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Towards Our Passions

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Editorial Team

Senior Editor: Ellen M.
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Front Cover

The front cover features work completed by one of our Year 13 students, Connor M. He is in the foreground of some of the photographs. Connor died in a road traffic accident in January 2026. He intended to pursue a career in the creative industries. Connor was a true friend to all. While we cannot capture everything that he was in life, our front cover commemorates his joyfulness and the passion he had for art. Connor, you will always be remembered.

Introduction

We are thrilled to present Cleeve School's inaugural academic journal, *Towards Our Passions*. It showcases the intellectual curiosity and commitment of our Sixth Form students; these qualities have enabled the journal's contributors to conduct research and develop articles that far bely their academic experience.

The topics students have chosen to discuss are eclectic. They have spent three months working on their pieces. Yet each article has been germinating for years, inspired by their interests and shaped by experiences they have shared with their family and friends – thank you for nurturing their dreams. We cannot wait to see where their passions take them in the future.

Headteacher Foreword by Mr Alywn Richards

Towards Our Passions reflects our exceptional Sixth Form. It is a celebration of our students' pursuit of knowledge and intellectual heft. Within these pages, you will encounter a collection of writing that is extremely well-crafted, highly thoughtful and unafraid to engage with the challenges and opportunities of the world around them.

Each article reflects not only a depth of research, but also a genuine personal investment in issues that matter to them. Together, they demonstrate what can be achieved when young people are challenged to think critically and write with purpose – and passion!

Our Sixth Form authors exemplify the very best of scholarship and we are so proud of them here at Cleeve.

I hope that this collection inspires all who read it — not only to recognise the talent and dedication of its contributors, but also to reflect on your own ideas and passions. These pages remind us that powerful writing has the ability to inform, challenge and inspire change. Well done to all of our students and to Sixth Form Team member – and writer – Dr Crouch for unleashing this talent in this format. I can't wait for the next addition of *Towards Our Passions*!

Alumni Reflection: Towards My Passions by Dr Rebecca Taylor

The 12 years since I left Cleeve School presented many challenges – particularly those navigating academia. I am relieved to have emerged 2 years ago with a PhD in Particle Physics, and now I spend my days in Switzerland designing future particle accelerators for cancer treatments and high energy physics.

Oddly, all this emerged from an IT class in Year 9. Our substitute teacher asked us to create a powerpoint slide of our dream holiday, a few months later my family drove across France to visit Annecy, and spent one day visiting the Large Hadron Collider at CERN in Geneva.

With my passion for particle physics lit, Cleeve did a great amount to support my ambitions: analysing data from the Faulkes Telescope with the Astronomy Club; creating our own sensors in GCSE Electronics; and our physics teacher Dr Pavlidou even invited University of Birmingham professors to visit in the atrium, where they had strips of particle tracks printed out from 1970s detectors.

I encourage all current students to stay curious – the truth about the universe and nature is often a lot more absurd and unexpected than classes teach us. And plenty of creativity is required in researching it.

Geneva, May 2026

Guided by Faith: A Personal Reflection of Islam, Justice and Responsibility for the Commitment to the Legal Profession by Wasima R.

I am thrilled to be going to university to study Law. My admiration for law originates from my deep belief in justice, fairness and moral responsibility. These are principles that are not only central to society, but also deeply rooted in my Islamic faith. The Qur'an states, "Stand out firmly for justice, even if it is against yourselves" (4:135). This verse inspires me to seek truth and fairness in every situation, reminding me that justice is not simply a profession, but a moral duty.

After graduation, I aspire to work in the civil service, particularly within immigration law, where I can support those who are often unheard or vulnerable. My Bangladeshi heritage places great emphasis on ensuring that all community members are supported. At Sixth Form, studying Health and Social Care alongside Law, has given me a unique insight into the way society functions and how laws protect individuals and how justice ensures dignity and equality for everyone. My faith has inspired my university choices, and my interest in the legal system deepened after a visit to Gloucestershire's Magistrates Court where I observed how evidence and reasoning can uncover truth and serve justice. Witnessing the accuracy of the structure of the legal process fascinated me; it demonstrated how law is not just about punishment, but also about protecting rights, and balancing fairness with compassion. Similarly, a trip to Parliament gave me an overview into how laws are shaped, debated and enacted. Seeing how discussions between parties can lead to decisions that affect society reinforced my desire to be involved in the legal system.

There are individuals and groups in Britain who seek to divide communities along ethnic and religious lines. However, the five British values are democracy, the rule of law, individual liberty, mutual respect, and tolerance of those with different faiths, beliefs and social cohesion. My faith encapsulates these principles as Islam emphasises justice, compassion, accountability and the protection of people's dignity. It demonstrates that faith and responsibility can work together, rather than in conflict. These strengthen my commitment to study Law, as it reflects my own responsibility as a British citizen and my religious views and morals.

Both outside and inside the classroom, I engage in debating and in group discussions; for example, in Islamic mosque sessions, where religious debates, learning and educating others takes place. These experiences have helped me understand that law is not simply about winning an argument, but also about reasoning logically and ethically, whilst considering opposing viewpoints. As I move forward into university life, my intention is to continue to develop these skills, through academic discussion and other opportunities to nurture my advocacy skills, to enable me to effectively represent and support individuals.

As a multilingual individual fluent in Bengali and English, understanding Urdu, Hindi and with the ability to read and write in Arabic, I have developed a deep appreciation for language, culture and communication. Faith should not divide; it should bring us together to gain mutual understanding and coexistence. I am committed to using my personal qualities to support individuals, mostly people from minority backgrounds, to ensure justice is inclusive and accessible to everyone. My cultural background has also made me more aware of issues such as inequality, representation and access to justice, motivating me to advocate for those who may be overlooked. The skills I have grown will empower me to connect with people from diverse backgrounds, understand multiple perspectives and adapt effectively to new environments.

My faith remains a central part of who I am. Islam teaches that justice ('adl') is one of the highest moral values, and that every person has a responsibility to uphold it. This belief drives my ambition to study Law not only for a personal achievement but to contribute positively to society. Once qualified, I am committed to working in areas such as immigration or human rights law, advocating for those who feel voiceless.

Can instapoetry be considered as “real” poetry?
by Harriet S.

Introduction

With the digitalisation of society and the continuously growing use of social media, it is inevitable that art forms will shift, adapt and evolve to maintain their relevance within a technology-obsessed world. Various artists, poets, and writers have turned to the internet (social media in particular) in order to share their work, as it provides an opportunity for them to quickly and easily gain popularity. The algorithm of social media allows their posts to be seen by people who are more likely to take interest in them, and a simple like or follow will cause a domino-like effect, making their work more visible and available to other enthusiasts. The most influential, and most debated, evolution in art caused by social media is instapoetry. Typically characterised by brief, snappy texts that are only a few lines long, instapoems often lack punctuation, making them seem like a sudden thought or quote, evoking emotion from the reader, or making them consider the topic of the poem in greater depth. For this reason, instapoetry is used to comment on various political themes, such as feminism. The topic is widely debated amongst scholars as to the authenticity of the works that are increasingly spread and discussed, and whether or not these poets can be deemed as truly possessing the talent that they are praised for, and often compare them to more traditional works in order to question their supposed genius.

What is instapoetry?

There is no official definition of instapoetry, due to the term’s modernity, however the genre is best defined as “short, visually impactful poems created specifically for consumption on social media” (Charry Roge, 2023). Despite the lack of a fixed definition, the most significant and identifying characteristic of the genre is its brevity. Instapoems are often very short, frequently consisting of just one or two lines, in order for the poem to fit onto a small phone screen. The poems lack any rhyme scheme or metre, avoid any use of punctuation and capitalisation and seem to deviate from any form, structure or constrictions held by traditional poetry and literature in its entirety, a point which many criticise as proof of the genre’s lack of authenticity.

To fully grasp what the term “instapoetry” encapsulates, it is necessary to use examples. Take this poem by Atticus, an anonymous poet who has a vast following of 1.6 million on Instagram (as of July 2025): “to avoid disappointment/take people as they are/and not what they could be” (Atticus, 2025). Evidently, the poem is simple, short, and lacks any rigid form or rhythm, exemplifying the typical structure of an instapoem. Another example from Rupi Kaur, the most followed instapoet with 4.2 million followers (July, 2025), reads “fall/in love/ with your solitude”, accompanied by a line drawing, a signature feature of numerous instapoems.

Does instapoetry conform to the definition of poetry?

The first step in answering this key question is determining what poetry is defined as. In the online Oxford English Dictionary (2025), the first definition of poetry is given as “imaginative or creative literature in general”. Using this definition, it could be said that any creative work involving words or structured writing could be considered poetry, meaning that instapoetry is encapsulated by the word, as it is thoughtfully constructed and formulated through creative means, and is a “written work”, so therefore stands as a piece of literature (The Little Oxford English Dictionary, 1930). However, the second definition given to poetry by the Oxford English Dictionary is “The art or work of a poet”. In order to sufficiently comply with this definition, we must consider whether an instapoet conforms to the definition of a poet, which is simply “a person who writes poems” (Cambridge Dictionary, 2025). Since these two definitions provide only interchangeable definitions, with no exact clarity, it can be argued that true poetry is open to interpretation, and is not limited to specific structure or form, meaning that instapoetry could be considered to be a valid form, depending on what the reader themselves perceives poetry to be.

