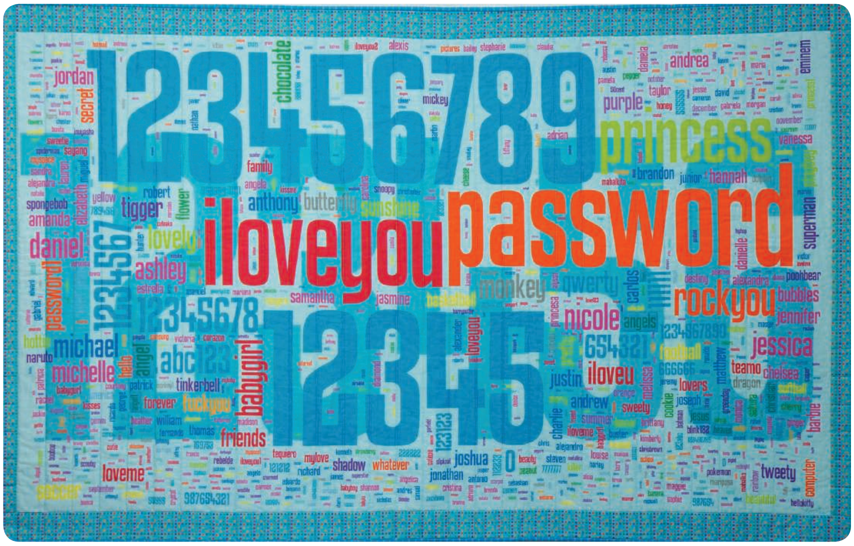
Honorable Mention
Security Blanket

Lorrie Faith Cranor, Carnegie Mellon University, Pittsburgh, Pennsylvania



How much protection do your Internet passwords provide? Some 32 million passwords stolen from the games website RockYou were published on the World Wide Web in 2009, and they reveal our penchant for choosing passwords that may offer no security at all.

Last year, Lorrie Faith Cranor, avid quilter and director of the CyLab Usable Privacy and Security Laboratory at Carnegie Mellon University, created *Security Blanket*, which displays a multicolored "word cloud" of the 1000 most common passwords in the RockYou release. The passwords were sized according to their frequency and colored according to their theme.

The most common—"123456"—was chosen by three times as many people as the next most popular password and is so large that it forms a faint backdrop across the whole quilt. But beyond the other obvious passwords (such as—duh—"password"), Cranor shows that our selections often converge on the same words. "Chocolate" is the most popular food-related password; "monkey" tops the animals category; and, reassuringly, words relating to love or tenderness far outweigh profanities.

Cranor has also made a password dress for herself, which she wore to the opening of an exhibition of her quilts. "A couple of friends have suggested turning the quilt design into a line of baby linens for the children of geeky parents," she adds.

Published by AAAS

Cortex in Metallic Pastels

Greg Dunn and Brian Edwards, Greg Dunn Design, Philadelphia, Pennsylvania; Marty Saggese, Society for Neuroscience, Washington, D.C.; Tracy Bale, University of Pennsylvania, Philadelphia; Rick Huganir, Johns Hopkins University, Baltimore, Maryland

FIRST PLACE
ILLUSTRATION

With a Ph.D. in neuroscience and a love of Asian art, it may have been inevitable that Greg Dunn would combine them to create sparse, striking illustrations of the brain. "It was a perfect synthesis of my interests," Dunn says.

Cortex in Metallic Pastels represents a stylized section of the cerebral cortex, in which axons, dendrites, and other features create a scene reminiscent of a copse of silver birch at twilight. An accurate depiction of a slice of cerebral cortex would be a confusing mess, Dunn says, so he thins out the forest of cells, revealing the delicate branching structure of each neuron.

Dunn blows pigments across the canvas to create the neurons and highlights some of them in gold leaf and palladium, a technique he is keen to develop further.

"My eventual goal is to start an art-science lab," he says. It would bring students of art and science together to develop new artistic techniques. He is already using lithography to give each neuron in his paintings a different angle of reflectance. "As you walk around, different neurons appear and disappear, so you can pack it with information," he says.

The painting was commissioned for the Johns Hopkins University School of Medicine's Brain Science Institute, but, Dunn says, "I want to be able to communicate with a wide swath of people." He hopes that lay viewers will see how the branching structures of neurons mirror so many other natural structures, from river deltas to the roots of a tree. "I want to help people to appreciate the beauty of the brain."

"It is just gorgeous," says judge Alisa Zapp Machalek. "The fact that science can be in an art museum is something we want to encourage."

Prints of Greg Dunn's art, including this winning painting, are available at www.gregadunn.com.

People's Choice

Human Hand Controlling Bacterial Biofilms

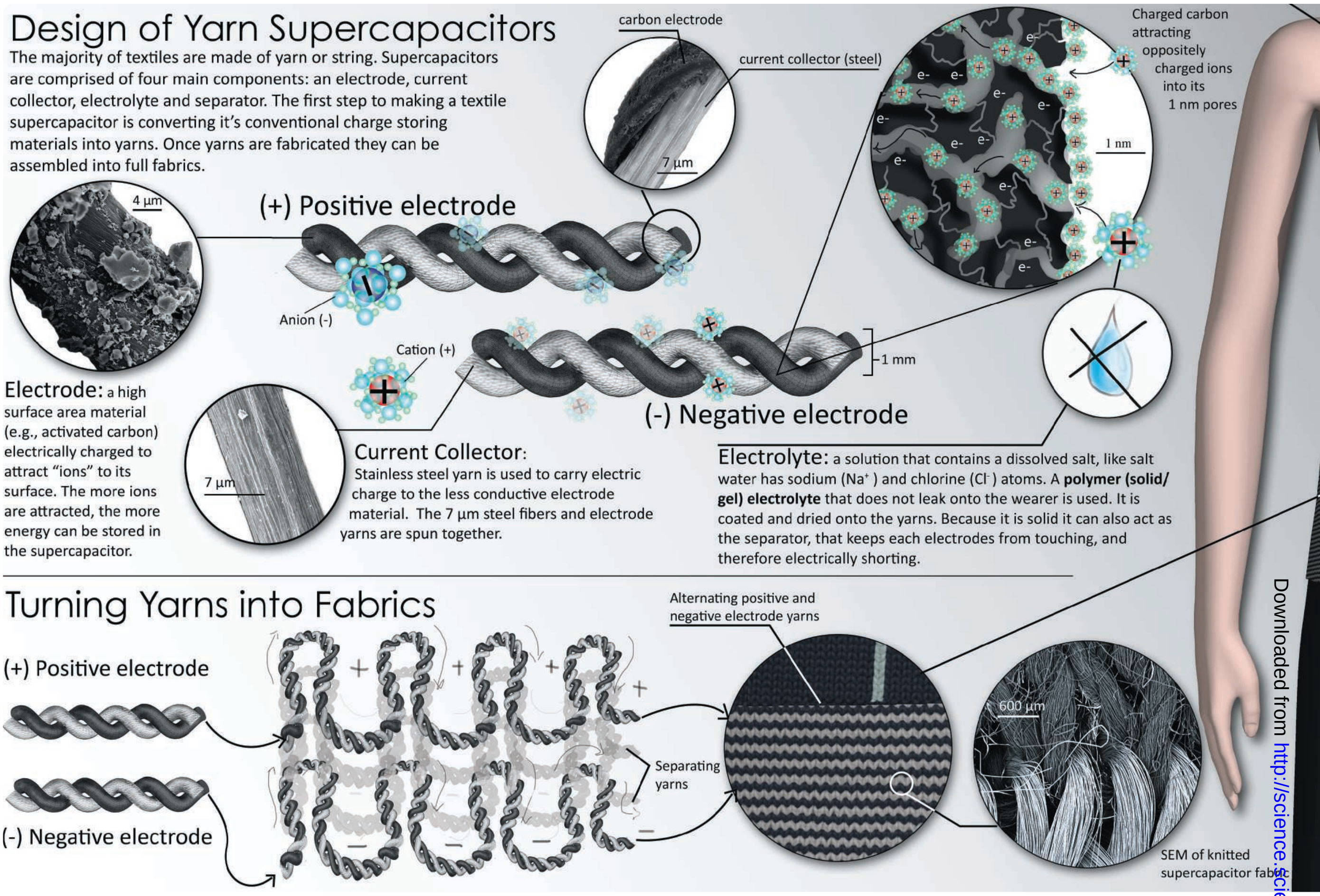
Lydia-Marié Joubert, Cell Sciences Imaging Facility, Stanford University, California

