DISEASE DETECTIVES

ARREST TB

TB = TUBERCULOSIS

There was once a little girl called Betty
Who woke every night feeling rather sweaty

She coughed and she coughed all day
And felt far too tired to play

Her mum said "she's getting worse"
Her dad said "we need to see the nurse"

And the nurse looked at Betty
"Hmm" she said "cough, tired and sweaty"

"I think it must be TB,
Let's take some snot and see"

Ah TB bacteria everywhere
Multiplying without a care

So small I needed my microscope
But now I spotted them no need to mope

The name might sound exotic
But the medicine you need is an antibiotic

Watch Lego animation version of the poem at:
https://youtu.be/QwNE8e_pU9c

Take them everyday
And the bacteria will soon go away

Your lungs will then be clear
And you'll be cured my dear

1. What are the symptoms of TB?*

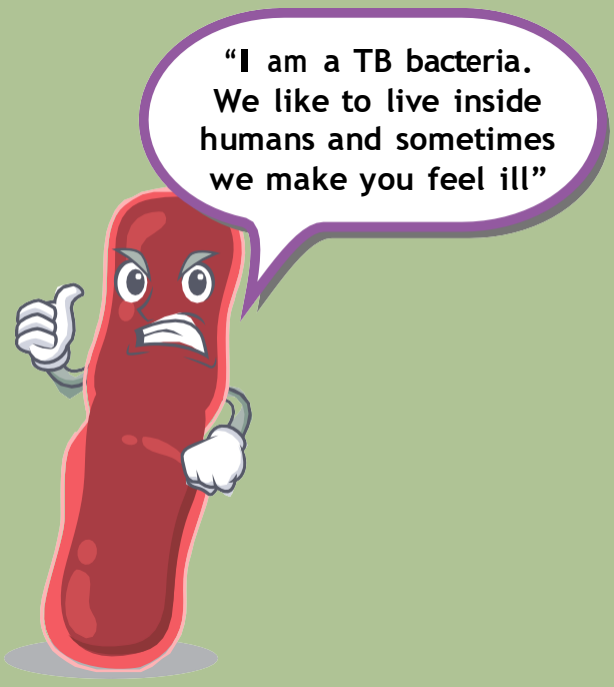
2. How do you check if someone has TB? What tests can doctors do?*

3. What is the name of the medicine you take that kills bacteria?*

Extension: *Write your own story about illness or bacteria and/or act it out with your toys.*

*see back page for answers

TB



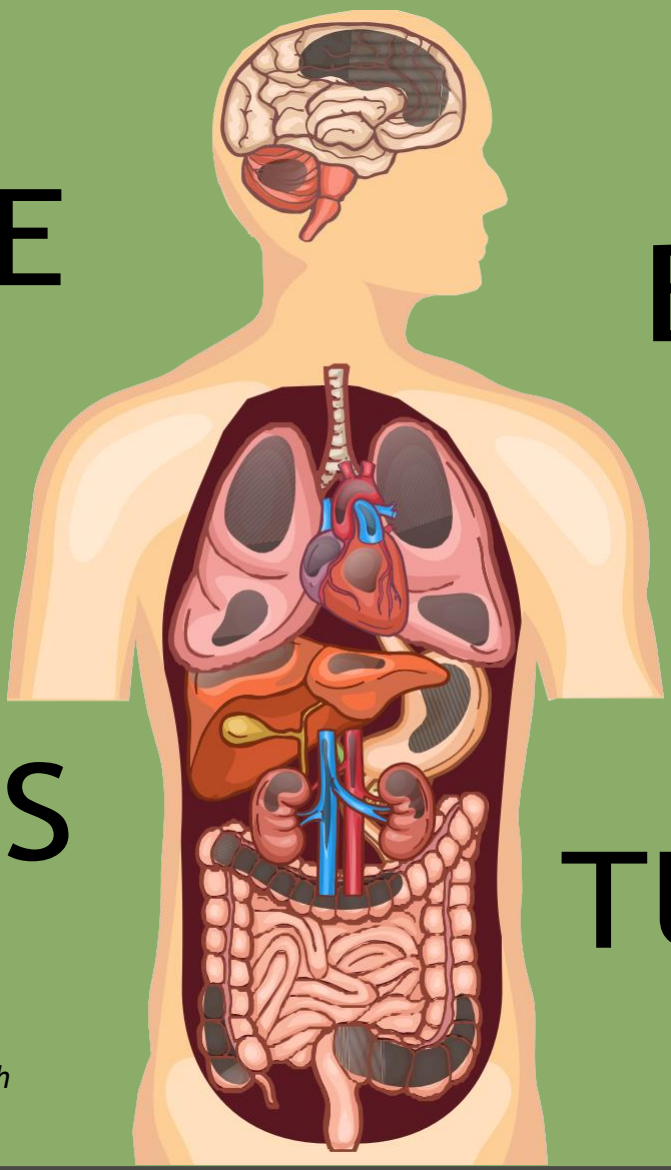
Join the dots to make the letters!

TB is mostly found in the: Lungs.
TB can also be found in the: Brain, Spine and Tummy.

