Synthetic Biology is Here to Stay

Students from around the world demonstrate the future of synthetic biology at iGEM 2009.

By Kristen Zannella

January 20, 2010 | **Guest Commentary** | MIT recently hosted the 2009 International Genetically Engineered Machine (iGEM) jamboree, the culmination of more than 100 undergraduate projects in synthetic biology. It's always fascinating to see what the competing student teams have been up to and they never fail to deliver. (The MathWorks is a sponsor of iGEM, supplying software and training to the teams.)

Wikipedia defines synthetic biology as a "new area of biological research that combines science and engineering in order to design and build ("synthesize") novel biological functions and systems." Synthetic biologists genetically design and build a biological system for a particular output, often one that would not occur naturally, such as bacteria that can sense and report on arsenic in water.

The annual iGEM competition is one of the biggest gatherings of synthetic biology work. Students conduct research projects over the summer and subsequently present their work at the iGEM Jamboree. The goal is to design and build an artificial, successfully-functioning biological system, and to submit new biological constructs to the Registry of Standard Biological Parts. Applications range from food, energy, manufacturing, environment, health and medicine, information processing and software. Many teams utilize both modeling and bench research to be able to complete a project in the short time. Teams are awarded medals for meeting specific criteria, performance in each application area, as well as overall Top 3 finishers.

Growing Up

iGEM has seen tremendous growth since its inception. It started with five teams in 2004 and went international in 2005. The competition has grown, on average 50-60% annually, to include 112 teams in 2009, with more than 1700 participants from around the world. This year, Europe seemed to dominate the finalists category, with teams from Cambridge, Heidelberg and Valencia as the top three awardees. Noteworthy is that these teams raise funding from local companies, including top pharmaceutical and biotech firms, to help support their research and travel to MIT for the Jamboree.

At iGEM I closely watch the adoption of modeling. Many teams will design and simulate their system prior to building it in the wet lab. This offers quick troubleshooting and allows teams to design the system in a fraction of the time it would take in the lab.

Perhaps most remarkable are the projects themselves. Applications range from health and medicine to manufacturing and environment. The grand prize team happened to be the Best of Environment award recipient for a project that involved sensitivity tuners and color generators. The sensitivity tuner distinguishes distinct pollutant levels, and a pigment output allows the tuners to be used without expensive sensing equipment. As an example, the team pointed to Bangladesh, which has severe problems with arsenic pollution, but where expensive sensor devices are unavailable.

The Best of Health or Medicine award went to the Stanford iGEM team for a system able to sense and correct T-cell populations in patients with autoimmune disorders, such as irritable bowel syndrome. This probiotic therapy would sense and correct levels of Th17 and Treg populations which control inflammation and immunosuppression respectively. The UNIPV-Pavia iGEM team received the Best of Food or Energy award for developing a process to valorize lactose in whey. The Best of Manufacturing award went to Imperial College of London for developing E.ncapsulator, a versatile manufacturing and delivery platform by which therapeutics can be reliably targeted to the intestine.

Some readers may be leery of synthetic biology, but they can rest assured that much attention is paid to ethics and human practices in this competition. Each team is asked to assess the biological safety of their project and to incorporate project-relevant safety and ethical content into their presentations and posters. The Imperial College and Paris teams tied for the Best Human Practices Advance award. Both teams dedicated part of their effort to safety and human practices, conducting interviews and researching the safety of synthetic biology. The Imperial College team even went so far as to add a step to its E.ncapsulator development to make sure the capsule would be safe for ingestion.

While synthetic biology remains primarily an academic practice, with only a few cases of commercial success, the 2009 iGEM competition showed that synthetic biology is here to stay. With interest growing exponentially, the rate at which iGEM teams are creating practical applications for synthetic biology means it's only a matter of time before we see more synthetic biology bleeding into industry.

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