



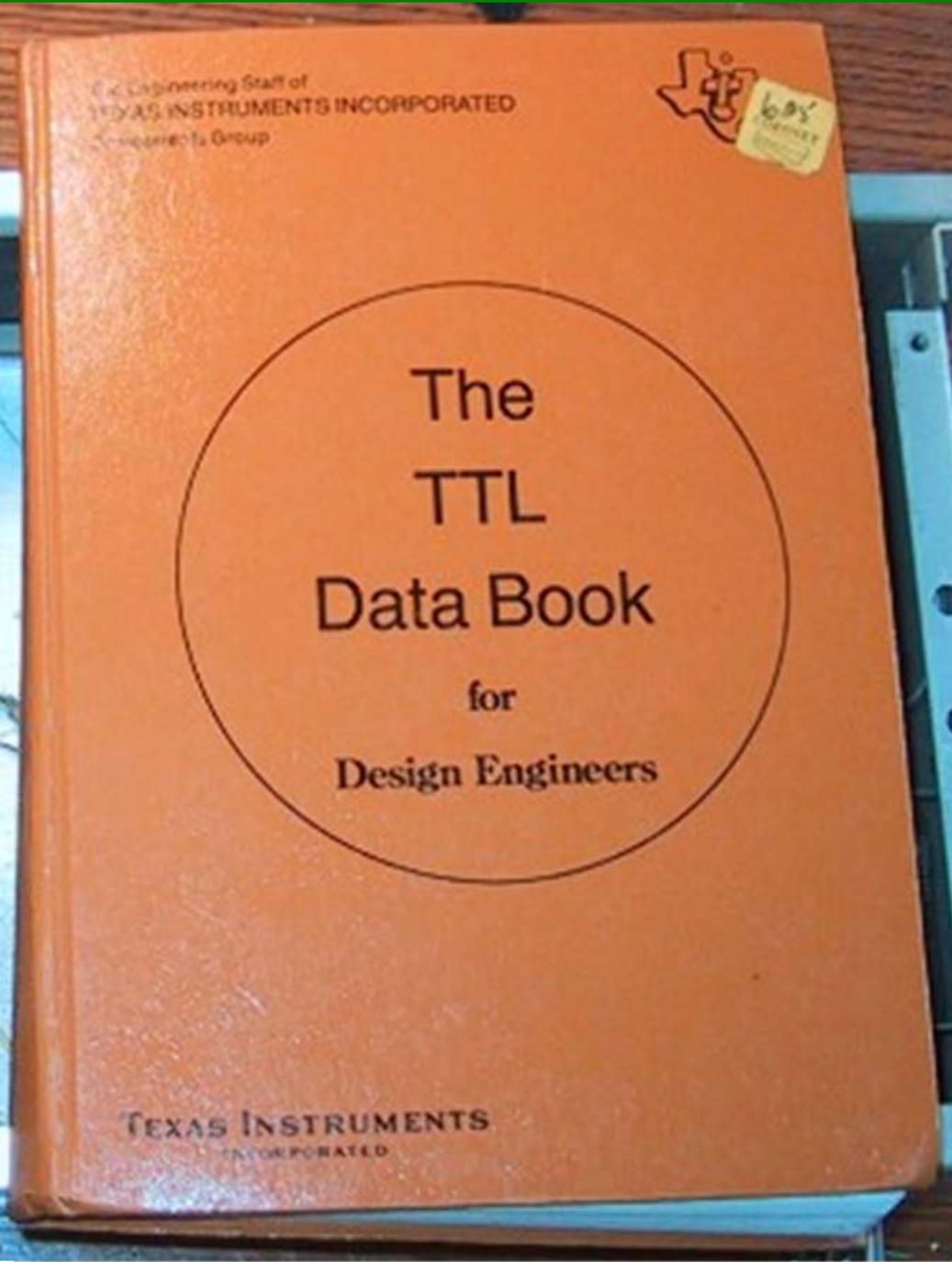
iGEM – The International Genetically Engineered Machine Competition and The Registry of Standard Biological Parts

Presidential Commission for the Study of Bioethical Issues
Randy Rettberg, Sept. 14, 2010





The TTL Data Book



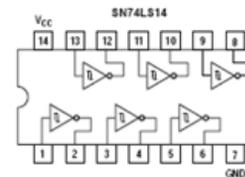
SN74LS14

Schmitt Triggers Dual Gate/Hex Inverter

The SN74LS14 contains logic gates/inverters which accept standard TTL input signals and provide standard TTL output levels. They are capable of transforming slowly changing input signals into sharply defined, jitter-free output signals. Additionally, they have greater noise margin than conventional inverters.

Each circuit contains a Schmitt trigger followed by a Darlington level shifter and a phase splitter driving a TTL totem pole output. The Schmitt trigger uses positive feedback to effectively speed-up slow input transitions, and provide different input threshold voltages for positive and negative-going transitions. This hysteresis between the positive-going and negative-going input thresholds (typically 800 mV) is determined internally by resistor ratios and is essentially insensitive to temperature and supply voltage variations.

LOGIC AND CONNECTION DIAGRAMS



GUARANTEED OPERATING RANGES

Symbol	Parameter	Min	Typ	Max	Unit
V_{CC}	Supply Voltage	4.75	5.0	5.25	V
T_A	Operating Ambient Temperature Range	0	25	70	°C
I_{OH}	Output Current - High			-0.4	mA
I_{OL}	Output Current - Low			8.0	mA



