INTRODUCTION TO BIOLOGY

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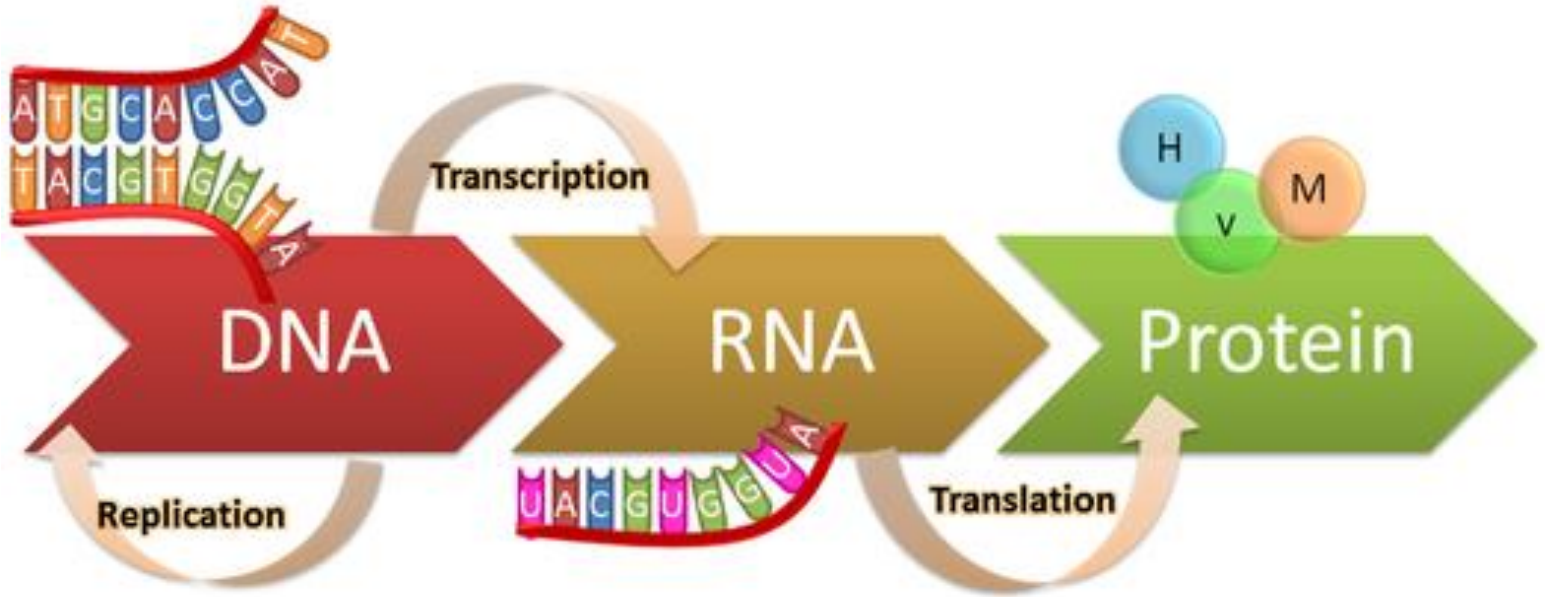
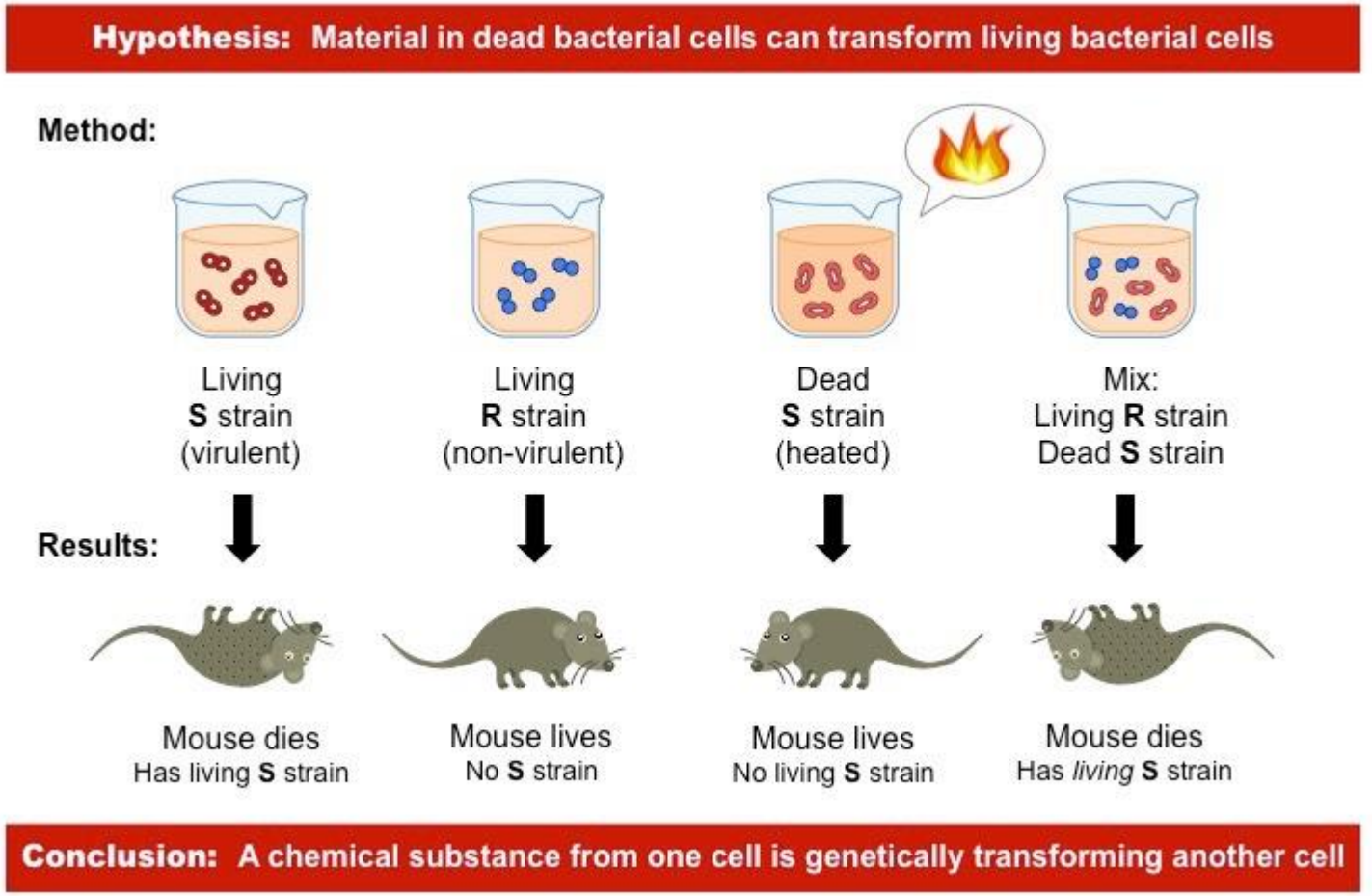
CENTRAL DOGMA OF LIFE

