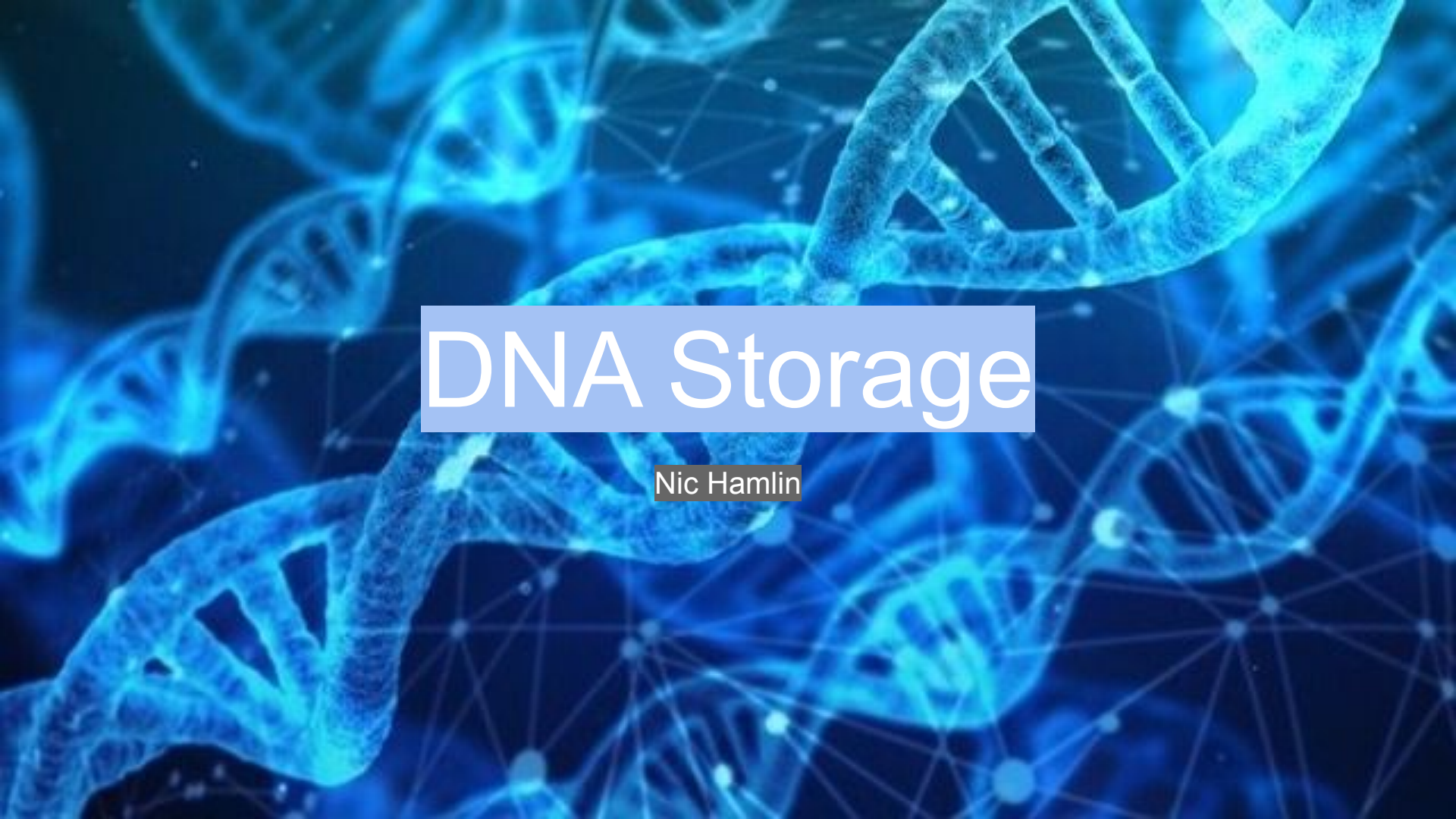
