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Wed 25th Feb - 16:45 - Kings College London

### Inaugural lectures: Oncology and photodermatology

<https://www.kcl.ac.uk/events/inaugural-lectures-professors-debashis-sarker-hiva-fassihi>

Fri 27th Feb - 19:20 - Royal Institution

### Exoplanet Composition

<https://www.rigb.org/whats-on/discourse-discovering-what-exoplanets-are-made>

Fri 13th March - 14:00 - Imperial

### Fluid Dynamics

<https://www.imperial.ac.uk/events/205192/fluid-dynamics-seminar-matthew-crowe-newcastle/>

Wed 25th Feb - 16:00 - Imperial College

### Number Theory Seminar

<https://www.imperial.ac.uk/events/205134/number-theory-seminar-alex-bartel/>

Fri 27th Feb - 12:00 - Imperial

### Particle Cosmology

<https://www.imperial.ac.uk/events/203574/particle-cosmology-seminar-35/>

Wed 4th March - 18:30 - The Royal Society

### Astronomy & Astrophysics as development drivers

<https://royalsociety.org/science-events-and-lectures/2026/03/rising-star-africa-prize-lecture/>

Most event suggestions (and more!!!) can be found on the websites of organisations such as the Royal Society, Institution and a variety of local universities (such as Imperial, UCL and KCL)

### Note from the Founder

I deeply apologise for the lateness of this edition with regards to these events, as some of these will be inaccessible as the date has passed. I will strive to publish newsletters at a faster pace to be able to provide the opportunities for the future.



**Daniel Mitchard**

“I work at Cardiff University’s Lightning Laboratory, where we make powerful lightning bolts in the laboratory to explore everything from ensuring commercial aircraft are safe when struck in flight, to whether a tree lives or dies when struck. It’s an exciting job and I really enjoy discovering things on the edge of science that no-one really knows. I also teach university classes of up to 200 students, which can be difficult, but many of them go on to good careers that they also enjoy. I think one of the things which allows you to work in areas you find interesting is to have a good foundation - whether it be an apprenticeship, degree, or even some training. It will open doors that you did not even know existed.”

A full-colour lightning strike between a threaded rod (top) and metal plate (bottom). The colours are from interactions with copper (blue-green) and tungsten (orange) metals.



An exploding piggy-bank struck by lightning in the lab.

Photo credit: Lightning Laboratory, Cardiff University

### Q. What did your career path trajectory look like?

“My career path has been a bit of an unusual one; I actually come from a very poor Welsh coal-mining family and only have 6 GCSEs, having failed the others. I did Physics because I was not deemed 'clever' enough to do medicine, which is what I really wanted to do. I got three A-Levels and did an undergraduate degree at Swansea, and they sent me to CERN, Switzerland, to do my PhD. I then worked in industry for four years before returning to academia and, a few years later, only ended up in lightning research to cover another physicist who had just left. I was only meant to be there for 1 year, and am now still here 10 years later. I would not say I even had an aim in mind, I just pursued things that I thought would be interesting or exciting to learn about. I think it's fine not to know what you want to do, or what decision to make, because you can always change your mind or do something else later on (I went to industry, then left industry).”

# Women in STEM

Written by Harvey

United Nations  
~11th February~

The United Nations' International Day, is a time to reflect on famous female scientists and their contributions despite historical prejudice. From Rosalind Franklin to Marie Curie, their work has defined the trajectory of the sciences in the modern day.

Innovation can only be achieved with new ways of thinking and curiosity, directly related to increased diversity of the scientific community.



This inspiring story explores the importance of women throughout history in the world of science, focusing on the female mathematicians at NASA and how their story has helped to shape the world we live in by changing perspectives on the impact of diversity and collaboration. As a milestone, the more diverse the science community, the greater the progression and innovation.

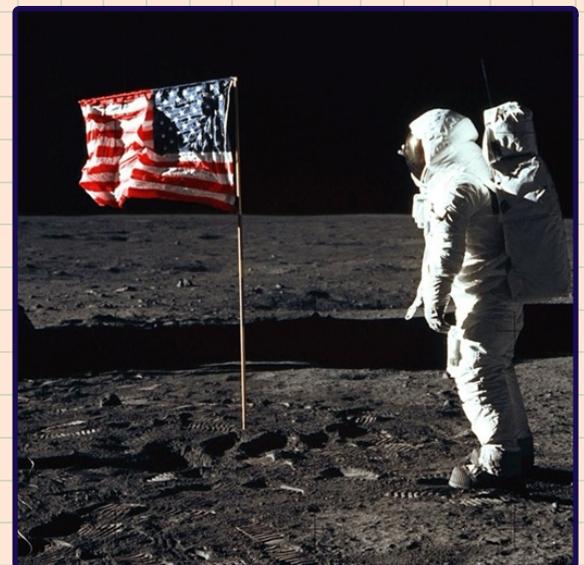


**Katherine Johnson**

As a less well known woman in STEM, Katherine worked at NASA as a lead mathematician (also mentioned in the TED talk above).

As well as being a woman during a time with more traditional viewpoints, Katherine was also African-American, which led to her experiencing racial discrimination alongside gender discrimination.

Working as a team with her fellow mathematicians, she developed a community in which everyone could feel safe to do their work, allowing for a successful planning of the 1969 Moon Landing (see right).



# COP30 summit

## ~Was It Effective?~

Written by Isla Nicholls

COP stands for “Conference of the Parties”, which refers to the almost 200 countries that have signed up to the original agreement of 1992. COP30 was the 30th annual UN climate meeting, running from the 10th to the 21st of November 2025, held in Belém, Brazil.

However, this choice of location caused significant problems.

For example, Belém is located on the edge of the Amazon Rainforest. The choice for this location was seen as controversial as a section of the Amazon rainforest was cleared out to build a road to allow easier access to the city for the summit. This in many ways goes against what the COP agreements stand for in terms of reducing deforestation.

### What was agreed at the COP30 summit?

#### Ecosystems:

Just prior to the COP30 summit, Brazil launched the “Tropical Forests Forever facility” which is a fund that hopes to raise \$125bn from investments and loans. This money would be used to prevent the loss of tropical rainforests by rewarding countries who manage to conserve their forests. In COP26, there was a pledge to stop and reverse the effects of deforestation, which Brazil announced a roadmap for outlining the steps to achieve this. However, this did not make it into the final agreement at the summit.

#### Money and investment:

At COP29 richer countries were committed to giving developing countries at least \$300bn a year by 2035 to assist with their tackle against climate change.

However, this was a lot less than the countries said they needed. The agreement also included the hope to raise this to 1.3tn from both private and public sources.

The COP30 deal demanded a trebling of money to assist the nation’s worst affected to adapt to the impacts of climate change by the same year (2035).

#### Fossil fuel usage:

At COP28 it was agreed, for the first time, that there was a need for the transition away from fossil fuels in energy systems.

This idea was at the time backed by dozens of countries but was very strongly opposed by others, including those reliant on fossil fuels. In the end, the agreement at last year’s summit only mentioned the existing UAE agreement and did not strengthen the point on moving away from fossil fuels.