ON Semiconductor
Formerly a Division of Motorola
<http://onsemi.com>

LOW
POWER
SCHOTTKY



PLASTIC
N SUFFIX
CASE 646



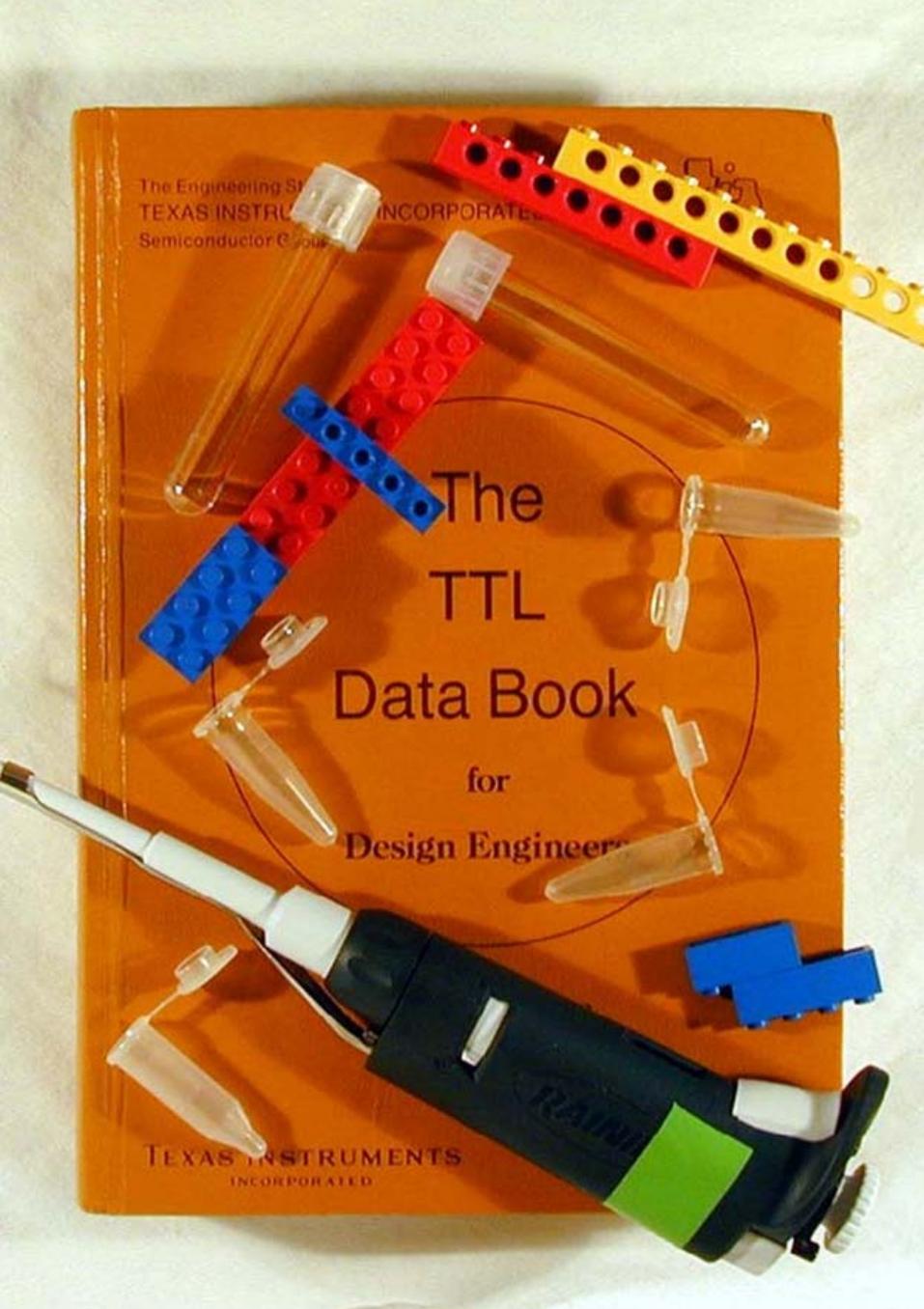
SOIC
D SUFFIX
CASE 751A

ORDERING INFORMATION

Device	Package	Shipping
SN74LS14N	14 Pin DIP	2000 Units/Box
SN74LS14D	14 Pin	2500/Tape & Reel



The Registry of Standard Biological Parts



High copy number assembly plasmid backbones

The most common set of plasmid backbones that people use to assemble BioBrick® standard biological parts together are high copy BioBrick plasmid backbones. High copy plasmid DNA is easily purified in high yield from cultures, so it makes [obtaining enough DNA](#) for assembly easy.

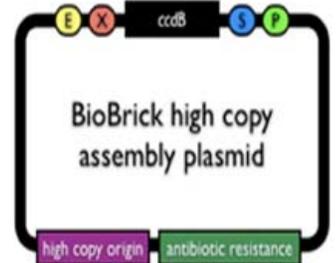
The high copy plasmid backbones listed below have a common set of features.

1. A complete BioBrick® cloning site for easy cloning and assembly of BioBrick parts.
2. Terminators flanking the BioBrick® cloning site to insulate the vector from read-through transcription originating in the cloned BioBrick® part, device or system.
3. Primer binding sites for the standard BioBrick® verification primers VF2 (BBa_G00100) and VR (BBa_G00101). These primers are located for convenient sequencing and [screening by colony PCR](#) of cloned BioBrick® parts, devices, and systems.

Plasmid backbones are distributed by the Registry with a default insert. There are just a handful of default plasmid inserts used in the Registry. Many of the available plasmid backbones have the *ccdB* positive selection marker (BBa_P1010) as the default plasmid insert within the BioBrick® cloning site.

The *ccdB* gene ensures that when assembling two BioBrick® parts together, the uncut plasmid is not transformed. However, inclusion of the *ccdB* gene means that these vectors must be propagated in a *ccdB* tolerant strain, such as *E. coli* strain DB3.1 (BBa_V1005).

Finally, to make assembly of BioBrick® parts easier, these BioBrick® assembly plasmid backbones are available with three different antibiotic resistance markers, so that you can use [3 antibiotic assembly methods](#) to assemble BioBrick® parts.



-?-	Name	Description	Resistance	Replicon	Copy number	Chassis	Length
A/W	pSB1A3	High copy BioBrick assembly plasmid	A	pMB1	100-300		2157
A/W	pSB1A7	Transcriptionally insulated high copy BioBrick plasmid	A	pMB1	100-300		2431
A/W	pSB1AC3	High copy BioBrick assembly plasmid	AC	pMB1	100-300		3055
A/W	pSB1AK3	High copy BioBrick assembly plasmid	AK	pMB1	100-300		3189
A/W	pSB1AT3	High copy BioBrick assembly plasmid	AT	pMB1	100-300		3446
W	pSB1C3	High copy BioBrick assembly plasmid					2072
W	pSB1K3	High copy BioBrick assembly plasmid					2206
W	pSB1T3	High copy BioBrick assembly plasmid					2463



Karmella Haynes, an instructor of the [2006 Davidson College iGEM team](#), designed and constructed the plasmid backbone pSB1A7. You can read more about the 2006 Davidson project in their open-access paper [Engineering bacteria to solve the Burnt Pancake Problem](#) published in the *Journal of Biological Engineering*.



Robbie Bryant constructed the plasmid backbone pSB1AC3 in Tom Knight's lab.



Community Parts Collection





Synthetic Biology Question

Can simple biological systems be built from standard, interchangeable parts and operated in living cells?

