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Volume 638 Issue 8052, 27 February 2025

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nature
TURTLE RECALL
Loggerheads learn magnetic maps to aid with navigation

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Turtle recall

Sea turtles can readily return to feeding sites even after long-distance migration. How they achieve this navigational feat remains unclear, but they are thought to use Earth's magnetic field as a guide. In this week's issue, Kayla Goforth and colleagues reveal that young loggerhead turtles (*Caretta caretta*, pictured on the cover) can learn the magnetic signatures of certain areas. The researchers taught young turtles to expect food when exposed to a particular magnetic signature that matched a real geographical location and to expect no food in a second — show all

Cover image: Wild Wonders of Europe/Solvin Zankl/ Nature Picture Library.

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Learn COVID pandemic lessons — before it's too late

Five years after the start of the COVID-19 pandemic, public weariness and irresponsible politics are hampering an effective response to global infectious-disease outbreaks.

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Combine AI with citizen science to fight poverty

Artificial-intelligence tools and community science can help in places where data are scarce, so long as funding for data collection does not falter in the future.

World View

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Move beyond 'publish or perish' by measuring behaviours that benefit academia

A standardized system to measure contributions in mentorship, collaboration and more could bring about systemic change in science.

Kelly-Ann Allen

World View
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Quantum technologies need big investments to deliver on their big promises

Sustained investments can deliver quantum devices that handle more information, more rapidly and more securely than can classical ones.

Jian-Wei Pan

Research Highlights

Research Highlight
19 Feb 2025

Newfound bat virus that uses notorious receptor poses 'spillover' risk

The virus is related to the pathogen that causes Middle East respiratory syndrome and capitalizes on the same 'entry receptor' used by SARS-CoV-2.

Research Highlight
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Low-iridium device speeds progress towards green hydrogen

A catalyst that reduces usage of an expensive rare metal could help to make hydrogen fuel affordable.

Research Highlight
21 Feb 2025

Tropical forest's last old growth is being toppled — illegally

Satellite imagery helps to identify two hotspots of deforestation in the Atlantic Forest along Brazil's eastern coast.

Research Highlight
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Ancient apex predator tore into hippos with hyena-like teeth

Newly discovered species of leopard-sized carnivore lived some 30 million years ago in what is now Egypt.

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News in Focus

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News
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Trump's siege of science: how the first 30 days unfolded and what's next

The breakneck pace and devastating impact of the administration's policy changes has shocked researchers.

Jeff Tollefson, Max Kozlov ... Dan Garisto

Collection: How Trump 2.0 is reshaping science

News
19 Feb 2025

Biggest-ever AI biology model writes DNA on demand

An artificial-intelligence network trained on a vast trove of sequence data is a step towards designing completely new genomes.

Ewen Callaway

News
20 Feb 2025

Rare genetic disorder treated in womb for the first time

The child, who is now almost three years old, shows no signs of the often fatal motor neuron disease.

Smriti Mallapaty

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20 Feb 2025

Revealed: NIH research grants still frozen despite lawsuits challenging Trump order

The Trump administration is exploiting a loophole to keep a funding freeze in place, leaving researchers in limbo.

Max Kozlov

Collection: How Trump 2.0 is reshaping science

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Woman in cancer remission for record 19 years after CAR-T immune treatment

CAR-T-cell therapy treated a girl with a rare childhood cancer, raising hopes for future recipients of the approach.

Heidi Ledford

Collection: Cancer at Nature Portfolio

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Microsoft claims quantum-computing breakthrough — but some physicists are sceptical

The tech giant aims to make 'topological' quantum computers that will reach useful scales faster than competing technologies.

Davide Castelvecchi

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How quickly are you ageing? What molecular 'clocks' can tell you about your health

Armed with an influx of cash and public enthusiasm, researchers are looking to improve how ageing is measured.

Heidi Ledford

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Can AI help beat poverty? Researchers test ways to aid the poorest people

Measuring poverty is the first step to delivering support, but it has long been a costly, time-intensive and contentious endeavour.

Carrie Arnold

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Books & Arts

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Will AI jeopardize science photography? There's still time to create an ethical code of conduct

Generative artificial-intelligence illustrations can be helpful, but fall short as scientific records.

Felice Frankel

Book Review

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The racial injustice laid bare by COVID must not be forgotten

A methodical analysis of pandemic policies in Chicago, Illinois, reveals why short-term interventions are unable to tackle systemic inequities that affect marginalized communities.

Annabel Sowemimo

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Opinion

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How scientists can drive climate action: celebrate nature and promote hope

After years of storytelling and running classes and festivals, I've seen first-hand how a love of nature makes people want to protect it.

