Project INSPIRE: Course 6, Lesson 6

Transcript

SPEAKER: Welcome to Nemeth Code Symbols Used in High School and Strategies for Supporting Math Learning. This is our final lesson, "Lesson 6, Calculators, Computers, Notetakers, and More in the Math Classroom."

Slide 2 is the objectives. You're going to be able to identify the features of common graphing calculators such as the Orion TI-84 Plus and the Desmos calculator, and these are calculators used by high school students who are braille users. You're going to be able to identify the pros and cons of using different tools, for example, the Perkins braillewriter or a braille notetaker for math tasks. And you're going to be able to support a student in deciding what tools to use for different math situations to maximize their independence.

Let's go on to slide 3 and talk about the importance of calculators. Early on, you want to have a meeting between the math teacher, the teacher of visually impaired students, and the student to discuss which calculator is best.

Ideally, as the teacher of students with visual impairments, you want to bring a variety of calculators or options to show the teacher, and hopefully, you've spent some time with the student getting them familiar with them so they can be very involved in the decision-making process. You want to think about what skills that student has. Where is their stress? Are they good at memorizing the locations of keys on a handheld?

What are their keyboarding skills like if they're going to be using a computer with a calculator? Where are they with their Nemeth skills? Also, talking with that general ed classroom teacher about what type of calculators is the rest of the students in the class going to be using, and what specific keys will all the students be responsible for needing to conduct math throughout the school year.

Slide 4 talks about scientific calculators, and we use these for computations such as 5 + 7 to the 3rd, the 4th root of 16, end root minus 8, the absolute value of -9 + 4, the log of 20, the sin of 30 degrees. When students are computing problems such as these examples, they're going to get a single numeric answer. With a scientific calculator, our students area able to do fractions, percents, exponents, radicals, logarithms, trigonometry, and more. And when we talk about a scientific calculator, it's really important to understand that we're not talking about a calculator that does graphing. We are going to talk about graphing calculators here in just a few moments.

Now, from an accessibility standpoint, there are lots of apps out there that are scientific calculators, however, most of them are not going to be accessible to a student who is using a screen reader.
Let's go on to slide 5, and I want to talk about the Orion TI-30XS which is a talking scientific calculator. Unfortunately, in the United States, this calculator is no longer available through the American Printing

House for the Blind on Federal Quota, however, you want to check in with your Ex-Officio Trustee because they may have some tucked away, so you still may be able to get one for your student.

Now, this calculator is available for purchase from Orbit Research. When we checked on February 1 of 2023, the price was $529 US. The Orion TI-30XS calculator does have a learning mode. It's important though that your student develop efficiency by memorizing the location of certain keys, not imperative, but they will be more efficient. And, of course, this calculator has speech output. Let's take a quick look at a demonstration of how to use the Orion TI-30XS Talking Scientific Calculator.

[VIDEO PLAYBACK]

- The Orion TI-30XS is just an accessible version of the regular TI-30XS scientific calculator. We're going to turn it on with the lower left button.

- [Calculator voice]: Home screen.

- Now, above that screen, there are three keys. The one on the left has an A on it. That's the "Access" key. The one in the middle has S/L, It's the "Silent and Learn" key. And the one on the right has an R on it, and it is the "Repeat" key. Now, there are two different modes on the TI-30XS. There's a MathPrint and a Classic. We have to be in Classic, and if we are not and go to do a problem, we will get an error message. So I'm just going to press the A key and see what that error message is.

- [Calculator voice]: MathPrint not supported by accessibility. It is required to switch to Classic mode. Press "Mode" key. Error.

- And it tells me how. Now, I could always silence that with that "S/L" key. I could turn the sound back on by just toggling that one more time and hitting it.

- [Calculator voice]: Speech on.

- All right, my speech is on. I'm going to go to the "Mode" key.

- [Calculator voice]: Mode, degree, degree.

- Go down to Classic.

- [Calculator voice]: Classic, MathPrint selected.

- And hit "Enter."

- [Calculator voice]: Classic selected.

- And then to get out of that area, I'm just going to do 2nd mode, which is "2nd Quit."

- [Calculator voice]: Sec quit, home screen.

- Now, I'm back at my home screen and it tells me that. Now, I can actually hold down that "A" key to change the volume and rate.

- [Calculator voice]: Orion settings on.

- "Up" and "Down Arrows" for volume.

- [Calculator voice]: Volume, volume. Volume 6. Volume 7. Volume 8.

- And I can use the left and right arrows to change the speech rate.

- [Calculator voice]: B 1, B 2, B 1.

- All right, to get out of there, I can just hit that "A" button again. And then to check battery status, I can hit—

- [Calculator voice]: 100% battery.

