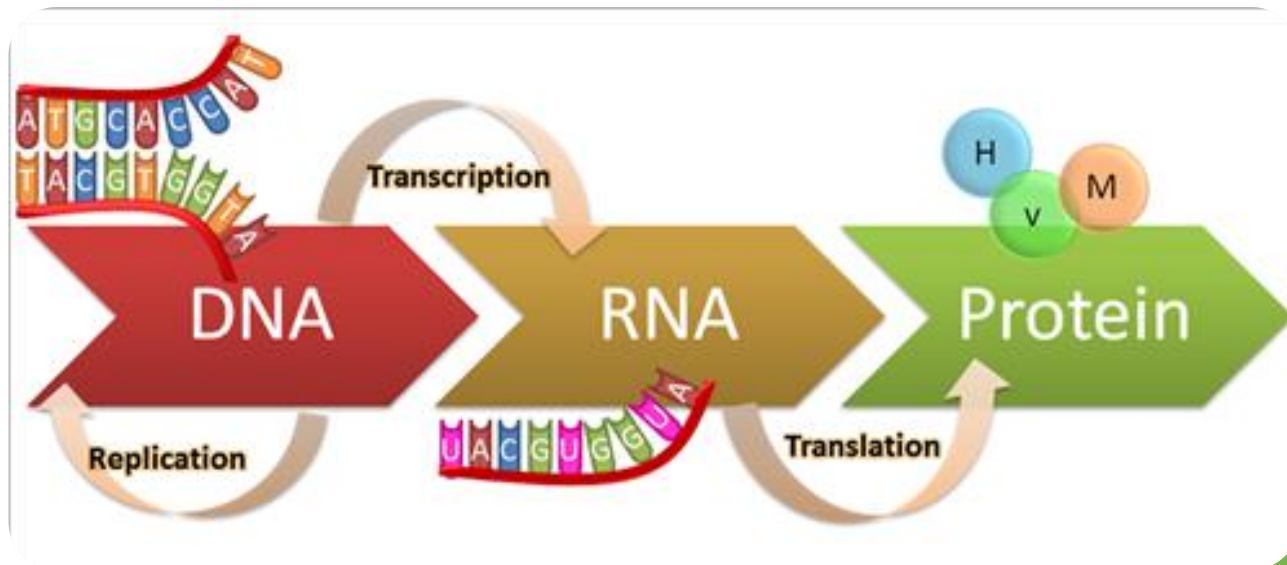
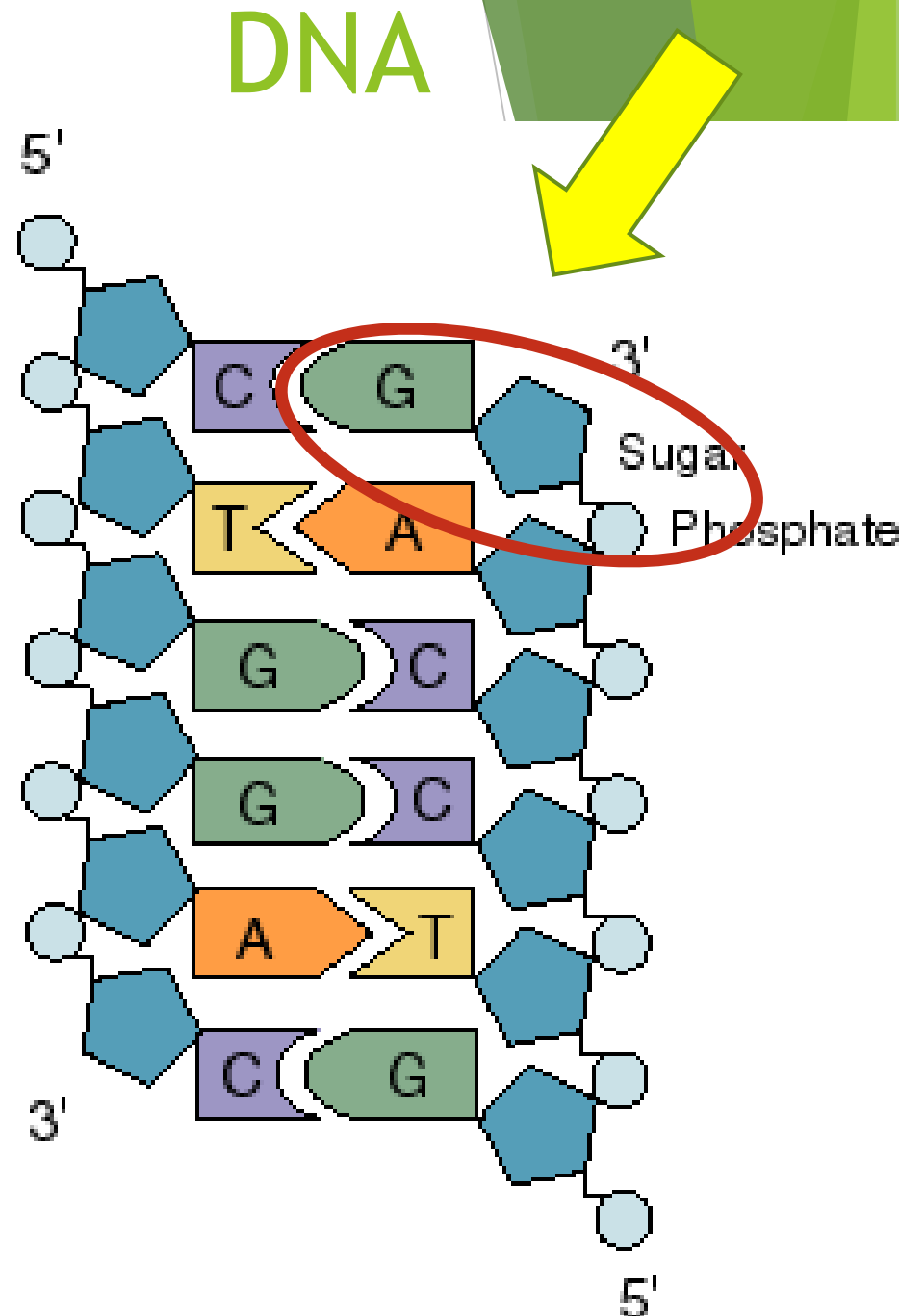


Unit 5



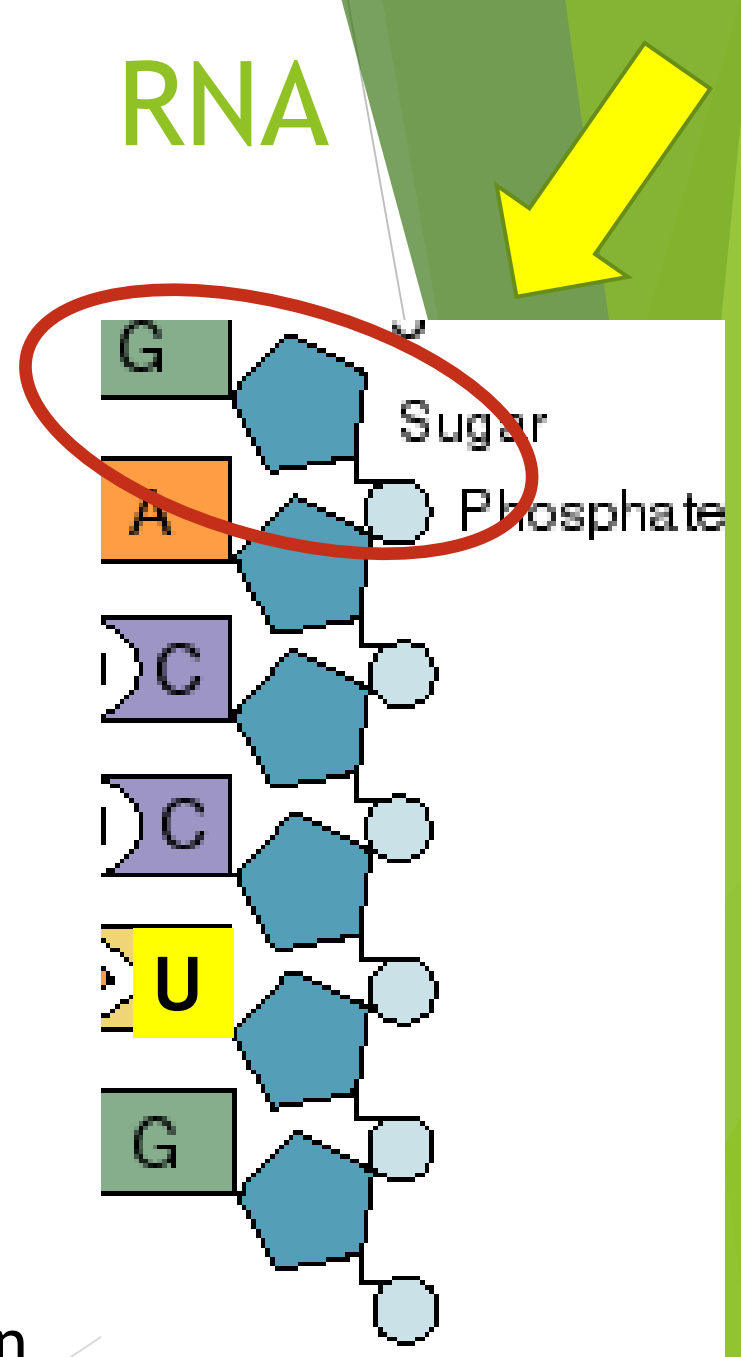
DNA Review

- ▶ Nucleotide: monomer of a nucleic acid
- ▶ Made of 3 parts:
 1. Deoxyribose Sugar (DNA)
 2. Phosphate
 3. Nitrogenous Base
(A-T C-G) Held by hydrogen bonds
- ▶ Shape:
 - ▶ DNA= double helix
- ▶ Function of Nucleic Acids
 - ▶ DNA stores genetic information



RNA

- ▶ Nucleotide: monomer of a nucleic acid
- ▶ Made of 3 parts:
 - ▶ Ribose Sugar (RNA)
 - ▶ Phosphate
 - ▶ Nitrogenous Base
(A-U C-G)
- ▶ Shape:
 - ▶ RNA= single-stranded
- ▶ Function of Nucleic Acids
 - ▶ RNA transmits genetic information

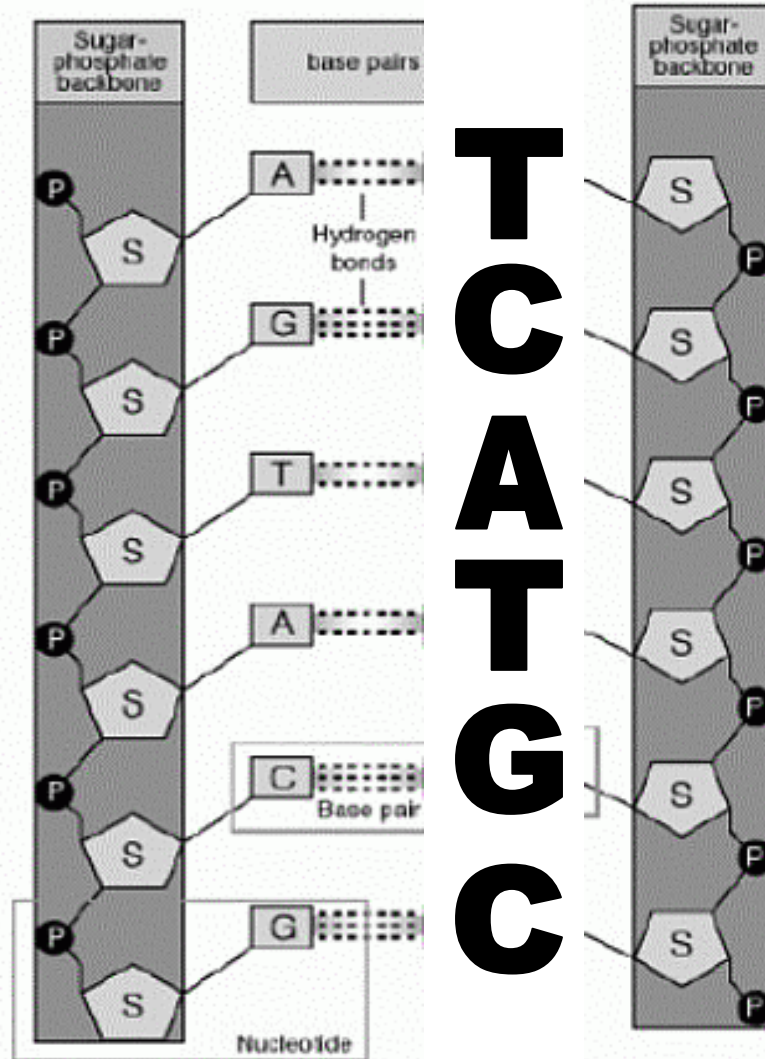


DNA/RNA Review

	Polymers	
	DNA	RNA
# of Strands	<u>2</u>	<u>1</u>
Shape	Double helix	<u>Single-stranded</u>
Monomers	<u>Nucleotide</u>	Nucleotide
Sugar	Deoxyribose	Ribose
Bases	<u>A, T, C, G</u>	<u>A, U, C, G</u>
Location	Nucleus only	<u>Nucleus & cytoplasm</u>

