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Time Zones: The motions of the Earth Planet

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The Earth has resembled to that of sphere with compressed polar axis and being out slightly around the equatorial area i.e. oblate spheroid. The earth oblate is caused by the force of gravity and rotation which dictates central part to deform into a centrifugal force that leads to an oblate structure.

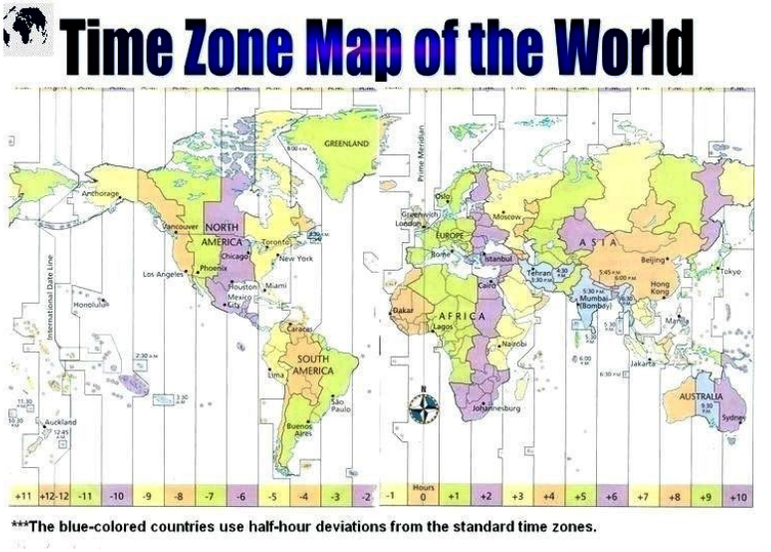
The earth is engaged in several motions through space each at a different level of magnitude and it is divided in to two categories: large scale movements and small scale movements. The large scale movements have limited significance to the earth because it needs a long time span to produce major changes. The small scale motions cause the earth to change its position constantly in respect of Sun. This motions is responsible for changing seasons and the alternations of day and night, weather and form the basis of our system of keeping time.

The movement of the earth around the sun is the basis of calendar of the year. The revolution time around the sun is 365 days 5 hrs and 49 minutes (365 days long). The earth orbital path (actually broad ellipse) has perihelion (nearest to sun) and aphelion (away or farthest location from sun) position which effects the seasons and temperature on earth in respect of hemispheres.

Rotation is the basis of our calendar day and due to the earths' west ward motion (west to earth). It can be described as counter clock wise from north and clockwise from south or eastward if is earth is viewed from a point in space above the equator.

All places on the earth complete one 360° rotations in a 24-hour period. It rotates through an angle of 1° every 04 minutes. Earth is inclined approximately 23½ from perpendicular axis.

The earth has been drawn lines connecting the two poles and they measure from equator east to west or vice versa. Such lines are called meridians. The parallels are imaginary lines that could be used to measure distances from north to south or vice versa from equator. The prime meridian and the place are measured with the help of longitudes of a



***The blue-colored countries use half-hour deviations from the standard time zones.

place in arc degrees of parallels. The Royal observatory at Greenwich confirms that the prime meridians is universally accepted as a meridian by itself to measure arc of a number of distances and the value of meridians 1° (degree) of longitude. The lines of longitudes have a range of 180° (degree) starting form 0° (degree) east or west. The approximate distance of one degree at equator is 111 KM or 69 miles.

The basic unit of time is the solar day which is the period of time needed for the sun to make one apparent 360° circuit of the sky. The solar day is of course divided into unit of hour minute and second.

Local time is historically used for establishing the time of day has been solar noon. Until the late 1800's communication made the time of mean occurrence of solar noon the official instant of noon and then simply subdivided the periods between solar noon into the approximate hours, minutes and seconds at every meridian.

During nineteenth century major shortcoming were occurred and eventually it was discontinued over most of

the world and finally standard time zones were developed for acquiring precisely time at places in respect of meridians.

Our present standard time system was officially established from the U.S.A. in November 1883 and adopted by most other countries. The standard time system is based on the position of noon sun but only at selected meridians of longitudes rather than at each specific site. The areas surrounding these standard meridians all have the same official time.

The earth rotates 15° in one hour the standard time zone differs by exact one hour intervals. Thus there is 24 time zones cover the earth. Time zones are the functional basis of standard time.

A zone on the terrestrial globe the is approximately 15° longitude vide and extends from pole to pole and within which a uniform clock time is used. The meridian used as the centres of their respective time zones are multiples of 15°. The basis for all the time zones is Greenwich meridians and time zones established by this meridians is called Greenwich Mean Time (GMT).

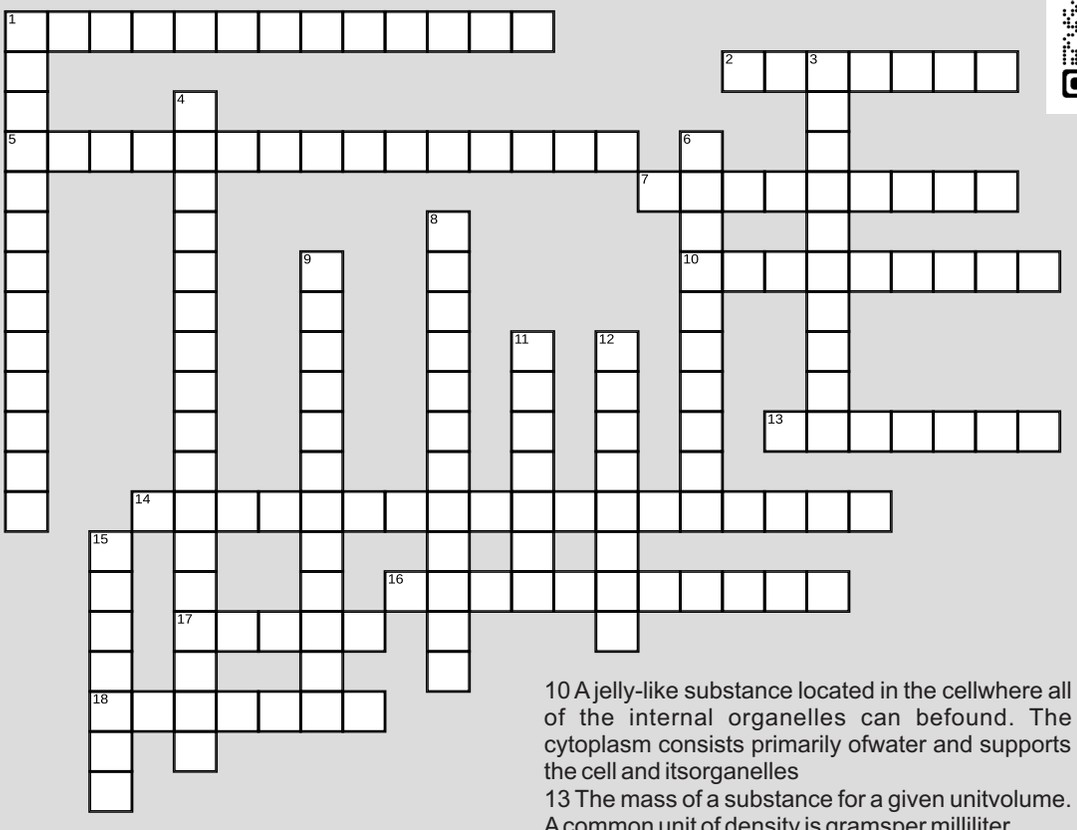
The standard time were followed by each time zone would be exactly centred on its standard meridian and would extend 7°30' (Seven degree thirty minutes) both east and west from the meridian to the boarders of adjacent time zone Indian Standard Time (IST) is determined by 82½° E longitude which locates Mirzapur (UP).

