



THE POWER OF 3

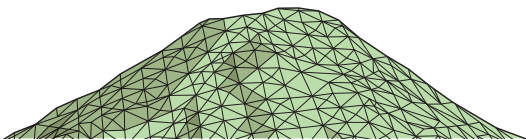
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group

HELLO THERE! MY NAME'S **TRIBUS**, FROM **GREENHATCH GROUP**, AND I'M A SURVEY SUPERHERO POWERED BY THE MAGIC NUMBER... THE NUMBER 3! EVEN MY NAME MEANS 'THREE' IN LATIN! I'VE BEEN BUSY EXPLORING MIDDLETOWN -- IN PARTICULAR, THE SECTION SHOWN IN THE GET KIDS INTO SURVEY **DIGITAL CONSTRUCTION** EXPLORATION POSTER -- AND I'VE SPOTTED SO MANY OF MY FAVOURITE, SUPER-STRONG SHAPE! CAN YOU GUESS WHAT IT IS? I'M SURE YOU WON'T HAVE TO 'TRI' VERY HARD! FROM ROOFS TO PYLONS TO PYRAMIDS, TRIANGLES ARE USED IN CONSTRUCTION ALL THE TIME -- BUT WHY? LET'S FIND OUT TOGETHER!

TASK 1: MAPPING WITH TRIANGLES

(MATHS OBJECTIVES - GEOMETRY / ART OBJECTIVES - CONTOUR SHADING)

Triangles are terrifically useful shapes! They've been used in computer design to take some of your favourite classic computer game characters (think Sonic, Mario and Link!) from 2D pixel designs to 3D renders. But how is a 2D polygon like a triangle used to create a 3D character or object? Well, that's where the power of the triangle comes in handy! Because a triangle can be stretched and sized and turned in lots of different ways, designers can use them like puzzle pieces to recreate the shape of a 3D object using 2D interlinked triangular panels. These panels can then be coloured to give the illusion of 3D when displayed on a flat screen.



As this technique developed, smaller and smaller triangles were used to create each object. For example, in Super Mario Odyssey, Mario's moustache alone was made up of over 800 tiny interlocking triangles! That's more than the Mario from Super Mario 64 had for his entire body!

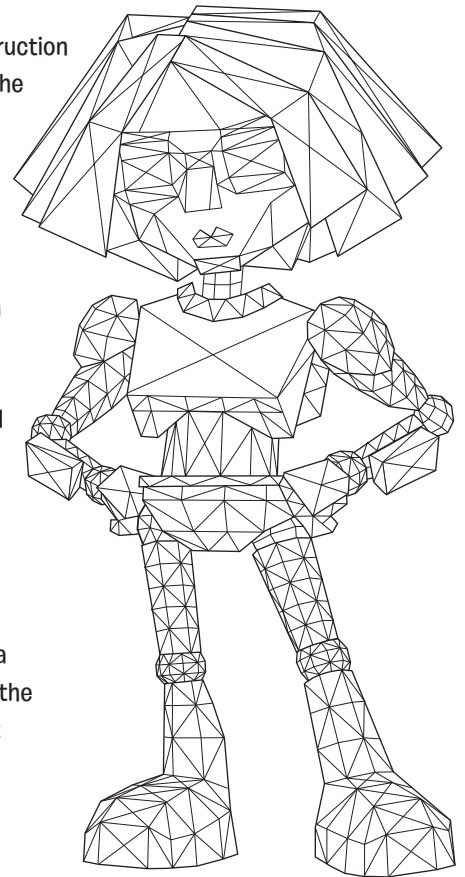
TASK 2: TRACKING THE TRIANGLES

(MATHS OBJECTIVES - IDENTIFYING SHAPES)

As well as being useful in designing and mapping, triangles are very popular in construction - especially where strength is needed. But why triangles in particular? Simply put, it's because triangles are the only shape that does not deform when pressure is applied to any of its sides; it keeps its shape and angles when put under far more

GeoSurveyors and construction workers are able to put the triangle's power of 3 to great use in their work too - using it the same way game designers do to represent features in three dimensions using a linked pattern of 2D shapes. The resulting images are called **digital terrain models**.

We'll explore them more in the final task. For now, your first challenge is to use the 'Mapping with Triangles' sheet to bring a polygon model of one of the GeoSquad's survey robot mechs to life!