Draw a line connecting each body part name to the correct place on the body picture

SPINE

Brain



LUNGS

TUMMY

Extension: *See if you can find more about what each of these body parts does*

TUBERCULOSIS AROUND THE WORLD

The amount of people around the world in 2019 that were ill with

TB

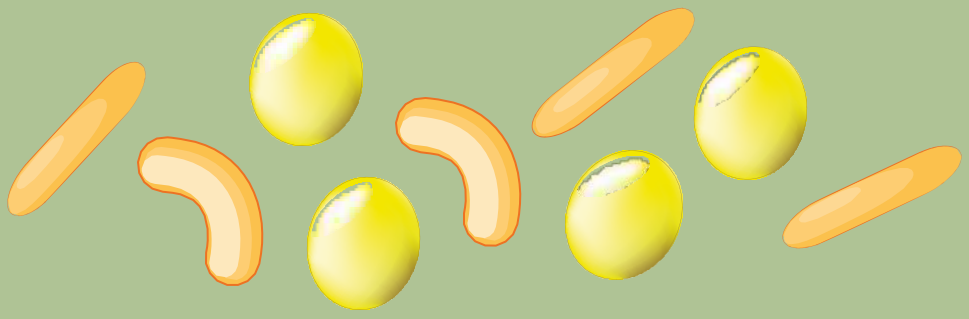
10,000,000

Places where a lot of people had the disease TB included:

INDIA, SOUTH AFRICA, CHINA, NIGERIA

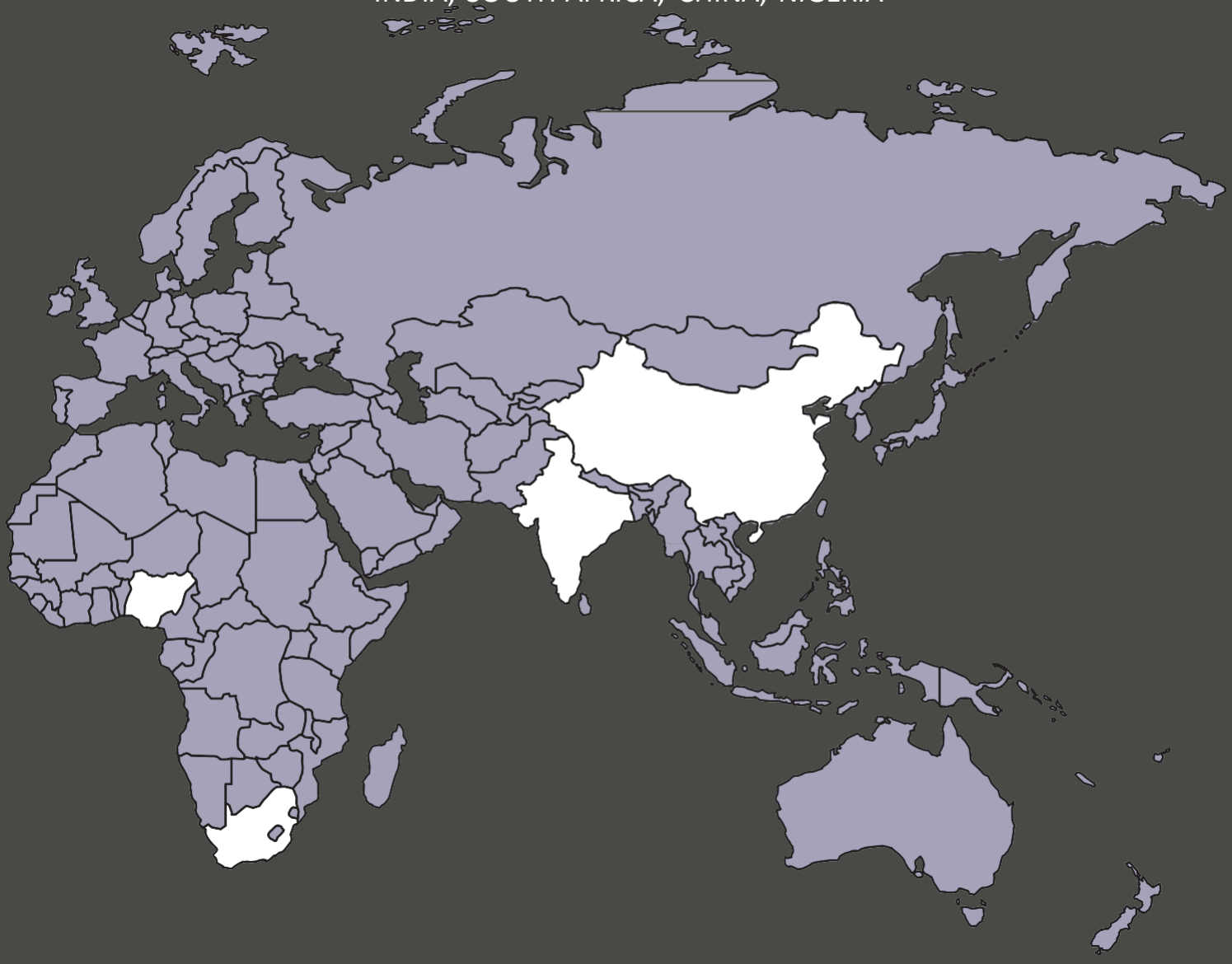
DIFFERENT SHAPES

Bacteria can be different shapes. Count the number of each bacteria.
Point to the answer in the number line below.

