Line	Time	Speaker	Transcript
1		R1	Anyway, do you know why you're here?
2		Jeff	No.
3		Michelle	Yeah. About the towers.
4		R1	About the tower. Milin?
5		Milin	Yeah about the towers. We're going to talk about this.
6		R1	Yeah, yeah, yeah. You know the tower problem?
7		Jeff	Yes I do.
8		R1	Yeah, the last one in class you did, remember what that was about?
9		Jeff	Robin Hood. That was the last one we did.
10		Stephanie	The towers of 5.
11		Stephanie & Jeff	The towers of 5.
12		R1	The towers of 5. And do you remember what you did with those towers of 5?
13		Jeff & Stephanie	Yeah.
14		R1	And tell me about it. What was the problem?
15		Jeff	How many [Michelle: You had to figure out…] to make 5.
16		Michelle	…how many towers you could make.
17		Jeff	Different towers you can have.

18		**Michelle**	Different towers you could make from 5 blocks up.
19		**R1**	Any 5 blocks?
20		**Stephanie**	No.
21		**Michelle & Milin**	It had to be 2 colors.
22		**R1**	Okay, and did you figure that out?
23		**All students**	Yeah.
24		**R1**	And what is it, do you remember?
25		**All students**	32
26		**R1**	You sure of it?
27		**All students**	Yes.
28		**R1**	How could you be so sure?
29		**Milin**	Because we all ready checked!
30		**R1**	How could you be so sure?
31		**Jeff**	Remember we did all those, the, the charts, the thingys for, [Milin: And then remember...] and all those different patterns? Remember I convinced you up in the, the watchamacallit…
32		**R1**	Yes, in the room.
33		**Jeff**	I don't feel like convincing you again.
34		**R1**	You don't feel like convincing me again, okay. Okay, but I remember saying to you, Jeff, and I remember saying to you, Michelle, and to you, Stephanie, and Stephanie did try to work on towers of 6. And I asked all of you…

35		Michelle	So did I.
36		R1	You did it. If you were building towers of 6, how many would there be.
37		Jeff	I didn't do it.
38		Michelle	I, I did some, but I didn't…
39		R1	But do you know how many?
40		Stephanie	Yeah.
41		Milin	Probably 64.
42		R1	Why do you think 64?
43		Milin	Well because there was a pattern.
44		R1	What's that?
45		Milin	You just times them by 2, and then…
46		R1	Times what by 2?
47		Milin	The towers by 2 because 1 is 2 and then you figure out 2 is 2 and then I mean 4. And then…
48		Michelle	See, if you only had 1 block...
49		Jeff	You're not making much sense.
50		R1	See, Jeff, okay, okay.
51		Michelle	If you have 1 block and 2 colors then you would have 2 towers and we figured out that the other day that you keep on adding 2…
52		Jeff	That was the opposites.
53		Michelle	You, you like 2 times 2 would be 4 and then the 3…

54		R1	So 4 would be for what?
55		Michelle	Four for there, there would be 4 towers for 2 high.
56		R1	Okay.
57		Jeff	It's always opposite though.
58		R1	Okay, but let me, let me hear what Michelle has to say.
59		Michelle	And then for the 3 high then you would have 8 towers. And then for 4 high, you would have 12 towers. And we kept on doing it like that.
60		R1	Do you agree with that?
61		Jeff	I don't know what you're talking about.
62		Stephanie	Well, what it is, is…
63		R1	Let's, let's stop here.
64		Michelle	And then for 5 towers, it'd be 25 then. And then…
65		R1	Okay, let's, let's get a piece of paper and write down what you're saying and see if you all agree. And I think Jeff hasn't been with us for a while, and he doesn't know what we're talking about, but let's take one at a time. And let's just agree as we're moving along. Go, go ahead, Michelle.
66		Michelle	If you had one high, saying there's red and blue. Then you would have 2. And then if you had…
67		R1	Okay, write that down. 2. Do, do you agree with that? [Jeff: Yeah] Do you know what she's talking about?
68		Jeff	There's one red and there's one blue. So you, there's only one way to do it so it's 2.
69		R1	One way to do it so it's 2?

70		**Jeff**	Yeah, see, if, if you have to make towers of one, and there's only two colors.
71	3:04	**Milin**	He doesn't beyond(?)doing that.
72		**Michelle**	It'd be 2.
73		**Jeff**	It'd be 2. It'd be 2.
74		**R1**	All right, let's go on.
75		**Michelle**	If you add, two towers high would be 4 because you have…
76		**Jeff**	Yeah, I agree with that. Okay. I agree.
77		**R1**	Okay, but hold on.
78		**Michelle**	See, but you times that. Two times 2.
79		**R1**	All right. Write the 4 down. But I don't, can you explain to me [Milin: I know] why from 2 you get to 4. Milin, tell me why.
80		**Milin**	Because you, for each one of them you could add 1, no 2 more or on because there's a black, I mean a blue and red…
81		**Jeff**	Yeah, but what she's doing…
82		**R1**	Shh. Let her finish. Okay.
83		**Milin**	See for that, you just put one more for red you put a black on top and a red on top, I mean a blue on top instead of a black. And on blue, you put a blue on top and a red on top. You keep on doing that.
84		**R1**	Do you understand what he's talking about? [Stephanie: Umm-hmm] You all understand what he's talking about? [Jeff: Yeah] All right, so, so we agree 4. What happens if you're building towers 3 high? What did you say it would be?

