DNA Sequencing
What and Why?

Mohamed N. Seleem

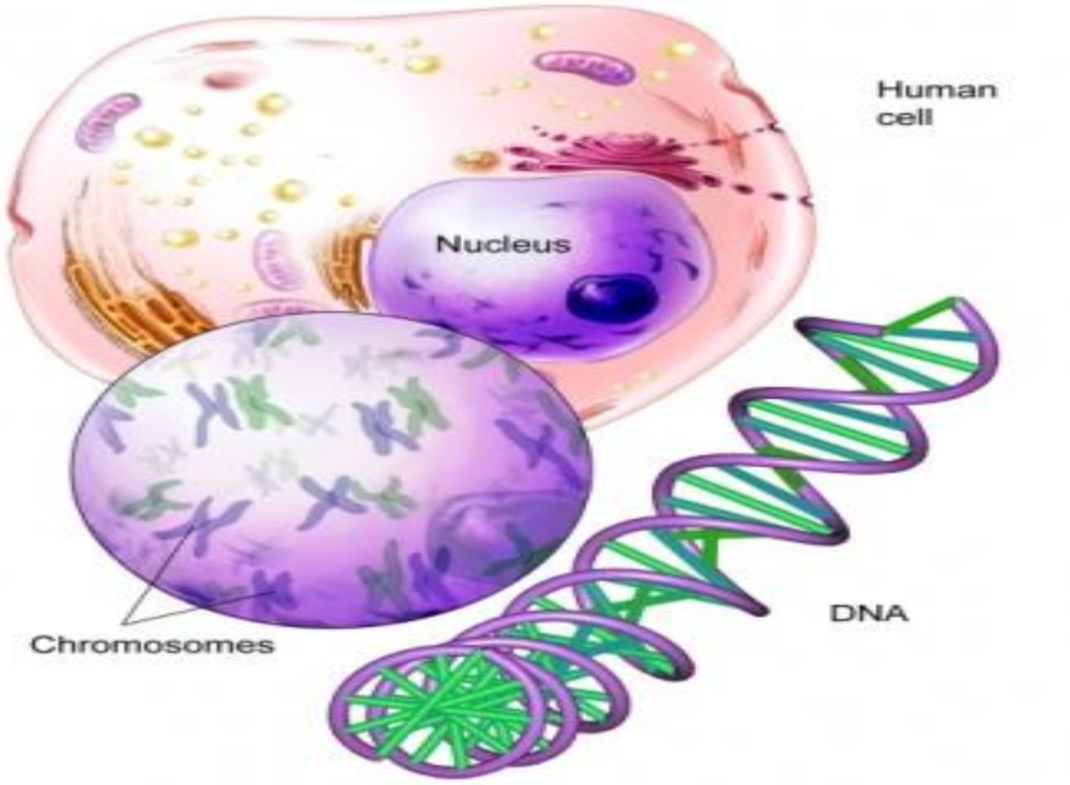
Environmental Signals

Adolf Friedrich
Nobel Prize
1939 (rejected)
Sex hormones
(Pheromones)

Chemical signals

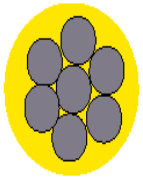
Echolocation signals

What is genetic material

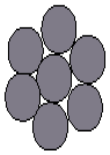


Frederick Griffith
transforming principle
1929

Streptococcus pneumoniae



Smooth colonies secrete a capsule and kill mice.