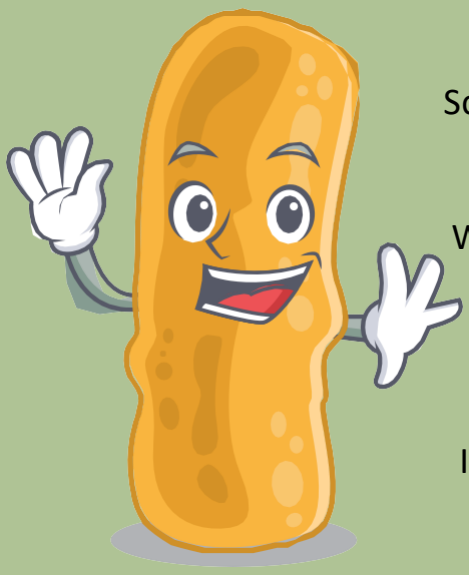


1 2 3 4 5

Colour in these countries and match them to their names opposite:
INDIA, SOUTH AFRICA, CHINA, NIGERIA



GOOD AND BAD BACTERIA



Some bacteria are useful and help us digest food, turn milk into yoghurt and cheese or clean up oil spills. Some bacteria make us feel sick.

Scientists are learning how to design bacteria and control their behaviour.
What would you design a bacteria to do?
Will it be helpful or will it make people sick?

Draw a picture of your bacteria.
What does it do?

If you have PlayDoh maybe you could make your bacteria out of PlayDoh!

PLAYDOH RECIPE:

1. Mix 100g plain flour with 20g salt;
2. Mix in 50mL of warm water and one tbsp vegetable oil. Add food colouring.
3. Knead dough on flat surface adding a little more flour if needed to stop it becoming too sticky. Some recipes suggest adding a little bit of lemon juice or baking soda to make the PlayDoh softer.

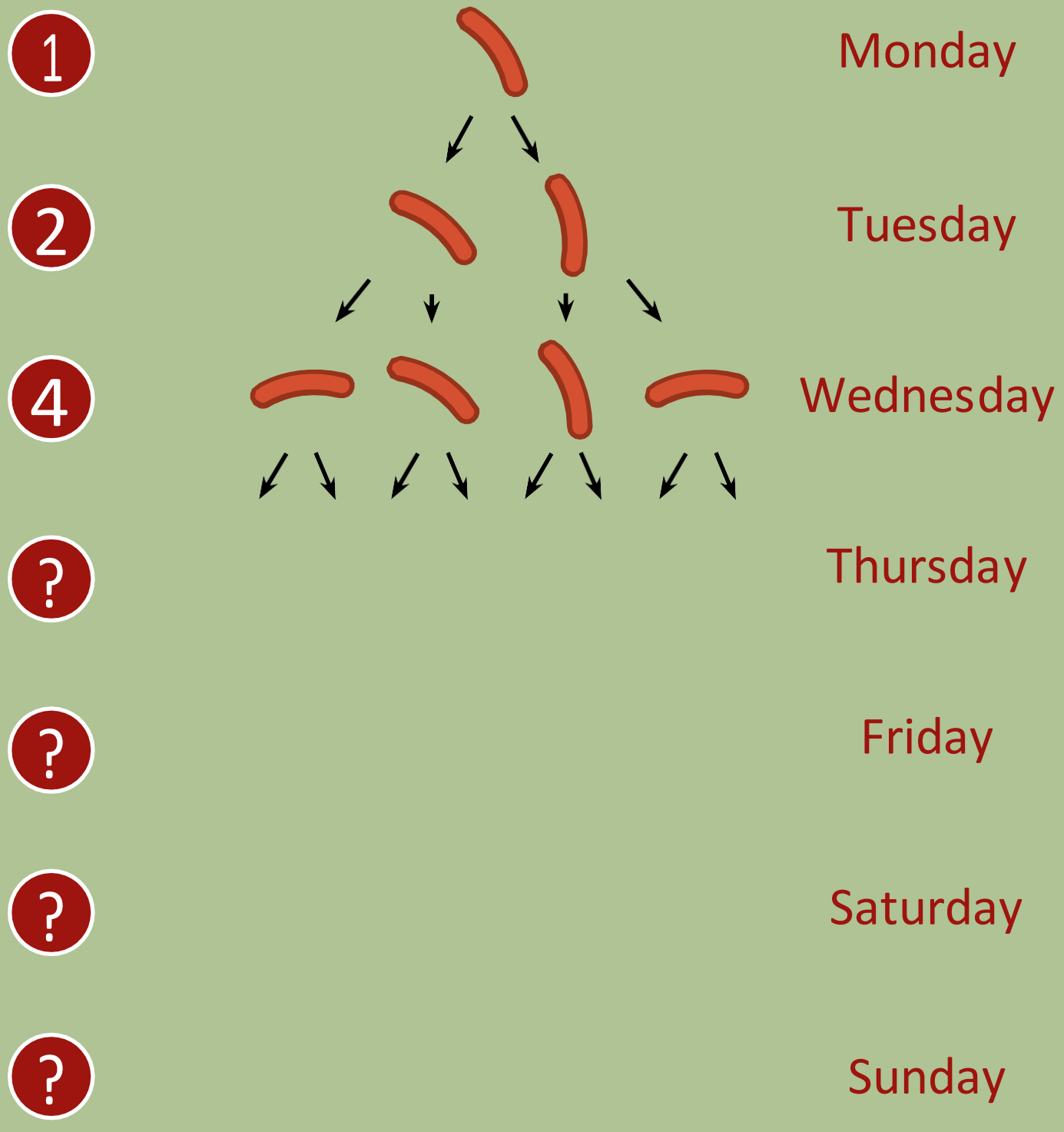
We would love to see your creations. Share them on: h.l.bridle@hw.ac.uk

