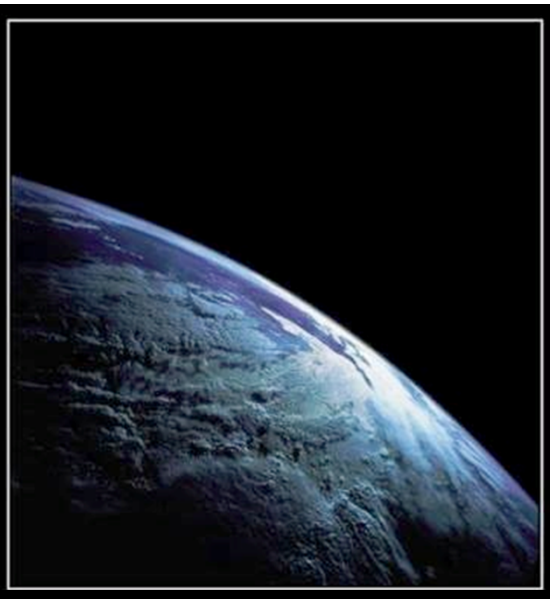
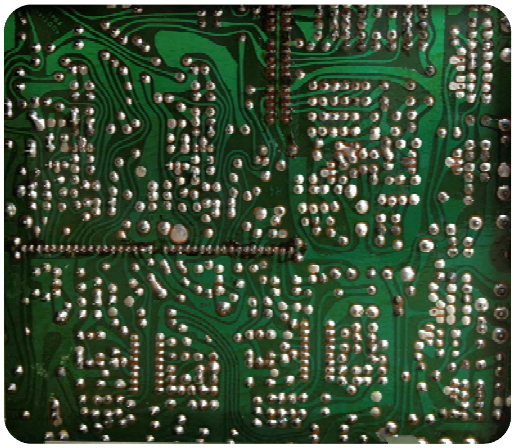
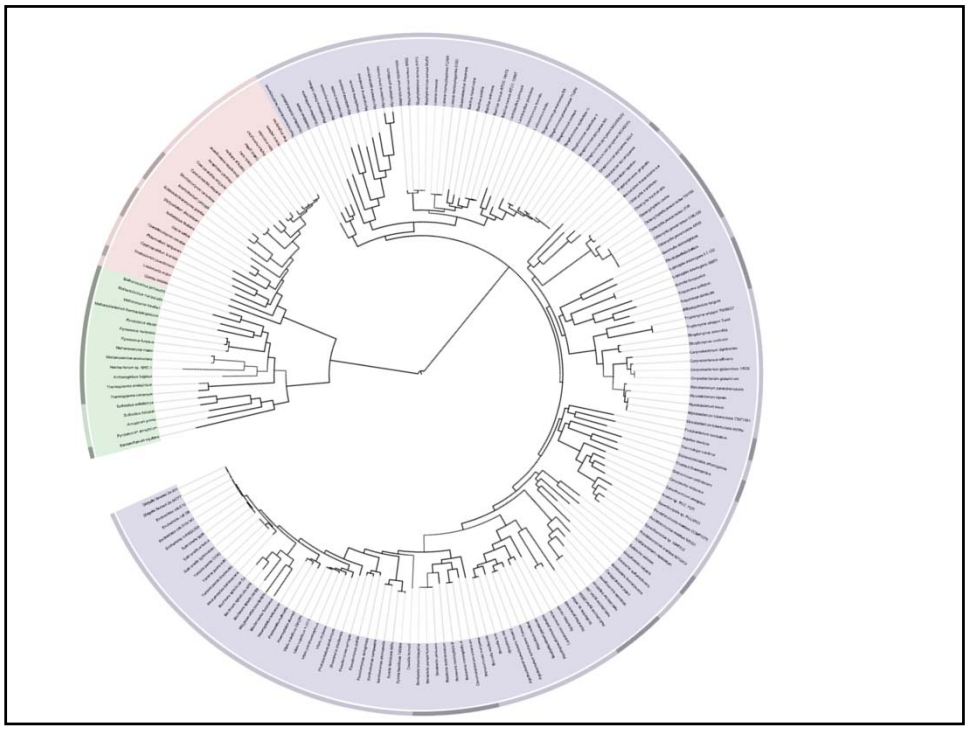
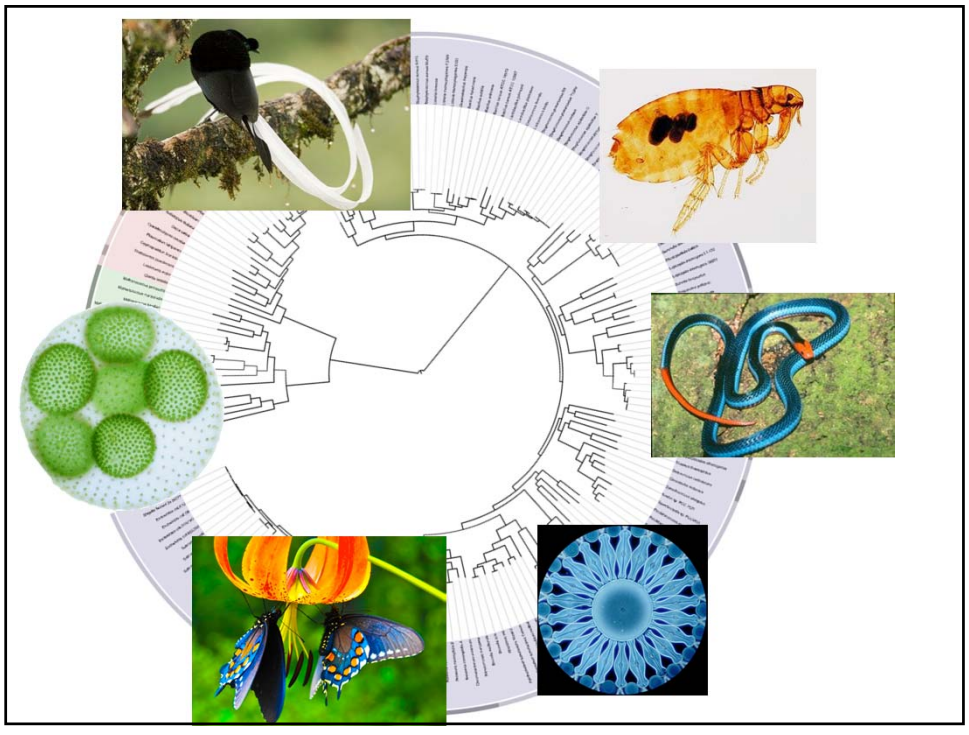


