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Could Mars Hide Traces of Life in Its Minerals?

Archana Ghode

Vivianite green



When scientists search for signs of life beyond Earth, they don't expect to find fossils of plants or animals. Instead, they look for **biosignatures**—clues in the form of substances, elements, or patterns that are usually linked to living things.

Biosignatures can be:

- **Chemical:** certain organic molecules.
- **Isotopic:** special ratios of light and heavy elements changed by biological processes.
- **Mineralogical:** minerals that often form with the help of life.

Two minerals of special interest on Mars are **vivianite** and **greigite**.

A September 10, 2025 paper published in the journal *Nature* reported the “likely” detection of vivianite and greigite in the Jezero crater on Mars (see picture from NASA/JPL-Caltech/MSSS/JHU-APL), by the *Perseverance* rover.

Vivianite: The Blue Mineral of Hidden Life

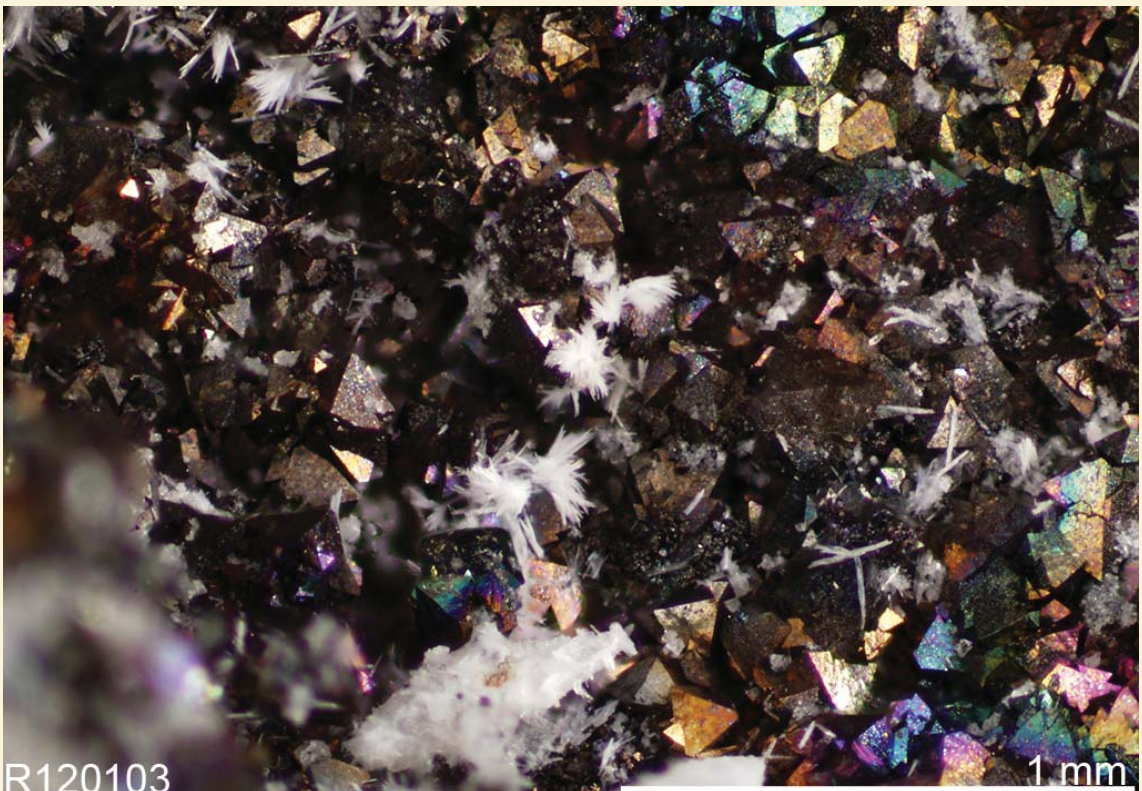
Vivianite ($\text{Fe}_3(\text{PO}_4)_2 \cdot 8\text{H}_2\text{O}$) is a beautiful blue mineral made of iron and phosphate. On Earth, it often appears in oxygen-poor places that are rich in decaying organic matter—like wetland soils or lake mud.

Why does this matter? Because vivianite usually forms when **iron, phosphorus, and low-oxygen conditions** come together. These are the kinds of conditions where microbes often thrive. Finding vivianite on Mars wouldn't prove life existed, but it would show that the planet once had the



Vivianite blue

Greigite as seen under a microscope



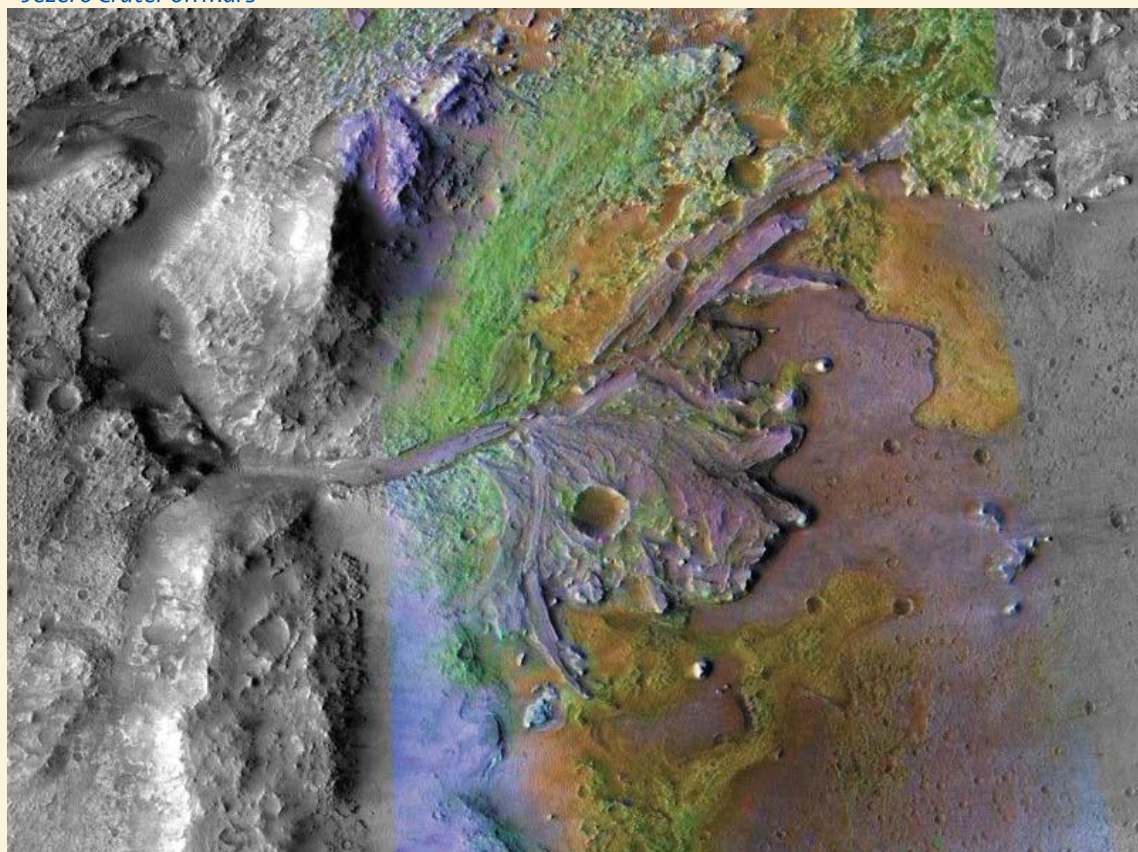
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Greigite

Jezero Crater on Mars



right environment for life.

Greigite: The Microbial Fingerprint in Iron Sulfides

Greigite (Fe_3S_4) is a magnetic mineral made of iron and sulfur. On Earth, it usually forms with the help of **sulfate-reducing bacteria**. These microbes use sulfate during metabolism, turning it into sulfide. The sulfide then reacts with iron, creating minerals like greigite.

as plants and meat. But they also eat minerals because minerals provide nutrition. Microbes living near hydrothermal vents “eat” sulfur which is emitted from the vent, since this also provides nutrition.

