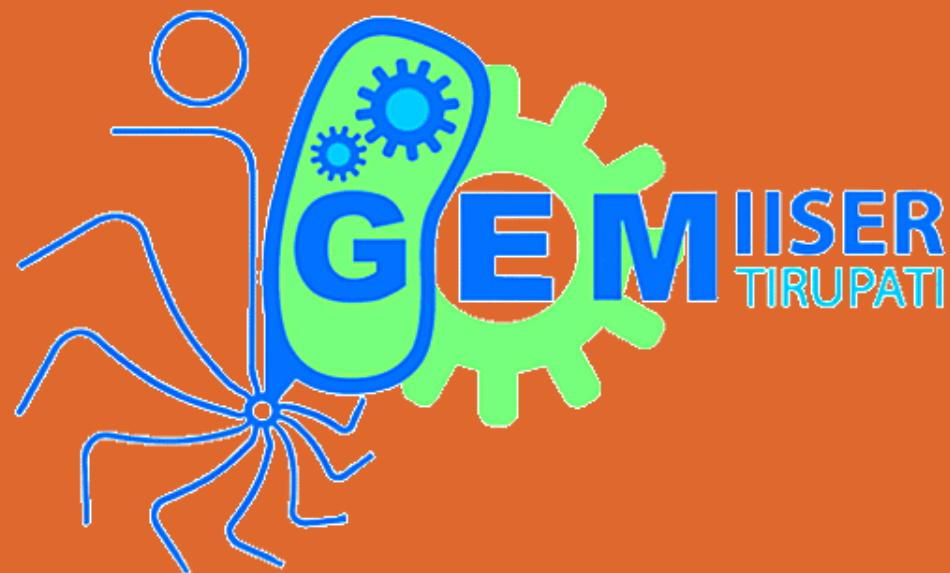
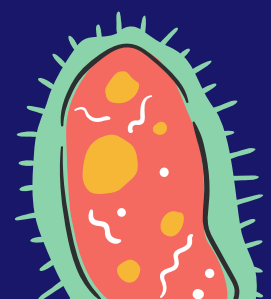


# Gene Gala

- A Visit to the SynBio World

iGEM 2021

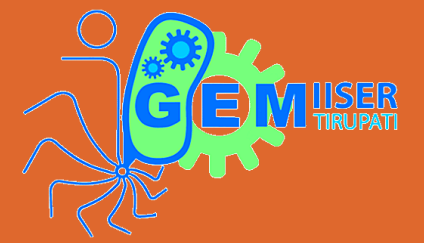
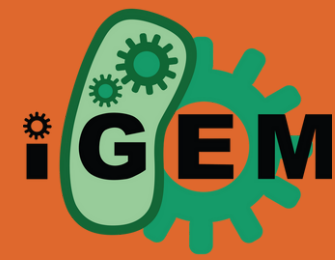


IISER Tirupati



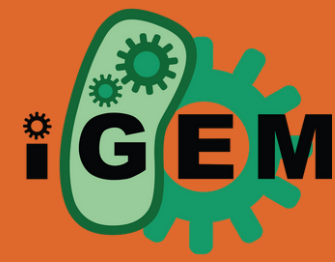
IISER Kolkata





# Team iGEM IISER Tirupati

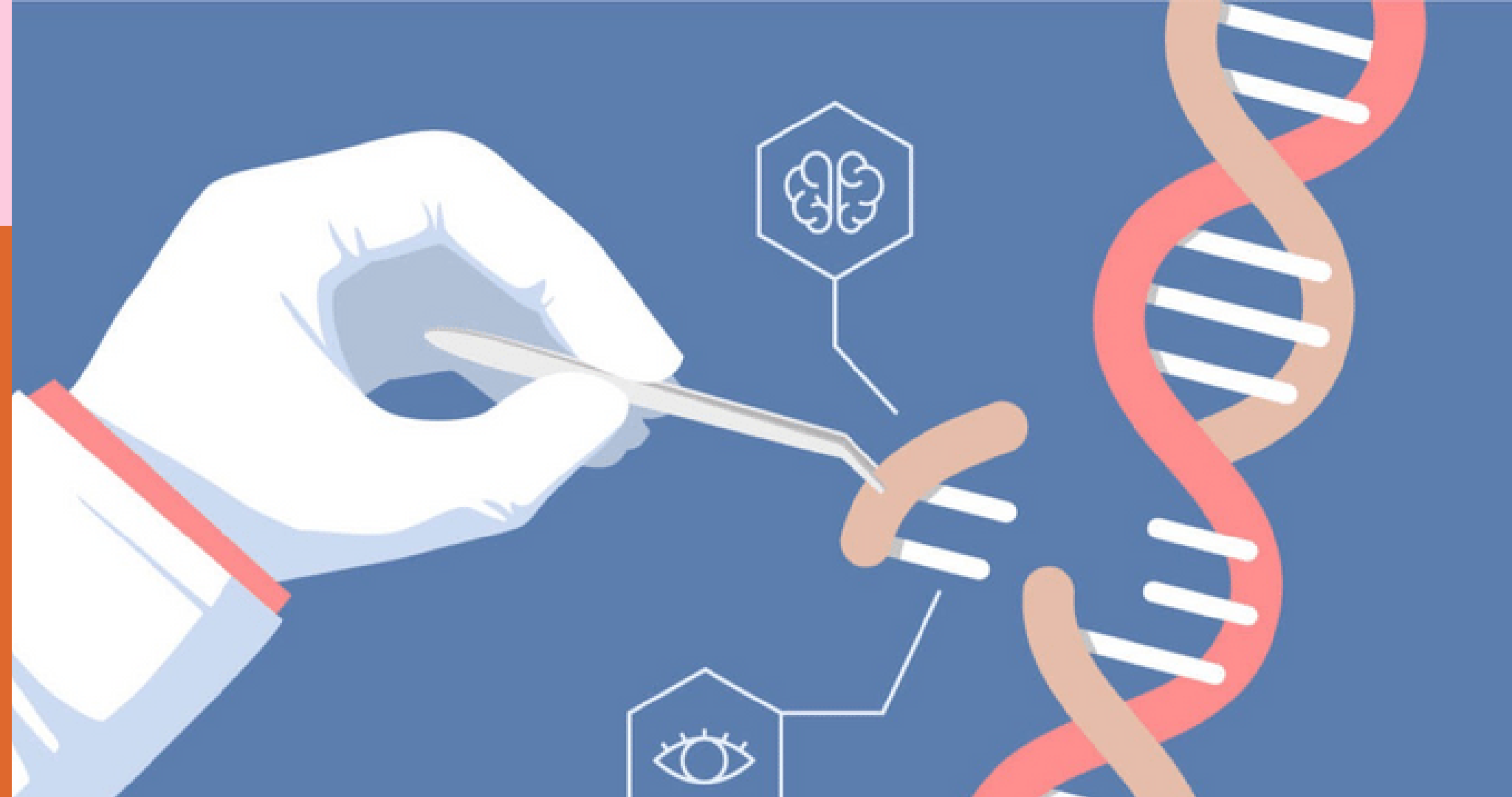
Members



# Team iGEM IISER Kolkata

Members

# A crash course on Synthetic Biology



Nucleic acids  
Proteins

Math-model  
Ethics

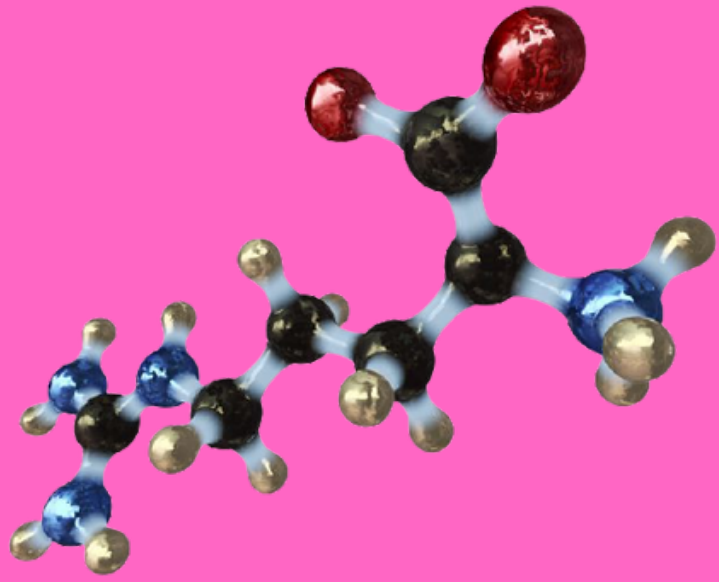
Molecular  
Biology  
Basics

Plasmid  
Design



Applications  
iGEM

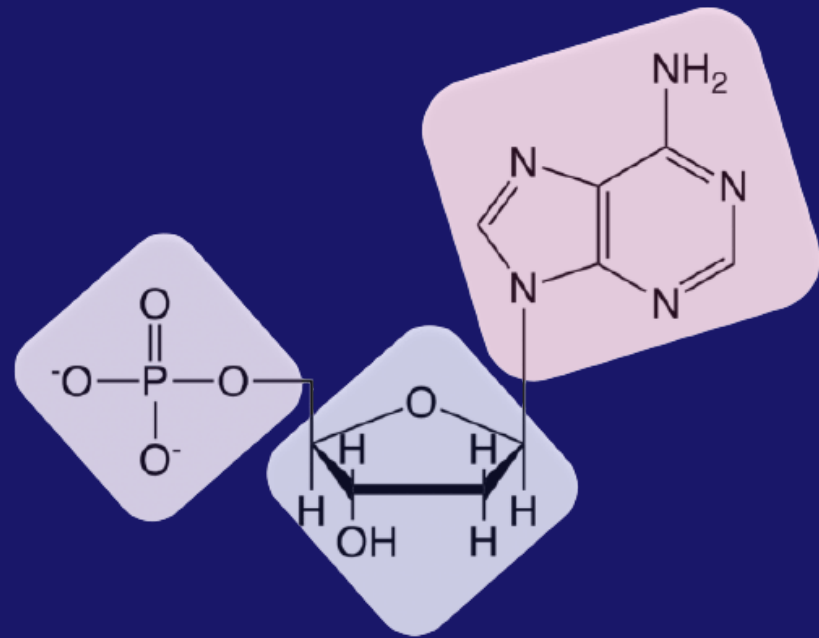
DAY 1



Amino acids



Structure of DNA



Nucleic acids



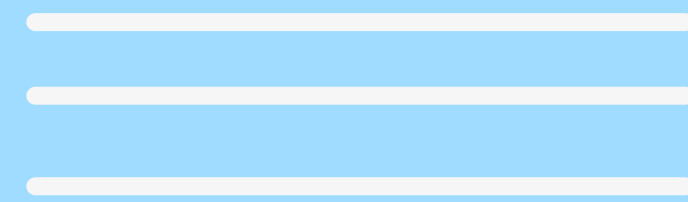
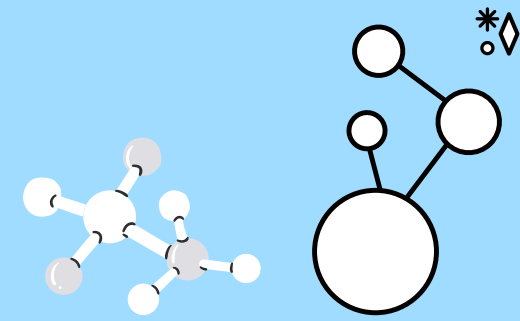
Central Dogma

The code of life & how to read it

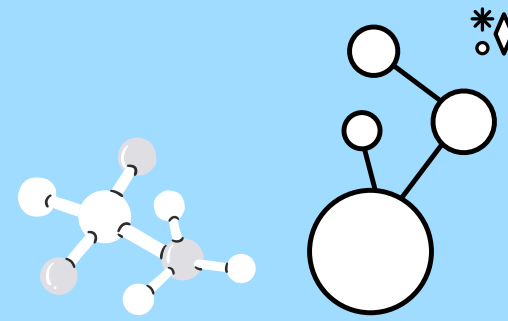
# Question of the Day

A top-down view of a variety of fresh and healthy ingredients arranged on a light-colored surface. In the center, there's a piece of salmon and a piece of raw beef. To the right, there's a bowl of rice and a bowl of beans. On the left, there's a bowl of almonds and a bowl of blueberries. At the bottom, there's a lemon, some green peas, and a halved avocado. On the right side, there's a halved grapefruit, some ginger, and a bowl of spices. The overall scene is vibrant and emphasizes a healthy, balanced diet.

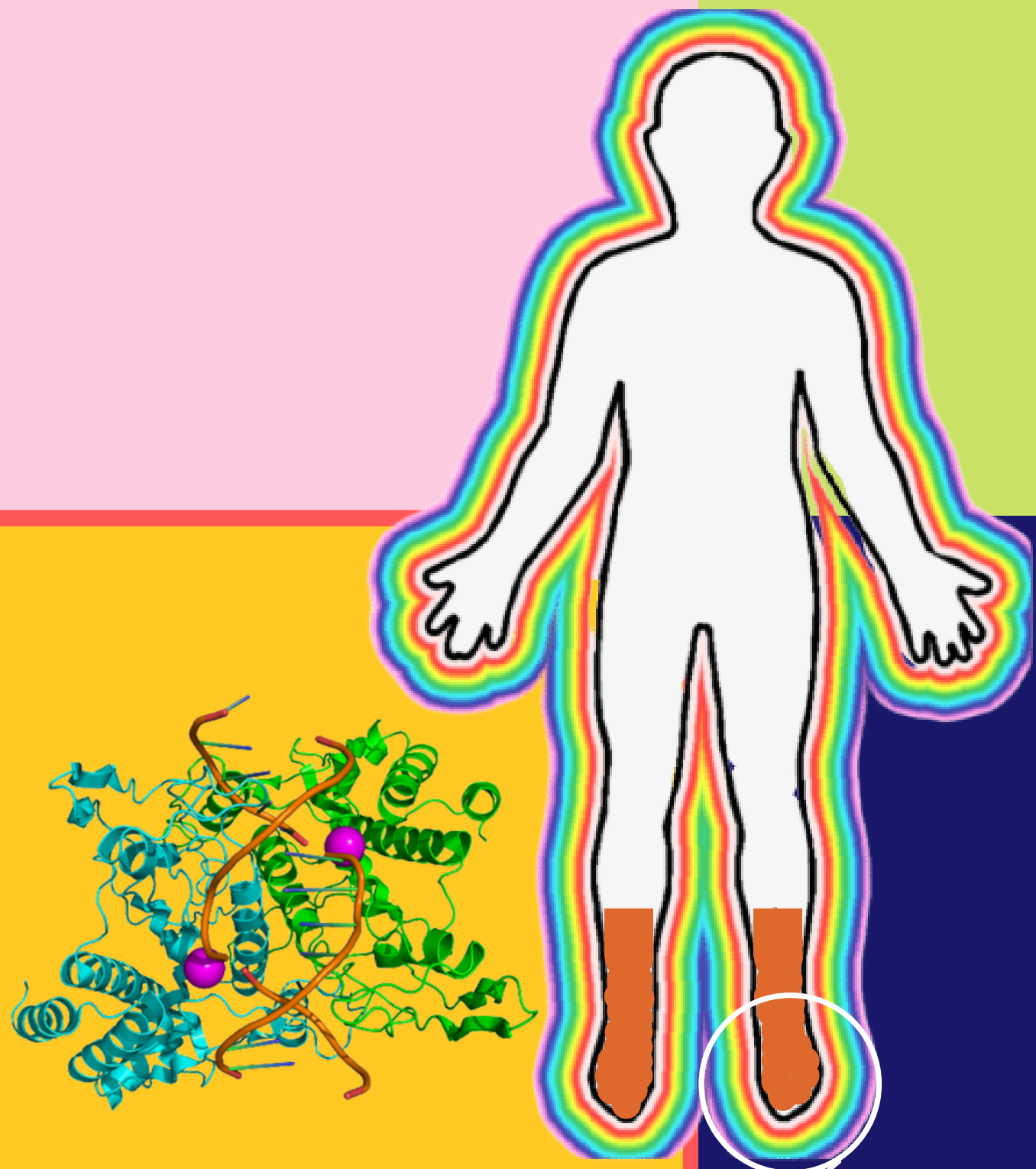
**Do you think proteins are important? Where do we get our proteins from?**



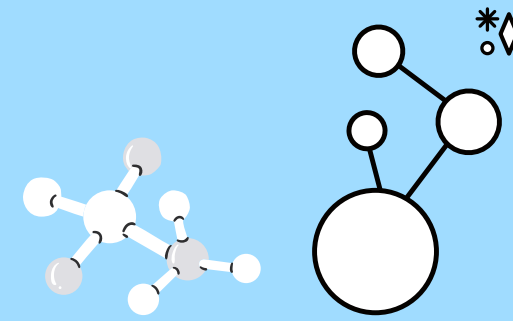
# Proteins



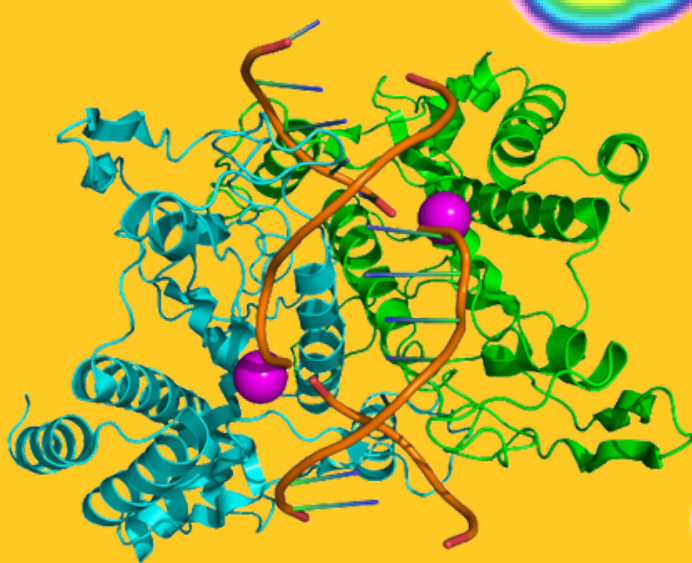
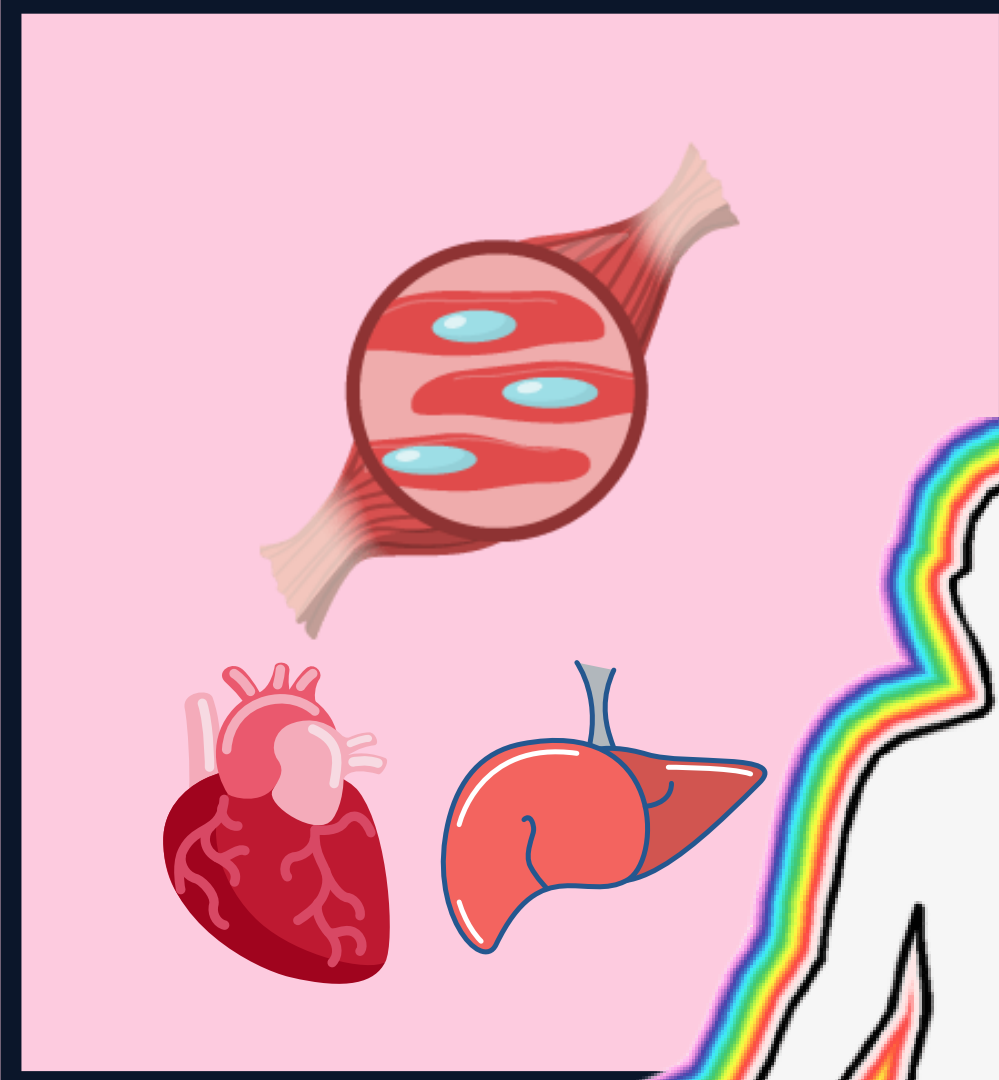
Proteins



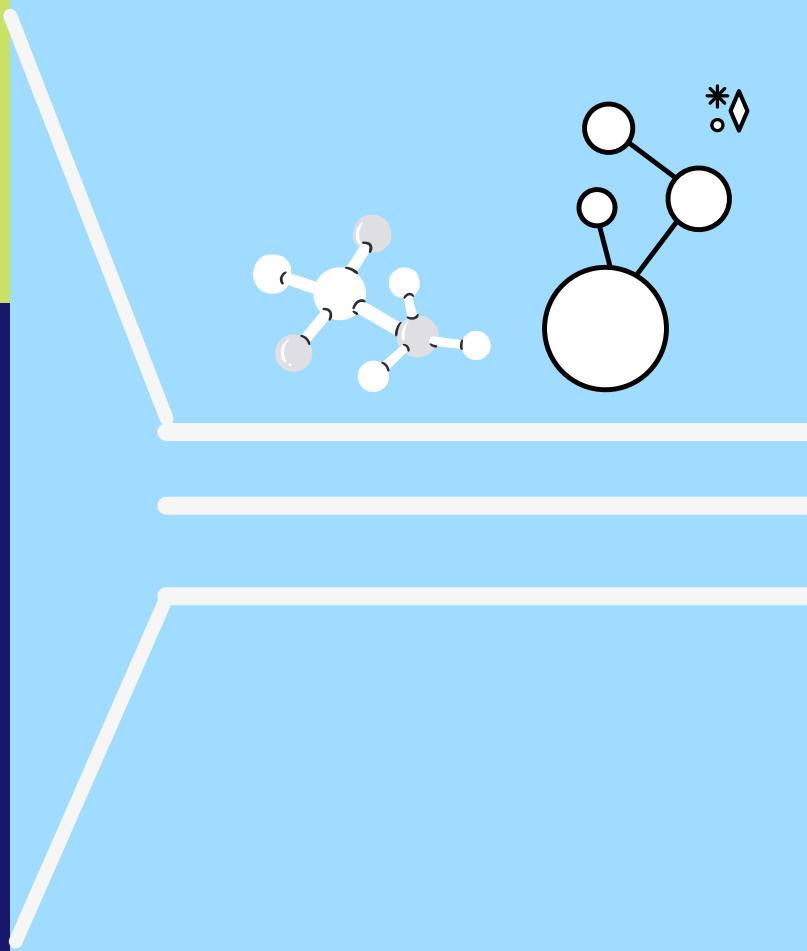
large, complex



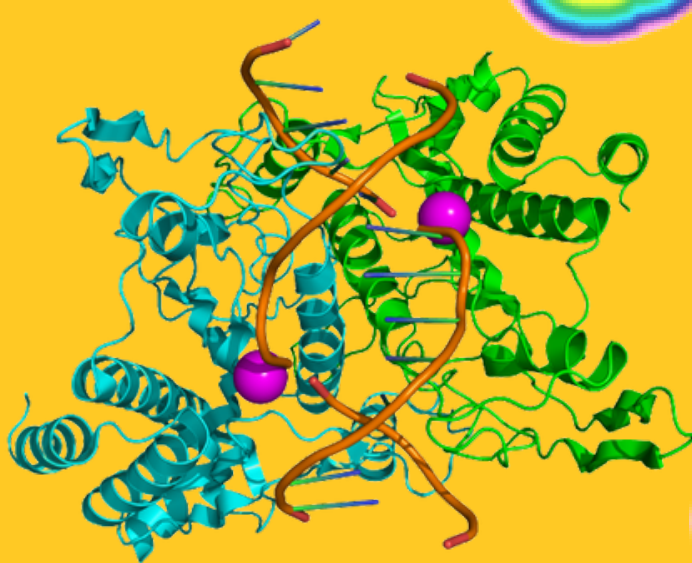
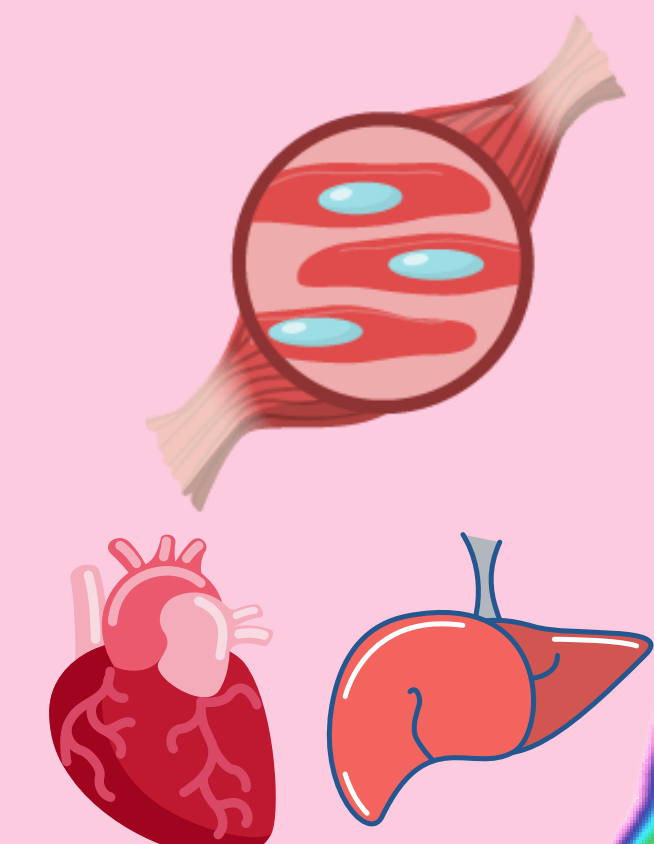
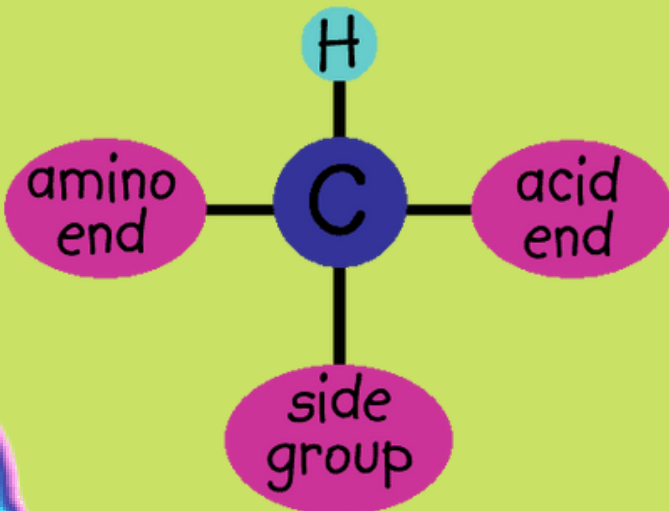
Proteins