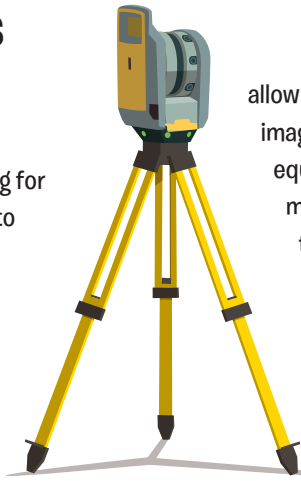
pressure than other shapes can withstand. For the first part of this challenge, take a look back at the Digital Construction Exploration Poster and see how many triangles you can spot. After that, complete the 'Tracking the Triangles' worksheet to see how many triangles you can find in examples of buildings from across the world!



TASK 3: TREMENDOUS TRIPODS

(MATHS OBJECTIVES - GEOMETRY / DESIGN TECHNOLOGY OBJECTIVES - DESIGN AND BUILD)

Did you spot the trio of tripods while you were searching for triangles in the Exploration Poster? GeoSurveyors love to mount their scanning equipment on tripods - for much the same reason as construction workers love them: strength and stability! Each of the three arms is adjustable, so even if the device has to be placed on an uneven surface, the tripod can shift shape to



allow the scanner to establish a secure position. You can imagine what would happen if a surveyor tried to mount their equipment on one or two legs! Toppling tripods! And four or more would be too rigid and inflexible. Three, as always, is the magic number!

For your challenge, use the 'Terrific Tripods' sheet to see if you can build with triangles, exploring their structural strength as you go for a world record build!

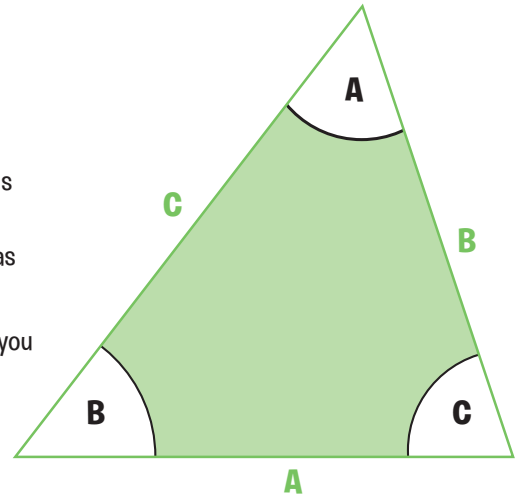
TASK 4: PLAYING ALL THE ANGLES

(MATHS OBJECTIVES - PROPERTIES OF SHAPES)

If you want to be a successful builder, surveyor, architect or anyone else responsible for construction, you're going to have to have some mad maths skills! The maths area that deals with the relationships between the sides and internal angles of triangles - and how to find unknown angles or side-lengths - would be a particularly useful one to practise, especially as we now know that triangles are so commonly used in construction!

Use this website, <https://www.bbc.co.uk/bitesize/topics/zb6tyrd/articles/z8twr2p> to help you understand the maths of triangles - then when you feel confident, have a go at the linked quizzes.

Harness the power of three!



TASK 5: TRIANGULATE THE TREASURE!

(MATHS OBJECTIVES - PROPERTIES OF SHAPE / GEOGRAPHY - MAP WORK)

I'm so glad you've worked so hard to master the power of 3... because I have just been given some terrible news! My arch surveying nemesis and evil cousin, **Malum the Pirate**, has stolen my best total station, mounted on my favourite tripod, and buried it on some vast, deserted island. And, to torment me, he's sent me a digital terrain model made up of my very favourite shape - triangles! There's a message attached, which seems to suggest that he's buried my gear under the area marked by one very specific triangle... but there's so many missing measures and absent angles!

Do you think you could use the 'Triangulate the Treasure' worksheet to work out the message, then use your terrific triangle maths skills to identify the exact position of my lost item!? You'd be my survey superhero - fuelled by the power of 3!



