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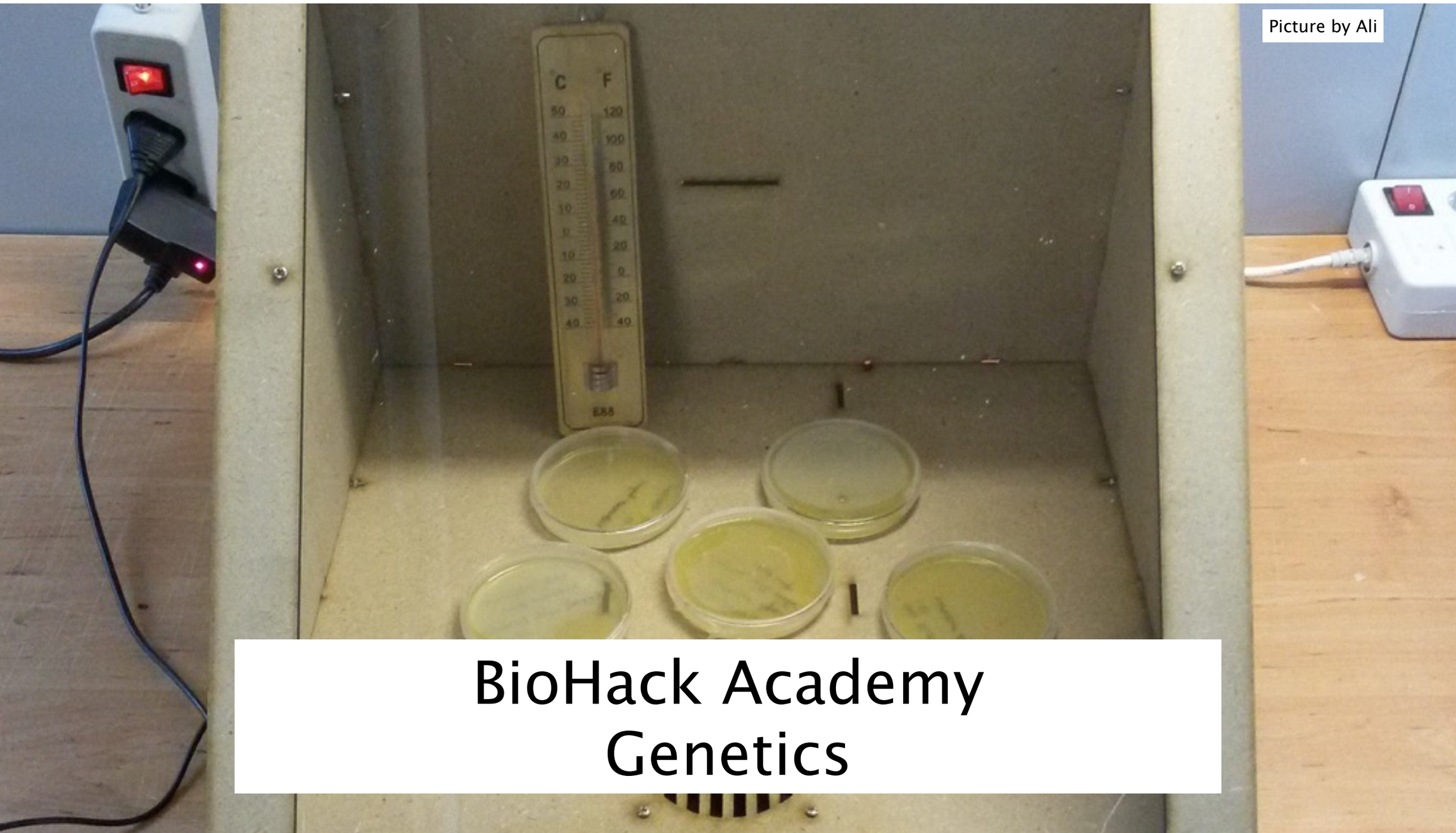
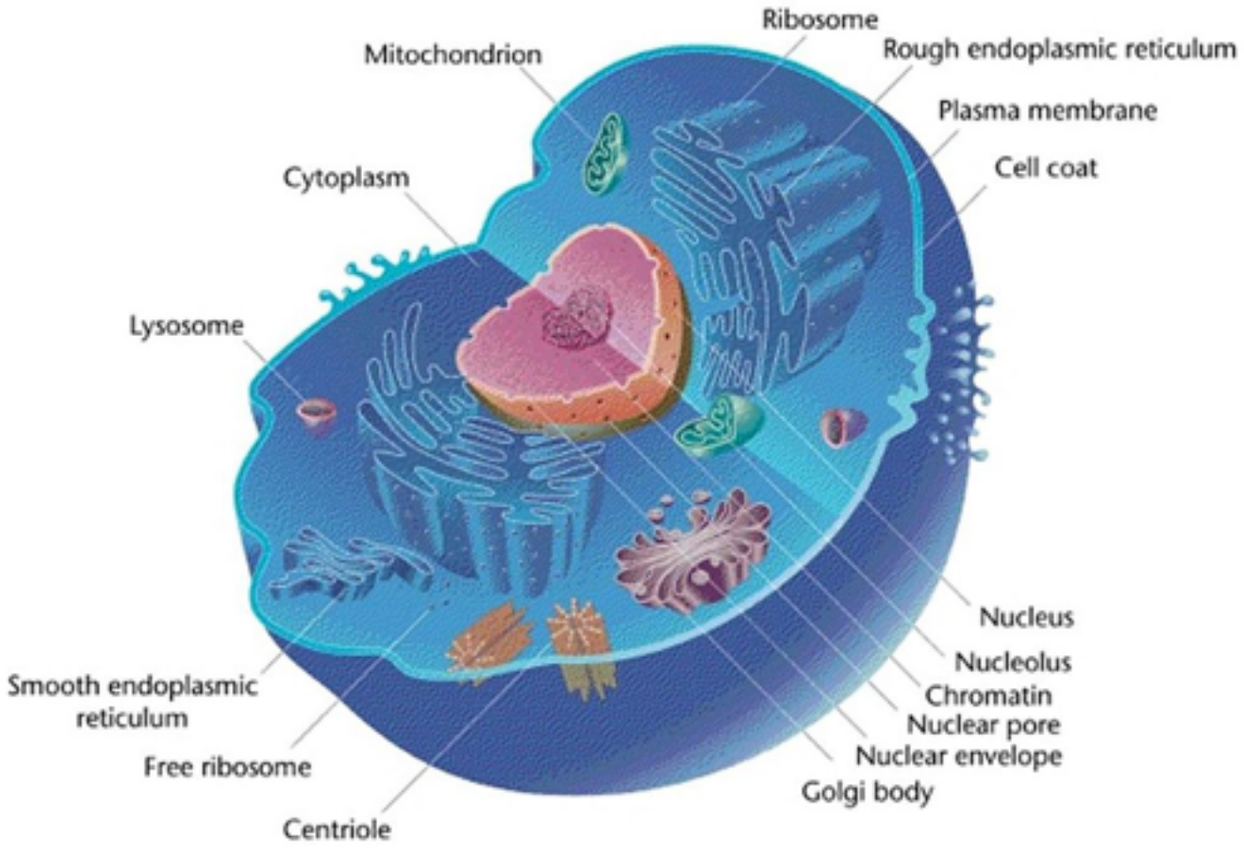


BioHack Academy
Genetics

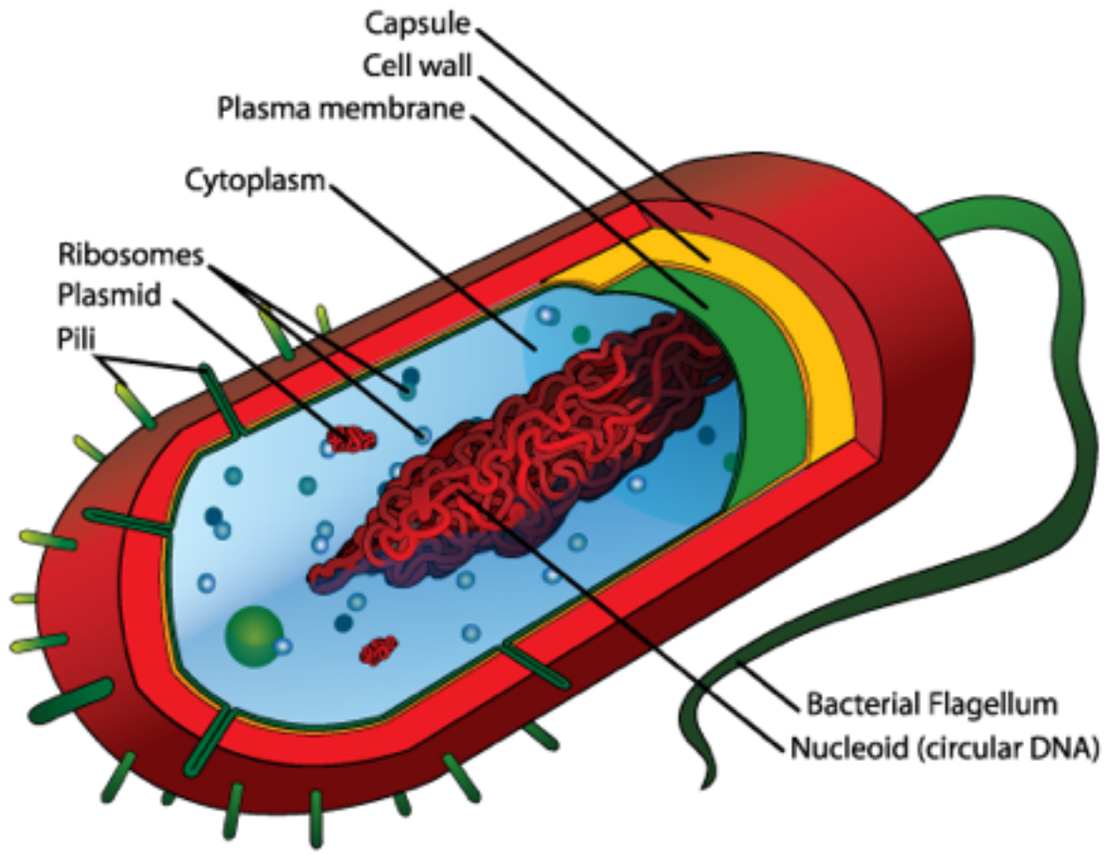
Two main categories

Eukaryotic cell



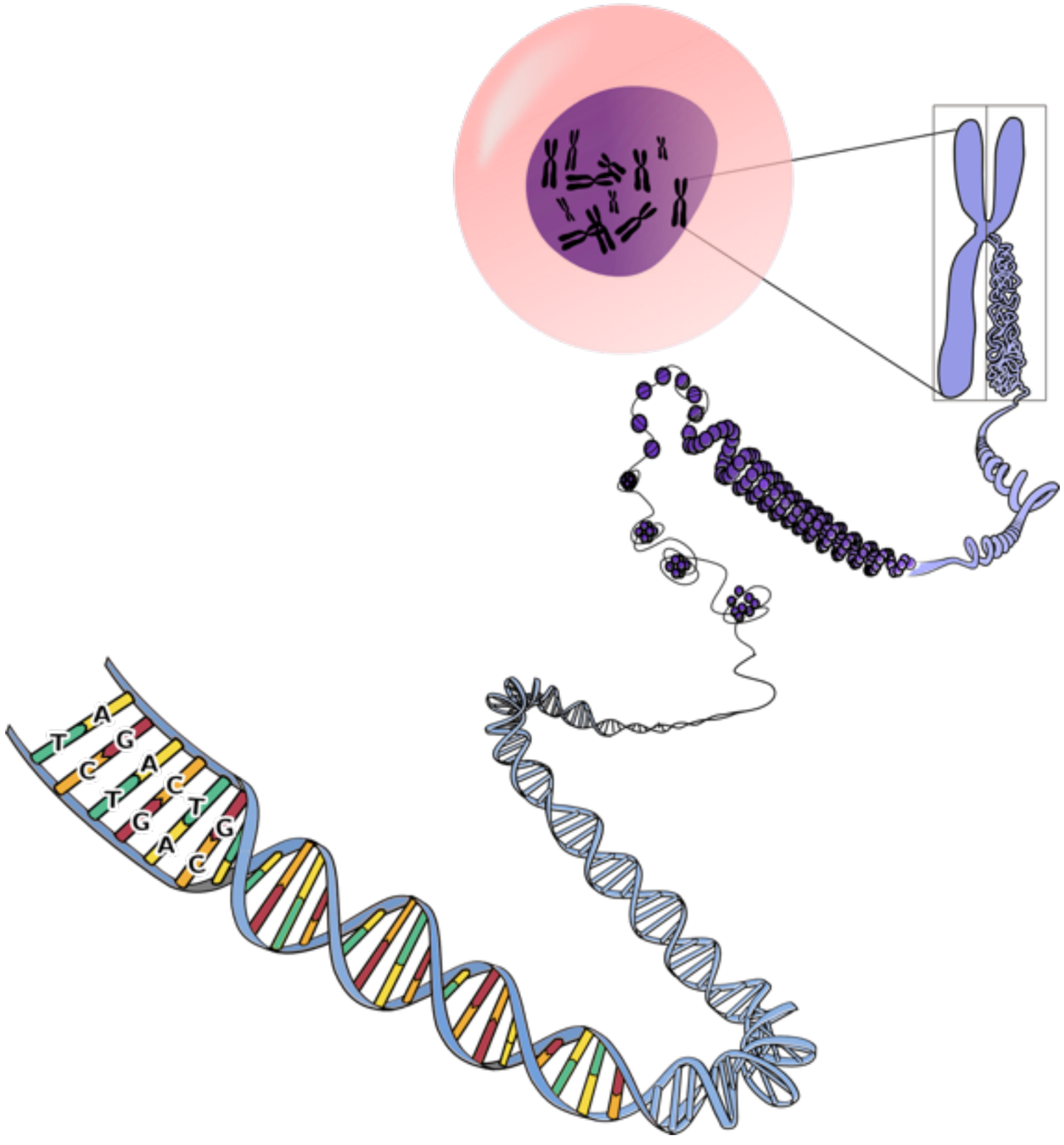
Marion - CC-BY-SA 3.0

Prokaryotic cell

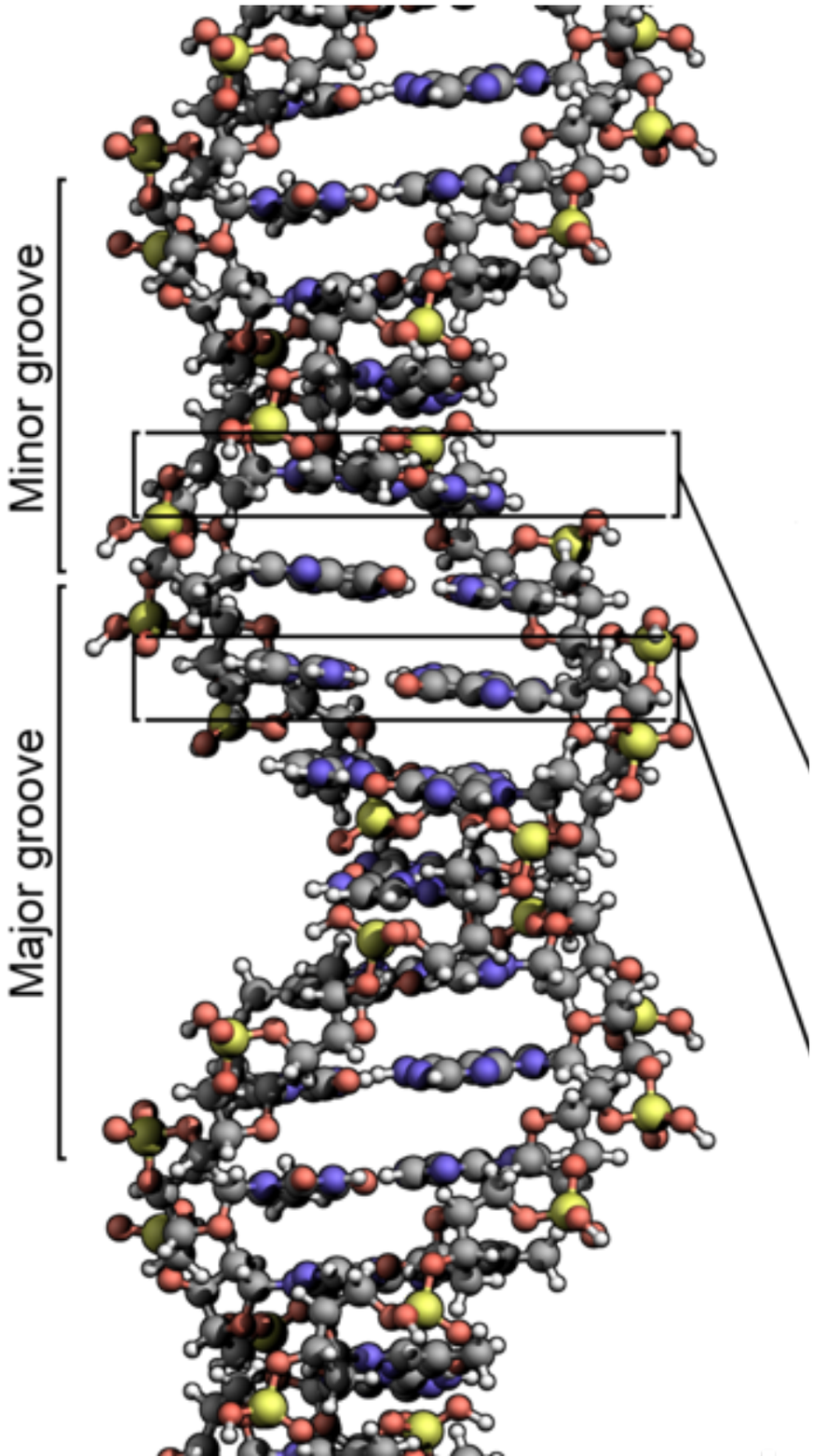


Public Domain

DNA in the cell



DNA Molecule



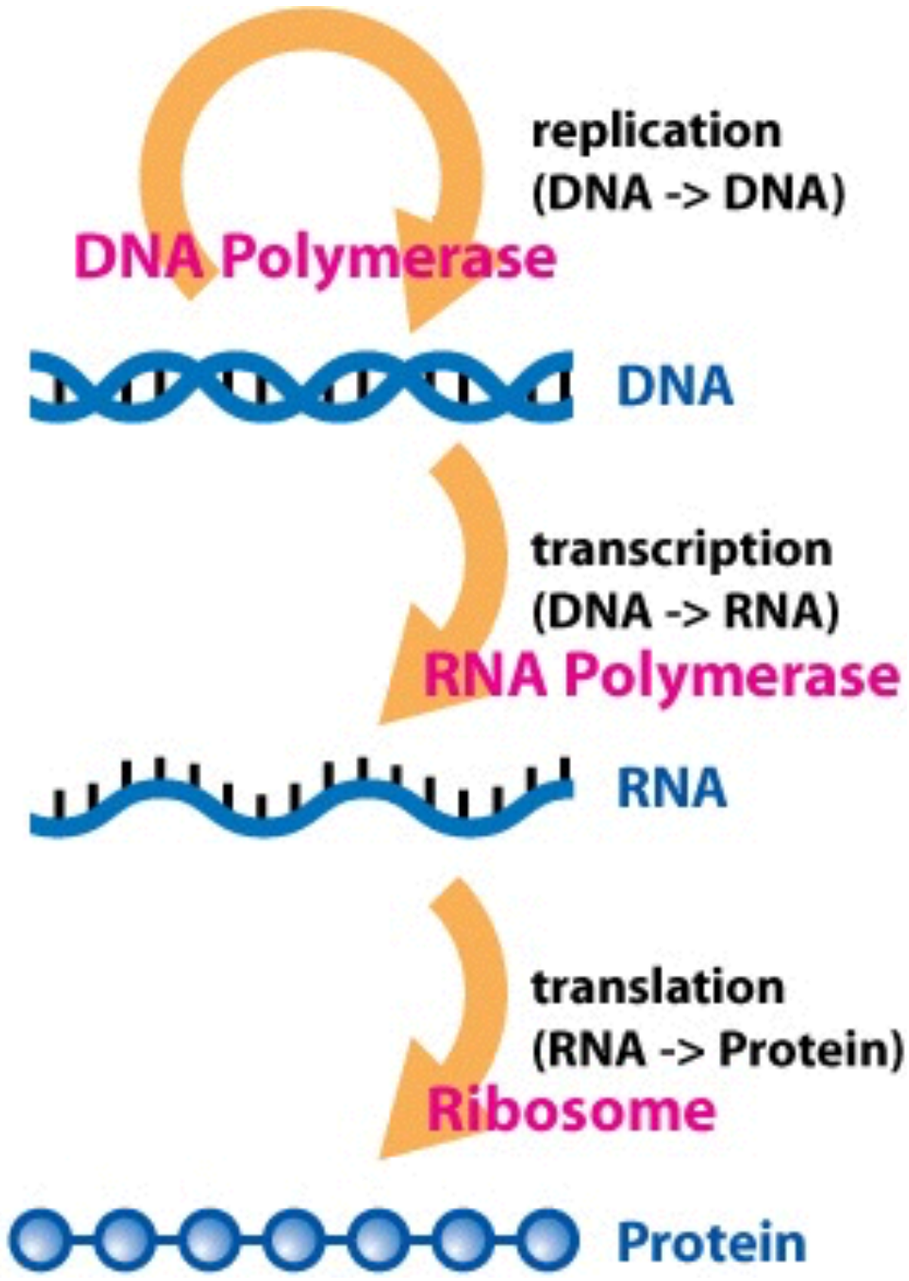
Living code:

AACATGACCTGACGA

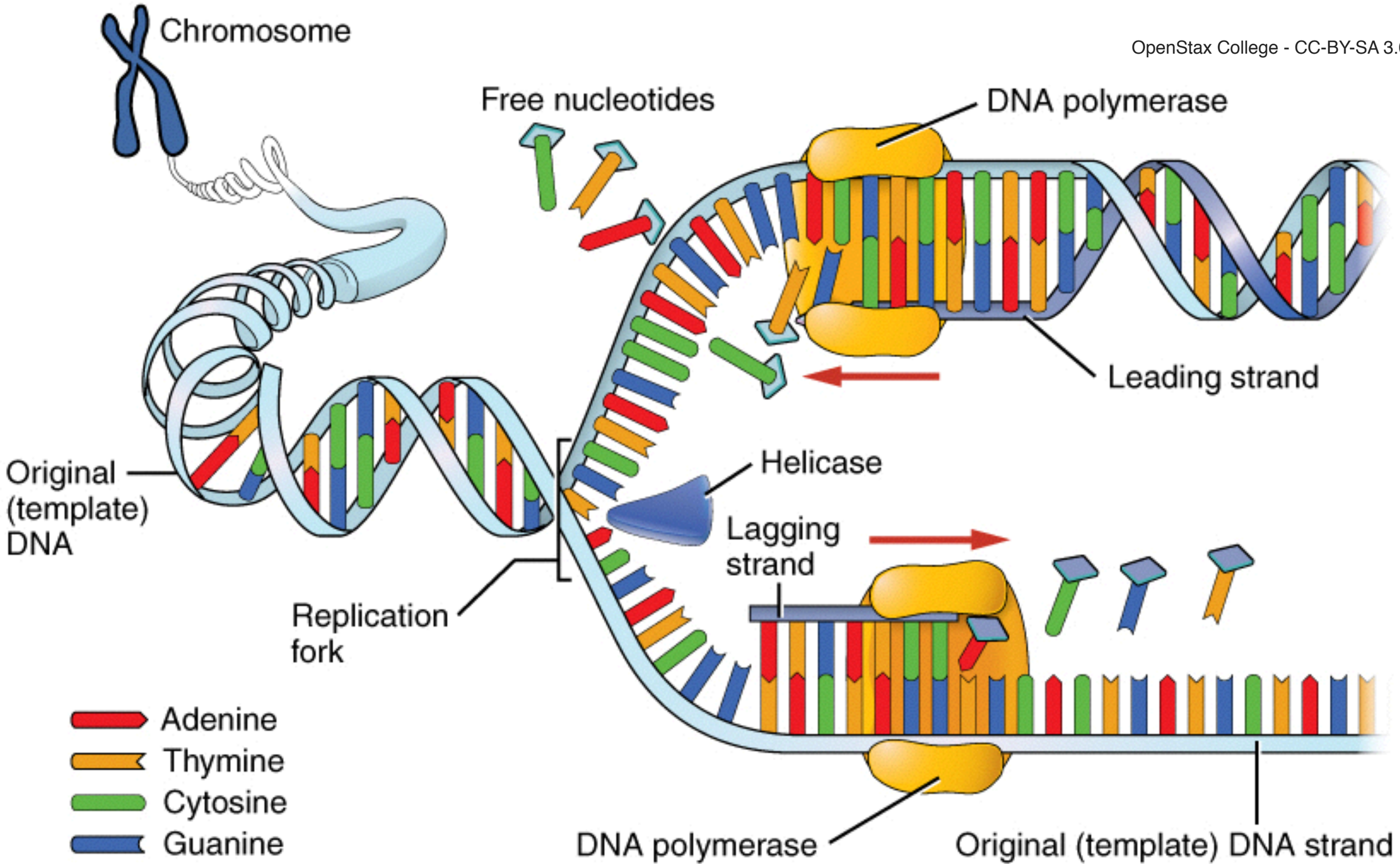
Digital code:

