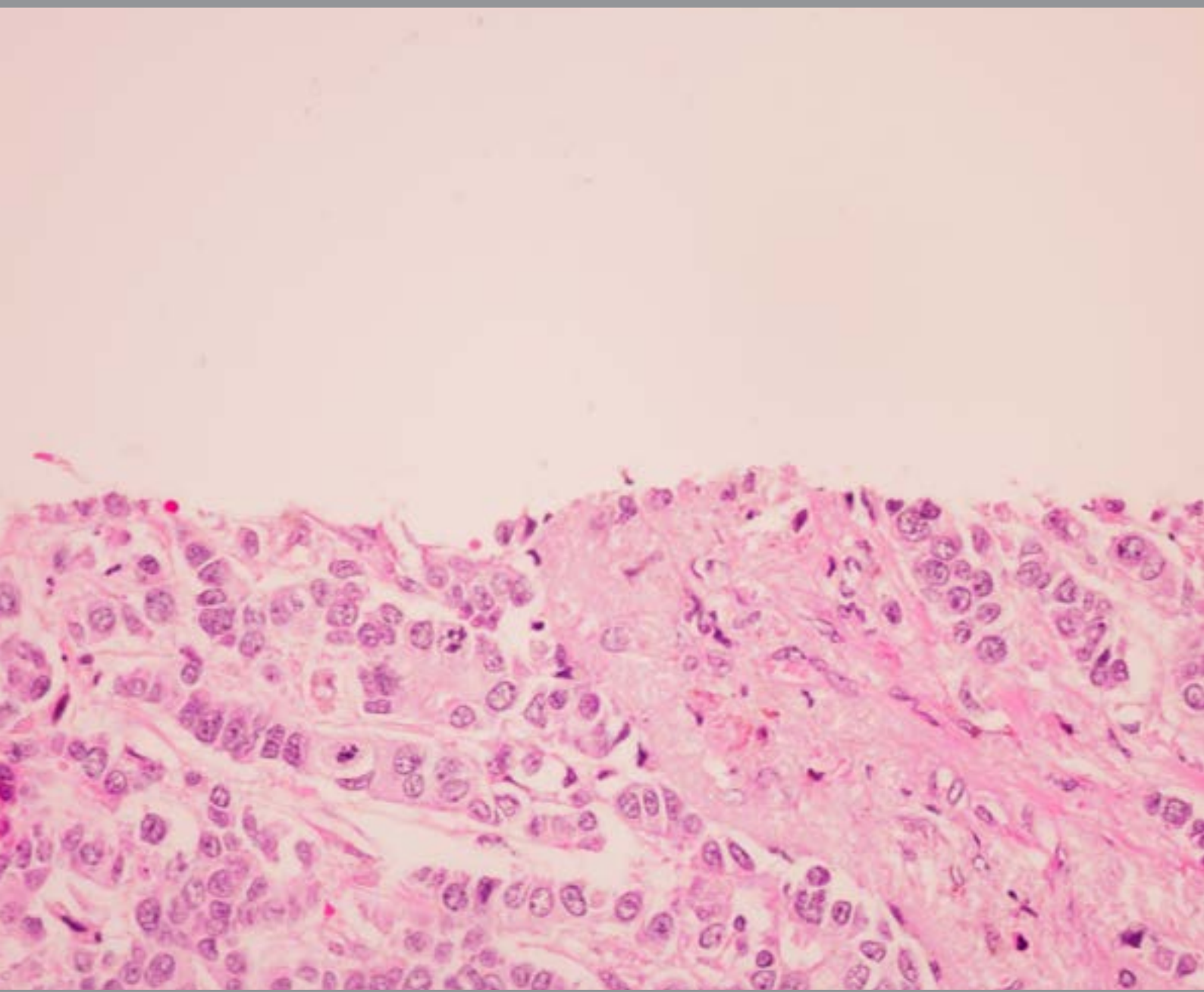
The Royal College of Pathologists
Pathology: the science behind the cure

PATHOLOGY **FOR LIFE**

Exploring how pathologists help to keep us healthy, from cradle to grave
The Royal College of Pathologists activity Resource Pack



Introduction

Pathology is the study of disease, and is the backbone of the NHS. It is the bridge between science and medicine. It underpins every aspect of patient care, from diagnostic testing and treatment advice, to using cutting-edge genetic technologies and preventing disease.

Pathologists play a critical role in research, advancing medicine and devising new treatments to fight viruses, infections and diseases such as cancer.

In the last 100 years, we've seen significant reductions in illnesses such as polio across the world, as well as major advances in blood transfusion, vaccination and treatment of inherited conditions.

In celebration of the pioneering work of pathologists, this pack offers a toolkit of ideas for running your own pathology-themed events, especially during **National Pathology Week**, which takes place in November each year.

We've included lots of different ideas and tools in this pack so you can run events, activities or workshops to help celebrate pathology and the vital role it plays in keeping us healthy throughout our life.

Section 1 of this pack includes guidelines and resources for running 12 interactive activities, that can be run at public events or in schools. They explore diverse pathology topics and specialties in creative ways to appeal to non-scientist audiences. We have split these activities into three categories: Prevention, Diagnosis and Treatment.

Section 2 offers a few other event format ideas, top tips and information about how the College can support your events and activities; these are mainly links to other pages of the College website.

Event or activity idea	URL
Pathology quizzes – an easy event or activity idea for medical undergraduate student societies	See our **quizzes page**
Careers talks for school or university students including ready to go PPT slides and other resources	See our **presentations page**
Get involved online – blogging, vlogging, tweeting and more!	See the **National Pathology Week** page for more information
Top tips including how the College can support your events	Event organisers **resource page**

A note on audiences

Most of the activities given here are suitable for all age groups, as many take place at public events that pathologists have previously volunteered for. However, pick your audience wisely and think about what they will already know/not already know about pathology before you embark on planning your event or activity. Detailed ethical discussions about organ transplantation may be better for older secondary school students rather than a primary school or family audience. And always remember to consider the socio-economic and cultural backgrounds of your audiences.

Event case study

Public engagement activities come in all shapes and forms. In July 2018, as the NHS turned 70, Dr Angharad Davies, clinical senior lecturer in medical microbiology from Swansea University Medical school organised a birthday party-themed activity for an adults-only Science Museum 'Late' event. The activity certainly looked like a birthday party: bunting, helium balloons, inflatable cake and celebratory tablecloths.

The aims were to bring to life a 'timeline' of important medical milestones in the NHS, including IVF, heart and liver transplants and for participants to learn about the contribution the NHS has made to medicine internationally. Dr Davies prepared a giant 'birthday card' with the number 70 on it as well as a picture of a birthday cake divided up into different 'slices' each labelled with a different decade.

Participants were challenged to put a series of NHS milestones, one from each decade, in chronological order, by matching eight pegs on a piece of string with decade labels to eight bunting flags with milestones on them. Clues were given in 'birthday photo albums' containing decade-by-decade illustrations of the various medical breakthroughs. If the flags were attached correctly to each peg, the word 'BIRTHDAY' would be revealed on the reverse of the flags.

Milestones included:

1950s: link established between smoking and cancer (UK, 1954)

1990s: NHS National Organ Donor register set up (1994)

2010s: first UK hand transplant (2012); 'three-person IVF' made legal in UK

Everyone was asked to vote for which milestone they considered the most influential, important or simply their favourite. And so many heartfelt messages of thanks to the NHS were left on post-it notes inside the giant birthday card.

Activities such as these are not just about communicating science. They encourage the public who are simply out for an enjoyable evening with their colleagues and friends to think more about the history of medicine, to discuss the ground-breaking innovations and discover the fascinating worlds and lives of the pioneers behind such work.

Which activity is right for me?

Have a read through the activities below and see what topic areas and activity formats most appeal to you and your chosen audience. Why not run a selection of the activities from section 1 as a 'carousel', with one from each of the different categories: Prevention, Diagnosis, Treatment? Under each category we have given you four activity ideas and links to many more in our 'Why not also try…' boxes. You could also combine an activity from section 1 with an event idea from section 2. If you have any questions or need support please get in touch with public engagement team on publicengagement@rcpath.org , or your nearest **Public Engagement Regional Coordinator**.

Prevention

If we can prevent diseases by simply by changing our own behaviours (such as washing our hands well, covering our nose and mouth when we sneeze, taking antibiotics appropriately, getting vaccinated and taking part in screening tests), we could also save the NHS so much time, effort and money in diagnoses and treatments.

