

Cover image: An internodal cell of *Chara corallina*, a freshwater alga, viewed from below on a horizontal microscope stage. Various internal structures in the 1-mm diameter cell have settled under gravity and gathered near the indifferent zone through the shearing action of cytoplasmic streaming. In their article on pages 3663–3667, Goldstein *et al.* explore the role of cytoplasmic streaming in mixing the cellular contents. Image courtesy of Raymond E. Goldstein, Idan Tuval, and Jan-Willem van de Meent.

From the Cover

- 3663 Microfluidics of cytoplasmic streaming
- 3696 Removing radioactive strontium
- 3805 Community gene expression
- 3843 Making sense of antisense
- 3951 Sugar-coated gut bacteria

Contents

THIS WEEK IN PNAS

3659 **In This Issue**

LETTER (ONLINE ONLY)

E13 The epidemiology of AIDS in Haiti refutes the claims of Gilbert *et al.*

Jean William Pape, Paul Farmer, Serena Koenig, Daniel Fitzgerald, Peter Wright, and Warren Johnson

COMMENTARY

3661 Does antisense make sense of AID targeting?

Sergio Roa, Fei Li Kuang, and Matthew D. Scharff
→ See companion article on page 3843

PHYSICAL SCIENCES

APPLIED PHYSICAL SCIENCES

3663 Microfluidics of cytoplasmic streaming and its implications for intracellular transport

Raymond E. Goldstein, Idan Tuval, and Jan-Willem van de Meent

3668 A 16-bit parallel processing in a molecular assembly
Anirban Bandyopadhyay and Somabrata Acharya

3673 Vacancy-mediated dehydrogenation of sodium alanate
Hakan Gunaydin, Kendall N. Houk, and Vidvuds Ozoliņš

CHEMISTRY

3678 A nanostructure-initiator mass spectrometry-based enzyme activity assay

Trent R. Northen, Jinq-Chyi Lee, Linh Hoang, Jason Raymond, Der-Ren Hwang, Steven M. Yannone, Chi-Huey Wong, and Gary Siuzdak

3684 DNA binding shifts the redox potential of the transcription factor SoxR

Alon A. Gorodetsky, Lars E. P. Dietrich, Paul E. Lee, Bruce Demple, Dianne K. Newman, and Jacqueline K. Barton

3690 Targeting the carbohydrates on HIV-1: Interaction of oligomannose dendrons with human monoclonal antibody 2G12 and DC-SIGN

Sheng-Kai Wang, Pi-Hui Liang, Rena D. Astronomo, Tsui-Ling Hsu, Shie-Liang Hsieh, Dennis R. Burton, and Chi-Huey Wong

3696 Layered metal sulfides: Exceptionally selective agents for radioactive strontium removal

Manolis J. Manos, Nan Ding, and Mercouri G. Kanatzidis


3700 Molecular asymmetry in extraterrestrial chemistry: Insights from a pristine meteorite

Sandra Pizzarello, Yongsong Huang, and Marcelo R. Alexandre



Free online through the PNAS open access option.

ENGINEERING


- 3705 **Simultaneous *in vivo* positron emission tomography and magnetic resonance imaging**
 Ciprian Catana, Daniel Procissi, Yibao Wu, Martin S. Judenhofer, Jinyi Qi, Bernd J. Pichler, Russell E. Jacobs, and Simon R. Cherry
- 3711 **Micro- and nanoparticles self-assembly for virtually defect-free, adjustable monolayers**
N. Aubry, P. Singh, M. Janjua, and S. Nudurupati

SOCIAL SCIENCES

ANTHROPOLOGY

- 3715 **Domestication of the donkey: Timing, processes, and indicators**
Stine Rossel, Fiona Marshall, Joris Peters, Tom Pilgram, Matthew D. Adams, and David O'Connor

ECONOMIC SCIENCES


- 3721 **Heritability of cooperative behavior in the trust game**
 David Cesarini, Christopher T. Dawes, James H. Fowler, Magnus Johannesson, Paul Lichtenstein, and Björn Wallace

