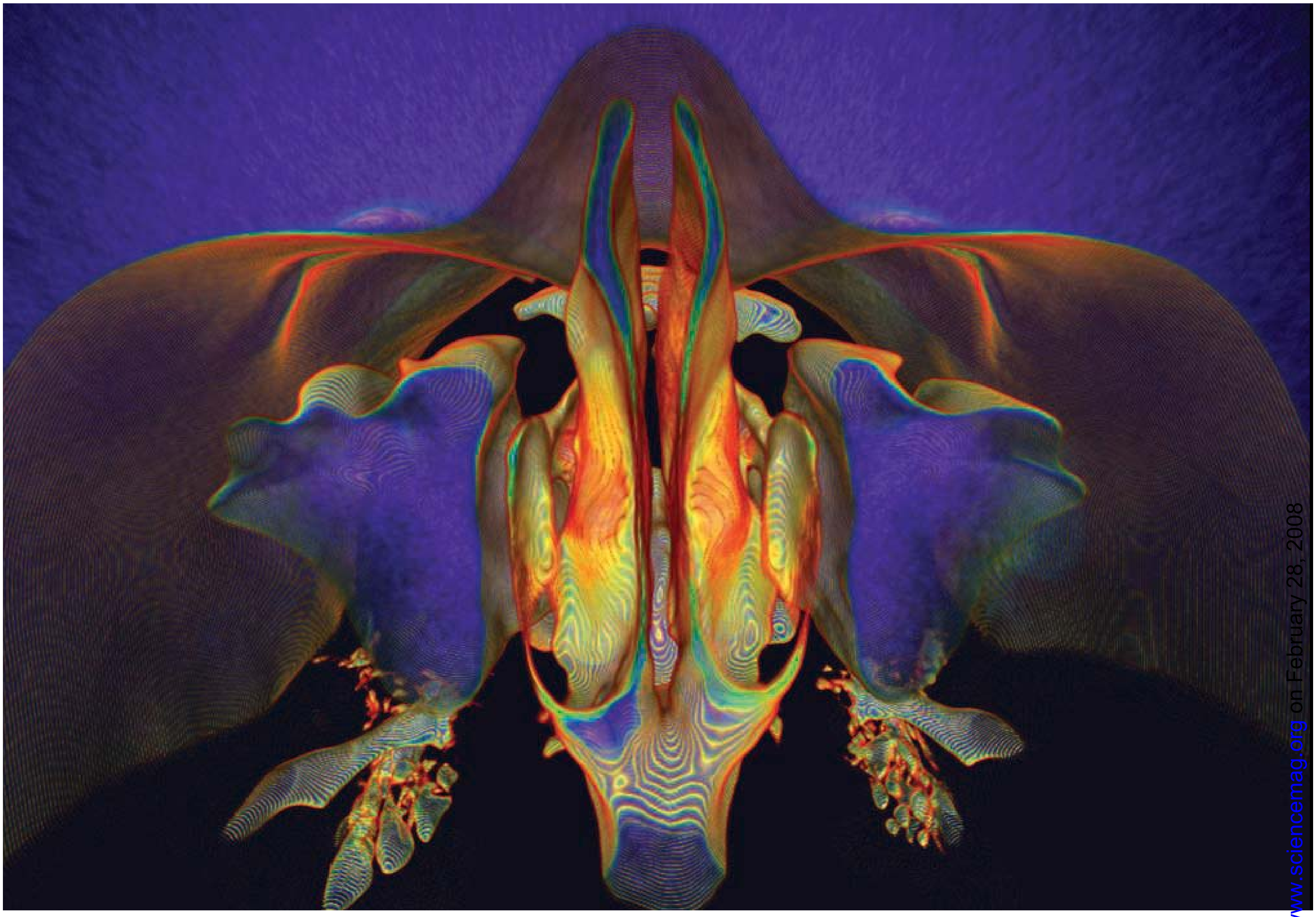

Photography

FIRST PLACE (TIE)

WHAT LIES BEHIND OUR NOSE?

Kai-hung Fung, Pamela Youde Nethersole Eastern Hospital

2007 Visualization Challenge

HUMAN ANATOMY IT MAY BE, BUT THE AIRWAYS THAT RIDDLE THE SPACE BEHIND OUR noses take on an alien aspect in this unearthly rendering created by Kai-hung Fung, a radiologist at the Pamela Youde Nethersole Eastern Hospital in Hong Kong.

