Description: Night Session – Pascal's Identity, Clip 7 of 7: Generating and generalizing Pascal's Identity Parent Tape: Night Session – Pascal's Identity Date: 1999-05-12 Location: David Brearley High School Researcher: Professor Carolyn Maher	Authors: Uptegrove, Elizabeth B. Verified: Poprik, Brad Date Transcribed: 2003 Page: 1 of 7

Line	Time	Name	Transcript	Coding and Explanation
1.	00:45:15	Jeff:	All right. Say we have this row right here. We got um, N choose 0. And over here we have N choose X. And then over here we have N choose N. All right? Then this right here would be- Oh, we're explaining the general addition, the addition rule using this type of, to fill out the triangle. Using chooses to fill out the triangle and this here would be N choose X plus one and then N, N choose X plus two and so on to whatever N equals. Right there'd be dot dot- I didn't, I didn't leave enough room. And this here would be X minus one and then-	
2.	00:46:02	Ankur:	You did that one man.	
3.	00:46:03	Jeff:	What?	
4.	00:46:04	Ankur:	Nothing.	
5.	00:46:05	Jeff:	That'd be X minus two and so on each way. Right? So it'd be that.	
6.	00:46:10	Ankur:	Can I see the row above that?	
7.	00:46:12	Jeff:	And the row above this would be N minus one, right? Yeah.	
8.	00:46:17	Michael:	Mm hm.	
9.	00:46:19	Jeff:	Um, choose zero. This again would be N, N minus one choose X and then-	
10.	00:46:29	Michael:	N minus one.	
11.	00:46:30	Jeff:	N minus one, N minus one. That's a one. Um, how do you want me to, to- Where do you want me to go from here?	
12.	00:46:40	R1:	Well, you know, um, Brian wasn't here, so you might want to give him some background to what you've been doing.	
13.	00:46:46	Jeff:	Start at the beginning? We did, we worked for an hour and a half getting to this point. Explaining this, doing this. All right, um.	
14.	00:46:54	R1:	But Brian's a quick study.	
15.	00:46:54	Brian:	That's what I am.	
16.	00:46:56	Jeff:	All right. We did, uh, this is Pascal's Triangle using-	
17.	00:47:02	Brian:	The whole choose thing.	
18.	00:47:03	Jeff:	-the choose situation. That's what this is.	
19.	00:47:04	Michael:	You know how choose works, like one, three, three, one.	
20.	00:47:06	Brian:	Yeah.	

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21.	00:47:07	Jeff:	Yeah.	
22.	00:47:07	Michael:	Three choose zero, three choose one-	
23.	00:47:08	Brian:	One, four, six-	
24.	00:47:09	Michael:	Yeah. It's all like chooses of something.	
25.	00:47:11	Jeff:	All right. So, um, I don't- Um, how would you like to, uh, how do you want to do this? How do you want to-	
26.	00:47:19	Michael:	We're just-	
27.	00:47:20	Jeff:	Well, tell him what we did.	
28.	00:47:21	Michael:	-replacing the three in the chooses by N's and X's.	
29.	00:47:24	Jeff:	Yeah, exactly. And rather doing, like, uh, rather- Say this is the, uh-	
30.	00:47:29	Michael:	If N was three.	
31.	00:47:30	Jeff:	Yeah, say if N was the third row, it would be three choose zero. That would give you one.	
32.	00:47:36	Ankur:	Like, you know how it's one, three, three, one. Three choose zero gives you one.	
33.	00:47:38	Jeff:	Three choose one.	
34.	00:47:39	Michael:	That'd be three.	
35.	00:47:39	Jeff:	That would give you the three. The three choose two. That would give you the other three. That's equal to three and then three choose three. That equals the other one. And like that's filling out this part of the triangle and so on. And that's what, that's what we're doing now. We went, other stuff we did we did the whole, we found that equation to find out choose.	
36.	00:48:01	Michael:	What choose means.	
37.	00:48:02	Jeff:	Yeah, we did all that.	
38.	00:48:03	Romina:	And choose.	
39.	00:48:04	Jeff:	But you missed out on all that. That's the choose equation.	
40.	00:48:05	Romina:	That's the choose equals.	
41.	00:48:08	Jeff:	And we spent time explaining. That's what we spent the bulk, bulk of the thing, trying to figure out how to explain that. And-	
42.	00:48:14	Brian:	What's that little exclamation point?	
43.	00:48:15	Michael:	//Factorial.	