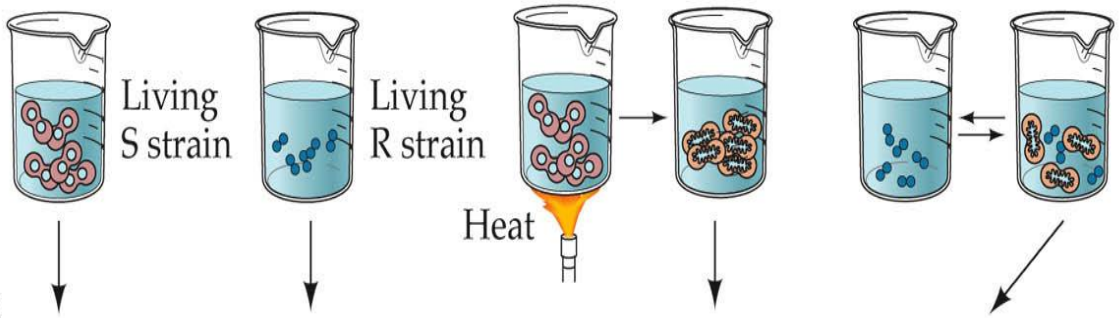


Rough colonies do not secrete a capsule and do not kill mice

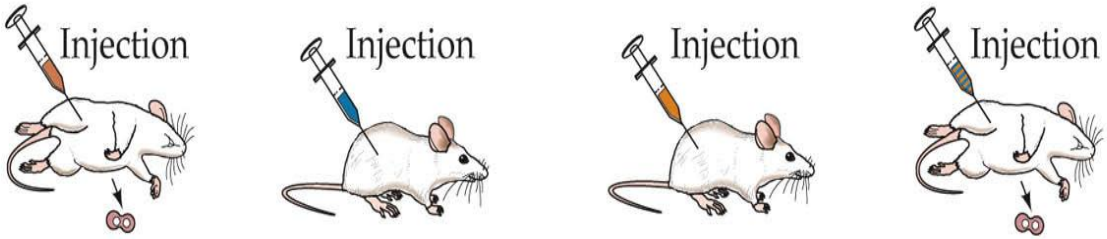
EXPERIMENT

Question: Can the presence of dead bacterial cells genetically transform living bacterial cells?

METHOD



RESULTS



Mouse dies	Mouse healthy	Mouse healthy	Mouse dies
Living S strain cells found in heart	No bacterial cells found in heart	No bacterial cells found in heart	Living S strain cells found in heart

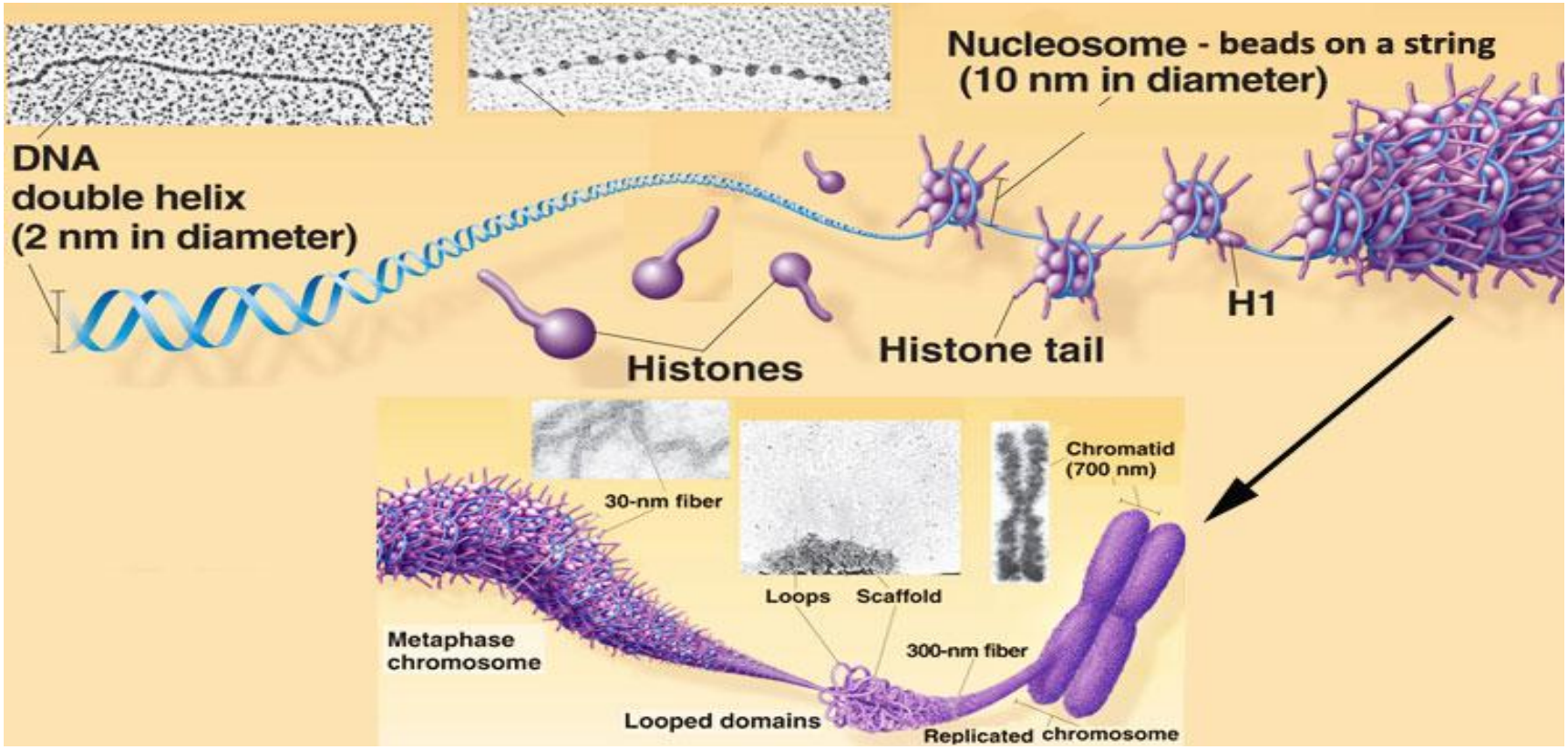
Conclusion: A chemical component from one cell is capable of genetically transforming another cell.

