

10.3 TRANSCRIPT - GROUP WORK ON 2/6/92

1.	00:00:30 People 4:17 work	R2	It has like a chimney on top. Do you see that? Okay, How many do you think you can build, under those conditions?... <i>The researcher is giving directions to the entire class. The following is the transcript for the group work for Milin and Michael.</i>
2.	00:00:37 People	Michael:	What'd you do, what'd you do with the tower? 1, 2, 3, 4, 5, 6, 7, 8, 9, 10. <i>(counts towers while the researcher is still asking questions)</i>
3.	00:01:19 00:05:06 work	Milin:	We did this last year. <i>(the researcher is still giving directions)</i>
4.		Michael:	Really? <i>(the researcher is still giving directions)</i> They start working on the problem while the researcher is still talking
5.	00:01:34 people	Michael:	Uh huh. Alright you gotta go like this. You gotta put them together like... you gotta build them like ...
6.		Milin:	I know, I know
7.		Michael:	With no, with no under... <i>(Michael builds a tower with 4reds on the bottom and 1yellow on the top)</i> you can't, they can't be, they have to be, they can't be different I mean, they gotta be the same.
8.	00:01:58 0:05:44	Milin:	Here <i>(Milin built one tower with three yellow cubes on the bottom and a red cube on the top)</i>
9.		Michael:	Put one more <i>(Milin adds another yellow on the bottom)</i>
10.		Milin:	Okay, Mike, lets do it like this
11.	00:02:05	Michael:	Yeah
12.		Milin:	You do this and that
13.		Michael:	Make the opposite of that. Let me see if I can make another one.
14.		Milin:	Na, no, no, gimme these two

15.		Michael:	Ou
16.	00:02:16	Milin:	These ... these two go like this. Look, look, look, look.
17.		Michael:	Here you made the opposite of it. Oops
18.	00:02:35	Milin:	Oh yeah I forgot.
19.	00:06:24 work	Michael:	Got this one <i>(Michael makes and adds a tower starting from bottom with yellow/red/yellow/red/yellow)</i>
20.		Milin:	You'll have to put this here, right? Mike? <i>(Milin points to the tower with two yellows on the top with three reds on the bottom)</i>
21.		Michael:	Yeah ... Wait a minute. What'd you do? This and ... <i>(Michael picks up the tower with three reds on the top and two red on the bottom)</i>
22.	00:02:48 00:06:34 work	Milin:	See <i>(Milin picks up the 3 reds on bottom and 2 yellows on the top)</i>
23.		Michael:	Which ones of these are opposites, this? <i>(Milin hands Michael the 3 reds on bottom and 2 yellows on the top tower)</i> first this and this. First this ... no
24.		Milin:	This
25.	00:03:02	Michael:	Yeah. Uh ... I just got an idea
26.		Milin:	There is going to be these two <i>(he continues to build towers)</i>
27.		Michael:	There's this and this. Make the one like this and start it with red. . Start one with red. What'd you do? <i>(Groans)</i> where'd this goes?
28.	00:07:08 work	Milin:	This goes with this
29.		Michael:	Alright
30.		Milin:	We only have this many.
31.		Michael:	It's easy

Line	Time	Name	Transcript	Manjit K. Sran
32.		Milin:	Yeah yeah but Mike what if we could make more and we can't use these blocks	
33.		Michael:	It can't be the same so ...	
34.		Milin:	Uh, where's, where's this ... or something like that.	
35.	00:03:48	Michael:	Where's the one like that? Right there. Alright. Did we try, we didn't try this one	
36.		Milin:	Did we do this, Mike?	
37.		Michael:	No. make the opposite of that	
38.	00:04:15	Milin:	Make the opposite with this. See two yellows on this side and two yellows on this side and one red. I'll do it.	
39.		Michael:	<i>(Michael flips the towers around)</i> Lot easier	
40.		Milin:	This?	
41.	00:04:43	Michael:	Oh, we got that already. <i>(Michael snatches the tower from Milin)</i> I did that already.	
42.		Milin:	I know, but I'm going to ...	
43.	00:04:48	Michael:	This is wrong. We've got twenty already...Counted by ones. <i>(Michael looks at what Milin is making)</i> We did it. ...that? ... Wait a minute. Where's that one you put down...	
44.		Milin:	<i>(Milin Points to the tower he had done)</i> did I do this?	
45.		Michael:	No	
46.	00:05:16	Milin:	Two reds and ...	
47.		Michael:	Here, I'll do this. I'll do that one. Take another one	
48.		Milin:	I already got this. No, Mike don't do that 'cause I already got it. No, I already got ...	
49.		Michael:	Ha ha <i>(Michael makes the tower before Milin)</i> Gotcha. I beat ya.	

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50.	00:05:38	Milin:	Mike we can't do it like this can we?	
51.		Michael:	If we didn't do it, yeah, no, turn it. Go to the next one. No.	
52.		Milin:	Yeah we could	
53.	00:05:57	Michael:	Yeah. I got this one. I got it Mil. How many do we have (<i>counts</i>) 6, 8, 10, 12, 13...oh, wait a minute. 2, 4, 6, 8 ... 16. This one goes over here. So altogether, how many do we have?	
54.		Milin:	(<i>shrugs his shoulders</i>) sixteen	
55.		Michael:	What's sixteen times two? What's sixteen times two?	
56.		Milin:	Huh?	
57.		Michael:	What's sixteen times two?	
58.		Milin:	No see 2, 4, 6, 8 ... 16.	
59.	00:06:41	Michael:	Yeah what's sixteen plus sixteen?	
60.		Milin:	You can't do that 'cause I counted by 2's	
61.		Michael:	1, 2, 3, 4 ...	
62.	00:10:40 work	Milin:	Sixteen. Right!	
63.		Michael:	Never mind.	
64.		Milin:	See? 2, 4, 6, 8, 10, 12, 14, 16.	
65.		Michael:	Never mind	
66.	00:10:52	Milin:	I just counted by two's	
67.		Michael:	Yeah, but I still get that. Did we do this one yet? (<i>Michael is holding a tower with four yellows on the top with one red on the bottom</i>)	
68.	00:11:00 work	Milin:	I just had this one (<i>Milin adds Michael's tower to their collection</i>)	
69.		Michael:	No you didn't do that.	

70.	00:07:19	Milin:	Yeah
71.		Michael:	You did
72.		Milin:	I did. The other way. See right here.
73.		Michael:	But you didn't have an opposite to it so . Yes, you do. Something ain't right...
74.		Milin:	See, this goes like this, so this stays on the bottom, see? This stays on the bottom and this stays on the bottom.
75.		Michael:	we got another pair
76.		Milin:	So that one would be the same as this
77.		Michael:	No it wouldn't
78.		Milin:	And this one would go like this (<i>Milin flips that tower</i>)
79.		Michael:	Yeah
80.		Milin:	No, different like this then it would be the same as this. (<i>Milin flips the tower back the way it was</i>)
81.		Michael:	Yeah, well it's a different match. So put it this way. It's a different match. (<i>Michael makes the new tower and put it in front of the previous tower</i>) Gotcha. Eighteen. I did it Mil.
82.		Milin:	I know, I know, you did? What about for this. (<i>points to tower</i>)
83.		Michael:	I did that
84.		Milin:	How? Okay. This goes with what?
85.		Michael:	This, Mil. Look, these ...
86.		Milin:	Oh yeah. 8:27
87.		Michael:	Go together. These go together.
88.		Milin:	Okay, okay.

89.		Michael:	These go together.
90.		Milin:	No, no, no, no, these two could be the same. Let me see.
91.		Michael:	These go together look. These go together. These go together. These go together
92.		Milin:	Yeah, you're right
93.		Michael:	These go together. These go together. Two I wonder if we did this one. No. maybe not
94.		Milin:	Did we do this?
95.		Michael:	Let's see
96.		Milin:	No
97.		Michael:	I don't think so
98.		Milin:	We couldn't have. I got this one. I got this one okay? <i>(Michael tries a tower to see if it is the opposite and Milin Finishes the opposite tower)</i>
99.		Michael:	Yeah
100.		Milin:	All of these reds turned yellow.
101.		Michael:	Yeah, yeah, yeah, yeah. Did we do this? 9.51
102.		Milin:	I think ... could ... here ... uh oh.
103.		Michael:	Ah!
104.		Milin:	Switch them to yellows. <i>(Milin starts building the opposite tower)</i> I got that 10.06
105.		Michael:	<i>(Michael Moves the new pair)</i>
106.		Milin:	Did I do this one?
107.		Michael:	Yeah. Its fine ... 20 altogether.
108.		Milin:	So far twenty. So anybody that said fifteen is wrong, right?

