SPECIAL REPORT **THE SCIENCE OF INEQUALITY** WHY THE GROWING GAP BETWEEN RICH AND POOR IS A PROBLEM FOR EVERYONE PAGE 54

SCIENTIFIC AMERICAN

SLEEP LEARNING

How to improve memories during slumber

PLUS

CAN GEOMETRY SAVE DEMOCRACY?
Mathematicians fight against gerrymandering PAGE 48

TEAM PLAYERS
Microbial partnerships that rule the planet PAGE 32

BACK IN TIME
Searching for the most distant galaxies in the universe PAGE 40

ScientificAmerican.com

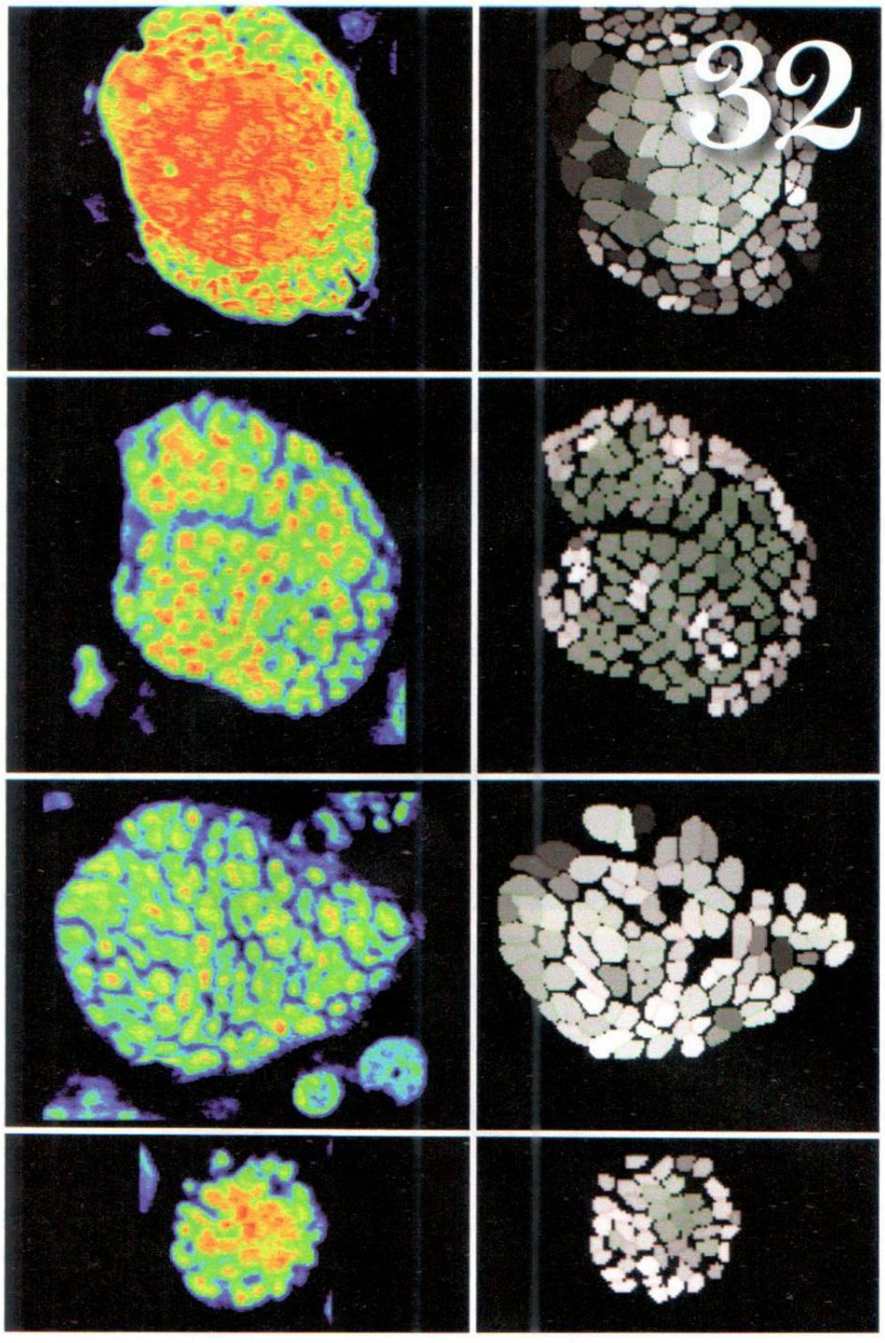
$6.99 U.S.

