



**Cover image:** Pictured is a common marmoset (*Callithrix jacchus*), a highly vocal New World monkey. Xindong Song et al. tested marmosets' ability to distinguish the fundamental frequency, or pitch, of harmonic sounds with varying spectral and temporal characteristics, and found that marmosets exhibit pitch perception characteristics similar to humans with respect to the importance of lower-order harmonics as well as the sensitivity to spectral harmonicity and the relative phase between harmonics. The findings suggest that pitch perception ability may have developed early in primate evolution. See the article by Song et al. on pages 781–786. Image courtesy of Yunyan Wang (Johns Hopkins University School of Medicine, Baltimore, MD).

## From the Cover

- 781 Pitch perception in monkeys
- E368 Influenza and narcolepsy
- 485 Catalytic mechanism of hydrogen evolution
- 509 Timing of dinosaur origins
- 572 Mortality and history of obesity

## Contents

### THIS WEEK IN PNAS

- 465 In This Issue

### LETTERS (ONLINE ONLY)

- E258 **Do patterns of covariation between human pelvis shape, stature, and head size alleviate the obstetric dilemma?**  
*Simon Underdown and Stephen J. Oppenheimer*
- E259 **Reply to Underdown and Oppenheimer: Roles of selection, plasticity, and genetics in the integration of human pelvis shape and head size**  
*Barbara Fischer and Philipp Mitteroecker*
- E260 **Fetal/placental weight ratio in a mouse model of maternal diet-induced obesity**  
*Lionel Carbillon*
- E261 **Reply to Carbillon: Fetal/placental weight ratio and placental function**  
*Irving L. M. H. Aye, Fredrick J. Rosario, Theresa L. Powell, and Thomas Jansson*

### CORE CONCEPTS—A brief introduction to emerging topics in science

- 468 **Computational social science**  
*Adam Mann*

### RETROSPECTIVE

- 471 **Leo P. Kadanoff (1937–2015): An appreciation**  
*Susan N. Coppersmith*

### COMMENTARIES

- 473 **Driven to metastasize: Kinases as potential therapeutic targets in prostate cancer**  
*Felix Y. Feng and Vishal Kothari*  
→ See companion article on page E172 in issue 2 of volume 113
- 476 **H1N1 infection of sleep/wake regions results in narcolepsy-like symptoms**  
*Sarah Wurts Black and Thomas S. Kilduff*  
→ See companion article on page E368
- 478 **Ligand steals spotlight from metal to orchestrate hydrogen production**  
*Jillian L. Dempsey*  
→ See companion article on page 485

480 **Dating the origin of dinosaurs**

Hans-Dieter Sues

→ See companion article on page 509

---

**PNAS PLUS**

482 **Significance Statements**

Brief statements written by the authors about the significance of their papers.

---

**INAUGURAL ARTICLE**

485 **Nickel phlorin intermediate formed by proton-coupled electron transfer in hydrogen evolution mechanism**

Brian H. Solis, Andrew G. Maher, Dilek K. Dogutan, Daniel G. Nocera, and Sharon Hammes-Schiffer

→ See Commentary on page 478

---

**PHYSICAL SCIENCES**

**APPLIED PHYSICAL SCIENCES**

E262 **Wetting hysteresis induced by nanodefects**

 Alberto Giacomello, Lothar Schimmele, and Siegfried Dietrich

493 **How faceted liquid droplets grow tails**

Shani Guttman, Zvi Sapir, Moty Schultz, Alexander V. Butenko, Benjamin M. Ocko, Moshe Deutsch, and Eli Sloutskin

608 **One-pot system for synthesis, assembly, and display of functional single-span membrane proteins on oil-water interfaces**

Peter J. Yunker, Haruichi Asahara, Kuo-Chan Hung, Corey Landry, Laura R. Arriaga, Ilke Akartuna, John Heyman, Shaorong Chong, and David A. Weitz

**CHEMISTRY**

485 **Nickel phlorin intermediate formed by proton-coupled electron transfer in hydrogen evolution mechanism**

Brian H. Solis, Andrew G. Maher, Dilek K. Dogutan, Daniel G. Nocera, and Sharon Hammes-Schiffer