109.		Michael:	Yeah. Twenty? What?
110.		Milin:	So anybody that said fifteen must be wrong or something.
111.		Michael:	I don't know
112.		Milin:	But didn't you say if you go like um this <i>(turned a tower upside down and knocked the other tower off the table)</i>
113.		Michael:	But you can't do this. <i>(Milin switches the tower back and Michael puts the fallen tower next to it)</i> They didn't say you could do that. so ...
114.		Milin:	But we might have.
115.		Michael:	No, we didn't. <i>(Michael starts rearranging towers)</i> I checked it personally. Here It'll give us more room. In case we have more to do as ... hey you got something...
116.		Milin:	This
117.		Michael:	Yeah alright
118.		Milin:	Do we have three on the bottom and one on the top?
119.	00:15:15 work	Michael:	That's only four.
120.		Milin:	No, but do we have the opposite of this? Uh huh. Do we?
121.		Michael:	Here put it ... 11:44
122.		Milin:	Nah
123.		Michael:	Put another red on top.
124.		Milin:	Do we have This. No. <i>(as Mike compares new tower to all towers)</i>
125.		Michael:	Something ain't right. We didn't make a match for something

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126.		Milin:	Three on the top ...	
127.		Michael:	That's a match. Put that together before. Don't do it. We didn't make a match for something.	
128.		Milin:	Why?	
129.		Michael:	'cause it doesn't make any sense. <i>(Milin adds the inverted pair to the collection)</i>	
130.		Milin:	2,4, 6, 8, 12...12	
131.		Michael:	Oh I guess so	
132.		Milin:	We haven't missed a match	
133.		Michael:	Are we sure everything matched	
134.		Milin:	That we're, we're losing ... do we do three...	
135.		Michael:	I think I did that. Yeah we did that.	
136.		Milin:	Where?	
137.		Michael:	Oh, two on the bottom and two on the top?	
138.		Milin:	This?	
139.		Michael:	Yeah, we did it.	
140.		Milin:	No, we didn't.	
141.		Michael:	Right here <i>(Michaels checks the tower Milin had built)</i>	
142.		Milin:	How? <i>(Milin puts the tower back)</i>	
143.		Michael:	No, we didn't make a match for it. See. I know we didn't make a match for something. This goes together. This goes together. This goes together.	
144.		Milin:	These go together	
145.		Michael:	This goes together. See we did it. No we didn't.	
146.		Milin:	We didn't	

147.		Michael:	Alright
148.		Milin:	But this has to, no, yeah but then these two go together too, 'cause these have to ... ah!
149.		Michael:	Oh yeah we did it.
150.		Milin:	Where?
151.		Michael:	Right here.
152.		Milin:	No
153.		Michael:	Yeah
154.		Milin:	No, there <i>(takes tower apart)</i> did we do this? Did we, uh, in the middle
155.		Michael:	Um that me
156.		Milin:	I don't think so
157.		Michael:	Uh huh
158.		Milin:	Not three yellows in the middle not three reds in the middle. I need this one. These two go together. 14.10
159.		Michael:	We could make a lot more if we had one more color
160.		Milin:	Blue. Yellow. If we had green I could put a green here.
161.		Michael:	Wait, I think I just got one. I think I just got one. I think I just got one. Did I make two
162.		Milin:	One on the bottom? <i>(Michael compares to check)</i>
163.		Michael:	Yeah. I think I got one
164.		Milin:	One on the bottom?
165.		Michael:	We didn't do it. We didn't do it Mil.
166.		Milin:	I think twenty-eight uh huh <i>(R1 arrives to talk to them)</i>
167.		R1	How are you working at it? <i>(Mike counts)</i>

168.		Michael:	We got twenty-eight
169.		Milin:	Because, see every time we make it like this, right? 15.25
170.		R1	Yeah
171.		Milin:	Then we change the color, like this.
172.		R1	Oh, so they come like that. 15.33
173.		Milin:	So we get doubles of this and this and all this.
174.		R1	Uh huh. So that's what you have done all along.
175.		Milin:	Uh huh.
176.		R1	Do you think there are more?
177.		Michael:	May be
178.	00:19:29 work	Milin:	Yeah
179.		R1	How are you gonna be able to tell...
180.		Michael:	I don't know. Put them together and see if they ...
181.		Milin:	When we lose all these use up the cubes
182.		R1	Uh, we have plenty more. But you have 28 now.
183.		Michael:	Yeah
184.	00:16:02 People	R1	Well, I'll come back and see if you have any more.
185.		Milin:	Do we have ...
186.		Michael:	Hey. We did ...let me see
187.		Milin:	This
188.		Michael:	Yellow, red yellow, yellow
189.		Milin:	Yes. Double. Lets see if this has a double.

190.		Michael:	We just did this one
191.		Milin:	No, this doesn't, until now. This ... ok two yellows
192.		Michael:	We did it
193.		Milin:	Phew
194.		R3:	Hi there.
195.	00:21:17 work	Milin:	So far we only got twenty-eight
196.		R3:	Twenty-eight
197.		Michael:	That's pretty ...
198.		R3:	What did you say Michael? I'm sorry I didn't hear that.
199.		Michael:	No I said that's ... he said we only had twenty-eight.
200.		R3:	Okay, do you think there are any more? 17.41
201.		Milin:	Maybe.
202.		Michael:	Ooo ...
203.		Milin:	Yeah
204.		R3:	Michael.
205.		Michael:	Maybe
206.		R3:	Yes and maybe. Okay. You probably want to work on this a little bit more. Are you sure that they're all different towers?
207.		Michael:	Yeah.
208.		Milin:	Yes.
209.		R3:	How do you know that?
210.	00:21:41 work	Milin:	Because everything we get, we make it like this, right?
211.		R3:	Uh hum.

212.		Milin:	Right now I am going to check, see its not ...
213.		Michael:	We made that one.
214.		Milin:	Where? <i>(Michael points to the tower)</i>
215.		R3:	Ah, so you check by moving it along here?
216.		Milin:	Yeah.
217.		Michael:	Yeah.
218.		R3:	Okay.
219.	00:18:13 people	Milin:	Did we make it this way?
220.		R3:	Also is there anything else that helps you to make sets or make towers?
221.		Milin:	Um, we just keep on checking to see if ... there's any ... and when we try to do it every way like we get that um ... we already know that we made five of these and five of the reds so we are not gonna try that again. <i>(Milin talks about his solid towers)</i>
222.		R3:	Okay. I have a question. There is something here that interests me and I saw Michael doing this. Michael maybe you could tell me about this. I noticed that your towers, there seems to be something interesting about them. What about these two?
223.		Michael:	We make ...
224.		Milin:	See this goes like this and this turns to yellows from reds and see this turns from ...
225.		Michael:	They are like opposites.
226.		Milin:	Yellow to red ...
227.		R3:	Like opposites what do you mean by opposites?
228.		Milin:	Like um when have this we change the color to the other color.

229.		R3:	You agree with that Michael?
230.		Michael:	Yeah like here.
231.		R3:	Show me.
232.		Michael:	We changed, we changed from, we made this one and then we changed yellow to red, these from red to yellow. From red to yellow. From red to yellow.
233.	00:23:13 work	R3:	Okay and that's interesting. Did you do that a lot here?
234.		Milin:	Yes
235.		Michael:	Yeah. That's how we got all these.
236.		R3:	That's how you got all of them. Okay. I am gonna let you continue to work these. Okay. Call me when you think you've found them all.
237.		Michael:	We did that one. I just did... tried that.
238.		Milin:	Its right there. Maybe just go like this
239.		Michael:	I gotta feeling ... did that
240.		Milin:	Is there a perfect match?
241.		Michael:	We did that
242.		Milin:	Here's an exact perfect match. Yep. Perfect. Did I try this? Yeah. Do we have a perfect match on this? Yep, yep. We have a perfect match on everything. What about ... make three reds.
243.		Michael:	We did that. 3 reds and 2 yellows
244.		Milin:	Nah! That is too much.
245.		Michael:	I know
246.		Milin:	We didn't try this.
247.		Michael:	Gotcha.
248.		Milin:	Come on. We have its opposite!

