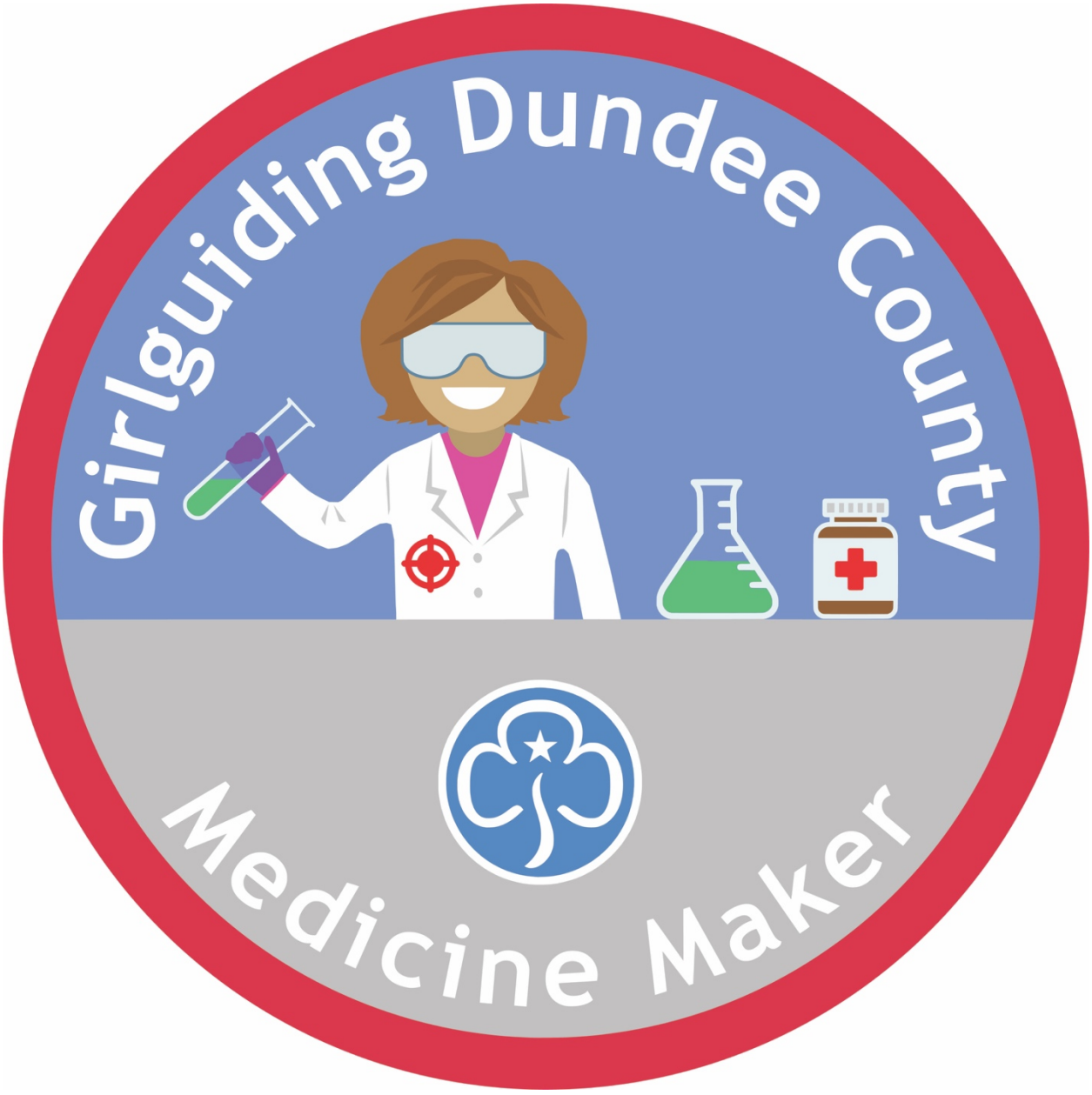


MEDICINE MAKER BADGE

WELCOME TO WELLCOME!

This badge is a collaboration between Girlguiding Dundee and the Wellcome Centre for Anti-Infectives Research (*W*CAIR). The Centre is part of the School of Life Sciences at the University of Dundee. The activities have been created by scientists who work on the development of new medicines to treat infectious diseases. We would like to thank everyone who has been involved for all of their hard work.

THE WELLCOME CENTRE FOR ANTI-INFECTIVES RESEARCH

*W*CAIR was established in 2017. We want to tackle the urgent need for drug discovery research against Neglected Tropical Diseases, or *NTDs*.

Have you ever wondered how a new medicine is made? What steps are taken by research scientists to design and develop a new medicine? Why is it important to develop new medicines? With this challenge pack, we hope to explore these questions and make understanding the drug discovery process fun and accessible for all in Girlguiding. We'd also like to encourage girls to consider a career in science.

THE CHALLENGE

We have set up the challenge so that there is as much variety as possible for all sections. They are planned to allow girls to take part in tasks as individuals, in small groups or as a whole unit. The activities have been written in a format that is easy to understand to encourage the girls to take the lead, much like the new programme activity cards. The tasks are split into four categories:

- Medicines and Infectious Diseases
- Medicines and the Lab
- Medicines and the Body
- Medicines and Me

Girls can choose to do as many tasks from each category as they like. We suggest a minimum of one activity from each section plus:

- Rainbows: 1 extra activity
- Brownies: 2 extra activities
- Guides: 3 extra activities
- Rangers: 4 extra activities
- Adults: 5 extra activities

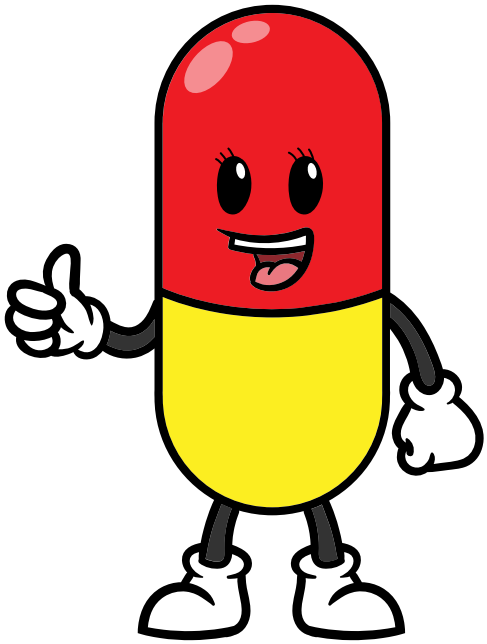
50% of the profits of the challenge will go towards Girlguiding Scotland's work in Africa where infectious diseases are prevalent. The remainder will go towards Girlguiding Dundee Financial Assistance Fund to help units who are struggling.

We have prepared some very short evaluation forms, which are at the back of the pack. There is one for before you start and after you finish. It's vital for us to know how well the activities are working, and to show people who support our public engagement that we're really making a difference.

If your unit makes anything cool that you'd like to share with us, or you'd just like to say hi, please do tweet us at @WCAIRDundee and @GirlGuidingDund using #medicinemakerbadge.

FUN FACT

Keep an eye out for Medi. She'll provide fun facts and interesting information along the way!



MEDICINE MAKER BADGE ORDER FORM

Unit:	
County:	
Leader's Name:	
Address (for delivery):	
Email:	

Total number of badges @ £1.00 each: £_____

Please add the following amount of postage depending on how many badges you order:

1 - 40 badges £2.50 ☐

40 – 100 badges £3.50 ☐

For international orders and those with larger numbers, please contact for postage costs.

Local Dundee orders can be collected from the Dundee Guide Shop by arrangement.

Total Amount Paid: £_____

Payment Method: cheque payable to "Medicine Maker Badge"

Bank Transfer to account no. 18680266

Sort code 80-22-60

Paypal to "Medicine Maker Badge"

Please return this order form either by email to "medicinemakerbadge@gmail.com"

or by post to *Medicine Maker Badge Orders, 3 Glenfeshie Road, Dundee. DD5 3XB*

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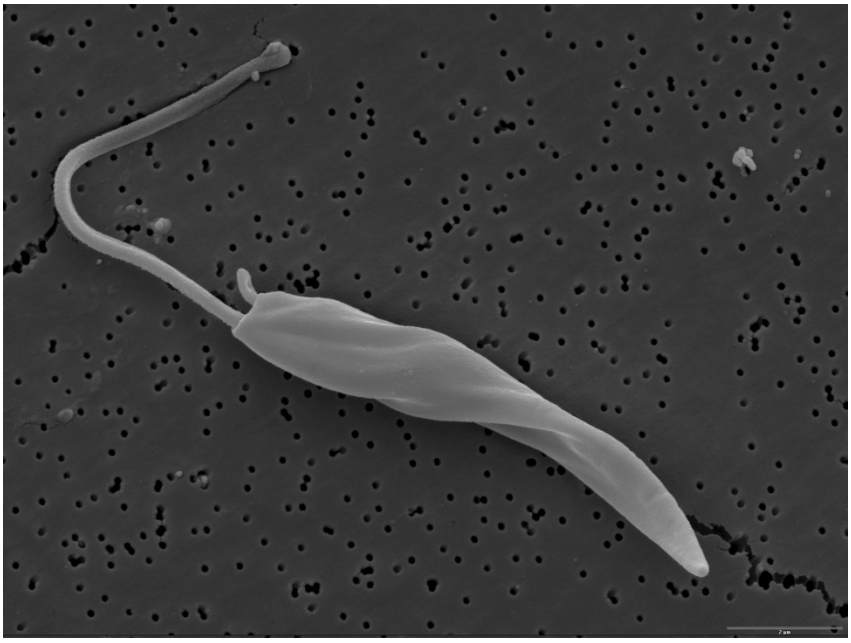
MEDICINES AND INFECTIOUS DISEASES

Infectious diseases are caused by tiny living things such as bacteria, viruses, fungi or parasites. We sometimes call living things "organisms". Many of these organisms live in and on our bodies. They are usually harmless, but sometimes they may cause disease. They can be passed from person to person, by bites from insects or animals, or by ingesting contaminated food or water.



Electron microscope picture of a Leishmania parasite by Dr. Sujatha Manthri and Martin Keirans of WCAIR

Many infectious diseases, such as measles and chickenpox, can be prevented by vaccines. Frequent and thorough hand-washing also helps protect you from most infectious diseases.

Some diseases are more common in different parts of the world. During this section you will learn about different diseases. You can also discover where they are found, what medicines help, what these organisms look like and how they are spread.

ACTIVITIES WITHIN THIS SECTION

- Infectious diseases of the world
- How are diseases transmitted?
- Making felt microbes
- Modelling bacteria
- Build a biofilm
- Resistance is futile?

INFECTIOUS DISEASES OF THE WORLD

AIM OF ACTIVITY

To learn about what infectious diseases are and where they are found.

ABOUT THE ACTIVITY

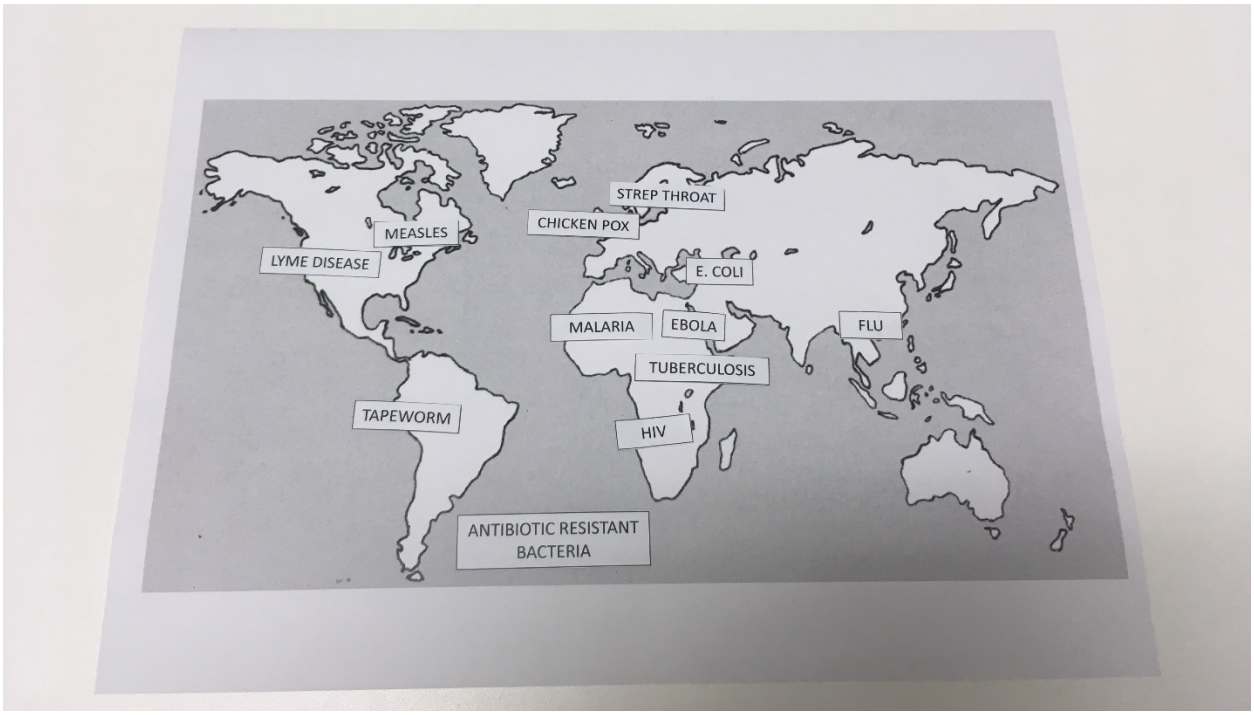
Infectious diseases are caused by tiny living things like bacteria, viruses and parasites. In this activity, a number of infectious diseases need to be placed onto a map to show where they are most common. Answers are found in the notes section.

WHAT YOU'LL NEED

- Outline of world map
- Disease names
- Pins

WHAT TO DO

1. Begin with a discussion about where diseases are found in the world. What do you know about them to begin with?
2. Place your list of diseases alongside your world map. Guess where each disease is most commonly found by placing the name next to the area of the map.



3. Discuss why those decisions were made, then check against our handy answer sheet. Were you right?

TAKE IT FURTHER

Find out more about one disease and design a poster to tell others more about it.

Older girls might also want to play with our app, This is Disease Lab. It's available for *free* on Google Play Store and iTunes, and you can check out our website at wcair.dundee.ac.uk for links and more information. We think it's the most infectious game in the world!

NOTES FOR LEADERS

There are lots of diseases around the world! These are a few of the most common. You can find out more information by looking at encyclopaedias, or on the internet. Do be careful with online information; it may be out of date, or it may simply be wrong! Sources like the NHS, the CDC in the United States and the World Health Organisation tend to be the most thorough and reliable.

Disease	Main area	Cause
Measles	Africa & Asia	Virus
Lyme disease	Europe & North America	Bacteria (Tick Bite)
Tapeworm	South America, Africa & Asia	Parasite
Chickenpox	Everywhere	Virus
Strep. throat	Everywhere	Bacteria
HIV	Africa	Virus
Flu	Asia	Virus
E. coli	Everywhere	Bacteria
Malaria	South America, Africa & Asia	Parasite (Mosquito)
Tuberculosis	South America, Africa & Asia	Bacteria
Antibiotic resistant bacteria	Everywhere	Bacteria
Ebola	Africa	Virus

You could do this activity all at once, or you could do it over a few weeks, gradually building up your own world map.

HOW ARE DISEASES TRANSMITTED?

AIM OF ACTIVITY
To explore and recognise how different infectious diseases are spread.

