Project INSPIRE: Course 6, Lesson 3 Transcript

SPEAKER: "Nemeth Code Symbols Used in High School and Strategies for Supporting Math Learning." This is "Lesson 3: Symbols for Advanced Math, Part Three." Slide two has the objectives. Participants are going to be able to read and write problems containing superscripts, subscripts, radicals with an index, functions, Greek letters, and you're also going to learn to use the five-step rule for Sigma notation. Slide three is a quick review of superscripts and an expansion on that concept. So a superscript indicator is dots 4-5. And remember, because we're away from baseline, we use dot 5 to return to baseline. Now, you don't use a baseline indicator if a superscript is followed by a space or if it's the end of a line. And if you have an exponent that's raised to another exponent, then you're going to need to use your superscript indicator twice instead of once before the second exponent. And I'm going to show you some examples here in just a second.

So my first example should look very familiar if you've taken our previous courses. This is a squared, plus b squared, equals c squared. I also could say a to the second power plus b to the second power equals c to the second power. So I begin with my a, my superscript indicator, which is dots 4-5, my 2, and then notice I have a dot 5 to return me to baseline before the plus sign. Very important to put that baseline indicator.

Then my b, my superscript indicator, and my 2 again, followed by a space, my equal sign, space, and my c, my superscript indicator, 2. And then because the space comes next, folks, I'm already back to baseline. No need to have a baseline indicator there after the b squared or the c squared because they are followed by spaces.

All right. Let's see if we can apply this concept to our higher level math. I have f inverse of x. So I'm going to begin with my f, superscript indicator, minus 1, baseline indicator, open parentheses, x, closed parentheses. Then my third example is e to the x squared power.

Ooh. That one sounds pretty hard math-wise, but our job is to braille it. So I've got my e, my superscript indicator, x, two superscript indicators because my x has its superscript of 2. So again, that's e, superscript indicator, x, superscript indicator, superscript indicator, 2.

Let's go on to slide four, and we're going to do a review of subscripts with no indicators. The subscript indicator is dots 5-6. And I'd like to think of that as being in the basement, because our subscripts are below baseline. When I have a variable or a function with a numeric subscript, I do not need to use a subscript indicator.

So let's look at a very common expression we see in math. A equals open fraction h over 2, closed fraction, open parentheses, b sub 1 plus b sub 2, closed parenthesis. So I start out with my capital A, space, equals, space, my fraction h over 2, close that fraction. I'm going to open my parentheses. Now I'm going to do b1 plus b2, closed parentheses.

You may be saying, well, wait. How does the braille reader know what this means here? Don't why don't we have a subscript indicator? We teach our braille readers that when you have a variable followed by a number that this is what it is, that it is a subscript. So they get it. Don't stress yourself out over it. They get it.

All right. Let's look at another example. The ordered pair x sub 1, y sub 1. So open parentheses x. I've got my 1 right afterwards. That's my subscript of 1, my Nemeth, comma, space, y, and then my 1-- that's subscript 1-- closed parentheses. Wasn't Dr. Nemeth really smart to give us this code? I'll tell you. He knew that we would be using subscripts a lot, so he wanted to simplify things for the braille reader.
Now, chemistry, H2O, water. So what am I going to do here? Capital H, subscript 2-- no subscript indicator needed, just H2 and then capital O. So just like it is in print, H2O.

We're going to go on to slide five. I'm going to look at examples of subscripts that use the subscript indicator and baseline indicators.

Now, again, if I have a space, I don't need to use my baseline indicators. I can end my subscript with a space just as I did with my superscripts. So let's look at the first example, a sub i. So I have my a, my subscript indicator, dots 5-6, and my i. My second example is read a sub n plus 1 equals a sub n-- then I'm going to go back to baseline-- plus 4.

So how do I braille that? Start out with my a, my subscript indicator, dots 5-6, n plus 1, space, equals, space, a, subscript indicator, n. Now, folks, I need my dot 5, my baseline indicator before that plus, 4. Okay. Take a good look at that. My last example on this slide is a equals open fraction v sub f baseline minus v sub i baseline over t close fraction. Let's look at how the third example is brailled.