BACTERIA REPRODUCTION

Bacteria reproduce by dividing into two.

Some bacteria do this very quickly meaning 1 bacteria can rapidly turn into hundreds or thousands. TB bacteria divide roughly once a day.

So if we start on Monday with 1 bacteria how many will there be on Thursday?
And how about Sunday?



Extension: *How many bacteria will there be after 2 weeks?*

*see back page for answers

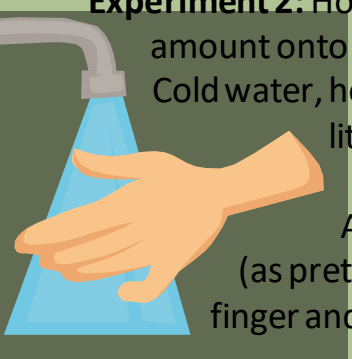
EXPERIMENTS!

When the TB bacteria are growing in our bodies we feel tired and sweaty and cough lots. When we cough the TB bacteria fly through the air and can get inside other people. This can maybe make them ill as well.

ACTIVITY: bacteria are so small we can't see them unless we use a microscope. Put a small amount of flour on your hands. Cough or blow onto your hands and see how the flour spreads. Bacteria can travel far!

Extensions – Experiment 1: How far do sneezes travel?

Measure the distance and impact of a "sneeze" using water from a spray bottle. For easier observation add green food colouring to the water. This activity might be best done outside! You could draw faces on the ground in chalk to see how many "people" get "snot" on them from the "sneeze". Use a tape measure to measure distance and count faces with spray on them. Try again covering the "sneeze" with your hand or a tissue and see what difference it makes.