85		Milin & Michelle	It would be 8.
86		R1	Write 8 down. Can, can you give me an argument, you don't have to do it, why we jump from 4 to 8?
87		Jeff	That's what I want to know. [Michelle, Milin start talking over each other]
88		R1	That's what Jeff wants to know. So, shh. Go slowly. It's Jeff you're convincing. Not me. Jeff.
89		Michelle	See, see, there's, there's, there's 2 blue. There's 2 here.
90		Jeff	I know that.
91		Michelle	And we went to 4 so it would have to be times 2*2. And then 4*2 would equal 8.
92		R1	That doesn't help Jeff understand. He just knows you're multiplying 2 [Milin: I know. I know. I know.] Okay. One at a time.
93		Jeff	If this was like a pattern, it would go 2-4-6 in between.
94		R1	Yeah, that's what he's saying.
95		Milin	No, no, no!
96		Stephanie	No, but [R1: Okay, one at a time] that's not the pattern that we're working on.
97		R1	Okay, go ahead, Stephanie.
98		Stephanie	The pattern we saw was this: for 1 block at a time we found 2.
99		Jeff	We all ready got 2 and 4 though.
100		Stephanie	I know.

101		Milin	2-4-6.
102		Stephanie	And then 8. 8, right? Two-4-then 8.
103		R1	But why 8? Jeff wants to know. [Milin: I know!] Go ahead, let, let Milin persuade Jeff.
104		Milin	If you do that, you just have to add for each one of those, you have to add one…
105		R1	Which one of what? These 4?
106		Milin	Yeah. You have to add one more color per…
107		R1	Which way are you adding it? Where are you putting that one more color, Milin?
108		Milin	Two more colors for each one. See.
109		R1	So this one with red on the bottom and blue on the top…
110		Milin	You could put another blue or another red.
111	5:21	R1	Do you agree with that you could put a blue or red on top and that would be…
112		Milin	So that will be 2 and then on this you could do, put another read or a blue on top. That would be 4.
113		Jeff	That's the same right there.
114		R1	No, this is blue-red.
115		Jeff	No, her, look. Look, it's. Okay, okay I see it.
116		Milin	See? Now you see it?
117		R1	Do you find what Milin is saying? [Jeff: Yeah] And down here you could put?
118		Milin	A red or a blue and the same thing with here.

119		R1	Do you understand that? [Jeff: Yeah] So, do you see how you get 8? Do you agree with that?
120		Michelle	Yeah because, 'cause there's 2 here and then 2 more.
121	5:51	Jeff	No, but, if you're [indecipherable] bound to get a different thing. If you use two colors, you're bound to get a different thing. Do, do another one for blue and she'll all ready have it. She will. Do it.
122		Milin	Do 4. Four that would be 16.
123		Jeff	No. Look, she…
124		R1	Let's get another piece of paper. Would you give me another piece of paper, please? Go ahead Jeff, show me what…
125		Jeff	She, she has 8 blocks with still only 2 colors
126		R1	Eight blocks with 2 colors. Okay, what, let's see this.
127		Jeff	She has like this: red and she kept on alternating. Blue-red-blue-red and she blue-red until she got 8. And then, blue. And then she did the same thing up here.
128		Michelle	I didn't do the same thing on top.
129		Jeff	Yeah, you kept on alternating.
130		R1	Why don't you do that? See what happens. It's what he thought he saw you do, but, that's interesting, maybe you didn't know you were doing that, Michelle. But look, blue-red-blue-red-blue-red-blue-red. He saw you alternating them on the bottom.
131		Jeff	Now, look, you got red and blue.
132		R1	So, so, you're saying that all of these are alternating and these are opposite alternating? Look, this is blue-red-blue-

			red-blue-red-blue-red.
133		Jeff	You see. This is the same thing up here. Red and blue. Red and blue. See, you have to cross off this one. And now red and blue, red and blue. It's a different way. You have to cross off that one because there's another one all ready there. And then over here, you have that right there.
134		Milin	But, Jeff, Jeff, Jeff.
135		Jeff	But the thing is that's exactly…
136		R1	Listen to Milin.
137		Milin	But that, this is for 3. So you could add 2 for each one of the 3.
138		Jeff	You didn't say that. She was only doing…
139		Michelle	It was supposed to be 3 high.
140		Milin	Yeah, she was doing the bottom ones first. That's why.
141		R1	She wasn't finished. She wasn't crossing them out yet because she hadn't finished the tops. Is that right, Michelle?
142		Michelle	It's 3 high, not 2. See. See how you got 8? There would be 3 high, so there would be…
143		R1	Can you tell me a little bit about how you would get the 8 now from here? Mil…I like Milin was, was helping me a minute ago or someone was helping. I even forget who it was.
144		Milin	You have to keep on putting 2 for this. Two for this. Two for this. And two for this. And it'll work out.
145		R1	Do you agree with that, Jeff?
146		Jeff	Yes.