→ See Commentary on page 478

497 **Small fluorescence-activating and absorption-shifting tag for tunable protein imaging in vivo**

Marie-Aude Plamont, Emmanuelle Billon-Denis, Sylvie Maurin, Carole Gauron, Frederico M. Pimenta, Christian G. Specht, Jian Shi, Jérôme Quérard, Buyan Pan, Julien Rossignol, Nelly Morellet, Michel Volovitch, Ewen Lescop, Yong Chen, Antoine Triller, Sophie Vrız, Thomas Le Saux, Ludovic Jullien, and Arnaud Gautier

503 **On the dynamical nature of the active center in a single-site photocatalyst visualized by 4D ultrafast electron microscopy**

Byung-Kuk Yoo, Zixue Su, John Meurig Thomas, and Ahmed H. Zewail

**EARTH, ATMOSPHERIC, AND PLANETARY SCIENCES**

509 **The precise temporal calibration of dinosaur origins**

Claudia A. Marsicano, Randall B. Irmis, Adriana C. Mancuso, Roland Mundil, and Farid Chemale

→ See Commentary on page 480

514 **Evolution of South Atlantic density and chemical stratification across the last deglaciation**

Jenny Roberts, Julia Gottschalk, Luke C. Skinner, Victoria L. Peck, Sev Kender, Henry Elderfield, Claire Waelbroeck, Natalia Vázquez Riveiros, and David A. Hodell

**ENGINEERING**

520 **Modular degradable dendrimers enable small RNAs to extend survival in an aggressive liver cancer model**

Kejin Zhou, Liem H. Nguyen, Jason B. Miller, Yunfeng Yan, Petra Kos, Hu Xiong, Lin Li, Jing Hao, Jonathan T. Minnig, Hao Zhu, and Daniel J. Siegwart

**ENVIRONMENTAL SCIENCES**

526 **Observed decrease in atmospheric mercury explained by global decline in anthropogenic emissions**



Yanxu Zhang, Daniel J. Jacob, Hannah M. Horowitz, Long Chen, Helen M. Amos, David P. Krabbenhoft, Franz Slemr, Vincent L. St. Louis, and Elsie M. Sunderland

662 **Forests synchronize their growth in contrasting Eurasian regions in response to climate warming**

Tatiana A. Shestakova, Emilia Gutiérrez, Alexander V. Kirilyanov, Jesús Julio Camarero, Mar Génova, Anastasia A. Knorre, Juan Carlos Linares, Víctor Resco de Dios, Raúl Sánchez-Salguero, and Jordi Voltas

**PHYSICS**

532 **Quantum violation of the pigeonhole principle and the nature of quantum correlations**



Yakir Aharonov, Fabrizio Colombo, Sandu Popescu, Irene Sabadini, Daniele C. Struppa, and Jeff Tollaksen

536 **Nonergodic metallic and insulating phases of Josephson junction chains**

Manuel Pino, Lev B. Ioffe, and Boris L. Altshuler

542 **Properties of the shear stress peak radiated ahead of rapidly accelerating rupture fronts that mediate frictional slip**

Ilya Svetlizky, Daniel Pino Muñoz, Mathilde Radiguet, David S. Kammer, Jean-François Molinari, and Jay Fineberg

548 **Geometry-induced protein pattern formation**



Dominik Thalmeier, Jacob Halatek, and Erwin Frey

**STATISTICS**

554 **The spreading of misinformation online**



Michela Del Vicario, Alessandro Bessi, Fabiana Zollo, Fabio Petroni, Antonio Scala, Guido Caldarelli, H. Eugene Stanley, and Walter Quattrociocchi

---

**SOCIAL SCIENCES**

**PSYCHOLOGICAL AND COGNITIVE SCIENCES**

560 **Using decision pathway surveys to inform climate engineering policy choices**

Robin Gregory, Terre Satterfield, and Ariel Hasell

566 **Changing climates of conflict: A social network experiment in 56 schools**



Elizabeth Levy Paluck, Hana Shepherd, and Peter M. Aronow

**SOCIAL SCIENCES**

554 **The spreading of misinformation online**



Michela Del Vicario, Alessandro Bessi, Fabiana Zollo, Fabio Petroni, Antonio Scala, Guido Caldarelli, H. Eugene Stanley, and Walter Quattrociocchi

