

MOLECULAR ENCODED STORAGE FOR SPACE EXPLORATION

Prompt Suathim
Chayapatr Archiwaranguprok
Saran Seehanam
Phoomparin Mano
Chottiwatt Jittprasong
Chanud Sitthipredanant
Watcharin Unwet
Puey Ounjai
Pakpoom Subsoontorn
Nattanon Dungsunenarn
Pat Pataranutaporn

MOLECULAR ENCODED STORAGE FOR SPACE EXPLORATION

Objective: $WSS \rightarrow DNA$
1. digital

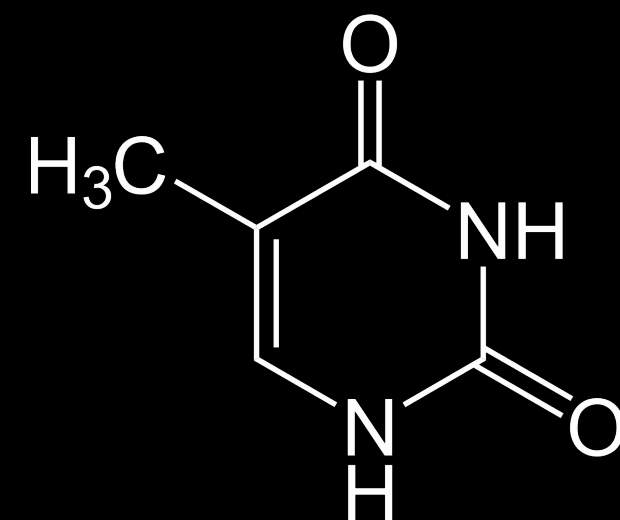
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A



