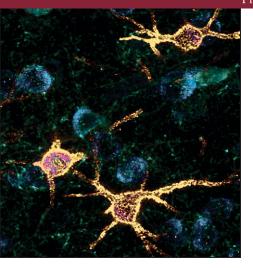


Proceedings of the National Academy of Sciences of the United States of America



Cover image: Pictured is an immunofluorescence image of sensorimotor cortex from an adult male Long-Evans rat, showing perineuronal nets (yellow) wrapped around parvalbumin (PV)+ interneurons (green); the nets protect the interneurons from oxidative stress (blue). Such PV+ networks drive critical periods of brain development. The Biological Embedding Across Timescales Special Feature explores the role of time and timing in the gene-environment interplay that governs biological embedding of experience, a process by which early life experiences can exert lifelong effects on behavior and health. See the Introduction to the Special Feature by W. Thomas Boyce, Marla B. Sokolowski, and Gene E. Robinson on pages 23235-23241. Image credit: Takao K. Hensch and Hing Cheong Lee (Boston Children's Hospital, Boston, MA).

From the Cover

23235 Timing of gene-environment interactions

23450 Cuttlebone microstructure and properties

23490 Data access and diversity of research

23942 Preventing microgravity-induced muscle and bone loss

Contents

THIS WEEK IN PNAS—This week's research highlights

23195 In This Issue

RETROSPECTIVE

23199 Robert May, 1936-2020: A man for all disciplines

Alison Galvani, Alan Hastings, Simon A. Levin, and Burton H. Singer

COMMENTARIES

23202 Paranthropus through the looking glass

Bernard A. Wood and David B. Patterson

→ See companion articles on pages 21921 and 21978 in issue 36 of volume 117

23205 Insights into the future of soil erosion

Timothy A. Quine and Kristof Van Oost

→ See companion article on page 21994 in issue 36 of volume 117

23208 Rethinking climate context dependencies in biological terms Jonathan Lenoir

→ See companion article on page 22858 in issue 37 of volume 117

PERSPECTIVE

23211 The pervasive threat of lead (Pb) in drinking water: Unmasking and pursuing scientific factors that govern lead release

Raymond J. Santucci Jr and John R. Scully

LETTERS

- 23219 Low-carbon transition is improbable without carbon pricing Jeroen van den Bergh and Wouter Botzen
- 23221 Reply to van den Bergh and Botzen: A clash of paradigms over the role of carbon pricing
 - Daniel Rosenbloom, Jochen Markard, Frank W. Geels, and Lea Fuenfschilling
- 23223 Breathing, voice, and synchronized movement Andrea Ravignani and Sonja A. Kotz
- 23225 Reply to Ravignani and Kotz: Physical impulses from upper-limb movements impact the respiratory-vocal system

Wim Pouw, Alexandra Paxton, Steven J. Harrison, and James A. Dixon

INAUGURAL ARTICLE

23227 Global potential, topology, and pattern selection in a noisy stabilized Kuramoto–Sivashinsky equation

Yong-Cong Chen, Chunxiao Shi, J. M. Kosterlitz, Xiaomei Zhu, and Ping Ao

BIOLOGICAL EMBEDDING ACROSS TIMESCALES SPECIAL FEATURE

INTRODUCTION

23235 Genes and environments, development and time W. Thomas Boyce, Marla B. Sokolowski, and Gene F. Robinson

PERSPECTIVES

23242 Critical period regulation across multiple timescales
Rebecca K. Reh, Brian G. Dias, Charles A. Nelson III, Daniela
Kaufer, Janet F. Werker, Bryan Kolb, Joel D. Levine,
and Takao K. Hensch

23252 The role of the genome in experience-dependent plasticity: Extending the analogy of the genomic action potential

David F. Clayton, Ina Anreiter, Maria Aristizabal, Paul W. Frankland, Elisabeth B. Binder, and Ami Citri

23261 Biological embedding of experience: A primer on epigenetics

Maria J. Aristizabal, Ina Anreiter, Thorhildur Halldorsdottir, Candice L. Odgers, Thomas W. McDade, Anna Goldenberg, Sara Mostafavi, Michael S. Kobor, Elisabeth B. Binder, Marla B. Sokolowski, and Kieran J. O'Donnell

23270 Behavior-related gene regulatory networks: A new level of organization in the brain

Saurabh Sinha, Beryl M. Jones, Ian M. Traniello, Syed A. Bukhari, Marc S. Halfon, Hans A. Hofmann, Sui Huang, Paul S. Katz, Jason Keagy, Vincent J. Lynch, Marla B. Sokolowski, Lisa J. Stubbs, Shayan Tabe-Bordbar, Mariana F. Wolfner, and Gene E. Robinson

RESEARCH ARTICLES

23280 Glucocorticoid exposure during hippocampal neurogenesis primes future stress response by inducing changes in DNA methylation

Nadine Provençal, Janine Arloth, Annamaria Cattaneo, Christoph Anacker, Nadia Cattane, Tobias Wiechmann, Simone Röh, Maik Ködel, Torsten Klengel, Darina Czamara, Nikola S. Müller, Jari Lahti, PREDO team, Katri Räikkönen, Carmine M. Pariante, and Elisabeth B. Binder

23286 Drosophila melanogaster foraging regulates a nociceptive-like escape behavior through a developmentally plastic sensory circuit Jeffrey S. Dason, Amanda Cheung, Ina Anreiter, Vanessa A.

