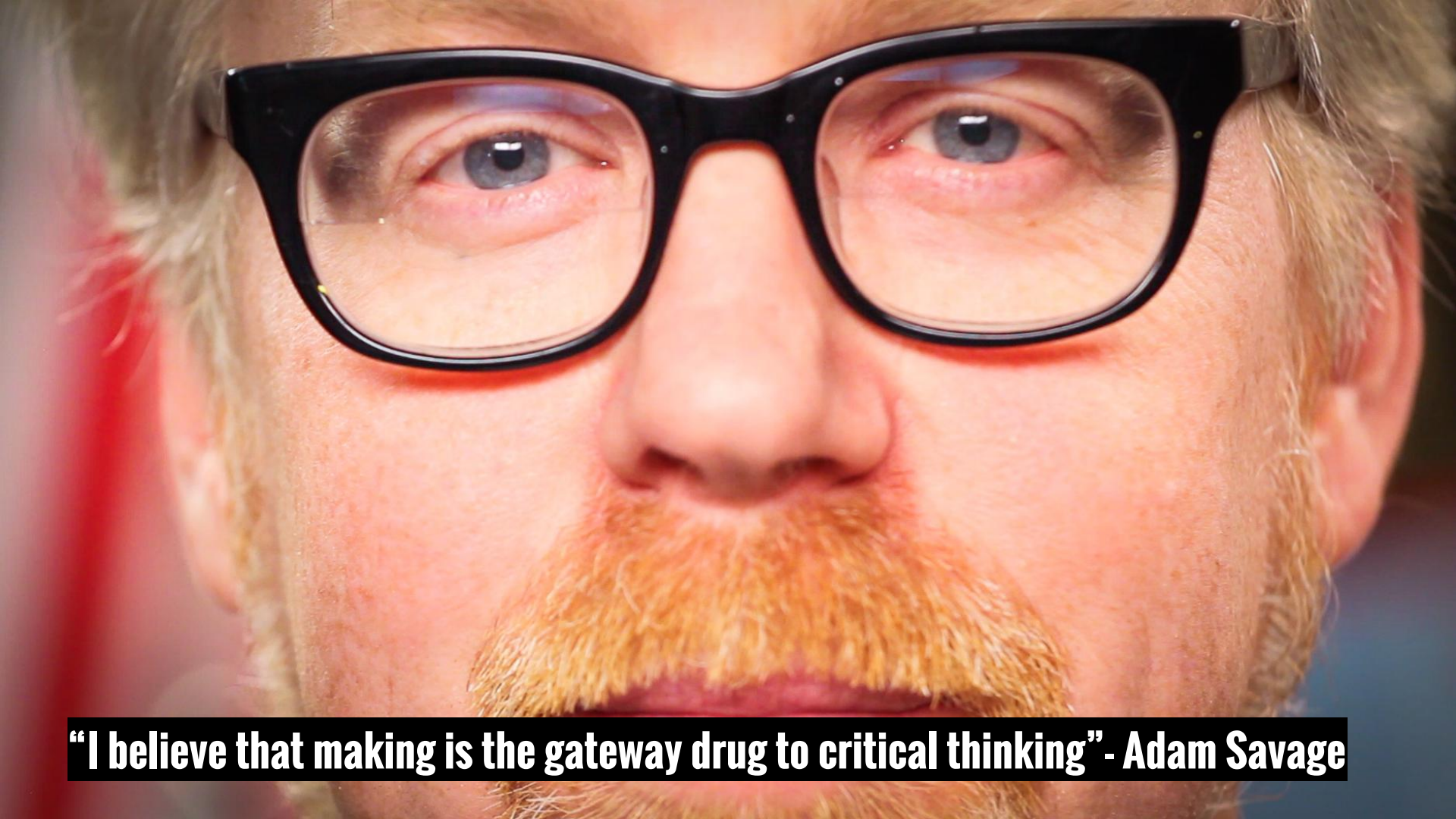


Biohacking (DIY-Bio): Creating critical thinkers through civic science

...

Meow-Ludo - Co-Founder BioFoundry



“I believe that making is the gateway drug to critical thinking” - Adam Savage

Meow

- Founded the biohacking movement in Australia
- Just got back from SF after launching a startup making biotech breast milk
- Spent 7½ years an undergrad
- Is now bionic
- Is sending an experiment to space next year
- Loves astrobiology, microfluidics, arguing about GMO safety