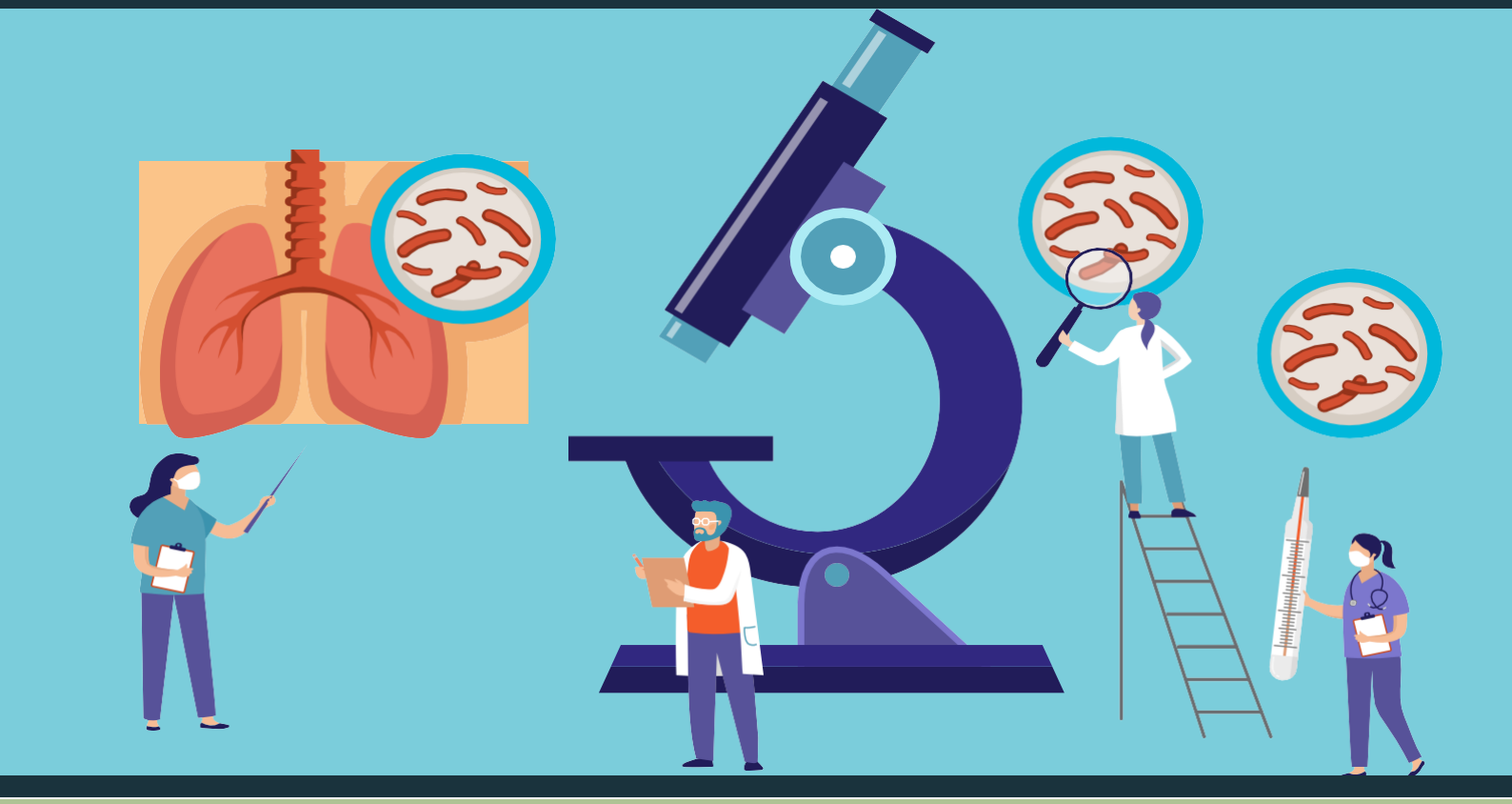


Experiment 2: How does hand washing help? If you have glitter (pretend this is bacteria) pop a small amount onto your hands and try different techniques to wash it off. What is most effective? Cold water, hot water, soap, different washing times? If you don't have glitter you could try a little bit of vegetable oil and cinnamon, or even paint, as the bacteria

Another way to see how soap gets rid of bacteria is to add a little bit of pepper (as pretend bacteria) to a dish of water. Put a small amount of washing up liquid on your finger and dip it into the middle of the pepper water mixture. What happens?

Find out more and get help to do these activities -
Sneeze experiment: www.stem.org.uk/rxx65 Hand washing: https://youtu.be/a0A-JbP9T0I
Pepper and soap: www.fantasticfunandlearning.com/make-germs-scatter-science-demonstration.html

DOCTORS



A doctor or a scientist can check if somebody has TB by using a microscope to look for the bacteria in snot, coughed up from the lungs. Usually the doctor takes the snot sample and sends it to a science lab for testing. The scientist adds a red dye which sticks to the TB bacteria making them red and easier to see. Help the scientist count the samples and write the numbers in the box for the doctor.

ACTIVITY IDEA: Challenge family or friends to count your TB bacteria in a sample. Either: 1) Draw your own sample. Add as many bacteria as you like. Remember TB is red and rod-shaped. Or: 2) mix up some "snot" and add some "bacteria"

Snot recipe: the simplest way is to mix together some flour, water and green food colouring. Maybe you can make it even more disgusting though if you have some gelatin at home (get an adult to help with the boiling water) or maybe include some glue. What can you use that is red and rod shaped for bacteria? Maybe PlayDoh or maybe you have other ideas?

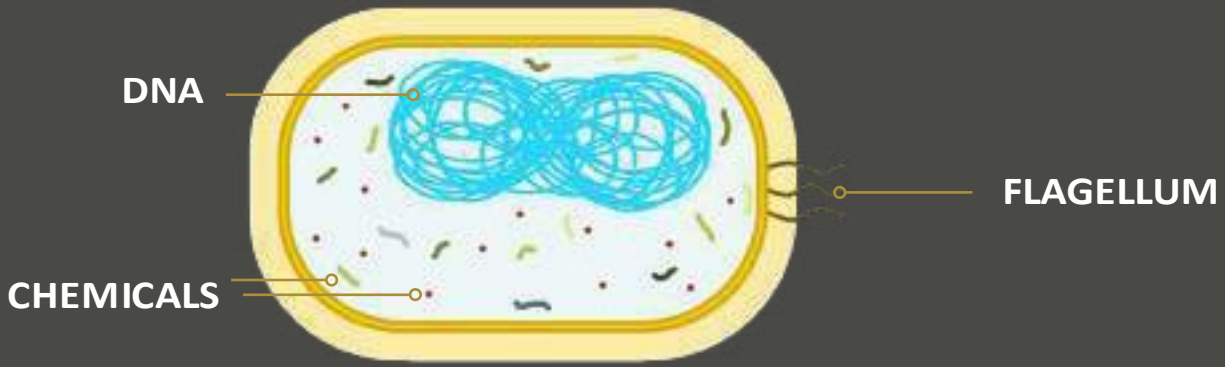
MEDICINES

There are medicines to treat people with TB and make them better.
Not all TB bacteria are the same though and so different medicines are needed.

Match the below patients to the right medicine.

How does the medicine work?

