

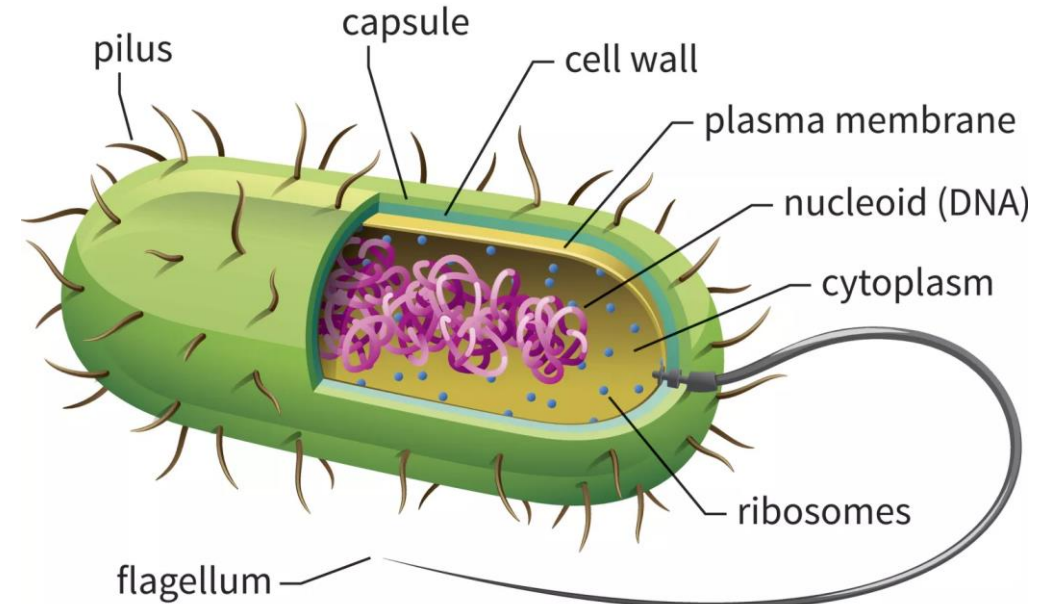
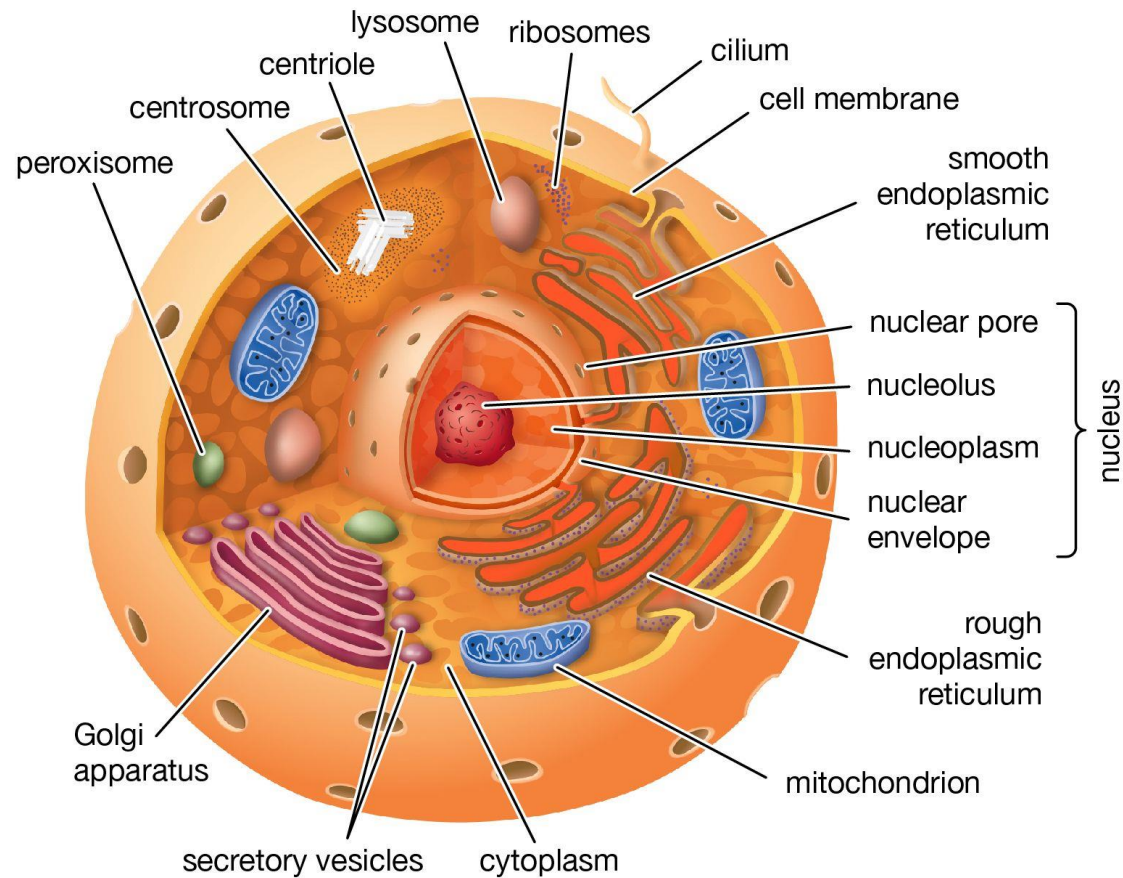
CRISPR-Cas Genome Editing

Chen Gang Goh
Graduate Student
Steve Jackson Lab
Gurdon Institute, University of Cambridge

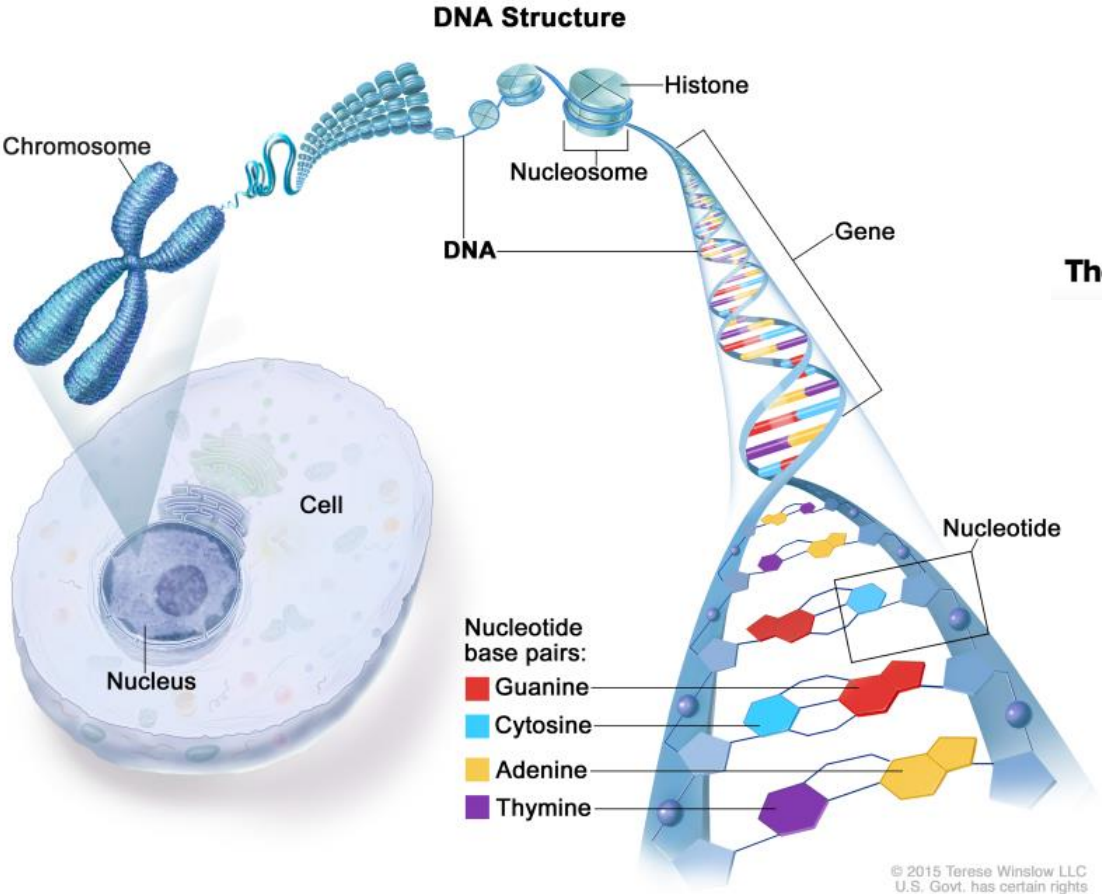
Part 1: The 'Central Dogma'

