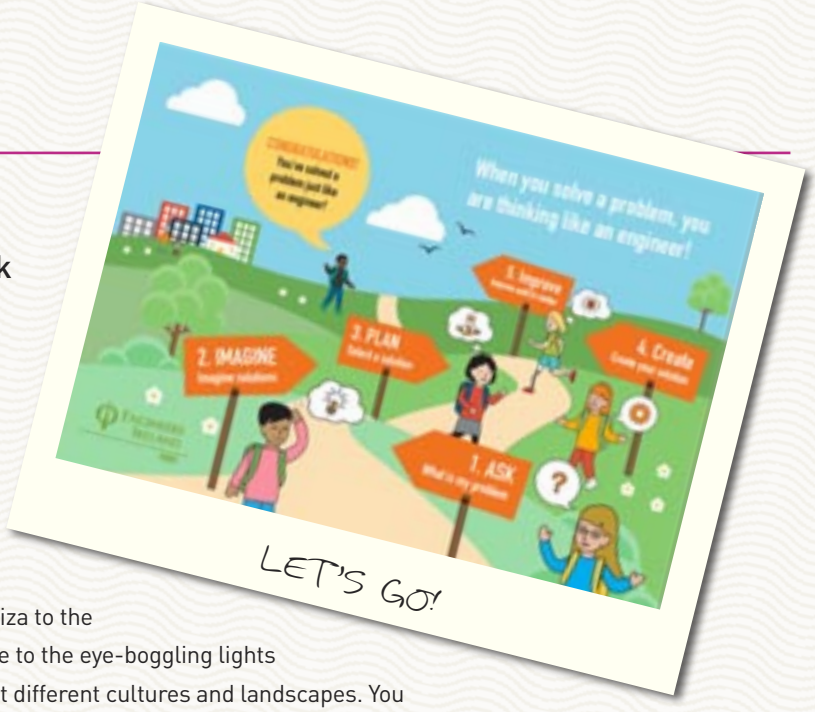
ENGINEERS IRELAND
STEPS

STEPS
Engineers Week

ENGINEERS WEEK
ADVENTURE WORKBOOK

BEFORE WE GO



Hello! And welcome to your Engineering Challenge Passport. We are about to embark on a Round-the-world engineering adventure like no other.

On this trip you will face many challenges. For each one you will need to use your inner-engineer to look at the problem facing you and come up with a way to solve it.

You will see many fascinating sights from the pyramids at Giza to the bullet trains of Japan; from the ancient tombs in Newgrange to the eye-boggling lights and fireworks in Time Square New York. You will learn about different cultures and landscapes. You will also see how, no matter where you are in the world, engineering is all around you and you will take on many engineering tasks along the way. You will learn that engineers like to solve problems, be creative and have fun!

For every task you complete in each country don't forget to collect your stamp for your passport to say "I've Been Here!". You can draw in the matching stamp for each challenge in the 'Stamp Square' at the bottom of the challenge page. There are 12 to collect in total.

Good Luck and Bon Voyage!

CONTENTS

STAMPS TO COLLECT

When you go on holiday (outside the European Union) your passport will be inspected at the airport and the officials will stamp your passport with the date you arrived. Each country has it's own unique stamp. Many people like to look at the stamps on their passport to remember their holidays and adventures. For your Engineering Challenge Passport you will also get a stamp for each country you visit and challenge you complete.

When you complete a challenge draw the matching stamp from the table below in the Stamp Box at the bottom of Engineering Challenge Passport page – before you move on to the next country and the next leg of the trip!

Don't forget to put the date on it!