Can Vivianite and Greigite Form Without Life?

Yes. Both minerals can form through purely chemical reactions, without biology. But on Earth, they are often linked to mi-

Perseverance Rover on Jezero



Greigite is exciting because it shows signs of an **active sulfur cycle**—a process strongly tied to microbes on Earth. Detecting greigite on Mars could mean similar life-related chemistry once took place there.

What Do Microbes Eat?

Maybe it never occurred to you that microbes “eat” iron. The bacteria in your stomach eat undigested organic matter such

as crobes living in oxygen-poor, carbon-rich environments. That’s why their presence on Mars excites scientists: they could be **biosignature minerals**, hinting at life-friendly chemistry.

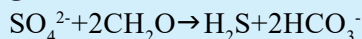
Why This Matters for Mars

- **Vivianite** suggests watery, oxygen-poor places with phosphorus—good conditions for microbes.

The Chemistry Behind Greigite

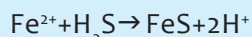
Here's how microbes can help build greigite step by step:

- Microbes reduce sulfate while eating organic matter:

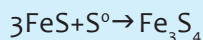


Note that the negative charges are balanced, with (2-) for the sulphate SO_4 ion and two molecules of the (1-) bicarbonate HCO_3 ion).

- The hydrogen sulfide (H_2S) reacts with dissolved iron:



- The iron sulfide (FeS) transforms into greigite:



Over time, greigite can change further into other iron sulfides like pyrites ("fool's gold").

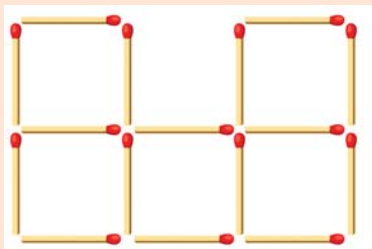
- **Greigite** points to sulfur cycling, another process tied to life on Earth.

Neither mineral alone proves life once existed on Mars. But together, they suggest the planet may once have had **dynamic, life-friendly chemistry**.

Conclusion: Finding minerals like vivianite and greigite on Mars does not mean we have found life. But they are important clues, showing that Mars once had the kind of conditions where life *might* have been possible.

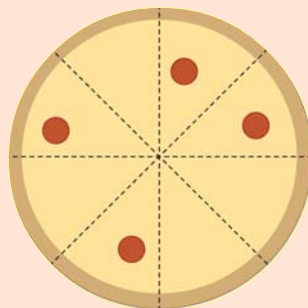
The next time a rover or lander drills into Martian rock, scientists will be watching closely. A shimmer of blue vivianite or magnetic greigite grains could be the subtle hints that Mars once had a life beneath its dusty-brown surface.

Puzzles to puzzle you!



Matchstick Squares

Move a single matchstick so that there are six squares. Each matchstick's entire length must be part of at least one square.



Pizza Puzzle

You're making a pizza. You've already tossed a few pieces of mushroom topping onto the pie as shown in the picture. Your friend comes in and wants to help. She says, "For every piece of mushroom that you place, I'll place one on the adjacent slice. We'll stop when all the slices have equal number of mushroom pieces." Is this possible? That is, will you ever reach this goal?

From Scientific American

Answers on page 16

Forget Speed Demons, Meet the Slow-Motion Superheroes of the Deep

Zareena, Mookayi, and Mari

What if the oldest living thing on Earth isn't a tree but a tiny, sleepy cell dreaming on, waiting for the Earth to move? Intrigued? Read our story to find out ...

We three friends—Zareena, Mookayi, and Mari—were super excited to be in China. We had come with Mari's mother, Usha, a biologist, for a conference about microbes that she was attending. Having just stopped recording the presentation on our mobiles, we huddled together. It was a talk by **Dr. Karen Lloyd** about a new class of microbes called “Aeonophiles”, which she has only recently named.

What's in a name?

The word aeonophile is derived from ‘aeon’, which means a very long period of time, and ‘phile’ which indicates fondness for, referring to their ability to survive over geological time scales.



Dr Karen Lloyd



Deep Sea Drill with sample

The hall was buzzing with people. Zar whispered in amazement, “I can’t believe what we just heard. Microbes ... that live for thousands of years? My brain is buzzing.”

Mooks said, “It’s not just that they live long. Dr. Lloyd said there may be more of them deep down than all the microbes on the surface, in the sea, and in all animals. How is that even possible?”

Mari replied, “It’s possible because they don’t use energy like regular microbes to reproduce. They use it almost entirely just to sustain themselves—to repair tiny bits of damage over thousands of years. Some of them may divide only once in tens of thousands, or

Where can you find an aeonophile?

You’re not likely to stumble accidentally upon an aeonophile. They’re typically found deep within the Earth’s crust, buried under kilometers of sediment and rock. Scientists look for signs of life using deep-sea drills that can reach depths of up to 2.5 km below the seafloor; see picture. In fact, subsurface environments actually support an enormous biosphere. Scientists have estimated that there are around 10^{29} living cells in the marine subsurface and roughly the same number in the continental subsurface! For context, there’s only about 10^{19} grains of sand on Earth. The ground beneath you is full of life.

even millions, of years. It’s like the ultimate survival mode, living on energy so low it almost doesn’t seem possible.”

We looked toward the front of the hall, where Dr. Karen was packing her notes. We gathered our courage and walked over.

Zar started nervously, “Excuse me, Dr. Lloyd?”

Dr. Lloyd turned and smiled warmly. “Hello!”

Mooks blurted out, “We just loved your talk. We’re students from India. We went on the field trip to the drilling site yesterday. It’s amazing that there are microbes even at 5,000 meters deep.”

Mari joined in, “And this is my mother, Dr. Usha. She’s a researcher, too.”

Usha smiled and shook hands with Karen.

“A fantastic presentation, Karen. You made the concepts so vivid.”

Karen said, “Thank you! And it’s wonderful to meet students who are excited. What did you find most interesting?”

Zar answered, “The part about how they evolve! You said evolution is about reproduction, variation, and selection of those that are fitter for the environment. But if an **aeonophile** barely ever reproduces... how does it get ‘fitter’?”

Karen grinned. “Ah, the million-year question! Think of it this way: we know animals that hibernate through winter have an advantage, right? They wake up in the spring, have babies, and pass on their ‘hibernation genes’. Now, imagine winter lasts not months, but a hundred thousand years. What periodic change is that like?”

Mooks’s eyes opened wide, and with excitement, she said, “Something like ... a volcano erupting? Or an earthquake shifting the rocks?”

Karen nodded. “Exactly! Or the slow, slow movement of tectonic plates. Imagine a microbe buried deep in seafloor mud or rock, several kilometres below the surface, completely cut off from sunlight and fresh food.” Karen paused to let that sink in. “Over hundreds of thousands of years, that seafloor might slowly push, scrape off, and lift up onto a continent,” she continued. “That journey could finally bring it to a new source of food or water, letting it wake up, divide, and begin a new chapter of life.”

Mari slowly said, “So ... the microbe is just ... waiting down there? For a geological alarm clock to go off?”

Deep_Sea_Drill

Dr Lloyd at work





Dr Lloyd at Fagradalsfjall volcano



Dr Lloyd at Svalbard

Karen enthusiastically agreed. “That’s the idea. To understand this concept, we need to move beyond the perspective of our short human lifespans. Imagine if a human lived only one single day.”

Zar’s forehead wrinkled as she tried to imagine. “Born at midnight ...”

Mooks continued, “... a teenager by breakfast ...”

Mari went on, “... a parent by lunch ...”

Karen smiled and completed the thought: “And by midnight, you have passed away of old age. Now, if your whole life happened in a snow-filled winter in China, Europe, or Canada, what would you think about trees?”

Usha got into the game. “You’d only ever see them brown, bare, and still. You might think they were dead or not alive at all. You’d never see their summer.”

Karen was pleased. “Precisely! We, with our 100-year lives, might be like those ‘one-day lifespan humans’ when we look at the sub-surface. We see stillness and think, ‘Nothing is happening.’ But the aeonophiles might be waiting for a ‘summer’ that comes only once every ice age or once every time a mountain range rises. Their patience is on a scale we can hardly comprehend.”