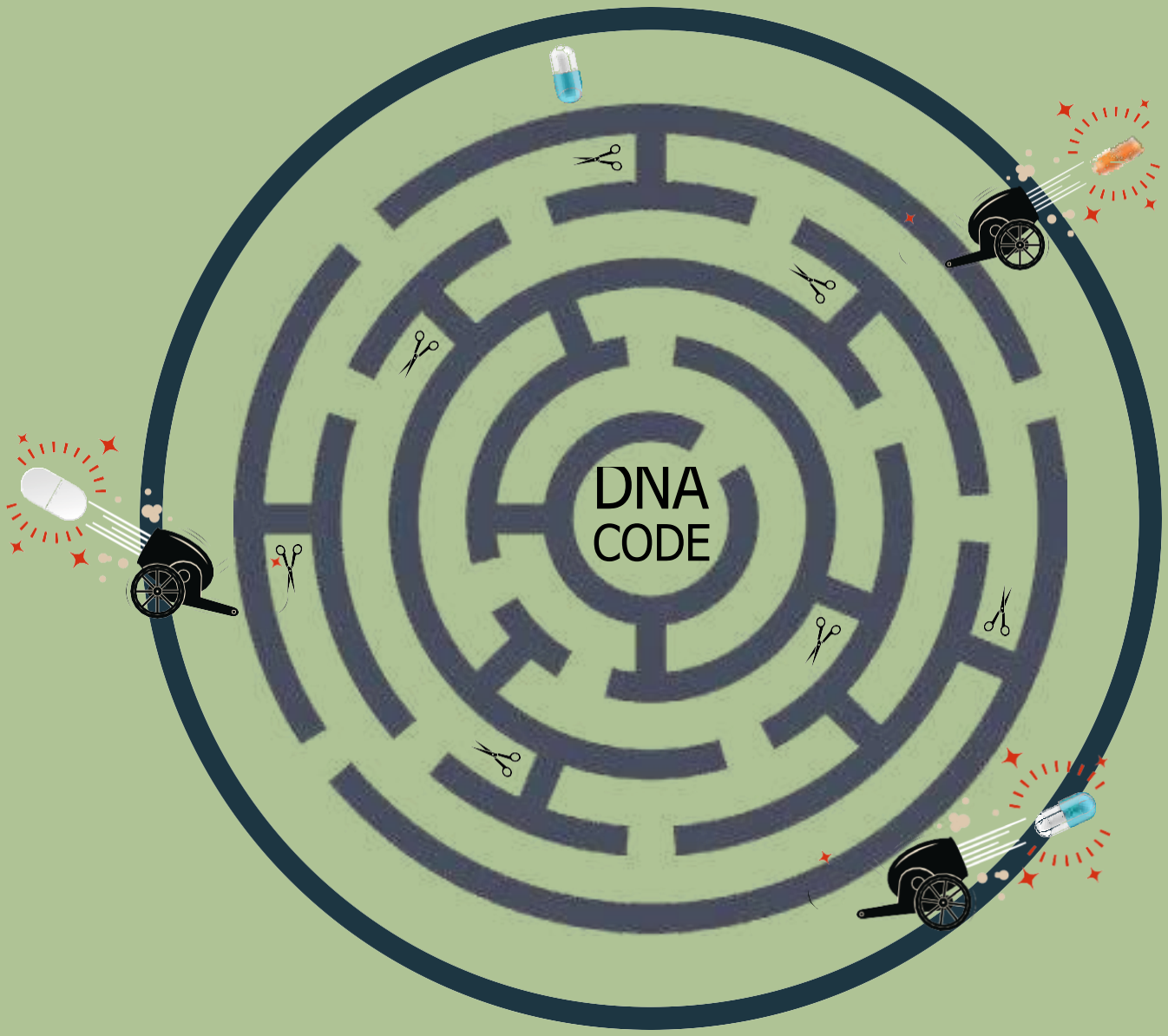
Before we can find that out we need to know more about what bacteria really look like:



ACTIVITY: Make a model of a bacteria. Look at the picture to see the essential parts of bacteria. There is a code or set of instructions (called DNA) that tell the bacteria how to behave, how to grow and reproduce. There is a wall around the outside. Inside are lots of "worker" chemicals which help the bacteria grow and transport messages and food to the right places. Some bacteria (but not TB) have flagella, a bit like long tails, which help them move about.
What can you use for these different parts?

MEDICINES

There are different medicines to kill bacteria.
For more info watch: https://youtu.be/JYWIx80Jrpw
Some destroy the bacteria wall. Some sneak inside and mess up the 'worker' chemicals or the code. Help these antibiotics get to the centre of the bacteria. Watch out for the enzymes that try to chop them up and pumps which try to eject them.



