UCSD Bioengineering Professor Wins National Academy of Engineering Award

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The National Academy of Engineering (NAE) will present its 2006 Founders Award to Shu Chien, a scientist at UC San Diego who forged the field of biomedical engineering, at an Oct. 15 ceremony in Washington, D.C.

Chien, an NAE member, is the Y.C. Fung Professor of Bioengineering and Medicine at UCSD and University Professor for the University of California system. He will receive the Founders Award, the academy's highest honor, "for outstanding contributions to elucidating the engineering foundation of cardiovascular dynamics, and integrating engineering and biomedical sciences for the development of the biomedical engineering profession." The award recognizes outstanding professional, educational, and personal achievement to the benefit of society, and it includes $2,500 and a gold medallion.

Although trained as a physician, Chien has made extensive contributions to bioengineering, especially in cellular, molecular, and cardiovascular bioengineering and related fields. In the 1960s, while on the faculty at Columbia University's College of Physicians and Surgeons, he was one of the few physiologists to apply engineering principles and techniques to the study of biological systems. "I have chosen to combine engineering and the biomedical sciences because I believe this combination leads to the most discoveries and innovations for the improvement of human health and quality of life," said Chien.

His interdisciplinary approach enabled Chien to better understand hemodynamics - the forces generated by the heart and movement of blood through the cardiovascular system - and the regulation mechanisms of blood rheology, which looks at how blood deforms and flows when stress is applied. His model of blood rheology was the first to elucidate its determinants, and he later applied the basic knowledge gained from these discoveries to understand cardiovascular and other diseases, such as sickle cell anemia.

Chien went on to combine his knowledge of cardiovascular dynamics and blood rheology to examine microcirculation, where the critical exchange between blood and tissue occurs. He figured out how blood cells and their interaction with the vessel walls govern flow dynamics. Chien used these discoveries to explain the mechanisms of hemorrhage and shock. He described the effects of hemodynamic forces on transendothelial transport of macromolecules and proposed the enduring "cell turnover-leaky junction" theory to describe susceptibility to atherosclerosis.

Chien's more recent research at UCSD has brought about a novel and detailed understanding of how mechanical forces of blood flow affect cell signalling and gene expression, and how cells adapt to their physical environment. This pioneering work has far-reaching implications for bioengineering and particularly for tissue engineering and regenerative medicine. Chien is also designing molecular techniques to prevent and mitigate complications following balloon angioplasty, and to analyze how the vascular system responds to procedures used to treat coronary artery occlusion. In addition, he is examining how cell signals are coordinated and function over time.

Chien is credited with transforming scientists' understanding of cells and tissues and their physical mechanisms, demonstrating that biological systems are governed by the laws of physics and chemistry. Chien's rich contributions to fundamental and applied bioengineering research are documented in some 450 peer-reviewed publications and nine books, and are recognized through numerous engineering and life-science awards and named lectureships. Furthermore, the American Society of Mechanical Engineers has twice presented Chien with the Melville Medal for the best original paper among its 20 Transactions journals; Chien is the only two-time winner of this honor.

At UCSD, Chien has been instrumental to building one of the country's top bioengineering programs. He founded and directs the Whitaker Institute of Biomedical Engineering, which facilitates research collaboration in biology, medicine, and engineering. Chien also led the formation of the Bioengineering Institute of California, a project of the University of California system that involves all 10 UC campuses and many other universities to disseminate the results of bioengineering research.

Chien has served as president for several professional societies, including the American Physiological Society, the Federation of American Societies for Experimental Biology, the International Society of Biorheology, and the American Institute for Medical and Biological Engineering, and he is currently president-elect of the Biomedical Engineering Society. His professional activities show the widespread admiration he has received from both life scientists and engineers. Moreover, Chien is one of only six living NAE members to also hold membership in the National Academy of Sciences and the Institute of Medicine.

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