PSYCHOLOGY

- 4004 **Language affects patterns of brain activation associated with perceptual decision**
Li Hai Tan, Alice H. D. Chan, Paul Kay, Pek-Lan Khong, Lawrence K. C. Yip, and Kang-Kwong Luke

BIOLOGICAL SCIENCES

ANTHROPOLOGY

- 3721 **Heritability of cooperative behavior in the trust game**
 David Cesarini, Christopher T. Dawes, James H. Fowler, Magnus Johannesson, Paul Lichtenstein, and Björn Wallace

APPLIED BIOLOGICAL SCIENCES


- 3727 **Cost-effective production of a vaginal protein microbicide to prevent HIV transmission**
Koreen Ramessar, Thomas Rademacher, Markus Sack, Johannes Stadlmann, Dimitris Platis, Gabriela Stiegler, Nikos Labrou, Fritz Altmann, Julian Ma, Eva Stöger, Teresa Capell, and Paul Christou
- 3733 ***In vitro* self-assembly of tailorable nanotubes from a simple protein building block**
Edward R. Ballister, Angela H. Lai, Ronald N. Zuckermann, Yifan Cheng, and Joseph D. Mougous

BIOCHEMISTRY

- 3678 **A nanostructure-initiator mass spectrometry-based enzyme activity assay**
Trent R. Northen, Jinq-Chyi Lee, Linh Hoang, Jason Raymond, Der-Ren Hwang, Steven M. Yannone, Chi-Huey Wong, and Gary Siuzdak
- 3684 **DNA binding shifts the redox potential of the transcription factor SoxR**
Alon A. Gorodetsky, Lars E. P. Dietrich, Paul E. Lee, Bruce Demple, Dianne K. Newman, and Jacqueline K. Barton

- 3690 **Targeting the carbohydrates on HIV-1: Interaction of oligomannose dendrons with human monoclonal antibody 2G12 and DC-SIGN**
Sheng-Kai Wang, Pi-Hui Liang, Rena D. Astronomo, Tsui-Ling Hsu, Shie-Liang Hsieh, Dennis R. Burton, and Chi-Huey Wong

- 3739 **A fusion-intermediate state of HIV-1 gp41 targeted by broadly neutralizing antibodies**
Gary Frey, Hanqin Peng, Sophia Rits-Volloch, Marco Morelli, Yifan Cheng, and Bing Chen

- 3745 **The thermodynamic H⁺/ATP ratios of the H⁺-ATPsynthases from chloroplasts and *Escherichia coli***
 Stefan Steigmiller, Paola Turina, and Peter Gräber


- 3751 **Analyses of Mlc-IIB^{Glc} interaction and a plausible molecular mechanism of Mlc inactivation by membrane sequestration**
Tae-Wook Nam, Ha Il Jung, Young Jun An, Young-Ha Park, Sang Hee Lee, Yeong-Jae Seok, and Sun-Shin Cha

- 3757 **Cleavage mechanism of human Mus81-Eme1 acting on Holliday-junction structures**
Ewan R. Taylor and Clare H. McGowan

- 3763 **Real-time electron transfer in respiratory complex I**
Marina L. Verkhovskaya, Nikolai Belevich, Liliya Euro, Mårten Wikström, and Michael I. Verkhovsky

- 3768 **Human HLTF functions as a ubiquitin ligase for proliferating cell nuclear antigen polyubiquitination**
Ildiko Unk, Ildikó Hajdú, Károly Fátýol, Jerard Hurwitz, Jung-Hoon Yoon, Louise Prakash, Satya Prakash, and Lajos Haracska

- 3774 **Opening and closing of the periplasmic gate in lactose permease**
Yonggang Zhou, Lan Guan, J. Alfredo Freitas, and H. Ronald Kaback

- 3992 **Impaired insulin secretion and glucose intolerance in synaptotagmin-7 null mutant mice**
 Natalia Gustavsson, Ye Lao, Anton Maximov, Jen-Chieh Chuang, Elena Kostromina, Joyce J. Repa, Cai Li, George K. Radda, Thomas C. Südhof, and Weiping Han