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Line	Time	Name	Transcript	Coding and Explanation
44.	00:48:16	Romina:	//Factorial.	
45.	00:48:16	Ankur:	//Factorial.	
46.	00:48:16	Jeff:	Factorial.	
47.	00:48:17	Brian:	That's what it is?	
48.	00:48:17	Romina:	Yeah.	
49.	00:48:17	Jeff:	Yeah.	
50.	00:48:18	Brian:	All right.	
51.	00:48:18	Jeff:	It was really excited, like N! [Michael laughs]	
52.	00:48:20	Romina:	You want to know what this is? That's all the combinations. [Romina points to her paper; refer to Figure J18.] That's minusing. You know how like they're saying-	
53.	00:48:26	Brian:	Yeah.	
54.	00:48:26	Romina:	-three choose two.	
55.	00:48:27	Brian:	Yeah.	
56.	00:48:27	Romina:	We don't care about the three, so that's like when the threes are switching, not the twos. And that's when the twos are like in the first place and the third place, and they just switch and nothing else moves.	
57.	00:48:35	Brian:	So this-	
58.	00:48:35	Romina:	It's basically the same thing.	
59.	00:48:35	Brian:	Is this, is that this over this?	
60.	00:48:37	Michael:	Yeah.	
61.	00:48:38	Romina:	It's N, N factorial over N minus X factorial times X factorial.	
62.	00:48:45	Michael:	And that equals N choose X.	
63.	00:48:46	Romina:	Like this is when the- the things we don't- No, I'm just saying these are the things that we don't care about when they- they switch and this is when the things we do care about, just switch in the same place and everything stays the same.	
64.	00:48:57	Brian:	All right.	
65.	00:48:58	Romina:	And that's all of them. [Romina laughs.]	
66.	00:49:00	Ankur:	The Reader's Digest version.	
67.	00:49:01	Romina:	Yeah.	

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68.	00:49:01	R1:	What was that, Ankur?	
69.	00:49:02	Ankur:	No, I just said like the Reader's Digest version or something. [Romina laughs.]	
70.	00:49:05	R1:	The Reader's Digest version?	
71.	00:49:07	Jeff:	Yeah. So where, where do you want to go with, with this?	
72.	00:49:10	R1:	Well, I want you to show me how the addition rule works in general.	
73.	00:49:14	Jeff:	All right. Well that's not much of a problem-	
74.	00:49:16	R1:	So you showed me what N minus one choose X-	
75.	00:49:17	Michael:	Go from, go from, go from $N\,X$ and $N\,X$ plus one.	
76.	00:49:19	Jeff:	Wait, this is, this is //[Inaudible]	
77.	00:49:21	Ankur:	Yeah, add that in terms of X. Like below it, you know what I mean?	
78.	00:49:23	Michael:	Add these two. What are these two going to equal?	
79.	00:49:26	Jeff:	All right, well that's gonna be-	
80.	00:49:27	Michael:	We want the next-	
81.	00:49:28	Jeff:	//N plus one over-	
82.	00:49:30	Michael:	//N plus one over-	
83.	00:49:30	Ankur:	X plus one.	
84.	00:49:33	Jeff:	X plus one?	
85.	00:49:33	Michael:	N.	
86.	00:49:34	Ankur:	Yeah. I think. Uh-huh.	
87.	00:49:37	Jeff:	That's what these two are going to come into?	
88.	00:49:39	Ankur:	Mm hm.	
89.	00:49:40	Jeff:	Right?	
90.	00:49:41	Michael:	Yeah.	
91.	00:49:41	Ankur:	Yeah.	
92.	00:49:40	Jeff:	And that's cause-	
93.	00:49:41	R1:	Can you write it, can you write it as an equation? Just like you wrote three plus three equals six.	
94.	00:49:46	Jeff:	Um, that would-	
95.	00:49:48	Ankur:	N plus, just that plus that.	
96.	00:49:50	R1:	Why don't you do it on the side?	

