



# **International Genetically Engineered Machine Competition**

# Overview

- What is iGEM?
- Caltech 2010
- Caltech 2011
- 2012 timeline
- Questions







Europe



Asia











Americas

Europe

Asia

# What is iGEM?

- Synthetic biology competition for undergraduates

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- Summer research project



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- Extension of SURF program

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- Synthetic biology competition for undergraduates
- Summer research project
- Extension of SURF program
- Modeling



# **What is iGEM?**

Real research

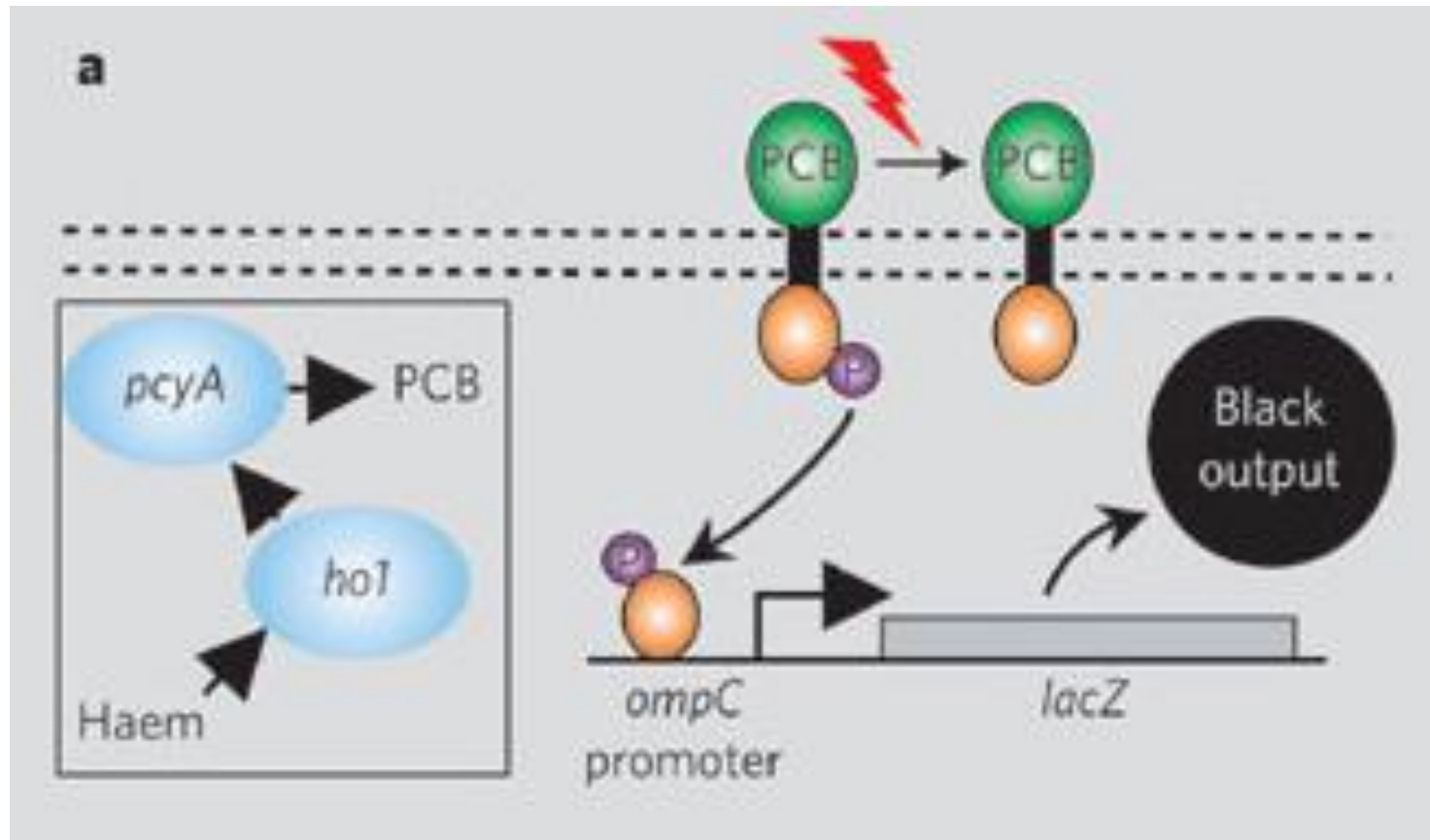
# What is synthetic biology?

“The goal of synthetic biology is to extend or modify the behavior of organisms and engineer them to perform new tasks.”

Andrianantoandro, E.; Basu, S.; Karig, D.; Weiss, R. *Science* 2006, 2, 1-14.



# Example: Coliroid



# Example: Coliroid



Synthetic biology: Engineering *Escherichia coli* to see light. *Nature* 2005, 438, 441-442.



# iGEM Research Tracks

- Environment
- Food/Energy
- Foundational Advance
- Health/Medicine
- Information Processing
- Manufacturing
- New Application
- Software

## Browse parts and devices by function

*This section replaces the previous **Featured parts** pages.*



**Biosynthesis:** Parts involved in the production or degradation of chemicals and metabolites are listed here.



**Cell-cell signaling and quorum sensing:** Parts involved in intercellular signaling and quorum sensing between bacteria.



**Cell death:** Parts involved in killing cells.



**Coliroid:** Parts involved in taking a bacterial photograph.



**Conjugation:** Parts involved in DNA conjugation between bacteria.



**Motility and chemotaxis:** Parts involved in motility or chemotaxis of cells.



**Odor production and sensing:** Parts that produce or sense odorants.



**DNA recombination:** Parts involved in DNA recombination.



**Viral vectors:** Parts involved in the production and modification of Viral vectors.



# Judging

- Impress the judges!
- Bronze/silver/gold medals
- Many paths to success...
  - Best poster
  - Best presentation
  - Best part
  - Best experimental measure approach
  - Best model
  - Best human practices advance



# Publication

## **Texas 2005**

Synthetic biology: Engineering *Escherichia coli* to see light. *Nature* 2005, 438, 441-442.

