

## Welcome to the February 2023 issue

SCIENCE NEWS *Monthly* is produced by the Science Department, St Benedict's Catholic Secondary School, Bury St Edmunds, Suffolk, UK.

## HEALTH - Diabetes artificial pancreas tech recommended for thousands on NHS

Approximately 400,000 people are currently living with type 1 diabetes in the UK, including around 29,000 children. Their pancreas produces no, or very little, insulin - an important hormone which helps to control the level of glucose in the bloodstream. So they have to closely monitor levels of glucose in the blood during the day and top up levels of insulin every day of their lives using either injections or an insulin pump. Now, in a major advance in this treatment, glucose monitoring and the operation of an insulin pump have been combined in a single technological innovation.

The system uses a glucose sensor under the skin to automatically calculate how much insulin needs to be delivered via a pump. Health assessors said it was the best way of controlling diabetes, barring a cure. A charity said it would transform lives and was the *"closest thing to a working pancreas"*.

"This technology has been proven to give the best control for managing type 1 diabetes and should make things like amputations, blindness, and kidney problems possibly a thing of the past," said Prof Partha Kar, national specialty adviser for diabetes at NHS England. "The quality of life this technology gives to those using it is huge," he added.

#### **ARTIFICIAL PANCREAS – HOW DOES IT WORK?**

#### Artificial pancreas: how does it work?



The sensor, also known as a continuous glucose monitor (CGM), works through a tiny sensor inserted under your skin, usually on your belly or arm. The sensor measures your interstitial glucose level, which is the glucose found in the fluid between the cells. The sensor tests glucose every few minutes. A transmitter wirelessly sends the information to an insulin pump which calculates the amount of insulin required.

An insulin pump is a small electronic device that releases the regular insulin your body needs through the day and night — so you don't need to do insulin injections. The pump device is attached to your body by a tiny tube called a cannula, which goes just under your skin.

Although CGMs and insulin pumps have been around for a while, this new system also allows users to monitor readings using a smartphone app - this also allows them to input data regarding the amount of carbohydrates being eaten at meals which can then update the pump to adjust the amount of insulin required for even more accurate glucose control.

Under draft recommendations, NICE said the system should first be offered to patients in England and Wales unable to control their diabetes, including pregnant women, which could be around 100,000 people in England alone. Hilary Nathan, policy director at JDRF, the type 1 diabetes charity which has funded research into the system for many years, said it was *"a game-changing treatment at the forefront of health technology and artificial intelligence"*. If approved, she said, it would transform the lives of people living with type 1 in England and Wales, reduce deaths from glucose high and lows, and cut the risk of long-term health issues from the condition.

https://www.bbc.co.uk/news/health-64211479

## **MATHEMATICS - Meet the newest additions to the metric system**

When the metric system was introduced in the 1790s, certain prefixes were also introduced to indicate multiples and submultiples of a basic unit. For example, the prefix *kilo*- was added to the basic unit, *gram*, to make *kilogram*, ie one thousand grams. Similarly, the prefix *milli*- can be added to gram to make *milligram*, ie., one thousandth of a gram...and so on for all metric weights and measures.

Originally there were 6 prefixes but, over the years, more have been added to cater for larger and smaller quantities. The last new prefixes were added in 1991. Now, at the 27th General Conference on Weights and Measures in Versailles, France last November, four new prefixes were agreed: the *ronna-*, *quetta-*, *ronto-* and *quecto-*. The first two describe exceedingly large numbers, while the last two describe the tiniest of the tiny.

Numerically, *ronna*- is  $10^{27}$  - that's a digit followed by 27 zeroes. *Quetta*is  $10^{30}$  (30 zeroes). Their tiny counterparts — *ronto*- and *quecto*- — also refer to 27 and 30 zeroes, but those come after a decimal point: hence  $10^{-27}$  and  $10^{-30}$ . The question is: *"Why do we need even more prefixes?"* 

The answer is given by Richard Brown, who is the head of metrology the study of measuring — at the National Physical Laboratory in Teddington, England. He says "The quantity of data in the world is increasing exponentially. And we expect that to continue to increase and probably accelerate — because of quantum computing.

