The Official Magazine of Medical Mavericks. Putting the **Inspiration In** to get the **Aspirations Out**

Medical Mavericks World

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

Autumn 2021

#BeMoreMaverick

A-Z of Medical Careers

Meet a Healthcare Assistant!

Try this at Home!

Make your arms sink into the floor!

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Explore how the virus and vaccines work!

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Your Medical Mavericks World Creators

Tom Warrender
Tom is the founder & Head Honcho of Inspiration at Medical Mavericks. His specialism is Physiology & Toxicology.

Chloe Russell
Chloe delivers our workshops in schools, has a degree in Biomedical Science and is converting to a Masters in Forensic Psychology.

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

Jargon & Lingo of University

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 Baccleureate) 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 YAYYYY!!!!

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

Administration

Administration roles in the NHS are essential to keep everything running as smoothly as possible. Without them, healthcare staff wouldn't be able to find the information they need to about their patients. This sector of the NHS includes clerks, health records staff, receptionists, secretaries, and switchboard operators. For this job, there is the opportunity to work shifts or a typical 9 to 5 pattern. Salaries can range from £19,000 to £40,000 at management level.

For any roles like this, you need a good level of literacy and numeracy, meaning you need GCSEs in English and Maths. Alongside this, IT skills and qualifications are important because most NHS systems are online. Throughout your NHS administration career, there is the opportunity to do further qualifications, in order to progress in the role.

To work in administration, you also need good time management and organisation skills to keep all those patient records in order! Additionally, you will need excellent communication skills, because the role involves talking to lots of people over emails, the phone and face-to-face.

In this role, there is the opportunity to work in offices with other admin staff. This is great if you think you'd like an office environment. For this type of admin, have a look at switchboard operators. However, if you like a hospital environment, being a receptionist or secretary might be perfect. Administration is not a patient-facing role but helps keep the NHS running, so if you think this might be for you, check out the NHS careers website.

Allergist

Allergists are doctors that specialise in treating individuals that have abnormal responses to certain substances. They help everyone that suffers from allergies and their symptoms. This includes helping people with anaphylactic shock, respiratory allergy, skin allergy, food allergy, drug allergy and allergy to latex rubber and venom. These specialists deal with conditions that range from mild to life-threatening.

For a role like this, you will need to become a qualified doctor that goes on to specialise. This means achieving top grades at GCSE and A level to get into medical school. Once you have completed your medical degree, you would be able to go on to specialise in allergy medicine. You would be able to earn over £65,000 when you have reached the top of this field.

You would need to have great communication skills and be approachable to patients. As well as this, you will need to have a good understanding of medical procedures and good time management to make sure all your patients receive the treatments that they need. In this job you will work with things like injections, x-rays and lung function tests.

Typical procedures include skin prick & patch tests to identify allergens along with desensitisation treatments and administering corticosteroids to reduce reactions.

Audio vestibular medicine

Doctors in audio vestibular medicine diagnose and manage hearing problems in children and adults. They also help with balance and communication disorders because these are also linked to issues with the ears. In this job, doctors interpret findings from diagnostic audio vestibular tests and aim to find the underlying causes of a patient's problem. Additionally, they implement treatment and prevention plans to help the patient have a better quality of life.

On a day-today basis, people working in audio vestibular medicine conduct neuro-otological exams, measure auditory functions of the ear and assess someone's suitability for hearing aids. Alongside this, they do investigations to find the cause of the problem, including radiological imaging, and a variety of blood and urine tests,

In this job, the salary can range from £45,000 to £77,500, depending on your level of experience. Your shift pattern would vary, as it does for any qualified doctor. When you are at the top of your field, you would be able to work a typical 9-5. However, you may also have to work various night and weekend shifts, depending on the speciality you worked in within this field and your years of experience.

Without someone doing this job in the NHS, disorders such as tinnitus (ringing of the ears) would not be treated effectively. There are lots of disorders that relate to the ear, from infections to neurological degeneration. Because of how broad this field is, you would work within a multidisciplinary team, meaning communication and teamwork are key skills for this job.

Audiology

Audiologists work alongside doctors that specialise in audio vestibular medicine, as part of the multidisciplinary team. This job is a type of healthcare scientist. They also assess hearing and balance and their associated disorders, in patients of all ages. This means you could work in paediatric or adult wards. You could also go into research, treatment development and teaching. The salary for this role is approximately £40,000 and requires a standard 37.5 hours a week. This can be Monday to Friday or in a shift pattern.

In this sector, you can work in hospitals and out in the community. There is the option to reach consultancy level if you undergo further training. Lots of audiologists operate referral clinics and may be the only point of contact for the patient. This job is extremely hands-on and patient-facing!

Within audiology, you could become: a new-born hearing screener, hearing aid audiologist, healthcare science, practitioner or a clinical scientist. This job involves conducting hearing assessments, using computer systems and lots of hearing aid equipment.

For this job, you must be able to record results accurately and have excellent written communication skills, to explain patient results to the wider healthcare team. You would be working alongside neonatal nurses, GPs and health visitors. If this job did not exist, people with hearing problems would struggle to navigate the world around them and would not have access to the wide range of support that audiologists offer.

Covid-19 Mechanism of Action

The Pathophysiology of Covid-19

How the virus infects our cells and causes the symptoms we experience!

By Tom Warrender

For the past 2 years the world has been through a pretty tough time with the Covid-19 pandemic. As a physiologist, one of the first things I wanted to know was how did the virus work in our body to cause such devastating effects. Luckily, scientists around the world had a really good understanding of its mechanism of action. The scientific term for this is pathophysiology. Let's look at how Covid-19 works inside our body.

To understand its action, we firstly need to look at the virus. Remember a virus is not like a eukaryotic cell. A virus does not replicate and create new viruses like a cell does. There is no mitosis to create a new virus. Instead, a virus uses our own cells to manufacturer new viruses, before being released from that cell to infect more cells which do the same again.

In summary, the whole aim of a virus is to invade a host cell and turn it into a virus making factory.

The Covid 19 virus infected cells with a special type of enzyme on the outside of its cell membrane, specifically called ACE2. ACE stands for Angiotensin Converting Enzyme which is why we referred to it as an enzyme.

This enzyme can be found on the outside of lots of different types of cells but is found quite heavily on the endothelial cells of the lungs. Endothelial cells are the ones that line a surface, for example the inside of the bronchioles (the tubes of the lungs) or the cells that make up the alveoli where gas exchange takes place.

You may have already started to link the symptoms of covid to its infection site... more on that later.

So how does the virus get into a cell with this enzyme on its surface?

The virus surface is covered in something called glycoproteins. A glycoprotein is a mix of a sugar (glyco) and a protein. You may also see them referred to as a spike protein. This is the 'key' to get into the cell. Our body's immune system would recognise a spike protein as an antigen as well.

1. The ACE2 enzyme on the surface of the cell is the 'lock' that the key fits into.

2. When the virus spike protein and the cell's ACE2 enzyme interact, it facilitates the movement of the virus into the cell. It opens the door to let the virus into the cell.

Once inside the cell, this is where the virus starts to cause chaos.