Eukaryotic cell

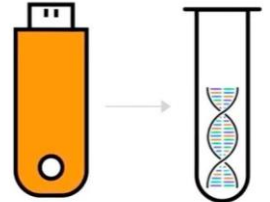
Animal cell



Nucleus - DNA and chromosome

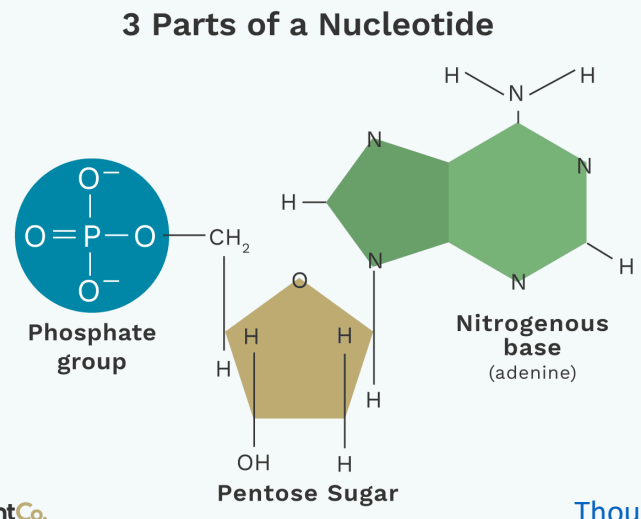


National Cancer Institute



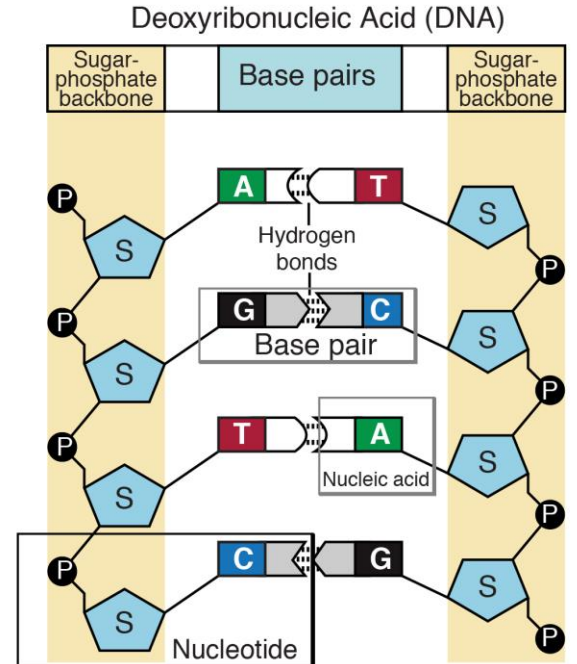
The Future of Digital Data Storage

Twist Bioscience



ThoughtCo.

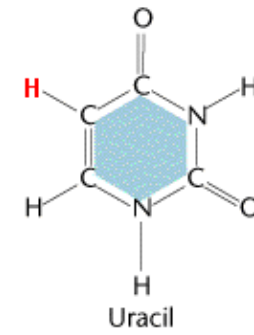
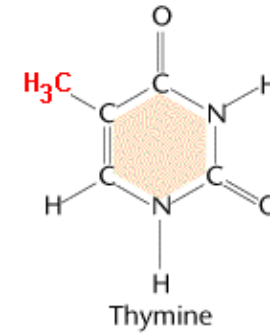
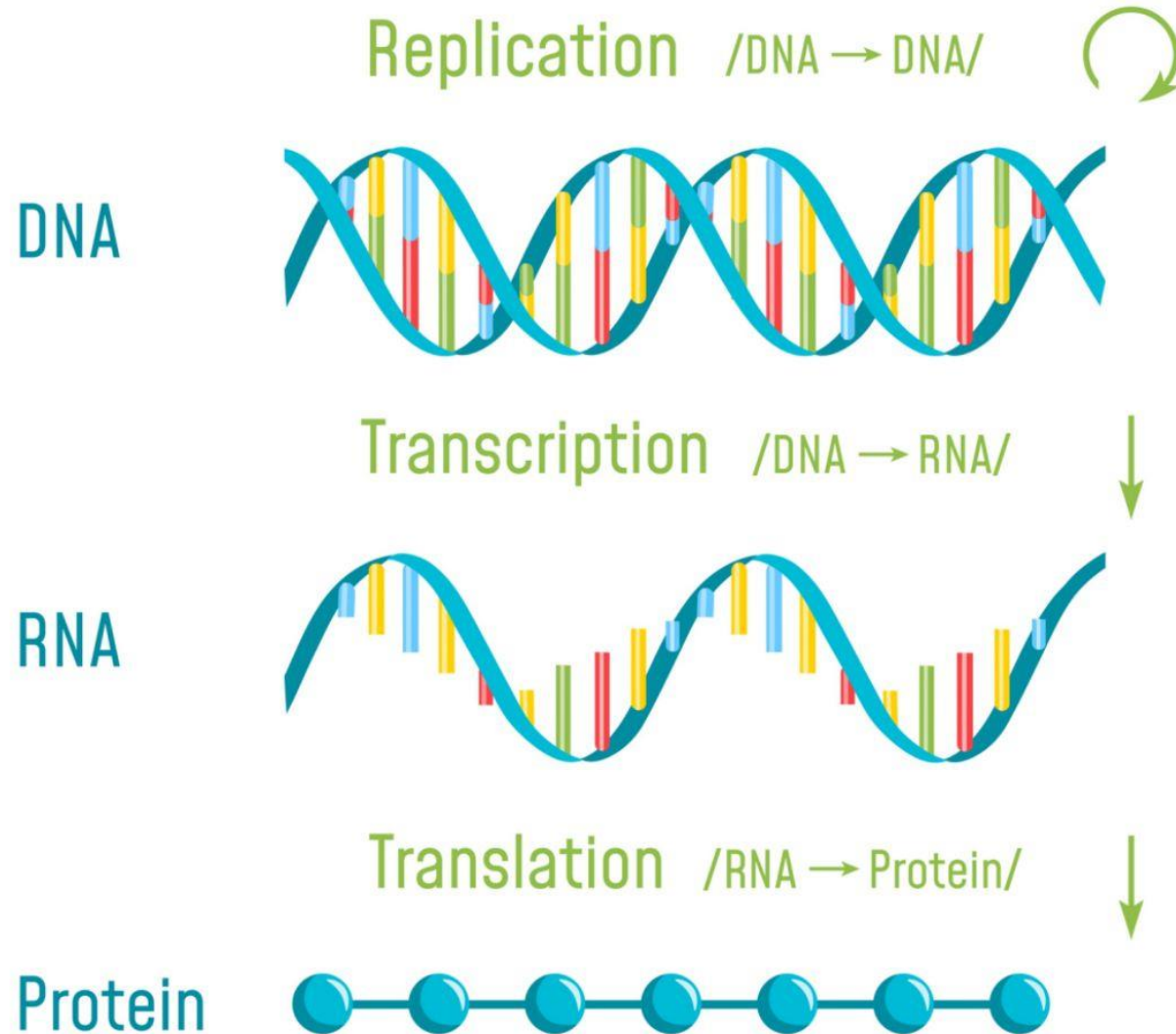
ThoughtCo.



- A Adenine
- T Thymine
- C Cytosine
- G Guanine

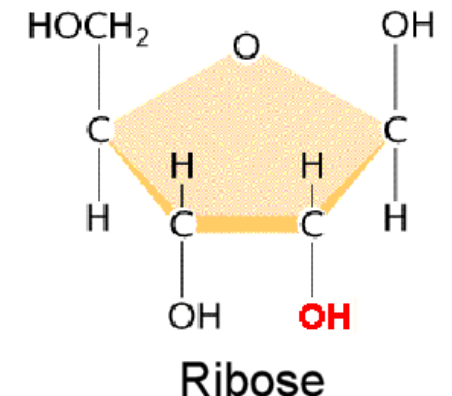
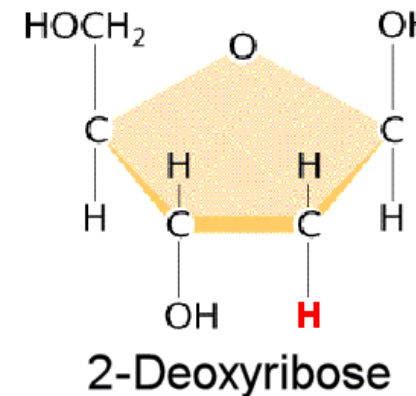
National Human Genome Research Institute

The “Central Dogma”