However, various sources and experts would argue that poetry must have a distinctive rhythm or rhyme scheme. For example, Dictionary.com defines poetry as the “art of rhythmical composition” (Dictionary.com LLC, 2025), and since most instapoems, despite their distinctive style, are written in free verse (“nonmetrical,

nonrhyming lines that closely follow the natural rhythm of speech"(Poetry Foundation, 2025)) without any crafting to bring about a rhythm or meter, and therefore do not conform to definitions such as this one. Many critics use definitions such as these to argue against instapoetry's validity, comparing it to more traditional poetic structures (for example, Shakespeare and the Romantics using iambic pentameter - a poetic metre which contains ten syllables per line, one stressed, one unstressed, creating a "da-dum" rhythm) to discredit instapoetry and deem it talentless or worthless in comparison. Moreover, determining that poetry must display a set rhythm or rhyme scheme would discredit a vast number of poetical works from the past century, due to the growing use of free verse to enable more freedom in artistic expression and less constriction.

Nevertheless, the evolution of poetry since its beginning has proven that defining the art form is a pointless task, due to its versatility and nature to adapt with the conventions of different time periods. The contrast between epic poetry, such as Homer's The Odyssey, or The Iliad, long narrative poems that depict tales of heroes or legendary figures (which, notably, lack rhyme schemes and fixed structures), and the Shakespearean sonnet, confined to fourteen lines with a rigid rhyme scheme of three quatrains (four-line stanzas) and a finishing rhyming couplet, renders it difficult to accept that the two forms can be defined by the same term. Various historical poets have argued that poetry defies the limitations of a definition. Samuel Johnson, a renowned eighteenth-centruy writer, claimed that "to circumscribe poetry by a definition will show only the narrowness of the definer" (Johnson, 1756), displaying that the act of defining what poetry is as an art form is of no worth, as it is not the definition that truly matters in this literary form, but the message and the impact that it has. Similarly, Emily Dickinson claimed that "if I feel physically as if the top of my head were taken off, I know that is poetry" (Dickinson, 1870), highlighting the significance of poetry in evoking emotion, rather than conforming to conventions.

Conclusion

To summarise, trying to determine a definition that will encompass all forms of poetry, while satisfying all literary critics and enthusiasts, is an impossible task. Therefore, it can be said that instapoetry can certainly be accepted and incorporated into the literary world, given that the poem itself has two key features: firstly, an impactful message, and secondly, considered composition by the poet themself.

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Towards My Passion: Visiting CERN by Dhruv P.

I am incredibly excited to be studying Mechanical Engineering at university. My passion for mechanical engineering comes from my experiences as a child and my obsession with racing. As a child, I was exposed to watching Formula One and the World Endurance Championship and watching machines of raw power race around a track gave me hope that one day, I will be designing and testing these vehicles or design something that will benefit and change the planet forever.

Recently, I was presented an opportunity by the school to go on a trip to a very big engineering company in Geneva, known as CERN. They specialise in particle and nuclear physics, and they are known for housing the biggest particle accelerator in the world - the Large Hadron Collider (LHC). We were offered a tour around the facility and two detectors that span across Geneva and the south of France. Seeing what I have been taught in Physics be put into a real-life context was really fascinating because it showed me that what I am being taught applies to the real world and has led to some of the most historical inventions and events in history.

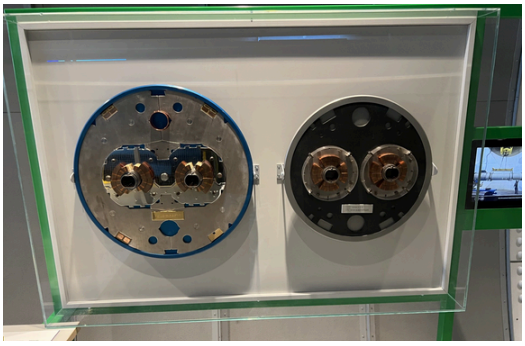


Exhibit from CERN

Before I departed for Geneva, I was looking forward to seeing what Swiss culture was like and having the freedom to walk the streets with my classmates. Our itinerary included: seeing the National Science Museum, the Botanical Gardens, the Red Cross Museum, the city centre, Cathedrale Saint Pierre, and then CERN itself. I was looking forward to the city centre because Geneva is known for its watches and wealth, so seeing the shops and the people there was eye opening. However, I think I was looking forward to CERN and the National Science Museum because if you couldn't have guessed, I am a science fanatic and learning what makes the world tick is quite interesting in my opinion.

In Geneva, we followed the itinerary but obviously from the student point of the view there are some funny stories my classmates and I took back with us. When we visited the city centre, my friend and I went on a quest for some food and found a local kebab shop. We buy our kebab and sit down on a bench. Coincidentally, we are sat in front of the Rolex store, and we have the great idea of going inside and surprisingly, they agreed and we are let in and one thing led to the other and I end up having a 40,000 Franc (£37,738.40) Rolex on my wrist. We leave without buying the watch (who would've guessed) and carried on with our day.

At CERN, we went around the control centres and learnt about the different components used in an accelerator and how magnetic fields and particle physics played a part in the development of the LHC and other colliders. I went to the Botanical Gardens thinking it wasn't going to be interesting; however, I was shown wrong. Some of the scenery was quite beautiful and I was blown away that they managed to house flamingos outside at five degrees in the middle of Geneva. They had a Japanese inspired structure which I thought was cool. It reminded me of hidden martial arts temples that Samurai used to train in.

This trip opened my eyes to how much physics surrounds us and it has given me additional motivation to achieve my goals. I understand what I was shown doesn't align with vehicles, but both industries require engineering genius and have made me wonder, maybe one day I could be up there with the brilliant minds and be known for doing and creating something that matches their passions and what they believe in.

Japanese temple

Could epigenetics solve the organ donor problem?
by Ethan W.

Introduction

In this paper I will be exploring part of the potential of epigenetics in regenerative medicine, specifically its applications in resolving the large wait list that there is currently for replacement organs. This paper will start by introducing what epigenetics is, leading on to the mechanisms which we can use to manipulate this. It will then explain how these cells can be used in combination with organ scaffolds to generate new organs.

What is epigenetics?

Epigenetics is a term that has gradually changed and become more specific over time. With the first reference to it made by Waddington referring to the epigenome as the "a complex network of interactions at the biomolecular, cellular and even environmental levels" (Meza-Menchaca, 2024). This hypothesis has been proved to a point with the definition becoming "the study of heritable changes in gene function which do not directly entail a change in DNA sequence" (Meza-Menchaca, 2024). Although there are many different definitions these two summarise the field together the best. Over time and through many experiments we discovered many of the molecules and interactions responsible for these interactions such as what I am about to explain.

Methylation of DNA

This occurs directly on the DNA strand and results in a cytosine nucleotide gaining a methyl group -CH3 (although it does occur on A,T and G nucleotides this is the most common). This change in the DNA results in a deregulation of that genes expression as RNA polymerase is no longer able to access it and transcribe mRNA (Kim and Kim, 2021). It is highly variable between cells and is often one of the factors that alter gene expression due to a change in environment. This can be attributed to enzymes in the nucleus called methyltransferases which can change or maintain the methylation of genes (Melamed et al, 2018).

Histone modifications

Histone proteins are larger proteins associated with large strands of DNA and when they are together it is referred to as chromatin. These proteins can be modified by a wide variety of enzymes. However, the main function is to (again) control the expression of DNA. Histone proteins do it in a different way to methylation. To modify expression, enzymes will change the polarity of the "tails" of these proteins. This results in either the DNA becoming wrapped around them "tightly" which is what allows these proteins to both promote (encourage) or repress genes (Mesa-Mechaca, 2024).

Why is this relevant?

An understanding of this is needed throughout the rest of this article as we will be delving into how we can manipulate the environment around cells to force their epigenome to change. This is highly important as to generate an organ from a personal adult cell (already differentiated) they will first need to become Induced Pluripotent Stem cells (IPS cells which display similar properties to embryonic stem cells found in the womb).

How are IPS cells made?

IPS cells are made from somatic (adult) cells and usually come from fibroblasts (skin cells). These then need to have the reprogramming factors implemented in them via one of two current methods retroviral transduction or non-integrating systems (Takahashi, 2007).

The first method "retroviral transduction" will usually utilise a retrovirus which will integrate its genome into the host cells resulting in the production of factors which edit the epigenetic expression of genes. The main problems with this method, are the risks associated, with the use of viruses. These can include: the cells becoming immune to the virus before its able to successfully create an IPS cell as it has a low success rate or the dangers that come with genome integrating techniques such as the chance that is it integrated within an oncogene or tumour suppressor gene causing the cell to become cancerous (Cohen, 2009).

The second method of non-integrating systems includes multiple ways of reprogramming without adding to the risks that come with genome integration. The most successful method which resulted in the most Yamanaka factors being expressed (these are factors which are identified as a benchmark for pluripotency) was a single strand of self-replicating RNAs that when translated into a protein will act as transcription factors which results in pluripotency. Due both its efficacy and the fact it is less likely to cause cancerous cells, as it stays separate from the genome, this is most likely what we would expect to use in regenerative medicine (Sharma, 2016).

Why is this relevant to organ donor problem?

This is relevant to the organ donor problem as it could provide more opportunities to create temporary to permanent solutions for people who are living without essential organs or face life changing consequences to them such as the missing of a liver requiring constant scheduling of dialysis. Other potentials could be saving lives making essential operations such as heart transplants.

