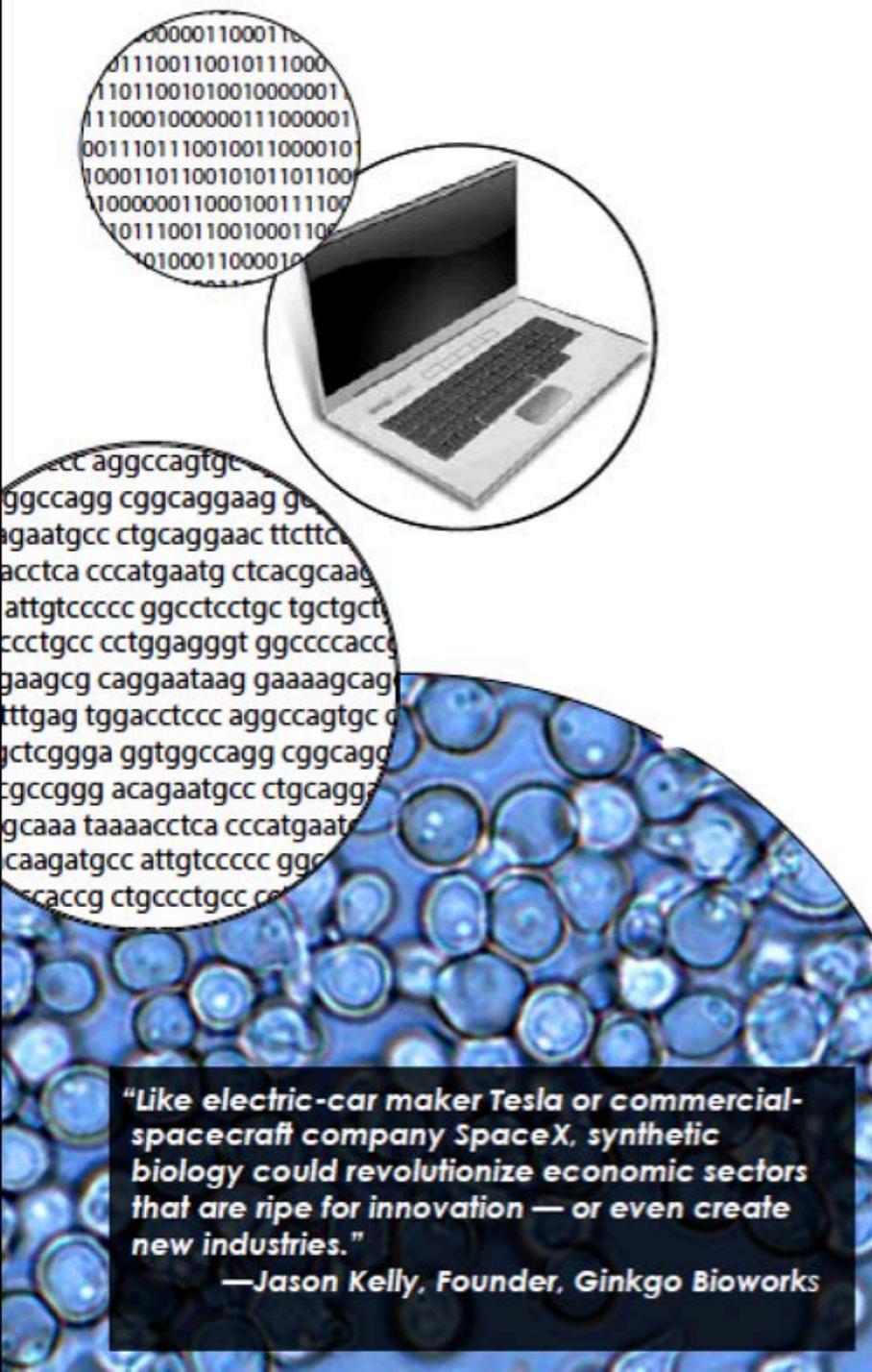


Synthetic Biology: an engineering toolkit for life science

Natalie Kuldell
BioBuilder Educational
Foundation
12.08.15



"Like electric-car maker Tesla or commercial-spacecraft company SpaceX, synthetic biology could revolutionize economic sectors that are ripe for innovation — or even create new industries."

—Jason Kelly, Founder, Ginkgo Bioworks

Synthetic Biology

- As a continuum
- As a process
- As a hypothesis
- As a practice

But first: what is it?

"Like electric-car maker Tesla or commercial-spacecraft company SpaceX, synthetic biology could revolutionize economic sectors that are ripe for innovation — or even create new industries."

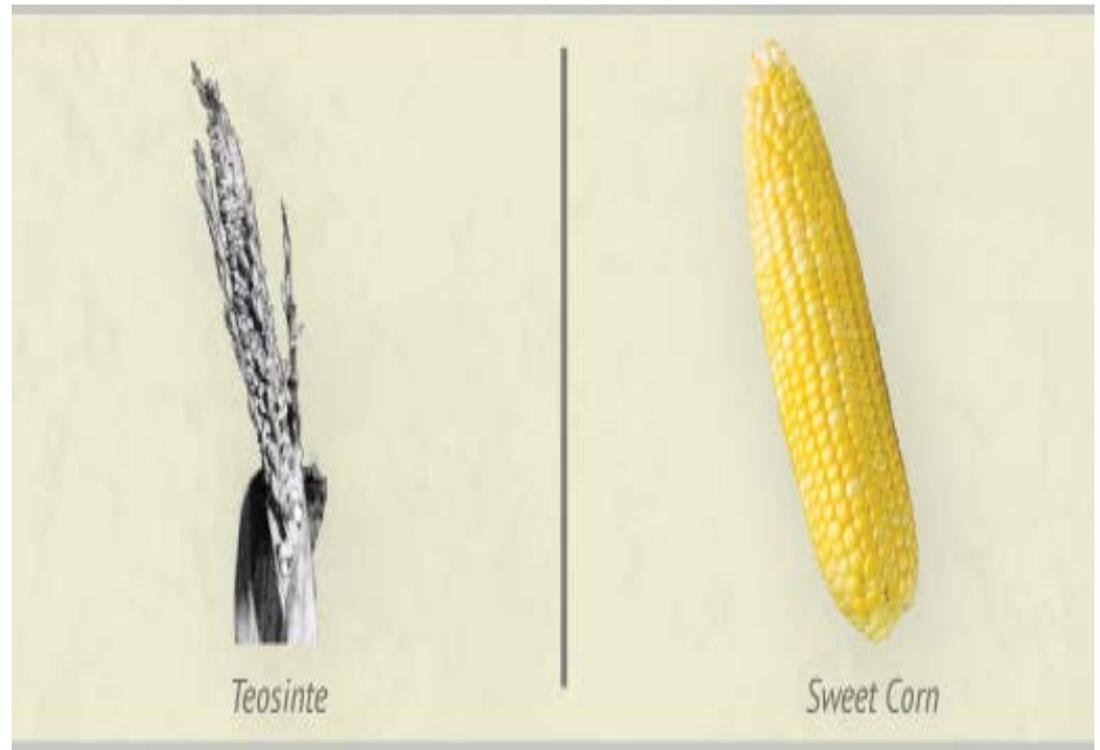
—Jason Kelly, Founder, Ginkgo Bioworks

Selective Breeding

grass x grass = grass'

