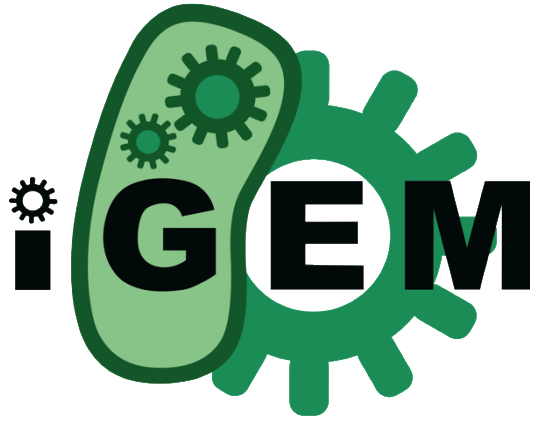


# iGEM at William & Mary



Caroline Golino (CAMS, '17)

John Marken (Mathematics, '17)

Margaret Saha (Biology)

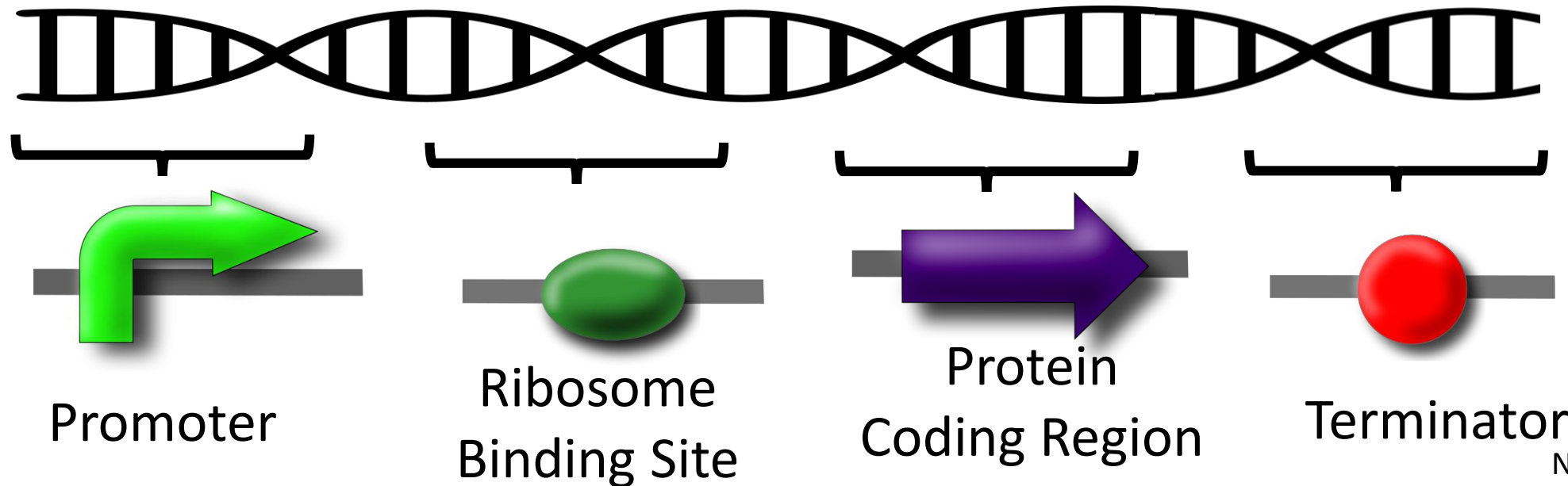
***“The new field of synthetic biology promises to change health care, computer technology, the production of biofuels, and more. Students participating in the International Genetically Engineered Machine (iGEM) competition are on the front lines of this revolution.” [Cell, 26 Jan. 2017]***

# What is Synthetic Biology?

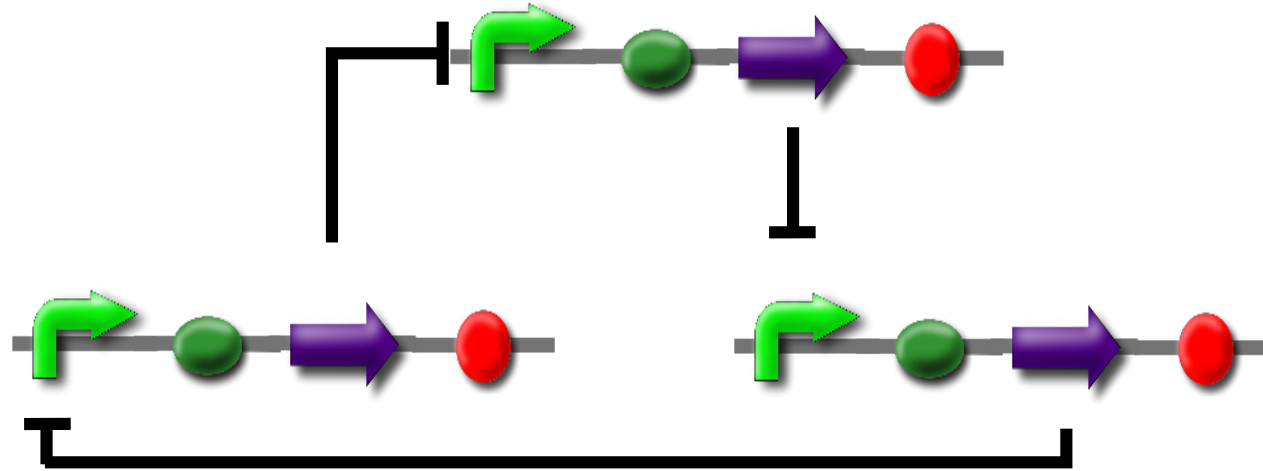
The design (or redesign) and construction of new biological entities such as enzymes, **genetic circuits**, and cells.

