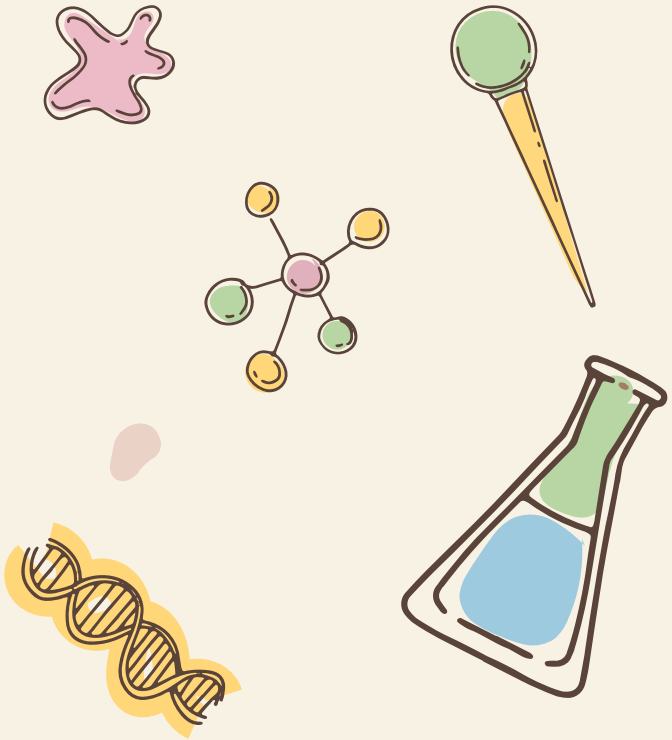
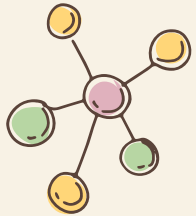
Biology - DNA, Amino Acids and Proteins

Science 10



Lesson Overview



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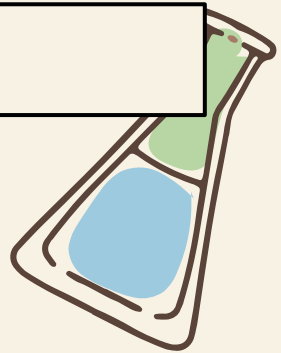
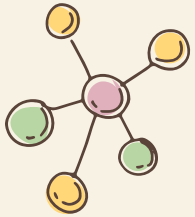
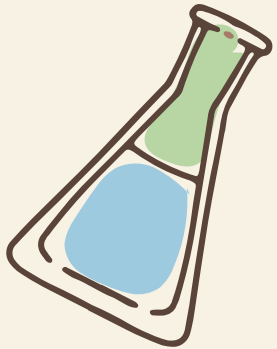




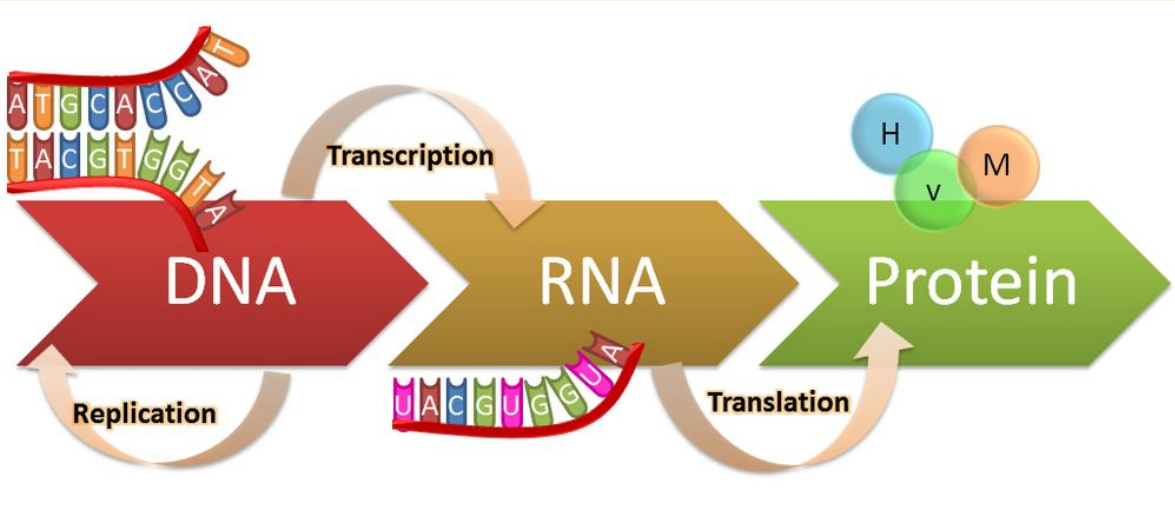
Warm Up Activity

Question: What is the difference or relationship between DNA, genes and proteins?