-
-
-

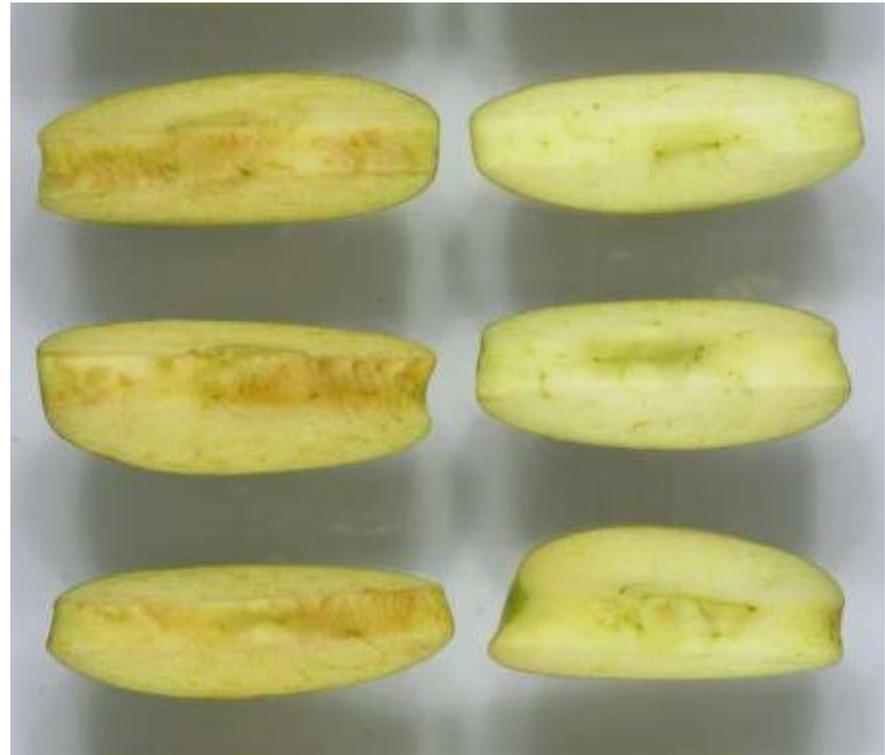
grass' x grass' = "corn"



Humans have been using **selective breeding** for 10,000 years to improve agricultural plants and animals. Farmers choose seeds for future planting from plants with the best traits selecting for taste, color, disease resistance, and productivity.

Genetic Engineering

Granny Smith
– gene for browning
= Artic Apple



Genetic engineering is a way to speed up and control the plant breeding process by altering or **inserting specific genes** into a new living organism.

Scientists can insert individual genes from one living organism into another using biotechnology methods. DNA does not need to come from a closely related species.

Genetic Engineering

Granny Smith
– gene for browning
= Artic Apple

OR

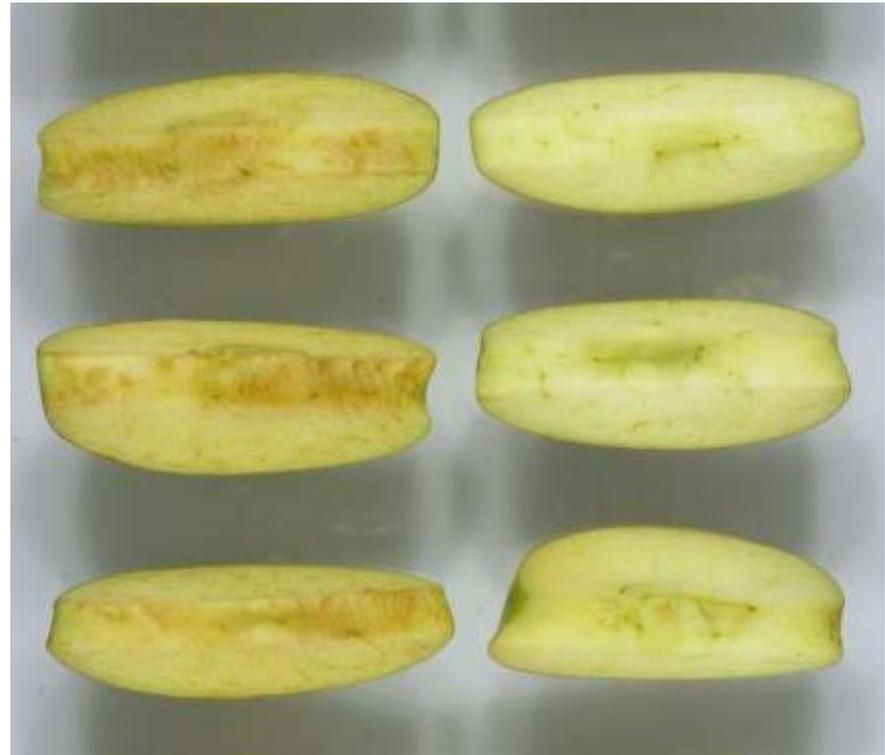


+



=

GMO



Genetic engineering is a way to speed up and control the plant breeding process by altering or **inserting specific genes** into a new living organism.

Scientists can insert individual genes from one living organism into another using biotechnology methods. DNA does not need to come from a closely related species.



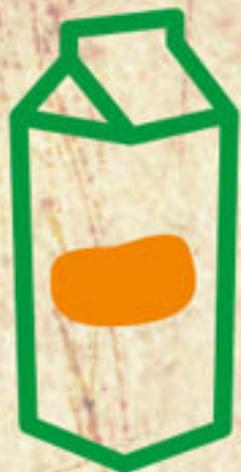
Don't label GMOs



BAN THEM !!! A.H.