SI prefixes				V·T·I
Prefix Name Symbol		Base 10	Decimal	Adoption [nb 1]
quetta	Q	1030	1 000 000 000 000 000 000 000 000 000 0	2022
ronna	R	1027	1 000 000 000 000 000 000 000 000 000	2022
yotta	Y	1024	1 000 000 000 000 000 000 000 000 000	1991
zetta	Z	1021	1 000 000 000 000 000 000 000	1991
exa	E	1018	1 000 000 000 000 000 000	1975
peta	Р	1015	1 000 000 000 000 000	1975
tera	т	1012	1 000 000 000 000	1960
giga	G	109	1 000 000 000	1960
mega	М	105	1 000 000	1873
kilo	k	10 <sup>3</sup>	1 000	1795
hecto	h	102	100	1795
deca	da	10 <sup>1</sup>	10	1795
		10 <sup>0</sup>	1	_
deci	d	10-1	0.1	1795
centi	c	10-2	0.01	1795
milli	m	10-3	0.001	1795
micro	μ	10-6	0.000 001	1873
nano	n	10-9	0.000 000 001	1960
pico	p	10-12	0.000 000 000 001	1960
femto	f	10-15	0.000 000 000 000 001	1964
atto	a	10-18	0.000 000 000 000 000 001	1964
zepto	z	10-21	0.000 000 000 000 000 000 001	1991
yocto	У	10-24	0.000 000 000 000 000 000 000 001	1991
i/Nano-	r	10-27	0.000 000 000 000 000 000 000 000 001	2022
quecto	q	10-30	0.000 000 000 000 000 000 000 000 000 0	2022

digitalization and things like that. At the same time, this quantity of data is starting to get close to the top range of the prefixes we currently use. People started to ask, what comes next?"

When you use a prefix with a unit, it means that the number associated with the unit changes. And people like small numbers that they can understand. So you can express the mass of the Earth in terms of ronnagrams: it's six ronnagrams. The mass of Jupiter is two quettagrams. Some good examples of [small numbers] are that the mass of an electron is about one rontogram. And the mass of one bit of data (as stored on a mobile phone) is around one quectogram.

https://www.snexplores.org/article/new-prefix-additions-metric-system

### SPACE SCIENCE – NOT! Where did non-stick frying pans really come from?

During the 1960s "Space Race" between the USA and the Soviet Union, in America there was huge controversy surrounding the amount of money that was being spent on space science and rocket research – around \$30 billion between 1957 and 1969 - surely such money could be better spent on more worthy, human causes? This controversy continued beyond the 60s and, in order to justify the expense, it was pointed out that there were many technological "spin-offs" that benefited us in our everyday lives, one of the most significant being **the non-stick frying pan**!

HOWEVER, THIS IS AN URBAN MYTH! The "non-stick" property is down to a coating of TEFLON™, which is the tradename for the chemical **polytetrafluoroethylene (PTFE)**. In 1938 a chemist called Roy Plunkett was trying to make tetrafluoroethylene gas as a refrigerant, but found some wax inside the cylinder as the gas had partially polymerized. It took some years and another chemist, Malcolm Renfrew, to come up with an industrial method giving the right chain length of the molecule, trademarked as Teflon by his company DuPont.



NOTHING STICKS TO HAPPY PAN

In France in 1954, engineer Marc Grégoire used PTFE to coat his fishing tackle to make

it easier to clean. His wife Colette demanded he use it to coat a frying pan. It took some work to make this nonsticky plastic adhere to metal in a hot pan, but in 1956 Colette and Marc had them in the shops, marketed as the "Happy Pan" in the US. So the non-stick frying pan clearly predates the 1960s space race. It is ironic that NASA <u>did</u> use Teflon/PTFE in many ways - in heat shields, in space suits, and even in cargo holds.

Another myth is that NASA invented **VELCRO®** - Yes, NASA has used Velcro in its missions. No, they didn't invent it. A Swiss engineer named George de Mestral came up with it in the late 1940s.

One thing space science <u>has</u> given us is the camera we have in our smartphones - In the 1990's, a Jet Propulsion Laboratory team was looking for ways to shrink cameras down in size for interplanetary travel. They came up with the camera-on-a-chip, also known as the **CMOS sensor**. Today, CMOS sensors are found in most of the world's camera phones and digital cameras.

https://www.wired.co.uk/article/nasa-invention-myth-or-miracle

#### CLIMATE – UK weather: 2022 was warmest year ever, Met Office confirms

The average annual temperature in 2022 was more than 10C for the first time, the national weather service said. The mean temperature across the 12 months was 10.03C - topping the previous all-time high of 9.88C in 2014. It means that 15 of the UK's top 20 warmest years on record have all occurred this century - with the entire top 10 within the past two decades. All four home nations set records for heat in 2022, with England seeing the highest average temperature at 10.94C, followed by Wales (10.23C), Northern Ireland (9.85C) and Scotland (8.50C).