LIFE: THE SCIENCE OF BIOLOGY, Seventh Edition, Figure 11.1 Genetic Transformation of Nonvirulent Pneumococci

Genetic materials???

- Protein (chromosomes 90% protein)
- DNA
- Carbohydrate
- Lipids

1944 Oswald Avery



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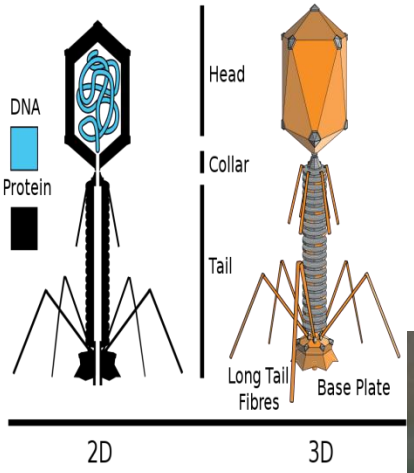
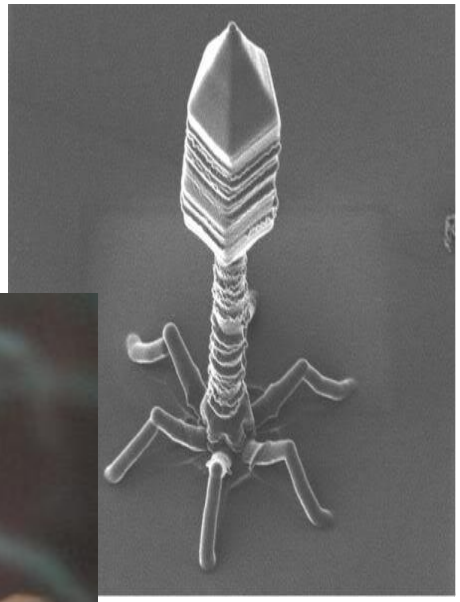
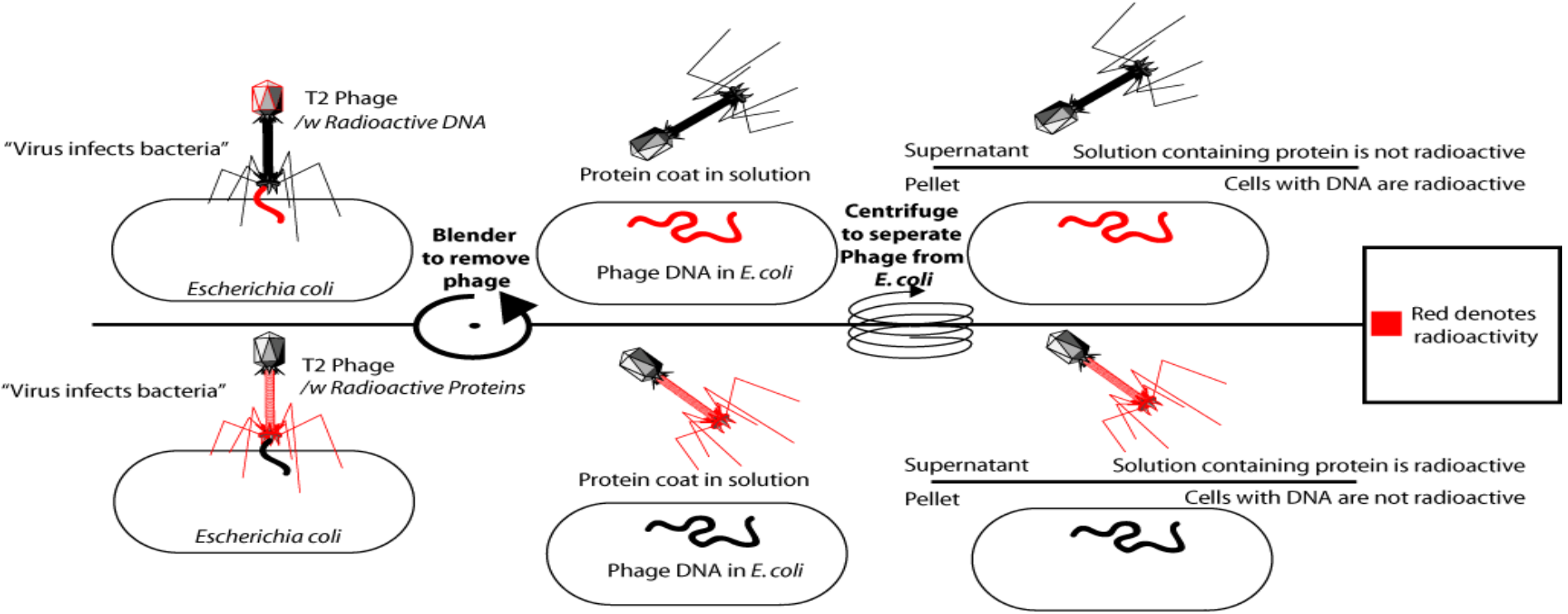
Alfred Hershey and Martha Chase
1952