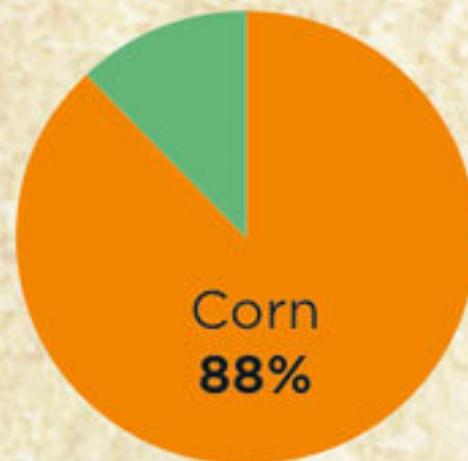
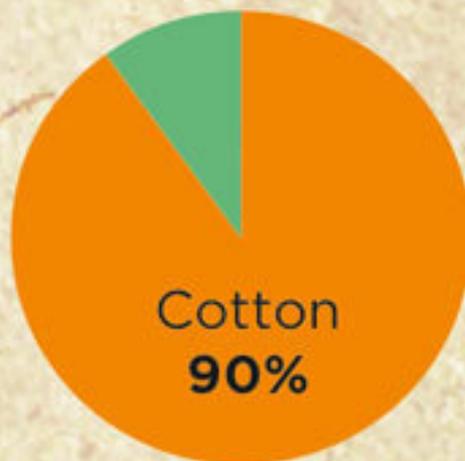
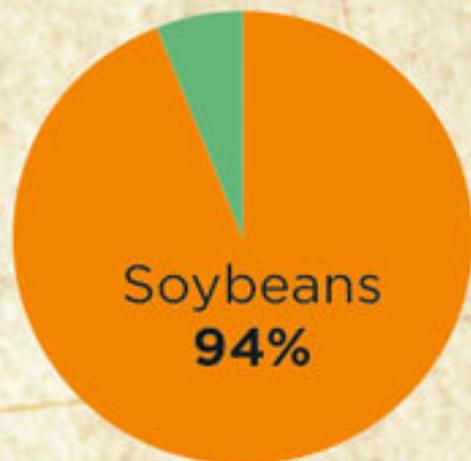
You probably eat GMOs **EVERY DAY.**



30,000

different GMOs exist on grocery store shelves (largely because of how many processed foods contain soy.)

PERCENT OF GMOS IN TOTAL CROP PRODUCTION
2011 (USA)

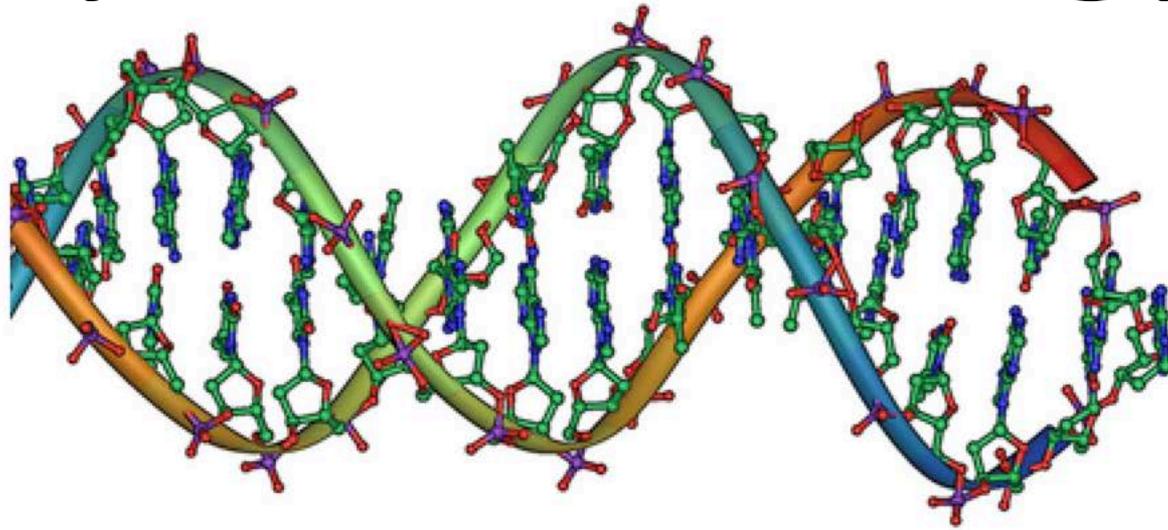




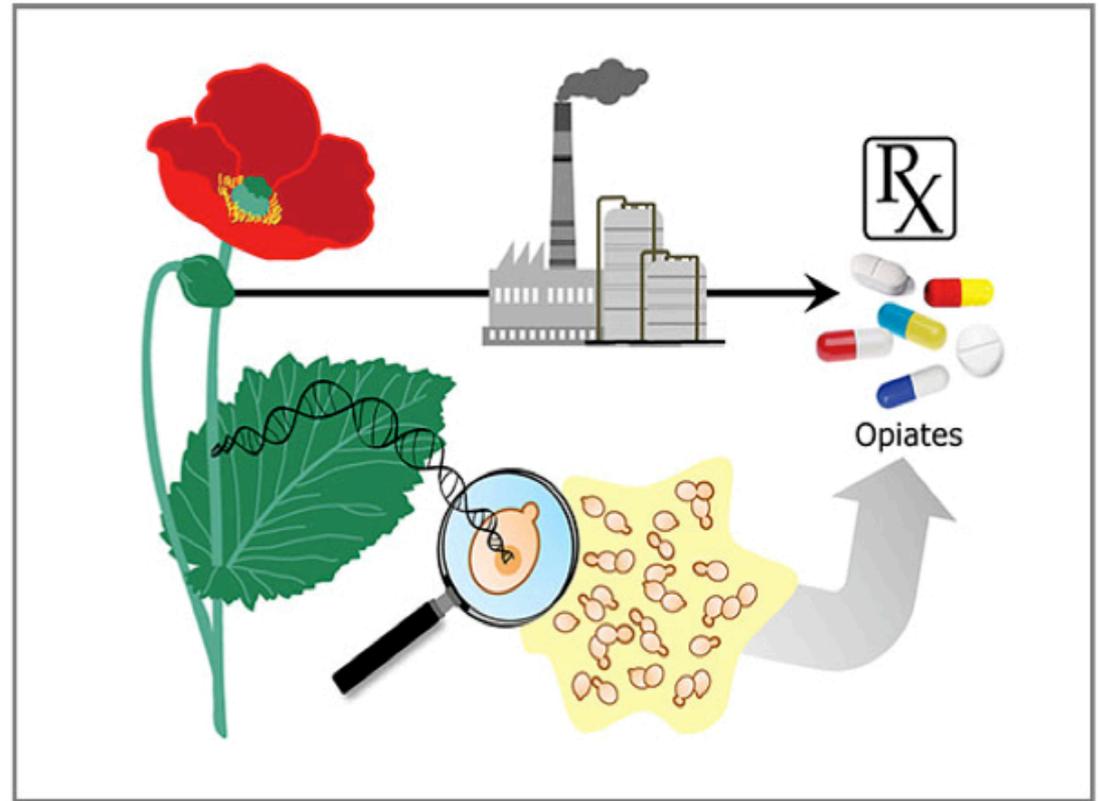
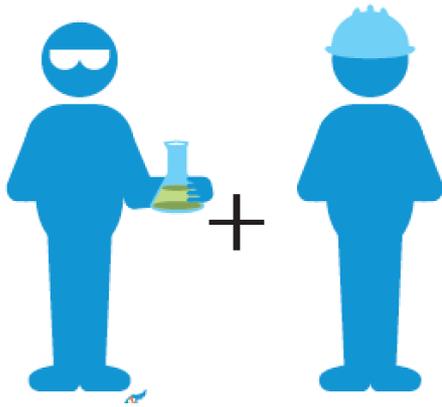
Genetic engineering's new frontier

