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BioHack Academy
History of Biohacking

Definitions

Google

bi·o·hack·ing

/ˈbīōhakiNG/

noun

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

Wiktionary

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

Urban Dictionary

TOP DEFINITION

biohacking

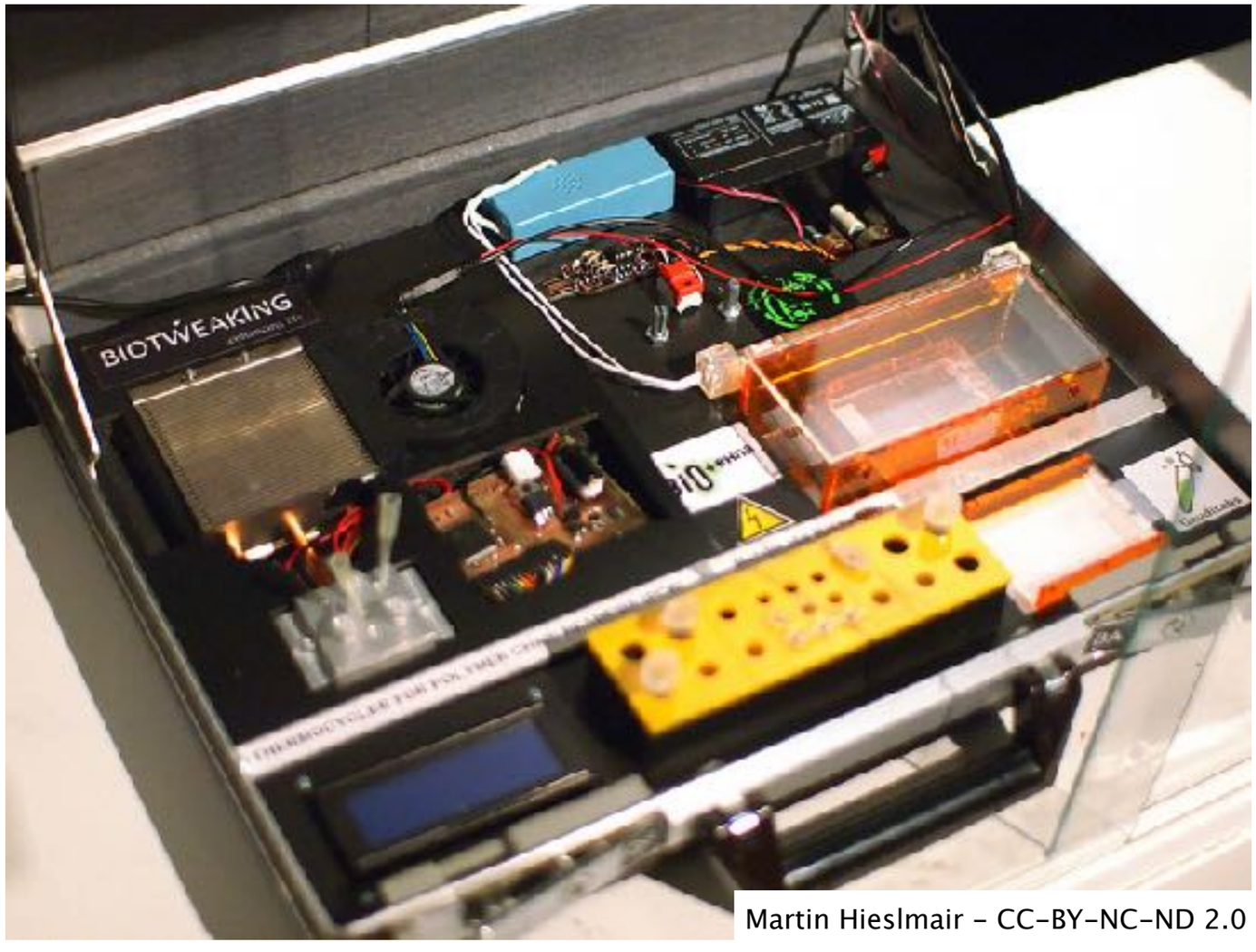
refers to managing one's own biology using a combination of medical, nutritional and electronic techniques.

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

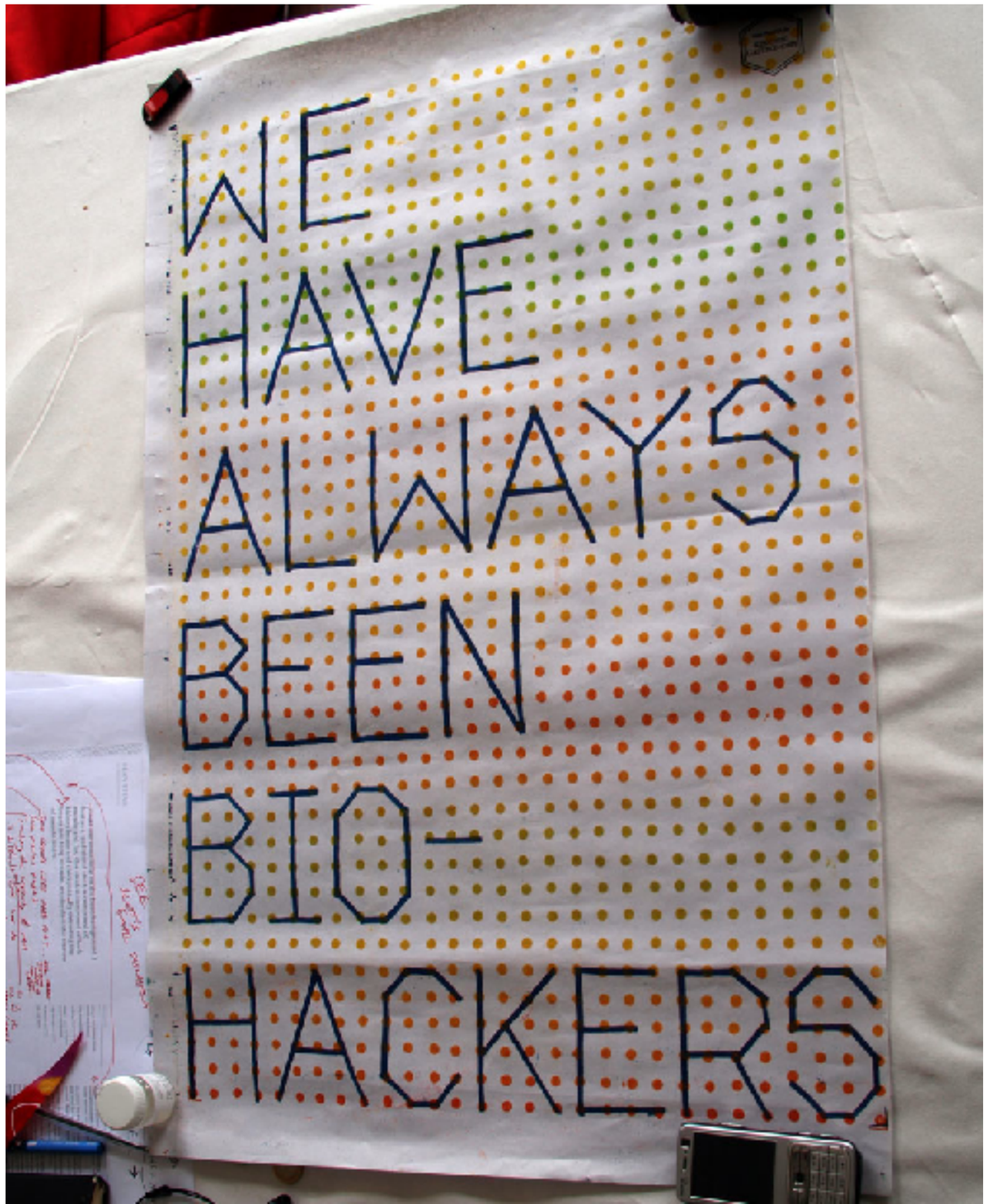
#bio hack #biohacker #bullet proof #biopunk #cybernetic

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

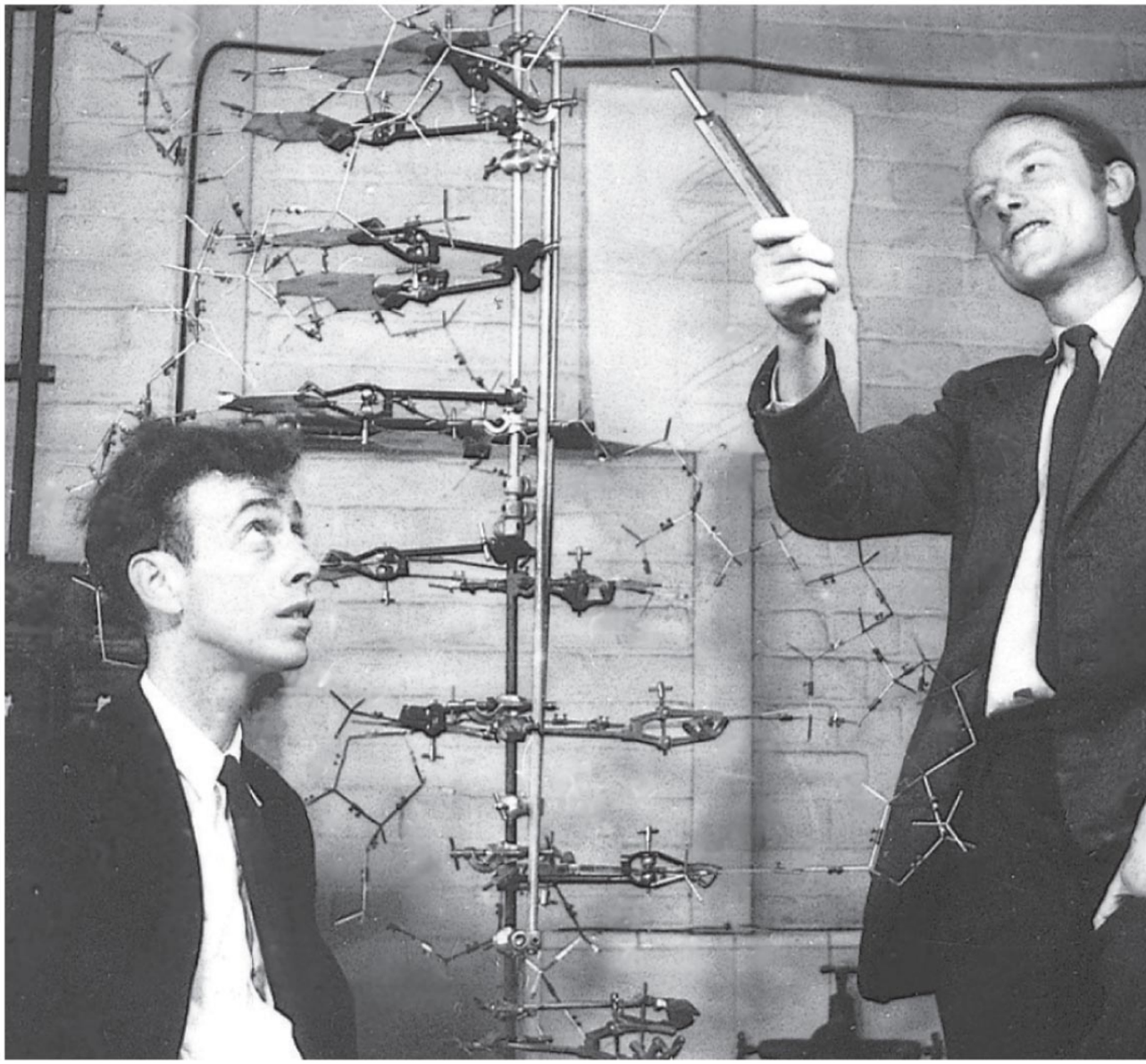


We have always been biohackers

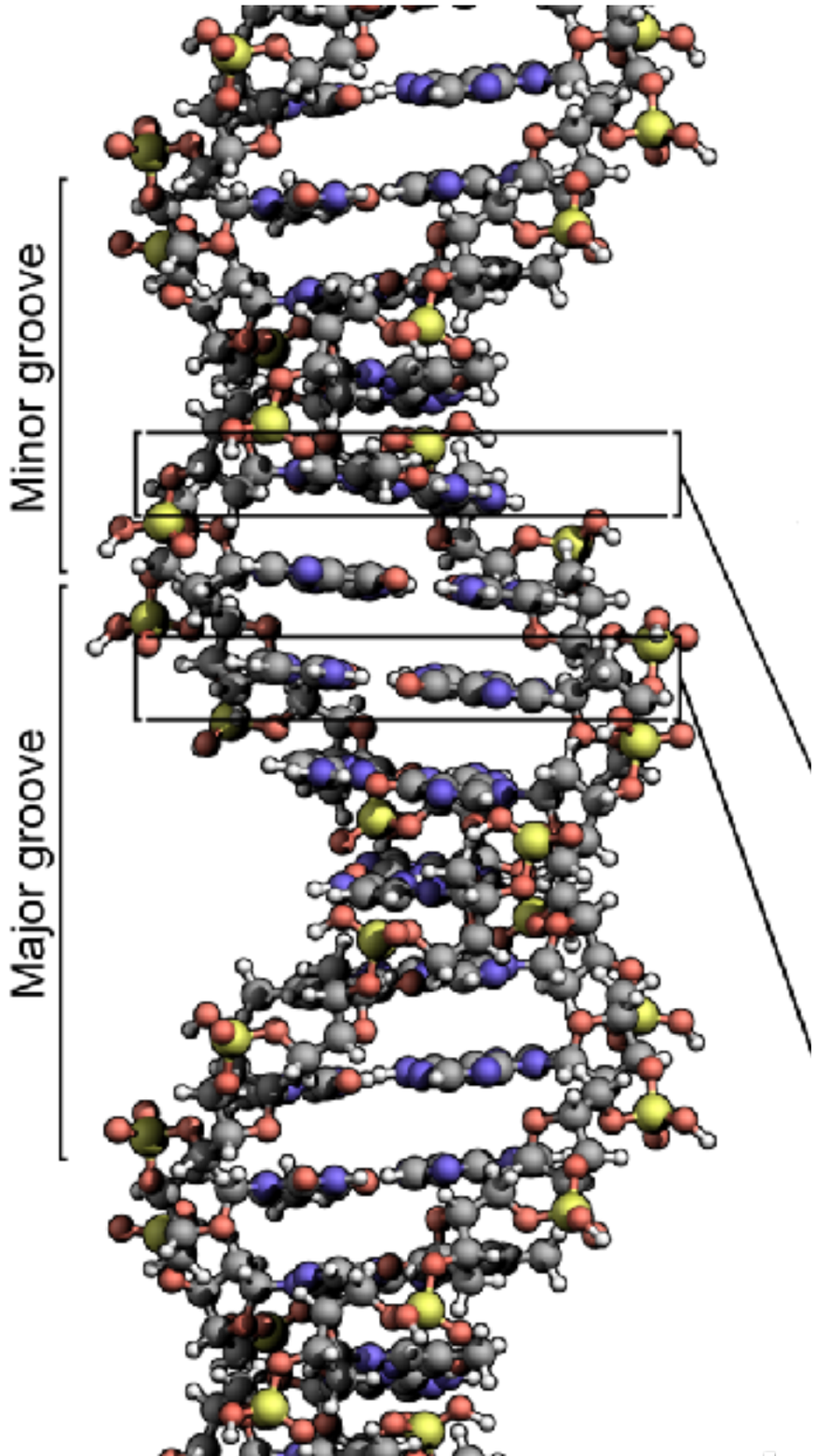


Center for Genomic Gastronomy

Discovery of Double Helix 1953



DNA Molecule



Living code:

AACATGACCTGACGA

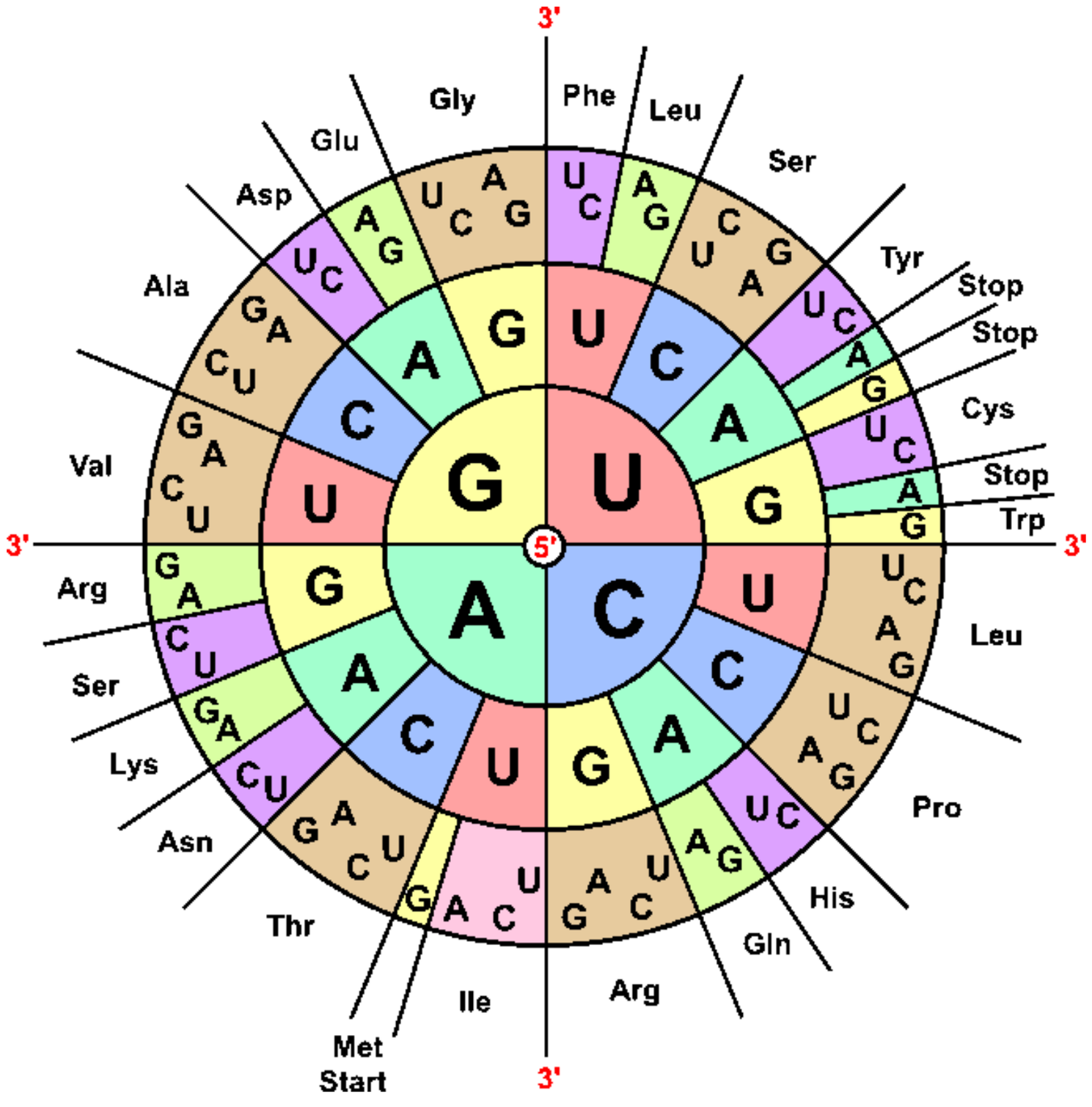
Digital code:

1001010011101010101010101010
0101010100101010100101010110
1101111001

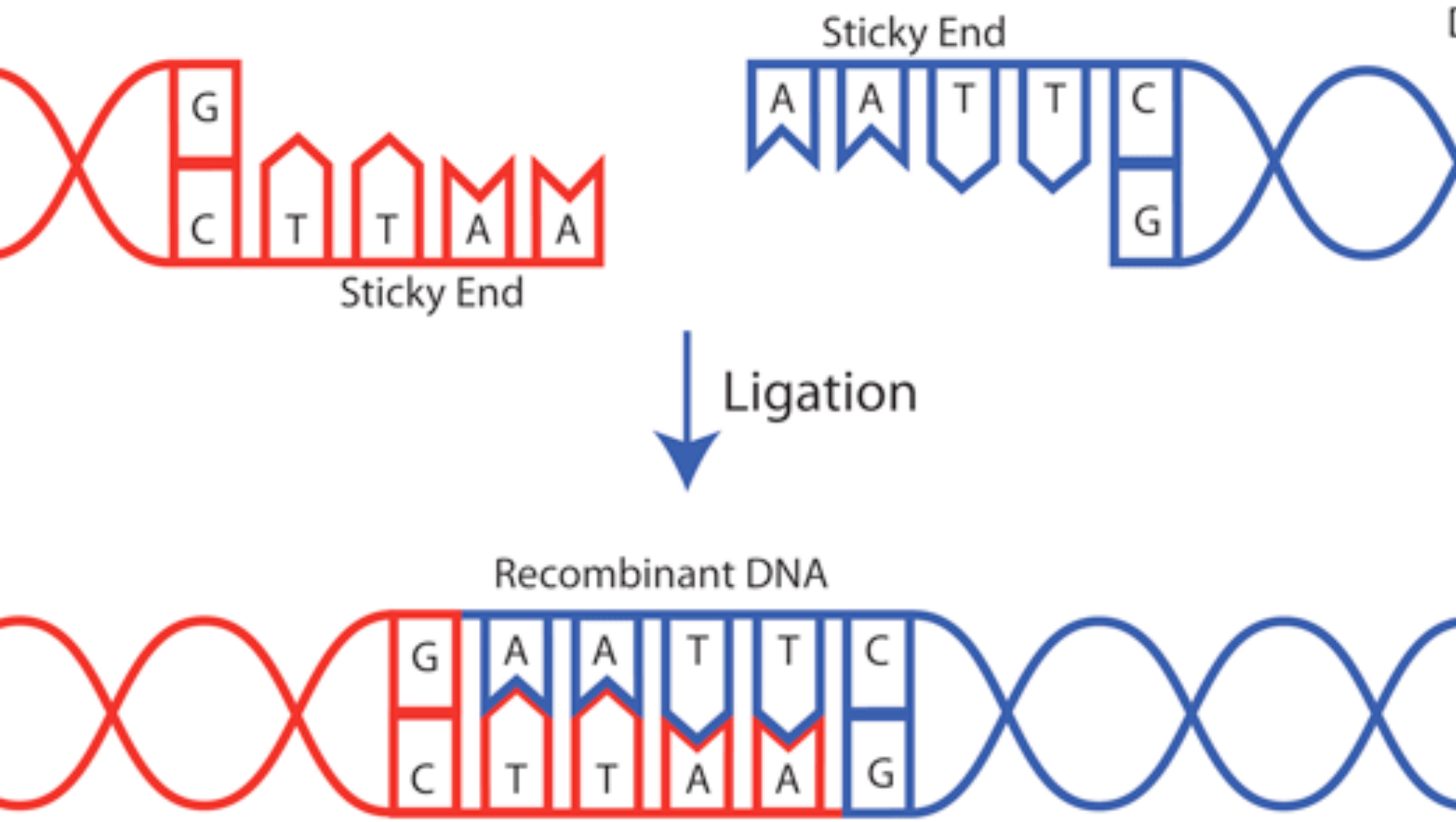
Robert W. Holley, Marshall Nirenberg, Har Gobind Khorana 1968

Nobel Foundation

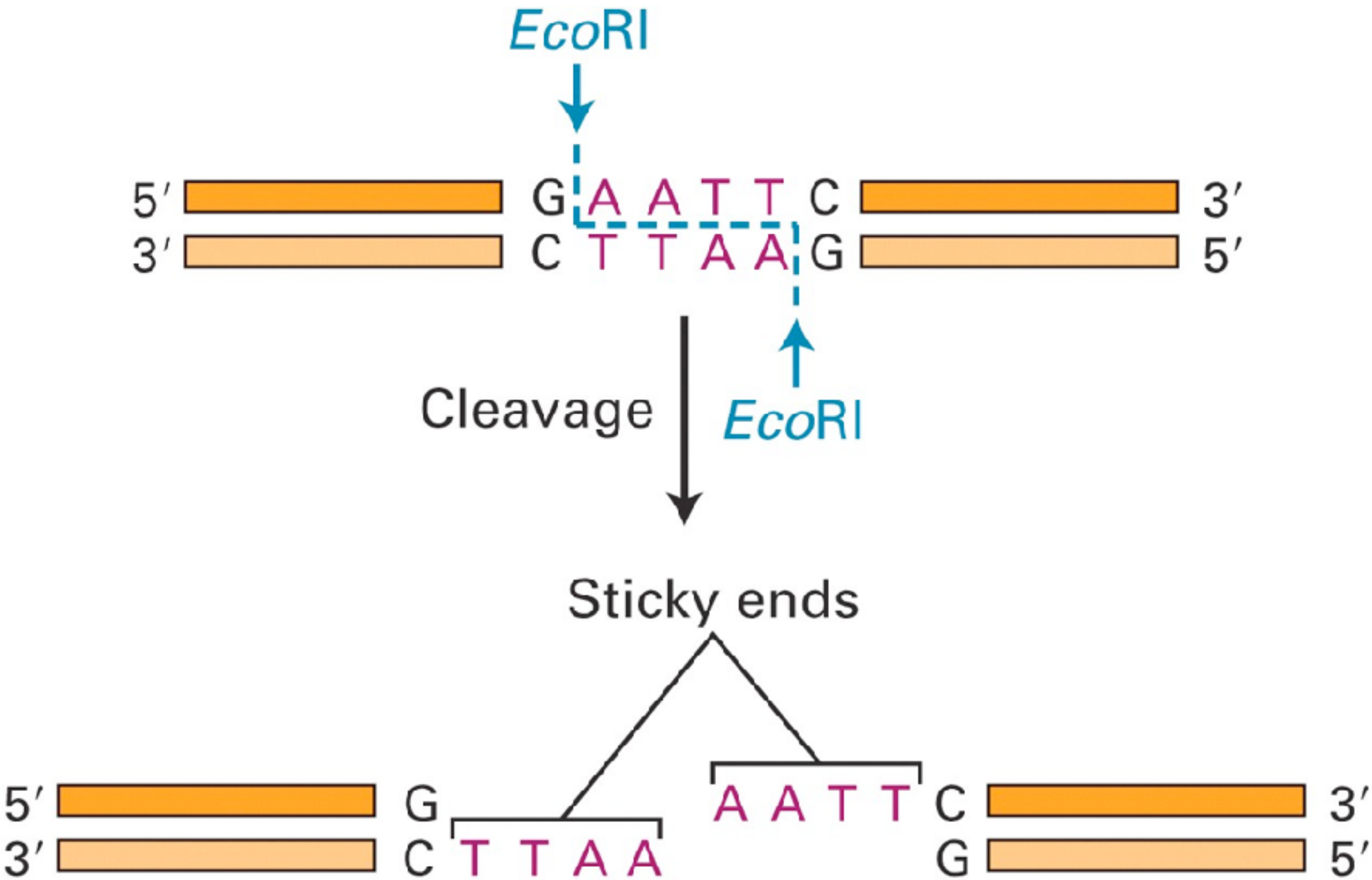
Amino acid rosetta stone



DNA ligase, 1967



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.

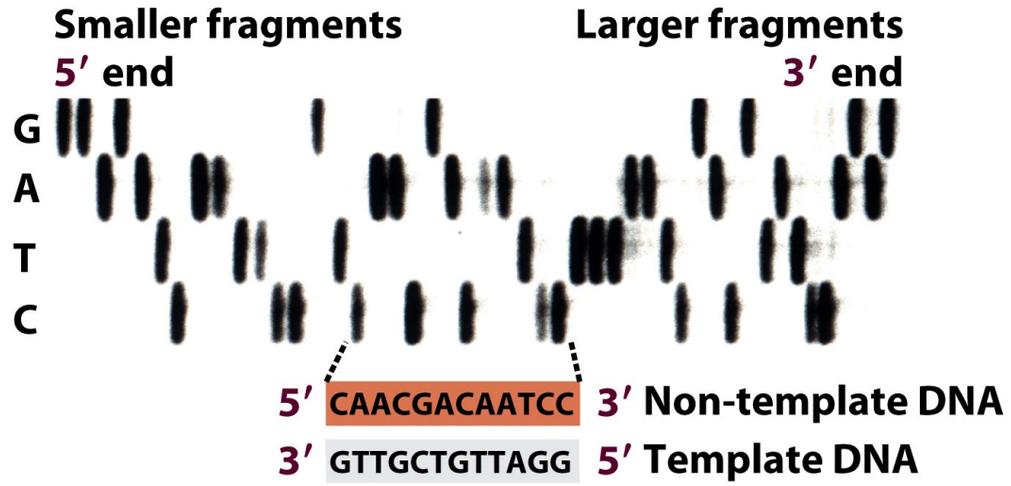
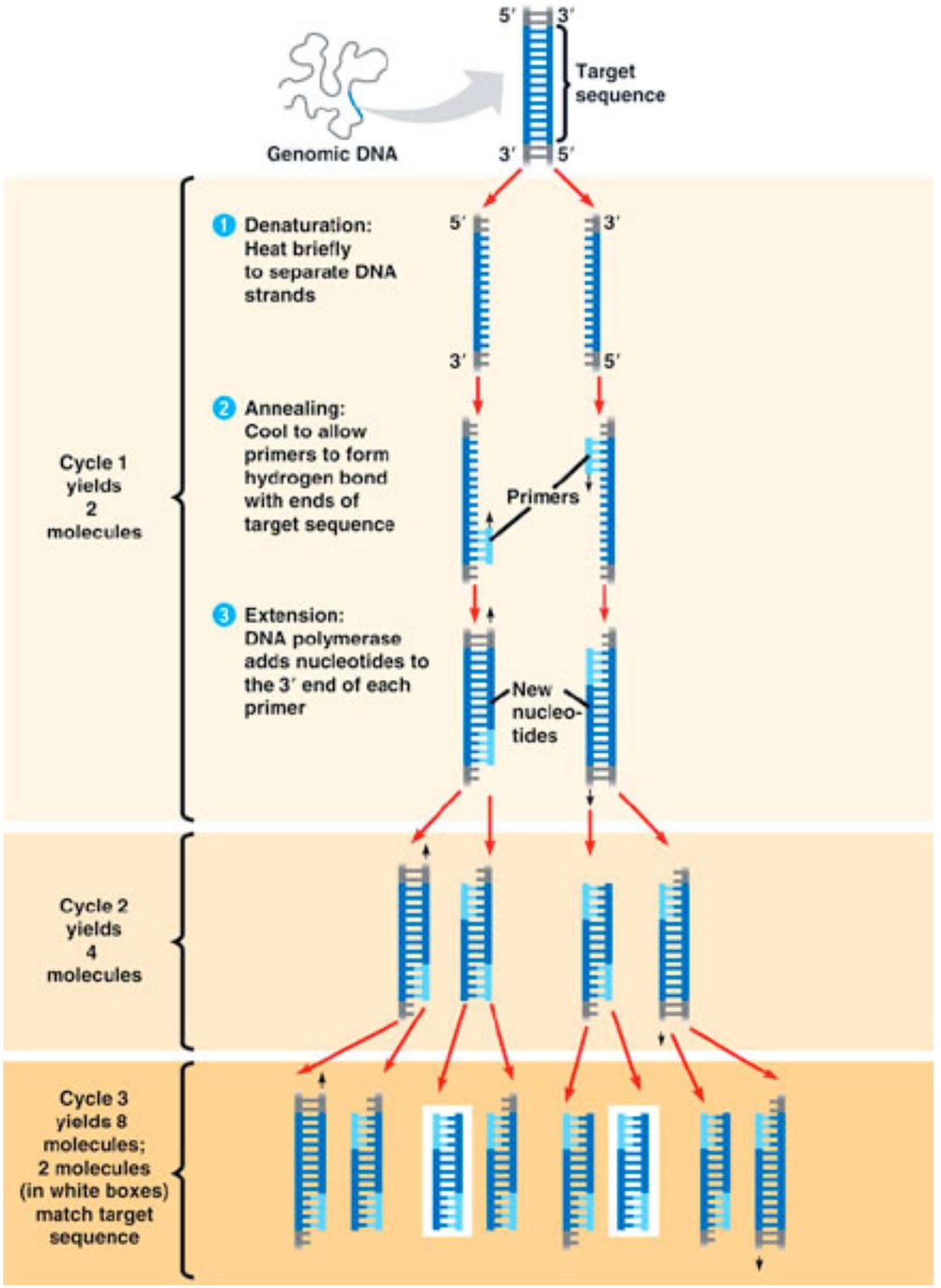


