

SPECIAL SECTION

Materials for Grid Energy

INTRODUCTION

921 Electricity Now and When

NEWS

- 922 Saving for a Rainy Day
- 925 Turning Over a New Leaf
Sunlight in Your Tank—Right Away

REVIEWS

- 928 Electrical Energy Storage for the Grid:
A Battery of Choices
B. Dunn et al.
- 935 Lowering the Temperature of
Solid Oxide Fuel Cells
E. D. Wachsman and K. T. Lee

>> Editorial p. 877, News Focus story p. 896, and Perspective p. 917



page 888

EDITORIAL

877 The Energy Research Imperative
Bill Gates
>> *Materials for Grid Energy* section p. 921

NEWS OF THE WEEK

880 A roundup of the week's top stories

NEWS & ANALYSIS

- 883 NSF Creates Fast Track for
Out-of-the-Box Proposals
- 884 Research Projects Could Be Roadkill
in Revision of Massive Highway Bill
- 885 Revolution Brings New Hopes
for Libyan Archaeology
- 886 China Looks to Balance Its Carbon Books
An Unsung Carbon Sink

NEWS FOCUS

- 888 Will Busting Dams Boost Salmon?
Out of the Frying Pan?
>> *Science Podcast*
- 893 Evolutionary Time Travel
- 896 Dreams of a Lithium Empire
>> *Materials for Grid Energy* section p. 921

LETTERS

899 Race Disparity in Grants:
Check the Citations
H. P. Erickson

Race Disparity in Grants:
Empirical Solutions Vital
J. L. Voss

Response
D. K. Ginther et al.

Race Disparity in Grants:
Oversight at Home
J. L. Sherley

Response
F. S. Collins and L. A. Tabak

905 CORRECTIONS AND CLARIFICATIONS

905 TECHNICAL COMMENT ABSTRACTS

BOOKS ET AL.

906 The Next Convergence
M. Spence, reviewed by C. I. Jones

906 Design with the Other 90%: Cities
C. E. Smith, curator;
Design with the Other 90%: Cities
C. E. Smith et al., reviewed by E. M. Sternberg

POLICY FORUM

908 Preparing to Manage
Climate Change Financing
S. D. Donner et al.

PERSPECTIVES

- 910 When More Is More
L.-A. Giraldeau
>> *Report p. 1000*
- 911 Understanding Tribal Fates
R. Arthur and J. Diamond
- 912 Human Locomotor Circuits Conform
S. Grillner
>> *Report p. 997*
- 914 One Atom Makes All the Difference
S. Ramaswamy
>> *Brevia p. 940; Report p. 974*
- 915 Antioxidant Strategies to Tolerate Antibiotics
P. Belenky and J. J. Collins
>> *Reports pp. 982 and 986*
- 916 Analyzing Solar Cycles
S. K. Solanki and N. A. Krivova
- 917 True Performance Metrics in
Electrochemical Energy Storage
Y. Gogotsi and P. Simon
>> *Materials for Grid Energy* section p. 921
- 919 Retrospective: Steven P. Jobs (1955–2011)
T. J. Misa

CONTENTS continued >>



COVER

Nighttime view of present-day Chicago, USA. Since the 1893 Chicago World's Fair introduced alternating current to the public, demand for electrical power has soared. Increased use of power from renewable resources will require new materials to store energy or generate power to ensure proper load balancing, as discussed in the special section beginning on page 921.

Photo: Jim Richardson/National Geographic/Getty Images

DEPARTMENTS

- 875 This Week in *Science*
- 878 Editors' Choice
- 879 *Science* Staff
- 1004 New Products
- 1005 *Science* Careers

BREVIA

- 940 Evidence for Interstitial Carbon in Nitrogenase FeMo Cofactor
T. Spatzal et al.
Structural data show that the light atom at the center of the nitrogenase active site cofactor is a carbon.
>> *Perspective p. 914; Report p. 974*

RESEARCH ARTICLE

- 941 Crystal Structure of the Eukaryotic 60S Ribosomal Subunit in Complex with Initiation Factor 6
S. Klinge et al.
The 3.5 angstrom-resolution structure provides insights into the architecture of the eukaryotic ribosome and its regulation.