- --the "On" key. It'll tell me that, in this case, I have 100%, but it's a good thing for the student to check that battery status. I can also, let's do a problem now. Let's do open parenthesis.

- [Calculator voice]: Open paren.

- 6 + 9.

- [Calculator voice]: 6 + 9.

- Right parenthesis.

- [Calculator voice]: 9.

- Oops, I didn't want that. Right parenthesis—

- [Calculator voice]: Right paren.

- --divided by 7.

- [Calculator voice]: Divided 7.

- And I want to go ahead and hit "Enter."

- [Calculator voice]: 2.142857143.

- Now, I get a long decimal. I can repeat that by hitting the "R" key.

- [Calculator voice]: 2.142857143.

- Now, let's say I want to change that to a fraction, but I don't know what key that is. I can hold down that "S/L" to go into learn mode.

- [Calculator voice]: Enter learning mode.

- And now I—

- [Calculator voice]: L and—

- --can look for the key.

- [Calculator voice]: --N over D.

- Oh, there's a fraction, but I think it's a 2nd fraction.

- [Calculator voice]: 2nd on. U and N over D.

- Nope, that's a mixed number.

- [Calculator voice]: 2nd on, N over D. 2nd on, F left arrowhead, right arrowhead, D.

- There it is. It's the F, left arrowhead, right arrowhead, D. So that's the key I want, "2nd," and then that key. So to get out of learning mode, I'm going to go ahead and hang onto my spot there, hold down that "S/L."

- [Calculator voice]: Exit learning mode.

- Exit learning mode. Now, I can hit-- and it didn't affect my problem here-- I can just hit "2nd"—

- [Calculator voice]: 2nd on.

- --and that key that I found.

- [Calculator voice]: 2.142857142.

- Hit "Enter."

- [Calculator voice]: 15 divided by 7.

- Now it has told me the fraction is 15 divided by 7 or 15/7. Let's try another problem here. 5 squared + 12 squared. So we're going to do 5.

- [Calculator voice]: 5.

- Caret 2.

- [Calculator voice]: Power 2.

- + 12 caret 2.

- [Calculator voice]: + 12 power 2.

- Then hit "Enter."

- [Calculator voice]: 169.

- Now, let's say I want to repeat that answer. I can hit that "R" key to repeat it.

- [Calculator voice]: 169.

- Or I can hold down that "Repeat" key and it will tell me the problem and the answer.

- [Calculator voice]: 2.142857143 2.142857142857 convert right, point to caret, 15 divided by 7, 5 to the power, 2 left, 12 to the power 2, 169.

- And what it did is it actually repeated everything that's on that screen. I can also just arrow up—

- [Calculator voice]: 169.

- --through those different parts.

- [Calculator voice]: 5 to the power 2, + 12 to the power 2, 15 divided by 7.

- --as far back as I want to go. Let's go ahead and go back to the bottom, and let's say that I want to now take the square root of that last answer. You don't even have to remember what that last answer is. We can go ahead and do the square root, which is 2nd squared.

- [Calculator voice]: 2nd on, square root.

- And then I could actually there's an answer key above the negative sign, so I'll hit 2nd and negative.

- [Calculator voice]: 2nd answer.

- And then hit "Enter."

- [Calculator voice]: 13.

- And it'll take the square root of that answer to get 13. If I wanted to do the cube root of 125, for that one, I would actually do for a cube root, that's a third root, I'm going to type 3 first.

- [Calculator voice]: 3.

- Then I'm going to type 2nd and the exponent, which is the "X Root" key. So 2nd—

- [Calculator voice]: 2nd on.

- x root.

- [Calculator voice]: x root.

- And we'll do 125.

- [Calculator voice]: 125.

- And hit "Enter."

- [Calculator voice]: 5.

- And it gives me that answer of 5, so that's how I would do a cube root would be a 3 before that key. A fourth root would be a 4 and then that key. Now, we're going to go ahead and turn the calculator off, and we do that by doing "2nd on"

- [Calculator voice]: 2nd on.

[END PLAYBACK]

Slide 6 talks about the Desmos Scientific Calculator, and, folks, this is a calculator that we're really seeing being used a lot in the general ed classroom, especially in schools where we're a one-on-one device school because this is free, it's an online calculator, and it has lots of embedded accessibility features. It

works really well with screen readers and includes audio or braille output, so we have some choice here for the student depending on what they want to use.

It can be used with a computer keyboard or a braille display. And what's really nice about this is it updates the answer as the student types the problem. Now, I have a link to the actual calculator itself and a link to the keystrokes. So let's watch a quick demonstration of the Desmos Scientific Calculator.