Adenine

T



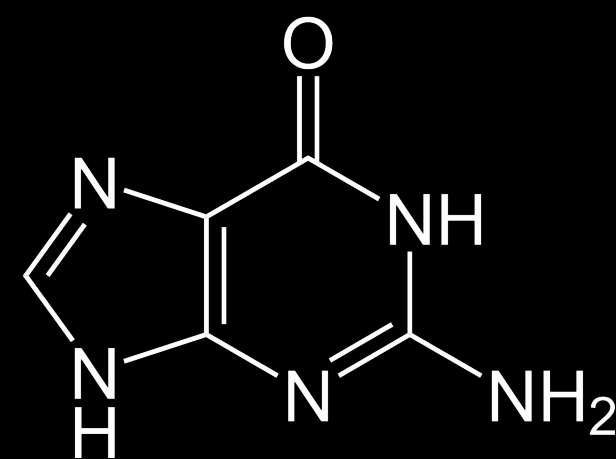
Thymine

C

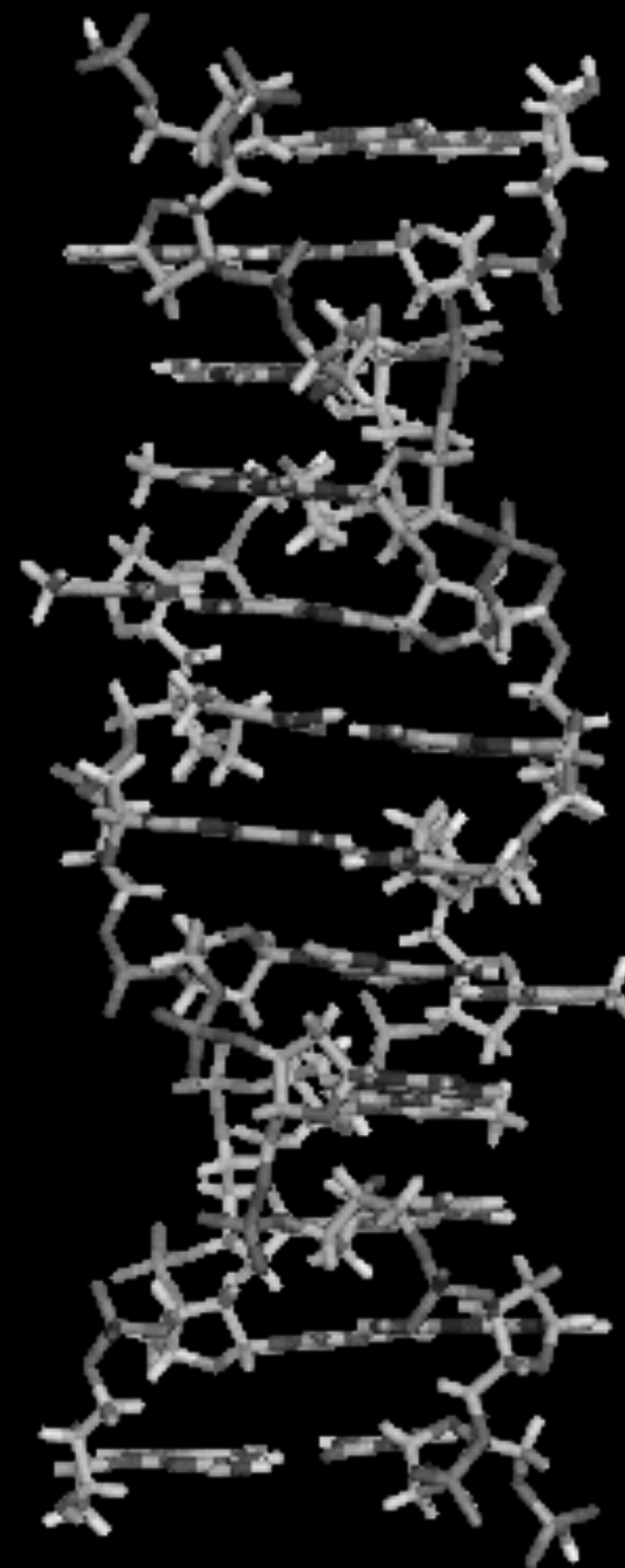


Cytosine

G

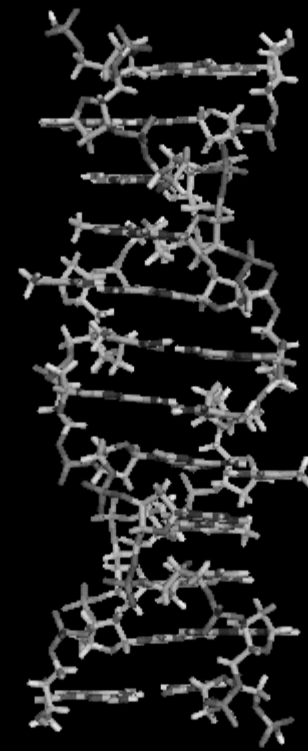


Guanine



DNA

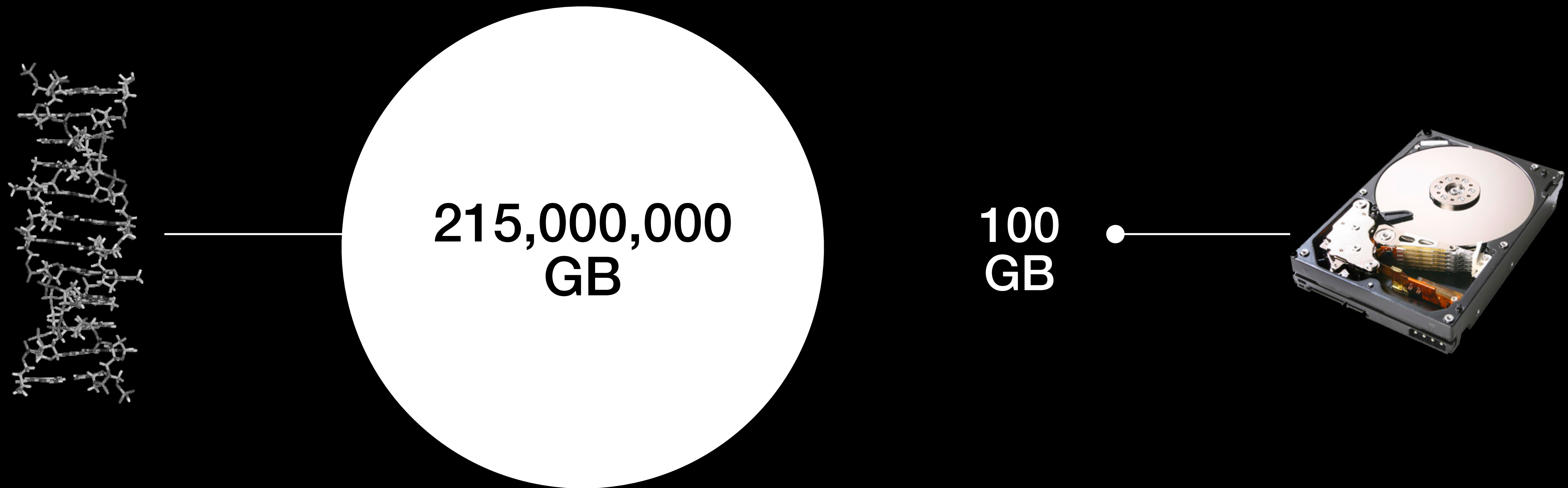
DeoxyribonucleicAcid



01101011010101010101010101101011010101010101010
11010110101010101010101011010110101010101010101
10101101010101010101010110101101010101010101

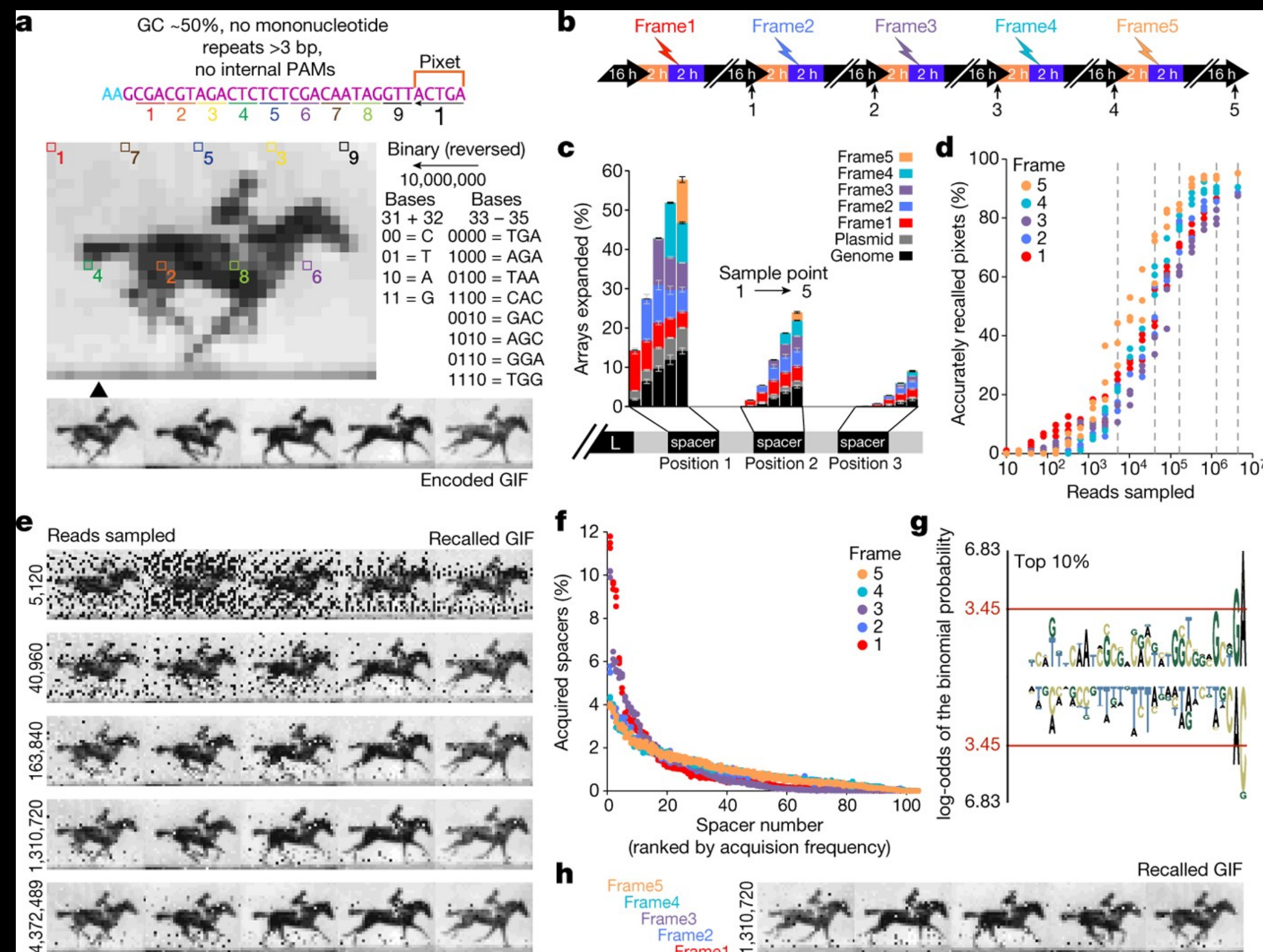


ATCCGATTCTCCCGATTACA
TTCCTATCCGATTCTCCCTACGGACTTCCTATCCGATTCTCCC
TACGGACTTCCTATCCGATTCTCCCTACGGACTTCCT



DNA can hold up to 215 petabytes in just a single gram

Erlich, Yaniv, & Zielinski, Dina. (2017). DNA Fountain enables a robust and efficient storage architecture. <http://doi.org/10.1126/science.aaj2038>



CRISPR-Cas encoding of a digital movie into the genomes of a population of living bacteria

Seth L Shipman^{1 2 3}, Jeff Nivala^{1 3}, Jeffrey D Macklis², George M Church^{1 3}

Affiliations + expand

PMID: 28700573 PMCID: [PMC5842791](#) DOI: [10.1038/nature23017](#)

[Free PMC article](#)

Towards practical, high-capacity, low-maintenance information storage in synthesized DNA.

