SUPERLAB 2

Science at the heart of healthcare

IBMS Institute of Biomedical Science

SUPERLAB is a fun and educational comic for KS2 children about the wonders of biomedical science. This comic can be enjoyed by children alone, in the classroom or with the help of adults.

age 7-11

Biomedical Superheroes!

We're all biomedical scientists who perform medical tests in hospital laboratories

I'm CHEMIGIRL the CLINICAL CHEMIST and I analyse the chemical components in blood and wee samples. The chemical building blocks of life are carbon, oxygen, hydrogen, nitrogen, sulphur & phosphorus!

I'm MEDI-LASS
I am a Super Medical Laboratory Assistant. Get to know me on p.13

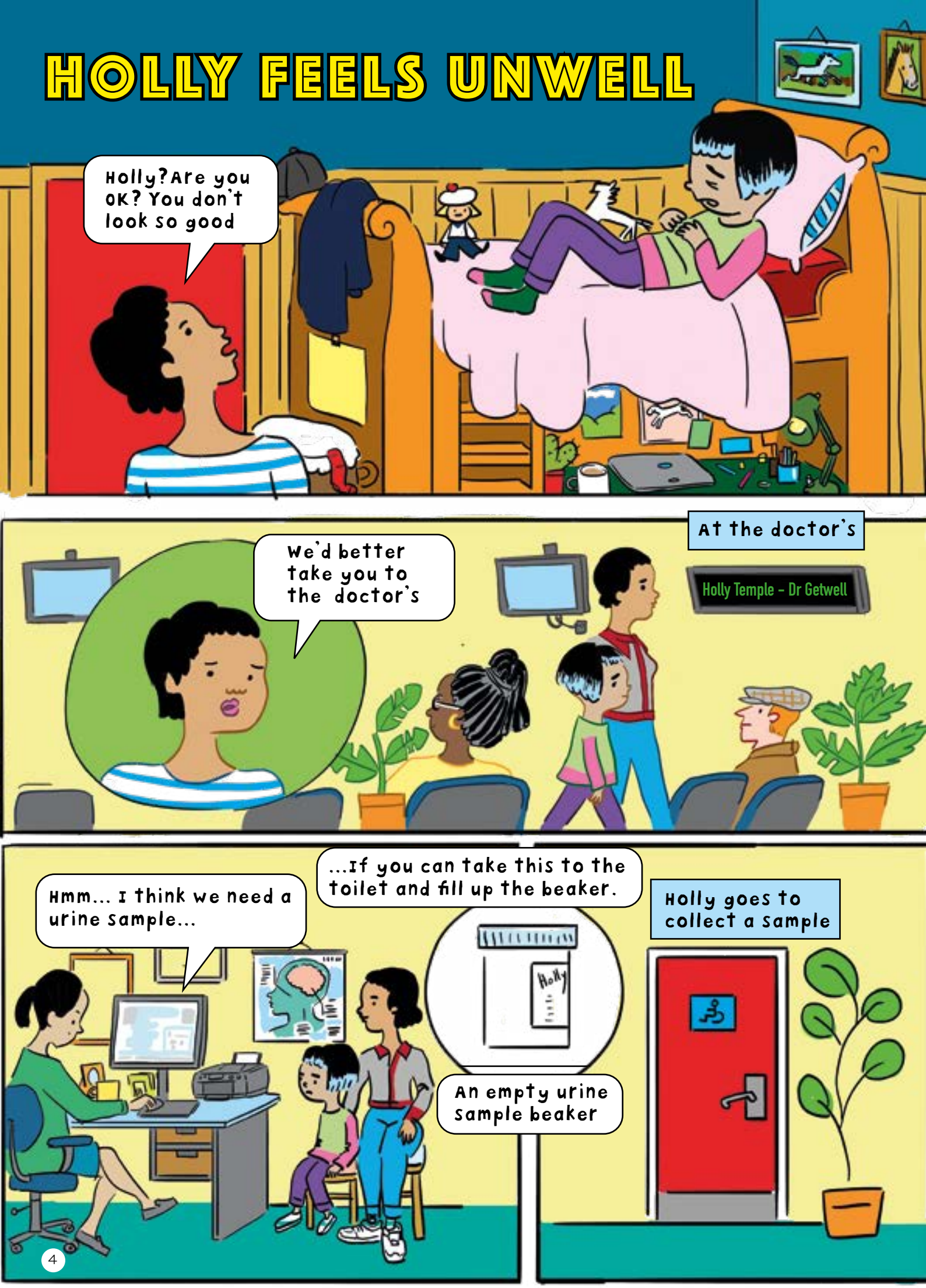
I'm IMMUNA the IMMUNOLOGIST and I understand your immune system, which is your body's alarm to fight against infection and diseases.

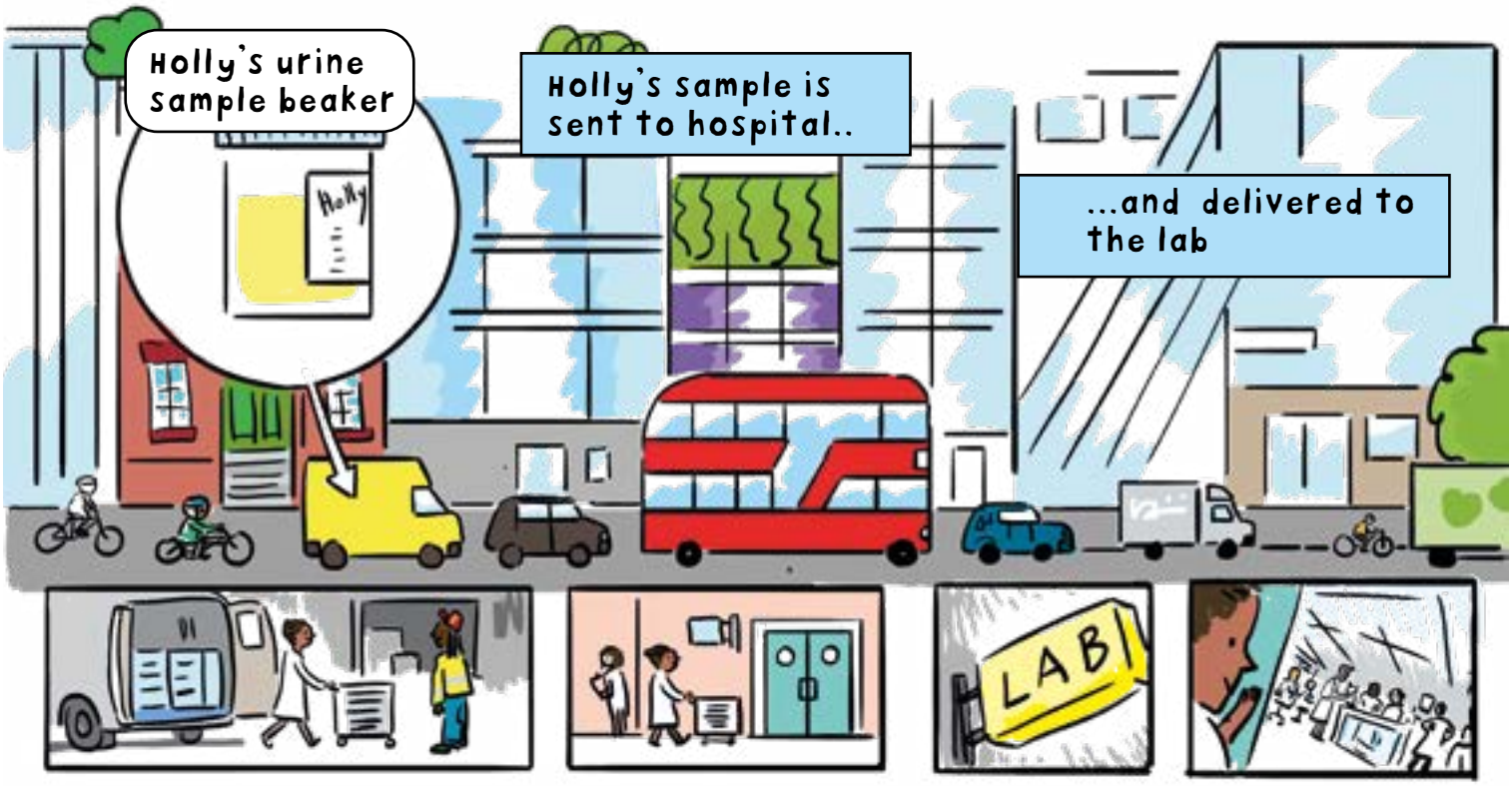
I'm BLOOD BOY the TRANSFUSIONIST and I make sure people who need blood donations get the right type of blood for them. 10% of your body weight is your blood!

