J. Craig Venter
INSTITUTE

Self Reproducing Systems: Digitizing Life

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Conversion of the Analog Genetic Code into Digital Code

- Genetic Code

ACGTTAGGCATAGTCAGT

- Computer Binary Code

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01000001 01010100 01000111
01000010 10001001 00101010
11100101 01100010 10001100
01001001 00001100 11110001
01001010 00011011 00010001
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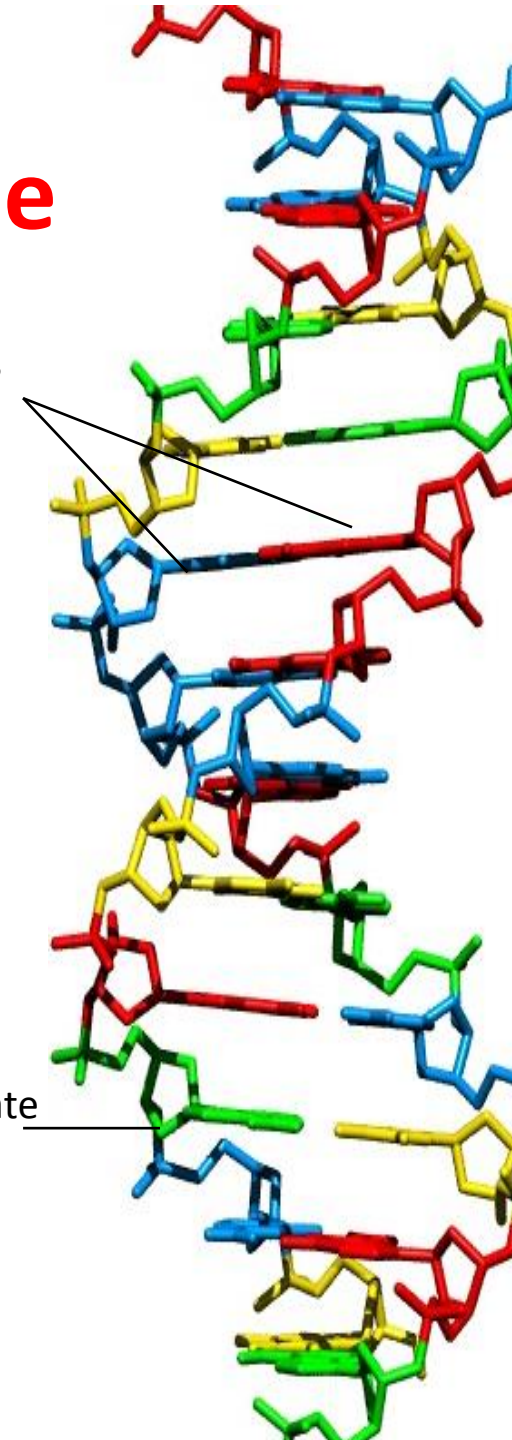
Cytosine Guanine