Goldman N¹ , Bertone P¹ , Chen S, Dessimoz C¹ , LeProust EM, Sipos B¹ , Birney E¹ 

[Author information](#) ▶

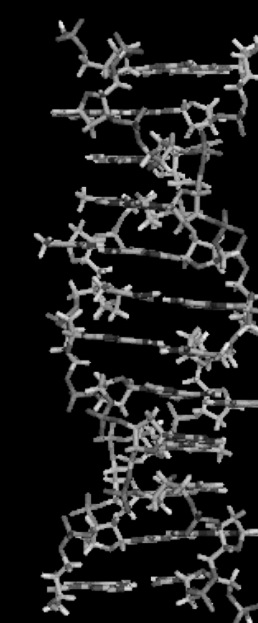
Protocol | Published: 29 November 2019

Reading and writing digital data in DNA

Linda C. Meiser, Philipp L. Antkowiak, Julian Koch, Weida D. Chen, A. Xavier Kohl, Wendelin J. Stark, Reinhard Heckel  & Robert N. Grass 

Nature Protocols **15**, 86–101(2020) | [Cite this article](#)

3812 Accesses | **13** Citations | **80** Altmetric | [Metrics](#)



215,000,000
GB

Future Data Storage for Space Exploration



**Molecular scale
computing**

**Interstellar
Civilization**

**Molecular scale
computing + Interstellar
Civilization**

Our Mission

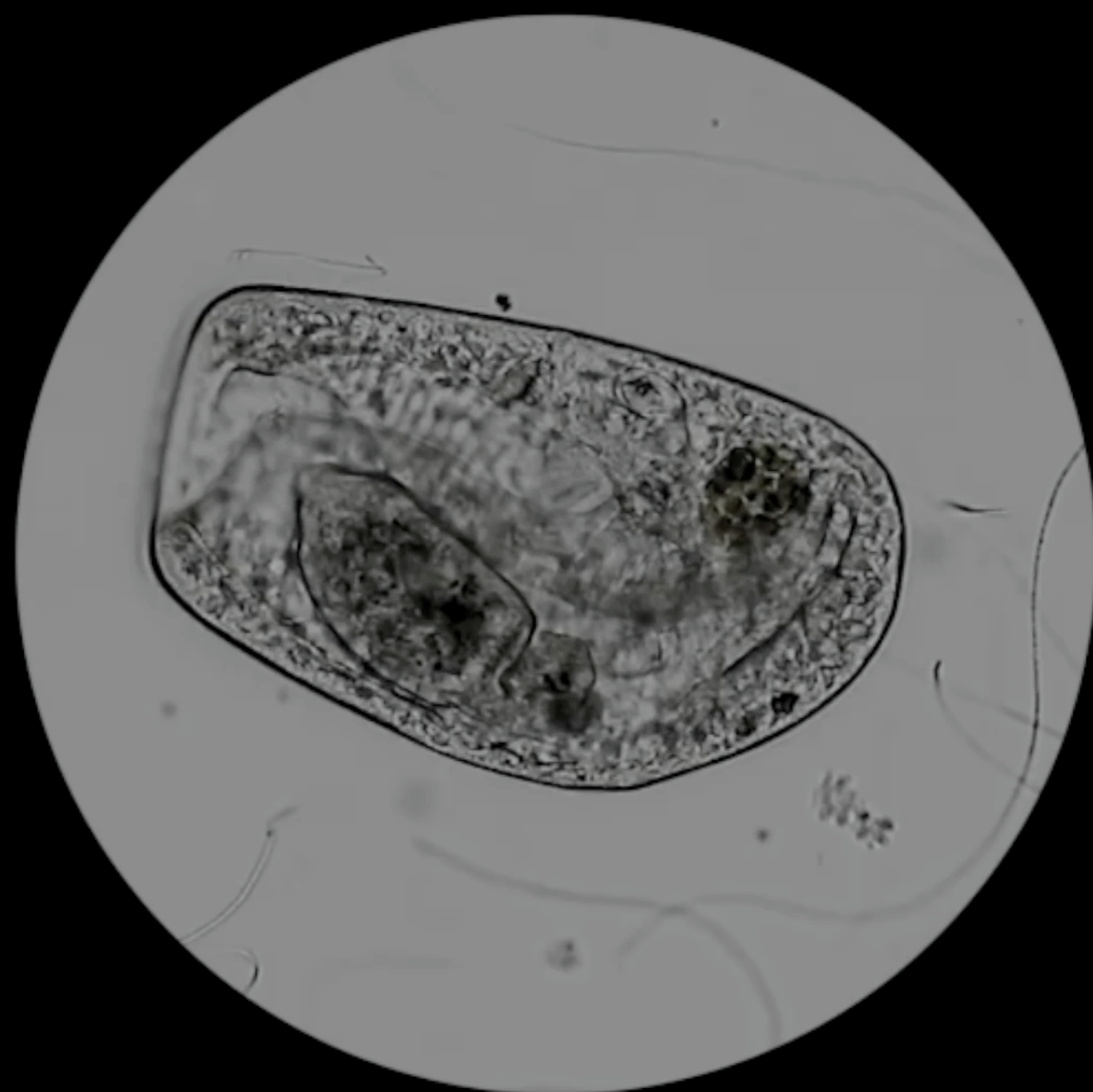
**Create an Algorithm
to store data on the DNA**