3. To replicate and make more copies of itself, the virus releases its own genetic material called RNA into the cell. RNA is different to DNA, in that RNA is a shorter single strand of genetic material and DNA is much longer and double stranded. (There are lots of other differences – this is just one example).

The viral RNA contains all the 'instructions' to manufacture a new virus. It just needs to be read by something that reads RNA and builds proteins. This structure is called a ribosome and our cells have loads of them.

Covid-19 Mechanism of Action

Normally ribosomes read small strands of RNA that have been produced by our own cell. Our own RNA is a short snippet of genetic material that has been produced by reading a section of our DNA, usually called a gene. Ribosomes reading our RNA typically results in the production of a protein.

4. However, the virus RNA uses the same ribosomes inside the cell to make viral proteins that are put together to make new viruses.

5 & 6 As the process continues, the cell fills up with viruses until the cell ruptures (or dies and then ruptures) and releases the newly made viruses into the local area to infect other cells or be carried to other parts of the body through our circulation and lymphatic system.

If you think about what is happening here, the virus is ultimately destroying a cell. As the infection progresses more and more cells are infected and are killed off.

This has serious consequences for whichever organ these cells were based in for several reasons. Firstly, fewer cells doing their job will impact on organ function. Secondly, cell death also results in an inflammatory response. Our immune system kicks in to deal with damage, initiate repair and fight the virus with antibodies.

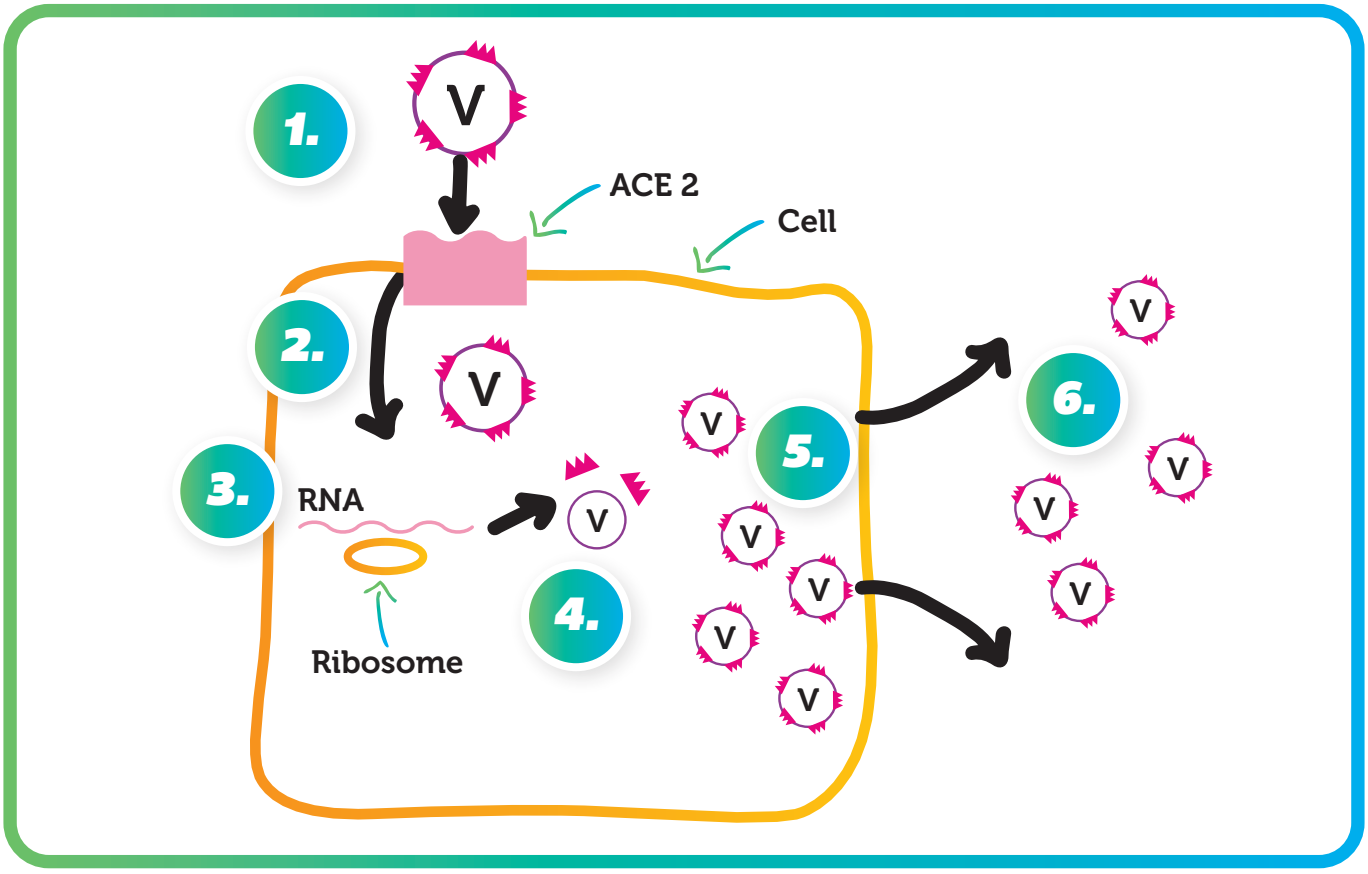
These two responses are what make us feel unwell. Our organs may not work effectively, and our body is flooded with inflammatory chemicals that can also make us feel a bit yuk, even though they are trying to help!

With Covid 19, the damage to the endothelial cells in the lungs results in poor gas exchange in the alveoli, so our oxygen sats drop and the level of carbon dioxide in our blood increases which can also make us more acidic. The inflammatory response can result in swelling and mucus production in the bronchioles, which reduce air flow in and out of the lungs, worsening the low oxygen sats and elevated carbon dioxide levels!

Other symptoms included a loss of taste, which was due to damaged cells in the nasal cavity that also have the ACE2 enzyme on their surface. Your nose is responsible for 85% of your taste, so damaging these cells means that aromas from our food are not detected and your taste sensation is diminished.

Research is still ongoing with regards to many of the other symptoms experienced through Covid-19 infections including memory loss, heart palpitations and long covid.

If you want to find out how the covid vaccine helps us fight this infection, turn over and Chloe will explain all!



COVID-19 Vaccine

Mechanism of the COVID-19 Vaccine

By Chloe Russell

Vaccines helps prepare our bodies to fight foreign pathogens that enter the body, to help prevent infection, reduce symptoms and avoid you getting ill. We want to show our immune system what to look for if the virus ever enters our body, so it knows what do destroy!

There are lots of types of vaccines but the one we are going to focus on today is called an mRNA vaccine.

This type of vaccine is relatively new because scientists are always looking for more effective ways to give people immunity to diseases. These vaccines won't work for all types of viruses but they do work for COVID-19 because it contains RNA.

The COVID-19 vaccine uses genetic information from the virus called mRNA. You'll know from the previous article that this is the instruction part of the virus RNA that is read by the ribosomes in our cells to build viral proteins. It is also known as "messenger RNA".

