Tools and Best Practices for Helping Blind Elementary School Students Succeed in Mathematics

Sponsored by:

National Organization of Parents of Blind Children Division (NOPBC)

NFB Convention
ORLANDO, FLORIDA
July 3, 2018

Presented by
Susan A. Osterhaus

Texas School for the Blind and Visually Impaired

Outreach Programs

1100 West 45th Street

Austin, TX 78756 U.S.A.

susanosterhaus@tsbvi.edu

www.tsbvi.edu/math

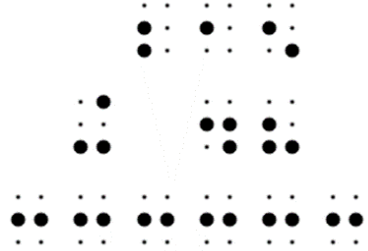
www.tsbvi.edu/videos-webinars/mathematics

Agenda

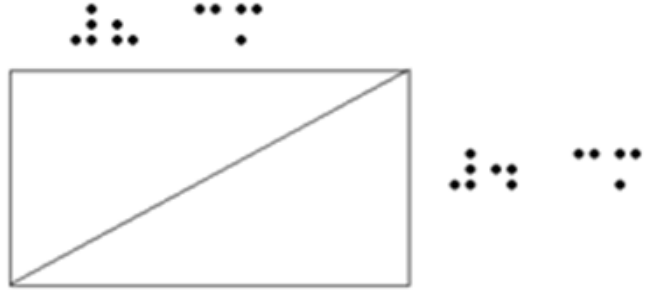
- Math Materials (Including Graphics)
  - Braille Reader
  - Low Vision Student
- Accessible Math Tools and Technology
  - Number and Quantity
  - Measurement
  - Algebra and Statistics and Probability
  - Geometry

Math Materials
Braille Reader

- High Quality Braille Textbooks & Assessments (Including Released Tests)
  - Nemeth Code
  - Tactile Graphics



- Teacher-Made Materials
  - Worksheets
  - Quizzes
  - Tests



What's New with Learning Nemeth!

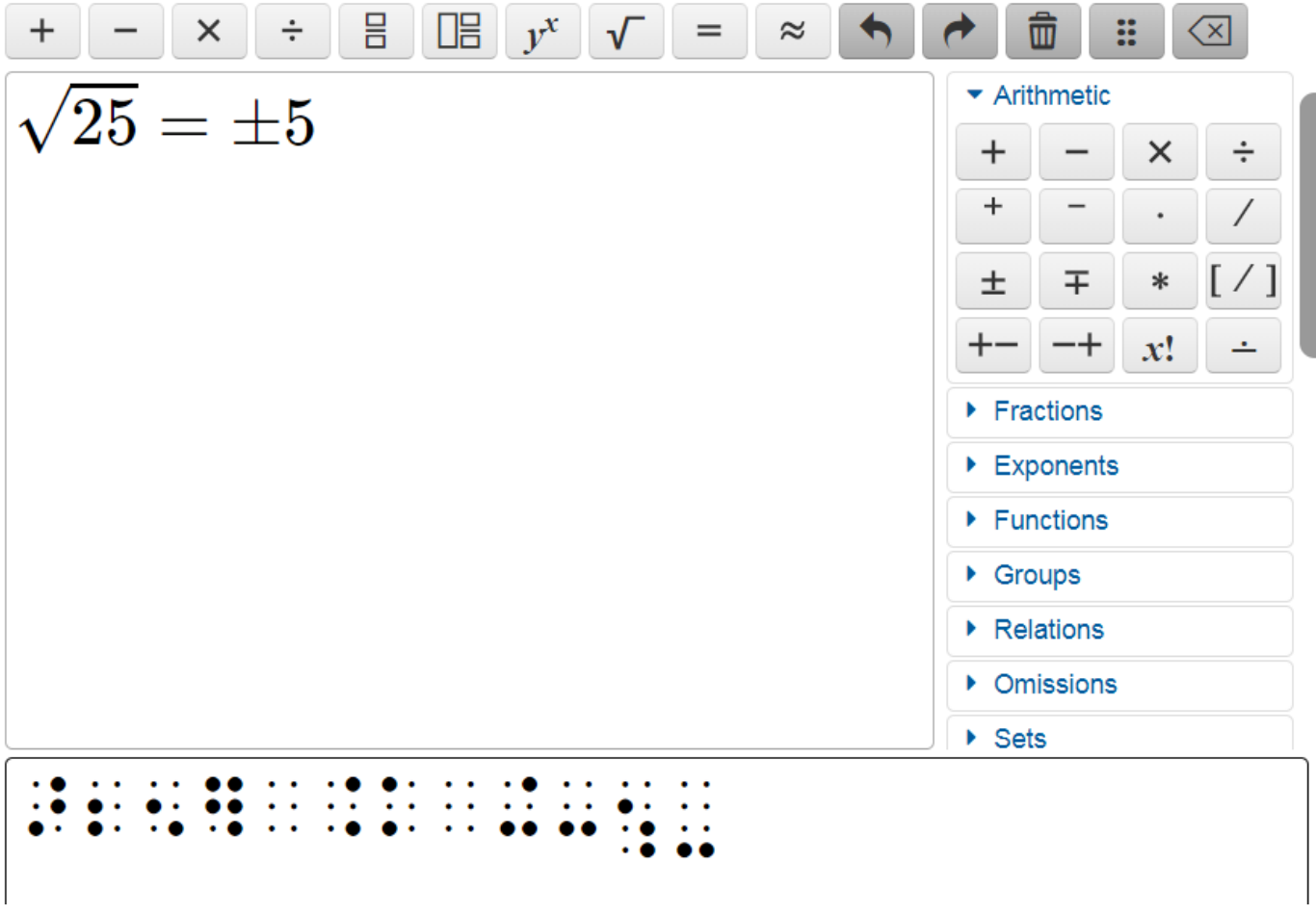
- *Guidance for Transcription Using the Nemeth Code within UEB Contexts,* Approved June 2016 (Revised 2018)

  www.brailleauthority.org/mathscience/math-science.html
- *Nemeth at a Glance: A Math Resource, Grade Level Chart, and Evaluation Tool*

  http://www.tsbvi.edu/store/ecom/index.php?action=ecom.pdetails&mode=nemeth
- Nemeth Braille Code Curriculum: http://accessibility.pearson.com/nemeth/

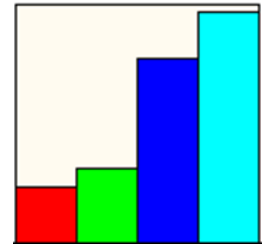
Accessible Equation Editor

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/phoenix.php

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

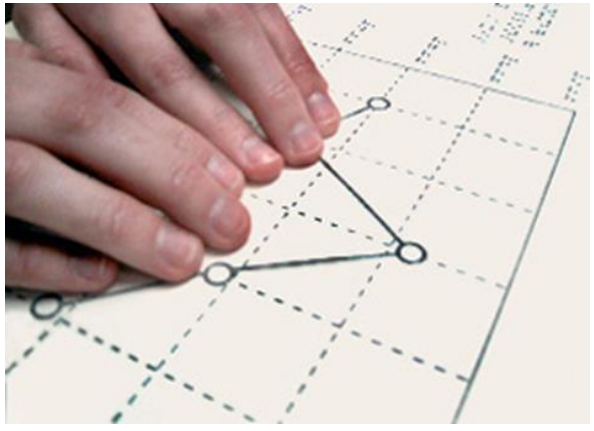
- Imagine the ability to scan your pictures, graphs and charts into your computer and with a few clicks of the mouse, emboss those images in high definition tactile graphics without compromising the quality of your Braille text.