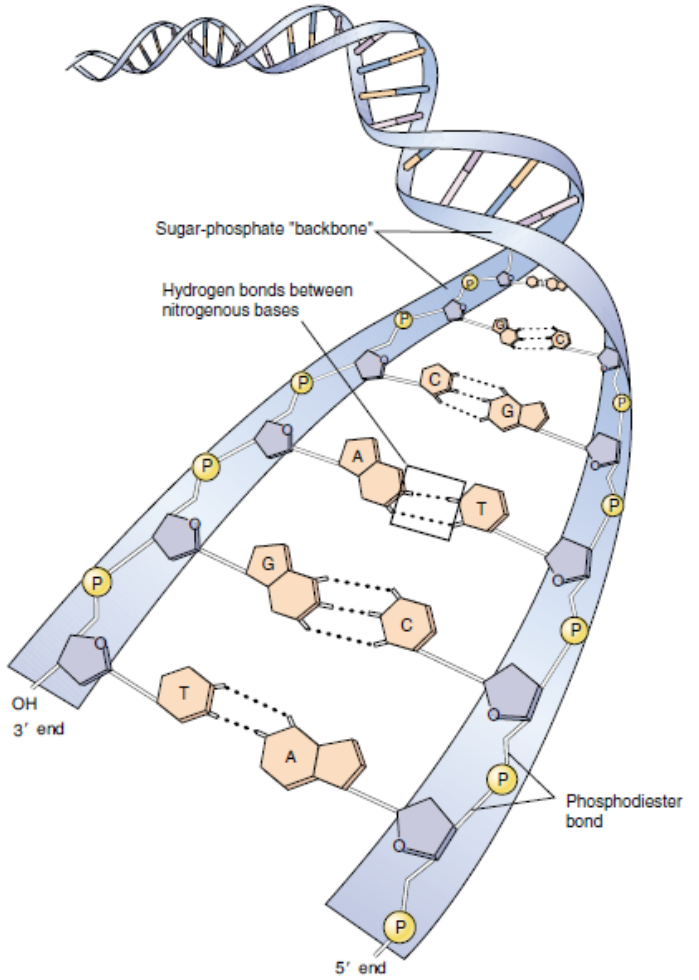


GRIFFITH'S EXPERIMENT

1928
-Frederick Griffith

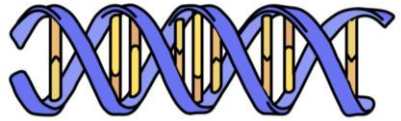


DNA- INFORMATION MOLECULE

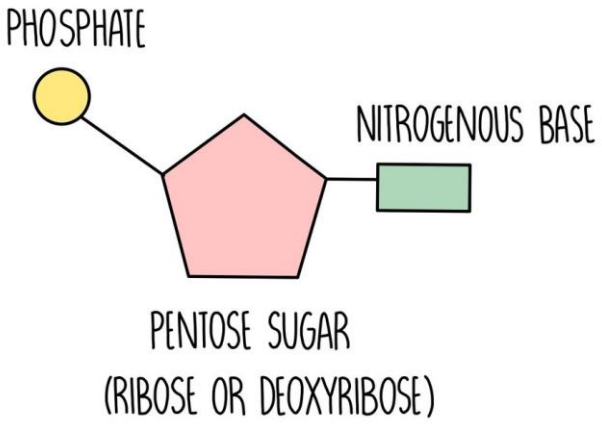


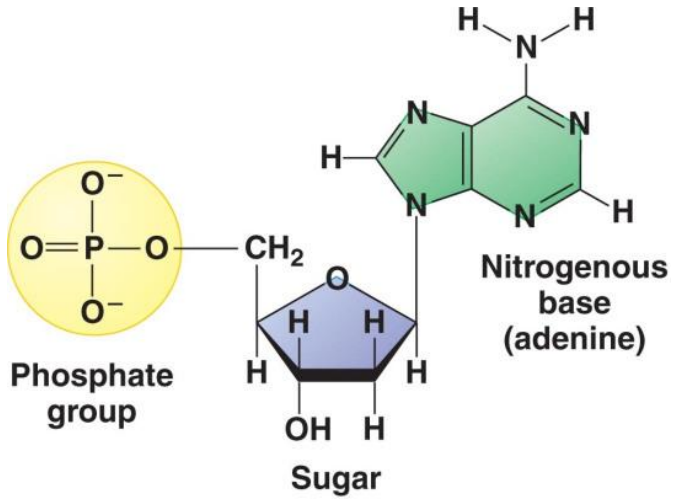
NUCLEIC ACIDS

- Composed of elements C, H, O, N, P
- Deoxyribonucleic Acid → Codes for protein/ RNA sequence

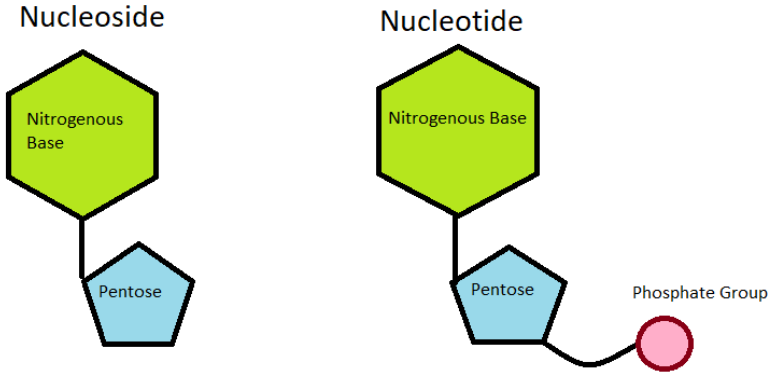


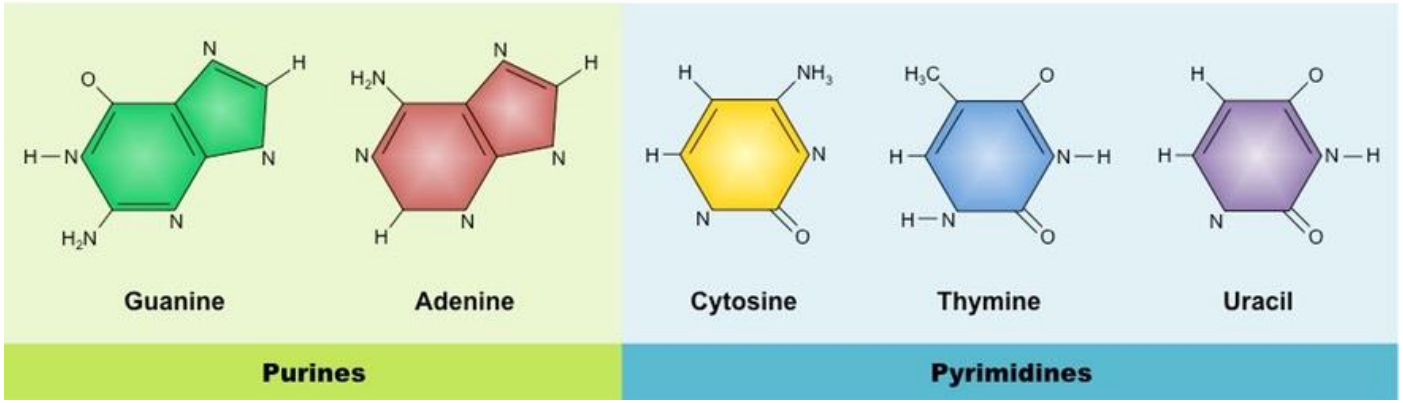
- Ribonucleic Acid → Reads DNA-coded information to direct protein synthesis

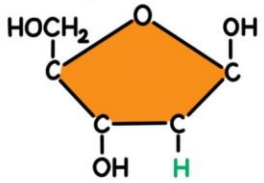
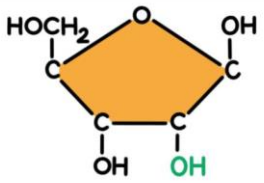