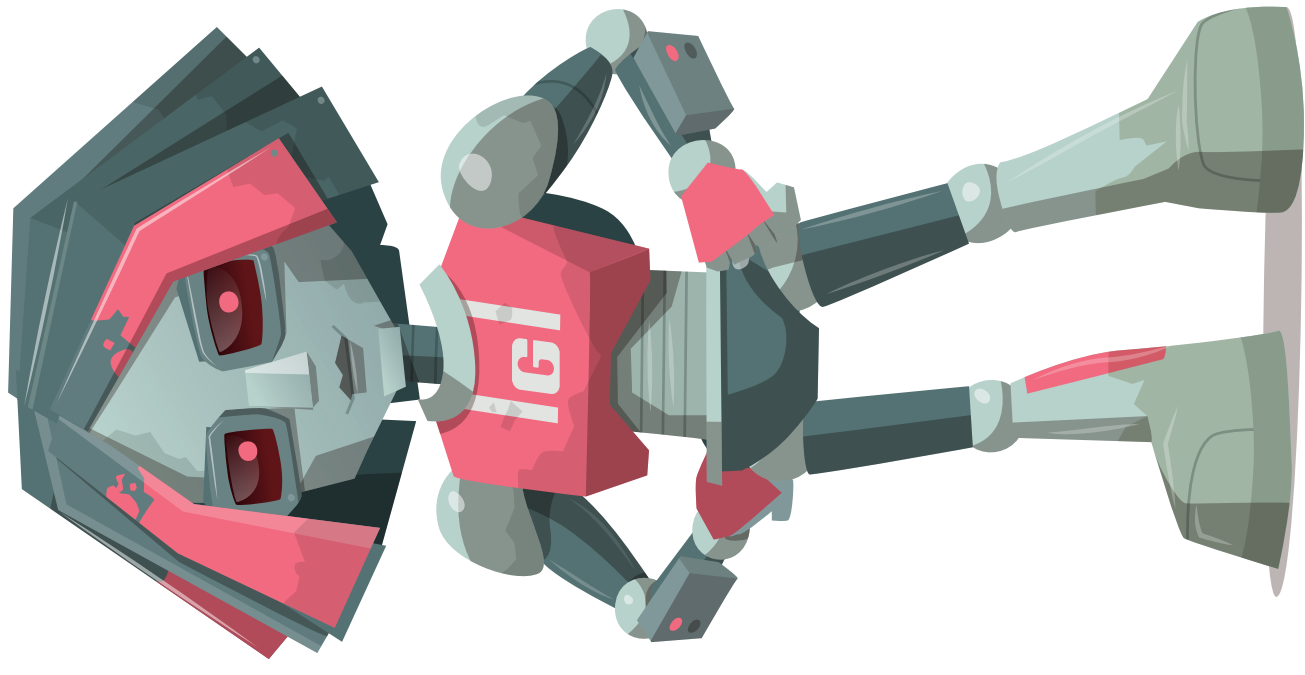
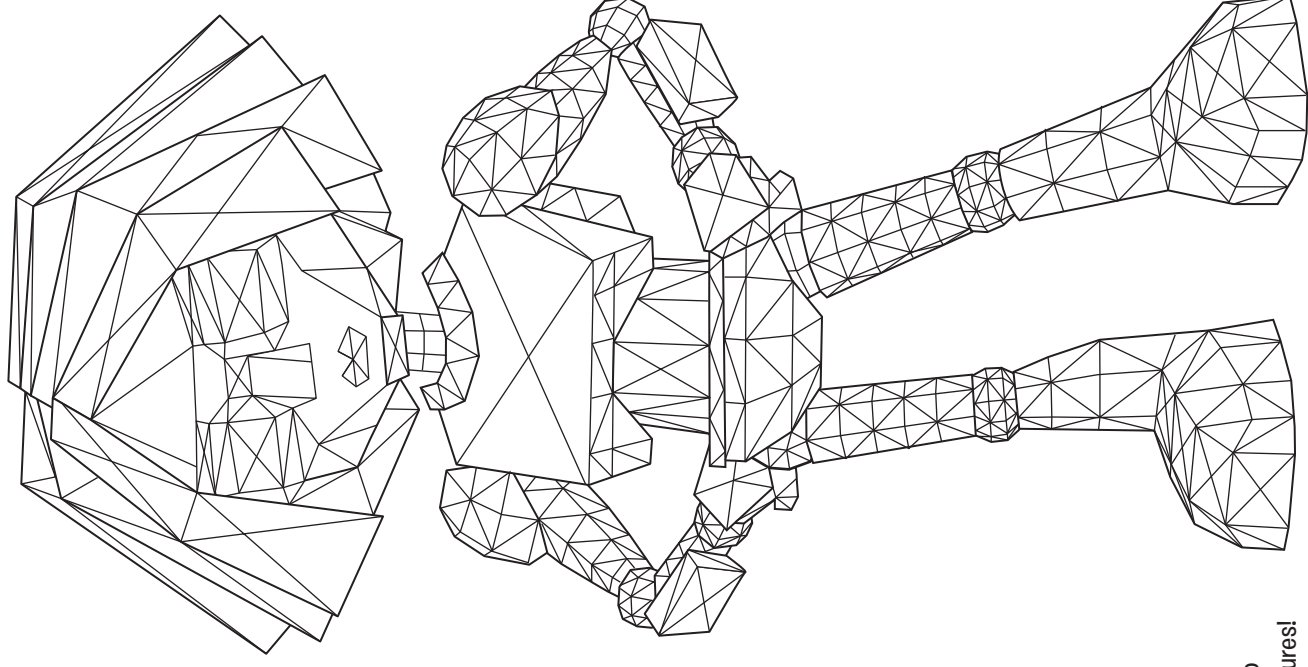
TASK 1:

