

1 01:00:59:04 01:01:00:25 In our last session,  
 2 01:01:00:27 01:01:04:20 we are going to have  
 an opportunity to discuss  
 3 01:01:04:22 01:01:07:22 how to apply the ideas that  
 we've explored in this course  
 4 01:01:07:24 01:01:09:13 in our teaching.  
 5 01:01:09:15 01:01:13:06 Namely, how do we take  
 the ideas from measurement  
 6 01:01:13:08 01:01:16:26 and actually translate them  
 into practice.  
 7 01:01:16:28 01:01:19:28 Now, to start,  
 what we want to first do  
 8 01:01:20:00 01:01:22:17 is make sure  
 that we're all clear  
 9 01:01:22:19 01:01:23:21 about some of the big ideas:  
 10 01:01:23:23 01:01:26:07 What is it that  
 we should be stressing?  
 11 01:01:26:09 01:01:28:26 And so, what I thought  
 we'd do today  
 12 01:01:28:28 01:01:33:16 is actually take one topic--  
 the topic of area--  
 13 01:01:33:18 01:01:37:01 and first generate together  
 14 01:01:37:03 01:01:40:23 some of the big ideas  
 about area.  
 15 01:01:40:25 01:01:44:04 Area's a measure of how much  
 surface is covered.  
 16 01:01:44:06 01:01:47:26 It seems pretty obvious to us,  
 it is not obvious to students.  
 17 01:01:47:28 01:01:50:25 It's one reason they confuse  
 so often "area," "perimeter."  
 18 01:01:50:27 01:01:53:05 They sometimes even  
 refer to solid shapes as  
 19 01:01:53:07 01:01:56:20 "Oh, that's square," when they  
 really are talking about a cube.  
 20 01:01:56:22 01:02:00:06 So this is an important thing  
 21 01:02:00:08 01:02:04:04 for us to constantly ask kids,  
 what is area?  
 22 01:02:04:06 01:02:07:19 Some shapes cover a surface more  
 completely than other shapes.  
 23 01:02:07:21 01:02:11:18 Namely, we can cover this floor  
 with square tiles,  
 24 01:02:11:20 01:02:14:22 but if we tried to cover this  
 floor with circular tiles,  
 25 01:02:14:24 01:02:18:04 we'd have to have a lot of grout  
 or something in between  
 26 01:02:18:06 01:02:20:27 to fill in the spaces.  
 27 01:02:20:29 01:02:25:09 The units associated with area  
 measurement are square units.  
 28 01:02:25:11 01:02:27:15 You notice how often in this  
 course I would ask you...  
 29 01:02:27:17 01:02:30:10 you would give me an answer  
 and I'd say, "What?"  
 30 01:02:30:12 01:02:34:05 Now, we as educators  
 have to be very careful  
 31 01:02:34:07 01:02:37:24 to use the correct units and  
 not to just say the numbers.

32 01:02:37:26 01:02:38:25 "It's 36."  
33 01:02:38:27 01:02:40:12 It's 36 what?  
34 01:02:40:14 01:02:42:16 If we don't focus in on  
that we're talking,  
35 01:02:42:18 01:02:45:06 in this case, square units,  
we're missing opportunities  
36 01:02:45:08 01:02:47:07 to really help students  
identify that unit,  
37 01:02:47:09 01:02:50:15 because getting back to,  
you know, "How do we measure?"  
38 01:02:50:17 01:02:52:12 Well, we have to think  
about the attribute,  
39 01:02:52:14 01:02:53:25 and then what is the unit  
40 01:02:53:27 01:02:56:09 that best can be used  
to measure that attribute.  
41 01:02:56:11 01:02:58:29 Well, here, because  
we want to cover,  
42 01:02:59:01 01:03:00:19 and we want to cover it  
completely,  
43 01:03:00:21 01:03:04:10 we want to use square units.  
44 01:03:04:12 01:03:06:05 The smaller the square unit,  
45 01:03:06:07 01:03:09:07 the more square units are  
necessary to determine the area.  
46 01:03:09:09 01:03:11:20 CHAPIN:  
In our final class,  
what we did was  
47 01:03:11:22 01:03:15:21 first try to list  
some of the big ideas  
48 01:03:15:23 01:03:19:02 around the measurement of area.  
49 01:03:19:04 01:03:23:13 And then, once we had some  
of the ideas articulated,  
50 01:03:23:15 01:03:26:18 I sent everyone back  
into grade-level groups  
51 01:03:26:20 01:03:31:10 to discuss how do those ideas  
get translated into practice.  
52 01:03:31:12 01:03:35:01 What kinds of activities could  
one do at their grade level,  
53 01:03:35:03 01:03:38:19 and what mathematics  
was being highlighted  
54 01:03:38:21 01:03:41:04 around, in this case,  
the topic of area.  
55 01:03:41:06 01:03:44:03 MAN:  
You could take  
something as simple  
56 01:03:44:05 01:03:45:10 as a 3 x 3 square  
57 01:03:45:12 01:03:48:11 and it would be, say,  
three feet by three feet  
58 01:03:48:13 01:03:50:08 and it would be  
12 feet in perimeter,  
59 01:03:50:10 01:03:53:25 but you could only fit  
nine square feet inside.  
60 01:03:53:27 01:03:55:10 And then there  
would be other ones  
61 01:03:55:12 01:03:56:21 where you could take,  
you know,  
62 01:03:56:23 01:03:57:29 very, very small

63	01:03:58:01	01:04:00:11	perimeters, or smaller perimeters with a larger area.
64	01:04:00:13	01:04:02:19	And then ones where they're even the same,
65	01:04:02:21	01:04:03:19	like a 4 x 4.
66	01:04:03:21	01:04:04:27	So.
67	01:04:03:21	01:04:04:27	Right.
68	01:04:04:29	01:04:06:12	But I think it would be important
69	01:04:06:14	01:04:07:25	to give them that experience,
70	01:04:07:27	01:04:09:17	as opposed to just saying, you know...
71	01:04:09:19	01:04:11:25	saying that to them.
72	01:04:11:27	01:04:13:00	I agree.
73	01:04:13:02	01:04:14:16	Actually cutting out the papers,
74	01:04:14:18	01:04:15:25	measuring the perimeter,
75	01:04:15:27	01:04:18:08	and doing the area.
76	01:04:18:10	01:04:21:07	Do it, actually do it.
77	01:04:21:09	01:04:22:14	Well, that's what we did
78	01:04:22:16	01:04:23:18	in this entire series,
79	01:04:23:20	01:04:24:28	was, you know...
80	01:04:25:00	01:04:25:29	Hit and miss.
81	01:04:26:01	01:04:27:14	Yeah, or well, going outside
82	01:04:27:16	01:04:29:18	and physically trying things.
83	01:04:29:20	01:04:31:23	And some of us succeeded very well
84	01:04:31:25	01:04:32:24	with our estimates sometimes,
85	01:04:32:26	01:04:34:06	and some of us failed miserably
86	01:04:34:08	01:04:35:08	with our estimates,
87	01:04:35:10	01:04:36:26	and realized why we were wrong later,
88	01:04:36:28	01:04:38:24	and some of us were kind of in the middle.
89	01:04:38:26	01:04:39:25	But going out there
90	01:04:39:27	01:04:41:10	and actually physically doing it
91	01:04:41:12	01:04:42:22	so much brought it into light
92	01:04:42:24	01:04:43:28	that it didn't...
93	01:04:44:00	01:04:46:14	You know it, it can be so abstract sometimes,
94	01:04:46:16	01:04:47:23	because we are so much more
95	01:04:47:25	01:04:49:27	mathematically advanced than our students,
96	01:04:49:29	01:04:51:00	that we take it