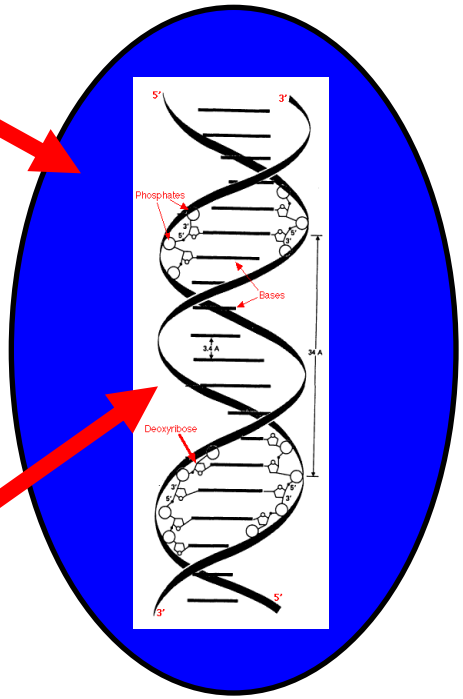
Thymine Adenosine



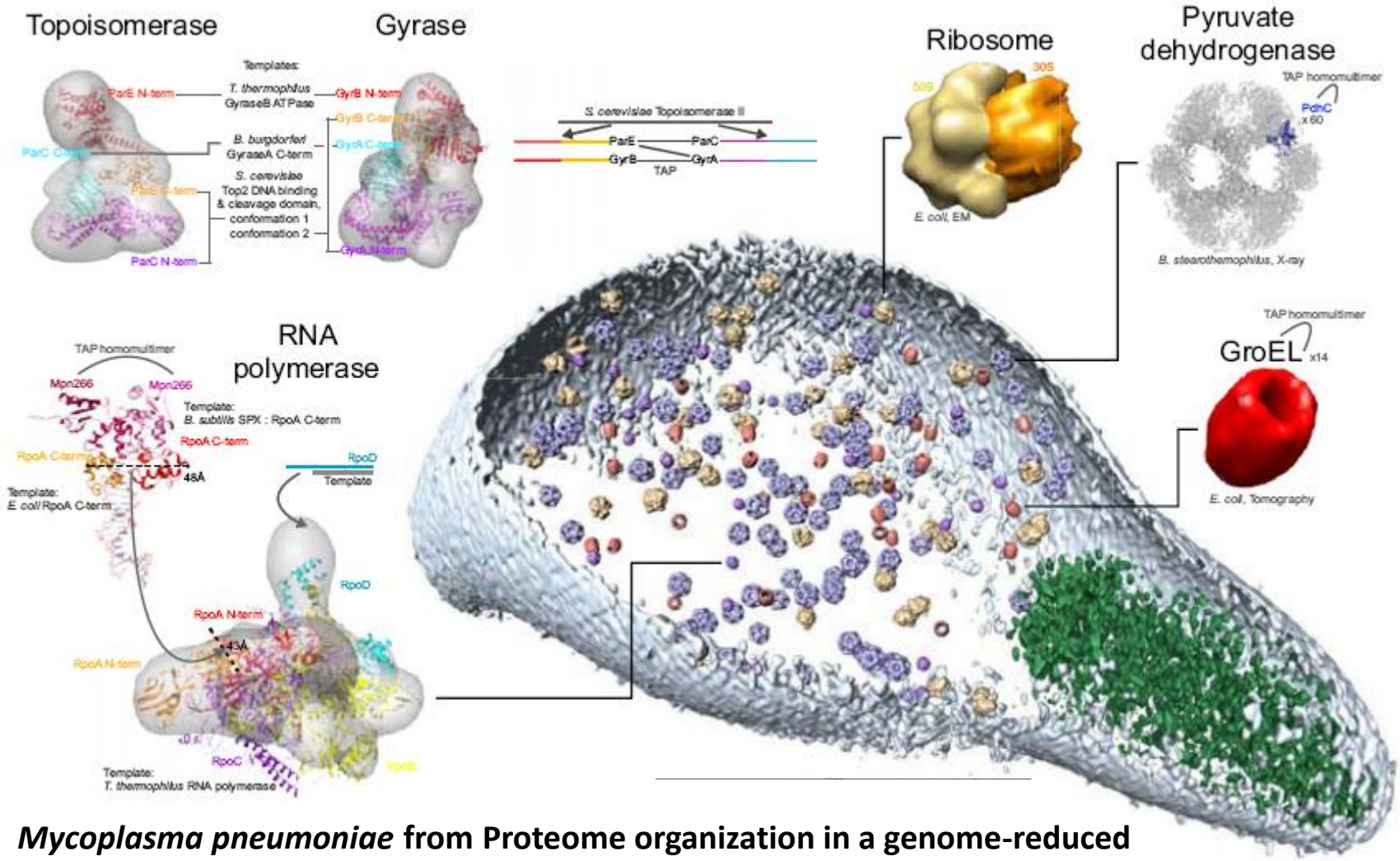
A computer analogy -- the genome of a cell is the operating system & the cytoplasm is the hardware

