

What is Synthetic Biology?

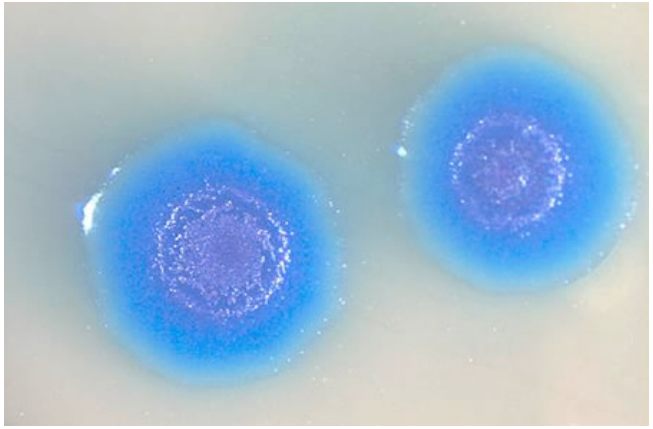
Synthetic Biology uses molecular methods to construct DNA-based devices that perform new functions.

Synthetic biologists:

- Design, model and construct new biological parts, devices and systems.
- Redesign existing, natural biological systems for useful purposes.
- An [hour overview of synthetic biology and systems biology](#) by Nobel laureate Sydney Brenner
- [YouTube 5 minute](#) summary defining synthetic biology (interview with Drew Endy).
- [1 hour lecture](#) by Drew Endy.
- [Six, 1-hour lectures](#) by George Church (Harvard) and Craig Venter as well as several news stories about the topic and these lectures.
- Lengthy article in [The New Yorker](#) (September, 2009)

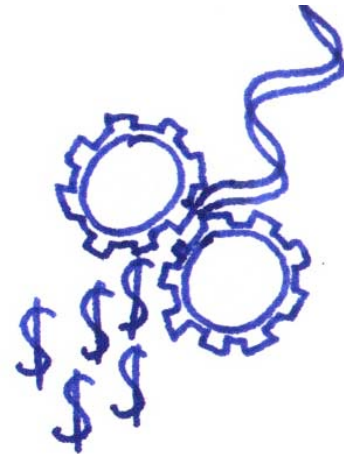
Synthetic Biology is divided into two areas:

- Entire Genome Engineering, especially on how to produce and manipulate whole-genome sized DNA, and get them into new cells. [Read one example](#).
- [YouTube 8 minute](#) BBC story (interview with Craig Venter)
- [20 minute TED lecture](#) by Craig Venter.
- [20 minute TED lecture](#) by Juan Enriquez (from 2009 economy to evolution of human into *Homo evolutis*, humans v 2.0)



Investigators at the J. Craig Venter Institute are engineering whole genomes and "rebooting" cells as bioengineering chassis.
[See genome synthesis paper here.](#)
[Genome transplantation paper here.](#)