1001010011101010101010101010
0101010100101010100101010110
1101111001

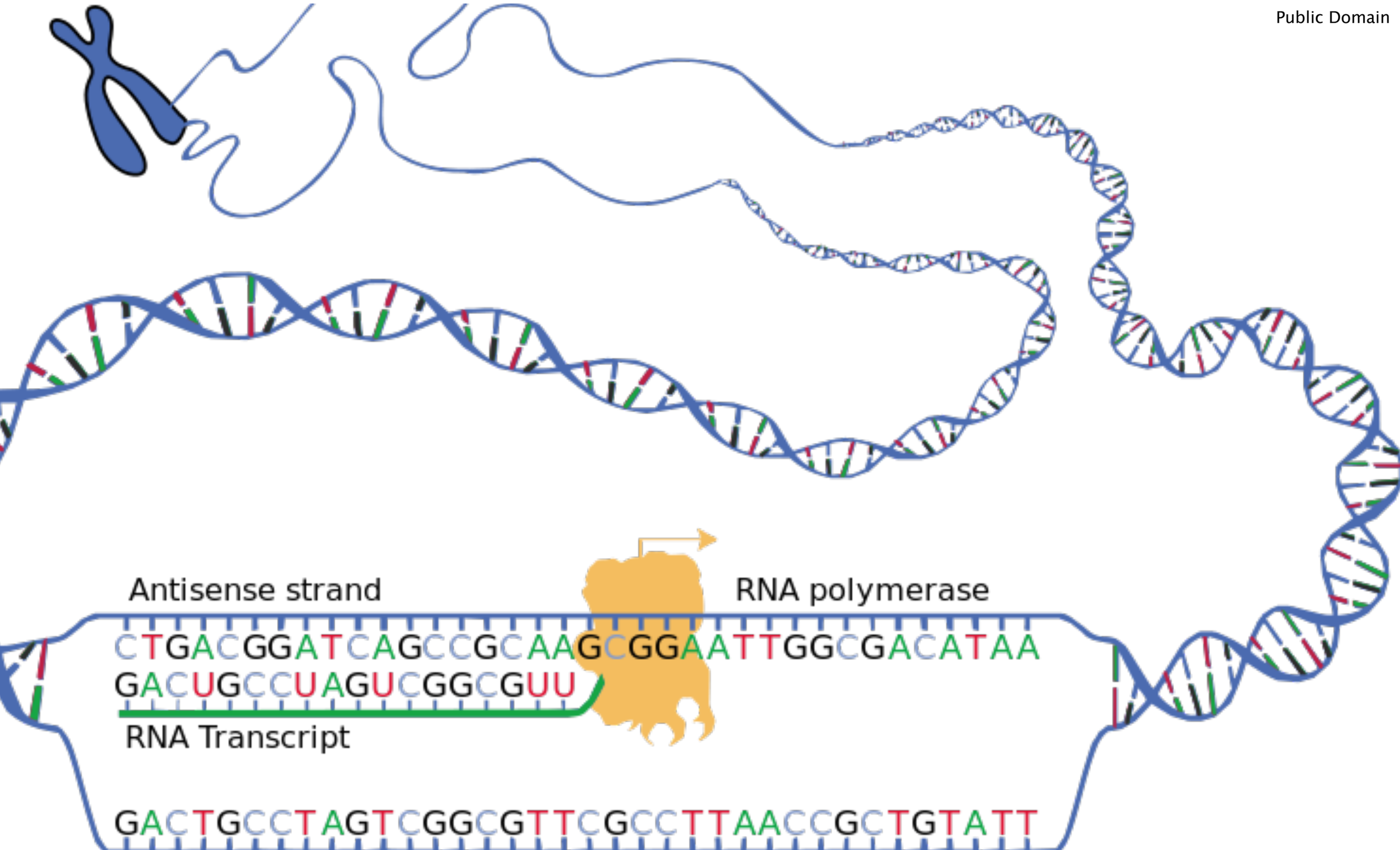
Central Dogma



DNA Replication

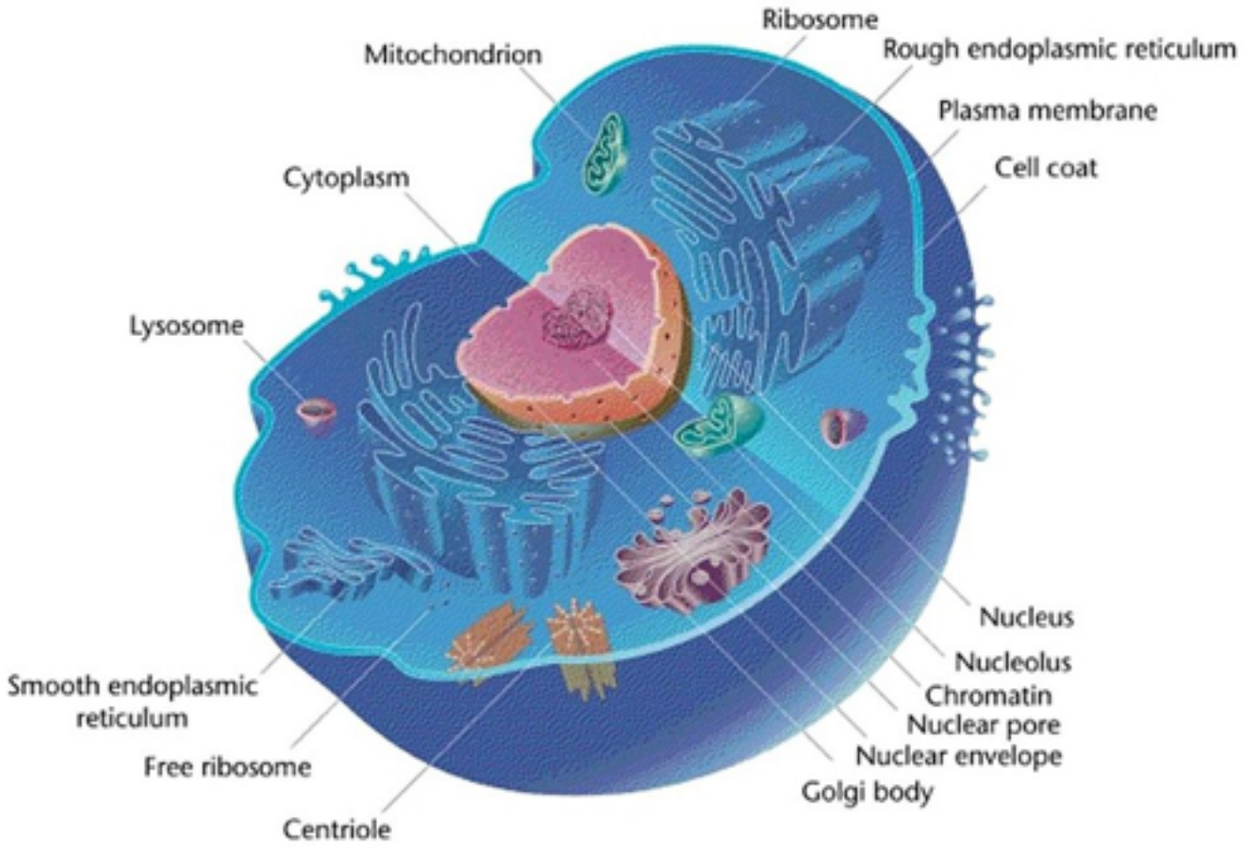


DNA Transcription

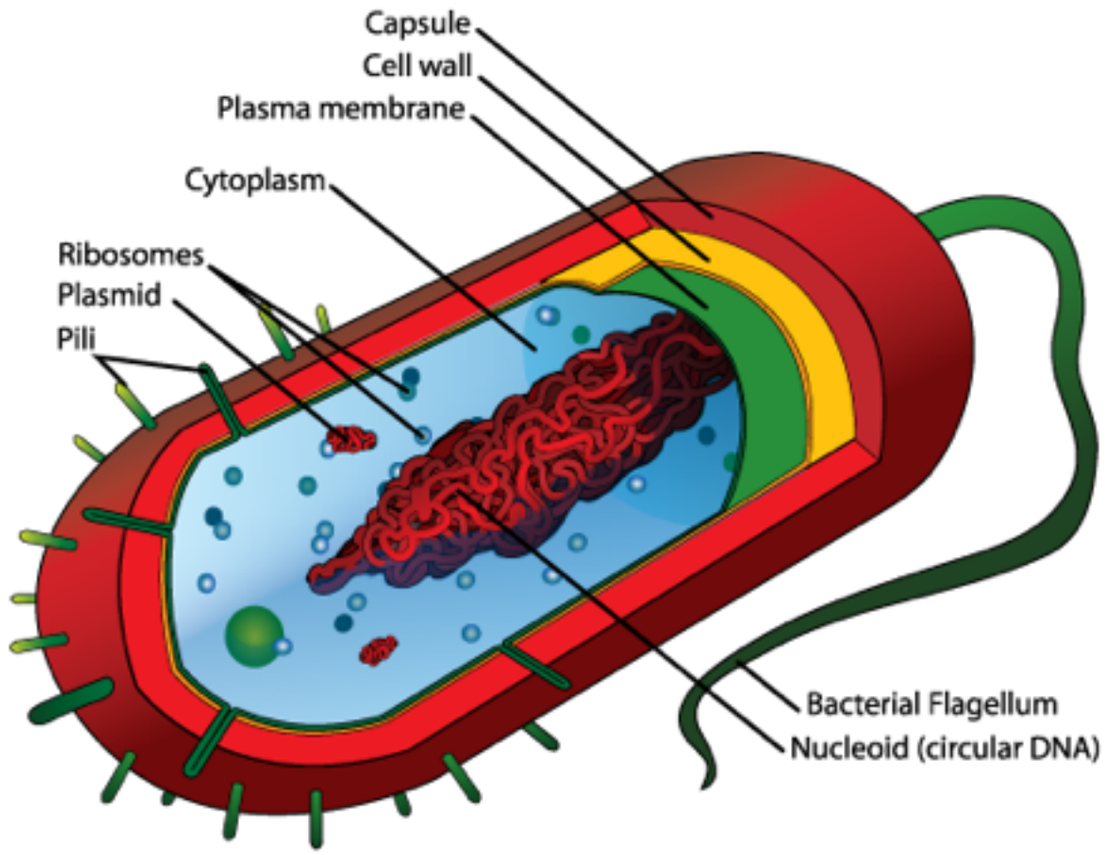


Getting out of the nucleus

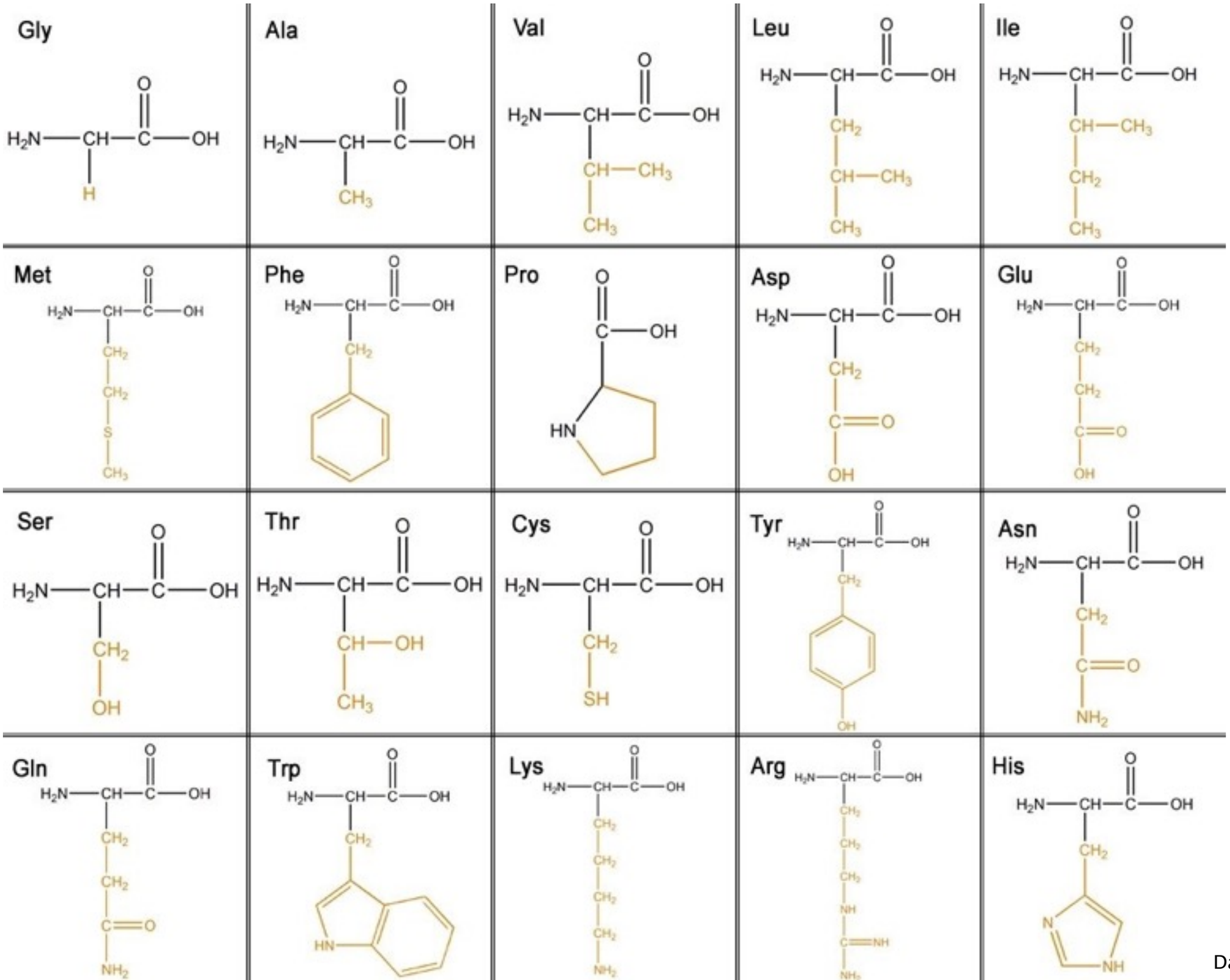
Eukaryotic cell



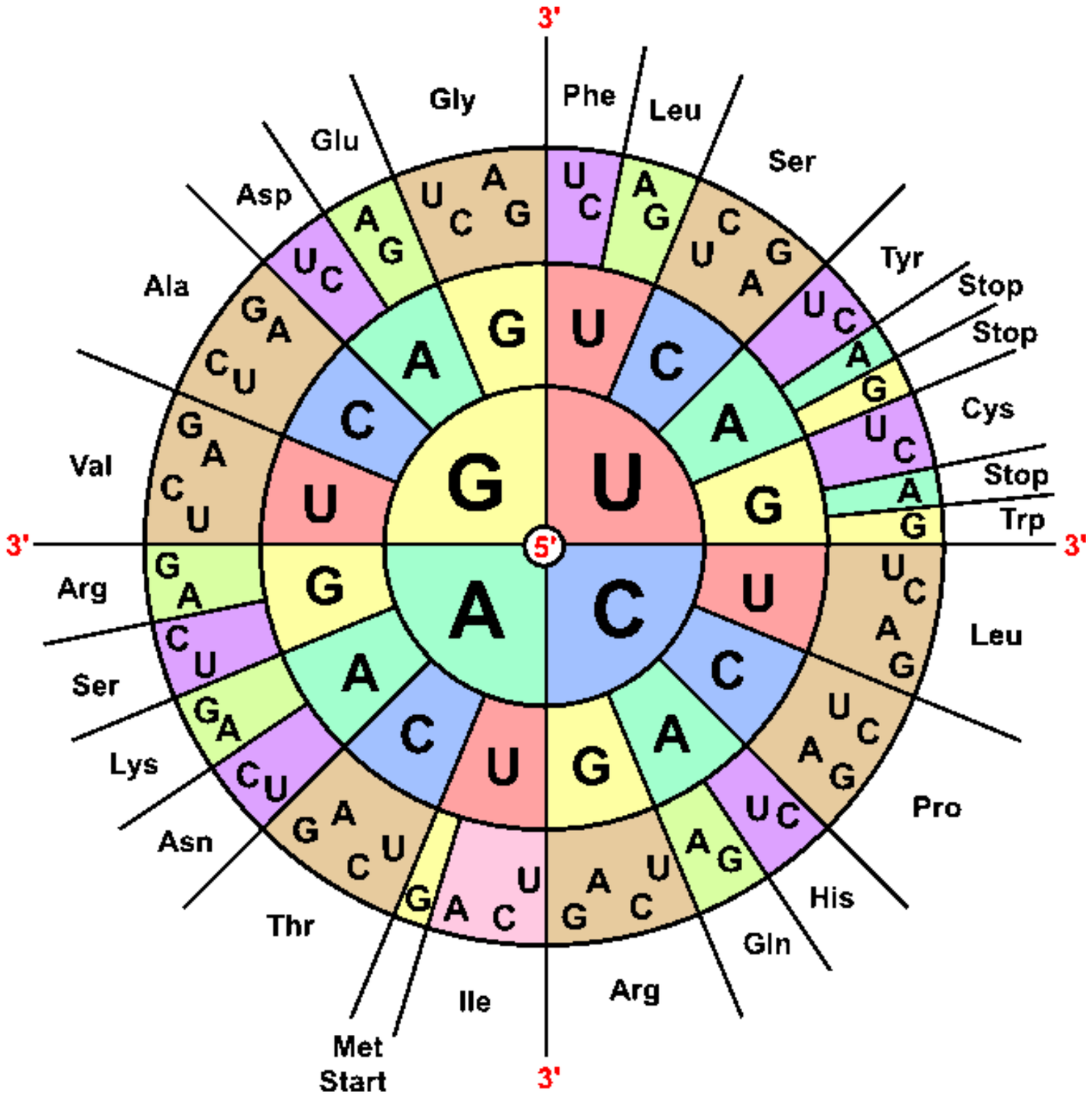
Prokaryotic cell



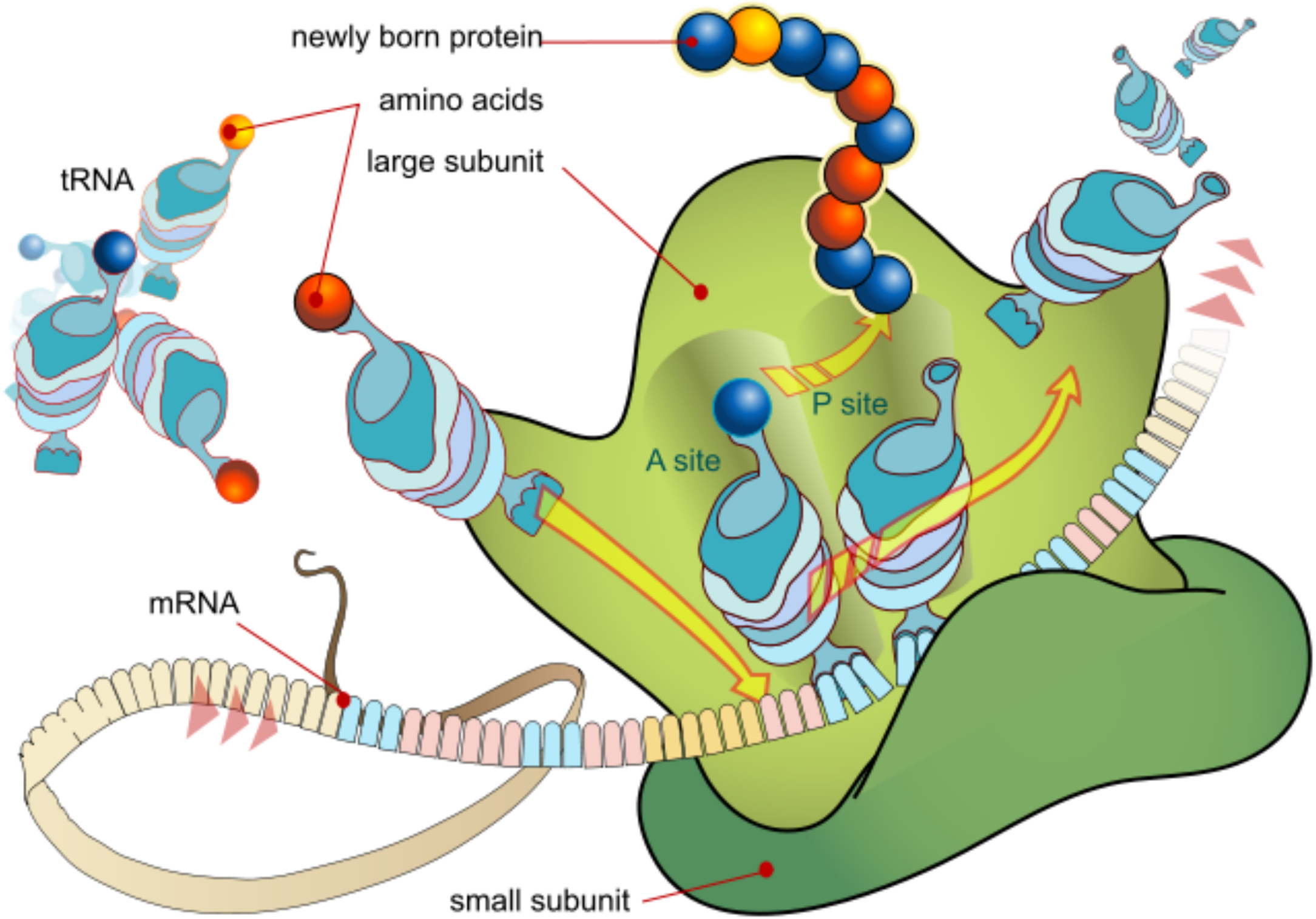
Amino acids, the building blocks



Amino acid rosetta stone



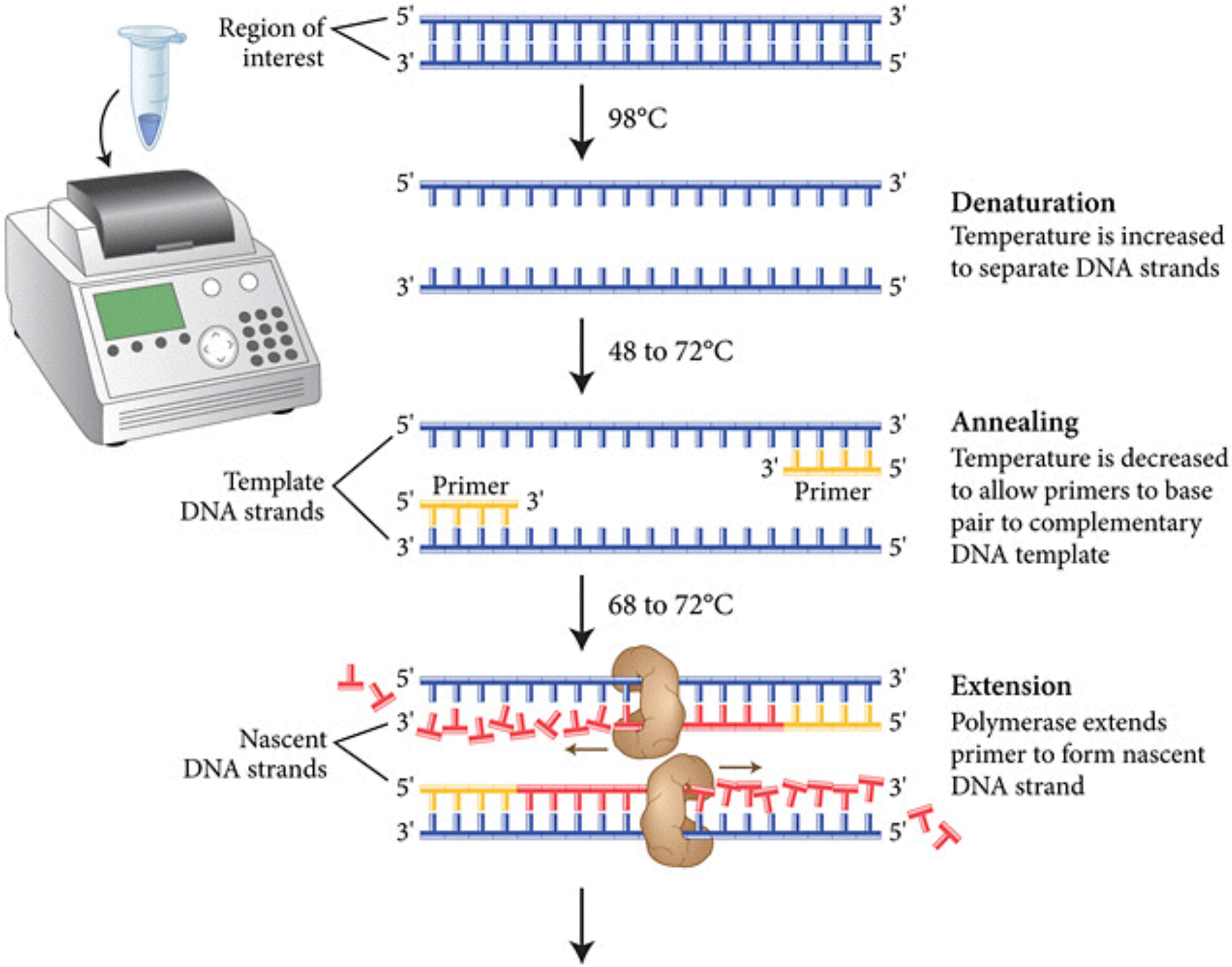
Translation



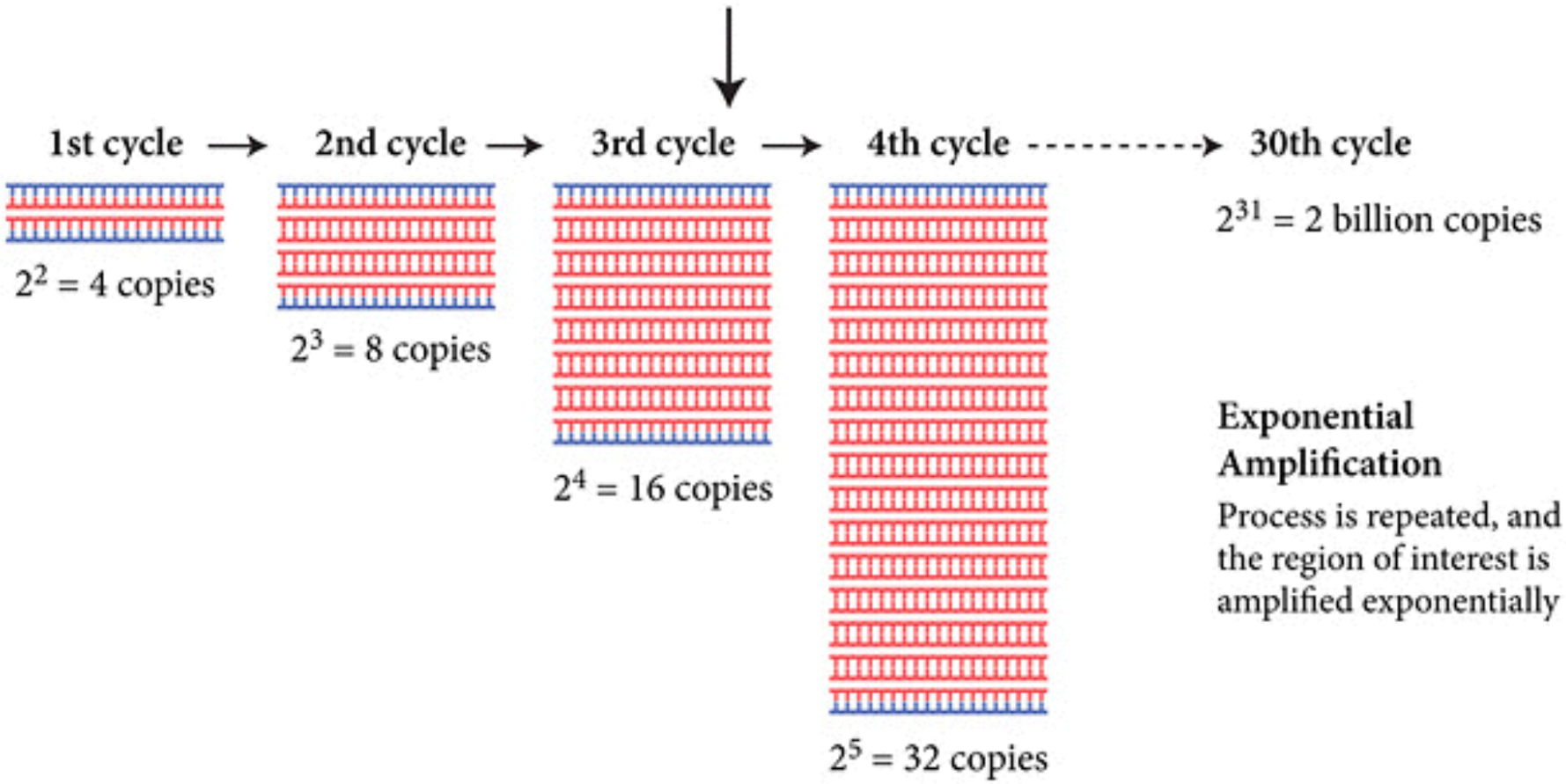
Polymerase Chain Reaction, 1983

Kary Mullis

Polymerase Chain Reaction



Polymerase Chain Reaction



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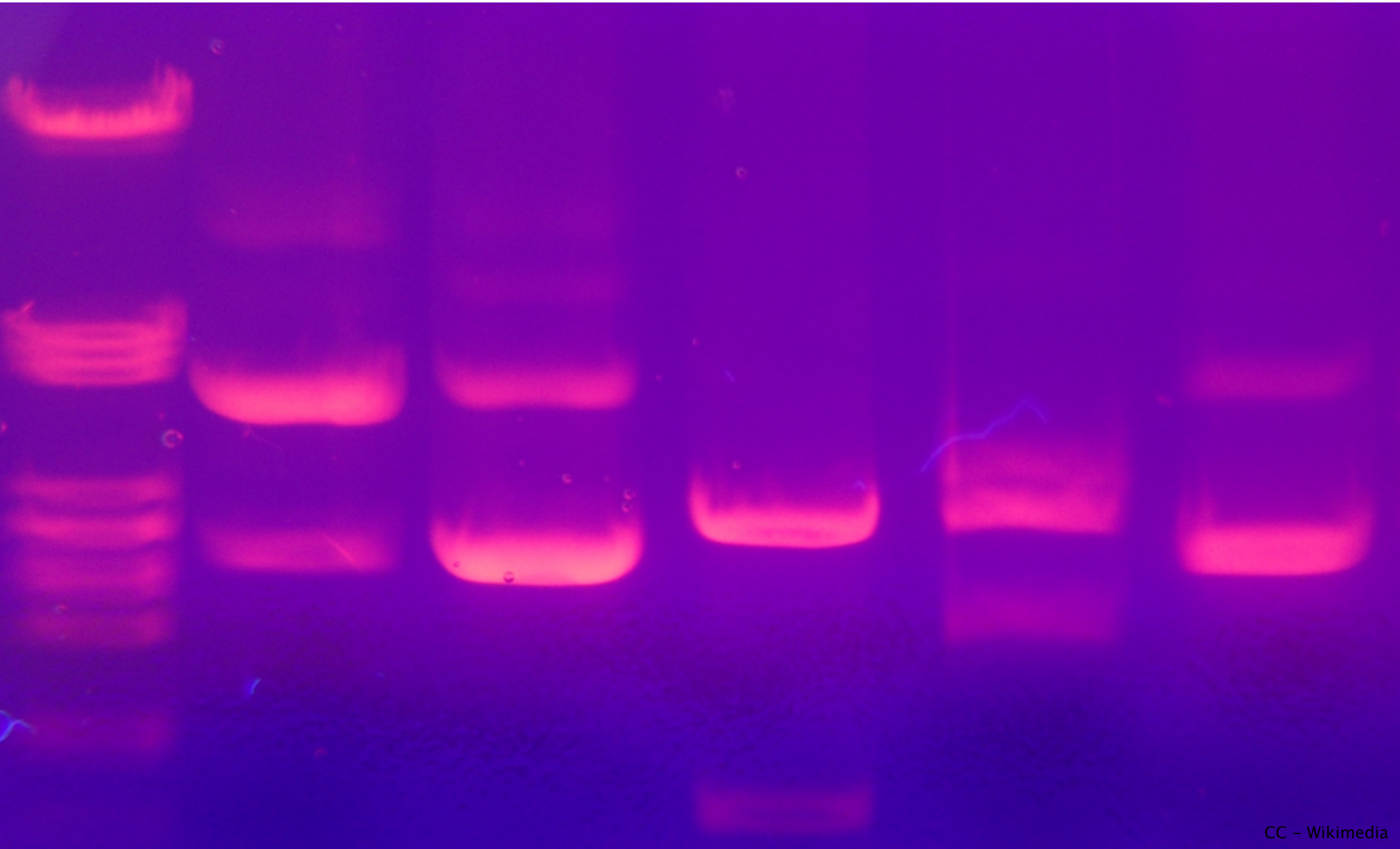
DNA fingerprinting

DNA fingerprint



CC – Wikimedia

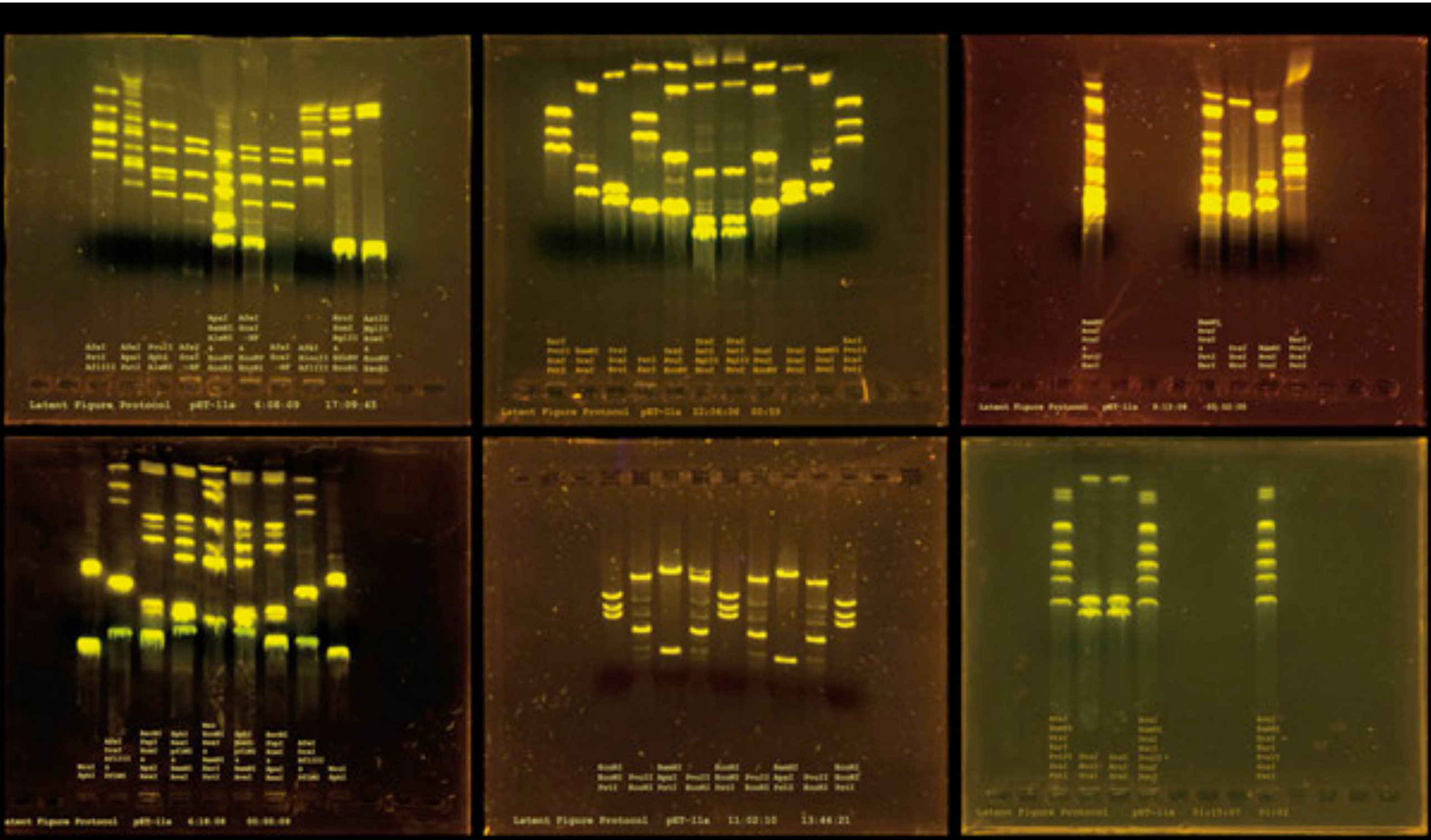