In our war against bacteria, the microbes are winning. That somber message is writ large in this image of a human hand covered with *Pseudomonas* bacteria.

"Antimicrobial resistance is a hot topic, especially since it has become clear that our efforts to eradicate microorganisms have made them more resilient," says Lydia-Marié Joubert, an electron microscopy specialist at Stanford University who created the image. While attending a conference at Gregynog Hall in Wales, Joubert photographed a 1.5-meter-high human hand that reaches out of the soil in the hall's gardens, sculpted by British artist Francis Hewlett. Then she overlaid micrographs of cultured biofilms, which had been stained with molecular probes to indicate the health of the cells. Those colored green are resistant to antimicrobial treatment—only a rare few are red, indicating that they have been vanquished.

"We try to control microbes," Joubert says, "but the unseen world remains victorious."

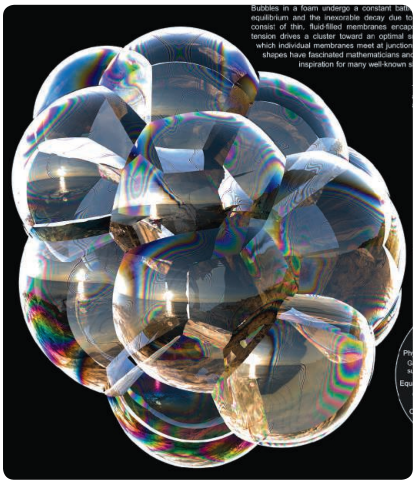
Published by AAAS

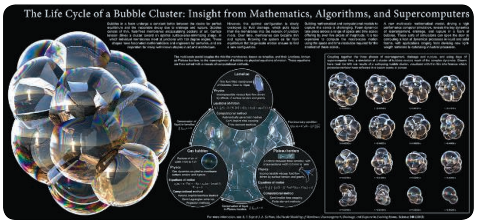


Honorable Mention

The Life Cycle of a Bubble Cluster: Insight from Mathematics, Algorithms, and Supercomputers

Robert I. Saye and James A. Sethian, Lawrence Berkeley National Laboratory and the University of California, Berkeley





"Isn't that just a photograph of soap bubbles?" Robert Saye and James Sethian hear that all the time when people see their poster. "Naturally we are eager to point out that it is in fact a visualization of a physics computational model," says Saye, who recently completed his Ph.D. with Sethian at the Lawrence Berkeley National Laboratory and the University of California, Berkeley.

Predicting how bubbles in a foam rearrange and rupture is a tough modeling problem, because it involves intricately coupled processes that operate at very different scales. The soap films are only micrometers thick, while the gas pockets themselves might be centimeters across. Meanwhile, individual films rupture in milliseconds; bubbles rearrange in a fraction of a second; and liquid inside the film drains over tens of seconds or longer.

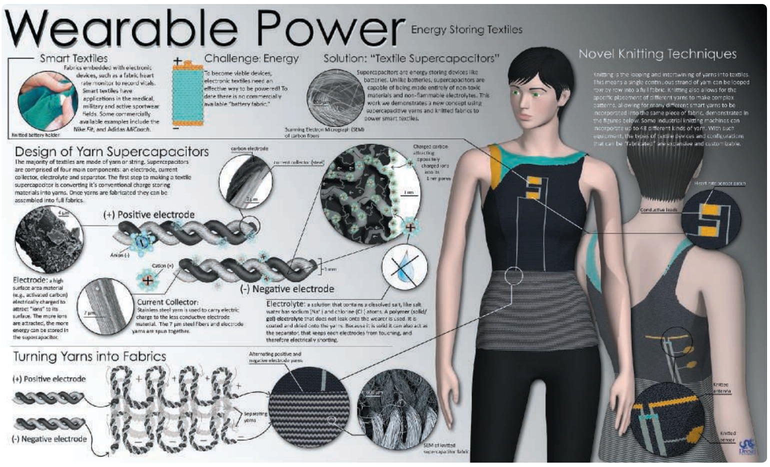
Running a simulation at the smallest scales to predict the macroscopic effects would eat up vast amounts of computer power. "Instead, we found a way to separate distinct time and space scales, and allow these to communicate so that the most important physics affecting foam dynamics are captured," Saye says. The model, published last year (*Science*, 10 May 2013, p. 720), could be useful in devising lightweight materials or optimizing industrial processes, he and Sethian suggest.

Watch a video of the foam simulation at www.youtube.com/watch?v=ciciWBz8m_Y.

Published by AAAS

Wearable Power

Kristy Jost, Babak Anasori, Majid Beidaghi, Genevieve Dion, and Yury Gogotsi, Drexel University, Philadelphia, Pennsylvania



FIRST PLACE
& PEOPLE'S CHOICE
POSTERS & GRAPHICS

"When I try to explain that I make fabric batteries to people, they kinda give me this look like their brain has just exploded," says materials scientist Kristy Jost, who is studying for her Ph.D. at Drexel University. "Having a visual is really helpful."

"Smart textiles" offer the opportunity to create functional clothes—a vest that can measure your heart rate, for example. But flexible sensors are still powered by hard, uncomfortable batteries. "Why not make the whole system out of textiles?" Jost asks. Her research aims to create fabrics from carbon and steel yarns that are coated with electrolytes so that the resulting garment is also a wearable capacitor, able to store energy.

