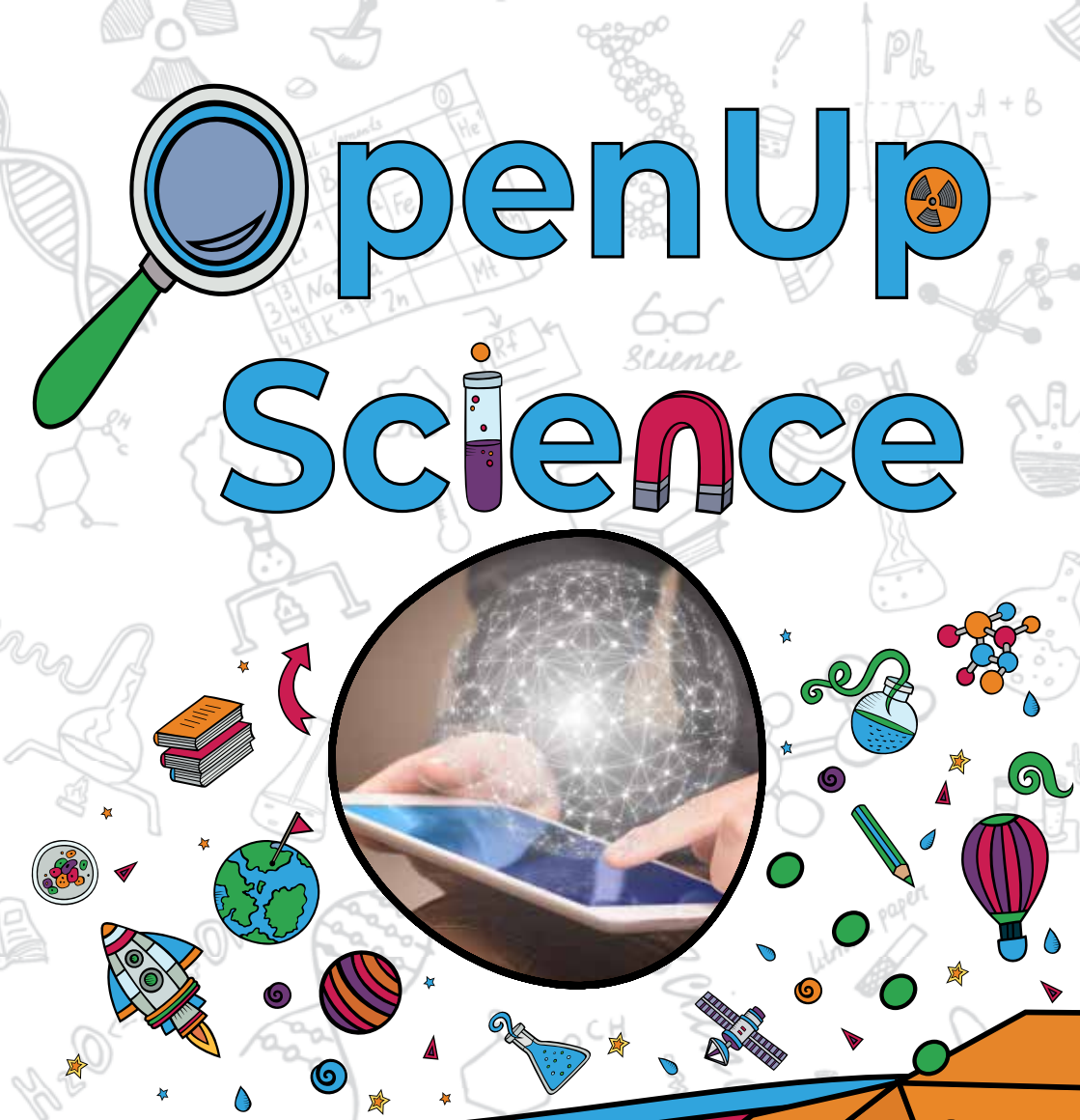
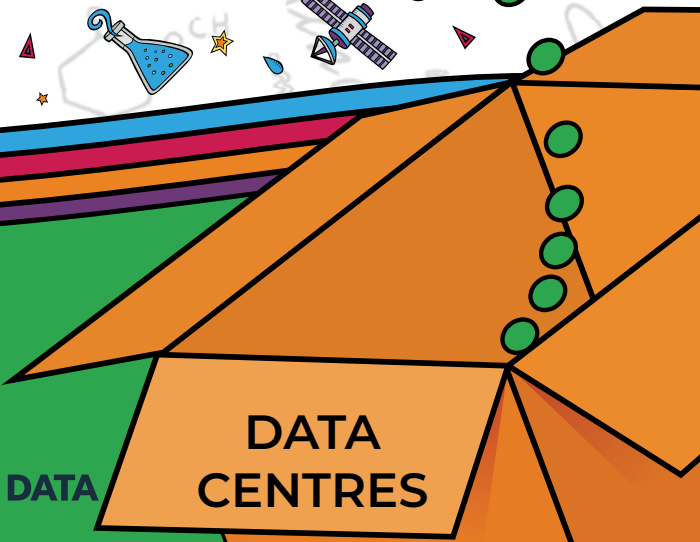