Harini Nagendra

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We use 30 billion tonnes of concrete each year — here's how to make it sustainable

Promising methods are emerging to reduce emissions, resource use and waste from construction industries.

Jianzhuang Xiao, Shuai Zou ... Surendra P. Shah

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Sharing benefits of research is key to effective science communication

Nicolás C. Zanetta-Colombo

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National climate policies must address mental health

Lea Schlatter, Manasi Kumar & Pushpam Kumar

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China's low-altitude economy needs to grow with more caution

Yong Wang & Dexin Ran

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Other countries should copy Nepal's approach to tackling cervical cancer

Binod G. C. & Alisha G. C.

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Work

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PhD scientists who forged a career off the beaten track

These seven scientists escaped big-city life after completing their PhDs. Here's how they make it work.

Katie L. Burke

Career Guide: Career resources for PhD students

Where I Work

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Chasing wildcats with my daughter

Mariola Sánchez-Cerdá works to track the elusive European wildcat's movements and habits.

Ugo Mellone

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Atlantic circulation could be more resilient to global warming than was thought

A system of ocean currents called the Atlantic meridional overturning circulation strongly affects climate, but is showing signs of shutting down. An analysis now suggests that total collapse is unlikely this century.

Aixue Hu

News & Views
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Skin in the game — locally made antibodies fight resident bacteria

How immune responses arise against microorganisms living on the skin is not fully understood. The discovery that skin maintains its own system to form antibody responses reveals an unexpected vaccination route.

Jeong-Mi Lee & Peter T. Sage

News & Views
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Superelastic titanium alloy has potential for space missions

Metallurgists have designed an extraordinary titanium alloy that is light, strong and flexible, and which recovers its original shape after large amounts of deformation — even when as cold as liquid helium or hotter than boiling water.

Shaolou Wei & Dierk Raabe

News & Views
05 Feb 2025

Superkiller complex problems expose a cancer-cell vulnerability

When a cancer cell no longer makes a particular functioning protein, it can become dependent on another protein for survival. The identification of one such relationship has uncovered a therapeutic target.

Christopher U. T. Hellen & Tatyana V. Pestova

Collection: Cancer at Nature Portfolio

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12 Feb 2025

Does a cell's gene expression always reflect its function?

Defining a cell's 'type' by the RNA transcripts it expresses is popular in biological research, but evidence from zebrafish neurons suggests that transcriptionally similar cells can be functionally diverse.

M. Neşet Özel & Claude Desplan

Reviews

Review Article
26 Feb 2025

Mass-spectrometry-based proteomics: from single cells to clinical applications

This Review summarizes advances in mass-spectrometry-based proteomics and explores the potential applications of these technologies in the clinic.

Tiannan Guo, Judith A. Steen & Matthias Mann

Articles

Article
Open Access
22 Jan 2025

Scaling and networking a modular photonic quantum computer

A proof-of-principle study reports a complete photonic quantum computer architecture that can, once appropriate component performance is achieved, deliver a universal and fault-tolerant quantum computer.

H. Aghaee Rad, T. Ainsworth ... Y. Zhang

Article
Open Access
09 Dec 2024

Quantum error correction below the surface code threshold

Two below-threshold surface code memories on superconducting processors markedly reduce logical error rates, achieving high efficiency and real-time decoding, indicating potential for practical large-scale fault-tolerant quantum algorithms.

Rajeev Acharya, Dmitry A. Abanin ... Nicholas Zobrist

Article
Open Access
26 Feb 2025

Hardware-efficient quantum error correction via concatenated bosonic qubits

Bosonic qubits can be engineered to feature intrinsic protection against certain kinds of errors, which makes quantum error correction across many bosonic qubits possible with less overhead.

Harald Putterman, Kyungjoo Noh ... Oskar Painter

Article
19 Dec 2024

Signatures of ambient pressure superconductivity in thin film $La_3Ni_2O_7$

Signatures of superconductivity in $La_3Ni_2O_7$ thin films are demonstrated, facilitated by the application of epitaxial compressive strain, suggesting that the observed low zero resistance T_c of around 2 K can be attributed to several factors.

Eun Kyo Ko, Yijun Yu ... Harold Y. Hwang

Article
19 Feb 2025

Modulated ringdown comb interferometry for sensing of highly complex gases

A new optical technique, modulated ringdown comb interferometry, is introduced for measuring the concentration of gas species in a complex sample and its efficacy demonstrated using exhaled human breath and ambient air in the mid-infrared.