ABOUT THE ACTIVITY
This activity will explain how different infectious diseases can be spread by using malaria as an example. Malaria is a life-threatening disease. It is transmitted via a mosquito bite. It can be prevented by the use of mosquito nets. For those who are infected there are medicines available, but the parasites are rapidly finding ways to survive them. The rise of *resistance* in malaria is one of the main reasons why we are trying to make new anti-malarial medicines.

WHAT YOU'LL NEED
- Ball
- Large, open space.

WHAT TO DO
This game is a variation on tig/tag.

1. Nominate one girl to be a doctor and one girl to be a mosquito.
2. Mosquitos 'spread' the disease by tagging the other girls. Once 'bitten', the girls must act ill and stand with their legs apart.
3. The doctor 'cures' the girls that have been 'bitten' by rolling the ball through their legs.
4. Once saved, the girls can run around again.
5. The doctor loses if all the girls are infected.

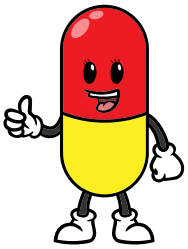
TAKE IT FURTHER
Why not try the game without any doctors or with extra mosquitos? What happens?

This game can also be used to explain the transmission of other diseases:

Tuberculosis (TB) is spread by coughs and sneezes. Why not have the girl who is "It" tag the girls by pretending to cough. Don't actually cough on each other, though!

WCAIR is trying to make new medicines to help people with Leishmaniasis and Chagas' disease. Leishmaniasis is a disease spread by sandflies. Chagas' disease is carried by an insect called a kissing bug. It crawls around houses made from things like wood and mud, and bites people. Is there a way of modifying the game to include these diseases?

FUN FACT
Only female mosquitos transmit malaria, as they are the only ones who bite. They need a blood meal so that their eggs can mature fully. Male mosquitos only eat things like nectar and honey dew.



MAKING FELT MICROBES

AIM OF ACTIVITY

To discover what parasites look like by creating your own felt microbe.

ABOUT THE ACTIVITY

Microbes are the small living things, or *micro-organisms*, that cause disease. They are so tiny that they can only be seen under a microscope. They can take different forms: bacteria, virus, parasite and more! In this activity, you will make your own microbe which is thousands of times bigger than its actual size.

You can make either:

- The leishmania parasite, whose proper name is *L. Donovani*, which is transmitted through the bite of a sandfly
- Malaria, a parasite which is transmitted by mosquitos
- The parasite which causes Chagas' disease, called *T. cruzi*, which is spread by kissing bugs
- Tuberculosis (TB), a bacterium that can be transmitted through coughing and sneezing. It mainly affects the lungs and throat.

WHAT YOU'LL NEED

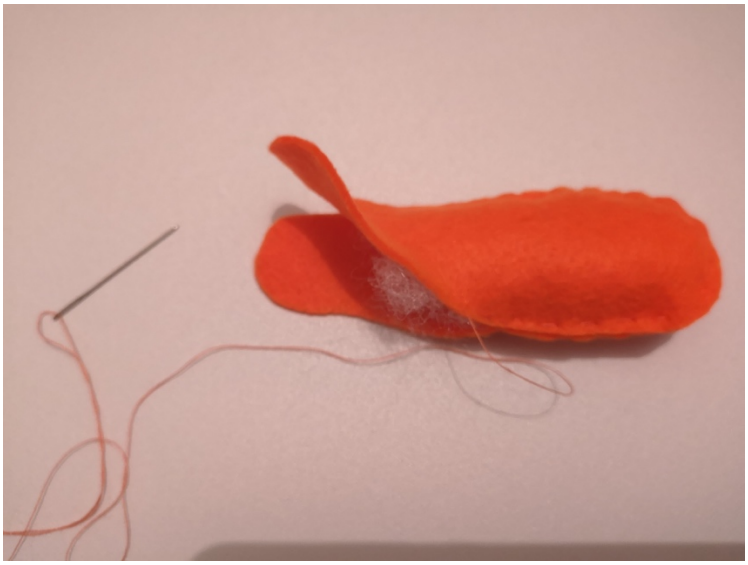
- template (found a back of the pack)
- paper
- pen
- felt
- googly eyes

- needle and pins
- thread
- wool
- stuffing
- glue gun or fabric glue

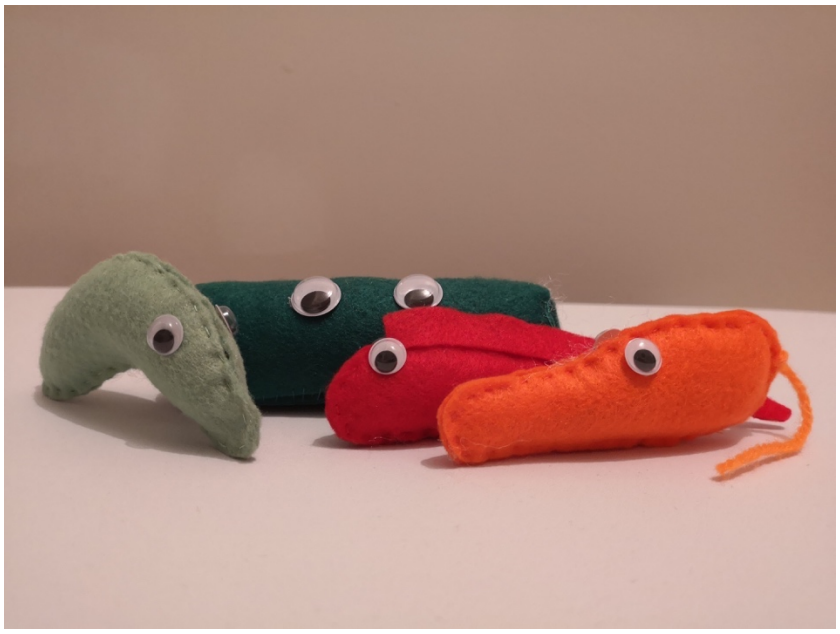
WHAT TO DO

1. Decide which microbe you would like to make.
2. Draw around your template onto felt. Remember for leishmaniasis and malaria to do two copies of the template.

3. Cut out your shapes – we'd recommend pinning the template to the felt to make it easier to cut.
4. Sew the pieces of felt together. Remember to leave a space at the end for the stuffing to go in.



5. Stuff your microbe.
6. Finish sewing the pieces of felt together.
7. Glue on the googly eyes plus any extra features your microbe has.



8. Enjoy your felt microbe. Why not compare what you've made to images found when you look under microscope? There are lots of them to be found on the internet.

NOTE TO LEADER

We would recommend for younger girls to make either leishmaniasis or malaria. Older girls would be more suited to making TB or Chagas' disease.

MODELLING BACTERIA

AIM OF ACTIVITY

To make your own bacterium and find out about what bacteria do.

ABOUT THE ACTIVITY

Bacteria are a type of living thing that are so small we can only see them with microscopes. When there are lots of them, we talk about 'bacteria', and if it's just one we say 'bacterium'.

There are millions and millions of different kinds of bacteria. They live in water, on plants, in the earth and even on us! You might think of them as being bad. Some do indeed cause diseases, but lots of them are good. They help keep us healthy, for instance by helping to digest our food and get lots of the vitamins that we need.

For this activity, you can make your own bacterium out of Play Doh and other crafting materials.

WHAT YOU'LL NEED

- Petri dish, or other small plate to hold your creation
- Play-Doh or Plasticine
- Other crafty materials, like sequins, pipe cleaners, and even googly eyes.
- Pictures of real bacteria can help you to add realism

WHAT TO DO

1. Look at some pictures of bacteria, or imagine what yours might look like.
2. What does your bacteria do? Does it help digest food, or does it make people sick?
3. Where does your bacteria live? Is it in on our skin, in our intestines, or on another plant or animal?
4. Once you've worked that out, it's time to get making! Take a Petri dish, or some other small plate, and start shaping your bacteria out of Play Doh or similar.

5. You can add other details to bring it to life. Some bacteria use bits that stick out to move themselves, a little bit like oars. We call these *flagella*. You could use pipe cleaners to make some.
6. Bacteria don't have eyes, as they're each only one cell, but if you want to make your bacterium cuter you can add an eye, or two, or three – however many you fancy, really.

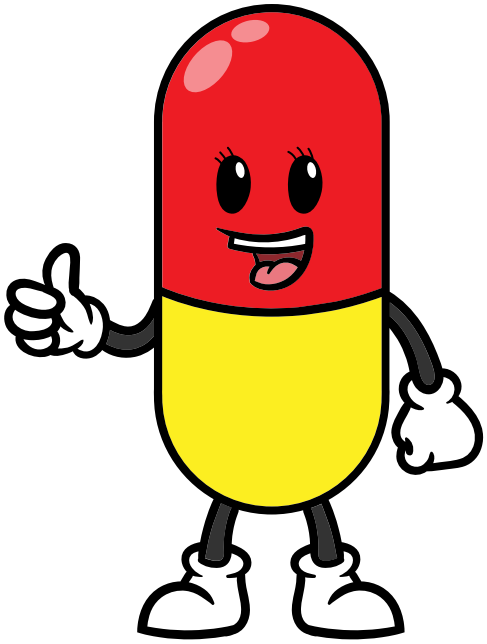
TAKE IT FURTHER

Instead of making your bacterium from Play Doh, why not try making it using different materials? Perhaps a pom-pom…

Some bad bacteria have found ways to survive an attack from antibiotics, medicines that normally kill them. We call these *antibiotic resistant bacteria* in scientific labs, but newspapers often call them *superbugs*. Can you make your bacteria into a superbug?

FUN FACT

Bacteria have a tough cell wall that gives them their shape and protects them from attack…usually.



BUILD A BIOFILM

AIM OF THE ACTIVITY

To consider biofilms and the role they play in diseases.

ABOUT THE ACTIVITY

Biofilms are communities of microbes that live on a variety of both natural and manmade surfaces. You have probably encountered biofilms before – the dental plaque that forms on your teeth and causes cavities is an example of one. So is the film that you scrub off your toilet bowl!

We sometimes call biofilms '*bacterial cities*' because it's a good illustration of what a biofilm is – lots of different types of bacteria and other microbes growing together on a surface. They cooperate and even communicate with one another in order to maximise their chances of survival.

Biofilms give bacteria protection from outside elements. A biofilm forms when bacteria attach to a surface and then produce a sticky, sugary matrix known as "extracellular polymeric substances", or EPS. The EPS surrounds the bacteria and allows them to form three-dimensional colonies which are protected against things that would otherwise kill them, like antibiotics. It has been shown that biofilms are resistant to doses of antibiotics over 1000 times stronger than those needed to kill free-floating bacteria! They also make it harder to remove the colonies with physical force, like with a toothbrush or toilet brush.

There are several different ways you can model biofilms. We have lots of ideas on our website: http://www.lifesci.dundee.ac.uk/sites/www.lifesci.dundee.ac.uk/files/Biofilms_teacher_guide.pdf One of the easiest and most fun for large groups is with paper cut-outs.

WHAT YOU'LL NEED

- shapes from resource pack
- colouring pens and pencils
- blu-tac or other way of sticking them up
- a wall or poster board to make your biofilm on

WHAT TO DO

1. Cut out the bacterial shapes from the template, either with the girls present or in advance
2. Colour in the bacteria, or write a message on them. If you have a fun fact, or a science question, it can be a great way of getting the girls to share them
3. Stick the bacteria up on a wall or other surface.
4. Share your work with the wider world, either by showing it off to parents or putting it online. Don't forget to use *#medicinemakerbadge* so that everyone else can see it! Say hi to us on Twitter – we're *@WCAIRDundee* and *@GirlGuidingDund*.

RESISTANCE IS FUTILE?

AIM OF ACTIVITY

To consider how antibiotics work and explore antibiotic-resistant bacteria.

ABOUT THE ACTIVITY

Antibiotics are medicines used to prevent and treat bacterial infections. Sometimes, bacteria can change to be able to survive an antibiotic attack. One common cause for this is people using antibiotics when they have a viral infection. It can also happen if you don't take all of the antibiotics a doctor prescribes – you'll kill the weaker bacteria but the strongest will survive and re-grow! When this happens, we talk about the bacteria as being *antibiotic resistant*. Only it is resistant – not the people or animals they infect.

If these bacteria infect humans or animals, the infections they cause are harder to treat than those caused by non-resistant bacteria. Antibiotic-resistant bacteria are one of the biggest challenges facing medicine in the 21st century, so always do what your doctor tells you with medicines.

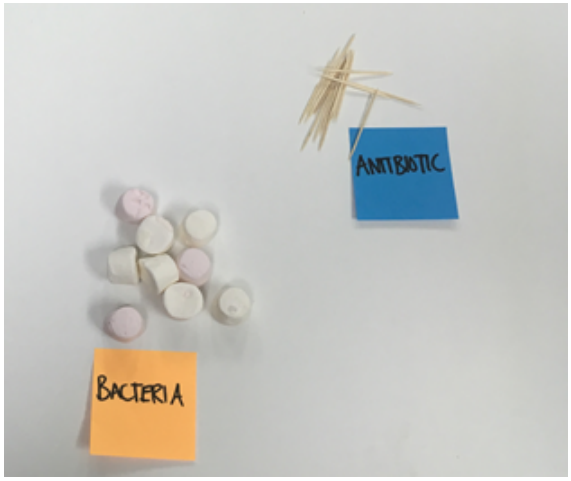
This game is intended to show that some bacteria are not affected by the antibiotics.

WHAT YOU'LL NEED

- Marshmallows to be bacteria
- Hard-shelled sweets to be resistant bacteria
- Cocktail sticks to be the antibiotics
- Post-it notes
- Marker pen

WHAT TO DO

1. Place marshmallows and cocktail sticks on a clean table with a post-it note explaining what they represent.



2. Explain that for the antibiotic to work it must break the surface of the bacteria. Can the girls pick up the bacteria with the antibiotic?
3. Now add the hard-shelled sweets onto the table and label them.

4. Now try to pick up the antibiotic resistant bacteria with the cocktail stick. It's pretty tricky. What happens when you mix the resistant bacteria in with the normal ones?

TAKE IT FURTHER

Play BrainPOP movie Antibiotic Resistance game, available online: https://www.brainpop.com/games/antibioticresistancegame/

Scientists are trying to make new medicines to work against antibiotic resistant bacteria. Some of them work by different ways than older antibiotics. Can you think of a way of picking up the hard-shelled sweets?

Can you explain to the rest of your group what causes resistance? What can you do to help the problem?

MEDICINES AND THE LAB

Every medicine used today has been developed by a team of scientists in a lab. It can take many years to achieve – on average, it takes 15 years and up to £1.5 billion to take a medicine from an initial idea to being approved as a treatment.

In the Wellcome Centre, lots of different kinds of scientists work together to make new medicines. Each one is an expert in their type of science. For example, there are:

- *Chemists* who make the medicines in the lab using chemical reactions
- *Biologists* who can test the medicine against the disease and tell the others if it works
- *Computational scientists* who look at the shape of different chemicals using powerful computers. This lets us know what shape the medicine needs to do its work.

Only by these scientists *working together in a team* can we develop new medicines

We use lots of different techniques in the lab. Some of them are to make the medicines, and others test if the medicine works. During this section you can discover some of the different ways our scientists work.

ACTIVITIES WITHIN THIS SECTION

- Design a lab coat
- Discovering chemical reactions
- Unlocking new medicines
- Modelling molecules
- Rainbow mosquitos
- Bacterial colonies
- Testing new medicine molecules – do they work?

DESIGN A LAB COAT

AIM OF THE ACTIVITY

To consider the safety equipment that scientists need to wear in a lab

ABOUT THE ACTIVITY

Staying safe is one of the most important aspects of working in science. There are chemicals and other things which could be nasty if they touch you. Fortunately, we have lots of different equipment to make sure we stay safe, clean and happy! This includes:

- safety glasses
- gloves
- hair ties
- sensible shoes
- lab coats

Lab coats are often simple and white, but sometimes we can have other colours and designs. In this activity, you can design your own cool, colourful lab coat.