## **Davidson-Missouri Western 2007, 2008**

Engineering bacteria to solve the Burnt Pancake Problem. *J. Bio. Eng.* 2008, 2.

Solving a Hamiltonian Path Problem with a bacterial computer. *J. Bio. Eng.* 2009, 3.

## **Valencia 2008, 2009**

Yeast cultures with UCP1 uncoupling activity as a heating device. *New Biotech.* 2009, 26, 300-306.

Aequorin-expressing yeast emits light under electric control. *J. Biotech.* 2011, 152, 93-95.

# Why iGEM?

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You pick your project.

# Why iGEM?

- Fun research



# Why iGEM?

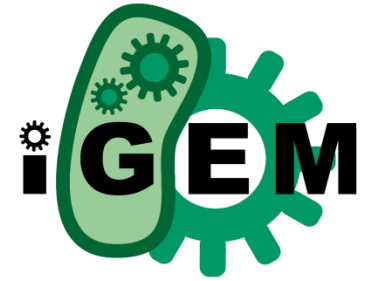
- Fun research
- Work as a team

# Why iGEM?

- Fun research
- Work as a team
- Flexible hours

# Why iGEM?

- Fun research
- Work as a team
- Flexible hours
- Jamborees!



# TOWARDS A BIOPLASTIC BIOPRINTER

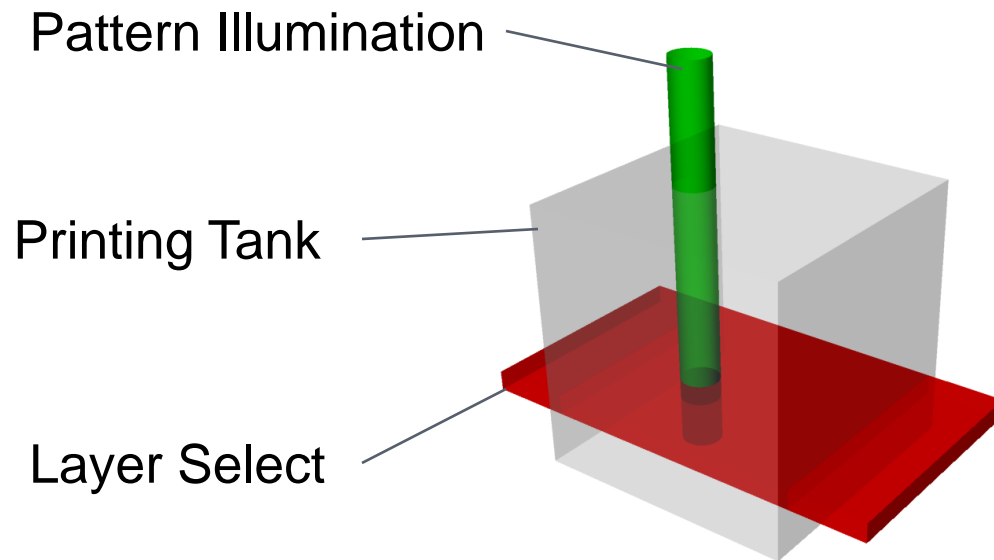
Caltech Team 2010



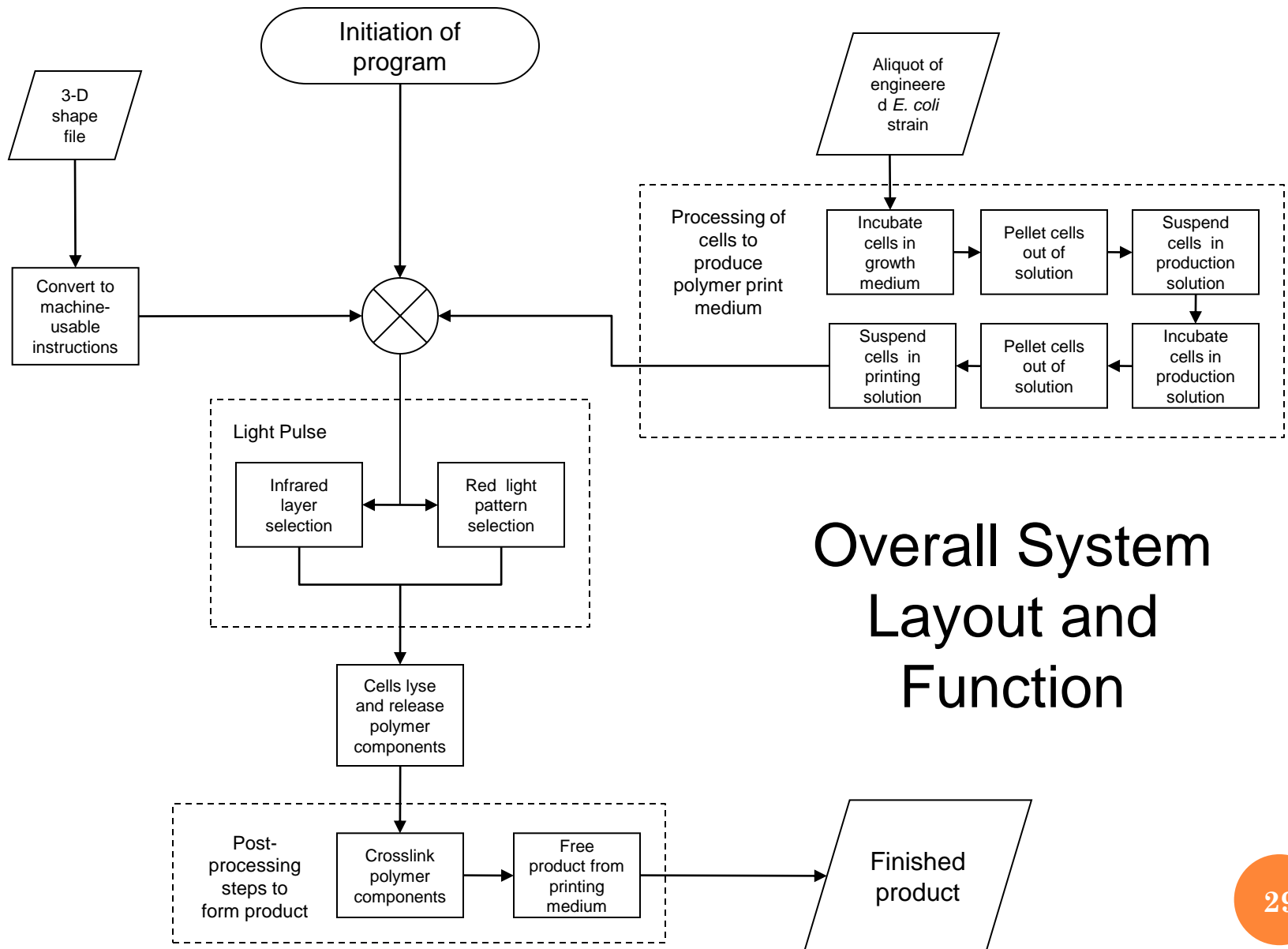
# PRINTING PLASTIC WITH BACTERIA

- Light-induced Lysis
- Plastic Production
- Print an Image
- Extensibility to 3D
- Potential advantages
  - Few to no geometry limitations
  - Surface quality
  - Mechanical properties
  - Production speed
  - Low material cost
  - Multiple material printing

# HOW IT WORKS: 3D PRINTING

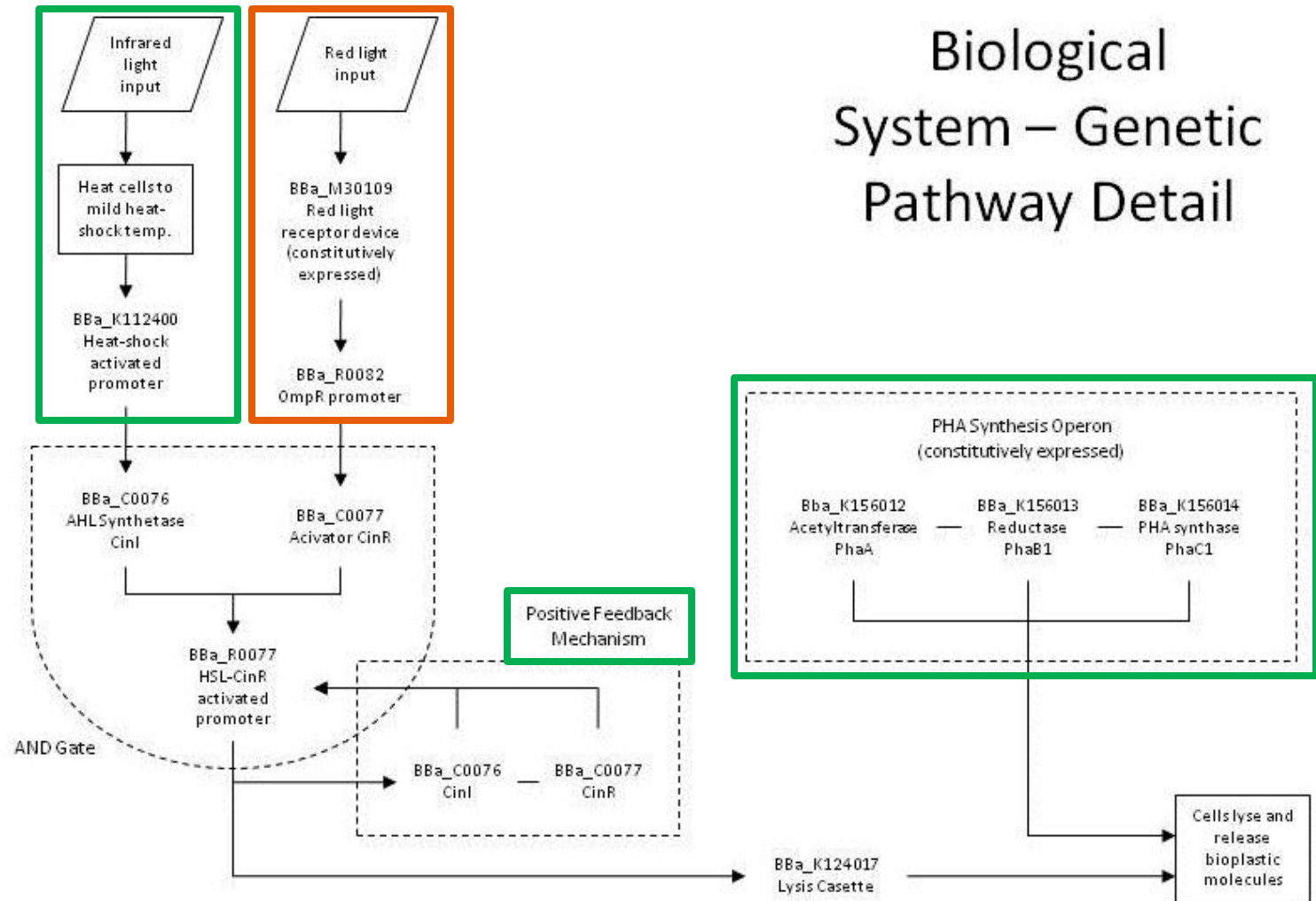


- Post-processing
  - Cross-linking
    - UV or other methods
  - Release Product