Montemurri, Aaron M. Allen, and Marla B. Sokolowski

23292 Idiosyncratic neural coding and neuromodulation of olfactory individuality in *Drosophila*

Kyle S. Honegger, Matthew A.-Y. Smith, Matthew A. Churgin, Glenn C. Turner, and Benjamin L. de Bivort

23298 Deep learning of spontaneous arousal fluctuations detects early cholinergic defects across neurodevelopmental mouse models and patients Pietro Artoni, Arianna Piffer, Viviana Vinci, Jocelyn LeBlanc, Charles A. Nelson, Takao K. Hensch, and Michela Fagiolini

23304 Subregion-specific rules govern the distribution of neuronal immediate-early gene induction

Ben Jerry Gonzales, Diptendu Mukherjee, Reut Ashwal-Fluss, Yonatan Loewenstein, and Ami Citri 23311 Acute social isolation alters neurogenomic state in songbird forebrain

Julia M. George, Zachary W. Bell, Daniel Condliffe, Kirstin Dohrer, Teresa Abaurrea, Karen Spencer, Albertine Leitão, Manfred Gahr, Paul J. Hurd, and David F. Clayton

23317 Social history and exposure to pathogen signals modulate social status effects on gene regulation in rhesus macaques

Joaquín Sanz, Paul L. Maurizio, Noah Snyder-Mackler, Noah D. Simons, Tawni Voyles, Jordan Kohn, Vasiliki Michopoulos, Mark Wilson, Jenny Tung, and Luis B. Barreiro

23323 Adolescents' perceptions of family social status correlate with health and life chances: A twin difference longitudinal cohort study

Joshua Rivenbark, Louise Arseneault, Avshalom Caspi, Andrea Danese, Helen L. Fisher, Terrie E. Moffitt, Line J. H. Rasmussen, Michael A. Russell, and Candice L. Odgers

23329 The PedBE clock accurately estimates DNA methylation age in pediatric buccal cells

Lisa M. McEwen, Kieran J. O'Donnell, Megan G. McGill, Rachel D. Edgar, Meaghan J. Jones, Julia L. MacIsaac, David Tse Shen Lin, Katia Ramadori, Alexander Morin, Nicole Gladish, Elika Garg, Eva Unternaehrer, Irina Pokhvisneva, Neerja Karnani, Michelle Z. L. Kee, Torsten Klengel, Nancy E. Adler, Ronald G. Barr, Nicole Letourneau, Gerald F. Giesbrecht, James N. Reynolds, Darina Czamara, Jeffrey M. Armstrong, Marilyn J. Essex, Carolina de Weerth, Roseriet Beijers, Marieke S. Tollenaar, Bekh Bradley, Tanja Jovanovic, Kerry J. Ressler, Meir Steiner, Sonja Entringer, Pathik D. Wadhwa, Claudia Buss, Nicole R. Bush, Elisabeth B. Binder, W. Thomas Boyce, Michael J. Meaney, Steve Horvath, and Michael S. Kobor

BRIEF REPORT

23336

CSF1R inhibition by a small-molecule inhibitor is not microglia specific; affecting hematopoiesis and the function of macrophages

Fengyang Lei, Naiwen Cui, Chengxin Zhou, James Chodosh, Demetrios G. Vavvas (Δημήτριος Γ . Βάββας), and Eleftherios I. Paschalis (Ελευθεριος Πασχάλης Ήλιος)

PHYSICAL SCIENCES

APPLIED PHYSICAL SCIENCES

23339 Ultra-sharp pinnacles sculpted by natural convective dissolution

Jinzi Mac Huang, Joshua Tong, Michael Shelley, and Leif Ristroph

23345 The limitations of extending nature's color palette in correlated, disordered systems

Gianni Jacucci, Silvia Vignolini, and Lukas Schertel

23350 Thermoelectric response from grain boundaries and lattice distortions in crystalline gold devices

Charlotte I. Evans, Rui Yang, Lucia T. Gan, Mahdiyeh Abbasi, Xifan Wang, Rachel Traylor, Jonathan A. Fan, and Douglas Natelson

BIOPHYSICS AND COMPUTATIONAL BIOLOGY

23356 Properties of protein unfolded states suggest broad selection for expanded conformational ensembles

Micayla A. Bowman, Joshua A. Riback, Anabel Rodriguez,

Micayla A. Bowman, Joshua A. Riback, Anabel Rodriguez, Hongyu Guo, Jun Li, Tobin R. Sosnick, and Patricia L. Clark

23365 Scaling relationships for the elastic moduli and viscosity of mixed lipid membranes

Elizabeth G. Kelley, Paul D. Butler, Rana Ashkar, Robert Bradbury, and Michihiro Nagao