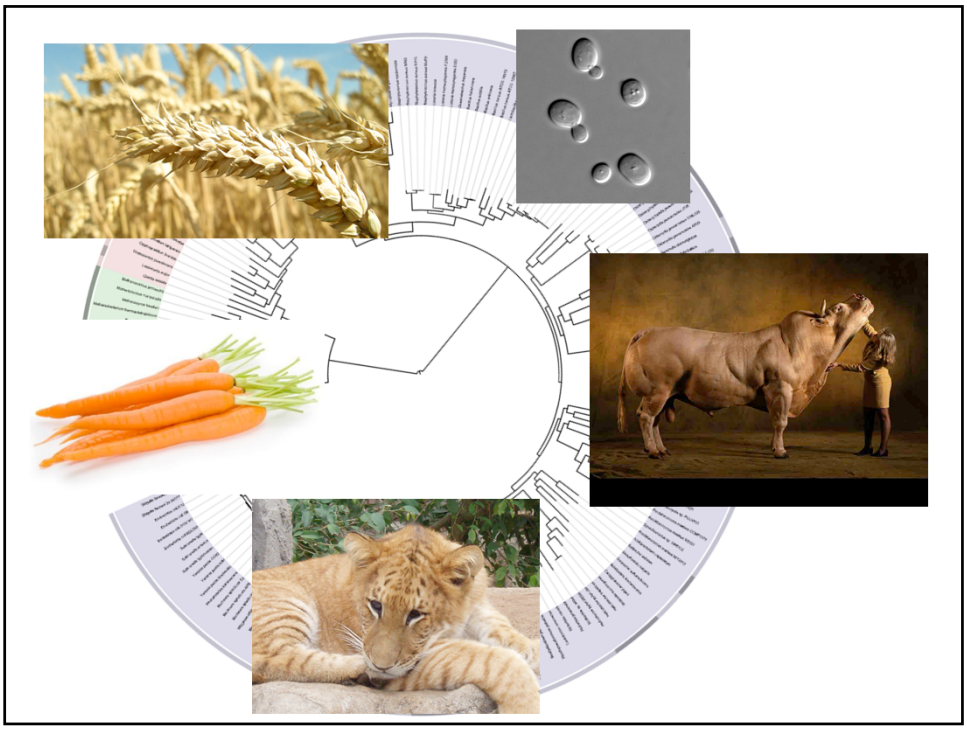
I bet Earth

makes fun of other planets for having no life









## Stier Herman

**“Die kosten zijn relatief hoog (zo'n 45.000 € per jaar), omdat de overheid strenge eisen stelt aan de verzorging en huisvesting van genetisch gemanipuleerde dieren.”**

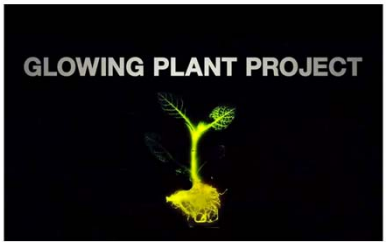
**Danio Glofish**

Item: 36-15189

Read all 84 reviews  Write a review

**$ 5.19**

KICKSTARTER



*Drosophila synthetica*


Moreno, 2012

## Synthetische biology

wat is het
&
hoe wordt er gebouwd?

# Wat is synthetische biologie?

REVIEWS

Foundations for engineering biology

Drew Endy

"Het ontwerpen van toepasbare synthetische biologische systemen is nog steeds een **duur**, **onbetrouwbaar** en ***ad hoc*** proces"

de knutsel-fase ontgroeit

**Genetische Modificatie**

1. Recombinant DNA
2. PCR
3. Automatische Sequencing

www.youtube.com/watch?v=XIuh7KDRzLk

## de knutsel-fase ontgroeit

**Genetische Modificatie**

1. Recombinant DNA
2. PCR
3. Automatische Sequencing

**Synthetische Biologie**

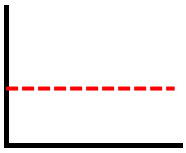
1. Automatische constructie
2. Standaard
3. Abstractie