Dr Mark McCarthy, head of the Met Office National Climate Information Centre, said: "Although an arbitrary number, the UK surpassing an annual average temperature of 10C is a notable moment

UK annual average temperature passed 10C for the first time in 2022



in our climatological history. It is clear from the observational record that human-induced global warming is already impacting the UK's climate."

A spell of heatwaves in June 2022 led to the UK experiencing its fourth warmest summer on record - and temperatures broke the 40C mark for the first time, leading the Met Office to issue its first-ever red warning for extreme heat. The record of 40.3C was recorded at Coningsby in Lincolnshire on 19 July. The hot summer and months of low rainfall also dried up rivers, damaged crops and fuelled wildfires, with an official drought declared in large parts of England.

The Met Office said that a UK mean temperature of 10C would have been expected once in 500 years in a natural climate - before humans started producing the emissions responsible for climate change with activities such as burning fossil fuels. But it said this was now likely to occur every three to four years.

https://www.bbc.co.uk/news/uk-64173485

#### ARCHAEOLOGY - Londoner solves 20,000-year Ice Age drawings mystery

A London furniture conservator has been credited with a crucial discovery that has helped understand why Ice Age hunter-gatherers drew cave paintings. Ben Bacon analysed 20,000-year-old markings on the drawings, concluding they could refer to a lunar calendar. It led to a specialist team proving early Europeans made notes about the timing of animals' reproductive cycles.



Cave paintings of animals such as reindeer, fish and cattle have been found in caves across Europe. But archaeologists had been stumped by the meaning of dots and other marks on the paintings. So Mr Bacon decided he would try to decode them. He collaborated with a team including two professors from Durham University and one from University College London and, by working out the birth cycles of similar present-day animals, they deduced that the number of marks on the cave paintings was a record, by lunar month, of the animals' mating seasons.



In particular, Mr Bacon examined a 'Y' sign on some paintings, which he felt might be a symbol for "giving birth" because it showed one line growing out from another. It is evident, along with other patterned markings, on the cave painting shown in the photo on the left which is dated to 15,000 ago.

The results show that Ice Age hunter-gatherers were the first to use a systemic calendar and marks to record information about major ecological events within that calendar.

Mr Bacon said "In turn, we're able to show that these people, who left a legacy of spectacular art in the caves of Lascaux [in France] and Altamira [in Spain], also left a record of early timekeeping that would eventually become commonplace among our species. Our ancestors were a lot more like us than we had previously thought. These people, separated from us by many millennia, are suddenly a lot closer."

https://www.bbc.co.uk/news/uk-england-london-64162799

## **MICROBIOLOGY - Meet some of the microbes that give cheeses flavour**

Bacteria get a bad press, as most people think of them as causing nothing but disease. However, the vast majority of bacteria actually work for us rather than against us and that is the case when it comes to cheese. Cheese making has been around for thousands of years, and there are now more than 1,000 varieties of cheese worldwide. But what exactly makes some cheeses like Parmesan taste fruity and others, such as Brie and Camembert, taste musty has remained a bit of a mystery. Now, scientists have pinned down the specific types of bacteria that produce these flavour compounds.



The findings, described in the journal *Microbiology Spectrum*, could help cheese makers more precisely tweak cheese flavour profiles to better match consumer preferences, say food microbiologist Morio Ishikawa and colleagues. A cheese's flavour depends on more than the type of milk and starter bacteria used to make the fermented dairy delight. A constellation of organisms that move in during the cheese-ripening process also contributes to the flavour.

Previous research by Ishikawa and colleagues used genetic analysis, gas chromatography and mass spectrometry to link specific flavour molecules with specific types of bacteria on surface mould-ripened cheeses made from pasteurized and raw cow milk in Japan and France. In the new study, to show that each bacterial suspect was responsible for producing the flavour compound it had been linked to, the team unleashed each type of microbe onto its own unripe cheese sample. The researchers then observed how flavour compounds in the cheese changed over 21 days. Notably, *Pseudoalteromonas* — a genus of marine bacteria found in various cheeses — produced the greatest number of flavour compounds. And the microbes produced esters, ketones and sulfur compounds, known to impart fruity, mouldy and oniony flavours in cheese.