BIOPHYSICS

- 3663 **Microfluidics of cytoplasmic streaming and its implications for intracellular transport**
Raymond E. Goldstein, Idan Tuval, and Jan-Willem van de Meent

- 3779 **Structural insights into an equilibrium folding intermediate of an archaeal ankyrin repeat protein**
Christian Löw, Ulrich Weininger, Piotr Neumann, Mirjam Klepsch, Hauke Lilie, Milton T. Stubbs, and Jochen Balbach

CELL BIOLOGY

- 3785 **TDP-43 regulates retinoblastoma protein phosphorylation through the repression of cyclin-dependent kinase 6 expression**
Youhna M. Ayala, Tom Misteli, and Francisco E. Baralle

DEVELOPMENTAL BIOLOGY

- 3790 **A *Caenorhabditis elegans* model for epithelial–neuronal transdifferentiation**
Sophie Jarriault, Yannick Schwab, and Iva Greenwald

ECOLOGY

- 3796 **Rapid evolution of seed dispersal in an urban environment in the weed *Crepis sancta***
P.-O. Cheptou, O. Carrue, S. Roufied, and A. Cantarel
- 3800 **Introduced rats indirectly change marine rocky intertidal communities from algae- to invertebrate-dominated**
Carolyn M. Kurlle, Donald A. Croll, and Bernie R. Tershy




ENVIRONMENTAL SCIENCES

- 3805 **Microbial community gene expression in ocean surface waters**
 Jorge Frias-Lopez, Yanmei Shi, Gene W. Tyson, Maureen L. Coleman, Stephan C. Schuster, Sallie W. Chisholm, and Edward F. DeLong
- 3811 **Mushroom fruiting and climate change**
Håvard Kausrud, Leif Christian Stige, Jon Olav Vik, Rune H. Økland, Klaus Høiland, and Nils Chr. Stenseth

EVOLUTION




- 3815 **The oldest North American primate and mammalian biogeography during the Paleocene–Eocene Thermal Maximum**
K. Christopher Beard
- 3819 **Elephant shark sequence reveals unique insights into the evolutionary history of vertebrate genes: A comparative analysis of the protocadherin cluster**
Wei-Ping Yu, Vikneswari Rajasegaran, Kenneth Yew, Wai-lin Loh, Boon-Hui Tay, Chris T. Amemiya, Sydney Brenner, and Byrappa Venkatesh

IMMUNOLOGY

- 3825 **Conditional MHC class I ligands and peptide exchange technology for the human MHC gene products HLA-A1, -A3, -A11, and -B7**
 Arnold H. Bakker, Rieuwert Hoppes, Carsten Linnemann, Mireille Toebes, Boris Rodenko, Celia R. Berkers, Sine Reker Hadrup, Wim J. E. van Esch, Mirjam H. M. Heemskerk, Huib Ovaa, and Ton N. M. Schumacher
- 3831 **Discovery of CD8⁺ T cell epitopes in *Chlamydia trachomatis* infection through use of caged class I MHC tetramers**
 Gijsbert M. Grotenbreg, Nadia R. Roan, Eduardo Guillen, Rob Meijers, Jia-huai Wang, George W. Bell, Michael N. Starnbach, and Hidde L. Ploegh
- 3837 **Identification of phosphatidylinositol 4-kinase type II β as HLA class II-restricted target in graft versus leukemia reactivity**
Marieke Griffioen, Edith D. van der Meijden, Elisabeth H. Slager, M. Willy Honders, Caroline E. Rutten, Simone A. P. van Luxemburg-Heijs, Peter A. von dem Borne, Johannes J. van Rood, Roel Willemze, and J. H. Frederik Falkenburg
- 3843 **Antisense transcripts from immunoglobulin heavy-chain locus V(D)J and switch regions**
 Thomas Perlot, Gang Li, and Frederick W. Alt
→ See Commentary on page 3661