This would be so beneficial as it would allow for organs that have the same antigens (identity markers on cells) which are the same as the recipient so they would no longer be required to take immuno-suppressants. Since the organs would be compatible with the patients, it would reduce the wait times they have for the treatment.

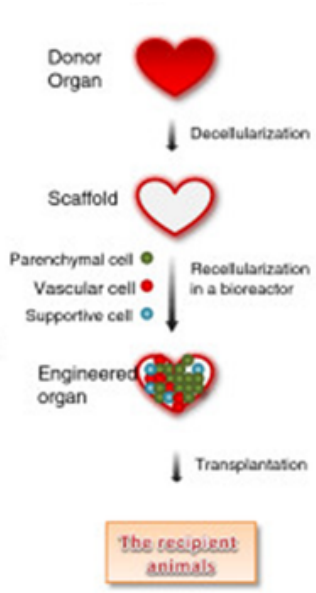
This all seems very futuristic, so how could we do this?

How can we "make" organs?

To properly direct the differentiation of the stem cells into true cell identity they must have the correct cell environment around of them. To create this, we use something called microfibrillar scaffolds. These are the product of adding a strong ionic detergent while preserving the extracellular matrix of an organ (Karamanos, 2021) (this is the macromolecules within an organ which define the structure and organisation of said organ).

This provides a similar enough environment to when the organ was first developing to allow for the correct differentiation patterns to be displayed most of the time.

This can be repopulated with the stem cells (in this case the IPSc). Since the correct environment is present, this causes changes in the expression of the genome (through epigenetics) which will result in similar behaviours to those in a naturally formed organ. If then provided with the correct nutrients the cells can replicate and differentiate to form the organ. To accelerate this growth, steroid and other growth hormones can be added (Liu, 2013).



Process of "making" organs

Why is it not already being done?

A multitude of issues with the risks of the directed differentiation of pluripotent stem cells. Since this is not a perfect process many cells can result in an incomplete state of pluripotency where some features present in only embryonic cells are present. This incomplete state can result in slowed growth rates, and the differentiation will be poor (Ohnuki, 2015).

The other major issue with this is that many of these differentiated cells will be tumorigenic and have a high likelihood of forming a cancerous tumour (Lezmi, 2022). This provides a multitude of complications when implanting in humans as no one wants a tumour implanted in them.

What is the potential of this in healthcare?

Stem cell treatment has massive potential in personalised medicine as organs with the same antigens (cell identifiers) as the recipient mean there will be no immune responses, leading to faster solutions than waiting for a donor with the current waiting list times.

The future use of the technology could branch into the development of personalised medicine where new medicines could be developed and tested on artificial organs before then be given to people so all personalised medicine could me safe and effective.

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The Atomic Bomb: Science Innovation and its Consequences by Stanson F.

Introduction

The development of the fission bomb in the twentieth century marked a turning point in both scientific understanding and global history. Emerging from rapid advances in nuclear physics, the fission bomb demonstrated the immense energy contained within the atomic nucleus and the profound consequences of releasing it. This essay explores the scientific principles that made nuclear fission possible, traces the historical path that led to the first atomic weapons, and examines the significant effects of their detonation.

History of the atomic bomb

In 1896, a scientist called Henri Becquerel proved that some elements, including uranium, emit radiation without exposure to sunlight; this led to the discovery of radioactivity. In the early 1900s, scientists Ernest Rutherford and Frederick Soddy demonstrated that these radioactive elements could change into other elements over time by breaking apart. By the late 1930s, Lise Meitner and Otto Frisch interpreted the splitting of the element uranium as nuclear fission. Further investigation showed that additional neutrons are released in nuclear fission which meets the requirement to kick off a chain reaction (a self-sustaining sequence of nuclear fission where each fission triggers the next one). The fission reaction is a form of nuclear transmutation, as the resulting fragments and daughter nuclei will be a different element to the original atom. The nuclei produced are slightly different in size and mass.

By early 1939, scientist Leo Szilard saw that Nazi Germany could potentially weaponize this nuclear fission, so he and other scientists, including Albert Einstein, signed a letter to warn the American President, Franklin D. Roosevelt, about the danger of Germany developing nuclear weapons first.

After scientists discovered the potential of nuclear weapons, and the events of the early years of World War Two, the Advisory Committee on Uranium suggested that an atomic bomb could be built and used by the Allied powers before Germany. Many scientists and engineers joined to form the Manhattan Engineer District to focus on the development of the nuclear bomb by combining military skills, science, and engineering. The Manhattan Project remained secret and was established in three main sites in the United States including Oak Ridge in Tennessee, Hanford in Washington, and Los Alamos in New Mexico. The officials evaluated a method to trigger nuclear explosion by compressing the plutonium core inward extremely quickly and evenly, in New Mexico on 16 July 1945, creating the world's first human-caused nuclear explosion.

A few years after the successes of the Manhattan Project, the United States dropped the uranium-fuelled 'Little Boy' atomic bomb on Hiroshima, Japan, on 6 August 1945. The United States then dropped the plutonium-fuelled Fat Man bomb on Nagasaki, Japan, on 9 August 1945, as it was believed it would be the quickest way to end World War Two with the least loss of life.

Technical details and impact of atomic bombs

At either end of a gun-assembly type atomic bomb, the device is filled with masses of Uranium-235; one is shaped like a 'bullet' and the other is shaped like a hollow cylindrical 'target' that fits around the bullet. When dropped, the chemical explosive, made of organic nitrogenic base compounds, acts like a gun and shoots the 'bullet' at the 'target.' Once they meet, they become a supercritical where the chain reaction is self-sustained and will grow exponentially. This means more uranium neutrons can be used in nuclear fission reactions, and this kicks off a chain reaction.

The first generation of fission creates approximately two or three neutrons (most fissions are binary fission, but occasionally ternary fission occurs which produces three neutrons) at around 20,000km/s which is equivalent to half-way around the Earth but in reality, neutrons do not travel anywhere near that far as they interact with air molecules quickly. Neutrons can also reach around two million volts of energy, mostly in the form of fission fragment kinetic energy. This then rapidly turns to heat, causing extreme temperatures. These neutrons trigger more nuclear fission reactions which generate more energy and extra neutrons. After one hundred generations, which takes less than a microsecond, the energy released reaches the level of kilotons of explosives.

The enormous energy causes the uranium to heat up to millions of degrees Celsius and creates a pressure inside the bomb. The core then bursts outwards, breaking the aluminium or aluminium alloy external cast. This leads to a massive high pressure "wall" of compressed air travelling faster than sound, and a blast of wind strong enough to destroy reinforced concrete.

When the uranium nuclei split, the fragments are unstable; they undergo radioactive decay which emits fast neutrons and gamma rays. These high frequency gamma rays will penetrate deeply into the body and ionize the molecules by knocking electrons out of the atoms inside cells, causing the DNA strand to split because the hydrogen and phosphodiester bonds are broken. If the DNA strands rejoin incorrectly, the errors during translation and transcription can lead to cell malfunction and cancer, and if the damage caused by the gamma rays is too severe, the cell undergoes apoptosis, which is where the cell kills itself. If too many cells die, it can be fatal to all living organisms.

Just like gamma rays, people will not feel fast neutrons directly. However, the effect they cause can appear quicker because fast neutrons do far more physical damage inside the body. They collide directly with the nuclei of atoms of our tissues. Within minutes of exposure, a person might feel sudden nausea, headaches, and dizziness, which are symptoms when fast neutrons kill large number of cells. As more cells accumulate damage or die, those tissues begin to fail. Even when the exposure is not immediately life-threatening, fast neutrons pose significant long-term risks. If broken DNA strands repair incorrectly, it can lead to mutations that increase the likelihood of cancer years or decades afterwards.

Other applications

The invention of the atomic bomb also led to other groundbreaking scientific, medical, and technological developments. For example, in medicine, understanding of how radiation damages DNA can be used to target cancerous cells to stop them from dividing and die off. In addition, in the power industry, using controlled nuclear fission to keep the reaction slow and predictable to generate heat for a coolant to absorb. The hot coolant then can transfer heat to water in a steam generator causing a turbine to spin and generate electricity. Many countries rely on nuclear power to reduce the use of fossil fuels as they produce no carbon dioxide gas, significantly reducing greenhouse gas emission, which slows the rise in global temperature by trapping less heat in the atmosphere.

Conclusion

The creation of the fission bomb demonstrated the power that can accompany scientific discoveries. By understanding the physics of nuclear fission and the historical context in which these weapons were developed, it becomes clear that their impact extends far beyond the moment of detonation. The environmental and humanitarian consequences continue to shape global discussions about security, ethics, and the role of science in society.

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On Racism and the Impact of Stereotypes by Zaina R.

Racism and stereotypes are a harmful and deeply damaging combination. Individually, they can cause serious harm, but together they create lasting effects that shape lives, limit opportunities, and affect how people see themselves and others. These forces can cause emotional pain, reinforce inequality, and, in extreme cases, even lead to loss of life. These problems are something we need to actively address and put a stop to so that we can live in a fair and inclusive society. This is incredibly important so that we can live in peace and feel accepted which leads to a safer and more empathetic society. We need to reduce social tensions and conflict to live in a safe ordered society. Racism is not a problem to be handled lightly with little care; it needs immediate attention.