Sushi test

PooPrints

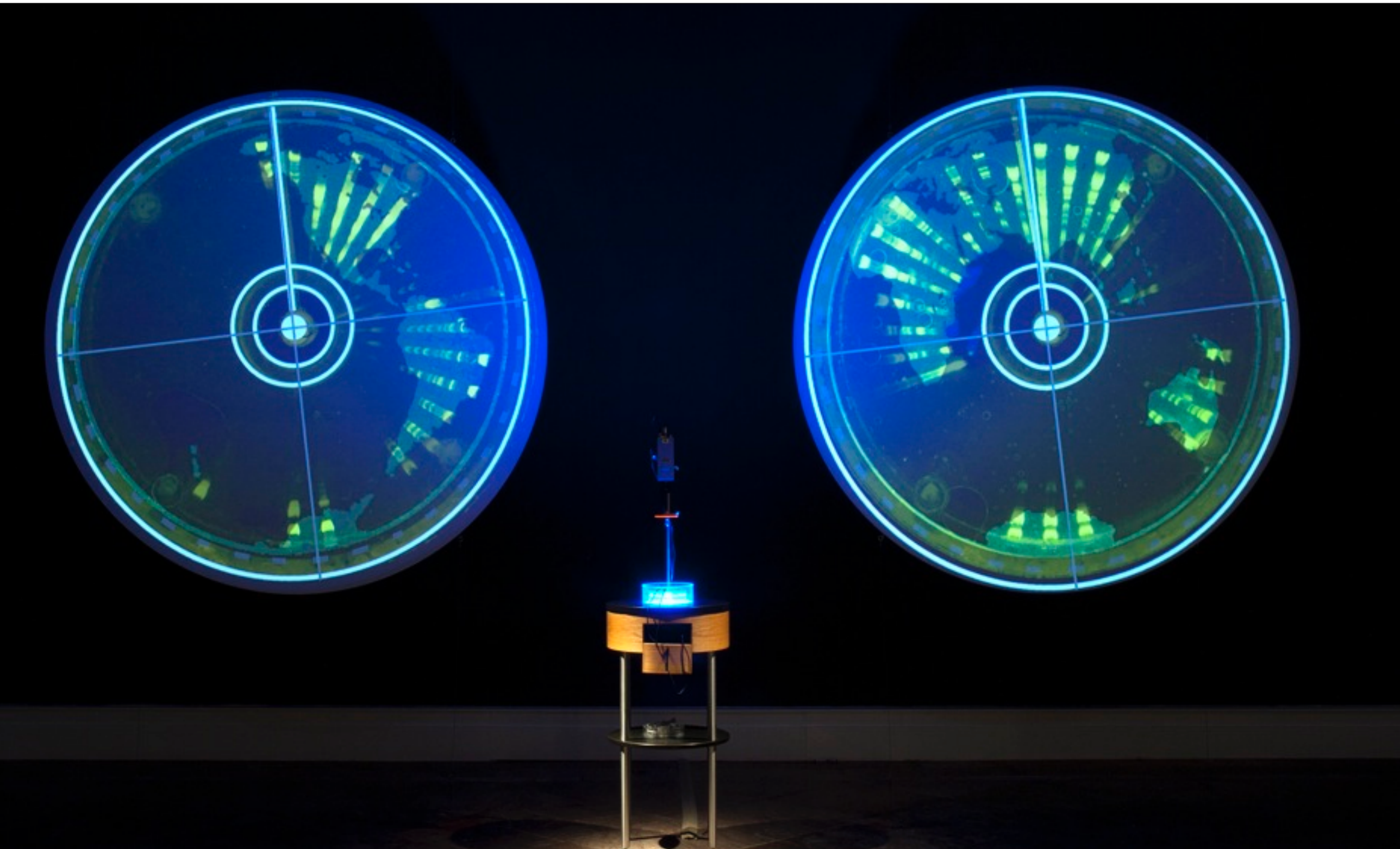

PooPrints™
Match The Mess Through DNA
DNA Collection Kit
D305-520
PET Identification Card
BioPet
Vet Lab
1-866-883-7389
Customer Information Card
*Required Information
Account Information
*Country:
*Email:
*Your Name:
*Address:
*City, State, Zip
Phone:
Pet Information
Apply Barcode Sticker Here
Pet's Name:
*Pet's Species: Dog Cat
Where did you purchase your DNA Pet ID Kit?
Company:
BioPet
Vet Lab
DNA World Pet Registry
Affix barcode sticker OR write dog's name here
Affix barcode sticker OR write dog's name here
BioPet
Vet Lab
BioPet
Vet Lab

Barcode

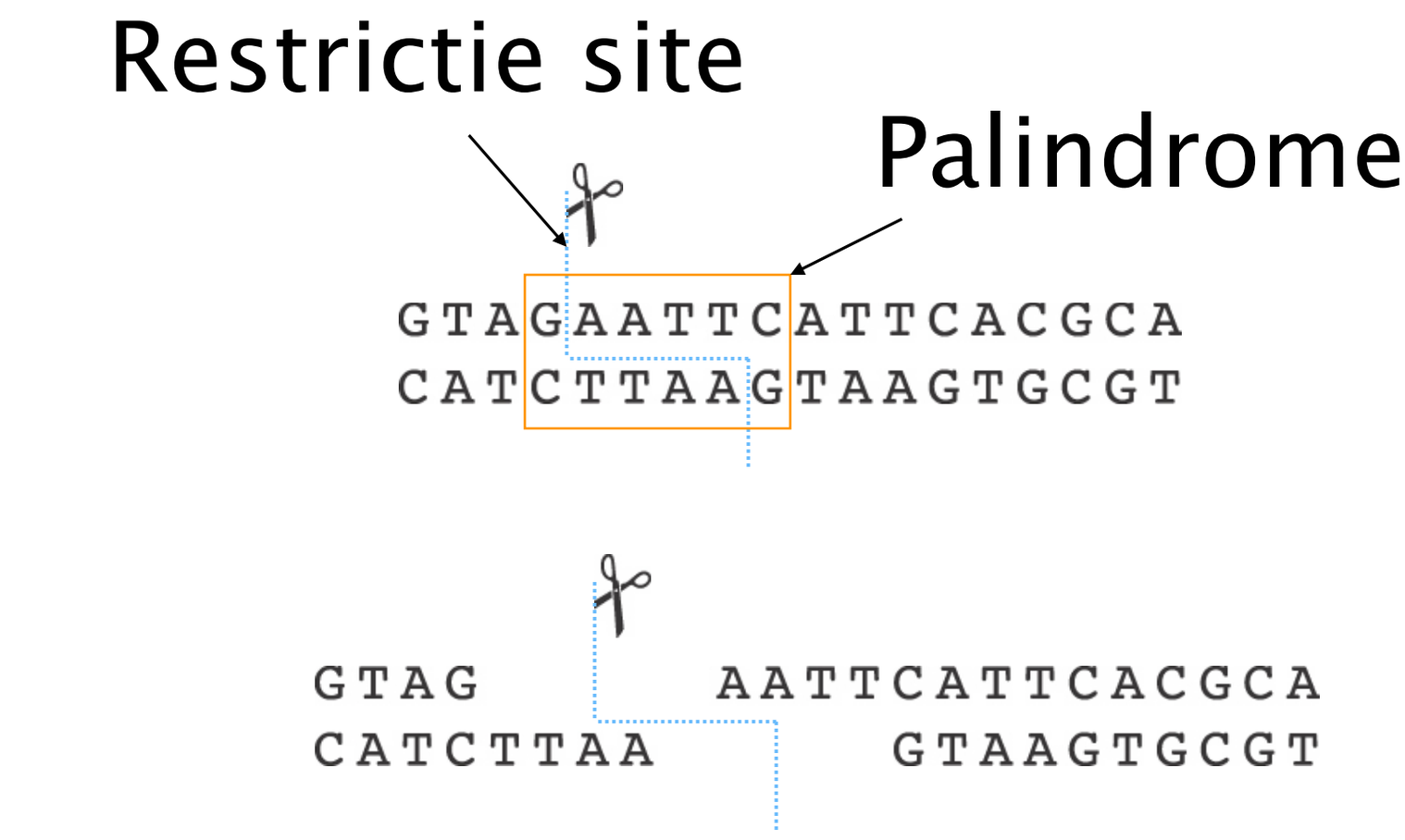
Paul Vanouse



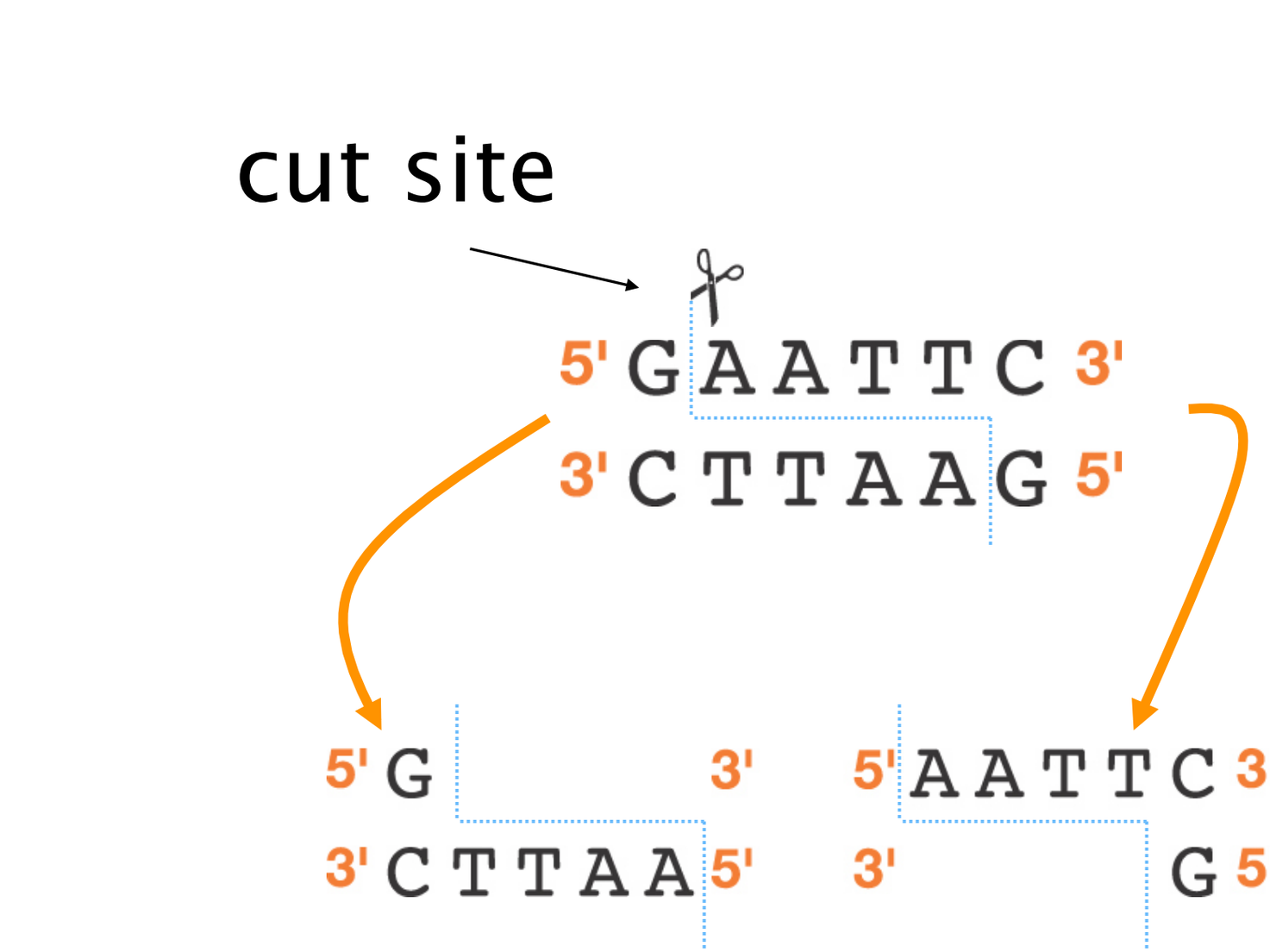
Paul Vanouse



Sequence specific cuts



5 vs 3 accent overlap



EcoRI en PstI

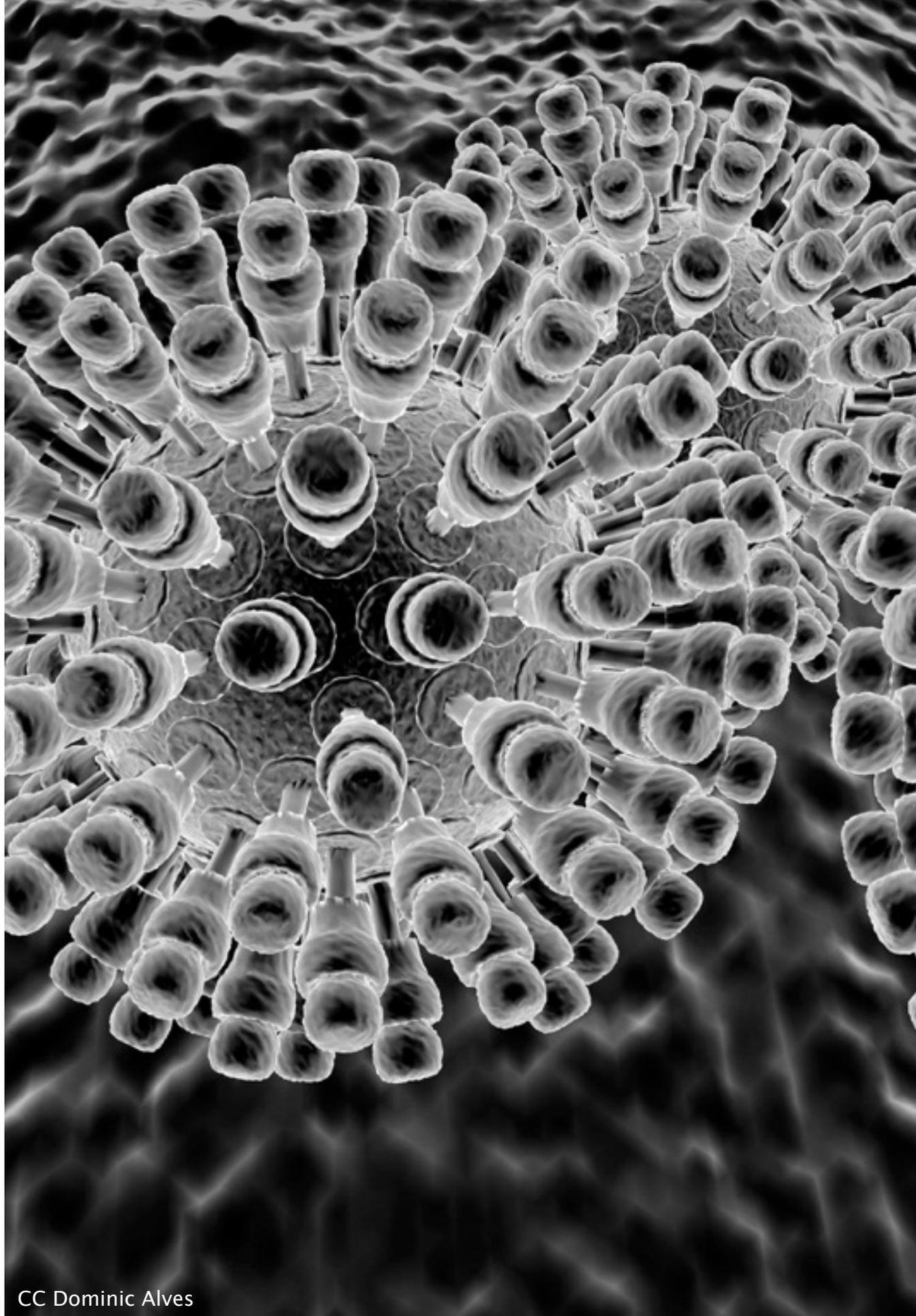
EcoRI
- Eschericha coli
- 5 prime overlap

