MYTHS, REALITIES AND HOW THE BIOSAFETY COMMUNITY CAN ENGAGE WITH THE DIYBIO/SYNBIO COMMUNITY

The Wilson Center

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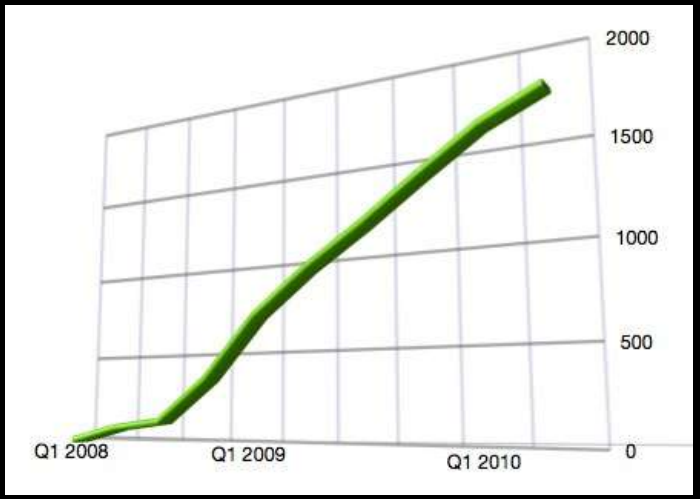
Global DIYbio Community



individuals on global mailing list

An informal network of ~3000 amateur biologists, DIYbio.org is fast becoming an organizational hub, uniting the movement's participants through its website, online forums, local chapters & community labs.

DIY Movement

My Desk – 5 years ago

Now

3-D Printer ($2,000)

Gel Electrophoresis Unit $200

Open PCR $500

Future?