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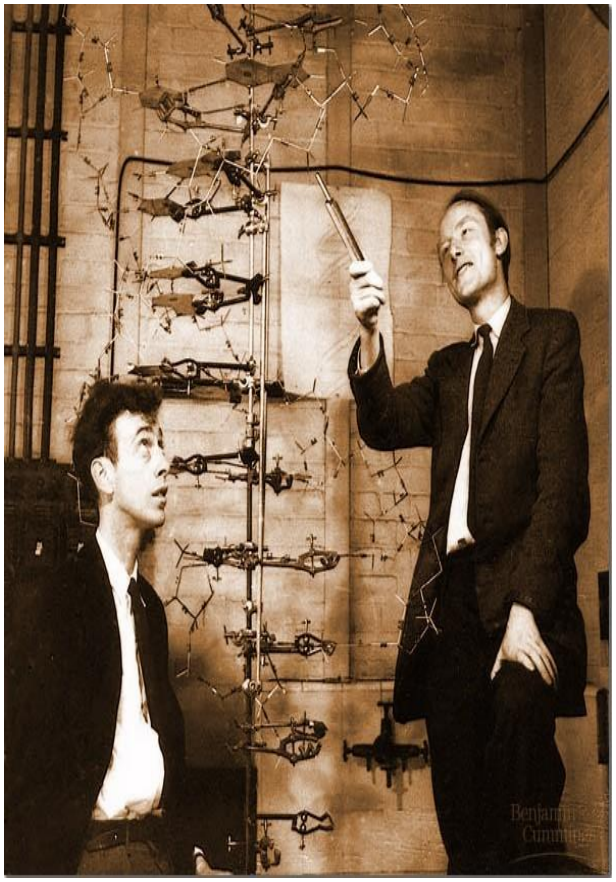
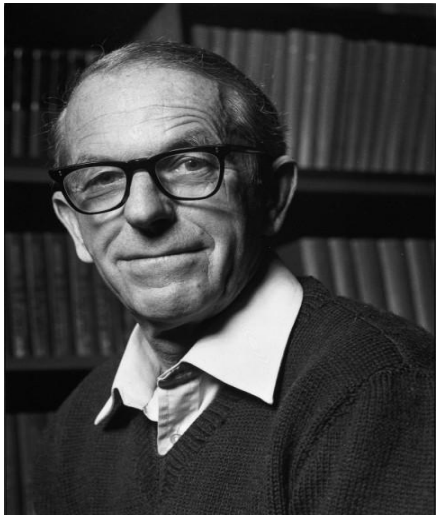
Cracking The Code



Watson and Crick
1953 DNA structure
Nobel Prize 1962

DNA Sequencing

Sanger Method
DNA sequencing by enzymatic synthesis



Frederick Sanger
Nobel Prize 1958, sequence of insulin
Nobel Prize 1980, DNA sequence

