

Democratizing Synthetic Biology

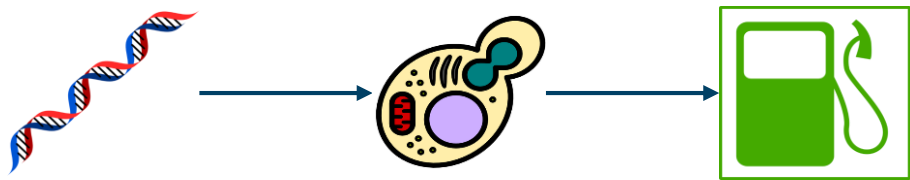
*Balancing Biosecurity, Biosafety, and
Citizen Science*

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August 2nd, 2018

Definitions

Synthetic Biology (SynBio)

Creating a biological cell that does a useful function



Democratize

To make something accessible to everyone.



How has Synthetic Biology been democratized?

Open-access

- Knowledge
- Tools and Equipment

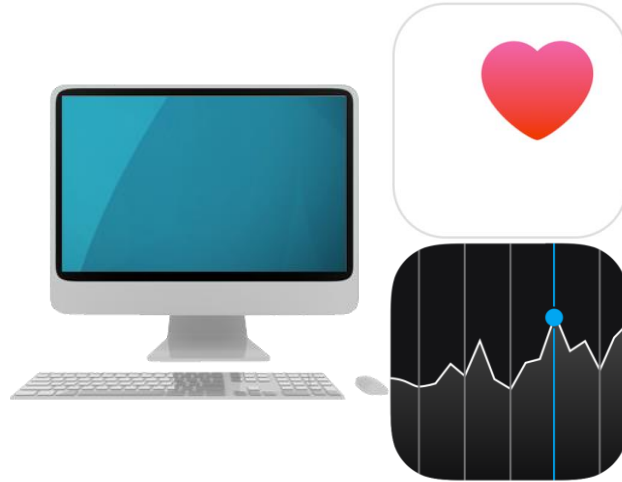
Do-It-Yourself Biology Movement

Community Laboratories

- Education
- Safety trainings
- Conduct Projects



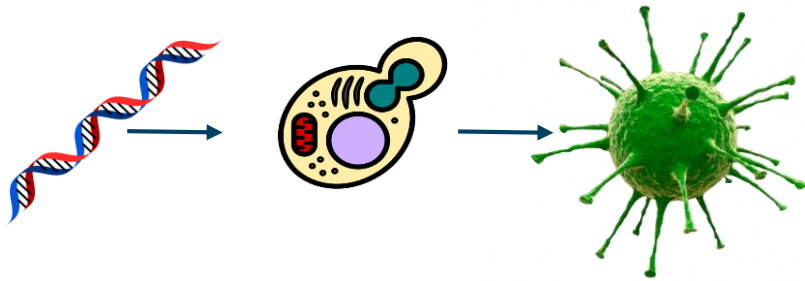
Why democratize Synthetic Biology?



Why democratize Synthetic Biology?



The Issue



- Fear of bioterrorism and bioerror
- Calls for regulation of DIYbio
 - Calls to limit access to information and tools

How to achieve safety and security without hampering democratization?

Open-Access Information



Concerns

- Pathogenic sequences online
- Instructions to create harmful products

Challenges

- **Working towards consensus**

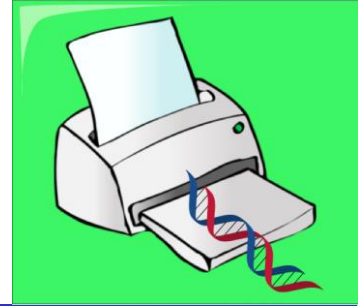
Realities

- **Nascent conversation**

Possible Fixes

- Surveillance
- Limit access

Creating Harmful DNA



Concerns

- Obtain pathogenic DNA
- “Print-at-home”
- Buy commercially

Realities

- **Screen customers and orders**
- **Static agent lists**
- **DNA printers are advancing**