A, space, equals, space, open my fraction, v, subscript indicator, f. I need to return to baseline for my minus sign, so I go ahead and put my dot 5 minus v. Now I need to do my subscript indicator, i, return to baseline because I need to do my fraction line to finish up my numerator. And I've got t, and I'm going to close my fraction.

So we're really following the imprint in applying our rules of when to use the subscript indicator and when to use the baseline indicator. Let's go on to slide six. Now, folks, we're going to be talking about logarithms with and without a subscript indicator. And we have abbreviations for a logarithm.
It can be abbreviated as l-o-g or as l-n. So you might be like me and might have thought that was a capital I, but it's l-n. And these are functions that should be followed by a space. If the log is followed by a subscript, then we don't put the space until after that subscript. So typically, that l-o-g or that l-n is followed by a space. But here's that exception, because there's always an exception.
If the log is followed by a subscript, the space comes after that subscript.

So I've got three examples here. My first example is log base b of a. So I'm going to braille out l-o-g, subscript indicator, b, space, a. Great. Very straightforward. My next one is log base 2 of x.

Going to braille. l-o-g, then my 2, space, x. And now I'm going to do my third example. Natural log of x equals log base e of x. So when I have the natural log, I'm using the l-n. You can talk to a math teacher about that. So here I have l-n, space, x, space, equals, space, log, subscript indicator, e, space, x. And I'm done. That wasn't too hard, was it?

Let's go on to slide seven, which is activity 3A. And it's time for you to braille four problems using the material we just went over. So when you're ready, come back and check your work.

All right. Slide eight has the answer key for activity 3A for problems one and two. Check to make sure that you braille these problems properly. And then on slide nine, that you also braille problems three and four properly.

OK. If you need to go back and review any material, please do. So here on slide 10, folks, we're going to talk about radicals, and we're going to start out by talking about square roots, which, for many of you, is going to be a review. So we open a square root with the radical symbol, which is dots 3-4-5. And we terminate, or end, our square root with dots 1-2-4-5-6.

So I have some pretty basic examples here for you. The first one is the square root of 1/4. So I'm going to open my radical with dots 3-4-5. And then I've got my fraction, 1 over 4. And then I'm going to end with dots 1-2-4-5-6.

My second example is the square root of 25 minus 3. So again, I'm going to open my radical, dots 3-4-5, 25, terminate dots 1-2-4-5-6, and then minus 3. If I was reading this aloud to a braille reader, I would say "square root of 25 end root minus 3" because I want to make it clear to them that that minus 3 is not part of the square root.

My next example is square root of x plus 7. So again, I'm going to open that radical, dots 3-4-5, then my x plus 7, and then my terminator dots 1-2-4-5-6. I would also read this to the braille reader using end root. So I would say "the square root of x plus 7 end root." And my final example is the square root of .49. So I braille my open radical indicator, dots 3-4-5, 0, my decimal, .49, and then my terminator, 1-2-4-5-6.

Slide 11 talks about radicals with an index. So my symbol for index of a radical, the indicator, is dots 1-2-6. Now I think it's visually important for our students to understand that, for print readers, that they're seeing that index outside of the radical. So for example, in my first example, the cube root of 64, the 3 is outside of the radical, and the 64 is underneath. So they may hear the math teacher talk about that and ask you about that. But from their perspective, how do we braille this? We begin with the index of a radical indicator, dots 1-2-6, then the 3, then I'm going to basically braille my radical.
So dots 3-4-5, in this case, 64, and then my terminator, 1-2-4-5-6.

My second example is the seventh root of x, end root, plus 3. And saying end root here is important because we want to make sure that the student knows that that plus 3 is not part of the radical. So I begin

with my index of a radical indicator, dots 1-2-6, my 7, my radical indicator, dots 3-4-5, my x, then my terminator, 1-2-4-5-6, and then my plus 3.

Slide 12 continues on with more examples of radicals with an index. So I have two examples here. The first one is the fifth root of open fraction, 1 over 32, closed fraction, end root. So I'm going to begin with my index of a radical symbol, dots 1-2-6, my 5, my open radical symbol, dots 3-4-5, that fraction, 1 over 32, and then my terminator, dots, 1-2-4-5-6.