Jost spends much of her time in Drexel's knitting research laboratory—yes, you read that right—which boasts state-of-the-art equipment donated by Shima Seiki, a Japanese company that makes computerized 3D knitting systems. The machines can knit an entire seamless garment in 20 minutes, and Jost has become adept at using the design software that drives them—although she admits sheepishly that she has not yet learned to knit by hand.

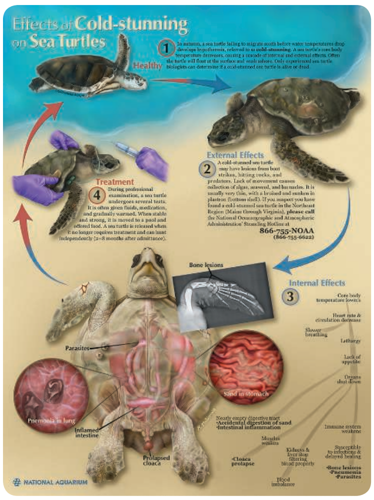
She used her design expertise in the winning poster, which shows how the yarns intertwine to create a complete item of clothing and includes scanning electron microscope images and nanoscale diagrams to illustrate how the smart textile works at different scales. "It has an incredible amount of technical material," judge Thomas Wagner says. "It's a phenomenal piece of education."

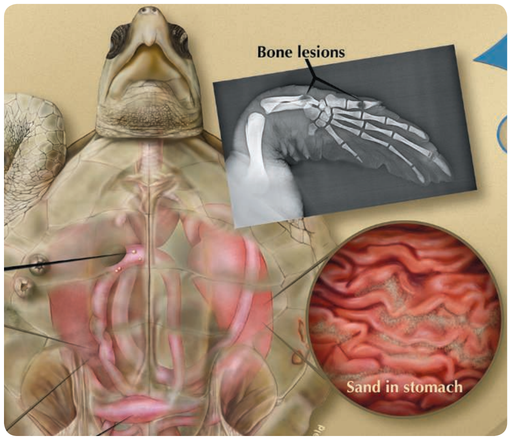
Jost was delighted by the judges' award, but was particularly pleased that she was also the People's Choice in this category. "When you also get the People's Choice award," she says, "you know you've really communicated the science well."

Honorable Mention

Effects of Cold-stunning on Sea Turtles

Katelyn McDonald and Timothy Phelps, Johns Hopkins University, Baltimore, Maryland; Jennifer Dittmar, the National Aquarium, Baltimore, Maryland

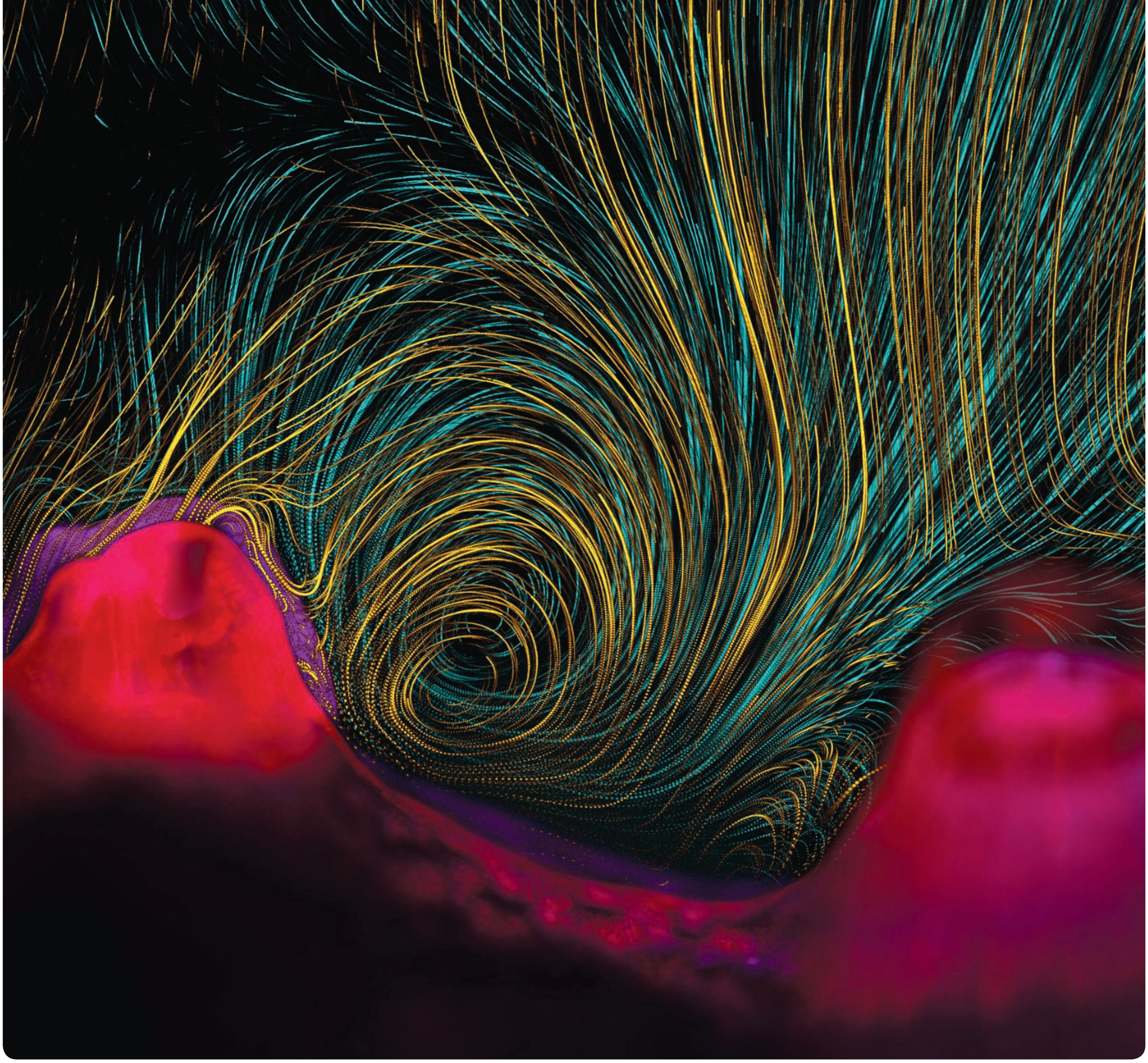




By the time October's chill winds begin to blow across the mid-Atlantic and northeastern United States, sea turtles near the coast are beginning to head south in search of warmer waters. But an unlucky few are overtaken by plummeting water temperatures and develop hypothermia. The turtle can lose consciousness and suffer shell damage and infections in a process called cold-stunning.

Katelyn McDonald, a master's student in biological and medical illustration at Johns Hopkins University, created the poster to explain cold-stunning to the general public, who may find afflicted turtles on the beach. "I am fascinated by sea turtles because of their majestic beauty, and how little is known about them, since they spend so little time on land," McDonald says.

