



Human_Internet @human_internet1

30 Mar 20 · 25 tweets · [human_internet1/status/1244451370356191233](https://twitter.com/human_internet1/status/1244451370356191233)



George Church, Ph.D.

George leads Synthetic Biology at the Wyss Institute, where he oversees the directed evolution of molecules, polymers, and whole genomes to create new tools with applications in regenerative medicine...

<https://wyss.harvard.edu/team/core-faculty/george-church/>

<https://patents.google.com/?inventor=George+M.+Church&page=1>

PATENTS ASSIGNED TO/ OR CONTRIBUTED BY

GEORGE CHURCH - HARVARD

<https://harvardmagazine.com/2004/01/dna-as-data.html>



Speaking Nature's Language

A new editing technology could allow scientists to push genetic alterations through wild populations of organisms.

<https://mail.harvardmagazine.com/2016/05/speaking-natures-language>

A	T	G	T	G	C	T	C	G	C	T	T	T	C	C	G	A	G	C		
T	T	G	C	T	C	G	C	T	T	T	C	C	G	A	G	C	G	A	G	
C	T	C	G	C	T	A	G	T	C	C	G	A	G	C	G	A	G	C	G	
G	C	T	T	T	T	C	C	G	A	G	C	G	A	G	C	G	T	A	G	
T	T	T	C	G	A	G	C	G	A	G	C	G	T	T	A	G	C	T	A	G
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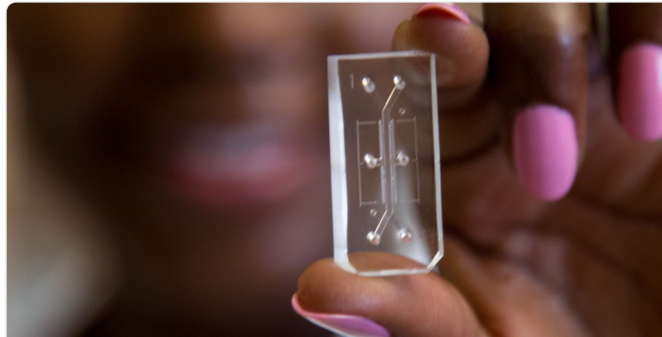
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G A G C G T A A A T G T T G C T C G
C G T A G A T G T T G C T C G C T T
A A A T G T T G C T C G C T T T A

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Life: The Edited Version

George Church has developed tools for large-scale editing of the genome as fast and easy as word processing.

<https://mail.harvardmagazine.com/2011/11/george-church-has-developed-tools-for-larg...>



Technologies

The Wyss Institute develops groundbreaking bioinspired technologies that range from devices and materials to high-value therapeutics and diagnostics.

<https://wyss.harvard.edu/technologies/?pg=10>

Harvard - Synthetic Biology Projects

arep.med.harvard.edu/SBP/

2001 DARPA grant

arep.med.harvard.edu/darpabiocomp/

DARPA BAA 01-26: BIO-COMP (3-May-2001) Start date 28-Sep-2001

https://web.archive.org/web/20010306074918/https://www.darpa.mil/ito/Solicitations/PIP_01-26.html

I. DNA COMPUTING

II. COMPUTATIONAL MODELS AND SIMULATION OF INTRA-CELLULAR PROCESSES

DNA Memory I/O & Minigenome Project

NEW RESOURCES:
 MOMA_Minimization of Metabolic Adjustment (Optimal & near-optimal metabolic fluxes)
 Future Technology
 Contributions to DARPA BioSPICE
 Synthetic Minigenome tables (2-May-2001)

Submitted in response to: **DARPA BAA 01-26: BIO-COMP** (3-May-2001) Start date 28-Sep-2001.
 MSWord copy of the proposal (2-May-2001)
 Revised goals (22-Aug-2001)
 15-Jan-2002 Quarterly Report
 15-Apr-2002 Quarterly Report
 12-Jul-2002 Annual Report
 15-Oct-2002 Quarterly Report
 15-Jan-2003 Quarterly Report
 15-Apr-2003 Quarterly Report
 11-Jul-2003 Annual Report
 15-Oct-2003 Quarterly Report
 Slides for the proposal.