December 2, 2015 by Bradley J. Fikes, The San Diego Union-Tribune

Synthetic Biology



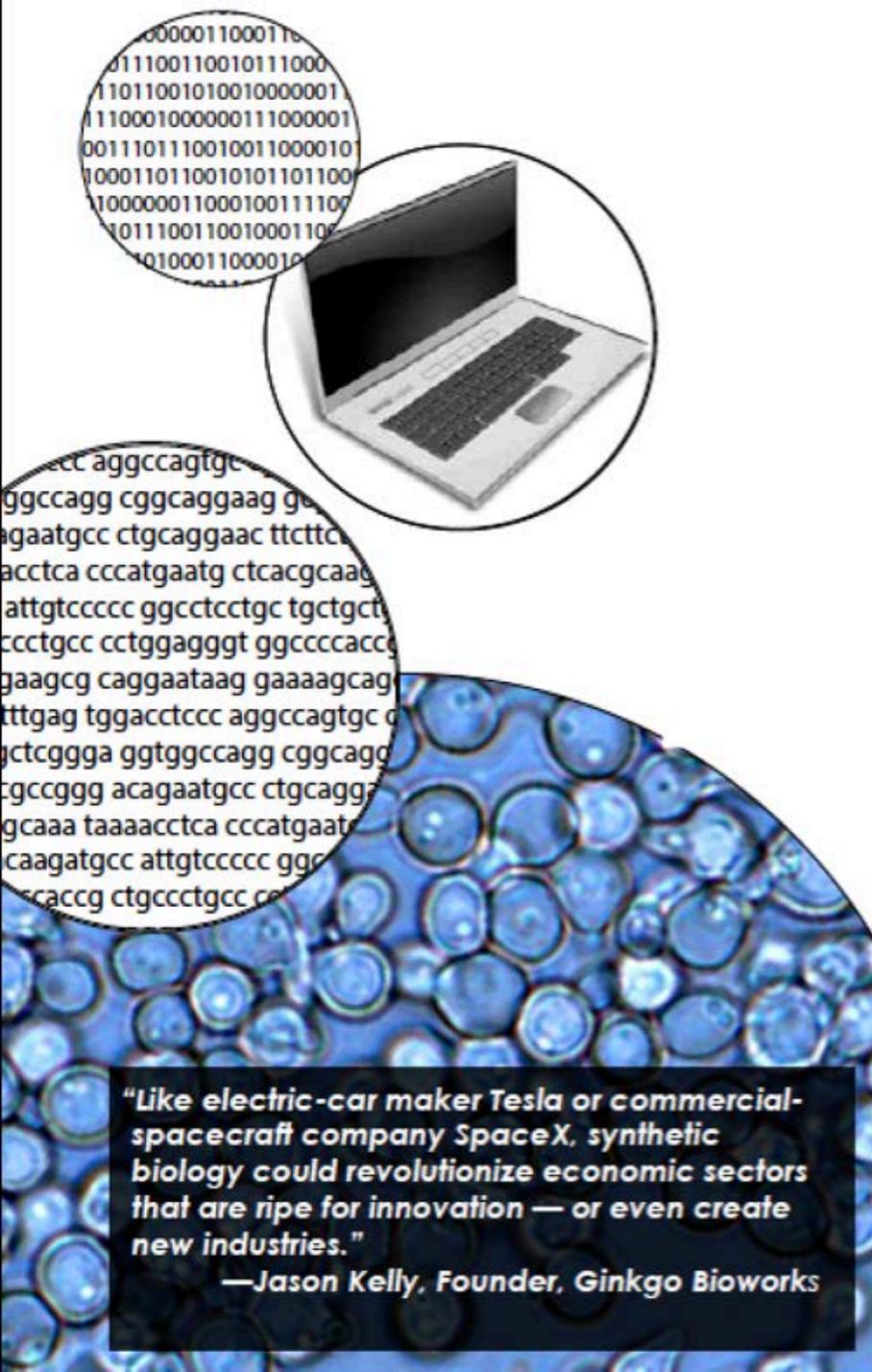
Synthetic Biology



Synthetic biology is a new way of combining biology and engineering to create **new or modified living organisms** and materials that do not currently exist in the natural world.

