



waag society

institute for art, science and technology



BioHack Academy History of Biohacking



Definitions

Google

bi·o·hack·ing

/bīōhakiNG/

noun

the activity of exploiting genetic material experimentally without regard to accepted ethical standards, or for criminal purposes.

biohacking

n. The manipulation of DNA or other aspects of genetics either for fun, or maliciously

More at Wordnik | from Wiktionary, Creative Commons Attribution/Share-Alike License

TOP DEFINITION

>

biohacking

refers to managing one's own biology using a combination of medical, nutritional and electronic techniques.

I'm going to do some biohacking on my hangover by getting some IV hydration with essential nutrients.

#bio hack #biohacker #bullet proof #biopunk #cybernetic

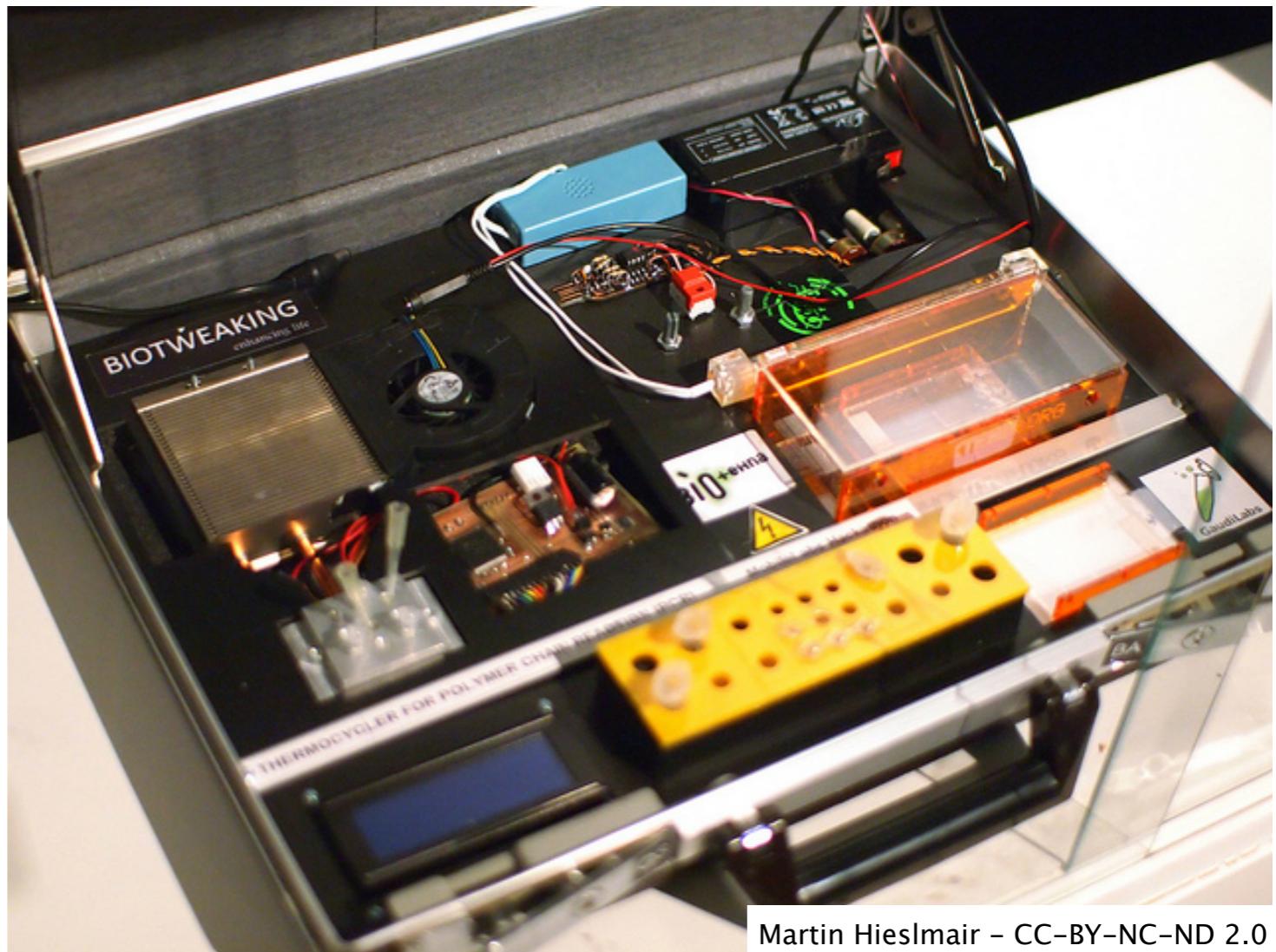
Wiktionary

Urban
Dictionary



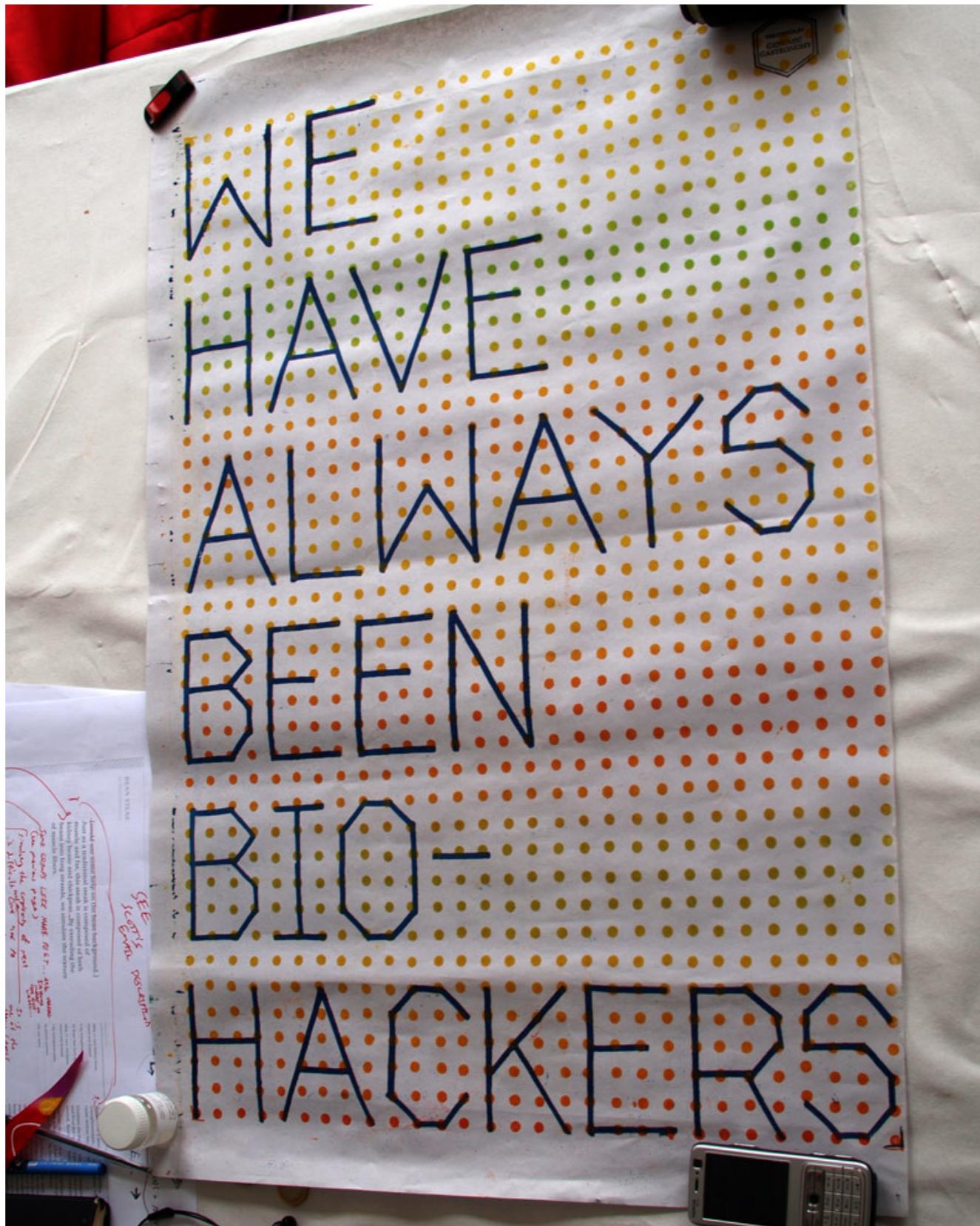
What it means to be a hacker

- Create & Share
- Freedom of inquiry
- Hostility to secrecy
- Sharing as ideology and strategy
- The right to fork
- Emphasis on rationality
- Distaste of authority
- Playful cleverness



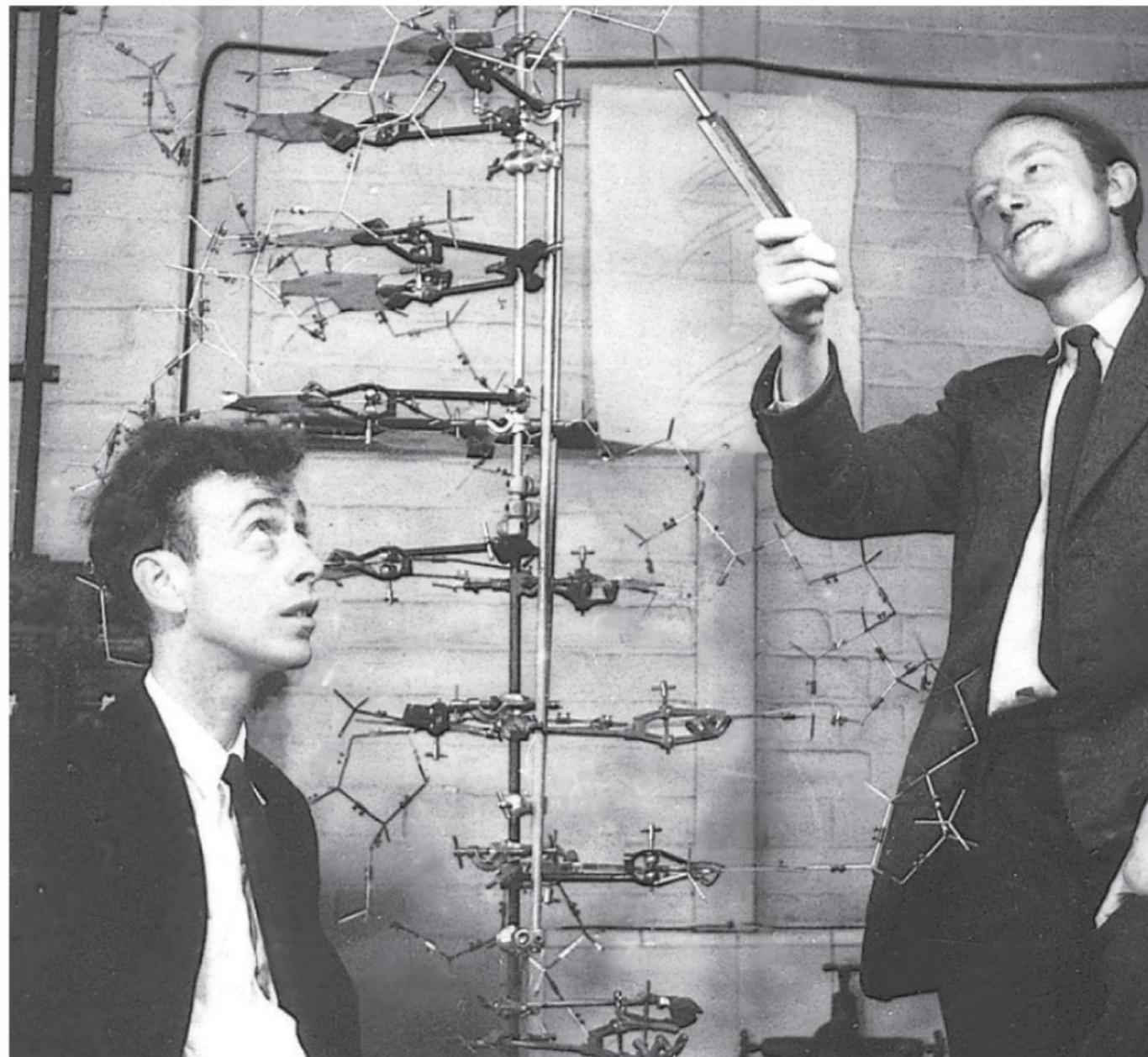


We have always been biohackers





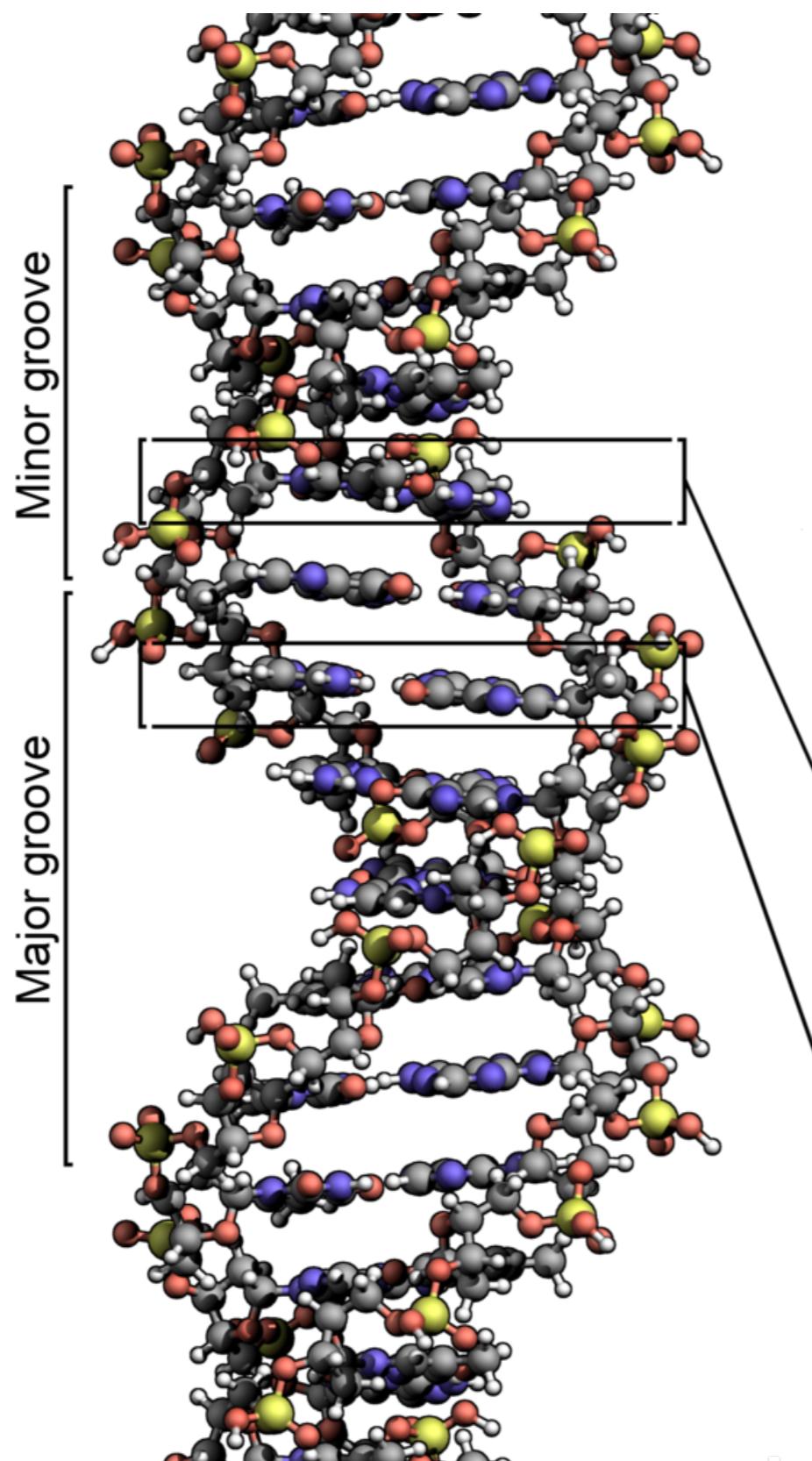
Discovery of Double Helix 1953



Copyright © 2009 Pearson Education, Inc.



