Project_INSPIRE_Course4_Lesson_3_Part_1

SPEAKER 1: Welcome to "Geometry and Tactile Graphics for Students in Grades 3 to 8". This is Lesson 3: Part 1, "Materials and Strategies for Geometry Instruction".

Slide 2 has the objectives for this lesson. You're going to be able to identify materials that you can use when teaching geometry and tactile graphics to your students who are in grades 3 to 8. We also want to make sure that you can recognize ways that you can support math instruction for your students who are learning geometry.

Many of the materials we're going to talk about today are from the American Printing House for the Blind. But as a TVI, a paraprofessional you're not limited to just APH materials. So, it's important that you check in with the math teacher to see what materials they have available.

But let's start off here on slide 3 with an APH product, which is the Math Builders Unit 6. And you get this on a federal quota. Comes all together so you're not doing a lot of having to look around. It also gives you a binder of lessons, a really cool Velcro board that we'll talk about later in the lessons with diagramming strips that you can use.

Geometros, which are one of my favorite products that we'll show you in a little bit, activity sheets, the Nemeth Code Reference Sheet for Basic Mathematics. This is in print and braille. And I do want to point out that this is focused on the symbols, not the rules about how to use the symbols.

And then two other things that come in this kit that I absolutely love are the 2-dimensional shapes and the 3-dimensional shapes. So, let's get ready to take a look at the 2-dimensional shapes. And I've got my assistant here who's going to help me demonstrate what we're doing here with a pentagon.

So, I've got a yellow 2-dimensional pentagon fitted on a rubber mat, because that's always great for our students. When I want my students to figure out how many sides there is in this pentagon, the important thing is that my student starts with an anchor.

So, my student is going to take her left finger, and she's going to place it in the top left vertex where those two sides come together. Now, with her right index finger she's going to start to count the sides. So, she's going to start up at the top, the first side.

Going to the right, the second side. She goes down that side, the third side down at the bottom. Swings over to the fourth side, now she's coming back up on the left to the fifth side. And her right and her left fingers meet up. She knows that she now has a five-sided figure or a pentagon.

Let's take a look at the 3-dimensional shapes that come with the Math Builder Unit 6. I have a triangular prism. And one of the first things I want to encourage my students to do is just to explore. A lot of times, gang, we want to just keep talking to our students. But we need to give them some time to explore on their own.

In math class, students are often asked to slice a 3-dimensional shape and then to give some information. How do you slice a plastic triangle prism? How about I just get out a simple rubber band. So, let's have my student here put her rubber band on the prism, the triangular prism.

And now what she can do, again using her fingers and anchor left index finger, she's going across each side. First side, second side, third side, fourth side. Fingers come back together, and she now knows that she has sliced this and has a four-sided shape, a rectangle.

So, I've given you a little introduction to the Math Builder Unit 6, and we'll come back and look at more of those materials. Let's go on to slide four and talk about the Geometry Math Window. Now, this is a kit that you can buy that contains a lot of stuff. So, you've got your symbols and expressions. And these are magnetic, and they have both print and braille on them.

You also have a flat board, which is on one side and raised grid on the other side. So, if I have to do that, you know, coordinate grid stuff, I'm all set up for it. 2-dimensional geometric shapes, so those are really helpful if I need my triangle or my parallelogram. I've got point markers, Wikki Stix. Attachable tile palette, very helpful so I can organize my materials. And it all comes in a canvas bag.

Some folks are really big Math Window fans and really want the student to use this tool to show their work, so to speak, to the geometry teacher. Other folks are more of the variety that this is a great tool to use for a last-minute thing that comes up in the classroom.

But let's have the student actually use other tools and their Nemeth skills in doing their geometry related activities. So, you really need to know your student and what's going to work best to allow that student to be independent.

Slide 5 has another one of my favorite APH products, and this is the Geometry Tactile Graphic Kit. This is actually a notebook. You probably have it on your shelf. But it's a binder that has some plastic raised geometry graphics. There are a ton of concepts that you can have your student practice with the diagrams in this notebook.

Another thing you could do is you can add braille labels-- make sure you peel them off-- for your student if there was, let's say, a specific problem. Just a few of the many things, parallel and perpendicular, the types of angles, congruence, area. You even have a model of the Pythagorean Theorem in here.

You can work on similarities. There's so much more. I can't even go into it. But all that stuff that's being covered in the geometry curriculum that your student needs to learn, here are some already made graphics.

So, let's take a look at two triangles that I've pulled up. So, the first one on the left is an isosceles triangle. Now, a couple things I want to point out with this isosceles triangle. On the long two sides, I have the tick marks so the student can see those. And also, the, the angle at the top, there's a nice tactual raised dot. I can use this to help the student learn what the general ed teacher is talking about geometry-wise.

