

合成生物学の国際学生コンテストiGEM 日本の1大学チーム監督としての視点

From a View point of PI of a Japanese iGEM team of a Japanese university

早稲田大学 電気・情報生命工学科

木賀大介 (きが だいすけ)

バックグラウンド: 生化学 (+生物物理学)

融合研究の手法: 生命科学 + 情報科学・制御工学

Kiga@waseda.jp

初期の 合成生物学とiGEM

- 再構成実験 Reconstitution
- 遺伝子工学 Genetic Engineering
- Genome Projectなどの網羅的解析
- DNA Synthesis 技術の進歩
- 2000年の3つのNature論文
- 2003 UC Berkeley Dept. SynBio
(Chair: J. Keasling)
- 2004 SynBio1.0国際会議MIT
- 2005 Nature SynBio特集
- 2006 SynBio2.0国際会議
UC Berkeley
- 2006 July SynBERC

科研費特定

「分子プログラミング」代表 萩谷昌己先生

- 2003 and 2004 IAP courses
- iGEM2004
– 5大学
- iGEM2005
– 13大学(米10、加、英、瑞)
- iGEM2006
– 32大学(東工大-分子プログラミング)
、千葉大も参加)
- 表彰制度開始

2005.4 木賀・東工大着任

2005.秋 SysBioI

国際会議@Boston

2006.1 TomKight来日

2006.5 iGEM teachers WS

第1回合成生物学会議 2004.6



MASSACHUSETTS INSTITUTE OF TECHNOLOGY

The First International Meeting on Synthetic Biology

Synthetic Biology 1.0

June 10 – 12, 2004

Cambridge, MA

Why a Synthetic Biology Conference?

Synthetic Biology 1.0 will bring together, for the first time, researchers who are working to (i) design and build biological parts, devices and integrated biological systems, (ii) develop technologies that enable such work, and (iii) place this scientific and engineering research within its current and future social context.

What is it?

The conference will be held over three days on the campus of the Massachusetts Institute of Technology. The first two days of the conference will consist of technical lectures describing current scientific and engineering research, featured presentations selected from submitted abstracts, and a conference-wide poster session. In addition, we will host a series of moderated discussions to help begin to explore issues related to (i) current and future biological risk, (ii) ethics related to the engineering of biology, and (iii) biological property rights. The third day of the conference will consist of tutorials that describe how to establish and run a registry of standard biological parts, approaches for teaching students how to engineer integrated biological systems, a new computer-based environment for integrated biological systems design, et cetera. An up-to-date program is available online at the URL below.

Who should attend?

Anyone who is interested in, or already working on, synthetic biology.

What else?

To provide the most opportunities for informal interaction and community building we are asking that conferees plan to participate in the entire program. In support of such participation we will provide meals throughout the conference.

デザイン
合成

リスク
倫理
知財

Japanese Society for Cell Synthesis Research 「細胞を創る」研究会 準備会2005~

「細胞を創る」会議

ご議論いただきたい項目

- 1) 「作るべき細胞」「作れるかも知れない細胞」のイメージ・その是非・可否
- 2) 技術的問題点
- 3) 産業応用・臨床応用の可能性
- 4) **生命倫理対策**
- 5) 研究体制
- 6) 今後の会合について

を考えておりますが、これに限るものではございません

H Iwasaki, K Kato, M Hayashi

2005年12月10日(土)~11日(日)

タカラホテル福岡

The poster is for a workshop titled "Synthetic Approaches to Cellular Functions" organized by the ICSB International Conference on Systems Biology. It is scheduled for October 12, 2006, at The Miraikan Science Museum in Dalba, Tokyo. The time is 9:30 am to 6:00 pm. The chair is D. Kiga, D. Endy, V. dos Santos & H.R. Ueda. The speakers are Drew Endy (MIT), Vitor dos Santos (Osaka Univ.), Tetsuya Yomo (Osaka Univ.), Jörg Stelling (ETH), Mitsuhiro Iitaya (Keio Univ.), Kazuo Kato (Kyoto Univ.), Masaharu Takeuchi (Nara Univ.), and Daijuke Kiga (Tokyo Inst. Tech.). A call for poster presentation is issued with a deadline of September 30th. The workshop is free of charge. Contact information and website links are provided at the bottom.