Whereas the actual virus contains all of the genetic information to make the whole virus, the vaccine only has part of the virus mRNA needed to a single part of the virus, specifically "spike proteins". Think of the mRNA as our viral blueprint and we are using a small part of the blueprint that shows us how to make spike proteins.

Spike proteins are found on the surface of the virus and are the "key" to enter our bodies' cells. However, we can also use them to tell our immune system what to look for if the virus ever ends up inside our body in the future.

Remember, mRNA has been modified in a lab by scientists so there is enough information to build spike proteins and develop immunity but not enough to replicate the whole virus... making more of the whole virus would just make us ill, which defeats the point!

1. The mRNA instructions for making these spike proteins are added to something called a vector, which helps transport the virus. This harmless vector is enveloped by a lipid (a type of fat in our cell membrane) in the vaccine. Because our cell walls are also made of lipids, this helps the lipid surrounding the mRNA/vector merge with our cell wall and enter our cells by just bumping into them.

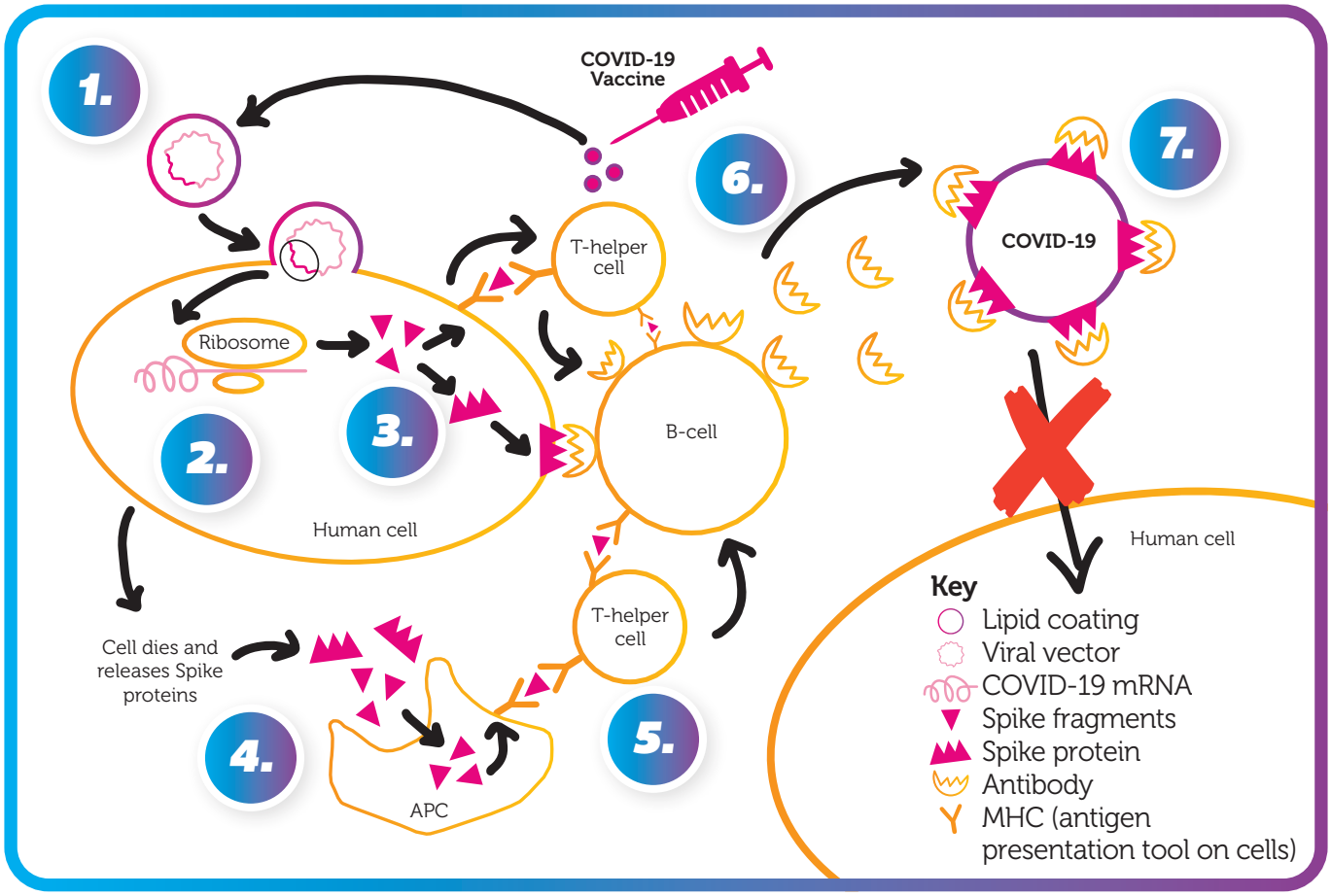
The mRNA is now in the cell... voila! We need this to happen to get those viral protein blueprints into our cells. The harmless viral vector/mRNA combo then enters the cell, with the genetic recipe to make spike proteins.

2. Once the viral mRNA is in the cell, the process of making spike proteins begins. This takes place using the ribosomes in the body's cells. Remember the mRNA in the vaccine doesn't have all the information for making a full virus, just the instructions to make the spike proteins. The ribosome reads the mRNA instructions and creates the protein building blocks to make the spike protein.

3. When the spike proteins have been made by the cell, they are presented on the surface of the cell. Think of it like one of your bodies' cells putting a fancy-dress costume on – it is playing "dress-up" as the virus! These surface proteins can now be recognised by our immune systems' cells.

Remember we are showing the immune system what to look for! There are several ways this happens.

COVID-19 Vaccine



4. Firstly, when this cell dies, the spike proteins end up free floating around our bodies. These can then be engulfed by a special immune cell called an Antigen Presenting Cell (or APC.)

When the spike proteins have been taken in by APCs, they are digested into protein fragments that can then be presented on the surface of these cells. When the proteins are presented on the surface of the cell, we call them an antigens.

APCs pretty much do what they say on the tin... they are cells that present antigens to other cells. Think of them as grabbing the attention of some other cells in our immune system.

5. The cells the APCs present to are the T-helper cells. They raise the alarm that there is something in our body that shouldn't be there. When the T-helper cells have raised the alarm, it interacts with other cells in the immune system to do the dirty work and fight the illness. One of the cells that the T-helper cells interact with is called a B-cell.

6. When B-cells latch onto cells with an antigen spike protein on a its surface or have been activated by a T-Cell, it causes the B-cell to create lots of antibodies that can stick to any antigens / spike proteins on the virus.

7. By sticking to the viral spike proteins, the antibodies block the virus from interacting and entering with the cells they replicate in. If they can't enter a cell, they can't replicate!

If they can't replicate and destroy our cells, the symptoms of the virus are reduced and we don't feel the full effects of the virus!

So how do we destroy the virus?

This job is performed by another T-Cell called a T-Killer Cell.

These killer cells not only have a cool name, they also do a great job of protecting our bodies. When they are activated, they seek out anything with the same antigen or spike proteins on them and destroy them, including the actual coronavirus!

If the virus every enters our body for real, both of these mechanisms result in the virus having a reduced impact because it cannot enter our cells to replicate and it is destroyed sooner.

