Description: Clip 4 of 7: Beginning to explore volume as it compares to area **Parent Tape: Early Algebra Ideas About Binomial Expansion, Stephanie's Interview Three of Seven** **Date: 1996-02-07** **Location: Harding Elementary School** **Researcher: Professor Carolyn Maher**	**Transcriber(s): Aboelnaga, Eman** **Verifier(s): Yedman, Madeline** **Date Transcribed: Fall 2010** **Page: 1 of 6**

0:00	1	R1	Okay. So what do you think I'm going to ask you next?
	2	Stephanie	I don't know. What? I don't…
	3	R1	What do you think?
	4	Stephanie	I don't
	5	R1	Now if you were in my place, what do you think would be a logical thing to ask?
	6	Stephanie	I don't know. Do you want me to like do it cubed or something?
	7	R1	Yeah. I think that's a very good thing. I think a cube would be a great thing to ask.
	8	Stephanie	Okay. [*Stephanie takes a cube from the bag on the floor and sets it on the table.*]
	9	R1	Okay. So we did *a* plus *b* quantity squared. And I really think, uh, you have a good mental model of that.
	10	Stephanie	Um hm.
	11	R1	Don't you think?
	12	Stephanie	Yes.
	13	R1	Don't you feel good about that? I betcha you could really take these blocks home and explain it to your little sister.
	14	Stephanie	Yes.
	15	R1	Do you think she'd be interested?
	16	Stephanie	No. [*They both chuckle.]*
	17	R1	That's what happens sometimes.
	18	Stephanie	Yeah.
	19	R1	I used to come home and think I'd want to explain this to my son. Do you think he'd be interested? No. Okay. But let's suppose you have this real interested younger sister.
	20	Stephanie	Okay.
	21	R1	Okay. Um. So. What should we do first? Should we start with something we know – that has a very explicit length
	22	Stephanie	Um for

Description: Clip 4 of 7: Beginning to explore volume as it compares to area **Parent Tape: Early Algebra Ideas About Binomial Expansion, Stephanie's Interview Three of Seven** **Date: 1996-02-07** **Location: Harding Elementary School** **Researcher: Professor Carolyn Maher**	**Transcriber(s): Aboelnaga, Eman** **Verifier(s): Yedman, Madeline** **Date Transcribed: Fall 2010** **Page: 2 of 6**

	23	R1	and find the
	24	Stephanie	for cubed?
	25	R1	and find the volume? What's volume?
	26	Stephanie	Volume is like
	27	R1	Is this volume? [*R1 taps the large cube which is sitting on the table between Stephanie and herself.*]
	28	Stephanie	Yes. It would be length, width, times depth.
	29	R1	What does that mean?
	30	Stephanie	That means this way, times this way, times this way. [*Stephanie traces the edges of the cube as she speaks.*]
	31	R1	Okay.
	32	Stephanie	'Cause there's – it – not – oh – it's length, width, height.
	33	R1	Um hm.
	34	Stephanie	'Cause it's not only – it's like three dimensional.
	35	R1	Alright. Now. You sorta convinced me that this square [*the flat used in the model previously*] has area, right? A hundred square units.
	36	Stephanie	Yes.
	37	R1	Even with the three and the seven and you could've done it with six and four or one and nine and all of this would work, right?
	38	Stephanie	Um hm.
	39	R1	If we did *a* is one and *b* is nine and you took one plus nine quantity squared.
	40	Stephanie	Um hm.
	41	R1	and you apply this, that would work? Would it?
	42	Stephanie	Um. Yeah. I thought – didn't – did we do that last time?
	43	R1	You see – I mean – we have ten, right?
	44	Stephanie	Yes.
	45	R1	We have a length of ten to play with. If we wanted *a* plus *b* to be ten, we could have a lot of fun with this. And if we really wanted to, we could have *a* to be two and a half, right? [*Stephanie chuckles.*] Right? And

Description: Clip 4 of 7: Beginning to explore volume as it compares to area **Parent Tape: Early Algebra Ideas About Binomial Expansion, Stephanie's Interview Three of Seven** **Date: 1996-02-07** **Location: Harding Elementary School** **Researcher: Professor Carolyn Maher**	**Transcriber(s): Aboelnaga, Eman** **Verifier(s): Yedman, Madeline** **Date Transcribed: Fall 2010** **Page: 3 of 6**

			what could we have *b* to be?
	46	Stephanie	*b* would be seven and a half.
	47	R1	Seven and a half? You know. The question is if you had a calculator with you now. The question is "Is two and a half the quantity squared, right?
	48	Stephanie	Um hm.
	49	R1	- plus two and a half times seven and a half plus seven and a half times two and a half, right? plus seven and a half squared?"
	50	Stephanie	Squared.
	51	R1	Right. What would you expect that to be?
	52	Stephanie	One hundred.
	53	R1	One hundred and so forth. You can think of lots of things. How many things add up to ten? – How many numbers
	54	Stephanie	Five?
	55	R1	add up to ten?
	56	Stephanie	Right? Is there five sets? - One plus nine. Eight plus um eight plus two, uh, seven plus three, six plus four, and five plus five.
	57	R1	Two and a half, seven and a half?
	58	Stephanie	Oh. Well then there's like – isn't there like an infinite amount?
	59	R1	Hm. Why do you say infinite amount?
	60	Stephanie	Because you could have like one point nine nine nine nine nine like forever, 'cause like numbers don't stop.
	61	R1	So it's really interesting. Even with this special case, right?
	62	Stephanie	Yeah.
	63	R1	We can keep trying this. But- we even have our shortcut of doing it. You know. Whatever you want to choose for *a* and *b*, you know, two and a half quantity squared plus twice two and a half times seven and a half
	64	Stephanie	Um hm.