147		R1	Okay. So.
148		Milin	Because you can't. There's only two colors. You can't put anymore on them.
149		R1	Okay, now imagine we have our 8. Where, where do we go from 8? Because I heard, Michelle say 12.
150		Milin	Sixteen.
151		R1	Well, what is it? Stephanie?
152		Jeff	I, I still want to see you build 3 up and then see if there's any…
153		R1	Okay, Jeff isn't convinced you have the 8 here, so you were going to fast.
154		Milin	Using Unifix cubes you could still…
155		Jeff	It doesn't matter. It's just easier to draw it. [Michelle draws]
156		Stephanie	I know.
157		Blonde teacher	Milin, why don't you draw what you think?
158		Milin	Okay. [Draws]
159		Jeff	You got that and that's the same as that. Blue-blue-red. Blue-blue. [Milin: No, look, look…] No, that's red.
160		R1	Red-blue-red.
161		Jeff	Yeah.
162		R1	Any ideas Stephanie how to show from 4 to 8?
163		Stephanie	I do. All right.
164	~9:50	R1	How about you, Jeff? Before, Milin said you understood

			when he got 4.
165		Jeff	I understand that, but…
166		R1	Okay, now, if this is what he got for 4 and if you understood what he just talked about, can you write down these 4, and use his idea to see if you could build 8? Why don't you write these down what he has here. These 4. Start with these 4 because that's what Milin said to start with. These 4.
167	10:24	Jeff	And then…
168		R1	You're going to run out of space if you're going to build them up.
169		Jeff	I'll go down.
170		R1	Okay, that's fine. Does it matter?
171		Jeff	No.
172		R1	Okay, now, what was his idea?
173		Jeff	I put too many things of red. You've got 2 reds. Two blues and the opposite. Then you're adding onto one to make this blue. And then you have to…
174		R1	But hold on. He said. That's not what Milin said.
175		Jeff	What did he say?
176		R1	Let's wait 'til he's finished thinking a minute and ask him because I think that's the key to it to know what Milin said and to see if that makes sense.
177		Milin	The thing is that you have to keep on adding 2.
178		R1	Okay, Milin, let's talk about this one. He had this, right?
179		Milin	Okay, then you just…

180		R1	Now, he said from here, add a blue. Is that what you said?
181		Milin	Yeah, you have to keep on adding to the top.
182		Jeff	It doesn't matter.
183		R1	No, he wants to add on the bottom.
184		Milin	You see for this, see, you have, have to have the bottom down here because you can't put the top otherwise it'll be different.
185		R1	Okay. But, he put a bottom "B" here.
186		Jeff	It would be the same. See, if you put a "b" up there, it'd be the same just as if you put on there. It'd be blue-blue-red. And then if you crossed that off, it'd be, put a "b" up there, it'd be blue-blue-red. Just like before.
187		Stephanie	Yeah, but, Jeff, Jeff.
188		R1	Okay, but…Hold on.
189		Michelle	If you look at this, you have it…
190		R1	Time out for a minute. I'm getting very confused because all of you are talking and you have all different ideas, and I think it would help me if we got one idea on the table at a time. Now the one idea that we have on the table that I wish we would explore before we hear all the new ideas is this one here. Now, I would like all of you to consider what Milin said here. Do you all see that? Get another piece of paper and write this down. Maybe write in the middle so we could build them both ways, and see if there's a difference. You don't have to cross off what you did. Now, what you have here, in this space is on the bottom red-blue-red-blue. And on the top you have blue-red-red-blue.
191		Milin	See, if you put this right…

192		R1	But hold on a minute. Let everyone get this down. You might want to separate them, too. Might be a good idea to do it just the way Milin or Michelle wrote it. I only want to see 4 down there because we're looking at Milin's strategy. That's not what Milin did. You made a chart. Milin didn't do that. I'm interested in [Stephanie: Oh]. Okay. Milin actually drew pictures or Michelle drew these pictures. Right? Did you draw this, Michelle, or Milin? You draw pictures of what these towers are going to look like. And see that's not really quite the same. That's interesting.
193		Jeff	But that's what we did. That's what she did. She did…
194		Milin	So you could do it anyway but, see, they're just put together.
195		R1	Now, what I think Milin is asking us all to do is, is to imagine in front of us, can you all see in front of you the towers of 2 that are these colors? Can you all imagine that in your mind? Can you see the first one? Red on the bottom? Blue on top? Do you see that in your mind, in the middle of the table there? Can you see it? The other one blue on the bottom, red on the top. I see these 4 towers. Now Milin is calling our attention to this first tower. Right? Red on the bottom and blue on the top. And what is he asking us to do with it?
196		Milin	Put another blue and then make another thing exactly…
197		R1	Right, put another blue. Now, can you draw a picture of what that tower will looks like of 3. This is a tower of 3. He's putting another blue. Now, he chooses to put it on the top or bottom, Milin? Next question we'll ask of you.
198		Milin	[Draws from top B-R-B tower] See, you put a blue here or you could put a red there and this one, [draws from top R-R-B] you could put this way. You could put a red instead of the blue.