Stop the spread

To help participants understand that we use our hands all the time and end up picking up millions of bugs, some of which are harmful to us. Through a simple activity, participants will learn about preventing the spread of diseases through effective hand washing.

Aim:

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Audience: All ages

Equipment:

- UV/Glo-Germ gel UV/Glo-Germ gel –
  can be ordered online from **www.Glotec.co.uk** and other suppliers
- 2 x UV torches (or a UV lightbox if available) –
  can be ordered online from **www.Glotec.co.uk** and other suppliers
- 2 x UV torches (or a UV lightbox if available)
- Liquid or bars of soap
- Laminated sheets explaining effective hand washing
- Hand towels
- Hand sanitiser (optional)
- Glitter or UV powder (optional)
- Hand lotion (optional)
- Bowls of water if activity is not near any sinks

Instructions:

- Explain to participants that during our daily routines, using our hands all the time means that millions of bugs (that are so small we can't see them) can stick to the oils on our hands. Some of these can be disease-causing bugs (pathogens), which is why we need to wash our hands with soap and water. Ask them what happens when we sneeze? If we catch it in our hands, and then shake hands with someone…?
- Ask participants how often they wash their hands, and do they think they are good at it?
- Invite them to take part in a demonstration. Ask them to coat their hands with some UV gel, and then to shine a UV torch over their hands to see how 'dirty their hands' have become. This is purely a simulation to see how good they are at washing their hands. The UV gel contains nothing infectious.
- Then ask the participants to wash their hands as well as they can. You can even show them the effective hand washing guides to make sure they wash under their nails, and in the spaces between their fingers. Ask them to dry their hands on a hand towel.
- Finally, ask them to look at their hands under the UV light. Are any areas still glowing? If so, these are the areas they need to make sure they wash thoroughly.
- Give all participants some hand sanitiser gel at the end to discuss how these products can also help kill bugs that might be lingering on your hand. Especially at times when you can't find some soap and water.

Suggested duration: 30 minutes

Additional information:

Disease-causing microbes (pathogens) can spread in the air, water, bodily fluids and through direct contact. Bacteria, viruses, parasites and fungi cause many diseases in humans and animals, and medical microbiologists are the pathologists looking for answers. They will collect a sample (swab, blood test, urine) and discover what pathogen it is: it might be a bacterium (e.g. MRSA), a fungus (e.g. thrush) or a virus (e.g. influenza).

Find out more: **www.rcpath.org**

Why not try?

Medical microbiologists identify the best treatment for infectious diseases and monitor patients following treatment too.

You could also use UV gel or powder, or even glitter mixed with hand lotion (to make an 'infectious mix'), and simulate the spread of germs when shaking hands. Add some of the 'infectious mix' to your hands, and shake hands with participants. Ask them to shake each others hands. Then using UV torches or simply looking at their hands (in the case of glitter), ask them how far the infection has spread.

There once was a cow called Blossom

Aim:

To explore the history and importance of vaccines, and help participants learn about the process of vaccination, and its link to Blossom the cow through a simple vaccination simulation using an acid-alkali reaction. This could run as a demo in a presenter-style or with small groups each having their own set of equipment to run the experiment.

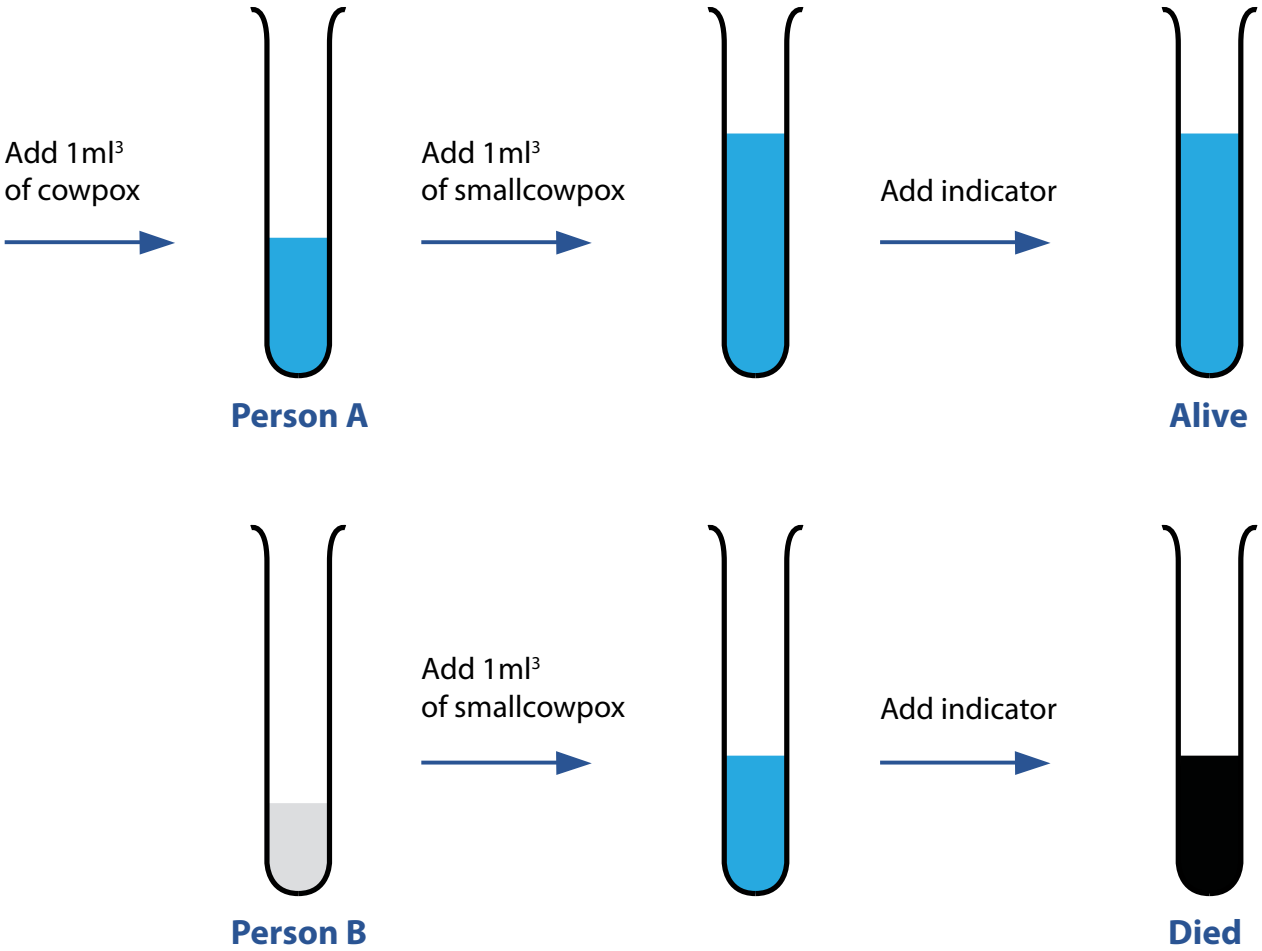
Audience: All ages, particularly useful for secondary students

Equipment:

- 2 x test tubes or small containers (more sets required if working with pairs of school students)
- 3 x 500ml beakers or clear cups
- 3ml plastic pipettes
- Distilled white vinegar
- Bicarbonate of soda
- Bromothymol blue indicator
- Marker pen to label beakers and test tubes
- Picture of Blossom the cow and Dr Edward Jenner (this can be downloaded **from here**)
- Toys/ figurines of a Gloucester cow (Blossom), a milk maid and a small boy (James Phipps) if you wish (these can be found online)

Instructions:

- Label one beaker with 'Cowpox pus' and fill this with distilled white vinegar.
- Label the second beaker with 'Smallpox' and add two heaped teaspoons of bicarbonate of soda and fill with water, mixing so that the bicarbonate of soda dissolves.
- Label the third beaker with 'Indicator' and fill with water and 2ml of Bromothymol blue.
- Show participants the picture of Blossom the cow, and ask them if they know the cow? Explain that it is the famous Blossom, the animal used by Edward Jenner (show picture) in his vaccination experiments to eradicate smallpox. The word vaccination comes from the Latin word for 'cow'… 'vacca'.
- Give the participant (or group of students) a set of two test tubes and ask them to label them as 'Person A' and 'Person B'. Only one will get vaccinated, but both will be infected with smallpox.
- Ask the participant to vaccinate 'Person A' by using the pipette to add 1ml 'Cowpox pus' (vinegar) to this test tube. (Note: The 1ml measurement here and below, does not need to be accurate).
- Ask the participant to now infect both 'Person A' and 'Person B' with smallpox, by using another pipette to add 1ml from the 'Smallpox' beaker (bicarbonate of soda) to both test tubes.
- They may notice that 'Person A' will start fizzing i.e. the vaccine is working! Ask them to add 1ml of indicator (Bromothymol blue) to both 'Person A' and 'Person B' to indicate who is still healthy and alive (colourless/light yellow – 'Person A') and who is infected and likely to die (bl**ue – 'Person B').**