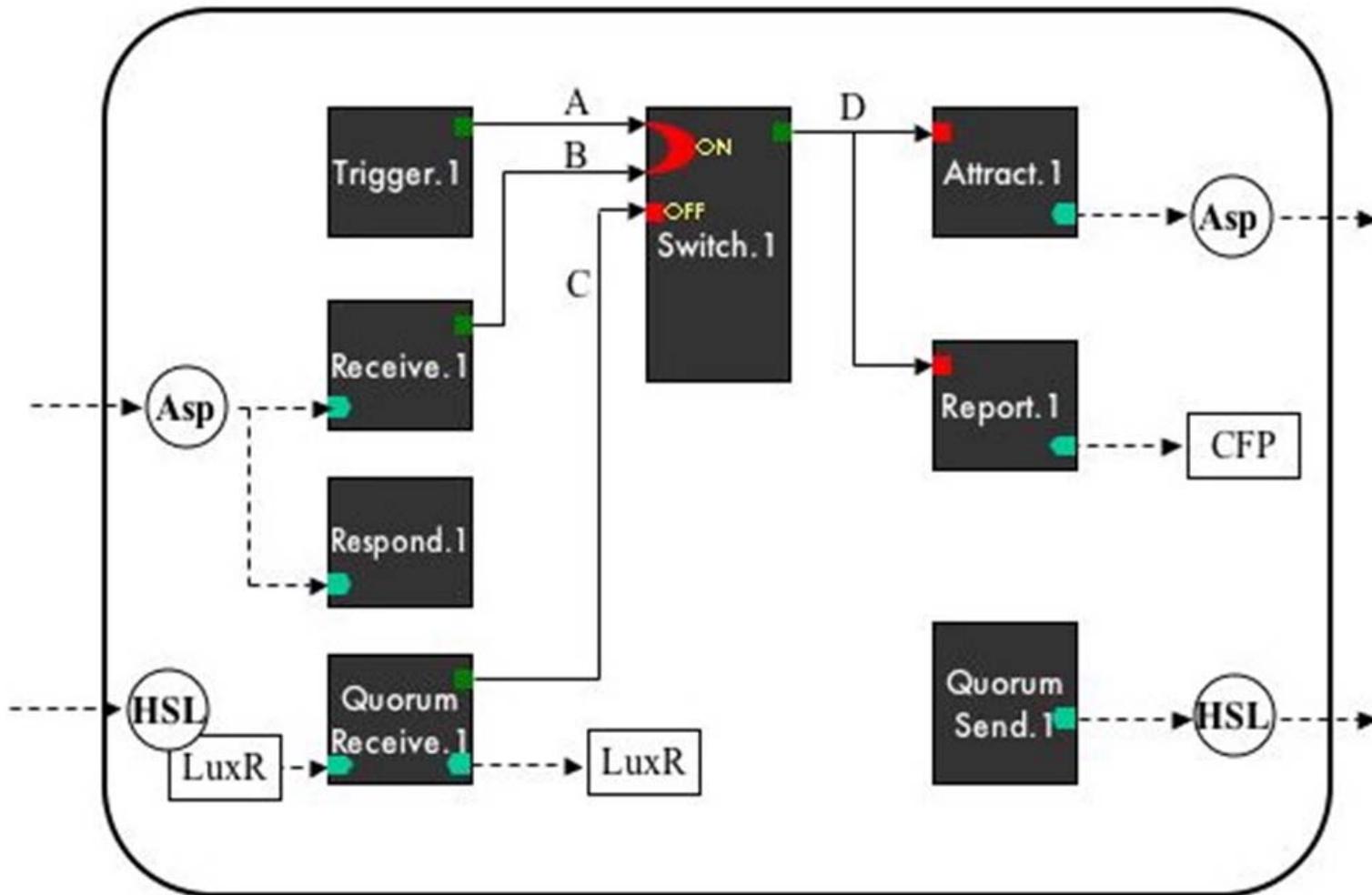
Or, is biology so complex that each case is unique?



