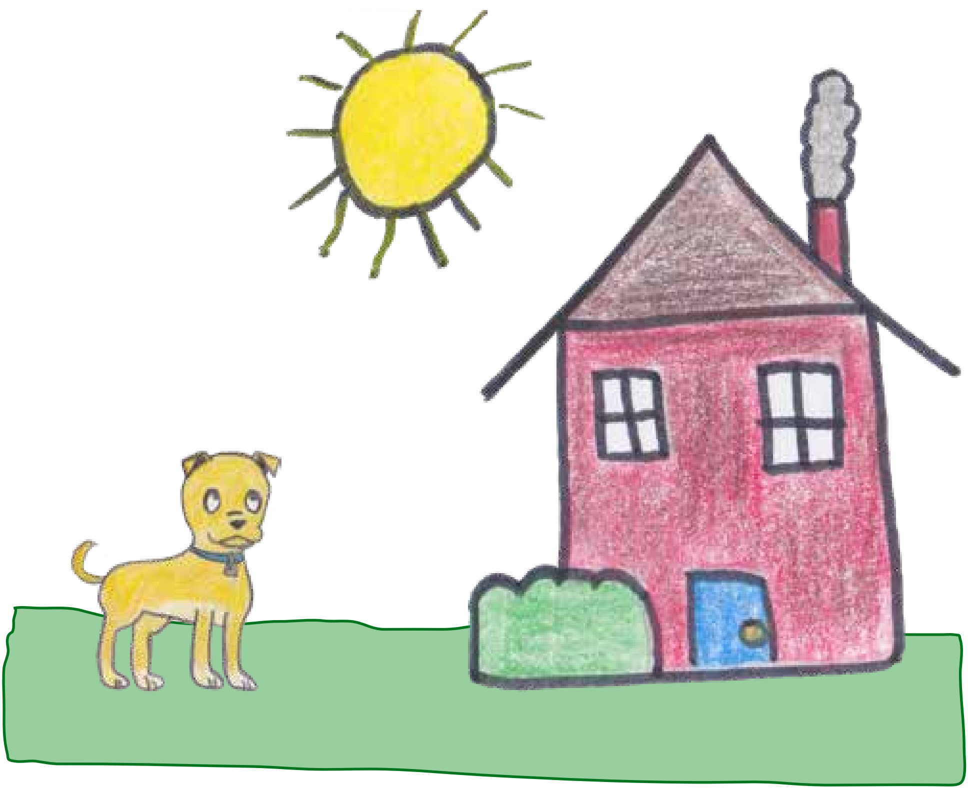
Alpha's Adventures in Mathematics: Book 1

The Journey Home



ACTIVITY BOOKLET

Using this Book

The activities in this book were designed to go along with the story found on lookmath.ca (click on Alpha's Adventures)

You can also do the activities without reading the story but reading along with Alpha makes it more fun! There are also activities you can share with Alpha and Pam by emailing us at lookmath@vedavox.ca (but remember to ask your parents first).

Now let's meet our cast of characters who will help us on our adventure!

HI! I'M PAM AND WHEN YOU SEE ME IT MEANS I'VE GOT SOME COOL AND INTERESTING MATH FACTS TO SHARE!

ALPHA HERE! WHEN YOU SEE ME IT MEANS THAT I HAVE A MATH PROBLEM TO SOLVE AND I NEED YOUR HELP WITH IT.

THIS HOUSE MEANS WE HAVE SOMETHING FOR YOU TO TRY AT HOME (AN ACTIVITY, OR MAYBE A WORKSHEET YOU CAN FIND ON OUR WEBSITE).

AND THIS LITTLE WORLD MEANS THERE'S A WHOLE WORLD OF THINGS TO EXPLORE ABOUT THIS TOPIC AND WE'LL GIVE YOU SOME IDEAS WHERE TO START.