Synthetic Biology

- As a continuum
- As a process
- As a hypothesis
- As a practice

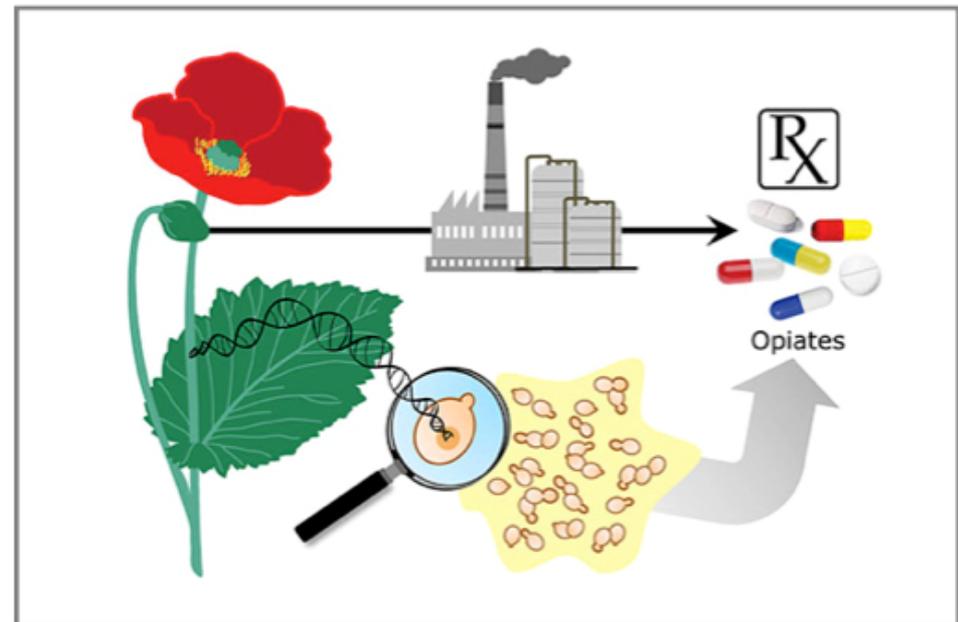
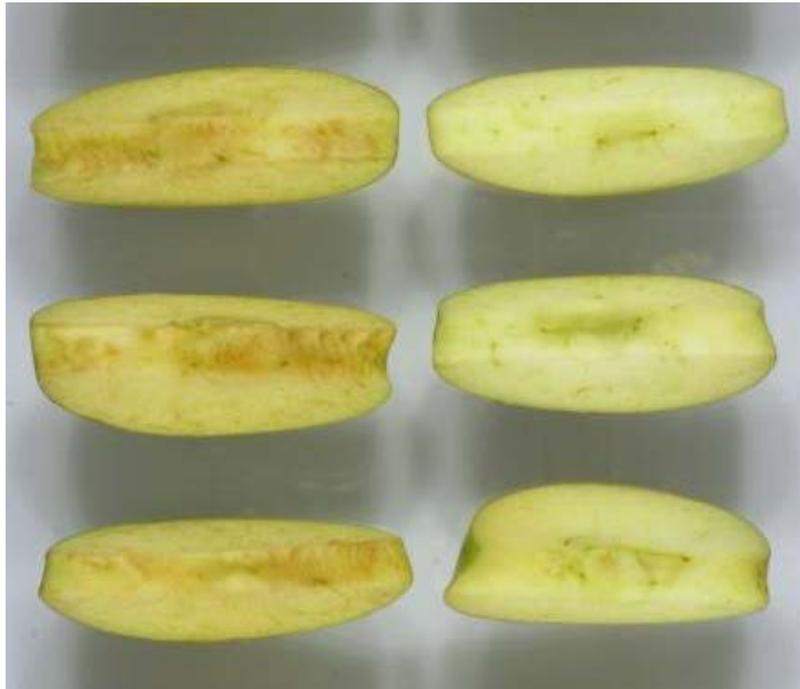
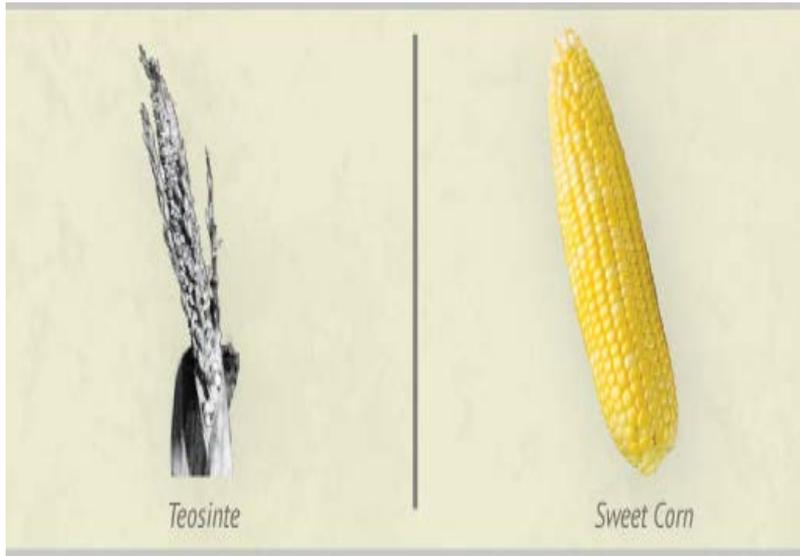


"Like electric-car maker Tesla or commercial-spacecraft company SpaceX, synthetic biology could revolutionize economic sectors that are ripe for innovation — or even create new industries."

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Synthetic Biology

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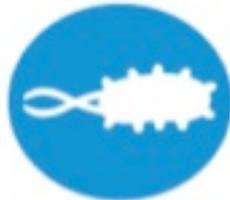


