Project_INSPIRE_Course4_Lesson_3_Part_2

SPEAKER 1: Welcome to Geometry and Tactile Graphics for Students in Grades 3 to 8. Lesson 3: Materials and Strategies for Geometry Instruction. This is Part 2.

Alright, let's begin on slide 15. So, we're continuing along from Part 1, and we're talking about linear measurement. In third grade, students are learning to measure to a quarter inch. In fourth grade, they're working on relative size, and they're beginning conversion tables. Fifth grade, we're really getting rocking and rolling with unit conversions.

Now, regardless of what grade your student is in, when the teacher tells you that they're going to be doing measurement, one of your first questions needs to be, are the student's going to be doing standard, or metric, or both? And what length are they going to be doing-- foot or yard? When you have that information, you can then make sure your student has the right tools to be using in the classroom.

One of the hardest things for our students is to line up what they're measuring so they're getting that "0 point." So, they're lining up the edge with the edge of the ruler. I want to point out that the APH yardstick-- the zero on the print side versus the zero on the braille side, you need to make sure you're using the right side, and you're getting your 0s lined up. So, check that out.

Now, a great tool is called the tactile caliper. This actually is not an APH product, but you can get it from multiple sources. So, let me show you a demo of the tactile caliper.

[VIDEO PLAYBACK]

- Let's take a look at the tactile caliper. So, I'm going to have my assistant bring that onto the screen. This is a yellow plastic device. It has markings at the top for the inches-- so 1 inch, 2 inch, 3 inches, et cetera, all the way up to 12 inches.

Now, what makes this tool unique is the part of the device that slides. So, if you look at where she's pointing, you're going to see that in braille we have the slash dots 3-4, and 16. And to the left of that, we have some pins. And those pins come up based on where it's positioned. So it's now 2, 1, 0, 9, 8, 7 as she's pushing towards the left. So, this is telling us how many sixteenths of an inch the measurement is.

So, I've got a red square prism that she's going to measure for us. So, she's laying the tactile caliper down at the bottom of the square prism, and she's making sure that she lines the left side up with the left edge of the prism. She's going to slide the slider from the right to the left until she can't slide anymore. And it's going to click in, so you're going to hear a click.

The nice thing about this is she can now remove the tactile caliper. And for our purposes, she's going to hold it up for you to see as she moves her fingers to find out how many inches it is. So we're going to go across from 0 inches, and then 1 inch, and then 2 inches. And now she finds the slider. She's going to check on the pins to see how many sixteenths of an inch. So, it's 2 and 3/16 of an inch.

[END PLAYBACK]

SPEAKER 1: On slide 16, I have information about linear measurement tools. For example, for standard, we have yardstick in both braille and print, or the 18-inch flexible ruler that is also in braille and print. Metric tools include the meter stick. Now, this one only comes in braille, so be careful if you have a print reader who needs a meter stick. The 30-centimeter flexible ruler is in braille and print, and so on.

And then, of course, we have the combined tools. The 1-foot braille ruler-- so that one's not in print. Those great little toss-away rulers-- 7 inches on one side, 17 centimeters on the other side, both in braille and print. And you've got your talking tape measure. So, you find out what the student is going to be doing measurement-wise and then what tool's going to be appropriate.

Alright, let's go on to slide 17. And we're going to get into graphing-- so coordinate graphs. Now, starting in fifth grade, we are having a student work in quadrant 1. So, the values on the x-axis are positive, and the values on the y-axis are positive. Our student's going to learn terms like axis, origin, ordered pair, coordinates, and not just saying those terms but really knowing what they mean. They're going to practice basic graphing-- so graphing a point, finding the horizontal and then the vertical value of that point.

When we move into sixth grade, we add a lot more skills. So, I have a shape, a polygon, and my student needs to be able to find the distance between the points. So, they're going to need to find those distances, both on the x-axis and on the y-axis, to get those coordinates.

There's a lot of great tools that we can use-- the Graphic Aid for Mathematics, tactile graph paper-- tons of different versions of that so that you can get the size that works best for the student. And then your student can use pushpins on a corkboard, or brass fasteners, tactile stickers. They can even use a hole punch and make their own dots.