- Explain to participants that this simulates what Edward Jenner did when he came up with the smallpox vaccine. If you have them (and if appropriate for the audience) you might want to use the toy versions of Blossom, the milkmaid and James Phipps to help tell the story of what happened: Blossom the cow was infected with cowpox. The milkmaid that tended to Blossom had contracted cowpox, but then didn't suffer from smallpox, which was prevalent at the time. Edward Jenner took some cowpox pus from the milkmaid's hands, and then added it to an open scratch on 8-year-old James Phipps' arm. James became a bit ill, but survived. Jenner then gave James smallpox directly, again scratching it into his arm. James survived, and this was the first ever 'vaccination'.
- By adding a small amount of the disease-causing microbes (cowpox pus) which caused a mild reaction in healthy people, it made these people less likely to suffer the consequences of smallpox if infected afterwards, and they would survive.
- You could also show the cartoon of the Jenner story (see below) to participants to help illustrate the story before or after the activity.

Suggested duration: 15-20 minutes, shorter for drop in sessions

Additional information:

Disease-causing microbes (pathogens) can spread in the air, water, bodily fluids and through direct contact. Bacteria, viruses, parasites and fungi cause many diseases in humans and animals, and medical microbiologists are the pathologists looking for answers. They will collect a sample (swab, blood test, urine) and discover what pathogen it is: it might be a bacterium (e.g. MRSA), a fungus (e.g. thrush) or a virus (e.g. influenza).

Cartoon about Edward Jenner:

Click here **www.youtube.com**

Click here **www.jennermuseum.com**

Click here **www.historyofvaccines.org**

Original activity and accompanying Powerpoint:

Click here **www.rcpath.org**

A little bit pooey

Aim:

To help participants understand that when we are not healthy on the inside we can test what comes outside to diagnose disease.

Audience: Any age

Equipment:

- Raw potato or horseradish (chopped into pieces and blended to a purée)
- Dark cocoa powder
- Test tubes or sample tubes
- Instant porridge flakes (e.g. Ready Brek®)
- Developing reagent and FOB (fecal occult blood test) cards, obtained from Alpha Labs (see below)
- Lolly sticks or wooden hot drink stirrers to use as applicators
- Some example FIT test bowel cancer screening test kits (see below)
- PPT to help guide people through the activity if useful (can be downloaded **from here**).

Instructions:

- Make up some stool samples, and place into test tubes or sample tubes:
  - Samples that will give a positive FOB result: Mix the blended potato or horseradish with cocoa powder to resemble faeces.
  - Samples that will give a negative FOB result: Mix some porridge flakes with cocoa powder and water to resemble faeces.

- Ask participants what they know about the digestive system, and what faeces are? What else do we call it (poo, stools)? Explain that our organs are great at telling us when something is wrong inside, by sending something outside. And pathologists can test that something... for example, testing our poo! Poo, or 'faeces', is the undigested food matter that comes out of our bottom. But there is so much more in our poo: bacteria, skin cells, salts, minerals and sometimes even blood. The clues in our poos can tell us if we have a healthy gut...or not.
- Show participants the FOB cards, and tell them that these are 'fecal occult blood' cards. 'Fecal' refers to 'faeces' also known as stool. 'Occult' means 'no obvious symptoms or signs' i.e. the presence of blood in the stools that is not obvious. Until very recently, people over the age of 60 were sent a FOB test kit to take samples of their poo and send in a sealed envelope for testing in a lab. This so-called 'poo in the post' test has now been replaced by a new test called FIT – Faecal Immunochemical Test. (show them test kit). Tell them you will tell them more about the new test, and its advantages, after we have test some poo with our faecal occult card.
- FOB tests are used to screen for various conditions, but mainly bowel (or colorectal) cancer. It detects the presence of haemoglobin, i.e. blood. Blood found in faeces can be a symptom of early cancer. By detecting cancer early enough, the patient can receive treatments so that the cancer cannot spread, and they can be cured. For every 100 people tested though, only 2 have an abnormal result. And of these, they don't usually have cancer. There are other reasons for gastro- intestinal bleeding, so further tests must always be done.
- Ask participants to choose a stool sample, a FOB card and an applicator. They can write some pretend 'Patient Details' on the front of the card, and then lift up the flap to apply the samples. Using the applicator, ask the participant to take a small amount of stool sample and smear it onto the first of the two oval areas. Then repeat, but this time ask them to take another small amount from a different area of the stool sample and smear lightly onto the second oval area.
- Ask the participant to close the flap and turn over the card, peel the 'developing area' section on the back and apply two drops of the developing reagent onto the two areas.
- An intense blue colour will occur within seconds if the test is positive (i.e. that there is blood in the stool sample).
- The test works because the paper on the FOB card is covered with guaiac resin. When the reagent (hydrogen peroxide) is added, it oxidises the guaiac resin to a blue-coloured quinone. If blood is present, the haem has a peroxidase-like effect, catalysing the reaction making the colourless-to-blue reaction happen in seconds.
- Discuss how false positives may occur, for example when a patient has eaten red meat within three days of testing (red meat contains haemoglobin), or vegetables with a high peroxidase or catalase content (horseradish and potatoes – which is why the stool samples here give a positive result).
- The new FIT test has been developed to try and reduce the number of false positives being detected as it only detects human haem iron so haem iron in the blood of other animals from meat consumption will not be picked up. There can be other causes of a 'false positive' – for example if the patient has taken any drugs to cause intestinal bleeding (e.g. anticoagulants or steroids) but overall the new FIT test is more sensitive and accurate and will therefore save time and money.

Suggested duration: 30 minutes, shorter for drop in sessions

Additional information:

Alpha Labs site for ordering FOB cards and reagents, and the new FIT test kits:
Click here **www.alphalabs.co.uk**

FOB tests:
Click here **www.nhs.uk**

Fecal Occult Blood tests on LabtestsOnline:
Click here **www.labtestsonline.org.uk**

Bowel (colorectal) cancer:
Click here **www.nhs.uk**

Faecal Immunochemical Test (FIT) kits:
Click here **www.bowelcanceruk.org.uk**

To screen or not to screen

Aim:

To help participants understand the importance of neonatal screening (and screening in general). To encourage participants to discuss the issues around why we should screen for inherited diseases, what life is like without screening, and whether changes in our lifestyles can mean leading longer, healthier lives.

Audience: Secondary school students, class groups or year groups (more in depth discussions possible with GCSE and A-level)

Equipment:

- Screening factsheet (can be downloaded **from here**).
- Neonatal blood cards
- 'Inherited conditions or healthy babies' sheet
- Container or bag for 'lucky dip'
- Disease cards (can be downloaded **from here**)

Instructions:

- Print out the 'Inherited conditions or healthy babies' sheet onto paper, and cut them out. Use only a few of the 'Your newborn baby is healthy' labels if limited time, as the activity takes longer the more healthy labels you have. Fold all of the labels up, including the five 'Your newborn baby has … condition', and place them into a container or bag for participants to pick like in a 'lucky dip'.
- Show participants a neonatal blood spot card (or a picture of one). Do they know what it is? Explain the advantages of using this non-compulsory test: one-week old babies have their heels pricked and a spot of blood is added to the card. This allows for babies to be tested for various inherited diseases. Also, ask participants what they think are the advantages of testing dried blood drops on cards: for ease of transport, easily stored, useful for further research.
- Give all participants a copy of the screening factsheet, and go through some of the important points and facts: what screening is, what neonatal blood spot cards can screen for, how early treatment such as changing a diet can be life-saving etc.