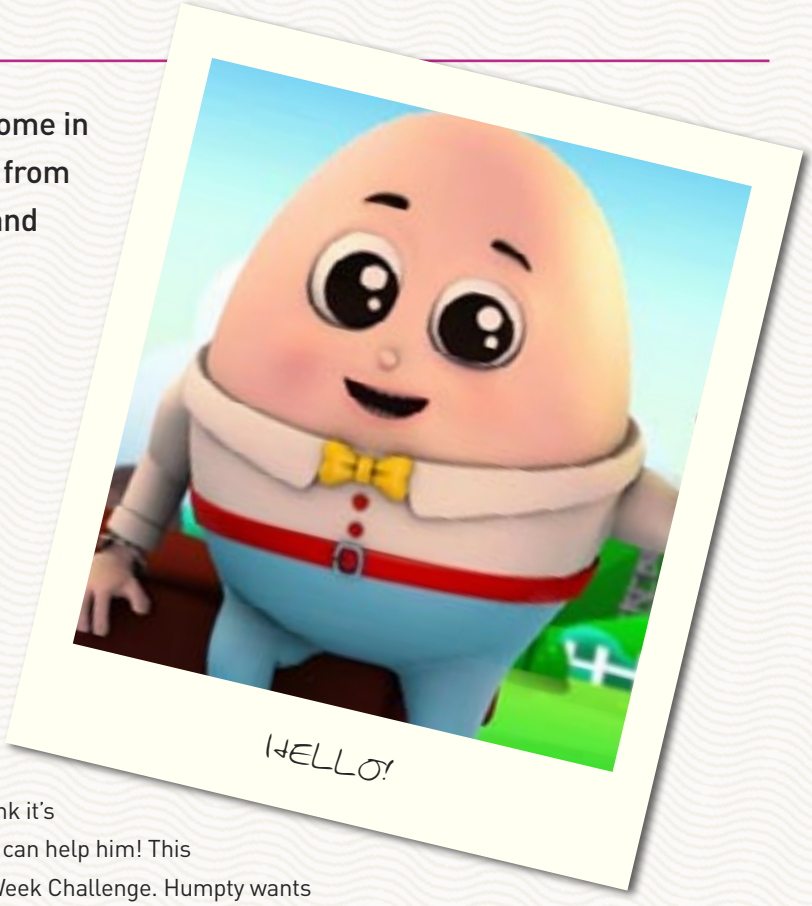
YOUR CHALLENGE

Can you collect them all?

IRELAND – EGG DROP	NEWGRANGE - MAZE	EGYPT - MAZE
		
JAPAN – ENGINEERING ORIGAMI	**SOUTH PACIFIC – GET CONNECTION**	**USA – LIGHT IT UP!**
		
CROSSWORD – THE WORLD	**FLIGHT HOME – IN FLIGHT ENTERTAINMENT**	**CONGRATULATIONS!**
		

IRELAND: HAVING THE CRAIC - WITH NO CRACK?

We will start our Engineering World Tour at home in Ireland. However, we will take our inspiration from 18th century England. A new nursery rhyme and riddle had just been published. Little did they know just how popular this rhyme would be! Maybe you know it?



"Humpty Dumpty sat on the wall
Humpty Dumpty had a great fall
All the king's horses and all the king's men,
Couldn't put Humpty together again!"

Fast forward a few centuries and poor Humpty is still falling off his wall and not being put back together again. I think it's clear that none of the king's horses or none of the king's men can help him! This year Humpty has contacted STEPS with a special Engineers Week Challenge. Humpty wants Irish children to design an engineering solution to his problem so that he doesn't need to be put back together again every time he falls.

The Engineers Week "havin' the craic with no crack" Egg-Drop Challenge

Your challenge is put on your engineering hat and devise a way to help Humpty! Can you design a device for Humpty so he can fall off his wall at will without fear for his safety? So he can have the craic falling off his wall – with no crack at all?!

If you have an idea (the whackier the better) we want you to make a prototype, test it, and then video Humpty (a raw egg) falling off his wall and landing happily in one piece, using your design.

As part of the Engineering Passport we want to showcase the beauty of lesser-known Ireland with the location in the video. This could be your local park, your garden, your living room or an interesting location for a great fall!

YOUR CHALLENGE

Materials:

Egg(s) - **raw** for your video entry (hint: use a boiled egg for testing the prototype)
1m wall/height to fall from
Materials of your choice for the engineering prototype (extra points for using sustainable materials)
Optional: Markers/clothes to bring the egg's persona to life (who is he or she? Give them a personality!)