Synthetic Biology

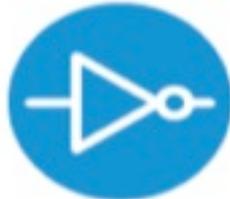
TOPIC AREA



SYSTEM



DEVICE



PARTS



DNA



- As a continuum
- **As a process**
- As a hypothesis
- As a practice

Synthetic Biology

- As a continuum
- As a process
- **As a hypothesis**
- As a practice

COMPLEXITY OF
HUMAN INTERVENTION

COMPLEXITY

Natural evolution

Traditional agricultural
breeding

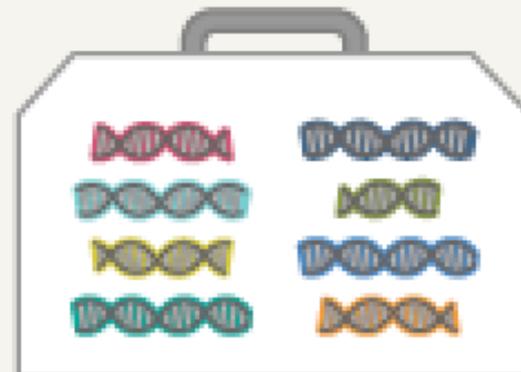
Genetic engineering

Synthetic biology



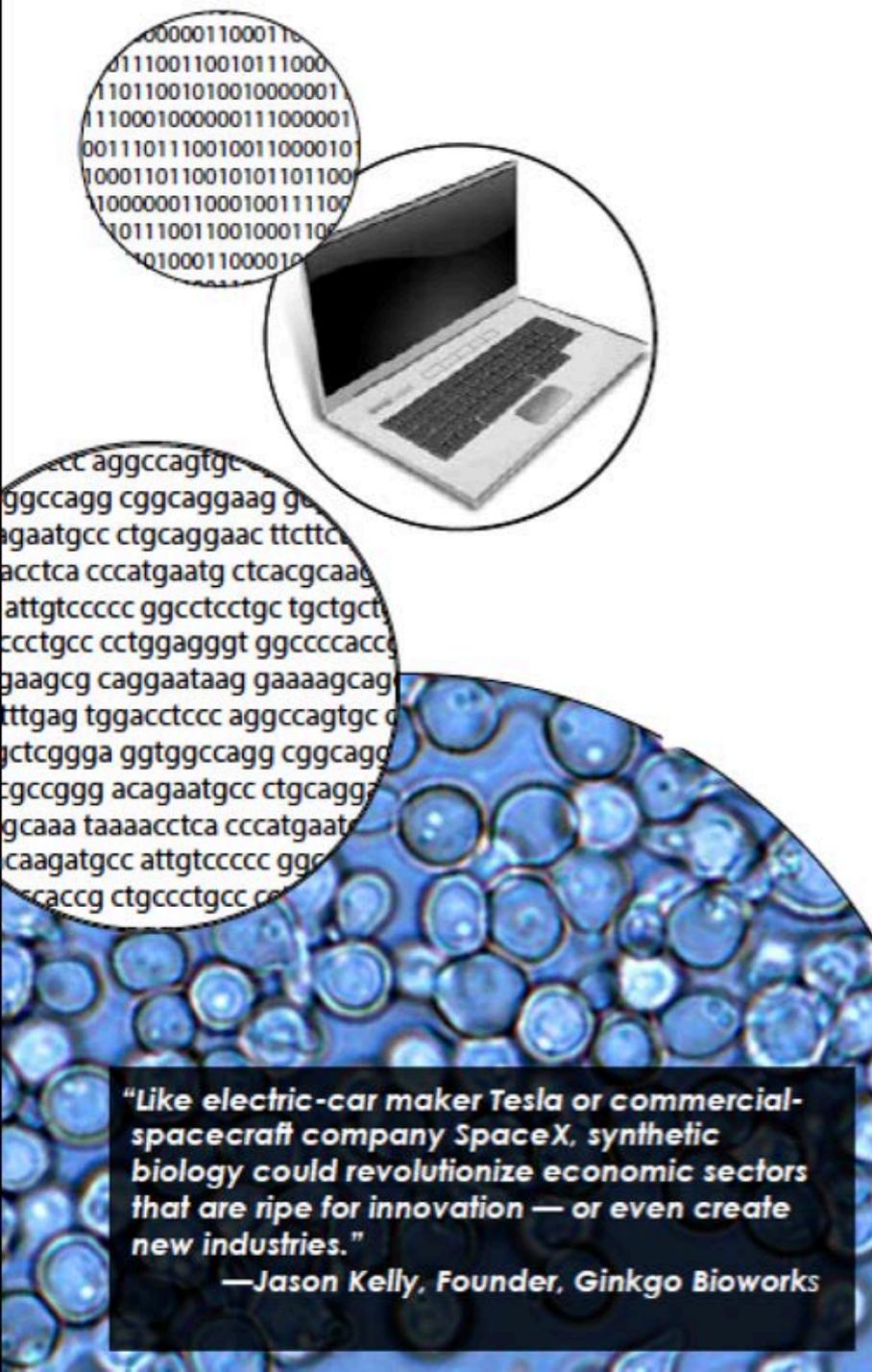
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TOOLBOX OF
BIOLOGICAL
FUNCTIONS



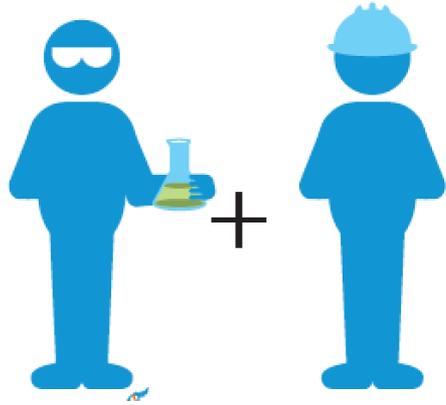
Synthetic Biology

- As a continuum
- As a process
- **As a hypothesis**
- As a practice



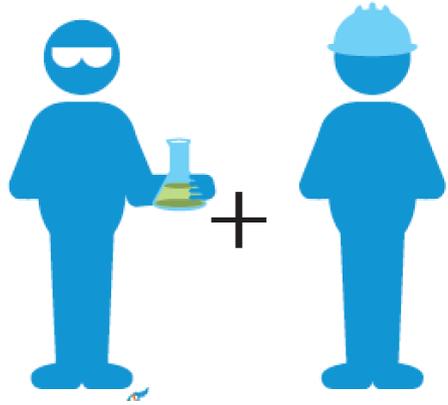
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Synthetic Biology

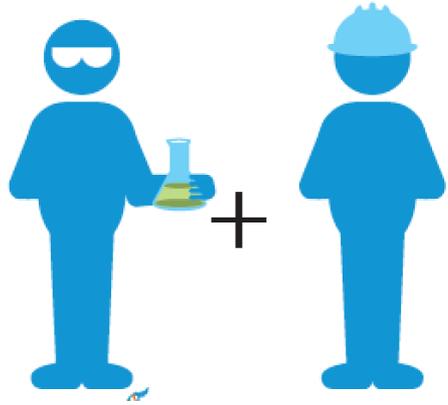
- As a continuum
- As a process
- As a hypothesis
- **As a practice**



Synthetic Biology

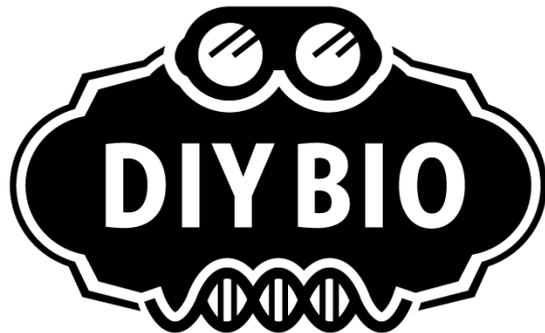
- As a continuum
- As a process
- As a hypothesis
- **As a practice**