$900 USB-powered DNA sequencer

SYNTHETIC BIOLOGY PROJECT / SYNBIO 5

SEVEN MYTHS & REALITIES

about Do-It-Yourself Biology

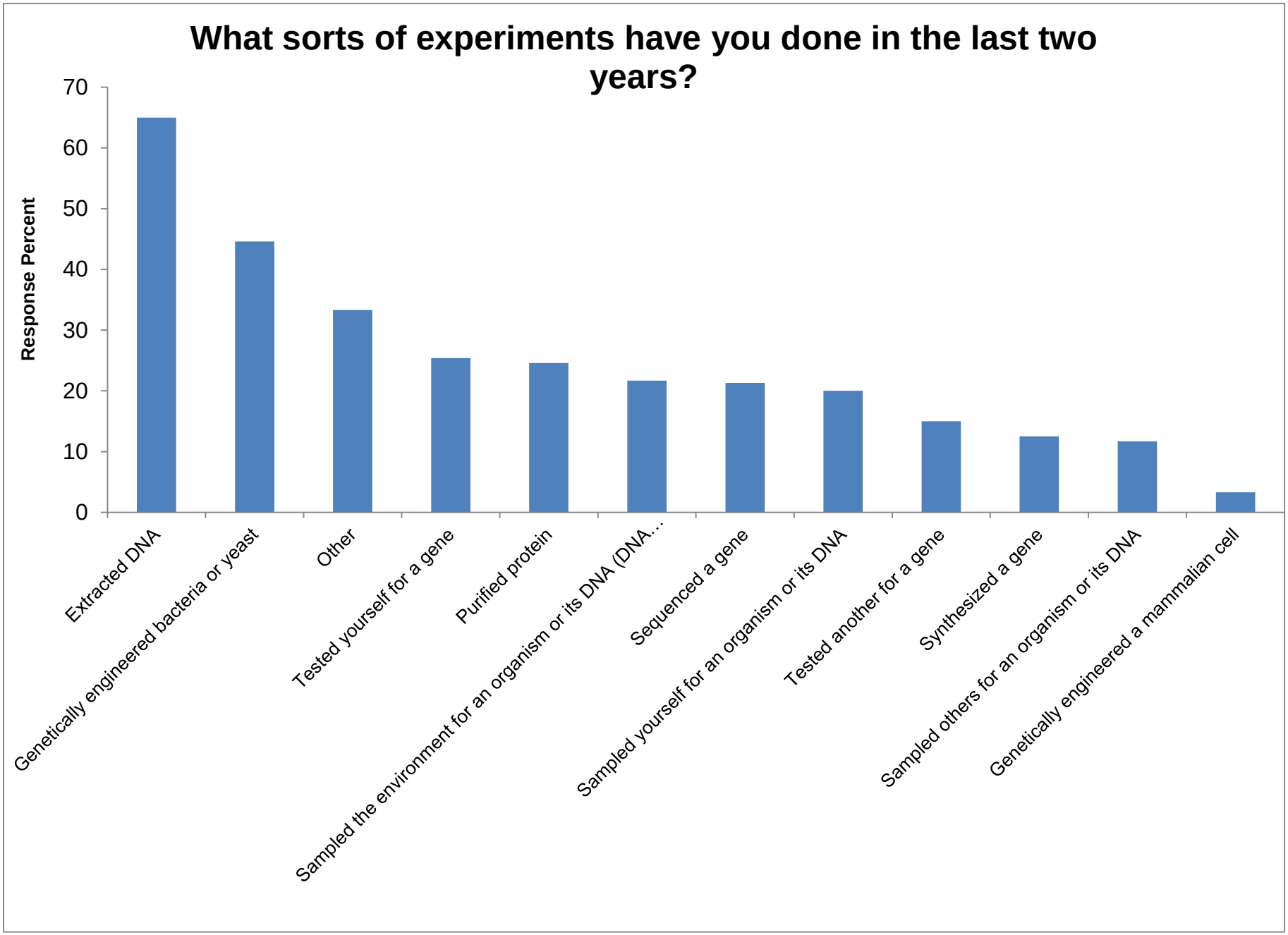
SYNBIO 5

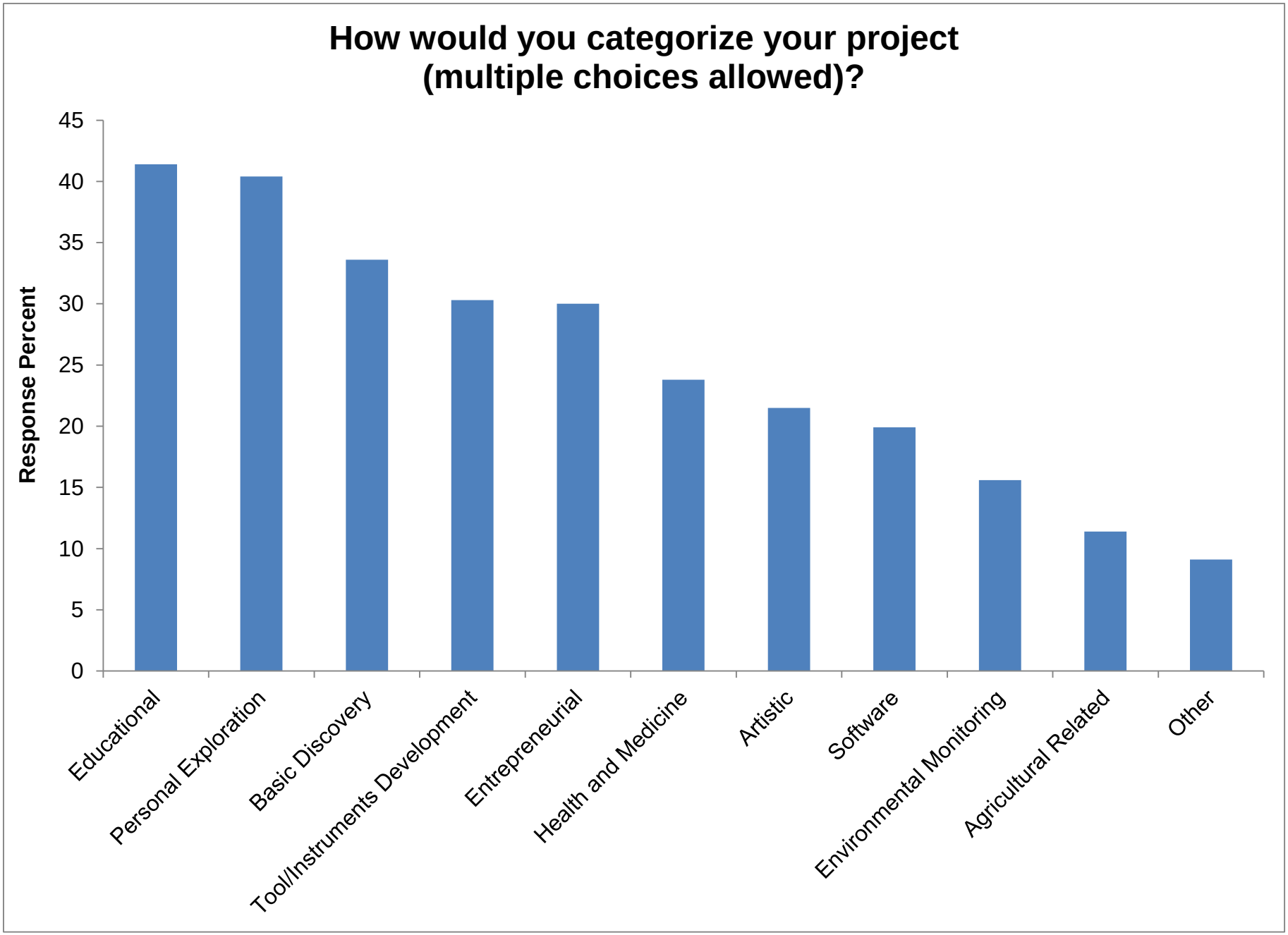
Synthetic BIOLOGY PROJECT

Wilson Center

Who are they?

- 82% from U.S.; 10% from Europe; 4% from Canada; 1% from Asia; 2% from other geographical areas
- 75% male – 25% female
- Younger than the general population
  - 15% under 25
  - 21% between 25-35
  - 42% between 35-45
  - 23% over 45
- More educated than the general population
  - 19% have a doctoral level degree
  - 27% have obtained a Master's degree
  - 37% have completed college


What sorts of experiments have you done in the last two years?
Response Percent
70
60
50
40
30
20
10
0
Extracted DNA
Genetically engineered bacteria or yeast
Other
Tested yourself for a gene
Purified protein
Sampled the environment for an organism or its DNA (DNA...
Sequenced a gene
Sampled yourself for an organism or its DNA
Tested another for a gene
Synthesized a gene
Sampled others for an organism or its DNA
Genetically engineered a mammalian cell


How would you categorize your project (multiple choices allowed)?
Response Percent
45
40
35
30
25
20
15
10
5
0
Educational
Personal Exploration
Basic Discovery
Tool/Instruments Development
Entrepreneurial
Health and Medicine
Artistic
Software
Environmental Monitoring
Agricultural Related
Other

Myth: DIYers work anonymously and solitarily

- The name do-it-yourself suggests working alone
- Between 2005-2011 media focused on a handful of individuals who built labs in their closets and garages
- Fear was that a wide, decentralized group would be difficult to find and reach
- Reality: 92% of DIYers work in group spaces
  - Split between community labs, group labs solely devoted to biotech, and electronic hackerspaces
  - Only 8%, or 23 respondents work exclusively in home labs

Community Labs – Science is for EVERYONE

Myth: Group labs may become unsuspecting havens for bioterrorists

- Many community labs have strict rules about lab access
- Directors in most labs approve reagents and biological materials that are purchased
- It is difficult to remain anonymous in a community setting
- Community labs lack facilities that would allow a nefarious actor to work safely
- Other Activities to reduce this risk
  - ASK program
  - FBI's Biological Sciences Outreach Program
- This question must continually be revisited as the technology and the DIYbio movement evolves

Amateurs Are New Fear in Creating Mutant Virus

WORRY An outbreak of the H5N1 bird flu virus was reported in Vi

By CARL ZIMMER
Published: March 5, 2012

Just how easy is it to make a deadly virus?

