Description: B34, Surface area and volume (side view), Grade 8, June 3, 1996, raw footage **Content: Harding School** **Research: Professor Carolyn Maher** **Date: 6/3/1996**	**Authors: Snee, Elizabeth** **Verified: Sigley, Robert** **Date: Spring 2014** **Page: 1 of 27**

Line	Time	Speaker	Transcript
1		**R1**	As kind of a maybe beginning, I thought we'd maybe start with an activity. We usually do, right? You know what these are? What do we call these things? [Michael: Cuisine squares.] [Brian: Blocks.] Cuisenaire rods, and most of you have used and I see that you're very familiar with, with these. Let's do a very quick warm-up, okay? Quick warm-up. I want you to find me a rod that's half as long as the blue rod. [Romina: Half as long as the blue rod?] [Michael: Yeah, yeah, yeah.] Find me a rod that's half as long as the blue rod.
2		**Romina**	Yellows?
3		**Brian**	Purple.
4		**Michael**	It ain't the purples.
5		**Brian**	It's not the yellows.
6		**Michael**	It cannot be - blue's odd.
7		**Brian**	Not yellow. Maybe it's these. Nah, these are purple.
8		**Romina**	The green one. Nope.
9		**Michael**	Blue is odd. Oh my god. Because two yellows goes up to that. Nothing. It's an odd number. I'll tell you what it is…
10		**Brian**	I think you're right, Mike.
11		**Michael**	I'll tell you what it is.
12		**R1**	If you're telling me there is none, you gotta prove to me there is none.
13		**Michael**	It's 9.

14		**R1**	How can you prove to me there is none? If you think you can prove to me there isn't any, [Michael: It's 9.] I'd like you to come up to the overhead and do it.
15		**Brian**	Prove to me is just another why of saying "why."
16		**Jeff(?)**	We can do it now.
17		**R1**	How many of you, how many people think there is no rod that's half as long as the blue rod? Raise your, raise your hand. Okay, now can you come up and prove it? Can you volunteer, come up and prove it?
18		**Michael**	I don't want to.
19		**Brian**	Mike wants to.
20		**Michael**	No.
21		**R1**	Okay, give it a try Jeff then. Because the overhead's right up there. Here. I heard an answer [indecipherable] verbally so let's see if what she said, I heard her say is the same thing.
22		**Jeff**	You have to give me a minute, but like [indecipherable]
23		**R1**	Yeah, I know it's a pain. Do you need some help?
24		**Jeff**	No, I think I can handle it. How many, how many different ones are there in total?
25		**Romina**	Seven, I think. No, 8. Sarah. Sarah. Sarah.
26	2:51	**Jeff**	Okay. Dark green. All right. I mean, none of them fit there. You can fit there for each one (?) [indecipherable] You could see that none of them are half…I mean that's too small, and that'd be it for next one up which is yellow, and yellow is too big. And the one smaller is like the pink one, and the pink one is too small. And there is nothing left. [indecipherable] So there's none in between them.

27		**R1**	And how do you know there's none in between?
28		**Jeff**	Because on top of the box they list all the different colors and those are all the different colors.
29		**R1**	Do you agree? [Students: Yes.] Thank you, Jeff. And I guess Leave that up there for a minute. I think what you, what Jeff, and many of you did spontaneously, I'd like to call your attention to it, because you've just proved, you've just provided what we call a mathematical proof. It's a different kind of proof than maybe one is accustomed to seeing. But as Jeff said, if you line them up, he showed all possibilities and nothing in between. And how can you really believe that there's nothing in between? He said well you read it on the box. But suppose I don't believe the box?
30		**Jeff**	It wouldn't lie to you though on the box. They're trying to tell you the problem. They're lying (indecipherable), and you won't buy it anymore.
31		**R1**	So you trust this. Is there another way thought if you're a skeptic like me? Michelle?
32		**Michelle**	Okay, you take how many of these white things and then create along the blue thing. Blue rod, you know? And you count how many there are. And there are 9. Along the white, I mean the blue thing. And nine can't be divided equally. So.
33		**R1**	Okay. So that's another way. Using the white. Is there another way? So you've had Jeff's way of reading the box. You had Michelle's way. You see what she was saying? You follow her? Is there another way of knowing there's nothing in between? What were you going to say, Sandy(?)?
34		**Sandy(?) purple shirt**	Those are all the possibilities that are given to you. That are provided. I mean, there weren't any other rods. There weren't like any other colors remaining besides what was