[VIDEO PLAYBACK]

- Now we're going to look at the Desmos Scientific Calculator. I have JAWS running. When you first go to that site—

- [Calculator voice]: Claiming menu to center. Desmos Scientific Calculator, expression list [INAUDIBLE].

- --it will take you straight to the entry area. Let's go ahead and use the problems that we used earlier with the TI-30XS. So I'm going to do open parenthesis, 6 + 9, close parenthesis, divided by 7.

- [Calculator voice]: Left paren, left paren, 6 + 9, right paren, right forward slash, over 7, 7, start fraction, left parentheses, 6 + 9, right parentheses over 7, end fraction, = 2.142857.

- Notice it told me the answer, but it was as a decimal. So let's say I want it as a fraction. I can "Tab" over to where it allows me to change it between decimals and fractions.

- [Calculator voice]: After the fraction, let's display as a decimal. Re-enter the display fraction button. To activate press "Enter."

- So I'll hit "Enter" to activate it.

- [Calculator voice]: Enter.

- Now, the one thing I've found is it's best to go back to the equation and to re-enter that last part of it to hear that fraction.

- [Calculator voice]: When you type in text, end of new denominator 7, when, 7, 7, start fraction, left parenthesis, 6 + 9, right parentheses over 7, end fraction = 58/7.

- So there it gave me that fraction, the answer. I'm going to go ahead hit "Enter." This time I'm going to enter our 2nd problem.

- [Calculator voice]: Enter expressions on a colon edit, type.

- This time I'm going to enter 5 squared + 12 squared, so I'm going to use the "Shift 6," which is my "Caret" key to do exponents, and I'll have to "Right Arrow" to get out of the exponent after I've entered it. So 5.

- [Calculator voice]: 5.

- Shift six.

- [Calculator voice]: Caret superscript baseline, 5 superscript baseline 2, 2.

- And then we'll hit the 2—

- [Calculator voice]: 5 squared =--

- Right arrow to get back to baseline.

- [Calculator voice]: --superscript 2 baseline + 2, 2, 5 squared + 12.

- Now, I'm going to go ahead and do the same thing and do "Shift 6" to get my caret to go up to the exponent and hit "2" for squared.

- [Calculator voice]: Caret, superscript, 2, 2, 5 squared + 12, enter expression 3 colon edit, type in text.

- Now, I hit "Enter" before I heard the answer, so I can go ahead and go back up to that and hear that answer.

- [Calculator voice]: Expression 2 colon 5 squared + 12 squared = 169 edit, type in text.

- And I just did the "Up Arrow" to go back to that previous expression. So I'm going to go back down now and take the square root of that answer. So I'm going to go back and find all the down arrow.

- [Calculator voice]: Expression 3 colon edit, type in text.

- To get the square root, I just type S-Q-R-T for square root.

- [Calculator voice]: S-Q-R-T, quote, T, quote, start root.

- So now I have my start root, and I'm going to enter-- I want the square root of the answer, so I could just type A-N-S for answer.

- [Calculator voice]: A-N-S, test quote, start root, ans, end root = 13.

- So it actually put the 169 in for me and then told me that the answer was 13. To do an nth root, instead of S-Q-R-T, I'm going to type N-T-H, so nth root. So let's go to the next line, hit "Enter."

- [Calculator voice]: Enter expression for colon edit, type in.

- Nth root, N-T-H.

- [Calculator voice]: N-T-H quote.

- R-O-O-T.

- [Calculator voice]: R-O-O-T, quote, T, quote, root index.

- Now, it said root index, so that's going to be for a cube root, the index is 3, so I'm going to type a 3.

- [Calculator voice]: 3, 3, start cube root, end cube root radical cannot—

- And now I'm going to go ahead and "Right Arrow" to get inside of the radical.

- [Calculator voice]: We're getting a radical.

- Type in 125.

- [Calculator voice]: 1 2 5, 5, start cube root, 125, end cube root = 5.

- And, again, I can arrow up and down to review anything that I've previously entered and hit "Enter" to go to a new problem.

[END PLAYBACK]

On slide 7, I talk about braille notetakers. Braille notetakers have a built-in scientific calculator, and you type using Nemeth Code for most of the options. There are a few keystrokes used for tasks such as converting between decimals and fractions, so it's going to be important that your student know how to use the Help feature in their specific braille notetaker to make sure that they know what they need to do. We have two helpful resources here for you. Of course, there's lots of braille notetakers out there, but if you're using let's say, a BrailleSense 6, Sara Larkin has organized a really nice table that provides information on the keystrokes. There are two videos that are going to help you and your student get started using their braille notetaker as a scientific calculator.