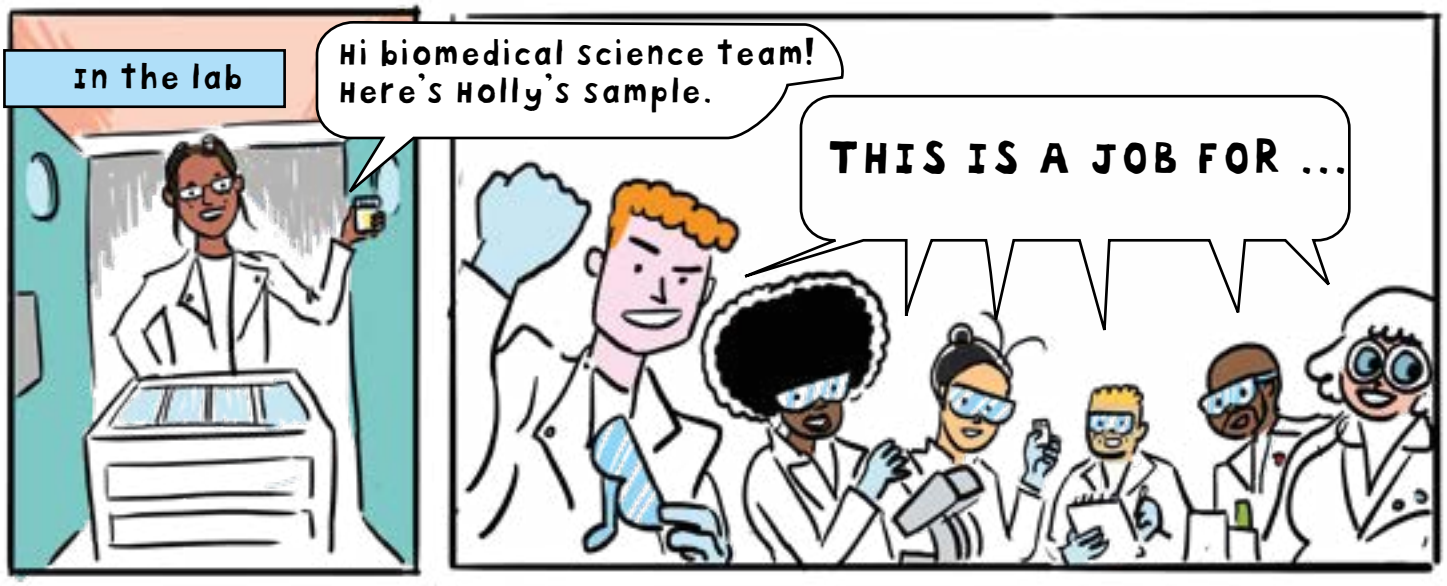
I'm SPECIMAN the CYTOLOGIST and I look for patterns in cells. There are over 200 types of cells that make up your body!

We help doctors find out why people are unwell

HOLLY FEELS UNWELL




Holly's urine sample beaker
Holly's sample is sent to hospital..
...and delivered to the lab
LAB


In the lab
Hi biomedical science team! Here's Holly's sample.
THIS IS A JOB FOR ...


...SUPERLAB!!!


Help SuperLab run Holly's tests on p.8!


The results are in!
Back at Holly's
HELLO?
Holly's results are in..
Holly and her mum go to the chemist to pick up medicine
Not so fast Holly!
A few weeks later- Holly is fully recovered!

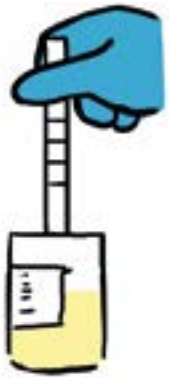
Let's perform some tests to see how SuperLab were able to help Holly using biomedical science!

wee sample

Chemigirl to the rescue! First, let's do a quick dipstick test to see if there's any infection

Urine sample

Dipstick goes into the urine pot

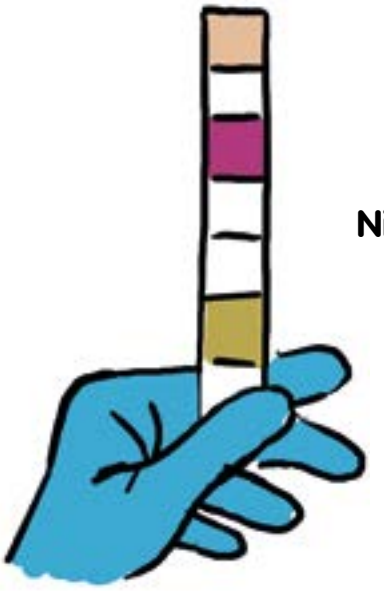


Dipstick results

The colours on the dipstick change based on the chemistry of the wee.

Match the dipstick results with the chart opposite. Circle the matching colour swatches

Result:



Dipstick chart:

Leucocytes

negative **trace** **positive**

Leucocytes are a type of WBCs (White Blood Cells) in wee – WBCs would only be in wee if your body was fighting an infection.

Nitrite

negative **trace** **positive**

The presence of nitrites in urine suggests there may be an infection.

pH

5 **6** **6.5** **7** **7.5** **8** **8.5**

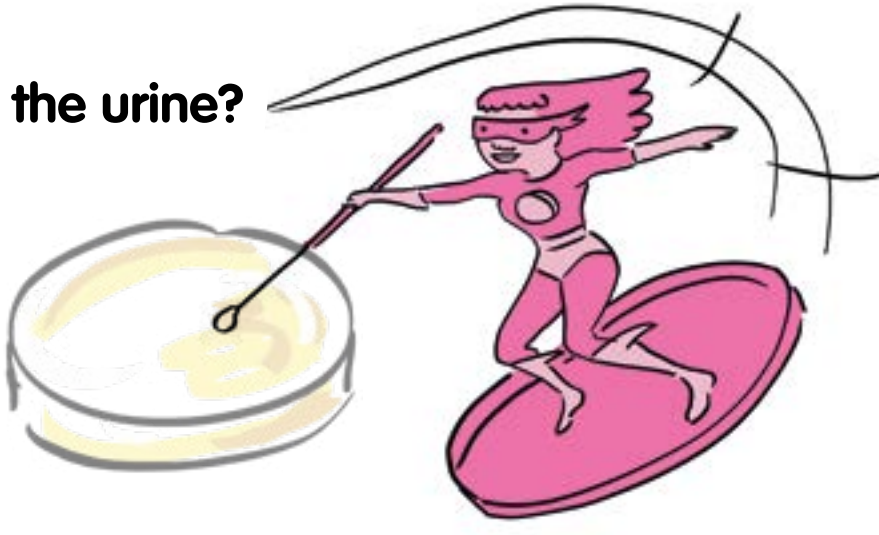
pH is a measure of acidity from 0 to 14. Healthy wee has a pH of about 5.