199		R1	Okay, Milin, can you show us in the middle here what you just did with that one tower? Thank you.
200		Milin	See, from this towers, right,
201		R1	From, from this one tower?
202		Milin	See, so I put the blue here, the red here on top of it so it's like this. And then I added one more. That would be red. But then I did like this: blue. Then I put the red back on top of it. Then I put a blue because there's only 2 colors, and I all ready...
203		R1	So what you're, what you're telling me here if I could, if I could make my picture, if I were doing what Milin asked me to do, where we had a blue and red, what he's telling me to do is he's saying from this tower, I'm going to put a blue on the top.
204	15:06	Milin	Or red.
205		R1	Or from this tower, I'm going to put a red on the top. [Milin: Yeah] Is that what you're telling me to do? So from this tower, we get these two? [Milin: Yeah] Is that what…
206		Milin	Yeah, and for each one you keep on doing that and for 6 you get 64.
207		R1	Does that make any sense? [Jeff: Yeah]
208		Milin	[Camera shows paper squares B-B-R in left column, RBR BR in right column] It followed a pattern to 5, why can't it follow a pattern to 6?
209		R1	I guess what, what I'm confused about, Jeff, is you took this one with blue and red and you only put a blue on the top. And you've only done, you've only made this one. Milin is telling you could also make this one. That you could've

			put…
210		**Jeff**	But I made that.
211		**R1**	Where is that? Red on the bottom, blue…
212		**Jeff**	Red.
213		**R1**	From this one, you could've put two things on the top. You only put one. From this one, you could….
214		**Jeff**	Okay, I understand.
215		**R1**	Does that make sense what he's talking about? And he's saying so from these 4…
216		**Milin**	You could make 8.
217		**R1**	So tell me now, convince Jeff why it's going to be 8 – why it's going to be double.
218		**Jeff**	Convinced?
219		**Michelle**	I all ready figured it out with this.
220		**R1**	And what's different about the way you did it, Michelle?
221		**Michelle**	I just, I just, I didn't do it the way Milin did it. I just made them out and I didn't find any that weren't the same.
222		**R1**	That's not what Milin did. He did something very different. How about you, Steph?
223		**Stephanie**	I found it like this. I drew my lines. And then I went red-red-red, blue-blue-blue, blue-red-blue, red-blue-blue, blue-blue-red, red-red-blue, red-blue-red, blue-red-red.
224		**R1**	Is yours different than the way Milin did it?
225		**Milin**	Yes.

226		**Stephanie**	Well, yes
227		**R1**	In what way?
228		**Stephanie**	He built his towers up like this. He went red, blue, red, blue, red, blue, and so on.
229		**R1**	I didn't see him do that.
230		**Stephanie**	Michelle did it like that.
231		**R1**	That's not what he did. He started with red and blue. Right? And from this red…
232		**Milin**	I put a red.
233		**Stephanie**	He put like…
234		**R1**	He put a red on top.
235		**Milin**	And a blue one that's like.
236		**R1**	You put a red on top. And a blue on top. So we've got blue, red, red, red. And from the blue…
237		**Milin**	I did the same thing.
238		**R1**	A red on top. That's how he got his red-blue. And then he put a blue on top and got blue-blue.
239		**Stephanie**	But that's like what he's like, that's what's different from mine. I just like took the things and went like, I just took one and went…
240		**Milin**	And kept on going
241		**Stephanie**	Here's one red-red-red, blue-blue-blue. And then I'd go like red-blue-blue, b-r-b.
242		**R1**	So what I'm hearing you say is that you're just you [Milin: Guessing] believe this 8, but you say guessing. Why does

			that sound like guessing?
243		Milin	Because what if you could make more?
244		Stephanie	Okay, this is the 3 high, right? And you're convinced you could make 8. I'm convinced I could make 8.
245		R1	Yeah, but you haven't, he's proved to me from the 4, you could only make 8. You could get two from this one, and two from this one, and two from this one, and two from this one.
246		Milin	But could you convince her?
247		Stephanie	Michelle? Him?
248		Milin	No, her.
249		Stephanie	Her?
250		Milin	Yeah.
251		Stephanie	All right. I've done this before. Okay.
252		R1	Take another piece of paper if you want to because it sounds like your approach is a little different.
253		Stephanie	Okay.
254		R1	You gotta convince me there are 8 and only 8. No more or fewer.
255		Milin	Whoa. You do draw big.
256		R1	Now, now Jeff, this is, this might be a little different here. Let's see what's going on here.
257		Stephanie	Okay, first you have without any blue. With just red. R-R-R.
258		R1	Okay, no blues.