Karen added softly, “Some scientists have wondered whether such creatures were really alive at all. Their metabolism is so slow that for years nothing measurable seems to happen.” She shook her head and went on, “Yet, deep underground, these aeonophiles are quietly repairing their DNA, fixing their proteins, and proving that life does not always



Dr Lloyd, in search of methane eaters

rush. Taken together, they might even form one of the largest reservoirs of living carbon on the planet.”

Mooks, ever thoughtful, added, “It makes you wonder ... if we went to Mars or Europa, could life deep under the surface there be just as patient? So slow we wouldn’t even notice it?”

Karen nodded seriously. “It’s a real possibility. The discovery of aeonophiles expands our understanding of life and its potential locations. It’s as big a discovery as when we first found microbes called **thermophiles** living in hot springs of boiling water.”

Extreme life forms

There are other organisms adapted to the extreme edges of life, such as

- thermophiles: they tolerate extreme heat such as found in volcanoes. See the picture of Dr Lloyd pulling lava from the fresh flow from the Fagradalsfjall volcano in Iceland,
- psychrophiles, with high tolerance to cold; see the picture of Lloyd and colleagues dig a snow pit in Ny Ålesund, Svalbard at 79°N latitude near the North Pole, to drill into permafrost and search for extremophiles capable of surviving in sub-zero temperatures,
- acidophiles and alkaliphiles, which are tolerant to low or high pH,
- barophiles and piezophiles, tolerant to pressure,
- halophiles, tolerant to high salt.

These are collectively referred to as **extremophiles**. Lloyd has even searched for methane-eating extremophiles; see the picture of Lloyd and colleagues aboard the ship *RV Atlantis*, getting ready to dive in the Alvin submersible off the Oregon coast in August 2023. Aeonophiles are unique, however, in that they're not adapted to an extreme chemical or physical condition but extreme timescales.



Usha put her arms around us as we walked away. “So, science journalists, are you satisfied now?”

“Just wait, Amma,” Mari said. “Our headline will be ‘Forget Speed Demons, Meet the Slow-Motion Superheroes of the Deep!’”

Zar continued, “And our first sentence will be: ‘What if the oldest living thing on Earth isn’t a tree but a tiny, sleepy cell dreaming on, waiting for the Earth to move?’”

We all laughed, our voices full of excitement, as we headed back to our room.

Images from interview with Dr Karen Lloyd, Quanta Magazine

Further reading:

<https://aeon.co/essays/the-discovery-of-aeonophiles-expands-our-definition-of-life>.

Zar grinned at her friends and Karen, saying, “We were hoping to write all this down for our favourite science magazine back home, Jantar Mantar. We want to tell other friends about the secret, slow-motion world under their feet.”

Karen’s face lit up. “That is a wonderful idea! Science needs storytellers. Here, let me give you my email. Send me the article; I’d love to read it.”

She gave us all a quick, excited hug and took her leave.

Do you know? Time Runs Slower at Your Feet Than at Your Head

K. Asvathi.

DG Vaishnav College, Chennai

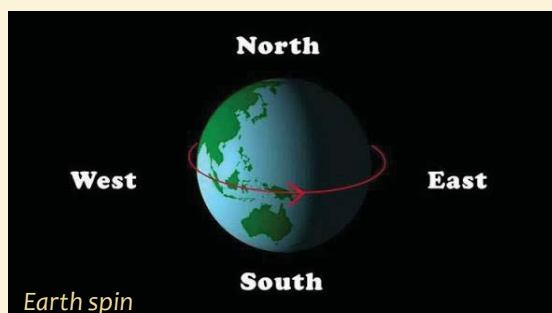
Yes! You read it right. This is a simple and surprising truth from Albert Einstein's Theory of Relativity. It might sound like science fiction, but it's a real and measurable fact. If you're standing up, time is passing a tiny bit slower for your feet than for your head. This strange behavior of time is not just theoretical — it's been experimentally proven using ultra-precise atomic clocks. The reason behind this is gravity, and the explanation is quite complicated and lies in both Einstein's Special Theory of Relativity (1905) and his General Theory of Relativity, proposed in 1915. Scientists have performed real-life experiments to prove this effect.

The Hafele Keating experiment

In the year 1971, Joseph C. Hafele, a physicist, and Richard E. Keating, an astronomer, took four cesium-beam atomic clocks aboard commercial airliners. They flew twice around the world, first eastward, then westward, and compared the clocks in motion to stationary clocks at the United States Naval Observatory.

When they returned to Earth, their times were compared with a clock that stayed on the ground. The clocks showed tiny but measurable time differences, just as predicted by relativity! The picture shows Hafele and Keating on a commercial aircraft, with two atomic clocks. Why does this happen?

According to relativity, time can slow down. This is due to kinematic and gravitational time dilation, which we explain below.



Kinematic time dilation

Special Relativity says that moving clocks run slowly. This is called time dilation. For instance, a clock at rest (with zero velocity) on Earth (technically called an inertial frame) will show a different time than a clock on the moving plane. So a clock aboard a moving plane will run slower than that on the ground. Remember that Earth rotates from west to east when seen from above (or from the North pole). So a clock on the plane going east (same direction as Earth's rotation), will have a greater velocity than the clock on the plane going west, against the Earth's rotation. So the clock on the east-going plane will run slower than both the clock on the ground as well as the clock on the west-going plane, due to special relativity.

Gravitational time dilation

General theory of relativity says that clocks which are closer to the source of gravitation (massive bodies like the Earth) go slower, while clocks that are further away go faster. That is,

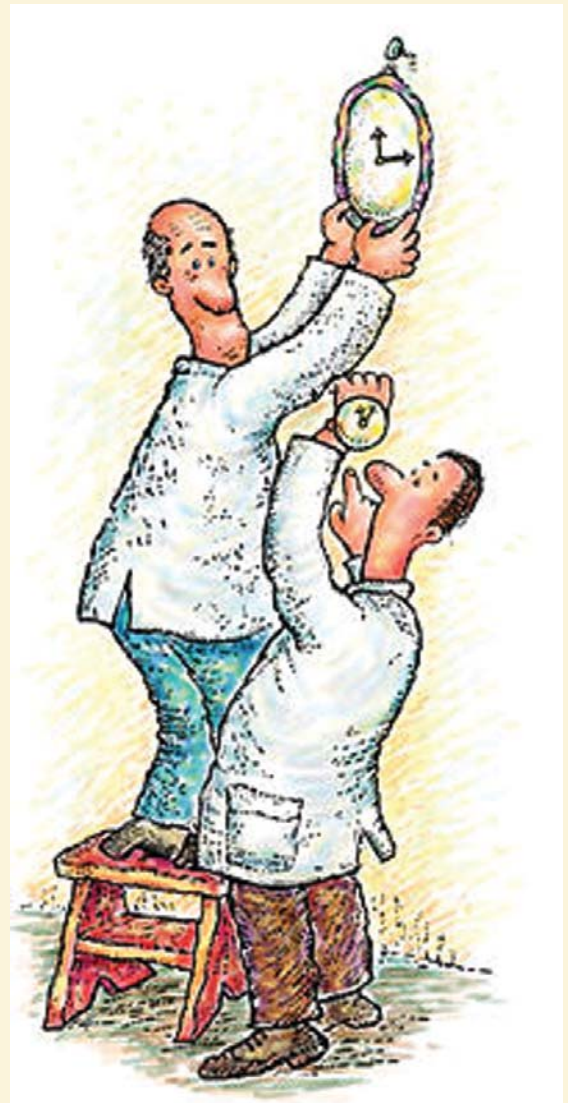
Stronger gravity = slower time;

Weaker gravity = faster time.

Since both planes flew at roughly the same altitude, both clocks on the plane (whether going east or west) speeded up due to this effect, compared to the clock on the ground.