- - - - -

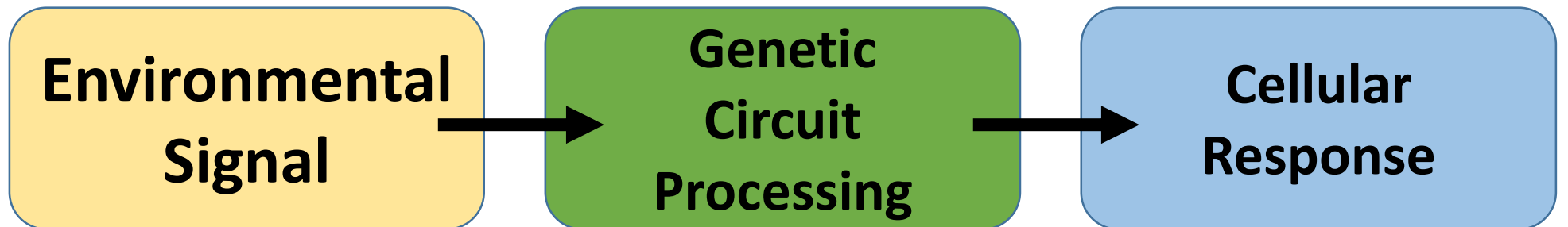
Genes consist of modular parts



**Genes (and their modular parts) can be wired into circuits**



**Genetic circuits can be coupled to cellular pathways**



# What is iGEM (international Genetically Engineered Machine)?

- iGEM maintains collection of standardized biological parts
- iGEM hosts annual competition in synthetic biology
- Students solve real world problems
- Build genetically engineered biological systems

Registry of Standard Biological Parts

tools catalog repository assembly protocols help search

main page design experience information part tools edit

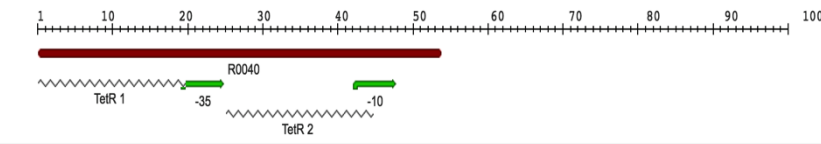
**Part:BBa\_R0040:Design**  
Designed by: June Rhee, Connie Tao, Ty Thomson, Louis Waldman Group: Antiquity (2003-01-31)

Regulatory p(tetR)

Released HQ 2013  
Sample In stock  
★ 1 Registry Star  
900 Uses  
9 Twins  
Get This Part

**TetR repressible promoter**

Subparts | Ruler | [SS](#) | [DS](#) Length: 54 bp [View plasmid](#) [Get part sequence](#)



Assembly Compatibility: [10](#) [12](#) [21](#) [23](#) [25](#) [1000](#)

**Design Notes** [\[edit\]](#)  
BBa\_R0040 (TetR repressible promoter) is based on a cl promoter. It has been modified to include two TetR binding sites.  
Constructed by DNA synthesis.







*William & Mary iGEM presents:*

# THE CALCIUM KIT

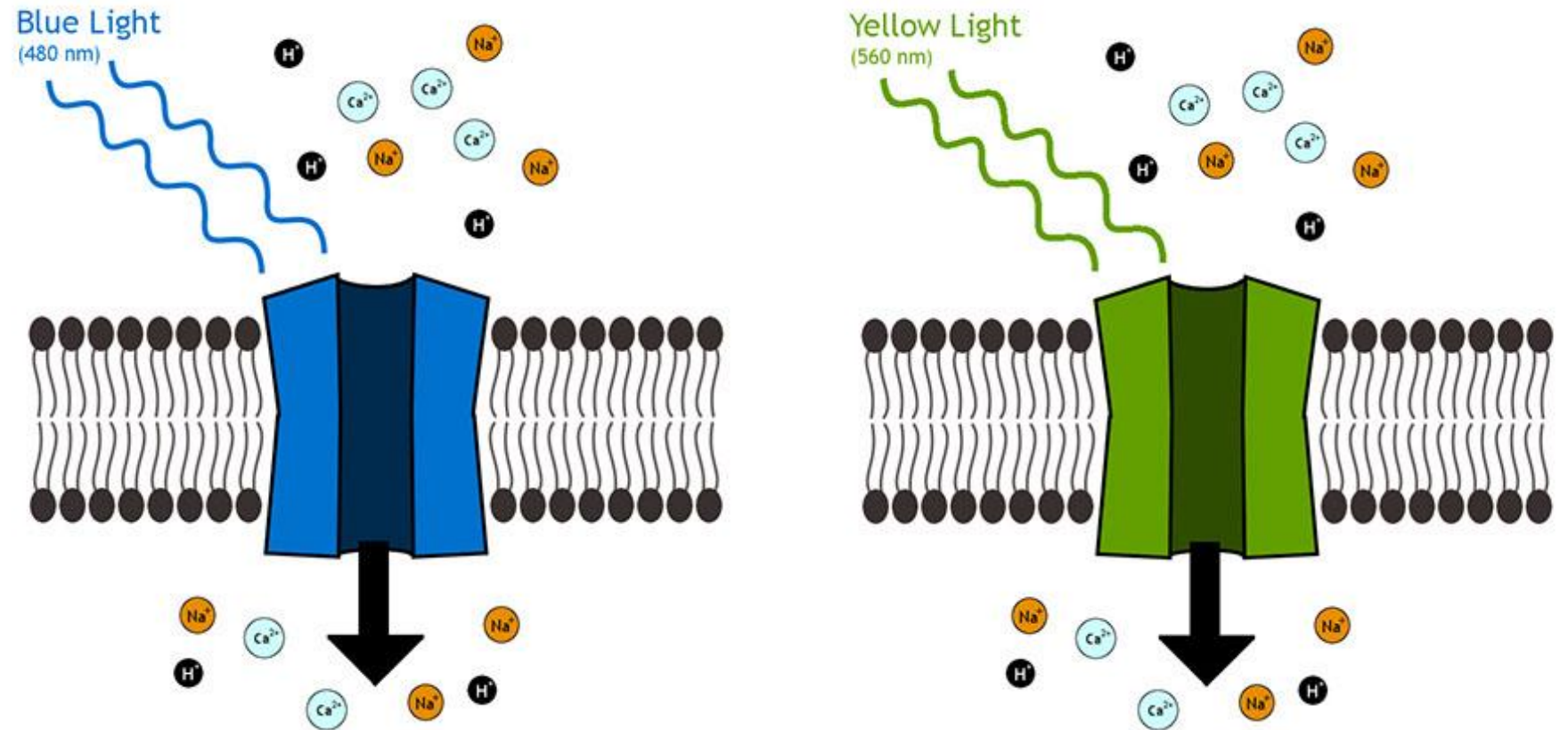


2014



# 2014 Summary

Submitted Channelrhodopsin-1 and Channelrhodopsin-2 in the BioBrick backbone to iGEM Registry



