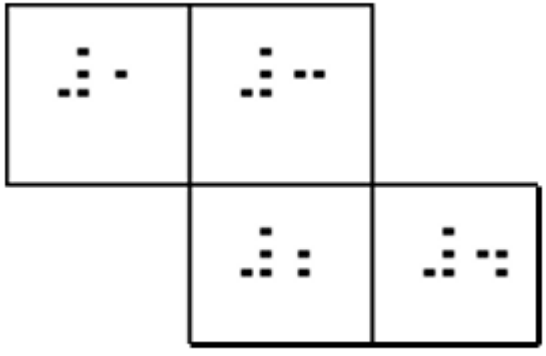
Geometro GS10 Cylinder and Cone

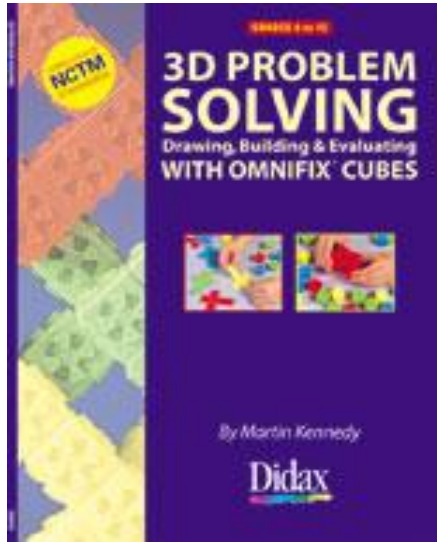
- Provides students with flat plastic shapes (six circles, two rectangles, and two circle sectors) that can be readily joined to form two cylinders and two cones. Each have the same base, but different heights.