572 **Revealing the burden of obesity using weight histories**



Andrew Stokes and Samuel H. Preston

578 **Social relationships and physiological determinants of longevity across the human life span**



Yang Claire Yang, Courtney Boen, Karen Gerken, Ting Li, Kristen Schorpp, and Kathleen Mullan Harris

## SUSTAINABILITY SCIENCE

- 560 **Using decision pathway surveys to inform climate engineering policy choices**  
Robin Gregory, Terre Satterfield, and Ariel Hasell
- 668 **Dynamic ocean management increases the efficiency and efficacy of fisheries management**  
Daniel C. Dunn, Sara M. Maxwell, Andre M. Boustany, and Patrick N. Halpin

## BIOLOGICAL SCIENCES

## AGRICULTURAL SCIENCES

- 584 **MicroRNA-276 promotes egg-hatching synchrony by up-regulating *brm* in locusts**  
Jing He, Qianqian Chen, Yuanyuan Wei, Feng Jiang, Meiling Yang, Shuguang Hao, Xiaojiao Guo, Dahua Chen, and Le Kang

## APPLIED BIOLOGICAL SCIENCES

- 590 **Sustainable proliferation of liposomes compatible with inner RNA replication**  
Gakushi Tsuji, Satoshi Fujii, Takeshi Sunami, and Tetsuya Yomo

## BIOCHEMISTRY

- 596 **Structural basis for m7G recognition and 2'-O-methyl discrimination in capped RNAs by the innate immune receptor RIG-I**  
Swapnil C. Devarkar, Chen Wang, Matthew T. Miller, Anand Ramanathan, Fuguo Jiang, Abdul G. Khan, Smitta S. Patel, and Joseph Marcotrigiano
- 602 **Bacterial RNA polymerase can retain  $\sigma^{70}$  throughout transcription**  
Timothy T. Harden, Christopher D. Wells, Larry J. Friedman, Robert Landick, Ann Hochschild, Jane Kondev, and Jeff Gelles

## BIOPHYSICS AND COMPUTATIONAL BIOLOGY

- E272 **Structure determination of helical filaments by solid-state NMR spectroscopy**  
Lichun He, Benjamin Bardiaux, Mumdooh Ahmed, Johannes Spehr, Renate König, Heinrich Lünsdorf, Ulfert Rand, Thorsten Lühns, and Christiane Ritter
- 608 **One-pot system for synthesis, assembly, and display of functional single-span membrane proteins on oil-water interfaces**  
Peter J. Yunker, Haruichi Asahara, Kuo-Chan Hung, Corey Landry, Laura R. Arriaga, Ilke Akartuna, John Heyman, Shaorong Chong, and David A. Weitz
- 614 **Nonnative SOD1 trimer is toxic to motor neurons in a model of amyotrophic lateral sclerosis**  
Elizabeth A. Proctor, Lanette Fee, Yazhong Tao, Rachel L. Redler, James M. Fay, Yuliang Zhang, Zhengjian Lv, Ian P. Mercer, Mohanish Deshmukh, Yuri L. Lyubchenko, and Nikolay V. Dokholyan
- 620 **Redox potential of the terminal quinone electron acceptor  $Q_B$  in photosystem II reveals the mechanism of electron transfer regulation**  
Yuki Kato, Ryo Nagao, and Takumi Noguchi

## CELL BIOLOGY

- E282 **PMCA2 regulates HER2 protein kinase localization and signaling and promotes HER2-mediated breast cancer**  
Jaekwang Jeong, Joshua N. VanHouten, Pamela Dann, Wonnam Kim, Catherine Sullivan, Herbert Yu, Lance Liotta, Virginia Espina, David F. Stern, Peter A. Friedman, and John J. Wysolmerski

- E291 **Highly efficient delivery of functional cargoes by the synergistic effect of GAG binding motifs and cell-penetrating peptides**  
James E. Dixon, Gizem Osman, Gavin E. Morris, Hareklea Markides, Michael Rotherham, Zahia Bayoussef, Alicia J. El Haj, Chris Denning, and Kevin M. Shakesheff