Maxam–Gilbert Method
DNA sequencing by chemical degradation

Walter Gilbert
Nobel Prize 1980, DNA sequence

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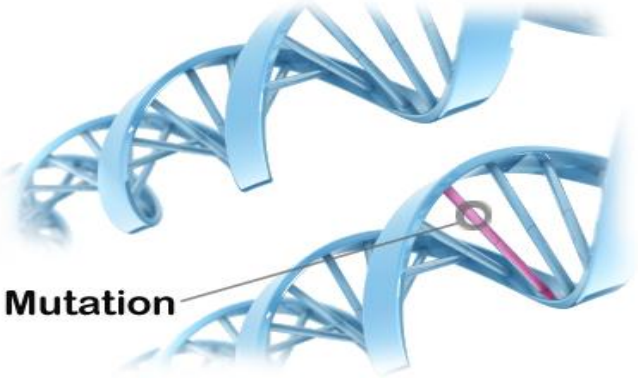
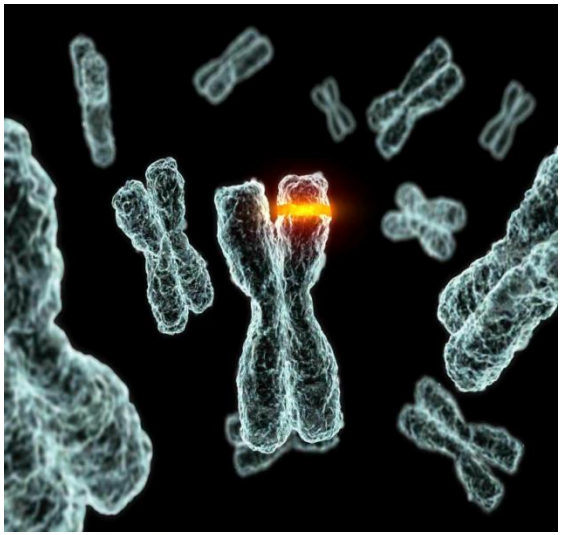
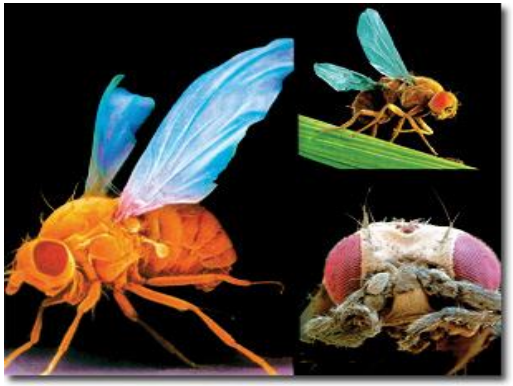
What is DNA Sequencing?

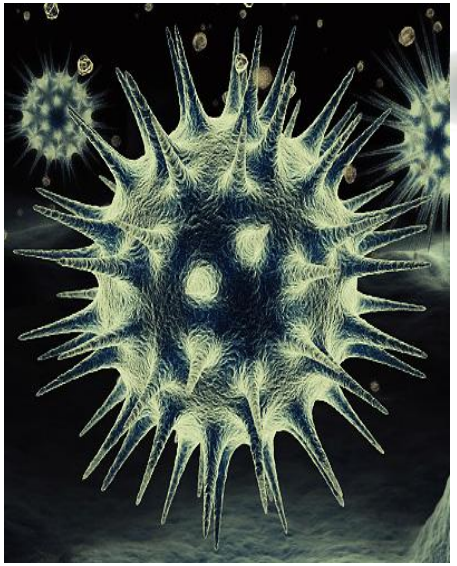
"Sequencing" means finding the order of nucleotides on a piece of DNA .