You can now see the complexity: special relativity causes the clocks in the plane to go slower, with the clock in the eastward-going plane having the maximum slowing down compared to the clock on the ground. But general relativity causes the clocks to go faster than the clock on the ground. The net effect they

saw is therefore not easy to imagine, and also very very small. Hafele and Keating measured that the clock going eastward lost 59 ns (nanoseconds) while the clock on the westward plane gained 273 ns compared to the clock on Earth. The measurement had an average error of 10 ns. If you do the calculations for both special and general relativity, Einstein's theories predict that the eastward clock should have lost 40 ns while the westward one should have gained 275 ns (with an error of about 20 ns). Hence the theory made the correct pre-

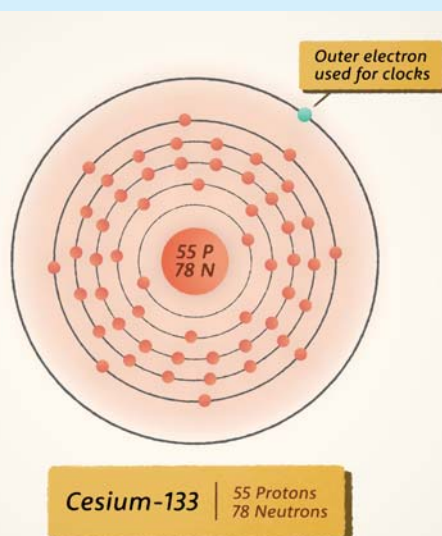


Caesium Clocks

In senior school, you will learn a model of the atom, due to Niels Bohr. Electrons do not randomly go around the central nucleus in an atom; instead, they are located in several orbitals with fixed energy levels around the nucleus. When energy (in the form of light, which is a form of electro-magnetic radiation) is given to the atom, the electron can “jump” from one level to another with greater energy. After some times, the electron drops back into its usual orbital, and radiates away the excess energy as light or radiation.

When the transition happens between two specific energy levels, the frequency of the light emitted is fixed. For instance transition between two “hyperfine levels” in a Caesium (Cs^{133}) atom gives rise to radiation with a very precisely known frequency of 9,192,631,770 Hz! A microwave cavity is used to give the Caesium the correct energy so that only this frequency of light is emitted by it. Since frequency is the number of vibrations per second, by counting the number of vibrations in a given time interval, the time can be found with extremely high precision. In fact, this frequency is now the standard with respect to which the second is defined in SI units since 1967.

Therefore such caesium clocks are used to define international standard time, as well as to synchronise precisely between two clocks, and also are crucial for networks and GPS systems which depend critically on time.



diction, and Hafele and Keating verified Einstein's theory.

What about the clock on your head?!

Since your feet are closer to the center of the Earth, they experience slightly stronger

gravity than your head. As a result, time passes just a little slower for your feet. The graphic (credit: Loel Barr for NIST) from the National Institute of Standards and Technology (NIST) shows that clocks tick faster if you are a foot

higher!

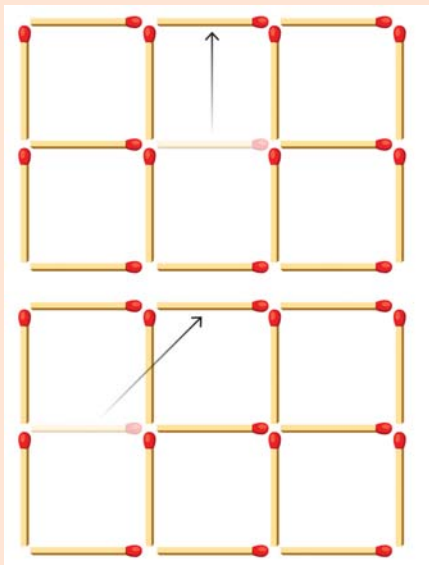
In everyday life, the difference is incredibly small — on the order of nanoseconds (billionths of a second). But over millions of years, even these tiny differences add up. If you stood on a tall mountain your whole life, you'd age slightly more than someone who lived at sea level — though not enough to notice without precision instruments!

Let us relate this interesting theory with a real life example. Imagine you have two clocks — one at your head, one at your feet. Since, your feet are closer to Earth's gravity, that clock ticks a tiny bit slower than the one near your head. You won't feel it, but the universe

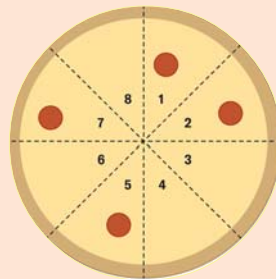
notices. So yes, your head is aging faster than your feet. This theory is highly applicable in the field of astronomy, and in communication where the GPS satellites orbit high above the Earth where gravity is weaker. Time ticks faster for the satellites than it does on the ground. But your GPS has corrected for this, and it shows not just the right time, but the right place! It is significant for high-accuracy physics experiments to consider gravitational time dilation. It's one of those beautiful, strange truths that make physics such an exciting subject!

Sources: <https://www.nasa.gov>, Wikipedia

Answers for 'Puzzles to puzzle you!'



Solution: There are three solutions, including the mirror image of the second shown solution. Be careful to look for the “small” and “big” squares: each solution creates four small squares and two large overlapping ones.



Solution: It is not possible to reach a state when all slices have equal number of toppings, starting from this arrangement. To see this, number the slices from 1 to 8 as shown. Now, when you and your friend place toppings on adjacent slices, the net result will be to add one topping on an even-numbered slice and one on an odd-numbered slice. So the total number of pieces on both odd- and even-numbered slices increases by one. But you have started with slices 1, 2, 5 and 7 already having a topping on them. That is, three odd-numbered slices (1, 5, and 7) and one even-numbered slice (2) have a topping already. You can never correct this imbalance by incrementing the number of pieces on odd and even slices by the same amount.



Kasavanahalli Lake: A Hidden Gem in Urban Bengaluru

Neil Thomas Abraham,

Class X, Bethany High School, Sarjapur, Bangalore

© Bijoy Venugopal

Bengaluru, then and now

Over the years, Bangalore has been in the news for many different reasons. More recently, the city lakes came into sharp focus for many different reasons including floods, droughts and the water crisis. Bangalore has always been a haven for nature lovers, and Nature itself. This is because of its temperate climate, gentle and undulating parks and botanical gardens. In addition, several small and large lakes foster biodiversity; hundreds of trees, energise groundwater supplementation and providing recreational opportunities to its residents.

In the recent past however, several of these lakes have been swallowed whole by construction projects that don't seem to understand what a fence means. Either they straight up steal the land or they dump construction debris into adjacent swamp areas, slowly polluting the main water bodies.

Amidst this chaos and cacophony thrives an almost unknown natural lake in the middle of a housing layout. This story is about this beautiful lake.

Kasavanahalli lake is part of the city's web of freshwater wetland ecosystems. It is part of the interconnected chain of lakes in the Koramangala and Challaghatta valley of suburban Bengaluru. Nestled in Shubh Enclave on Haralur Road, this small yet

relatively well-maintained lake offers a peaceful setting for morning joggers, evening walkers, a gang of surprisingly friendly dogs and a huge variety of birds, and other wetland organisms.

Eurasian Coot



Asian Openbill



Spotbill Duck



Swamp Hen



Asian Openbills



Mozambique Tilapia



Egret and Heron



Mosquito fish



Murrel Snakehead



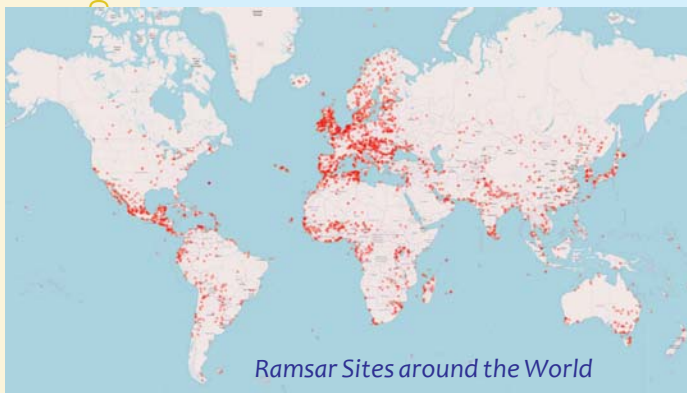


Nile Tilapia

What is a wetland ecosystem

Wetland ecosystem is a *distinct semi-aquatic ecosystem* whose groundcovers are flooded or saturated in water, either permanently, or temporarily. Wetlands form a transitional zone between waterbodies and dry lands, and are among the most biologically diverse of all ecosystems. They support a wide range of aquatic and semi-aquatic plants (e.g., cattails, lilies) and animals, offering critical habitats. They function as “biological supermarkets” and natural filters. They help reduce flooding of adjacent areas during rains, store carbon, and support 40% of world species. Wetlands of international importance are called Ramsar sites, there are 98 in India.