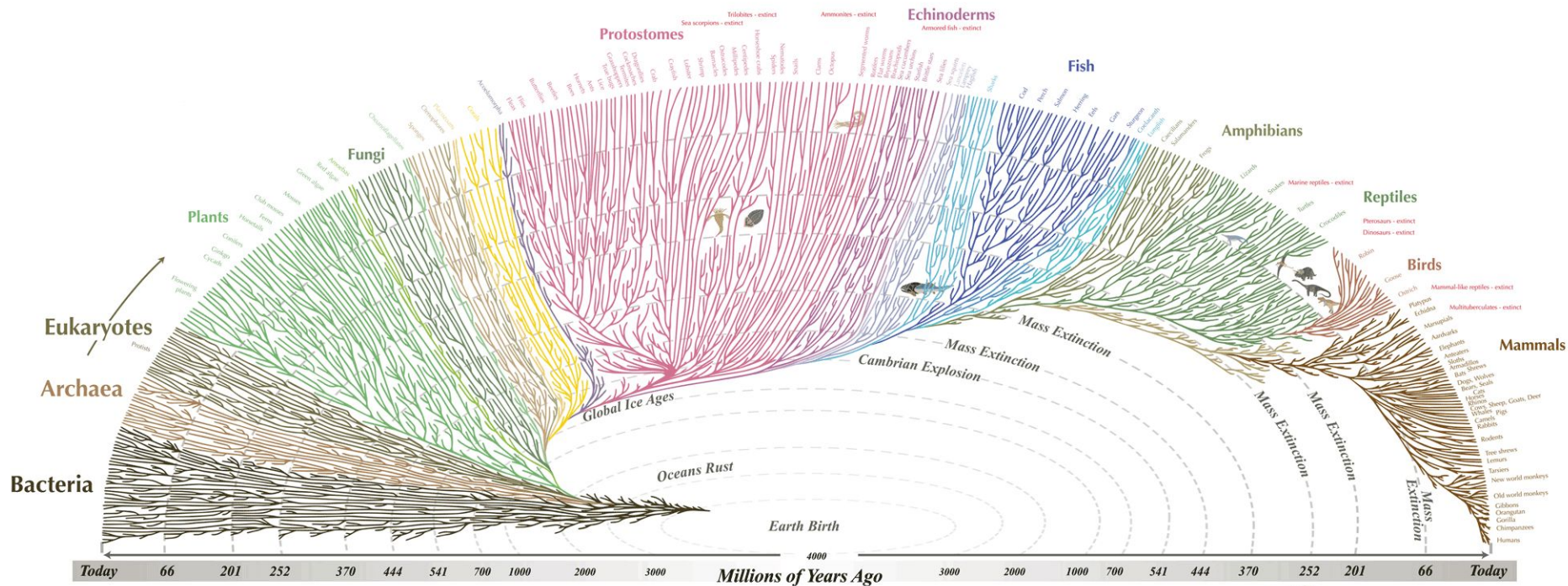