# 2014 Results



Arizona State	BIOSINT Mexico	Bordeaux	Brasil-SP	British Columbia
BUCT-China	Caltech	Evry	Georgia State	Goettingen
Harvard BioDesign	HIT-Harbin	HokkaidoU Japan	HUST-Innovators	IIT Delhi
Kent	Linkoping Sweden	Melbourne	METU Turkey	Michigan Software
Missouri Miners	NEAU-Harbin	NJU-QIBEBT	Northwestern	NU Kazakhstan
OUC-China	OU Norman	Penn	PoznanSoft	Queens Canada
Reading	SCU-China	SJTU-BioX-Shanghai	Stony Brook	Sumbawagen
SYSU-China	TCU Taiwan	Tianjin	Toronto	Tsinghua-A
Tuebingen	UB Indonesia	UChicago	UCLA	UCSC
UC Santa Barbara	UGA-Georgia	UiOslo Norway	UST Beijing	USyd-Australia
Vanderbilt	Vanderbilt MF	Vanderbilt Software	Warsaw	William and Mary
WLC-Milwaukee	Yale	Zamorano	ZJU-China	

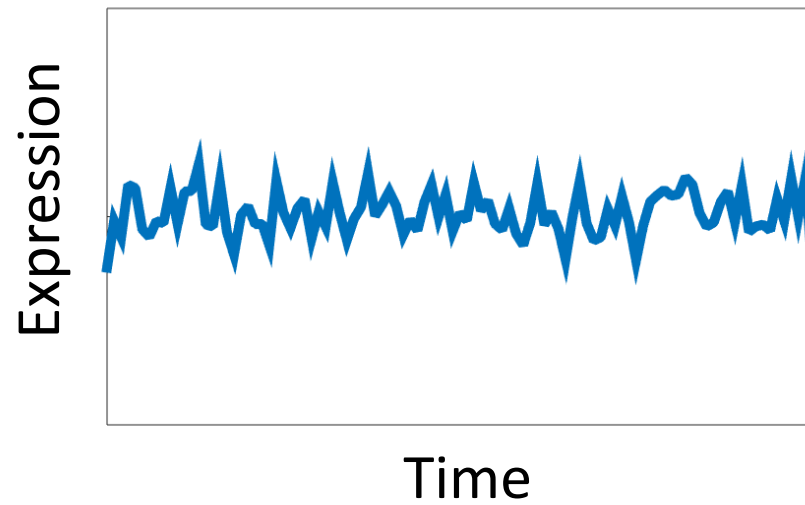


# NOISE

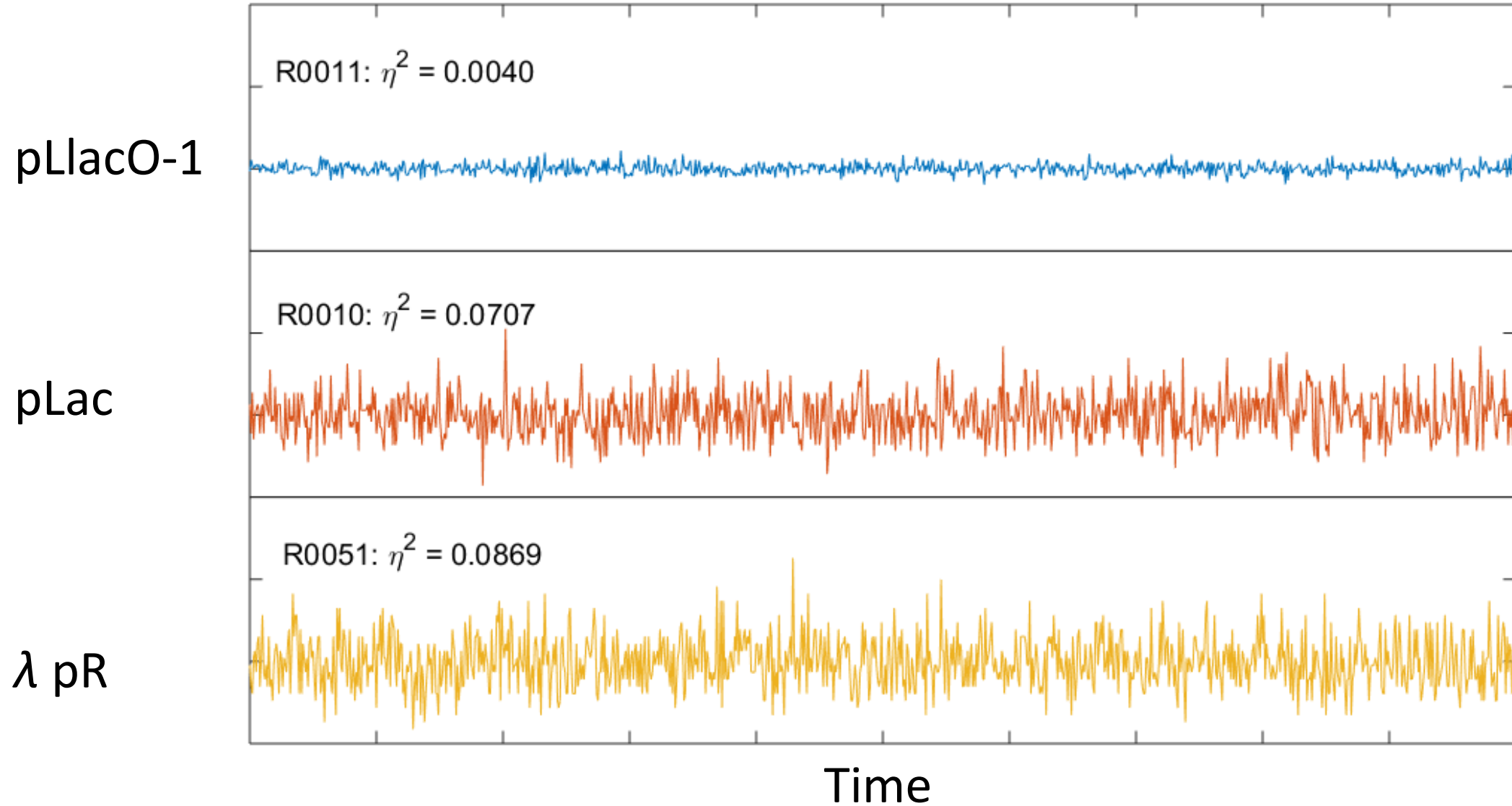
William & Mary iGEM 2015









# What is Noise?



# Noise Measurement Results



# 2015 Results

Team ▲	Medal ▼	Award
William_and_Mary		Finalist, Undergrad
William_and_Mary		Grand Prize Winner, Undergrad
William_and_Mary		Best Measurement Project
William_and_Mary		Nominated for Best Model, Undergrad
William_and_Mary		Best Education and Public Engagement, Undergrad
William_and_Mary		Best Presentation, Undergrad