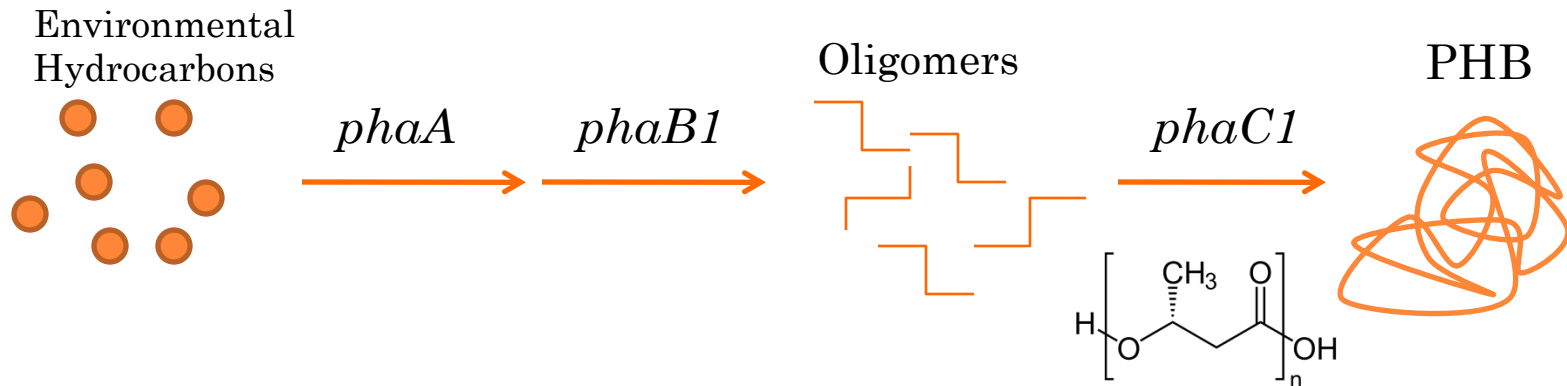
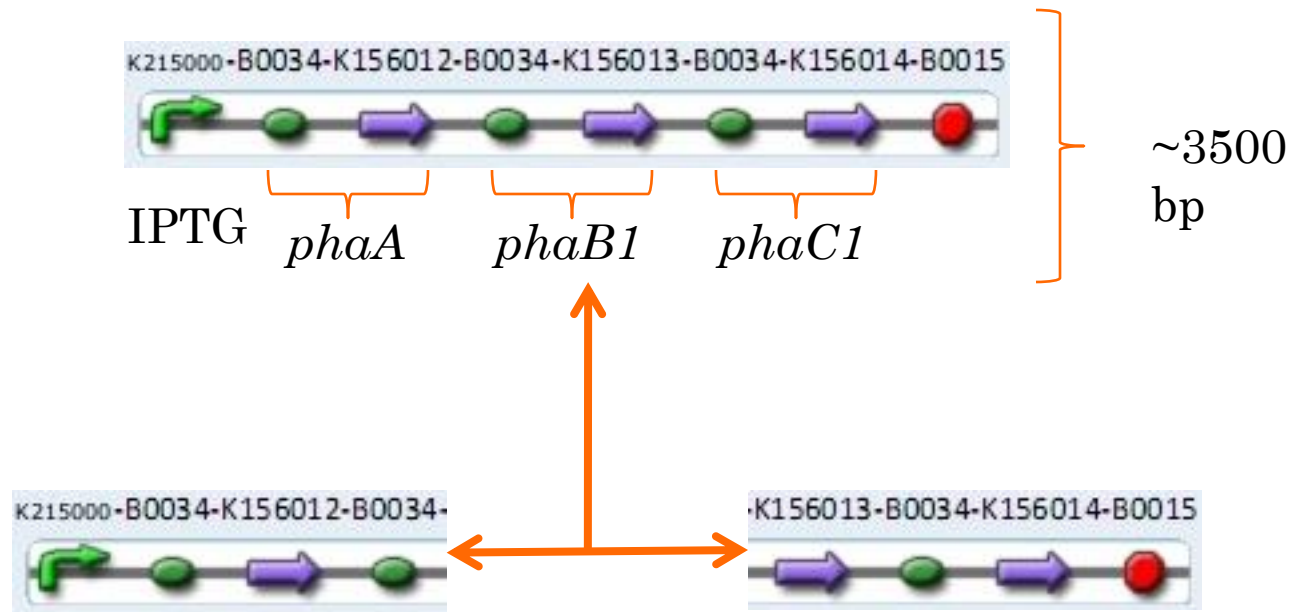
## Overall System Layout and Function