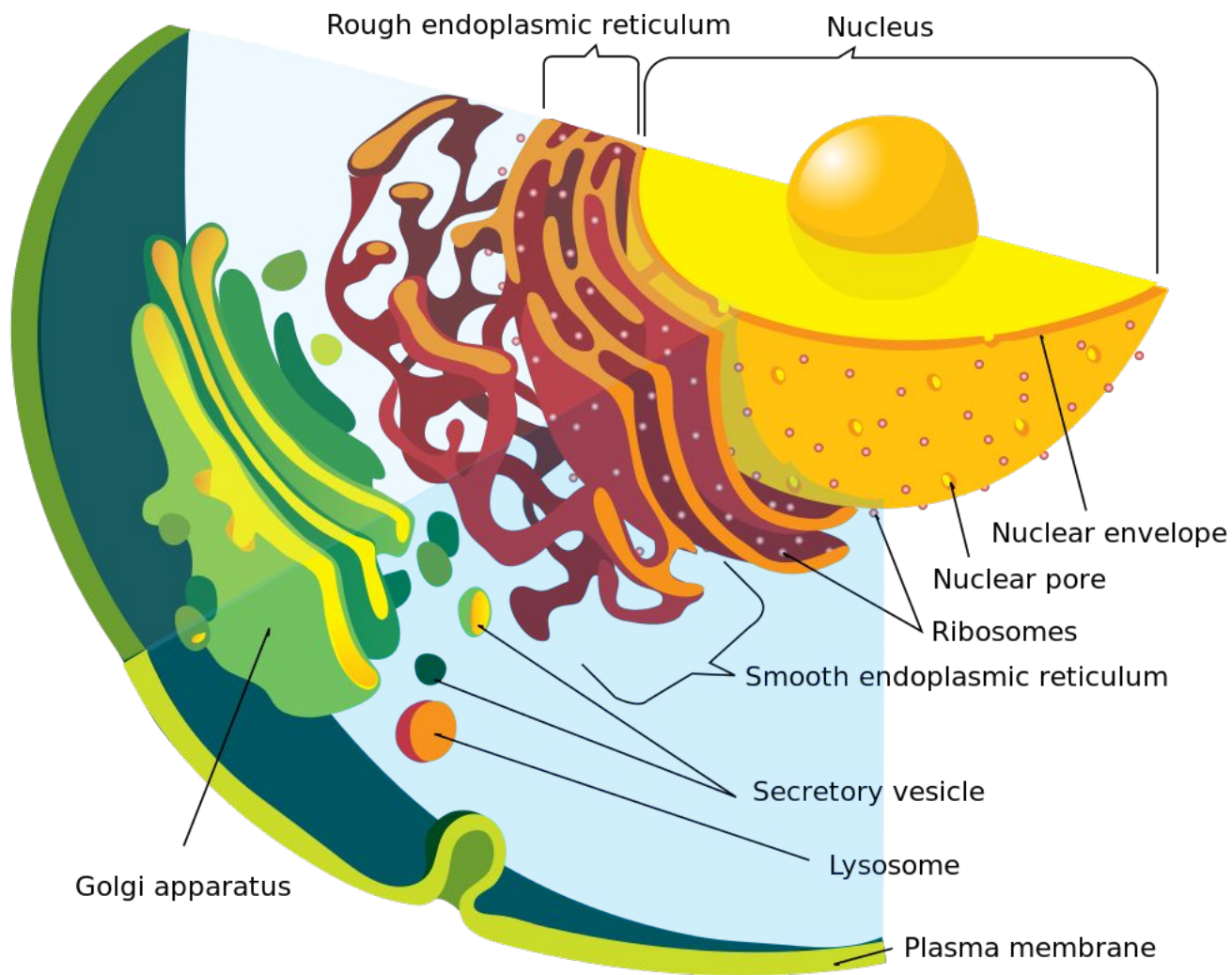
DNA Storage

Nic Hamlin

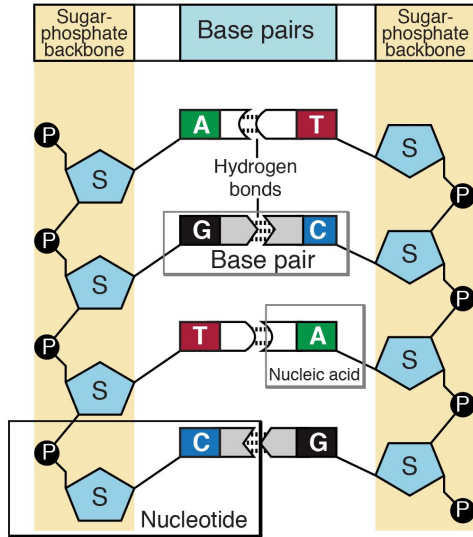


All the major and many of the minor living branches of life are shown on this diagram, but only a few of those that have gone extinct are shown. Example: Dinosaurs - extinct 