PstI
- Providencia stuartii
- 3 prime overlap

DNA restriction enzymes

- Protect against viral infections

- Over 3000 types known



Step 1: samples and enzymes

Get DNA and enzymes

Crime Scene

Suspects

1 2 3 4 5

DNA reference

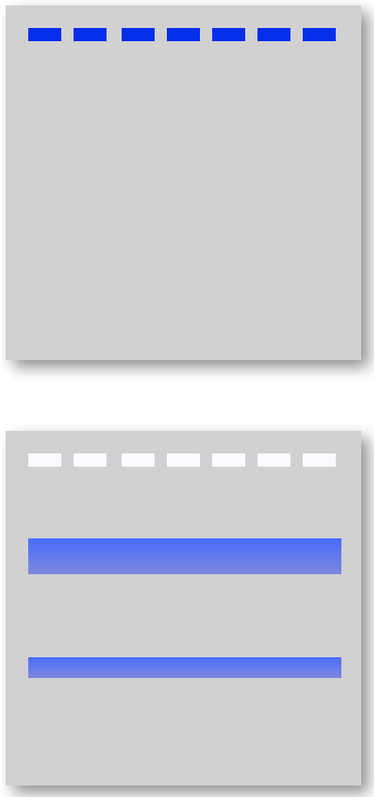
Take the 5 samples

Cut it using a EcoRI/ PstI restriction-enzymmix

Incubate 45 minutes at 37 degrees

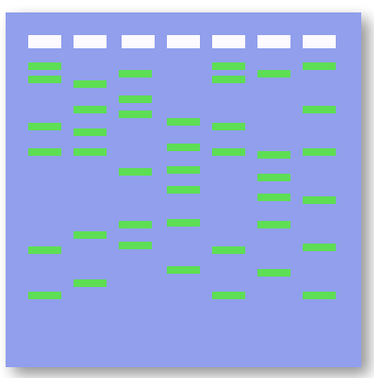
Step 2: Gel electrophoreses

Mix the samples with loading dye



Load the samples in a gel

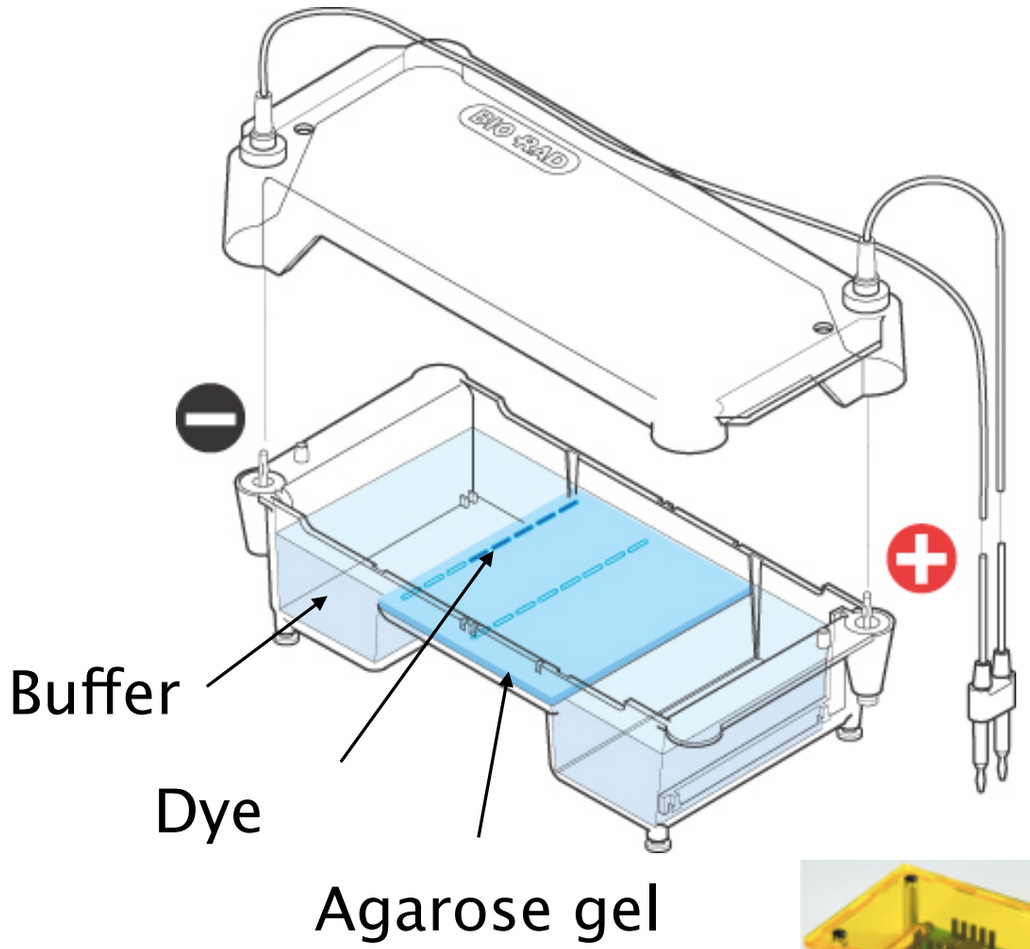
Apply current

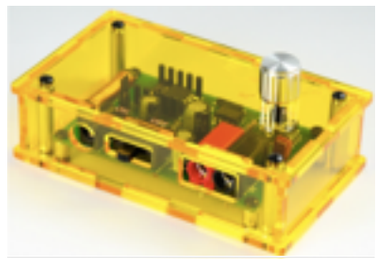


Read the pattern

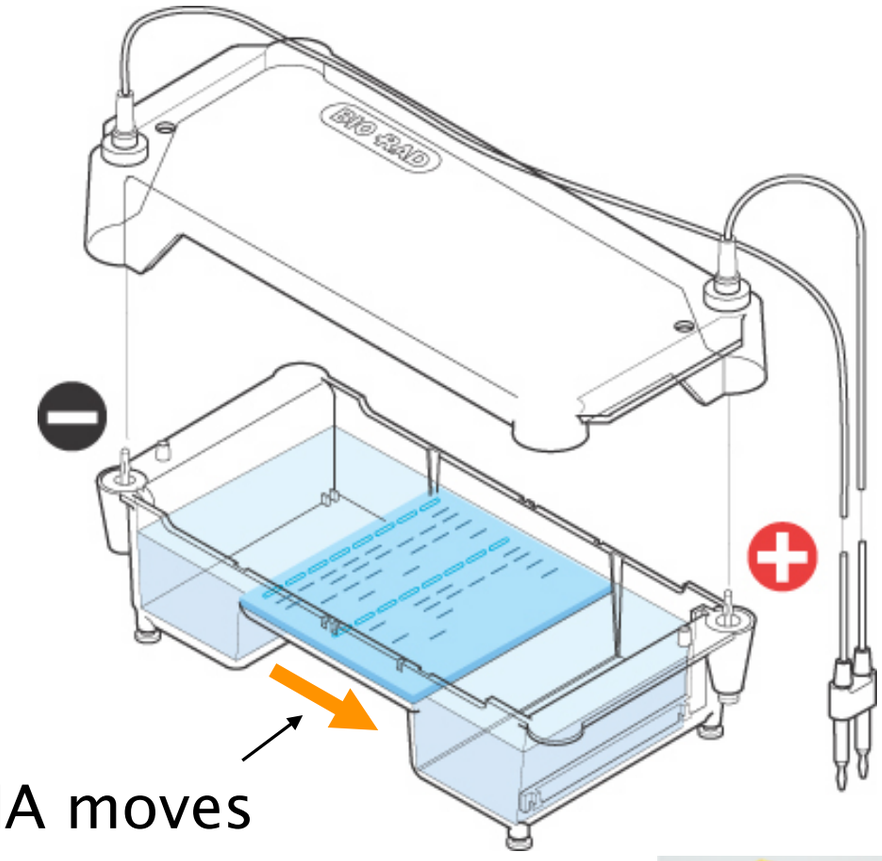
Identify the killer

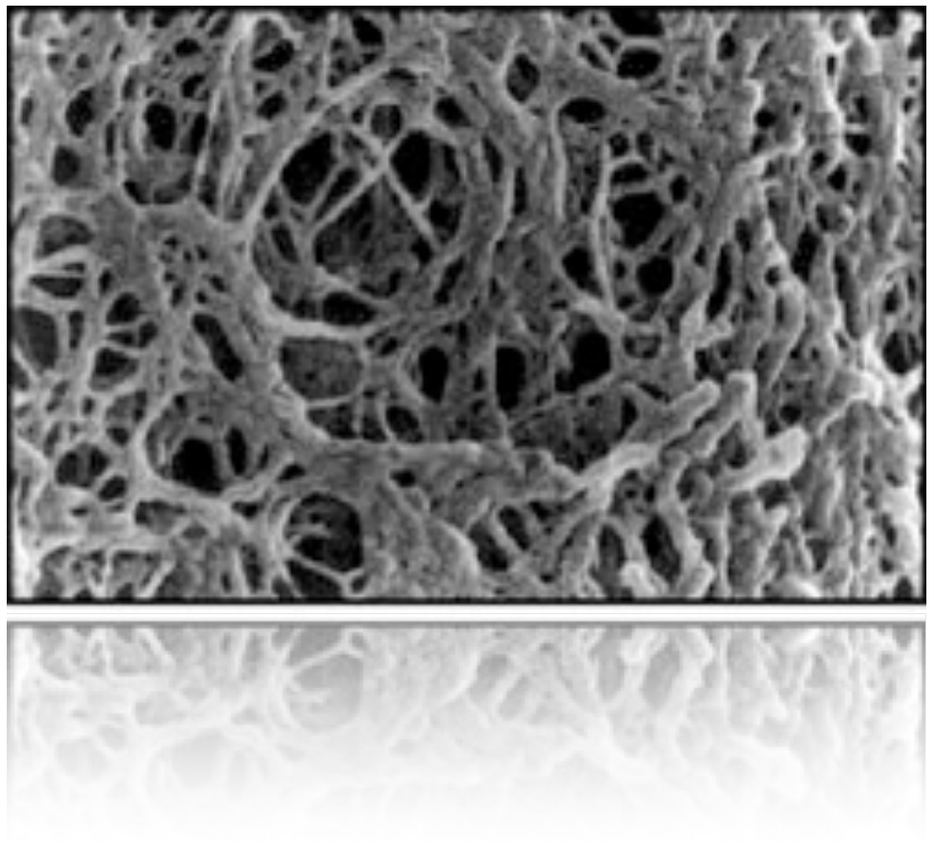
DNA is attracted by the anode

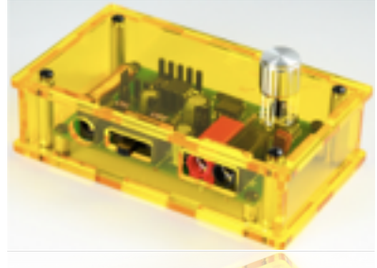




Short pieces move faster than long pieces





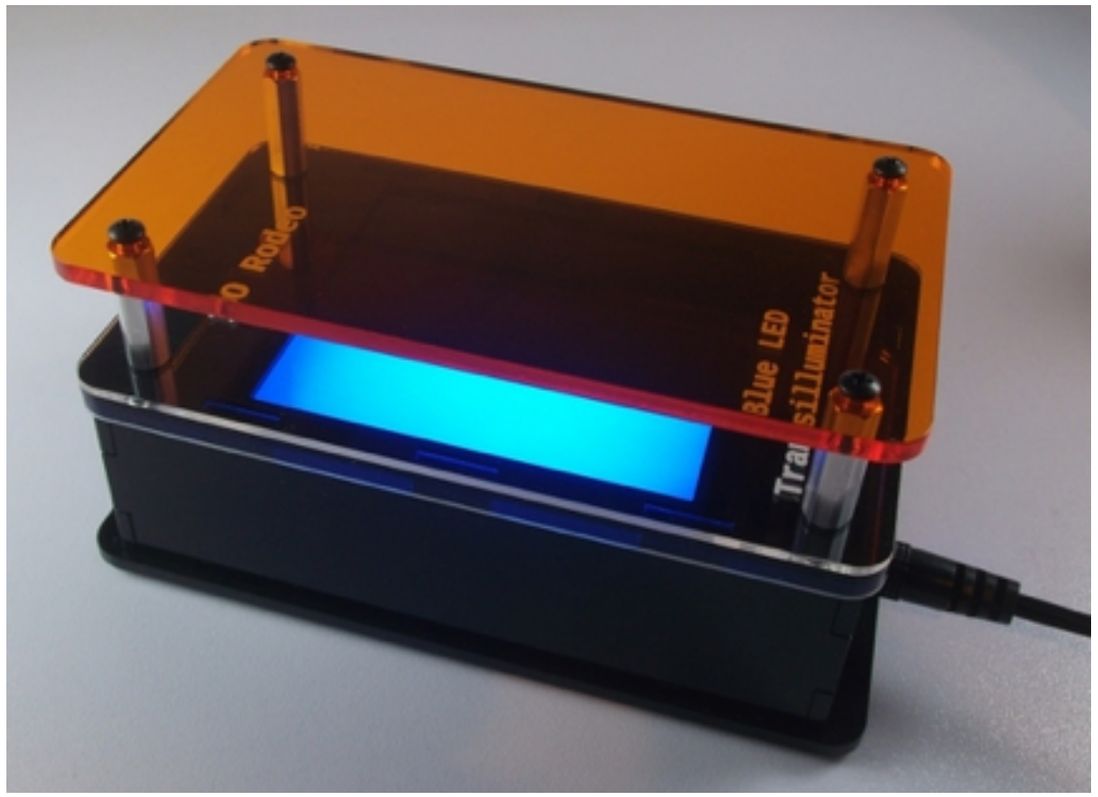