Figure 19-6c Biological Science, 2/e

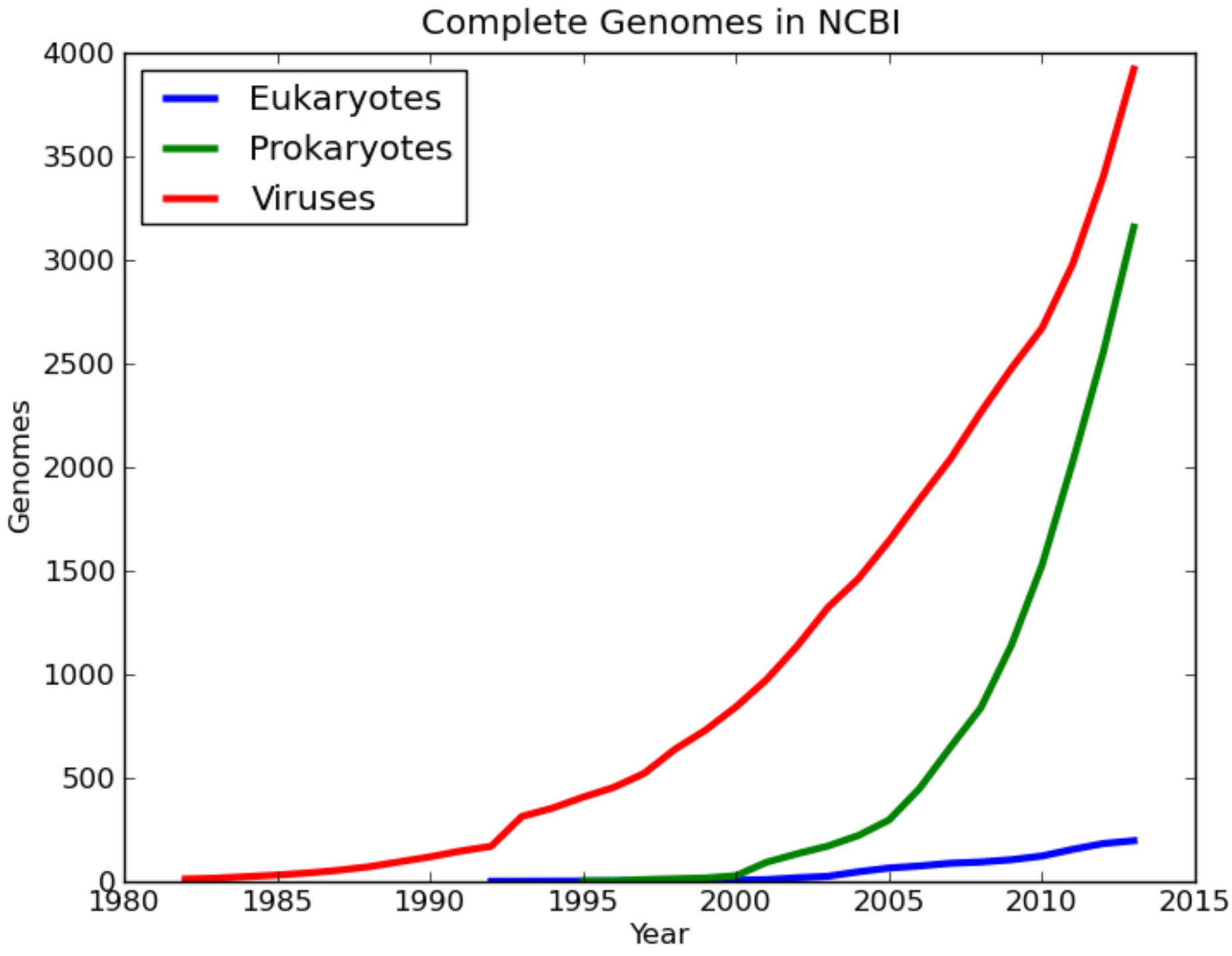
Polymerase Chain Reaction, 1983



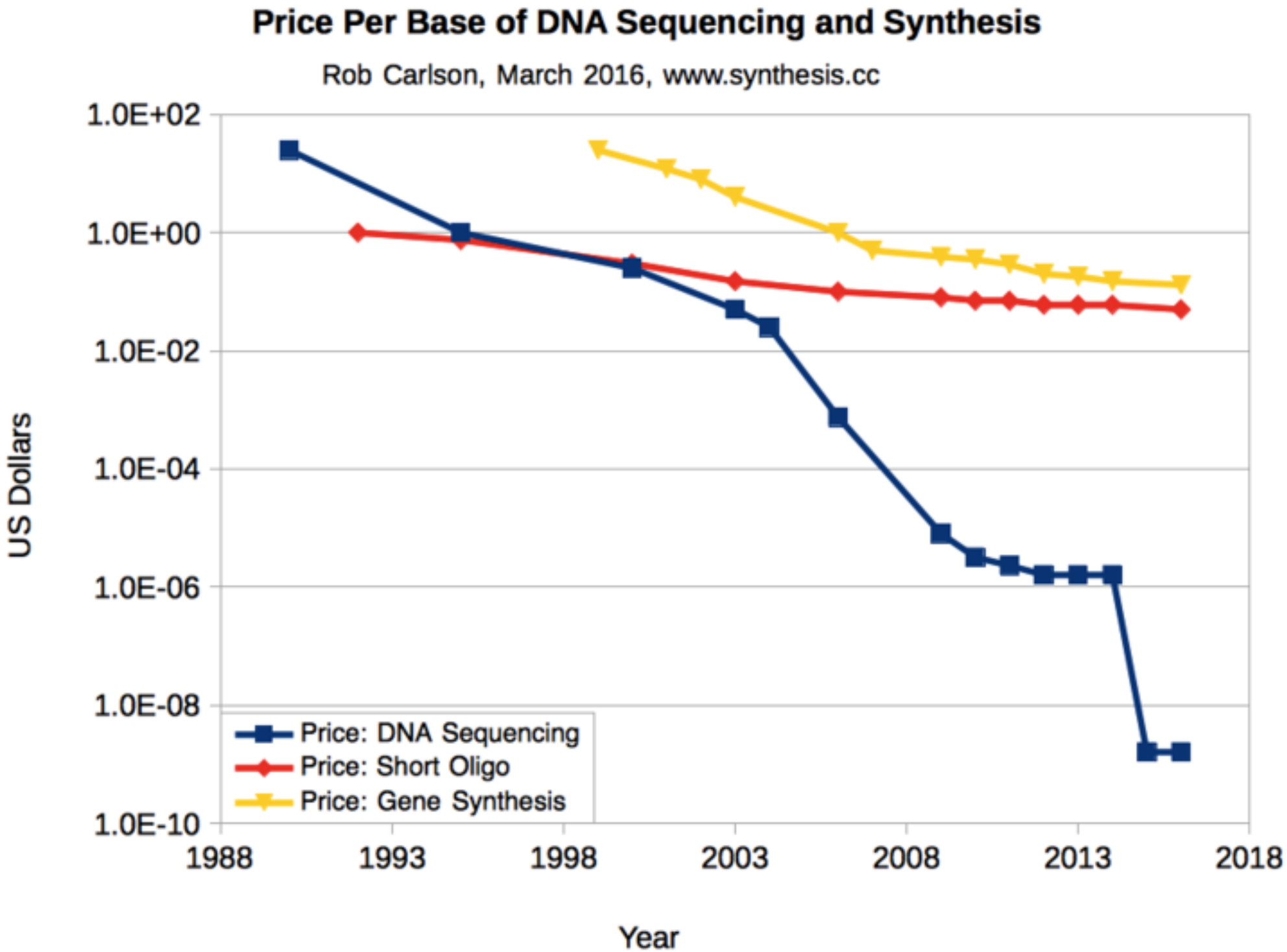
Reading DNA

Bejing Genomics Institute

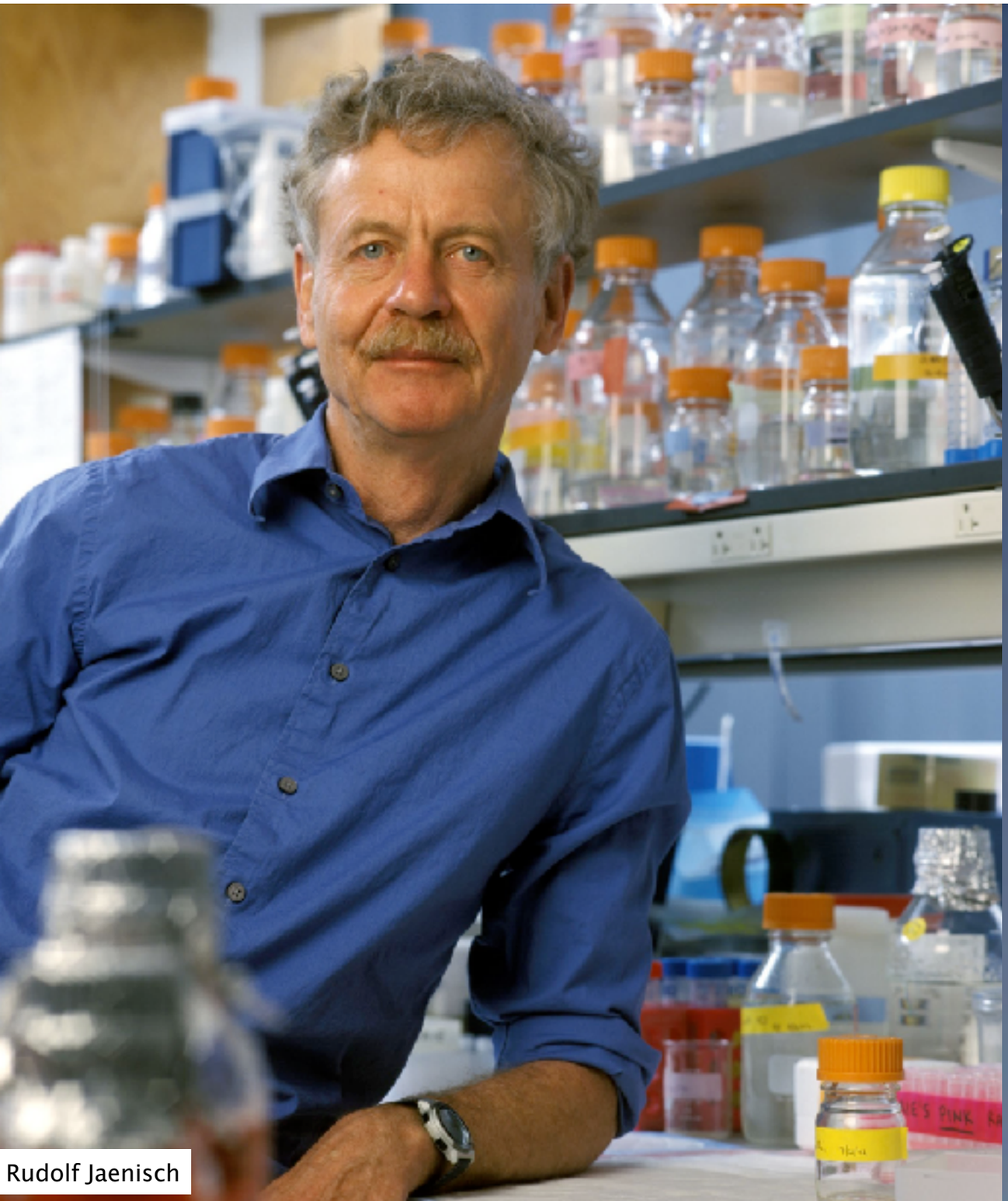
Growth of Genbank



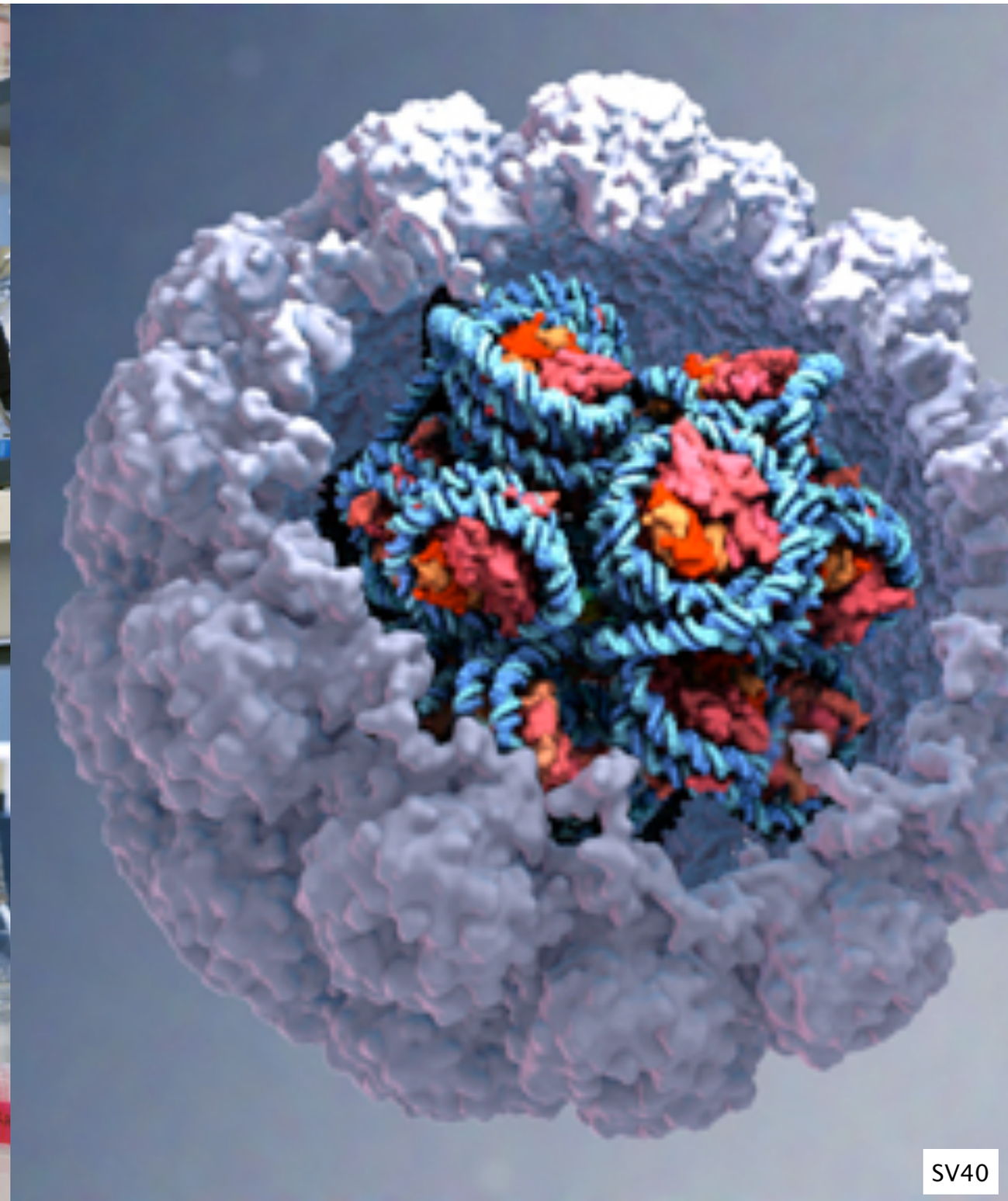
Cost of DNA


Price Per Base of DNA Sequencing and Synthesis
Rob Carlson, March 2016, www.synthesis.cc
1.0E+02
1.0E+00
1.0E-02
1.0E-04
1.0E-06
1.0E-08
1.0E-10
US Dollars
1988
1993
1998
2003
2008
2013
2018
Year
Price: DNA Sequencing
Price: Short Oligo
Price: Gene Synthesis

Transgenic Mouse, 1973



Rudolf Jaenisch



SV40

Transgenic Plant, 1983

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 type[1] 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 induction[2]. 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 deleted[4]. 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-DNA[5]. The availability of this dominant selectable marker should allow a wider range of experiments to be under taken using different host plants.