DNA Molecule



Living code:

AACATGACCTGACGA

Digital code:

100101001110101010101010
01010101001010101001010110
1101111001

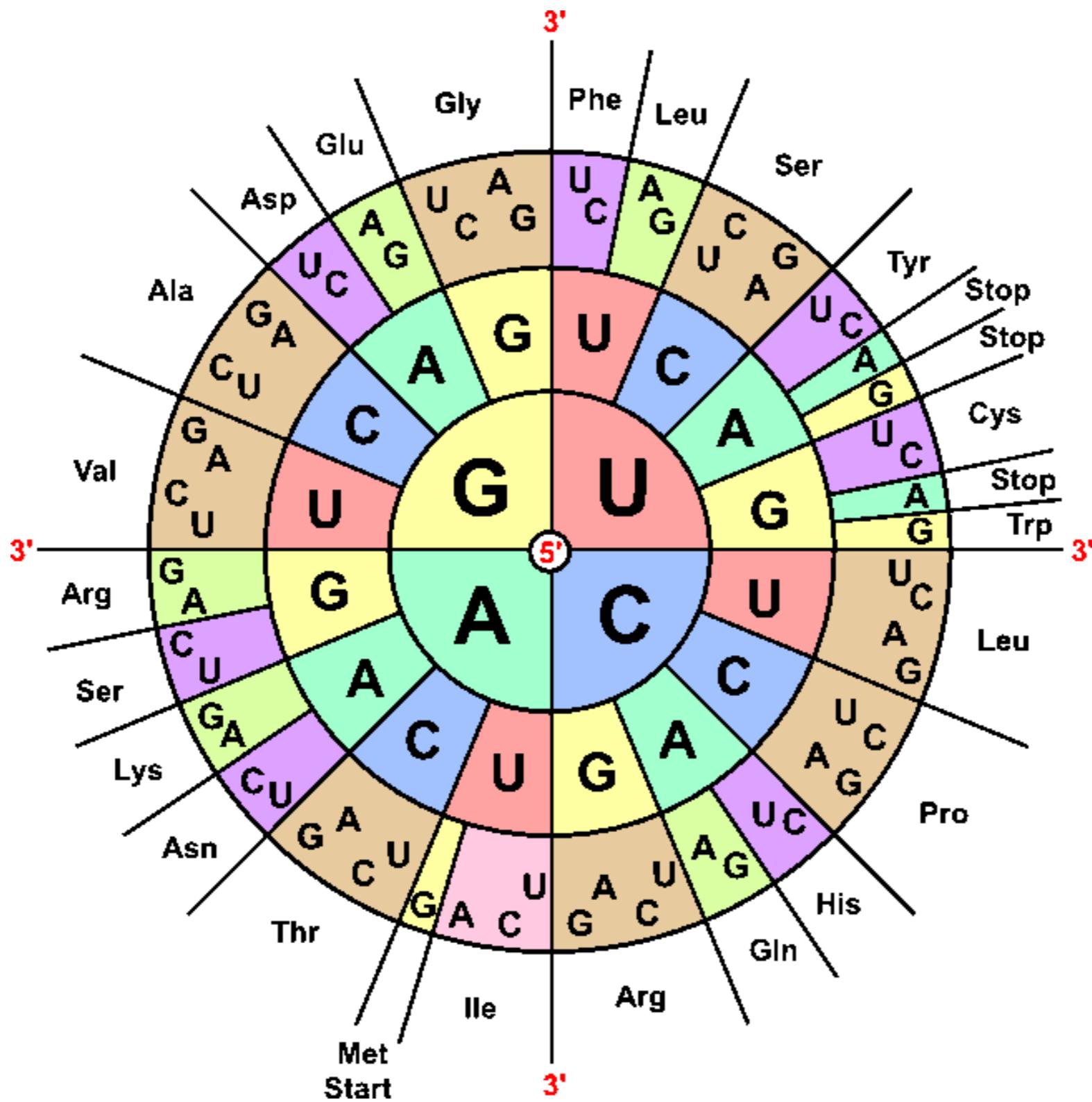


Robert W. Holley, Marshall Nirenberg, Har Gobind Khorana 1968



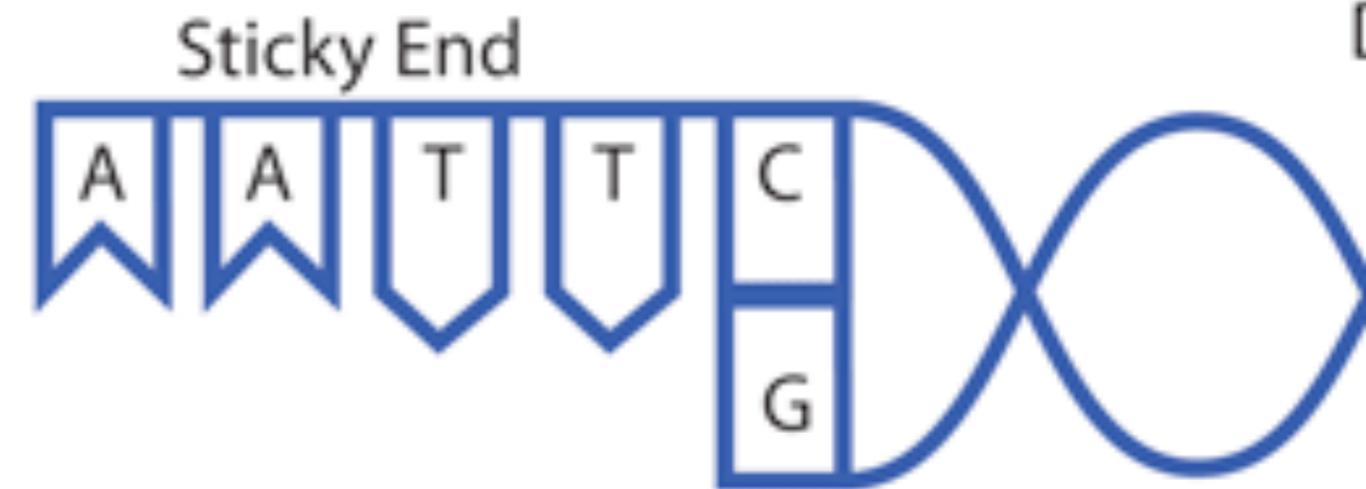


Amino acid rosetta stone

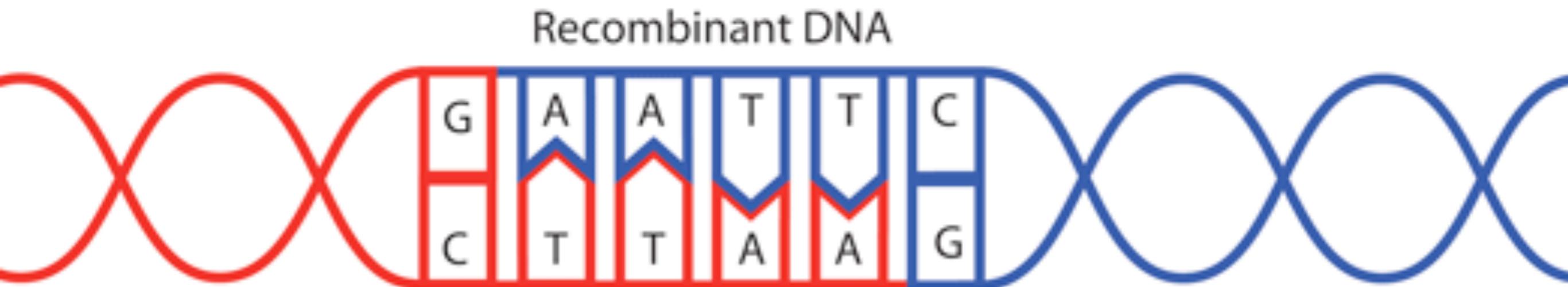




DNA ligase, 1967

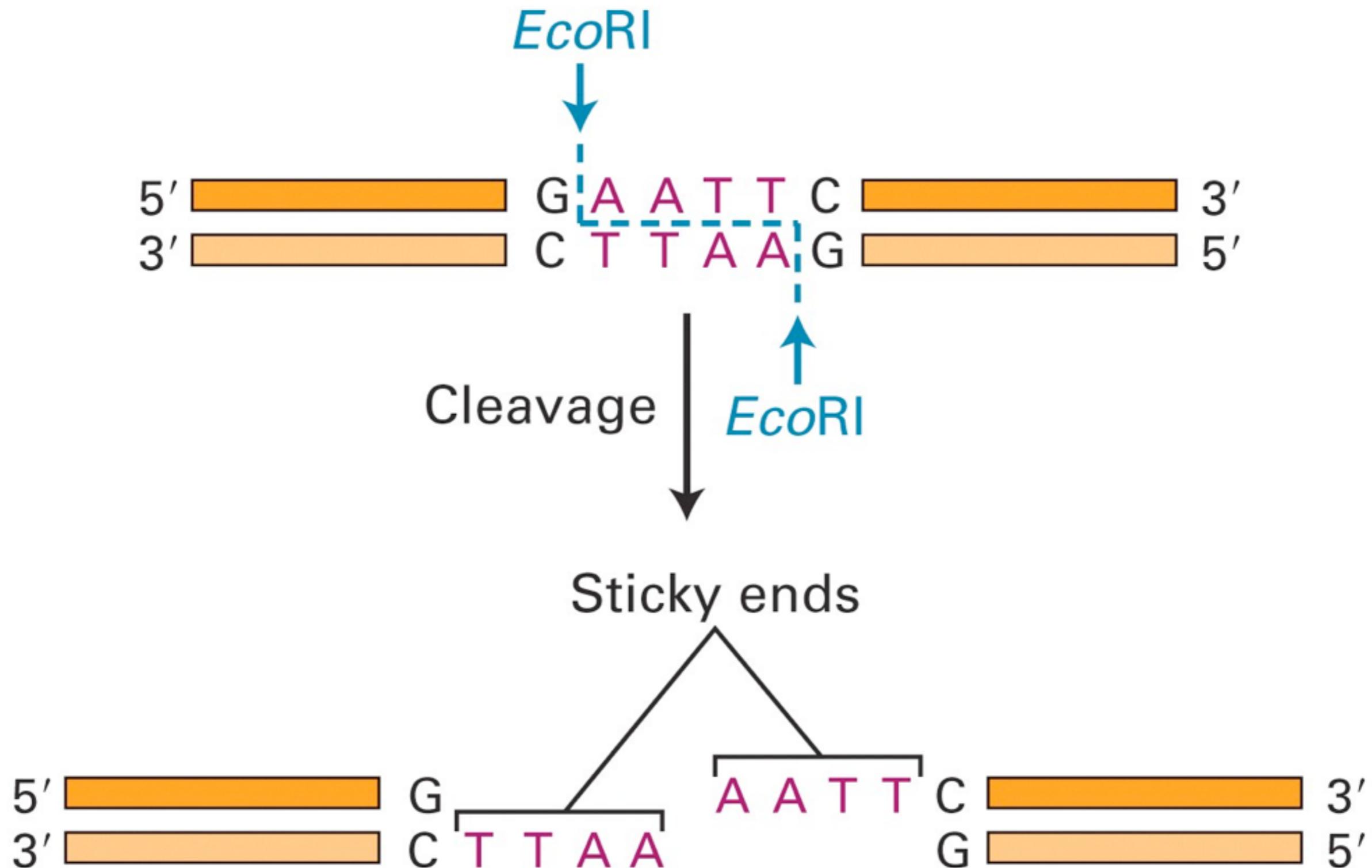


↓
Ligation





Restriction Enzyme 1970





Reading DNA 1977



Courtesy of Dr. F. Sanger, MRC, Cambridge.
Noncommercial, educational use only.

Different-length strands can be lined up by size to determine DNA sequence.