• Small Devices and Systems Engineering

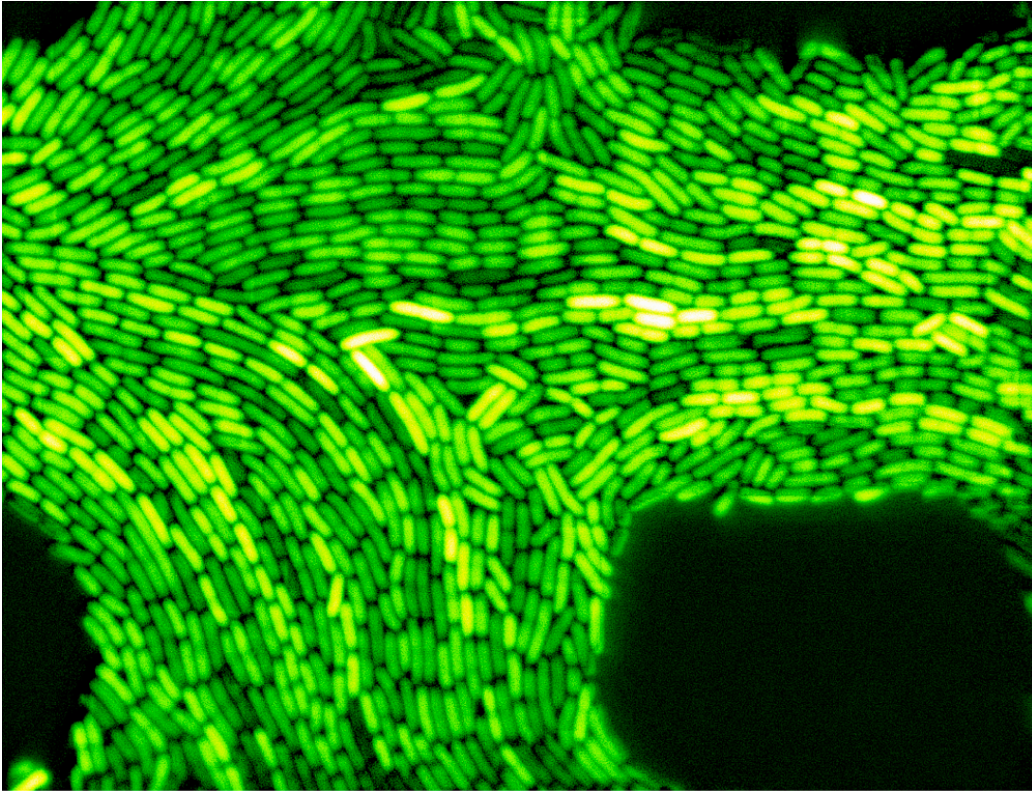


Synthetic biologists at UT Austin developed the world's first bacterial photography. Shine light on the cells and they turn black.
[Read profile of artists working with synthetic biologists.](#)

Synthetic Biology is Win-Win Research

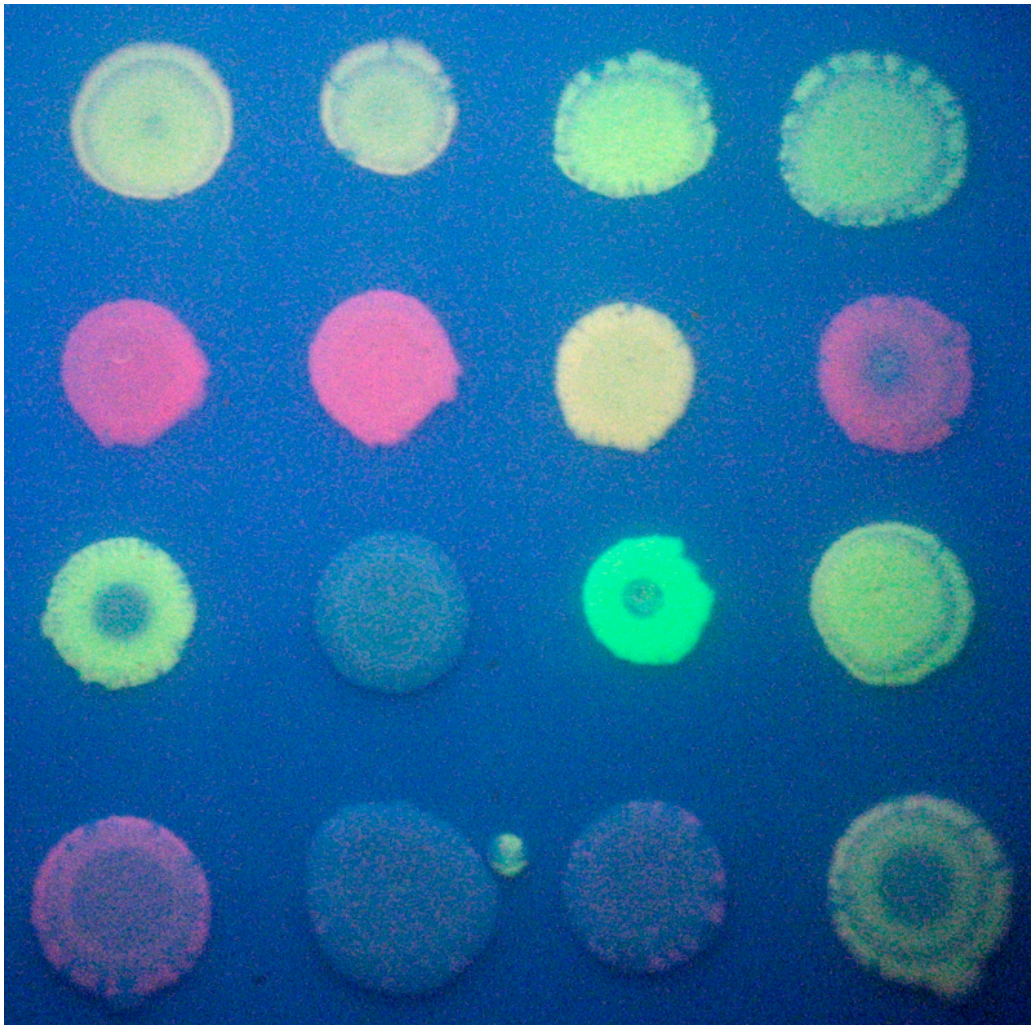
- Win #1: your design functions as expected.
- [Jay Keasling 2006 Scientist of the Year](#), *Discover* magazine (2