Description: Clip 4 of 7: Beginning to explore volume as it compares to area **Parent Tape: Early Algebra Ideas About Binomial Expansion, Stephanie's Interview Three of Seven** **Date: 1996-02-07** **Location: Harding Elementary School** **Researcher: Professor Carolyn Maher**	**Transcriber(s): Aboelnaga, Eman** **Verifier(s): Yedman, Madeline** **Date Transcribed: Fall 2010** **Page: 4 of 6**

	65	R1	plus seven and a half squared, but we always know that no matter what we do
	66	Stephanie	it's going to be a hundred.
	67	R1	Isn't that really powerful? Isn't that exciting?
	68	Stephanie	Yeah.
	69	R1	Now you can – so if you took this example, you could've just taken it and sliced it any place in here. Arbitrarily, you can pick *a*.
	70	Stephanie	Um hm.
	71	R1	Right?
	72	Stephanie	Yeah.
	73	R1	But once you've picked *a* and this is ten, you know what *b* is going to be.
	74	Stephanie	Yeah.
	75	R1	Okay. So that can be great fun. So you've convinced me of this. How do you then begin to convince someone to move from here to volume? What is the volume of this by the way?
	76	Stephanie	A thousand?
	77	R1	A thousand what?
	78	Stephanie	A thousand units cubed.
	79	R1	What do you mean by that?
	80	Stephanie	Well – [*chuckles*] 'cause um squared is like two dimensional,
	81	R1	Um hm.
	82	Stephanie	so cubed is like three dimensional.
	83	R1	Yeah.
	84	Stephanie	(inaudible)
	85	R1	That's what makes these hard for me. I have a lot of trouble with these. You know why? Because this really is a cubic unit, isn't it?
	86	Stephanie	Um hm.
	87	R1	It's not a square unit. If I put this on an overhead
	88	Stephanie	Yeah.
	89	R1	it'll look like a square unit, but it really is a cubic

Description: Clip 4 of 7: Beginning to explore volume as it compares to area **Parent Tape: Early Algebra Ideas About Binomial Expansion, Stephanie's Interview Three of Seven** **Date: 1996-02-07** **Location: Harding Elementary School** **Researcher: Professor Carolyn Maher**	**Transcriber(s): Aboelnaga, Eman** **Verifier(s): Yedman, Madeline** **Date Transcribed: Fall 2010** **Page: 5 of 6**

			unit. So what does that mean in terms of this little – this is a cubic unit – only one side of it is a square unit, right?
	90	Stephanie	Um hm.
	91	R1	'Cause we're supposed to imagine there's no depth here and that's really hard for for a lot of students to do. Because that's one of the criticisms of using these blocks – you're supposed to imagine this is only two dimensions, but it really is three. And any time you have anything, I mean, this really is three dimensions. [*R1 holds up a piece of paper*.] This has a thickness. Isn't that right?
25:00 - 29:59	92	Stephanie	Yeah.
	93	R1	You'll be dealing with these ideas in geometry next year. But you're supposed to imagine it doesn't
	94	Stephanie	Um hm.
	95	R1	Even when we write something on the board. The thickness is the chalk, but you're supposed to imagine it's not there. Do you see where students get confused?
	96	Stephanie	Yes.
	97	R1	"Boy, this teacher, boy, is really losing it!" Right? [*Stephanie chuckles.*] But anyway, so this really is a cubic unit. So that's what's nice about this. It has – so how many of these are in here – if you (inaudible)
	98	Stephanie	A thousand.
	99	R1	A thousand. And you really you really believe that.
	100	Stephanie	Yes.
	101	R1	You really imagine building it up. How can you – you know there are a hundred here? How can you quickly show there are a thousand?
	102	Stephanie	Well. It would take ten of these [*indicates the flat*]
	103	R1	Um hm.

Description: Clip 4 of 7: Beginning to explore volume as it compares to area **Parent Tape: Early Algebra Ideas About Binomial Expansion, Stephanie's Interview Three of Seven** **Date: 1996-02-07** **Location: Harding Elementary School** **Researcher: Professor Carolyn Maher**	**Transcriber(s): Aboelnaga, Eman** **Verifier(s): Yedman, Madeline** **Date Transcribed: Fall 2010** **Page: 6 of 6**

	104	Stephanie	to build all the way up and ten times a hundred is a thousand.
	105	R1	Ten times a hundred?
	106	Stephanie	Yeah. 'Cause there's a hundred here.
	107	R1	Okay.
	108	Stephanie	So
	109	R1	So, a hundred, a hundred, a hundred…ten times.
	110	Stephanie	Um hm.
	111	R1	Okay. Alright. Neat. So my next question is: We know how this works for a cube with a very explicit length