

MEDICAL

Mavericks World

Helping students discover amazing opportunities in the world of health, medicine & STEM.

Summer 2023

#BEMOREMAVERICK

Don't miss a beat **The Journey of Heart Transplantation**

Check out pages 8-12

How to perform
MAGIC and
see through
your hand
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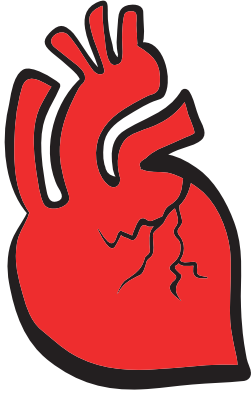
The latest
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Your Medical Mavericks World Creators



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Hattie also delivers our workshops, has a degree in Biomedical Science and is starting a Masters in Paramedic Science.

Do You Know What a BSc (Hons) is?

Throughout this magazine and in your school life, you may hear different words being used about careers, university, routes to employment, qualifications and courses you can study on, and you may not want to admit you don't have a CLUE about what they mean. This is a brief guide to some of these words and terms, we will start with the classic route, before looking at alternatives.

Let's start at the beginning.

When you are at school and you can study your GCSEs (General Certificate of Secondary Education) in years 10 & 11. In 6th form or college you can study your A-Levels, BTECs (Business and Technology Education Council), IBACs (International Baccalaureate) amongst others and then after that where do you go? We are going to focus on the University route here, but at the end of the chapter there is more info on other routes after GCSE and Sixth Form, including Apprenticeships.

A Degree

A degree is a course you study at University. You can choose your subject by looking through a University prospectus or searching the UCAS website. Typically a degree is three years long.

However, some courses are 4 years as they include a placement

year where you leave the course to work in a sector linked to your degree, or work abroad, for a year. You can also study part time, but the courses take 5-6 years to complete! There are several types of degree. We will go through each one on the following pages.

Undergraduate Degree

This is the first degree you can take at university after Sixth form or college. Typically, you study different modules and topics over the three (or four) years. You are assessed at your University by taking exams, writing essays and performing presentations. In your 3rd year of your degree you can complete a major project called an Honours Project (see below) as well as a Dissertation, which is pretty much a 10,000 word essay!

BSc (Hons) or Bachelor of Science (Hons)

There are different types or titles of degree you can take. This is not the subject! For example, a degree subject could be Human Biology or History. The type of degree is usually listed on the University website and UCAS. A science based degree has the title BSc, which stands for Bachelor of Science. Other degree titles examples include:

- BA – Bachelor of Arts
- BEd – Bachelor of Education
- BEng – Bachelor of Engineering

You'll see these 'codes' after people's names. For example, mine would look like this:

Tom Warrender BSc (Hons)

I know what you're thinking now... what does the Hons bit mean?

A degree with Hons...

Hons refers to 'Honours'. For example, my degree was: BSc (Hons) in Human Physiology & Exercise Science. You get the Hons bit by completing a project in your 3rd year called, guess what... an honours project!

In Science, this usually includes you having to come up with your own experiments and theory to test in a lab. My honours project tested professional footballers and the heart rates they trained at, as well as linking it to how much lactic acid they produced during training. Some of my friends did projects on how bone was destroyed by increases in temperature when it was drilled during certain types of surgery, how caffeine affected performance in explosive and endurance sports, and how exercise affected your immune system. All cool stuff, but really hard work.

When you complete your degree you become a Graduate.

WOOHOOO
WELL DONE YAYYYYY!!!!

The Degree Results

- **First** – Also known as a Geoff Hurst (if you don't know who Geoff Hurst is, then shame on you!).

This is the top result you can get. Around 20% of graduates get a First. Think of it like an A grade and you usually have to have an average pass grade of 70% or more.

- **2:1 – Or Upper Class Degree.**

This is the next grade down. Almost like a B grade and you have to average 60-69% in your assessments. Around 45% of graduates get a 2:1.

- **2:2 – AKA a 'Desmond'...** why? For some strange reason it was linked to Archbishop Desmond Tutu... get it 2:2...

This is like a C grade and requires an average of 50-59% in assessments. It can also be known as a Lower Second Class Degree.

- **3rd** – The lowest official grade you can get.

It is awarded if your average results in assessments are in the 40-49% range.

- **Unclassified** – This is a pass and to be honest it is worth less than the paper it's written on, as you have only averaged around the 40% mark in assessments, or potentially below. That may sound harsh, but if you don't do the work, the university is not just going to hand out results on a platter.

Avoid at all costs.

Postgraduate Degree

Once you have completed your undergraduate degree, you can go onto study at an even higher level on a Postgraduate Course of which there are several types.

The order of which are:

- **Post Graduate Certificate**
- **Post Graduate Diploma**
- **Masters**

One usually leads into another, or you can go straight into the Masters. When I studied my post-grad course in Medical Toxicology, you started off studying for the certificate, if you passed certain modules you qualified for the Diploma and then if you wanted to, at the end of that, you could study for another year for the Masters. The whole process for the above takes between 1 – 2 years and varies at different Universities. Some are practical based in labs and others are lesson or research based.

PhD

PhD stands for Doctorate in Philosophy. It is a research based qualification with no lectures or classic teaching lessons. At the end of it you can call yourself a doctor!

You're not a medical doctor. You are a doctor in your subject. You can become a doctor in any subject: languages, history, art, science, medicine...the list could go on. Some people put the letters PhD at the end of their name, some put Dr at the start. So don't assume when you see someone with Dr at the start that they are a medical doctor!

Typically, you can start a PhD once you have a Masters. You don't always need a Masters, but many students use it as a stepping stone to a PhD.

You get a PhD after extensively researching an original idea or concept in your chosen subject. It usually takes 4-8 years to complete as you are finding out something no one has ever found

out before in a subject and this takes time. There are so many facets to science subjects, there is always something to discover.

In a science based PhD you'll spend a lot of time in the lab performing experiments, analysing results, writing reports and papers that get published in scientific journals. These are critiqued by other scientists to make sure the science stands up! It can be quite brutal... but you can't have duff science. Your results and findings could go on to change the world!

After your PhD you can carry on researching in what is called a Post Doc (post doctorate). You may even become a Professor! Many PhD graduates go on to become an academic. This is where you are the expert in your field at the University and you teach about it as a lecturer in University. However you don't always need a PhD to become a lecturer. I became a lecturer at the age of 24 with just a degree!

So there you have it, the route from school to PhD! What do you fancy studying?



A-Z of Medical Careers

Clinical Bioinformatics



Clinical Bioinformatics is a combination of biology and computer science that focuses on the acquisition, storage, analysis, and distribution of biological data. In other words, this is an important computerised tool to manage all the information produced by scientists!! Within the NHS, clinical bioinformatics can be divided into 3 categories: genomics, health informatics and physical science. For

example, genomic informatics applies bioinformatic resources, including data bases and online tools, to genomics. This enables creation of next generation sequencing pipelines and designing databases to ensure data collected from laboratories is utilised in efficient and standardised manners.

To apply for this job, you will require a degree in an applied or pure science subject relevant to the specialism you are applying for. This enables you to apply

for the Scientist Training Programme (STP) within the NHS alongside the ability to demonstrate a strong understanding of clinical informatics. Trainee clinical scientists will receive a salary of band 6 level, following qualification clinical scientists receive band 7 scale pay. With further experience and training, it is possible to reach band 9 pay as a consultant clinical scientist. This role can also lead into research or teaching positions.

