Description: Night Session – Pascal's Identity, Clip 3 of 7: Further explorations of factorials and combinations **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 8**

Line	Time	Name	Transcript	Coding and Explanation
1.	00:01	Jeff:	Yeah but say, all right, say we're doing five choose two, right, with this. Then we go five factorial. Which is what?	
2.		Michael:	That'll give you all the combinations they can put everybody in.	
3.		Jeff:	Uh, twenty times three.	
4.		Ankur:	OK. Sixty.	
5.		Jeff:	Would be sixty times two.	
6.		Ankur:	One-twenty.	
7.		Jeff:	One-twenty? That would be; it's one-twenty, right, Romina?	
8.		Romina:	Yeah.	
9.		Jeff:	We're faster than the calculator, around here. [Romina laughs.] We're good like that. So that'd be one-twenty.	
10.		Michael:	And, and if you're doing choose two, obviously there's going to be a lot of times where those two are going to be in the same spot as the other three are going to be-	
11.		Romina:	What are you doing, five choose two?	
12.		Michael:	-you know, I guess moving around different spots.	
13.		Jeff:	Yeah.	
14.		Michael:	That's why you want to get rid of the, the *n* minus *x* thing.	
15.		Jeff:	Yeah, we got, that makes sense.	
16.		Michael:	Yeah, that, that makes sense to you?	
17.		Jeff:	That, that part right here, is this all good? Up to this point? Do you understand why this is all happening?	
18.		R1:	I'm waiting for the whole thing.	
19.		Michael:	Whole thing? Oh we're not done with that yet.	
20.		Jeff:	Then, um, then you multiply. Well, at this point here you have three.	
21.		Romina:	That's six.	
22.		Jeff:	Yeah, it's six. So you have one-twenty over six times five factorial.	
23.		Romina:	No isn't it-	
24.		Michael:	Oh I think its the repeats-	
25.		Jeff:	Or-	

Description: Night Session – Pascal's Identity, Clip 3 of 7: Further explorations of factorials and combinations **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: 2 of 8**

Line	Time	Name	Transcript	Coding and Explanation
26.		Michael:	Would, would be like-	
27.		Romina:	Isn't it three factorial, two factorial?	
28.		Jeff:	Three factorial. Oh two, oh, it's act-, all right, yeah. Two.	
29.		Michael:	Yeah, I guess the, the *x*-	
30.		Jeff:	That's the number you were raising-	
31.		Michael:	That *x*.	
32.		Jeff:	-and, and five choose *x*, say and there was-	
33.		Michael:	That's what. Since you- Mm hm.	
34.		Jeff:	And this was-	
35.		Ankur:	I get it. I get it. I get it. I get it. [Romina laughs.]	
36.		Michael:	I, I got it now.	
37.		Jeff:	Like that.	
38.	01:25	Michael:	All right, then the last number would be-	
39.		Jeff:	Because this just gives you the number.	
40.		Michael:	You have- Yeah.	
41.		Jeff:	You're going to multiply by the number.	
42.		Michael:	Those, those, you want to get rid of those. The, all the combinations that the three are moved around and those, those two aren't.	
43.		Jeff:	Yeah, they-	
44.		Michael:	But then those two themselves will be repeat-	
45.		Jeff:	Yeah-	
46.		Michael:	You will be mixed up.	
47.		Jeff:	Be repeating that's what you- that's why you	
48.		Michael:	That's why you want to get rid of that, too.	
49.		Jeff:	Exactly. And then, so that would be just two.	
50.		Michael:	Yeah.	
51.		Jeff:	So it would be one-twenty divided by twelve and you get ten. Is that what it is?	
52.		Michael:	Yeah it is. Do you get like why we divide by the *n* minus *x* and the, the *x*? You know, you, you get that?	

Description: Night Session – Pascal's Identity, Clip 3 of 7: Further explorations of factorials and combinations **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: 3 of 8**

