LAMBETH ACADEMY SCIENCE EDUCATION REVIEW

20 November 2020

Dear Readers

I am extremely excited to welcome you to the Science Department's very first LASER, Lambeth Academy Science Education Review, newsletter. I hope that all of you will learn something new that will open your minds to the beauty and the wonderful world of science, as well as the weird and bizarre abnormalities.

Science is there to explain everything we see, where it is real or fiction – can Spiderman's webs actually hold his weight? Or what would happen to any faeces left on the moon by our astronauts?

Coronavirus has impacted our lives in such a huge way this year and it is now more important than ever that we understand the importance of vaccines but also have the ability to understand the scientific evidence being presented on the news, or some of the news being reported. We need to be able to identify what news is incorrect or is even just 'fake news'!

Our Sixth Form science students work incredibly hard and are some of the most conscientious students in the school. They engage with so much science content outside of the school curriculum, whether that be attending lectures and online events or reading scientific articles and non-fiction books for enjoyment and pure interest.

This newsletter aims to highlight just some of the wonderful work they do and give you a snippet of their reports.

Enjoy the first of many news articles and if you would like to submit any readings or articles to me, please feel free to do so!

Ms Patel

Lead Practitioner of Science & KS5 Science Coordinator

Mass Extinction by Jacob Thompson 12L

Mass extinction is an intimidating word backed up by a very horrific reality where over a quarter of all living species on the planet die out in a short geological time. So what causes these frightful events and are we perhaps living in one right now?

To begin extinction is the scientific term for when all the individuals of a species no longer exist anywhere on the planet and a mass extinction event is where a high percentage of multiple species go extinct. In all of Earth's history there have been 5 confirmed mass extinctions and many scientists believe we are living in the 6th one today therefore I will review each mass extinction and then present evidence based on that to see if we are living in the sixth mass extinction.

The 1st mass extinction occurred 444 million years ago and is called the Ordovician-Silurian extinction, and this is named such because of the period in which the mass extinction occurred between. In this mass extinction all life was still in the oceans and because of global cooling and glaciation near to 85% of marine species went extinct. This happened because the super continent at the time (Gondwana) drifted into the north pole which resulted in a massive drop in temperature and a massive increase in glacial formation therefore reducing sea levels which in turn caused the extinction of many marine species.
The 2nd mass extinction to occur was the Late Devonian extinction around 365 million years ago and it saw the extinction of nearly 82% of all species on Earth. The main believed cause of this mass extinction is incredibly plants which many ecologists like Professor Thomas Algeo believe could have caused what can only be compared to widespread eutrophication. This is because the plant life had grown to such an extent on land that the soil that was being uprooted by the fauna (plant life) into the ocean was causing an increase of bacteria and algae within the ocean which in turn leads to an increase in oxygen intake and the suffocation of many marine species this is called ocean anoxia. This isn't a confirmed reason as to why this extinction happened as many marine species that require large amounts of oxygen to survive like sharks but still survived the extinction.

The 3rd mass extinction to occur was the Permian-Triassic mass extinction which happened approximately 250 million years ago and is the worst extinction event to happen in all of history which resulted in the extinction of over 95% of marine species on the planet and 70% of land species which is the reason it is common called “The Great Dying”. The causes of which was a series on incredibly powerful volcanic eruptions on what is today mainland Europe around Siberia which caused a massive influx of greenhouse gases into the atmosphere which then caused incredible rapid climate change of up to an increase of 10 Degrees Celsius. This caused ocean temperatures to increase rapidly killing off many marine species but also this rapid increase in temperature resulted in the removal of oxygen from the oceans further killing off many marine species. Furthermore, due to the high acidic gas concentration in the atmosphere, there was also a large increase in acid rain resulting in the extinction of most of land animals and fauna. Another fact is that this extinction was so deadly it is the only known extinction of insects.

The 4th mass extinction is named the Triassic-Jurassic mass extinction and occurred only 40 million years after the Permian mass extinction around 210 million years ago and saw the extinction of 76% of Earths species. The causes can be contributed to the breaking of the super continent Pangea which released large amounts of CO2 into the atmosphere resulting in massive global increase of temperature and a period of anoxia once again. However, dinosaurs were able to thrive in this environment because of their evolved respiratory system and would become some of the largest land animals in all of Earth's history.

The 5th mass extinction is called the Cretaceous-Tertiary mass extinction and only occurred 65 million years ago and is considered the most famous mass extinction which resulted in the extinction of dinosaurs and nearly 75% of all of Earths species. The main believed cause of this extinction event is that a massive meteor struck the Earth in Yucatan Peninsula of Mexico resulting in the displacement of massive amounts of dust particles into the atmosphere reflecting sunlight resulting in global dimming and the consequent death of all large dinosaurs. This however paved the way for the ancestors of all mammals and birds to evolve. This extinction is proved by high levels of Iridium in the sediment layer from that time period suggesting a meteor impact and a large crater found in Mexico.