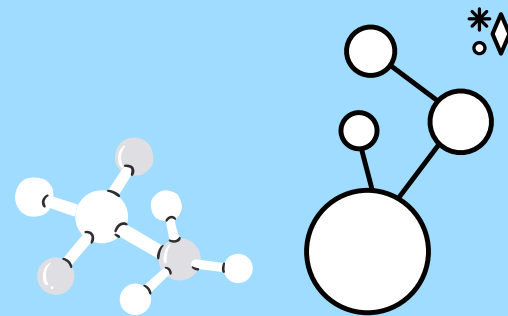
large, complex



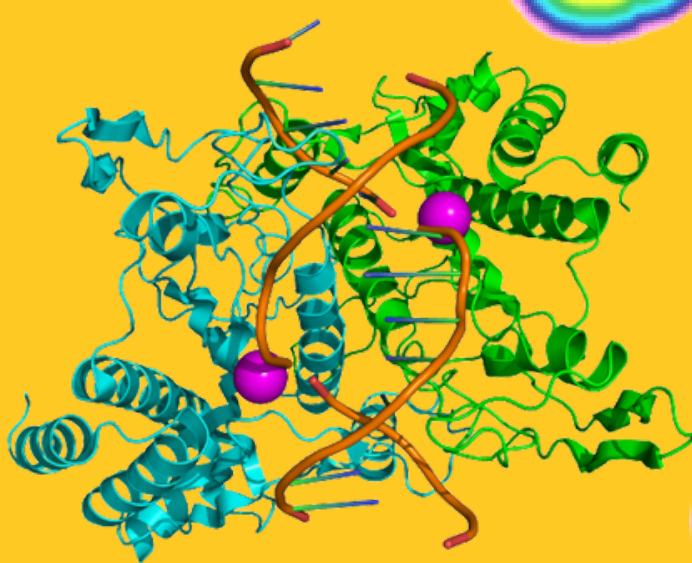
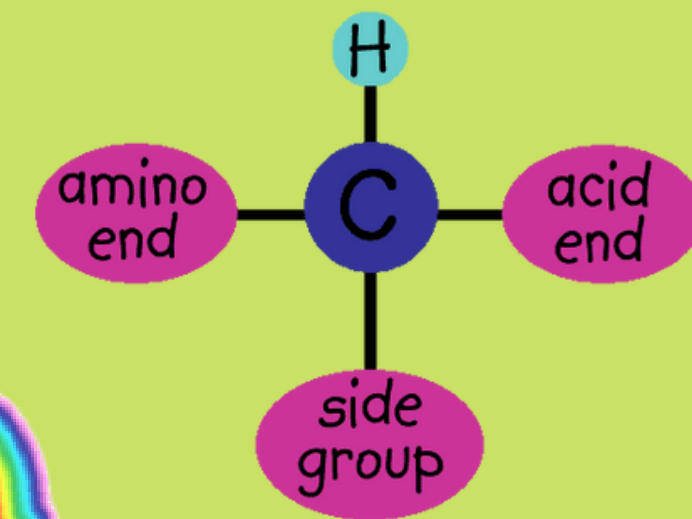
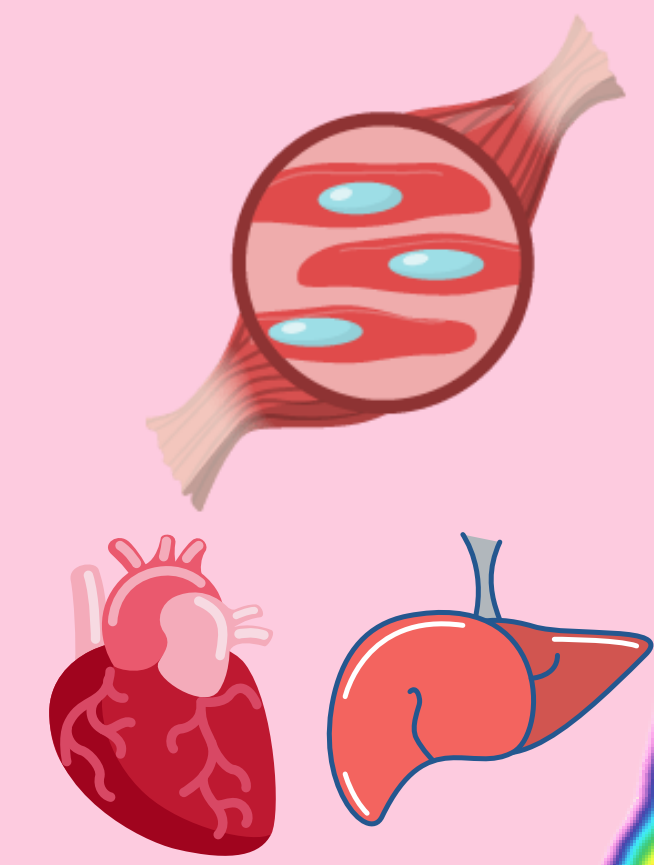
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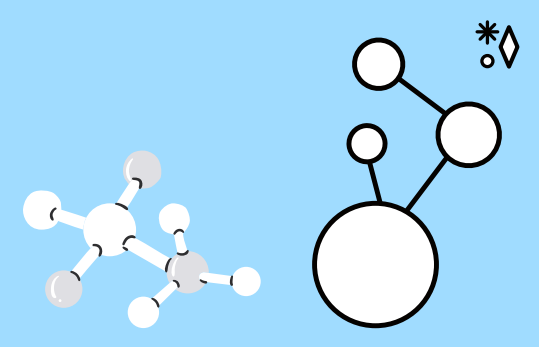
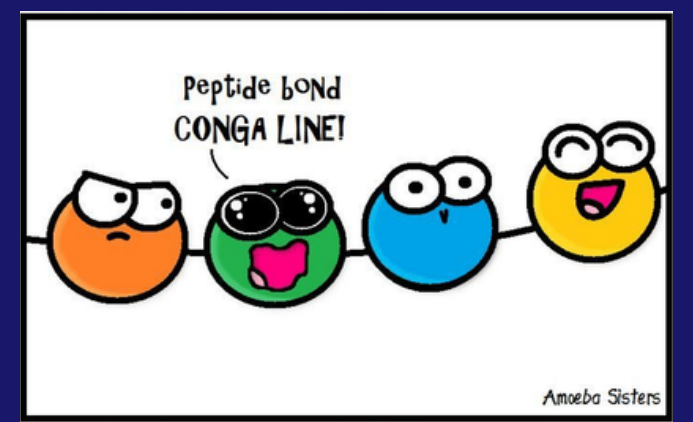
large, complex



# Proteins

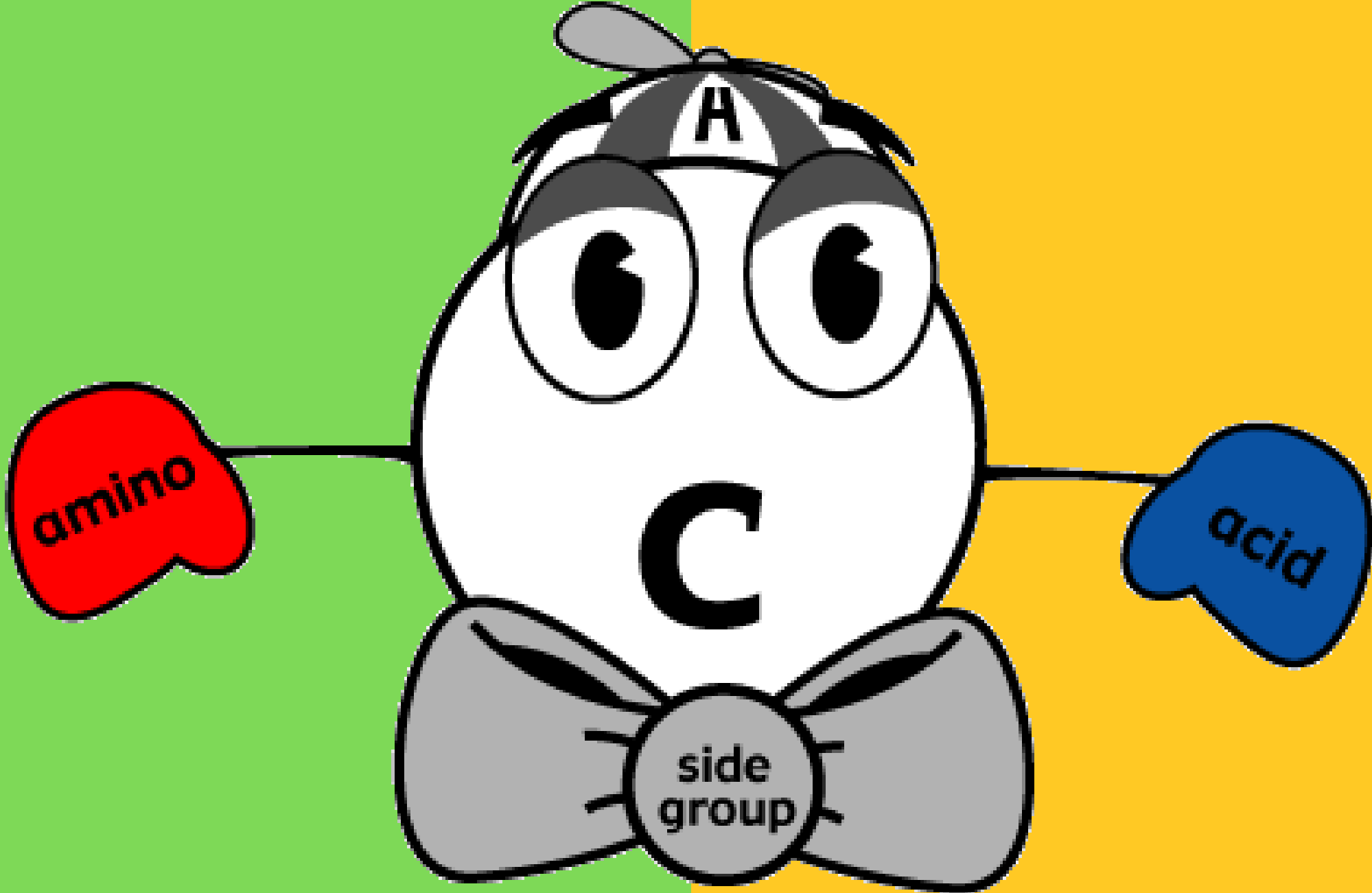
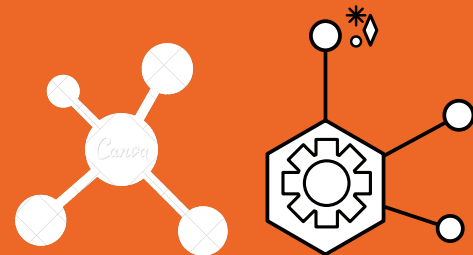


large, complex

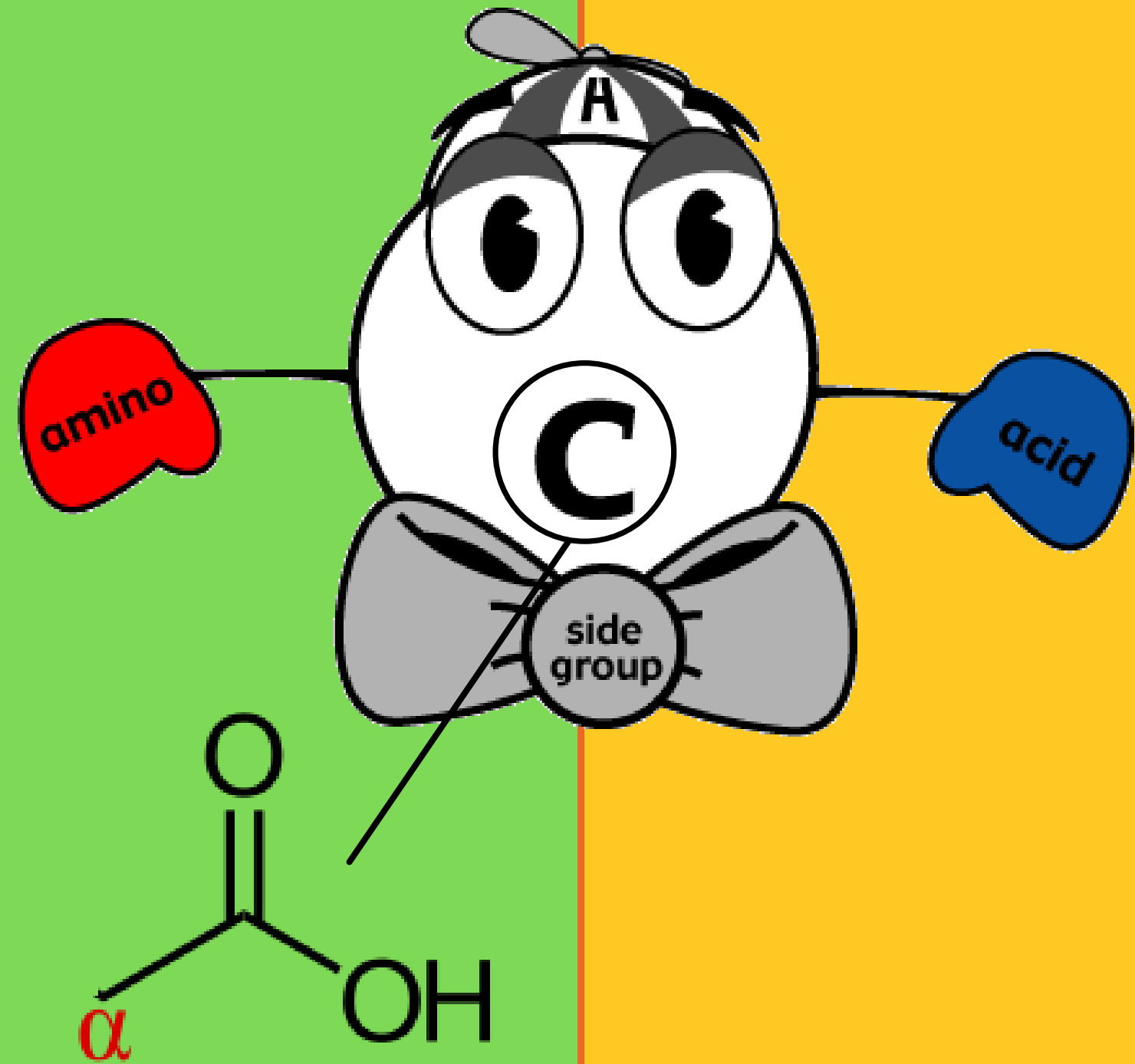
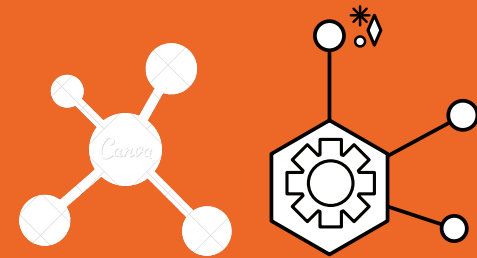