- Now explain that all participants are soon-to-be parents. Split the group into two. One half (Parents A) live in a world where there is no neonatal screening. The other half (Parents B) live in a world with a successful neonatal screening programme, where 99% of babies are screened for inherited diseases. Unless parents are aware that they are carriers of a disease, they will have no idea of any inherited conditions that their newborn child might have, i.e. the 'lucky dip' nature of this activity.
- Ask one 'parent' from the Parents A group to come to the front with someone from Parents B group who will join them. One of them chooses a folded piece of paper from the 'lucky dip' and reads the statement. If it says 'Your newborn baby is healthy' then both of them can sit down (relieved!). Explain to the group that This means that wherever each parent was based, they have a healthy child.
- If however they find out that their babies have a condition, give them the appropriate disease card and ask one of them to read it out.
- What does this mean for Parent A? Obviously Parent A will not have had their child screened, so would not know about the condition. What will happen to their child?
    - What does this mean for Parent B? Parent B can make lifestyle changes to have a child that will live healthier and longer, because neonatal screening allows for early treatment.
    - Continue the process, alternating between parent groups as to who picks whom to come to the front with them, and who picks in the 'lucky dip'.
- If there's time, you could also discuss with participants the parents' concerns when being asked for consent by pathologists to conduct the screening. In the UK parents rarely oppose testing, however they may want to know more. How would participants answer the following questions if they were the pathologists instead of the parents:
    - Why do we need to bother with screening?
    - Why do you need to keep my child's blood spot records on file?
    - What if I find out my child is a carrier for a disease? I would rather not know!
    - What if my child has a disease, I don't think I will be able to cope? Is it going to cost me a lot in treatments?

Suggested duration: 40 minutes

Additional information:

Newborn blood spot test:
Click here **www.nhs.uk**

Other activities related to disease prevention you can try:

Resistance is futile:
Click here **www.rcpath.org**

Mouldy medallions:
Click here **www.rcpath.org**

Split your genes:
Click here **www.rcpath.org**

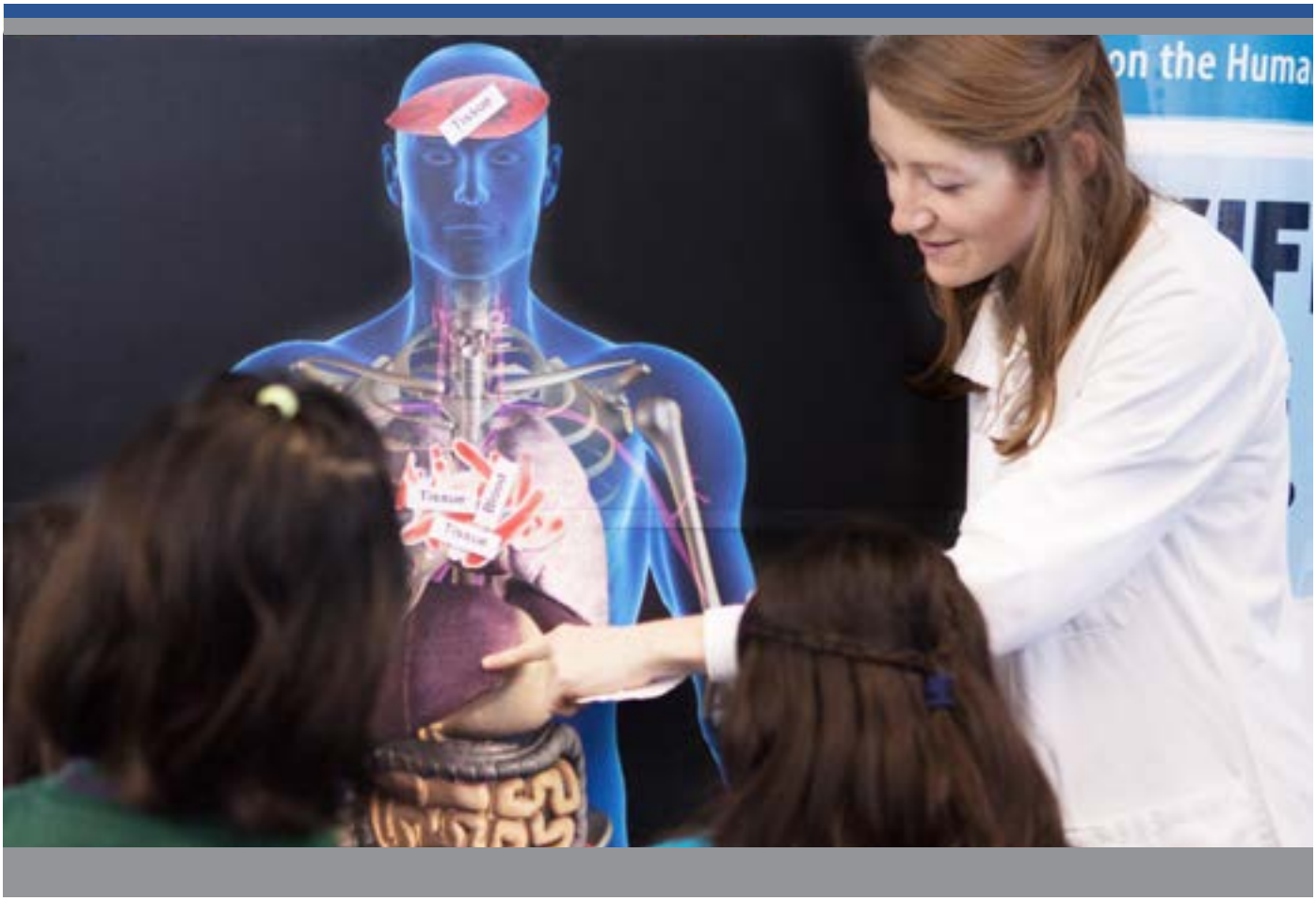
Diagnosis

Should a patient fall ill, it's important to work as fast as possible to diagnose the disease, in order to administer the most effective treatment. Medical microbiologists can diagnose the presence of different disease-causing microbes (pathogens), like bacteria and viruses, and choose the correct treatment, such as antibiotics. Histopathologists can identify what is wrong by scrutinising tissue samples under the microscope.

Cancer occurs when cells in part of the body grow and multiply, invading and destroying healthy tissues. We once believed that only radiotherapy, chemotherapy or surgical removal could reduce or eradicate tumors regardless of the patient's genetic makeup… however, cancer diagnosis has evolved. Through molecular pathology techniques, which brings together so many pathology specialties, we can now analyse an individual patient's genome to tailor the exact treatment and ensure survival.

Pathologists also need to diagnose the cause of death, by performing a post mortem (autopsy). By learning from the deceased, pathologists can help care for the living.

Pin the microbe on the human



Aim:

To introduce the idea of how different disease-causing microbes infect particular parts of the body using a life-size cut-out or outline of a human body to pin microbes to different organs. The activity also enables participants to explore what samples of body tissue/ fluid pathologists take to test in the lab in order to identify the microbe and diagnose the disease.

Participants will also learn that microbes (bacteria, viruses and parasites) infect humans, and can infect many organs in the body.

Audience: Any age

Equipment:

- Cardboard cut-out of human body with organs labelled (see below), or a large piece of paper to draw around a person
- Microbe images (ideally laminated) – (can be downloaded **from here**)
- Microbe descriptions sheets (ideally laminated) – (can be downloaded **from here**)
- 'Type of test' labels (ideally laminated) - (can be downloaded **from here**)
- Answer sheet (can be downloaded **from here**)
- Blu Tack

Human body cutout:

The College has a life size human body showing all major organs plus the laminated labels and microbes for this activity that can be lent out to members who wish to use it at their public engagement event.

We also have the stock image we purchased for this that can be used to get your own printed via a cardboard cut-out company such as **www.cutoutme.com**

Get in touch on publicengagement@rcpath.org if you would like to find out more.

Equipment:

- Either use a cardboard cut-out of a human, or draw around someone on a large piece of paper. When drawing around a volunteer, leave the space between the legs un-drawn and then fill this in free-hand once the volunteer has stood up.
- Attach the cut-out/human poster to the wall, with description sheets laid out on a table nearby.
- Ask participants to take turns to pin (using Blu Tack) microbe images to the human, where they believe they cause infection. You can discuss some of the key facts (on the microbe description sheets) to help participants make their decisions.
- After attaching a microbe, ask participants to attach a 'type of test label' (below and also downloadable as a sheet from the website) to the microbe description sheet, i.e. what sample they believe is taken to identify the microbe in an infected patient.