for granted  
 97 01:04:51:02 01:04:52:19 that, you know,  
 area's two dimensional  
 98 01:04:52:21 01:04:54:01 and that's that.  
 99 01:04:54:03 01:04:55:01 And taking it  
 outside  
 100 01:04:55:03 01:04:56:13 and physically  
 covering a space--  
 101 01:04:56:15 01:04:57:23 you know, like  
 Lombi said--  
 102 01:04:57:25 01:05:00:08 physically covering a space  
 with a sheet of paper,  
 103 01:05:00:10 01:05:02:24 and then finding  
 the next spot and  
 the next spot.  
 104 01:05:02:26 01:05:04:17 As opposed to just saying  
 it's two dimensional  
 105 01:05:04:19 01:05:05:20 because I know it is,  
 106 01:05:05:22 01:05:07:02 because I learned it  
 ten years ago,  
 107 01:05:07:04 01:05:08:02 I learned it  
 20 years ago.  
 108 01:05:08:04 01:05:09:09 ( *all chuckling* )  
 109 01:05:09:11 01:05:10:29 NARRATOR:  
 David Cellucci will be teaching  
 110 01:05:11:01 01:05:13:11 his third year of  
 eighth-grade mathematics  
 111 01:05:13:13 01:05:16:16 at the Beachmont Middle School  
 in Revere, Massachusetts.  
 112 01:05:16:18 01:05:18:04 We visited his classroom  
 113 01:05:18:06 01:05:20:00 while his students  
 were investigating  
 114 01:05:20:02 01:05:22:22 one of the topics examined  
 during the measurement course:  
 115 01:05:22:24 01:05:26:15 the relationship between  
 surface area and volume.  
 116 01:05:26:17 01:05:28:22 CELLUCCI:  
 So before we start,  
 117 01:05:28:24 01:05:31:15 tell me what you already know  
 about rectangular solids,  
 118 01:05:31:17 01:05:33:04 and we can get some ideas.  
 119 01:05:33:06 01:05:34:26 Because before we can  
 talk about using them,  
 120 01:05:34:28 01:05:36:15 we should at least  
 know what they are,  
 121 01:05:36:17 01:05:39:24 maybe their properties,  
 what they look like.  
 122 01:05:39:26 01:05:41:01 Throw out some answers.  
 123 01:05:41:03 01:05:43:01 What do you think?  
 124 01:05:43:03 01:05:44:18 Nick?  
 125 01:05:44:20 01:05:46:13 They're, like,  
 three-dimensional shapes.  
 126 01:05:46:15 01:05:48:04 CELLUCCI:  
 That's good.  
 127 01:05:48:06 01:05:53:13 They are three-dimensional.  
 128 01:05:53:15 01:05:55:19 What does that mean?

129	01:05:55:21	01:06:01:06	Instead of being, like, 2D, just being like a square,
130	01:06:01:08	01:06:04:21	they like pop out and have, like...
131	01:06:04:23	01:06:06:01	Um, I don't know how to word it.
132	01:06:06:03	01:06:07:01	Thickness?
133	01:06:06:03	01:06:07:01	Yeah.
134	01:06:07:03	01:06:08:01	Something like that?
135	01:06:08:03	01:06:09:01	Excellent.
136	01:06:09:03	01:06:10:17	So they have some chunk to them.
137	01:06:10:19	01:06:12:10	They're not flat.
138	01:06:12:12	01:06:13:15	Instead of being flat...
139	01:06:13:17	01:06:15:17	What's the math word for "not flat"?
140	01:06:15:19	01:06:17:13	It takes up space or it has...
141	01:06:17:15	01:06:18:13	"Area," or "volume."
142	01:06:18:15	01:06:19:13	"Volume," very good.
143	01:06:19:15	01:06:21:03	That's the word I was going for.
144	01:06:21:05	01:06:23:08	Let me throw out a question to all of you.
145	01:06:23:10	01:06:26:10	How many sides are we talking about?
146	01:06:26:12	01:06:27:10	Richard.
147	01:06:27:12	01:06:28:19	Six.
148	01:06:28:21	01:06:30:03	( <i>Cellucci writing on chalkboard</i> )
149	01:06:30:05	01:06:32:15	Good, there are six sides to a rectangular solid.
150	01:06:32:17	01:06:34:15	Tell me something about the properties of these sides
151	01:06:34:17	01:06:37:04	in relationship to other sides within the shape,
152	01:06:37:06	01:06:38:21	within the same shape.
153	01:06:38:23	01:06:41:04	If we were going to build one, maybe the top and the bottom,
154	01:06:41:06	01:06:42:24	is there a relationship between them?
155	01:06:42:26	01:06:43:29	What would they look like?
156	01:06:44:01	01:06:45:09	Each side has...
157	01:06:45:11	01:06:48:13	the opposite side's the same as itself.
158	01:06:48:15	01:06:50:06	Exactly.
159	01:06:50:08	01:06:53:09	CELLUCCI: Our introduction centered around rectangular solids.
160	01:06:53:11	01:06:56:11	Specifically, before we were to deal with them as a class,
161	01:06:56:13	01:06:58:24	I wanted to make sure that the students understood
162	01:06:58:26	01:07:00:10	the properties of a rectangular solid.

163 01:07:00:12 01:07:03:02 Without that knowledge  
being right in front of them,

164 01:07:03:04 01:07:04:17 fresh in their minds,

165 01:07:04:19 01:07:06:26 it would have be difficult  
for them to make a construction.

166 01:07:06:28 01:07:10:09 Also, the relationship  
between milliliters

167 01:07:10:11 01:07:11:20 and cubic centimeters--

168 01:07:11:22 01:07:13:19 to make sure that they could  
transfer volumes--

169 01:07:13:21 01:07:15:28 was also a prior knowledge  
that the opening discussion

170 01:07:16:00 01:07:17:17 definitely helped us  
lay the framework

171 01:07:17:19 01:07:19:03 for what we were about to do.