So, let's go ahead and look at how my student, as a fifth and sixth grader, would do these skills to build their knowledge of coordinate planes.

[VIDEO PLAYBACK]

- Alright, let's take a look at a piece of APH graph paper. And I have cut this down, so I have an 8 by 8 grid. And you'll notice at the top that my paraprofessional has helped me out by having used a hole punch and cut out some dots. So, I have three of them up there that I can use for my points. Hint here-- don't put the dots on too early because they lose the sticky really fast.

So, the first thing I want my student to do is get familiar with the x-axis. So, I'm going to have my student go along the bottom. We're going to talk about the x-axis, that each square has a value of 1. So 1, 2, 3, and so on. Then I'm going to make sure my student understands the y-axis. So, I'm going to have my student start at 0, 0. And we're going to go up, and we're going to talk about 1, and 2, and 3, and so on up to 8 so that my student really understands how this graph is set up.

Now it's time to learn about putting the points on. So, I want my student to do the coordinate pair 4, 2. So the math teacher is really stressing that the 4 is the value on the x. So, I'm going to make sure my student can count to the fourth-- so going over to 1, 2, 3, 4. And now I want my student to go up 2 on the y. It's 2, so we're going to go, 1, 2.

Now, I want my student to keep that right finger there while she gets the dot with her left hand from the top, and brings it down and puts it on the value of 4, 2. And I really like my students to go back and confirm. So, I would have my student, again go 1, 2, 3, and 4 on the x-axis. And now go up 2 on the y-axis. And yep, that's where I left my point.

[END PLAYBACK]

SPEAKER 1: Let's take a look now at sixth grade skills. And I'm using my Graphics Aid for Mathematics. So, the first thing I did was I created the x and the y-axis using pushpins and a rubber band. So basically, I just put the pushpin down along the x-axis on the left and on the right, and wrapped my rubber band around that. And the same thing for the y-axis. I placed another pushpin at the origin, 0, 0.

Now, I want my student to work on their polygons using coordinate pairs to draw these, and also working on the distance between points that are on the same axis, like the x-axis. So, I'm going to have my student do graphing of a polygon here. So, the first thing I want her to do is to put a pushpin at point 2, 5.

So, she's starting on the origin, where I've put a pushpin, so that she can get oriented. And she's going to go 2 to the right on the x-axis, and she's going to go up 5 on the y-axis. She's holding her finger in place, and she's putting her pushpin.

And again, I really like my student to double check that she's done it right. So we're going to go over 2 on the x-axis and up 5 on the y-axis. And for the sake of the video, I'm not going to have her confirm each of her other points, but you're going to have your student confirm.

So, I want her to go ahead and do the point 2, 2. So she's going to count over 2 on the x-axis and up 2 on the y-axis and put her pushpin. Now she's going back down to the origin, and I want her to go ahead and do 7, 2. So 7 over on the x-axis and now 2 up on the y-axis. And she's putting her pushpin.

Now, you're smart enough to know she's made a triangle. She's going to take a rubber band and connect those three points. And we can see that she's now created a right triangle. So, she can feel that shape by feeling the rubber band.

Alright, we're going to go on to slide 18, and then we're up to seventh grade. And an important skill our students learn in seventh grade is scale drawing. And this is where they're solving problems involving scale. So, what's the relationship between the two figures? They're going to actually compute the actual lengths and areas based on that scale.

The Graphics Aid for Mathematics is a great tool to use for this. And I have a photo, so I want you to carefully look at this photo of a student who's working with this tool. Now, in quadrant 1, using the Graphic Aid for Mathematics and rubber bands and pushpins, the student has made a triangle on the left and then a triangle that is twice as big on the right. So, we're comparing this scale between the one on the left and the one on the right.

In the bottom of this, in quadrant 4, the student has drawn a rectangle, again with the pushpins and the rubber band, and then inside of that rectangle has drawn a smaller rectangle half the scale of the large rectangle, and is comparing the two of those.

