

next summer yeah I got it I got it I didn't read it though well that's all right my dad told me I got something yeah but that really might be

fun I so far away from

yeah the board today oh your eyes are are they naturally or no your eyes totally Match Your Shirt did you know that no did your shirt make your eyes change color or I

have that's really really a

pretty on the boy where is the boy right

there there's ready get I

if we've been uh filming a couple times in your class already this year haven't we so this is you guys are old hands but for you all have you been on in filmed situations before

Now I it's been so long I can just to see you in about what what grade do you remember 17th grade yeah is that when you joined sixth grade sixth grade that's what I remember sixth grade it was that would you would have been sixth grade in Miss carella's class Mr Po and Mr Po but but but you came special to Mr Po for for math and you did too didn't joined in the middle of the year or did you join early do you the middle I think I think the middle that's what I remember sort of all of a sudden you all came in it's like after the first marking period or something like that yeah yeah I have no idea we're g we'll talk about that a little bit and because I want to know where all of you came from and Robert you and Michelle were with us from earlier than that what from first grade I was from first I don't know were from second around there and you from like second like from second grade my yeah I remember Miss Mar Marin name oh was the first year that we had these little groups right and then in the second grade we were in I can remember being in two or three different rooms with some of you and then in the third grade with Mr Bender Mr Bender with the piano he's gonna stay yeah we're what I would like to know is is sort of a little bit more of the conversation that we were just saying Robert you say that Michelle you say you remember since first grade mhm and Robert from about second and Angela and Magda from six did you move to Kenworth at that time or had you been I went to St Teresa till 6th grade and then I went to Harding yeah yeah what about you m um I moved from Roselle Park

Park yeah yeah and then joined this group that we were doing uh sort of after their first marking period yeah kind of yeah and then Ashley you're brand new I just moved here so just moved here well not just but like two years ago two years ago and so came to Brearley when it opened yeah yeah where were you before Elizabeth in Elizabeth yeah and sure it from where I went to the St Teresa in sixth grade from sixth grade yeah yeah and then came to Brearley last year

yeah what do do you all remember about anything that we did the cubes those Cube problems and do you all know what they're talking about the cube problems um what are they do you know what they're called unifix cubes I think they're called yeah and like having those yeah oh god um and doing all like the combination problems and everything what do you mean a combination problem like if you had two colors and you can make stacks of four how many different combinations can you make mhm mhm do you remember those mhm what about you Robert what are your memories um there was this garage door problem like Miss O'Brien she couldn't get her car in the garage because she forgot her um combination on the door open we had to write out all the combinations and like see how many possibilities there were oh for the numbers that we open the garage door yeah there was like special rules like I don't think you have two numbers in a row like you couldn't have one one two uh-huh it's one of those uh-huh yeah did you do the cube thing too far yeah you remember that one as well what

about what about you Angela remember obviously remember yeah and um the thing was like how many ways could you make seven with like two dice or whatever it was like something like that oh throwing it was some game yeah it was just like how many ways you can make seven them or something you remember I have no clue I don't remember if you were throwing two

dice can anybody think that in their head how many ways could you make

seven like

six everybody want to pin in case you have to think about these things six six yeah what would they be one I mean I'm not saying yeah I'm just saying is that what you're thinking that there might be six yeah because one and six six and one two and five five and two three and four and four and six is that six or is that eight I

don't okay

you do backwards do backwards what we say what do you mean backward no like one that will say six the other one will say one and then like switch them like the one that said six will say one and the other one will say

six okay so what you mean because they're to die or something then two dice it makes a difference yeah because they they have different numbers on them no yeah and so all of you great and you remember that from sixth grade or whatever other sixth or seventh grade yeah and you mag how do you remember from when they came in I have no clue I don't remember anything don't remember any of them I know we did like number problems like how many different combinations can you get but did a lot of those like with d with like different numbers with like stuff like that yeah and you too have you done that kinds of problems before I did in Mr pil class in Mr like what what do you what kind

of I Didn't Do problems like that but I did problems like we did a bouncing ball problem what a bouncing ball problem and like we had to make a graph of how it bounced yeah like the way around yeah when it comes down I bet that was really and

um we did a balloon

problem

we we did like Cube problems out of these things yeah it did something like you know the the big round Cube that has like a lot of different colors and he was like trying to tell us um if you go like that what color do you think will be there stuff like that oh I'm having a hard time imagining can somebody else help me imagine what that kind of cube would be um a big Cube and it's like a lot of different colors on all sides it has four sides it looks cube like a Rubik's Cube like that thing and you're having to imagine what have you ever done anything with this kind of cube so this is new for you what do you remember what you been thinking about I didn't any of this yeah yeah um and so so you all sort of coming into this do you hear them talking about these things ever or is this just sort of the first time you've heard about their no I knew they were doing before like that but I didn't know exactly what they doing what kind of problems no I didn't know yeah yeah um and so you remember these probably more than some other things or what because we worked on them like every year I remember doing something with them like every year from first grade on yeah I remember in Miss marinara's room kid what did you do in the first grade remember um I think there were just still like the tower problems I'm not really sure I remember what was the tower problem can you can you name it um it was like we were given like two different colors like blue and yellow or something and I'm going to pull up some two different colors and okay what we had like we were given like a set amount like three blocks high or whatever yeah let's say four it's a little bit more interesting okay so four blocks high right and we had to like mix the colors and well you've got two colors to choose from is that right mhm okay and see how many combinations we can make like it would be like blue on top and three yellow okay do you remember that all of them had to sort of go this way um you couldn't have a tower this is for you guys you couldn't have a tower going this way because it over okay so towers are this way and the reason uh that that that I'm saying that is that sometimes that that that might make a difference but anyway if they're for tall and you've got like two colors two colors to choose among and like you from like layer the colors differently to find as many combinations as you can okay um just so that we can all understand and remember that I'm going to ask us to do that again um and I'm going to have you two work together to see you know what you remember and how and how you come up and like you two to work together is that okay and you two to work together now Can you let's see I'm going to give everybody and I've got I've got tons of these things under here maybe Robert and Michelle for you all and if that's not enough please ask for