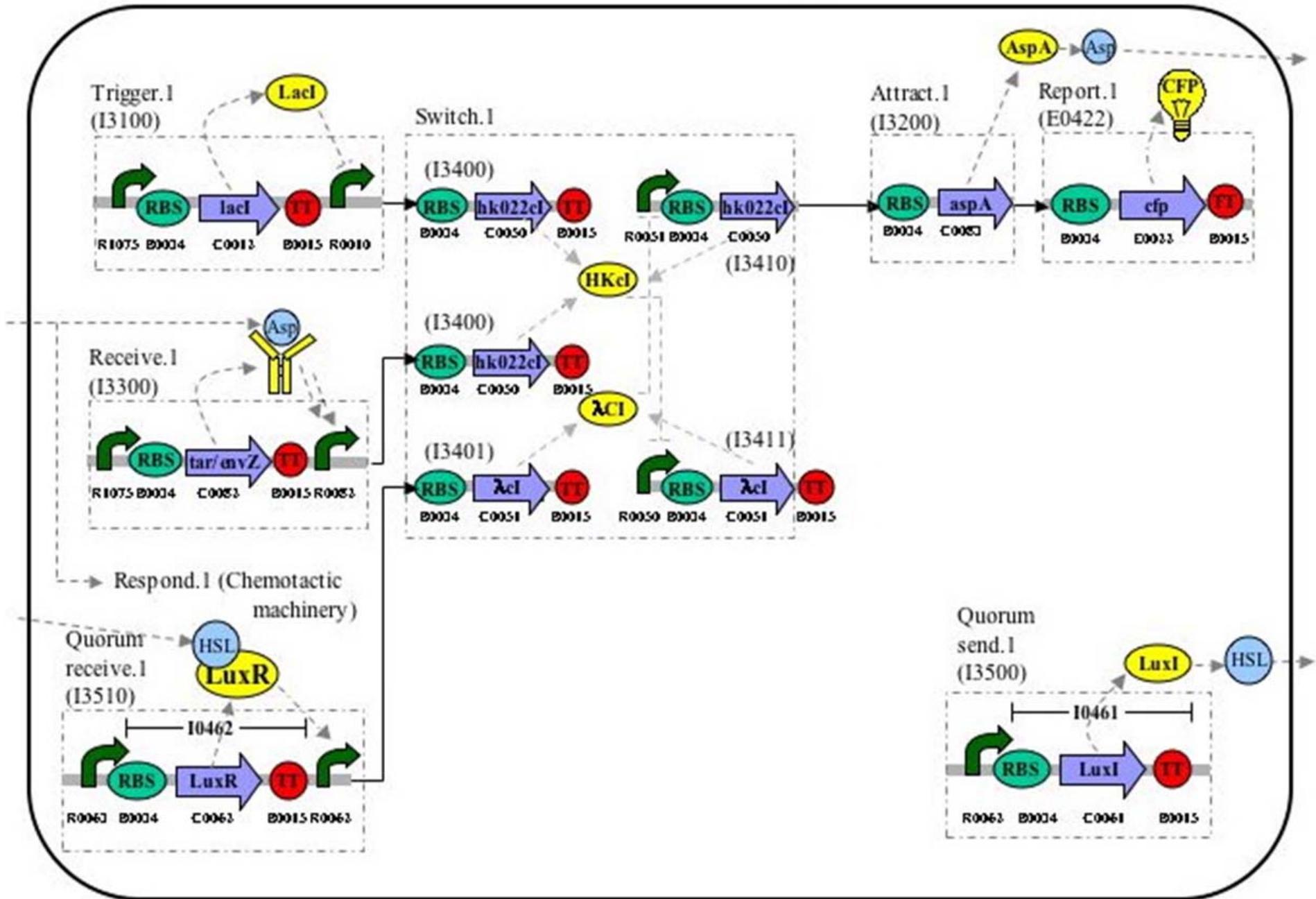
Education Driving Research



iGEM Device-Level System Diagram 2003

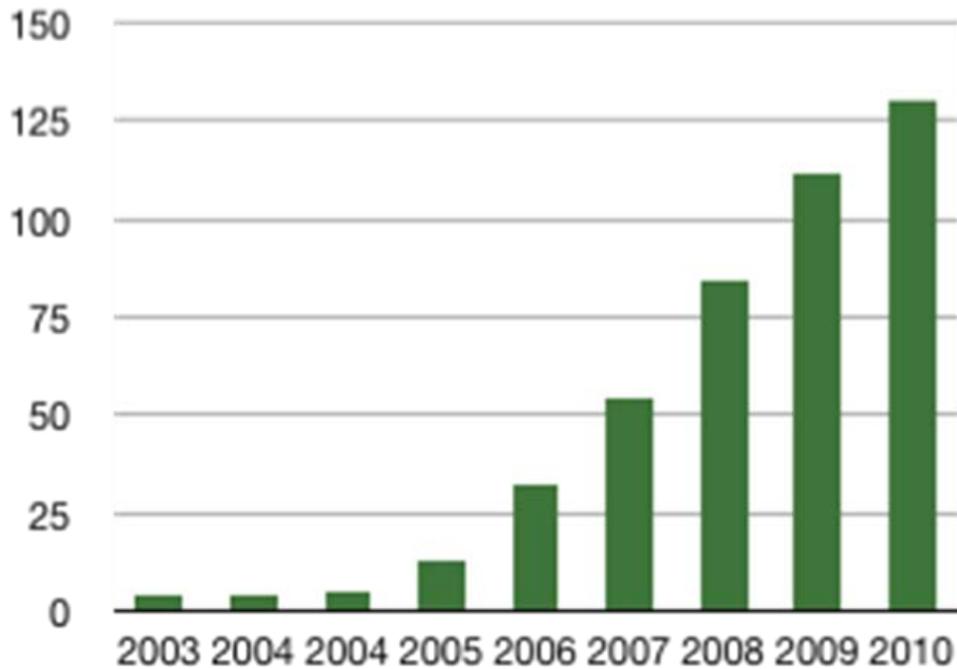


iGEM Parts- and Device-Level System Diagram





iGEM Growth and Scale



Year	Teams	Participants
IAP	4	20
2004	5	70
2005	13	150
2006	32	400
2007	54	750
2008	84	1180
2009	112	1650
2010	130	1900
2011	170	2500
2012	225	3300
Projected		



iGEM 2009



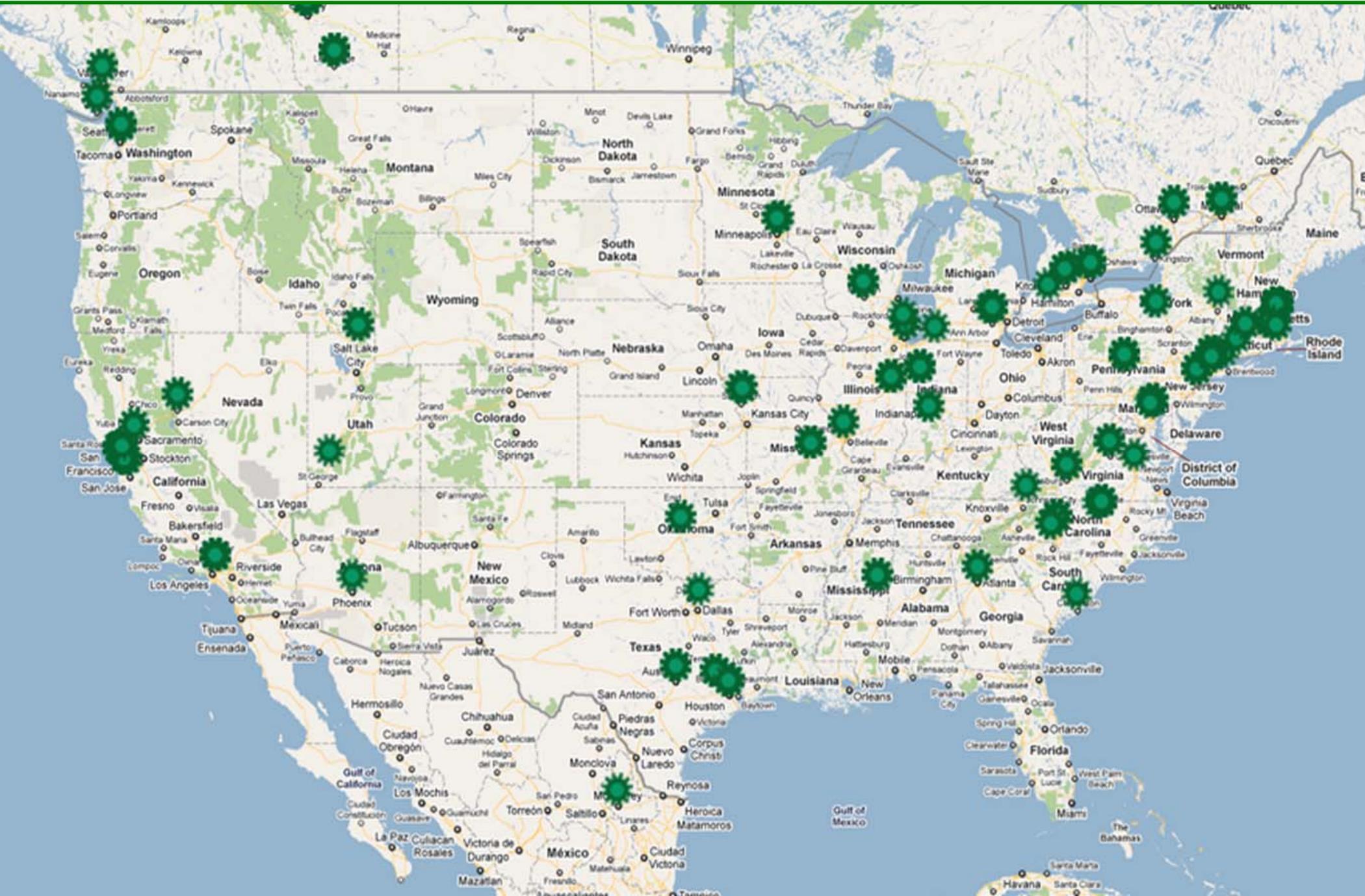


iGEM Sites





iGEM Sites





Get and Give

Teams are expected to use the parts, ideas, and experience of teams in previous years.

Teams are expected to contribute their parts, ideas, and experiences.



Community Beyond iGEM

iGEM and Registry User and Group Management System



iGEM Competition

- [iGEM 2010 Website](#)
- [iGEM 2010 Team List](#)
- [Previous iGEM Competitions](#)



Labs

- [Lab List](#)
- [Register a New Lab](#)



Courses

- [Course List](#)
- [Register a New Course](#)



Users

- [Login](#)
- [Create a User Account](#)
- [Alumni Association](#)
- [Requirements](#)

iGEM and the Registry of Standard Biological Parts have a large and diverse user community. The skill levels run from high-school students who are new to synthetic biology to world-acclaimed experts in the field. Our user community spans the globe with users from over 26 countries and regions participating in iGEM alone last year. The field of synthetic biology is young, but individual synthetic biologists have already progressed from iGEM team member to graduate student advisor, or from advisor to professor advising a team and running a lab.