The antigens stay in the body and our immune system remembers how to fight the virus if it ever enters our body. This reduces the risk of us getting ill or infecting other people!

Medical Miracles

Amazing stories exploring medical wonders and survival against the odds!

Blind man has sight partially restored

A 58-year-old blind man recently has had his sight partially restored! The man was diagnosed with retinitis pigmentosa and lost his sight almost 40 years ago. The treatment involves gene therapy to modulate the neurones involved in sight. As a result, the neurones fire when exposed to certain wavelengths of light. It is also known as optogenetic therapy and this is the first successful case!

After the gene therapy, the patient has to wear a special pair of goggles to be able to see. The goggles capture images from the real world using a camera on the front. These images are then converted into pulses of light on the inside of the goggles, into the patient's eyes! The light being shone into the eyes is at the correct wavelengths that the patient's neurones will respond to. As result the patient can see! Currently this goes as far as seeing shapes and outlines.

Falling 22,000 feet and living to tell the tale

Alan Magee was an American airman during World War II who is said to have survived falling 22,000 feet through the air. When flying, he discovered that his parachute had become damage, leaving it ripped and useless. His plane was attacked, causing it to spiral out of the air. Due to the impact, he was knocked unconscious and the force threw him clear of the plan debris. After this, he fell 4 miles through the air (!!!) and smashed through the glass roof of a railway station. When he woke up he had several broken bones, severe damage to his face and internal organs, and nearly lost his right arm but... he was still alive! There is no explanation for this (supposedly true) event, other than he is the true definition of the luckiest man alive and a medical miracle!

3 Episodes of MMTV You Need to See!

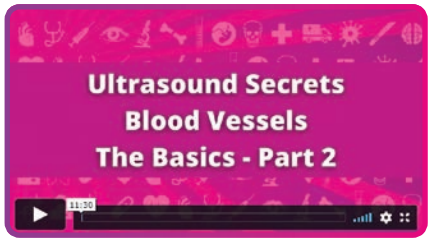
Each week we release a new episode of Medical Mavericks TV. We cover all sorts from medical procedures, diseases, careers info, guides to HE and much more. Some times we even dress up!

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.

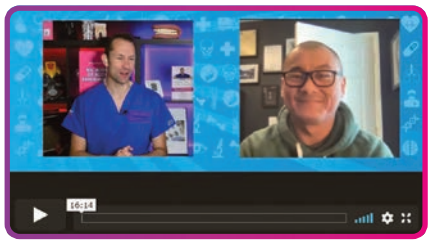
Episode 26 - Bone Growth Plates - See where your bones grow from!

Using our ultrasound machine, we take a look at Beatrice's growth plates in her radius, ulna and tibia! You can actually see where your bones are growing from!



Episode 29 - What do arteries and veins sound like?

Using a pulse doppler, Tom shows you what the blood flowing through a vein and artery in his arm sounds like! Some say it sounds like a dog barking, others say the wind! Make sure you check out this video to make your own mind up.



Episode 30 - Say hi to a real Paramedic

In this episode Tom chats to Simon who is a Paramedic and explores the different routes into this amazing career. Simon also tells us about some of the other skills you'll need aside from your school qualifications!

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

YouTube Medical Mavericks TV

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 Ben Barres
Date of Birth: 13/09/1954
Date of Death: 27/12/2017
(sadly died of pancreatic cancer at age 63)
Job: Neuroscientist

Famous for: Ben Barres was known for being a pioneering scientist in the field of

"I lived life on my terms: I wanted to switch genders, and I did. I wanted to be a scientist, and I was. I wanted to study glia, and I did that too. I stood up for what I believed in and I like to think I made an impact, or at least opened the door for the impact to occur. I have zero regrets and I'm ready to die. I've truly had a great life."

Dr Ben Barres

neurobiology. He specialised in looking at glial cells, which are cells that support the proper functioning of the central nervous system. He also pioneered many techniques for investigating neurones more effectively and discovered new signals that glial cells emit.

As well as his amazing achievements in neuroscience, Ben was also openly transgender and wrote a memoir about his experience of this in the world of science ("The Autobiography of a Transgender Scientist"). In this book he is extremely open about the struggles he overcame and how he went on to have an unbelievably successful career. Not only did he make ground-breaking discoveries about the brain, he also became the first ever transgender scientist to be elected to the National Academy of Sciences. Alongside this, he also campaigned for gender equality in science!

Name: Dr Sagar Sengupta
Date of Birth: 23/06/1968
Job: Immunologist, cancer biologist and scientist

Famous for: Sagar is known for his studies on tumour suppressor genes and oncogenes. Because of this work, he has been awarded the National Bioscience Award for Career Development, one of the highest Indian science awards, for his contributions to biosciences.

His most astounding discovery so far centres around early detection of colon cancer. Sagar led the study in his lab, which will help treat people and increase survival from this disease. Through this research, colon cancer can now be detected as early as stage 1 (the earliest stage of cancer). The detection is done via discovering certain molecules that increase in number during colon cancer, called microRNAs. These microRNAs are called DNA damage sensitive microRNAs (or DDSMs, for short), and can be detected in the body to help find colon cancer at an early stage. This increases the chance of successful treatment and, therefore, survival.

"We believe that the identified DDSMs can serve as an invaluable biomarker for colon cancer early detection process. We now have to determine whether the DDSMs can also be detected in patient blood samples. If that is possible, it would make colon cancer detection as simple as the detection of blood sugar in diabetic patients"

Dr Sagar Sengupta

How it works

How it works: Keyhole Surgery edition

What is keyhole surgery?

In this issue's version of "how does it work?", we are going to take a look at keyhole surgery! This is a special type of surgery that is also known as "minimally invasive surgery". It is a surgical technique that lets surgeons access the inside of the body, without cutting the patient wide open. Instead, small incisions are made in the body, near to where the organ being operated on is. This type of surgery means that the need for open surgery (cutting someone wide open) is far less than it used to be.

Keyhole surgery has lots of different names, depending on which part of the body is being operated on. When keyhole surgery is used to access the abdomen for digestive system or female reproductive organs, it is known as a "laparoscopy". It can also be used to operate on the thorax – the fancy name for chest – and in this scenario it is called "video-assisted thoracoscopic surgery". Keyhole surgery on a joint, such as the knee, is called an arthroscopy.

During this surgery, a thin rod called an endoscope, is inserted into the skin through a small incision. The endoscope has a telescopic lens, small camera and a light source attached so the doctor can see what they are doing. They see images from the camera in the endoscope on a screen.

Our student Mavericks trying their hand at being surgeons with our keyhole surgery simulator!

The camera allows doctors to diagnose conditions by seeing inside the body, without causing the amount of discomfort to a patient that open surgery would. Surgical instruments can also be inserted through other incisions, allowing surgeons to operate. Keyhole surgery can be used to remove damaged or diseased organs, such as the appendix.

This type of surgery is really useful for the patients because they can recover more quickly than they would with traditional surgery... sometimes they are up walking the next day! Alongside this, the patient experiences less pain, scarring, and less risk of blood loss.

When is keyhole surgery needed?