**Launch our DNA on a
space mission**

**Study the impact of space
on the DNA**

♪ Ambition and the universe

ความฝันกับจักรวาล



Life

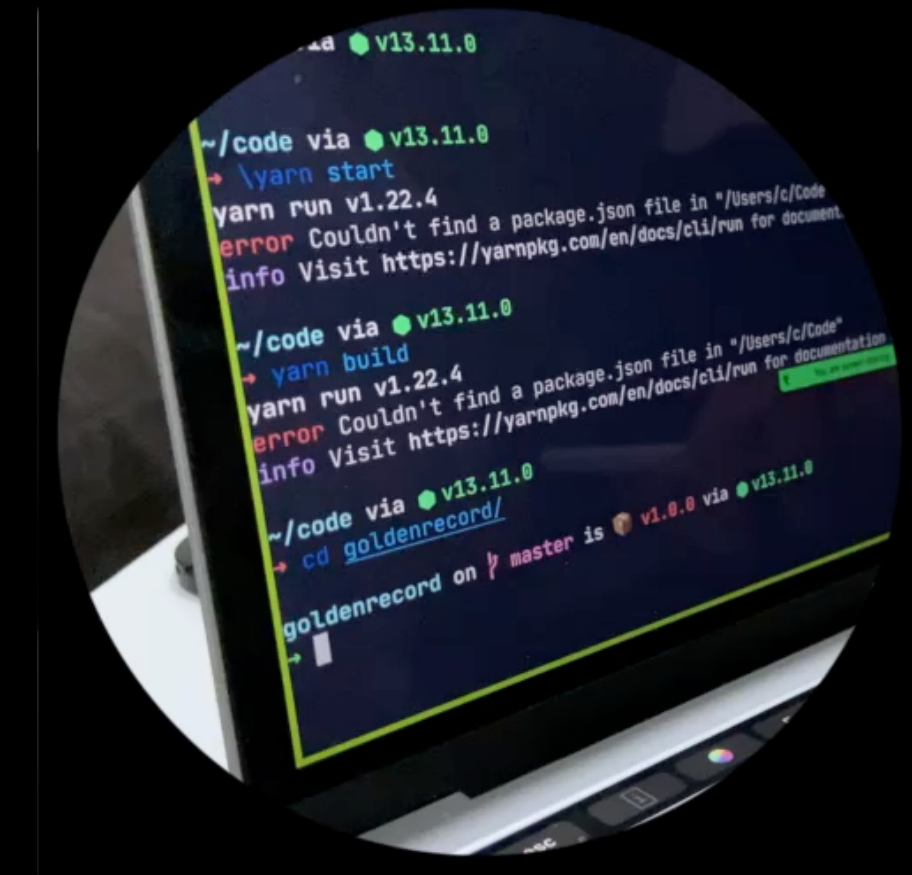


Music

Encoding the song in to the DNA

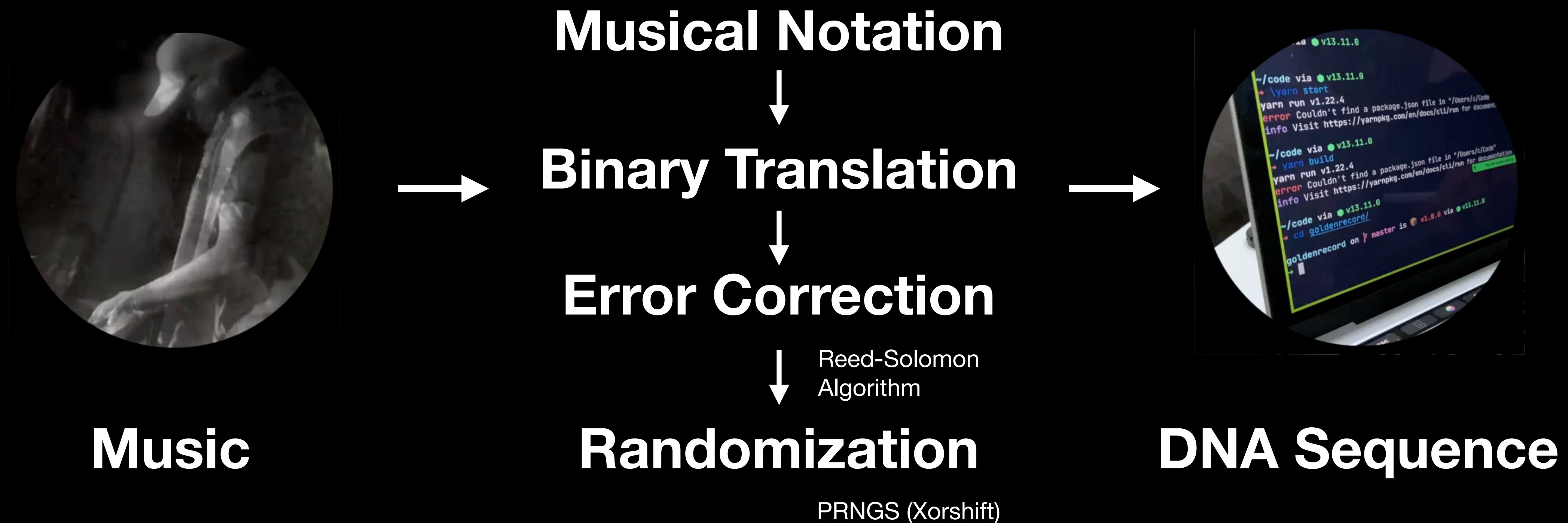


Music



DNA Sequence

Encoding the song in to the DNA

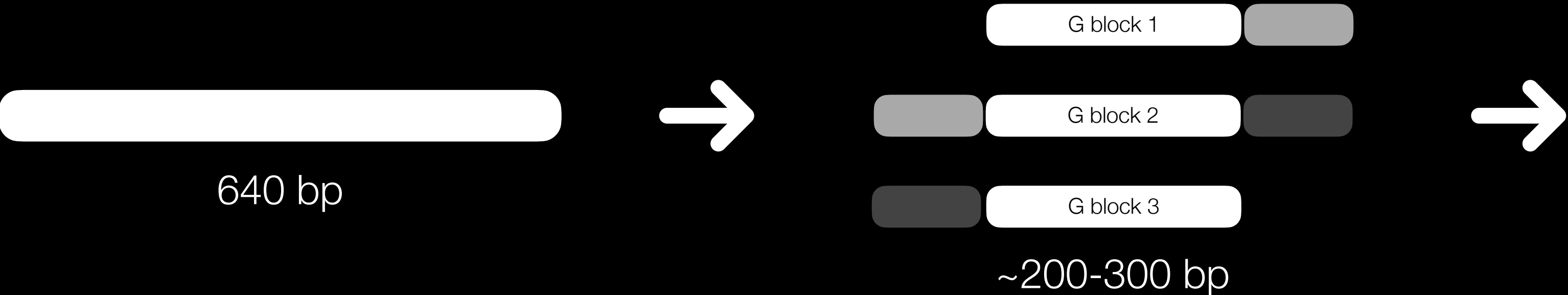


640 Base Pairs

**Space DNA
Self-Assembly**

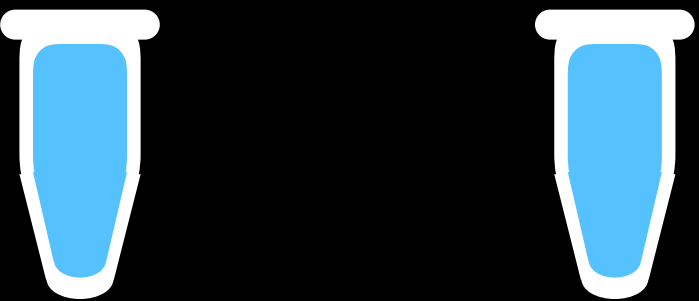
**Counter DNA
Bioterrorism**

Space DNA Self-Assembly