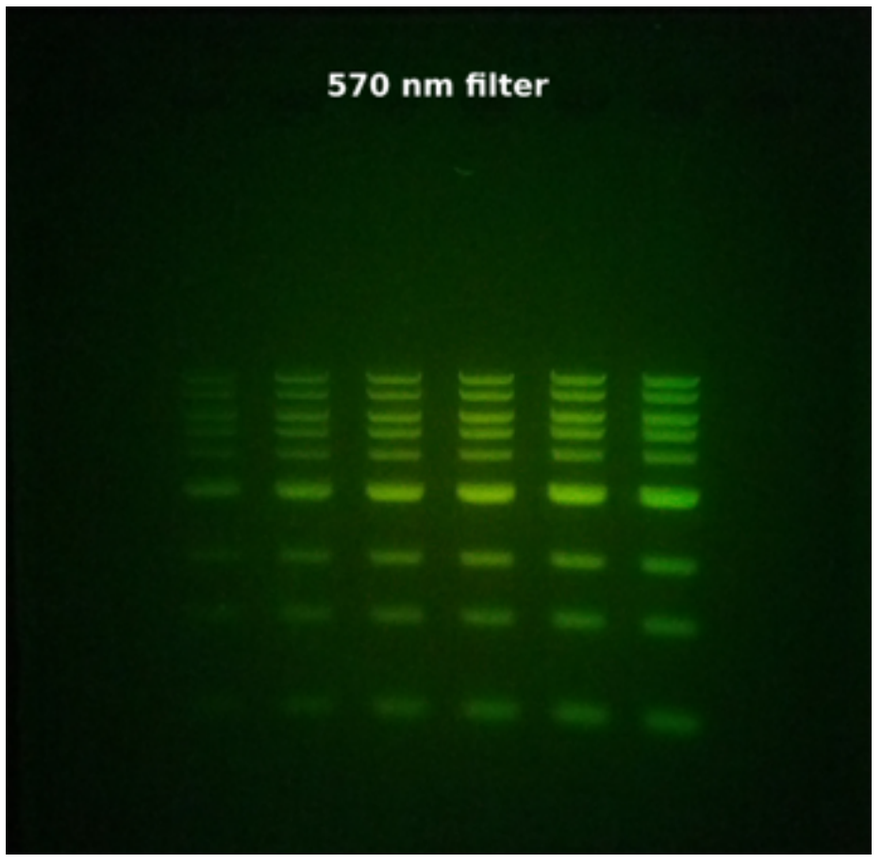
Transillumination

- Fluorescent DNA dye

- Sensitive to blue light
- Emits green light

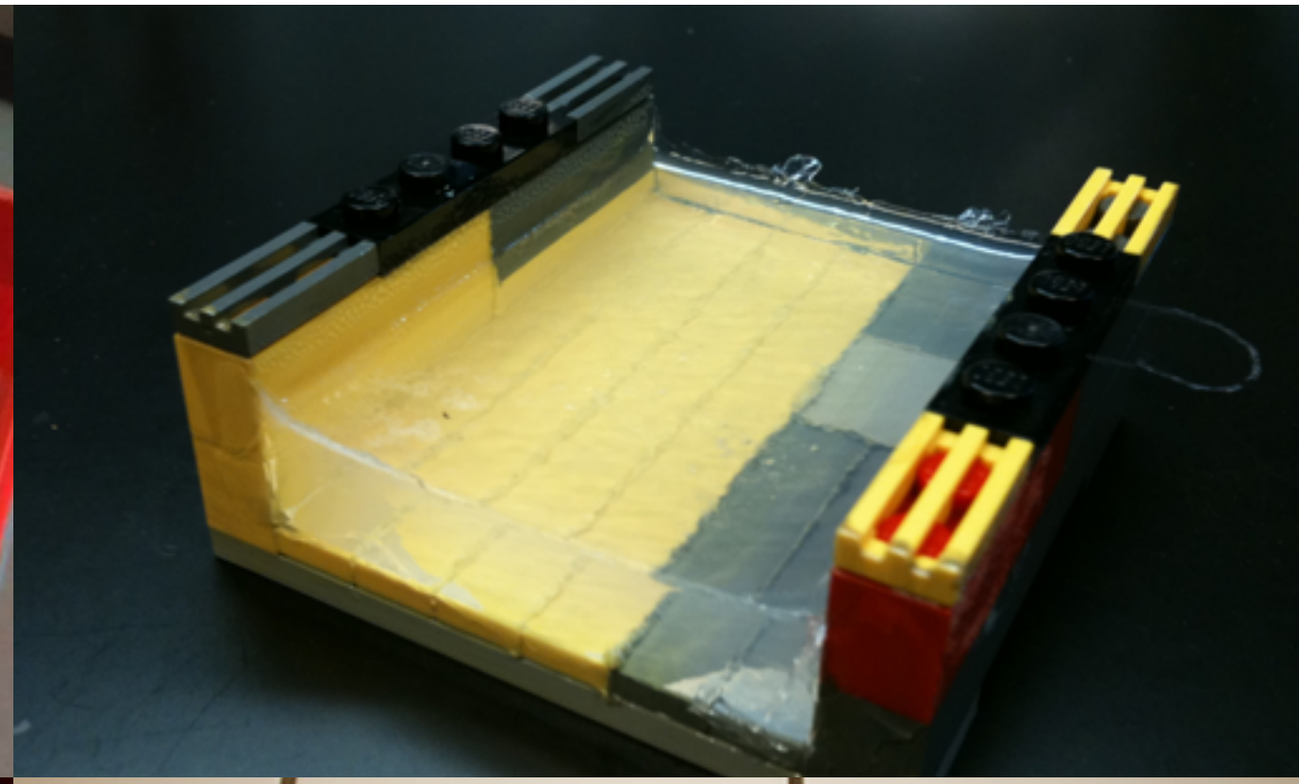
- Orange filter blocks blue light

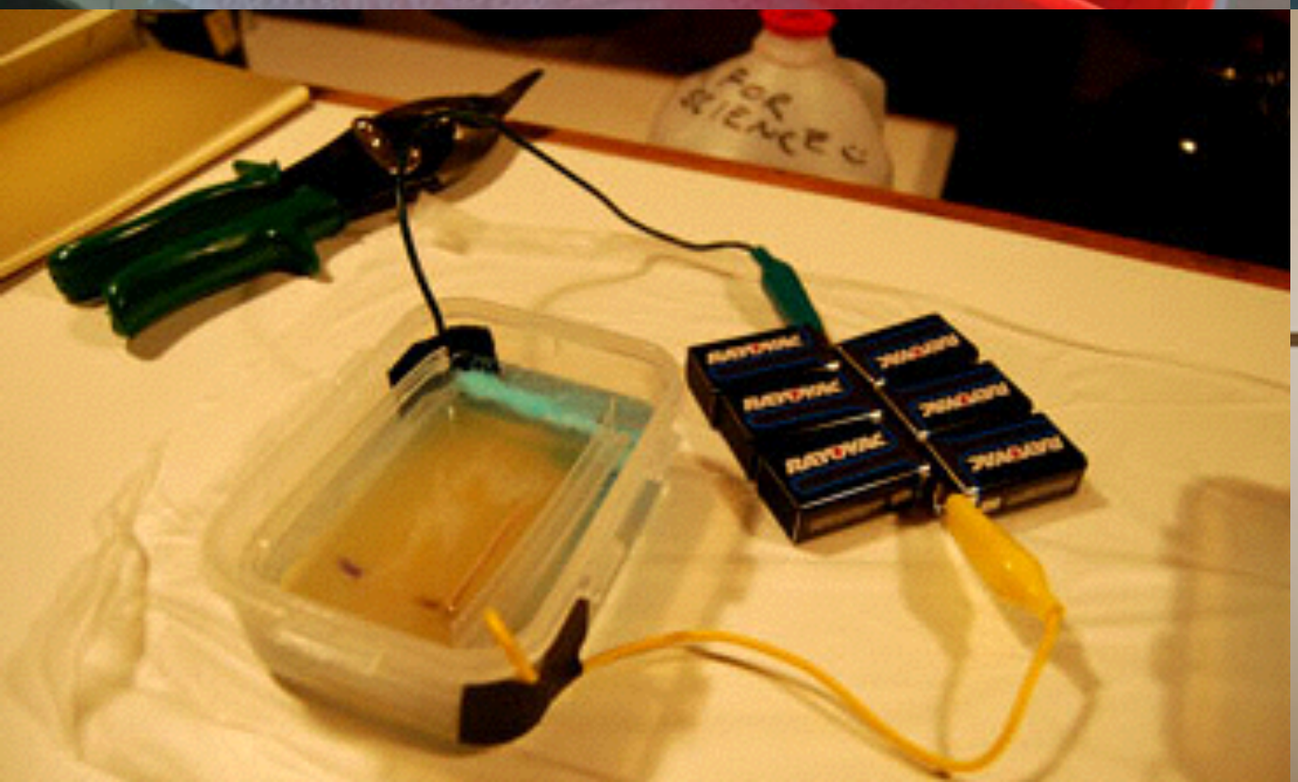


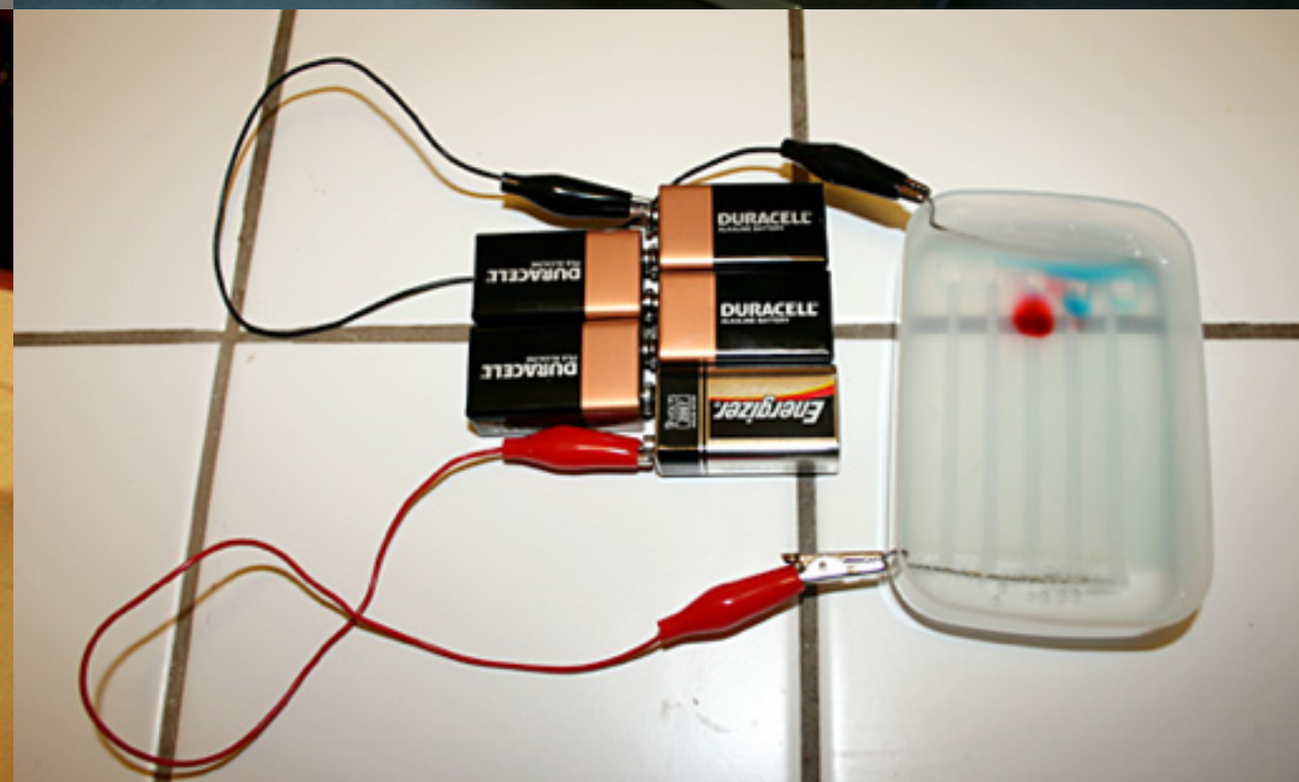


DIY Electrophoresis

http://fablab.waag.org/project/ow-dna-gel-electrophoresis-box







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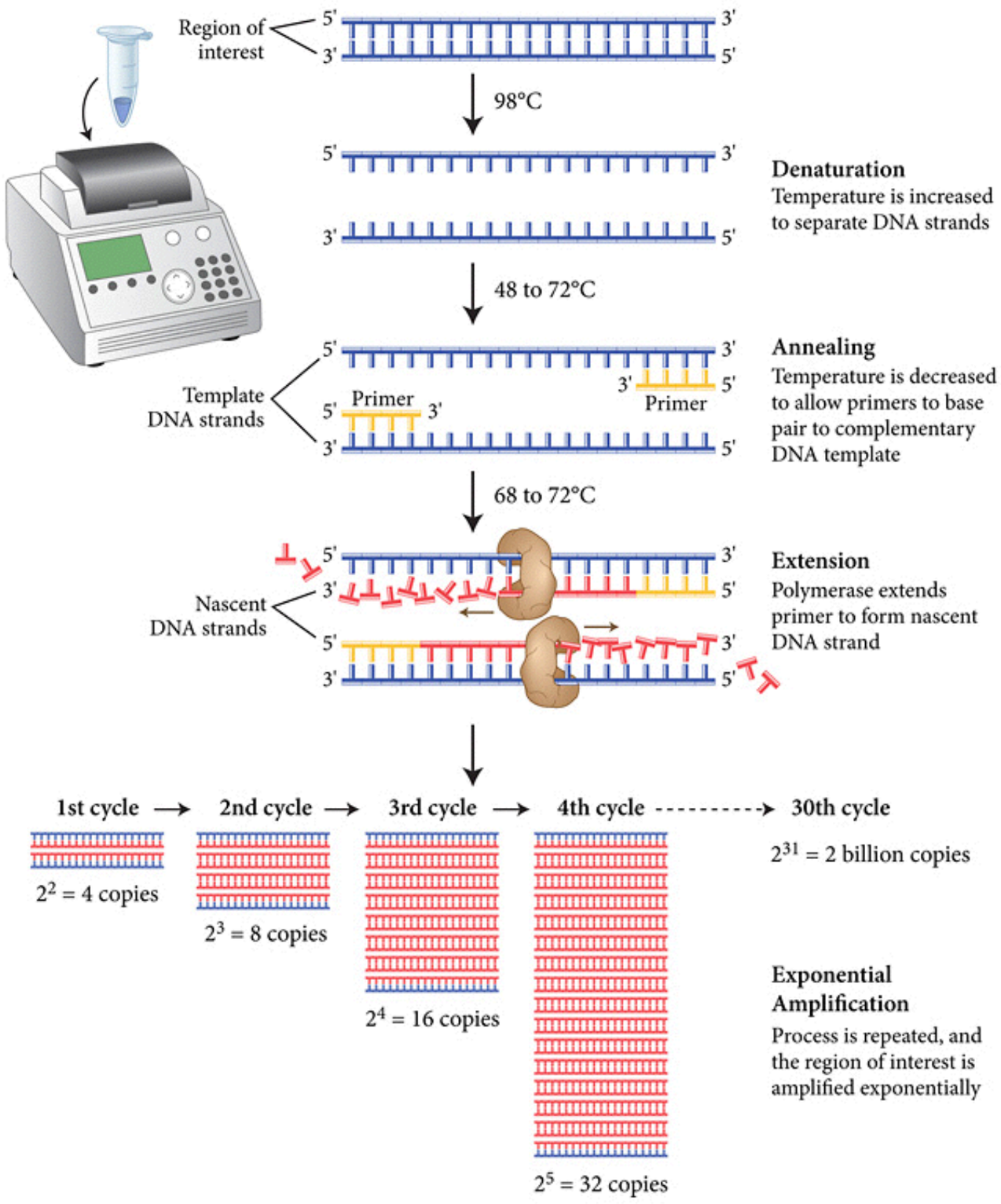
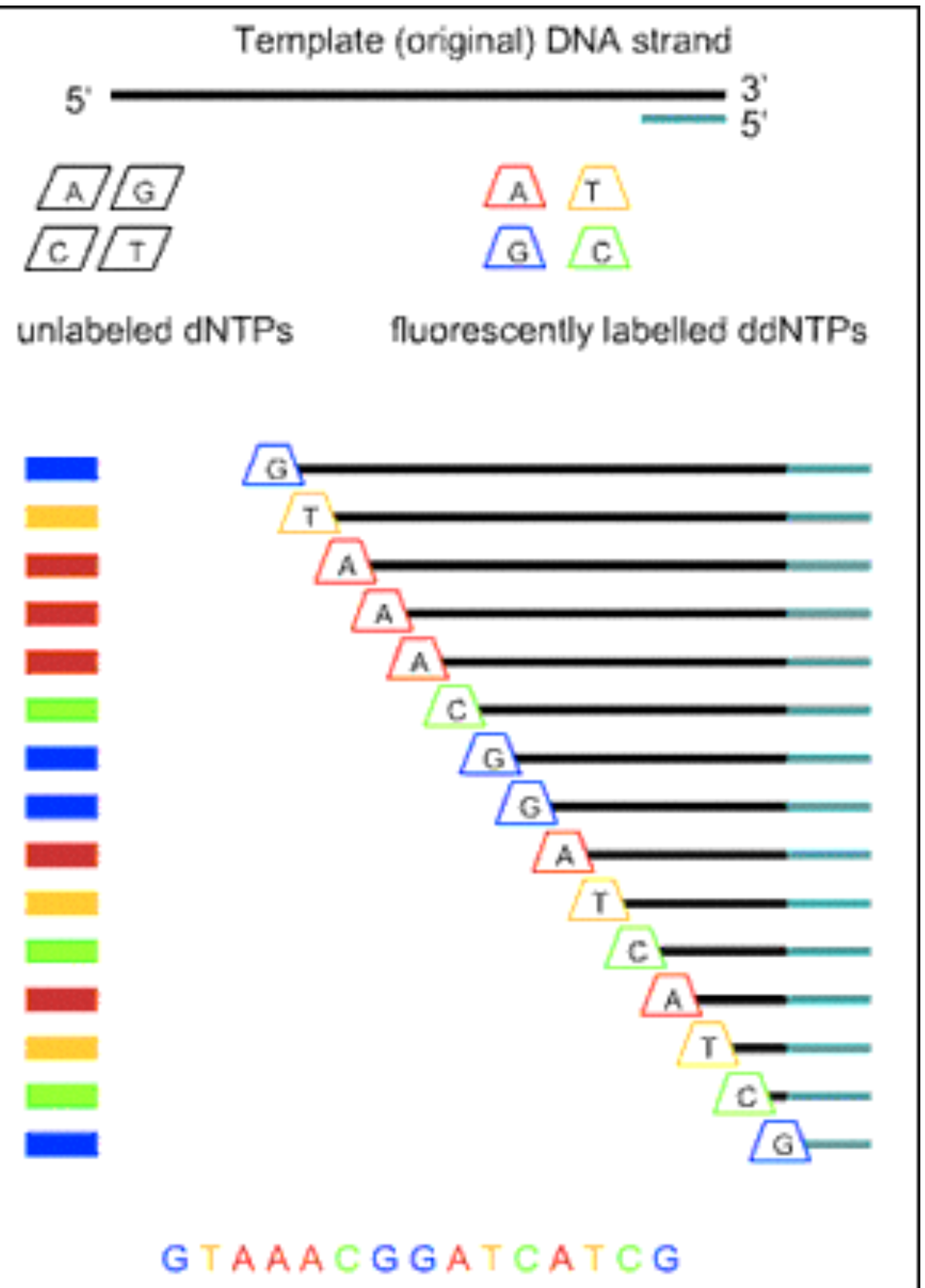
DNA analytics

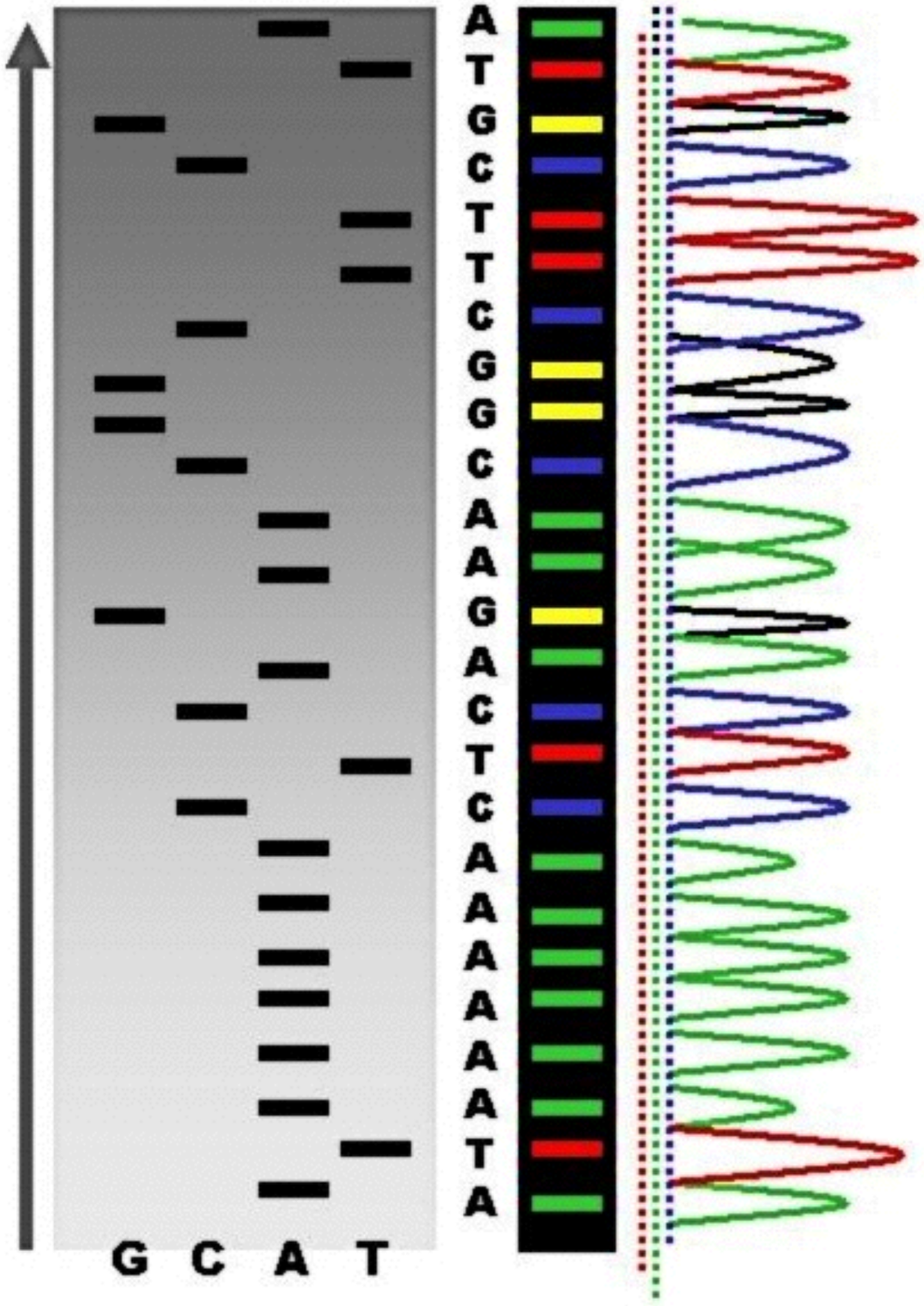
Polymerase Chain Reaction



New England Biolabs

Sanger Sequencing - chain termination

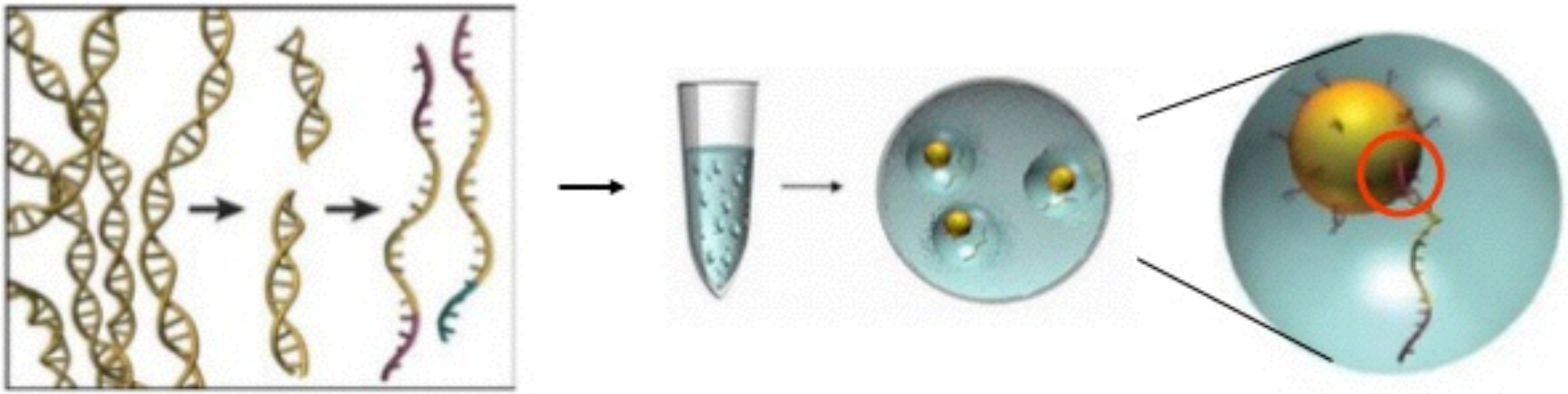


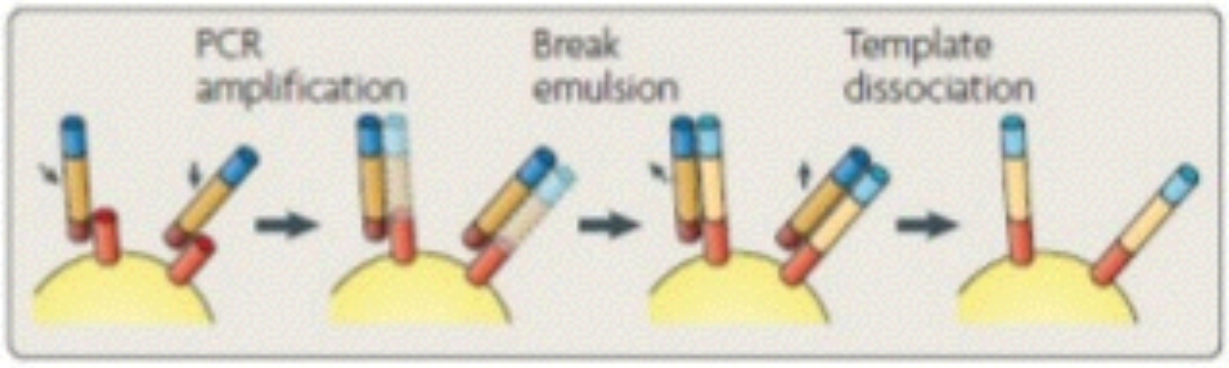


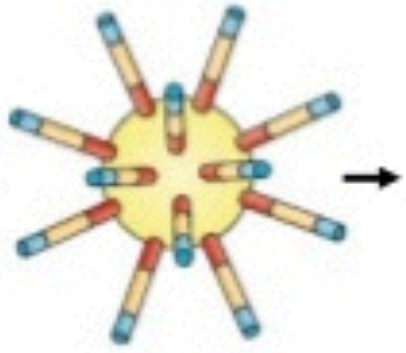
454 sequencer

454 Pyrosequencing

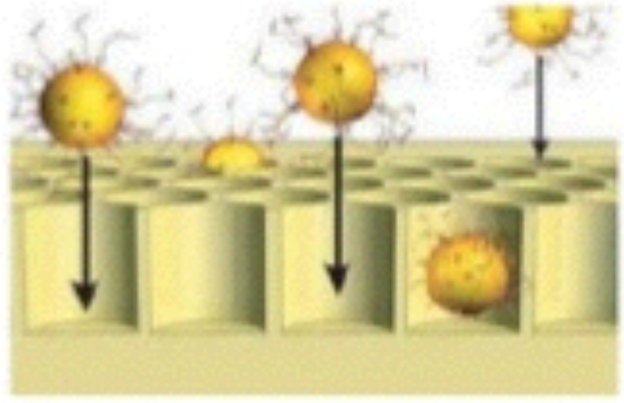
1. **Emulsion-based sample preparation (emPCR)**