Mutation









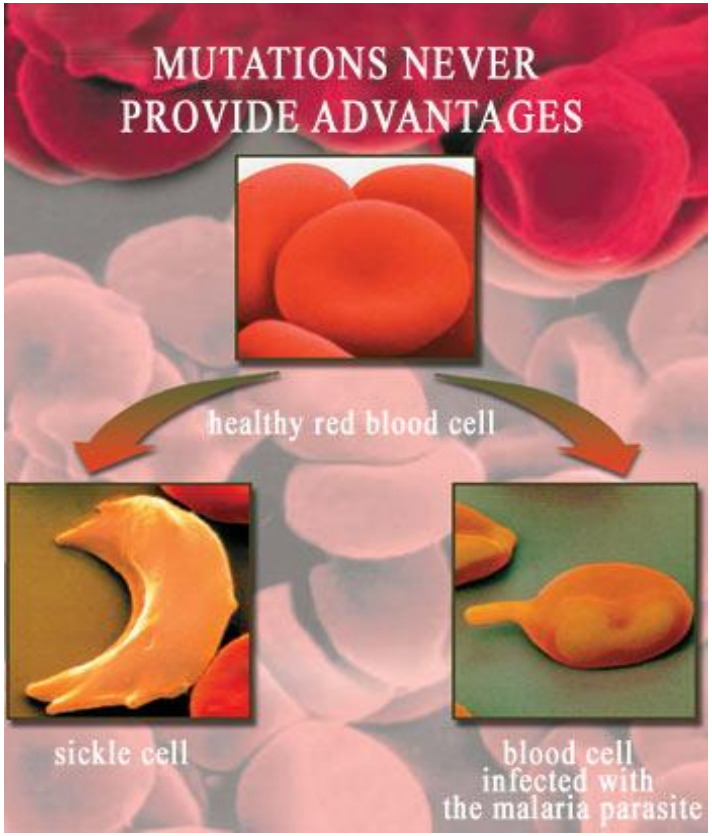
Sickle Cell Anemia

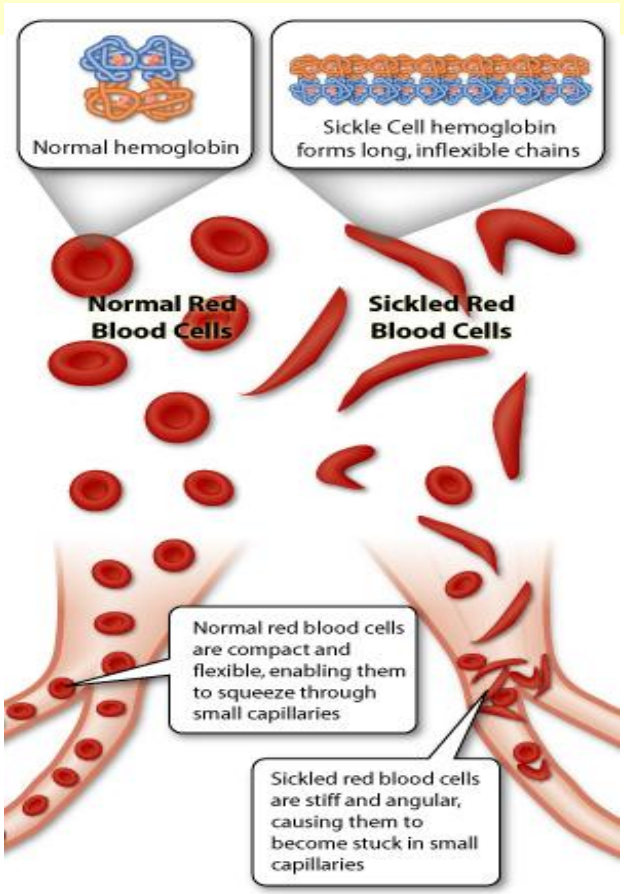
HBB Sequence in Normal Adult Hemoglobin (Hb A):

Nucleotide	CTG	ACT	CCT	GAG	GAG	AAG	TCT
Amino Acid	Leu	Thr	Pro	Glu	Glu	Lys	Ser
	3			6			9

HBB Sequence in Mutant Adult Hemoglobin (Hb S):

Nucleotide	CTG	ACT	CCT	GTG	GAG	AAG	TCT
Amino Acid	Leu	Thr	Pro	Val	Glu	Lys	Ser
	3			6			9





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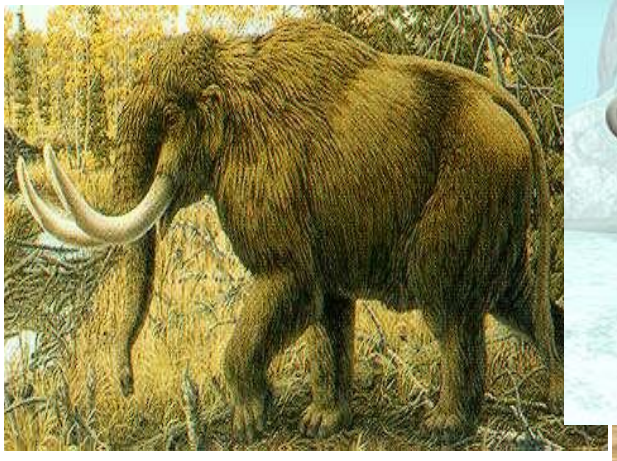
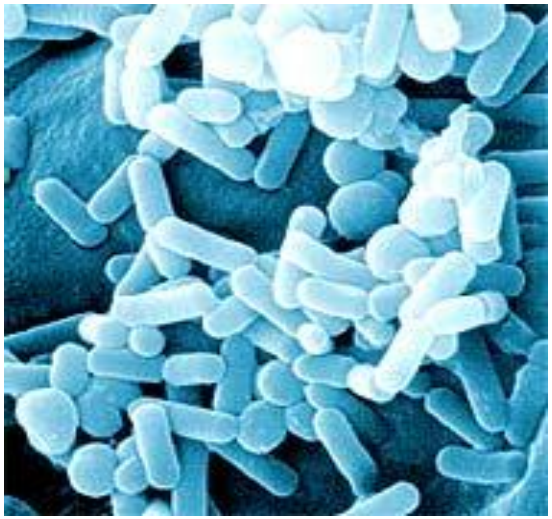
Studying evolution



