

**SPECIAL SECTION**

## Aging

**INTRODUCTION**

**1180** Toward healthy aging

**NEWS**

**1182** Why we outlive our pets  
*By D. Grimm*

**1186** Death-defying experiments  
*By J. Cohen*

**1188** The final countdown  
*By E. Underwood*

**REVIEWS**

**1191** Healthy aging: The ultimate preventative medicine  
*M. Kaeberlein et al.*

**1193** Human telomere biology: A contributory and interactive factor in aging, disease risks, and protection  
*E. H. Blackburn et al.*

**1199** Stem cells and healthy aging  
*M. A. Goodell and T. A. Rando*

**1204** Mitochondrial dysfunction and longevity in animals: Untangling the knot  
*Y. Wang and S. Hekimi*

**1208** NAD<sup>+</sup> in aging, metabolism, and neurodegeneration  
*E. Verdin*

**PERSPECTIVE**

**1214** Gut microbiota and aging  
*P. W. O'Toole and I. B. Jeffery*

**ON THE COVER**



Hands of a 78-year-old man and a 9-month-old baby reveal signs of aging. This special issue focuses on the biology of aging and the goal

of increasing healthy life span. See page 1180. *Photo: Erin Scott*

**SEE ALSO** ▶ EDITORIAL P. 1135  
▶ PODCAST ▶ VIDEO

**1148 BORN TO REWILD**

A father and son's quixotic quest to bring back a lost ecosystem—and save the world  
*By E. Kintisch*

▶ VIDEO

## INSIGHTS

**BOOKS ET AL.**

**1152 SB&F PRIZES FOR EXCELLENCE IN SCIENCE BOOKS**

**1160 ROYAL SOCIETY YOUNG PEOPLE'S BOOK PRIZE**

**PERSPECTIVES**

**1162 MITOCHONDRIA SHAPE CARDIAC METABOLISM**

Quality control of mitochondria in cardiac muscle affects heart function  
*By R. A. Gottlieb and D. Bernstein*

▶ RESEARCH ARTICLES PP. 1220 & 1221

**1163 PHAGE THERAPY REDUX—WHAT IS TO BE DONE?**

Bacteriophage biology should move beyond a model system to support human health  
*By R. Young and J. J. Gill*

**1165 A SPEEDY MARRIAGE IN SUPRAMOLECULAR CATALYSIS**

Cross-coupling reactions can be accelerated by trapping the metal catalyst in a confined space  
*By K. Yan and M. Fujita*

▶ REPORT P. 1235

**1166 CORRIDORS FOR PEOPLE, CORRIDORS FOR NATURE**

How can the environmental impacts of roads be reduced?  
*By N. M. Haddad*

**1168 CAN PARIS PLEDGES AVERT SEVERE CLIMATE CHANGE?**

Reducing risks of severe outcomes and improving chances of limiting warming to 2°C  
*By A. A. Fawcett et al.*

**1170 POLITICAL AGENCY: THE KEY TO TACKLING CLIMATE CHANGE**

Individuals play a central role in the transformations required to avoid dangerous climate change  
*By K. O'Brien*

Science Staff .....	1132
New Products .....	1270
Science Careers .....	1271

## NEWS

**IN BRIEF**

**1136** News at a glance

**IN DEPTH**

**1138 MUD TSUNAMI WREAKS ECOLOGICAL HAVOC IN BRAZIL**

Researchers analyze sludge for heavy metals and assess potential for recovery  
*By H. Escobar*

**1139 DNA HELPS BUILD MOLECULAR LIBRARIES FOR DRUG TESTING**

Pharmaceutical firms and biotech companies embrace DNA-encoded chemical libraries  
*By T. Gura*

**1140 U.K. RESEARCH WINS HOLLOW VICTORY**

Budget is protected for 5 years, but lags because of past inflation  
*By E. Stokstad*

**1142 JAPANESE PROBE PRIMED FOR SECOND RUN AT VENUS**

Akatsuki spacecraft aims to plumb planet's weird atmosphere  
*By D. Normile*

**1143 DATA CHECK: NSF'S NOVEL SOLUTION TO A WORKLOAD CRUNCH**

Hiring more rotators and clamping down on submissions helped avert a labor crisis  
*By J. Mervis*

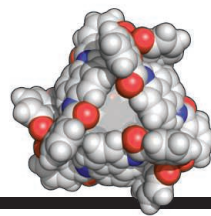


Cave paintings of aurochs in Lascaux, France.