The “Global Mutirão” (meaning collective efforts) was the central theme for COP30, which focuses on collaborative and voluntary action in implementing and maintaining the climate goals set out by the Paris Agreement (2015). COP30 was also branded as the “COP of implementation”, with the aim being to move from pledges to action in reducing the rate of climate change.

The fact that the finalised deal doesn't contain a direct reference to the fossil fuels that are currently one of the largest causes of climate change is irritating, especially for the more than 80 countries that were hoping this meeting would make a commitment to ending or slowing the use of fossil fuels. However, oil-producing nations believed that they should be allowed to continue to use fossil fuels to allow their economies to continue to grow. As well as this many leaders were absent at this summit, including the presidents of both China and the US. This was also unhelpful in the matter of reducing fossil fuel emissions as China and the US are two of the biggest emitters of greenhouse gases on the planet.

Overall last year's COP summit had mixed results. Although there was development in finance and climate justice, there was a lack of decisive commitment and of action in meeting the goals set at previous summits and in prior agreements.

## Further Reading

If you are interested in learning more about the environment and the goals that have been set to stabilise climate change and craft a better world for future generations, then here are a few ideas:



### An Analysis on Plastics

Since mass production, plastics have changed and morphed into almost everything. Whilst this offers no problem, pollution destroys our natural world, as a contributor to climate change.



### David Attenborough's - The Blue Planet

As always, this series of episodes exploring the natural world that we live in is extraordinary.

Through the beautiful cinematography, The Blue Planet shows us the world that we must protect, one of peace, diversity and vibrancy. This is what humanity is striving to protect and preserve for the future generations, and one of the largest parts of the world is the ocean...

<https://www.bbc.co.uk/iplayer/episode/b0074mhp/the-blue-planet-1-introduction>

<https://www.ted.com/talks/>

# Science Technology Engineering Mathematics

In teaching a STEM subject, one is fascinated about process and structure. The order in which the process is performed is fundamentally important as a change in it will facilitate a completely different outcome. It is true when I say that Mathematics is exceptionally difficult because a solution is dependent on the correct process and if you can't apply such processes in the right order you will not derive the correct outcome whereas an essay, at least, can be improved over time by adding additional content. The structure provides us with a series of ordered routines that have been observed, proven and are accepted maxims.

STEM explains pretty much everything around us whether it is visible or not. We use communication devices, transport, timetables and buildings each day, all arranged to enhance our lifestyles. Our lives are governed by mathematical, physical and chemical observations that appear to work and have been refined over time by notable discoverers. No one knows whether these laws are true but they appear to fit all the criteria that have been presented. We continue to broaden our horizons through advanced engineering and technology making our lives easier and in making all these advances happen, we need to appreciate that we need to continue to advance ourselves as humans for the betterment of our civilisation.

**Mr B.**

(Mr Blyghton)

# TED What to Watch <sup>N</sup>



<https://www.bbc.co.uk/iplayer/episode/m002hgz7/wild-london>

As another beautiful documentary, we are transported to the wild and fantastical city that is London.

From the deer in Richmond Park to the hedgehogs and foxes that roam the streets at night, London's animal diversity becomes apparent under the cloak of darkness. Being able to appreciate the nature in our everyday lives is wondrous, from the peregrine falcons by the Houses of Parliament to the green flocks of parakeets.

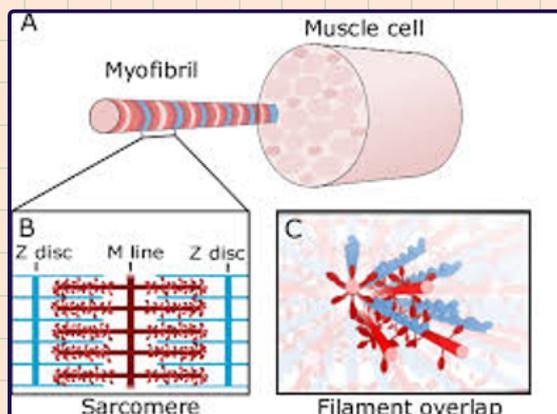
With a genuine interest in nature and a passion to share his wonder with the rest of the world, Sir David Attenborough shows the other side of London for which many of us have never seen.

# An Insight Into Muscle Growth

Written by Harry Lin

## What is Muscle Hypertrophy?

“Muscle Hypertrophy is the enlargement of total muscle mass and cross-sectional area”. Skeletal muscles do not typically grow by mitosis (the development of new cells) but rather the increase in size of existing muscle fibres. Muscle hypertrophy is usually experienced after 6 to 7 weeks of resistance training. During muscle hypertrophy, the rate of muscle contractile protein synthesis is greater than the rate of decay, leading to greater numbers of actin (thin) and myosin (thick) filaments in the myofibrils. Hormones are a crucial part of this process as they stimulate muscle growth by increasing protein synthesis, protein breakdown, or both.



## Mechanical Tension and Cellular Signalling

Mechanical tension refers to the force generated by muscle fibres during active contraction or passive stretch. This force is sensed by muscle fibres and results in a cascade of signalling events. The main pathway for this cascade of events is the mTORC1 pathway which promotes muscle protein synthesis (MPS) in ribosomes – the metabolic process of building new actin and myosin.

Another important driver of hypertrophy is the activation of skeletal muscle satellite cells, which are dormant myogenic cells that act as a reserve population of cells that can multiply give rise to regenerated muscle and more satellite cells.

A common misconception is that microtears are the main driver of growth in muscles. Although it is a contributing factor of growth, it is not the primary mechanism of hypertrophy.

## Major Anabolic Hormones

While mechanical tension initiates muscle growth, hormones determine how strongly the body responds. Hypertrophy depends on the balance between anabolic and catabolic signals.

Testosterone is one of the most influential hormones contributing to muscle building. It enhances MPS and increases the activation of satellite cells. During puberty, rising testosterone levels explain increases in muscle mass, particularly in males.

Growth Hormone promotes muscle hypertrophy by stimulating protein synthesis, tissue repair, and the release of IGF-1, acting synergistically with testosterone. It contributes indirectly to muscle hypertrophy as the release of IGF-1 promotes muscle cell growth and supports the activation of signalling pathways such as mTORC1.

Insulin also plays a crucial role by facilitating the uptake of glucose and amino acids into muscle cells. This creates an anabolic environment that supports recovery and MPS.

## Major Catabolic Hormones

Cortisol is the main catabolic hormone that negatively affects muscle growth. It is triggered by physical and emotional stress, e.g. poor sleep, overtraining, or poor diet. Cortisol increases the breakdown of proteins and mobilises energy stores, which is beneficial in the short-term as the release of energy allows your body to cope with the stress of exercise, but chronically elevated cortisol levels can impair protein synthesis and recovery.