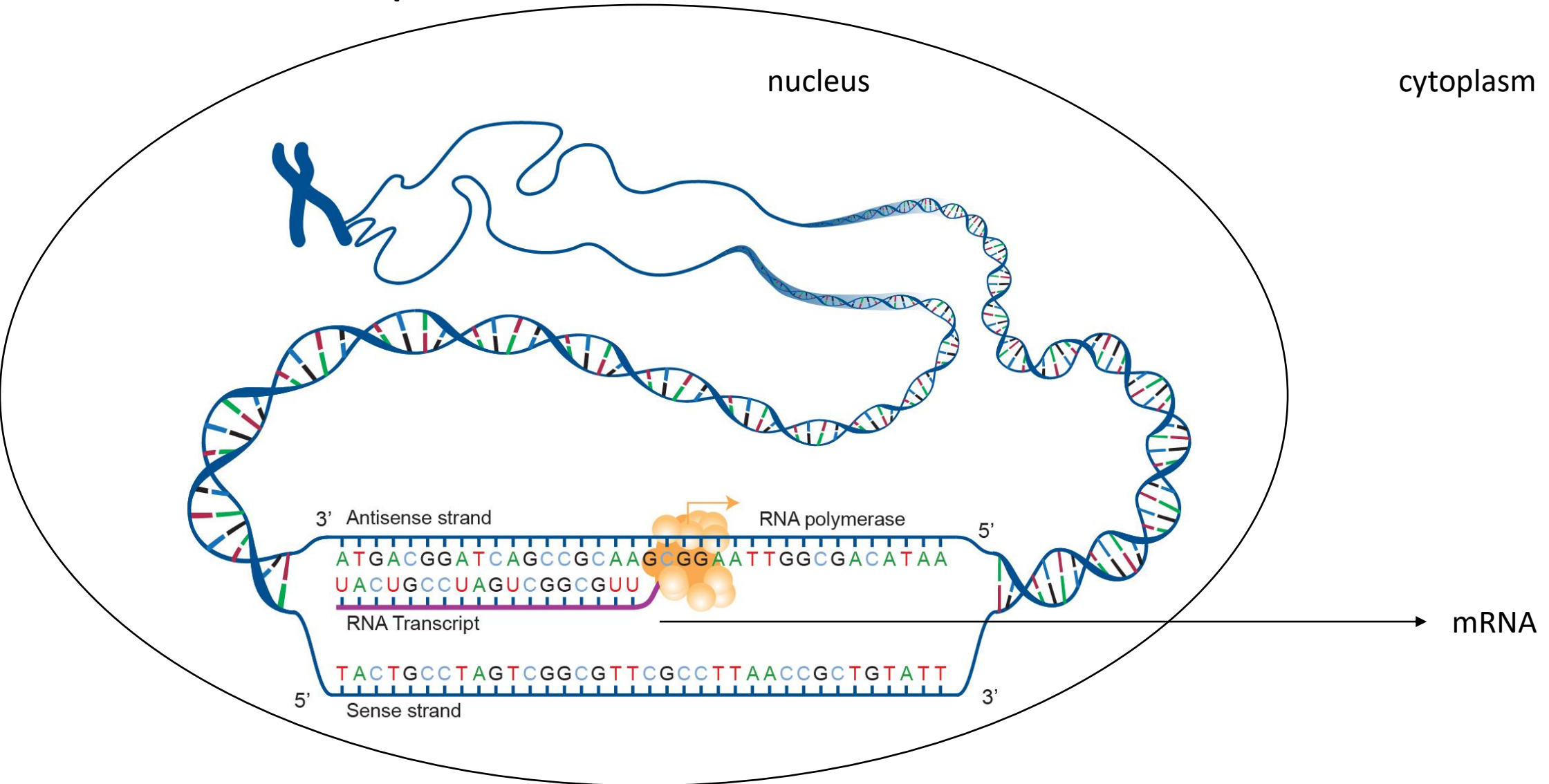
(Klug & Cummings 1997)

Mun.ca

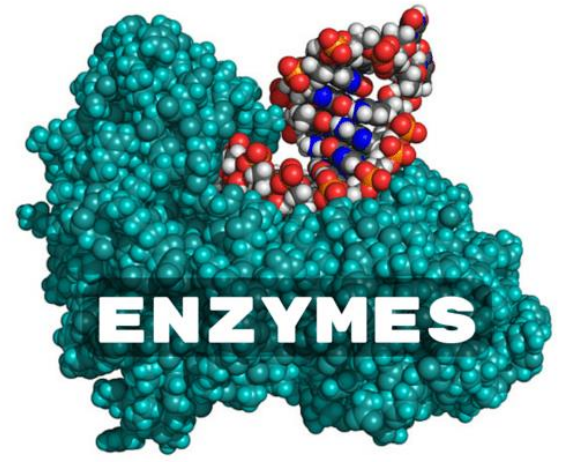
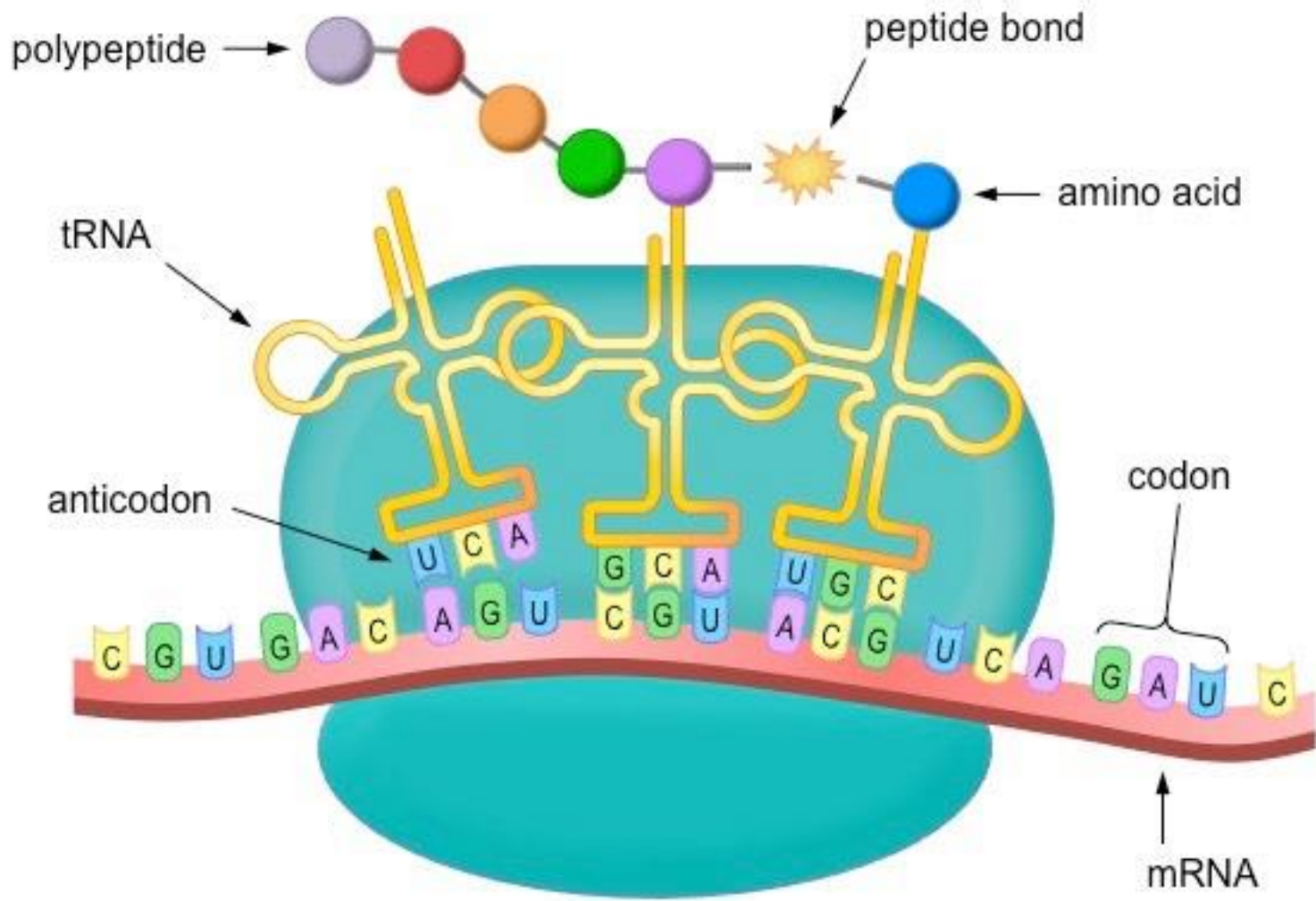