- 3849 **Unmodified self antigen triggers human CD8 T cells with stronger tumor reactivity than altered antigen**
Daniel E. Speiser, Petra Baumgaertner, Verena Voelter, Estelle Devevre, Catherine Barbey, Nathalie Rufer, and Pedro Romero
- 3855 **T cell expression of MyD88 is required for resistance to *Toxoplasma gondii***
David F. LaRosa, Jason S. Stumhofer, Andrew E. Gelman, Adeeb H. Rahman, Devon K. Taylor, Christopher A. Hunter, and Laurence A. Turka
- 3861 **Editing and escape from editing in anti-DNA B cells**
Salar N. Khan, Esther J. Witsch, Noah G. Goodman, Anil K. Panigrahi, Ching Chen, Yufei Jiang, Amy M. Cline, Jan Erikson, Martin Weigert, Eline T. Luning Prak, and Marko Radic
- 3867 **HIV-1 matrix protein p17 induces human plasmacytoid dendritic cells to acquire a migratory immature cell phenotype**
Simona Fiorentini, Elena Riboldi, Fabio Facchetti, Manuela Avolio, Marco Fabbri, Giorgio Tosti, Pablo D. Becker, Carlos A. Guzman, Silvano Sozzani, and Arnaldo Caruso
- 3873 **Nucleoprotein structure of the CD4 locus: Implications for the mechanisms underlying CD4 regulation during T cell development**
Ming Yu, Mimi Wan, Jianmin Zhang, Jie Wu, Rohini Khatri, and Tian Chi

MEDICAL SCIENCES

- 3705 **Simultaneous *in vivo* positron emission tomography and magnetic resonance imaging**
 Ciprian Catana, Daniel Prociassi, Yibao Wu, Martin S. Judenhofer, Jinyi Qi, Bernd J. Pichler, Russell E. Jacobs, and Simon R. Cherry
- 3879 **Low-level viremia persists for at least 7 years in patients on suppressive antiretroviral therapy**
 Sarah Palmer, Frank Maldarelli, Ann Wiegand, Barry Bernstein, George J. Hanna, Scott C. Brun, Dale J. Kempf, John W. Mellors, John M. Coffin, and Martin S. King
- 3885 **Kuru prions and sporadic Creutzfeldt–Jakob disease prions have equivalent transmission properties in transgenic and wild-type mice**
 Jonathan D. F. Wadsworth, Susan Joiner, Jacqueline M. Linehan, Melanie Desbruslais, Katie Fox, Sharon Cooper, Sabrina Cronier, Emmanuel A. Asante, Simon Mead, Sebastian Brandner, Andrew F. Hill, and John Collinge
- 3891 **The organic solute transporter α - β , Ost α -Ost β , is essential for intestinal bile acid transport and homeostasis**
Anuradha Rao, Jamie Haywood, Ann L. Craddock, Martin G. Belinsky, Gary D. Kruh, and Paul A. Dawson
- 3897 **RelB is the NF- κ B subunit downstream of NIK responsible for osteoclast differentiation**
Sergio Vaira, Trevor Johnson, Angela C. Hirbe, Muhammad Alhawagri, Imani Anwisy, Benedicte Sammut, Julie O'Neal, Wei Zou, Katherine N. Weilbaecher, Roberta Faccio, and Deborah Veis Novack
- 3903 **Suppression of non-small cell lung tumor development by the *let-7* microRNA family**
Madhu S. Kumar, Stefan J. Erkeland, Ryan E. Pester, Cindy Y. Chen, Margaret S. Ebert, Phillip A. Sharp, and Tyler Jacks

3909 ***In vivo* correction of a Menkes disease model using antisense oligonucleotides**
Erik C. Madsen, Paul A. Morcos, Bryce A. Mendelsohn, and Jonathan D. Gitlin

3915 **Inhibition of midkine alleviates experimental autoimmune encephalomyelitis through the expansion of regulatory T cell population**
Jinyan Wang, Hideyuki Takeuchi, Yoshifumi Sonobe, Shijie Jin, Tetsuya Mizuno, Shin Miyakawa, Masatoshi Fujiwara, Yoshikazu Nakamura, Takuma Kato, Hisako Muramatsu, Takashi Muramatsu, and Akio Suzumura