# DESIGN & PROGRESS





# PLASTIC: *PHAA*, *PHAB1*, *PHAC1*

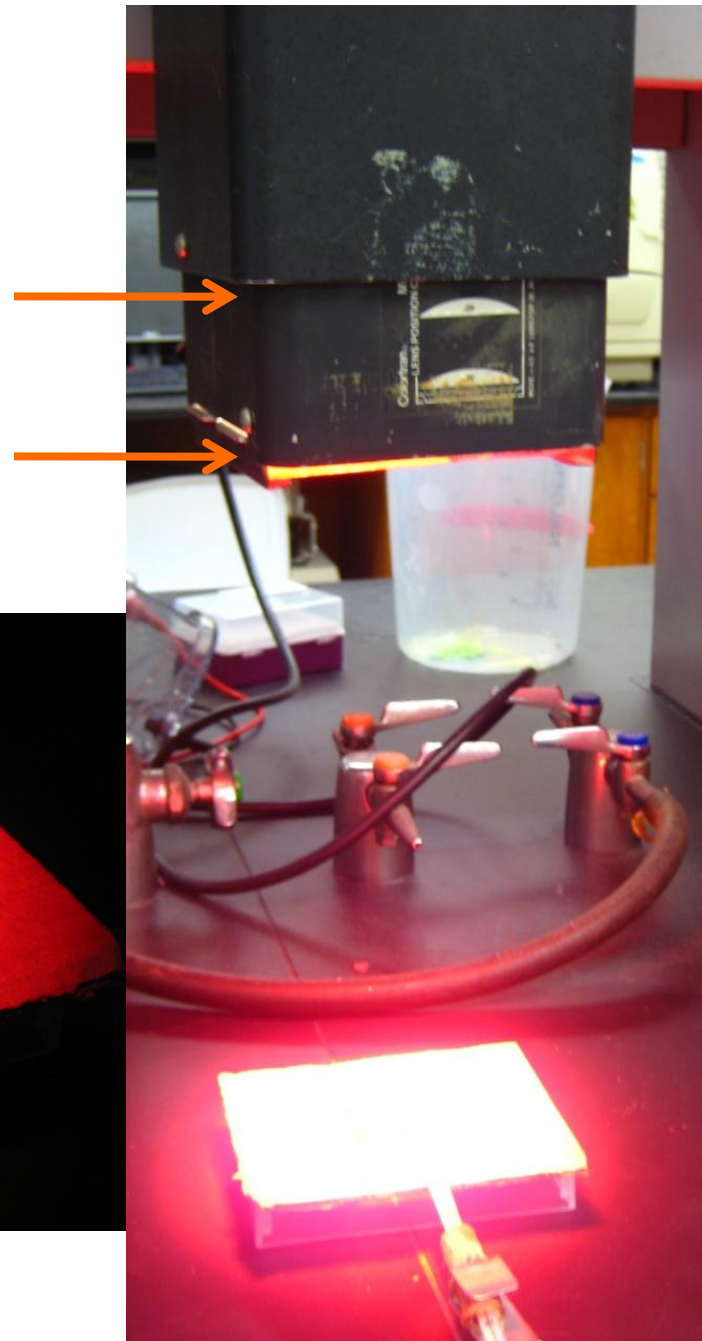
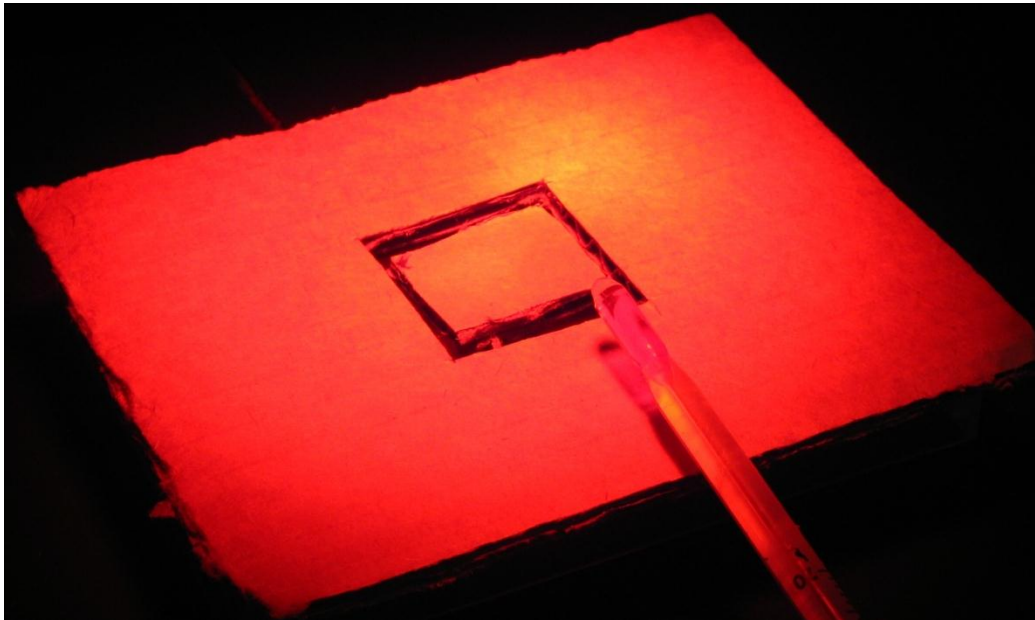


# PRINTING APPARATUS

Theater  
Lamp

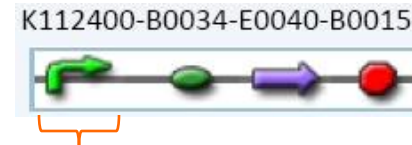
Red light  
filter

Stage: 42°C

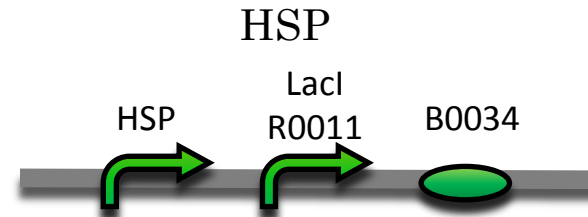


# BIOBRICKS SUBMITTED

1. Infrared promoter (K338001)



2. HSP+LacI (K338002)

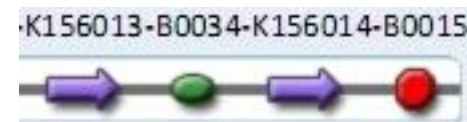


3. Plastic groups

- *phaA* (K338003)



- *phaB1* + *phaC* (K338004)



4. Ligation Intermediates & Reporters (8)

# CONCLUSIONS

- Plastic production may be within reach
- Submitted BioBricks
  - Fixed faulty BioBricks
- Obtained provisional patent: CIT 5637-P
- Gold medal at iGEM 2010 Jamboree



