

<b>Description: Clip 5 of 7: Testing the partial symbolic expansion of the cube of <math>(a+b)</math> for <math>a=3</math> and <math>b=7</math></b> <b>Parent Tape: Early Algebra Ideas About Binomial Expansion, Stephanie's Interview Three of Seven</b> <b>Date: 1996-02-07</b> <b>Location: Harding Elementary School</b> <b>Researcher: Professor Carolyn Maher</b>	<b>Transcriber(s): Aboelnaga, Eman</b> <b>Verifier(s): Yedman, Madeline</b> <b>Date Transcribed: Fall 2010</b> <b>Page: 1 of 7</b>
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0:00	1	R1	Okay. Alright. Neat. So my next question is: We know how this works for a cube with a very explicit length
	2	Stephanie	Um hm.
	3	R1	of one side, right?
	4	Stephanie	Yes.
	5	R1	Now suppose we wanted to do $a$ plus $b$ quantity cubed. That's our next question. [ <i>R1 writes: <math>(a + b)^3 =</math></i> ] Right?
	6	Stephanie	Um hm.
	7	R1	Now. What do you want to do? Do you want to come up with the theoretical answer for this?
	8	Stephanie	Mmm.
	9	R1	Before you build it? Or do you want to build it?
	10	Stephanie	It would probably be easier to build it than to come up with it.
	11	R1	Oh. That's interesting. Okay. Sure.
	12	Stephanie	'Cause ...I guess, 'cause
	13	R1	What does this mean, though? Can you tell me what this means?
	14	Stephanie	$a$ plus $b$ times $a$ plus $b$
	15	R1	Why don't you write that?
	16	Stephanie	Okay. [ <i>Stephanie writes: <math>(a + b) \cdot (a + b) \cdot (a + b)</math></i> ]
	17	R1	Okay. Do you know any – you have a binomial times a binomial, right? And then you have another binomial, right? That's what this means.
	18	Stephanie	Okay.
	19	R1	Now if I said to you? - [ <i>pause</i> ] Sometimes it's convenient to go from right to left or left to right. I don't know which way you're comfortable doing it, but suppose we multiplied the last two. Do you know what that product is?
	20	Stephanie	That product?
	21	R1	$a$ plus $b$ times $a$ plus $b$
	22	Stephanie	Well. – Do I know what it is or could I just say like $a$ plus $b$ squared?
	23	R1	You're telling me $a$ plus $b$ times $a$ plus $b$ is $a$ plus $b$ quantity squared?
	24	Stephanie	Yes.

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	25	R1	But if you are to actually square it, do you know what that would be? The quantity – $a$ plus $b$ times the $a$ plus $b$ ?
	26	Stephanie	Without numbers? Like just...
	27	R1	Without numbers – the general way. Whenever I multiply $a$ plus $b$ times another $a$ plus $b$ . We know what it's not. We know that it's not $a$ squared plus $b$ squared.
	28	Stephanie	Um hm.
	29	R1	Do we know what it is? 'Cause you proved it last time.
	30	Stephanie	I did?
	31	R1	The quantity $a$ plus $b$ times $a$ plus $b$ .
	32	Stephanie	Oh. Well, I proved that it was $a$ squared plus $ab$ plus uh two $ab$ plus $b$ squared.
	33	R1	Right. Isn't that right?
	34	Stephanie	Yeah.
	35	R1	Okay. So you know what this piece is [ <i>the last two factors</i> ].
	36	Stephanie	Um hm.
	37	R1	Let's put – let's actually do it. Right? $a$ plus $b$ times $a$ plus $b$ you told me is $a$ squared plus two $ab$ plus $b$ squared. Isn't that right?
	38	Stephanie	Yes.
	39	R1	Now I didn't have to do these two. I could've done these two.
	40	Stephanie	Yeah. You could've
	41	R1	You understand that?
	42	Stephanie	Yeah. I understand.
	43	R1	I could've done the first and the last, but I just chose to do that.
	44	Stephanie	Um hm.
	45	R1	Right. So. So, we've done part of it already. Isn't that right?
	46	Stephanie	Um hm.
	47	R1	Well. We haven't finished it. 'Cause what part didn't we do?
	48	Stephanie	We have $a$ plus $b$ left.
	49	R1	We have to multiply $a$ plus $b$ times this. [ <i>indicates (</i> $a^2 + 2ab + b^2$ <i>)</i> ]
	50	Stephanie	Yes.
	51	R1	Okay.

