$$(a+b)^2 = 1a^2 + 2ab + 1b^2$$

$$(a+b)^3 = a^3 + 3a^2b + 3ab^2 + b^3$$

$$(a+b)^4 = a^4 + 4a^3b + 4ab^3 + \underline{6a^2b^2} +$$

Green - A

Blue - B

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from 3 green to 4 green we found
4 & divided by 4.
from 2 green to 3 green we found
12 & divided by 3.

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$$(a+b)^4 = a^4 + 4a^3b + 6a^2b^2 + 4ab^3 + b^4$$

$$C^4_2 = 6$$

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$C^4_1 \quad \binom{4}{1} = 4$

$C^4_2 = 6 \quad C^4_3 = 4$

$C^4_4 = 1 \quad C^4_0 = 1$

$C^4_r =$

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Combinations

In this project we started like the towers project only we were building trains. The trains were 4 cubes long. I had two different colors to choose from, red & yellow.
I was shown that if I was selecting 1 red from 4 cubes I could write it in 2 ways, C^4_1 or $\binom{4}{1}$. We found that there was four ways to do this

R			

	R		

		R	

			R

$$C^4_1 = 4$$

If I chose 2 red (C^4_2) I had 6 combinations

$$C^4_2 = 6$$

three was $C^4_3 = 4$, this is the opposite of 1 red. Because if there is 1 red there are 3 yellows

R	Y	Y	Y

So both C^4_1 & C^4_3 have the same number of combinations.

If you take 4 out of 4

$$C^4_4 = 1$$

None out of 4

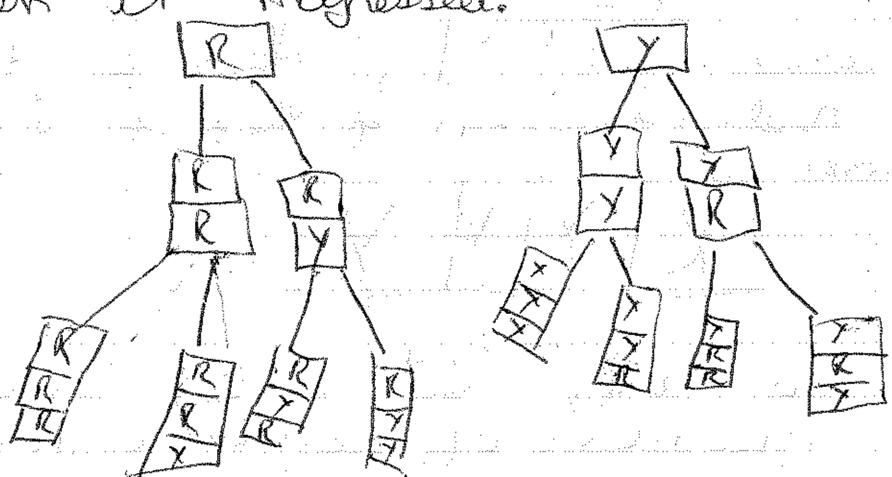
$$C^4_0 = 1$$

Next we added a varible r. and the problem became r out of 4

$$C^4_r.$$

r could only equal 0, 1, 2, 3, or 4 because these are the only amount of things you can select from 4.

Now we refered back to the train proble but we turned it into the tower problem. I was asked if I remembered building a family of towers. I did. It started with towers 1 high wit 2 colors. then it progressed.