Rules

Humpty must fall 1.5m min
He must land on the ground (and stay there after landing)
The egg must be raw for the video
The egg must not be damaged in any way by the fall

The Competition

Make a 1 minute max video of Humpty falling and landing
Showcase the location
(feel free to add an introduction to your egg and your prototype)
Post the video on Engineers Ireland Facebook page
Use the hashtag #STEPSENGINEERSWEEK

Prize

A €100 One-for All voucher

You can Submit your videos to STEPS@engineersireland.ie

Inspiration

There are lots of ideas available on the internet. Of course, if you can design something original the Engineers Ireland judges will be very impressed. The device is usually something with a protective case for the egg and aerodynamic qualities to slow down the device on the fall (think balloon, parachute, wings, etc).

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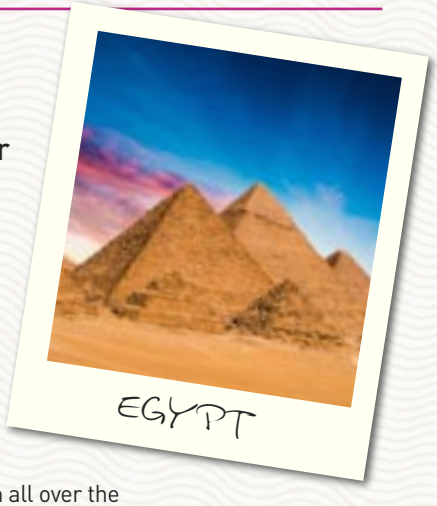
TIME TRAVEL TO EGYPT: AN A-MAZE-ING ENGINEERING HOLIDAY



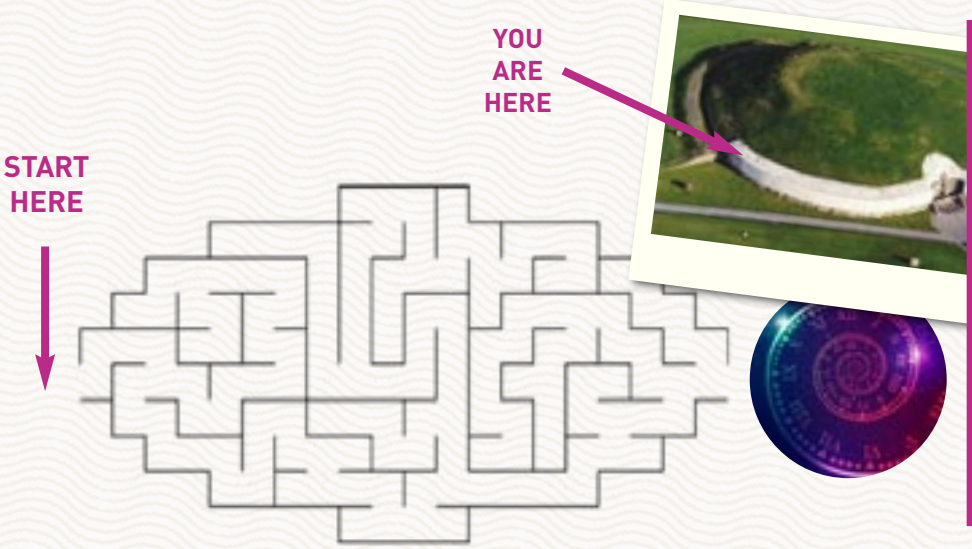
Are you ready to go on holidays? The first stop on our Engineering Extravaganza is Ancient Egypt (2500BC) where the Pharaohs (and their engineers!) are very busy building what will be the highest structures ever built (at the time): The Pyramids in Giza.