International Date line is the boundary (180° Longitude) where each calendar day starts and separates two dates; when somebody cross the date line travelling towards east of the meridian he has to subtract a day and crossing the line towards west he has to add a day as per the time zone (04 minutes per longitude + or – as the case may be).

Hence, all the phenomenon regarding time, season, duration of day-night is connected with the motions of Earth.

check the answers to the crossword published in the previous issue, scan this QR code.

Science Crossword



Across

1 An apparent grouping of stars in the sky thatis used for identification purposes. Thesestars are not necessarily near each other inspace since they are not necessarily thesame distance from the Earth.

2 A unit of measure for the relative intensity ofsounds

5 The region on a continent where new crustis being created, and the plates on eitherside of the rift are moving apart

7 The part of a vector that lies in the horizontalor vertical direction

10 A jelly-like substance located in the cellwhere all of the internal organelles can befound. The cytoplasm consists primarily ofwater and supports the cell and itsorganelles

13 The mass of a substance for a given unitvolume. A common unit of density is gramsper milliliter

14 A boundary between two of the Earth'splates that are moving toward each other.

16 The celestial coordinate similar to that oflatitude on the Earth. This measures howmany degrees, minutes, and seconds northor south of the celestial equator an object is.

17 A fan shaped deposit of material at themouth of a river

18 The flow of charge past a point per unit time;it is measured in Amperes

Down

1 A measure of the amount of solute that ispresent in a solution. A solution thatcontains very little solute is called dilute. Asolution that contains a relatively largeamount of solute is said to be concentrated.

3 An organelle that contains the entire DNA ofthe organism

4 A boundary between two of the Earth'splates that are moving away from each other

6 The last stage of the scientific methodwhere explanations are made about why thepatterns identified in the analysis sectionoccurred.

8 The change in position of an object.Computed from the final position minus theinitial position. Common units of measureare meters

9 Organelles that are the internal "bones" ofthe cell. They exist in thick and thin tubules.

11 A solid in which atoms or molecules have aregular repeated arrangement

12 A substance composed of more than oneelement that has a definite composition anddistinct physical and chemical properties

15 The top layer on a leaf. It is a non-livinglayer consisting primarily of wax that isproduced by the epithelium, a cell layerdirectly underneath

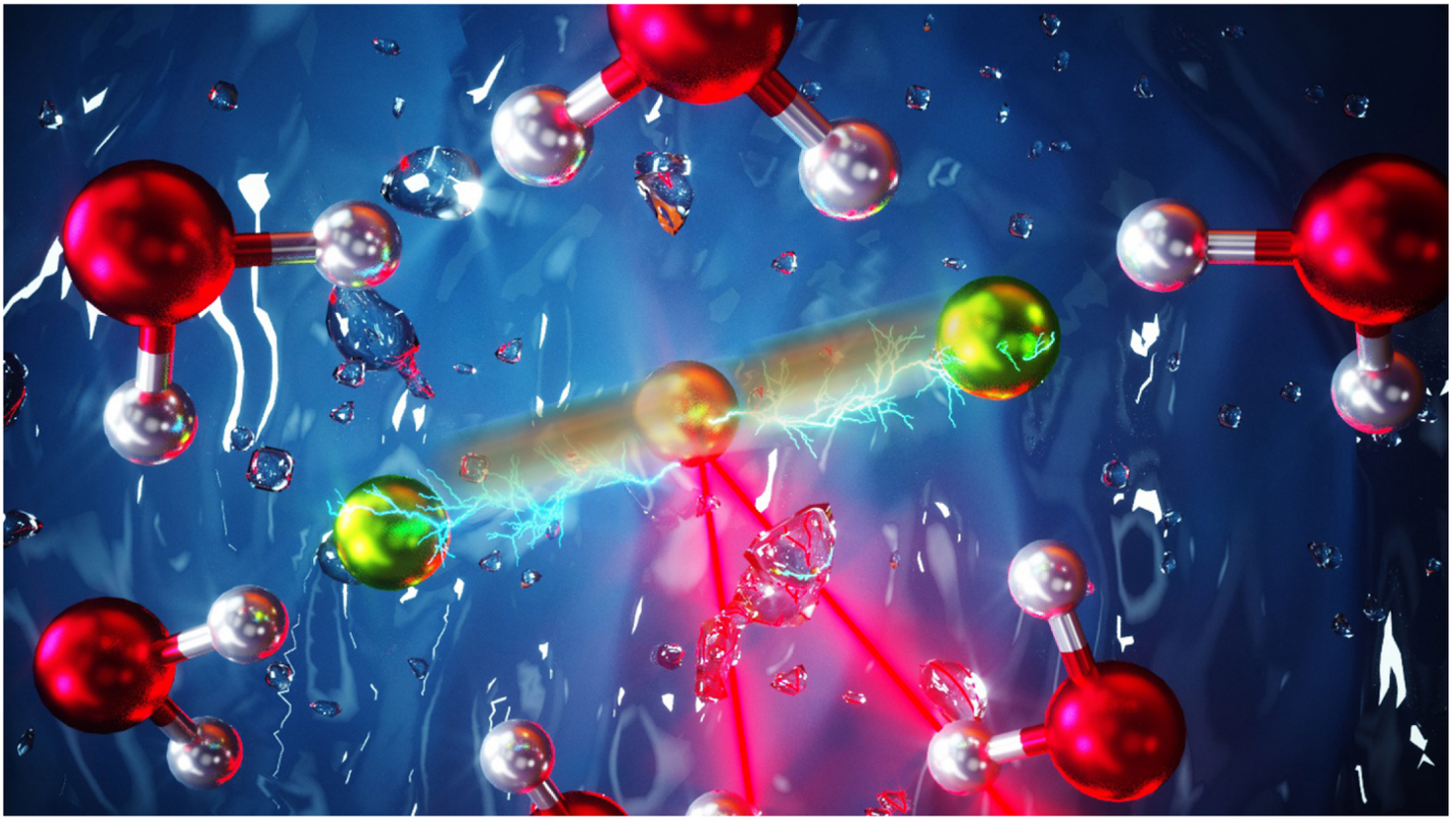
Answers will be published in the next issue of the Science Spectrum