George Church - Updated 3/3/2019

arep.med.harvard.edu/gmc/

Harvard Molecular Technologies Updated 1/4/2019

arep.med.harvard.edu

64-x.com/news

64-x.com/team

64-x.com

spacegenetics.hms.harvard.edu



GEORGE CHURCH LABORATORY GRANTS

HARVARD

http://arep.med.harvard.edu/gmc/gc_grants.html

Harvard Molecular Technologies | Contact | Calendar | Courses | G.Church | Lab | News | Publications | W3C HTML 5.0

Church Laboratory Grant Proposals

- 1987...2002, 2007, 2012, 2016 - present: [DOE-Technology](#)
- 2003-2009: [NIH NHGRI CEGS MGIC: Molecular and Genomic Imaging Center](#)
- 2009-2014: [NIH NHGRI CEGS CCV: Casual Consequences of Variation](#)
- 2015-2020: [NIH NHGRI CEGS CGEO: Genomically Engineered Organs](#)
- 2015-2019: [NIH NIA TR01: Genome Engineering an iPSC Model of Alzheimer's Disease](#)
- 2016-2021: [NIH NIMH R01: Exploring a Novel Paradigm of Schizophrenia and Bipolar Disorder](#)
- 2013-2018: [NIH NIMH TR01: Recording neural activities onto DNA](#)
- 2005-present: [Personal Genome Project ; Cell Resources](#)
- 2008-present: [Wyss Inst. Synthetic Biology Platform](#)
- 2001-2004: [DARPA Bio-Camp](#) (Sri Kumar, PM)
- 2012-2015: [DARPA Living Foundries](#) (Alicia Jackson, PM)
- 2011-2014: [DARPA Dialysis Like Therapeutics program](#) (Col. Matthew Hepburn, PM)
- 2016-2021: [IARPA MICRONS BRAIN](#) (Jacob Vogelstein, David Markowitz, PM)
- 2017-2021: [DARPA Safe Genes](#) (Renee Wegrzyn, PM)
- 2017-2021: [DARPA Engineered Living Materials \(ELM\)](#) (Justin Gallivan, PM)
- 2017-2020: [IARPA Functional Genomic and Computational Assessment of Threats \(Fun GCAT\)](#) (John Julius, PM)

[Grantome](#)

Latest Update: 22-Apr-2018 by George ([email](#)).

DNA ENCODING

HARVARD

DNA AS "STORAGE" FOR DATA

http://arep.med.harvard.edu/gmc/DNA_data.html

Novel Polymer Encoding Methods

Team	Method	Goal	<i>In vivo</i>
CatalogDNA	-	Info	N
Centrilliontech*	Chem+Enz	Seq	N
DNAScript	Enz	Bio	N
Iridia*	-	Info	N
Evonetix*	-	Bio	N
Kern Systems*	TdT	Info	N
Microsoft*	Chem	Info	N
Molecular Assemblies	TdT	Bio+Info	N
Nuclera*	TdT	Bio	N
Palluk et al.	TdT	Bio	N
Church et al. 2012*	Chem	0.5 Mbyte	N
Shipman et al. 2017*	Cas1/2	Info	Y
Kalhor et al. 2017*	hgRNA	1TByte	Y
Technicolor*	Chem	Info	N
Twist*	Chem	Bio+Info	N

Chem: Phosphoramidite, water-free acetonitrile, etc.

Enz: Enzymatic Polymerization (PNP, TdT, ligase, etc.)

TdT: Terminal deoxynucleotidyl Transferase

Bio: High fidelity required for synthetic biological applications

Info: Storage Lower raw accuracy, yet high consensus accuracy

Seq: Oligos for complete genome sequencing

In vivo, Y: applications to recording biological data in living cells

* = Church lab related.

Molecular Information Storage -- [MIST IARPA](#).

[The impending data storage crisis, and how DNA will fix it](#) (Synbiobeta, 6-May-2019 | Matt Klusas)

A Path to SuperCells Therapies



GC Therapeutics

<https://www.gc-tx.com>

"Engineering cell types is the key to cell therapies, transplants and testing new drugs"

George Church



MICrONS (IARPA)

HARVARD Participation

arep.med.harvard.edu

IARPA - MICrONS PROGRAM

<https://www.iarpa.gov/index.php/research-programs/microns>

Office of the Director of National Intelligence

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Home > Research Programs > MICrONS

Machine Intelligence from Cortical Networks (MICrONS)

MICrONS seeks to revolutionize machine learning by reverse-engineering the algorithms of the brain. The program is expressly designed as a dialogue between data science and neuroscience. Participants in the program will have the unique opportunity to pose biological questions with the greatest potential to advance theories of neural computation and obtain answers through carefully planned experimentation and data analysis. Over the course of the program, participants will use their improving understanding of the representations, transformations, and learning rules employed by the brain to create ever more capable neurally derived machine learning algorithms. Ultimate computational goals for MICrONS include the ability to perform complex information processing tasks such as one-shot learning, unsupervised clustering, and scene parsing, aiming towards human-like proficiency.