The **cytoplasm** is the **hardware** that runs the operating system

The **chromosome** is the **operating system**



1) Self-replicate to make new cells

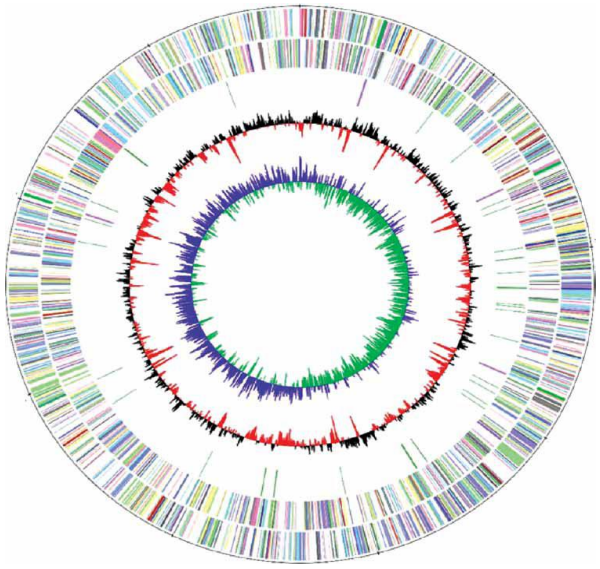


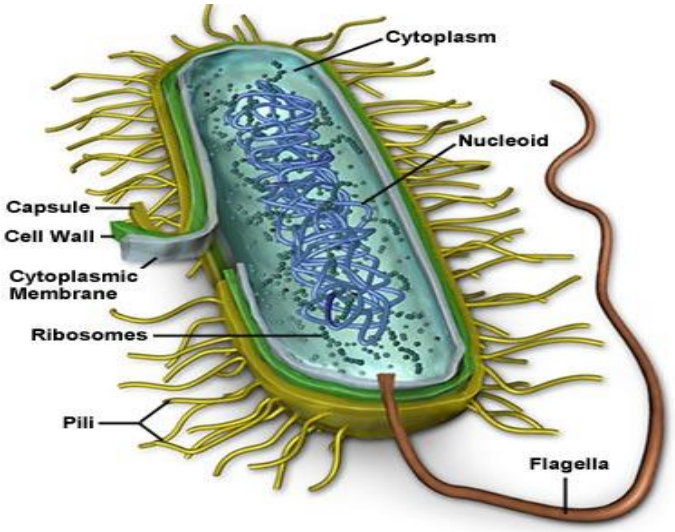
Mycoplasma pneumoniae **from Proteome organization in a genome-reduced bacterium. Kuhner et al. 2009 Science 326: 1235-40**