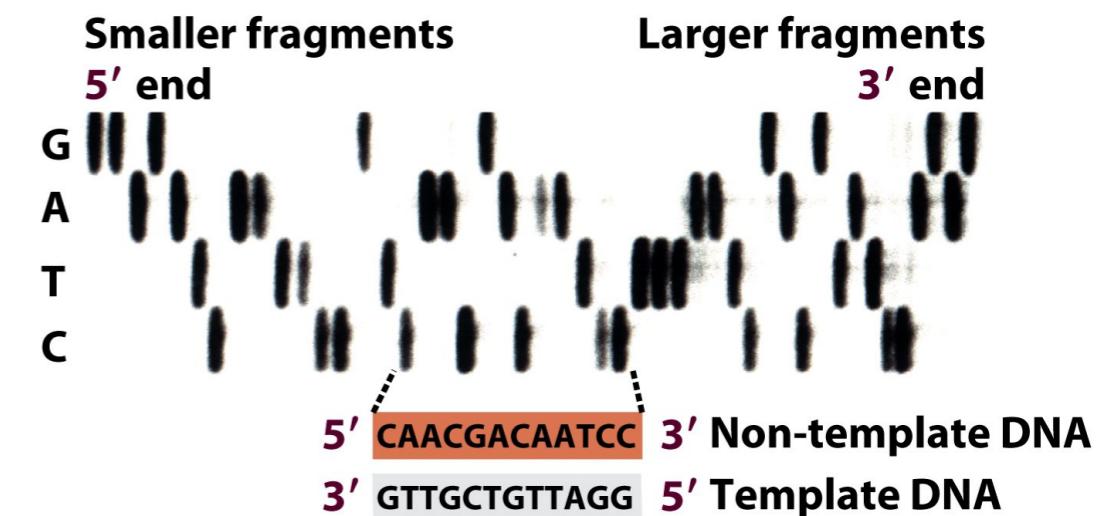
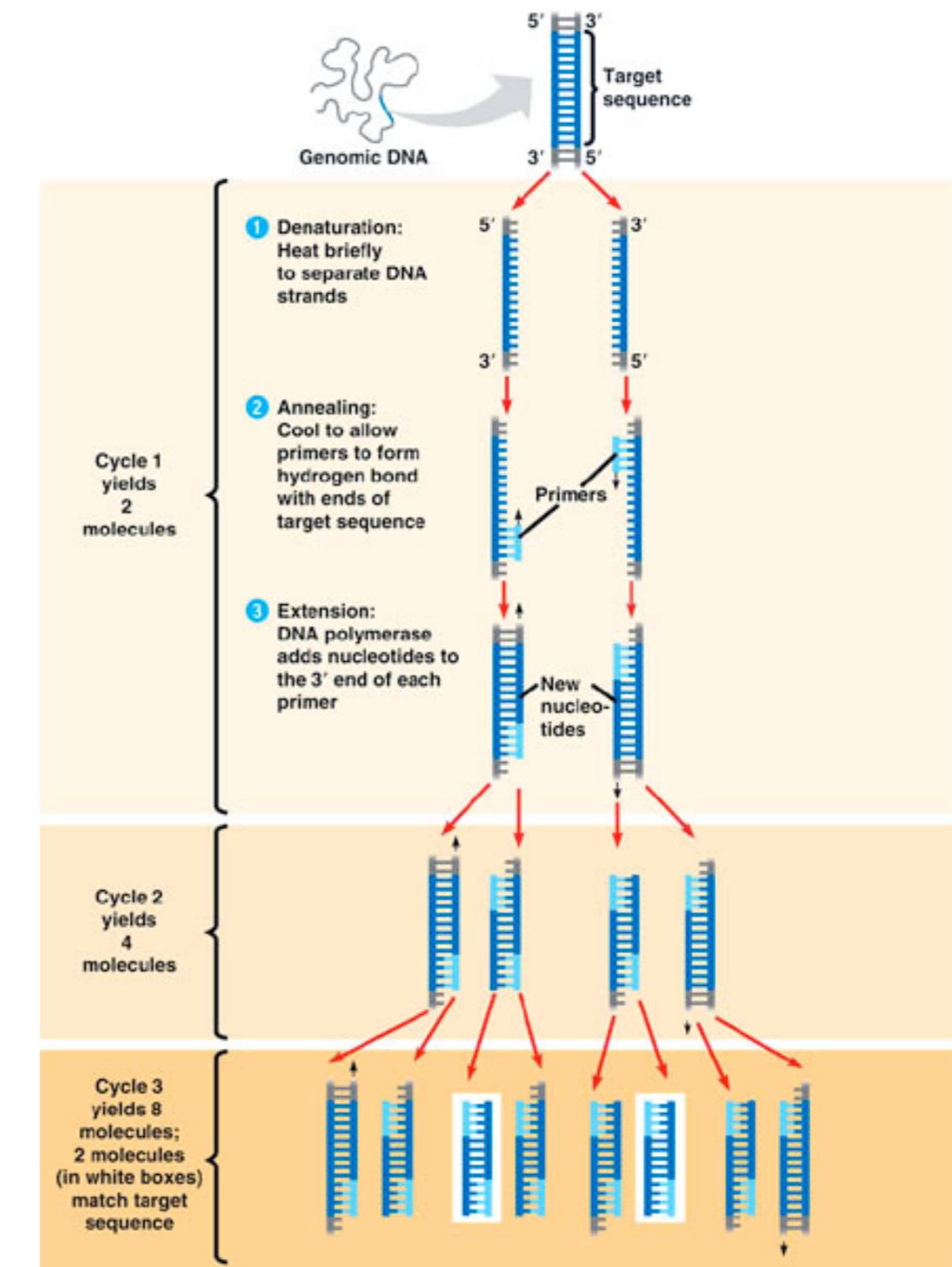


Figure 19-6c Biological Science, 2/e

© 2005 Pearson Prentice Hall, Inc.