Justin Knight,  
iGEM Foundation



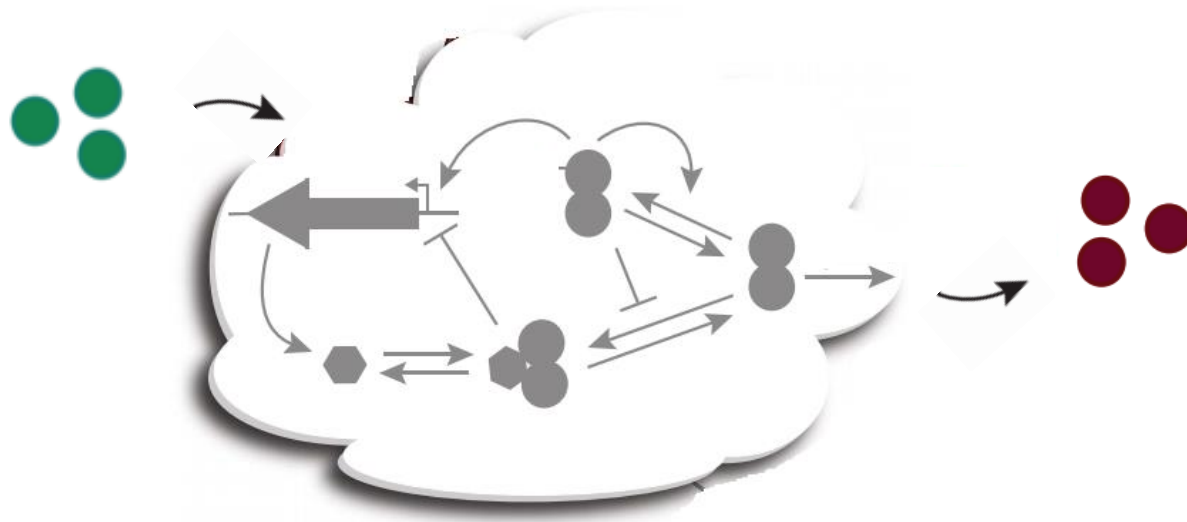
# CIRCUIT CONTROL

William & Mary iGEM 2016