YOU WILL NEED

- Colouring pens, pencils or crayons
- The lab coat template from the back of this pack, or another paper lab coat if you want to make your own

WHAT TO DO

Think about what you want your scientist to look like. Do they have a logo they want to include? They might want a name badge, or some design that reflects what they do

Design and make your lab coat.

As scientists always work in teams, why not collect all the lab coats your unit makes in one place?

Share your work with friends, family and the wider world. If you share them on social media, we'd love to hear about it. Use #medicinemakerbadge so that everyone else doing the challenge can see what your've created. We're on Twitter as @WCAIRDundee too, so say hello.

DISCOVERING CHEMICAL REACTIONS

AIM OF ACTIVITY

To state that a true chemical reaction always creates new products and illustrate this by baking a cake.

ABOUT THE ACTIVITY

In a chemical reaction, substances undergo a chemical change to form a different substance. If it has been a true chemical reaction, you can't get the original substances back.

In the lab, scientists perform chemical reactions to make medicine molecules but chemical reactions also happen in everyday life.

A good example is baking a cake. The ingredients undergo a chemical reaction caused by mixing and heating in the oven to form a different product. We know a chemical change has taken place because the ingredients can no longer be recovered in their original form – you can't take eggs back out of a baked cake!

WHAT YOU'LL NEED

- 225 g unsalted butter
- 225 g caster sugar
- 225 g self-raising flour
- 1 tsp baking powder
- 4 eggs
- 1 tsp pure vanilla extract
- Icing
- Sprinkles/other decorations

WHAT TO DO

1. Preheat the oven to 180 °C. Line a bun tray with 18 – 20 paper baking cases.
2. Place the butter, sugar, flour, baking powder, eggs, and vanilla extract in a large bowl and beat until light and fluffy.
3. Spoon into the baking cases and bake for 18 minutes or until risen and golden brown.
4. Transfer to a wire rack to cool before decorating.

TAKE IT FURTHER

Another example of a chemical reaction is mixing together baking soda and vinegar. You can see the reaction taking place because bubbles of gas are released!

You could decorate the cupcakes with a simple molecule, like water – it has the formula H_2O.

UNLOCKING NEW MEDICINES

AIM OF ACTIVITY

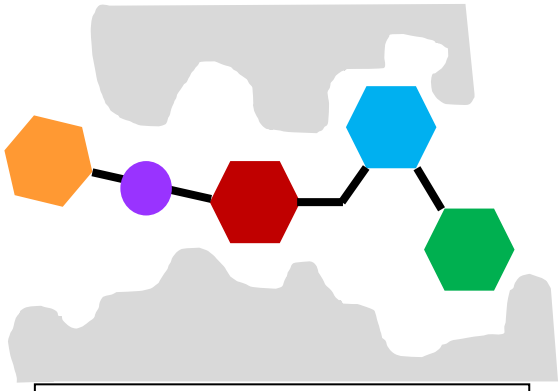
To recognise that the shape of a medicine molecule is important in how it works.

ABOUT THE ACTIVITY

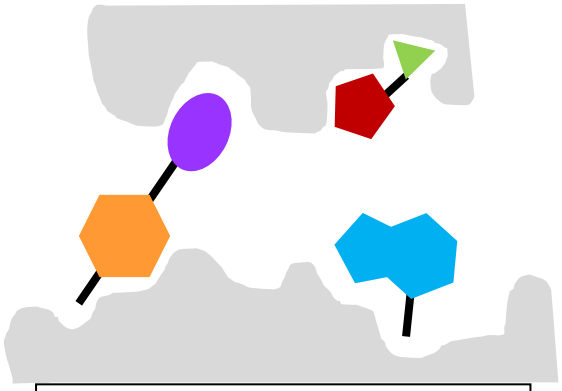
A medicine's shape is really important in determining if it will work. To have an effect, each molecule of a medicine has to fit into the right bit of the cell it's working on. We call this bit the *target*. This is true whether it's a pain killer helping you to feel better, or an antibiotic attacking an invading bacterium. This place where the medicine molecule sticks to on the target is called a *receptor*.

When designing a new medicine to target a specific receptor it is important to think about the shape of the receptor. If a medicine can't fit well into the receptor, it won't work. Think about it like a lock and key – the key (medicine) has to be the correct shape to fit into the lock (receptor) or it won't unlock.

Rather than taking a medicine that is too big for the receptor and doesn't fit well, a common approach is to use small '*fragments*'. We can then join these together to form a bigger molecule that is the correct shape.



Big medicine molecule – doesn't fit well into the shape of the receptor



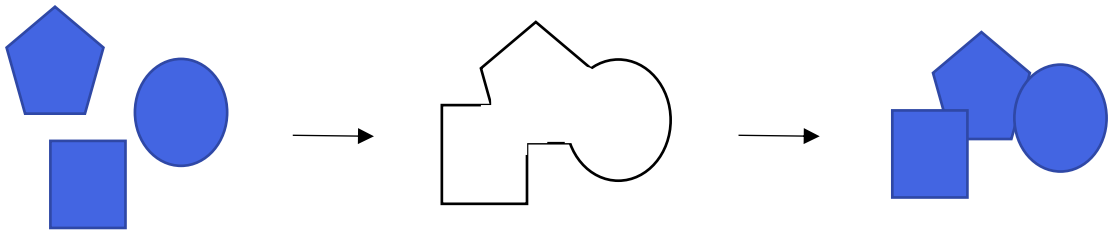
Smaller fragments – fit better into the shape of the receptor

WHAT YOU'LL NEED

- Pieces of paper/card cut into three shapes – pentagon, circle, and a square
- A 'receptor' drawn on a larger piece of paper
- Sticky tape or glue

WHAT TO DO

The girls are given one shape each. They have to find two other girls with different shapes that can be stuck together to match the shape of the receptor. The first team to put together a 'medicine' that is the correct shape to fit into the target 'receptor' wins!



Girls are given one of three cut-out shapes

An outline of a receptor is stuck on the wall

Girls have to work together to find the three shapes needed to stick together to form a 'medicine molecule' that will fit the shape of the receptor

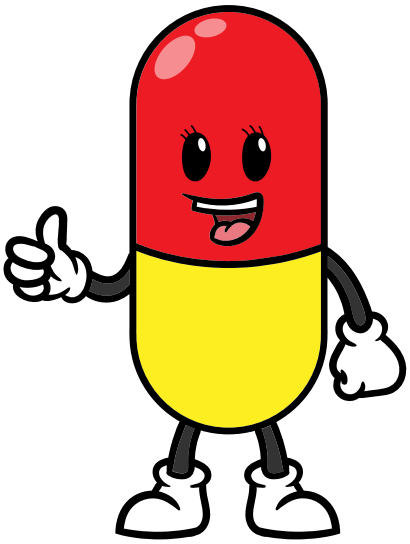
TAKE IT FURTHER

For older girls you can make it even trickier by adding in extra shapes, or choose more elaborate shapes – hexagon, rhombus, trapezium, or others. http://drugdiscoverygame.com/ has some really complex downloadable templates.

Think of a name for the medicine you have created. What neglected disease could it be used to treat? This might come in useful in a later section of the challenge…

FUN FACT

The lock and key model was first proposed in 1894, by German chemist Emil Fischer.



MODELLING MOLECULES

AIM OF ACTIVITY

To build your own 3D chemical structures.

ABOUT THE ACTIVITY

At the level we can see them, medicines look like tablets, pills or liquids. At a much smaller level, tinier than we can see, they have a much wider variety of shapes. They're often so tiny that we have to use special lab equipment to know what they look like, but each type of medicine has its own shape. They can have rings, lines, all sorts of shapes. They work in 3 dimensions!

We can model what they look like. There are modelling kits that you can buy, but it's also easy enough to do it with things you might find around the house. Fruit can be a surprisingly useful tool for science!

Every medicine you take is made up different atoms. They are joined together by chemical bonds, which are formed in chemical reactions. For every type of atom, rules apply as to how many chemical bonds it can form. These are the most common type of atoms in medicines:

Atom name	Chemical symbol	Number of bonds	Common colour in model
Carbon	C	4 bonds for each atom	Black
Nitrogen	N	3 bonds for each atom	Red
Oxygen	O	2 bonds for each atom	Blue
Hydrogen	H	1 bond for each atom	White

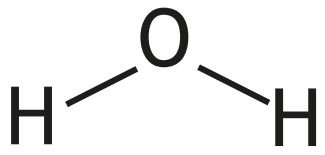
WHAT YOU'LL NEED

- 4 different objects, 1 each for carbon, oxygen, nitrogen and hydrogen atoms. For example:
    - Fruit: white grapes, black grapes, blueberries, strawberry
    - Sweets: marshmallows, liquorice, gummy bears, cherries
    - Marshmallow: 4 different sizes / colours
- Cocktail sticks to attach everything together.

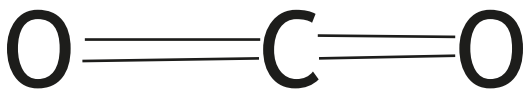
WHAT TO DO

You might want to start by building some simple molecules that you may have heard of – *water* and *carbon dioxide*.

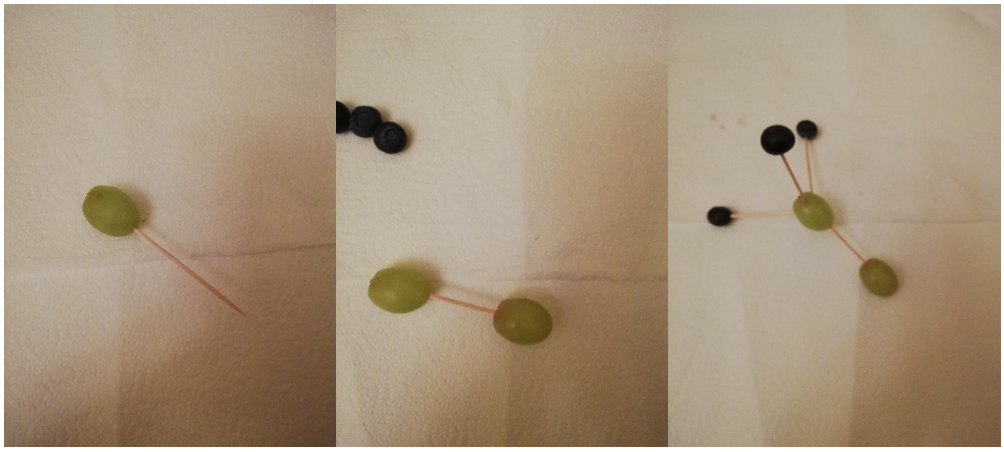
1. Hopefully, you already know what water is – it's the clear, colourless liquid that we drink. A *chemical formula* helps scientists describe what makes a molecule. Water's chemical formula is H_2O, which means it has 2 atoms of hydrogen and one of oxygen.



2. Carbon dioxide is another chemical you may have heard of. It's what gives fizzy drinks their bubbles. It's also made when cars, lorries and other things burn fuels. Carbon dioxide has the formula CO_2, which means it has 1 atom of C, or carbon, and 2 of O, or oxygen. Because carbon always has to have 4 bonds for each atom, and oxygen always has to have 2, it looks a bit more complicated than the water molecule.



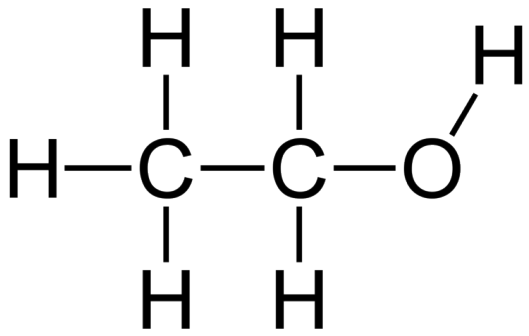
3. Now that you've become an expert on chemical modelling, you can move onto more advanced chemicals…even medicines! Start from a carbon/white grape and attach a stick (or 2 if in the drawing there are 2 lines connecting 2 atoms). On the other side attach the next atom/fruit. Congratulations, you formed a chemical bond!



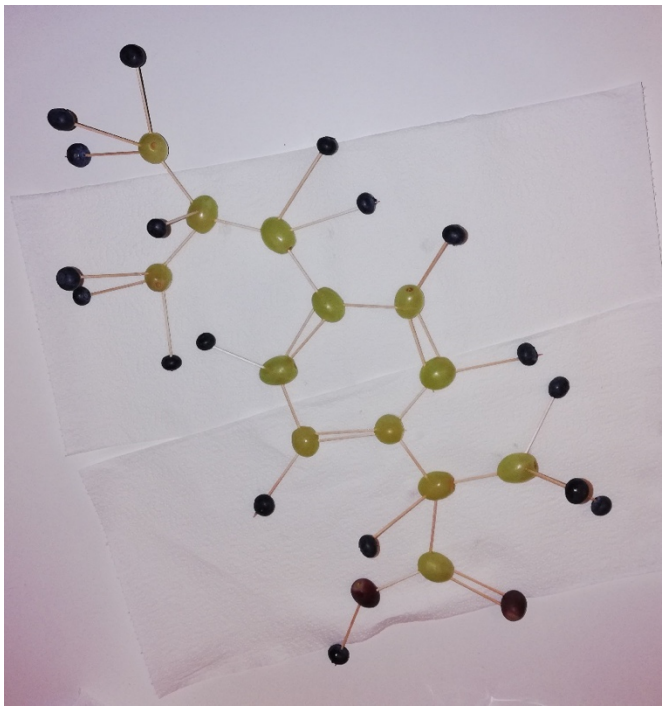
Now, add another atom and so on until you build the whole molecule. Watch out with the sticks because you can hurt other people if not used correctly.

You can find many, many different chemical molecules if you look on the internet. Here are a couple that you might have heard of:

- Ethanol:



- Ibuprofen:



NOTES TO LEADER

These are just suggestions of what to use. They can be adapted to anything you have more available. Release your imagination and try to build molecules in most extravagant way!

TAKE IT FURTHER

What about inventing your own molecule? You can create any molecule you want – so long as you follow the rules about the number of bonds!

RAINBOW MOSQUITOS

AIM OF ACTIVITY

To make a fun, colourful mosquito and apply the chemistry technique chromatography.

ABOUT THE ACTIVITY

When a chemist is making a medicine to treat a disease, they make sure it is pure enough using a technique called c*hromatography*. This separates the pure medicine from the impurities – other chemicals we don't want. In this activity, you will use chromatography to separate ink into the individual colours it is made up of. The colourful paper can then be shaped into an insect.

