PULSE

Science magazine

COSMETIC CHEMISTRY

What are you really putting on your skin?

MINING

How damaging to the environment is it?

HAPPY HORMONES

What is happiness to your brain?

Dopamine Crystals
Image source: Karl Gaff, 2018

North London Collegiate School
Founded 1850

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COSMETIC CHEMISTRY: SURFACTANTS AND MICELLAR WATER

Surfactants (or surface-active agents) are simple compounds with a hydrophilic head and a hydrophobic or lipophilic tail: the head of the compound is attracted to water, and the tail repels water and attracts oil. Concentrated at the interfaces between bodies or droplets of water and those of oil, surfactants behave as an emulsifying agent, creating self-assembled molecular clusters called micelles in a solution. (Micelles act as a loosely bound aggregation of several discrete atoms or molecules, forming a single colloidal particle.)

Usually the molecules of the substances called surfactants have an alkyl chain with around 8–22 carbons. This chain makes up the hydrophobic group, which does not show affinity to water. The surfactant molecules also have a functional group called the hydrophilic group that has affinity to water. This kind of structure with two opposing functions is called an amphiphilic structure.

When surfactants are added to an oily dish, for example, and then scrubbed with water, they help it break lipids up into droplets or *emulsion droplets.* They surround the oil and hide it from the water, allowing it to be smuggled out and washed away to leave a clean surface. Surfactants are the key ingredients in micellar water, as well as in detergent, soap, shower gel, face wash, shampoo etc. When enough surfactant is added to water (more than the *critical micelle concentration* or CMC), the surfactant molecules assemble themselves into clusters called micelles. These micelles are spherical arrangements of surfactant molecules, with the tails pointing in and the heads facing out – this means the hydrophobic tails are protected from the water by the hydrophilic heads.

The micelles aren't bound together into a molecule, which means they are able to rearrange easily. When you soak a cotton pad in micellar water, the micelles come apart and the heads of the surfactants bind to the pad (which is made of cellulose, a hydrophilic substance). This leaves the hydrophobic tails exposed. When you swipe your face with the pad, the tails attract themselves to any hydrophobic substance on your face – dirt, oil, makeup. The reaction is instantaneous, and the hydrophilic heads re-attach themselves to the cotton pad quickly after the tails have bound to the dirt on your face.

If the micellar water is poured onto a cotton wool pad, for example, it rearranges into an oriented monolayer - the heads are stuck to the cotton wool (made of cellulose, which is hydrophilic), and the tails stick out. When you wipe off the make-up with the cotton pad, the layer of lipophilic tails absorb the oil-based make-up.

AUTHOR: Danica

SOURCE: https://www.sciencedirect.com/topics/chemistry/surfactant
https://www.britannica.com/science/micelle

MINING

How is extracting materials from underground harmful to the environment?

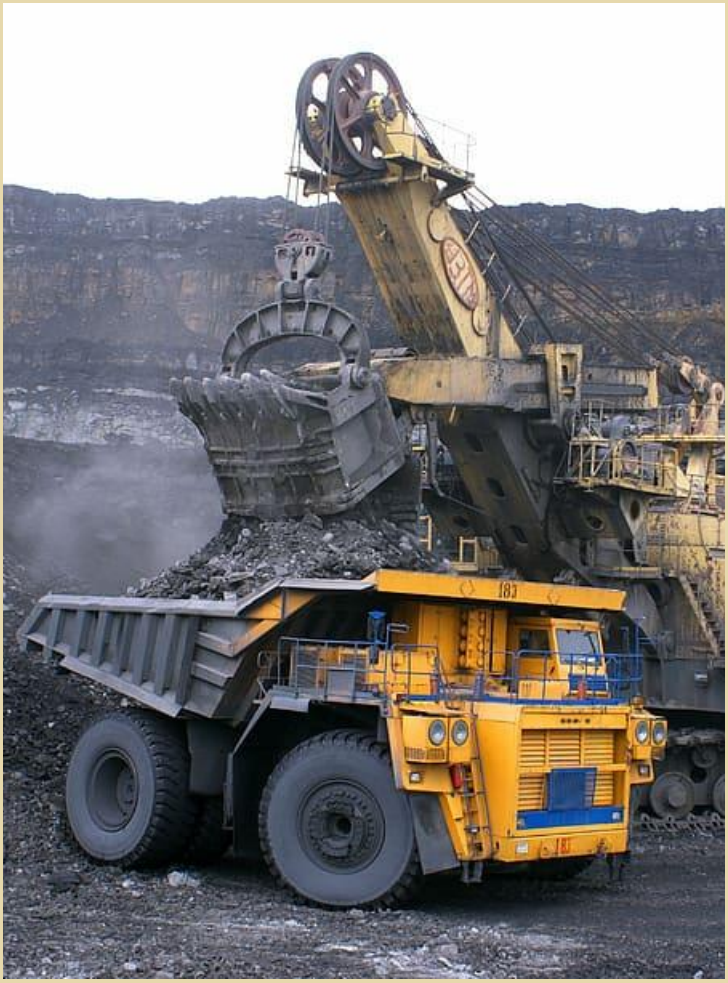
Lots of people don't take into consideration the effects of mining materials from the earth impact the environment and human health overall.

Extract these materials are underground mines established in areas with ore deposits. Iron ore deposits normally lie deep underground. A shaft must be dug from the surface and an elevator or hoist must be installed. The shaft is the channel through which people and ore are transported in and out of the mine. Most iron ore leaves the mine by rail, after which, much is transferred to ships. Another way is when the iron ore lies close to the surface, it often can be uncovered by stripping away a layer of dirt, sometimes only a few feet thick. The wide holes in the ground are created by drilling, blasting, and mining is then referred to as "open pits' '.

Mining can pollute air and drinking water, which harms wildlife and habitats. Pollution compromises water supplies and increases costs as more water becomes contaminated and to make water safe for consumption/agricultural use. Mining large amounts of ore that contains precious metals, such as gold, silver, iron and other sulphides can have bad impacts on the environment.

When sulphides in the ore are exposed to water and air, sulfuric acid is created, which can seep into waste rock piles which lead to streams, rivers, and groundwater (which is called acid mine drainage). Acid mine drainage also leaks toxic metals, (arsenic, cadmium, chromium, lead,), causing additional water pollution. Sometimes acid mine drainage, such as mercury, can stay in the environment for decades. Wildlife can then be poisoned after drinking contaminated water in ponds, rivers and lakes. This can kill trout, salmon, and other aquatic organisms.

Tons of rock are unearthed in mining, increasing the amount of dust/particulates in the air. Air pollution can form for all types of reasons; the main reasons for air pollution are industrialization/ burning of fuels. In addition, mine tailings, which may contain finely ground and even toxic waste, can become airborne. Air can react and undergo complex chemical reactions to form air pollution when in the atmosphere, which can affect human health.