A computed tomography (CT) scan from a 33-year-old Chinese woman being examined for thyroid disease provided the raw data for Fung's rendering. He stacked together 182 thin CT "slices" to create a 3D image looking upward at the sinuses from underneath the head.

Fung chose to use the patient's CT images for his rendering, he remembers, because "[she had] a very straight nasal septum and wavy maxillary sinuses; … the anatomy was exceptionally beautiful," he says.

Normally, CT renderings meld slices together into smooth surfaces, but, in what he terms the "Rainbow Technique," Fung instead broke them apart, creating a topographical map of the airspaces described by the contour lines of individual slices, and colored according to the density of the tissues that border them.

Fung digitally removed the bones, soft tissue, and fat from the rendering to create a solid "cast" of the sinuses' air envelope. "The sinuses are hollows in the bone just like the central cavity in a papaya," he says. One way to get a feel for the shape of such a cavity is to look at a cross section of it, but, he says, it's much more readily apparent in a mold.

The upward-looking angle that Fung used was fascinating, says panel of judges member Sherry Marts. "You react [to the image] on two levels; it piques your curiosity … and then draws you in to the information that's contained in [it]."

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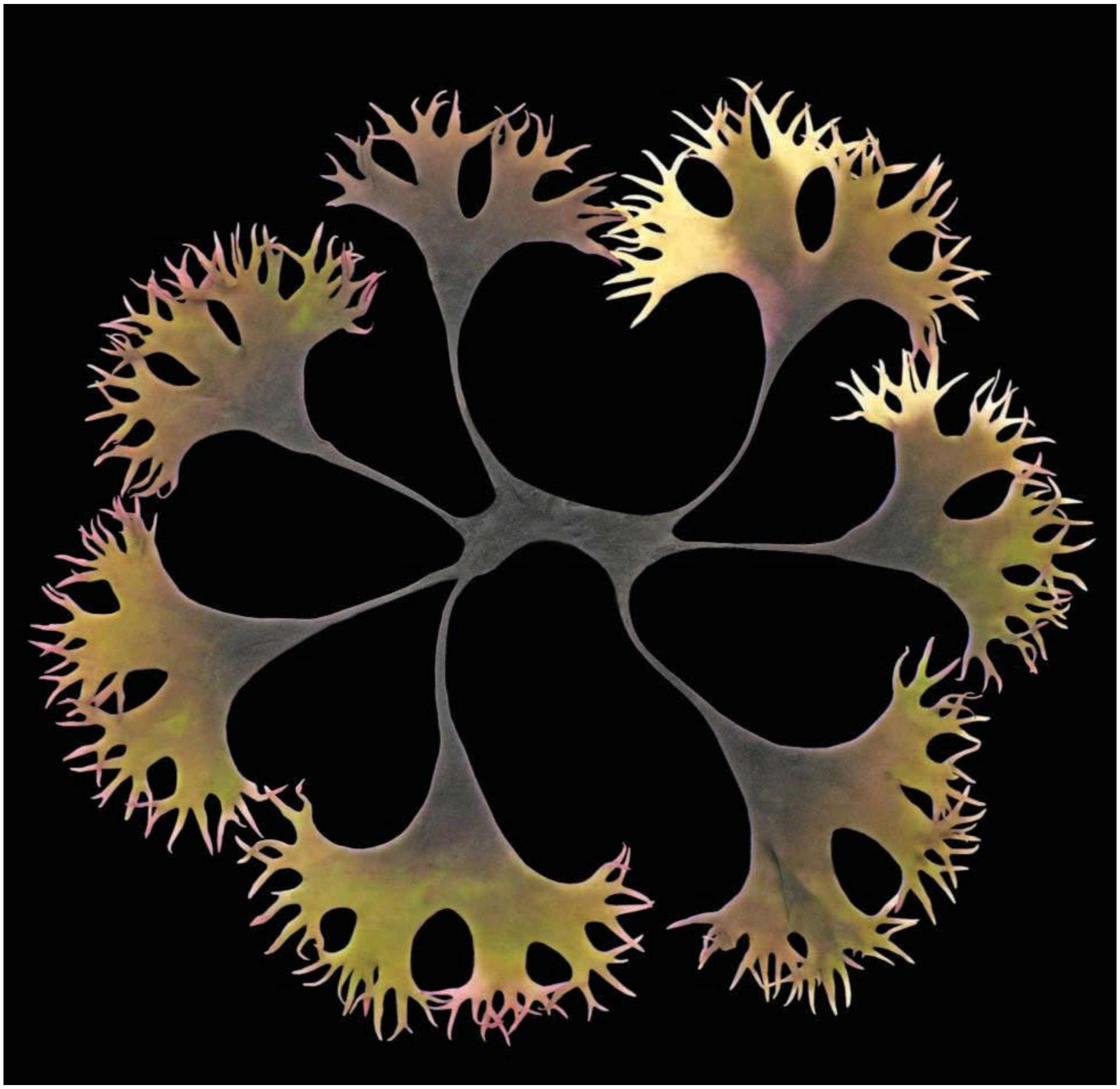