172 01:07:19:05 01:07:20:23 If I could get you to look  
at the bottom part

173 01:07:20:25 01:07:22:18 of your first sheet.

174 01:07:22:20 01:07:24:06 It says "Activity A,"

175 01:07:24:08 01:07:26:06 and you'll see the materials  
that you'll need--

176 01:07:26:08 01:07:27:20 they should all be  
in front of you.

177 01:07:27:22 01:07:30:26 What I'm asking you to do today  
is fold...

178 01:07:30:28 01:07:34:03 is cut paper into squares  
or rectangles.

179 01:07:34:05 01:07:36:08 Six panels,  
because like we said,

180 01:07:36:10 01:07:38:18 a rectangular solid  
has six sides.

181 01:07:38:20 01:07:40:18 CELLUCCI:  
In first activity,  
the students' goal

182 01:07:40:20 01:07:43:18 was to construct  
a rectangular solid

183 01:07:43:20 01:07:46:09 that had a volume  
of 72 cubic centimeters,

184 01:07:46:11 01:07:48:27 while maximizing surface area.

185 01:07:48:29 01:07:52:25 Their procedure was to use  
rectangular panels, six of them,

186 01:07:52:27 01:07:54:00 to form the rectangular solid,

187 01:07:54:02 01:07:56:10 and rearrange them  
in certain ways

188 01:07:56:12 01:07:57:23 so that to maximize  
surface area

189 01:07:57:25 01:08:00:29 while keeping the volume fixed  
at 72 cubic centimeters.

190 01:08:01:01 01:08:03:12 We chose 72 as a number,  
because it can have

191 01:08:03:14 01:08:05:28 a great amount of factors  
that can be broken down

192 01:08:06:00 01:08:08:03 into several different  
combinations of three numbers

193 01:08:08:05 01:08:09:13 that can be  
multiplied together--

194 01:08:09:15 01:08:10:24 length times width  
times height--

195 01:08:10:26 01:08:13:29 to total the 72 that  
we needed for our volume.

196 01:08:14:01 01:08:15:17 Once you've assembled it  
into a solid,

197 01:08:15:19 01:08:17:06 you're to poke  
a little hole in it--

198 01:08:17:08 01:08:19:14 use your pen or a scissors,  
or something like that--

199 01:08:19:16 01:08:21:19 roll the piece of paper  
into a funnel,

200 01:08:21:21 01:08:24:19 and pour rice into it  
until your solid is full.

201 01:08:24:21 01:08:26:00 Fill it to capacity;

202 01:08:26:02 01:08:27:26 shake it around so that  
the rice compacts.

203 01:08:27:28 01:08:30:15 Once you've gotten all the rice  
in there that it'll hold,

204 01:08:30:17 01:08:32:27 you're transferring it  
into your measuring cup,

205 01:08:32:29 01:08:35:29 and reading the measurements  
right on your sheet.

206 01:08:36:01 01:08:37:27 You'll have a place to note that

207 01:08:37:29 01:08:39:04 right on your chart as well.

208 01:08:39:06 01:08:40:26 One thing that I'd like  
to talk about...

209 01:08:40:28 01:08:43:17 We haven't talked about this  
since the beginning of the year,

210 01:08:43:19 01:08:44:27 when we did the metric system,

211 01:08:44:29 01:08:46:15 and I'm going to  
put this over here.

212 01:08:46:17 01:08:52:29 Remember: one cubic centimeter  
equals one milliliter.

213 01:08:53:01 01:08:56:08 They are exactly  
the same volume.

214 01:08:56:10 01:08:58:18 We're going to be measuring  
our rectangular solid

215 01:08:58:20 01:09:00:07 in cubic centimeters.

216 01:09:00:09 01:09:03:19 Our measuring cup-- if you look  
at one side, the metric size,

217 01:09:03:21 01:09:05:01 it's measured in milliliters.

218 01:09:05:03 01:09:06:24 You can transfer back and forth

219 01:09:06:26 01:09:09:28 to those without doing anything  
but changing the units;

220 01:09:10:00 01:09:12:11 there's no conversion  
with numbers there,

221 01:09:12:13 01:09:14:18 so there shouldn't be  
any difficulty.

222 01:09:14:20 01:09:17:13 So, what's another  
combination with...

223 01:09:17:15 01:09:20:11 it adds...  
wait, when you  
multiply it,

224 01:09:20:13 01:09:22:14 it's 72 cubic  
centimeters?

225 01:09:22:16 01:09:26:26 GIRL:  
Four times six  
times three.

226 01:09:26:28 01:09:29:28 BOY:  
So now we just have to  
put that into a shape

227 01:09:30:00 01:09:32:29 to find the  
surface area.

228 01:09:33:01 01:09:34:00 Four...

229 01:09:38:21 01:09:43:11 BOY:  
Four... four...  
four... three.

230 01:09:47:16 01:09:49:24 Now just to find  
the lengths--

231 01:09:49:26 01:09:51:24 four times six.

232 01:09:51:26 01:09:54:06 GIRL:  
Twenty-four.

233 01:09:54:08 01:09:57:00 So, 12 and 18.

234 01:09:57:02 01:09:58:17 Now we just have to  
add them all together

235 01:09:58:19 01:10:00:09 and multiply by two.

236 01:10:02:16 01:10:05:13 And basically they're  
all 3 x 8, right?

237 01:10:05:15 01:10:07:10 Yeah.

238 01:10:07:12 01:10:09:12 CELLUCCI:  
If you're  
going to have

239 01:10:09:14 01:10:14:00 a 3 x 3 x 8 somewhere on  
that rectangular solid,

240 01:10:14:02 01:10:17:21 you're going to have to have  
something that's 3 x 3.

241 01:10:17:23 01:10:19:12 Let's think about it.

242 01:10:19:14 01:10:22:04 This side is 3 x 8,

243 01:10:22:06 01:10:24:15 so the front and back  
are 3 x 8.

244 01:10:24:17 01:10:27:11 The roof is 3 x 8,

245 01:10:27:13 01:10:29:12 so there's your  
three times eight again.

246 01:10:29:14 01:10:32:28 But the side panels  
are 3 x 3,

247 01:10:33:00 01:10:34:15 not 3 x 8 like  
your charts indicate.

248 01:10:34:17 01:10:35:17 So your surface  
area

249 01:10:35:19 01:10:36:27 is now going to be  
different, too.

250 01:10:36:29 01:10:39:12 So you're going to have  
to take a step back.

251 01:10:39:14 01:10:43:00 Instead of having these side  
panels with an area of 24,

252 01:10:43:02 01:10:46:01 they're only going to have  
an area of nine now

253 01:10:46:03 01:10:48:00 and that's going  
to throw off all  
of your numbers.