Mun.ca

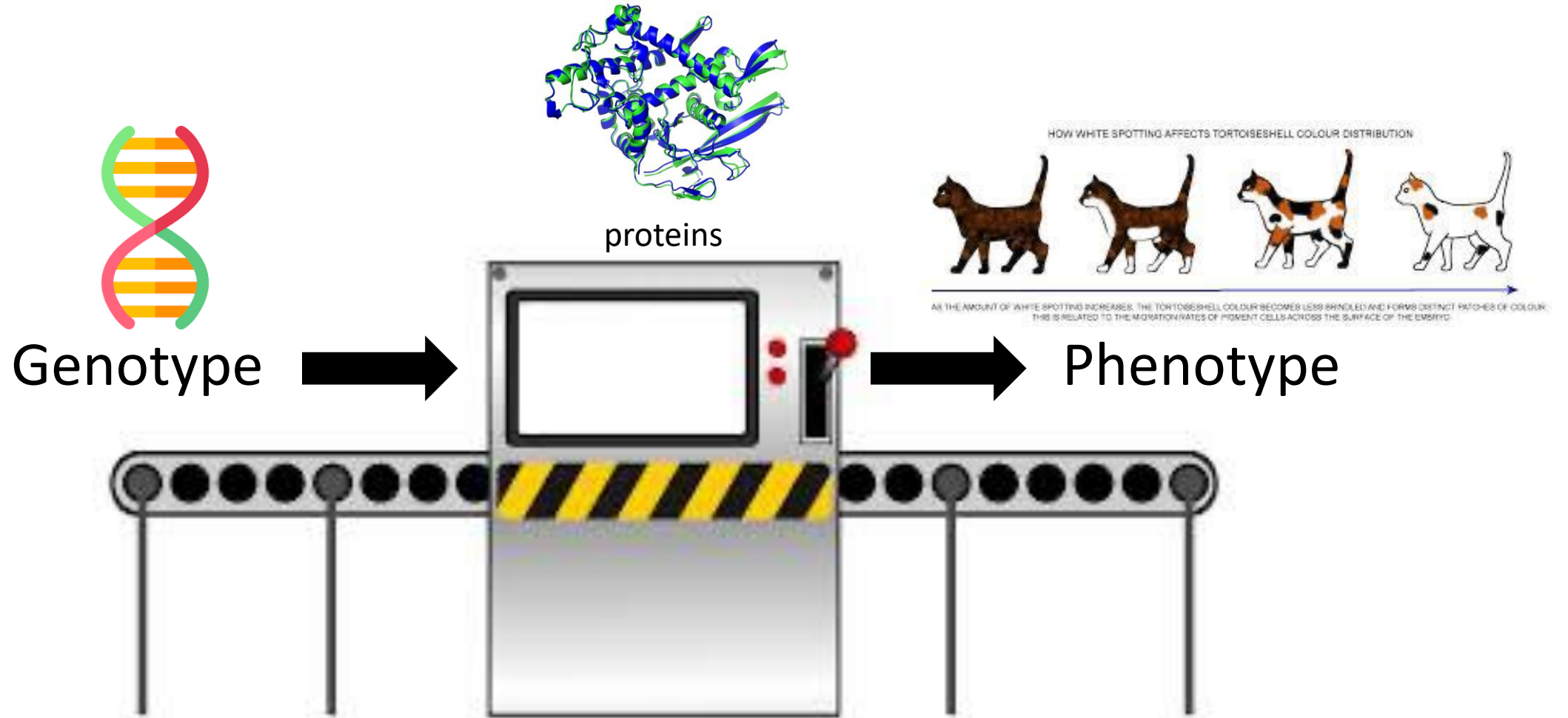
Transcription



Translation



Genotype VS Phenotype

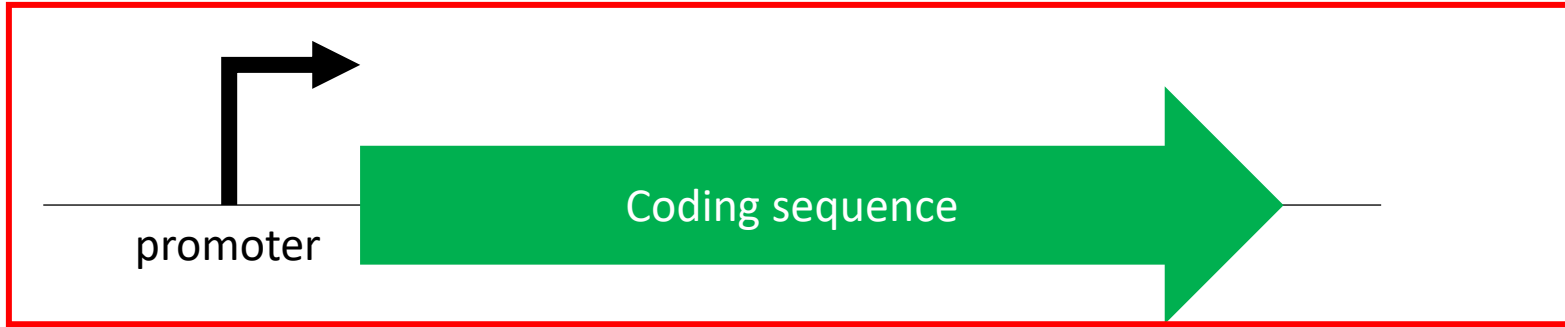


Quiz 1

Part 2: Genes and Diseases

Genes

GENE



DNA



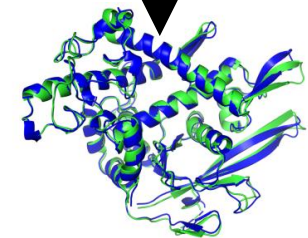
RNA



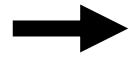
Phenotype



polypeptide