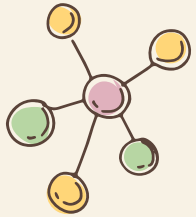
The Central Dogma

The central dogma of biology is a theory stating that genetic information flows only in **one direction**, from DNA, to RNA, to protein, or RNA directly to protein.



DNA **transcription** copies DNA in the form of RNA or mRNA (messenger). **Translation** is the process of taking RNA and turning it into **proteins**.

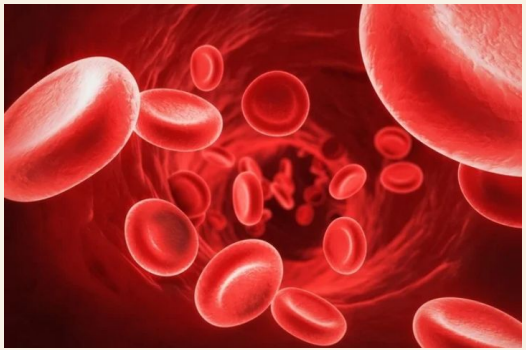
What Are Proteins



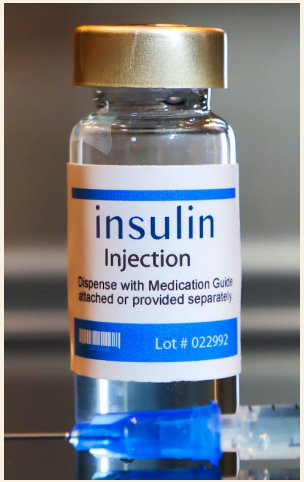
Question: With your partner discuss:

1. What are proteins?
2. What is a protein?
3. Do you encounter proteins in your daily life?

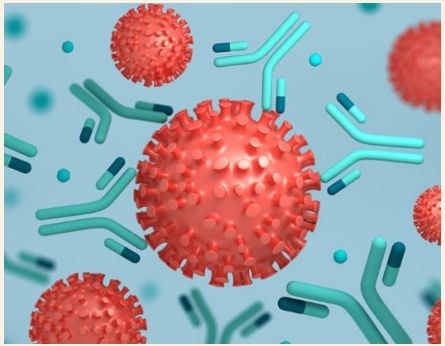
What Are Proteins



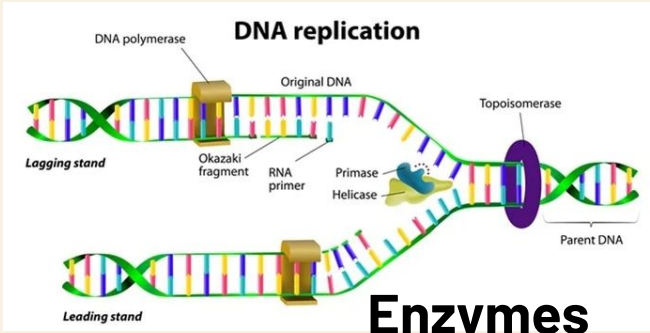
Hemoglobin



Insulin

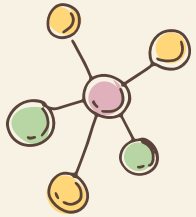


Antibodies



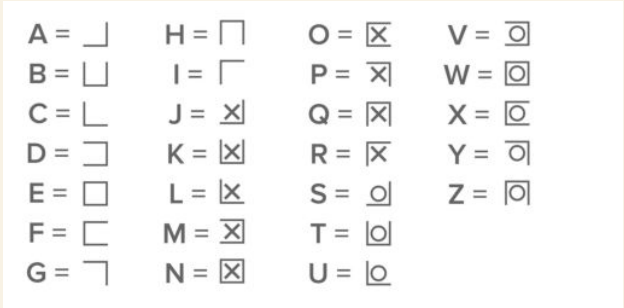
Enzymes

What Are Proteins



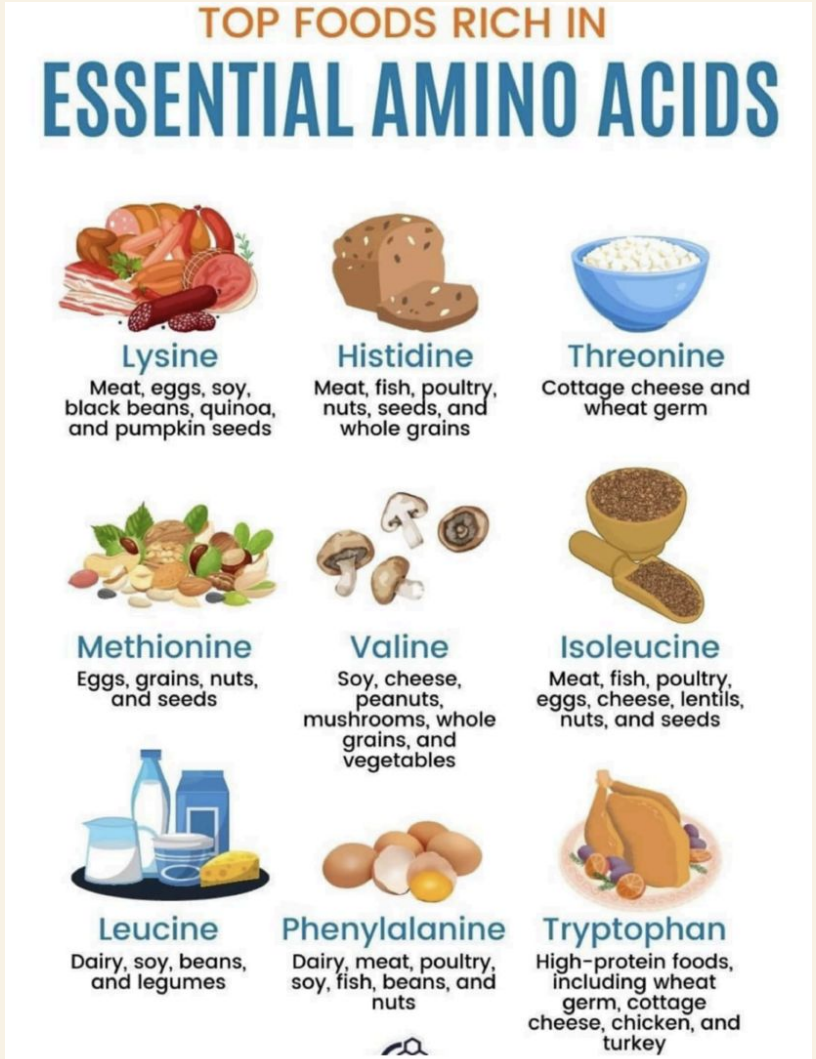
Proteins: Are molecules in all living things and responsible for nearly all aspects of normal biological function.

Amino Acids: Are the building blocks of proteins. Proteins in humans are made up from varying combinations of 20 amino acids, 9 of which are called essential amino acids because they cannot be made in our bodies and must be received through diet.

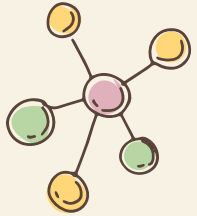


Question: What do you think are the dietary implications of the 9 essential amino acids?

Essential Amino Acids



Complexity of Proteins



Question: If there are only 20 amino acids, how can the human body make up more than 100,000 different proteins?

20^n different combinations.

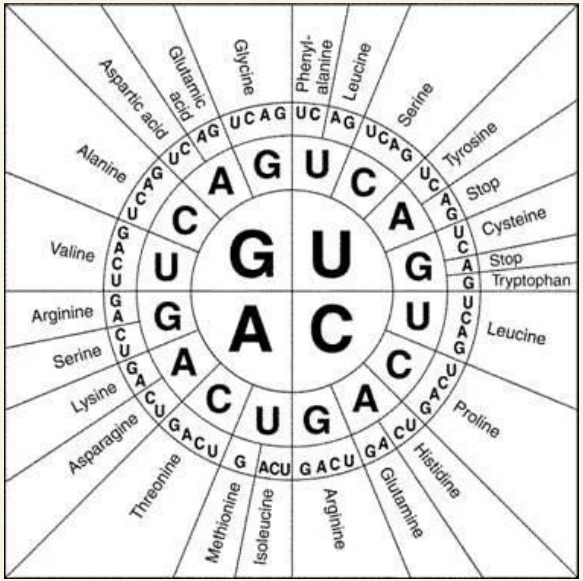
Amino acid length	Number of possible combinations
1	20
5	3,200,000
20	1.0×10^{26}
141 (hemoglobin)	2.8×10^{183}

How are Proteins Made?

