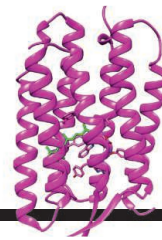


CONTENTS



127 & 145

Responding to light

13 JULY 2018 • VOLUME 361 • ISSUE 6398



NEWS

IN BRIEF

112 News at a glance

IN DEPTH

115 ICE REVEALS A MESSENGER FROM A BLAZING GALAXY

Neutrino astronomy is born as IceCube and other instruments find likely home of particle *By D. Clery*

► RESEARCH ARTICLES PP. 146 & 147; PODCAST

116 CHINA ANNOUNCES NEW FLOTILLA OF SPACE SCIENCE MISSIONS

Probes will watch for colliding black holes, image Earth's magnetosphere, and monitor the sun *By D. Normile*

117 DIGITAL CHEMICAL TEST IMPRESSES

Giant database shows promise for replacing animal studies

By V. Zainzinger

118 A 'GENE DRIVE' MAKES ITS DEBUT IN MAMMALS

CRISPR-based gene-spreading strategy promises to speed development of engineered mice *By J. Cohen*

119 MOLECULAR 'BARCODES' REVEAL LOST WHALE HUNTS

DNA method can rapidly identify species, shows toll of ancient cultures on biodiversity *By E. Pennisi and M. Price*

FEATURE

120 LIQUID SUNSHINE

Ammonia made from sun, air, and water could turn Australia into a renewable energy superpower *By R. F. Service*

► VIDEO

INSIGHTS

PERSPECTIVES

124 WHEN PERSISTENCE DOESN'T PAY

Rats, mice, and humans all invest more time in a foraging task than is in their interest *By S. F. Brosnan*

► REPORT P. 178

125 MANY ROADS TO CONVERGENCE

Plant genomes highlight complex mechanisms behind evolutionary convergence *By L. G. Nagy*

► RESEARCH ARTICLE P. 144

127 FEMTOSECOND STRUCTURAL PHOTOBIOLOGY

Time-resolved crystallography reveals how bacteriorhodopsin uses light to drive chemistry *By K. Moffat*

► RESEARCH ARTICLE P. 145

128 DOUBLE TROUBLE AT THE BEGINNING OF LIFE

Dual-spindle assembly in early embryos can compromise mammalian development *By A. P. Zielinska and M. Schuh*

► REPORT P. 189

130 ERADICATION GENOMICS—LESSONS FOR PARASITE CONTROL

Genomic surveillance could help achieve targets for the elimination of tropical diseases *By J. A. Cotton et al.*

132 PEROVSKITE FERROELECTRICS GO METAL FREE

Metal-free perovskites exhibit ferroelectric properties rivaling those of BaTiO₃ *By W. Li and L.-J. Ji*

► RESEARCH ARTICLE P. 151

133 JENS CHRISTIAN SKOU (1918–2018)

A pioneer in the biochemistry of membrane proteins *By P. Nissen*

POLICY FORUM

134 CITIZEN SCIENCE, PUBLIC POLICY

New research models may benefit from policy modifications *By C. J. Guerrini et al.*

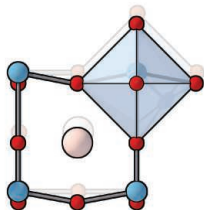
BOOKS ET AL.

137 TO BE A BEE

A charming account celebrates the insects' idiosyncrasies and the people passionate about protecting them *By R. Winfree*

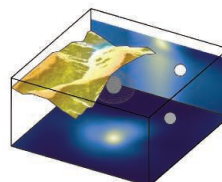
138 LEARNING FROM DIFFERENT DISCIPLINES

Conversations spark connections as scientists search for inspiration in other fields *By B. Uzzi*



132 & 151

All-organic perovskites



166

Satellites locate nuclear test

LETTERS

139 BRAZIL NATURALIZES NON-NATIVE SPECIES

By M. F. G. Brito et al.

139 FREE SATELLITE DATA KEY TO CONSERVATION

By G. M. Buchanan et al.

140 FUNDING AGENCIES CAN PREVENT HARASSMENT

By L. L. Iversen and M. Bendixen

140 TECHNICAL COMMENT ABSTRACTS

RESEARCH

IN BRIEF

141 From *Science* and other journals

RESEARCH ARTICLES

144 PLANT SCIENCE

Phylogenomics reveals multiple losses of nitrogen-fixing root nodule symbiosis
M. Griesmann et al.