Based on the dipstick test, does Holly have an infection? **YES** ☐ **NO** ☐

Are there some bacteria in the urine?

First Bug Rider inoculates the Petri dish with the sample taken from urine

Then Bug Rider will look at the bacteria that grew on the plate under the microscope



Let's do a GRAM stain to learn more about the type of infection

A GRAM stain is a procedure of dyeing the cells. The way the colour sticks to the cells can help us identify the type of bacteria.

Key

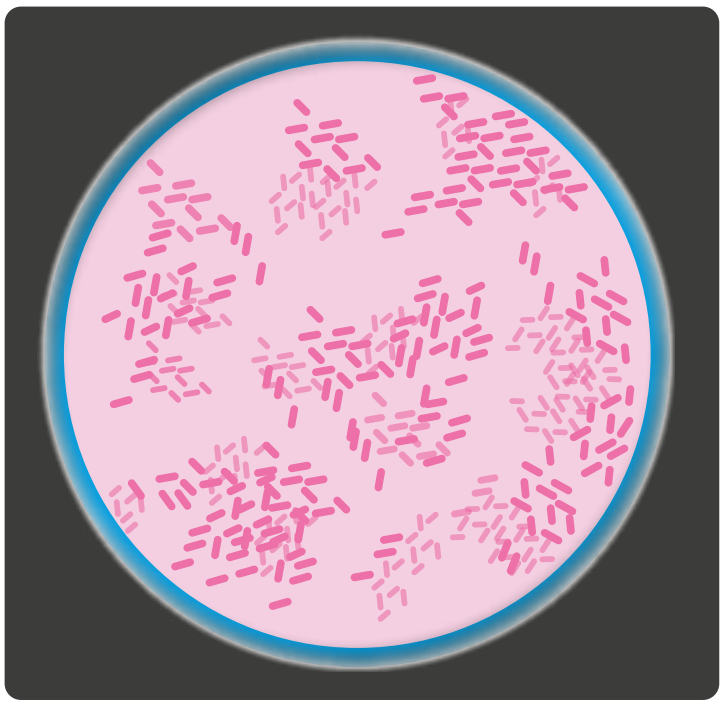
GRAM +
Colour: purple
Shape: round/cocci

Gram-positive organisms contain a thick membrane that holds onto the blue dye used first, crystal violet.

GRAM -
Colour: pink
Shape: long/rod

Gram-negative organisms do not hold onto the violet dye. They instead hold onto the second dye used, which leaves the cells pink.

Let's identify the type of bacteria with shapes and Gram staining



Are the bacteria in Holly's sample GRAM + or GRAM - ?

Result:

Examples
Gram-positive: *Streptococcus, Staphylococcus, Corynebacterium, Listeria, Bacillus, Clostridium, etc.*
Gram-negative: *E. coli, Salmonella Typhi, Shigella, Pseudomonas aeruginosa, Yersinia pestis, etc.*

THE SUSPECTS:

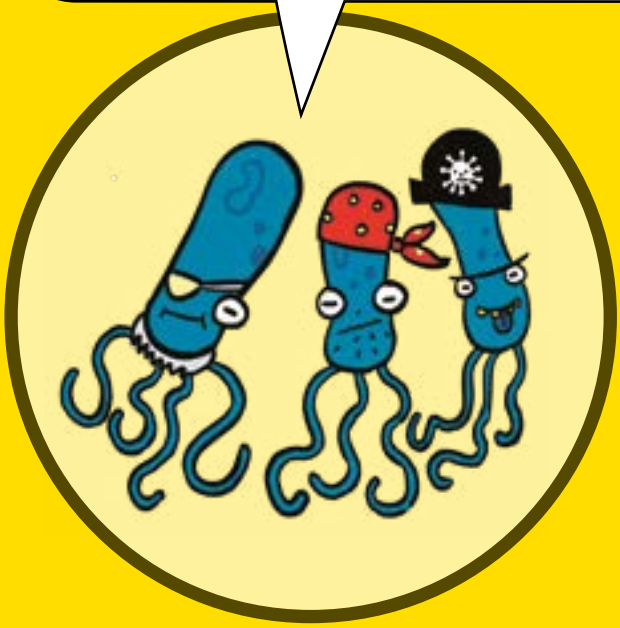
Based on the tests, which bacteria could have infected Holly? :

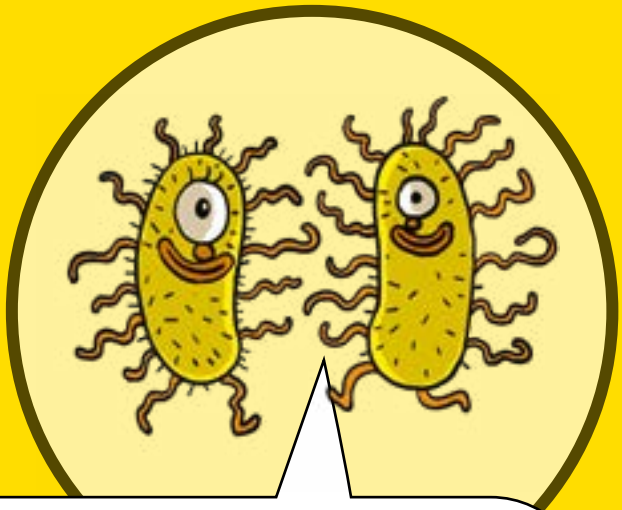
Let's call Holly's Doctor with the results so they can get Holly the medicine to make her better!

We are E. coli!

We can move at the bacterial-equivalent speed of a torpedo! We're commonly found inside human & animal guts but can cause food poisoning or urine infection if spread to the urinary tract.

GRAM (-)





We are Lactobacillus!

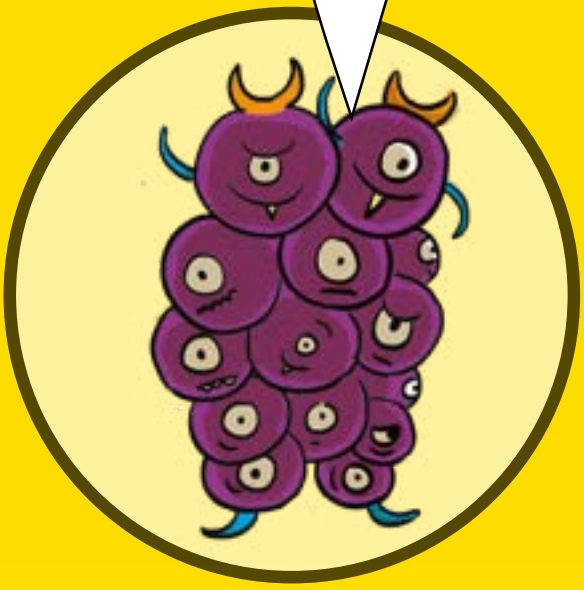
We're PRO-biotic, good bacteria. We're one type of many good bacteria found inside your guts. We help you to digest food and maintain a healthy gut. We're found naturally in yoghurt! Though we wouldn't normally be in your urinary system, we could show up in a wee sample because we help get rid of bad bacteria & fungus. But, we certainly wouldn't cause an infection!