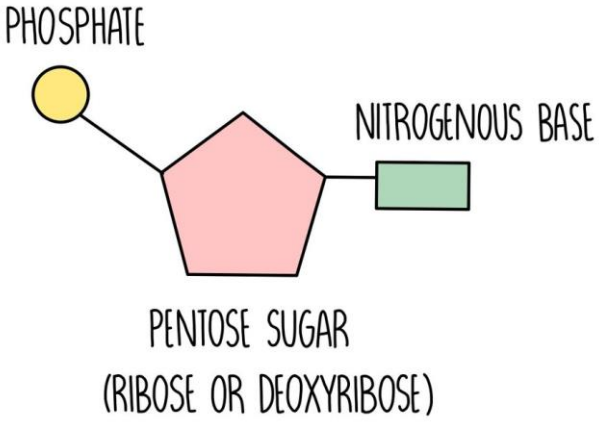
COMPONENTS OF NUCLEOSIDES

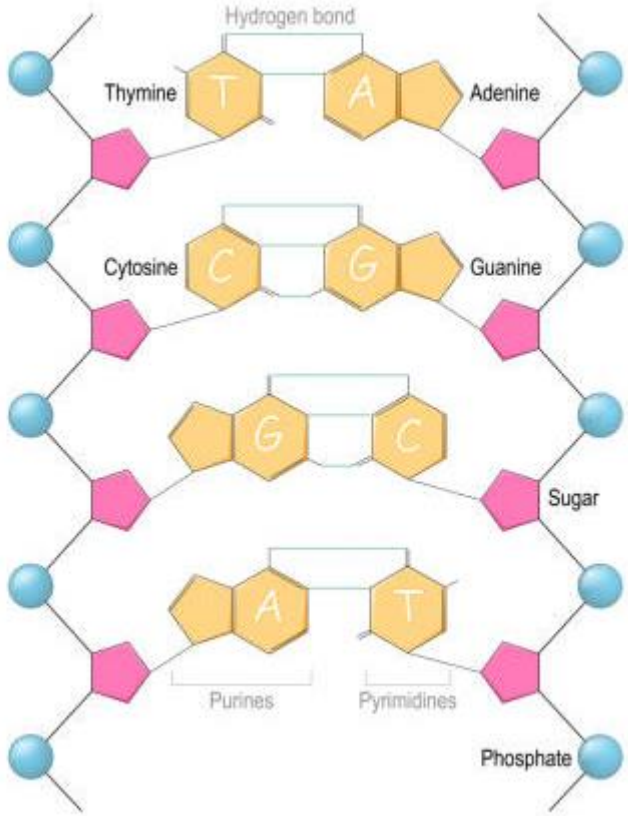




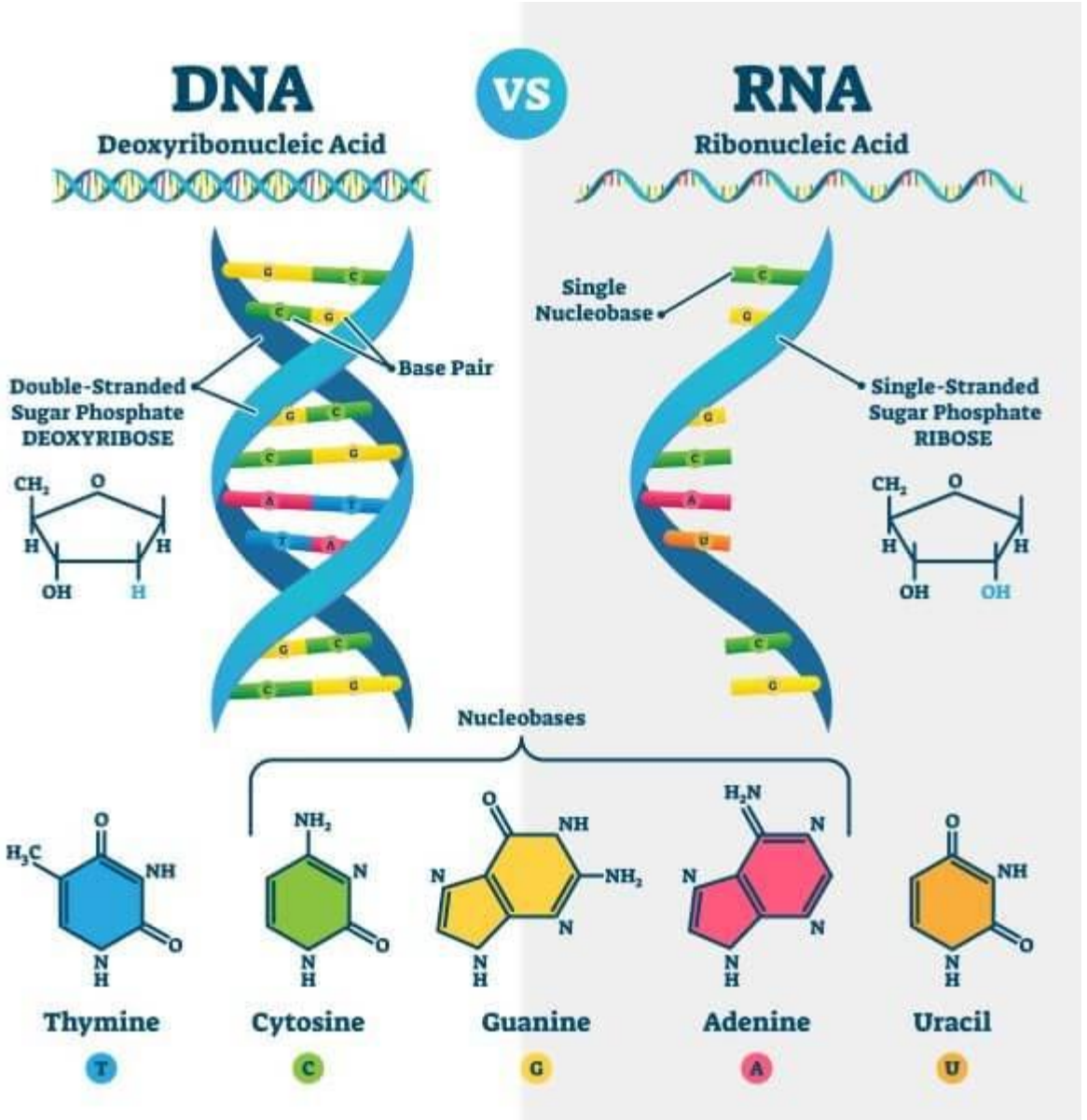
	DNA	RNA
SUGAR	 DEOXYRIBOSE	 RIBOSE

DNA IS A REPEAT OF NUCLEOTIDES

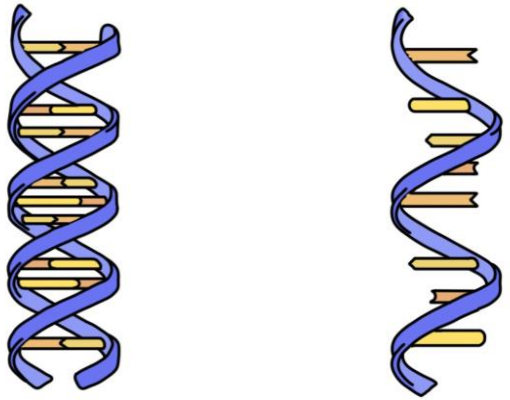


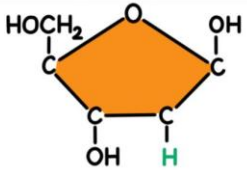
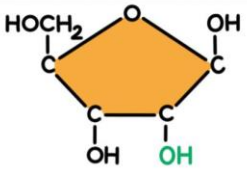
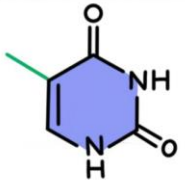
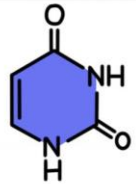


DNA VS RNA

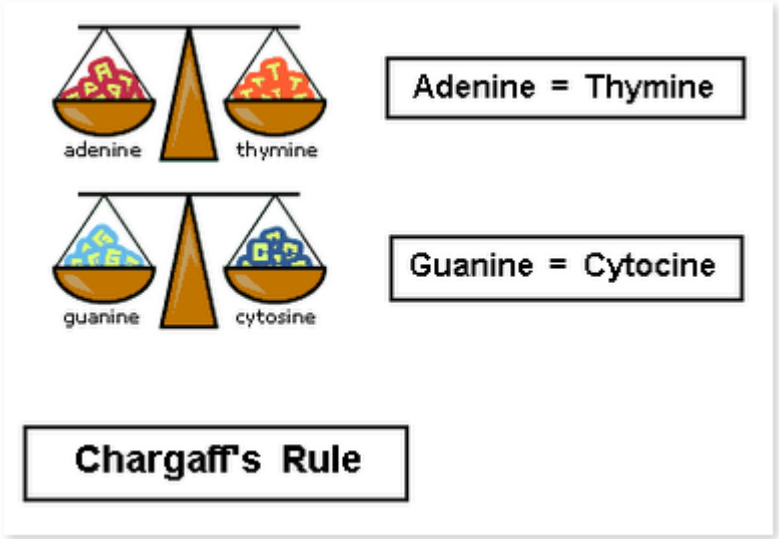

DNA
VS
RNA
Deoxyribonucleic Acid
Ribonucleic Acid
Single Nucleobase
Base Pair
Double-Stranded Sugar Phosphate DEOXYRIBOSE
Single-Stranded Sugar Phosphate RIBOSE
Nucleobases
Thymine
Cytosine
Guanine
Adenine
Uracil
T
C
G
A
U

DNA VS RNA



	DNA	RNA
SUGAR	 DEOXYRIBOSE	 RIBOSE
BASE	 THYMINE	 URACIL

CHARGAFF'S RULE



- The amount of Adenine = the amount of Thymine.
- The amount of Guanine = the amount of Cytosine.
- He failed to make a connection to the structure of DNA.
- Indicated that DNA is symmetrical.

In other words- A/T=1; G/C=1
Also, Purines = Pyrimidines (A+G= C+T)

Avg. Molecular Weight of 1 base pair (bp) = 650

Q. What is the MW of duplex DNA needed to code a protein of 200 amino acids?

Q. What is the MW of the gene needed to code a protein of 200 amino acids?

Answer: Each amino acid is coded by 3 DNA molecules

So, 3X200 = 600 base pairs (bp)

Now MW for each bp = 650

Therefore, MW of DNA = 650X600 = 390,000

Dr. Hargobind Khorana

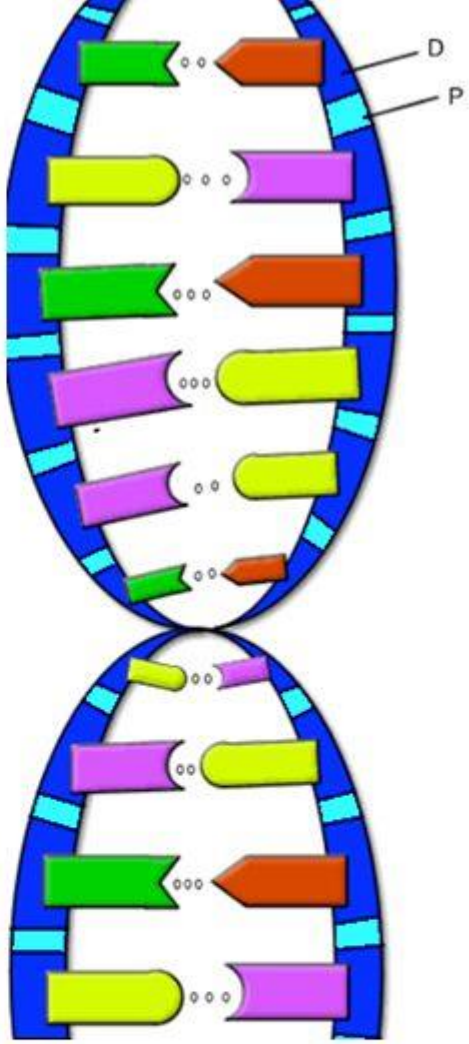
Second Letter

1st letter	U	C	A	G	3rd letter
U	UUU Phe UUC UUA Leu UUG	UCU UCC Ser UCA UCG	UAU Tyr UAC UAA Stop UAG Stop	UGU Cys UGC UGA Stop UGG Trp	U C A G
C	CUU CUC Leu CUA CUG	CCU CCC Pro CCA CCG	CAU His CAC CAA Gln CAG	CGU CGC Arg CGA CGG	U C A G
A	AUU AUC Ile AUA AUG Met	ACU ACC Thr ACA ACG	AAU Asn AAC AAA Lys AAG	AGU Ser AGC AGA Arg AGG	U C A G
G	GUU GUC Val GUA GUG	GCU GCC Ala GCA GCG	GAU Asp GAC GAA Glu GAG	GGU GGC Gly GGA GGG	U C A G

Amino Acid Codons

What is DNA?

- deoxyribonucleic acid
- hereditary material
- Nearly every cell in a person's body has the same DNA.
- Most DNA is located in the cell nucleus, but a small amount of DNA can also be found in the mitochondria.

