Project INSPIRE Course 6 Lesson 5 - Part 2

SPEAKER: All right. We're going to go on to geometry on slide 15. So we're saying goodbye to algebra for the moment, but you're going to see there's some overlap in the tools that our students use. Now, geometry in high school, we're getting to characteristics of shapes or triangles or quadrilaterals. All those good kinds of things. 2D and 3D figures. Area, perimeter, surface area, and volume. Oh, those are fun. Making constructions and proofs. And that will depend on the class how much the teacher gets into proofs. And then, also, they may be getting into some trigonometry. And again, that's going to depend on the curriculum and where the teacher is headed.

Slide 16 are some of our must-haves for geometry. And again, that braillewriter that we must have for algebra, we must have for geometry. Going to be using graphing tools again and materials. Having a draftsman or a similar type of device is really helpful for the students so that they have a drawing board. Shape stencils. These are just something you get, regular math stuff. They're nothing special for our visually impaired students.

But we do want to make sure that our braille readers have a protractor and a ruler that is labeled in braille so they can use that independently. And I really encourage you to get that APH catalog and go through the math section because there's all kinds of things like APH Art Tape, Graph Benders, those Feel 'n Peel stickers that I really love. So we put some of this information for you on the resource list. And your student, again, is going to need that scientific or graphing calculator, and we want to keep reminding you. The best person to check in with what the functions the student needs is that math teacher.

All right. Slide 17. When we're thinking about tactile graphics, and we've talked about tactile graphics in some of our other courses, we've talked about titles, keys, labels, lead lines for labeling, right angles, tick marks for congruency, arrows for parallel lines, dotted lines for lines that are hidden. So that key, title, and label stuff and lead lines we've talked about before, but now when we're getting into geometry. These right angles, tick marks, arrows, and dotted lines are specific to geometry, and we want our student using these at the high school level.

Slide 18 is talking about drawing 3D figures. I have a picture of the draftsman where I have drawn a cube and a cone using stencils, and these are just commercial stencils. What I've done at the high school level is I'm using dotted lines to show perspective. So on this slide, I talk about what the student needs to do to draw a cube or prism, a pyramid, a cone, or a cylinder so that the student gets that practice with drawing those shapes and getting the perspective of them. This definitely, for many students, will come into your pre-teaching time to make sure they're really comfortable with interpreting these 2D drawings of three-dimensional figures and knowing how to draw them, if that's required of them.

Slide 19 talks about approaches for illustrating word problems. And it's important that our students have their own method for creating the pictures that they need to draw to represent problems. So they have to be comfortable drawing straight lines, curved lines, and adding labels. So a problem that they may need to solve is we have a building that our student has drawn a rectangle to represent, and there's a ladder leaning against that building. So we're forming a triangle.

So the length of the ladder is 17. The distance from the ladder to the building, if I'm looking at the bottom, is 8. And then B stands for the distance from the ground to the top of the ladder. So the student's going to need to then solve for the value of B.

My second example is a circle with a diameter of 6. So my student has drawn the circle. They've put a dotted line to represent the diameter. And then they have labeled 6 for the length of that diameter.

Let's go on to slide 20, and let's talk a little bit about tactile graphics. Now, I hope you're familiar with the APH Geometry Tactile Graphics Kit. Now, this begins with drawings that we use in the earlier grades but then moves into more advanced concepts. And you can flip through this and find a drawing that is similar or exactly the same as what the student needs in the class. So you don't have to reinvent the wheel because some of these common graphics that we use in geometry class are already done for you.
I also really encourage you to go to the student's textbook and pre-teach with the student how to read the tactile graphics efficiently. If they are versed in understanding those tactile graphics in their textbooks, they're going to be able to put their focus on learning the math content. So you really want to encourage that student to look ahead to what's coming up in math. And if they have any questions, to get with you so that they're sure that they understand those tactile graphics.

Slide 21 talks about altitude or height on triangles, so our student needs to learn to look for the right angle. Now, I have a triangle on my bottom left that is drawn, and the two sides connect. Side A and side B connect, and where they connect, we're forming a right angle. I have three triangles drawn on the right side of my slide. And for these triangles, the height is a dotted line, and it is not a side of the triangle. So our student needs to learn to look for the right angle that's at the base of that dotted line.

On slide 22, we're going to really focus on those tactile graphic skills. There are different types of angles that we look at when we have parallel lines cut by a transversal. So what I've done is on a smaller Wheatley board I've just used the lines to make two parallel lines, and then a third one that's diagonal through those two lines, which we call a transversal. Now, in that, we're going to look at vertical angles and a linear pair first.