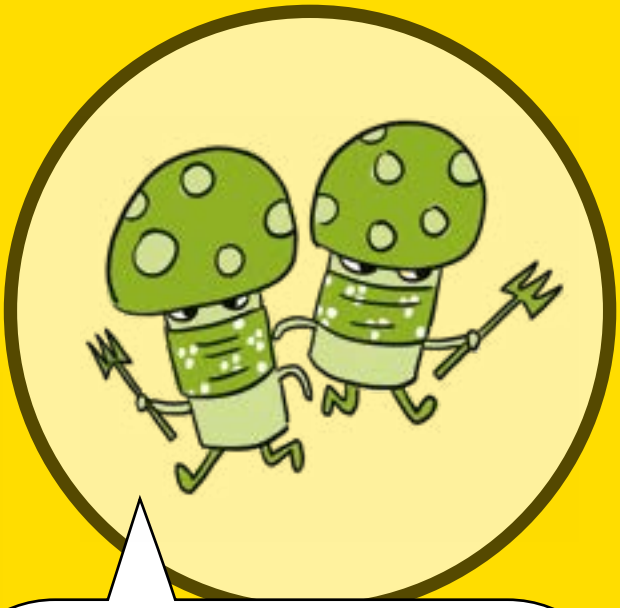
GRAM (+)

We are Staphylococcus!

Our name is from the Greek 'staphyle' which means bunch of grapes - that's exactly what we look like under the microscope! We're normally found on skin, but can cause infections when you've got a cut – always disinfect!

GRAM (+)



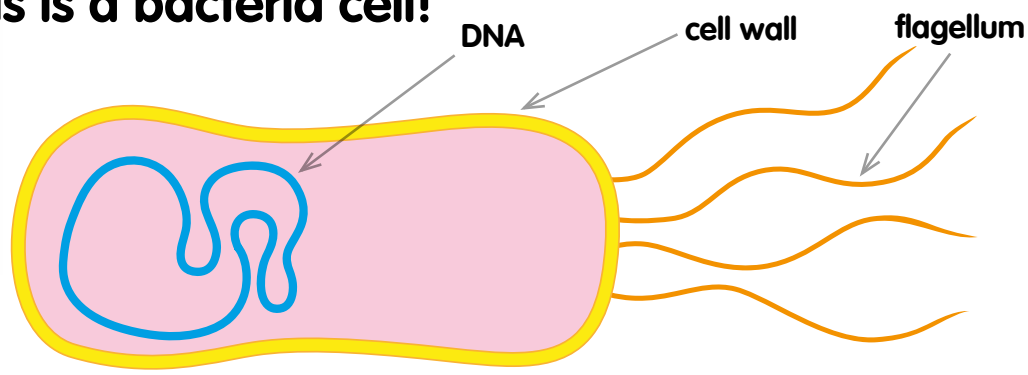


We are Candida albicans!

Not bacteria, we are a fungus among us – We're a super-common type of fungal yeast found on the body. The good bacteria in your gut help keep my levels in check – too much of me can lead to a fungal infection.

GRAM (+)

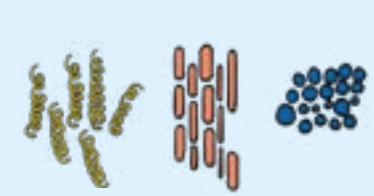
This is a bacteria cell!



Bacteria are unicellular, meaning they are made of one cell.

There are over 10,000 known species of bacteria! Though most bacteria are helpful, some can be harmful.

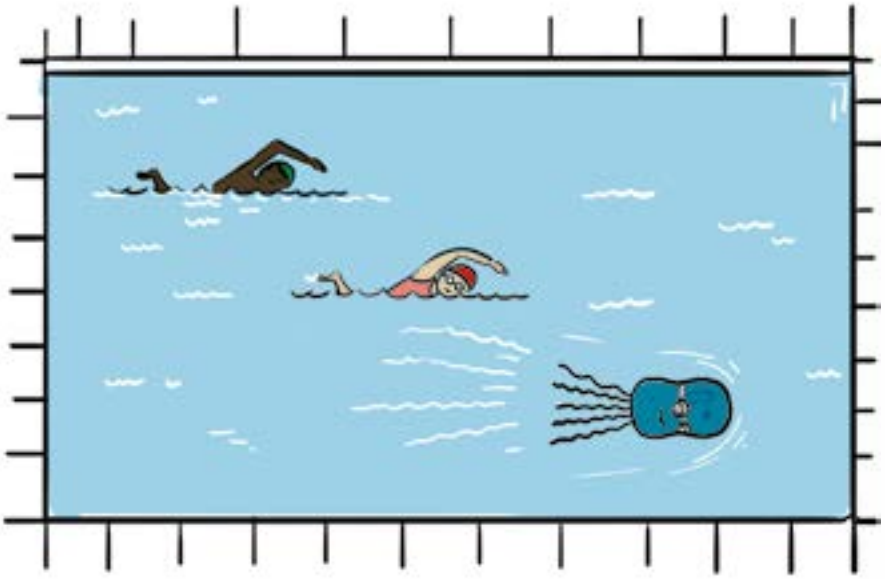
Bacteria are most commonly split into 3 groups based on their shape: spirilla, rods, cocci.



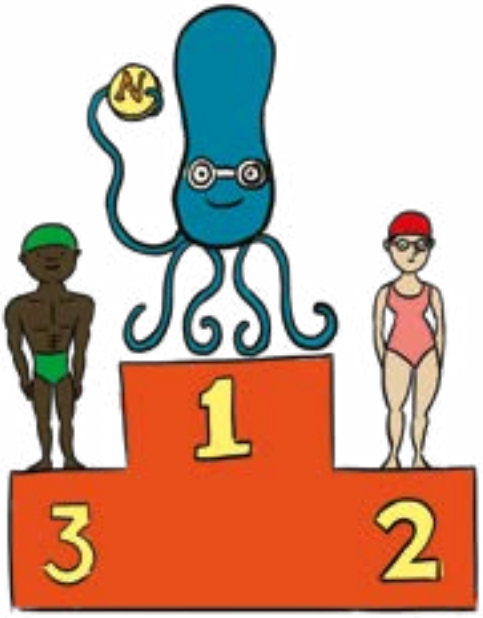
Spirilla Rods Cocci

Draw your own species of bacteria & name it here!

Bacteria are fantastic swimmers!