249.		Michael:	We do?
250.		Milin:	No, I made this opposite make this its opposite. We don't got this but we, we have this an, an opposite instead. <i>(Milin points with the tower he is holding)</i>
251.		Michael:	No, I you turn it upside down. Go ahead. Turn it upside down.
252.		Milin:	But, see? Now we have to make an opposite for this.
253.		Michael:	My eyes went weird. Whoa, whoa, whoa, what? Which was the one I just made?
254.		Milin:	This.
255.		Michael:	What are you talking about?
256.		Milin:	See, I see look this is a perfect match. Now we have to get a perfect match for this.
257.		Michael:	This is nuts. This is nuts. This is nuts. We're all nuts. Got it.
258.		Milin:	We have this so ...
259.		Michael:	No, we got it. Its right here.
260.		Milin:	But do we have it here? There's probably gonna be at least one more pair
261.		Michael:	Yeah there is gotta be <i>(counts towers)</i> 30.
262.		Milin:	Thirty? There's gotta be another pair. I'm telling you. It looks like you are on TV Mike.
263.		Michael:	Mil, I doubt it.
264.		Milin:	Mikey, look over there. Hands are on TV.
265.		Michael:	Mumbles
266.		Milin:	Do we have this? Mike, Mike, mike, mike, you have to see if we have this

267.		Michael:	We do. I made it remember.
268.		Milin:	Where? Yellow/red/yellow/red/red
269.		Michael:	Maybe not
270.		Milin:	Yeah thirty-two. Thirty-two, I think we're done.
271.		Michael:	Hmm.
272.		Milin:	Just see. I think I got ... I'm on to one, yeah, this. None of those none of these.
273.		Michael:	Okay, I got it already, Mil maybe we ought to put it the other way.
274.		Milin:	No, there's
275.		Michael:	Thirty things in the way. No, don't move that its taped. <i>(Milin and Michael are rearranging the set of towers on the table)</i>
276.		Milin:	How many do we have altogether?
277.		Michael:	Thirty-two
278.		Milin:	I just want to make sure because I think some ...
279.		Michael:	Oh, no thirty-four. We just made one.
280.		Milin:	Oh, yeah, yeah thirty-four. I think I am convinced.
281.	00:25:49 00:29:34	Michael:	No, there's got to be one more. There's got to be a match like
282.		Milin:	See if you do this right? Then this, right? Then we could do this the opposite of that. see? This on the other way. They don't know if...
283.		Michael:	Hey, I think you have got that.
284.		Milin:	So that means we have to come up with sixty some what?
285.		Michael:	No, I don't think so.

286.		R1	About done?
287.		Milin:	We have about thirty-four now.
288.		R1	About? Exactly or about?
289.		Milin:	Exactly, exactly.
290.		R1	Show me.
291.		Michael:	I don't think so
292.		Milin:	All that plus 2 more.
293.		Michael:	Thirty-six
294.		R1	You have thirty-six?
295.		Milin:	Thirty-six
296.		R1	Now how are we going to decide if you have any that are duplicates?
297.		Milin:	Because see we still keep on going like this and see this?
298.		R1	Yeah.
299.		Milin:	It's a duplicate of this so we can't use this.
300.		R1	Oh, I understand that but what about the ones that you have? How can you be sure that there aren't any duplicates there?
301.		Milin:	Because we always keep on going like this and, and then ... if we find any duplicates, in our way... Mike, this can't be used. We need five
302.		R1	Yeah because that's a copy of one
303.		Michael:	Yeah, I know. I just want to check something out.
304.		R1	You already have?
305.		Michael:	Think there's one more left?

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306.		Milin:	If there is there's...	
307.		R1	You know I am just busy looking and I think I see one that looks like this over towards the bottom down there. See if you don't see if you want to check that out.	
308.		Milin:	No	
309.		R1	Another one besides ...	
310.		Milin:	This? This. Yeah, this is a dupli...	
311.		R1	What do you think?	
312.		Milin:	It's a duplicate	
313.		R1	Why'd you take two?	
314.		Michael:	'cause they're, we made them like we made them opposite.	
315.		Milin:	These two, one of this and this is out ... these two ... this is out.	
316.		Michael:	Took the bottom?	
317.		R1	How many do you have now?	
318.		Milin:	Thirty-four, thirty-four, we had thirty-six and then she came (Mike counts) just trying to figure out if we have any more duplicates. These two are alright.	
319.		R1	Count them for me, I can't do it.	
320.		Michael:	2, 4, 6, 8, 10...32	
321.		R1	Thirty-two	
322.		Milin:	How did we lose four?	
323.		R1	Maybe there's some that you took out?	
324.		Milin:	Let's see if this one is a duplicate.	
325.		Michael:	Remember the one we were about to make, but we didn't make when she came? I counted that in. that's	

			how we got the four left. The four out, I just told you what I did.
326.		Milin:	Nah, this, this doesn't have any exact duplicates. This might not either.
327.		R1	Any ideas about how you can tell if you're all done or not?
328.		Milin:	Um, if we keep on doing these and we keep on getting duplicates.
329.		R1	That's a one way.
330.		Milin:	Then we'll probably be done.
331.		R1	Really, why? What makes you think you're...
332.		Milin:	'cause we only, see, we keep on, we just found two duplicates.
333.		Michael:	And its getting harder and harder as we go along.
334.		R1	I bet it is. Gets harder and harder
335.		Michael:	To keep finding them.
336.		Milin:	So when it gets too hard and we can't make that many more and if we go about four minutes without making some more then we're probably done. Because every like one minute we made one.
337.		R1	Do you think there is any way ever to know for sure? Whether you are done or not.
338.		Milin:	Uh huh
339.		Michael:	No I don't think so.
340.		R1	You don't think there is any way to know for sure? So that if you kept looking and kept looking you really might find another?
341.		Milin:	If you had ...
342.		Michael:	Maybe

343.		Milin:	But that's only if you are really not done.
344.		R1	Only if you are really not done. So you're saying there really is a there really is a done... you really think there really is a special number, there's not any more.
345.		Michael:	Yeah
346.		Milin:	Because see ...
347.		R1	Why?
348.		Milin:	Um. We could make a duplicate of this see, we make a duplicate of each one but we, we change the colors so then that would be different and then we keep on doing it
349.		R1	You mean different colors.
350.		Michael:	Yeah
351.		R1	But we can't do that 'cause we just counted red and yellows.
352.		Milin:	See if we have this, right? We change all the threes to yellow and these two to reds ...
353.		R1	Hmm, but you've already done that, haven't we? Isn't that the way you did it? I wonder I wish I could come up with a way of thinking whether
354.	00:31:56	Milin:	Maybe there's an answer sheet? I think we're done. I think we're done. So does Michael. So that's more than ten minutes and we still didn't find one.
355.		R1	Has it really been a long time?
356.		Milin:	Cannot have one
357.		R1	I keep wondering if there's some way you can tell when you've finished.
358.		Milin:	Uh, there is one way. If you take hundred hours and still haven't found any.