Line	Time	Name	Transcript	Coding and Explanation
53.		R3:	I don't get that. Could you [Inaudible.]?	
54.		Michael:	You don't get that?	
55.		R1:	Ankur, did you have that?	
56.		Jeff:	What, what part don't, don't..	
57.		R1:	I wonder if Ankur has that? I wonder if Ankur could explain.	
58.		Romina:	I don't think the *x* [Inaudible.].	
59.		Michael:	All right. The top thing, the *n* to the, the *n* to the, uh, factorial was going to give you how many?	
60.		Romina:	That's all the combinations.	
61.		Michael:	That's every single combination.	
62.		Romina:	I got that. That I got.	
63.		Michael:	Right? Now you're, you're only worried about them, those two people in that line. So there's going to be some instances where those two people are going to be in the same place and those three-	
64.		Jeff:	Are the ones changing.	
65.		Michael:	Will be, you know, will be switch, you know, changing.	
66.		Jeff:	And that's-	
67.		Michael:	So that's, that would be the, the three factorial. You want to, you want to get rid of that. You want to get rid of them.	
68.		Ankur:	Wait, say that again.	
69.		Romina:	Hold on. Well, we-	
70.		Michael:	Don't worry about that three, we're doing like five.	
71.		Romina:	No, we're doing this one so the two-	
72.		Ankur:	All right, so you have the five minus two, is that what you're explaining on there?	
73.		Romina:	Five minus two, that's-	
74.		Michael:	So you have the hundred and twenty different combinations.	
75.		Ankur:	Yeah.	
76.		Jeff:	Total.	
77.		Michael:	All right. But you don't think like when those two people are going to be in these	

Description: Night Session – Pascal's Identity, Clip 3 of 7: Further explorations of factorials and combinations 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: 4 of 8

Line	Time	Name	Transcript	Coding and Explanation
			two spots-	
78.		Jeff:	And everyone else is changing.	
79.		Michael:	-not those other three.	
80.		Jeff:	And those are, those are, those make no difference because all we're worried about are where those two people are.	
81.		Romina:	Oh like when, oh, oh, okay, okay, okay.	
82.		Michael:	All right, those two people are going to be moving around and it- you know, they're like-	
83.	02:59	Jeff:	These people are going to stay the same and every, all the three people, they're just going-	
84.		Michael:	-the two people staying in the same place. So that's why you get rid of that.	
85.		Jeff:	You know, going nuts.	
86.		Michael:	But then those two people themselves could switch places too.	
87.		Ankur:	Yeah. [Ankur nods.]	
88.		Michael:	You know what I'm saying?	
89.		Ankur:	Um-huh.	
90.		Michael:	Or if-	
91.		Ankur:	So then you got to get rid of those, too.	
92.		Michael:	-there were three that could go on.	
93.		Jeff:	So that's why you get rid of the three.	
94.		Ankur:	That's why you do the *x* factorial	
95.		Michael:	Then you get rid of the, you know-	
96.		Jeff:	The other one.	
97.		Ankur:	Yeah, so you get rid of those.	
98.		Romina:	OK.	
99.		Jeff:	And then, then-	
100.		Romina:	Oh, there you go. That makes sense.	
101.		Michael:	Because you're not worried about every, each person.	
102.		Romina:	Just the two.	

Description: Night Session – Pascal's Identity, Clip 3 of 7: Further explorations of factorials and combinations 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: 5 of 8

Line	Time	Name	Transcript	Coding and Explanation
103.		Michael:	Just worry about two, right.	
104.		Jeff:	Just those two. Exactly.	
105.		Romina:	Yeah, we all have, I got it. I'm good.	
106.		Michael:	Extension?	
107.		R1:	Ankur? Can you explain this because poor Researcher 3 is trying to understand this, and she's not following Michael.	
108.		Ankur:	Something like, I understood it but-	
109.		Jeff:	Just go through it dude.	
110.		Ankur:	All right. The top number is five factorial, that's the total number of possibilities for, for five, for five people.	
111.		Michael:	One twenty	
112.		Ankur:	And then the five minus two comes, comes in where you're not worried about everyone, you're just worried about two people at a time. So we need to subtract the five minus two. Those get, that gives you and you do factorial, that gives you all the possibilities of just two people, right?	
113.		Michael:	No, that gives you	
114.		Romina:	Three people.	
115.		Jeff:	No, three extras.	
116.		Michael:	The three that you don't, you're not worried about.	
117.		Jeff:	That's going to eliminate everyone except the two people you're worried about.	
118.		Ankur:	OK. Everyone except the two people you're worried about. And then the *x* factorial eliminates, except the-	
119.		Michael:	When the two people-	
120.		Romina:	Two people, yeah.	
121.		Ankur:	Yeah. When the two people are switched back and forth when you have the same ones over again. [Romina laughs].	
122.		Jeff:	OK, [Inaudible.].	
123.	04:29	R3:	It's, it's getting better. It's getting better. So they switch back and forth you're saying and with your fingers. I think I'm getting switch back- So could you give	

Description: Night Session – Pascal's Identity, Clip 3 of 7: Further explorations of factorials and combinations 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: 6 of 8

