

UC SANTA BARBARA

THE *Current*

October 16, 2012

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Envisioning Novel Approaches for Eye Disease: 'The New Medicine' at UC Santa Barbara

By growing new retinal cells to replace those that have malfunctioned, scientists hope to one day create and fuse entire layers of fresh cells -- a synthetic patch akin to a contact lens -- as a treatment for age-related macular degeneration, the top cause of visual impairment among people over 60.

Such is the goal of an elite research team at UC Santa Barbara, which aims to advance the novel therapy out of the lab and into the clinic by way of regenerative bioengineering. With stem cells also showing great promise for diabetic retinopathy, the same group is taking a similar approach to this condition -- the leading cause of blindness in younger adults.

Based at UCSB's Center for Stem Cell Biology and Engineering, the two projects are being pursued in tandem, in a new, five-year endeavor funded by a \$5-million gift from philanthropist Bill Bowes, founder of biotechnology giant Amgen. With the development of cellular therapies as its goal, the Garland Initiative for Vision -- named for Bowes' mother, who was a physician and Santa Barbara native -- will position the campus to propel its ocular innovations toward clinical trials.

"UC Santa Barbara is honored by the visionary and generous philanthropy of Bill and Ute Bowes in establishing the Garland Initiative. We are deeply grateful for their

longstanding leadership and dedication to advance critical research in ocular diseases," said Chancellor Henry T. Yang. "This gift expands the impact of the Bowes' earlier inspirational gift to establish the Ruth Garland Professor and Co-Director of the Center for Stem Cell Biology and Engineering, and will fuel new discoveries and further strengthen the outstanding work of our faculty conducting interdisciplinary research in bioengineering and biomedicine.

Asked what inspires him to give, Bowes, Amgen's first chairman and the still-active founding partner of Silicon Valley-based U.S. Venture Partners, said, "For me, philanthropy is the best use of resources, by far. I've come to respect UC Santa Barbara as a very important technological institution. My firm has used Santa Barbara technologies to start companies, and that has enabled me to get a pretty good look at what's going on down there. My respect level has been going up and up and up over the years. That's all it takes.

"I put UC Santa Barbara in a small cadre of institutions that I have respect for and work with and support ... that includes Caltech, UCSF, Stanford, and Harvard," Bowes added. "The people at UC Santa Barbara and the technology there are ripe for a program that makes some real accomplishments in the vision field."

A stem cell dream team of renowned researchers -- all directors of the UC Santa Barbara stem cell center -- will lead the Bowes-funded project. They include Dennis Clegg, a professor of molecular, cellular, and developmental biology, and co-principal investigator of the California Project to Cure Blindness; Neuroscience Research Institute research biologist Peter Coffey, director of the London Project to Cure Blindness; James Thomson, professor of molecular, cellular, and developmental biology at UCSB, and director of Regenerative Biology at the University of Wisconsin's Morgridge Institute for Research; and H. Tom Soh, professor of mechanical engineering and of materials, associate director of the California NanoSystems Institute, and a 2010 Guggenheim Fellow in engineering.

The Garland Initiative will tackle age-related macular degeneration and diabetic retinopathy with biology and engineering -- two of UCSB's core scientific strengths.

"Starting with the study of the fundamental molecular biology of stem cells and how to differentiate them into the ocular cells we need, and then applying novel biotechnologies to deliver those cells to the right place, we feel we can make a huge impact," said Clegg. "We have a unique combination of high caliber expertise in

regenerative bioengineering that will allow us to go forward and develop stem cell treatments for those conditions."

Bowes' serendipitous donation to fight ocular disease also marks the high-profile lead gift for EMBODI, an effort to unite UCSB's myriad biomedical forces under a common goal: to espouse their collective strides to a wider audience. Bearing the slogan "This is the new medicine," EMBODI (Engineering, Medicine, Biology, Discovery, Innovation) will see assorted campus institutes, centers, and research groups collaborate to spread the word about homegrown advancements that have the potential to impact global human health. Messaging is especially essential for an institution without a medical school, according to campaign organizers, who describe UCSB's aptitude for such research as a "well-kept secret."

"This is a great way of telling our story and reaching out to the community, both locally and more broadly, and to our alumni too," Pierre Wiltzius, the Susan and Bruce Worster Dean of Science, and professor of physics, said of EMBODI. "It's important that our supporters are informed that we are at the forefront."

Helping to keep the campus at that forefront are faculty researchers like Frank Doyle, a professor of chemical engineering and a key player in EMBODI's conception, whose development of an artificial pancreas -- like the stem cell project -- is "part of the tapestry" of the nascent endeavor.

"It's truly remarkable to see the catalog of everything going on at UCSB with dimensions leading to medical -- spanning the whole spectrum of fundamentals, technology, and ultimately clinical trials," said Doyle, the Mellichamp Chair in Process Control and director of the Institute for Collaborative Biotechnologies. "It's all happening here, at a very high level of excellence."

Campus leaders describe the Garland Initiative as the latest evidence of that excellence, with Bowes's pledge serving as further proof of UCSB's scientific prowess.

"UCSB's achievements thus far in bioengineering have come from leveraging our strengths in engineering and science, and working across disciplines to find solutions to important medical challenges," said Rod Alferness, the Richard Auhll Professor and Dean of Engineering. "This gift from Bill Bowes is an investment in our progress to confront the most critical medical issues affecting society."

The efforts and entities that comprise EMBODI, including the vision initiative and Doyle's pancreas project, exemplify that progress:

- At the Neuroscience Research Institute, co-directors Ken Kosik and Stuart Feinstein and colleagues are studying the molecular and cellular defects that underlie Alzheimer's disease, with an eye toward treatment and early detection.
- At the Center for Bioengineering, researcher and director Samir Mitragotri and his team are revolutionizing drug delivery with their synthetic "stealth" red blood cells, which disguise drugs as normal blood cells, making our bodies more likely to accept and absorb them.
- At the Center for Nanomedicine, Jamey Marth and fellow scientists are developing a new generation of diagnostics and therapies for cancer, cardiovascular disease, and diabetes. Renowned researcher Erkki Ruoslahti's team innovated a way to get bigger payloads of cancer-fighting drugs deeper into cancer tumors without added impact to non-malignant tissues.
- At the Brain Imaging Center, Scott Grafton's multidisciplinary team is collecting and analyzing data that is enabling the understanding of post-traumatic stress disorder and treatment of traumatic brain injuries.
- Systems and quantitative biologists, including Professor Joel Rothman, are developing computational and mathematical approaches to life's fundamental functions. For instance, their modeling of the roundworm *C. elegans* is informing research on cancer and human development.
- Chemistry professor Galen Stucky's award-winning innovation on blood-clotting gauze is being used to treat gravely wounded soldiers -- and save lives -- in Iraq and Afghanistan.
- The Translational Medicine Research Laboratory, a new partnership with Santa Barbara Cottage Hospital, will see scientific experts, physicians, and patients come together in a state-of-the-art operating room to develop diagnostics, treatments, cures, and more efficient protocols, plus provide educational opportunities for students and residents.

"UCSB is pushing at the boundaries of medical research problems," said Doyle. "We're going back to fundamentals, and building from that understanding and

knowledge of what's happening in the body to inform new ways for doctors to carry out therapeutics and diagnostics. That, for us, is very compelling and very different from the traditional approach to medical research."

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† Bottom image: A bioengineering team at UCSB has developed synthetic platelets to deliver drugs directly to the source of disease. Indicative of the UCSB medical efforts that comprise EMBODI, the innovation could lead to major advances in medical therapies.

Credit: Peter Allen

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