The poster describes the physiological changes that lead to cold-stunning in a series of beautiful anatomical illustrations that were all based on medical images, but were drawn and assembled using computer design software. It also shows how to identify a cold-stunned turtle and provides the number of a turtle stranding hotline. McDonald says her goal is that the public "would learn more about the health of sea turtles, and hopefully be aware of the appearance of cold-stunned sea turtles and then call the hotline to seek help."



Invisible Coral Flows

Vicente I. Fernandez, Orr H. Shapiro, Melissa S. Garren, Assaf Vardi, and Roman Stocker, Massachusetts Institute of Technology, Cambridge

FIRST PLACE PHOTOGRAPHY

The swirling patterns moving around these coral polyps may look like fireworks streaking across a long-exposure photograph—but they are the result of a cunning technique that uses false colors to help compress time and movement into a single picture.

The image shows two *Pocillopora damicornis* polyps roughly 3 millimeters apart, colored pink. To reveal how the corals' wafting cilia beat the water into a vortex, the team tracked particles in the water by video and super-imposed successive frames to highlight the flow (gold). About 90 minutes later, the coral polyps have changed position (shown in purple), altering the water flow (cyan), "but the vortex stayed roughly the same," says Massachusetts Institute of Technology environmental engineer Vicente Fernandez, part of the research team that produced the image. The spacing between points in the vortex tracks even reveals the speed of the particles, he adds: "Up close you can see the steps of individual particles, see where the flow is strongest." Fernandez says that the team drew inspiration from the palette used by Andy Warhol in his *Flowers* prints, which feature vivid, strongly contrasting colors.

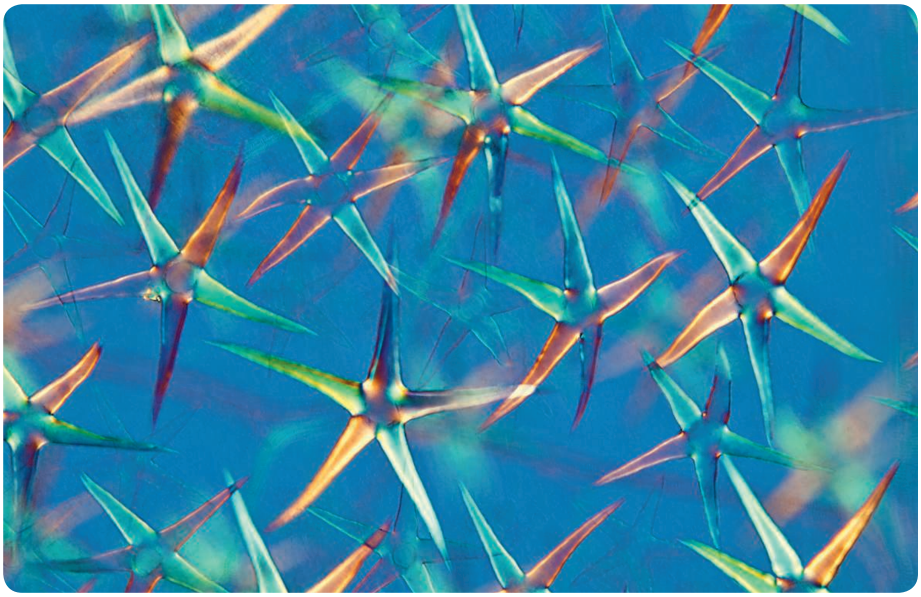
The vortex helps draw nutrients toward the coral and sweep away waste products, says Fernandez's colleague Orr Shapiro, an ecologist at the Weizmann Institute of Science in Rehovot, Israel. "Everywhere I look at corals now I find these vortical swirls," he adds.

"This was a unanimous winner," says judge Alisa Zapp Machalek. "It's a striking image—but it also represents an aspect of nature that, to our knowledge, had never been captured before."

Honorable Mention

Stellate leaf hairs on *Deutzia scabra*

Steve Lowry Photography, Portstewart, Northern Ireland, U.K.



These exuberant starbursts shoot from the leaves of *Deutzia scabra*, a deciduous shrub sometimes known as "Pride of Rochester." Its leaves are covered with tiny hairs tipped by stars a quarter-millimeter across, giving it a fuzzy texture that Japanese woodworkers sometimes use for fine polishing.

Microscopist Steve Lowry created the image's vibrant hues using polarized light microscopy and emphasized the blue color by filtering the light through a crystal of selenite (calcium sulfate). He has been interested in this 19th century technique since 2007, when he produced an exhibition of images from Victorian microscope slides.

Lowry says that the image shows how this microscopy technique, whose use has waned in recent years, can still be a valuable tool in plant taxonomy. By revealing variations in the stars' density, size, and shape, for example, it can help distinguish the more than 20 different species of *Deutzia*. But it also offers aesthetic insight, he says, introducing people "to the hidden beauty of plants not visible to the human eye."

People's Choice

Polymer Micro-structure Self-assembly

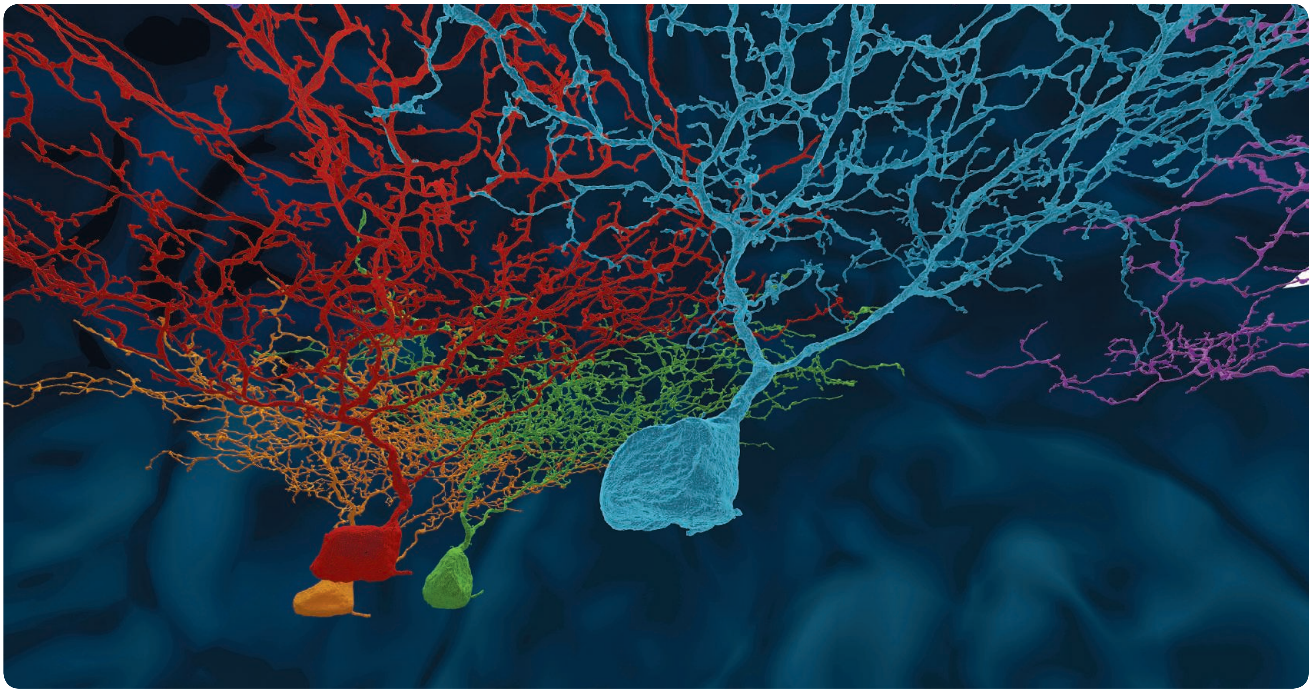
Anna Pyayt and Howard Kaplan, University of South Florida, Tampa