254 01:10:48:02 01:10:49:00 See the difference?



255 01:10:49:02 01:10:50:00 GIRL:  
Yeah.

256 01:10:50:02 01:10:51:18 Okay, so the way  
we can get

257 01:10:51:20 01:10:53:16 the biggest possible  
surface area

258 01:10:53:18 01:10:56:07 is by doing  $24 \times 3 \times 1$ ,  
right?

259 01:10:56:09 01:10:57:07 Yeah.

260 01:10:57:09 01:10:58:07 You all agree  
on that?

261 01:10:58:09 01:10:59:14 No.

262 01:10:58:09 01:10:59:14 Hold on now.

263 01:10:59:16 01:11:00:26 Yup.

264 01:10:59:16 01:11:00:26 BOY:  
Yeah.

265 01:11:00:28 01:11:02:21 All right, so  
we'll make it 24...

266 01:11:02:23 01:11:03:23 BOY:  
It was 72,  
right?

267 01:11:03:25 01:11:04:23 What?

268 01:11:03:25 01:11:04:23 Seventy-two?

269 01:11:04:25 01:11:06:06 Yeah.

270 01:11:06:08 01:11:08:15 So twenty-four,  
it'll be length  
by width by height.

271 01:11:08:17 01:11:10:04 So one would be  
the height, right?

272 01:11:10:06 01:11:11:12 Yeah.

273 01:11:11:14 01:11:12:25 All right, so you  
draw that on the board,

274 01:11:12:27 01:11:15:11 and me and Justin will  
draw it on the paper.

275 01:11:16:24 01:11:19:11 CHAPIN:  
One group,  
interestingly, decided

276 01:11:19:13 01:11:23:00 that even though they could have  
a  $72 \times 1 \times 1$  solid,

277 01:11:23:02 01:11:27:06 that that solid might be  
very difficult to build.

278 01:11:27:08 01:11:29:03 And so they understood

279 01:11:29:05 01:11:35:01 that using whole-number values  
for the sides of the solid

280 01:11:35:03 01:11:36:15 they could build this--

281 01:11:36:17 01:11:38:17 based on the paper and  
what materials they had--

282 01:11:38:19 01:11:41:03 that that actually might not be  
terribly practical

283 01:11:41:05 01:11:43:04 when they were then  
going to fill it with rice.

284 01:11:43:06 01:11:47:10 The largest surface area  
we can have is 72 because it...

285 01:11:47:12 01:11:48:29 unless we did  
72 times one times one.

286 01:11:49:01 01:11:50:23 But that still wouldn't work,

287 01:11:50:25 01:11:54:23 because it wouldn't  
fit on the paper,

288 01:11:54:25 01:11:58:21 and then we wouldn't have much  
of a solid to fill with rice.

289 01:11:58:23 01:12:00:23 BOY:  
But they would fit  
in the roll.

290 01:12:00:25 01:12:02:01 So, yeah.

291 01:12:02:03 01:12:06:20 So 24 x 3 is the largest  
surface area we can have

292 01:12:06:22 01:12:08:09 and that's the diagram of it,

293 01:12:08:11 01:12:10:16 and I'll make it exact  
when I use the ruler.

294 01:12:10:18 01:12:11:23 BOY:  
I got it.

295 01:12:11:25 01:12:12:22 You got  
2 x 4 x 9?

296 01:12:12:24 01:12:13:22 Yes.

297 01:12:13:24 01:12:14:22 Go down.

298 01:12:14:24 01:12:15:23 Uh, draw that one.

299 01:12:15:25 01:12:16:27 BOY:  
So well go  
two sides down?

300 01:12:16:29 01:12:17:27 Two down.

301 01:12:17:29 01:12:19:29 Yeah, it  
would be  
two down.

302 01:12:20:01 01:12:21:11 And four in depth  
and nine...

303 01:12:21:13 01:12:22:21 No, it's nine  
across.

304 01:12:22:23 01:12:24:08 Yeah, nine  
across.

305 01:12:24:10 01:12:25:08 Nine across.

306 01:12:25:10 01:12:27:13 BOY:  
So just as  
a small...

307 01:12:27:15 01:12:29:22 we'll draw  
a big... across...

308 01:12:29:24 01:12:31:17 and it'll  
come down.

309 01:12:31:19 01:12:33:00 And it's one...

310 01:12:33:02 01:12:35:07 Can we do 36?

311 01:12:33:02 01:12:35:07 Huh?

312 01:12:35:09 01:12:36:13 Can we do 36?

313 01:12:36:15 01:12:40:02 Yeah-- I have to tape  
some papers together,

314 01:12:40:04 01:12:42:00 but we could  
do that.

315 01:12:42:02 01:12:43:00 All right.

316 01:12:43:02 01:12:45:10 Plus the area,  
220.

317 01:12:49:10 01:12:51:21 CELLUCCI:  
I had them draw nets  
on the dry-erase boards

318 01:12:51:23 01:12:54:05 that they were provided

with for two reasons.

319 01:12:54:07 01:12:55:25 One: I thought being able  
to visualize

320 01:12:55:27 01:12:57:08 what their rectangular solid  
321 01:12:57:10 01:12:58:29 would look like  
all laid out flat,

322 01:12:59:01 01:13:01:03 would help them construct  
the individual pieces.

323 01:13:01:05 01:13:03:23 And two: that shows  
a higher level of thinking,  
324 01:13:03:25 01:13:05:29 that they can...  
they're able to conceptualize

325 01:13:06:01 01:13:08:28 what their rectangular solid  
would look like unfolded,  
326 01:13:09:00 01:13:10:27 before it's even created.  
327 01:13:10:29 01:13:12:12 Well, I'm going  
to fill this up

328 01:13:12:14 01:13:15:21 to 72 milliliters,  
because... it just says

329 01:13:15:23 01:13:18:12 it should be  
72 cubic centimeters;

330 01:13:18:14 01:13:20:01 That's how much rice  
331 01:13:20:03 01:13:21:29 should fit  
inside of it.

332 01:13:27:12 01:13:28:11 BOY:  
Just fill it up.

333 01:13:41:23 01:13:43:03 GIRL:  
Are we going  
to need more?

334 01:13:43:05 01:13:44:03 Yup.

335 01:13:44:05 01:13:45:12 We just need a little bit,  
336 01:13:45:14 01:13:47:01 because I spilled  
a little bit.

337 01:13:51:17 01:13:53:08 ( *girl giggling* )  
338 01:13:53:10 01:13:55:08 All right, we  
can't have this  
rice all over.