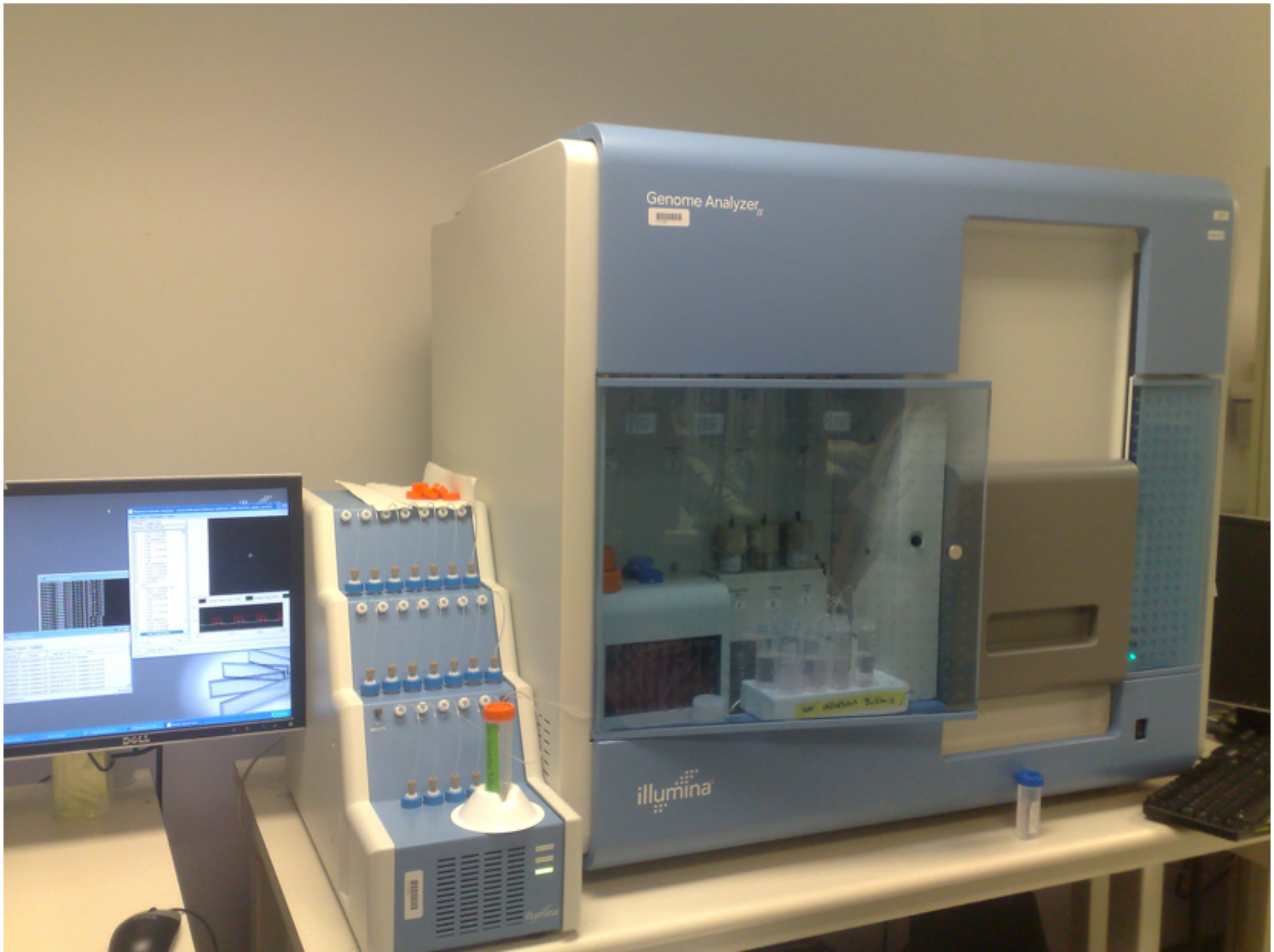


Several thousand copies of the same template sequence on each bead

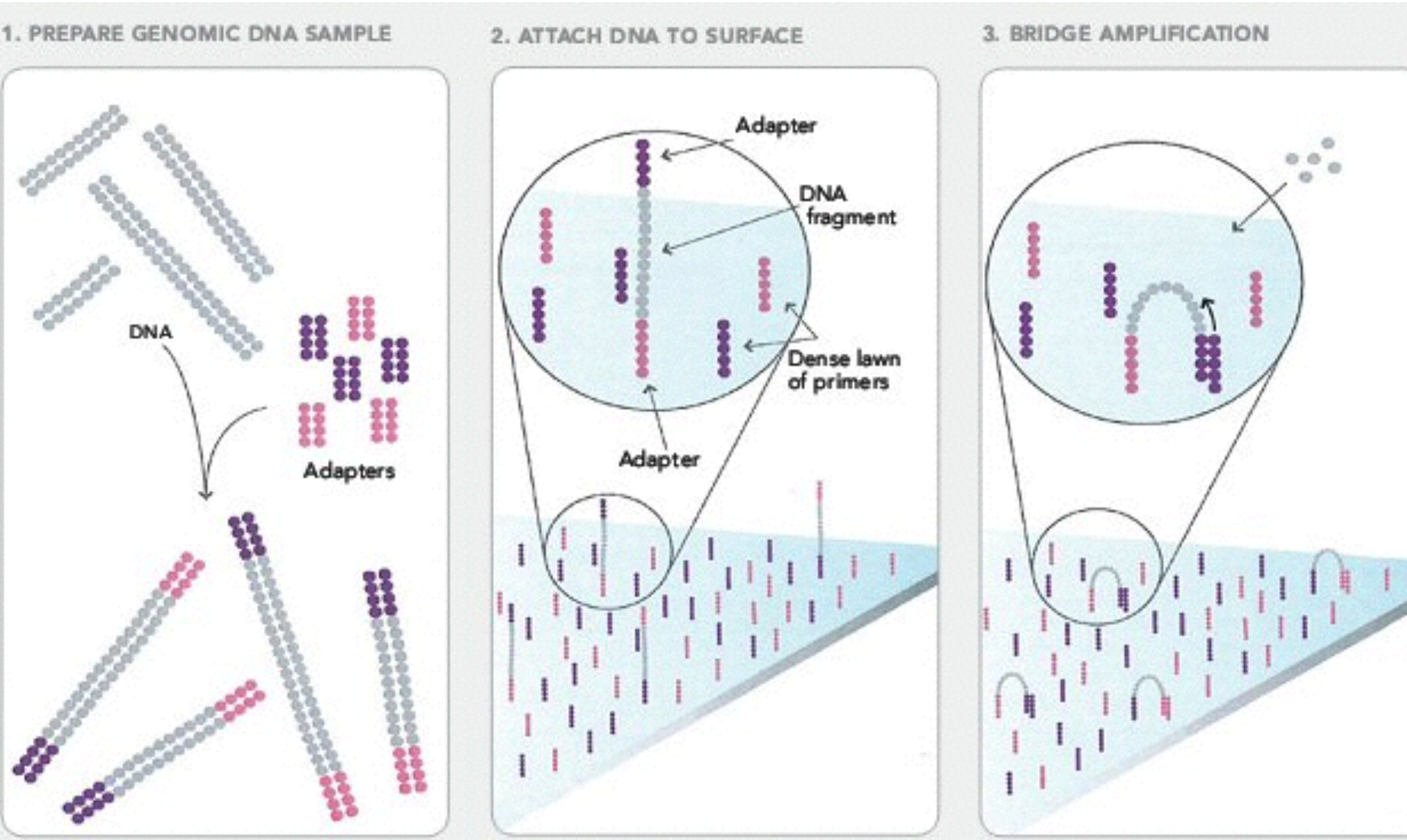


on average 1.6 million wells

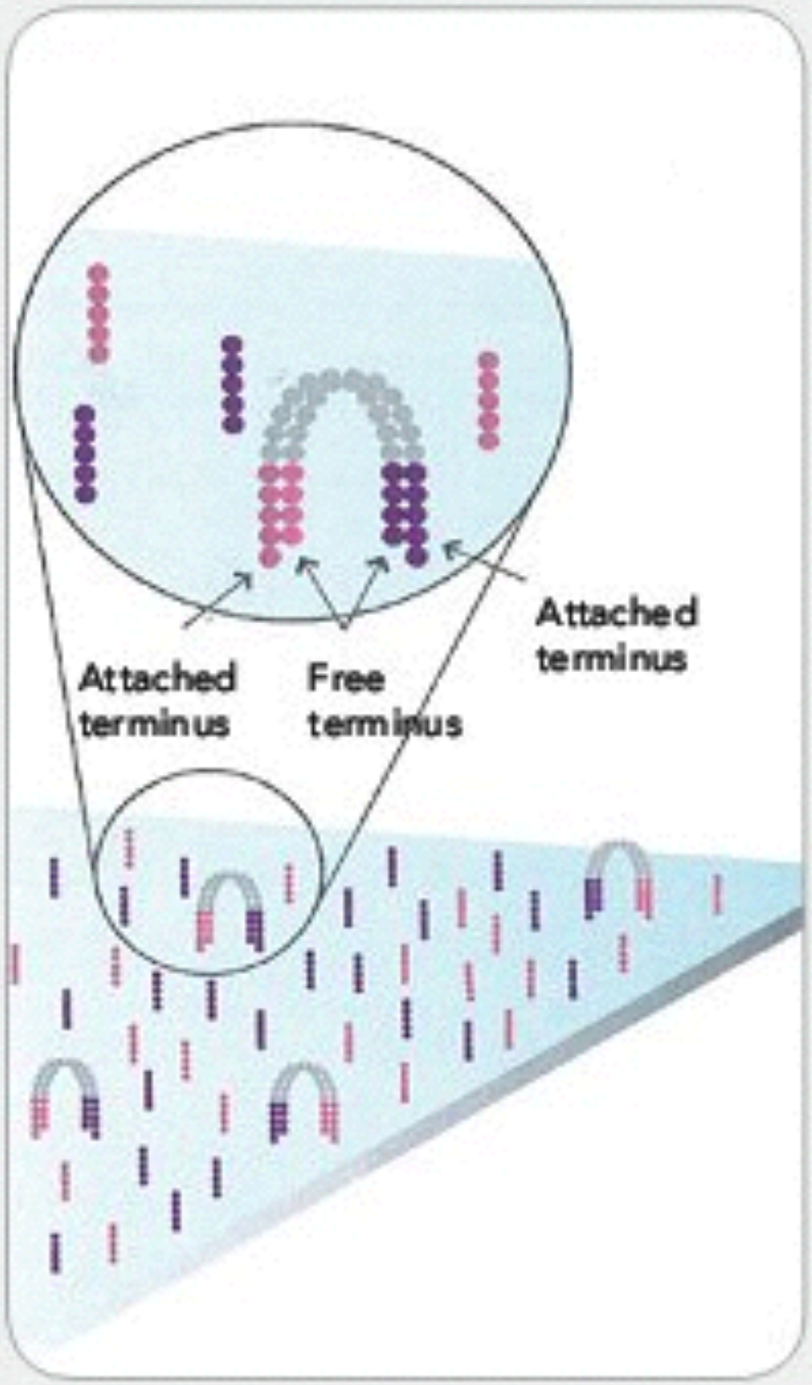
Illumina - Solexa



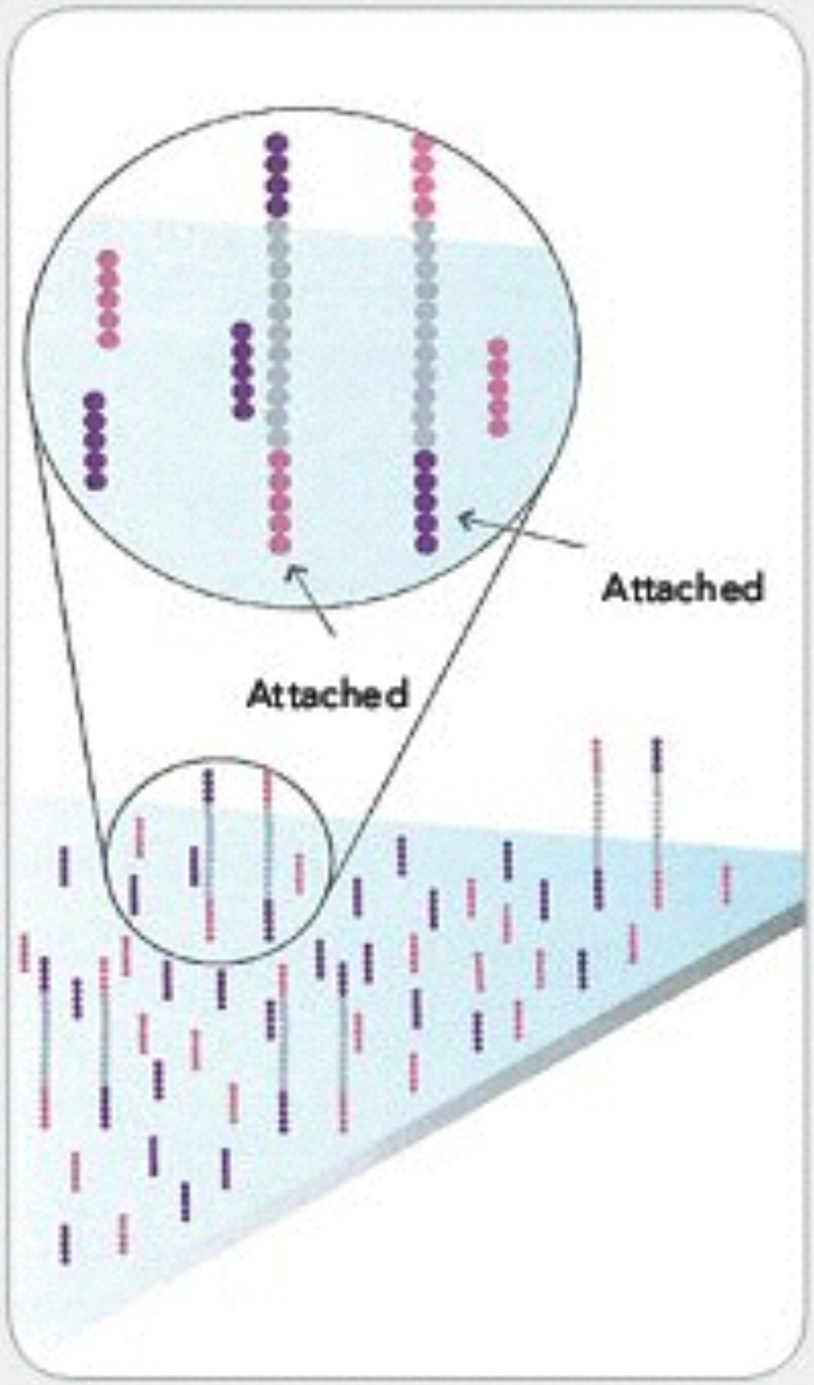
Solexa – Illumina sequencing



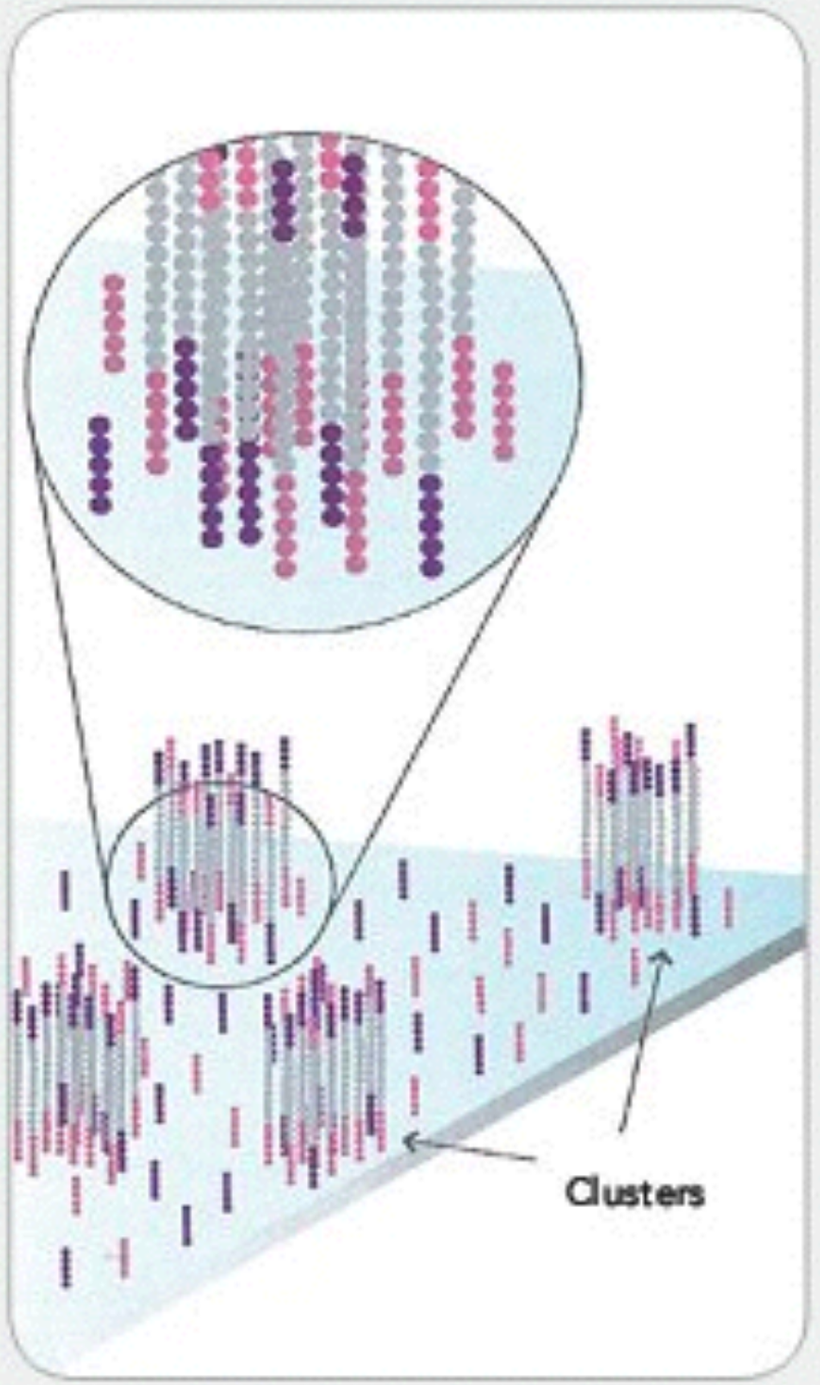
4. FRAGMENTS BECOME DOUBLE STRANDED



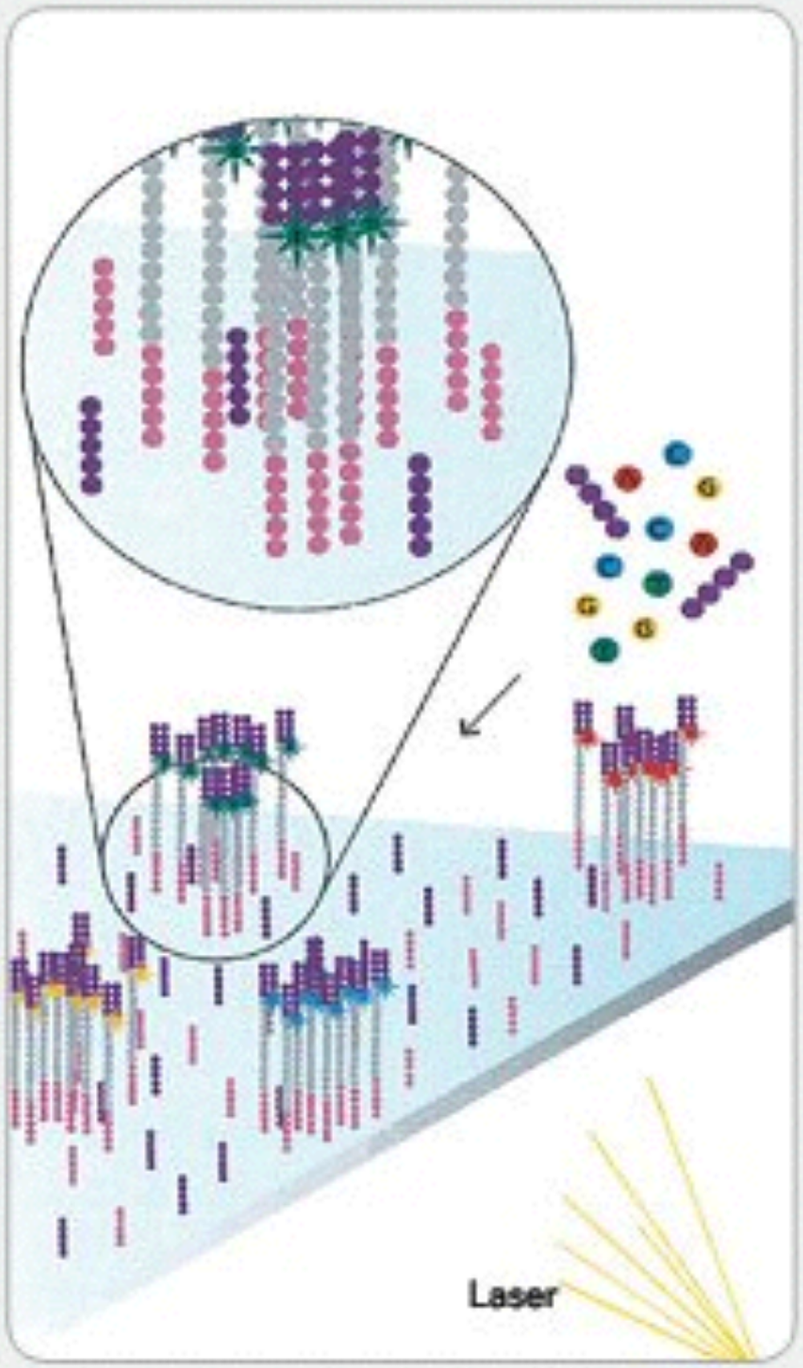
5. DENATURE THE DOUBLE-STRANDED MOLECULES



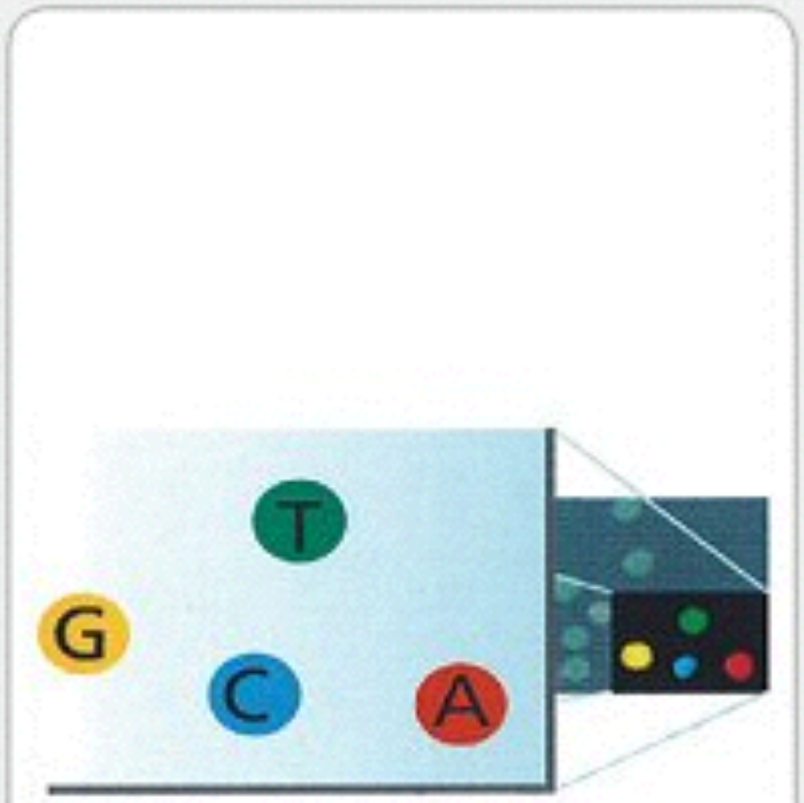
6. COMPLETE AMPLIFICATION



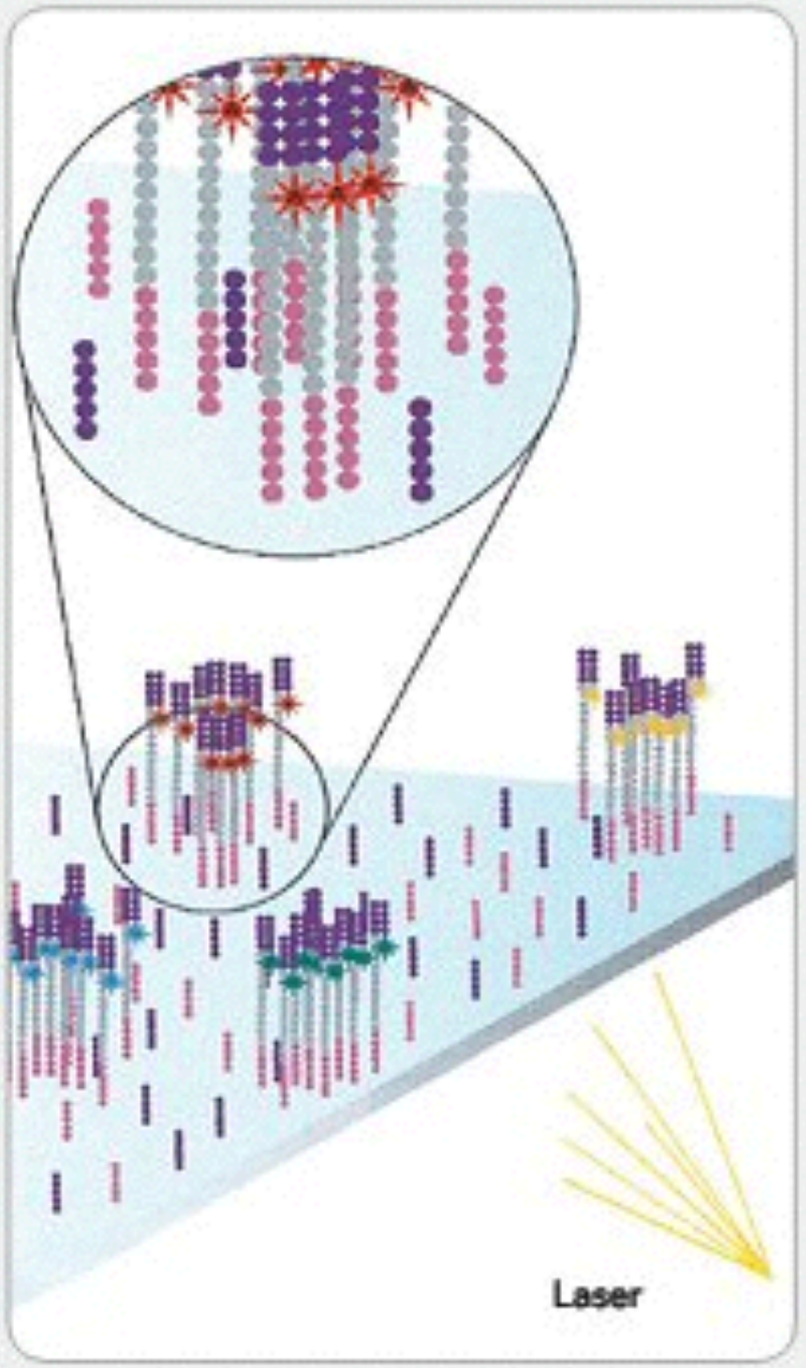
7. DETERMINE FIRST BASE



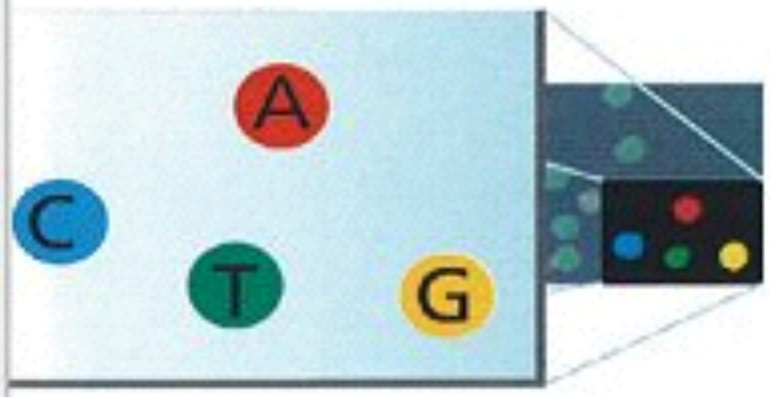
8. IMAGE FIRST BASE



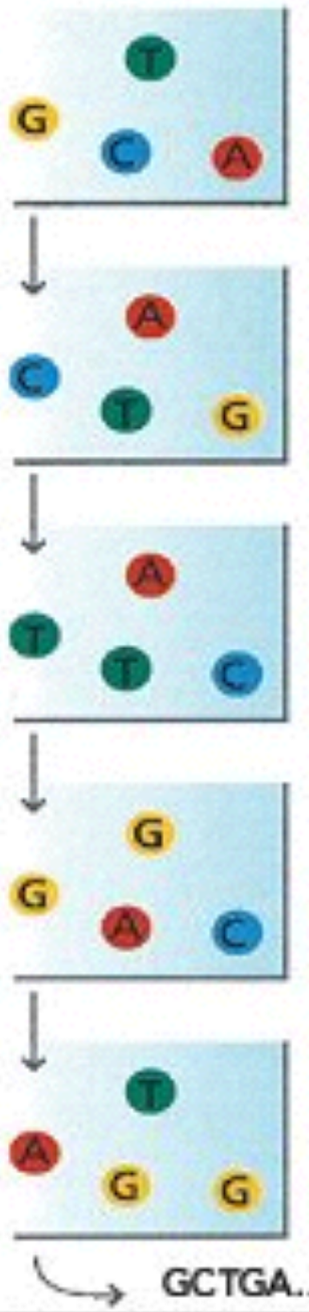
9. DETERMINE SECOND BASE



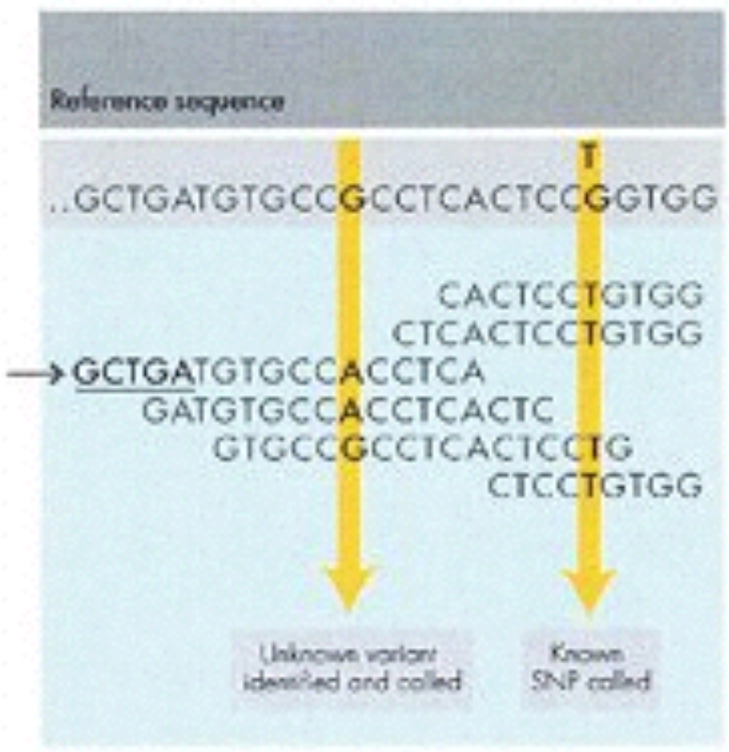
10. IMAGE SECOND CHEMISTRY CYCLE



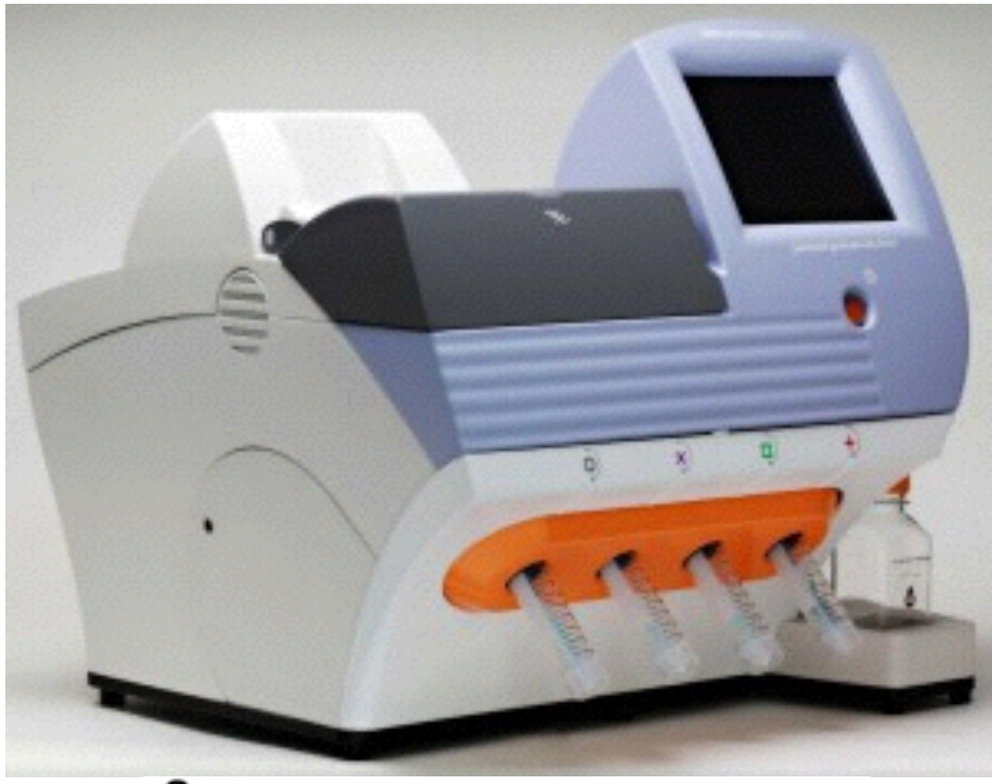
11. SEQUENCE READS OVER MULTIPLE CHEMISTRY CYCLES