This disturbing q
the minds of man
thanks to a pair o
experiments in wi
flu virus was tran

Related

Genetically Altered Bird Flu Virus Not as Dangerous as Believed, Its Maker Asserts (March 1, 2012)

Despite Safety Worries, Work on Deadly Flu to Be Released (February 18, 2012)

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SIDE EFFECTS

D.I.Y. Biology, on the Wings of the Mockingjay

By JAMES GORMAN

nts

s are not wildly popular these days,
t is central to the hugely popular movie
Games." That's the mockingjay, a cross
genetically engineered spy bird called a

The action in "The Hunger Games" takes place in a fictional future in which teenagers are forced to hunt and kill one another in annual competitions designed to entertain and suppress a highly controlled population. The mockingjay first appears as a symbol, when Katniss Everdeen is given a pin that depicts the bird. Mockingj
although not the birds, have spread to the re

"They're funny birds and something of a slap
the Capitol," Katniss explains in the first boo
nature of that slap in face is a new twist on th

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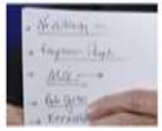
host being human cell
vipers, and another on

the Atlantic

The Democratic Data Advantage



The P
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Special Reports Video Photo Newsletters JUST IN Obama Shows, Once Again, That Crying Is for Winners *Eleanor B*

NOVEMBER 2012 ATLANTIC MAGAZINE

SHARE EMAIL PRINT

Hacking the President's DNA

The U.S. government is surreptitiously collecting the DNA of world leaders, and is reportedly protecting that of Barack Obama. Decoded, these genetic blueprints could provide compromising information. In the not-too-distant future, they may provide something more as well—the basis for the creation of personalized bioweapons that could take down a president and leave no trace.

By ANDREW HESSEL, MARC GOODMAN and STEVEN KOTLER +1 81 Share 75 Recommend 2.2k

HOME NEWS OPINION BUSINESS SPORTS ARTS LIFE HEALTH TECH

'Doomsday' virus revealed, along with DIY instructions

BY MARGARET MUNRO, POSTMEDIA NEWS MAY 3, 2012

Myth: DIYers risk accidents and environmental release

- Risk is currently low
  - Community labs contract with biological waste disposal service
  - Some indicated disposal at university labs
  - “ASK” program designed to help
- Other issues:
  - Data suggests experiment performed at one lab might be continued at another
  - Some individuals carry parts back and forth
- In the future DIYers may need to set stricter safety measures about transporting their experiments

Ask a biosafety professional your question

Submitted questions are sent to a panel of professional biosafety experts and members of the American Biological Safety Association (ABSA.org).

How it works

Ask Now

I have read the disclaimer

Previously answered questions

Are there any special safety issues to consider when planning to work with amphibian or reptilian cells?
January 28, 2013

What safety practices we should have in place prior to transforming or transfecting plants?
February 3, 2013