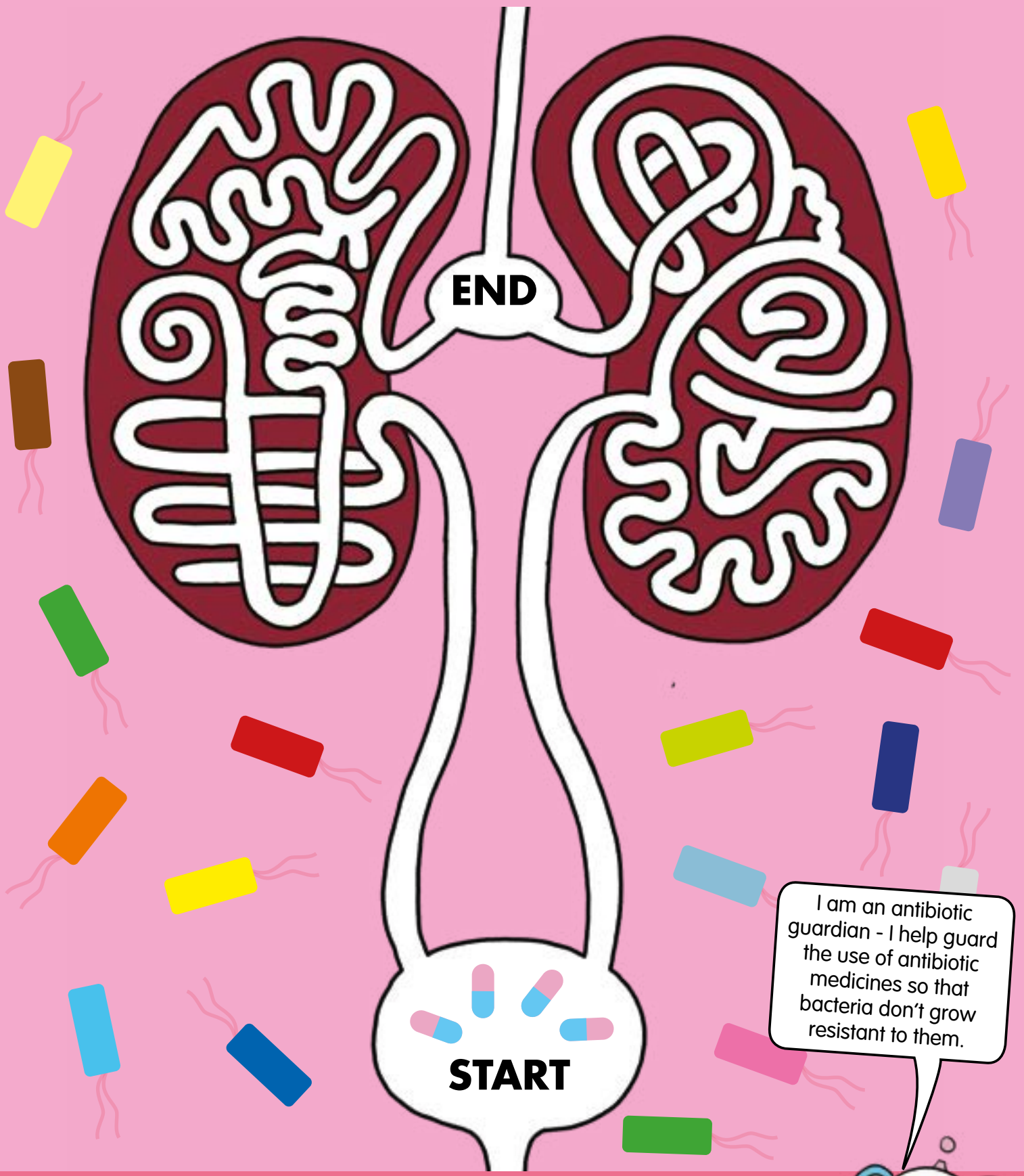


bacteria *with flagellum* can swim much faster than an Olympic swimmer.



Though they don't have any Olympic medals, E. coli is the most-studied free-living organism of ALL TIME & has a record of 11 Nobel Prizes associated with it!

Help the antibiotics through the urinary tract to the kidneys!



Doctors prescribe antibiotics for illnesses where bacteria need to be stopped or killed off – just like how Holly's doctor prescribed antibiotics to stop her infection. Antibiotics can only be taken when prescribed by a doctor and do not work against viruses like the common cold.

Find out more about viruses with Captain Virus & Supergene on p.16.

Meet some of the REAL scientists behind SuperLab!

Meet Tahmina

Hi, I'm Tahmina and I am a Specialist in Haematology & Blood Transfusion

- **My favourite part of being a biomedical scientist is** making a difference to patient lives during their diagnosis, monitoring and treatment of illness.
- **My favourite test is** looking at and analysing blood cells under a microscope.
- **My favourite science fact about blood is** that there are not only red blood cells, there are also white blood cells! White bloods cells are superheroes because they fight off infections and disease. Red blood cells deliver oxygen to the tissues in your body!
- **When I'm not in the lab, I enjoy** baking cakes (and eating them)!
- **My hero is Malcolm Robinson** - Founder of Harvey's Gang, which is a charity named after Harvey Buster Baldwin. Harvey's Gang allows hospitals to give tours of their labs to young patients so they can understand why it is important to have their blood taken to get tested.

Meet Hayley

the inspiration for Medi-Lass

My name is Hayley and I am an Associate Practitioner

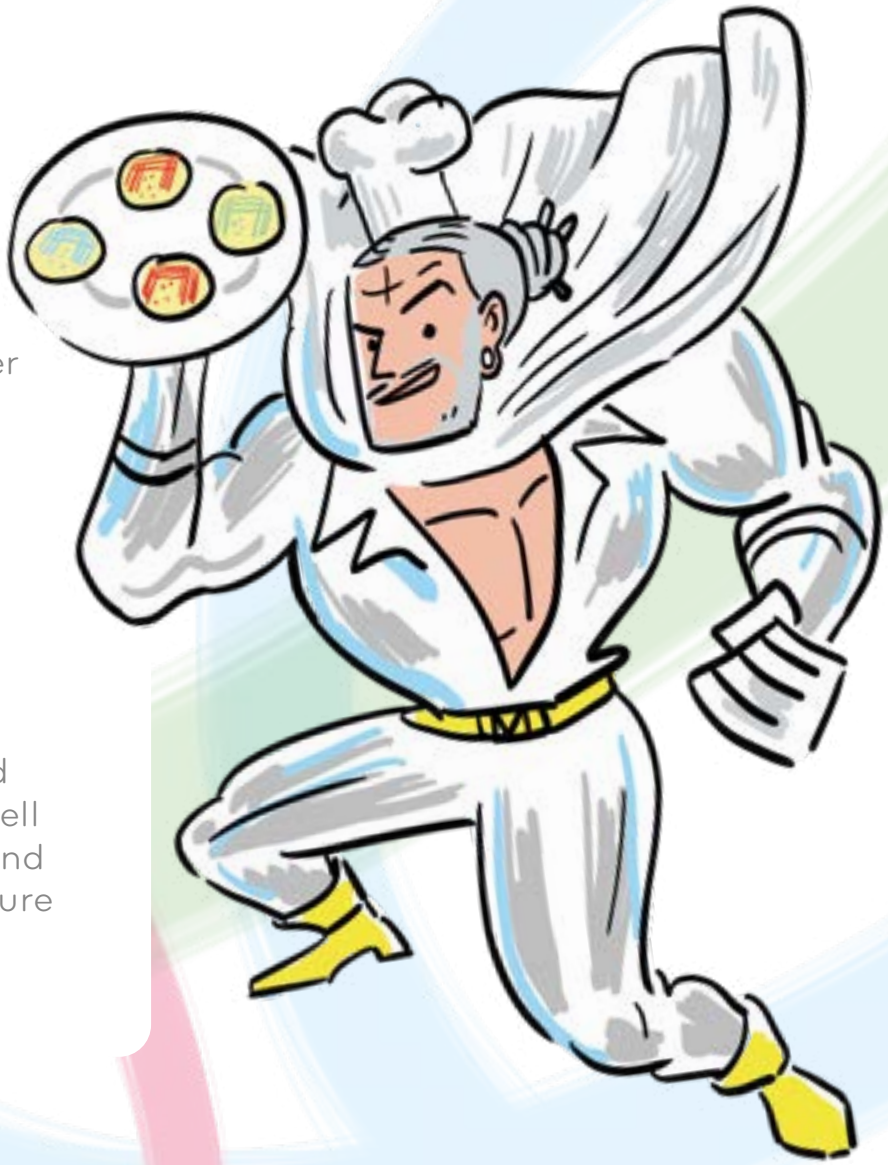
- **My favourite part of working in a biomedical science lab is** helping patients and their families. It's very rewarding to know that we help diagnose, treat and monitor diseases.
- **My favourite part of the job is** called grossing. This is where we get small bits of tissue to describe & dissect. I love this because it's where we get the information to plan a report so that patients can start treatment.
- **My favourite biomedical science fun fact is** that we are involved in over 70% of all diagnoses made - this involves millions of tests being carried out each year!
- **When I'm not in the lab, I enjoy** drawing, which I find very relaxing. I also like reading!
- **My heroes are my colleagues** - they are incredible and I'm always in awe over their skills and knowledge. My grandad is also a hero of mine - he has always encouraged me to never stop learning.