DNA to DNA base pairing review

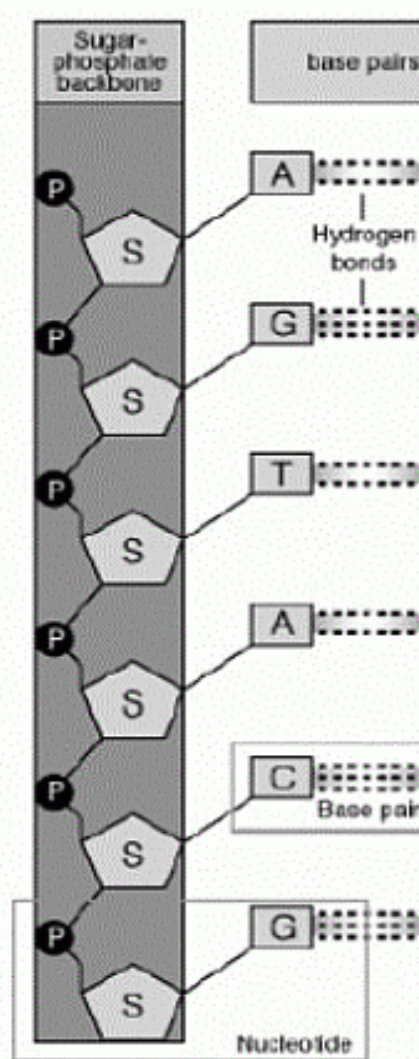
DNA



DNA

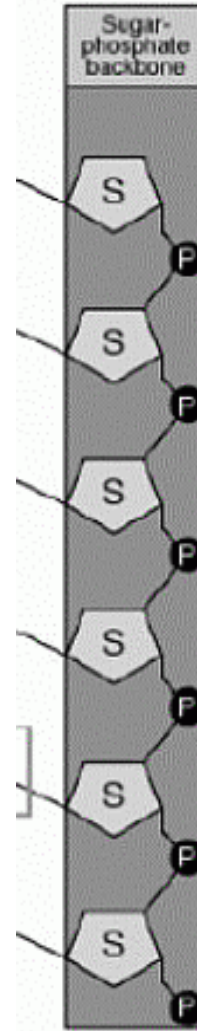
DNA to RNA base pairing

DNA

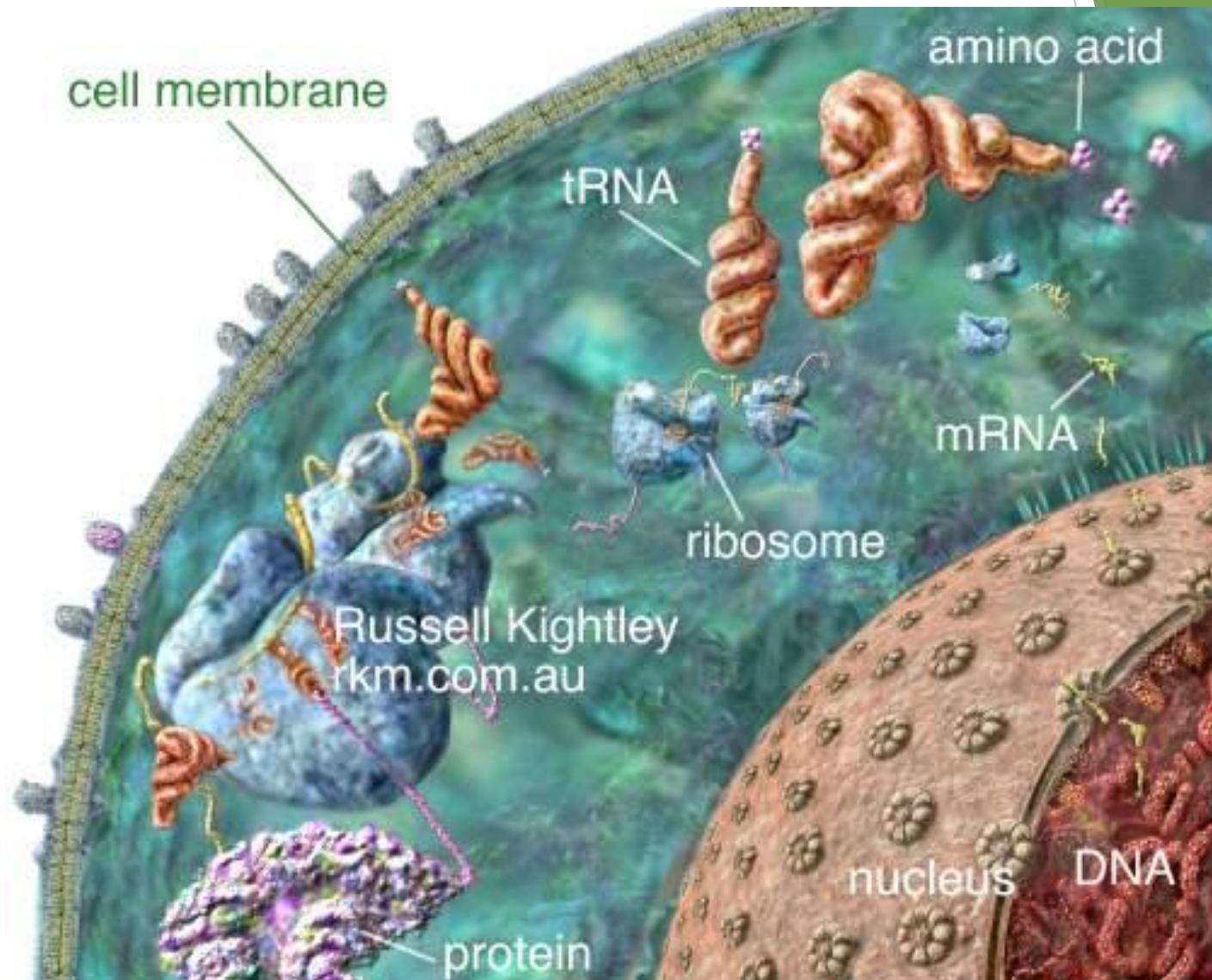


**U
C
A
U
G
C**

RNA

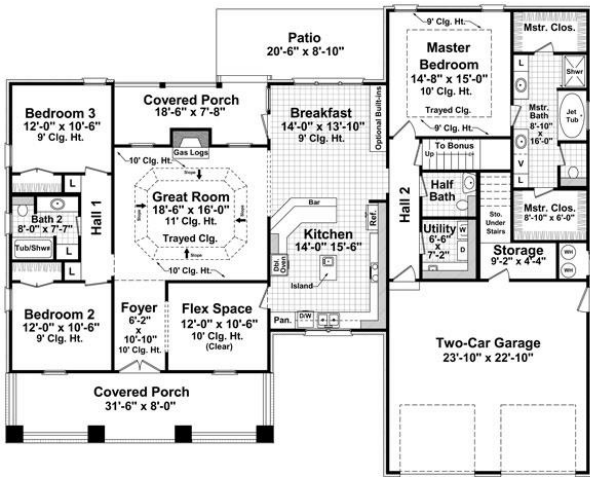


Protein Synthesis

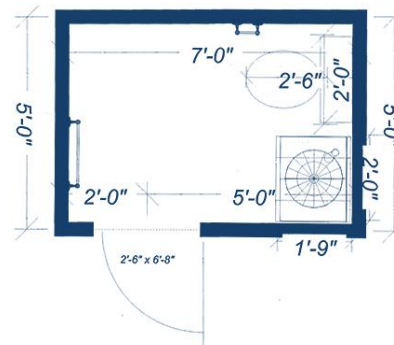


How do I get from the instructions to building a HOUSE?

ALL of the master Instructions



Bathroom instructions



Bathroom materials



Home

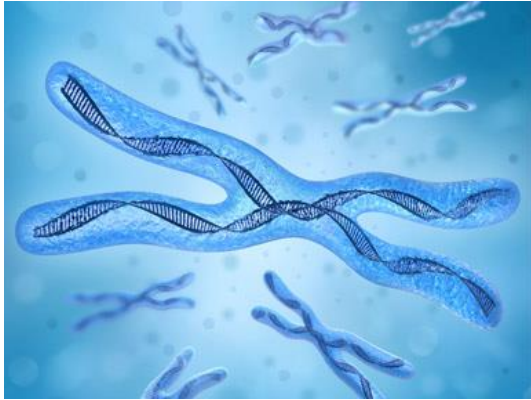


Bathroom



How do I get from the instructions to building YOU?

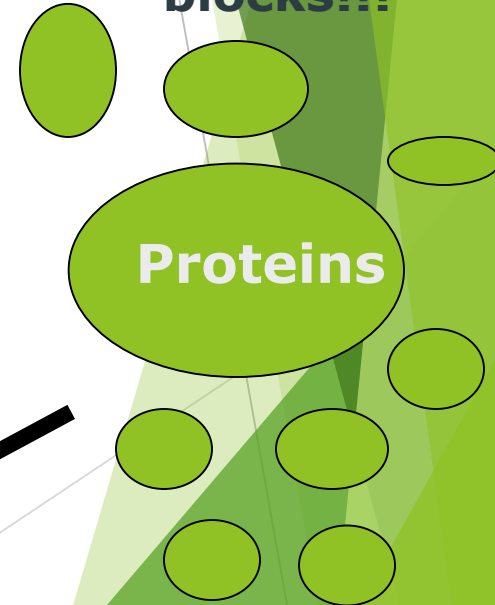
DNA: The master Instructions



Genes: parts of the instructions



Proteins: building blocks!!!



Proteins

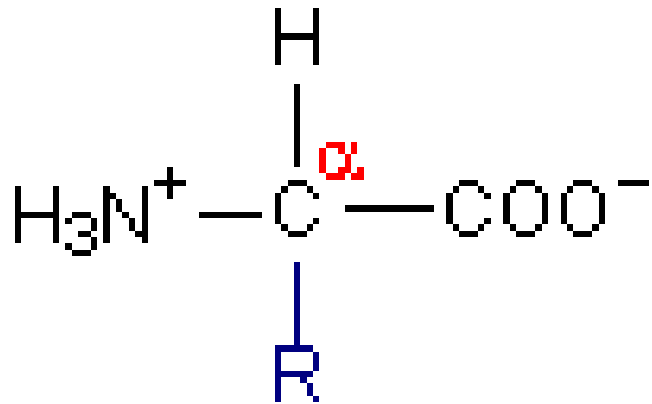
Cells: basic unit of life



Structure and Function of Proteins

Structure of Proteins:

- ▶ Monomers are amino acids
- ▶ Contain the elements Carbon (C), Hydrogen (H), Oxygen (O), and Nitrogen (N)



amino acid

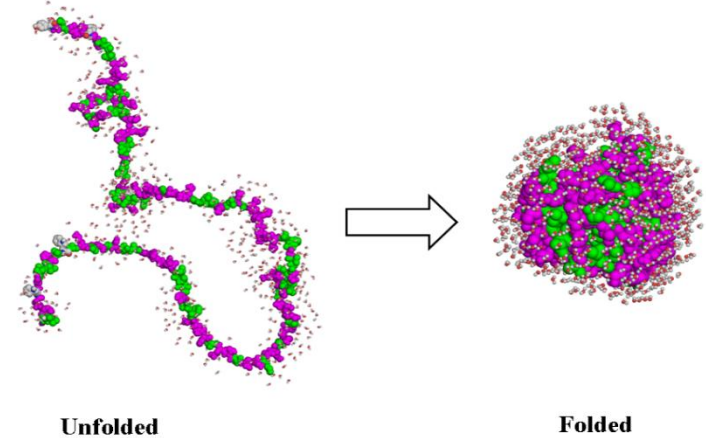
Function of Proteins:

- ▶ Growth and repair
- ▶ Signaling from one cell to another
- ▶ Transport channels in cell membranes
- ▶ Defense against invaders
- ▶ Catalyzing chemical reactions (enzymes are proteins)

Protein Structure and Function

Protein Shape Determines Function

* If the protein folds incorrectly it will not work properly!



Protein Shape Example:

When the oxygen carrying protein hemoglobin differs by one amino acid then it can cause the blood cell's shape to change. The blood cell is now inefficient at carrying oxygen.

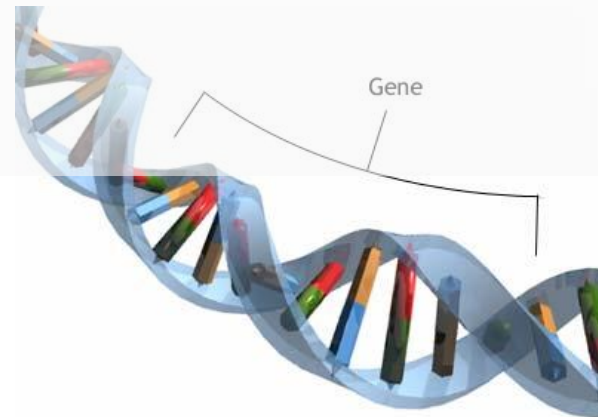


Protein Synthesis Background

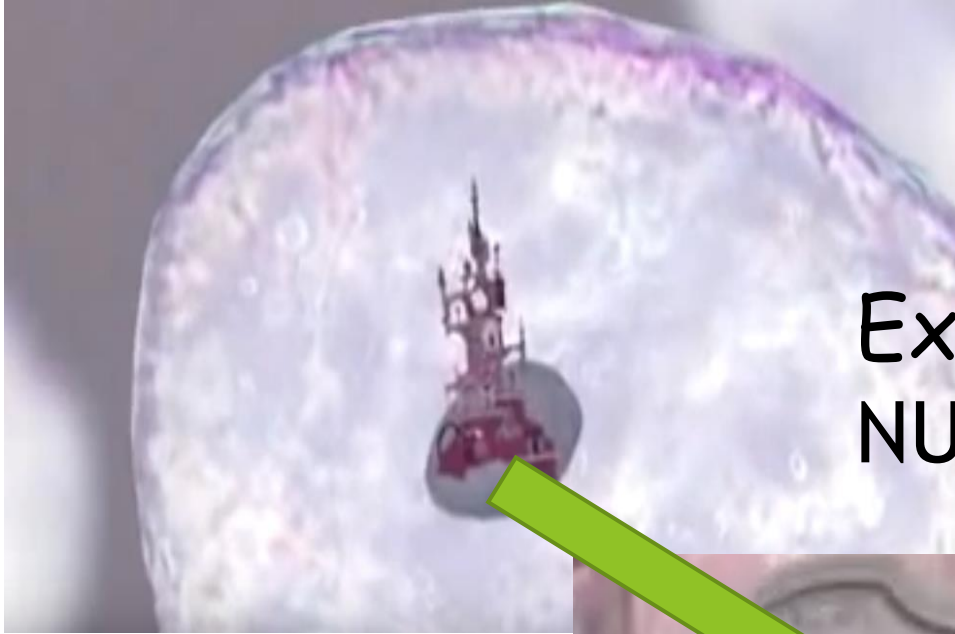
- ▶ Also called Gene Expression
- ▶ Process of cells making new PROTEINS to show genetic TRAITS using DNA instructions.

DNA → RNA → amino acid → protein → phenotype (traits)

- ▶ Genes- sections of chromosomes (DNA) that control the production of proteins and activities within a cell.



RNA Video ~
watch only to
2:39 min



Ex: The castle is the
NUCLEUS in the video



3 Types of RNA used in Protein Synthesis

1. Messenger RNA (mRNA)-
carries copies of
instructions for assembling
proteins from DNA to
ribosome in cytoplasm.

(Because DNA CANNOT
leave the nucleus or it may
get destroyed)



Ex: The **SCRIBE** in the video

3 Types of RNA used in Protein Synthesis

- ▶ 2. Ribosomal RNA (rRNA)- makes up the ribosome (small organelle) and is the site (factory) of protein synthesis.



Ex: The **CHEF** in the video

3 Types of RNA used in Protein Synthesis

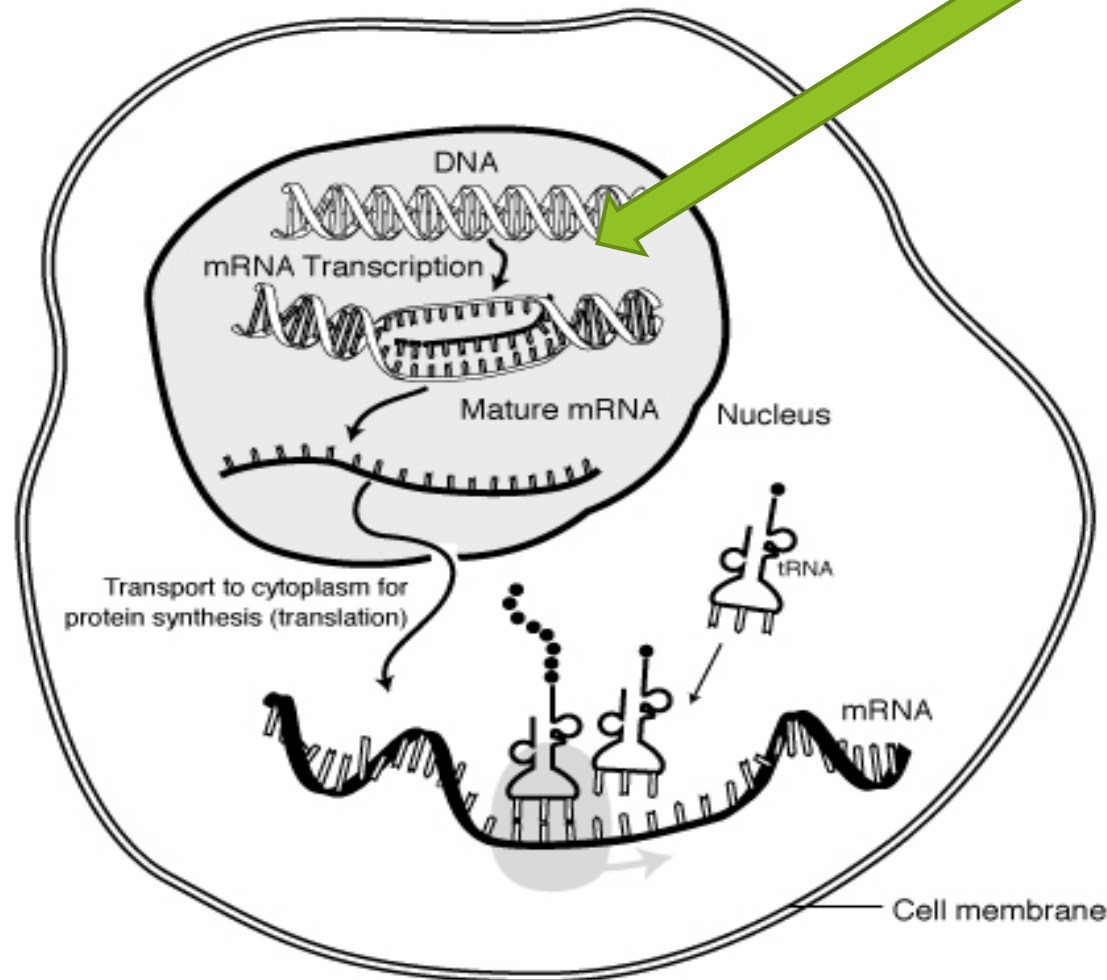
▶ 3. Transfer RNA (tRNA)- transfers amino acids to the ribosome and matches them to the coded mRNA message. tRNA gets reused/recycled after it drops off amino acid.



Ex: The **INGREDIENTS** in the video

Protein Synthesis

► Part 1. Transcription (occurs in the nucleus)



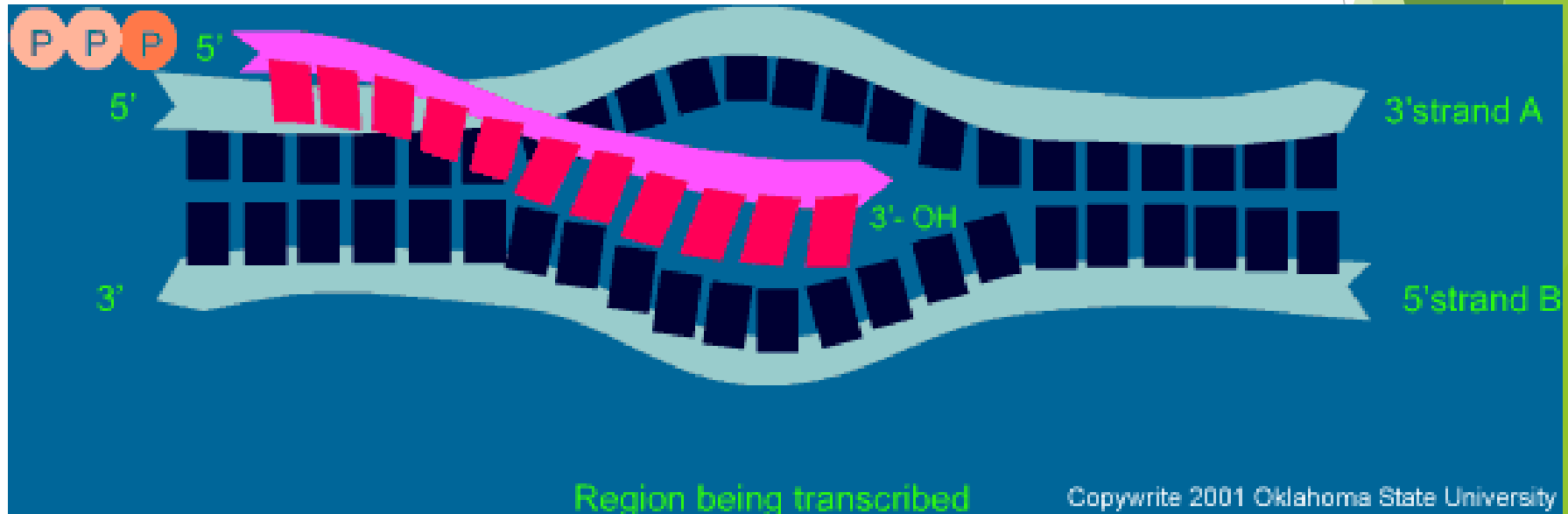
Part 1: Transcription

When complementary messenger RNA (mRNA) molecules are produced by copying segments of the DNA sequence

- Free floating nucleotides match up with the DNA template in groups of 3 bases (codon).
3 mRNA bases is a codon(A-U and C-G)
- Each codon codes for a specific amino acid
(Ex. 2 codons = 2 amino acids= 6 bases)

Part 1: Transcription

- ▶ Single new strand of mRNA leaves the nucleus and carries the instructions to the ribosome where proteins are assembled
- ▶ mRNA attaches to the ribosome and waits for the tRNA.