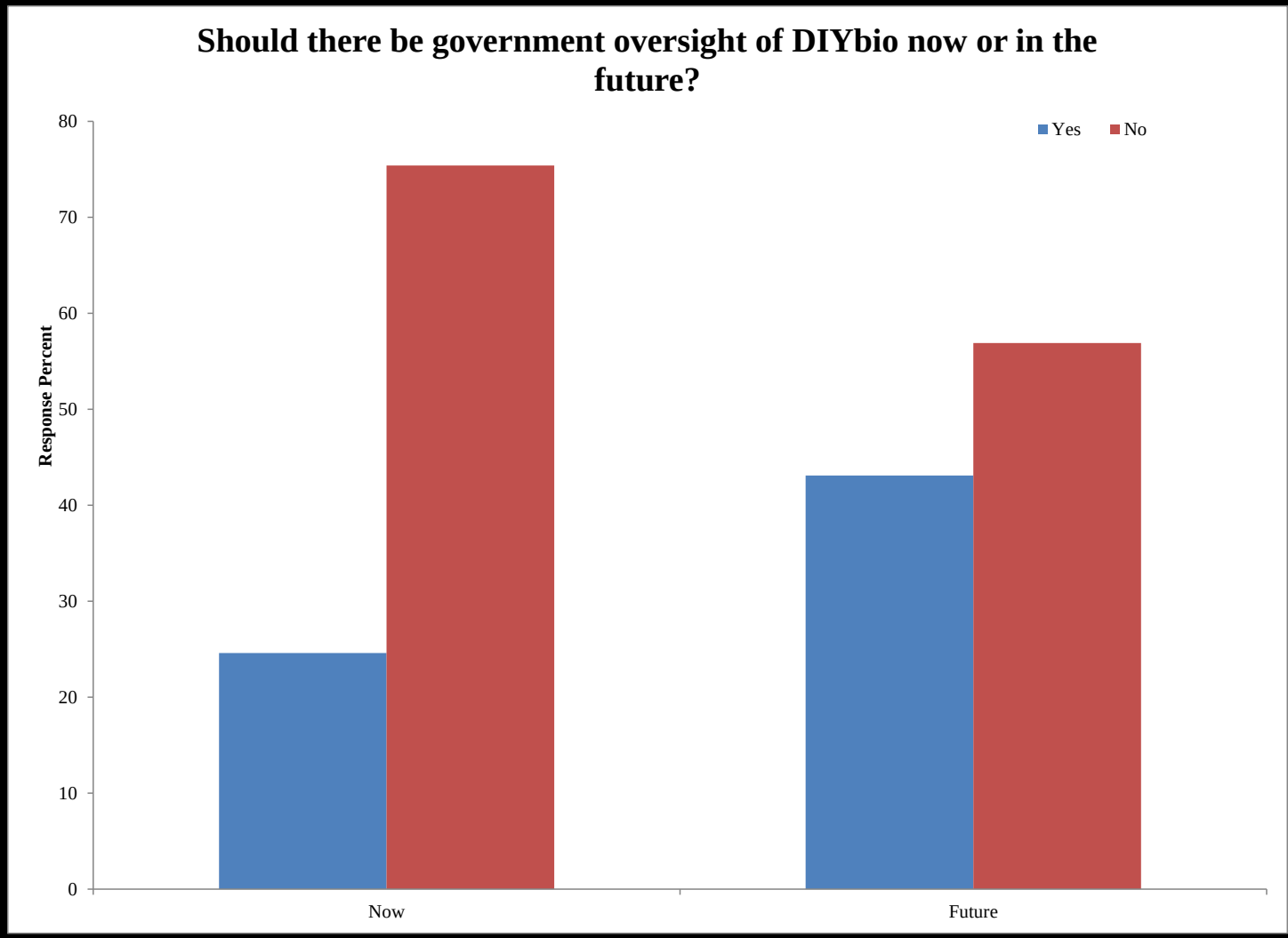
Current ASK Volunteers

- Amy F. Helgerson, MS, RBP, Iowa State
- Amy L. Razukiewicz, MPH, NY Medical College
- Gretchen Demmin, PhD, MT(ASCP), Demmin Consulting
- J. Craig Reed, Ph.D., RBP
- Joleen Weese, Fred Hutchinson Cancer Research Center
- Lisa Burley, Univ. Wisconsin - Madison
- Marissa M. Cardwell, PhD, MIT
- Matthew Anderson, PhD, University of Nebraska Lincoln
- Molly Stitt-Fischer, Ph.D., CPH
- Rebecca L. Moritz MS, CBSP, Univ. Wisconsin - Madison
- Robert Foreman, PhD, Univ. Chicago
- Stephen Rusbarsky, MPH, ASQ SSGB, Saint Louis University
- Ted Myatt, Sc.D., RBP

MYTH: DIYers are averse to government oversight?