C A L I F O R N I A   I N S T I T U T E   O F   T E C H N O L O G Y

# **BIOREMEDIATION OF ENDOCRINE DISRUPTORS**

**Julia Brown**

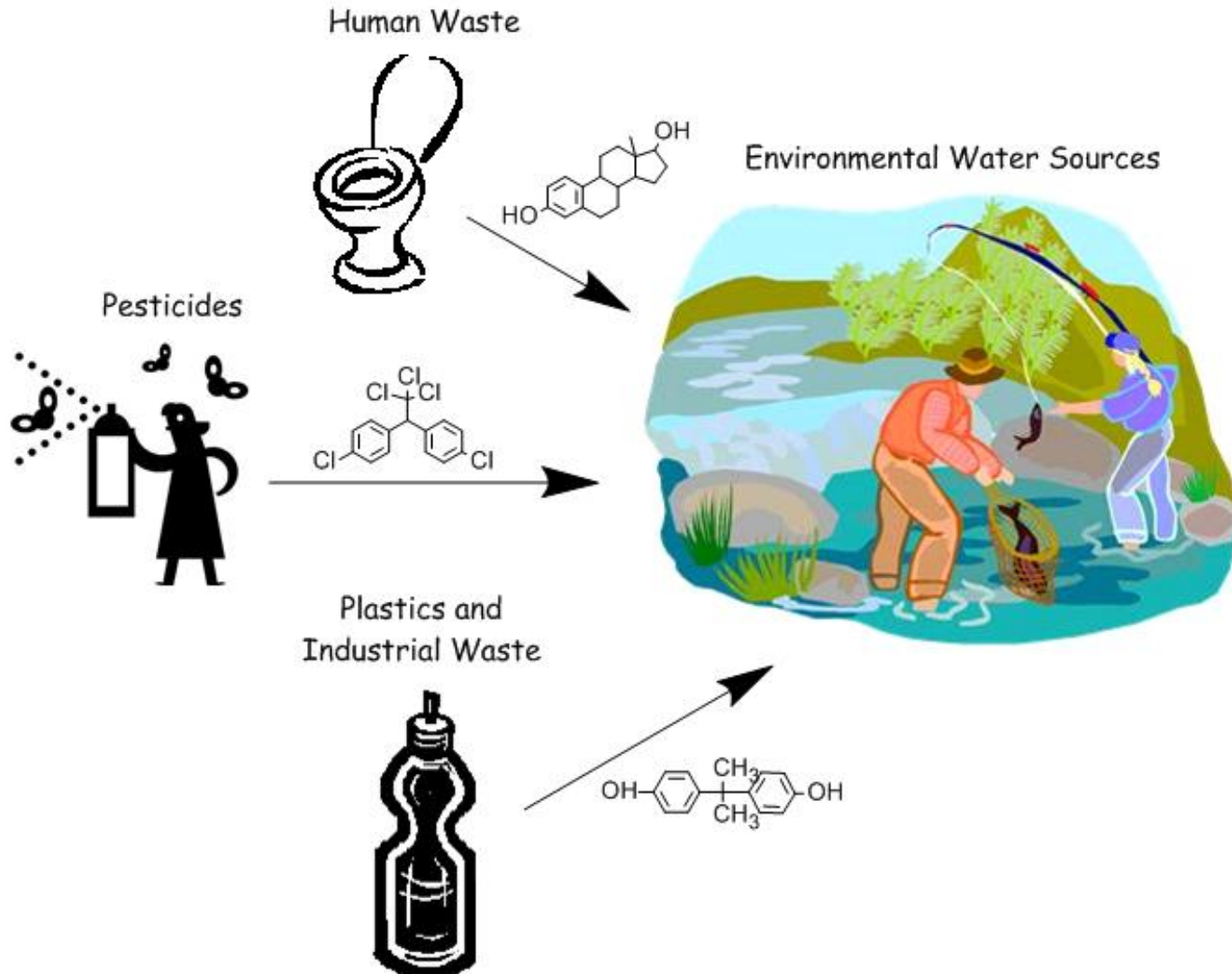
**Puikui Cheng**

**Amanda Shelton**

**Ashley Su**

**Nicole Thadani**

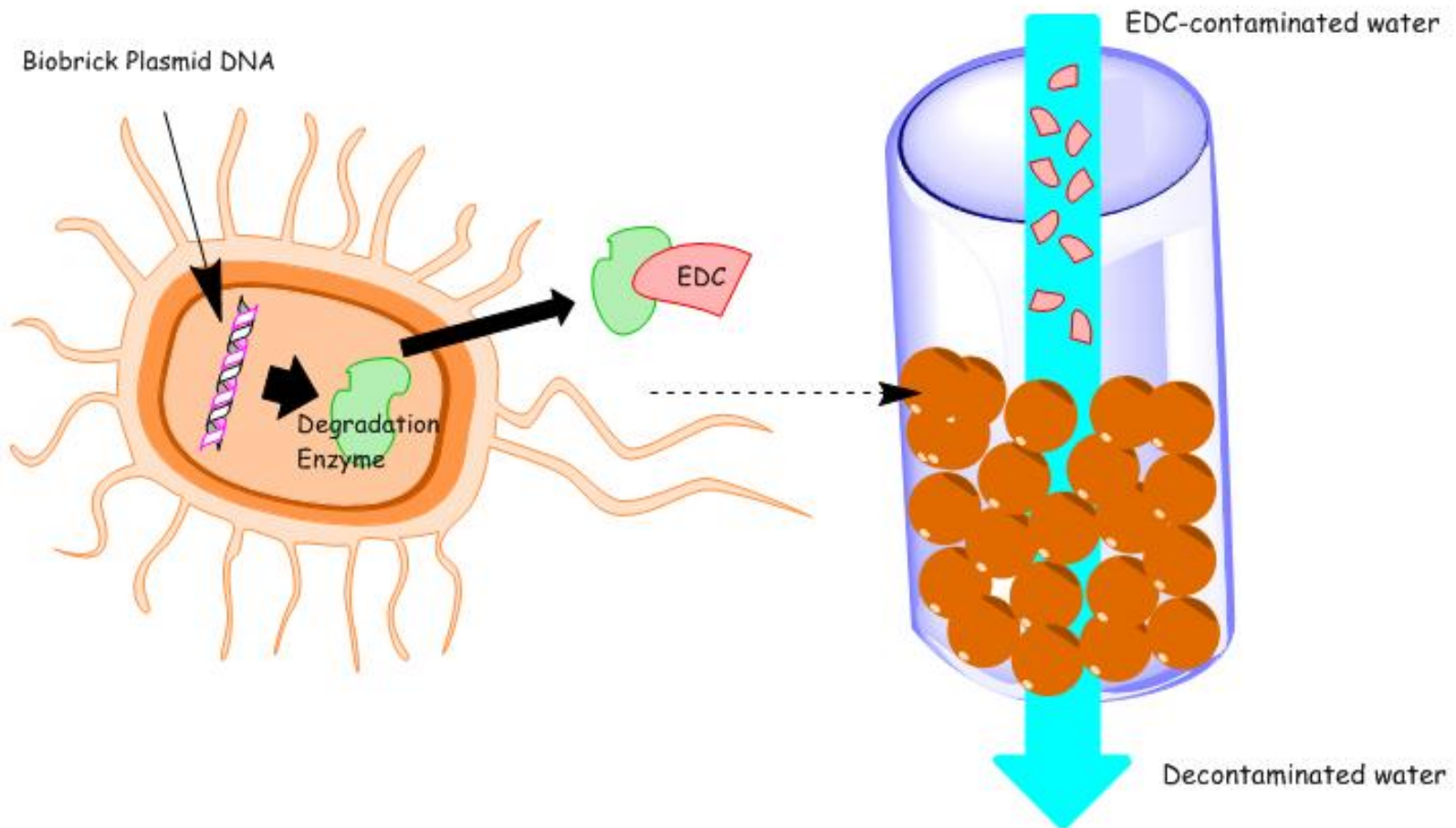
# The Problem





# Our Solution

Purification Column with Biofilm-Coated Beads



# Finding a Degradation Pathway

- Gene Fishing
- BisdA and BisdB
- Investigation of DDT Dehydrochlorinase
- Cytochrome p450 analysis