Modulariteit

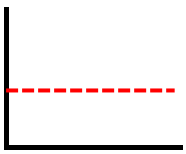
www.youtube.com/watch?v=XIuh7KDRzLk

## waar moeten we aan denken?

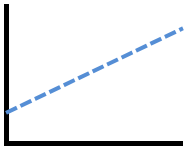
constitutieve genexpressie

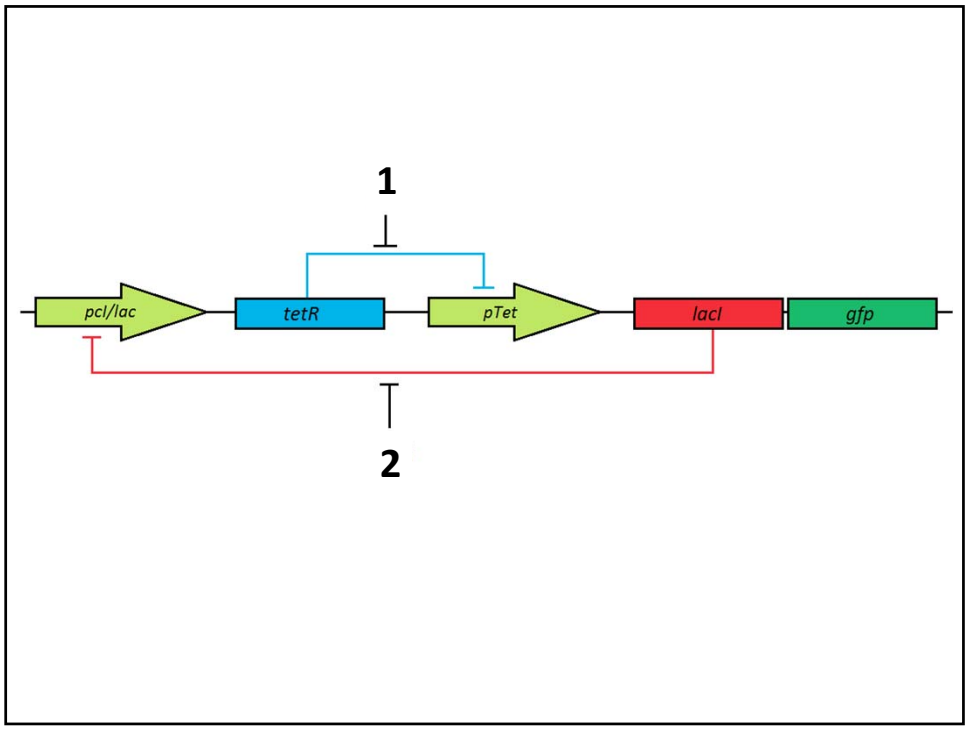


constitutieve genexpressie

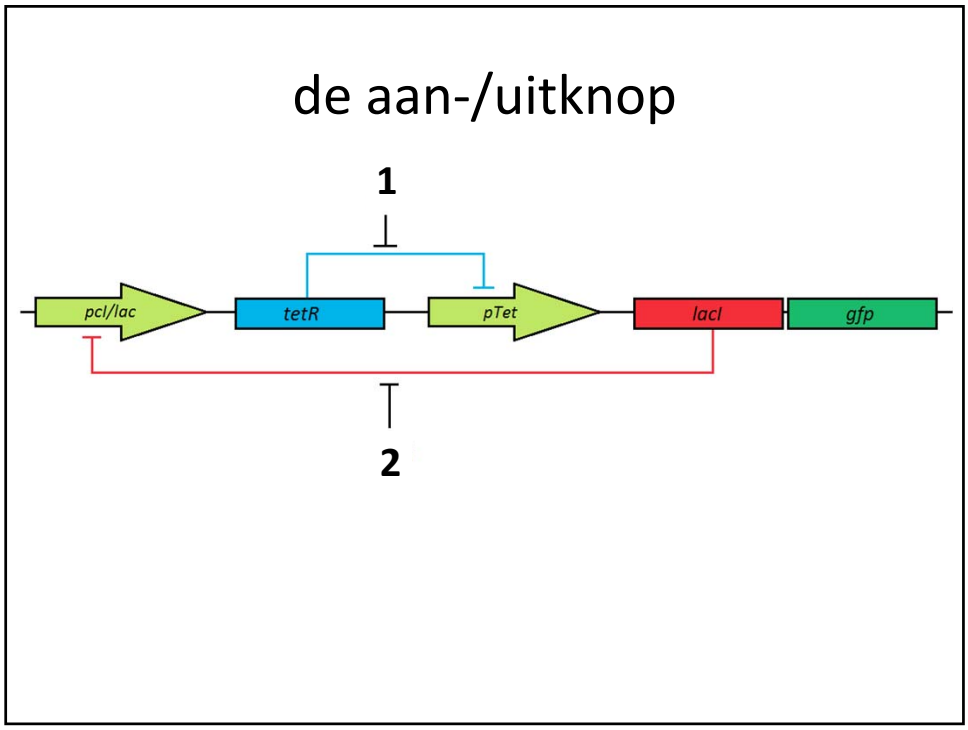


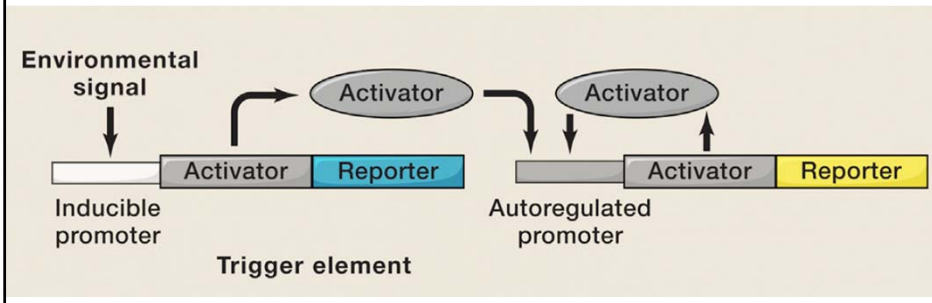
induceerbare genexpressie



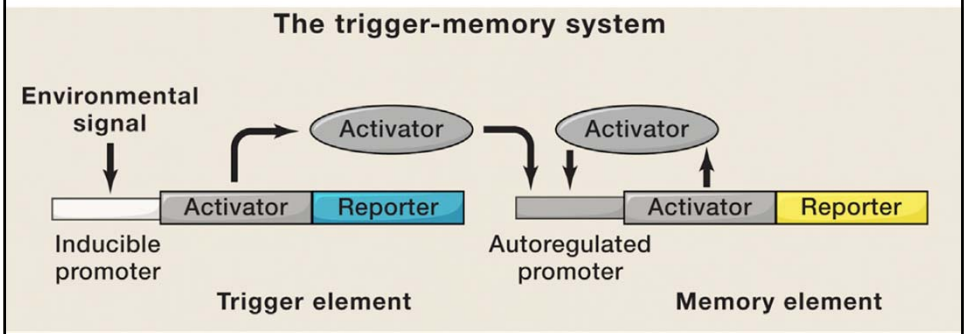



# de aan-/uitknop





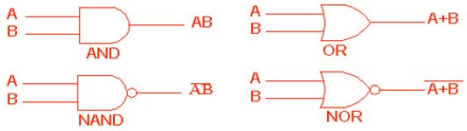

# het geheugen



**Construction of a genetic toggle switch in *Escherichia coli***

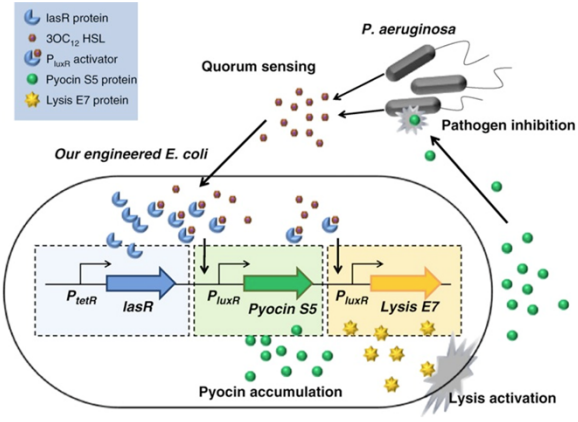

**Rewritable digital data storage in live cells via engineered control of recombination directionality**

**Genetic programs constructed from layered logic gates in single cells**



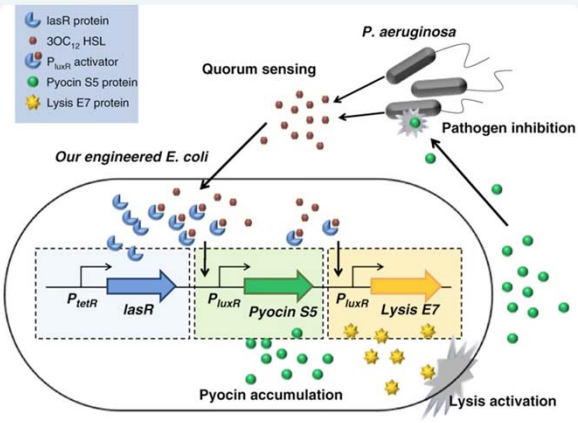