339 01:13:55:10 01:13:56:17 Rice disaster.  
340 01:13:56:19 01:13:57:21 Okay, so...  
341 01:13:57:23 01:13:58:27 BOY:  
So now  
we measure.

342 01:13:58:29 01:14:00:24 All right, pour all  
the excess in there.

343 01:14:03:25 01:14:06:14 BOY:  
Should be seven...

344 01:14:06:16 01:14:08:25 72 milliliters.  
345 01:14:08:27 01:14:11:19 CELLUCCI:  
It's a very powerful learning  
tool for students this age

346 01:14:11:21 01:14:13:15 to learn with hands-on  
materials.

347 01:14:13:17 01:14:15:21 It's one thing for me to  
stand up in front of them

348 01:14:15:23 01:14:16:29 and preach the formula  
349 01:14:17:01 01:14:18:21 for the surface area

of a rectangular solid  
 350 01:14:18:23 01:14:21:24 and draw some three-dimensional  
 cubes on the board,  
 351 01:14:21:26 01:14:24:16 but it's another thing  
 to have them start  
 352 01:14:24:18 01:14:26:23 with two-dimensional  
 flat paper,  
 353 01:14:26:25 01:14:29:07 and physically build that  
 three-dimensional solid,  
 354 01:14:29:09 01:14:32:01 and see how the dimensions are  
 going to shape up, and see  
 355 01:14:32:03 01:14:35:00 how much stuff, physically,  
 literally, goes inside,  
 356 01:14:35:02 01:14:38:11 and truly have them understand  
 what volume or capacity means.  
 357 01:14:38:13 01:14:41:11 CELLUCCI:  
 If I could get everybody  
 to stop just for one second.  
 358 01:14:41:13 01:14:43:06 We're going to kind of  
 change gears here.  
 359 01:14:43:08 01:14:45:03 You've been working on the one  
 360 01:14:45:05 01:14:47:07 that had the larger  
 surface area,  
 361 01:14:47:09 01:14:48:17 the worksheet entitled, "Big."  
 362 01:14:48:19 01:14:50:12 We're going to change gears  
 just a little bit.  
 363 01:14:50:14 01:14:53:29 Same exact procedure,  
 same exact materials.  
 364 01:14:54:01 01:14:58:07 Now, though, I would like you  
 to start using the orange paper,  
 365 01:14:58:09 01:15:00:25 and you're going to build  
 another rectangular solid.  
 366 01:15:00:27 01:15:03:09 This time your goal is to try  
 to find the rectangular solid  
 367 01:15:03:11 01:15:06:12 that'll use the smallest amount  
 of surface area.  
 368 01:15:06:14 01:15:08:09 Now we're trying to be  
 economical.  
 369 01:15:08:11 01:15:10:13 We're trying to find  
 a small package.  
 370 01:15:10:15 01:15:12:28 Of course, we know  
 it's still going to hold  
 371 01:15:13:00 01:15:15:20 72 cubic centimeters  
 or 72 milliliters of rice.  
 372 01:15:15:22 01:15:17:02 Use the orange paper.  
 373 01:15:17:04 01:15:19:16 The rules are  
 that you will still have  
 374 01:15:19:18 01:15:22:14 72 cubic centimeters  
 of volume to work with.  
 375 01:15:22:16 01:15:24:25 As little paper as you can  
 possibly use to achieve that  
 376 01:15:24:27 01:15:26:03 is your goal on this one.  
 377 01:15:26:05 01:15:28:06 Same idea, talk yourselves  
 through it,  
 378 01:15:28:08 01:15:31:04 let's see some drawings,  
 let's see some dimensions,

379 01:15:31:06 01:15:32:27 and get to it.  
 380 01:15:32:29 01:15:34:16 Well, Kristen,  
 I think  
 381 01:15:34:18 01:15:37:23 that we shouldn't  
 have to use  
 whole numbers,  
 382 01:15:37:25 01:15:39:23 so if we do  
 four times four  
 383 01:15:39:25 01:15:41:29 times 4.5, we end up with 72,  
 384 01:15:42:01 01:15:44:20 and that's what  
 we're trying to get.  
 385 01:15:44:22 01:15:47:28 So first we should  
 start by drawing  
 a cube, probably.  
 386 01:15:48:00 01:15:49:03 All right.  
 387 01:15:49:05 01:15:53:00 And labeling the sides  
 "four centimeters,"  
 388 01:15:53:02 01:15:56:10 another "four centimeters,"  
 and then "4.5."  
 389 01:15:56:12 01:15:58:19 And then you  
 can multiply out  
 390 01:15:58:21 01:16:02:06 and put the formula  
 front, back,  
 left, right,  
 391 01:16:02:08 01:16:04:17 and the top  
 and the bottom.  
 392 01:16:06:15 01:16:07:27 Okay, so it's...  
 393 01:16:07:29 01:16:09:05 What is it?  
 394 01:16:09:07 01:16:11:23 You can start by doing  
 front and back...  
 395 01:16:11:25 01:16:14:10 Would be four times four  
 equals 16 each.  
 396 01:16:17:17 01:16:23:07 And the left and right, four  
 times 4.5 is 18 centimeters.  
 397 01:16:23:09 01:16:25:28 KRISTEN:  
 Which is what?  
 398 01:16:26:00 01:16:27:25 18 centimeters.  
 399 01:16:27:27 01:16:30:15 And the top and bottom is  
 like the front and back,  
 400 01:16:30:17 01:16:31:15 and that's also...  
 401 01:16:31:17 01:16:32:24 I mean, it's  
 like the sides,  
 402 01:16:32:26 01:16:34:08 and that's also  
 18 centimeters.  
 403 01:16:37:06 01:16:39:11 We should label them  
 "length" and "width,"  
 404 01:16:39:13 01:16:41:10 so we can remember  
 which one is it.  
 405 01:16:41:12 01:16:44:09 KRISTEN:  
 So this is going to be length  
 and that's going to be width?  
 406 01:16:44:11 01:16:45:14 BOY:  
 Yeah.  
 407 01:16:45:16 01:16:46:16 We could start  
 408 01:16:46:18 01:16:48:10 by constructing our cube  
 409 01:16:48:12 01:16:50:27 to four centimeters

with measuring.

410 01:16:50:29 01:16:52:05 BOY:  
I already did

411 01:16:52:07 01:16:53:10 the first height,  
412 01:16:53:12 01:16:55:11 and this is  
the left and right.

413 01:16:55:13 01:16:58:06 KRISTIN:  
So that's less  
than the right one?

414 01:16:58:08 01:17:00:28 Yeah, that's 4 by 4.5.  
415 01:17:01:00 01:17:03:10 To find the surface area,  
416 01:17:03:12 01:17:07:17 we need to add 16 plus 16,  
417 01:17:07:19 01:17:13:14 plus 18, plus 18, plus 18,  
418 01:17:13:16 01:17:14:14 plus 18.  
419 01:17:14:16 01:17:16:05 And that's  
the surface area.