Source : https://mycrosswordmaker.com/

THIS WEIRD CHEMICAL BOND ACTS LIKE A MASH-UP OF HYDROGEN AND COVALENT BONDS

Hydrogen atoms sandwiched by fluorine exhibited the quirk of chemistry

Dr Lav Varma
Department of Chemistry



Fluorine atoms (illustrated in green) squeeze a hydrogen atom (orange) between them, when dissolved in water (red and silver). Researchers used infrared laser light (red lines) to study the chemical bond that formed (branching blue lines), which acts like a hybrid between a hydrogen bond and a covalent bond.

Chemistry students around the world are acquainted with covalent bonds and hydrogen bonds. A study now reveals a strange kind of bond that acts like a hybrid of the two. Its properties raise questions about how chemical bonds are defined,

Hydrogen bonds are usually considered as weak electrical attractions rather than true chemical bonds. Covalent bonds, on the other hand, are strong chemical bonds that hold together atoms within a molecule and result from sharing of electrons among atoms. Now, researchers have reported that the unusually strong type of hydrogen bond is actually a hybrid, as it involves shared electrons, blurring the distinction between hydrogen and covalent bonds.

Andrei Tokmakoff of the University of Chicago said, "Our understanding of chemical bonding, the way we teach it, is very much black and white". The new research shows that "there's indeed a continuum."

Tokmakoff and colleagues characterized the hybrid bond by observing groups of atoms called bifluoride ions, consisting of a single hydrogen atom sandwiched between a pair of fluorine atoms, in water. Conventionally, the hydrogen atom is bound to one fluorine by a covalent bond and to the other fluorine by a hydrogen bond.

Researchers utilized infrared light to vibrate bifluoride ions and measured the response of hydrogen atoms, revealing a series of energy levels at which the hydrogen atoms vibrate. In a typical hydrogen bond, the gap between these energy levels decreases as the atom moves further up the energy ladder. But instead, the researchers found that the spacing between the energy level increased. This behaviour indicates that the hydrogen atom was shared between the two fluorine atoms equally,

rather than being tightly bound to one fluorine atom by a covalent bond and more loosely bound by a usual hydrogen bond to the other fluorine. Study co-author Bogdan Dereka, at the University of Chicago said, "In this arrangement, the difference between the covalent and hydrogen bond is erased and is no longer meaningful"

Computer calculations showed that this behaviour depends on the distance between the two fluorine atoms. As the fluorine atoms get closer to each other, they squeeze the hydrogen between them, the normal hydrogen bond becomes stronger, until all three atoms start sharing electrons like covalent bond, forming a single link. The researchers call this a hydrogen-mediated chemical bond. For fluorine atoms that are farther apart, the conventional explanation of distinct covalent and hydrogen bonds still apply.

The hydrogen-mediated chemical bond can nott be explained by either pure hydrogen bond or a pure covalent bond, the researchers conclude. "It's actually some hybrid of both," says chemist Mischa Bonn of the Max Planck Institute for Polymer Research in Mainz, Germany.

Hydrogen bonding occurs in a wide variety of substances, most notably in water. Without hydrogen bonding, water should be a gas at room temperature instead of a liquid. Most hydrogen bonds in water are weak, but water with excess hydrogen ions can form strong hydrogen bonds similar to bifluoride ions. Two H_2O molecules can sandwich a hydrogen ion, creating what is known as a Zundel ion, in which the hydrogen ion is equally shared between the two H_2O molecules. The new results reverberate the behaviour of Zundel ion, says chemist Erik Nibbering of the Max Born Institute for Nonlinear Optics and Short Pulse Spectroscopy in Berlin.

Strong hydrogen bonds are thought to involved in the transport of hydrogen ions. This process is vital for a variety of biological mechanisms including powering cells and for technologies like fuel cells. So better understanding these bonds could shed light on a variety of effects.

And the new observation has insinuations for how scientists understand basic principles of chemistry. Bonn said, "It touches on our fundamental understanding of what a chemical bond is,"

This afresh understanding of chemical bonding also provokes questions about what qualifies as a molecule. Atoms connected by covalent bonds are considered part of a single molecule, while those joinedby hydrogen bonds can remain separate entities. So bonds like this raise the question, "when do you go from two molecules to one molecule?" Tokmakoff says

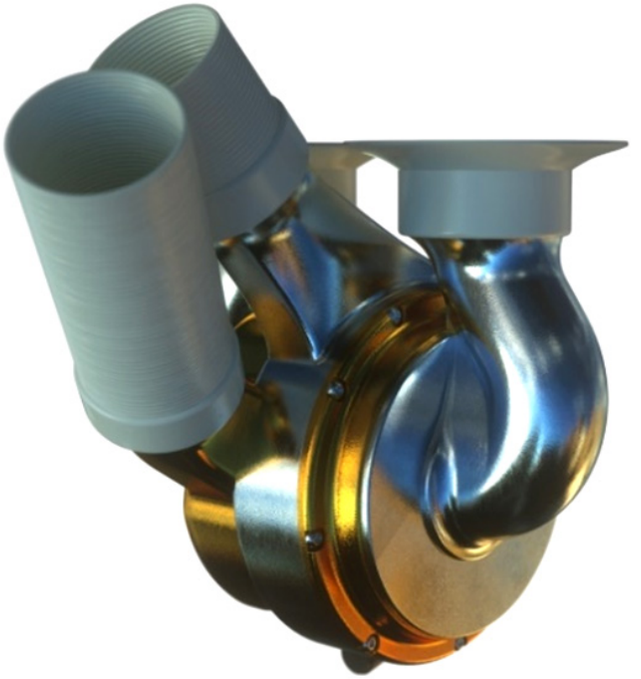
Source : https://www.sciencenews.org/article/new-weird-hybrid-chemical-bond-hydrogen-covalent

WHY DOES A FROG CROAK?