43% who believe future oversight may be needed divide into three categories

1. DIYbio should be treated no differently from academic or industrial labs
2. Organisms and equipment should be regulated rather than labs and individuals
3. Regulations should depend on the state of the technology



draft DIYbio Code of Ethics

as agreed by U.S. delegates
July 2011

OPEN ACCESS
Promote citizen science and decentralized access to biotechnology.

TRANSPARENCY
Emphasize transparency, the sharing of ideas, knowledge and data.

EDUCATION
Engage the public about biology, biotechnology and their possibilities.

SAFETY
Adopt safe practices.

ENVIRONMENT
Respect the environment.

PEACEFUL PURPOSES
Biotechnology should only be used for peaceful purposes.

TINKERING
Tinkering with biology leads to insight; insight leads to innovation.

DIYbio Code of Ethics

Draft from the European Delegation
09/07/2011

Transparency
Emphasize transparency and the sharing of ideas, knowledge, data and results.

Safety
Adopt safe practices.

Open Access
Promote citizen science and decentralized access to biotechnology.

Education
Help educate the public about biotechnology, its benefits and implications.

Modesty
Know you don't know everything.

Community
Carefully listen to any concerns and questions and respond honestly.

Peaceful Purposes
Biotechnology must only be used for peaceful purposes.

Respect
Respect humans and all living systems.

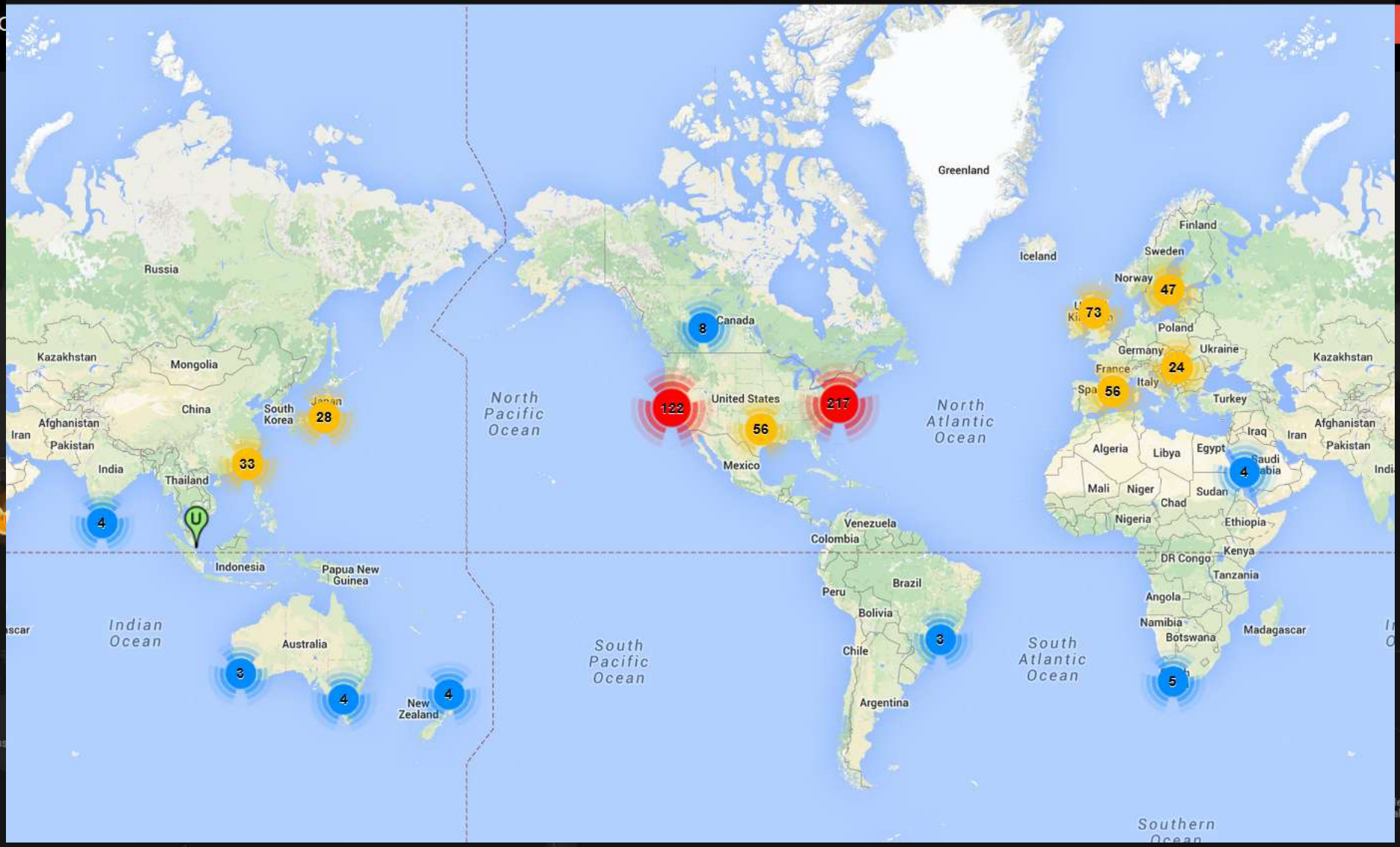
Responsibility
Recognize the complexity and dynamics of living systems and our responsibility towards them.

