



## COVER

A mouse embryo at 9 days of gestation, stained for  $\alpha$ -fetoprotein in the liver bud and yolk sac (upper left and right green domains) and for the transcription factor Pdx-1 in the ventral and dorsal pancreas buds (upper and lower red domains). Understanding the basis for organ development can provide insights into disease and stem cell programming. See the special section beginning on page 1489.

*Image: Ewa Wandzioch and Ken Zaret*

## DEPARTMENTS

- 1429 Science Online
- 1431 This Week in *Science*
- 1437 Editors' Choice
- 1440 Contact *Science*
- 1443 Random Samples
- 1445 Newsmakers
- 1567 New Products
- 1571 Science Careers

## EDITORIAL

- 1435 A Scientific Approach to Policy  
*by Bruce Alberts*

## SPECIAL SECTION

# Organ Development

## INTRODUCTION

New Release: *The Complete Guide to Organ Repair* 1489

## REVIEWS

Generation and Regeneration of Cells of the Liver and Pancreas  
*K. S. Zaret and M. Grompe* 1490

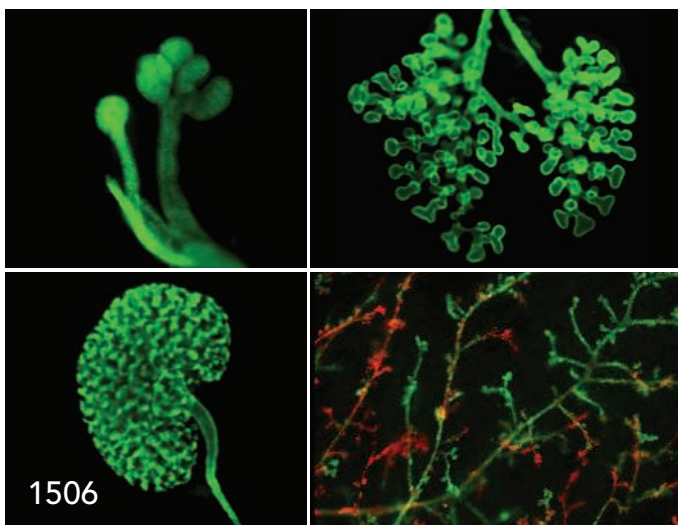
Cardiogenesis and the Complex Biology of Regenerative Cardiovascular Medicine  
*K. R. Chien et al.* 1494

Origin of Stem Cells in Organogenesis  
*J. M. W. Slack* 1498

Morphogenetic Cell Movements: Diversity from Modular Mechanical Properties  
*D. J. Montell* 1502

Patterning Mechanisms of Branched Organs  
*P. Lu and Z. Werb* 1506

>> *News story p. 1460; for related online content, see page 1429 or go to [www.sciencemag.org/organdevlopment/](http://www.sciencemag.org/organdevlopment/)*



## NEWS OF THE WEEK

Three Asian Nations Link Up to Form a Formidable Radio Telescope Array 1446

Ministers Bankroll European Space Agency's Ambitions 1447

Less Vaccine Can Be More 1449

## SCIENCESCOPE 1449

In Rare Encounter, U.S. and Chinese Scientists Craft Nuclear Glossary 1450

Fetal Immune System Hushes Attacks on Maternal Cells 1450

>> *Report p. 1562*

Treat Everyone Now? A 'Radical' Model to Stop HIV's Spread 1453

## NEWS FOCUS

Hopping to a Better Protein 1454

>> *Science Podcast*

Sanctuaries Aim to Preserve a Model Organism's Wild Type 1456

Philippines Plans Research Revival 1459

Coming Soon to a Knee Near You: Cartilage Like Your Very Own 1460

>> *Organ Development section p. 1489*

## LETTERS

Spore Show Not Gaming the Science System 1463  
*M. Rosenfeld*

Limiting the Impact of the Impact Factor *J. B. A. Green*

Putting Materials and Methods in Their Place *D. Shriener*

Artificial Intelligence Disappoints *G. Vannucci*

ChemCam's Cost a Drop in the Mars Bucket

*R. C. Wiens and S. Maurice*

An Order of Plumpy'nut, Hold the Aflatoxins

*C. P. Wild and R. Montesano*

In Defense of GM Crops *N. H. Ammann*

CORRECTIONS AND CLARIFICATIONS 1466

CONTENTS continued >>

## SCIENCE EXPRESS

www.scienceexpress.org

## DEVELOPMENTAL BIOLOGY

Human Fetal Hemoglobin Expression Is Regulated by the Developmental Stage-Specific Repressor *BCL11A*

V. G. Sankaran et al.

A way to reactivate a fetal form of  $\gamma$ -globulin in adults—by releasing it from repression by an inhibitor—may prove useful for treating certain genetic anemias.