penUp Science



with
 KAO DATA



DATA
CENTRES

Welcome to OpenUpScience

from Cambridge Science Centre.



This issue is all about Data Centres

and is kindly sponsored by  **KAO DATA**
who own data centres.

**But what is data? What is a data centre?
And what is the internet?!**

Data is the information that computers use to make words, pictures and videos. A data centre is a place with lots of computers called servers that can store lots of data. The internet connects data centres and computers, phones and games consoles all over the world, letting people share information.

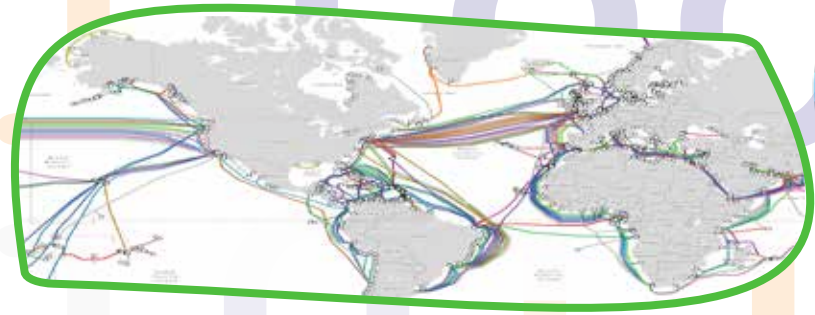
But how does it all actually work?

**If you want to see a website,
your computer sends a
request to the internet.
This request is sent as data.**



**Your computer
assembles the data
into the website you
see on your screen.**

**..and all of this happens
almost instantly!**



The internet is data centres around the world connected by fibre optic cables buried underground. These cables run everywhere, across countries and even through the sea (shown in the map!), and the data moves through the cables as light.

Kao Data takes its name from Sir Charles Kao who worked out how to make glass fibre optic cables that are able to send data as light over long distances .

Your request goes to a data centre which then connects to other data centres



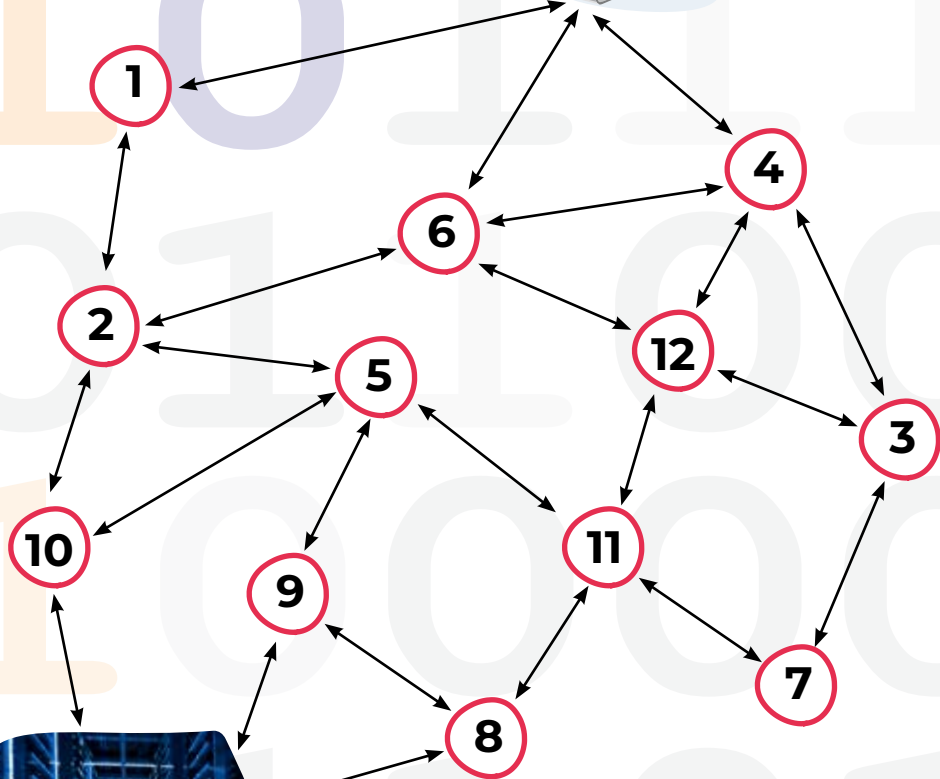
The data centre with the server that has the website you want then sends the data to your computer.