minute interview).



Engineered *E. coli* pulse lights on and off as designed. [Read about the Repressilator.](#)

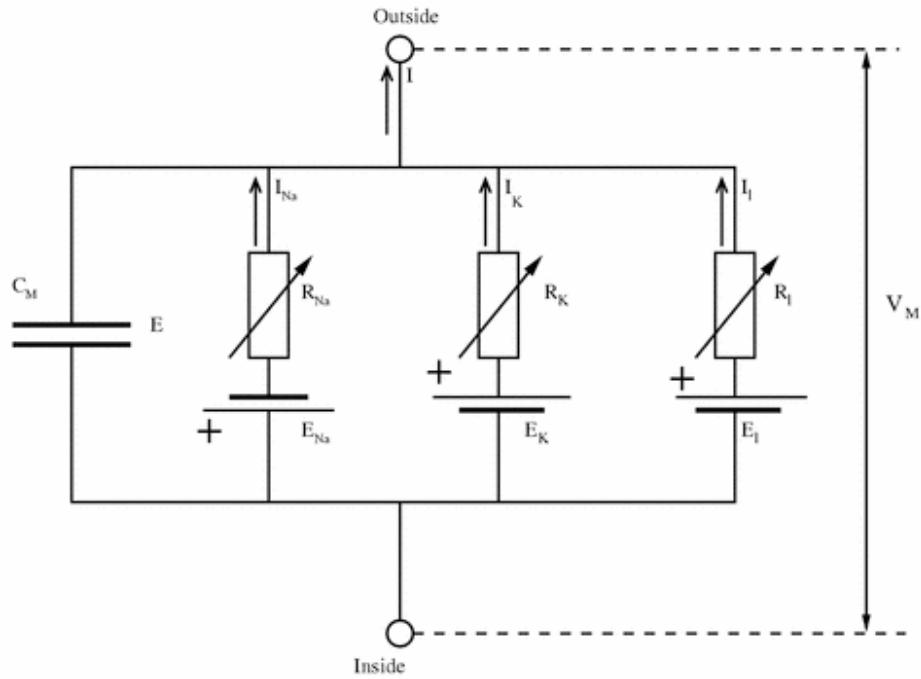
- Win #2: your design fails but you uncover basic biology