FIRST PLACE (TIE)

IRISH MOSS, *CHONDRUS CRISPUS*

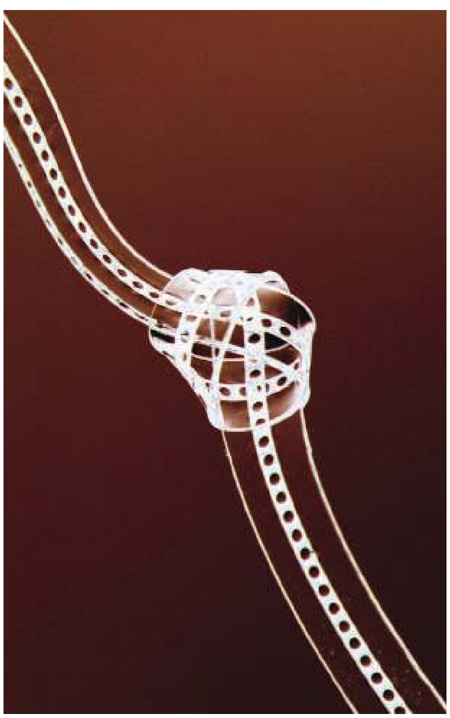
Andrea Ottesen, University of Maryland

THE SLIMY, GLISTENING MASS OF seaweed washed up on a sandy beach seems light-years distant from this feathery, dendritic image of Irish moss (*Chondrus crispus*) created by Andrea Ottesen, a botanist and molecular ecologist at the University of Maryland, College Park. "If you pull *Chondrus* out of the ocean, it's folded on itself—really curled up," she says. It wasn't until after she had "pressed every one of those little ends down with sea stones" and left it to dry for 2 days that the seaweed's beautiful, simple shape was revealed.

Ottesen uses only a black background, a Canon ELPH 7-megapixel digital point-and-shoot camera, and natural lighting to photograph many of the plants she encounters in her work. Her winning photo shows a piece of Irish moss she collected off the coast of Cape Breton Island, Nova Scotia, while cataloging the use of kelp products as fertilizers for a sustainable agriculture experiment. "You can get just as good light—or even better—with natural light" than with strobes and spotlights, she says.

The 15-centimeter-wide red algae seems exotic in this abstract portrait, but it is ubiquitous both in nature and in our day-to-day lives. Besides being one of the most common seaweed species on the Atlantic coast, says Ottesen, Irish moss and algae like it are sources of natural thickeners and stabilizers called carrageenans, which are widely used in processed foods as diverse as lunch meat and ice cream.

"There was this gasp when this photo came up on the screen," says panel of judges member Felice Frankel. "We shouldn't forget that we don't need [complex equipment and techniques] to create beautiful representations."