Call Handler



Call handlers, also known as an emergency medical dispatcher (but just to complicate matters these can also be 2 different roles) are responsible for handling medical situations over the phone and act in the most appropriate manner by dispatching an ambulance or referring the caller to another service.

Call handlers and emergency medical dispatchers work under tremendous amounts of pressure and are a very much under-appreciated role within the NHS. A day in the life might involve dealing with life-or-death emergencies such as road traffic

accidents, heart attacks, broken bones or fights involving injuries. Whilst health professionals such as paramedics or clinicians are on their way via ambulance, helicopter, or fast responder vehicles, call handlers may have to take the caller through emergency procedures such as clearing an obstruction from someone's airway or performing CPR. Call handlers are also used in the NHS 111 service to provide help to members of the public and some healthcare professionals regarding non-emergency health problems.

As a call handler, you will typically start at a band 3 or 4 (starting salary: £24,000- £26,000), there are

options for career progression to a band 6 team leader. There is also potential to become a duty manager at band 7 - responsible for the management of staff and call centre during a shift (£40,000-£45,000). The shift pattern of weekdays, weekends, and nights will depend on the trust. To be a successful call handler, you must possess the ability to remain calm in highly stressful situations and under pressure when callers are angry, upset or in shock. You must type up incidents efficiently, to quickly triage patients to A&E, by assessing the level of emergency and nearest hospital.

By Hattie Adley



Cancer Genomics



Cancer genomics is the study of genes within the body and how upon alteration, these changes may lead to cancer development. Working within this field would involve identifying different types of cancer that are causing alterations in genes. To identify these changes, these scientists would use chemical experimentation and laboratory procedures enabling examination of DNA. These

scientists would work with a multidisciplinary team involving other healthcare scientists and doctors to aid a diagnosis for each patient.

This position within the NHS usually revolves around a 37.5-hour shift pattern with a salary between band 5 and 9 depending on your precise role, experience, further qualifications, and responsibility. To enter into this role, you will require 2-3 A Levels enabling you to apply for the NHS Practitioner Training

Programme (PTP) by taking an accredited BSc degree in a healthcare science, such as genetic science. There are plenty of opportunities relating to a career within cancer genomics such as working with the 100,000 Genomics Project, increasing your experience and working within research, specialising in particular branches of cancer genomics or entering into education to pass on your knowledge.

Cardiologist



Cardiology is a branch of medicine whereby doctors diagnose, assess, and treat disorders, diseases and defects surrounding the cardiovascular system (the heart and blood vessels). These conditions may include angina, atherosclerosis, thrombosis, arrhythmias, congenital heart disease and more. *Note – a paediatric cardiologist is a different speciality. Due to the rise in obesity and metabolic syndrome-related disorders like diabetes and high blood pressure, cardiology is a fast paced and ever advancing career. With a focus on extending

patient lives, cardiologists use cutting edge technology and therapies including emergency care.

Cardiologists require a degree in medicine followed by 2 foundation years as a doctor. Following this, doctors will undertake core training for 2 years where they can choose either internal or acute medicine. The cardiology speciality training itself usually takes 5 years, however, many trainees undertake further academic research during this training which can increase in length. An interest in cardiology, which drives these researchers, enables this field to be an extremely forward-thinking

specialty, with advancements in scientific knowledge and understanding improving treatments and therapies. Within cardiology, there are also sub-specialties! These can include cardiac imaging, electrophysiology, interventional cardiology, cardiac oncology and more.

There is plenty of career progression associated with this speciality, with positions as consultants, clinical directors, medical educators, and associate deans, allowing for a very varied career!

How is a Heart Transplant Performed?

By Chloe Russell



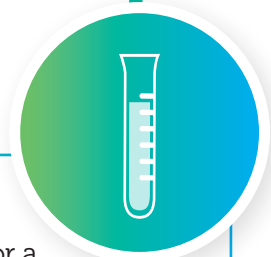
1. BEING OFFERED A HEART TRANSPLANT

- To be considered for a transplant, you must have a condition called heart failure. This comes in many different forms and has lots of different causes.
- Transplant hearts are extremely rare so surgery will only be considered if the patient is extremely unwell with their heart condition.
- To be eligible, their heart condition must not have improved through any other medical procedures.



2. TRANSPLANT TESTS

- If the doctor thinks someone could be suitable for a heart transplant, they will undergo a series of tests.
- These tests include blood, tissue and antibody tests and physical tests to check they are fit enough for surgery.



3. ON THE WAITING LIST

- Being called for a transplant depends on finding a suitable match and this requires the donor heart that is the right size, tissue type and blood type... this is why it can take so long to find a suitable match.
- Whilst waiting for the transplant, patients may have a special device fitted, called a Left Ventricular Assist Device. This helps the heart continue to function.
- If the patient is found to be suitable for a transplant, they are added to a waiting list and could be called for a transplant at any time!
- The donor heart has to be used within about 4 hours of organ removal!



4. GETTING READY

- When they hear from the transplant centre, they will be told not to eat or drink anything to get ready for surgery. They will be told to pack their hospital bag and take all their medications with them.
- When the patient reaches the transplant centre, they will be reassessed to check they are still fit for surgery.
- The patient will change into a hospital gown and head down to surgery!



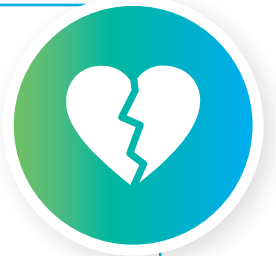
Transplant Surgery

**5. PREPARING THE BODY FOR SURGERY**

- The patient is put to sleep and attached to a ventilator so they can breathe during surgery.
- An IV line is inserted to inject fluids and medicines throughout the surgery. A catheter is inserted into the bladder to drain urine and other catheters around the body to monitor the body throughout surgery.
- The chest is cleaned with antiseptic solution.
- The operation takes between 4 and 6 hours.

6. REMOVING THE HEART

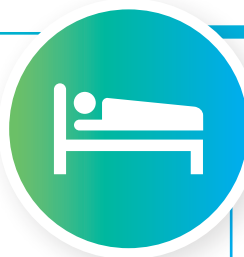
- An incision is made down the centre of the chest and the sternum (the bone down the middle of the chest) is cut in half.
- Tubes are put into the chest so the blood is pumped through a cardiopulmonary bypass machine. This keeps the blood flowing whilst the heart is replaced.
- The diseased heart is removed

**7. REPLACING THE HEART**

- The new heart is sewn into place and the blood vessels are connected.
- The blood that was in the bypass machine is allowed back into the heart.
- To make the new heart start beating, it is shocked with small paddles.
- The team watch the heart beating to check there are no leaks.
- Pacing wires might be put into the heart and attached to a pacemaker. These might only be needed for a short period of time.

**8. CLOSING UP THE WOUND**

- The sternum is fixed together with small wires and the skin is closed up with surgical staples or sutures.
- Tubes are inserted into the chest to drain excess fluid from the heart.
- A sterile dressing is applied.