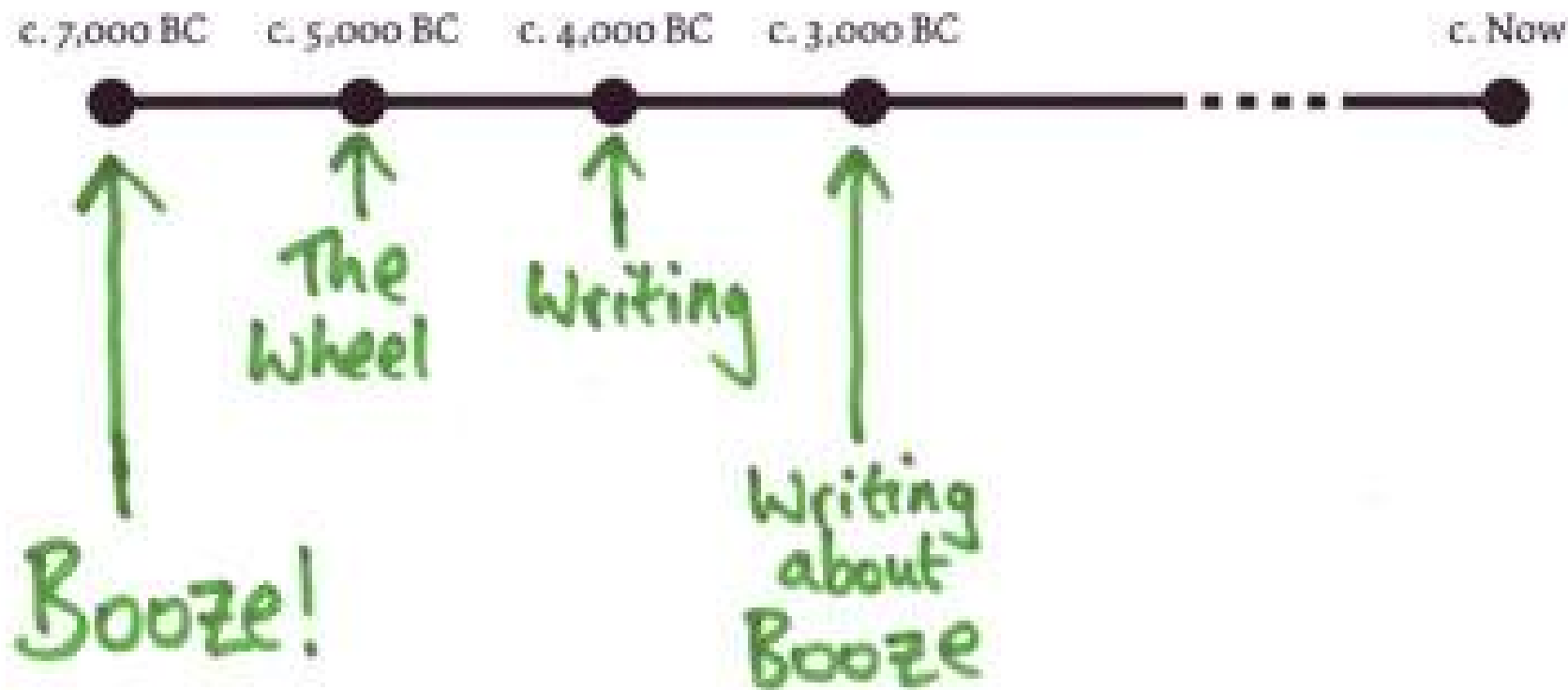


Origins of Biotechnology and Biohacking

- Brewing alcohol is possibly responsible for the rise of civilisation
- Crop and animal domestication
- Beer, wine, bread, cheese
- Biohacking is a more formalised approach to something we've always been doing