Some insects carry parasites which spread disease to humans through a bite. For example:

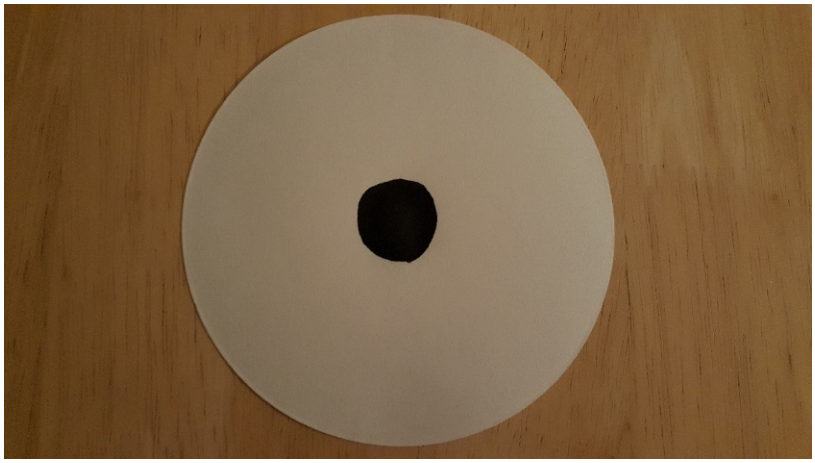
- A sandfly transmits a tropical parasite that causes leishmaniasis
- A mosquito which transmits a parasite that causes malaria
- A kissing bug which transmits a parasite that causes Chagas' disease

WHAT YOU'LL NEED

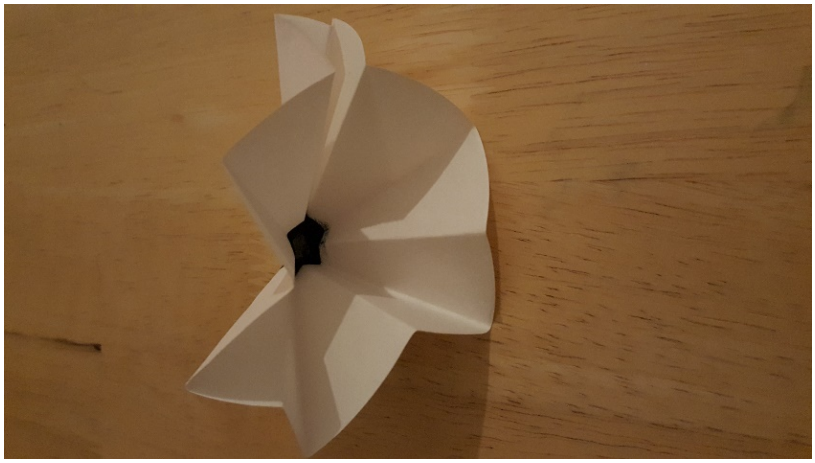
- Filter paper or coffee paper
- Water based felt tip pens (non-permanent)
- A clear container or glass
- Water
- Pipe cleaners

WHAT TO DO

1. In the middle of the paper, colour in a circle with the felt tip pen.

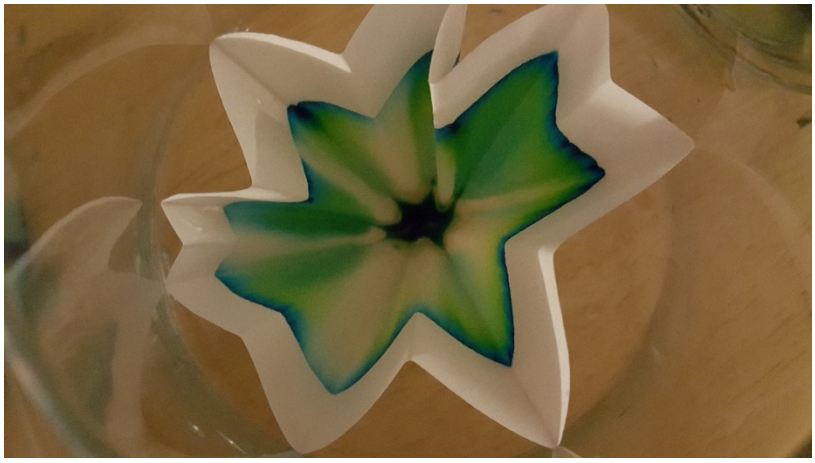


2. Fold the paper into a fan, then unfold it so you have zig-zagged circle.



3. Fill the glass or container with a minimal amount of water. Place the paper in so the tip just touches the water. You may have to hold it in place.
4. Watch the ink run up the paper and separate into the individual colours.

5. Let the paper dry.



6. Once dry, pinch the paper in the middle to form two wings.
7. Put three pipe cleaners across the middle and a fourth to tie the paper and pipe cleaners together.

8. Twist the pipe cleaner that was used to tie everything together to form a long-pointed nose.
9. Separate and bend the others into 6 legs.
10. You can tie a piece of string around the insect to hang it up.

NOTES TO LEADER

It's best to just use one colour per mosquito, at least for starting out. It can be fun to get the girls to predict which colours will come from different colours of pen. Black is a particularly dramatic colour to use.

The fan shape really helps the pen move evenly up the paper.

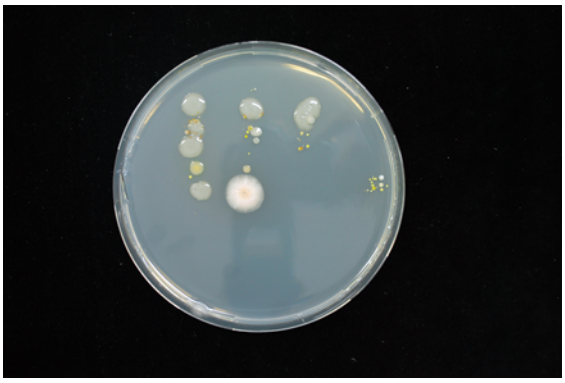
BACTERIAL COLONIES

AIM OF ACTIVITY

To model bacterial colonies and discover what they need to live.

ABOUT THE ACTIVITY

Bacteria are tiny living things that you can only see with a microscope. When there are lots and lots of bacteria together, we can see their big group. We call this a *colony*.



There are lots of types of bacteria and they live all around us; in soil, on skin and in the gut. Some are good and help us with things like digesting our food. Others can make us sick causing things like diarrhoea, skin sores, and blood diseases.

In our labs, we grow them on special things called 'agar plates'. Bacteria can grow and multiply and we will be able to see the colonies after a few days. Why do we use these plates?

- Agar is like a firm jelly. It has food that the bacteria can eat while they grow on it.
- The plate gives them shelter, stopping them getting squashed or scraped by something on top.
- It also helps to keep the water in as, just like us, they need it to live.

An incubator is a special box to keep them warm. Bacteria grow and multiply best when they are warm and moist. When bacteria are warm, moist, well fed, and in company, they can make more of themselves. We call this *multiplying*.

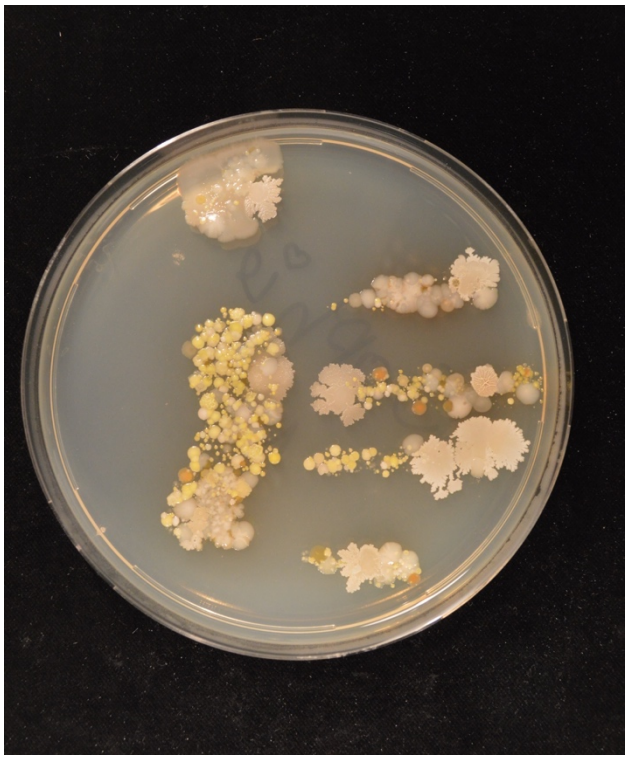
It's not safe to grow bacteria outside of the lab, but you can make your own pretend plate using craft materials. It has the advantage of being safer, shinier, and smelling better too – real agar plates can get pretty funky!

WHAT YOU'LL NEED

- Pictures of agar plates
- Paper or felt to be the 'plate'
- A circular template to cut around
- Colouring pencils, pens, sequins, or anything else colourful that you want to be your bacteria

WHAT TO DO

1. Take the material you'll be working on and cut it into a circular shape
2. Add colourful things until you get a plate of bacteria you think looks cool!



Here are two plates we've grown from the bacteria people's hands. There are lots of types of microbe here! This is why hand-washing is a good thing…

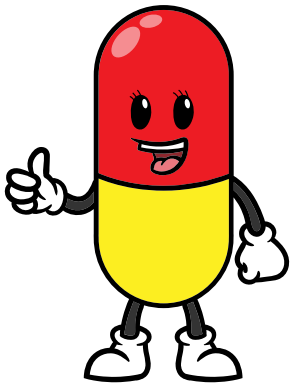
TAKE IT FURTHER

Scientists can use these plates to grow bacteria, but they can also put a drop of different medicines on them to see if they kill the bacteria. Why not add a different shiny object to make a second plate showing this effect?

FUN FACT

Alexander Fleming was a Scottish scientist. In 1928, he went away for his summer holidays without cleaning his lab. When he came back, his plates were covered with mould! He was going to throw them away, but then realised something important. Around the mould, the bacteria had been killed.

From this, the first *antibiotics* were eventually created. You can see Fleming's plates at the National Museum of Scotland either in person or online, at https://www.nms.ac.uk/explore-our-collections/collection-search-results/?item_id=649943



TESTING NEW MEDICINE MOLECULES – DO THEY WORK?

AIM OF ACTIVITY

To consider how scientists test how well new medicine molecules they make work.

ABOUT THE ACTIVITY

Before a chemical molecule is a medicine, we often talk about it using the word *compound*. When we're trying to make a new medicine, we will make lots of new different compounds to try to find the one that works best against the disease. In order to know which compound is best, a biologist tests the compounds in an experiment we call an *assay*.

An assay is carried out on a *plate*. This contains many very small biological reactions in each of its tiny wells. An assay plate can have 96, 384 or even more wells. Each one can test a different compound. To see how good the compound is, they test the compound in a biological reaction (like yeast turning sugar into alcohol) contained inside the well. Once the reaction is complete, they can then look at the different colours to see if the compound has had an effect. For our biology experiments, we want to see the medicines that have stopped the bacteria from growing, or killed them entirely. We call this effect *inhibition* – it's inhibiting growth.

In this experiment we are going to recreate what a biologist would do to find out which compounds are active or not. We'll use different household solutions and a pH indicator – red cabbage. See pH explanation activity for more information.

WHAT YOU'LL NEED

It's always a good idea to wear appropriate protective gear. This can cover your clothes, your hands and, most importantly, your eyes. Eye protection is available very cheaply in DIY stores.

- red cabbage, cut in to pieces
- hot water
- bowl
- ice cube tray
- pipettes/small spoon
- range of house hold solutions such as:
- vinegar
- lemonade (or some other colourless fizzy juice)
- water
- lemon Juice
- baking powder mixed with water
- bleach
- fruit juice
- washing powder
- salt water

WHAT TO DO

1. Well in advance, the leader should randomly place a range of different household solutions in an ice cube tray. Some can be repeated. An example is shown below:

lemon juice	vinegar	water	salt water	lemon juice	bleach	water	bleach
fruit juice	baking powder and water	salt solution	vinegar	washing powder	baking powder and water	lemon juice	washing powder

2. Cut the cabbage in to pieces and add to hot water. Leave for 10 mins, or until cooled enough. Be very careful around hot water.

3. Filter the liquid from the cabbage – KEEP THE LIQUID. It should be a blueish-violet colour.

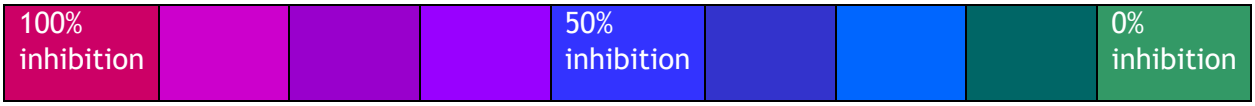
4. Add a small amount of the liquid to each well of the ice cube tray.

5. Note down the colour of each well.

QUESTIONS

- Which well has the best inhibition?
- Which has the best compound in it?
- What would you tell the chemists?

Scale:

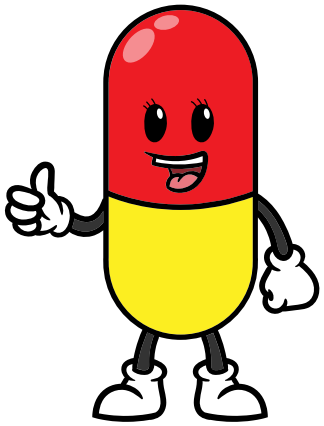


NOTE FOR LEADER

A wider range of pHs will give more of a spectrum of colour. Be careful handling strong acids or bases, like bleach.

FUN FACT

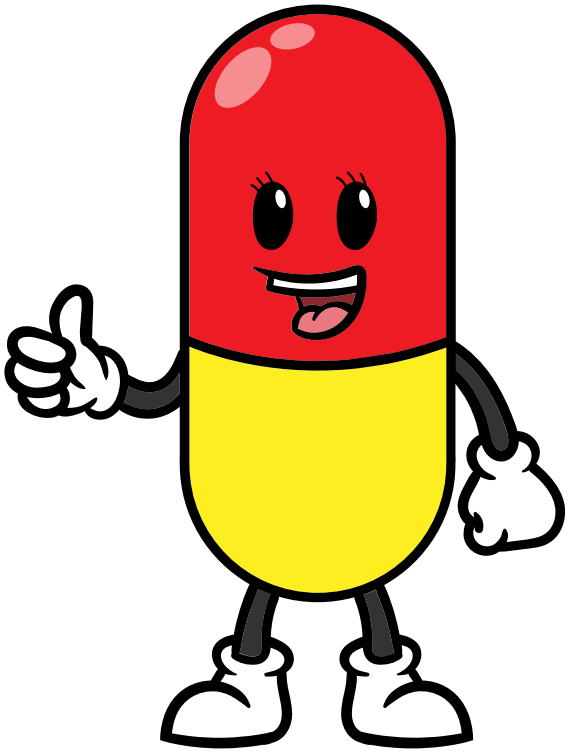
Red cabbage releases pigment molecules called anthocyanins. These molecules change colour depending on the pH of the environment they are in.



MEDICINES AND THE BODY

The human body is very complicated. Before any medicine can be approved for people to take, its effects on the body need to be investigated. This is done by a team of scientists who will make sure the medicine works right. We need to discover if it will dissolve properly, reach the bloodstream and get where it needs to be in the body. At the same time, we need to be sure the medicine is safe to take – there's no point developing a medicine to kill bacteria if it also makes your hair turn blue!

During this section you can explore what different organs do in the body. You can also find out what diseases can be found in these organs and what different things the scientists have to consider when designing a new medicine.



ACTIVITIES WITHIN THIS SECTION:

- Build a body
- Capsule's coming
- Making blood
- Hitting the right target
- Exploring pH
- Dissolving a medicine

BUILD A BODY

AIM OF ACTIVITY

To identify where organs are in the body and learn which organs some diseases target.

ABOUT THE ACTIVITY

Before designing a new medicine it is important that we understand the body, as different treatments need to reach different organs. For example, medicines that treat TB need to target the lungs while medicines that treat malaria need to target the liver and/or the blood.

WHAT YOU'LL NEED

- Paper large enough to draw around one of the girls from the pack.
- A pen to draw around the girl.
- The organs, the diseases and the "how it is transmitted" cards printed out from the resources found at the end of the pack.
- Blue-tac, tape or sticky Velcro tabs.

WHAT TO DO

1. In small groups, choose a girl to draw around onto the paper.
2. Let the girls guess where to put the organs (please refer to the supporting PDF as to where the organs should go).
3. Once the girls have the correct location for all the organs, they can play our game to learn which diseases affect which organs and how these diseases are spread.
4. Give each group a disease and a copy of the "how it is transmitted" cards.
5. The girls should guess the correct target organ and transmission method. Once they have the correct combination, let them try a different disease.
6. All answers can be found in the table below.