10.1126/science.1165409

## CELL BIOLOGY

## Nascent RNA Sequencing Reveals Widespread Pausing and Divergent Initiation at Human Promoters

L. J. Core, J. J. Waterfall, J. T. Lis

RNA sequencing identifies antisense transcription immediately upstream of genes with transcriptionally engaged RNA polymerase.

10.1126/science.1162228

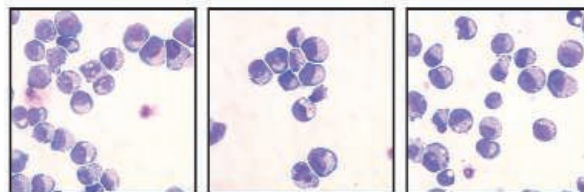
## CELL BIOLOGY

## Divergent Transcription from Active Promoters

A. C. Seila et al.

Active genes produce promoter-localized sense and antisense short RNAs, suggesting frequent transcription by divergently oriented RNA polymerase II complexes at mammalian promoters.

10.1126/science.1162253



## CELL BIOLOGY

## RNA Exosome Depletion Reveals Transcription Upstream of Active Human Promoters

P. Preker et al.

Highly unstable transcripts exist upstream of active human promoters.

10.1126/science.1164096

## CELL BIOLOGY

## The Antisense Transcriptomes of Human Cells

Y. He, B. Vogelstein, V. E. Velculescu, N. Papadopoulos, K. W. Kinzler

The abundance and nonrandom genomic origin of antisense transcripts in human cells suggest that these RNAs are an important feature of gene regulation.

10.1126/science.1163853

## TECHNICAL COMMENT ABSTRACTS

## CLIMATE CHANGE

Comment on "Phytoplankton Calcification in a High-CO<sub>2</sub> World" 1466

U. Riebesell et al.

[full text at www.sciencemag.org/cgi/content/full/322/5907/1466b](http://www.sciencemag.org/cgi/content/full/322/5907/1466b)Response to Comment on "Phytoplankton Calcification in a High-CO<sub>2</sub> World"

M. D. Iglesias-Rodriguez et al.

[full text at www.sciencemag.org/cgi/content/full/322/5907/1466c](http://www.sciencemag.org/cgi/content/full/322/5907/1466c)

## BOOKS ET AL.

## Science Books for Fun and Learning—Some Recommendations from 2008 1468

## BROWSINGS 1471

## POLICY FORUM

The Gender Gap in NIH Grant Applications 1472  
T. J. Ley and B. H. HamiltonScience Policy in Kazakhstan 1474  
G. E. Schweitzer

## PERSPECTIVES

How Cold Is Cold Dark Matter? 1476  
G. Gilmore >> [Science Podcast](#)A Curious Antipathy for Water 1477  
S. Granick and S. C. BaeCrops for a Salinized World 1478  
J. Rozema and T. FlowersControlling Cold-Atom Conductivity 1480  
L. Fallani and M. Inguscio >> [Research Article p. 1520](#)Elements and Evolution 1481  
A. D. AnbarFat Stress and Liver Resistance 1483  
W. Ogawa and M. Kasuga >> [Report p. 1539](#)

## PERSPECTIVES CONTINUED...

Competitive Centromeres 1484  
D. Charlesworth >> [Report p. 1559](#)

## ESSAY

GE Prize Winner: Understanding a Minimal DNA-Segregating Machine 1486  
E. C. Garner

## BREVIA

## PSYCHOLOGY

The Long-Run Benefits of Punishment 1510  
S. Gächter, E. Renner, M. Sefton

In human social groups, punishment of uncooperative behaviors increases teamwork, but the benefits of cooperation only outweigh the costs of punishment after a long time.

## RESEARCH ARTICLES

## CELL BIOLOGY

Dynamic Proteomics of Individual Cancer Cells in Response to a Drug 1511  
A. A. Cohen et al.

Cells that escape death from a chemotherapy drug express a different array of proteins than do genetically identical cells that die, which may help to inform cancer therapeutics.

## MATERIALS SCIENCE

Tough, Bio-Inspired Hybrid Materials 1516  
E. Munch et al.

Lamellar ice is used as a template to form an aluminum oxide scaffold that can be pressed and filled with a polymer, producing a tough layered structure reminiscent of nacre.