			provided.
35		**R1**	So Jeff's building another staircase really did in fact show what the box was advertising. But the reasoning is very interesting here. It's called the proof by finding we call a upward bound. You see the upward bound would be the two yellows. And then you find the lower bound. The lower bound would be the two purples. They look pink here though, right? So you found one that's too big, as Jeff said. One that's too small, as Jeff said. And nothing in between because of the white, as Michelle said. Right? And that's a mathematical proof. And even though it's sort of an informal proof, and an intuitive proof, it's a very valid mathematical proof. And you sort of did it spontaneously. You sort of did it without, without thinking a lot. And that's very nice. I'd like to, I'd like to move from, from this kind of what I call a warm-up activity to think of another one. I'd like you to imagine, if you'd like. Can you find your white rod? Okay. I want you to think of the white rod, imagine your white rod as a stamp. And imagine if you were to stamp it on a pad, the white rod, that that part that you'd stamp would now be colored red. Can you imagine that in your head? And I want you to think about that that notion of stamping to figure out the surface area of each rod. Now can you tell me the surface area of a rod measuring it in terms of a white rod stamp? Do you understand my question? So let's pick a rod. Someone pick a rod. [Green] All right. Which green one? Light or dark? [Light] Light green? Okay. So in terms of that white rod stamp, can you tell me what the surface area of this light green rod is? I want you to talk to your partners. If you think you have it at your table, raise your hand?
36		**Michael**	14.
37		**Romina**	What?

38		**Michael**	14. [Counts] And 14.
39		**R1**	So if you think you agree at your table, someone raise their hand.
40		**Brian**	Raise your hand, Mike.
41		**R1**	Do you agree?
42		**Brian**	14.
43		**Michael**	14.
44		**Romina**	Is that the problem? Is that what she wants?
45		**Brian**	I think so.
46		**R1**	Okay, over here. Karina(?)? How many?
47		**Karina(?)**	14.
48		**R1**	Okay, you all say 14. So you can figure out the surface area of each of these rods. About how many are there in a box? [Student: 10] Ten. If you're not sure of that, you might want to check it. Okay. Can you tell me a quick way of find the surface area of every rod in that box? Work that out with your partner, with your table. If you can you find a quick way of finding the surface area of every rod in the box?
49		**Brian**	Length times 4 plus 2.
50		**R1**	If you can, write it down, write it down on a piece of paper the four of you.
51		**Michael**	All right. [Grabs paper]
52		**Brian**	Length times 4 plus 2.
53		**Michael**	All right. How do you spell length?

54		**Romina & Brian**	G-t-h.
55		**Michael**	[Writes: (Length x 4) +2 = Surface Area of a Cuisenaire rod of any color] Area.
56		**Romina**	Mike.
57		**Brian**	You got some nice handwriting.
58		**Michael**	I don't. Of the…[Brian: That's pretty nice like right there.] Okay how do you spell it?
59		**Romina**	What are you looking for?
60		**Brian**	C-u-i-s-e-n-a-i-r-e
61		**Romina**	Is that what it's called? I don't have that on mine. Cuisine. That's mine.
62		**Michael**	Okay. I put a period down…[indecipherable between Brian & Romina] You can build a house. Two greens(?) make a green.
63	10:06	**R1**	Okay, do you want to write it on the overhead?
64		**Romina**	I'll write it.
65		**Michael**	Copy it.
66		**Romina**	I have to copy it?
67		**Michael**	Put it on top of it.
68		**Romina**	Wait, I can handle it. I'm not copying it.
69		**R1**	Okay. You sure it works for every single rod? Right? You tested it?
70		**Michael**	Of any color.