Suggested duration: 20-30 minutes, shorter for drop in sessions

Additional information:

This activity was developed by one of the College staff members, Jonathan Baker.

Activity 1 **Activity 2**

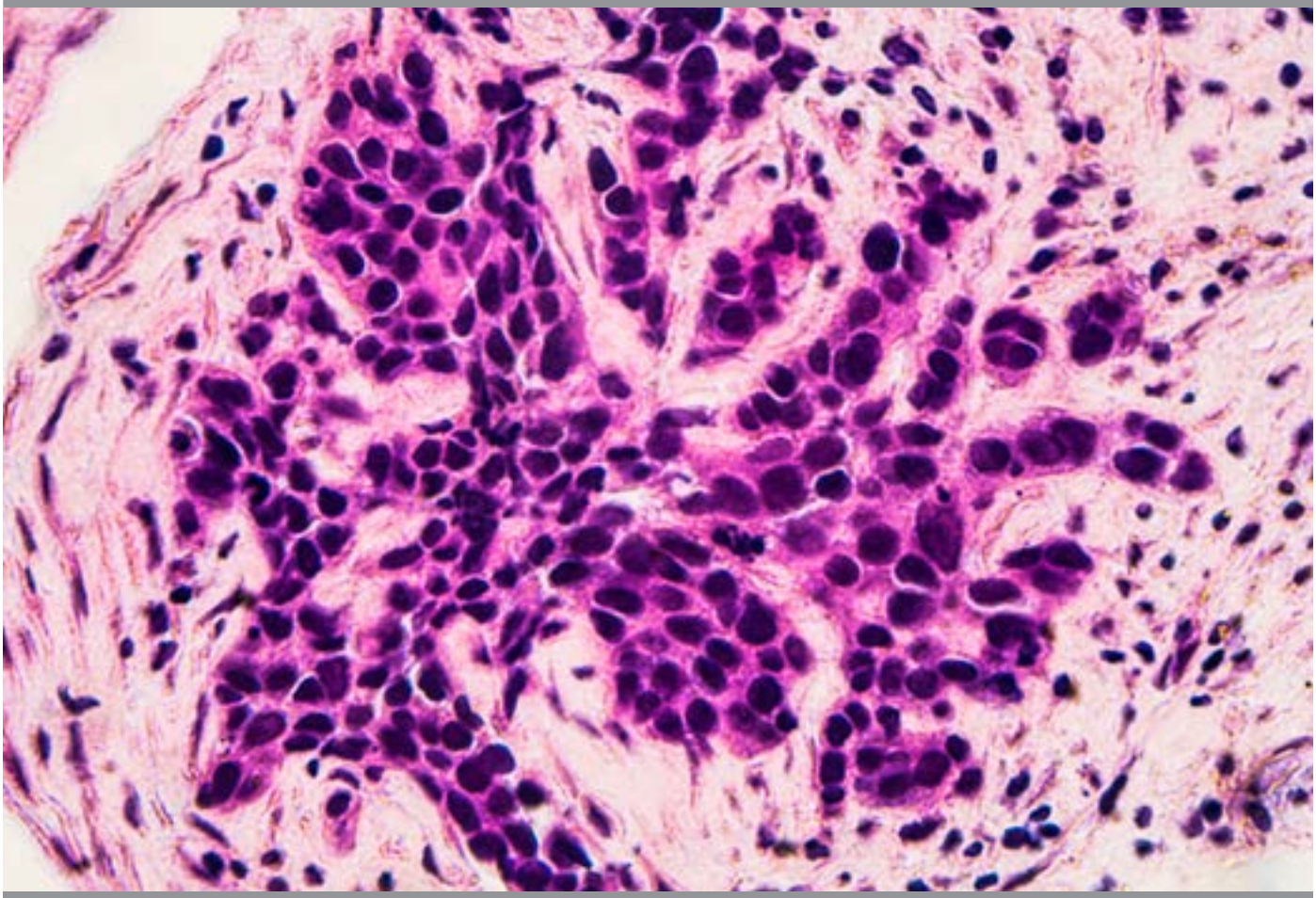
Type of test labels:

TISSUE	**URINE**	**BLOOD**	**FAECES**
TISSUE	**URINE**	**BLOOD**	**FAECES**
TISSUE	**URINE**	**BLOOD**	**FAECES**

Pin the microbe on the human aswers:

MICROBE	INFECTED TISSUE	SAMPLE TESTED
PLASMODIUM FALCIPARUM	BLOOD, BRAIN, LIVER	BLOOD
HEPATITIS C	LIVER	BLOOD
TRYPANOSOMA BRUCEI	BLOOD, BRAIN	BLOOD
HUMAN IMMUNODEFICIENCY VIRUS	BLOOD	BLOOD
ESCHERICHIA COLI	SKIN, BLOOD, BLADDER	URINE, TISSUE, BLOOD
MYCOBACTERIUM TUBERCULOSIS	LUNGS	TISSUE
TRICHOPHYTON RUBRUM	SKIN	TISSUE
STAPHYLOCOCCUS AUREUS	SKIN, EYES, BLOOD, HEART	TISSUE, BLOOD
TOXOPLASMA GONDII	BRAIN	TISSUE, BLOOD

Cancel cancer



Aim:

To help participants understand what molecular pathology is and what this means for cancer diagnostics. By using a simple simulation, participants will learn that we may all seem the same, but our genetics can make us more likely to suffer from certain conditions…which can mean different treatments are required even if it's the same disease.

Audience: Suitable for secondary school students and above

Equipment:

- Several (dependent on the size of group)
  2ml Eppendorf tubes half-filled with different solution mixes (see 'Instructions')
- UV torches
- Bicarbonate of soda, made into a solution with water
- Tonic water (preferably flat, and must contain quinine)
- Bromothymol blue indicator
- Plastic cups/beakers for the indicators and solutions
- Plastic pipettes for participants to add indicator 'treatment'
- A large box/bag for storing the tubes, allowing for random selection by participants

Instructions:

- Make up the Eppendorf tubes as follows (enough tubes for the number of participants); two sets of half-filled tubes:
  - Set 1: Contains bicarbonate of soda solution
  - Set 2: Contains flat tonic water
- Start off by explaining that cancer is where cells in part of the body grow and multiply, invading and destroying healthy cells, tissues and organs. The process of cancer spreading to anywhere in the whole body is called metastasis. There are over 200 different types of cancer, each with its own diagnosis methods and treatments. The 4 most common cancers in the UK are: breast, lung, prostate and bowel cancer, and it is thought that more than 1 in 3 people will develop cancer at some point in their life. Our lifestyles can also cause cancer, such as if we smoke, or are exposed to asbestos.
- Give out tubes randomly to each participant (or let them pick one out of a box/bag), and mention that this is a simulation to help us understand what molecular pathology is, and why knowing our individual genetic make-up matters to ensure effective treatment.
- Explain that each tube is a patient with cancer. They all look the same (the tubes are colourless, containing colourless liquid)...we're all human beings. Just these 'people' all happen to have lung cancer. But each human is an individual, and our unique genetics can mean that even if two people have lung cancer, the cancers can be very different.
- A common type of lung cancer is adenocarcinoma: cancer of the mucus-making lining cells of the lung airways. But there are two subtypes of this cancer based on genetic mutations, and so need different treatments. Tell the participants that some of their 'lung cancer patients' have EGFR lung cancer (epidermal growth factor receptor – Subtype 1) and others have ALK lung cancer (anaplastic lymphoma kinase – Subtype 2).
- The advantage of using molecular pathology techniques to test patients for the type of cancer they have, is that you can ensure they receive the right treatment and avoid wasting time, expense and unwanted side-effects (that can happen with the wrong/ineffective treatment). Let participants know that they will now try one of the tests to see which subtype of lung cancer their patient has.
- Test A is adding a small amount of Bromothymol blue indicator and Test B is shining the UV torch on the tube.

Test	Positive Respsonse	Negative response
Test A (indicator: blue is positive, colourless/yellow is negative)	This patient has Subtype 1 adenocarcinoma of the lung.	Further tests need to be done. Try Test B.
Test B (torch: glowing is positive, non-glowing is negative)	This patient has Subtype 2 adenocarcinoma of the lung.	Further tests need to be done. Try Test A.

- If it's a negative response, then ask them to try the second test and again record what happens. Whenever a test is negative, further tests need to be carried out. Encourage participants to compare their results with each other verbally, and work out which subtype of adenocarcinoma of the lung they think their patient has.