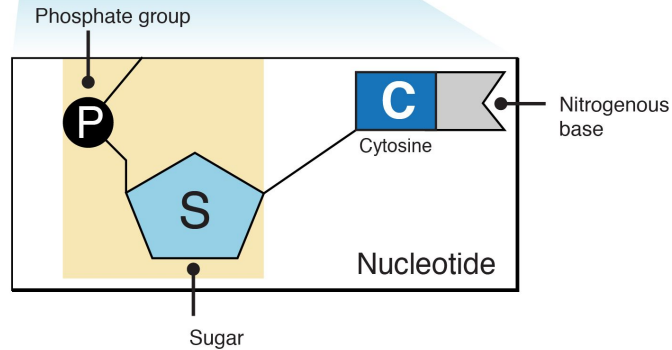
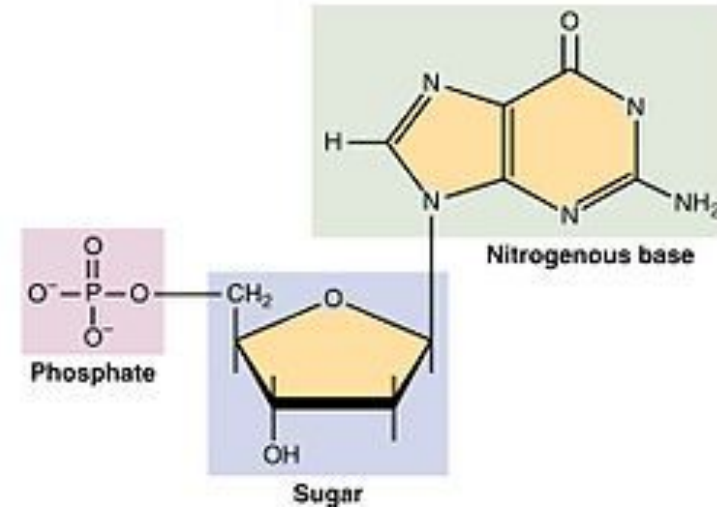
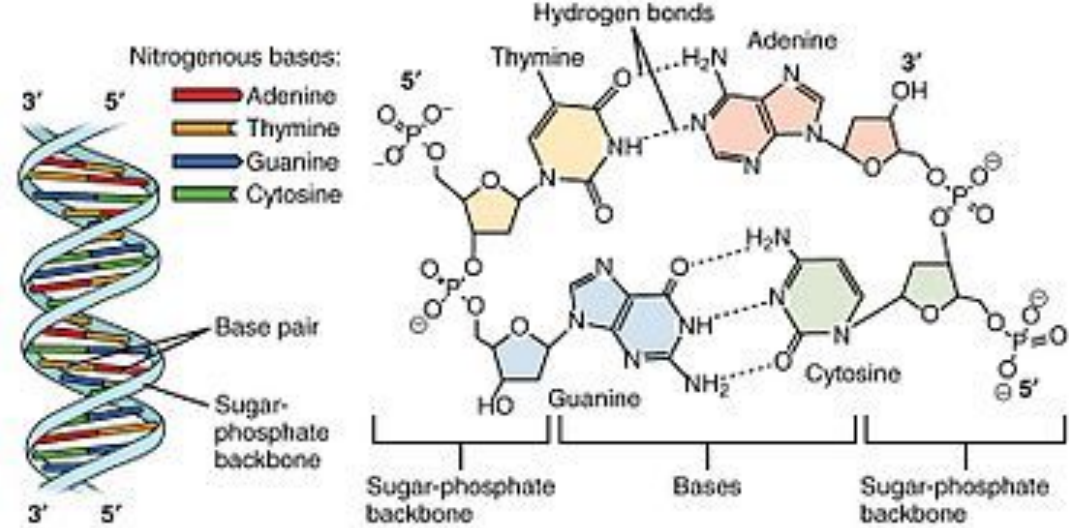
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evogeneo.com

