

SNAPSHOTS



Diversity in drosophila
Fruit flies (*Drosophila melanogaster*) were made to walk following a line, and while some took a straight path, others made a wavy pattern. Such behavioural diversity, which was constant for each individual, was seen to arise because of differences in the wiring up of neurons in the visual system. The greater the asymmetry in the brain circuit, the better the fly was able to follow the line, according to an article published in *Science*.



Sniffing out diseases
Dogs were tested for their abilities to sniff and identify a bacterial plant disease known as citrus Huanglongbing. This is caused by the bacterium *Candidatus Liberibacter asiaticus* which has jumped from the animal kingdom to plants in the last 200 years. The dogs could detect 30-day-old infections, while genetic testing could reveal the disease only much later. The *PNAS* article estimates that about 92% of trees in an orchard could be saved by such early detection.



Memory replayed
While studying the brains of epilepsy patients temporarily living with electrodes implanted in their brains, in order to monitor brain activity, researchers learnt about the way episodic memory (memories of our past experiences) is stored. During a memory task, the neurons fired in a particular pattern when the patient learnt a word pair. This pattern of firing was repeated just before the patient recalled the words. The research was published in *Science*.

The Sun brings out a fresh batch of sunspots

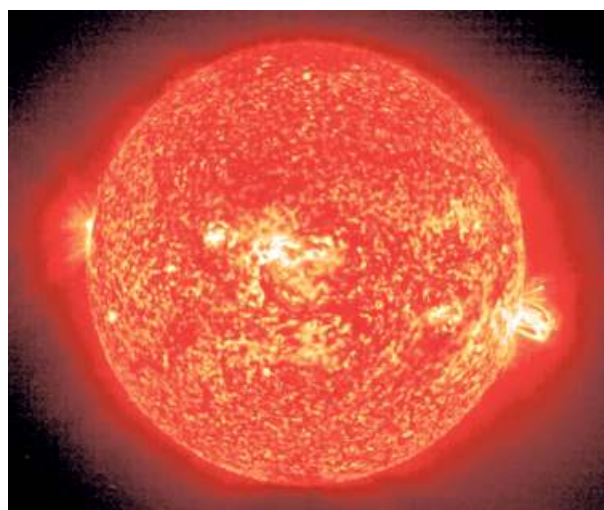
The sunspots identified by researchers from IISER Kolkata herald the start of a new solar cycle

SHUBASHREE DESIKAN

Sun spots are relatively cooler spots on the Sun's surface. Their number waxes and wanes in cycles that last 11 years approximately. We are currently at the minimum of one such cycle. Amidst claims that the Sun would "go silent" and not give out sunspots for an extended period, a group from IISER Kolkata has shown that the next sunspot cycle has begun and the Sun has indeed spoken. Their results were published in *Research Notes of the American Astronomical Society*.

From our safe distance of about 148 million km, the Sun appears to be sedate and constant. However, huge solar flares and coronal mass ejections spew material from its surface into outer space. They originate from sunspots, an important phenomenon that people have been following for hundreds of years.

Sunspots occur in pairs, with a leader and a follower. They originate deep within the Sun and become visible when they pop out. Their number is not constant but shows a minimum and then rises up to a maximum and then falls again in what is called the solar cycle. So far,



Not sedate: Huge solar flares and coronal mass ejections spew material from the solar surface into outer space. *AFP

astronomers have documented 24 such cycles, the last one ended in 2019.

Start of cycle 25

Following a weakening trend in activity over the last few cycles, there were predictions that the Sun would go silent into a grand minimum in activity, with the disappearance of cycles. However,

a team from IISER Kolkata has shown that there are signs that cycle 25 has just begun. They used the data from the instrument Helioseismic and Magnetic Imager aboard NASA's space-based Solar Dynamics Observatory

for their calculations.

"There has been a lot of controversy about solar cycle 25 stemming from observations of a weakening trend in solar activity over the past three sunspot cycles. This has led to speculation that the solar cycle is about to die and we are going to enter a grand minimum in solar activity lasting many decades. Some groups have claimed that this would give rise to a mini ice age and cooling of global climate," says Dibyendu Nandi of IISER Kolkata who led the effort. "Our findings indicate that sunspot cycle 25 fields have already

started appearing, implying that we are going to have a solar cycle. Speculation and predictions of a grand minimum are unfounded."