259		**Stephanie**	Then you have with one blue.
260		**R1**	Okay.
261		**Stephanie**	B-R-R. Or R-B-R. Or R-R-B.
262		**R1**	Anything else?
263		**Michelle**	And you would do the same pattern for everything else?
264		**Stephanie**	No, not with the blue. Not with one blue.
265		**Michelle**	You would, you would do it with the one red and two blues…
266		**Jeff**	You would alternate like…
267		**Michelle**	You would do it the other way around.
268		**R1**	That's not what she said. Let her finish. That's what you would do. Let's hear what Stephanie does. Maybe she's not the same.
269		**Stephanie**	Well, there's no more of these because if you had to go down the other one, you'd have to have another [indecipherable]. But okay.
270		**R1**	You buy that? That's all there is of those? [Yeah] Okay.
271		**Stephanie**	Then you have with 3 blues. Well, no, not with 3 blues. I'll go like that.
272		**R1**	You have no blues and now you have exactly one blue.
273		**Stephanie**	Okay. Now you have exactly 2 blues. Wait, wait, actually, yeah, that's what I did last time because I did it back with 2 things.
274	20:08	**R1**	Okay, let's see that.

275		**Milin**	Then with 3 blues!
276		**Stephanie**	Which is…
277		**Milin**	Then you get every single one.
278		**Stephanie**	You could put B-B-R. You could put R-B-B.
279	20:26	**Milin**	You could put B-R-B. You could put…
280		**Stephanie**	Yeah, but that's not what I'm doing. I'm doing it so that they're stuck together.
281		**Jeff**	There should be one with one red. Then you could make it up and then there's one with two reds, and there's one with 3 reds.
282		**Milin**	Ahh, but see you did the same thing, but there's blue…
283		**Jeff**	There's all reds. And then there's 3 reds, 2 reds. There should be one with one red. And then you change it to blue.
284		**Stephanie**	Well, that's not how I do it.
285		**R1**	Let's hear how, how Steph…we'll hear, we'll hear that other way. That's interesting. Okay, now, so what you've done so far is…
286		**Stephanie**	One blue. Two blue.
287		**R1**	Okay. No blues.
288		**Stephanie**	One blue. Two blue.
289		**R1**	One blue and two blues. But Milin just said you don't have all two blues, and you said, that's, why is that?
290		**Stephanie**	[Hands paper to Milin] Okay show me another 2 blue? With them stuck together because that's what I'm doing it.

291		Milin	In that case [Hands back paper]
292		R1	Okay, now what are you doing, Stephanie?
293		Michelle	But, but if you just had 2 blues and they weren't stuck together, you could…
294		Stephanie	But that's what I'm doing, I'm doing the blues stuck together.
295		R1	Okay.
296		Stephanie	Then we had 3 blues that you could only make one of. Then you want 2 blues stuck apart, not stuck apart, took apart.
297		R1	Separated?
298		Stephanie	Yeah, separated. And you can go blue, red, red - do I have that? No. Blue.
299		R1	Okay, so Milin wanted to stick that in earlier, I thought and Michelle, right? When you were doing 2 blues? You wanted that stuck…
300		Milin	Because see, look at this. For 2 reds and one blue. Two reds…
301		Michelle	And that's stuck together here for 2 reds.
302		Milin	Yeah, so you're following no pattern.
303		Michelle	And you have more stuck together here.
304		Stephanie	Well, you're following your pattern. But my pattern goes no red, one red. This was not meant to be like that. That's not. It's in the category of one blue. That. I could stick that some place in another category. But I want this to be in the category of one blue. Not in the category of the opposite of this one. And then I have this one, the red-red-blue. So to you, that, you might put that way at the end of the line. But I

			put it right here.
305		Jeff	I have a question. Do you have to make a pattern?
306		Milin & Stephanie	No.
307		Jeff	Well then why is everybody going by a pattern?
308		Milin	Because we liked it.
309		Stephanie	Yeah, it's easier.
310		Michelle	It's easier…
311		Stephanie	Because it's easier than just going ooh-ooh.
312		Michelle	Because if you, because if you, because if you just keep on guessing like that, you're not sure if there's going to be more.
313	~23	Stephanie	It's easier maybe like Shelly and Milin's pattern was to go put this in a different category…
314		Jeff	I know their patterns.
315		Stephanie	Okay, but what I'm saying is that it's, that it's just easier to work with a pattern.
316		Milin	Oh here's another one! Let's see…
317		Stephanie	Yeah, I'll put that in.
318		Michelle	Because you might have a duplicate. And, and you may not know.
319		Stephanie	It's harder to check. It's harder to check just having them like come up from out of the blue.
320		Milin	Then just going like this and getting 2 from…

321		Jeff	How do you know there's different things in the pattern?
322		Milin	Since, see, look at this. These are all different, right?
323		Jeff	I see that. Yeah.
324		Milin	Yeah, see? From this, right, you can make two more so because here there's a blue-red and then a blue, red…
325		Michelle	Because, because there's only 2 colors more so you know you can't make more. Yeah, so.
326		Milin	And then there's red, I mean blue-red-red. And you can't make anymore on this one so you go onto the next one.
327		Stephanie	All right, and then...
328		Jeff	How do you know you can't make any more from that?
329		Stephanie	Because…
330		Milin	Because there's not any more color.
331		Stephanie	Look. Okay. Start here. Start here. Okay? You have the 3 together? The one 1 blue. You have the 1 blue. How could I build another one blue?
332		Jeff	You, you can't.
333		Stephanie	All right. So I've convinced you that there's no more 1 blue. All right.
334		Michelle	But if you didn't have that pattern, it would be harder to convince you.
335		Stephanie	If I went, I'll put this one blue over here. And that blue will it'll be on another piece of paper. However that goes.
336		Jeff	Yeah, but you can make a blue different what…if you go like this.