Observatory



Ramsar Sites around the World

When you walk through the gate, Kasavanahalli Lake seems like any other in the Bellandur area. Surrounded by three large apartment complexes, it is a popular retreat for local residents.

Bird Life

While this is not a birders paradise, it does offer bird-watchers an exciting set of possibilities with its regular resident-birds and annual visitors who make their presence felt at the turn of the season. The lake’s yearly residents include *Purple Swamphe*ns, *Eurasian Coots*, *Egrets*, *Heron*s, and *Cormorants*. In the monsoon, the lake is graced by the visit of *Pelicans* (see photo on front cover), on their migrating path, and the *Asian Openbill* arrives with the onset of winter. These birds are nothing special, but seem to enjoy the lakes, many trees and the central island. *Ducks* and *Coots* even breed here, with families often seen swimming in formation in the shallow parts of the lake.

Aquatic Life

What most people do not stop to recognise is the rich ecosystem inside the water and around the lake-bed. A closer look at its

Tank Goby



water's edge reveals a rich and often overlooked biodiversity. Though the lake's water is not crystal clear, it has been spared the severe pollution that afflicts its sister lakes, like **Kaikondrahalli Lake**, which is akin to a fish graveyard with algae-infested water and barely any aquatic life. As a result of the cleanliness at the Kasavanahalli lake, the lake is host to a relatively diverse set of aquatic organisms.

Among the lake's inhabitants are common fish species like *Tilapia* and *Carp*—two species of carp—Catla and grass carp—both of which are abundant, *Mozambique* and *Nile Tilapia*. A glance from the walking trail often reveals a shoal of Tilapia, with the occasional Catla swimming among them. These fish, with their iridescent hues and synchronized movements, captivate both children and adults alike. The lake is also home to many small fish like *Tank Gobies*, *Mosquito fish* and *Spike Tailed Paradise* fish. I am absolutely certain there are many more fish species that I am unaware of, and this I gather from the washed-up fish bodies. Several parts of the lakebed are simply inaccessible to me.

The fish are a primary food source for many

animals. Quite surprisingly, cats from the nearby apartments come into the lake to hunt, and I've seen a few courageous cats chewing on fish heads at the lake's edge. In the breeding season of the tilapia, schools of thousands, if not tens of thousands of baby tilapia, none more than a centimetre long, can be seen throughout the lake serving as food for the other fish including other tilapia.

The Lake has even more to offer. One of its most fascinating piscine residents is the *Murell* (snakehead), known to grow up to three feet in length. Once, I spotted an individual nearly five feet long, almost as big as my dog, and incredibly large for a snakehead.

By the Lake side

One of the most intriguing spots along the lake is a small slope that allows visitors to walk down to the water's edge and observe aquatic life up-close. The shallow areas host a thick layer of eucalyptus leaf detritus, sheltering a variety of invertebrates. I will talk about them in the next issue of *JM*.

Images courtesy Bijoy Venugopal, JLRexplore.com, and Wikipedia

Do You Know?

Animal Do You Know?

This one is about the very strange and fascinating platypus!

1. Is a platypus a mammal or a bird?
2. Does a platypus have a stomach?
3. How does a platypus defend itself?
4. How does a platypus find its way in water?
5. What is so special about platypus fur?

Answers in next issue's Do You Know?



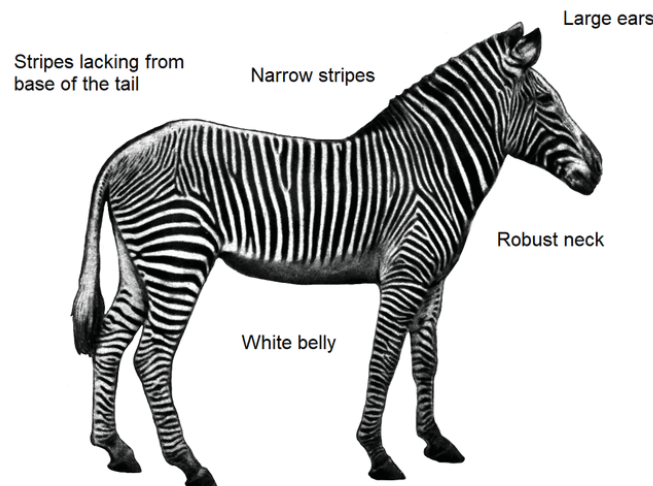
Answers to last issue's Animal Do You Know?

1. What use are a zebra's stripes?

Ans: Zebras' dazzling stripes make them among the most recognisable mammals. Several theories have been proposed for the function of these patterns. Now most evidence suggests they act as a deterrent for biting flies.

The **crypsis hypothesis** of the 19th century suggests that the stripes allow the animal to blend in with its environment or break up its outline. This was the earliest hypothesis and proponents argued that the stripes were particularly suited for camouflage in tall grassland and woodland habitat. However, it has been noted that zebras graze in open habitat and do not behave cryptically, being noisy, fast, and social and do not freeze when a predator is near. Lions and hyenas (natural prey of zebras) do not appear to perceive the stripes when they are far away. This makes the stripes useless in blending in.

Grévy's zebra (*E. grevyi*)



The **confusion hypothesis** states that the stripes confuse predators, making it harder to distinguish individuals in a group as well as determining the number, speed, or direction of zebras in a group. But lions appear to have no difficulty targeting and catching zebras when they get close and take them by ambush. A study disputed the idea and concluded that moving objects that

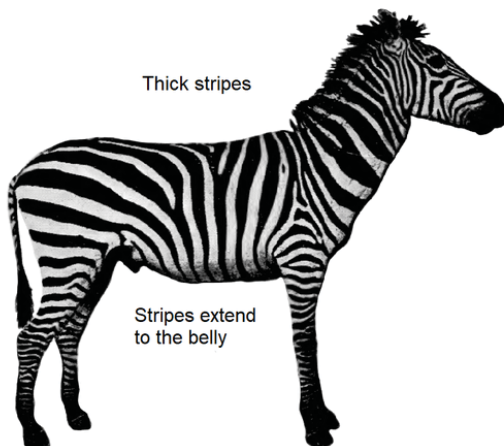
are solidly grey or less contrasted patterns are actually more likely to escape being caught. The **aposematic hypothesis** suggests that the stripes serve as warning colouration but this was also given up.

The **social function hypothesis** states that stripes serve a role in recognition of individuals of a group, social bonding, or a signal of fitness. **Charles Darwin** also endorsed this idea. However, no correlation has been found between striping and social behaviour or group numbers among equines, and no link has been found

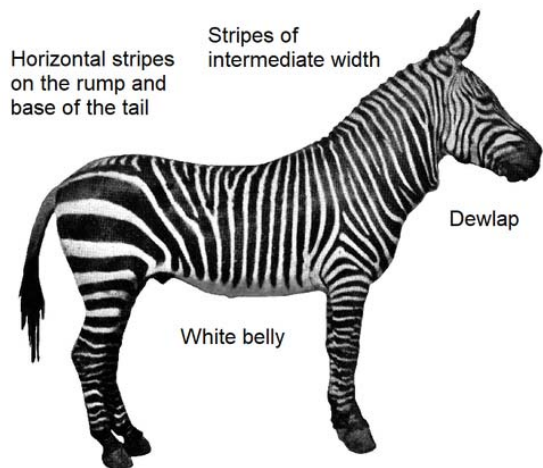
has been found.