Sometimes we save our files to our computers, but sometimes we save them to the 'cloud'. This isn't an invisible data cloud that floats up in the sky! Instead, you are saving your files, or data, to a server in a data centre!



The Route Of Data Puzzle

This young scientist wants to look at a Cambridge Science Centre video.



The data travels as light through the internet. There are lots of different routes that the light can take, it will always take the quickest routes at the time.

How many different routes could the data take?

Which are the quickest routes (fewest steps)?

Why We Need Data Centres



Data centres provide huge amounts of data storage, colossal quantities of computing power and allow superfast connectivity between computers.

If you have ever...

used online shops

streamed music

binged a tv series

gamed online

found a route on a map

sent an email

had a chat on a video call

...then you have used the power of data centres!

But what else do data centres do?

Data storage - streaming services need huge amounts of data storage to hold all of your favourite films and tv shows.

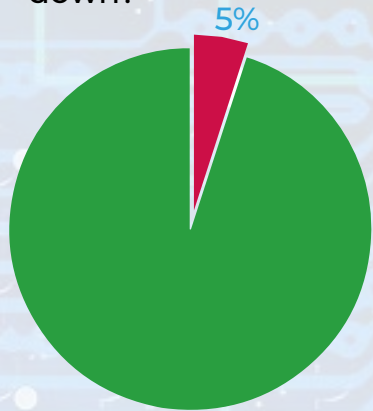
Computing power - healthcare companies need colossal quantities of computing power for drug development research.

Superfast connectivity - online conferences allow 1,000s of people to meet, talk, and share ideas. You may have done this with online lessons!

Cooling Computers

Ever felt a computer get hot? Well, with great computing power comes great heat. Data centres get *very* hot! So how do we cool them down?

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Cooling computers with air conditioning takes a lot of energy! Estimates are that around **5%** of Europe's energy bill is spent on cooling computers!

So we want another way of cooling the computers. What other ways can we cool things down? How does your body cool you down?

Our body has a built in cooling system - sweating! When we are too hot, the part of our brain that is in charge of temperature called the hypothalamus (say: hi-po-THAL-uh-mus) sends a message to your body telling it to sweat. The sweat leaves your skin through tiny holes called pores. When the sweat hits the air, it evaporates off your skin, cooling you down.



Chilling Science

Feel the cooling effect of evaporation!

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What to do

1. Carefully drop a small amount of hand sanitiser onto the back of your hand and spread the liquid with your finger. *How does the sanitiser feel when it touches your skin?*
2. Blow softly on the area that you put the sanitiser. *Does your skin feel any different when blowing on the sanitiser? Can you feel a temperature difference?*

What you'll need

- Hand sanitiser

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What is happening?!

Blowing on your hands helps the sanitiser to evaporate. To evaporate, the sanitiser needs to turn from a liquid into a gas. This takes energy in the form of heat. The heat is taken from your hand, meaning your hand is left colder. Kao Data use evaporation in their data centre cooling systems. The heat to make a liquid evaporate is taken from the air inside the data centre through an evaporative chiller, which then leaves the air cooled.