Human Civilisation



What DIY-Bio is and isn't

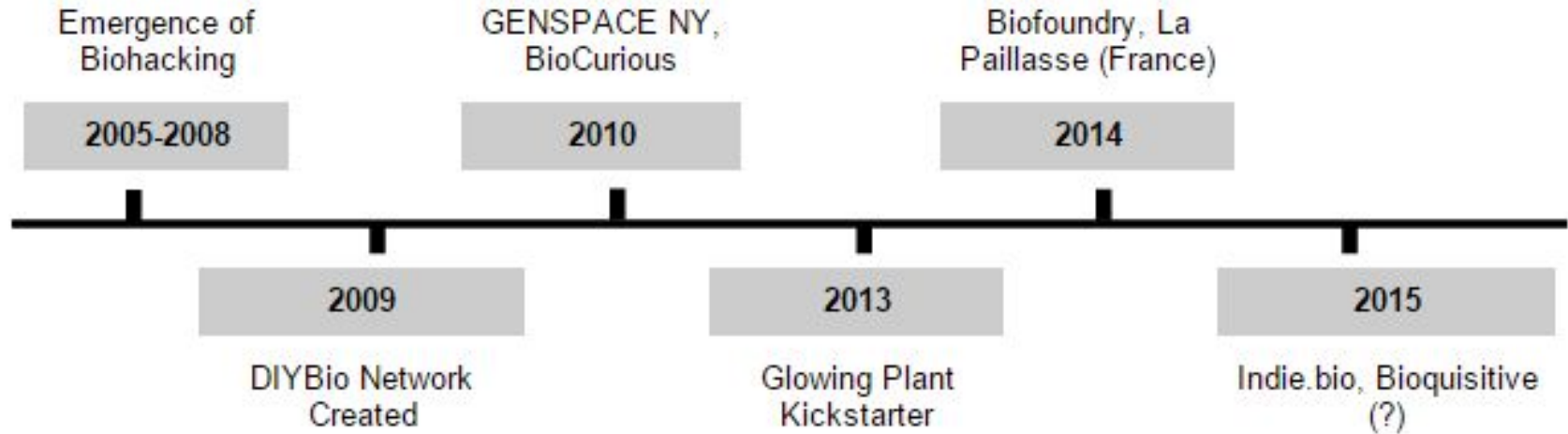
IS

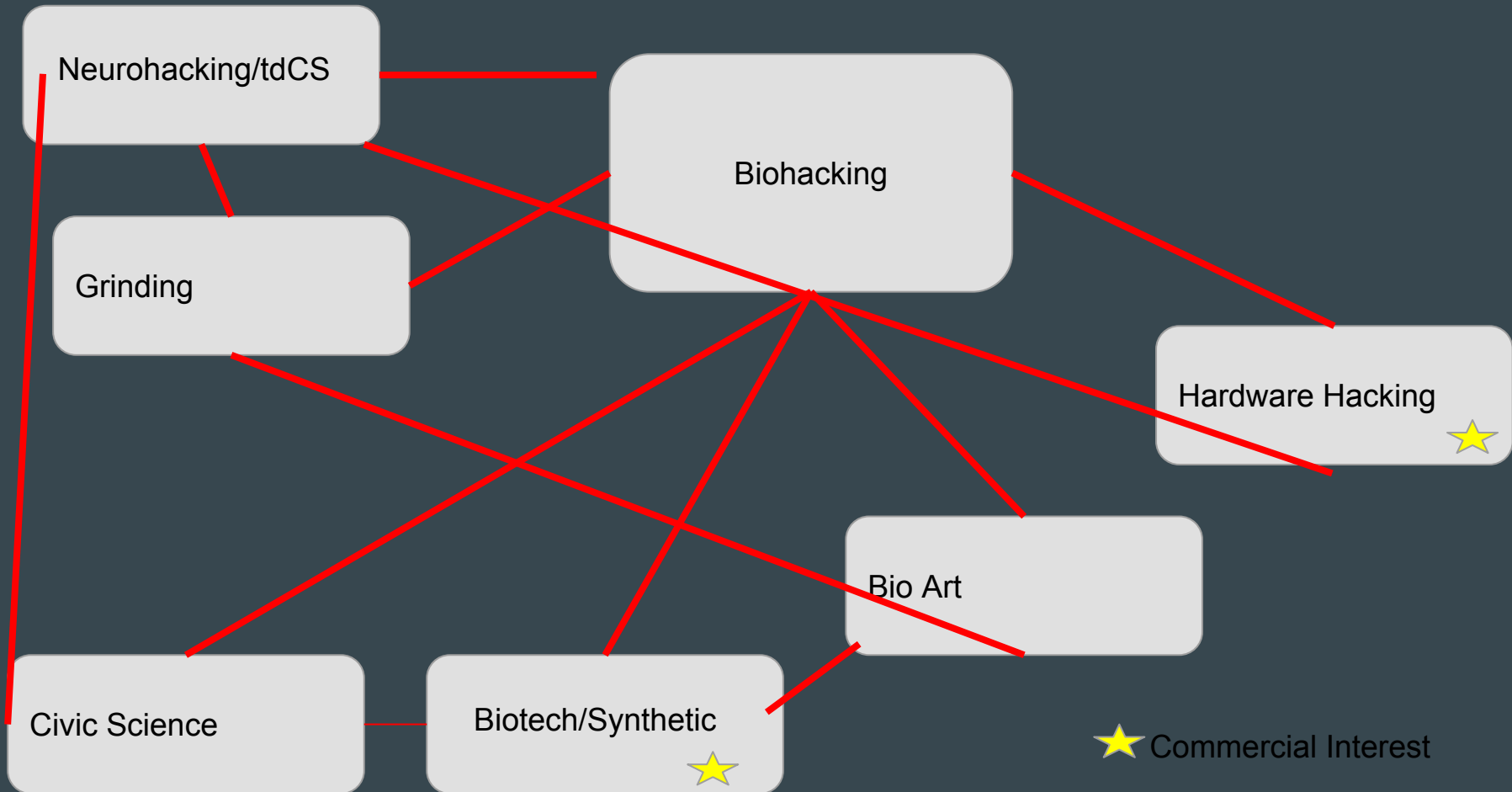
- GMOs
- Tinkering (within limits)
- “Non-spreadable”
- Helpful, Humane
- Practice based