Split GFP and RFP produced a variety of colors, more than were expected. [Read more.](#)

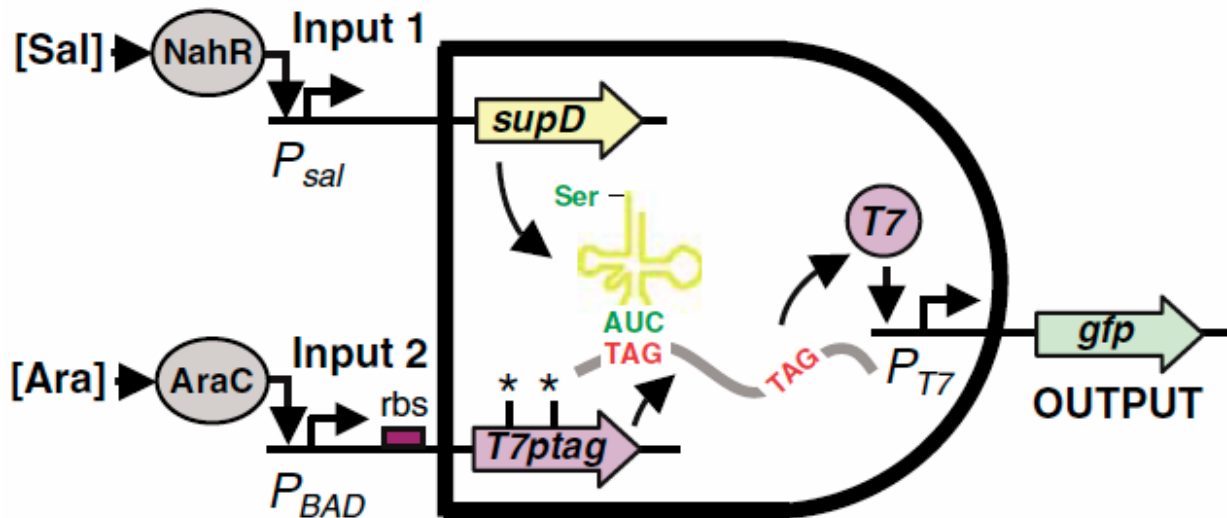
How is Synthetic Biology Different? Synthetic biology uses four principles not typically found in genetics, genomics, or molecular biology: abstraction, modularity, standardization, and design and modeling.

Abstraction: don't focus on the DNA sequences, but think of the parts as units in a circuit diagram. Abstraction means you can use parts/devices/systems without having to worry about how they work. DNA is used to make parts. Parts are assembled into devices. Devices are connected to make systems. [Read more.](#)



Circuit diagram for membrane potential.