Additional Sources:

<https://pmc.ncbi.nlm.nih.gov/articles/PMC3146557/>

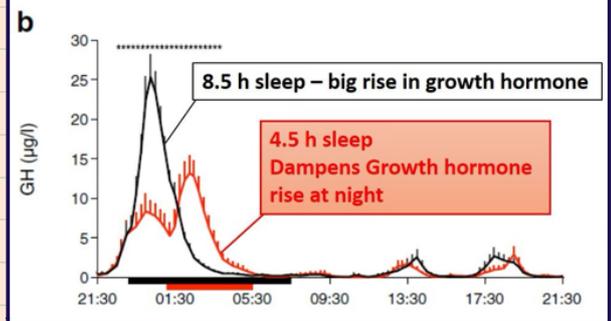
<https://journals.lww.com/nsca-jscr/fulltext/2010/10000/>

[the\\_mechanisms\\_of\\_muscle\\_hypertrophy\\_and\\_their.40.aspx](#)

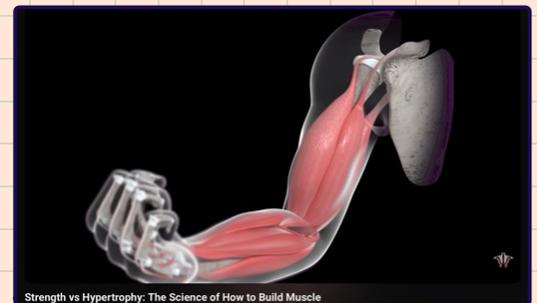
<https://my.clevelandclinic.org/health/articles/23309-human-growth-hormone-hgh>

### Sleep restriction increases free fatty acids in healthy men

Josiane L. Broussard · Florian Chapotot · Varghese Abraham · Andrew Day · Fanny Delebecque · Harry R. Whitmore · Esra Tasali



## Further Reading



Strength vs Hypertrophy: The Science of How to Build Muscle

<https://www.youtube.com/watch?v=sxn5kPQ4GI0&t=616s>

As a more detailed explanation of muscular hypertrophy, this video explores more of the cellular biology that is involved during the process. Although, this also highlights the difference between muscular hypertrophy and strength training.



What makes muscles grow? - Jeffrey Siegel

<https://www.youtube.com/watch?v=2tM1LFFxeKg&t=140s>

As a short animated explanation, this TED video clearly explains the importance of continued physical work to either sustain or grow muscle mass through muscular hypertrophy.

# How The Immune System Protects Us

Written by Kushi Pravinkumar

Every day our bodies come into contact with millions of germs like bacteria, viruses and fungi that can make us sick. We do not get ill every time because our immune system is always working to keep us safe. The immune system is a network of cells, tissues and organs that work together to defend our body against infection and disease (Healthdirect, 2023). It is like the body's defense force on the lookout and ready to respond when bad germs enter.

The immune system works in steps to keep us safe. First it tries to stop germs from getting into the body. Our skin acts as an outer layer while mucus in our nose and airways catch dust and germs before they can travel deeper. Tiny hairs called cilia help move this mucus out stopping germs from settling in our lungs. These early protections reduce the number of germs that get inside giving the system a better chance of keeping us healthy. If germs do manage to get inside the next stage of defense begins.

The immune system detects that something is wrong and sends blood cells to deal with the threat. White blood cells are cells designed to protect us and each one does a different job. Some white blood cells, called phagocytes, surround and eat germs breaking them down so they can no longer cause harm. Others, called lymphocytes recognize germs and produce antibodies (Healthdirect, 2023).

Antibodies are very important because they help the immune system identify and destroy germs. Each type of antibody is made to match a germ like a "lock and key". Once attached to a germ, antibodies can stop it from harming cells or mark it so other immune cells can destroy it easily. This makes the immune response more accurate and effective.

The immune system also uses communication to boost its response. When immune cells detect germs they release chemical signals that alert other cells and attract more white blood cells to the affected area. This is what causes inflammation. You might notice inflammation when a cut becomes red, warm or swollen. Although it might feel uncomfortable this is actually a sign that the immune system is working to remove germs and repair damage.

One of the impressive things about the immune system is its “*memory*”. After the body fights off an infection some lymphocytes stay in the body as memory cells. These cells remember how to fight that germ. If the same germ enters the body again the immune system can respond more quickly and effectively often stopping the illness before symptoms even appear. This long-term protection is what we call immunity.

Several important organs help the immune system do its job. Bone marrow makes blood cells, including blood cells that fight infection. The thymus helps certain immune cells mature so they can work properly. Lymph nodes act as filters that catch substances and germs while the spleen helps detect and remove germs from the blood. Together these organs ensure the immune system runs smoothly and can respond quickly when needed.

Without the system even small infections could become serious or life-threatening. The immune system protects us from illnesses like colds, flu and food poisoning as well as helping the body recover from injuries and infections (Medical Literacy Initiative, 2020).

Overall the immune system defends us by identifying germs destroying them and remembering them to provide protection in the future.

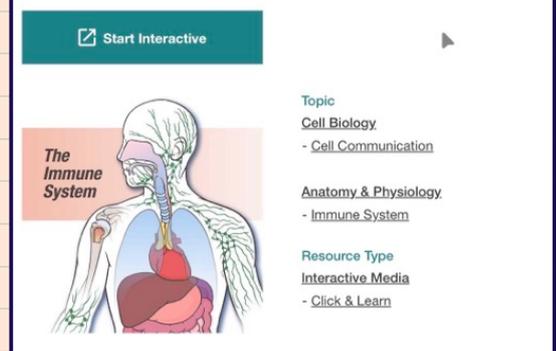
## Further Reading



<https://youtu.be/lXfEK8G8CUI?si=nXl-0davX08gLNfm>

Explained with a beautiful array of illustrations, the team at “Kurzgesagt” clearly summarise the processes involved with the immune system. Explored in more detail in their book: “Immune”, this video is a great starter for anyone interested in Immunology.

## The Immune System



<https://www.biointeractive.org/classroom-resources/immune-system>

This detailed interactive exploration of the immune system, goes through the anatomy and vital organs responsible for the system itself, alongside explanatory videos and concise diagrams.