359.		R1	Its just a matter of ... do you know what you are supposed to do when you think you are done? Let me go find out.
360.		Milin:	We have gotta be done.
361.		Michael:	mm.
362.		Milin:	Kids think they are done, right? Only up to 15 or something. 20?
363.		Michael:	And we got thirty-four, thirty-four
364.		Milin:	If she finds one more for us we got a lot more to do. I think we have to do it by today.
365.		Michael:	We still got tomorrow I think.
366.		Milin:	Yeah, but tomorrow, this is gonna be all wrecked. Don't ya think?
367.		Michael:	No, not really
368.		Milin:	Could be.
369.		Michael:	Not if she puts them in a bag.
370.		Milin:	With our names on it. I'll go get and ... okay? Okay? We have thirty-four
371.		R3:	Okay you have thirty-four
372.		Michael:	Thirty-two wasn't it?
373.		R3:	I don't know
374.		Milin:	No, thirty-two
375.		R3:	I am trusting in the two of you. So can you check for me?
376.		Michael:	Mike counts
377.		Milin:	How much do you get so far?
378.		Michael:	Thirty-two

379.		R3:	Thirty-two. Alright. How did you find all these?
380.		Milin:	You made duplicates. But you have to change the colors around.
381.		R3:	Okay, explain to me what duplicates are?
382.		Milin:	Like, see
383.		R3:	Where you change the color.
384.		Milin:	See, you have this right?
385.		R3:	Hmm.
386.		Milin:	These two look the same but see this changes to yellow, this changes to red, this changes to yellow, and this changes to red.
387.		R3:	Okay, Michael you show me a pair of duplicates that are switched around.
388.		Michael:	This, this yellow compares to red, red compares to yellow, red compares to yellow and these yellows compare to the these reds.
389.		Milin:	And all these compare to each other
390.		R3:	Alright. Why do you think you found them all?
391.		Milin:	Because it took us one minute to find another one and now its like 10 minutes left?
392.		R3:	Its taking a long time to find it. Have you found any in the past ten minutes?
393.		Milin:	Nah uh
394.		R3:	No?
395.		Milin:	We just lost some
396.		R3:	What do you mean you just lost some?
397.		Milin:	Because we made a duplicate of two

398.		Michael:	We made like these two the same and these two the same.
399.		R3:	I see, so you, you had a pair there that was the same as another pair?
400.		Milin:	Yeah
401.		Michael:	Yeah
402.		R3:	Okay. And you feel pretty convinced about this?
403.		Michael:	Uh hum
404.		Milin:	Yeah
405.		R3:	Alright okay, just sit tight, then. I think we're gonna talk about these in a minute. Alright.
406.		Milin:	I thought we were supposed to leave five minutes ago?
407.		R3:	No, this is, we're having an extended math class today, so you'll all be here for a little while , okay you'll be here for a double period, today.
408.		Milin:	Oh!
409.		Michael:	Uh huh
410.		R3:	You see, now make sure that you've thought about this and there aren't any others. Okay?
411.		Milin:	Could this be?
412.		Michael:	Oh, great they're out of here.
413.		Milin:	How come?
414.		Michael:	Check it out dude
415.		Milin:	Let me see
416.		Michael:	That's what I was actually checking for. Well we don't have thirty two anymore we only have thirty

417.		Milin:	There's gotta be more. <i>(Someone says thirty four)</i> thirty four they are gonna lose some right now I'm telling ya. I wish you could make it out of 10. Really then I would get like fifty. There's gotta be thirty four. At least thirty-two.
418.		Michael:	Well we had thirty-six and then we lost four actually six.
419.		Milin:	Check if we have this. Yellow, yellow, yellow
420.		R3:	We're -----to now talk about ...
421.		Michael	This looks familiar
422.		Milin	Sighs
423.		Milin	We have got to get one more
424.		Michael	There's gotta be-
425.		Milin	I think this was there
426.		Milin	Check if we have any of these two
427.		Milin	Guess not. Now how many do we have?

10.4 TRANSCRIPT - SHARING SESSION ON 2/6/92

1.		Jeff:	We Have...
2.	00:00:00	R2:	Okay. But hold on a minute Jeff, I am gonna want you to explain. How many did you find?
3.		Jeff:	We are not sure
4.		Michelle:	Well so far we found thirty two.
5.		R2:	Okay Michelle says thirty two, but the way you're gonna explain it- you made some extras you are telling me to explain it
6.		Michelle:	Yeah we found some extras.
7.		Jeff:	We need some more colors though we don't have any more
8.	00:00:24	R2:	Oh! We can get you some more colors if you need it. Okay, this table here how many did you make?
9.		Stephanie:	We made thirty four but we are still checking so there are probably one or two duplicates
10.		R2:	Oh! Did anybody else here get thirty four? Okay, so you, this group has thirty four. What about this group over here?
11.		Michael:	Thirty two.
12.		Milin:	Thirty two.
13.		R2:	You have thirty two. Did any other group get thirty two? There are lots of groups here in the front that got thirty two but what about your group Sebastian?
14.		Sebastian	Thirty five.
15.		R2:	You have thirty five. Okay, do you think it is possible to have an odd number?
16.		Students:	No.
17.		R2:	They have an odd number thirty five.
18.		Michael 2:	You can't because when you have a number you could

			have the opposite if you have one of this then you have another one of this because it is the opposite...If you have ten of these and you have another one that's opposite so it makes twenty.
19.		R2:	So what you are telling us, Sebastian and his group that they got to have thirty four or thirty six? Do you believe that? Do you understand what he is saying? Does that make any sense?
20.		Students:	Uh huh!
21.		R2:	What do the rest of you think? Do you think that makes sense? What do you think Jennifer?
22.	00:01:28	Jennifer:	It makes sense, but he could have what ever number he wants. It just depends if he put it opposite or not opposite.
23.		R2:	So he might not have used an opposite way of doing it you are suggesting? What do you think about that?
24.		Student:	I think originally he has thirty six but if you make doubles they cut it down to not doubles like umm...but different colors like one goes red, yellow, red, red, red or it could go yellow, red, yellow, yellow, yellow and that could make it go to thirty four could be the same
25.		R2:	But could it be thirty five?
26.		Michael 2:	It could be, but then you would need another one.
27.		R2:	I see. What do you think back there?
28.		Milin:	Um, we got thirty six before, but then we found duplicates...but now we um got thirty two and we keep on duplicating it by changing the color. So, you can't get an odd number unless you don't duplicate it and get all of them.
29.		R2:	You know what I am interested in? I am interested in knowing how those of you who think you have found all possibilities um can convince me but I guess some of you think there are only thirty two and some of you think there are more than thirty two. Maybe, what we should do is for the people who think there are more

			than thirty uh who think there are only thirty two is to take a look at some of the patterns of the people who found more to see if they found any duplicates. What do you think about that?
30.	00:03:00	Dina:	When Robert said that he had thirty five, he could split, when you get ten of 'em of these in a same color like this like this (<i>holds up a long blue tower then takes a ten tall tower of all brown</i>) when you get one of these you could split them into five like two fives and that makes uh that makes an odd number so maybe he could have he could have five in each group and so we could split this into fives.
31.		R2:	Why don't we take a look to see what Sebastian and his group has. He claims he has thirty five. Some of you here, if you could turn around and take a look and see what was built by Robert and Sebastian. What do you think? Do you see any duplicates there? Maybe they have thirty five. Maybe there are thirty five gee, I don't know. Did any of you find duplicates? Some of you think you have really good methods of finding duplicates. You want to come and peek? Anyone here find a duplicate?
32.		Milin:	There's thirty four! (<i>there are really thirty four</i>)
33.		R2:	There are thirty four?
34.		Student:	Yeah. (<i>Student counts the towers made by Sebastian and Robert</i>) thirty four thirty five. (<i>miscounted</i>)
35.		R2:	You have thirty five. Those of you who found thirty two are telling me that they have three that ought to be duplicates. Now if that's true you should be able to find them. Want to study this for a few minutes? Okay, I will give you a few minutes to study it.
36.		Student:	I found two
37.		Ankur:	We found a duplicate!
38.		R2:	Oh! You found a duplicate. Show me the duplicate. You are not gonna throw both of those away. You are gonna keep one and throw the other away. Very Good! Do you agree? Do you agree Robert and Sebastian

			that's a duplicate? Okay.
39.		Michael:	I think there is another one.
40.		Ankur:	Found one. Here is another duplicate
41.		R2:	Okay! You boys agree there's another duplicate?
42.	00:05:13	Milin:	Yes!
43.		R2:	Okay. Now how many do you have?
44.		Student:	Thirty two
45.		Ankur:	Thirty two oh yeah thirty three
46.		Milin:	There's got to be thirty two
47.		Student:	There is no more duplicates.
48.		Student:	Has to be, there has to be.
49.		Michael:	Let me see that one.
50.		R2:	Okay. Ones that are out why we don't put them aside so that they don't get mixed up. Is that another duplicate?
51.		Michael:	Yeah.
52.		R2:	Okay, we found another. Now let's see what we have left. Will you count then? What did you think Alex?
53.		Michael 2:	One two three...thirty. I missed some.
54.	00:06:10	R2:	What about the ones that Mrs. Barnes has?
55.		Ankur:	Those are duplicates.
56.		Milin:	Those are duplicates.
57.		Michael 2:	Two, four, six, eight, ten...eighteen was it these two? Eighteen...thirty, thirty one.
58.		R2:	So. Is it possible to have thirty one?