Now here we are to the modern era where humans are now the dominant species on the planet and may even be causing the 6th mass extinction event which has already been named the Holocene mass extinction. There is much evidence to suggest that we are in an ongoing 6th mass extinction such as that current extinction rates are about 1000 times larger than the background extinction rates (the natural extinction rates before humans became a primary contributor to extinction) this has caused 80% of marine mammals, 50% of plants and 15% of fish have all gone extinct since the dawn of human civilization only 7000 years ago. On a geographical timescale this is just a blink of an eye and is a great cause for concern furthermore the large amount of CO2 being produced by human activity is also causing the ongoing extinction of marine mammals through the acidification of ocean waters. Which causes calcium-based shells to simply deteriorate and resulting in the extinction of many marine animals. Additionally, habitat destruction by machinery to gather resources like lodging or deforestation is causing many extinctions of land species approximately 137 which can have a devastating impact on any ecosystems or food chains that those species may have been a part of.

In conclusion I believe that it is undoubted truth that we are now living in the 6th mass extinction and that humans and the main driving factor resulting in the mass extinction of all these species. Therefore, we must learn to reduce these factors like CO2 pollution and habitat destruction to allow many land and ocean species to thrive and if we don't learn it would eventually lead to our self-destruction and the homo-sapiens would join the other 99.99% of Earths species that are now extinct.

Can You Travel Through Wormholes? By Christopher Tran 12A

Our universe is like a big flat sheet, bent in just the right way. Wormholes could connect two very, very distant spots with a short bridge that you could cross almost instantaneously. Enabling you to travel the universe even faster than the speed of light.

Presently wormholes are only found on paper. General relativity says that they might be possible, but that doesn't mean they have to exist.

General relativity is a mathematical theory consisting of a set of equations that have many possible answers, but not all maths describes reality.

These answers are theoretically possible. The first kind of wormholes to be theorised were Einstein's' Rosen Bridges. They describe every black hole as a sort of portal to an infinite parallel

universe. Empty space time is flat but curved by objects on it. If we compress that object, space-time gets more curved around it. Eventually space-time becomes so warped that it has no choice but to collapse into a black hole. A one-way barrier forms: the event horizon, which anything can enter but nothing can escape; trapped forever at the singularity at its core.

What happens if there is no singularity?

One possibility is that the other side of the event horizon looks a bit like our universe again but mirrored upside down, where time runs backwards. In our universe things fall into the blackhole. In the parallel universe, with backwards time, the mirrored black hole is spewing things out a bit like a big bang. This would be called a white hole. Unfortunately, Einstein's Rosen bridges cannot be crossed. It takes an infinite amount of time to cross over to the opposite universe and they crimp shut in the middle.

If you go into a black hole, you won't become the stuff coming out of the white hole,

You'll only become dead.

How to travel the cosmos in a blink of an eye:

Humans would need a different kind of wormhole, a traversable wormhole. If string theory or one of its variations is the correct description of our universe, then our universe could already have countless amounts of wormholes. Shortly after the big bang quantum fluctuations in the universe at the smallest scales far smaller than an atom may have created many traversable wormholes. Threaded through these wormholes are strings, called cosmic strings. The ends of these tiny wormholes were pulled light years apart, scattering them through the universe. If wormholes were made in the early universe whether with cosmic strings or some other way, they could be all over; just waiting to be discovered. One might even be closer than we realise.

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Observing the Shortest Interval of Time by Haifa Monadee 12M

Albert Einstein's special theory of relativity has been put into practice as scientists observe the shortest time intervals between two events.

Scientists have measured the shortest interval of time ever recorded as they measured how long it takes a particle of light to cross a single molecule of hydrogen. This took 247 zeptoseconds, according to a team of German researchers, with a zeptosecond representing a trillionth of a billionth of a second. (This is equivalent to the number 1 written behind a decimal point and 20 zeroes.)

These findings are important because it makes it possible to measure shorter and shorter time spans in physics and this offers scientists a way to precisely measure atomic changes through what's known as the photoelectric effect.

Albert Einstein proposed the theory of the photoelectric effect in 1905, describing the emission of electrons from atoms after they are hit by the light. In 1999, an Egyptian chemist, Ahmad Zewail, used ultrashort laser pulses to observe how molecules change their shape. He won the noble prize for his research and measured these minuscule changes in femtoseconds (one millionth of a billionth of a second).