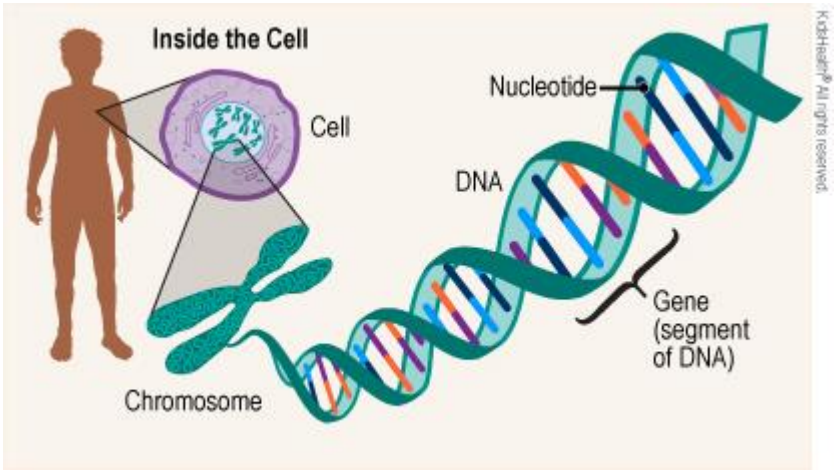


Thymine
Adenine
Guanine
Cytosine

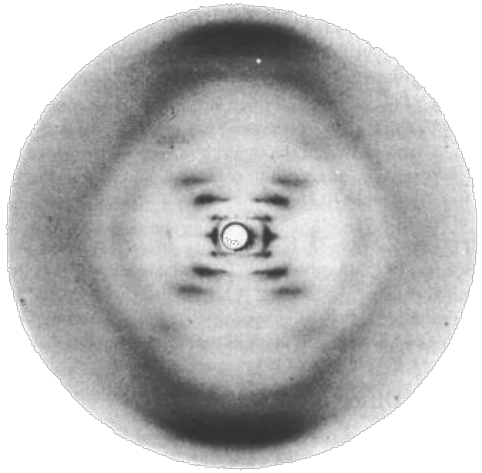
D = Deoxyribose (sugar)

P = Phosphate

Hydrogen Bond



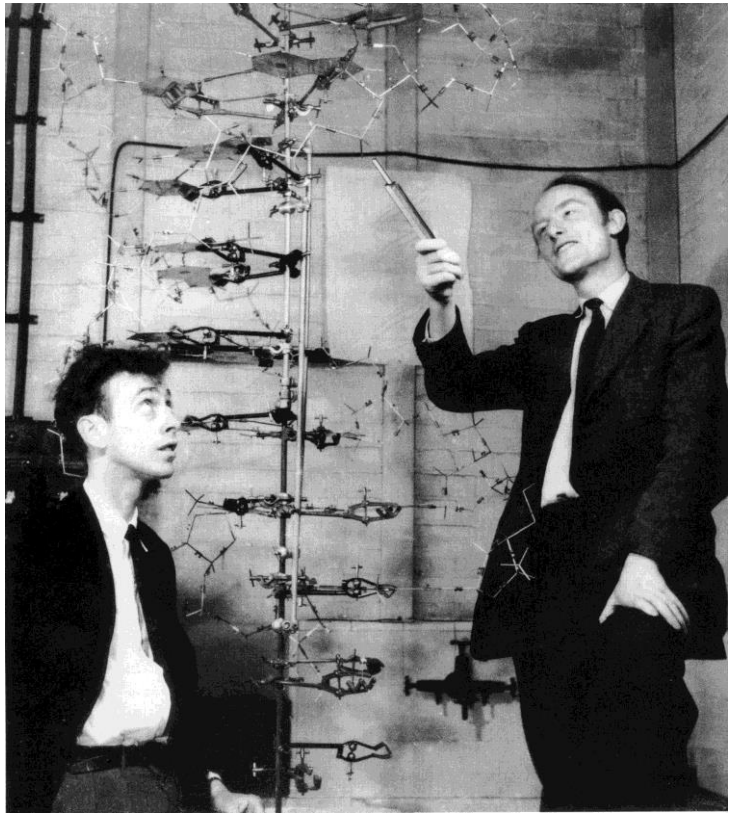
EARLY BREAKTHROUGH DISCOVERIES

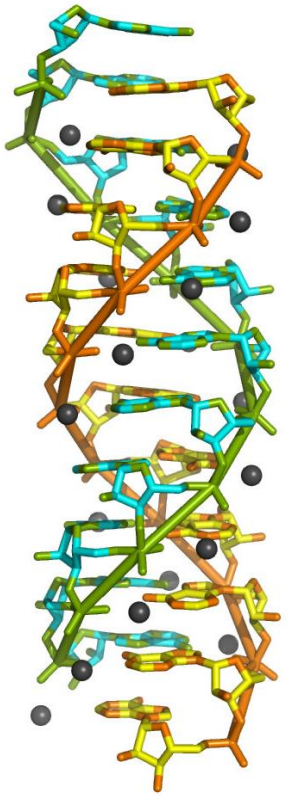


1. Erwin Chargaff (1951):
   - Rule of Base pairing

2. Rosalind Franklin & Maurice Wilkins (1953):
   - X-ray diffraction pattern of DNA

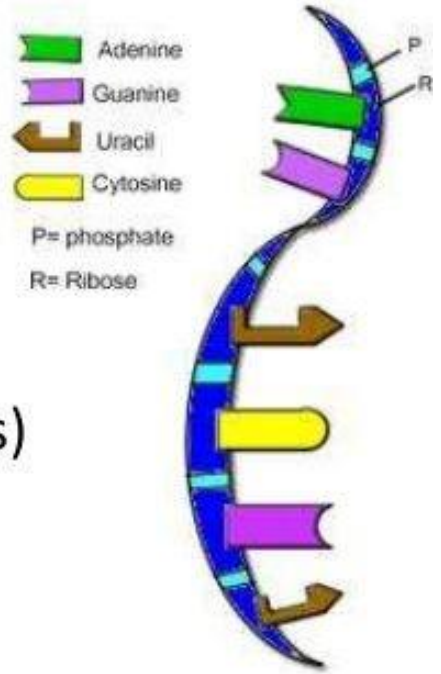
3. James Watson & Francis Crick (1953):
   - Molecular structure of DNA





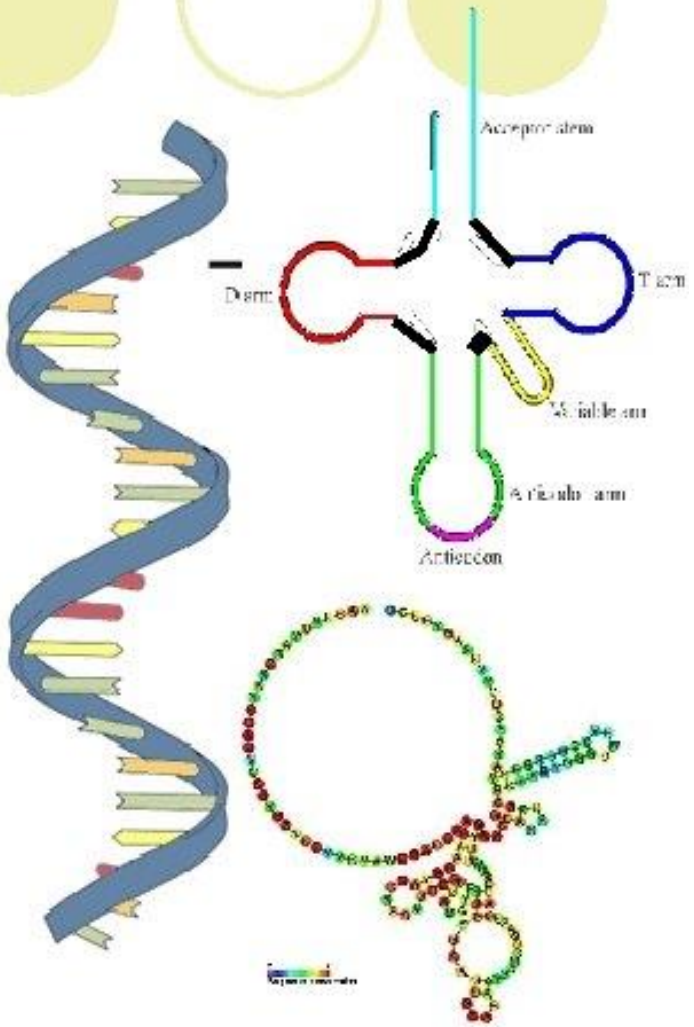
What is RNA?

- "Ribonucleic acid," a type of nucleic acid
- R = "ribose" (a type of sugar)
- Single stranded
- Can be found inside OR outside the nucleus
- Made of monomers (building blocks) called nucleotides. Each nucleotide has a sugar, phosphate, and nitrogenous base.

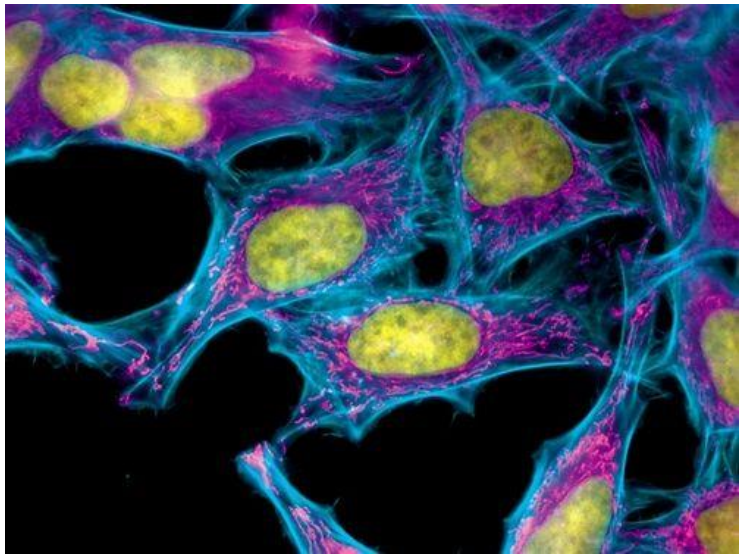


What is RNA?