ISN'T

- Human genetic modification
- Pathogens
- Bioweapons
- Viruses
- Theory based

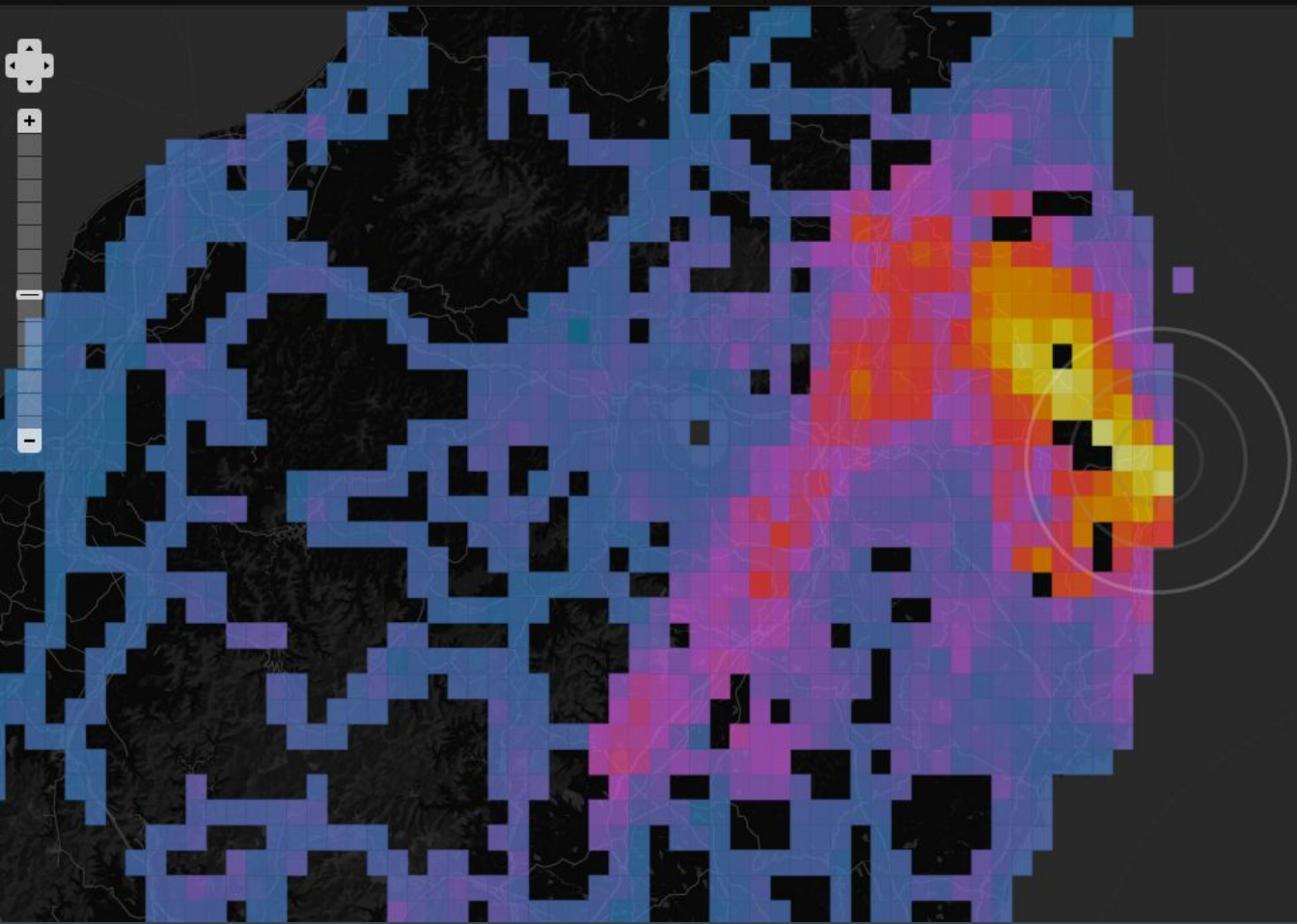
Key Milestones





★ Commercial Interest

Safecast



Layers ⊕ ⊖

▾ **Safecast** ⓘ 🔍 ⊕ ⊖
3.6M of 10.2M Ⓞ

0.03 0.29 0.5 1 2.86 10+

cpm **μSv/h**

Source: Safecast (updated 2013/06/13)