Then explain the subtypes and possible treatments using the possible treatments poster.

Available here: **www.rcpath.org**

Suggested duration: 30 minutes

Additional information:

Original activity:
Click here **www.rcpath.org**

About lung cancer:
Click here **www.nhs.uk**

About molecular pathology: Molecular pathology is enhancing a range of long-standing techniques and practices in a range of pathology specialties, including microscope analysis in histopathology and antibiotic testing in micro; see this article for more information:

Click here **www.rcpath.org**

Click here **www.virtualpathology.leeds.ac.uk**

My-croscope

Aim:

To make your own microscope and hear from pathologists about how they use microscopes in their work

Audience: Any age, works well with younger children (6-11 year olds)

Instructions:

- Ask the participants to make a small hole, using the hole-puncher in the middle of the larger square of card. It does not need to be directly in the middle.
- Using the sticky tape, ask them to stick the cellophane square over the hole. This is going to be the droplet-card, i.e. the lens of the light microscope.
- Using a pipette, participants can add a small drop of water carefully over the hole, on top of the cellophane. (Tip: Make sure they add the droplet onto the side with the cellophane on it, as the droplet can leak into the card if they use the other side). Also make sure that they do not flip the card over otherwise the droplet will slip off.
- The droplet-card already works as a magnifying glass, so you can ask the participants to hold it over various small items and to make observations on the detail they can see.
- Using the smaller piece of card, ask the participants to wrap it in a small amount of foil (carefully so that there are no creases), in order to make a mirror. Make a stand for the mirror out of another piece of card.
- Tell them to place the mirror at an angle on to a piece of plasticine and place this under an upside down shot glass.
- The base of the shot glass is now a platform onto which they can place whatever it is they wish to view: a small dead insect, a flower petal etc. Then ask them to place their droplet-card on top.

- Ask them what they can see through the water drop.
- Older groups can investigate ways in which to make the image sharper, and other ways they could create a simple microscope.
- An extra option is to show how a smart phone can be used as a digital microscope. Switch the camera on the phone to 'selfie-mode' and place it on the table. Add a droplet of water to the front-facing camera and gently lower specimens in front of the water droplet. Images will appear on the screen and can be photographed.

Equipment:

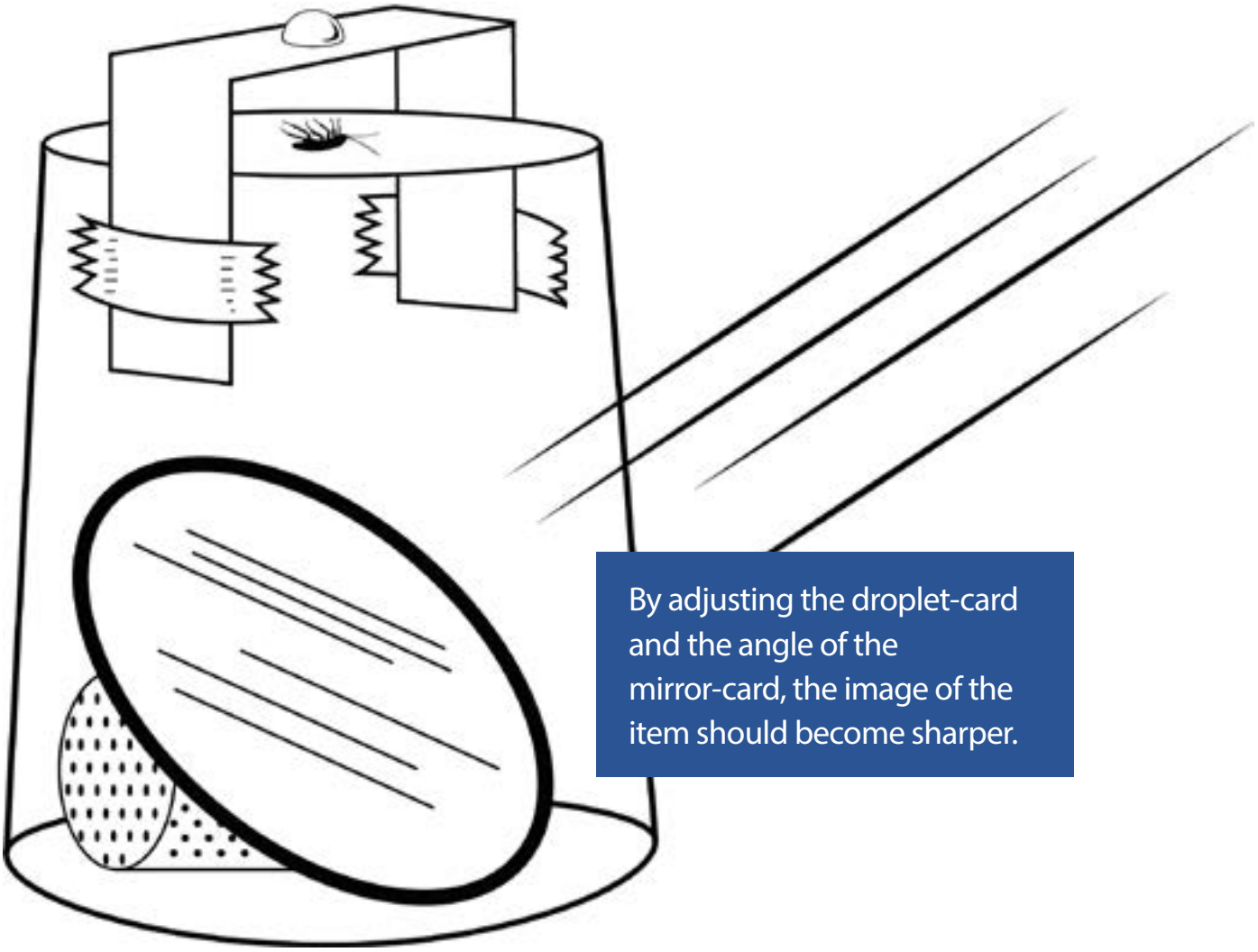
- Clear plastic shot glasses
- Strong card, in 2.5cm squares and 4cm squares (e.g. cereal box card or plain craft card – note that corrugated card is not suitable)
- Hole-puncher (to make a hole in the 4cm square card)
- Aluminium foil
- Clear plastic sleeve, in 2.5cm squares (e.g. cellophane/cornstarch wrapping from greeting cards)
- Water
- Plasticine (note that soft/ air-drying modelling clay is not suitable)
- Pipettes
- Sticky tape
- Small items to view (dead insect, leaf, flower, onion skin, newspaper pieces, skeleton leaves work well – collect lots as these go missing easily).
- Torch (optional, if natural light is not suitable)
- Mobile phone with front-facing camera (optional)

Suggested duration: 20 minutes

Additional information:

Microscopes are vital in diagnosis. Pathologists can look at tissue samples under the microscopes to magnify cells and find any abnormalities. Anything that looks different can hold clues as to what the patient might be suffering from, and what the treatment needs to be.

The drop can magnify small items up to fifty times, and works like a convex lens. When we look at an object, light travels in parallel rays, bouncing off an object into our eyes, where an upside down image of the object appears on the back of the eye (retina), and our brain makes sense of what it is (and flips it the right way up). A convex lens is rugby-ball shaped, and bends (refracts) the light rays, bringing them together to a point. This reaches our eyes and creates an image on the retina, which makes it seem as if the object is bigger than it actually is.



By adjusting the droplet-card and the angle of the mirror-card, the image of the item should become sharper.

For Older Groups:

- Foldscope **click here**
- Cellscope **click here**
- Instructables **click here**

Sock-romosomes…

Aim:

To help participants creatively learn how changes in our chromosomes can affect our health, and how pathologists can study these changes to diagnose these genetic disorders.

Audience: Secondary students and general public

Equipment:

- Full karyotype image (can be downloaded **from here**)
- Socks (46 to make a karyotype)

Instructions:

- If you do not have enough socks, and you're running this activity in a classroom, you could ask the class to bring in a spare pair of socks with them on the day you are running the activity. Or ask colleagues, teachers, and students to bring in socks (and even ties) that they have at home in the weeks leading up to the activity.
- This activity would work well in the hall, outdoors, or alternatively clear some space in the middle of a classroom.
- Explain that DNA (deoxyribonucleic acid) is the information within our cells that makes us who we are and can determine what diseases we may develop. DNA is coiled up into chromosomes and a karyotype is a picture of the complete set of chromosomes in a cell. By analysing a karyotype, pathologists working in genetics can interpret the characteristics of the chromosomes and diagnose genetic disorders such as Down's syndrome.
- Show or project an image of a human karyotype and ask all participants to help make a giant karyotype using socks, on the ground. Remember to point out that there must be a complete set of chromosomes: 23 pairs, and the chromosomes must be arranged in order of size.

