

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

## Lesson 6: Calculators, Computers, Notetakers, and More in the Math Classroom



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## Objectives

Participants will be able to:

- Identify the features of common graphing calculators (e.g., Orion TI-84 Plus, Desmos) used by high school students who are braille users.
- Identify the pros and cons of using different tools (e.g., Perkins braillewriter, braille notetaker) for math tasks.
- Support a student in deciding what tools to use for different math situations to maximize their independence.

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## Calculators

- It is important to have a meeting with the teacher, TVI, and student to discuss which calculator is best.
- Allow the student to try out the different options and be a part of the decision making process.
- Consider skills of the student in selecting a calculator:
  - Memorization of keys on a handheld?
  - Keyboarding skills?
  - Nemeth skills?
- Consider the classroom
  - What type of calculator do peers use?
  - What keys will the student need?

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## Scientific Calculators

- Used for computation:

$$5 + 7^3 \quad \sqrt[4]{16} - 8 \quad |-9 + 4| \quad \log 20 \quad \sin 30^\circ$$

- Gives a single numerical answer.
- Includes fractions, percent, exponents, radicals, logarithms, trigonometry, and more.
- No graphing capabilities.
- Most scientific calculator apps are not accessible.

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## Orion TI-30XS Talking Scientific Calculator

- No longer available through APH quota funds, but may still be available through your APH Ex-Officio Trustee.
  - Available to purchase from [Orbit Research](#)\*.
  - The calculator has a learning mode.
  - Students will be more efficient if they memorize where certain keys are located.
  - Has speech output.
- \*Cost \$529 US as of 2-1-2023.



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## Desmos Scientific Calculator

- Free online calculator with many embedded accessibility features.
- Works with screen readers and includes audio or braille output.
- Can be used with a computer keyboard or a braille display.
- Updates the answer as the student types the problem.
- Link to calculator: <https://www.desmos.com/scientific>
- Link to keystrokes <https://www.desmos.com/scientificshortcuts>



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## Braille Notetakers

- Have a built-in scientific calculator.
- Type using Nemeth Code for most options.
- There are a few keystrokes used for tasks such as converting between decimals and fractions.
- BrailleSense 6
  - [Reference sheet](#) (Organized by Sara Larkin)
- BrailleNote Touch Plus
  - [KeyCalc Part 1](#) (video)
  - [KeyCalc Part 2](#) (video)



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## Graphing Calculators

- Used for equations with variables.
- Used to graph equations or a table of values.
- Also includes all the features of a scientific calculator.

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

$$y = -\frac{1}{2}x + 4 \quad y = 2 \sin(3x)$$

$$y = x^2 - 5 \quad 2x - 3y = 6$$

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## Orion TI-84 Plus Talking Graphing Calculator

- No longer available through APH quota funds, but may still be available through your APH Ex-Officio Trustee.
  - Available to purchase from [Orbit Research](#).\*
  - The calculator has a learning mode.
  - Students will be more efficient if they memorize where certain keys are located.
  - Plays the graph using a change in pitch.
  - Vibrates when graph is below the x-axis.
- \*Cost \$649 US as of 2-1-2023.



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## Useful Links for the Desmos Calculator

- Accessibility page  
<https://www.desmos.com/accessibility>
- Getting started page for graphing  
<https://learn.desmos.com/accessibility>
- Full list of keyboard shortcuts
  - <https://www.desmos.com/graphingshorts>
- Downloadable Keyboard Shortcuts for graphing
  - [Graphing Calculator Keyboard Shortcuts for Windows \(.docx\)](#)
  - [Graphing Calculator Keyboard Shortcuts for Windows \(.brf\)](#)
  - [Graphing Calculator Keyboard Shortcuts for Mac \(.docx\)](#)
  - [Graphing Calculator Keyboard Shortcuts for Mac \(.brf\)](#)

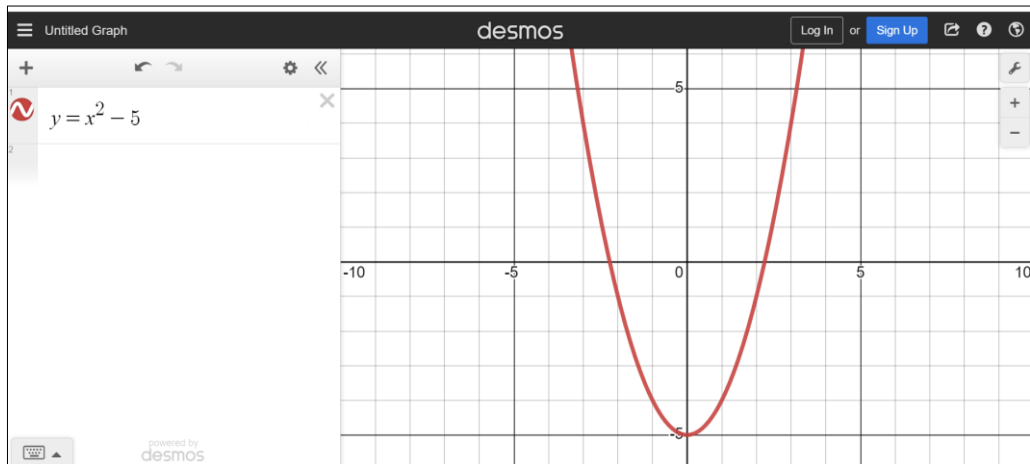
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## Desmos Graphing Calculator