Math Graphics
Made to Order by Others

- gh, LLC

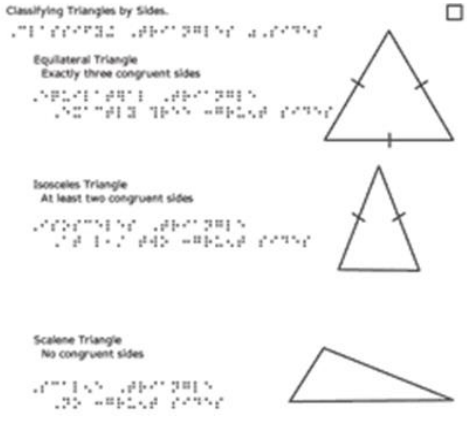
  LaserLine™ Graphics

  www.gh-accessibility.com



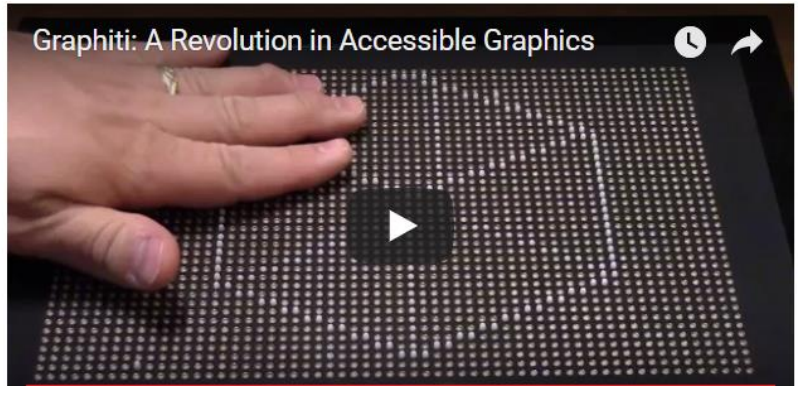
- Tactile Vision Graphics

  http://tactilevisiongraphics.com

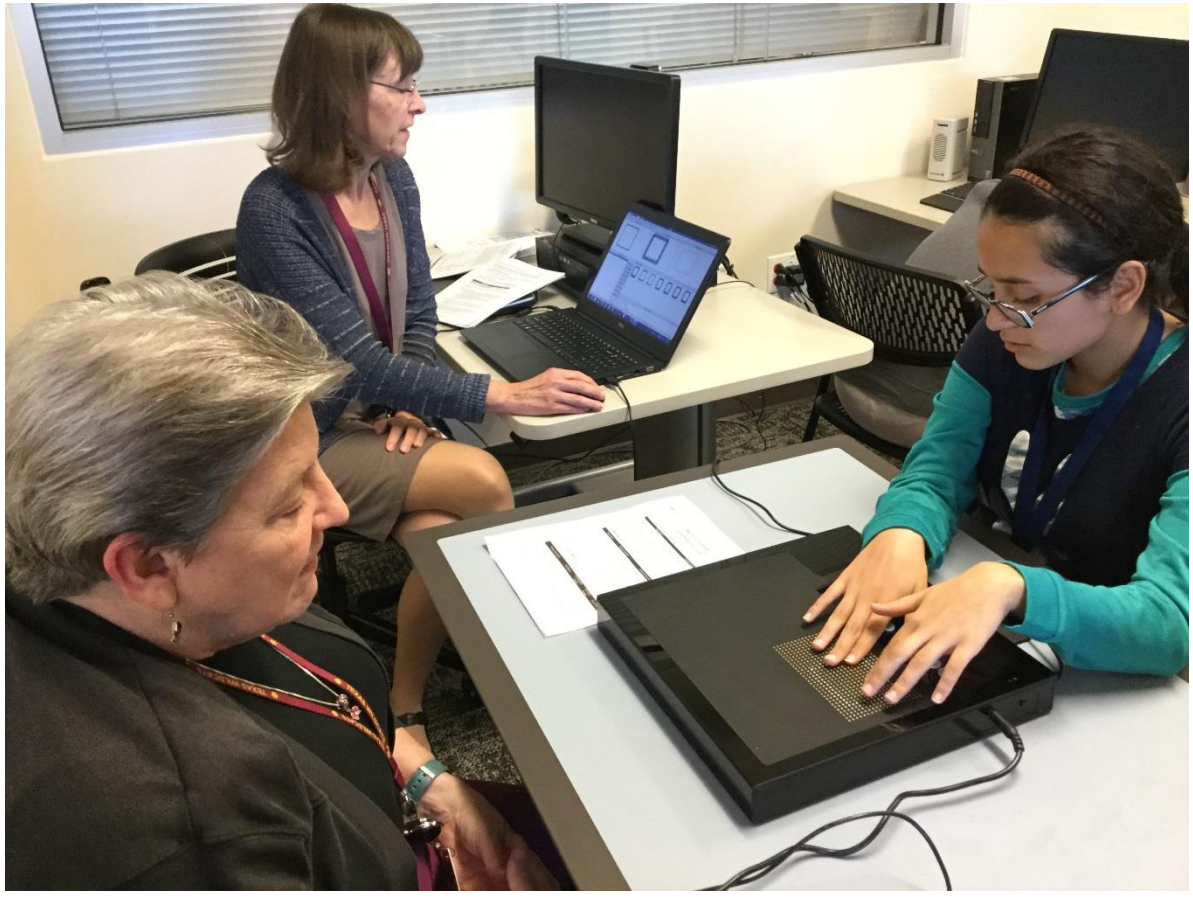


Graphiti www.aph.org

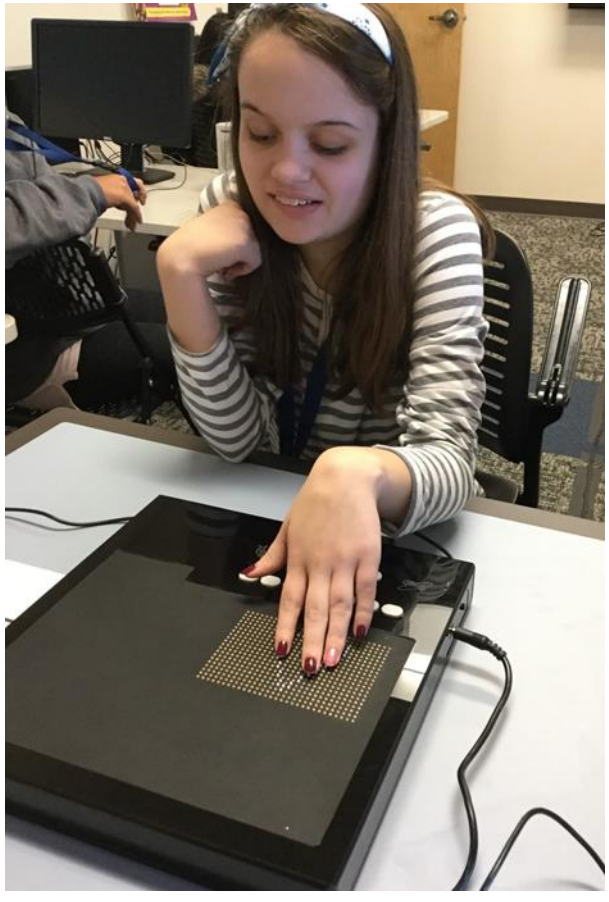
- **Graphiti is a dynamic multilevel tactile touch display** developed by Orbit Research and the American Printing House for the Blind. Graphiti allows students and adults to access a wide variety of on-screen graphics by touch.