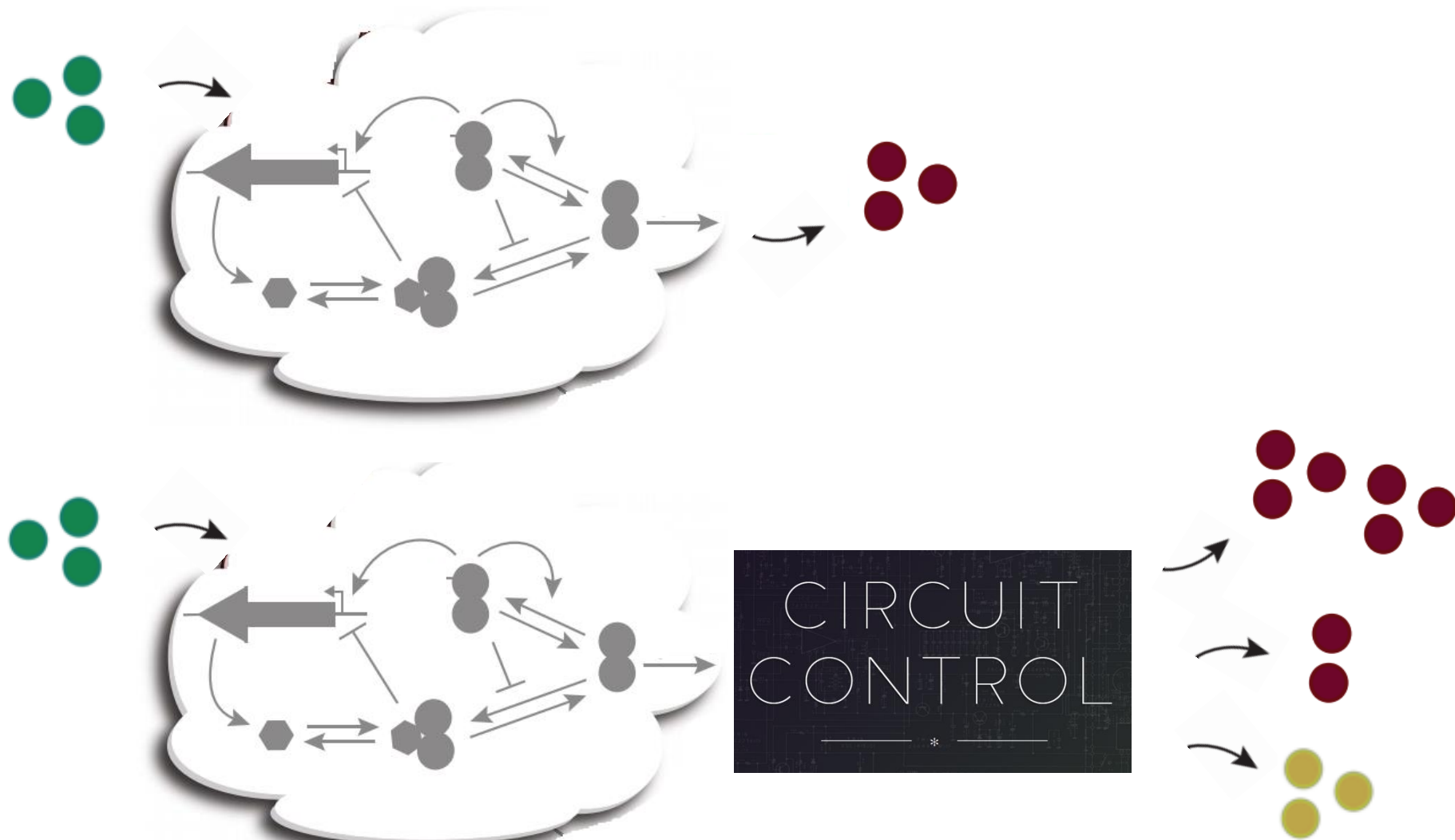




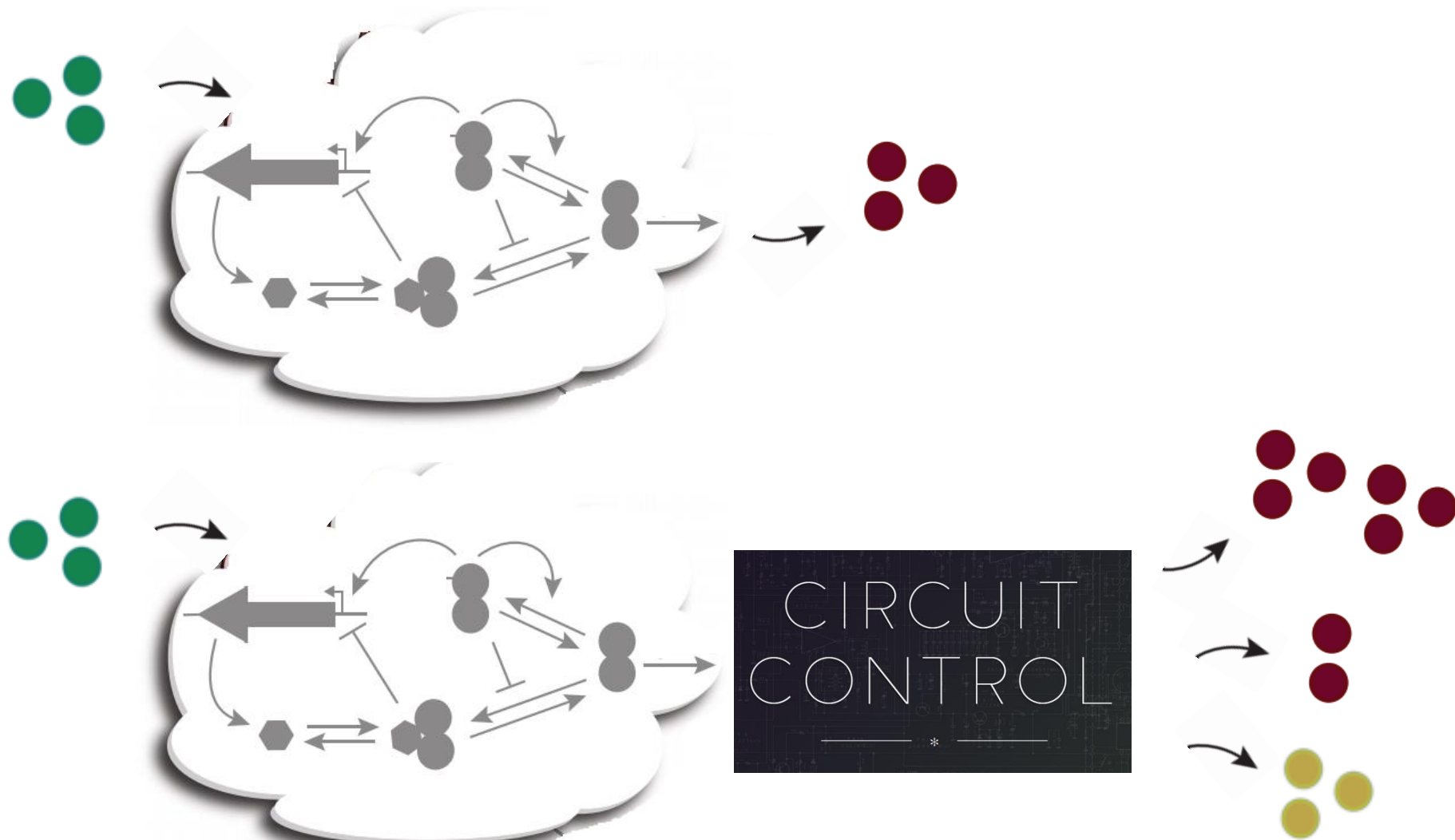
# Application of modular and additive control