Polymerase Chain Reaction, 1983





Reading DNA



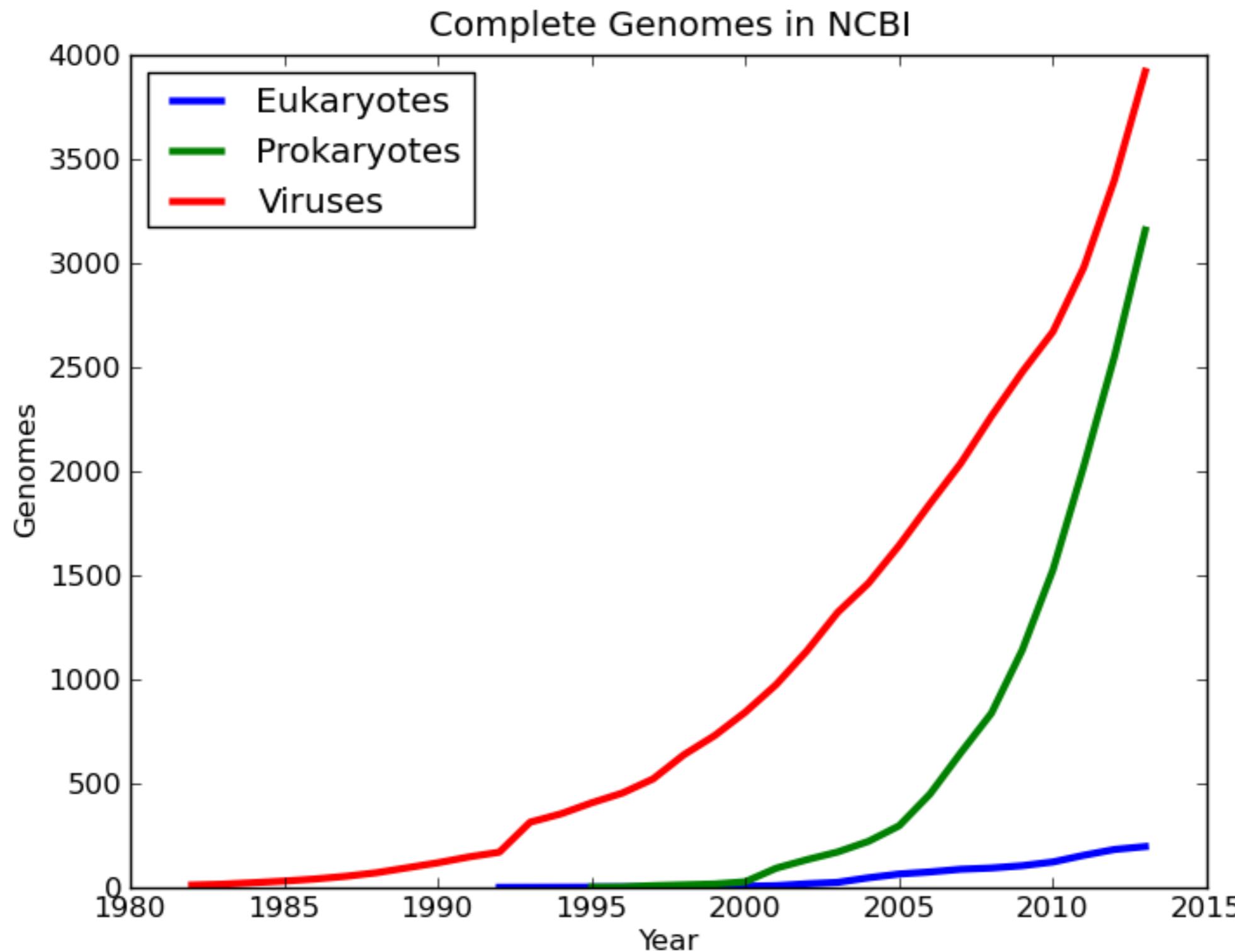


Beijing Genomics Institute





Growth of Genbank

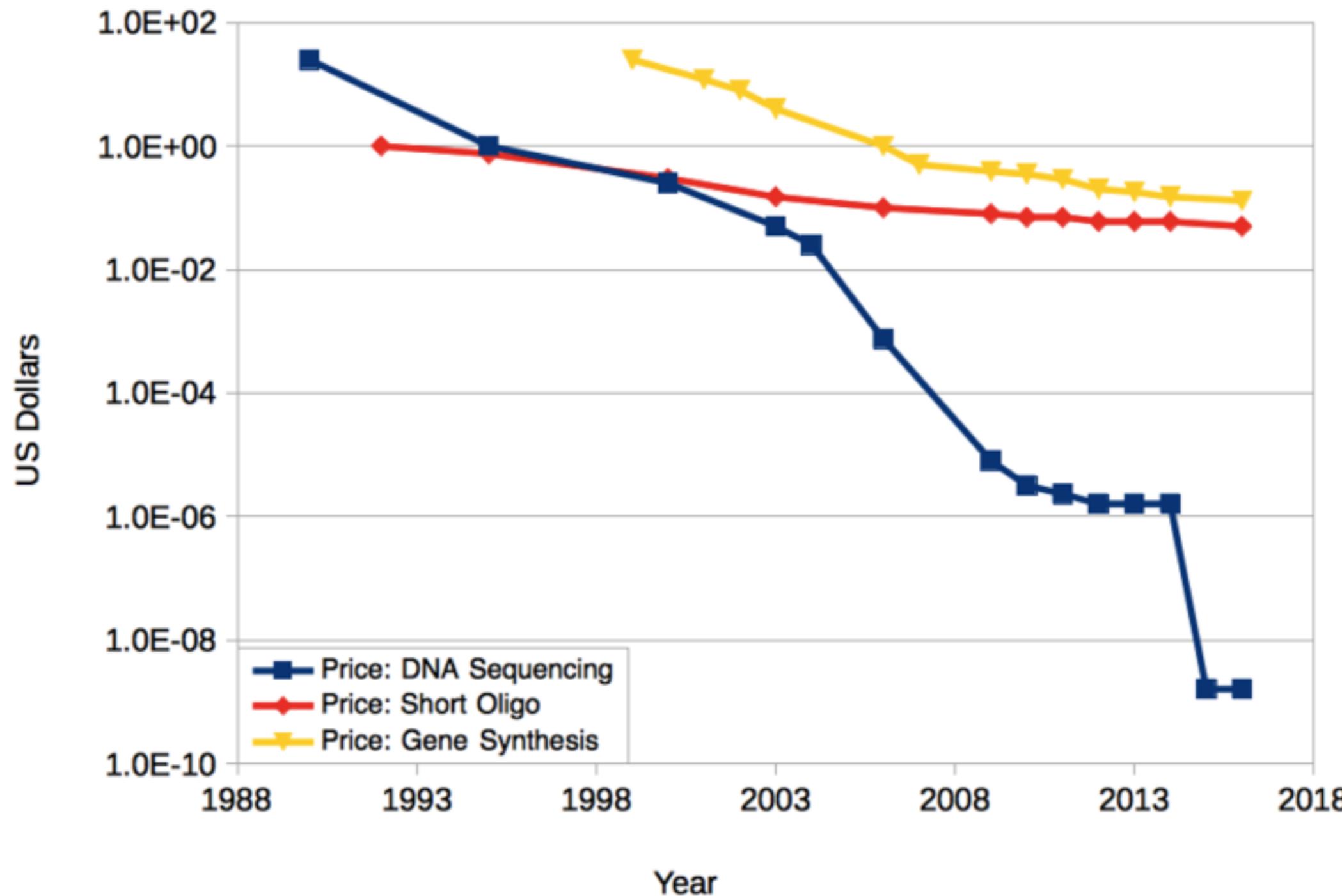




Cost of DNA

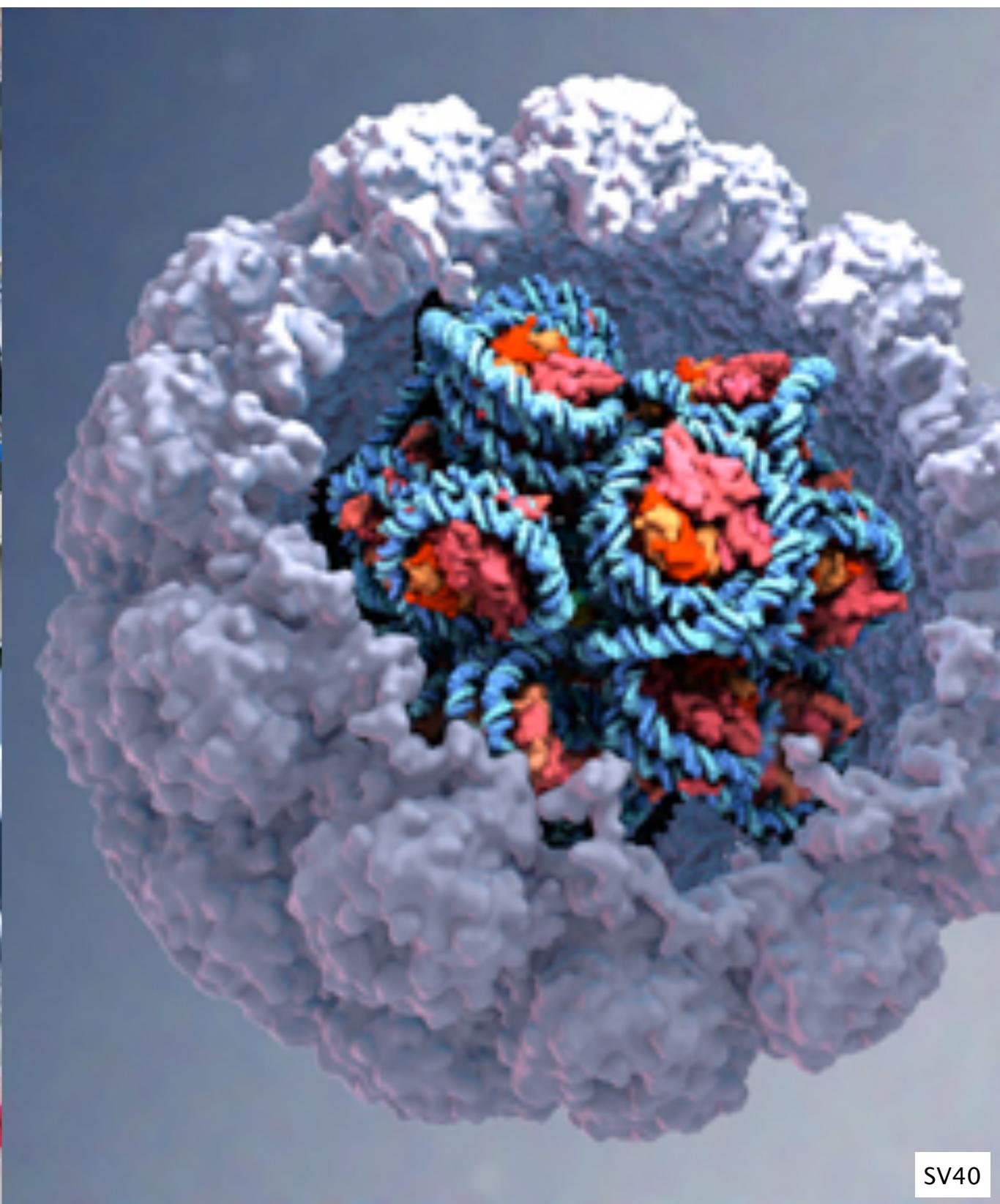
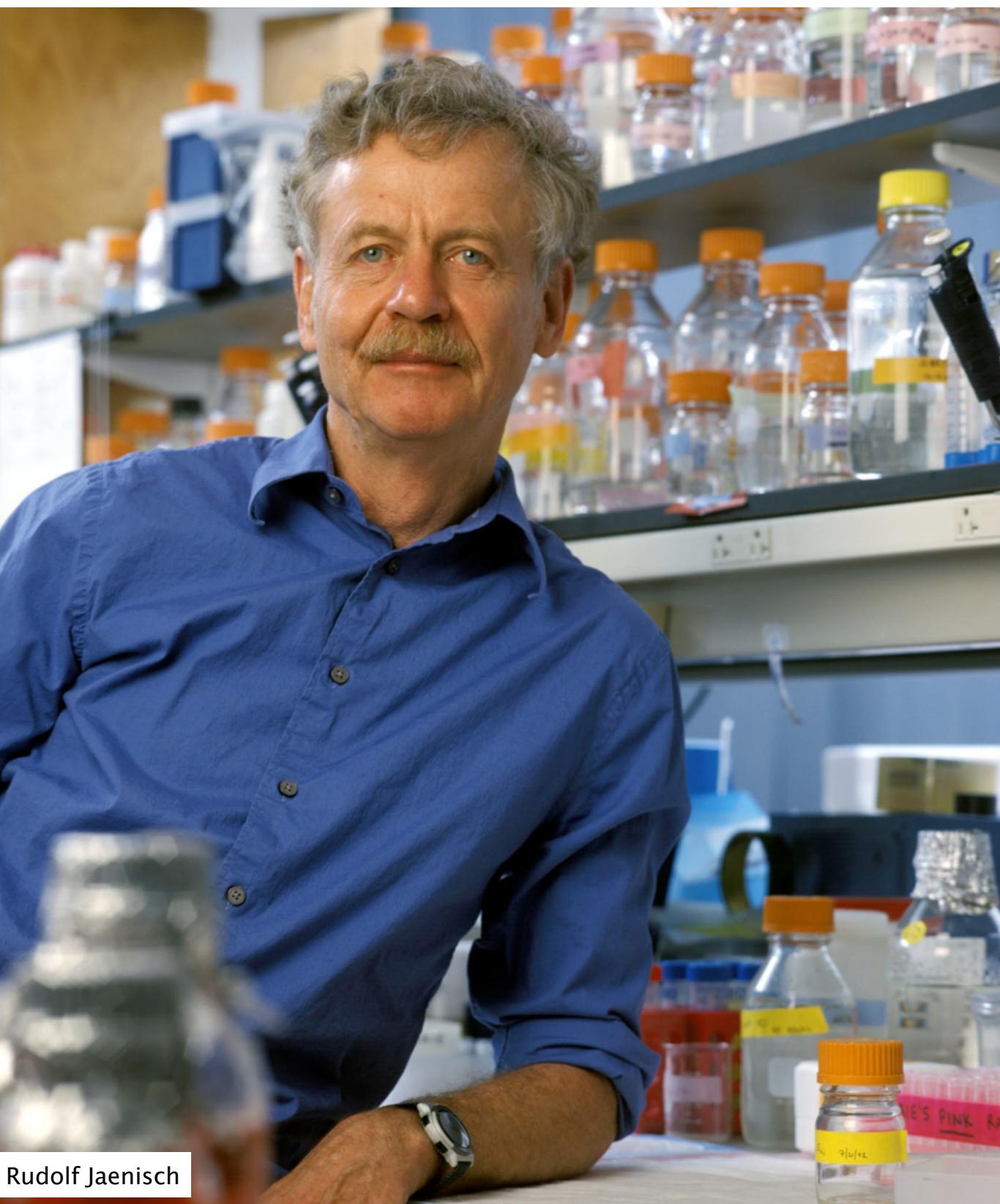
Price Per Base of DNA Sequencing and Synthesis

Rob Carlson, March 2016, www.synthesis.cc





Transgenic Mouse, 1973





Transgenic Plant, 1983

[nature.com](#)[about npg](#)news@nature.com[naturejobs](#)[natureevents](#)[help](#)[site index](#)

nature

[my account](#)[e-alerts](#)[subscribe](#)[register](#)[SEARCH JOURNAL](#) Go

Thursday 20 November 2014

[Journal Home](#)
[Current Issue](#)
[AOP](#)
[Archive](#)[THIS ARTICLE ▾](#)[Download PDF](#)
[References](#)[Export citation](#)
[Export references](#)[Send to a friend](#)[View articles like this](#)[Table of Contents](#)[Previous](#) | [Next >](#)

letters to nature

Nature 304, 184 - 187 (14 July 1983); doi:10.1038/304184a0

A chimaeric antibiotic resistance gene as a selectable marker for plant cell transformation

MICHAEL W. BEVAN^{*}, RICHARD B. FLAVELL^{*} & MARY-DELL CHILTON[†]

^{*}Plant Breeding Institute, Maris Lane, Trumpington, Cambridge CB2 2LQ, UK

[†]Department of Biology, Washington University, St Louis, Missouri 63130, USA

The T-DNA region of *Agrobacterium tumefaciens* tumour-inducing plasmids of the nopaline type¹ contains a gene coding for the enzyme nopaline synthase. This gene is expressed constitutively in host plant cells to which it is transferred during tumour induction². We have exploited the regulatory elements of this gene to construct a chimaeric gene that confers antibiotic resistance on transformed plant cells. The chimaeric gene encodes the expected chimaeric transcripts in plant cells, and confers on transformed cells the ability to grow in the presence of normally lethal levels of the antibiotic G418 (ref. 3). Experiments using *in vitro* transformation techniques on single plant cells indicate that this antibiotic resistance can be used as a selectable marker, and can therefore be used in selecting cells transformed by T-DNA vectors that have had the genes for hormone autotrophy deleted⁴. Plant cells transformed by such 'disarmed' T-DNA vectors can be regenerated into entire plants, whose sexual progeny contain unaltered copies of the inciting T-DNA⁵. The availability of this dominant selectable marker should allow a wider range of experiments to be undertaken using different host plants.

References

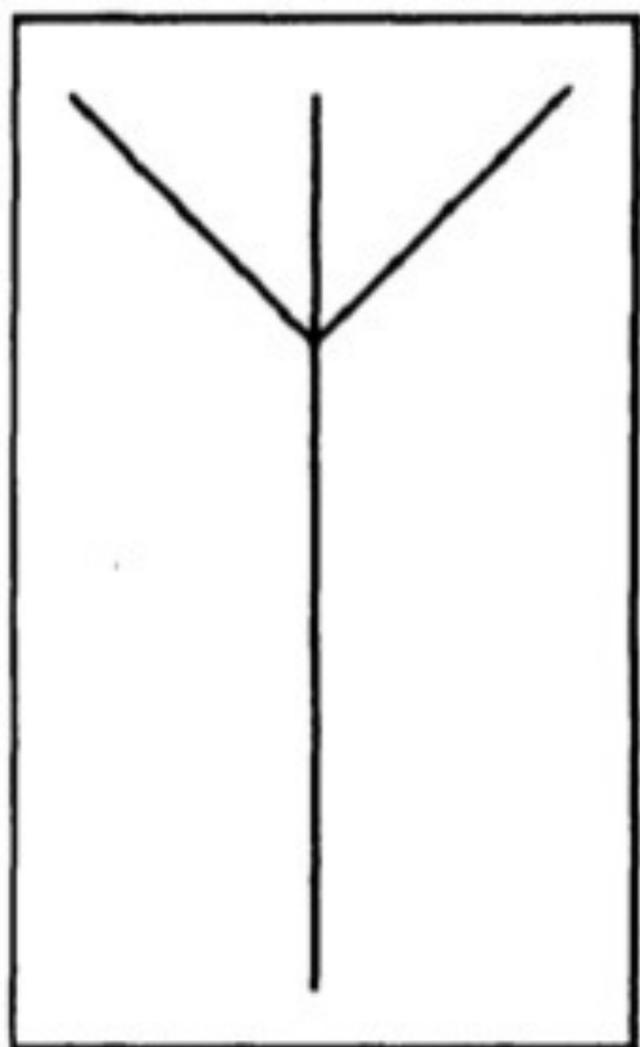


Oncogene mouse, Phil Leder, Tim Stewart 1984





Joe Davis, 1987



10101
01110
00100
00100
00100
00100
00100



CCCCCCCAACGCGCGCGCT

FIG. 1 Microvenus icon.



Bull Herman, Leiden 1990





Life finds a way, Jurassic Park 1993





Dolly the Sheep, Edinburgh 1996





Eduardo Kac – GFP Bunny, 2000





Science turned into technology

EXTREME SNAP CIRCUITS™

BUILD OVER 150 EXCITING PROJECTS

Contains over 80 pieces!
Create your own experiments!

Includes over 50 computer interfaced experiments

AGE 8 - 108

4 "AA" Batteries Required

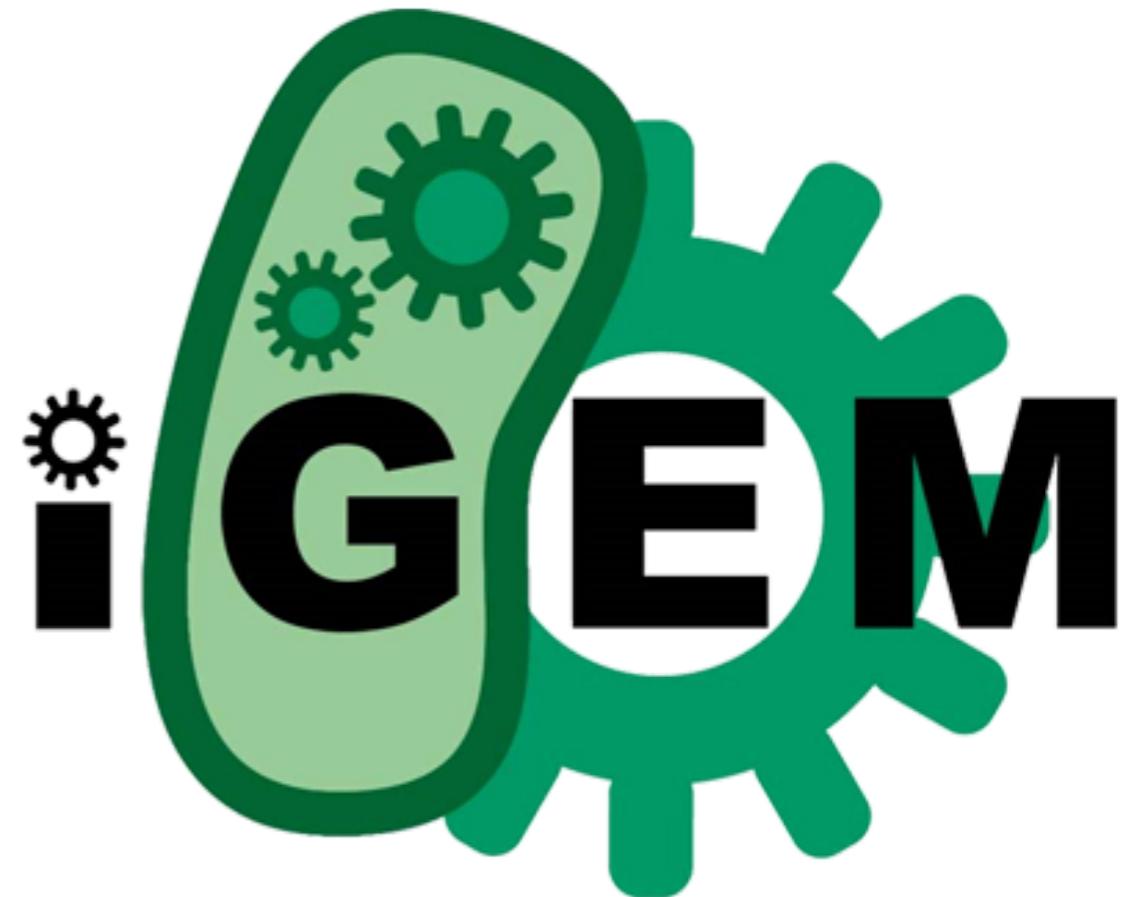
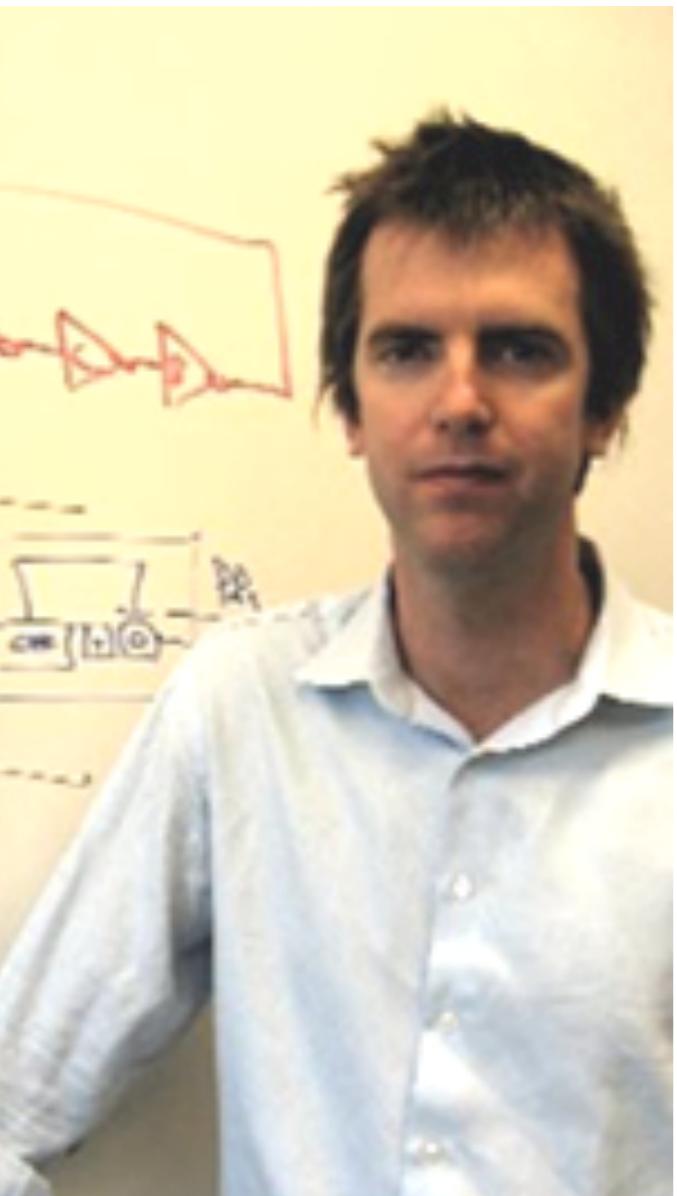
Computer Not Included