Mastodon

11,000
years ago



Enterobacter cloacae

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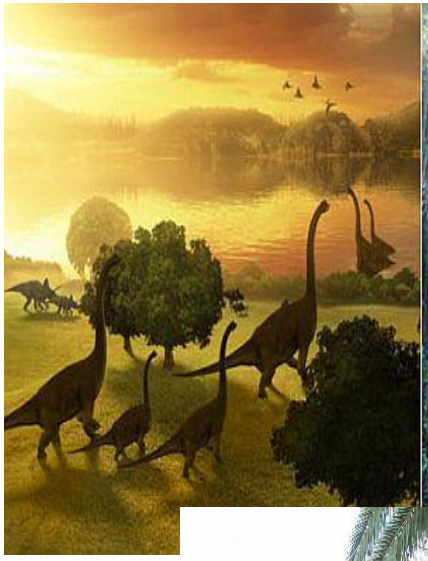
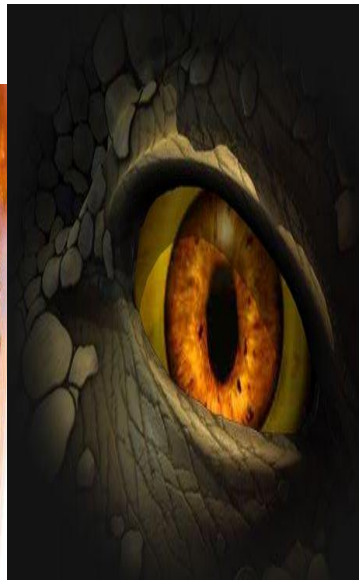
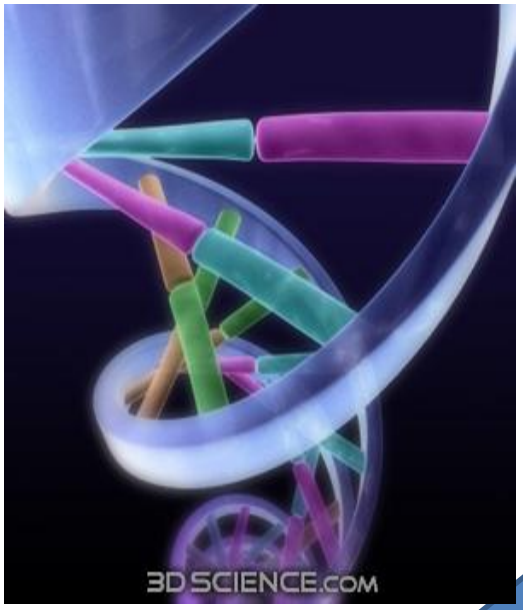
Fossils







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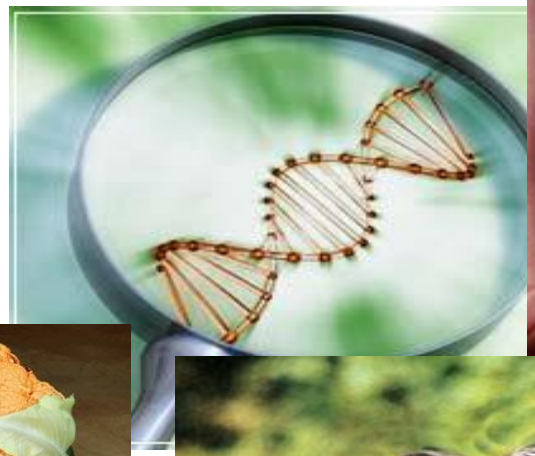
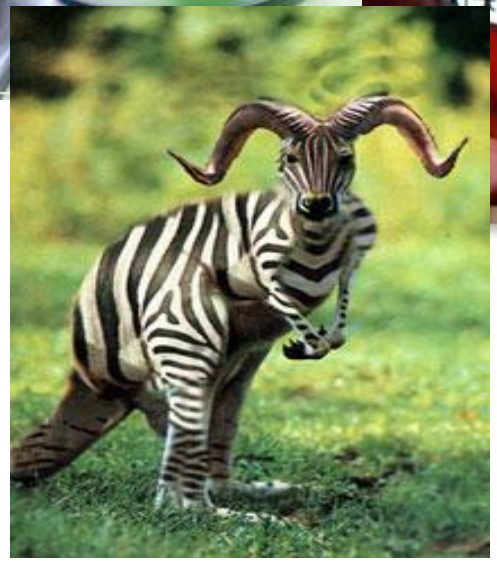
Genetic Engineering & Biotechnology