## en wat kunnen we bouwen?

**Engineering microbes to sense and eradicate *Pseudomonas aeruginosa*, a human pathogen**



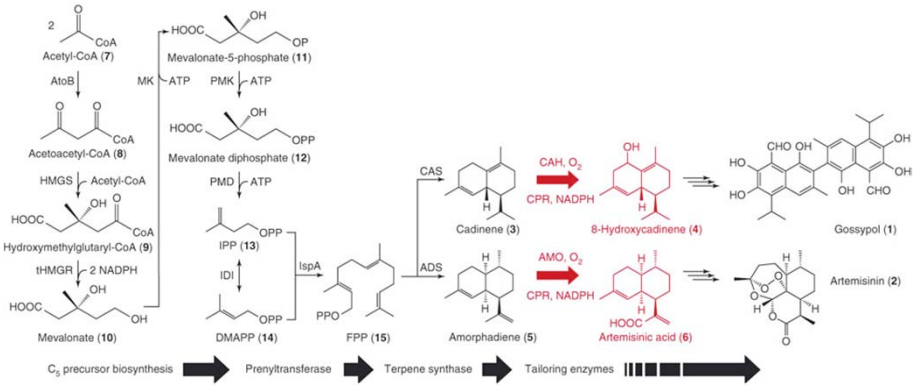
# en wat kunnen we bouwen?

## Colours of Biotechnology: Kamikaze E. coli – bacteria fighting bacteria




nature International weekly journal of science

## High-level semi-synthetic production of the potent antimalarial artemisinin



nature International weekly journal of science

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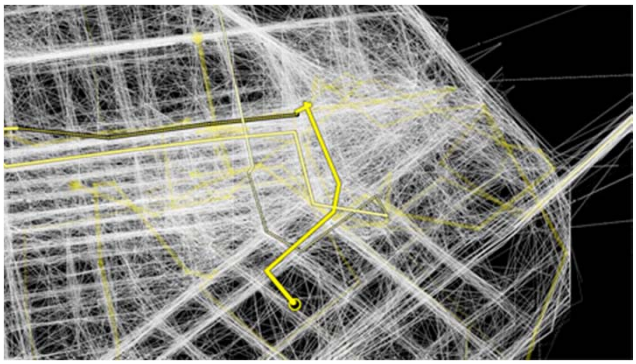
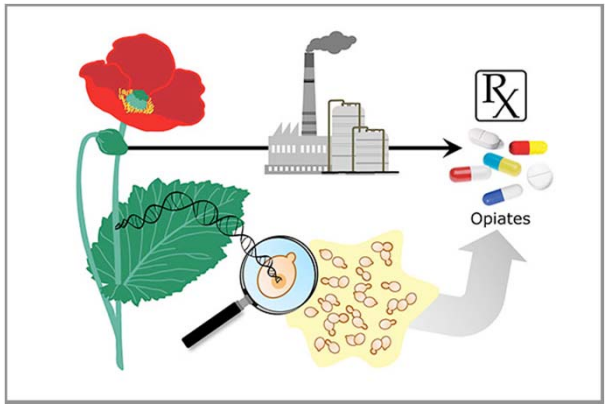


Stanford Report, August 24, 2014

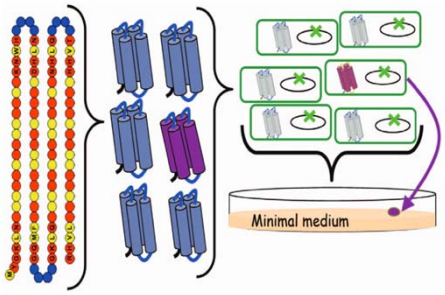
Stanford bioengineers close to brewing painkillers without using opium from poppies



OPEN ACCESS Freely available online

PLOS one

***De Novo* Designed Proteins from a Library of Artificial Sequences Function in *Escherichia Coli* and Enable Cell Growth**