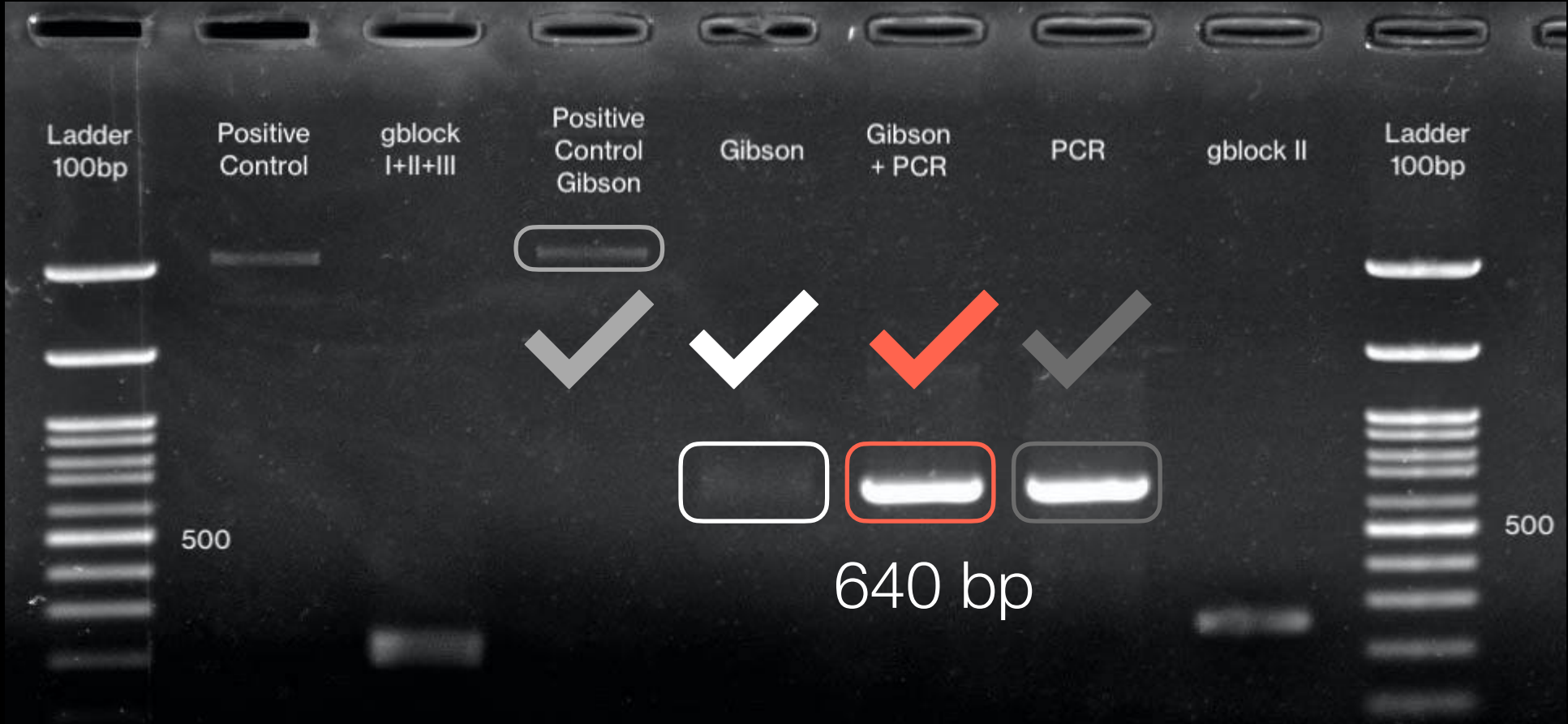


(NEB E2621)
Gibson
Assembly

PCR
Assembly



Various Genome
Assembly Methods

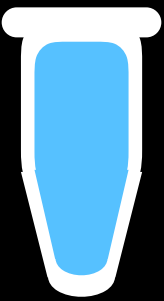


E2621 (+)
control

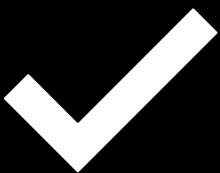
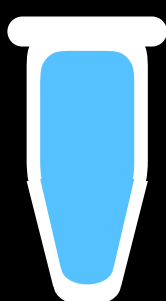
PCR
Assemble

Gibson
Assembly

PCR'd
Gibson



Gblocks
I - III



PCR'd
Gibson



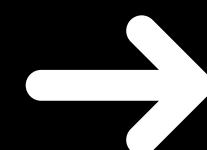
Counter DNA Bioterrorism

Counter DNA Bioterrorism

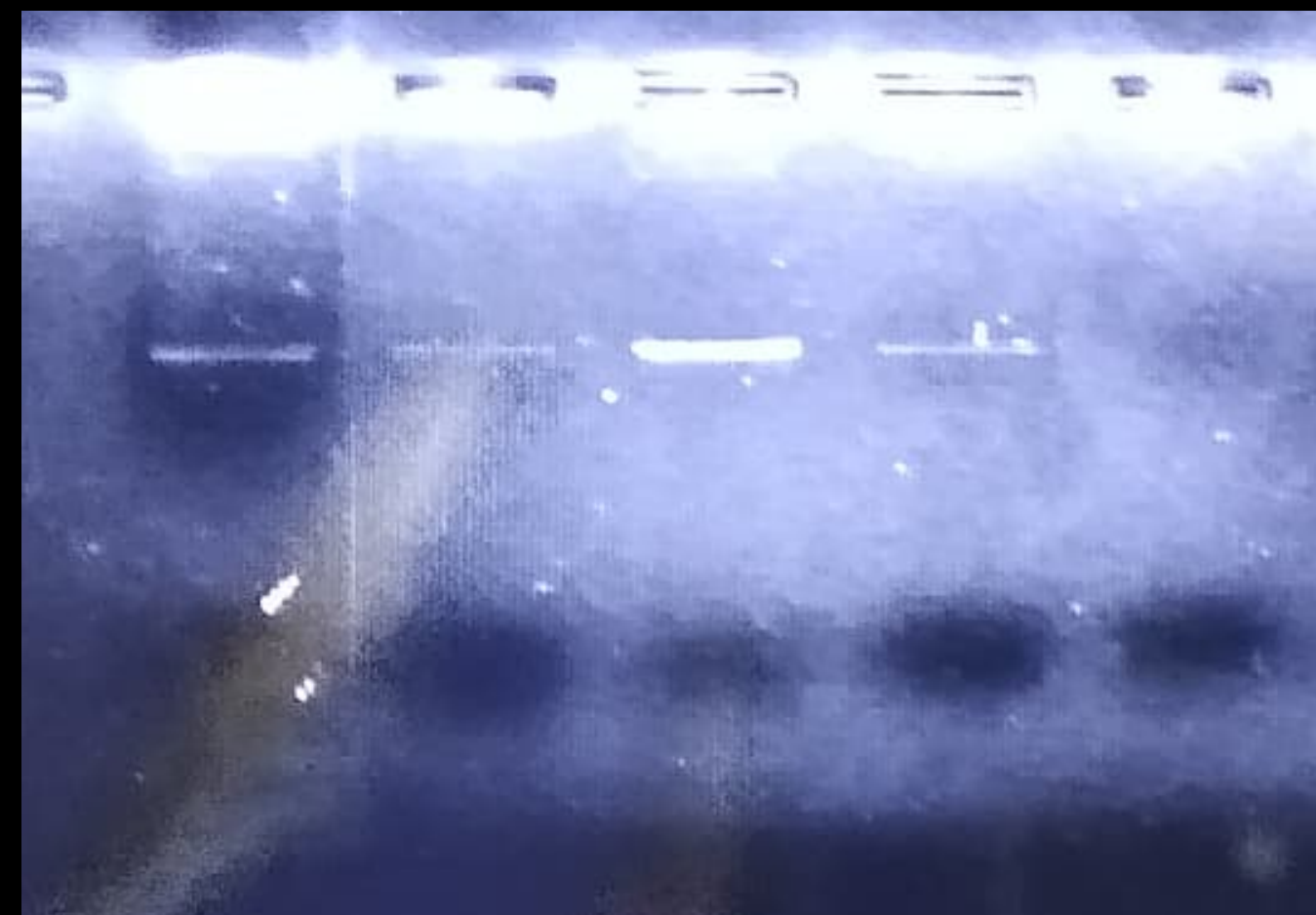
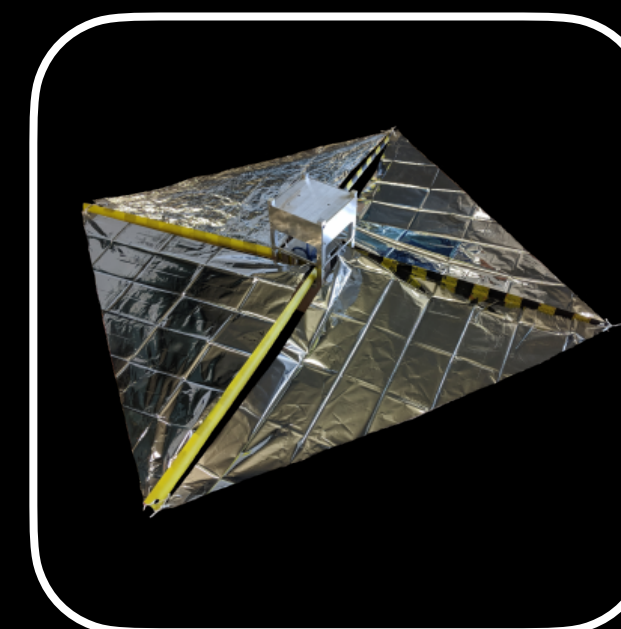
PCR'd Gibson