71		**Romina**	Okay, Mike you can write it.
72		**Michael**	I can? Wow. [Romina & Brian indecipherable side conversation]
73		**Romina**	You messed up?
74		**Michael**	No, I don't want that. Okay, don't go over there. You don't need it.
75		**Romina**	I'm missing the black rod.
76		**Michael**	Did you dump your rods on the floor?
77		**Brian**	He did.
78		**Michael**	I hate it. I can't do it, the sides are all messed up. It must be messy.
79		**Brian**	How do you think they come packaged?
80		**Romina**	I found a dark one.
81		**R1**	Okay, now, while they're catching up to you, I'm going to talk about this, this cube. Right? [Holds white cube] The size of this cube. I'm going to call this a unit. Okay? This would be a volume would be one unit cubed. Could you figure out what the volume is of every other rod in the box?
82		**Michael**	Every other?
83		**R1**	Well this has a volume of one. What would the volume of this one be? [Michael: okay.]
84		**Romina**	Wouldn't that be 2?
85		**R1**	Two what?
86		**Brian**	Two units

87		**R1**	So cube units. Right? So I want you to figure out all of them. Right?
88		**Romina**	So just the length?
89		**Michael**	Length times width times height.
90		**Romina**	Well, yeah, Mike.
91		**Brian**	There would be three of these.
92		**Romina**	Because that's one.
93		**Brian**	And this would be three units cubed.
94		**Michael**	Oh, yeah. Length equals length plus volume of the rod.
95		**Brian**	Volume equals length of a rod squared. [Michael: No.] Cubed.
96		**Michael**	Cubed. That's great.
97		**Romina**	No because we don't want lengths cubed. Length cubed because that's just like…
98		**Brian**	Length equals volume. Where'd you get that?
99		**Romina**	Equals volume, doesn't it? Like of the with, with the with the unit?
100		**Michael**	This is the length of 5.
101		**Romina**	No because you could put the length. No, if you put that wouldn't you think that. Okay, what's the length of this? Wouldn't you think that, if I saw that, if I saw that, wouldn't you go like this? Wouldn't you think it's 5 cubes? [Michael: 1 by 5] 5 times 5 times 5.
102		**Brian**	Okay. I know what you're doing.

103		**Michael**	Romina, you write nice. Doesn't she? [Brian: Yeah.] [Romina: Oh yeah.] So length equals length?
104		**Romina**	Doesn't length equal volume?
105		**Brian**	No because volume is cubed. No.
106		**Michael**	Who cares about the cubes?
107		**Romina**	If the length is 5 divided by 5 cubes. I don't know.
108		**Brian**	Three cubed units.
109		**Michael**	I'll write it with Cuisenaire rods. Length… [Brian indecipherable]
110		**R1**	Did you write down the formula?
111		**Romina**	No, we don't know if it's right.
112		**Michael**	It's right. I'm just writing it down.
113		**Brian**	How can that be right?
114		**Romina**	Yeah, Mike, but we have to go a little more specific.
115		**Michael**	It is specific.
116		**Romina**	Michael.
117		**Brian**	Length of rod equals volume of rod.
118		**Michael**	Okay, length of rod equals volume of rod.
119		**Brian**	Length of rod in units equals volume.
120		**Michael**	Okay fine. [Romina & Brian side conversation re: a poem Brian has written for someone possibly]
121	16:43	**Romina**	So what are we going to put?

122		**Michael**	Length equals volume. It sounds good.
123		**Romina**	Length equals volume. Could we put…How could we phrase this?
124		**Michael**	I don't know.
125		**Romina**	Okay, the length of the, of the rod chosen equals. Okay, how about the length of the rod chosen and.
126		**R1**	Could you do that problem?
127		**Romina**	We're trying to word it because we know, we know what it is.
128		**R1**	Get Michelle to write it down.
129		**Michael**	Yeah, Michelle. Write it.
130		**Brian**	Go Michelle. You got contacts.
131		**Romina**	You got contacts? [side comments re: contacts] Okay, go Michelle. You can write it down. Go Michelle, you can write it down.
132		**Michelle**	Well, wouldn't this be like even though it is the length equals the volume, you have to state that it's length times width times height so you put length times one times one even though it is just length to show.
133		**Romina**	Yeah. I guess. [Brian: Uh-oh.] But it's because the length is, we all ready have the cubes and we just need the surface. No? I don't know. I don't know.
134		**Brian**	Rutgers always stresses me out.
135		**Romina**	Don't throw tables or anything. I can't believe you did that that one time.