OPEN ACCESS Freely available online

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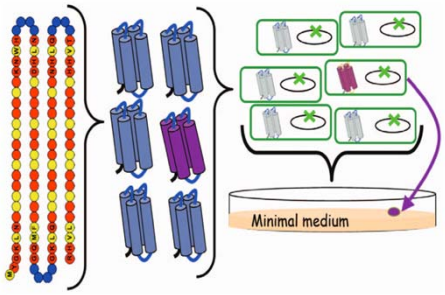
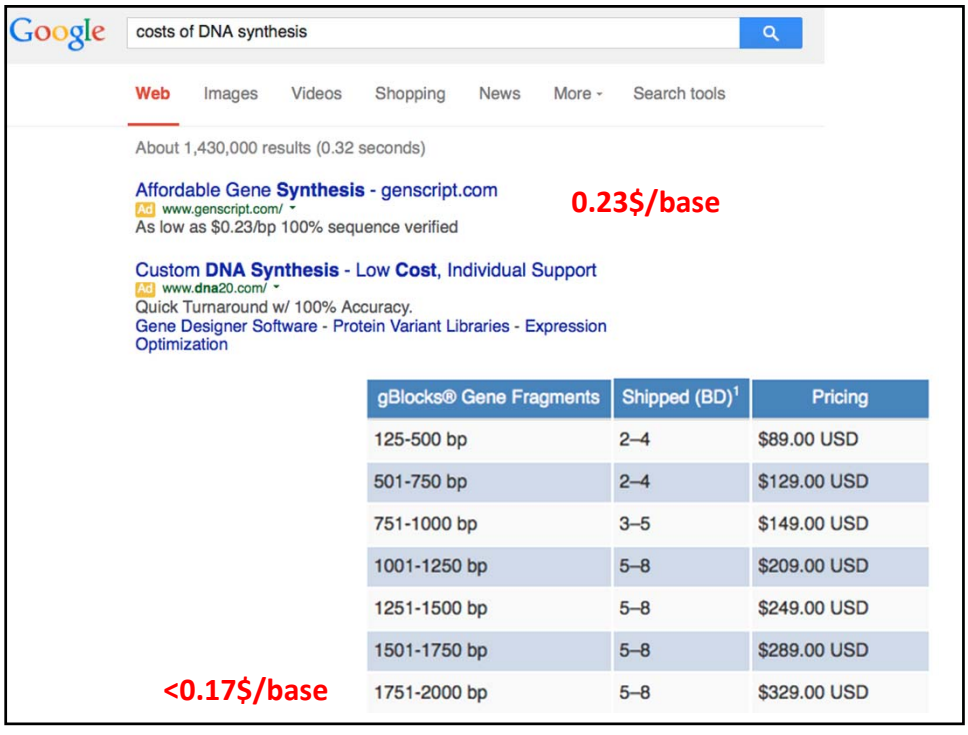



the theoretical diversity of this library is
$5^{22} \times 6^{34} \times 8^{12} =$ **$5 \times 10^{52}$**

the artificial library is only $5 \times 10^{6}$ genes

# hoe wordt er gebouwd?

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| 1001-1250 bp | 5–8 | $209.00 USD |
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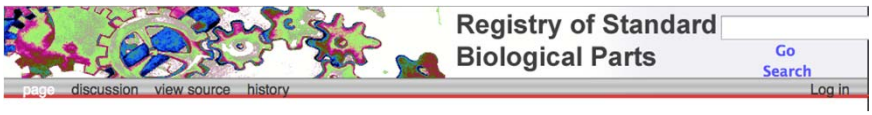
| 1501-1750 bp | 5–8 | $289.00 USD |
| 1751-2000 bp | 5–8 | $329.00 USD |

# hoe wordt er gebouwd?

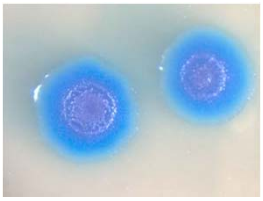


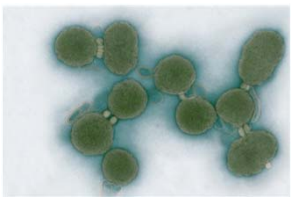

# hoe wordt er gebouwd?

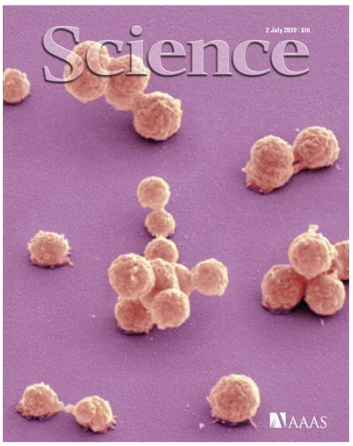

# hoe wordt er gebouwd?

**Creation of a Bacterial Cell Controlled by a Chemically Synthesized Genome**

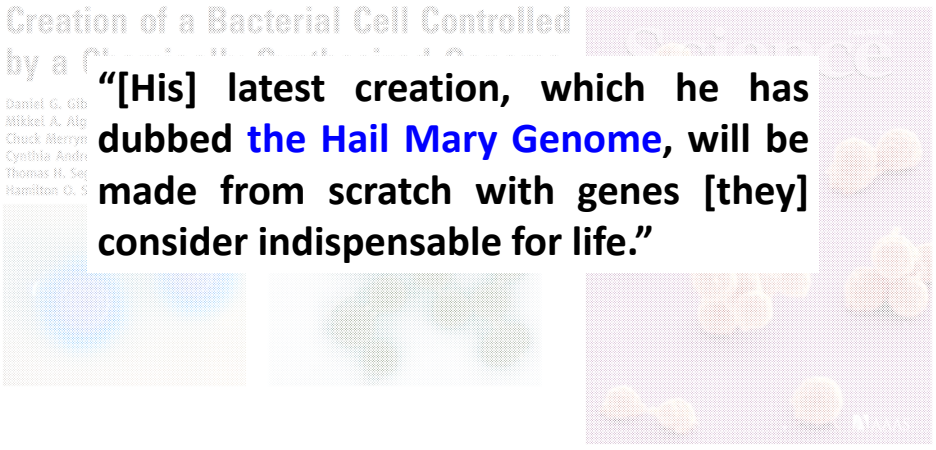
Daniel G. Gibson,[1] John I. Glass,[1] Carole Lartigue,[1] Vladimir N. Noskov,[1] Ray-Yuan Chuang,[1] Mikkel A. Algire,[1] Gwynedd A. Benders,[2] Michael G. Montague,[1] Li Ma,[1] Monzia M. Moodie,[1] Chuck Merryman,[1] Sanjay Vashee,[1] Radha Krishnakumar,[1] Nacyra Assad-Garcia,[1] Cynthia Andrews-Pfannkoch,[1] Evgeniya A. Denisova,[1] Lei Young,[1] Zhi-Qing Qi,[1] Thomas H. Segall-Shapiro,[1] Christopher H. Calvey,[1] Prashanth P. Parmar,[1] Clyde A. Hutchison III,[2] Hamilton O. Smith,[2] J. Craig Venter[1,2]*