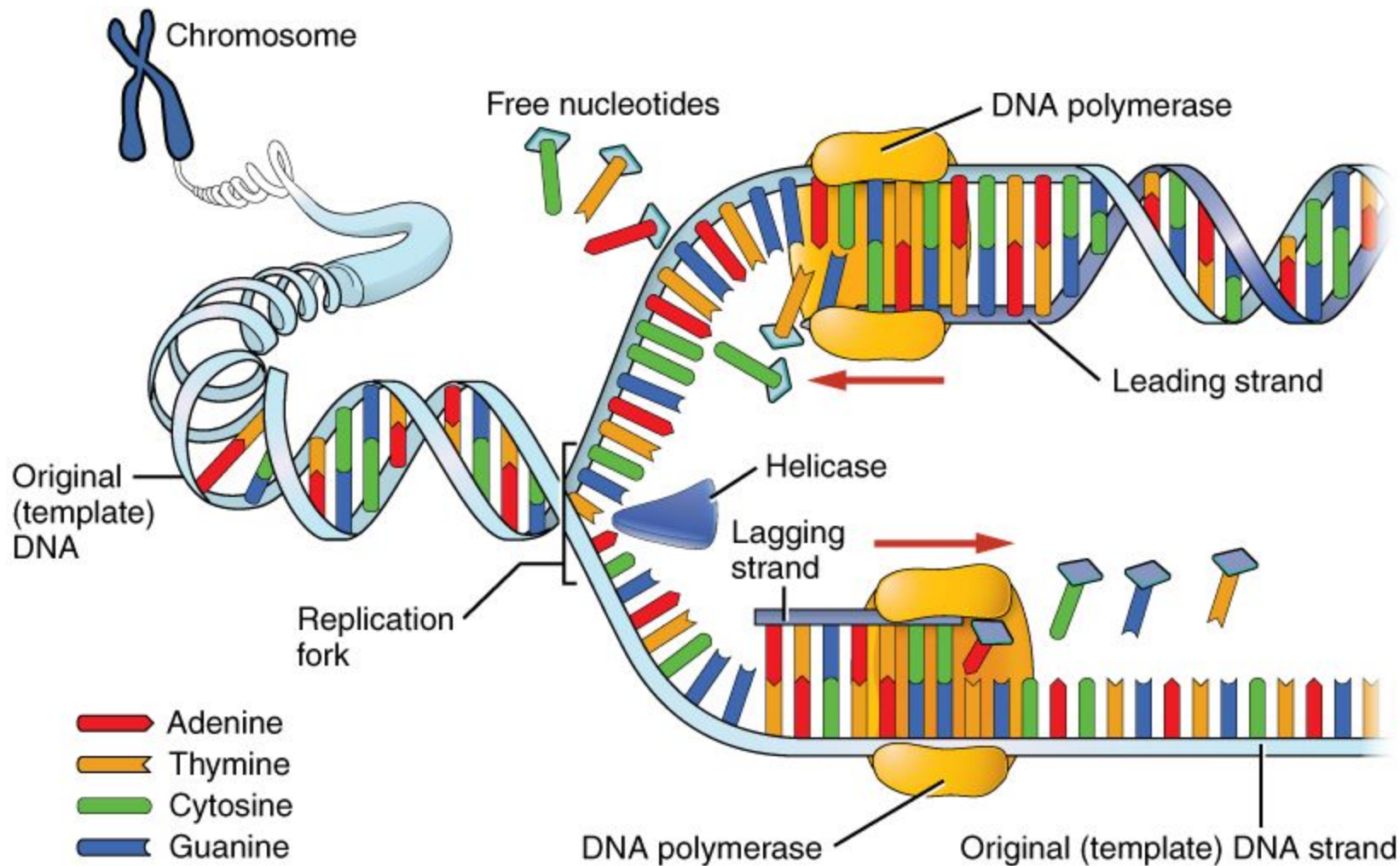


Deoxyribonucleic Acid (DNA)