This works with water too, but sanitiser evaporates quicker which means your hand feels cooler!

Code Puzzler

Computers communicate in a code called binary which is made up of different combinations of 1's and 0's. Here is the word science in binary!

01010011 01100011
 01101001 01100101
 01101110 01100011
 01100101 00001010
 00001010

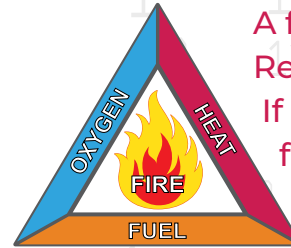
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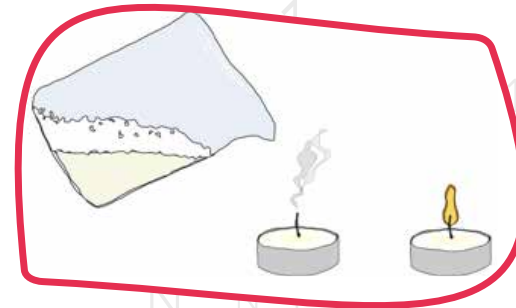
Fire Control Experiment

Most large buildings, like schools, will use water sprinklers that automatically go off when there's a fire. Why might this not be a good idea in a data centre full of computers? What could we do instead?

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A fire needs three things - fuel, oxygen and heat. Remove any of these things and the fire goes out. If there's a fire, data centres remove the oxygen from the room, replacing it with a different gas that won't let the fire burn.



What you'll need

- A jug
- A teaspoon
- Bicarbonate of soda
- Vinegar
- Tealights
- Matches
- **Adult supervision**

Here is the alphabet in binary. Use this to answer the questions below.

A	01000001	H	01001000	O	01001111	V	01010110
B	01000010	I	01001011	P	01010000	W	01010111
C	01000011	J	01001010	Q	01010001	X	01011000
D	01000100	K	01001011	R	01010010	Y	01011001
E	01000101	L	01001100	S	01010011	Z	01011010
F	01000110	M	01001101	T	01010100		
G	01000111	N	01001110	U	01010101		

Solutions at the back

Q1. What letter can you swim in?

Answer: 01000011 or _____

Q2. What letter buzzes around flowers?

Answer: 01000010 or _____

Q3. What letter do you use to see?

Answer: 01001011 or _____

Q4. What is a pirate's favourite letter?

Answer: 01010010 or _____

Notice how each letter is made of a combination of eight 1's or 0's? We call the 1's and 0's 'bits' and 8 bits = 1 byte. A byte is the amount of information a computer needs to make one letter. A Kao Data data centre has petabytes of storage. One petabyte is 1,125,899,900,000,000 bytes - that's lot of storage!