- Following the central dogma we go from DNA -> RNA (ribonucleic acid) -> Protein.
- The **order** in which proteins are assembled from their amino acids is determined by the **order** of the bases found in the RNA that is created for the purpose of protein synthesis.

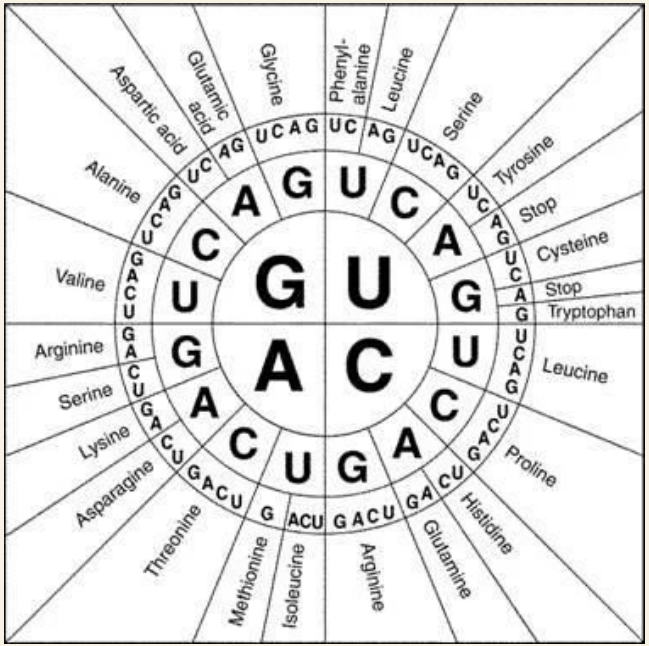
- RNA differs from DNA in that it is only a **single strand** and that Thymine (T) in DNA is replaced by **Uracil (U)** in RNA.

- This means that A pairs with U on RNA.



How are Proteins Made?

- We can “decode” a mRNA sequence into a protein by using the following chart.
- **Codons** correspond to **three consecutive** bases in an mRNA sequence.
- Start in the center and work your way out!



Example:
Which amino acid would be coded for by:

mRNA sequence: CGAUCACUCAAACAGUGA

How are Proteins Made?

Example:
Which amino acid would be coded for by:

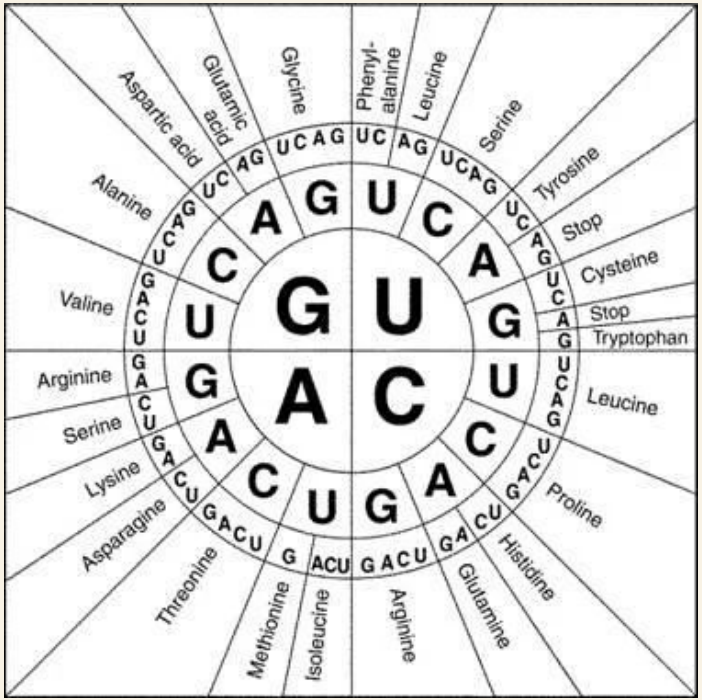
mRNA sequence: CGAUCACUCAAACAGUGA

Step 1. Find your codons (sets of three)
CGA UCA CUC AAA CAG UGA

Step 2. Determine the amino acid for each codon by using the table. Start from the center and move out.