# What to Read

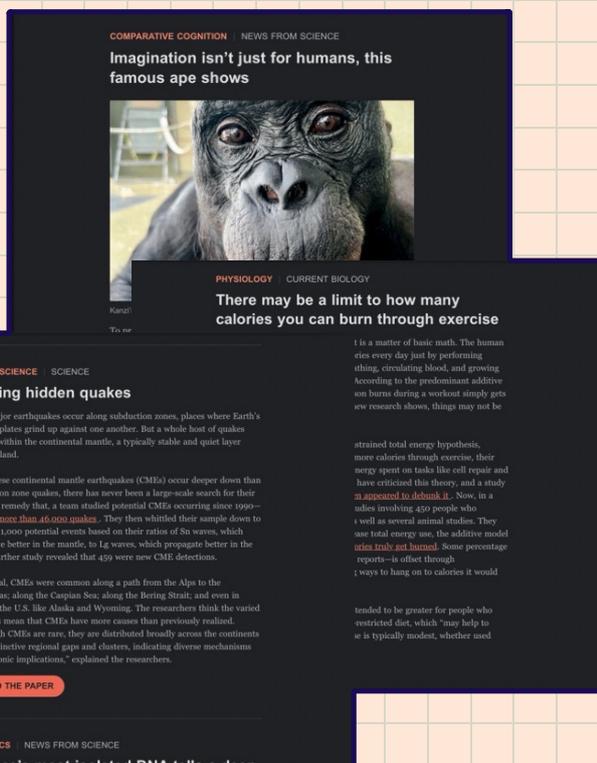


## Science Adviser

<https://www.science.org/content/page/scienceadviser>

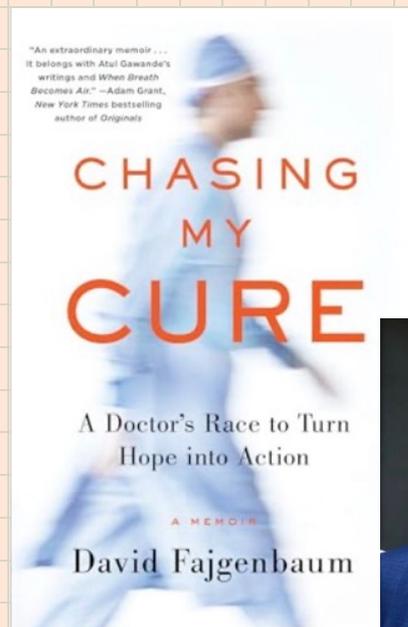
As a section of Science (one of the world's most famous scientific-research publishers), the team works to provide short emails to its group of subscribers about the top stories of the day. From physiology to biology and general affairs that affect the progression of science in our society, the summaries help to quickly digest information about the latest research.

This small daily reading can help to improve scientific literacy and fuel your passion for the sciences.



In his book, “Chasing My Cure”, David reflects on his own journey from health and fitness to a patient of “Castleman’s Disease” to a survivor hoping to inspire and help the medical community. He explains how he was a researcher by conducting experiments on himself, trialling different drugs and analysing the effects that they had on the disease itself. His main ideas evolve around being able to use medicinal drugs and therapies for other diseases or “issues”.

We often see the use of a single drug or procedure for one disease, though these sometimes have beneficial effects when treating other diseases.



<https://www.abebooks.co.uk/>

9781524799632/Chasing-Cure-Doctors-Race-Turn-1524799637/plp

# The Landolt (Iodine Clock) Reaction

Written by Carol Mbusse

Many people are familiar with the striking “clear-to-black” chemical demonstration often used metaphorically in educational or religious settings to illustrate themes such as inevitability, accumulation, or delayed consequence. Whilst metaphors are effective interpretative tools, the chemistry behind the colour change is a rather mechanistic process controlled by kinetics and molecular interactions.

The *Landolt Reaction*, commonly known as the *Iodine Clock Reaction*, was first described in 1886 by Swiss chemist Hans Hinrich Landolt. It was designed to demonstrate differences in rates of reaction and the principle of chemical kinetics. The reaction is notable for its spontaneous and dramatic colour change: two initially colourless solutions are mixed, followed by a measurable delay, and then the solution abruptly turns deep blue-black.

Fascinatingly, the predictability of this delay (only when concentrations are controlled) is what gives the reaction its “clock” designation.

## Experimental Procedure (Vitamin C Variant)

In one commonly performed version, the reaction involves:

- Ascorbic Acid (Vitamin C)
- Providine-iodine solution
- Hydrogen Peroxide (H<sub>2</sub>O<sub>2</sub>)
- Cornstarch
- Water

Step 1: Crush a 500 mL caplet of Vitamin C

Step 2: Dissolve crush Vitamin C in 128 mL warm water

Step 3: Stir in 12 mL of 10% providone-iodine.

Step 4: In a separate container, add 40 mL of boiling water

Step 5: In the boiling water, stir 200mg of cornstarch

Step 6: In the water and cornstarch mixture, add 100 mL of 3% H<sub>2</sub>O<sub>2</sub>

Step 7: Combine both mixtures, mixing well, and watch for reaction

When the two prepared mixtures are combined, no immediate colour change occurs. After a period of ‘apparent inactivity’, the solution rapidly transitions to a dark blue-black colour - a result of competing redox processes occurring simultaneously.

## The Chemical Mechanism

The observed change arises from a sequence of interrelated reactions governed by reaction rates and reagent depletion.

### 1 Oxidation of Iodide to Iodine

Hydrogen peroxide acts as an oxidising agent in acidic conditions. It oxidises iodide ions (I<sup>-</sup>) to diatomic molecular Iodine (I<sub>2</sub>).



This reaction is relatively slow and continuously generates iodine in solution.

### 2 Reduction of Iodine by Ascorbic Acid

Simultaneously, the iodine produced is reduced back to iodide ions by Vitamin C. This reduction is significantly faster than the oxidation step. As long as ascorbic acid remains in excess, any iodine produced is immediately reduced. The solution therefore remains colourless, despite iodine being formed.



This apparent “delay” is therefore the time required for the ascorbic acid to be completely consumed.

### 3 Starch - Iodine Complex Formation

Once the ascorbic acid (specifically S<sub>2</sub>O<sub>3</sub><sup>2-</sup>) is exhausted, iodine begins to accumulate in solution. Free iodine rapidly associates with starch (specifically the amylose component) to form a complex.

The Iodine molecules insert into the helical structure of the amylose chains, producing deep blue-black colour. The colour change is therefore not caused by iodine alone, but also by the formation of a complex between iodine and starch.

### Why the Change Appears Sudden

Although iodine is produced gradually, the solution appears unchanged because the reduction reaction masks its presence by being a very fast reaction. When the reducing agent (S<sub>2</sub>O<sub>3</sub><sup>2-</sup>) is depleted, the reaction system transitions from a state in which iodine is removed as quickly as it is formed to one in which its rate of production exceeds its rate of consumption.

### Further Interest

For those of you interested in the **applications** of this reaction, or would like to look into a different **variation** of this reaction, check out the links below.