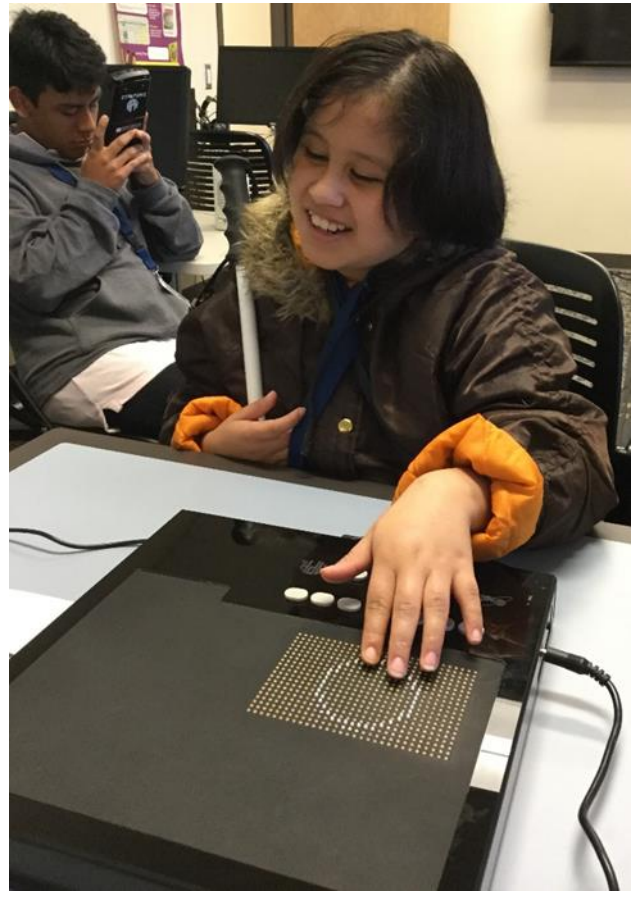


Graphiti – Short Term Programs' Math Tools Class - Guess the Shape

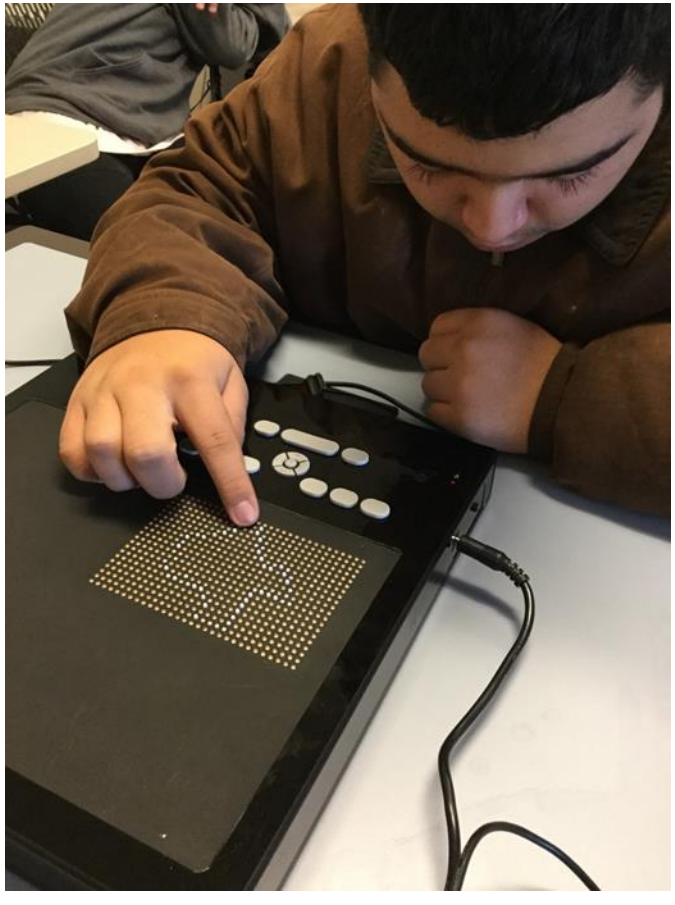


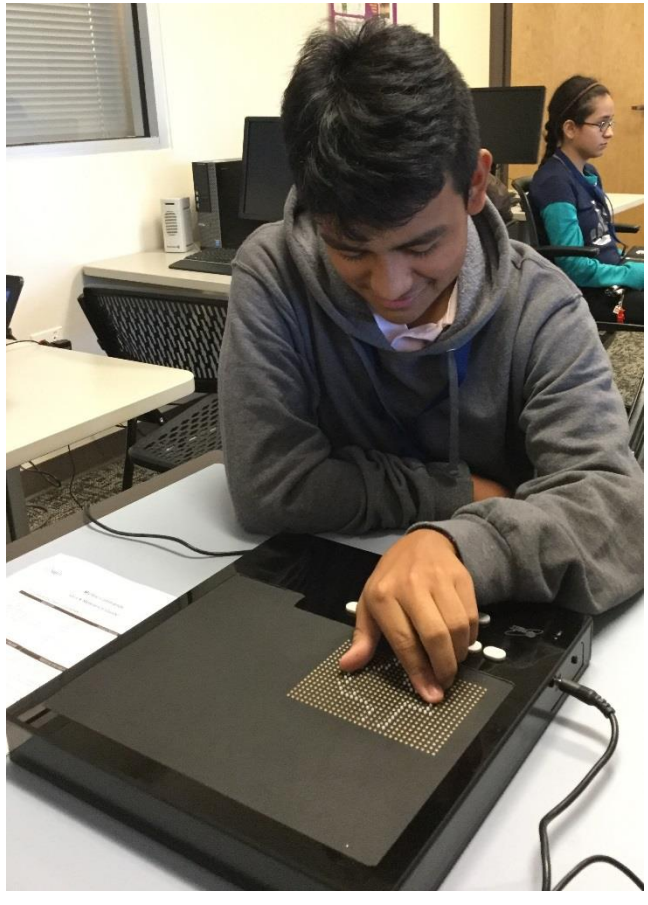
Graphiti – Triangle and Circle





Graphiti – Is that Texas?





Thoughts on Visual vs Tactual Perception

1. **Visual impairment is not an isolated condition; it affects the whole process of information-gathering.**

2. **Vision enables a person to simultaneously perceive all parts of an object in its totality and in its relationship to other objects.**

3. **The learner who is visually impaired has to rely on sequential observations (only part of an object can be seen or felt at a time), and the entire image has to be "built-up" out of the components. Relationships with other objects can be lost entirely.**

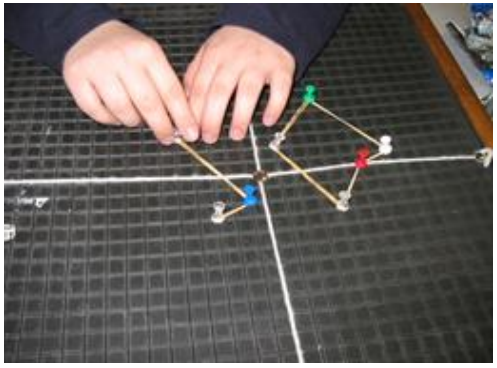
4. **The level of cognition needed for integration of sequential information is higher than that needed for concept formation through immediate visual perception.**

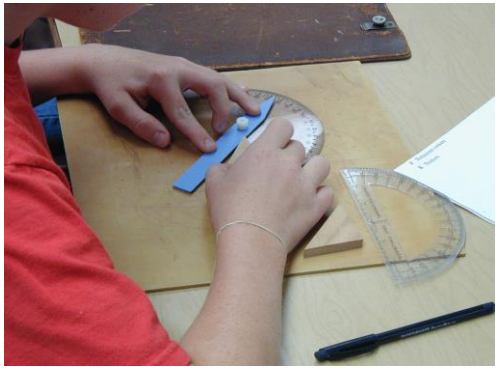
5. **If you have vision, you can experience this way of processing information by looking at a drawing through a very small hole in a piece of card held over the drawing; I think that you will find that it's hard for you to "get the picture."**

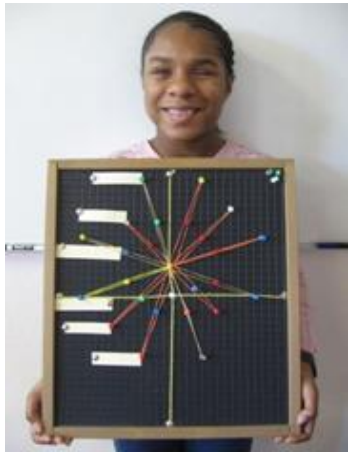
Teaching Students How to Read Tactile Math Graphs

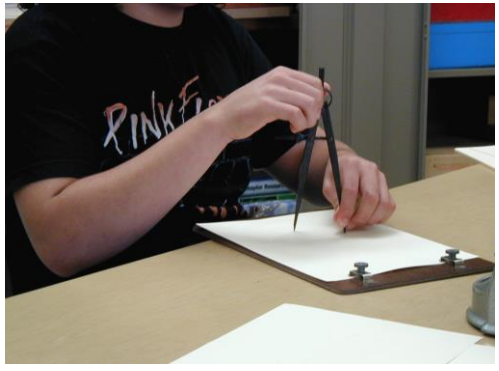
- Begin at an early age
- Start with real objects
- Move to 3-D models
- Then to 2-D manipulatives
- Finally try tactile graphics on various surfaces
  - Hard plastic
  - Thermoformed Brailon of foil or collage
  - Capsule/Swell/Flexi-Paper
  - Braille Paper
- Use the APH Tangible Graphs Kit to evaluate and/or re-teach if necessary.

Accessible Math Tools and Technology





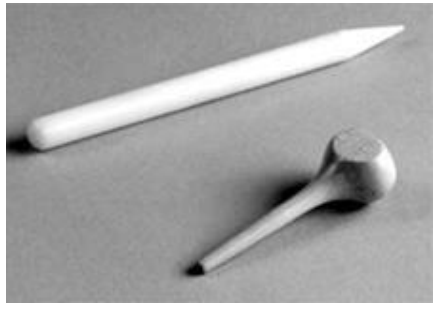




Basic Math Tools
Braille Reader

- Braillewriter
- Braille Paper

- Braille Eraser



Basic Math Tools
Large Print Reader

- Appropriate Paper
  - Bold line paper
  - Unlined paper
- Proper Writing Implement
  - Sharpie

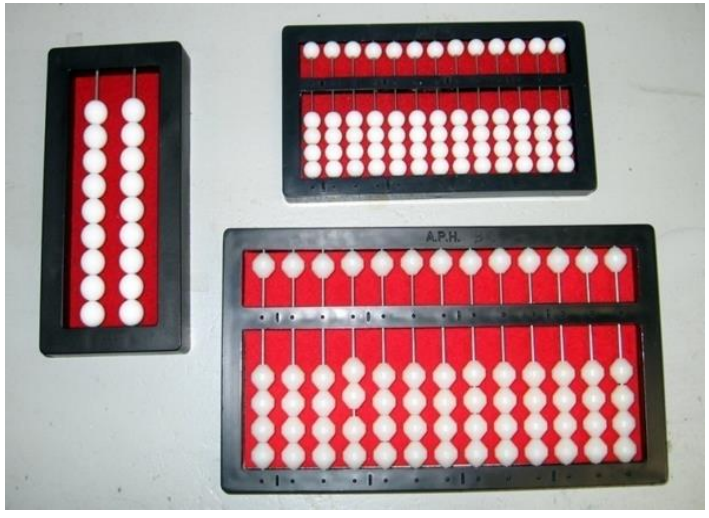
  - 20/20
  - Flair

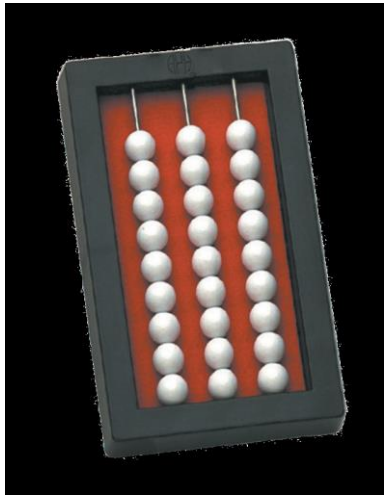
  - Staedtler Mars Technico Mechanical Pencil

Number and Quantity

Abaci from APH www.aph.org

- Cranmer Abacus
- Beginner's Abacus Kit
- Expanded Beginner's Abacus Kit





Manipulatives to Enhance Number System Concepts

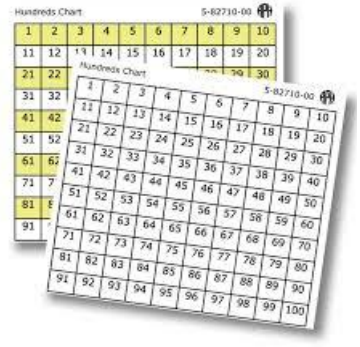
Digi-Blocks www.digiblock.com/

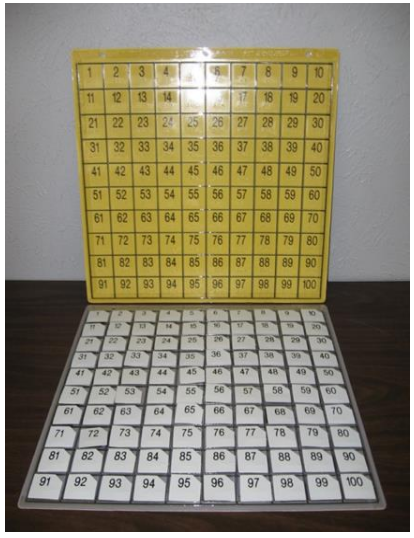
APH Tools to Enhance Number System Concepts

