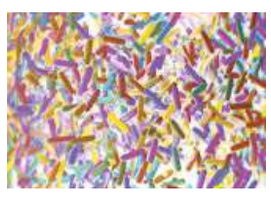
CAPSULE

Dialogues in the brain
Imagining a scene requires a dialogue between different regions of the brain, a new study finds. While the region called ventromedial prefrontal cortex selects the elements for a scene, the hippocampus constructs the scene imagery. The researchers imaged the brains of participants who were asked to imagine novel scenes or single objects.

Small world of fish
New research finds that global fish populations behave like a small world network, with currents carrying populations far and wide. The researchers modelled how currents distribute the larvae of about 700 species of fish. Using network analysis, they assessed the distribution. This has implications for global conservation and management of fish and food supplies.



Medicine munchers
Researchers have shown how a person's gut microbiome can interact with the medication taken. They used levodopa, the Parkinson's disease drug and pointed out that *Enterococcus faecalis* in the gut was able to degrade the drug. This reduced the amount of drug reaching the brain, making patients take a higher dose leading to side-effects.

IIT Guwahati uses water-repelling cotton for sustained drug release

Duration of drug release can be tuned by varying the water-repelling property of cotton

R. PRASAD

Sustained release of drugs for as long as 110 days has now been achieved by researchers at the Indian Institute of Technology (IIT) Guwahati by immobilising the drugs on cotton that is extremely water repelling (superhydrophobic). A team led by Uttam Manna from the Department of Chemistry found that 30% of the drug was released within 48 hours and the remaining drug over a period of 110 days. Two drugs – aspirin and tetracycline – were tested for sustained drug release.

Tuning in: We can tailor water repellency from 125 to 150 degrees so that the drug is released in a sustianed manner over several days, say (from right) Uttam Manna, Arpita Shome and Adil Rather.

Collaboration
"We have extended this approach [use of superhydrophobic cotton coated with the drug for sustained release] to make bandages for wound healing," says Dr. Manna. "Animal studies will be undertaken soon. The collaborative work with the Delhi-based International Centre for Genetic Engineering and Biotechnology (ICGEB) has already begun."

The researchers found that the duration of drug release can be tuned by varying the degree of water repelling property of cotton. For instance, when water repellence was reduced from 155 degree to 125 degrees, the duration of drug release reduced sharply from 110 days to over 50 days. "When the cotton was moderately water-repelling (125 degrees), 64% of the drug was released over 48 hours and the remaining drug was released over 50 days in the case of both the drugs tested," Arpita Shome from IIT Guwahati and first author of a paper published in the journal *ACS Sustainable Chemistry & Engineering*.

Altering properties
To make the supremely water-absorbing cotton to repel water the researchers coated the cotton with a naturally occurring protein – bovine serum albumin (BSA). The BSA protein is dissolved in water and when ethanol is added it forms nanoparticles, which get embedded on the cotton. The BSA nanoparticles are made to bind to each other to form a 3D coating on the cotton with the addition of a cross-linker (5ACl). "The residual acrylates of 5ACl are further exploited to react with amine-containing long-chain hydrocarbons. The long hydrocarbon chain of the alkyl amine renders hydrophobicity to cotton," says Shome.

"Two essential criteria are needed for achieving extreme water repellence – topography which can trap a layer of air and low surface energy coating that makes the cotton inert so it does not react with water," says Dr. Manna. In this case, the BSA nanoparticles provide the required topography and the long hydrocarbon chain of the alkyl amine makes the cotton inert.

"We can tailor water repellency to varying degrees – 125-150 degrees – by selecting an appropriate alkyl amine to react with the residual acrylates on the BSA nanoparticles," Dr. Manna says.

The drug to be loaded onto the extremely water-repelling cotton is dissolved in ethanol and the cotton is soaked in the drug-containing ethanol. When the cotton is removed, the ethanol evaporates leaving behind the drug molecule on the cotton. Superhydrophobicity returns once ethanol evaporates.

How it works
When the cotton containing the drug comes in contact with water, the air that is trapped gets displaced. Water slowly starts penetrating the cotton and comes in contact with the drug molecule and dissolves it. The dissolved drug diffuses out of the cotton and thus the slow release of drug over a period of over three months is achieved.

When cotton is supremely water repelling, there is sustained release for about 110 days after the burst-release in the first 48 hours. When the cotton is moderately water-repelling, 64% of drug is released in 48 hours and the remaining over the next 50 days.

Both the drugs were released in a similar fashion and the bioactivity of the tetracycline released at one, three and seven days was examined. "The bioactivity was similar to the native drug at all three time periods. Tetracycline was able to prevent the proliferation of both *E. coli* and *Streptococcus aureus*," says Dr. Manna.

The antibacterial study was done in collaboration with Prof. Biman Mandal's group at IIT Guwahati.

Why did woolly rhino, mammoth go extinct?

Yak dung analysis helped to map out the different plants and trees in the area

ASWATHI PACHA

A pile of dung may irk many, but not these researchers who spend days analysing yak dung to understand the vegetation and climate of the past and the connections they have to extinct mega herbivores such as the woolly rhino and mammoth.