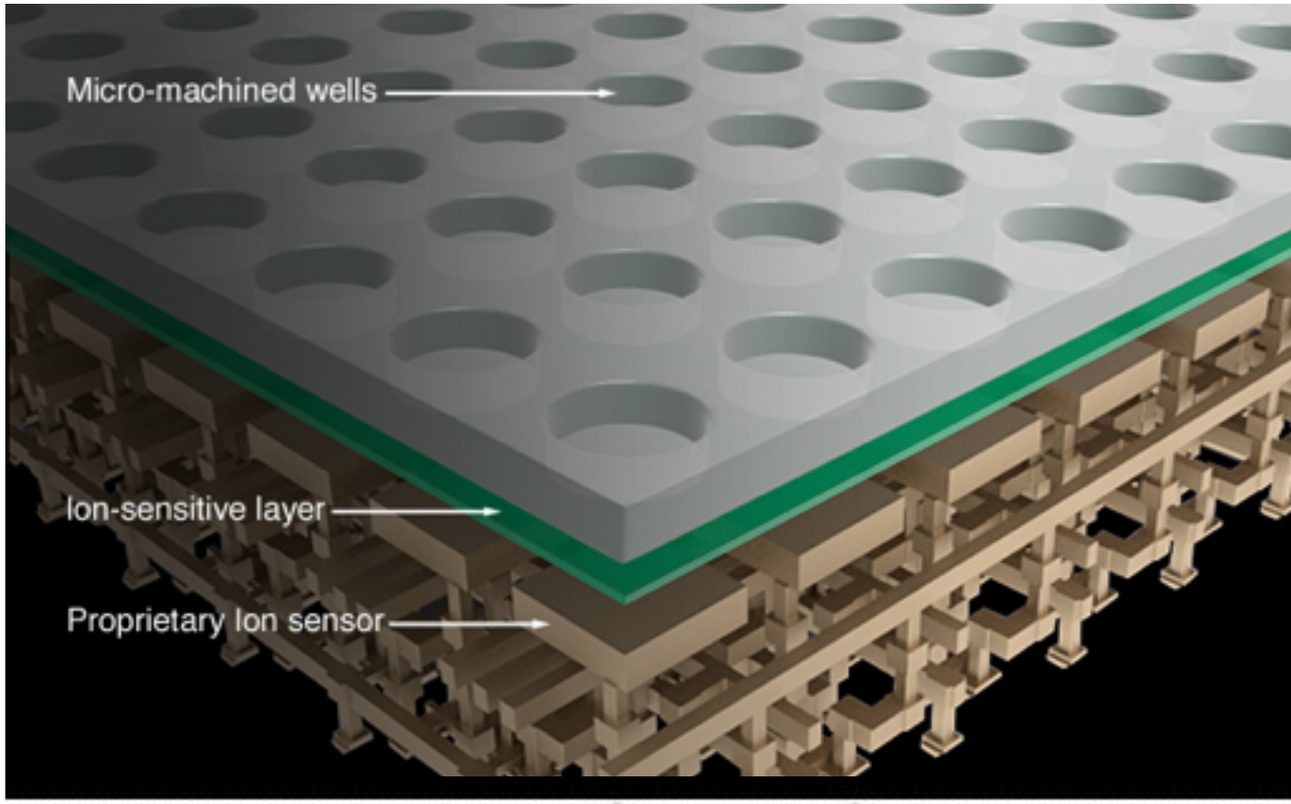


12. ALIGN DATA



IonTorrent sequencing





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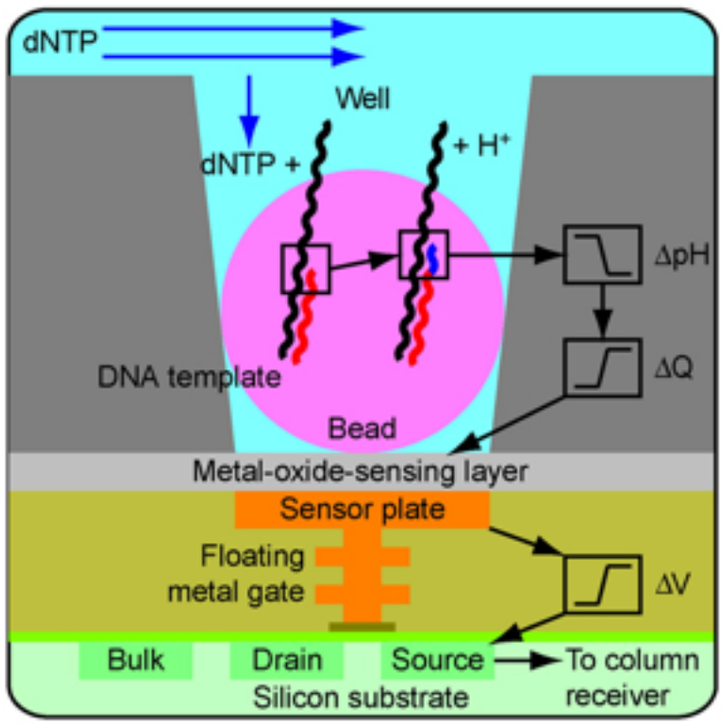
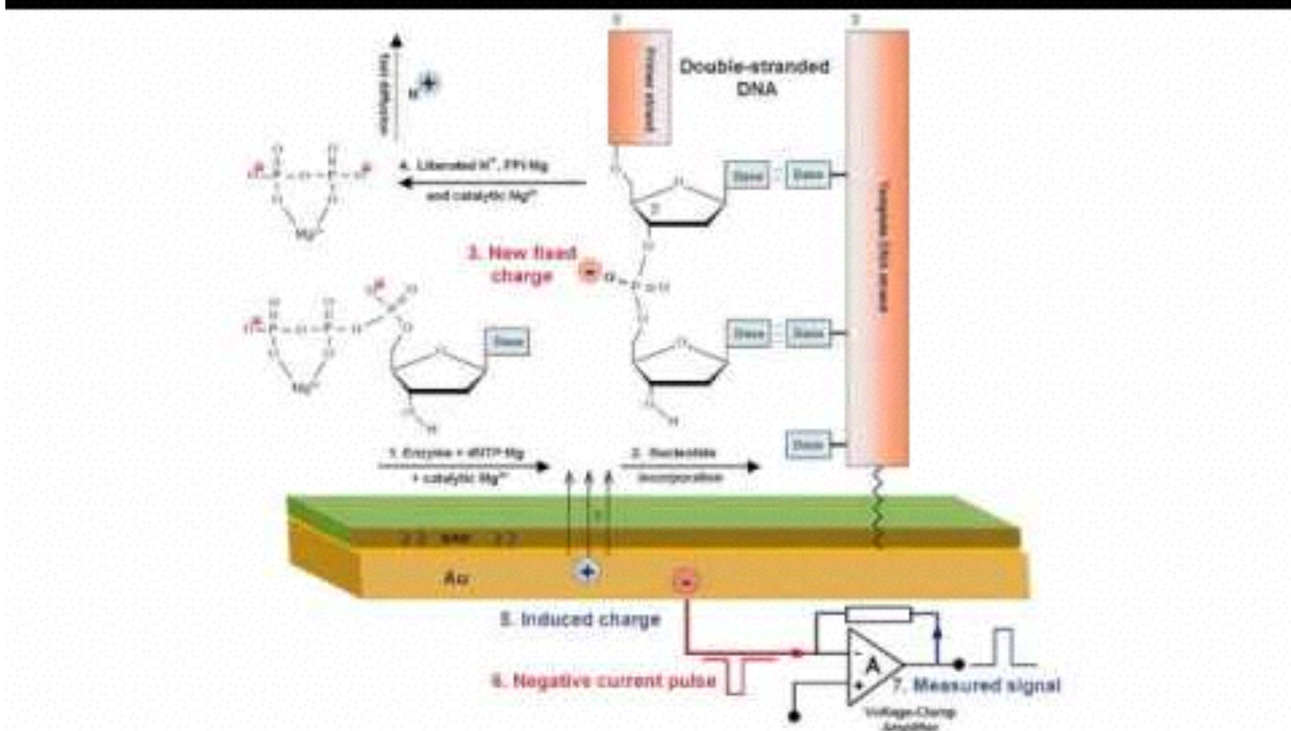
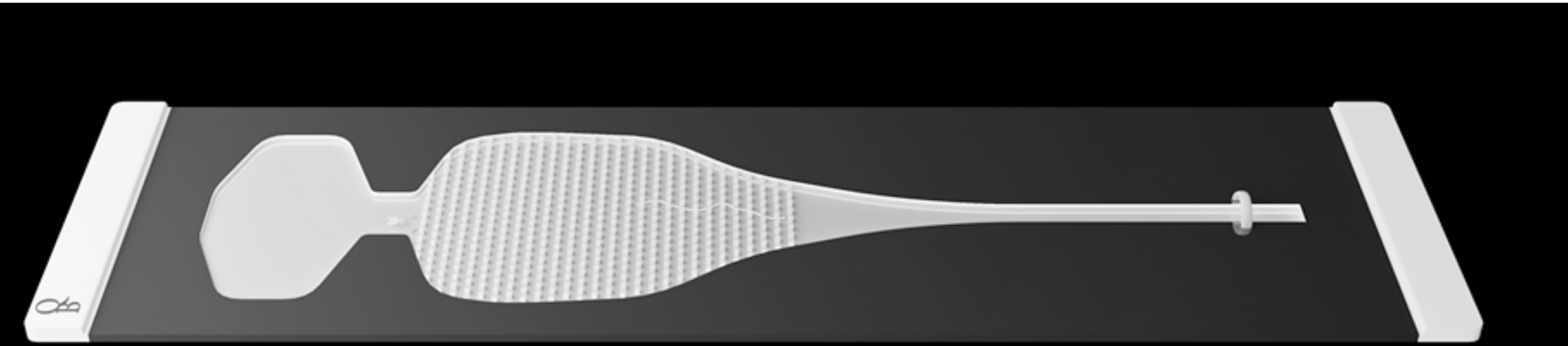
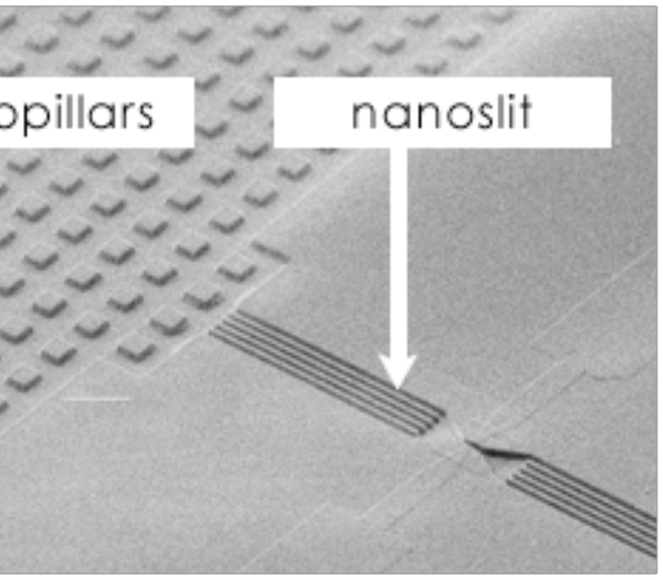
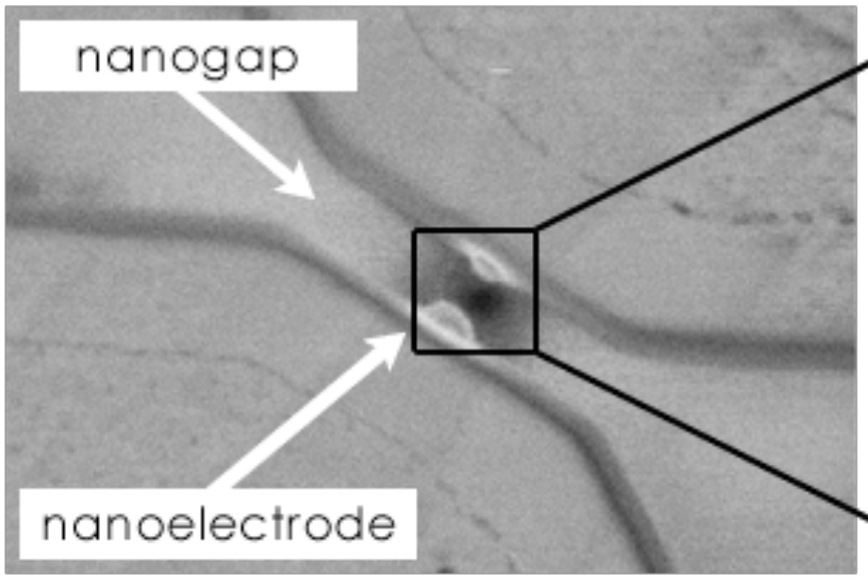


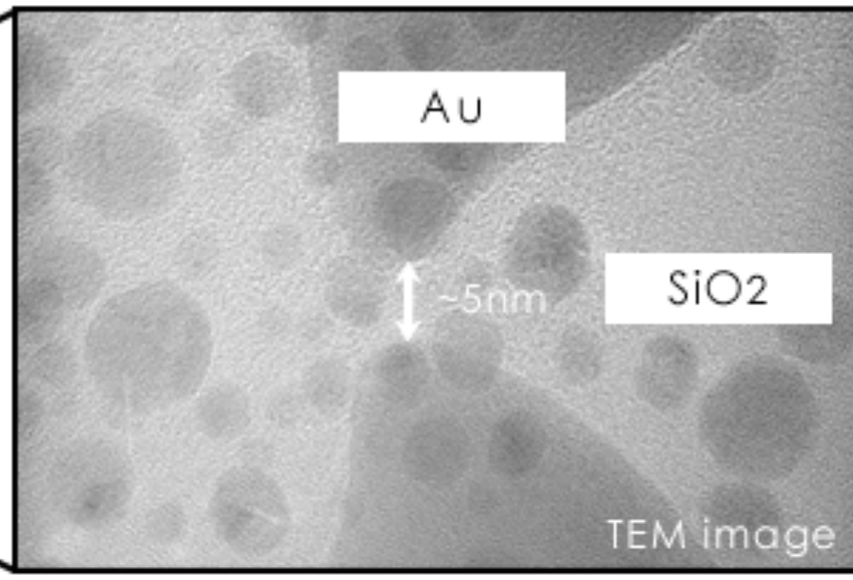


Nanopore sequencing



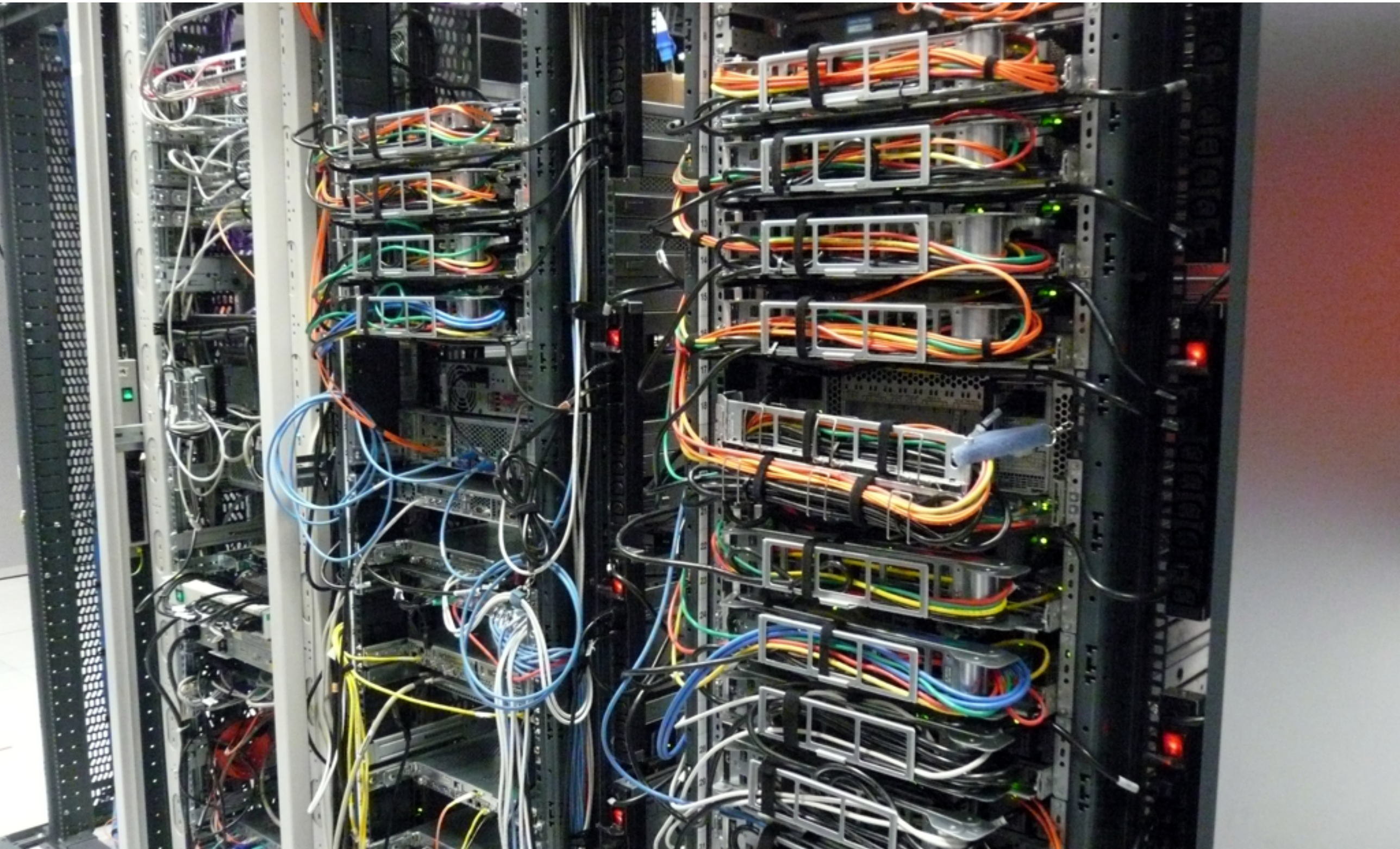






Quantum Biosystems

Bioinformatics



DIY?

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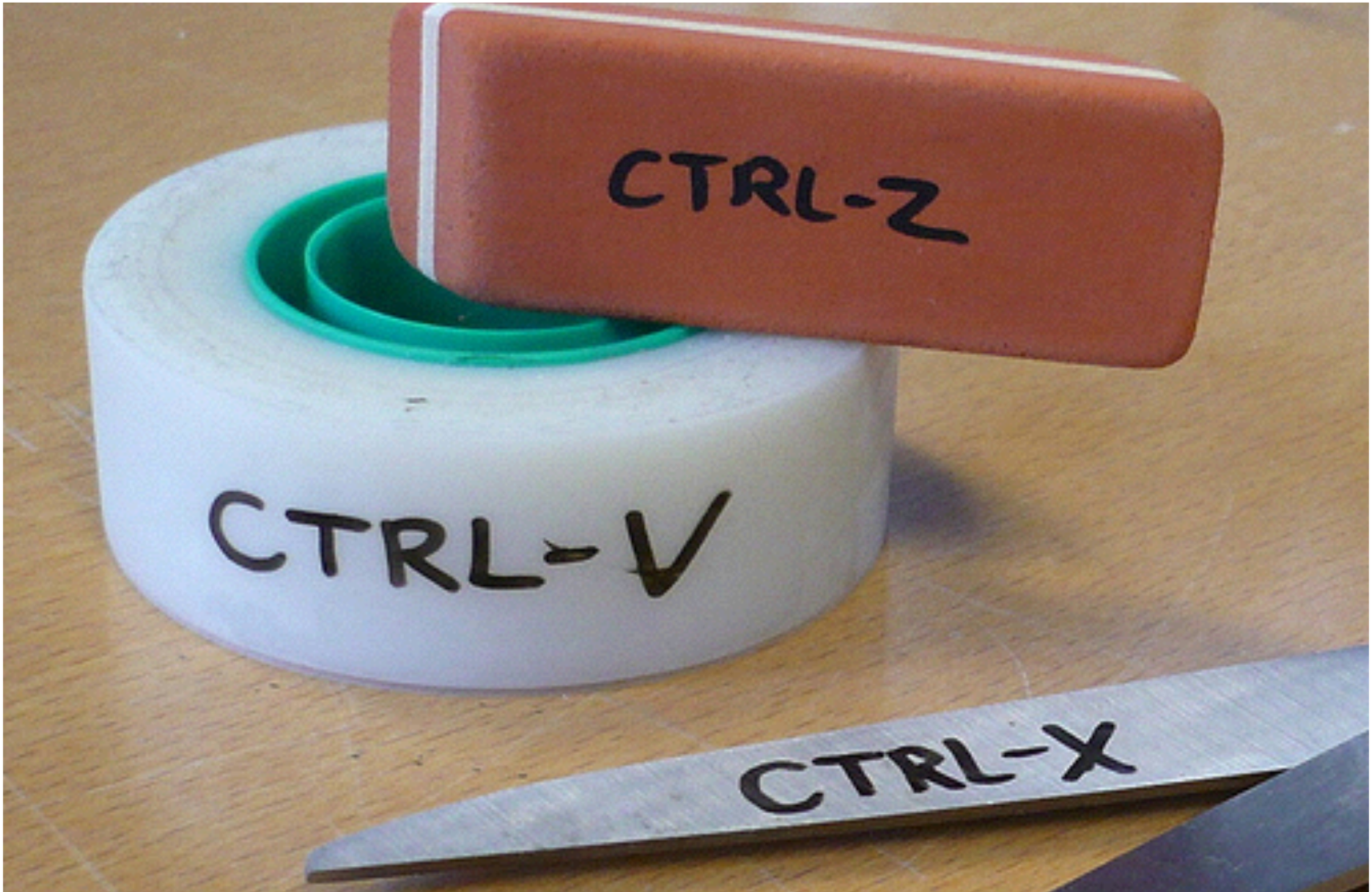
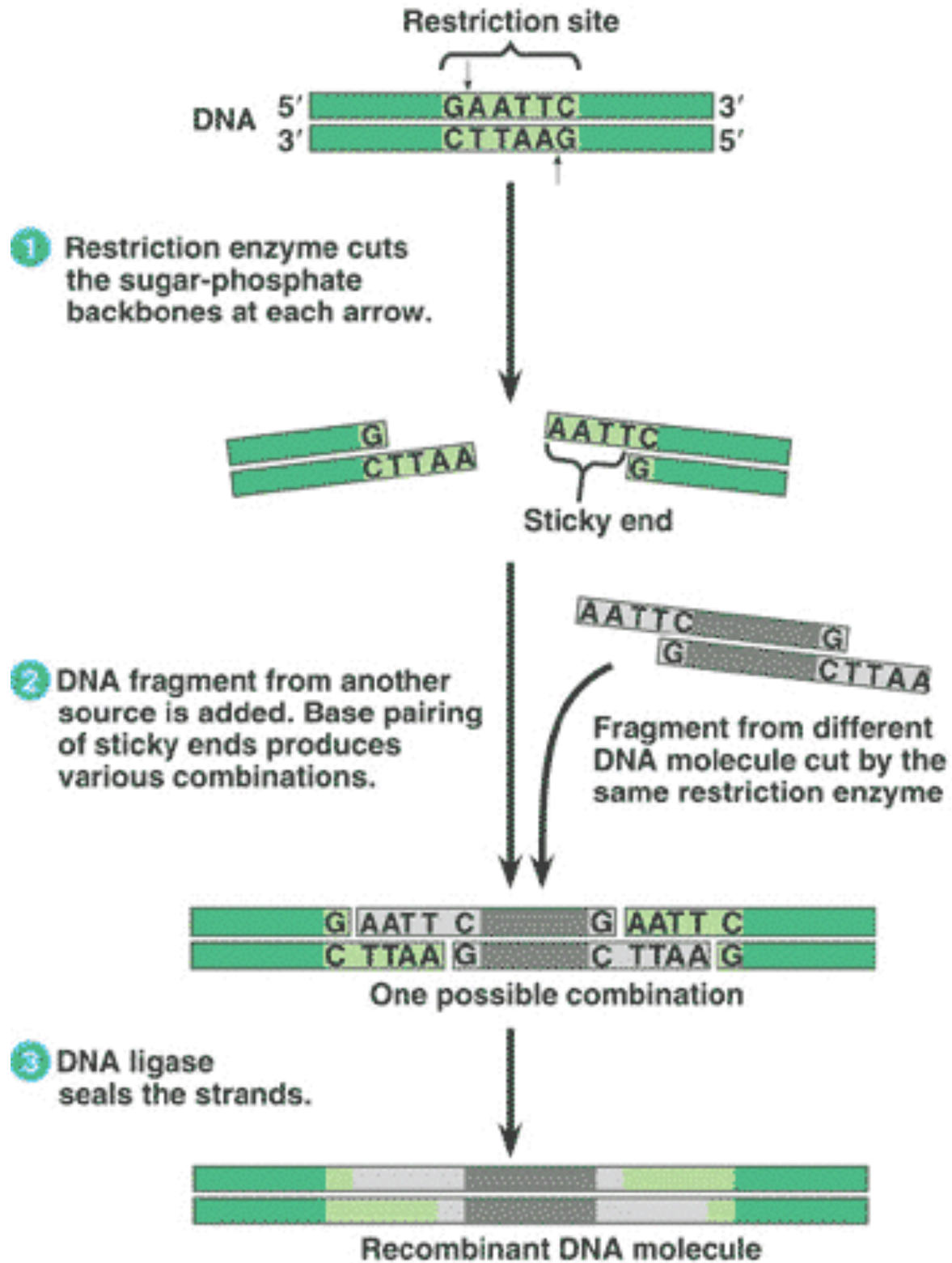
DNA editing