CHEMISTRY

23374 Direct functionalization of C-H bonds by electrophilic anions

Jonas Warneke, Martin Mayer, Markus Rohdenburg, Xin Ma, Judy K. Y. Liu, Max Grellmann, Sreekanta Debnath, Vladimir A. Azov, Edoardo Apra, Robert P. Young, Carsten Jenne, Grant E. Johnson, Hilkka I. Kenttämaa, Knut R. Asmis, and Julia Laskin

23380 Ultranarrow plasmon resonances from annealed nanoparticle lattices

Shikai Deng, Ran Li, Jeong-Eun Park, Jun Guan, Priscilla Choo, Jingtian Hu, Paul J. M. Smeets, and Teri W. Odom

23385 Spatially dependent H-bond dynamics at interfaces of water/biomimetic self-assembled lattice materials

Haoyuan Wang, Jackson C. Wagner, Wenfan Chen, Chenglai Wang, and Wei Xiong

COMPUTER SCIENCES

23393 Stacking models for nearly optimal link prediction in complex networks

Amir Ghasemian, Homa Hosseinmardi, Aram Galstyan, Edoardo M. Airoldi, and Aaron Clauset

EARTH, ATMOSPHERIC, AND PLANETARY SCIENCES

23401 Polar amplification of Pliocene climate by elevated trace gas radiative forcing

Peter O. Hopcroft, Gilles Ramstein, Thomas A. M. Pugh, Stephen J. Hunter, Fabiola Murguia-Flores, Aurélien Quiquet, Yong Sun, Ning Tan, and Paul J. Valdes

23408 Timing and structure of the Younger Dryas event and its underlying climate dynamics

Hai Cheng, Haiwei Zhang, Christoph Spötl, Jonathan Baker, Ashish Sinha, Hanying Li, Miguel Bartolomé, Ana Moreno, Gayatri Kathayat, Jingyao Zhao, Xiyu Dong, Youwei Li, Youfeng Ning, Xue Jia, Baoyun Zong, Yassine Ait Brahim, Carlos Pérez-Mejias, Yanjun Cai, Valdir F. Novello, Francisco W. Cruz, Jeffrey P. Severinghaus, Zhisheng An, and R. Lawrence Edwards

23418 The Cl isotope composition and halogen contents of Apollo-return samples

Anthony Gargano, Zachary Sharp, Charles Shearer, Justin I. Simon, Alex Halliday, and Wayne Buckley

23426 Chondrules reveal large-scale outward transport of inner Solar System materials in the protoplanetary disk

Curtis D. Williams, Matthew E. Sanborn, Céline Defouilloy, Qing-Zhu Yin, Noriko T. Kita, Denton S. Ebel, Akane Yamakawa, and Katsuyuki Yamashita

ENGINEERING

23436 Liquid harvesting and transport on multiscaled curvatures

Chuxin Li, Cunlong Yu, Shan Zhou, Zhichao Dong, and Lei Jiang

23443 Direct characterization of solute transport in unsaturated porous media using fast X-ray synchrotron microtomography

Sharul Hasan, Vahid Niasar, Nikolaos K. Karadimitriou, Jose R. A. Godinho, Nghia T. Vo, Senyou An, Arash Rabbani, and Holger Steeb

23450 Mechanical design of the highly porous cuttlebone: A bioceramic hard buoyancy tank for cuttlefish

Ting Yang, Zian Jia, Hongshun Chen, Zhifei Deng, Wenkun Liu, Liuni Chen, and Ling Li

MATHEMATICS

23460 The mysterious story of square ice, piles of cubes, and bijections

Ilse Fischer and Matjaž Konvalinka

PHYSICS

23227 Global potential, topology, and pattern selection in a noisy stabilized Kuramoto-Sivashinsky equation Yong-Cong Chen, Chunxiao Shi, J. M. Kosterlitz, Xiaomei Zhu,

23467 Evolution of the Kondo lattice electronic structure above the transport coherence temperature

Sooyoung Jang, J. D. Denlinger, J. W. Allen, V. S. Zapf, M. B. Maple, Jae Nyeong Kim, Bo Gyu Jang, and Ji Hoon Shim

SOCIAL SCIENCES

ANTHROPOLOGY

23317 Social history and exposure to pathogen signals modulate social status effects on gene regulation in rhesus macaques

Joaquín Sanz, Paul L. Maurizio, Noah Snyder-Mackler, Noah D. Simons, Tawni Voyles, Jordan Kohn, Vasiliki Michopoulos, Mark Wilson, Jenny Tung, and Luis B. Barreiro

PSYCHOLOGICAL AND COGNITIVE SCIENCES

23323 Adolescents' perceptions of family social status correlate with health and life chances: A twin difference longitudinal cohort study

Joshua Rivenbark, Louise Arseneault, Avshalom Caspi, Andrea Danese, Helen L. Fisher, Terrie E. Moffitt, Line J. H. Rasmussen, Michael A. Russell, and Candice L. Odgers