The Registry of Standard Biological Parts serves the academic research community, providing the first and largest catalog of standard biological parts. While much of the growth has been in the iGEM community, over 70 academic labs are now members of the Registry community. We are making it easier for labs to participate and the number is growing.

This site focuses on the Registry, iGEM, and lab accounts and personal pages of the enduring community of synthetic biology based on standard parts. This site is a mixture of wiki pages and computer generated pages that allow users to manage their personal accounts as well as the accounts of their lab and their teams.

User Accounts

- [Create an Account](#)
- [List of Users](#)
- [Requirements](#)

iGEM Competition

- [iGEM 2010 Main Page](#)
- [iGEM 2010 Teams](#)
- [Previous iGEM Competitions](#)

Labs

- [Lab List](#)
- [Lab Parts](#)
- [Register a New Lab](#)

Courses

- [Courses](#)
- [Course Parts](#)

Registry of Standard Parts

- [Registry Main Page](#)
- [Registry Catalog](#)
- [Registry Help](#)

UNG Tools

- [Manage Teams](#)
- [Upload Jamboree Files](#)
- [Judge Dashboard](#)



iGEM Statistics

- 6,513 users
- 2,478 users have logged in this year
- 1,005 have entered parts
- 85 labs registered

- 12,327 parts in the Registry
- 5,166 samples in the Repository
- 2,328 parts reported to work
- 1,691 parts sent by iGEM 2009 teams
- 800 confirmed parts (of 1000)



iGEM Schedule: Assemble Your Team



5 High School Students
5 Undergraduate Students
3 Graduate Students
3 Faculty

Utah State - iGEM 2009



iGEM Schedule: Raise Money





iGEM Schedule: Attend A Workshop





iGEM Schedule: Get the BioBrick Parts





iGEM Schedule: Work At Your School





iGEM Schedule: Attend the Jamboree



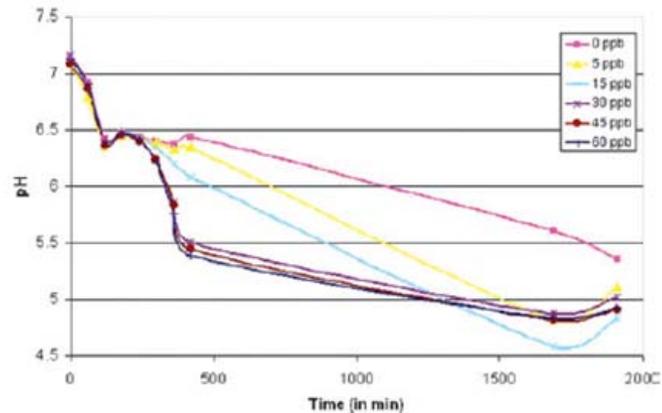
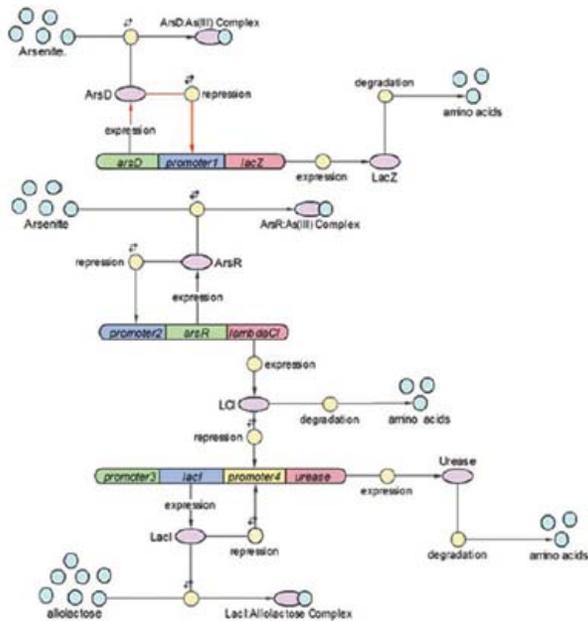
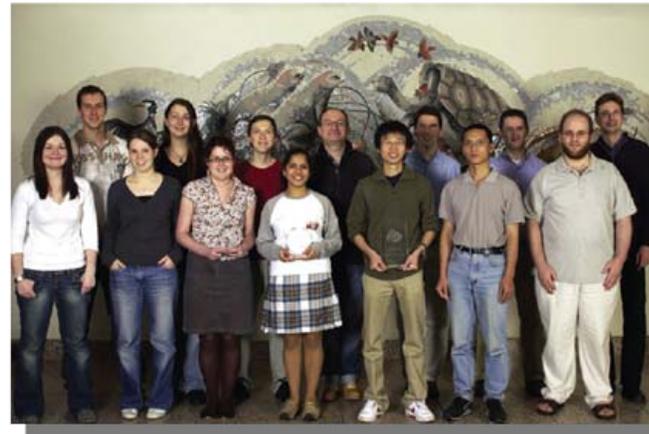


iGEM Schedule: Win Awards



Development of a novel biosensor for the detection of arsenic in drinking water

J. Aleksic, F. Bizzari, Y. Cai, B. Davidson, K. de Mora, S. Ivakhno, S.L. Seshasayee, J. Nicholson, J. Wilson, A. Elfick, C. French, L. Kozma-Bognar, H. Ma and A. Millar