It increases the risk of respiratory infections, heart disease and lung cancer. Short and long term exposure to air pollutants have been associated with health impacts. The most health-harmful pollutants – closely associated with excessive premature mortality – are fine PM2.5 particles that penetrate deep into lung passageways (particulate matter is the term for particles found in the air, including dust, dirt, ect). Particles less than 2.5 micrometres in diameter are known to be "fine" particles and pose the greatest health risks. Because of their small size, fine particles can lodge deeply into the lungs.

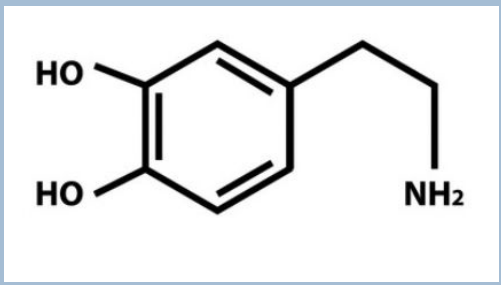
In conclusion, the effects of mining materials from the earth impacts the environment and us more than we would think they do, which is why it is so important to educate people about this harmful environmental problem.

AUTHOR: Ella Mountjoy

SOURCES: https://www.energy.gov/sites/prod/files/2013/11/f4/iron.pdf
https://wman-info.org/resource/environmental-impacts-of-mining/
https://www.who.int/news/item/15-11-2019-what-are-health-consequences-of-air-pollution-on-populations

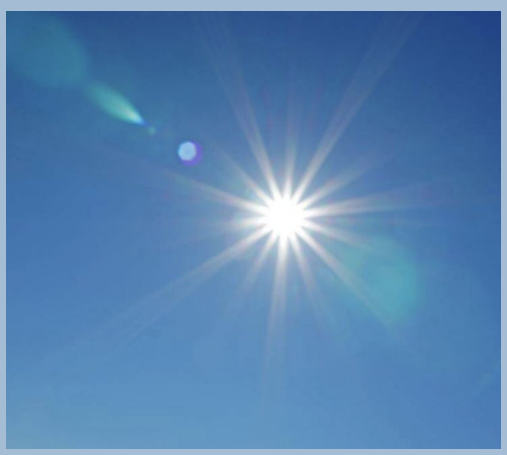
HAPPY HORMONES

Hormones like dopamine, oxytocin, serotonin and endorphins are known as Happy Hormones. You can boost levels of these with some simple lifestyle changes, like diet, exercise, and meditation, and possibly improve your mood in the process.



Dopamine plays an essential part in your physical movement but is also crucial to your general well-being. For example, it helps you feel pleasure, like for example when you eat something delicious or hear your favourite song. It is also heavily involved in the brain's reward system and influences motivation.

Oxytocin is a hormone that's produced in the hypothalamus and released into the bloodstream by the pituitary gland. Its main function is to facilitate childbirth, which is one of the reasons it is called the "love drug" or "love hormone." Oxytocin can induce anti-stress-like effects such as reduction of blood pressure and cortisol levels, it can be triggered by calming and/or social activities.



Serotonin is a chemical nerve cells produce. Serotonin helps stabilize moods, regulate feelings of well-being and happiness, regulate anxiety, and control sleep. The 4 natural ways of boosting your serotonin are; sunlight, massage, exercise, and remembering happy events.

Endorphins are the body's natural painkillers. Endorphins are released by the hypothalamus and pituitary gland in response to pain or stress, this group of peptide hormones both relieves pain and creates a general feeling of well-being. Cardio, moderate exercise, and weight training can all signal your brain to release endorphins

AUTHOR: Malia Tom

SOURCES: Samitivehospitals.com. 2022. *8 key factors behind the production of happiness hormones*. [online] Available at: <https://www.samitivejhospitals.com/article/detail/happiness-hormones> [Accessed 30 May 2022].
Healthline. 2022. *Happy Hormones: What They Are and How to Boost Them*. [online] Available at: <https://www.healthline.com/health/happy-hormone> [Accessed 30 May 2022].

UNIQUE MORPHOLOGY OF THE HUMAN EYE

AUTHOR: Maeji Son

"You look clueless" ;This will be your very first thing to say when you see your friend move their eyes back and forth, staring at you blankly. Likewise, we tend to guess people's emotions through their eyes, such as fear indicated by wide open eyes. However, this is a unique morphology of the human eye, as other species cannot identify nor visualize emotions through the eye. When you compare the eyes of various animals with the eyes of humans, you can notice that unlike other species, humans have sclera - a protective layer that encloses the entire eyeball, apart from the transparent cornea at the front of the eye. Unlike any other animals, the human sclera is very white and horizontally wide, so much of the sclera is exposed as the melanin cells in the sclera are almost non existent in the front half of the eyeball. This allows one to see where the person's eyes are facing by looking at the person's eyes, yet why did humans adapt to its characteristics?

According to Tokyo Institute of Technology's research, carried out in 2001, humans have evolved to develop non-verbal communication to ensure their safety when hunting. As a quick flick of eyes from a hunter full of fear could alert a danger to other hunters, its trait has been formed to allow humans to detect and follow another's gaze while communicating as a group. This is called a 'cooperative eye hypothesis,' where one can recognize the other's emotion even in unconscious situations through the direct eye contact with the presence of white sclera. As human beings have eyes with a distinct color contrast between the white sclera, the coloured iris, and the black pupil, this visual contrast allows them to be easily aware of social reactions.

This acted as a significant defense mechanism to primitive man, who had to hunt as one huge group for their living, as they were able to sense the danger quickly and prepare for an emergency just by a single look without any verbal warning. Through this social response, primitive man increased their chance of survival. This need for sensitivity could also be explained by our daily lifestyle context, while working together on tasks. For example, what could happen if someone is chatting in front of the door with friends before class starts and suddenly, your friends stare at your back all googly eyed? You would instantly notice that your professor might have arrived. Similarly, this immediate reaction plays a key role in human's communication, uniquely characterized by our white sclera. Then, are we the only animal that has been adapted to have this trait? If you look at the graph above, you can see that the difference in hue between the sclera and the pupil is almost as large as the orango abelii, the gorilla, and the homosapiens. Through this, we can infer that its trait has been adapted in highly social and intelligent animals that require immediate communication for their survival.

Thus, one can argue that humans were adapted to make social communication advantageous for hunting while other animals such as lions and bears were physically adventaged in their claws to hunt their prey as they do not require any communications.