Have fun learning all about electronics

Dr. Toy 100 BEST Children's Products WINNER

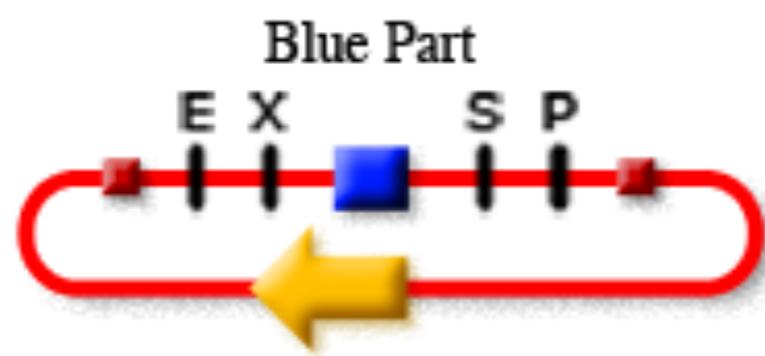


Drew Andy, Tom Knight

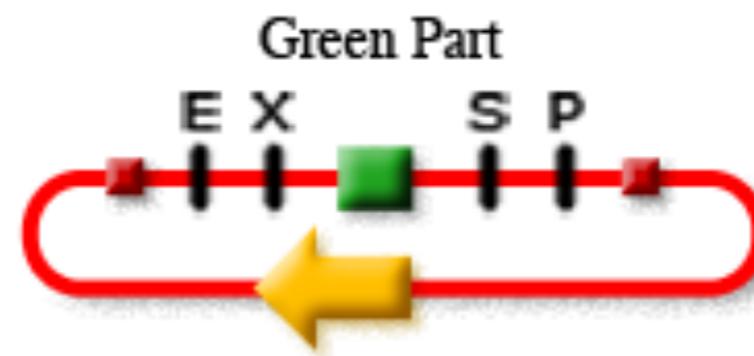




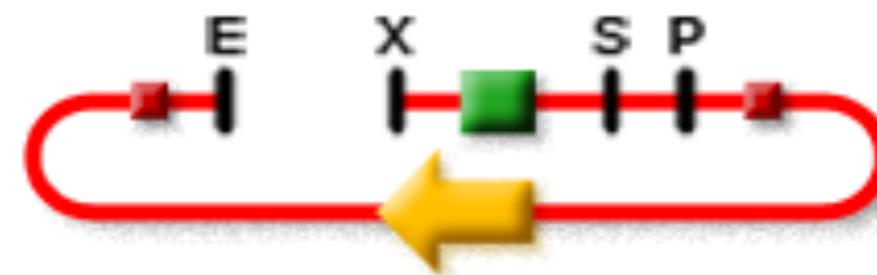
Biobrick standard 2003



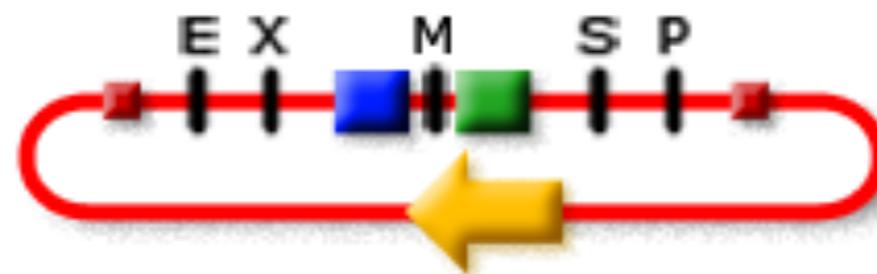
Cut with
EcoRI and SpeI



Cut with
EcoRI and XbaI



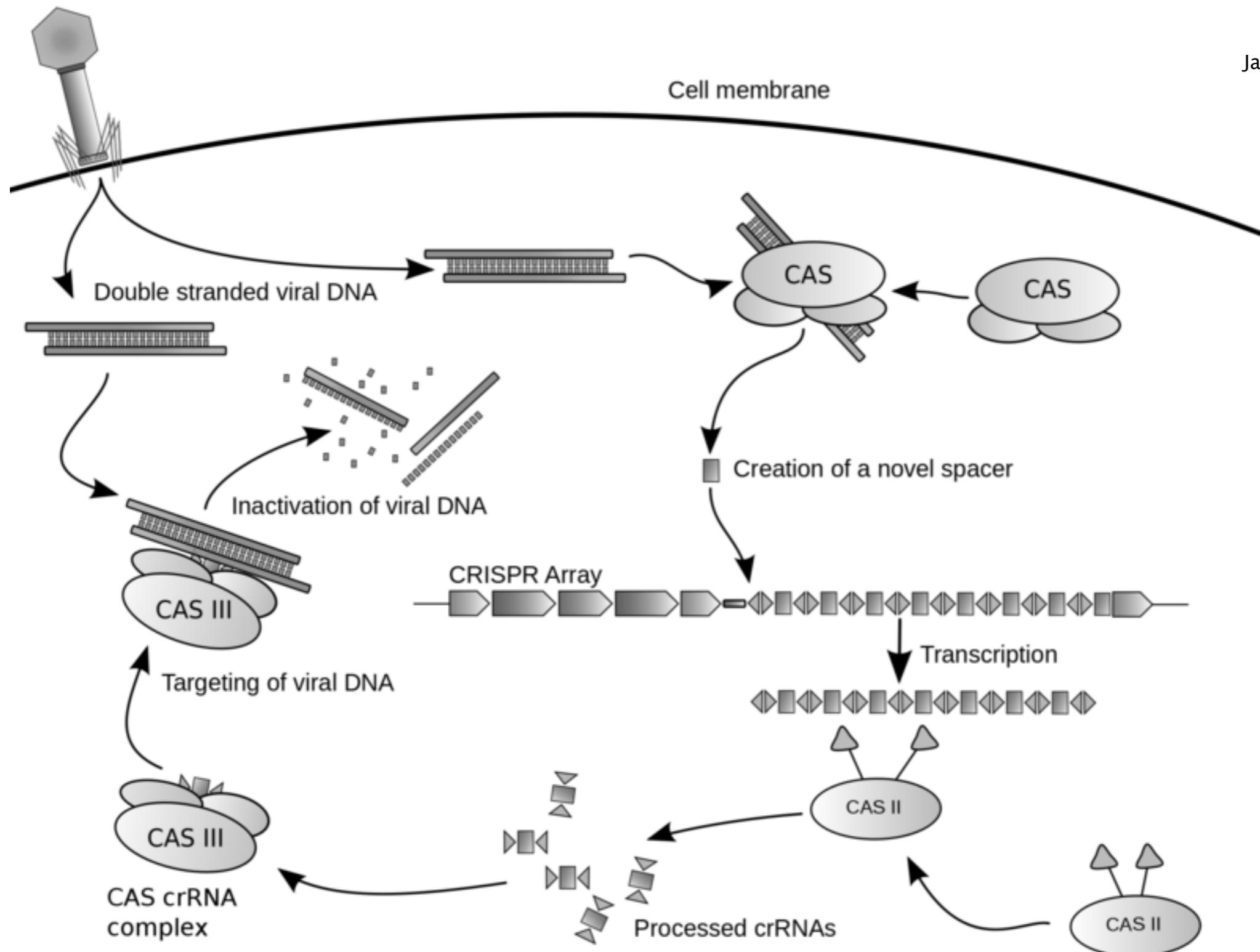
Mix and Ligate
(Blue-Green Part)





CRISPR – Cas9

James Atmos - CC-BY-SA 3.0





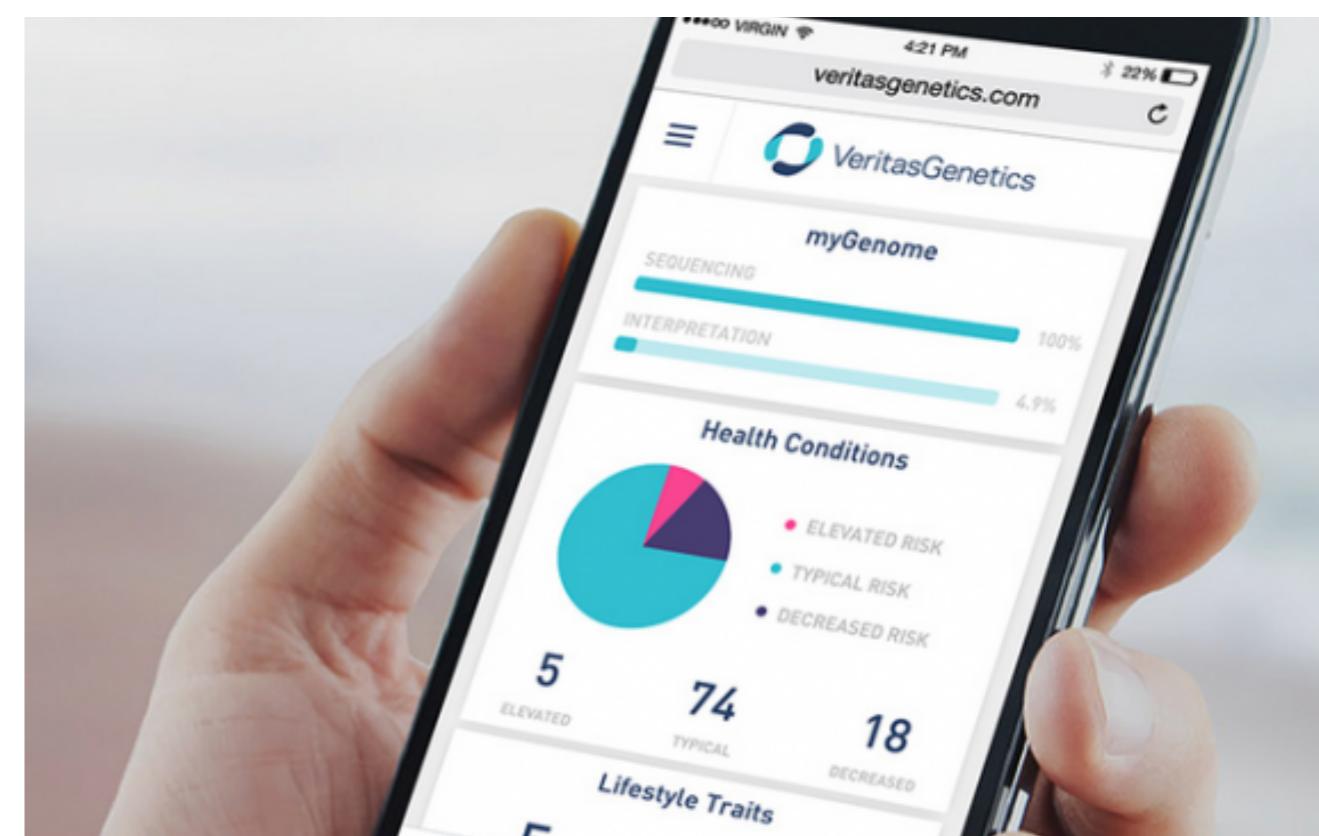
Labs as a service



23andMe



Personal Genome Project





Center for Postnatural History – Rich Pell





Conclusions

- Biology:
 - No longer framed by the possible
 - Transformed from observation to engineering
 - Changing:
 - Value chains
 - Business models
 - Design process