Disease	Organ	Transmission
Tuberculosis	Lung	Inhalation
Malaria	Liver/blood	Insect bite
Cryptosporidiosis	Intestine	Contaminated food or water
Dengue fever	Blood	Insect bite
Sleeping sickness	Brain/blood	Insect bite
Chagas' disease	Heart/blood	Insect bite
Helicobacter pylori	Stomach	Contaminated food or water

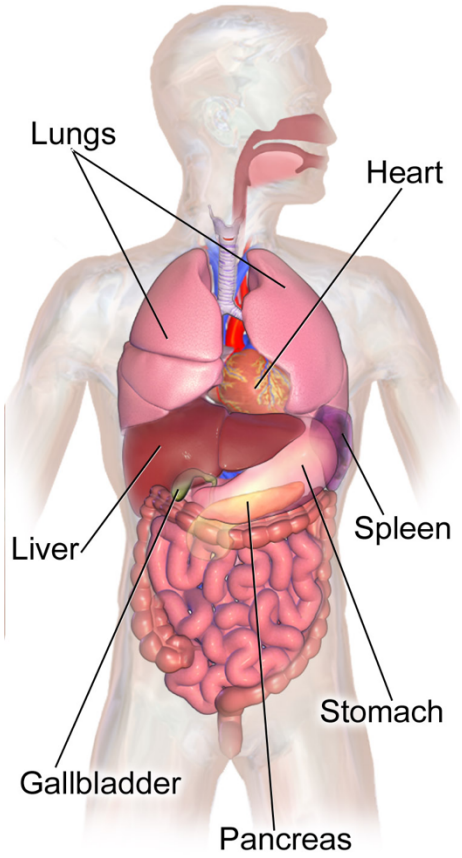
TAKE IT TO THE NEXT LEVEL

Once you've added the organs, can you add other systems to the body? You might want to add bones, or even the circulatory system if you're feeling brave!

NOTE FOR LEADER

We'd recommend that rainbows and younger brownies do parts 1 and 2 and learn where the organs are found in the body. Older brownies and guides should complete the whole activity.

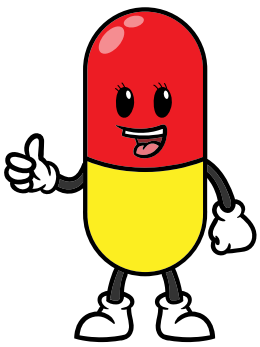
There are several great sources online for information about anatomy. We've provided a diagram here, but feel free to explore yourself.



Used under creative commons. Original source:
https://commons.wikimedia.org/wiki/File:Abdominal_Organs_Anatomy.png

FUN FACT

The biggest organ in the human body might surprise you. It's our skin.



CAPSULE'S COMING

AIM OF ACTIVITY

To recognise that different medicines are used to treat different diseases and target different organs.

ABOUT THE ACTIVITY

This is an adaptation of the classic game "Captain's coming". When we develop a new medicine, we have to design it to treat one specific disease. Often, a disease is found in one main organ, so understanding where in the body the infection is located is key to treating the illness. For example, medicines that treat a rash need to target the skin whereas medicines that treat asthma must reach the lungs.

WHAT YOU'LL NEED

- wide, open space
- pen/paper to label each of the corners (if required)

WHAT TO DO

1. Label each of the "corners" in the room a different organ. Explain which infectious diseases affects that organ.
2. Nominate a leader to shout each of the commands.
3. Girls compete against each other to complete the commands. The last girls to complete the command are removed from the game until only 1 or 2 girls are left.

Our suggested commands:

Command	*Action*
Tuberculosis	Go to the corner labelled "lung"
Malaria	Go to the corner labelled "liver"
Sleeping sickness	Go to the corner labelled "brain"
Chagas' disease	Go to the corner labelled "heart"
Infection	Apart from TB, each of these diseases are spread by the bite of an insect. If this command is given, have the girls "tag" another girl.
Pandemic	Girls lie on floor, pretending to be ill.
Cure	Girls run around, celebrating that their illness has been treated.

MAKING BLOOD

AIM

To name the key components in our blood and identify what each of them does

ABOUT THIS ACTIVITY

Blood is incredibly important to our bodies. It helps us carry oxygen and nutrients from our lungs and guts to wherever it's needed. It also helps to keep us healthy and fight off infections. The blood is made of three components:

- plasma, which is the liquid part. It carries the cells and any medicines that you might need
- red blood cells, which carry oxygen around your body
- white blood cells, which are a key part of the immune system which fights illness

With some diseases, microbes can be found in the blood itself. Malaria parasites live in red blood cells, as well as the liver. The white blood cells are our body's defensive mechanism so they try to attack Tuberculosis by forming a defensive wall, known as a granuloma, around the Tuberculosis bacteria.

WHAT YOU'LL NEED

- a plastic bottle
- a sandwich bag
- yellow and red food dyes
- water
- Cheerios
- small white marshmallows

HOW TO MAKE BLOOD:

1. Half fill a plastic bottle with water and then add a few drops of yellow food dye. This is the plasma.
2. Fill a sandwich bag with cheerios and a few drops of red food colouring. Give the bag a good shake. These are the red blood cells that give blood its colour.
3. Add the red blood cells to the bottle. You should see it change from yellow to red.
4. Add a few small white marshmallows. These are the white blood cells.

You have made blood!

HITTING THE RIGHT TARGET

AIM OF ACTIVITY

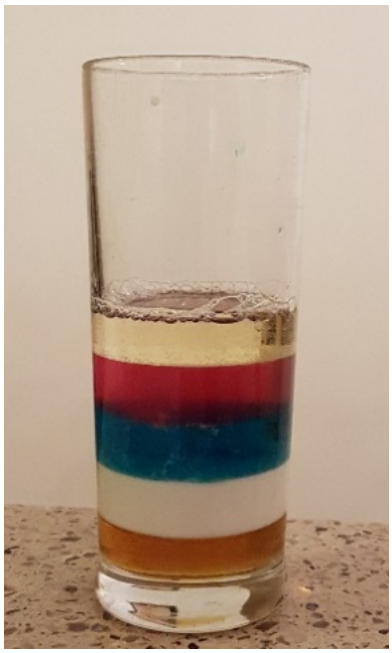
To explain what density is, and consider how this relates to medicines and their journey around the body.

ABOUT THE ACTIVITY

Medicines often need to target specific organs in the body. Common examples are skin creams for eczema, eye drops for conjunctivitis and inhalers which get asthma medicines into the lungs. These work partly because we put them where they need to be – applying a cream to skin is pretty easy.

Other medicines need to be taken as a pill, so how do they reach the lungs or the brain? Medicines can be designed to go to organs such as the gut or liver without affecting the rest of the body. The *chemical properties* of a medicine can determine where in the body it goes.

One example of a chemical property is *density* – how closely packed the molecules of a substance are. We can explore this idea using a *density tower*. This is made of several layers of liquids that sit on top of each other without mixing due to differences in the density of the liquids used. Here we use a density tower as a model of the body, where each layer is a different organ. Several simple objects are then added to the "body" as our "medicines" to find out which organ they will go to.



The activity can be run in pairs or teams. Adult supervision will be needed for younger children.

WHAT YOU'LL NEED

- Runny honey
- Whole milk
- Washing up liquid (brightly coloured)
- Water
- Food dye (a colour to contrast with the colour of the washing up liquid)
- Cooking oil
- Pipettes or droppers – available very cheaply online
- Measuring jug
- Tall drinking glass or clean empty jar
- Digital kitchen scale (optional for taking it further)
- A range of objects to put into the density tower. Good examples are a screw or nail that will quickly sink to the bottom, a cherry tomato that usually sits in the milk layer and a plastic bottle top that will float on the oil. Other interesting items include seeds, pulses, blueberries, raisins, beads or very small bits of Lego.

WHAT TO DO

Try and make each layer roughly the same height (2-3cm). Use the measuring jug to help with this. The volume needed will vary depending on the glass vessel used. Try to avoid the walls of the jar with the first 3 layers. Be careful, especially at the start of a new layer. Use a different pipette for each layer.

1. Pour in honey into the middle of the jar
2. Use a pipette to add milk onto the middle of the honey to make a layer the same size as the honey.
3. Use a pipette to add washing up liquid onto the milk layer.
4. Use the food colouring to dye your water.
5. Use a pipette to add coloured water onto the washing up liquid layer. Gently add this onto the wall of the jar starting about 3 cm above the last layer.
6. Use a pipette to add cooking oil onto the water layer. Gently add this onto the wall of the jar starting about 3 cm above the last layer.

Which objects do you think will sink the deepest into the density tower? Write down your predictions so you can compare them with the actual results.

Gently add your objects one at a time, dropping them from as close to the surface of the oil as you can.

TAKE IT FURTHER

Density is basically how much "stuff" is packed into a particular volume. It's a comparison between an object's mass and its volume.

Try and find out the density of the different layers. To test if this is right, you might want to set up a sensitive kitchen scale and weigh the liquids that you added to the column. Use less

liquid than for the tower but use exactly the same volume each time. Write down the weight from lightest to heaviest. Does it match the order of the layers from the tower?

Look at your predictions of which objects would end up where. Were you right with them all? The density of the objects will determine which layer it ends up in.

NOTE FOR LEADERS

There are lots of websites and videos that show you how to do this experiment. Some are:

https://www.kiwico.com/diy/Science-Projects-for-Kids/3/project/Density-Tower/2601

https://www.stevespanglerscience.com/lab/experiments/density-tower-magic-with-science/

EXPLORING PH

AIM OF ACTIVITY

To recognise what pH is, and how it is important in the body and for medicines.

ABOUT THE ACTIVITY

One of the really important chemical properties of any medicine is its pH. This is a measure of how *acidic* or *basic* something is. Acids have a low pH and bases have a high pH, and water is neutral. The pH scale goes from 0 to 14.

- acids have a pH from 0 to 6
- neutral is 7 – it's neither acidic nor basic
- bases have a pH from 8 to 14.

If we want to know whether something is an acid or a base we can use a chemical called an *indicator*. This might come in a liquid form, or embedded into pH paper. These change colour depending whether something is an acid or a base.

In this experiment we are going to find out the pH of some different household solutions. We can also think about the different pHs around the body.

There are lots of different pHs around the body.

- When we swallow food, it goes to the stomach. It is strongly acidic, around pH 2. This it helps to break down the food that we eat and to kill any bacteria that enter our system.
- After the stomach, our food goes in to the intestine. The body makes a substance called bile, this has a pH of 8 (basic) and gets released in to the intestine. This helps to neutralise the stomach acid, making the intestine pH 6 – 7.
- The blood has a neutral pH of around 7.

As you can see, there are lots of different pH environments in our bodies. This means we have to work very hard to make sure that the medicine you swallow gets to the right place in your body and is still in a form that works. If the medicine was broken down in an acidic environment, for example, it wouldn't reach the place that needed it.

WHAT YOU'LL NEED:

- rubber gloves
- eye protection, which is often available very cheaply in hardware shops
- something to protect your clothes
- pH paper (or red cabbage, see Ice-cube tray assay activity)
- range of household solutions such as:
    - vinegar
    - lemonade (or any fizzy, citrus-y drink)
    - water
    - lemon juice

- baking powder/bicarbonate solution
- bleach

WHAT TO DO

1. With adult supervision, use the pH paper to test the different chemicals you might find in a kitchen. Be very careful! It's a good idea to wear rubber gloves, like washing up gloves, and something to protect your clothes and, most importantly, your eyes.
2. Note down the colour change and what you think the pH is.
3. Take some vinegar or lemon juice and test the pH. This has an acidic pH, around 3. This is a similar pH to the stomach. If we get indigestion or acid reflux, we might want to neutralize some of the acid in the stomach. To do this, you would have an "ant-acid" tablet, indigestion tablet, or a liquid like Gaviscon or Milk of Magnesia.
4. Add some baking power/bicarbonate to the vinegar or lemon juice solution.
5. Test the pH again. The solution should now be nearly neutral or even slightly basic, depending how much you add. This is what happens when we take an indigestion remedy.

QUESTIONS

What happens when we add a base to an acid?

Do you see anything happening to the solution? You might see or hear a gas being produced.

NOTE TO LEADER

Chemicals with a wider range of pH will give a broader spectrum of colour. Be careful handling strong acids or bases, like bleach.

HOW TO DISSOLVE A MEDICINE

AIM OF ACTIVITY

To learn about how different delivery methods for a medicine can determine how quickly you feel an effect.

Used under creative commons. Original file: https://commons.wikimedia.org/wiki/File:Brausetablette.JPG

ABOUT THE ACTIVITY

When you take medicine, it needs to dissolve in order to be passed into your bloodstream. The medicine often needs to be packed into a pill or capsule to make it easier to swallow. In some cases, the medicine could be taken as a liquid, or even inhaled.

How does the delivery method of a medicine change how quickly it enters your bloodstream? Does the particle size make a difference?

Here we use sugar as our “medicine”.

WHAT YOU’LL NEED

- Sugar cubes
- Sugar granules
- Castor sugar
- Water

- Measuring jug
- Clear plastic cups
- Stopwatch

WHAT TO DO

1. Put a sugar cube into a clear plastic cup.
2. Put a teaspoon of sugar into a clear plastic cup.
3. Put a teaspoon of castor sugar into a clear plastic cup.
4. Using the measuring jug pour 100 ml of water into each cup and start your stopwatch.
5. Monitor each cup and note down the time when the "medicine" has dissolved in the water. You can swirl the water round the cup or stir it to help the medicine dissolve.

QUESTIONS

- Which 'medicine' dissolved faster?
- Which 'medicine' has the smallest particle size (bits)?
- Do you think small things or big things dissolve faster assuming they are made of the same substance?

TAKE IT FURTHER

- Does temperature change how fast something dissolves?
- Repeat above experiment but use warm tap water.
- What happens to how long it takes the three "medicines" to dissolve?

MEDICINES AND ME

Medicines are all around us. We might take them if we have a cold, a bacterial infection, or a huge range of other problems. The more we know about them, the better. It can help us to know when to take certain types of medicines and when not to, like pain killers for a ache or antibiotics for an infection, but we don't need to take antibiotics for a virus, like a cold, because anti**biotics** only work on **bacteria**!

Medicines also have an important place in our society. They have a long and fascinating history. You can learn about it by visiting places like museums and science centres. You can also take a virtual visit to our real science lab, where we discover new medicines!

You can also find out more about the contributions that women have made to science. We hope that you'll see how amazing it is to know about science. Maybe you'll even grow up to be a scientist and discover a new medicine!

ACTIVITIES WITHIN THIS SECTION

- Draw a scientist
- Design your own medicine container
- DNA and me
- Women in science
- Visit a virtual lab
- Visit a science centre or museum

DRAW A SCIENTIST

AIM OF ACTIVITY

To draw what you think a scientist looks like.

ABOUT THE ACTIVITY

Scientists come in all shapes and sizes, and from all over the world. What do you think a scientist looks like? Scientists often work in the lab so might wear lab coats and safety goggles to keep them safe. You could include these in your picture, or perhaps some of the equipment they use.

WHAT YOU'LL NEED

- Pens and pencils for drawing and colouring
- Paper
- Decorative craft items

WHAT TO DO

1. Think about what you think a scientist looks like.
2. Draw the scientist and colour it in.
3. You could even draw yourself as a scientist.
4. Scientists work in teams, and almost never alone. Why not make a big display of all the scientists your unit has made?
5. Why not share it with us? We'd love to hear from you on Twitter, where we're @WCAIRDundee and @GirlGuidingDund. Make sure you include #medicinemakerbadge in your post so everyone else doing the challenge can see what you've done.