420 01:17:18:15 01:17:20:12 It's 104.  
421 01:17:20:14 01:17:21:19 104 centimeters  
422 01:17:21:21 01:17:24:00 for the surface area.  
423 01:17:24:02 01:17:25:02 BOY:  
Yeah.

424 01:17:26:08 01:17:29:19 You want to have  
the square be 4 x 4.  
425 01:17:29:21 01:17:33:10 Then you want to go  
up 4.5 on each side.  
426 01:17:33:12 01:17:36:06 And then down 4.5  
on each side.  
427 01:17:36:08 01:17:37:09 Doesn't  
matter...

428 01:17:37:11 01:17:38:28 JUSTIN:  
Yeah, it does.

429 01:17:39:00 01:17:40:00 NICK:  
Because...

430 01:17:40:02 01:17:41:15 You don't want  
to start off 4.5 by 4.  
431 01:17:41:17 01:17:43:09 BOY:  
It really doesn't  
matter, because...

432 01:17:43:11 01:17:44:12 That'll make  
a bigger...

433 01:17:44:14 01:17:45:26 That'll make a bigger  
surface area.

434 01:17:45:28 01:17:47:19 Yeah, that'll make  
a bigger surface area.

435 01:17:47:21 01:17:50:15 As long as the surface  
area stays the same...

436 01:17:50:17 01:17:52:24 JUSTIN:  
Yeah, but if  
I change this...

437 01:17:52:26 01:17:54:20 If that ends up 4.5,  
and that ends up 4,  
438 01:17:54:22 01:17:56:07 that makes the surface  
area larger.

439 01:17:56:09 01:17:57:08 Makes it 18.  
440 01:17:57:10 01:17:58:14 If you did 4 x 4,  
it'd just be 16.

441 01:17:58:16 01:18:00:02 NICK:  
Yes,

442 01:18:00:04 01:18:02:02 that's the way we want it; we  
want the smallest surface area.

443 01:18:02:04 01:18:03:11 Okay.

444 01:18:03:13 01:18:04:25 CELLUCCI:  
So what are we talking about?

445 01:18:04:27 01:18:06:03 What are we coming up with here?

446 01:18:06:05 01:18:07:11 NICK:  
We're coming up with,

447 01:18:07:13 01:18:10:16 um... in order to find  
the smallest surface area,

448 01:18:10:18 01:18:11:27 which we think is 16,

449 01:18:11:29 01:18:13:23 by using 4  
by 4 by 4.5.

450 01:18:13:25 01:18:15:15 So you're using...  
you're going to build

451 01:18:15:17 01:18:16:28 a rectangle that's  
4 by 4 by 4.5?

452 01:18:17:00 01:18:18:21 How did you come up  
with those numbers?

453 01:18:18:23 01:18:20:04 Was that a guess  
and check,

454 01:18:20:06 01:18:22:08 or did you build it  
off something you'd  
done earlier?

455 01:18:22:10 01:18:25:03 NICK:  
Um... when we  
were doing

456 01:18:25:05 01:18:27:18 the big square, I was  
pretty much trying

457 01:18:27:20 01:18:29:11 to find one  
that would work,

458 01:18:29:13 01:18:31:13 and I came across  
4 by 4 by 4.5,

459 01:18:31:15 01:18:35:04 and we automatically  
knew that would not  
be the biggest...

460 01:18:35:06 01:18:36:04 Mm-hmm.

461 01:18:36:06 01:18:37:04 So...

462 01:18:37:06 01:18:38:07 Oh, so in  
the earlier one,

463 01:18:38:09 01:18:39:29 the one we built out  
of the blue paper,

464 01:18:40:01 01:18:41:11 you came up with  
those numbers.

465 01:18:41:13 01:18:42:16 NICK:  
Yes.

466 01:18:42:18 01:18:44:17 That worked out kind  
of nice for you, huh?

467 01:18:44:19 01:18:45:19 We haven't built this shape yet,

468 01:18:45:21 01:18:46:23 but when we do build it,  
roughly,

469 01:18:46:25 01:18:48:00 what is it going to look like?

470 01:18:48:02 01:18:50:07 Gary, what do you think  
it's going to look like?

471 01:18:50:09 01:18:52:01 I think it's going  
to be, like,

472 01:18:52:03 01:18:54:27 almost a square, because  
it's... all the edges are 4.4.

473 01:18:54:29 01:18:56:10 Well, it can't be a square.

474 01:18:56:12 01:18:57:13 The sides will be squares.

475 01:18:57:15 01:18:59:00 But what's the shape  
going to be?

476 01:18:59:02 01:19:01:11 We don't call them squares if  
they're three-dimensional.

477 01:19:01:13 01:19:02:11 A rectangle.

478 01:19:02:13 01:19:03:15 A rectangular solid.

479 01:19:03:17 01:19:05:05 It's going to look  
most like...

480 01:19:05:07 01:19:06:11 Say that again, Gina?

481 01:19:06:13 01:19:07:17 A cube?

482 01:19:07:19 01:19:09:00 It's going to look  
most like a cube,

483 01:19:09:02 01:19:11:14 like a perfect  
square box.

484 01:19:11:16 01:19:13:18 Of course, it won't be,  
like, a perfect cube,

485 01:19:13:20 01:19:15:00 but it will look  
something like this.

486 01:19:15:02 01:19:16:00 Absolutely.

487 01:19:16:02 01:19:17:10 It will be very,  
very similar,

488 01:19:17:12 01:19:18:18 and of course,  
4 by 4 by 4.5,

489 01:19:18:20 01:19:20:18 we're only talking  
about a half a centimeter,

490 01:19:20:20 01:19:21:24 and to the naked eye,

491 01:19:21:26 01:19:23:28 that's going to look  
very much like a cube,

492 01:19:24:00 01:19:25:27 instead of a box that  
we go out to the store

493 01:19:25:29 01:19:26:27 and buy pencils in.

494 01:19:26:29 01:19:28:11 It's definitely not a cube.

495 01:19:28:13 01:19:30:11 We poured the rice  
into the cup,

496 01:19:30:13 01:19:32:11 and we measured  
how much it was,

497 01:19:32:13 01:19:34:18 and we poured  
the rice into there,

498 01:19:34:20 01:19:36:20 and the excess  
we left in there,

499 01:19:36:22 01:19:38:21 and measured how  
much that was.

500 01:19:38:23 01:19:40:00 That's how much  
we could fit.

501 01:19:40:02 01:19:41:20 Oh, so you took  
the difference, then.

502 01:19:41:22 01:19:43:21 So you started with  
a known quantity of rice.