- 497 **Small fluorescence-activating and absorption-shifting tag for tunable protein imaging in vivo**  
Marie-Aude Plamont, Emmanuelle Billon-Denis, Sylvie Maurin, Carole Gauron, Frederico M. Pimenta, Christian G. Specht, Jian Shi, Jérôme Quérard, Buyan Pan, Julien Rossignol, Nelly Morellet, Michel Volovitch, Ewen Lescop, Yong Chen, Antoine Triller, Sophie Vriza, Thomas Le Saux, Ludovic Jullien, and Arnaud Gautier

- 626 **Micronucleus formation causes perpetual unilateral chromosome inheritance in mouse embryos**  
Cayetana Vázquez-Diez, Kazuo Yamagata, Shardul Trivedi, Jenna Haverfield, and Greg FitzHarris

- 632 **Loss of the BBSome perturbs endocytic trafficking and disrupts virulence of *Trypanosoma brucei***  
Gerasimos Langousis, Michelle M. Shimogawa, Edwin A. Saada, Ajay A. Vashisht, Roberto Spreafico, Andrew R. Nager, William D. Barshop, Maxence V. Nachury, James A. Wohlschlegel, and Kent L. Hill

- 638 **SDPR functions as a metastasis suppressor in breast cancer by promoting apoptosis**  
Sait Ozturk, Panagiotis Papageorgis, Chen Khuan Wong, Arthur W. Lambert, Hamid M. Abdolmaleky, Arunthathi Thiagalingam, Herbert T. Cohen, and Sam Thiagalingam

- 644 **EGFR phosphorylates FAM129B to promote Ras activation**  
Haitao Ji, Jong-Ho Lee, Yugang Wang, Yilin Pang, Tao Zhang, Yan Xia, Lianjin Zhong, Jianxin Lyu, and Zhimin Lu

## DEVELOPMENTAL BIOLOGY

- 650 **Growth factors and medium hyperglycemia induce Sox9<sup>+</sup> ductal cell differentiation into  $\beta$  cells in mice with reversal of diabetes**  
Mingfeng Zhang, Qing Lin, Tong Qi, Tiankun Wang, Ching-Cheng Chen, Arthur D. Riggs, and Defu Zeng

- 656 **Extracardiac septum transversum/proepicardial endothelial cells pattern embryonic coronary arterio-venous connections**  
Elena Cano, Rita Carmona, Adrián Ruiz-Villalba, Anabel Rojas, You-Ying Chau, Kay D. Wagner, Nicole Wagner, Nicholas D. Hastie, Ramón Muñoz-Chápuli, and José M. Pérez-Pomares

## ECOLOGY

- 662 **Forests synchronize their growth in contrasting Eurasian regions in response to climate warming**  
Tatiana A. Shestakova, Emilia Gutiérrez, Alexander V. Kirdyanov, Jesús Julio Camarero, Mar Génova, Anastasia A. Knorre, Juan Carlos Linares, Víctor Resco de Dios, Raúl Sánchez-Salguero, and Jordi Voltas
- 668 **Dynamic ocean management increases the efficiency and efficacy of fisheries management**  
Daniel C. Dunn, Sara M. Maxwell, Andre M. Boustany, and Patrick N. Halpin
- 674 **Region effects influence local tree species diversity**  
Robert E. Ricklefs and Fangliang He
- 680 **Limited tolerance by insects to high temperatures across tropical elevational gradients and the implications of global warming for extinction**  
Carlos García-Robledo, Erin K. Kuprewicz, Charles L. Staines, Terry L. Erwin, and W. John Kress

## EVOLUTION

- E300** **A rigorous comparison of sexual selection indexes via simulations of diverse mating systems**  
Jonathan M. Henshaw, Andrew T. Kahn, and Karoline Fritzsche
- 509** **The precise temporal calibration of dinosaur origins**  
Claudia A. Marsicano, Randall B. Irmis, Adriana C. Mancuso, Roland Mundil, and Farid Chemale  
→ See Commentary on page 480
- 686** **Natural selection against a circadian clock gene mutation in mice**  
Kamiel Spoelstra, Martin Wikelski, Serge Daan, Andrew S. I. Loudon, and Michaela Hau

## GENETICS

- E309** **Sex-specific silencing of X-linked genes by Xist RNA**  
Srimonta Gayen, Emily Maclary, Michael Hinten, and Sundeep Kalantry