First of all, we want to look at one of those intersections, and there are actually four points at an intersection. So I might have the student just kind of put a dot or a square at each of those four angles at an intersection. Those opposite ones are actually my vertical angles, and I could do either set, but those opposite ones are vertical. The ones instead that are next to each other are a linear pair. So any two that are next to each other are a linear pair.

Also, we talk about corresponding angles. Now, corresponding angles are in the same general position. So for instance, if I look at the first intersection, and I place a dot in the upper right angle, and then, in the second intersection, where those four angles are, place one in the upper right as well, those are corresponding.

For alternate interior, the easiest way is to have the students place these dots wherever those interior angles are. Interior, meaning inside of the parallel lines. So there are four angles between the parallel lines. So I've placed a dot in each of those interior angles.

Now, alternate interior just means alternate sides of that transversal. So I can take two away so that I have one on the right of the transversal and one on the left. Those are alternate interior. Similarly, if I wanted to do alternate exterior, we would focus on where are those exterior angles? So I've placed the two clear at the top and the two clear at the bottom on either side of the transversal.

Now, alternate exterior would be those opposite sides of that transversal. So one left of the transversal and one right. So I have clear in my upper left and clear down on the lower right. So really focusing just on the overall concept of interior and exterior between the parallel lines or outside of the parallel lines. And then, opposite sides of that transversal.

So we're going to go on to slide 23 and talk about lines in a circle. And our students are often going to see lots of lines with a circle. And so teaching them to follow the line to see how that line interacts with the circle is really important, especially as we get more and more complex. So for example, our line labeled A is a chord, and that's a segment that connects two points on a circle. And you can see that on our circle here.

Our secant is a line that intersects the circle twice, and we have that labeled as B. So the chord is A, the secant is B. Our tangent is labeled as C, and that's the line that intersects the circle but only once. Our radius is line D in my example, and that's the segment that connects the center and a point on the circle. And then, my diameter, which I've labeled E, is the chord that goes through the center of the circle. So your student really needs to understand these different lines, what their meaning is, and have that skill to tactually follow the line.

And I'm going to give a plug for our students with low vision as well. When we get into geometry, and there's a lot of lines and angles and points and stuff, our low-vision students often will need some pre-teaching as well so that they don't get visually lost in these circles. I know we're focusing on our braille readers, but got to give a plug there for our low-vision folks like your narrator.

All right. Moving on to slide 24, I want to talk about angles in a circle. And I have two drawings here. The first one is a central angle, and that's the angle with its vertex at the center of the circle. And then, my inscribed angle is the drawing on the bottom of my slide, and that's the angle with its vertex on the circle. Now, keep in mind, we've drawn these here for you so that you're just seeing one thing, but I also could have a tangent or a radius or a diameter also drawn on the circle, so your student's going to be seeing multiple lines.

Let's go on to slide 25 and talk about ways that your student can engage with acute right and obtuse angles, for example. And this is where maybe your student wants to create a math journal where they have a page for each type of angle that describes that angle, and they create a tactual picture. And this is theirs, so they do what makes sense to them.

So for example, they might have the word "acute," and they might come up with their definition that it's an angle that is smaller than a right angle, and they might use the phrase "it's a cute, little angle." So what's going to make sense to that student to help them remember is going to be individualized, but encouraging them to have a way to remember the definitions and a tactual representation is helpful.

So your student can have some very simple manipulatives that they can use for themselves. So for example, they can have two circles-- you can even use paper plates, folks-- and you cut the radius on one of those circles, you interlock those, and then the student can make the different size angles. Not getting into measurement here, but just so that they can get that overall picture. So I have that shown on my slide.

I also just took two strips of braille paper, connected those with a brad, so the student can manipulate and make different angles. Another thing, classrooms have these Geo Sticks. Really easy to find in a classroom. The student can use those, let's say, with a square that maybe I have it made out of a puck type of paper. And the student can then manipulate those Geo Sticks against the corner of that square. So do I have an acute angle? Do I have a right angle? Do I have an obtuse angle? So the student can use these different tools to get the gist of what they're doing. Even their own folding cane has angles. Let's go on to slide 26, and I want to talk about the size of a right triangle. And this is so important that our students really understand how to find the different parts of a right triangle. This is really going to become important in trigonometry. So I have a right triangle drawn here, so I have sides A and B. My hypotenuse is C. My angles are A, B, and C.