Synthetic Approaches to Cellular Functions
ICSB International Conference on Systems Biology Workshop
October 12, 2006
The Miraikan Science Museum, Dalba, Tokyo
9:30 am - 6:00 pm
Chairpersons: D. Kiga, D. Endy, V. dos Santos & H.R. Ueda
Speakers: Drew Endy (MIT), Vitor dos Santos (Osaka Univ.), Tetsuya Yomo (Osaka Univ.), Jörg Stelling (ETH), Mitsuhiro Iitaya (Keio Univ.), Kazuo Kato (Kyoto Univ.), Masaharu Takeuchi (Nara Univ.), Daijuke Kiga (Tokyo Inst. Tech.)
Call for poster presentation (deadline: Sep 30th)
Free of charge!
Contact email: synbio-ws@rs.dls.titech.ac.jp
For more information:
http://www.rs.dls.titech.ac.jp/ICSB_WS2006for_syntheticbiology.html
Access: http://www.miraikan.jp/go.php/guide/map_index.html
sponsored by mirai-its performing project, MEXT, JSPS

2006. Oct

Human Practice in my early PI Career

社会との関わり: 学生が行う前に教員が率先して

サイエンスアゴラ2006



武田先端知財団
サイエンスカフェ2010
w/ 大島泰郎 先生

科学未来館
サイエンスカフェ2007
「科学俳句 Science HAIKU」



w/ 海部宣男先生など

Emergent Risk

学術会議フォーラム2011



2011シンポジウム



2008 BioSecurity
ワークショップ

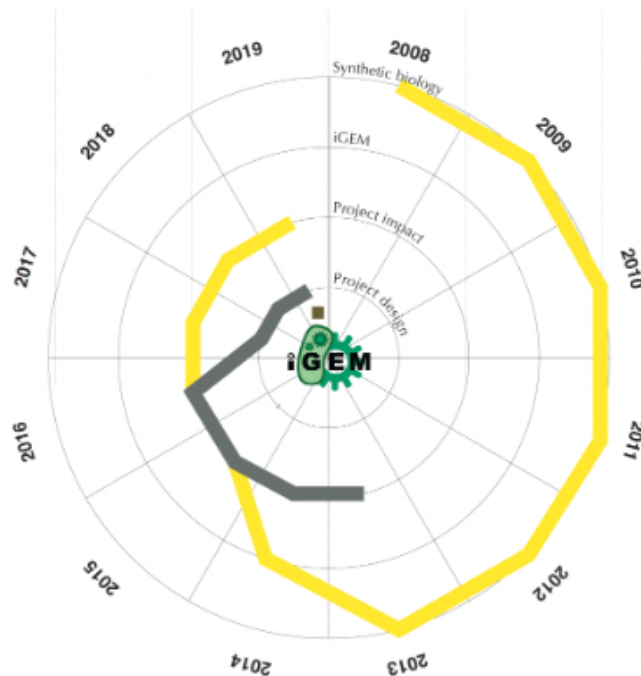
合成生物学者にとって理解・共感できる iGEM Human Practice 評価軸の進展

since 2012

メダル以外にもfinalist,部門賞
(Track Award)の評価にも含まれる

How thoughtful and thorough was the
team's consideration of human practices?

Competition Incentives



Since 2008: Prize for "Best Human Practices Advance"

Since 2008: Human Practices as an optional Gold Medal activity

Since 2013: Human Practices compulsory for a Silver Medal

2014-2015: Human Practices re-named as Policy & Practices; dedicated Policy & Practices Track experimented

Since 2019: Human Practices compulsory for a Bronze Medal

Human practice: "Science Café"