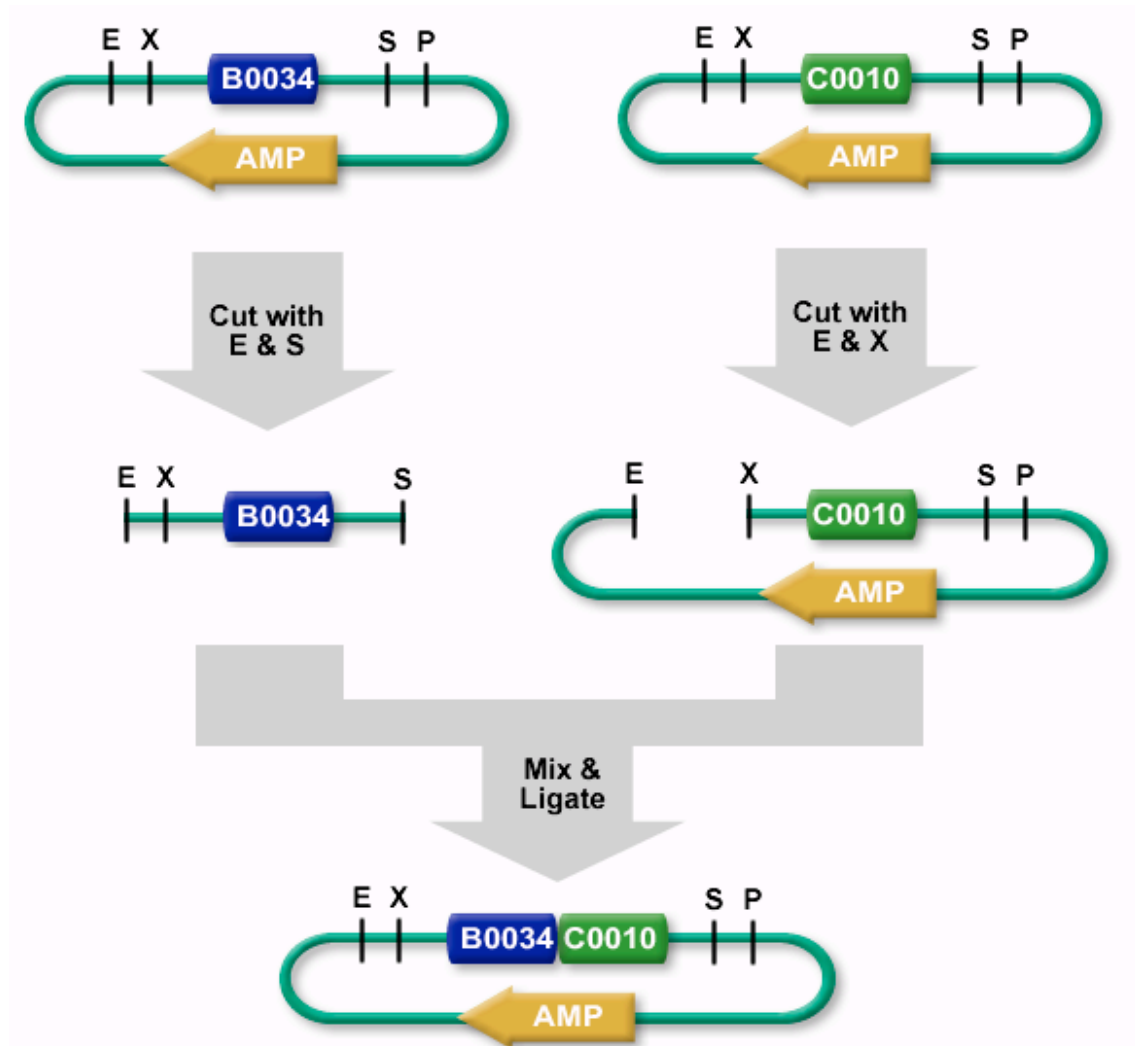
Modularity: parts, devices and systems can be connected as self-contained units and combined in any combination you want.



Modular AND logic gate built by [Chris Anderson at UC Berkeley](#).
[Read the paper](#). Read about [logic gates](#).