Introduction

The Fibonacci sequence is a very famous list of numbers that goes like this:

0, 1, 1, 2, 3, 5, 8, 13, ... (where the ...'s mean it goes to infinity)

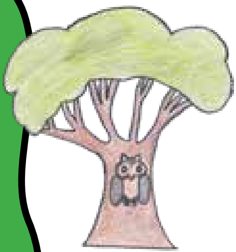
You find the sequence by starting with 0 and 1. You then add these numbers together to get the next one, and then the new number plus the one before it to get the next number, and so on.

Like this:
0 + 1 = 1
1 + 1 = 2
1 + 2 = 3
2 + 3 = 5
3 + 5 = 8
5 + 8 = 13

Can you figure out the next two numbers? How about the 15th number?

Answer: 21, 34; 377

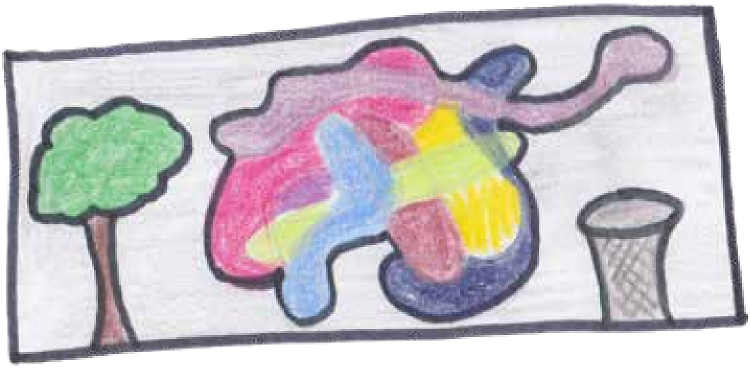
Check out the Intro Chapter on our website for some great resources on exploring the Fibonacci sequence in nature. Then take a look at our Math in Art and Math in Nature videos as well.



Trees and flowers follow the Fibonacci sequence when they grow! Look around where you live for some trees or flowers or other plants and take some pictures of them, or try to draw them and see if you can find the pattern for yourself.

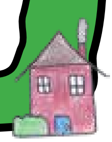
Artists use a combination of just a few colours to create a whole spectrum of shades and they use ratios to create them. On a computer, you can combine 27 parts Red to 135 parts Green to 212 parts Blue (written 27 : 135 : 212) to get a very specific shade of blue (the blue we use for Alpha's box actually). By using just these three colours in different combinations we can make any colour we want.

Important note: when mixing actual colours (like paint) it's actually Red, Blue and Yellow (as Blue and Yellow make Green) that are combined in different ratios. These are called Primary colours. Computers use Red, Blue and Green though.



Using a graphics program, or a Digital Colour Meter, on your computer try selecting different colours and see how the combinations of just Red, Green and Blue (called RGB) can give you different colours.

Or pick up some Red, Blue and Yellow paints and mix those colours in different ratios to see what you can create.



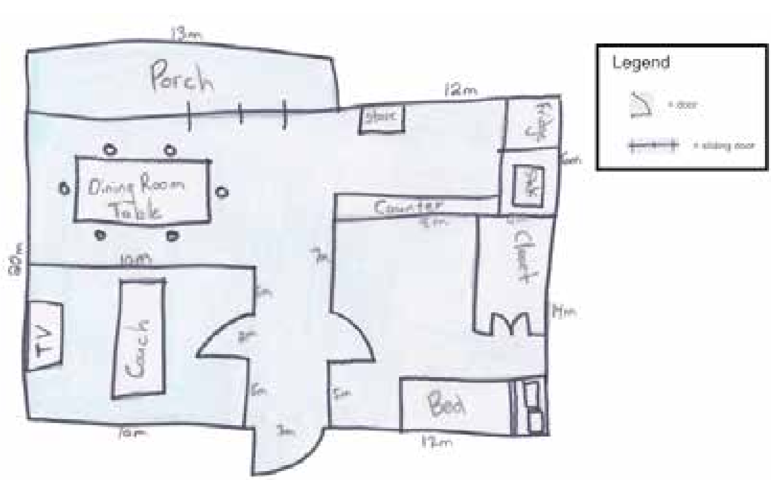
Chapter 1

Houses are built using blueprints.