# Application of modular and additive control

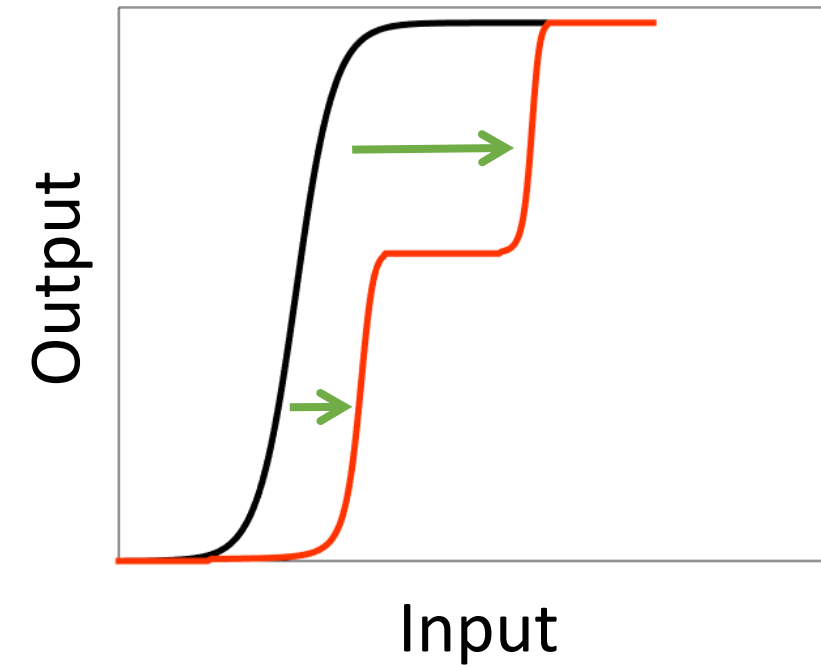


# Application of modular and additive control



# Modifying circuit behavior

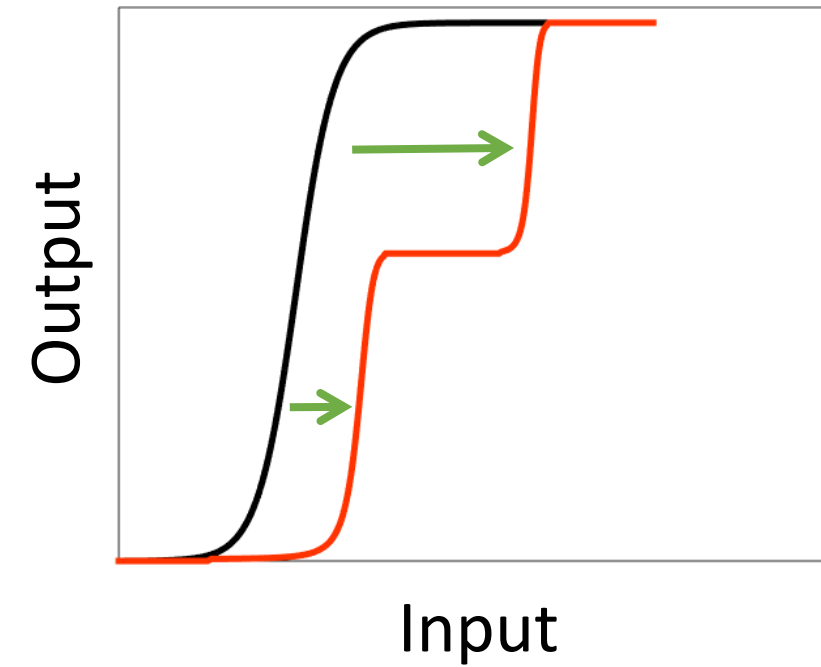
Multi-State Response



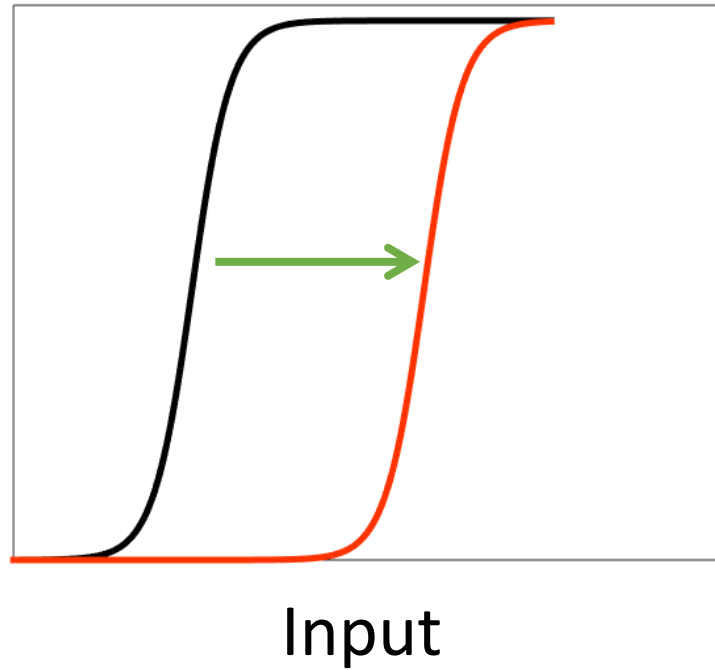


# Modifying circuit behavior

Multi-State Response