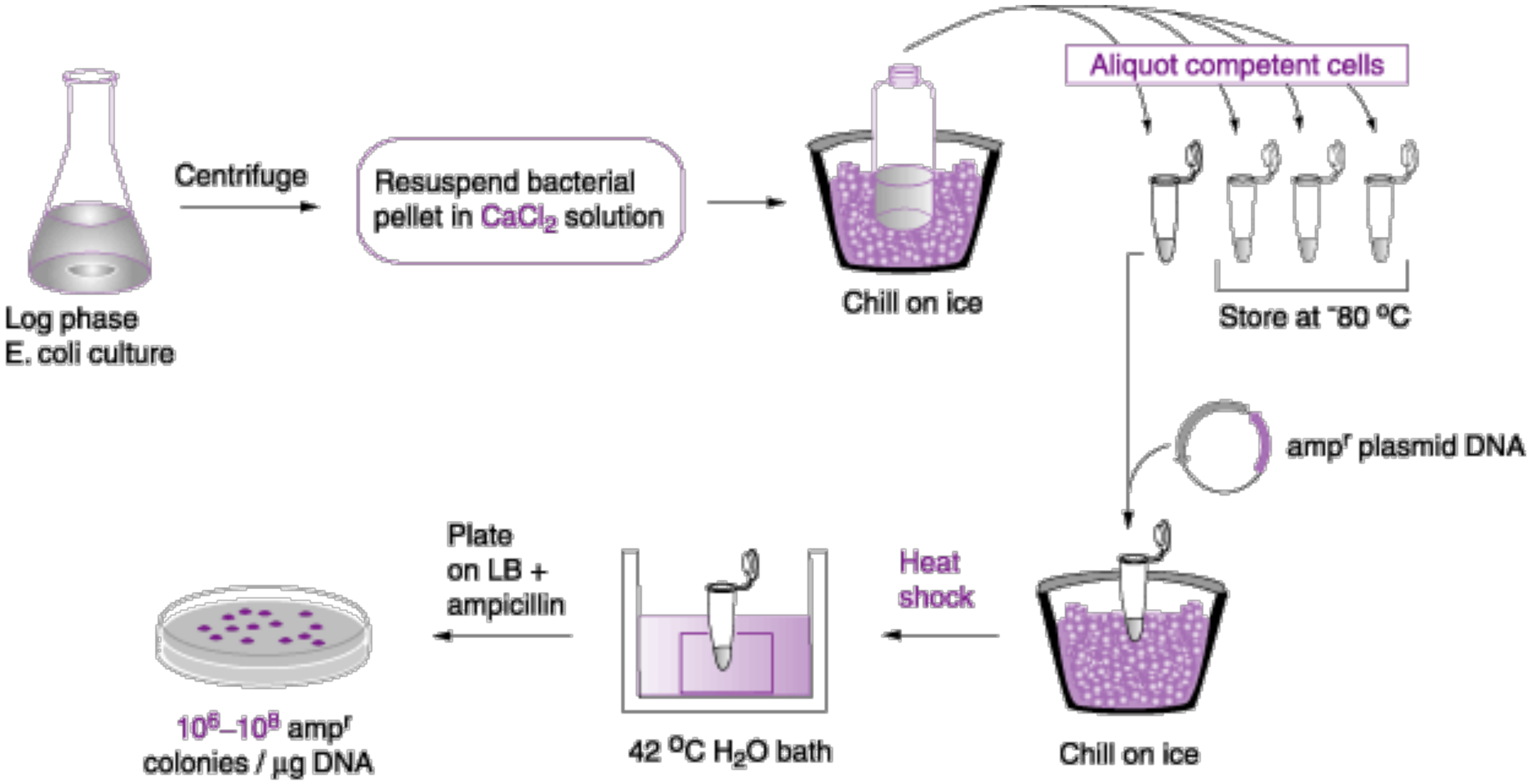
Cutting & Pasting



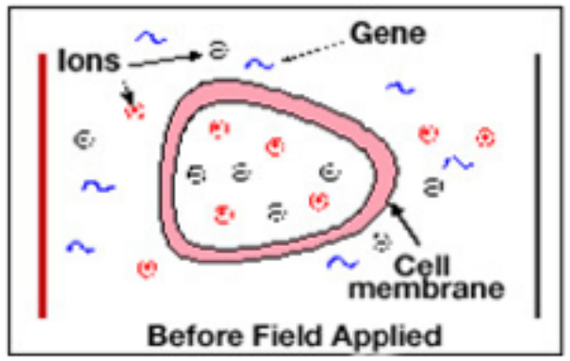
DNA Restriction Ligation

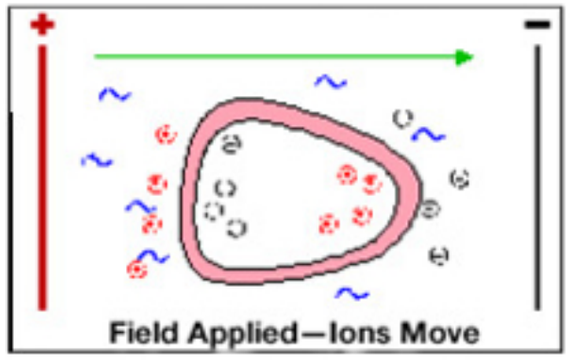


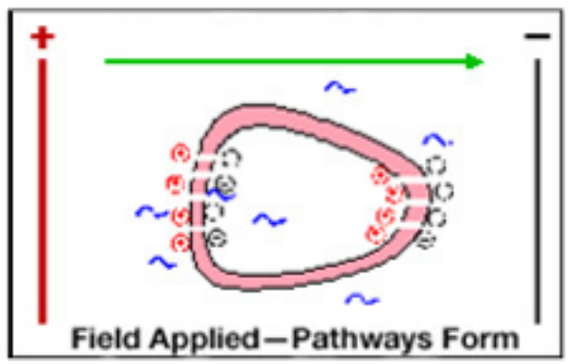
Heat Shock Transformation



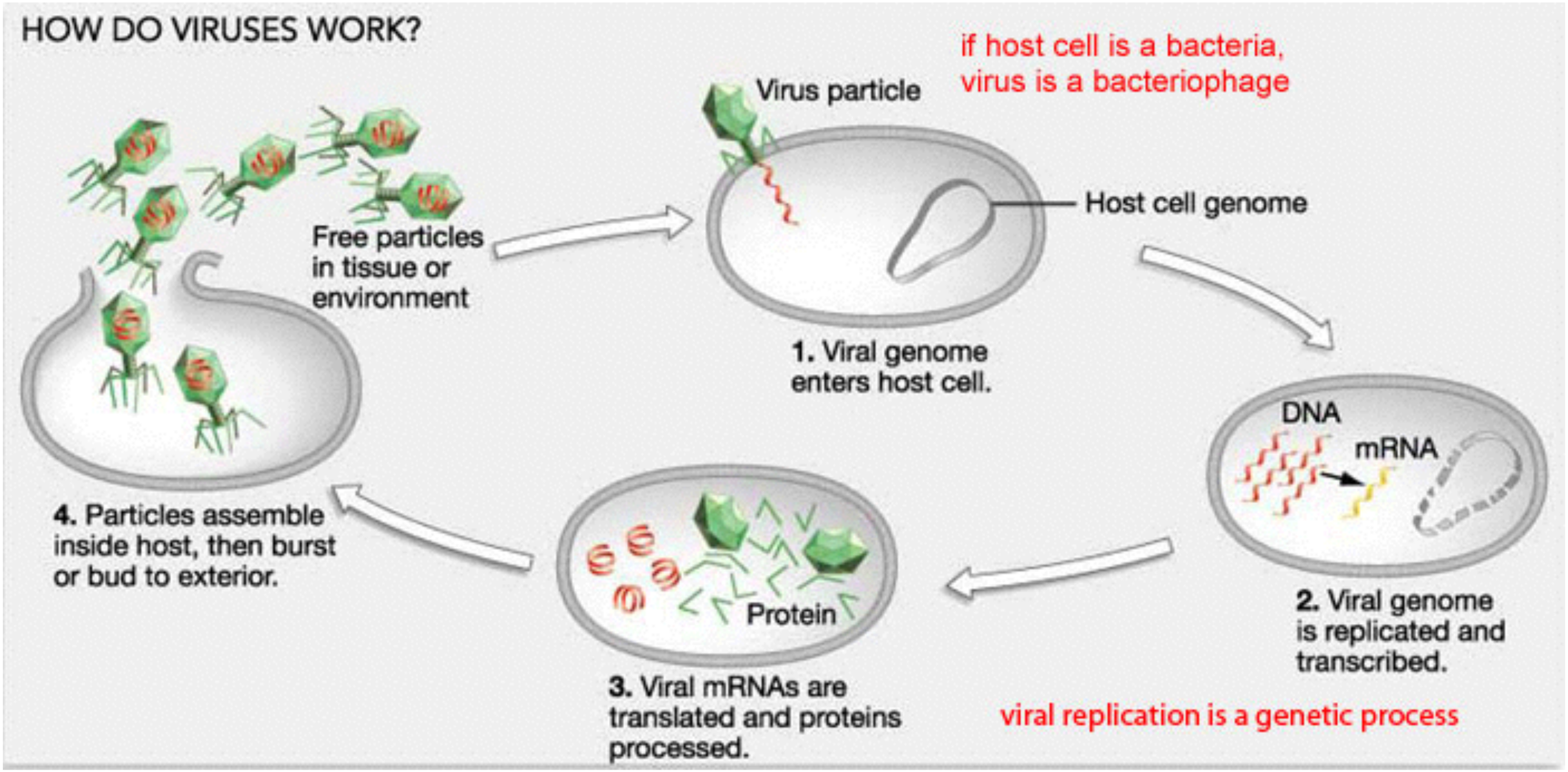
GeneGun – Electroporation



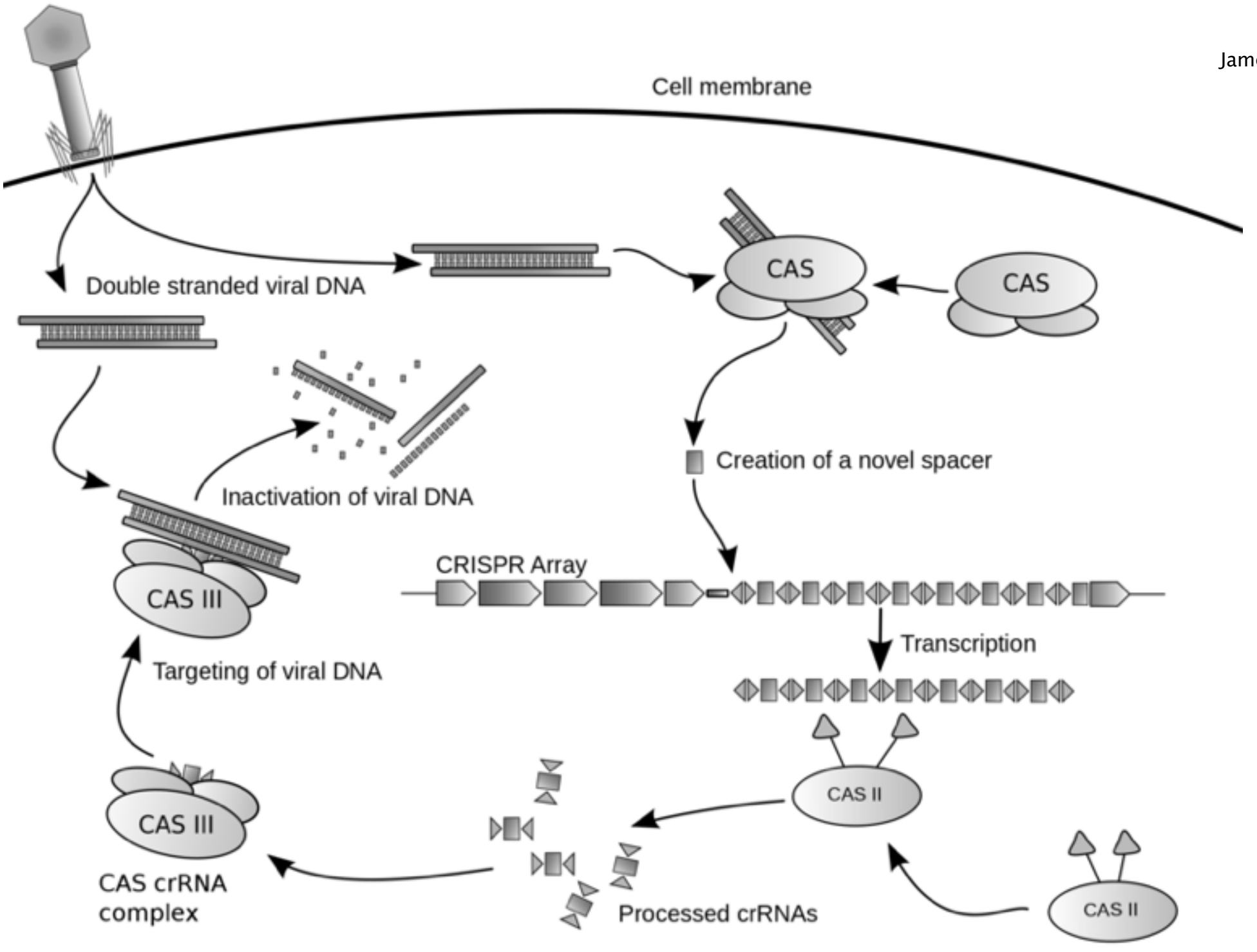




Viral Transformation



CRISPR - Cas9



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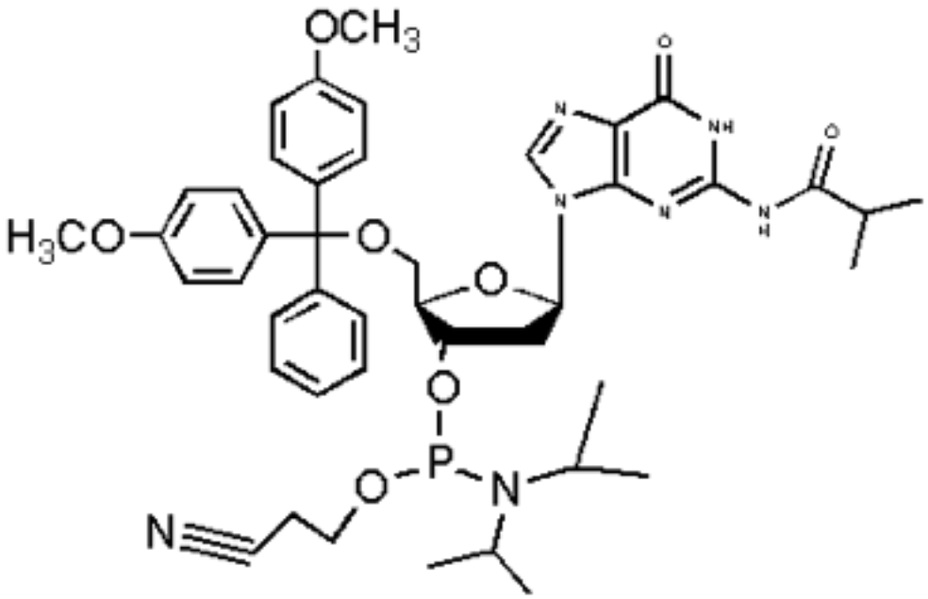
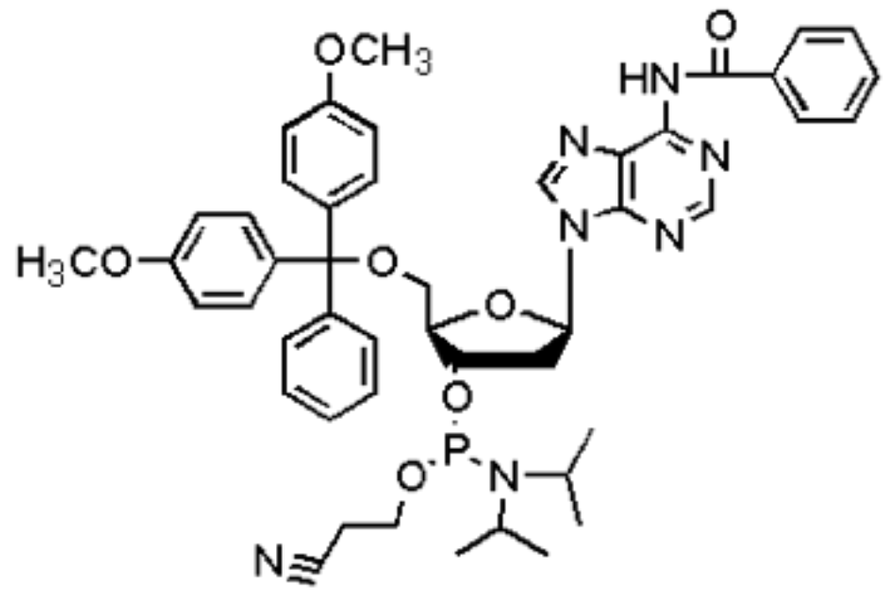
DNA synthesis

in 4 easy steps

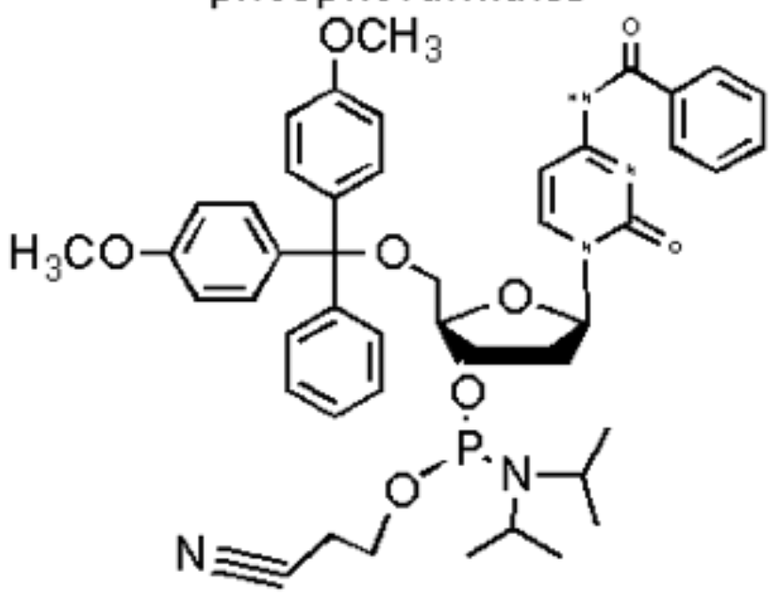
Deblocking



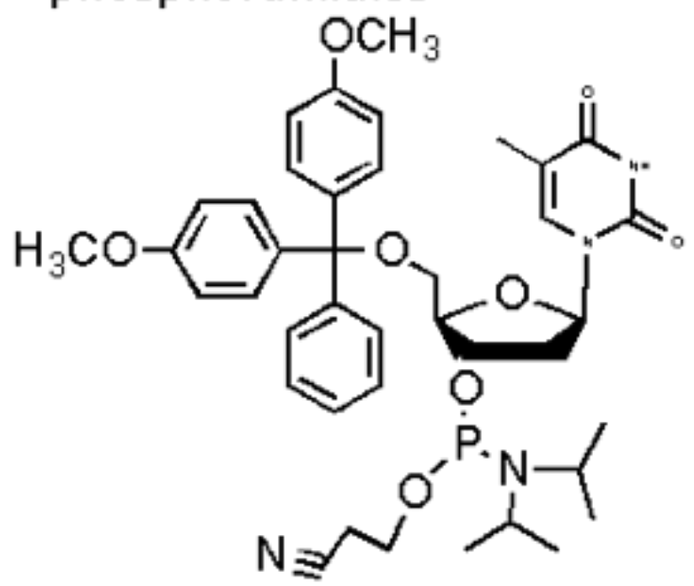
N-2-isobutryl deoxyguanosine phosphoramidite



N-6-benzoyl-deoxyadenosine phosphoramidite

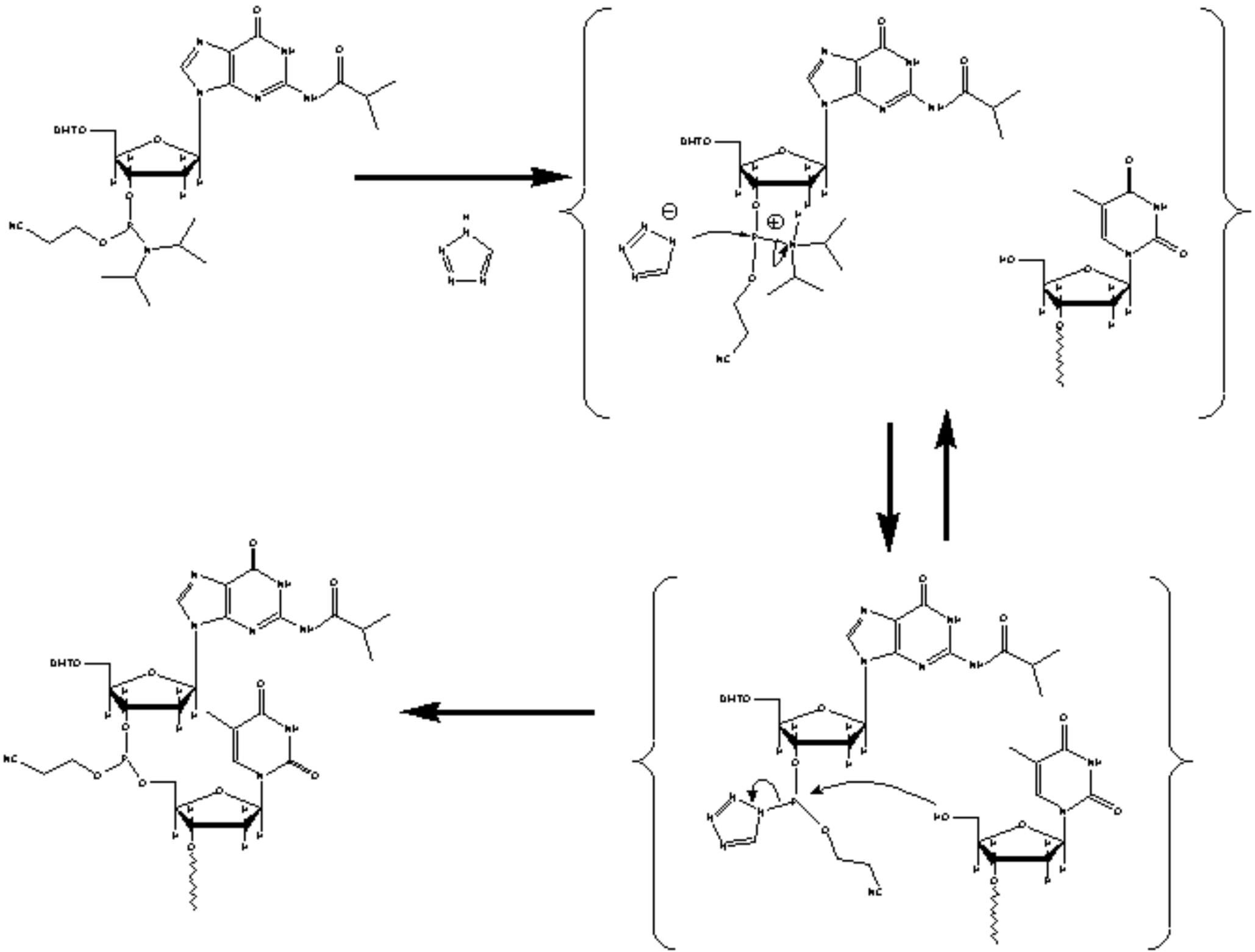


N-4-benzoyl-deoxycytidine phosphoramidite

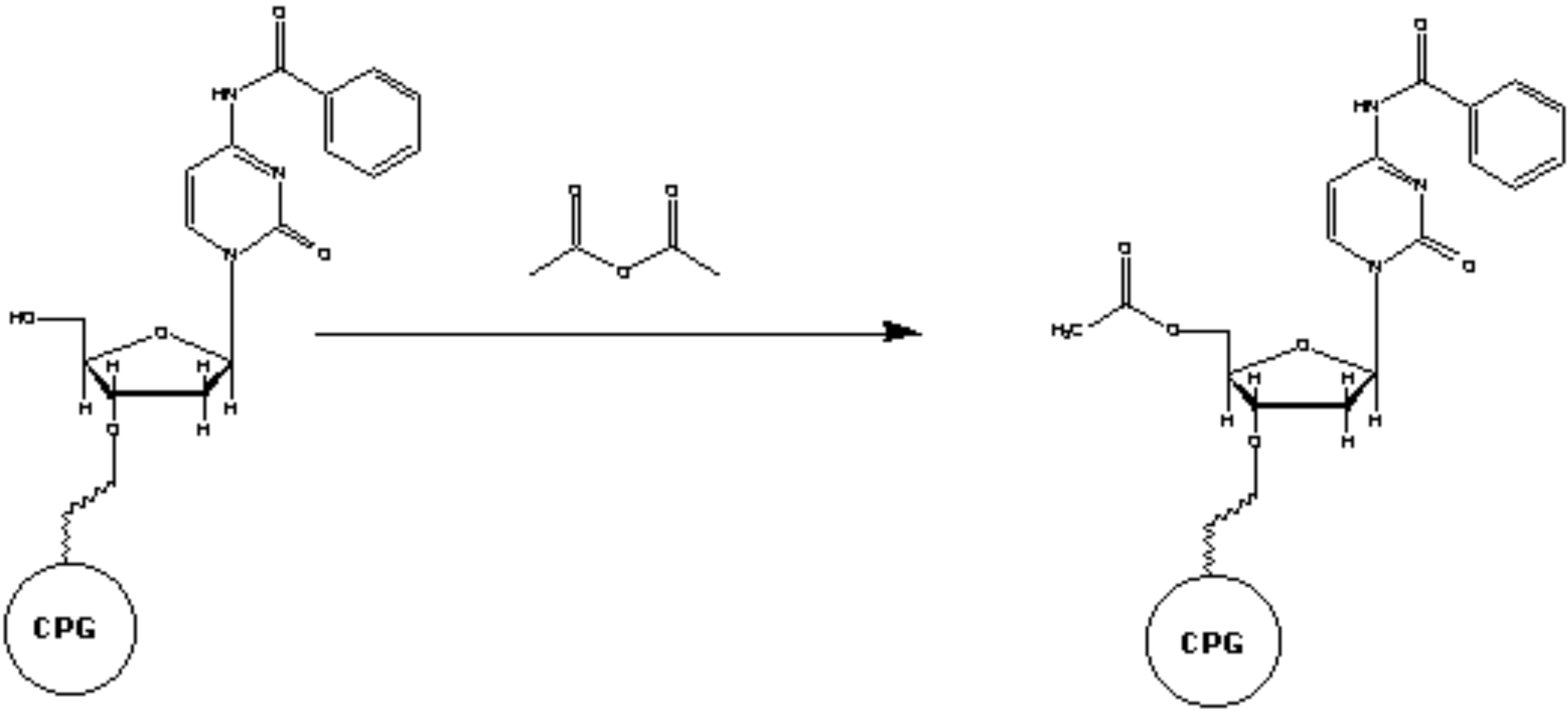


deoxythymidine phophoramidite

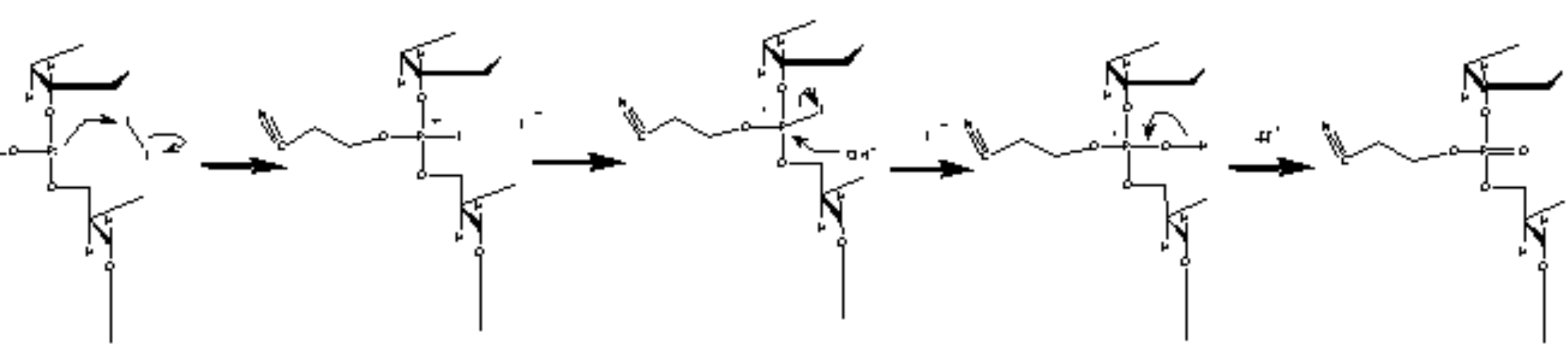
Condensation



Capping



Oxidating



Repeat