▾ **Evacuation zones** ⓘ ⊕ ⊖
3 of 3 Ⓞ

10 20 30

km

Source: nature.com

▾ **Nuclear Accidents** ⓘ ⊕ ⊖

▾ **Earthquakes** ⓘ ⊕ ⊖

Citizen vs Civic Science

- Getting people involved in all steps of the science
- Mentoring combined with tinkering
- Publishing
- Safecast - Fukushima

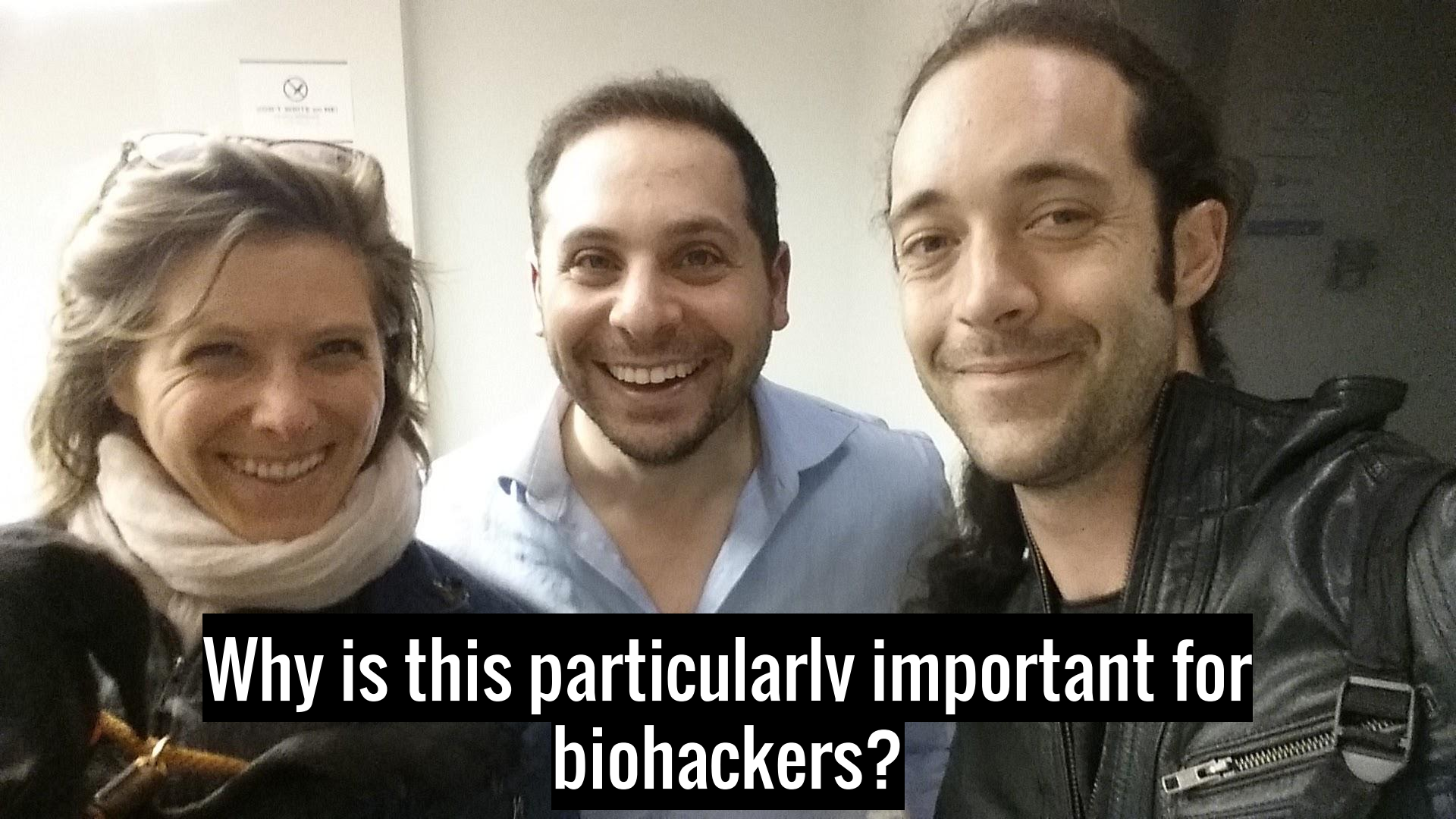
Goals of Biohackers vs Traditional Biotech

Biohackers

- Implicitly community driven
- Decentralised
- Agile funding models powered by emerging technology
- Able to tackle problems that are not profitable
- Able to utilise lean start up approaches to pivot and produce products in-line with consumer need
- Generally open IP