These are maps that show where walls go, where rooms are in relation to one another, where the stairs are and more.

People who make blueprints are called architects and they have to use a lot of measurement math to make sure that everything they want to put into a house will fit.

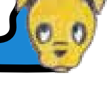
Most houses are designed to have 90 degree angles (so square and rectangular rooms) but they don't have to be. Some houses have curved walls or circular staircases or triangular spaces (like attics).



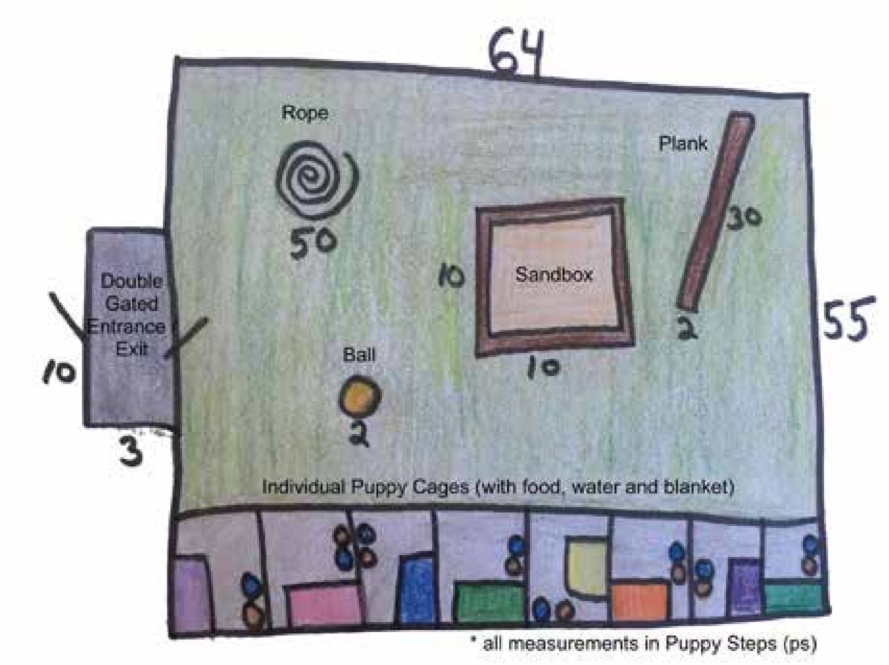
Make a blueprint of where you live. Measure out the walls and furniture and draw a map of your home.

Use a ruler and protractor to make the lines and angles as straight as possible and remember to draw your doors with the round part going the way the door swings (so the round part should be inside the room if the door swings into the room).

I so dream of a forever home filled with math. Can you help me design one? Use your blueprint of your own home as a template (something you can copy) and help me design my dream home. You can share your designs with me too (ask your parents first).



Chapter 2

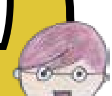


Alpha spent his first few days in the shelter making measurements of everything in there, trying to plan his escape (you can see his map above).

The yard contained a lot of pieces he could have used (a plank, a ball, rope, the sandbox). It also contained 8 identical cages for the puppies.

If each cage is exactly the same size (8ps) and the length of the wall they were against is 64ps, how long is each cage?

Answer: 8ps



When I was at the shelter all I wanted to do was escape! Using the materials available in the yard, can you help me design a way to get out? What ways can you think of to escape? If you had other materials available, what would they be and how could you use them? Feel free to send me your esape plans (with permission of course)!

Take a look around your house (or yard if you have one) and see if you can build an escape plan of your own. Make the regular exit to the space inescapable and see what other ways you could get out (a window or a hole in the fence) and what items you could use. Measure items around your house and see how things could be moved around to get over obstacles or walls or fences.