# Proteins

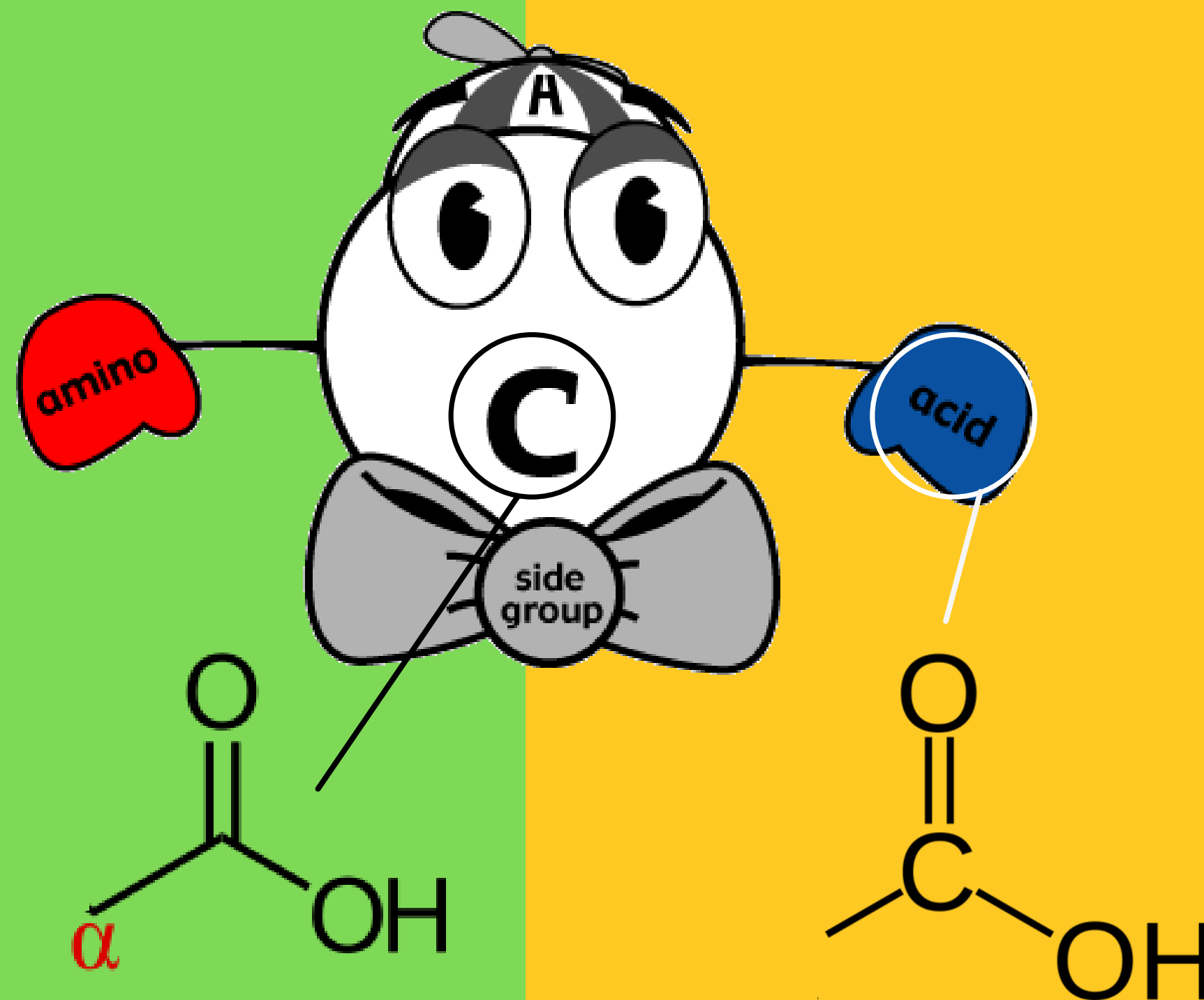
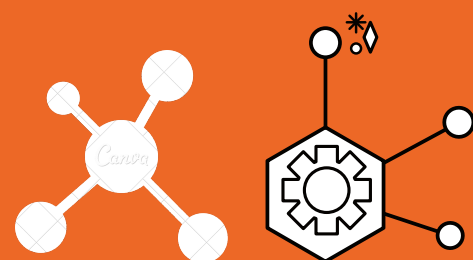
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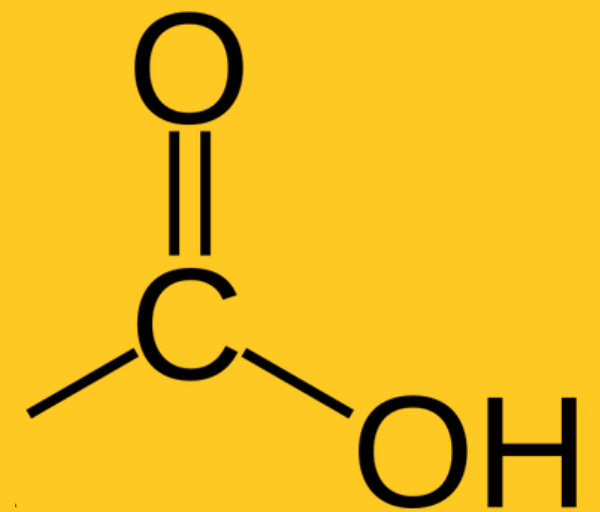
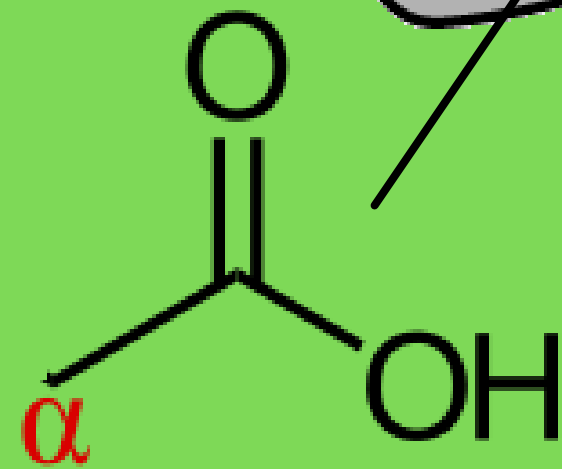
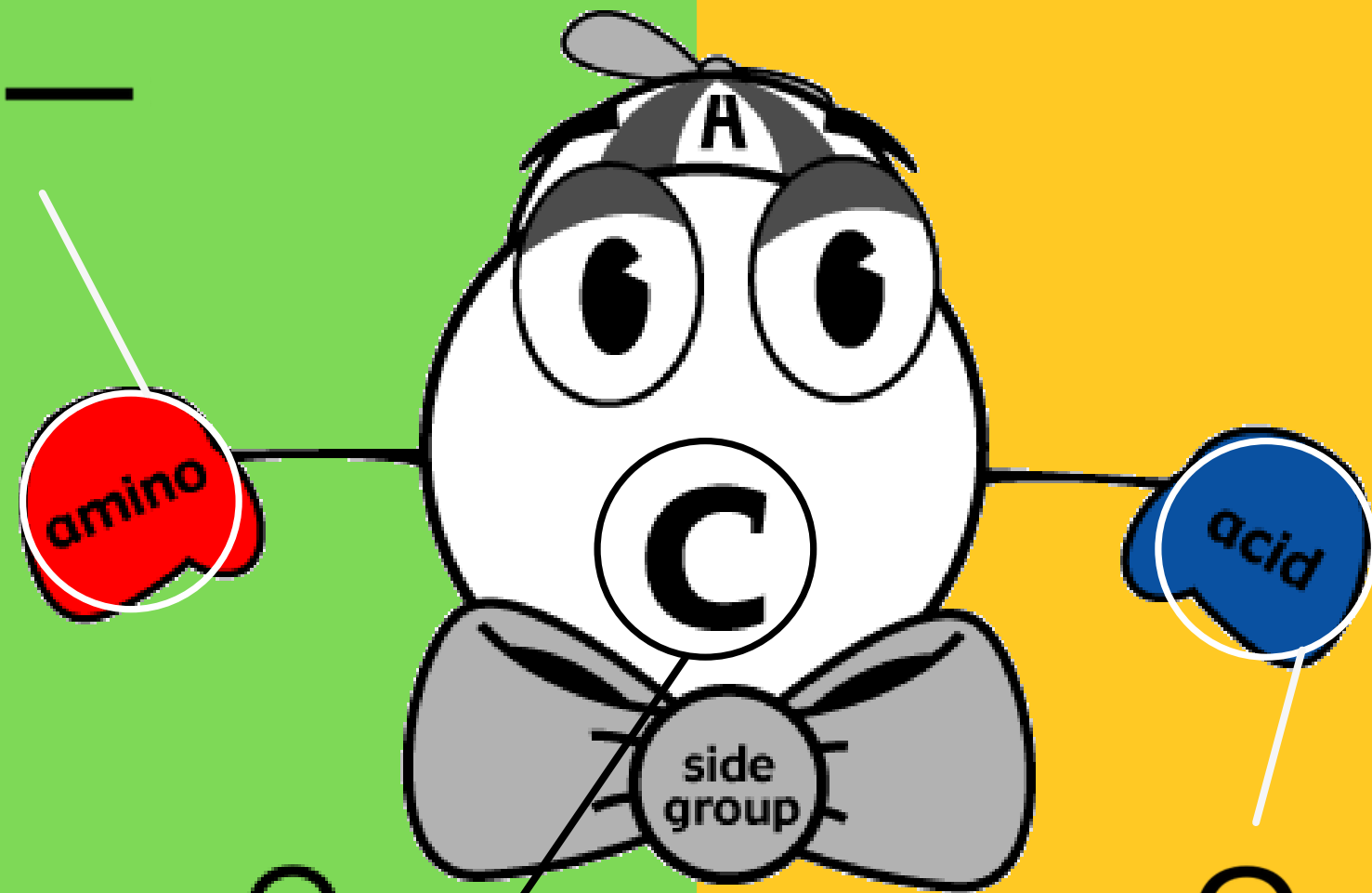
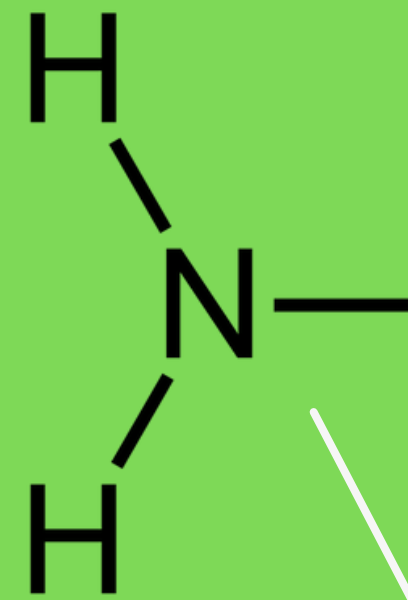
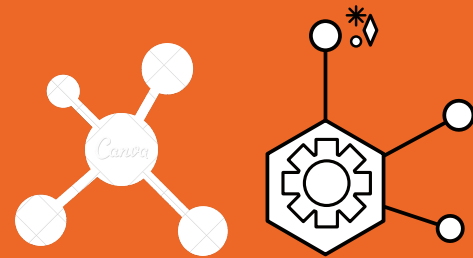
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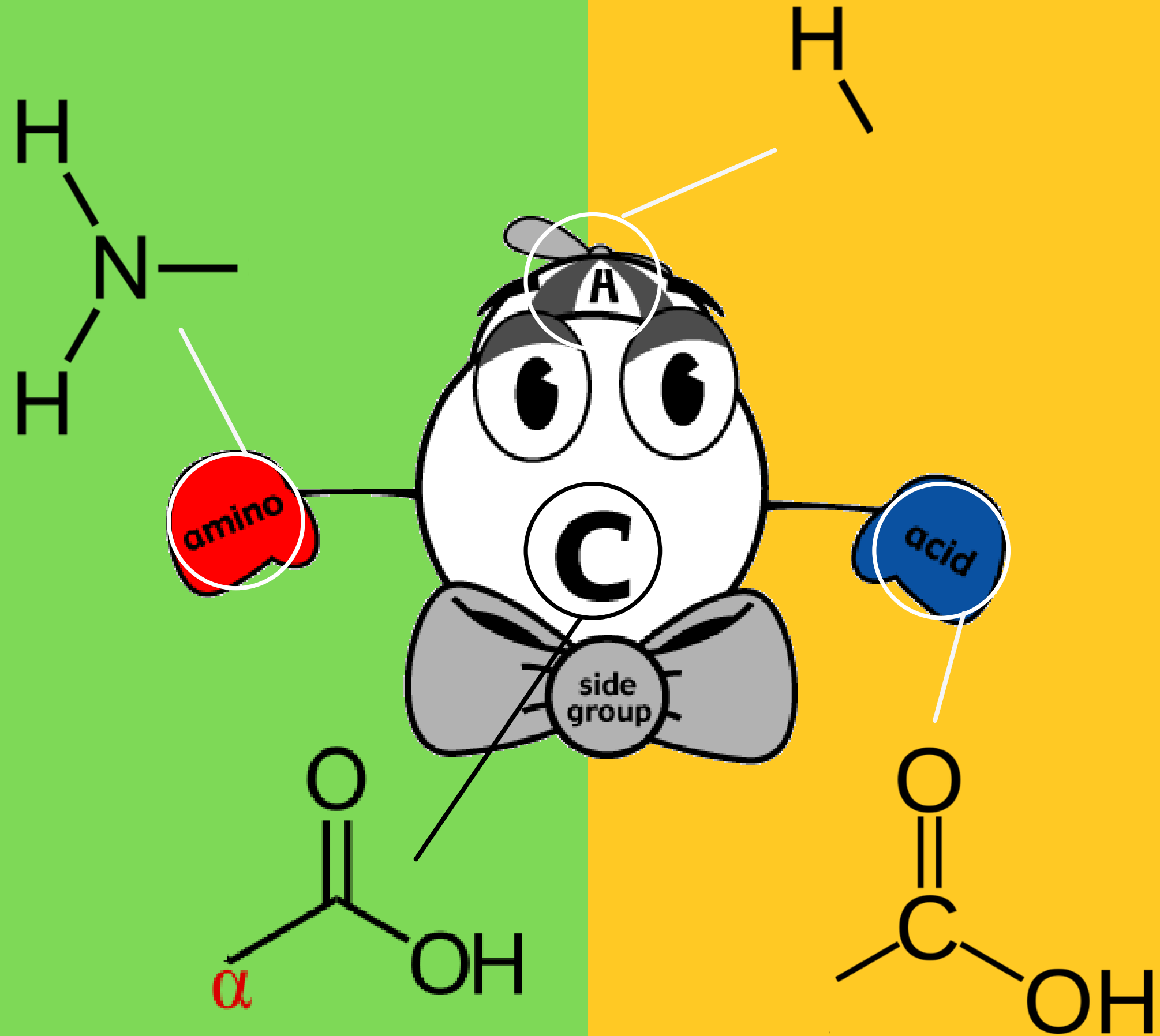
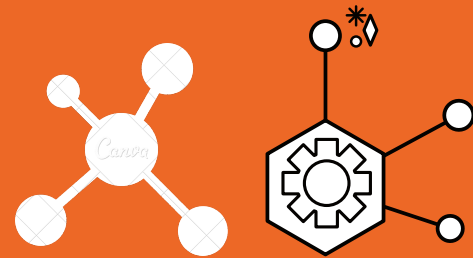
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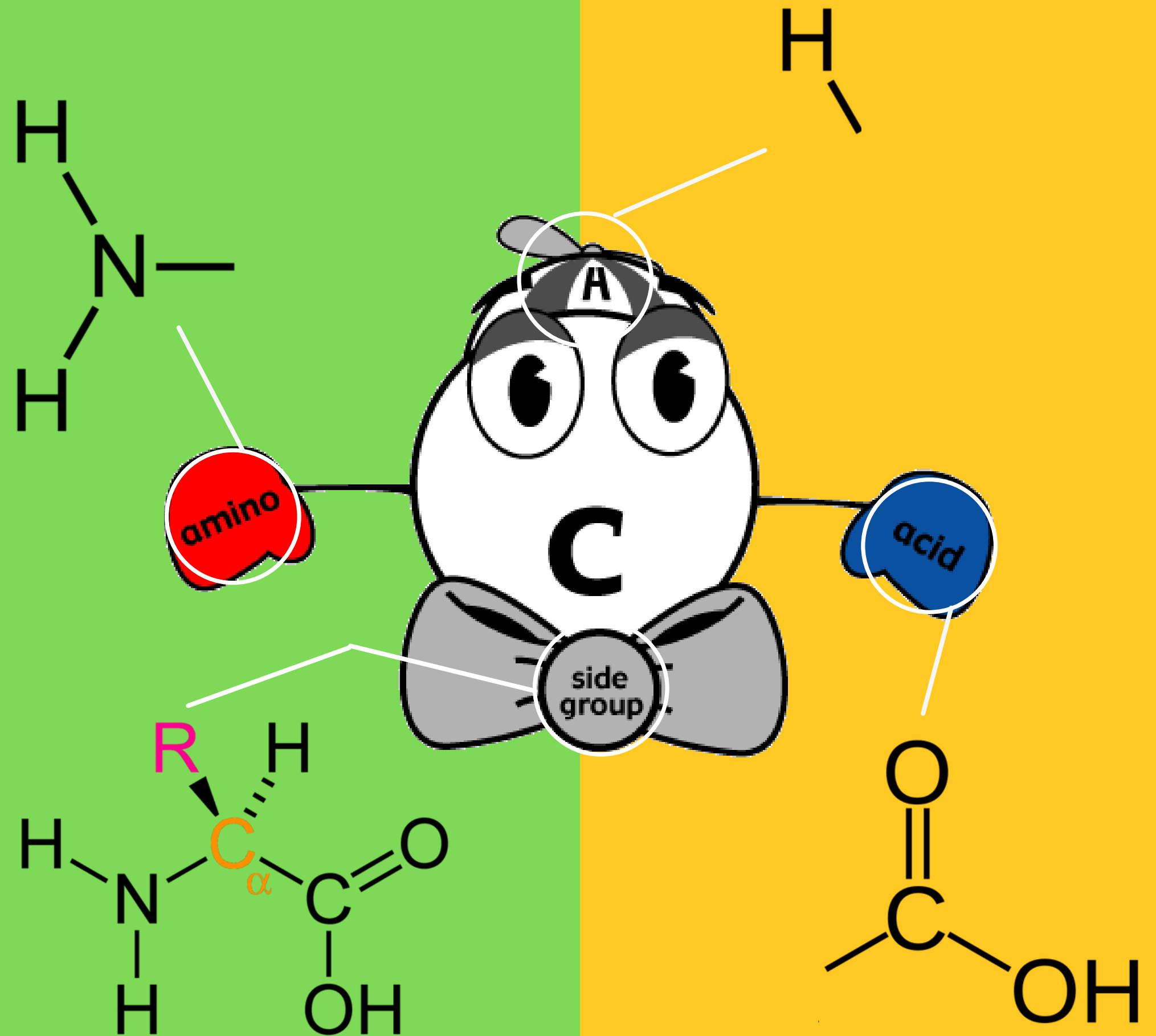
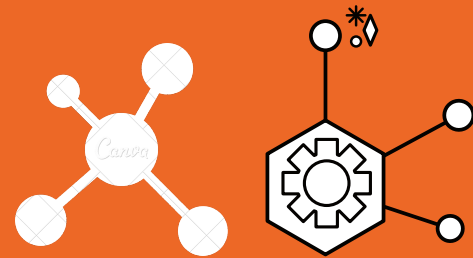
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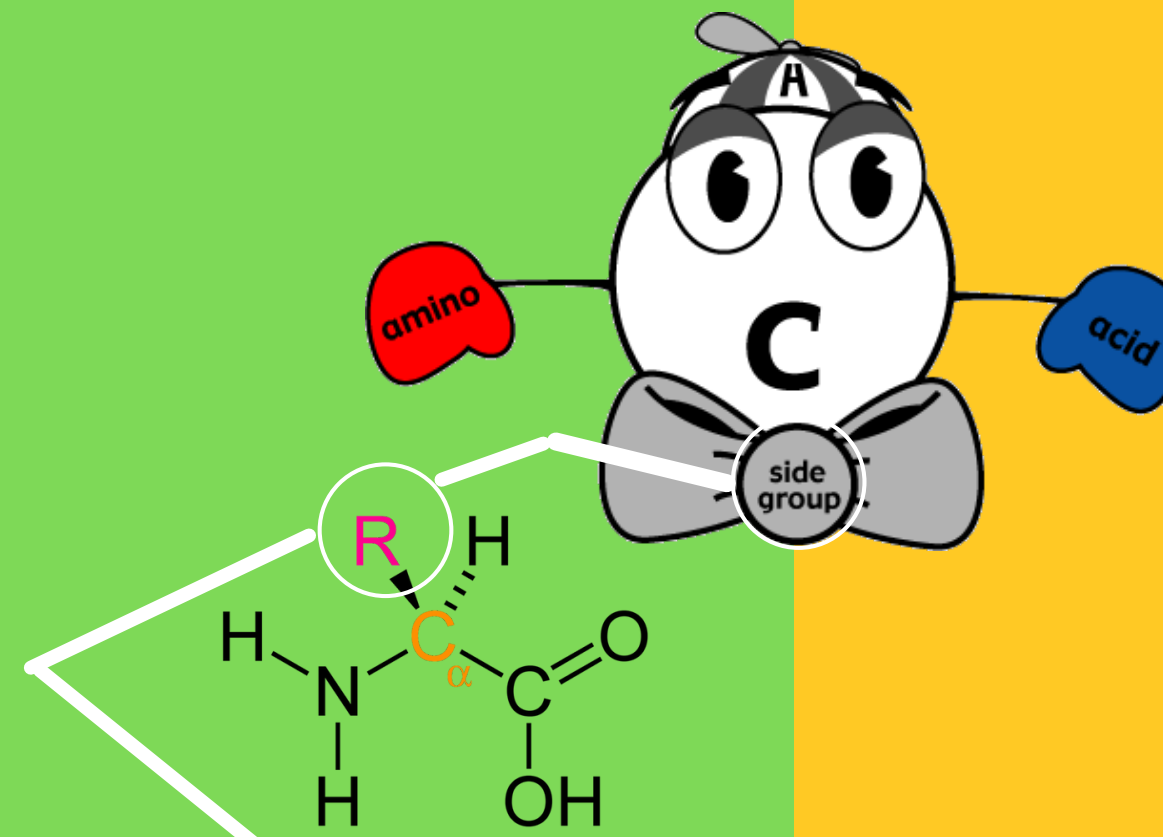
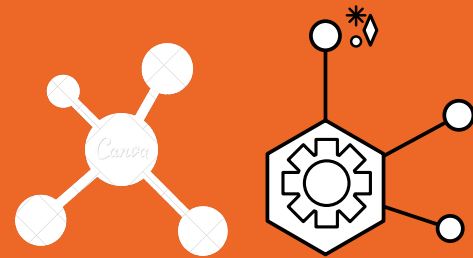
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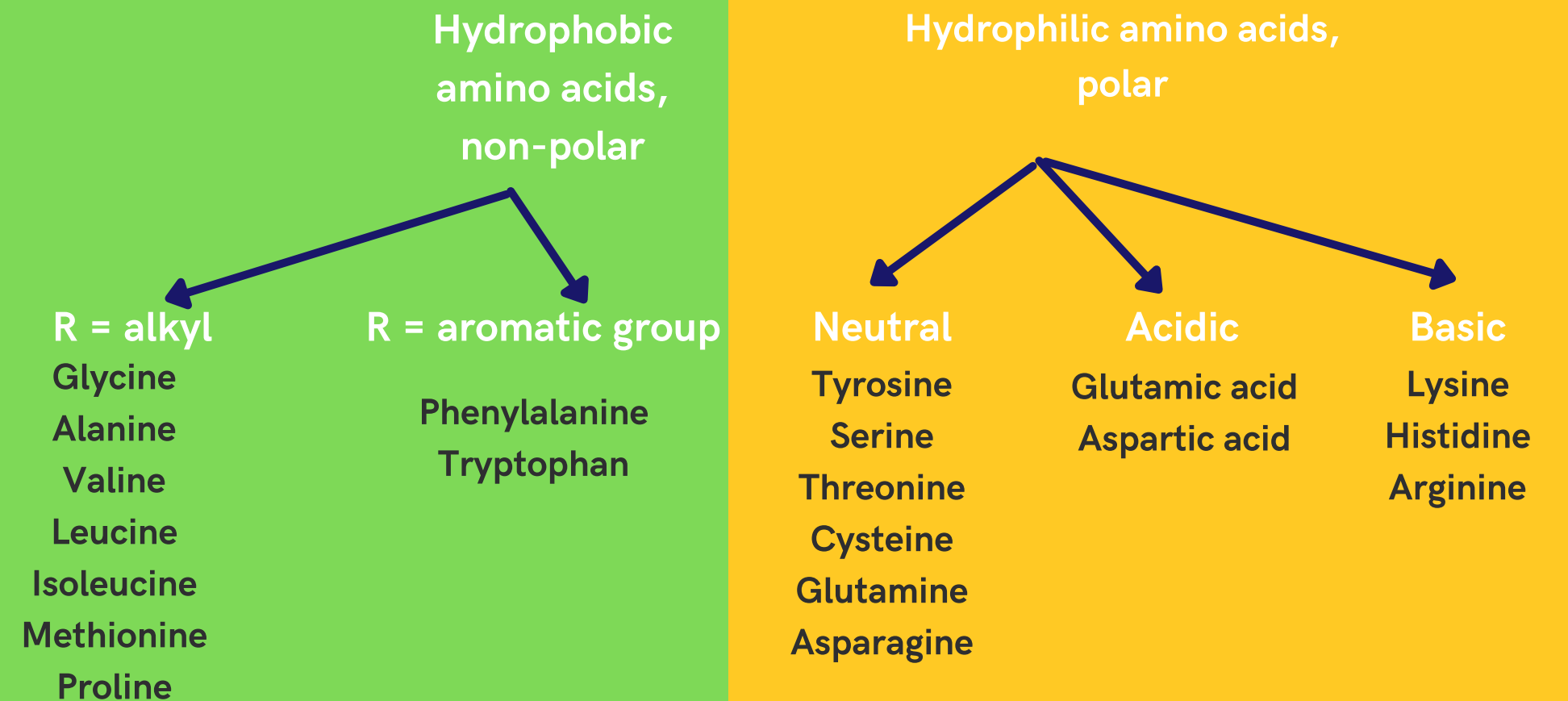
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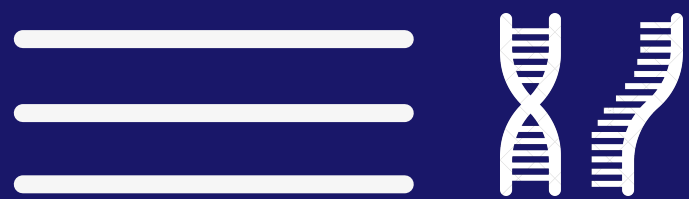
# Amino acid Structure



## Amino acids



# Nucleic Acids

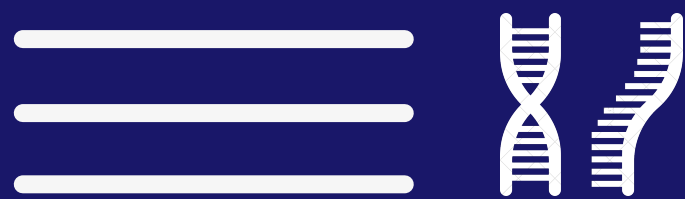


STILL SINGLE?



DNA

# Nucleic Acids



STILL SINGLE?



DNA

ALWAYS.



RNA

# Nucleic Acids

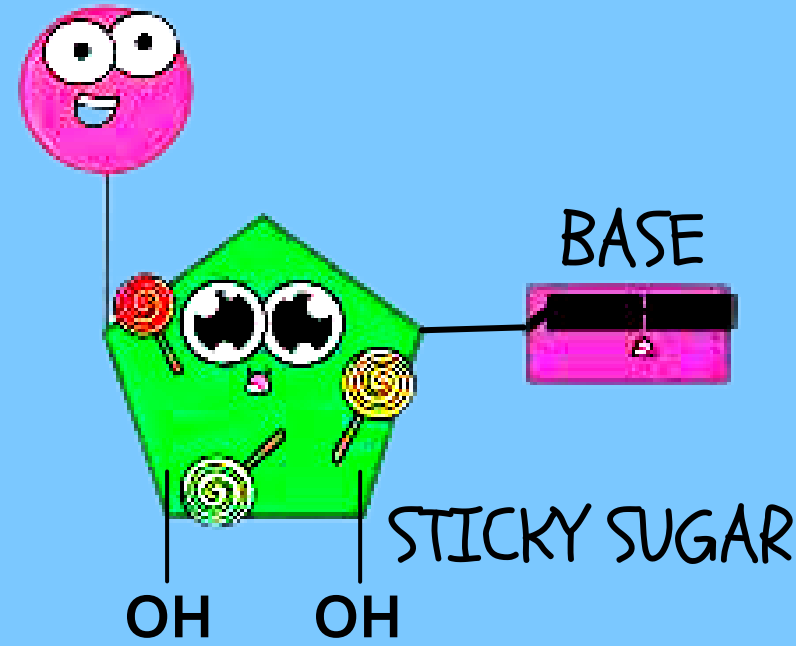


STILL SINGLE?



DNA

PHOSPHATE

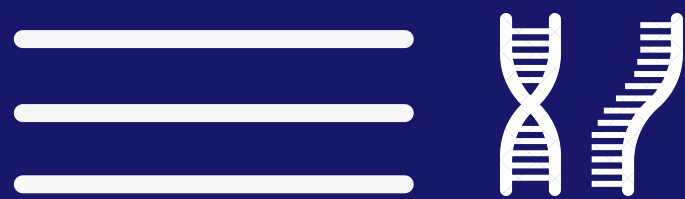


ALWAYS.



RNA

# Nucleic Acids

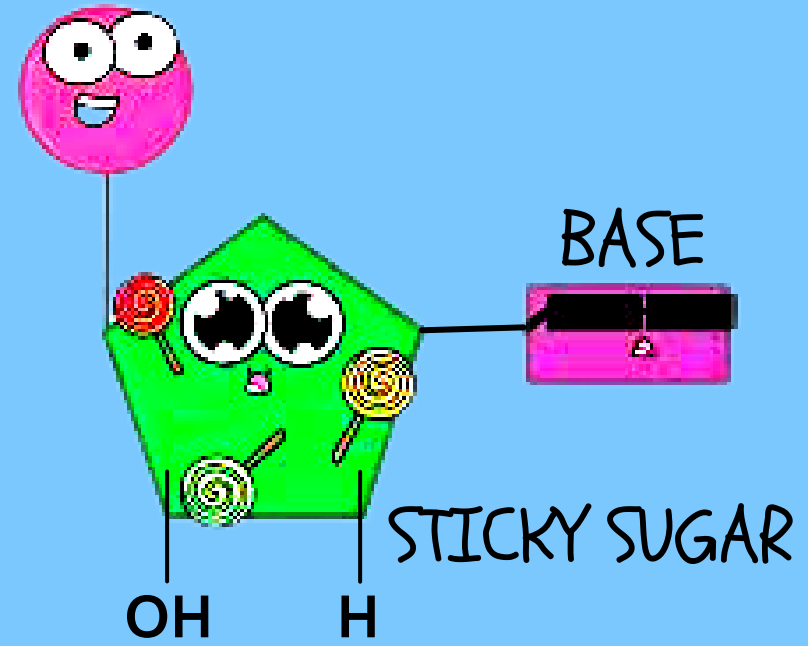


STILL SINGLE?



DNA

PHOSPHATE

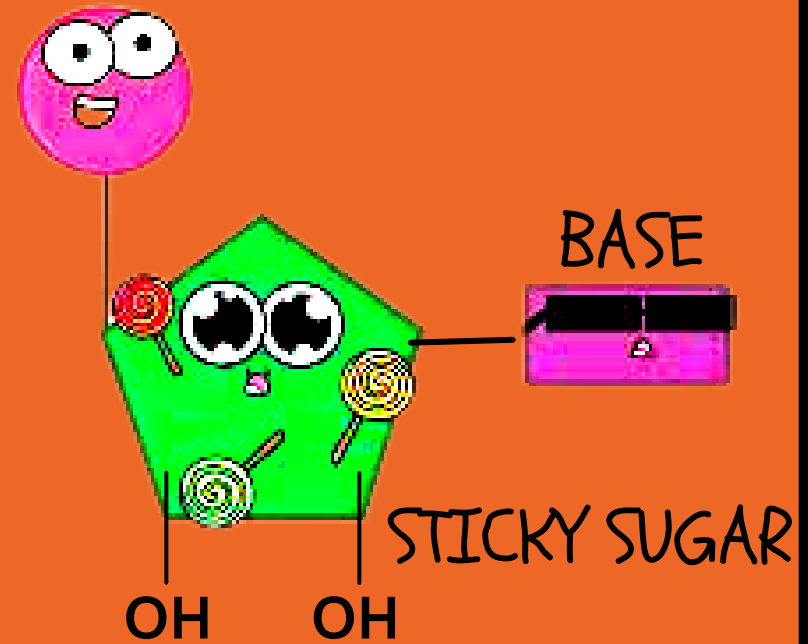


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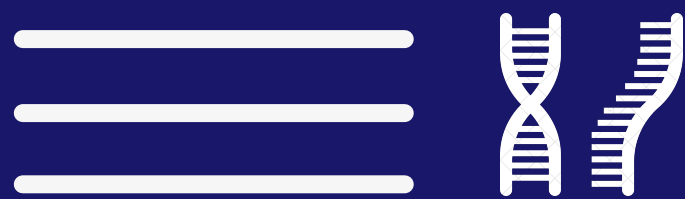


RNA

PHOSPHATE



# Nucleic Acids

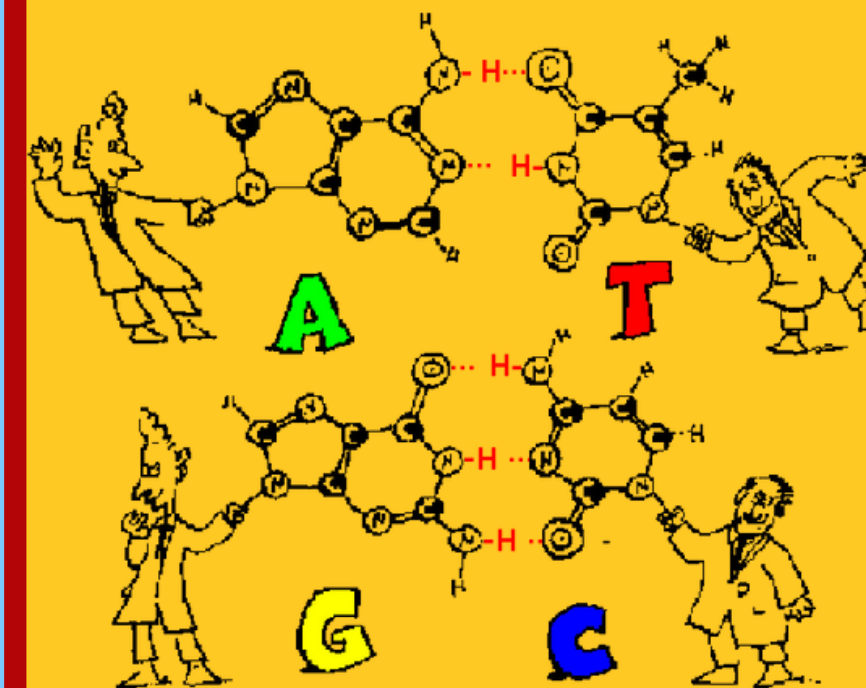
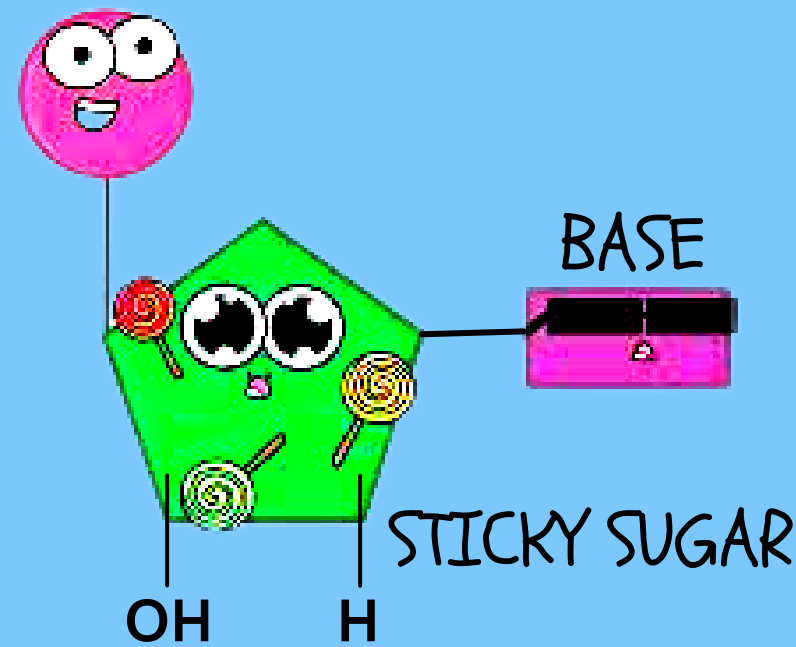


STILL SINGLE?