<https://www.sciencedirect.com/science/article/abs/pii/S0026265X63900328#:~:text=The%20reaction%20between%20peroxide%20sulphate%20and,masking%20reagent%20such%20as%20fluoride.>

<https://greenchemuoft.wordpress.com/2015/08/17/a-green-iodine-clock-reaction/#:~:text=A%20Green%20Iodine%20Clock%20Reaction%20The%20iodine,which%20leads%20to%20no%20initial%20observable%20change.>

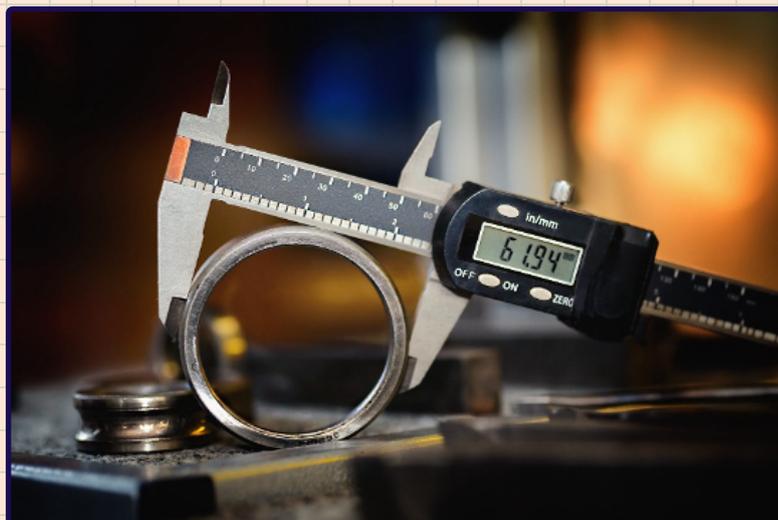
# Metrology

You Mean Meteorology Right?

Written by Jaipreet Dhaliwal

No, I don't. Metrology is defined as the science of measurement and its application, its existence and use ensure measurements are stable, comparable and accurate, giving us confidence in a measurement at a stated level. In a nutshell it establishes reliable units of measurement, but what does that mean?

Let's use an example: a farmer buys a kilogram of vegetables every week and uses a balance to measure so, however the balance is incorrectly calibrated so that the farmer takes home 970g. It doesn't seem like a lot but after 52 weeks the farmer would have lost 1.54 kilograms of vegetables! Errors are inevitable in any measuring system which is why calibrating our equipment is essential, which is where metrology comes in.



Metrology allows us to make comparisons to calibrate all types of machinery and devices to ensure that they are operating at standardized, acceptable levels at an optimal precision and accuracy, ensuring conformity across machinery and correct measurements every time.

## Types of Metrology

Metrology is made up of many different branches, but it can be summarised into three main types:

*Scientific Metrology* – this can be considered the R&D of Metrology, where metrologists develop new units of measurement where necessary and establish frameworks for international use. These are areas where global agreement is needed. This subfield essentially sets up measurement systems and then declares them worldwide.

*Legal Metrology* – this is the regulatory / legal area of metrology. Experts in legal metrology are tasked with ensuring existing units of measurement are correct and regulated to protect consumers and economy. This can involve establishments of laws to maintain transparency, traceability, and accuracy of measurements worldwide so consumers and organizations can make decisions confidently.

*Industrial Metrology* – this subfield is centred around manufacturing, supply chain and technology. It's where findings and standards created from scientific metrology are applied to real life. Examples include automobile manufacturing or pharmaceutical companies.

### Importance of Metrology

Metrology is essential in ensuring science and society has good measurements. This enables societal progress and economic growth through a globally agreed quality infrastructure. Overall, it:

- Improves effectiveness of research and development and confidence in its result
- Improves efficiency by reducing waste and increasing productivity
- Speeds up innovation which gets products to key markets faster, or allowing them to fail faster
  - Enables change to occur faster, creating a larger good impact to society



### Further Interest

One of the most impactful sections of Metrology is the impact of “SI units”, standard units by which all things can be measured.

From the temperature of the day to the volume of a glass to the speed of a car, standard universal units allow us all to understand the nature of a system without the need to physically replicate it.

Having said that, if you are still intrigued by the idea of Metrology then think about the differences between metric and imperial units. One important idea to focus on is whether we still need both and if it is better to accept one over the other (e.g. does the mile replace the kilometre or should we use gallons over litres?).

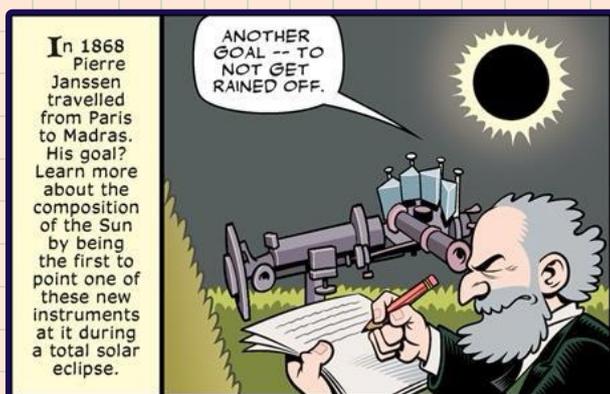
## A Brief History of the Noble Gases

Written by Marwan Froukhi

Throughout history most of the elements on the periodic table were discovered through chemical reactions where physical changes could be observed such as changes in colour, production of gas, formation of precipitate, heat release, changes in density and more.

However, the noble gases located on the rightmost side of the periodic table are chemically unreactive, colourless and odourless elements which made it practically invisible to chemists for thousands of years.

As the noble gases couldn't be detected via chemical reactions it led to them accidentally being discovered through unconventional techniques unlike the other elements on the periodic table.



### Discovery of Helium

Helium was first discovered in 1868 during a solar eclipse by Pierre Janssen & Norman Lockyer using a spectroscope (which analyses different wavelengths of light emitted from atoms).

A unique spectral line was detected that did not match any known elements suggesting a new element was being detected.

As a result, Lockyer proposed naming the new element Helium ("Helios" as Greek for the Sun) where Helium is the only element first discovered from outer space.

### Discovery of Argon

Argon was first discovered by Lord Rayleigh and William Ramsey in 1894. They noticed that nitrogen extracted from the air was slightly heavier than nitrogen extracted from compounds which after testing suggested there was an unknown, inert gas mixed with nitrogen in the air. They were able to isolate it by chemical reactions that removed oxygen, carbon dioxide and nitrogen from the air leaving only argon behind (which wasn't removed as it didn't react with anything.)

### Discovery of Neon, Krypton and Xenon.

After discovering the existence of argon, William Ramsey suspected more noble gases existed so when the technology became available to liquefy air in 1898, Ramsey was able to use distillation to liquefy air and slowly boil off the different components.

As different elements had different boiling points and would escape the liquid at different temperatures allowing them to be separated.

Once the different gases were separated, Ramsey was able to confirm they were new elements by looking at their densities and chemical reactivity (which would've been zero, due to the inert nature of the noble gases).

### Discovery of Radon

Radon was discovered in 1900 by Friedrich Ernst Dorn while studying the radioactive decay of Radium (a radioactive element discovered by Marie Curie).

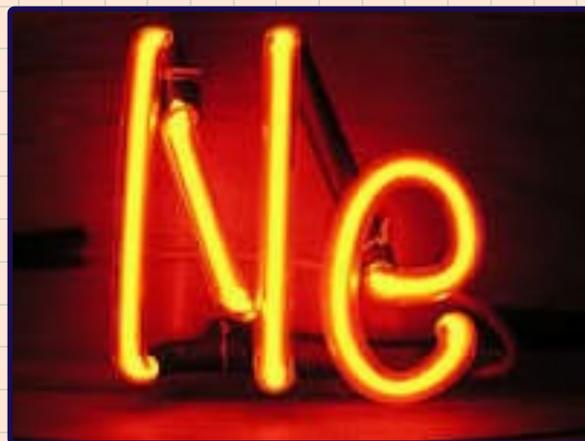
He noticed that when radium was stored in a closed container, the air around it would also become radioactive over time.