A male frog can attract a mate by using a mating call. Not only do frogs have vocal cords, like us, but most also have a vocal sac, which is an inflatable membrane that acts like an amp. The frog breathes in, closes its nostrils and forces air back and forth between the lungs and the vocal sac, which vibrates the vocal cords. The air resonating inside the vocal sac amplifies the call.

Source : HowItWorks170

ARTIFICIAL HEART MADE FROM MAGNETS AND TITANIUM



Pragya Singh
Department of Chemistry

Researchers have come up with an artificial heart: BiVACOR; a titanium, pumpless, device with spinning magnets which looks nothing like a bonafide heart. The BiVACOR is a total artificial heart designed to take over the complete function of a patient's failing heart.

BiVACOR was developed by Dr Daniel Timms, who began developing artificial hearts when his father Gary, a plumber, suffered a heart attack in 2001.

Heart failure affect a large number of people every year, and treatment options are slim. Medication can help, but some people need a heart transplant for a full recovery. Still, donor hearts are hard to find because the number of people who need a heart far exceeds what's available. And, donor hearts have many conditions to be fulfilled. The blood type and size need to be just right.

The BiVACOR is designed to be a long-term device that can replace the total function of the patient's native heart. The small, compact device uses proven rotary blood-pump technology to provide the required cardiac output. The system comprises a magnetically levitated rotor located between opposing pump casings. The key feature that enables this device to support both the left and right sides of the heart is the left and right impeller blades, which are mounted on either side of the rotating hub. The hub is levitated and rotated via an electromagnetic motor and bearing arrangement on top of the pump casings. The dedicated hydraulic design of the impellers, combined with state-of-the-art magnetic levitation (MAGLEV) technology, permits control of the circulation to be fine-tuned by means of a differential fluid output. An external controller and batteries provide power to the internal device via a percutaneous driveline.

The BiVACOR and human hearts work on entirely different principles. A human heart has two distinct sides. Blood first loops from the smaller, right side to the lungs and back, so that its oxygen can be replenished; it then crosses over to the larger, stronger left side, which pumps it forcefully into the body. The BiVACOR heart is one combined chamber. It sends blood in two directions using its spinning disk, or "rotor," which has two differently contoured sides, each shaped to create the appropriate level of blood pressure. Where the heart of a healthy adult beats anywhere between sixty and a hundred times a minute, the BiVACOR spins at between sixteen hundred and twenty-four hundred r.p.m.

BiVACOR heart in transitional state, currently they are not open for human transplantations. However, they have conducted successful trials in animals like sheep and they survived for several months.

Currently, artificial hearts only sustain life for about 130 days (although a lucky few have lasted for over 4.5 years), but BiVACOR promises to last as much as ten years. The company has tested it in a cow, which lived and was healthy 90 days later and could exercise on a treadmill. And the heart has been temporarily placed in humans just before they received an actual heart transplant.

BiVACOR has once again raised hopes that artificial hearts could put an end to the fraught and often futile search for donor hearts. The new design has not only raised millions of dollars in funding, but has also has gained support from the Texas Heart Institute.

BiVACOR is finally preparing to launch its first human trials. Successful human trials could mean patients no longer have to wait and hope that a donor heart will become available to them.

Source : https://www.sciencefocus.com/news/artificial-hearts-made-from-magnets-and-titanium-could-save-many-lives/

MICROPLASTIC PARTICLES NOW DISCOVERABLE IN HUMAN ORGANS AND HUMAN PLASMA

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Department of Chemistry

What are actually these microplastics? Microplastics, defined as pieces of plastic smaller than 5 mm in size, and are shed by synthetic clothing being washed, vehicle tyres, and the spillage of plastic pellets used by manufacturers. The physical breakdown of plastic litter also creates them. Rain washes them into rivers and the sea, but they can also be blown by the wind and end up in fields. These microplastics are consumed via food and water, and to breathe them in. Microplastics have polluted the entire planet, from Arctic snow and Alpine soils to the deepest oceans. Their potential impact on human health is still studied and a lot of researchers are working in this area.

The researchers have identified chemical traces of plastic in tissue. But isolating these minuscule fragments is difficult, and contamination from plastics in the air is also a challenge. Generally, the analytical method is used by the researchers to identify dozens of types of plastic including the polyethylene terephthalate (PET) used in plastic bottles and the polyethylene used in plastic bags. To test this technique, they took 47 samples of lung, liver, spleen and Kidney tissue from the tissue bank that was established to study neurodegenerative diseases. As it was seen that microplastic particles could be detected in every sample. They detected bisphenol A (BPA), a chemical used to make plastics in all 47 samples. The US Environmental Protection Agency is concerned about BPA because “it is a reproductive, developmental and systemic toxicant in animal studies”. The researchers examined lung, liver, spleen and kidney tissue as these organs are likely to be exposed to microplastics.

Charles Rolesky, one of the team member working as a researcher in Arizona State University said, “In a few short decades, we've gone from seeing plastic as a wonderful benefit to considering it a threat”. Another member Varun Kelker of Arizona State University said' “we never want to be alarmist, but it is concerning that these non-biodegradable materials that are present everywhere (may) enter and accumulate in human tissue, and we don't know the possible health effects”. Microplastics are those less than 5mm in diameter and nanoparticles have a diameter of less than 0.001 mm. Both form largely from the abrasion of larger pieces of plastic dumped into the environment. Research in wildlife and laboratory animals has linked exposure to tiny plastic to infertility, inflammation and cancer. Other work has shown different kinds of nanoparticles from air pollution are present in human heart and brain, and have been linked to brain cancer.