23477 The neural basis of language development: Changes in lateralization over age

Olumide A. Olulade, Anna Seydell-Greenwald, Catherine E. Chambers, Peter E. Turkeltaub, Alexander W. Dromerick, Madison M. Berl, William D. Gaillard, and Elissa L. Newport

SOCIAL SCIENCES

23484 Local exposure to school shootings and youth antidepressant use

Maya Rossin-Slater, Molly Schnell, Hannes Schwandt, Sam Trejo, and Lindsey Uniat

23490 Improving data access democratizes and diversifies science

Abhishek Nagaraj, Esther Shears, and Mathijs de Vaan

BIOLOGICAL SCIENCES

AGRICULTURAL SCIENCES

23499 Molecular regulation of ZmMs7 required for maize male fertility and development of a dominant male-sterility system in multiple species

Xueli An, Biao Ma, Meijuan Duan, Zhenying Dong, Ruogu Liu, Dingyang Yuan, Quancan Hou, Suowei Wu, Danfeng Zhang, Dongcheng Liu, Dong Yu, Yuwen Zhang, Ke Xie, Taotao Zhu, Ziwen Li, Simiao Zhang, Youhui Tian, Chang Liu, Jinping Li, Longping Yuan, and Xiangyuan Wan

APPLIED BIOLOGICAL SCIENCES

23393 Stacking models for nearly optimal link prediction in complex networks

Amir Ghasemian, Homa Hosseinmardi, Aram Galstyan, Edoardo M. Airoldi, and Aaron Clauset

23436 Liquid harvesting and transport on multiscaled curvatures

Chuxin Li, Cunlong Yu, Shan Zhou, Zhichao Dong, and Lei Jiang

BIOCHEMISTRY

23356 Properties of protein unfolded states suggest broad selection for expanded conformational ensembles Micayla A. Bowman, Joshua A. Riback, Anabel Rodriguez, Hongyu Guo, Jun Li, Tobin R. Sosnick, and Patricia L. Clark

23510 Dynamic structural order of a low-complexity domain facilitates assembly of intermediate filaments

Vasiliy O. Sysoev, Masato Kato, Lillian Sutherland, Rong Hu, Steven L. McKnight, and Dylan T. Murray

23519 Structure of the dimeric ATP synthase from bovine mitochondria

Tobias E. Spikes, Martin G. Montgomery, and John E. Walker

23527 Clathrin light chain diversity regulates membrane deformation in vitro and synaptic vesicle formation in vivo

Lisa Redlingshöfer, Faye McLeod, Yu Chen, Marine D. Camus, Jemima J. Burden, Ernest Palomer, Kit Briant, Philip N. Dannhauser, Patricia C. Salinas, and Frances M. Brodsky

23539 Records of RNA locations in living yeast revealed through covalent marks

Hugo C. Medina-Munoz, Christopher P. Lapointe, Douglas F. Porter, and Marvin Wickens

23548 The roles of SDHAF2 and dicarboxylate in covalent flavinylation of SDHA, the human complex II flavoprotein

Pankaj Sharma, Elena Maklashina, Gary Cecchini, and T. M. Iverson

23557 A kinetic rationale for functional redundancy in fatty acid biosynthesis

Alex Ruppe, Kathryn Mains, and Jerome M. Fox

23565 CydDC functions as a cytoplasmic cystine reductase to sensitize *Escherichia coli* to oxidative stress and aminoglycosides

Alexander Mironov, Tatyana Seregina, Konstantin Shatalin, Maxim Nagornykh, Rustem Shakulov, and Evgeny Nudler

23571 Structure of the human clamp loader reveals an autoinhibited conformation of a substrate-bound AAA+ switch

Christl Gaubitz, Xingchen Liu, Joseph Magrino, Nicholas P. Stone, Jacob Landeck, Mark Hedglin, and Brian A. Kelch

23581 Hemolymph protease-5 links the melanization and Toll immune pathways in the tobacco hornworm, Manduca sexta

Yang Wang, Fan Yang, Xiaolong Cao, Zhen Zou, Zhiqiang Lu, Michael R. Kanost, and Haobo Jiang

23588 TRIM28 functions as the SUMO E3 ligase for PCNA in prevention of transcription induced DNA breaks

Min Li, Xiaohua Xu, Chou-Wei Chang, and Yilun Liu

23597 HDAC3 deacetylates the DNA mismatch repair factor MutSβ to stimulate triplet repeat expansions

Gregory M. Williams, Vasileios Paschalis, Janice Ortega, Frederick W. Muskett, James T. Hodgkinson, Guo-Min Li, John W. R. Schwabe, and Robert S. Lahue

BIOPHYSICS AND COMPUTATIONAL BIOLOGY

23606 Hidden dynamic signatures drive substrate selectivity in the disordered phosphoproteome

Min-Hyung Cho, James O. Wrabl, James Taylor, and Vincent J. Hilser

CELL BIOLOGY

23617 Decanoic acid inhibits mTORC1 activity independent of glucose and insulin signaling

Eleanor C. Warren, Stephanie Dooves, Eleonora Lugarà, Joseph Damstra-Oddy, Judith Schaf, Vivi M. Heine, Mathew C. Walker, and Robin S. B. Williams