Let's go on to slide 8. So I'm going to move away from scientific calculators and I'm going to start talking about graphing calculators, however, graphing calculators do have all the same features as a scientific calculator, so we're still going to be able to do all those problems that we talked about a couple slides

ago. But what's nice about a graphing calculator is that I use it when I'm doing equations with variables, and I can actually graph that equation or a table of values. And I have an example of a table on my slide and for math problems. I'm not going to read those to you, but these are the types of problems that you can graph using a graphing calculator.

Slide 9 talks about the Orion TI-84 Plus Talking Graphing Calculator, and this one also currently is not available on APH quota funds, but you still may be able to check in with your APH Ex-Officio Trustee and find one to use. If you opt to purchase it from Orbit Research, the current cost as of February 1, 2023, was $640 US. This calculator also has a learning mode, and, again, we believe the students will be more efficient if they memorize where certain keys are located on the calculator.

Now because the Orion TI-84 Plus is a graphing calculator, it's going to place the graph using a change in pitch, so the student will need to listen to that. It will also vibrate when the graph is below the x-axis. Let's watch a demonstration of using the Orion TI-84 Plus Talking Graphing Calculator.

[VIDEO PLAYBACK]

- The Orion TI-84 Plus Graphing Calculator is actually a regular TI-84 Plus Graphing Calculator, plus it has a helmet for accessibility and sound. That helmet that's above the screen is arranged in a set of six dots looking like a braille cell, so often, I'll refer to the dot numbers when I'm talking about those keys. So for instance, to change volume, I would use "dot 2" to decrease it and "dot 5" to increase it. To change the speech rate, I can hold down the "Control" key which is "dot 3," and then hit those same keys to change the rate. There's also a set of arrows above the screen so that when I'm in settings and so forth, I can arrow around those settings.

We're going to do two things-- click on here-- the table and a graph. To do the table, I'm going to hit the "STAT" key. Let's go ahead turn it on.

- [Calculator voice]: Home screen.

- Hit "STAT."

- [Calculator voice]: STAT, STAT, edit, menu.

- To edit. I'm going to just hit "Enter."

- [Calculator voice]: L1 open 2, 1 close 3 =--

- So now I'm at L1 which is basically my x's. I'm going to use x's of -1, 0, and 1, so I'll enter those.

- [Calculator voice]: L1 [INAUDIBLE] cube of 0, L1, 0. Clear, run, L1 over 2, 4 close 2.

- And now we'll go ahead and enter the y values, so I'll arrow to the right to get to the y column.

- [Calculator voice]: L2 open 2, 1 close 2.

- And I'm going to enter y values of 4, 1, and -2.

- [Calculator voice]: 4, L2 open y, L2 open then -2, L2 open then 4 close then =--

- And that's all there is to entering in a table, and, of course, those could be graphed. Let's look at a graph of an equation. So I'm going to get out of the STAT and just go to my y equals, which is the leftmost button just below the screen.

- [Calculator voice]: y equals, y run equals equation disabled.

- Now I'm going to-- it says disabled because I haven't entered an equation yet. So we're going to enter y = x squared - 5, so I just have to enter the x squared - 5 part. Let's say I forget where that x key is, there is a learning mode by just hitting the 2nd button three times.

- [Calculator voice]: 2nd set, help on. 2nd on.

- So now it says help on. So now as I press buttons—

- [Calculator voice]: 7.

--it is not registering on the screen until I find the key I want.

- [Calculator voice]: Press "G" for exit. [INAUDIBLE]—

- Now I can hit the "2nd" button three times.

- [Calculator voice]: --variables do say help off.

- And my help turns off, so it's just a toggle. Now, I can hit that x squared x key.

- [Calculator voice]: x.

- To do squared, I do caret 2,

- [Calculator voice]: Caret 2.

- And then I can hit -5.

- [Calculator voice]: -5.

- So x squared -5. Now, at this point, I want to graph it. The "Graph" key is just below the screen but all the way on the right. When I hit "Graph," it's going to make some tones, and that just means that it's working on the graph.

- [Calculator voice]: Graph. Graph screen. Graph precursor.

- At the point that those tones stop, now, I know my graph is on the screen. Now to play it, I'm going to hit the "Trace" key, and that "Trace" key is going to actually play that graph. So as the graph falls, the pitch falls. As the graph rises, the pitch rises. And it will also vibrate when it's below the x-axis.

- [Calculator voice]: [INAUDIBLE] playing equation 1. y 1 = x power 2 - 5. Graph style is line.

- If I want to play that back, I could again use those accessibility keys up above the screen, so I could hold down the "dot 6" and press the "dot 4" key, and it'll play it back for me.

- [Calculator voice]: Playing equation 1.