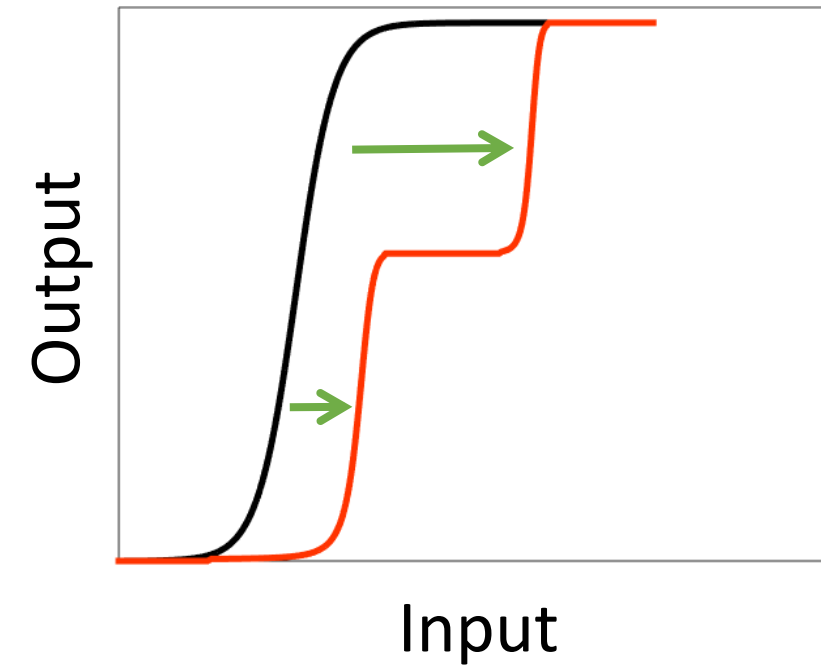


Shifting Sensitivity

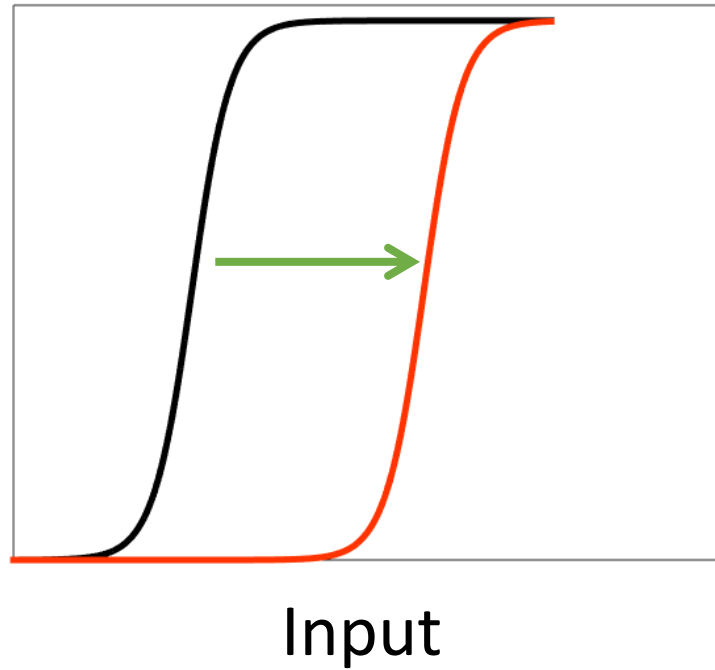


# Modifying circuit behavior

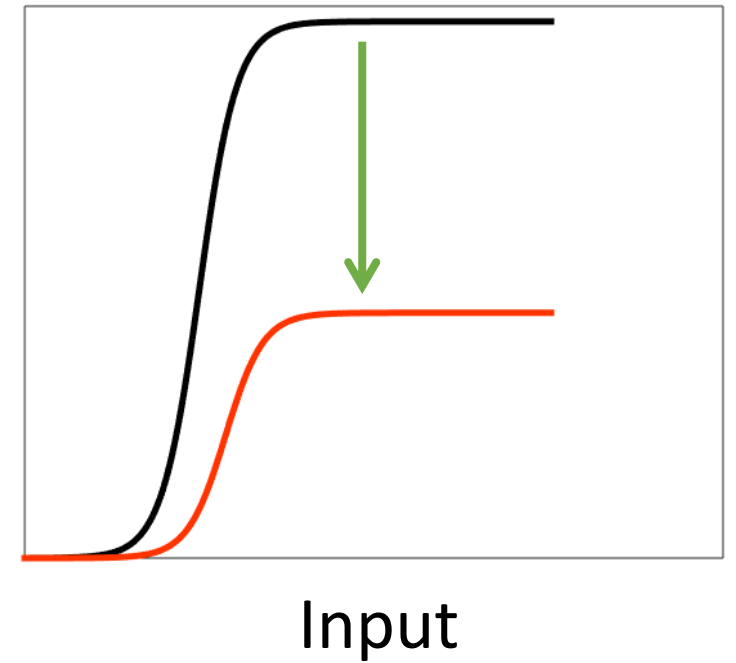
Multi-State Response



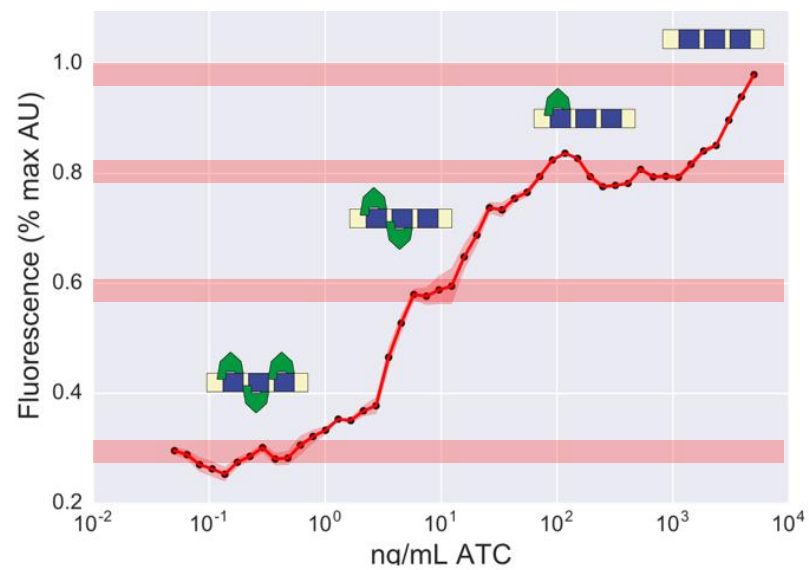
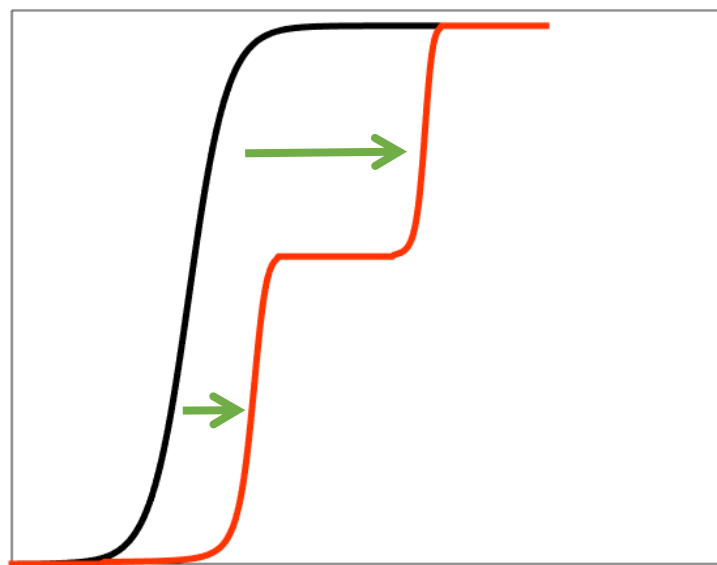
Shifting Sensitivity