Maunder minimum

Why is this so important to us on earth? After all the sunspots look small and are hardly even visible to us. Contrary to this, sunspot activity may be correlated with climate on earth. In the period between 1645 and 1715, sun spot activity had come to a halt on the Sun - a phenomenon referred to as the Maunder minimum. This coincided with extremely cold weather globally. So sunspots may have a relevance to climate on earth. Such links are tenuous, but definitely solar activity affects space weather, which can have an impact on space-based satellites, GPS, power grids and so on.

Solar dynamo

Given the high temperatures in the Sun, matter exists there in the form of plasma, where the electrons are stripped away from the nuclei. The Sun is made of hot ionised plasma whose motions generate magnetic fields in the solar interior by harnessing the energy of the plasma flows. This mechanism

is known as the solar dynamo mechanism (or magnetohydrodynamic dynamo mechanism). "Simply stated, it is a process by which kinetic energy of plasma motions is converted to magnetic energy, which generates the magnetised sunspots, giving rise to the solar cycle," explains Prof. Nandi.

Because of the nature of the solar dynamo, the part of its magnetic field that gives rise to sunspots reverses direction when it moves from one solar cycle to another. This can be inferred by observing when the relative orientation of the sunspot pairs flip. Studying 74 such pairs of magnetic regions, the researchers find that in 41 the orientation corresponds to cycle 24, and in 33 the orientation corresponds to cycle 25. Thus they conclude that the Sunspot cycle 25 is brewing within the solar interior.

"Small magnetic regions and a few full grown sunspots with the magnetic polarity orientation that is expected of sunspot cycle 25 have already started appearing on the solar surface. This means that we have either already seen the start of sunspot cycle 25 or it is just about to start," says Prof. Nandi.

Evidence of a 'social network' in early animals

PRESS TRUST OF INDIA

Some of the first animals on the Earth were connected by networks of thread-like filaments which may have been used for nutrition, communication or reproduction, the earliest evidence yet found of life being connected in this way, according to a study.

Scientists from the Universities of Cambridge and Oxford in the U.K. discovered the fossilised threads - some as long as four metres - connecting organisms known as rangeomorphs, which dominated the Earth's oceans half-a-billion years ago. The study, published in *Current Biology*, found these filament networks in seven species across nearly 40 different fossil sites in Newfoundland, Canada.

Successful life forms

Towards the end of the Ediacaran period, between 571 and 541 million years ago, the first diverse communities of large and complex organisms began to appear. Prior to this, almost all life on the Earth had been microscopic in size, the researchers said.

These were some of the most successful life forms during this period, growing up to two metres in height

and colonising large areas of the sea floor, they said. The rangeomorphs may have been some of the first animals to exist, although their strange anatomies have puzzled palaeontologists for years.

These organisms do not appear to have had mouths, organs or means of moving, according to the researchers. One suggestion is that they absorbed nutrients from the water around them, they said.

Rooted rangeomorphs

Since rangeomorphs could not move and are preserved where they lived, it is possible to analyse whole populations from the fossil record. Earlier studies of rangeomorphs have looked at how these organisms managed to reproduce and be so successful in their time.

"These organisms seem to have been able to quickly colonise the sea floor, and we often see one dominant species on these fossil beds," said Alex Liu from University of Cambridge's Department of Earth Sciences. "How this happens ecologically has been a longstanding question - these filaments may explain how they were able to do that," Liu said.

Finally, India shares two SARS-CoV-2 genome sequences

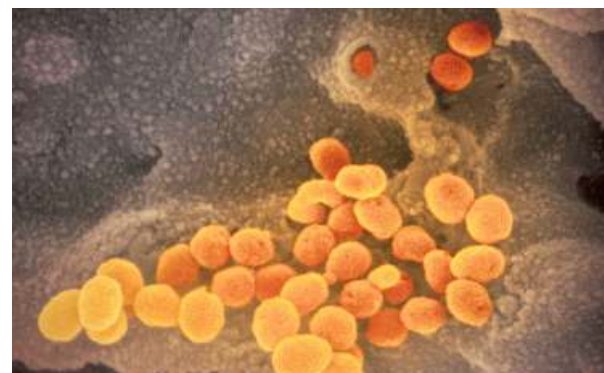
NIV deposits two genome sequences in public databases a day after *The Hindu* reported that India has not shared them

R. PRASAD

India has finally shared two whole genome sequence data of the novel coronavirus (SARS-CoV-2) with the Global Initiative on Sharing All Influenza Data (GISAID).

The two sequences were shared by the Pune-based National Institute of Virology. This news comes after *The Hindu* reported on March 4 that India has not shared any genome sequence data with the GISAID.