Synthetic Biology

- As a continuum
- As a process
- As a hypothesis
- **As a practice**





Synthetic Biology

- As a continuum
- As a process
- As a hypothesis
- **As a practice**

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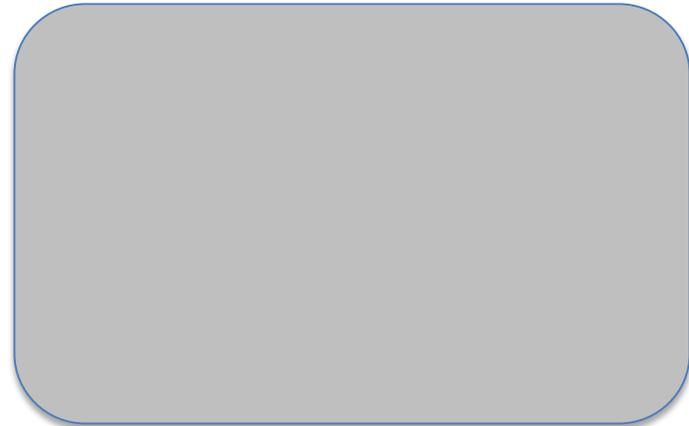
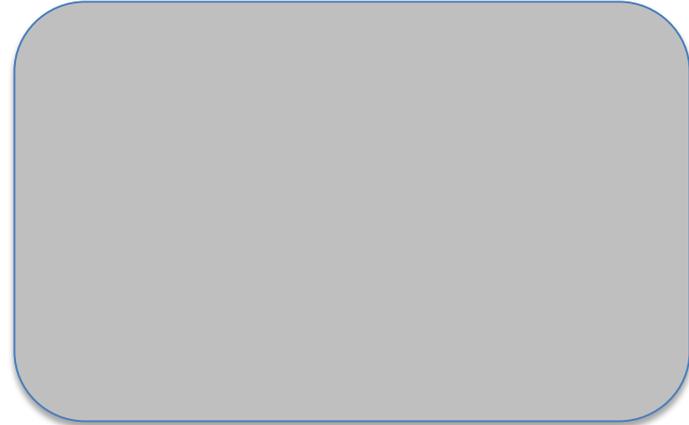
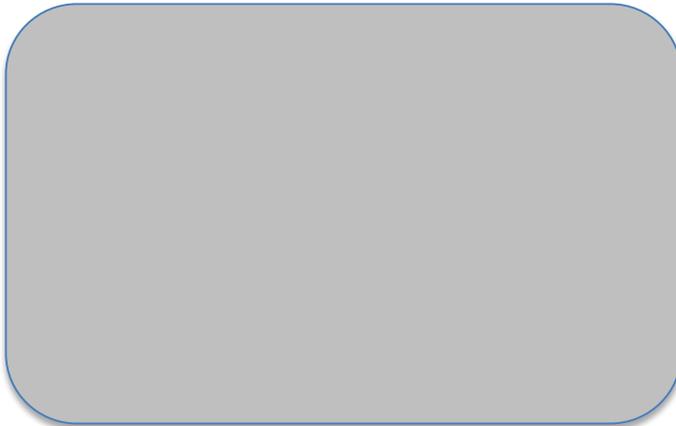
[about the Foundation](#) [for Students](#) [for Teachers](#)

Empowering individuals in biotechnology

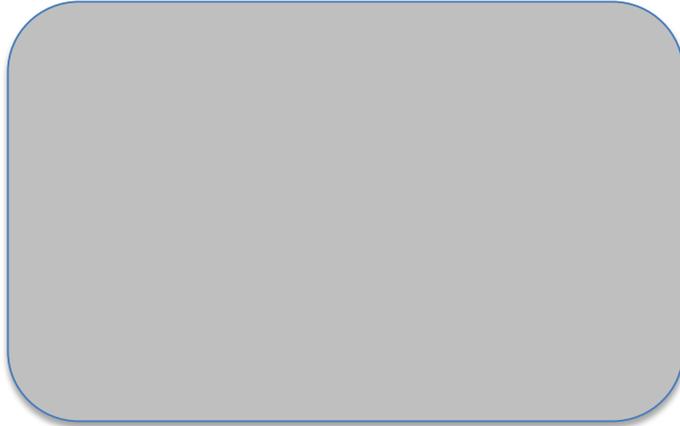
We convert cutting-edge science and engineering into teachable modules, fostering an engaged community and increasing understanding of these fields.

Building with Biology: distilling to 4 key concepts

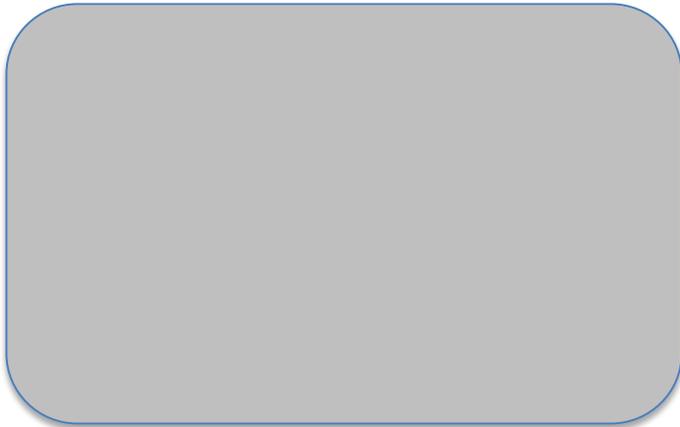
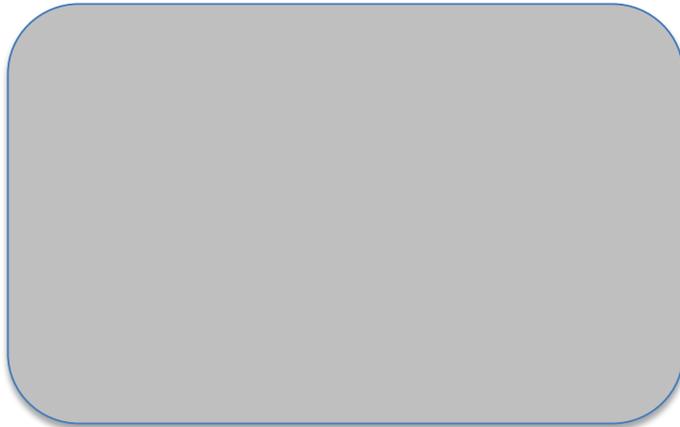
Synthetic biology
**builds biological
systems**