My second example is the fourth root of 0.0016. So I begin with the index of a radical indicator, dots 1-2-6, my 4, dots 3-4-5 to open my radical, which is 0.0016, and then my terminator. So following that in print is so important.

Let's see how you do on slide 13 by interlining the problems in activity 3B. When you're ready, please come back.

Slide 14 is the first part of the answer key to activity 3B. And slide 15 is the second part of the answer key.

Let's go on to slide 16 and talk about functions. So "sine" is written as "s-i-n," "cosine" is written as "c-o-s," "tangent" is written as "t-a-n," "log," as we talked about, is "l-o-g" for "log," and then that natural "log" is "l-n."

Now, we'll see in my next example-- and we've already seen in previous examples-- that when we use l-n for the natural log, the constant, e, is often used with it. And I'll show you this on the next slide. Very important. When you're brailling functions, you are not going to use the English letter indicator.
Let's take a look on slide 17 at my examples.

So the first one is sine of 45 degrees. So I have s-i-n, space, numeric indicator, 45, and then my superscript indicator, dots 4-5, and my degree sign, dots 4-6, 1-6. The second example is cosine of A. So c-o-s, space, capital A. My third one is tangent of 2B. So I have t-a-n, space, numeric indicator, 2, capital B.

My next example is log base 2 of 8. So I have l-o-g, 2, space, numeric indicator, 8. Now, that 2 is my subscript. So just again, log, 2, and then space, 8. My next example is natural log of e to the sixth power. So I'm going to use l-n, space, e, superscript indicator, 6.

My final example is "Find sin A, comma, if cosine A equals 1/2 period." So I'm going to begin with the word "find", space, going to open up Nemeth Code, 4-5-6, 1-4-6, space, s-i-n space, capital A, Nemeth comma because I'm in Nemeth, space. I've got the word "if." This is just a single word. So remember, I'm going to use that single word switch indicator, dot 6, dot 3, if, space, cosine is abbreviated c-o-s, space, capital A, space, equals, my fraction 1/2, space. I need to terminate Nemeth, dots 4-5-6, 1-5-6, and then my period.

All right. Let's go on to slide 18. And we're going to talk about Greek letters. So the Greek letter indicator is dots 4-6. Common Greek letters include alpha, which is lowercase, so 4-6, a; beta, which is also lowercase, which is 4-6, b. Our friend pi, 4-6, p. Make sure you have some pie on March 14; theta, which is also lowercase, 4-6, th. And our uppercase Delta, which is for 4-6, D. So it's the Greek letter indicator, then the capital, and then the D.

All right, I've got some examples here for you on slide 19. My first one is cosine of 2 alpha. So I'm going to braille c-o-s, space, 2, Greek letter indicator, a. My next one is beta equals 30 degrees. So Greek letter b, space, my equal sign, space, numeric indicator 30 and then my degree sign, which is the superscript indicator dots 4-5, and then 4-6,1-6.

My third example is open angle bracket 3 comma pi close angle bracket. So my open angle bracket is dots 4-6, 4-6, 1-2-3-5-6, 3, comma, my pi which is 4-6, p, so that Greek letter indicator pi, and then my closing angle bracket 4-6, 4-6, 2-3-4-5-6.

Hey, I'm sneaking something in here on you guys. Let me give you another function. So this is a bonus function, which is secant, which is abbreviated s-e-c. So my example here is secant of theta equals 2. So s-e-c, space, my theta, which is 4-6, th, so that Greek letter indicator dots 1-4-5-6, space, equals, space, and then 2.

Getting near the end here on these examples. My next one is m equals open fraction delta y over delta x close fraction. So we're going to do the m, space equals, space, my open fraction indicator dots 1-4-5-6, my delta which, remember, is capitalized, so it's Greek letter indicator, capital indicator D, y, my fraction line dots 3-4. And then my delta which is Greek letter indicator capital letter indicator D, and then my x, and then my close fraction indicator.

My last example on the slide-- find sine of open parentheses alpha minus beta close parentheses. Going to have find, space, open Nemeth indicator, space, s-i-n for sine, space, open parentheses. For my alpha I'm going to have Greek letter indicator a minus, for my beta, Greek letter indicator b, close parentheses, space, Nemeth terminator, period.