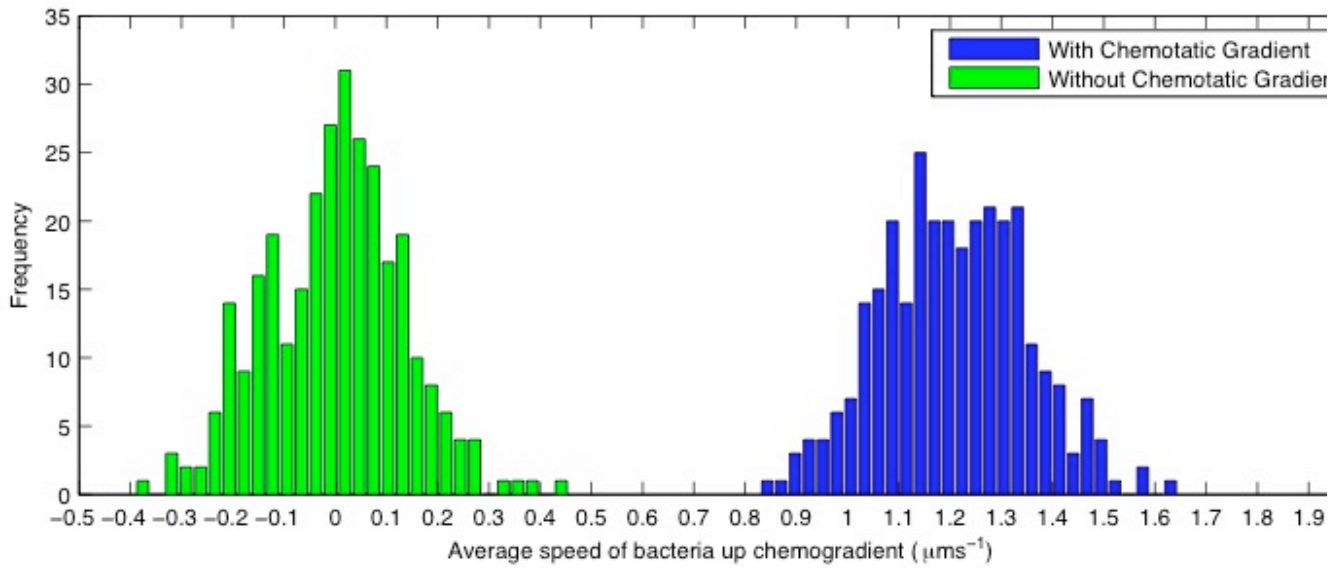
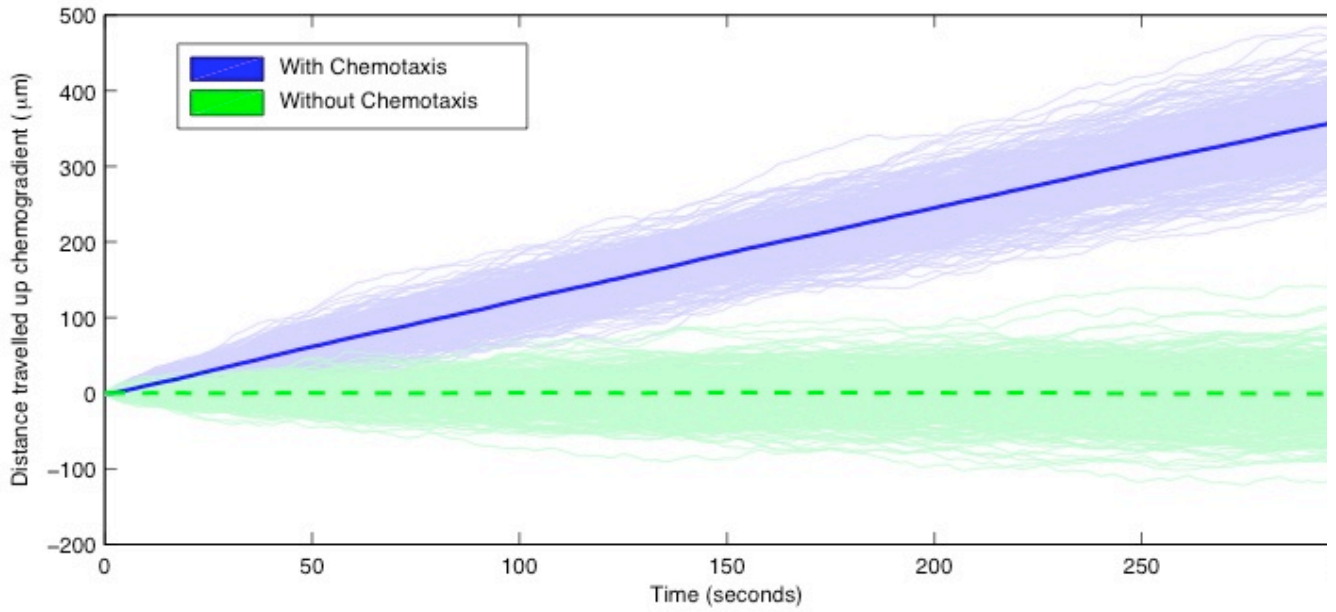
Standardization: by agreement, many aspects of the designs are standardized to improve overall function. One example is the standard way parts, devices, and systems are connected so that new designs will fit with old designs. An everyday example is that all light bulbs

