Description: PUP Math – Night Session Location: David Brearley High School – Kenilworth, NJ Researcher: Professor Carolyn Maher	Transcriber(s): Private Universe Project Verifier(s): Sigley, Robert, Sran, Kiranjeet Date Transcribed: Spring 2000 Page: 1 of 4

Line	Time	Speaker	Transcript
1.		*NARRATOR*	In May of their junior year, Kenilworth High School students returned to school one evening around 7:30 p.m. for a research session with Carolyn Maher and her colleagues from Rutgers University. Carolyn began the session by asking them to review what they had discussed in their pre-calculus class earlier that day. The class had touched on binomial expansions, and the students had learned about a way to calculate the co-efficient of any term without having to write out Pascal's triangles. The notation is called N choose R. It evaluates how many ways there are of choosing R objects from a set of N objects. Mike drew Pascal's triangle, and explained how the numbers could be assigned to the N choose R notation.
2.		MIKE	All right. This would be like 3 choose 1. How many different places could you put that 1, that one guy- there's only one place. The next one would be 3 choose 3. There's obviously 3 different places-
3.		CAROLYN MAHER	You 3 choose what? What's the next one?
4.		MIKE	-3 choose 1. The next would be 3 choose 2, which you just figured that out-- is 3. And the last one is 3 choose 3. You can only put those 3 people in 3 places. You can't-- no other place to put

			them.
5.		CAROLYN MAHER	I have another question. You could write more rows of that triangle. And now you're telling me you can write them as the "choose" way, you've called that. So can you take, let's say, another row or two? And show me the addition rule, and what it looks like, with your new notation for a particular row.
6.		MIKE	Add this and this, and go like that?
7.		CAROLYN MAHER	Sure. Or 3 and 3 is 6. Show me what that looks like with that new notation.
8.		MIKE	All right. Let's go to this one. This would be, like, 3 different places, I guess.
9.		JEFF	Which one are we looking at?
10.		MIKE	That one right there.
11.		JEFF	That would be a plus b to the third?
12.		MIKE	Let's say you have-- like, here's a number, right? Zero means no toppings, 1 would be a topping. So the first category is everything with no toppings, and that's your number for that one. This is like binary numbers or something, Next would be- there's all the ones that have 1 topping.
13.		JEFF	Mike, you got to make that a zero at the end. You messed up.
14.		MIKE	What? I knew that. There's your 3 choose 1, and there's 3 different combinations you can put that. And I can go on forever doing this. But when have a new- when you add another place, another topping-
15.		JEFF	That can be one or the other- one or the other- one or the other-
16.		MIKE	So it could be one or the other. It could

			be a zero or a one, a zero or a one, a zero or a one. So all these 3's would either move up a step onto the next category, and have 2 toppings, or they might stay behind and still only have 1, if they have the zero. So 3, I get a topping-- go to this one. And 3 won't-will stay. And obviously, this guy's going to get a topping; that's why you add this one. So now this guy's going to have-- without toppings-- you're going to add a topping onto him-- and it's going to be 1 topping. These 3 with 1 topping won't get one. So, you know, you can put them in the same category as this one, that's 4.
17.		JEFF	Yeah. Those are 4.
18.		MIKE	And, you know, the 3 that had 2 toppings won't get any.
19.		JEFF	Yeah. So that'll go to the left?
20.		MIKE	And you'll put them together with the ones that did get some. That's why you would add- keep on adding.
21.		CAROLYN MAHER	Well I want you to show me how the addition rule works, in general.
22.		JEFF	N choose X plus N choose X + 1
23.		MIKE	-Equals that
24.		JEFF	-plus 1 equals that right there. Well that's because this would be gaining an X and going into the X + 1, and this would be losing an X.
25.		MIKE	No, no, no-
26.		ANKUR	That stays the same.
27.		JEFF	That's staying the same, and that's- is the X + 1
28.		MIKE	And the toppings going to change

			because you have more-
29.		JEFF	-because you have more things. And why do it? -Because when you add another topping on to it, say the toppings were one and zero, if it gets a topping, that's why it goes up to the X + 1, and since it doesn't get anything, it will stay the same. And in this one, it's staying the same, right? And that's why it's going there, like saying that's the zero, and going to there. Make sense?
30.		BRIAN	Yes, it actually does.
31.		JEFF	So that would be the general addition rule, in this case.
32.		CAROLYN MAHER	In fact, I wish someone would do it on the board on the right there, write that addition statement, using factorial notations.
33.		JEFF	Minus X plus- exactly. You know like, how intimidating this equation must be, like if you just pick up a book and look at that?
34.		CAROLYN MAHER	Could you very carefully check that arithmetic?
35.		MIKE	You think we're wrong?
36.		ANKUR	Yeah, it's right there.
37.		JEFF	Where is it?
38.		ANKUR	It's right above n over x.
39.		MIKE	There you go.
40.		CAROLYN MAHER	You sure?
41.		MIKE	Yeah, I'm sure. You got anything else?