Racism is prejudice, discrimination, or antagonism directed at individuals or groups based on their race or ethnicity, often targeting those who are marginalised. Racism can take many forms, including verbal abuse, exclusion, or physical harm. High-profile cases, such as the death of George Floyd, show the extreme consequences racism can have. However, racism is not always this visible - everyday actions, such as using racial slurs or making insensitive comments, also contribute to the problem. People around the world have experienced some form of racism, whether they recognise it immediately or not. According to recent surveys from the BBC and other sources, in the UK 80% of minoritised ethnic groups have experienced racial discrimination, and 56% of hate crimes in Scotland are racially motivated. The latest available data from UNESCO shows that close to one in six people globally experience racial discrimination, which is approximately 1.6 billion people. That is 1.6 billion different racial discrimination acts. These acts are discriminatory but do not include racial slurs or physical harm caused to someone. Data including all types of racism shows that roughly 64% of the world population have been a victim of racism. In the UK 92% of black students have reported hearing or witnessing racial language at school. It is a profoundly serious issue that exists not only in obvious acts like hate crimes, but also in everyday behaviour, language, and attitudes.

In today's world, where society is becoming more diverse and interconnected through social media and globalisation, racism can spread quickly and become more visible. For example, through social media the world has become more affiliated and has allowed people to freely express opinions without worrying about repercussions as they are hidden behind a screen at home. Among black and racially minoritised youth in Britain, 95% of these people have encountered violent or abusive racist comments online. Racism is frequently embedded in institutions, policies, and everyday norms that are not immediately recognized, such as university portraits, campus visuals, and hiring practices, which can perpetuate exclusion while appearing neutral. This makes racism harder to detect, however situations where racism is apparent are due to overt acts like slurs, harassment, and violence.

The Role of Stereotypes

A racial stereotype is a simplified and often inaccurate belief about a group of people based on their race or ethnicity. These beliefs are usually based on clichés rather than real understanding. Stereotypes are harmful because they reduce the complexity of individuals and erase their uniqueness, identity, and personal experiences.

They can influence how people are treated in education, employment, and everyday interactions. Stereotypes also contribute to "stereotype threat," a form of anxiety where individuals feel pressure about confirming negative assumptions, which can affect their confidence and performance. More broadly, stereotypes help reinforce systemic discrimination. They can shape how people are viewed in society, often placing marginalised groups at a disadvantage. They also contribute to unconscious bias which is automatic assumptions people make without even realising it.

Personal Experience and Real-World Impact

Racism is not just an abstract concept; it is something many people experience in their daily lives. I have experienced racism first-hand on multiple occasions. The first time I recognised it was at the age of 12, when I was called a racial slur.

This was a direct and offensive act that had a lasting impact on how I viewed people and human behaviour. I realised the world isn't as kind as it seems through a child's eyes and it was the first time I felt like I had to grow up and see the world as it truly was; a place of inequality where people had to cope with being treated differently just because of their skin colour.

I have found that some people are far too comfortable using derogatory language. For example, when trying to guess where I am from, people sometimes use offensive terms as if they are normal or acceptable. This shows how normalised certain attitudes have become. Instead of asking my country of origin, many people think it is okay to list countries that are Asian or African because of my skin colour and when they realise I am not originally from an African nation they proceed to use the n word in front of me because I'm not of African descent so I can't possibly be offended. Other occasions of racism I've received is where people automatically assume I'm from India because "that's where all brown people are from" - anonymous. It makes it hard to be proud of my country of origin when people are constantly putting you down and belittling not only you but your country as well. When I proudly state my country of origin is Bangladesh, I've been told on many occasions that they didn't know that place existed or was a country.

It is highly concerning when people make assumptions about my background or identity and then behave inappropriately based on those assumptions. For instance, when people assume I am from a particular region and then casually use offensive language, it reflects a lack of awareness and respect.

As a proud Muslim who openly speaks about my faith, I have also experienced harmful stereotypes linked to religion. Some people assume that being Muslim means supporting violence or extremism, which is false. These ideas often come from media portrayals and global events that unfairly generalise an entire religion. For example, following the 9/11 terrorist attack, any form of terror attack is associated with Muslims, when statistically it's proven that 94% of terror attacks were committed by non-Muslims. Between 1970 and 2012, approximately only 2.5% of terrorist attacks on US soil were carried out by Muslims. In Europe, Europol data from 2006 to 2010 showed that less than 0.4% of terrorist attacks were "Islamist" in nature. Most attacks were motivated by ethno-nationalist or separatist beliefs. Muslims are often the most frequent victims of terrorism globally. Since a high concentration of terrorist attacks occur in majority Muslim countries like Iraq, Afghanistan, and Pakistan, it is estimated that the vast majority of fatalities from such attacks are Muslims. Around 90% of British Muslims and most Muslim leaders reject any form of violence and war following what the prophet Muhammed (PBUH) believed, which was to prioritise diplomacy over violence and only act in self-defence. Terrorism being linked to Islam is a form of propaganda and a scapegoat response to horrific events that occur. When attacks happen the first assumption made before any information is released is that it is a Muslim who is at source of the attack. Even when later revealed that it wasn't a Muslim who committed the action, the damage is already done and the reputation of the religion gets further tarnished even though the accusations were false. This is a key example which demonstrates how stereotypes can spread and influence how people are treated in society.

Unconscious Bias and Its Influence

These experiences show how stereotypes and unconscious bias form and continue to grow. Unconscious bias refers to automatic judgments people make without being aware of them. These biases are often shaped by media, culture, and societal narratives rather than personal experience. When certain groups are repeatedly portrayed in a negative or limited way, it affects how people perceive them. Over time, these perceptions influence behaviour, decisions, and even institutions, reinforcing inequality in areas such as education, employment, and social treatment. For instance, my mum wasn't promoted nor hired for different roles for nearly 10 years and was compelled to leave the organisation because of racial bias in the workplace. Interview panels would hire people who looked like them and who grew up in similar situations to them which became really challenging for my mum to grow within her career. My mum wears a hijab and is very open about her religious beliefs and she is of an ethnically minority background. All my mum wanted to do was set a good example and to be an exemplary role model to her three daughters but because of this institutional racism and unconscious bias that took place in her working environment she

couldn't excel in her specialist field of work. Even with many high level qualifications that she has, making her much more of a suitable asset than other candidates, that unconscious bias and racism stopped her from developing in her career.

Addressing racism requires more than simply rejecting obvious discrimination. It involves recognising and challenging stereotypes and unconscious biases in everyday life. This includes being mindful of language, questioning assumptions, and educating ourselves about different cultures and perspectives. By actively challenging stereotypes and becoming more aware of unconscious bias, we can reduce the harm caused by racism and promote respect, equality, and understanding. Creating a fair and inclusive society depends on understanding the impact of our words and actions, which is important to guarantee the safety of humanity. By mitigating these problems of racism and stereotypes, we can strengthen social cohesion which therefore means we can embrace diverse perspectives and backgrounds, which promotes mutual respect, leading to the reduction of social tensions and conflict. Inclusive environments boost self-esteem and confidence while reducing stress, anxiety, and depression caused by discrimination or isolation.

So, we collectively need to make an active effort to challenge unconscious bias, educate ourselves on real and false stereotypes and to force racism out of society by standing together as a united front. Only we can make that happen. It's up to me. It's up to you. It's up to us.

The Mechanisms Behind Thalidomide's Effects by Tim Z.

Introduction

As a Y13 student, I first encountered thalidomide after seeing it in relation to optical isomerism in A level Chemistry. After further reading, I found the story very compelling - a drug responsible for one of the worst pharmaceutical disasters ended up acting as a base for drugs that treat conditions from leprosy to cancer. It also introduced me to the complex physiological pathways that stem from a single molecule. This article explores the mechanisms behind the wide range of thalidomide's effects.

History

Thalidomide was first introduced in the 1950s as a sedative that was believed to be safe and non-addictive. It did not seem to have any side effects while being incredibly potent at treating a range of conditions from insomnia to coughs and headaches and was widely described as a 'wonder drug'. Soon it was discovered that it also worked well as an antiemetic and worked especially well for morning sickness that occurs in pregnant women. It therefore became very popular around the world, being sold in 46 countries (Vargesson, 2015).

Even though no noteworthy toxicity was identified when it was being tested in rodents (such as a mouse), with a lethal dose failing to be identified (Rehman et al., 2011), reports of patients experiencing peripheral neuropathy quickly arose after its release (Vargesson, 2015). In the 1960s, it was found to be highly teratogenic, leaving newborns with severe developmental defects such as phocomelia, which is characterised by severe malformation of the limbs. The drug was withdrawn from the market soon after.

After the drug was banned from the commercial market, research about its mechanisms and possible therapeutic uses continued. In 1965 it was identified to be effective towards erythema nodosum leprosum (ENL), which is an inflammatory complication of leprosy that leads to painful lesions on the skin. After that it was then established that it was effective for several other autoimmune conditions in the 1980s, such as rheumatoid arthritis and chronic graft-vs-host disease, before it was noticed that it was also effective for preventing angiogenesis as well as multiple myeloma in the late 1990s (Ito and Handa, 2020).

Thalidomide target deconvolution

But how could a drug with such devastating effects also be useful therapeutically? In 2010, the direct target of thalidomide was identified as cereblon (CRBN) - a protein previously associated with a gene flagged for potentially causing mild intellectual disability and is highly conserved. It was discovered using affinity purification, where thalidomide molecules were covalently bonded to magnetic beads and cell extracts were washed over them to capture any proteins that would bind to thalidomide. The proteins that eluted were then identified using proteolytic digestion and tandem mass spectrometry, whereby proteins are cut in certain locations to produce unique fragmentation patterns that can be matched against a database. A mass spectrometer, as the name suggests, measures the mass of the fragments. This was confirmed via immunoblotting, where complementary antibodies are used to check for a corresponding protein's presence (Ito et al., 2010).