DNA

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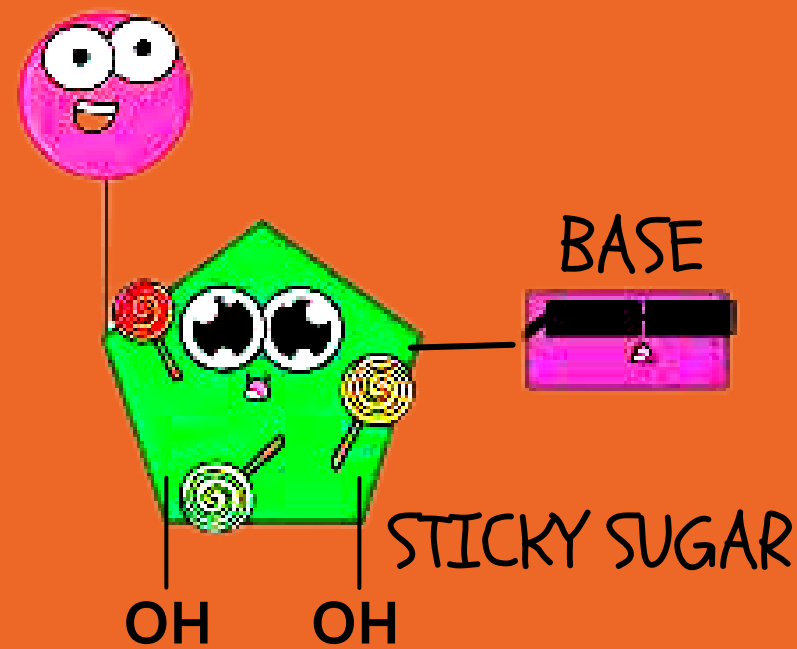


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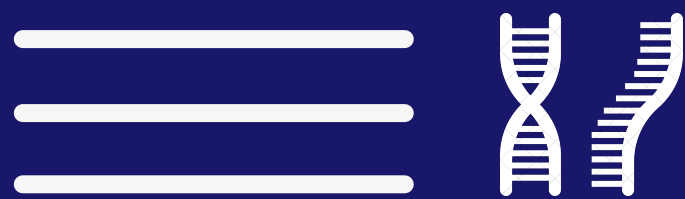


RNA

PHOSPHATE



# Nucleic Acids

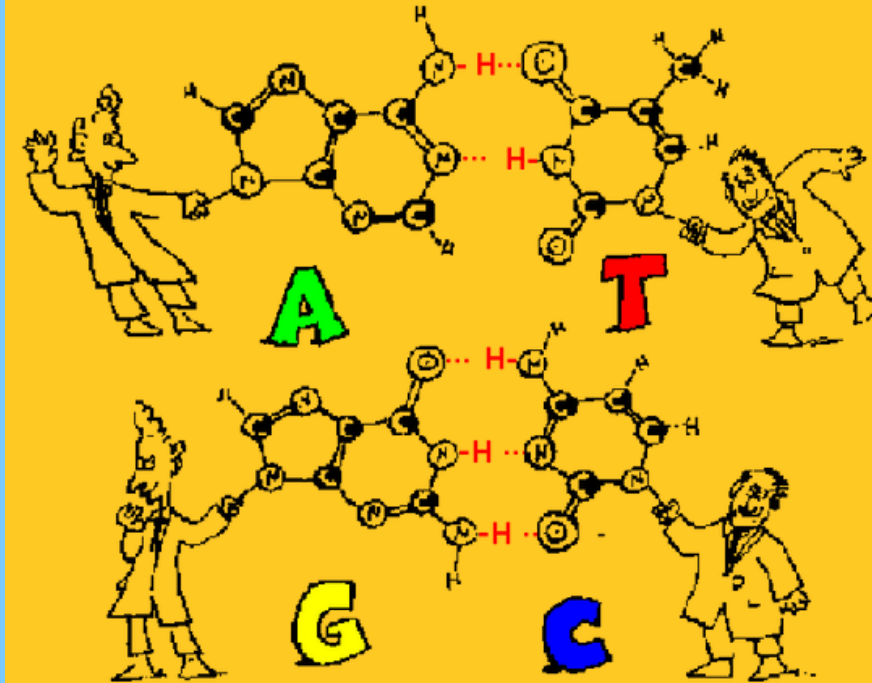
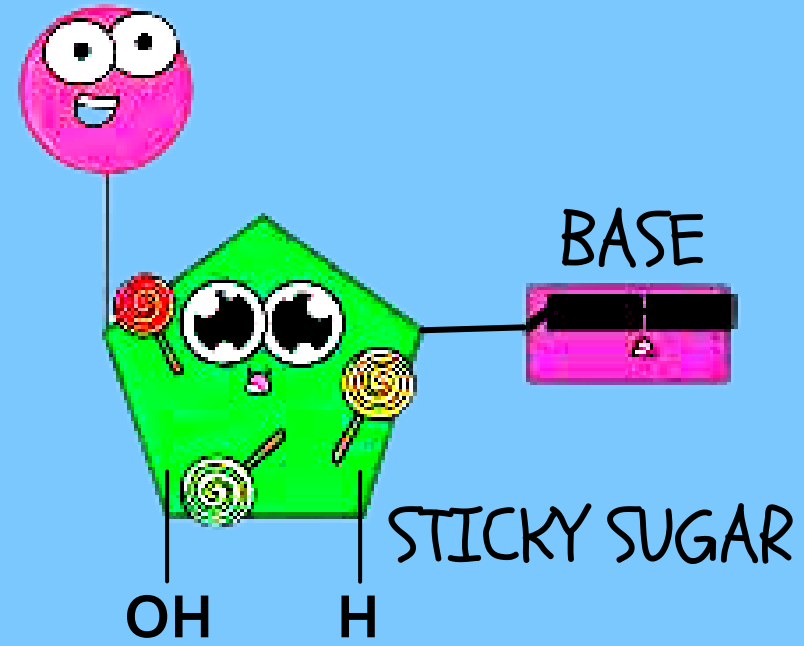


STILL SINGLE?



DNA

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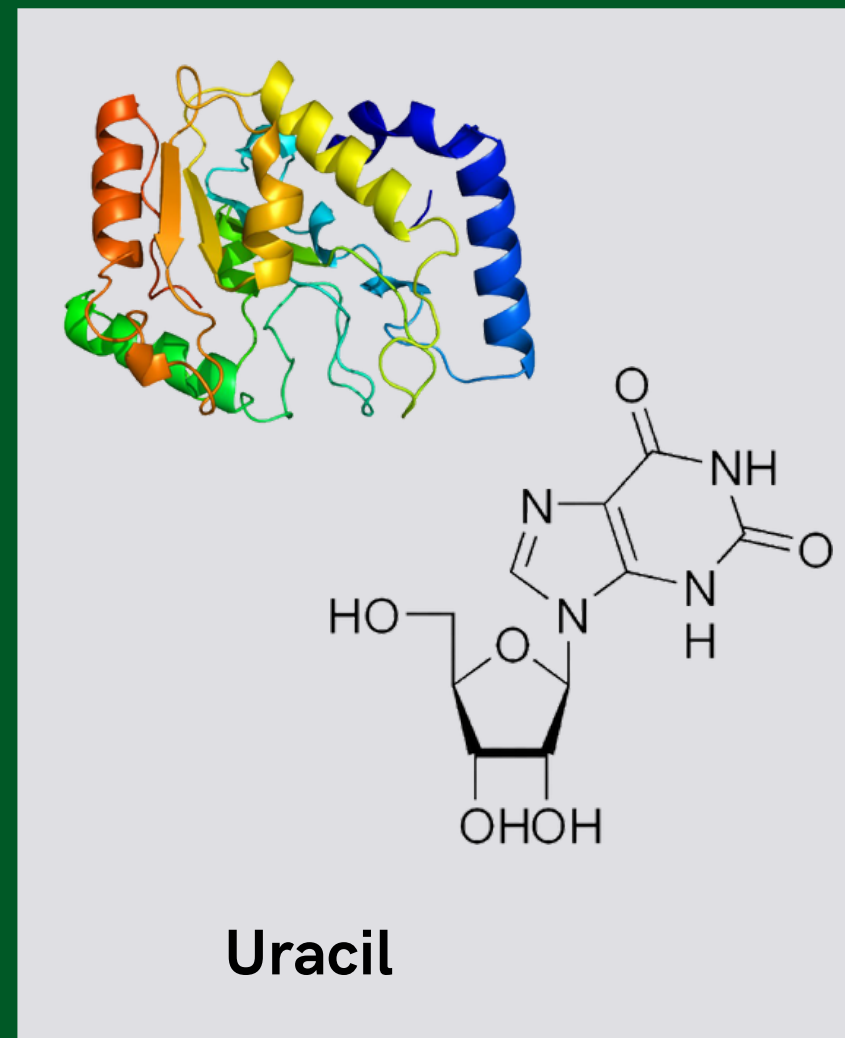
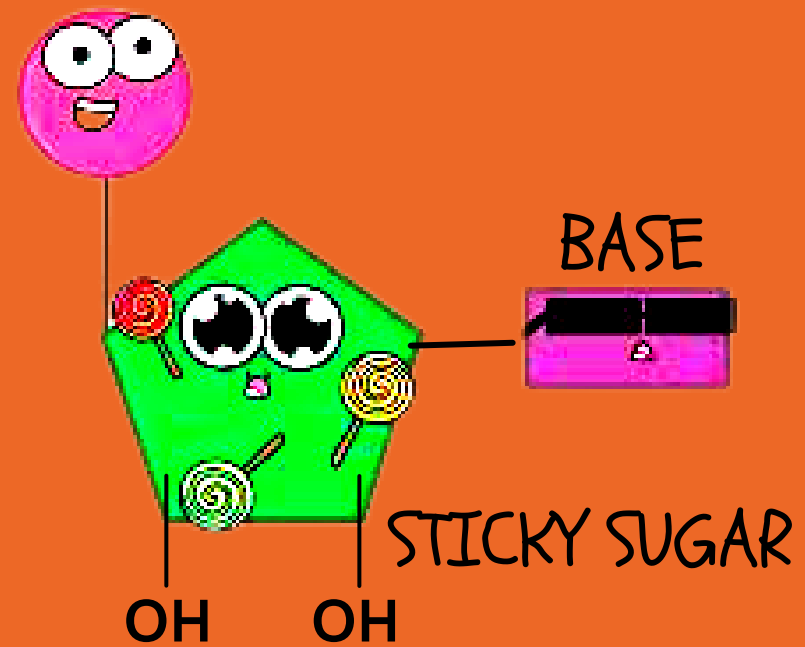


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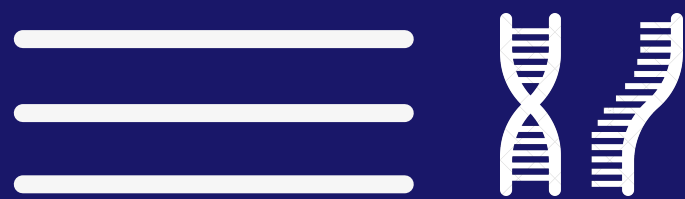


RNA

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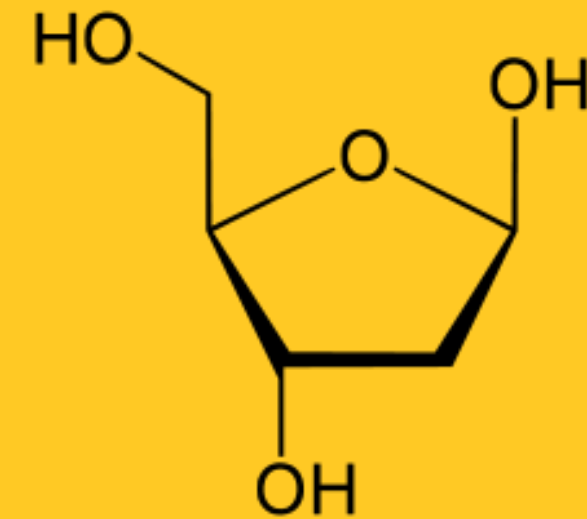
# Nucleic Acids



STILL SINGLE?



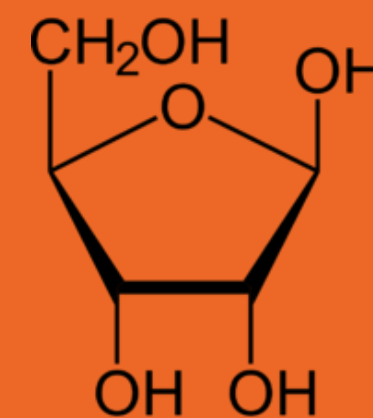
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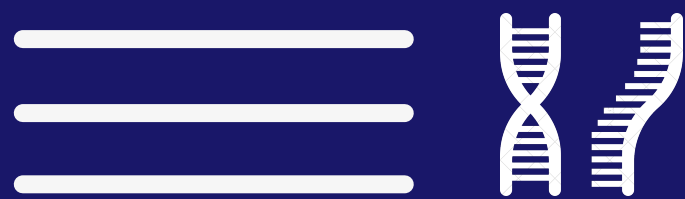
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RNA



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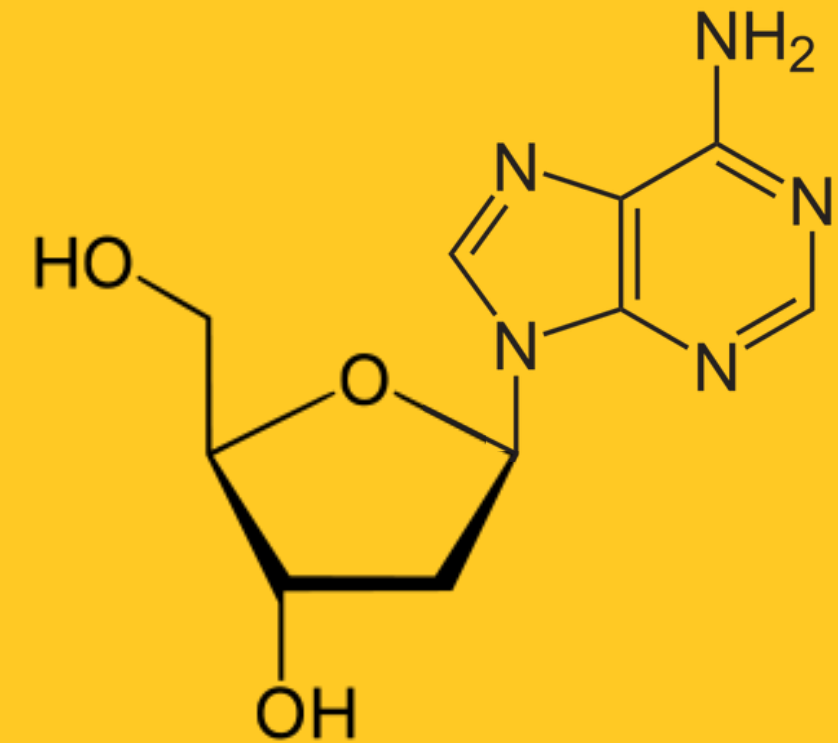


STILL SINGLE?



DNA

## Nucleoside

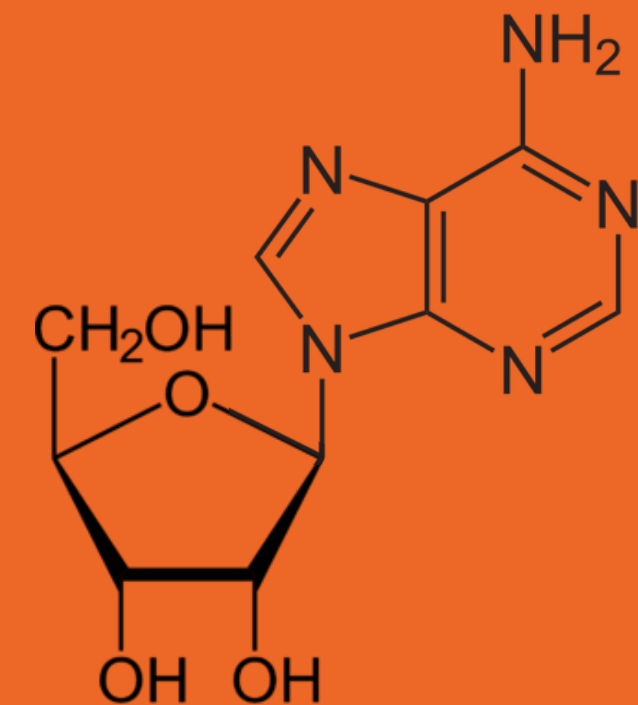


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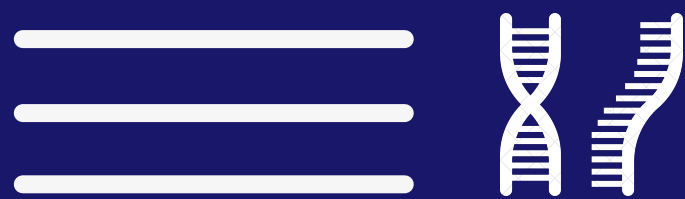


RNA

## Nucleoside



# Nucleic Acids

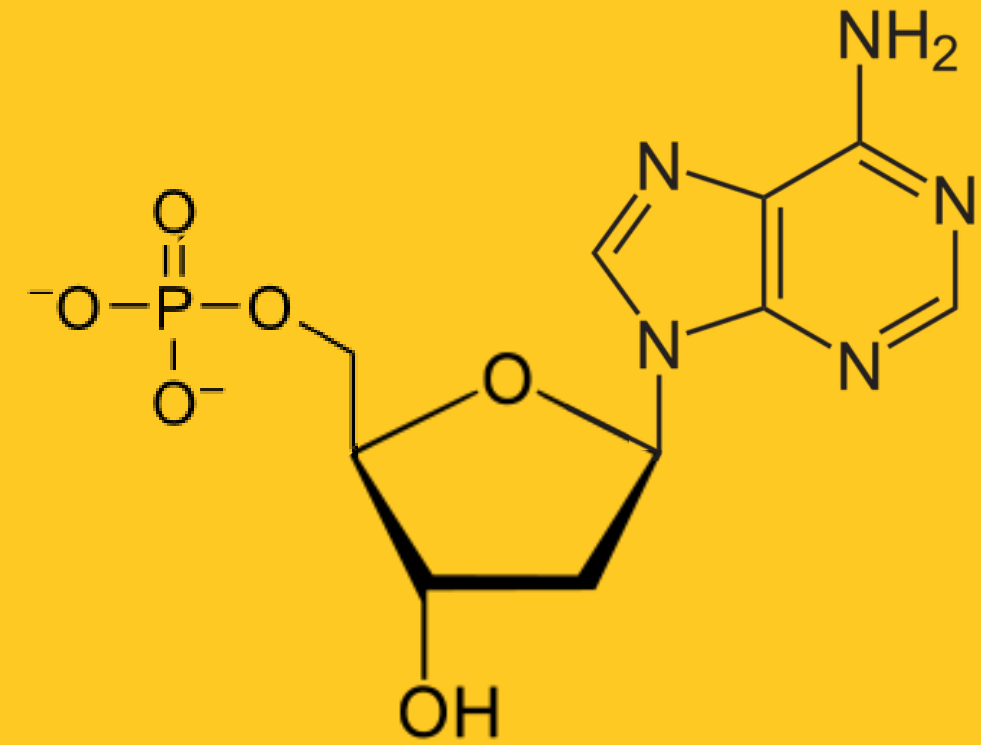


STILL SINGLE?



DNA

## Nucleotide

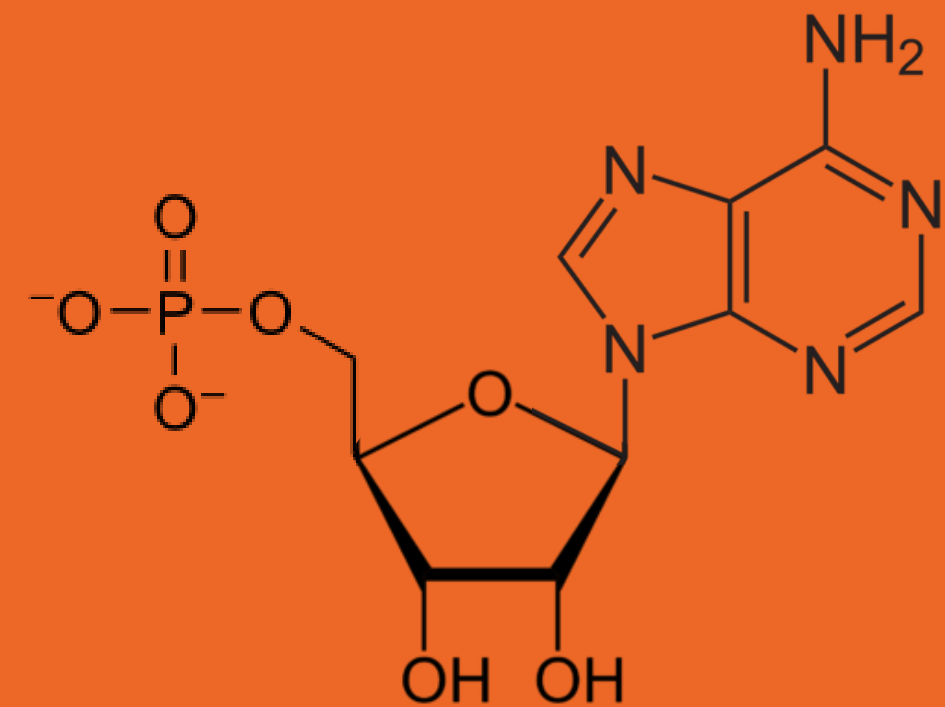


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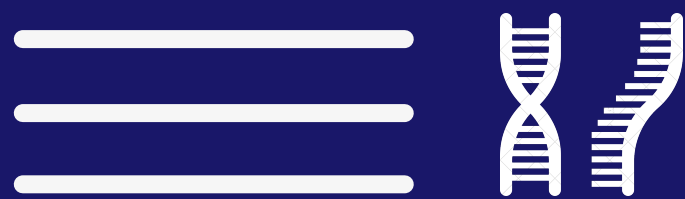


RNA

## Nucleotide



# Nucleic Acids



STILL SINGLE?

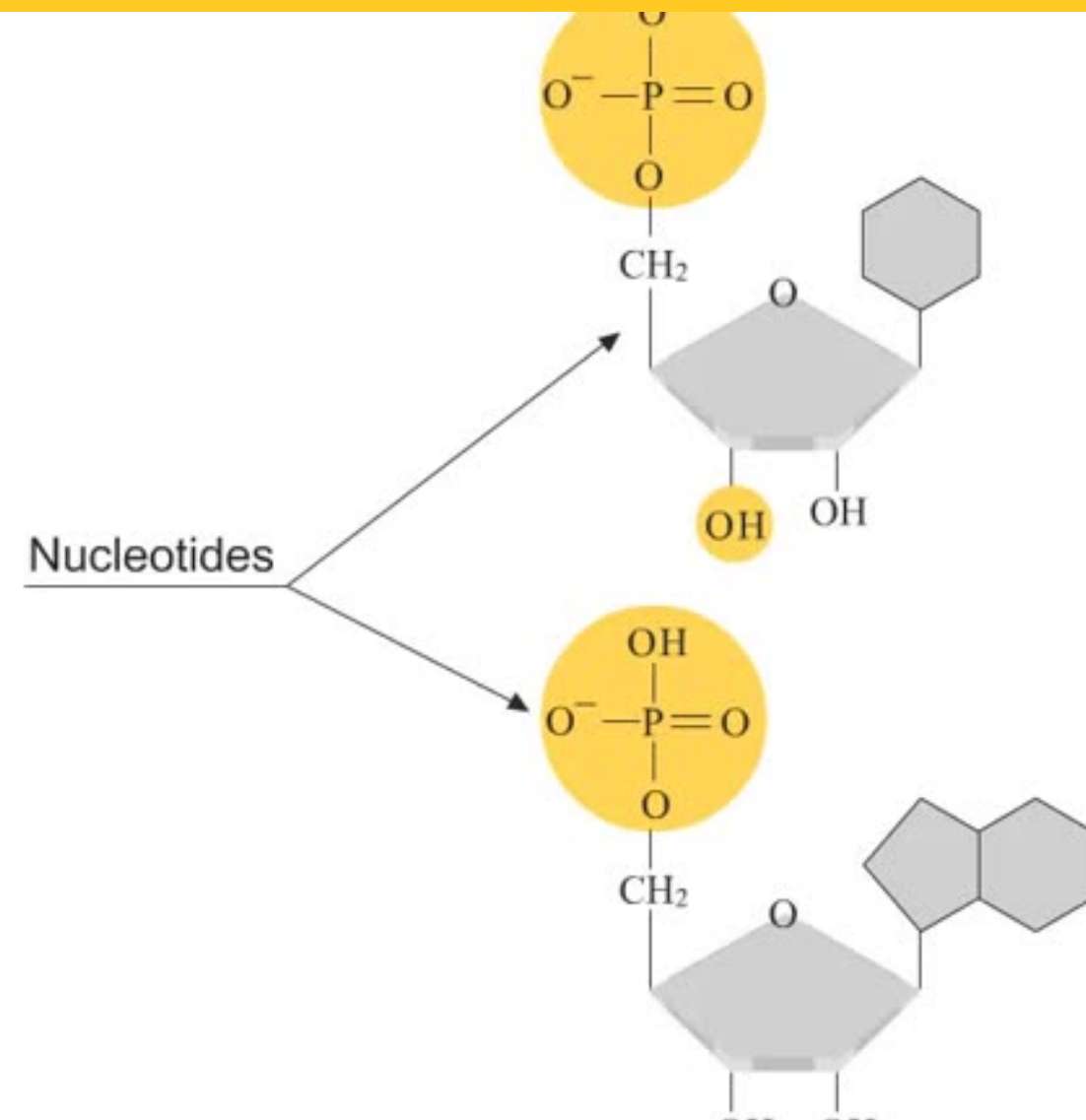


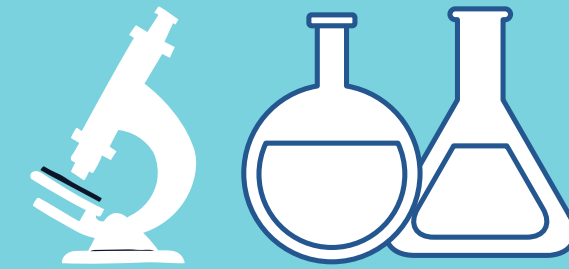
DNA

ALWAYS.