References

Oncogene mouse, Phil Leder, Tim Stewart 1984

Joe Davis, 1987

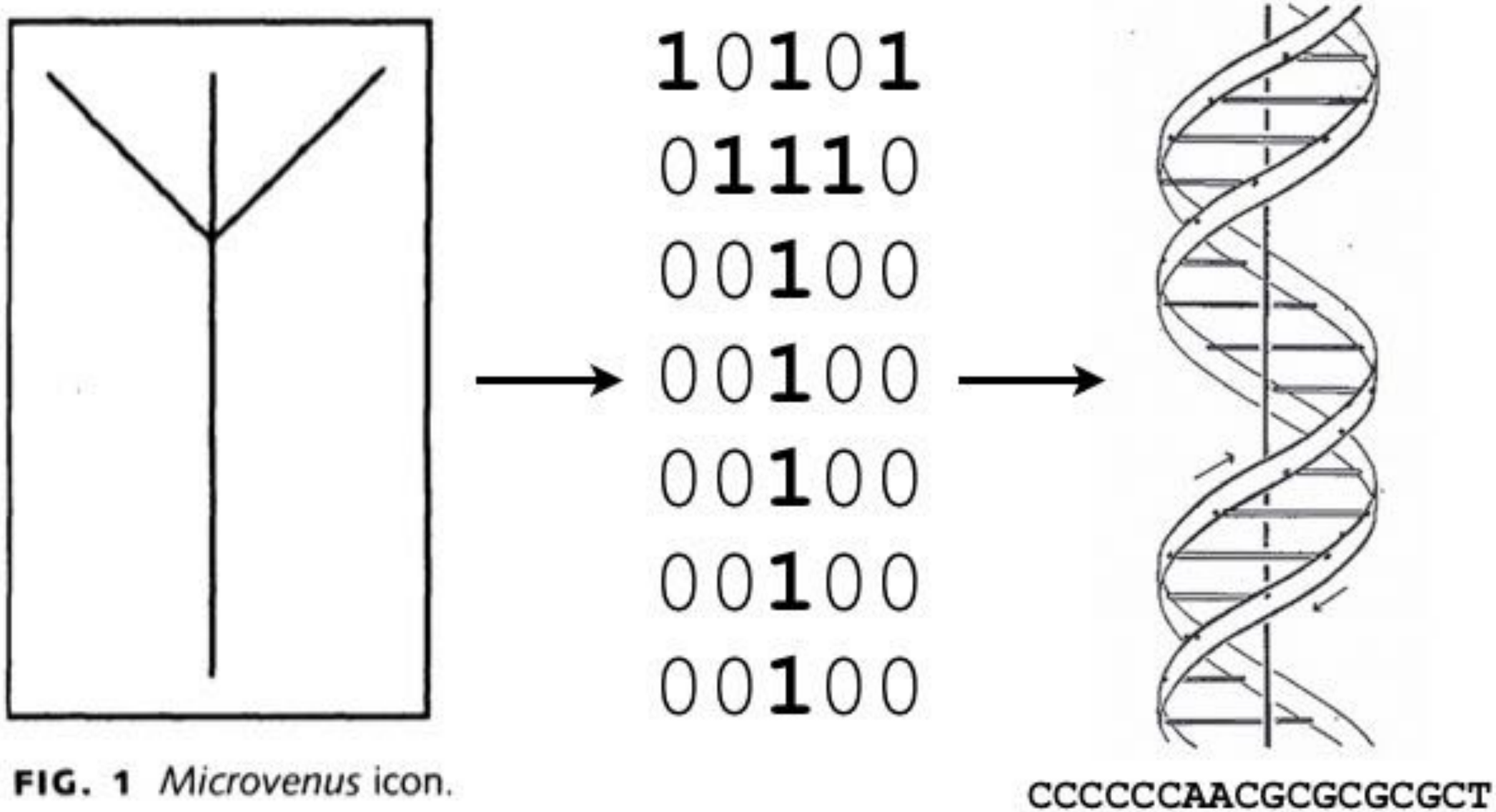


FIG. 1 *Microvenus* icon.