MAPPING WITH TRIANGLES

YOU FIRST CHALLENGE IS TO USE THIS SHEET TO BRING A POLYGON MODEL OF ONE OF THE GEOSQUAD'S ROBOT SURVEY MECHS* TO LIFE! THINK ABOUT USING YOUR SHADING SKILLS TO CREATE THE ILLUSION OF DEPTH -- TRIANGLES CLOSER TO A LIGHT SOURCE WITH BE LIGHTER, AND ONES THAT ARE FURTHER AWAY, OR WHICH HAVE LIGHT BLOCKED BY OTHER AREAS, WILL BE DARKER.



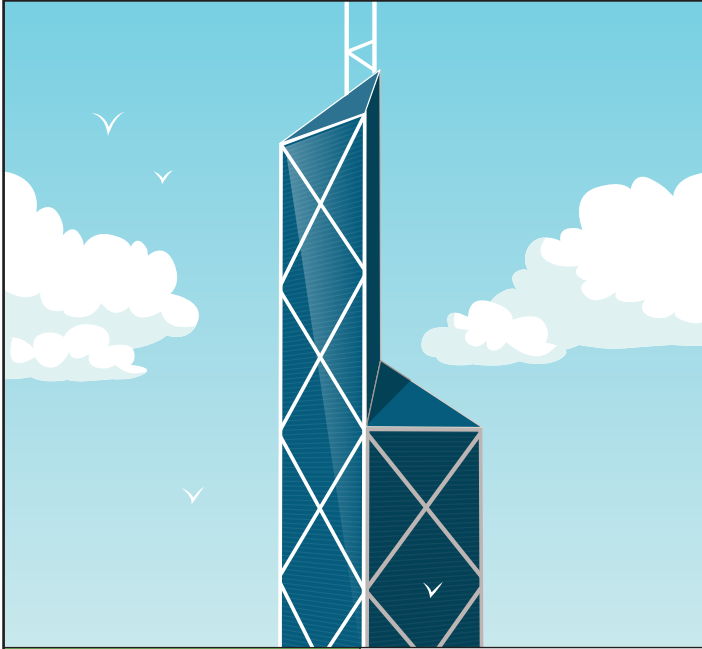
*Mech: An abbreviation of 'mechanical', used to describe robots with limbs and humanoid features!



TASK 2:

TRACKING THE TRIANGLES

COMPLETE THIS WORKSHEET TO SEE HOW MANY TRIANGLES YOU CAN FIND IN EXAMPLES OF BUILDINGS FROM ACROSS THE WORLD!



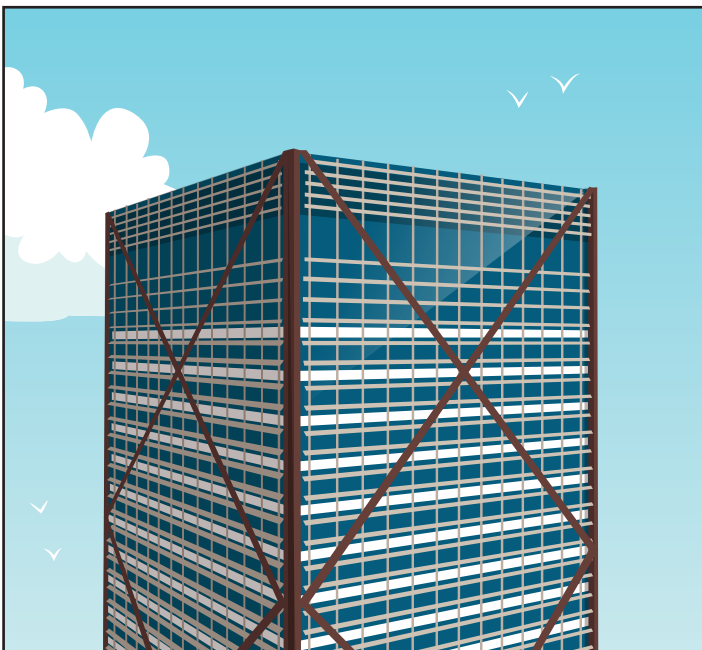
Bank of China Tower

Number of triangles:



