

BREAKTHROUGH of the YEAR

WINNER

1344 Development cell by cell

RUNNERS-UP

1346 Ice age impact

1347 An archaic human 'hybrid'

1347 How cells marshal their contents

1348 Forensic genealogy comes of age

1348 Molecular windows into primeval worlds

1349 Gene-silencing drug approved

1350 Molecular structures made simple

1351 Messengers from a far-off galaxy

1351 #MeToo makes a difference

BREAKDOWNS OF THE YEAR

1352 Climate-fueled disasters rise, political action stalls

SEE ALSO

► EDITORIAL P. 1333; VIDEO; PODCAST

ON THE COVER



A zebrafish embryo at an early stage of development. Fluorescent markers highlight cells expressing genes involved in determining the type of cell they will become. The ability to track

development in stunning detail by marking early embryonic cells to trace their lineage, isolating thousands of cells during development, and sequencing their RNA cell by cell, is *Science's* 2018 Breakthrough of the Year. See page 1344. Image: Jeffrey Farrell, Schier Lab/Harvard University

NEWS

IN BRIEF

1334 News at a glance

IN DEPTH

1337 HINTS OF YOUNG PLANETS PUZZLE THEORISTS

Astronomical survey finds telltale gaps in dusty disks around newborn stars
By D. Clery

1338 UNIVERSITIES 'HELD HOSTAGE' IN NICARAGUA'S POLITICAL CRISIS

Intensifying oppression paralyzes teaching and research
By L. Wade

1339 ANTARCTIC ICE MELT 125,000 YEARS AGO OFFERS WARNING

Ice sheet apparently collapsed in a previous warm period
By P. Voosen

1340 FOSSILS PUSH BACK ORIGIN OF KEY PLANT GROUPS MILLIONS OF YEARS

Findings from Middle East point to the dry tropics as cradle for plant evolution 250 million years ago
By E. Pennisi
► REPORT P. 1414

1341 LINK TO ALZHEIMER'S SEEN IN NODDING SYNDROME

Protein tangles hint that childhood illness is a degenerative disease of the brain
By L. Spinney

1342 'FIVE DEEPS' MISSION TO EXPLORE MYSTERIOUS OCEAN TRENCHES

Crewed sub aims to spot new species and gather rocks
By E. Stokstad

1343 NATIONAL ACADEMIES URGES RENEWED COMMITMENT TO FUSION

U.S. should stick with ITER, build a power plant, panel says
By A. Cho

INSIGHTS

PERSPECTIVES

1354 TESSELLATING TINY TETRAHEDRONS

A tiling rule guides the formation of quasicrystalline superlattices of nanocrystals
By S. Wu and Y. Sun
► REPORT P. 1396

1355 CHEMOTHERAPY AND TUMOR IMMUNITY

Inducing senescence in tumor cells stimulates antitumor innate immune responses
By S. Cornen and E. Vivier
► REPORT P. 1416

1357 SEEING A GLOBAL WEB OF CONNECTED SYSTEMS

Social-ecological shifts may often be causally linked
By M. Scheffer and E. H. van Nes
► RESEARCH ARTICLE P. 1379

1358 HYDROPATTERNING—HOW ROOTS TEST THE WATERS

Local water cues modulate auxin signaling to instruct root developmental decisions
By R. F. H. Giehl and N. von Wirén
► REPORT P. 1407

1359 UNUSUAL TRANSCRIPTION FACTOR PROTECTS AGAINST HEART FAILURE

Cleaved fragment of a cardiomyocyte structural protein moonlights as a transcription factor
By A. Padmanabhan and S. M. Haldar
► RESEARCH ARTICLE P. 1375

1360 ESCAPING ATMOSPHERES OF EXTRASOLAR PLANETS

The study of helium absorption opens a new window on escaping exo-atmospheres
By M. Brogi
► REPORTS PP. 1384 & 1388

POLICY FORUM

1362 NEXT-GENERATION WARGAMES

Technology enables new research designs, and more data
By Andrew W. Reddie et al.

BOOKS ET AL.

1365 THE SEX ROBOTS ARE HERE

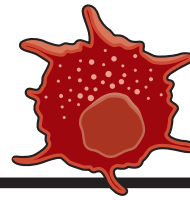
Advances in robotics and AI bring new concerns to age-old questions about human intimacy
By L. Frank

1366 BEYOND BLOOD

Strangers conceived via the same sperm donor reveal the role of choice in how we think about kin
By S. Zadeh

Science Staff	1330
AAAS News & Notes	1370
New Products	1429
Science Careers	1430

CONTENTS



1355 & 1416

Hunting senescent
tumor cells

21 DECEMBER 2018 • VOLUME 362 • ISSUE 6421

LETTERS

1368 PROTECT THIRD POLE'S FRAGILE ECOSYSTEM

By *J. Liu* et al.