- Braille & LP

  "Numbers to 100" Charts

  www.aph.org





APH Tool to Help Increase Basic Math Skills

- Quick Pick: Math

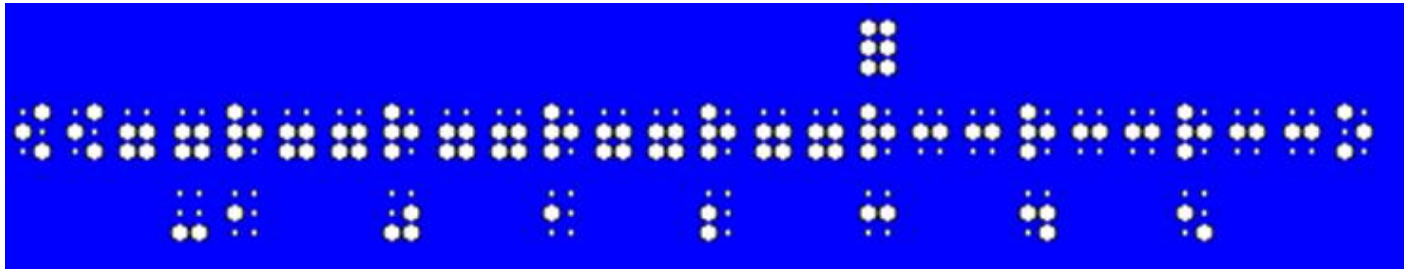
Fractions

- Fraction Pies
- Fraction Tiles
- Fractions for Dessert

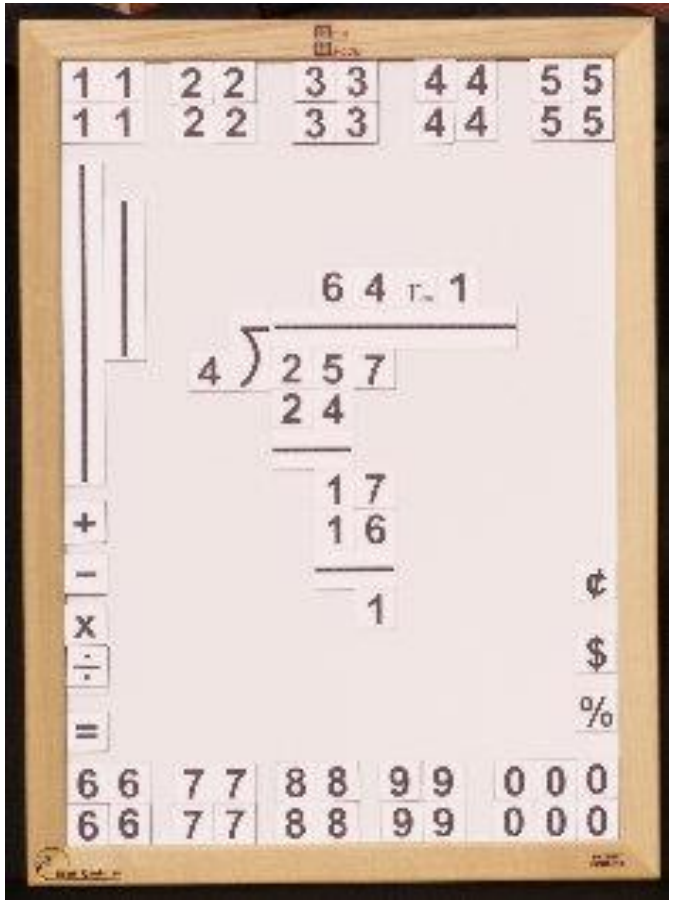
Student-Generated Graphics on a Number Line

- APH Number Line Device
- APH Consumable Number Lines

- Desktop Stick-On Number Lines
- Student-Made Number Lines



Hands-On Computation Tool



Math Window in Braille and Large Print

www.mathwindow.com

APH Math Apps

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

- Math Flash (Action for Google Home/Google Assistant) Based on APH's popular Math Flash™ software that combines math flash cards with fun audio feedback and animated characters!

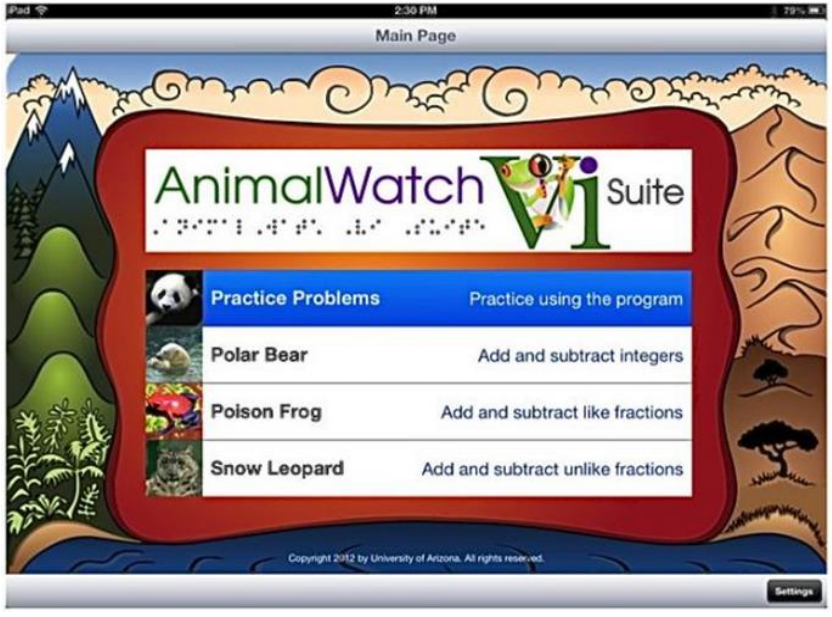
- Slapstack Math (for iOS devices) Slapstack Math™ is an action and memory game that uses math flash cards instead of playing cards. The goal is to collect the most points by pulling in the most cards.

Math Robot™ from APH

https://itunes.apple.com/app/math-robot/id704570512

- Math Robot iOS App
  - Works with your iPad or iPad mini running iOS 7 or later!
  - Use with a refreshable braille display

AnimalWatch VI Suite



- http://awvis.arizona.edu
- www.aph.org

Publications and Videos

- Abacus: Getting Started with the Counting Method
- 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

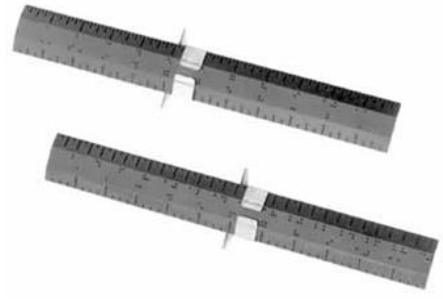
  www.tsbvi.edu/resources/2316-susans-math-technology-corner-standardized-braille-number-lines