I've got a really great equilateral triangle to the right of this. Notice that all three angles have the raised dots showing me where my vertices are. These are nice clear tactile diagrams.

Let's go on to slide 6 and talk about 2-D shapes. Now, I've already talked to you about 2-D shapes at the beginning of this lesson, but a couple more things I want you to think about when we think about third to fifth grade skills. Not only do our students need to be able to count the number of angles and the number of sides, they also need to be able to look at congruency.

So, are those sides equal? Are those angles equal? Parallel and perpendicular, which we'll get to in a little bit. They need to classify shapes. So being able to look at parallelograms and trapezoids and making classifications.

And it's really important as I told you earlier and I demonstrated for you with the pentagon that our students really need to learn that skill of those starting point. And that way they really count accurately with their sides and their angles.

There are a lot of great APH tools that can help you have manipulatives for your students when they're working on these skills. So, the Geometry Tactile Graphics Kit, the Tactile Tangrams Kit, I love that one.

The Geoboard, and I have a picture here of the textured sorting circles and shapes. And just as an aside though we're not talking about Venn diagrams today. This kit's really great because you actually can also use it when your student's doing Venn diagrams, let's say in English class. So, lots of ways to use our APH products.

Let's take a look at slide 7. It talks about a fourth-grade skill called symmetry. Now, the idea with symmetry is that the student is going to divide a shape in half, and those two halves are going to be equal. So, for example, drawing a diagonal line across a square. Now, in the general ed classroom for sighted children, they do a lot of paper folding.

So, my demonstrator here has a paper square that she has folded diagonally in half so that it goes from the top right corner to the bottom left corner. The nice thing for our braille readers is that they turn over. Once they've folded the piece of paper, that line is a lot easier to feel.

So right now she has it held as a diamond. So I have a triangle at the top, and a triangle at the bottom. Let's take a look at how I would do this with the Draftsman now. A lot of times we grab the stylus and we draw the shape. And my assistant has drawn this square, and she again has drawn a diagonal line. But you visually and tactually could very easily see that things are not equal here.

We are definitely not symmetrical. So, we really encourage you to use stencils. So, she's going to bring up a stencil of a square. And using the stylus from the Draftsman, she's going to trace the square. So, she's going to trace the left side, the bottom, the top, and the right side.

Now, when it comes time to draw that symmetrical line, she's going to turn the stencil on its side and use it as a ruler going from bottom left corner to top right corner. And when she pulls away,

I can visually see and I can tactually feel that that is a real square, and that I have two sides that are symmetrical.

Now some shapes are not just able to be divided one way, actually just about all shapes are. But circles are really kind of a fun shape. So, let's take a look at our circle stencil. So, my assistant has drawn her circle with the stencil. Now she goes to draw her symmetrical line. Well, there's lots of ways she could do that.

First, she could just draw a line that equally divides that circle. So, she's now doing from the top to the bottom. And she's using the side of her stencil as a ruler. But what if she took and/or made another circle, and this time when she goes to draw the line, she does not make it so it's equal?

So right now, she's making it kind of where she only has just a very small section on the bottom of the circle, and most of the circle is in the second section.

So, when my student compares the circle on the left where the line of symmetry goes from the top to the bottom-- and I have two equal sides that I could fold on top of each other-- that's very different from the circle on the right, where there's not a line of symmetry. I don't have two equal halves. I've a very small part at the bottom and a very big part at the top of the circle.

Slide 8 talks about points, segments, rays, and lines. Again, we're still at fourth grade here, and our student has a lot of things they need to learn how to do. They need to be able to tactually differentiate between points and arrows.

So, if you're drawing a line for a student, let's say using the Draftsman, it's really important that you make sure that that arrow at the end of the line is tactually clear. Close your eyes and feel it. Our students need to be able to track lines. They also need to notice where two lines intersect.

And they're going to need to be able to find those intersections on 2-D and 3-D shapes. And of course, they're going to be able to name what it is they're finding. So, we have a lot of those APH tools that are really helpful as I mentioned, the Draftsman, the Geometry Tactile Graphics Kit. I love my Peel 'n' Feel stickers and Braille-Print Alphabet Letters.

So, as you're helping your students learn about lines and points and rays and segments, you have tools at your disposal to make very clear and accurate depictions of what they're learning in the math class.

Let's take a look at a rectangle I've drawn with the Draftsman. I've used the Feel 'n' Peel stickers to do my labeling. The short side has a 10, the long side has a 20, and then the angles has an "a," a "b," a "c," and a "d."