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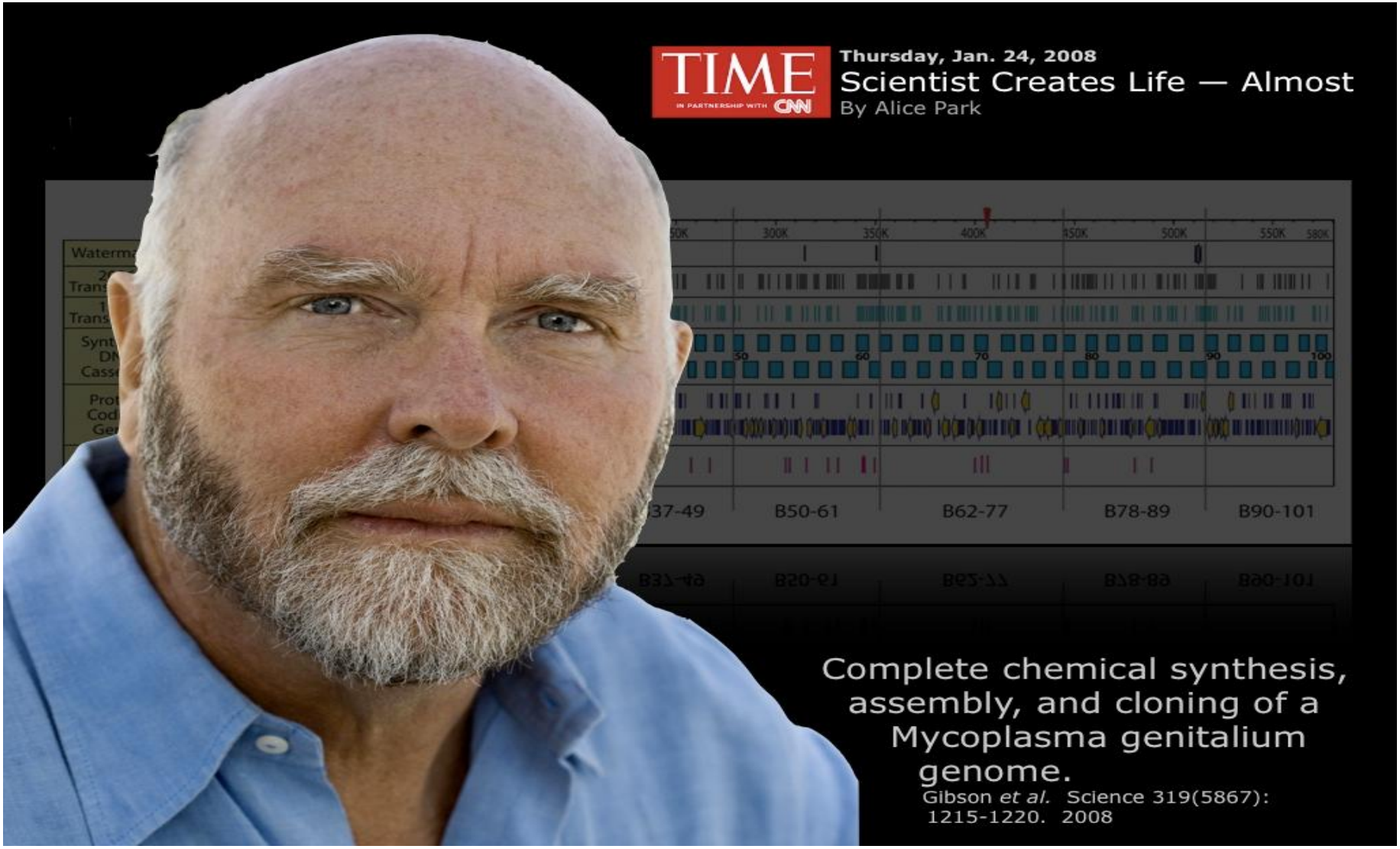
Synthetic life



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M. genitalium

Obligate intracellular bacterium
482 genes and 580,000 bp
Smallest genome

Energy Bug

382 genes essential for life

Biological Alternative Energy