DEVELOPMENTAL BIOLOGY

23626 CHD7 and Runx1 interaction provides a braking mechanism for hematopoietic differentiation

Jingmei Hsu, Hsuan-Ting Huang, Chung-Tsai Lee, Avik Choudhuri, Nicola K. Wilson, Brian J. Abraham, Victoria Moignard, Iwo Kucinski, Shuqian Yu, R. Katherine Hyde, Joanna Tober, Xiongwei Cai, Yan Li, Yalin Guo, Song Yang, Michael Superdock, Eirini Trompouki, Fernando J. Calero-Nieto, Alireza Ghamari, Jing Jiang, Peng Gao, Long Gao, Vy Nguyen, Anne L. Robertson, Ellen M. Durand, Katie L. Kathrein, Iannis Aifantis, Scott A. Gerber, Wei Tong, Kai Tan, Alan B. Cantor, Yi Zhou, P. Paul Liu, Richard A. Young, Berthold Göttgens, Nancy A. Speck, and Leonard I. Zon

FCOLOGY

23636 Strong spatial embedding of social networks generates nonstandard epidemic dynamics independent of degree distribution and clustering

David J. Haw, Rachael Pung, Jonathan M. Read, and Steven Riley

23643 Most invasive species largely conserve their climatic niche

Chunlong Liu, Christian Wolter, Weiwei Xian, and Jonathan M. Jeschke

EVOLUTION

23652 A SARS-CoV-2 vaccine candidate would likely match all currently circulating variants

Bethany Dearlove, Eric Lewitus, Hongjun Bai, Yifan Li, Daniel B. Reeves, M. Gordon Joyce, Paul T. Scott, Mihret F. Amare, Sandhya Vasan, Nelson L. Michael, Kayvon Modjarrad, and Morgane Rolland

GENETICS

23663 p53 drives a transcriptional program that elicits a non-cell-autonomous response and alters cell state in vivo

> Sydney M. Moyer, Amanda R. Wasylishen, Yuan Qi, Natalie Fowlkes, Xiaoping Su, and Guillermina Lozano

IMMUNOLOGY AND INFLAMMATION

23674 Circulation of gut-preactivated naïve CD8⁺ T cells enhances antitumor immunity in B cell-defective mice

Maryam Akrami, Rosemary Menzies, Kenji Chamoto, Michio Miyajima, Ryuji Suzuki, Hiroyuki Sato, Akiko Nishii, Michio Tomura, Sidonia Fagarasan, and Tasuku Honjo

23684 A bilateral tumor model identifies transcriptional programs associated with patient response to immune checkpoint blockade

Ivy X. Chen, Kathleen Newcomer, Kristen E. Pauken, Vikram R. Juneja, Kamila Naxerova, Michelle W. Wu, Matthias Pinter, Debattama R. Sen, Meromit Singer, Arlene H. Sharpe, and Rakesh K. Jain

23695 LncRNA *Malat1* inhibition of TDP43 cleavage suppresses IRF3-initiated antiviral innate immunity

Wei Liu, Ziqiao Wang, Lun Liu, Zongheng Yang, Shuo Liu, Zhongfei Ma, Yin Liu, Yuanwu Ma, Lianfeng Zhang, Xuan Zhang, Minghong Jiang, and Xuetao Cao

23707 Ubiquitination of TLR3 by TRIM3 signals its ESCRTmediated trafficking to the endolysosomes for innate antiviral response

> Wei-Wei Li, Ying Nie, Yan Yang, Yong Ran, Wei-Wei Luo, Mei-Guang Xiong, Su-Yun Wang, Zhi-Sheng Xu, and Yan-Yi Wang

vi | www.pnas.org

17 Synaptic secretion from human natural killer cells is diverse and includes supramolecular attack particles Ashley R. Ambrose, Khodor S. Hazime, Jonathan D. Worboys, Olatz Niembro-Vivanco, and Daniel M. Davis

23721 Radiation induces dynamic changes to the T cell repertoire in renal cell carcinoma patients

Jacky Chow, Nicholas C. Hoffend, Scott I. Abrams, Thomas Schwaab, Anurag K. Singh, and Jason B. Muhitch

23730 Plasmacytoid dendritic cells cross-prime naive CD8 T cells by transferring antigen to conventional dendritic cells through exosomes

Chunmei Fu, Peng Peng, Jakob Loschko, Li Feng, Phuong Pham, Weiguo Cui, Kelvin P. Lee, Anne B. Krug, and Aimin Jiang

Ataxin-1 regulates B cell function and the severity of autoimmune experimental encephalomyelitis

Alessandro Didonna, Ester Canto Puig, Qin Ma, Atsuko Matsunaga, Brenda Ho, Stacy J. Caillier, Hengameh Shams, Nicholas Lee, Stephen L. Hauser, Qiumin Tan (谭秋敏), Scott S. Zamvil, and Jorge R. Oksenberg