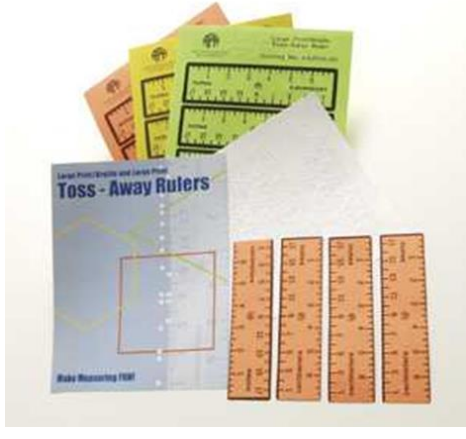
Measurement

Linear and Angle Measurement

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

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



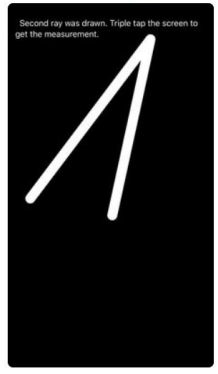


Draw2Measure Protractor App

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

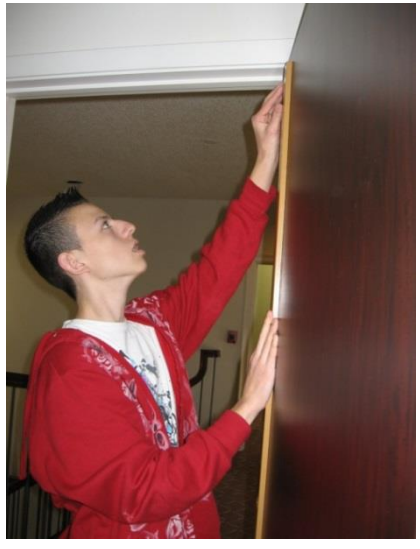
Tactile Caliper – 1 mm Precision

- 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

Students at Work Measuring



Measurement Resources

- Linear Measure, Perimeter, Area

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

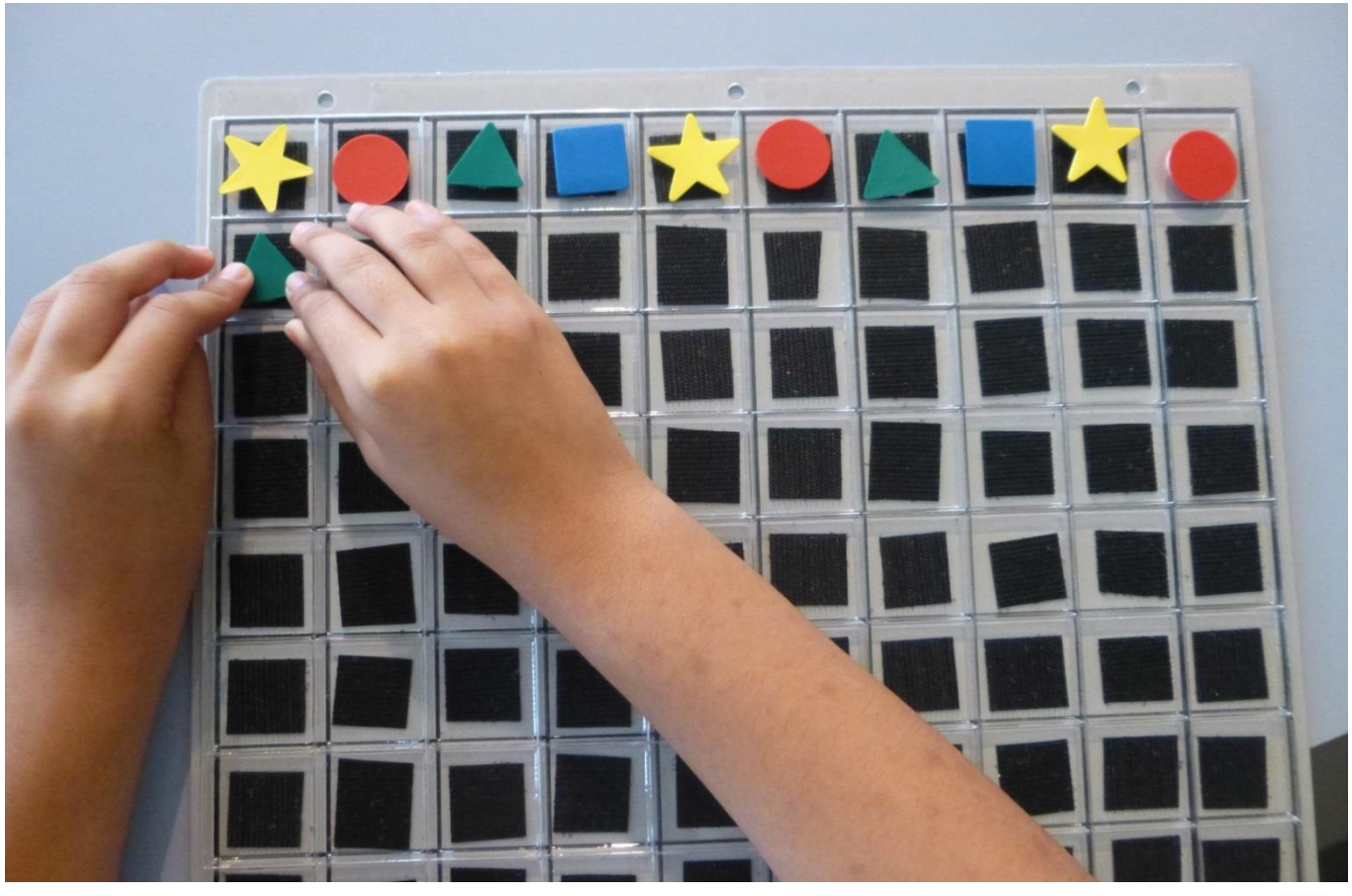
  www.tsbvi.edu/videos-webinars/mathematics