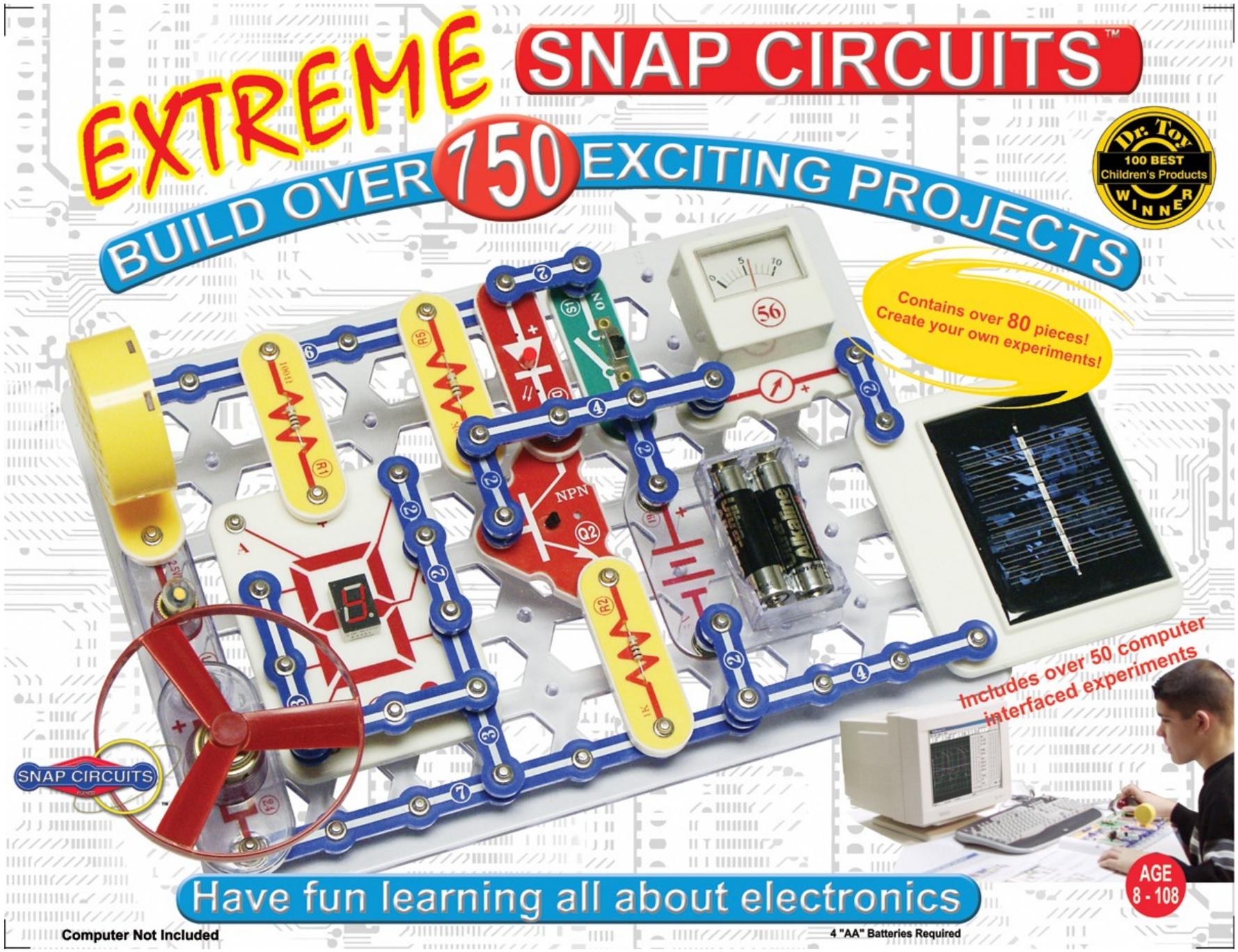
Bull Herman, Leiden 1990

Life finds a way, Jurassic Park 1993

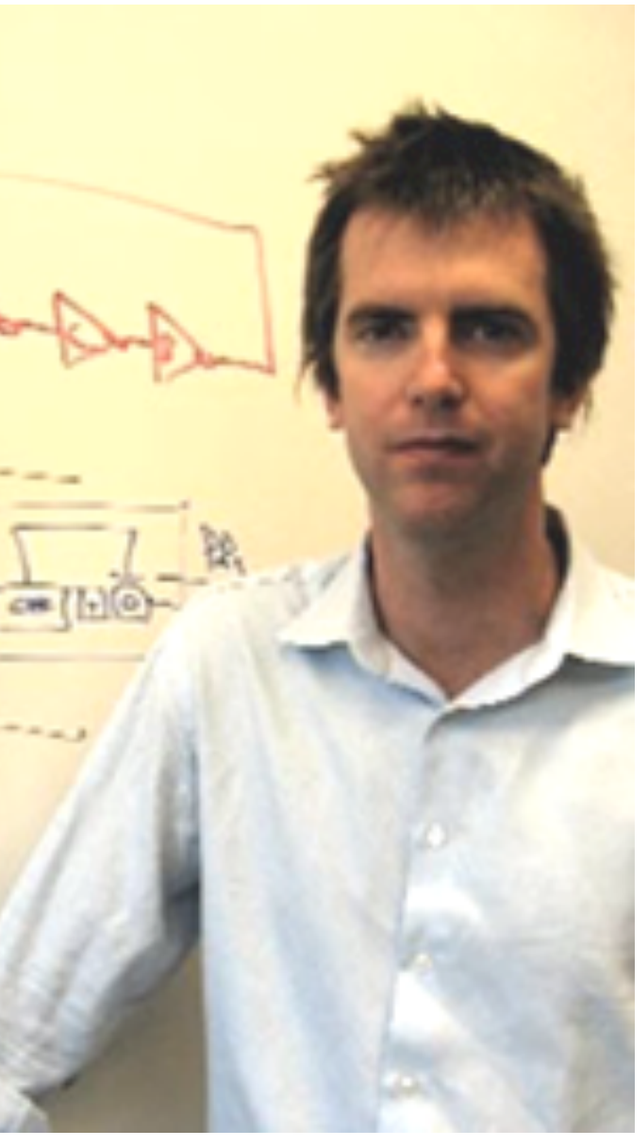
Dolly the Sheep, Edinburgh 1996

Eduardo Kac – GFP Bunny, 2000

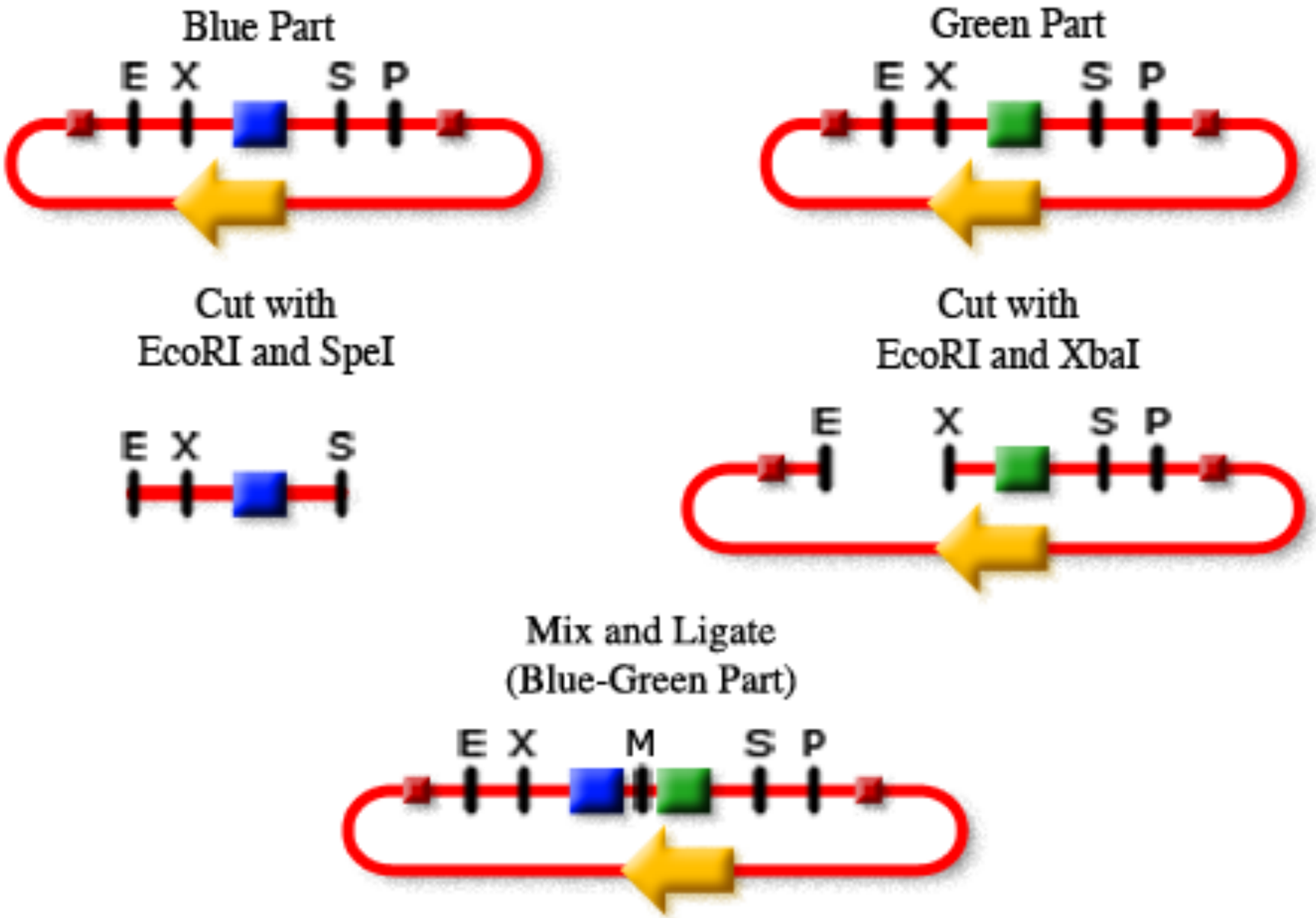
Science turned into technology



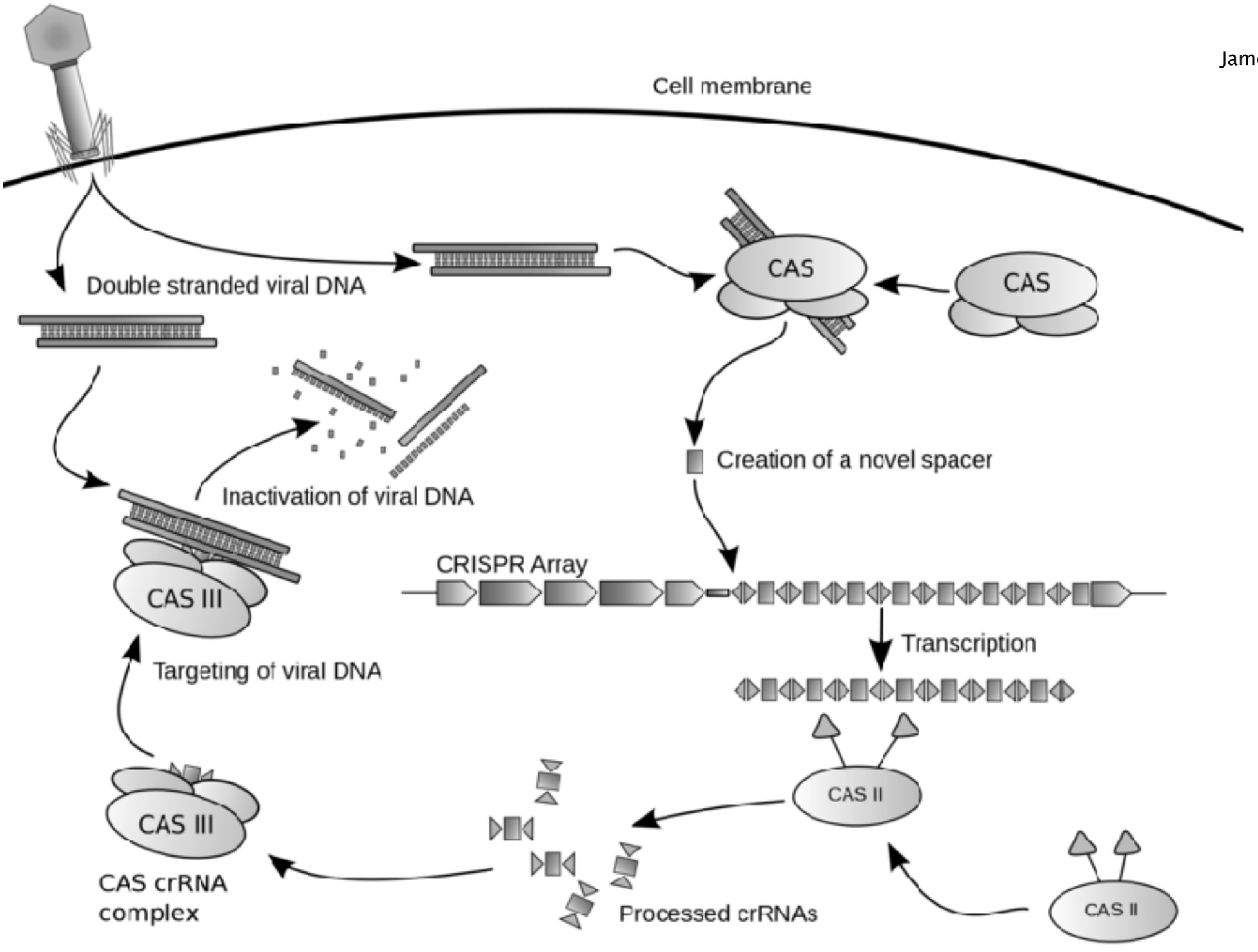
Drew Andy, Tom Knight



Biobrick standard 2003



CRISPR - Cas9

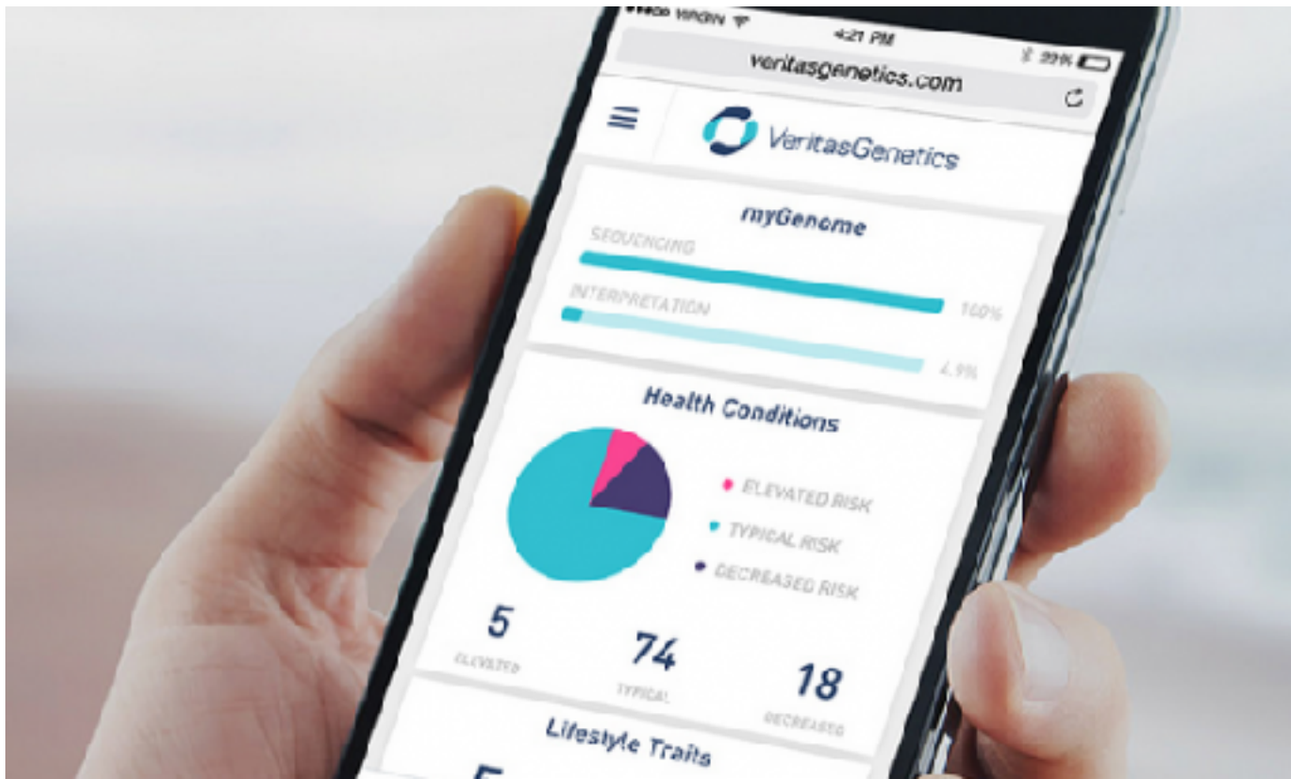


Labs as a service

23andMe

μBiome

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

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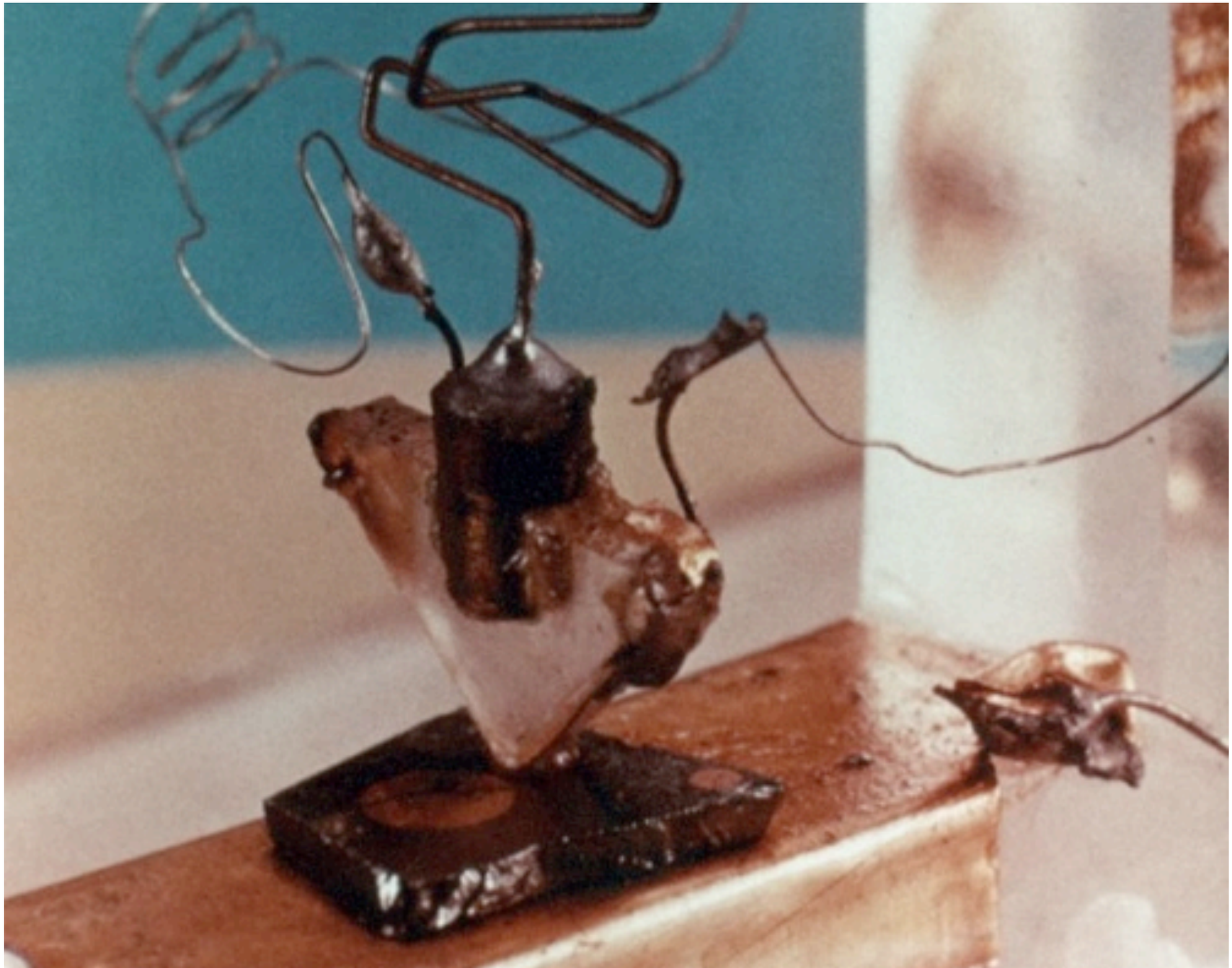
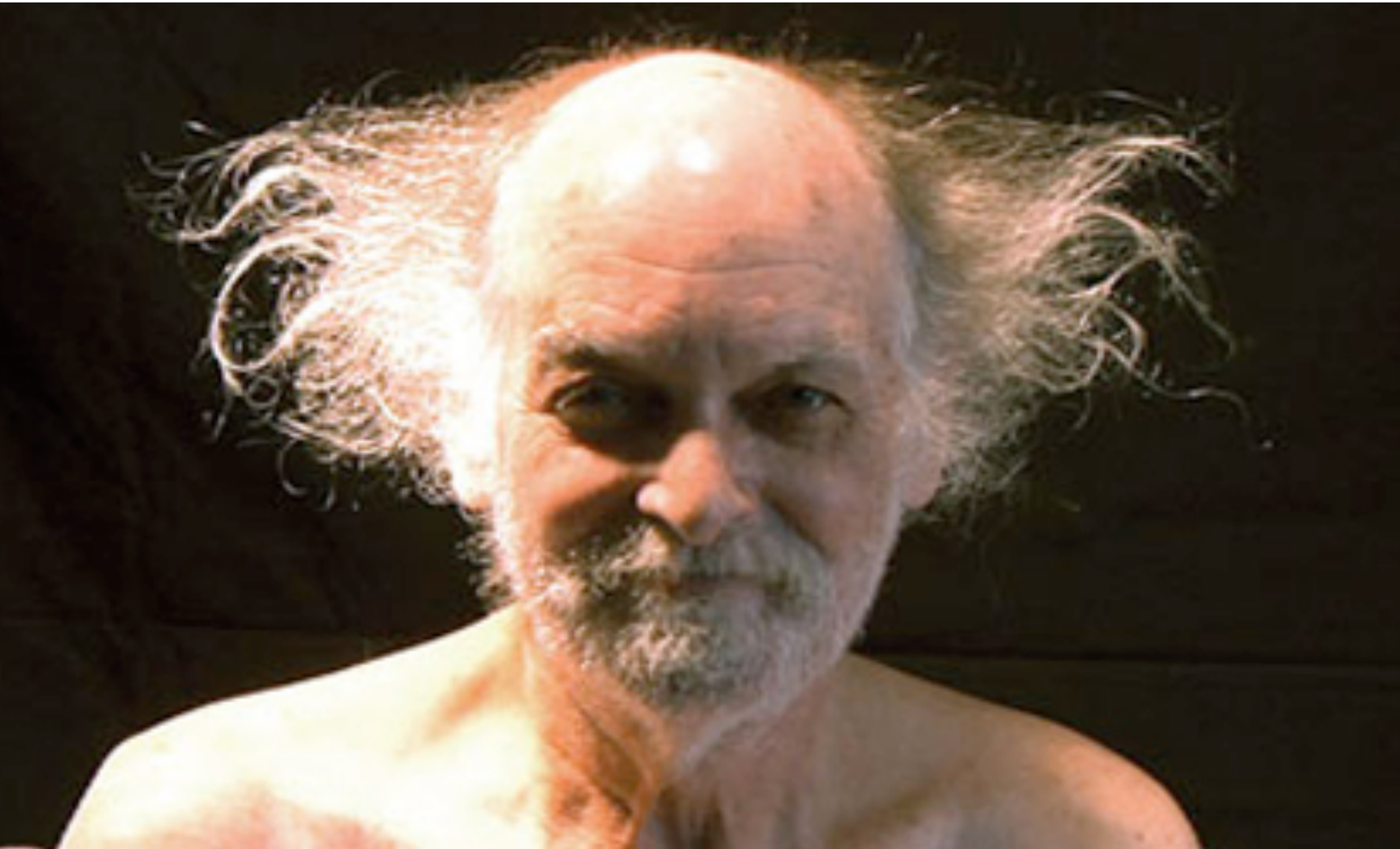
Biology & hacking