3921 **Txnip balances metabolic and growth signaling via PTEN disulfide reduction**
Simon T. Y. Hui, Allen M. Andres, Amber K. Miller, Nathanael J. Spann, Douglas W. Potter, Noah M. Post, Amelia Z. Chen, Sowbarnika Sachithanatham, Dae Young Jung, Jason K. Kim, and Roger A. Davis

3927 **Tumor cell cycle arrest induced by shear stress: Roles of integrins and Smad**
Shun-Fu Chang, Cheng Allen Chang, Ding-Yu Lee, Pei-Ling Lee, Yu-Ming Yeh, Chiuan-Ren Yeh, Cheng-Kung Cheng, Shu Chien, and Jeng-Jiann Chiu

3933 **Temporal activation of p53 by a specific MDM2 inhibitor is selectively toxic to tumors and leads to complete tumor growth inhibition**
Sanjeev Shangary, Dongguang Qin, Donna McEachern, Meilan Liu, Rebecca S. Miller, Su Qiu, Zaneta Nikolovska-Coleska, Ke Ding, Guoping Wang, Jianyong Chen, Denzil Bernard, Jian Zhang, Yipin Lu, Qingyang Gu, Rajal B. Shah, Kenneth J. Pienta, Xiaolan Ling, Sanmao Kang, Ming Guo, Yi Sun, Dajun Yang, and Shaomeng Wang

3939 **Urocortin2 inhibits tumor growth via effects on vascularization and cell proliferation**
Zhengrong Hao, Yan Huang, Jake Cleman, Ion S. Jovini, Wylie W. Vale, Tracy L. Bale, and Frank J. Giordano

3945 **Distinctive microRNA signature of acute myeloid leukemia bearing cytoplasmic mutated nucleophosmin**
Ramiro Garzon, Michela Garofalo, Maria Paola Martelli, Roger Briesewitz, Lisheng Wang, Cecilia Fernandez-Cymering, Stefano Volinia, Chang-Gong Liu, Susanne Schnittger, Torsten Haferlach, Arcangelo Liso, Daniela Diverio, Marco Mancini, Giovanna Meloni, Robin Foa, Massimo F. Martelli, Cristina Mecucci, Carlo M. Croce, and Brunangelo Falini

MICROBIOLOGY

3951 **Regulation of surface architecture by symbiotic bacteria mediates host colonization**
Cui Hua Liu, S. Melanie Lee, Jordan M. VanLare, Dennis L. Kasper, and Sarkis K. Mazmanian

3957 **Antibiotic-resistant soil bacteria in transgenic plant fields**
Sandrine Demanèche, Hervé Sanguin, John Poté, Elisabeth Navarro, Dominique Bernillon, Patrick Mavingui, Walter Wildi, Timothy M. Vogel, and Pascal Simonet

3963 **Disclosure of the mycobacterial outer membrane: Cryo-electron tomography and vitreous sections reveal the lipid bilayer structure**
Christian Hoffmann, Andrew Leis, Michael Niederweis, Jürgen M. Plitzko, and Harald Engelhardt

3968 ***Shewanella* secretes flavins that mediate extracellular electron transfer**
Enrico Marsili, Daniel B. Baron, Indraneel D. Shikhere, Dan Coursolle, Jeffrey A. Gralnick, and Daniel R. Bond

3974 **ISG15 inhibits Ebola VP40 VLP budding in an L-domain-dependent manner by blocking Nedd4 ligase activity**
Atsushi Okumura, Paula M. Pitha, and Ronald N. Harty

3980 ***Leishmania* requires Rab7-mediated degradation of endocytosed hemoglobin for their growth**
Nitin Patel, Sudha B. Singh, Sandip K. Basu, and Amitabha Mukhopadhyay