640 bp



Dried on to

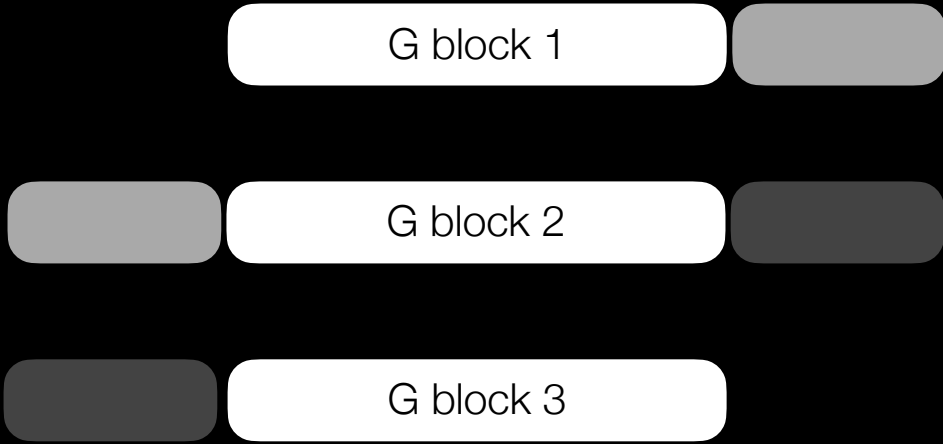


Recovery test on Earth

Space DNA Self-Assembly



640 bp

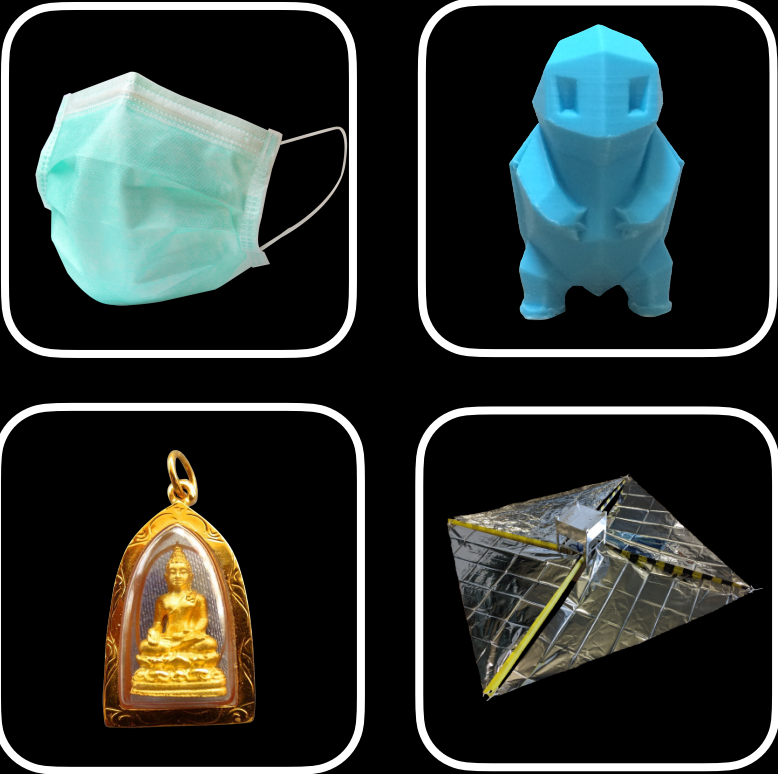


~200-300 bp

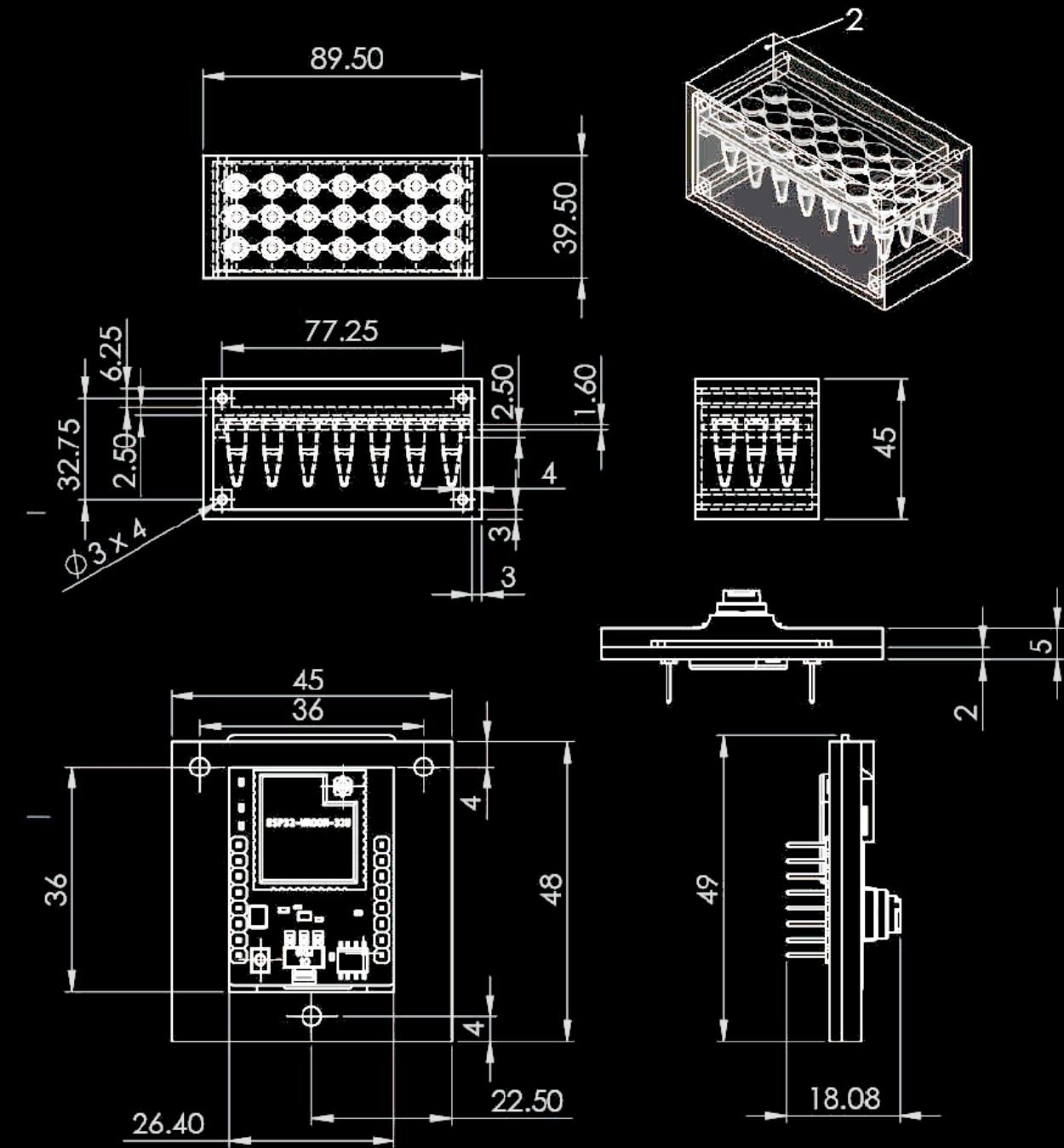
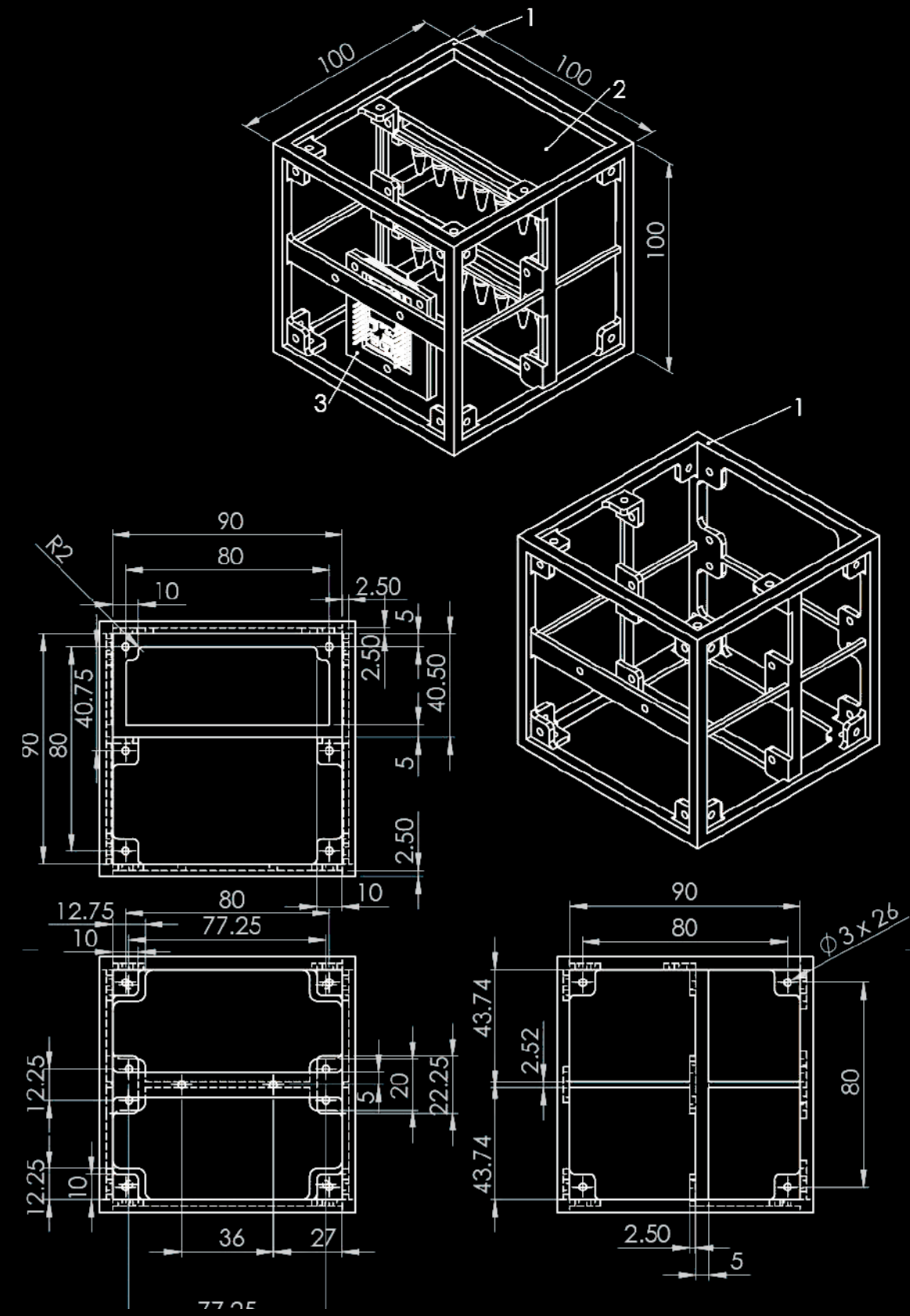
Counter DNA Bioteerrorism