REPORTS

- 948 The Large, Oxygen-Rich Halos of Star-Forming Galaxies Are a Major Reservoir of Galactic Metals
J. Tumlinson et al.
Observations with the Hubble Space Telescope show that halos of ionized gas are common around star-forming galaxies.
- 952 The Hidden Mass and Large Spatial Extent of a Post-Starburst Galaxy Outflow
T. M. Tripp et al.
A galaxy that has experienced a recent burst of star formation has an extended halo of hot, ionized gas surrounding it.
- 955 A Reservoir of Ionized Gas in the Galactic Halo to Sustain Star Formation in the Milky Way
N. Lehner and J. C. Howk
Clouds of ionized gas located inside our Galaxy provide a major supply of matter for fueling ongoing star formation.
- 958 Giant Piezoelectricity on Si for Hyperactive MEMS
S. H. Baek et al.
High-quality piezoelectric thin films are grown and exhibit superior properties for microelectromechanical systems.
- 962 Ultralight Metallic Microlattices
T. A. Schaedler et al.
A route is developed for fabricating extremely low-density, hollow-strut metallic lattices.
- 965 Silica-Like Malleable Materials from Permanent Organic Networks
D. Montarnal et al.
A polymer shows thermoset-like stability while displaying melt processability like that of a thermopolymer.
- 968 Domain Dynamics During Ferroelectric Switching
C. T. Nelson et al.
The role of defects and interfaces on switching in ferroelectric materials is observed with high-resolution microscopy.

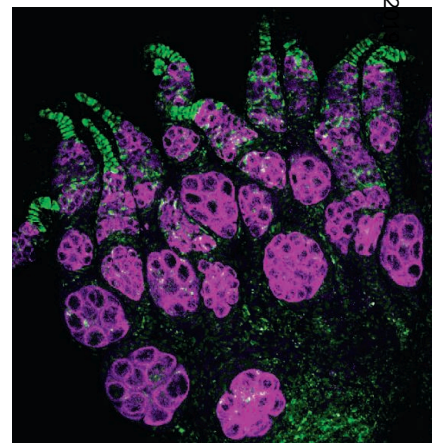
- 972 Negative Frequency-Dependent Selection of Sexually Antagonistic Alleles in *Myodes glareolus*
M. Mikkonen et al.
Selection of rare-male types in a population can maintain genetic variation that benefits one sex but harms the other.
- 974 X-ray Emission Spectroscopy Evidences a Central Carbon in the Nitrogenase Iron-Molybdenum Cofactor
K. M. Lancaster et al.
A central light atom in a cofactor at the nitrogenase active site is identified as a carbon.
>> *Perspective p. 914; Brevia p. 940*
- 977 Structural Basis of Silencing: Sir3 BAH Domain in Complex with a Nucleosome at 3.0 Å Resolution
K.-J. Armache et al.
A regulatory protein forms extensive interactions with the nucleosome core particle to create the basis for gene silencing.
- 982 Active Starvation Responses Mediate Antibiotic Tolerance in Biofilms and Nutrient-Limited Bacteria
D. Nguyen et al.
During growth arrest, bacteria tolerate the presence of antibiotics, thanks to mechanisms that protect against oxidant stress.
>> *Science Podcast*
- 986 H₂S: A Universal Defense Against Antibiotics in Bacteria
K. Shatalin et al.
Sulfide formation helps to protect various bacteria from antibiotic toxicity.
>> *Perspective p. 915*
- 990 *Wolbachia* Enhance *Drosophila* Stem Cell Proliferation and Target the Germline Stem Cell Niche
E. M. Fast et al.
A bacterial endosymbiont up-regulates mitosis of *Drosophila* germline stem cells and blocks programmed cell death.
- 993 Correction of Sickle Cell Disease in Adult Mice by Interference with Fetal Hemoglobin Silencing
J. Xu et al.
Manipulation of a transcriptional repressor promotes expression of protective fetal globin genes.
- 997 Locomotor Primitives in Newborn Babies and Their Development
N. Dominici et al.
Mammalian locomotion patterns share common roots.
>> *Perspective p. 912*
- 1000 Rational Choice, Context Dependence, and the Value of Information in European Starlings (*Sturnus vulgaris*)
E. Freidin and A. Kacelnik
Context-related information improves serial decision-making but impairs simultaneous choice.
>> *Perspective p. 910*