337		Michelle	That's if you have 4.
338		Jeff	If you go like this. You can go r-r-b or you can go b-r-r. Red…
339		Stephanie	That's what I have. No.
340		Jeff	No. They're all, they're all different. You can do…
341		Stephanie	What I'm saying is this is 1 blue. This is one blue.
342		Jeff	Yeah but there's 2 more different with one blue.
343		Stephanie	Yeah. There is…
344	25:07	Milin	No, but only on the bottom.
345		Stephanie	Look, but I have those three. Look. B-r-r, r-b-r, r-r-b, but then how am I supposed to make another one once that blue got down to my last block?
346		Jeff	Okay.
347		Stephanie	Okay. So I've convinced you there's no more 1 blue? [Jeff: Yeah] All right, now.
348		Michelle	Then you have to go to 2 blue.
349		Stephanie	Two blue. Here's one, right? 2 blue. We have one, b-b-r, then we have r-b-b. How am I supposed to make another one?
350		Jeff	B-r-b.
351		Stephanie	No, this is the other. Milin gave me that same argument.
352		Michelle	She means, she means together.
353		Jeff	But the thing is it doesn't matter…
354		Stephanie	I don't…

355		Michelle	No, she means stuck together.
356		Stephanie	Stuck together, that means, like okay I took…
357		Jeff	I know.
358		Stephanie	Okay, so can I make any more of that kind?
359		Michelle	Then you have to move to three, which you can only make 1.
360		Stephanie	Yeah, you can only make 1 and then you could make the 3, without blue, and where there's 3 red.
361		Michelle	Then you can make 2 split apart.
362		Stephanie	Two split apart, which you can only make 1 of. And then you could make, you could find the opposites right in the same group. [Jeff: Okay] All right, so then I've convinced you that there's only 8?
363		Jeff	Yeah. [Stephanie: Yes!]
364		R1	How many if you're making towers of 4?
365		Michelle, Milin, Stephanie	16
366		R1	You agree, Jeff?
367		Jeff	Yeah.
368		Michelle	Because you have…
369		R1	Jeff, why do you agree? Don't let them go by so easily. This could be pressure here.
370		Michelle	See, look it's because, say you add a red or a blue, you can add a red or blue here.

371		R1	Make a drawing for your sentence showing it..
372		Jeff	I understand because you can only, you could put…
373		Michelle	Put 2 colors here, you could put 2 colors there. You can keep on going.
374		Jeff	You can keep doing 2 colors for each one, and that's…
375		Michelle & Jeff	2-4-6-8-10-12-14-16.
376		R1	And so that's for towers of…
377		Jeff	4
378		Milin	My guess is 16, but…
379		Jeff	We all ready got 16.
380		Milin	Why, why did she say in the beginning of the whole thing that 12
381		Jeff	This…
382		Michelle	It's, it's like, it's like…
383		R1	Why did you say 12, Michelle?
384		Jeff	Listen, you could do a red or a blue. You could do either a red or a blue. A red or a blue.
385		Milin	Jeff, Jeff, Jeff. I know that [indecipherable] But I want to know why she said 12 before?
386		Stephanie	Yeah, Michelle, why did you?
387	27:11	Jeff	Because she was guessing, not making patterns.
388		R1	Is that true, Michelle? Poor Michelle, it's okay. You think 12 or 16, Michelle?

389		Michelle	16.
390		R1	Michelle thinks 16. Now, now you made towers of 5 in class, and what did you get?
391		Milin, Michelle, Stephanie	32
392		R1	Does that work the same way?
393		Milin, Michelle, Stephanie	Yeah.
394		Milin	If you get towers of 4
395		Jeff	They're multiples of 2.
396		Stephanie	The hard part is making patterns. Like, you, from now, we know how to just oh you could give us a problem, like how many in 10 and we'd know.
397		R1	Okay, how many in 10? You know the answer?
398		Stephanie	I know the answer. I figured it out. It's 1,024.
399		R1	1,024.
400		R2	Are you sure?
401		Stephanie	Uh-huh.
402		Jeff	Don't try to convince me.
403		R1	Try to convince him.
404		Milin, Michelle	No! No!
405		Milin	Okay, okay, okay

406		Stephanie	I think we have 1,000 units.
407		R1	You could do that later. However, you were saying you know the answer, but…
408		Stephanie	But the problem is, the hard part is you could just give us a problem and we could go like well, we'll go 22*2…
409		Michelle	See for how we're doing you keep on adding what you have all ready. For here, you add 2 more. For here, you add another 4 so for here and for the 16
410		Jeff	You sure it's 1000? You sure?
411		Stephanie	Yeah.
412		Jeff	Because look you have…
413		Stephanie	Now, see you're dividing the…
414		Jeff	I'm not dividing…
415		Stephanie	The problem. You're timesing, no you don't times it. It's the same thing I did. I counted ahead. I just counted ahead 5 or 6, and I said oh, I could just multiply it by that and that'll give me the same answer, but it didn't work.
416		Jeff	Okay. It didn't work.
417		Stephanie	Okay. You have to figure out what's in between that.
418		R2	What did you find then?
419		Teacher	What do you mean?
420		Stephanie	In between, okay.
421		R2	Show me a little bit
422		Stephanie	Do you want me to figure out 10, right? But, in order to figure out 10, I was only up to 5. So what I had to do was I