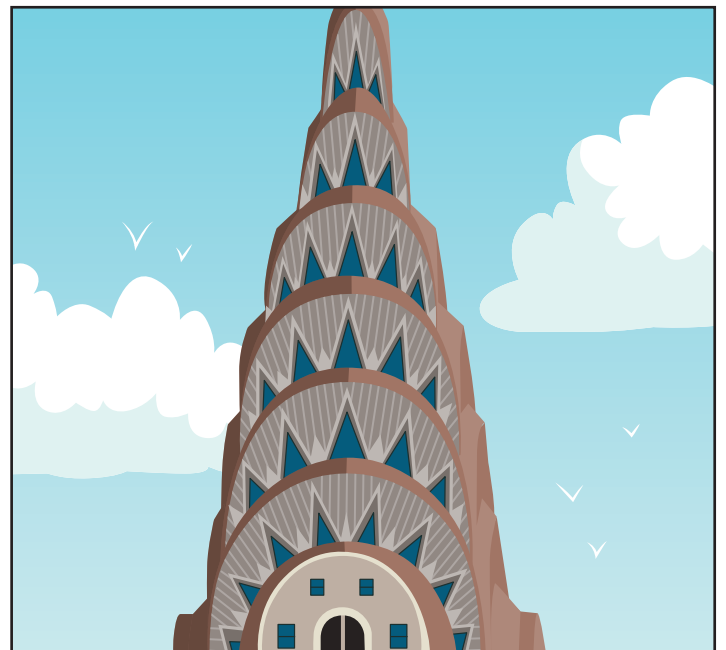
Oakland Bay Bridge

Number of triangles:



1 Undershaft

Number of triangles:



Chrysler Building

Number of triangles:

EXTRA CHALLENGE: IF YOU'VE MANAGED TO TACKLE ALL THE TRIANGLES ON THIS SHEET, GO ONLINE AND SEE IF YOU CAN COUNT ALL THE TRIANGLES IN THE SUPER TRICKY '*SIERPINSKI TRIANGLE*'!



TASK 2:

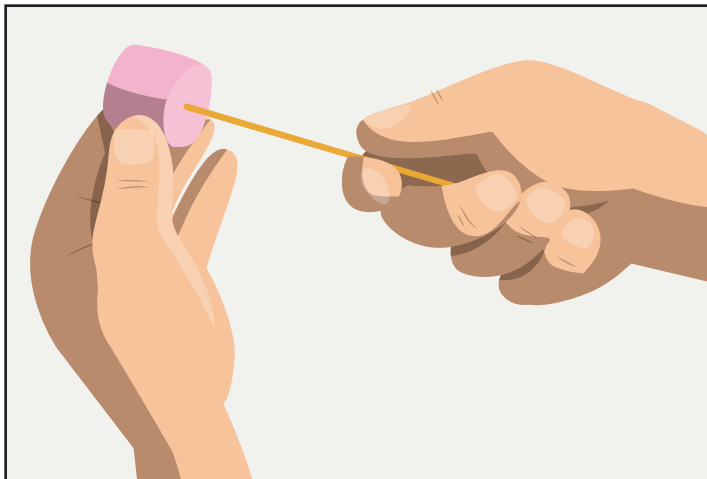
TERRIFIC TRIANGLES

FOR THIS CHALLENGE, SEE IF YOU CAN BUILD WITH TRIANGLES, EXPLORING THEIR STRUCTURAL STRENGTH AS YOU GO FOR A WORLD RECORD BUILD!