## IMMUNOLOGY AND INFLAMMATION

- E319** **Combination OX40 agonism/CTLA-4 blockade with HER2 vaccination reverses T-cell anergy and promotes survival in tumor-bearing mice**  
Stefanie N. Lynch, Melissa J. Kasiewicz, Michael J. McNamara, Ian F. Hilgart-Martiszus, Mohammad Farhad, and William L. Redmond
- 692** **Surface expression, peptide repertoire, and thermostability of chicken class I molecules correlate with peptide transporter specificity**  
Clive A. Tregaskes, Michael Harrison, Anna K. Sowa, Andy van Hateren, Lawrence G. Hunt, Olli Vainio, and Jim Kaufman
- 698** **Cytokine Diedel and a viral homologue suppress the IMD pathway in *Drosophila***  
Olivier Lamiable, Christine Kellenberger, Cordula Kemp, Laurent Troxler, Nadège Pelte, Michael Boutros, Joao Trindade Marques, Laurent Daeffler, Jules A. Hoffmann, Alain Roussel, and Jean-Luc Imler

## MEDICAL SCIENCES

- E328** **Autoregulatory loop of nuclear corepressor 1 expression controls invasion, tumor growth, and metastasis**  
Olaiá A. Martínez-Iglesias, Elvira Alonso-Merino, Sara Gómez-Rey, Juan Pedro Velasco-Martín, Rosa Martín Orozco, Enrique Luengo, Rosa García Martín, Inmaculada Ibáñez de Cáceres, Agustín F. Fernández, Mario F. Fraga, Pilar González-Peramato, Constantino Varona, José Palacios, Javier Regadera, and Ana Aranda
- E338** **Inhibition of Hif1 $\alpha$  prevents both trauma-induced and genetic heterotopic ossification**  
Shailesh Agarwal, Shawn Loder, Cameron Brownley, David Cholok, Laura Mangiavini, John Li, Christopher Breuler, Hsiao H. Sung, Shuli Li, Kavitha Ranganathan, Joshua Peterson, Ronald Tompkins, David Herndon, Wenzhong Xiao, Dolrudee Jumlongras, Bjorn R. Olsen, Thomas A. Davis, Yuji Mishina, Ernestina Schipani, and Benjamin Levi
- 520** **Modular degradable dendrimers enable small RNAs to extend survival in an aggressive liver cancer model**  
Kejin Zhou, Liem H. Nguyen, Jason B. Miller, Yunfeng Yan, Petra Kos, Hu Xiong, Lin Li, Jing Hao, Jonathan T. Minnig, Hao Zhu, and Daniel J. Siegart
- 572** **Revealing the burden of obesity using weight histories**  
Andrew Stokes and Samuel H. Preston
- 704** **Heparanase-neutralizing antibodies attenuate lymphoma tumor growth and metastasis**  
Marina Weissmann, Gil Arvatz, Netanel Horowitz, Sari Feld, Inna Naroditsky, Yi Zhang, Mary Ng, Edward Hammond, Eviatar Nevo, Israel Vlodavsky, and Neta Ilan

- 710** **Bioengineered yeast-derived vacuoles with enhanced tissue-penetrating ability for targeted cancer therapy**  
Vipul Gujrati, Miriam Lee, Young-Joon Ko, Sangeun Lee, Daejin Kim, Hyungjun Kim, Sukmo Kang, Soyoung Lee, Jinjoo Kim, Hyungsu Jeon, Sun Chang Kim, Youngsoo Jun, and Sangyong Jon

- 716** **Long-term clinical study and multiscale analysis of in vivo biodegradation mechanism of Mg alloy**  
Jee-Wook Lee, Hyung-Seop Han, Kyeong-Jin Han, Jimin Park, Hojeong Jeon, Myoung-Ryul Ok, Hyun-Kwang Seok, Jae-Pyoung Ahn, Kyung Eun Lee, Dong-Ho Lee, Seok-Jo Yang, Sung-Youn Cho, Pil-Ryung Cha, Hoon Kwon, Tae-Hyun Nam, Jee Hye Lo Han, Hyoung-Jin Rho, Kang-Sik Lee, Yu-Chan Kim, and Diego Mantovani