136		**Brian**	I never threw a table at you.
137		**Romina**	Oh, you were about to throw the table.
138		**Brian**	I left it and dropped it because it was too heavy.
139		**Romina**	Okay, the length of the square units.
140		**R1**	Romina, I know you have an idea here, but you have to work on the language for it, right? What's, what's, what's, what's causing you trouble?
141		**Romina**	No because length equals volume but see it's that's too…
142		**R1**	You know that's not true. You know that's definitely false.
143		**Michael**	It's not.
144		**Romina**	Okay, if you use this. This is what we're using as a measuring tool. And one, two of these equals that one. So then this one is two units cubed.
145		**Michael**	Which also equals length.
146		**Romina**	But wouldn't length equals "y."
147		**R1**	You know length can't equal volume.
148		**Romina**	Yeah we know that.
149		**R1**	But what you're trying to tell me. I think. I think what you're trying to tell me is that you used two of these, right? [Romina: Yeah.] Or you used two times as many of these. Right? To make a this. Isn't that right? But you haven't said length is equal to volume. It's the length that told you how many to use. Now see if you could write that down mathematically. Do you understand, Michelle? [Michael: Length equals volume.] But you're not really saying length equals volume because that doesn't make any sense because we know the length of this. The length is two units. The

			volume is cubic units. See. The volume of this is one cubic unit. So the volume of this is not equal to length of two units. The volume is equal to two cubic units. Is that true? So watch those units a little bit and see if you can write it.
150	20:28	**Romina**	Go Michelle.
151		**Michael**	I'm going to bring up some (indecipherable). Here's Mr. Volume. [Romina: Mr. Volume.] Here's Mr. Length.
152		**Teacher**	What did you say the volume is?
153		**Romina**	Wouldn't that be 3?
154		**Teacher**	Three because it's three long, right?
155		**Romina**	Yeah.
156		**Teacher**	How long is this?
157		**Michael**	Three long.
158		**Teacher**	Is that three still?
159		**Michael**	No.
160		**Romina**	And the height is one. See, that's what Michelle was saying.
161		**Michael**	Here's Mr. Length and here's Mr. Volume.
162		**Romina**	Length times one times height.
163		**Michelle**	See, you have to state what the width and the height is to calculate volume even if it is just one.
164		**Romina**	Length times one times one.
165		**Teacher**	Is that true here: length times 1 times 1?
166		**Romina**	Well, because, well, not here. Length times, we could do length times width times height.

167		**Teacher**	Right, but you're giving me a formula for one rod, right? [Romina: Yeah.] But I think what she wants you to think [Michael: X, Y equals] about is, is that the length here isn't always volume. Okay. So kind of be more general there. Your rule should fit volume more generally.
168		**Romina**	How about length in units times width in units times height in units equals volume?
169		**Teacher**	Does that work?
170		**Michael**	Don't we know that all ready?
171		**Teacher**	In another case?
172		**Romina**	Yea because this, then the length of this would be 3. The width of this would be 2 and the height of would be 3.
173		**Michael**	Of course it would.
174		**Teacher**	But the volume does not equal length.
175		**Romina**	No. We knew that.
176		**Teacher**	Okay. No. That's not what you were saying. You were saying L equals V.
177		**Michael**	Why did you say that? Now you're making us look stupid.
178		**Teacher**	So when you make up a rule, make sure you say something that's true.
179		**Romina**	Go for it Michelle.
180		**Michelle**	Length times width times height?
181		**Romina**	Length in units times width in units times height in units.
182		**Brian**	I didn't know it was such a simple answer. Answer.

