

# Synthetic Biology and iGEM – student research and involvement

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## Part 1: What is iGEM?



# What is iGEM?

- ◇ the International Genetically Engineered Machine Foundation, and the competition it hosts
- ◇ its competition is a global opportunity in synthetic biology for any student





# iGEM's Projects

- ◇ iGEM Competition
- ◇ Maintaining the Registry
- ◇ Get, Give, Share Philosophy
- ◇ Labs Program
- ◇ and more





# History of iGEM

- ◇ originated from MIT in 2003, became an independent organization in 2012.
- ◇ High school division created in 2011, Entrepreneurship division created in 2012.
- ◇ 54 HS teams, 244 University teams in 2014





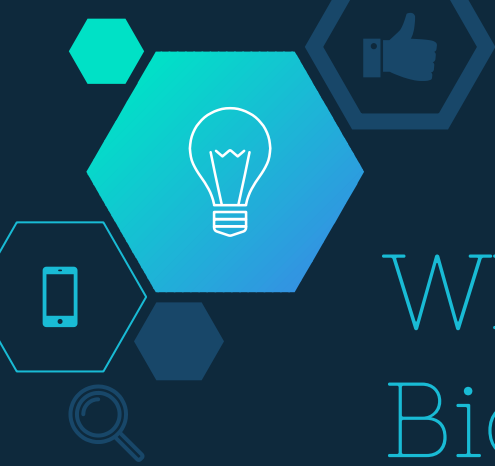
# Video – team experiences

<https://vimeo.com/119981367>





## Part 2: What is Synthetic Biology?




# What is Synthetic Biology?

- ◇ “normal” biology or the general field of biology: deals with “organisms and systems and explain how they operate in a broad and specific sense.” (iGEM - What is Synthetic Biology)
- ◇ Synthetic biology is the creation of new, previously non-existent biological products
- ◇ This can be done, for example, by the manipulation of DNA.

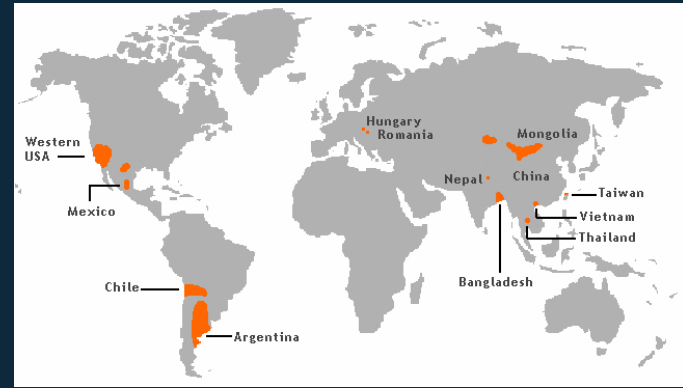






# Example Team Projects

- ◇ Arsenic Biodetector: bacterial biosensor that responds to a range of arsenic concentrations and produces a change in pH that can be calibrated in relation to arsenic concentration.
  - used in impoverished areas where arsenic water poisoning is common





# Example Team Projects



- ◇ BactoBlood: cost-effective red blood cell substitute from engineered *E. coli* bacteria.
  - safely transports oxygen in the bloodstream without inducing sepsis, and to be stored for prolonged periods in a freeze-dried state.





# Standard Parts

- ◇ the system used by iGEM and its competition participants to conduct experiments with synthetic biology
- ◇ follow a certain Assembly "Standard"
- ◇ use already existing biological "Parts"





# More about Standard Parts

- ◇ helps create a simplified and standard procedure that reduces the time necessary to conduct bioengineering
- ◇ less need for manual configurations as most procedures have been standardized for use





## Part 3: Philosophy of iGEM



# The Registry

- ◇ A resource made by the iGEM Foundation
- ◇ collection of biological parts to be used in building synthetic biology systems and devices
- ◇ sorts parts and biological devices based on various categories, helping synthetic biologists who want to use them.





# The Get, Give, Share Philosophy

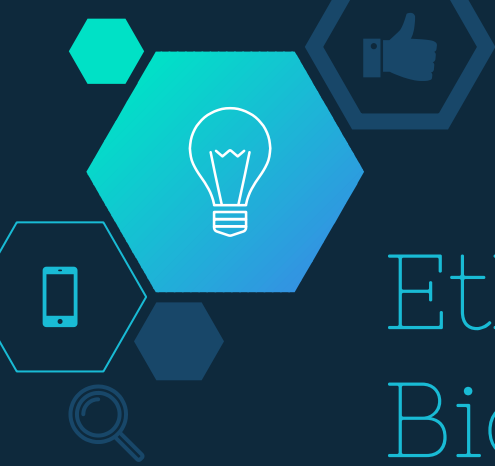
- ◇ philosophy of the Registry
- ◇ **GET** parts, data, tools and samples
- ◇ **GIVE** back new parts, data, and experience on new parts
- ◇ **SHARE** experiences/collaborate in Registry's community





## Part 4: Ethics and Morality of iGEM





# Ethics of Bioengineering

- ◇ Some ethical issues with bioengineering:
  - safety and security
  - artificial life
  - "playing God"





# Safety and Security

- ◇ fears similar to those of GMOs - some claim that similar to GMOs, synthetic biology could produce potentially unexpected results.
  - GMOs are not the same as synthetic biology experiment results
  - In response: safety measures are possible (George Church)
  - OpenWetWare: many solutions, e.g. autodestruction systems and containment.





# Artificial Life

- ◇ Concerns that new life created from synthetic biology could complicate our known definition of life
  - But as OpenWetWare states, most synthetic biology projects are not creating new life but building on existing organisms.
  - new creations: bio systems, not new life





# “Playing God”

- ◇ Concerns that creating life would mean people take such an ability into human hands
  - misunderstanding of synthetic biology’s role
    - a process of primarily creating and editing DNA rather than whole organisms
    - not for the creation of new animals and plants, but rather for real-world issues like countering disease






## Part 5: Other iGEM Programs



# The Labs Program

- ◇ a subscription access for the Registry of Standard Parts, containing synthetic biology materials that anybody can use
- ◇ for academic laboratories around the world
- ◇ part of the Get, Give, and Share Philosophy





# Giant Jamboree and Tracks


- ◇ Jamboree: a global meeting of iGEM Participants
  - iGEM also utilizes several fields in its competitions
  - e.g. Measurement, Policy and Practices, Art and Design, and Software





## Part 6: The Ultimate Purpose of iGEM






# What can iGEM really do?

- ◇ pioneer student involvement in the rather unknown field of synthetic biology
- ◇ make synthetic biology efforts throughout the world easier
- ◇ advance a community effort for biology and education, and work ethics for the future





# Why should you care?

- ◇ “There will be very few aspects of our lives that will remain untouched by synthetic biology.”  
(Adam Rutherford, former editor of *Nature Magazine*)
- ◇ Synthetic biology is the future of science, expected to become worth \$38.7 billion by 2020 (Allied Market Research)
- ◇ iGEM leads the way in young student’s efforts to contribute in this field.