I use the same materials for scale drawing that I use for coordinated planes that we already talked about-- the Graphic Aid for Mathematics, tactile graph paper, and all those hands-on manipulatives like the pushpins, and the brass, and the stickers.

Alright, we are rocking and rolling here with our coordinate graphing activities. Moving on to slide 19 for transformation-- eighth grade skill. Now, there's a lot of concepts that we work on-- reflection, which is flipping, translation, which is shifting, rotation, which is turning, dilations, making larger or smaller.

This is a great time, if you're not strong in math, to make sure you're on the right page with that general ed math teacher and that you understand these concepts. So, then you can make sure your tactual learner understands the concepts and can actually demonstrate them.

We're going to use the same types of tools that we've been using for the last couple graphing activities-- that graphics math aid, tactile graph paper, pushpins, and all that stuff.

Now, I want to just do a quick little video demo here with you, because sometimes it's not necessarily that we need to know the coordinates. So, if you look at my video, you'll see all I've done is basically make a cross. I've made the x-axis with one Wikki Stix, and the y-axis with another Wikki Stix, and real simple.

What I'm working on in the class is reflection. So, I'm going to use one of my felt shapes that have sticky on the back. And so I have a green rectangle. My student has usable vision. I do want to make sure I have high contrast. And I'm placing that down in quadrant 1.

Now, the students are working on, well, what does reflection mean? Reflection on the x-axis-- I'm going to take a second rectangle, same shape, and I'm going to put it below the x-axis so that the student can see how the shape reflects on the x-axis. So that would be down in quadrant 4. If we're doing reflection across the y-axis, my student is actually going to put the shape in quadrant 2. And that way my student can feel that, hey, these are the same, and they're just mirrored. They're reflected.

Slide 20 talks about the Pythagorean Theorem. And this is an eighth-grade skill where we have our triangle, and lines a and b, the legs, are going to form a right angle. And the hypotenuse is c, and that's the side that's opposite that right angle. And I'm going to show you how to draw this for our braille reader in just a moment.

The idea here is that the student's going to learn to solve for the unknown side using that famous theory-- a squared plus b squared equals c squared. When your student is doing this on a coordinate plane, they're going to need to learn how to count the lengths of side a and b. So you're going to use graph paper or the Draftsman. And I'm going to show you the Draftsman in just a moment when the student's drawing. If they're going to be actually solving problems, it works really well with a braille writer.

So, let's take a look. We're going to draw and label a right triangle. Now, I have a stencil. This particular stencil has five types of triangles in it. But you'll notice that the right triangle on the bottom left is pretty small. So, I'm not going to use that because it's too small for my braille reader. Instead, I'm going to take my rectangle stencil and go to the large rectangle. And I'm going to draw two sides of my triangle.

So, I'm going to draw side a, which goes from top to bottom, and side b, which goes along the bottom. And so now I have two out of the three sides of my right triangle. I'm going to use the side of the stencil to draw that diagonal line, what we will label as c.

So, I have done this on my Draftsman. I've got my triangle. Now I need to label it. So, I like my feel and peel stickers. So, I'm going to get my a sticker, and I'm going to label it on the left side. And I'm going to be sure that I label it so that my edge of the sticker does not go over the line. I'm going to label the bottom line b. And I'm going to label that diagonal line c.

So, my braille reader can now go tactually around the perimeter of this triangle, stopping to feel the stickers to find out the sides and their labels. If my student was doing numbers, you know, figuring out the length of side c, then I could use my feel and peel number stickers.

Let's take a look at the picture that's on this slide. I have a rectangle with the long side 8 centimeters, and the short side 4 centimeters, and a diagonal line going through it. And you'll notice that this rectangle is actually two right triangles put together. So that side c, the hypotenuse, we don't know the length of it. And so our student needs to figure out the length of that diagonal line, and that's where this Pythagorean Theorem comes in.

Alright, slide 21 goes on to talk about perimeter. So, we're going back to third grade, where our student needs to learn if they have a square on a piece of graph paper, for example, or a rectangle, how many squares make up that shape. And to do that, they're going to find the length of each side, and they're going to determine the length of missing sides based on what information we've given them.