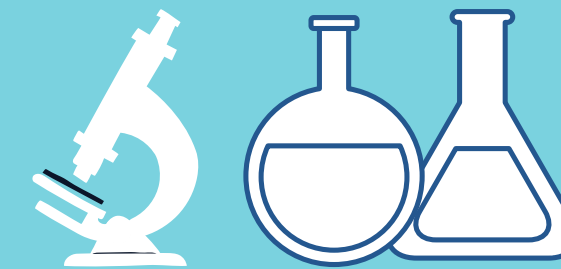
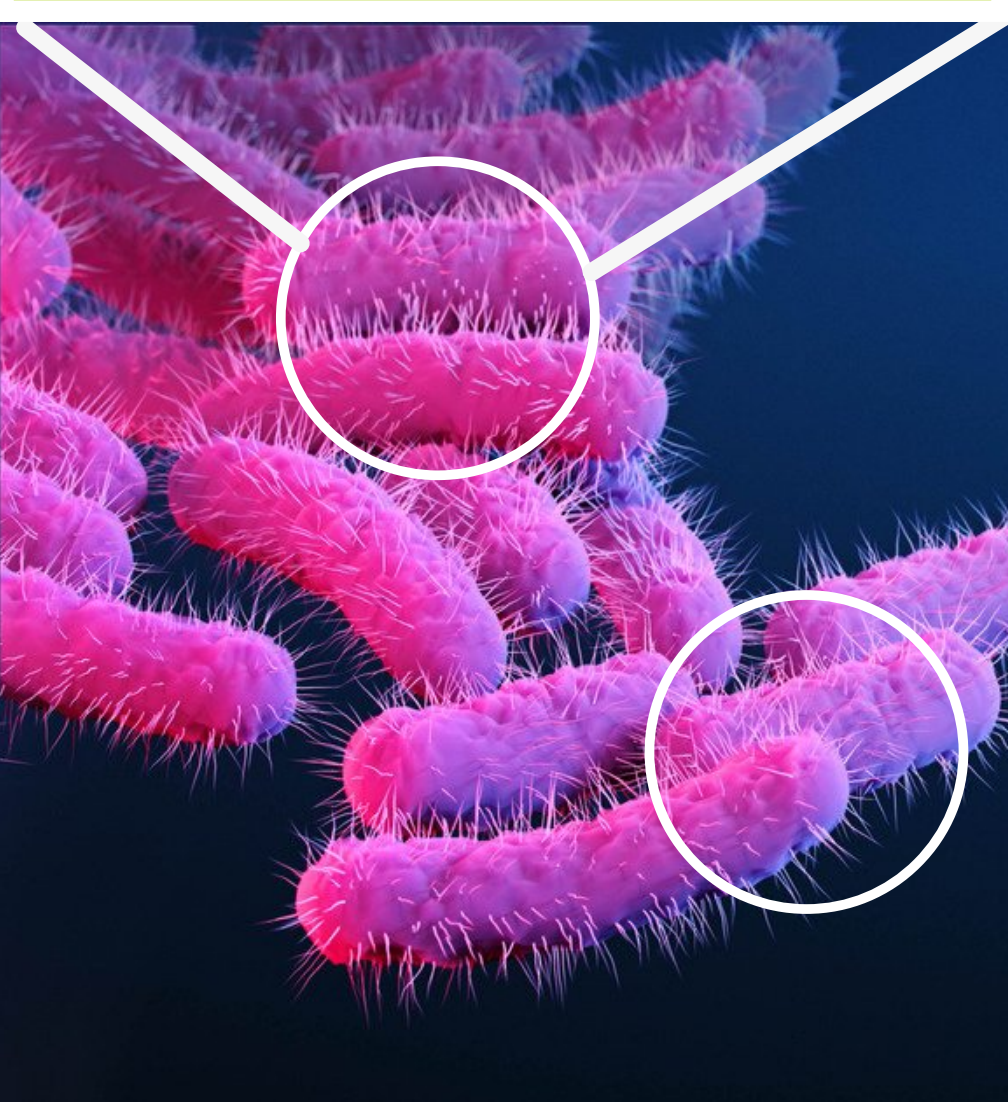
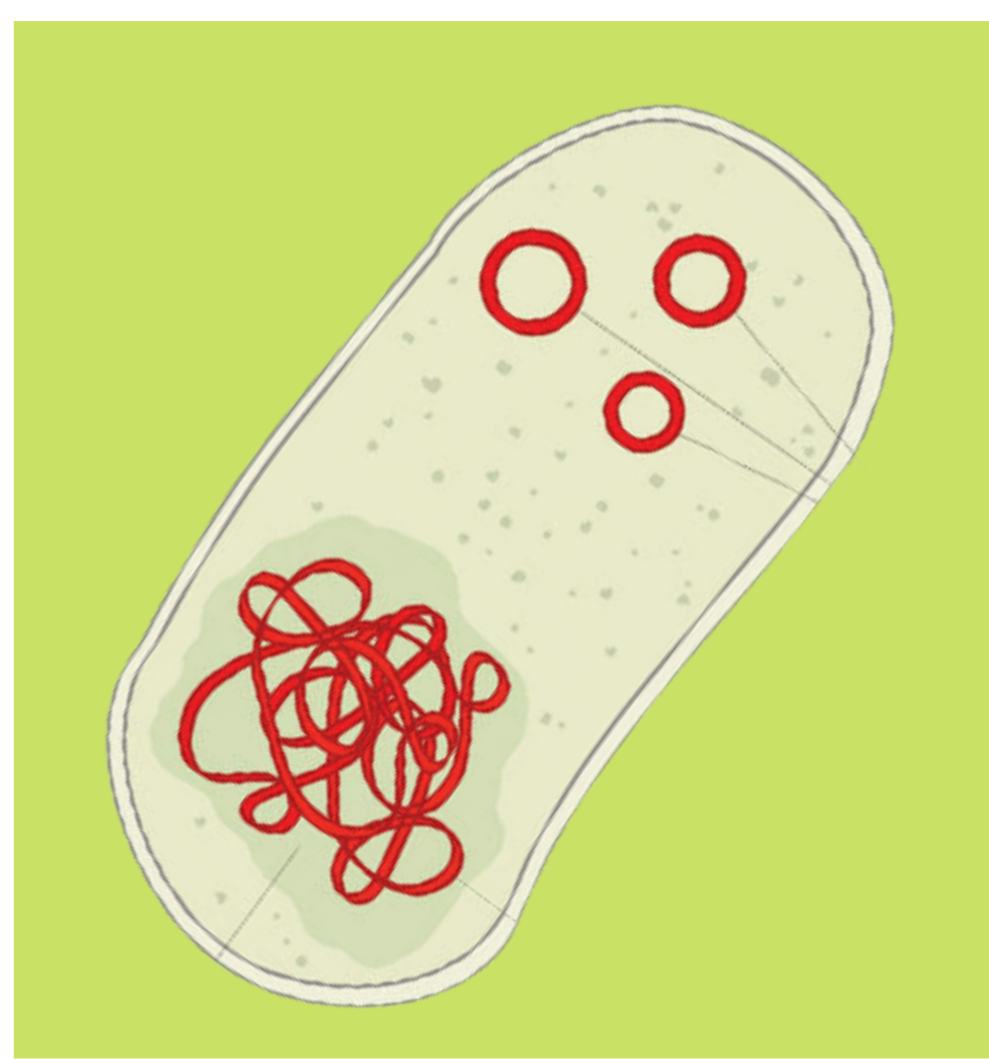


RNA





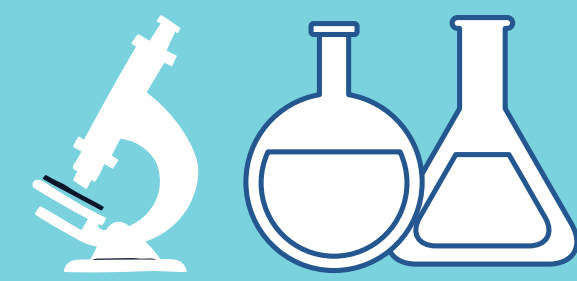
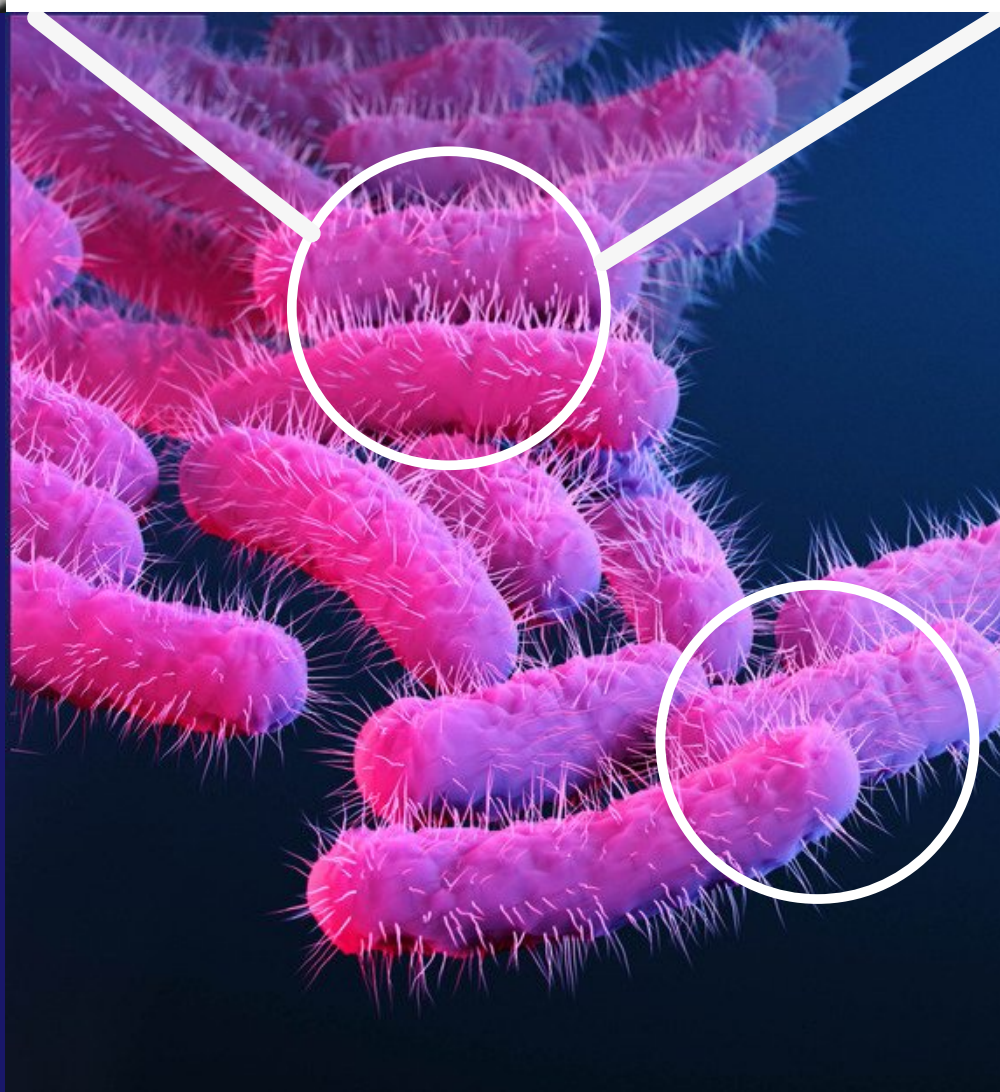
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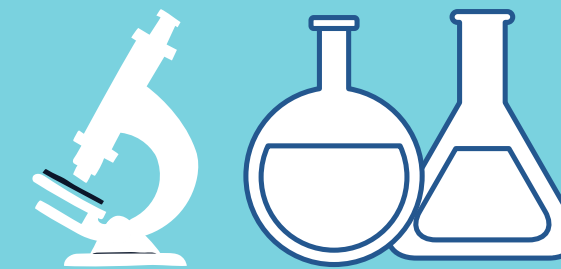
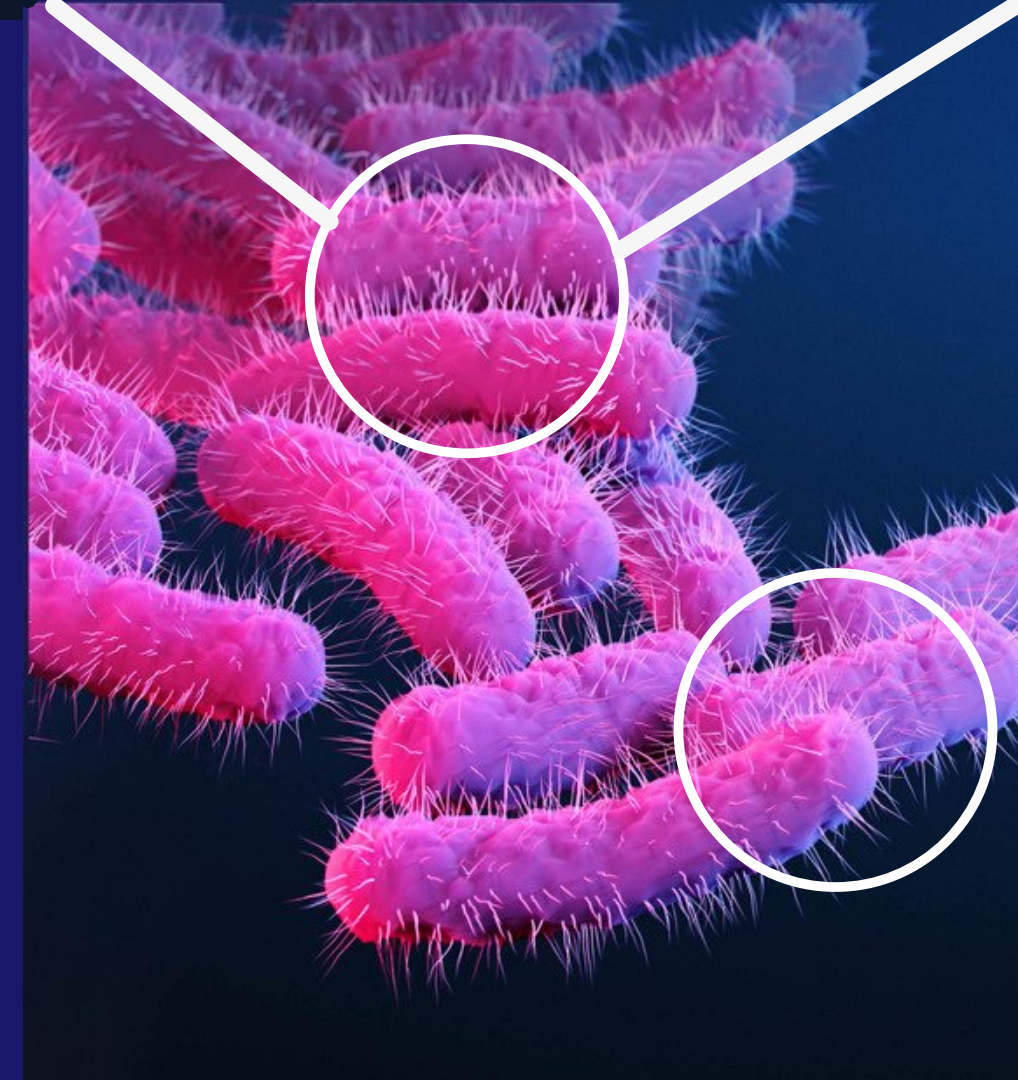
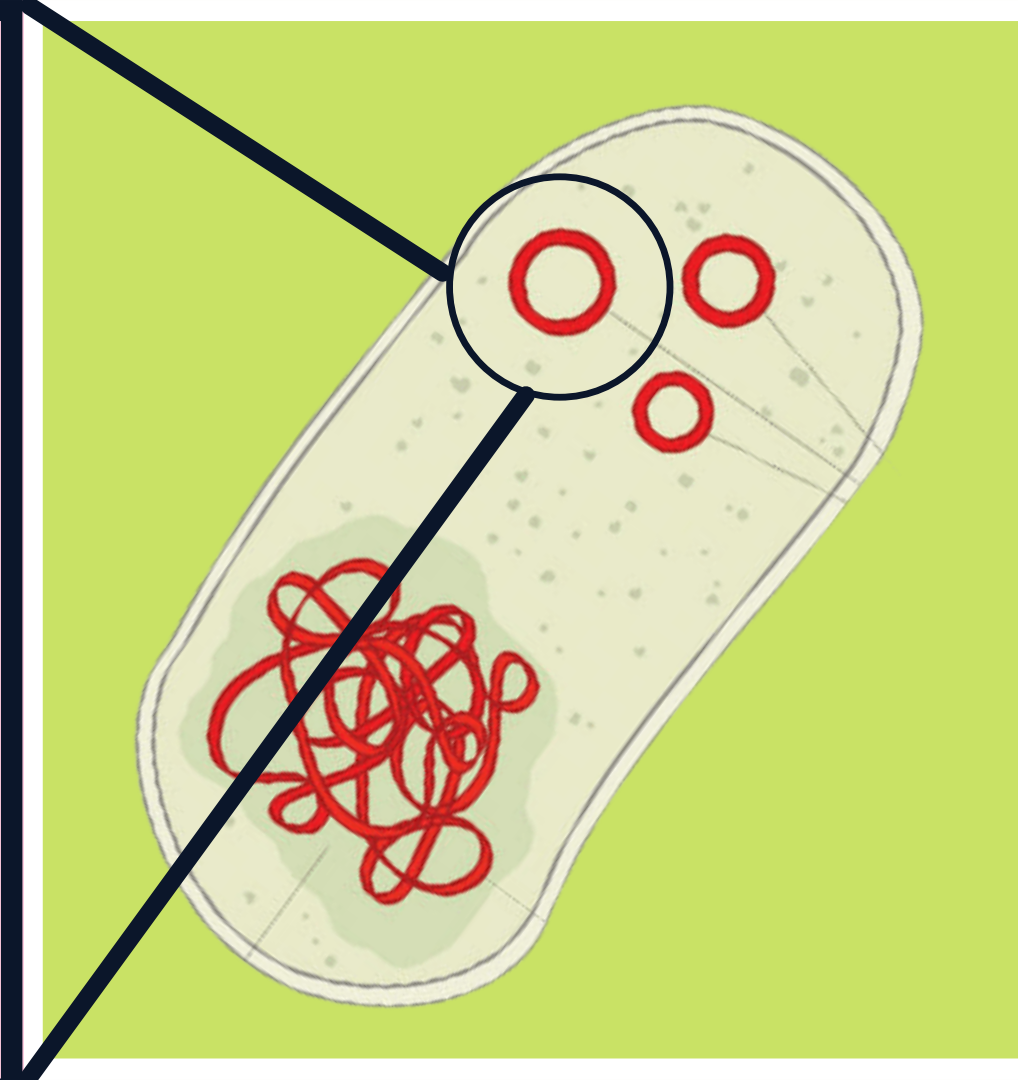
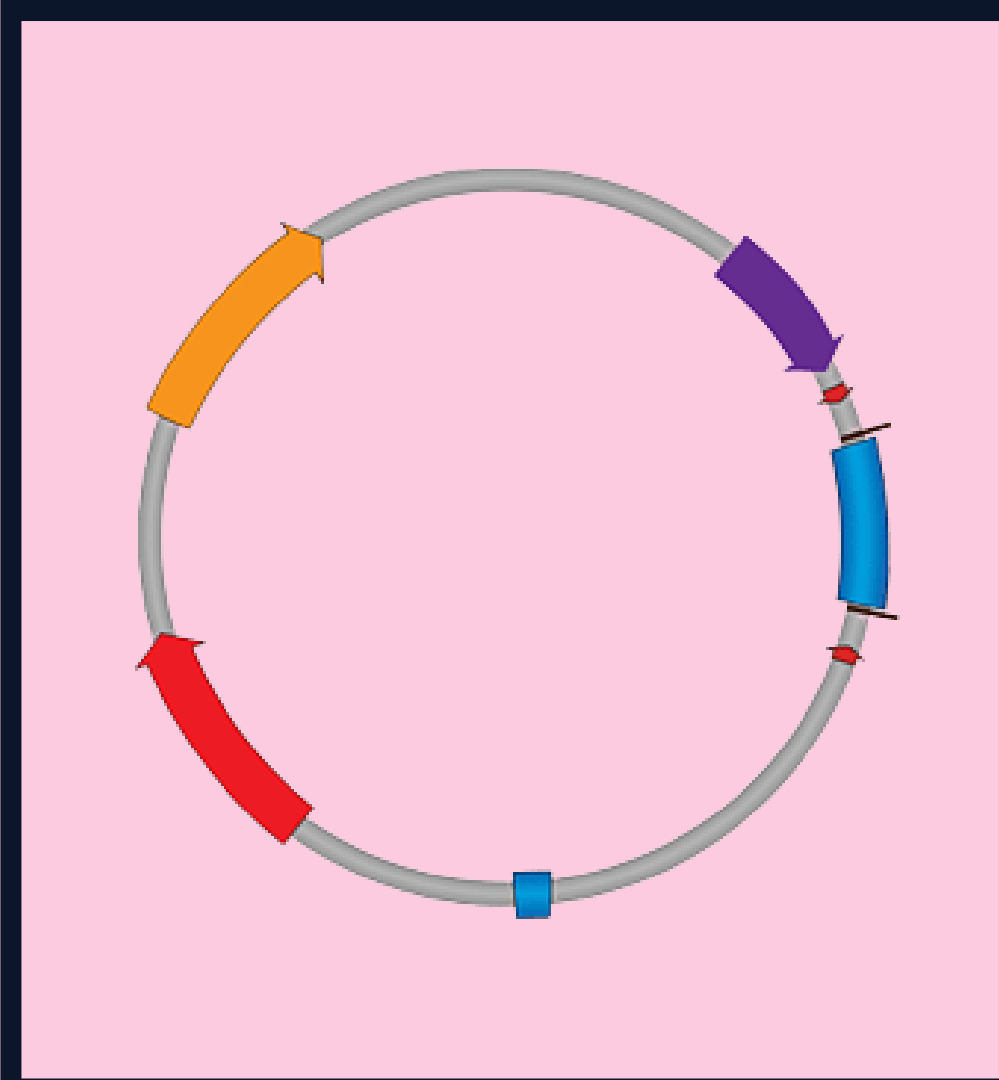
≡ DNA

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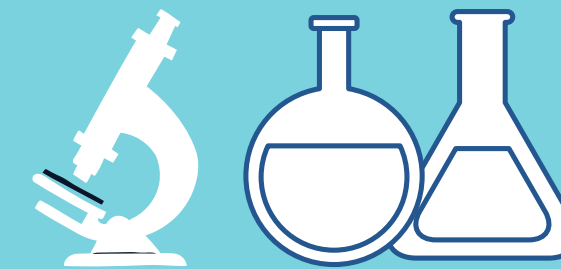
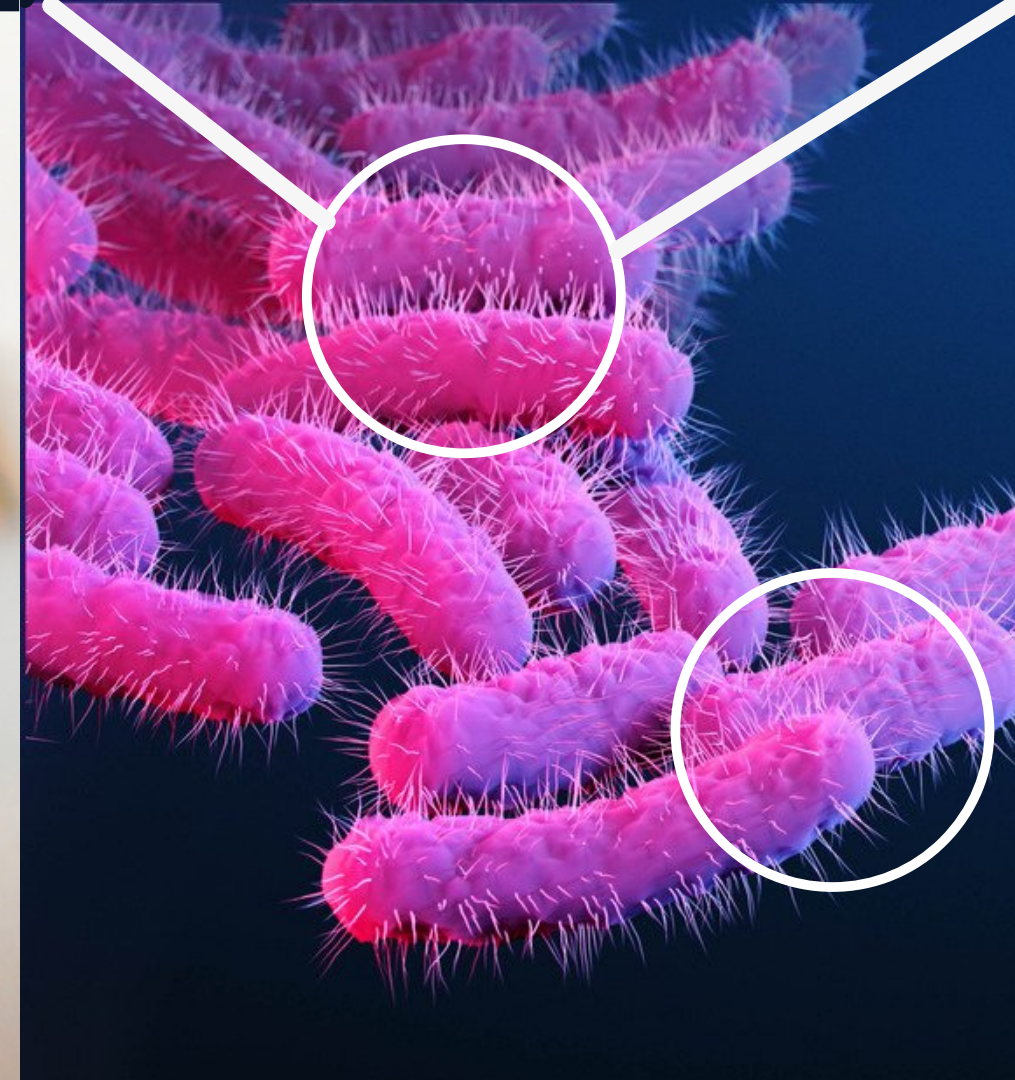
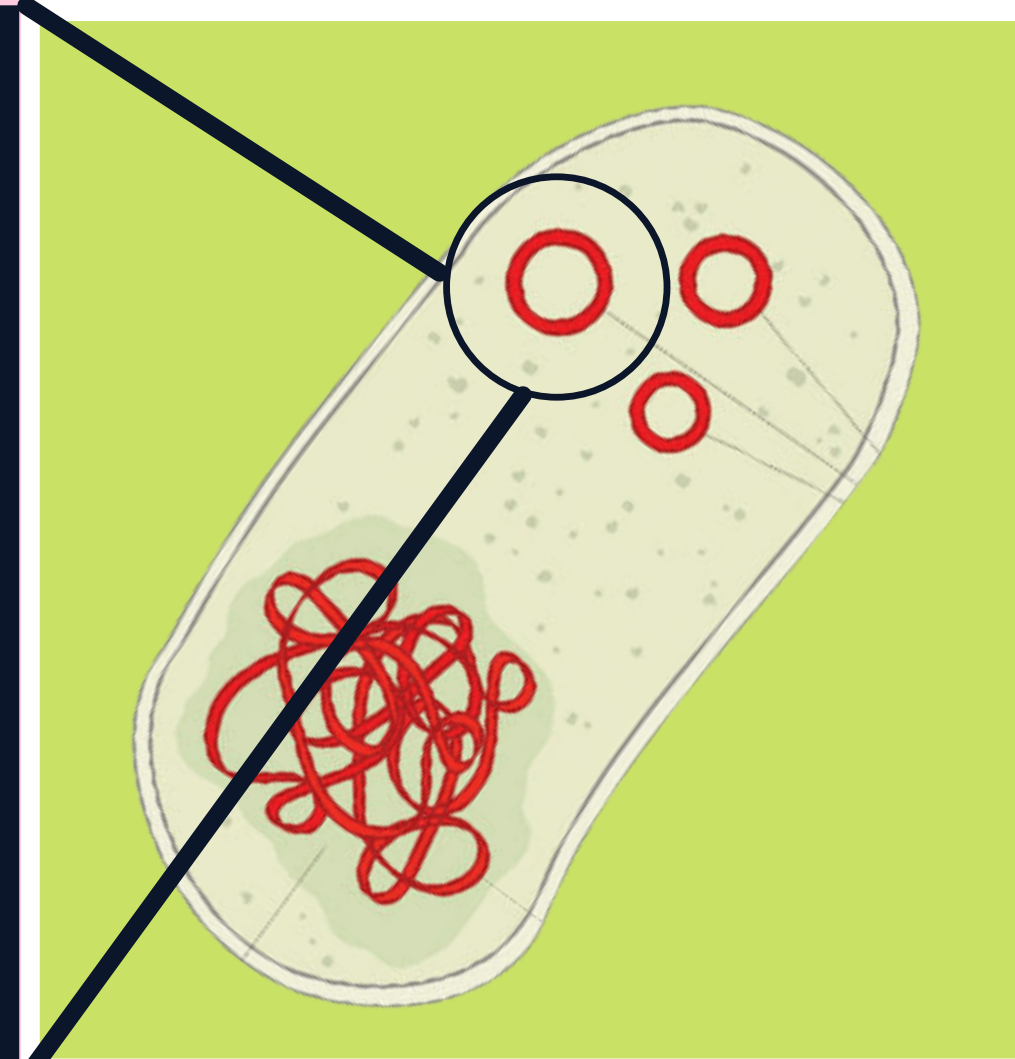
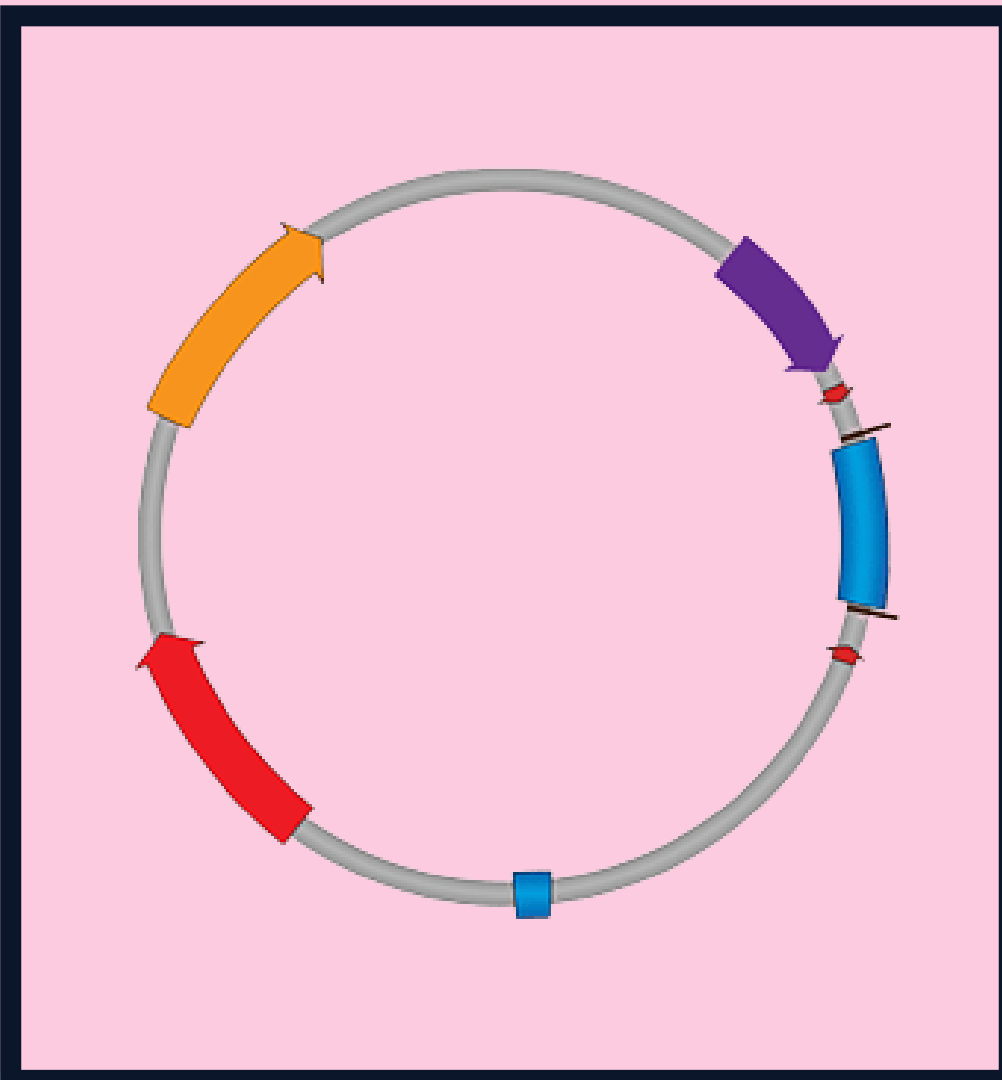
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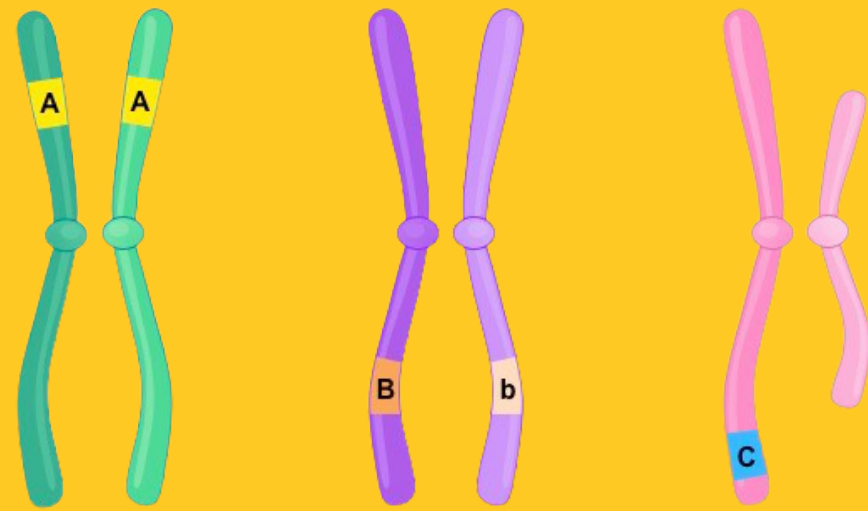
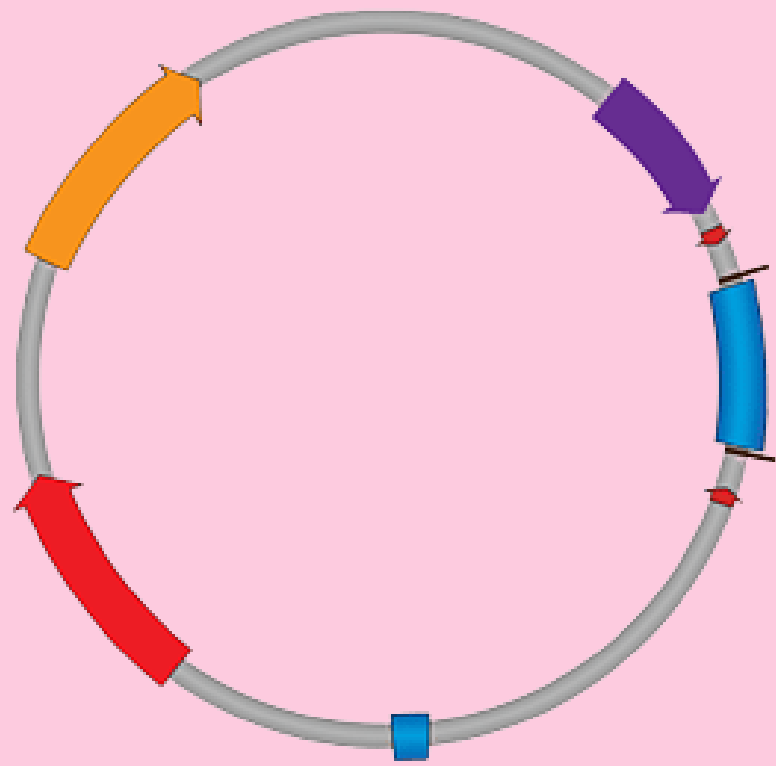
Code!