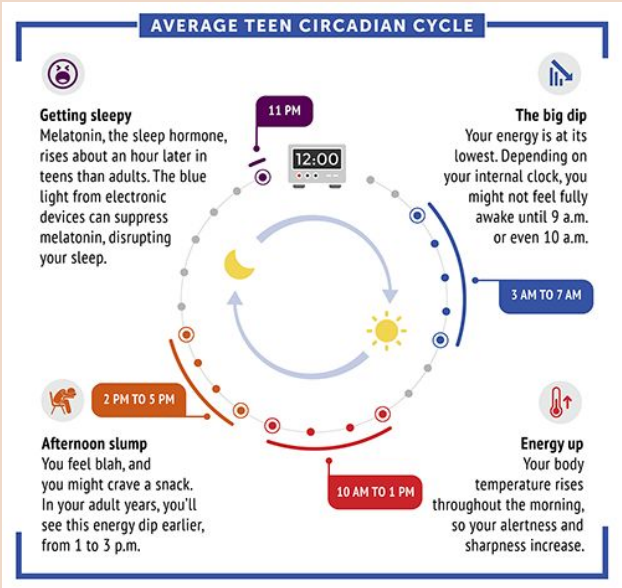
SOURCES: Dan-Ning Hu, Shen Yao, Codrin E. Iacob, Jerome Giovinazzo, Richard B. Rosen, Hans E. Grossniklaus & Jodi Sassoon (2020) Quantitative Study of Human Scleral Melanocytes and Their Topographical Distribution, Current Eye Research, 45:12, 1563-1571, DOI: 10.1080/02713683.2020.176778

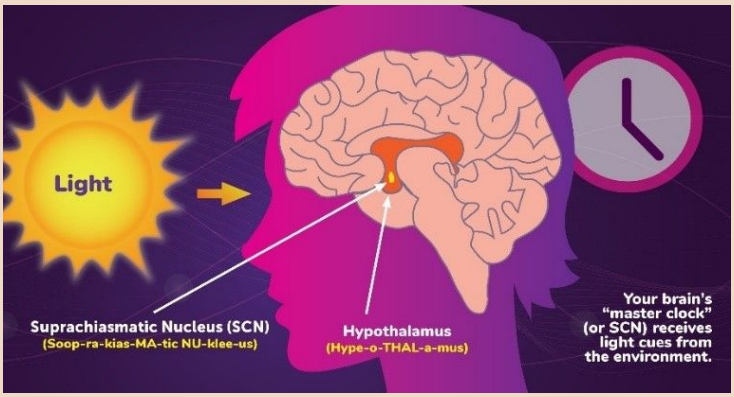
CIRCADIAN RHYTHMS AND CHRONOTYPES

Biological rhythms are a series of bodily functions that regulate the body's internal clock, and controls cycles such as sleep, wakefulness, body temperature, hormone secretion, etc.These rhythms are affected by eating habits, light exposure and other environmental cues, meaning not maintaining these biological rhythms can lead to serious health issues.

Cycles usually cycle in 24 hour periods, though some – such as the menstrual cycle – can last longer. Diurnal cycles lasts day and night, circadian rhythms last 24 hours, ultradian rhythms last more than 24 hours, circalunar cycles last for 1 month and circannual for 1 year.

Chronotypes are the natural inclination of the body to sleep at a certain time. different chronotypes include early birds – people who have more energy in the morning and less later in the day – and night owls – people who have more energy later in the day than in the morning. This makes it easier for early birds to wake up and harder for night owls to wake up, but night owls are able to stay up later than early birds. Chronotypes fall on a spectrum , and people in the middle are often referred to as "hummingbirds". These chronotypes depend on someone's age, genes, geographical location, etc. Chronotypes are different to circadian rhythms, as circadian rhythms can be "trained" whilst chronotypes tend to be more permanent.





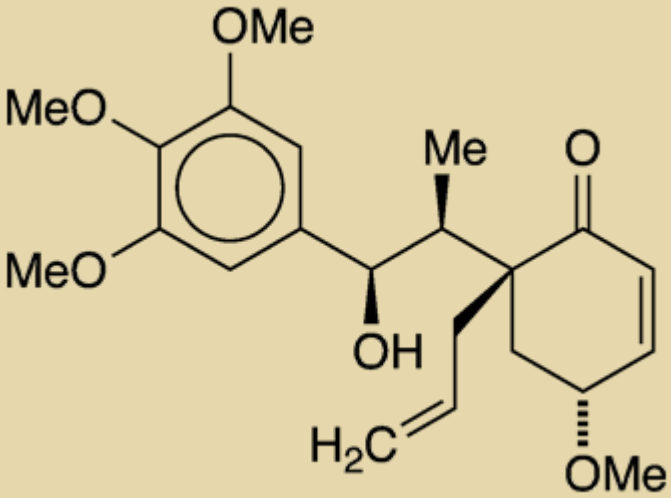
20,000 nerve cells make up the suprachiasmatic nucleus in the brain that sits in the hypothalamus and controls the body's circadian rhythms. Light is the largest factor when it comes to circadian rhythms as the nerves link the eyes directly to the brain. Having less light in an environment causes the eyes to signal to the brain to produce more melatonin (the hormone that regulates the sleep-wake cycle), and produce less melatonin when there is more light in an environment.

Circadian rhythms change naturally as someone ages, though external factors such as blue light from devices, travel (jet lag), extra sleep, night shifts, menstrual cycles, etc. all have a lasting impact on the circadian rhythms of the body. Although the circadian rhythm is hard to control, changing habits such as limiting screen time, taking fewer naps, doing more exercise, etc. can help reset the circadian rhythm of the body. By knowing your chronotype as well as how the circadian rhythm works, you can improve your productivity as well as sleep quality and quality of life in general.

AUTHOR: Karina Gunawan

SOURCES: https://www.webmd.com/sleep-disorders/find-circadian-rhythm
https://nigms.nih.gov/education/fact-sheets/Pages/circadian-rhythms.aspx.
https://www.webmd.com/a-to-z-guides/what-are-biological-rhythms
https://www.sleepfoundation.org/how-sleep-works/chronotypes

MOLECULE OF THE MONTH



Can you guess the molecule of the month?

Work through the clues to solve the mystery. If you solve with the help of just the first clue - well done, your chemical knowledge is on par with members of the american chemistry society. If you need a few more clues, don't worry, we won't judge! And if you are left in the dark after reading all the clues, scan the QR code to find out the answer and learn more about the molecule.

CLUE 1: My name is associated with high school cheerleaders

CLUE 2: I am named after a South American Laurel tree

CLUE 3: My chemical formula is $C_{22}H_{30}O_6$

AUTHOR: Mrs Parker

SOURCE: https://www.acs.org/content/acs/en/molecule-of-the-week/archive/m/megaphone.html

SCIENCE IN THE NEWS: HAMSTER MASSACRE

The Covid-19 pandemic has influenced the daily activities of countless lives across the globe, including hamsters. As of February 2022, pet hamsters in Hong Kong are suspected of transmitting the Delta variant of SARS-CoV-2 to humans. The Hong Kong government made the decision to cull over 2,000 hamsters as an effort to contain the situation, preventing further transmissions. ("Hong Kong Hamster Cull Necessary to Prevent 'Another Disaster', Expert Says").