## MICROBIOLOGY

- E348** **Separable roles for *Mycobacterium tuberculosis* ESX-3 effectors in iron acquisition and virulence**  
JoAnn M. Tufariello, Jessica R. Chapman, Christopher A. Kerantzas, Ka-Wing Wong, Catherine Vilchère, Christopher M. Jones, Laura E. Cole, Emir Tinaztepe, Victor Thompson, David Fenyö, Michael Niederweis, Beatrix Ueberheide, Jennifer A. Phillips, and William R. Jacobs Jr.
- 722** **Cross-talk among flesh-eating *Aeromonas hydrophila* strains in mixed infection leading to necrotizing fasciitis**  
Durasamy Ponnusamy, Elena V. Kozlova, Jian Sha, Tatiana E. Erova, Sasha R. Azar, Eric C. Fitts, Michelle L. Kirtley, Bethany L. Tiner, Jourdan A. Andersson, Christopher J. Grim, Richard P. Isom, Nur A. Hasan, Rita R. Colwell, and Ashok K. Chopra
- 728** **Neutralizing antibody titers against dengue virus correlate with protection from symptomatic infection in a longitudinal cohort**  
Leah C. Katzelnick, Magelda Montoya, Lionel Gresh, Angel Balmaseda, and Eva Harris

## NEUROSCIENCE

- E358** **Luminopsins integrate opto- and chemogenetics by using physical and biological light sources for opsin activation**  
Ken Berglund, Kara Clissold, Haofang E. Li, Lei Wen, Sung Young Park, Jan Gleixner, Marguerita E. Klein, Dongye Lu, Joseph W. Barter, Mark A. Rossi, George J. Augustine, Henry H. Yin, and Ute Hochgeschwender
- E368** **H1N1 influenza virus induces narcolepsy-like sleep disruption and targets sleep-wake regulatory neurons in mice**  
Chiara Tesoriero, Alina Codita, Ming-Dong Zhang, Andrij Cherninsky, Håkan Karlsson, Gigliola Grassi-Zucconi, Giuseppe Bertini, Tibor Harkany, Karl Ljungberg, Peter Liljeström, Tomas G. M. Hökfelt, Marina Bentivoglio, and Krister Kristensson  
→ See Commentary on page 476
- E378** **Nonequivalent release sites govern synaptic depression**  
Hua Wen, Matthew J. McGinley, Gail Mandel, and Paul Brehm
- 734** **Opposing roles for serotonin in cholinergic neurons of the ventral and dorsal striatum**  
Michael S. Virk, Yotam Sagi, Lucian Medrihan, Jenny Leung, Michael G. Kaplitt, and Paul Greengard
- 740** **Cortical cell and neuron density estimates in one chimpanzee hemisphere**  
Christine E. Collins, Emily C. Turner, Eva Kille Sawyer, Jamie L. Reed, Nicole A. Young, David K. Flaherty, and Jon H. Kaas

- 746 Sympathetic innervation controls homeostasis of neuromuscular junctions in health and disease**  
Muzamil Majid Khan, Danilo Lustrino, William A. Silveira, Franziska Wild, Tatjana Straka, Yasmin Issop, Emily O'Connor, Dan Cox, Markus Reischl, Till Marquardt, Dittmar Labeit, Siegfried Labeit, Evelyne Benoit, Jordi Molgó, Hanns Lochmüller, Veit Witzemann, Isis C. Kettelhut, Luiz C. C. Navegantes, Tullio Pozzan, and Rüdiger Rudolf


- 751 KCC2 rescues functional deficits in human neurons derived from patients with Rett syndrome**  
Xin Tang, Julie Kim, Li Zhou, Eric Wengert, Lei Zhang, Zheng Wu, Cassiano Carromeu, Alysson R. Muotri, Maria C. N. Marchetto, Fred H. Gage, and Gong Chen

- 757 Reversal of morphine-induced cell-type-specific synaptic plasticity in the nucleus accumbens shell blocks reinstatement**  
Matthew C. Hearing, Jakub Jedynak, Stephanie R. Ebner, Anna Ingebretson, Anders J. Asp, Rachel A. Fischer, Clare Schmidt, Erin B. Larson, and Mark John Thomas