What to do

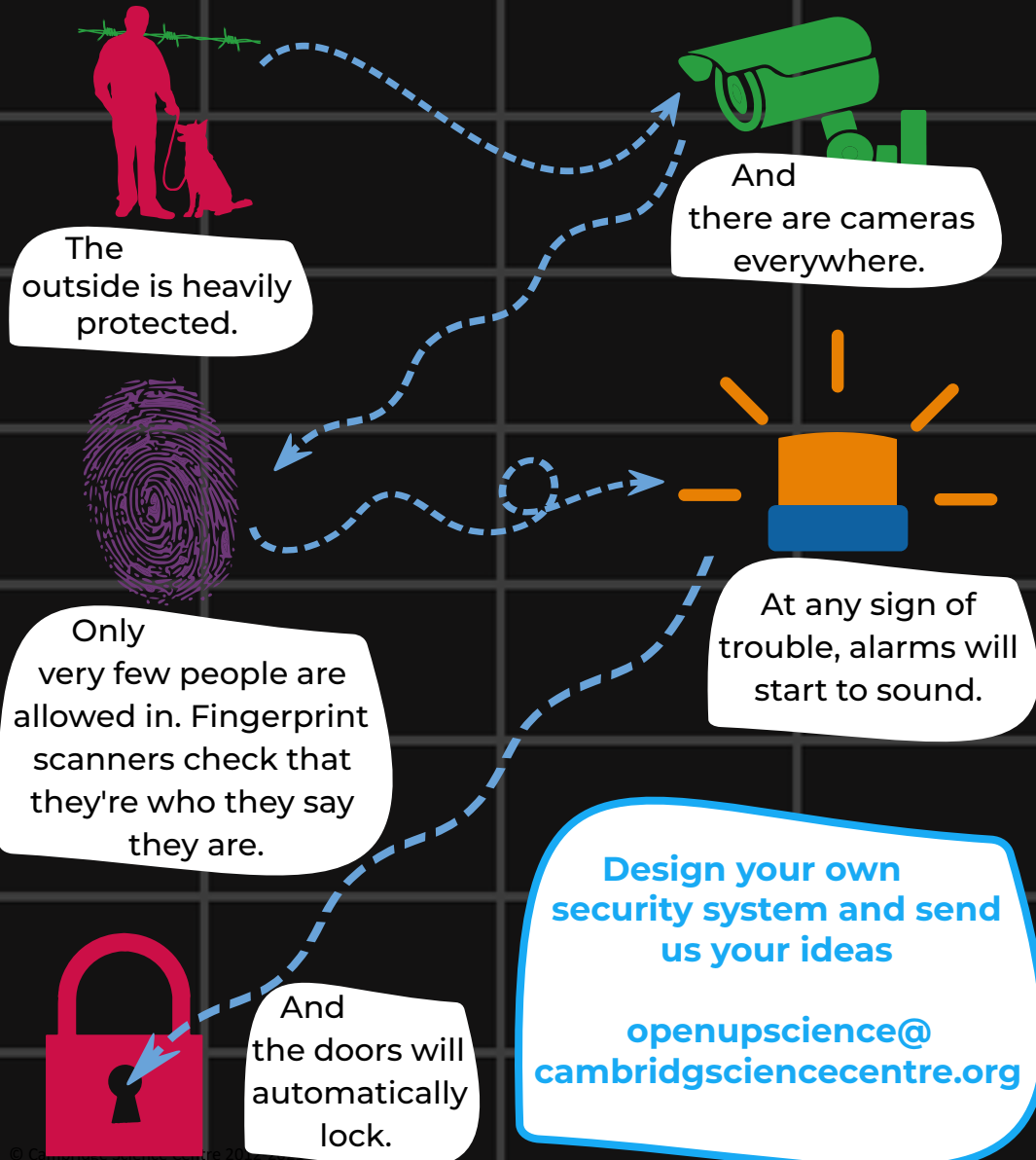
1. Put two teaspoons of bicarbonate of soda in a jug
2. Slowly add a small amount of vinegar. The mixture will fizz.
3. Light a row of tealights.
4. When the bicarbonate of soda and vinegar stops bubbling, pour the 'gas' from the jug over the tealight. Don't pour the liquid.

What is happening?!

Bicarbonate of soda and vinegar react to make carbon dioxide gas (CO₂). CO₂ is heavier than air so stays in the jug. When you tip the jug, you pour the CO₂ over the candle, which replaces the oxygen meaning the candle can't burn.

Securely Locked Away

Data centres have lots of personal information on their computers like names, addresses and passwords. This means that they need to be super secure...



Design your own security system and send us your ideas

openupscience@cambridgesciencecentre.org

Powering Data Centres

Data centres use electricity to run all of their servers. Kao Data get their electricity from renewable sources, limiting the release of CO₂ gas.



But, what happens if there is a power cut?

Because data centres house servers that run very important work, they can't stop. To keep data centres working, even in a power cut, they have backup batteries and generators.

These back-up generators usually run on diesel. Just testing the generators each year produces 33,500 tonnes of CO₂ gas! But, **KAO DATA** use a bio-fuel for their generators, reducing that CO₂ output by 90%.



Did you know?
If you put all the data created in one day onto DVDs, you could stack all those DVDs on top of each other and reach the moon - twice!



Puzzle Solutions

- Q1. What letter can you swim in? Answer: 01000011 or **C**
- Q2. What letter buzzes around flowers? Answer: 01000010 or **B**
- Q3. What letter do you use to see? Answer: 01001011 or **I**
- Q4. What is a pirates favourite letter? Answer: 01010010 or **R**

If you have any questions or want to send us a photo of your experiments, drop us an email at openupscience@cambridgesciencecentre.org

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or didn't like -
about this
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