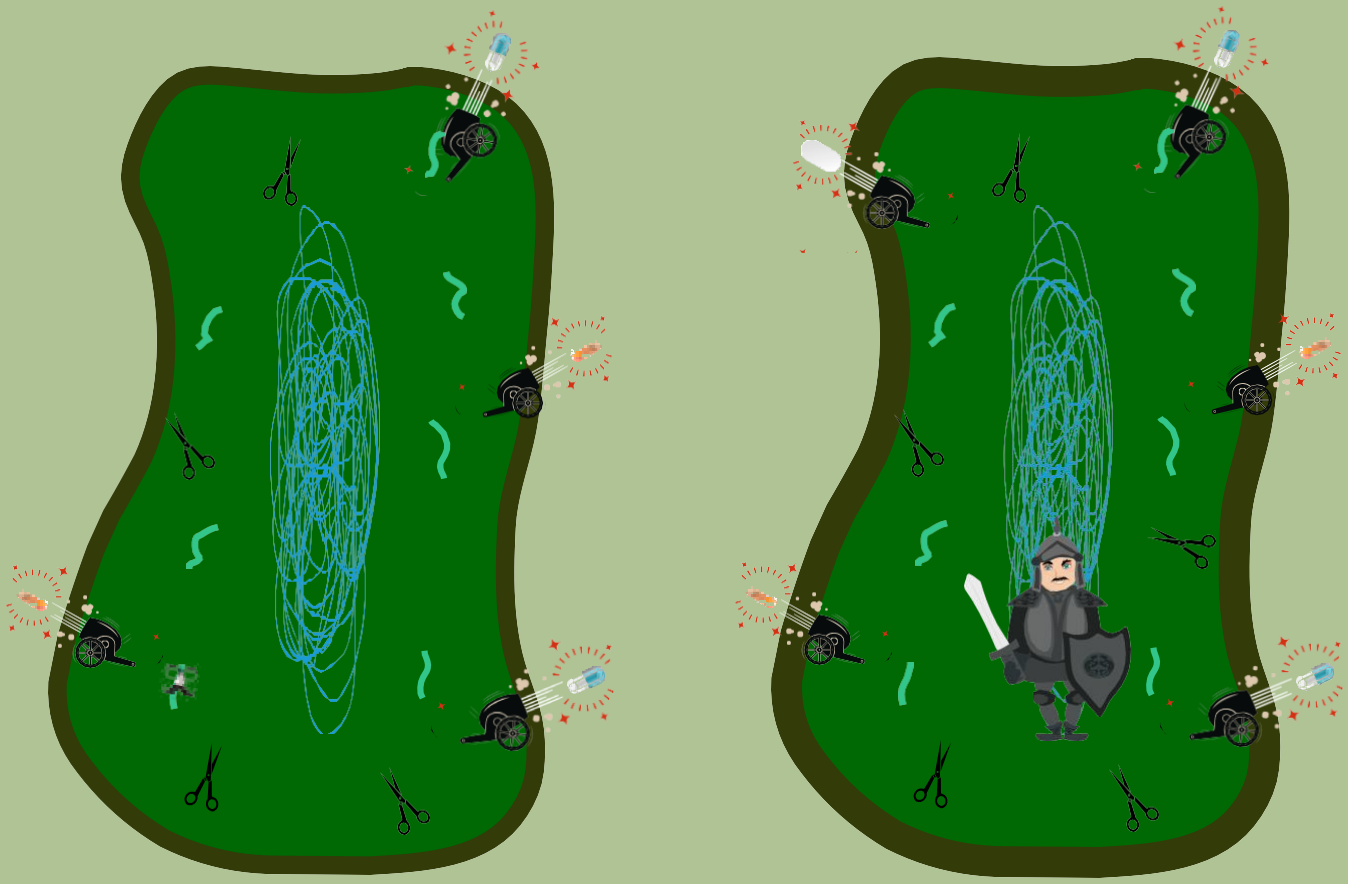
Question: What do you think bacteria can do to stop the medicine working?
*see page 11 for answers

BACTERIA FIGHT BACK

Bacteria populations can change over time and sometimes this means that the medicines don't work anymore. We call this antibiotic resistance.

Bacteria can develop a stronger wall to stop destruction or a thicker wall to keep the medicine out. Bacteria can also get better at pumping out or chopping up any medicines that do get inside. They can also try to 'protect' the code or disguise the 'worker' chemicals so the medicine doesn't find them.

SPOT FIVE DIFFERENCES BETWEEN THESE TWO BACTERIA



Question: Medicines don't work for one of the above bacteria. Which one do you think it is and why?

Extension: *Find out more about antibiotic resistance and things we can do to prevent it here:*

www.pfizer.co.uk/superbugs-join-fight-school-programme

Tuberculosis Tale

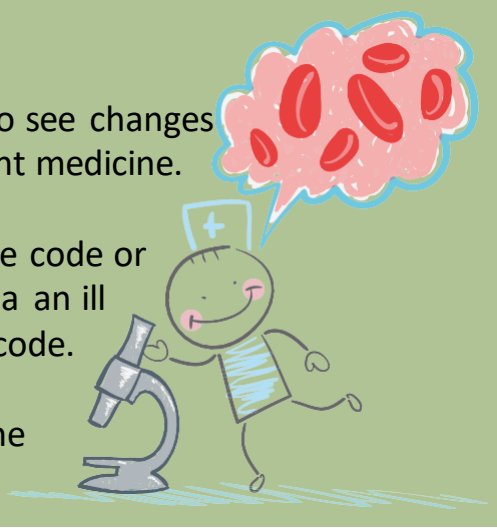
CRACKING THE CODE

If we know what the bacteria inside an ill person are like we can pick the best medicine to make them better. For example if the bacteria have strong walls we don't use the medicine that is too weak to break those walls but instead can use a medicine that is good at sneaking inside.

But when we look down the microscope it is impossible to see changes in the bacteria. So doctors find it hard to pick the right medicine.

Any changes that bacteria make are put into the code or instructions so one way to find out what type of bacteria an ill person has is to read the code.

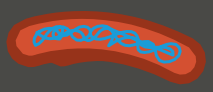
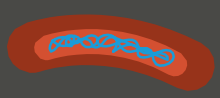
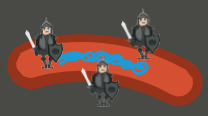
There are special machines which can take out and read the bacteria code.