Traditional Biotech

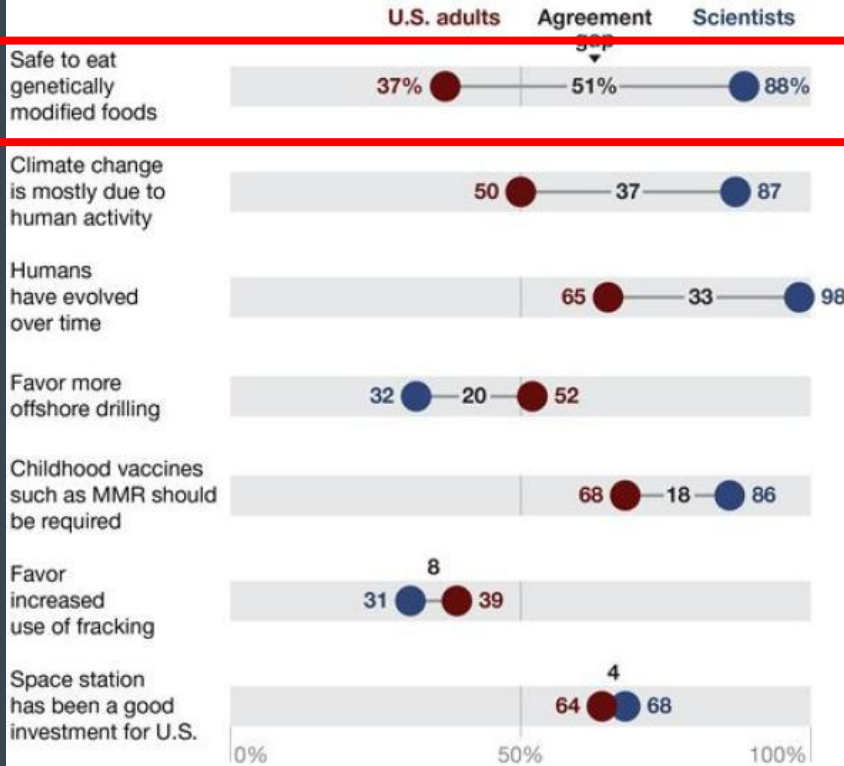
- Implicitly Profit Driven
- Strict hierarchy and structure
- Static funding and research models
- Focus on big projects, big returns
 - Pharma
 - Agriculture
- End goal is to return biggest return on investment: the consumer is not always the person buying the end product
- Generally closed IP



Why is this particularly important for biohackers?

Opinion differences between the public and scientists

Percentage agreeing with statement



Survey of U.S. adults done Aug. 15-25, 2014 (error rate of +/- 3.1%).
Survey of AAAS scientists done Sept. 11-Oct. 13, 2014 (error rate of +/- 1.7%).

Public Opinion

- Why is public opinion so radically different to scientific consensus?
- What can be done to fix this?
-



NEW HARVEST



VeganGMO

@VeganGMO

As vegans, we feel it is important to stay open-minded about genetic engineering and biotechnology. Please check out our blog to find out more.

veganamo.com

-Jamie Foley
(@SkepticalVegan)



BIOFOUNDRY





Laser microscope
demo

And now...





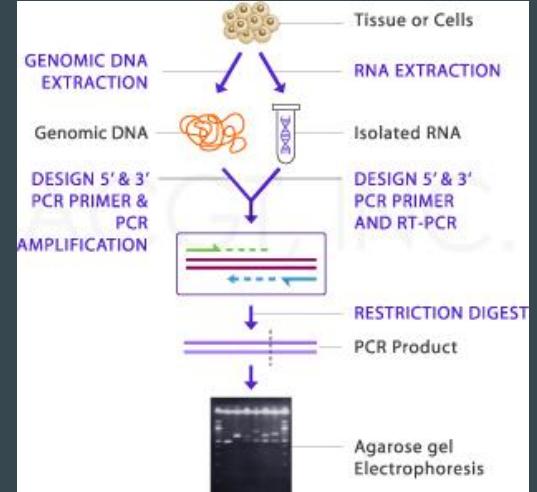
Safety from a global perspective

- In short: Every study says that biohack labs are not only safe, but prevent against bioterrorism attacks
- These investigations have been performed at federal and international levels
- If anyone is interested in this specifically, I can provide more information after the talk

Projects

...

