**BLOSSOMS VIDEO LESSON TRANSCRIPT**

**Fantastic Factorials Transcript**

Assalamualaikum and greetings

I'm Shawalni

I’m a mathematics teacher at one

of the High School

in Kuala Lumpur, Malaysia

Throughout this video

you will be able to learn

how we can organize various objects

in many different ways

and different in a situation

by using the mathematical concept of factorial.

Noah, I want to seat here

No, you can't

Adam, Can I seat here?

No, you can't

Stop fighting

When we left

you will exchange seat on our journey later

Ok dad

As you can see

to get the spot they like in the car

especially by the window

No one wanted to sit in the middle

I need help to determine the

order that will satisfy them all

Can you help me?

Now, you will be working in groups

Each group will be given cards

labeled Adam, Bakar and Noah

Try to arrange the card

to find the number of possible

arrangements of seating

The answer to our first activity is 6

Did you get it right?

Let me explain to you using supported video

acted by Mrs. Bashirah’s children in the car

In this video, A represents Adam

B represents Bakar

and N represents Noah

The number of arrangement is 6

Now let’s continue to the next scene

Mom.. I cannot open the bag

I have a secret code set for

the combination log of the bag

The clue for the code is that the code uses only 4 digits

of even numbers 2, 4, 6, and 8 and without repetition

Could you please help the kids

to figure out the code

for the combination lock?

Please work in your group

to solve the code

for the combination lock

Each group will be given cards

labeled 2 , 4 , 6 and 8

Try to arrange the card

to find the number of possible

arrangements to unlock the luggage bag

I will see you in a while

Did you get the answer

to the combination lock?

Let’s watch this video

for the answer

Mom, I got it

Well done son

what is the code?

6 4 2 8

As you can see

Bakar managed to figure out the answer

during his 15th attempt

May I use this camera, mom?

Sure Adam but be careful

let's go out and take pictures

Ok Dad

Can you give us a suggestion

on all the possible seating arrangements

for the photo session?

Please work in your group

to help Mrs. Bashirah

in finding the possible seating

arrangements for the photo session

Each group will be given card labeled

Mom, Dad, Adam, Bakar and Noah

Try to arrange the card to find

the number of possible arrangements

to capture the picture in different positions

This require “mom” and “dad”

not to stay at only one position, at the center

they have to also switch places with their children

The answer to the numbers

of possible seating

arrangements for the

photo session is

120

What will happen if we have to arrange

5, 6, 7

or more objects?

Can we still use the same method

as suggested earlier to find

the possible number of arrangements?

it can be done

but there will be too many answers

Can we list down all the possible arrangements?

Do you know that we have another method

to find the solution to the problem

We can use a

Multiplication Rule

We have 1 place to filled in

if we have an object

the place can be filled in 1 way only

this is one factorial

If one thing can be done in m ways

and a second thing can be done in n ways,

then the total number of ways in which the two

things can be done together

or in succession is m x n

This principle can be extended to the

case where more than two things have to be done

We started with two objects at two places

The first place can be arranged either

object 1

or object 2

2 ways

if an object we've put in the first place

2nd place can only be filled with one way

here multiplication rule can be used

two events occurring in sequence

then the number of ways is

if one thing can be done in m ways

a second thing in n ways

a third thing in p ways

then the total number of ways

in which these thing can be done together

or in succession is m x n x p x...

to compile 3 objects in three places

The first place can be arranged either

object 1 or 2 or 3

namely 3 ways

if we take first object to the first place

second place can only be filled in 2 ways

either by 2nd object or 3rd object

Next the third place

can only be filled by one way only

multiplication rules can be used here

three events occur in sequence

then the number of ways is

3 x 2 x 1 = 6

How about to organize

4 objects in 4 places

and 5 objects in 5 places?

Try to solve the problem

Together with your teacher.

We will meet shortly

Thus we can conclude that

If 2 objects at 2 places

2 x 1 equal to 2!

If 3 objects to the 3rd places

3 x 2 x 1 equal to 3!

If 4 objects to the 4 places

4 x 3 x 2 x 1 equal to 4!

If 5 objects to the 5 places

the number of ways is

5 x 4 x 3 x 2 x 1 equal to 5!