Algebra
and
Statistics and Probability

MathBuilders K-3, Unit 1: Matching, Sorting, and Patterning

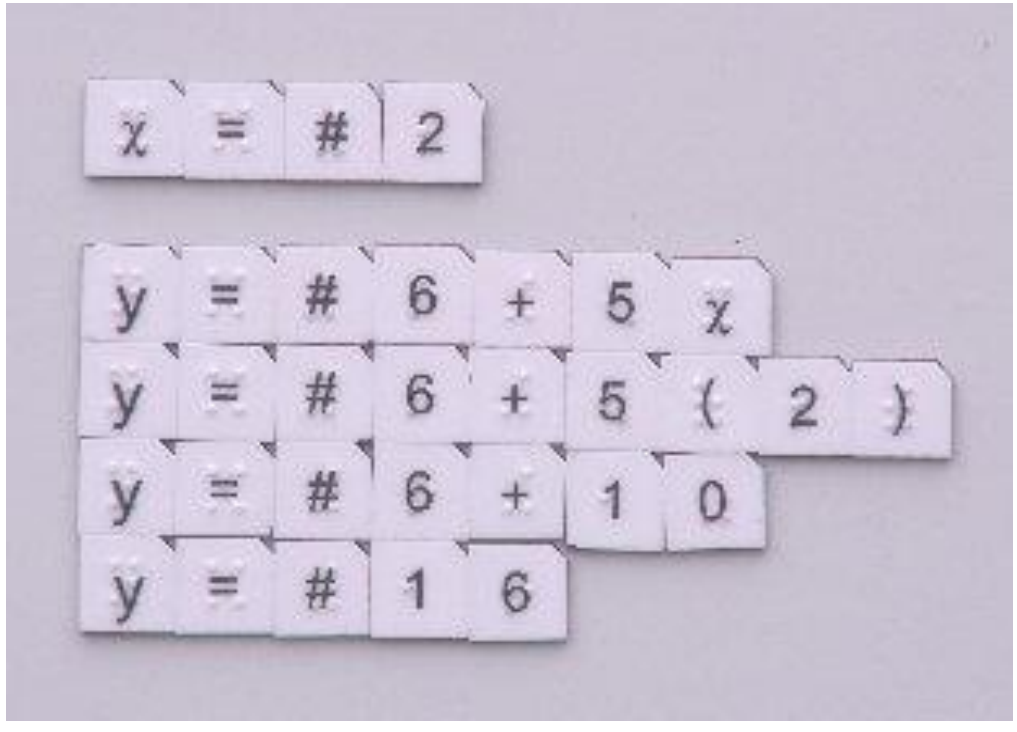
www.aph.org

Patterns on the Hundreds Board



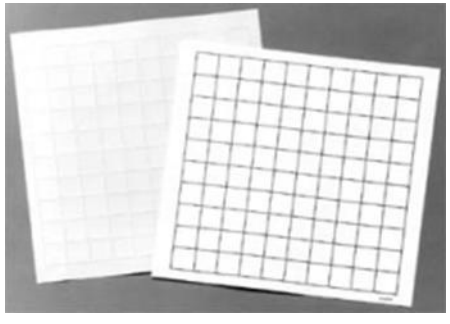
Math Window Algebra Add-On

www.mathwindow.com

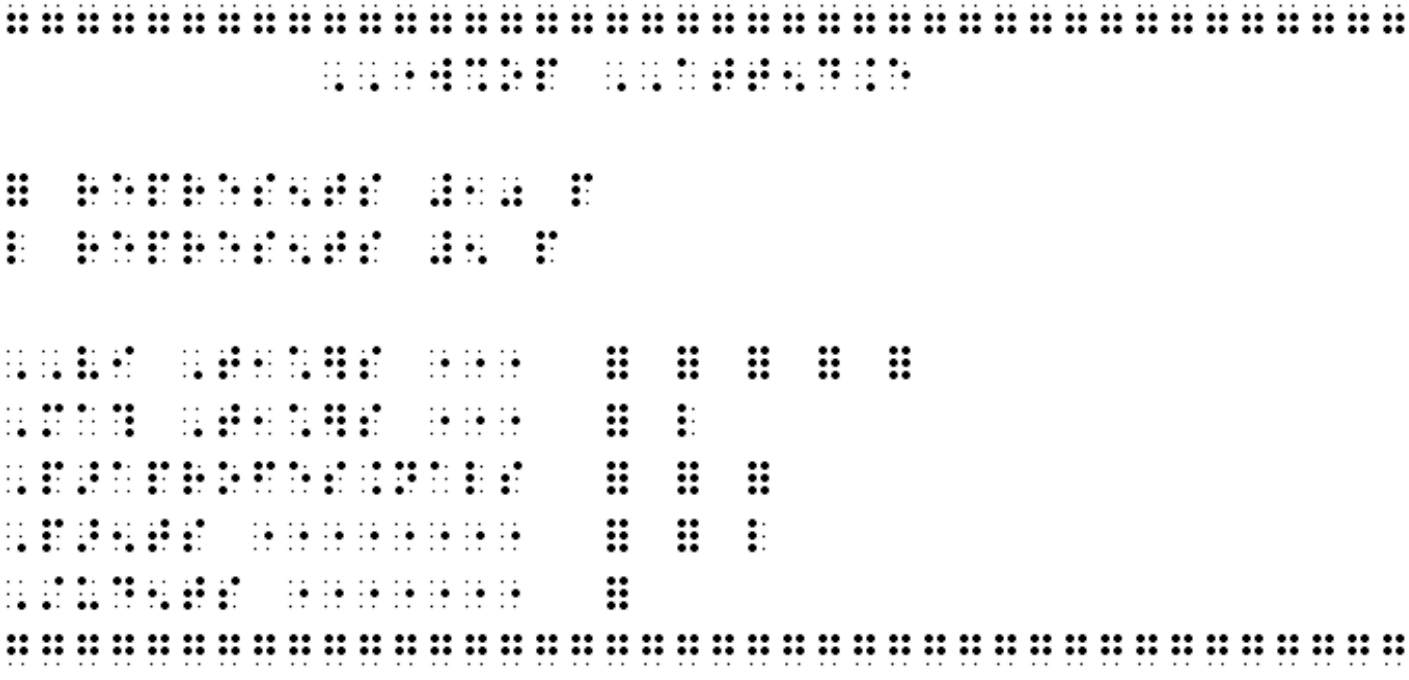


Student-Generated Graphics on a Coordinate Plane

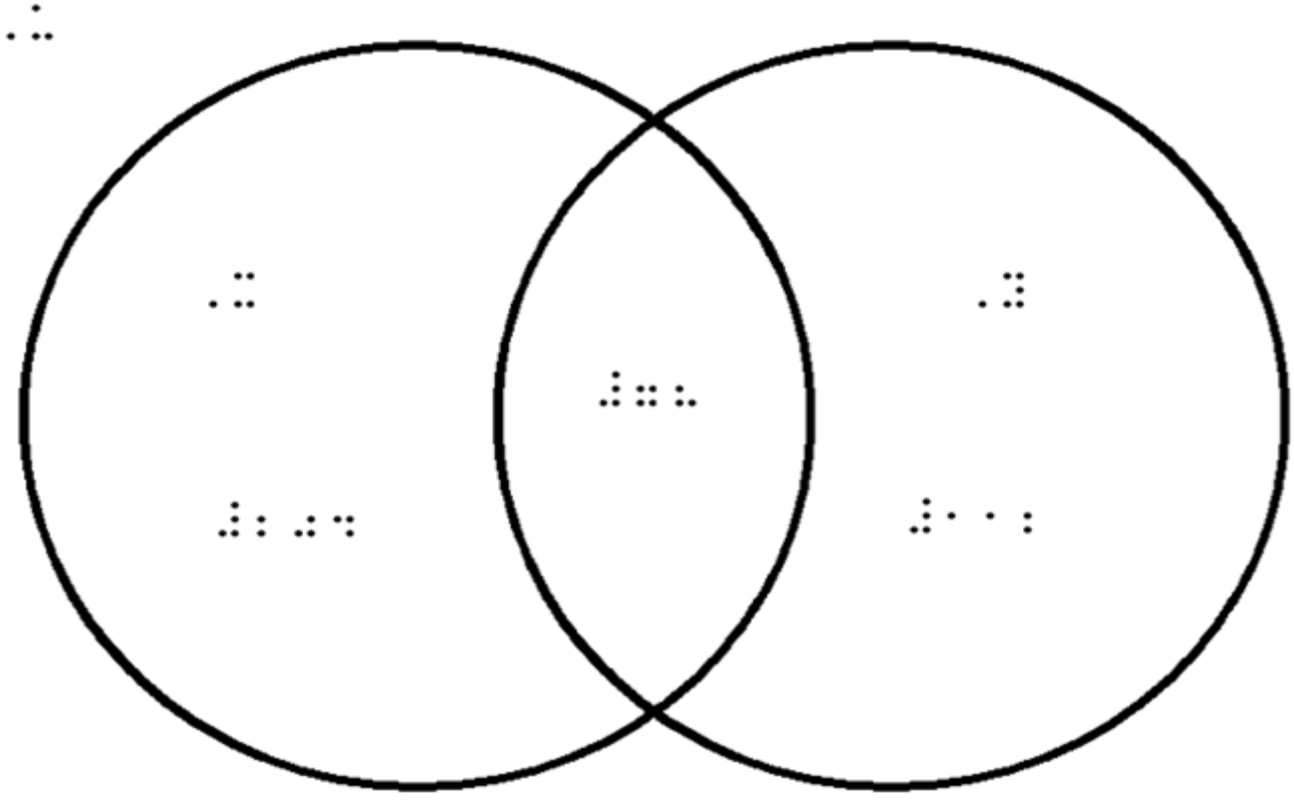
- **APH Graphic Aid for Mathematics**
- **Graph Paper**



Student- or Teacher-Generated Braillewriter Pictograph

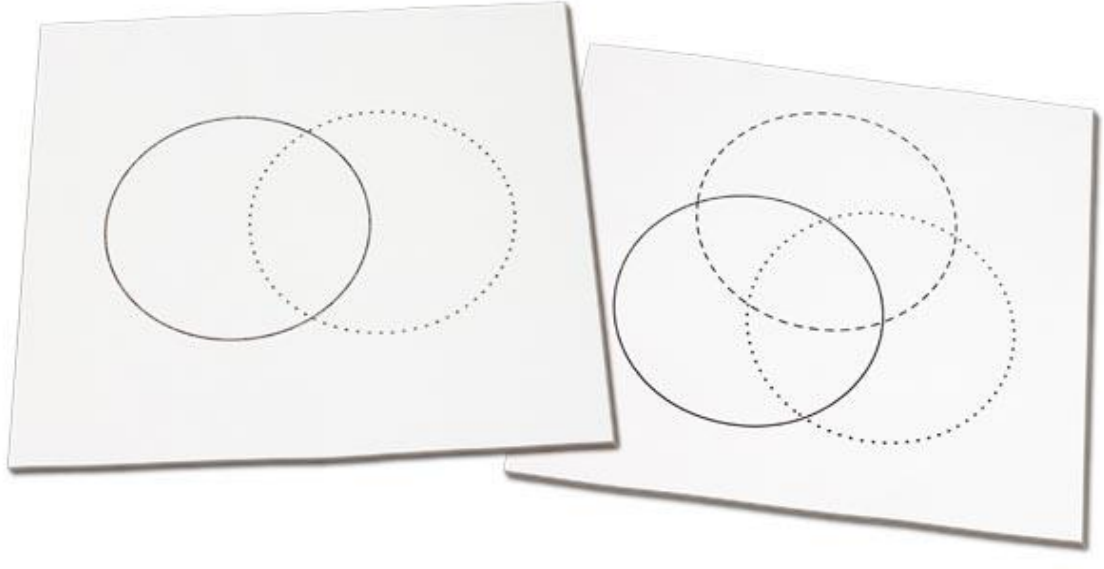


Student- or Teacher-Generated Venn Diagram

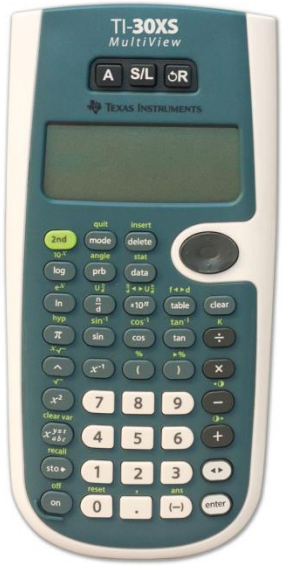


Venn Diagram Template Kit

www.aph.org



Talking Scientific Calculators



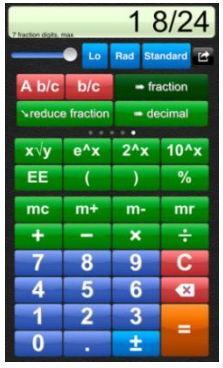
- ORION TI-30XS

  www.aph.org (available on federal quota money)

- Talking Scientific Calculator

  By Adam Croser

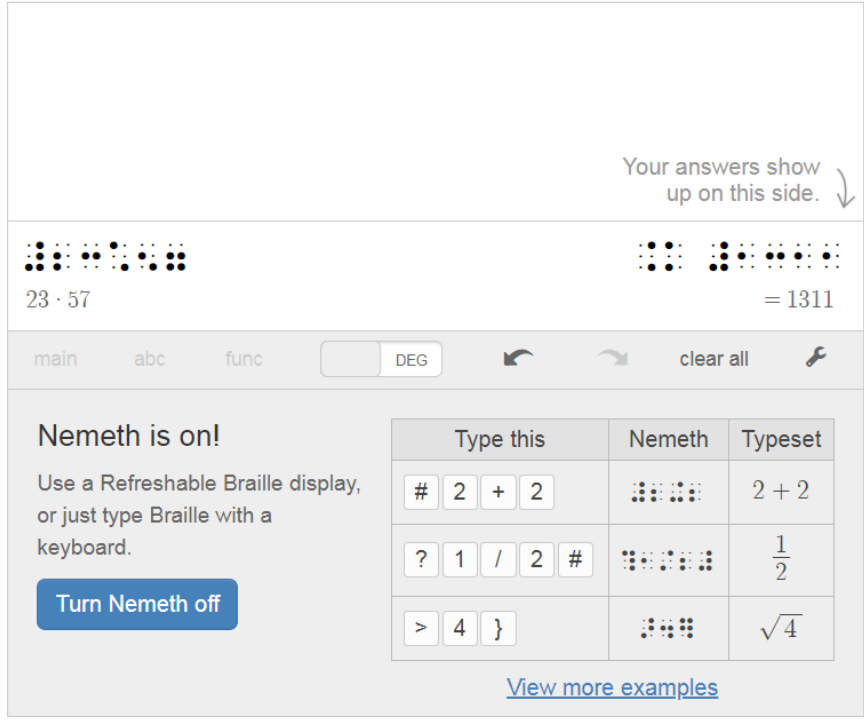
  https://itunes.apple.com/us/app/talking-scientific-calculator/id411433609?mt=8