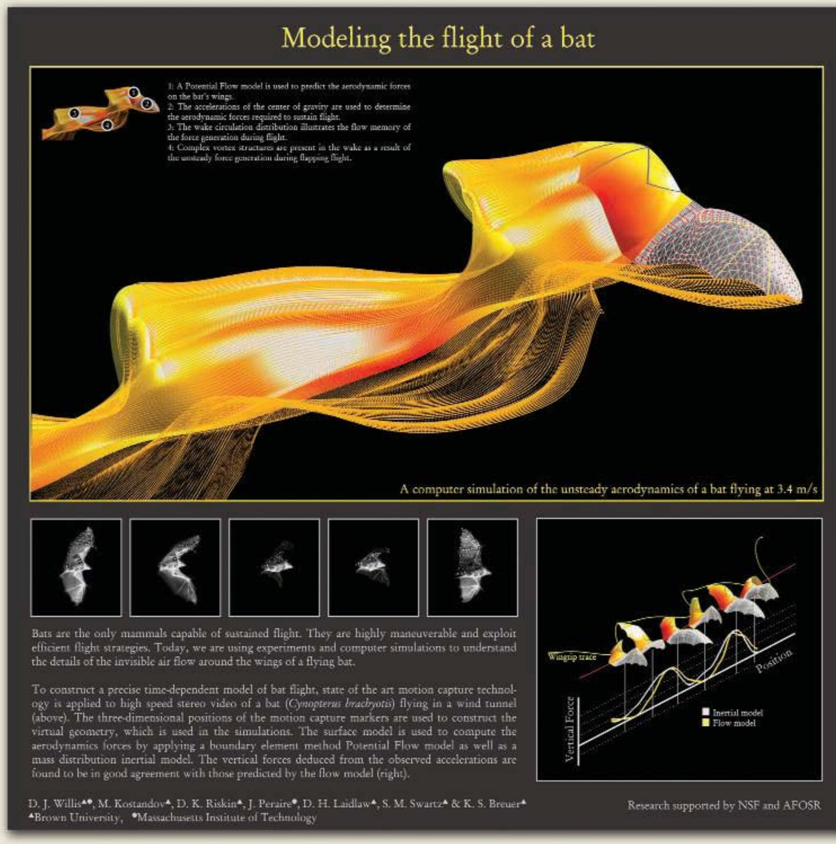


HONORABLE MENTION

TINY METAL PATHWAYS

Adam C. Siegel and George M. Whitesides, Harvard University

IT'S NOT OFTEN YOU SEE A WIRE INTENTIONALLY tied into a knot, especially when that wire is a state-of-the-art microstructure only 200 micrometers wide. However, Adam Siegel and colleagues at Harvard University tangled up their invention to prove a point: Flexibility is key to integrating microelectrical circuits into fabrics, according to Siegel. Rather than extruding the wire, Siegel and colleagues poured molten indium/tin solder into a microfluidic channel in clear silicon and allowed it to cool. Depending on the solder composition, he says, the wire can be solid or flexible, and any breaks can be healed by simply reheating it.



FIRST PLACE

MODELING THE FLIGHT OF A BAT

David J. Willis, Brown University/MIT, and Mykhaylo Kostandov, Brown University

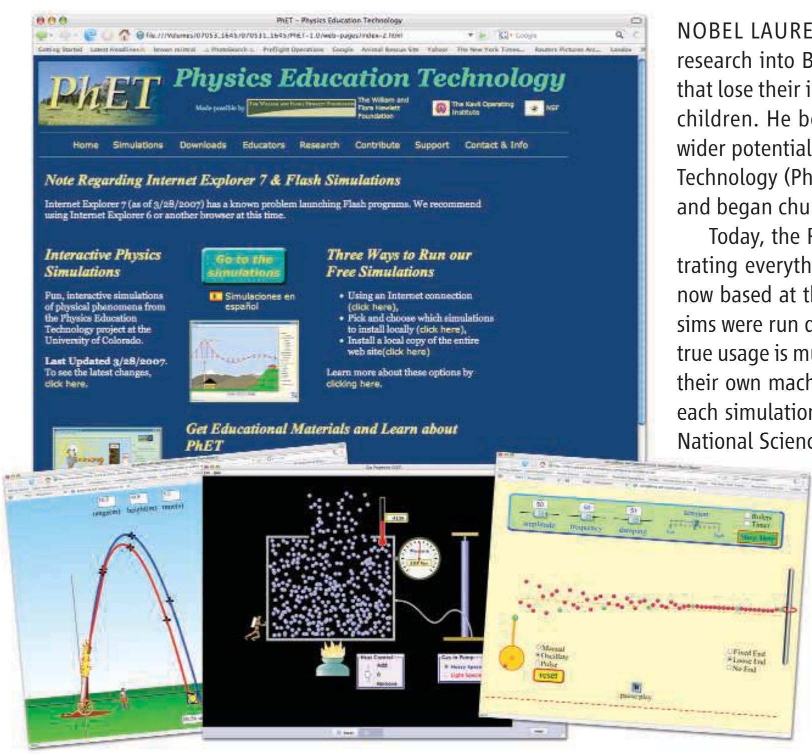
MOST SHORT-NOSED FRUIT BATS (*Cynopterus brachyotis*) spend their nights flitting about in the jungles of Southeast Asia. However, some of the tiny creatures, which weigh less than 50 grams fully grown, lead an altogether different existence: flitting about in wind tunnels under the watchful eyes of aerodynamics researchers.