Accountability
Remain accountable for your actions and for upholding this code.

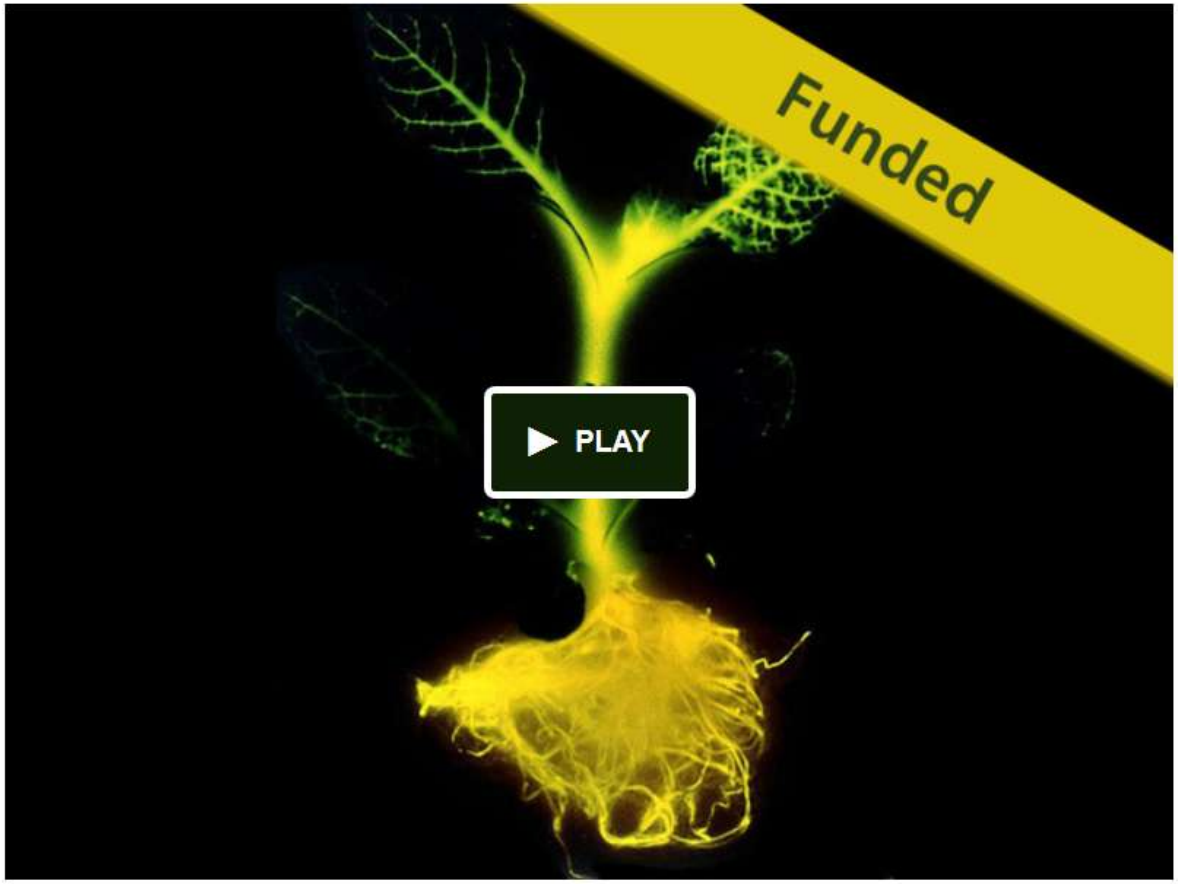
Synthetic Biology

based on standard parts

SynBio Map



Funded! This project was successfully funded on June 7, 2013.



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Create GLOWING PLANTS using synthetic biology and Genome Compiler's software - the first step in creating sustainable natural lighting

8,433
backers

$484,013
pledged of $65,000 goal

0
seconds to go

Project by
Antony Evans
San Francisco, CA

First created · **22 backed**

Antony Evans 1132 friends

glowingplant.com

See full bio | Contact me

Pledge $5 or more

426 backers

You'll get a 2"x3" sticker showing the

Real Vegan Cheese!

Story | Updates 12 | Comments 59 | Funders 696

7.6k Share | 739 Tweet | 227 +1 | Email | Embed | Link | Follow

Biohackers are engineering baker's yeast to produce Real Vegan Cheese. No cows needed!

$37,369 USD
RAISED OF $15,000 GOAL

249% | 0 time left

This campaign started on Jul 01 and closed on August 30, 2014 (11:59pm PT).

Flexible Funding

CAMPAIGN CLOSED
This campaign ended on August 30, 2014

SELECT A PERK

$100 USD — Featured

Biohacker's Lab Coat

A classic white lab coat with your choice of text and matching graphic, "Biohacker" or "Real Vegan Cheese"

$35,000 Broadcasting Lights! Camera! Action!
Pro recording equipment for open science Instructional videos!
Achieved!

$30,000 Yeast bioreactor
Scaling up from lab scale to kitchen scale
Achieved!

$20,000 Narwhal Cheese!
0% narwhals bothered, 100% cheese!
Because we can.
Achieved!

$15,000 Initial Proof-of-Principle Research
Express cheese proteins in baker's yeast
Achieved!

