Description: Clip 8 of 9: Issues related to a physical model for (a+b) cubed and the volume of the model for a=1 and b=2 **Parent Tape: Early Algebra Ideas About Binomial Expansion, Stephanie's Interview Four of Seven** **Date: 1996-02-21** **Location: Harding Elementary School** **Researcher: Professor Carolyn Maher**	**Transcriber(s): Aboelnaga, Eman** **Verifier(s): Yedman, Madeline** **Date Transcribed: Fall 2010** **Page: 1 of 4**

0:00	1	Stephanie	[*Stephanie reaches for paper from earlier with $(a+b)^3$ expanded and simplified*] –oops- [*knocks into table*] –was- find out if we had, like, all the pieces that were here, and so if you build, um, and then [*reaches for Algebra blocks, drops one*]–oops- if we build this up, like if you keep building like that, like [*placed ab^2 piece on diagram*], *a* cubed *b* [*places a^2b piece on diagram, then a^3*]-um *a* squared *b*, *a* cubed [*places a^2b piece*], *a* squared *b*, [*places b^3 piece on top of ab^2*] and you build it up. If you built [*removes b^3, ab^2 pieces, points to b^2 part of diagram, holding b^3 piece*] *b* squared up *b* times- *b* units, it would become *b* to the third. So this piece is *b* cubed. So you have every piece here [*referring back to the paper with $(a+b)^3$ work on it*]. You have *a* cubed [*picks up a^3 piece, places it down; picks up a^2b piece*], you have, um [*pauses*], what is that? *a* squared *b* [*places piece down, picks up ab^2 piece*] you have *ab* squared [*places piece down, picks up b^3 piece*] and you have, um, *b* cubed [*places piece down, gathers all a^2b pieces*]. And you have three of these, so that becomes 3*a* squared *b* [*gathers ab^2 pieces*], and you have three of these, so it becomes 3*b*- 3*ab* squared, and you have your *a* cubed and your *b* cubed. And that makes up the problem. And you can build that into like [*pauses, assembles pieces into cube*].
	2	R4	And it doesn't matter which way you put the colors?
	3	Stephanie	No, because the colors don't matter. It's the [*points to edge of cube*] units.
	4	R4	I have to tell you, I find that very interesting, because I- I know what *a* plus *b* quantity cubed, uh, raised to the third power is, but I never saw it like that.
	5	Stephanie	Yeah.
	6	R4	And why is it 3*a* squared *b*, and 3*ab* squared- that- th- I- I find that totally interesting.
	7	R1	You know what? I think this -this is sort of difficult for me. [*pause*] Sort of- when you take that little yellow one-
	8	Stephanie	Yeah.
	9	R1	We think- we've been taught to think about that as a unit cube- as length, width, and height being one unit. And so we're not thinking in term of algebraic or general terms, we're thinking of something very specific. This is a cube with volume one. Right?

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			And, we- if we think about that yellow cube as a cube of volume one, we've now made, um-
1:00:00 - 1:04:59	10	R3	Well then this is, is 8 [b^3 *piece*]-
	11	R1	That's 8.
	12	R3	-and this is 4 [ab^2 *piece*], and this is 2 [a^2b *piece*], and so on.
	13	R1	So what does it all become? Wh-what-
	14	R3	It all becomes-
	15	R1	-if we think of the yellow cube as a cube of volume one, if we think of the unit as one unit, what kind of-what kind of model are we doing with, um , it's not, wh-what are the values of *a* and *b*?
	16	Stephanie	Oh, well then *a* would be 1-
	17	R1	And *b*?
	18	Stephanie	2.
	19	R1	So okay, so th-the cube you constructed has what volume?
	20	Stephanie	The cube I constructed? Is a- if *a* is 1 and *b* is 2?
	21	R1	Mhm.
	22	Stephanie	It would be, um, [*muttering*] 1 plus *b* 2 is… is 9.
	23	R1	Cubed? You put a square.
	24	Stephanie	Oh. 3 squared is 9.
	25	R3	You can sort of count them [*gathers Algebra blocks, constructs cube*]
	26	Stephanie	Yeah, you could.
	27	R3	Count them.
	28	R1	What's the cube? What's the volume of the cube with side-
	29	Stephanie	What? Oh with side-
	30	R1	3.
	31	Stephanie	-um 1+2? [*muttering*] 3 plus… 9 times… 9 um, yeah, 81?
	32	R1	How'd you get that?
	33	Stephanie	Wait.
	34	R1	81 will get you –
	35	Stephanie	Forget it. It would be [*reaching for cube*] now, [*deconstructs cube, reconstructs cube*] well it would just be, um, [*writes on paper*] 3 cubed.
	36	R1	Or?

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	37	Stephanie	Oh.
	38	R1	What is 3 cubed?
	39	Stephanie	3 cubed is 3 times 3, and that's 9. Then it would be 9 times 3, and that's 27.
	40	R1	So is that true, are there 27 little cubes there?
	41	Stephanie	Yeah, I guess.
	42	R1	You check 'em? Didn't look like it. [*Stephanie deconstructs cube, counts unit cubes*]
	43	Stephanie	1 [*moves a^3 piece*] 2, 3 [*moves a^2b piece*], 4, 5 [*moves a^2b piece*], 6, 7, 8, 9 [*moves ab^2 piece*] –
	44	R1	I'm beginning to believe you.
	45	Stephanie	10, 11 [*moves a^2b piece*], 12, 13, 14, 15 [*moves ab^2piece*], 16, 17, 18, 19 [*moves ab^2piece*], 20, 21, 22, 23, 24, 25, 26, 27 [*moves b^3 piece*].
	46	R1	Is that neat?
	47	Stephanie	Yeah.
	48	R1	So if *a* is 1 and *b* is 2…
	49	Stephanie	Then, it's 27. The volume is 27.
	50	R1	You have a mental picture of volume, you have 27 of those-
	51	Stephanie	Yes.
	52	R1	-little unit cubes now.
	53	Stephanie	Mhm.
	54	R1	But here now, when I say the, um, yellow is *a*, right-
	55	Stephanie	Mhm.
	56	R1	How many [*pause*] what's your unit cube now? It's not volume 1, the unit cube, what is the volume, what is the volume, what is the size of *a*, the yellow one
	57	Stephanie	The-
	58	R1	with side *a*?
	59	Stephanie	It would- I- what? Like, you wanna know the volume of the yellow one if it's *a*?
	60	R1	Mhm.
	61	Stephanie	*a* cubed.
	62	R1	*a* cubed.
	63	Stephanie	Yeah.
	64	R1	And so it's moving in that kind of thinking, something very

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			specific to something general, that- that's hard because it is specific, isn't it. Once you built your model it's very specific, and y- you're forcing yourself to think in somewhat of an artificial way, you know? And that could be very difficult to do. Don't you think? I mean I could still- I could be a student saying, but wait a minute, what are you calling that *a*, *a*, *a*.
	65	R3	You should build a model of cubes that are all the same color that are, uh, have Velcro on the edges so you could sort of do a true *a* plus *b* and sort of build all the parts.
	66	R1	What do you think Stephanie? Do you know what Dr. Pearl's saying?
	67	Stephanie	Yeah.
	68	R1	That would be a great class project.
	69	R3	It's a great…
	70	R1	What do you think?
	71	R3	It's probably a new manipulative [*laughing*]
	72	R1	-with sugar cubes and glue.