

15 January 2010 | \$10

Science

Innate Immunity

AAAS

SPECIAL SECTION

Innate Immunity

INTRODUCTION

- 283 Recognizing the First Responders

PERSPECTIVE

- 284 RIGorous Detection: Exposing Virus Through RNA Sensing
J. Rehwinkel and C. Reis e Sousa

REVIEWS

- 286 How the Noninflammasome NLRs Function in the Innate Immune System
J. P. Y. Ting et al.

- 291 Regulation of Adaptive Immunity by the Innate Immune System
A. Iwasaki and R. Medzhitov

- 296 The NLRP3 Inflammasome: A Sensor for Metabolic Danger?
K. Schroder et al.

>> Editorial p. 249 and related content at www.sciencemag.org/special/immunity/



pages 260 & 343

EDITORIAL

- 249 New Approaches in Immunotherapy
Paul G. Thomas and Peter C. Doherty
>> Innate Immunity section p. 283

NEWS OF THE WEEK

- 254 An Indefatigable Debate Over Chronic Fatigue Syndrome
- 255 Neandertal Jewelry Shows Their Symbolic Smarts
- 256 NIST Grants Help Schools Build for Tomorrow's Research
- 257 Catalyst Offers New Hope for Capturing CO₂ on the Cheap
>> Report p. 313
- 257 From Science's Online Daily News Site
- 258 Oldest Galaxies Show Stars Came Together in a Hurry
- 258 Inventory Asks: Where Is the Non-Dark Matter Hiding?
- 259 White House Mulls Plan to Broaden Access to Research Papers
- 259 From the Science Policy Blog

NEWS FOCUS

- 260 The Little Wasp That Could
>> Report p. 343; Science Podcast
- 263 Fishing for Gold in the Last Frontier State
The Secret Lives of Ocean Fish
- 266 Questions Abound in Q-Fever Explosion in the Netherlands
Humans, Animals—It's One Health. Or Is It?

LETTERS

- 268 The Potential of Nutritional Therapy
A. Gardner et al.
Emissions Omissions
T. J. Wallington et al.
Response
S. C. Jackson

269 CORRECTIONS AND CLARIFICATIONS

BOOKS ET AL.

- 270 The Passage to Cosmos
L. D. Walls, reviewed by N. A. Rupke
- 271 Nature's Ghosts
M. V. Barrow Jr., reviewed by J. Farmer
- 271 Browsers

POLICY FORUM

- 273 Reforming Off-Label Promotion to Enhance Orphan Disease Treatment
B. A. Liang and T. Mackey

PERSPECTIVES

- 275 CO₂mmon Sense
W. B. Frommer
- 276 Explaining Bird Migration
O. Gilg and N. G. Yoccoz
>> Report p. 326
- 278 Green Gold Catalysis
C. H. Christensen and J. K. Nørskov
>> Report p. 319
- 279 The Botanical Solution for Malaria
W. K. Milhous and P. J. Weina
>> Report p. 328
- 280 Ion Chemistry Mediated by Water Networks
K. R. Siefertmann and B. Abel
>> Report p. 308
- 282 Retrospective:
Paul A. Samuelson (1915–2009)
R. M. Solow

CONTENTS continued >>



COVER

Dendritic cells of the immune system recognize and bind bacteria and other microbes by means of receptors expressed on the dendritic cell membrane and within the cell, thus triggering an immune response. Microbial sensing is associated with the innate arm of the immune system, and recent developments in this area are described in the special section starting on page 283.

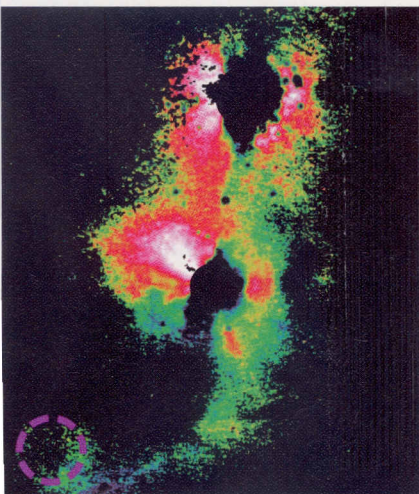
Image: Chris Bickel

DEPARTMENTS

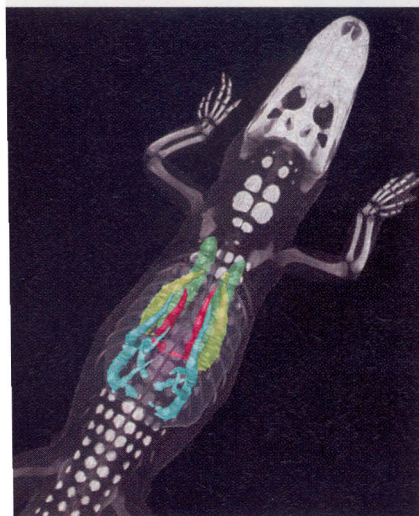
- 247 This Week in Science
- 251 Editors' Choice
- 252 Science Staff
- 253 Random Samples
- 352 Information for Authors
- 354 New Products
- 355 Science Careers



page 271



page 306



page 338

BREVIA

- 301 Hungry Codons Promote Frameshifting in Human Mitochondrial Ribosomes**
R. Temperley et al.
 During translation of mitochondrial genes, shifting the ribosome reading frame avoids unconventional arginine codons.