This suggested that radium was releasing a radioactive gas into the air which Dorn collected and analysed finding out it was unreactive gas that was later named Radon.

### Further Interest

Whilst there are no texts or literature reviews specifically dedicated to the noble gases, lots of material is scattered within textbooks of varying levels.

This includes the A-level syllabus and beyond, although the main importance of the noble gases are seen in producing inert atmospheric conditions for reactions to prevent side reactions, and due to the rarity of bond formation.

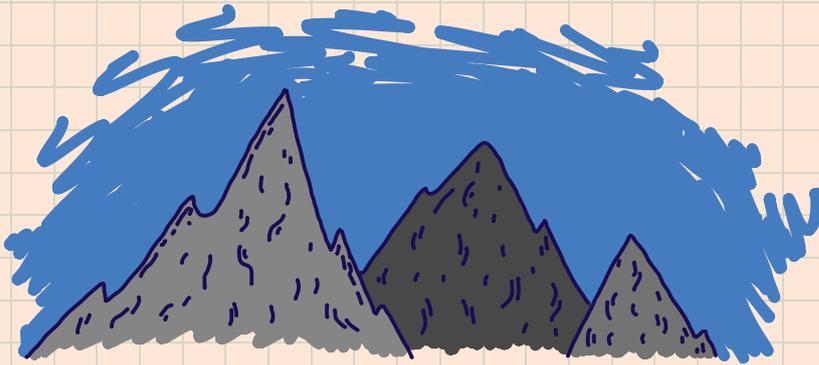


# What to Listen to



## PlanetGeo: The Geology Podcast

Chris and Jesse



From Rifts To Rifles - The Regional Geology of the Battle of the Gettysburg

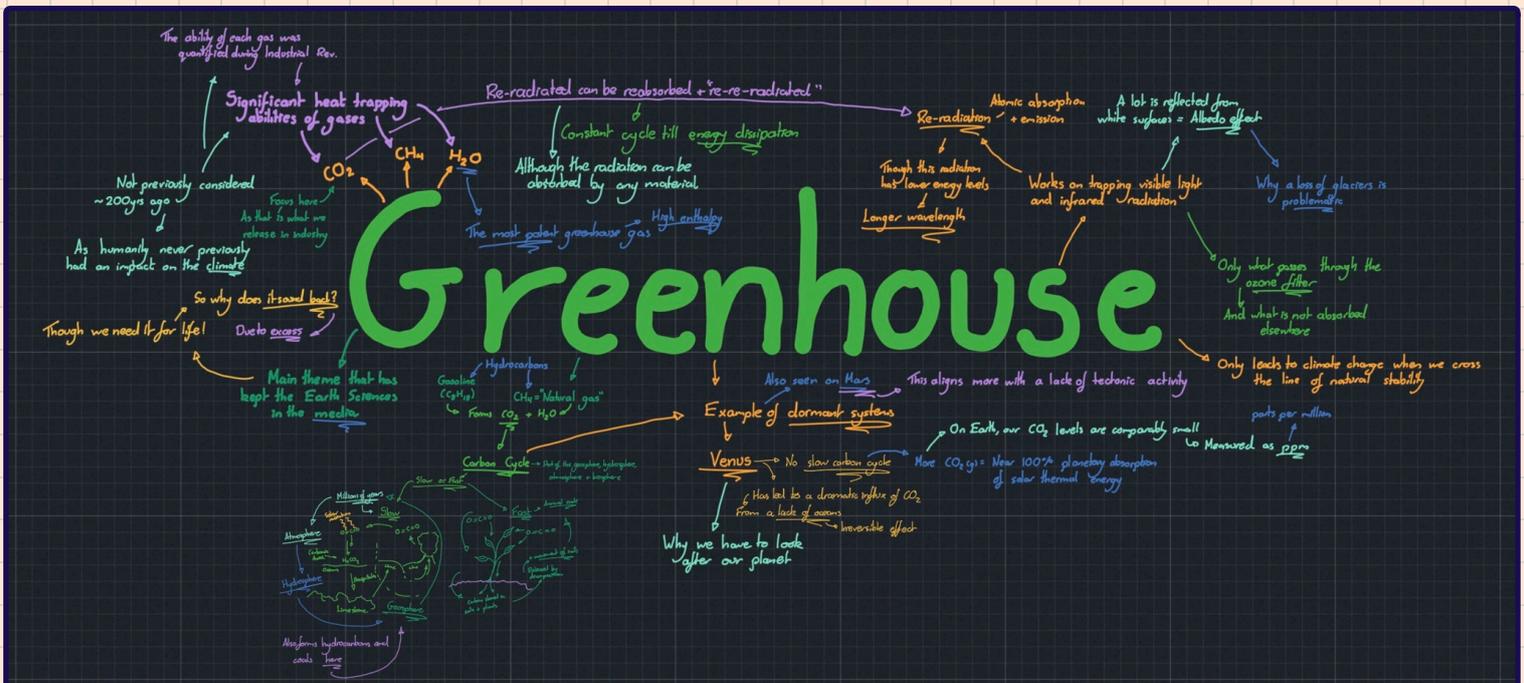


What is a Continent? Part 1 - The Composition



Stories in Stone - with David Williams

This podcast features the hosts, Chris and Jesse, discussing all things geological. From the beautiful Yellowstone National Park to the story of diamonds and why geologists are so good at dating rocks (but not humans). This podcast is for anyone with a genuine interest in the Earth and its many processes. It is also a good source of interest for those studying geography or geology.



(Above is a summary of an episode about the greenhouse effect)

Due to the implications that geology has as a study of the Earth, this science has clear future implications and importance. Alongside the future of the Earth, its importance is also made apparent with space travel, an area of astronomy which seems to be growing alongside the Artemis Mission.

# An Overview of the Blood Brain Barrier

Written by Dammy Ogundalu

The brain serves as the central hub of a wide range of physiological processes. It combines information from the external surroundings with signals from within the body to coordinate and carry out specific functions. With all the vital and specialised processes that occur within this organ, it is crucial that the chemical environment in which these cells work is strictly regulated and controlled, this is where the Blood Brain Barrier comes in.