CRBN was found as part of an E3 ubiquitin ligase called CRL4-CRBN, which stands for Cullin-RING Ligase 4, named after its scaffold protein (Cullin 4), the protein domain for recruiting the E2 enzyme (RING), and ligase, which is a class of enzymes that bind 2 things together. An E3 ubiquitin ligase is part of the ubiquitination system, where a protein called ubiquitin is attached to proteins that are to be degraded by the cell, and it is the system that controls intracellular protein levels from yeasts to humans. The E3 enzyme catalyses the transfer of this ubiquitin chain from the E2 enzyme - a previous component in this system - to the substrate. CRBN specifically acts as the substrate receptor of that specific E3 ligase. Since there are other receptors available to this complex, CRBN normally has to compete with them and is auto-ubiquitinated - meaning it ubiquitinates itself - regularly. Thalidomide inhibits its auto-ubiquitination, suggesting that regulation of CRBN is also disrupted by thalidomide (Ito and Handa, 2020).

Structure of thalidomide and its interaction with CRBN

Thalidomide has a chiral centre, i.e. a carbon that has 4 different substituents. This means that there are 2 optical isomers (the R-enantiomer and the S-enantiomer) that are mirror images of each other sharing the same structure but a different 3D arrangement – like a left hand and a right hand glove. When it was in the market, it was sold with both isomers in equal amounts, known as a racemate. In 1979, Blaschke et al. discovered that only the S-enantiomer is responsible for the teratogenicity of thalidomide in animal experiments. However, it is unclear if only offering the (R)-thalidomide would have avoided the disaster, as it was shown that thalidomide undergoes racemisation – where it interconverts between the 2 enantiomers – in serum with a half life of 1 hour (Tokunaga et al., 2018).

It was later shown that the difference in both therapeutic and teratogenic effects stemmed from the binding affinity of each enantiomer for CRBN, where the S-enantiomer has a 6-10 fold higher affinity than that of the R-enantiomer, resulting in the preferential binding and stronger activity. This was initially shown by substituting the hydrogen bonded to the chiral carbon with a deuterium, an isotope of hydrogen, to prevent racemisation, before the 2 enantiomers are compared in a competitive binding assay with each deuterated thalidomide enantiomer covalently conjugated to ferrite beads (Mori et al., 2018). It was later found using X-ray crystallography that the R-enantiomer binds to CRBN in a 'twisted' form while the S-enantiomer binds in its relaxed form, one that is similar to how it is found in water (Ito and Handa, 2020).

Mechanisms for teratogenicity

After binding to CRBN, thalidomide effectively acts as a molecular glue between the receptor and its neosubstrates – i.e. a substrate it is not supposed to bind to, and the various consequences of thalidomide stem from incorrect protein degradation (Ito and Handa, 2020). During embryo development, thalidomide-bound CRBN targets several transcription factors, which are involved in organ and limb development. A prominent example is SALL4. It was shown in rabbit embryos that thalidomide downregulated this protein.

The exact function of this factor is unclear, but members in the SALL family are involved in development of tissues and organs during embryonic development. Based on its effects in other animals such as zebrafish, it seems to have to do with limb formation (Medline Plus, no date). This genetic factor has also been associated with some developmental diseases upon mutating, such as Duane-Radial-Ray syndrome and Holt-Oram syndrome. Duane-Radial-Ray syndrome is an eye movement disorder characterised by not being able to look outwards, limited inwards movement, and retraction of the eyeball into its socket upon looking inwards, while Holt-Oram syndrome involves the abnormality of bone structure in the upper limbs, e.g. a missing thumb or partial/complete absence of bones in the forearm (Al-Baradie et al., 2002; Medline Plus, 2014). However, despite the overlap with the syndromes linked to SALL4 mutations and thalidomide embryopathy, thalidomide's effects have not been tested in animals with non-degradable SALL4, so causality cannot be established (Ito and Handa, 2020).

Another neosubstrate implicated in thalidomide syndrome is p63, which belongs in the same family as the well-understood p53 tumour suppressor genes. Aside from its tumour suppressing abilities, p63 plays an important role in limb development. Mutations in this gene cause ectodermal dysplasia (large family of disorders relating to skin, sweat glands, hair, teeth, and nails, often alongside limb or facial deformities, which originates from when the outer layer of tissue (ectoderm) of the embryo does not develop correctly) (NIDCR, 2024). p63 comes in several isoforms, among which ΔNp63α and TAp63 are targeted by thalidomide-bound CRBN, which is essential for limb and heart/cochlea development respectively. It was shown in zebrafish (which isn't resistant to thalidomide unlike rodents) that thalidomide induced degradation of both factors, which led to fin defects from downregulation of FGF8 – a growth factor in limb outgrowth, as well as downregulation of Atoh1, a transcription factor responsible for cochlea development. In this case, non-degradable variants were not able to be degraded by thalidomide-bound CRBN, thus causality can be concluded (Ito and Handa, 2020).

This explains why, during pregnancy, the period upon which thalidomide is consumed matters. The critical period extends between day 20 to day 36 of pregnancy (though early exposure induces miscarriage and late exposure has been shown to cause brain damage in

rats), and the time at which thalidomide is taken affects the wide range of phenotypes that the infant can display, such as the absence of external ear if taken between day 20 to 23, or inner ear damage if between 24 and 33 (Vargesson, 2015).

Therapeutic effects

Thalidomide's therapeutic effects are based on the same mechanism. Thalidomide is in a class of drugs called immunomodulatory imide drugs (IMiDs), which consists of its derivatives and itself. As suggested by the name, they modulate the immune system, while imide points to a functional group in their structure.

Ever since thalidomide's use for conditions such as ENL by the FDA in 1998 and multiple myeloma in 2006 (Rehman et al., 2011), more potent derivatives have been synthesised, such as lenalidomide and pomalidomide which both bind more strongly to CRBN (Ito and Handa, 2020). The neosubstrates of CRBN that lead to thalidomide's therapeutic effects are then able to be elucidated from these analogues.

Lenalidomide was found to decrease IRF4 in myeloma cells, which are plasma cancer cells, before the discovery of CRBN. IRF4 is a crucial survival factor that myeloma cells rely on and its degradation leads to growth defects in myeloma cells as well as anti-proliferative effects. However, IRF4 was not the direct substrate of CRBN in this case. It was only later found that lenalidomide induces degradation of 2 transcription factors IKZF1 and IKZF3, standing for Ikaros family zinc finger, where zinc finger is a protein domain that is composed of 2 cysteine and histidine residues that coordinate a zinc ion. They are also called Ikaros and Aiolos respectively. This family of proteins are involved in the differentiation of lymphocytes and are important in IRF4 expression. This was confirmed by CRBN-binding deficient mutants of Ikaros/Aiolos suppressing the anti-proliferative effect. Pomalidomide and thalidomide also have the same effect through this same mechanism, though noticeably less potent. Additionally, the degradation of Ikaros and Aiolos upregulates interleukin 2 (IL-2) expression, which is a chemical messenger (cytokine) that stimulates proliferation and activity of T cells, including cytotoxic T cells which directly kill cancer cells (Ito and Handa, 2020).

Lenalidomide is also highly effective for myelodysplastic syndrome (MDS), which is a group of disorders when the bone marrow produces non-functional blood cells. It is caused by the loss of part of the long arm on chromosome 5, which is the longer segment of the two formed by the centromere, denoted as 5q-. Alongside other genes essential for healthy hematopoietic cell production, CSNK1A1 which codes for Casein kinase 1 alpha (CK1α), with kinase meaning it phosphorylates other proteins, is lost. It has roles in multiple cellular activities and it has been shown in genetically modified mice that homozygous loss for this gene activates p53 and triggers apoptosis. However, heterozygous loss causes accumulation of β-catenin, as it is one of the proteins that get phosphorylated by CK1α to be degraded, leading to increased proliferation as well as stem cell maintenance (Krönke et al., 2015).

Since 5q- cells produce less of CK1α, lenalidomide is able to selectively have a greater effect on 5q- cells, as the degradation of the remaining proteins was able to trigger apoptosis, while normal cells are more resilient. This was shown when regular human stem blood cells (CD34+) were introduced with shRNAs (short hairpin RNAs) via lentiviral vectors that either caused degradation of CSNK1A1 mRNA or did not do anything as a control. Cells expressing CSNK1A1 shRNA depleted when left alone while treatment with lenalidomide enhanced this depletion. Cells expressing control shRNA were unaffected, suggesting that the knockdown of CSNK1A1 not only inhibited growth and survival but also showed that the level of CK1α decides how sensitive a cell is to lenalidomide. Though, overexpression of CK1α in 5q- MDS patient cells did not uniformly rescue their cells from lenalidomide, suggesting that there are other factors at play that contribute to its therapeutic effect in some patients (Krönke et al., 2015).