Microplastics were detected in human blood for the first time in March, with scientist finding the tiny particles in 80% people tested, showing the particles can travel around the body and may lodge in organs. The researchers analysed blood samples from 22 anonymous donors, all healthy adults and found plastic particles in 17. Half the sample contained PET plastic, which is commonly used in drinking bottles, while a one third contained polystyrene, used for packaging food and other products. A quarter of the blood sample contained polystyrene, from which plastic carrier bags are made.

After the plastics were detected in blood, they are also found in lungs. Laura Sadofsky said, “we did not expect to find the highest number of particles in the lower region of the lungs or the particles of the sizes we found. It is surprising as the airways are smaller in the lower parts of the lungs and we would have expected particles of these sizes to be filtered out or trapped before getting this deep”. Recently in a research, samples of healthy lung tissue from next to the surgery targets were taken. It analysed particles down to 0.003 mm size and used spectroscopy to identify the type of plastic.

A 2021 study in Brazil on autopsy samples found microplastics in 13 of the 20 people analysed. Polyethylene, used in plastic bags, was one of the most common particles found in lungs. A US study of lung cancer patients in 1998 found plastic and plant fibres in more than 100 samples. In cancerous tissue, 97% of the samples contained the fibres and in non-cancerous samples, 83% were contaminated.

Microplastics have been found in the placenta of pregnant women, and in pregnant rats they pass rapidly through the lungs into the heart, brain, and other organs of the fetus. Workers exposed to high levels of microplastics are also known to have developed diseases. The study in general shows that babies and young children are more vulnerable to chemical and particle exposure.

The big question is what is happening in our body? Are the particles retained in the body? Are they transported to certain organs, such as getting past the blood brain barrier? And these levels are sufficiently high to trigger diseases? We urgently need to find answer to these questions so that we can further proceed with the ways to tackle this problem.

Source : https://www.theguardian.com/environment/2020/aug/17/microplastic-particles-discovered-in-human-organs

World's First Malaria Vaccine

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The World Health Organization(WHO) on 6th October 2021allowed the widespread use of the world first vaccine against malariaa common mosquito borne disease that claims more than four lakhlives every year. Developed by Galaxo Smith Kline the vaccineknown as RTS,S / AS01, has already been administered to nearly eightlakh children in Ghana, Kenya and Malawi as a part of a pilotprogramme since 2019. The WHO endorsement paves the way of useof this vaccine outside the pilot programme, in all areas where malariais known as to be widely prevalent. But the RTS,S / AS01 vaccine,known by its brand name Mosquirix, is considered only the first steptowards effective immunization of global population against malaria.This vaccine is able to prevent serve of malaria in only 30% of thecases and the quest for the more effective vaccine is still underway.The vaccine act against P.falciparium, the most deadly malariaparasite globally, and the most prevalent in Africa among childrenwho received 4 doses in large scale clinical trials, the vaccine wasable to prevent approximately 4 in 10 cases of malaria over 4-yearperiod. This is the first Malaria vaccine that has completed the clinicaldevelopment process, and received a positive scientific opinion fromEuropean Medicines Agency (EMA).WHO's recommendation is based on the advice of its two globaladvisory bodies, one for immunization and the other formalaria.WHO has recommended that in context of comprehensivemalaria control the RTS,S/AS01 Malaria vaccine be used forprevention of P.falciparum malaria in children living in the regionswith moderate to high transmission as defined by it, The malariavaccine should be provided in schedule of 4 doses and children fromfive months of age for the reduction of malaria disease and burden.The next step for The WHO-recommended malaria will includeunding decisions for the global health community for border rollout inendemic countries, and the country decision-making on whether toadopt the vaccine as a part of national malaria control strategies. Avaccine is breakthrough addition to the malaria toolkit and can helpget malaria control back on track. A malaria vaccine has taken muchlonger to come to fruition because there are thousands of genes inmalaria compared to around a dozen in coronavirus, and are very highimmune response is needed to fight. "The vast majority of vaccinehaven't worked because it's very difficult".Other recent clinical evidences show the strategic delivery of thevaccine just prior to the high malaria transmissions season in areaswhere malaria is highly seasonal, can optimize impact and markedlyreduced mortality, especially when combined with otherrecommended malaria control interventions. Malaria is known to bethe world's deadliest disease in human history, having claimedmillions of lives. Even now, the disease kills over four lakh everyyear, according to WHO figures. This is still a huge improvementfrom twenty years ago, when close to double the number of peoplewhile succumbing to the disease. Malaria is most endemic in Africa,with Nigeria, Congo, Tanzania, Mozambique, Niger and BurkinaFaso together accounting for over half the yearly deaths. In 2019,there were estimated 229 million cases of malaria worldwide ,and theestimated number of malaria deaths that year stood at 409,000.Children aged under five years are the most vulnerable group affectedby malaria; in 2019, they accounted for 67% (274,000) of all malariadeaths worldwide. India is one of the countries badly affected by thedisease. Death due to malaria has come down sharply in last few yearsofficially these are only hundred now but infections continue to be inmillions globally the elimination.

Source : https://indianexpress.com/article/technology/science/yearender-2021-first-malaria-vaccine-milestone-7700400/

THE SCIENCE OF CLIMATE CHANGE

Priyanka Relan
Department of Chemistry

A polar bear walks along a rocky shore, looking for food. The bear would usually be on the sea ice hunting for seals, pouncing when the seal comes up to breathe. But the ice has started to melt earlier and re-form later than it has in the past. Without the sea ice, the polar bear must scavenge for other, less nutritious food.

These changes in polar sea ice are a result of climate change. But this isn't just affecting polar bears—climate change affects everyone.

Climate is sometimes mistaken for weather. But climate is different from weather because it is measured over a long period of time, whereas weather can change from day to day, or from year to year. Climate can be affected by Earth's atmosphere. Our Earth is surrounded by an atmosphere made up of gases. When sunlight enters our atmosphere, some of the 'suns heat is trapped by the gas, and some bounces back out into space. By trapping that heat, our atmosphere keeps Earth warm enough to live on. Without it, our planet would be very cold, like Mars.