DESMOS

https://www.desmos.com/accessibility

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



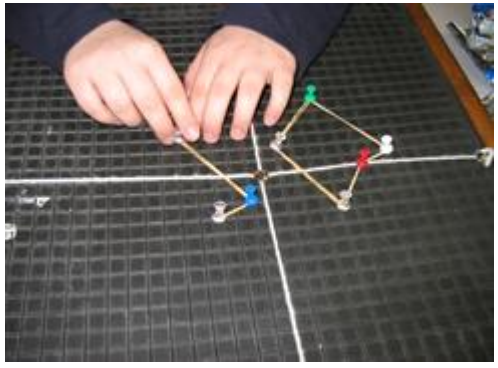
Publications and Videos (Algebra)

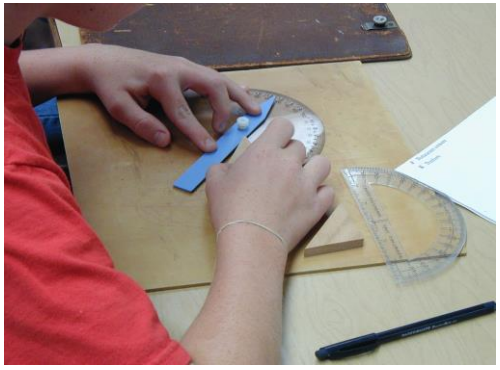
- Osterhaus, S.A. (2002). Susan's Math Technology Corner: Teaching A Blind Student How to Graph on a Coordinate Plane: No Tech, Low Tech, and High Tech Tools. *Division on Visual Impairments Quarterly, 47*(3), 23-26

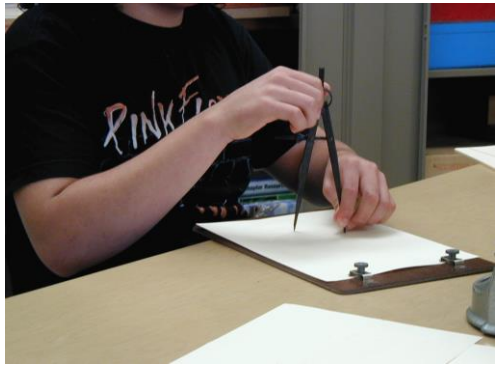
  www.tsbvi.edu/index.php?option=com_content&view=article&id=3619:coordinate-plane&catid=54

  www.tsbvi.edu/videos-webinars/mathematics

Geometry







MathBuilders, Unit 6: Geometry

K-3 www.aph.org

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

Geometro Sets Available from APH

www.aph.org

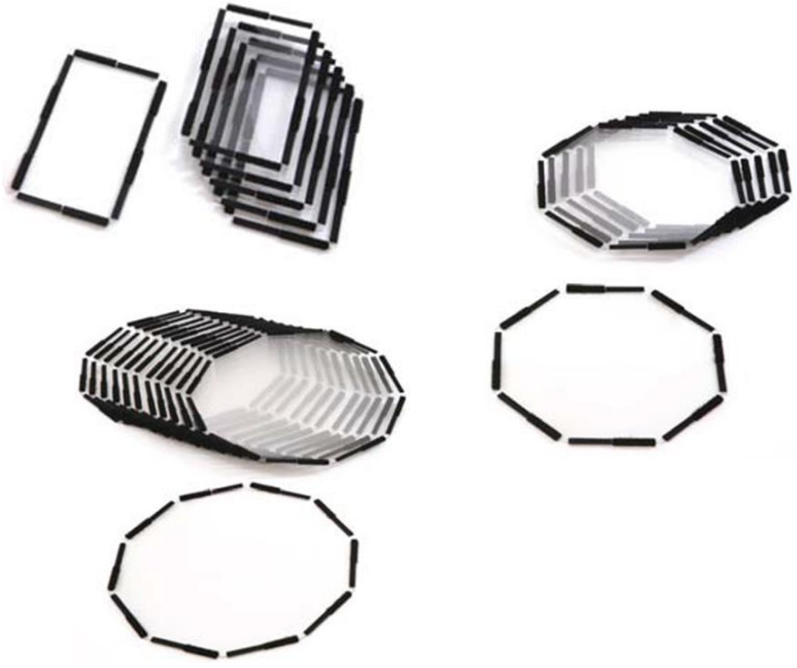
Mini

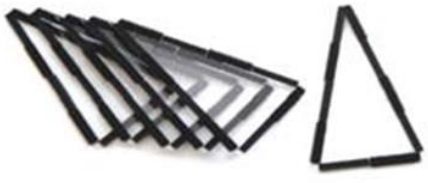
Medium

Large

More Geometro Shapes

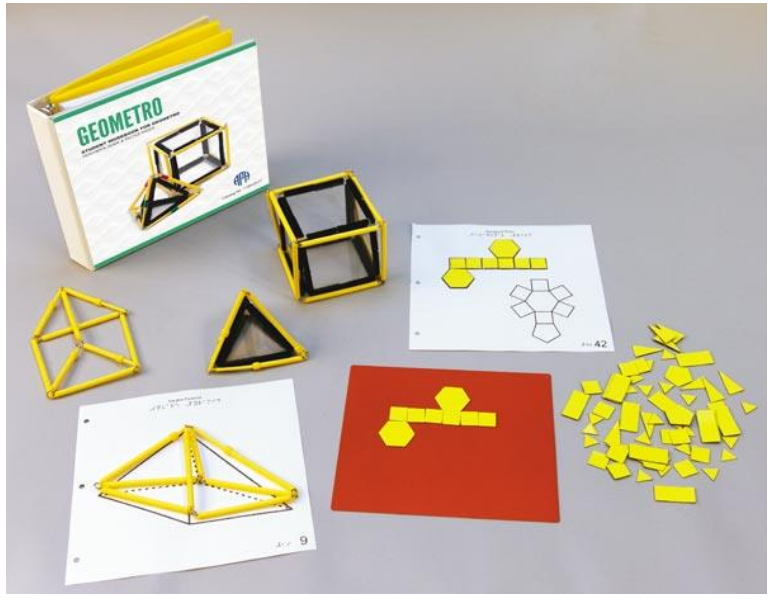
- Rectangles
- Octagons
- Decagons
- Isoceles Triangles
- Hook Material Rods





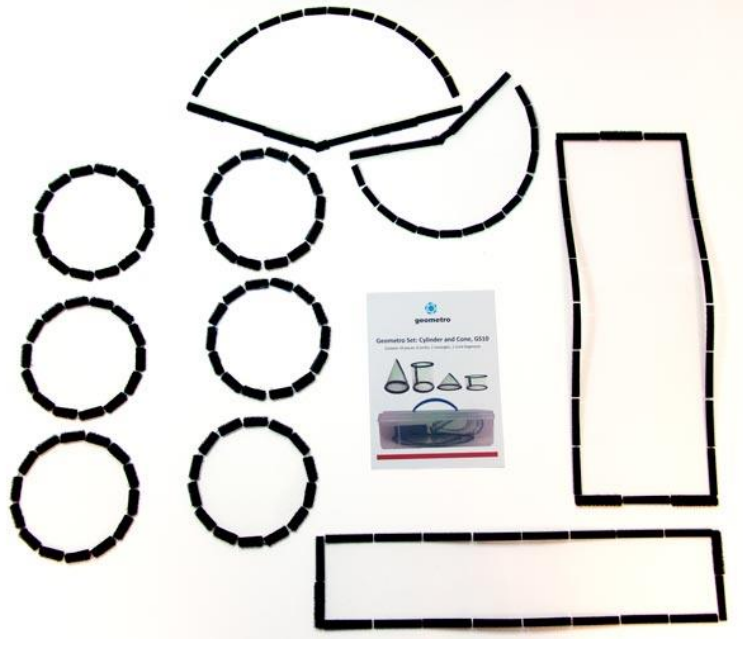
Geometro: Student Workbook Kit

- 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



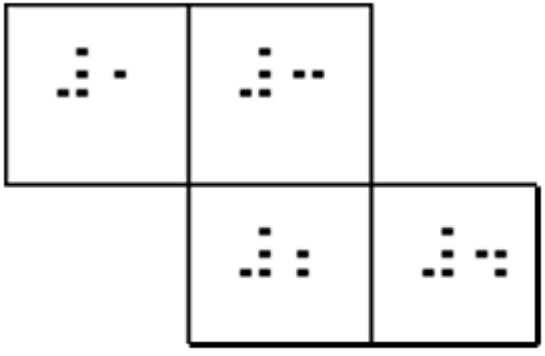
Geometro GS10 Cylinder and Cone

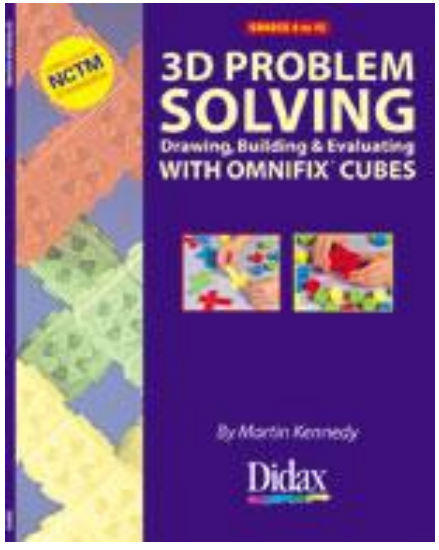
- Provides students with flat plastic shapes (six circles, two rectangles, and two circle sectors) that can be readily joined to form two cylinders and two cones. Each have the same base, but different heights.