Is this an alien microbe, glowing with unearthly vitality? Or perhaps an aerial shot of Manhattan Island after a catastrophic flood? In fact, it shows the microstructure of a 2-millimeter-long fragment of self-assembled polymers, which University of South Florida materials scientist Anna Pyayt is using to build miniature "lab-on-a-chip" devices for biomedical diagnostic applications.

Processing combinations of polymers at various temperatures or humidities creates completely different textures, she explains, which can help to control the movement and proliferation of cells inside the devices. The digitally enhanced micrographs are even more revealing after Howard Kaplan at the university's Advanced Visualization Center turns them into 3D images. "We have been using a huge 20-megapixel 3D-visualization wall to study little details and nuances of topographies that we produce in our experiments," Pyayt says. With the help of a 3D printer, they have even turned the images into tactile objects the size of a candy bar.

"To see this complex, rich structure with so many little details was amazing," Pyayt says. "The first word that we usually hear is 'Wow.' "

Published by AAAS



EyeWire

Mark Richardson, William Silversmith, Matthew Balkam, Jinseop Kim, Amy Robinson, Alex Norton and H. Sebastian Seung, EyeWire, Massachusetts Institute of Technology, Cambridge

Swamped by a deluge of data, some labs are using the power of crowds to make sense of their results. These citizen science projects ask nonspecialists to analyze real research data, often by looking for patterns that computers are unable to spot. Some of the most successful efforts turn the task into games, fostering a sense of competition that can keep players hooked.

EyeWire is one of the fastest growing citizen science projects ever created. After going live in December 2012, "we got to 100,000 players on our first birthday," says Amy Robinson, the project's creative director. "It solves a big technical bottleneck in neuroscience—reconstructing neuron circuits."

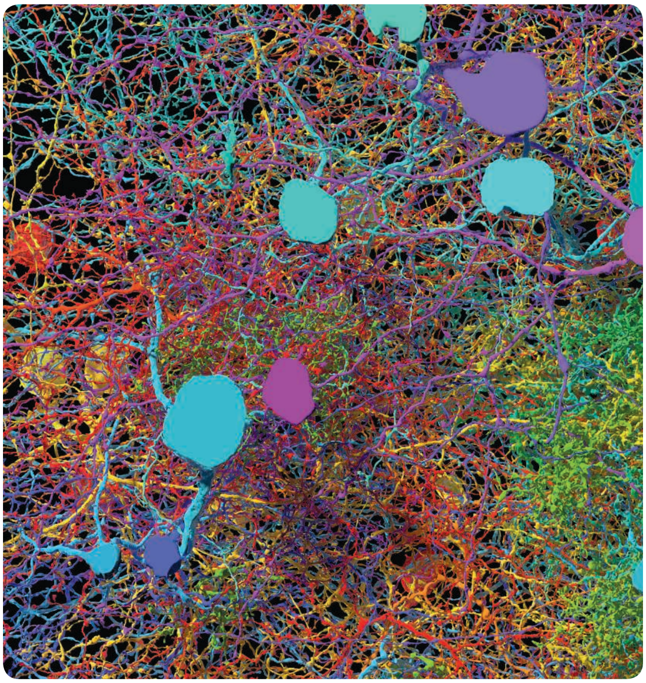
Run from the lab of Massachusetts Institute of Technology neuroscientist H. Sebastian Seung, the game presents players with micrographs that show the neurons in a mouse's retina. The goal is to distinguish the twists and turns of a particular neuron in 3D, in order to build up a complete map of the complex connections involved in vision.

FIRST PLACE
GAMES & APPS

It's proved difficult to develop artificial intelligence software that can do the job, whereas the army of human volunteers can use subtle contextual clues, such as jagged edges or discontinuities, to delineate each neuron. Seung's team is using the EyeWire maps to help them understand how the eye detects motion, and their first paper using the game's results is now under review.

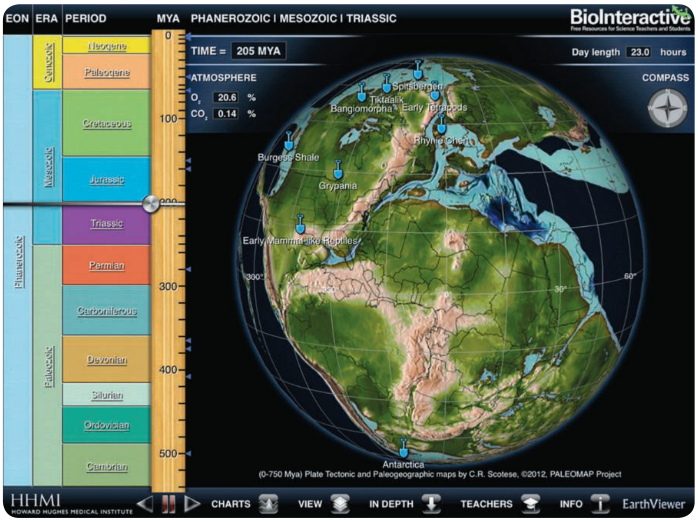
One of the game's biggest strengths is the close collaboration between the EyeWire team and their recruits—everyone is consulted before new features are introduced, for example. "I'm constantly amazed by the community we've built," Robinson says. EyeWire is proof that games have become a powerful force in science communication, says judge Lori Kozlowski: "You're able to reach the public in a way that allows them to become much more comfortable with the science."

Visit the website at eyewire.org.



Honorable Mention
EarthViewer

Mark Nielsen and Satoshi Amagai, Howard Hughes Medical Institute, Chevy Chase, Maryland; Michael Clark, EarthBuzz Software Pte Ltd., Singapore; Blake Porch; Dennis Liu, Howard Hughes Medical Institute, Chevy Chase, Maryland



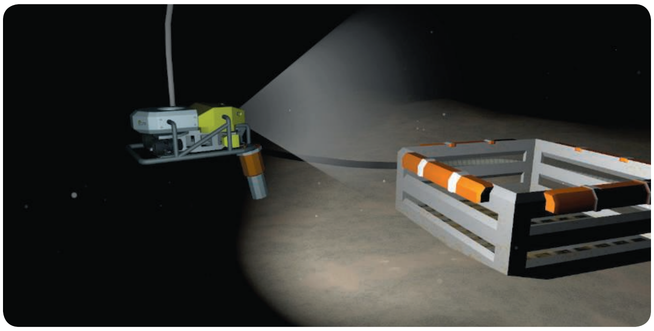
EarthViewer is an iPad app that puts our planet's deep history at your fingertips. You can scroll through billions of years in a few seconds, watching how continents shift and how changes in solar luminosity, atmospheric composition, and climate interact. A simple swipe across the screen rotates this virtual Earth, letting you explore at will. The app also comes with profiles of the creatures that inhabited the ancient Earth and allows you to zoom in on where their fossils were found.

