



# Teaching Math & Science to Students Who Are Visually Impaired

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- Guidelines for designing tactile graphics
- Teaching tactile graphics in math
- Teaching tactile graphics in science



# Questions to Ask Yourself

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- When should I introduce tactile graphics?  
(early)
- What's the main purpose of this picture and what's the simplest way to convey it?
- What is necessary and unnecessary?
- Will the graphic lead to a better understanding or is the same information provided in text?



# Rule of Thumb

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- Plan ahead, does the teacher consider it important?
- Simpler is better, but keep necessities
- Embossed paper vs. materials put on top of the paper
- Pay attention to contrast and spacing (Use color **contrast** if the student has some usable vision)



# Rule of Thumb Continued

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- Use only relevant information
- Avoid using too many kinds of symbols
- Use straightedges when possible
- Think tactile, not visual (picture borders?)
- Points (highest), outline, textures (lowest)
- Not necessarily an exact reproduction
- Cost and time not primary consideration



# Paging

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- If a picture presents several concepts at once, consider breaking up into several pictures (one may be an overview)
- Use keys, legends, and abbreviations when needed and have easy access to them for reference (before or after on same page, on facing page, not on back of graphic)



# Labels

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- Don't break up a line for a label
- For a key, use single letters with single letter indicator or capital letter indicator or use 2-letter abbreviations. Spell out the full label in the key
- Omit capital signs in labels if not needed
- Retain the capital in titles or captions where there is more room



# Graphs

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- Omit grid lines if only the shape of the graph is important
- Put unit markers along the outside of the axis
- Leave space between bars on bar graph and texture bars



# Lines

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- Dotted or dashed lines stand out more than solid lines
- Use lead lines (connect graphic to label) sparingly so they aren't confused with the actual graphic (different and less prominent than graphic)
- Use different types of lines to convey different types of information





# Textures

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- Use textures sparingly
- Avoid decorating the graphic
- Orient texture in the same direction or it changes meaning
- With 2 or more textures, use border lines
- Primary (rough), secondary (smooth)
- APH Tactile Marking Mat (makes crayon marks tactile)



# APH Items

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- Graphic art tape
- Feel and Peel Stickers
- Textured Paper Collection
- graph paper, stick-on rulers
- Draftsman board
- Braille Transcriber's Kit: Math (rulers, number lines, protractors, thermometers, clock faces, low-relief graph paper)



# Non-APH Items

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- Wikki Stix
- Hot glue gun
- Foam sheets
- Sandpaper
- String or heavy thread (use of knots)
- Pipe cleaners
- Lots of other household and craft items



# Puff or Craft Paint

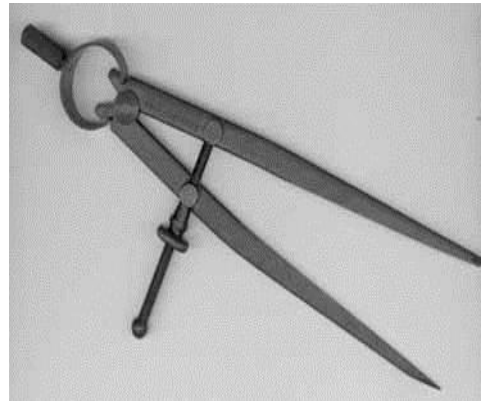
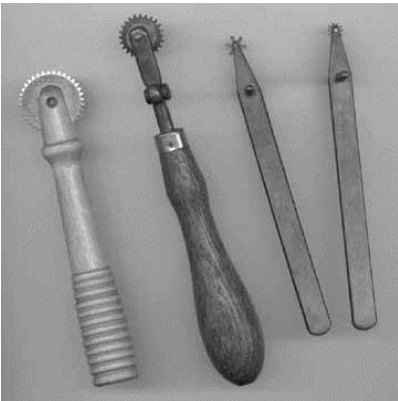
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- smaller tips help provide more control
- glitter, regular, dotted, dashed, thin, thick
- pull away from paint placement
- angle bottle away from straightedge
- leave time for drying
- careful of sharp peaks
- don't fold papers or put other papers on top of it or they tend to stick

# Tools

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- Tracing wheel
- Tooling
- Gum rubber pad or cardboard (softer the pad, the higher the embossing)





# Kits from APH

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- Tactile Graphics Starter Kit
  - Craft ink, fabrics, point symbols, slate and stylus, manual with good and bad examples
- Tactile Graphics Kit
  - Point symbol tongs, areal pattern plates, line drawing tools, slate and stylus, braille eraser, rubber embossing pad, ruler, foil sheets
- Line-Drawing Tool Kit (tools only)



# Software

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- QuickTac
- Tiger Software
  - Using graphics from the Internet
  - Using the drawing toolbar
  - Using Excel graphs



# Higher Cost Options

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- Microcapsule paper and an image enhancement device
  - TIE (Tactile Image Enhancer)  
[www.repro-tronics.com](http://www.repro-tronics.com)
  - PIAF (Pictures in a Flash)  
[www.humanware.com](http://www.humanware.com)
  - Swell-form machine  
[www.americanthermoform.com](http://www.americanthermoform.com)





# Links

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- BANA's Guidelines and Standards for Tactile Graphics can be viewed online or downloaded at <http://www.brailleauthority.org/tg/>
- APH Tactile Graphic Image Library <http://www.aph.org/tgil/>



# Early Learning from APH

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- Setting the Stage for Tactile Understanding: Making Tactile Pictures Make Sense (transition between real objects, thermoform, raised-line drawings)
- Flip-over concept books (Line Paths, Parts of a Whole)
- Teaching Touch (tracking, searching, verbal description, use of symbols)
- Tactual Discrimination Worksheets

# Teaching Tactile Graphics in Math



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- Students need to understand vocabulary such as diagonal, parallel, perpendicular, intersecting, angles, symmetry, reflection, rotation
- When graphing, have axes (thicker), grid lines (thinner), and graphed lines appear differently
- Use textbooks and APH Geometry tactile graphics



# Teaching tactile graphics in science

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- Evaluate whether a tactile graphic or a model is more appropriate.
- Must often it should be explicitly taught before the student needs to use it.
- Use textbooks and APH basic science, life science, anatomy tactile graphics