RESEARCH ARTICLE

- 302 Adaptive Evolution of Pelvic Reduction in Sticklebacks by Recurrent Deletion of a *Pitx1* Enhancer**
Y. F. Chan et al.
 Loss of a tissue-specific enhancer explains multiple parallel losses of the pelvic girdle in stickleback populations.

REPORTS

- 306 Direct Imaging of Bridged Twin Protoplanetary Disks in a Young Multiple Star**
S. Mayama et al.
 An infrared image taken with the Subaru Telescope reveals young binary stars and their circumstellar environments.
- 308 How the Shape of an H-Bonded Network Controls Proton-Coupled Water Activation in HONO Formation**
R. A. Relph et al.
 Vibrational spectroscopy uncovers the role of a surrounding water network in the mediating reaction of a solvated ion.
 >> *Perspective p. 280*
- 313 Electrocatalytic CO₂ Conversion to Oxalate by a Copper Complex**
R. Angamuthu et al.
 A copper complex can reductively couple carbon dioxide, even in the presence of oxygen.
 >> *News story p. 257; Science Podcast*
- 315 Ligand-Enabled Reactivity and Selectivity in a Synthetically Versatile Aryl C–H Olefination**
D.-H. Wang et al.
 A palladium-based catalyst eliminates the need for halogenated compounds for the formation of carbon-carbon bonds.
- 319 Nanoporous Gold Catalysts for Selective Gas-Phase Oxidative Coupling of Methanol at Low Temperature**
A. Wittstock et al.
 Leaching of gold-silver alloys creates a highly active catalyst for partial oxidation reactions.
 >> *Perspective p. 278*
- 322 Large-Scale Controls of Methanogenesis Inferred from Methane and Gravity Spaceborne Data**
A. A. Bloom et al.
 Satellite measurements allow the strength of wetland emissions of methane to be determined.

- 326 Lower Predation Risk for Migratory Birds at High Latitudes**
L. McKinnon et al.
 Egg predation rates measured at artificial nests along a 3000-kilometer transect decrease northwards.
 >> *Perspective p. 276*
- 328 The Genetic Map of *Artemisia annua* L. Identifies Loci Affecting Yield of the Antimalarial Drug Artemisinin**
I. A. Graham et al.
 A linkage map for an important medicinal crop plant points to breeding targets for enhancing drug production.
 >> *Perspective p. 279*
- 331 Tetrathiomolybdate Inhibits Copper Trafficking Proteins Through Metal Cluster Formation**
H. M. Alvarez et al.
 Complex formation between a copper chaperone and a metallo-drug prevents copper transfer to target enzymes.
- 335 Global Analysis of Short RNAs Reveals Widespread Promoter-Proximal Stalling and Arrest of Pol II in *Drosophila***
S. Nechaev et al.
 The initially transcribed sequence plays a key role in inducing polymerase stalling.
- 338 Unidirectional Airflow in the Lungs of Alligators**
C. G. Farmer and K. Sanders
 Crocodilian and bird lungs share patterns of air flow, indicating a common evolutionary origin.
- 340 G Protein Subunit G α_{13} Binds to Integrin $\alpha_{11b}\beta_3$ and Mediates Integrin "Outside-In" Signaling**
H. Gong et al.
 Cell adhesion mediated by integrins is coupled to intracellular signaling by direct binding to G proteins.
- 343 Functional and Evolutionary Insights from the Genomes of Three Parasitoid *Nasonia* Species**
The Nasonia Genome Working Group
 The genomes of three parasitoid wasp species offer insights into speciation, insect evolution, and parasitoid biology.
 >> *News story p. 260*
- 348 Zebrafish Behavioral Profiling Links Drugs to Biological Targets and Rest/Wake Regulation**
J. Rihel et al.
 The effects of most neuroactive drugs are conserved and can be detected by behavioral screening.