The wild yak is an endangered species restricted to the higher Himalayas of Asia, the Tibetan plateau and parts of North Russia. It can tolerate temperatures as low as -40 degrees Celsius and is associated with the Himalayan tahr and White-bellied musk deer. The most non-invasive way to study its diet and the local vegetation is by examining its dung.

During the summer of 2017, researchers from Birbal Sahni institute of Palaeosciences, Lucknow set out to the hilly terrain which is about 25 km from the Dronagiri village in Chamoli district of Uttarakhand and collected the dung samples. This exercise was repeated in the winter season too.

Endangered : The wild yak is restricted to higher Himalayas of Asia, the Tibetan plateau and parts of North Russia..

Diverse diet
Once back in the laboratory, they carried out the macro- and micro-botanical analyses to decode its diet. A good diversity of pollen, spores and phytoliths (silica bodies found in plants) were seen. This meant that the yak preferred a variety of food – simple grass to leaves and fruits of woody trees. This diversity was high during summer and the yak could walk up to 50 km in search of food.

This also indicated that the yak was able to modify its diet according to the climatic change of the past. "The end of the Pleistocene epoch (11,700 years ago) and the start of Holocene brought about a change in vegetation and also introduced humans," explains Swati Tripathi, one of the authors of the paper published in *PLOS ONE*. "Giant mammoth and woolly rhino which used to live with the yak about 18,000-20,000 years ago were not able to adapt to these changes and thus went extinct. This is a classic example of 'survival of the fittest'. Our humble yak proved to be the fittest one."

The yak dung analysis also helped to map out the different plants and trees in that area, thus, generating modern botanical analogue for palaeo environmental studies in higher Himalayas.

Mega herbivores
"Across the globe, many researchers are working on coprolite or fossilized dung of extinct animals. A comparison of the present results with the extinct ones can help understand more about ancestor climatic factors and other adaptation strategies of mega herbivores.

"These animals mostly depend on the regional flora and studies can throw light on the past vegetation of an area," adds Dr. Sadhan Kumar Basumatary, corresponding author of the paper.

Controversial telescope to be built on sacred Hawaiian peak

PRESS TRUST OF INDIA

After years of protests and legal battles, officials have announced that a massive telescope which will allow scientists to peer into the most distant reaches of our early universe will be built on a Hawaiian volcano that some consider sacred.

Hawaii Governor David Ige said it was the final legal step in a long, often contentious, process, and that construction is expected to begin sometime this summer.

Scientists say the summit is one of the best places on Earth for astronomy. The telescope would be three times as wide as the largest existing visible-light telescope in the world, with nine times more area. Several telescopes and observatories are already on the summit.

But opponents say the telescope will desecrate sacred land atop Mauna Kea, a place of religious importance to Native Hawaiians.

State officials arrived at the summit to remove Native Hawaiian structures that had been built on land where the telescope will be constructed.

Native Hawaiians have used the structures for years, said Kealoha Pisciottaa a Native Hawaiian activist whoconsiders the removal of the structures to be desecration and discriminatory.

The new telescope will allow astronomers to reach back 13 billion years, to the time just after the big bang, and scientists say it will help answer fundamental questions about the advent of the universe.

Bhubaneswar becomes 0.5 degree C hotter due to urbanisation

Cuttack and Bhubaneswar have seen the most increase in local temperature while warming in rural areas is less

R. PRASAD

How urbanisation of cities in the last decade can sharply increase the local temperature has been well documented by a recent study undertaken by researchers at the Indian Institute of Technology (IIT) Bhubaneswar.

Blame it on increased urbanisation, the local surface temperature in large cities in Odisha – Cuttack and Bhubaneswar – has increased by as much as 40-50% during the period 2001-2010. While temperature has increased by about 0.9 degree C due to regional warming, which is a global phenomenon, urbanisation or changes in land use and land cover alone has contributed 40-50% of that increase in these cities. In other words, there has been a 0.5 degree C increase in absolute local temperature in large cities in the State during the period 2001 to 2010 solely due to urbanisation.

In the case of smaller cities and town in the State of Odisha, the change in local warming caused by urbanisation or changes in land use and land cover has been about 25%.

Thirty-year data
The team used 30 years of surface temperature measurements taken from over 22 sites over the state of Odisha coupled with Earth Observation data and model output to explore the effect of land use land cover and its changes.

"When compared with rural areas, the local warming in cities in Odisha is double due to urbanisation," says Dr. V. Vinoj from the Institute's School of Earth, Ocean and Climate Sciences and corresponding author of a paper published in the journal *Scientific Reports*. "The local warming due to urbanisation in Odisha in 2001-2010 is comparable to any other developed region of the world."