I find it really helpful to use the feel and peel number stickers to label the missing sides so that the student, as they decide the length of it, they can add the sticker right onto the shape. So, lots of tools that we've already demoed and talked about-- my Draftsman, my Geoboard, my graph paper-- are all different tools that your student can have at their disposal when they need to calculate perimeter.

Alright, I'm going to use my Draftsman to have my student determine the length of a missing side. So, the first thing-- it's really important with our students, when they have a shape, that they

make sure they're going to use an anchor as they explore it. So, my student's going to start with her left pointer finger in the top left corner of the shape. Now she's going to take and go down with her right finger from that finger. And oh, this side has a label of 9.

So, she's now going to go down, and she finds the next side. She's going to go across and check that out. And she sees that there's a label of 18. She's really going to check it out. Wow, that's a really long side. From there, she's going to go up. And that's a pretty short label till I get to the 3. Yeah, that really is a short side.

Now I'm going to keep going up. Oh, I go off to the left. Oh, there is no label. Hmm. Okay. I'm going to go up from there, and there's another side without a label. Okay, I've got two sides that don't have a label. At the top, I'm going to go across. There's an 11. And I'm back to my anchor finger.

So, my student's now explored this shape. Okay. So how does my student determine the length of that? This is, again, where I need to work with the math teacher. How is this skill being taught?

Okay, I need to look at that side that's 18, my longest side in this case. And the parallel side to that, I have 11, and then it stops. So 11 plus what equals 18? 7. So I know that the length of that missing side at the top is 7. So I'm going to go ahead and put my 7 sticker there.

And I see the side on the left is 9, and the side on the right is 3. Okay. 3 plus what equals 9? 6. So, I know that the other side that is missing is a length of 6. So, the missing part of this shape is 6 by 7. So, I would then be able to answer my question for my teacher and have a visual representation for that teacher to see my work.

Area is the topic of slide 22. So, in third grade, we're learning tiling. Basically, we're learning to count the number of squares that make up the shape. When we get to 4th to 7th grade, we're going to start adding in the formulas for determining area. Now, it's really important with our students that we teach them to count accurately. Because if we don't get that down in third grade, guys, if they can't count the squares accurately on a piece of graph paper, everything else is going to really go downhill really fast.

So, you want to spend a lot of time with the pushpins, with the Wikki Stix to mark, you know, the number of squares they've already counted. You want to teach them to use that anchor finger. Really, really important that they have a systematic way to count. And then, as they start to learn the formulas, they're going to be able to apply.

Now, we also get into what we call decomposing shapes. And that's where we're going to take that shape apart. So, you can use Graphics Art Tape, Wikki Stix, or other tools to help them see, hey, I can take this rectangle, and I can make it into two right triangles. So that idea of, how am I manipulating that shape? I also really like the Tactile Tangrams and the Geoboards-- really great tools for helping our students understand the concepts behind area.

So, let me show you how my student can use the APH Tactile Tangram Kit to decompose a shape. So, this comes with plastic overlays that are raised with shapes on them. So, I have the

right pointing arrow, and I actually have two blue triangles that are foam and a Wikki Stix. So, let's put this to work.

First thing my student's going to do is take the Wikki Stix, and she is going to draw the line that's going to separate the pointy part of the arrow-- so we have a big triangle-- with the square part. And she can trace over, and she can feel that she has a square. And she can trace and feel that she has a triangle.

Now I've got two right triangles that are with the kit. And she can take and put those into the triangle of the arrow. So, she's actually going to decompose that big triangle into two smaller triangles using her two right triangles. Very nice.

Now she can take those same blue, foamy triangles, and now she can decompose the square. And now she has put those together and made a square. So, lots of ways for my student to manipulate and understand how we see shapes inside of shapes.

On slide 23, we begin to talk about circles. And in this case, we're really at the seventh-grade level, because our students are getting into some of these circle related concepts, like radius, diameter, pi-- don't forget Pi Day on March 14-- circumference, and area. Now, we're not going to talk today about how your student is going to calculate circumference and area. But I do want to point out it is important that they use a scientific calculator when they are doing that computation.