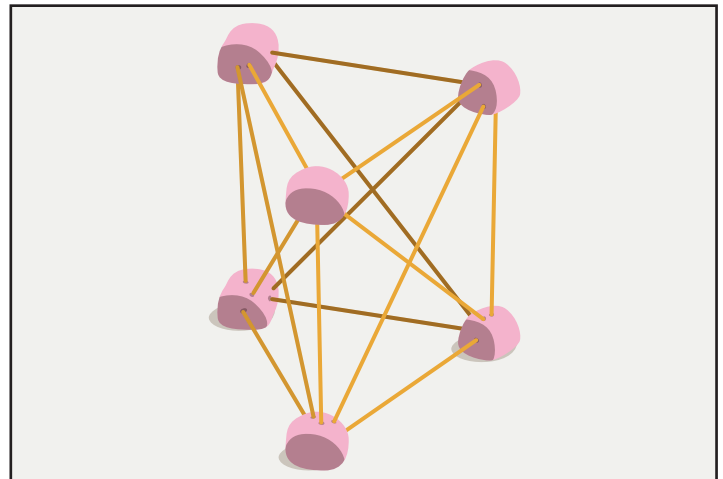


You will need:

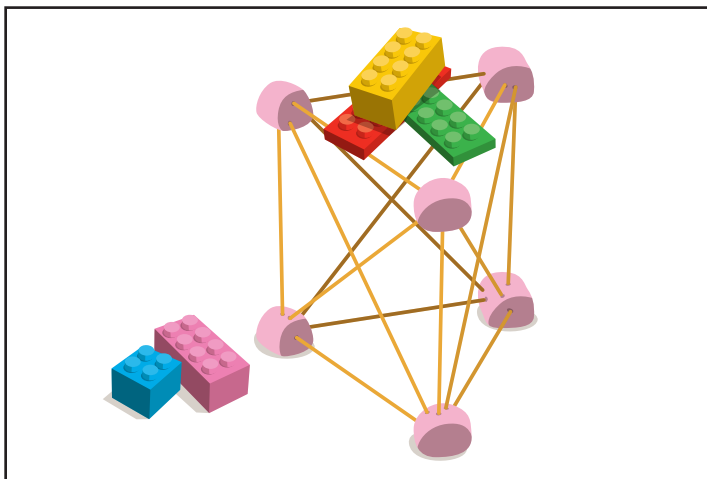
- One pack of dried spaghetti pasta
- One pack of marshmallows



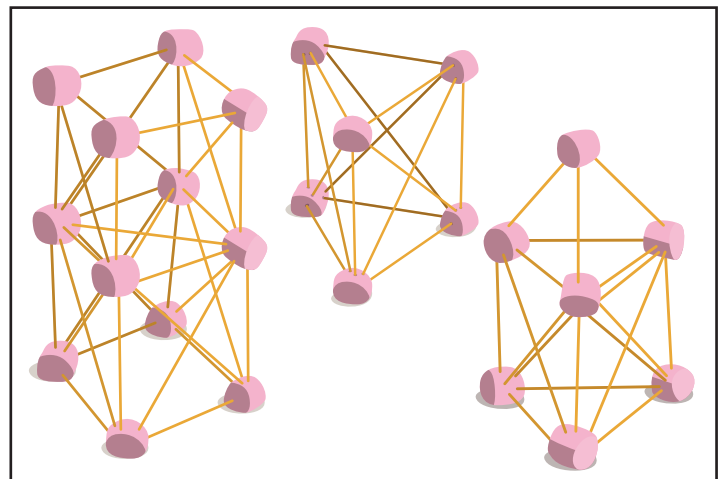
First, insert a piece of spaghetti into one of your marshmallows. Pay close attention to the amount of force it can handle before it snaps!



Repeat the process to create interlinking shapes - remember that triangles are the strongest!



Test the rigidity and strength of your construction by placing small toys on top - can it hold their weight?



Try a variety of structures and see which one allows you to build the highest, and which one supports the most weight!

EXTRA CHALLENGE: TRY REPEATING THIS ACTIVITY WITH A RANGE OF DIFFERENT BUILDING MATERIALS TO SEE WHICH SET MAKES THE STRONGEST STRUCTURE! YOU COULD START WITH LOLLY STICKS AND PLAY CLAY!



TASK 5:

TRIANGULATE THE TREASURE

ARRR! IF YE BE IN SEARCH OF A SCANNER, PROVE YOUR FAITH IN THE POWER OF 3 AND LOCATE THE SEGMENT WITH ONE RIGHT-ANGLE, ONE 70 DEGREE ANGLE, AND SIDE LENGTHS OF 23MM, 8.6MM AND 24.5MM!