SCIENCEONLINE

SCIENCEEXPRESS

www.sciencexpres.org

A Genetic Variant BDNF Polymorphism Alters Extinction Learning in Both Mouse and Human

F. Soliman et al.

Commonly genetic variation in fear learning operates through the same pathways in mice and men.
10.1126/science.1181886

Evolutionary Dynamics of Complex Networks of HIV Drug-Resistant Strains: The Case of San Francisco

R. J. Smith et al.

Modeling of data from the U.S. indicates the potential for an epidemic wave of antiretroviral-resistant HIV.
10.1126/science.1180556

Ferroelectric Control of Spin Polarization

V. Garcia et al.

Ferroelectric tunnel junctions control the spin polarization of electrons emitted from iron electrodes.
10.1126/science.1184028

Effect of Ocean Acidification on Iron Availability to Marine Phytoplankton

D. Shi et al.

Ocean acidification caused by anthropogenic carbon dioxide is changing the chemistry and bioavailability of iron in seawater.
10.1126/science.1183517

Deglacial Meltwater Pulse 1B and Younger Dryas Sea Levels Revisited with Boreholes at Tahiti

E. Bard et al.

A coral-based record of sea level from Tahiti defines changes in the rate of sea-level rise between 14,000 and 9000 years ago.
10.1126/science.1180557

SCIENCENOW

www.sciencenow.org

Highlights From Our Daily News Coverage

Egyptian Eyeliner May Have Warded Off Disease

Lead-based cosmetics could have killed bacteria on the skin.

Bering Strait's Ups and Downs Alter Climate

Rise and fall of the land bridge affect the extent of ice sheets.

Why Light Makes Migraines Worse

Researchers trace effect to a particular receptor in the eye.

SCIENCESIGNALING

www.sciencesignaling.org

The Signal Transduction Knowledge Environment

RESEARCH ARTICLE: Extensive Crosstalk Between O-GlcNAcylation and Phosphorylation Regulates Cytokinesis

Z. Wang et al.

Protein O-GlcNAcylation regulates cell division.

RESEARCH ARTICLE: Quantitative Phosphoproteomics Reveals Widespread Full Phosphorylation Site Occupancy During Mitosis

J. V. Olsen et al.

Protein phosphorylation during the cell cycle may be an all-or-none process in many instances.

PERSPECTIVE: Cyclic Nucleotides Converge on Brown Adipose Tissue Differentiation

P. S. Amieux and G. S. McKnight

cGMP-mediated signaling pathways are required for the differentiation and function of brown adipocytes.

REVIEW: Basal Release of ATP—An Autocrine-Paracrine Mechanism for Cell Regulation

R. Corriden and P. A. Insel

Responses to ATP play an important role in regulating the signaling and function of a diverse array of cells and tissues.

GLOSSARY

Discover what RANKL and RANK mean in the world of signaling.

SCIENCECAREERS

www.sciencereers.org/career_magazine

Free Career Resources for Scientists

Tenure-Track Jobs Remain Scarce

S. Carpenter

Although most universities have cut faculty hiring, a few are taking advantage of a rich applicant pool.

Tooling Up: What's Your Mission?

D. Jensen

Your unique life philosophy is the cornerstone of your success and job satisfaction.

Science Careers Blog

Science Careers Staff

Get frequent advice, opinion, news, funding opportunities, and links to other career resources.

SCIENCETRANSLATIONAL MEDICINE

www.sciencetranslationalmedicine.org

Integrating Medicine and Science

PERSPECTIVE: Why Most Gene Expression Signatures of Tumors Have Not Been Useful in the Clinic

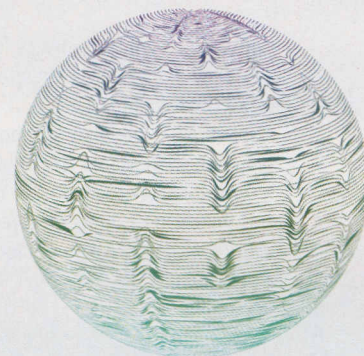
S. Koscielny

Gene microarray literature polluted with invalidated gene expression signatures needs revamping.

COMMENTARY: Translational Medicine Policy Issues in Infectious Disease

R. Fears et al.

European policy strategies can guide the scientific community to improve the translational medicine environment.



SCIENCESIGNALING

Global view of the cell cycle phosphoproteome.

RESEARCH ARTICLE: Uncovering Residual Effects of Chronic Sleep Loss on Human Performance

D. A. Cohen et al.

Sleep loss may be lost forever.

RESEARCH ARTICLE: Intermittent Prophylaxis with Oral Truvada Protects Macaques from Rectal SHIV Infection

J. G. Garcia-Lerma et al.

Treating monkeys with an antiretroviral drug before and after exposure to SHIV provides protection against infection.

SCIENCEPODCAST

www.sciencemag.org/multimedia/podcast

Free Weekly Show

Download the 15 January *Science* Podcast to hear about a carbon capture catalyst, parasitoid wasp diversity, innate immunity, and more.

SCIENCEINSIDER

blogs.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 © 2010 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): \$146 (\$74 allocated to subscription). Domestic institutional subscription (51 issues): \$910; 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 \$20.00 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