page 906



page 962



page 990

CONTENTS continued >>

SCIENCEONLINE

SCIENCEEXPRESS

www.sciencexpress.org

The Structure of the Eukaryotic Ribosome at 3.0 Å Resolution

A. Ben-Shem et al.

A close-up view of the ribosome's 79 proteins and 5500 RNA nucleotides.

10.1126/science.1212642

Imaging of *Plasmodium* Liver Stages to Drive Next-Generation Antimalarial Drug Discovery

S. Meister et al.

Imidazolopiperazine compounds inhibit liver-stage malaria parasites with one oral dose in mice.

10.1126/science.1211936

>> [Science Podcast](#)

Host Proteasomal Degradation Generates Amino Acids Essential for Intracellular Bacterial Growth

C. T. D. Price et al.

The bacterial pathogen *Legionella pneumophila* ensures amino acid supplies by promoting degradation of target host proteins.

10.1126/science.1212868

Calibrating the End-Permian Mass Extinction

S. Shen et al.

High-precision geochronologic dating constrains probable causes of Earth's largest mass extinction.

10.1126/science.1213454

The Origin of OB Runaway Stars

M. S. Fujii and S. P. Zwart

Most of the unusually fast, young stars in our galaxy are produced in three-body encounters within dense clusters of stars.

10.1126/science.1211927

TECHNICALCOMMENTS

Comment on "Global Trends in Wind Speed and Wave Height"

F. J. Wentz and L. Ricciardulli

Full text at www.sciencemag.org/cgi/content/ful/334/6058/905-b

Response to Comment on "Global Trends in Wind Speed and Wave Height"

I. R. Young et al.

Full text at www.sciencemag.org/cgi/content/ful/334/6058/905-c

SCIENCENOW

www.sciencenow.org

Highlights From Our Daily News Coverage

Leonardo's Formula Explains Why Trees Don't Splinter

This geometry rule probably evolved to help prevent wind breakage.

<http://scim.ag/Leotrees>

Not Pulling Your Leg: Tractor Beams May Be Possible

Several different groups come up with similar ideas for laser beams that can pull objects.

<http://scim.ag/tractor-beam>

Ancient Landslide Merged Trout Populations

River blockade explains surprising genetic similarities in two groups of fish.

<http://scim.ag/land-slide>

SCIENCE SIGNALING

www.sciencesignaling.org

The Signal Transduction Knowledge Environment

15 November issue: <http://scim.ag/ss111511>

RESEARCH ARTICLE: Signaling by the Matrix Proteoglycan Decorin Controls Inflammation and Cancer Through PDCD4 and MicroRNA-21

R. Merline et al.

A component of the extracellular matrix promotes inflammatory responses in sepsis and in tumors.

RESEARCH ARTICLE: Local Application of Neurotrophins Specifies Axons Through Inositol 1,4,5-Trisphosphate, Calcium, and Ca²⁺/Calmodulin-Dependent Protein Kinases

S. Nakamura et al.

Neurotrophins stimulate calcium signaling to promote axon specification.

RESEARCH ARTICLE: The Long-Term Survival Potential of Mature T Lymphocytes Is Programmed During Development in the Thymus

C. Sinclair et al.

T cell receptor signaling in thymocytes determines their responsiveness to a survival cytokine later in life.