The cause of current climate change is largely by human activity, like burning fossil fuels, like natural gas, oil, and coal. Burning these materials releases what are called greenhouse gases into Earth's atmosphere. There, these gases trap heat from the sun's rays inside the atmosphere causing Earth's average temperature to rise. This rise in the planet's temperature is called global warming. The warming of the planet impacts local and regional climates. Throughout Earth's history, climate has continually changed. When occurring naturally, this is a slow process that has taken place over hundreds and thousands of years. The human influenced climate change that is happening now is occurring at a much faster rate.

Here's how it works: the planet's temperature is basically a function of the energy the Earth absorbs from the sun (which heats it up) and the energy Earth emits to space as infrared radiation (which cools it down). Because of their molecular structure, greenhouse gases temporarily absorb some of that outgoing infrared radiation and then re-emit it in all directions, sending some of that energy back toward the surface and heating the planet. Scientists have understood this process since the 1850s.

Today, however, we are the ones causing CO2 levels to increase at an unprecedented pace by taking ancient carbon from geologic deposits of fossil fuels and putting it into the atmosphere when we burn them. Since 1750, carbon dioxide concentrations have increased by almost 50 percent. Methane and nitrous oxide, other important anthropogenic greenhouse gases that are released mainly by agricultural activities, have also spiked over the last 250 years.

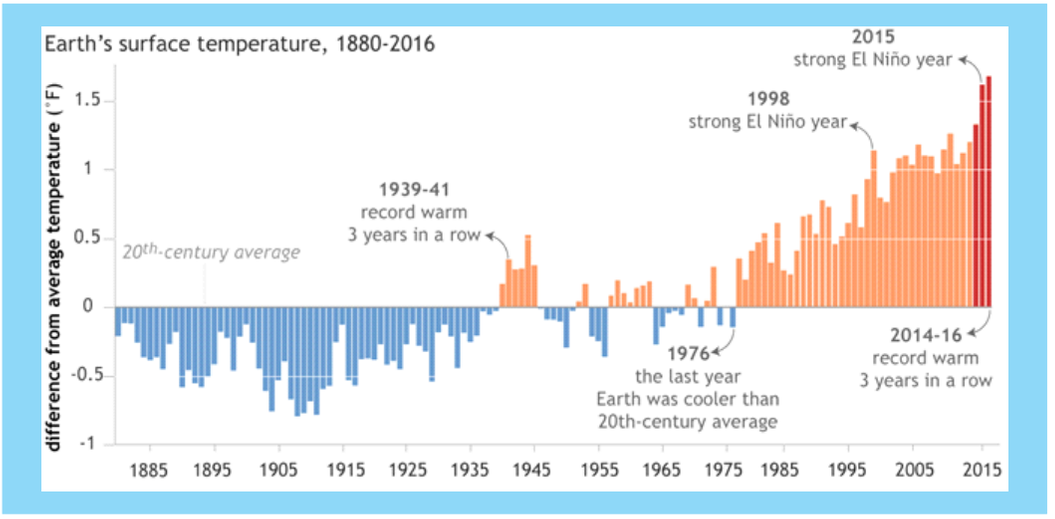
We know based on the physics described above that this should cause the climate to warm. We also see certain telltale "fingerprints" of greenhouse warming. For example, nights are warming even faster than days because greenhouse gases don't go away when the sun sets. And upper layers of the atmosphere have actually cooled, because more energy is being trapped by greenhouse gases in the lower atmosphere.

Carbon comes in three different masses: 12, 13 and 14. Things made of organic matter (including fossil fuels) tend to have relatively less carbon-13. Volcanoes tend to produce CO2 with relatively more carbon-13. And over the last century, the carbon in atmospheric CO2 has gotten lighter, pointing to an organic source.

We can tell its old organic matter by looking for carbon-14, which is radioactive and decays over time. Fossil fuels are too ancient to have any carbon-14 left in them, so if they were behind rising CO2 levels, you would expect the amount of carbon-14 in the atmosphere to drop, which is exactly what the data show.

It's important to note that water vapor is the most abundant greenhouse gas in the atmosphere. However, it does not cause warming; instead it responds to it. That's because warmer air holds more moisture, which creates a snowball effect in which human-caused warming allows the atmosphere to hold more water vapor and further amplifies climate change. This so-called feedback cycle has doubled the warming caused by anthropogenic greenhouse gas emissions.

In fact, surface temperatures actually mask the true scale of climate change, because the ocean has absorbed 90 percent of the heat trapped by greenhouse gases. Measurements collected over the last six decades by oceanographic expeditions and networks of floating instruments show that every layer of the ocean is warming up. According to one study, the ocean has absorbed as much heat between 1997 and 2015 as it did in the previous 130 years. Numerous studies have found that more than 90 percent of scientists who study Earth's climate agree that the planet is



warming and that humans are the primary cause. Currently, more than 97 percent of publishing climate scientists agrees on the existence and cause of climate change. We know that, from 1900 until the 1950s, solar irradiance increased. And studies suggest that this had a modest effect on early 20th century climate, explaining up to 10 percent of the warming that's occurred since the late 1800s. However, in the second half of the century, when the most warming occurred, solar activity actually declined. This disparity is one of the main reasons we know that the sun is not the driving force behind climate change.

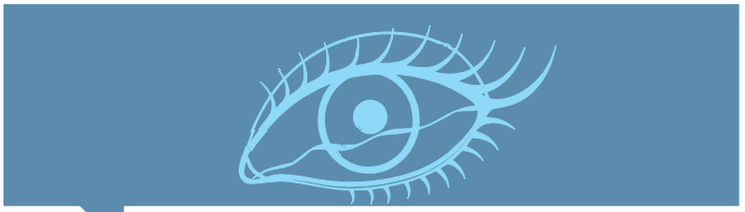
Another reason we know that solar activity hasn't caused recent warming is that, if it had, all the layers of the atmosphere should be heating up. Instead, data show that the upper atmosphere has actually cooled in recent decades since volcanoes mainly act as climate coolers, they can't really explain recent warming. However, scientists say that they may also have contributed slightly too rising temperatures in the early 20th century. That's because there were several large eruptions in the late 1800s that cooled the planet, followed by a few decades with no major volcanic events when warming caught up.

On top of that, warmer weather is aiding the spread of infectious diseases and the vectors that transmit them, like ticks and mosquitoes. Research has also identified troubling correlations between rising temperatures and increased interpersonal violence, and climate change is widely recognized as a "threat multiplier" that increases the odds of larger conflicts within and between countries.