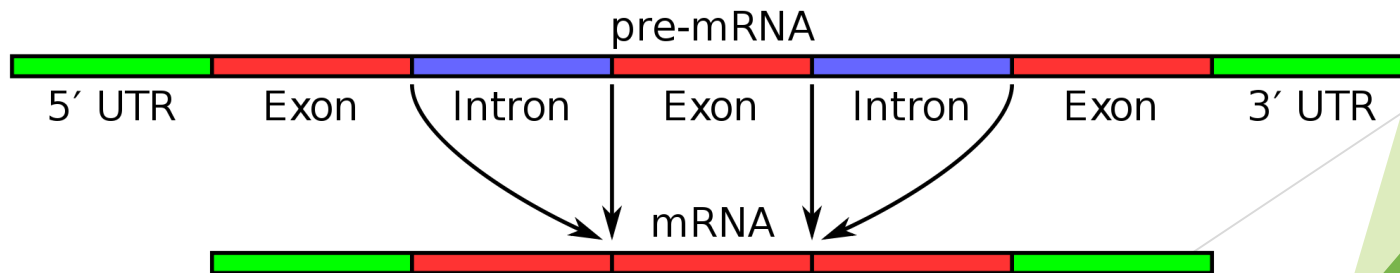


****Add to the bottom of notes****

- mRNA editing: new RNA **molecules** will be **edited** before the message is complete

introns- portions that are **cut** out and **discarded**

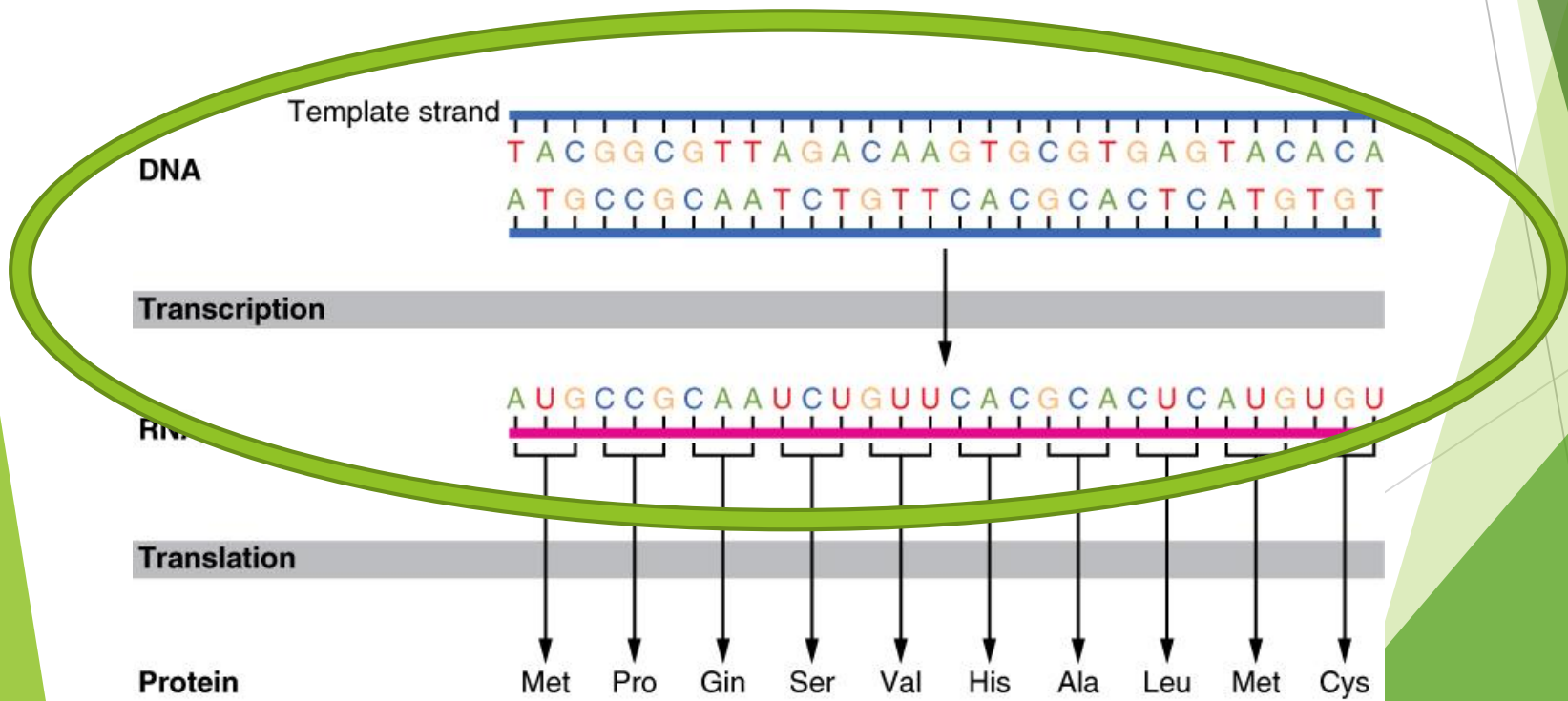
exons- needed pieces of RNA that are **spliced** back **together** to form **final mRNA**



Transcription Summary

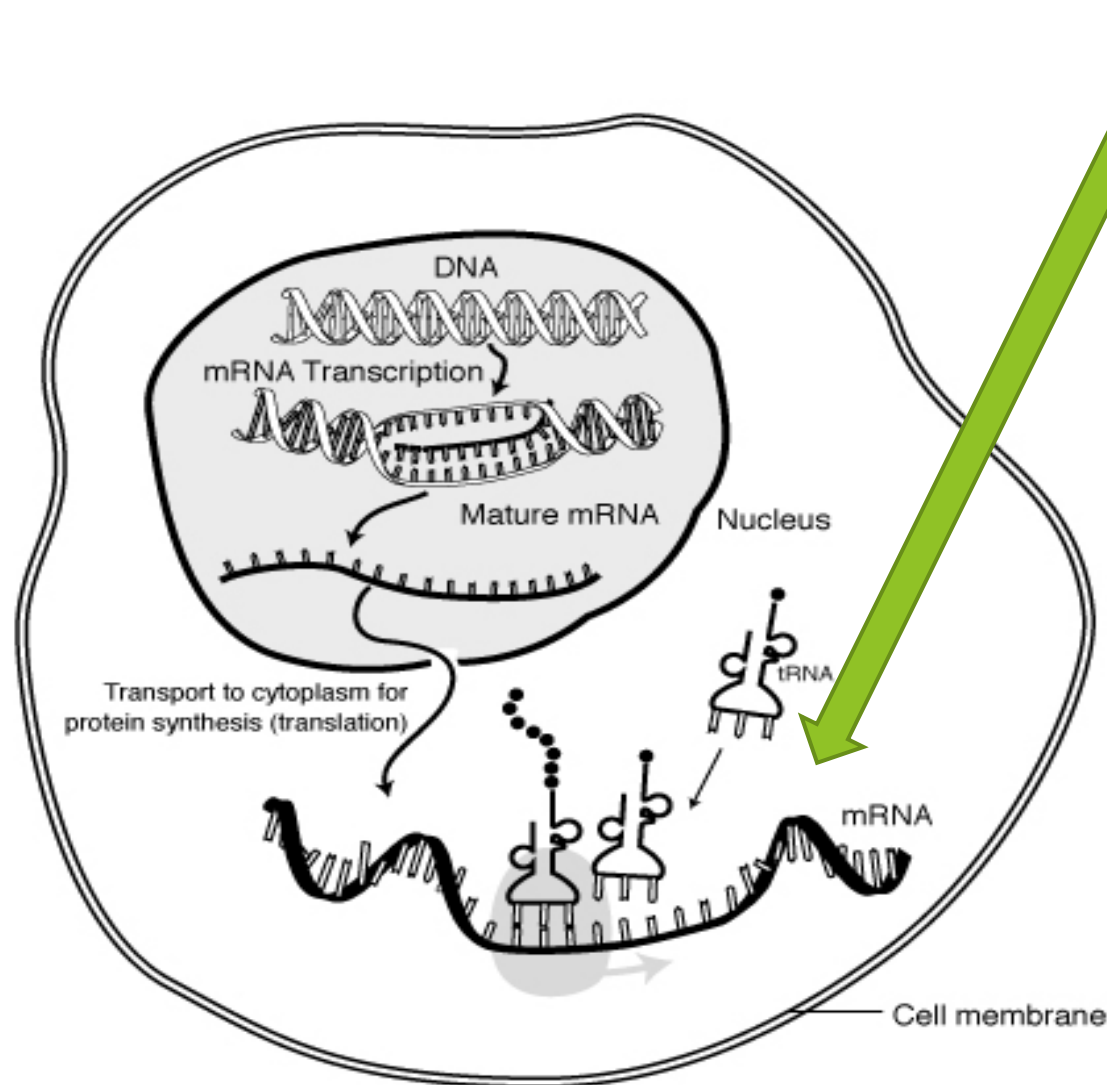
Video: in real time

- ▶ Transcription sends the instructions to make proteins from the nucleus to the ribosomes in the form of mRNA



Protein Synthesis

- ▶ Part 2. Translation (occurs in the cytoplasm)



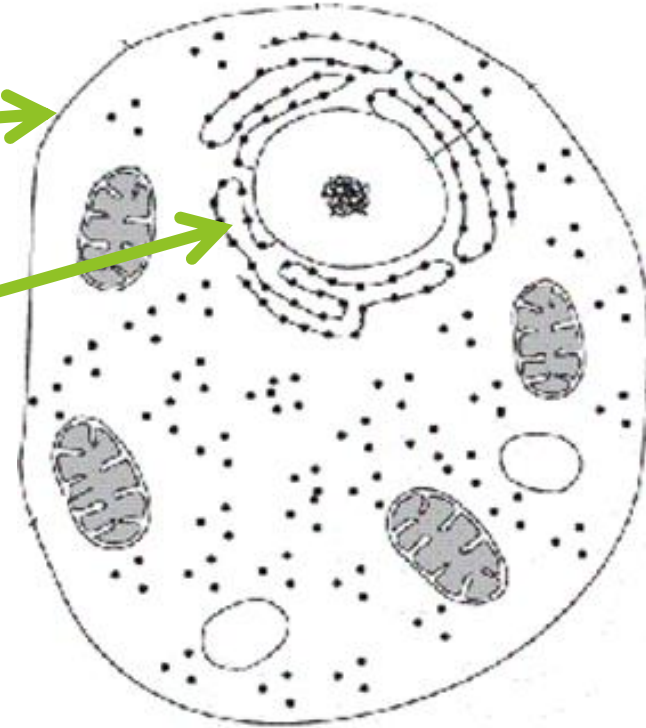
Part 2: Translation

Ribosomes: make proteins using instructions from the nucleus

▶ Can be:

▶ Free Floating

▶ Attached to rough endoplasmic reticulum

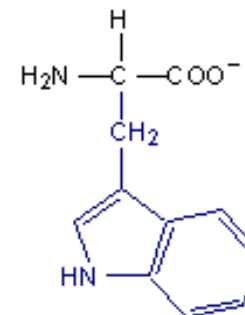
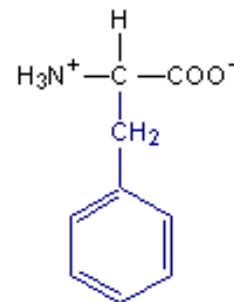
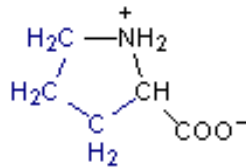
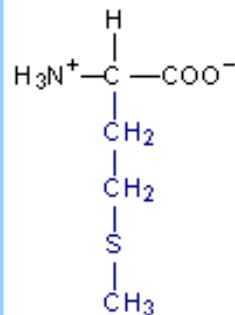


Part 2 : Translation

Decoding of an mRNA into a polypeptide chain (protein)

- tRNA (anticodon) is composed of 3 bases
- tRNA picks up a specific amino acid in the cytoplasm and takes it to the ribosome.
- tRNA will “read” the mRNA and drop off the amino acid in the **correct** sequence to build the protein needed
- 20 different amino acids- 64 possible codon combinations (there are **multiple** ways to **code** for the **same amino acid** in some instances to help prevent mutations)

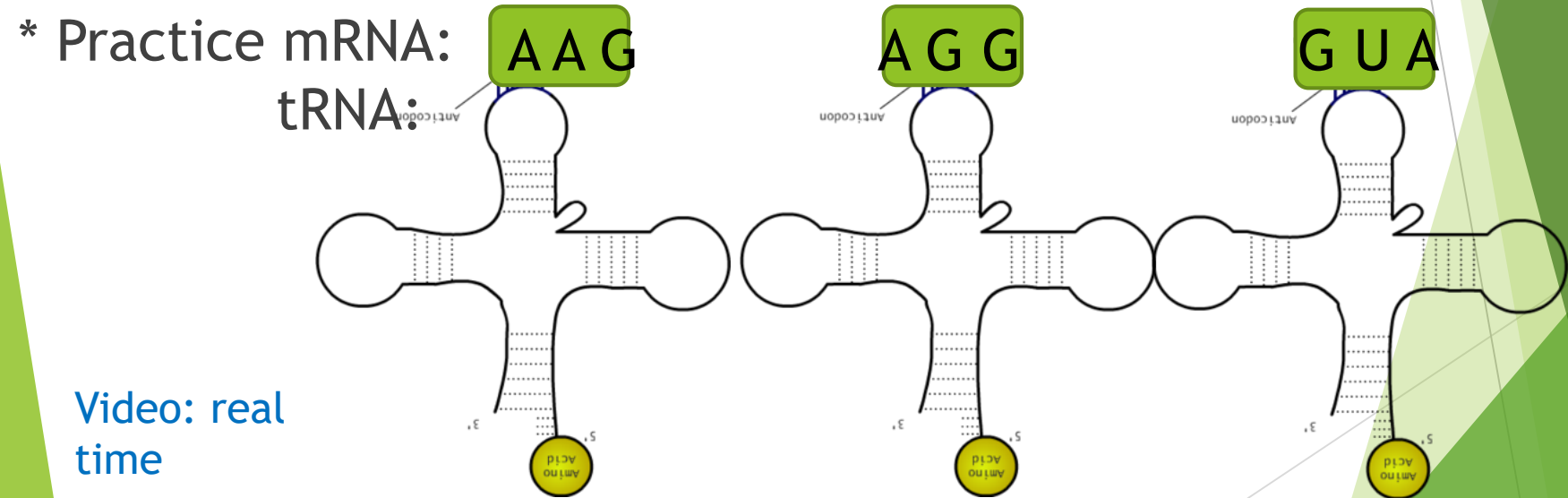
methionine (Met, M) proline (Pro, P) phenylalanine (Phe, F) tryptophan (Trp, W)



amino acids: non-polar R-groups (cont.)

Translation Summary

- ▶ The genetic code (mRNA codons) matches up with tRNA anticodons to put the amino acids in the correct order.
- ▶ Amino acids form a polypeptide chain held together by peptide bonds; this is a protein.