Meet Dr Martin

My name is Dr Martin Khechara and I am a microbiologist and Associate Professor.

- **My favourite part of being a biomedical scientist is** helping students learn all about biomedical science.
- **My favourite test to run** is a GRAM stain as they can look so interesting under the microscope.
- **My favourite microbiology fun fact is** that a species of Neisseria bacteria is the strongest thing on the entire planet - capable of pulling a force equal to 100,000 times its body weight!
- **When I'm not in the lab, I enjoy** being an adventure training instructor and helping children enjoy the outdoors
- **My hero is the microbiologist Paul Fildes**. He is no longer with us but much of what we know about very dangerous microbes we owe to work he started in Salisbury, UK.

Dr Martin's PETRI DISH Biscuits!

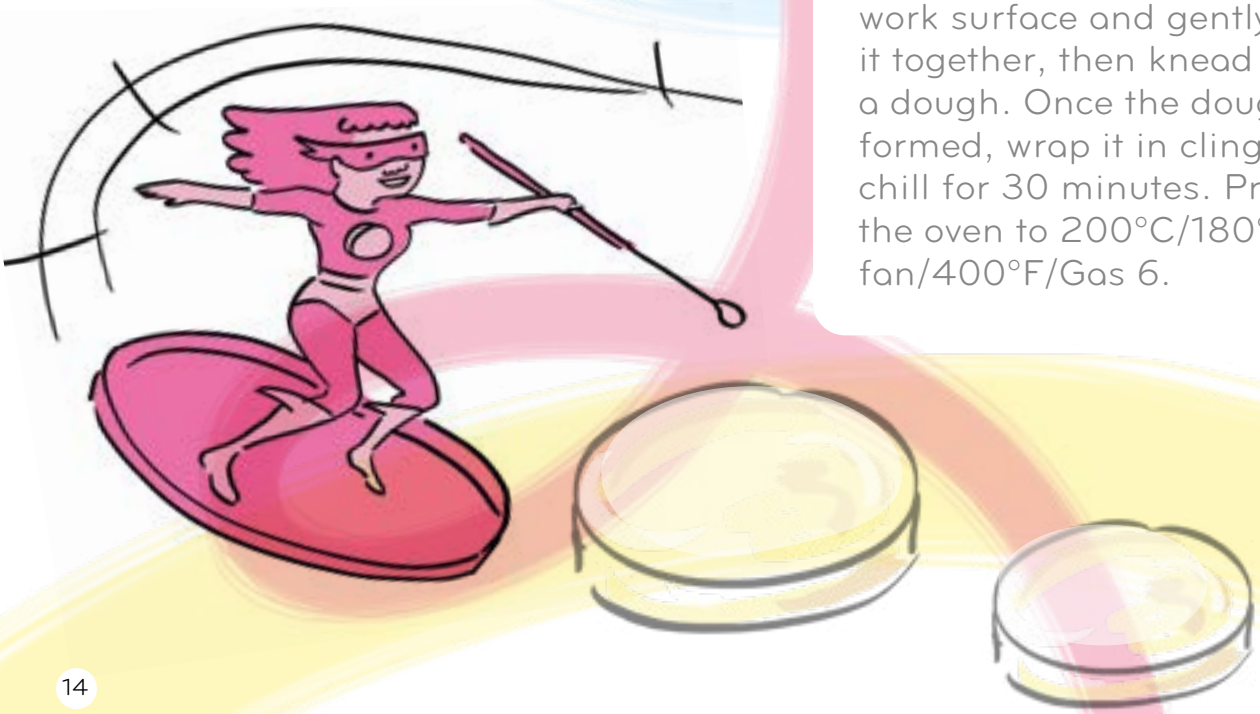


You will need:

- 125g unsalted butter
- 55g caster sugar, plus extra to sprinkle
- 200g plain flour
- 6cm fluted biscuit cutter
- baking paper

How to:

1 Put the butter and sugar in the bowl of a food processor and blitz until well combined. Add the flour and pulse briefly until the mixture resembles breadcrumbs.



2 Tip out the mixture onto a work surface and gently bring it together, then knead it into a dough. Once the dough is formed, wrap it in cling film and chill for 30 minutes. Preheat the oven to 200°C/180°C fan/400°F/Gas 6.

3 Once the dough has chilled, lightly flour the work surface and roll out the dough until it is about 3mm thick (about the thickness of a £1 coin). Use the 6cm fluted cutter to stamp out 16 biscuits, re-rolling the trimmings as necessary.

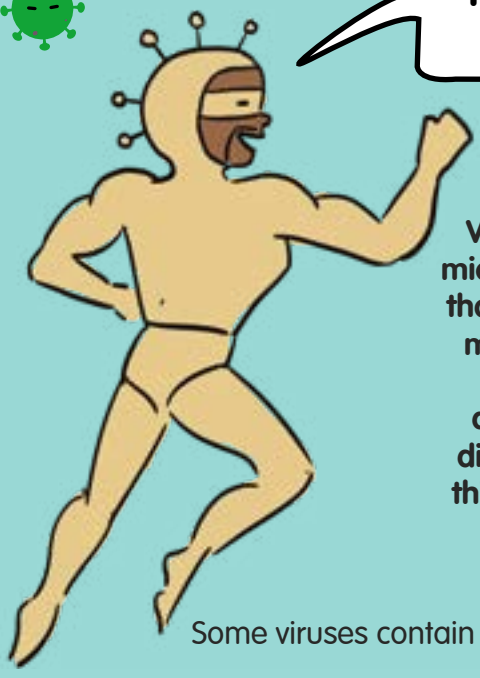
4 Place the biscuits on the lined baking sheet and chill for another 5 minutes, then use a fork to prick a few lines of holes in the centre of each. Sprinkle the biscuits with a little caster sugar and bake for 10–12 minutes, or until lightly golden.