## PHYSICS

Metallic and Insulating Phases of Repulsively Interacting Fermions in a 3D Optical Lattice 1520  
U. Schneider et al.A cold atom cloud confined to an optical lattice can be tuned from a metal to an insulator. >> [Perspective p. 1480](#)

CONTENTS continued &gt;&gt;

## REPORTS

### PHYSICS

#### Attosecond Ionization and Tunneling Delay Time Measurements in Helium 1525

*P. Eckle et al.*

A technique based on resolving the momentum of an electron escaping from a helium atom in an elliptically polarized light field clocks tunneling at less than 34 attoseconds.

### GEOPHYSICS

#### Optical Absorption and Radiative Thermal Conductivity of Silicate Perovskite to 125 Gpa 1529

*H. Keppler, L. S. Dubrovinsky, O. Narygina, I. Kantor*

At high pressures, silicate perovskite, abundant in Earth's mantle, is not opaque to optical and infrared light, implying that radiative heat flow is important in the deep Earth.

### PLANETARY SCIENCE

#### Quasi-Periodic Bedding in the Sedimentary Rock Record of Mars 1532

*K. W. Lewis et al.*

Stereo topographic mapping on Mars shows that some large impact craters were filled with sedimentary rock sequences made up of cyclical packages of meter-scaled beds.

### MOLECULAR BIOLOGY

#### Photoexcited CRY2 Interacts with CIB1 to Regulate Transcription and Floral Initiation in *Arabidopsis* 1535

*H. Liu, X. Yu, K. Li, J. Klejnot, H. Yang, D. Lisiero, C. Lin*

Blue light triggers the association of a photoreceptor, transcription factor, and DNA site, thus inducing expression for the gene *FT* (flowering time) and initiating flowering.

### CELL SIGNALING

#### A Stress Signaling Pathway in Adipose Tissue Regulates Hepatic Insulin Resistance 1539

*G. Sabio et al.*

In mice, some detrimental effects of a diet high in fat—insulin resistance, for instance—result from hormonal signals sent from fat cells to the liver. >> *Perspective p. 1483*

### CELL BIOLOGY

#### Inhibition of Rac by the GAP Activity of Centralspindlin Is Essential for Cytokinesis 1543

*J. C. Canman et al.*

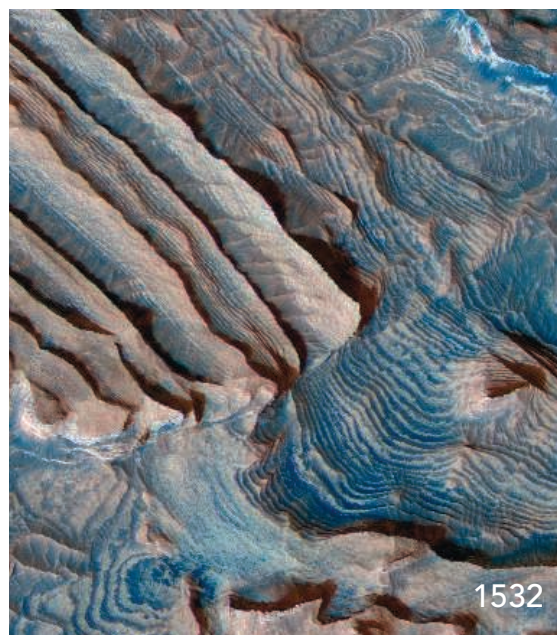
During cell division, a component of the spindle inhibits a small regulatory binding protein, allowing another regulator to constrict a ring between the separating daughter cells.

### DEVELOPMENTAL BIOLOGY

#### Dynamic Analyses of *Drosophila* Gastrulation Provide Insights into Collective Cell Migration 1546

*A. McMahon, W. Supatto, S. E. Fraser, A. Stathopoulos*

Live fluorescence imaging of over 1500 cells within a *Drosophila* embryo during gastrulation reveals that a fibroblast growth factor coordinates cell migration.



### NEUROSCIENCE

#### Astroglial Metabolic Networks Sustain Hippocampal Synaptic Transmission 1551

*N. Rouach, A. Koulakoff, V. Abudara, K. Willecke, C. Giaume*

The glial astrocytes that surround neurons supply glucose or lactate to excitatory synapses through gap junctions that open when the neurons are active.

### NEUROSCIENCE

#### Activation of Pannexin-1 Hemichannels Augments Aberrant Bursting in the Hippocampus 1555

*R. J. Thompson et al.*

Activation of a glutamate receptor in hippocampal cells leads to secondary opening of a gap junction–like channel that can contribute to seizure-like bursting.