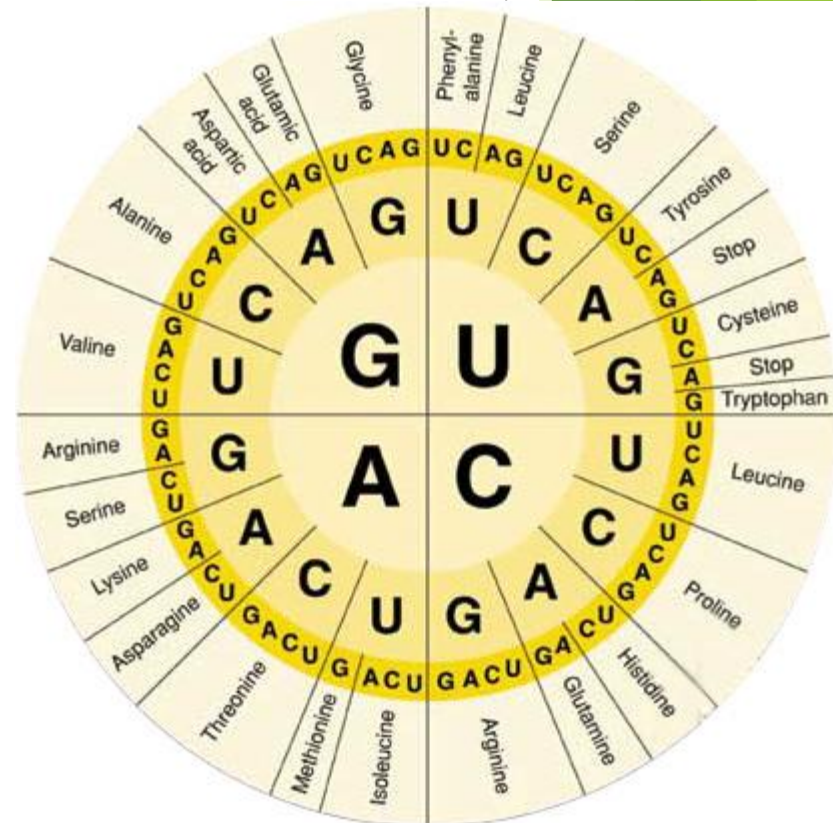


Video: real
time

Explanation of Protein Synthesis Chart/Circle:

► Codon Chart

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



Practice

DNA: GAC CCT TAT

mRNA: CUG GGA AUA

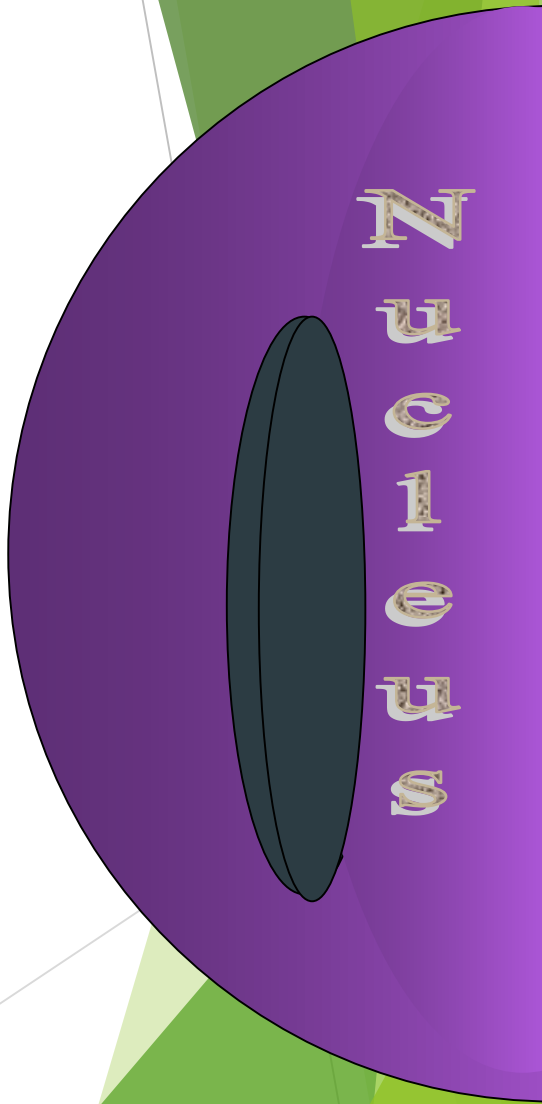
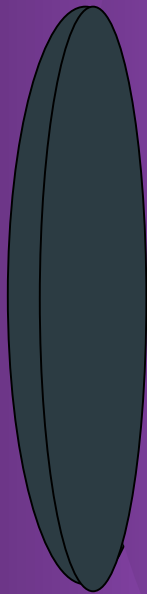
Amino Acid Sequence: Leucine Glycine Isoleucine

tRNA: GAC CCU UAU

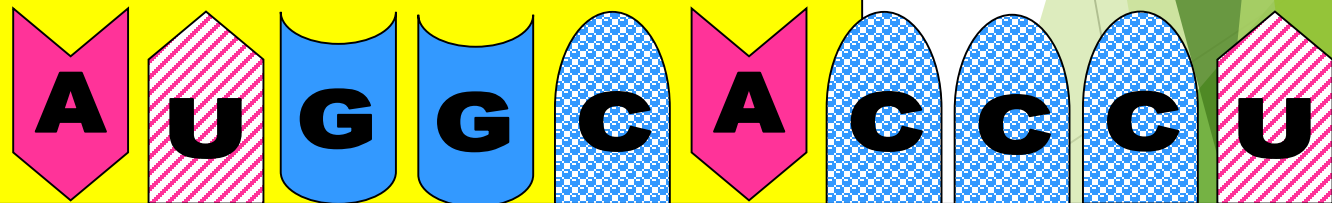
Animation of translation

Click to automatically start animation.

