Two National Yang Ming Chiao Tung University Teams Win Gold Medals at the 2022 International Genetically Engineered Machine Competition

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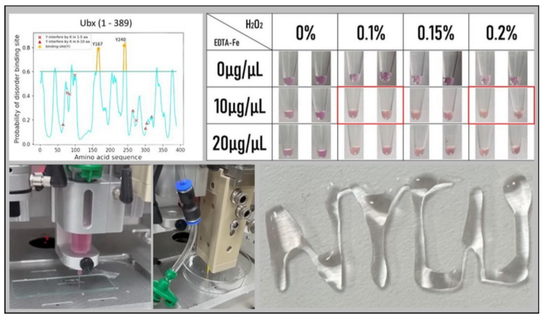
The 2022 International Genetically Engineered Machine (iGEM) competition was held in Paris, France at the end of October. Two NYCU teams, NYCU_Formosa and NYCU-Taipei iGEM, competed with 356 teams from top universities from around the world and each won a gold medal. Moreover, the NYCU_Formosa team was nominated for Best Manufacturing Project, and the NYCU-Taipei iGEM team was awarded the Team Impact Grant.

Guided by Professor Wen-Liang Chen and Assistant Professor Lee Hsiao-Ching, the NYCU_Formosa team from NYCU's Boai Campus developed biomaterials for use in regenerative medicine through simulating self-assembling peptides in Drosophila proteins and combined bioinformatics engineering with BioArt. Guided by Professor Chuan-Hsiung Chang and Dr. Ching-Fen Chang, the NYCU-Taipei iGEM team from NYCU's Yangming Campus developed a remote device for observing bacterial growth through color changes, which is valuable for medical research and industrial application.

★ NYCU_Formosa team developed self-assembling peptides for use in regenerative medicine
Combining expertise in biotechnology and engineering, the NYCU_Formosa team conducted the interdisciplinary development of self-assembling biomaterials applicable to three-dimensional (3D) bioprinting and regenerative medicine, thereby proposing an innovative and novel type of self-assembling biomaterial applicable to a wide range of practical settings. Through mathematical modeling and programming application, the team simulated self-assembling peptide fragments in Ultrabithorax (Ubx) proteins from the Drosophila insect. Fusion proteins were formed using minimized Ubx peptide fragments and diverse proteins with varying functions. The technique effectively increases the yield of biomaterials and can be extensively applied to various biomaterials.

Through experimentation, the new type of biomaterial (i.e., the generated Ubx fusion proteins) proved to be both self-assembling and able to preserve its original protein functions. To achieve the practical application of the product, the team applied 3D printing to the produced material and established the potential of the Ubx peptide biomaterial for producing biomedical materials and, in the field of regenerative medicine, cytoskeletal proteins in stem cells. Product efficacy maximization can be achieved through combining functional proteins with varying functions and of varying proportions.



The NYCU_Formosa team broke down the boundaries between science and the humanities through combining bioinformatics with BioArt. Bioinformatics engineering technologies were employed to predict the brightness change over time in mixtures of fluorescent proteins of varying proportions. Data simulation results were presented in the form of a coral-skeleton 3D model. A series of obtained images were displayed as BioArt in an online exhibition entitled "Digital Fluorencence." The team successfully created a third space through bioinformatics and BioArt integration to increase the accessibility of science to the public. Through an online BioArt gallery and a BioArt workshop, diverse facets of synthetic biology were presented from a humanistic perspective.
Through the competition, bioengineering and information engineering concepts as well as ideas associated with humanistic society were fully deployed and applied in diverse fields, demonstrating Taiwan's strength in biology, engineering, and the humanities to the world. For their distinctive conception and thorough project planning, the team won a gold medal and was nominated for Best Manufacturing Project. It was the only Taiwanese teams nominated for a Track award.

This work required 1 year of research and testing. In addition to its innovativeness and extensive application, the team's research experiences were shared by the assistant professor, triumphantly publicizing NYCU's excellent research outcomes on the global stage. Moreover, innovation has been successfully promoted in Taiwan's education sector and civil society. Through interacting and sharing their results with the general public, NYCU students developed strong cross-domain learning skills.

★NYCU-Taipei iGEM developed E.COLOR, a remote device for observing bacterial growth
Guided by Professor Chuan-Hsiung Chang and Dr. Ching-Fen Chang of the Yang Ming Chiao Tung Institute of Biomedical Informatics and Center for Systems and Synthetic Biology, the NYCU-Taipei iGEM team participated in the iGEM competition with a project entitled "E.COLOR," which focused on the precise color-based indication of phases of bacterial growth. The E.COLOR device enables researchers to observe bacterial growth and determine the optimal time for incorporating inducers for protein production (e.g., the IPTG technique), which can improve the industrial production of protein products such as protein drugs.

Through integrating multiple disciplines such as genetic engineering, artificial intelligence, programming, mathematical modeling, and mechanical design, the team realized the E.COLOR device, which enables the automatic remote observation of phases of bacterial growth. Device user can easily observe experiment results on a mobile phone or on other mobile devices to determine the optimal timing for supplementing chemicals. Additionally, with a built-in mathematical modeling tool, the E.COLOR device enables the pre-experiment prediction of bacterial growth on the basis of parameters such as initial bacteria count and initial bacterial status; the experiment design and supplementation timing can then be modified accordingly. With the recognition that this innovative device is valuable for academic research and industrial application, the NYCU-Taipei iGEM team were awarded the Team Impact Grant and US$2,500 in prize money.

Since 2007, the NYCU-Taipei iGEM team has been taking part and excelling in the international iGEM competition, winning an Environment Track championship and ranking among the top six international teams and third among Asian teams as well as winning numerous special prizes, 12 gold medals, two silver medals, and two bronze medals. In recent years, the team has further engaged in disseminating synthetic biology concepts among people unfamiliar with the discipline, including general students, through activities such as synthetic biology–related internships in senior high schools and synthetic biology lectures in universities, thereby promoting knowledge sharing. Furthermore, the team helped outstanding high school and university students in Taiwan to participate in synthetic biology–related competitions, further publicizing Taiwan's related achievements on the global stage.