Synthetic Organism Designer 1.0

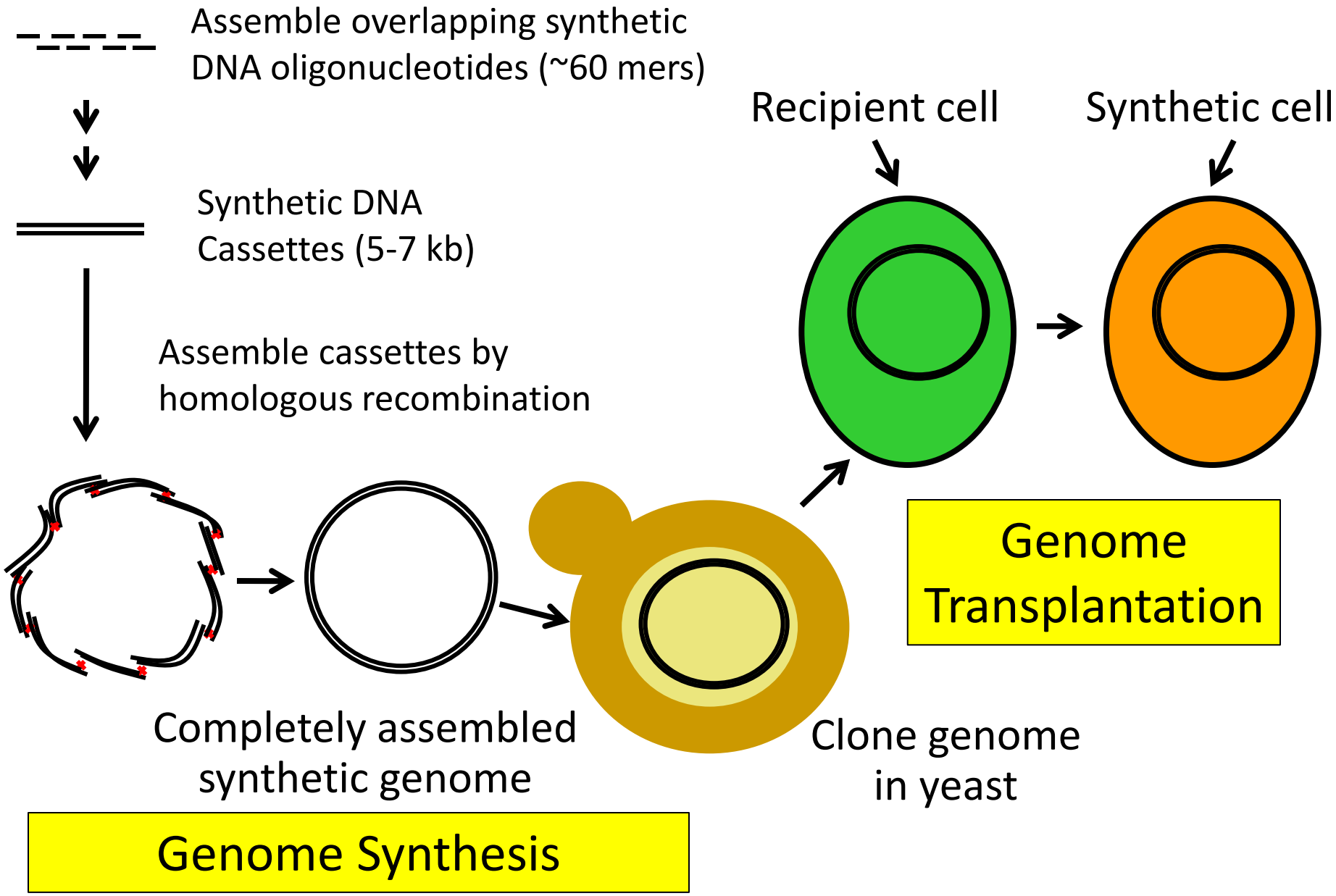
Design | Codon Opt. | Oligo Synthesis

Organism	Cell Membrane	Division Type	Form of Metabolism	Structural Genes	Control & Safety
Archaea	Gram +	Meiosis	Photosynthesis	Rubisco (30,000)	Auxotrophic Marker
Bacteria	Gram -	Mitosis	Methanogenesis	Ferredoxin (82,000)	Suicide Gene
Single Cell Euk	Archaeal	Cellular Septation	Glycolysis	Plastocyanin (9,000)	
Virus	Euk		Calvin Cycle	ATP Synthase (100,000)	
Multicellular Euk			Pentose Phosphate		