5 Remove the biscuits from the oven and allow to cool on the baking sheet for 10 minutes. Then, transfer the biscuits to a wire rack to cool completely.

6 Decorate the cooled biscuits with coloured icing to match the bacterial streaking on agar plates, just like Bug Rider would!

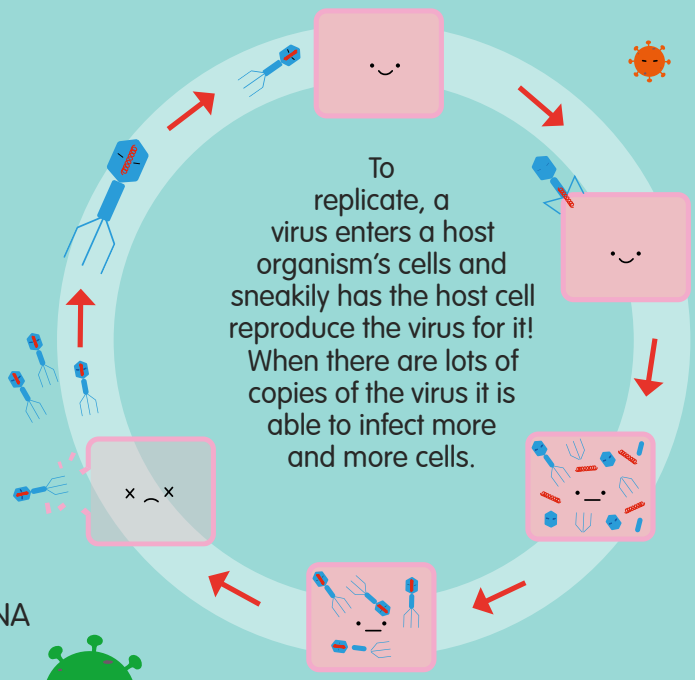
Captain Virus!

Let's learn more about viruses!



Viruses are not living things because they rely on their host's cells to make copies of themselves. Because viruses are not alive, antibiotics cannot treat viruses.

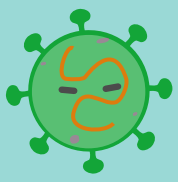
Viruses are teeny tiny microbes – much smaller than bacteria. There are many types of viruses that look and act differently and infect different types of living things, from bacteria to plants & animals.



To replicate, a virus enters a host organism's cells and sneakily has the host cell reproduce the virus for it! When there are lots of copies of the virus it is able to infect more and more cells.

Some viruses contain RNA and some others DNA

RNA



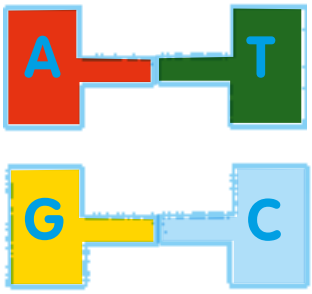
DNA

Supergene is doing a PCR

To study and understand viruses, scientists need to uncover their genetic code using PCR – which stands for Polymerase Chain Reaction.

The purpose of PCR is to make lots and lots of copies of the genetic code, so that we can read & understand it.

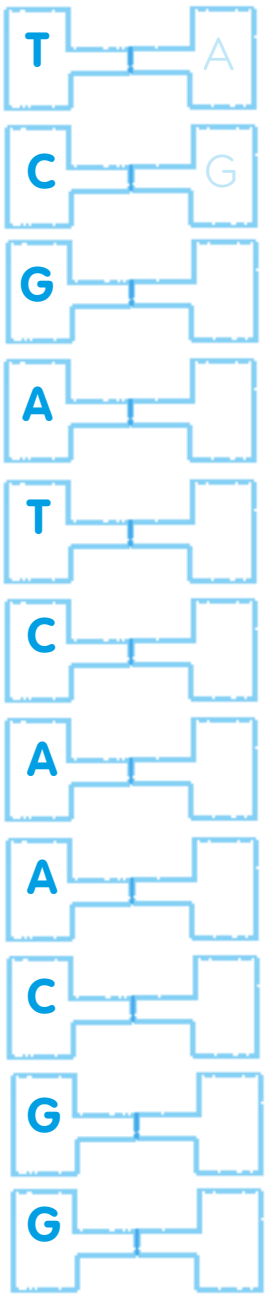
Key:

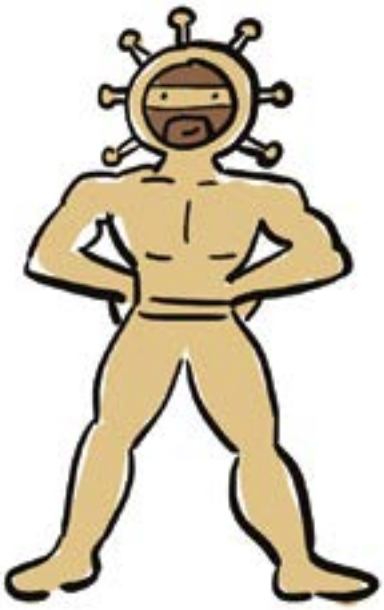


Help Supergene run PCR by filling in the missing letters and colouring them in from the key above.

A (red) always faces **T** (green).
G (yellow) always faces **C** (blue).

This is how the DNA is copied and amplified in the lab!

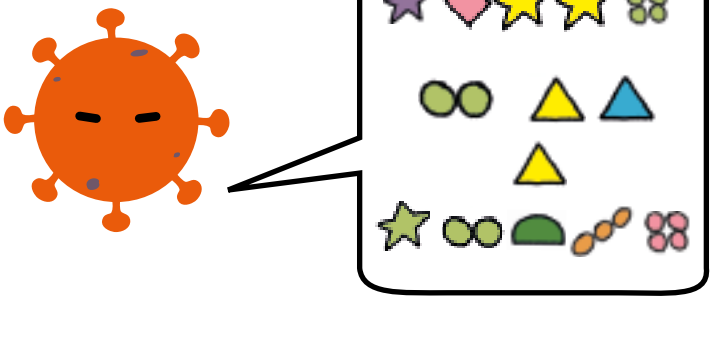


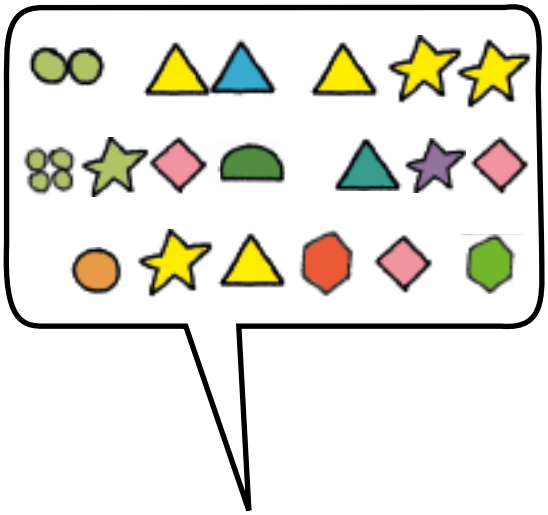


What are the viruses saying?

By uncovering the viral code scientists can figure out what part of the virus is helping it infect and harm our cells. When scientists are able to crack the viral code they can create VACCINES to stop the virus from multiplying!