They did such a brilliant job on the construction and design that they were indeed the highest building in the world - a record they kept for a staggering 3800 years!!
In order for us to go and look at these structures for ourselves we will have to find our Irish Time Machine which we've heard is hidden in Newgrange, Co. Meath. Newgrange is an incredible example of ancient engineering. And it was built about 500 years before the pyramids in Giza! It was designed so that the sun would light up the passage to the centre of the large tomb on the Winter Solstice (21st December) every year, which many millennia later it still does. Thousands of people from all over the world apply for a chance to witness this special event, but may never get a ticket as it is drawn by lottery. And even if you do get a ticket – the sun may not come out!

YOUR CHALLENGE

Can you make it through the maze to find the Time Machine?

Our Irish Time Machine which we've heard is hidden in Newgrange, Co. Meath. Newgrange is an incredible example of ancient engineering. And it was built about 500 years before the pyramids in Giza! It was designed so that the sun would light up the passage to the centre of the large tomb on the Winter Solstice (21st December) every year, which many millennia later it still does.



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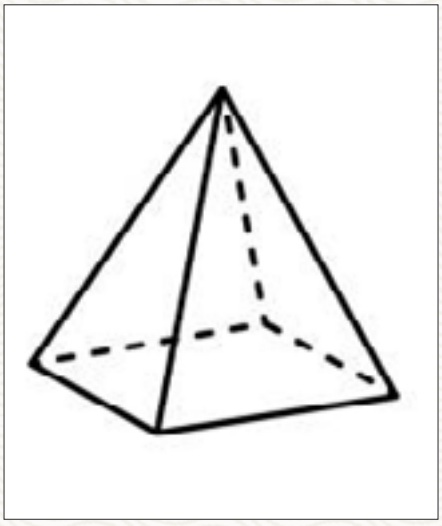
YOU MADE IT! CONGRATULATIONS!

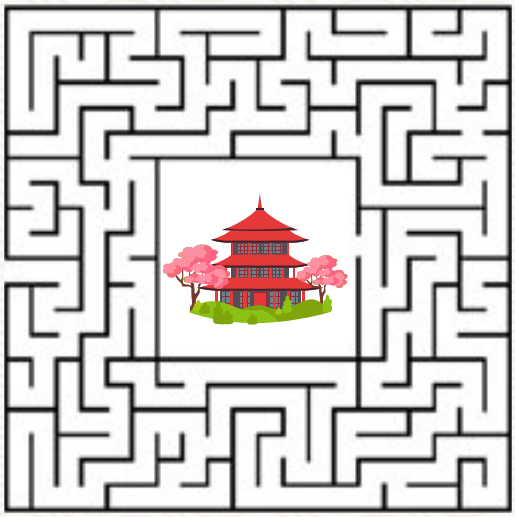
We are in Giza – looking at the amazing pyramids! And a-maze-ing they are! They, like Newgrange, are also filled with many passageways, but they are much bigger.



A pyramid is a shape that is also called a tetrahedron. It is a very stable shape as it has a large square base and it is very difficult to knock over. So it was a good choice by the Egyptian design engineers at the time!

Your next challenge is to make it to the **central chamber** of the largest pyramid in Giza, The Great Pyramid. This is a more difficult maze. Once you get to the centre you will be whisked away to the next stop on our trip. The next section is Japan

START
HERE



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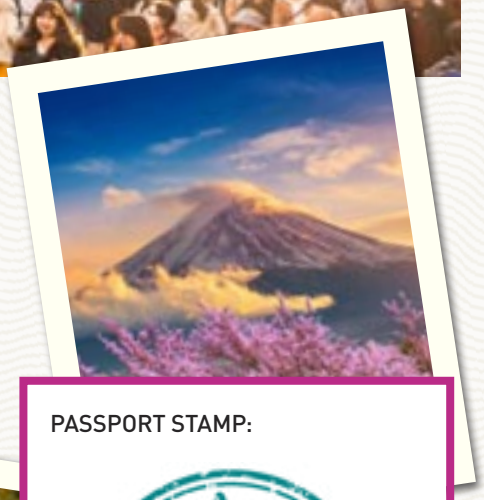
JAPAN - PAPER ENGINEERING

こんにちは

Kon'nichiwa (which means hello in Japanese) and welcome to Japan!