Be creative and come up with a few plans...

If you're on an upper floor see if you can figure out what you could use to build a rope or ladder, or if you're below ground, what could be used to climb upon?

Chapter 3

Watching bubbles in the bath made me think about how air molecules fill up space.

I wanted to figure out how they were filled. To do this I first drew a couple of different shapes: a square, a triangle and a circle.

Then I calculated the area of each shape (Pam - below - can help explain how I did this) and I made each shape so it had the same area.

Then I filled each of the shapes with little circles, each as close to the same size as I could.

Then I counted how many circles fit inside each shape and then multipled the area of each circle by how many circles I could fit in the shape.

Finally, I subtracted the area of all the circles from the area of the shape and compared the results to see which one had the smallest area left over.

It turned out the circle had the least amount of space left over. This meant that the circle was the optimal (or best) shape for holding air molecules.

In order to calculate area Alpha had to use a few equations. Let's see what he did.

Alpha learned the following equations from the school classroom (note: * means to multiply and / means divide):

Area of square or rectangle = l * w
Area of triangle = b * h / 2
Area of circle = $\pi * r^2$

He knew that l is the length of one side of a rectangle and w is the width of the other side (in a square both l and w are the same). He also knew that b is the base (or bottom) of a triangle and h was the height from the base to the highest point.

Finally, for the circle he knew that r was the radius (the distance from the very middle of the circle to the outside) and π is the number 3.14. The tricky part was where it said r. But he remembered learning that a 2 written like ^{2} meant 'squared' and to 'square' a number meant to multiply it by itself.

So let's try some out. If Alpha had a square with length of 5, what's the area of it? (Remember, in a square l and w are the same.)

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Answer:
Area = l * w
Area = 5 * 5
Area = 25

Great work!

Now let's try a triangle with a base (bottom) of 8 and a height of 4.

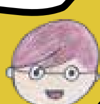
Answer:
Area = b * h / 2
Area = 8 * 4 / 2
Area = 32 / 2
Area = 16

Fabulous!

Now, the tricky one: a circle. If the radius of the circle is 6, what's the area?

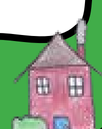
Answer:
Area = $\pi * r^2$
Area = 3.14 * 6 * 6
Area = 3.14 * 36
Area = 113.04

Great Job!



Using circle stickers or punch outs from a hole punch, draw some different shapes and see how many circles fit inside the shapes. This will be more accurate than drawing the circles. But make sure that all your shapes have the same area (like Alpha did).

You can do the same challenge as Alpha as well!



Chapter 4

I want to know how fast the plane I'll be taking to get to Canada compares to the speed of the car to the airport. If I know that dividing distance by time gives me speed, then I can use the fact that the airport is 100km away from the shelter and that it takes 2 hours to get there to figure out how fast the car is going.

Bonus: I can also find out how much faster the plane travels when compared with the car by dividing the speed of the plane by the speed of the car. This gives me the ratio of plane speed to car speed.

Extra Bonus: If I was able to drive from Korea to Toronto on a highway with a speed limit of 100 km/hr, how long would the trip take? (Korea is 10,580km away)

Here are the answers to Alpha's questions:

The car is travelling 100 km / 2 hr = 50km/hr

The plane travels 755 km/hr / 50 km/hr = 15.1 or about 15 times faster than the car

If Alpha could drive at 100 km/hr and the distance is 10,580 km then we would set up the equation:

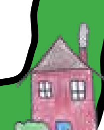
10,580 km / 100 km/hr = 105.8 hr (or almost 4 and a half days!)

Think about a trip you've taken and how you got there. It could be a trip to somewhere far and exotic or from your home to your school.

Think about how long it takes you to get there and how far way it is (hint: you can use Google Maps to find the distance).

Using the equations we just learned, you can figure out how fast you travelled to get there.