23751 Perinatal androgens organize sex differences in mast cells and attenuate anaphylaxis severity into adulthood Emily Mackey, Kyan M. Thelen, Vedrana Bali, Mahsa Fardisi, Madalyn Trowbridge, Cynthia L. Jordan, and Adam J. Moeser

MEDICAL SCIENCES

23329 The PedBE clock accurately estimates DNA methylation age in pediatric buccal cells

Lisa M. McEwen, Kieran J. O'Donnell, Megan G. McGill, Rachel D. Edgar, Meaghan J. Jones, Julia L. MacIsaac, David Tse Shen Lin, Katia Ramadori, Alexander Morin, Nicole Gladish, Elika Garg, Eva Unternaehrer, Irina Pokhvisneva, Neerja Karnani, Michelle Z. L. Kee, Torsten Klengel, Nancy E. Adler, Ronald G. Barr, Nicole Letourneau, Gerald F. Giesbrecht, James N. Reynolds, Darina Czamara, Jeffrey M. Armstrong, Marilyn J. Essex, Carolina de Weerth, Roseriet Beijers, Marieke S. Tollenaar, Bekh Bradley, Tanja Jovanovic, Kerry J. Ressler, Meir Steiner, Sonja Entringer, Pathik D. Wadhwa, Claudia Buss, Nicole R. Bush, Elisabeth B. Binder, W. Thomas Boyce, Michael J. Meaney, Steve Horvath, and Michael S. Kobor

MICROBIOLOGY

23762 Molecular insights into the genome dynamics and interactions between core and acquired genomes of Vibrio cholerae

Archana Pant, Satyabrata Bag, Bipasa Saha, Jyoti Verma, Pawan Kumar, Sayantan Banerjee, Bhoj Kumar, Yashwant Kumar, Anbumani Desigamani, Suhrid Maiti, Tushar K. Maiti, Sanjay K. Banerjee, Rupak K. Bhadra, Hemanta Koley, Shanta Dutta, G. Balakrish Nair, Thandavarayan Ramamurthy, and Bhabatosh Das

23774 Secondary structure of the mRNA encoding listeriolysin O is essential to establish the replicative niche of *L. monocytogenes*

Bret N. Peterson, Jonathan L. Portman, Ying Feng, Jeffrey Wang, and Daniel A. Portnoy

23782 Human norovirus exhibits strain-specific sensitivity to host interferon pathways in human intestinal enteroids

Shih-Ching Lin, Lin Qu, Khalil Ettayebi, Sue E. Crawford, Sarah E. Blutt, Matthew J. Robertson, Xi-Lei Zeng, Victoria R. Tenge, B. Vijayalakshmi Ayyar, Umesh C. Karandikar, Xiaomin Yu, Cristian Coarfa, Robert L. Atmar, Sasirekha Ramani, and Mary K. Estes

23794 The primary step of biotin synthesis in mycobacteria
Zhe Hu and John E. Cronan

23802 Helper bacteria halt and disarm mushroom pathogens by linearizing structurally diverse cyclolipopeptides

Ron Hermenau, Susann Kugel, Anna J. Komor, and Christian Hertweck

23807 Dynamic PB2-E627K substitution of influenza H7N9 virus indicates the in vivo genetic tuning and rapid host adaptation

William J. Liu, Jun Li, Rongrong Zou, Jingcao Pan, Tao Jin, Liqiang Li, Peipei Liu, Yingze Zhao, Xinfen Yu, Haoqiu Wang, Guang Liu, Hui Jiang, Yuhai Bi, Lei Liu, Kwok-Yung Yuen, Yingxia Liu, and George F. Gao

23815 Highly infectious prions are not directly neurotoxic Iryna Benilova, Madeleine Reilly, Cassandra Terry, Adam Wenborn, Christian Schmidt, Aline T. Marinho, Emmanuel Risse, Huda Al-Doujaily, Michael Wiggins De Oliveira, Malin K. Sandberg, Jonathan D. F. Wadsworth, Parmjit S. Jat, and John Collinge

23823 Lifestyle adaptations of *Rhizobium* from rhizosphere to symbiosis

Rachel M. Wheatley, Brandon L. Ford, Li Li, Samuel T. N. Aroney, Hayley E. Knights, Raphael Ledermann, Alison K. East, Vinoy K. Ramachandran, and Philip S. Poole

23835 Concanamycin A counteracts HIV-1 Nef to enhance immune clearance of infected primary cells by cytotoxic T lymphocytes

Mark M. Painter, Gretchen E. Zimmerman, Madeline S. Merlino, Andrew W. Robertson, Valeri H. Terry, Xuefeng Ren, Megan R. McLeod, Lyanne Gomez-Rodriguez, Kirsten A. Garcia, Jolie A. Leonard, Kay E. Leopold, Andrew J. Neevel, Jay Lubow, Eli Olson, Alicja Piechocka-Trocha, David R. Collins, Ashootosh Tripathi, Malini Raghavan, Bruce D. Walker, James H. Hurley, David H. Sherman, and Kathleen L. Collins