## Feasibility Analysis

- Biofilm construction
- Water plant integration analysis

# Timeline

team finalized



SURF applications due



**December**

**January**

**February**



project brainstorming  
journal club

# Timeline

Rosen grant due



**March**

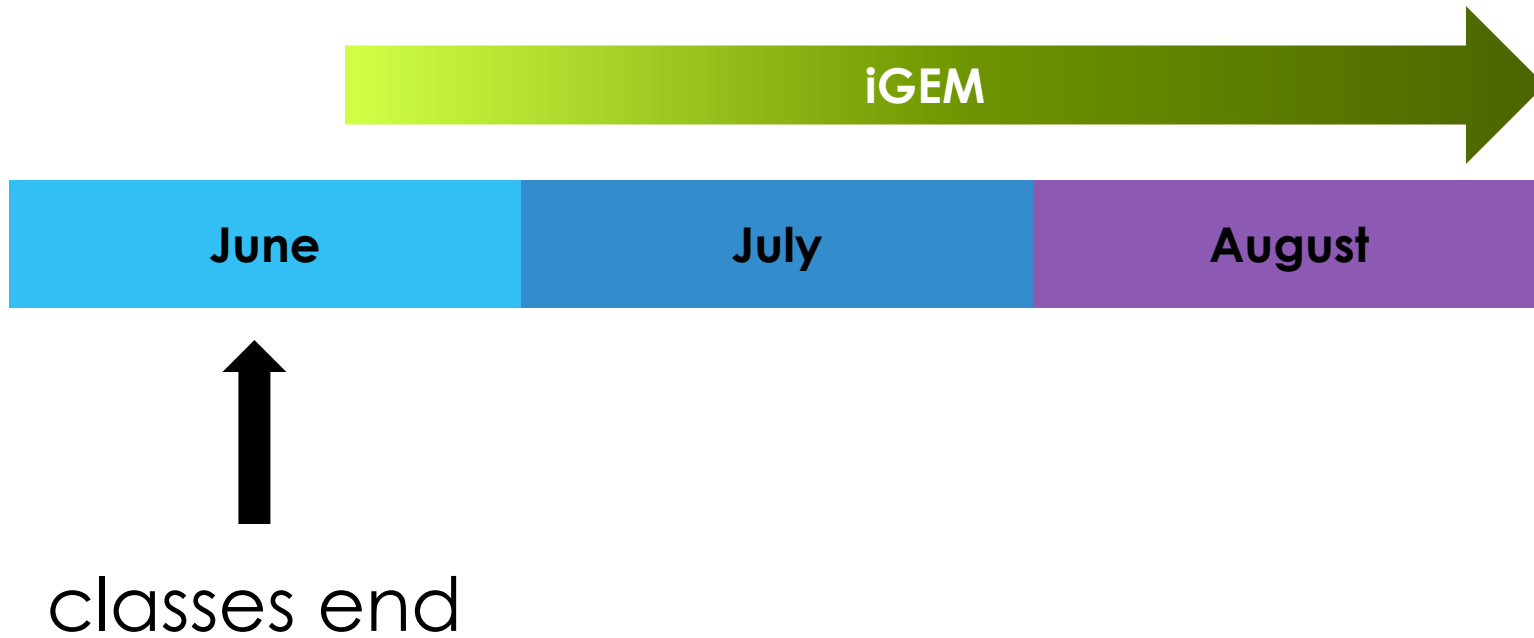
**April**

**May**

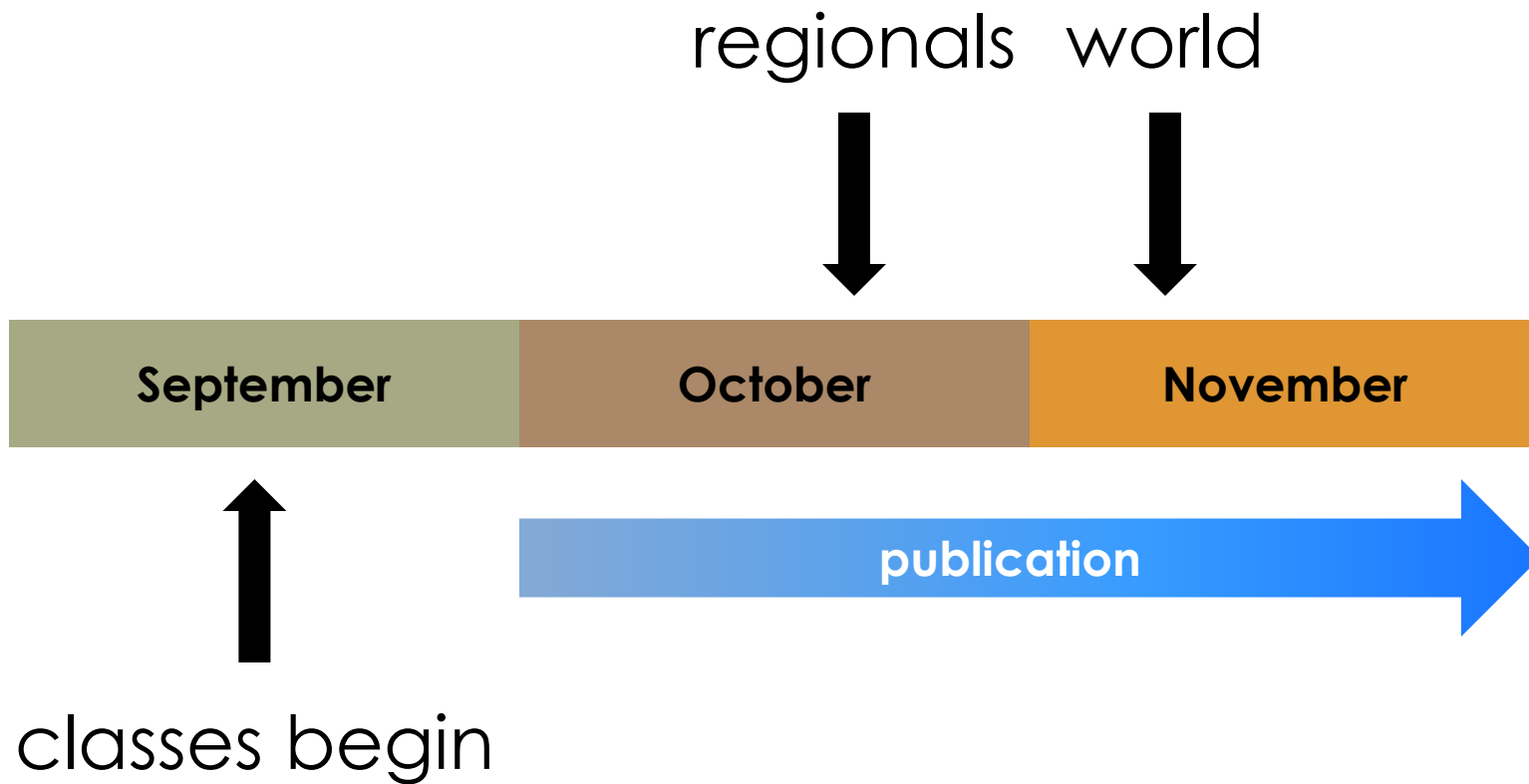
project brainstorming  
journal club