The Blood Brain Barrier (BBB) is a selectively permeable membrane that regulates the passage of molecules into the microenvironment of the neurons. This is done by the aid of numerous controlled cellular transport channels scattered along the membrane, including:

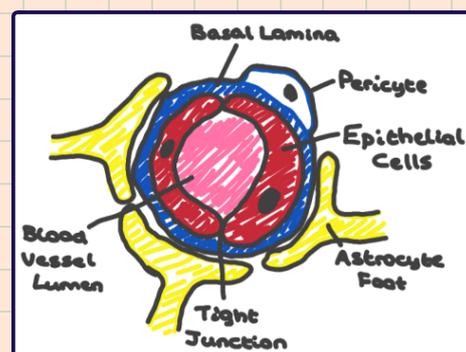
- Amino acid transporters
- Glucose transporter 1 (GLUT1)
- Nucleoside & nucleotide transporters
- Monocarboxylate transporters (MCT1 and MCT2)
- Ion transporters ( $\text{Na}^+/\text{K}^+$ -ATPase pumps) that facilitate the transport of essential molecules into the brain

## The Structure of the Blood Brain Barrier

The Blood Brain Barrier is a protective barrier that keeps the brain's environment chemically stable and protects against harmful pathogens, as if these pathogens enter the brain, they could cause devastating, irreversible damage.

The structure is composed of three primary components:

- **Tight Junctions:** These “zip” endothelial cells that line the blood vessels together, unlike in normal blood vessels, blocking unwanted substances slipping through
- **Astrocytes:** Glial cells with extensions called foot processes that wrap around capillary walls, providing additional support while also restricting the entry of certain substances
- **Pericytes:** Specialized mural cells that wrap around small blood vessels, particularly capillaries, arterioles, and venules. Pericytes demonstrate remarkable plasticity and can differentiate into other cell types under specific conditions. When there is injury or inflammation, pericytes become active in responding to the damage. They can move away from blood vessels, multiply, and help repair the tissue in different ways. However, if this response is not properly controlled, their activity can also lead to problems such as fibrosis.



## What Can and Can't Cross Through

Certain substances, such as small lipid-soluble molecules (such as O<sub>2</sub> and CO<sub>2</sub>), water and non-polar molecules can easily pass through the barrier. However certain substances, such as large molecules (such as bacteria and many drugs) and Polar/hydrophilic molecules cannot pass through this barrier. And other substances such as glucose and amino acids, cannot cross the Blood Brain Barrier without carrier-mediated transport proteins.

## Pathogens and Trojan Horses?

In contrast to the direct movement of a microorganism across the BBB, the Trojan-Horse method is an indirect form of microbial transfer. The BBB is permeable to phagocytic white blood cells, which regularly circulate in the blood to provide immunological surveillance, migrating in and out of tissues. Some microorganisms use this natural process and use it to their advantage. In the Trojan-Horse method, microbial transfer occurs with the transmigration of an infected phagocyte. As an infected white blood cell crosses the BBB, the microorganism also gains access to the CNS.

## Exceptions to the Blood Brain Barrier

Despite the Blood Brain Barriers effectiveness, there are some sections of the brain that do not contain the Blood Brain Barrier, these are:

- *Posterior Pituitary Gland* - The pituitary gland is not covered by the blood-brain barrier because the hormones it secretes need to go into circulation and pass through the rest of the body without interruption from the Blood Brain Barrier
- *Pineal Gland* - The pineal gland secretes the hormone melatonin, which controls circadian and seasonal rhythms, also known as sleep/wake cycles. The pineal gland is not covered by the blood brain-barrier because it secretes the hormone into the bloodstream.
- *Median Eminence of the Hypothalamus* - The median eminence of the hypothalamus connects the hypothalamus to the pituitary gland.
- *Subfornical Organ (SFO)* - Located on the anterior wall of the third ventricle, the SFO is responsive to hormones, particularly Angiotensin II, which plays a role in regulating blood pressure. The SFO communicates with other brain regions to help maintain fluid balance and blood pressure.

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### Additional Sources

<https://drmicheleross.com/brain-not-protected-blood-barrier/>

<https://asm.org/articles/2020/april/how-pathogens-penetrate-the-blood-brain-barrier>

# Navigating the Medical Field

~An Interview with a Foundation Year 1 Doctor~

An Interview by Katie Herd

Any interested reader, whom finds curiosity within medical-based books, films or TV shows (fictional or not), would understand that being a doctor isn't like any other job. A statement that could perhaps be used for all worldly occupations; however being any healthcare professional - albeit a nurse, doctor, surgeon, paramedic, physician or other - derives distinctly from the principle of wanting to help others, selflessly.

The responsibility of caring for another living human on such a fundamental level carries a weight not all could bare, and only most when there is little to no other choice but to do so.

On paper, becoming a doctor in the UK is a structured, carefully regulated journey: five or six years of medical school followed by two foundation years designed to ease graduates into clinical life.

Though to explore the realities behind the title, I spoke to a foundation year doctor, and what emerged was not a dramatic tale of medical emergencies, but something perhaps more revealing: a story about responsibility, hierarchy, resilience - and quiet growth.

## Learning the Art of Professionalism

If hierarchy and pressure form one side of hospital life, mentorship and modelling form the other.

When asked whether the positives outweigh the frustrations, the doctor was quick to correct any impression of cynicism. "Yeah, definitely...

100% as much as it sounds like I'm just complaining," they said. "That's only like the 10% or 5% — like 80 to 90% of people, they're really helpful".

That distinction is important. While tensions and disagreements exist within a hierarchical system, the dominant culture they describe is one of teamwork and shared growth. Much of that learning happens quietly — through observation rather than formal instruction.

"I've learned loads of things... even day to day, about how to interact and communicate professionally with colleagues".

Watching senior doctors interact with consultants revealed a level of composure and structure that does not always come naturally.

"Sometimes I feel like the most professional way... and I speak to them as if I'm speaking to my friend," they admitted. Through observation, however, they began to understand professional boundaries and tone:

"This is the correct way. This is the professional way to speak to them".

These lessons extend beyond staff interactions and into patient care. Small gestures — rarely written into formal training manuals — carry enormous weight. Having a brief conversation before taking blood, offering reassurance during a procedure, and consciously modelling calmness are practices they have adopted after watching others. “Seeing some of my colleagues do that, I’ve kind of incorporated it myself”.

Perhaps the most significant growth emerges in moments of urgency. Being called to assess a severely unwell patient can provoke immediate anxiety. “Obviously, now you’re the doctor that’s been called,” they reflected. Yet observing senior colleagues calmly “lead the situation” has provided something invaluable: a framework to follow. Even if they do not yet feel able to manage every aspect independently, they now know how to begin.

The reality of being a UK Foundation doctor is therefore shaped not only by responsibility and stress, but also by mentorship, growth, and resilience. As this interview suggests, professional identity is not formed overnight; it develops gradually through modelling, reflection, and experience.

## Further Interest

Currently at Beths, we have the Medicine Society for Year 12 and 13s, and MiniMedSoc for Year 10s. These societies all focus on passions in medicine and how best to go about preparing for future study.

If you would like any support or are deeply interested in this, you can attend the sessions where more information is below.