- RNA is short for Ribonucleic Acid
- Very similar to DNA, except it is single-stranded and has the nitrogenous base uracil instead of thymine
- RNA is made from DNA, and has many functions, including helping to manufacture proteins
- Examples of RNA include tRNA, rRNA, and mRNA



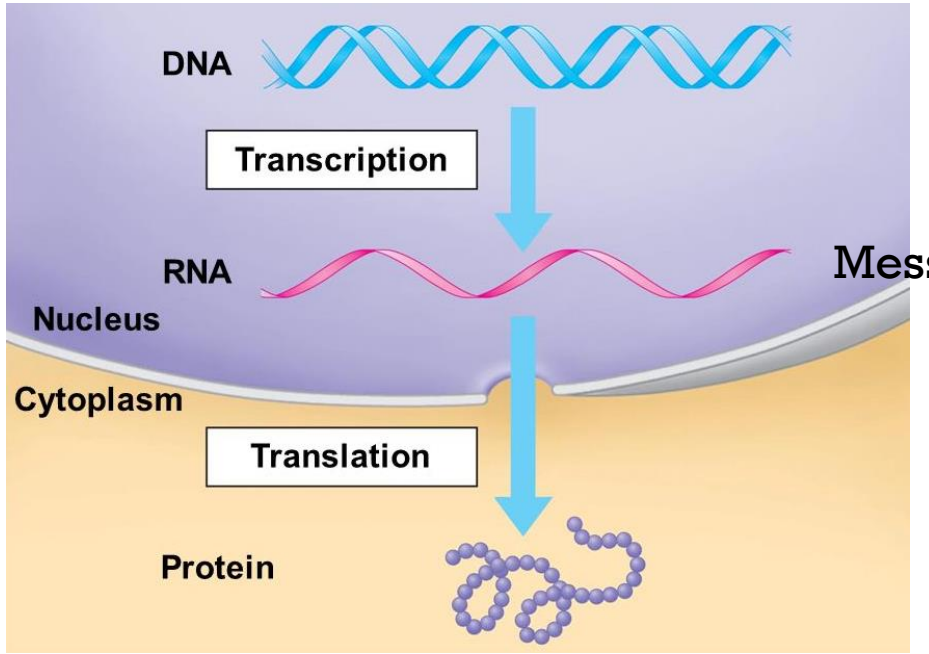
RIBONUCLEIC ACIDS (RNA)



- DNA never leaves nucleus. How does it pass information/ codes?

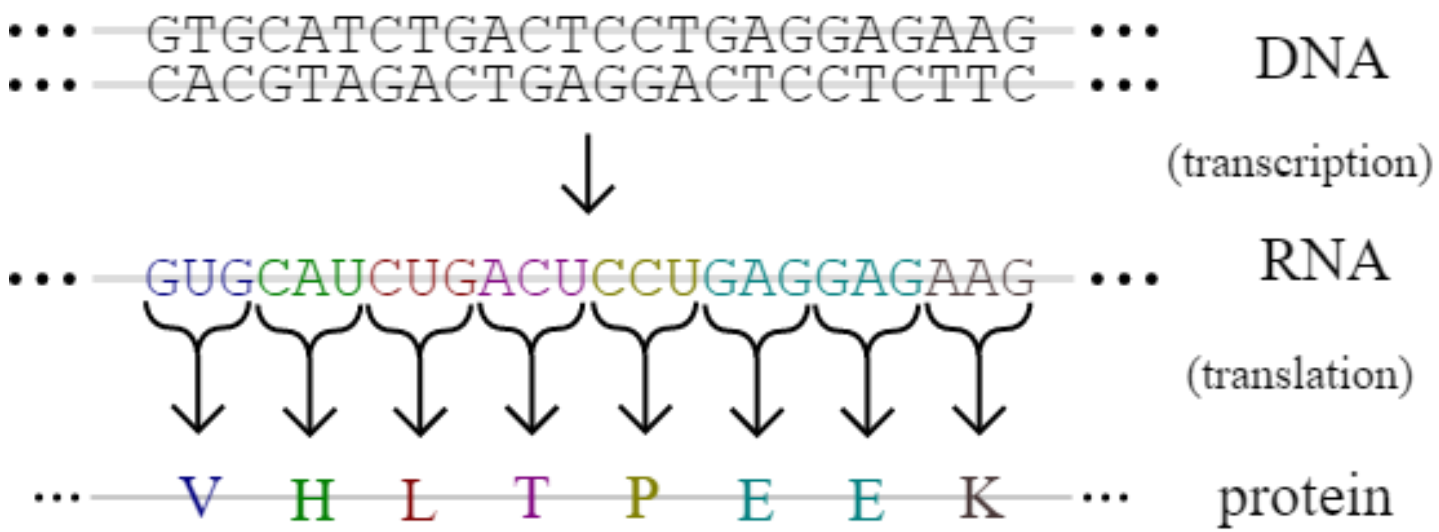
- RNA Roles:

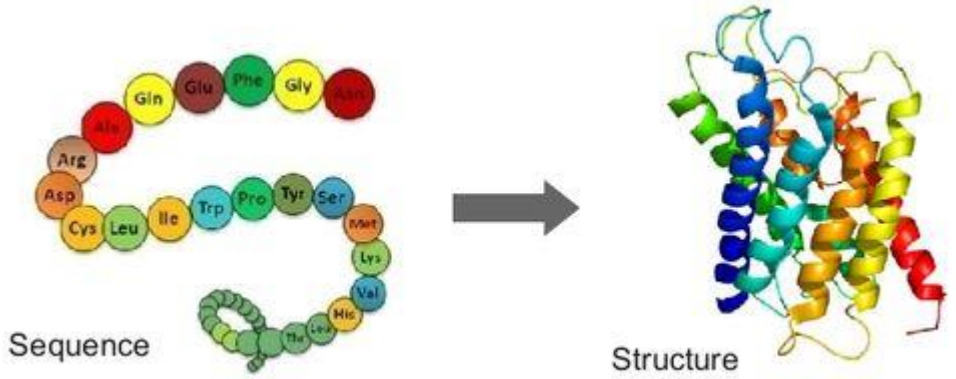
1. Genetic: Transfer of genetic info during protein synthesis
2. Non-genetic: Control of gene expression



Messenger RNA (mRNA)