59.		Students:	No
60.		R2:	Okay. Got to find that other one then or else take one away.
61.		Student:	There is two of the same one.
62.		Teacher:	Okay, hand me one.
63.		Ankur:	Okay, so they have thirty two.
64.		R2:	How many?
65.		Ankur:	Thirty two.
66.	00:06:50	R2:	Okay, you absolutely convinced? What does Sebastian and Robert think? Are they convinced?
67.		Students:	14, 16, 18, 20, 22...30, 31(counting the towers)
68.		Student:	There is one more duplicate
69.		Teacher:	Got to figure out which one it is.
70.		Milin:	It's either that or we took more out than there was supposed to be.
71.		Teacher:	Well maybe somebody is not counting right.
72.		Students:	Sebastian said he found a duplicate
73.		Teacher:	There is one on the floor there.
74.		Student :	This is confusing.
75.		Teacher:	Somebody is not counting them right.
76.		Student:	Wait wait wait
77.		Teacher:	Let's have one person count them instead of everybody counting them at once. Let Michael count them. Michael, stand them all up and count them.
78.		Michael 2:	Which ones? These? (he points to a group of towers)
79.		Teacher:	Count them all. Bobby says these are the ones we took

			out
80.		Ankur:	Those are the duplicates.
81.		Teacher:	Put them up. One person should count them
82.		Student:	There should be thirty two
83.		Teacher:	Yes. There is three out and you started with thirty five
84.		Michael 2:	Two, four, six, eight, ten, twelve, fourteen, sixteen, eighteen, twenty, twenty two, twenty four, twenty six, twenty eight, thirty, thirty one.
85.	00:08:26	R2:	Now let me ask you a question here, how could you, how could you figure out if you think there is an extra one or you think there is one missing ?
86.		Ankur:	One missing
87.		R2:	How could you... You have a strategy for figuring out the one that is missing. How could you do that?
88.		Milin:	You could take one to thirty six.
89.		Student:	- and then which ever one doesn't have a opposite
90.		R2:	Is that a good strategy? Why don't you work on that strategy? What is the prize for finding that one if there is one?
91.	00:08:58	Milin:	Its either that or you could check with our own (<i>walks away to the back of the room</i>)
92.		Michael 2:	I found a match a match Yes I did this is a match.
93.		Teacher:	Leave them here till you find matches (<i>she put the towers on the table</i>)
94.		Students:	This is a match. These are matches.
95.		Milin:	This has got to get a match
96.		Student:	Wait.
97.		Student:	Found another match

98.		Student:	These are two the same take one.
99.		Teacher:	Okay, choose one person alright here.
100.		Student:	Now we have thirty
101.		Teacher:	Okay, Bobby
102.		Student:	Now we have thirty
103.		Teacher:	No, we put the others back in.
104.		Student:	We should have all duplicates.
105.		Ankur:	Did you put the duplicates back in?
106.		Teacher:	Because we didn't know which ones are the duplicates.
107.		Ankur:	There's more duplicates
108.		Michael 2:	Found another one
109.		Teacher:	Michael what do you mean by duplicates?
110.		Milin:	We say matches (he is holding up a tower with three reds and two yellows) because this changes these two could be red and these
111.		Michael:	I just called it a match.
112.		Teacher:	What do you mean by duplicates?
113.		Michael 2:	I didn't say duplicate he did (<i>point to the Ankur next to him</i>)
114.		Teacher:	What are you saying? Find a match? What do you mean by a match?
115.		Michael 2:	They go together see?
116.	00:10:34	Milin:	See, right here all these turn yellow (<i>he is holding a tower with three red and two yellows</i>) and these two turn red
117.		Michael 2:	Its' a match

118.		Student:	Hey! Here's a match
119.		Michael 2:	No, that's not a match.
120.		Milin:	This could be a match.
121.		Matt:	No its not (he is holding the inverted pair given by Milin)
122.		Milin:	If you put it the other way yeah.
123.		Student:	I found a match.
124.		Student:	I found a match.
125.		Ankur:	Let me see those two. This is a match. Mike look here's a match.
126.		Student:	Aren't these the same?
127.		R2:	Where are you putting your matches? Are you keeping them next to each other? Are you putting them along side each other? Okay. You keeping a record of them here?
128.		Teacher:	Let's let Sebastian and Bobby find it. Let's go over to Michael.
129.		R2:	You boys need to move back
130.		Teacher:	Bobby and, Joey you need to move around. Okay, before, I asked the question what did you mean by the opposite or the match. Michael, want to show us? Because you have yours in pairs you would you explain to us about your pairs. Joe you want to come around here so you can see better. Joe come here there is plenty of room. Okay, Michael I would like you to explain
131.		Michael 2:	See when it is the opposite see we call it a match because they go together.
132.		Teacher:	Okay, can you explain a little bit more about how they go together?

133.	00:12:43	Michael 2:	You do it. (Michael asks his partner to explain)
134.		Student:	Well, These are a pair because these two are red and these two are yellow and this is yellow and this is red, red yellow, yellow red (he compares the colors in the left tower to the colors in the right tower)
135.	00:12:58	Milin:	I know what they mean. See this yellow turns into red on this one and all of these reds turn into yellow in this one
136.		R2:	Oh good! Okay, I see what you mean. I see what you mean. That helps me.
137.		Ankur:	You switch them
138.		R2:	What are you switching?
139.		Milin:	This color changes into this (he points to the towers he had used earlier)
140.		Students:	You switch the colors around
141.		R2:	You are switching the colors. Oh I see you are switching the red to the yellow and yellow to the red that's what you mean by opposites? Okay.
142.		Teacher:	Michael what, how did you use that as a strategy for finding them?
143.		Michael 2:	See, what I-
144.		Teacher:	What made to come up with that?
145.		Michael 2:	See when I found it I found another one I made one that looked like this and I said to Paul that We should make al these the ones that are like if we have ten we get twelve..
146.	00:13:48	Milin:	They got doubles
147.		Teacher:	May be they have them mixed up a little.
148.		Paul:	We still have doubles
149.		Teacher:	Don't have a double.

150.		Michael 2:	Let me see.
151.		R2:	Ah huh!
152.		Milin:	Doubles. Doubles (Michael is looking at four towers) no no Mike, Mike this and this are doubles you can't take those two again. Milin points to second and the fourth towers.
153.		R2:	Which is the top and which is the bottom? How do you know which is the top of the tower? Can you show me what's the top of the tower?
154.		Student:	Shows the chimney side of a tower
155.		R2:	On the ones you think are doubles can you stand them up for me so I can see them? So they look the same to me I see. Okay, why don't you work on that? Maybe we should hear from somebody else.
156.		Michael 2:	Yeah we had some of these left. I thought they were like, we did it and we forgot to break them apart.
157.		Teacher:	Let's go over to Ankur. Hey Ankur I want you to tell us how you went about going and getting yours.
158.		Ankur:	We ...
159.		R2:	Hold on a minute Ankur, hold on a minute
160.		Teacher:	I want you to step back a little so we can see. Ankur I want you to explain how you did yours.
161.		Ankur:	I made one all red (he points to an all red tower) then I took a red away and put one yellow and then I took another yellow away red away and I made yellow and left the bottom the same. I did that all the way down
162.		R2:	Oh! That's very neat. Okay, I see how you made all of these that's really neat. What about the others?
163.		Ankur:	We just made anyone that way.
164.		R2:	Oh!