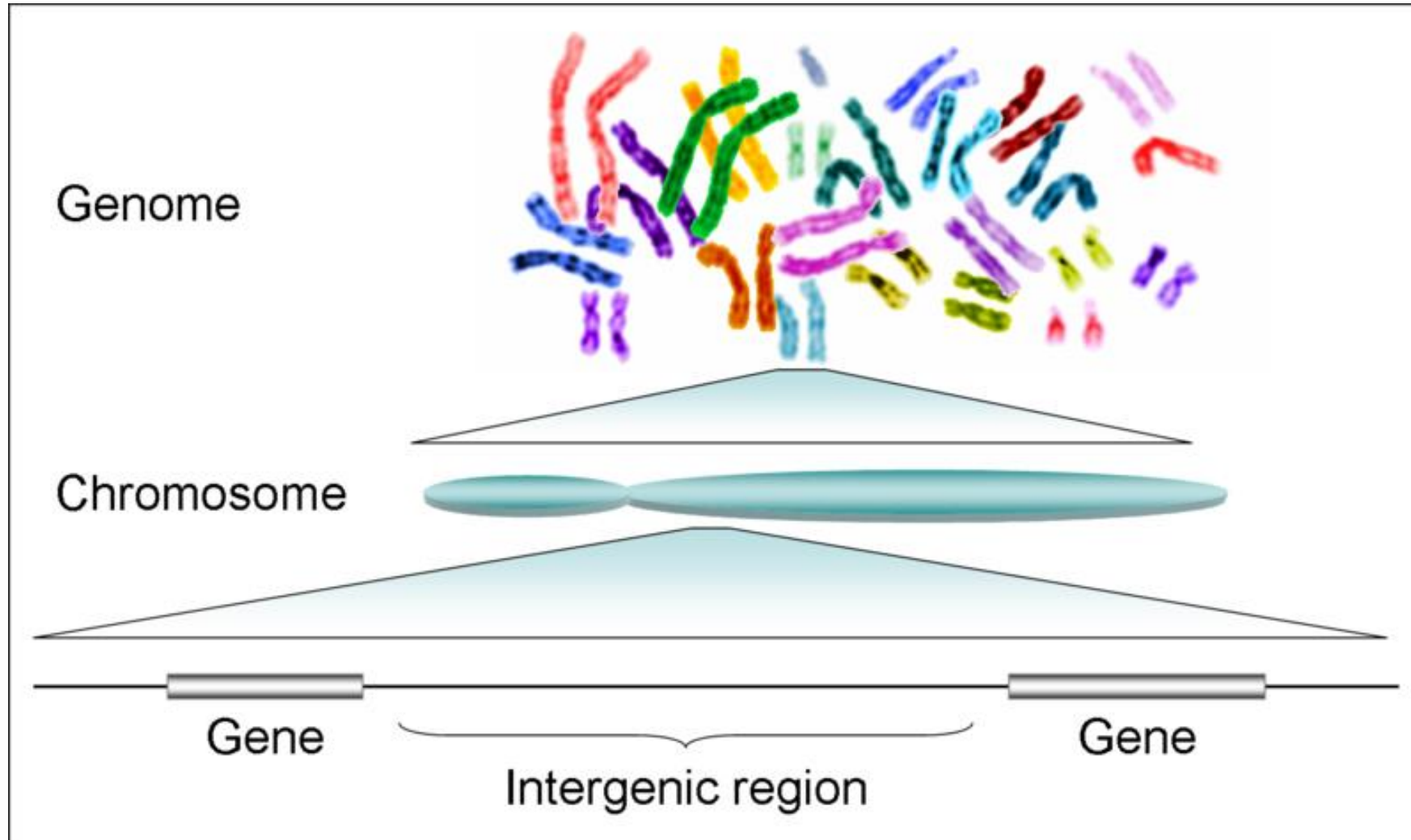


protein



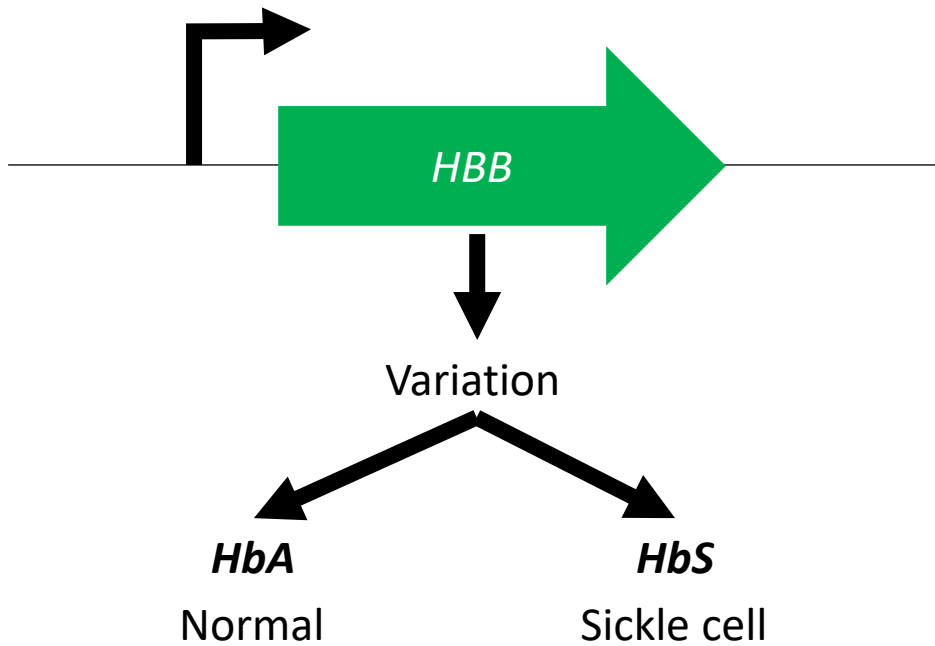
Phenotype

Genome



Variations in humans – Genetic Disease

Sickle Cell Disease

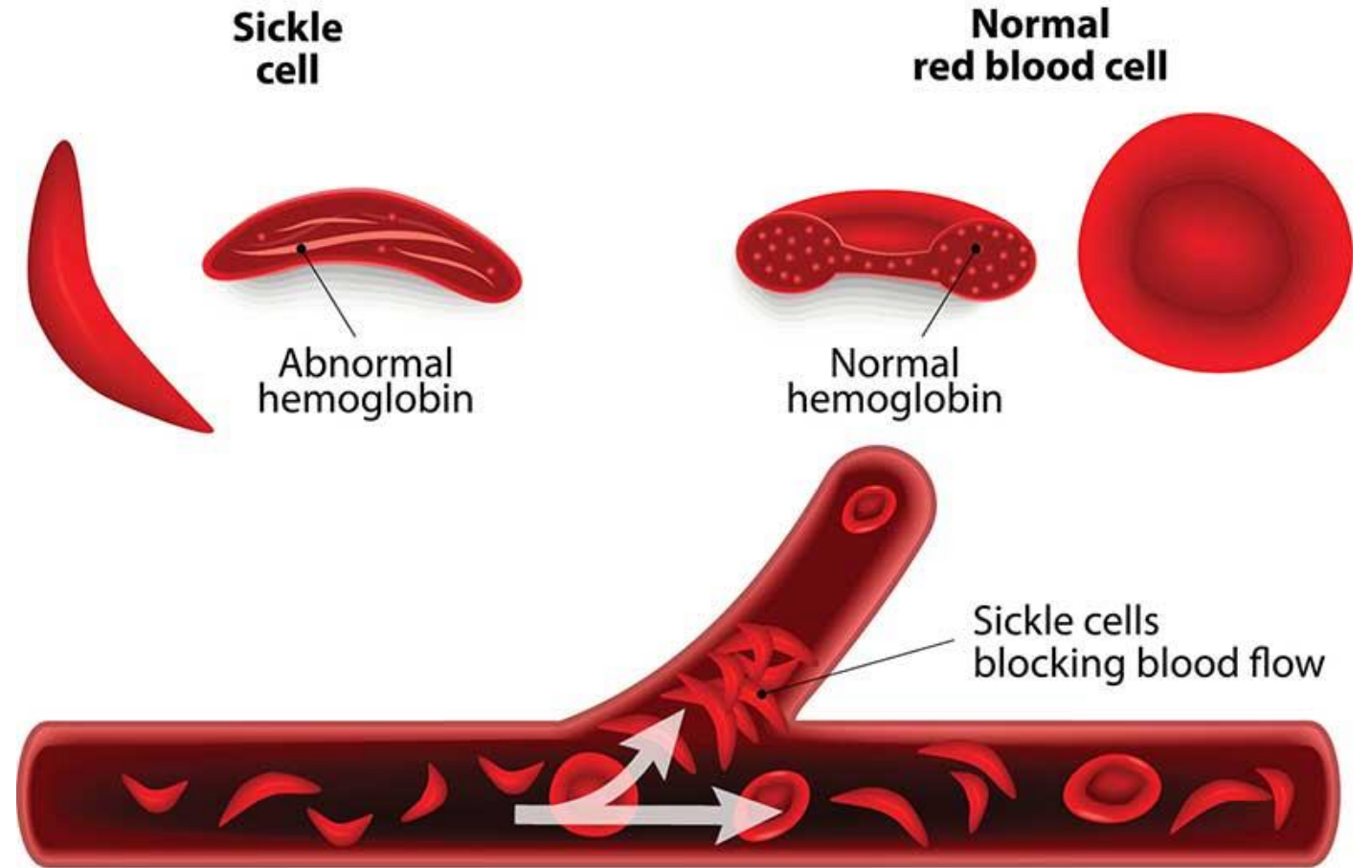


CCT GAG GAG

Pro **Glu** Glu

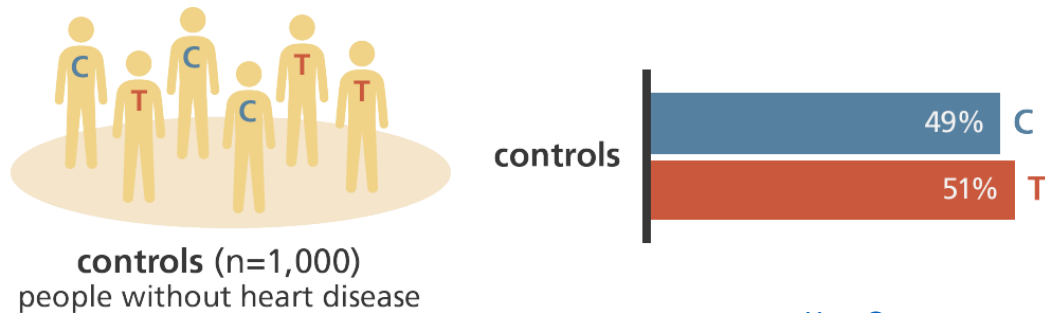
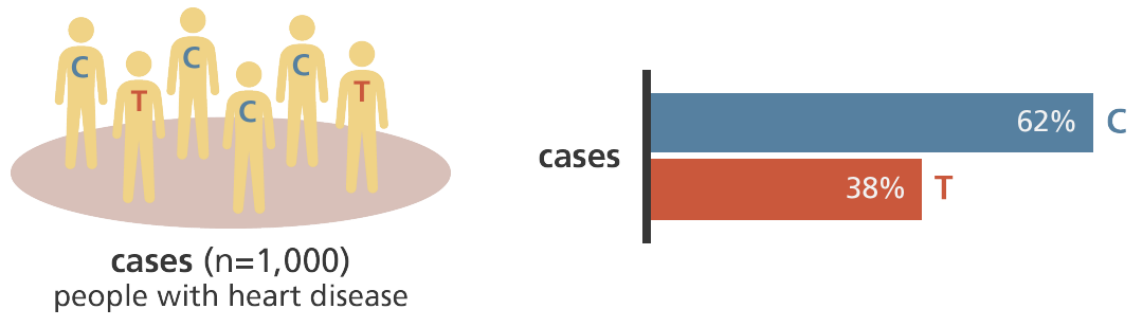
CCT GTG GAG