**9. AFTER SURGERY**

- After surgery, the patient is taken to the intensive care unit. Here, they are connected to an ECG (electrocardiogram) to monitor the heart. Other vital medical signs are also monitored.
- The patient is still connected to ventilator and may not wake up for a little while and will receive around-the-clock care.
- When they are deemed ready, they will move onto a lower-level ward.
- They can usually leave hospital to go home within 4 weeks.

10. AT HOME

- The patient will have been taught how to look after themselves, this includes keeping the wound clean and not doing certain activities.
- There will be frequent follow-up tests to watch for signs of rejection.
- The tests include biopsies, blood tests, X-rays and much more.
- For the heart to survive in the body, the patient must take medications for the rest of their life.



Careers Involved in a Heart Transplant

By Tom Warrender



It's not just surgeons involved in transplanting a heart from one person to another. There is lots of work carried out before, during and after surgery and it takes a huge team to ensure it all goes to plan and the patient is given the best chance of surviving! Here's some of the most common careers involved! Which one do you fancy trying?



Anaesthetist

I'm an anaesthetist I put the patient to sleep and monitor them during the surgery.

To do this job, you need: GCSEs (all levels 8s and 9s, inc. Maths, English and Science) → A-Levels (A*A*A*-AAA) → medical school → 2-year foundation programme → 7-8 years of speciality training

Salary: Band 7 – Band 9 (£39,467 - £114,003)

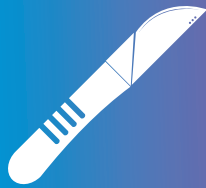


Operating Department Practitioner

I'm an Operating Department Practitioner and I prepare the specialist equipment and drugs. I am responsible for providing the correct surgical instruments. I also support and monitor the patient.

To do this job, you need: GCSEs (5x levels 9-4, inc. Maths, English and Science) → A-Levels or equivalent (usually BBC) → 3-year degree (BSc Operating Department Practice) or apprenticeship → Health and Care Professions Council registration

Salary: Band 5 (£25,655 - £31,534)



Theatre Nurse

I am a Theatre Nurse and I support the anaesthetist and provide the surgical tools. I also monitor the patient and provide general patient care.

To do this job, you need: GCSEs (5x level 4 and above, inc. Maths, English and Science) → A-Levels or BTEC equivalent → 3-year degree (BSc Nursing) → specialist theatre training course.

Salary: Band 5 (£25,655 - £31,534)

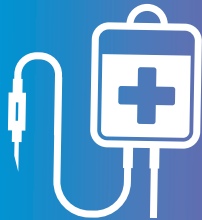


Cardiothoracic Surgeon

I am the cardiothoracic surgeon and I perform the actual surgery. I am responsible for making incisions in the correct places and connecting the new heart.

To do this job, you need: GCSEs (all levels 8s and 9s, inc. Maths, English and Science) → A-Levels (A*A*A*-AAA) → medical school → 2-year foundation programme → 7-8 years of speciality training

Salary: Band 8d – Band 9 (£84,559-£114,003)



Clinical Perfusion Scientist

I am a clinical perfusion scientist and I control the machinery that circulates the patient's blood during surgery and the machine that controls their respiration.

To do this job, you need: GCSEs (check the university's website) → 3 A-levels (check the university's website) → 3-year undergraduate degree (2:1 BSc in a science or medicine-related subject) → MSc in Perfusion Science (currently only offered at the University of Bristol!!) → Certificate of Accreditation in Basic Clinical Perfusion Sciences → MSc in Perfusion Science valuable.

Salary: Band 7 (£40,057- £45,839)

OTHER JOBS INVOLVED IN TRANSPLANTS:



Surgical Careers

Other Jobs Involved in Transplants:



Dietitian

I advise patients on their diet after transplant surgery. This is because the risk of coronary artery disease and illness from food poisoning is high after heart transplants.

To do this job, you need: GCSEs (5x levels 9-4, inc. Maths, English and Science) → A-Levels or equivalent (check the university's website) → accredited degree in dietetics (check www.bda.uk.com and www.hcpc-uk.org)

Salary: Band 5+ (£32,306+)



Healthcare Scientist

I work with other healthcare scientists to prevent, diagnose and treat a wide range of medical conditions. Some of us work with patients and some in laboratories.

To do this job, you need: GCSEs (5x levels 9-4, inc. Maths, English and Science) → A-Levels or equivalent (check the university's website) → PTP or STP (check out page 23).

Salary: Varies depending on your specialism (check out NHS careers website).



Transplant Co-ordinator

I guide the patient through the donor process, transplantation and surgery, and coordinate the transplant operation.

To do this job, you need: 2-3 A-levels (university dependent) or A-level equivalent → 5 years as a nurse/ respiratory therapist → training in organ donation

Salary: Band 7 (£40,057- £45,839)

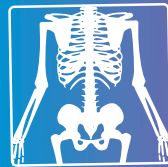


Pharmacist

I use my knowledge of drugs to manage the patient's medications before and after surgery.

To do this job, you need: GCSEs (5x levels 9-4, inc. Maths, English and Science) → A-Levels or equivalent (AAB-BBB, including chemistry and another science / maths) → 5-year accredited MPharm degree (check out www.pharmacyregulation.org)

Salary: Band 6 – Band 9 (£32,306-£108,075)



Radiographer

I use a wide range of imaging equipment to look inside the body and monitor the patient.

To do this job, you need: GCSEs (5x levels 9-4, inc. Maths, English and Science) → A-Levels or equivalent.

You need 5 GCSEs at levels 9-4 (including English, maths and science) → A-levels or equivalent (inc. physics, chemistry or biology) → accredited degree in diagnostic radiography (check out www.hcpc-uk.org)

Salary: Band 5+ (£32,306+)



Physiotherapist

I help the patient regain movement and build strength after surgery. I use movement, ultrasounds and massages to provide treatment.

To do this job, you need: GCSEs (5x levels 9-4, inc. Maths, English and Science) → A-Levels or equivalent (with biology or PE) → 3-year accredited degree in physiotherapy (check out www.hcpc-uk.org)

Salary: Band 5+ (£32,306+)

For more info on any of these careers, check out
www.healthcareers.nhs.uk!

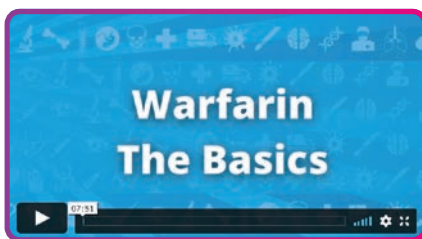
3 Episodes of MMTV You Need to See!

Each week we release a new episode of Medical Mavericks TV. We cover all sorts from medical procedures, diseases, careers info, guides to HE and much more. Sometimes we even dress up!



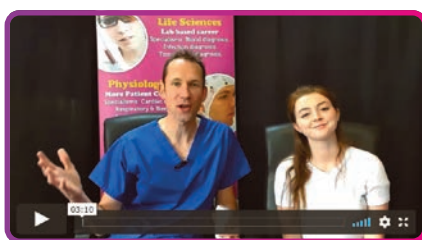
You can watch all our episodes in our student zone. Head over to www.medicalmavericks.co.uk/for-students and click MMTV.

Here are three of our favourite episodes.