iGEM2012 TokyoTech

People who don't specialize in biology



1. Plan an Imaginary synbio project

2. Get Peer-Review

the project from public points of view



3. Improve the project

w/西條先生、川本先生

Propose Constructive advices

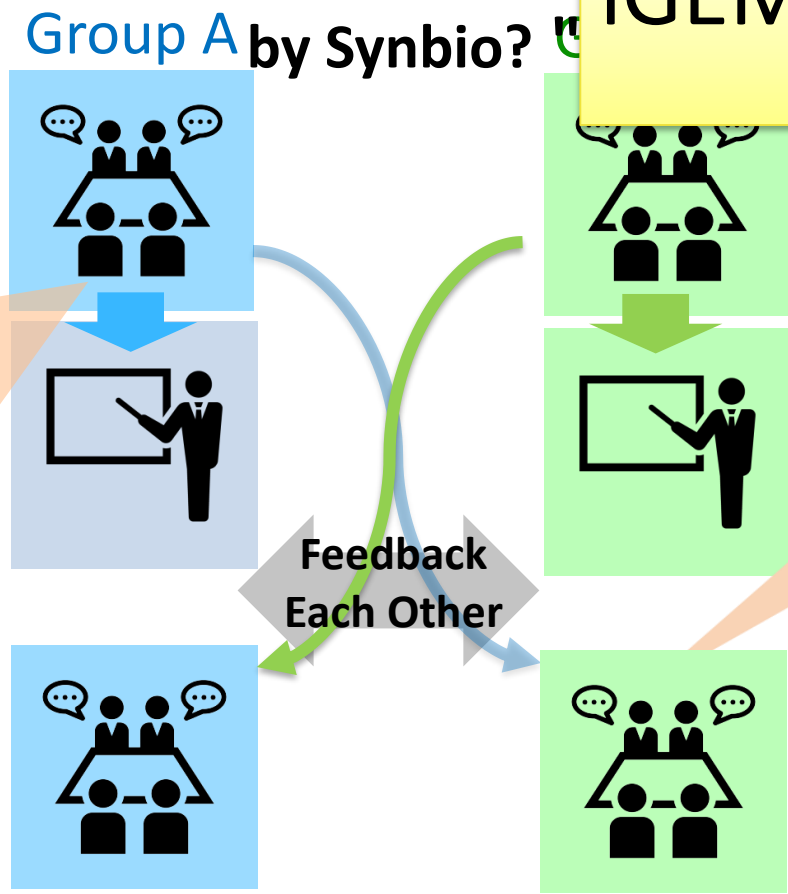
iGEM東工大2012より



DBTL Cycle Proposed by the General Public

iGEM2022 Waseda & Tokyo Tech

"How can we detect feminine hormones by Synbio?"



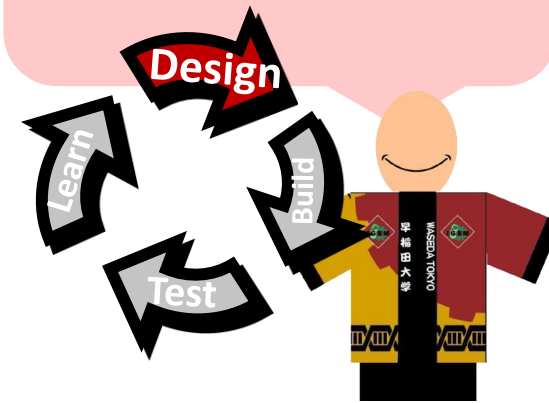
Design & Build
Hormone detection by enzymes **at home**

Test & Learn
Temperature Control Is Okay??

Feedback
Symptoms vary **from person to person...?**

Our "Learn"
Future Plan
Implementation needs the management method

Our "Design"
Future Plan
"Deal With **Individual Difference** by modeling"



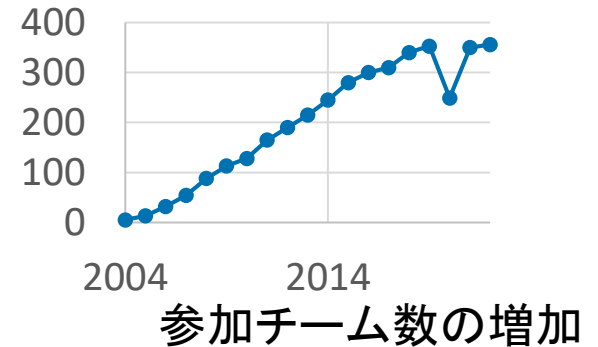
コンテストや教員個人としては？ 研究者集団の合意形成のためには？

- (1) what kind of activity is needed to ensure safety, security and ELSI/RRR in research activities (what needs to be considered, what are the obstacles), and how to embed them in R&D process
- (2) how to create an ecosystem for engineering biology –education and workforce, who sponsor/who should be involved, global collaboration etc)
- 教育について、個人の経験から: Self Reflection for Education
 - 研究者の独立・安定した職位: Independent&Stable PI positions for Academia
 - 教育の試みへの表彰: Award for Education
 - (学生アンケートの結果ではなく、審査員による内容の精査。審査コストへの対価)
 - 東工大教育賞、ナイスステップな研究者、工学教育賞
 - 教育を受ける側へのインセンティブ、効果の周知: Incentive for students & trainee
 - Medal, iGEM経験学生の活躍
- 研究者集団、評価者の意識の好転
 - KAKENHI 新学術「合成生物学」～2009申請 2010採択時には
 - JST, Ministry of Economy系のファンドの措置



iGEM: 合成生物学 国際学生コンテスト

合成生物学の「ロボコン」 による学際人材育成



- 指導した東工大・早稲田学部生チームの戦歴
- 2006年 国際化の初回から参加、特別賞
 - 2007年～ 12回の参加時には必ず金賞受賞
 - 2010年 日本初 となる部門賞 2011年 学生投票世界一 2012-2014年 部門賞3連覇
 - 2020年 早稲田の監督として復帰、部門賞

教育効果

- 学際研究の重要性を知る
- 国際交流経験
- 科学技術と社会との関わりを考える機会
- 「まじめに」遊ぶ
 - 学生の自由な発想
 - 科学のスタンダードに則ったデータ取得
 - プレゼンテーション

2022早稲田チーム
iGEM代表 R Rettberg
創業者T Night

指導実績が認められ
「ナイスステップな
研究者(2012)」
「工学教育賞(2014)」
に選定