more right here

and okay and so the the task here is just as Michelle just said is that if this is a tower can everybody imagine one that's also for tall and you can select from two colors here that would look different from this what comes to your

mind can you build another

one too bad there you go okay they were just coloring this it won't look different it just be different colors well that would look different don't you think okay help me with what you're thinking you think let you put

this oh okay yeah um and so you would but all of us would agree that that that these two would be the same okay and so your job with your partner is to come up with all possible different Towers okay that are four tall and the other part of it is and I'm sure Michelle and Robert can remember that this is a part of what we're saying is that not only to find all possible combinations or all possible Towers but to come up with your partner with a way to convince yourself and to convince the rest of us that you have all of them and you don't have any duplicates can you work on that for just a minute

put three I don't know what I'm we already have that one

okay yeah but it's different in different Oh I thought you meant like never mind I thought you me

that one switch that

one the

middle messed up my system it's all

chaos no I did that

where's the one that one right here oh okay we have one else is that it

we got to do

like hold are we

missing I can actually this a little you know what else can we do I the order it I

lied that it have the yellow yellow two on if you have one

blue here you have three here you have two

um what thank you Magda you were organizing there is one blue these there's two three and four four in that yellow one four and four yell okay help me to understand I that too didn't we have this traveling down then just one blue in the first group one blue in the first group and three yellows and two and two one yellow three blues and then four how did you decide that you had all of them in the one

blue for the yellow it down I don't know the yeah the Blue's in a different position each time yeah position there's only four spots yeah and did you use that same for the three one or how can you be sure that you have all better exactly are we do any

duplicates I don't know how to explain it there's just like no other possibilities for it the yellow so four places you have them like you know yellow on top blue on top yellow and bottom and then there's something blue on top and bottom there's one at the bottom and I guess I'm with these two I'm having a hard time being sure about the two and

two I can't do yellow bottom because I already have that

little okay can we separate

these so you found two more what if we did did you did the yellow ones like this right all right so where's the one at the middle right there no no

no

bottom the top yeah you do start

this one

go we have the same thing no it's down it's down hey how did you figure out that you had them all

for think so I know we I don't know start out with two here down and like this do we all have the same thing yeah this one move that down and then we move the top one down to the second so we got this and move the bottom one down so we got that and we them all down one more position that was the only okay I I have to understand what you said say that again all right we started with like one on the top and you mean like blue yeah like one blue on the top set okay and we took the other one just moved it to each position like down you see that move to here two I see and move top one down to

two and we put this one below and so where is the I see does that make sense to you Michelle and we move the second one down to three and that was what which one is that oh this one like had it two and then this was down move the down one the fourth yeah and then since it couldn't go down anymore for that one like there's no more Foundation in a second it down to three that's this one yeah and move what down to three that's this well this top one which one to here and again to here so this one's like always staying in the same place so there's no more combinations okay and then when there's no more it moves down so I see so it's six is that right are the six over there yeah better are two and two yeah I see I think that's long there's like 16 all together if let me ask you to think about this one I'm talking to the others if they were if they were three tall how many do you think they're big how many do you have all together

6 like six around eight I know maybe nine maybe that's good sort of good ideas what do you think why why six eight or

nine what about if they were five what do you think there would there be more or would there be fewer well I guess you could just look at the ones that we have right that like two like you take out this one oh what are you talking about for three or what what are you saying yeah we just like take out like the ones that have Blues of about four so like take these no I'm saying it just take like one

um but you're not true what do you think Michelle um I have no idea would there be let I think there's eight if there were three how many did you off yeah I how did you we just kind of did things like we had these first and then we did like we took one from the bottom we just kind of change the

colors yeah get that yeah yeah yeah and so that was for exactly one blue and did the opposite of it yellow yeah and you felt there couldn't be anymore with just one in it did we had like two here oh but those are two and two oh yeah but with just one yellow anymore why not because it Doesn't no more yeah and I'm okay with these how did you decide about the two and two this is the opposite color so we just put them together how come are you sure there only six

about put this yellow

and so you and so you think there's 16 11 how many do you think there would were just three if if you made Towers only three tall instead of four tall do you think there'd be more or do you think there'd be fewer that work there' be four why

how many do you think for sure there's no more for three I'm sure no because I mean I got eight too for five know you can be wrong

five 2 interested how you get that you I don't know just got

next cube is three * three yeah gave you nine and what would that mean for five might okay uh I think what I'd like you to do is to to build the the three tall and see what you think about that if you think there you can find those nine um Magda and Angela what did you all think you you sort of how did you decide about the two and twos

look at this because I think everybody

used three

and what you do with those two try write so I can understand what you have fancy little method like Robert yeah take that I mean there's just like no other way to put it does that mean anything okay you know you have to have two yellows and two just figure out different just like switch the colors you

yeah you had sort of the Opposites of each other that me is that what you mean by this this one this one this one it does they're pretty much all opposite of each other then you could do it like you know like that yeah you

could yeah but you didn't use that quite as much except for those because you know the three and one it was just like a lot easier to see it you should tell her that that pattern going down now what do you think about it were three go how