We have landed in the biggest city in the world: Toyko, in Japan. The Japanese have some incredible examples of engineering. Their train service is famous for the numbers of people they carry everyday at very fast speeds and on time. The bullet train is one of the fastest trains in the world. If it was in Ireland it would bring you from Dublin to Galway in about 40minutes! What other examples of incredible engineering can you find in Japan? There are lots!



For this challenge we will use the Japanese traditional art of origami to create a prosthetic finger. Engineers, especially biomedical engineers, apply principles of engineering to help develop medical solutions. So prosthetics is just one example. Prosthetics are getting more and more advanced with engineering input and making the quality of people's lives much better.

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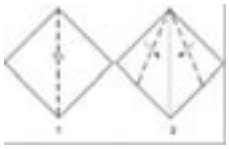
YOUR CHALLENGE

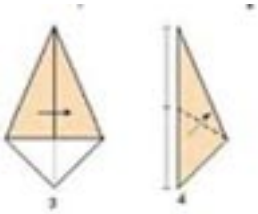
Design an origami prosthetic finger.

For this Japanese-inspired engineering challenge you will need square piece of paper. (For a big finger use 20cm2. For smaller child-size finger use 14cm2.) You can easily make a square sheet out of A4 or A5 paper by folding one corner to meet the otherside of the page and cutting the remaining paper at the bottom so there is a triangle left. Unfold to make a square).

1. Fold the square into a triangle and unfold again to make a crease line down the centre. Then fold the two edges to the centre to make a kite shape (see figure 3).



2. Fold the kite shape in half. Find the half-way point along the spine of the folded kite and fold the bottom half up so that it folds between the halfway point and the right-hand edge (see figure 5).

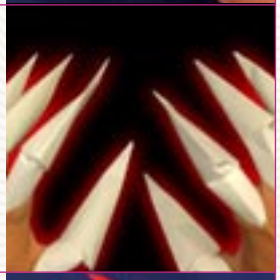


3. Continue folding the same piece around the body and tuck in the remaining piece into the pocket created.

4. All you have to do now is fit your finger in the gap and bring your prosthetic finger to life!

5. Now you have made an origami prosthetic finger! Could you add some other features like nails, knuckles, a ring to make them look more realistic? Could you add a mechanism to make it move?

6. What about making some more to make a set of claws?



7. And decorating them?

8. Or what about making some bird puppets?

Congratulations! You have used your engineering intuition and creativity to design prosthetic device. A prosthetic is a device that will helps to improve someone's quality of life. In general, all engineers use their skills to improve the quality of people's lives, be it through better transport, medical equipment, even entertainment like videogames... the list goes on.

Wow so far this has been a busy trip full of travel, adventures and challenges. It's time for a break! Let's go and get lost on a desert Island in the South Pacific.

SOUTH PACIFIC: STRANDED ON A DESERT ISLAND

It was paradise at first. The white sand beach all to yourself. The coconut tree to climb for some fresh coconut water. There were huge starfish in the clear blue waters and colourful fish to chase. You thought you would never want to leave.

But then you got hungry (for some yummy chips or ice-cream) and got tired of sleeping in tent. You have started to miss your family and friends and a solid bed! So now you want to leave. But you can't seem to find any phone connection from your hammock on the beach to call home or to book your ticket off the island.

But you are an engineer – so of course you have a cunning idea!