503 01:19:43:23 01:19:44:29 How much did you  
start with?



504 01:19:45:01 01:19:46:12 175.  
 505 01:19:46:14 01:19:47:26 CELLUCCI:  
 Started with  
 175 milliliters,  
 506 01:19:47:28 01:19:49:11 or cubic centimeters,  
 507 01:19:49:13 01:19:52:02 and then you poured some into  
 the cube, and then remeasured...  
 508 01:19:52:04 01:19:53:03 Yeah.  
 509 01:19:53:05 01:19:54:18 And you found  
 a difference, then.  
 510 01:19:54:20 01:19:55:19 Yeah.  
 511 01:19:55:21 01:19:57:03 How much rice had  
 been poured out?  
 512 01:19:57:05 01:19:58:17 How much rice  
 had been displaced?  
 513 01:19:58:19 01:19:59:21 Like, around,  
 like, 75...  
 514 01:19:59:23 01:20:01:03 Now that you're  
 at this stage,  
 515 01:20:01:05 01:20:02:18 is there a way  
 to double-check that?  
 516 01:20:02:20 01:20:04:03 Yeah-- pour the rice  
 back in there,  
 517 01:20:04:05 01:20:05:23 and then measure how  
 much is in there.  
 518 01:20:05:25 01:20:07:11 CELLUCCI:  
 Exactly, and  
 the two totals  
 519 01:20:07:13 01:20:08:16 should match each other.  
 520 01:20:08:18 01:20:10:04 Let's settle that in.  
 521 01:20:10:06 01:20:12:27 GIRL:  
 It's about 75-- a little  
 bit less than 75.  
 522 01:20:12:29 01:20:15:00 So... and that's  
 pretty approximate,  
 523 01:20:15:02 01:20:17:12 because the measurements  
 on here aren't that perfect,  
 524 01:20:17:14 01:20:18:19 and for the most part,  
 525 01:20:18:21 01:20:20:13 that's good enough  
 for what we need to do.  
 526 01:20:20:15 01:20:23:25 What should the volume be if we  
 did it absolutely perfectly?  
 527 01:20:23:27 01:20:24:25 Seventy-two?  
 528 01:20:24:27 01:20:26:03 It should be 72.  
 529 01:20:26:05 01:20:28:14 CELLUCCI:  
 They did conceptually build  
 530 01:20:28:16 01:20:31:26 rectangular solids that had a  
 volume of 72 cubic centimeters,  
 531 01:20:31:28 01:20:34:00 although when they actually  
 went ahead and measured  
 532 01:20:34:02 01:20:35:21 the volume of rice  
 that would go in it,  
 533 01:20:35:23 01:20:38:10 very few groups got something  
 that actually equaled 72.  
 534 01:20:38:12 01:20:39:28 I was trying to get them  
 to realize

535 01:20:40:00 01:20:43:00 that there's some natural error  
in, perhaps, their measurement,  
536 01:20:43:02 01:20:45:03 or their cutting,  
or the built-in error  
537 01:20:45:05 01:20:47:09 in the space between  
the grains of rice,  
538 01:20:47:11 01:20:48:27 and if we use sand or water,  
539 01:20:48:29 01:20:51:04 it may have been closer  
to a true volume.  
540 01:20:51:06 01:20:52:29 You guys did a really  
nice job today,  
541 01:20:53:01 01:20:55:22 both building the figure  
with the largest surface area  
542 01:20:55:24 01:20:58:04 and one with the smallest  
possible surface area.  
543 01:20:58:06 01:21:00:08 Walking around  
to all six groups,  
544 01:21:00:10 01:21:02:22 I saw many different results,  
many different shapes.  
545 01:21:02:24 01:21:04:23 Now it's time to share  
some class results.  
546 01:21:04:25 01:21:07:20 First thing I'm going to ask  
each group to do is be prepared  
547 01:21:07:22 01:21:10:29 to tell me the dimensions--  
length, width and height--  
548 01:21:11:01 01:21:13:16 and then also, since you should  
have calculated already,  
549 01:21:13:18 01:21:15:12 the surface area of your  
rectangular solid.  
550 01:21:15:14 01:21:17:08 Why don't we start  
with group number one,  
551 01:21:17:10 01:21:18:18 right over here-- Gina?  
552 01:21:18:20 01:21:20:16 Length, width  
and height, please?  
553 01:21:20:18 01:21:22:21 24 by 3 by 1.  
554 01:21:22:23 01:21:24:24 24 by 3 by 1.  
555 01:21:24:26 01:21:26:12 I think it's safe to assume  
556 01:21:26:14 01:21:28:11 that these are all  
in centimeters,  
557 01:21:28:13 01:21:30:11 and of course, your  
surface area then is...  
558 01:21:30:13 01:21:32:04 198 centimeters.  
559 01:21:32:06 01:21:34:04 198 square  
centimeters.  
560 01:21:34:06 01:21:35:22 Group number two,  
561 01:21:35:24 01:21:38:27 the length, width and height  
of your blue rectangular solid?  
562 01:21:38:29 01:21:40:06 Juan, what do  
you have for me?  
563 01:21:40:08 01:21:44:19 Um, we have, um...  
sides of 9 by 4  
564 01:21:44:21 01:21:46:10 by 2.  
565 01:21:46:12 01:21:47:25 9 by 4 by 2,  
566 01:21:47:27 01:21:49:25 also equaling  
72 cubic centimeters,  
567 01:21:49:27 01:21:51:23 and a surface area of this one?

568 01:21:51:25 01:21:53:14 From your earlier calculations?

569 01:21:53:16 01:21:54:18 124.

570 01:21:54:20 01:21:56:24 124 square centimeters-- good.

571 01:21:56:26 01:21:58:11 CELLUCCI:  
We put the groups'

572 01:21:58:13 01:22:01:13 small and large surface-area lengths, widths and heights

573 01:22:01:15 01:22:04:21 on the board, and compared the different surface areas.

574 01:22:04:23 01:22:06:03 For some of the students,

575 01:22:06:05 01:22:08:00 that's when it finally started to click,

576 01:22:08:02 01:22:10:24 that as the dimensions-- the length, width and height--

577 01:22:10:26 01:22:13:22 grew closer together, you ended up with a smaller surface area,

578 01:22:13:24 01:22:16:14 and a shape that ended up being closer to a cube,

579 01:22:16:16 01:22:18:00 and the flip side,

580 01:22:18:02 01:22:21:18 as the dimensions tended to get farther apart-- a 1 by 1 by 72--

581 01:22:21:20 01:22:24:05 the shape tended to be much more elongated,

582 01:22:24:07 01:22:26:14 and the surface area was somewhat maximized.

583 01:22:26:16 01:22:27:16 Christina?

584 01:22:27:18 01:22:28:20 What do you have?