Inspiration & justification



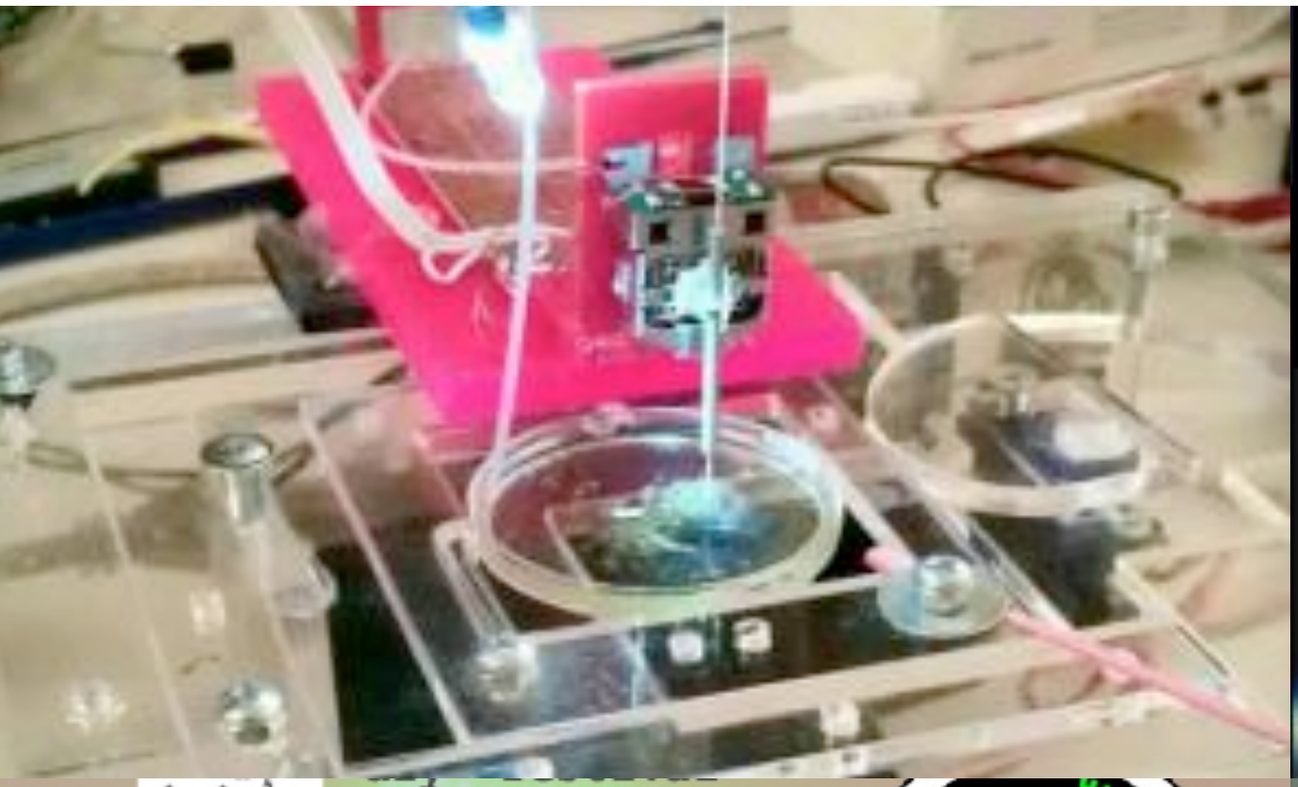
Joe Davis

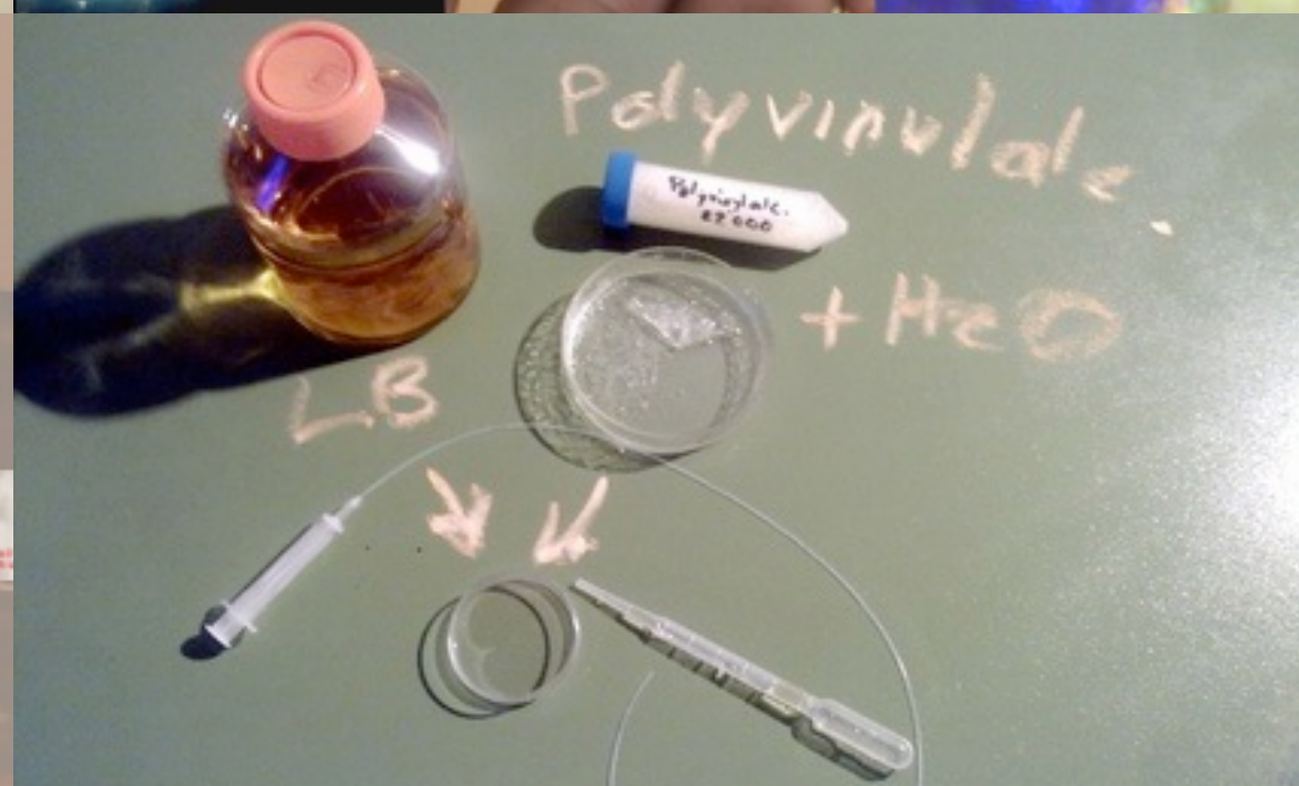


Critical Art Ensemble - Free Range Grain 2003

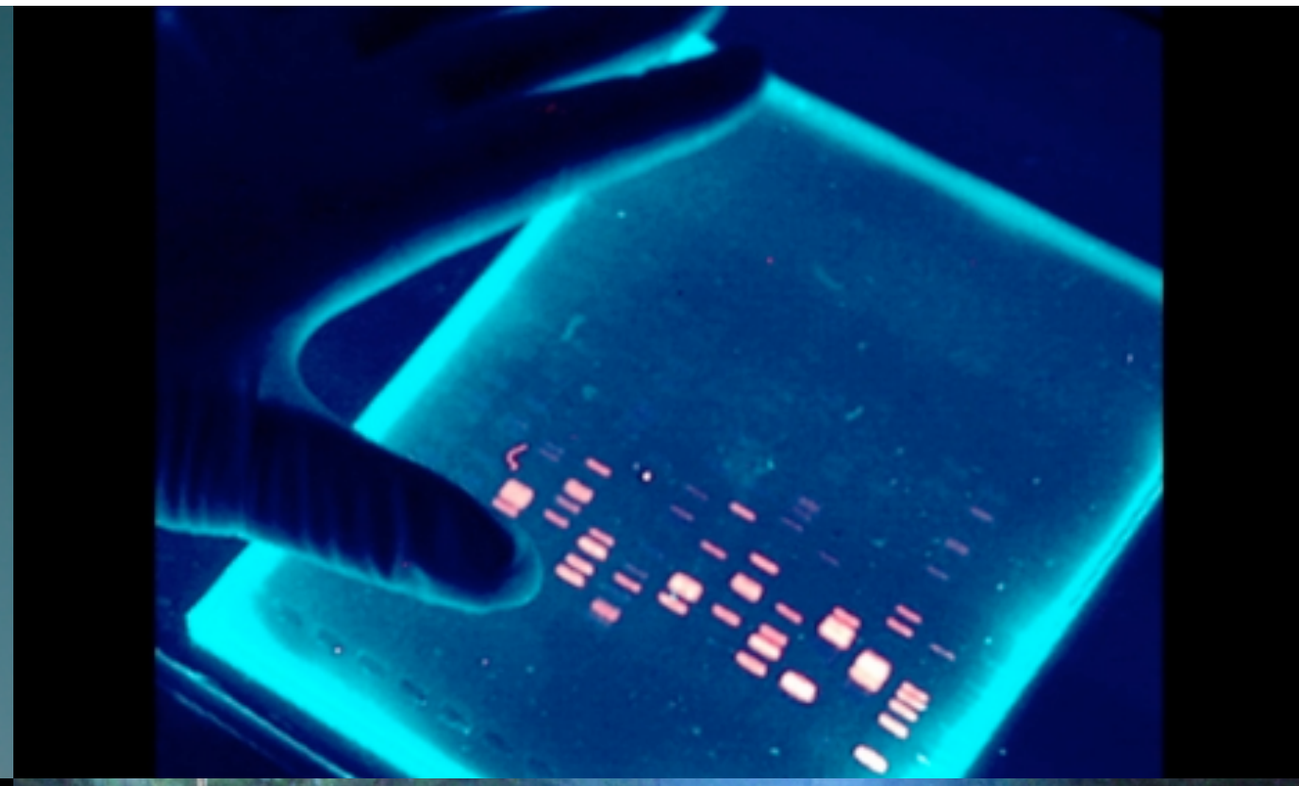
DIYBio 2008

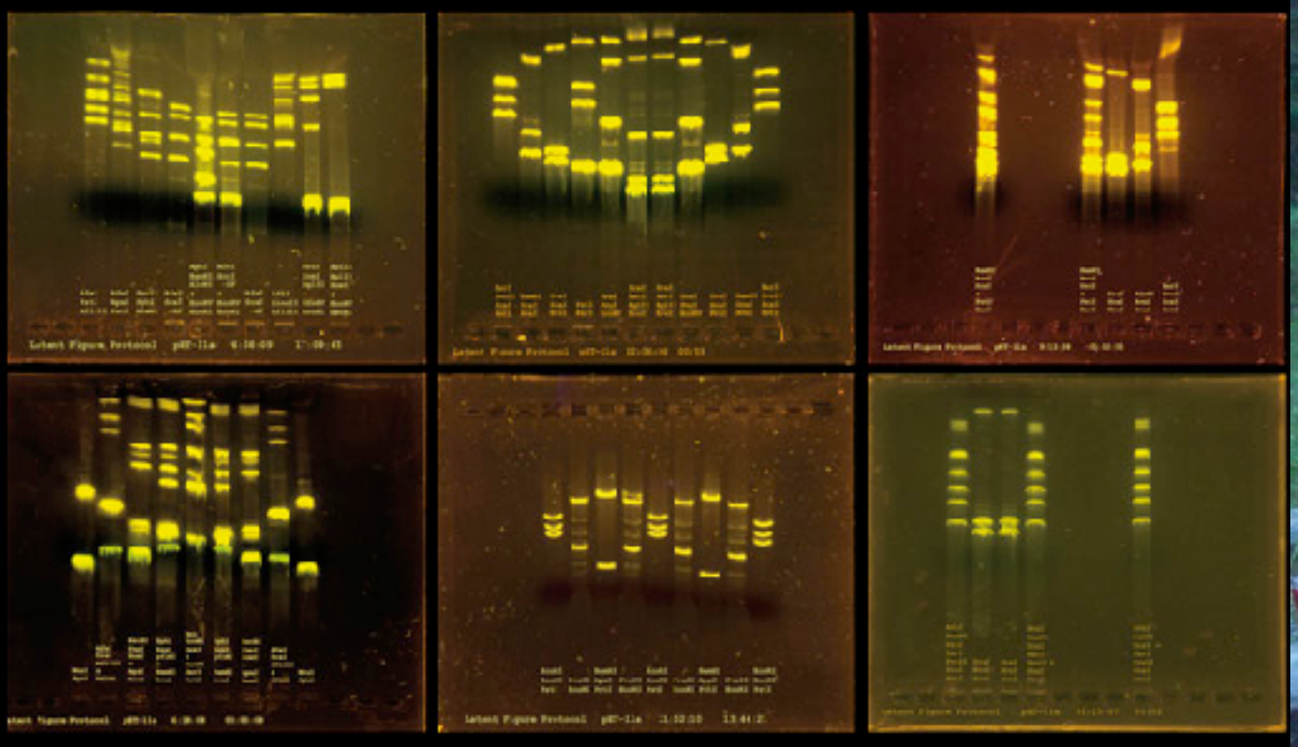
Hackteria, 2009





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”