Since IKZF1 is also degraded by lenalidomide, it had to be shown that overexpression of IKZF3 led to no difference in the survival of 5q- MDS cells, normal karyotype (meaning an intact and complete set of chromosomes) MDS cells, and normal cells when exposed to lenalidomide, which confirmed that IKZF1 degradation does not explain lenalidomide's selectivity (Krönke et al., 2015). However, thalidomide and pomalidomide have little effect on CK1α level, which suggests that CRBN's neosubstrates depend at least partly on the CRBN-binding ligand (Ito and Handa, 2020).

Thalidomide also has anti-angiogenic (inhibition of formation of blood vessels) and anti-inflammatory impacts, the former of which is another major factor for its and its analogues' anticancer effects. However, a correlation between anti-angiogenesis and CRBN-binding affinity of the thalidomide analogue could not be established, suggesting that the main target for this effect still remains to be discovered (Heim et al., 2021). As for its anti-inflammatory effects, it is known that thalidomide selectively inhibits the production of several pro-inflammatory cytokines such as TNF-α, IL-8, and IL-12, partly through the inhibition of NF-kB which is a transcription factor involved in turning on inflammatory genes in an immune response as well as degrading TNF-α mRNA (Rehman et al., 2011; Moreira et al., 1993). Thalidomide also inhibits Caspase-1, whose role is to activate cytokines like IL-1 (Rehman et al., 2011). Notably, this has implications for its anti-angiogenic effects as NF-kB is involved in regulating pathways that switch on the gene for VEGF (a growth factor for blood vessel formation) (Drugbank, no date). That said, whether these effects are mediated through CRBN is still unclear, and other pathways may be involved.

Broader implications

Ever since the development of lenalidomide and pomalidomide, new CRBN-binding compounds have been synthesised that have other potential uses. A notable example is CC-885, which has a similar structure to lenalidomide. In phenotypic screening it was shown to cause growth defects in various cells, including cells present in acute myeloid leukemia (AML), which is an aggressive cancer of myeloblasts (immature white blood cells). It represented a new class of CRBN-binding drugs that can potentially be used to treat AML. The neosubstrate was identified via a coimmunoprecipitation assay as G1 to S phase transition 1/eukaryotic release factor 3a (GSPT1/eRF3a), which forms a part of the complex responsible for translation termination and is highly conserved between different species. By degrading GSPT1, translation termination is disrupted, causing a dividing cell to arrest in the G1 phase. This was the finding that led the field to acknowledge that CRBN-binding drugs have functions beyond immunomodulation, as this translational termination factor had no connection to the immune system. Thus, IMiDs were renamed to Cereblon E3 ligase modulators (CELMoDs). CC-90009, a derivative of CC-885, has since been developed and investigated as a specific treatment for AML (Ito and Handa, 2020).

New CELMoDs are being developed to treat diseases that traditional IMiDs cannot. CELMoDs such as iberdomide and avadomide are being investigated for treatment in diseases that range from diffuse large B-cell lymphoma (DLBCL), a blood cancer that involves the lymphatic system, to systemic lupus erythematosus (SLE), which is a chronic autoimmune disease that involves inflammation and damage across multiple organs, even though the targets have not been identified (Ito and Handa, 2020).

Besides synthesising new CELMoDs, a particular area of interest is the development of Proteolysis-Targeting Chimeras (PROTACs), which consist of a ligand that binds to a protein of interest (POI), an E3 ligase-recruiting ligand, and a chemical linker that connects the two. Unlike CELMoDs, which require the neosubstrate to fit to be touching both the drug and CRBN's surface, PROTACs act as a bridge that allows essentially any protein to be the target without needing the E3 ligase and its neosubstrate to be in direct contact, including proteins that were previously considered untargetable due to the lack of a conventional binding site (Doshi, 2025).

PROTACs' therapeutic potential is immense, with advanced development in several areas, such as vepdegestrant (ARV-471) which degrades the oestrogen receptor – a key driver in proliferation of breast cancer cells – and is showing promise; and avdegalutamide (ARV-110) which is an androgen receptor degrader investigated for use in prostate cancer. It could also have implications for neurodegenerative diseases such as Alzheimer's and Huntington's disease, caused by the accumulation of misfolded proteins, with amyloid-beta plaques and huntingtin aggregates respectively (Doshi, 2025).

Thalidomide was involved in one of the largest drug safety catastrophes in history, and despite many of its physiological pathways still remaining unclear, such as the full mechanism of thalidomide's teratogenic, antiangiogenic and anti-inflammatory effects, the discovery of its interaction with CRBN stimulated the development of an entirely new class of drugs that exploit E3 ubiquitin ligases to degrade targeted proteins – with the potential to treat diseases previously beyond reach.

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How objects hold people: reflections from Auschwitz by Archie T.

The extent of the Holocaust cannot be comprehended by the mind. If asked to conjure six million people, each with lives and loved ones, the mind will fail. It is therefore only possible to experience the effects of the Holocaust through other means.

In March 2026, I was given the opportunity to both meet a Holocaust survivor and travel to Auschwitz through the Holocaust Educational Trust's Lessons from Auschwitz programme. As my first time leaving the UK, on top of the horrific events of the Holocaust, I had expected it to be a challenging experience. Yet, I felt an incomprehensible normality upon entering Auschwitz and as I moved through each new building, despite being faced with heart wrenching stories, pictures of people unknowingly moments away from death and intensive recreations of the gas chambers. This sense continued. It is odd to proclaim, but I looked at these events with more of a sense of grim fascination than grief, as if a visitor to a museum, not a death camp. I was aware of the vast suffering that had occurred in Auschwitz and throughout the Holocaust. Despite this, there was a noticeable disconnect between me and "them". Reflecting on this moment, I realised I could not perceive people as anything more than numbers and names, warped through a barrier of time.

Now, as I entered a different space, this illusion of normality would shatter. In front of me, stacked high, rested three thousand pairs of shoes. All stolen from murdered children. In that moment, able to tangibly see eighty-year-old slaughter, I looked away. The first thought entering my head, was of my brother and sister, both aged seven. Some of those shoes were the same size as theirs, others significantly smaller.

Shoes

Jane Bennett, a political theorist, writes of 'the curious ability of inanimate things to animate, to act, to produce effects dramatic and subtle' (2010; p.6). In my opinion, there are no better words to describe the impact of these belongings on me. Shoes, in contrast to a life, are such simple objects and yet, horrifically, so much can be understood from those worn pairs. This image will stay with me forever.

Auschwitz Camp

Crockery

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OS maps: their importance in historic and modern map making and the usage of trig pillars in the retriangulation of Great Britain by Sophia T.

What is an Ordnance Survey (OS) map?

OS maps are maps created by the Ordnance Survey, an organisation which is part of the British government, previously part of the Board of Ordnance. The Ordnance Survey conducts the official surveying of Great Britain (with the first survey occurring as a military strategy to map the Scottish Highlands in 1745). OS maps are extremely accurate and reliable; providing critical geographical data for the government, businesses, and individuals. To obtain such a high level of accuracy, before satellite images were available, permanent points called trig pillars were built (starting in 1935) to be utilised as precise, known points in the retriangulation of Great Britain.

OS maps utilise the Ordnance Survey national grid, also known as the British national grid. The British national grid divides Great Britain into 100km x 100km grid squares. Each of these squares are assigned a two-letter code, then within each square, the location of a specific point is given by the Easting and Northing values. This differs from longitude and latitude coordinates; however, the two systems can be converted from one to the other. OS maps generally use a standard key, allowing for effective interpretation of the contents of the map. In addition, the maps also use elevation lines, allowing for the height, as well as the gradient of the landscape to be clearly shown.

The Ordnance Survey accurately surveyed Great Britain, supplying map makers today with the valuable data sets needed to create more modern maps. OS maps are an important element in the history of map making, as they were some of the first maps that accurately mapped Great Britain. To facilitate the accuracy of the OS maps, the Ordnance Survey commissioned the development of more accurate technology, such as the Ramsden theodolite (a surveying instrument used to measure angles) meaning the Ordnance Survey played a critical role in developing more accurate methods of map making.

The history of OS maps

OS maps started as a military strategy to map the Scottish Highlands following a rebellion in 1745, where accurate maps were needed to plan military activity in the steep terrain. William Roy was tasked with creating the initial map, as Roy wished to build a “superior map” of Great Britain. Starting in 1747, to construct this map, Roy utilised a simple surveying compass to measure angles, and chains to measure distance. However, only key locations such as roads or settlements were accurately mapped, with a large part of the map being sketched by eye. It is said that Roy described his map as more of a “magnificent military sketch than a very accurate map of the country”. However, despite the lack of accuracy, this map was the start of the Ordnance Survey creating scale maps of Britain, marking this map the inception of OS maps

In 1784, Roy was tasked by the Royal Society to accurately find the relative positions of the Royal Observatories of Greenwich and Paris. To do this, Roy commissioned Jesse Ramsden (a renowned scientific instrument maker) to create a theodolite more accurate than the ones previously available, leading to the creation of the Ramsden theodolite. By utilising the sine rule and the new theodolite, Roy mapped out a series of accurate triangles that extended to France. The introduction of the Ramsden theodolite was an important part of the history of maps, allowing for more accuracy in the angles, and therefore distances, between components on a map. In 1791, the Board of Ordnance bought a second, improved Ramsden theodolite, which was crucial in the principal triangulation of Great Britain. This purchase also marks an important date; the officially recognised start of the Ordnance Survey. The Ramsden theodolite shows just how important Roy and the Board of Ordnance were in developing the accuracy of maps, with the creation of the Ramsden theodolite marking a large improvement in the accuracy of map making.