Thus if n objects to n places

the number of ways is

n x (n-1) x (n-2) x…

x 4 x 3 x 2 x 1

are known as

n factorial

Therefore

if we want to arrange n different objects

we can use this formula

n ! = n (n-1) (n-2) (n-3) x ……x 4 x 3 x 2 x 1

Let us do an experiment

teacher will have to invite students

one by one to the front of the class

and appoint them each with role of

Adam, Bakar, Noah and Nancy

You will also have to prepare a blanket

or large sheet of paper

for the next activity

Have fun

Let us discuss

About the activity that you just did

Adam

Represents one way

Adam

plus Bakar

represent 2 ways

When Adam

Plus Bakar

Equal to 2

When multiply by Noah

the answers is 2 ways

Similarly, if the position is changed

Noah plus Bakar and multiply by Adam

the answers is still 2 ways

Again, if we change the position

Noah

plus Adam

and multiply by Bakar

you will get the same answer of 2 ways

this can be formulated to

this can be formulated to

6 + 6 + 6 + 6 = 24 = 4\*3! = 4!

Now, try to imagine

If we had to add another student

This time we use the formula

Proof by Induction

Congratulations, students

With your blanket exercise

what you were really doing is something called

Proof by Induction

With 3 students behind the blanket

and one outside,

didn't have to rearrange

the students behind the blanket

You knew from your previous work

that the number of ways

to arrange those 3 students

was 6 = 3!

And you had one outside the blanket

One by one

you exchanged the visible student

with one who was invisible

behind the blanket

You found that there were

4 ways to put an individual student

outside the blanket

and for each there were 3! Ways

to arrange those behind the blanket

In that way you discovered that there are

4\*3! = 4!

distinct ways to arrange 4 students

So what have you done

in your class activity?

with your blanket exercise

You've discovered Proof by Induction

Lets' talk about Proof by Induction

Mathematical "proof by induction" sounds complicated but it really isn't!

We deal only with positive integers, 1, 2, 3, and so on

You start with a simple base case and show that your result is true, as we have shown in this BLOSSOMS video.

Then you say, "Suppose my result is true for some value of N, say N=3, then I can show it is true for the next N, in this case N = 4."

This method, applied first from a small value of N, then to the next value of N, and so on and so on, then proves that your result is true in general.

It's pretty powerful, pretty neat, and usually reserved for college students. But let's do it here! It's fun with Fantastic Factorials!

Proof by induction says,

Suppose for some value of N

the number of distinct ways

to arrange N different objects is N!

We have already shown this to be true

for small values of N

in particular N=1, 2, 3 and 4

Now consider an

arbitrary value of N

something like N=99, for instance

Suppose we have shown

it to be true for that value of N

This means that there are

N! = 99!

way to arrange 99 different objects

Then we want to show that

it is also true for N+1

for instance for the number 100

How to formulate this?

Place the N objects (students)

behind the very large sheet

and we know that the number of

distinct ways to arrange them is N!

That is using what we call the

inductive hypothesis

And we have the N+1st object

call him Rahim

standing outside the sheet to the left

But now we place Rahim behind the sheet

and we take Noah out

standing to the left

Do this for for all N+1 students

one by one

For each student outside the sheet

there are N! ways

to arrange the N different

students behind the sheet

But there are N+1 times we do this

that is each of the total of N+1 students

get his or her turn outside the sheet

So, just as we showed before

there are N+1 times that we do this

and for each there are N! ways

to arrange students behind the sheet

If we sum

N! a total of N+1 times

we get

(N+1)N! = (N+1)!

This is proof by induction

You did this standing in front

of the class with the sheet

We can start

with N=4

our result shows

that then there are 5!

ways to arrange five students

Then, since our result

is good for five students

applying our result

it must be good for six

And then 7

and 8

and so on

ninety-nine students

You see

this proof by induction

wasn't so complicated

And welcome to a

college math argument

In relation to the topic of arrangement

I will leave you with some homework

You will have to solve the

task given by your teacher

and discuss them in your next class

Meaning, we will not discuss

the answers to your homework here

but you will have to do it

with your teacher in the next class

You can apply what you have learned

through this lesson in your daily life

For example

while you were arranging things in your home

like arranging furniture in the living room

posters

pots, pans and even

photo frames like what

Mrs. Bashirah is doing now

Not only this

factorial can be useful

for your other daily life practices

For example

to arrange books in your classroom

or library

at the window display

arrange cars in a showroom

and arrange luggage in the car bonnet

I hope you have enjoyed the lesson

and I really hope that this video

manage to assist you with learning

concept of factorials

This video is intended to relate

everyday life factorial topic

Students are expected to apply

the principle of multiplication

listing all the possibilities

and the proof by induction

Through these videos

students are exposed to cooperative learning

and role playing in class

In addition to cards labeled technique

teacher can also lead students to organize

their position in the class

so that all students feel

different sides of seat

Not only that

teachers can use any objects

that can be stacked like books, tables and chairs

Happy exploring factorial topic