The wonders of keyhole surgery can be used in a range of medical scenario, with its uses falling into the category of diagnosis or treatment. Whilst lots of departments in the NHS use keyhole surgery, it is mainly used in gastroenterology (digestive system), gynaecology (female reproductive system) and urology (urinary system).

When keyhole is used for diagnosis, it is often as a last resort. This is because whilst it is known as "minimally invasive", it does still involve inserting something into the patient's body. It is used or diagnosis when things like ultrasounds and CT scans don't give clear results about the condition a patient is experiencing. It can be used to diagnose things such as: appendicitis, ectopic pregnancy, endometriosis, female infertility, fibroids, inflammation of the gallbladder, gallstones, ovarian cysts, pelvic inflammatory disease and unexplained abdominal or pelvic pain... lots of things, right?!

It can also be used in a procedure called a "biopsy". This is a technique that is used to retrieve a tissue sample from inside the body. Once the tissue sample has been taken, it is sent to the lab for analysis. This can help diagnose lumps in the body and help the medical professional know whether the growth is cancerous or not.

Finally, keyhole surgery can be used for treatment. It is most commonly used for:

- Removing fibroids (non-cancerous tumours that can develop in the womb)
- Remove or partially remove organs affected by cancer
- Remove sections of the intestine
- Remove the appendix
- Remove the gallbladder
- Remove the womb, for example in cases of pelvic inflammatory disease or endometriosis
- Treat ectopic pregnancies
- Treat hernias (when an organ protrudes through a weak spot in the abdominal wall)
- Treat problematic stomach ulcers

How is keyhole surgery performed?

Keyhole surgery is usually performed under general anaesthesia. This means that the person undergoing surgery is put to sleep and woken up once the procedure is complete. When the patient is asleep, their skin will be cleaned and the small incisions are made in the skin. If the procedure is being performed for diagnostics, usually only one incision is needed but if it is for treatment the more holes may be needed for more tools. However, there is a form of modern keyhole surgery called a "single-port laparoscopy", which allows doctors to perform treatment operations using a single incision.

Abdominal laparoscopy

When operating on the tummy, a gas, usually carbon dioxide or nitrous oxide, is inserted through one of the incisions. This inflates the abdomen and allows the surgeon to see more clearly. By lifting the skin and muscles away from the organs. The laparoscope is inserted through an incision so doctors can use the attached camera to see images from inside the cavity.

Video-Assisted Thoracoscopic Surgery

This type of surgery uses one or more small incisions. It is usually used to remove lumps and bumps that have been found from X-rays or CT scans. A thoracoscope is inserted into the small incisions, with the camera attached so the surgeon can see what they are doing. This procedure can be used to do things like take lung biopsies and perform heart surgery. Once the operation is finished, the instruments are removed, and the incision/incisions are closed. Usually, a patient will have chest drains inserted to allow excess fluid and air to leave the body.

Arthroscopy

This type of keyhole can be done on joints, such as the knees. Whilst the other types of keyhole surgeries are done under general anaesthetic, this one can be used under local anaesthetic, depending on the procedure. A small cut is made in the skin next to the joint so that an arthroscope can be inserted. Additional cuts can be made for more surgical tools, the same as other procedures. Sometimes, a special fluid is inserted into the joint to expand the skin and make it easier for the surgeon to see the joint. The surgeon can then examine the joint and remove damaged tissue such as meniscus or cartilage.

Modern advances in keyhole surgery

Keyhole surgery is now so advanced that we are beginning to see it performed remotely! The surgeon Mehran Anvari operates on patients that are 400km away. He does this by controlling a robot in a different part of the country to operate on his patient. This means that patients can receive high standards of care without having to travel when they are unwell. Hopefully, one day, surgeons will be able to operate on people all over the world, meaning people that would otherwise die can receive life-saving treatments!

How to become a surgeon

1. Medical school (5-6 years)
2. Foundation training (2 years)
3. Core surgical training (2 years)
4. Speciality training (6 years)
5. Specialised training

Try this at home

Do Try This At Home! Floaty Arms!

Step 1

Ask your friend to lie on the floor face down with their arms outstretched above their head, so they look like one big long sausage. Ask them to relax and close their eyes.

Step 2

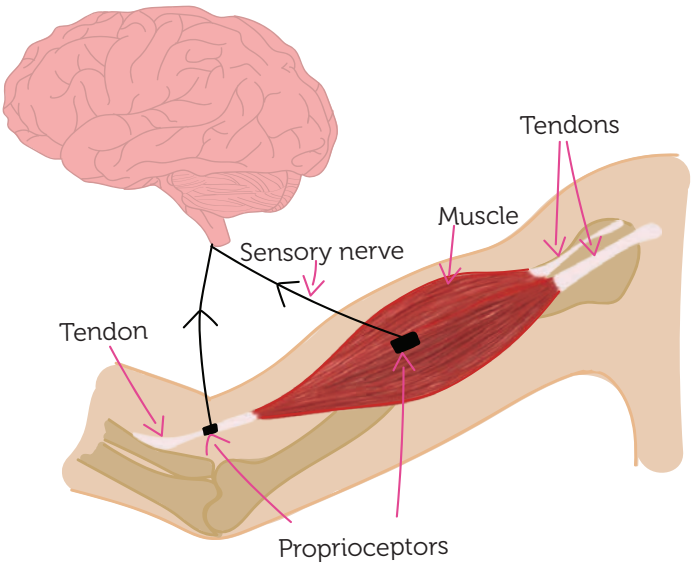
Stand by their hands and gently lift their hands off the ground, pulling their arms up as well. Their elbows should be above their head if possible, but don't lift too far if your friend is uncomfortable. Hold their arms up for about 1 minute.

Step 3

After 1 minute, **slowly** lower their hands down toward the floor in a controlled manner.

Your friend might freak out a little as they will feel like their hands are going through the floor!

What is happening in this experiment?



In the tendons that attach muscles to bones around joints, there are special sensors called Proprioceptors. These detect the movement of your joints so your brain has an awareness of where all your limbs are at any point. This allows you to do things like touch your nose with your eyes closed.

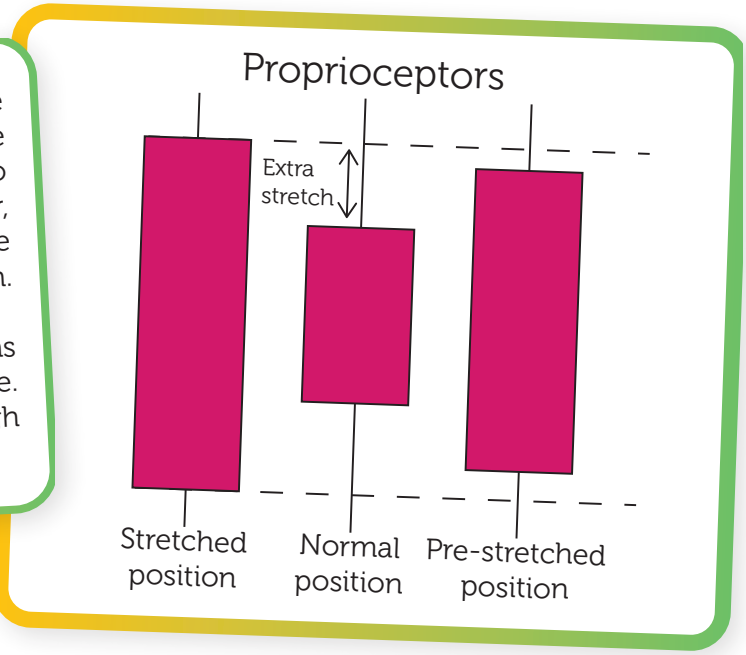
Your brain uses your other senses such as sight to help build a picture of what is going on and where your body is.