165.		Teacher:	What made you stop following it?
166.		Ankur:	We couldn't find any other ones.
167.		Teacher:	Then after you stopped here and you couldn't find any more what made you decide to go this way.
168.		Ankur:	We did that from the bottom up
169.		R2:	Let me ask you a question. In these I see here you have one red, two reds, three reds, four reds right? (she starts from the right side and counts)
170.		Ankur:	Uh huh!
171.		R2:	I guess may be, five reds and here you have one yellow, two yellows three yellows, four yellows, five yellows. Alright, so that's a pattern I could see very easily. You want to put this over here to have five. (a student picks up the five red tower and moves it next to the others)What about here though I have trouble seeing that can you help me see that? (points to the remaining towers)
172.		Ankur:	We didn't do anything here.
173.		R2:	You want to think about that how you can better explain that to me. That is very neat. Okay, think about how you can explain. This is very nice. Can we hear from somebody else?
174.		Student:	Not yet. Not yet.
175.		R2:	Not yet?
176.		Stephen:	Over here. Over here
177.	00:17:04	R2:	Okay, give you a minute to get set up.
178.		Teacher:	Joe I want you to sit over there cause you can see just as well from there. Are you ready yet Stephen?
179.	00:17:37	Stephen:	Almost.
180.		Teacher:	Okay, Stephen how did you go about solving that problem?

181.		Stephen:	Uh!
182.		Focundo:	It just came out.
183.		T eacher:	What do you mean it just came out?
184.		Focundo:	I just thought of them.
185.		Teacher:	Okay, what did you start with? Do you remember the one you started with?
186.		Stephen:	Yeah, we started with (his partner picked up a yellow and four red tower)
187.		Teacher:	And after you decided to do it that way what was your next?
188.	00:18:36	Stephen:	This one (picks up four yellows and one red)
189.		Teacher:	What made you do it that way?
190.		Stephen:	Because it is the opposite see red yellow, red yellow (he shows an opposite pair)
191.		Teacher:	And where did you go from there?
192.		Stephen:	Then we did,
193.		Focundo:	These two. (gives the two solid towers to Stephen)
194.		Stephen:	These two.
195.		Teacher:	Okay, why those two? Look at them. Put them down and then you can tell me.
196.		Stephen:	They are all plain. All you had to do was put five yellow and five red. You put them together and you see you got a match.
197.		Teacher:	Where did you go next? Did you have anything in mind when you chose the next one or were you just going to guess?
198.		Stephen:	(he finds the inverted pairs of the first towers) They are not the same 20:07

199.		Teacher:	What is different about those two?
200.		Stephen:	Because this one is down here is yellow and up here is yellow. Goes red-yellow, red-red, red-red, red-red, and yellow-red
201.		Teacher:	Now when I saw you working at the beginning um, you were working and getting groups of them together and Focundo was getting his group together. And then I noticed that you were each getting your own set and I told you that your set had to be the same.
202.		Focundo:	Same.
203.		Teacher:	Not the same but you had to come up with one set as a pair. How did you straighten it out hen because Stephen was working by himself and you were working by yourself so I said it had to be a group effort
204.		Stephen:	Well, Focundo made them and we had them and then I just checked them with the others to see if there if there was a double.
205.		Teacher:	Did you have any doubles?
206.		Stephen:	Yeah, like five
207.		Teacher:	Did you fight over who was going to keep whose double?
208.		Stephen:	No.
209.		R2:	Where is he?
210.		Matt	I am not sure.
211.		R2:	Okay, We are going to move on to someone else and come back. Okay Jeff:.
212.	00:21:37	Jeff:	We got a whole bunch. Twelve, fourteen.... Forty seven
213.		Michelle:	There is a duplicate of this (she removes a duplicate tower)
214.		Jeff:	Okay.

215.		R2:	So you think there are other duplicates here
216.		Jeff:	I don't. I will put them all in a straight line
217.		Michelle:	I am a mover. (she removes a duplicate)I think there are thirty two
218.		R2:	You think there are still thirty two. I think you found more. Well maybe you need to work on this some more. Now, Jeff: I see you are organizing them differently. Tell me a little bit about how you are organizing them.
219.		Jeff:	First we made them all in patterns and now we are checking them for duplicates.
220.		R2:	Can you show me? Can you tell me about your patterns?
221.		Jeff:	You see we just went up like that like that we did all different ones.
222.		R2:	Okay, here you went up with these two reds. What about here?
223.		Jeff:	I am not sure because they all got mixed up 23.07
224.		R2:	You want to work on that a little more?
225.		Jeff:	Yeah.
226.		R2:	Give you a little bit more time. Well you check that we are going to see what Stephanie and Dana are did
227.		Dana:	Twenty eight
228.		Stephanie:	Twenty eight
229.		R2:	Oh! You lost some
230.		Stephanie:	We are checking. We have a lot left.
231.		R2:	Now you are back to twenty eight
232.		Stephanie:	Yeah

233.		R2:	Are you finished or are you still working on it? What about you? What are you convinced of now?
234.		Stephanie:	We are convinced that you always have to think there are more
235.		R2:	Well that's interesting.
236.	00:23:38	Stephanie:	Well you do. You don't know the answer. There is no way, you could not go into your head and say I can figure this out in my head, you couldn't. you always have to think this isn't like the problem you gave us like there were five shirts and four pairs of pants where you could go in your head and figure it out. For this one you have to go and say like you have to keep going and say I have twenty eight but there might be thirty two as a total.
237.		R2:	You don't think there is any way you ever know that you have them all and there can't possibly be any more.
238.	00:24:15	Stephanie:	No, because you could buy like, the biggest, you could have reds and yellows all over this room and people could still get ideas. You would not know that one person could have forty four and other person could have, be having, would be having fifty eight and still going for more because they you don't know until you are finished until you are absolutely positively sure.
239.		R2:	How do you become absolutely positive?
240.		Stephanie:	That's
241.		R2:	You haven't gotten there yet. You are absolutely positive. Okay. Can you tell me a little bit how you have them arranged?
242.		Stephanie:	In groups.
243.		R2:	So you have them in groups
244.		Stephanie:	This is a group, This is another group.
245.		R2:	How did you choose your groups? Dana tell me about

			how did you choose your groups?
246.		Dana:	Well when we looked, we made one we just took the other colors and did like, say I Made this one (holding a tower with red on top yellow, red yellow, yellow) Stephanie would take the yellow first then the red then the yellow how I have the red in the middle and then the two reds how have the two yellows.
247.	00:25:16	R2:	Okay I see. Okay so keep working and see what you can come up with I like to know when you think you know. Okay. Now let's see, did we hear back here yet did we hear from Mike and Milin?
248.		Milin:	We just got to fix this stuff real quick
249.		R2:	Okay. You ready to talk to us I think, right?
250.		Michael:	Yeah
251.		R2:	Okay.
252.		Michael:	We don't have that?
253.		R2:	Very interesting. By the way how many did you get?
254.		Milin:	Now we think we got thirty four. We just got to check this.
255.		R2:	Okay. Now you think thirty four.
256.		Milin:	Now we got this, this is a double.
257.		Michael:	Aye!
258.		Milin:	This can't be a double
259.		R2:	Do you want a little bit more time to think about it?
260.		Michael:	Yeah
261.		Milin:	Wow! take this away I mean. Okay we got this straightened out. (he corrects a couple of his towers that were paired incorrectly)
262.		R2:	You want to explain to me?

263.		Milin:	Sure! See
264.		R2:	Now hold on Mike and Milin how many do you think there are?
265.		Milin:	Thirty two now.
266.		R2:	You think there are thirty two? You want to put these others aside? Okay. How do you think you know that?
267.	26.56	Milin:	Because right now we can't find any doubles any more.
268.		R2:	Okay.
269.		Milin:	Now. See we had a little problem because we put one, this, in the wrong place. I mean yeah this in the wrong place I put this here so (points to two pairs of towers) These two got stuck together and these two got stuck together and now I just switched them back cause I found that out. So now we still think there is thirty two. (Milin points to these two corrected pairs).
270.		R2:	You still think there is thirty two. Okay. That's interesting. Okay. Did we hear from everybody? Did everyone have a chance to explain? There is one more group who didn't have a chance to explain and I like to talk to- Save what you have. I want to talk to all of you in a moment don't mess up what you have. Okay, can we have our last group here? Let's hear from Matt and Jenifer then we go to Ankur and see what he has done. Okay. What did you find? How many?
271.		Matt	We found thirty two.
272.		R2:	That what you believe there are? How did you do it?
273.		Matt:	Well every time we found a pattern we would put the opposite color say we have yellow, yellow, yellow, red, yellow then red, red, red yellow, red.
274.		R2:	Okay. How did you work with Jennifer? How did you-
275.		Jennifer:	I made them.
276.		Matt:	Every time I found a pattern I would tell her to