In other words, climate change will bring many changes that no amount of money can stop. What could help is taking action to limit warming.

The challenge is that we need to reduce emissions now to avoid damages later, which requires big investments over the next few decades.

Source : https://www.nytimes.com/article/climate-change-global-warming-faq.html



WHY CAN I TASTE EYE DROPS WHEN I USE THEM?

There's nothing to worry about; it's perfectly natural. There are small openings in the inner corners of your eyelids that allow the drainage of excess fluid, such as eye drops, into a tube called a tear duct, or nasolacrimal duct. Eye drops are then transported to the back of your nose and throat and can be tasted. This system usually removes excess tears that lubricate and protect our eyes from infection. As a side note, this link between the back of our throat and our eyelids also explains how someone can appear to 'drink' a liquid, such as milk, and shoot it out through their eyelids.

Source : HowItWorks170

WATER PROCESSING: LIGHT HELPS DEGRADE HORMONES

Radhika Garg
Department of Chemistry

Micropollutants in water are frequently hormones that accumulate in the environment and can harm humans and animals. Researchers from the Karlsruhe Institute of Technology (KIT) and the Leibniz Institute of Surface Engineering (IOM) in Leipzig have created a method for photocatalytically degrading these pollutants as they pass through polymer membranes. It was published in the journal Nature Nanotechnology. Irradiation with light triggers a chemical reaction, as a result of which steroid hormones are degraded on the membranes coated with titanium dioxide.

Hormones used in contraception or agriculture enter the wastewater wherever people live.

Steroid hormones, such as sex hormones and corticosteroids, can build up in the environment and have a negative impact on humans and animals by impairing behavioural development and fertility. Male fish, for example, may develop female sexual characteristics as a result of sex hormones. As a result, it is critical to remove hormones, as well as other micropollutants, from wastewater before they enter the natural water cycle, from which drinking water is extracted.

“Providing people with safe drinking water is currently one of the most pressing global challenges”, says Professor Andrea Iris Schafer, Head of KIT's Institute for Advanced Membrane

Technology (IAMT). "Micropollutants pose a significant threat to our future because they impair fertility and brain function."

The method is inspired by Solar Cell Technology. Schafer has studied water processing by nanofiltration for many years. She employs polymer membranes with nanometer-sized pores for

this purpose. However, nanofiltration necessitates high pressure and, as a result, a lot of energy.

Furthermore, micropollutants may accumulate in polymer membrane materials and slowly enter the filtered water. Even if the pollutants are separated completely, a flow of concentrated

pollutants may develop and require further treatment.

Inspired by Professor Bryce S. Richards' work on solar cell technology, Schafer came up with the idea to coat polymer membranes with titanium dioxide and design photocatalytic membranes.

Photocatalytically active titanium dioxide nanoparticles are applied to microfiltration

membranes, which have slightly larger pores than nanofiltration membranes. Irradiation with

light then triggers a chemical reaction, as a result of which steroid hormones are degraded on the membranes.

"We developed a water catalyst," Schafer summarises her work. Steroid hormones were removed in continuous flow mode using photocatalytic polymer membranes down to the analytical detection limit of 4 ng/l. In fact, the concentrations measured were very close to the WHO's new Drinking Water Guideline limit of 1 ng/l. The researchers are currently optimizing their technology by reducing the amount of time and energy required. Furthermore, they emphasize the use of natural light. Their research focuses on using photocatalysis to degrade other pollutants, such as industrial chemicals like perfluoro-alkylated and polyfluorinated substances

(PFAS) or pesticides like glyphosate. Another goal is to improve technology.

Source : https://www.sciencedaily.com/releases/2022/04/220422094315.htm

Interview of our Alumna Dr. Manjinder Kour

PeerJ Physical Chemistry spoke to 12th Triennial Congress of the World Association of Theoretical and Computational Chemists (WATOC 2020) PeerJ Award winner Manjinder Kour

Can you tell us a bit about yourself and your research interests?

I am working in the group of Prof. Eric Boyd at Montana State University (MSU), USA. I am both a computational and experimental chemist. I thrive on tackling problems with relevance to practical applications that have clear public benefit. My PhD research included the design, controlled synthesis, purification, characterization of structurally controlled compounds and, quantum calculation to decipher the reactivity, reaction mechanism, diastereoselectivity, thermodynamic stability, molecular properties, coordination, and spectroscopy of newly synthesized organic compounds and organometallic complexes. During my first postdoc, I used a variety of approaches to relate molecular chirality, reactivity, coordination, excited states, fundamental interactions, photochemistry, catalysis, and reaction mechanism to the molecular properties of compounds. Currently, I am working on iron-sulphur coordination compounds at MSU. The goal of this project is to uncover the mechanisms that underpin how methanogenic archaea reduce pyrite (FeS_2) and assimilate reduction products, including metals of national strategic importance to meet biosynthetic demands. Under the supervision of my external supervisor, Prof. Robert K. Szilagyi at University of British Columbia – Okanagan, Canada, I work closely with a group of microbiologists, geochemists, biochemists, and surface scientists for this project.

What first interested you in this field of research?

Pyrite (FeS_2) is the most abundant sulfide mineral in the Earth's crust and is common in environments inhabited by methanogenic archaea. FeS_2 can be reduced by methanogens, yet the chemical transformations that take place at the surface of FeS_2 during reduction are not clear. To bridge this critical knowledge gap, I am developing fundamental structural models and exploring the chemical space that connects the abiotic pyrite reduction and dissolution reactions to biotic FeS cluster acquisition in methanogens. Using state-of-the art imaging, spectroscopic, and computational approaches, we are probing the reaction mechanisms, rates, and chemical transformations at the surface of FeS_2 during reduction, focusing on molecular interactions at the mineral-cell interface. Our emphasis is on the computational investigation of iron-sulphur coordination compounds, clusters, nanoparticles and mineral surfaces, and synchrotron spectroscopy of inorganic and organometallic complexes involved in FeS2 reduction. Information from modeling and experiments will ultimately be used as a framework to improve the recovery of trace metals of bioenergy and national security relevance from pyritic ores.

Can you briefly explain the research you presented at WATOC?