N
u
c
l
e
u
s



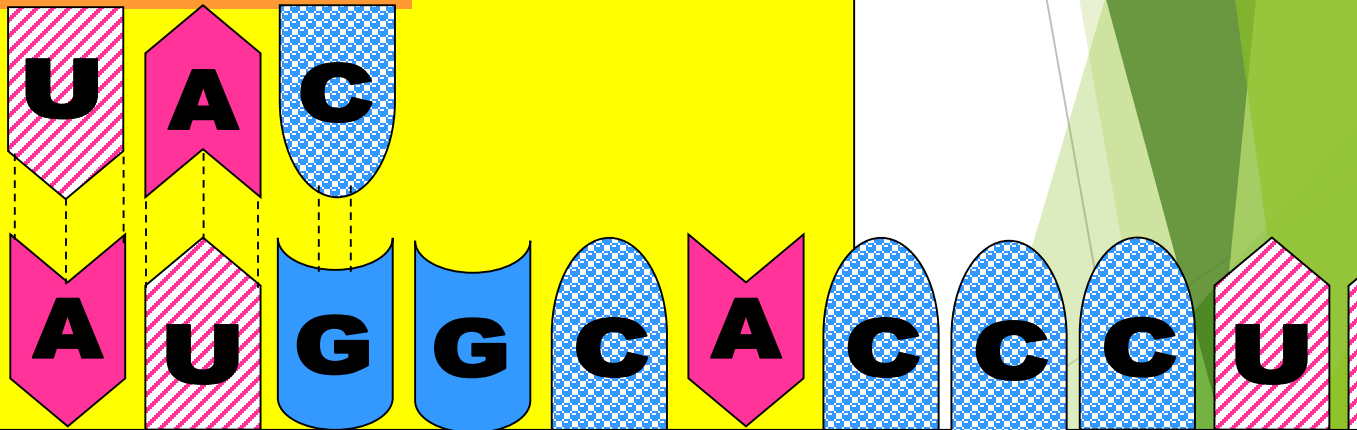
**This is a
ribosome.**



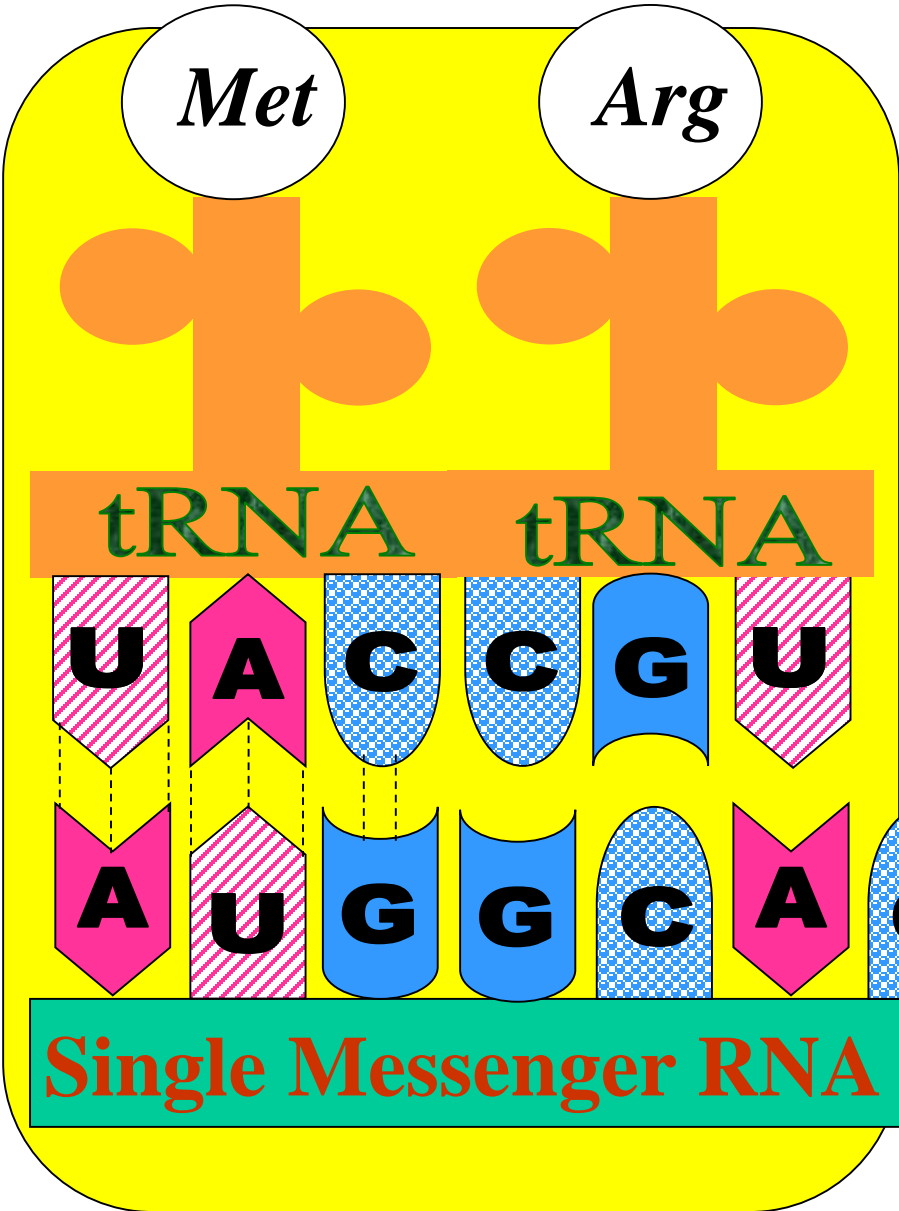
Single Messenger RNA Strand

Met

tRNA



Single Messenger RNA Strand



Met

Arg

tRNA

tRNA

U

A

C

C

G

U

A

U

G

G

C

A

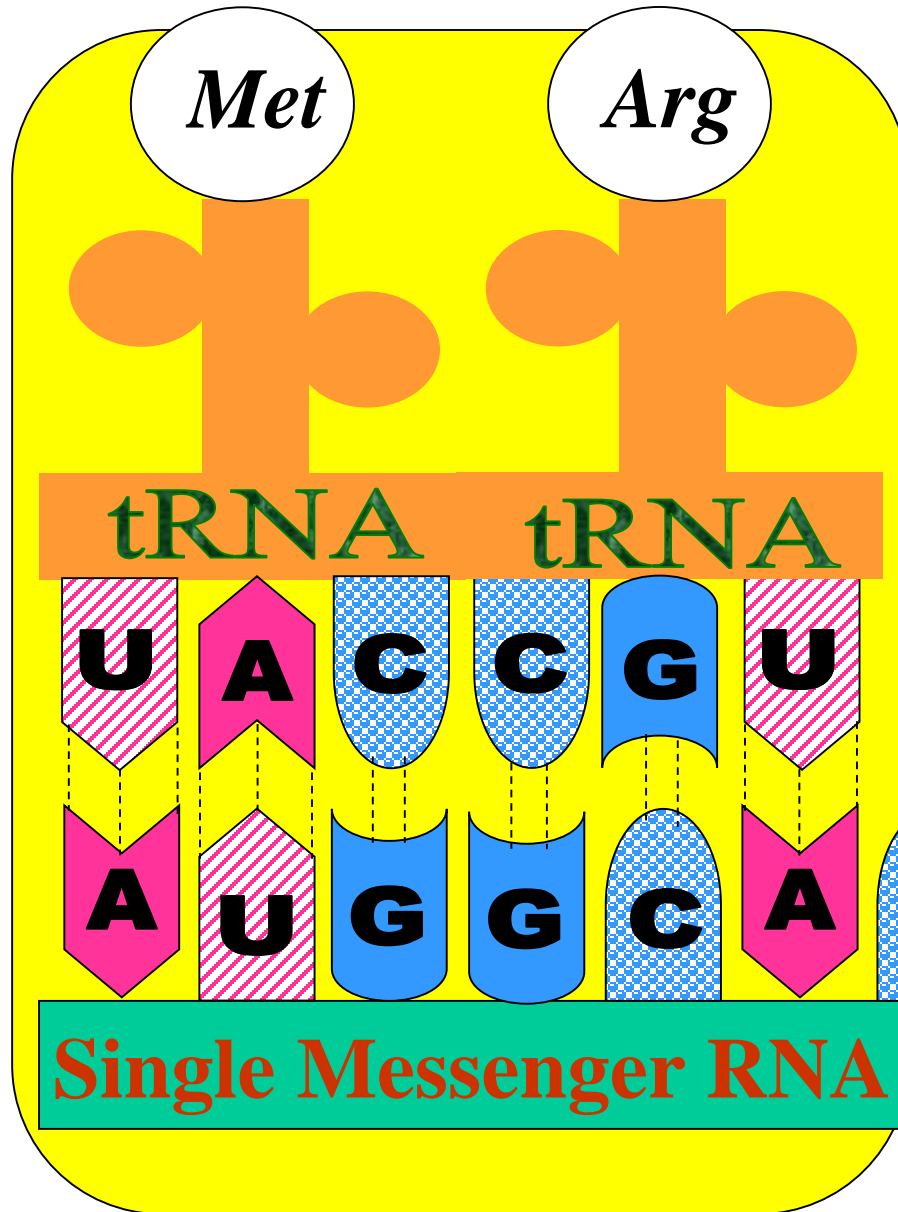
C

C

C

U

Single Messenger RNA Strand



Single Messenger RNA Strand

Met

Arg

tRNA

tRNA

U

A

C

C

G

U

A

U

G

G

C

A

C

C

C

U

Single Messenger RNA Strand

Met

Arg

tRNA

tRNA

U

A

C

C

G

U

A

U

G

G

C

A

C

C

C

U

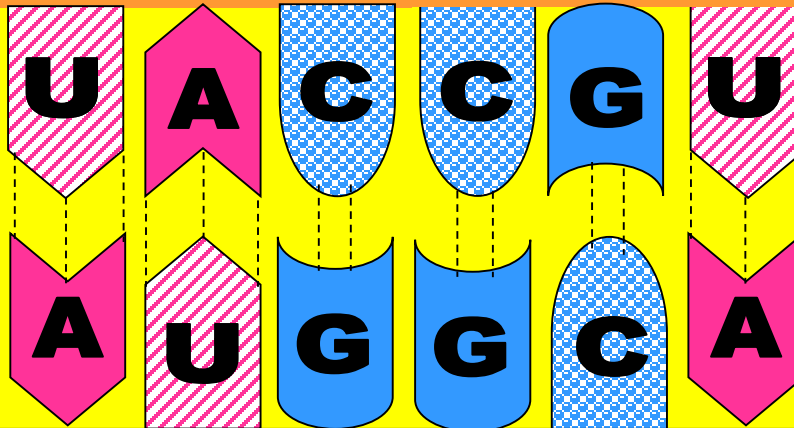
Single Messenger RNA Strand