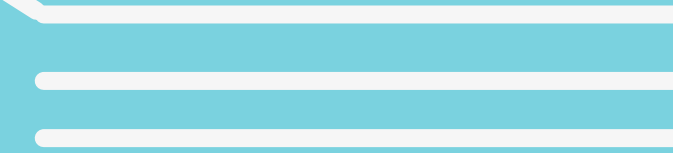
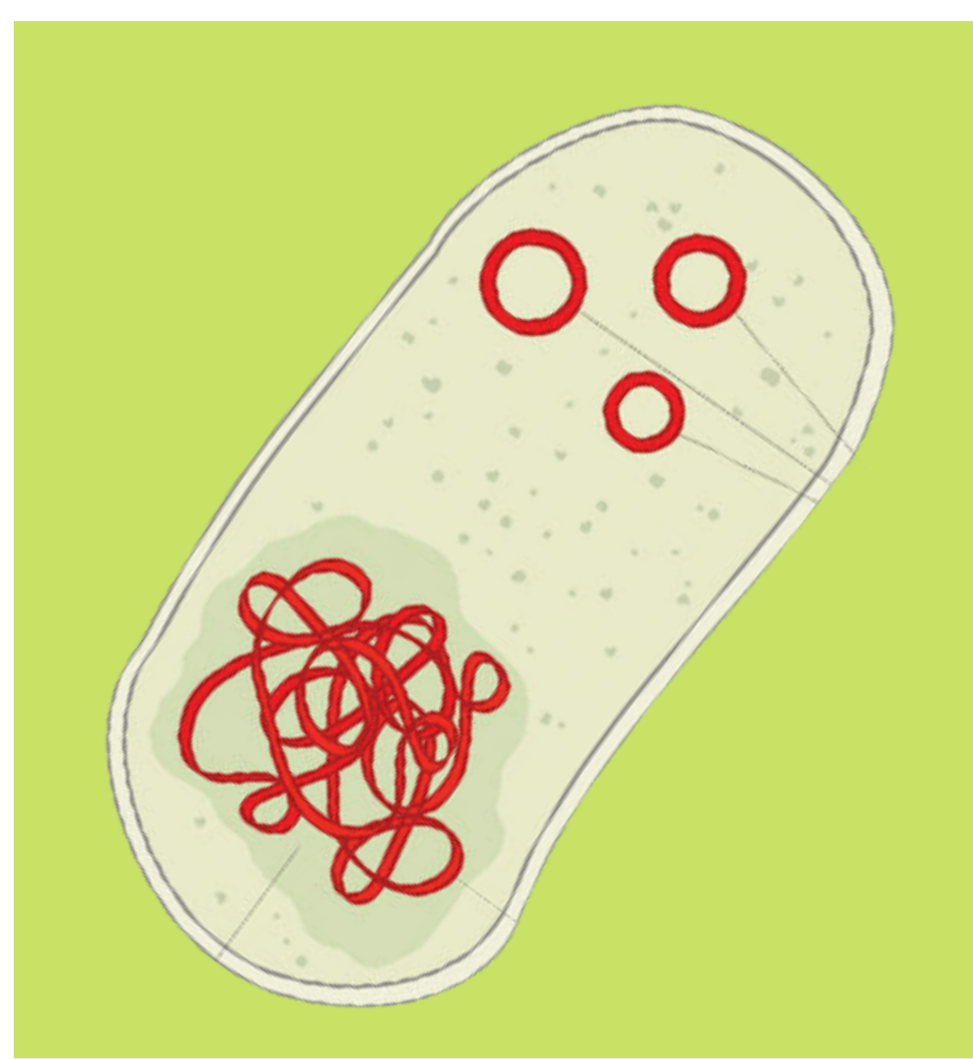
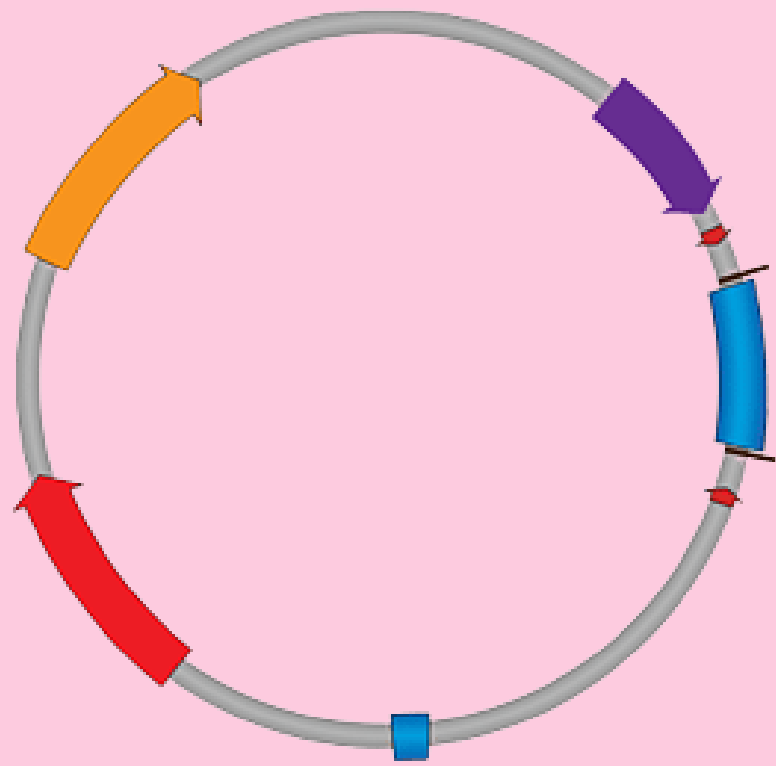
**Code!**



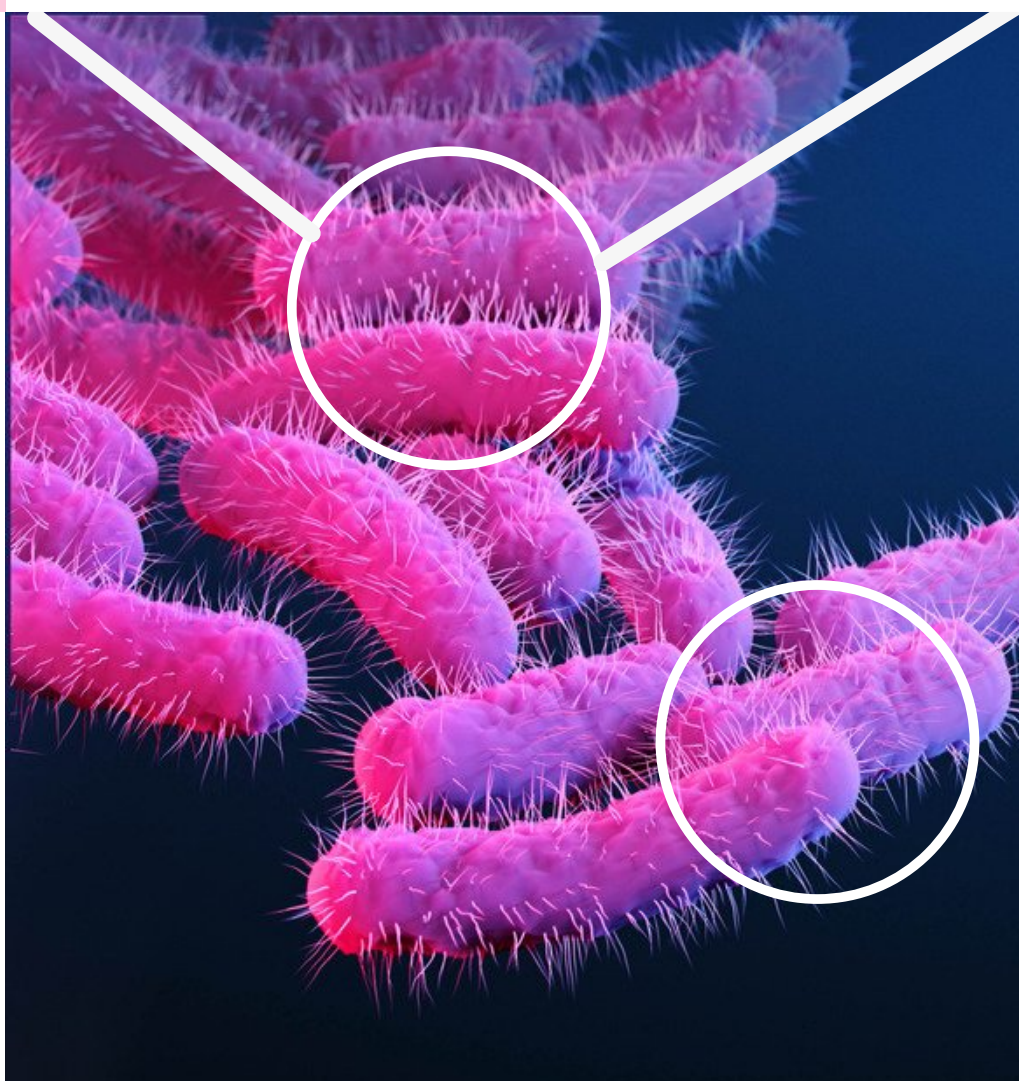
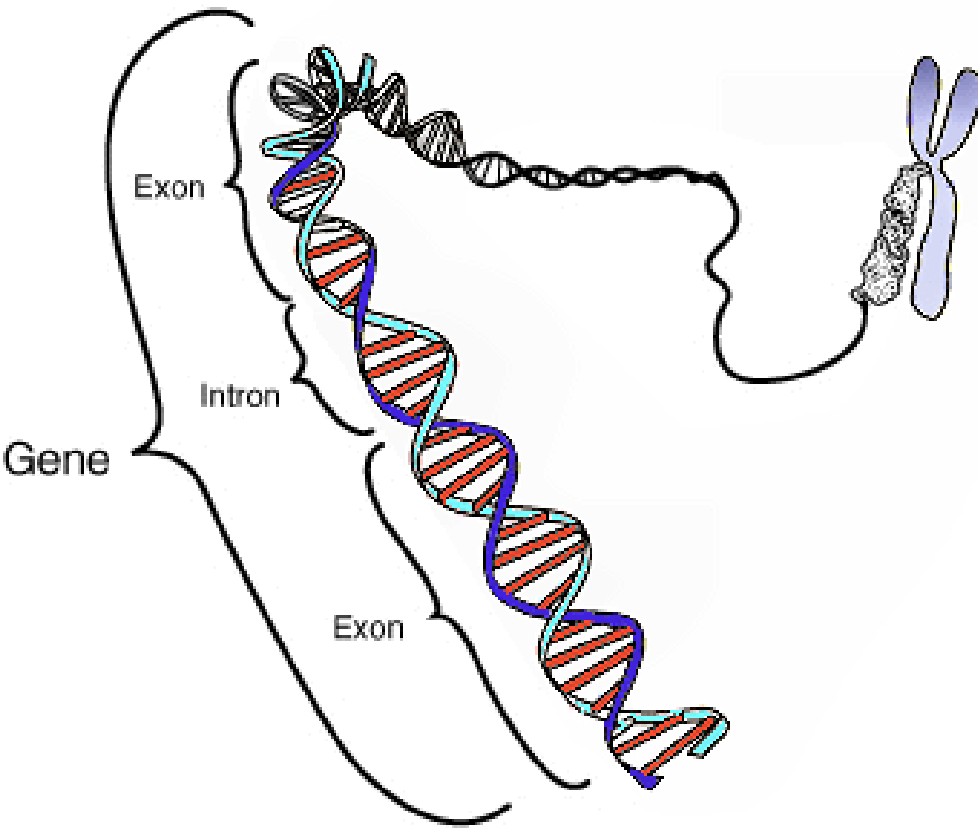
Code!



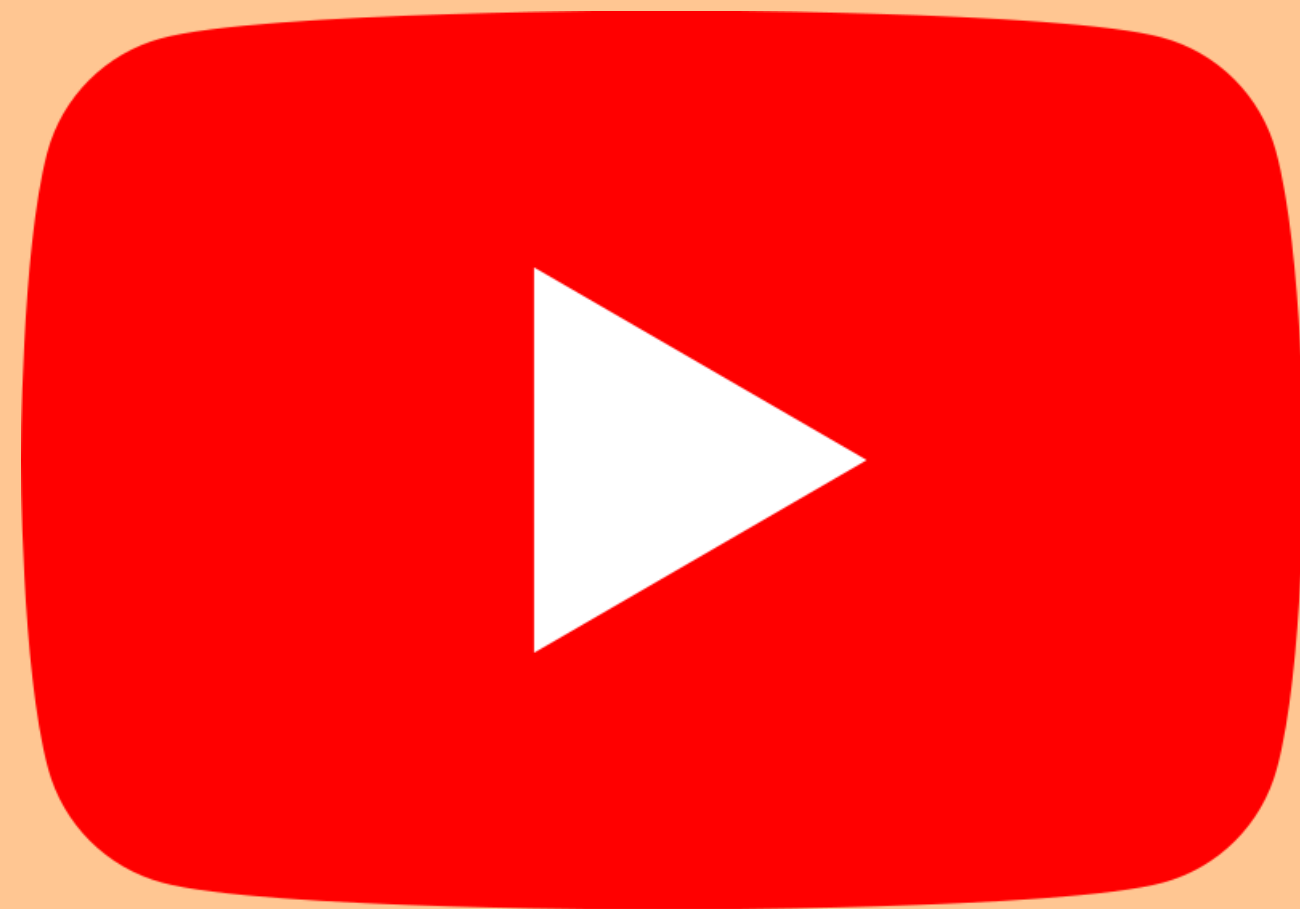
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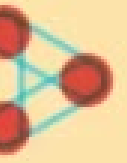


**Code!**

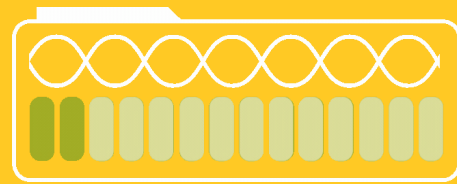


# Structure of DNA

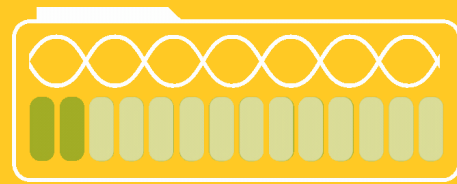




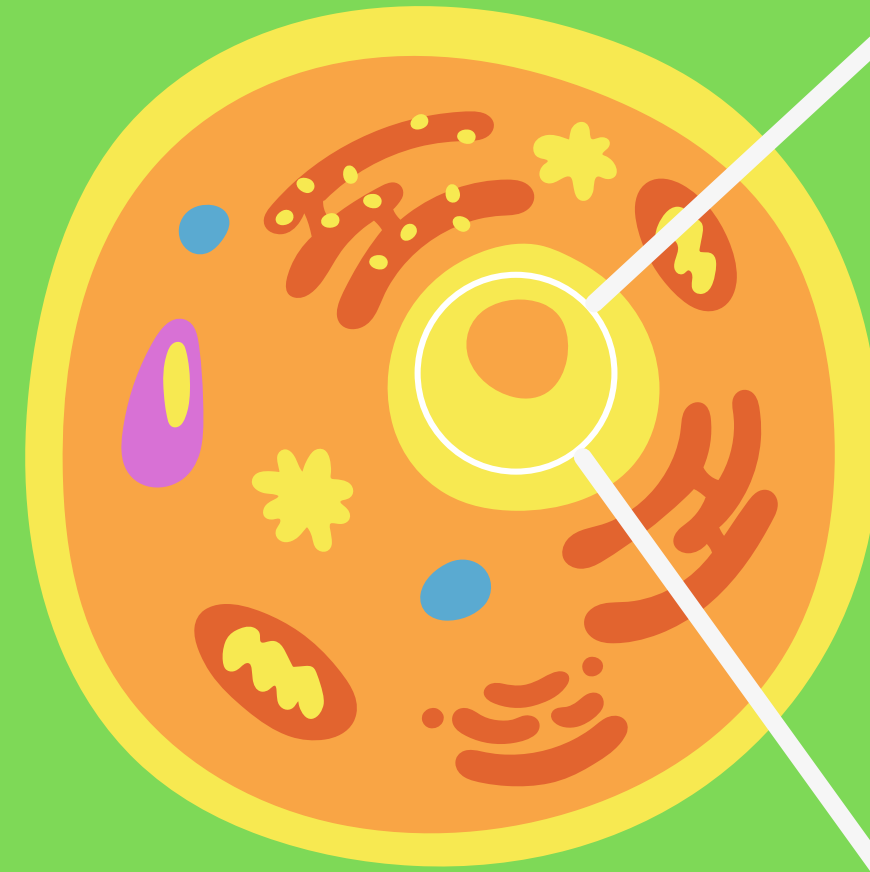
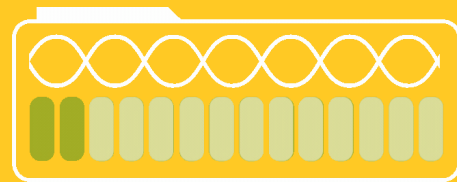
# Central Dogma of Life



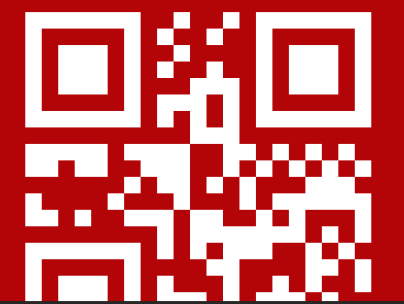
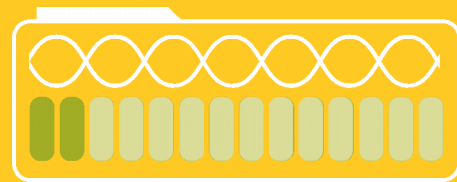
# Central Dogma of Life



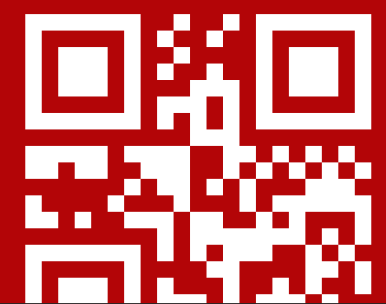
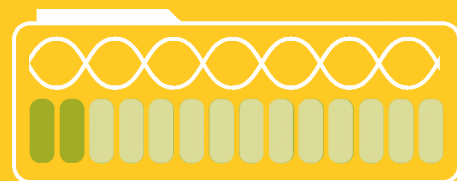
# Central Dogma of Life