RESEARCH ARTICLE SUMMARY; FOR FULL TEXT:

[dx.doi.org/10.1126/science.aat1743](https://doi.org/10.1126/science.aat1743)

► PERSPECTIVE P. 125



145 STRUCTURAL DYNAMICS

Retinal isomerization in bacteriorhodopsin captured by a femtosecond x-ray laser
P. Nogly et al.

RESEARCH ARTICLE SUMMARY; FOR FULL TEXT:

[dx.doi.org/10.1126/science.aat0094](https://doi.org/10.1126/science.aat0094)

► PERSPECTIVE P. 127

NEUTRINO ASTROPHYSICS

146 Multimessenger observations of a flaring blazar coincident with high-energy neutrino IceCube-170922A
The IceCube Collaboration et al.

RESEARCH ARTICLE SUMMARY; FOR FULL

TEXT: [dx.doi.org/10.1126/science.aat1378](https://doi.org/10.1126/science.aat1378)

147 Neutrino emission from the direction of the blazar TXS 0506+056 prior to the IceCube-170922A alert
IceCube Collaboration

► NEWS STORY P. 115

151 FERROELECTRICITY

Metal-free three-dimensional perovskite ferroelectrics
H.-Y. Ye et al.

► PERSPECTIVE P. 132

156 SYNTHETIC BIOLOGY

Programming self-organizing multicellular structures with synthetic cell-cell signaling
S. Toda et al.

REPORTS

162 PHYSICS

Phase transitions in a programmable quantum spin glass simulator
R. Harris et al.

166 GEODETIC MONITORING

The rise, collapse, and compaction of Mt. Mantap from the 3 September 2017 North Korean nuclear test
T. Wang et al.

171 ORGANIC CHEMISTRY

Deconstructive fluorination of cyclic amines by carbon-carbon cleavage
J. B. Roque et al.

174 EARLY OCEAN

Late inception of a resiliently oxygenated upper ocean
W. Lu et al.

178 EVOLUTIONARY COGNITION

Sensitivity to “sunk costs” in mice, rats, and humans
B. M. Sweis et al.

► PERSPECTIVE P. 124

181 PLANT SCIENCE

Ethylene-gibberellin signaling underlies adaptation of rice to periodic flooding
T. Kuroha et al.

► PODCAST

186 GREENHOUSE GASES

Assessment of methane emissions from the U.S. oil and gas supply chain
R. A. Alvarez et al.

189 EARLY DEVELOPMENT

Dual-spindle formation in zygotes keeps parental genomes apart in early mammalian embryos
J. Reichmann et al.

► PERSPECTIVE P. 128

DEPARTMENTS

111 EDITORIAL

Spain's good news
By Amaya Moro-Martín

198 WORKING LIFE

Heed the call to change
By Tracy Evans

ON THE COVER



Artist's impression of the IceCube Neutrino Observatory in Antarctica. Spherical digital optical modules (DOMs), each about 35 cm in diameter, are positioned up to 2.5 km deep in the ice. More than 5000 DOMs make up a cubic-kilometer detector weighing more than a billion tons. The DOMs detect the faint flash of light created when a high-energy neutrino interacts with the ice. See pages 115, 146, and 147. Image: *Jamie Yang and Savannah Guthrie/IceCube/NSF*

Science Staff	110
New Products	194
Science Careers	195

SCIENCE (ISSN 0036-8075) is published weekly on Friday, 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 © 2018 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): \$1808. Foreign postage extra: Mexico, Caribbean (surface mail) \$55; other countries (air assist delivery): \$89. 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; 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 is granted by AAAS to libraries and others who use Copyright Clearance Center (CCC) Pay-Per-Use services provided that \$35.00 per article is paid directly to CCC, 222 Rosewood Drive, Danvers, MA 01923. The identification code for Science is 0036-8075. Science is indexed in the Reader's Guide to Periodical Literature and in several specialized indexes.

Science

361 (6398)

Science **361** (6398), 111-198.

ARTICLE TOOLS

<http://science.sciencemag.org/content/361/6398>

PERMISSIONS

<http://www.sciencemag.org/help/reprints-and-permissions>

Use of this article is subject to the [Terms of Service](#)

Science (print ISSN 0036-8075; online ISSN 1095-9203) is published by the American Association for the Advancement of Science, 1200 New York Avenue NW, Washington, DC 20005. The title *Science* is a registered trademark of AAAS.

Copyright © 2018 The Authors, some rights reserved; exclusive licensee American Association for the Advancement of Science. No claim to original U.S. Government Works.