			duplicate and I keep on finding a pattern and then she found a pattern I would duplicate.
277.		R2:	Uh huh! So you took turns doing that. Is there any way you can be sure you have found them all?
278.		Matt:	Well we kept on trying to get more but every time we try-
279.		R2:	You couldn't find any more. I see. That's interesting. Let's hear what Ankur has to tell us about his way of trying to find all of them. Now this is interesting.
280.		Ankur:	Over here we made three, we had a pattern like this going down
281.		R2:	Okay now, let's look at this. Let's look at these patterns. What's special about these patterns?
282.		Ankur:	Well – you go (lets Joey explain)
283.		Joey:	We kind of mixed them up like, over here we have three yellows then red and yellow over here we have three reds and a yellow and red here we got two reds/one yellow/ two reds. Two yellows/one red and two yellows, and one red/one yellow/three reds.....
284.		Ankur:	We put them in the same place with different colors
285.		Joey:	One yellow/one red/ and three yellows.
286.	00:29:52	R2:	This set I set you only have one red and here you have one yellow in all of these and they are in the middle position I see that. Now here I also notice you have one yellow but you put it here can you explain to me why you put it with this group? You didn't put it with this group you put it with this group. Can you tell me why? That's interesting.
287.		Ankur:	Because in here it is one, this is two, then three, and then four
288.		R2:	And which one would this be? How many yellows in here?
289.		Ankur:	None

290.		R2:	So you have none, one, two, three and four oh and then you have five if you want to. Then you have the opposites here. No red, one red that's very interesting! I wonder if we should share what you have done here with the class. Is there a way that we could share this? Do you have some tape?
291.		Amy:	Yes
292.	00:30:47	R2:	Cause' what you have done here I haven't seen anyone else do and I'd like people to think about it. Okay. Amy is going to help us tape this together.
293.		Amy:	You want all this in one piece?
294.		R2:	Now this is Ankur and your name is?
295.		Joey:	Joey
296.		R2:	Ankur and Joey did something interesting to keep track of the some of the ones they found. That I haven't seen yet so I thought you might be interested in seeing it. Are you interested?
297.		Student:	I didn't hear him.
298.		R2:	You didn't hear it? They are going to tell us in a minute what they did
299.		Amy:	Can I put these up against each other?
300.		R2:	These three go together. You could put them together is that okay.
301.		Amy:	Is that okay? Can we put them together like this?
302.		Ankur:	Yeah
303.		R2:	You can explain what you did here.
304.		Amy:	We can hold it up
305.		R2:	Let's do this group first. Then we can talk about the others. Boy oh boy art class too.

306.		Amy:	Powerful tape!
307.		R2:	Why don't you come and stand up here and explain to the class. Now you all kind of can see what they did here and tell me if you think that you might have done something like this if it were interesting. Why don't you hold it up and explain to the class what you did.
308.	00:32:03	Ankur:	Over here we used one all red. We used one yellow, then two yellow, then three yellows and then four yellows all five yellows and then in this one we used one red two reds, three reds, and then four reds. And over-
309.	00:32:29	R2:	Let me see, here. Can you all see this? Can you all see this here? I just want be sure you...I guess Ankur is having us look at this piece here. I am covering the other part with my hand. See where they are all reds. He told me before how many yellows there were there. How many yellows were there on this one? This first one (she points to the tower with her thumb)
310.		Ankur:	Zero
311.		R2:	There were zero yellows. And the next one had how many yellows?
312.		Ankur:	One
313.		R2:	And the next one had two, three, four and five. So he saw a pattern that way. You see that? The same thing similar thing... did anybody else do something like that? Anybody else? Did you do something like that there? (looks at the towers made by a group in the front)
314.	00:33:	Student:	We did like a yellow then red, yellow, yellow then red...we made like stairs
315.		R2:	So you made stairs like that. What about this end in here? (she points to the left side of the taped set of towers the towers with one yellow or one red in the middle positions) This is interesting here. This is another way of looking for...I will hold and you talk
316.		Joey:	For these right here and these we kind of did the same

			thing as them like we put three red then yellow and then another red, and here we got two and yellow and two, one a yellow then three and then a yellow red and we did the same thing here we put a yellow red three yellows, two yellows a red and two yellows, three one and one and then we got a whole row.
317.		R2:	Okay now. I saw other people do something like this where they had exactly one red and here they put it in the middle but here but I was really curious to understand they did something different. When you see here they have a red. Let's say the second floor. Can we say this is the second floor of the tower red on the third floor, only one red in this tower, a red on the fourth floor? I say gee! Where is your tower where you only have one red on the bottom floor and only one red on the top floor? Cause' that's what most of you did. Isn't it? When you showed the one red you showed them on every floor. How many of you did that? Show one red on every floor. Raise your hand if you did that. I saw a few of you use that as a strategy. Or you used one yellow on every floor. But they didn't do that. They didn't do that for this pattern here. And I asked them why uh they did that. But notice what they did because they used that one red on the top floor for very different pattern this other pattern. I noticed Jeff: saw that too. And when Jeff: saw that what he ended up doing I think you ended up using it twice then didn't you Jeff:? You were using it for one pattern and then you picked it up and used it for the other pattern isn't that right?
318.	00:35:35	Jeff:	Yeah well
319.		R2:	And you ending up with more than thirty two?
320.		Jeff:	Yeah we got more than thirty two but we rounded back down to thirty
321.		R2:	Ahh! So you are down to thirty. But you were looking different ways to help me follow your pattern you see that because there are different ways of organizing these. Now this ids exactly one red or exactly one yellow. Um, I am kind of interested in what you did with may be exactly two reds or exactly two yellows did anybody look for patterns with exactly two reds or

			exactly two yellows? I am kind of curious about that. You want to talk to your partner and think and take a look at what you built. What do you see there? Do you see any thing in that?
322.		Milin:	Holds up a tower
323.		R2:	Now that's exactly two. Let's worry about exactly two. Let's worry about exactly two reds. Tell me what you can tell me about patterns that have exactly two reds. Can you help me with that? If I want to be sure you didn't miss any and you didn't count any twice. Can you find me patterns that have exactly two red cubes in your towers? That has four in it. That has three (students were holding up towers)
324.	00:36:53	Student:	I have one.
325.		R2:	But I want to see all of them with exactly two reds.
326.		Student:	Here! Here!
327.		R2:	Is that the only one you have? Why don't you study those for a minute your towers with exactly two reds.
328.		Students:	Here!
329.		R2:	You only have four towers with exactly two reds? (Students were holding up four towers) here is another one.
330.		Student:	We have all these.
331.		R2:	Why don't you study those for a minute? You have exactly two reds together? Show me all your. Convince me that you have to have all of them and there are no more. Just work on these for a minute. But you have to convince me by looking at a pattern that you have not missed any. You can take that apart we will put it together another way (talking about Ankur's and Joey's Taped towers and helps them take the tape off). Okay you all listening? Now somebody at this table told me that when I look at all the towers with exactly two reds, there were how many of them? (she is walking around and kids are holding up towers to show her)

332.		Student:	Ten
333.		R2:	How many got ten towers with exactly two reds? How many? Okay. I want you to think tomorrow is how you can convince me that what you found are ten that there can't be eleven or twelve or eight or nine or six. How can you- you study those towers and you find a way of convincing me that you have all of them. Now let me give you something to think about that might be interesting. Alex showed me this. Now these two reds are both on the bottom floors, right? Is that right? So I can keep track of this in my head easily these two reds are in the bottom floor. And he showed me that when we look at these two reds next to them they are on the second and third floor right? You see that? The first two reds are on the first and second floor these two are on the second and third floor. What is another possibility when I have these two reds together? Any ideas? Ankur?
334.		Ankur:	Third and fourth
335.		R2:	Okay, lets find a third and fourth. Does that do it? What is another possibility? We have the third and fourth. Alex?
336.		Alex:	Fourth and fifth.
337.		R2:	Where is the fourth and fifth? We have first and second, second and third, third and fourth, can you give me fourth and fifth? You have it? You have it here somewhere?
338.		Student:	No, we had doubles.
339.		R2:	You told me that there should be one. Can you find one? So there should be two reds together. First and second, second and third, third and fourth, and you told me fourth and fifth. May I borrow yours? Although that's not two reds that is three reds. Okay, alright now we have here four towers with two reds are together these ways. Do the two reds always have to be together?
340.		Students:	No.