Pro **Val** Glu



Single Nucleotide Polymorphism (SNP)

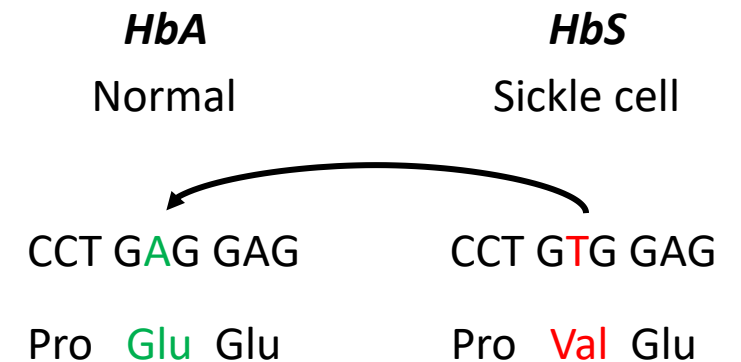
Genome-Wide Association Study (GWAS)



[YourGenome](#)



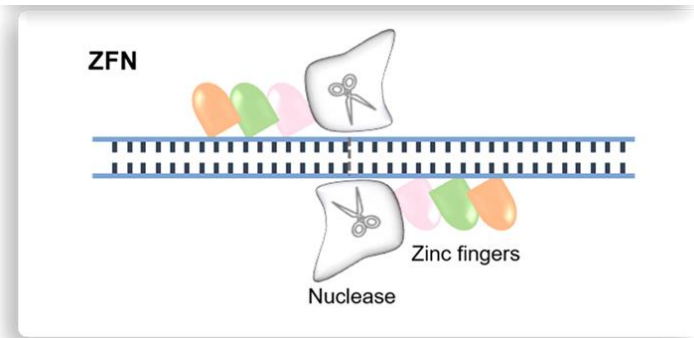
[23andme](#)



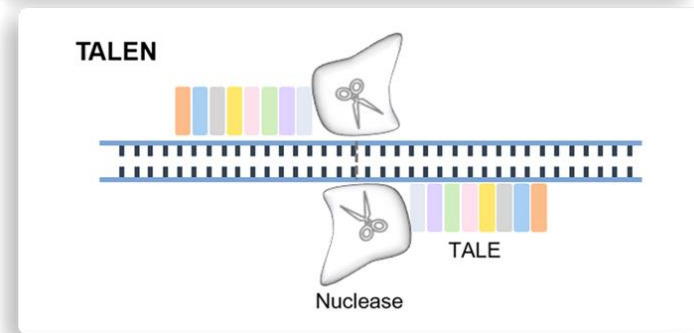
Quiz 2

Part 3: CRISPR-Cas Genome Editing Tool

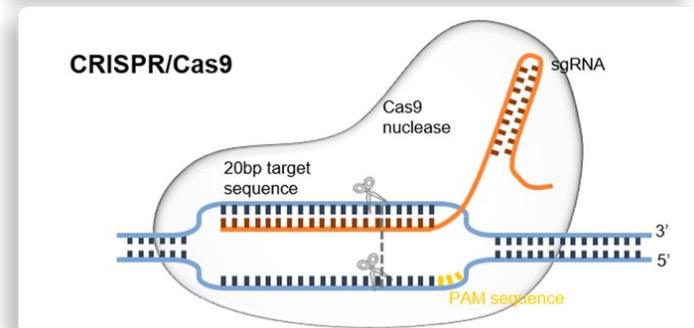
DNA “Molecular Scissors”



Zinc Finger Nuclease (ZFN)



**Transcription Activator-Like
Effector Nuclease
(TALEN)**



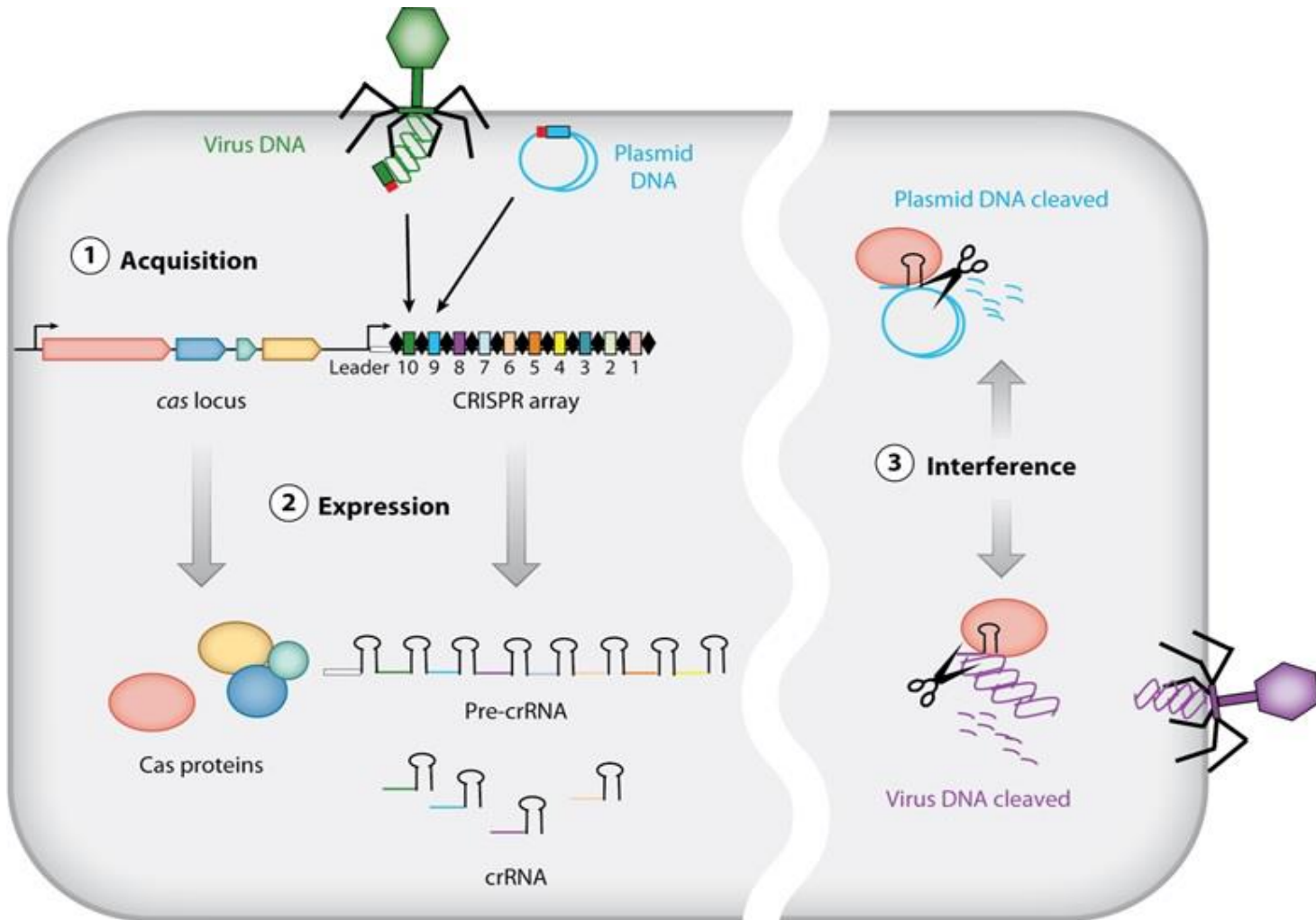
**Clustered Regularly Interspaced
Short Palindromic Repeats
(CRISPR)**

DNA-binding protein modules

DNA-binding RNA
(complementary base-pairing)