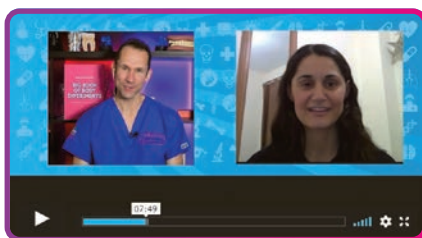
Episode 31 - How Killing Rats Helped Thin Our Blood

This sounds weird I know, but we use a drug for medicinal purposes that was previously used to kill rats! In fact the chemical in this drug was found accidentally when cows started to mysteriously die in America! The drug we are talking about is Warfarin! Watch this 1st episode of 4 on Warfarin, taken from The Medical Mavericks Academy, where Tom explains more.



Episode 32 - A Cracking Good Episode

Do you crack your knuckles? If so, you'll love what we have here for you. We have used our ultrasound machine to scan the knuckle joint in Lizzie's had as she cracks the joint to see what happens! It is very cool indeed!



Episode 33 - An Interview With A Sports Therapist

Have you heard of Sports Therapy? It is a fab career that is VERY different to Physiotherapy. We interviewed Jo, an amazing Sports Therapist that has worked in all sorts of different sports. She tells us she loves nothing more than seeing a limb pointing in the wrong direction!

See these episodes and more on our YouTube channel. Just Search for Medical Mavericks TV



YouTube

Medical
Mavericks TV

Try This at Home



Hole in the hand!

In this experiment you're going to look through your hand! Yep, a great big hole is going to appear in your hand for you to look through!

Step 1



Roll a piece of paper up into a tube and with your left hand hold it up against your left eye. Look through it like a telescope, but keep both eyes open!

Step 2



Next, take your right hand and slowly bring it towards the tube. Place your right hand so the tube sits between your thumb and index finger.

Step 3

Remember to keep both eyes open! It should look like you have a hole in your hand and you are looking straight through it!



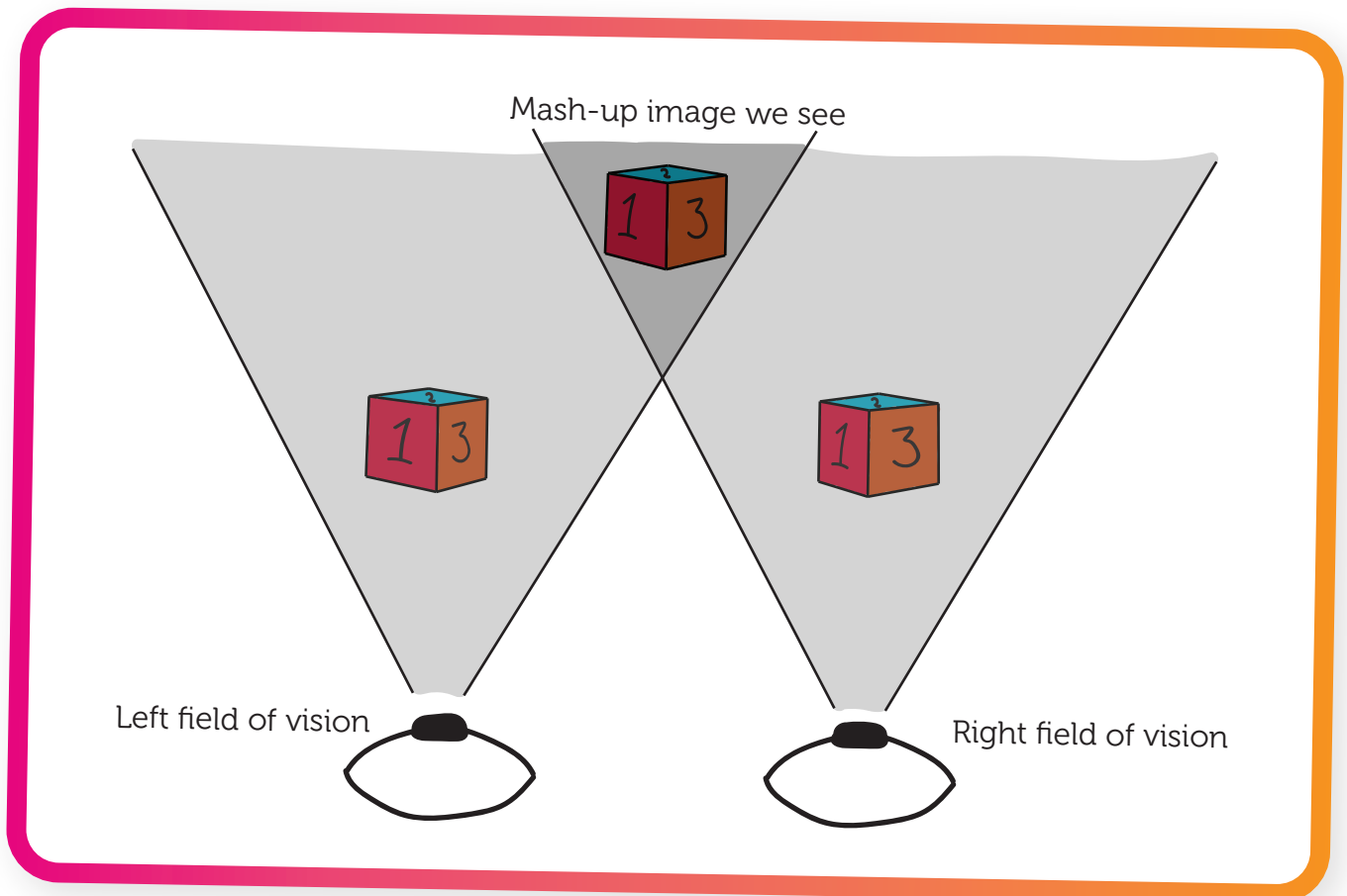
What is Happening in This Experiment?

As we have 2 eyes, your brain gets two sets of information on what we see to compile together in a 'mash up' image.

This mash up image is what we 'see' and it makes it seem as if we have one eye in the middle of our head! We call this the Cyclopean Image.

With the sausage trick, when we focus on something in the distance, your brain can't mash up the part of the image that has your fingers in it.

As a result the brain uses the image of your right finger tip from your left eye and the left finger tip from your right eye to create another mash up in the middle!



Something similar happens with the hole in the hand experiment. All your brain is doing is creating a mash up of what each eye is seeing.

The left eye is seeing down the tube and the right eye is looking at the back of your hand. Combine the two images together and you 'see' a hole in the back of your hand!

Traditional Medicine

An Ancient Medical Treatment Still Used Today... Leeching!!!

Leech therapy in medical terminology is called hirudotherapy. It was introduced by the Egyptians approximately 3000 years ago, but is still used today in modern medicine, even in the NHS. Leeches are worm-like invertebrates belonging to the Annelida phylum that have a habit for blood sucking! In their natural habitat they are commonly found in shallow freshwater such as in rivers with slow currents. Being ill thousands of years ago was perceived by Hippocrates, a Greek physician, as having an imbalance which must be corrected. 'Bloodletting' is a term used to describe withdrawing blood to prevent or cure disease and sometimes the imbalance described by Hippocrates was having 'excess blood'. Leeches were used to perform this bloodletting to remove this excess blood!

How Does a Leech Suck Your Blood?

