UC SANTA BARBARA

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UC Santa Barbara's Kavli Institute Receives Two Grants to Explore Interface of Physics and Biology

Imagine being able to mathematically describe the process by which an embryo develops into an animal, assigning numbers to its every function, and dysfunction. Such capability holds enormous implications for medicine, pointing to the potential for determining when and where things go developmentally awry –– and paving the way to possible solutions.

This sort of breakthrough is one of the long-term goals of theoretical physicists and experimental biologists at UC Santa Barbara, where the Kavli Institute for Theoretical Physics (KITP) is uniting researchers from the disparate disciplines in joint study. Two new grants, together totaling $2 million, are giving those interdisciplinary efforts a big boost.

The Gordon and Betty Moore Foundation has awarded KITP $1.6 million for its ongoing interdisciplinary biology initiatives, including workshops, postdoctoral fellowships, and plans for a new summer program –– the Santa Barbara Advanced School for Quantitative Biology (SBASQB) –– aimed squarely at the interface of physics and biology. A $400,000 grant from the Burroughs Wellcome Fund will go exclusively toward the latter endeavor.

"We are profoundly grateful for the extraordinary gift from the Gordon and Betty Moore Foundation, whose steadfast support of scientific research and the pursuit of knowledge in emerging fields is of vital importance. Their grant to KITP will be a tremendous boon to the institute's work at the interface of physics and biology," said UCSB Chancellor Henry T. Yang. "The remarkable generosity of the Burroughs Wellcome Fund provides another lasting benefit by helping to launch the Santa Barbara Advanced School for Quantitative Biology, an innovative, interdisciplinary new course with the potential for groundbreaking scientific discoveries."

Set to welcome its first class in 2013, SBASQB aspires to advance both physics and biology by unifying their practitioners in intensive summer study. Side-by-side in lectures and in the lab, researchers will explore subjects such as morphogenesis, embryology, microbial biology, and evolution. The new program is the brainchild of physics professor and permanent KITP member Boris Shraiman, and Joel Rothman, chair of UCSB's Department of Molecular, Cellular, and Developmental Biology.

"We thank the Moore Foundation for their generosity and their vision in supporting a broader range of activities at the KITP, and we are delighted that, with our proposed course, we were able to rise to the challenge set by the Burroughs Wellcome Fund," Shraiman said.

"It really has been a dream to set up a course like SBASQB," Shraiman added. "It is a merger of two cultures drawing on the lab course tradition in biology and the workshop tradition in theoretical physics –– and it is going to be a rather unique combination of the two."

Describing SBASQB as the culmination of their shared vision to bring together theorists and experimentalists in an active lab setting, Shraiman and Rothman said the venture was largely inspired by the storied research program at the Marine Biological Laboratory in Woods Hole, Mass., which boasts more than 50 Nobel laureates among its past participants.

What sets such courses apart, said Rothman –– who likes to think of SBASQB as a sort of "Woods Hole West" –– is the way they turn scientific convention on its head. The elite, intensive program will, on occasion, see graduate students and postdoctoral students serving as instructors to faculty; theorists engaging in lab work; experimentalists participating in theory-focused lectures; and instructors and students collaborating on experiments. Differentiating SBASQB from Woods Hole:

the former will be built on the foundation of the KITP, grounded in the physical science community.

"There is a lot of exciting stuff going on at the interface of traditional, hard physical sciences and biology that I think will engender what really will be a new discipline," said Rothman, who served as Woods Hole summer faculty for 18 years, spending five years as course director. "A new generation of scientists who've had strong training in both realms will ultimately be creating the new departments of quantitative biology."

In fact, a quantitative approach may be essential to scientists as they seek to truly understand, and definitively explain, the most intricate biological problems and processes –– such as the inner workings of an embryo.

"Biologists like myself have become very good at collecting data, but we're only fair at making sense of that data," Rothman said. "We're missing a major instrument, and that is the math. Math is the language and the tool that really allows you to get insights."

Shraiman concurred, noting, "It won't be a simple ‘equation,' but understanding how to encode something as complex as, say, the shape of a limb in DNA is a challenge that will require new tools –– quantitative tools –– yet it's not that far off. It's not something we can do today, but it's a safe bet that some of the graduates of our new course will be able to do it in 10 or 15 years."

The Gordon and Betty Moore Foundation, established in 2000, seeks to advance environmental conservation and scientific research around the world and improve the quality of life in the San Francisco Bay Area. The Foundation's Science Program aims to make a significant impact on the development of provocative, transformative scientific research, and increase knowledge in emerging fields. For more information, please visit www.moore.org.

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