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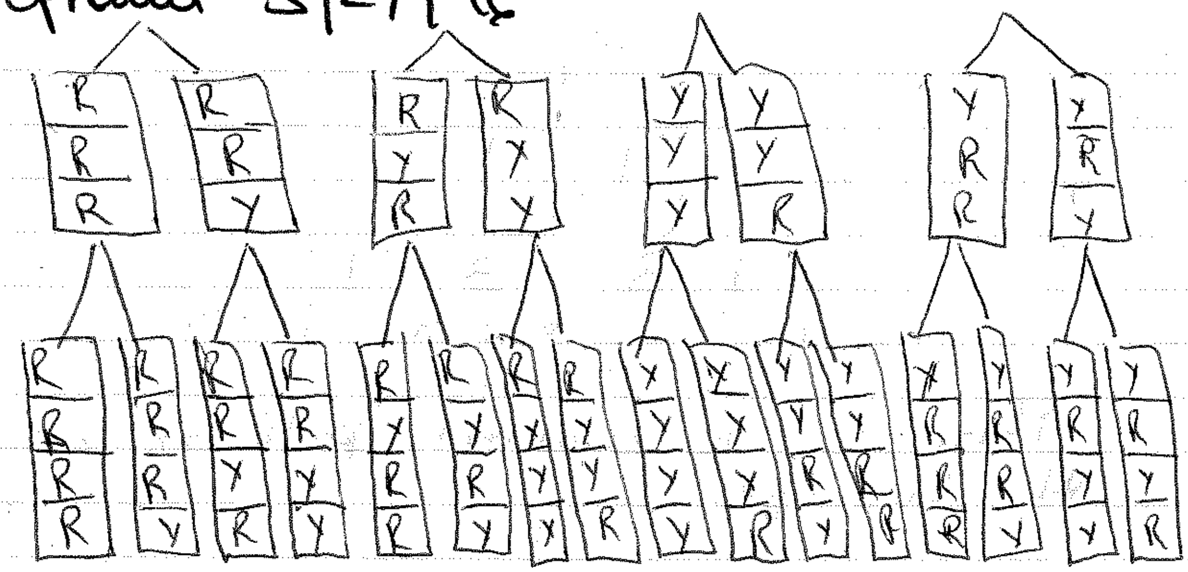


I knew that this would turn out to be 16.

This = $C^4_0 = 1$ also equals 16.

$C^4_1 = 4$

$C^4_2 = 6$

$C^4_3 = 4$

$C^4_4 = 1$

Next we incorperated this into Blaise Pascal's triangle.

$C^0_0 = 1$

$C^1_0 = 1$

$C^1_1 = 1$

$C^2_0 = 1$

$C^2_1 = 2$

$C^2_2 = 1$

$C^3_0 = 1$

$C^3_1 = 3$

$C^3_2 = 3$

$C^3_3 = 1$

$C^4_0 = 1$

$C^4_1 = 4$

$C^4_2 = 6$

$C^4_3 = 4$

$C^4_4 = 1$

now we put the answers in the triangle.

1

1 1

1 2 1

1 3 3 1

1 4 6 4 1

There is a distinct pattern in the triangle.

1

+

2

+ + +

3 3

+ + +

4 6 4

after that we changed numbers into combinations

$$\binom{0}{0}$$

$$\binom{1}{0} \quad \binom{1}{1}$$

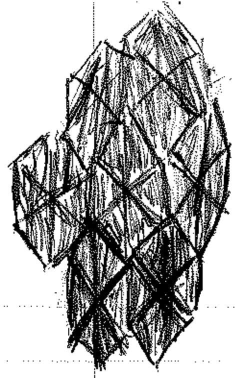
$$\binom{2}{0} \quad \binom{2}{1} \quad \binom{2}{2}$$

$$\binom{3}{0} \quad \binom{3}{1} \quad \binom{3}{2} \quad \binom{3}{3}$$

$$\binom{4}{0} \quad \binom{4}{1} \quad \binom{4}{2} \quad \binom{4}{3} \quad \binom{4}{4}$$

here we also discovered a pattern.

$$\binom{1}{0} + \binom{1}{1} = \binom{2}{1} \qquad \binom{2}{0} + \binom{2}{1} = \binom{3}{1}$$



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The question of what would

$$\binom{n}{0} + \binom{n}{1} =$$

after some time we found the answer

$$\binom{n}{0} + \binom{n}{1} = \binom{n+1}{1}$$

Now I was asked to take out my paper on $(a+B)^2$. I had worked with this all the way up to $(a+b)^6$.

Without even looking at my paper Dr. Maher told me all of the exponents in one of the problems, using only the numbers in the triangle.

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$(A+B)^0 = 1$

$(A+B)^1 = A+b$

$(A+B)^2 = A^2+2ab+b^2$

$(a+b)^3 = A^3+3a^2b+3ab^2+b^3$

$(a+b)^4 = A^4+4a^3b+6a^2b^2+4ab^3+b^4$

$(a+b)^5 = A^5+5a^4b+10a^3b^2+10a^2b^3+5ab^4+b^5$

$(a+b)^6 = A^6+6a^5b+15a^4b^2+20a^3b^3+15a^2b^4+$
$6ab^5+B^6$

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