# Central Dogma of Life

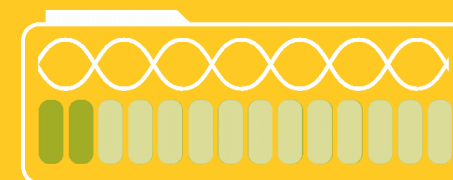


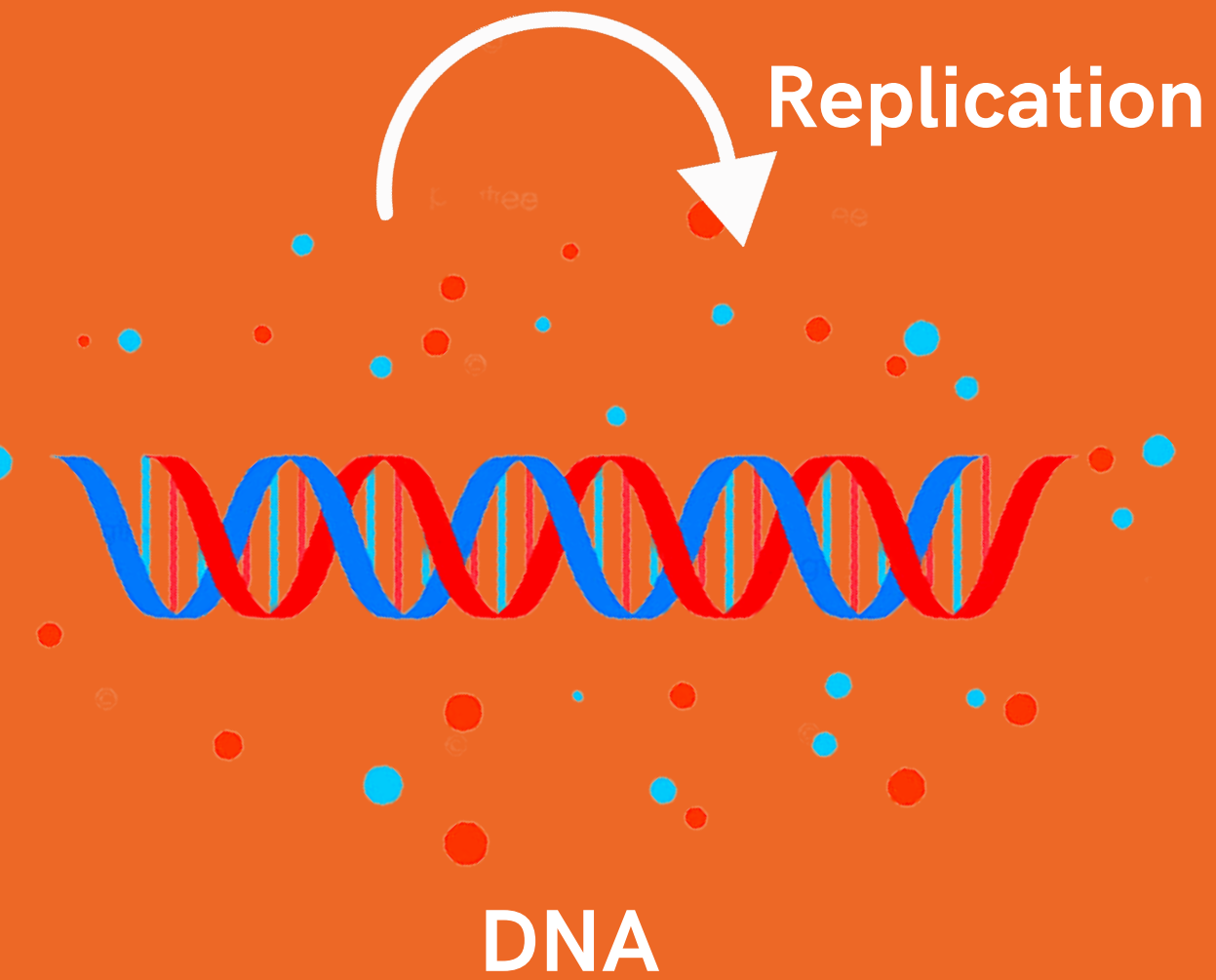
# Central Dogma of Life



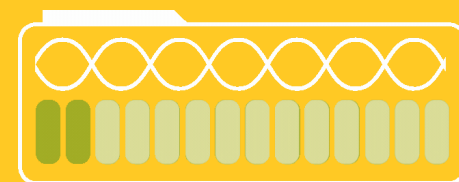


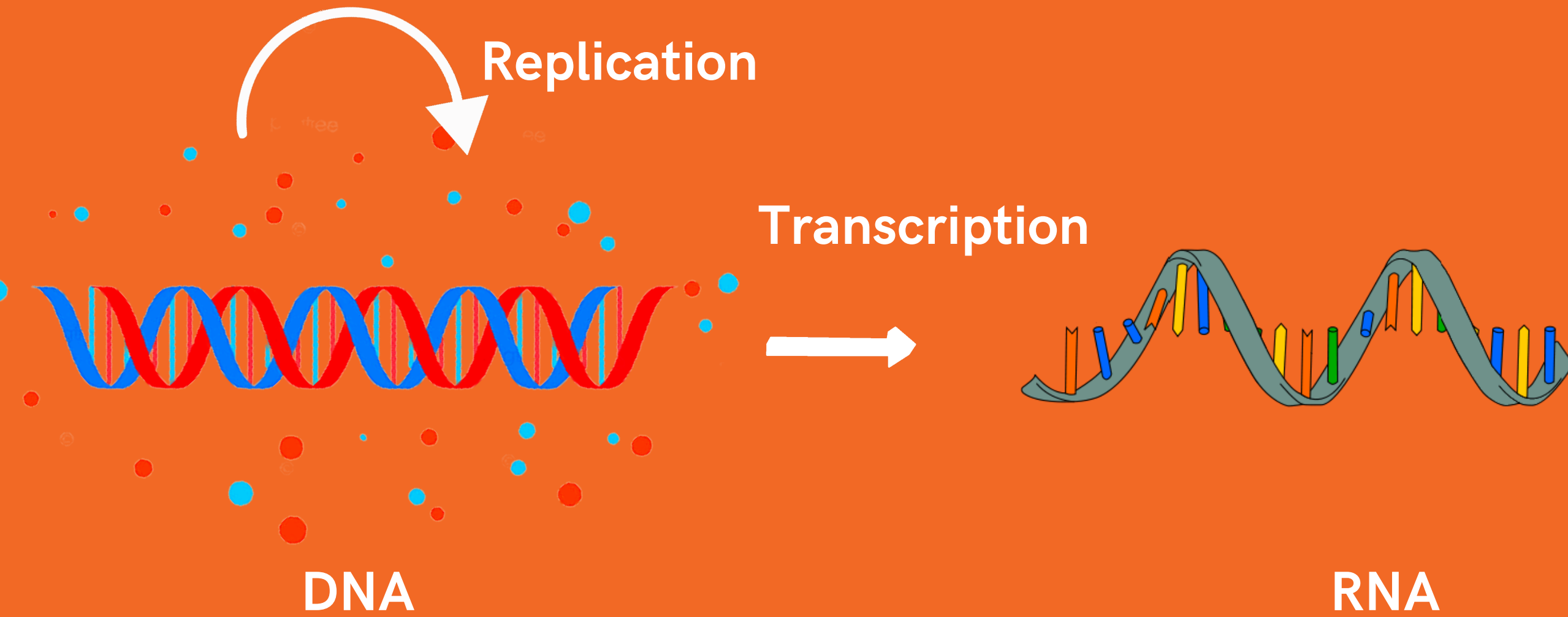
# Central Dogma of Life



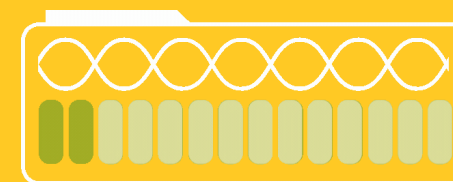


# Central Dogma of Life



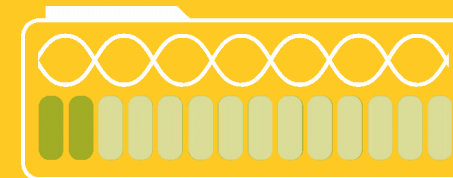


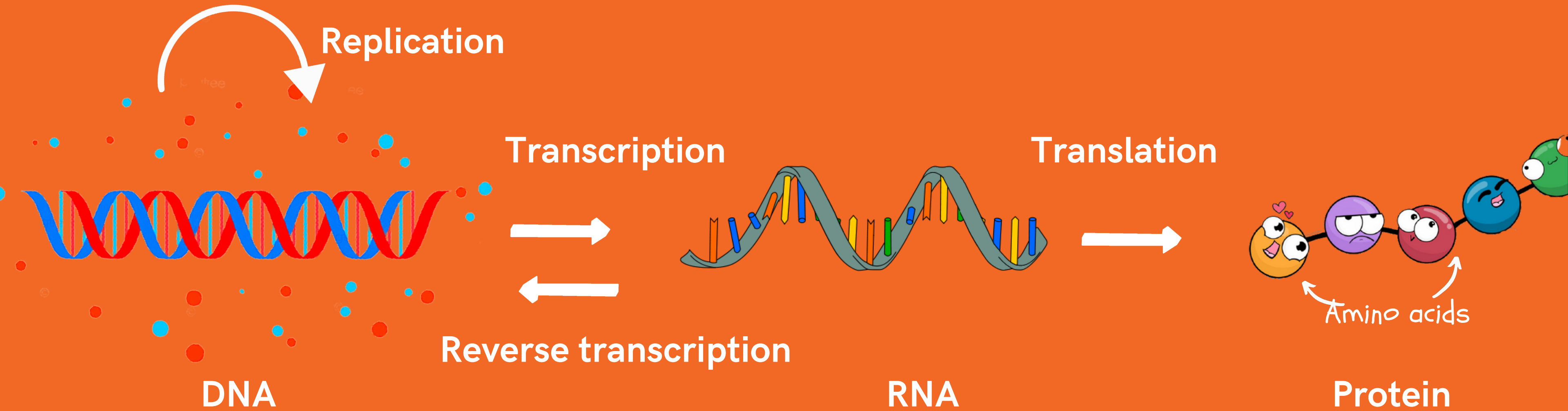
# Central Dogma of Life



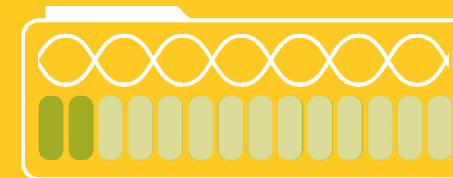


# Central Dogma of Life

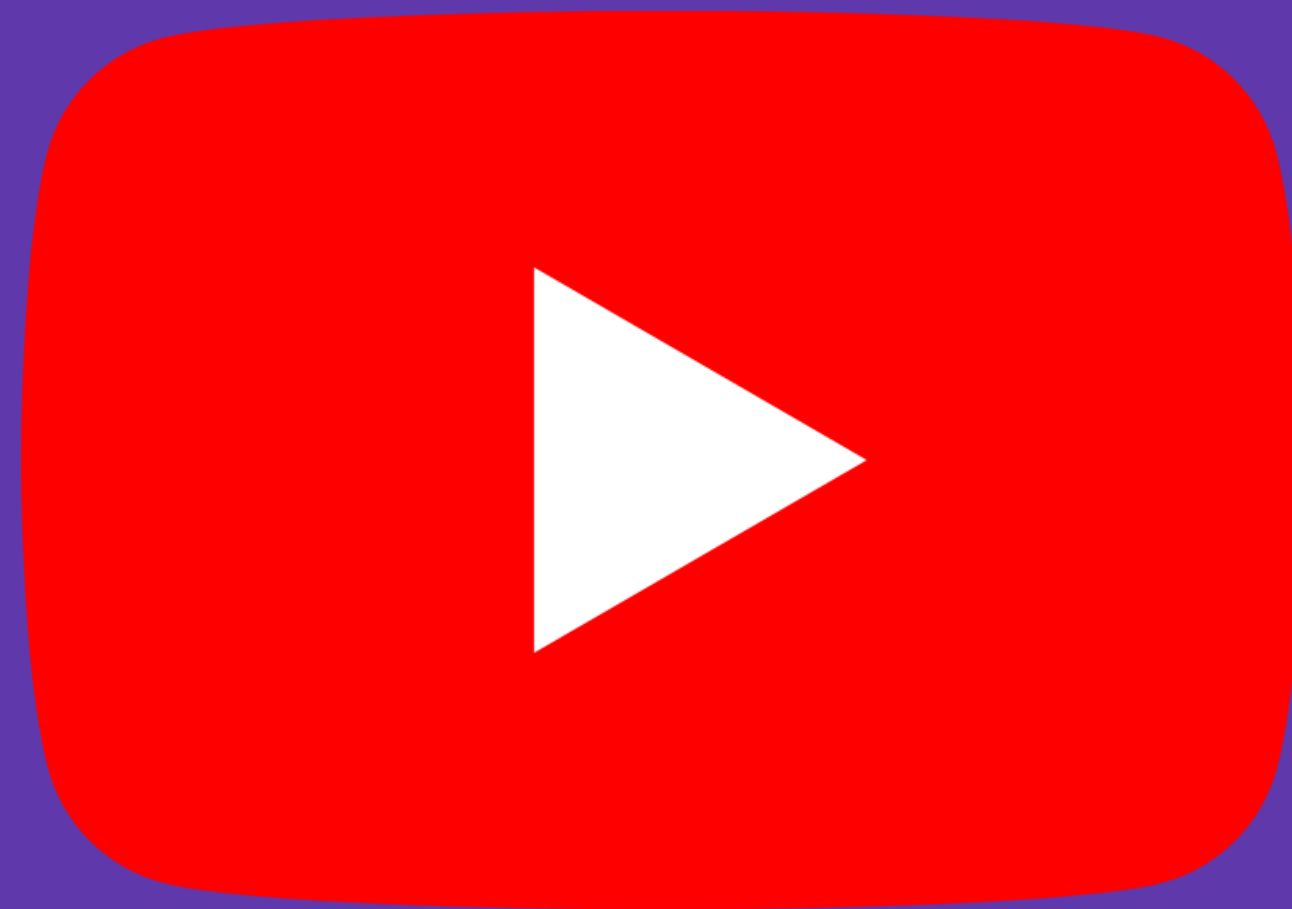




# Central Dogma of Life



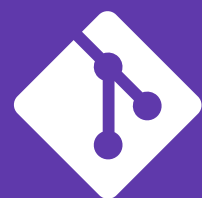
# DNA Replication



Source - [DNA Replication by Amoeba Sisters](#)



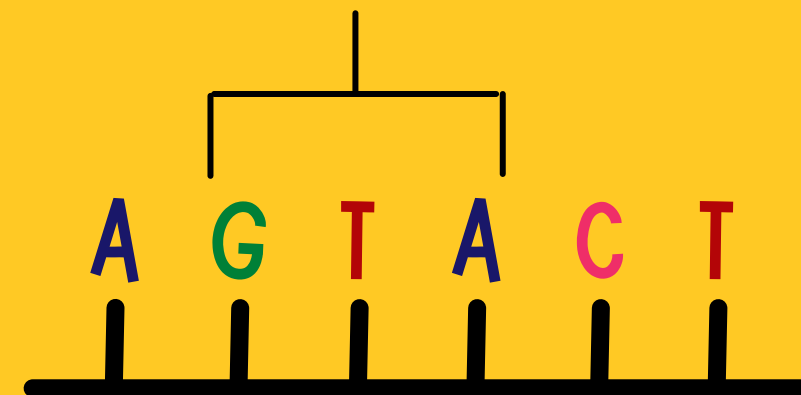
# Codon



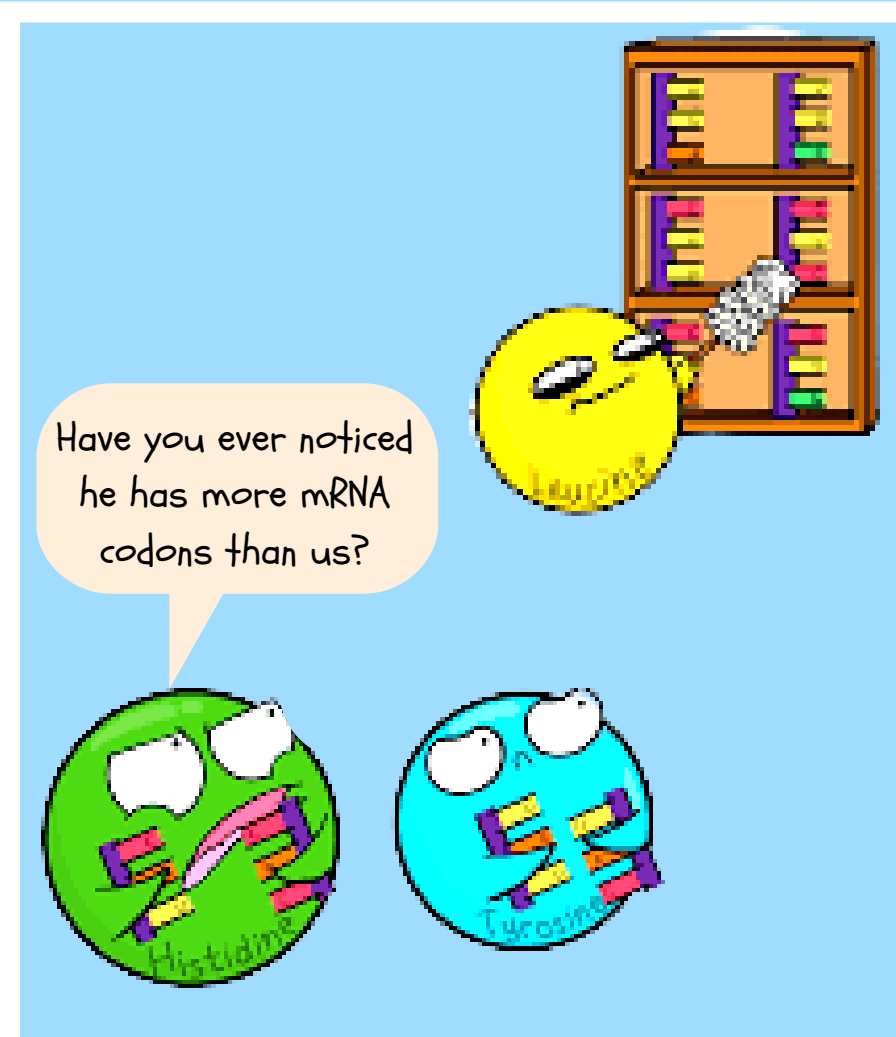
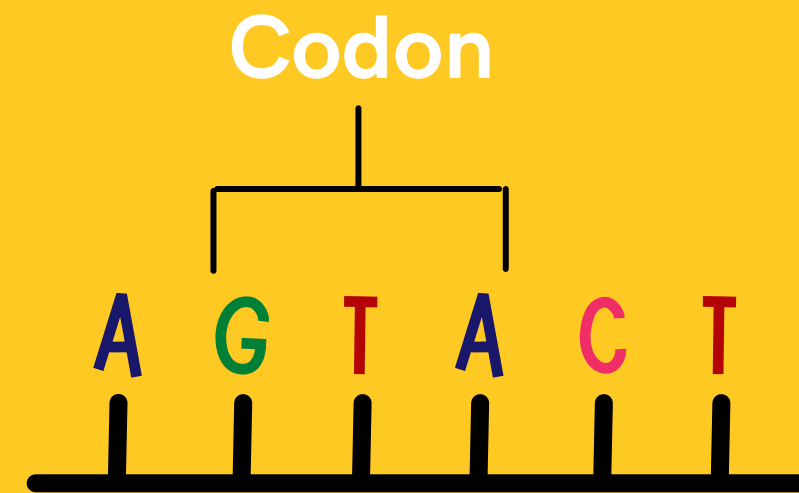
# Codon



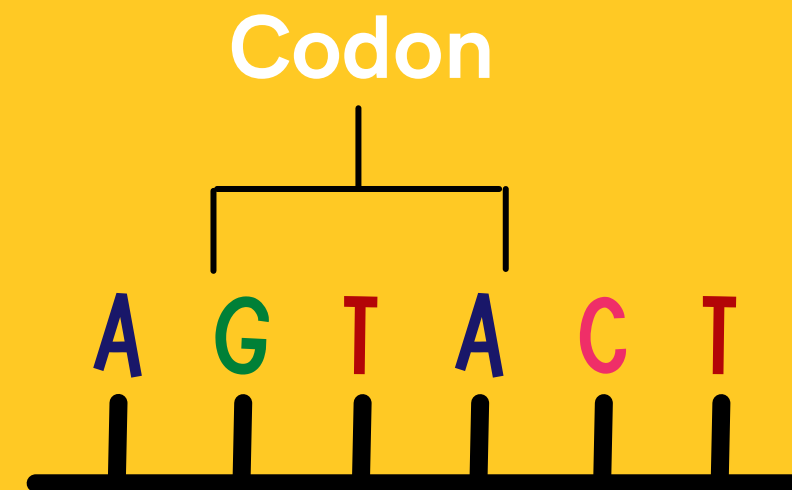
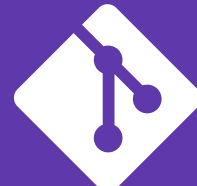
Codon



# Codon



# Codon

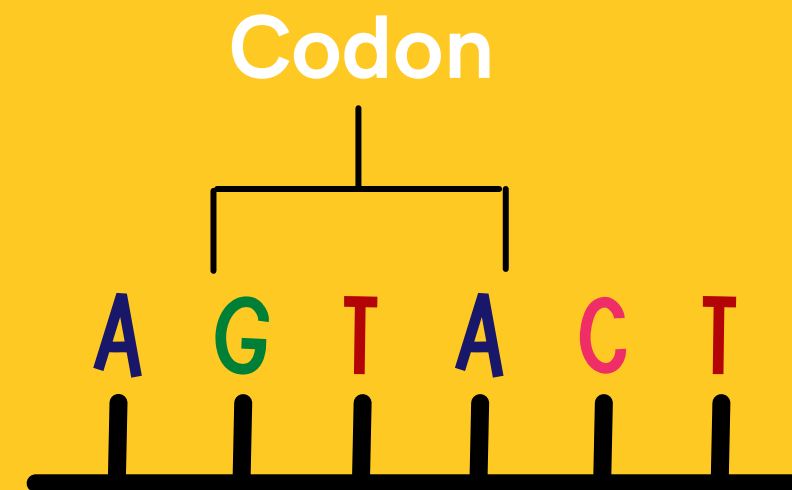


Have you ever noticed he has more mRNA codons than us?



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

# Codon



Have you ever noticed he has more mRNA codons than us?

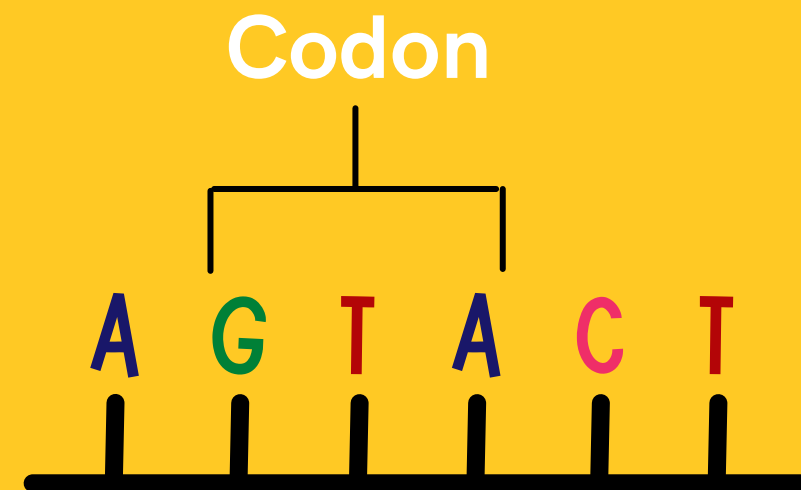


UAA  
UAG  
UGA

Codon

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

# Codon



Have you ever noticed he has more mRNA codons than us?