HELP THE DOCTOR CHECK THE CODES

Try to match the below sequences and circle the correct coloured medicine.

This table shows changes bacteria have made and what shows up in the code:

BACTERIA TYPE:				
Code change (easy):	None	CACA	ATGG	GACT
Code change (tricky)	None	CCTGCTGAAC	GGATACGTAA	GATAGTCATG
Medicine needed:				

Help the doctor check the codes. Try to match the below sequences and circle the correct coloured medicine.

T	G	C	A	G	C	A	T	G	A	C	T	C	G	A	T	G	C

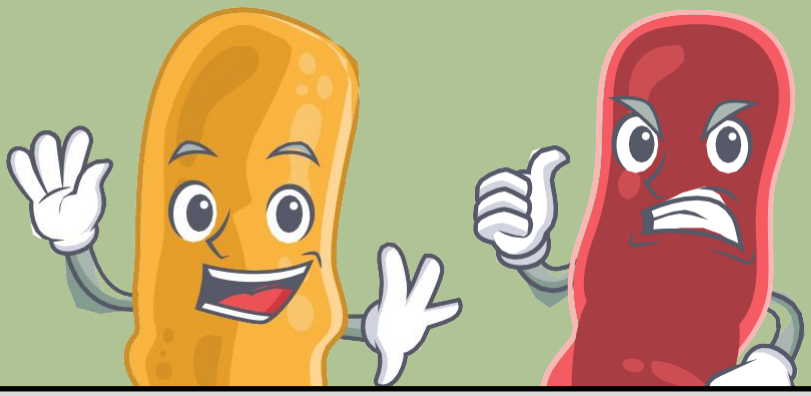
(easy)

T	T	G	G	A	A	C	C	A	A	T	G	C	A	C	G	T	A
G	G	C	G	T	A	A	G	G	G	T	T	T	C	C	C	C	T
C	G	A	T	C	G	T	C	C	G	G	A	T	C	G	T	A	T
C	T	G	T	A	A	C	A	G	T	A	T	G	T	T	A	C	G
T	A	T	C	C	C	A	G	A	T	A	G	T	C	A	T	G	A
T	T	G	G	G	G	T	C	T	A	T	C	T	G	T	A	G	C
T	A	G	A	G	T	A	C	A	T	G	C	T	A	G	T	C	A
A	C	C	A	G	T	C	G	T	A	C	T	A	G	C	T	A	A
G	C	T	A	A	T	G	C	C	A	T	G	G	A	G	A	T	C
C	A	G	A	G	C	T	A	G	C	T	A	G	C	T	A	G	T
C	G	A	T	C	G	T	A	T	T	G	T	G	T	G	T	G	T

(tricky)

MEET THE TEAM

Scottish scientists and engineers are working to stop TB. Meet some of them here:



NAME: Helen
WORKS AT: Heriot-Watt University
WORKING ON: ARREST-TB project

Helen works with Caleb, Sumanth and Marc at Heriot-Watt. We are developing a cheaper, faster and easier method to get the DNA out of the bacteria, and to look for changes in the DNA. By checking the DNA the doctor can tell what type of TB bacteria a patient has, and which is the right medicine (see page 13).

NAME: Sesha
WORKS AT: University of Edinburgh
WORKING ON: Arrest-TB project

Sesha is the project manager, making sure the team which includes scientists in Scotland, Italy and Spain as well as doctors at the TB Research Institutes in India and Russia, are all working well together. With colleagues at University of Edinburgh he is also working to make the red dye brighter (see page 8) and a portable microscope so doctors can check "snot" themselves rather than having to wait to hear back from the lab.

NAME: Helen
WORKS AT: University of Edinburgh
WORKING ON: One Health project

Helen is working with patients and doctors, in the UK and India, to make sure the technologies developed are exactly what people need. She uses surveys, interviews and observations to get feedback on the development of our new testing methods.

Read more online at: *arrest-TB.net*

OUR SPONSORS

ANSWERS:

Page 1: Q1) TB symptoms: coughing, sweating, feeling tired;
Q2) To detect TB: Look for bacteria using microscope; Q3) Medicine name: antibiotics

Page 6:

Day of the Week	Week 1	Week 2
Monday	1	128
Tuesday	2	256
Wednesday	4	512
Thursday	8	1024
Friday	16	2048
Saturday	32	4096
Sunday	64	8192

Number of TB bacteria starting from 1 on Monday of week 1.

Page 11 – Bacteria on the right hand side because it has a thicker wall and more defences
Page 13 – Code cracking: blue medicine needed (for both easy and tricky codes)

FOR TEACHERS: Curriculum for Excellence links
Page 1 – LIT0-01b/0-11b; LIT1-04a; LIT1.22a; LIT1.24a.
Page 2 – HWB1-47b.
Page 4 – MTH0-16a.
Page 5 – EXA0-02a; EXA1-02a.
Page 6 - MNU0-10a; MNU1-03a; MTH1-13b.
Page 7 – SCN0-07a; SCN1-07a; SCN1-13a; MNU1-11a; HWB1-38a.
Page 8 – MNU0-02a.
Page 9 – TCH0-09a; TCH1-09a; TCH1-10a.
Page 14 – SCN0-20a; SCN1-20a.