- Ask participants to find chromosome 22 and chromosome 9. The Philadelphia chromosome is an abnormally short chromosome 22, which forms following exchange of material with chromosome 9 in a process called translocation. This abnormal chromosome causes an abnormal enzyme, tyrosine kinase to form, causing bone marrow cells to divide uncontrollably. This leads to the person developing a type of leukaemia called chronic myeloid leukaemia.
- Let participants know that because pathologists working in genetics can identify these abnormal chromosomes, the treatment of this type of leukaemia is possible through drugs that inhibiting the tyrosine kinase enzyme, such as Glivec.
- Other discussion points could include:
  - Is the karyotype of a female, or male? How do you know? How do we change it? (Look for the XX or XY chromosomes).
  - What would the karyotype look like if the individual had Down's Syndrome? What would you change? (An extra copy of chromosome 21).
  - How some conditions are X-linked, such as Haemophilia.

Suggested duration: 30 minutes, shorter for drop in sessions, longer for classroom sessions with background and discussion

Additional information:

This activity links to objects in 'A History of Pathology in 50 Objects'
(Karyotype and Philadelphia chromosome):
Click here **www.rcpath.org** or here **www.ghr.nlm.nih.gov**

Gina Glover's Art in Hospitals:
Click here **www.artinhospitals.com**

Why not also try:

Urine trouble:
Click here **www.rcpath.org**

Too many broken hearts:
Click here **www.rcpath.org**

Point of care testing:
Click here **www.rcpath.org**

Living Autopsy: video of lecture by Dr Suzy Lishman and video guides to running your own autopsy-related public event.

Treatment

Following the diagnosis, an appropriate treatment needs to be given to the patient. Antibiotics are often administered for bacterial infections. However it is important that patients take antibiotics exactly as prescribed (i.e. taking the full course for the duration required, at the right times and at the correct dose), to prevent antimicrobial resistance (AMR) - a huge issue in health services worldwide right now.

Sometimes the treatment isn't about a medicine, but about the patient needing a transfusion or a transplant. Blood and organ donation, through NHS Blood and Transplant (**www.nhsbt.nhs.uk**) is an integral part of the NHS, ensuring blood banks are replenished regularly and patients requiring organs are cared for appropriately.

Dinky dishes

Aim:

To discuss how medical microbiologists use agar plates to grow bacterial cultures and find which antibiotics work best (antibiotic susceptibility testing), through a creative art activity. Participants will also understand the importance of taking antibiotics correctly.

Audience: Any age, works well with family groups

Equipment:

- Small 35mm Petri dishes or 2 x 3.5cm diameter circles of clear acetate
- Hole punches
- Filter paper or plain paper
- Glass paints, poster paints or marker pens (red, cream-yellow, light brown, to represent agar)
- Narrow clear tape (e.g. 12mm tape)
- Small glue dots for attaching 'antibiotic discs'
- Key ring fastenings, badge pins or loops of string/wool (best attached to Petri dishes in advance using a glue gun or sticky pads/double-sided tape
- Image of a bacterial culture in a Petri dish that has antibiotic discs and visible clear zones, ideally printed A3 and laminated (can be downloaded **from here**).

Instructions:

- Explain to participants how antibiotic discs work and what the clear zone indicates, and what antibiotic susceptibility testing means.
- To do this, you can use the image of a bacterial culture and explain that in order to decide which antibiotics can be used against different bacteria, we need to test them to see which antibiotic will stop the bacteria growing. First a sample of the bacteria is spread across an agar jelly plate. Small paper discs are added to the top of the agar, where each disc has been pre-soaked in a different antibiotic. The plates are left in an incubator for the bacteria to grow and the antibiotic to leak into the agar jelly. If the antibiotic in the disc is powerful enough to stop the bacteria from growing at all, the agar plate will be completely clear. This means that the antibiotic will work and make the patient better. If the bacteria is still growing all over the plate, it means it is resistant to the antibiotic, and the antibiotic will not help the patient get better.
- But what we usually see is that some antibiotics can stop some bacteria growing in the area closest to the disc. The discs with the largest clear zones around them are the antibiotics that will work the best.
- Now invite participants to make their own Petri dish accessory that will look exactly like a bacterial culture plate being tested for antibiotic susceptibility. Ask participants to use a hole punch to make their own antibiotic discs out of filter paper or plain paper. These can be stuck to the bottom of the Petri dish, or onto one of the discs of clear acetate.
- Ask them to paint around the paper discs, with glass paints (or markers or other paint), choosing some of the discs to contain powerful antibiotics, i.e. will need a clear zone round them.
- Add the lid of the Petri dish, or place the second disc of clear acetate on top, and seal with the thin clear tape.
- Attach key ring fastenings, badge pins or loops of wool using sticky glue dots, sticky pads or similar so that these Petri dishes can be worn.

Suggested duration: 15-20 minutes, shorter for drop in sessions, longer for classroom sessions with background and discussion

Additional information:

Blood and Bugs resources for more information on Antibiotic Susceptibility Testing:
Click here **www.rcpath.org**

Totally organ-ised!

Aim:

To help participants remember where all the organs are and what their functions are in the body.

Audience: All ages

Equipment:

- A set of illustrated organs to print and cut-out (and ideally laminated). These can be downloaded from the RCPath website (see below)*
- Large piece of paper, roughly 6 x 3 ft
- Marker pen
- Blu Tack
- A set of organ labels cut out (can be downloaded **from here**).
- A set of food items listed below, each with its approximate weight (can be downloaded **from here**)
- Printed copies of table showing organ, average weight and food item of equivalent weigh (can be downloaded **from here**).

*The organs are as close to life size as possible. They can be printed on standard copier paper or card and used as they are or cut out. The printed organs could be laminated to make them more durable. Two of the organs (liver and colon) have had to be printed over two pages so will need to be stuck together

Instructions:

- Draw around one of the participants on the large piece of paper. For the space between the legs, this should be left un-drawn and filled in free-hand once the participant has stood up. Take care not to draw onto clothing with marker pens.
- Ask each participant to take a laminated organ, to name it and to add it onto the drawn body outline in the correct location.
- Then ask them to take a food item and work together to match the weight shown on item with the correct organ. Are they surprised by how heavy/light some organs are?
- Finally, go through their answers – did they name, position and match the weights of all the organs correctly?
- Looking at the organ function table, are there clues to each organ's function based on their structure and size? Discuss with participants what could go wrong with different organs, and which organs can be donated and why (see organ function table and additional info links).

Suggested duration: 30 minutes

Why not try?