many oh you figured it out did you do talking just trying to figure out if you can figure out a way doing all that like actually building it so I'm trying to figure out all the combinations for five that what you're working on

yeah other people bring the yellow down oh you did that a different order you had six that had exactly two and two yell when when you had the yeah they're right here yeah are these the three guys that way okay um how many if they were five tall right the

same you building over here i like you to think right now is how many of

those we have exactly two yes maybe I don't

know we're still looking at that still looking how did you or this I we did the same thing last time we did like pairs but then we just reorganized it like went down oh he started with this one yeah we do like opposites again oh this one and that one and then we just kind of rearranged it because like like um before we had like this with this and we just kind of made him look like so it looks oh they're opposites of each other and then you went back to the design that you had before where you had the one going down yeah why do you think there aren't right yeah don't know um could there be

no I don't think they like you can't have an odd number because you have to have like an opposite oh so it needs to be even yeah that's what I do and good reason and so you on your paper figured out the eight is that right and so you agree with them how many do you think there'd be that were explain I think 24 you think 24 it can be odd number and since this one's eight 24 I don't know I'm going to try it I understand what what were you thinking where did you where did the eight where did the eight and the

24 this one's eight because we tried it and we can't get nine because yeah we're saying that you couldn't have an odd number so maybe

five we're doing maybe five what be 24 yeah because 5 we just but you really you think this 32 things okay we need to we need to figure it out all before here let me give you some more so you can keep the

your here thank you okay you all are doing it by

drawing because there two really different ideas here that some of you going to 32 and some of you going for

20 no no I

start are you working on my my question how many two yeah we just guessed but trying what you what what was your guess I guess 10 she said eight I think I said nine nine I think they're wrong think she's wrong you think you're wrong yeah you think you're both wrong why you think they might

more do

yellow doesn't look

so

double

double look at Robert go

down as fast as I

can now I'm

doing you have all blue and all yellow you don't have all yellow I'm too confused getting doubles and it's just not working

is that all now we have to do three no we have that

more oh you don't have that I have to let me do the opposite of this like talking to myself here I'll continue this because look how you carried one down I did this so do the opposite of this because look how you carried one yellow down I didn't I did I took one from the back do the

opposite yeah no then do this instead

of yellow

blue do you have this one do you have this one no you

don't what you writing

like you have I don't know I like sectioned yeah do you see it

Yow and then all blue yeah but I have no you don't yeah no no no

wait I'm doing do all these yellow in this

blue you think got

its

now

forever I no you don't yes you do you are still $3 * 2$ is

that's why don't we just six and see if that works all right I mean we don't have to

you could just like add to the

add now have

28 okay me too

maybe two yellows a blue oh yeah 22 I don't know I might have double I got a little confused in draw two blue down like the opposite mhm and then when I shut that down it's the same thing as that well then I did all yellow this this yellow do you have all blue one yeah I know I don't have three in a row on the top of the blue you do right here yes I do we have you have three in a row then yellow yellow do you no that's what I

do

this what if we

do when I shift it down hold on but when I shift it down hold on this is what I'm thinking shift the whole three things
yellow more do I have that one

though I

how you guys doing I need yellow I

blue so we're shifting shifted those down what about groups of two did you do groups of two yeah of two did one on the
bottom but what about like mixed up ones like this two four six 10

148 you got 28 that's what I got didn't

you do like blue yellow blue blue yellow blue yellow blue blue yellow hold blue yellow blue

blue blue yellow blue blue blue blue too confusing yeah I should have that do you I see it not no okay because I didn't did
I

that no because you got to have a blue on top so yellow blue yellow

yellow

other do we have that okay and and so in terms of building it up no we don't have I don't think so no we have what did
you find for I

remember oh because we have to yeah but okay so what do you mean and could you drop it just so I can remember

what was it

before four there six right I think we did them off it's four so you'd have two yellow you have two blue you have two yellow we're missing something 14 16 18 28 why don't we have 28

all do we have like two

and two that yeah we have

that off here you want to take two off no right okay no shouldn't we do four

I think we can have them all I don't know we have no logic I'll come have that then I started with two blues that what two Blues together that's what I did well that's two blues together if we do it this way hold on do we have any oops see I'm not that dumb

yes we have another two Blues do we have this one yellow yellow yellow blue blue you I two Blues yeah that's what I you know it doesn't matter when I say it

though okay about three now right now would you count we have threes in a around that like having but that's like this for the yellow set count twice the three three in a row okay that's why we can't oh oh well they're the same thing they're just backwards right I found something okay give me this two and three are pretty much the same thing right yeah so what did you decide okay this is our mixed up ones in terms exactly two whichever you're focusing

so this isn't the opposite of this is

it to three we have

six would like to know if you have

had everything just broken okay okay those are twos in a row these are the threes in a row we have three on top yeah but don't we have that

already okay oh my gosh so okay because we started like if we start three on top here and this one okay then we need to ship that down so this is that wait go on now see three on top from what like taking

yeah on top and we need to shift that three down and put the yellow

that underneath over you know what I'm saying and then just again three down have that one you add it a minute you took it away it's not the same do you see what I'm seeing

here we go where's the one that we made before it goes in between these two well okay here we go now I can explain okay because here we have two in a row here we have three in a row find it yeah go on I think we need that

one it's not doubles because I didn't one because I took it from here well if you put if you put blue blue yellow yellow yellow it's already my question what if you're focusing on one color do we have blue blue yellow yellow blue blue right there it's a double if we shift this down okay have just two yellows so you could have done it on like if we did it with this and we did that you know shifted the whole thing down we have that six of each yeah that's what I'm saying so that's what I'm saying we have the I'm checking if we have all now we start with three things three on