"We shared the two sequences with GISAID on March 5 evening," said Priya Abraham, Director of NIV. "We had shared the sequences with GenBank [a public database] about two weeks ago." However, the GenBank website mentions that whole



Lab culture: Undated electron microscope image shows the novel coronavirus SARS-CoV-2, orange, emerging from the surface of cells, grey. *AP

genome sequences of two oronasopharynx (mouth, nose, throat) samples collected on January 27 and January 31 from two COVID-19 patients in Kerala were deposited in GenBank only on March 6.

The accession number of the two sequences is MTOI2098 (collected on January 27) and MTO50493 (collected on January 31).

The two sequences were shared by Varsha Potdar and others from NIV. Dr. Potdar

heads the Influenza Group and her "major interest is molecular epidemiology of influenza and other respiratory viruses".

In a tweet on March 6 evening, Newstrain said it has "updated" the database with "two SARS-CoV-2 sequences from Kerala sampled at the end of January". It added: "These sequences do not link very closely to other sequences in the tree."

First cases

The three adults in Kerala who were found to be infected with the novel virus had returned from Wuhan. The first COVID-19 patient in India, a medical student who had returned from Wuhan, was laboratory confirmed by NIV on January 30. Two more adults from Kerala

were laboratory confirmed by NIV within a couple of days.

Different from others

At this point, it is not clear why the sequences appear to differ from the rest in the phylogenetic tree. A virologist who did not want to be named said that it could possibly be due to sequencing errors.

"NIV should rule out sequencing errors or contact Chinese CDC to find out if these sequences are linked to other sequences in Wuhan and not deposited in GISAID," says Shahid Jameel, CEO of the Wellcome Trust/DBT India Alliance.

Referring to the Indian genome sequences not closely linked to other sequences in the tree, Dr Chitra Pattabirra-

man from the National Institute of Mental Health and Neurosciences (NIMHANS), Bengaluru says: "There are at least two possibilities - sequences could reflect the variations of the virus in China or they could be errors in sequencing, which can be corrected over time. The former is more likely and this can be resolved by adding more sequences."

Why study genomes

Studying viral genome sequences immensely helps in epidemiological investigations. "Sequencing the genome of novel coronavirus will help us to know where the virus came from and how the virus has spread. For instance, by sequencing the genome of the virus isolated from an Indian patient, it will

become possible to know if the virus had come from China or any other country," Gautam Menon, professor of physics and biology at Ashoka University, Sonapat, Haryana, and the Chennai-based Institute of Mathematical Sciences had earlier told *The Hindu*.

So far, 26 countries, including India, have shared 178 SARS-CoV-2 genome sequences with the GISAID. At 70, China has shared the highest number of sequences.

The other countries that have shared higher number of sequences are the U.S. (22), Australia and Japan (10 each), and Singapore and South Korea (eight each). Nepal, Vietnam and Cambodia have also shared one sequence each.

How wounded plants heal, survive

Creating injuries similar to what plants suffer took nearly a decade

ASWATHI PACHA

It's hard life being a plant! From pathogens and herbivores to unfavourable weather, they are constantly injured or wounded and their sessile lifestyle only adds to the trouble. Despite all this, they heal and survive. How did they evolve such a great repair mechanism? What are the molecules and proteins aiding it? These were some of the questions an international team of researchers set out to answer and have now found some interesting mechanisms.

Ability to repair

A paper recently published in *Development* shows that a protein named PLETHORA (PLT), which encodes stem cell promoting factors, helps in the regeneration of the vascular system at the site of injury. This protein binds to and activates the expression of another gene (CUC2). These two together increase the production of a plant growth hormone called auxin at the wound site. The combination of these proteins and hormones gives the plant the ability to repair wounds.

The corresponding author of the paper Kalika Prasad explains that the work spanned nearly a decade to create the right set of injuries mimicking those that plants encounter throughout their life and then hunt for the plant proteins that help in this essential quick fix. He is from the School of Biology at the Indian Institute of Science Education and Research at Thiruvananthapuram (IISER-Tvm).

"Though it was known that



Silent healer: A protein named PLETHORA, which encodes stem cell promoting factors, helps in the regeneration of the vascular system at the site of injury. *SPECIAL ARRANGEMENT

plants communicate within their different parts and with other plants during injury, not much was known about how they handle the injury. Though we carried out the initial studies on the roadside mustard plant, we noticed similar results when tested the using rice PLT protein too," he adds.

Regenerating veins

It was seen that the injury healed not just at the surface but the veins regenerated too. "There was proliferation of the epithelial cells to seal the wounds and also functional restoration of tissue cells. The vein regeneration is very essential as transport of food, hormone, water, happens through it and any disruption may further hinder the plant growth," explains Dhanya Radhakrishnan, PhD scholar and first author of the paper from IISER-Tvm.