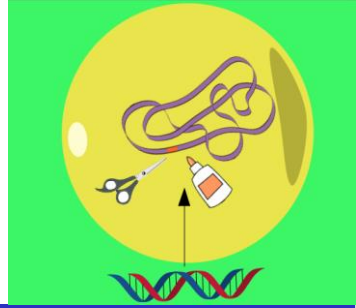
Challenges

- **Technological barriers**

Possible Fixes

- Government funded research (Fun GCAT)
- Licenses or registration for DNA printers

Gene Editing Technology: CRISPR



Concerns

- Human germline editing
- New tech expedites process, empowering bad actors

Challenges

- **No consensus**

Realities

- **CRISPR widely available**

Possible Fixes

- Ban use of CRISPR outside of institutions

Recommendations

Regulating SynBio in Public

	Democratization	Political Feasibility	Security & Safety	Cost
Continue with no regulation on public participation in SynBio	+	+	-	+
NAS synthetic biology license and registration study	○	+	+	-
AIChE create synthetic biology trainings	+	+	+	+

Open-Access Information

	Democratization	Political Feasibility	Security & Safety	Cost
FBI and DHS facilitate discussions to develop best practices	+	+	-	+

DNA Synthesis and DNA Printers

	Democratization	Political Feasibility	Security & Safety	Cost
Consistent Congressional Appropriations for DARPA and IARPA projects	+	+	-	+
State Dept. raise tech at Biological Weapons Convention	○	-	+	+
Congress mandate CDC to conduct horizon scans on printer technology	○	+	+	-

