Synthetic biology competition inspires young microbiologists to change the world

Synthetic biology is a rapidly expanding area of science that incorporates engineering principles to design and build biological processes for useful and sustainable purposes. In addition, synthetic biology projects often incorporate expertise from the arts and humanities. As a truly interdisciplinary subject synthetic biology offers exciting opportunities to train the next generation of scientists in a wide range of useful and transferable skills. Within this review we describe how the International Genetically Engineered Machine (iGEM) competition provides an excellent platform to develop this training, as well as providing in-depth opportunities to experience research-led teaching. More significantly, it links these transferable skills to important “real-life” employment skills: students require good planning and time-management skills to be successful. We provide an introduction to important developments within synthetic biology, and describe how projects undertaken as part of the iGEM competition offer wide-ranging training and educational experiences for early career microbiologists.

The image shows the attendees at the iGEM 2015 Jamboree. Used with permission from the iGEM Foundation

Synthetic biology research has been proposed as one of the scientific technologies that can help address the challenges that societies across the globe will face in the 21st Century. In particular, it has huge potential in biotechnology and medicine, which brings important ethical and moral issues to address. To ensure that these types of challenging issues are discussed widely, a significant driving force during the development of synthetic biology research requires good engagement between the scientists, funders of the research and the wider general public. This has led to increased visibility for ethical considerations of synthetic biology projects, particularly in relation to its potential impact on society and the environment. Within the review we present examples of good practice in the way that scientists communicate findings from their projects with wide-ranging communities that do not often have a detailed understanding of science.

The iGEM competition is a global competition for teams of students to carry out pilot scientific projects that link to all aspects of synthetic biology. Projects within iGEM are designed to address global challenges, positively engage with society and collaborate with an international scientific community. The iGEM competition for university students began in 2003 at MIT, Massachusetts, USA, and had grown into an international competition with 245 teams by 2014, the last point at which data was available at the time of writing*. Within our article we discuss the growth of the competition and highlight how microbiological methodologies have been important for the overwhelming majority of iGEM projects. Elements of the competition are judged against specific criteria and teams can win medals and prizes across several categories. Collaboration is an important element of iGEM, and DNA constructs synthesized by iGEM teams are made available to all researchers through the Registry for Standard Biological Parts.

Due to the excellent training in research and transferable skills provided by iGEM projects, graduates from iGEM teams have excellent records for gaining employment, particularly as PhD students. Although there are a wide range of significant benefits from iGEM projects, our review also highlights the challenges associated with them, particularly the costs associated with student/staff time and the costs of research reagents and participating in the competition. Future developments could try to rein in (or reduce) costs of iGEM teams, which could widen participation in the competition and it will be useful to develop its good practices within teaching delivered by universities (and other teaching institutions).

In summary, this review is targeted at educators that focus on microbiology and synthetic biology, but will also be of value to undergraduate and postgraduate students with an interest in this exciting subject area.

*Since publication of this review the 2015 iGEM competition has completed, with 280 teams from across the globe participating. There were more than 2700 attendees at the final conference that was held in Boston at the end of September 2015 (see image below) and a full report of the results from the competition is available at: 2015.igem.org/Main_Page.

Publication

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