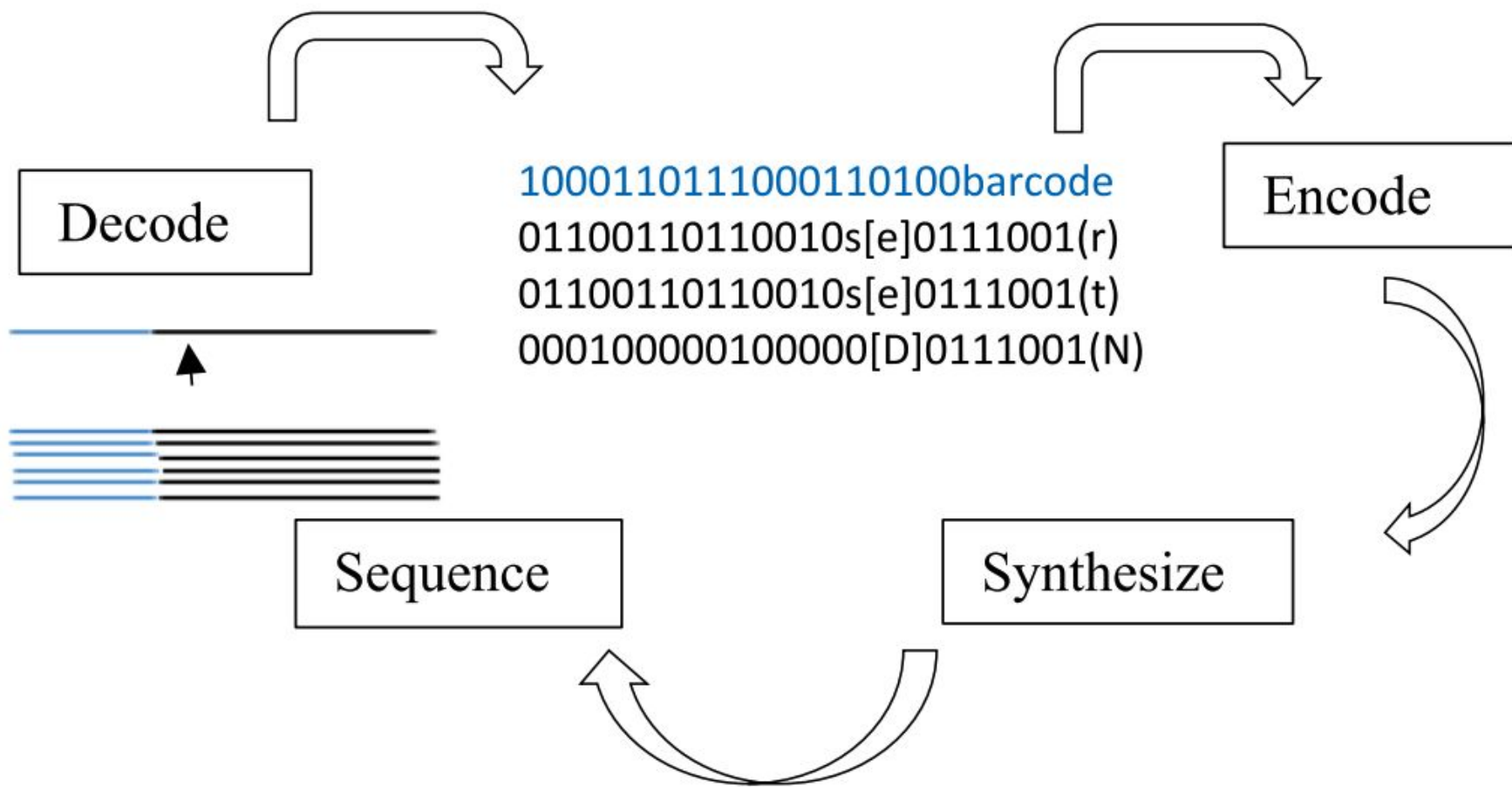


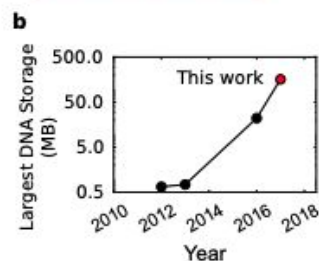
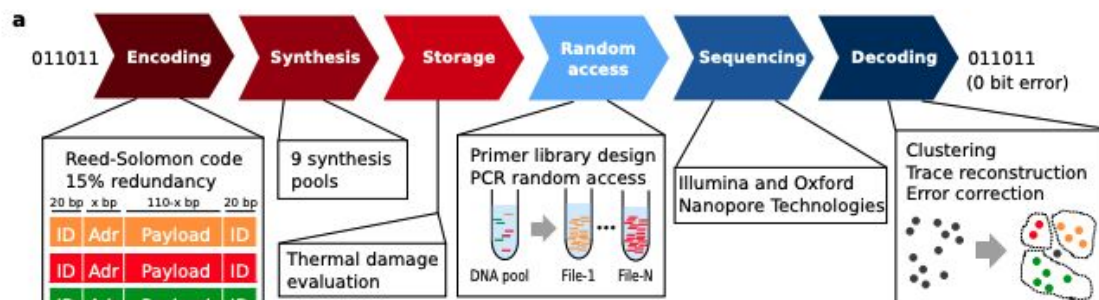
A Adenine
T Thymine
C Cytosine
G Guanine





Storage Type:	Speed:	Density (bits/mm ³):	Lifespan:
Tape	minutes	Areal(bits/inch ²): 10 ¹¹ ~	15-30 years
CD/DVD	seconds	~10 ⁶	20-100 years
HDD	10s milliseconds	~10 ⁹	5 years
SSD	milliseconds	~10 ⁹	5 year
PCM NVRAM	10s nanoseconds	Areal(bits/micrometer ²): ~ 0.00250	Years
DNA	Hours to days	~10 ¹⁶	Centuries
Quantum	?	~10 ¹³	?





c

Data	File size	Number of DNA sequences
OK GO (HD video)	44.2 MB	3.2 million
Classical music collection (Music)	13.9 MB	890 thousand
Seed portal (Text)	11.1 MB	708 thousand
Total 35 files	200.2 MB	13.4 million

d

	Data size	Coverage	Can decode when each read has multiple deletions	Bits per base including primers	Bits per base excluding primers	Random access