Qizhong Liang, Apoorva Bisht ... Jun Ye

Article
19 Feb 2025

Perovskite heteroepitaxy for high-efficiency and stable pure-red LEDs

A heteroepitaxial-strain-based strategy for enhancing the stability of perovskite quantum dots for spectrally narrow (pure) red LEDs is reported.

Keyu Wei, Tong Zhou ... Mingjian Yuan

Article
19 Feb 2025

Hypotaxy of wafer-scale single-crystal transition metal dichalcogenides

A new method 'hypotaxy' enables wafer-scale, single-crystal transition metal dichalcogenides growth directly on crystalline, lattice-mismatched and amorphous substrates.

Donghoon Moon, Wonsik Lee ... Gwan-Hyoung Lee

Article
Open Access
26 Feb 2025

A lightweight shape-memory alloy with superior temperature-fluctuation resistance

A Ti–Al-based shape-memory alloy adhering to the stringent criteria of lightness, functionality and extreme thermal fluctuation resistance is introduced, showing excellent superelasticity with a recoverable strain exceeding 7% and an ultra-wide temperature window from 4.2 K to 400 K.

Yuxin Song, Sheng Xu ... Ryosuke Kainuma

Article
19 Feb 2025

Thermal Ca^{2+}/Mg^{2+} exchange reactions to synthesize CO_2 removal materials

Reactions of Mg-rich silicates with calcium carbonates/sulfates result in the formation of materials that could potentially be used for low-cost carbon dioxide removal from the atmosphere.

Yuxuan Chen & Matthew W. Kanan

Article
23 Dec 2024

Total synthesis of 25 picrotoxanes by virtual library selection

Concise routes to 25 naturally occurring picrotoxanes were devised using a virtual library of intermediate analogues triaged by reactivity; this approach can overcome challenges in the use of computers for synthesis design.

Chunyu Li & Ryan A. Shenvi

Article
Open Access
26 Feb 2025

Continued Atlantic overturning circulation even under climate extremes

Climate models suggest that the Atlantic Meridional Overturning Circulation is unlikely to collapse this century, owing to stabilization from wind-driven upwelling in the Southern Ocean.

J. A. Baker, M. J. Bell ... R. A. Wood

Article
29 Jan 2025

Warming and cooling catalyse widespread temporal turnover in biodiversity

Global-scale analyses of marine, terrestrial and freshwater assemblages found that temporal rates of species replacement were faster in locations with faster temperature change, including warming and cooling, and vulnerable assemblages were especially responsive.

Malin L. Pinsky, Helmut Hillebrand ... Shane A. Blowes

Article
Open Access
15 Jan 2025

Widespread occurrence and relevance of phosphate storage in foraminifera

Phosphate storage in foraminifera is found to be widespread, indicating that these organisms are probably relevant for marine phosphorus cycling and potentially buffer anthropogenic eutrophication in coastal environments.

Nicolaas Glock, Julien Richirt ... Hidetaka Nomaki

Article
Open Access
15 Jan 2025

Ancient DNA reveals reproductive barrier despite shared Avar-period culture

Ancient genome-wide data of 722 individuals and interdisciplinary analysis of large seventh- to eighth-century CE neighbouring cemeteries near Vienna are used to address the impact of the encounter between Eastern Asian Avars and Europeans.

Ke Wang, Bendeguz Tobias ... Zuzana Hofmanová

Article
12 Feb 2025

Learned magnetic map cues and two mechanisms of magnetoreception in turtles

Loggerhead sea turtles, which undergo long-distance migrations, can learn magnetic signatures associated with different geographic areas and have two different magnetic senses, each based on a different underlying mechanism.

Kayla M. Goforth, Catherine M. F. Lohmann ... Kenneth J. Lohmann

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Article
Open Access
12 Feb 2025

Transcriptomic neuron types vary topographically in function and morphology

Transcriptomic profiling of neurons from the zebrafish optic tectum identified more than 60 cell types; functional imaging revealed that response tuning, morphology and connectivity of specific cell types vary systematically with the neurons' positions in the tissue.

Inbal Shainer, Johannes M. Kappel ... Herwig Baier

Article
15 Jan 2025

Ensemble reactivations during brief rest drive fast learning of sequences

In macaques, motor cortex activity associated with motor learning tasks is reactivated during brief breaks between learning blocks and predicts subsequent performance gains.

Sandon Griffin, Preeya Khanna ... Karunesh Ganguly

Article
Open Access
11 Dec 2024

Skin autonomous antibody production regulates host–microbiota interactions

A study reveals that the skin acts as an autonomous lymphoid organ, producing antibodies to control the local biomass of the microbiota and protect against systemic infection, maintaining homeostasis between the host and its microbiota.