183		**Romina**	Here, Michelle, you could write on this. I don't know. [Side conversation with Brian] Sorry Michelle. Sorry, Michelle I did it again. [Romina/Brian side conversation and playing with rods]
184	26:35	**R1**	Okay. So what did you do here?
185		**Romina**	We have, show her in units times height units times width and units times length equals volume.
186		**Brian**	A simple answer.
187		**R1**	Again, one more time.
188		**Romina**	It's just length times height times width equals volume. So for example, this would, just this one would be 2 x 1 x 1. That's length times height times width. If you had something like this it'd be 2 x 2 x 2.
189		**R1**	Okay, now what id like you to do. I want you to come up with a way of expressing every rod. Suppose you stack them. Pick one, pick one like lets say green. Pick any one you want. You know what I mean by stacking them like this? You can stand them up or put them like this. Can you come up with a way of finding the surface area or volume for them stacking as high as we want to stack?
190		**Brian**	Isn't that the question Mr. [name] came and asked us?
191		**R1**	That's sort of the question he came and asked you. For every one of the rods, okay, because I'd like you to record your results and be able to convince us that that works. Do you understand the question, Brian?
192		**Brian**	Yes, I do.
193		**Romina**	Brian, what are you going to do?
194		**R1**	But you can't just tell me your formula of length times width

			times height. You gotta sell it to me.
195		**Romina**	I hate [indecipherable]. Six times 3 is 18 plus 3. Six times 6.
196		**Brian**	Six times 4.
197		**Romina**	Six times 3.16 times 1. Isn't that the same thing?
198		**Brian**	Depends. Three. Oh okay.
199		**Romina**	Six times 3. I got that by 6 this equals 1. And then 2 and 3. And then other way 6 times 3.
200		**Michelle**	Wait. Didn't she want us to find like, like the formula for surface area though?
201		**Romina**	Uh, I didn't know that's what she wants us to do. You can do that.
202		**Michelle**	Well, wouldn't it be 6 times 6 and then times 6 times 6 times 6 times 6 times 6 times 6 and then plus everything at the end. Like everything 6.
203		**Brian**	Okay, this is where we go in parentheses. We do 6…
204		**Michelle**	But it depends on how many you like stack in a row. Like if you put 3, it's going to be different than 4.
205		**Brian**	Okay here's what's going on. You do in parentheses 6 times 4 plus 2 in parentheses and go on that side, number all the rods. Like that would be just the unknown.
206		**Romina**	What?
207		**Brian**	Never, never mind. Okay. Okay. See that thing? We're finding, find the surface area. It would be 6 times 4.
208		**Romina**	Why 4? Where's the 4 from?
209		**Brian**	[Motions levels] Four times. Plus 2. All that would be in parentheses. All of that, put it like that. [Romina: 26] And

			outside would be number of rods.
210	30:00	**Romina**	Length times 4 plus 2. Isn't that what you're trying to say?
211		**Brian**	Yeah. Times number of rods.
212		**Romina**	Did I get it though? Okay.
213		**Michael**	How big is this?
214		**Romina**	So, let's say you had this one. 3 that's 12. That's 14. How many, how many do you want?
215		**Michelle**	3
216		**Romina**	That's 42. Now is that what it would be? I just thought it would be. This is 3 squared. Like three cubes. And like 3 x 3 would be 9 instead of 42.
217		**Michelle**	What if it were like the length of your rod. Say it's the green one. That's 3. And then if you have 3 of them then it would be times 8 because…
218		**Romina**	How about length times. Hold on. Length times.
219		**Brian**	She told you to hold on, Mike.
220		**Michael**	I'm sorry.
221		**Romina**	Wouldn't it be length times number of rods equals volume?
222		**Michael**	Look everybody.
223		**Romina**	I mean that would make sense.
224		**Michelle**	No because you still have to add the ending because if you have like 3 here. It's going to be 3 plus 3 plus 3 plus 3 plus 3 plus another three 3s. And then plus the end.
225		**Romina**	I don't get that because that wouldn't be volume.

226		**Michelle**	But she wanted us to find surface area.
227		**Romina**	She wants surface area?
228		**Brian**	Yeah.
229		**Romina**	Oh. I didn't know that. Didn't she say the volume? Ah, well then just disregard everything she said. Okay, so what did we have?
230		**Michelle**	Okay, so if we kept it like going straight…
231		**Romina**	If she wants that, wouldn't it just be length times 4 plus 2? Yeah, wouldn't it be that?
232		**Michelle**	No because there's not, there's like…
233		**Romina**	Length times 4 the number of sides plus 2.
234		**Brian**	Wait. Wait.
235		**Michelle**	It's the length times
236		**Brian**	L times
237		**Michelle**	8
238		**Brian**	Number of rods
239		**Romina**	Wouldn't we just do this one and then times 3.
240		**Brian**	Times 4. Plus 2
241		**Romina**	Yeah, but she's saying that's covered.
242		**Brian**	That is it.
243		**Michelle**	It's like your length times 8.
244		**Romina**	No, it's not. Look. Michelle's saying that, that you don't count these.