			had to go and I had to say, well, what's 6, what's 7, what's 8, and what's 9, and times that times the last number I had.
423		R1	Well, let's, let's take a look at what you had here. This, this is what Stephanie had, guys. If you want to do it yourself for a minute. When I asked Stephanie how many for towers of 10, what Stephanie, why don't you say what you did to get 1,024 and then let's talk about this…
424		Milin	Yup, she's right.
425	~29:20		[indecipherable]
426		Stephanie	I was up to #5 so I took the #6. I was up to #6.
427		R1	64 is…Why don't you write that? Okay. Towers of 6.
428		Stephanie	Okay, now I was up to #6.
429		R1	You agree with that?
430		Jeff	Yeah
431		Stephanie	So I multiplied, I tried, first of all, I tried multiplying it times 8 because I figured well, all I have to do was 6+4 times 2 that's 8 so 64 times 8.
432		Jeff	What are you saying?
433		Milin	She did it wrong.
434		R1	No, no, no, let's hear what she's saying. Let's hear her thinking.
435		Stephanie	First, I thought, well, I don't want to go ahead, and I don't want to have to multiply 7, 8, 9, and 10. 7, 8, 9 before I get 10. So I figured 6+4 equals 10. And since I'm timesing times 2, I'll multiply 4*2 to get 8 and then just multiply 64*8.

436		Michelle	But she was wrong.
437		Stephanie	Yeah.
438		Michelle	And then, and then, no, she was right here. She only timesed it by 2 so she was right.
439		Stephanie	Then I did…
440		Milin	You keep timesing it by 2
441		Stephanie	Then I did 128*2. 256, 512, and then…
442	30:29	Milin	You get your answer.
443		R1	Except that, this is where I'm very, very interested what she did. How come she got something, she got 512…
444		Jeff	And you all ready got 512 over there.
445		R1	So Is that so very wrong?
446		Jeff	And then you could've timesed this by 2…
447		Milin	No, that's the same thing.
448		Jeff	But you could've just timesed this by 2 and you would've had it a lot easier than going, times, times, times.
449		R1	So in other words, could this have worked, that's my question. Now, when would this work? Why didn't the 8 work? Why did you have to keep…
450		Stephanie	Ahh, I just thought of something. I'm wondering if this will work. This 8 is #8, okay? This is #8, right? This is the answer to #8.
451		Jeff	You had it right, you just didn't follow a pattern, you just took a guess. And then if you filled it out exactly.

452		R1	Okay. So what you're suggesting is multiplying by 8 didn't work. It gave you 512, which was…
453		Jeff	Which gave you to #8.
454		R1	To #9, to #8? Or to #9?
455		Jeff	So, if you…
456		Michelle	This pattern works here.
457		R1	If I plugged in #8 or #9…
458		Milin	It would've worked, her pattern would've…
459		R1	Let's get another piece of paper and see what happened here because this is just a mess.
460		Milin	It would've worked where, but then she has to [R1: Get me another piece of paper. Let's start again.] to times it by 2 after she gets her number. She has to times it by 2 after she gets her number.
461		R1	But, you know what I'm thinking, I'm thinking maybe what we should do is I want you to, I don't want to throw away Stephanie's idea here, okay, because what Stephanie has here in her idea, once she got to towers of 9, right, she said there were 512. That's by each time multiplying it by 2.
462		Michelle	And then you have to move [R1: But, hold on a minute] [indecipherable] This would work if you multiply it times 2. You still get 1024 like over here.
463		R1	Right, but why, why didn't multiplying by 8 work when she had towers of 6?
464		Michelle	Because, because she wasn't so sure about going like this…
465		R1	Okay, but why, how could she be sure? In other words if 8 didn't work, do you understand my, my challenge to you?

			[Yeah] All you mathematicians here. My challenge to you is I don't want to throw out this idea because, you know, because if Stephanie has something here, she'll save you a lot of work in the future, right? If she has a good idea here? Do you understand the problem here? And I think what we'll do, I want to be sure. I don't know if Mrs. Barnes is gone. I want to be sure your teacher understands what's going on here so to sort of push you to think about this so that next time I come, maybe you could invent another way. If I said towers of…
466		**Michelle**	80
467		**R1**	80. Now, and I said I'll give you a calculator, but you have to know what to do with your calculator, right?
468		**Stephanie**	There's a problem because you have to go all the way from 10 to 80.
469		**R1**	Well, my question is let's not worry about that big problem for a moment. Let's try to do it with a simple problem. Suppose you didn't know towers of 6 were 64 and towers of 7 were, what did you say that was? What do you have there?
470		**Milin**	Towers of 7…
471		**R1**	128? Is that what you have, Milin?
472		**Milin**	Yeah, I think.
473		**R1**	And so. Suppose you didn't know that. How could you jump from towers of 6 to towers of 10 without going through all those steps and why?
474		**Milin**	Get out.
475		**R1**	But isn't that a nice, challenging question? I have one more question to get to. I'm going to put this one aside for a minute because that's going to take some time. When we