Leeches have 3 jaws with small rows of teeth that pierce the skin. The saliva that is in their mouth contains molecules called anticoagulants and platelet aggregation inhibitors (very fancy!), these substances prevent our blood from clotting. The important coagulant called hirudin gives leech

therapy the name hirudotherapy! Amazingly, they even try to do this to humans pain free as their saliva kindly contains a local anaesthetic, so we might not even notice it is happening at all! When the leech attaches to your skin, it can extract approximately 15ml which causes them to swell up and fall off when they are full enough!

Why Do We Need Leech Therapy?

Leeches can improve the blood circulation of people with high blood pressure and are very commonly recommended for varicose veins as they release chemicals that can prevent blood clotting. This can help reduce congestion of blood vessels and make sure blood is flowing in a 'laminar' fashion through the body.

Some people are advised to not have leech therapy if they are living with anaemia or blood clotting conditions.

Are They Really That Great Though?

Yes, they definitely are!! They have been used throughout medical history and modern medicine to produce pharmaceutical drugs used to this very day to treat conditions such as varicose veins, haemorrhoids, and



hypertension. A leech's saliva contains anti-inflammatory and anaesthetic properties which help in conditions such as arthritis and osteoarthritis to improve pain and tenderness at inflamed joints.

They are being investigated for their use in heart disease and cancer too! There is growing evidence that leech saliva might help stop metastasising (spreading) cancer and reduce cancer-related pain. In the NHS leeches are also used in the plastic surgery departments. Following reconstructive surgery involving transfers of tissue from one part of the body to another, the reattachment process can be difficult as blood supply to the area may become congested. The leeches can help to drain this congestion and try to maintain that blood flow and improve the healing process.

Continuous Blood Glucose Monitoring

By Hattie Adley



People living with **diabetes** use insulin therapy to maintain their blood glucose levels at a constant level. Some people suffer with **hypoglycaemia unawareness** whereby they are susceptible to episodes of low glucose levels and do not present with the predictable symptoms usually associated with hypoglycaemia.

What Affects Blood Glucose Levels?

- Diet
- Exercise
- Sleep
- Dehydration
- Prescription medications
- infection/illness
- Menstrual cycle
- Caffeine
- Traveling
- Even extreme weather!

So How Does Continuous Blood Glucose Monitoring Work?

Continuous blood glucose monitoring starts with a monitor being inserted under your skin. This monitor is usually placed on an arm, somewhere in the abdomen or on the buttocks! The monitor is inserted using an applicator and only hurts a little bit! The monitor measures the blood glucose levels in your interstitial fluid, the fluid

that bathes cells. This fluid comes from the blood so although the sensor does not insert directly into blood supply, this interstitial fluid is more than accurate enough for people needing to manage a condition such as diabetes.

The sensor itself is extremely intelligent and a little bit complicated! The sensor is a small needle that acts as a glucose-oxidase doped platinum electrode and catalyses glucose oxidation. This results in the production of hydrogen peroxide causing a current which is received by the electrode and calibrated into a glucose measurement.

There are variations of these devices and how often blood glucose levels are measured. Some devices you can scan with your phone, and it will immediately show what the level is, this is called flash monitoring. Others measure every few minutes and wirelessly transmit to a monitor, this is called continuous monitoring.

What is Better: Continuous Monitoring or Flash Monitoring?

This decision completely depends on the person using it! Their lifestyle and preferences. Factors such as cost, availability on the NHS and compatibility with insulin pumps can affect the decision on methods of glucose monitoring.

Why is Continuous Blood Glucose Monitoring a Good Method?

Blood glucose levels constantly vary with daily activities such as eating, exercising, sleeping. People commonly monitor their glucose levels using 'finger prick tests' whereby they draw a small amount of blood from a fingertip and use a test strip to measure the amount of glucose in their blood. This can be painful, especially for younger children, and overtime it can decrease the sensitivity of your nerve endings in your fingers and harden the skin. As everyone is so individual in terms of how their body works, their sensitivity towards certain foods, their susceptibility to illness from common colds, it can often be tricky to prevent an episode of high blood glucose (hyperglycaemia) or low blood glucose (hypoglycaemia). Therefore, continuous measuring decreases the likelihood of such episodes, allows for better management of their condition, and means less finger pricks!

Continuously monitoring blood glucose levels can enable the user to identify trends in the measurements so they can learn more about their condition and how to manage it better. Being able to prevent emergency episodes can lead to fewer complications later in life.

Sports Science

How Wearable Technology Can Tackle Head Injuries in Sport



By Victoria Hayden

What is a Sports-Related Concussion?

The word 'concussion' may be familiar to you, but what does it really mean? Even concussion experts struggle to answer this question and define concussion! This is because the symptoms of a concussion are often very different. Only some players may lose consciousness, be disorientated, have a headache, or feel nauseous, and this may happen immediately, or not for days, weeks or even months. Concussions are referred to as invisible injuries, as unlike broken bones or bruises their symptoms cannot be seen, even on most CT brain scans. This makes diagnosing a concussion even more challenging. What is certain, is:

A sports-related concussion occurs when a force is either directly received or transmitted to the head from any area of the body, affecting the brain.

Concussion is a major health concern for athletes who play contact or collision sports. For example, in rugby union, the most common injury is concussion, and female players are more likely to sustain a concussion than male players! When a concussion is suspected, rugby law requires the player to have a Head Impact Assessment. If a concussion is diagnosed, the player is not allowed to return to the game. However, these assessments are not very accurate, and a concussion can be very difficult to recognise – so players may not get the medical attention they need.

In 80-90% of cases, the symptoms of concussion disappear within ten days. But, after a recent concussion you are more likely to sustain another concussion. It is important that an athlete recovers completely before taking part again, because multiple concussions can cause serious health issues for athletes in the future. CTE is a rare brain disease usually first detected years, or even decades after rugby players have stopped playing!

Athletes, scientists, and medical professionals now realise how important it is that we improve our understanding of concussion using research.

What are Instrumented Mouthguards, how do they Work?

A quick and accurate method of identifying and recording concussion was needed... **The instrumented mouthguard!**

Mouthguards have recently been developed that contain very small sensors. The sensors, called an **accelerometer** and **gyroscope**, are used to record how quickly the head accelerates, and the direction and rotation of the head movement.

When **acceleration** of the head is recorded by the mouthguard, data is transmitted to the sideline via radio frequency, where it can be viewed immediately on a laptop app. The mouthguard also contains a proximity sensor, which means that data is only collected when the mouthguard is fitted to the players teeth - not when they tuck it into their sock!



How can Instrumented Mouthguards make Sport Safer?

The data assists coaches, doctors, and researchers - They can immediately see when a head acceleration has occurred and give head impact assessments and medical treatment. Instrumented mouthguards can be worn in any contact sport, they have already been used in rugby, American football, boxing, and martial arts!

Did you know that the accumulation of multiple small head impacts in a short space of time can be just as dangerous as one large head impact? If the mouthguard has recently recorded several small head accelerations, the coach can adjust the amount of contact in training, reducing the risk of concussion. Coaches are even including training exercises to increase neck muscle, as research has found improving neck strength by one-pound, decreases the risk of concussion by five percent! Instrumented mouthguards can help to investigate this!

Currently the rules of many sports, are the same for males and females. However, in rugby, females sustain their concussions differently to how male players do, they also have different symptoms, brain, and neck structures. So, we must separate men and women's concussion research and treatment. In the future, this may lead to changes to the rules of sports and how we treat concussion, to improve the sports safety and help patients' recovery.