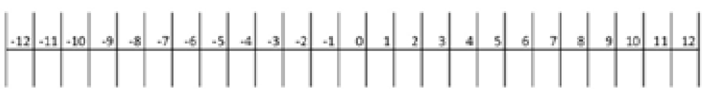
Try it with different modes of transit (walking, biking, car, public transit, even an airplane).



Chapter 5

Let's build a simplified time zone line (like Alpha did in the book). Start by drawing a straight line and dividing it into 24 equal parts. You can also use a globe and wrap a string around it and then measure and divide that string into 24 parts.

Start on the left side and label it -12, then count by ones until you get to the other end and label it +12 (see Alpha's version of it below).



Pick some places you've been, or would like to go, and try to figure out the local time and how long it would take to get there by plane.

Explore the world through time zones and let us know of any amazing places you find!

Use the following website to see what time zone different cities are in:
https://www.timeanddate.com/time/map/

You can also look up flight times and use Google Maps to show what route planes take to get to different parts of the world.

Explore travelling both east to west and west to east and see how time zones change.

Remember: There are actually 37 time zones (not 24). You can explore more about the other special time zones that make up the 13 additional ones on the above website too!

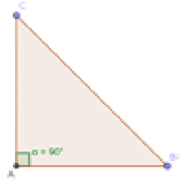
Check out the time zone activity sheet on lookmath.ca for more on time zones and using them to go back in time!

Chapter 6

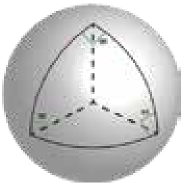
Alpha wants to learn about how plotting a course on a globe is tricker than plotting a course on a flat map.

This is because a globe is curved and geometry works differently on a sphere. For example right angles on a sphere are different than on a flat surface.

On a flat piece of paper a triangle can only have one right angle:



But on a sphere a triangle can actually have 3 right angles:



This is because lines curve on a sphere.

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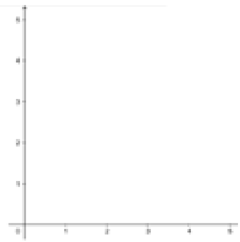
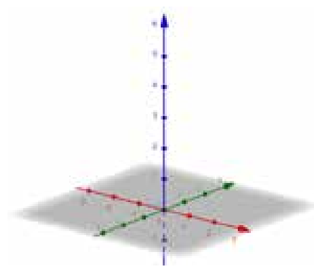
It's also because in 2-dimensions we only have x- and y- axes to draw shapes on (length and width), but a sphere is drawn in 3-dimensions using x-, y- and z- axes (length, width and depth).

When x- and y- meet they make one 90 degree angle:



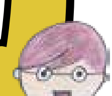
But when we have three axes (x, y and z), we have three places where a 90 degree angle can form:



If we look at this on a sphere (or a globe) it's where the lines from the equator to the pole meet.

Neat, huh?

So this means, when a plane is flying from one place to another, it does not follow the rules of 2-D geometry, so pilots have to plot their courses differently than what it might look like on a flat map.



Want to learn more? Check out "Alpha's Adventures", Chapter 6, to see what Alpha's route looked like on the plane, more on navigation, and an interactive sphere you can play with.

The biggest city in the world by population is Tokyo with 37.5 million people.

Paju has a population of 420,000. How much bigger is Tokyo than Toronto or Paju?

How about where you live?

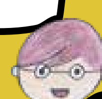
How much bigger (or smaller) is where you live compared to Toronto, Paju or Tokyo?

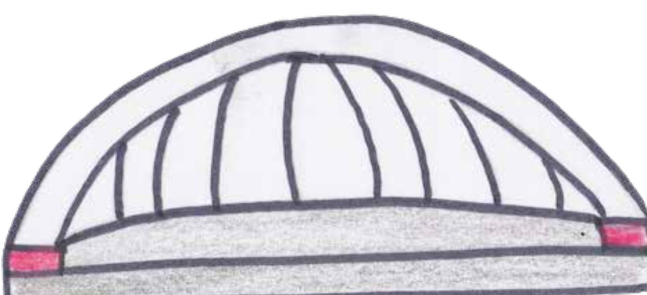
The CN Tower is one of the world's tallest free-standing structures.