How can you draw circles for your student? Well of course, you can do the Draftsman. And we've shown you that several times. But in this video, I'm going to show you how I use a rubber pad and the tactile compass for math and art. So let's go ahead and watch this video.

So, the first thing you'll see is that I have my rubber pad. And by the way, you can order this separately from APH. I put my braille paper on top of my rubber pad, because, obviously, I've got to have the braille paper on top of the pad. Now, let me show you my tactile compass for math and art. So, let's take a look at this device.

Now, this is a metal device. It has different notches on it so I can click in. But I want you to notice that it has two wheels. So, the wheel I have on the right actually is a 2 wheel, and the wheel in the middle is 1. If you're just drawing a circle, you're going to use the single wheel. But why in the world do we have two wheels, you might be wondering. If you're drawing a Venn diagram, it's really handy to have that second wheel so that you'll have a texture that's different between your two circles.

I'm going to go ahead and take off the wheel that has the 2. So I just pulled off the rubber tip. I'm unscrewing it, and it's gone. So now I have my pin, and I have my single wheel. I need to think about how big my circle is going to need to be. And I'm going to put my pin in the middle, and having adjusted my wheel so I can get the right circumference of my circle.

I'm going to hold the pin in place, and I'm going to move the wheel. And I like to start with moving it as far away from me as possible. And so now I've made my wheel going around. I'm

going past 12 o'clock, 3 o'clock, and back down to 6 o'clock where I started. And I can pull that away. And it's hard to see on my video, but once I flip it over, you can see, as I've held it up, that you can see the hole from the pin in the middle and how I've made the raised line. So, I had to flip over my paper-- key.

Now, how do I draw a radius in this wheel? I'm going to go back to the back of the paper, and I'm going to get my sewing wheel that I can pick up, you know, in any Walgreens type of store or JOANN's Fabric. And I'm going to actually use this sewing wheel-- it's looks like a little mini pizza cutter-- to make my radius. And I'm going to use any straight edge. I just happened to pull out my tactile caliper, but it could be a ruler. And I'm going to draw that radius on this circle. Again, I'm going to flip over my paper. And I'm going to be able to tactually feel the radius.

Congruence is our topic for slide 24. And this is an eighth-grade skill where we're really looking at the same shape and size. That's really what congruent means. Now, one of the key things our students need to learn how to do is to read tactile markings on a graphic. And that way, they're able to tell what sides and what angles are congruent, or the same.

I have a print picture here of a triangle that has been divided in half. And you'll see that down at the bottom, there is one tick mark on the left and one tick mark on the right, showing us that those two are congruent. And on the left and the right side of the triangle, there are two tick marks, showing congruence. Doesn't matter how many tick marks, which one is the one or which one is the two. The point that the student needs to understand is that those sides are the same.

The same thing with the arcs that I have in the angles. So, the bottom left and the bottom right angles are congruent. So I have one arc. And at the top, the left and the right are congruent. So, I have two arcs. Now, I'm going to show you in a minute how we do this for our braille reader using the Draftsman.

But I do want to point out that sometimes the student is going to need to estimate. So, we're not talking about an exact measurement. And I'm going to show you how to do that with an index card. But sometimes our student does need to be exact, and that's where the ruler or the protractor comes in. You know, I think you're figuring out here that we use the Geometry Tactile Graphics Kit, our Draftsman board, our stickers, and our Wikki Stix, as we've been using throughout this lesson for geometry concepts.

Let's go ahead and look at the video. I've already taken with my Draftsman, and I have drawn a triangle. And then I've also drawn an angle. But let's start out focusing on the triangle. I want my student to determine if this triangle has congruent sides.

So, the first thing I could have my student do is to take an index card, and my student is going to measure the length of the bottom side and just fold that index card a bit to make a crease. Now, just for our visual learners here, we're going to go ahead and make a black line on that crease just, just to make it easier for this demo. We would not have the tactile learner do this.