Omnifix Cubes

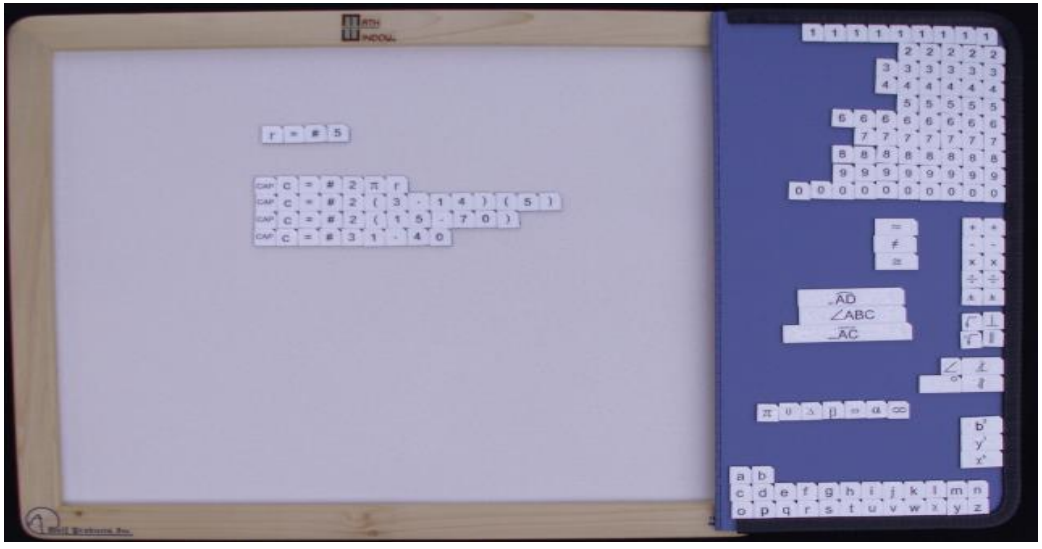
www.didax.com

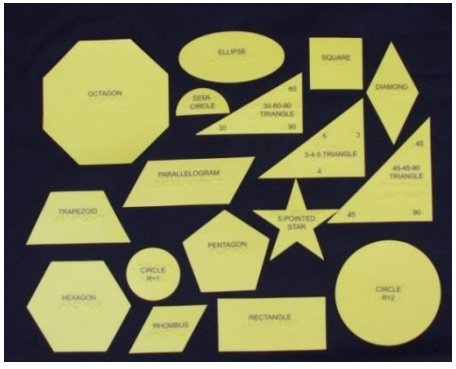


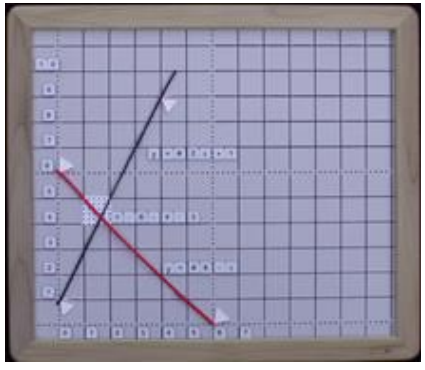


Math Window Geometry Kit

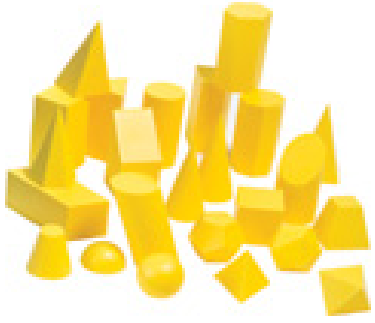
www.mathwindow.com







Geometric Manipulatives



- Didax Plastic Geometric Models 25 shapes
- Discovery Toys Playful Patterns Design
- Didax 4 Geometric Templates

Drawing/Construction Tools

- Drawing Board
- Compass

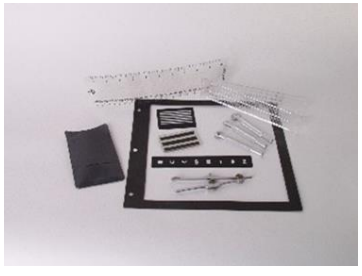
www.maxiaids.com

www.fiskars.com

www.APH.org

www.staedtler.us/en/

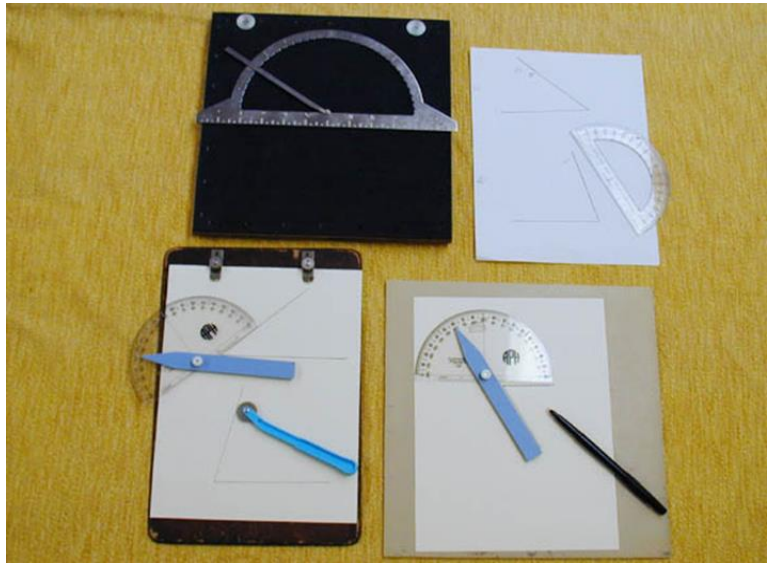
www.easytactilegraphics.com/



Drawing/Construction Tools (cont.)

- Protractor
- Straightedge
- Tracing Wheel
- Stylus and/or Pen
- Drawing Board

www.APH.org/



Publications and Videos (Geometry)

- Geometric Constructions

  www.tsbvi.edu/resources-math/3237-teaching-strategies#Geometric

  www.tsbvi.edu/videos-webinars/mathematics
- Transformations, Line Symmetry, and Tessellations

  www.tsbvi.edu/resources-math/3237-teaching strategies#Transformations
- APH Braille/Print Protractor

  www.tsbvi.edu/videos-webinars/mathematics

Other Math Resources

- Delta **www.delta-education.com**
- Didax **www.didax.com**
- ETA Hand2Mind **www.hand2mind.com**
- Math Forum **www.mathforum.org**
- Nasco **www.enasco.com/math**
- Online Math Tutorial Videos
  www.tsbvi.edu/videos-webinars/mathematics

Thank you for your kind attention.

Now, it’s time for questions…