Church <i>et al.</i> ³	0.65 MB	3000x	No	0.60	0.83	No
Goldman <i>et al.</i> ⁵	0.63 MB	51x	No	0.19	0.29	No
Grass <i>et al.</i> ²	0.08 MB	372x	No	0.86	1.16	No
Bornholt <i>et al.</i> ⁴	0.15 MB	40x	No	0.57	0.85	Yes
Erlich and Zielinski ¹⁵	2.11 MB	10.5x	No	1.18	1.55	No
Blawat <i>et al.</i> ⁶	22 MB	160x	No	0.89	1.08	No
Yadzi <i>et al.</i> ¹⁶	0.003 MB	200x	Yes	1.71	1.74	Yes
This work	200.2 MB	5x	Yes	0.79	1.08	Yes

Keywords

2

- DNA
 - Chromosomes
 - Hydrogen bonds
- RNA
- Nucleotides
- Base Pair
- Oligonucleotides

1

- Tree of Life
- Eukaryote
- Nucleus
- Enzymes
- Angstrom

3

- Tape
- Floppy/CD/DVD
- HDD
- SSD
- NVRAM
- DNA
- Quantum

4

- DNA Storage
- DNAzymes
- Data Encoding
 - Huffman
 - Alienburg and Rotstein
 - Comma
 - Alternating
 - Alignment-based
 - Goldman
 - Reed Solomon
- Sequencing
- Synthesis
- DNA of Things