[END PLAYBACK]
On slide 10, we're going to start talking about the Desmos calculator, specifically around graphing. So I want to point out that there's a couple of useful links for you, the accessibility page, how to get started with graphing, the full list of keyboard shortcuts, and then you can also download keyboard shortcuts for graphing. So I want to make sure that your student gets that BRF file so that they have access to those keyboard shortcuts for themselves.

Let's go on to slide 11. And I want to get us ready for a demo where we're going to see how we use the Desmos graphing calculator to do tables, graphs, statistics, trigonometry, et cetera. So let's go ahead and watch that video.

[VIDEO PLAYBACK]

- The Desmos graphing calculator is a graphing calculator that is web-based. For that, I can just use it on a computer with a screen reader. When I go to the page—

- [Calculator voice]: Leaving menu standard, graphing calculator, dash, Google Chrome, dash, 0, left paren, [INAUDIBLE].

- --it takes me straight to the entry field, and, again, we're going to do a table and a graph. So to do a table, I can either do a keystroke or I can just type in the word "table."

- [Calculator voice]: T-A-B quote L quote L-E, grid, row 1, pole, one pole, and end.

- At the point that I finish the word "table," it has displayed a two-column table for me. And this time instead of entering all of the x's and all of the y's, I am actually going to enter the x-y coordinates for a point and hit "Tab" after each coordinate. So the first point is -1, 4. I'll do -1 tab 4.

- [Calculator voice]: Dash 1, 1, row 4.

- And then Tab to get down to the next point.

- [Calculator voice]: Row 2 pole, 1 pole, and edit, column 1, row 3.

- This point, I'll do 0 Tab 1.

- [Calculator voice]: 0, 1.

- "Tab" again to get down to the third point.

- [Calculator voice]: Row 3, pole 1, pole.

- And now I'll enter the point 1, -2 and, again, I'm just using the minus or the dash to do a -1, -2.

- [Calculator voice]: 1, row 3, pole 2, dash 2, 2.

- And at this point, my points are playing on the graphing screen and can be played. I can arrow between them. But let's go ahead and find an equation for this table, and I would do that by entering in a new function. And I do that by hitting "Alt-Control-X."

- [Calculator voice]: Alt Control X, expression 2, colon, edit, type, and text.

- Now, to type my equation, I'm going to do a basic slope intercept equation, so y1.

- [Calculator voice]: y1, subscript, 1, baseline.

- And now instead of an equal sign, I'm going to do a tilde, which is above the "Tab" key. So, I'm going to do "Shift Tilde."

- [Calculator voice]: Tilde filled, quote, y, quote.

- And then mx1 plus b.

- [Calculator voice]: mx1, Sub less, less b, quote, b, quote, quote, y, quote.

- Now, at this point, it's actually graphed a line through those points that were in my table, and it's giving me statistics for that equation including the slope and the y-intercept. The slope is m, which is -3, in this case, and the y-intercept is 1, which is b, in this case, and I can just "Tab" to get to that data. Now, to graph an equation only without a table of values, I'm going to get rid of these. I can delete out what's in there by pressing "Control-Shift-D."

- [Calculator voice]: Control Shift D, Control-Shift-D, expression one, colon edit.

- Now, I've been able to get rid of both my other equation and my table, and now I can just type in my new equation. So we're going to do Y = X squared - 5 again. So y =--

- [Calculator voice]: Y equals, equals, quote y, x, quote, x, quote, quote.

- And the exponent is "Shift 6." It's the "Caret" key.

- [Calculator voice]: Caret, superscript, base, 2, 2.

- 2 for squared.

- [Calculator voice]: Quote, y, quote =, quote, x.

- Now, I'm going to "Right Arrow" just to get down to baseline.

- [Calculator voice]: After superscript to baseline.

- And hit - 5.

- [Calculator voice]: Dash 5, 5, quote, Y, quote, equals, quote.

- At the point that I'm putting that in, it's actually graphing on the right side of the screen, but to get to that graph, I can actually, at that point that I hit that last number, it'll tell me what to do. So I'm to go back and enter that 5 again. So I'm going to delete it out and enter it again and listen carefully.

- [Calculator voice]: When 5, 5, quote, y, quote, equals quote, X, quote, squared minus 5 and graph. To audio trace, press "Alt plus T."

- OK, so it told me to press "Alt plus T."

- [Calculator voice]: Alt-T. Audio trace on. Use arrow keys to navigate. To hear the graph, press "H." To disable audio trace, press "Alt plus T." Expression 1 intercept. External with X colon 0, Y colon -5. Graph paper, X access visible from--

- So notice it told me a little bit about the graph and where the intercepts are, and it also told me to press "H" to hear the graph or the "arrows" to navigate the graph. I'm going to just press "H." it's similarly going to decrease in pitch as the graph goes down and then increase as the graph comes back up, and there will be a static sound as it's below the x-axis.