341.		R2:	No. Now here they are always together. Can they be separated by a floor?
342.		Students:	Yes.
343.		R2:	Can they be separated by two floors?
344.	00:40:52	Students:	Yes.
345.		R2:	Can they be separated by three floors?
346.		Students:	Yes.
347.		R2:	Can they be separated by four floors?
348.		Students:	No. yes.
349.		R2:	Well can they be separated by four floors? Make me a tower that is five high where there are two reds separated by four floors.
350.	00:41:15	Michael:	You can't!
351.		R2:	You told me you can make it so make it for me.
352.		Ankur:	You can't unless you have six tall.
353.		R2:	Only five blocks. So if you only have two reds you are going to separate them, you can only separate them by how many blocks? Can you do one? Make it. Show it. Show me the two reds separated by one. Is there only one way to have that (holds up a tower handed by a student red/yellow/red/yellow/yellow).
354.		Students:	No
355.		R2:	Is there another-Oh! Then you moved it up to the second floor. (yellow/red/yellow/red/yellow). Is there another way to have two reds separated by one floor?
356.		Students:	Yes
357.		R2:	Give me another one I don't want to make it I want to keep these. We have two reds separated by one.

358.		Student:	Here, I have one
359.		R2:	That's not two reds that is four reds. That is three reds. We could only have two reds.
360.		Student:	Here, here, here
361.		R2:	That's two reds separated by two. I want...
362.		Students:	I got one, I got one
363.		R2:	This is the same I have this one
364.		Steven:	I have one
365.		R2:	That's the same as this. Ah here we go. We have two reds separated by one. I want another one. Can you make me another one with two reds separated by exactly one. Suppose to think real hard. Stephanie are you thinking real hard? We have that one, look.
366.		Alex:	You can't
367.		R2:	Why cant you Alex? You mean I can't have two reds where I can have my red in the fourth floor and my yellow in the fifth floor and my red in the sixth floor? I Can't do that?
368.	00:42:58	Student:	No, you can't do any.
369.		R2:	Why?
370.		Student:	You only have five blocks so you can't make it up to the seven.
371.		R2:	Ohh! So these are all that's possible to have two reds separated by one yellow?
372.		Students:	Yes.
373.	00:43:09	R2:	So what about two reds separated by- what else- two yellows? Alright, find me all the possibilities.
374.		Michael 2:	I got one here
375.		Stephen:	Here

376.		R2:	Alright when you get one raise your hand. Hold on. Oh here is the first floor Where is the second floor? Where is the third floor? I want the third floor. Where is the red in the third floor? Think. Think. I am asking you to find me exactly two reds separated by two.
377.		Students:	Right here. Right here.
378.		Milin:	Got one. Uhg.
379.		Ankur:	There are only two
380.		R2:	Why are there only two? He claims there are only two. How many of you, if you think you know the answer raise your hand if you think you know. Don't speak out. Why do you think there are no more? Just raise your hand if you think you know. Again, exactly two reds separated by two why do you think there are no more? You thinking hard? See a lot of hands up here. Yes.
381.	00:44:26	Michael 2:	Because if you needed one more you would need more than five because you need another one
382.		R2:	Wonderful? You would need another block? Let's put this here. Is there another way to have two reds separated by three?
383.		Student:	I have it right here.
384.		R2:	Ah hah! I want to two reds separated by three another way.
385.		Milin:	There isn't any
386.		R2:	Why not?
387.		Milin:	On ones there is only three. On two's there is only two. And on threes there is only one.
388.		R2:	You believe that? How many of you agree? Ahh! Look now I have exactly two reds how many ways? Can you tell me? Exactly two reds how many different

			ways do I have them? If you know raise your hand. Don't speak out. How many ways are there to have exactly two reds?
389.		Michael 2:	I know
390.		R2:	How many ways are there to have exactly two reds? Jaime.
391.		Jaime:	Ten
392.		R2:	Could there be any more Jaime?
393.		Jaime:	No.
394.	00:45:26	R2:	Why Not? How many of you are convinced there can be no more? You really think that if you had to go to another teacher or if we invited a new teacher in that you can convince the new teacher you found all of the two reds and there are no others. What do you think Stephanie?
395.	00:45:45	Stephanie:	I think so. Because with the four you can only make, with the four you can make, with the that the first one with two together you can make four with one in between you can make three, ,with two in between you can make two, with one in between you can make one I mean with three in between you can make one. But you can't make with four in between five in between or any thing else you don't have enough you can't you can only use five blocks.
396.		R2:	That's really great. You know I am going to ask you the sixty four thousand dollar question. Did you ever hear about the quiz show where you get sixty four thousand dollars if you answer it right?
397.		Ankur:	Yeah. Yeah.
398.	00:46:27	R2:	Okay. Now that you have all possible ways for building your towers there are ten with exactly two reds, what do you automatically know the answer to? Look at the hands going up. You know some more towers without doing any building you see them in your mind don't you? The minute you see them in your mind you

			didn't even have to make them. What do you see in your mind?
399.	00:46:53	Ankur:	You could just make these yellows red and this red yellow and switch the colors around.
400.		R2:	How many thought of that? About just switching the colors around. So, how many more towers do we know with exactly two of one color? How many more do we have?
401.		Student:	Um, how many we...
402.		R2:	We have ten here with exactly two red, how many more do we have with exactly two yellow?
403.		Michael 2:	I know
404.		Student:	Ten.
405.	00:47:20	R2:	Ten so, all together with exactly two, red or yellow, how many towers do we have already?
406.		Student:	Altogether?
407.		R2:	Yes.
408.		Student:	Twenty.
409.		R2:	We have twenty towers with exactly two, and you all convinced you can take a stranger and tell them there are no more, right? Now remember when I walked around and you were convinced cause you worked so hard doing this problem, I mean you really worked hard I don't ever remember seeing a fourth grade class work so long on a math problem ever, as you worked without stopping you were incredible! But you now can see that this is how many you can find with exactly two. I want to ask you a question. Could you use the same kind of reasoning when you are here tomorrow to find out how many there are with exactly three? You already did exactly one. Everybody in this class showed me how many towers you can build with exactly one, remember that, you did that. How many were there by the way I don't remember? With exactly one red for instance. With exactly one red how many

			towers did you have? Can you see that in your mind don't look at the towers imagine it? If you can imagine it raise your hand. Oh! Look how many people can imagine it. Great! Wonderful! Okay, anybody else imagining it? Okay, Jeff: back there, Jeff: tell me how many with exactly one red in your mind.
410.		Jeff:	Um, um,
411.		R2:	You can consult with your partner.
412.		Jeff:	Okay. One.
413.		Milin:	No.
414.		R2:	Oh so we don't agree. Stephanie?
415.		Stephanie:	With exactly one red five towers high? Uh you can build five.
416.		R2:	How many agree with Stephanie? Five. Show me.
417.		Stephanie:	Alright, well, you have one red
418.		R2:	Well you have them build just take them from your table and show me.
419.		Stephanie:	Alright!
420.		R2:	Get your friend to help you – get you the five with one red
421.		Stephanie:	Here's one. This is the second one, this is the first one, this is the third one
422.		R2:	Okay, you get the picture? See you can see the five already coming up. You all see that? Jeff: you agree?
423.		Stephanie:	Here we go!
424.		R2:	Okay, how many with exactly one yellow?
425.		Stephanie:	Five!
426.		R2:	So we now built how many more towers?

427.		Stephanie:	Ten
428.		R2:	We have twenty here and we built another ten, right?
429.		Stephanie:	Uh huh.
430.		R2:	That's interesting. So we have thirty? I don't have thirty two. What did I miss?
431.		Student:	You don't have all red
432.		R2:	Oh no, with five red. Okay, how many with five red?
433.		Ankur:	Two
434.		R2:	With five red?
435.		Milin:	Only one!
436.		R2:	Okay, so that gives me thirty one.
437.		Ankur:	And you have all yellow.
438.		R2:	Oh that gives me thirty two. That makes me feel better. I am going to go home and sleep better tonight cause I really believe there are thirty two. I really believe that. I think you are great! Let's give you a round of applause.