Another interesting find was that these two proteins did not play any role in the general development of vascular system but stepped into action only during

its injury.

"We were able to set up a mathematical model that gave us guidance that as the size of the wound changes the nature of the repair changes. The numerical simulations showed that after a particular size injury, the plant will be unable to regenerate or heal," adds Anil Shaji from the Department of Physics at IISER-Tvm. He is one of the authors of the papers and has set out to uncover the physical processes like the flow of hormones that are involved in this healing process.

"We are now trying to find out all the different genes and pathways involved in the healing process and also the cellular reprogramming events. To decode if this process would also be interesting," adds Anju P.S., a research scholar and one of the first authors of the paper from the institute. The researchers hope that in the future these genes can be produced in surplus to create plants that can withstand insect attack and other injuries.

Imposing travel restrictions alone has 'modest' effect on virus spread

R. PRASAD

Travel restrictions in areas that have been affected by novel coronavirus can only modestly reduce the spread of the outbreak, a new modelling study published in *Science* finds.

The spread of the virus can be reduced by cutting the transmission chain. This can be achieved through early detection and isolation of people found infected with the virus as well as by bringing about behavioural changes and raising awareness level in the community.

Even "sustained" restrictions on travel to and from mainland China by as much as 90% only can only "modestly affect the epidemic trajectory" unless combined with a 50% or higher cut in transmission in the community, the study found. Shutting down Wuhan and imposing travel ban in the city on January 23 delayed the epidemic from spreading to other parts of mainland China by just three to five days.

Even when travel restrictions are as high as 90%, the epidemic in mainland China is delayed for no more than two weeks if concomitant steps to reduce virus transmissibility are not taken, the authors found.

One of the reasons is that by January 23 when travel ban was introduced in Wuhan, the virus had already spread to other parts of mainland China.

Travel restrictions to China introduced by several countries, including the U.S., and a reduction or suspension of flight to China by 59 airline companies have not

achieved extraordinary results in reducing the spread of the virus outside China, the study finds.

There was an initial 10-fold reduction in the number of imported cases when travel restrictions from China were introduced. But according to the model, by March 1, the number of imported cases per day shot up to 170 and 35 for 40% and 90% travel restrictions, respectively.

The number of cases outside mainland China will "resume its growth" after two-three weeks from cases that had their origin elsewhere, the model suggests.

The reason: despite the travel restrictions to and from mainland China, a large number of people who were already infected by the virus have been travelling across national borders without being detected.

Of the several imported cases, a couple of cases could be "seeding multiple outbreaks" across the world, thus leading to an expansion of the epidemic. This was observed in the case of Iran, South Korea and Italy after mid-February.

"The concurrent presence of both travel and transmissibility reductions, however, produce a much larger synergistic effect visible by both delaying the epidemic activity in Mainland China and the number of internationally imported cases," the authors write.

"Moving forward we expect that travel restrictions to COVID-19 affected areas will have modest effects, and that transmission-reduction interventions will provide the greatest benefit to mitigate the epidemic," they note.

Question Corner

Charging batteries

Q What is the best way to increase battery life - charge them only when they have almost drained or when the charge drops below a certain percentage?

A PROF. RAMAPRABHU SUNDARA
Department of Physics, IIT Madras

Rechargeable lithium ion battery technology is the heart of today's portable devices. Since many chemical reactions take place inside the battery, the capacity to store lithium ions in electrode materials reduces over time. This is "battery aging."

Good charging habits are needed to enhance the battery life. During charging and discharging, chemical reactions occur inside the battery. In sealed batteries, overcharge results in heat being generated inside the battery. This is because once a battery is fully charged, the charging current has to be dissipated by the generation of heat and gases, both of which are

bad for batteries. Always charge up to ~80%.

Good charging means we should be able to detect when the reconstitution of the active chemicals is complete during charging (that is, all the usable lithium ions move back to negative electrode), maintain the cell temperature within its safe limits and to stop the charging process. Detecting this cut off point and ending the charge process is critical. We should not drain the battery till it reaches 0%. This will reduce its lifetime. If we leave a battery in fully discharged state till ~0%, the battery could fall into a deep discharge state, slowly making the battery incapable of holding a charge when we charge again. This will reduce the battery life time. We should always charge it when ~25% of the charge is remaining. This limit depends on battery type and battery manufacturers.

This week's question

Q Does prolonged usage of smartphone, laptop and other gadgets lead to myopia?

Readers may send their questions / answers to questioncorner@thehindu.co.in