For such a small piece of wearable technology, the instrumented mouthguard has a huge amount of power in keeping players' heads safely in the game!

Each player has a profile on the laptop app, that stores all their head acceleration data recorded by their mouthguard.

You may now be wondering how something worn in a player's mouth can show the forces acting on a player's brain? Well, researchers realised that a mouthguard would be the perfect place to record the acceleration of the head, which may result in a concussion, for two reasons. Firstly, sports scientists had previously used sensors stuck onto an athlete's skin behind their earlobe (called an xPatch) to record the acceleration of the head. These skin-mounted sensors were inaccurate as during movement, the skin

moves more than the movement of the bone beneath the skin. As a mouthguard attaches to an athlete's upper set of teeth, it moves in the same way as their skull! If large enough, a sudden head acceleration can cause the brain to continue to accelerate against the skull, which can cause a concussion. Secondly, most athletes who participate in contact sports already wore regular mouthguards. Despite protecting the teeth, they did not protect the player against concussions. Sensors attached to clothing, or the skin are prohibited as they may cause injury to other players, but by embedding the sensors in a mouthguard, they could be worn during professional games!

Remember, acceleration is the change in an object's velocity in a certain time, in terms of its speed and direction. Picture a car at the start line of a racetrack, when the driver presses the pedal, the car surges forward getting faster and faster, this change in velocity is acceleration.



Diversity in Science

STEM is for Everyone!



Celebrating Diversity in STEM

For each issue of this magazine, Medical Maverick's "Diversity in Science" segment covers 2 professionals that have made outstanding contributions to STEM. We will cover people from different countries, people that are in the LGBTQ+ community, women in STEM and people with disabilities, just to name a few! We want to show you that science and healthcare is for EVERYONE by sharing the amazing achievements of these underrepresented people. If you hear of any professionals that you think deserve a shoutout in our next issue, tweet us at @MedicMavericks!

Name: Dr Mae Carol Jemison

Date of Birth: 17/10/1956

Job: engineer, physician, and former NASA astronaut

Famous for: The brilliant Mae Carol Jemison was the first Black woman to travel into space and held the position of "mission specialist" on Space Shuttle Endeavour. She orbited Earth for nearly 8 days in September 1992. Not only was Mae an astronaut, she has degrees from



Diversity in Science

"It would be nice—and I think it will be nice—to have more and more people of all kinds involved with space exploration."

Dr Mae Carol Jemison



became the Youth Mental Health Ambassador for the UK.

From his experience as a doctor and his own struggles with mental health, he advises the government on mental health topics. To further his work, Alex is on a mission to make mental health education a compulsory part of education in schools. He has also worked with multiple mental health charities across the UK. Across his social media platforms, Alex has become a leading voice in mental health, and he uses his platform to make health and medicine more accessible to young people.

Stanford University in chemical engineering as well as African and African American studies. Additionally, Dr Jemison holds a medical degree from Cornell University. She used this degree and was a practicing doctor before going on to be an astronaut with NASA. To recognise all her amazing achievements, she also holds multiple honorary doctorates.

Alongside being a NASA astronaut, she also founded a technology research company and a non-profit educational foundation! She feels strongly about highlighting the inequalities in American healthcare, science and education and uses her platform to reduce that inequality. Throughout her career she has emphasised promoting the importance of access to education and healthcare, having delivered many talks on these topics over the years.

Fun fact:

Mae C. Jemison features in the "Women of NASA" LEGO set!

Name: Dr Alex George

Date of Birth: 15/02/1991

Job: Doctor and social media personality

Famous for: Dr Alex is famous for his debut on Love Island but has stayed as the focus of media attention due to his mental health advocacy campaigns. He is a qualified doctor from Wales and has experience working in A&E. He is also a fully qualified personal trainer. In 2021, he began a campaign to ensure the government prioritises the mental health of young people. From this work, he officially

"My number one goal is to help bring meaningful change to mental health education at schools across the UK"

Dr Alex George

Medical Miracles

Weird Science

By Chloe Russell



1. Humans have 46 chromosomes, peas have 14, and crayfish have 200

2. The average person walks around the world 5 times in their lifetime



J



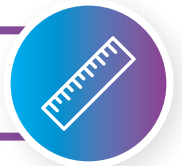
3. The only letter not used as a symbol in the periodic table is "J"

4. Women blink nearly twice as much as men and the average person blinks about 20 times per minute



5. You produce about 40,000 litres of spit in your lifetime, which is about enough to fill 500 bathtubs

6. You shrink about 1cm from when you wake up to when you go to bed because the soft cartilage between your bones gets squished



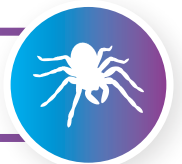
7. Everyone has a different tongue print, in the same way that everyone has different fingerprints

8. Clouds are not as light as they look... big cumulus clouds can weigh nearly half a million kilograms



9. Did you know oxygen is actually pale blue? This happens when it is frozen!

10. In 2013 scientists found that phobias might be genetic, based on your ancestors' experiences



Qualifications: Have you Heard of STP or PTP?

STP vs PTP

What is the difference between the STP and PTP? What even is an STP and PTP? Why do I need to know about these? Well... if you are interested in working in healthcare science then this information is ESSENTIAL for you!

Healthcare science is an amazing part of the NHS with over 50

different careers. Staff in these roles play a vital role in prevention, diagnosis and treatment of a huge number of medical conditions. They also help people live independent lives through rehabilitation. People in these roles are responsible for over 85% of diagnostic tests that are done in the NHS so they are absolutely essential to the service!

There are careers that work directly with patients, work in

labs, help design and maintain equipment in engineering and those that work in new areas of IT such as bioinformatics.

You need 5 GCSEs at levels 9-4 as a start point and most universities accept A-levels, BTECs, Scottish Highers and IBACs. However there are 2 routes in, as set out in the table below. Have a read to help you decide which might be suited to you!

	Practitioner Training Programme (PTP)	Scientist Training Programme (STP)
How long is the course?	3 years	3 years
What are the entry requirements?	GCSE typically levels 9-4 A-level typically B grades BTEC Distinction & Merit grades	Previous degree in related subject results 1st or 2:1
How many places are available?	Places at over 50 Universities	Limited spaces and dependent on regions
What are the specialisms?	Range from life science to physics to physiology to pathology	Very specific and not all are available each year. Depends on demands in specific regions for job roles
Fees or salary?	Uni fee £9k+ a year	You get paid! (This makes applications very competitive) (Fees must be paid for your first degree)
How to apply	With UCAS, but use the NHS course finder first! (See episode 21 of MMTV to see how to use it)	During application window via National School for Healthcare Science website https://nshcs.hee.nhs.uk/
Total time training	3 years	6 years (3 initial degree and 3 STP)
Summary	Most common route, good number of spaces, have to pay fees, broad specialism range	Longer route, very competitive, limited specialisms, but you get paid to train!

Puzzles

Puzzles



Medical Word Search

Can you find the 10 medical themed words below?