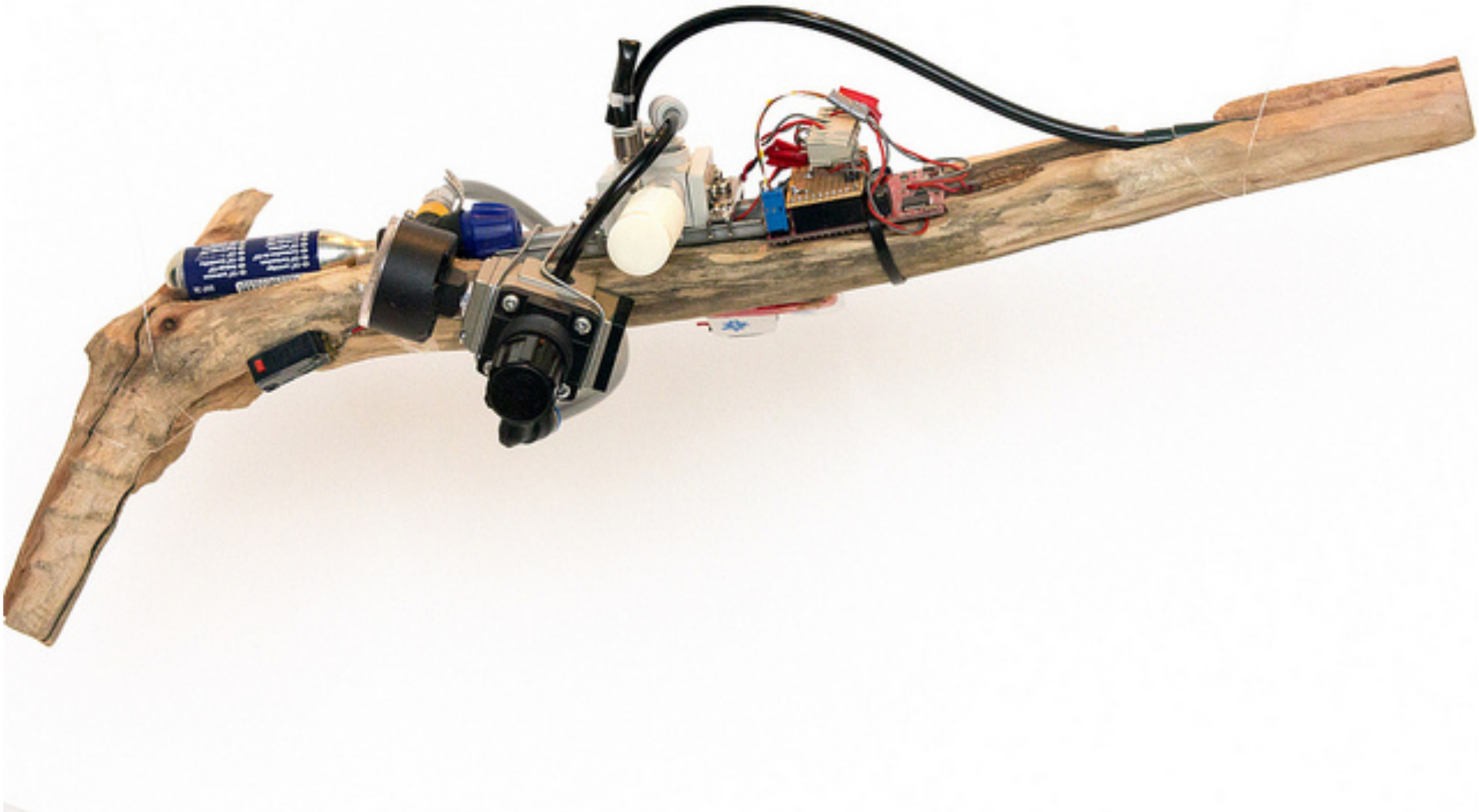
Cathal Garvey, Ireland 2012

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



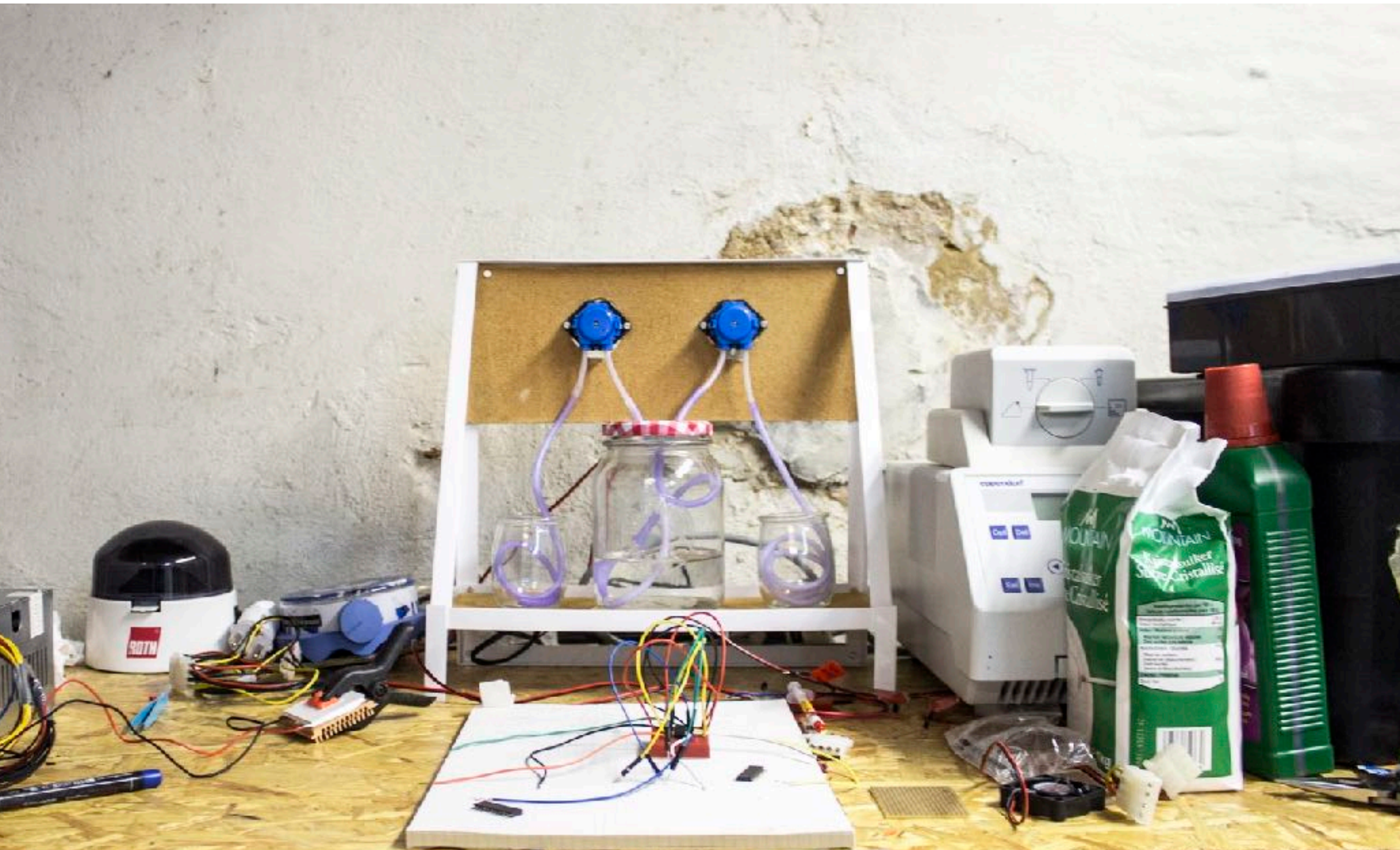
Trojok

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.biotop-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

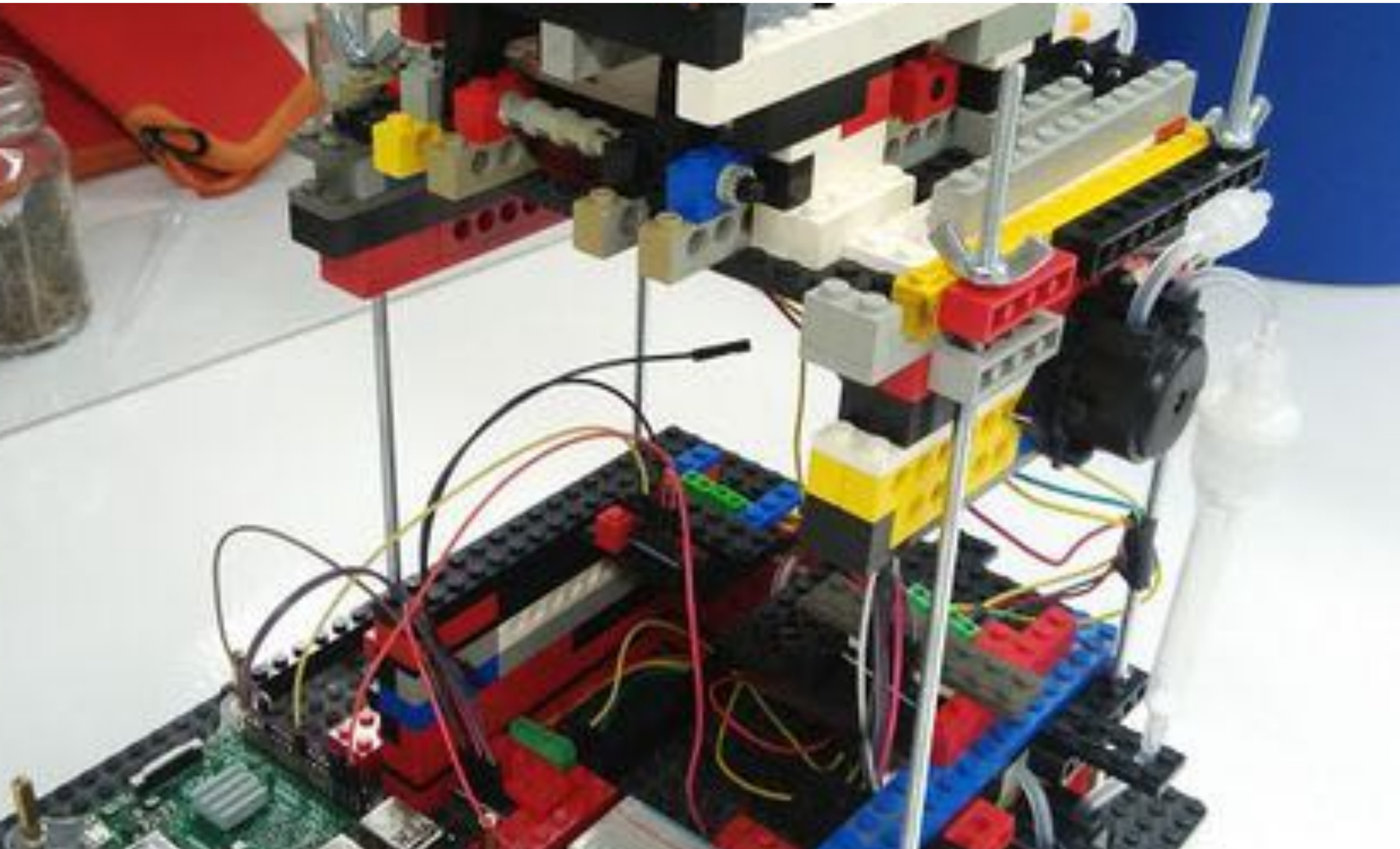
reagentlab.org - DIY bioreactor



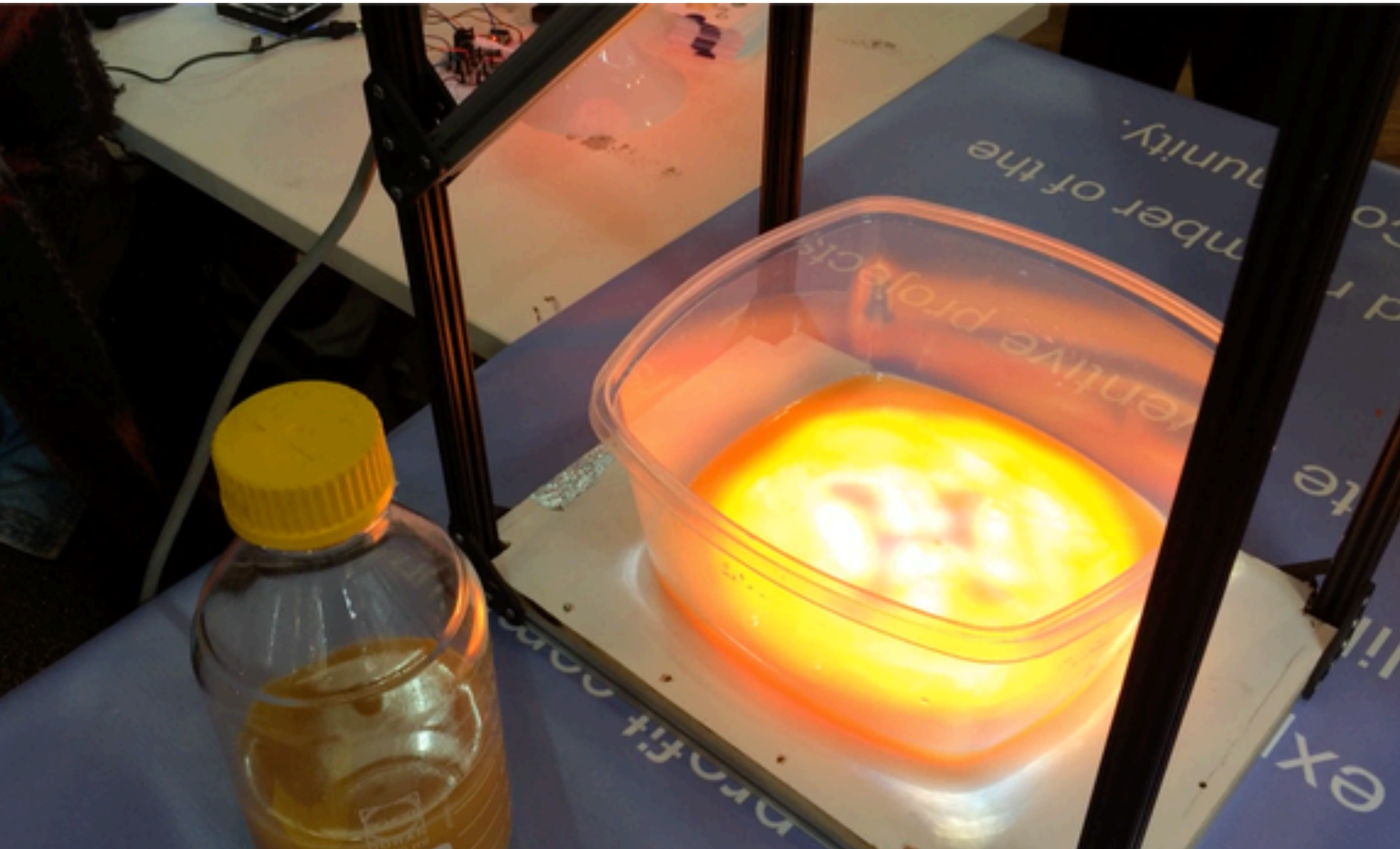
Open Biolab Graz - BSL1

BeerDeCoded - Hackuarium

Protein purification – Hackuarium



Juicyprint - London Biohack Space

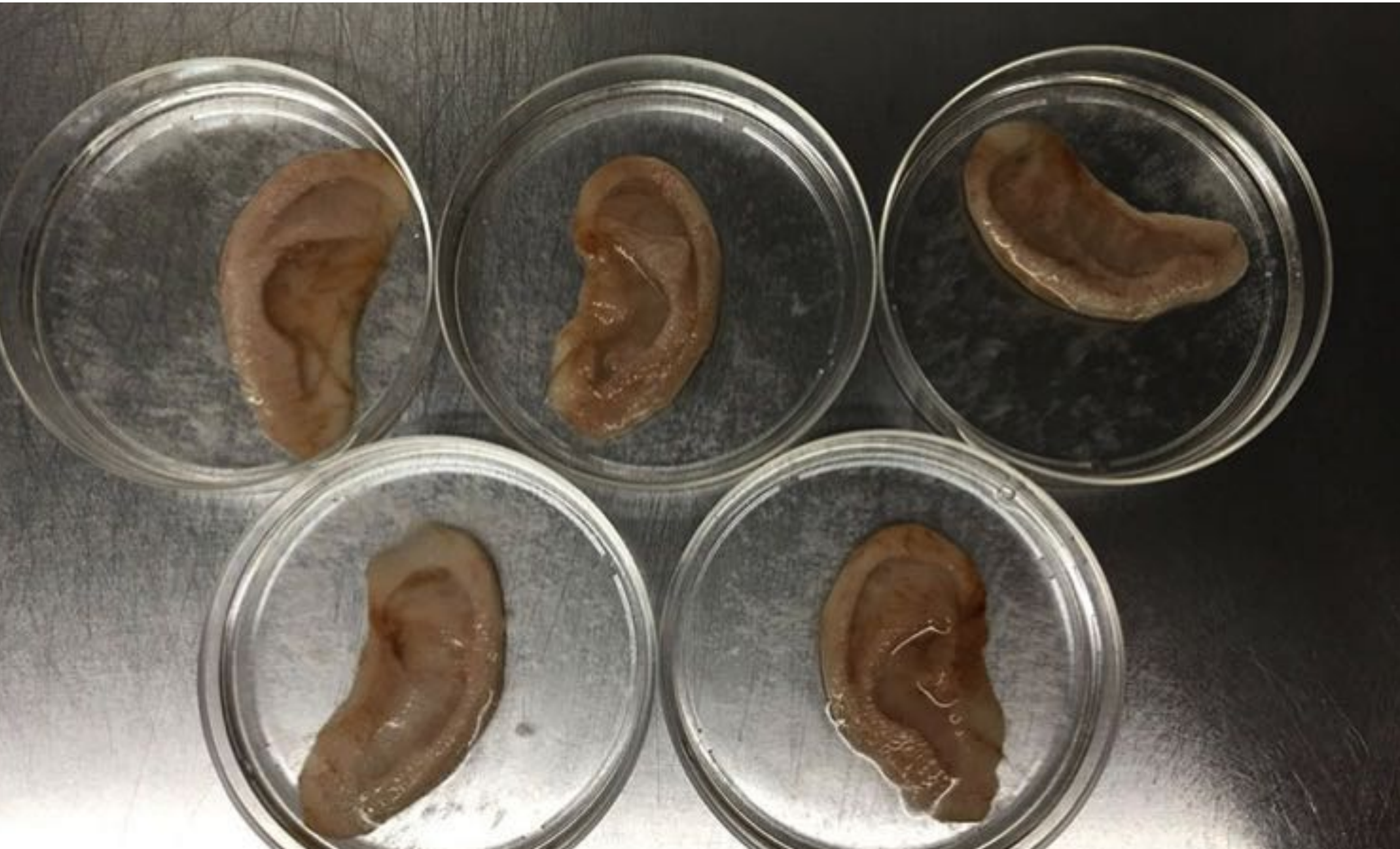


BRMScope - BRMLab

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

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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