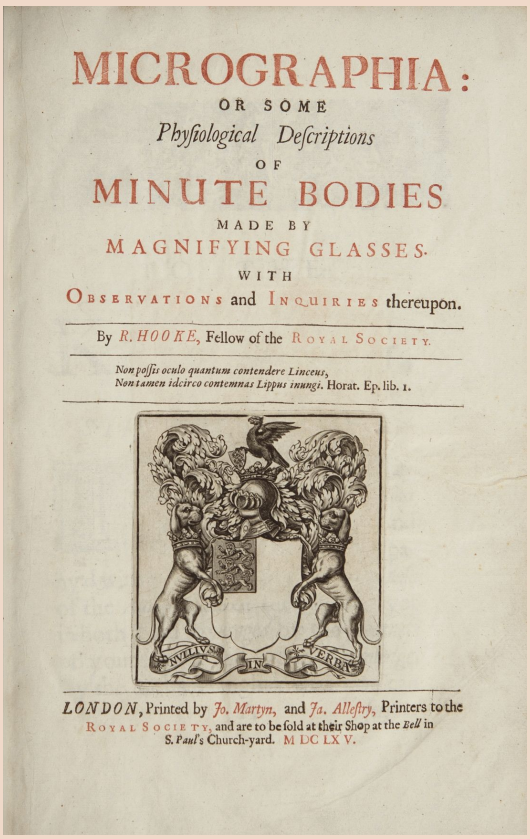
The outbreak is suspected to be a result of the virus being transmitted from human to hamster while an infected individual visited the pet shop, which consequently led to a cluster of Covid-19 cases. According to Nature, hamsters are highly susceptible to SARS-CoV-2, and are used as a model to conduct research on the virus. Research findings proved that the virus can be transmitted from human to hamster and vice versa (Mallapaty). According to Leo Poon, a virologist at the University of Hong Kong, people are still more likely to transmit the virus to each other than to be infected by pets. However, he believes that it is something worthy of being taken note of (Yen et al.). The pandemic seems to have impacted more than just society, but also the lives of our furry little companions.

AUTHOR: Janaine Ho

SOURCES:www.nature.com/articles/d41586-022-00322-0, 10.1038/d41586-022-00322-0.
www.scmp.com/news/hong-kong/health-environment/article/3164000/hong-kong-hamster-cull-top-covid-19-expert
papers.ssrn.com/sol3/papers.cfm?abstract_id=4017393

MY FAVORITE SCIENTIST – MRS PARKER BIOLOGY

Robert Hooke was perhaps one of the most important scientists from the 17th century, yet most people have never heard of him. He should be celebrated in the wall of fame alongside Darwin and Einstein, but sadly he is not.


MICROGRAPHIA:
OR SOME
Physiological Descriptions
OF
MINUTE BODIES
MADE BY
MAGNIFYING GLASSES.
WITH
OBSERVATIONS and INQUIRIES thereupon.
By R. HOOKE, Fellow of the ROYAL SOCIETY.
Non possis oculo quantum contendere Linceus,
Non tamen idcirco contemnas Lippus inungi. Horat. Ep. lib. 1.
LONDON, Printed by Jo. Martyn, and Ja. Allestry, Printers to the ROYAL SOCIETY, and are to be sold at their Shop at the Bell in S. Paul's Church-yard. M DC LX V.

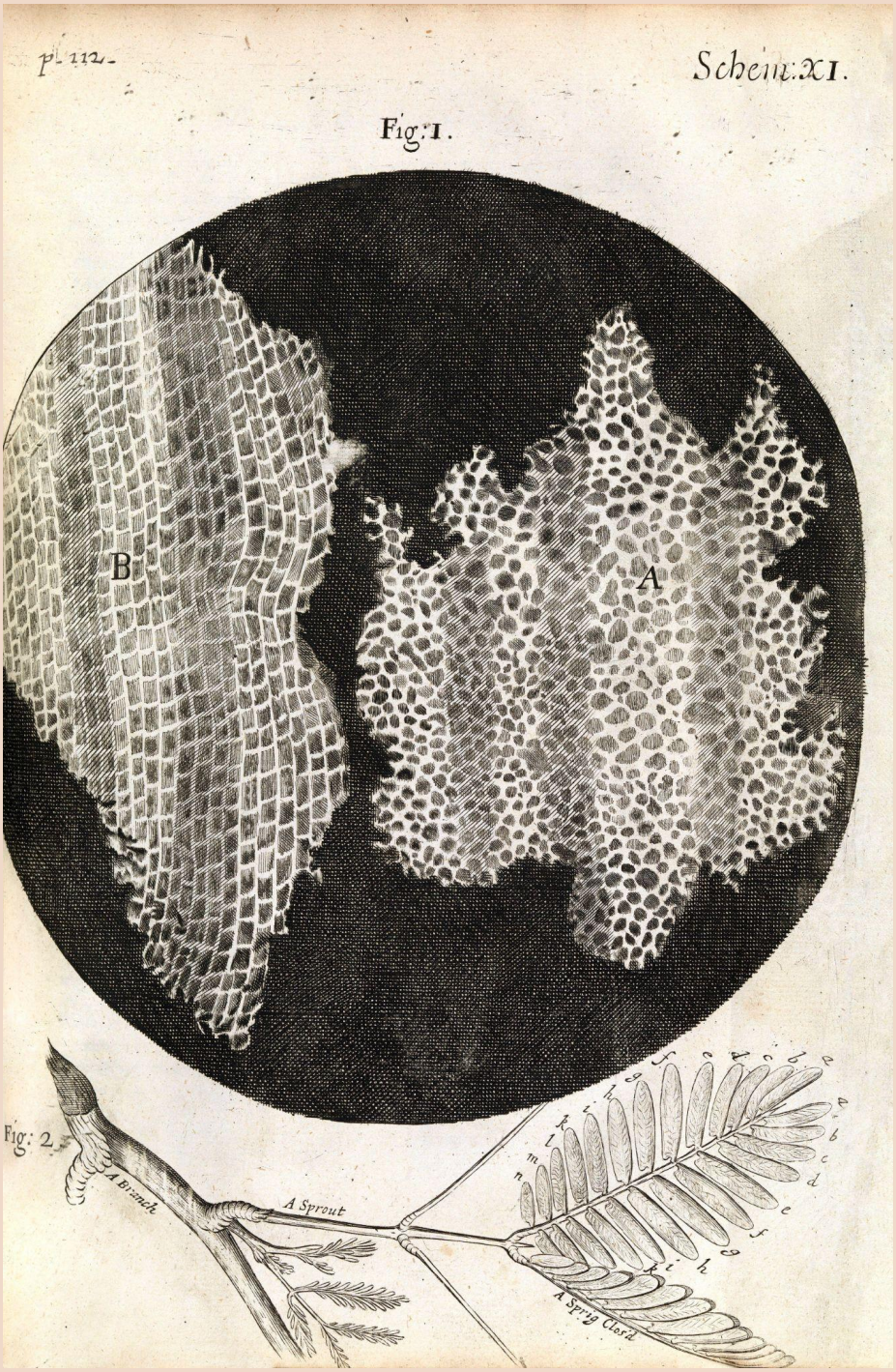
He was born in 1635, on the Isle of Wight in England. He lived a modest childhood and suffered much ill health which led him to miss lots of schooling. Sadly he was orphaned at just 13 years old, and he bravely used his inheritance to travel up to London and seek work as an apprentice. Once in London he joined Westminster School and quickly excelled at his academic studies. With the encouragement of his Headmaster, he secured a full scholarship for Oxford University in 1653, aged 18.