Sascha Karberg: Dog poo detective



The face of litter - HK May 2015

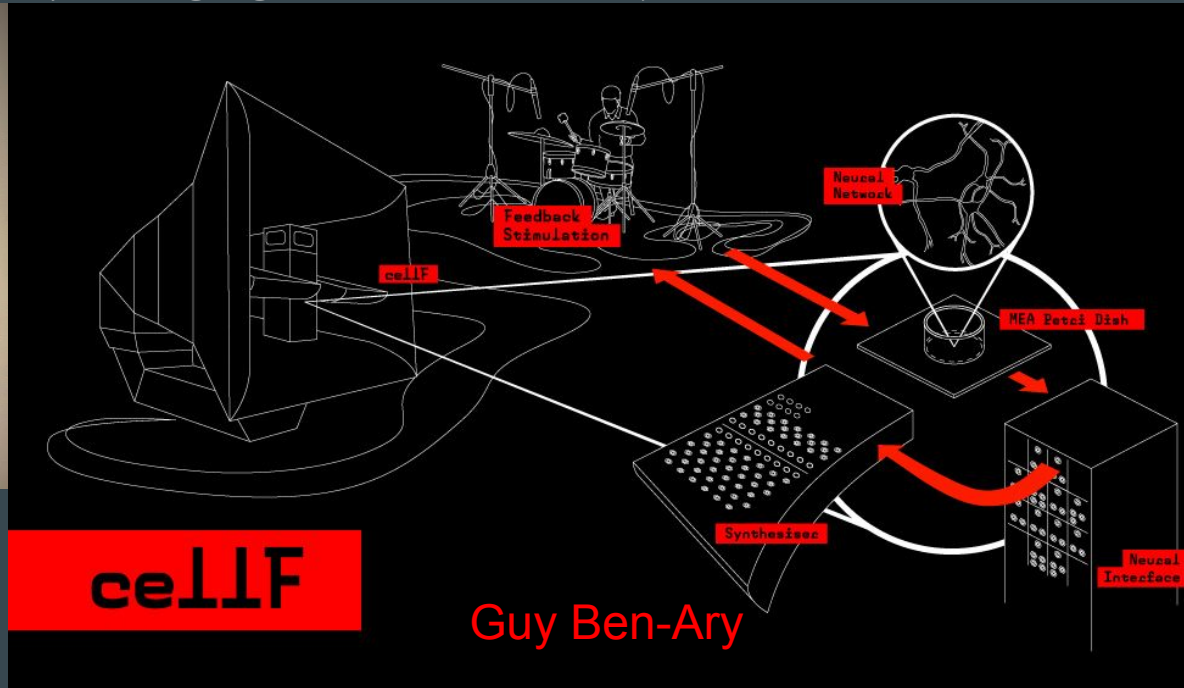


Biohacking and Bioart

- Australia is the Mecca for Bioart, SymbioticA, The Edge (SL QLD)
- Fledgeling bioart community emerging in Brisbane (Svenja Kratz, Laini Burton)



Heather Dewey-Hagborg

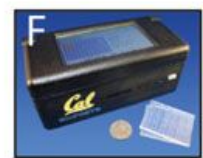
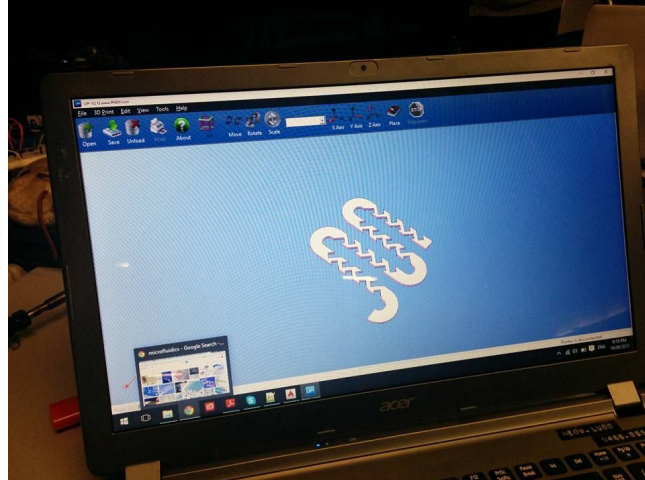
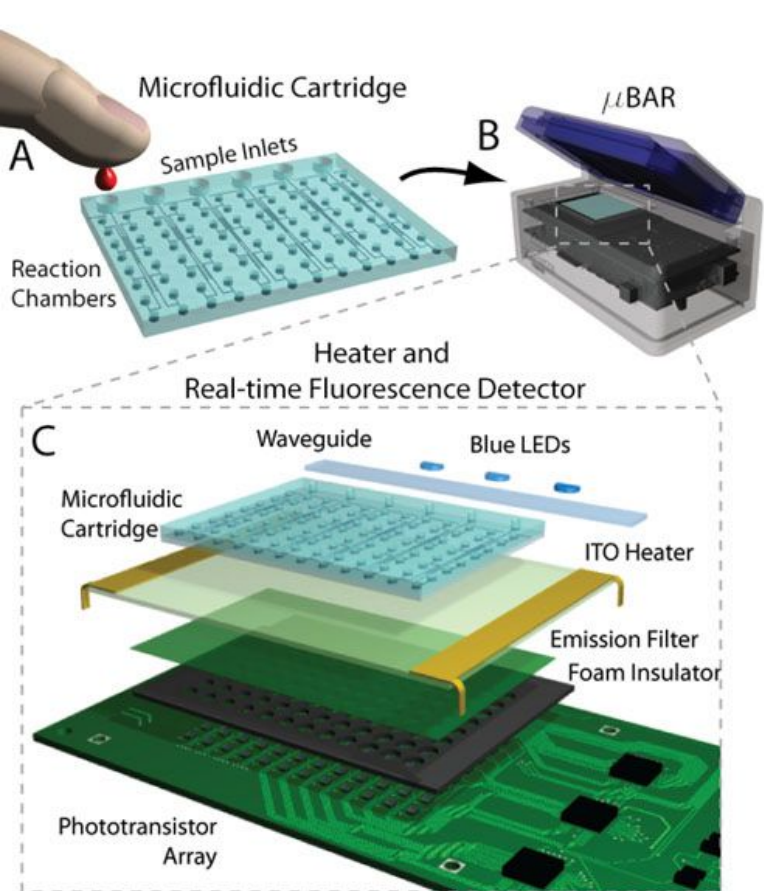