"Besides helping perfect popular cheeses," Ishikawa says, "the findings might help cheese makers conduct new orchestras that would play new harmonies."

https://www.sciencenews.org/article/microbes-give-cheeses-flavor-bacteria

#### ASTRONOMY - Searching for the earliest galaxies in the Universe

Astronomers have used data from NASA's James Webb Space Telescope (JWST) Early Release Observations and discovered 87 galaxies that could be the earliest known galaxies in the universe. The finding moves the astronomers one step closer to finding out when galaxies first appeared in the universe – about 200-400 million years after the Big Bang. This research has been produced by a team of astrophysicists at the University of Missouri-Columbia (US) and is published in *The Astrophysical Journal Letters*. GL-z13 is a galaxy in the early universe that appears as seen by JWST (see photo, right) when the universe was only a few hundred million years old. [Courtesy: NASA, ESA, CSA, STScI]



In the study, the astronomers searched for potential galaxies at very high redshifts. The concept of redshifts in astronomy allows astronomers to measure how far away distant objects are in the universe – like galaxies – by looking at how the colours change in the waves of light that they emit. If a light-emitting source is moving toward us, the light is being 'squeezed,' and that shorter wavelength is represented by blue light, or blueshift. But if that source [of light] is moving away from us, the light it produces is being 'stretched,' and changes to a longer wavelength that is represented by red light, or redshift. Edwin Hubble's discovery in the late 1920s that our universe is ever-expanding is key to understanding how redshifts are used in astronomy.



Up until this time, most astronomers believed that the universe should have very few galaxies beyond redshift **11**. At the very least, the new research results challenge this view. The JWST was critical to this discovery because objects in space like galaxies that are located at high redshifts – **11** and above – can only be detected by infrared light. This is beyond what NASA's Hubble Space Telescope can detect because the Hubble telescope only sees from ultraviolet to near-infrared light. As the results are from just a very small portion of the universe, it is likely that many more early galaxies will be discovered as JWST enlarges its area of coverage.

## ARCHAEOLOGY - Lasers reveal sites used as the Americas' oldest known star calendars

**Olmec** and **Maya** people living along Mexico's Gulf Coast as early as 3,100 years ago built star-aligned ceremonial centres to track important days of a 260-day calendar, a new study finds. The oldest written evidence of this calendar, found on painted plaster mural fragments from a Maya site in Guatemala, dates to between 300 and 200 B.C., nearly a millennium later; but researchers have long suspected that a 260-day calendar developed hundreds of years earlier among Gulf Coast Olmec groups.

The Olmec civilization, the oldest major ancient culture in Central America, is what is known as an archaeological culture. This means there is a collection of artifacts thought by archaeologists to represent a particular society. What is known about archaeological cultures is based on artifacts, rather than texts. The Olmecs flourished during Mesoamerica's formative period, dating roughly from as early as 1500 BCE to about 400 BCE. The Maya were engaged in a dynamic relationship with neighbouring cultures that included the Olmecs and others. It appears that the Olmec civilization faded out around 400 BCE, whereas the Mayans persisted beyond 1500 CE.



An airborne laser-mapping technique called light detection and ranging, or **lidar**, has revealed astronomical orientations of 415 ceremonial complexes dating to between about 1100 B.C. and A.D. 250, say archaeologist Ivan Šprajc and colleagues. Most ritual centres were aligned on an east-to-west axis, corresponding to sunrises or other celestial events on specific days of a 260-day year, the scientists report in the journal *Science Advances*. The finding points to the earliest evidence in the Americas of a formal calendar system that combined astronomical knowledge with earthly constructions. This system used celestial events to identify important dates during a 260-day portion of a full year.