At Oxford he worked as a research assistant for Robert Boyle, who was investigating gas pressure theories. Boyle's Law is based on Hooke's work with springs, compression and elasticity. Hooke was a talented mathematician and excellent at conducting experiments, in 1663 he was awarded his degree and began working at the Royal Society, later he was promoted to President of the Royal Society; a position he held for decades.

He began working with glass lenses to design a light microscope that was powerful enough to view tissue specimens. In 1665 he published his book "Micrographia" which quickly became a bestseller. He coined the term 'cell' for the first time ever and shared hundreds of hand-drawn illustrations of the microscopic details he could see with his microscope. Samuel Pepys called it "the most ingenious book that I ever read in my life".

He was also the first to build a new type of telescope, the Gregorian telescope, with which he was able to observe the rings of saturn. After the great fire that devastated London in 1666, he was appointed the City of London Surveyor and assessed his dear friend Christopher Wren in the designing of the Royal Greenwich Observatory, Monument and the dome of St. Paul's Cathedral.

Robert's career and life achievements make impressive reading, so why is he not a household name? His downfall was an intense rivalry with Isaac Newton. The two clashed bitterly and had opposing viewpoints about many scientific phenomena. Their conflict began in 1972 when Newton submitted his first paper to the Royal Society about light. Newton claimed that light was a particle but Hooke believed light to travel in waves. A number of scientists launched attacks on Newton's paper and methodology, but Hooke's were the most scathing. Tension exploded when Newton published his Principia in 1687, containing his Law of Universal Gravitation. Hooke had already suggested the planets were attracted to the Sun, and that this force of attraction got stronger the closer the objects were together. Newton was the first to create rigorous mathematical proof for this idea, but Hooke was convinced *Principia* would have been impossible if he hadn't first postulated about the attraction between celestial bodies.



After Hooke's death in 1703 Newton was elected President of the Royal Society. Some say he then went to great efforts to tarnish his predecessor's reputation. The only portrait of Hooke was removed from the Royal Society during Newton's presidency. As Newton's reputation grew, Hooke's deteriorated: a narrative forming that he was a bitter scientist unjustifiably trying to take credit from the work of others.

Hooke was most definitely an innovator, a great mind and contributor to the scientific community. Perhaps, even a support and mentor to some of the more famous names of that era. But sadly he failed to solidify his theories into something tangible and timeless, allowing his contributions to be overshadowed and credited to the other scientists that did take the time to prove the theories. Perhaps there is a lesson in this story that it it better to do one thing well, than to do many things but leave them unfinished.

THE NEUROSCIENCE OF GIVING UP

The phenomenon of psychogenic death has raised concerns within medical professionals for years. Previously known as “give-up-itis”, a psychogenic death is characterised by regression, resignation, and apathy, that ultimately ends up in one's death (Stumpfe, 1979). It is hypothesised that this occurs due to malfunctions in the anterior cingulate circuit located in the frontal lobes, which is responsible for motivation and goal-directed behaviour. This occurrence is not linked with depression or suicide, but rather a traumatic event that causes the individual to feel as if there is no escape (Bernshtein, 2018).

The five stages of psychogenic death are as follows: Social withdrawal, Apathy, Aboulia (lack of motivation), Psychic akinesia (unaware of acute pain), and Psychogenic death (Bernshtein, 2018). After a traumatic event, the individual may perceive no way past the trauma, causing their prefrontal cortex to release more dopamine than normal, inhibiting its release in the nucleus accumbens. This leads to energy-saving behaviours such as withdrawal and apathy (Leach, 2019)
A famous case of psychogenic death regards a cancer patient in 1992, whose family and doctor believed that he would die from cancer. However, in the autopsy after his death, it was revealed that the cause of death was not from cancer. Hence, Scientist Clifton K. Meador hypothesised that the cause of death was the patient’s imminent belief that he was going to die (MEADOR, 1992).

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However, in the autopsy after his death, it was revealed that the cause of death was not from cancer. Hence, Scientist Clifton K. Meador hypothesised that the cause of death was the patient's imminent belief that he was going to die (MEADOR, 1992).

Psychogenic death is also a common reason used to explain why old couples normally die within a few months following their partner's death. Conversely, there is no scientific reason or data to support this claim. Additionally, this phenomenon is only partially understood. Scientists have not uncovered the true reason behind the physiological factors that ultimately lead to one's death, and are unable to explain the nuances of the case.

This leads back to the idea of "mind over matter". In fact, it is the complete opposite, where one's will to die overpowers their biological mechanisms compared to their willpower to overcome physical challenges. The mind and the body are entangled and work together to create a whole. However, such cases where it seems that the mind overpowers the body or vice versa begs the question - could one's complete lack of motivation cause the body's biological mechanisms to give up as well?

AUTHOR: Janaine Ho

SOURCES: Bernshtein, M. (2018). *What is psychogenic death?* [online] Medical News Bulletin. Available at: https://medicalnewsbulletin.com/what-is-psychogenic-death-stages-symptoms/ [Accessed 13 Jun. 2022].

Leach, J. (2019). *The Neuroscience of Giving Up*. [online] Proto Magazine. Available at: https://protomag.com/neurology/neuroscience-giving/ [Accessed 13 Jun. 2022].

MEADOR, C.K. (1992). Hex Death. *Southern Medical Journal*, 85(3), pp.244–247. doi:10.1097/00007611-199203000-00004.