Making a super-stable, free-standing structure isn't as easy as you may think and involves a lot of math.

One of the trickiest parts is making sure the base of the building is strong and stable enough to support not only the weight of the building, but also so it can handle things like wind or earthquakes. (Neat fact, if you stand at the top of the tower, even on a calm day, you can see the tower moving back and forth with the wind.)

So engineers need to build these towers to be super stable, even in high winds.





Here's your challenge:

Gather the following materials:
- thick spaghetti noodles (thin ones will work but it will make construction more difficult)
- marshmallows

That's it!

What you want to do is try to build the tallest tower you can using just noodles and marshmallows (the marshmallows are to connect the pieces of pasta together).

You can also use white glue to connect the pasta pieces together and you can use straws instead of noodles - be creative with the materials you choose.

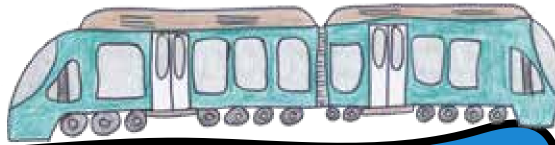
Bonus: you can use a fan or a hairdryer (careful with the heat) to blow on your tower and see if it still stands.

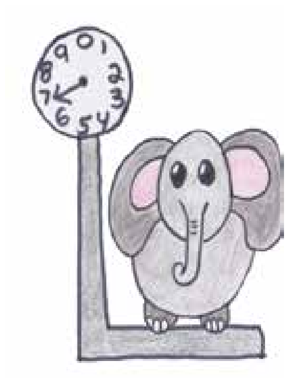
Experiment with different types of bases (a round one like the CN Tower, or a square one like the Eiffel Tower in Paris). Play around with different ways to connect the noodles (or straws or pipe cleaners) to each other.

The most important thing to remember is that you can't have anything outside the tower supporting it. So no strings attaching it to the ground/table or noodles propping up the sides. The tower has to be completely free-standing.

If you get a great design you want to share, send us a picture!

Chapter 7





I learned once from a magazine page that I found that an average elephant weighs 7 tonnes. I want to use that fact to compare the weight of an elephant to the weight of a train. Can you help me?

I know a train weighs 22,745 tonnes and an elephant weighs 7 tonnes so we divide:
22,745 / 7 = 3,249 (approx)

That means you would need about 3,249 elephants to have the same weight as one train.

Train Weight By Alphas

If I weigh 13 kg, how many of me does a train weigh?

Well, this is a bit tricker, but still doable!

First we need to make sure we are comparing the same weights, so either tonnes to tonnes or kg to kg (this is VERY IMPORTANT in math)!

We can either convert my weight to tonnes (so we divide it by 1,000) or we convert the train weight to kg (mulitiply it by 1,000). Let's do the second one and use the train's weight in kg (you can try the other way yourself).

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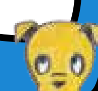


So the train weighs 22,745 tonnes or:
22,745 x 1,000 = 22,745,000 kg

I weigh 13kg, so, same as the elephant calculation:
22,745,000 / 13 = 1,749,615 (approx)

Wow, that's a LOT of me's!

Can you figure out how many of you it would take to weigh the same as a train?

How about to weigh the same as an elephant? How many Alphas would it take to weigh the same as you?

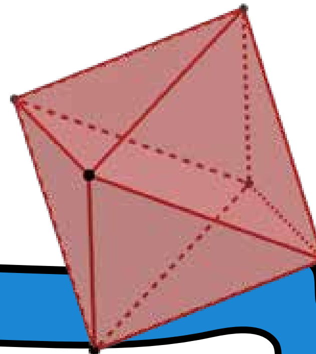
Important note: if you're using a scale to measure yourself make sure it is showing your weight in kg and not in pounds. If your scale only shows pounds you can figure out your approximate weight in kg by dividing your weight in pounds by 2.2

You can also compare your weight, the train, an elephant, and Alpha to how much other things weigh, such as:
- a plane (572 tonnes)
- a small car (2.9 tonnes)
- a bike (10 kg)

Try to think of other things you could compare.

