

CONTENTS

8 JANUARY 2026 | VOLUME 391 | ISSUE 6781

118

Leonardo da Vinci's
genetic signature may
be trapped in his works.

EDITORIAL

109 Weathering budget

cuts: Lessons from NASA

—J. Vertesi

NEWS

110 Can ecosystems recover after the deep sea is mined?

Race to scoop metals from
the sea floor spurs efforts to
understand impacts on rare
abyssal species

—C. Elliott

112 Fake data from trial sites ruin studies, drug firms say

Alzheimer's drug developer
accuses companies it
hired of providing "medically
impossible" results

—C. Piller

114 NIH leadership turmoil adds to politicization concerns

NIH director was prevented from
reappointing institute head

—J. Kaiser and J. Cohen

115 Jellyfish sleep a lot like us—and for the same reasons

Study adds to evidence that sleep
likely evolved among ancient animals
as a means of repairing neurons

—J. Tamisiea

116 New conflicts erupt over key virus database

GISAID, accused of "autocratic"
behavior, stops providing data to
SARS-CoV-2 dashboards

—K. Kupferschmidt

FEATURES

118 The real Da Vinci code

Scholars on a quixotic quest to
identify Leonardo da Vinci's DNA
achieve a milestone —R. Stone

121 Art historians turn to biology

PODCAST

COMMENTARY

PERSPECTIVES

124 Making faces

Facial expressions are produced
through a coordinated system of
voluntary and emotional pathways

—B. M. Waller and J. Whitehouse

RESEARCH SUMMARY p. 152

125 The source of IDH-mutant gliomas

Deep sequencing of human brain
tissue identifies the probable cell of
origin of IDH-mutant gliomas

—C. W. Mount and M. L. Suvà

RESEARCH SUMMARY p. 150

127 Not just a pain in the bone

Growth factors secreted by sensory
nerves promote fracture healing

—V. Rosen and F. Gori

RESEARCH SUMMARY p. 151

128 Tree bark microbes for climate management

Microbes living in bark can process
the greenhouse gases methane,
hydrogen, and carbon monoxide

—V. Gauci

RESEARCH SUMMARY p. 149

BOOKS ET AL.

130 The paradox of conscientious medicine

Conscientious refusers of medical
care face few costs in the US;
conscientious providers face many

—R. Y. Stahl

131 Rethinking drug use and addiction

A philosopher advocates for a more
humane and context-informed
approach —C. L. Boness

LETTERS

132 Iran's largest river in crisis

—H. M. Behzad *et al.*

133 Iran's ancient Hyrcanian forests on fire
—M. Mousazadehgavan and K. Madani

133 Improve air quality in public transportation
—S. Agathokleous *et al.*

ANALYSIS

POLICY ARTICLE

134 Did the illicit fentanyl trade experience a supply shock?

A synthesis of government and social media data suggests a disruption, possibly tied to events in China —K. Vangelov *et al.*

REVIEWS

REVIEW SUMMARY

137 Physics
Data sharing helps avoid “smoking gun” claims of topological milestones —S. M. Frolov *et al.*

RESEARCH

HIGHLIGHTS

143 From *Science* and other journals



160

Miso, like other gifted word-learner dogs, learns toy names like a toddler.

RESEARCH SUMMARIES

146 Drug discovery
Deep contrastive learning enables genome-wide virtual screening
—Y. Jia *et al.*

147 Neuroscience
Ontogeny of the spinal cord dorsal horn
—R. B. Roome *et al.*

148 Cell atlas
Chinese Immune Multi-Omics Atlas —J. Yin *et al.*

149 Microbiota
Bark microbiota modulate climate-active gas fluxes in Australian forests
—P. M. Leung *et al.*
PERSPECTIVE p. 128

150 Cancer
IDH-mutant gliomas arise from glial progenitor cells harboring the initial driver mutation
—J. W. Park *et al.*
PERSPECTIVE p. 125