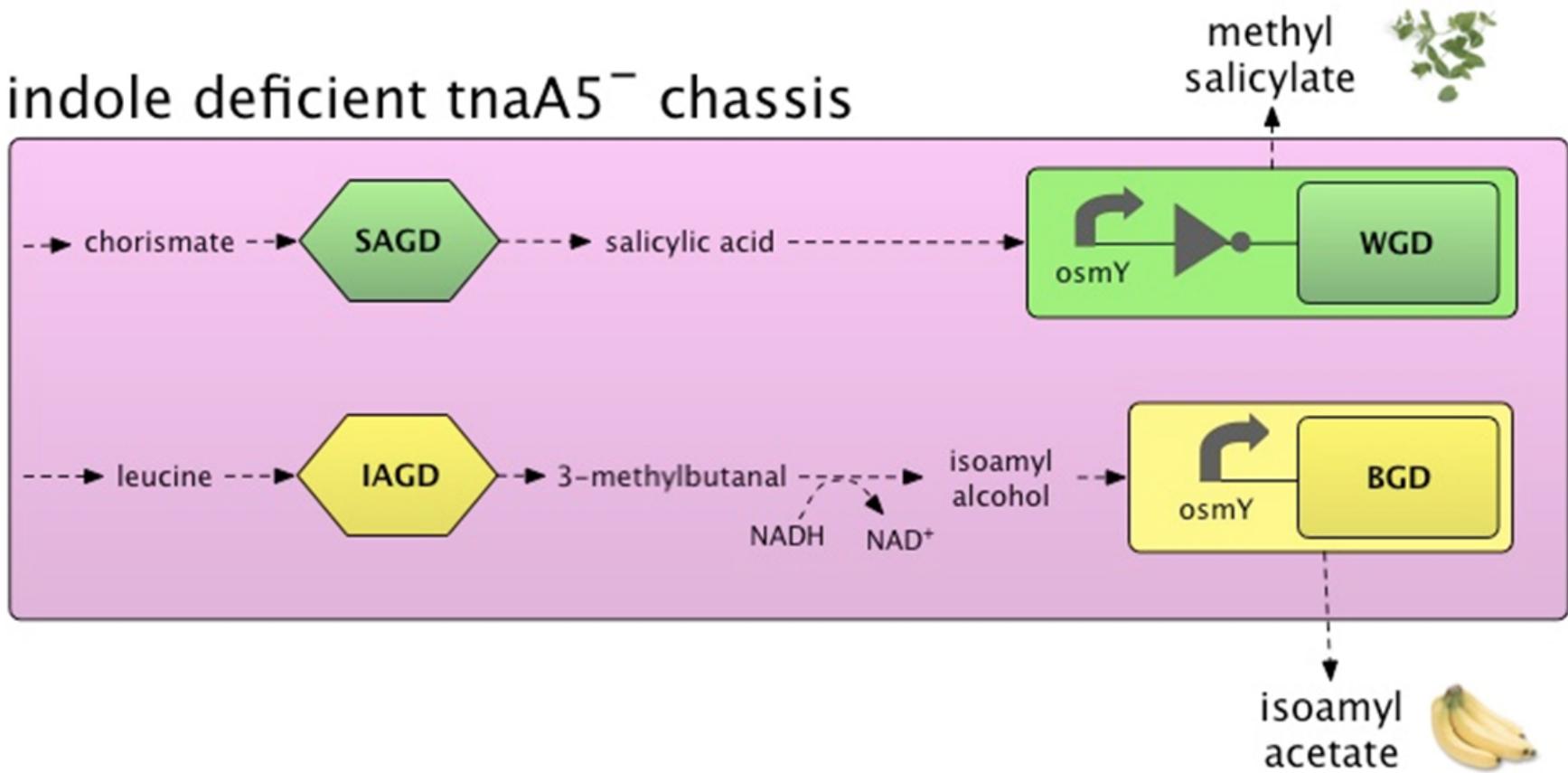




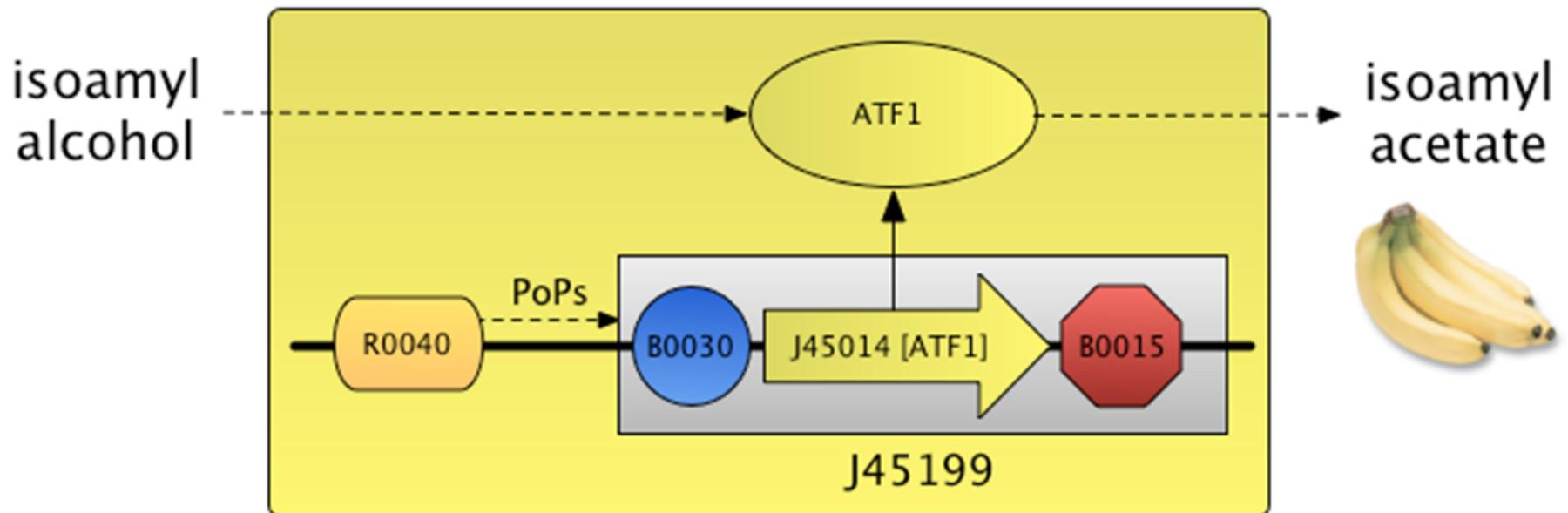
MIT iGEM 2006



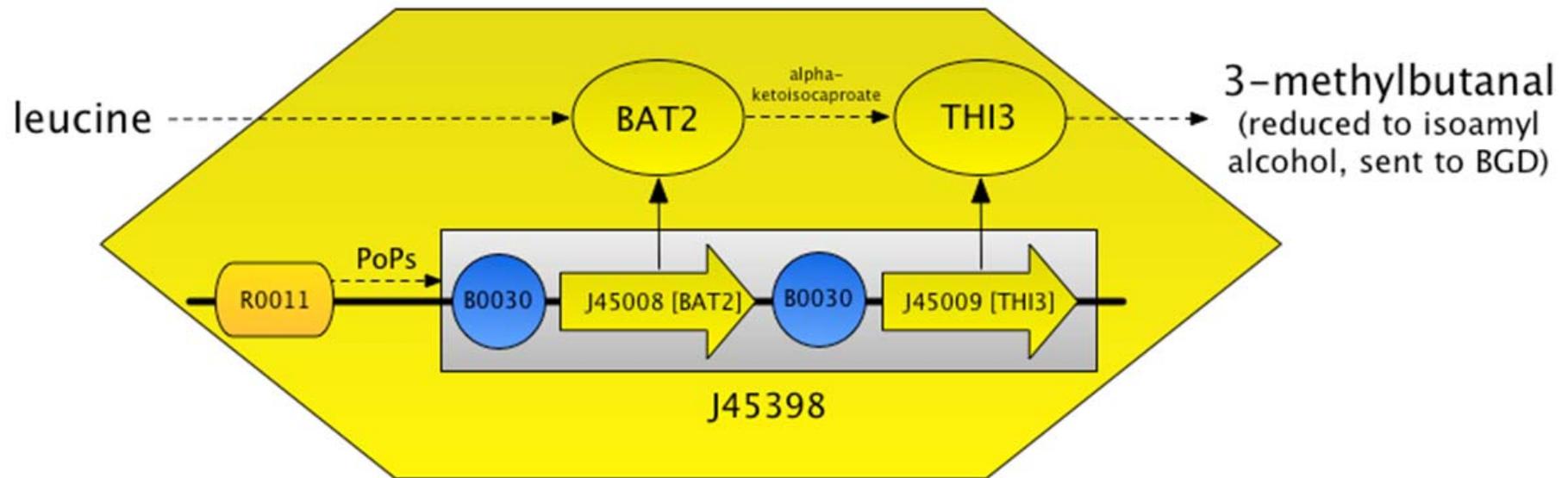
indole deficient *tnaA5⁻* chassis



J45200 – Banana Generating Device (BGD)