On slide 20 we're going to talk about the Greek letter sigma, which is braille dots 4-6 capital S. And I'm going to show you an example here and then talk on the next slide about what we call the five step rule, which I'm actually applying here.

So I have the expression "the sum from i equals 1 to 5 of i." To braille this, I'm going to do a multipurpose indicator-- so my dot 5, my sigma which takes three cells, my Greek letter indicator dots 4-6, my capital, my S. Then I have my directly under indicator, which is dots 1-4-6, my i, space, equals, space, numeric indicator one. Then my directly over indicator, which is dots 1-2-6, then my 5, then I'm going to terminate, so dots 1-2-4-5-6. And then I have my i.

Let's go on to slide 21. And we're going to talk about five steps that you need to follow when you're brailling sigma notation. Now spoiler alert here, folks, you don't just go like 1, 2, 3, 4, 5. We go 1, 2, 3, 4, 3, 4, 5. So hang in here with me while I walk you through how we braille "the sum from i equals 1 to 5 of i." And you'll see that example down at the bottom of your slide.

So my first step is the multipurpose indicator. And then my second step is sigma, which takes three cells; that's 4-6 Greek letter indicator, dot 6 capital indicator, and then my s for sigma. So this is the expression that I'm trying to modify here.

Then I'm going to do step 3. And this is my modification for where I'm using either my directly under indicator or my directly over indicator. So-- and then in step 4 is actually what I'm modifying. And when I'm all done, I get to terminate and step five. Isn't that exciting?

So in my example here, I start out with step 1, my multipurpose indicator. And then step 2 is that sigma. So look down at the braille in example. I got 4-6, dot 6, my s. My step 3 is that directly under indicator, dots 1-4-6. My step 4 is, well, what am I modifying? In this case, it's an i. Then I'm going to do my space, my equals, my 1 and now back to step 3 with my directly over indicator dots 1-2-6. Step 4, what am I modifying? In this case, it's a 5. And then I get to terminate dots 1-2-4-5-6 and then I have my i.

We're going to go on to slide 22 and I have two more examples of sigma notation. Keep these handy when you have to browse sigma notation and life will be good folks. So my first one is "the sum from j equals 2 to 10 of 5j minus 3." So I'm going to just follow the five-step rule. So I'm going to start out with my multipurpose indicator, my sigma, dots 4-6, dot 6, s, my directly under indicator, j, space, equals, 2, my directly over indicator dots 1-2-6, my 10, terminator. Then my 5, then my j, minus 3.

My second example is the sum from i equals 0 to infinity of 2 open parentheses open fraction 1 over 3, close fraction, close parenthesis to the i power. Wow, this one's a big one, but I'm going to just follow those steps and I'm going to be able to braille it without a problem.

All right, so I start out with my multipurpose indicator dot 5, my sigma dots 4-6, dot 6, s, my directly under indicator, i, space, equals, space, my 0, my directly over indicator, my infinity symbol, dot 6, and then the full cell, my terminator. Then I have 2, and then my open parentheses, 1/3, and then my close parentheses, and then my superscript i.

Let's go on to slide 23, which is our last activity for this lesson. So in activity 3B we actually have six problems for you to braille. Because we're doing such high-level math here, we actually have a little helper box for you.

My colleagues keep sneaking in those new functions for us and so cotangent is actually written c-o-t. And you'll be using cotangent in problem 1. In problem 6, boy, they really want to trick all of us. They want to point out that you need to use a multipurpose indicator dot 5 between the two vertical bars, where the first is a closing vertical bar and the second is an opening vertical bar. And I know we haven't gone over that.

But the way I think about that is I just need to let the braille reader know one thing ends and the next thing is beginning. So go ahead and pause, braille out these six problems carefully, and when you're ready, come on back.

Slide 24 is the answer key for activity 3B for problems 1 to 3. So check your work carefully. Make sure you brailled everything correctly and that you understand why. And then slide 25 is the answer key for problems 4, 5, and 6 here in activity 3B.

Congratulations, you have finished Lesson 3, where we have really gone over a lot of the symbols that are used in higher level math. Lesson 4 is going to look at formatting when we're preparing materials at the high school level. So we'll see you back for Lesson 4. Thank you so much.