Approach used to synthesize bacterial cell



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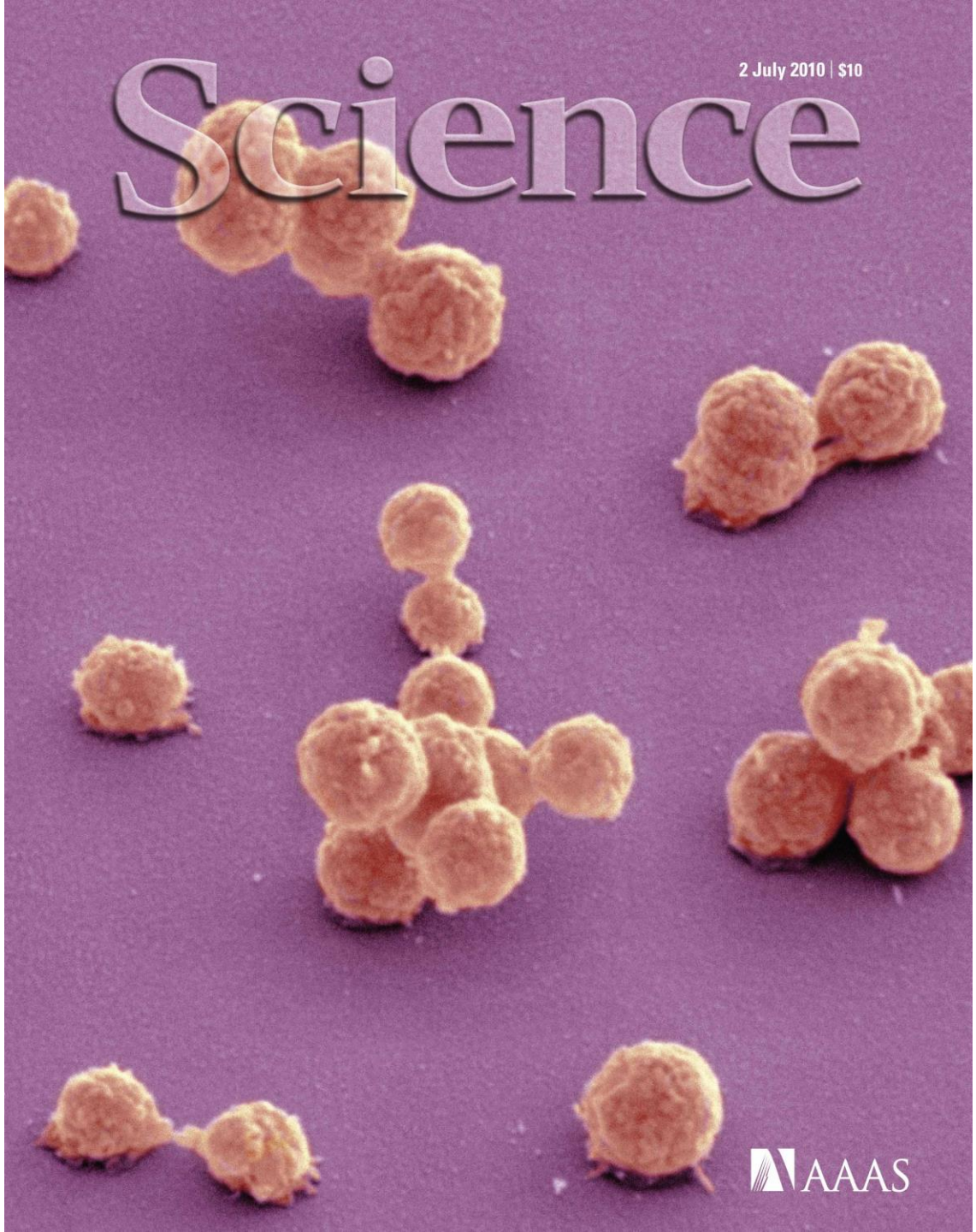
Science