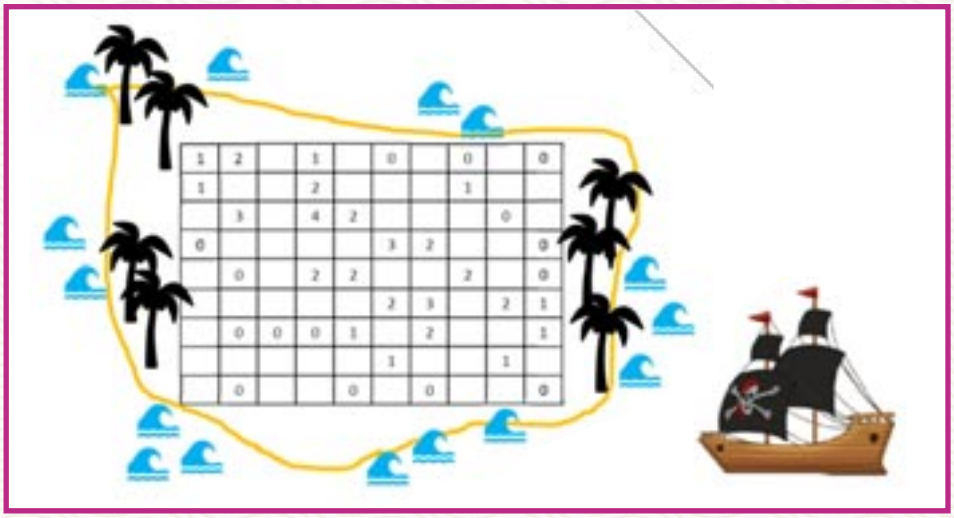
You have found a map below showing the phone signal connection on the island. However, it is not complete – it got damaged when the girl who gave it to you went for a swim in the sea. However, you know that there are exactly 10 connection points on the island and you know that there is enough information on the map to work out exactly where they are.

YOUR CHALLENGE

Using the map, can you find the 10 squares which have signal connection on the island?

Each square with a number on it shows how many connection points that square touches. For example, if the square shows 2 then 2 of the squares it touches have connection points. **Hint:** Start with the squares labelled 0. These squares do not touch any connection points – so mark 'X' in the boxes surrounding the '0' boxes so you know there are no connection points in them.

When you have found the 10 signal connection point squares, can you work out the best place (square) to make the phonecall? (This will be the square which touches the most connection points.)



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NEW YORK TIME SQUARE: NEW YEARS PARTY!

Well done! You worked out the best place to make a phonecall and boarded the next cruise ship to New York City USA. This is the last stop on your way home.

But what a great way to end the trip! Manhattan Island is a city of skyscrapers with a very famous skyline. Can you imagine if you were an engineer on one of those skyscrapers? How proud would you be seeing your designs and creations in major Hollywood Blockbusters? Amazing!

You have come to New York city at a great time. It is very cold compared to the island in the South Pacific – but it buzzing here. It is a special time of year. There is snow, ice-skating and choirs singing in the streets – because we are about to ring in the New Year. And where better to go then Time Square? It will be full of people, fireworks and lights!

However, there is a problem. With the fireworks and the numbers of people, the mayor of the city is worried that this might cause a fault with the electricity. And if the lights go out there might be panic among the crowds and the New Year may be a black-out.

They have asked for an engineer to help!