H	O	Q	N	V	D	L	O	H	Q	F	A	D	P	C	I	R	P	T	L
D	G	M	I	Z	Q	Y	F	Q	P	T	C	L	L	U	C	T	U	Q	K
I	F	A	T	M	H	A	S	F	Q	G	F	L	Z	Q	P	U	U	B	F
L	Y	Y	R	E	T	R	A	O	G	T	G	A	V	O	J	B	R	Z	N
Q	I	X	Q	J	L	X	D	R	N	E	D	Y	C	I	T	T	D	D	A
Z	K	W	H	L	A	V	E	I	N	O	U	K	P	D	H	Y	F	Z	D
H	K	M	Y	R	E	T	I	N	A	S	G	W	N	Q	D	K	B	A	A
R	E	C	N	R	H	S	V	Q	J	Y	T	R	T	K	F	V	Y	I	T
T	R	O	O	Z	V	K	W	N	N	N	U	M	A	R	L	E	H	L	E
U	A	E	V	N	Y	J	K	T	D	H	A	O	M	P	V	Q	T	E	M
G	T	M	A	D	Z	I	V	U	H	C	K	U	K	M	H	X	N	C	P
Q	I	C	E	H	G	Y	R	Z	X	V	V	U	D	J	I	E	L	M	E
I	N	S	G	D	P	J	I	Q	F	E	Q	R	H	U	U	Z	R	W	R
N	D	L	R	X	E	T	D	F	Q	H	L	Y	N	R	Y	N	N	N	A
R	M	J	A	P	I	O	K	O	V	J	U	C	O	I	P	F	B	O	T
E	V	R	F	F	P	N	Z	L	Y	O	J	N	S	M	W	V	D	R	U
E	Q	V	O	E	W	Q	V	B	O	Y	E	O	G	X	Y	Y	T	A	R
O	V	N	Q	P	U	Z	P	G	O	O	H	Z	C	E	M	T	H	Y	E
G	V	S	N	L	R	L	C	V	W	K	R	E	W	I	G	H	M	E	Z
A	B	W	O	A	I	B	K	M	U	W	B	E	B	L	M	I	O	X	K

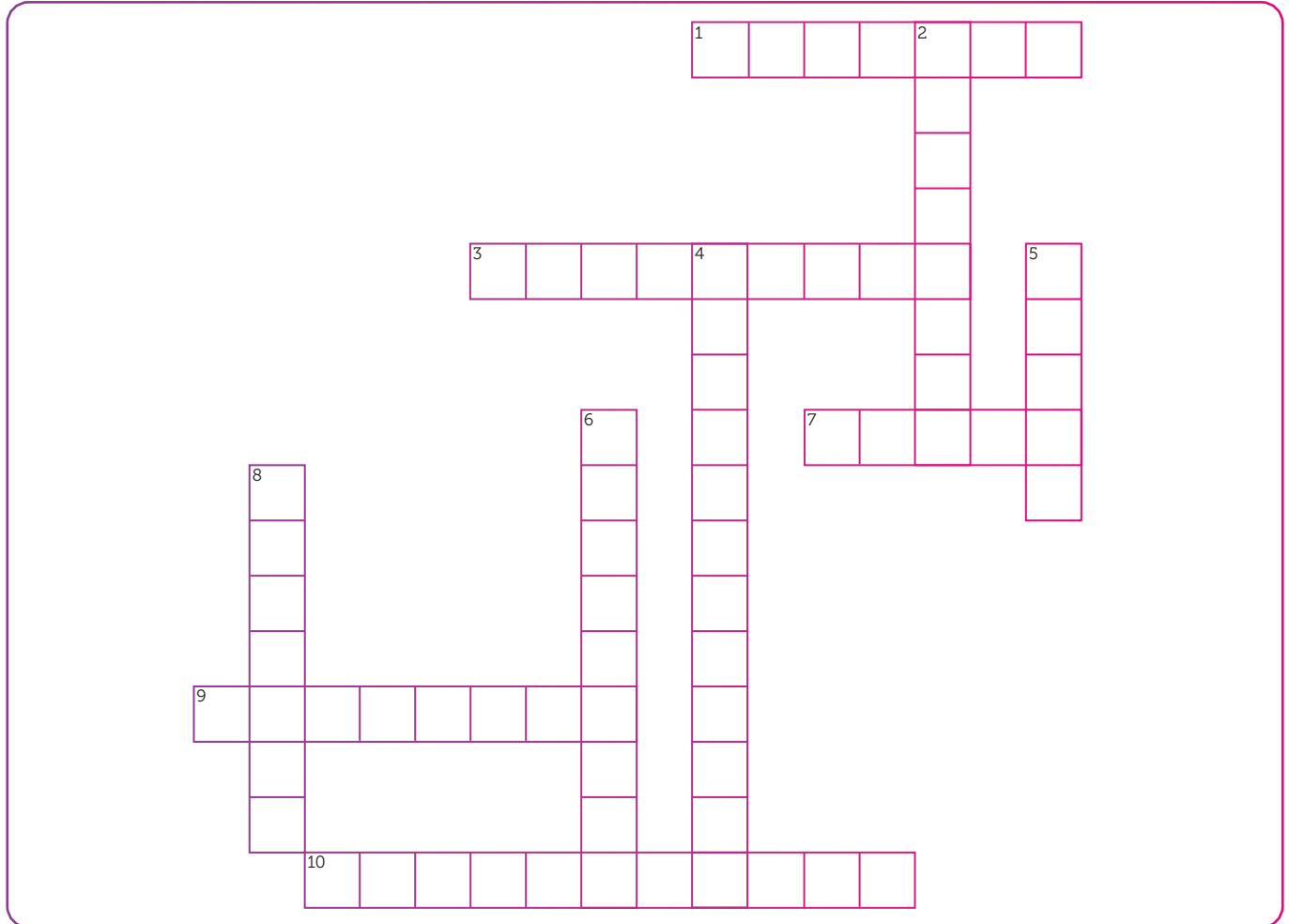
- ARTERY
- NEURONE
- SONOGRAPHER
- XRAY

- HEALTH
- OEDEMA
- TEMPERATURE

- KERATIN
- RETINA
- VEIN

Medical Crossword

What's your medical knowledge like? See if you can figure out the clues to complete the crossword?



Across

1. These tiny air sacs in your lungs move O₂ into your bloodstream and CO₂ out of your bloodstream
3. This person provides advanced emergency medical care for critical patients who access the emergency medical system, often arrive
7. We have 2 of these in the chest and they allow us to breathe
9. The place you go when unwell
10. Rearrange these letters to find the name of this common painkiller (C M A R P O T A L E A)

Down

2. This person is the technician who fits glasses, contact lenses, and other vision-correcting devices
4. The _____ is the powerhouse of the cell
5. This person is trained to care for people who are ill or not able to care for themselves because of injury or old age, and manage
6. This important structural part of the body is a type of connective tissue that is tough and flexible
8. This subject is the scientific study of life



Tom's Brain Teasers

Testing what's already in your brain!