Now I can take that same index card, and I can move it to one of the sides of the triangle. So I'm going to go with the left side just so we can see that that crease lines up with the top point of that triangle. So that's one way your student can check for congruency.

Now, sometimes my students need to determine whether they have an acute triangle, a right triangle, or an obtuse triangle. So, this index card can also come in handy for this activity. So, I'm going to take my index card, and I'm going to place it so it is at the bottom of the triangle. So, the edge, I'm lining up the left edge with the bottom left of the triangle. And now I can feel. And I am not feeling the other line of the triangle because this is an acute triangle, which means it's a cute little triangle hidden by the card.

Now, just for demonstration purposes, we're going to look at the angle that I have drawn on the right. This is an obtuse angle. So, when I line that card up with the bottom of the angle, my student can feel that the ray on the angle is visible. So, we know that this is an obtuse angle.

Now that I've determined that my triangle sides are congruent, it's time for me to mark them. I'm going to use Wikki Stix. So, I've cut my Wikki Stix into small pieces, and I'm going to place one Wikki Stix in the middle of each of the three sides of the triangle to show that those three sides are congruent.

Now, my angles are congruent as well in the triangle. So, for that, I'm going to use raised dots. So, I'm going to place one in the top, a second dot in the left, and a third dot in the right angles of the triangle. So now I've shown that I have an equilateral triangle.

Slide 25 takes us to one of my favorite products, as we start to talk about three-dimensional shapes. Now, in sixth grade, our students are going to learn how to represent 3-D shapes using nets made up of rectangles and triangles. And I'm going to show you how to do that in just a minute.

In seventh grade, they're going to be able to describe 2-D figures that result from slicing a 3-D figure. I want you to think about using those geometric forms that we've already looked at. So, we already saw the square prism, for example. And then I want you to think about using one of my favorite products, the Geometro Sets, and you can get these in mini, medium, and large.

So, let's look at the sixth-grade scale on my video, where we're going to talk about how you use 3D shapes with nets. So, I have laid out, from my Geometro Kit, the square. And this is going to be the base of my square pyramid. So, if you're having your student work with nets, we always start with first laying everything flat. So, I have four triangles, and I'm going to use the triangles to connect.

And so you have the Velcro, so it's going to hook together. So, place my first triangle down on the right. I'm going to place my second triangle at the top. So these are connecting to my square. My third triangle on the left. And my fourth triangle on the bottom. So, I now have attached the triangles to the square, and this is called a net.

How does my student understand how this two-dimensional figure becomes three-dimensional? They're going to fold the triangle sides up. And again, they loop together with the Velcro. My student now can explore their square pyramid. So, she's able to see that there's squares on the bottom and that the four sides are triangles.

Slide 26 talks about surface areas, which is a sixth-seventh grade skill. And we're going to be using nets to find surface areas of 3-D shapes. So, let's go back to the video where I have my square pyramid. And this is put together, so the first thing I'm going to have my student do is pull those triangles apart to create the net.

So, I've now pushed the four triangles apart. So I've got my square in the middle and my four triangles. My student is going to be able to determine the surface area by adding up the area of the square with the area of each of the four triangles. And that will give my student the surface area of the square pyramid.

Also, on slide 26, we talk about using formulas to find area. And one tool I really like for this is the StackUps, which is another APH product. So, in my video, you'll see that I've used my StackUps to create a rectangular prism. It's got six blocks on the top and six blocks on the bottom.

So my student is able to count up the number of blocks on the top, which is 6, and the number of blocks on the bottom, which is also 6, the number of blocks on the side, which is 4 on the left side, 4 on the right side, and the 6 blocks in the front, and the 6 blocks in the back. And by adding all of the areas together, my student finds out that the surface area of this rectangular prism is 32.

Slide 27 gets us into volume of prisms. And volume is the last topic we are going to talk about in this lesson. So, let's start with the fifth-sixth grade skill of being able to use unit cubes to form a solid figure, and then being able to find the volume of that figure by counting the cubes. Now, if I, let's say, have a rectangular prism-- and we just made a rectangular prism with our StackUps on the last slide.