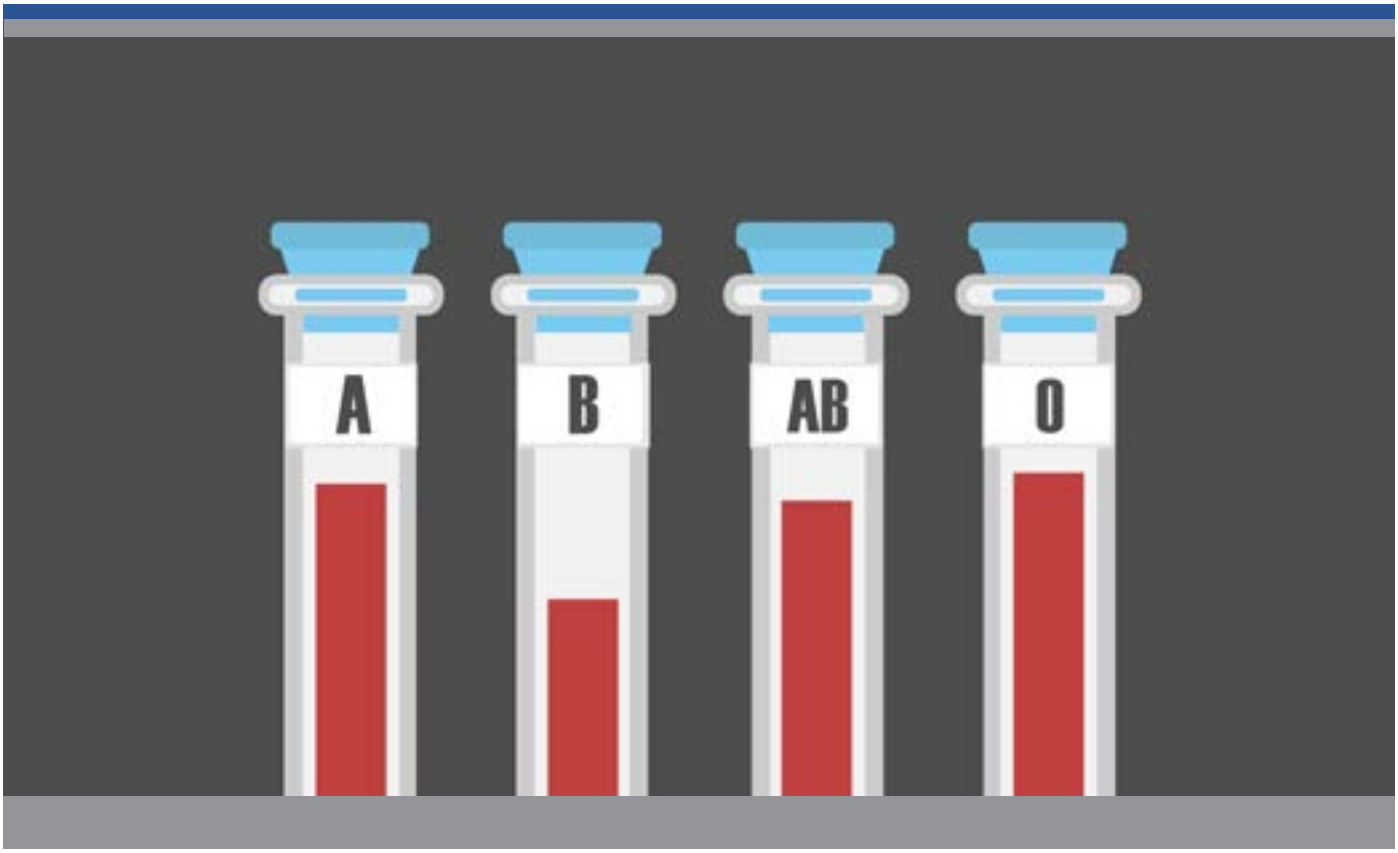
The organs can also be used as prompts in discussions about organ transplantation, infections or cancer.

The activity can also lead into an ethical discussion about organ transplant; the printable discussion cards for this activity can be downloaded from the same page as this pack.

Additional Information:

www.nhsbt.nhs.uk

Spin to match



Aim:

To help participants understand that our blood type depends on the presence of certain antigens on our red blood cells; antigens cause our immune system to produce antibodies (see below for additional information on antibodies).

This activity uses salad spinners and pom poms to simulate a cross-match test known as Column Agglutination Technology (more commonly referred to as the Gel Card test) in which the red cells and plasma are added to a gel or bead column and then spun in a specially adapted centrifuge. If the red cells remain at the top of the gel, they have clumped and cannot pass between the beads (positive reaction) and if they have not clumped together then they can pass to the bottom of the column (negative reaction).

Note: For the purposes of this activity, to quicken and simplify, Rhesus has been overlooked, and although plasma pom poms would look better in a different colour, separating them back out for each activity would take too long.

Audience: All ages, particularly useful for A-level students

Equipment:

- 2 x salad spinners (set up with Velcro stuck on the inside – 1 with sticky side lining the salad spinner interior, 1 with non-sticky side lining the salad spinner interior)
- Red felt pom poms
- Plastic cups (for holding felt pom poms) in the following colours:
- Green, Red, Yellow, White (or use clear cups with different coloured stickers)

- Coloured stickers or cards to match the cup colours
- Laminated cards showing how blood types can be matched; see below or download card from the same page as this activity pack (can be downloaded **from here**)
- Gel cards (if available, otherwise show diagram of one, can be downloaded **from here**)
- Gilson pipettes and tips (optional)

Instructions:

- Participants can be given a sticker or piece of card with a colour that represents their 'blood group': green, red, yellow or white to match the cups.
- The coloured cups are set up with red felt pom poms inside (i.e. red blood cells).
- Show participants the blood group laminated card. Ask them if they know what their blood group is (based on their sticker/card), and to look at which blood types are compatible with theirs.
- You can explain the following:
  - Blood Group AB has both A and B antigens on the red blood cell surfaces, but no A or B antibodies in the blood plasma. (Universal Recipient).
  - Blood Group A has A antigens on the red blood cell surfaces, but B antibodies in the blood plasma.
  - Blood Group B has B antigens on red blood cell surfaces, but A antibodies in the blood plasma.
  - Blood Group O has no A or B antigens on red blood cell surfaces, but has A and B antibodies in the blood plasma. (Universal Donor).
- Now participants are going to see if their blood is compatible with another type of blood in order to transfuse. Compatibility between the blood groups of donor and recipient determines a successful transfusion.
- Ask participants to take a sample of their blood (i.e. a cup of pom poms in the right coloured cup i.e. matches their sticker colour) and then ask them to look at the card and select another coloured cup with which they think theirs is compatible.
- Then based on the two coloured cups they have chosen, give them either the sticky or non-sticky salad spinner depending on whether they have chosen the correct blood type for compatibility or not.
- Ask them to put both blood samples which into a 'gel card' (i.e. add both cups of pom poms into the salad spinner, the salad spinner representing one gel card column magnified) containing the gel/bead column (Velcro), and spun.
- If the blood samples (pom poms) clump together and can't pass to the bottom (i.e. are stuck on the top and sides of the salad spinner with sticky Velcro) it's a positive reaction and so it's not a match.
- If the blood samples (pom poms) remain unclumped and go to the bottom of the column (i.e. in the salad spinner with non-sticky Velcro), it's a negative reaction and so it's a match. The attendee's blood sample can be donated to the patient who supplied the plasma, safely.
- Show participants real gel cards and pipettes so they can see how such small amounts of blood are used.

Suggested duration: 20 minutes, shorter for drop in sessions

Additional information:

An antibody is a protein produced by the body's immune system in response to a foreign substance such as a bacterium or virus. Each antibody is unique and defends the body against a single foreign substance (antigen). Usually you can tell if you know someone's blood group, which blood to give them, but sometimes there may be other antigens. Cross-matching is used by a doctor to make sure that the specific donor blood that will be used during a transfusion does not react with a patient's blood.

This was originally one of the Royal College of Pathologists' Blood and Bugs suite of activities during the BBC WW1 at Home Centenary tour:
Click here **www.rcpath.org**

The College public engagement team has a set of the materials needed to run this activity that can be lent out to members who wish to run the activity. Get in touch with the team on publicengagement@rcpath.org to find out more.

Click here **www.nhs.uk**

Click here **www.nhsbt.nhs.uk**

Why not also try:

My heart belongs to you:
Click here **www.rcpath.org**

Human tissue resource:
Click here **www.rcpath.org**

Thank you for using this pack.

To find out more about pathology visit:

www.rcpath.org

www.rcpath.org/discoverpathology

www.rcpath.org/careers

If you're keen on public engagement but don't know where to start get in touch with the public engagement team on publicengagement@rcpath.org and/or one or more of the organisations below:

STEM Learning and the STEM Ambassadors scheme: **www.stem.org.uk**

Speakers for Schools: **www.speakers4schools.org**

I'm A Scientist, Get Me Out Of Here: **www.imascientist.org.uk**

WISE Campaign: **www.wisecampaign.org.uk**

British Science Association: **www.britishscienceassociation.org**

Science Live: **www.sciencelive.net**

Ideas on funding your events

The Royal College of Pathologists Public Engagement Innovation Grant Scheme:
Click here **www.rcpath.org**

Royal Society of Biology Regional Grant Scheme:
Click here **www.rsb.org.uk**

Microbiology Society Education and Outreach Grants and Prizes:
Click here **www.microbiologysociety.org**

Society for Applied Microbiology Public Engagement Grant:
Click here **www.sfam.org.uk**

Biochemical Society Scientific Outreach Grants:
Click here **www.biochemistry.org**

The Physiological Society Public Engagement Grants:
Click here **www.physoc.org**

The Royal College of Pathologists
Pathology: the science behind the cure