So when my student needs to find a leg that's adjacent to the right angle, they need to know where that right angle is and what the word "adjacent" means. When they're going to find out what leg is opposite angle A, for example, they're going to need to travel through that triangle to get to side A. When my student needs to find the leg that's adjacent to angle A, then they're going to need to find angle A, and then they're going to need to look and see that the hypotenuse is adjacent on one side and line B is adjacent on the other side.

Now, I'm not going to get into trigonometry with you, but the trig teacher is probably going to talk about the acronym "SOH CAH TOA." So when the student is doing the "SOH," we're talking about the "Sine equals Opposite over Hypotenuse." And that's why it's so important that our student knows what a hypotenuse is and where that opposite side is.

Slide 27 talks about using graphics when you're doing proofs. Now, students can find it easy to mark things on their proof, such as congruent lines, by using Graph Benders, Wikki Stix, Graphic Art Tape, tactile dots. When the student has these available, then once they're done marking up their proof, they can remove them and move on to the next activity.

Let's go on to slide 28 and talk a little bit about when a student is going to have a tactile graphic, and that tactile graphic is going to have lead lines pointing to specific angles or lines, and how you should make sure that these lead lines look different than any other line on the graphic. So your lead line is the least significant line on the graphic. So you want to make sure that it's at least 3/4 of an inch long, so that way we know what it's actually pointing to, that the student has enough of a length to feel.

So it'd be up to even 1 and 1/2 inches long. You want to make sure that that lead line is as straight as possible. No arrowheads, folks. And it needs to touch the component it identifies at one end. So if it's pointing to a line, it needs to touch that line. You need to have at least an 1/8 of an inch from the beginning or end of the braille label at the other end of the lead line.

So I'm going to show you some examples here on slide 29. So I have both in print and braille a diagram that shows two parallel lines with one line that is perpendicular to them. And I have a letter C that is pointing to an angle. And you'll notice in both the print and the braille version that that lead line is touching the angle, but it is not touching the C. And this is really important.

Slide 30 has an example of a proof, and I know we talked about formatting proofs in Lesson 4. But I did want to just point out, as a reminder, that after we do the given and the proof, as the student is doing the statement and the reason, which in print are presented in a table with the statement in the first column and the reason in the second column, it doesn't work to do columns for our braille reader when we're doing the proof.

So for my first statement, I'm going to braille 1S period, and then what that statement is. Underneath it, on the next line that I come to, I'm going to do 1R period and what the reason is. And then I'm going to just alternate 2 statement, 2 reason, and so on. Very important with proofs that we teach our students a systematic way of doing them.

On slide 31, we're going to look at constructing triangles with specific measurements. Often, the students do have to perform different types of constructions. In this case, we're going to do it with specific sides and angles, so we're going to need a protractor for the angles and then either a tactile caliper or a ruler to measure the sides.

So we're going to do Side-Angle-Side, which means we're going to do a side of 3 inches, in this case, an angle of 45 degrees, and a side of 4 inches to make our particular triangle with those sides and angles. So first, I'll either set the tactile caliper at 3 inches, or I'll set my ruler at 3 inches. And then I'll go ahead and draw that line against that tactile caliper. So now I have a line of 3 inches.

Now, for the protractor, I need to make my 45-degree angle, so I have a single dot every 5 degrees, a double every 10, and triple every 45. So I'm going to actually go to that triple dot and make a 45-degree angle, and then I'm going to line this up. Now, the student's going to need to be able to feel that, so we don't want it right up against it. They will need to be a little bit away. They should be able to feel the end of that. And then once they are sure they are on there, then we can move it up towards there.

Now, we're going to start the angle but not finish it yet because we need to make it be a certain length. So now I'm going to change my caliper to 4 inches for the third side. And then we're going to go ahead and match that up and continue it until I get to the 4 inches. At that point, I have two of my sides-- my 3 inch and my 4 inch. My angle of 45 degrees. And then we can just connect those up to make our triangle.
Slide 32 talks about 3D figures and mat plans. And in one of our previous courses we did give some examples in our Course 5, so you can go back and take a look. But with mat plans, what our student is doing is they're looking at the top view of a solid with a number of cubes appearing in each vertical column displayed in a corresponding box. Folks, it sounds complicated. But, honestly, if we get out our 1-inch graph paper and our Omnifix cubes, it's very easy for our student to create mat plans.
And what we want to do, especially with our students who may be struggling with this abstract concept, is give them these manipulatives, even at the high school level. So I have a mat plan that I've done with Omnifix cubes. And what I have is I have, down at my bottom right, I have a picture where I have in my first row two Omnifix cubes and then one Omnifix cube, so my student is going to braille a 2 in the top left of the graph paper, and in the next column, a 1.