top then you ship those so yellow wait so that's like a continue in the pattern there okay that goes there for Towers here because there's only four like have two of

reaching over here so for fun if you're yeah but you know what I'm saying you shut

down are mess up mess

up actually this is it's like the yellow ones it's like and we have do we have when there's three because well when there was two there was one right of each and there was three of each and there was six of each and there's 10 15 it's like plus two plus three start plus four whatever plus five so if keep going plus shift them down did one shift

three is just the

opposite be the opposite one and these are the mixed up do we have the two fives do we have all if there's two no so because I had the two ones over there and you took them

apart was carried down like yeah Didn't I put them over there

probably I didn't know they were like important plus plus 2 22 30 there

32 and what about the other many 10 12 14 16 188

mess has to

be are we shifting anything here yeah we're bringing this one

Up's know we don't have

to know what I'm saying

are yeah

right two separate

like so what did you 30 but Magda just convinced there 30 oh really why said it's 32 I think okay we have 32 I don't know how but we're missing

one why don't you all talk to each other and figure

out this one um 32 and that's what we got to do that one's right there where that one's right here yeah you can't have them both so now you're back to 30 this work the

first these

double these two are just

like two

Blues two Blues in each this in each and they're just like you know the opposite so this is you know two yellows and this is three yeah here's some more com these are what we call mixed up ones because there's no organization these are like two together here everything like moves down oh I see and so over here how come you can't have two of them that's the same as that and this one's the same as that one too you got to get rid of

them but any okay so what you did that's interesting and then you took one off the bottom and put it on the top that's cute okay and you did the same thing here yeah yeah we just did opposite okay and so that was really sort of taking them down and then and then when you put this one back up it start over wouldn't it okay now let's look at these want do seven but I don't think we kind of don't know what we just messed them up okay here's these and those have exactly whatever I don't understand no organization to yeah some of them have two blues and some of them have three is that right they're just kind of

chaotic okay yeah I understand the opposite thing hold these are opposite yeah they these are no they're not no they're not here we

go well if we did it like with like two Blues two blues there you go there's no like organization to them really that

is what were you thinking you removing those one that one right here you had those and then you had those how come they quit you

have going down you had Blues going down over the real combination all right total yellow yellow combination two yeah your notion of imagine you did a you took the bottom one adding this to this you want to do total combination I would rather little

more are there any

this is one I'm telling you there's

know hold on have this and there's the opposite be one that was one no no no you're right it's just that I was trying to keep a parallel here and this one seemed to be something else oh this is you're moving that okay but it can't

be okay if you took this bottom one off and put it on top with don't take just this would happen do we have that I guess I couldn't read my handwriting yeah make a new one instead of killing your last one because

you do we have

that six and then eight yeah eight we have this and then four was six six and another six and 16 because remember I'm really curious is it make something or is something

differently

no it's like this one backwards but can do

that it's different no because to go over there is that what you're telling me like this is this upside down

15 there another one I don't think we have

that thing works how about find that one do we have that

one two to the eight for height

you want think yeah is this one but so this go this group that off so we have

32 okay so now we're going this if we move that one On Top we move that one on top the two

you want to do your head that's

no going to be 128 I don't make 12 things so long so you double so we

have no because I thought like because when you have the thing like two height you can make um eight of them then you have three you have make doubles then we have five you make 30 like for five you make 32 so probably like six will make 64 why does that I don't know we could test this one though was like a little test this but you sure you have them all are you sure you have all of this thing well yeah because if you move this one up like that you got

okay and you did it used the same idea for that didn't you could you have used the same idea for

those moving

up it do we have this basically did same

okay and so what you're telling me is that when you get to the end of the group that you know you're done for each group is that right yeah yeah how do you know there are not any more groups wait where's

okay I don't know well could you do like the instead of these or is

that upside down and then you have those and then you have these let do the

498 I think we did so can you do that and they are the we don't have those though one know that's not that is oh I see yeah but but is it are they these you mean like yeah that's what I was looking at because turned this put that over

there I was just trying to see if maybe we should write like

this so they go up that help it helped me a little bit okay how many do you have two h all right now that was and

then

that do what we didn't really do that did you get 64 that's my yeah they got 64 understandable to you I don't know why but does someone who never saw this problem before did see that's have keep in mind you don't have to write let's see

equal

ones okay these have the two yellows together and the two blues together put it only works for two high

ones and these have the two Blues separate stealing my paper two separate by one yeah this one does to doesn't it two separate by one yeah I agree they're different it couldn't keep going up it could but no the but no I mean this this little group here we have the two blues I think we have that don't we I don't know wait you know what I'm saying do you understand what yeah I blue and yellow separated this is the opposite of this one no you can only have two look look look it'll be that and then two yellows on the bottom you have some more more know what I'm saying yeah for your own

good this thing goes

up opposite of these and hope we don't

have this one wait this one was killing me because I think we have them already yeah that one is the opposite of this one what are where are the other two um two BL yellow okay and all I have to do was blue no that's on it you have to be able you still have your rotation thing they

