Description: Clip 10 of 10: Generating the Exponents in the Expansion of (a + b) to the Seventh Power **Parent Tape: Early Algebra Ideas About Binomial Expansion, Stephanie's Interview Five of Seven** **Date: 1996-03-13** **Location: Harding Elementary School** **Researcher: Professor Carolyn Maher**	**Transcriber(s): Aboelnaga, Eman** **Verifier(s): Yedman, Madeline** **Date Transcribed: Fall 2010** **Page: 1 of 6**

Time	Line	Speaker	Transcript
0:00	1	R1	I'd like you to kind of write up how all of this fits together, like a little essay.
	2	Stephanie	Ok.
	3	R1	You know, starting with the cubes. Like, you can even write a little short story. The cubes. The cubes. The cubes. I know you're all getting sick of them, right? But a lot of that, um, powerful mathematical ideas can be developed, I think, from it, even the probability. You're going to play with that a little bit. But do you see how the algebra fits?
	4	Stephanie	Yes.
	5	R1	But you couldn't do this stuff until you had some algebra.
	6	Stephanie	Yeah.
	7	R1	You see? And the exponents and I want you to think real hard when you look at all of these terms and you know these coefficients are important. You see, they can be mapped right into Pascal's Triangle.
	8	Stephanie	Yeah.
	9	R1	Right? But not only do you – what's nice about it when you think of these terms, once you know the coefficients and how many of them there are – let's look at this – this is the sixth, right? And we know they have to be 1, 2, 3, 4, 5, 6, 7 terms. 1, 2, 3, 4, 5, 6, 7, terms, right?
	10	Stephanie	Mm-hmm.
	11	R1	And I know you probably worked hard to do this. Now, so now, if you asked me to do, do it what I'd say, the seventh one, I'd say, well, it's going to be a one, right? That's the first term.
	12	Stephanie	Mmhmm.
	13	R1	Next one's gonna have a seven, right? The next one's gonna have a 21, right?
	14	Stephanie	Mm-hmm.
	15	R1	The next one's gonna have
	16	Stephanie	35…
	17	R1	And then –

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	18	Stephanie	21. Oh, that's another one. 35. And then 21.
	19	R1	There's a little symmetry here. 21.
	20	Stephanie	Yeah. Oh and then seven and one.
	21	R1	Ok, and then you ought to think about why that's symmetry.
	22	Stephanie	Ok.
	23	R1	Ok, now the key –
	24	Stephanie	[*interrupting*] Oh, well,
	25	R1	Go ahead.
	26	Stephanie	Oh, like with the cubes, isn't it just 'cause it's the opposite?
	27	R1	All right, say more.
	28	Stephanie	'Cause, like, if I have two – if I have towers of four, and it's two red.
	29	R1	[*interrupting*] let's say towers of four
	30	Stephanie	Right, then there's going to be two yellow.
	31	R1	Ok is that why you think so?
	32	Stephanie	So it's just like the opposite.
	33	R1	Ok, so let's look at a particular line. You said towers – how high did you say?
	34	Stephanie	Of four.
	35	R1	So towers of four is which line here?
	36	Stephanie	Yeah, that one. And if I have two- I have two red on it –
	37	R1	So two red would be this.
	38	Stephanie	Yeah.
	39	R1	So this would contain two red and two yellow?
	40	Stephanie	Well, I mean, wouldn't it just be – Yeah, see, right here. See *a* squared and see *b* squared.
	41	R1	I was thinking of the symmetry here, like, 4 *a cubed b* and *4 a b cubed.*
	42	Stephanie	But isn't that like the same thing?
	43	R1	Okay, tell me why it's the same.
	44	Stephanie	Well, 'cause here it's just there's two but here it's three.
	45	R1	Okay. So you have those opposites in those same categories is what you're saying?
	46	Stephanie	Yeah.

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	47	R1	You once said that in an interview I had with you when you were in fourth grade. You said the opposites are in the same categories, but you were thinking of cubes then. Now, I know there are how many – 1, 2, 3, 4 , 5, 6, 7, 8, - terms here-
	48	Stephanie	Mm-hmm
	49	R1	-and if I'm doing this to the –
	50	Stephanie	Seventh.
	51	R1	Seventh, I know this is going to be *a* to the what?
	52	Stephanie	Um, seventh.
	53	R1	Seventh. Ok, that means all of them are going to be red.
	54	Stephanie	Mm-hmm.
	55	R1	Right? Now, I'm going to have seven of them, of which-
	56	Stephanie	Um, *a* is to the sixth and *b*
	57	R1	Six red and one yellow. Right?
	58	Stephanie	Yeah.
	59	R1	And this is going to be –
	60	Stephanie	*a*, um, fifth, *b* to the third. *b* to the, um, fourth. I don't know.
	61	R1	Ok, now that's a question, right?
	62	Stephanie	Mm-hmm.
	63	R1	Now, let's see if there's anything in here that can help you. Know that. Let's look at something you know. Now in the sixth, you said this was *a* to the sixth.
	64	Stephanie	Mmhmm. Ok.
	65	R1	This is *a* to the fifth *b.* What's the exponent of *b* here?
	66	Stephanie	Oh it's- is it gonna be squared? It's- uh- gonna be squared?
	67	R1	Why do you think squared?
	68	Stephanie	Well, because they're all squared. Like, all, like that one, every one that looks like that is all squared. But, I don't know.
	69	R1	Okay, so the question is the exponents. What do you think these exponents need to be? 'Cause if you knew that, gosh-
	70	Stephanie	Yeah.
	71	R1	-you'd have it all, right? You'd be able to write the next one out-
	72	Stephanie	Mm-hmm.
	73	R1	-without- so the question is studying this and seeing if there are