- 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

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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

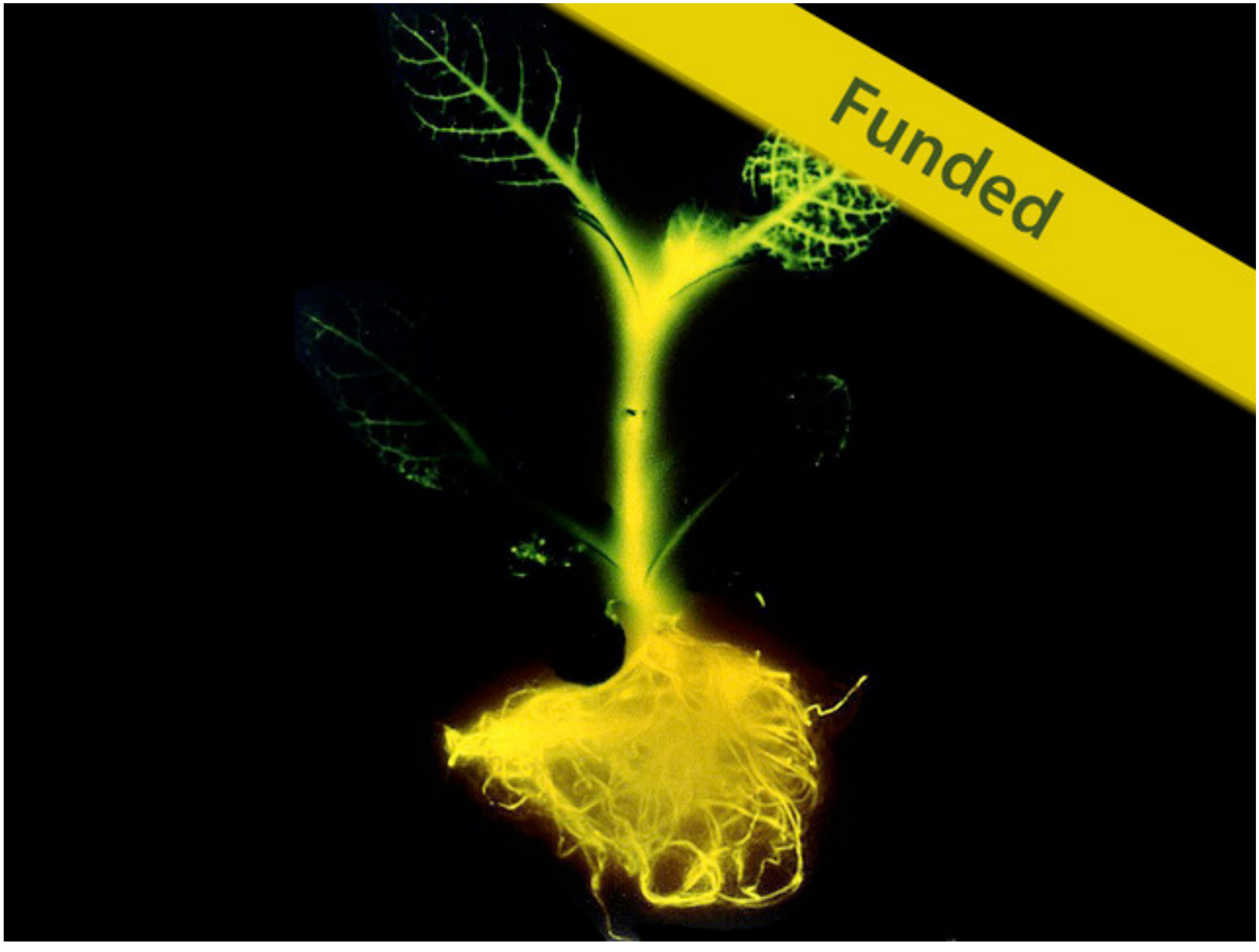
0
seconds to go

Project by

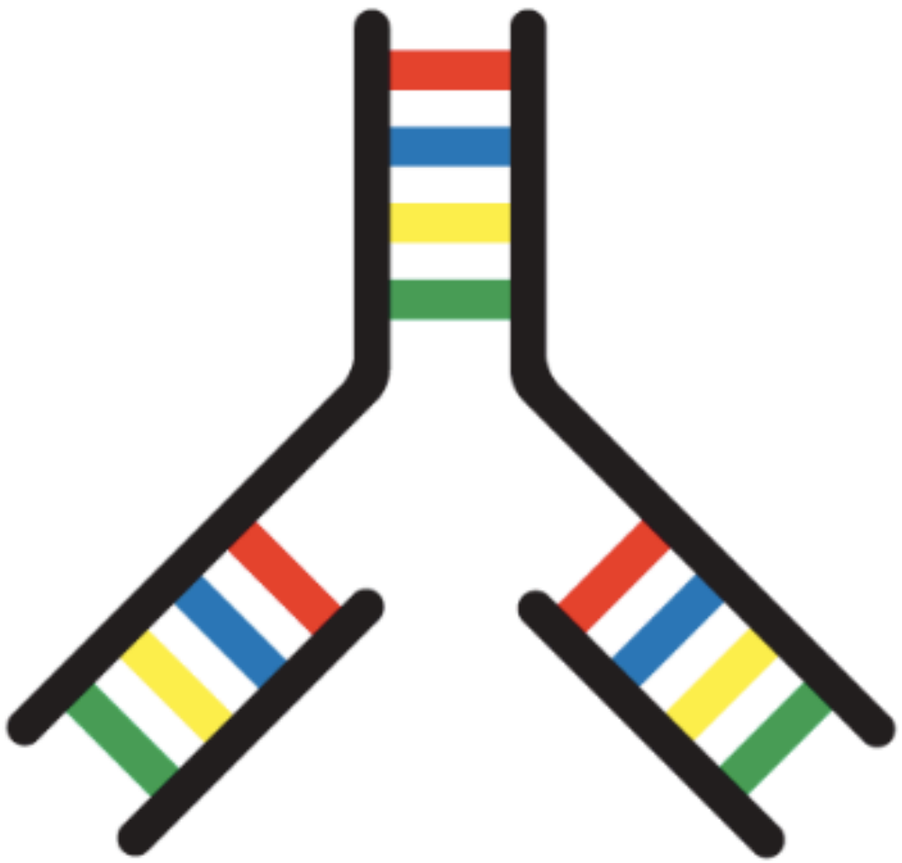
http://OpenPCR.org -- Tito and Josh

San Francisco, CA

Glowing Plant 2013



Indie Bio



INDIE BIO

San Francisco CA, USA

RebelBio

Cork, Ireland

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Super powers

What are the big players up to?

RNAi in agriculture

CRISPR edited embryos

nature International weekly journal of science

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

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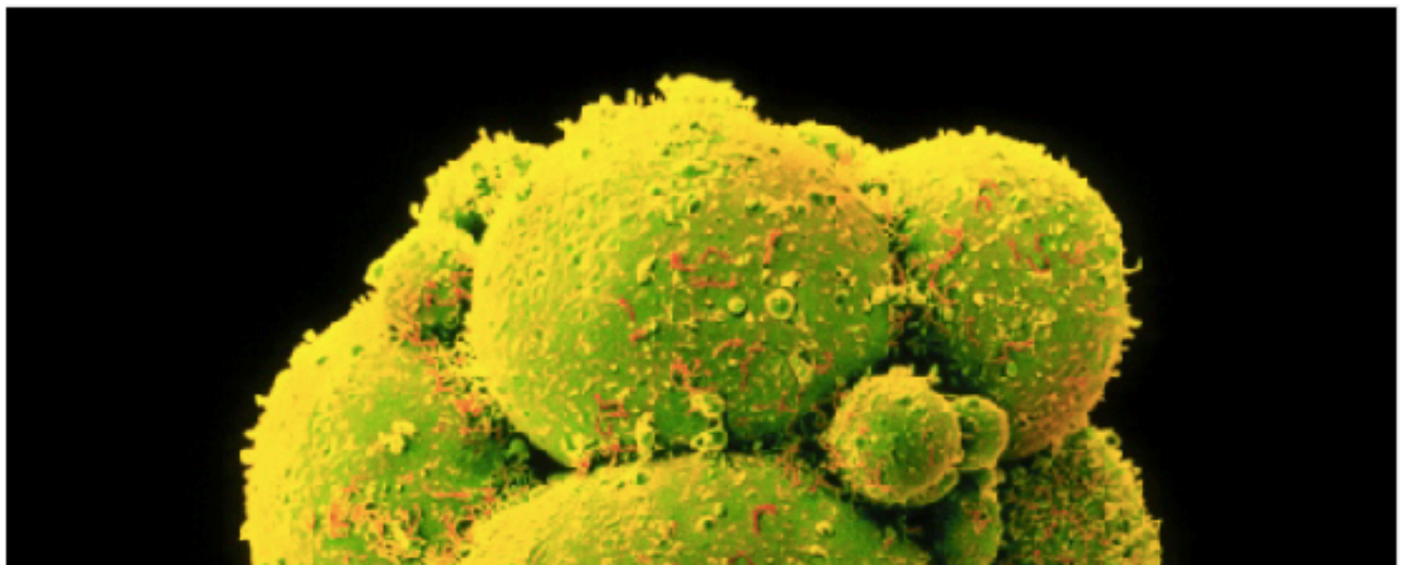

Moonshot!

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

NATURE | NEWS

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

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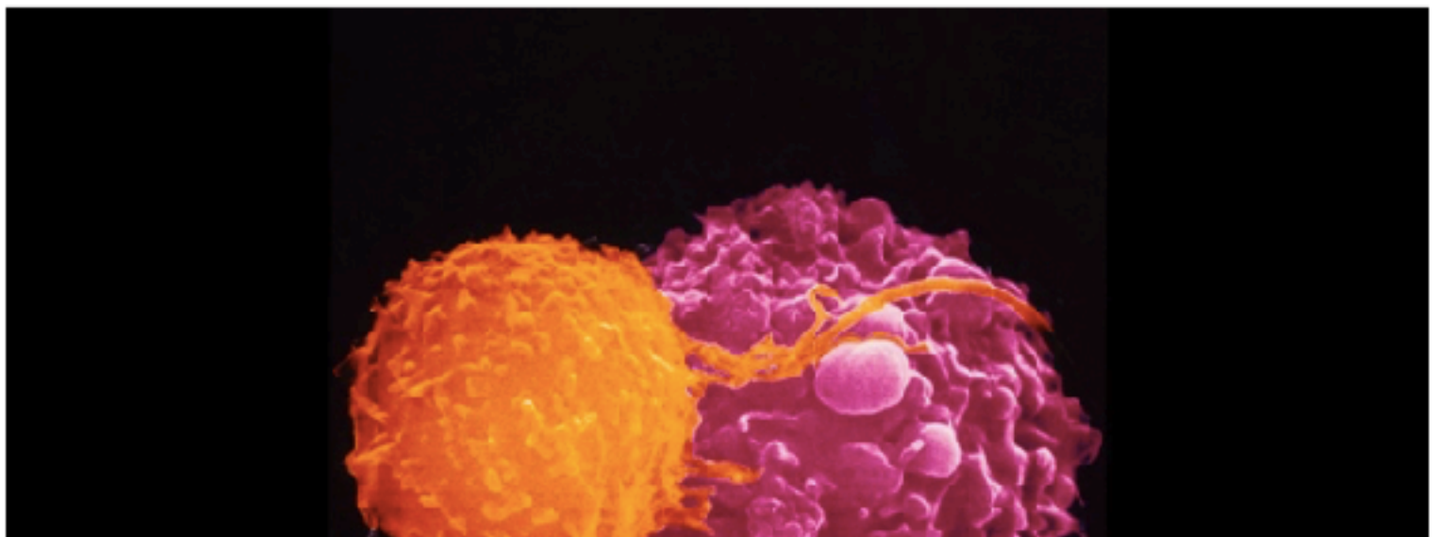

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2. Meet the scientists affected by Trump's immigration ban
   Nature | 29 January 2017
3. Trump agenda threatens US legacy of

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 Regalado September 6, 2016

Neurogenerative stem cell therapy

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

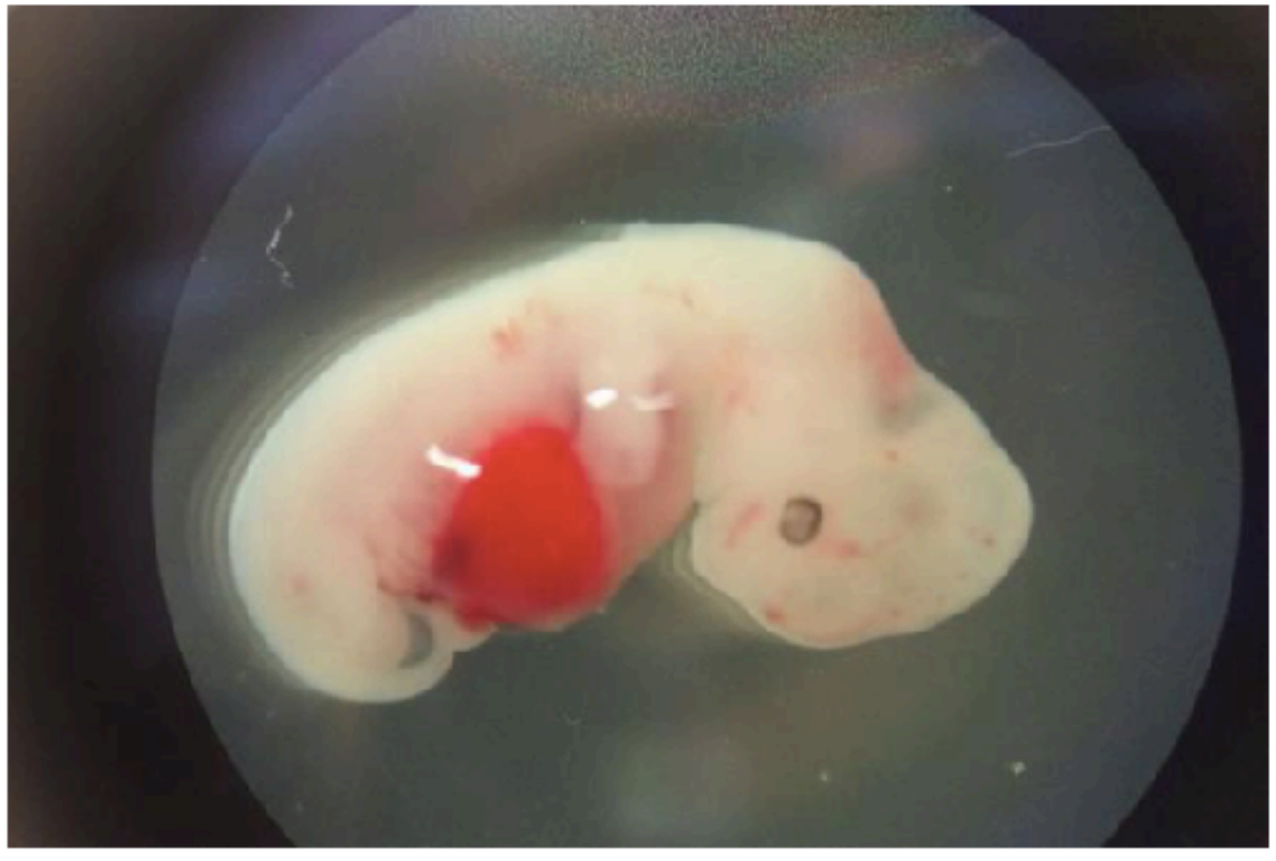
The 21-year-old who suffered a cervical spine injury in March gains significant improvement in his motor function at Keck Hospital of USC

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