ST NETWORK: The Nobel Prize in Physiology or Medicine 2011

This year's Prize was awarded for breakthroughs in innate and adaptive immunity.

SCIENCE TRANSLATIONAL MEDICINE

www.sciencetranslationalmedicine.org

Integrating Medicine and Science

16 November issue: <http://scim.ag/stm111611>

FOCUS: Biomarker-Based Early Cancer Detection—Is It Achievable?

W. D. Hazelton and E. G. Luebeck

A new mathematical model evaluates the power of blood-based biomarkers for early cancer detection.

RESEARCH ARTICLE: Mathematical Model Identifies Blood Biomarker-Based Early Cancer Detection Strategies and Limitations

S. S. Hori and S. S. Gambhir

Early cancer detection using current clinical blood-based biomarker assays may not be possible within the first 10 years of tumor growth.

PERSPECTIVE: Targeting Chaperone-Mediated Autophagy in Cancer

A. Thorburn and J. Debnath

Tumors need chaperone-mediated autophagy for growth and metastasis.

RESEARCH ARTICLE: Chaperone-Mediated Autophagy Is Required for Tumor Growth

M. Kon et al.

Cancer cells depend on chaperone-mediated autophagy for growth revealing a new target for preventing tumorigenesis and inducing tumor regression.

RESEARCH ARTICLE: Treatment and Prevention of Urinary Tract Infection with Orally Active FimH Inhibitors

C. K. Cusumano et al.

Optimized mannoside compounds that block pathogenic *Escherichia coli* entry into bladder epithelium were effective in the treatment and prevention of urinary tract infections in mice.

SCIENCE CAREERS

www.sciencereers.org/career_magazine

Free Career Resources for Scientists

Tooling Up: Views on an Interview, Part 2

D. Jensen

Ups and downs continue during Scott Jackson's interview at ABC Technologies.

http://scim.ag/TU_Interviews2

Where Are the Neuroscience Jobs?

M. Price

Our correspondent reports from the Neuroscience 2011 meeting in Washington, D.C.

<http://scim.ag/neurocareers2011>

A Mycologist Reaps the (Glowing) Fruit of His Labor

S. Reed

Patrick Hickey's career has grown in a way as unpredictable as the organisms he cultivates.

<http://scim.ag/Hickeyprofile>

SCIENCEPODCAST

www.sciencemag.org/multimedia/podcast

Free Weekly Show

On the 18 November *Science* Podcast: how starved bacteria resist antibiotics, next-generation antimalarial drugs, the science of dam removal, and more.

SCIENCEINSIDER

news.sciencemag.org/scienceinsider

Science Policy News and Analysis

SCIENCE (ISSN 0036-8075) is published weekly on Friday, except the 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 © 2011 by the American Association for the Advancement of Science. The title SCIENCE is a registered trademark of the AAAS. Domestic individual membership and subscription (51 issues): \$149 (\$74 allocated to subscription). Domestic institutional subscription (51 issues): \$990; Foreign postage extra: Mexico, Caribbean (surface mail) \$55; other countries (air assist delivery) \$85. First class, airmail, student, and emeritus rates on request. Canadian rates with GST available upon request, GST #1254 88122. 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:** \$10.00 current issue, \$15.00 back issue prepaid includes surface postage; bulk rates on request. **Authorization to photocopy** 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 other users registered with the Copyright Clearance Center (CCC) Transactional Reporting Service, provided that \$25.00 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.



ADVANCING SCIENCE, SERVING SOCIETY

Science

334 (6058)

Science **334** (6058), 875-1004.

ARTICLE TOOLS

<http://science.sciencemag.org/content/334/6058>

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. 2017 © The Authors, some rights reserved; exclusive licensee American Association for the Advancement of Science. No claim to original U.S. Government Works. The title *Science* is a registered trademark of AAAS.