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Volume 639 Issue 8053, 6 March 2025

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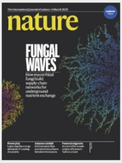

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Fungal waves

Mycorrhizal fungi build vast networks in the soil to exchange nutrients with the roots of plants. Much of these dense networks consist of extremely fine tubes called hyphae, which can reach lengths of 100 metres per cubic centimetre of soil. In this week's issue, Loreto Oyarte Gálvez, Corentin Bisot and colleagues reveal how these complex networks are created. The researchers built a bespoke imaging robot to track more than 500,000 growing fungal nodes simultaneously. They then measured some 100,000 trajectories of cytoplasmic flow within the hyphae. They — show all

Cover image: Corentin Bisot.

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This Week

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Trump 2.0: an assault on science anywhere is an assault on science everywhere

US President Donald Trump is taking a wrecking ball to science and to international institutions. The global research community must take a stand against these attacks.

Collection: How Trump 2.0 is reshaping science

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We moved a conference halfway around the globe to avoid visa discrimination

Event organizers often overlook the visa-related difficulties that researchers in low- and middle-income countries face. This must change.

Kara Hanson

Research Highlights

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27 Feb 2025

Lhasa's rocks reveal an Australian birthplace

Granite from the chunk of Earth's crust called the Lhasa terrane did not come from India, as had previously been thought, but from much further afield.

Research Highlight
27 Feb 2025

Our Galaxy's central black hole puts on a fireworks show

The James Webb Space Telescope uncovered repeated flares from the supermassive object called Sagittarius A*.

Research Highlight
28 Feb 2025

Just a smidgen of yellow-fever vaccine is enough

The standard protective dose is almost 14,000 units, but even 500 units raises antibody levels sufficiently to do the job.

Research Highlight
26 Feb 2025

Take me home, country toads

Cane toads have remarkable navigation abilities, even when their sense of smell and magnetic-sensory systems are compromised.

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News in Focus

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24 Feb 2025

Postdocs and PhD students hit hard by Trump's crackdown on science

As US federal grants remain frozen and budget cuts loom, anxiety and fear grip early-career researchers.

Heidi Ledford & Humberto Basilio

Collection: How Trump 2.0 is reshaping science

News
21 Feb 2025

What sparked the COVID pandemic? Mounting evidence points to raccoon dogs

More than five years on, studies suggest the animal is the most likely culprit, but other candidates haven't been ruled out.

Smriti Mallapaty

News
24 Feb 2025

Breast cancer is on the rise: data reveal drastic gap in survival rates

Lack of screening and limited treatment options mean that low- and middle-income countries face higher death rates despite having fewer cases than wealthier nations.

Giorgia Guglielmi

News
26 Feb 2025

US pulls back from gold-standard scientific climate panel

Trump officials bar NASA climate scientist from international meeting, and the space agency shuts down a team supporting the next global climate assessment.

Jeff Tollefson

Collection: How Trump 2.0 is reshaping science

News
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How a junk-food splurge can change your brain activity

A short bout of indulgence in fatty, sugary snacks leads to lingering brain-activity changes — even if it does not cause weight gain.

Julian Nowogrodzki

News
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NIH turmoil sparks anxiety over future of its global grants

Researchers are concerned about whether the US National Institutes of Health will continue to fund international projects.

Smriti Mallapaty & Miryam Naddaf

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'Slime' keeps the brain safe — and could guard against ageing

Slippery proteins in the brain's blood vessels form a protective barrier that breaks down with age, studies in mice show.

Heidi Ledford

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Iconic ocean-current system is safe from climate collapse — for now

But even a weakening of the Atlantic Meridional Overturning Circulation could have grave consequences worldwide.

Humberto Basilio

Features

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How much energy will AI really consume? The good, the bad and the unknown

Researchers want firms to be more transparent about the electricity demands of artificial intelligence.

Sophia Chen

News Feature
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The science of shopping addiction: what makes people buy loads of stuff?

From China to Brazil to Germany, huge numbers of people are addicted to shopping, driven in part by companies that use gaming strategies.

Emma Marris

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Tracking pathogens more effectively in cities

Microbiologists in Kyoto are enhancing pandemic preparedness, including addressing the growing problem of antimicrobial-resistant bacteria.

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Books & Arts

Book Review

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Against the odds: 12 women who beat bias to succeed in science

A book deftly highlights how women have been considered unsuitable as researchers for reasons other than their ability and commitment.

Georgina Ferry

Book Review
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Stories of people, past, present and future: Books in brief

Andrew Robinson reviews five of the best science picks.

Andrew Robinson

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Opinion

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Train clinical AI to reason like a team of doctors

As the European Union's Artificial Intelligence Act takes effect, AI systems that mimic how human teams collaborate can improve trust in high-risk situations, such as clinical medicine.