DESIGN YOUR OWN MEDICINE CONTAINER

AIM OF THE ACTIVITY

To consider how medicine boxes are designed, and why they say the things they do on them.

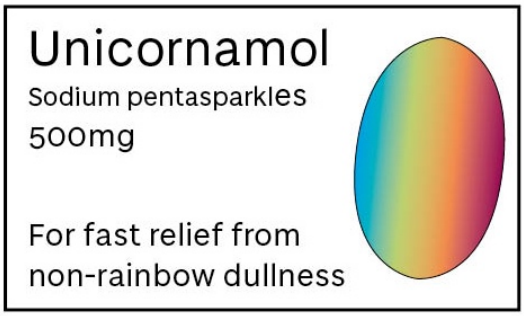
ABOUT THE ACTIVITY

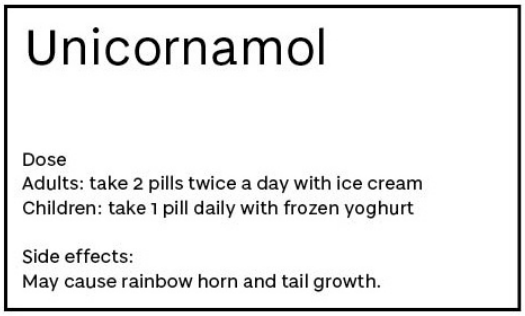
Medicines come in lots of different forms, like pills, tablets, syrups and even injections. Each of them comes in a container of some kind, and all of them have to be carefully designed. People like for them to look nice, but they also have lots of really important information on them. This can include:

- The brand name if it has one – Calpol is an example of a brand name
- The name of the chemical in the medicine – this might be something like "paracetamol"
- How much of the medicine is in it. This might be in grams, or more likely milligrams (there are a thousand milligrams in a gram, so it's a really tiny amount). It could also be a percentage – how much of the liquid is medicine and how much is water or something else
- What it can help with, or cure
- The dose – how many pills or spoons you need to take, and when
- Side-effects – these are things that can, very rarely, go wrong if you take a medicine.

It might also have a picture of the medicine on it, or a person with the illness getting better.

Here's one for an imaginary medicine that we've made up. The front side is the top and the lower one is the back of the box.





Can you design your own?

WHAT YOU'LL NEED

- Paper
- Pens and pencils for colouring in
- An imaginary disease that you want to cure
- An imaginary medicine to cure it

WHAT TO DO

1. Medicines need lots of time and thinking! Begin by thinking about an imaginary illness you want to cure. What could it be? What does it do? What is it called?
2. Then, you'll need to think about your medicine. How will it help your disease, and what will you call it? After that, you'll need to think about all of the other things – how to take it, any possible side effects, and anything else you can think of.

TAKE IT FURTHER

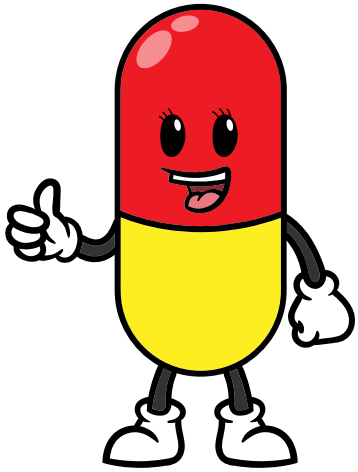
For older girls, ask your parents what medicines they have at home. If it's okay, they might even be able to show you some of the boxes for things that they have in the house. Lots of people have medicines like paracetamol and ibuprofen at home. People with hay fever might have a kind of medicine called an anti-histamine, which helps stop sneezing and itchy eyes!

NOTE TO LEADERS

We would *not* recommend letting girls run riot through their parents' medicine cupboards – there could be any manner of surprises lurking there. If you want to demonstrate some 'real' boxes, it might be better to bring in some old, empty containers for simple, uncontroversial medicines.

FUN FACT

The top 10 most prescribed drugs in UK are: Simvastatin, Aspirin, Levothyroxine, Ramipril, Bendroflumethiazide, Paracetamol, Salbutamol, Omeprazole, Lansoprazole and Co-codamol. How many of them does your family use?



DNA AND ME

AIM

To extract DNA from strawberries and explore its structure and function.

ABOUT THE ACTIVITY

Life on earth comes in all different shapes and sizes – people, animals, plants, even bacteria and parasites. One thing they have in common is something called *DNA*, or deoxyribonucleic acid (you don't have to learn that, though!).

All of these living things are made up of tiny, tiny things called cells. Bacteria live as single cells, all by themselves, while most plants and animals like you and me are made up of thousands, millions, billions or trillions of cells! DNA is a chemical which sits in the centre of each of our cells, telling them what to do, and how to be each kind of cell.

Like a long recipe from a cook book, it's made up of lots of chemical letters. Unlike our alphabet, which has 26 letters, DNA only has 4 – A, T, G and C. Each letter represents a different chemical compound. They're so small we can't see them, but we can use science to read them. The order of these letters tells a cell what to do. To make a human, it takes around 3 billion letters, or enough to fill a whole case of books.

The DNA in each cell is tiny, but if we extract DNA from lots of cells we can actually see it. For our experiment, you can try it from one of our plant relatives: strawberries.

WHAT YOU'LL NEED

- Some cups
- A jug
- Filter funnels
- Test tubes – you may find that sample tubes work well. You can find them online, for instance on Amazon, for around £3 for 10. Alternatively, you might want to contact your local university's outreach team to see if they can give you any, or your GP or local hospital. Anyone else who works in healthcare might be able to give you some.
- Sandwich or freezer bags with a good seal
- Coffee filters
- Water
- Strawberries
- Salt
- Washing up liquid
- Rubbing alcohol, also known as *isopropanol*, kept nice and cold in the freezer

WHAT TO DO

Well in advance:

The experiment works best if you freeze the strawberries overnight, then leave them out to thaw. If you have to microwave them that's okay, just be careful not to let them get too hot. If they're a bit icky for the experiment, that's ideal.

You'll also need a mixture of dish soap, salt and water – using around 500ml of water with 3-4 large squirts of dishsoap and a teaspoon or so of salt should work. Stir gently – you want them mixed, but not frothy.

WHAT TO DO

1. Put 3 smooshy strawberries in a sandwich bag. Add 1-2 tablespoons of soapy salty water mix.
2. Squeeze most of the air out of the bag and seal really well. Smoosh the strawberries up in the soap and salt mix. You should be able to get it so that there are very few chunks of strawberry left – just some skin and bits of leaf.
3. Leave to rest for a few minutes. While it rests, think about some of the traits that DNA gives us – our hair and eye colour, freckles, height, whether we start out as a girl or a boy, even some aspects of taste! Coriander – yuck!
4. Once it has rested for about 5 minutes, set up a filter funnel with a coffee filter in it over a test tube. Pour the sample through and wait for the liquid to drip to into the tube.
5. You should have a pink liquid. The DNA is in the liquid, free of its cells – the soap and salt should have broken them up. We can't see it yet because of one of DNA's properties. It's a bit like sugar – if you add it to tea, it disappears into the water. The scientific word for this is *dissolves*. If something dissolves in water, we say it's *soluble*.
6. Like sugar in tea, DNA is soluble in water. It isn't soluble in another liquid, though – rubbing alcohol! So, if we add some rubbing alcohol it should make the DNA turn solid, which means we'll be able to see it.
7. Take a small amount of cold rubbing alcohol and very gently, pour it down the side of the test tube. It should sit neatly on top of the pink liquid – they don't mix.
8. Does anything start to happen? With a bit of luck you should start to see a white, lumpy, fluffy bit of gunk appear.
9. Once you have this white gloop, congratulations! You have extracted DNA! If you have something like a skewer or a toothpick nearby you can even, with a little bit of care, pull the lump out.

TAKE IT FURTHER

There are lots of different ways of exploring DNA.

One really fun idea is making beads. If you use 4 colours you can represent the different letters, A, T, G and C, that make up our genetic code. One other Wellcome institute has made this great resource: ftp://ftp.sanger.ac.uk/pub/yourgenome/downloads/activities/sequence-bracelets/ftsequencebracelets.pdf

WOMEN IN SCIENCE

AIM OF ACTIVITY

To consider the role played by famous female scientists

ABOUT THE ACTIVITY

There are many famous female scientists who have made pioneering discoveries. These have revolutionised the way medicines are designed today. Not all of them are household names though. This is a great opportunity to learn about these women and their contributions to science!

WHAT YOU'LL NEED

Access to the internet or a library with an encyclopaedia

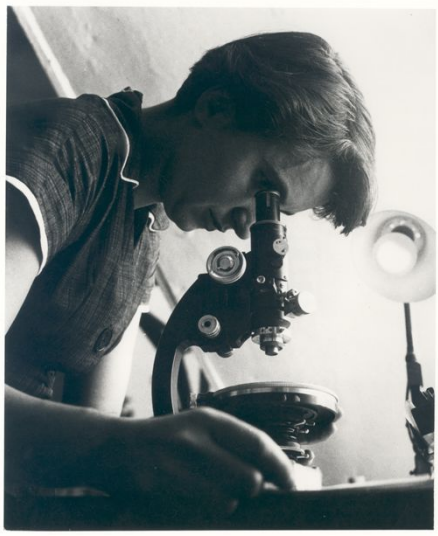
Some way of writing down what you discover – a computer, or good old-fashioned pens, pencils and paper

WHAT TO DO

1. Choose a famous woman scientist.
2. Find out about what famous discoveries she made. How has their work contributed to the field of medicine? Has their research made an impact on how new medicines are designed today? Some examples are:

Dorothy Hodgkin: a British chemist who developed a technique that used X-rays to determine chemical structures. This led to revolutionary treatments for bacterial infections, Alzheimer's disease, and diabetes.

Photo credit: https://www.nobelprize.org/prizes/chemistry/1964/summary/



Rosalind Franklin: a British chemist who contributed to determining the structure of DNA. This revolutionised how we understand genetics and hereditary diseases.

Photo credit: By MRC Laboratory of Molecular Biology - From the personal collection of Jenifer Glynn., CC BY-SA 4.0, https://commons.wikimedia.org/w/index.php?curid=68494240

Donna Strickland: a Canadian optical physicist who won the 2018 Nobel Prize for her work with lasers. Her research has applications in laser eye surgery and other types of laser surgery.

Photo used under creative commons. Original source: https://flickr.com/photos/97469566@N00/46183560632

3. Tell a group of people about what you discovered. They could be your leaders, or everyone else who is doing the badge.

Here are some useful resources:

https://www.factinate.com/people/40-groundbreaking-facts-female-scientists/

https://www.sciencefocus.com/science/10-amazing-women-in-science-history-you-really-should-know-about/

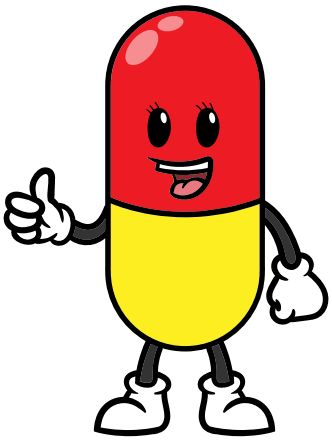
https://www.srg.co.uk/blog/4-female-scientists-today-who-are-changing-the-world

TAKE IT FURTHER

Design a poster showing some key facts about the famous female scientist you have chosen.

Discussion points for guides: Why do you think more women aren't involved in science? What would make more people in interested in science in general?

Do you know any female scientists you could talk to in person? It might surprise you how interesting their jobs can be!



FUN FACT

Only 39% of scientific researchers in the UK are women!*

*
http://uis.unesco.org/sites/default/files/documents/fs51-women-in-science-2018-en.pdf

VISIT A VIRTUAL LAB

AIM

To visit real chemistry and biology labs using Google maps.

ABOUT THE ACTIVITY

The Wellcome Centre for Anti-Infectives Research is an exciting place with world-class labs. It can be pretty difficult to get in to visit, though – it's busy and there are lots of complex safety rules.

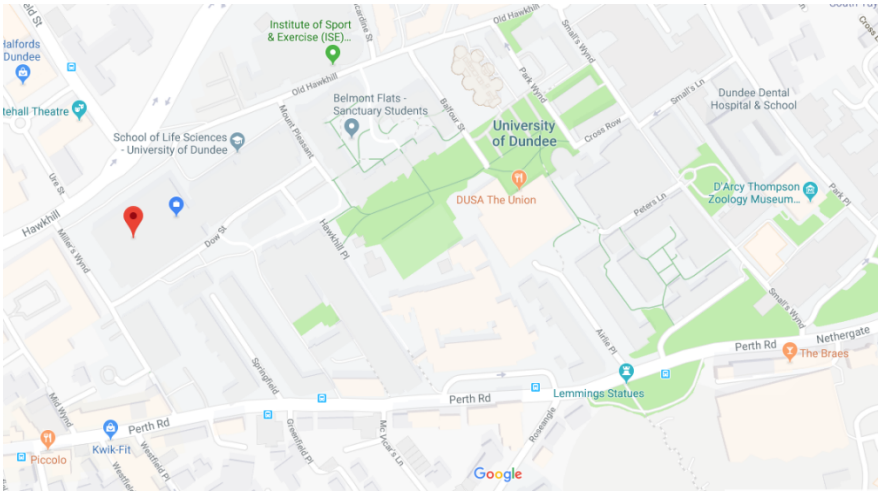
With the wonder of the internet you can safely take a virtual tour, from the comfort of your own home.

WHAT YOU'LL NEED

- a computer, laptop, tablet or phone
- an internet connection
- an internet browser

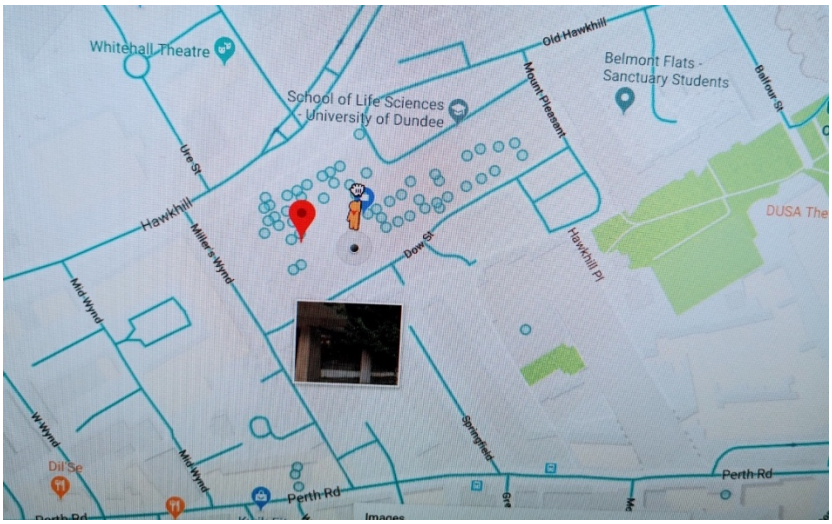
WHAT TO DO

On your internet browser, go to maps.google.co.uk. Enter our postcode as DD1 5EH. Our building is the School of Life Sciences, University of Dundee.



Red dot marks the spot! You might want to zoom in on it a little.

In the lower right corner of your screen will be the yellow Streetview figure. Click and drag it onto our building. Several different blue circles will appear.



Pick any one of them and begin your journey around our labs!

To give you an idea of what you might see, on the left/northwest side of the building are our biology labs, while on the right/southeast side are the chemistry labs.

In the middle is our big open space and, perhaps most importantly, our coffee shop.