over they still stay up

did 21 work out oh we didn't try it we didn't try it you think it

yeah we figured out like how and we also saw something I just saw us right now I don't know if it's right like two $1 * 2$ is 2 and then two $* \text{a half}$ is one $3 * 1$ is three four $* \text{one}$ is like help me with that you all right like I guess you start like and two $* \text{like}$ keep going up by half and then $2 * \text{half}$ is one and $3 * 1$ is three what where does this half thing come from I don't know I'm just looking no no I'm just asking I'm just trying to understand what you're saying you're taking this this number yeah and you multiply it by that number no no no just like we start with zero then. five and then one 1.5 like 1 time like this doesn't even count like let's say we didn't know what this number was take one time and you get zero take two $* .5$ and you get one and $3 * 1$ another five you get $4 * 1.5$ is 6 you know what I'm saying and then $5 * 2$ is 10 what's this $6 * 2.5$ is 15 $7 * 3$ is 21 okay you're taking a half of the one before it I guess where did where does this half thing two time a half is one we just no no no like one time zero we start with zero and then $1 * 0$ is like zero and that's how many two blue are okay and for some reason I don't know I just looked at 5 so $2 * .5$ is 1 that's how many two blue there are yeah that's where this number came from yeah $2 * .5$ was one and we need I need I need I need for you to all right okay so so you said start with zero and 5 is z no zero do like one what's five do like one time yeah that's how two please and you go by one time zero okay okay put equals and do two oh I understand three by one and the one came from half of this or you're just adding five

to

yeah know we did just moved took this one off guess that's what we did but I don't know what you

doing very very interesting and then why does that work no idea I was just because we um we came up with like the number thing like oh like if you add one and you add two and you add three then thought like what if you want one 200 High we're not going to go adding like one two so we tried to figure an easy way out and so then how you going to get that you multiply $6 * 2 * 7 * 3$ I guess you divide by two and minus by 5 because like one two is .55 that's zero and then two

two two half of two is 1-5 you get that's really interesting what's eight going

um yeah 2 I guessing because like half of eight is four 5 you get 3.5 that's what you're going to multiply five you take

do it the next one so I can remember time is 28 okay now you were saying that there was some sort of adding pattern that you saw plus one plus 2 I wrote it

here see that's keep working $4 * 4 * 4 = 64$ does it I guess we did like enough examples and so nine would let's do one why you do that where where do you get this two from I guessing your start I guess we have um the back yeah what you you want me to write it yeah why don't you try and write it first all right I'll put that on you don't have to equals what number are we finding the two number of two colors like I guess I don't know how to write that mhm be exactly two colors yeah and H is how high the cube is so H equals of

tower uh and that's that's really make sure you yeah we're okay what did you okay well I don't

like put that in parentheses

to yeah close three different colors it might be like three I don't know

I how many would there be a how would you right there yeah understand what

yeah I there you go so what would you for right

I what have you been doing our

visit the table I can't you ready can you tell me what you were doing what you

we randomly did this the first one we did like where the yellow went up but um just but into the what do you mean by like um you see how this is yeah the positive negative like instead of two yellows on the bottom would be two blues and three on top did over here and we just and so this is so you have to sort of go back and and this one she kind of point out there's a sequence like it was blue yellow blue and then we brought that sequence down like a little bit it works tell me more about that we didn't we we didn't have it set up like this so if you know the number of colors we had I don't know what we were doing before we had like this one not in here and she kind of point out that there's somebody two blues and yellow that broke them up and then that was the same thing here and here and so it just kind of went in order don't

know we didn't notice that either so did four they said why do you have this group together because it's just the opposite that and then

this so this is Robert and Michelle were sort of saying that this is this this is if you add it another color you see the

color but I mean not for your

exactly what are you sure

of um idea not much right

now no we know we have this down because you could see that that tell me about this tell me what you're sure of here well that we travel yellow up by one we do same the color like one here one here had the color you're saying for these right yeah since we all we need one whole blue a whole yellow okay so you're yeah that's definite I what's definite well it's just that there's no well the only opposite of that is the yellow so how are these different than because in this one we took a blue one out and we put it for yellow oh so here you have a yellow one here we started so so how would you describe

this okay I just saw the pattern I don't know explain like we just kind of took the and kind of moved his position like among the five

you well in this one only one yellow travels okay and with this one two okay so I'll call this the one yellow okay now my question to you is this how do you know you have all of the one yellow because um because there's only like five possible locations like along the tower and so we did all five for that yellow and then it kind of goes down you can't go any do you agree with that I know it's more I just don't you think there are more that have one yellow according to your much okay let's let's let's she's not persuaded how would you persuade her are you persuaded well yeah because look like we're only working with one yellow that's different and each case that like all right this is like one this is two this is three this is four this row five and each one we just shifted it down so yellow can't be in like why do it just does just I'm curious why you put that here the other one I'm just trying to see the pattern when it's going down probably just put like the opposite color I me in fact before you had the old blue one there didn't yeah we had it like here or I don't think it makes much difference this is the same thing over here well how would you describe this group original describe that as one positive negative like you know from this one you're building up you get and uh do yellow should be here okay so if I think about this group and this group are are you convinced that there are no more one blues yeah are you absolutely positively sure of that no well yeah yeah because you can't put anywhere else you only have like five places can you make me another one those with one blue no why because it went into all possible locations for each Tower do you buy that you build this you can get yes because otherwise and you have like two blues you wouldn't have this one blue okay so you're absolutely convinced there so if I say I I could imagine one more with one blue just make a tower here and put one blue on the top

another one with one

does this work yeah isn't that the same no that's six though you wanted five right oh see this one's not a no because our limit was five columns five rows oh so you can't have this one okay you agree see this one doesn't go wrong can't you just go down one more why not because there's no location for that do do you agree with that