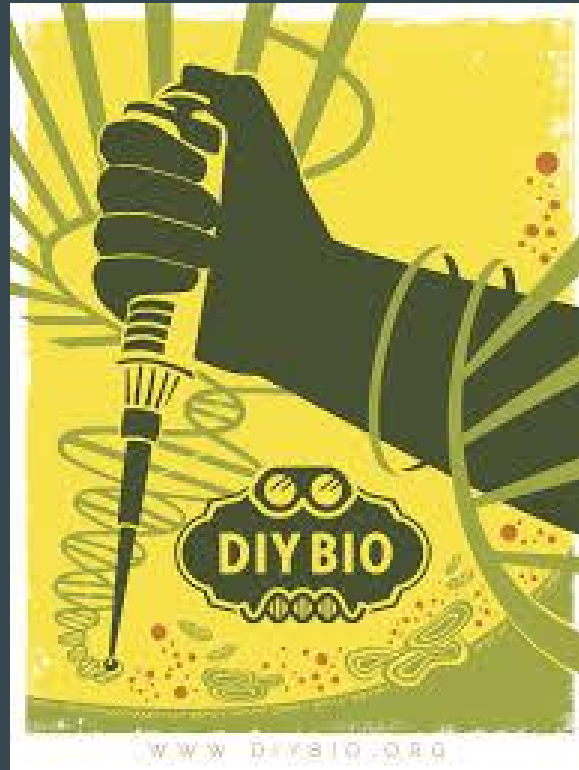
LAMP Diagnostics Hackagong Entry







DIY-Bio Example Projects



Sushigate

- high school students discover one-quarter of fish sold in their NYC neighborhood is mislabeled
- Used DNA Barcoding technology



Outcome

- Seven of nine samples that were called red snapper were mislabeled, and they turned out to be anything from Atlantic cod to Acadian redfish, an endangered species.
- In October 2011, US FDA officially adopted DNA barcoding for detection of seafood fraud

Glowing plant

- \$484,013 raised

- Problems

- Use to science



Chai Biotech

- Cost
- Funding
- Ability

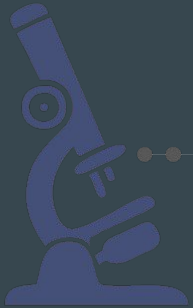


Vegan Cheese

- BioCurious
- How it works
- Funded on indiegogo



real vegan cheese



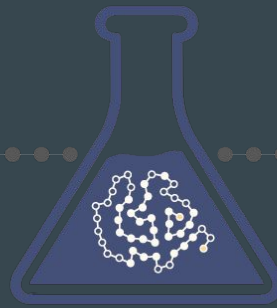
Search Animal Genome
for Milk Protein DNA



Synthesize Yeast DNA
Based on Those Sequences



Put DNA into Yeast



Collect Milk Proteins from Yeast



Make Vegan Milk



Make Real Vegan Cheese

Lifepatch - Jogjarkarta, Indonesia

- JRP - Jogja River Project
- University + biohackers
- Sample local rivers for coliform bacteria
 - indicators of pollution
- Data is open, allows councils and citizens to make informed decisions about usage and maintenance

Conclusion

“People are not stupid. They believe things for reasons. The last way for skeptics to get the attention of bright, curious, intelligent people is to belittle or condescend or to show arrogance toward their beliefs.”

— Carl Sagan



Useful links

- [BioHackSyd](#)
- [BioFoundry](#)
- [TED Talk](#)
- [Biocurious](#)
- [OGTR](#)
- [DIY-Bio](#)
- [Bioinformatics](#)
- [Biotech Projects](#)
- [DIY-Bio Journal](#)
- [Open Source Biotech](#)
- [GENspace](#)
- [Bio.science](#)
- Meow@foundry.bio
- 0466 965 321