Program Manager
David Markowitz

Program Information
[IARPA-BAA-14-06](#)
[IARPA Day Poster](#)
[GitHub Repository](#)
[Software](#)
[Documentation](#)

Research Area(s)

- Theoretical neuroscience
- Computational neuroscience
- Machine learning
- Connectomics
- Brain activity mapping

Related Publications
To access MICrONS program-related publications, please visit [Google Scholar](#).

Related Article(s)

HARVARD MEDICAL SCHOOL

THE SILVER LAB

<http://silver.med.harvard.edu/index.php/education-programs/>

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Our research

- Engineered Protein Therapeutics
- Viruses
- Genetic Circuits and Genome Engineering
- Biostasis
- Bionic Leaf
- Reprogramming the Gut

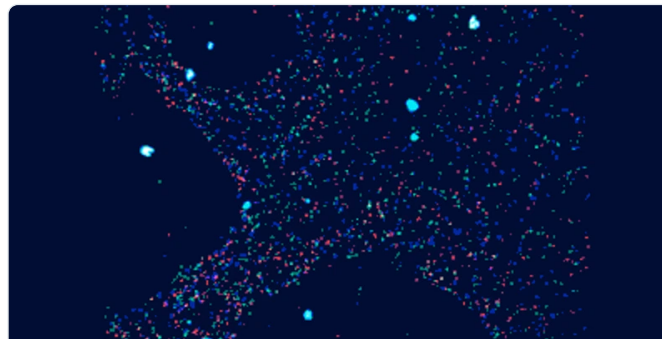
George Church A Peek at the Future of Synthetic Biology and Radical Wellness



<https://www.youtube.com/embed/nvgaks9eePY>



https://www.youtube.com/embed/gseGg_8gSSw



Wyss Institute Will Lead IARPA-Funded Brain Mapping Consortium

The Wyss Institute for Biologically Inspired Engineering at Harvard University today announced a cross-institutional consortium to map the brain's neural...

<https://wyss.harvard.edu/news/wyss-institute-will-lead-iarpa-funded-brain-mapping-con...>

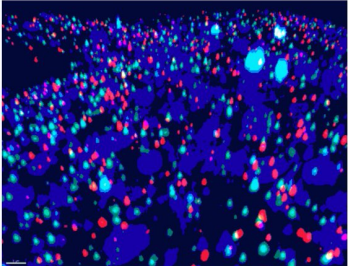
...To map neural connections, the consortium will genetically engineer mice so that each neuron is barcoded throughout its entire structure with a unique RNA sequence,...

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"Historically, the mapping of neuronal paths and circuits in the brain has required brain tissue to be sectioned and visualized by electron microscopy. Complete neurons and circuits are then reconstructed by aligning the individual electron microscope images, this process is costly and inaccurate due to use of only one color (grey)," said Church, who is the Principal Investigator for the IARPA MICRONS consortium. "We are taking an entirely new approach to neuronal connectomics, immensely colorful barcodes, that should overcome this obstacle; and by integrating molecular and physiological information we are looking to render a high-definition map of neuronal circuits dedicated first to specific sensations, and in the future to behaviors and cognitive tasks."

Church is Professor of Genetics at Harvard Medical School, and Professor of Health Sciences and Technology at Harvard and MIT.

To map neural connections, the consortium will genetically engineer mice so that each neuron is barcoded throughout its entire structure with a unique RNA sequence, a technique called BOINC (Barcoding of Individual Neuronal Connections) developed by Anthony Zador at Cold Spring Harbor Laboratory. Thus a complete map representing the precise location, shape and connections of all neurons can be generated.



See how the Wyss-developed FISSEQ technology is able to capture the location of individual RNA molecules within cells, which will allow the reconstruction of neuronal networks in the 3-dimensional space of intact brain tissue. Credit: Wyss Institute at Harvard University

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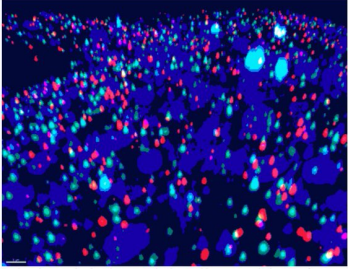
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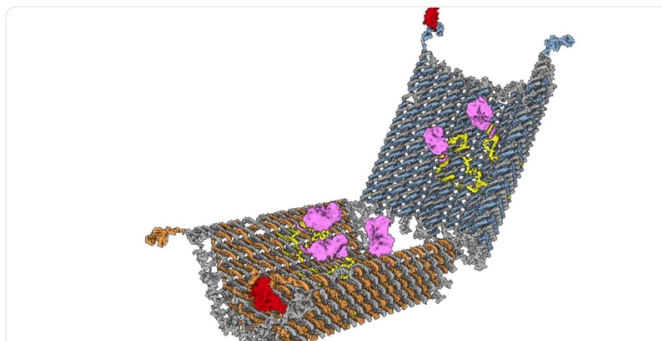
See how the Wyss-developed FISSEQ technology is able to capture the location of individual DNA molecules within cells, which will allow the reconstruction of neuronal networks in the 3-dimensional space of intact brain tissue. Credit: Wyss Institute at Harvard University