585 01:22:28:22 01:22:29:22 4.16.

586 01:22:29:24 01:22:31:14 Oh, wait, hold on.

587 01:22:31:16 01:22:33:12 I wasn't prepared for that.

588 01:22:33:14 01:22:34:13 4.16...

589 01:22:34:15 01:22:35:21 By 4.16.

590 01:22:35:23 01:22:37:06 By 4.16.

591 01:22:37:08 01:22:38:12 By 4.16.

592 01:22:38:14 01:22:39:25 By 4.16.

593 01:22:39:27 01:22:41:25 And it's 103.8.

594 01:22:41:27 01:22:44:11 103.8.-- Are these numbers all rounded off,

595 01:22:44:13 01:22:46:28 or are these exact how they came out in your calculator?

596 01:22:47:00 01:22:50:28 They're rounded off, but we went to the high side.

597 01:22:51:00 01:22:53:04 What do you think happens

598 01:22:53:06 01:22:58:24 to a shape to achieve the smallest surface area

599 01:22:58:26 01:23:00:15 in these rectangular solids?

600 01:23:00:17 01:23:02:15 And I was working with your group,

601 01:23:02:17 01:23:04:00 so Richard, I'll ask you.

602 01:23:04:02 01:23:06:24 I noticed that as the lengths were more similar,

603 01:23:06:26 01:23:08:17 the surface area got smaller,  
 604 01:23:08:19 01:23:10:27 but as the lengths  
 were more lopsided--  
 605 01:23:10:29 01:23:12:28 like on the board,  
 1 and 1 and 72--  
 606 01:23:13:00 01:23:14:29 the longer the surface area was.  
 607 01:23:15:01 01:23:16:03 Sure.  
 608 01:23:16:05 01:23:18:25 The one that was  
 the most symmetric,  
 609 01:23:18:27 01:23:22:15 the length, width and height  
 were all the same.  
 610 01:23:22:17 01:23:25:16 We came out with  
 the most economical way  
 611 01:23:25:18 01:23:27:05 to build a package--  
 612 01:23:27:07 01:23:28:22 a perfect what, Richard?  
 613 01:23:28:24 01:23:30:04 Cube?  
 614 01:23:30:06 01:23:32:03 You built a cube,  
 exactly, where  
 the length, width  
 615 01:23:32:05 01:23:35:01 and height-- where all sides--  
 happened to be the same length,  
 616 01:23:35:03 01:23:36:24 and all sides happened  
 to be squares.  
 617 01:23:36:26 01:23:39:02 Where did this number  
 4.16 come from?  
 618 01:23:39:04 01:23:40:29 It seems a little awkward  
 for guess and check.  
 619 01:23:41:01 01:23:42:26 Where did this number  
 come from in your mind,  
 620 01:23:42:28 01:23:43:26 Justin?  
 621 01:23:43:28 01:23:44:27 It's the cube root of 72?  
 622 01:23:44:29 01:23:46:05 That's exactly right,  
 623 01:23:46:07 01:23:47:26 and I'm going to show  
 you that right over here.  
 624 01:23:47:28 01:23:49:13 Earlier... we talked...  
 625 01:23:49:15 01:23:52:10 earlier this year we've done  
 a lot of work on square roots.  
 626 01:23:52:12 01:23:53:28 When I was working with Justin,  
 627 01:23:54:00 01:23:56:04 right at the very beginning  
 of class, he said  
 628 01:23:56:06 01:23:58:11 that if we were going  
 to make a perfect cube,  
 629 01:23:58:13 01:24:00:28 if we did a 4 by 4 by 4,  
 630 01:24:01:00 01:24:05:07 we would end up  
 with 64 cubic centimeters,  
 631 01:24:05:09 01:24:08:06 and if we did a 5 by 5 by 5,  
 632 01:24:08:08 01:24:12:19 we would end up with  
 125 cubic centimeters.  
 633 01:24:12:21 01:24:14:16 So if we were going  
 to make a perfect cube  
 634 01:24:14:18 01:24:16:25 to equal 72 cubic centimeters,  
 it would have to be  
 635 01:24:16:27 01:24:18:11 somewhere between 4 and 5.  
 636 01:24:18:13 01:24:21:15 We did work like that with  
 square roots earlier this year:  
 637 01:24:21:17 01:24:23:08 between which two whole numbers

638 01:24:23:10 01:24:25:03 is the square root  
of... something?

639 01:24:25:05 01:24:27:19 Now we're not talking  
about squaring something.

640 01:24:27:21 01:24:30:10 We're talking about taking  
a number and cubing it,  
641 01:24:30:12 01:24:32:01 or doing it to the third power.  
642 01:24:32:03 01:24:34:06 What is the opposite  
of cubing a number?

643 01:24:34:08 01:24:35:29 We do a lot of equations  
in here.

644 01:24:36:01 01:24:37:12 We do the opposites a lot.  
645 01:24:37:14 01:24:40:04 Well, since the opposite  
  
of squaring the number  
646 01:24:40:06 01:24:43:18 would be to square-root it,  
you would have to cube-root it.

647 01:24:43:20 01:24:44:26 Exactly, and  
that's something  
648 01:24:44:28 01:24:46:07 we really haven't  
touched upon  
649 01:24:46:09 01:24:48:08 too much in here,  
but in your calculator,  
650 01:24:48:10 01:24:49:21 you're probably going to see  
651 01:24:49:23 01:24:51:16 a button that looks  
similar to this.

652 01:24:51:18 01:24:53:24 It has the square root,  
or radical-- symbol,  
653 01:24:53:26 01:24:57:19 with an x inside, and perhaps  
another variable out there,  
654 01:24:57:21 01:25:01:04 and you can do all different  
kinds of roots there.

655 01:25:01:06 01:25:05:01 So if we ended up...  
what this group did was  
656 01:25:05:03 01:25:09:19 they cube-rooted 72, and they  
came out to approximately 4.16.  
657 01:25:09:21 01:25:11:24 And that's the perfect  
symmetrical cube,  
658 01:25:11:26 01:25:14:03 and even your dimensions  
are rounded off.

659 01:25:14:05 01:25:16:05 CHAPIN:  
This lesson was very appropriate  
660 01:25:16:07 01:25:18:24 in that it took advantage  
of what students already know,  
661 01:25:18:26 01:25:20:17 extended their knowledge  
662 01:25:20:19 01:25:24:07 by situating it into  
a problem-solving situation,  
663 01:25:24:09 01:25:28:14 and then again furthering it,  
because it asked them to relate  
664 01:25:28:16 01:25:30:19 how, when we have  
a constant volume,  
665 01:25:30:21 01:25:34:13 does the surface area change  
based on the shape of the solid?  
666 01:25:41:14 01:25:46:12 Captioned by  
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