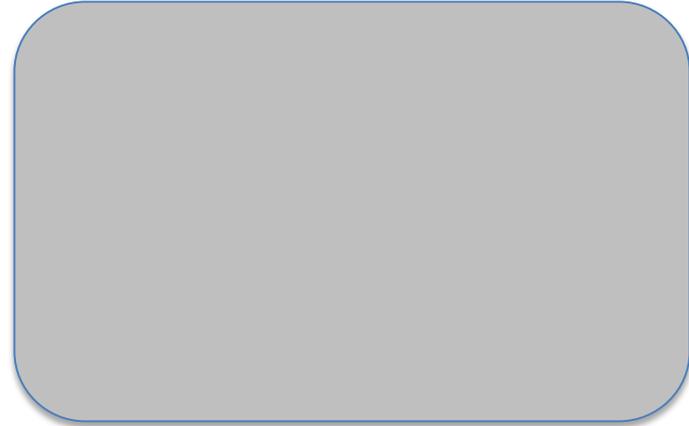
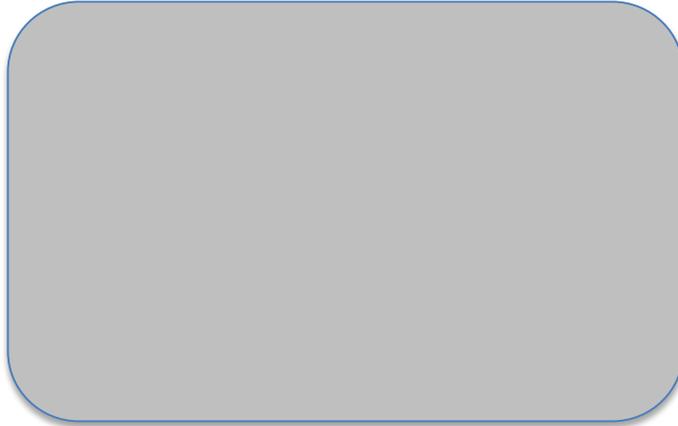
Building with Biology: distilling to 4 key concepts



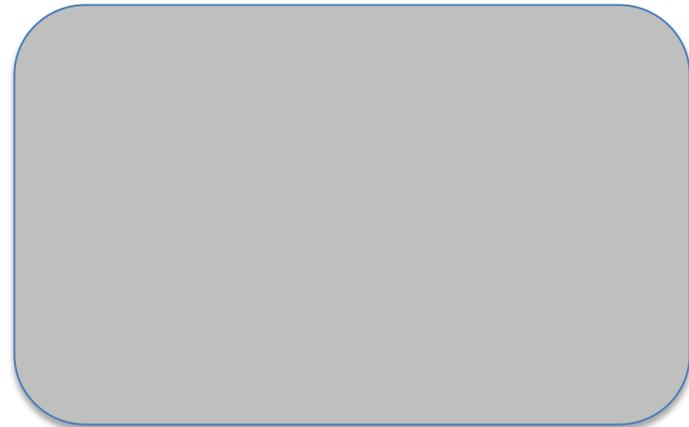
**Synthetic biology
generates new tools
and knowledge**



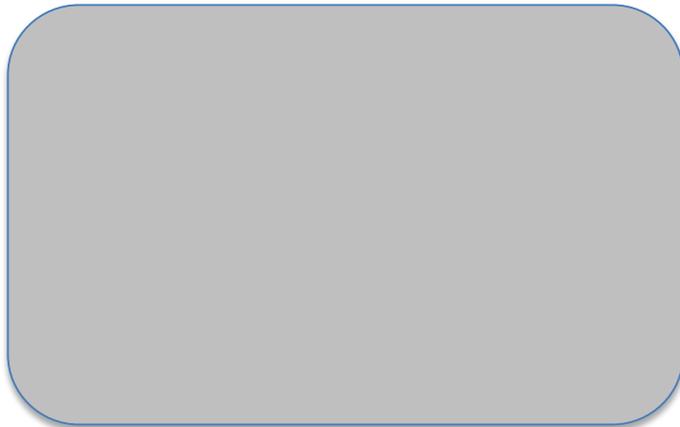
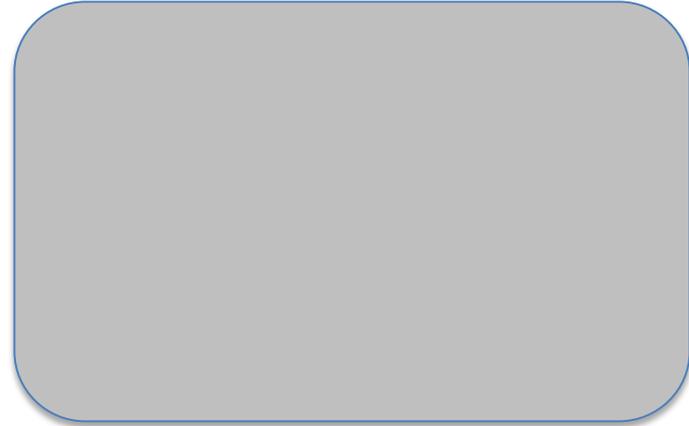
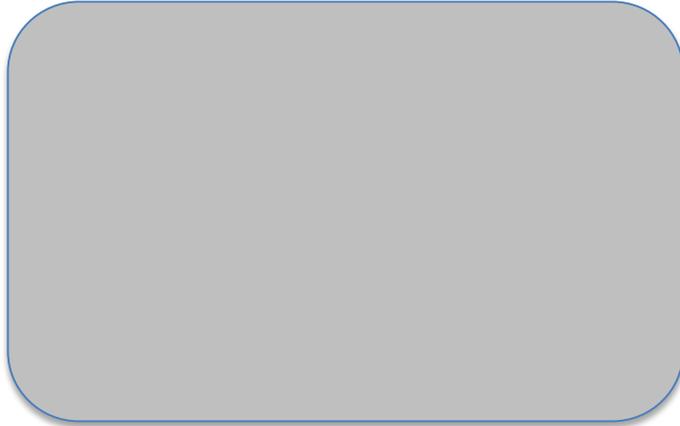
Building with Biology: distilling to 4 key concepts



Synthetic biology
**benefits from
many voices**



Building with Biology: distilling to 4 key concepts



**Synthetic biology
is interconnected
with society**

Synthetic biology
**builds biological
systems**

Synthetic biology
**generates new tools
and knowledge**

Synthetic biology
**benefits from
many voices**

Synthetic biology
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