Information Storage in DNA

Information Storage in DNA on Wyss Institute | George Church and Sriram Kosuri discuss the benefits of using DNA as a storage medium and the approach they...

<https://wyss.harvard.edu/media-post/information-storage-in-dna/>



DNA Nanorobot: Cell-Targeted, Payload-Delivering

DNA Nanorobot: Cell-Targeted, Payload-Delivering on Wyss Institute | This video describes a cell-targeted, payload-delivering DNA nanorobot developed at the...

<https://wyss.harvard.edu/media-post/dna-nanorobot-cell-targeted-payload-delivering/>

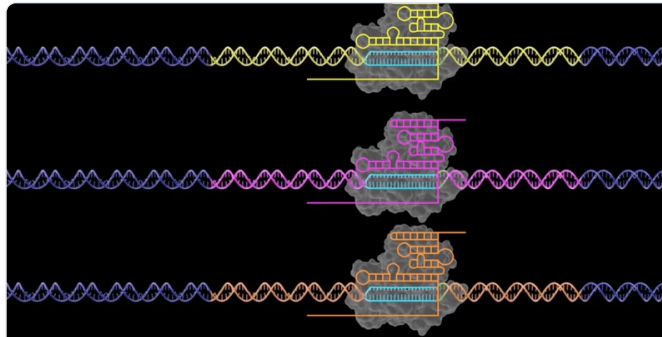




CRISPR-Cas9: Gene Drives

CRISPR-Cas9: Gene Drives on Wyss Institute | This animation explains how an emerging technology called “gene drives” may be used to potentially spread...

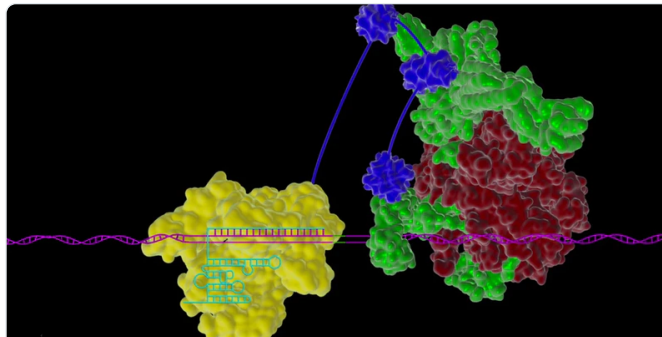
<https://wyss.harvard.edu/media-post/crispr-cas9-gene-drives/>



CRISPR-Cas9: Gene Target Troubleshooting

CRISPR-Cas9: Gene Target Troubleshooting on Wyss Institute | In this animation, learn how a “library on library” approach was used to create a software...

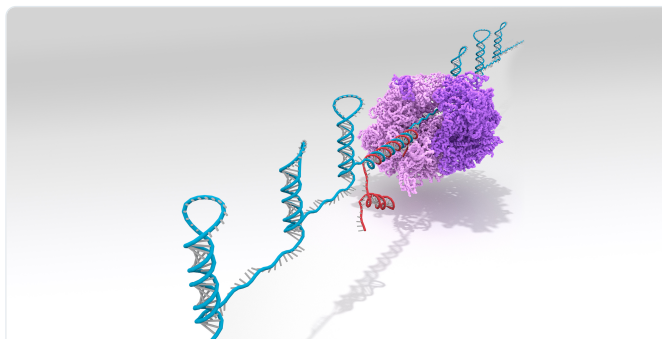
<https://wyss.harvard.edu/media-post/crispr-cas9-gene-target-troubleshooting/>



Cas9: As a Transcriptional Activator

Cas9: As a Transcriptional Activator on Wyss Institute | In this technical animation, Wyss Institute researchers instruct how they engineered a Cas9 protein...

<https://wyss.harvard.edu/media-post/cas9-as-a-transcriptional-activator/>



Toe-hold Switches for Synthetic Biology

A nanodevice that can sense environmental stimuli and produce proteins for diagnostic and other synthetic biology applications

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