# hoe wordt er gebouwd?



**“[His] latest creation, which he has dubbed the Hail Mary Genome, will be made from scratch with genes [they] consider indispensable for life.”**

# hoe wordt er gebouwd?

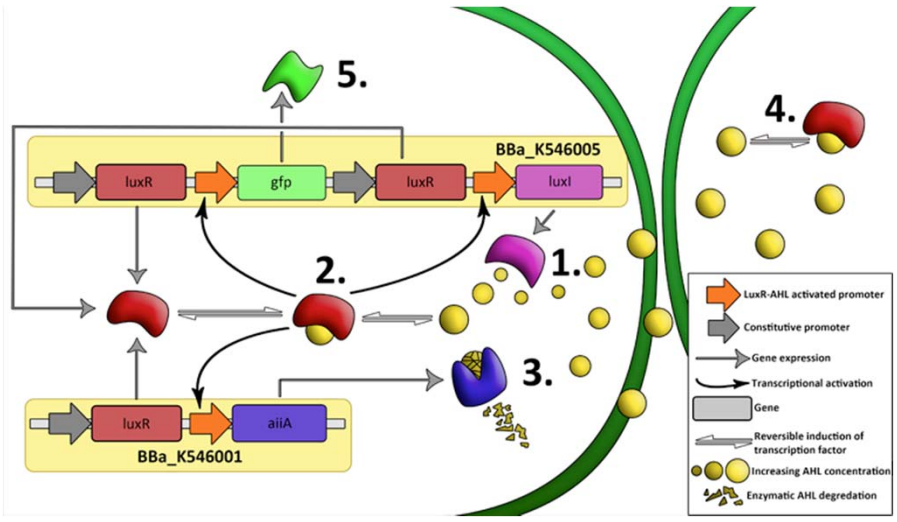
**"[His] latest creation, which he has dubbed the Hail Mary Genome, will be made from scratch with genes [they] consider indispensable for life."**

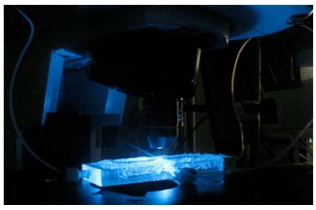
**"Evolution is very messy," Smith added.**

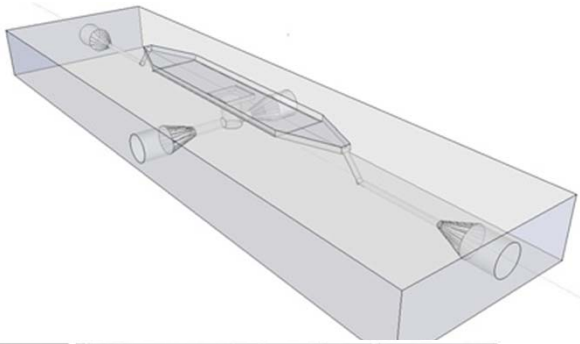
**"We're trying to clean it up," Venter said.**

iGEM@Wageningen UR 2011

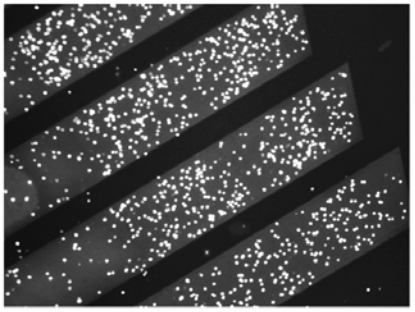
## een synchroon cell communicatie systeem