Links between the Olmec and later Maya culture, known best for Classic-era cities and kingdoms that flourished between roughly 1,750 and 1,100 years ago, are unclear. But Classic Maya inscriptions and documents also reference the 260-day calendar. Mobile groups in Mesoamerica, an ancient cultural region that extended from central Mexico to Central America, may have scheduled large, seasonal gatherings using the 260-day calendar long before it gained favour among Classic Maya kings. The 260-day ritual calendar continues in use today in modern Maya communities in the highlands of Guatemala and Chiapas, where they use it to organize maize cultivation and schedule agricultural rituals.

https://www.sciencenews.org/article/laser-americas-olmec-maya-star-calendar

#### PLANTS - Why dandelions are so good at widely spreading their seeds

We all know the white, fluffy seed head of the dandelion plant and how you can give it a puff and many of the individual seeds, with their white "parachutes", will fly away – but not all of them at once and this is interesting.

How dandelion seeds respond to the wind depends on where they sit on the seed head, says Jena Shields. She's a biophysicist at Cornell University in Ithaca, N.Y. The feathery seeds on the side facing a breeze will let go most easily. The others hold on tens to hundreds of times more tightly — until the wind shifts. It's almost as though the dandelion is saving some of its seeds for when the wind changes direction, an adaptation that would benefit the plant by increasing the area over which its seeds are distributed.

The research was inspired by a child. Shields' adviser was watching his toddler play with



dandelions. He noticed that the flowers' seeds didn't all come off the same. Some came loose more easily than others, but it depended on how they blew on the seed heads. So Shields set out to study what was going on. She measured the force it takes to pluck dandelion seeds. To start, she superglued a fine wire to the tufted ends. Then she pulled them from the seed heads at various angles. This seed-by-seed study mimicked what happens when the wind, or someone's breath, pushes them over.

Each seed released most easily for winds from one direction, Shields confirmed. That helps prevent seeds from one head all going the same way. And it may explain why the plants are so successful at spreading. Once blown off a dandelion, a seed's umbrella-like tuft carries it on the breeze that pulled it away.

https://www.snexplores.org/article/why-dandelion-seeds-scatter-wind

## WEIRD BIOLOGY - Could humans ever produce venom?

The question is not as crazy as it sounds – all reptiles and mammals have the capability to produce venom, according to an article published in the journal *Proceedings of the National Academy of Sciences*. Basically, we have all the tools we need, and it's up to our genes and evolution to get us there.

Oral venom is common across the animal kingdom, present in creatures as diverse as spiders, snakes and slow lorises, the only known venomous species of primate. Biologists knew that oral venom glands are modified salivary glands, but the new research reveals the molecular mechanics behind the change.

Venom is the ultimate example of nature's flexibility. Many of the toxins in venom are common across very different animals; some components of centipede venom, for example, are also found in snake venom. The new study does not focus on the toxins that make venom poisonous, but on what are called "housekeeping" genes, the genes that are associated with venom but aren't responsible for



creating the toxins themselves. These regulatory genes form the basis of the whole venom system.

The researchers started with the genome of the Taiwan habu (*Trimeresurus mucrosquamatus*), a brown pit viper that is well studied. The team found a constellation of genes that are common in multiple body tissues across all amniotes. (Amniotes are animals that fertilize their eggs internally or lay eggs on land; they include reptiles, birds and some mammals.) Many of these genes are involved in folding proteins, which makes sense because venomous animals must manufacture a large quantity of toxins, which are made of proteins. Unsurprisingly, the same sorts of regulatory housekeeping genes are found in abundance in the human salivary gland, which also produces an important stew of proteins — found in saliva — in large quantities. This genetic foundation is what enables the wide array of independently evolved venoms across the animal kingdom.

In other words, every mammal or reptile has the genetic scaffolding upon which an oral venom system is built. And humans (along with mice) also already produce a key protein used in many venom systems. **Kallikreins**, which are proteins that digest other proteins, are secreted in saliva; they're also a key part of many venoms. The new research may not raise many hopes for new superpowers for humans, but understanding the genetics behind the control of venom could be key for medicine.

https://www.livescience.com/could-humans-be-venomous.html

#### **EVERYDAY PHYSICS - Is each snowflake really unique?**

In our communities, seasonal snow plays a central role in day-to-day activities. For some, it means a day off from school. For others, it's a signal that the skiing season is starting. Or maybe it's a harbinger of an extra-long commute to work. It's remarkable how many memories and emotions can be evoked by a few billion tiny ice crystals. We may see snow as a blanket or drifts across the landscape or our driveway. But when was the last time you took a closer look at snow, and I mean a really close look?