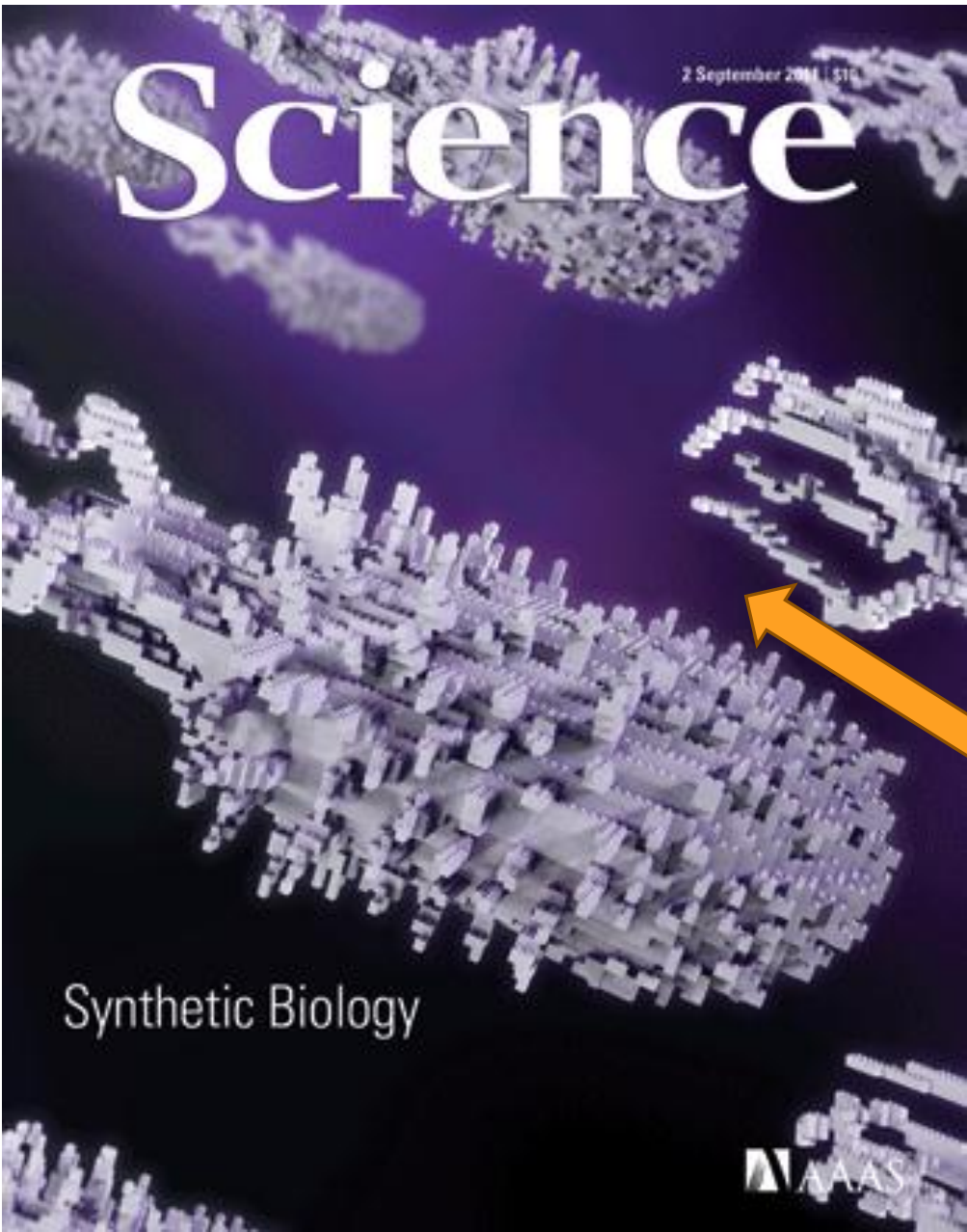
bootcamp  
ChE 130?

# Timeline



# Timeline





Caltech goes here



# What's next?

- Take a signup sheet  
Return by Nov 30
- Join the igem-interest list
- Team decided Dec 7-9
- For more information:
  - [igem.org/about](http://igem.org/about)
  - [2011.igem.org](http://2011.igem.org)
  - [surf.caltech.edu](http://surf.caltech.edu)

# Questions