However, in this experiment when you close your eyes your brain now only has the information from the proprioceptors in the tendons around your shoulder to rely on for your arm position.

By holding the arms up for 1 minute you are stretching these tendons and sensors ever so slightly beyond their normal length.

So as you move the arms back down to the start position over the exact same distance as you lifted them, the sensors are also returning to their normal length. However, as they have been stretched they have 'further to go' to reach their normal length.

Your brain interprets this as your arms actually moving further than they have. You sense this as them falling through the floor!



Day in the Life

Day in the Life of a Healthcare Assistant

By Hattie Adley

A Healthcare Assistant or HCA are fundimental to the wellbeing of all patients admitted into hospital. All wards require this member of the multidisciplinary team; however, different wards require healthcare assistants to perform different roles.

As someone new to the role, I was eager to try out all of the different wards that I could at the East Kent University Hospitals NHS Foundation Trust. I tried maternity, A&E, ITU, ambulatory care, surgical wards and general medical wards.

As a hospital predominantly specialising in neurology, I found myself working on a neurological rehabilitation ward at Kent and Canterbury Hospital for most of my time. I would start work in the mornings at 7:30am and receive a handover from the staff working the previous shift, this would tell the new team of staff important information including whether anyone has

had an accident such as a fall, whether there were any patients whose vital observations were looking slightly worrying or if any new admissions were received. After handover, we would look at the patient's timetables to see who had their therapy appointments first, these included physiotherapy, speech and language and occupational therapy alongside specialised appointments and scans. After making a note of these, we would prioritise the patients receiving therapy first and help them get washed and dressed ready for the day.

Approaching patients can be nerve-wracking at the start but you have to remember that they are feeling much more vulnerable and scared than you! Most weekdays we begin providing personal care by helping patients with a bed wash. This involves filling up a bowl of warm soapy water and giving them a good scrub so that they feel nice and clean. The more rehabilitated the patient, the more we try to encourage them to wash themselves, this means that when the return home they are well-prepared to care for themselves. Once patients have had a wash and brushed their teeth, we like to help them out of their beds and into wheelchairs or bedside chairs, sometimes this can be difficult when patients are less mobile, so we use a piece of medical equipment called a hoist. A hoist is essentially a mini crane and allows us to move a patient without hurting them and ourselves!

Once patients are up and awake, the buzzers start going off! All patients have a call bell that we refer to as a buzzer, this means if a patient needs our help they can press for assistance

or another button in case of an emergency. Most patients buzz us to ask for help to go to the toilet or if they cannot reach something. Sometimes patient ring their buzzer because they are feeling lonely and want someone to talk to, in which case it is our pleasure if we have time to sit down and chat to them. Sometimes we also have to help feed patients at mealtimes. In-between answering buzzers, HCAs have to fill out various items of paperwork to show that they have provided care for them and that we are not neglecting any patients.

A more clinical aspect to our role as HCAs is to record their vital observations. This includes their heart rate, oxygen saturation, blood pressure, temperature, their alertness and whether or not they have been to the toilet or not! Recording these observations allows us to give them a score, the higher the score, the worse they are and the more often we have to perform these recordings. For many patients in hospital, they have type II diabetes, this means that we have to test their blood glucose levels by pricking their finger at certain times within the day.

Being a healthcare assistant is hard work, you definitely get sweaty, and you must get stuck in! Sometimes we have to carry out tasks that make you feel slightly queasy such as taking blood or emptying a stoma bag. Other times we have to be emotionally strong and prepare someone for the mortuary who has just passed away. However, working with these patients is also incredibly rewarding, knowing that you have played an important role in a patient's time in hospital makes me happy!

Written by Hattie Adley.

STEM in Sport - How Cycling Uses STEM

Science & Engineering of Cycling

ITS ALL ABOUT THE DRAG!

1. What is drag?

Drag is a force that acts on an object in the opposite direction to which the object is moving.

2.

Athletes need drag to be as small as possible because it slows them down!

3.

Drag is created when the air pressure in front of the moving object is higher than behind it.

4.

The faster you go, the bigger the pressure difference = more drag

5. What increases drag?

Unfortunately this pressure difference and drag are caused by these factors

- The faster your go = more drag (double speed / Quadrouple drag!) – we want to go fast!!!
- Big objects with a large surface area. EG: Us!
- Uneven shapes that disturb airflow. EG: Us!

6.

However we can do lots of cool science & engineering to reduce drag, just like this!

Here's how science & engineering are used to reduce drag and increase cyclist speed!

Position

Cyclists tuck down to reduce the surface area moving through the air. This reduces drag.

Upright =
Larger Surface Area

Tucked=
Smaller Surface Area

Front View / Head On Shows the surface area hitting the air!

Helmet

Tear drop shape smooths air flow and resistance to reduce drag.

Some helmets have vents at the sides to direct airflow out the back of the helmet which has also been found to reduce drag.

Frame

Oval or tear shaped frames smooth air flow around the frame and reduce drag.

Wheels

Disc wheels with no exposed spokes reduce turbulance and drag. However they are heavier that spoked wheels. Carbon Fibre helps minimise this.

Skin Tight Suits

Skin tight suits help smooth air flow over the cyclist.