Gene Editing: CRISPR

**CDC, USDA-APHIS, and NIH
review and recommend
updates to the Federal Select
Agents List**

+

-

+

-

Democratization

Political Feasibility

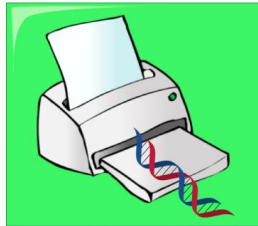
Security & Safety

Cost

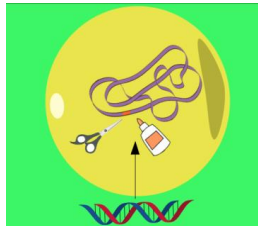
Review



**Continue the dialogue
on open-access**



**Patch gaps in
screening and
printing**



**Organism based
control**

**NAS study on
licenses or
registration**

**AIChE trainings on
SynBio**

Acknowledgements

AIChE

Bette Lawler

Joshua Leonard

Darlene Schuster

Gabriel Levesque-Tremblay

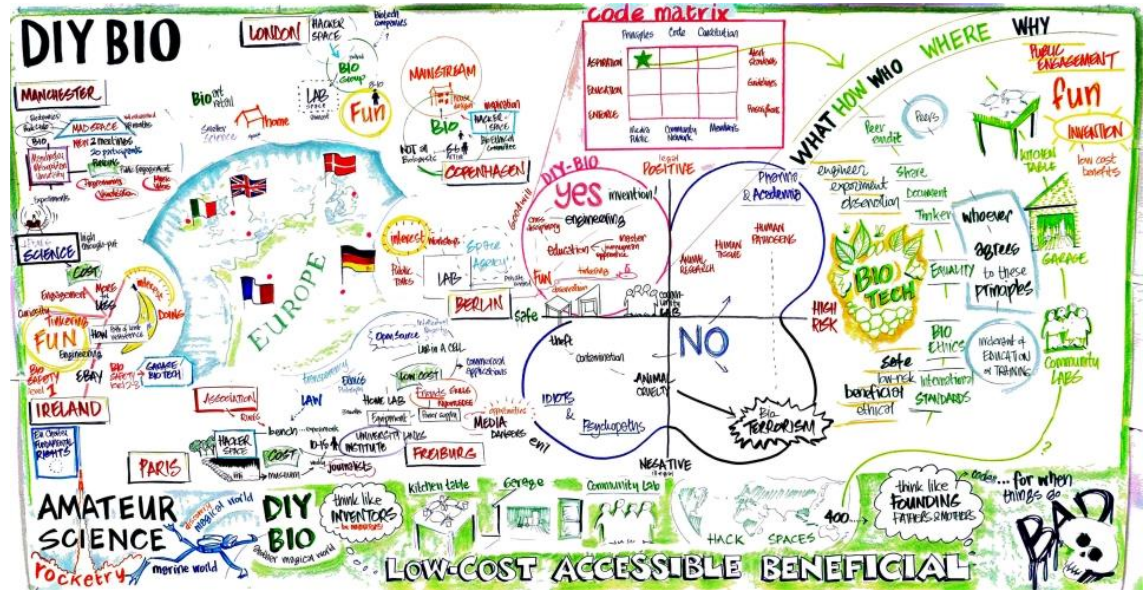
WISE

Dr. Gilbert Brown

Erica Wissolik

Diana Librizzi

Russell Harrison

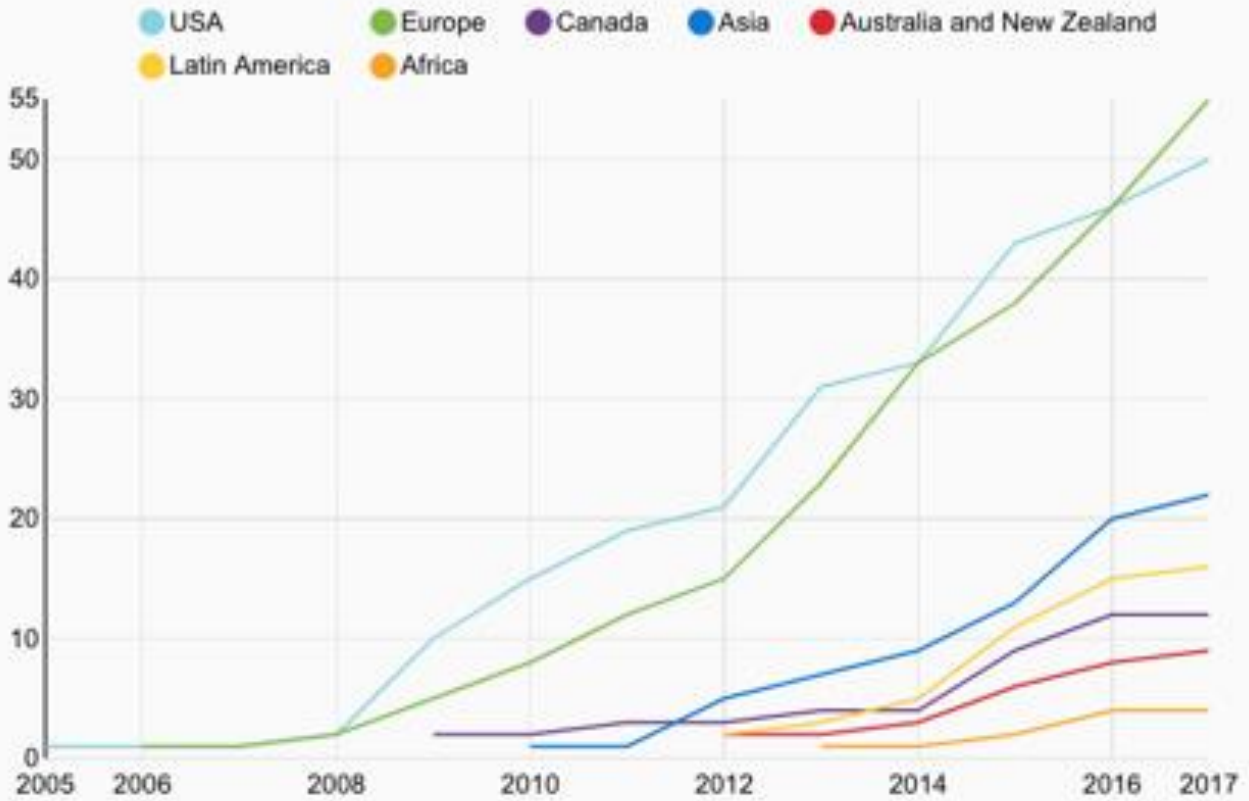


Questions

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Total DIYbio groups



Projects

Open-Insulin

Heavy-metal removal

Velcro-skin

Biofabrics

Much More!