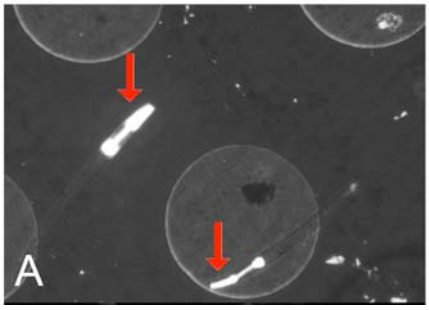


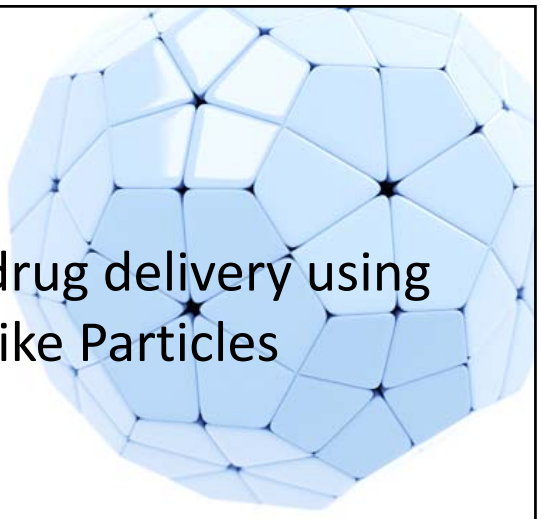




groeimachines



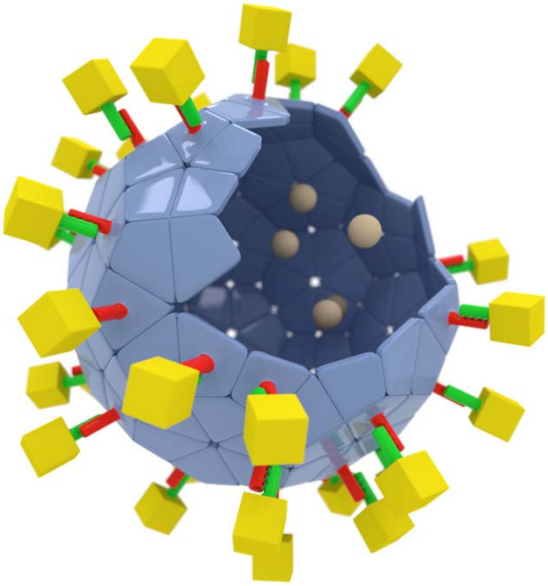


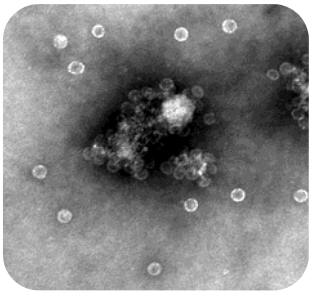



Site-specific drug delivery using Virus-Like Particles

iGEM@Wageningen UR 2012

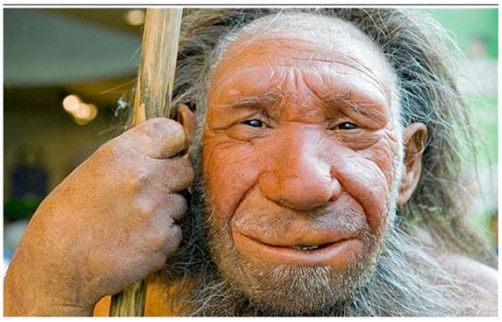
## gemodificeerde virus-achtige deeltjes





'I can create Neanderthal baby, I just need willing woman'

A scientist has said it would be possible to clone a Neanderthal baby from ancient DNA if he could find a woman willing to act as a surrogate.



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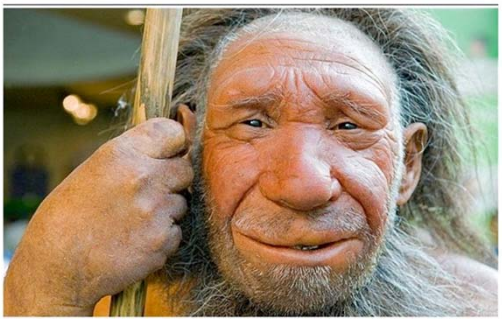
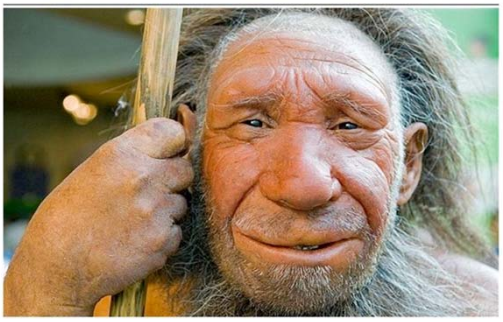


"The result would be a freshly minted Neanderthal genome in a living cell. From there, creating a living, breathing Neanderthal would merely require implanting the cell into the uterus of a chimpanzee, or perhaps into an adventurous human female."

George Church, 2010

'I can create Neanderthal baby, I just need willing woman'

A scientist has said it would be possible to clone a Neanderthal baby from ancient DNA if he could find a woman willing to act as a surrogate.

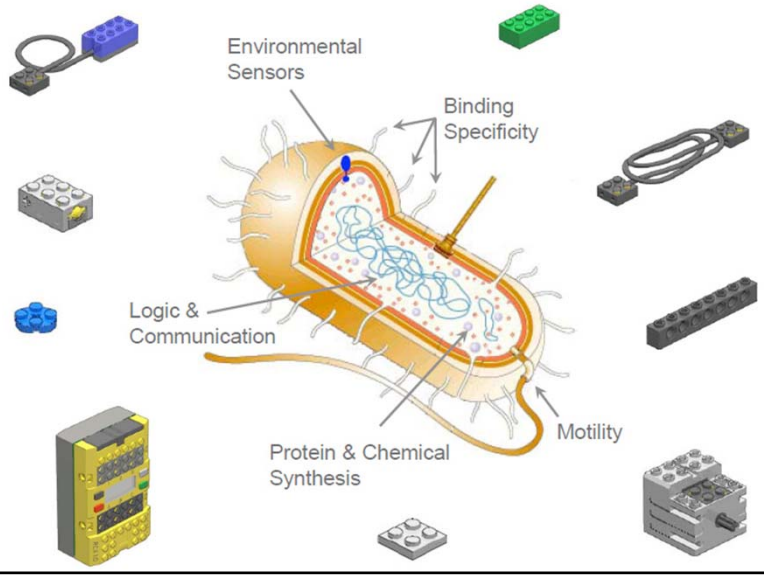


"You don't see anything sacrilegious about this?"

"I wouldn't say sacrilegious," Church responds. "Humans have been manipulating humans in many ways for many years."

George Church, 2010

# weten we nu wat synthetische biologie is?

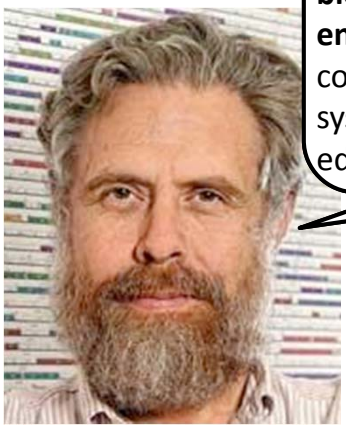


VIEWPOINT

# Realizing the potential of synthetic biology

*George M. Church, Michael B. Elowitz, Christina D. Smolke, Christopher A. Voigt and Ron Weiss*

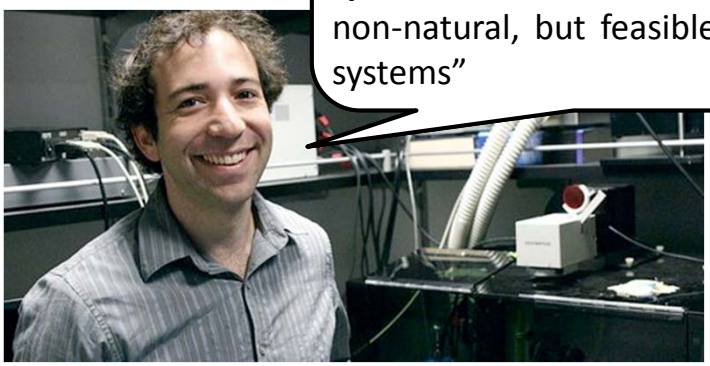
> Synthetic biology is an engineering discipline — there is a desire to build things that do not yet exist.