AUG

START

Codon

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

# Codon



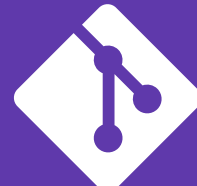
## Introns and Exons

Taking attendance in the genome



<http://biocomical5.blogspot.com>

# Codon

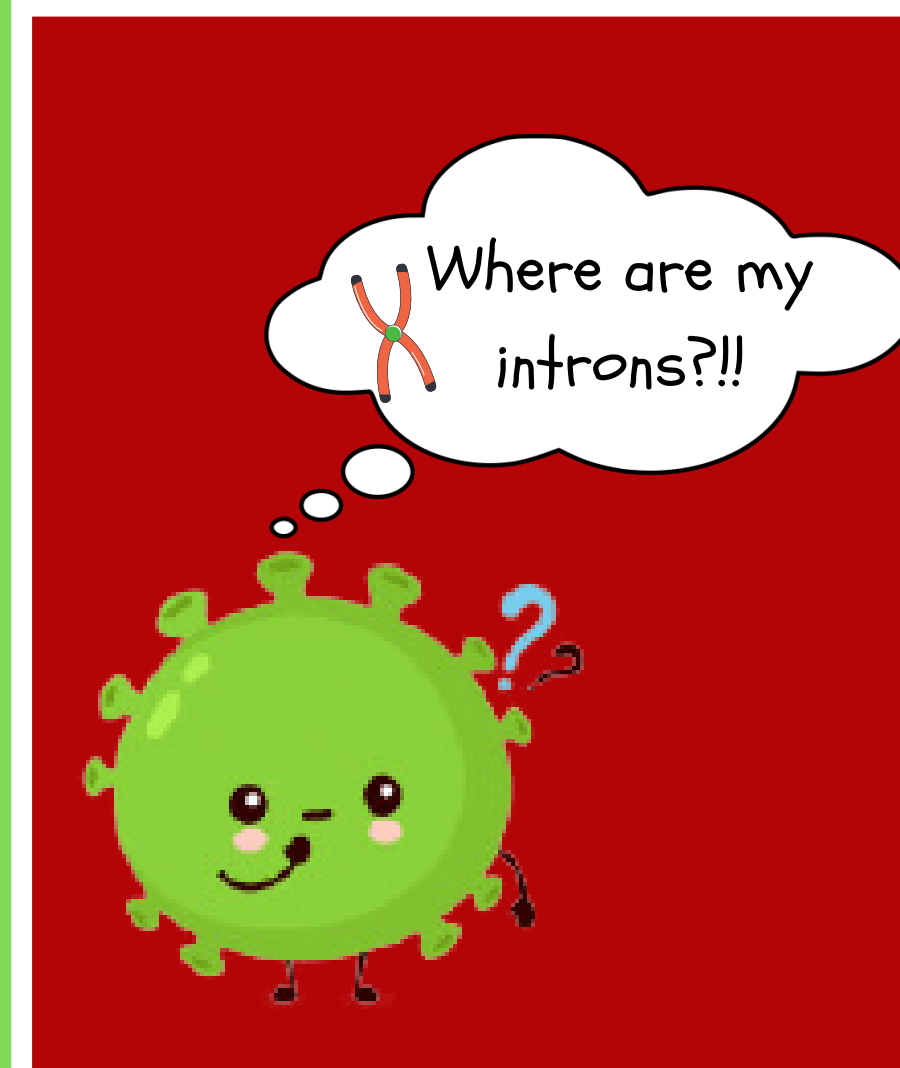


## Introns and Exons

Taking attendance in the genome



<http://biocomicals.blogspot.com>



# Codon

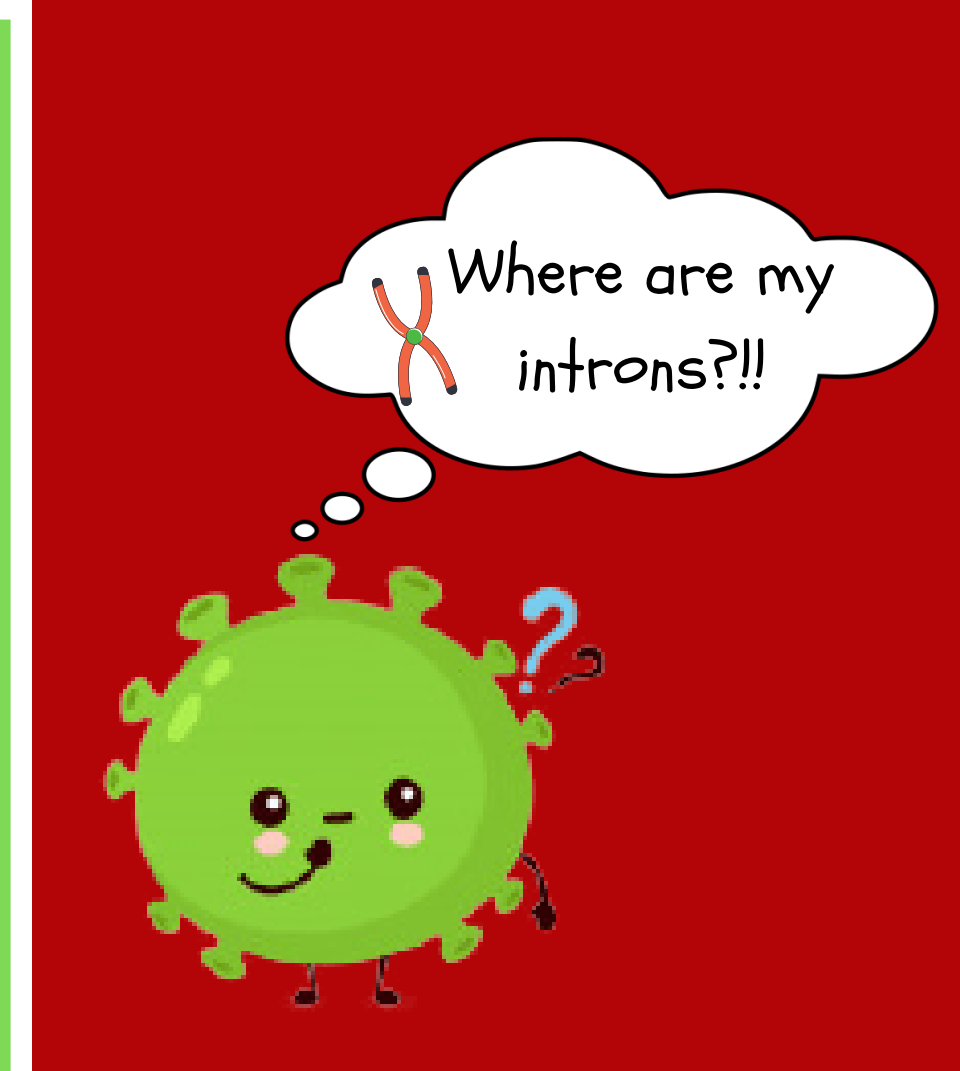
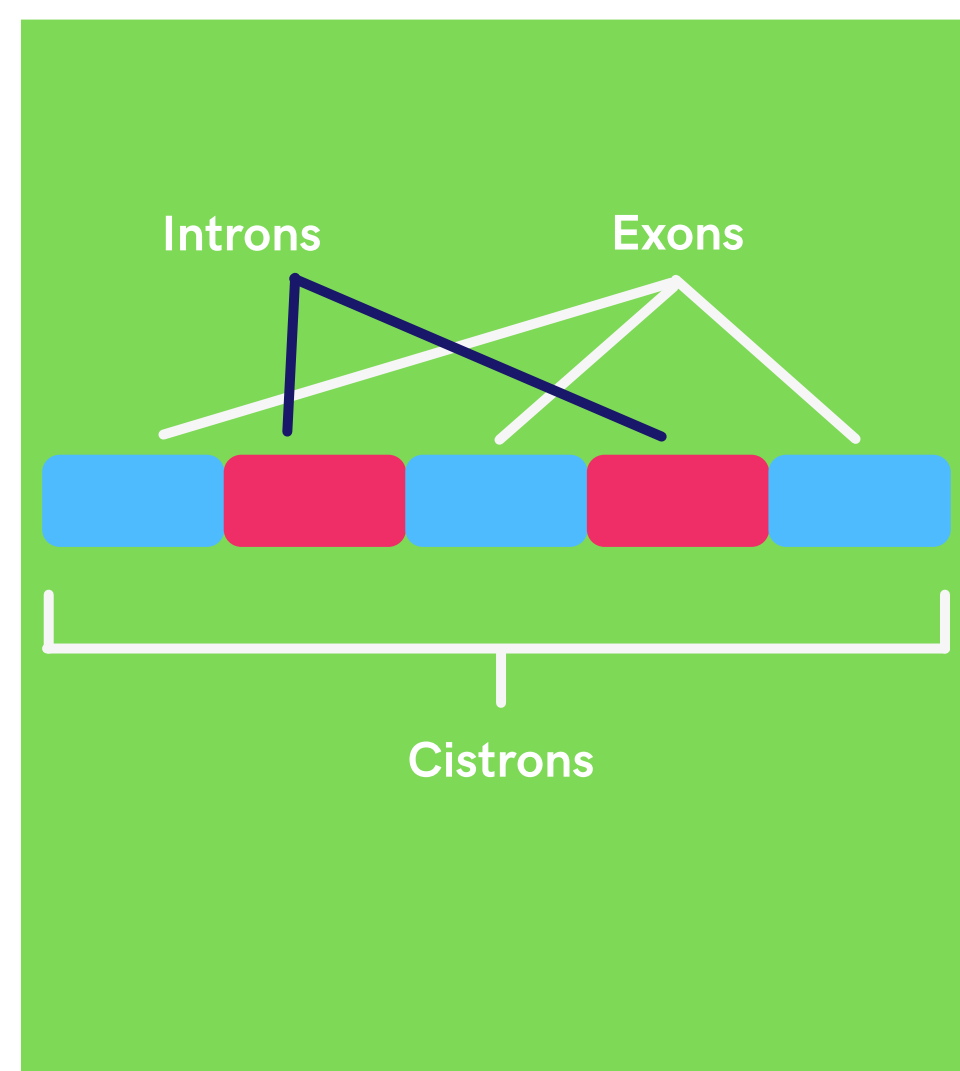


## Introns and Exons

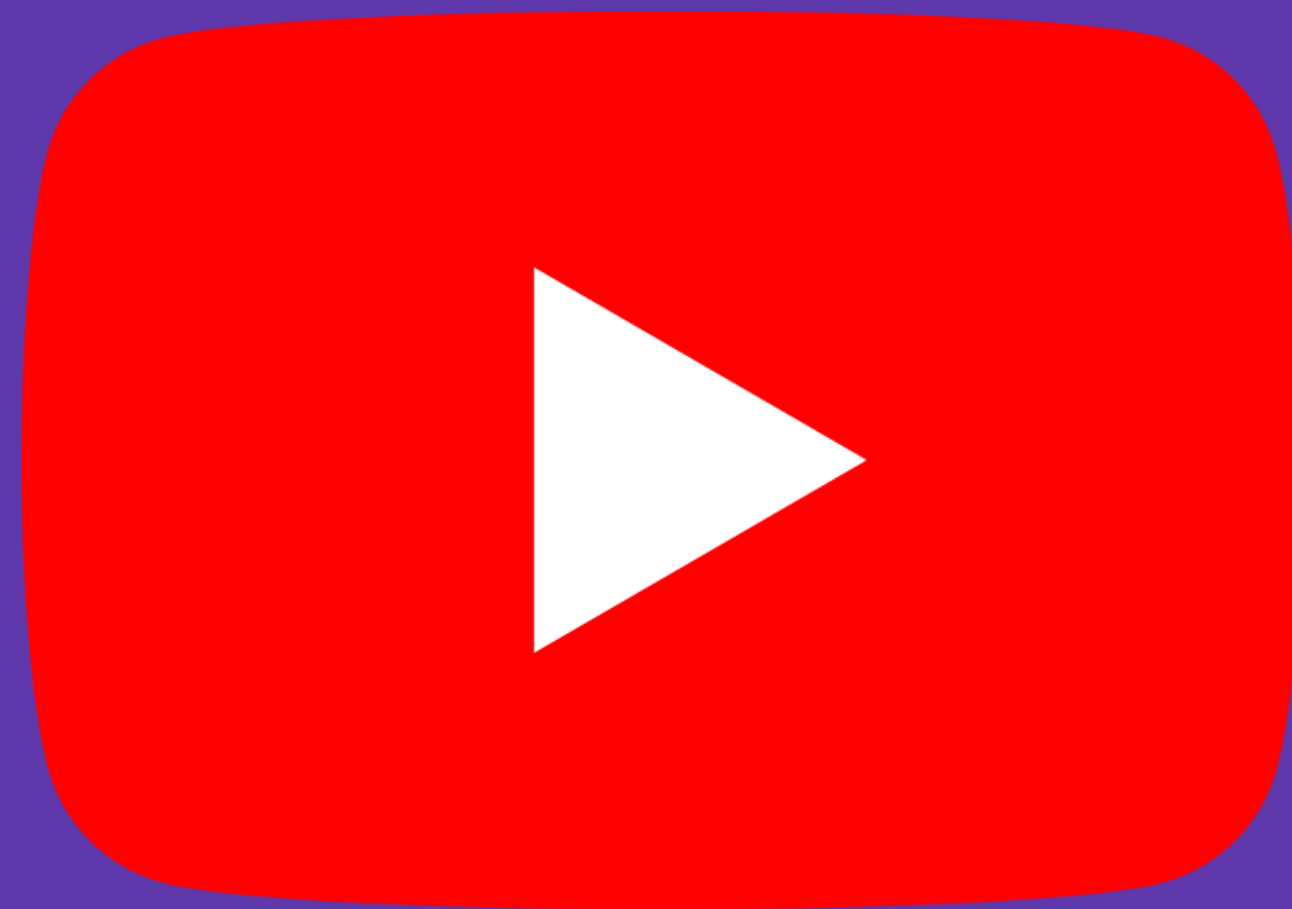
Taking attendance in the genome



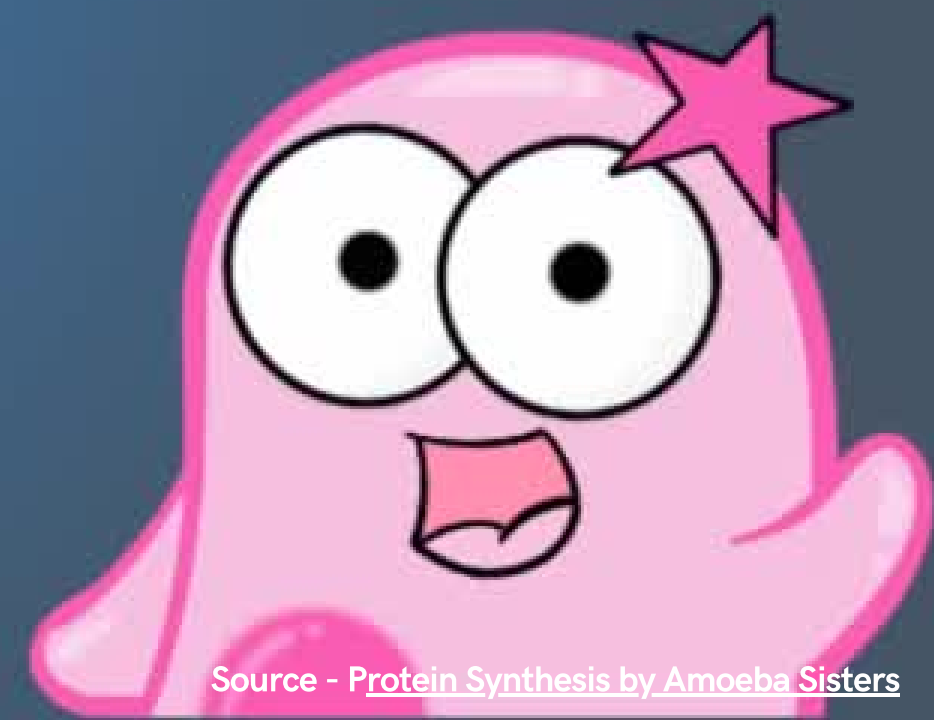
<http://biocomicals.blogspot.com>



# Transcription & Translation



Source - [Protein Synthesis by Amoeba Sisters](#)





**Thank You for listening!**

**Let's move on to the**

**Activity Section...**

# Let's play a game



Try to share your phone number in the form of an RNA sequence or a protein sequence.



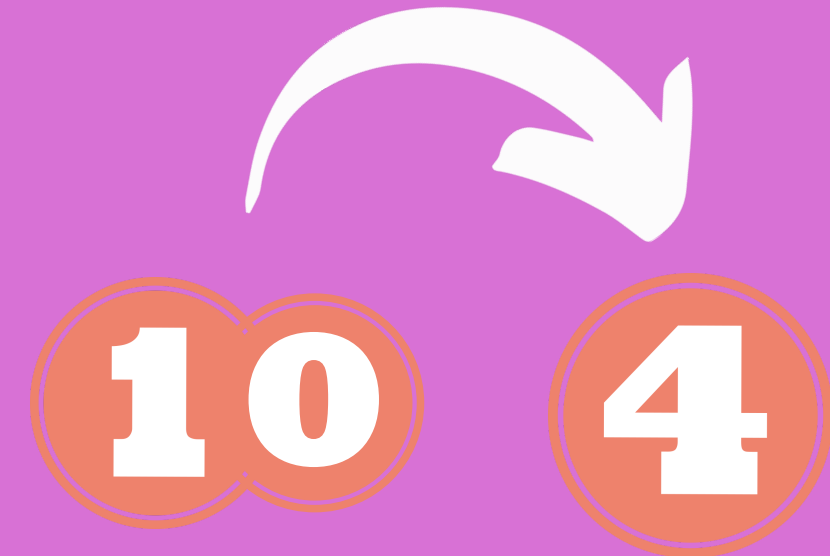
Hi! Can I get your  
number please??!

Only if you  
can solve this  
code!

# Example



86174 55021



Convert this number into  
base 4 from base 10

# Solutions



0 → A

1 → C

2 → G

3 → U

GAAACGGAUUGUCGUC

Number turns into



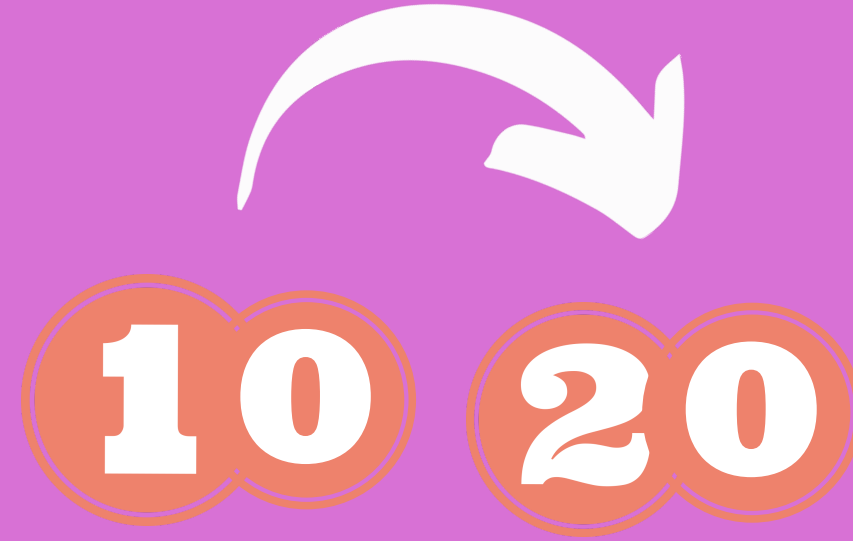
2000122033231231

[Link of converter](#)

## Example



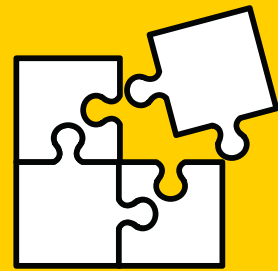
86174 55021



Convert this number into  
base 20 from base 10

## Base-20

The vigesimal or base 20 numeral system is based on twenty. The twenty symbols used are 0, 1, 2, 3, 4, 5, 6, 7, 8, 9, A, B, C, D, E, F, G, H, I and J. Plural name is base-20.



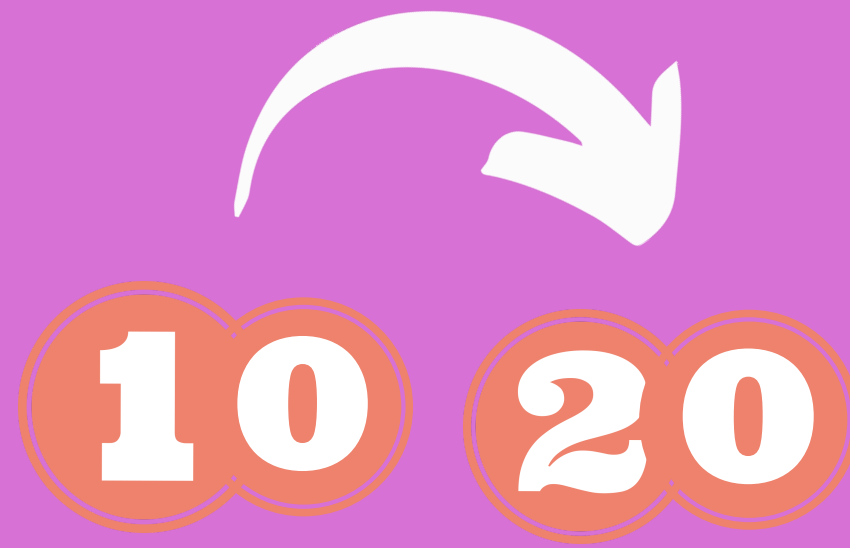
# Solutions



# Example



86174 55021



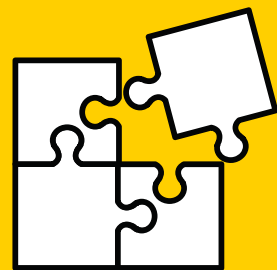
Convert this number into  
base 20 from base 10

Number turns into



6ECJ1HB1

[Link of converter](#)



# Solutions

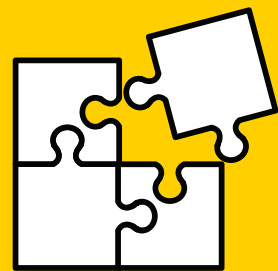


- alanine - ala - 0
- arginine - arg - 1
- asparagine - asn - 2
- aspartic acid - asp - 3
- cysteine - cys - 4
- glutamine - gln - 5
- glutamic acid - glu - 6
- glycine - gly - 7
- histidine - his - 8
- isoleucine - ile - 9

- leucine - leu - A
- lysine - lys - B
- methionine - met - C
- phenylalanine - phe - D
- proline - pro - E
- serine - ser - F
- threonine - thr - G
- tryptophan - trp - H
- tyrosine - tyr - I
- valine - val - J

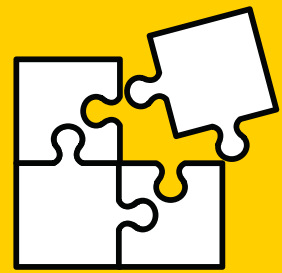
## Crypted amino acid sequence

Glu - Pro - Met - Val -  
Trp - Lys - Arg



# Solutions





# Changing Basis

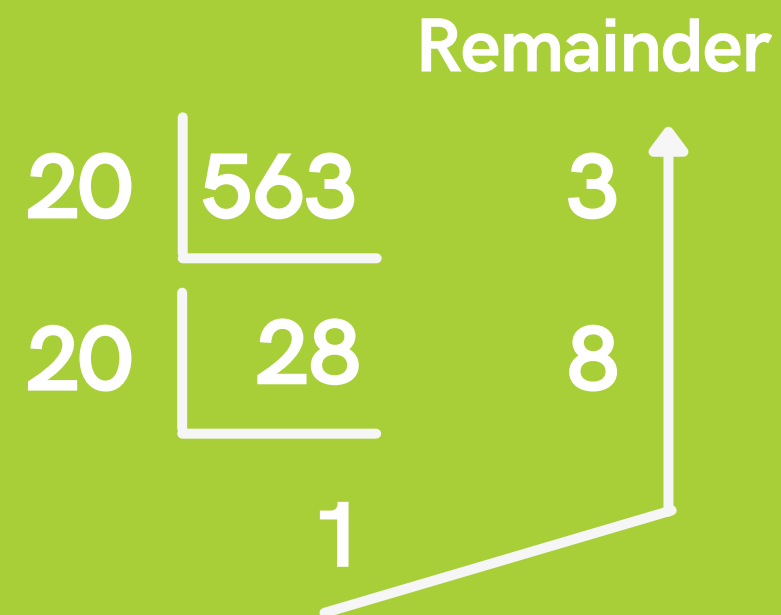
## Base 10 Example: 563

Base 10 to Base 4



The Base 4 number is 20303

Base 10 to Base 20



The Base 20 number is 183

(Not so elegant)

# Solutions



## Example



86174 55021

Encrypted message  
will start as

AAAAAAAAACAAAAA  
ACAC.....

Each digit from 1-9  
will be expressed by  
writing it A as many  
times

To denote the  
end of a digit,  
we will use C

To denote  
zero, we will  
use G



**Try Out!**

**Decode these RNA sequences to  
get the contact numbers!**

**Woman Helpline number – CACAAU**

**CoVID helpline number – UGACGGU**

**My Gov whatsapp helpline (COVID 19) – GACGCAUGCUACUACGU**

**Find out!**

**What is the advantage of having double-stranded DNA and single-stranded RNA molecules ?**

**HINT : Stability!**

STILL SINGLE?



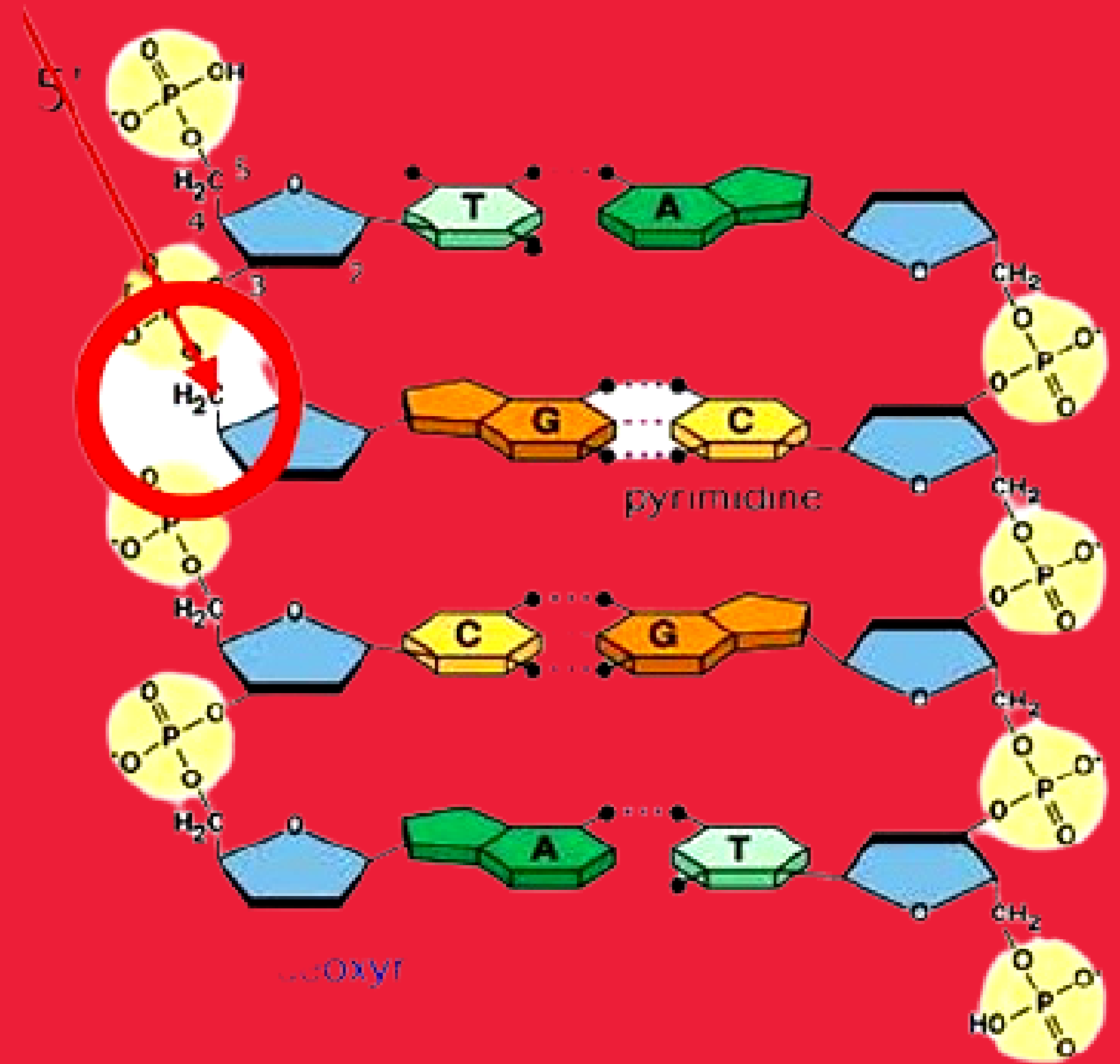
DNA

ALWAYS



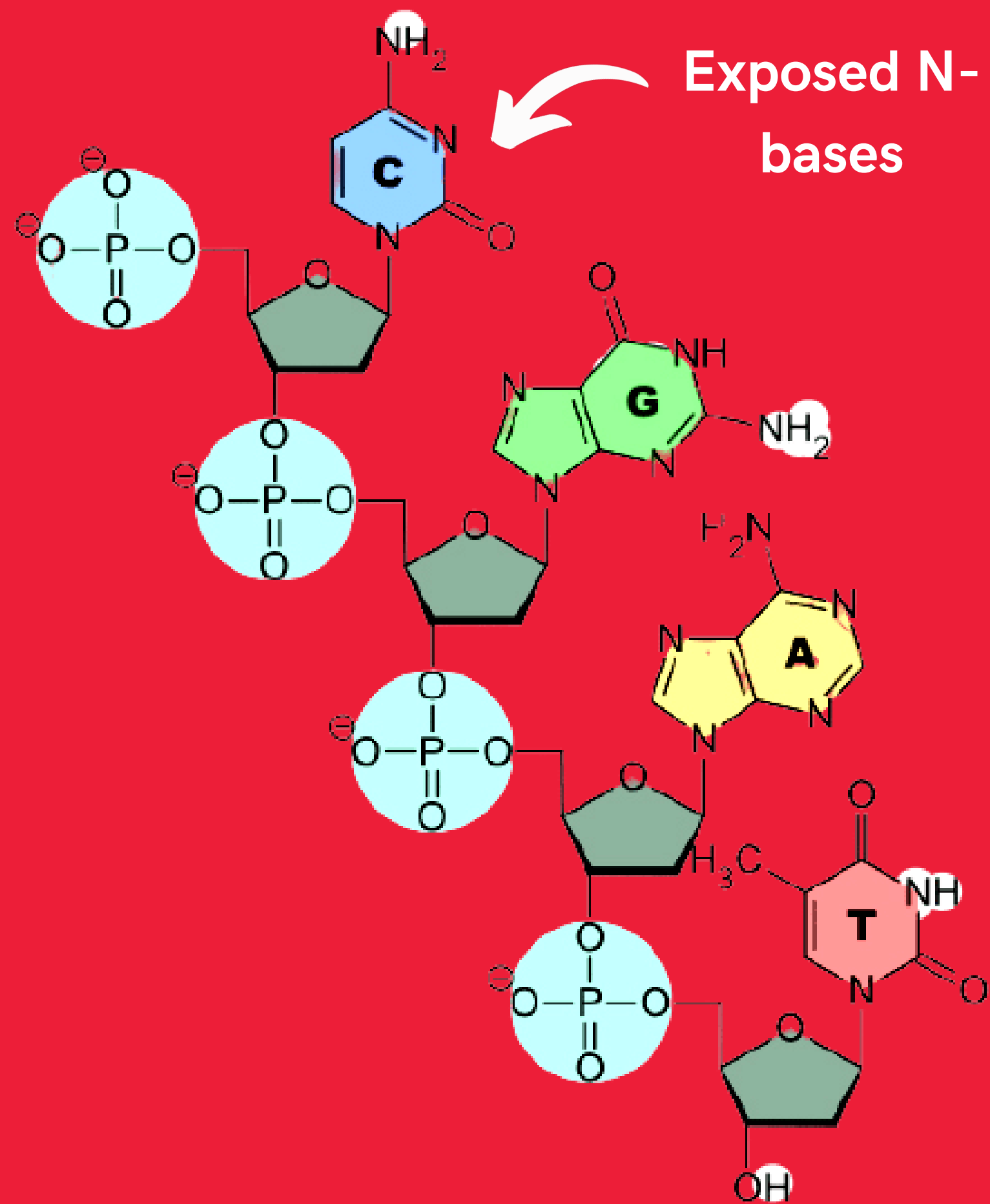
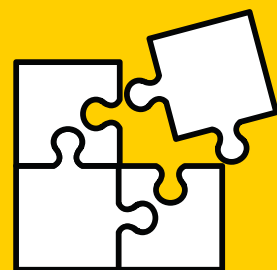
RNA

# Answer



dsDNA

# Answer



# Answer



ssRNA