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Line	Time	Name	Transcript	Coding and Explanation
97.	00:49:51	Jeff:	Just N. Oh, would it be-	
98.	00:49:51	Michael:	Oh, N choose X.	
99.	00:49:52	Jeff:	N choose X, um, plus-	
100.	00:49:53	Ankur:	Plus.	
101.	00:49:54	Jeff:	-N choose X plus one.	
102.	00:49:57	Michael:	Equals that.	
103.	00:50:00	Jeff:	Plus one, equals that right there.	
104.	00:50:02	R1:	//[Inaudible]	
105.	00:50:04	Jeff:	Then, well, that's, that's because this would be gaining an X and going into the X plus one.	
106.	00:50:14	Michael:	Yeah.	
107.	00:50:15	Jeff:	And this would be losing an X.	
108.	00:50:16	Michael:	No, no, not losing, not getting anything.	
109.	00:50:16	Ankur:	Staying the same.	
110.	00:50:17	Romina:	No.	
111.	00:50:18	Ankur:	It's not getting anything.	
112.	00:50:18	Jeff:	That would be staying the same and that's-	
113.	00:50:19	Ankur:	That's, yeah, the plus that.	
114.	00:50:20	Jeff:	-is the X plus one.	
115.	00:50:22	Michael:	And the top numbers have changed because you have more.	
116.	00:50:24	Jeff:	Because you're adding more things.	
117.	00:50:25	Ankur:	One more.	
118.	00:50:25	Jeff:	One more-	
119.	00:50:27	Michael:	Topping or-	
120.	00:50:27	Jeff:	Place	
121.	00:50:28	R1:	Say it so Brian can follow it because he wasn't here for the earlier pizza discussion.	
122.	00:50:31	Michael:	He follows, you can follow it?	
123.	00:50:32	Brian:	I can just sit in the back and watch.	
124.	00:50:33	R1:	Go ahead, Brian. Don't be easy on them, Brian, make them work.	

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Line	Time	Name	Transcript	Coding and Explanation
125.	00:50:35	Jeff:	What, what we're doing is the next line of the triangle- Remember how today in class you know how the other triangle was one, two-	
126.	00:50:40	Brian:	Yeah.	
127.	00:50:41	Jeff:	-three, that whole row there? Well, that's the increase in N, and then the X plus one. If you added another topping onto your whole. Say we're doing pizzas.	
128.	00:50:50	Brian:	All right.	
129.	00:50:51	Jeff:	If you add another topping onto it?	
130.	00:50:53	Romina:	You know how we get the triangle and how we go one two one and add those two together.	
131.	00:50:56	Brian:	Yeah.	
132.	00:50:56	Jeff:	Yeah.	
133.	00:50:57	Romina:	That's what we're doing right there.	
134.	00:50:57	Jeff:	Yeah. Well, that's what we're doing.	
135.	00:50:58	Ankur:	We're just adding it.	
136.	00:50:58	Michael:	You know why, do you know why we add, though?	
137.	00:50:58	Brian:	That's all you're all doing?	
138.	00:50:59	Romina:	That's all we're doing.	
139.	00:51:02	Jeff:	We, we were explaining why you add.	
140.	00:51:03	Brian:	All right, keep going.	
141.	00:51:03	Jeff:	And why you do it, is it cause when you add another topping like onto it, this one- Say the toppings were one and zero.	
142.	00:51:10	Brian:	Uh huh.	
143.	00:51:11	Jeff:	If it gets a topping, that's why it goes up to the X plus one. And since it doesn't get anything, it'll stay the same. And in this one, it's staying the same, right?	
144.	00:51:20	Michael:	Yeah.	
145.	00:51:21	Jeff:	And that's why it's going there. Like saying that's the zero.	
146.	00:51:25	Brian:	OK.	
147.	00:51:26	Jeff:	And going to there. Make sense?	
148.	00:51:28	Brian:	Yes. It actually does.	
149.	00:51:30	Jeff:	So, so that would be the general addition rule in this case? That's it?	

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150.	00:51:34	R1:	Are you impressed?	
151.	00:51:35	Jeff:	Impressed?	
152.	00:51:37	R1:	Mm hm.	
153.	00:51:37	Michael:	Not really.	
154.	00:51:37	Jeff:	Not really. I don't think we did anything that spectacular.	
155.	00:51:42	Michael:	Yeah, that's all.	
156.	00:51:43	R1:	Well, you might be.	
157.	00:51:44	Ankur:	Nothing more than we ever did before.	
158.	00:51:45	R1:	You might pick up a probability book in-	
159.	00:51:46	Jeff:	Is this all in-	
160.	00:51:47	R1:	-freshman college and see if you recognize this.	