A 1981 study proposed that repelling flies was a function of zebra stripes. The **fly protection hypothesis** holds that the stripes deter blood-sucking flies. Horse flies, in particular, spread diseases that are lethal to equines such as African horse sickness, equine influenza, equine infectious anemia and trypanosomiasis. This hypothesis is the most strongly supported by the evidence. It was found that flies preferred landing on solidly coloured surfaces over those with black-and-white striped patterns. Studies

Plains zebra (*E. quagga*)



Mountain zebra (*E. zebra*)



between fitness and striping.

The **thermo-regulatory hypothesis** suggests that stripes help to control a zebra's body temperature. In 1971, biologist **H. A. Baldwin** noted that heat would be absorbed by the black stripes and reflected by the white ones and in 1990, zoologist **Desmond Morris** suggested that the stripes create cooling convection currents. No evidence for this

have found that zebras are rarely targeted by these insect species. In particular, a study of captive zebras and horses showed that neither could deter flies from a distance, but zebra stripes kept flies from actually landing on the animal, both on zebras and horses dressed in zebra print coats.

There are three different zebra species; see

pictures. There does not appear to be any difference in the effectiveness of repelling flies between the different zebra species; thus the difference in striping patterns may have evolved for other reasons. White or light stripes painted on dark bodies have also been found to reduce fly irritations in both cattle and humans. It is thought that the high colour contrast and relative thinness of the patterns make it difficult for the insects to find a place to land. Maybe we can repel flies by painting ourselves in stripes, or wearing striped clothes!

2. What happens to a whale after it dies?

Ans: When whales die, their giant bodies usually sink to the seafloor and can nourish an entire ecosystem of deep-sea creatures, from large scavengers to microscopic bacteria. They provide inhabitants of the mostly deserted ocean floor with a sudden and immense source of food.

Decay sets in soon after the death of a whale, as the insides begin to decompose. The animal then expands with gas and sometimes floats up to the ocean's surface, where it can be scavenged by sharks and seabirds.

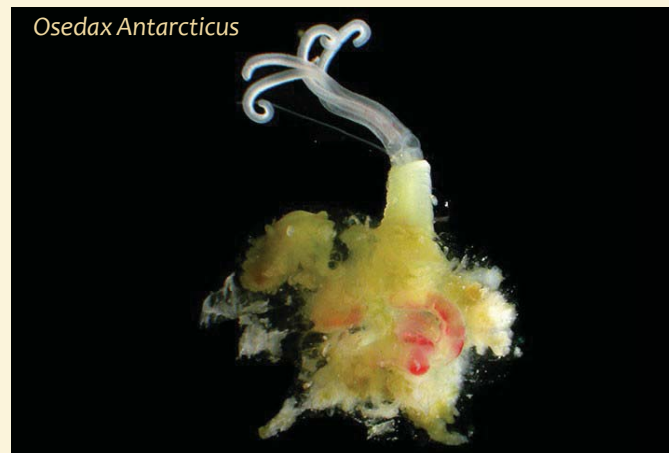
Eventually the ocean giant will begin to sink, falling kilometre after kilometre, until finally coming to rest on the seabed. This is when the carcass becomes known as a *whale fall*.

A natural whale fall is a rare sight, so scientists have few opportunities to study whales that have died and naturally sunk in the open ocean. Whale falls that are observed by scientists are usually dead



stranded whales. Only a few whale falls have been happened across naturally. The rest have been from sinking experiments. A grey whale was planted on the seafloor in 1998. Six years later, communities of invertebrates and bacteria had taken over the carcass; see picture.

Once the whale lands on the seabed, **hagfish, sleeper sharks, crabs, lobsters,** and a host of other scavenging animals eat the blubber and muscles down to the bone. A single whale can provide animals with sustenance for up to two years during this





Whalefall, after 6 years

adulthood there. It becomes an entire population.

Zombie worms - species in the genus *Osedax* - were first discovered on a three-kilometre-deep whale fall in 2002. These are the most important animals responsible for the process of breaking

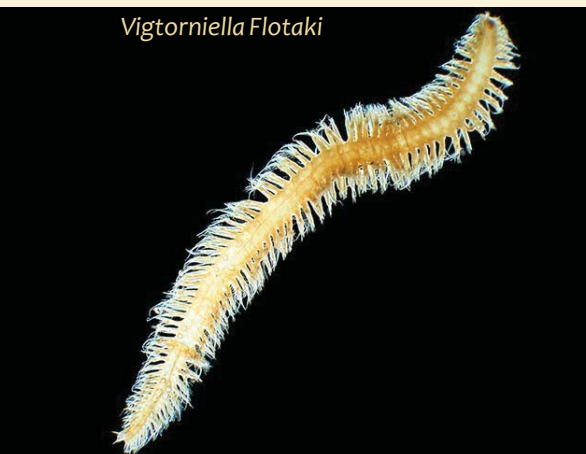
initial scavenging stage.

Large scavengers may reduce the carcass to a pile of bones, but there is still plenty of food left for some much smaller diners. **Sea snails, bristle worms** and **shrimp** devour any remaining scraps of blubber or muscle. They will also eat organic matter that is emitted from the carcass.

Polychaete worms such as *Vigtoniella flokati* feed on the tissues of the dead whale, helping to reduce the carcass to bare bones. The animals accumulate in numbers around the whale, move in and grow to

down the bones. Also known as **bone worms**, these invertebrates chemically eat the bones, breaking down elements such as collagen and fat using specialised methods. Additionally, they push oxygen into the bones, a process which speeds up decay.

The worms, such as *Osedax mucofloris* - a name which literally means 'bone-eating snot-flower' - bore their bacteria-filled root system into the bone, leaving their feathery plumes waving in the open water, taking in oxygen. Deep in these roots, the worms and bacteria make acid and enzymes to break



Vigtoniella flokati



Osedax mucofloris

down different elements of the bone. These small scavengers can spend as long as 10 years harvesting the remains of a whale.

While scavengers are at work digesting the bones, for 10 to 50 years the whale fall provides for a more specialised set of feeders. The bones are taken over by bacteria that produce hydrogen sulphide, a gas that smells of rotten eggs. A process called **chemoautotrophy** is a way for animals to gain energy through this and other chemicals, rather than through food. Specialised mollusc and tube worm species are **chemoautotrophs** that take advantage of whale falls, feeding on the chemicals released from the bones.

Before whale falls were well documented, it was thought that this type of biodiversity was only seen at cold-seep sites and hydrothermal vents where hydrogen sulphide and methane naturally escape through the sediment. But it is now

acknowledged that whale falls offer a unique stepping stone for specialised animals from these sites to disperse across the predominantly desolate ocean floor.

3. Hippos have big round bellies and a waddling walk. Is it that they are just fat?

Ans: No, hippos are not fat; they are actually massive, densely muscled creatures with very little body fat. Despite their rounded, chubby appearance, their bulk is composed of dense muscle, thick skin (up to 5 cm thick), and heavy bones. Their 2,000kg+ bodies are built for power, acting as underwater tanks rather than buoyant, fat-insulated mammals.

Underneath their skin, they are almost entirely packed with powerful muscles, particularly in their jaws and torso. Their fat layer is surprisingly thin while their tough skin acts as armour.

Wild hippos typically have only 2% to 5% body

Hippopotamus



fat. For comparison, a healthy human male usually has 15% to 20%, and even elite bodybuilders often maintain around 5% during competition. Their skin makes up about 18% of their total body weight. This provides massive protection and contributes to their rounded, “inflated” appearance.

They are so dense that they cannot float; instead, they walk or run along the bottom of rivers. Beneath that skin lies a massive frame of dense muscle, particularly in the neck and jaws, which allows them to deliver a bite force of 1,800 to 2,000 PSI—strong enough to snap a crocodile in half.

Their shape is an adaptation for living in water, where their dense bones allow them to sink and navigate riverbeds rather than swim. Their dense muscle and heavy bones act like a weight belt, allowing them to “run” or walk along the bottom of riverbeds rather than floating. If they were actually fat, they would be too buoyant to stay submerged effortlessly.

