# The Brown iGEM Team

## Who we are

•Brown iGEM is an independent undergraduate research team focusing on projects in the field of synthetic biology. Our efforts are showcased at an annual international competition at MIT

•Each year, team members bring together experience in a range of disciplines—Biology, Neuroscience, Human Biology, Computer Science, Computational Biology, Engineering, and more. With the support of graduate and faculty advising, we maintain our own lab space and carry out research in a self-directed manner.

•Since its founding in 2006, Brown iGEM has built a distinguished reputation. Our awards include Best Environmental Project, Gold, Silver, and Bronze medals. Brown iGEM alumni can be found in industry and labs at the forefront of synthetic biology and biotechnology.

## The iGEM Competition

• The International Genetically Engineered Machine competition (iGEM) is the world's premiere undergraduate synthetic biology event, geared towards the advancement of the field and of the BioBrick Standardization movement.

•Over 128 university teams from 6 continents participate in iGEM, designing original biological systems and contributing new parts to an expanding registry of standard BioBricks.

•At the iGEM Jamboree in November, teams present their projects. Prizes are awarded for categories such as practical application, usage of BioBricks, presentation format, and experimental practices.

iGEM Jamboree 2008

Picture from http://2008.igem.org/Main_Page

## What is Synthetic Biology?

•A shift from the *descriptive* phase of biology into the *synthetic* phase: synthesizing new parts and new functions in cells
•Finding biological solutions to problems
•Applying engineering principles to the parts of life—genes, proteins, cells—instead of mechanical devices, chemicals, or electrical circuitry
•Adding new modules to existing genomes or building up wholly new genomes

## Examples of synthetic biology at different levels

<u>Individual Proteins</u>

•Fusing two or more protein domains to couple existing functions in original ways
•Using computational models to rationally design protein binding sites

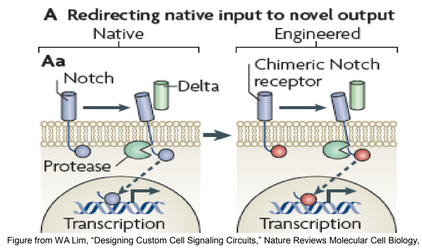
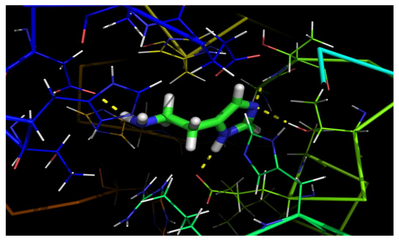



Figure from WA Lim, "Designing Custom Cell Signaling Circuits," Nature Reviews Molecular Cell Biology, 2010.

Changing the cleaved portion of a surface receptor to create new downstream effects

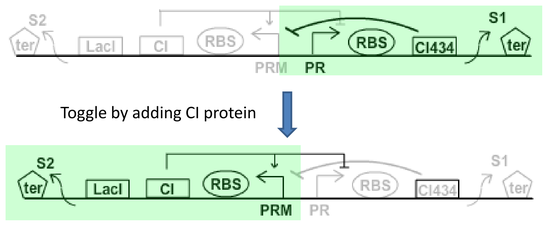


Novel protein binding pocket created by Brown iGEM 2009

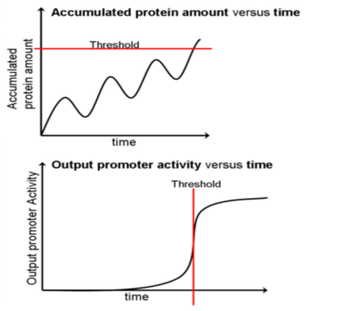
<u>Biological Circuits</u>

•Changing endogenous signal pathways to modify responses to inputs
•Manipulating gene regulation networks to create computational functions

Stable two-state switch



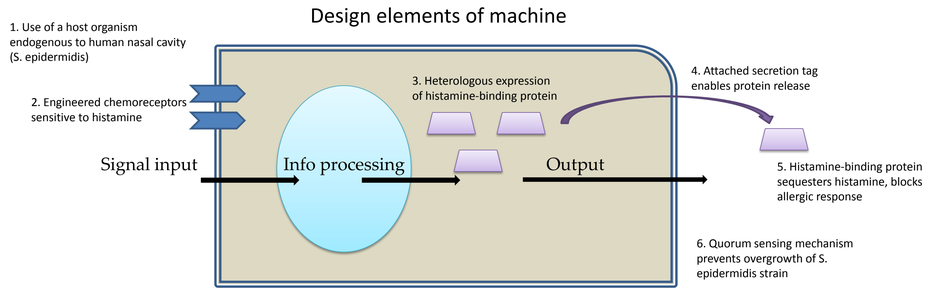

Timer using a negative feedback loop




<u>Complex Biological Machines</u>

•Viewing the cell as a platform for interchangeable parts

Example: Nasal bacteria that produce histamine-sequestering protein in response to elevated histamine levels (Brown iGEM 2009)



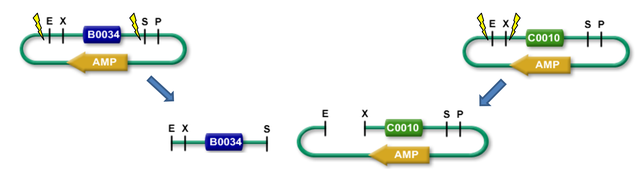

## BioBrick Standardization

•The BioBrick movement: adding a standard prefix and suffix to pieces of DNA to make them compatible
•Prefix and suffix contain restriction enzyme sites
•BioBricks can be joined together, swapped to create new biological machines

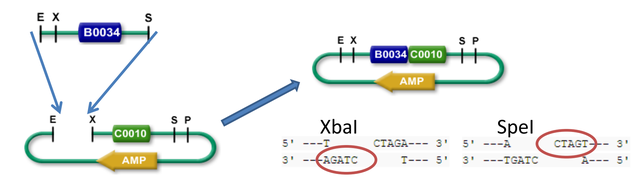
```
Prefix:                                  Suffix:
GAATTC GCGGCCGC T TCTAGA G               T ACTAGT A GCGGCCG CTGCAG
EcoRI     NotI      SpeI                 SpeI      NotI     PstI
```

### How to join BioBricks

<u>Step 1: Perform double restriction digest on parts</u>




<u>Step 2: Purify digest products and ligate</u>




XbaI and SpeI sticky ends complementary!

<u>Step 3: Repeat as necessary</u>


## The Registry of Biological Parts

•The Registry is a searchable online database of all BioBricks
•More than 2000 well-characterized parts exist, along with many other uncharacterized parts
•BioBricks can be obtained in DNA plasmid form from annual iGEM distributions or upon request from the central repository at MIT

Types of BioBricks

| To construct a gene: | To construct a machine: |
|---|---|
| •Regulators of expression | •Protein generators |
| •Protein coding sequences | •Switches |
| •Protein domains | •Measurement devices |
| •Vectors | •Reporters |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