They're going to go down to the second row. They're going to feel their Omnifix cubes and see that again they have 2-1, so they're going to braille a 2 and a 1 in the second row of the graph paper. And then, when they go down to the third row, in the Omnifix cubes they're only going to see one, so they're going to braille a 1. So this is a way to represent, for the student, a mat plan.

Slide 33 talks about orthographic views. And we use StackUps from APH, that StackUp Kit, to help our students really understand the height. And in this StackUp Kit, the rough side of the cubes are really important for the student to feel. So for example, I have a photo on the left where I will see the mat plan is 2 and 2 in the first row, and 2 in the second. So my student is able to feel the rough texture on the top of each of those cubes and see that it's all the same height.

My mat plan on the right is three rows of 2-1, 2-1, and 2-1. And when my student feels the top, that rough texture on the cubes, they're able to tell that there's a height difference between the first column and the second column. So in our role as a teacher of students with visual impairments, we really need to make sure that we spend some time with our students, helping them learn how to interpret these 3D drawings. This often takes your previewing time with the student, your pre-teaching time, or reinforcement time. Don't just make the assumption that the student gets it automatically.

All right. Let's go on to slide 34 and talk about the Geometro. Now, this is a tool we start using with our students when they're a lot younger. So that APH Geometro kit has a workbook. It has the magnetic tiles and board. It has rod models. You can do your square, your prism, your triangular prism, your square pyramid, your triangular pyramid. Lots of cool things that you can do. And remember, Geometros come in mini and medium sets. But, especially by the time we get to the high school level, we often don't have enough shapes, so you may need to order two kits for a student who needs a lot of hands-on.

Now, I want to talk about what we really focus on in the high school, so I've got three pictures here. In the first picture, I have a picture of a cube that I've made with Geometro. Then, what I've done is I've taken the yellow rods, and I have put those around my cube. And this is something we really want our high school student to do. So they're going to put those yellow rods around whatever shape they made. In my case, in my second picture, it's my cube.

In my third picture, you can see I removed the physical cube, and I've laid the yellow rods flat. And what happens here is that the rods that lay underneath the other rods are representing that hidden ones that become the dotted lines in the picture. So when we think about that idea of teaching perspective, our Geometros can really help our students get that idea of perspective.

Folks, you have been doing a great job working with us to learn a lot about methods and materials. And as we wrap up this lesson, my last three slides are talking about the Nemeth Symbol Library webpage. So on slide 35, I have a screenshot of the webpage, and I do have the URL at the bottom of the slide. It's also in your resource list.

This is a resource that several of our Project INSPIRE team members-- Susan Osterhaus, Sara Larkin, and Tina Herzberg-- have created. It works with any screen reader, and you can use it with a braille display, or you can emboss the information that you can find the examples.

So on slide 36, I tell you a little bit about the Nemeth Symbol Library. And what it is, it's a glossary of terms used in math which can be linked to a description of how to write each in Nemeth Code related to that content. So we have-- they have-- your narrator is not part of it-- they have 240 terms and 136 definitions. So if you're a student needs to know the definition of "log," or they need to learn the definition for "sigma," they can go look that up. Several terms land you on the same description. So if your terminology is slightly different, you're still going to get where you're going. And that's important because not every teacher uses the same terms.

There's lots of examples. There's actually over 600 of the examples, and they're presented in three different ways. Nemeth in EBAE is both a brf file for students. Nemeth within UEB contexts as a brf file for students. And then Nemeth in Print and Simbraille for teachers.

Our last slide is slide 37, and it's really important that our students are taking responsibility for their learning. So there is a tutorial that you want your students to use so that they learn how the library is structured and how to move around in it. So they need to learn the keystrokes for navigating to a webpage and then around a webpage. And this isn't just for this library, but for all webpages.
They need to learn how to use Insert-F7 to open the link list and find the term they are needing. So if they need to know the definition of "cosine," they need to know how to get to that link list and do it. And we really need to make sure we're giving our students opportunities to practice looking up the definitions and

examples because the math content that is in this Nemeth Code Library goes with them to college as they do even more advanced math.

I hope that you've gotten a lot of great ideas from Lesson 5 here. We have one more lesson for you in this course, and that is about calculators. So we'll see you on Lesson 6. Thank you very much.