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A New Wave SCIENCE AND ART MEET IN THE SEA

BY CHERYL LYN DYBAS

Stay along the coast, offers the ad. Enjoy views of bald eagles, great blue herons, and ospreys. But this is no vacation condo promotion. It's a flyer for a University of Mississippi Field Station course, Biology & Art. Students learn scientific illustration techniques and conduct research on the Gulf of Mexico ecosystem.

It's part of a global effort known as transforming STEM to STEAM: science, technology, engineering, the arts, and mathematics.

BRANCHES OF THE SAME TREE: FROM STEM TO STEAM

A recent US National Academies of Sciences, Engineering, and Medicine (NAS) report, *The Integration of the Humanities and Arts with Sciences, Engineering, and Medicine in Higher Education: Branches from the Same Tree*, emphasizes that all disciplines and forms of inquiry are, as Einstein stated, "branches from the same tree."

Faculty and administrators, notes the 2018 report, "are advocating an approach to education that moves beyond the general education requirements found at almost all institutions, to an approach that melds knowledge in the arts, humanities, physical and life sciences, social sciences, engineering, technology, mathematics, and the biomedical disciplines."

The report refers to this new direction as integration. "Advocates of integration see all human knowledge as connected, a network of branches arising from a trunk made up of human curiosity, passion, and drive, but also generative, as new branches split off and grow from old ones, extending into new spaces and coming into contact with other branches in new ways."

Take the idea of in-course integration. That can range from a class that includes a component of another discipline, such as a neuroscience lecture series with an assignment to write a haiku poem about synapses, or an entire course such as design engineering. In such "left brain meets right brain" efforts, integration works well.

In one undergraduate neuroscience course, students who were required to make a three-to-five minute film outperformed those who learned concepts solely through conventional approaches, according to the NAS report. And a course in biochemistry that featured sculpture-building based on how proteins fold allowed students to develop a new understanding of the complex concepts of protein structure.