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			any patterns that might-
	74	Stephanie	Well-
	75	R1	-but think of the towers, because, remember, you're building your towers how tall?
	76	Stephanie	Um, in this one? Six.
	77	R1	Alright, so you're building them six tall. What does this five mean?
	78	Stephanie	Oh, would it- it would have to add up to seven.
	79	R1	Why?
	80	Stephanie	Well, because you're building it seven high.
	81	R1	Right, so what does this –
	82	Stephanie	So five and two, you could do that.
	83	R1	So the five means what?
	84	R1/ Stephanie	Five reds and two yellows.
	85	R1	So the next would be . . .
	86	Stephanie	Um, *a* to the - I don't know 'cause the, see here, it's like an . .
	87	R1	Well, think of what case this is. Here, all your seven are red.
	88	Stephanie	Yeah.
	89	R1	Right? Here, six are red and one is yellow. Here, five are red-
	90	Stephanie	Mm-hmm. Four-
	91	R1	-and two are yellow.
	92	Stephanie	Four *a*. Three *b?* [a^4b^3]
	93	R1	Doesn't that make sense?
	94	Stephanie	Yeah.
	95	R1	So, uh, notice something. These are seven tall. They can't be more than seven tall. They could be distributed.
	96	Stephanie	Mm-hmm. Um, the next one would be the opposite, *a* to the third *b* to the fourth and then it would just keep going the opposite.
	97	R1	Ok. So you need to study that. Those numbers and those relationships, but always look for meaning, Stephanie.
	98	Stephanie	Ok.
	99	R1	Try to imagine these towers and what does this mean? This means, this is the part of the, you know what these mean. These

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			mean seven are exactly red. This means, ok.
	100	Stephanie	Yeah.
	101	R1	Oh this was none of them exactly red and this was all of them exactly red.
	102	Stephanie	Yes.
	103	R1	I'm sorry, I didn't want to confuse you. I think I said that wrong. So, some interesting things to think about. Um, how do we do this? I really do want a copy of what you've done here, but how do we get copies? Now, we don't . . .
	104	Stephanie	I can go down to the office and see if I can get them there.
	105	R1	So can you do the same thing again and make copies of these? I'd like you to put your name on them and a date on them and if you can remember to order and number them, that would be absolutely phenomenal.
	106	Stephanie	Alright. Do you know what the date is?
	107	R1	Today is the thirteenth. March thirteenth.
	108	Stephanie	Ok.
	109	R1	Since we're so unorganized. Ok. Anything you can write me about, your whole, you know, thinking about these towers and this notation and whatever.
	110	Stephanie	Ok.
	111	R1	You're just probably done the first, what, she's done some Algebra II. Is some of this in Algebra II, Steve?
	112	R2	Um, combinatorics?
	113	R1	Yeah.
	114	R2	Um, I don't think so.
	115	R1	What would it be in? Pre-calculus?
	116	R2	Well, no, okay now- um there's some binomial expansion in Algebra II.
	117	R1	So binomial expansion is in Calculus and Algebra II. Ok, that would also be in finite math. It would also be in statistics.
	118	R2	In a probability class you're just gonna-
	119	R1	A lot of this in probability.
	120	R2	They do lots of cool stuff like (inaudible) card games.

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	121	R1	Now, Stephanie, you're going to be in ninth grade next year. My son is in ninth grade; he took probability.
	122	Stephanie	Really?
	123	R1	With a satellite course. His high school didn't have it; isn't that right? He dabbled with a little of these ideas. But he didn't build towers, so he was at a direct disadvantage. Any other questions, Elena or Ethel?
	124	R2	(inaudible)
	125	R1	If they're not exactly right, the camera, Ethel will number them correctly for us when she looks at the tape, right? So it'll be real important to get as much of what you see here in your ideas pulled together in writing to get ready as if you were going to make a presentation and maybe I'd like to invite you to our Summer Institute and present this to the teachers, ok?
	126	Stephanie	Ok, uh-huh. Um. [*laughs*]
	127	R1	Steve, you can be the cameraperson that day. You'll help us. I should also say in all the institutes we've run, the teachers never got this far. It's true.
	128	R2	(inaudible)
	129	Stephanie	Alright, you want me to go down and see if they'll make copies?
	130	R1	That would be wonderful.
	131	Stephanie	Alright, how many copies do you want?
	132	R1	I like this piece of mathematics a lot. I think this is one of the prettiest things- the way these different things come together.
	133	Stephanie	Alright.
7:37	134	R1	And I have to tell you, Stephanie, it didn't come together to me until I was in college.