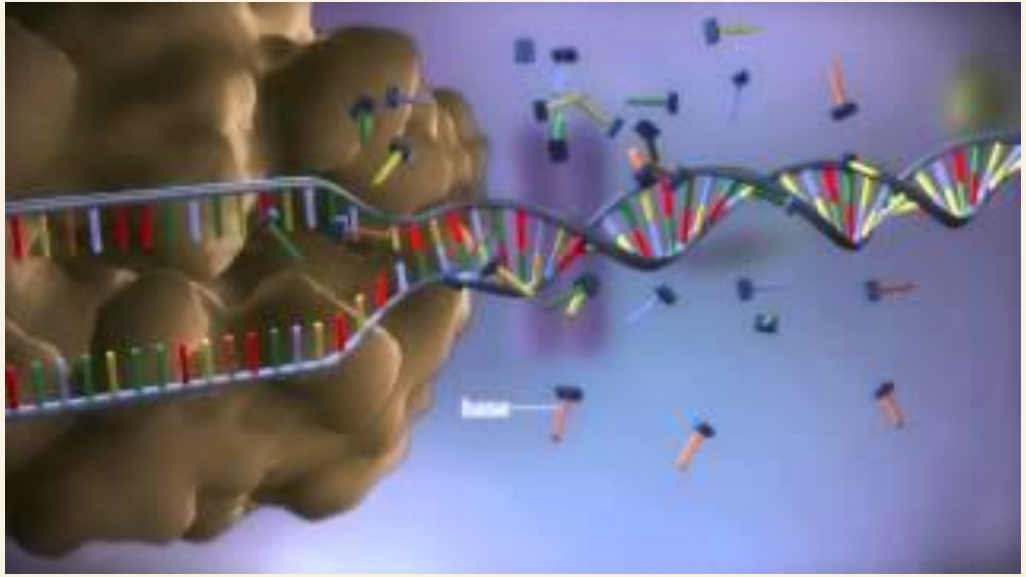
Step 3. Solve!

Arginine–Serine–Leucine–Lysine–Glutamine–Stop



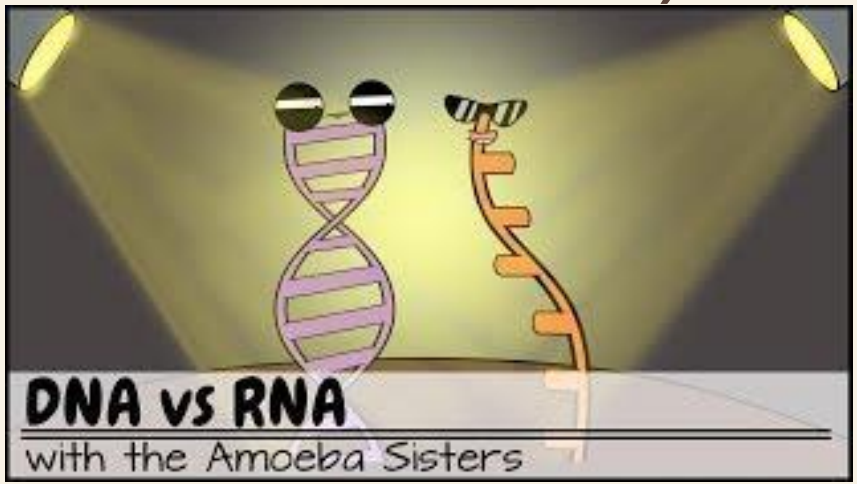
The Central Dogma

https://www.youtube.com/watch?v=gG7uCskUOrA&t=1s

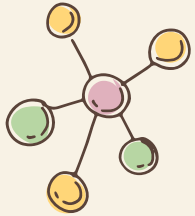


DNA vs RNA

https://www.youtube.com/watch?v=JQByjprj_mA&t=1s (watch until 2:22s)



Review



1. What is the central dogma of biology?
2. What are proteins? What are amino acids?
3. What is the difference between DNA and RNA?
4. Why is there a relationship between diet and essential amino acids?
5. What is a codon?
6. Find the amino acid sequence for the following mRNA sequence:
    a. UCCAACCAGGGGAUUCGAUGA
    b. UGGGGAUUAUGCCUAGAUAAC

Challenge Question: The central dogma of biology explains how genetic information flows from DNA to RNA to proteins. If a mistake (mutation) happens during the process of converting DNA into RNA, how could this affect the protein that is produced? Explain using a diagram and an example sequence.