-  **763 Palmitoylation controls DLK localization, interactions and activity to ensure effective axonal injury signaling**  
Sabrina M. Holland, Kaitlin M. Collura, Andrea Ketschek, Kentaro Noma, Toby A. Ferguson, Yishi Jin, Gianluca Gallo, and Gareth M. Thomas

#### PHYSIOLOGY

- E387 Uterine ALK3 is essential during the window of implantation**  
Diana Monsivais, Caterina Clementi, Jia Peng, Mary M. Titus, James P. Barrish, Chad J. Creighton, John P. Lydon, Francesco J. DeMayo, and Martin M. Matzuk

-  **578 Social relationships and physiological determinants of longevity across the human life span**  
Yang Claire Yang, Courtney Boen, Karen Gerken, Ting Li, Kristen Schorpp, and Kathleen Mullan Harris

- 769 Activation of integrin  $\alpha 5$  mediated by flow requires its translocation to membrane lipid rafts in vascular endothelial cells**  
Xiaoli Sun, Yi Fu, Mingxia Gu, Lu Zhang, Dan Li, Hongliang Li, Shu Chien, John Y.-J. Shyy, and Yi Zhu

-  **775 Novel cystine transporter in renal proximal tubule identified as a missing partner of cystinuria-related plasma membrane protein rBAT/SLC3A1**  
Shushi Nagamori, Pattama Wiriyasermkul, Meritxell Espino Guarch, Hirohisa Okuyama, Saya Nakagomi, Kenjiro Tadagaki, Yumiko Nishinaka, Susanna Bodoy, Kazuaki Takafuji, Suguru Okuda, Junko Kurokawa, Ryuichi Ohgaki, Virginia Nunes, Manuel Palacín, and Yoshikatsu Kanai

#### PLANT BIOLOGY


- E396 Calcium-dependent oligomerization of CAR proteins at cell membrane modulates ABA signaling**  
Maira Diaz, Maria Jose Sanchez-Barrena, Juana Maria Gonzalez-Rubio, Lesia Rodriguez, Daniel Fernandez, Regina Antoni, Cristina Yunta, Borja Belda-Palazon, Miguel Gonzalez-Guzman, Marta Peirats-Llobet, Margarita Menendez, Jasminka Boskovic, Jose A. Marquez, Pedro L. Rodriguez, and Armando Albert

#### PSYCHOLOGICAL AND COGNITIVE SCIENCES

-  **781 Complex pitch perception mechanisms are shared by humans and a New World monkey**  
Xindong Song (宋欣东), Michael S. Osmanski, Yueqi Guo, and Xiaoqin Wang

- 787 Mice plan decision strategies based on previously learned time intervals, locations, and probabilities**  
Tuğçe Tosun, Ezgi Gür, and Fuat Balci

#### SUSTAINABILITY SCIENCE

-  **793 Ecosystem heterogeneity determines the ecological resilience of the Amazon to climate change**  
Naomi M. Levine, Ke Zhang, Marcos Longo, Alessandro Baccini, Oliver L. Phillips, Simon L. Lewis, Esteban Alvarez-Dávila, Ana Cristina Segalin de Andrade, Roel J. W. Brienen, Terry L. Erwin, Ted R. Feldpausch, Abel Lorenzo Monteagudo Mendoza, Percy Nuñez Vargas, Adriana Prieto, Javier Eduardo Silva-Espejo, Yadvinder Malhi, and Paul R. Moorcroft

---

#### CORRECTION (ONLINE ONLY)

##### ENGINEERING

- E406 Ultrasensitive gas detection of large-area borondoped graphene**  
Ruitao Lv, Gugang Chen, Qing Li, Amber McCreary, Andrés Botello-Méndez, S. V. Morozov, Liangbo Liang, Xavier Declerck, Nestor Perea-López, David A. Cullen, Simin Feng, Ana Laura Elías, Rodolfo Cruz-Silva, Kazunori Fujisawa, Morinobu Endo, Feiyu Kang, Jean-Christophe Charlier, Vincent Meunier, Minghu Pan, Avetik R. Harutyunyan, Konstantin S. Novoselov, and Mauricio Terrones

- ix Subscription Form**