245		**Michelle**	No because they're hidden and you can't count them.
246		**Romina**	So wouldn't it be 1, 2, 3, 4.
247		**Michelle**	Okay. The length is 3. So it's 3 times 8 so that's another 6. 30. Okay, is that right? 8 plus 8 because there's 8 sides showing. There's 1, 2, 3, 4, 5, 6 and then an 8, 24. 30.
248		**Brian**	I see what you're talking about.
249		**Romina**	Yeah, I see what you're talking about, too. So there's that.
250		**Michelle**	It's your length times 8 if we're like keeping it like…
251		**Brian**	How many blocks there are to 2 sides there's 2. 4 blocks 3 sides.
252		**Romina**	Wait, if there's 3 of them. 3 x 3 minus 1 and you get 8. I don't know. How many times do you get 8. 1-2-3-4. Are you guys done?
253		**Michelle**	Wouldn't it be length times however many sides are showing [Brian: Yes] then [Brian: No]depending on how many…
254		**Brian**	No, because you gotta add the two on the edge like that…
255		**Michelle**	And then plus the number of things over there.
256		**Brian**	Plus, 2 times number of blocks because these 2 can never be cut off. These are going to be on the end unless it's like this.
257	35:04	**Romina**	Yeah, but I can make one like this.
258		**Brian**	Shut up. Shut up. I doubt there's going to be one equation to satisfy all our things. All those different lengths. [side conversation w/Romina]
259		**Romina**	We have to figure this out. Okay.

260		**Michelle**	Plus it's length however many sides and then plus however many ends there are How long the row is.
261		**Romina**	Times how many ends? Plus. I mean plus.
262		**Michelle**	Yeah because if you have 5 things…
263		**Romina**	Oh well length 3 times length times how many sides [Michelle: 10], yeah times 10 plus [Michelle: 8] 8. Sorry Would that be 40, 38? 48? [Michelle 38] 38? Is that right? Wait 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 24, 25, 26, 27, 28, 29, 30. Where are we going to get the other one from?
264		**Michelle**	From the other ends. [Counts up to 38 on blocks]
265		**Brian**	So is that right?
266		**Romina**	Yeah, if we, if they accept that. But you know they're going to make us prove that.
267		**Brian**	So use that.
268		**Romina**	Mike, what are you doing? You want to ask if they'd accept that?
269		**Brian**	I'm not gonna because I don't know.
270		**Romina**	Where's Mr. [name]? He's not here. [Side conversation with Brian. Michael draws an "awesome face."] Is this acceptable? Length times how many sides times plus how many ends?
271	40:10	**R1**	I don't know what you mean by an end. You have to define, you have to say what a side is and what an end…
272		**Romina**	How many faces, faces plus how many…
273		**R1**	When, is this a times or a next?

274		**Romina**	Times
275		**R1**	That's confusing. Can you try to come up with a way that if you had to pass this to another group, they would know exactly what you mean. Okay, length times…
276		**Romina**	Length times number of faces plus ends like these.
277		**R1**	What do you mean by ends? You're going to have to come up with what you mean by that. Michelle, do you have a way of saying this? Just say what an end is? Say what you mean by an end…
278		**Michelle**	How about cm? Or whatever cubic unit or whatever it's called.
279		**R1**	The only thing I would advise that might help you is remember if you're thinking of just one of these, that's a square. That's a square unit. Right? And if you're thinking of the whole thing, the volume, that's a cubic unit. So either talk about your square units, the face, right, that's surface area in terms of the square unit. Or a cubic unit. So try to keep that distinction so that your units come out in the final answer of the unit you want it to be. So the surface area. What's your final unit going to have to be? If you're doing things for surface area, I'm stamping, finding out how many of these stamps…
280		**Romina**	You would have to square.
281		**R1**	Square units. Right? But if I'm doing volume, if I'm stacking these, right, I'm going to count how many of these, it's gotta turn into the cubic unit. Right? Just check to be sure that happens however you define it. And you can have an end, but tell me what an end is. Fair enough? Brian, what are you doing now?
282		**Brian**	Finding an end. What are you doing?