NOVEMBER 2018

NOVEMBER 2018

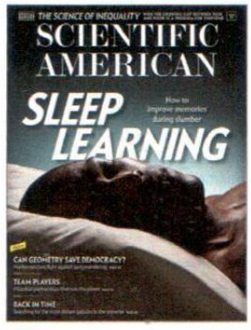
VOLUME 319, NUMBER 5

SCIENTIFIC AMERICAN

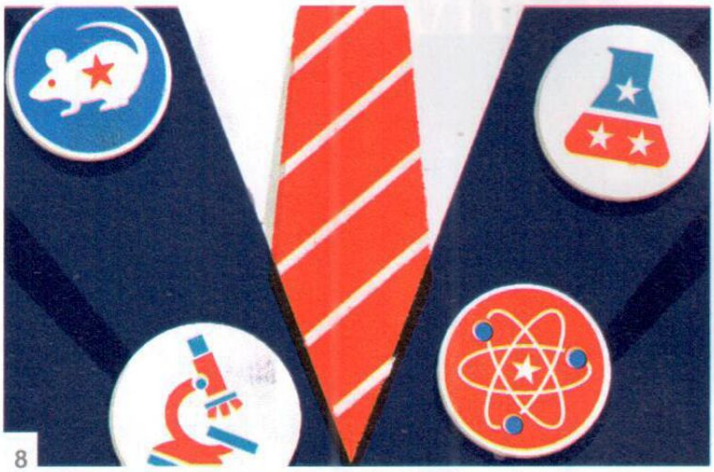


ON THE COVER

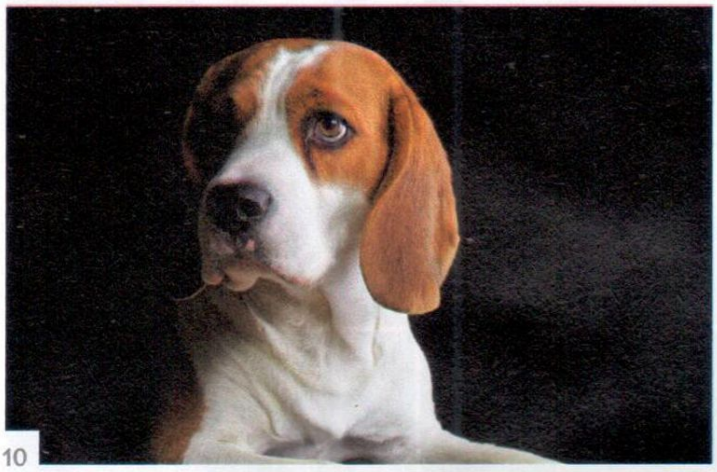
Learning while asleep turns up as a trope in novels and in popular culture. Now one form of sleep learning is getting a serious hearing in reputable neuroscience labs. The sleeping brain spontaneously reactivates existing memories. Researchers want to understand how these periods of off-line recall serve as de facto study sessions that help us remember what we learned during the day.
Photograph by Hannah Whitaker.



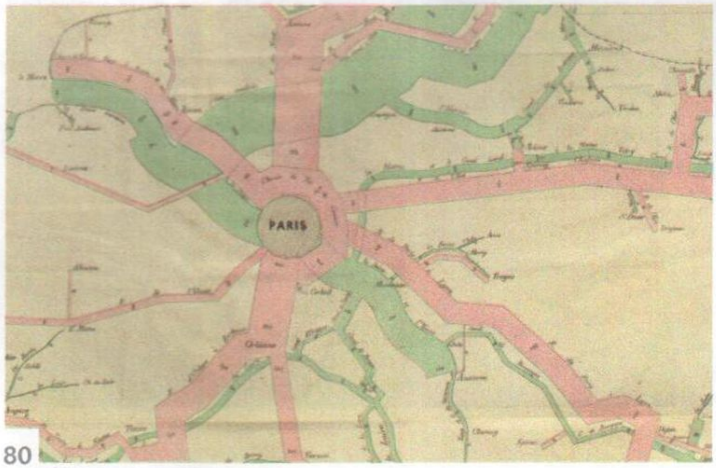
SCIENTIFIC AMERICAN



8



10



80

ON THE WEB

Audio Files

Scientific American has a new podcast that offers a deeper dive into the latest Advances. Listen online at the link below, on iTunes or wherever you get your podcasts.
Go to www.ScientificAmerican.com/nov2018/advances-pod

Scientific American (ISSN 0036-8733), Volume 319, Number 5, November 2018, published monthly by Scientific American, a division of Springer Nature America, Inc., 1 New York Plaza, Suite 4500, New York, N.Y. 10004-1562. Periodicals postage paid at New York, N.Y., and at additional mailing offices. Canada Post International Publications Mail (Canadian Distribution) Sales Agreement No. 40012504. Canadian BN No. 127387652RT; TVQ1218059275 TQ0001. Publication Mail Agreement #40012504. Return undeliverable mail to Scientific American, P.O. Box 819, Stn Main, Markham, ON L3P 8A2. **Individual Subscription rates:** 1 year $49.99 (USD), Canada $59.99 (USD), International $69.99 (USD). **Institutional Subscription rates:** Schools and Public Libraries: 1 year $84 (USD), Canada $89 (USD), International $96 (USD). Businesses and Colleges/Universities: 1 year $399 (USD), Canada $405 (USD), International $411 (USD). Postmaster: Send address changes to Scientific American, Box 3187, Harlan, Iowa 51537. **Reprints inquiries: (212) 451-8415. To request single copies or back issues, call (800) 333-1199. Subscription inquiries: U.S. and Canada (800) 333-1199; other (515) 248-7684. Send e-mail to scacustserv@cdsfulfillment.com.**

COURTESY OF ÉCOLE DES PONTS PARISTECH FROM *THE MINARD SYSTEM*, BY SANDRA RENDGEN, PUBLISHED BY PRINCETON ARCHITECTURAL PRESS. REPRINTED WITH PERMISSION FROM THE PUBLISHER *(map)*