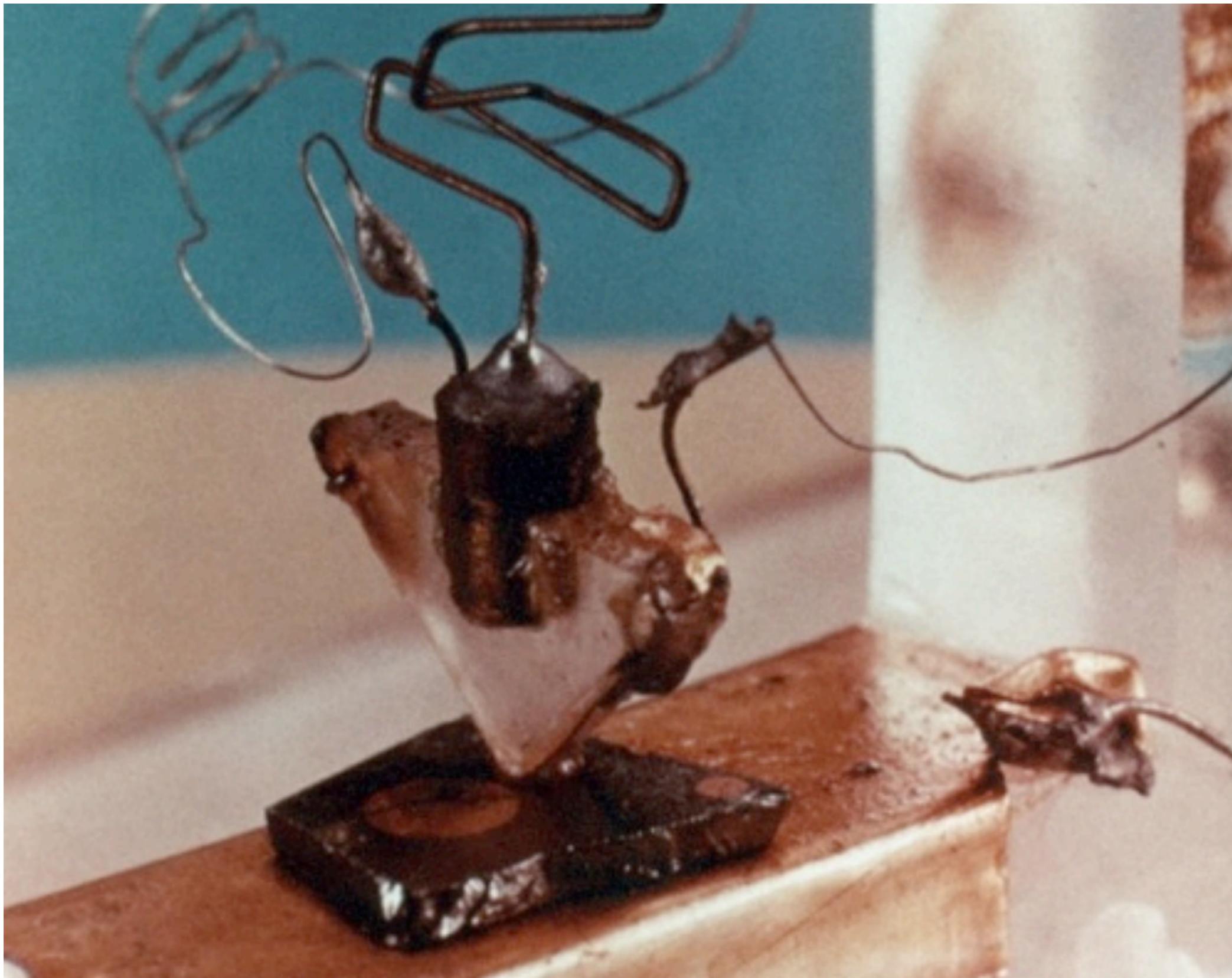
waag society

institute for art, science and technology

Biology & hacking

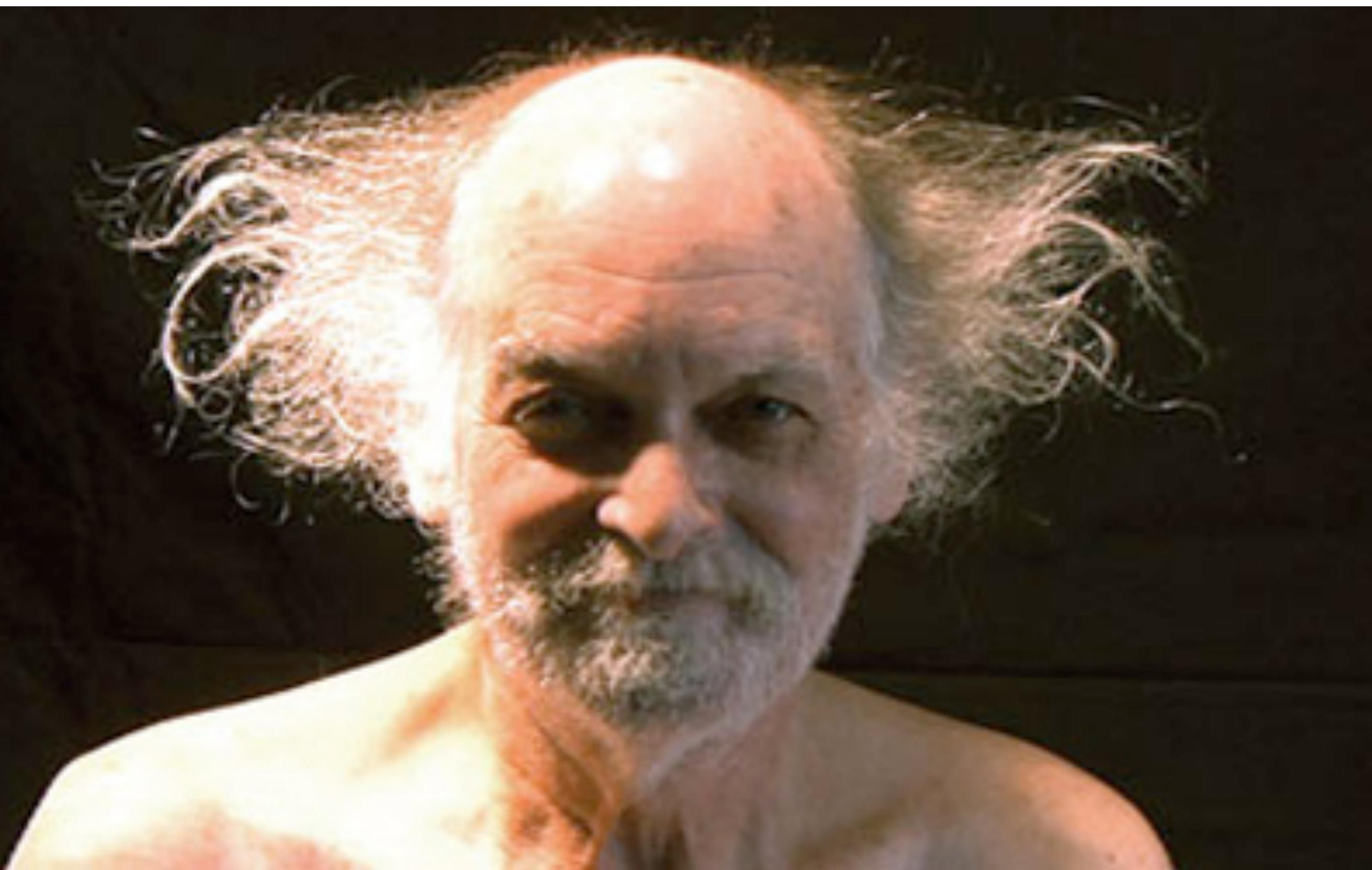


Inspiration & justification





Joe Davis





Critical Art Ensemble – Free Range Grain 2003



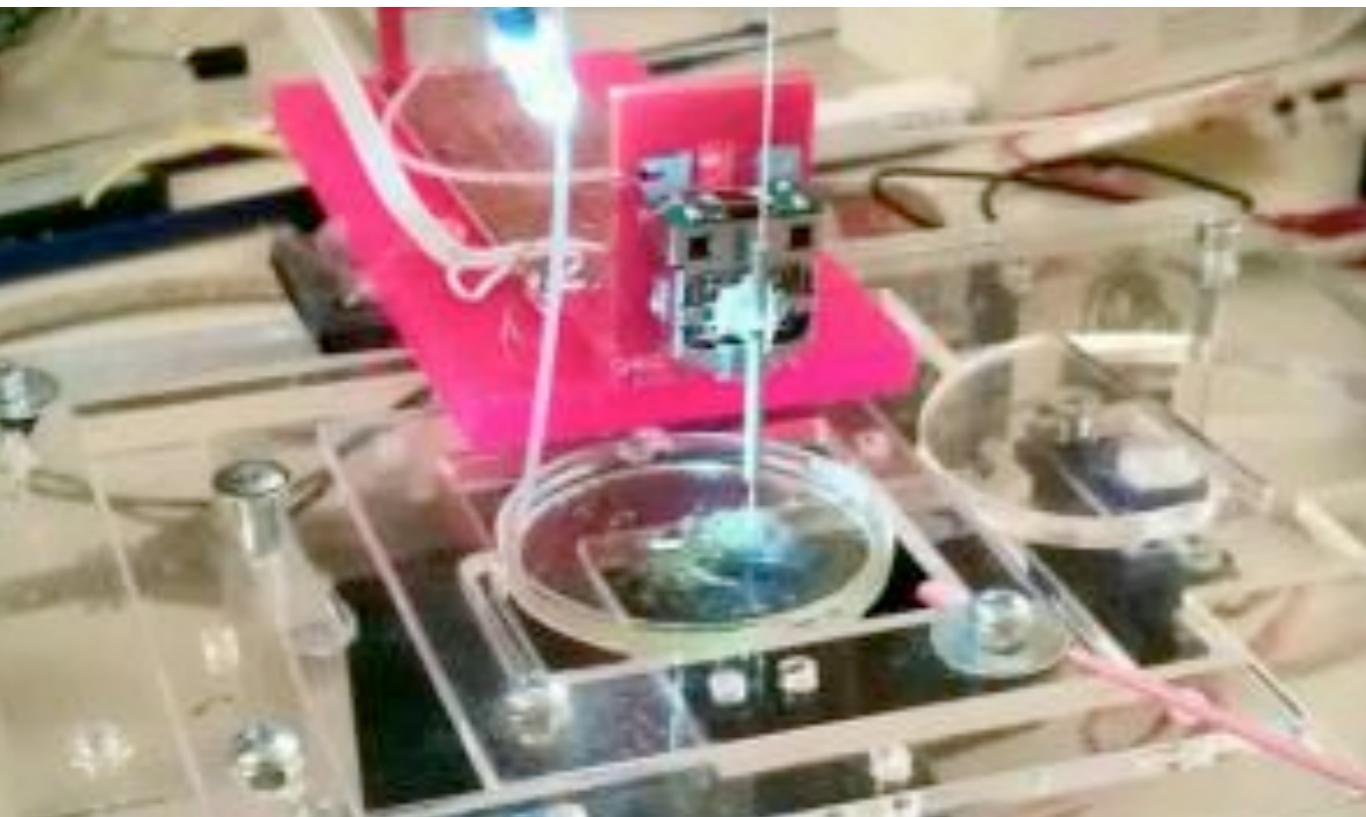


DIYBio 2008

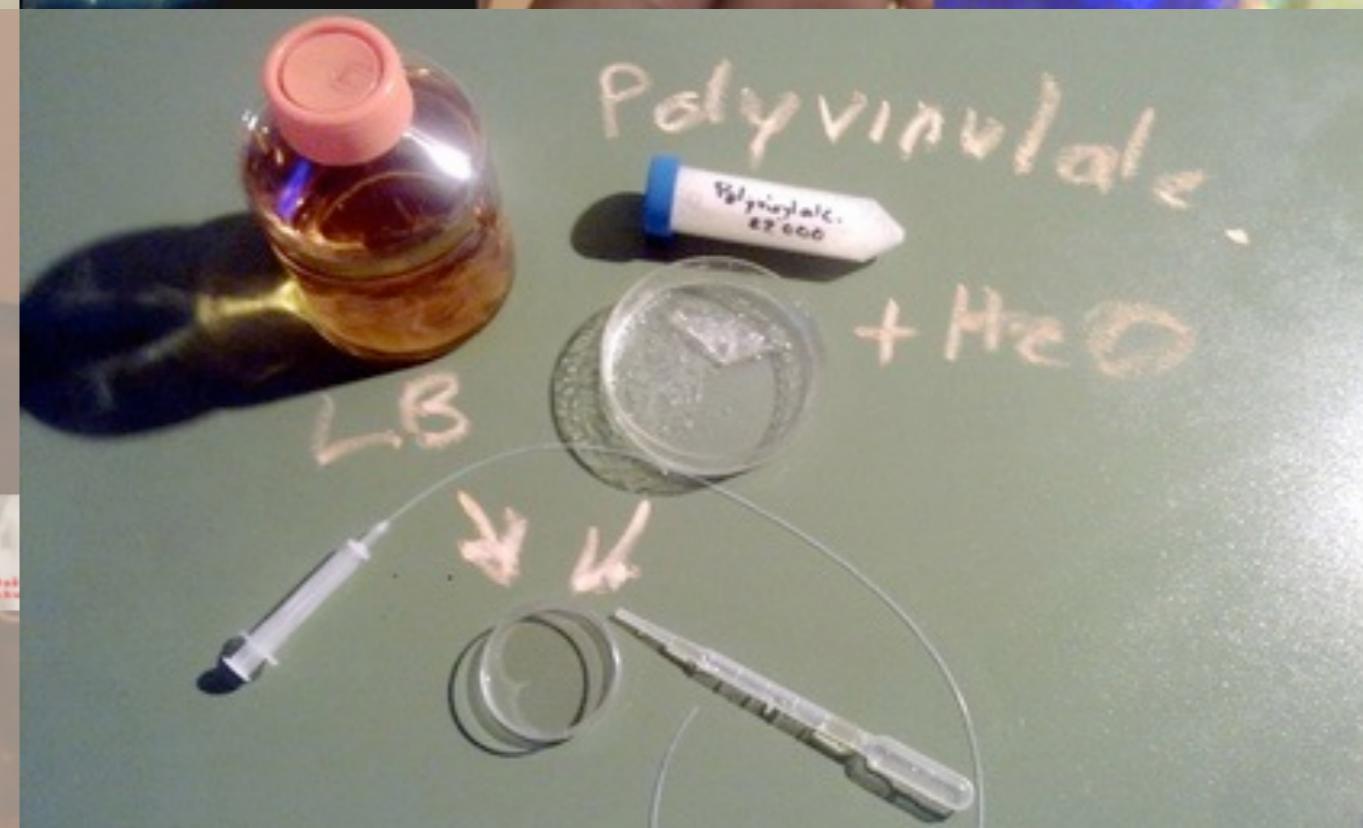




Hackteria, 2009



Biology|LifeSciences|Biotechnology





Paul Vanouse 2009





Kay Aull



Ellen Jorgensen - Genspace 2010





Meredith Patterson

Biopunk Manifesto 2011

“we assert that the right of freedom of inquiry, to do research and pursue understanding under one's own direction, is as fundamental a right as that of free speech or freedom of religion”



Cathal Garvey, Ireland 2012

Doing Biotech in My Bedroom

A new generation of biologists embraces the do-it-yourself ethic of computer programming.

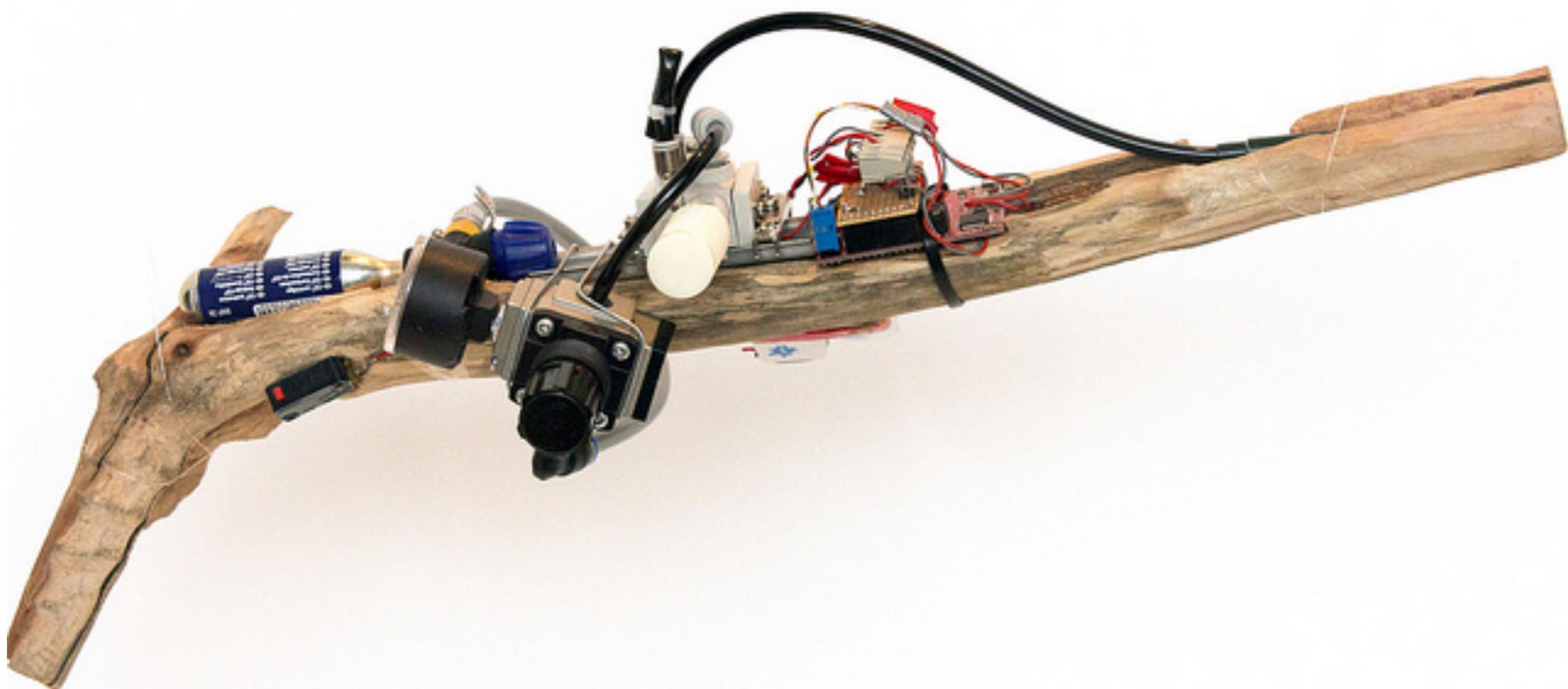
By Antonio Regalado on February 14, 2012