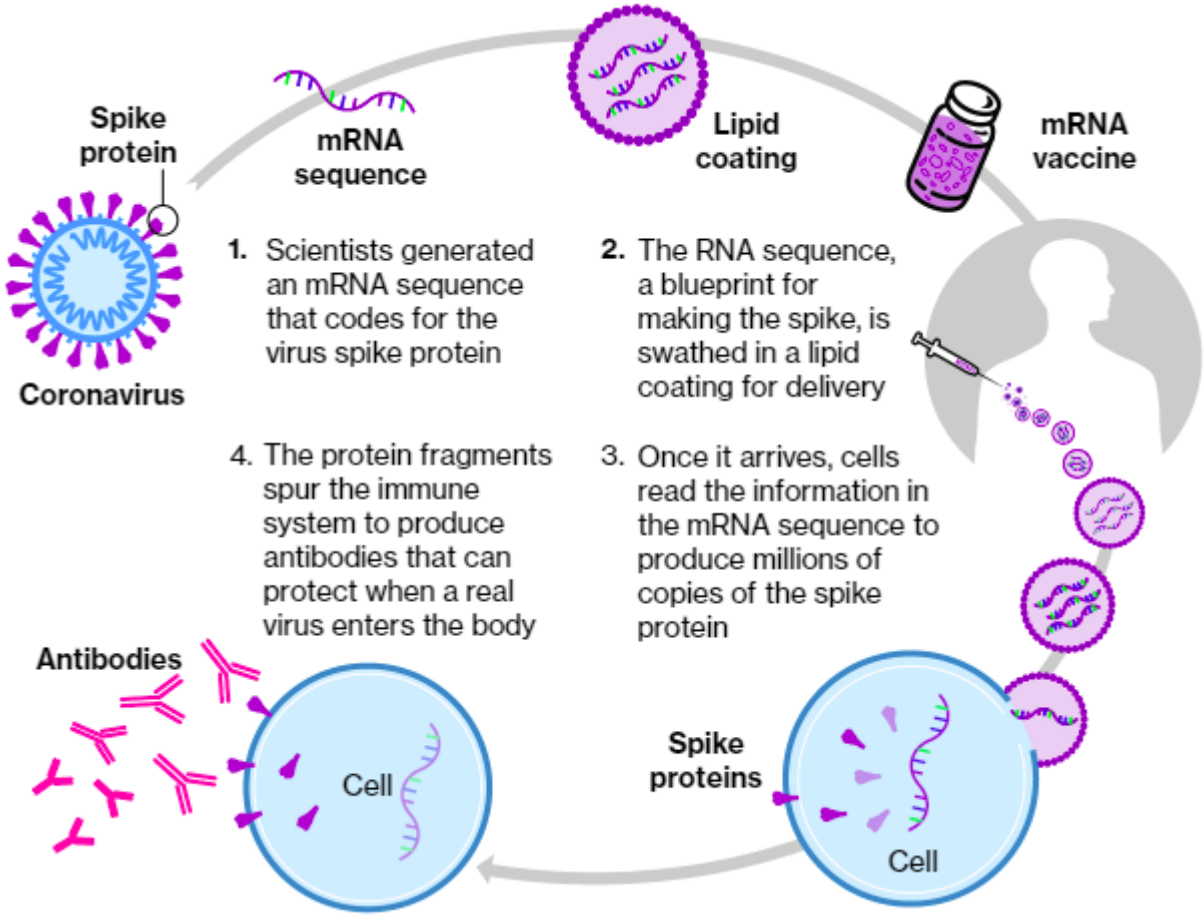
CENTRAL DOGMA





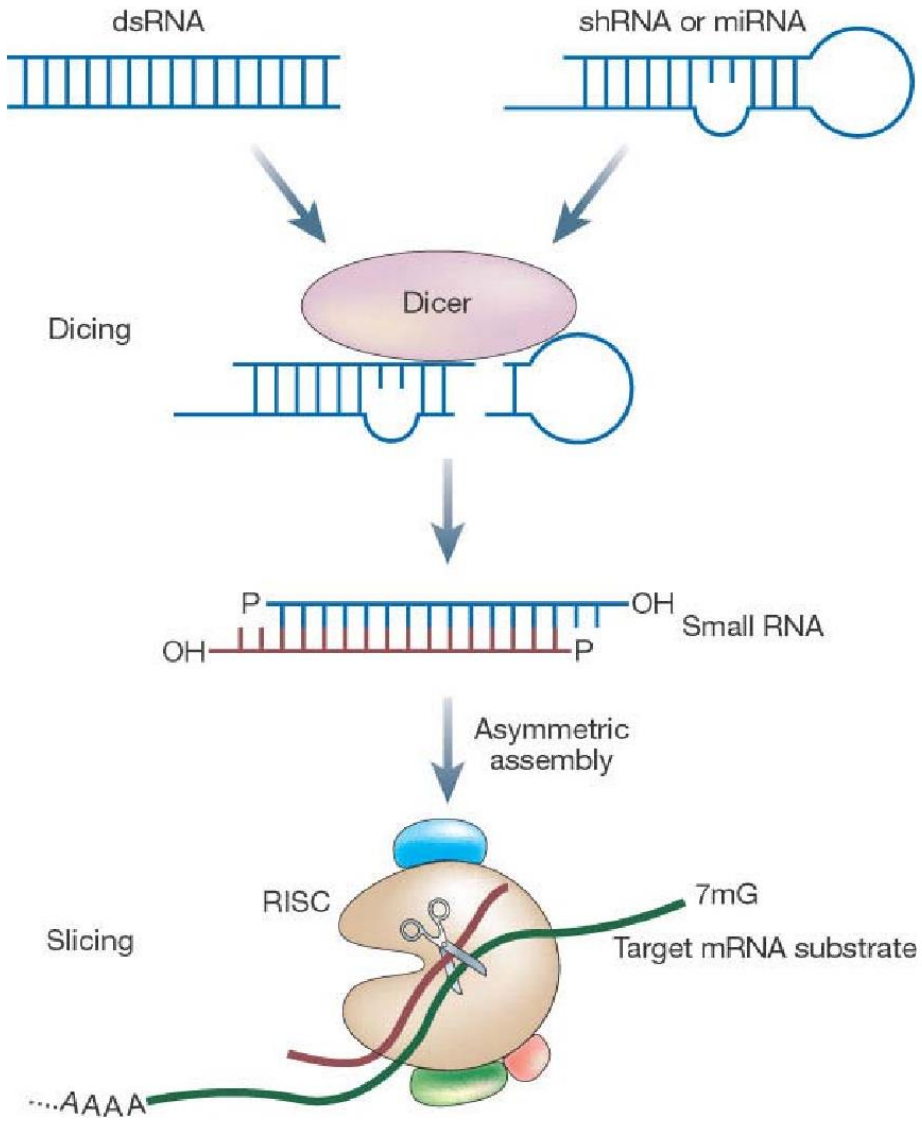
RNA: CONTROL OF GENE EXPRESSION

Pfizer Vaccine Based on mRNA



RNA: CONTROL OF GENE EXPRESSION

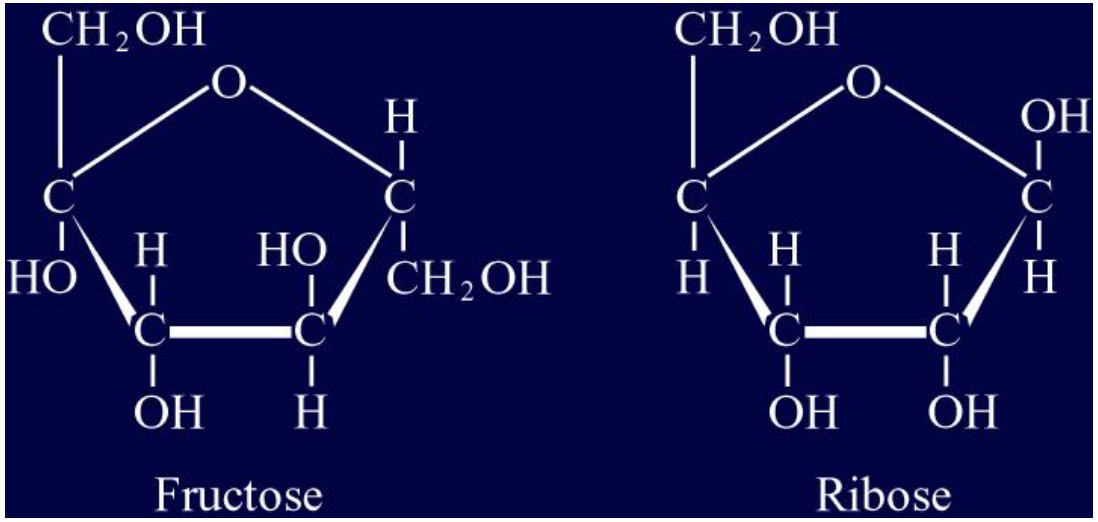
- Certain genes are over-expressed in disease conditions like cancer
- Small interfering RNA (siRNA), sometimes known as short interfering RNA or silencing RNA, is a class of double-stranded RNA non-coding RNA molecules, typically 20-27 base pairs in length. It interferes with the expression of specific genes with complementary nucleotide sequences by degrading mRNA after transcription, preventing translation.
- A microRNA (miRNA) is a small single-stranded non-coding RNA molecule (containing about 22 nucleotides) found in plants, animals and some viruses, that functions in RNA silencing and post-transcriptional regulation of gene expression.

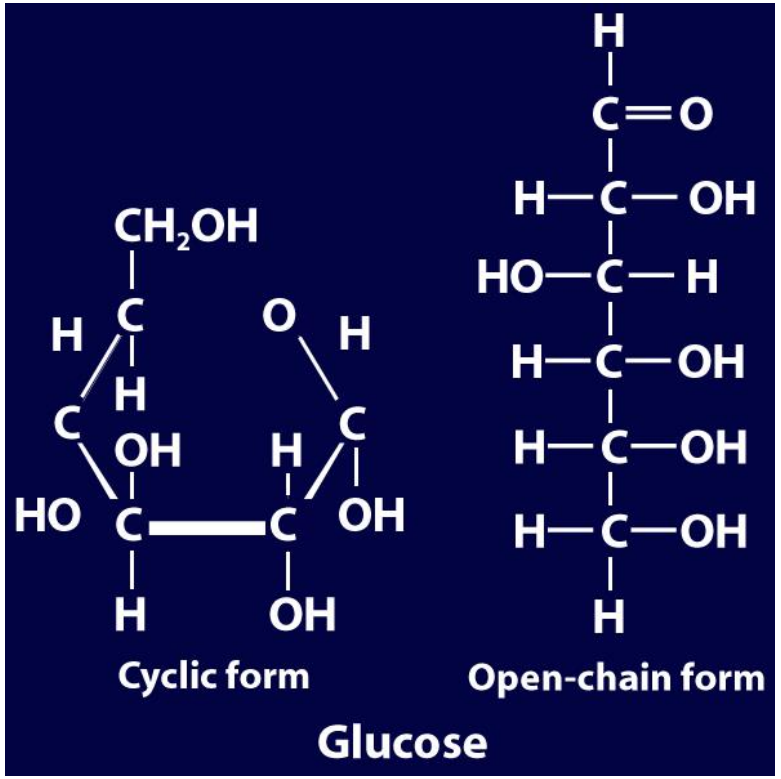


CARBOHYDRATES

- Hydrates of Carbon (H and O present in the same ratio as water)- $C_nH_{2n}O_n$ (Ratio 1:2:1)
- Examples- Sugar, Starch, Cellulose
- ❖ Monosaccharides (monomer)
- ❖ Oligosaccharides (2-10 monosaccharides)
- ❖ Polysaccharides (100-1000s of monosaccharides)