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

Article
11 Dec 2024

Discovery and engineering of the antibody response to a prominent skin commensal

Staphylococcus epidermidis induces a potent, durable and specific antibody response that is conserved in humans and non-human primates, and which could be redirected against pathogens as a new form of topical vaccination.

Djenet Bousbaine, Katherine D. Bauman ... Michael A. Fischbach

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Article
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22 Jan 2025

Mapping cells through time and space with moscot

Moscot is an optimal transport approach that overcomes current limitations of similar methods to enable multimodal, scalable and consistent single-cell analyses of datasets across spatial and temporal dimensions.

Dominik Klein, Giovanni Palla ... Fabian J. Theis

Article
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15 Jan 2025

IL-33-activated ILC2s induce tertiary lymphoid structures in pancreatic cancer

IL-33 induces tertiary lymphoid structures.

Masataka Amisaki, Abderezak Zebboudj ... Vinod P. Balachandran

Article
Open Access
20 Nov 2024

A cell atlas foundation model for scalable search of similar human cells

In a 23.4-million-cell atlas of 412 single-cell RNA-sequencing studies, SCimilarity query of macrophage and fibroblast profiles from interstitial lung disease reveals similar cell profiles across other fibrotic diseases and tissues.

Graham Heimberg, Tony Kuo ... Aviv Regev

Collection: The Human Cell Atlas: towards a first draft atlas

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Article
Open Access
05 Feb 2025

Synthetic lethality of mRNA quality control complexes in cancer

PELO–HBS1L and SKI complexes in the human mRNA quality control pathway exhibit a synthetic lethal interaction and may represent novel targets for the development of cancer therapies.

Vivian Prindle, Adam E. Richardson ... Joshua P. Plotnik

Article
Open Access
05 Feb 2025

SKI complex loss renders 9p21.3-deleted or MSI-H cancers dependent on PELO

Analysis of large-scale CRISPR screening data, combined with experiments in patient-derived tumour organoid models, identifies *PELO* as a potential therapeutic target in chromosomal 9p21.3-deleted cancers and microsatellite-unstable cancers harbouring specific mutations.

Patricia C. Borck, Isabella Boyle ... Francisca Vazquez

Article
15 Jan 2025

Targeting FOXM1 condensates reduces breast tumour growth and metastasis

The transcription factor FOXM1 forms functional condensates, the formation of which can be targeted with a specific peptide to suppress breast cancer growth and metastasis.

Feng Xie, Xiaoxue Zhou ... Long Zhang

Article
08 Jan 2025

RNA control of reverse transcription in a diversity-generating retroelement

This study presents cryogenic electron microscopy structural analysis of a diversity-generating retroelement (DGR) reverse transcription system from *Bordetella* bacteriophage, with results indicating that RNA surrounding the template controls reverse transcription through mechanisms that are conserved across distant taxa.

Sumit Handa, Tapan Biswas ... Partho Ghosh

Article
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08 Jan 2025

The sequence–structure–function relationship of intrinsic ERα disorder

Serine 118 phosphorylation drives conformational changes through the disruption of hydrophobic interactions between aromatic-rich clusters, showing how hydrophobic mutations can restore oestrogen receptor-mediated transcription.

Zhanwen Du, Han Wang ... Sichun Yang

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Streamflow shifts with declining snowfall

Wouter R. Berghuijs & Kate Hale

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Reply to: Streamflow shifts with declining snowfall

Juntai Han, Ziwei Liu & Yuting Yang

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Causal claims, causal assumptions and protected area impact

Jonas Geldmann, Julia P. G. Jones ... Paul J. Ferraro

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Reply to: Causal claims, causal assumptions and protected area impact

Jedediah F. Brodie, Jayasilan Mohd-Azlan ... Matthew Scott Luskin

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04 Feb 2025

Author Correction: GZMK-expressing $CD8^+$ T cells promote recurrent airway inflammatory diseases

Feng Lan, Jizhou Li ... Hai Qi

Author Correction
04 Feb 2025

Author Correction: Virus-induced senescence is a driver and therapeutic target in COVID-19

Soyoung Lee, Yong Yu ... Clemens A. Schmitt

Author Correction
Open Access
10 Feb 2025

Author Correction: A map of the rubisco biochemical landscape

Noam Prywes, Naiya R. Phillips ... David F. Savage

Author Correction
11 Feb 2025

Author Correction: High fatigue resistance in a titanium alloy via near-void-free 3D printing

Zhan Qu, Zhenjun Zhang ... Zhefeng Zhang

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