Interested in the tiny mammals' flight dynamics, Brown University engineer Kenneth Breuer used lasers and a sophisticated multicamera motion-tracking system to record how their wings and the air around them distorted as the animals flapped against the wind. Based on the experiments, aeronautical engineer David Willis, who has a joint appointment at Brown and MIT, Brown computer scientist Mykhaylo Kostandov, and their colleagues created a computer model of bat flight—visually conveyed in this poster.

"When viewed in slow motion," says Willis, "bat flight is beautiful and complex. The goal of this illustration is to capture that beauty while also adding scientific merit."

"You didn't have to read anything; the poster conveyed information … from across the room," says panel of judges member Sherry Marts. Judge Gary Lees likens the main image to "silk blowing in the wind."

Interactive Media



NOBEL LAUREATE CARL WIEMAN WAS LOOKING FOR A WAY TO EXPLAIN HIS research into Bose-Einstein condensates—strange assemblies of supercold atoms that lose their individuality and form "superatoms"—to both physicists and schoolchildren. He began creating computer simulations, but he swiftly realized their wider potential for teaching physics of all types and initiated the Physics Education Technology (PhET) project at his then-home of the University of Colorado, Boulder, and began churning out simulations.

Today, the PhET Web site lists 65 simulations available for free download, illustrating everything from quantum tunneling to projectile motion. Wieman, who is now based at the University of British Columbia in Vancouver, says several million sims were run directly off the Web site in the first 6 months of this year, but says the true usage is much higher, because most people download the sims and run them off their own machines. At a cost of between $10,000 and $50,000 to create and test each simulation, the project is a considerable enterprise, bankrolled at first by the National Science Foundation and later by a medley of sources, including Wieman's own Nobel money. "They're not cheap to do right," he says.

However, Wieman and team got what they paid for. "Some of the principles of physics have never been as well depicted and elucidated," says panel of judges member Gary Lees.

FIRST PLACE

PHYSICS EDUCATION TECHNOLOGY PROJECT (PhET)

Carl Wieman and the PhET team, Univ. of Colorado, Boulder

Informational Graphics

WHAT TIES LIFE FORMS TOGETHER? Visitors to the Exploratorium in San Francisco, California, discover that life has four basic traits: Life needs energy; all life shares common materials; life creates more life; and life changes over time. Unveiled in 2003, the "Traits of Life" exhibit has been hugely popular, even spawning a traveling road show. This poster sprang from the drive to provide examples of the ways in which life uses energy. Geared toward high school students, it explains the cycle that muscles use to "turn energy into motion."