Christopher R. S. Banerji, Tapabrata Chakraborti ... Ben D. MacArthur

Comment
03 Mar 2025

Use your research to beat health inequities: four strategies from experts

Scientists must commit to engaging with the communities they want to help at all stages of the research process — from planning to dissemination.

Lynn Hendricks, Raeka Aiyar ... Nyasha Phanisa Sithole

Correspondence

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AI hallucinations are a feature of LLM design, not a bug

Joseph Dumit & Andreas Roepstorff

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AI must be taught concepts, not just patterns in raw data

Vinay K. Chaudhri

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Elon Musk has some supporters in science

Saleem H. Ali

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Should scientists ditch the social-media platform X?

Ivano Amelio

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Work

Feature

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Behind every great woman in science, there's another great woman in science

To mark International Women's Day on 8 March, six award-winning female scientists highlight women who have inspired them by pushing innovative research and creating opportunities for others.

Amanda Heidt

Technology Feature

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03 Mar 2025

ChatGPT for students: learners find creative new uses for chatbots

The utility of generative AI tools is expanding far beyond simple summarisation and grammar support towards more sophisticated, pedagogical applications.

Amanda Heidt

Where I Work

Where I Work
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Tracking gulls to prevent a bird flu pandemic

Sölvi Rúnar Vignisson observes species of sea bird as they gather and mix in Iceland.

Miles Lizak

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Research

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Revealing how fungi build planet-altering 'road' networks

Fungi made Earth's land liveable by building networks that released nutrients locked in primordial rock and supplied those nutrients to plant roots. An imaging study now sheds light on how these fungal networks are constructed.

Neo D. Martinez & Gianna L. Marschmann

News & Views
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Amazonian deforestation makes the wet season wetter, and the dry season drier

Clearing of Amazonian forest boosts rainfall during the wet season, but reduces it in the dry season, when the ecosystem needs water most — highlighting the need to prevent further clearance of a climate-regulating environment.

Wim Thiery

News & Views
18 Feb 2025

Molecular glue unexpectedly mimics the effect of cancer mutations

Many conventional small-molecule drugs work by inhibiting proteins, affecting their function. One small molecule instead imbues a protein with a new function in a mechanism that could inform rational drug design.

Jonathan W. Bushman & Patrick Ryan Potts

Collection: Cancer at Nature Portfolio

News & Views
05 Mar 2025

AI algorithm helps telescopes to pivot fast towards gravitational-wave sources

Fast electromagnetic follow-up observations of gravitational-wave sources such as binary neutron stars could shed light on questions across physics and cosmology. A machine-learning approach brings that a step closer.

Michael J. Williams

News & Views
18 Feb 2025

Could psychedelics be fine-tuned to relieve anxiety but skip the 'trip'?

Interest in psychedelic substances as medicines is rising. Identifying the neural circuits that mediate the benefits of psychedelics could pave the way for long-lasting anxiety treatments without the short-term sensory disturbances.

Cory A. Knox & Alex C. Kwan

News & Views
05 Feb 2025

Genetic and geographical origins of Eurasia's influential Yamna culture

Ancient genomes from modern Ukraine and Russia reveal the origins of the Yamna people, pastoralists who migrated from the Eurasian steppe to Europe 5,000 years ago, spreading their ancestry, culture and, probably, language.

Lehti Saag & Mait Metspalu

Articles

Article
Open Access
05 Mar 2025

Real-time inference for binary neutron star mergers using machine learning

Analysis of gravitational waves from merging binary neutron stars was accelerated using machine learning, enabling full low-latency parameter estimation and enhancing the potential for multi-messenger observations.

Maximilian Dax, Stephen R. Green ... Bernhard Schölkopf

Article
26 Feb 2025

Multiplexed entanglement of multi-emitter quantum network nodes

Multiplexed entanglement distribution in a quantum network, with each node comprising multiple solid-state emitters in nanophotonic cavities, enables scalable quantum communication.

A. Ruskuc, C.-J. Wu ... A. Faraon

Article
26 Feb 2025

Spectroscopy of the fractal Hofstadter energy spectrum

High-resolution STM/STS visualizes the fractionalization of flat moiré bands into discrete Hofstadter subbands in moiré graphene near the predicted second magic angle, and experimentally establishes several fundamental properties of the fractal Hofstadter energy spectrum.

Kevin P. Nuckolls, Michael G. Scheer ... Ali Yazdani

Article
Open Access
26 Feb 2025

Interplay of geometrical and spin chiralities in 3D twisted magnetic ribbons

The interplay between geometrical and spin chiralities in three-dimensional twisted magnetic ribbons can lead to new functionalities that could allow for innovative chiral spintronics.