J45400 – Isoamyl Alcohol Generating Device (IAGD):





Medical Applications

BACTOBLOOD



Researchers

Arthur Yu • Austin Day • David Tulga •
Hannah Cole • Kristin Doan • Kristin
Fuller • Nhu Nguyen • Samantha Liang •
Vaibhavi Umesh • Vincent Parker

Teaching Assistants

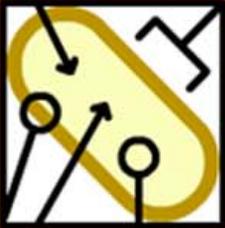
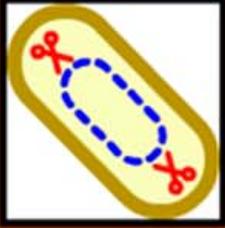
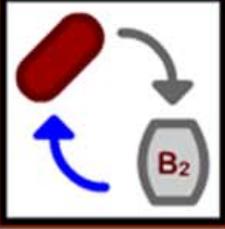
Amin Hajimorad • Farnaz Nowroozi •
Rickey Bonds

Advisors

John Dueber • Christopher Anderson •
Adam Arkin • Jay Keasling



Medical Applications - Bactoblood

The System's Components	
	<p>Oxygen Transport</p> <p><i>Our system is designed to produce Hemoglobin, Heme, and the necessary chaperones and detoxifying agents to promote the transport of oxygen throughout the bloodstream. We also investigated alternatives to hemoglobin and other strategies for its production.</i></p>
	<p>The Chassis</p> <p><i>Our bacterial chassis has been heavily modified to remove its sepsis-inducing toxicity, immunogenic factors, and ability to grow within the bloodstream, as well as promote its ability to last longer in the bloodstream by masking it from the immune system.</i></p>
	<p>The Controller</p> <p><i>The Controller is an integrated genetic circuit comprised of two plasmids that allows stable maintenance of the system's various operons on a large single-copy plasmid in a dormant state. Upon induction, the copy number of the operons and their transcription increase 100-fold resulting in a dramatic increase in protein expression.</i></p>
	<p>Genetic Self-Destruct</p> <p><i>To prevent chance of infection or unwanted proliferation after hemoglobin production, we have engineered a genetic self-destruct mechanism whereby when induced, the bacterial cell will express a genetic material-degrading toxin which kills the cell, but leaves it physically intact.</i></p>
	<p>Freeze Drying</p> <p><i>To enable preservation of our bacteria for prolonged periods, we are including the ability to produce the compounds hydroxyectoine and trehalose that will enable our bacteria to survive freeze-drying intact. This will dramatically increase shelf-life and decrease transport costs.</i></p>



A test tube could contain all the necessary components: Freeze dried bacteria, growth medium, indicator powder, Ampicillin salt, etc...



- These tubes could then be given to local villagers to monitor their own water quality themselves
- A good alternative to the widely used Gutzeit method





Live Forever - BioBeer - Resveratrol

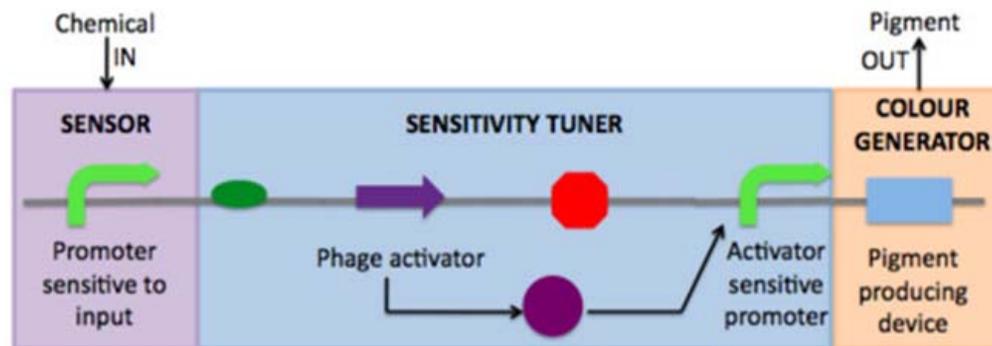


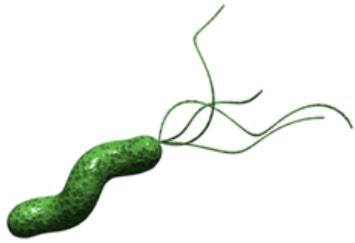


2009 Winner - Cambridge



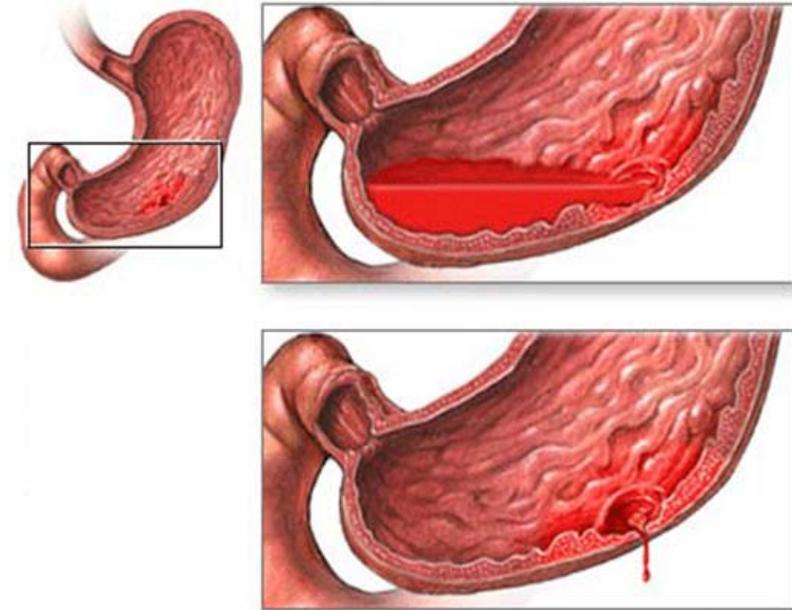
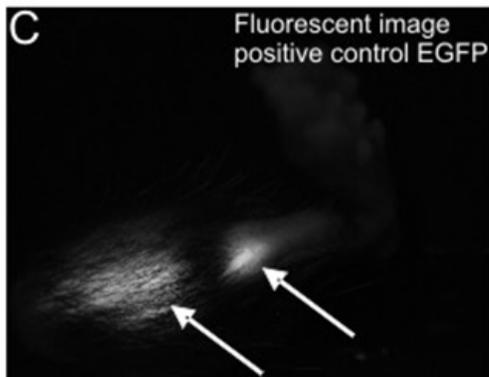
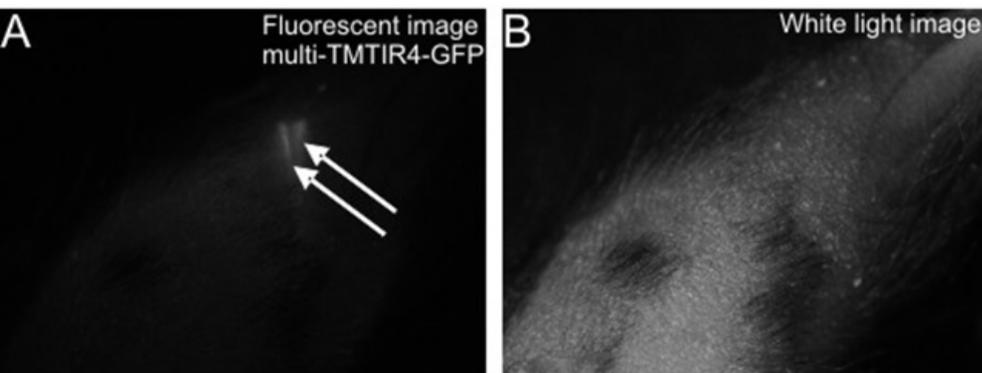
Biobrick	Colour
BBa_K274100	Red
BBa_K274200	Orange
BBa_K274001	Brown
BBa_K274002	Violet
BBa_K274003	Dark Green
BBa_K274004	Light Green