4. How and why do lizards lose their tails so easily?

Ans: Autotomy (‘self-amputation’, from the Greek auto-, “self-” and tome, “severing”) is the behaviour whereby an animal sheds or discards an appendage, usually as a self-defense mechanism. Some animals like lizards are able to regenerate the lost body part later. Autotomy is thought to have evolved independently at least nine times.

Lizards can easily detach their tails, a defense mechanism called caudal autotomy, to escape predators by distracting them

with a wiggling, broken limb. This process occurs at specialized, weak “fracture planes” within the tail vertebrae, allowing for a clean break that minimizes blood loss. While they can eventually regenerate a new, mostly cartilage-based tail, it is a costly sacrifice affecting speed, social status, and energy storage.

When grabbed by a predator, the lizard triggers an, often, voluntary break in the tail. The detached tail continues to move, drawing the predator’s attention while the lizard escapes. How does it do this?

Lizards are born with a line of weakness in their tail, technically called a **fracture plane**. If a point on the tail is hit or stressed, the muscles along the fracture plane pull away from one another rather than knitting together – this is known as a reflex muscle spasm. The pulling apart of the muscles causes the tail to fall off along the line of weakness. Lizard tail autotomy has developed so that when the tail breaks there is hardly any blood loss. Specialized **sphincter muscles** in the tail contract immediately around the arteries to minimize blood loss, and skin flaps often fold over to seal the wound. The tail regrows over six months to a year. The tail skeleton is replaced by a rod of cartilage with new muscles growing along it, producing a replacement tail that is usually shorter and less coloured compared with the original.

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Science News

Headlines

- Bonobos share human ability to imagine
- A 65,000 year hand stencil in Indonesia is now the oldest known rock art
- A particle collider in the U.S. shuts down to make room for a new one
- Polar bears in the Barents Sea are staying fat despite rapid sea ice loss
- Building blocks of life discovered in Bennu asteroid

Read more about some of them below.

Bonobos share human ability to imagine

In a series of tea party-like experiments, researchers at *Johns Hopkins University* demonstrated for the first time that apes can use their imagination and play pretend, an ability thought to be uniquely human.

Scientist **Jane Goodall** discovered that chimps make tools, and that led to a change in the definition of what it means to be human. This new discovery really invites us to reconsider what makes us special and what mental life is out there among other creatures.

By age 2, human children can engage in pretend scenarios, like tea parties. Even at 15-months-old, infants show measures of surprise when they see a person “drinking” from a cup after pretending to empty it.

There had been no controlled studies of pretense in nonhuman animals, although several verbal reports pointed to such behaviour both in the wild and in captivity. For example, in the wild, young female

chimpanzees have been observed carrying and playing with sticks, holding them like mothers would hold their infants. And a chimpanzee in captivity seemed to drag imaginary blocks along the floor after playing with real wooden blocks.

Christopher Krupenye and co-author **Amalia Bastos** wondered if they could test this capacity to pretend in a controlled environment. They created experiments very similar to a child’s tea party to test **Kanzi**, a 43-year-old bonobo living at *Ape Initiative*, who could respond to verbal prompts by pointing.

In each test, an experimenter and Kanzi faced one another, tea party- style, across a table set with either empty pitchers and cups or bowls and jars. In the first task there were two transparent cups on the table, both empty, alongside an empty transparent pitcher. The experimenter tipped the pitcher to “pour” a little pretend juice into each cup, then pretended to dump the juice out of one cup, shaking it a bit to really get it out. The other cup still contained the imagi-



Kanzi

nary juice. They then asked Kanzi, “Where’s the juice?” Kanzi pointed to the correct cup that still contained pretend juice most of the time, even when the experimenter changed the location of the cup filled with pretend juice.

In case Kanzi thought there was real juice in the cup, even if he couldn’t see it, the team ran a second experiment. This time there was a cup of real juice alongside the cup of pretend juice. When Kanzi was asked what he wanted, he pointed toward the real juice almost every time.

A third experiment repeated the same concept, except with grapes. An experi-

menter pretended to sample a grape from an empty container, then placed it inside one of the two jars. They pretended to empty one of the containers and asked Kanzi, “Where’s the grape?” Kanzi again indicated the location of the pretend object.

Kanzi was never perfect, but he was consistently correct. “It’s extremely striking and very exciting that the data seem to suggest that apes, in their minds, can conceive of things that are not there,” Bastos said. “Kanzi is able to generate an idea of this pretend object and at the same time know it’s not real.”

Unfortunately, Kanzi died last year. The

findings inspire continued study, especially trying to test whether other apes and other animals can engage in pretend play or track pretend objects. The team also hopes to explore other facets of imagination in apes, perhaps their ability to think about the future or to think about what's going on in the minds of others.

A 65,000 year hand stencil in Indonesia is now the oldest known rock art

A stencilled outline of a hand found on the Indonesian island of **Sulawesi** is dated to be 67,000 years old! It shows a red outline of a hand whose fingers were reworked, re-searchers say, to create a claw-like shape, pointing to great symbolic imagination.

The painting has been dated to at least 67,800 years ago – around 1,100 years before the previous record, a controversial hand stencil in Spain. The find also strengthens the argument that our species, *Homo sapiens*, had reached the wider Australia–New Guinea landmass, known as Sahul, by around 15,000 years earlier than some researchers argue.

To put this into perspective: Anatomically modern humans (i.e. *Homo sapiens*) are believed to have emerged in Africa around 300,000 years ago. It is believed that their way of life hardly changed until about 50,000 years ago. This marked the beginning of the **Upper Palaeolithic** age, the third and last subdivision of the Old Stone Age. Very broadly, it dates to between 50,000 and 12,000 years ago. At this time, human behaviour changed and modernised.

For instance, there was a marked increase in the type of artefacts found associated with



modern human remains. Evidence for this was seen throughout Asia and Eurasia, as humans moved out of Africa. This may also have led to the extinction of the Neanderthals. The Upper Palaeolithic has the earliest known evidence of organized settlements, in the form of campsites, some with storage pits. Artistic work blossomed, with cave painting, petroglyphs, carvings and engravings on bone or ivory.

However, over the past decade, a series of discoveries on Sulawesi Island in Indonesia has overturned the old idea that art and abstract thinking in our species burst suddenly into life in Ice Age Europe and spread from there. Cave art is seen as a key marker of when humans began to think in truly abstract, symbolic ways – the kind of imagination that underpins language, religion and science.

Early paintings and engravings show people not just reacting to the world, but representing it, sharing stories and identities in a way no other species is known to have done. The oldest Spanish cave art is a red hand stencil



Sulawesi painting

Griffiths University.

The latest discovery is from a limestone cave called **Liang Metanduno** on *Muna*, a small island off south eastern Sulawesi. It has been spray-painted: an ancient graffiti artist pressed their hand flat against the cave wall, then blew or spat a mouthful of pigment around it so that, when

in **Maltravieso** cave in Western Spain, dated to be at least 66,700 years old - though this is controversial and some experts don't think it to be that old.

In 2014, hand stencils and animal figures dating back at least 40,000 years were found in Sulawesi, followed by a hunting scene that is at least 44,000 year old, and then a narrative pig and human painting dated to at least 51,200 years ago. Each step pushed sophisticated image making further back in time, according to Professor **Maxime Aubert** of



Enhanced image

they pulled the hand away, a negative outline was left behind on the rock. This can be clearly seen in the picture, where the central part of the picture is enhanced and zoomed in.

That was not all. After the original stencil was made, the outlines of the fingers were carefully altered – narrowed and elongated to make it look more claw-like; a creative use of imagination in ancient humans. One fragmentary hand stencil in the cave is overlain by thin mineral crusts that, when analysed, was found to have a minimum age of 67,800 years, making it the oldest reliably dated cave art anywhere in the world.

It is very likely that the people who made these paintings in Sulawesi were part of the broader population that would later spread through the region and ultimately reach Australia.

A particle collider in the U.S. shuts down to make room for a new one

When the Universe formed with the Big Bang, all of space was a cosmic cauldron filled with a fiery liquid of fundamental particles heated to trillions of degrees. This primordial soup only lasted a few microseconds. Matter's more ordinary building blocks, protons and neutrons, settled out of it as the universe expanded and cooled, and the strange stuff vanished, never to be seen again.