The researchers fired X-rays from the PETRA III accelerator at a molecule of hydrogen, which is made of two protons and electrons. The scientists said they used a single particle of light (one photon), to jostle the electrons free. When the photon hit the hydrogen molecule, it ejected one electron first and then the second quickly after. The effect created waves in what's known as the "interference pattern" this allowed the scientists to accurately measure the electrons as they were escaping.

"since we knew the spatial orientation of the hydrogen molecule, we used interference of the two electron waves to precisely calculate when the photon reached the first and when it reached the second hydrogen atom," Sven Grundmann, a Ph.D. candidate at Goethe university.

From the start to the finish, it took 247 zeptoseconds for the photon to cross the hydrogen molecule, though there is some variation depending on how far apart the atoms in the hydrogen are when they are hit by the photon, according to Grundmann.

The mysterious world of Sand by Keijo Danjuk 12M

Sand – one of the unsolved problems in physics. No one understands the true physics behind how sand works. It may be one of the hardest problems faced in physics, harder than quantum mechanics and general relativity. There are scientists out there who specialize in sand and other granular materials such as Karen Daniels, a physicist at North Carolina State University. He figures that one of the most challenging parts of finding a general formula is the fact that there are many different properties for sand: size, shape, roughness etc. Therefore, as an example, it's very hard to predict the time it takes for sands with different properties to go from the top of an hourglass to the bottom because they will flow at different rates.

LASER

Understanding the physical properties of sand is not enough though. You also must look at how they are organized. For example, loosely packed grains will be able to slide making them soft whereas closely packed grains will have no room to rearrange therefore making it firm, which also brings on to the shape of the grains. When a grain is spherical with smooth edges, it can slide past other grains quite easily making it feel soft, whereas when it's an odd shape with very rough edges, the grains instead of sliding past each other may get stuck onto each other therefore as well making it feel firm. This brings onto explain while the surface sand layers are much easier to dig than the layers underground as the grains in the deeper layers are pressed much closer together.

Sand is just one of those problems that many of the scientists don't like. It's not a matter of not trying to find the correct solution to the problem, it's a matter of we aren't just that good at it, but even if we don't know the solution, we aren't completely unaware of the mystery of sand. There are surrounding factors that affect sand as well, such as moisture from cold air. The moisture causes smaller sand grains to stick together which causes the material to feel very clumpy and firm.

There are a few examples of the softest granular materials, but one in particular "Q-Cell" which was said by Dr. Daniels to be the one of the softest granular materials that they had ever touched, but although it may be one of the softest, it's not the most pleasant as its more of a powder than more of a sand as the grains are much further apart. Therefore, inhaling it can be extremely hazardous to your lungs. Truly the best type of sand is the one that has all the properties required to make it nice to walk on and doesn't make it more of a dust than sand. So overall, as there are so many factors to consider when finding a general formula of sand, you need a lot of experimental data, only further research will tell us the solution. The solution will just take a matter of time. We may not understand it now but we may understand it in the future.

Dr Schrodinger's: The Cat in the Box by Jack Downie 13A

You have a cat, a box, a Geiger counter, a hammer, a radioactive substance and some poison. What does this give you? Well according to Nobel prize winning scientist Erwin Schrodinger – you have a statement on existing quantum particle theories. The question he asked was (essentially) as follows:

"If you place a cat in a closed box with a contraption such that when a radioactive substance decays, a Geiger counter causes a hammer to break a bottle of poison – if the radioactive substance decays every hour, without opening the box, would the cat be dead or alive after an hour?"

According to the Copenhagen interpretation of quantum mechanics, the cat would be simultaneously dead and alive – as this occurred in a closed system. The Copenhagen Interpretation is the idea that a quantum particle exists in all possible states at

once, until being observed – where it then has to choose one state. When observed at different times, the particle may be in one of its other states – explaining why quantum particles seem to be erratic. For context Schrödinger wasn't the biggest fan of this interpretation of quantum mechanics, hence why he came up with this disturbing idea of killing a cat in a box in the first place. In his own words "One can set up quite ridiculous cases" when referring to explanations of the Copenhagen interpretation. The thought experiment is intended to show how simple and general the Copenhagen interpretation is and that it can't be applied to everyday objects – such as a cat.

Despite this an undergraduate student and their physics professor at Hiroshima University, Japan and Indian Institute of Technology Bombay have come up with an idea of how to look at the 'cat' with out disturbing the quantum system. You would think that you could just take a photo of the cat, however, as put by Holger F. Hofmann (the lead author of the study) "In order to look you need light … a single photon of light can transfer energy away from the object you are viewing." causing a disturbance in the system. This has been deemed as the 'price you pay for looking'

The study focuses on an idea of looking without "paying the price" of doing so. They came up with the idea – in the context of Schrödinger's cat – of placing a hypothetical camera outside of the box that can somehow take an image of the situation inside the box. Once the image has been taken, it contains two pieces of information: how the cat has changed as a result of the photograph being taken and whether if the cat is alive or dead. Developing this image in such a way that the cat may remain in its alive and dead state, the system won't be interrupted.