Hot days: The local surface temperature in large cities in Odisha, such as Cuttack and Bhubaneswar, has increased by 40-50% during the period 2001-2010. ▪ ASHOKE CHAKRABARTY

The 0.5 degree C increase in local temperature in Bhubaneswar can be traced back to rapid urbanisation of the city in about 15 years. An earlier study by the team led by Dr. D. Swain from IIT Bhubaneswar and a co-author of the latest paper had found 83% increase in urbanisation of Bhubaneswar between 2000 and 2014. The rapid increase in urbanisation was at the cost of dense vegetation and crop fields. While dense vegetation reduced by 89%, crop fields shrunk by 83%.

Cropping patterns
The study shows that across the State of Odisha, changes in cropping pattern and urbanisation have together had a clear effect on long term temperature changes. For instance, the cropping pattern has seen a clear shift from Kharif crops (July-October) to Rabi crops (October-March). Compared with 2004, Kharif crop cultivation area in 2010 had reduced by 28,000 sq. km, whereas there has been an increase of 38,000 sq. km in Rabi crop cultivation area during the same period.

The northeast part of the State has witnessed the greatest change in land use and land cover during the period 2001-2010. During the period 1991-2000, the western part of the State saw the most change in land use and land cover causing more warming in that region. However, during the period 2001-2010, the trend shifted to northeast as changes in land use and land cover were more pronounced in that part of the State causing more warming in northeast Odisha.

"Our study provides crucial information for policy makers to understand the relative contribution from each land use type to surface temperature, we believe this information would help with future land use planning in the state of Odisha," Prof. J. Dash from the University of Southampton, UK and a co-author of the paper says in a release.

Remotely sensed indices unreliable in informing elephant forage

Grass abundance, which indicates elephant fodder, tends to be low in locations with dense canopy cover

SHUBASHREE DESIKAN

A field study by researchers from Bengaluru shows that a popularly used index that remotely estimates density of vegetation does not yield a reliable estimate of food abundance for elephants in tropical forests. In fact, researchers show that this index has a negative correlation with graminoids (grassy food - grasses, sedges and rushes - preferentially consumed by elephants) in tropical forests.

Out of reach: Grazing elephants that cannot reach up to the level of the canopies mostly feed on the grassy species. ▪ KABINI ELEPHANT PROJECT

Monitoring vegetation
For both academic and practical purposes, there is the practice of remotely monitoring vegetation in an area and representing it in terms of maps and parameters. One such parameter used is the normalized difference vegetation index (NDVI) which is measured remotely from satellite data. This has been used to estimate the amount of food abundance available to herbivorous animals, for example, elephants. The NDVI is used, for instance, in attempts to track the presence of elephants using the vegetation they consume. However, this work clearly establishes that this can be misleading, and field-based studies are the ones which can yield definitive results. The work is published in the journal *Biotropica*.

"There is a need to establish this, because the obvious has not been understood," says Ajay Desai who is a consultant to World Wildlife Fund, India, and an expert on Asian elephants.

The researchers were led by T.N.C Vidya from the Evolutionary and Organismal Biology Unit of Jawaharlal Nehru Centre for Advanced Scientific Research (JNCASR), Bengaluru.

They carried out the study in the Nagarhole National Park, in the Nilgiris-Eastern Ghats in southern India and sampled five 20m X 5 m vegetation plots along each of 17 transects (lines along which the regions to be sampled can be marked out) in the wet season in 2011 and 22 transects in the dry season. The transects included three forest types: moist deciduous, dry deciduous and teak forests. "We found that the abundance of food plants is not correlated with NDVI. This should be a prerequisite before using NDVI as a proxy of food abundance," says Hansraj Gautam, the first author of the paper, who is also at JNCASR.

> **We found that NDVI was negatively correlated to grasses. This means grass abundance tends to be low in locations where NDVI is high and vice-versa.**
>
> T.N.C. VIDYA
> Evolutionary and Organismal Biology Unit, JNCASR

The NDVI is a simple indicator which tells how much of the ground is covered with vegetation. It basically calculates the difference between the red and near infrared components of light reflected by objects, from, say, a satellite. Since healthy vegetation strongly absorbs red and reflects near infrared light, this difference can indicate the presence of healthy vegetation and map it into a colour code.

Negative correlation
"We found that NDVI was negatively correlated to grasses. This means grass abundance tends to be low in locations where NDVI is high and vice-versa," says Dr Vidya. Though this is counterintuitive, she explains why this occurs: "While canopy cover and shrub abundance contribute positively to NDVI, they negatively affect grass abundance. Because of the poor correlation, NDVI cannot be reliably used as a measure of forage abundance in a multi-storeyed forest with a low proportional abundance of food species." Grasses form a large component of food of elephants and also ungulates (hoofed animals) like deer, sambar and gaur.

"NDVI is extremely useful... and has been used to inform the ecology of various species, from elephants and red deer to mosquitoes and birds. But it is known to perform badly to help assess changes in primary productivity of plants under a dense canopy," says Nathalie Pettorelli, a conservation ecologist from Zoological Society of London and an expert on remote sensing and management of natural resources. "The results do not surprise me... this pattern was shown in other settings [in Poland, in deciduous forests]," she adds.