**FEATURES**

**1144 BRINGING BACK THE AUROCHS**

By conjuring the extinct ancestor of modern cattle, breeders are making Europe just a little bit wilder  
*By E. Stokstad*



### 1176



#### 1171 SILICA-SUPPORTED CATALYSTS GET A NEW BREATH OF LIFE

Methods emerge for dispersing metals as stable nanoparticles on silica surfaces  
*By S. Soled*

#### 1172 CLASSICAL ENTANGLEMENT?

Entanglement is a property of the quantum world; classical systems need not apply  
*By E. Karimi and R. W. Boyd*

#### SCIENCE PRIZE ESSAY

#### 1174 TEAMWORK: THE TUMOR CELL EDITION

Subclone cooperation maintains tumor growth  
*By A. S. Cleary*

#### LETTERS

#### 1176 EXOSKELETON PROGRESS YIELDS SLIPPERY SLOPE

*By D. Greenbaum*

#### 1176 TORTURE'S INEFFICIENCY LONG ESTABLISHED

*By D. R. Witzling*

#### 1176 POLLUTION THREATENS MIGRATORY SHOREBIRDS

*By Z. Tang et al.*

#### 1177 TECHNICAL COMMENT ABSTRACTS

## RESEARCH

#### IN BRIEF

1217 From *Science* and other journals

#### RESEARCH ARTICLES

##### HEART MITOCHONDRIA

1220 Parkin-mediated mitophagy directs perinatal cardiac metabolic maturation in mice  
*G. Gong et al.*  
RESEARCH ARTICLE SUMMARY; FOR FULL TEXT: [dx.doi.org/10.1126/science.aad2459](http://dx.doi.org/10.1126/science.aad2459)

1221 Imbalanced OPA1 processing and mitochondrial fragmentation cause heart failure in mice  
*T. Wai et al.*  
RESEARCH ARTICLE SUMMARY; FOR FULL TEXT: [dx.doi.org/10.1126/science.aad0116](http://dx.doi.org/10.1126/science.aad0116)

► PERSPECTIVE P. 1162

#### REPORTS

##### 1222 PEROVSKITE LEDS

Overcoming the electroluminescence efficiency limitations of perovskite light-emitting diodes  
*H. Cho et al.*

##### 1225 LASER PHYSICS

Ultraviolet surprise: Efficient soft x-ray high-harmonic generation in multiply ionized plasmas  
*D. Popmintchev et al.*

##### 1231 QUANTUM HALL EFFECT

Evidence for a fractional fractal quantum Hall effect in graphene superlattices  
*L. Wang et al.*

##### 1235 CATALYSIS

A supramolecular microenvironment strategy for transition metal catalysis  
*D. M. Kaphan et al.*  
► PERSPECTIVE P. 1165

##### 1238 SOLAR PHYSICS

Particle acceleration by a solar flare termination shock  
*B. Chen et al.*

##### 1242 BLACK HOLES

Resolved magnetic-field structure and variability near the event horizon of Sagittarius A\*  
*M. D. Johnson et al.*

#### 1245 EDUCATION

Democratizing education? Examining access and usage patterns in massive open online courses  
*J. D. Hansen and J. Reich*

#### 1248 WATER RESOURCES

Local flow regulation and irrigation raise global human water consumption and footprint  
*F. Jaramillo and G. Destouni*

#### 1251 NEURODEVELOPMENT

Single-cell transcriptomics reveals receptor transformations during olfactory neurogenesis  
*N. K. Hanchate et al.*

#### 1255 PROTECTED AREAS

Protected areas and global conservation of migratory birds  
*C. A. Runge et al.*

#### 1258 GENE REGULATION

Single-base pair differences in a shared motif determine differential *Rhodopsin* expression  
*J. Rister et al.*

#### 1262 HUMAN GENETICS

De novo mutations in congenital heart disease with neurodevelopmental and other congenital anomalies  
*J. Homsy et al.*

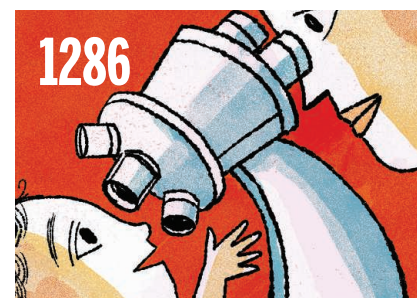
#### DEPARTMENTS

##### 1135 EDITORIAL

Japan's longevity challenge  
*By Hiroko Akiyama*  
► AGING SECTION P. 1180

##### 1286 WORKING LIFE

Science made me a better parent  
*By Ignacio Amigo*



# Science

**350 (6265)**

*Science* **350** (6265), 1135-1286.

**ARTICLE TOOLS**

<http://science.sciencemag.org/content/350/6265>

**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.