QUESTIONS

- What kind of things are the same and different on each side?
- What colours can you see in the labs?
- What lab clothes are the scientists wearing? Is it all the same, or are there any differences?
- Can you see any of the glassware the scientists are using? What shapes can you see?
- We wear lots of different safety equipment in our labs. Can you pick any out?
- We also use lots of cleaning chemicals – some of the same as you might see at home. Can you pick any out?
- You might see some big grey boxes in the labs. Believe it or not, those are our robots! What do you think they do? Why do we use them?

WHERE'S ALLY?

One of our scientists has a beard, a manbun, and likes to wear particularly cool red sneakers. He seems to be everywhere! How many Allys can you find across the labs?

TAKE IT FURTHER

We use lots of robots in the lab. Can you think of what you might want a robot to do for you? What would it look like? Would it have a name? Do you think it would look like a person or something different?

NOTE FOR LEADERS

There are lots of different things to see in the Wellcome Centre's labs. You might want to pick a few things that are the same and different across each type of lab – for instance, what people wear (there are blue and green lab coats in the biology labs, for those who work in more hazardous areas). There are also lots of hazard signs, which can be a great way to start thinking about how to do science safely.

If you are interested in lab tours at your local university they may be possible, but will require planning well in advance! More and more, universities have dedicated public engagement staff, who are often very keen to break down barriers and let people into new spaces.

VISIT A SCIENCE CENTRE OR MUSEUM

AIM

To visit a science centre or a museum with science links.

ABOUT THE ACTIVITY

Science centres and museums hold a huge range of exhibits and objects just waiting for people to come and experience them. Why not take a trip to your local one and discover something new and exciting about the world?

They also have staff members who can bring the trip alive, so don't forget to ask them lots of questions. Many of these places also run amazing workshops where you can get hands-on with science.

WHAT YOU'LL NEED

- Some information about your local options – this could be from the internet, from leaflets that you can often find in places like schools and sports centres, bus adverts, or asking friends and family
- A science centre or museum – some museums focus on science, while others might not seem to. If you dig a little bit, most have some interesting links. Could you find a painting from a country with one of the diseases you're investigating?
- Curiosity

WHAT TO DO

1. Find out about what you can go to nearby
2. Look online or give them a call – they can often tell you more about what activities they have on and they may even offer *discounts* for uniformed groups like Girlguiding.
3. Plan your visit carefully. You might want to set the girls a challenge to find out:

a. What time does it open and close?
b. How will you get there?
c. What will the weather be like? Do you need to dress warmly?
d. Think about whether you need to take snacks or a packed lunch. Lots of museums have places where you can eat your own food for free. Don't forget water!

4. Are there any objects there that sound interesting? You can often check online, or ask on the phone or even at an information desk when you arrive
5. You might want to take a notebook or a camera to remind yourself what you learned. Make sure you're allowed to take pictures, though. Sometimes you're allowed to take photos but not to use flash.
6. After your trip, you'll need to tell everyone where you went, and what you saw and did. What was your favourite thing? Did anything surprise you?

TAKE IT FURTHER

You could visit another place, perhaps going further afield. You could also use your first trip to find some interesting objects and then return later to find out more about them, or with a sketchbook so that you can draw them.

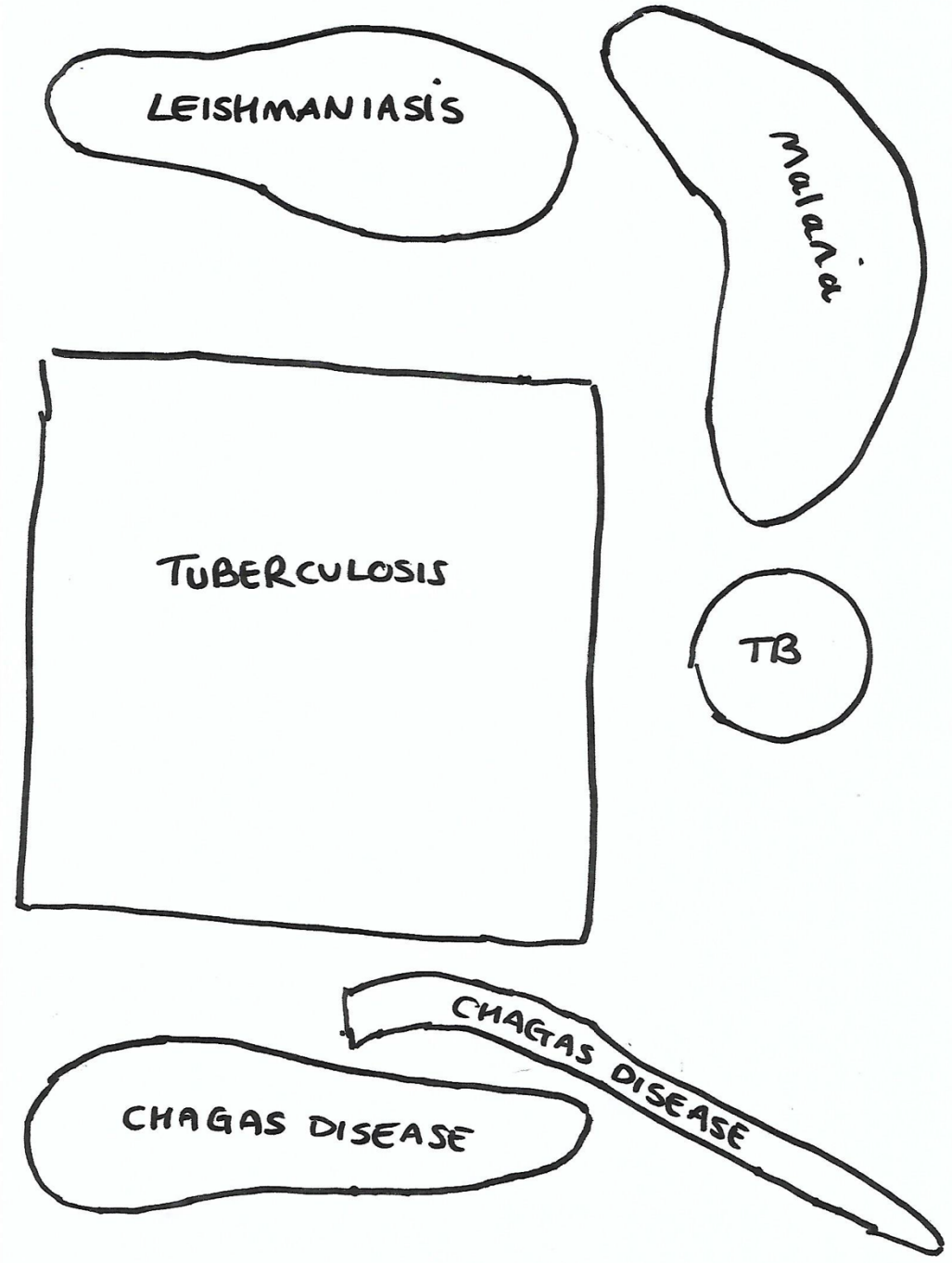
Some tourist attractions may also run sleepovers, some even specifically aimed at uniformed groups.

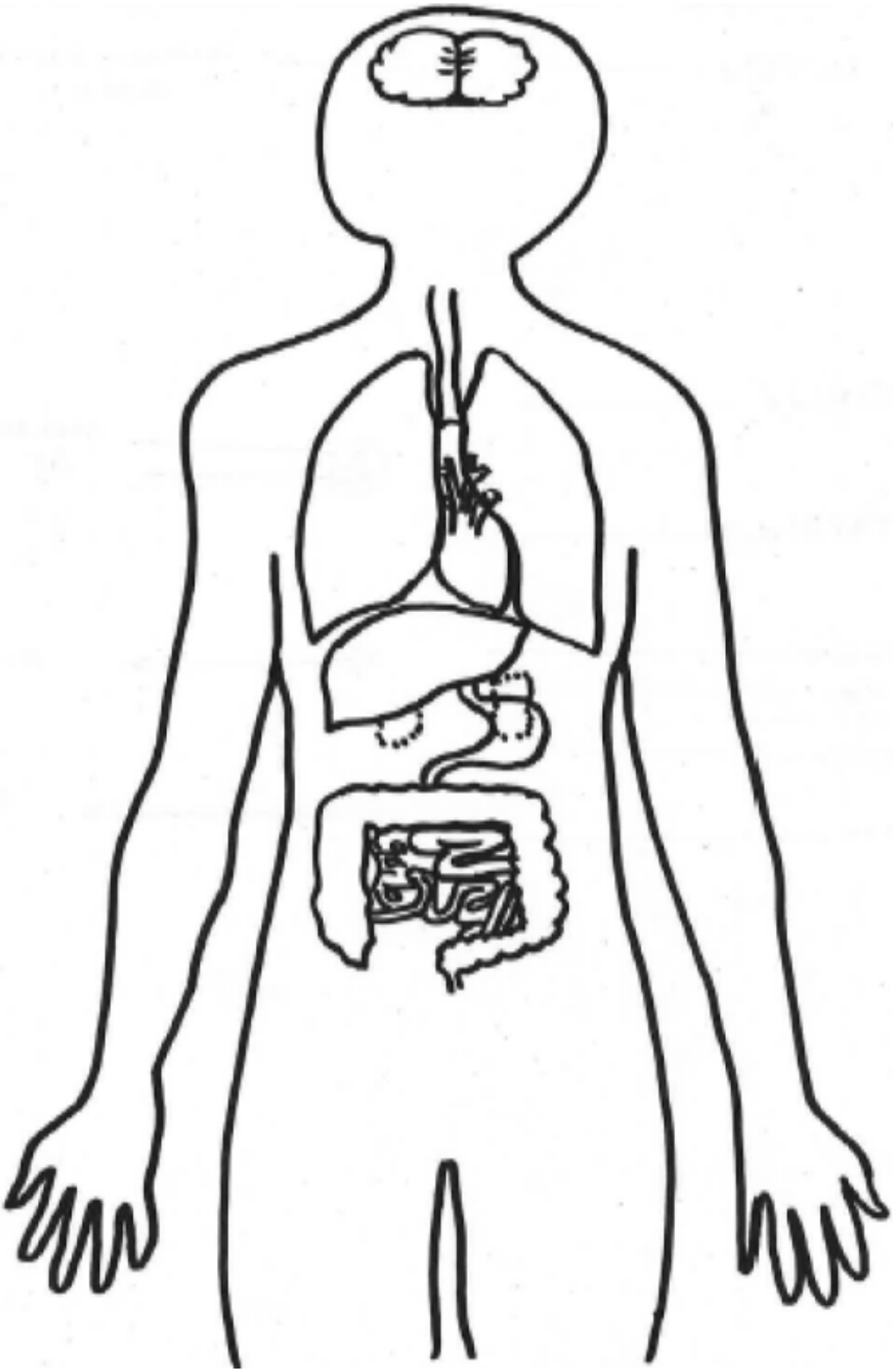
Many museums have ways of looking at their collections online, for free. The National Museum of Scotland's collection search is here: https://www.nms.ac.uk/explore-our-collections/search-our-collections/

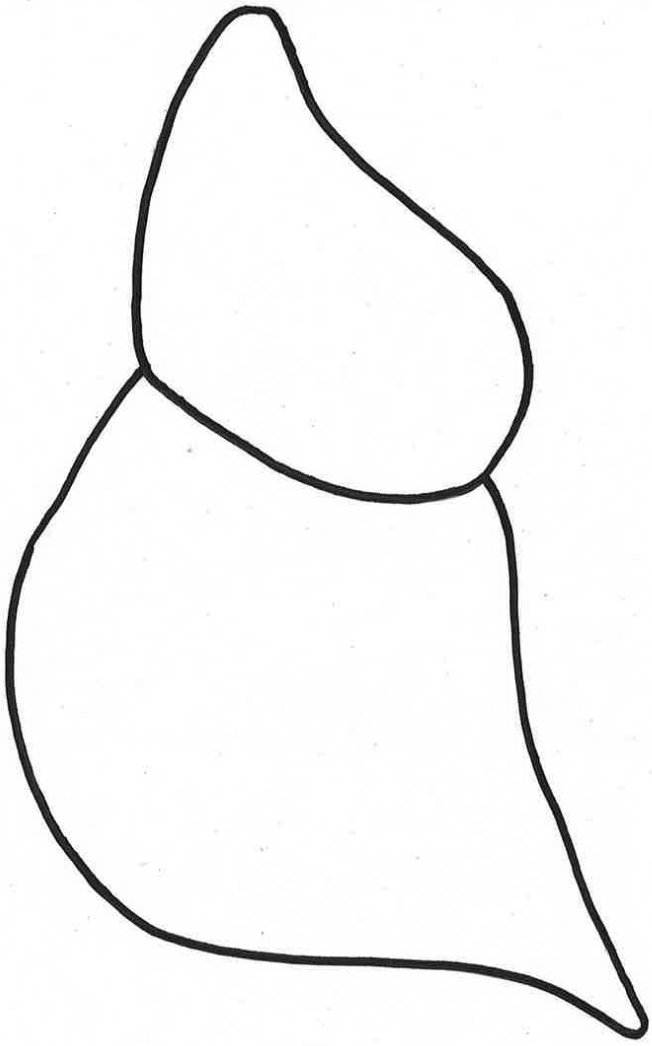
NOTE FOR LEADERS

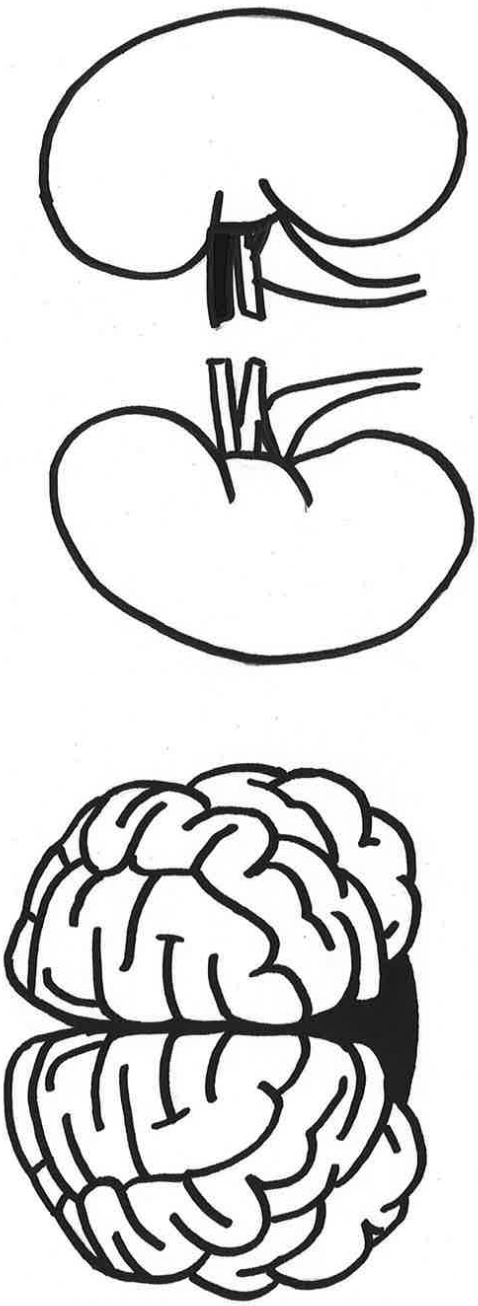
There are lots of wonderful free museums for an affordable, fun day out. While science centres usually charge, and museums may have exhibition spaces that aren't free, there are often substantial discounts for uniformed groups. Do get in touch before you go, particularly if you are a larger group. It will help their planning and they may be able to offer your group a special space for lunches etc. They may be able to offer special workshops, or trails which bring their objects to life in a new way.