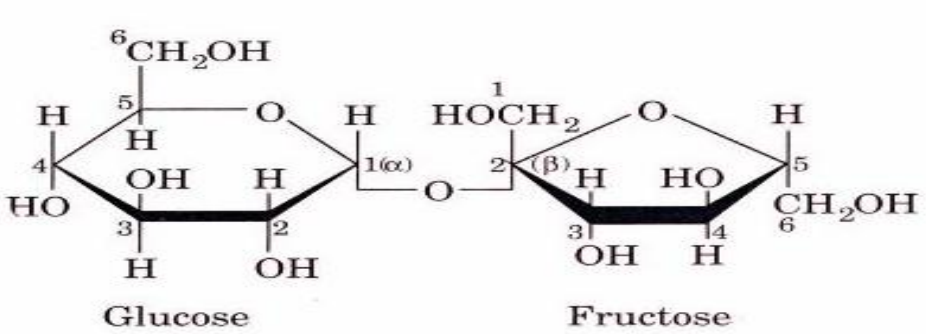
MONOSACHARRIDES



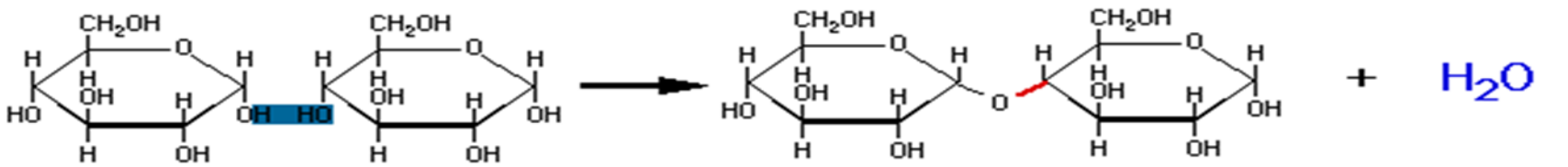


DISACCHARIDES

Sucrose:

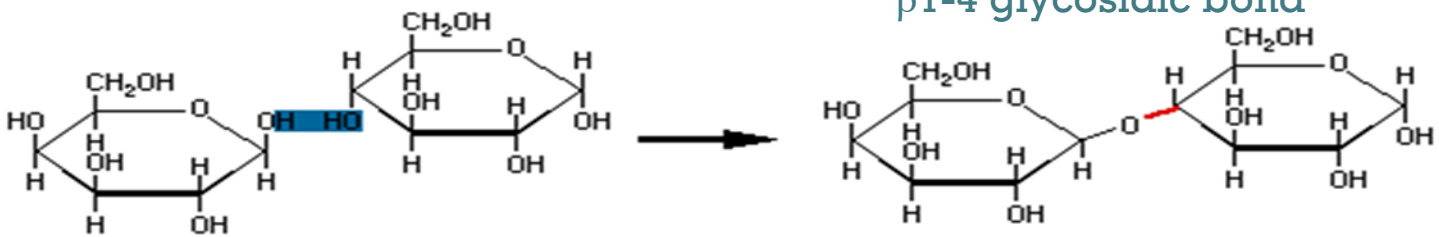


α1-4 glycosidic bond



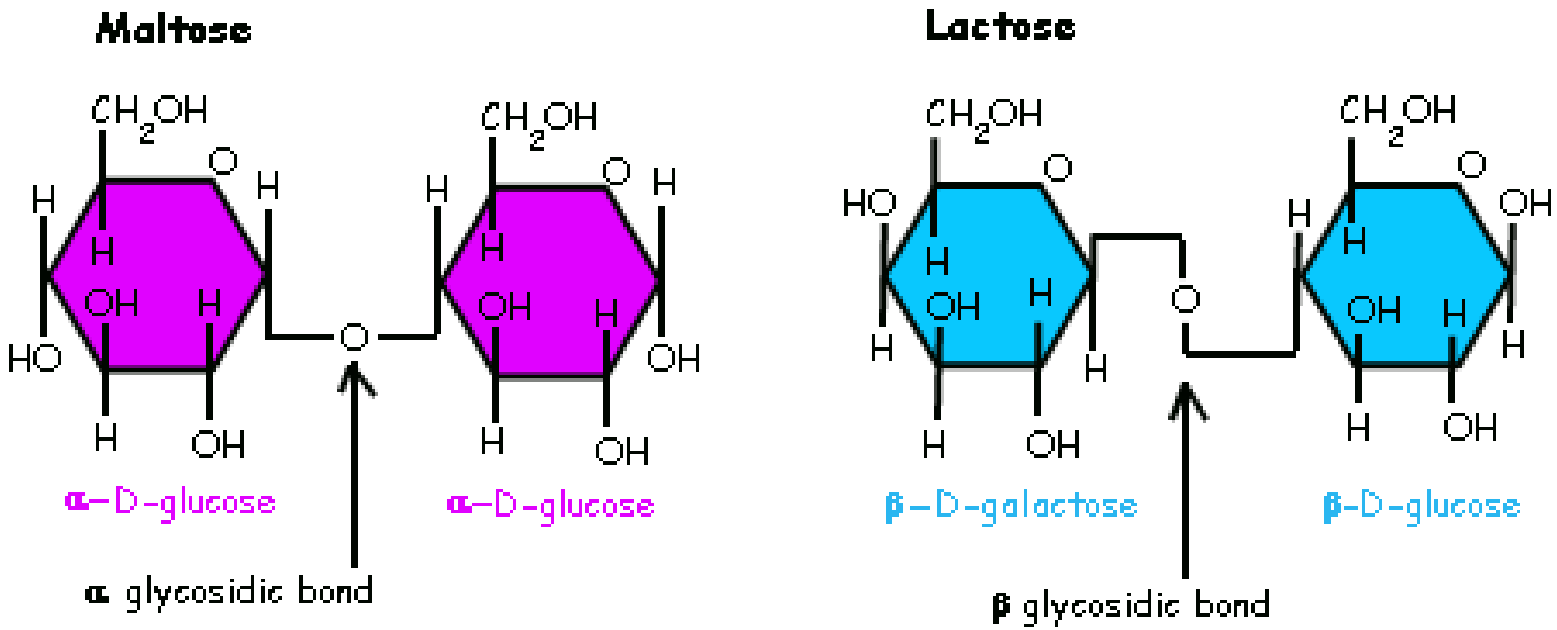
Glucose + Glucose = Maltose + Water + H_2O

β1-4 glycosidic bond



Galactose + Glucose = Lactose + Water + H_2O

GLYCOSIDIC LINKAGES



ISOMERS AND STEROISOMERS

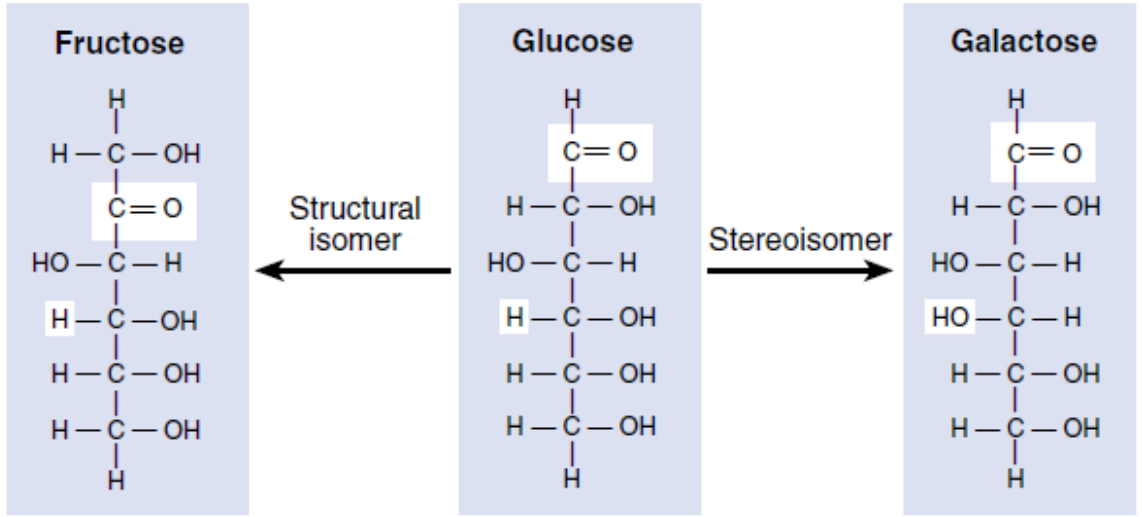


FIGURE 3.24
Isomers and stereoisomers. Glucose, fructose, and galactose are isomers with the empirical formula $C_6H_{12}O_6$. A structural isomer of glucose, such as fructose, has identical chemical groups bonded to different carbon atoms, while a stereoisomer of glucose, such as galactose, has identical chemical groups bonded to the same carbon atoms but in different orientations.

