FIRST PLACE WINNER
AND PEOPLE’S CHOICE

Alya Red: A Computational Heart
Guillermo Marin, Fernando M. Cucchietti, Mariano Vázquez, and Carlos Tripiana, Barcelona Supercomputing Center

From this tangled swirl of fibers, scientists hope to divine the deepest secrets of the human heart. Based on MRI data, each colored strand represents linked cardiac muscle cells that transmit electrical current and trigger a model human heartbeat. The image is an artistic rendering of Alya Red, a new computer model of the heart at the Barcelona Supercomputing Center that marries modern medical imaging techniques with high-powered computing.

Despite centuries of study, scientists are still largely baffled by the heart’s complex electrical choreography, says physicist Fernando Cucchietti, who helped produce the video. When faced with the challenge of presenting Alya Red to a general audience through video, he says, “It took a lot of work to get a script that was engaging, but still scientifically deep enough for an expert eye to see interesting details.” The most challenging part was to get the heart fibers in the image above to move in a realistic way, Cucchietti says. At one point, he says, the animation showed the electrical currents moving backwards. “We had to keep going back to the scientists—did we mess something up?”

“We wanted to create a sense of wonder at the complexity” of the heart itself, he says. The awe wasn’t lost on the judges. “I was literally blown away,” says Michael Reddy. “After the first time I watched the video, I thought, ‘I’ve just changed the way I thought about a heart.’”

HONORABLE MENTION

Observing the Coral Symbiome Using Laser Scanning Confocal Microscopy

No dyes or digital software produced the brilliant color of these corals—the glory is all their own. Fluorescent molecules, innate to the corals and to the red algae that live inside and nourish them, shine like Christmas lights under different wavelengths of light emitted by a confocal microscope.

When she saw the corals under the lens for the first time, “my jaw just dropped,” says Ruth Gates, a coral biologist at the University of Hawai’i, Manoa, and the narrator of the video. “Most people think corals are inanimate rocks,” she says. “We showcase how beautiful and dynamic they are as animals.” In the video, which compiles the images into three-dimensional, time-lapse animations, corals extend and retract their glowing tentacles. Tiny creatures crawl over the corals, all part of a complex and threatened ecosystem. In the future, Gates says, it might be possible to use confocal microscopy to classify different coral species or diagnose coral disease by their fluorescent patterns. Prior to applying this technique, she says, “that was not even a facet in our thinking about coral biology.”
HONORABLE MENTION

Fertilization
Thomas Brown, Nucleus Medical Media

Few narratives in biology are so iconic—or so frequently portrayed—as the epic voyage of the beleaguered sperm to the defensive egg. In most videos about human fertilization, however, “you see little parts of the journey, and then suddenly you see the sperm entering the egg,” says Thomas Brown, chief creative officer of Nucleus Medical Media in Kennesaw, Georgia. “It’s beautiful and iconic, but you don’t really know how you got there.” Given new developments in the science of conception, as well as advancements in digital media, his team decided it was time for a remake. “Fertilization” starts with 300 million sperm, following their perilous journey up the cervix and into the fallopian tube with unprecedented detail and continuity, Brown says. By the time the last few dozen surviving sperm reach the egg, he says, “you’re famished, troubled, and hopeful.” In a new twist based on recent science, he says, the first sperm to reach the egg is rewarded with an embrace, as the egg’s inner membrane encloses and absorbs it.

HONORABLE MENTION

Revealing Invisible Changes in the World
Michael Rubinstein, Neal Wadhwa, Frédéric Durand, William T. Freeman, and Hao-Yu Wu, MIT

A sleeping infant appears still, but its chest subtly rises and falls with steady breathing. A towering crane looks stable, but rocks imperceptibly in the breeze. In this video, a team of computer scientists at the Massachusetts Institute of Technology in Cambridge demonstrates a new method of magnifying subtle changes normally invisible to the eye. “What the microscope did for visualizing minute objects, we hope to do for minute motions and changes,” says Ph.D. student Michael Rubinstein. Using video as input, the team analyzes each pixel for slight variations in color over time—for example, rhythmic reddening in a man’s face as blood pulses through his veins. Then they apply an algorithm that magnifies the variation, and extract the information they need. By amplifying the man’s slight blush, for example, they were able to obtain his heartbeat. Among other applications, they say, the technique could help doctors take their patients’ vital signs remotely.