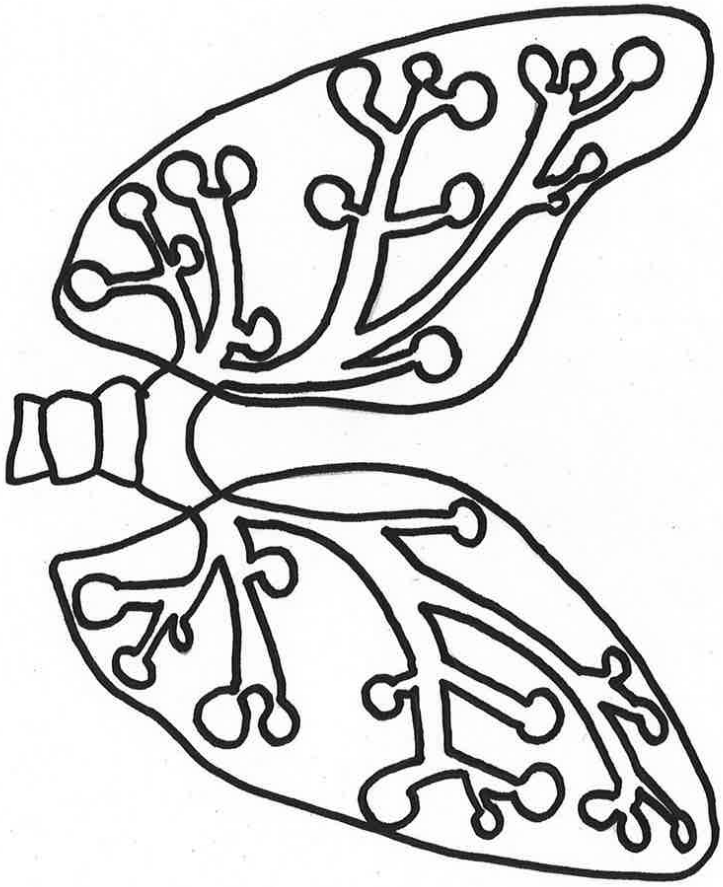
Many smaller museums struggle with how they present STEM subjects, but there are lots of ways they might do it without realising. Try and think creatively – paints are, after all, chemicals, and many people from British history, particularly around colonialism, were afflicted by tropical diseases.

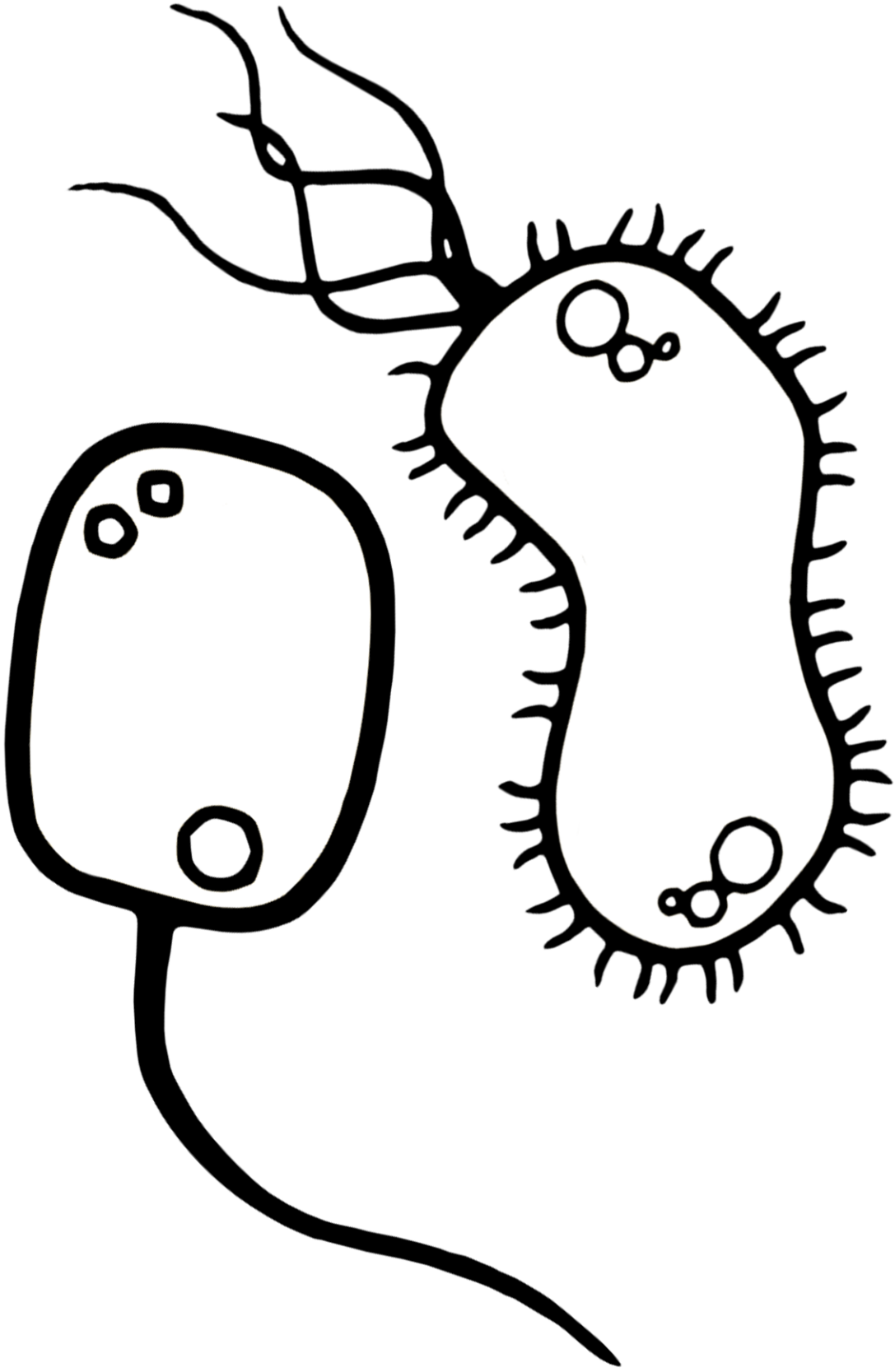

LEISHMANIASIS
Malaria
TUBERCULOSIS
TB
CHAGAS DISEASE
CHAGAS DISEASE

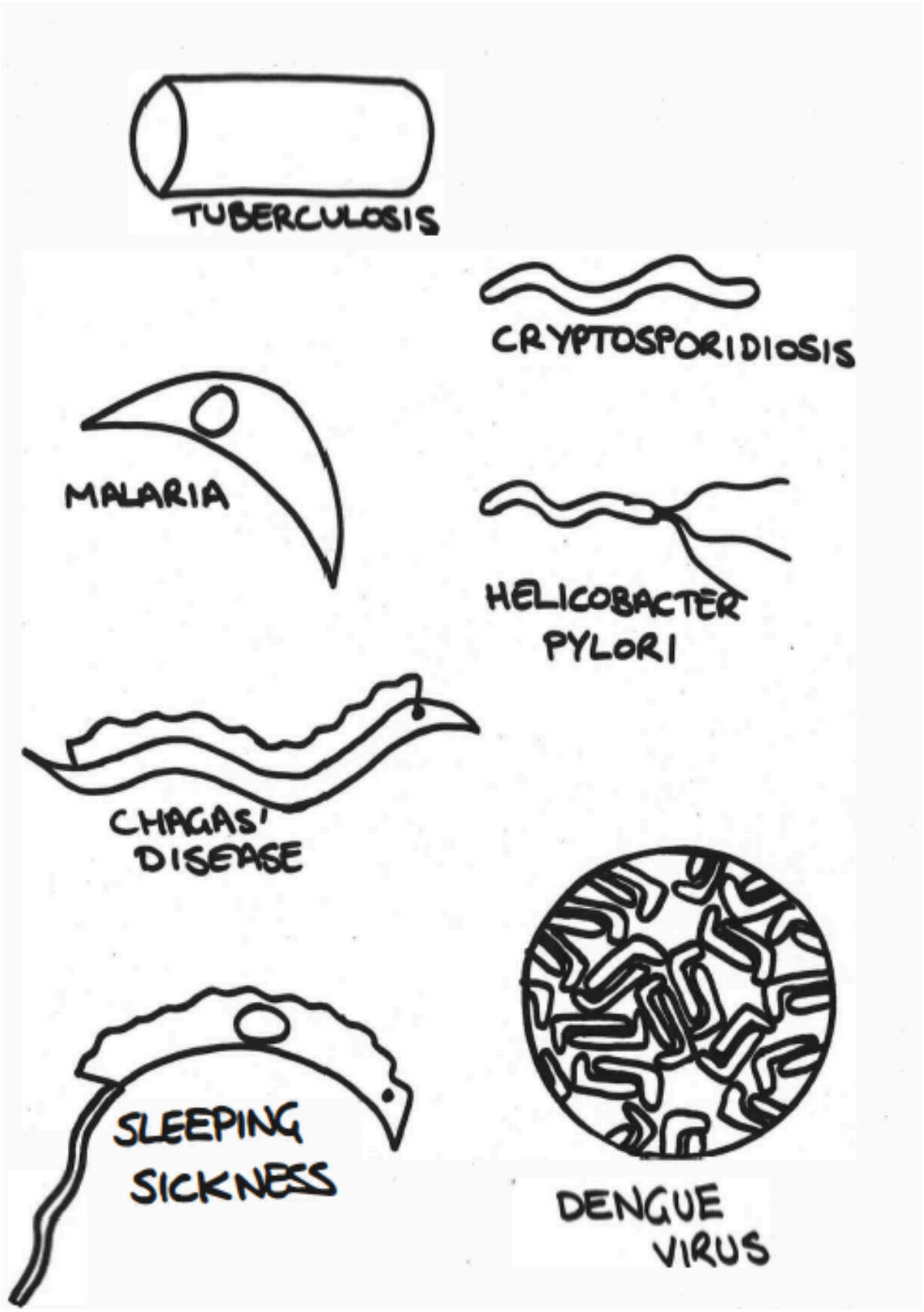




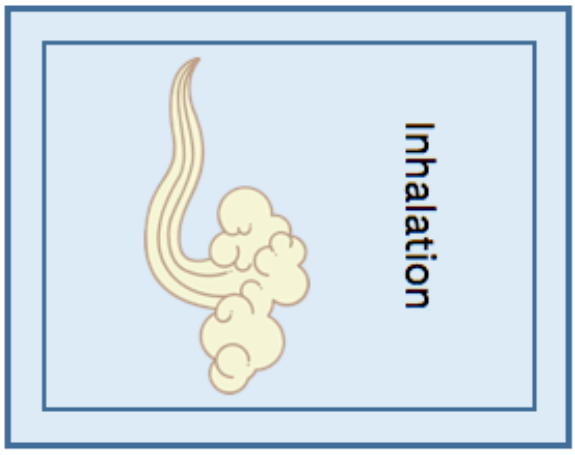


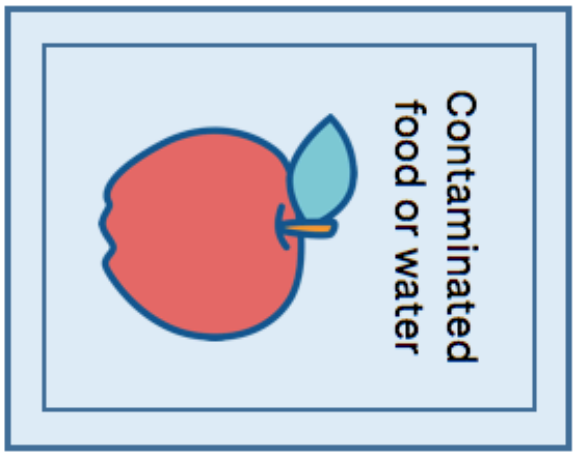





TUBERCULOSIS
CRYPTOSPORIDIOSIS
MALARIA
HELICOBACTER PYLORI
CHAGAS' DISEASE
SLEEPING SICKNESS
DENGUE VIRUS

Insect bite


Inhalation


Contaminated food or water

GLOSSARY

Bacteria	A microscopic type of life. They live as single cells, although can sometimes form biofilms, which are like cities of bacteria. Some are good for our health, while others can make us sick.
Compound	A chemical substance which is made up of more than one kind of atom. Water is a compound made of atoms of hydrogen and oxygen, joined by a chemical bond.
Parasite	A microscopic form of life, which live as single cells. Those cells are much more like our own cells, which means that treating them without hurting us is really difficult.
pH	The scale that we use to measure how acid or alkaline a liquid is.
Acid	Acids have a low pH. They include things like vinegar, and fizzy drinks are often acidic. Our stomachs make a very strong acid. This helps to kill any unwanted bacteria or parasites, and also to provide the right chemical environment for us to digest our food.
Base	The opposite of an acid. Things like bleach are basic.
Biologist	A scientist who studies living things. This includes from the tiniest of microscopic life right up to blue whales. They can look at whole animals, specific organs, individual cells, or anything else so long as it's living.
Wellcome Trust	A charity, which provides vast amounts of resource to help health and medical sciences. Founded by Sir Henry Wellcome, they are the world's second biggest funder in this area. Their generous support has made this pack possible.
Chemist	A scientist who looks at how substances are made up. They know how to work out what atoms and bonds make different chemicals. In the drug discovery process, they can make tiny changes to compounds so biologists can explore what happens

Hello Fiona,

Thank you for your email and working with us to make your badge on brand.

I can confirm your "Medicine Maker" badge meets Girlguiding brand guidelines as it has the correct localisation, trefoil and badge name.

Any questions, feel free to email us.

Have a lovely day.

Kind regards,
Jenny
Jennifer Glancey

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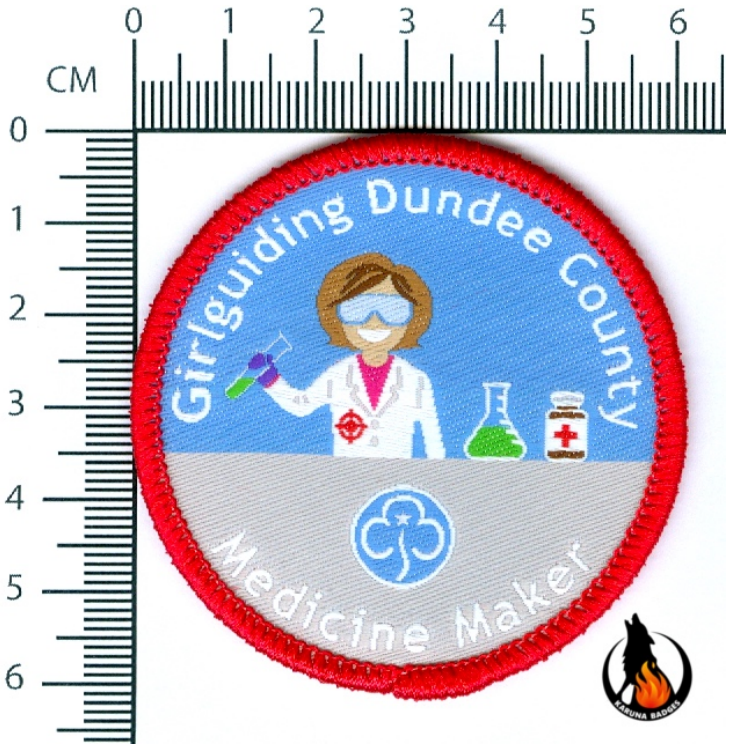
Girlguiding is the leading charity for girls and young women in the UK. We build girls' confidence and raise their aspirations. We give them the chance to discover their full potential and encourage them to be a powerful force for good. We give them a space to have fun.