or you're not sure about that yes you do towers can there be one blue for

the I don't know I think that's right I don't know she you're not you think that her reasoning that there can only be this many one blue okay any more like this are you sure of that can someone try to persuade you there's another one that has five yellows I'll right it other than this but so but what are you going to tell me I'm going to tell you a limit of five you going tell me that okay so that's sort of contradicts the fact that you were told five high okay so you agree that this no one can persuade you you're absolutely convinced of this you don't think it you know it's not that your friend persuaded you right Ashley you believe that there's no so there are certain things here you're absolutely convinced of right okay and that be you sure okay now what else are you sure of I want you to think about what else you sure of and and what are your reasons for being sure okay we change where this because this is one this is going to two yellows two yellow okay so talking about two Blues extra of that's two Blues in each case we always do opposite like positive or negative so we're you think of both at the same time yeah these are two blues and these are two you're convinced there are no more that have two Blues with a limit of five what about this one more together okay so so you're absolutely convinced that can't you just put two here how do you know what what would be your argument that there are no more two that are together than these four and you really believed that this would happen yes did you hear what they were saying no um

can you show that to these and see if they or not they think it should double as well and it should be but if you do it again it just repeat same okay so stand up all day okay so but you're saying these are not all the two blues now can you I'm going to leave you be for a minute I want you to be able to convince me or not convince me that these are all the other two blues and you haven't missed any just like you've convinced me here you to come up with an argument two Blues okay okay and we'll leave you alone

okay here's the thing in this one here's our problem in this one we did two Blues together this one we broke up by one yellow we could say if you wanted two Blues we could do blue two yellow you kind of add that one yellow on top of you see just here let me but it for you because look in this one we took two blues together this one we broke it up by one yellow what if we broke it up by two yellows I guess just take this you know I don't already did

that where over here

that's very lovely she said it branch no no we don't that's not there oh don't so okay do we have it somewhere else yes we do okay here would that work if you had three different colors as well opposite where is Angela what do you right here how would it look if you had three colors okay well like these little

it'll be a lot bigger would it would it prove your theory or so we do would you like to see our

Theory together like that because you would you guys each put your name on your they're separated together I think we need to begin how many did you up with 32 and you feel pretty confident I have no idea I you done great yeah it's interesting that you sort of have revised your theory yeah this is what you're great these ones which ones are you the least comfortable with well it's Magda Angela are you comfortable with all of them because when I let you a while ago like they're not always you were working with these the twos apart by one and H is the height yeah but now we have to figure something out or like maybe we separate it by two yellow oh and that's this one yeah but we found like we had a for that so we have to put that in different oh separated by two yeah and then what would be the next one would it be that one I okay okay and then we one where there's but they can't go any further can separated by two you have okay don't know yeah you can't is that right Yeah

that's that's the other that's the opposite of it is it right where's the other one that's the opposite of it one no yeah okay yeah that's that's two blue separated no two yellows separate yeah yellow

separate explain the problem okay what else could you separate

what we could do two Blues separate by three yellows but we have that somewhere else too yeah there that's this they don't need that don't

about this is for when you have two of one and three of the other is that what you're telling me yeah and you first had them separated by one and then you have them

separated two two like and this was three

why and how many do you have the same the same number we just put them in different order yeah but how many do you have all together oh 32 right why were you like absent like every day last and can you have them separated by

four no because um I it was five finished what then you'd have a blue on the top and a blue on the bottom oh so here's the separated B and you can only have one of them is that this yeah and this is the separated by two of them and you have two of them oops okay that's hard with your paper every time we it okay and separated by one and you had three of them right is that

right I don't like talking I like talking okay separated by one separated one so it was three two do you prefer so it's three of those two of these and one of these so you want to call you Robert okay I call you Robert sorry

just interesting also came up with the same number you had to revise your 25 thing yeah what do you think it would be if there were oh my

God see you have to hang out at for like two hours three was

eight

was so six eight times Maybe because it's a

double maybe possibly what what would maybe uh if they were just too tall can you think of what they would that's easier to prove can you think what they would be just like soap op blown up in cars these those two two of those

well that's what I meant I mean like what else yellow blue blue yellow so that's right what if they were just one tall normal people one tall too what would they look like yellow blue okay we need to sort of up and I want everybody to talk but I want to come actually figure something out there

Dr. Maher you remember Dr. Carolyn do you remember all these people uh you remember you know Robert and you remember absolutely and you remember Angela absolutely and Magda absolutely they were saying that they remembered making sense out of dice and as out of the sixth grade when they came the beginning and then you I saw you talking to Ashley and Sherly but uh because we do have to sort of close up and people were doing such different things I would love it if you all would explain yeah I'm I'm still interested what Ashley and Sherly did with the two with the two of a color did you come up with an argument yeah are you convinced you have all of the yeah two that aren't together why did you tell them the question I was asking you what was it do you remember what I was asking you what for um are you do you all hear what what Ashley's saying here the blue Robert are you

sorry go

ahead oh my God I don't you ask the question about the blue like um if we think these all these right here just make two we calling just make two out of these four right here if we can make oh we can make any more combinations other than these four right here with two Blues look you know how in this one we have the two Blues together well on this one the two Blues are separated by yellow and then this one we had two Blues separated by two yellows and then this one we had two Blues separated by three yellows oh okay that's interesting so here we have two Blues separated by no there's just together oh no yellows yeah okay and these two Blues are separated by one yellow okay how do you know you have all of the two Blues separated by one yellow can you convince me of that

because Angela really was wondering about that weren't you Angela what were you wondering Angela because you just shift them down you see what I'm saying no okay this is what we did it's like us taking this and putting it right top putting it on top and you get the same thing then you take the one on the bottom again and you put that on top and you take the one on the bottom put that on top system we don't have any system well we can do like they put it's basically the same idea with that like if you