Puzzles

Puzzles

Medical Word Search

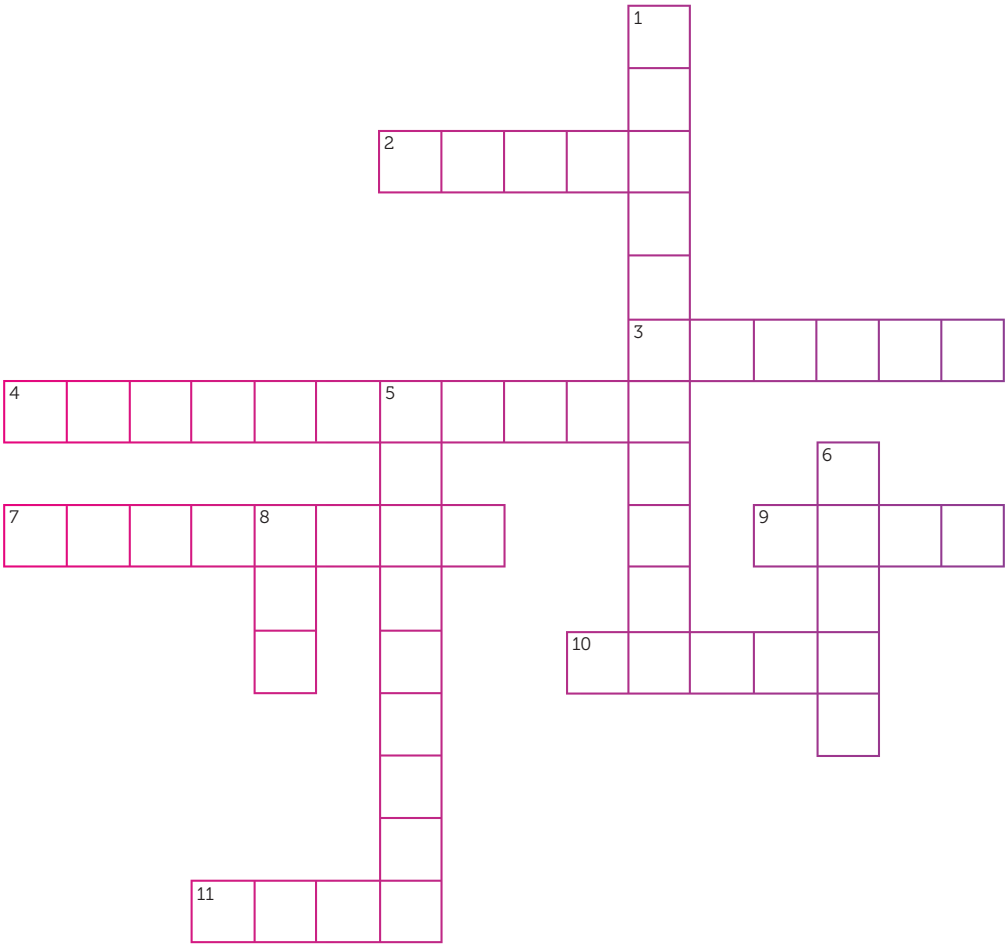
Can you find the 10 medical themed words below?

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

- ☐ ABDOMEN
- ☐ KETONE
- ☐ OPTICIAN
- ☐ ULTRASOUND
- ☐ DIAPHRAGM
- ☐ LARYNX
- ☐ PANCREAS
- ☐ HEADACHE
- ☐ NUTRITION
- ☐ TENDONS

Medical Crossword

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



Across

2. Your _____ is the word for how many times your heart beats in a minute
3. The gas we need to survive
4. Medicine used to treat bacterial infections
7. A condition that affects the way the body is able to turn blood sugar into energy
9. 'You'd lose your ____ if it wasn't screwed on!'
10. The longest bone in the body
11. A feeling you get when you hurt yourself

Down

1. A device used to listen to your lungs, digestive system, and heart
5. Done in theatres but also a the name of a retro game that beeps at you
6. Pumps blood around your body
8. Where is the smallest bone in the body?

Tom's Brain Teasers

Testing what's already in your brain!

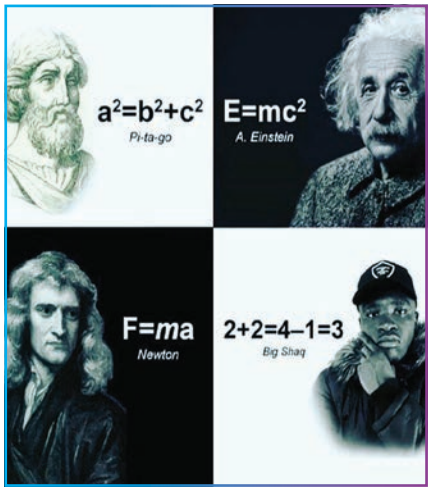
This months brainteaser: Pair these words to give longer words and figure out which word is not used?

BIT STALE PLAY BODY HOB HORSE MATE

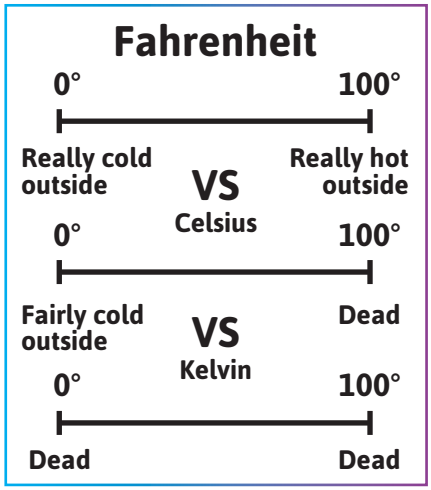
Answer on page 27

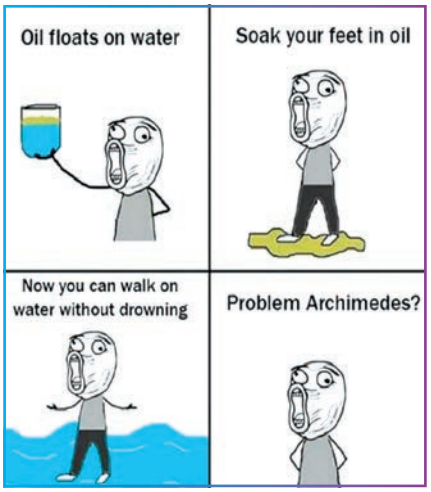
Memes

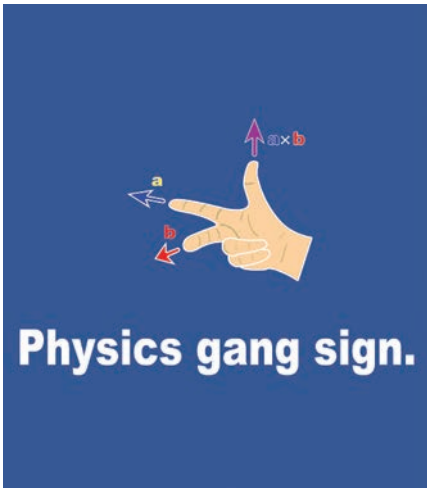
We Memes

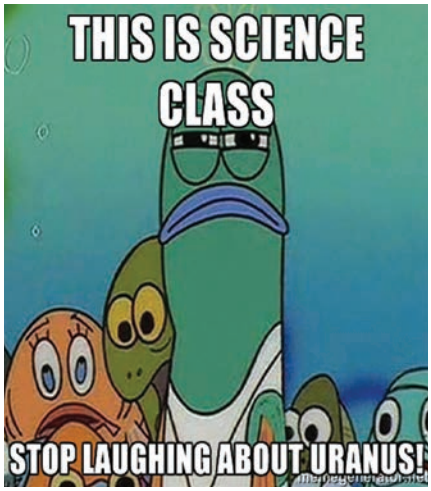


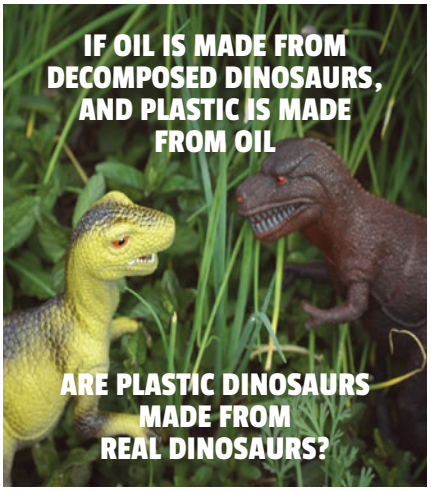
> what kind of fish is made of only two sodium atoms
>
> 2 Na
>
> I actually want to cry