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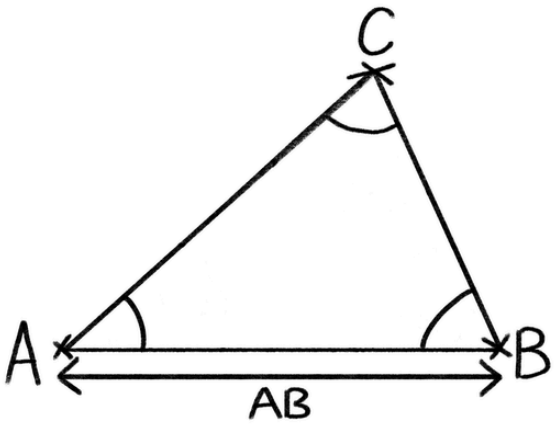
After World War One, the maps created from the principal triangulation were not accurate enough to accommodate Britain's post World War One rapid development. A new triangulation was needed, which used different, and more accurate, techniques than those used in the late eighteenth century and early nineteenth century. Therefore, in 1935, the retriangulation of Great Britain began. To carry out the retriangulation, Brigadier Martin Hotine designed trig pillars. These were essential to the retriangulation, as they provided permanent, physical points, with all the pillars having a centre point with an exact height and elevation. This enabled OS maps to have the accuracy that they are known for today, and has helped to create maps since the retriangulation, even into the present day.

How were trig pillars used?

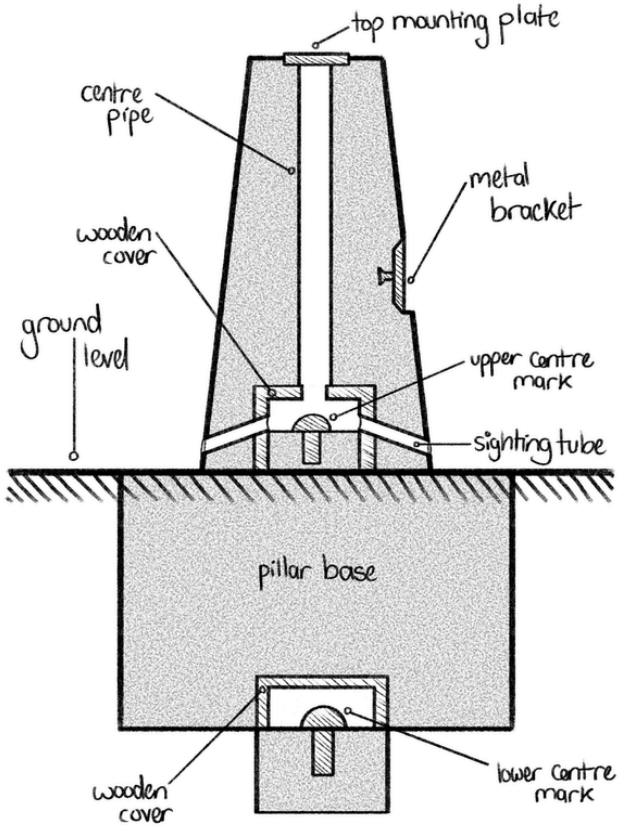
Trig pillars were placed on visible areas of land, such as the top of hills or mountains across Great Britain, with a distribution so that from one pillar, it was possible to see at least two other pillars on a clear day. This was so that the three pillars could form the corners of a triangle, allowing for distance to be measured and then utilised to create a to-scale map. To find the length of a side of this triangle, the sine rule was used. To start, a distance between two of the three pillars was measured. We can call these pillars A and B respectively, the known distance AB, and the third pillar C. Next, a theodolite was mounted onto pillar A and used to find angle ∠BAC, then mounted onto pillar B to find angle ∠ABC. These angles were then subtracted from 180° (as angles in a triangle add to 180°) to find angle ∠ACB. The sine rule (A/sinA = B/sinB = C/sinC) was then used to find the other two lengths.



Maths underpinning trig pillars

This was integral to the retriangulation, as exact lengths were needed to plan for the various infrastructure developments which followed World War One. The information found in the retriangulation of Great Britain was important in making new, accurate maps that could be better utilised in infrastructure projects. The information found is still being used today, along with satellite imagery, to create highly accurate maps that can be used in applications such as air travel, where accurate maps and GPS are crucial to avoid potentially fatal errors.

T**he components of a trig pillar**



Cross section of a trig pillar

The OS trig pillar contained multiple features to optimise its use in the retriangulation of Great Britain. The first of these features was the top mounting plate, which provided a mount for the theodolite. This was key as it allowed the sensitive tool to be securely held in place, meaning all angles measured from the pillar were measured from the exact same point, allowing for the extremely high accuracy that was crucial to carry out calculations on a large scale. Furthermore, the mounting plate ensured that the theodolite was an exact known height above the centre mark, so that this height could be accounted for when using the angles to measure the distances between pillars.

Other important features of the pillar were the upper and lower centre marks. The upper centre mark sat inside the pillar, just above the top layer of the ground. It marked the exact point that the coordinates of the pillar described, defining the position of the pillar. A hollow centre pipe encased the mark and ran vertically through the middle of the pillar, offering support for the structure, and ensuring that the mounting plate sat directly above the mark. A wooden box surrounded the centre mark, acting as a sacrificial cover, and sighting tubes near the base of the pillar that angled slightly upwards allowed for the mark to be observed. Under the section of pillar visible above ground sat the pillar base. The depth of the base was 2'6" minimum, ensuring the base was strong, allowing for the pillars to be extremely stable and near impossible to remove. This was important as people at the time expected to have to use these pillars in mapping for decades to come, meaning durability was key for accuracy and longevity. Under this base sat the lower centre mark. The lower centre mark was also covered by a sacrificial wooden cover and had a 1'0" x 1'0" base. The lower centre mark was included in the pillar in case the upper portion of the trig pillar was destroyed or damaged. It acted as a marker to show where the pillar and upper centre mark were, by sitting at a known depth vertically below the upper centre mark. The lower centre mark sat far below the ground, ensuring there was always an indicator of where a trig pillar was if any ever had to be rebuilt.

Trig pillars were usually comprised of concrete, as it is a cheap and accessible material that can be moulded to quickly and accurately reproduce the shape of a trig pillar, whilst also creating a strong structure, especially when reinforced with iron rods and the centre pipe. Some pillars also mixed in local stone into the concrete, allowing for a stronger material that was visually in keeping with the local area. On the outside of each trig pillar sat a metal bracket, which showed the code for the pillar, and a symbol indicating the pillar was government property, which was similar to the symbol utilised in the carving of OS benchmarks.

Conclusion: changes over time and modern uses

The introduction of satellite imagery and surveying made trig pillars redundant as distances and angles are instantly measurable using the new technology. However, trig pillars were for decades, a critical instrument in creating accurate maps used in many applications.

In addition, the information on the location of features of the landscape found during the retriangulation was used in combination with the new satellite technology, meaning the information found still played an important role, despite the implementation of new technology. Today, the Ordnance Survey map newly developed areas, such as new housing estates, meaning they continue to hold an important role in modern day map making. Therefore, whilst the Ordnance Survey are no longer utilising trig pillars to create maps, the Ordnance Survey still carry out an important role in modern day surveying.
Since they were first constructed, hundreds of trig pillars have been destroyed by various causes, such as urban development and costal erosion. However, thousands of trig pillars are still present today, with only slight damage or alterations. Whilst they are no longer used in surveying, the pillars have evolved to have other modern uses, for example, trig bagging, a popular hobby for hikers and outdoor enthusiasts, in which people try to visit as many trig pillars as possible. In addition, the recognisable shape and visible location of the pillars have led to them becoming local landmarks. This means that trig pillars have become synonymous with the locations they are found in, making them an integral part of local landscapes across Great Britain. This has led to trig pillars holding a new role; becoming part of the landscape and defining people's perception and sense of place of their local area and community. Although no longer being used for surveying, trig pillars still hold a different, but important, role in peoples' lived experience of their home and community, affecting our lives in small ways to this day.

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The advancement of Kurdish Rights by Zak E.

Introduction

Following the Treaty of Lausanne in 1923, the Kurdish people were not given a recognised territory to practise their culture and beliefs. This meant that Kurds who lived in the newly defined area of Turkey were treated as outsiders, including bans on the Kurdish language and Newroz (festival celebrating new year). Naturally, the oppressed Kurds would try to establish their rights in Turkey and create equal representation and freedom.

This article will evaluate the effectiveness of political strategies to advance Kurdish rights in Turkey and will cover: Kurdish attempts to establish the Republic of Ararat, the work of the PKK (the Kurdistan Workers' Party which was a militant political organisation led by Abdullah Öcalan from 1978 until its dissolution in 2025), as well as attempts by Kurdish lawyers to bring appeals in the European Court of Human Rights (ECtHR) against the Turkish government. It will evaluate the effectiveness of these approaches to progress Kurdish rights in Turkey, both in the short term and long term.

Republic of Ararat and other uprisings

The first attempt to establish Kurdish rights in Turkey was not through legal mechanisms. In eastern Turkey, a Kurdish rebellion led to the Republic of Ararat, a self-declared Kurdish state (1927-1931). Kurdish people saw this as a safe space to be able to freely practise their culture and religion. This was a clear statement to the Turkish government that the Kurds would rather have an independent state than live under Turkish control. Since the rule of Mustafa Kemal Ataturk led to the suppression of the Kurdish culture and identity, the Republic did advance Kurdish rights in the short run. Unfortunately, for the Kurds, the Republic did not last. After being independently governed for four years, it collapsed in 1931, following military defeat in the autumn of 1930.