took well if you took the one on bottom and put it on top and you'd have that one then I don't want to mess up our little thing took this one put it on top you have that one and so on and like if you took this one and you put it on top then you have the first one so you know that there's no more in that group how many groups did you have one two three four five six did I count something else twice six six so you have six groups yeah plus like this little thing here okay I want to hear about that but did you follow what they were saying Ashley and yeah that's but you weren't thinking about it that way were you yeah I think tell them how you were thinking about it because it's a little different we saw the little sequence going down you know like how there was that and then I don't know yeah you could just kind of like look at it and you this one right here on the top is two Blues then in the middle is two this two Blues separated by a yellow then in the middle is two blue separated by yellow then the bottom is two blue separated by yellow just keeps going like that then these are right here are just the opposite of these it's two yellows separated by a blue then there two yellows in the middle separated by a blue then there two yellows again right here separate by Blue it's just the opposite on both sides and then what did you do and I don't know what do no then we had like two two blue separate by two yellows okay and that's all there are I don't know yeah why because you can't do anything else you could see it though like you could kind of see it like you can't have a you can't have two blue separated by what was it we tried to make anything else we kept

getting the same thing so we just sort of like what Angela was saying and then you told me you couldn't have them separated by four no because there be six then

oh and you all came up with 32 you had predicted 24 so you had to rise your your plan okay but are you really convinced you have them all and you've accounted for all I'm not I don't know what we're missing but I'm not okay um um is there anybody who's convinced that they have them all of any of the towers any particular height we think we don't but you think you're convinced yeah Michelle let's hear about it okay okay let's they think they're convinced so let's listen to that and then show them what she showed us yeah okay well we had the for the total possible combinations um we had X which would be the number of colors raised to the H which would be the height and like it works for like if you have like two high it's like two to the second and you get four you understand you want to explain it okay and if you have like three then it would be um 2 to the 3 which would be eight and then so on like if you have four it would be um 2 to 4th which is uh 16

shut up oh my God okay and then what was this for this was for combinations yeah okay so and this is another way of doing it you want to help here oh my this looks different which one does this

go give me a second so with your rule what would you predict if you were making them tent to um if it was 10 tall then it would be like two to the second like if we two the 10th if it were like two colors think

I so how do why do you think that works I don't know do you know why it works uh no just figured it out you don't know why it works what did you do there can you explain what you did there you were explaining it to Angela and Magda oh um I guess I'll say we had one like everyone knows or it's kind of see like these are the only two combinations if you have one high and two separate colors and we built on that by putting a blue on top and a yellow on top of each one so you know like you have each combination for that and then we just elaborate by keep going out by we put a blue on top of this and a yellow on top of this blue yellow blue yellow blue yellow so do you want to see what he's talking about and we just she helped us with this because she got start and then we figured it out um and then I guess it could work for like any color because if you had like four colors you just like say you had red blue green and yellow you just put a red blue green yellow and you put one of each on top of um like you put a right on top of a yellow green on top of yellow blue on top of yellow yellow on top of yellow and you have like the things will just be bigger the branches but you'll still have all the combinations okay what are you showing me there oh that looks very different than what I'm seeing here so I'm confused does that have anything to do with this well it does it's like it's just another way of starting like the proof that we have them all I guess just the way because you just start out with this and you keep adding on to it and I guess when we get up to five like you keep adding on we can get up to five and it'll be um 32 now then we have like proof that that's some show me how you'd go to the next level from where you are now I all right whatever I'll see there's one here with three on the bottom so you take three take two three on the bottoms and you had um a yellow on top of one this one minute oh we're starting over here you add a yellow on top of one part and blue over here and you take two bases that look exactly like this two blue on the bottom and one yellow on top

and then you got a blue and a yellow do it and just keep doing that for all them like then this one you'll take a blue on the bottom and two yellow on top and add a blue on top and a yellow on top and then take this one and make two exactly

like and add a blue and a yellow and just do that for all of them and then I guess when you go next thing you take four blue on the bottom and you add a yellow and blue on top and then you have all all that for that just keep going till you get till you want to stop I guess you sure you've got all of them by doing that yeah because if like you're sure you got all this mhm and there's only like two ways you can change this and that's by putting one on top of each and there's only two ways you can change this by putting a yellow and a blue on top couldn't I put one on the bottom uh but now it would be the same thing as something over here so this just like just always always add on to the top and you keep going and then like this is all the possible for two and if you just add one on top of each of them like different color I guess you'd have all for three and do that for three so you got all for four Etc so what do you think about that rest of it here does that make any sense can you explain it again it makes sense you want explain I understand you just add one like every like everything you just add one every time you add one you're just making the same patterns but just adding one I don't I don't know how to explain it that's what I think he's saying you just keep adding one for every stack like four you have these are four so you'll start off from four then you'll have these four again and you just add a blue and then add a yellow just keep doing that for all that's what I think I think you do get all of them now

okay do you have anything you want to ask each other about what you did I would really like if Robert and Michelle it just sort of showed that other thing you worked on at the beginning because that's still a mystery to me as to why it works were you figure out how there's two blue and two yellow thing yeah it was it was the question you were exploring at first which is that um that I asked asked you you had built four high I think and I asked you how many that would be five high with exactly two blue yeah and then we figured that out and then and you said there would be uh 10 and you said there would be 10 do you agree five high with exactly two blue do you all agree there' be 10 and you all have them in front of you could prove let ask them five high two blue mhm with exactly two blue you guys have it there's five of them are there any

more yeah okay but it's a different question you have 10 how do you know you have oh we should have we did the same idea like you know if you took the one off the bottom put it on top