### EVOLUTION

#### Centromere-Associated Female Meiotic Drive Entails Male Fitness Costs in Monkeyflowers 1559

*L. Fishman and A. Saunders*

Competition between chromosomal homologs causes non-Mendelian meiotic segregation and fitness polymorphism in a natural monkeyflower population. >> *Perspective p. 1484*

### IMMUNOLOGY

#### Maternal Alloantigens Promote the Development of Tolerogenic Fetal Regulatory T Cells in Utero 1562

*J. E. Mold et al.*

Exposure of the human fetus to maternal cells during pregnancy can prompt development of regulatory T cells that prevent responses to non-inherited maternal antigens.

>> *News story p. 1450; Science Podcast*



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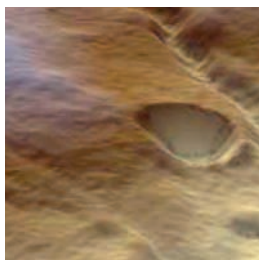
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CONTENTS continued >>>



Hidden impact crater in Canada unmasked.

## SCIENCE NOW

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HIGHLIGHTS FROM OUR DAILY NEWS COVERAGE

### Lasers Uncover Craters

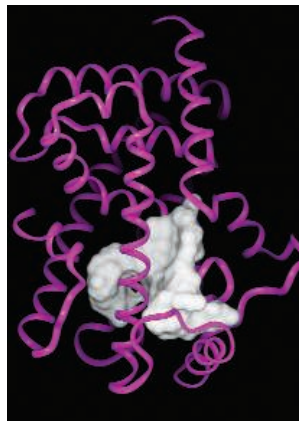
New technology pinpoints previously unknown meteor impacts.

### The Long Road to Modernity

Archaeological dating suggests modern humans may have inherited some fancy tools.

### Most Planets May Be Seeded With Life

Discovery of RNA precursor in planet-forming cloud suggests building blocks of life are common in the universe.



Ligand-binding pocket of PPAR $\gamma$ .

## SCIENCE SIGNALING

[www.sciencesignaling.org](http://www.sciencesignaling.org)

THE SIGNAL TRANSDUCTION KNOWLEDGE ENVIRONMENT

### PERSPECTIVE: Ligand-Dependent and -Independent Regulation of PPAR $\gamma$ and Orphan Nuclear Receptors

*H. E. Xu and Y. Li*

It is too soon to conclude that the physiological activities of PPAR $\gamma$  are truly ligand-independent.

### PODCAST

*S. W. Lee, P. P. Ongusaha, A. M. VanHook*

Sam Lee and Pat Ongusaha discuss their research on the mechanisms by which ultraviolet B radiation induces cell death.

### GLOSSARY

Find out what TSC, NG2, and ASIC mean in the world of cell signaling.

### PREVIEW

Get a sneak peek at articles coming up in the 9 December issue related to this week's *Science* special section on organ development.

>> *Organ Development* section p. 1489 and [www.sciencemag.org/organdevlopment/](http://www.sciencemag.org/organdevlopment/)



How will scientists fare in the new administration?

## SCIENCE CAREERS

[www.sciencereers.org/career\\_development](http://www.sciencereers.org/career_development)

FREE CAREER RESOURCES FOR SCIENTISTS

### The Job Outlook for Physician Scientists

*K. Hede*

Job opportunities make a bright future for scientists with clinical degrees.

### Taken for Granted: Can Scientists Believe in Change?

*B. L. Benderly*

Science is one of many priorities for the new presidential administration.

### Beating the Odds

*G. Sinha*

Cinzia Casiraghi won €1.65 million for setting up her own lab in Germany.

### December 2008 Funding News

*J. Fernández*

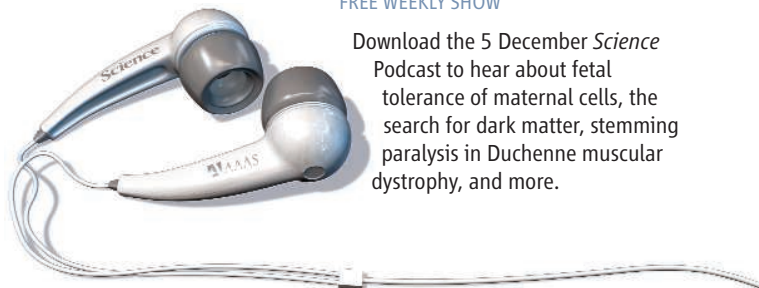
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