NEUROSCIENCE

3986 **Genetic analysis of synaptotagmin-7 function in synaptic vesicle exocytosis**
Anton Maximov, Ye Lao, Hongmei Li, Xiaocheng Chen, Joseph Rizo, Jakob B. Sørensen, and Thomas C. Südhof

3992 **Impaired insulin secretion and glucose intolerance in synaptotagmin-7 null mutant mice**
Natalia Gustavsson, Ye Lao, Anton Maximov, Jen-Chieh Chuang, Elena Kostromina, Joyce J. Repa, Cai Li, George K. Radda, Thomas C. Südhof, and Weiping Han

3998 **Synaptotagmin-1 and -7 are functionally overlapping Ca²⁺ sensors for exocytosis in adrenal chromaffin cells**
Jean-Sébastien Schonn, Anton Maximov, Ye Lao, Thomas C. Südhof, and Jakob B. Sørensen

4004 **Language affects patterns of brain activation associated with perceptual decision**
Li Hai Tan, Alice H. D. Chan, Paul Kay, Pek-Lan Khong, Lawrence K. C. Yip, and Kang-Kwong Luke

4010 **Internal body state influences topographical plasticity of sensory representations in the rat gustatory cortex**
Riccardo Accolla and Alan Carleton

4016 **Hypothalamic neurodegeneration and adult-onset obesity in mice lacking the *Ubb* polyubiquitin gene**
Kwon-Yul Ryu, Jacob C. Garza, Xin-Yun Lu, Gregory S. Barsh, and Ron R. Kopito

4022 **Selective association of misfolded ALS-linked mutant SOD1 with the cytoplasmic face of mitochondria**
Christine Vande Velde, Timothy M. Miller, Neil R. Cashman, and Don W. Cleveland

4028 **The maturing architecture of the brain's default network**
Damien A. Fair, Alexander L. Cohen, Nico U. F. Dosenbach, Jessica A. Church, Francis M. Miezin, Deanna M. Barch, Marcus E. Raichle, Steven E. Petersen, and Bradley L. Schlaggar

PHYSIOLOGY

4033 **Gating-associated conformational changes in the mechanosensitive channel MscL**
Kenjiro Yoshimura, Jiro Usukura, and Masahiro Sokabe

4039 **The RCK1 high-affinity Ca²⁺ sensor confers carbon monoxide sensitivity to Slo1 BK channels**
Shangwei Hou, Rong Xu, Stefan H. Heinemann, and Toshinori Hoshi

PLANT BIOLOGY

- 4044 **A SPIKE1 signaling complex controls actin-dependent cell morphogenesis through the heteromeric WAVE and ARP2/3 complexes**
Dipanwita Basu, Jie Le, Taya Zakharova, Eileen L. Mallery, and Daniel B. Szymanski
- 4050 ***In vivo* hyperspectral confocal fluorescence imaging to determine pigment localization and distribution in cyanobacterial cells**
Wim F. J. Vermaas, Jerilyn A. Timlin, Howland D. T. Jones, Michael B. Sinclair, Linda T. Nieman, Sawsan W. Hamad, David K. Melgaard, and David M. Haaland
- 4056 **Thioredoxin-mediated reversible dissociation of a stromal multiprotein complex in response to changes in light availability**
Thomas P. Howard, Metodi Metodiev, Julie C. Lloyd, and Christine A. Raines
- 4062 **Barley grain with adhering hulls is controlled by an ERF family transcription factor gene regulating a lipid biosynthesis pathway**
Shin Taketa, Satoko Amano, Yasuhiro Tsujino, Tomohiko Sato, Daisuke Saisho, Katsuyuki Kakeda, Mika Nomura, Toshisada Suzuki, Takashi Matsumoto, Kazuhiro Sato, Hiroyuki Kanamori, Shinji Kawasaki, and Kazuyoshi Takeda

PSYCHOLOGY

- 4068 **Broad bandwidth of perceptual learning in the visual system of adults with anisometropic amblyopia**
Chang-Bing Huang, Yifeng Zhou, and Zhong-Lin Lu

xi–xii Author Index

xiii Subscription Form