Omnifix Cubes

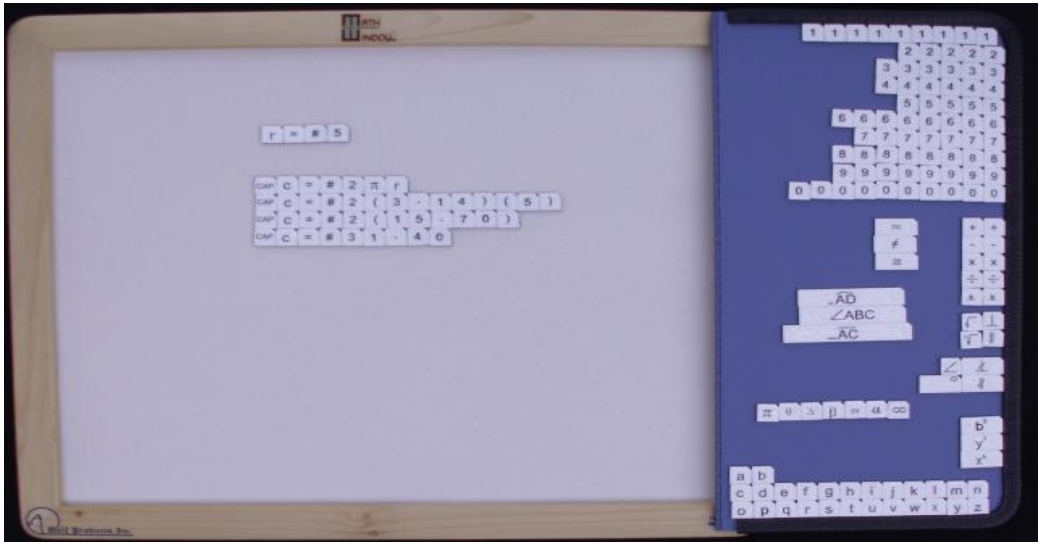
www.didax.com

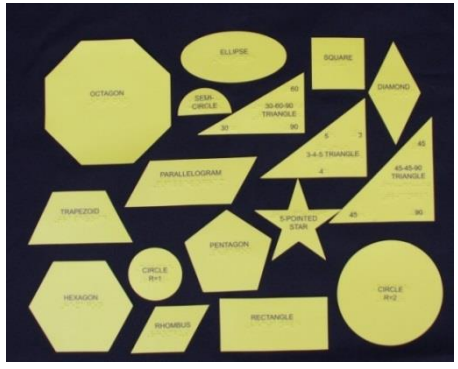


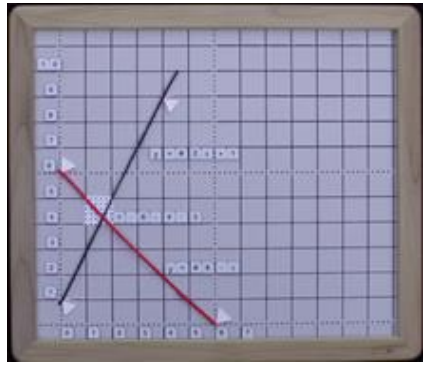


Math Window Geometry Kit

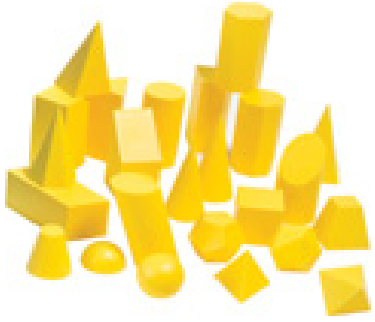
www.mathwindow.com







Geometric Manipulatives



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

Drawing/Construction Tools

- Drawing Board
- Compass

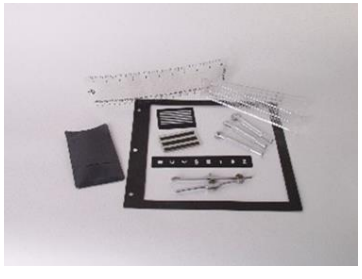
www.maxiaids.com

www.fiskars.com

www.APH.org

www.staedtler.us/en/

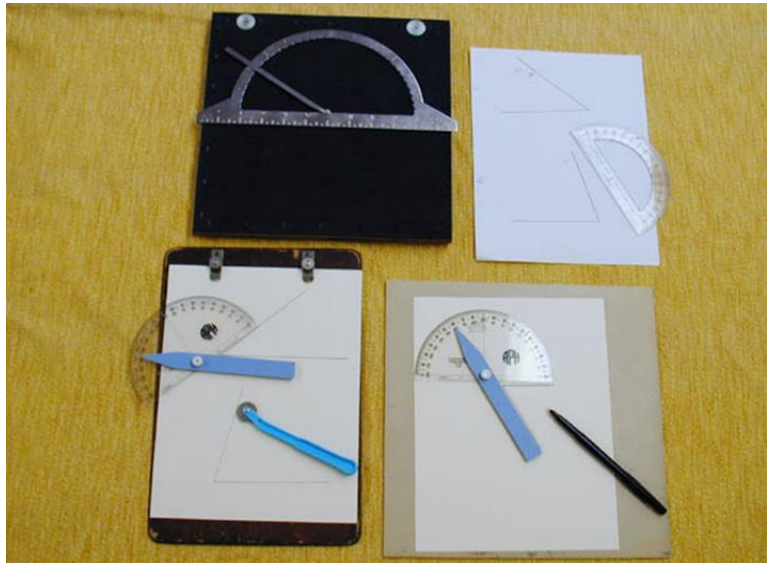
www.easytactilegraphics.com/



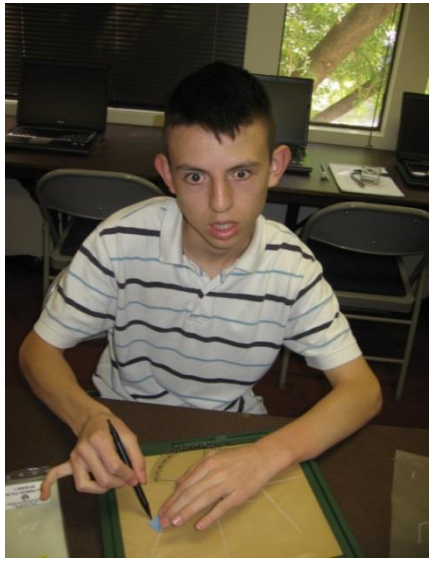
Drawing/Construction Tools (cont.)

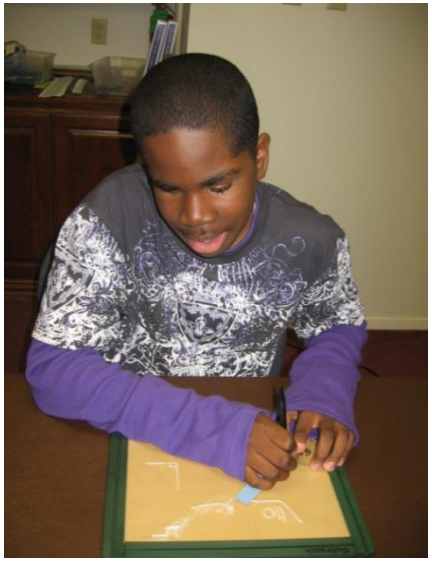
- Protractor
- Straightedge
- Tracing Wheel
- Stylus and/or Pen
- Drawing Board

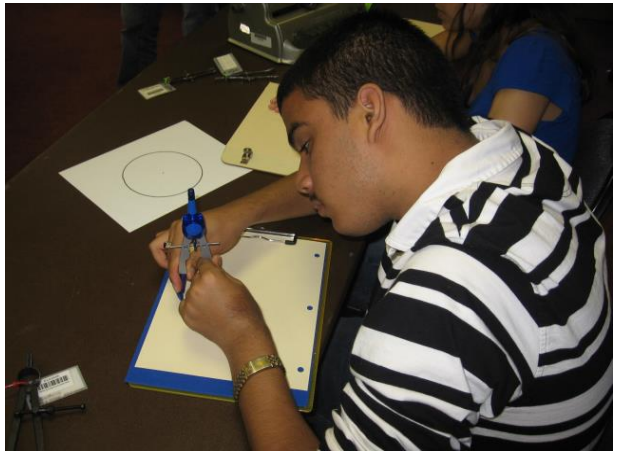
www.APH.org/

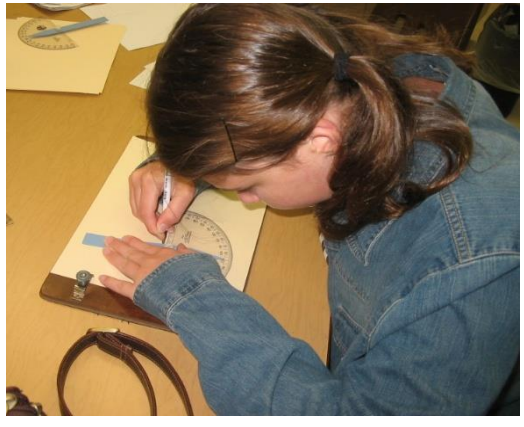


Students at Work Drawing









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

New Geometry Videos

www.tsbvi.edu/videos-webinars/mathematics

Videos for regular education math teachers that demonstrates teaching parallel lines, perpendicular lines, and skew lines to a student who is blind or visually impaired; strategies, tools, and materials.

- Parallel Lines
- Perpendicular Lines
- Skew Lines

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…