fit into any socket!



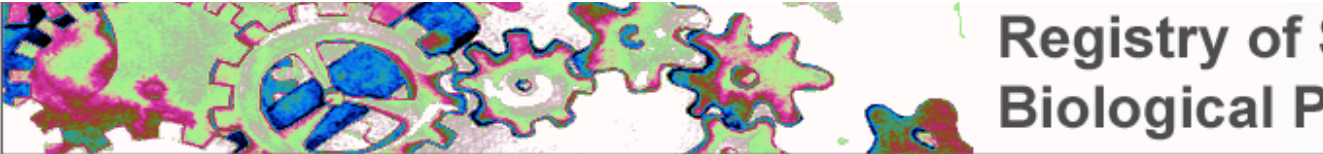
BioBrick assembly allows users to connect each others parts, devices, and systems. [Read more.](#)

Designing and modeling: before building, build a model and test the devices capacity. This not only improves design but tests basic biological assumptions that could be false.



Models of cellular chemotaxis by undergraduates at Bristol University, UK. [Read more.](#)

BioBrick Registry of Standard Parts: http://partsregistry.org/Main_Page




Registry of Standard Biological Parts

page discussion view source history


Welcome to the Registry of Standard Biological Parts.

The Registry is a collection of ~3200 genetic parts that can be mixed and matched to build synthetic biology. At MIT, the Registry is part of the Synthetic Biology community's efforts to make biology easier to engineer. It provides parts to iGEM teams and academic labs.


The Registry is based on the principle of "get some, give some". Registry users benefit from using the parts and in designing their engineered biological systems. In exchange, the expectation is that Registry users will, in turn, contribute parts and new parts that they make to grow and improve this community resource.




Catalog of parts & devices



Help




Users & groups
(Apply for an account)



DNA repositories

Registry tools

- Search parts (
- Add a part
- Send parts to
- Sequence ana



You'll notice some significant changes to the Registry recently. In particular, the Registry [catalog](#) for easier browsing of the available parts and devices. You can now browse parts and devices by notice that the documentation and help pages for each class of parts have been greatly enhance. The Registry of Standard Biological Parts is *always* a work in progress. Please browse the new free to edit and improve the pages further.

Parts designed and built by undergraduates since 2004. [Read more.](#)

What is iGEM?

[International Genetically Engineered Machines](#)

[Jamboree](#)/Competition. Gathering of the top synthetic biology students from around the world in a friendly competition to learn and share.

[Do it yourself Biology](#) (1 hour lecture by Natalie Kuldell and Reshma Shetty)

at a glance:

1925 minutes of talks	77 presentations
1200 participants	24 awards
825 jamboree attendees	22 weeks of work
84 teams	21 countries



International Genetically Engineered Machines Jamboree/Competition 2008 photo. [Read More.](#)

Additional Resources and Information

See a [PowerPoint Slide Show](#) that includes two research projects by undergraduates. The slide show also presents a new approach to introductory biology called *Integrated Systems Biology* as a way to improve undergraduate biology education that would better prepare students for biology in general and biology research in particular.

Read [an open access Burnt Pancake Problem paper](#) published by undergraduates. You can also read another [open access paper by undergraduates addressing the Hamiltonian Path Problem](#).

[Link to some papers about synthetic biology.](#)

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