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	52	Stephanie	Okay.
	53	R1	Now. If you were to multiply $a$ plus $b$ times this that's going to be you know a bit of algebraic work here, right?
	54	Stephanie	Yeah.
	55	R1	You know. I don't know if you – what that means – if you have $a$ plus $b$ of these – we can talk about what does that mean – to have $a$ plus $b$ of these.
	56	Stephanie	Um hm [pause] I – um – I don't
	57	R1	But we can think of it this way. Three plus seven cubed. [R1 writes: $(3 + 7)^3$ ]
	58	Stephanie	Okay.
	59	R1	That might help. Is three plus seven times three plus seven times three plus seven. Right? Isn't that right? [R1 writes = $(3 + 7)(3 + 7)(3 + 7)$ ]
	60	Stephanie	Um hm.
	61	R1	We know the answer to that.
	62	Stephanie	Um hm.
	63	R1	Or, what I just did here is this, didn't I? I said it's the same as three squared. Right? You told me plus two times three times seven plus seven squared. Right? [R1 writes = $(3 + 7)(3^2 + 2 \cdot 3 \cdot 7 + 7^2)$ ]
	64	Stephanie	Um.
	65	R1	Now you know enough arithmetic- how to finish this.
	66	Stephanie	Um. Yes.
	67	R1	What would you do next?
	68	Stephanie	Well. First, I'd um do everything in the parentheses.
	69	R1	What do you mean? Well, okay. But I don't want you to do everything in the parentheses.
	70	Stephanie	Well, I can
	71	R1	All I want you to do is this. Okay. – I want – come with – suppose you said that was nine and you said this was what? Forty-two?
	72	Stephanie	Yeah.
	73	R1	And this is forty-nine. Okay?

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	74	Stephanie	Um hm.
	75	R1	That's as much as I want you to do in the parentheses. Right?
	76	Stephanie	So you want
30:00-34:59	77	R1	I mean you could add these up and add these up but we know it's a thousand. So. But suppose rather than do everything in the parentheses – is there anything that you've learned about arithmetic that you could stop this from being a multiplication problem. Does any of that look familiar to you? <i>[pause]</i>
	78	Stephanie	I don't know. I've usually – 'cause if you just have numbers like that you just like
	79	R1	But suppose they were letters?
	80	Stephanie	Well, if they were letters I'd probably like – get help or something to figure it out. I don't know. I don't – um – to stop it from being a multiplication problem?
	81	R1	Um hm.
	82	Stephanie	I don't know.
	83	R1	Have you heard of the Distributive Property?
	84	Stephanie	Well. Yeah. But I mean if I was really going to distribute, I'd just
	85	R1	What would you distribute?
	86	Stephanie	I'd add them first. And then I'd distribute that.
	87	R1	But sometimes you can't add them. Like if they're $a$ and $ab$ .
	88	Stephanie	Well. Yeah.
	89	R1	So if you can't add them first, how would you distribute them?
	90	Stephanie	Well, it would be nine – like parentheses – three plus seven plus forty-two parentheses three plus seven plus forty-nine parentheses, you know, three plus seven. Like, you know.
	91	R1	Okay. That's a way. That's a absolutely perfectly good way to do that. So you would distribute the three plus seven times the nine, the three plus seven times the forty-two, and the three plus seven times the forty-nine.
	92	Stephanie	Yeah.
	93	R1	I would do it a little differently, but that's – your way is as good as mine.
	94	Stephanie	Well, how else – how can you do it?