Developed by the Educational Resources Group at the Howard Hughes Medical Institute, it is intended primarily as a teaching tool in high school. But it is pretty addictive for inquisitive adults, too—even those who have always had trouble telling the Paleocene from the Pliocene.

Visit the website at www.hhmi.org/biointeractive/earthviewer.

Honorable Mention
Deep-sea Extreme Environment Pilot (DEEP)

Daniel Rohrlick, Eric Simms, Cheryl Peach, and Debi Kilb, Scripps Institution of Oceanography, San Diego, California; Charina Cain, Birch Aquarium at the Scripps Institution of Oceanography, San Diego, California



This educational game enables budding deep-sea explorers to guide a remotely operated vehicle (ROV) as it studies a virtual hydrothermal vent. Giant tubeworms sway gently as an eel swishes past; a nosy octopus even comes over for a look. As the ROV moves through its 3D environment, the pilot can take temperature readings, snap pictures, and grab samples with the craft's robot arm to complete a series of research missions.

Educators at the Scripps Institution of Oceanography developed the interactive game to inspire middle school pupils. It offers the same freedom afforded by commercial "open world" games, allowing users to explore at their own pace. Its appeal is not limited to schoolchildren, notes Daniel Rohrlick, one of the developers: "Even ROV pilots enjoy the game."

Visit the website at siogames.ucsd.edu/deep.html.

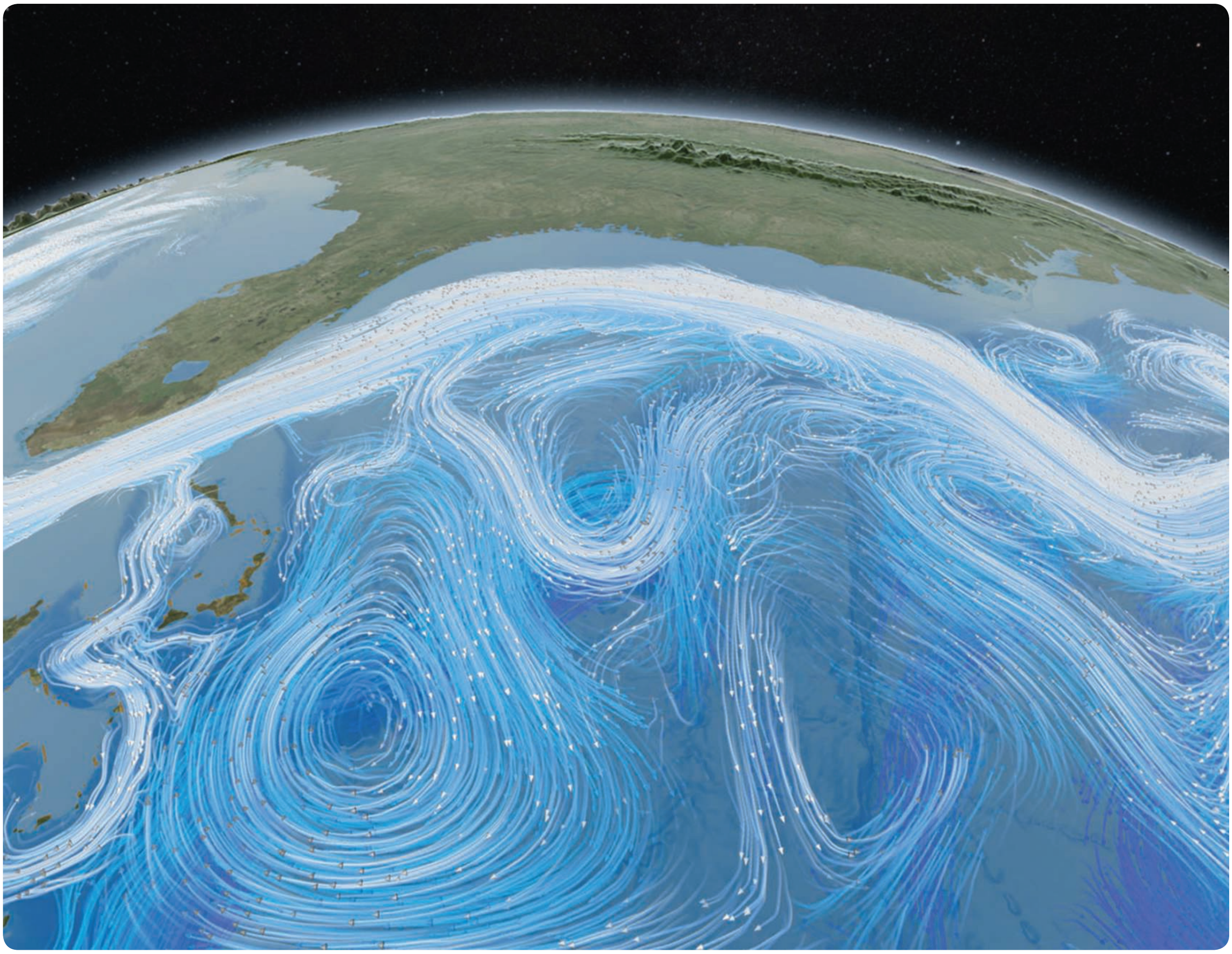
People's Choice
Meta!Blast: The Leaf

Eve Syrkin Wurtele, William Schneller, Paul Klippel, Greg Hanes, Andrew Navratil, and Diane Bassham, Iowa State University, Ames

"Most people don't expect a whole ecosystem right on the leaf surface," says Eve Syrkin Wurtele, a plant biologist at Iowa State University. Meta!Blast: The Leaf, the game that Wurtele and her team created, lets high school students pilot a miniature bioship across this strange landscape, which features nematodes and a lumbering tardigrade. They can dive into individual cells and zoom around a chloroplast, activating photosynthesis with their ship's search lamp. Pilots can also scan each organelle they encounter to bring up more information about it from the ship's BioLog—a neat way to put plant biology at the heart of an interactive gaming environment.

This is a second recognition for Meta!Blast, which won an Honorable Mention in the 2011 visualization challenge for a version limited to the inside of a plant cell.

Visit the website at www.metablast.org/scivis2013.