Sucrose

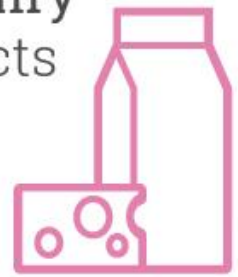
is often called **table sugar**. Made up from glucose and fructose, it is extracted from **sugar cane** or **sugar beet** and is naturally present in most **fruits** and **vegetables**

Glucose & Fructose

are found in **fruits**, **vegetables** and **honey**

Lactose

is commonly called milk sugar because it is found in **milk** and **dairy** products

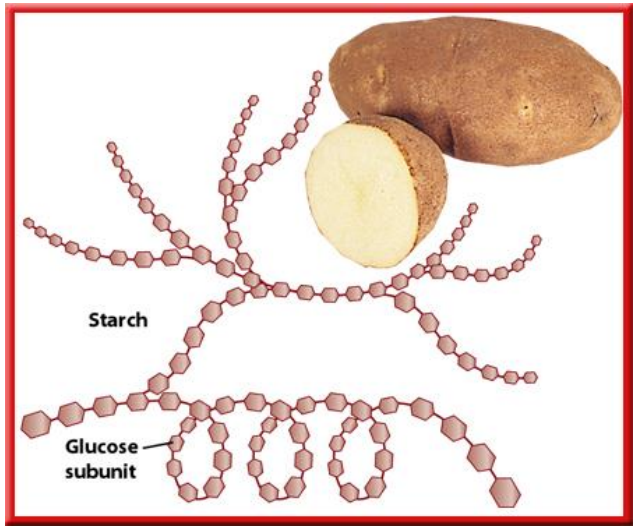


Maltose

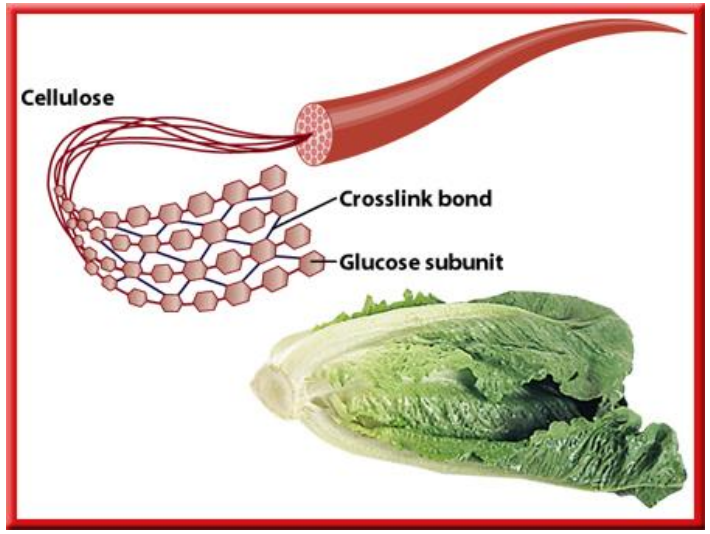
is also commonly known as malt sugar, found in **malted drinks** and **beer**

POLYSACCHARIDES: NON-SUGARS

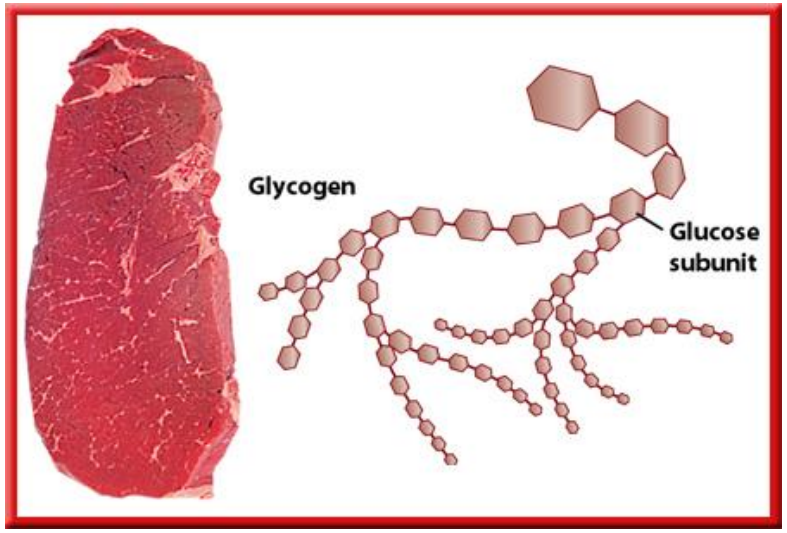
Starch- Simple polysaccharide with glucose repeats



Cellulose- Polysaccharide with glucose cross-links. Forms plant cell walls.

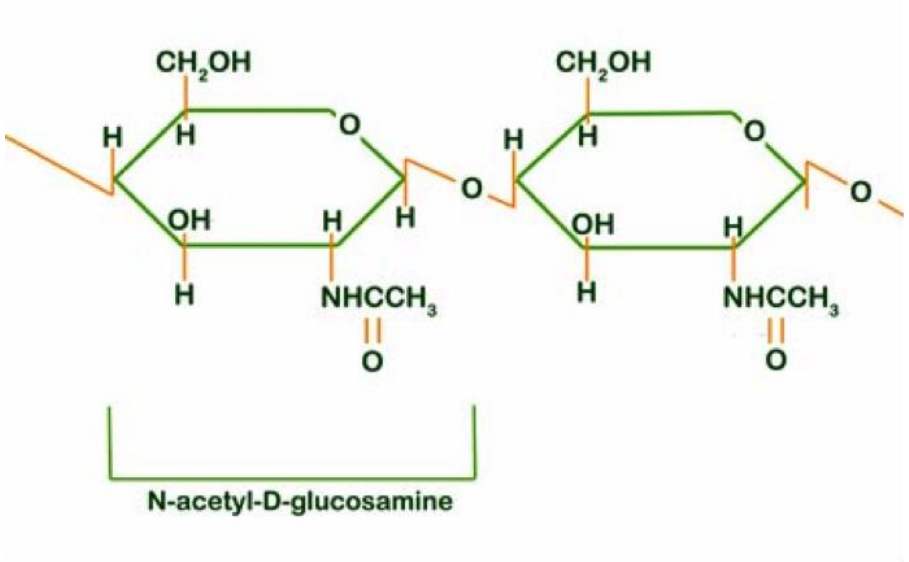


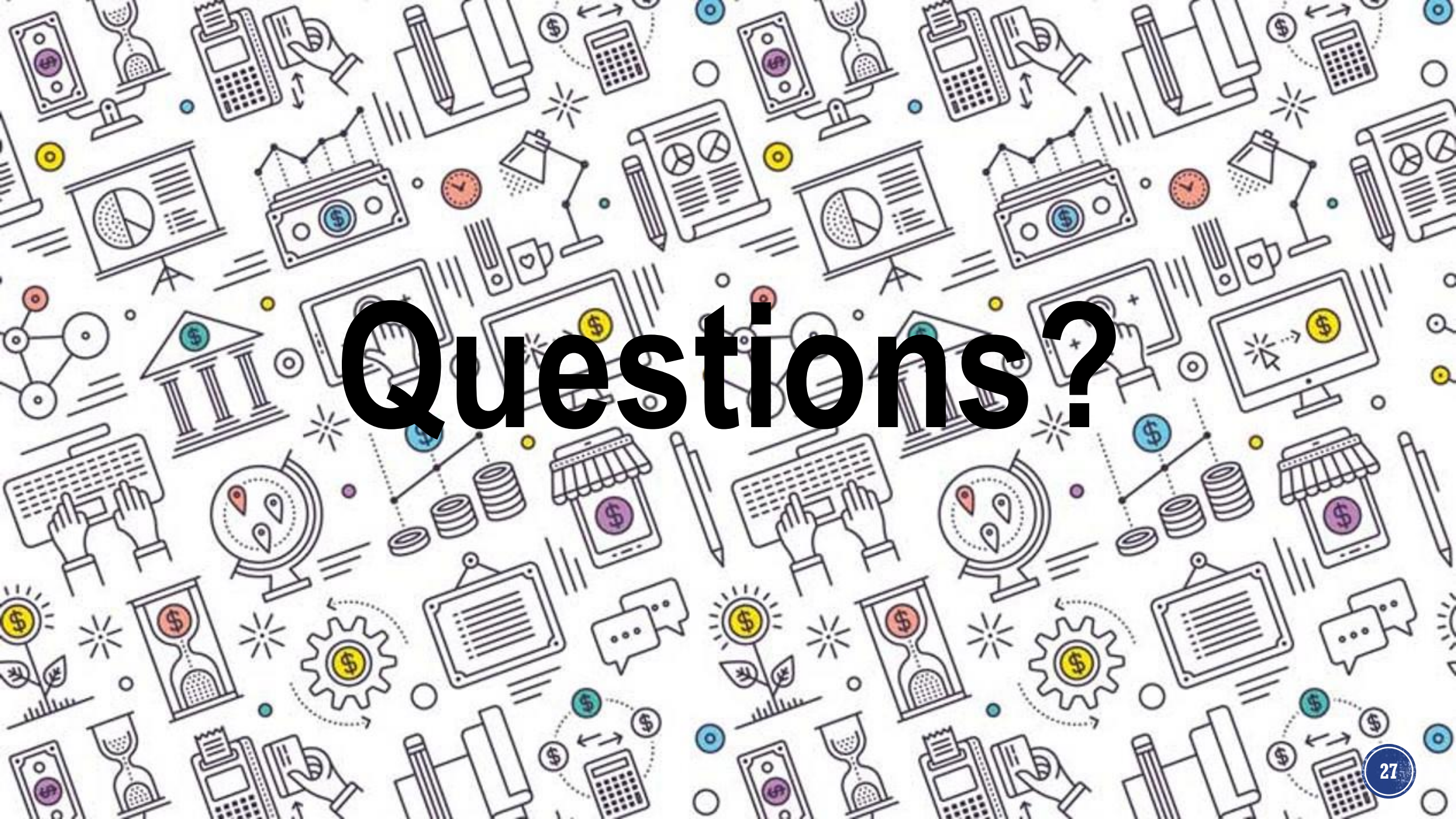
Animals store glucose as glycogen, similar to starch



STRUCTURAL COMPONENT

Chitin- Forms cell wall of fungi and exoskeleton of arthropods




Questions?