23847 Coregulation of dimorphism and symbiosis by cyclic AMP signaling in the lichenized fungus Umbilicaria muhlenbergii

Yanyan Wang, Xinli Wei, Zhuyun Bian, Jiangchun Wei, and Jin-Rong Xu

23859 The small GTPase MgIA together with the TPR domain protein SgmX stimulates type IV pili formation in *M. xanthus*

Anna Potapova, Luís Antonío Menezes Carreira, and Lotte Søgaard-Andersen

23869 Neural progenitor cell pyroptosis contributes to Zika virus-induced brain atrophy and represents a therapeutic target

Zhenjian He, Shu An, Jiahui Chen, Shuqing Zhang, Chahui Tan, Jianchen Yu, Hengming Ye, Yun Wu, Jie Yuan, Jueheng Wu, Xun Zhu, and Mengfeng Li

23879 A conserved subcomplex within the bacterial cytokinetic ring activates cell wall synthesis by the FtsW-FtsI synthase

Lindsey S. Marmont and Thomas G. Bernhardt

NEUROSCIENCE

23280 Glucocorticoid exposure during hippocampal neurogenesis primes future stress response by inducing changes in DNA methylation

Nadine Provençal, Janine Arloth, Annamaria Cattaneo, Christoph Anacker, Nadia Cattane, Tobias Wiechmann, Simone Röh, Maik Ködel, Torsten Klengel, Darina Czamara, Nikola S. Müller, Jari Lahti, PREDO team, Katri Räikkönen, Carmine M. Pariante, and Elisabeth B. Binder

23286 Drosophila melanogaster foraging regulates a nociceptive-like escape behavior through a developmentally plastic sensory circuit

Jeffrey S. Dason, Amanda Cheung, Ina Anreiter, Vanessa A. Montemurri, Aaron M. Allen, and Marla B. Sokolowski

23292 Idiosyncratic neural coding and neuromodulation of olfactory individuality in *Drosophila*

Kyle S. Honegger, Matthew A.-Y. Smith, Matthew A. Churgin, Glenn C. Turner, and Benjamin L. de Bivort

23298 Deep learning of spontaneous arousal fluctuations detects early cholinergic defects across neurodevelopmental mouse models and patients Pietro Artoni, Arianna Piffer, Viviana Vinci, Jocelyn LeBlanc,

Pietro Artoni, Arianna Piffer, Viviana Vinci, Jocelyn LeBlanc, Charles A. Nelson, Takao K. Hensch, and Michela Fagiolini

23304 Subregion-specific rules govern the distribution of neuronal immediate-early gene induction

Ben Jerry Gonzales, Diptendu Mukherjee, Reut Ashwal-Fluss, Yonatan Loewenstein, and Ami Citri

23311 Acute social isolation alters neurogenomic state in songbird forebrain

Julia M. George, Zachary W. Bell, Daniel Condliffe, Kirstin Dohrer, Teresa Abaurrea, Karen Spencer, Albertine Leitão, Manfred Gahr, Paul J. Hurd, and David F. Clayton

23477 The neural basis of language development: Changes in lateralization over age

Olumide A. Olulade, Anna Seydell-Greenwald, Catherine E. Chambers, Peter E. Turkeltaub, Alexander W. Dromerick, Madison M. Berl, William D. Gaillard, and Elissa L. Newport

23886 Spatiotemporal dissociation of fMRI activity in the caudate nucleus underlies human de novo motor skill learning

Yera Choi, Emily Yunha Shin, and Sungshin Kim

23898 Rapid hippocampal plasticity supports motor sequence learning

Florencia Jacobacci, Jorge L. Armony, Abraham Yeffal, Gonzalo Lerner, Edson Amaro Jr, Jorge Jovicich, Julien Doyon, and Valeria Della-Maggiore

23904 The emergence of a functionally flexible brain during early infancy

Weiyan Yin, Tengfei Li, Sheng-Che Hung, Han Zhang, Li Wang, Dinggang Shen, Hongtu Zhu, Peter J. Mucha, Jessica R. Cohen, and Weili Lin

23914 Interplay between cell-adhesion molecules governs synaptic wiring of cone photoreceptors

Yan Cao, Yuchen Wang, Henry A. Dunn, Cesare Orlandi, Nicole Shultz, Naomi Kamasawa, David Fitzpatrick, Wei Li, Christina Zeitz, William Hauswirth, and Kirill A. Martemyanov

23925 Medin aggregation causes cerebrovascular dysfunction in aging wild-type mice

Karoline Degenhardt, Jessica Wagner, Angelos Skodras, Michael Candlish, Anna Julia Koppelmann, Katleen Wild, Rusheka Maxwell, Carola Rotermund, Felix von Zweydorf, Christian Johannes Gloeckner, Hannah A. Davies, Jillian Madine, Domenico Del Turco, Regina Feederle, Tammaryn Lashley, Thomas Deller, Philipp Kahle, Jasmin K. Hefendehl, Mathias Jucker, and Jonas J. Neher