"Real Vegan Cheese is a not a cheese substitute! It all begins with regular old baker's yeast. Through synthetic biology, we engineer our yeast to become milk-protein factories, churning out real milk proteins (known as caseins). These milk proteins are then combined with water, vegan sugar and oil to make a kind of milk which is ultimately converted into Real Vegan Cheese using the age-old cheese-making process." https://www.indiegogo.com/projects/real-vegan-cheese

Moving forward

- Expand biosafety beyond “traditional” disciplines
  - Including training of biosafety professionals on new and emerging disciplines
- Set a horizon when discussing risks
- Benchmarks should be set to determine when the DIYbio community should submit to further oversight
- Create more opportunities for interaction between DIYbio and government
- Foster open communication between the DIYbio (synbio) and biosecurity/biosafety communities

Thank you and…… WE NEED YOUR EXPERTISE so if you are interested in learning more about ASK and/or iGEM opportunities please let me know

www.synbioproject.org

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What are the potential choke points in the system?

- Barriers to entry are low and will continue to drop
- Monitor People, Access or the System as a whole?
  - Space
    - Survey suggests a community lab model over home labs
  - Equipment
    - Costs will continue to drop providing easier access
  - Materials
    - As synthetic biology develops how does the digitization of DNA/RNA sequences change our ability to control access to materials? Currently ordering DNA is a choke point.
  - Knowledge
    - Publication of sequence data and techniques
    - iGEM wikis