640 bp



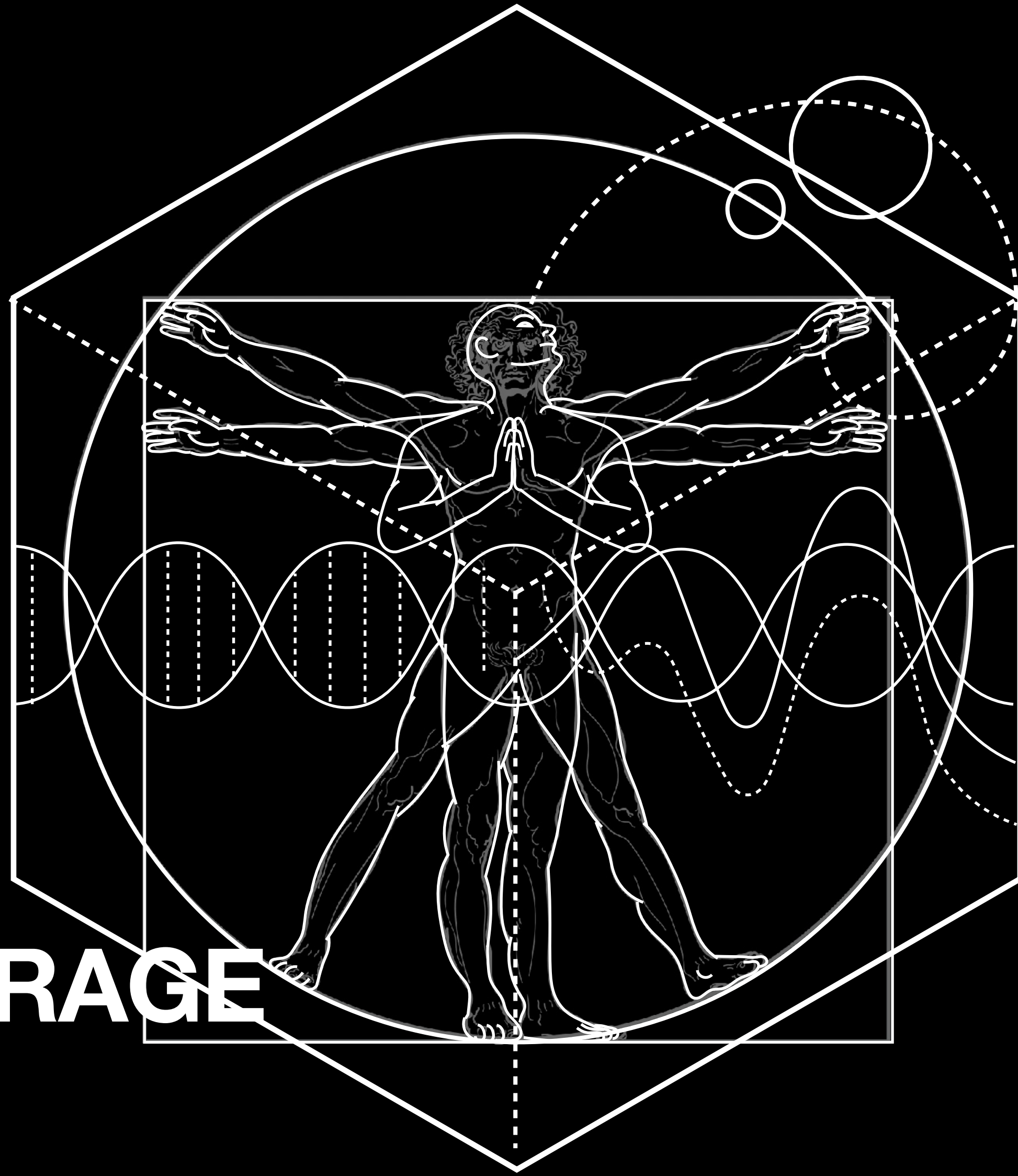
Payload Design

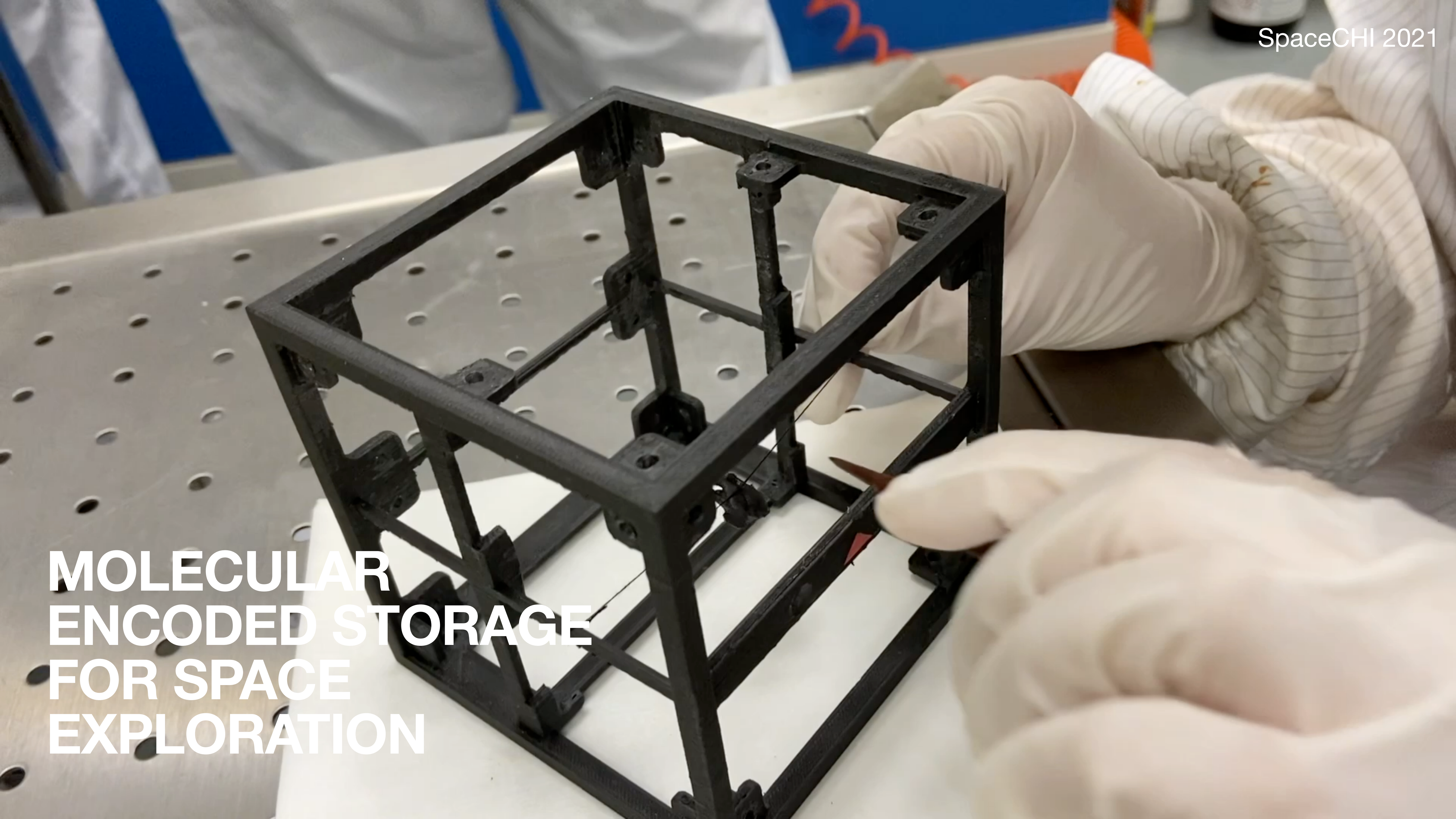




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SPACETH.CO



Biocomputing + Space Civilization

SpaceCHI 2021

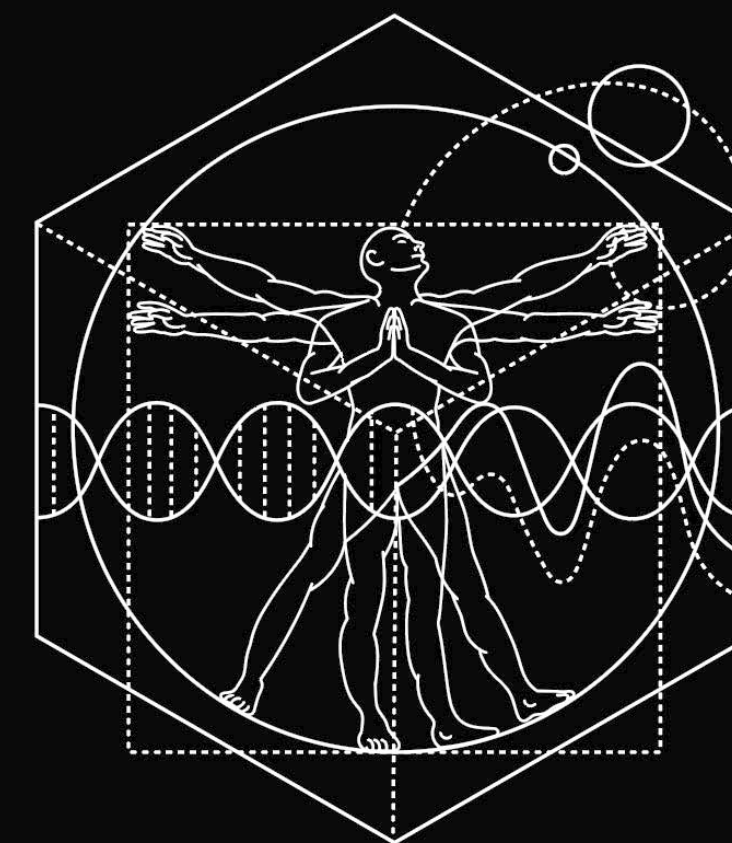


Gibson
Assembly
Experiment

Counter
Bioterrorism
Experiment



3D Printed
1U Payload



Anti-disciplinary

Launched to

100KM Apogee



**FIRST
DNA STORAGE
TO SPACE**

**MOLECULAR
ENCODED STORAGE
FOR SPACE
EXPLORATION**

**DNA
640
Base Pairs**

**Lead by
High School
Students**

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spaceth.co/messe/eng