Coronal Mass Ejection and Ocean/Wind Circulation

Greg Shirah, Horace Mitchell, and Tom Bridgman, NASA Goddard Space Flight Center Scientific Visualization Studio, Greenbelt, Maryland

FIRST PLACE VIDEO

Like a million-strong armada, solar particles hurtle toward Earth—and we are flying with them. The planet's magnetic field forms a safe cocoon against the invaders, but the sun's warmth permeates our atmosphere, and we can see how it drives wind patterns in immense loops and whorls. Our flight ends with a plunge into the ocean, exploring the majestic structure of the Gulf Stream, which our guide tells us "carries enough heat energy to power the industrial world a hundred times over." It truly is an immersive experience.

The video segment is just part of a longer film called *Dynamic Earth: Exploring Earth's Climate Engine* that has played to audiences in planetaria around the world. "It's one of the top visualizations we've ever done," says Horace Mitchell, who leads NASA's Scientific Visualization Studio.

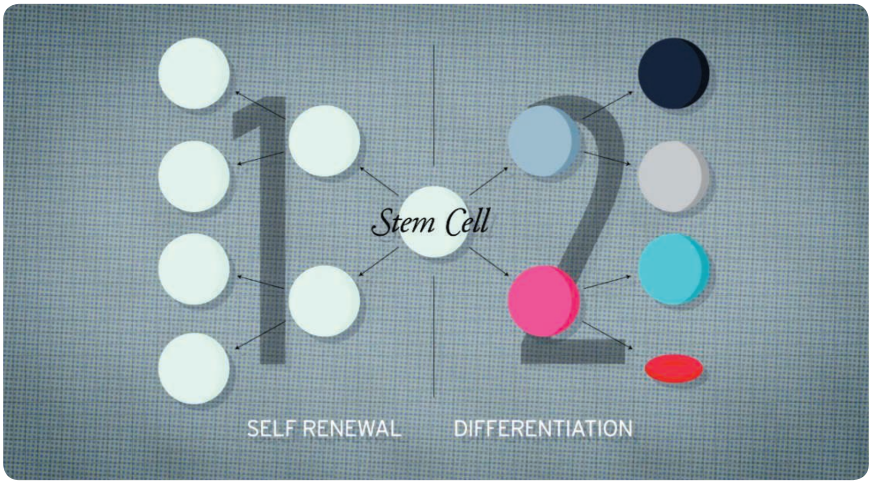
The film took about a year and a half to produce, using real satellite data and six computational models to create a vision that is both beautiful and scientifically accurate. Its long, swooping scenes reveal how different parts of the climate system interact at very different scales. "I was impressed by how the video was able to connect phenomena starting at the sun down to planet Earth," says judge Alisa Zapp Machalek.

Mitchell uses the same production software as commercial studios such as Pixar. But unlike animators, who see only what they plan and create, his team is often surprised by what their virtual creations reveal: "After we put the data in, we say 'Wow, we didn't know it was going to look like that.' "

Watch the video at www.youtube.com/watch?v=ujBi9Ba8hqs.

Honorable Mention
StemCellShorts

Ben Paylor, Michael Long, Jim Till, Janet Rossant,
Mick Bhatia, David Murawsky, and James Wallace,
Stem Cell Network, Ottawa



"In an animated medium, almost anything is explainable within 60 seconds," says Ben Paylor, a Ph.D. candidate at the University of British Columbia, Vancouver, in Canada. Witness these three 1-minute videos, created by Paylor and Michael Long, a postdoctoral fellow at the University of Toronto, to introduce a lay audience to stem cells in their embryonic and induced pluripotent forms.

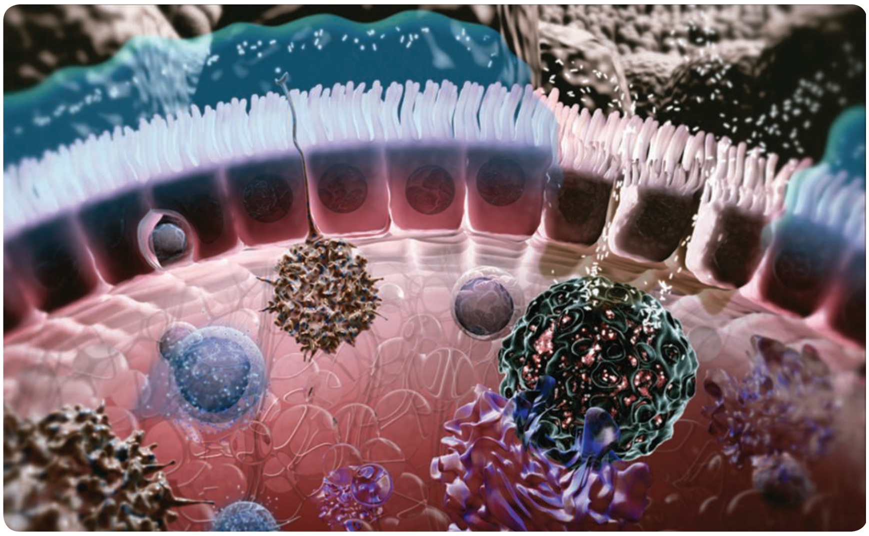
Paylor and Long co-founded InfoShots, an animation studio based in Vancouver, to turn complicated science into compact, digestible films. After winning a grant from the Stem Cell Network, which funds applied stem cell research across Canada, they recruited eminent scientists to help script and voice these slick animations. "It was pretty amazing to hear Jim Till explain the experiments that he and Ernest McCulloch performed in the 1960s, which led to the discovery of stem cells," Long says.

Paylor and Long are now expanding the series to cover adult and cancer stem cells, as well as ethical issues surrounding stem cell research, in the hope that it will help foster informed public dialogue about the implications and future of the work.

Watch the video at youtu.be/_hbgeQzmU9U.

Honorable Mention
Immunology of the Gut Mucosa

Doug Huff and Elizabeth Anderson, Arkitek Studios, Seattle, Washington; Zoltan Fehervari, *Nature Immunology*, London; Simon Fenwick, *Nature Reviews*, London

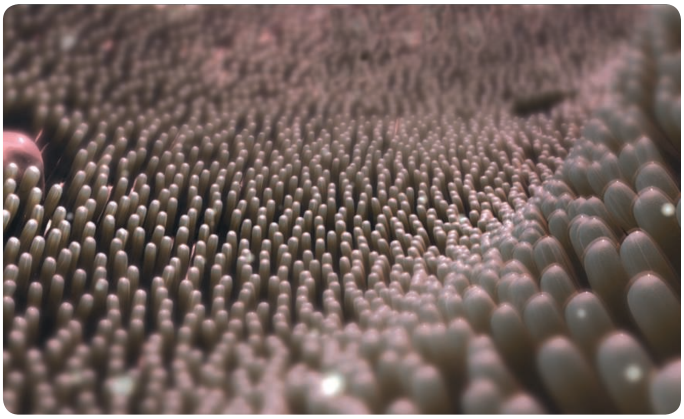


If James Cameron's long-delayed remake of the '60s sci-fi classic *Fantastic Voyage* ever hits the big screen, it might look something like this. After hurtling down a virtual throat, the 7-minute animation takes us on a tour around the gut—home to the body's largest population of immune cells—where a few hardy pathogens are beginning to cause trouble.