Use the viral code to figure out what the viruses are saying!

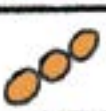


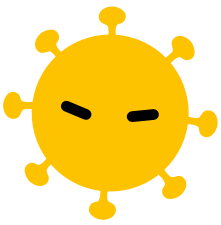


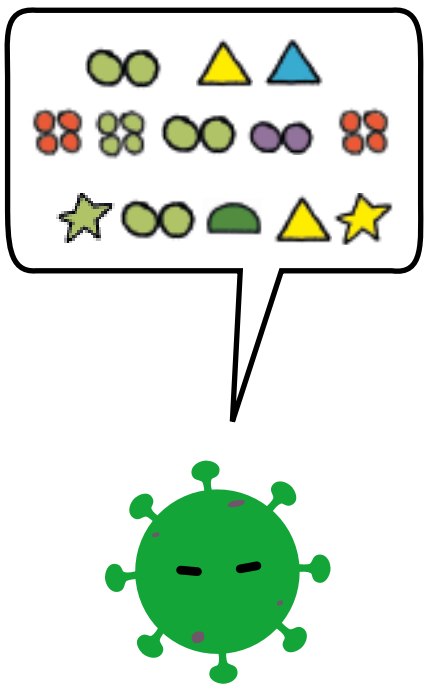
Virus code

	A
	B
	C
	D
	E
	F
	G
	H
	I

	J
	k
	L
	M
	N
	O
	P
	Q
	R

	S
	T
	U
	V
	W
	X
	Y
	Z
	!





SUPER MEDICAL ROBOTS

MATCH THE ROBOT TO SUPERLAB HEROES

I'm CHEMIGIRL the CLINICAL CHEMIST

I'm BLOOD BOY the TRANSFUSIONIST

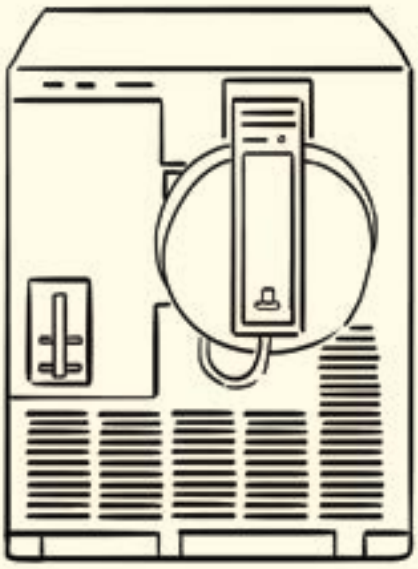
I'm IMMUNA the IMMUNOLOGIST

I'm CAPTAIN VIRUS the VIROLOGIST

I'm SUPERGENE the GENETICIST

I'm SPECIMAN the CYTOLOGIST

I am a Mass Spectrometer.
I am used by ChemiGirl and Speciman

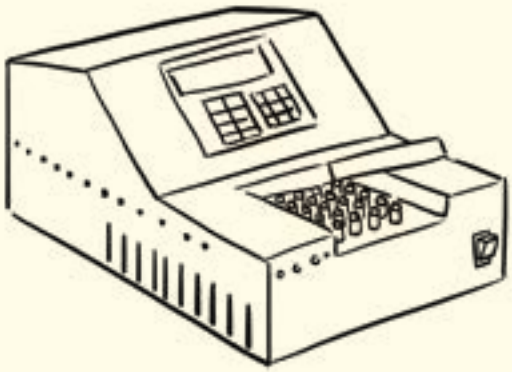


Give me a name

This is inspired by the organisation Harvey's Gang, who name lab robots too!

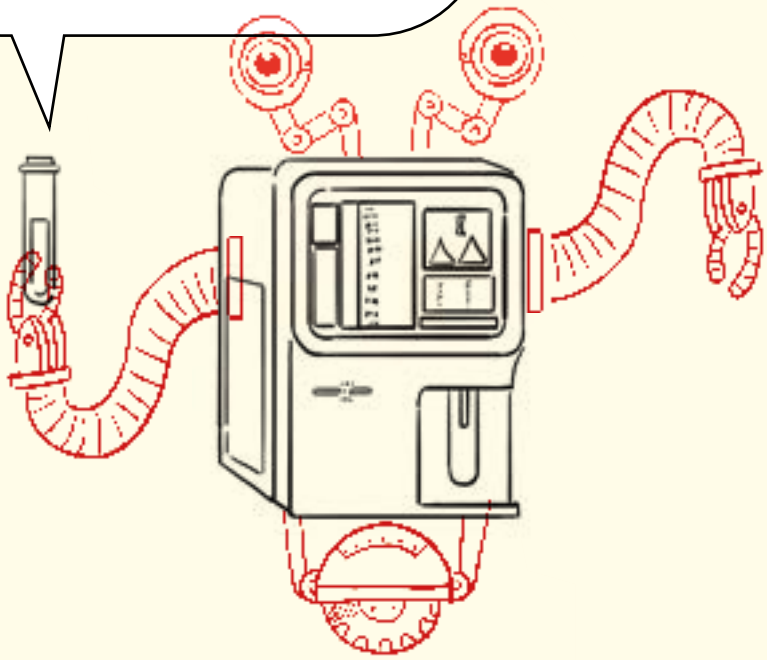
Harvey's Gang offers young patients tours around a hospital's real-life biomedical science labs. Thanks to Harvey's Gang, kids get to understand the science behind their healthcare.

I am a PCR Machine.
I am used by Super Gene and Captain Virus



Give me a name

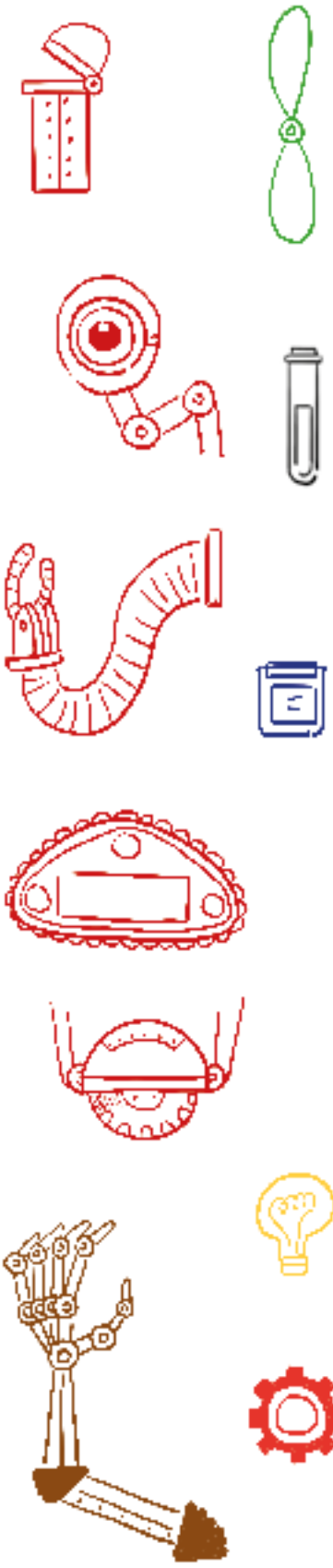
I am a Blood test machine.
I am used by Haematoman, Blood Boy, Immuna and ChemiGirl



Give me a name

ROBOT PARTS

Draw these parts on the machines to turn them into fun robots!



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OKIDO