While different sources will say that there are seven types of snowflakes, or eight or 35, we are probably most familiar with the classic six-sided dendrite forms, characterized by elaborate and nearly symmetrical branches. The dendrite form is a study in water physics. When ice forms at the molecular level, the angle between the hydrogen and oxygen atoms will always be 120 degrees; put three of these together to get a full ring of molecules with a six-sided structure. In fact, every time a water molecule attaches itself to this ring, it will do so at the same angle. As the snowflake grows, the attachment of water molecules is determined by the temperature and humidity of the air. Since these characteristics don't change too much at the size of a growing snowflake, those attachments tend to occur evenly



across the six points of the hexagonal flake. This makes it sound as though the vast majority of snowflakes will be identical – but the reverse is true.

A typical dendrite is made up of about a quintillion (10<sup>18</sup> - that's a one with 18 zeroes after it) individual water molecules. Given slight changes in temperature and humidity and the huge number of molecules and bonding opportunities involved, the ice structures created can be incredibly diverse and complicated. For this reason, it is entirely likely that no two snowflakes form in exactly the same way, and consequently no two snowflakes are alike.

So next time you're out in the snow, even if you're grumbling about having to shovel the driveway for the umpteenth time this winter, take a moment to catch a snowflake on your mitten and have a look at it. You're looking at a formation no one has ever seen before.

https://phys.org/news/2023-01-snowflake-unique-fluffy-heavy-amazing.html

## CRAZY PHYSICS - How a rotating universe makes backwards time travel possible!

Is time travel possible? Short answer: Yes, and you're doing it right now — hurtling into the future at the impressive rate of 24 hours per day. You're pretty much always moving through time at the same speed, whether you're watching paint dry or wishing you had more hours to visit with a friend from out of town.

But it is the notion that we could somehow speed up our journey into the future, or even manage to journey back into the past, that has captured the imagination. It was H.G. Wells who most popularised the idea of controlling **time travel** when he published his novel, *The Time Machine* in 1895. But surely this is not possible.....or is it?

More than 100 years ago, Albert Einstein came up with an idea about how time works. He called it relativity. This theory (there are actually two theories – *special relativity* [1905] and *general relativity* [1915]) says that time and space are linked together. Einstein also said our universe has a speed limit: nothing can travel faster than the speed of light (186,000 miles per



second). What does this mean for time travel? Well, according to this theory, the faster you travel, the slower you experience time. Scientists have done some experiments to show that this is true. For example, there was an experiment that used two atomic clocks, accurate to within billionths of a second, set to the exact same time. One clock stayed on Earth, while the other flew in an airplane (going in the same direction Earth rotates). After the airplane flew around the world, scientists compared the two clocks. The clock on the fast-moving airplane was slightly behind the clock on the ground. So, the clock on the airplane was traveling slightly slower in time than the clock that stayed on the ground.

So we can affect the rate at which we travel into the future, albeit to an infinitesimally degree. But what about being able to travel backwards in time into the past? Well, it turns at that we could...at least in theory.



The famous German mathematician and philosopher **Kurt Gödel** was a friend and neighbour of Albert Einstein at Princeton in the 1940s. He became incredibly curious about Einstein's general theory of relativity, which was and continues to be our modern formulation of the gravitational force. That theory connects the presence of matter and energy to the bending and warping of space and time, and then connects that bending and warping to the behaviour of matter and energy. Gödel was curious as to whether relativity could allow time travel into the past. Einstein's theory purported to be an ultimate framework for the nature of space and time, and as far as we know time travel into the past is forbidden. So Gödel reckoned that general relativity should automatically disallow it.

But Gödel discovered that actually general relativity is perfectly fine with time travel into the past. The trick is to set the universe in motion. Gödel constructed a relatively simple and artificial model universe to prove his point. This universe is rotating and contains only one ingredient. That ingredient is a negative cosmological constant that resists the centrifugal force of the rotation to keep the universe static. Gödel found that if you follow a particular path in this rotating universe you can end up in your own past. You would have to travel incredibly far, billions of light years long, to do it, but it can be done. As you travel, you would get caught up in the rotation of the universe. That isn't just a rotation of the stuff in the cosmos, but of both space and time themselves. In essence, the rotation of the universe would so strongly alter your potential paths forward that those paths loop back around to where you started. You would set off on your journey and never travel faster than the speed of light, and you would find yourself back where you started but in your own past.