- [Calculator voice]: H.

[PITCH GOING DOWN]
[PITCH GOING UP]
[END PLAYBACK]

All right, I hope the video demonstration of how to use the Desmos Graphing Calculator gave you some really good information. I'm going to just point out that those keyboard shortcuts for equation area on the Desmos calculator, we have some mnemonics to help your student remember the functions. So for example, Control-Alt-E is what we use to focus on an expression, so we've got the E in Control-Alt-E and the E in expression. Control-Alt-X is to add an expression, so focus on that X in expression. Control-Shift-D, that's what we use to delete the current expression, so D for delete and D in Control-Shift-D.
When it comes to wanting to add a new table, you have two choices. You can do Control-Alt-T, so T for table or you actually can type the word "table," T-A-B-L-E, and as soon as you hit that E, then you're going to be right there ready to put in your data for your table. My last one is Alt-T, and this lets you audio trace, toggle to get to graph or back to equation, so T in trace is how I remember it.

Let's go on to slide 13 and just a couple more keyboard shortcuts that I have listed here. H to hear the graph, P for point of interest, X for X coordinate, Y for Y coordinate, O for move to origin, so O in origin, Alt-S is your basic summary of the graph, and Alt-PageUp or Alt-PageDown is going to let you move between graphs. So your student is going to need to learn these commands, and we, again, give you some reference material in our resource list.

Slide 14. Now, I really want to emphasize the importance of sharing graphs between the teacher and the student, and the Desmos calculator is a great tool for them to go both ways. So they can share a graph electronically using Control-Alt-S. The student can copy the link or the teacher can copy the link and they can send it to each other. So if the teacher is doing some graphing, they can very quickly share with the student. If the student is doing their work, they can share with the teacher to turn in their work.

Also, when we have a paraprofessional or a TVI who is preparing braille materials, the student can get the graph shared with them through Control-Alt-S. They can export that image then. They can select the graphic embosser that they're going to be using under their Size dropdown menu, follow the embossing instructions, and voila, they have that graph to give to the student. And we've listed for you the full set of directions on how to do that in the link on the slide that's also in our resource list.

Now, slide 15, I do want to point out that you can use a braille display or braille notetaker with Desmos, however, we do want to really let you know that there is some time that needs to be invested in doing the

setup, and so there are video instructions on our resource list. We give you a link to that. What we have found in our work is that most students tend to prefer using the computer keyboard and screen reader as opposed to the braille notetaker. Again, every student is different, so just know that this is a possibility. But there's so many notetakers out there that you're going to need to take some time to figure out what works best.

All right, let's go on to slide 16 and talk about why it's so important for your student to share their math work with their teachers. As we said in Lesson 5, our students really need to use their braillewriter when they're thinking through and learning a process about solving a math equation or other type of math work, but they can email their answer to their teacher. Students also need a way to label their work so they can find it if they need it again, whether they're studying, whether they're meeting with the teacher to go over something that's challenging them.

And students can keep their work in a folder or a binder so that they do have that for those later discussions, and once they're done with a unit, it's OK for them to purge that material when they no longer need it or they're going to be totally inundated with braille. But it's really, really important at the high school level that our students are taking responsibility for coming up with systems that work for them. Let's go on to slide 17 and talk about how the student's going to prepare a graph for the teachers, so lots of different options. They can use tactile graph paper and turn that in. They could use a tool such as the Graphic Aid for Mathematics, remember, that's the rubber board, and they can take a picture for the teacher, and we demonstrated that in Lesson 5 for you in one of the videos. They can use the Desmos calculator and email the link to the teacher as we talked about. They can take a tactile drawing board, such as the Draftsman, and then they can draw their graph and turn it in.

Slide 18. Now I want to talk a little bit about the fact that our screen reading programs, JAWS and NVDA, actually work with math. Now, as teachers of students with visual impairments, we know the screen reader piece, the JAWS, and the NVDA piece. The math teachers have their tools for producing mathematics. MathType and Equation Editor are two tools that are used in the Microsoft Suite, and as of January of 2021, folks, these tools work with JAWS.

So you're able to-- if your student's in a Microsoft environment, they're able to do braille output in Nemeth when they have their braille display attached to their computer that's running their screen readers. We have a link here on the slide and also in our resources to show you how this is done. But our students can use JAWS to access math that the teacher's created using MathType or Equation Editor.