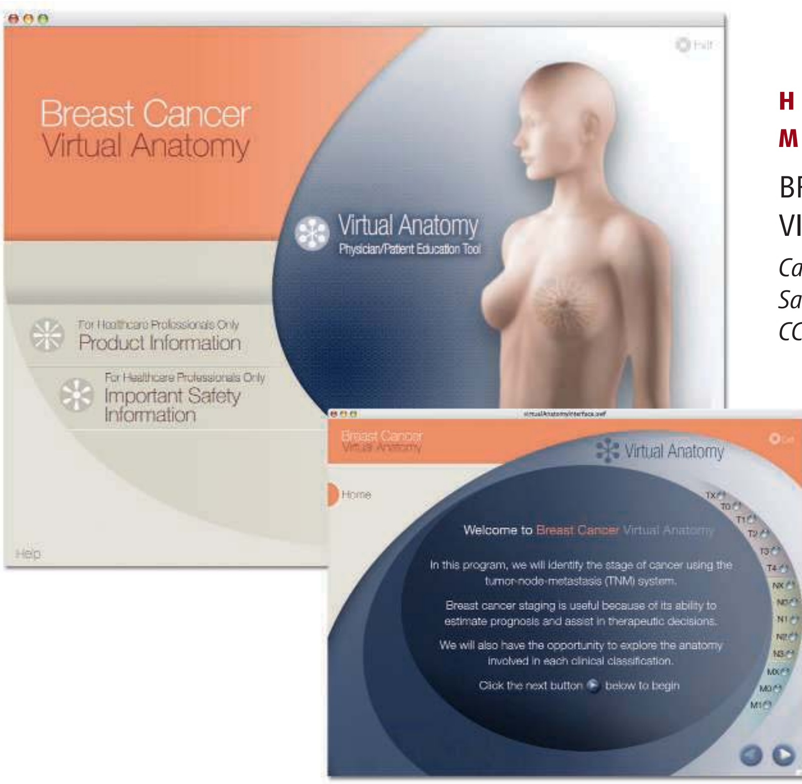
Graphic designer Mark McGowan, scientific illustrator David Goodsell, and their Exploratorium colleagues use the example of gripping a baseball to explain how muscles work. Zooming in on a chunk of hand muscle with a magnification power of 200,000, the exactly scaled poster shows how club-headed molecules of myosin use energy from ATP to repeatedly grab long filaments of actin and drag them toward each other "like a ship's crew pulling a rope hand over hand." Repeated trillions of times in all the muscle fibers of the hand, the result is a baseball that doesn't fall to the floor.

The Exploratorium has distributed the poster widely, in part by including it in the winter 2003 issue of *Exploratorium Quarterly*, to nearly 20,000 members, subscribers, and teachers.

HONORABLE MENTION

HOW DOES A MUSCLE WORK?