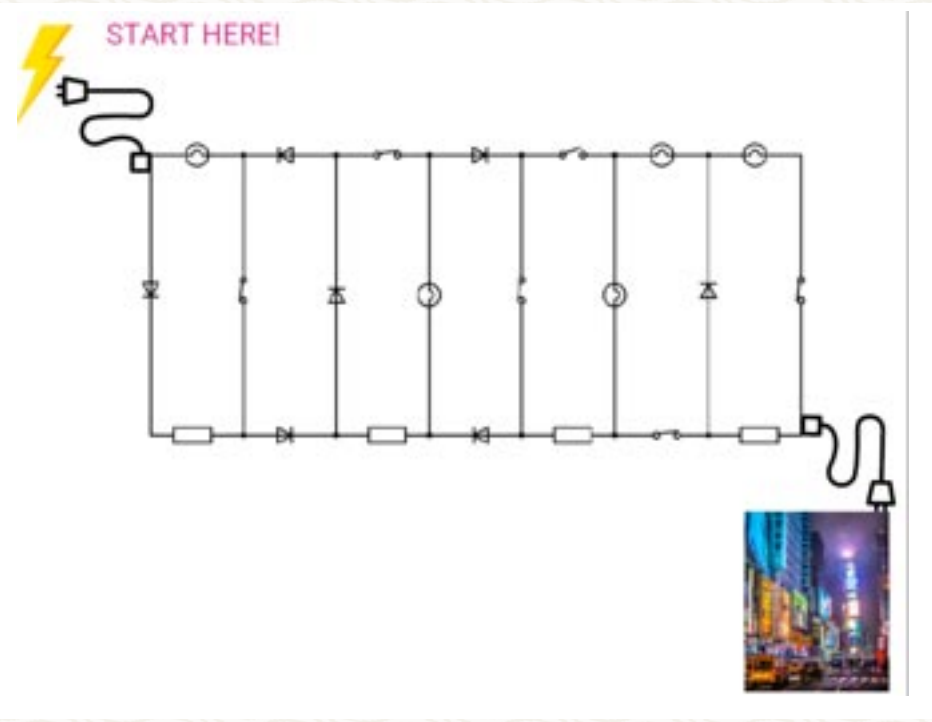
YOUR CHALLENGE

As an engineer you have been asked by the mayor to help. She has given you the circuit diagram for the lights in Time Square and wants you to make sure that everything is on track for a great night. She would also like to keep energy wastage to a minimum as she wants New York to be as energy efficient as possible.

Can you work out if the lights will turn on when the plug is connected to the electricity? Use the table explaining the symbols to work it out. (Note: There are a more than one path the electricity can take).

Can you find the route that wastes the least energy? The bulbs and resistors both slow down the current and waste energy. The resistor wastes twice the energy of the bulb. Can you select the route with the least energy wastage?

Now – what if there is a problem? What if somebody opens switch 1 in error on the night? What will happen the electricity and the current? Will the lights turn on in Times Square on New Years Eve?



Each symbol represents a different feature that will affect the current.

Diode The Electricity can go in the direction of the arrow only (forward)	**Resistor** Current can pass through the resistor but it will slow it down. It will slow it down and use twice as much energy as the bulb.
Reverse Diode The Electricity can go in the direction of the arrow only (backwards)	**Open Switch** Current cannot flow through an open switch
Bulb The current can flow through the bulb and will light it up as it goes. This will slow down the current slightly and use extra energy.	**Closed Switch** Once the switch is 'turned on' current can flow through

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IN-FLIGHT ENTERTAINMENT

What a great way to end the trip with the lights and fireworks in New York for New Year's Eve! And they went ahead without a hitch – thanks to the brilliant engineering design and your help!

Now we are on the plane home to Ireland. Wow! Airplanes are amazing pieces of engineering! To think that humans have learnt how to defy gravity and use the properties of the air to fly from one place to next is mind-blowing! Have you thought about how much flight has changed the world as we know it in the one hundred years since the first flight?

But more importantly... where are the in-flight snacks? While we are waiting for the service and the movies to be turned on here is a puzzle to keep you going.

YOUR CHALLENGE

Can you work out the four-number code?

A tick means the number is correct and in the correct place
A line means the number correct (it is of the four numbers) but it is not in the right place
An 'X' means that number is not one of the four

1	2	7	8
2	5	6	1
3	6	1	6
4	5	6	7
9	9	5	6

✓	✗	✗	✗
✗	✓	|	|
✗	|	|	✓
|	✓	|	✗
✗	✗	|	|
✓	✓	✓	✓

(Hint: fill in the numbers with ticks in the blank spaces provided first)

PASSPORT STAMP:

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BACK HOME CROSSWORD CHALLENGE – THE WORLD (LEVEL 1)

We have arrived home safe and sound – thanks to the brilliant engineering safety design of all the transport we have used along the way.

What a trip we had! We had adventure. We had intrigue. We had history. We celebrated. We relaxed. We saw some great examples of engineering on our trip and we used our engineering intuition to tackle the many challenges we faced along the way. Let's look back at our trip with another challenge – a cross-world challenge!

Engineers have to solve problems every day. Crosswords are brilliant ways to solve problems using words instead of numbers.