Met

Arg

tRNA

tRNA



Single Messenger RNA Strand

Met

Arg

tRNA

tRNA

U

A

C

C

G

U

A

U

G

G

C

A

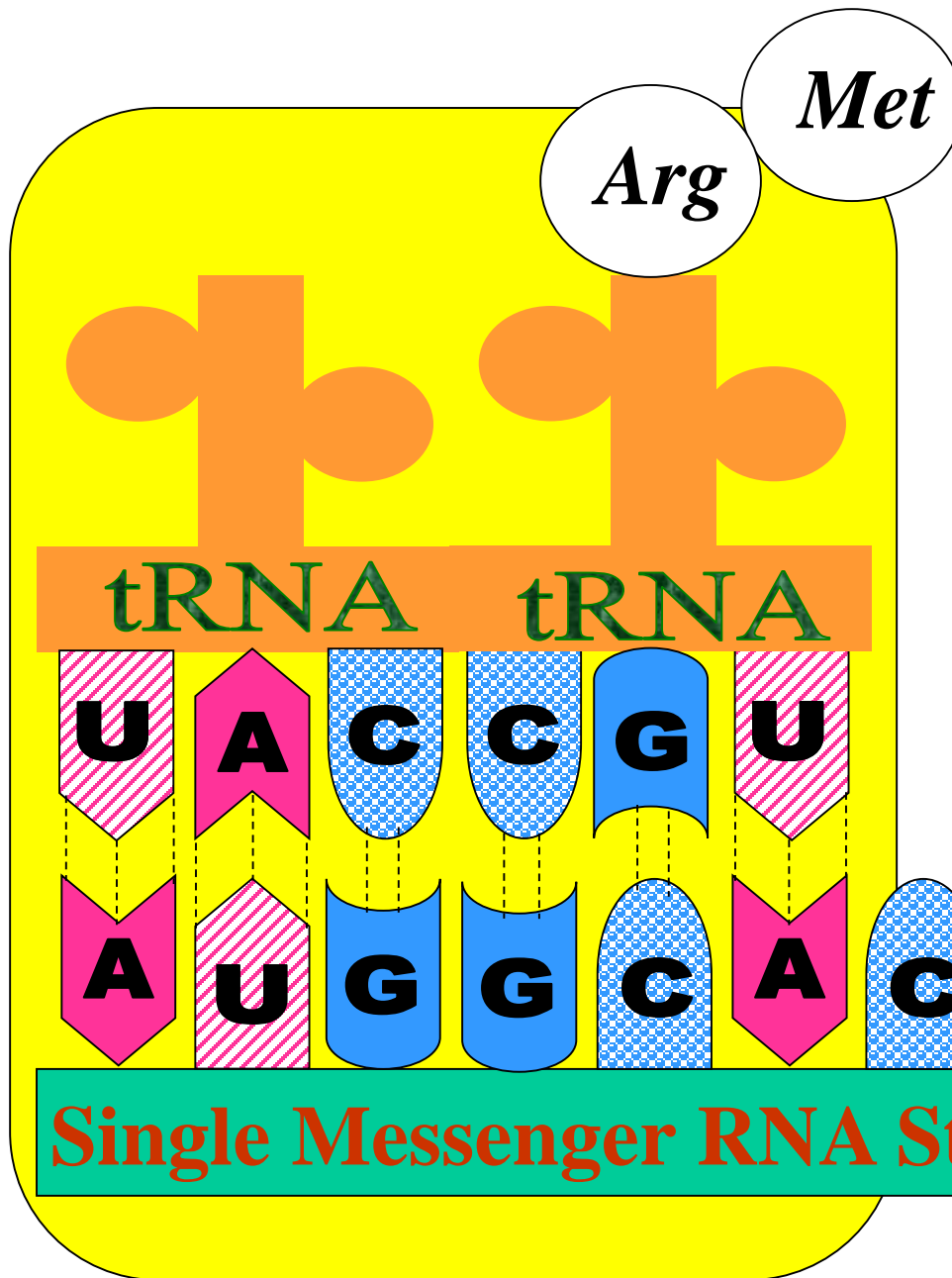
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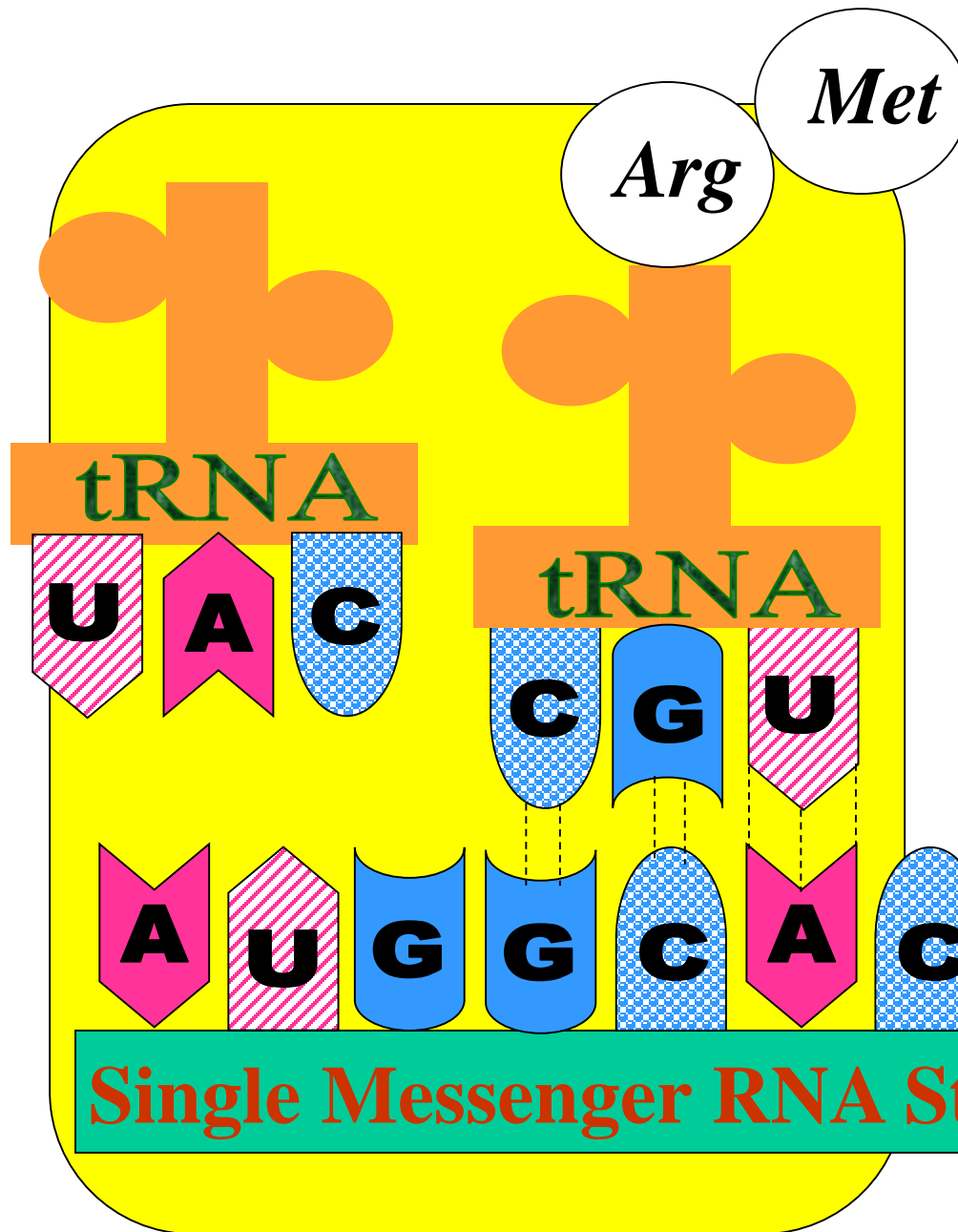
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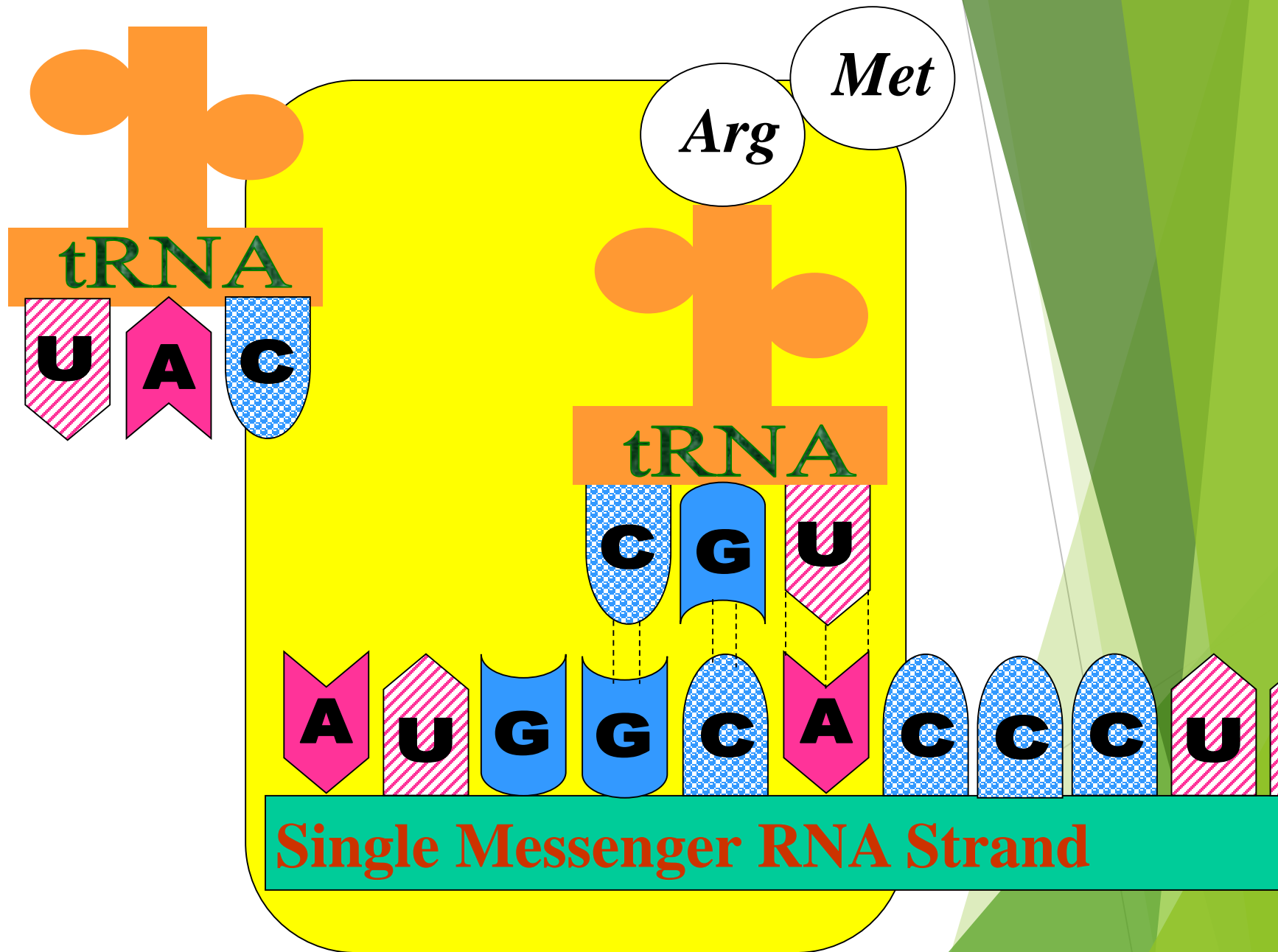
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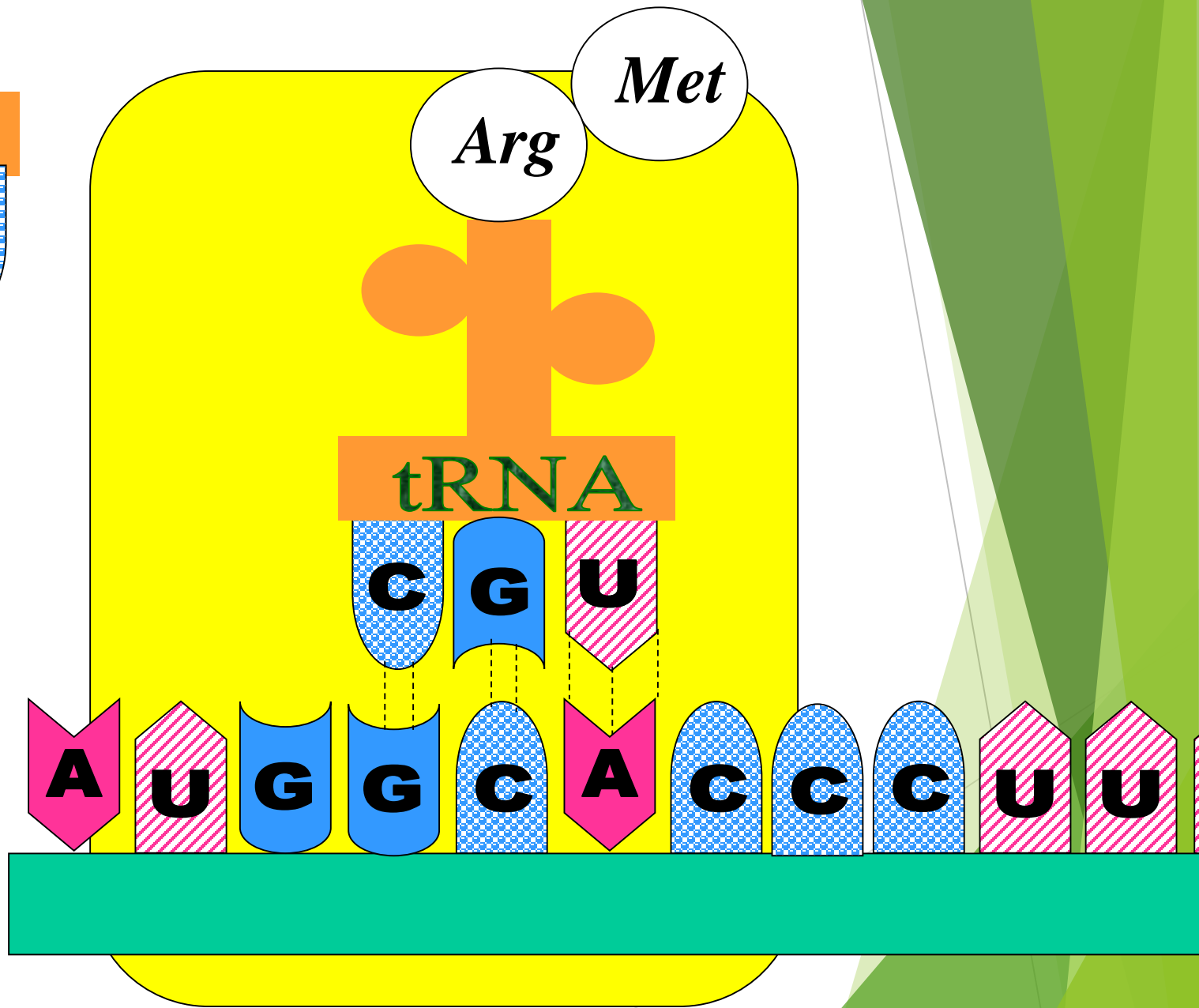
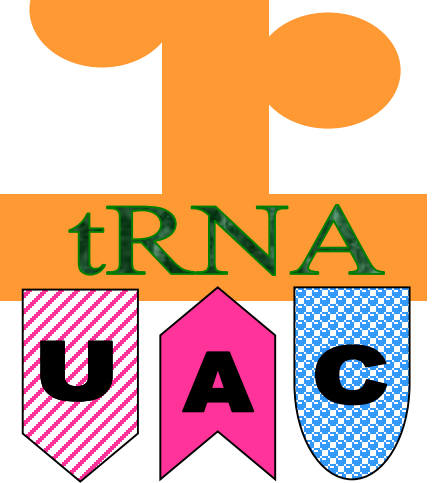
U

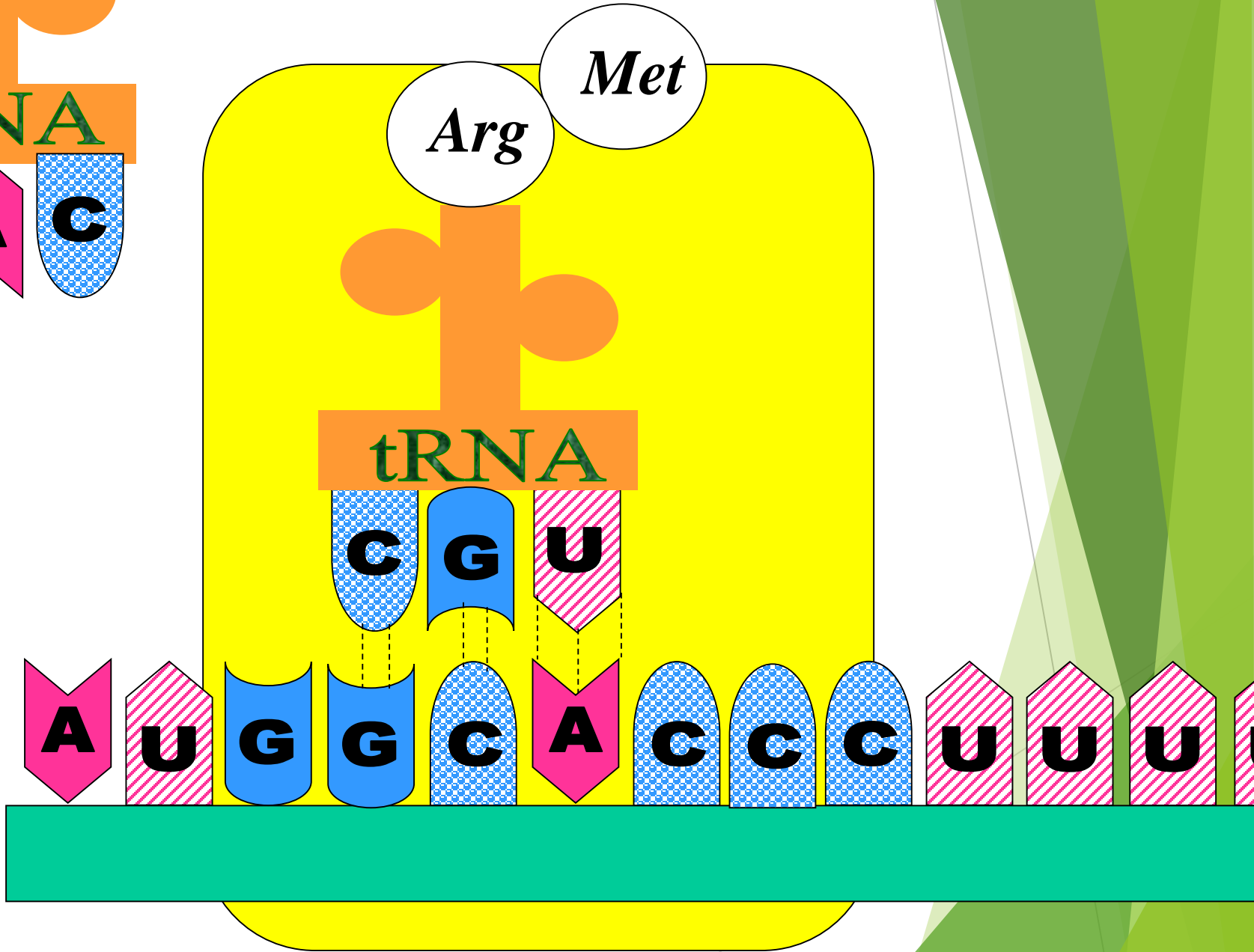
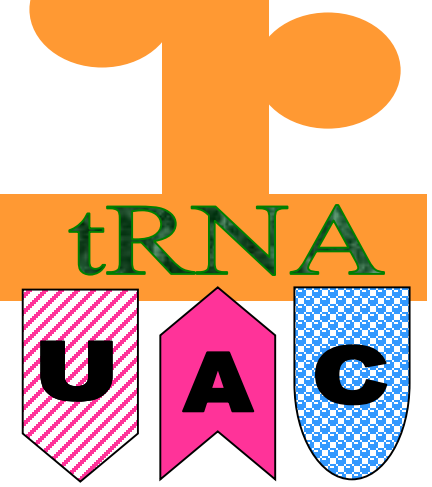
Single Messenger RNA Strand