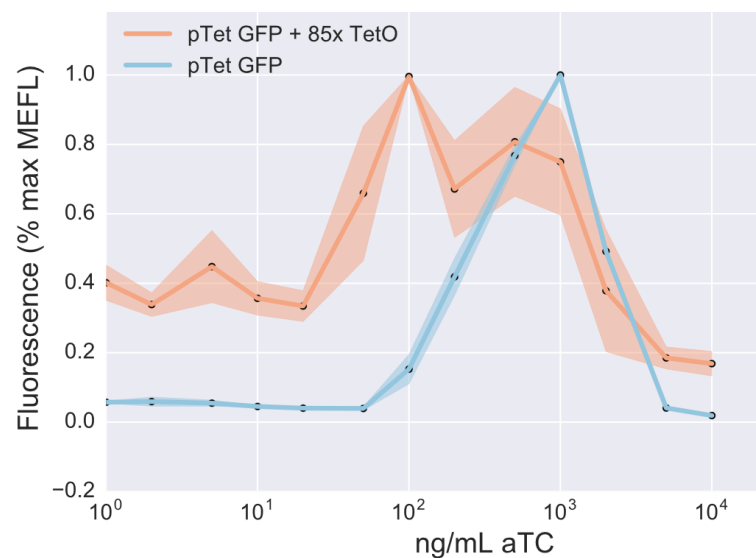
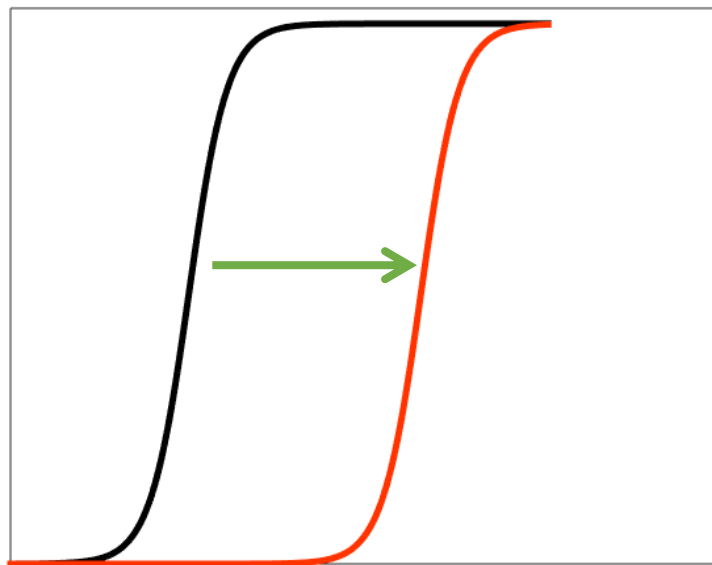
Scaling Magnitude



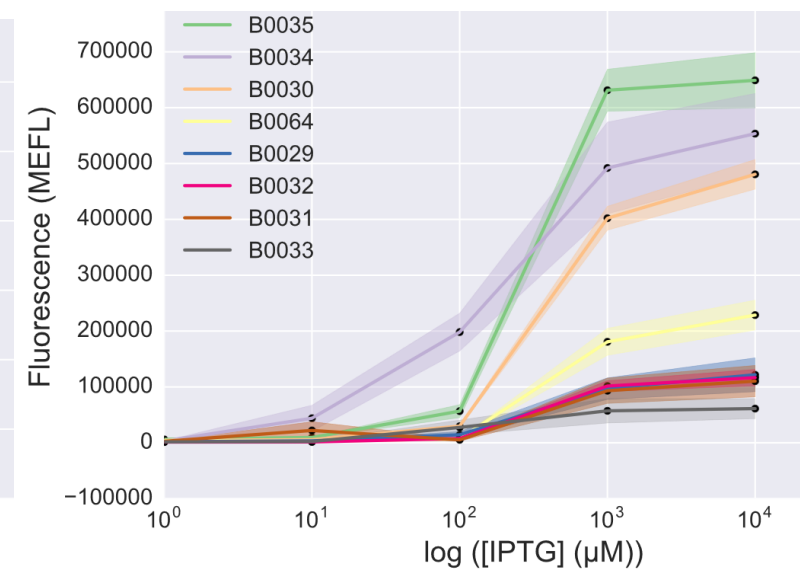
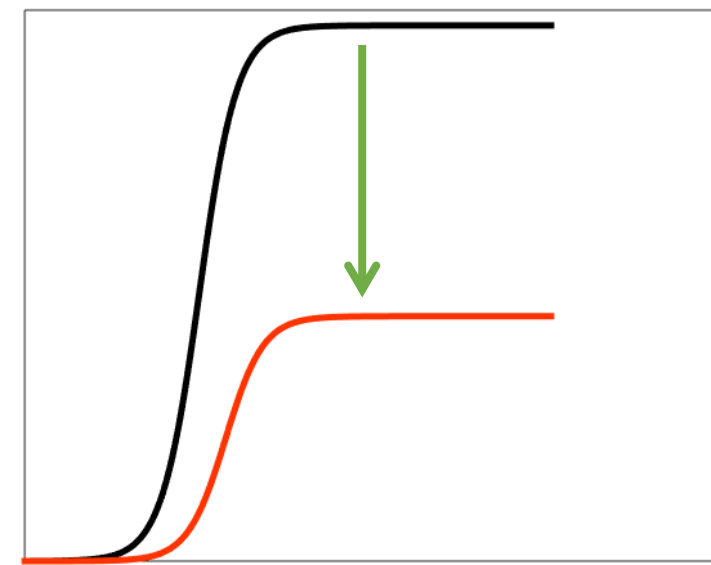
## Multi-State Response





## Shifting Sensitivity



## Scaling Magnitude



# 2016 Results

Team ▲	Medal ▼	Award ▼
William and Mary		Nominated for Best Foundational Advance Project
William and Mary		Nominated for Best Poster





# **Broader Impacts of iGEM @ W&M:**

- **Ideas for new COLL courses**
- **Collaboration with W&M “Maker Movement”**
- **Synergy with W&M Engineering and Data Science initiatives**
  - **Outreach to local schools**
  - **Partnerships with industry**

**The BioMakerSpace in ISC3**

# The Future of Synthetic Biology: Engineering a Biological Revolution ...

**RNA-Guided Human Genome  
Engineering via Cas9**

SYNTHETIC BIOLOGY

**Complete biosynthesis of opioids  
in yeast**

**Synchronized cycles of bacterial lysis for *in vivo*  
delivery**

**Cell**

**Precision Tumor Recognition by T Cells With  
Combinatorial Antigen-Sensing Circuits**

**Cell**

**Rapid, Low-Cost Detection of Zika Virus Using  
Programmable Biomolecular Components**

**Phototactic guidance of a  
tissue-engineered soft-robotic ray**

Mali *et al.* 2013, *Science*  
Galanie *et al.* 2015, *Science*

Roybal *et al.* 2016, *Cell*  
Pardee *et al.* 2016, *Cell*

Din *et al.* 2016, *Nature*  
Park *et al.* 2016, *Science*