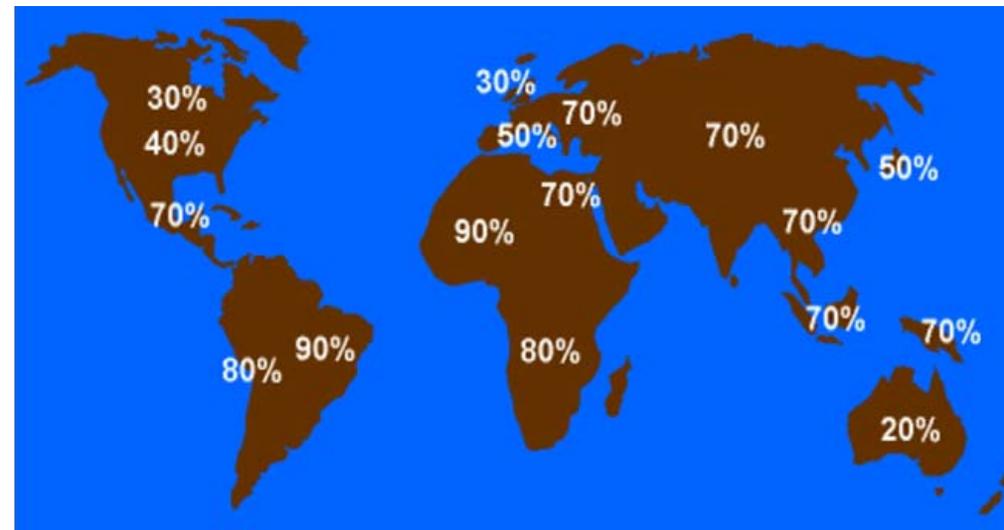


Helicobacter pylori

Testing in Mice



Peptic Ulcers





Is iGEM Safe?



2009



[page](#) [discussion](#) [edit](#) [history](#) [move](#) [watch](#) [teams](#)

Safety

For iGEM 2009 teams are asked to detail how they approached any issues of biological safety associated with their projects.

Specifically, teams should consider the following four questions:

1. Would any of your project ideas raise safety issues in terms of:
 - researcher safety,
 - public safety, or
 - environmental safety?
2. Is there a local biosafety group, committee, or review board at your institution?
3. What does your local biosafety group think about your project?
4. Do any of the new BioBrick parts that you made this year raise any safety issues?
 - If yes, did you document these issues in the Registry?

Teams, please document any answers to these (or other) safety questions in your presentation, wiki presentation, or poster.

Judges will be asked to evaluate your project, in part, on the basis of if and how you considered and addressed issues of biological safety.

If any questions arise regarding iGEM and biological safety please send an email to [safety AT igem.org](mailto:safety@igem.org).



Human Practices - Heidelberg 2008

makers: They first have to know about synthetic biology, have to understand this new research area and therefore have to understand the basics of molecular and cell biology. And this step is where our project is involved.

"Only a well-informed public is able to develop a non-prejudiced and profound opinion about synthetic biology."

From the past we learned, that modern bioscience is not always accepted and fully integrated in the public interest. A good example is the public view on green biotechnology in Germany and Europe. Many people in

combination in many cases leads to fear and by that to non-acceptance in the society. And this is what green biotechnology has to battle every single day.

"Science can only work successful and develop useful inventions if it is based on a high level of acceptance in the society."

Synthetic biology is up to now very young and far away from experiencing the same problematic lack of acceptance that genetic engineering and green biotechnology underwent in many European countries. But



Is iGEM Secure?



page discussion edit history delete move protect watch teams

Randy My account Log out

Security



"Biology should be more fun. It should be about exploring the world around us. We should want to get out there and do things. We should be able to do things more easily. Securing biology should be something that helps us do that. It cannot be something that gets in the way."

Scientific research continues to bring us new and unexpected knowledge, technologies and approaches. Synthetic biology, being on the very cutting edge of what is possible, promises unprecedented opportunities for health, wealth and better living. But science and technology can be used for destructive purposes as well as for constructive ones. Refining our control of biology opens up chances to intentionally cause harm to humans, animals, plants and the environment that just did not exist before. That's why it is important now, more than ever, for us to think about how others might use what we are doing in ways we would not be happy with.

Preventing Malign Use

Securing biology is not a simple task. It is not something those outside biology could, or should, do alone. Equally, this is not something that biologists can do by themselves (our focus, as the name implies is on the biology). This is a truly interdisciplinary problem - one that means we will need to work together, in new ways, with new partners, to find an approach that provides benefits for all. Given the interdisciplinary nature of synthetic

As a participant in iGEM, there are three things you can do right now to help us secure our science:

1. Include something in your project description and presentations that demonstrates that you have thought about how others could misuse your work
2. Contribute to community discussions on

Resources

People



Piers Millet
BWC ISU
bwc@unog.ch
www.unog.ch/bwc

The BWC ISU is the closest thing to an international organisation to ensure biology is used solely for beneficial purposes. It is housed in the UN Office for Disarmament Affairs in Geneva and, as Deputy Head, Piers helps States Parties to the Biological Weapons Convention ban the hostile use of biology. As a microbiologist and chartered biologist, Piers supports the technical aspects of the ISU's work.

Reports



Synthetic Genomics: Options for Governance
by the J Craig Venter Institute, CSIS and MIT,
October 2007



iGEM Awards: Finalists

2009	2008	2007	2006
Cambridge	Slovenia	Peking	Slovenia
Freiburg	Caltech	UC Berkeley	Imperial
Groningen	NYMU Taipei	Slovenia	Princeton
Heidelberg	Freiburg	Paris	
Imperial	Harvard	UC San Francisco	
Valencia	UC Berkeley	USTC China	