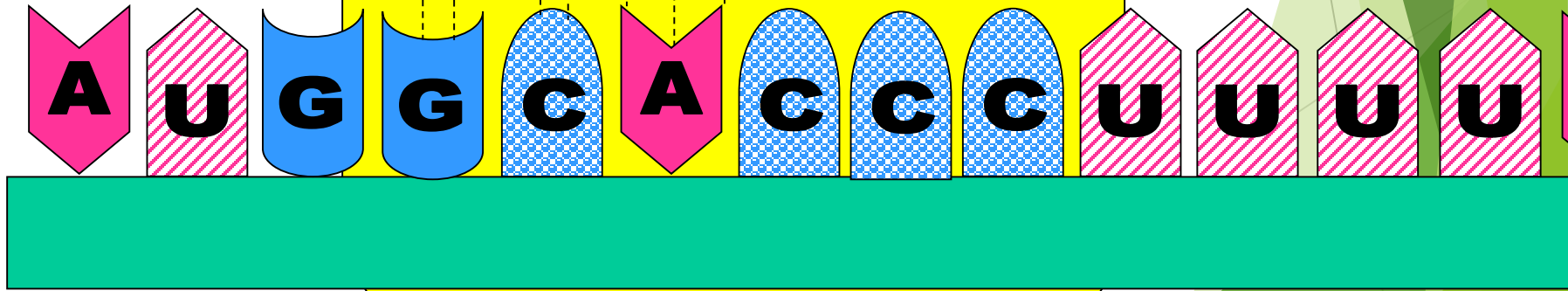
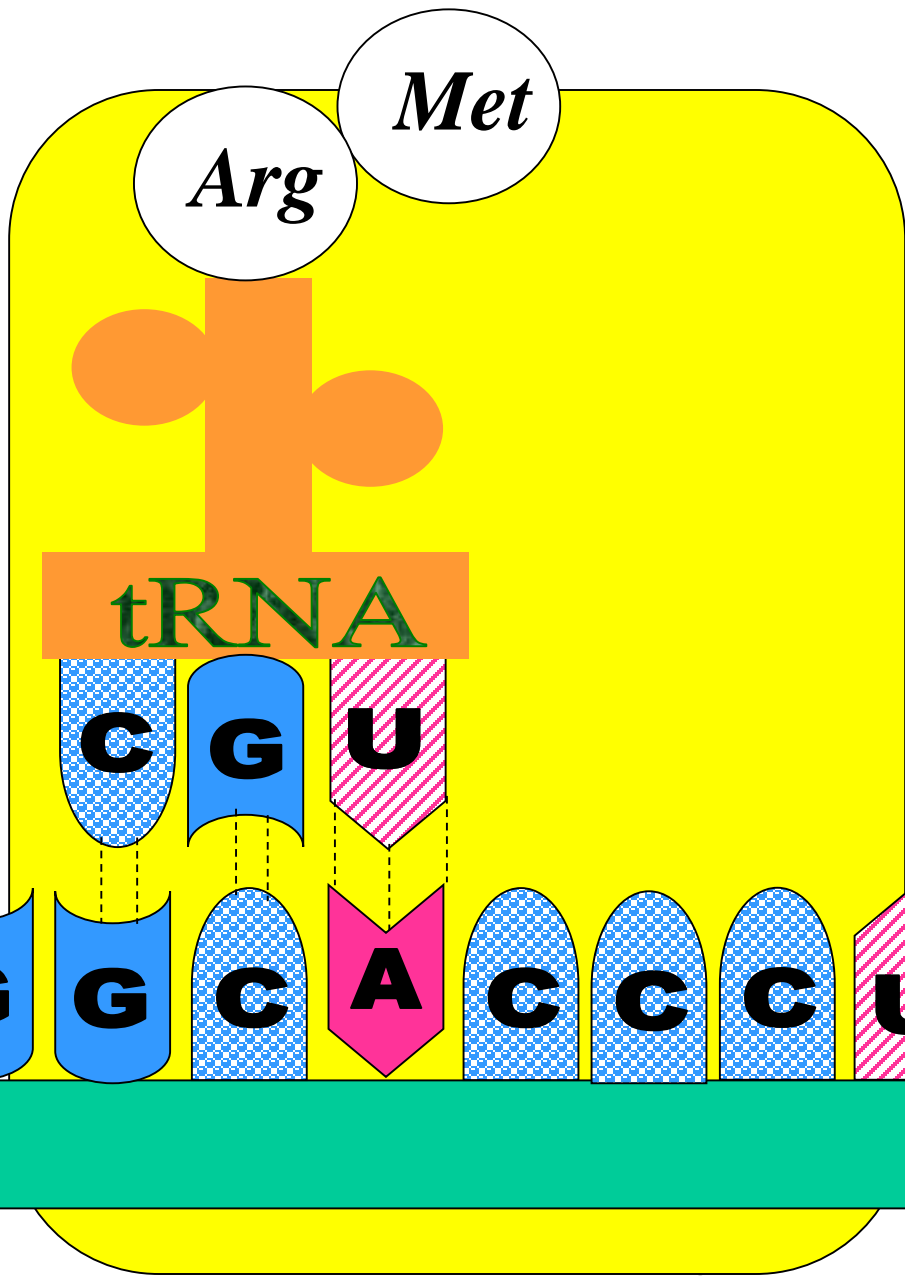
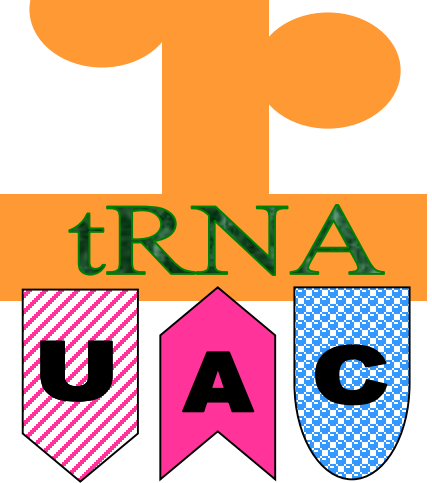












RNA

A

C

Arg

Met

tRNA

C

G

U

A

U

G

G

C

A

C

C

C

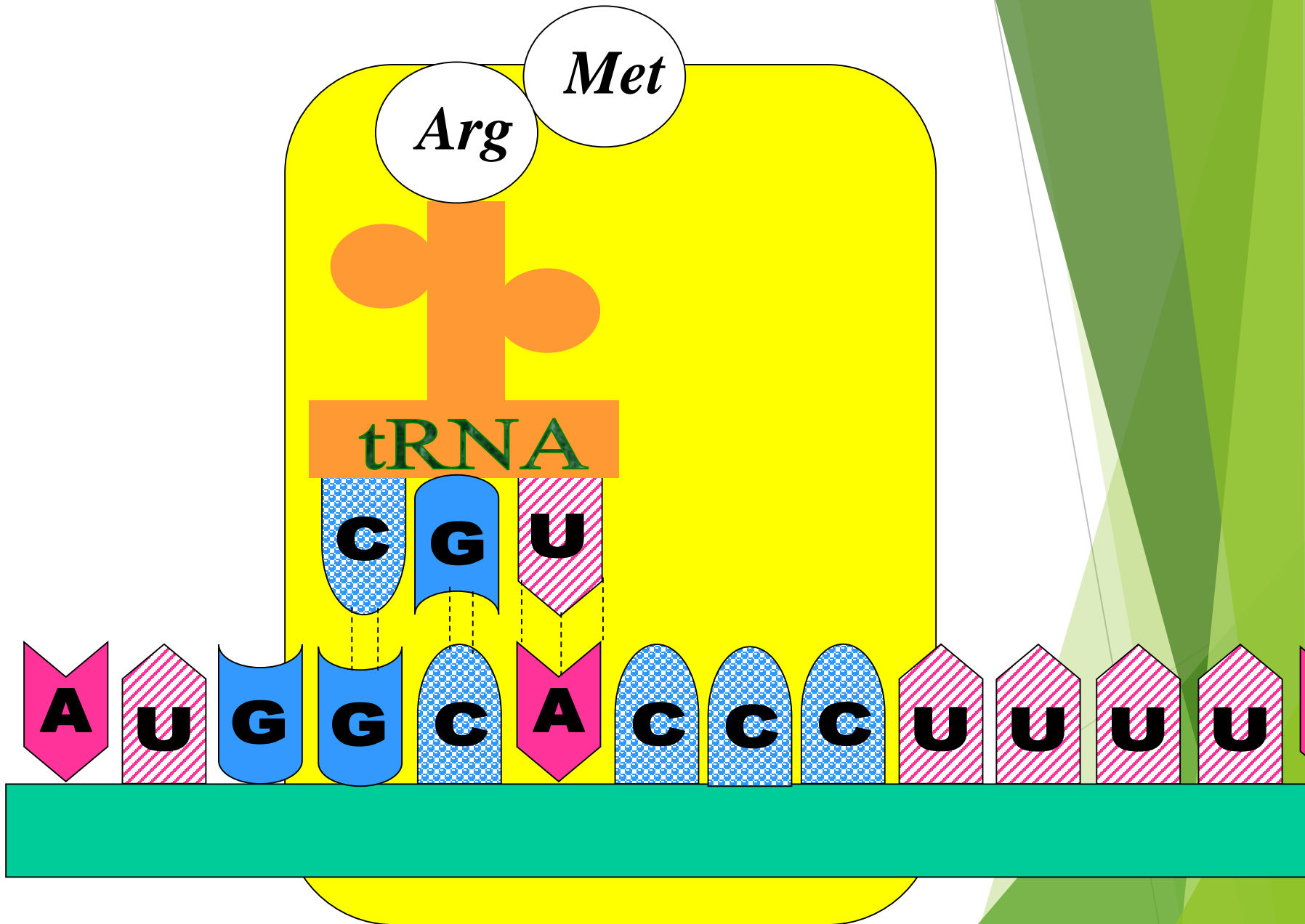
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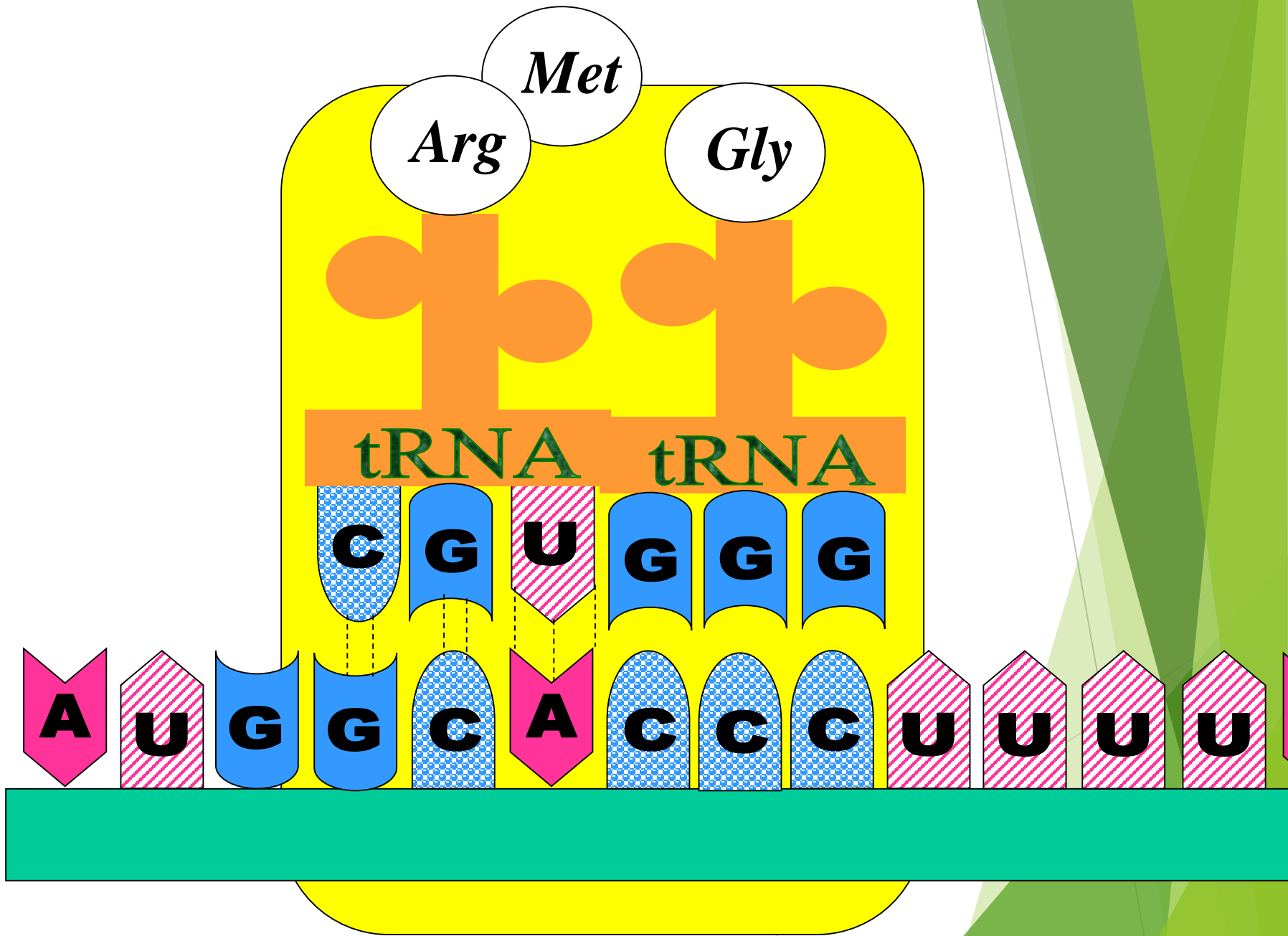
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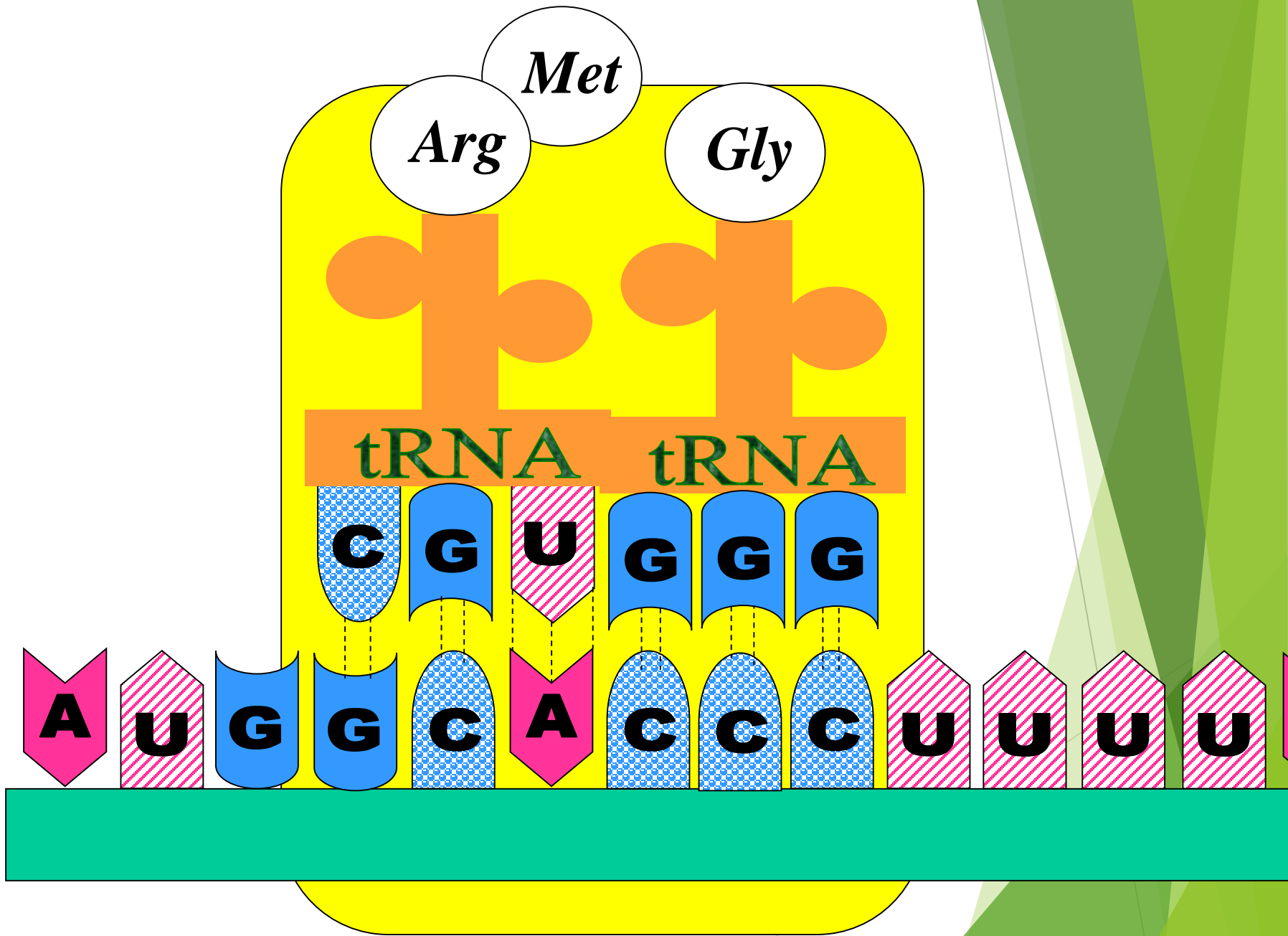
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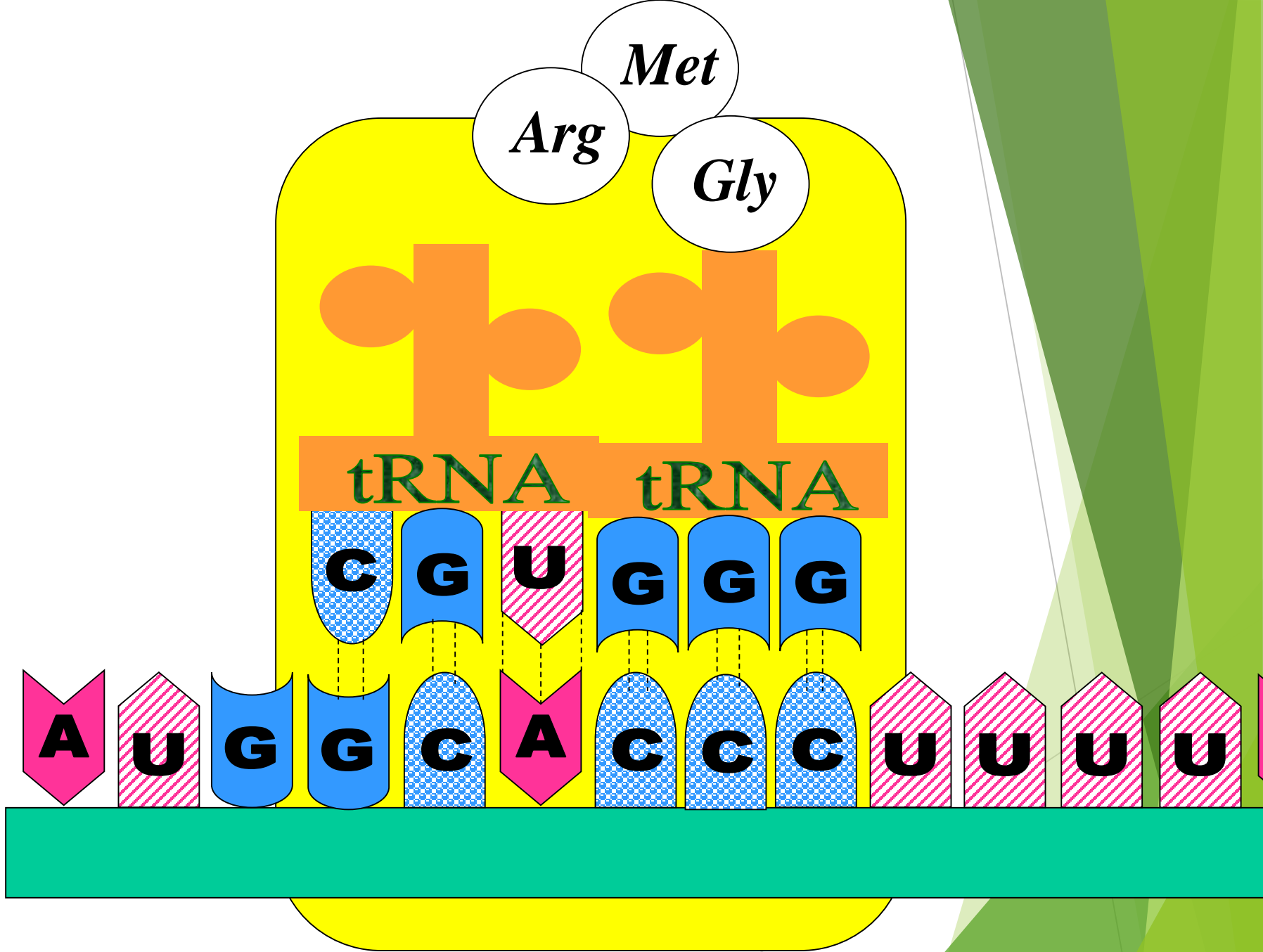
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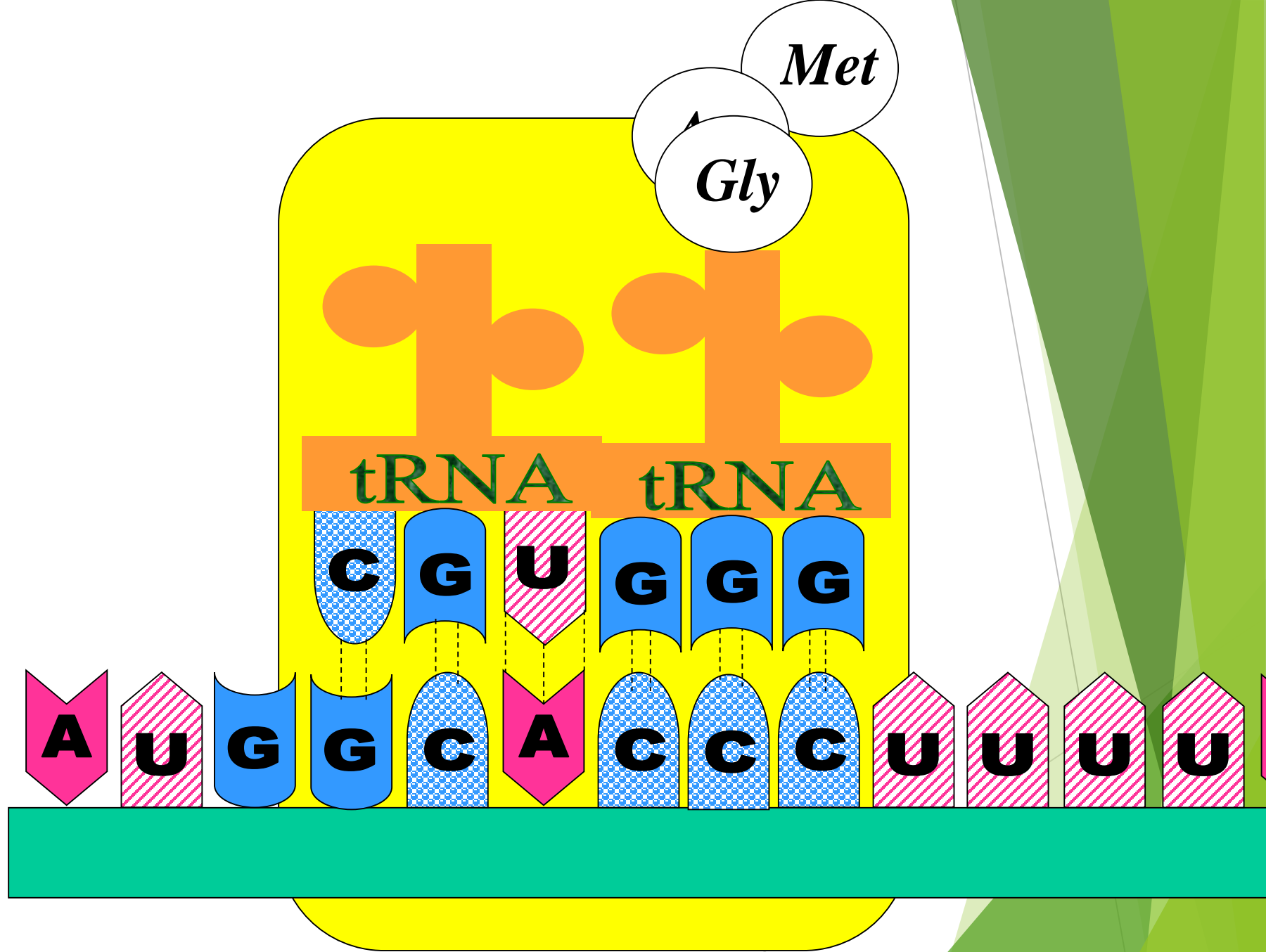