1369 THE FRESHWATER BIODIVERSITY CRISIS

By *I. Harrison* et al.

1369 CHINA'S REOPENED RHINO HORN TRADE

By *H. Cheung* et al.

1369 ERRATA

RESEARCH

IN BRIEF

1372 From *Science* and other journals

RESEARCH ARTICLES

1375 CELL BIOLOGY

E-C coupling structural protein junctophilin-2 encodes a stress-adaptive transcription regulator *A. Guo* et al.

RESEARCH ARTICLE SUMMARY; FOR FULL TEXT:

[dx.doi.org/10.1126/science.aan3303](https://doi.org/10.1126/science.aan3303)

► PERSPECTIVE P. 1359

1376 STRUCTURAL BIOLOGY

Structure of human TFIID and mechanism of TBP loading onto promoter DNA *A. B. Patel* et al.

RESEARCH ARTICLE SUMMARY; FOR FULL TEXT:

[dx.doi.org/10.1126/science.aau8872](https://doi.org/10.1126/science.aau8872)

1377 STRUCTURAL BIOLOGY

Structures and gating mechanism of human TRPM2 *L. Wang* et al.

RESEARCH ARTICLE SUMMARY; FOR FULL TEXT:

[dx.doi.org/10.1126/science.aav4809](https://doi.org/10.1126/science.aav4809)

1378 MOLECULAR MAGNETS

A linear cobalt(II) complex with maximal orbital angular momentum from a non-Aufbau ground state *P. C. Bunting* et al.

RESEARCH ARTICLE SUMMARY; FOR FULL TEXT:

[dx.doi.org/10.1126/science.aat7319](https://doi.org/10.1126/science.aat7319)



1379 CRITICAL TRANSITIONS

Cascading regime shifts within and across scales *J. C. Rocha* et al.

► PERSPECTIVE P. 1357

REPORTS

EXOPLANET ATMOSPHERES

1384 Spectrally resolved helium absorption from the extended atmosphere of a warm Neptune-mass exoplanet *R. Allart* et al.

1388 Ground-based detection of an extended helium atmosphere in the Saturn-mass exoplanet WASP-69b *L. Nortmann* et al.

► PERSPECTIVE P. 1360

1391 PLASMA ASTROPHYSICS

Electron-scale dynamics of the diffusion region during symmetric magnetic reconnection in space *R. B. Torbert* et al.

1396 QUASICRYSTALS

Single-component quasicrystalline nanocrystal superlattices through flexible polygon tiling rule *Y. Nagaoka* et al.

► PERSPECTIVE P. 1354

1400 MOLECULAR MAGNETS

Magnetic hysteresis up to 80 kelvin in a dysprosium metallocene single-molecule magnet *F.-S. Guo* et al.

► PERSPECTIVE P. 1359

1403 MARINE PROTECTED AREAS

Elevated trawling inside protected areas undermines conservation outcomes in a global fishing hot spot *M. Dureuil* et al.

1407 PLANT SCIENCE

Root branching toward water involves posttranslational modification of transcription factor ARF7

B. Orosa-Puente et al.

► PERSPECTIVE P. 1358

1410 SOCIAL NETWORKS

The strength of long-range ties in population-scale social networks *P. S. Park* et al.

1414 PALEOBOTANY

A hidden cradle of plant evolution in Permian tropical lowlands *P. Blomenkemper* et al.

► NEWS STORY P. 1414

1416 CANCER

NK cell-mediated cytotoxicity contributes to tumor control by a cytostatic drug combination *M. Ruscetti* et al.

► PERSPECTIVE P. 1355

1423 CELL BIOLOGY

ATP-dependent force generation and membrane scission by ESCRT-III and Vps4 *J. Schöneberg* et al.

DEPARTMENTS

1333 EDITORIAL

Exploring organisms cell by cell
By *Jeremy Berg*

► BREAKTHROUGH OF THE YEAR P. 1344

1442 WORKING LIFE

Forced to change—for good
By *Katarina Radošević*

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 #R125488122. 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

362 (6421)

Science **362** (6421), 1333-1442.

ARTICLE TOOLS

<http://science.sciencemag.org/content/362/6421>

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.