[View full report](#) ➔ [Download](#) ➔ [Purchase a print copy](#) ➔





DIY GeneGun 2012





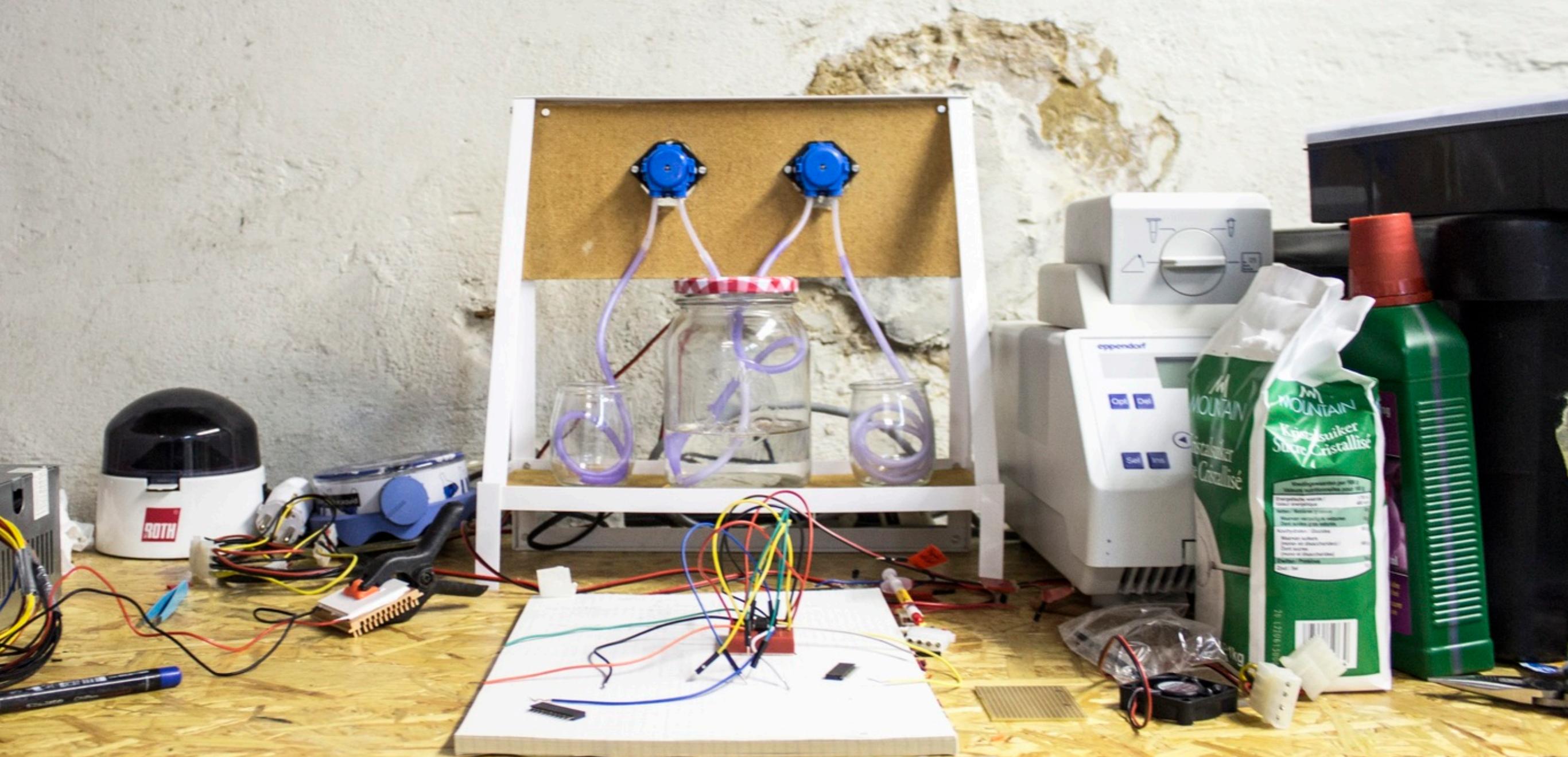
Labs everywhere - diybio.org/local

EUROPE

Amsterdam	NL	http://www.meetup.com/Dutch-DIY-Bio/
Barcelona	ES	http://www.diybcn.org/
Berlin	DE	https://www.biotinkering-berlin.de/
Brussels	BE	http://www.openbiolab.be/
Budapest	HU	http://biodisplay.tyrell.hu/
Cambridge	UK	https://biomake.space/
Copenhagen	DK	http://biologigaragen.org/
Cork	IE	https://groups.google.com/forum/#!forum/diybio-ireland
Eindhoven	NL	http://bioartlab.com/
Geneva	CH	http://bioscope.ch/
Ghent	BE	http://reagentlab.org/
Graz	AT	https://www.facebook.com/OpenBioLabGraz
Groningen	NL	http://www.diybiogroningen.org
Heidelberg	DE	http://www.biotox-heidelberg.de
Kiev	UA	https://groups.google.com/forum/#!forum/diybio-kiev
Lausanne	CH	http://www.eprouvette.ch
Lausanne/Renens	CH	http://wiki.hackuarium.ch/w/Main_Page
London	UK	https://biohackspace.org/
London	UK	https://london.hackspace.org.uk/
London	UK	http://www.meetup.com/BioChanges/
Manchester	UK	http://diybio.madlab.org.uk/
Maribor	SI	http://irnas.eu/symbiolab.html
Moscow	RU	http://vk.com/biohax
Munich	DE	http://biogarage.de/
Namur	BE	http://www.diybio.be/
Nottingham	UK	http://opengenx.wordpress.com/
Paris	FR	http://www.lapaillasse.org/
Prague	CZ	http://brmlab.cz/project/biolab
Stockholm	SE	http://www.bionyfiken.se/
Switzerland / Slovenia	CH	http://hackteria.org/
Trento	IT	http://www.openwetlab.org/
Turin	IT	http://www.facebook.com/be.into.7