From an NVDA standpoint, the student can use Equation Editor with the MathPlayer and MathType. And so you need to chat with the math teacher to find out how they're creating their problems, and then have your student try using both JAWS and NVDA if they have access to JAWS to see which is going to be more efficient for them with their particular technology.

You want to really encourage that student to dialogue with the teacher and for the two of them to talk about how do we deal with situations when the math is not being read properly because believe me, this

is going to happen and we're going to have glitches. Things are going to go south for the student, so that student needs to have a backup plan and work through that with the teacher.

Let's go on to slide 19 and talk about auditory information and braille displays. Now, an advantage or a pro of auditory information is that when the math isn't complex, you can really quickly get the information. However, a con is that when we have a high cognitive load with complex content, hearing all that auditorily and keeping up with it can be really challenging for a student.

If they have that auditory paired with their braille display, they might be hearing the information accurately, but they're not reading it accurately. And we give you an example, so it's highlighted in blue, the word why, W-H-Y, and the number written out, the number 2, the word "hundred," and the number 50. So I'll read a little bit of what my student is hearing, but pay attention to the why and the 250.

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 of 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."

Notice there's lots of other wording things in the way it is written out. But we wanted to just kind of highlight that why, W-H-Y instead of the letter Y, and the 2 hundred and fifty, the number 2, the word hundred, and the fifty is helping you realize that that's going to really challenge our braille reader who's having to listen to complex information and then is seeing something different. We have an example of an expression. "J squared times open parentheses fraction with numerator K raised to the sixth power and denominator K raised to the fourth power times K cubed, closed parentheses, raised to the negative third power." Again, that's a lot of information for our student to need to keep in their brain.

Slide 20 talks about the use of the brailler, and, of course, a pro as we've been talking about is it allows the student to work through longer multi-step problems and still view multiple lines quickly and easily. You cannot do that on a notetaker. Of course, the con is that it's not very portable, so if you can, you want to have a braillewriter that stays in the math classroom and one that stays in the home. Of course, that general ed teacher doesn't know braille so that can be problematic. And I know we've all heard this before, but the braillewriter makes noise, and the teachers have more problems than the kids. We all know that.

Slide 21 talks about the pros and cons of using a braille notetaker. So a pro, of course, is that it allows the student to work an answer instantly and to have that information displayed right there so that the teacher can see it, that they can email it to the teacher and it just pops up for the teacher. Con is that that student, again, can only see one line. And if the student doesn't use Nemeth correctly, then they're going to end up having gibberish.

And so it's not that they don't know the concept that they're being instructed about and being asked to show mastery of, but if they're off in their Nemeth knowledge, then that can impact their ability to demonstrate their knowledge.

It's really important that the student become proficient with Nemeth Code or math modes in the notetaker and also that process of emailing to a teacher. So that's a set of technology skills our students need to have so that they can interface independently with that general ed teacher.

All right, when we think about computers, a pro is that the content shows up in print for the teacher to see so they can look on the screen to see what the student is doing. The student has to know the computer keyboard and how to enter correct math symbols. So that's where that MathType equation editor come into play potentially.

Slide 23. Now, we're going to have some fun to end this lesson. As we were doing our planning, we talked about all the challenges that we see students facing, and there are so many of them. We picked nine of the more common ones, and what we've done is we've created scenarios that we want you to think through in this lesson. But you can turn around and use these scenarios with your students, so you can give them the scenario and see what options they come up with that they might use. Keep in mind there's almost always more than one option that can work, so we want you to think outside the box and we want you to encourage your students to think outside the box.

All right, so scenario 1, the student does not know what the teacher is writing on the board. I am sure this has never happened to any of your students. Pause for a second and think about what are three things that the student can do in this situation. The first one we came up with, they could work with the teacher to come up with a way of communicating when the teacher is not being descriptive enough. Simple. They could raise their hand to ask for clarification. The student can pull out the Draftsmen board and ask a peer to quickly draw the picture. So three options for scenario 1.

Let's go on to scenario 2. Student doesn't have enough room for their book and technology on the desk, so what are three things that you think that student can do? Let's pause for a second and see what you come up with. Did you come up with asking for a table instead of a desk? Put it in their notetaker on their lap, real simple. They could ask about having a small cart or table next to their desk. So these are simple ways that our students can advocate so that they are able to ensure that they can access and participate in the curriculum.

Scenario 3, the student forgot the Nemeth symbol for a ray, and they are beginning a new unit on geometry that uses that symbol. What are three things they can do? Let's go ahead and pause and see what you come up with. Did you come up with that they could look up the symbol online using something like the Nemeth Symbol Library or the Nemeth Tutorial? We talked about both of those in Lesson 5. They can look up the symbol in the Math Symbol Reference Booklet from APH, and for those of you who have been around the block a few times, they've revised this over at APH. It's looking really good, folks, so make sure that your student has a braille copy and if you're a print reader, you can get a print copy.