Mark McGowan and David Goodsell, Exploratorium



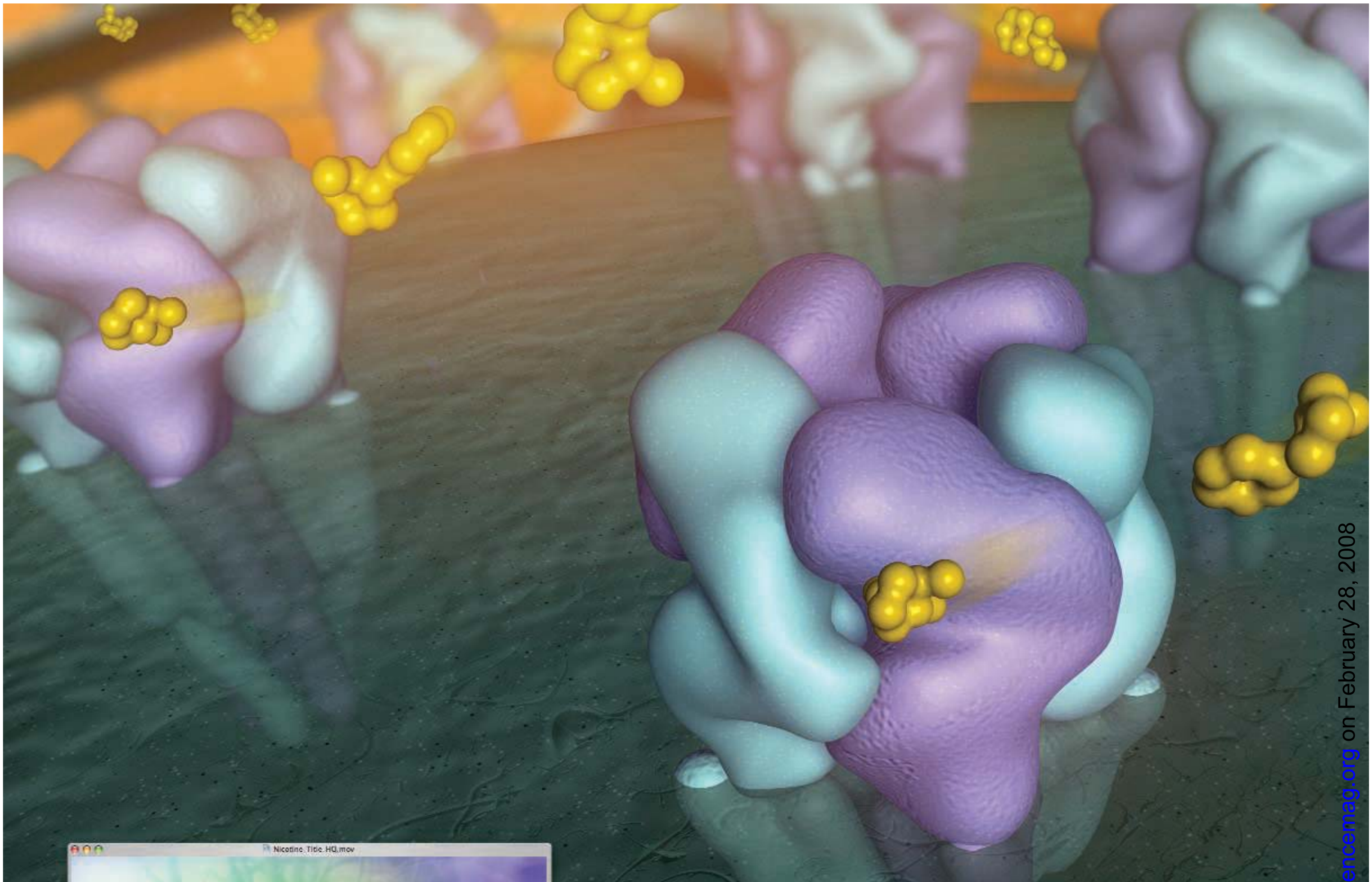
HONORABLE MENTION

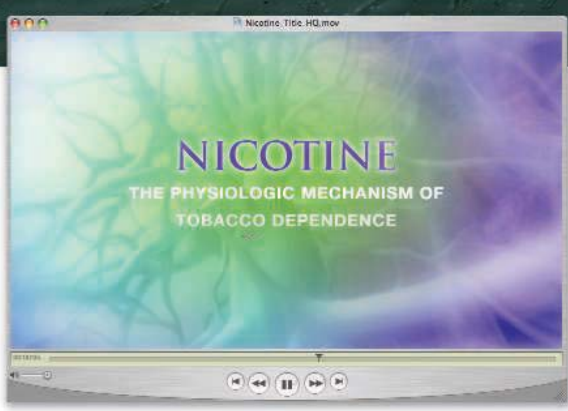
BREAST CANCER VIRTUAL ANATOMY

Cathryn Tune and Samantha Belmont, CCG Metamedia

A VISIT TO THE DOCTOR'S office can be a scary, confusing experience, particularly when the subject under discussion is chemotherapy's failure to eradicate breast cancer. Cathryn Tune, Samantha Belmont, and their team at CCG Metamedia, a medical education company based in New York City, created this interactive tool to help doctors explain to their patients the anatomy and progression of their cancers in a clear, easy-to-understand manner. The interface allows doctors to select tumor size and level of metastasis and displays the part of the patient's anatomy that cancer is attacking while suggesting treatment options.

The program was created to promote Abraxane, an injectable drug designed to treat patients whose chemotherapy has failed, and was distributed to oncologists during an educational course titled "Difficult Cases in Metastatic Breast Cancer," funded by Abraxis BioScience, the drug's developer.