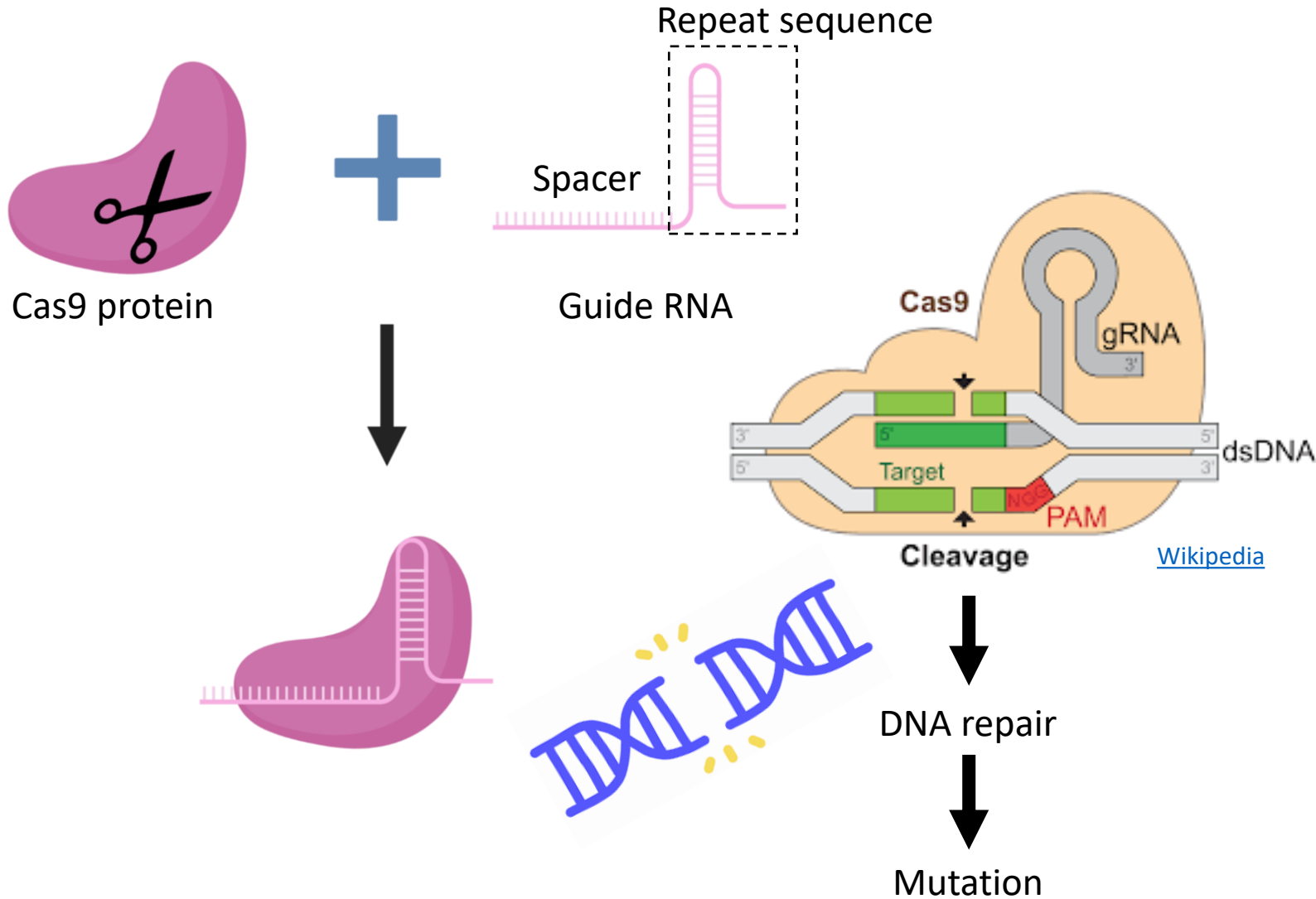
2012

CRISPR-Cas9



- Adaptive immunity in bacteria
- Discovered as early as 1993
- 2 crucial components:
 - Cas locus
 - CRISPR array

CRISPR-Cas9 as a Genome Editing Tool



Jennifer Doudna & Emmanuel Charpentier



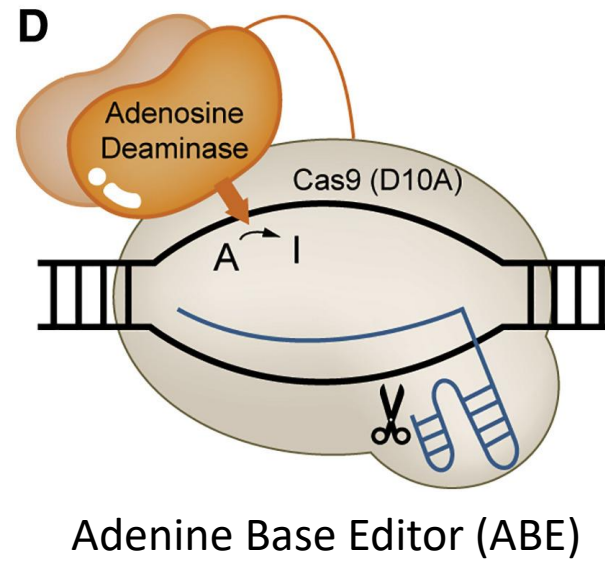
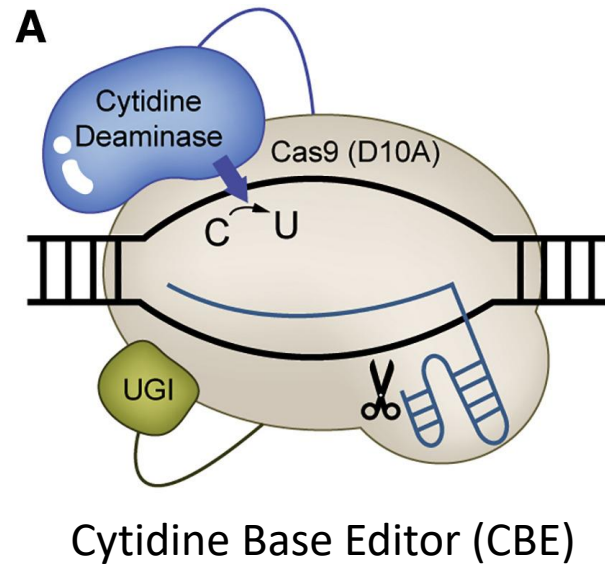
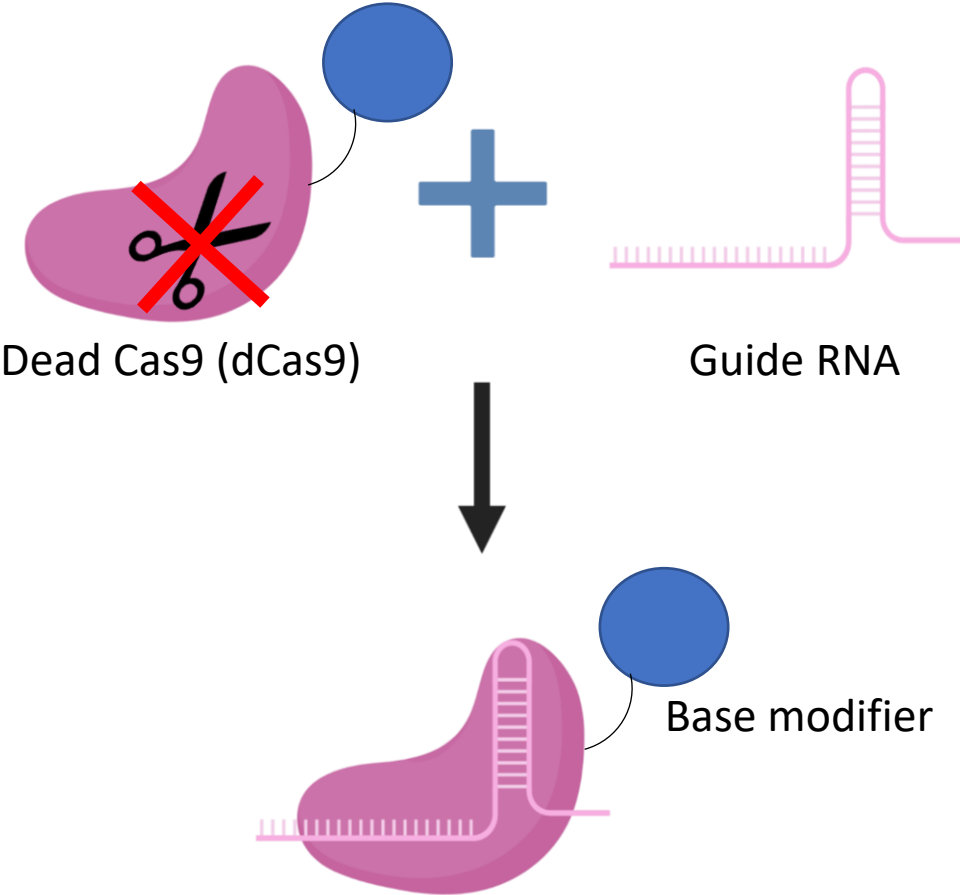
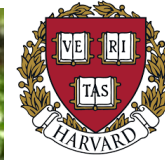
[Nature](#)

