**Volume of Sphere**

**Section 1**

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| 00:00:00 | TEACHER: We're trying to figure out how do you find the |
| 00:00:02 | volume of a sphere? If I had a sphere and a cylinder with the same height and the same radius, do they have the same volume? You've already reviewed exactly how to find the volume of a cylinder. Now, let's take a look to see if there's any relationship between the volume of a sphere and the volume of cylinder. |

**Section 2**

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| 00:00:00 | TEACHER: A sphere is a three-dimensional circle that |
| 00:00:03 | is the set of all points that are a given distance from a fixed point. That fixed point is called the center and located here. Now the radius of the sphere is a segment from that center to the edge or to an edge of the sphere. The diameter of a sphere is a segment that goes from one edge to the other, but it has to pass through that center. The great circle-- |
| 00:00:33 | we have it drawn right here. Basically you just think of that great circle as if a plane just sliced that circle right through the middle. Now a sphere has no base, but the shape of that great circle is the same as the base of a cylinder. |

**Section 4**

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| 00:00:00 | TEACHER: Let's compare a sphere and a cylinder. |
| 00:00:03 | They have the same radius and the same height. Taking a look at the sphere here, we see we have a radius of 3. And over here on the cylinder, on its base, we have a radius of 3 as well. Now we have a diameter here. Well, this is actually the height of the sphere. Now remember the diameter of a sphere is |
| 00:00:26 | just double the radius. So since I know the radius is 3, this must be 6. And if this height is 6, we already said the cylinder has the same height. So this height also has to be 6 here. Now since they're the same height and since they have the same radius, do they hold the same volume? What do you think? |
| 00:00:49 | Let's take a closer look at that. Let's compare the volumes of each. In this diagram here, we've actually placed the sphere inside the cylinder. But as you can see, although we have the same height and the same radius, I have all of this excess space in here that's not filled. So even though the sphere and the cylinder have the same |
| 00:01:21 | height and the same radius, the volume of the cylinder is still greater than the volume of the sphere. Let's take another look at this comparison. In this case, suppose that this was somehow filled up with liquid. And we took that and we squeezed it into the cylinder. It's a better comparison, I think. As you can clearly see now, the volume of the sphere does |
| 00:01:50 | not equal the volume of the cylinder. In fact, this is only 2/3 the volume of the cylinder. So for a general idea, the volume of our sphere is equal to 2/3 the volume of a cylinder. |

**Section 6**

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| 00:00:00 | TEACHER: Let's see if we can determine the exact formula |
| 00:00:03 | for the volume of a sphere. The volume of a cylinder is represented by the formula V equals Bh, where B is the area of the circular base and h is the height. What we have here is not the exact formula. It's more of an outline for the formula. I can change this into mathematical symbols and this to give us something that is actually usable. |
| 00:00:26 | So the volume of a sphere-- we'll just denote it with V-- is 2/3 the volume of a cylinder. Well, what was the volume of a cylinder? That was given by Bh. But remember, B is the base area. So I can change that B to pi r squared. And if you remember, on our sphere, the |
| 00:00:50 | height was the diameter. And the diameter is 2 times the radius. So this height is actually equal to 2r. The height is actually equal to 2r. Let's simplify. That 2 on 2r can get multiplied with the 2/3 to give me 4/3. And that r multiplies with r squared to give me r cubed. |
| 00:01:28 | This is the exact formula for the volume of a sphere. |

**Section 7**

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| 00:00:00 | TEACHER: You've been trying to answer the lesson question, |
| 00:00:02 | how can you find the volume of a sphere? We've already figured out that there is a relationship between the volume of a sphere and the volume of a cylinder, and we used that information to find the exact formula for the volume of a sphere. Now, let's see if we can use this formula to find volumes of spheres. |

**Section 8**

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| 00:00:00 | TEACHER: Let's see if we can find the |
| 00:00:01 | volume of this sphere. The sphere has a radius of 4 centimeters-- what is its volume? We've been given the formula v equals 4/3 pi r cubed. Let's see if we can use this formula to figure out the volume of the sphere. So we have v equals 4/3 pi r cubed, but what is r? In order to find v, I need to know r. |
| 00:00:25 | r has been given to me-- the radius of the sphere is 4 centimeters. Let's put that in for r-- we're substituting 4 for r, so we have 4 cubed. Number 4 cubed is 4 times 4 times 4, that's going to give me a 64. Now I'm going to multiply 4/3 and 64-- that's going to give me 256 over 3 pi, and since we're |
| 00:01:01 | working with volume it's going to be centimeters cubed. |

**Section 11**

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| 00:00:00 | TEACHER: Let's take a look at finding the volume when given |
| 00:00:03 | the diameter. So this sphere has a diameter of 1 centimeter, and you can see that depicted here. So we want to know what the volume is. We've been given the volume formula but notice, there's an r in the formula, not a d for diameter. Well I know that r, the radius, is just half the diameter. |
| 00:00:22 | So if the diameter is 1 centimeter, then r must be a half a centimeter. Now that I know what r is, I can substitute the 1/2 in for r in the volume formula. So I have 4/3 pi r which is 1/2 cubed. Now I'm going to cube the 1/2. So 1/2 cubed is 1 over 8. Now I'm going to take 4 over 3 and multiply it with 1 over 8. |
| 00:00:53 | And I get 4 over 24 pi. Now simplify 4 over 24, and that will give me 1 over 6 pi. My units are centimeters. And I'm dealing with volume, so it must be centimeters cubed. So the volume of this sphere is 1/6 pi centimeters cubed. |