reagentlab.org - DIY bioreactor





Open Biolab Graz – BSL1



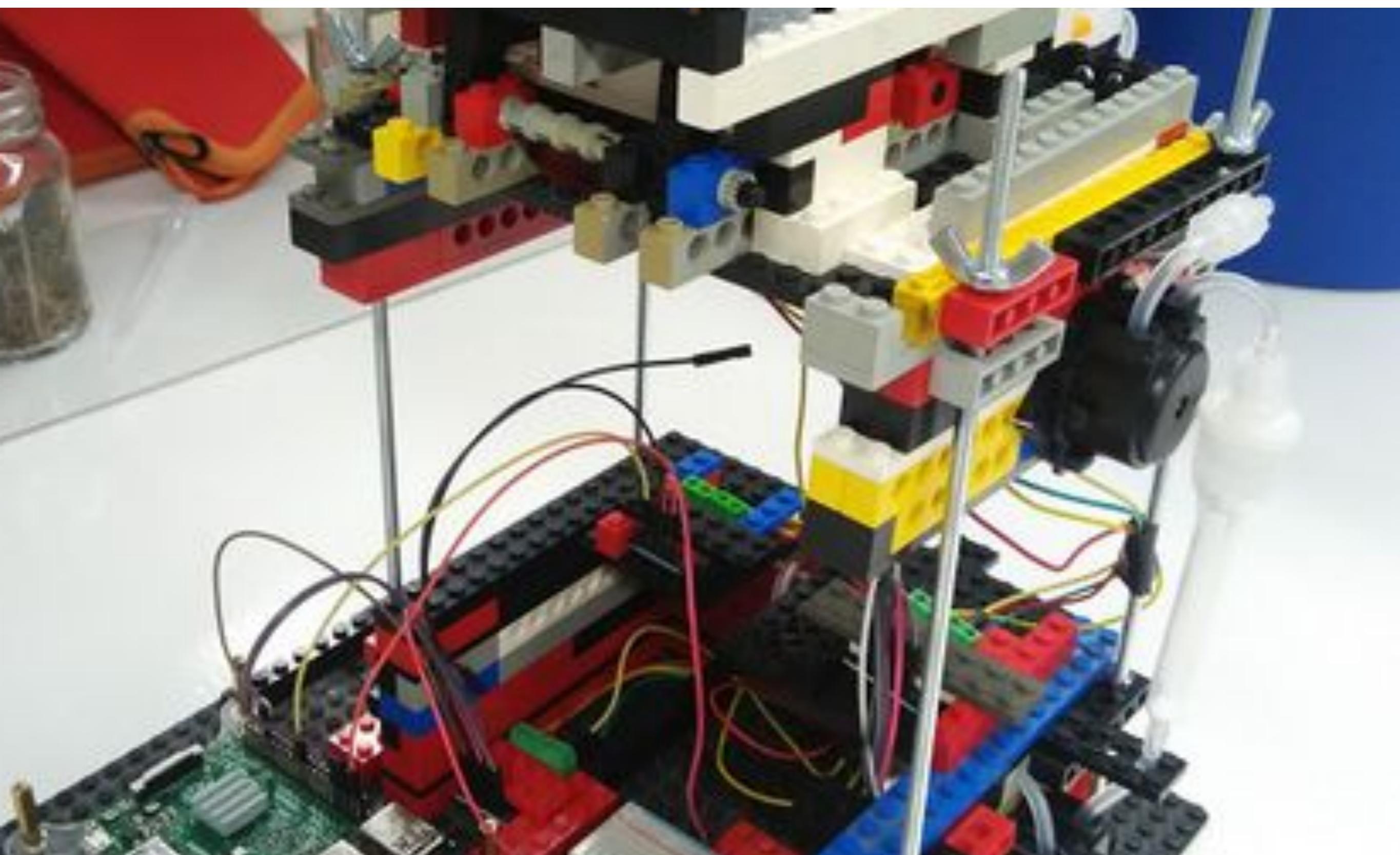


BeerDeCoded - Hackuarium



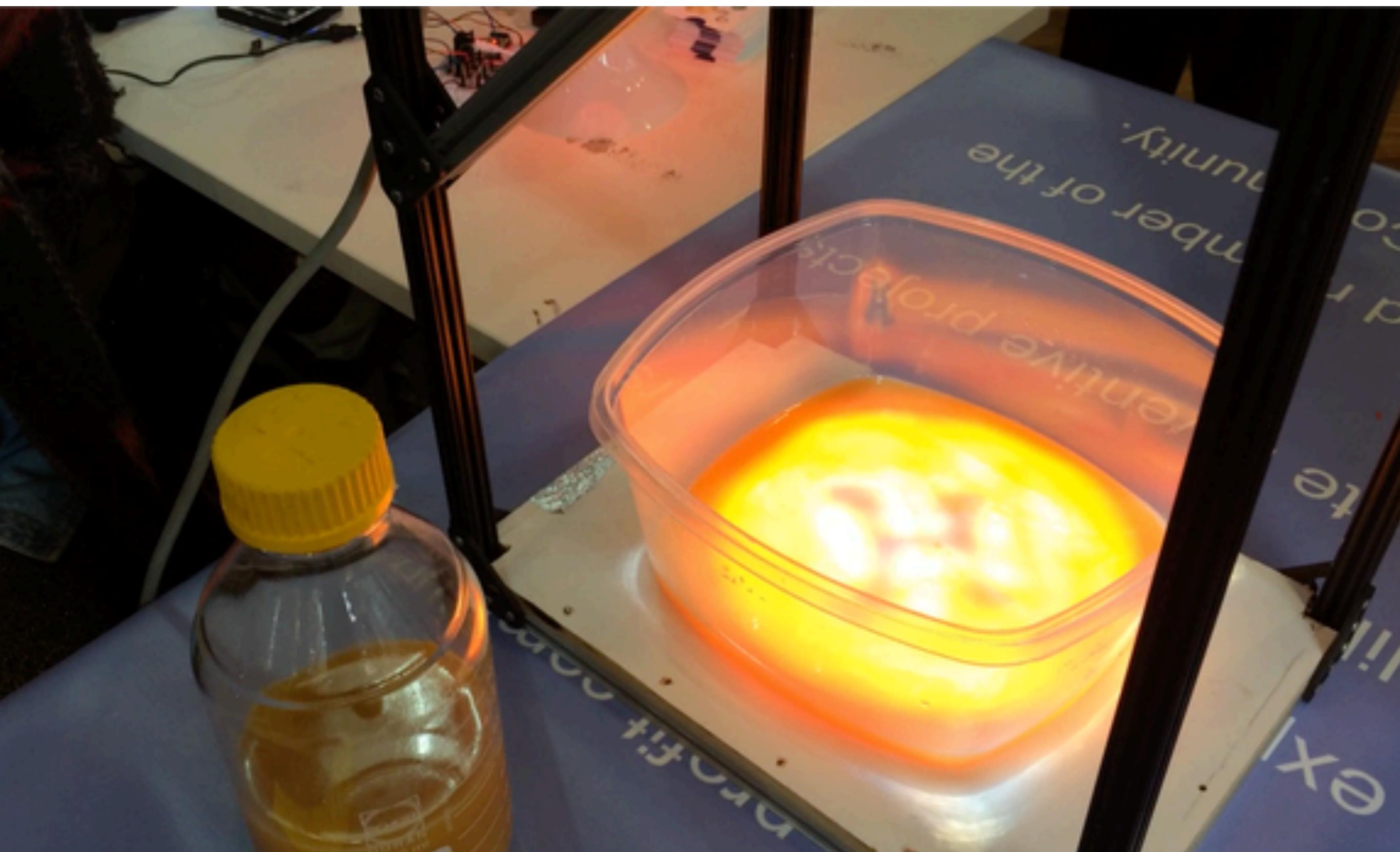


Protein purification - Hackuarium



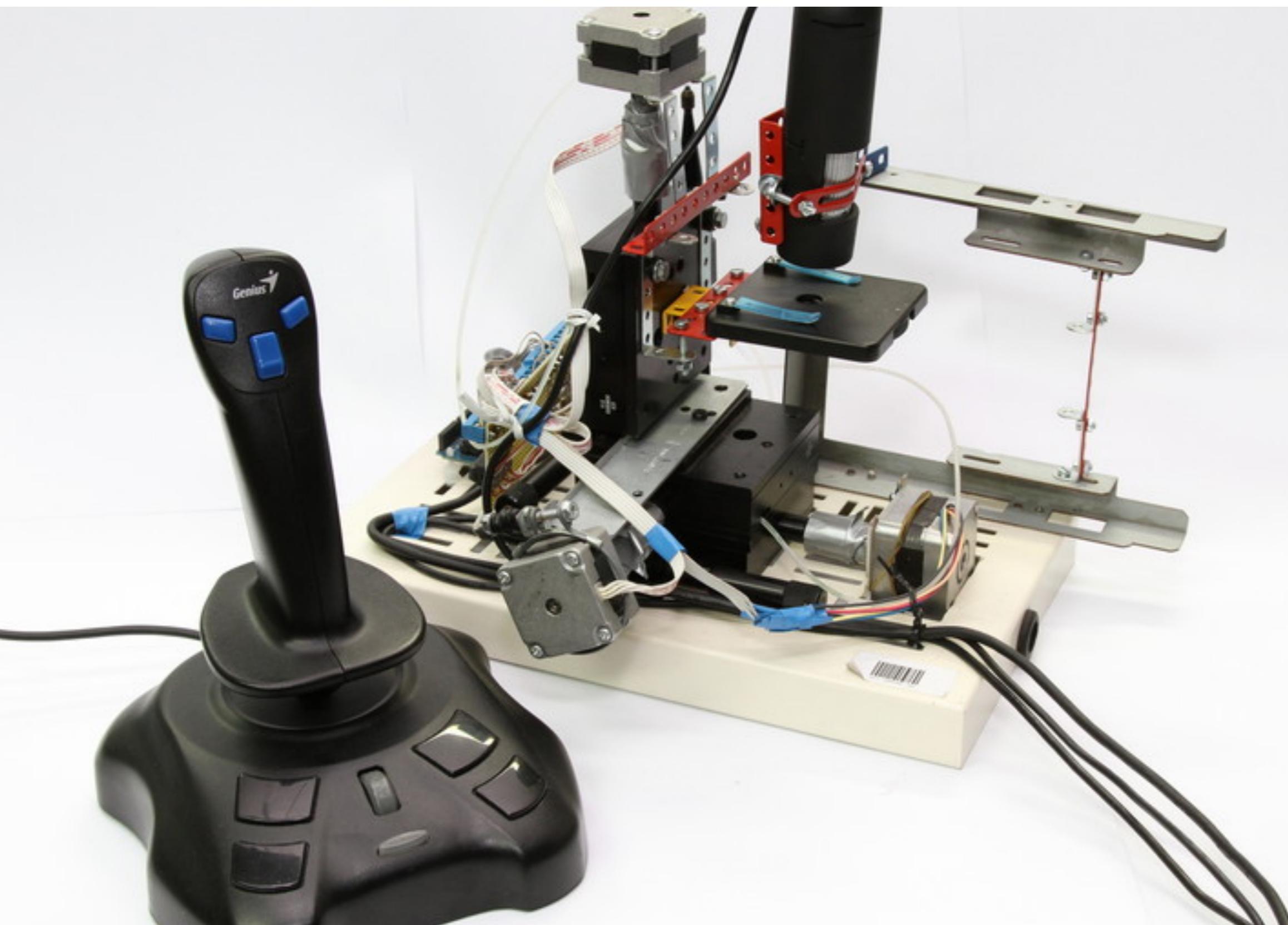


Juicyprint - London Biohack Space





BRMScopes – BRMLab





NFC implants - Bionyfiken



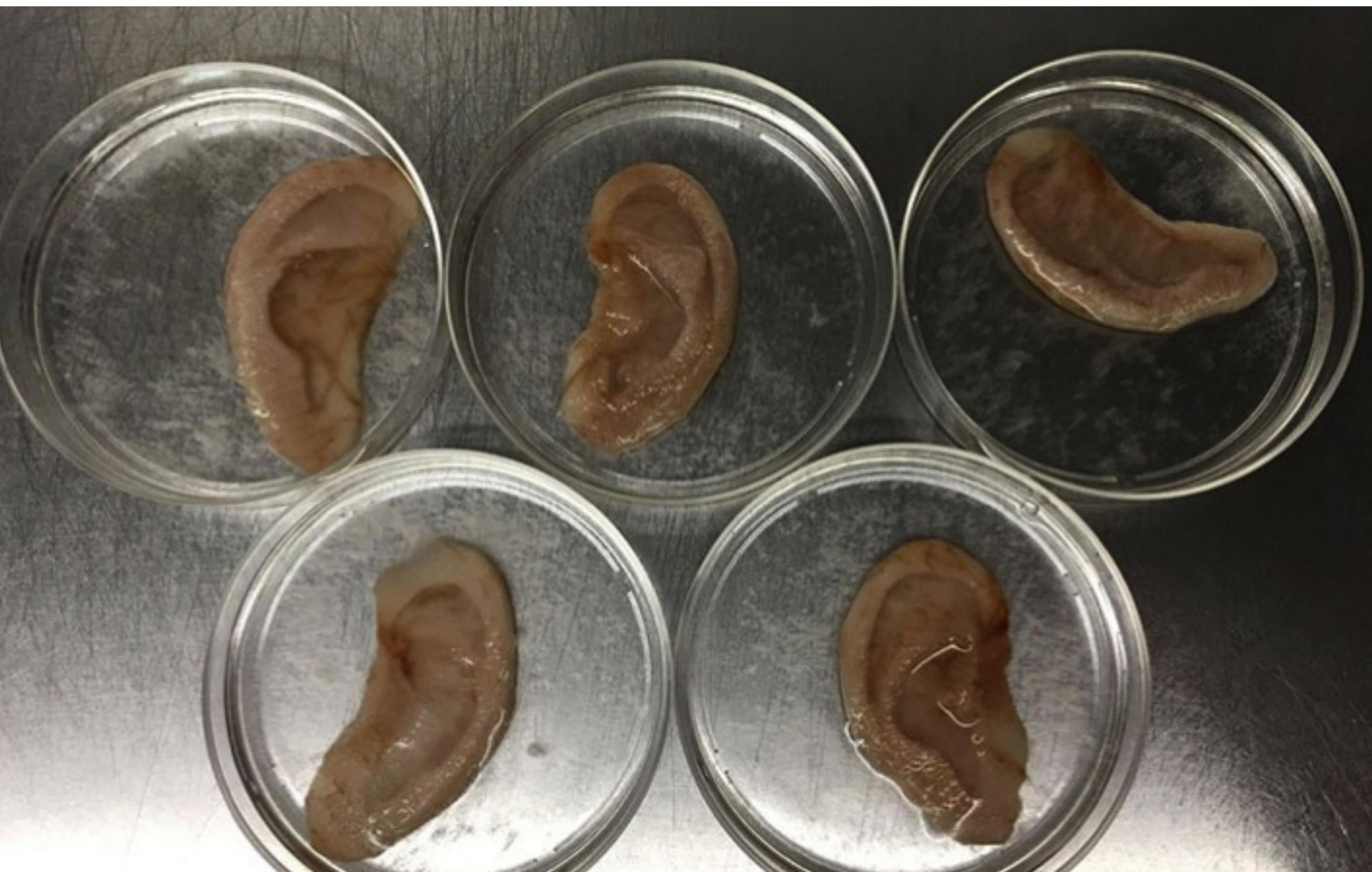


Duckweed - Hackteria





Apple Ears – Andrew Telling





Ontology

- Biohacking / DIYBio is a mix of:
 - 1960 Do It Yourself culture
 - 1980 Open Source movement
 - 1995 Internet powered Citizen science
 - 2003 Synthetic biology



waag society

institute for art, science and technology

Online communities

Biohack spaces as
distributed knowledge hubs



Networks

- hackteria.org
kitchen mailing list:
 - <http://lists.hackteria.org/cgi-bin/mailman/listinfo>
- biohacklabs.org
European biohacker list:
 - <http://www.biohacklabs.org/Europe>
 - List of labs:
 - [http://www.biohacklabs.org/List](http://www.biohacklabs.org>List)
- diybio.org
International mailing list:
 - <https://groups.google.com/d/forum/diybio>
- Facebook



Events

- Announced on the mailing lists
 - Hackteria Lab
 - CCC Hamburg
 - Pixelache Helsinki
 - OuiShare





waag society

institute for art, science and technology

Market & non-market rationales

“Do it without”: pharma, agrotech

vs

Bio innovation



OpenPCR 2010

KICKSTARTER

Discover

Start

Search projects

Sign up Log in

OpenPCR - open source biotech on your desktop

by <http://OpenPCR.org> -- Tito and Josh

Home

Updates 11

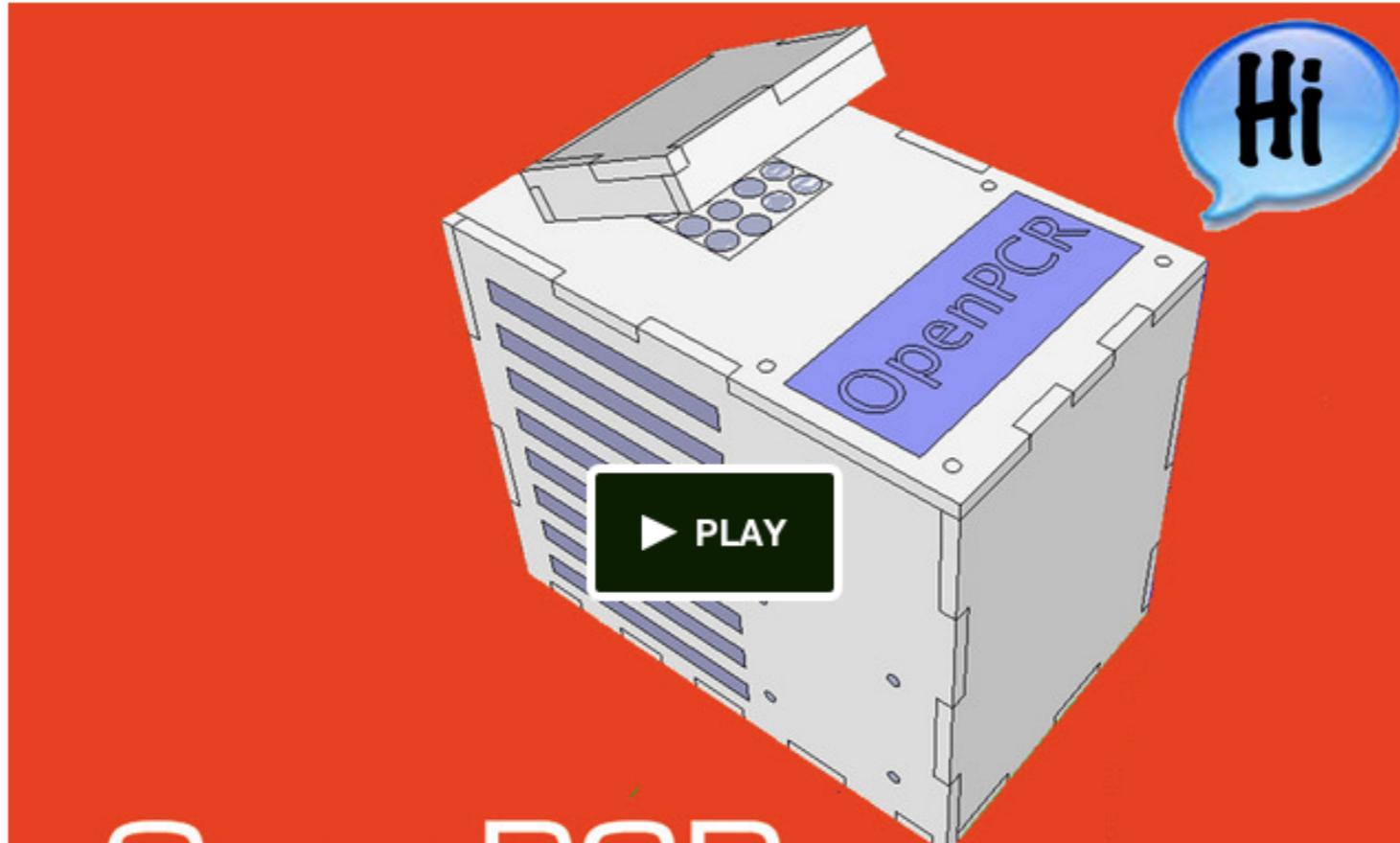
Backers 158

Comments 22

San Francisco, CA

Hardware

Funded! This project was successfully funded on July 23, 2010.



158

Backers

\$12,121

pledged of \$6,000 goal

0

seconds to go



Project by

<http://OpenPCR.org> --
Tito and Josh
San Francisco, CA



Glowing Plant 2013





Indie Bio



INDIE BIO

San Francisco CA, USA



RebelBio

Cork, Ireland



waag society

institute for art, science and technology

Super powers

What are the big players up to?



RNAi in agriculture



RNAi in Agriculture



CRISPR edited embryos

nature
International weekly journal of science

Search Go ▶ Advanced search

Home | News & Comment | Research | Careers & Jobs | Current Issue | Archive | Audio & Video | For Authors

News & Comment > News > 2017 > January > Article

NATURE | NEWS

Chinese scientists genetically modify human embryos

Rumours of germline modification prove true — and look set to reignite an ethical debate.

David Cyranoski & Sara Reardon

22 April 2015

Rights & Permissions

Moonshot!

Big science has a buzzword problem

Moonshots, road maps, frameworks and more are proliferating, but few can agree on what these names even mean.

Recent Read Commented

1. Consider drug efficacy before first-in-human trials
Nature | 30 January 2017
2. Meet the scientists affected by Trump's immigration ban
Nature | 29 January 2017
3. Trump agenda threatens US legacy of science diplomacy
Nature | 27 January 2017



Curing cancer with viruses

nature International weekly journal of science

Search

Go

► Advanced search

Home | News & Comment | Research | Careers & Jobs | Current Issue | Archive | Audio & Video | For Authors

Archive > Volume 526 > Issue 7575 > News > Article

NATURE | NEWS

E-alert

RSS

Facebook

Twitter

Cancer-fighting viruses win approval

US regulators clear a viral melanoma therapy, paving the way for a promising field with a chequered past.

Heidi Ledford

28 October 2015

Rights & Permissions

Moonshot!

Big science has a buzzword problem

Moonshots, road maps, frameworks and more are proliferating, but few can agree on what these names even mean.

Recent

Read

Commented

1. Consider drug efficacy before first-in-human trials

Nature | 30 January 2017

2. Meet the scientists affected by Trump's immigration ban

Nature | 29 January 2017

3. Trump agenda threatens US legacy of science diplomacy



Gene drive mosquito eradication

**MIT
Technology
Review**

[Topics+](#) [Top Stories](#)

Biomedicine

Bill Gates Doubles His Bet on Wiping Out Mosquitoes with Gene Editing

But the technology for extinguishing species is dividing conservationists.

by Antonio Regaldo September 6, 2016



Neurogenerative stem cell therapy

Experimental stem cell therapy helps paralyzed man regain use of arms and hands

The 21-year-old who suffered a cervical spine injury in March gains significant improvement in his motor function at Keck Hospital of USC

September 8, 2016





Human pig embryos

Human-Pig Hybrid Created in the Lab—Here Are the Facts

Scientists hope the chimera embryos represent key steps toward life-saving lab-grown organs.



This pig embryo was injected with human cells early in its development and grew to be four weeks old.

PHOTOGRAPH COURTESY JUAN CARLOS IZPISUA BELMONTE



These slides are
licensed under
CC - BY - SA 3.0

some
rights
reserved