- Includes table, graphs, statistics, trigonometry, etc.

<https://www.desmos.com/calculator>



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## Keyboard Shortcuts for the Equation Area on the Desmos Calculator

- Use the underlined letters to help you and your student remember these keystrokes!
  - Ctrl-Alt-E – focus on the expressions list
  - Ctrl-Alt-X – Add an expression
  - Ctrl-Shift-D – delete the current expression
  - Ctrl-Alt-T or type "table" – Add a new table
  - Alt-T – Audio trace toggle to get to graph or back to equation

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## Keyboard Shortcuts for the Graph Area on the Desmos Calculator

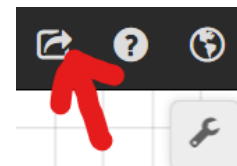
- Hear graph (H)
- Point of interest (P)
- X coordinate (X)
- Y coordinate (Y)
- Move to origin (O)
- Alt-S – Basic summary of graph
- Alt-PageUp or Alt-PageDown to move between graphs

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## Sharing Graphs Between Teacher and Student Using the Desmos Calculator

- Electronically
  - Go to Share Graph (Ctrl-Alt-S)
  - Copy link
  - Email to teacher or student
- Tactile – paraprofessional or TVI can emboss the graph for the student.
  - Go to Share Graph (Ctrl-Alt-S)
  - Select Export Image
  - Select your graphics embosser under the Size dropdown menu
  - Follow embossing instructions on the screen
  - Full set of directions  
<https://www.desmos.com/accessibility#embossing-graphs>



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## Using a Braille Display or Braille Notetaker with Desmos

- Desmos has the option to be used with a braille display or braille notetaker.
- Set up and video instructions are in the Resource List.
- Most students tend to prefer using the computer keyboard and screen reader.

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## Students Sharing Math Work with the Teacher

- Students should manipulate the math on the braillewriter and then email answers to the teacher.
- Students must label their work so they can find it if they need it.
- Students can keep work in a folder or binder for discussion later, if needed and purge after unit is finished or when no longer needed.

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## Students Preparing Graphics for the Teacher

- Students can produce graphs/pictures using one of these methods:
  - On tactile graph paper that can be turned in
  - On the Graphic Aid for Mathematics (rubber board) and take a picture for the teacher
  - In Desmos and email link to the teacher
  - On a tactile drawing board that can be turned in

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## Integration of Math with Screen Readers

- [JAWS](#) – Works with either MathType or Equation Editor in Microsoft Word as of January 2021.
  - Includes braille output to Nemeth when a braille display is attached to the computer running the screen reader.
- NVDA – Equation Editor or use MathPlayer with MathType.
- Have student try both and see what they prefer with their technology.
- Encourage the student to inform the teacher when content is not reading properly since there are so many ways to produce math and not all work with screen readers.

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## Auditory Information and Braille Displays

- Pros
  - Can be quick if information is not complex
- Cons
  - High cognitive load with complex content

Note: Changes highlighted in blue are pronounced accurately, but not written accurately on a braille display.

- Graphic - "The title of the graph is, distance traveled by Tim; The x axis is titled, number of hours; The axis has a range from 0 to 10, increasing in increments of 2; The why axis is titled, distance, miles; The axis has a range from 0 to 2 hundred 50, increasing in increments of 50; A solid line with five points labeled is on the graph. The line begins at 0 comma zero, and passes through the points, 1 comma fifty, 2 comma 1 hundred, 3 comma 1 hundred fifty, 4 comma 2 hundred, and 5 comma 2 hundred fifty. The line continues."
- Expression - "J squared times, open parenthesis, fraction with numerator K raised to the sixth power and denominator K raised to the fourth power times K cubed, closed parenthesis, raised to the negative third power."

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## Use of the Brailer

- Pros
  - Allows the student to work through longer multi-step problems and still view multiple lines quickly and easily.
- Cons
  - Not very portable – helpful to have one that stays in math class and one that stays at home.
  - The teacher usually doesn't know braille.
- Common complaint among teachers
  - Noise – although peers just get used to it over the years and it becomes something they don't even notice.