At WATOC 2020, I presented my work on the development of atomic-scale models for low temperature pyrite reduction reactions. We developed models for FeS2 , Fe1-xS, and bulk, surface, and nanoparticulate FeS mack /FeS (aq) phases . We used the bulk mineral structures for validation of the computational level of theory. The mineral surface models were created to feature the most reactive crystal faces as determined experimentally. A new nanoparticle construction strategy was presented that considers the rectangular, pentagonal, and hexagonal building blocks in FeSmack , FeS_2 , and Fe1-xS, respectively. The nanoparticle models as molecular maquettes of mineral surfaces will provide us with the versatility to describe geometric and electronic structure changes, energetic consequences of electrochemical reduction, small molecule coordination and electron transfer, surface decomposition, and HS- release along the $FeS_2 \rightarrow$ Fe1-xS $\rightarrow$ FeS mack continuum.

What are your next steps?

Computational models as virtual nanoreactors will be utilized to determine the mechanism of abiotic reductive dissolution of pyrite through proposed pyrrhotite intermediate and formation of mackinawite-like nanoparticles. The continuation of the work will involve the investigation of heterometal substitution as experimentally shown for the considerable increased reactivity of pyrite nanoparticles when they are doped with Ni ion.

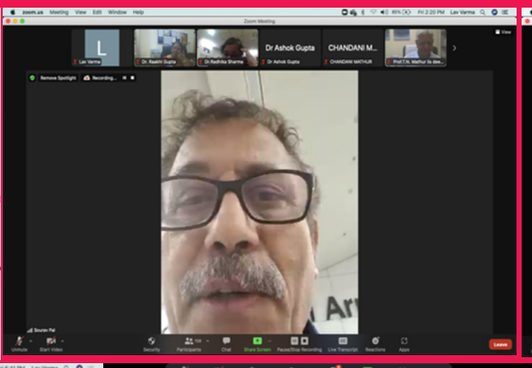
Source : https://peerj.com/blog/post/115284886318/watoc-award-winners-4/

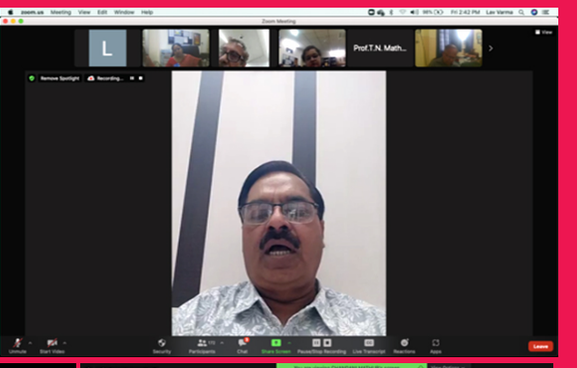
A National Event
4-Minute Research Pitch

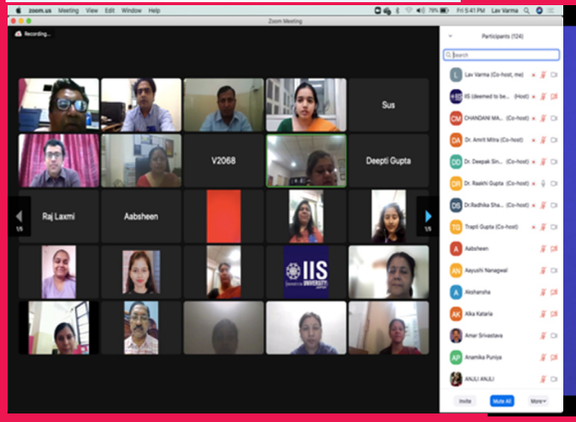
A National event, '4-Minute Research Pitch', was collaboratively organised by The Department of Chemistry, IIS (deemed to be University), Jaipur and Govt. Madhav Science College, Ujjain on 15-16 April 2022 under the aegis of ACT's Research Convention 2021. A total of 558 registered delegates witnessed the event. 71 Undergraduate and Postgraduate students, research scholars and faculty members shared their research-ideas on the current advancements in frontier areas of Chemistry. The Association of Chemistry Teachers was represented by Prof. D.V. Prabhu, General Secretary, ACT & Govt. Madhav Science PG College, Ujjain was represented by its principal Dr. Arpan Bharadwaj. The Keynote Lecture was delivered by Prof. Sourav Pal, Director, Indian Institute of Science Education and Research, Kolkata. He enlightened the audience with the versatile role of chemistry in life, emphasising its industrial applications, while Prof. P. K. Chattaraj from IIT, Kharagpur, delivered the invited talk.

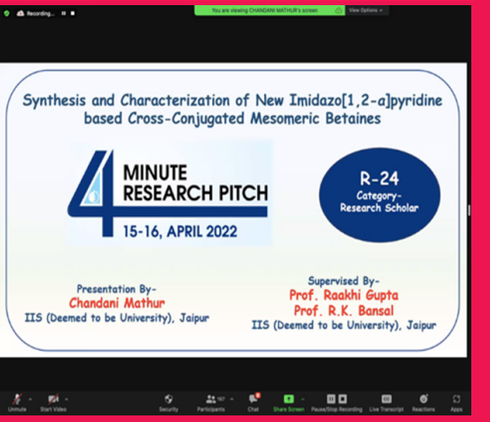
The major thrust areas covered in three technical sessions spread over two days were: Synthetic Organic Chemistry, Organometallics and Co-ordination Chemistry, Material Science, Bio-organic and Green Chemistry, Solid State Chemistry, Environmental Chemistry, Computational Chemistry, Chemical Education, Drug Design and Pharmacology, Nuclear and Radiochemistry, Analytical Chemistry, Electrochemistry, etc.

The expert talks were delivered by Prof. A. Sakthivel, Central University of Kerala; Dr. Amrit Krishna Mitra, Govt. General Degree College in Singur, West Bengal; Prof. Tanmoy Chakraborty, School of Basic Sciences and Research, Sharda University; Dr. Wasudev Balaji Gurnule, Kamla Nehru Mahavidyalaya, Nagpur; Prof. Helen P. Kavitha, Institute of Science and Technology, Tamil Nadu; Prof. Pradeep Bhatnagar, Dean, Faculty of Sciences, IISU, and Dr. Manisha Patni, Head, Department of Chemistry, IISU. The presentations were evaluated by a panel of experts and best presentations in each category were awarded. Prof. Brijesh Pare, President, ACT and Prof. R. K. Bansal, Department of Chemistry, IIS (deemed to be University), Jaipur announced the results.









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