If you find some interesting/unique ones, send us the details.

Chapter 8

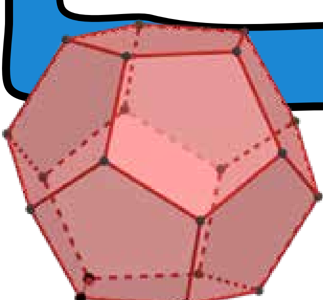


3D shapes have unique and interesting names made up of two parts: a prefix (the first part) and a suffix (the second part).

Many 3D shapes have the suffix 'hedron' but the prefix changes depending on how many faces it has. Let's look at a few:

4 faces: tetra
8 faces: octa
12 faces: dodeca
14 faces: cubocta
20 faces: icosa
26 faces: rhombicubocta
32 faces: icosidodeca
62 faces: rhombicosidodeca

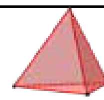
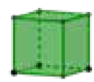
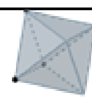
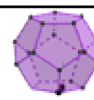
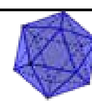
When I met Pam for the first time she was wearing a unique necklace made up of an 8-faced shape inside of a 12-faced shape. Can you help me name them both?



Answer: dodecahedron and octahedron

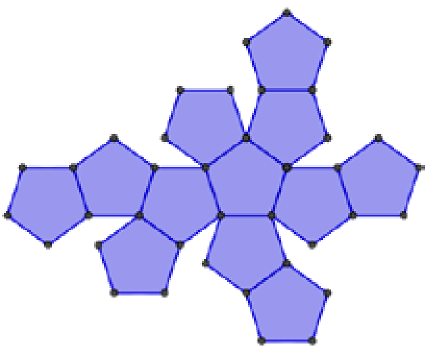
In geometry 3D shapes (like the ones in my necklace) that are made up of exactly the same shape are called Platonic solids (named after a famous Greek philosopher named Plato), and there are only 5 of them!

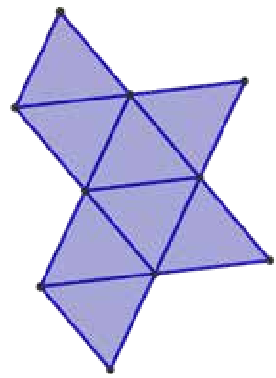
What's cool is that Plato also assigned elements to each:

Name	**# of Faces**	**Face Shape**	**Element**	**Image**
Tetrahedron	4	Triangle	Fire	
Cube	6	Square	Earth	
Octahedron	8	Triangle	Air	
Dodecahedron	12	Pentagon (5 sides)	Universal Force	
Icosahedron	20	Triangle	Water	

Mathematicians use nets to build 3D shapes like the Platonic solids. A net is an expanded view of the shape.

Here are the nets for the shapes in my necklace (see how the shapes used are all the same):





Using scissors and glue you can cut out various nets and put them together to make your very own 3D shapes.

Try it out at home by downloading our Platonic solids geometry net worksheets found on our website.

Check out "Alpha's Adventures", Chapter 8, on our website for some links where you can explore Platonic solids more.

WELL THAT'S ALL FOR NOW! WE HOPE YOU ENJOYED EXPLORING SOME NEAT AND INTERESTING MATH WITH US, AND THAT YOU LEARNED SOMETHING NEW ALONG THE WAY!

KEEP CHECKING BACK ON lookmath.ca TO SEE WHAT NEW AND EXCITING CONTENT WE HAVE COMING UP!

BYE FOR NOW!