They could send a quick email or text to the TVI to ask for that symbol. I know a lot of you give out your information to your students and will text with them, and this would be a quick ask of you.

Let's go on to scenario 4 on slide 27. So the student has to measure with a ruler and there's no braille ruler in the classroom. There's not even one anywhere in the school. What can that student do? Go ahead and pause and see if you can come up with three ideas.

OK, well, they could definitely email their TVI and ask about getting a braille ruler, but that's not going to solve the problem when I need it right now in class. They can pull out some graphic art tape or tactile dots and have a peer place on each inch or every other centimeter on a regular ruler. So they're using the same ruler as everybody else, but they quickly have come up with an idea on how somebody can help them make that tactual. They could see if that classroom teacher has an old measuring tape that can be notched with a scissor. So coming up with on-those-fly ideas because they're not always going to have the tools that are accessible to them.

Scenario 5 and this is on slide 28. The student has no charge on the computer or notetaker they normally use. Oh my gosh. You personally have never been in this situation with my iPhone, right? So what are three things that student might be able to do to solve the situation?

First, they could find the power cord and sit by the electrical outlet. You know, sometimes we have to move our seat. They could pull out the Perkins braillewriter and use it until their technology is charged, and that's why it's great to make sure there's one in the math classroom. And if the computer loses its charge and they have a notetaker, they can grab their notetaker or vice versa. Now, I know not every student has multiple technology options, but if they do, many of our students have phones, so maybe they can pull out their phone even and use it. So they have options.

Slide 29 goes on to scenario 6. So there's a lesson on proofs and no one prepared the tactile graphics you need in order to access the teacher's lecture. Your paraprofessional at your school is absent today, so you can't even go to the para and say, hey, can you help me out? What are four things that student might be able to do?

They could ask a peer to help make the diagrams using a tactile drawing board and some print and braille stickers and to verbalize the proof so they can write it down. Now, that's why I love those APH Feel 'n Peel stickers. Those are great because they have the print and the braille on them. They can ask the teacher about working together with a peer. They can use the braille notetaker to take notes while the peer is talking through it. They can have a stash of tactile supplies in the classroom, so maybe a Wheatley board, the tactile drawing board, Graphic Aid for Math, tactile stickers, graphic art tape; you know, have a nice little stash of those types of things. And they can either have their teacher or their peer create last-minute graphics for them, or they can ask the teacher to email them the text and the math part of the proof so they at least have that information and then they can get the tactile graphic down the line when that paraprofessional comes back or they get with their TVI.

Let's go on to slide 30 and this is 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. So pause for a moment and let's see what you come up with.

We came up with three options. Ask the group to use the Graphic Aid for Mathematics or braille graph paper, the student could ask the teacher if they can work independently as they use different tools than other group members, or the student could explain to the group members that you need them to verbalize what they are drawing so you can participate in the design. So several options there for students all involve advocacy and making your needs known.

Let's go on to slide 31, scenario 8. You're feeling that you're falling further and further behind in Algebra class because you're not understanding the concepts. We came up with four things that the student could do. Why don't we pause for a moment and see what you come up with?

How about the student going in before school, after school, or at another time during the school day to get help from that general education teacher? Or the student could ask their TVI if they can meet with them to help them preview the material that will be covered in Algebra class. The student could have a peer explain the concepts that they're finding challenging. Sometimes another student explaining the information is better than an adult. Student could talk to their family about getting a tutor who can work with them on the material.

All right, slide 32 is our last scenario, so scenario 9. You're having trouble reading the graphic in your math book. So what can you do?

We came up with having a peer use a tactile drawing board to recreate the graphics, or the student can ask the paraprofessional or a teacher to reproduce the graphics another way so they're easier to read. Student might ask the TVI to work with them to see if they are missing any pieces of how to explore a graphic and get information, and maybe that TVI can teach them some strategies that they can use to approach the graphic more efficiently. Though our materials for AnimalWatch VI, Building Graphics Literacy are designed for a group that's a little bit younger at the middle school level, the student could practice their graphics literacy skills using those materials as a way to review how to approach line graphs, for example.

So, we hope that our nine scenarios that we've quickly gone over here with you will be helpful to you as you think about how you can support your students in advocating for themselves and solving some of these real-world problems that they potentially have now or definitely will have as they move into higher education and the workforce. So, take time to role-play with your students around these scenarios and other ones that you create for your students.

We want to thank you for taking part in Course 6. We hope the information we have shared with you about supporting high school students in mathematics will be helpful to you in your future work. Thank you.