The film guides us deftly through the complex cast of characters that unite to battle the bacteria: T cells, macrophages, neutrophils, and more. Some of these iridescent warriors fizz with messenger molecules, while others pulse with deadly energy before exploding to destroy the bacteria. The video also shows how disorder in the ranks of immune soldiers can lead to problems such as inflammatory bowel disease.

"We've had a wonderful response, particularly from people suffering from complications of the gut who've expressed satisfaction at finally having a window on what's going on inside them," says Beth Anderson, CEO of medical visualization company Arkitek Studios, which created the video.

Watch the video at www.youtube.com/watch?v=gnZEge78_78.

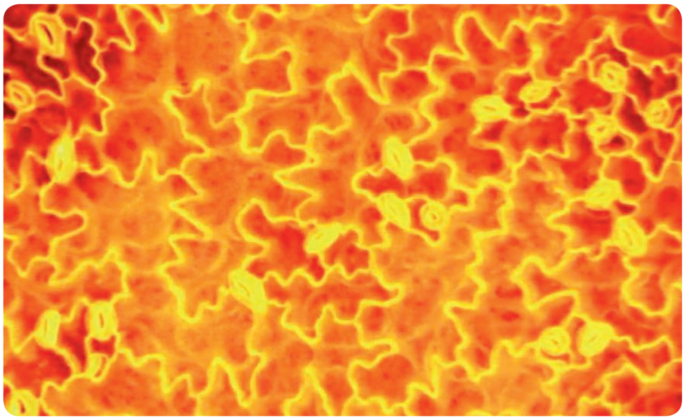


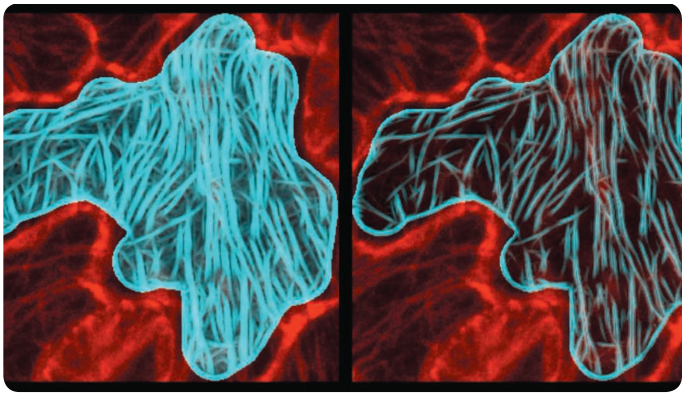
Published by AAAS

Honorable Mention

Visualizing Leaf Cells from Within

Geoffrey J. Harlow, Shuo Li, Albert C. Cruz, Jisheng Chen, and Zhenbiao Yang, University of California, Riverside





Leaves come in a dazzling variety of shapes and sizes, and Geoffrey Harlow wants to know why. As a Ph.D. candidate at the University of California, Riverside, Harlow is studying the genetic factors that influence the architecture of pavement cells, which form a strong interlocking layer across a leaf's surface and help determine its overall shape.

Looking at endless microscopy images to work out how a particular genetic mutation affected the pavement cells of the workhorse lab plant *Arabidopsis thaliana* was subjective, and time-consuming. So Harlow worked with electrical engineer Albert Cruz to develop an automated system to identify the shapes of the pavement cells and the orientation of their internal skeleton of microtubules. "I was extremely shocked at how quickly the software could speed up analysis," Harlow says. The system is more than 900 times faster than a human poring over each image, he estimates.

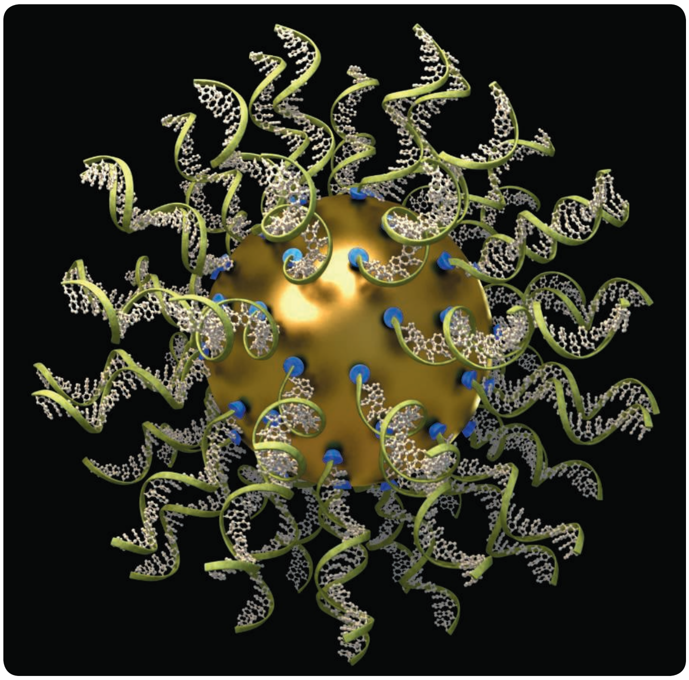
Harlow used free editing software to create this explanatory video about his research. The 3-minute presentation offers enough detail to satisfy fellow plant biologists, while being accessible enough for anyone to glean the import of his work. "Even my 89-year-old grandma now has a basic understanding of the pavement cell system," Harlow says.

Watch the video at youtu.be/tlc02tFoZ40.

People's Choice

Spherical Nucleic Acids

Quintin Anderson, The Seagull Company, Midland, Texas; Chad Mirkin and Sarah Petrosko, Northwestern University, Evanston, Illinois



The floating golden sphere, bristling with corkscrew strands of RNA, drifts majestically toward the jostling lipid bilayer that surrounds a cell. Slowly, gently, it squeezes through the layer until it is inside the cell.

Breezing across cell membranes is just one talent of these spherical nucleic acids (SNAs) developed by nanotechnology pioneer Chad Mirkin at Northwestern University. Once inside a cell, they can fend off attacks from enzymes, which makes them hot prospects as vehicles for delivering gene therapy treatments. SNAs also bind strongly to complementary strands of genetic material, an ability being used in a commercial medical diagnostics system called Verigene.

Mirkin commissioned Quintin Anderson, creative director at scientific animation firm The Seagull Company, to create a video explaining his research to colleagues and funders. The toughest part, Anderson says, was creating the lipid bilayer. "There are hundreds of thousands of lipids in those scenes and it required a complicated mathematical algorithm to create the random movements."

Watch the video at www.youtube.com/watch?v=YxRQ1-MI24g.

Published by AAAS

2013 Visualization Challenge

Science **343** (6171), 600-610.
DOI: 10.1126/science.343.6171.600

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. The title *Science* is a registered trademark of AAAS.