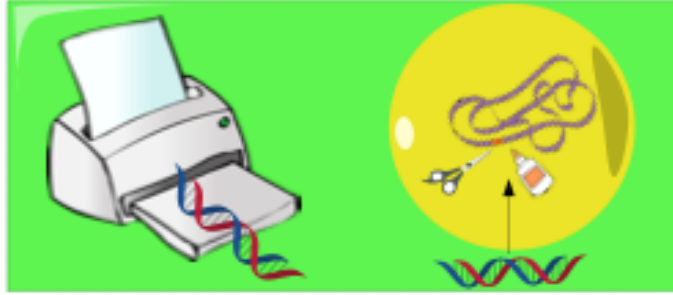
Source: The Brookings Institution

Understanding The Process: D-B-T

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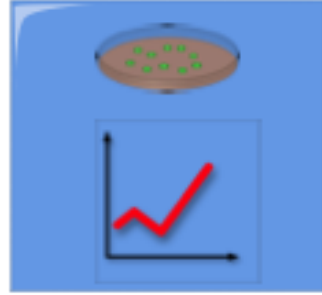
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Design

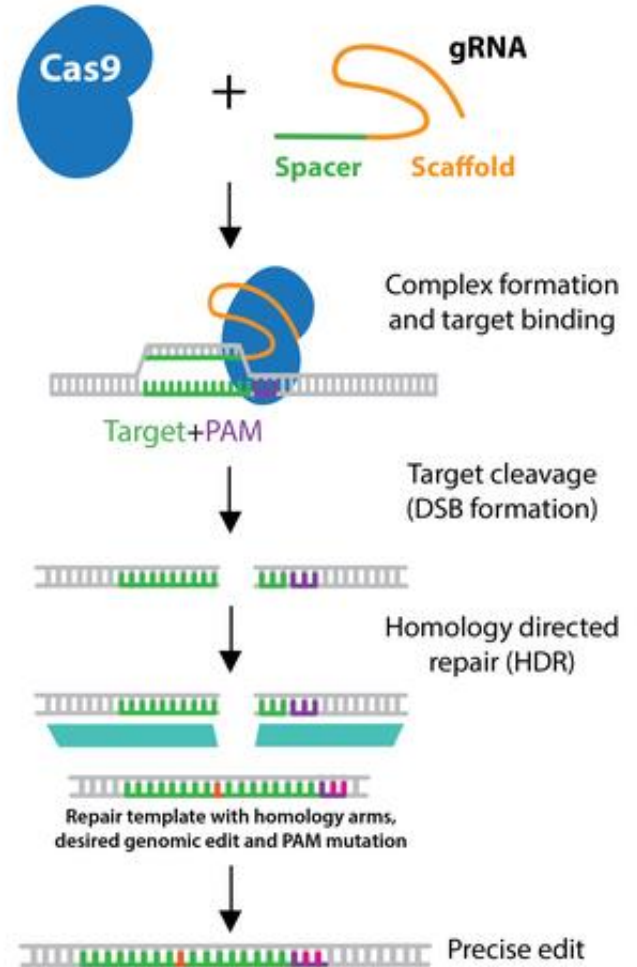
Build

Test

Scale



Clustered Regulatory
Interspaced Short
Palindromic Repeats



Price Per Base of DNA Sequencing and Synthesis

Rob Carlson, March 2016, www.synthesis.cc