Ratner, P. (2018). *You can die simply by giving up the will to live, suggests new research*. [online] Big Think. Available at: https://bigthink.com/neuropsych/can-you-die-from-giving-up/ [Accessed 13 Jun. 2022].

Stumpfe, K.D. (1979). [The psychogenic death of Mr. J. A case report]. *Zeitschrift Fur Psychosomatische Medizin Und Psychoanalyse*, [online] 25(3), pp.263–273. Available at: https://pubmed.ncbi.nlm.nih.gov/494838/ [Accessed 13 Jun. 2022].

METEORITES: THE SEARCH FOR LIFE

In recent years, the age-old question of whether we are alone has resurfaced with a renewed effort from humanity to search for extraterrestrial life. In our search for life, we have attempted to identify the conditions required for life (or at least as we know it). These conditions help us to narrow down our search in the vast universe. One example of this would be the Goldilocks Zone or the Circumstellar habitable zone: the range of orbits around a star within which a planetary surface can support liquid water. Instead of having a broad focus on whole galaxies, we can narrow down our search to specific planetary systems (based on the assumption that liquid water is required for life).

Recent evidence suggests that meteoroids were essential in the development of life on Earth; delivering the nucleobases that make up DNA to ancient Earth. Previous to this, only A and G were found in space rocks but new, state-of-the-art analytical techniques (UV-visible spectroscopy and thin-layer chromatography), originally designed for use in genetic and pharmaceutical research, were used to detect tiny trace amounts of nucleobases. These nucleobases come in two different 'flavours': purines and pyrimidines. A and G are both purines, made of a hexagonal molecule infused with a pentagonal one. The ones previously undetected in space rocks until now (U, C and T) are pyrimidines. Scientists theorise that this disparity in abundance is due to the pentagonal ring that purines possess that pyrimidines don't. They also believe that the milder extraction method, using cold water instead of the harsher acid used before, helped to keep the bases intact during extraction. Lab experiments simulating the conditions in outer space have also suggested that these bases very well could have been formed during photochemical reactions in interstellar molecular clouds. However we are still not sure whether these trace amounts were contaminations picked up by the meteorite from Earth or were formed in space. Samples from the surrounding sites of the meteorites were also collected to compare the quantities of nucleobases (using the same technique of detection). It was found that for some detected compounds, the values found in meteorites were significantly higher than those found in the meteorites which provides further evidence that these nucleobases were indeed formed in outer space. However, we will get further confirmation after the samples from Ryugu and Bennu; samples that have not been significantly compromised by terrestrial contamination.

Originally, the prevailing theory was that the intense ultraviolet radiation and lightning on the early Earth provided the needed energy for chemical reactions between compounds such as water, ammonia and methane. It then suggests that these reactions lead to the formation of nucleobases and then genetic material (DNA and RNA). However there are significant gaps in the theory based on what we now know today about the early Earth's atmosphere. We already know that meteorites were crucial for the development of life on Earth with a type of meteorites known as the carbonaceous chondrites believed to have delivered most of the planet's water and other organic material. Therefore, it is entirely plausible that the basis for our genetic material was delivered to ancient Earth in meteor strikes. This is rather hopeful for our search as it suggests that genetic material is not specific to Earth and is more common than we previously thought: meteorites could have delivered the necessary nucleobases, for life as we know it, to other planets in the universe.

AUTHOR: Rohan Janaki
SOURCE: https://www.nature.com/articles/s41467-022-29612-x

HOW LONG IS ONE SECOND ?

How long is a second? When faced with this question, a common answer would pop into our minds would be the amount of time it takes for the second hand in the clock to tick, or even 1000 milliseconds. But that begs the question, who decides how long it takes for the second hand to move? Exactly how long is one millisecond? And that's how the never ending loop of questions begins.

A second is the base unit of time defined in terms of the radiation frequency at which atoms of cesium change from one state to another. Since 1967, a second was declared to be "9,192,631,770 cycles of radiation associated with the transition between the two hyperfine levels of the ground state of the cesium-133 atom" (Betts, 2019), at a temperature of 0K and at mean sea level (MSL). In simple terms, when an atom is exposed to an electromagnetic field, it can slightly disturb the electron's orientation. At the right frequency, it can cause the electron to vibrate, resembling a ticking pendulum. Thus, the 13th General Conference on Weights and Measures concluded that a second is equivalent to 9,192,631,770 oscillations of the electron in a cesium-133 atom, giving rise to atomic clocks which help us keep time in the most precise manner (Scharping, 2018).

AUTHOR: Janaine Ho

SOURCES:Betts, J.D. (2019). Second | unit of time. In: *Encyclopædia Britannica*. [online] Available at: https://www.britannica.com/science/second.

Scharping, N. (2018). *Why 1 Second Is 1 Second*. [online] Discover Magazine. Available at: https://www.discovermagazine.com/the-sciences/why-1-second-is-1-second.

HISTORICAL DATES IN SCIENCE

- The discovery of krypton

In May 1898, Krypton, one of the rarest gases in the Earth's atmosphere, was discovered; it is a noble gas that normally exists as single atoms. Its name is derived from the Greek "Kryptos", meaning hidden.

On 1898 May 30th, Scottish chemist William Ramsay and English chemist Morris Travers discovered Krypton by evaporating almost all other components of liquid air, leaving behind Krypton. For his discovery, Ramsay was later awarded a Nobel prize in 1904. In fact, this discovery was partially by accident.

Unsurprisingly, like all other noble gases, Krypton's boiling and melting point are only 4 degrees apart; Krypton melts at –157.4 °C and boils at -153.4 °C. This gap is extremely small in comparison to atoms such as Gallium, which melts at 29.8 °C and boils at 2,400 °C.

Krypton is not especially useful in experiments as it normally does not react. This is due to the stability of its structure as it obtains a full shell of electrons and all the orbitals are filled up. However, one real-life application of Krypton is bright white light bulbs used in photography.

Despite its limited applications, the discovery of Krypton on May 30th, 1898 is significant as it allows scientists to gain a deeper understanding of noble gases.

Fun fact: The earth's atmosphere is about 0.0001% krypton! A super small portion!

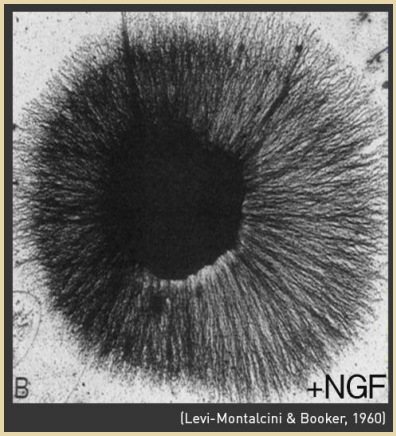
AUTHOR: Inez Wang

SOURCE:

American Chemical Society, Chemistry for Life. 2018. Krypton [Online]. Available from: <https://www.acs.org/content/acs/en/molecule-of-the-week/archive/k/krypton.html#:~:text=In%201898%2C%20British%20chemists%20William,Prize%20in%20Chemistry%20in%201904> [Last accessed: 11/06/2022].