So, if I have that rectangular prism, I'm going to need to find the length of each edge of that prism. So, I'm going to use that formula-- length times width times height. So, volume equals length times width times height. What I want to show you is that I can use my StackUps, starting with the cubes and then moving to cards, to help my student build their understanding of volume.

So, let's go ahead and go to the video. In this video, the first thing I want to show you is I have one StackUp cube, and I have a card that looks just like that. So, I have the 3-D and the 2-D. How should you have your student explore the card? So, let's take a look at this card that has one cube on it.

I'm going to have my student begin on the bottom, and they're going to feel the first side. And the way they're going to know that side is done is they're going to feel the corner. They're also going to feel that there's a dotted line going up-- a couple of tactual cues there, depending on what your student needs.

So, going back to this cube, I have one side, so that's my length. I turn the corner. I have another side. That's my width. So, I'm going to the right. And then that height is that dotted line. So, I'm going up, and I have 1. So, this way, I know that my length is 1, my width is 1, and my height is 1. So, our volume is 1 unit cubed.

Let's go on to a more complex card and see how our student would continue to work on volume. I have the 3-D version, which is 6 cubes that are pressed together, one layer. So, my student may want to explore those before they work with the card, or they may want to look at that after they work with the card to confirm. But let's go ahead and look at the card.

So, the first thing I need to do is to find the length. So, I'm going to explore my card and find the bottom edge. And I'm going to count, and I'm going to see I have 2 cubes on that length. Now, I'm going to look at the width. So, I'm going to go around the corner, and I'm going to see that I have 3 cubes. So, I now know my length is 2, my width is 3. And then I'm going to check that dashed line and find out that my height is 1.

So, using my volume formula, I'm going to do 2 times 3 times 1. And I'm going to get 6 units cubed. And I can have my student explore the 3-D version to confirm.

Slide 28 is about volume of prisms and pyramids. So, we're in seventh grade at this point, and our student is going to be finding the volume of solid figures. And they're going to do this by decomposing into rectangular prisms. So we're going to look at this in just a second. But I want to make sure that you realize, just like any other skill, we need to scaffold. So, it's important that we start with basic prisms. And then our student advances into 3-D figures that are more complex.

So, let's look at my video, where you'll see I have Omnifix cubes. And I have a figure that's composed of a 3 by 2 array of the Omnifix cubes. And if I'm going to lay that on its side, then you'll see that below the left side, I have an array of 2 by 1 cubes.

Very simple for my student to decompose this figure. My student simply needs to pull the 2 by 1 array apart from the 3 by 2 array. My student can lay them next to each other and see how their one solid became two rectangular prisms.

Our last slide for Lesson 3 talks about volume of cones, cylinders, and spheres. By now, we're in eighth grade with our student, and it's important that they learn how to find the radius in their cones, their cylinders, and their spheres. And this is where it's going to be really important that you work with the math teacher.

They also need to be able to find the height of cones and cylinders. And of course, when they're doing all this, they must be able to understand and know the formulas for volume that go with all these things. And this is, again, where coordination with the math teacher is so important.

Now, your student can use their scientific calculator and the tactile graphics from their textbooks and other supplemental materials. Now, we really have been stressing so far using products to represent concepts that the student is learning. But our student, hopefully, has a braille math

textbook. And it's really important that that student is getting familiar with reading the graphics in that textbook and how do the graphics in the textbook relate to the graphics that I'm representing here using some of my APH materials.

The other thing I think it's important for us to think about is that the student is going to be in testing situations. So, if you know the type of process being used to prepare the graphics that the student will be seeing in testing, you also want to give them opportunities to practice with those graphics.

And for some of our students, you're going to need to spend considerable time pre-teaching, helping them build their hand skills and the skills that your student needs to develop to be efficient and accurate when doing geometry. We're going to talk specifically about that in Lesson 6 in this sequence.

You have hung in there for Lesson 3, and we really thank you. Take a breather, and then I want you to go on to Lesson 4, where you're going to learn about creating tactile graphics for your student. Thank you.