The 1937-38 Dersim uprising further severed trust and respect for the Kurdish people and their cause, along with the PKK's consistent breaking of ceasefires and peace processes. These small rebellious movements ultimately hindered the Kurds' ability to progress their rights, but at the same time created a statement to the Turkish government about their resilience and desire to be free.

PKK

The second strategy that will be considered is the formation of the PKK in 1978, and the lasting effects the organisation has had on Kurdish rights. From the outset, the PKK tried many ways to build a political presence. This included releasing propaganda and leading protests (The Kurdish Project, n.d.). Since 1984, the ongoing conflict between the PKK and the Turkish government has damaged the image and reputation of the Kurdish people in Turkey. After the Islamic State (IS) suicide bombing in Suruc in 2015, the Turkish government came out, and announced peace talks with the PKK would stop. After the attack, it started targeting the PKK more than IS, though claiming they were only hitting unoccupied buildings (Özyürek, 2015). Furthermore, the Turkish government have arrested over 800 people linked with the HDP (Peoples' Democratic Party) and PKK in comparison to only around 100 from IS (Özyürek, 2015).

In 2025, the PKK leader, Öcalan, announced the dissolution of the PKK saying, "I believe not in arms, but in the power of politics and social peace, and call on you to put this principle into practice." This may show his belief that the PKK has been unsuccessful in its long-term effectiveness to advance Kurdish rights in Turkey, by calling for a new, more diplomatic approach to be pursued by the Kurds for their rights (Karatas, 2025). Another reason to support the argument that the PKK was not effective in the long term, is that many countries continue to view the PKK as a terrorist group due to alleged human rights violations (GOV.UK, 2023). However, the PKK may have been successful in other ways. The pressure they exerted through armed struggle and the ability to negotiate ceasefires, did help to create a bit more freedom for the Kurdish people in Turkey. For example, bans on the Kurdish language and Newroz were both lifted within the first eight years of the Turkey-PKK conflict.

Legal challenges

In the 1990s, Kurdish lawyers appealed to smaller courts and eventually the ECtHR about human rights violations against the Kurdish people by the Turkish Government. Kurban (2020) stated that: "The Court's rulings broke new ground by holding that unacknowledged detention is a 'complete negation' of the right to liberty" (p.258). This was one of the early cases brought to a supranational court, creating new arguments to counter the Turkish government's transgressions against the minority Kurdish population in Turkey.

The Turkish government continued to violate Kurdish people's rights, even with ECtHR litigation to try and prevent this. Unfortunately, due to the lack of training and education of Kurdish lawyers, the legal route was not as successful as it might have been, leading to weak cases and arguments against Turkish lawyers. Distrust between Turkish and Kurdish lawyers limited legal community collaboration so that stronger challenges were not mounted against the Turkish government for their abuses, and opportunities were lost to create actual change for the oppressed Kurds.

Conclusion

The political strategies used to try and advance Kurdish rights in Turkey were mostly unsuccessful. Most attempts were rarely peaceful, and if peaceful, were not executed as successfully as they could have been. The Republic of Ararat emphasised the lack of political power held by the Kurds. The PKK tried to negotiate with the Turkish government. However, the PKK was too violent and unwilling to adjust, meaning they made it harder for themselves and future generations to be able to develop and leverage power and respect into something beneficial for Kurdish rights. The appeal from Kurdish lawyers to the ECtHR had high potential, but was not executed appropriately, and did not change the Turkish view of Kurds.

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How do the modern-day structures of schools inhibit environments of abnormal levels of carbon dioxide, which directly impact cognitive function? by Aiden H.

Introduction

Many individuals understand the consequences that increased carbon dioxide levels have on a global scale (such as global warming, which then leads to climate change through various processes). However, not as many people are aware of the localised impact that carbon dioxide levels have beyond climate change, even though this is an effect that impacts us more directly: our cognitive abilities. Although majorly not influenced by rising carbon emissions, the average person is unaware of this phenomenon, which is especially concerning, as 87 per cent of our time alive is spent indoors, according to the National Human Activity Pattern Survey (Klepeis et al, 2001). Furthermore, with the increasing volume of carbon dioxide in our atmosphere through anthropogenic emissions, this issue that is widely unheard of, will exacerbate.

The basics: what is carbon dioxide, and what impact does it have on our bodies in natural environments?

Carbon dioxide is a naturally occurring odourless, colourless gas that makes up only 0.04 per cent of the atmosphere (Cho, 2019). Carbon dioxide is extremely important in regulating the Earth's atmospheric temperature as a greenhouse gas, trapping solar energy that reflects off the Earth's surface instead of letting it escape into space (Velev, 2025). Natural releases of this gas include respiration, outgassing (escaping from the mantle and out of the crust; for example, volcanic eruptions), decomposition, wildfires and, of course, anthropogenic combustion (Herring, 2020). Despite the small concentration of carbon dioxide in the atmosphere, the trace 0.04 per cent composition, or 423.9 ppm (as of 2024) does enter our lungs with the other gases we breathe in, such as oxygen, nitrogen, argon and so forth (World Meteorological Society, 2025). If the holistic composition of the atmosphere is maintained, then this volume of carbon dioxide entering our body is not harmful and, in fact, is very important in maintaining homeostasis. For example, it is essential for regulating blood pH, respiratory drive, and haemoglobin's affinity for oxygen (Patel et al, 2022). Although carbon dioxide levels have peaked in recent years at 423.9ppm in 2024, compared to the average 280 ppm seen before the industrial era (Mulhern, 2020), this concentration is nowhere near enough to have a detrimental effect on the cognitive ability or health of humans.

Why are enclosed spaces, such as classrooms, reporting much greater levels of carbon dioxide than the natural environment?

Carbon dioxide levels can increase in areas with poor ventilation and large sources of the gas, such as respiring animals. This is made worse when these environments are small and enclosed, such as an internal space, and lots of respiration is occurring (Morris, 2025). These are descriptions that can be attributed to many school buildings, not just around the United Kingdom, but all over the world. Depending on the size of the school and the number of students (typically 26-32 students in a classroom up to GCSE (National Education Union, 2024)), levels of carbon dioxide can rapidly accumulate and reach levels that disrupt cognitive function. Teachers often criticise students for acting sluggishly in class or looking uninterested and demotivated, but this may be attributed to the impact of carbon dioxide. The true effects of this concentration of gas can be greatly demonstrated by Kurtis Baute and his experiment to seal himself in a ‘jar’. Using a homemade biodome (30,000 litres volume), he stopped all external air from getting into his habitat and used 2000 plants to provide him with oxygen, so he did not suffocate. The three-part series released on YouTube greatly demonstrated the impact of high levels of carbon dioxide, such as dizziness, lack of coordination, and nausea, when carbon dioxide reached 6500 ppm (Scott and Baute, 2019).

So, what are the parameters of different levels of carbon dioxide?

As of 2024, natural environments sit at 423.9 ppm. Human cognitive function remains normal, as this is what our species is adapted to. In urban environments, this level can reach close to 500 ppm. At this level, cognitive ability remains sharp. The real issue is when carbon dioxide levels reach over 1000 ppm, a feature often

occurring in educational environments. Cognitive ability can decrease up to 15 per cent (Chao, 2012), which can create an environment for students to be less attentive in the classroom. Parts per million can exceed this, depending on the number of students, size of the room, and whether sufficient ventilation is present. Although beyond the scope of this investigation, it is still important to notice greater carbon dioxide levels than those seen in a classroom. Beyond 5000 ppm, it is imperative that people do not stay in these conditions for more than eight hours a day as long-term health issues can emerge. Pushing 15,000 ppm, this exposure should not last any longer than fifteen minutes to prevent damage to health (Health and Safety Executive, 2023).

What impact will rising carbon emissions have on our cognitive abilities?

By the end of the century, carbon dioxide is expected to reach anywhere between 425 and 1000 ppm, depending on predicted scenarios. If the worst-case scenario occurs, this could decrease our cognitive abilities by 15 per cent by just being out in open spaces. The increase in indoor environments would be far worse. Consider the potential impacts of this: technological advancements in the future may slow down due to this impairment, as critical thinking and innovation are disrupted.

What has been done in the United Kingdom to tackle the classroom issue?

In recent years, many schools have become aware of the contemporary issue of rising carbon dioxide levels in classrooms. In the United Kingdom, under the Conservative Government in 2021, a press release stated that "all schools to receive carbon dioxide monitors" (GOV.UK, 2021; no page) and by 2022, the Government had provided: "£25 million of funding to provide over 300,000 CO_2 monitors to state-funded education" (Service.gov.uk, 2022; no page). It is a good sign that, at least in some Western societies, this issue is being recognised and mitigations made for decreasing cognitive functions, although the effectiveness of this scheme is yet to be fully known due to the short time that this operation has persisted.

Conclusion

This article has brought to light the little-known impact of cardon dioxide on human cognitive functions. It is hoped that readers will now better understand the rising issues caused by carbon dioxide levels in classrooms, and how anthropogenic sources of carbon dioxide are exacerbating the issue. This is an area I want to explore further in my future practice, testing these theories and carrying out formal and primary research, to add to studies that have already published their results and contributed to the research for this article.

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