Nobel Prize in Chemistry 2020

DNA Base Editor



Alexis Komor



Targeted, specific base editing

Quiz 3

Part 4: Ethics and Safety of CRISPR-Cas

Health VS Aesthetic



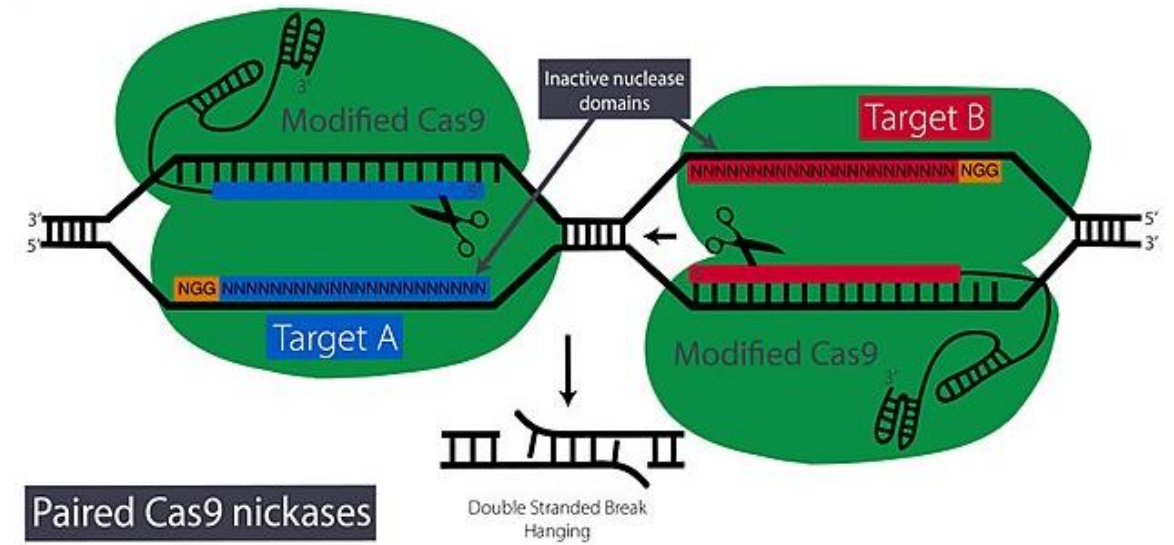
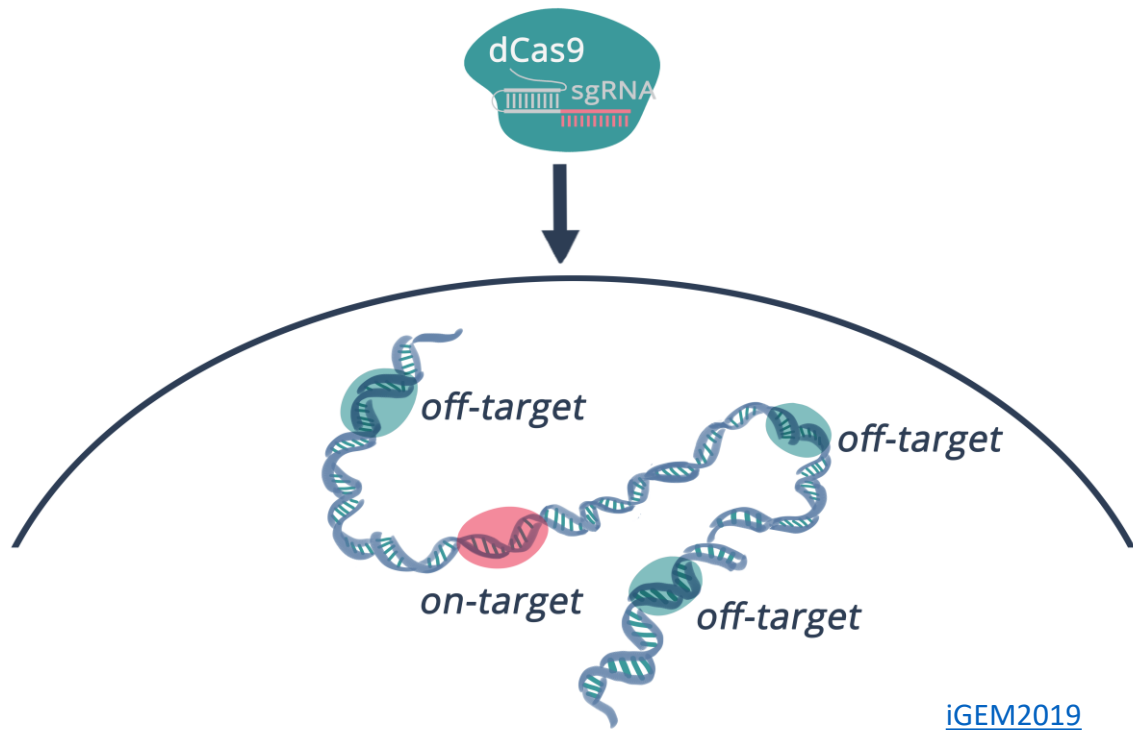
Health Improvement

VS



Aesthetic Enhancement

Safety concerns

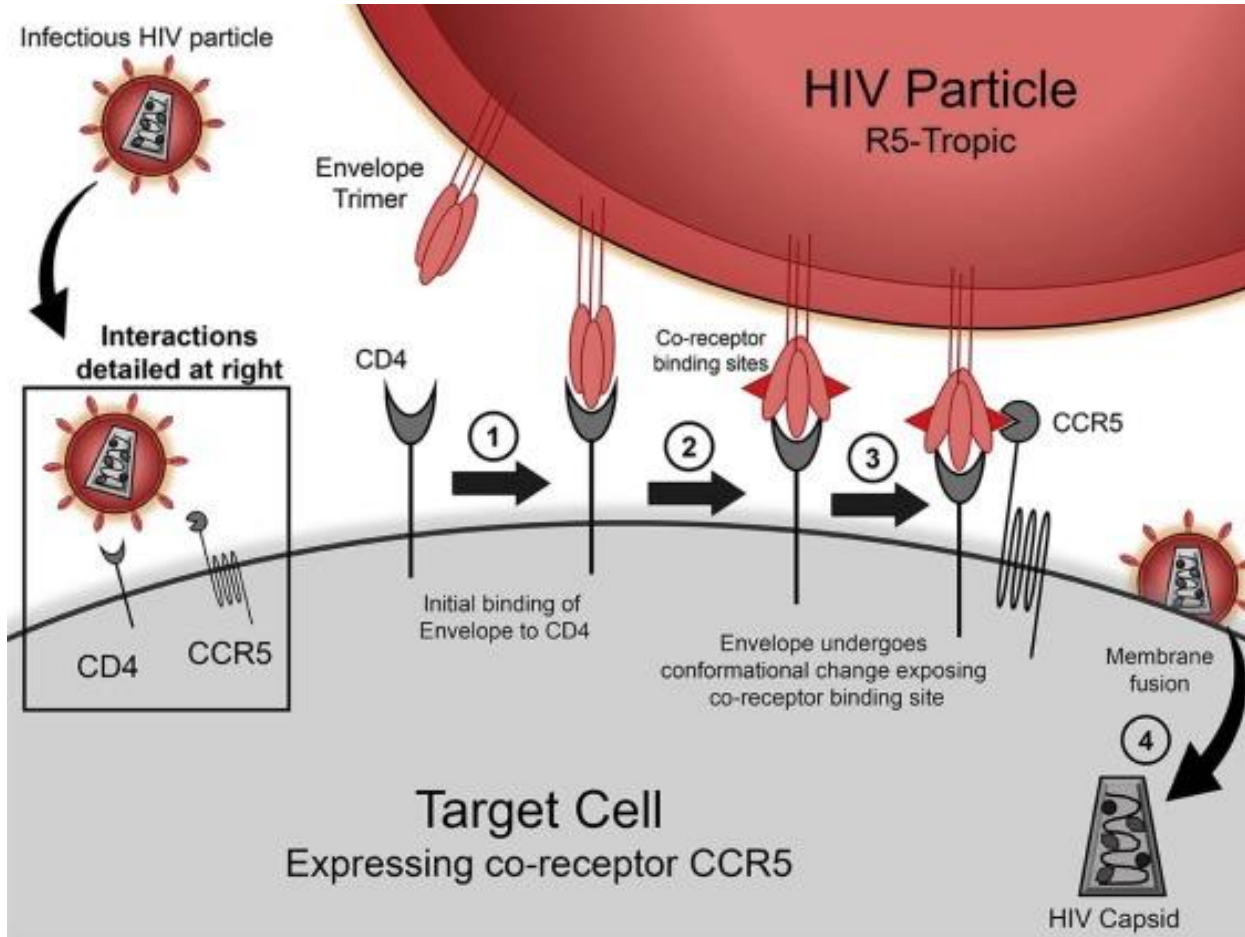


Off-target effects

Delivery of genome editing tools

Genome editing in germline

World's first gene-edited babies – Lulu & Nana



He Jiankui

[Wikipedia](#)

Disrupt *CCR5* gene to confer innate resistance to HIV infection

Summary Video



Potential of CRISPR in Genetic Engineering