			come back, then we'll talk about it. You could bring your calculator, Jeff. Fair enough? Okay, now look. You said this was like shirts and pants, and I would like for you to say if you agree it's like shirts and pants…
476		Jeff	I agree.
477		R1	But why?
478		Michelle	But if you kept on going up, you would have to add…
479		R1	Okay, one at a time. Let's hear Jeff.
480		Jeff	You have the same pattern, same pattern
481		R1	In what way?
482		Jeff	Because with shirts you have to keep on alternating the shirts with the pants. And keep on alternating pants with the shirts…
483		R1	I'm not so sure I follow what you're saying.
484		Jeff	Neither do I.
485		R1	Stephanie is working on the towers of 10.
486		Stephanie	I might have it here. I'm thinking if I multiply the last number I got which was 1,024 times 80, that I got, [Michelle: You would get the answer probably] 81,120, but I'm not sure if I'm right or not. You know, I'd have to go through all that…
487		Michelle	Nuh-uh.
488		Milin	Nuh-uh.
489		Michelle	Or maybe you would multiply it by 70 because you all ready go 10.

490		Milin	No, but times it by 8 [Jeff: You guys are losing me here] because you have to have 8 more.
491		R1	Me too, I'm lost too.
492		Stephanie	You wouldn't times it by 8 because we timesed it by 8 when we were on 8. We times it by 80 when we're on 80.
493		Jeff	True.
494		R1	But when, I don't understand. Hold on.
495	35:00	Milin	Nuh-uh. Did you times it by 80 when you were on 80?
496		Stephanie	I went, I said well, there was …
497		Milin	8*8. 64. How could that be?
498		Stephanie	Actually, you would multiply it by 1,600.
499		R1	Can, can we call time out for a minute?
500		Jeff	What are you guys talking about?
501		R1	Yeah, I'm a little lost and Jeff is lost. And I don't know how Michelle is doing here. And you two can continue this when we leave and work this out. However…
502		Michelle	Finish your fight.
503		R1	I don't really want you to really solve the problem for towers of 80. I want you to solve the problem of towers of 10.
504		All	We did that.
505		R1	But hold on, you have to pretend, you only know the answer for towers of 6.
506		Michelle	Just keep on building.

507		R1	That's one way.
508		Milin	I all ready did that. I all ready did that.
509		Stephanie	You want us to try and figure it out the way I tried to figure it out the first time.
510		R1	Right with only multiplying by 1 number. And convince me that that number makes sense to multiply by. Does that make sense? Do you understand?
511		Milin	This [holding up his work]…
512		Jeff	But all you did…
513		R1	Okay. Hold on. Time out.
514		Jeff	You didn't know times 2 times 2 would help you.
515		Milin	I did.
516		R1	Well, you sort of know it. But I want to save all those intermediate steps because if you had to go to, to build towers of 80, let's see, when you had to build towers of, 2 of 2, how many times, of 3 high, how many times did you multiply by 2?
517		Milin	She's right, Jeff. You should really multiply by 8(?).
518		R1	When you had to build towers of 3, how many times did you need to multiply by 2?
519		Milin	Times 3. 4 times 2.
520		R1	I said by 2.
521		Milin	Oh. 4. Same thing.
522		R1	Okay, 2*2. That's one time you multiply it by 2. You got 4. Then you multiply by 2 again…

523		Milin	8
524		R1	And that gave you 8. So how many times did you multiply by 2?
525		Stephanie	You multiplied the amount of times you…
526		R1	Well, twice. You multiplied it once. This is 2*2 once, right? And then you multiplied it by 2 again, right? 2*2, let me write this. 2*2 gave you 4. That was one time. Then you multiplied it by 2 again another time and you got 8. So you multiplied it twice to build towers of 3, is that right?
527		Jeff	Yeah.
528		Milin	No.
529		R1	No?
530		Milin	Because to get towers of 2, then it will be much easier.
531		Jeff	Yeah, but the thing is it's right, it's easier…
532		R1	I think we've run out of time.
533		Jeff	Yeah, we did.
534		R1	Will you come back?
535		All	Yeah, okay.
536		R1	Okay. Would you come back? Would you come back another time? Can we come back another time? [Yeah] Okay, next question is I want to know what this has to do with shirts and pants.
537		Milin	Shirts and pants?
538		Stephanie	No.

539		Jeff	Oh no. I have no idea. I didn't think of it…
540		R1	You can talk about it before and share it.
541		Stephanie	Can I tell you what I told you last time I was here about shirts and pants?
542		R1	What, what?
543		Stephanie	Because remember, it was the problem with the shirts, the pants. You had to match up Steven's pants with the shirts to make like a tower…
544		R1	Yeah.
545		Stephanie	Remember?
546		Milin	He has to have at least big hands.
547		R1	Well thank you. This was great. Well, thank you so very much. This was fun. I love coming to talk to you about math.
548		Milin	Thank you.
549		R1	My budding mathematicians here.