2007 Visualization Challenge

Noninteractive Media

FIRST PLACE

NICOTINE: THE PHYSIOLOGIC MECHANISM OF TOBACCO DEPENDENCE

Donna DeSmet and Jason Guerrero, Hurd Studios

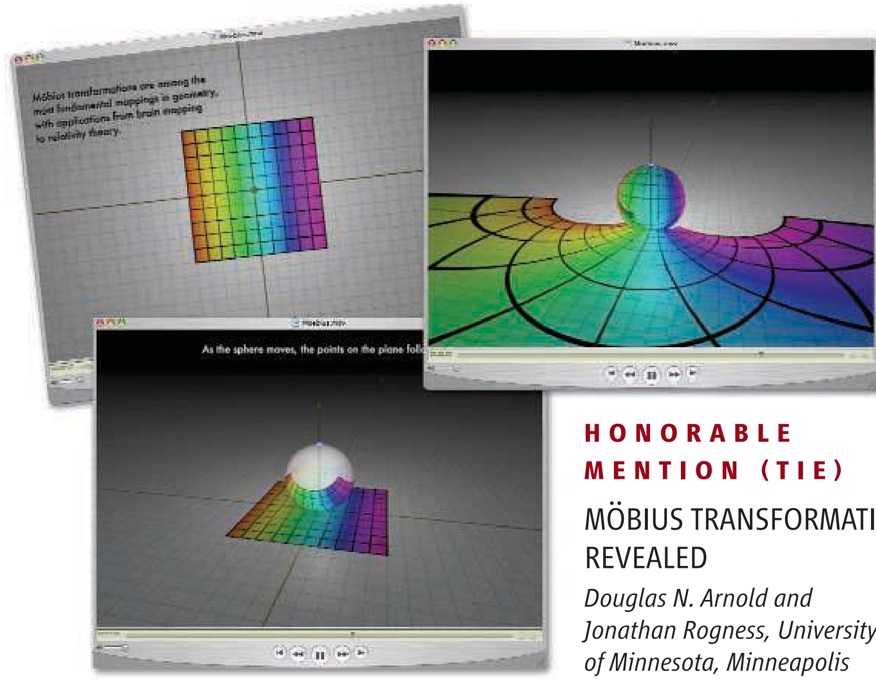
WITH EVERY DRAG A SMOKER TAKES, TRILLIONS OF NICOTINE molecules rush from the lungs to the bloodstream and into the brain, where they bind to $\alpha4\beta2$ nicotinic acetylcholine receptors and stimulate the release of pleasure-inducing dopamine. But as nicotine is eliminated, dopamine levels fall, and smokers begin to crave another dose.

Over time, the brain becomes dependent on the drug, and the result is an addiction that claims 4 million lives a year from emphysema, lung cancer, heart disease, and other smoking-related diseases.

That is the message of this video, created by art director Donna DeSmet, animator Jason Guerrero, and their team at New York City–based Hurd Studios, a scientific visualization company specializing in "cutting-edge science with educational aspects," according to president Jane Hurd.

The video was distributed to physicians worldwide as part of an educational course funded by the pharmaceutical company Pfizer, which manufactures the smoking-cessation drug Chantix.

Panel of judges member Gary Lees was impressed with the direct simplicity of the video. "[The video] pulled it together," he says, "from the outside world to the molecular level of the addiction."



HONORABLE MENTION (TIE)

MÖBIUS TRANSFORMATIONS REVEALED

Douglas N. Arnold and Jonathan Rogness, University of Minnesota, Minneapolis

ANY REAL NUMBER CAN BE PLOTTED ON A LINE THAT RUNS FROM NEGATIVE TO POSITIVE infinity, but throw in an imaginary component and the line becomes a plane, where complex numbers are plotted on both the real and the imaginary axes. Möbius transformations are mathematical functions that send each point on such a plane to a corresponding point somewhere else on the plane, either by rotation, translation, inversion, or dilation. It may sound confusing, but after watching this simple and elegant explanation of Möbius transformations created by Douglas N. Arnold and Jonathan Rogness of the University of Minnesota, Minneapolis, everything becomes clear. Set to classical music, the video demonstrates the transformations in two dimensions but then backs away and adds a third—placing a sphere above the plane and shining light through it. As the sphere moves and rotates above the plane, suddenly all the transformations become linked, in a way that conveys visually in minutes what would otherwise take "pages of algebraic manipulations" to explain, says Rogness.

HONORABLE MENTION (TIE)

TOWERS IN THE TEMPEST

Gregory W. Shirah and Lori K. Perkins, NASA/GSFC

THE CENTER OF A HURRICANE'S eye may be calm, but its walls are anything but. As NASA's Tropical Rainfall Measuring Mission satellite orbited above the Caribbean in 1998, it captured radar images of vast clouds dubbed "hot towers," stretching up nearly 18 kilometers into the sky, in the eye wall of Hurricane Bonnie as the hurricane moved northwest along the northern edge of the Bahamas. In "Towers in the Tempest," Gregory W. Shirah, Lori K. Perkins, and their colleagues at NASA's Goddard Space Flight Center in Greenbelt, Maryland, use satellite imagery and supercomputer simulations to reveal these hot towers as the hurricane's "express elevators," intensifying the storm as they launch swirling air from the storm's base up all the way to the edge of the stratosphere at 18,000 meters.

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