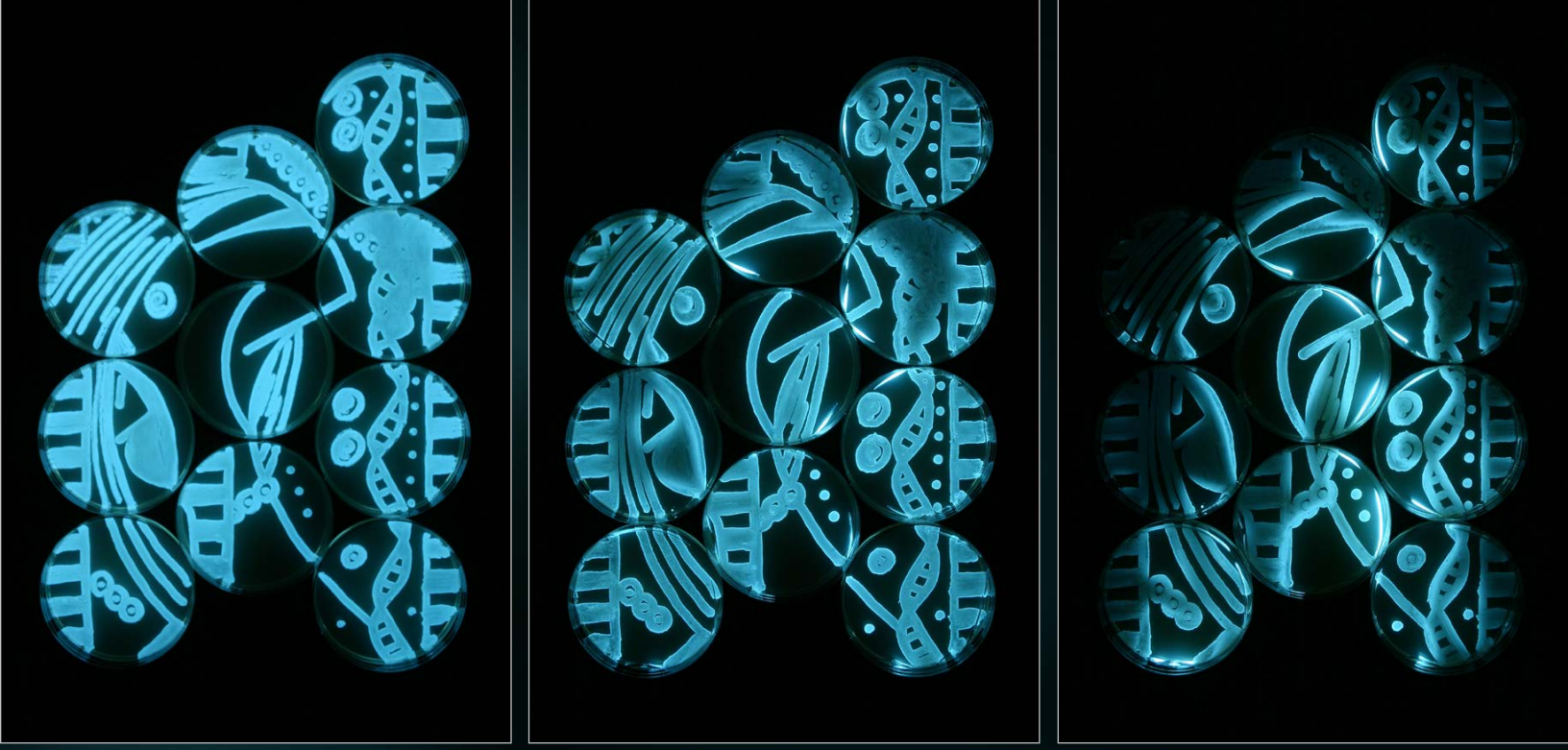
DRAWING WITH LIVING LIGHT: BIOLUMINESCENT BACTERIA

In the marine sciences, STEM has morphed into STEAM in an unusual way in the artwork of Hunter Cole. A geneticist at Loyola University New Orleans, Cole produces paintings that are inspired by science but literally live as art through the otherworldly glow of the bioluminescent bacterium *Photobacterium phosphoreum*.

Photobacterium phosphoreum lives in Pacific rockfish, where it emits bluish light. The rockfish, also called Pacific Ocean perch (*Sebastes alutus*), are widely distributed in the North Pacific from southern California to northern Honshu, Japan, including the Bering Sea. Pacific Ocean perch are abundant in British Columbia, the Gulf of Alaska, and the Aleutian Islands.

Cole cultures *Photobacterium phosphoreum*, then, using a paintbrush, draws the bacteria, which she refers to as her collaborators, into different shapes in a Petri dish. The biologist-artist then photographs the luminescent petri dishes to create what she calls modern works of provocative symbolism.

Bioluminescent bacteria become art. Pictured: A work titled "Insecta." *Image: Hunter Cole*



With a paintbrush, a geneticist–artist draws bioluminescent bacteria into different shapes, then photographs them. Pictured: Series titled "Her Own DNA." In the second and third images, the bioluminescence has begun to dim. *Images: Hunter Cole*

Her subjects include lilies, insects, and other flora and fauna, all seen by the light of bioluminescent bacteria. She often photographs people illuminated by her paintings—onlookers as the bacteria's living light shines then slowly disappears.

"Art and science have always been mutually inclusive for me," says Cole. "Biology serves as a vehicle for expressing my creativity and artistry. Art serves as a motivation to interpret our living world."

In January 2018, a multimedia display at Chicago's ARC Gallery—Living Light: Photographs by the Light of Bioluminescent Bacteria—featured Cole's creations. The exhibit showcased her bioluminescent artworks developed between 2005 and 2017. In addition to looking at bioluminescent photos, visitors watched a time-lapse video of luminous bacteria growing and dying, accompanied by a musical score based on protein sequences in the bacteria.

A SPARK OF AN IDEA

How did Cole come up with the concept of painting with living light? "In 2003, I was an adjunct professor at the University of Wisconsin-Milwaukee, and that's when I started using bioluminescent bacteria in art," she says.

A member of her lab, she recalls, drew a heart in bioluminescent bacteria. "That was such a meaningful symbol," says Cole. "One of the functions of bioluminescence is to attract a mate. Bioluminescence is also important in communication and is integral to many marine predator-prey relationships."

The symbolism and surreal nature of using light created by an organism that lives for a brief time, she says, attracted her to this medium.

Drawing with bioluminescent bacteria is a tricky endeavor, Cole found. "First I make a culture of the bacteria, dipping a paintbrush or Q-tip in liquid and painting on agar in a Petri dish. But it's like painting with invisible ink. You need to wait until the next day to see it glowing—and what you've created." She photographs the paintings as the luminescent bacteria grow and die over a period of days.

Cole's paintings are some of the more unusual examples of ocean art. Among her most stunning works is what might be called a triptych of her own DNA. As the bacteria's bioluminescence begins to fade, each painting grows dimmer. "It's a metaphor for life," she muses.

Cole has now developed a Loyola course: Biology Through Art. The class offers students an opportunity to create their own bioluminescent drawings while working in a biology laboratory. "It's amazing how much the arena of art and science has expanded, especially related to the ocean," says Cole. "There are so many more practitioners now than there were just a few years ago."

It's a symbiotic relationship, say Cole and others. Collaboration with artists has altered scientists' designs and methods, according to Aaron Ellison of the University of Massachusetts Amherst. In a recent paper in the *Bulletin of the Ecological Society of America,* Ellison writes that partnering with scientists "has helped artists delve deeper into issues, gain insight into processes, and tackle more complicated concepts in their artistic practice. These partnerships may change and enrich the way we do both science and art."

ABOUT THE AUTHOR

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