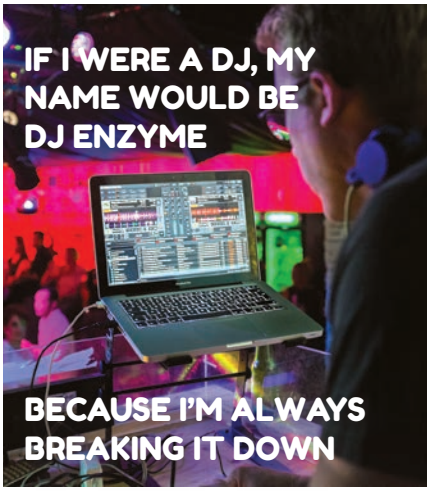


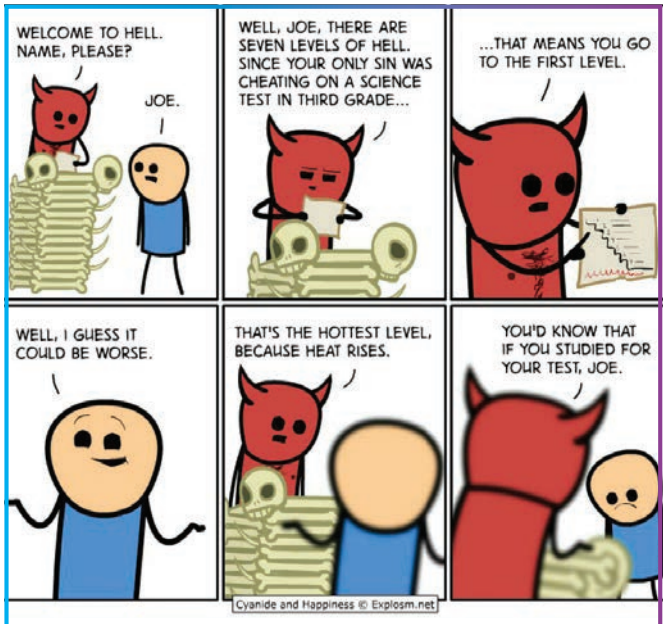




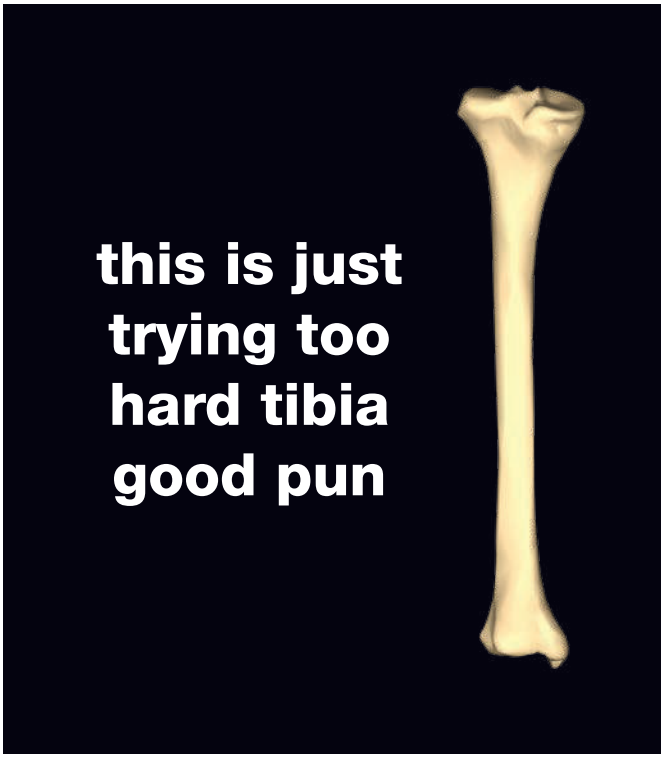


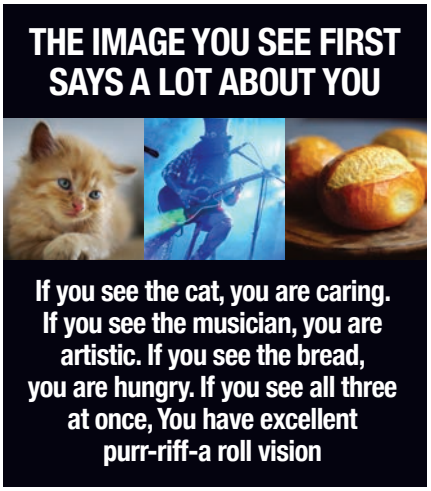


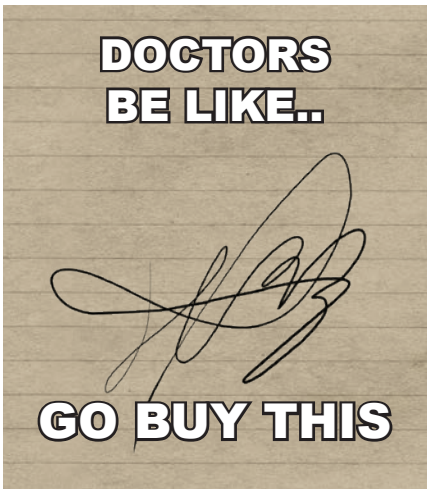


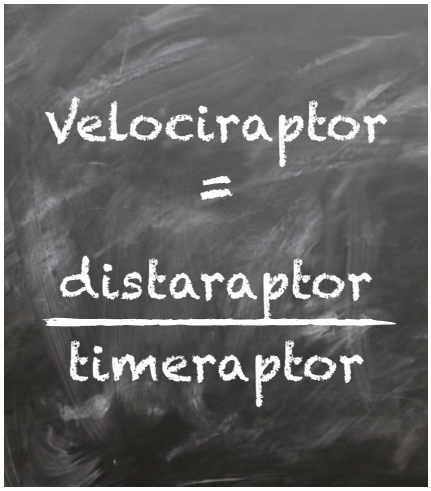


Why studying is important









Tom's Brain Teasers Answer: BODY

Medical Mavericks' Schools ★★ Roll of Honour ★★

Schools we have visited in Sept & Oct 2021

School list:

Anglia Ruskin University
Bishop Auckland College
Bolton St Catherines Academy
Coopers Company And Coburn School
Dr Challoner's Grammar
Erdington Academy
North East Futures UTC
Orchard Community Primary School
St Bede's Inter Church School
St Francis Of Assisi Catholic College
Thistley Hugh Academy
Tyne Coast College
University College Birmingham
Walsall Studio School
Whitley Bay High School
Wolverhampton Royal School
Bradford Grammar Junior School
Coombe Girls' School
Faringdon Community College
Haberdashers' Aske's Girls' School
Hodge Hill College
Jack Hunt School
Madeley Academy
Manor Croft Academy
Merton College
Priory Southsea
Ramridge Primary
Rodillian Academy
St Benedict's Catholic High School
West Bromwich Collegiate Academy
Westminster Primary School

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