Royal Society of Chemistry. On This Day - May 30: Krypton was discovered [Online]. Available from: <https://edu.rsc.org/resources/on-this-day-may-30—krypton-was-discovered/10530.article> [Last accessed: 11/06/2022].

SCIENTIST OF THE MONTH



(Levi-Montalcini & Booker, 1960)

Rita Levi-Montalcini began her scientific career in danger, as a Jew in Fascist Italy, ending it in triumph however, as the neuroembryologist who co-discovered nerve growth factor, a prominent figure in Italian politics, and an active researcher and mentor until her death at the age of 103. Born in Turin, Italy, in 1909, Rita Levi-Montalcini was raised by an authoritarian father who strongly disapproved of women's education beyond finishing school. She convinced him to let her study medicine. Woefully undereducated to that point, she crammed years' worth of Greek, Latin and mathematics into eight months, and then entered medical school at the University of Turin. Levi-Montalcini graduated with the highest distinction in medicine and surgery in 1936, but, inspired by a professor, histologist and researcher Giuseppe Levi, she was no longer certain she wanted to be a doctor. She started advanced studies in neurology and psychology, but she was soon kicked out of school, when Mussolini's newly published 1938 Race Laws forbade any non-Aryan from having a professional or academic career. Levi-Montalcini went to Brussels for a short time to study at a neurological institute, but had to flee when Germany was poised to invade Belgium.

She started advanced studies in neurology and psychology, but she was soon kicked out of school, when Mussolini's newly published 1938 Race Laws forbade any non-Aryan from having a professional or academic career. Levi-Montalcini went to Brussels for a short time to study at a neurological institute, but had to flee when Germany was poised to invade Belgium. Eventually she even took on an assistant, also expelled from the academy because of his religion: Giuseppe Levi, her medical school mentor. With Levi, Levi-Montalcini came up with a theory about embryonic nerve cells – that they proliferated, started to grow, then died – that ran counter to the model described in Viktor Hamburger's article. That theory laid the foundation for the modern concept of nerve cell death as a part of normal development. As Jews, they couldn't publish in Italian journals, but their results were published in foreign journals in the early 1940s.

When the Allies bombed Turin, Levi-Montalcini moved her makeshift lab to the country. When the Germans invaded and started rounding up Jews, she and her family travelled south under false names. They survived, and as the war ended, Levi-Montalcini briefly did become a doctor, treating patients in a refugee camp. Soon after Levi-Montalcini arrived at Hamburger's laboratory, in 1948, they noticed that a particular type of mouse tumour spurred nerve growth when implanted into chick embryos. Levi-Montalcini and Hamburger figured out the cause: a substance in the tumour that they named nerve growth factor (NGF). The tumour caused similar cell growth in a nerve-tissue culture in the lab. From that point, biochemist Stanley Cohen, her colleague at Washington University, was able to isolate the NGF, a protein subunit, from the tumour. Having faced so many obstacles herself, Rita Levi-Montalcini spent much of the latter part of her career ensuring that other scientists have access to funds, equipment, and support.

AUTHOR: Danica
SOURCE: https://www.nobelprize.org/womenwhochangedscience/stories/rita-levi-montalcini

Rita Levi-Montalcini
22 April 1909 – 30 December 2012

CAREER SPOTLIGHT:

PYROTECHNIC ENGINEERS

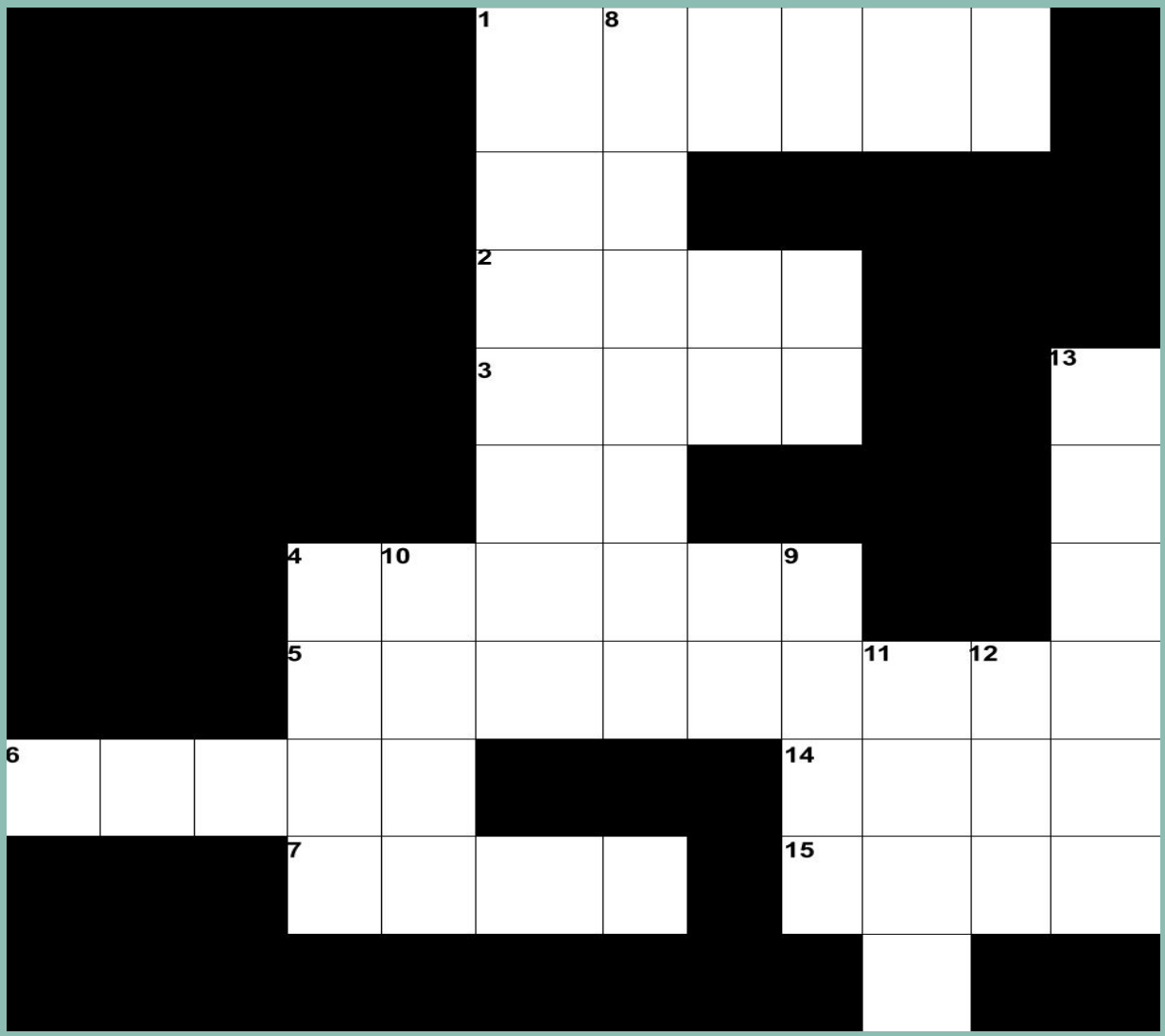
Pyrotechnic engineers work with explosives and reactive chemicals to organize displays of fire and fireworks. Their jobs rely on an extensive knowledge of how certain compounds react with other inputs in order to design and produce fireworks and pyrotechnic displays for sports arenas, concert venues or special effects in movies and television. They must have extensive knowledge of both chemistry and physics to accurately determine and control how a reaction will occur. The requirements of pyrotechnic engineers vary depending on the position they have and the state where they work. The position of a pyrotechnic engineer revolves around putting a working knowledge of science and math into effect by designing precisely timed explosions. They deal with many aspects of making these explosions happen, from testing the materials to making precise measurements and calculating each chemical compound.