Around 2000, at Brookhaven National Laboratory, U.S.A., a newly built experiment called the **Relativistic Heavy Ion Collider** (RHIC) was designed to recreate the Universe's earliest moments by smashing together atomic nuclei at close to the speed

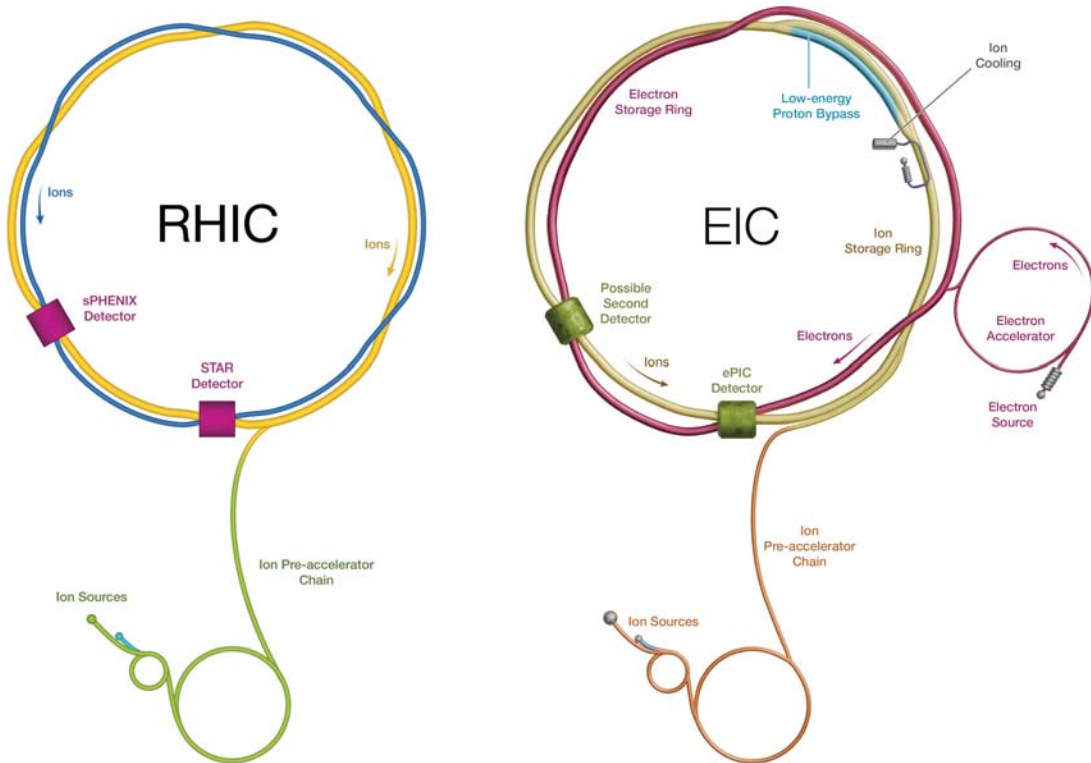
of light.

The Relativistic Heavy Ion Collider consisted of two rings (shown) that accelerated protons and atomic nuclei to nearly light speed before smashing them together. During its record-breaking 25-year run, antimatter was created at RHIC. It probed the proton's spin. And, of course, it brought physicists closer to the big bang than ever before. But now the great machine has been switched off. Why?

It will make room for an even better collider: a far more powerful electron-ion collider to further push the frontiers of physics. This new machine will be built partly from RHIC's bones, especially from one of its two giant, subterranean storage rings that supplied the circulating, near-light speed nuclei.

RHIC's purpose was to shed light on the **strong force**, that operates between *quarks* which come together to form protons and neutrons alike, which in turn form the nuclei of atoms. The strong force occurs when quarks exchange yet other particles called *gluons* among themselves. So the proton is made up of these quarks and gluons. How do the properties of the proton reflect in those of the underlying quarks and gluons? This is the question that has not fully been answered in the last 50 years!

The Electron Ion Collider (EIC) that will replace RHIC, will address many of the still-open puzzles about protons and their constituent quarks and gluons. Instead of colliding gold ions on gold ions, it will beam electrons on gold ions. So one of RHIC's ion rings will be replaced with a new ring for cycling electrons. The EIC will use those tiny,



fast-flying electrons as tiny knives for slicing open the much larger gold ions.

It will be the first new collider built in the US since RHIC. “For at least 10 or 15 years,” says Abhay Deshpande, BNL’s associate laboratory director for nuclear and particle physics, “this will be the number one place in the world for young physicists to come.

Polar bears in the Barents Sea are staying fat despite rapid sea ice loss

Polar bears in Norway’s **Svalbard** archipelago are becoming fatter and healthier despite rapidly melting sea ice, as a new study shows. They have adapted by foraging for land-based prey like reindeer, bird eggs, and

scavenged walrus carcasses. While this behavioral flexibility offers a temporary boost in condition, experts warn this is likely a short-term, localized trend and not sustainable as the long-term habitat loss will eventually outweigh these alternative food sources.

Scientists expected the opposite, but polar bears in the Norwegian Arctic archipelago of Svalbard have become fatter and healthier since the early 1990s, all while sea ice has steadily declined due to climate change. Polar bears rely on sea ice as a platform from which to hunt the seals that they rely on for blubber-rich meals. The bears’ fat reserves provide energy and insulation and allow mothers to produce rich milk for cubs.

Researchers weighed and measured 770 adults in Svalbard between 1992 and 2019 and found that bears had become significantly fatter. The discovery, published in *Scientific Reports*, was particularly puzzling because of the impact of climate change in Svalbard. During the same period that this research was carried out, global temperature rise has increased the number of ice-free days per year in the region by almost 100 - at a rate of about four days each year.

“The fatter a bear is the better it is,” explained lead researcher **Dr Jon Aars** from the Norwegian Polar Institute. “And I would have expected to see a decline in body condition when the loss of sea ice has been so profound.”

They think that Svalbard bears have adapted to recent ice loss by eating more land-based prey, including **reindeer** and **walruses**. Walruses have been officially protected in Norway since the 1950s, after they were hunted to near extinction. That protection has boosted their numbers, and apparently provided a new source of fatty food for polar bears.

“There are a lot more walruses around for them to hunt these days,” said Aars. “It is also possible that they are able to hunt seals more efficiently.” He explained that, if seals have smaller areas of sea ice available to them, they will congregate in those smaller areas, presenting easier collective pickings for bears.

While this is unexpected good news for these Arctic predators, the researchers think it is unlikely to last. As the sea ice continues to decline, bears will have to travel further to

access hunting grounds, using more energy and depleting precious fat reserves.

The charity **Polar Bears International** points out that Svalbard's polar bears were some of the most heavily-hunted in the world, until international protections were introduced in the 1970s. Experts think the new findings could be linked to the population recovering from that hunting pressure. That, combined with an increase in the number of walruses - and of reindeer - in recent decades, appears to have provided the bears with a temporary boost.

Elsewhere in the Arctic, climate change is having a very different effect on polar bears. There are 20 known sub-populations of polar bears across the Arctic. In Canada's **Western Hudson Bay**, where the most southerly and best studied bears live, a decline in the population has been directly linked to warming temperatures.

Whiteman added that the long-term picture for polar bears was clear - they need sea ice to survive. “Ice loss ultimately means bear declines, but this study shows that the short-term picture can be very region-specific. In the long term, if ice loss continues unchecked, we know the bears will eventually disappear.”

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Nature Diary

Tabebuia rosea, Trumpet tree

This tree is native to Central America and was brought to India by the British. It grows well in cities and in limited spaces. It is common across India, flowering during Jan-Mar, with both pink and yellow flowering varieties. There are concerns that it may deplete the groundwater, but it makes for a spectacular show such as in Bangalore (see picture) which is carpeted with these flowers during the season.



Cover Photo Credit: Wikipedia, Pelicans in National Zoo, Bangladesh, by Sifat Sharker

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Polar Bear, with cub



Image Courtesy Wikimedia Commons

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