Line	Time	Name	Transcript	Coding and Explanation
			me an example?	
124.		Ankur:	Like when you have, when you have like person *A* and, over here.	
125.		Michael:	You want to stand up and show them?	
126.		Ankur:	And person *B* over here. And then you have person *B* and person *A*.	
127.		Michael:	You want to be in a line and we'll show them?	
128.		R1:	Michael, start from the beginning very slow.	
129.		Michael:	All right. You have five people.	
130.		R1:	Stand up and show us.	
131.		R3:	Stand up and show us.	
132.		Jeff:	All right, I'm going to sit in your seat cause I can't see.	
133.		Michael:	I'm going to write it nice and clear so you all can see. All right. You got five people, in a line. You agree with me that's how many different combinations you can put those five people.	
134.		R3:	That part I understand.	
135.		Michael:	All right.	
136.		R3:	I understood the multiplication that you showed.	
137.		Michael:	Now in, you're only worried, you want to know how many different places you can put those two people. All right? So, in all the combinations you're going to have, they're going to be repeated a lot. A lot. When you have like, the two people in a certain place and you know, those three. If the three are, are like this. And then one of them switches, that's another combination. And you get a lot of repeats like that.	
138.		R3:	Oh, I see. OK.	
139.		Michael:	So by eliminating that, you eliminate the combinations that repeat by the three people moving around.	
140.		R3:	Uh-hum.	
141.		Michael:	Then let's say you just have those two people in, in any given combination. If, if one, if this guy switches the place with this guy it's the, they're different combinations, but in this we're not worried about where they are. We just, you	

Description: Night Session – Pascal's Identity, Clip 3 of 7: Further explorations of factorials and combinations **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: 7 of 8**

Line	Time	Name	Transcript	Coding and Explanation
			understand?	
142.		R3:	Mm hm.	
143.	06:01	Michael:	That's why we get rid of the, the two factorial to, to, uh, eliminate the amount like as many times as you could, as many combinations as you could put those two people. Right? Like the three would, would be to eliminate the combinations you could put those three people that you're not worried about. Then the two, they would repeat because those people too, they move around. They, they could, they move around in the, in the line also. And then when, when, when you're done with all that, you just get, um, you get how many places you can just put that two. Like you're not worried if, like you don't care who they are. You don't care like if this guy has a switch with this guy. You understand like why you would eliminate, how that eliminates.	
144.		R1:	OK. I don't want to think of people. I want to think of the tower now. Isn't that what Jeff said? And now I'm thinking of towers that are five tall?	
145.		Jeff:	Yeah. You can, we just-	
146.		R1:	And we're talking of those that have two reds?	
147.		Jeff:	Yeah. Well. [Inaudible.]	
148.		R1:	Explain it to me with that.	
149.		Jeff:	All right. Say, say we're doing, we're doing towers that were, were five tall. Towers of five tall with two different colors in it. Then that's the total amount of possibilities is the five factorial that you could have. All right, in, with, with five high with the combinations. So that's where, that's the five factorial on top. Then the three factorial on the bottom would be five different, five different spots minus the two spots that you're concerned about, leaving you with the three other spots-	
150.		Romina:	You could say-	
151.		Jeff:	-that you don't care about. That's going to eliminate all of them.	
152.	07:29	Romina:	That's like, if you say like the reds. Let's say reds are our two colors that they stay in the same place, and like-	
153.		Jeff:	Reds.	

Description: Night Session – Pascal's Identity, Clip 3 of 7: Further explorations of factorials and combinations **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: 8 of 8**

Line	Time	Name	Transcript	Coding and Explanation
154.		Romina:	They're. Like yeah, the two stay in the same place and then the other three are just switching while they're in staying in the same place.	
155.		Jeff:	Yeah, they're staying in the same spot.	
156.		Romina:	But we're not concerned with them.	
157.		Jeff:	That's why you're not concerned with those.	
158.		Michael:	It's going to repeat like six times.	
159.		Jeff:	Yeah. So that's where the three factorial comes from, and you're multiplying that by the two factorial. Those are what you're-	
160.		Romina:	That's to say like the first place and the third place and then they just switch.	
161.		Michael:	Yeah, like- this way	
162.		Jeff:	Exactly.	
163.		Michael:	They just don't have a name on them so the, they're the same thing.	
164.		Romina:	Yeah.	
165.		Jeff:	And then that's where the bottom number comes from and then you divide them by each other and that gives you what we're looking for.	
166.		R1:	OK, so I think I follow what you said.	