thing right is that it know not exactly in I mixed them up before yeah full backwards okay if you took that one off the bottom put it on top you have this take this off the bottom put it on top you have this take this off the this off the bottom put it on top the bottom and the bot so this off the bottom put it on top you'd have this so I mean you'd have doubles then you know when we went through the whole little cycle thing so you're convinced by that same reasoning you used to generate them is that true for you also what about you you're convinced that you have all of them 10 yeah have 10 but your argument was a little different than theirs

right you weren't taking it off and moving yeah we were just kind of like we saw the sequence like we where was it like in this one we could kind of just see it we didn't like you could see that was going down a little bit like know we just kind of visualize we talked about that but yours is now different Robert your argument is different and and Michelle than theirs wow what's here do you want to hear it you all want to hear his their argument okay go ahead Alice says she's confused all right first we start out by doing this and we did it up to five and we figured out how many two blue two yellow and made a nice little chart right here the

camera okay thank all right um and the chart like just tells can put how high the tower is and how many how many um two Blues two yellows and how many total are and then how many total combinations and for one it was like one height and there was zero two blue zero two yellow so there's zero two blue two yellow totals there was two total combinations did all the way up to five and then we looked at the numbers and we figured out if you take the height and divide it by two and minus that by .5 like take two two is 1 minus 5 be half and you multiply and then you get the number of color Towers so I guess yeah so like if you had um four you would divide by two which is two -.5 is 1.5 and then you multiply the height times that number and you get how many two blue Towers door B I think that's it okay does that work for yeah we did it for everyone and worked for all then we did um six and we guessed ahead of time what we thought it would be like based on our two things that we thought of formulas or whatever they and what we did came out exactly to what we thought of which was what um 152 Blues 152 yellows 32 total and then 64 combinations now do you have any idea why that interesting formula works oh yeah we didn't get a chance to look at yeah they were going to work a bit more because you're going to think about that maybe you can share that you could all think about that you had an addition thing that worked too how did yeah that like okay no you can explain it all right well first thing you do is we looked at numbers and we noticed that if you take the um total like two blue wait a minute and you added one to the first number it be one and then if you added two it be three and if you added three it be six like we just took out the difference and it was like Plus 1 plus 2+ 3+ 4 + 5 and I guess it would keep going but then but then we came with the second one because we thought like what if someone want to find like a tower that was 100 high you to find out how many two yellow were in it we didn't want to go like one plus one plus two so then we looked at all the numbers and we figured out that thing according to your formula what oh um 50 I don't know whatever I guess 400 95 I don't know whatever $49.5 * 100$ is 49.5 time 100 so 4,900 I I fascinated where the five comes in I mean there's no such thing as a five high tower oh I guess how how did you get into that uh I really don't know we were just looking at numbers you look at numbers it seem to work so just stuck with it mm we're looking at differences and um notice like when you take one we start with zero and one time is zero and that's how me two there but then we looked at two and we first we were going up by one and $2 * 1$ is two but there's only one blue so we tried to see what gets there and it's half mhm we went to three and we kept going up by half and $3 * 1$ is three that's how many are and $4 * 1.5$ is 6 and then $5 * 2$ is 10 then keep going on and guess just by trial and error found that out okay see great hey you that's something to think you you were all great to come today on your day off um you g to come back you all going to come back some of you are coming Monday uh if you haven't signed up and you still want to come we'd like to talk to you individually you can still sign up even to the later shift I know some of you are working but um we're bringing our class here Monday night we have a class that meets and some of the folks here are in the class others aren't right new and so if you would like give us a chance to chat with you and if you haven't signed up to the list when was here in your class you can still do that or if not we'll do it another time okay what I would really really like you to do

us would you mind writing up what you did today would you mind writing up it's written already okay well we're going to we're going to collect that and want you to put it aside and try to re rethink it rethink what went on what made sense to you know you worked with your partner right you could talk to each other if you want to but would you mind writing up your own and bringing it Monday and even if you're not staying after school we'll catch you sometime or leave it I know it's sort of you know it really helps helps us a lot if we have it and it'll help you later as we move to be able to look at some of this we think so if you can take the time while it's sort of fresh in your mind and write up your ideas and have a chance to rethink them if you want to borrow some of these to think about you're welcome to okay not here yeah if you really would like to take some and if you want to think about it some more over the weekend or explain it to someone you know someone might ask you what were you doing and that'll teach them to ask you right you might be able to show them what you were doing you're welcome to do that and we can maybe them as long as you promise to bring the cues back on Monday or I'll be in big trouble okay so you can decide that do you have anything you want to ask us anything you want to ask our visitors did you meet our visitors um we have two professors here from out of the country

and uh do you want to ask any question do you want to ask Professor any question she she studies proof in in students um that's sort of her special specialty of proof and uh she has no questions to ask do you have any questions to ask her this is your great chance they go home this weekend she teaches at the University of Toronto in Canada and at the University of British Columbia which is on the other side of does she sound like she's from Canada do you want to know where she's really from anybody want to guess talk some more Susan let me say thank you very much for letting me be here and England where where do you think she's

from she's from Oxford I you know of University yes at the University before you all go Linda whispered to me that we really do need your papers and if you can remember looking at and on the back of them put the number of the order in which you wrote them does that make sense this is you worked on this one did you work on that make sure your names are on it either both your names or one of your names

whatever put and then any order that you especially you all because um because this is something I need to think about I need to look

yeah name on it and it was just your scrap work we need

it it's on there that was where you came up with no yeah because she doesn't like my hand so I wrote it down there first

that's like thank you all so much for

working put these back you want oh yeah it would be a

okay unless you want hey um unless you want to take them with you for the weekend if you're going to use them through your writing up you don't need to take them apart if you would

help I get the yellows you get the blues too small

biology it's only because you've been absent like a million times biology you're in biology take sure

great bags anybody wants to take home