"... synthetic biology was never focused on 'genetic circuits', but rather **on biology rapidly maturing as an engineering discipline**, including computer-aided-design (CAD), safety systems, integrating models, genome editing and accelerated evolution"

George Church, Harvard

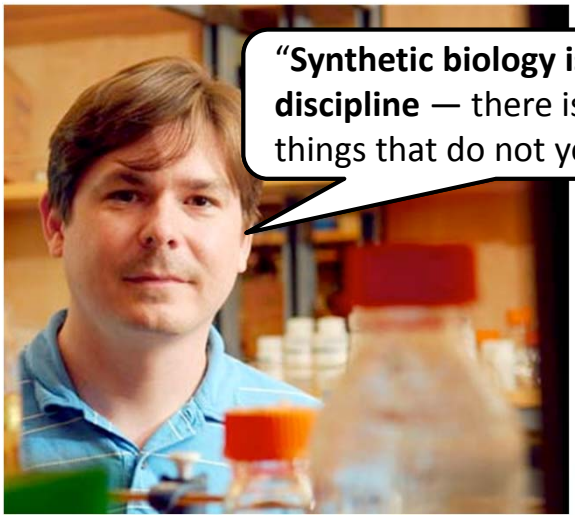
"At the most general level, **synthetic biology expands the subject matter of biology from the space of existing species** ... to the even larger space of non-natural, but feasible, species and systems"



Michael Elowitz, CalTech

"**Synthetic biology has expanded and evolved substantially** from its initial rather narrow focus to appreciate and use more fully the diversity of mechanisms found in natural biological systems"

Christina Smolke, Stanford



"**Synthetic biology is an engineering discipline** — there is a desire to build things that do not yet exist"

Christopher Voigt, MIT

"... **synthetic biology has helped to transform the biological sciences into a true engineering discipline**.
Notable achievements include the creation of a registry of composable parts, ...."

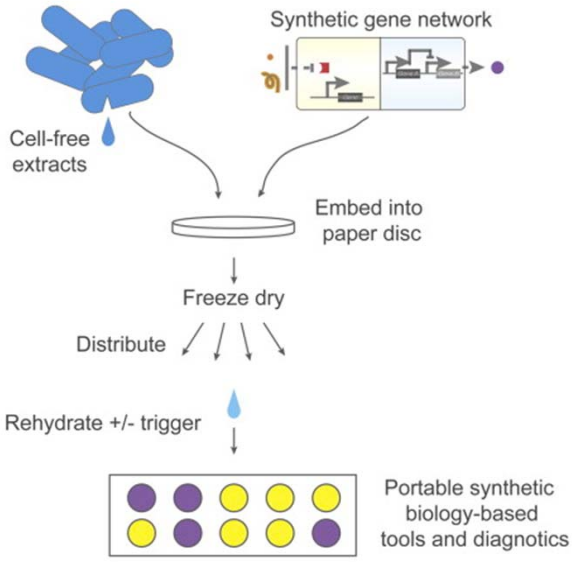
Ron Weiss, MIT

"Screw it. Let's build new biological systems - systems that are easier to understand because we made them that way."

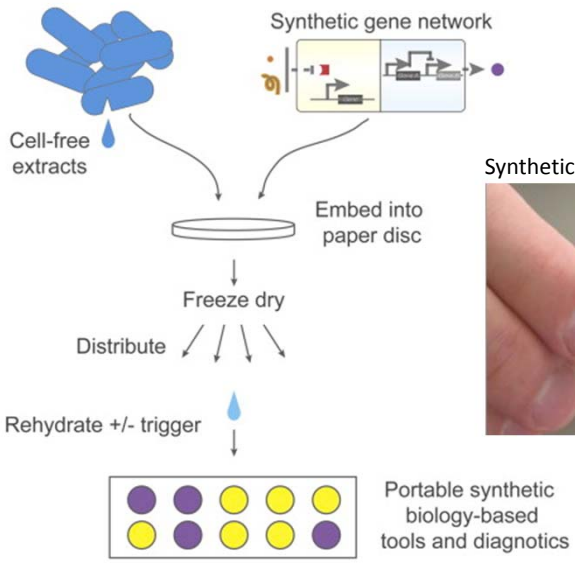
Drew Endy, WIRED, 2005

## maar ....

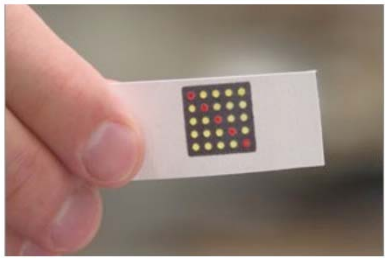
hoe zou het zijn als synthetische biologie abiotisch zou worden toegepast?




http://www.iflscience.com/health-and-medicine/scientists-print-ebola-test-tiny-bits-paper




Synthetic Biology Looks Good on Paper



http://www.iflscience.com/health-and-medicine/scientists-print-ebola-test-tiny-bits-paper

Een stabiel, steriel en abiotisch platform voor synthetische biologie

Makkelijk gebruik in het veld: real-world applications!

Inmiddels is dit getest voor bijv. Ebola detectie

http://www.iflscience.com/health-and-medicine/scientists-print-ebola-test-tiny-bits-paper

# aanbevolen lees- en kijkmateriaal

**What is Synthetic Biology?** Youtube film
www.youtube.com/watch?v=XIuh7KDRzLk

**The Factory of Life.** een overzicht van The Scientist
https://www.sciencenews.org/article/factory-life

**Biohacking.** TED lezing over DIY biologie
http://tinyurl.com/nrbgwzj

# Stelling

DNA synthese wordt goedkoper en goedkoper.

Het wordt bioterroristen steeds makkelijker gemaakt om virussen na te maken.

*Source: http://www.genesynthesisconsortium.org*

## International Gene Synthesis Consortium (IGSC)

## - Harmonized Screening Protocol -

Gene Sequence & Customer Screening to Promote Biosecurity

***http://www.genesynthesisconsortium.org***