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	95	R1	Um. We can test to see if it matters. Your way is interesting. You're distributing three plus seven times each of these.
	96	Stephanie	Yeah. 'Cause
	97	R1	I would distribute just three times each of them.
	98	Stephanie	Oh. Okay.
	99	R1	And then the seven times each of them. But we can test to see if that works.
	100	Stephanie	Um hm.
	101	R1	Why don't we do it? Why don't we do it your way and my way and see if this really comes out to a thousand. We know the answer. Right?
	102	Stephanie	Um hm.
	103	R1	Why don't we try the three plus seven times the nine, the three plus seven times the forty-two and the three plus seven times the forty-nine? Do you understand what we're doing here?
	104	Stephanie	Yeah. But still
	105	R1	We're testing an idea.
	106	Stephanie	Then can I add them? Like after I distribute
	107	R1	Yeah.
	108	Stephanie	Three plus seven to each – can I add them?
	109	R1	Absolutely.
	110	Stephanie	Okay.
	111	R1	Three plus seven times the nine plus three plus seven you told me times the forty-two, right?
	112	Stephanie	Um hm
	113	R1	Plus three plus seven times the forty-nine.
	114	Stephanie	Yes.
	115	R1	That's what you told me?
	116	Stephanie	Um hm.
	117	R1	Right?
	118	Stephanie	And that would be ninety.
	119	R1	And I'm going to put my – the way I would've done it here. I would've done the three
	120	Stephanie	Okay.
	121	R1	times the nine plus the three times the forty-two plus the three

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			times the forty-nine and then I would've done the seven times the nine
	122	Stephanie	Um hm
	123	R1	plus the seven times the forty-two plus the seven – I don't know why? And the question is – let's do the arithmetic
	124	Stephanie	Okay.
	125	R1	and see if it works.
	126	Stephanie	So that would come
	127	R1	We know what the
	128	Stephanie	out to ninety.
	129	R1	Alright. Write that down. Ninety.
	130	Stephanie	Ninety plus four twenty
	131	R1	Um hm.
	132	Stephanie	plus four ninety. And your answer is – is one thousand.
	133	R1	Um hm. Check my way.
	134	Stephanie	Oh God.
	135	R1	You did that really fast, Stephanie.
	136	Stephanie	Oh. Yeah. Well, they're the same numbers as before except with the zeros on the end, so...
	137	R1	Um hm.
	138	Stephanie	Okay. Three times nine plus three? Okay. So. Three times nine is twenty-seven plus three.
	139	R1	Is that twenty-seven plus three or plus three times forty-two?
	140	Stephanie	Oh. Okay. So those are like each squared – like they're each – like that?
	141	R1	So – yeah. Maybe we should put parentheses. [ <i>They do.</i> ]
	142	Stephanie	Okay. That's three times nine, twenty-seven, plus three times forty-two, that's – twelve – plus three times forty-nine – (inaudible) twelve, fourteen, plus seven times nine is sixty-three plus seven times (inaudible) that's (inaudible) twenty-eight, twenty-nine, plus (inaudible), three, six, (inaudible). Okay.
	143	R1	Your's was less work than mine.
	144	Stephanie	[ <i>Stephanie sighs.</i> ]
	145	R1	So – gee

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	146	Stephanie	Um.
	147	R1	No one has a calculator.
	148	Stephanie	[ <i>chuckles</i> ] Okay. I 'm just gonna do it up here.
	149	R1	Here take another piece of paper.
	150	Stephanie	Okay.
	151	R1	... a calculator? (inaudible) Oh. There's a math teacher. Travels with a calculator.
	152	Stephanie	[ <i>Stephanie chuckles.</i> ]
	153	R1	You could show her how (inaudible) you know how to do it.
	154	Stephanie	Oh. We used those last year.
	155	R1	Okay. Great.
	156	Stephanie	Yeah.
	157	R1	Texas Instruments.
	158	Stephanie	Um hm – [ <i>Stephanie works with the calculator.</i> ] Oh. There's stuff on here.
	159	R2	That's okay. Clear it.
	160	Stephanie	Okay. Um. If I remember how I can. Okay. Okay. Twenty-seven.
	161	R1	You want me to read them to you?
	162	Stephanie	Yeah.
	163	R1	Twenty-seven. Okay. Plus one twenty-six
	164	Stephanie	Um hm.
	165	R1	plus one forty-seven
	166	Stephanie	Um hm.
	167	R1	plus sixty-three, plus two ninety-four, plus three forty-three.
	168	Stephanie	That's it?
	169	R1	Um hm. Equals?
	170	Stephanie	One thousand. They both work.
	171	R1	They both worked.
	172	Stephanie	Um hm.
	173	R1	Okay. Hm. Now. Why don't you leave it here? We may need this again. Um.