PHYSIOLOGY

23932 Dynamic changes in DICER levels in adipose tissue control metabolic adaptations to exercise

Bruna B. Brandão, Søren Madsen, Atefeh Rabiee, Matteo Oliverio, Gabriel P. Ruiz, Danilo L. Ferrucci, Jéssica L. Branquinho, Daniela Razolli, Silas Pinto, Thomas S. Nielsen, William T. Festuccia, Adriano S. Martins, Beatriz A. Guerra, Thiago L. Knittel, Ditte Søgaard, Steen Larsen, Jørn W. Helge, Josef Brandauer, Lício A. Velloso, Brice Emanuelli, Jan-Wilhelm Kornfeld, C. Ronald Kahn, Sara G. Vienberg, Juleen R. Zierath, Jonas T. Treebak, and Marcelo A. Mori

23942 Targeting myostatin/activin A protects against skeletal muscle and bone loss during spaceflight

Se-Jin Lee, Adam Lehar, Jessica U. Meir, Christina Koch, Andrew Morgan, Lara E. Warren, Renata Rydzik, Daniel W. Youngstrom, Harshpreet Chandok, Joshy George, Joseph Gogain, Michael Michaud, Thomas A. Stoklasek, Yewei Liu, and Emily L. Germain-Lee

23952 Sexually dimorphic effects of forkhead box a2 (FOXA2) and uterine glands on decidualization and fetoplacental development

Pramod Dhakal, Andrew M. Kelleher, Susanta K. Behura, and Thomas E. Spencer

23960 Genome-wide variation and transcriptional changes in diverse developmental processes underlie the rapid evolution of seasonal adaptation

Edwina J. Dowle, Thomas H. Q. Powell, Meredith M. Doellman, Peter J. Meyers, McCall B. Calvert, Kimberly K. O. Walden, Hugh M. Robertson, Stewart H. Berlocher, Jeffrey L. Feder, Daniel A. Hahn, and Gregory J. Ragland

PLANT BIOLOGY

23970 Fruit setting rewires central metabolism via gibberellin cascades

Yoshihito Shinozaki, Bertrand P. Beauvoit, Masaru Takahara, Shuhei Hao, Kentaro Ezura, Marie-Hélène Andrieu, Keiji Nishida, Kazuki Mori, Yutaka Suzuki, Satoshi Kuhara, Hirofumi Enomoto, Miyako Kusano, Atsushi Fukushima, Tetsuya Mori, Mikiko Kojima, Makoto Kobayashi, Hitoshi Sakakibara, Kazuki Saito, Yuya Ohtani, Camille Bénard, Duyen Prodhomme, Yves Gibon, Hiroshi Ezura, and Tohru Ariizumi

23982 MAC5, an RNA-binding protein, protects pri-miRNAs from SERRATE-dependent exoribonuclease activities

Shengjun Li, Mu Li, Kan Liu, Huimin Zhang, Shuxin Zhang, Chi Zhang, and Bin Yu

23991 Stable unmethylated DNA demarcates expressed genes and their cis-regulatory space in plant genomes

Peter A. Crisp, Alexandre P. Marand, Jaclyn M. Noshay, Peng Zhou, Zefu Lu, Robert J. Schmitz, and Nathan M. Springer

POPULATION BIOLOGY

23317 Social history and exposure to pathogen signals modulate social status effects on gene regulation in rhesus macaques

Joaquín Sanz, Paul L. Maurizio, Noah Snyder-Mackler, Noah D. Simons, Tawni Voyles, Jordan Kohn, Vasiliki Michopoulos, Mark Wilson, Jenny Tung, and Luis B. Barreiro

CORRECTIONS

BIOCHEMISTRY

24001 Alkyltransferase-like protein clusters scan DNA rapidly over long distances and recruit NER to alkyl-DNA lesions

Natascha Rill, Ann Mukhortava, Sonja Lorenz, and Ingrid Tessmer

MICROBIOLOGY

24002 Selective translation by alternative bacterial ribosomes Yu-Xiang Chen, Zhi-yu Xu, Xueliang Ge, Suparna Sanyal, Zhi John Lu, and Babak Javid

24003 Prevention and treatment of SHIVAD8 infection in rhesus macaques by a potent D-peptide HIV entry inhibitor

Yoshiaki Nishimura, J. Nicholas Francis, Olivia K. Donau, Eric Jesteadt, Reza Sadjadpour, Amanda R. Smith, Michael S. Seaman, Brett D. Welch, Malcolm A. Martin, and Michael S. Kay

PLANT BIOLOGY

24004 Channelrhodopsin-mediated optogenetics highlights a central role of depolarization-dependent plant

Antonella Reyer, Melanie Häßler, Sönke Scherzer, Shouguang Huang, Jesper Torbøl Pedersen, Khaled A. S. Al-Rascheid, Ernst Bamberg, Michael Palmgren, Ingo Dreyer, Georg Nagel, Rainer Hedrich, and Dirk Becker

viii | www.pnas.org Contents