One more thing I want to point out about using the Feel 'n' Peel stickers is you need to be really careful that the sticker doesn't cover the line of the drawing. So, if you look visually at this drawing that we have on the Draftsman, you'll notice that none of the stickers are on the lines, that I've made sure that they're not covering up the line so my student can go all the way around and feel the rectangle.

Slide 9 is another fourth-grade skill, parallel and perpendicular. And we want our student to be able to identify parallel and perpendicular lines in 2-D drawings. We also want them to be able to classify 2-D figures. So, for example, if I have a rectangle, I've got four right angles and I've got two sides that are parallel to each other on the short sides, and two sides that are parallel to each other on the long sides.

So, I'm going to use Wikki Stix to make a rectangle. And this way my student can see I've got the two long lines that are parallel to each other. And now I'm going to add in the two short ones. And so my student-- I've got one down. I'm getting my other Wikki stick-- and now my student can feel that the two long lines are parallel, and the two short lines are parallel.

My student can also see that the short line is perpendicular to the long line so that I can get these concepts of parallel and perpendicular. Now, one thing I like about Wikki Stix is that they are good for on the fly when something is needing to be shown right now. But don't plan on durability with Wikki Stix.

Let's go on to slide 10 and talk about angles. And we're going to actually talk about angles for the next couple of slides. We start with angles in fourth grade. And one of the first things the students need to learn is that it takes two rays to make an angle. And they need to learn how to name an angle.

So I have a large angle here, which is angle "D-O-A" made up of ray "O-D", and ray "O-A." Now, this particular angle has two other rays drawn, so I have "O-C" and "O-B." And I actually can talk with the students about this angle of "D-O-A" is composed of three smaller angles: "D-O-C," the second one is "C-O-B," and the third angle is "B-O-A."

So, our students learn terms like composing and decomposing, and they start to learn how to measure the angles. Again, lots of APH tools, I can use the Draftsman board, the Geometry Tactile Graphics Kit. Those Feel 'n' Peel stickers, you know how much I love those. Braille-Print Alphabet Letters. I've got the Feel 'n' Peel stickers that have the Nemeth and the print numbers up to 100.

So, you really need to have all these things on hand for the student to be able to produce the materials that they're going to need to learn to do things with angles.

Now I'm going to go on to slide 11 and talk about measuring angles, which we begin with in fourth grade. Our students need to learn how to measure equal, acute, obtuse, and right angles. And if you're like me, you're going now, which one's obtuse again? And which one's acute? I want to remind you that's where we really have to work with the math teacher.

Make sure that you as a TVI or you as the paraprofessional are getting that math content, because you want to use those accurate terms with the student. In fourth grade is when we start using a protractor. And for our students who are braille or needing large print, APH has a protractor that I'm going to demonstrate for you in just a second.

Our students also need to be able to classify 2-D figures based on the type of angle in the figure. So, I know that this is a square if it has four right angles. So, let's take a look at a couple different tools that our students can use for measuring angles.

I want to talk to you about the APH protractor. And this is a tricky tool, especially if you are a professional who is sighted. Because the way you want to use it, and the way our braille reader needs to use it are two different things. So first, let's get familiar with this tool. This has a plastic half circle that has tactile markings on it.

So, for every 5 degrees, I have one dot. For every 10 degrees, I have two dots. And when I get to 45 degrees, I have three dots. So, for the braille reader, there are no numbers. They happen to be there nicely for you, the print reader, which can be confusing for us print readers.

Now I have this blue wand that's very tactually clear, and it has an arrow. And it's that arrow that's the key for where my student needs to count. So, on my braille paper I use graphics art tape to draw an angle, very tactually clear for the braille reader.

The student needs to measure this angle. So, your inclination as a sighted person would be to put the protractor so that what would be the equivalent of a zero or the bottom line is on the bottom of the angle. This doesn't work for the braille reader because they can't feel the angle through the plastic, gang.

So, let me show you the way we'd like you to do it. So, what you're going to do is you're going to have your student take the handle or the wand, and they're going to put that at the bottom of the angle. And then they're going to take the edge of the plastic semicircle, and put that on the other ray of the angle.

So, the wand's on one ray, and the bottom of the plastic half circle is on the other ray. Now, my student is going to hold it in place and be able to count the number of dots 5, 10, 15, 20, and so on all the way up until they feel the point of the wand and then they're going to know how many degrees their angle is. And in this case, it looks like it is 50 degrees.

Visually, if you look where my wand is pointing, you see 130. And so it's not uncommon for you to want to tell your student that it's 130 degrees. And sighted students who are using protractors will also make this error. So, it's really important that you have your student focus on what they're feeling, how many dots ones, and how many dots of twos so that they're counting 5, 10, 15 all the way up to however wide their angle is.

Like to show you an APH product called Draw2Measure, which is another tool students can use when they need to measure an angle. So I've got my iPad. I've got VoiceOver on. I found my APH folder. I'm going to swipe until I hear Draw2Measure.