André M. A. Farinha, See-Hun Yang ... Stuart S. P. Parkin

Article
26 Feb 2025

Orbital hybridization in graphene-based artificial atoms

Orbital hybridization in artificial atoms is achieved by altering their shape, and the anisotropy of the confining potential gives rise to the hybridization between quasibound states with different orbital quantum numbers within the artificial atom.

Yue Mao, Hui-Ying Ren ... Qing-Feng Sun

Article
26 Feb 2025

A single-fibre computer enables textile networks and distributed inference

A textile fibre computer combining sensing, memory, processing and communication in a 5-g mass has been developed, enabling distributed computation on the human body through garments.

Nikhil Gupta, Henry Cheung ... Yoel Fink

Article
26 Feb 2025

Achieving kilowatt-scale elastocaloric cooling by a multi-cell architecture

An elastocaloric cooling platform is constructed based on shape memory alloys with a cellular architecture that enables cooling powers above 1 kW.

Guoan Zhou, Lingyun Zhang ... Shuhuai Yao

Article
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23 Dec 2024

Steering perovskite precursor solutions for multijunction photovoltaics

Understanding the chemistry of perovskite precursor solutions enables improved film optoelectronic properties, allowing the fabrication of multijunction solar cells achieving power conversion efficiencies beyond the radiative limit of single-junction cells.

Shuaifeng Hu, Junke Wang ... Henry J. Snaith

Article
Open Access
05 Mar 2025

Impact of Amazonian deforestation on precipitation reverses between seasons

Reversed precipitation responses to Amazon deforestation show that deforestation leads to precipitation increases in the wet season and decreases in the dry season.

Yingzuo Qin, Dashan Wang ... Zhenzhong Zeng

Article
Open Access
26 Feb 2025

Glacial isostatic adjustment reveals Mars's interior viscosity structure

Emplacement of the north polar cap of Mars is investigated by combining viscoelastic deformation calculations and observations, showing that it formed over the last 1.7–12.0 Myr atop a stiff lithosphere and high-viscosity mantle (10^{22} Pa s), and that glacial isostatic adjustment could be further constrained.

A. Broquet, A.-C. Plesa ... D. Breuer

Article
29 Jan 2025

Contrasting drought sensitivity of Eurasian and North American grasslands

Eurasian grasslands have high production sensitivity to extreme drought compared with North American grasslands.

Qiang Yu, Chong Xu ... Xingguo Han

Article
Open Access
29 Jan 2025

Maize monoculture supported pre-Columbian urbanism in southwestern Amazonia

Remote sensing, field survey and microbotanical analyses show that the pre-Columbian Casarabe culture in the Bolivian Amazon invested heavily in landscape engineering, constructing a complex system of drainage canals and newly documented savannah farm ponds.

Umberto Lombardo, Lautaro Hilbert ... Francis Mayle

Article
05 Feb 2025

A genomic history of the North Pontic Region from the Neolithic to the Bronze Age

Whole-genome sequencing analysis of 81 prehistoric individuals reveals how the genetic makeup of people from the North Pontic region was influenced by waves of migration during the Eneolithic period and Early Bronze Age.

Alexey G. Nikitin, Iosif Lazaridis ... David Reich

Article
05 Feb 2025

The genetic origin of the Indo-Europeans

Ancient DNA reveals how the explosive expansion of Yamnaya steppe pastoralists began with a small community north of the Black Sea speaking ancestral Indo-European, and detects genetic links with Anatolian speakers, stemming from a common Indo-Anatolian homeland in the North Caucasus–lower Volga region.

Iosif Lazaridis, Nick Patterson ... David Reich

Article
25 Nov 2024

Opponent control of reinforcement by striatal dopamine and serotonin

A double-transgenic mouse model that enables monitoring or manipulation of dopamine and serotonin simultaneously in the brain's nucleus accumbens shows that these neuromodulators have opponent roles in reward learning.

Daniel F. Cardozo Pinto, Matthew B. Pomrenze ... Robert C. Malenka

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Article
08 Jan 2025

Hippocampal neuronal activity is aligned with action plans

Using high-density electrophysiological recordings, how internally generated cell assemblies are updated by action plans to meet external goals is explored.

Ipshita Zutshi, Athina Apostolelli ... György Buzsáki

Article
29 Jan 2025

Fine-tuning gibberellin improves rice alkali–thermal tolerance and yield

Precise regulation of the phytohormone gibberellin to optimal levels may not only confer alkali–thermal tolerance to Green Revolution rice varieties but may also further enhance their yield, and *ATT2*, by enabling the fine-tuning of gibberellins, is expected to be a potential new post-Green Revolution gene.

Shuang-Qin Guo, Ya-Xin Chen ... Youshun Lin

Article
Open Access
26 Feb 2025

A travelling-wave strategy for plant–fungal trade

Symbiotic fungi control network-level structure and flows to meet trade demands.