The possibility of backwards time travel creates paradoxes and violates our understanding of causality. Thankfully, all observations indicate that the universe is not rotating, so we are protected from Gödel's problem of backwards time travel. But it remains to this day a mystery why general relativity is OK with this seemingly impossible phenomenon. Gödel used the example of the rotating universe to argue that general relativity is actually incomplete, and he may yet be right.

https://phys.org/news/2023-01-rotating-universe.html

# word(s) of the month: FISSION (noun, *"FIH-zhun"*)

Fission is a physical reaction where the nucleus of an atom breaks apart. In the process, it unleashes a bunch of energy. This is the physics behind all of today's nuclear power plants, as well as some ships and submarines. Unstable forms, or isotopes, of atoms can undergo fission. Uranium-235 is one example. Plutonium-239 is another. Fission occurs when a particle, such as a neutron, hits an unstable atom's nucleus. This collision splits the nucleus into smaller nuclei, releasing energy and throwing out more neutrons. Those newly freed neutrons can then strike other unstable nuclei. The result is a chain of fission reactions.

## 2022 WAS NOT ALL BAD NEWS - HERE'S SOME GOOD NEWS FROM LAST YEAR!

It seemed as if the world was plunging from one crisis to another last year. Just as most countries broke free from the shackles of the pandemic, the horror of war returned to Europe, millions around the world suffered at the hands of extreme weather, and the double pain of energy shortages and inflation arrived. But thanks to the hard work of scientists and a bunch of companies and policymakers, it wasn't all bad. Here's a rundown of the best news to come out of 2022.....

**THE FIRST TRAIN LINE SWITCHED FULLY TO HYDROGEN** Germany has put into service the world's first fleet of hydrogen-powered trains. The fleet of 14 engines has replaced diesel trains on a commuter line near the city of Hamburg, where the high costs of electrification would be too expensive. Hydrogen trains are equipped with fuel cells that generate electricity by combining hydrogen and oxygen, producing no emissions other than water vapour.

**SCIENTISTS FOUND A WAY TO REDUCE SHARK BYCATCH** A battery-powered device, called SharkGuard, prevents sharks and rays from accidentally getting caught in commercial fishing nets and lines by emitting a short electrical pulse every two seconds. These pulses temporarily overstimulate the marine animals' electro sensory organs, called ampullae of Lorenzini. When this happens, they choose to swim away, unharmed.

**BEAVERS WERE GIVEN LEGAL PROTECTION IN ENGLAND** Four hundred years after they were hunted to extinction for their fur, meat, and glands, beavers are now a protected species in England. Since October it's been illegal to deliberately trap, injure, kill, or otherwise disturb the charismatic rodents, whose dams create wetlands. The reason for the law change? Hundreds of reintroduced beavers live in England today, so the government now officially recognizes them as native wildlife.

WILD MAMMALS MADE A COMEBACK IN EUROPE Once on the brink, populations of iconic animals like gray wolves, brown bears, bison, and, yes, beavers are thriving again in Europe thanks to legal protections, changes in land use, and human interventions like rewilding. Initially the beaver colonies in England reappeared through illegal releases or escapes from private collections, but more recently the UK government has authorized releases in enclosures—in 2002, nine beavers were brought in from Norway and officially released in Kent.

A RARE PIGEON WAS CAPTURED ON CAMERA For the first time in 140 years, researchers have sighted and scientifically documented a rare bird, the blacknecked pheasant pigeon. The large ground-dwelling species is found only deep in the forests of Papua New Guinea and was considered lost to science and possibly extinct.

**DART PROVED WE CAN PROTECT EARTH FROM ASTEROIDS** No asteroid or comet is currently on a collision course with Earth, but it's best to be prepared for the worst. In September, NASA and its partners deliberately crashed the DART spacecraft into a small asteroid at 14,000 miles per hour to see if the impact could deflect its path. It did. But let's hope we never have to do this for real.

**SPINAL IMPLANTS HELPED PARALYZED PEOPLE WALK AGAIN** Several people with severe spinal injuries were able to take some first steps within hours of neurosurgeons implanting nerve-stimulation devices into their spines. And with months of consistent training and by controlling the device using a touchscreen tablet, one patient even regained the ability to cycle and swim independently.

https://www.wired.co.uk/article/2022-positive-news