151 Bone biology
Mapping somatosensory afferent circuitry to bone identifies neurotrophic signals required for fracture healing —M. Xu *et al.*
PERSPECTIVE p. 127

152 Neuroscience
Facial gestures are enacted through a cortical hierarchy of dynamic and stable codes
—G. R. Ianni *et al.*
PERSPECTIVE p. 124

RESEARCH ARTICLES

153 Solar cells
Multivalent ligands regulate dimensional engineering for inverted perovskite solar modules
—X. Chang *et al.*

160 Comparative cognition
Dogs with a large vocabulary of object labels learn new labels by overhearing like 1.5-year-old infants —S. Dror *et al.*

164 Solar cells
Molecular press annealing enables robust perovskite solar cells
—J. Hu *et al.*

171 Organic chemistry
Leveraging triatropic rearrangements for stereoselective skeletal reshuffling —Y. Niu *et al.*

179 Applied ecology
Multispecies grasslands produce more yield from lower nitrogen inputs across a climatic gradient
—J. O'Malley *et al.*

184 Plant biology
The molecular basis of the binding and specific activation of rhizobial NodD by flavonoids
—Y. Ruan *et al.*

190 Magnetism
Self-induced Floquet magnons in magnetic vortices —C. Heins *et al.*

195 Prokaryotic immunity
Recurrent acquisition of nuclease-protease pairs in antiviral immunity
—O. T. Tuck *et al.*

202 Organic chemistry
Access to four-membered cyclic sulfonamides by energy transfer catalysis —D. Zhai *et al.*

ON THE COVER



This photograph, taken at the ephemeral wetland study site in Bogangar, Australia, shows a paperbark tree (*Melaleuca quinquenervia*)—a hardy, iconic Australian wetland species that is recognized by its layered, papery bark. Research reveals that paperbarks, among other trees, host abundant, specialized, and metabolically active bark-dwelling microbial communities that modulate climatically relevant gases, including methane, hydrogen, and carbon monoxide. See pages 128 and 149. Photo: Elise Derwin/Southern Cross University



ON THE PODCAST

The real da Vinci code, and the world's oldest poison arrows

WORKING LIFE

210 Learning to lead
—D. O'Keeffe

208 New Products

209 Science Careers

Science serves as a forum for discussion of important issues related to the advancement of science by publishing material on which a consensus has been reached as well as including the presentation of minority or conflicting points of view. Accordingly, all articles published in *Science*—including editorials, news, commentary, and book reviews—are signed and reflect the individual views of the authors and not official points of view adopted by AAAS or the institutions with which the authors are affiliated. *Science* (ISSN 0036-8075) is published weekly on Thursday, except last week in December, by the American Association for the Advancement of Science, 1200 New York Avenue, NW, Washington, DC 20005. Periodicals mail postage (publication No. 484460) paid at Washington, DC, and additional mailing offices. Copyright © 2026 by the American Association for the Advancement of Science. The title *Science* is a registered trademark of the AAAS. Domestic individual membership, including subscription (12 months): \$165 (\$74 allocated to subscription). Domestic institutional subscription (51 issues): \$3125; Foreign postage extra: Air assist delivery: \$135. First class, airmail, student, and emeritus rates on request. Canadian rates with GST available upon request, GST #125488122. Publications Mail Agreement Number 1069624. Printed in the U.S.A. Change of address: Allow 4 weeks, giving old and new addresses and 8-digit account number. Postmaster: Send change of address to AAAS, P.O. Box 96178, Washington, DC 20090-6178. Single-copy sales: \$15 each plus shipping and handling available from backissues.sciencemag.org; bulk rate on request. Authorization to reproduce material for internal or personal use under circumstances not falling within the fair use provisions of the Copyright Act can be obtained through the Copyright Clearance Center (CCC), www.copyright.com. The identification code for *Science* is 0036-8075. *Science* is indexed in the Reader's Guide to Periodical Literature and in several specialized indexes.