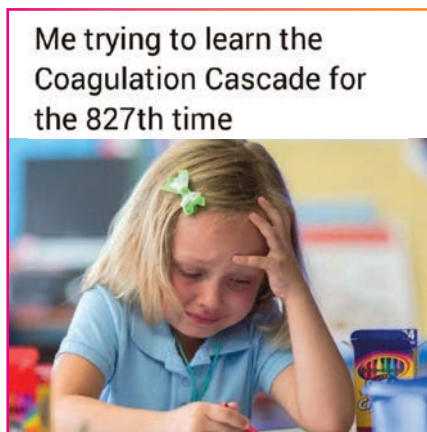
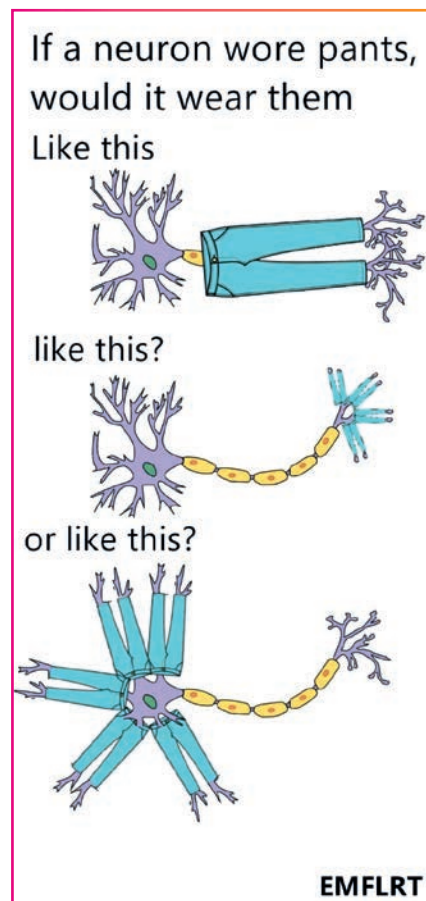
This Month's brainteaser: These letters are tasty, but what meal could you eat with them?

L R I G L

ANSWER ON PAGE 27

Memes

We Memes

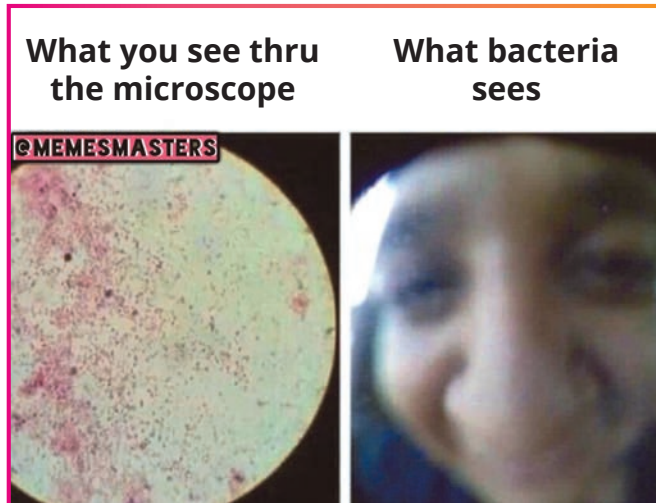
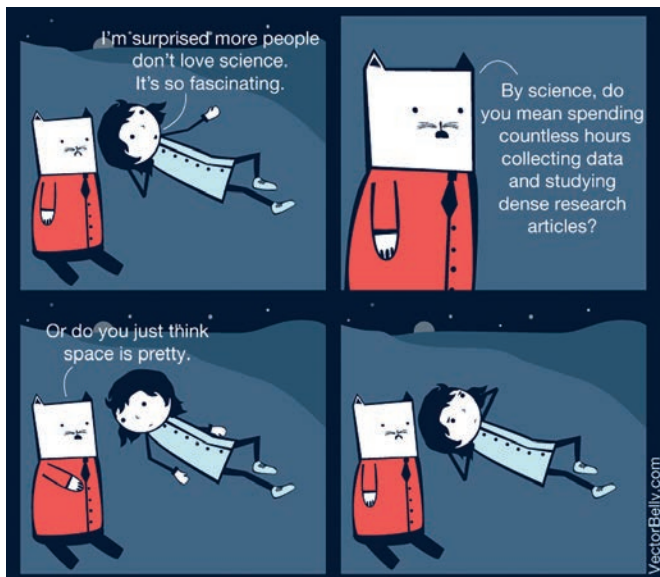


WHAT DO YOU CALL AN ACID WITH AN ATTITUDE?

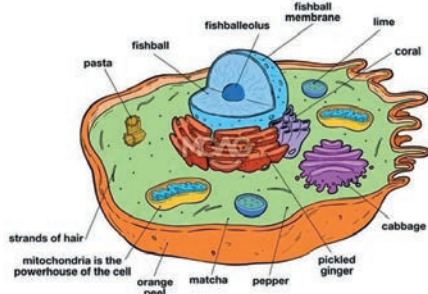
gimme ur lunch



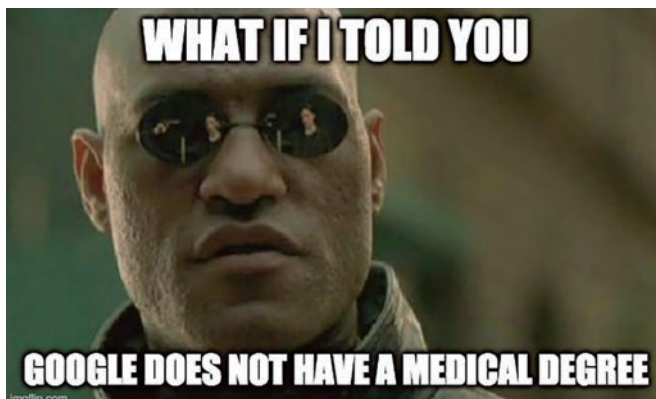
A-mean-oh acid.



What we study in class:



What we see on the exam paper:



Medical Mavericks' Schools

★★ Roll of Honour ★★

Some of the schools we have visited in 2023

Schools visited (Dec-Feb):

Aston University	Macmillan Academy
Audenshaw School	Manshead CE Academy
Audenshaw School	Mark Rutherford School
Basingstoke College of Technology	Matthew Boulton College
Bately Grammar	Mayfield School
Beamont Collegiate Academy	Montsaye Academy
Blacon & Queens Park	New Durham College
Brighton Hill Community School	Northampton Academy
Broadway Academy	Northampton International Academy
Brockington College	Northfield School
Cardinal Newman	Our Lady of Sion School
Cockburn John Charles Academy	Outwood Acklam Academy
Corby Technical School	Padgate Academy
E-Act Royton & Crompton Academy	Paxman Academy
Eastleigh College	Rainham Mark Grammar
Edgbaston High	Rushden Academy
Felsted School	Ruskin Community High School
Francis Holland	Salesian College
Garth Hill College	Sheffield Springs Academy
Gateway Academy	Shireland Collegiate College
Havant & South Downs College	Sir William Stanier
Hill House School	Stowlawn Primary
Hodge Hill College	Telford College
Hope Valley	Tewksbury School
Hugh Baird School	The Henrietta Barnett School
John Spence Community High	The Moreley Academy
Joseph Chamberlain 6th form	The Parker E-Act
Judgemeadow Community College	The Portsmouth Academy
King Alfred's Academy	University of York
King John School	Walsall Academy
Kingsthorpe College	Whitcliffe Mount School
	Whitley Bay High
	Wigan & Leigh College
	Wolverhampton Girls School



If you want to inspire your students with one of our workshops, head to [medicalmavericks.co.uk](https://www.medicalmavericks.co.uk) and click teachers to find out more.

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