Before we start - let's remember some of the places we visited

Egypt and Pyramids of Giza:
engineering in the ancient times

We flew to a desert island to get away from it all.
But used our engineering mindset to reconnect!

Japan - high technology and engineering mixed with ancient traditions

We ended in New York City – home of the iconic skyscrapers like the Empire State Building

We had a lot of fun!

YOUR CHALLENGE

Can you solve the crossword and guess the missing word (6 Down)!

Read the clues for the crossword and fill in the answer in the puzzle.
There is no clue for number 6 Down. Can you guess the word?

Hint – There are lots of clues in the memories above. If you need an extra help there is a list of all the words below and you can match them to the clue.

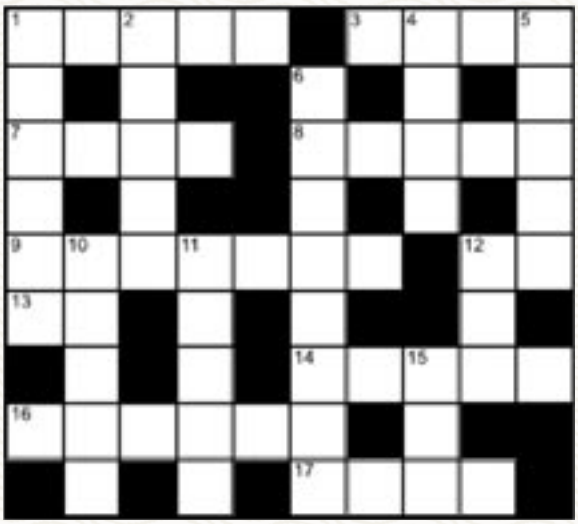
Good Luck!

Across

1 A game, or games, played according to rules. for example soccer, hurling, running, basketball (5)
3 A holiday or car journey or school outing (4)
7 A seperated area within a building, for example kitchen or lounge (4)
8 A specially trained Japanese warrioer, also associated with the Teenage Mutant Turtles (5)
9 One of the famous triangular (tetrahedral) buildings in Giza, where ancient Eguptian kings are said to have been buried (7)
12 Us, collectively. for example: _____ went to the birthday party (2)
13 European Union in short - the initials (2)
14 The _____ Tower. Famous French landmark in Paris (5)
16 A famous skyscraper in New York. the _____ State Building (6)
17 A circle, or a piece of jewellery typically used to propose to someone, or to call someone on the telephone (4)

Down

1 A line, as part of a series of lines. For example on a Zebra it's either black or white (6)
2 A smell or scent, usually unpleasant (5)
4 Class - as Gaeilge (4)
5 What you fly on to go on holidays (5)
6 *Fill this clue in last*. Can you guess what the word is? (8)
10 Mmm... Delicious! (5)
11 The room under the roof in a house, where a lot of stuff is stored (5)
12 Sorrow. (Clue: rymes with toe!) (3)
15 Enjoyment! What you have when you are on holidays, or when you are playing games with your friends, for example (3)



Here is the list of words in the crossword if you need a hint!

ATTIC	FUN	RANG	TRIP
EIFEL	NINJA	RING	WE
EMPIRE	ODOUR	ROOM	WOE
ENGINEER	PLANE	SPORT	YUMMY
EU	PYRAMID	STRIPE	

PASSPORT STAMP:

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ANYWHERE – ENGINEERING IS EVERYWHERE AND ANYWHERE

Congratulations! You have made it around the world and collected your Engineering Passport Stamps to prove it. Along the way you have learnt that engineering is everywhere – even where you don't expect it! It is all around you and you interact with it everyday. You have also seen that engineers love to solve problems. They are practical and creative and look at the challenge presented to them and try to work out the best solution.

YOUR LAST CHALLENGE

Can you find at least 20 examples of engineering in this picture?

When you have finished – colour them in and show off
your creative side! You can post your creations to #STEPSEngineersWeek so we can see your great work!

PASSPORT STAMP:

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