283		**Romina**	She's speaking to you.
284		**Brian**	These ends. Like.
285		**R1**	So what do you mean? You mean, you mean the face? [Brian: The square unit.] You mean the square unit? Why don't you say the square unit?
286		**Romina**	The square unit. Does it make sense? Okay, let's, does it make sense?
287		**Brian**	Why'd you knock down my building? [Romina: Because she was talking…] It was totally balanced.
288		**Romina**	Length of one square. Of one. Okay length. How about length of one rod?
289		**Brian**	Can I get the fuzz out?
290		**Romina**	Yes. Okay, length of one rod is 3 times number of faces [counts 10] times 10 plus square unit, which is 1. Would you get it if I said that?
291		**Michelle**	Yeah because square units is like the same thing.
292		**Romina**	Plus perimeter. Can we say that? Isn't that what it basically is because it's 8, right?
293		**Michelle**	Why don't we just say square unit ends and just so they don't think it's the side or something.
294		**Romina**	Would it be, it would be 3 and 3, [counts to 14]. Why did I get 14 this time?
295		**Michelle**	14 right and then plus the 14. Plus the 12 on the top and the 12 on the bottom. That's 14+24.
296		**Brian**	But, wait, wait. Wouldn't it just be width, wouldn't it just be width squared then. That's the width? It's squared.

297		**Romina**	Hold on, what I mean is like length. We have length times number of faces. Number of faces is 10. And then that's 30 and this is just supposed to be 8. So it'd be just on this side.
298		**Michael**	I found… Uh oh. I can't do this. [making tower]
299		**Romina**	What is that?
300		**Michael**	I'm going to try something else. Four, four, four. 6, 6. Which is the length and which is the width?
301	45:18	**Romina**	Length. Width.
302		**Michael**	3, 6 plus 8. 2.
303		**Romina**	What are you doing? Four of them and I'll tell you what I get what I think it's supposed to be…
304		**Michael**	It's 32.5.
305		**Romina**	Mike, do it like this. So it would be…
306		**Brian**	You're gonna get 4.
307		**Michael**	It works.
308		**Romina**	It works.
309		**Michael**	Excuse me, ma'am. For this is different than that. That. I'd include it but.
310		**Romina**	Two times length.
311		**Michael**	Listen, cross it out. Want to cross it out? You know what, yes.
312		**Romina**	Maybe switch with green?
313		**Michael**	Shh. I have everything. Everything. Everything
314		**Romina**	But, length, okay, two times length times width plus height

			times width…times two.
315		**Michael**	I tried a flat one and I tried a square one. Yes. Equals surface…
316		**Romina**	How did you get that?
317		**Michael**	You wouldn't understand
318		**Romina**	Oh, I'm not meant to be.
319		**Michael**	Okay, I'll tell you how I got it. I ended up with that 2ly times…
320		**Romina**	Not everybody else knows that.
321		**Michael**	Okay, I got it.
322		**R1**	You think you have it?
323		**Michael**	I do have it.
324		**R1**	I could see. Okay, I'll come around. You have a plain white paper, Michelle? All right, explain to me.
325		**Michael**	Two times this equals that. Now. [Has written (Length x 4) + 2= The surface area]
326		**R1**	I don't know what that means. I don't know what L.
327		**Michael**	Length and width. Height.
328		**Brian**	Put "l" length. "W" width. And "h" height.
329		**Romina**	You spelled it wrong. Mike. H-e-i-g-h-t. [Also has 2(LW+HW+HL) = surface area]
330		**R1**	All right. Let's see what this is. So tell me what you're doing here? Surface area. So I'm stacking them, right?
331		**Michael**	Whichever way you stack them…