Loreto Oyarte Galvez, Corentin Bisot ... Thomas S. Shimizu

Article
Open Access
05 Feb 2025

Limited impact of *Salmonella* stress and persisters on antibiotic clearance

Experiments in infected mice and tissue-mimicking chemostats show that resilience of *Salmonella* against antimicrobial compounds is largely a result of starvation-induced general resilience rather than survival of a small subset of hyper-resilient cells.

Joseph Fanous, Beatrice Claudi ... Dirk Bumann

Article
29 Jan 2025

Methanol transfer supports metabolic syntrophy between bacteria and archaea

Zhaonella formicivorans produces methanol, for a novel syntrophic interaction, without requiring methylated compounds as an input.

Yan Huang, Kensuke Igarashi ... Masaru K. Nobu

Article
Open Access
29 Jan 2025

SARS-CoV-2 evolution on a dynamic immune landscape

A modelling approach predicts SARS-CoV-2 variant dynamics on the basis of immunity and cross-neutralization, which was shaped by a region's SARS-CoV-2 infection history.

N. Alexia Raharinirina, Nils Gubela ... Max von Kleist

Article
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05 Feb 2025

Antibody prophylaxis may mask subclinical SIV infections in macaques

Viral sequencing reveals subclinical infections in animals challenged with simian immunodeficiency virus even in the presence of potent neutralizing antibodies, with implications for clinical trials of antiviral agents against human immunodeficiency virus.

Christopher A. Gonelli, Hannah A. D. King ... Mario Roederer

Article
22 Jan 2025

CD45-PET is a robust, non-invasive tool for imaging inflammation

A non-invasive in vivo positron emission tomography imaging approach detects inflammatory disease using various preclinical models.

Ali Salehi Farid, Jennifer E. Rowley ... Mohammad Rashidian

Article
Open Access
15 Jan 2025

De novo designed proteins neutralize lethal snake venom toxins

Deep learning methods have been used to design proteins that can neutralize the effects of three-finger toxins found in snake venom, which could lead to the development of safer and more accessible antivenom treatments.

Susana Vázquez Torres, Melisa Benard Valle ... David Baker

Article
Open Access
12 Feb 2025

UM171 glues asymmetric CRL3–HDAC1/2 assembly to degrade CoREST corepressors

UM171 promotes corepressor degradation by acting as a molecular glue to induce KBTBD4–HDAC1/2 interactions with the help of inositol hexakisphosphate.

Megan J. R. Yeo, Olivia Zhang ... Ning Zheng

Article
Open Access
12 Feb 2025

Converging mechanism of UM171 and KBTBD4 neomorphic cancer mutations

We show that gain-of-function cancer mutations in the KBTBD4 E3 ligase promote neodegradation of substrates via a shape-complementarity-based mechanism, which converges with the mechanism of action of the UM171 molecular glue degrader and can be blocked by HDAC1/2 inhibitors.

Xiaowen Xie, Olivia Zhang ... Brian B. Liau

Article
15 Jan 2025

Structural insights into RNA cleavage by PIWI Argonaute

After target binding, PIWI proteins undergo a conformational change from 'open' to 'locked', facilitating base pairing and enhancing target cleavage efficiency, providing insights into how dynamic conformational changes from PIWI coordinate cofactors to safeguard gametogenesis.

Zhiqing Li, Qikui Xu ... En-Zhi Shen

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Amendments & Corrections

Author Correction
Open Access
13 Feb 2025

Author Correction: India–Eurasia convergence speed-up by passive-margin sediment subduction

Hao Zhou, Jiashun Hu ... Xiumian Hu

Author Correction
Open Access
17 Feb 2025

Author Correction: FANCD2–FANCI surveys DNA and recognizes double- to single-stranded junctions

Pablo Alcón, Artur P. Kaczmarczyk ... Lori A. Passmore

Author Correction
Open Access
18 Feb 2025

Author Correction: Fetal hepatocytes protect the HSPC genome via fetuin-A

Xiao-Lin Guo, Yi-Ding Wang ... Deng-Li Hong

Author Correction
Open Access
19 Feb 2025

Author Correction: Seasonal advance of intense tropical cyclones in a warming climate

Kaiyue Shan, Yanluan Lin ... Fengfei Song

Publisher Correction
Open Access
13 Feb 2025

Publisher Correction: Immune evasion through mitochondrial transfer in the tumour microenvironment

Hideki Ikeda, Katsushige Kawase ... Yosuke Togashi

Publisher Correction
Open Access
19 Feb 2025

Publisher Correction: Skin autonomous antibody production regulates host–microbiota interactions

Inta Gribonika, Victor I. Band ... Yasmine Belkaid

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Nature Outlook

Nature Outlook
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Vision

Most people experience the world through a wide array of senses, but it is vision that is valued the highest.

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