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## Use of the Braille Notetaker

- Pros
  - Allow for work and answers to be instantly displayed to the teacher and e-mailed to the teacher when work is complete .
- Cons
  - Student can only see one line at a time.
  - If the student doesn't use correct Nemeth Code, it can show up as gibberish.
- Important that students become proficient with Nemeth Code or math modes in the notetaker and emailing to teacher.

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## Use of the Computer

- Pros
  - Content shows up in print for the teacher.
- Cons
  - Student must know the computer keyboard and how to enter correct math symbols.
- Equation Editor is the most accessible for students using a screen reader, but not all schools use Microsoft.
- As schools move to Google, math accessibility has decreased.

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## Scenarios to Role Play with Your Student

- We've created 9 scenarios for **YOU** to think through in this lesson.
- You can use the scenarios with your students so they can think through the options they have and decide what to do in situations that **THEY ARE** going to encounter.
- There is almost always more than one option that can work. Think outside the box!

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## Scenario 1

- You do not know what the teacher is writing on the board.
  - Work with the teacher to come up with a way of communicating when the teacher is not being descriptive enough.
  - Raise your hand and ask for clarification.
  - Pull out the Draftsman board and ask a peer to quickly draw the picture.

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## Scenario 2

- You do not have enough room for your book and technology on your desk.
  - Ask for a table instead of a desk.
  - Place the notetaker on your lap.
  - Ask about having a small cart or table next to your desk.

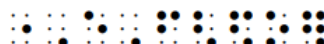


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## Scenario 3

- You forgot the Nemeth symbol for a ray, and your teacher is beginning a new unit on geometry that uses that symbol.
  - Look up the symbol online using something like the Nemeth Symbol Library or Nemeth Tutorial.
  - Look up the symbol in the [Math Symbol Reference Booklets](#) from APH.
  - Send a quick email or text to your TVI.

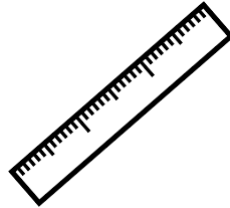
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## Scenario 4

- You have to measure with a ruler and there is no braille ruler in the classroom or at the school.
  - Email the TVI about trying to get a braille ruler.
  - Pull out some Graphic Art Tape or tactile dots and have a peer place them on each inch or every other centimeter on a regular ruler.
  - See if the teacher has an old measuring tape that can be notched with a pair of scissors.



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## Scenario 5

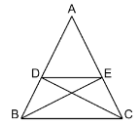
- You have no charge on the computer or notetaker you normally use.
  - Find the power cord and sit by the electrical outlet.
  - Pull out the Perkins braillewriter and use that until the technology is charged.
  - If the computer loses its charge, grab the notetaker, or vice versa.



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## Scenario 6



- There is a lesson on proofs, and no one prepared the tactile graphics you need in order to access the teacher's lecture. The paraprofessional at your school is absent today.
  - Ask a peer to help make the diagrams using a tactile drawing board and some print/braille stickers and to verbalize the proof so you can write it down.
  - Ask the teacher about working together with a peer. You can use the braille notetaker to take notes.
  - Have a stash of tactile supplies in the classroom (Wheatley, tactile drawing board, Graphic Aid for Math, tactile stickers, graphic art tape) that can be used by your teacher or peers to create last minute graphics for you.
  - Ask the teacher to email you the text and math part of the proof.

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## Scenario 7

- The class has been divided into groups and are given graph paper to draw a house. You can't see what your group members are drawing.
  - Ask the group to use the Graphic Aid for Mathematics or your braille graph paper.
  - Ask the teacher if you can work independently as you use different tools than your other group members.
  - Explain to your group members that you need them to verbalize what they are drawing so you can participate in the design.

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## Scenario 8

- You are feeling that you're falling further and further behind in Algebra class because you're not understanding the concepts.
  - Go in before school, after school, or another time during the school day to get help from the teacher.
  - Ask your TVI if they can meet with you to help you preview the material that will be covered in Algebra class.
  - Have a peer explain the concepts that you're finding challenging.
  - Talk to your family about getting a tutor who can work with you on the material.

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## Scenario 9

- You are having trouble reading the graphics in your math book.
  - Have a peer use a tactile drawing board to recreate the graphics.
  - Ask the paraprofessional or teacher to reproduce the graphics another way so they are easier to read.
  - Ask the TVI to work with you to see if you're missing any pieces of a graphic as you view it and teach you strategies to approach graphics more efficiently.
  - Practice with [AnimalWatch VI: Building Graphics Literacy](#) materials as a review.

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