332		**R1**	Do them with these. I want to test them. I want to be sure this works.
333		**Michael**	It would flatten it would work…
334		**R1**	So how does this work?
335		**Michael**	The height is 1. I'll write it. L, W. Height is 1. The width is, which one are you talking about, 4, and the length is 6. Now you take this equation. Two times LW is 24. Plus HW is 4. Plus HL is 6. Which that equals 30, no, 30 square. [Michelle: 38] 34 times 2 is 68. Right? Okay. Now that is the answer. I want to see, I think, where's my other paper that you guys took away? I think I already did that one somewhere. Okay and it's 68 and now the way to prove is to just look at it. 4 plus 4 on the other side and then this is 24 so it's 24 and 6 and 60. 28. It's 68. It works.
336	50:02	**R1**	Wow, so if I did any other one, with these, this would also work?
337		**Michael**	Yeah, even if you did them in squares.
338		**R1**	So it doesn't matter how many you got?
339		**Michael**	Yeah, it'll work with these too. It'll have a different surface area.
340		**R1**	It'll have a different surface area?
341		**Michael**	Yeah, I think so, but I'm not sure. I'm not positive.
342		**R1**	That's an interesting question. Does it work? Okay, let's do it 2 ways. Now, let's do it this way.
343		**Michael**	It works squared too.
344		**R1**	It works this way, and…

345		**Michael**	With this, it'll be…Length is still 6. Width is 2. Height is 2. So. LW is 12. HW 4. And HL is 12. That'll be 28. Times 2 56. And this 4. This is 12. Plus, so wait.
346		**Romina**	6, yeah. 60.
347		**R1**	What are you saying, Michelle? It's always going to work?
348		**Michael**	56. Yeah. I figured this out.
349		**R1**	So that's the general way. now, and volume. What about volume?
350		**Michael**	Volume?
351		**R1**	Did you do volume yet?
352		**Michael**	I just did surface area. I'll do volume now.
353		**R1**	Okay, work on volume now.
354		**Romina**	I thought it was length times width times height.
355		**R1**	Okay let me ask you another question. Suppose I took those, it's the question you just asked, you might want to write the volume this down. What if I staggered it by one, what if I staggered it by 1? I asked you to find the volume and surface area. Would the surface area change, do you think? [Romina: Yeah.] You think the surface area changes. Does the volume change? Do you think the volume will change? Michelle doesn't think the volume will change. That's my next question. Okay. Why don't you do that in general?
356		**Romina**	What does she mean? This is added like this?
357		**Michelle**	It's like steps. You have just like one.
358		**Michael**	I don't know [indecipherable to another group.] Want to see ours? [side conversations]

359	1:01:00	**R1**	How are you doing?
360		**Michael**	Um. Fine.
361		**Romina**	We're not getting anywhere.
362		**Michael**	I found the surface area of this. That's 68. Now, I'm trying to find the same kind of formula for those in-between.
363		**Brian**	Gotta share. Share.
364		**R1**	It's time to share? You're getting tired of working on this? Getting really tired? Okay.
365		**Brian**	Share. [side conversation]
366	1:01:40	**R1**	Why don't you write up what you got. Write up as far as you got and everything you found out. And put your names on there. Okay. Do you need another overhead? Need another overhead?
367		**Romina**	No, not really.
368		**Michael**	Cross that out. And that out. [Brian: But that's right.] No I's not. This is the right surface area. That's the wrong surface area.
369		**Romina**	Oh one cube of one rod.
370		**Michael**	Okay. No, that's right.
371		**Romina**	No it's not.
372		**Michael**	That's volume. [Brian: No.] I made a mistake.
373		**R1**	If you need another piece of paper. Do you need another pen? [Romina: Do you want it neater?] We're gonna share it so whatever you feel comfortable with.
374		**Brian**	What'd you do?

375		**Romina**	I don't know.
376		**Brian**	You need another sheet.
377		**Romina**	I don't want to do this. I don't see how that got on there.
378		**R1**	Okay, what I would like you to do. I think what makes the most sense is to try, get your data organized. Whatever you found. tomorrow we'll begin by sharing. So try to get good notes. If you want to take a view graph home, you can do that. Get ready for your presentations tomorrow.