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Biophysicist in Profile

MARGARET S. CHEUNG

“Figuring out how biology works always amazes me,” says Margaret S. Cheung, Assistant Professor of Physics at the University of Houston (UH)—specifically, theoretical biological physics and theory of protein folding. “It is really exciting that there are technologies now available to probe molecular interactions inside cells,” she says. “However, it is still difficult to quantify information, or even to define meaningful phenomena from complex systems. My research aims at a quantitative description of protein folding, structure, and interaction in a cellular environment. I would like to sort out the needed knowledge for a better understanding of protein biophysics inside cells.”

Cheung’s interest in science dates back to her primary school days. “When I was about 10 years old, my mother subscribed to a monthly science magazine for children and I was fascinated by the beautiful photos and pictures,” she recalls. Her father, a civil engineer, and her mother, a housewife with a degree in education, took Cheung to science centers and museums, and brought home Legos, science kits, and telescopes for her from their numerous trips abroad. In Taipei First Girls’ High School in Taiwan, Cheung entered science fairs and joined a biology outreach program for younger students. “How biology works at a molecular level motivated me to pursue a college degree in chemistry,” she says. She did so at National Taiwan University, and in her senior year was introduced to her new love: biophysics.

“Biophysics is a highly interdisciplinary field and there is a lot to learn.”

—MARGARET S. CHEUNG

The inspiration for Cheung’s current work on the theory and computation of protein folding, structure, and interaction under cell-like conditions harkens back to her days as a PhD student in *José Onuchic’s* lab at the University of California, San Diego. “During those years, we were interested in understanding the interplay between structure-search of the native structure and desolvation in determining the mechanisms for protein folding,” says Onuchic. Cheung created a minimalist model showing that neither factor is dominant but in fact both are equally important and complementary. “Her initial paper on this topic, where she applies this model to the SH3 domain, is already becoming a classic,” says Onuchic. “This is the first paper on a new generation of minimalist models that will be able to incorporate both of these effects.”

In collaboration with an experimental group, Cheung’s lab now uses computer simulation to demonstrate the effects of macromolecular crowding on the structure, function, and folding landscape of phosphoglycerate kinase (PGK). “She has developed a superb biological physics program and, in addition, taken her teaching and outreach very seriously,” says

Gemunu Gunaratne, Associate Chairman of the Physics Department at UH. “She expects a serious level of commitment and strong work ethic from her students and postdocs.” Her students agree. “As a mentor, she sets a high standard for her students, and she dedicates most of her time and effort in helping them achieve their research goals,” says *Qian Wang*, one of Cheung’s graduate students. He cites Cheung’s unique habit of bringing her students along for meals when scientific luminaries visit her lab as an example. “She always does her best to create the opportunity for her students to network as well as learn from these acknowledged professors,” he says.

As one of the few women in her institution’s physics department, Cheung admits sometimes feeling lonely in her chosen profession. “It’s a career path that demands a long period of time and there are not many women in this field to share ideas or life experiences with,” she says. However, like the women in science she admires, she doesn’t let being in the minority lessen her contribution to the field. “Rosalind Franklin, Marie Curie—I admire their strength when challenged unfairly,” she says. Indeed, she has overhauled the thinking of an entire department. “Our Physics faculty was exclusively male until a dozen years or so ago,” says Gunaratne. “As a result there were occasional insensitive comments made publicly. Since receiving many appropriate rebukes, mainly from Margaret, these dinosaurs know to behave themselves now.”

Cheung not only champions for women’s equal place inside a male-dominated field, she extends her influence to mentoring students and teachers alike to get involved in science and to do what they do better. “[It’s rewarding to] motivate young people, particularly young girls, to learn about science and mathematics [and to] develop fun and inexpensive physics demonstrations for science teachers from elementary and middle schools,” she says. Indeed, she recently taught a course on energy and matter to Houston Independent School District elementary school science teachers. Cheung divided the



Margaret Cheung and her husband, Brenden Wyker, visiting Stockholm. The couple spends time traveling together as often as possible.

course into three-hour segments, working in engaging, economical physics projects that the teachers could easily recreate in their own classrooms.

But Cheung doesn’t stop at organizing lectures for science teachers. In 2010, she organized a well-attended session called Biopolymers in Cellular Environment at the Biophysical Society (BPS) 54th Annual Meeting. “A few of us managed to capture this momentum,” she says, and in 2011 officially formed the newest BPS subgroup, Biopolymers in vivo (BIV), which Cheung now chairs. Like other BPS subgroups, BIV hosts a symposium and a dinner for its members. “They provided excellent opportunities for networking and collaborations for people who wanted to learn about this field,” she says of BIV’s 55th Annual Meeting events. And yet, starting the subgroup means more than merely putting together a useful event complete with good science. “I have been a member since 1997, since I was a graduate student,” says Cheung. “Attending the BPS meeting has always been an exciting experience that has moved me to go a step further in my career.”

Cheung’s next career step brims with questions. “[I want to] figure out a general principle of who, how, when, and what protein interacts with other partners in response to environmental cues that arise to communication inside cells,” she says. Cheung is certainly up to the task. “Be patient and try to take the time to figure out why the problems you are working on are indeed interesting,” she advises. “It’s very rewarding to discover new ideas or solutions to longstanding problems.”