Texas School for the Blind and Visually Impaired

Presents

Accessible Mathematics for Students with a Visual Impairment and/or Additional Disabilities

AccessU 2018
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Presented by
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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
  – Algebra and Statistics and Probability
  – Geometry
  – Measurement

• What’s New in Research Regarding Accessible Mathematics?
Early Childhood: Where Learning Mathematics Begins

The Multi-Sensory Approach
Toys Count

Elementary School
Math Materials
Braille Reader

• High Quality Braille Textbooks & Assessments (Released Tests)
  – Nemeth Code
  – Tactile Graphics

• Teacher-Made Materials
  – Worksheets
  – Quizzes
  – Tests
### Examples of the Nemeth Code

<table>
<thead>
<tr>
<th>Spatial Arrangement</th>
<th>Horizontal Arrangement</th>
</tr>
</thead>
<tbody>
<tr>
<td>$215$</td>
<td>$(x + 4)(x + 5)$</td>
</tr>
<tr>
<td>$ + 48$</td>
<td>$= x^2 + 5x + 4x + 20$</td>
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<td>$= x^2 + 9x + 20$</td>
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<td>$(x + 4)(x + 5)$</td>
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</tr>
<tr>
<td></td>
<td>$k \ x^2 + 9x + 20$</td>
</tr>
</tbody>
</table>
Nemeth Translation Packages

• Duxbury: ≥ DBT WIN 10.3  
  www.duxburysystems.com

• MacKichan: Scientific Notebook  
  www.mackichan.com

• Design Science: MathType  
  www.dessci.com
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
  http://www.brailleauthority.org/mathscience/math-science.html
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

• HIMS v8.2 Firmware Upgrade for Braille Sense Notetakers
  https://hims-inc.com/braille-sense-v8-2-released/

• Duxbury Systems www.duxburysystems.com
  Now Translating from Braille Math to Inkprint Math via Word*
  *Requires Microsoft Word and MathType
What’s New with Learning Nemeth!

• *Guidance for Transcription Using the Nemeth Code within UEB Contexts*
  [www.brailleauthority.org/mathscience/math-science.html](http://www.brailleauthority.org/mathscience/math-science.html)

• *Nemeth at a Glance: A Math Resource, Grade Level Chart, and Evaluation Tool*
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)
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
Creating Graphics Using the Microsoft Word Drawing Toolbar (Quadrilaterals)
Creating Graphs Using the Microsoft Word Drawing Toolbar
Large Print Graphs by Graph
www.padowan.dk
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](http://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
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
Basic Math Technology
Braille Reader

• Refreshable Braille
  – Braille Notetaker
  – PC with Refreshable Braille Keyboard

• Laptop
Basic Math Technology
Large Print Reader

• Computer
• iPhone
• iPad

• Magnification Software
Number and Quantity

- 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


• 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

  www.tsbvi.edu/resources/2316-susans-math-technology-corner-standardized-braille-number-lines
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-36X
  www.orbitresearch.com

• ORION TI-30XS
  www.aph.org (available on federal quota money)

• Talking Scientific Calculator
  By Adam Croser
ORION TI-84+ Talking Graphing Calculator

• Available from APH with federal quota money [www.aph.org/](http://www.aph.org/)
DESMOS
www.desmos.com/accessibility
Large Display Scientific/Graphing Calculator Solutions

- TI-Smart View 2.0
  The Emulator Software Package for the TI-84+
- TI-NSpire (or TI-NSpire CAS+)
- Scientific Notebook
  www.mackichan.com
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)

  
  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-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

• Multiplication of Polynomials
Geometry
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
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
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

• Perkins School for the Blind
  www.perkinselearning.org/accessible-science

• Independence Science
  www.independencescience.com
What’s New in Research Regarding Accessible Mathematics?
DAISY Consortium Adopts Modular Math Extension


• New MathML-based extension will make math accessible to students with disabilities

• LONG BEACH, Calif. — March 21, 2007 — The DAISY Consortium, an international industry standards organization, announced today that it has formally adopted the Specification for a Digital Talking Book Modular Extension for Mathematics. This development is a critical element for integrating accessible mathematics into DAISY and NIMAS-compliant digital content. Now that this specification has been published, it is important for the education and accessibility communities to begin incorporating it into textbook accessibility requirements.
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

• 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/

\[ x^2 + y^2 = 4 \]
DESMOS

https://www.desmos.com/accessibility

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

https://www.desmos.com/scientific?braille
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
Other Math Resources

- Delta [www.delta-education.com](http://www.delta-education.com)
- Didax [www.didax.com](http://www.didax.com)
- ETA Hand2Mind [www.hand2mind.com](http://www.hand2mind.com)
- Math Forum [www.mathforum.org](http://www.mathforum.org)
- Nasco [www.enasco.com/math](http://www.enasco.com/math)
Thank you for your kind attention.

Now, it’s time for questions...

[Link](https://www.surveymonkey.com/r/AccessU2018)