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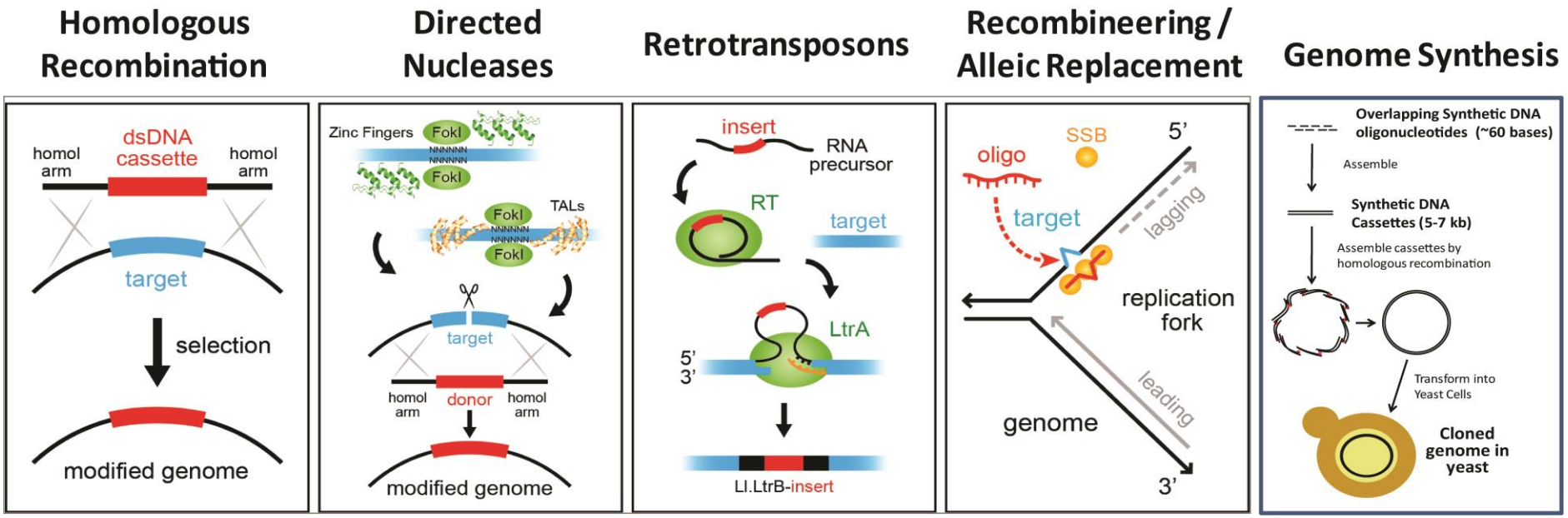
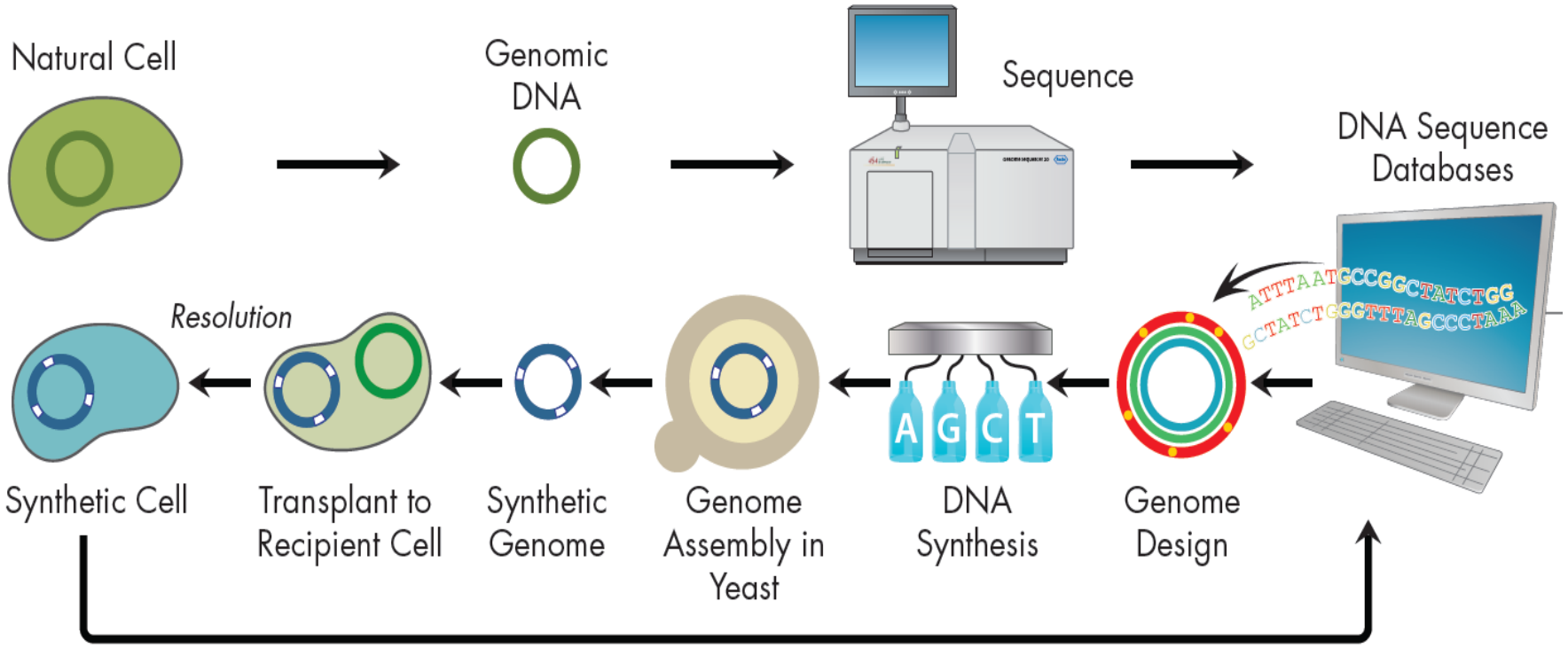
Genome Scale Engineering Approaches



Adapted from "Genome scale engineering for systems and synthetic biology" KM Eswell & HH Wang. 2013. *Mol. Syst. Biol.* **9:**641.

Moving life into the digital world and back



Our capacity to build organisms capable of solving human problems is limited only by our imagination