If they are working for a manufacturer of fireworks, they must know how to artificially produce colors and different visual effects. Working for concerts or sporting arenas requires an engineer to have their display timed to coordinate perfectly with the music or the sporting action.

Safety is an extremely important part of a pyrotechnic engineer job. The sensitive nature of pyrotechnic displays requires an engineer to be especially cautious about ensuring that every explosion is well-planned and monitored.

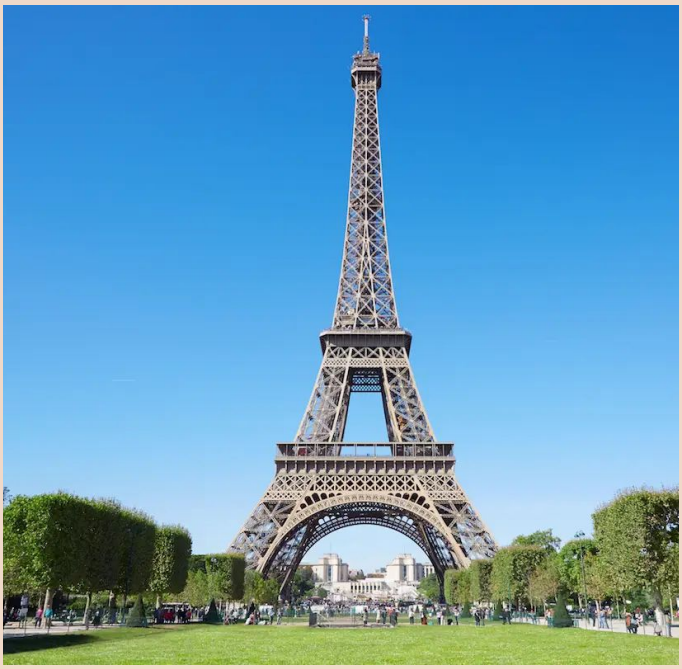
AUTHOR: Maeji
SOURCE:(2022). Retrieved 20 June 2022, from https://www.careermatch.com/job-prep/career-insights/profiles/fireworks-maker/

Crossword

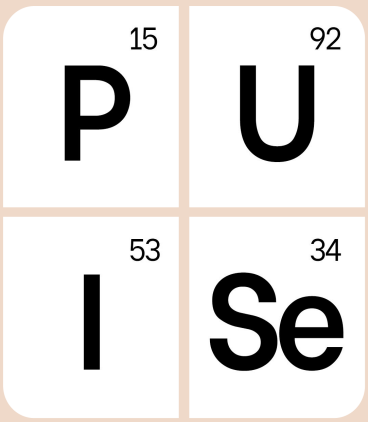


Down	Across
1. An organic compound (C_2H_6O) 4. a molecule or other species which can donate a proton or accept an electron pair in reactions. 8. giant waves caused by earthquakes or volcanic eruptions under the sea. 9. a crustacean, found chiefly on seashores, with a broad carapace, stalked eyes, and five pairs of legs, the first pair of which are modified as pincers. 10. a traditional Mexican dish consisting of a hand-sized corn or wheat tortilla topped with a filling. The tortilla is then folded around the filling and eaten by hand. 11. also called nerve fibre, a portion of a neuron that carries nerve impulses away from the cell body. 12. the smallest 2 digit number 13. one of two or more versions of DNA sequence (a single base or a segment of bases) at a given genomic location.	1. It is the second member of the alkane series (C_2H_6) 2. How predators prey 3. Plural form of a common insect that begins with A 4. of, relating to, or concerned with atoms 5. the act of making sure that a scientific process or instrument will produce results which are accurate 6. a bond that is formed by the complete transfer of some electrons from one atom to another 7. prehistoric extinct bird 15. any of the pieces of hard whitish tissue making up the skeleton in humans and other vertebrates.

DID YOU KNOW?



The 324 metre tall Eiffel Tower not only becomes hotter in summer, but it also becomes taller. In the summertime, it can grow 15 cm. This is due to thermal expansion in the iron structure. The greatest growth on record occurred in 1976, when this heat-induced expansion added another 18 centimetres (seven inches) to the tower's 324 metre height.



NEW LOGO

Congratulations to Malia G9 for her winning submission for the new logo. We have been working with a team of graphic designers to polish her original idea. We are all in love with our new logo and we hope you also agree how fabulous it looks!

"It is commonly believed that anyone who tabulates numbers is a statistician. This is like believing that anyone who owns a scalpel is a surgeon.. "

Robert **HOOKE**

PULSE

Contributors

- Danica
- Inez
- Janaine
- Jieun
- Karina
- Maeji
- Malia
- Manlin
- Nancy
- Rohan
- Xilan

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53	34
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Thank you to our guest writer for this edition - Ella Mountjoy G7.

Pulse CCA meets every Monday 3:45-4:45 in E620. Presently only Grades 9, 10 and 11 can attend in person. However, we welcome guest articles from all members of our community. If you would like to learn more or submit an article please email cparker@nlcssingapore.sg

Down	Across
1. Ethanol	1. Ethane
4.Acid	2. Hunt
8.Tsunami	3. Ant
9.Crab	4. Atomic
10. Taco	5. Calibrate
11. Axon	6. Ionic
12. Ten	7. Dodo
13.Allele	15. Bone

LINK TEACHER: Chanelle Parker