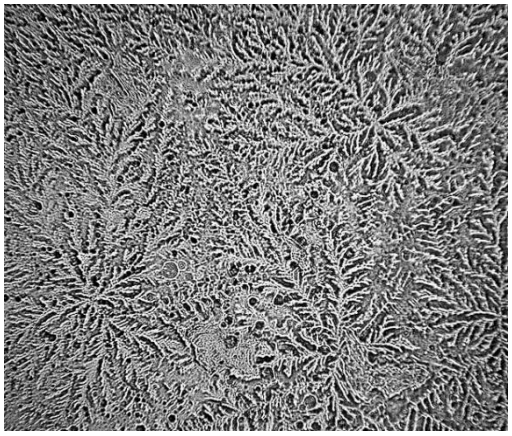
Their idea is to develop the image with a low resolution – causing the measurement (being whether if the cat is alive or dead) to not disturb the whole system due to the measurability of the image decreasing due to a low resolution. To put it simply, the resolution of an image is proportional to its disturbance.

In summary this idea shed new light on the study of quantum particles – where a lower resolution measurement causes less disturbance to the system. Where this may not solve any current issues, it does open up further understanding of quantum particles and their behaviour. Where it doesn't fully crack the enigma of quantum physics, it does chip a piece of its obscurity away. Many of you may wonder why this maybe important to you – "How would a sadistic cat thought experiment envisioned by a man over 80 years ago and how to measure it affect MY life?". Well the truth is that it may not in terms of the present. You can go on with your merry day not having to worry about it. But in terms of the future, the understanding of quantum particles and their behaviour may answer the simple yet complex questions we have about why many things are how they are, where they came from and why they behave in this way. What is the universe? How did it happen? Why did it happen? All of this could be answered with reference to a cat, a box, a Geiger counter, a hammer, a radioactive substance, some poison and a low-resolution image.

The Secret our Tears Hold by Pilar Perez Olivera 12B

What are tears? In normal terms tears are a product of crying. However, tears are more complex than just a fluid from our eyes excreted when we cry. Tears aid with lubricating the eyes when they become dry; removing irritants such as dust; and aiding the immune system from pathogens entering our body. Tears also occur to aid with pain.That means that tears are composed of different chemicals to help us combat these problems.

But, are all tears the same? Do all tears hold the same chemical properties? No. There are variations of tears in order to serve the different types of functions the tears have. Each type of tear has its unique chemical composition to best suit the situation and hand. It makes sense, just as in real life you would choose different types of clothing to best fit the climate and setting.



Tears have been categorized into three different types of tears- psychic tears caused by emotional situations, basal tears released periodically to keep the cornea lubricated and reflex tears that are released in response to an irritant. Even in these subsections tears can vary a lot.

Most tears contain oils, antibodies and enzymes- but they have different chemical composition. In the case of psychic tears, they contain a natural painkiller called leucine enkephalin which is released when the body is under stress.

Understanding the chemical composition is important- not just because it is interesting and gives us an insight to our body's coping mechanisms- but also because it can help us to treat diseases. Tears have so many key functions - unlocking them can prove very useful in the future to combat diseases- physical and mental

STEMM FUTURES

The Outreach team at Imperial College London will be holding a four- part webinar series called STEMM Futures for young people of Black African and Afro- Caribbean heritage in Year 7- Year 13 who are interested in science, technology, engineering, mathematics and medicine. As Black people are currently underrepresented in STEMM we recognise that it can be hard for young Black students to understand what their next steps should be. These webinars will be a fantastic opportunity for students to find out more about studying at university, future career options, and speak to current Imperial students. They will take place every Saturday from 21st November- 12th December.

Discover Imperial **Saturday 21 November, 14.00–15.00**	This session is aimed at students in **Year 7–Year 13**.
Choose your future in STEMM **Saturday 28 November, 14.00–15.30**	This session is aimed at students in **Year 7–Year 13**.
Careers showcase **Saturday 5 December, 14.00–15.00**	This session is aimed at students in **Year 7–Year 13** and is run in partnership with Women in the City Afro-Caribbean Network.
Goal Setting & Revision Techniques **Saturday 12 December, 13.00–15.15**	This session is aimed at students in **Year 10–Year 13** and is run in partnership with The Ladder Project. Students from other year groups are also welcome.