MedSoc - Tuesday Lunch - Every Week

MiniMedSoc - Thursday Lunch - Every Week

If you would like to see more interviews like this or medicine related content then message me at:

[20B-Todd@beths.bexley.sch.uk](mailto:20B-Todd@beths.bexley.sch.uk)

And, check out the Medicine Society Journals on the School website and keep a look out for new releases soon

# The TikTok Brain

~ How Short-Form Media is  
Rewiring Adolescent Attention ~

Written by Nuvini Gunawardene

Scroll. Laugh. Swipe. Repeat. For millions of teenagers, short-form video platforms such as TikTok, Instagram Reels and YouTube Shorts have become a daily rhythm being fast, enticing and endlessly rewarding. But psychologists are increasingly concerned that this constant stream of rapid entertainment may be shaping the adolescent brain in ways that reduce attention span and heighten reward-seeking behaviour. The phenomenon has become widely referred to as the “TikTok brain”: not a clinical condition, but a growing concern in social science, about how short-form media may influence adolescent cognition and motivation.

Adolescence is a particularly sensitive development period. Whilst the brain’s reward system is highly active during the teenage years, the prefrontal cortex, responsible for planning, self-control and long-term decision-making is still developing (Steinberg, 2008). This imbalance makes teenagers more likely to seek immediate reward, short-form content is designed to exploit this vulnerability by delivering rapid entertainment in quick bursts, reinforcing repeated viewing behaviours.

Psychologically, this effect can be understood through reinforcement learning. Many short-form platforms use variable reward schedules, where users cannot predict what video will appear next. This unpredictability is powerful because it encourages continued engagement, similar to mechanisms seen in gambling behaviour (Montag et al., 2019). Each swipe becomes a “reward opportunity,” increasing and reinforcing compulsive use.

Dopamine is widely misunderstood as a “pleasure chemical,” but in psychology and neuroscience it’s more accurately linked to motivation and reward anticipation, the drive to seek rewards again and again (Berridge and Robinson, 2016). This explains why teenagers may continue scrolling long after they intended to stop, a term more commonly referred to as “Doomscrolling”. As author Nicholas Carr warns, “what the Net seems to be doing is chipping away my capacity for concentration and contemplation” (Carr, 2010). For adolescents still developing attention control, the effect may be even more pronounced.

Research also indicates that frequent exposure to rapid media switching (going from one video to the next) will shorten sustained attention spans. In a landmark study, heavy media multitaskers performed worse on tasks requiring focus and filtering out distractions (Ophir, Nass and Wagner, 2009).

Over time, this may condition young people to find slower-paced activities such as reading, studying, or even face-to-face conversation less stimulating and more difficult to maintain.

However, psychologists caution against turning the debate into a moral panic.

Short-form platforms can also be beneficial, offering social connection, creative expression, and educational content. The key issue is not that teenagers are using the platforms, but the excessive prolonged exposure and the psychological impact of endless feeds, which prioritise engagement over wellbeing.

Ultimately, the “TikTok brain” reflects an interaction between adolescent development and persuasive technology. Psychology suggests the strongest protection is not total restriction, but teaching media awareness, encouraging healthy viewing habits, and strengthening offline activities that rebuild longer attention spans.



## Further Interest

If you are more interested in the neuroscience aspect of the implications that social media platforms (such as TikTok) have for people, then I would recommend listening to the ‘Huberman Lab’ podcast (recommended in the previous edition).



Andrew Huberman is a professor of ophthalmology and neurobiology at the Stanford School of Medicine. His range of speakers and personal knowledge makes his podcast an obvious place, for anyone interested in neuroscience and psychology, to go and check out.

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- Berridge, K.C. and Robinson, T.E. (2016) ‘Liking, wanting, and the incentive-sensitization theory of addiction’, *American Psychologist*.
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- Ophir, E., Nass, C. and Wagner, A.D. (2009) ‘Cognitive control in media multitaskers’, *Proceedings of the National Academy of Sciences*.
- Steinberg, L. (2008) ‘A social neuroscience perspective on adolescent risk-taking’, *Developmental Review*.

# Coming Soon...

How to Improve the  
Quality of your Sleep



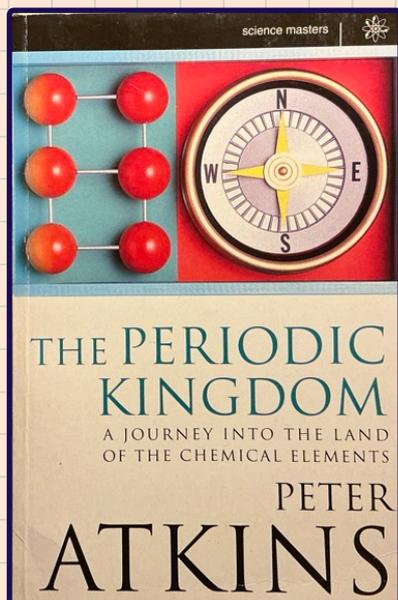
And why it is one of  
the most important  
things that you can  
do...



An interview with Stephanie  
Smith on her journey into  
microbiology and  
Washington State University



A must-watch film for any aspiring  
astrophysicist or space-enthusiast



Why this is a  
must-read for  
any aspiring  
chemist!

# And So Much More!

# Special Mentions

~Daniel Mitchard~

~Mr Blyghton~

~New Members of the Team~

## Picture Credit

STEM - <https://bigthink.com/starts-with-a-bang/what-explains-fibonacci-sequence/>  
COP30 - <https://concertus.co.uk/news/cop30-what-it-means-for-design-and-construction/>  
COP30 - <https://space4climate.com/looking-ahead-to-cop30-themes-priorities/>  
Medicine - <https://www.theguardian.com/society/2018/aug/30/modern-medicine-major-threat-public-health>  
Blood Brain Barrier - <https://cordancemedical.com/the-problem/blood-brain-barrier/>  
Iodine - <https://en.wikipedia.org/wiki/Iodine>  
Nature Photo - Psychology - Taken in Sweden (personal source)  
Royal Society Photo - <https://programme.openhouse.org.uk/listings/2135>  
Royal Institution Photo - <https://www.rigb.org/visit>  
Neon - <https://www.theguardian.com/science/punctuated-equilibrium/2011/apr/15/1>  
Helium Balloons - <https://www.livescience.com/28552-facts-about-helium.html>  
Katherine Johnson - <https://www.nytimes.com/2020/02/24/science/katherine-johnson-dead.html>  
David Fajgenbaum - <https://davidfajgenbaum.com/>  
Moon Landing - <https://kids.nationalgeographic.com/history/article/moon-landing>  
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## About Us

As you can imagine, as this is the first newsletter, the Team is very small in producing these meticulous arrangements of articles. The main idea behind Beths Science is to be able to explore the sciences, free from the constraints of trying to simplify language to be able to fully explore passions. The beauty of science cannot be expressed if I one has to use simple words, if there is a much more efficient specialist term.

If you would be interested in contributing to future newsletters, contact our founder/editor Harvey Todd at:

[20B-Todd@beths.bexley.sch.uk](mailto:20B-Todd@beths.bexley.sch.uk)

This can be used for both my email and for my teams account, if you drop a message I will take a look and then organise something for you, whether that is a short feature article or experience etc. or whether you would like to participate by writing as part of the Team.

Some images have been extracted screenshots from sources such as the Kurzgesagt channel and PlanetGeo