VoiceOver: Math Robot. Slapstack Math. Draw2Measure Protractor.

SPEAKER 1: Gonna double-tap to open.

VoiceOver: Draw2Measure Protractor.

SPEAKER 1: Okay. I'm now in the app, I'm going to swipe right until I hear Measure by Drawing.

VoiceOver: Measure by Drawing, button.

SPEAKER 1: OK. I'm going to double tap to open that.

VoiceOver: Place the angle on the screen, then triple tap the screen to begin.

SPEAKER 1: So, I'm physically going to put my piece of paper down on the screen and then triple tap.

VoiceOver: Place the angle-- please draw the first ray of the angle. Triple tap the screen to cancel.

SPEAKER 1: So with my finger, I'm going to literally draw the bottom line of my--

VoiceOver: Please draw the first ray of the-- first ray was drawn. Please draw the second ray. Triple tap the screen to cancel.

SPEAKER 1: So I'm going to draw that second ray.

VoiceOver: First ray was drawn. Second ray was drawn. Triple tap the screen to get the measurement. The angle is 43 degrees, 0.75 radians.

SPEAKER 1: So, one thing I want to point out, when I visually drew the bottom ray and then went to draw the second ray, so the one that was on an angle, I didn't have the two lines actually touch, those rays didn't touch. And the app still recognized it. So that's really important for our students.

Let's go on to slide 12 and talk about angle relationships with lines. Now we're at seventh grade. There's a lot of terms that our student is going to be learning: supplementary, complementary vertical, adjacent.

Your job, as the TVI or the paraprofessional, is to make sure that you understand these concepts, that your student has ways to represent these concepts. And so that when the teacher, for example, is talking about complementary angles and whose sums are 90 degrees, your student needs to be able to braille and read the degree symbol.

They need to understand how complementary angles are laid out so that they can then solve problems involving these types of relationships. Our Wheatley board and our Draftsman are two great tools as is some of the things that come with the Math Builders Kit.

So, let me go on to slide 13 and then I'm going to show you an example. When we think about angle relationships with parallel lines-- this is now moving into eighth grade-- our student's going to need to understand how parallel lines are cut by a transversal. So, you're going to need to understand concepts like interior and exterior angles, corresponding angles.

And again, I like the Wheatley, I like the Draftsman, and from the Math Builders Kit, I like the blue Velcro board, the yellow diagramming strips, and the nice little pink circles they have. They're really tactually clear. So, let's go to the video and let's just see how I use some of these tools to help my student be able to understand parallel lines cut by transversals.

So, I have the blue Velcro board. I have two yellow diagramming strips that are parallel. So I've got the one on the bottom and the one on the top. And then I've got a third diagramming strip that transverses, that cuts across those two parallel lines at an angle. If my student is doing interior angles, I can have my student look at those four angles that are between the two parallel lines.

Now, let's say I want my student to do corresponding angles. So, they can use one of the pink circles to mark one of their angles. So, we're going to do the one on the top right. And then a corresponding angle to that is on the bottom. And it's, again, on the top right of the bottom. So, my student can see how those two angles correspond to each other.

Continuing on with angles here on slide 14, let's talk about angle relationships with triangles. So now I'm in eighth grade, and one of the first things we're going to talk about is interior angles and exterior angles. And I want to go back and show you a quick little video snippet of using my Draftsman.

So, on my Draftsman I've drawn a triangle. Now, I've taken it at the bottom of the triangle and I've extended the line. So the student needs to understand that my interior angles are the three angles inside of the triangle. But my exterior angle is the angle that's formed between the side of the triangle and the extension of the line.

The other thing I want to talk about on slide 14 is this concept of our student learning angle sums. My total is 180 degrees, and I can form a straight line. So, what they typically do in eighth grade is the students make a triangle out of paper. And then they tear off two of the corners and lay them next to the other corner to see that they make a straight line.

Now, when our braille reader goes to tear off their corners, then they get a little mixed up on where everything was. So, the first thing you want to do is have your student use tactual markers, so little dots, and place one in each of the three corners. So, I've just placed one in one corner, one in the second corner, and now my assistant is placing one in the third corner.

So now she's going to rip off two of the corners of the triangle. So, she's just ripping, and she's laying it to the side. She's ripping the second one and laying it to the side. So now what she has to do is she has to line all three triangles up to see that she gets a straight line.

So, she's taken the two ones that she's ripped up and put them on either side of the point of the triangle she did not rip up. And then she can run her finger along and see that she has made a straight 180-degree line.

We've covered a lot of information in Part 1 of Lesson 3. In Part 2, we'll go on to be talking about measurement.