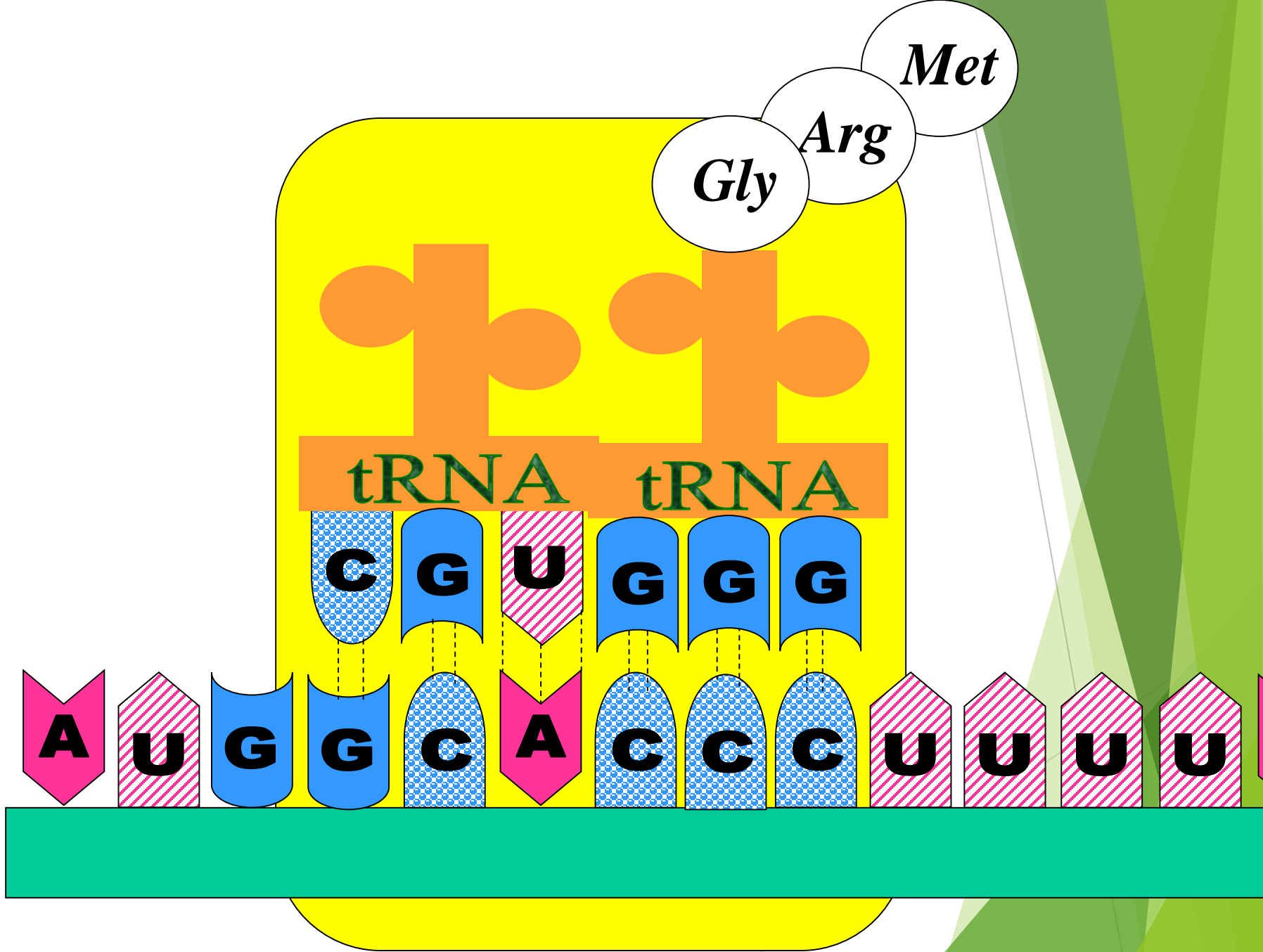


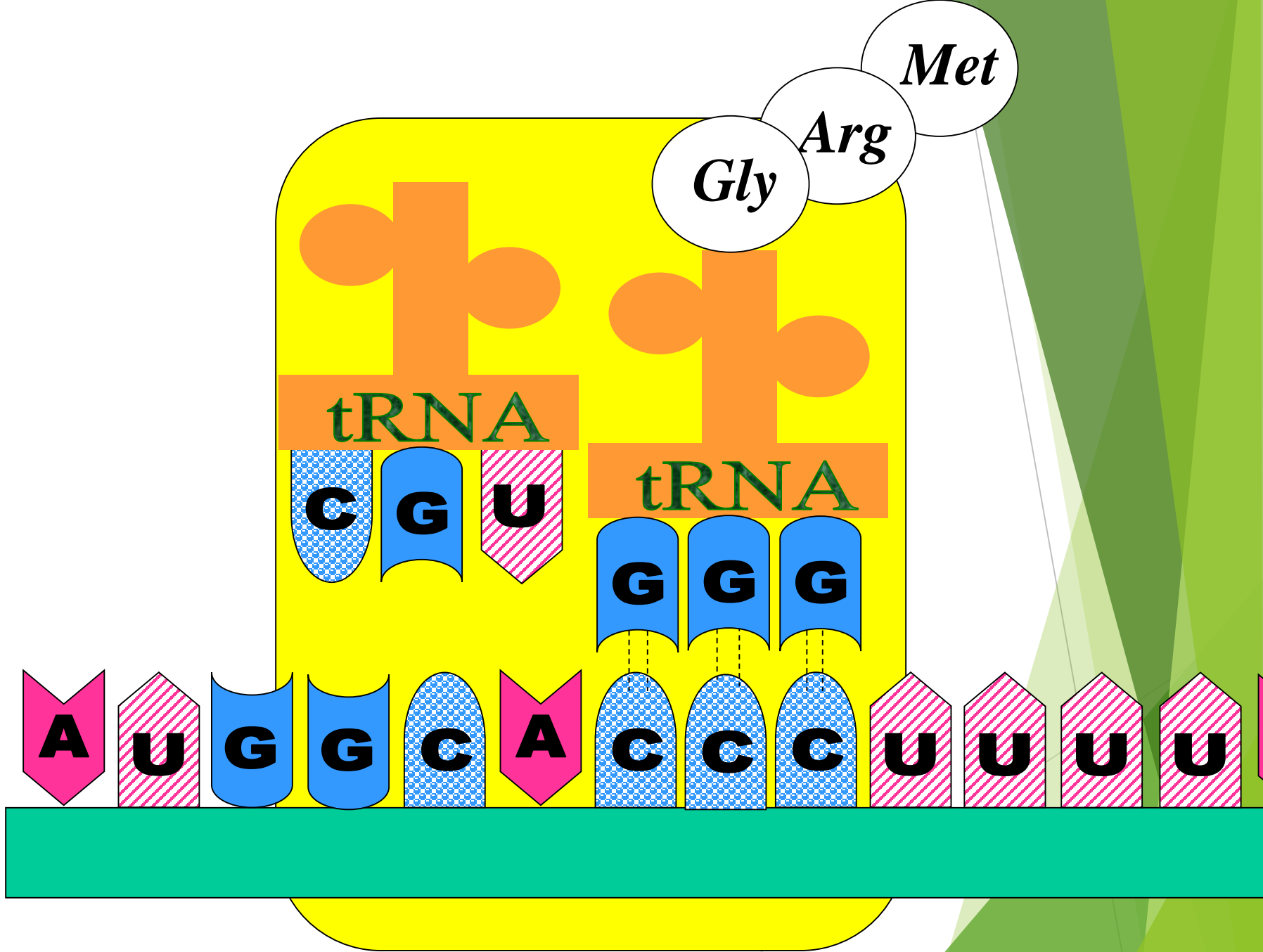












Met

Arg

Gly

tRNA

tRNA

C

G

U

G

G

G

A

U

G

G

C

A

C

C

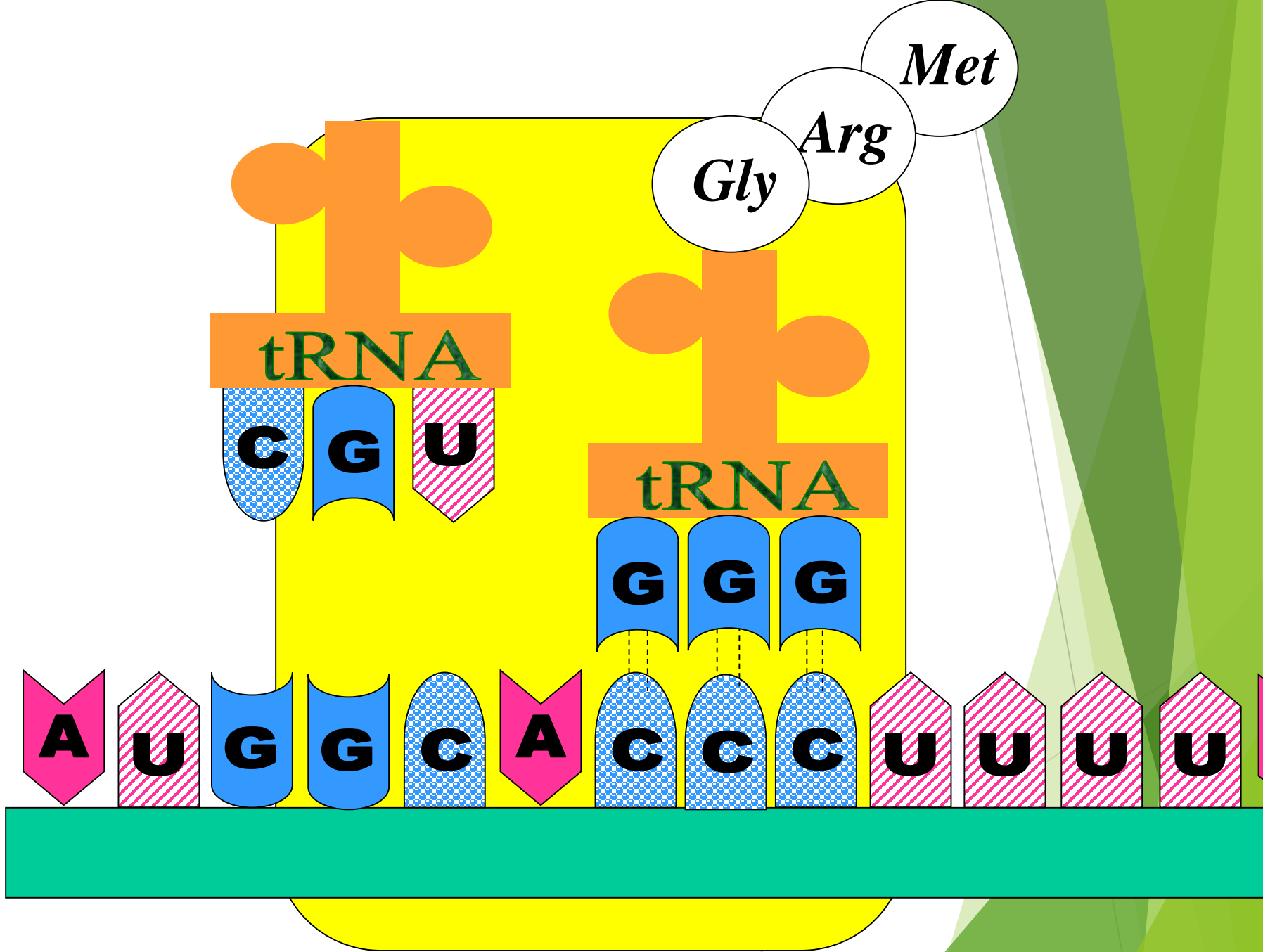
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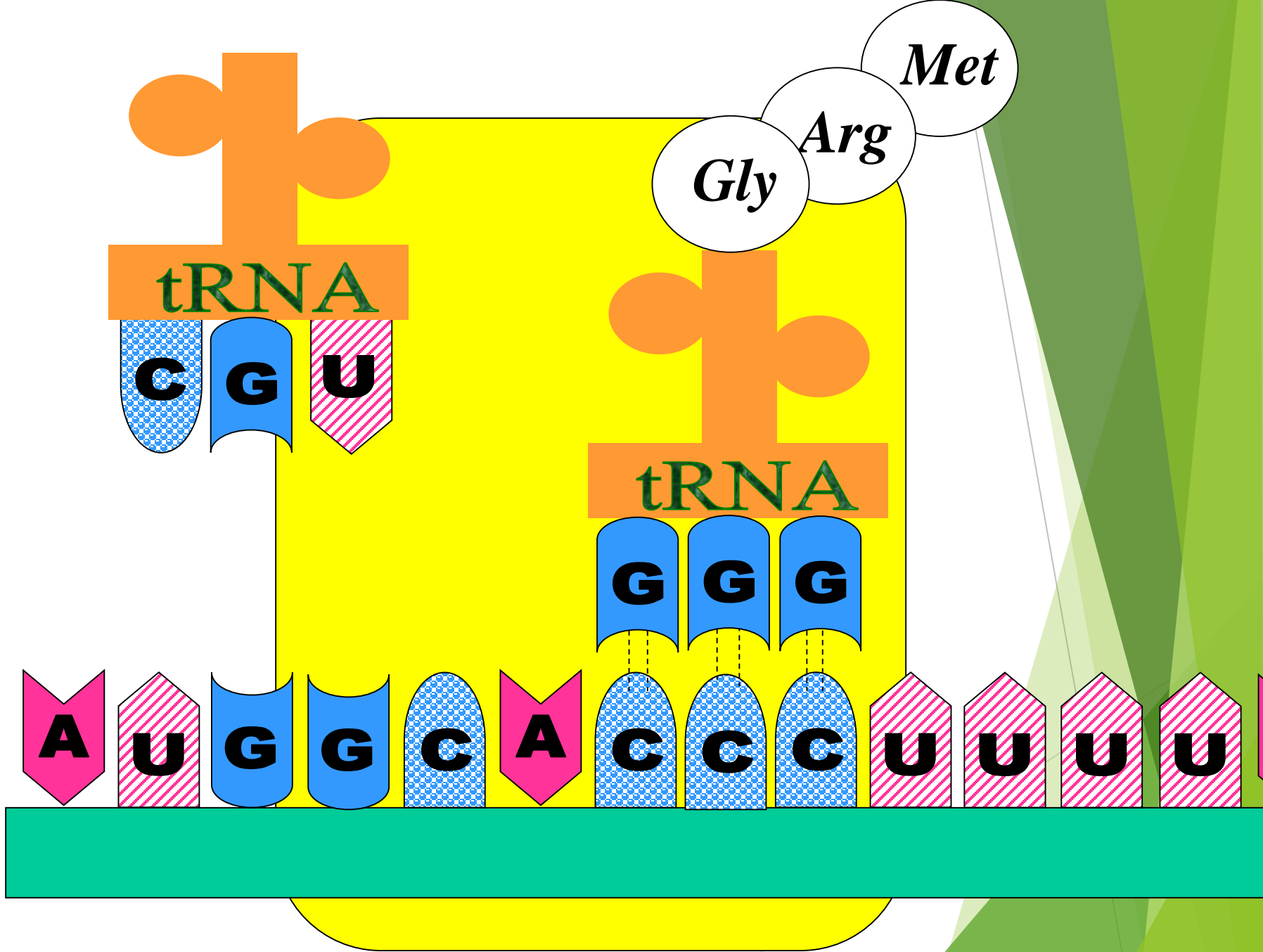
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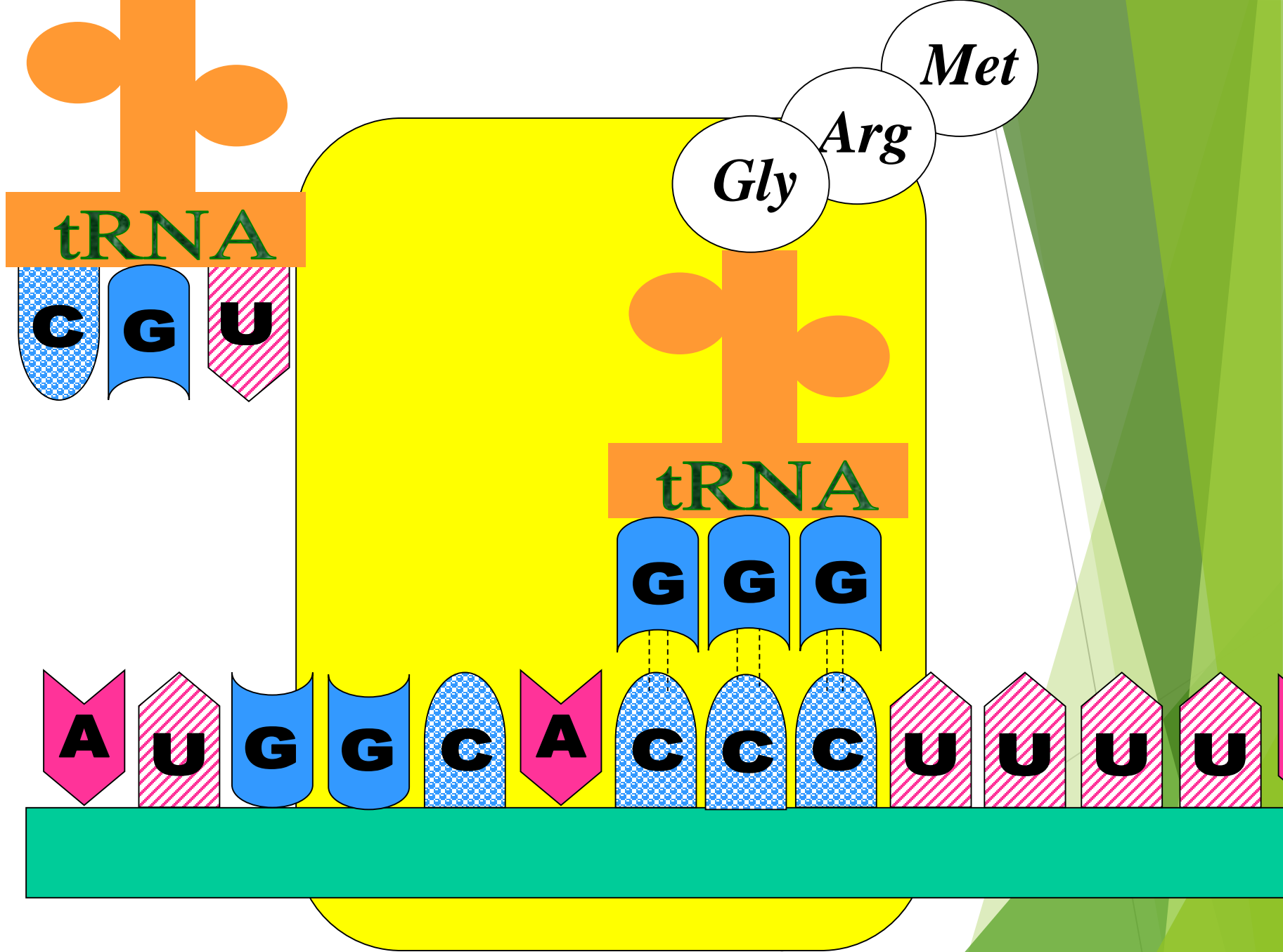
U

U

U







tRNA

C G U

Gly

Arg

Met

tRNA

G G G

A

U

G

G

C

A

C

C

C

U

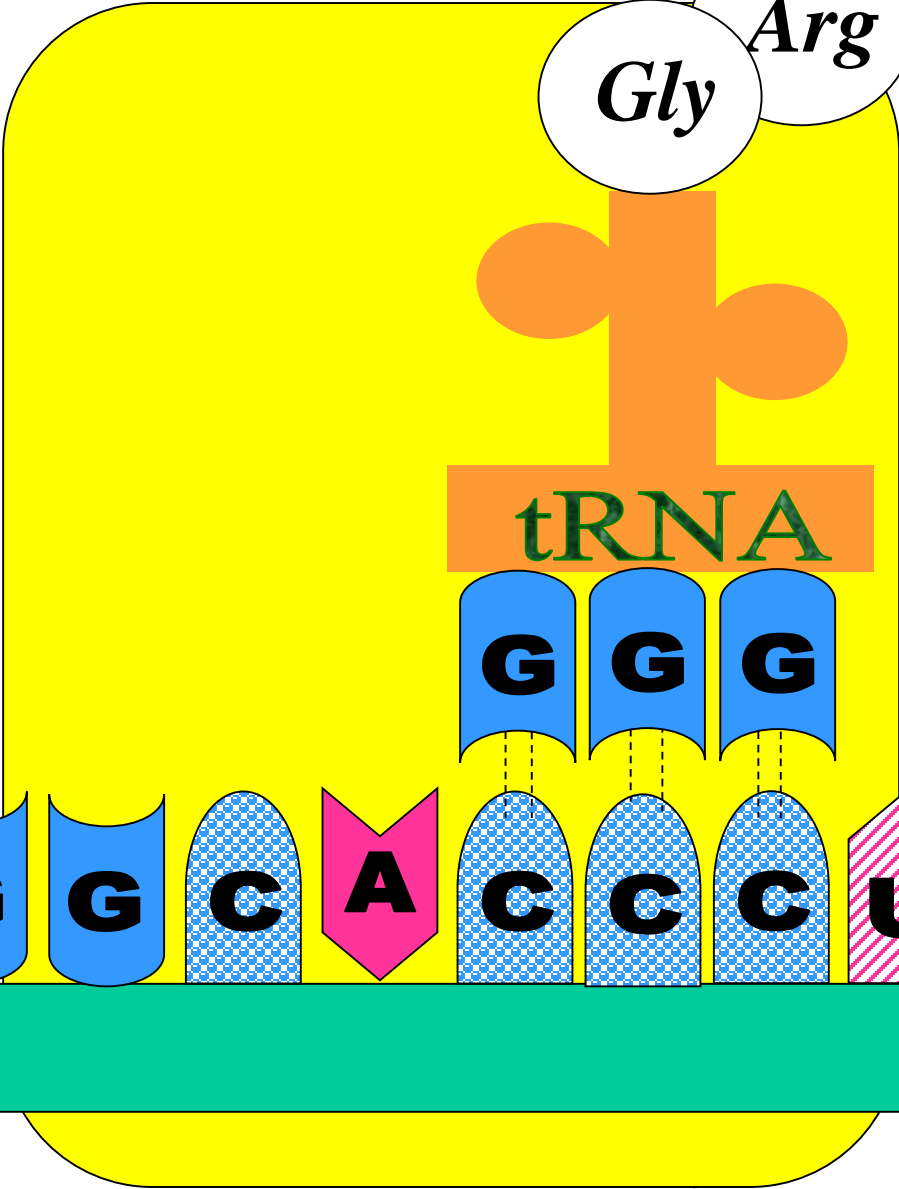
U

U

U

rRNA

G U



Gly

Arg

Met

tRNA

G G G

A

U

G

G

C

A

C

C

C

U

U

U

U



NA

G

U

Gly

Arg

Met

tRNA

G

G

G

A

U

G

G

C

A

C

C

C

U

U

U

U

NA

G

U

Met

Arg

Gly

tRNA

G G G

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C

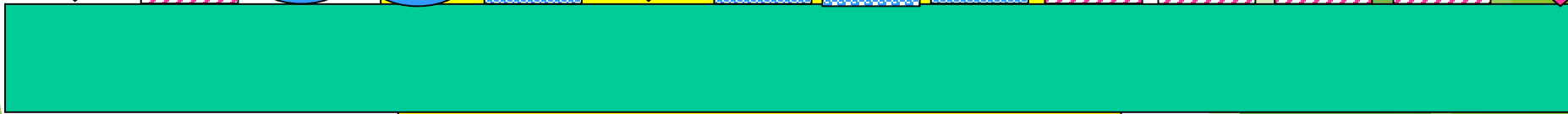
U

U

U

U

A



NA

G

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Met

Arg

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tRNA

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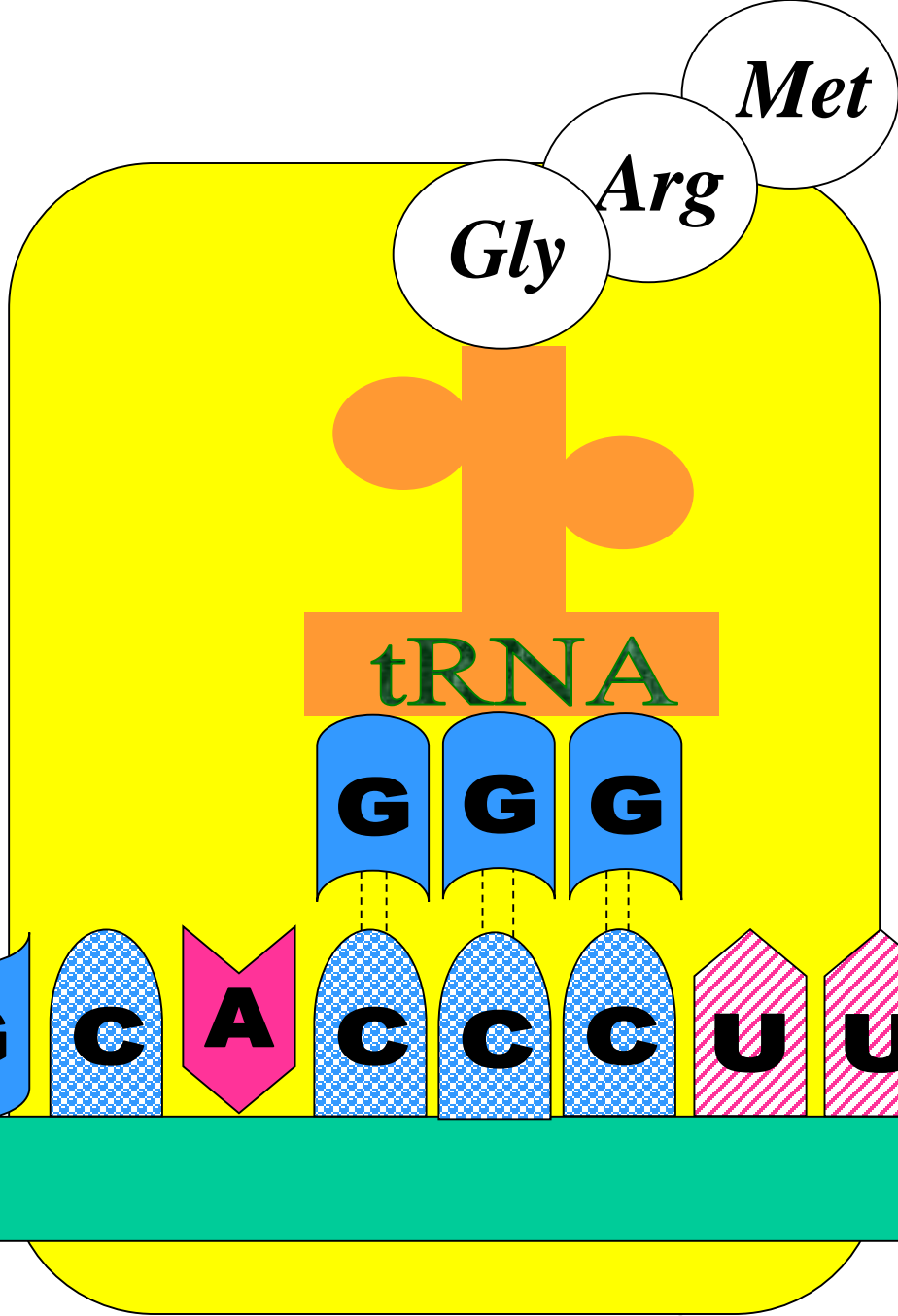
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U

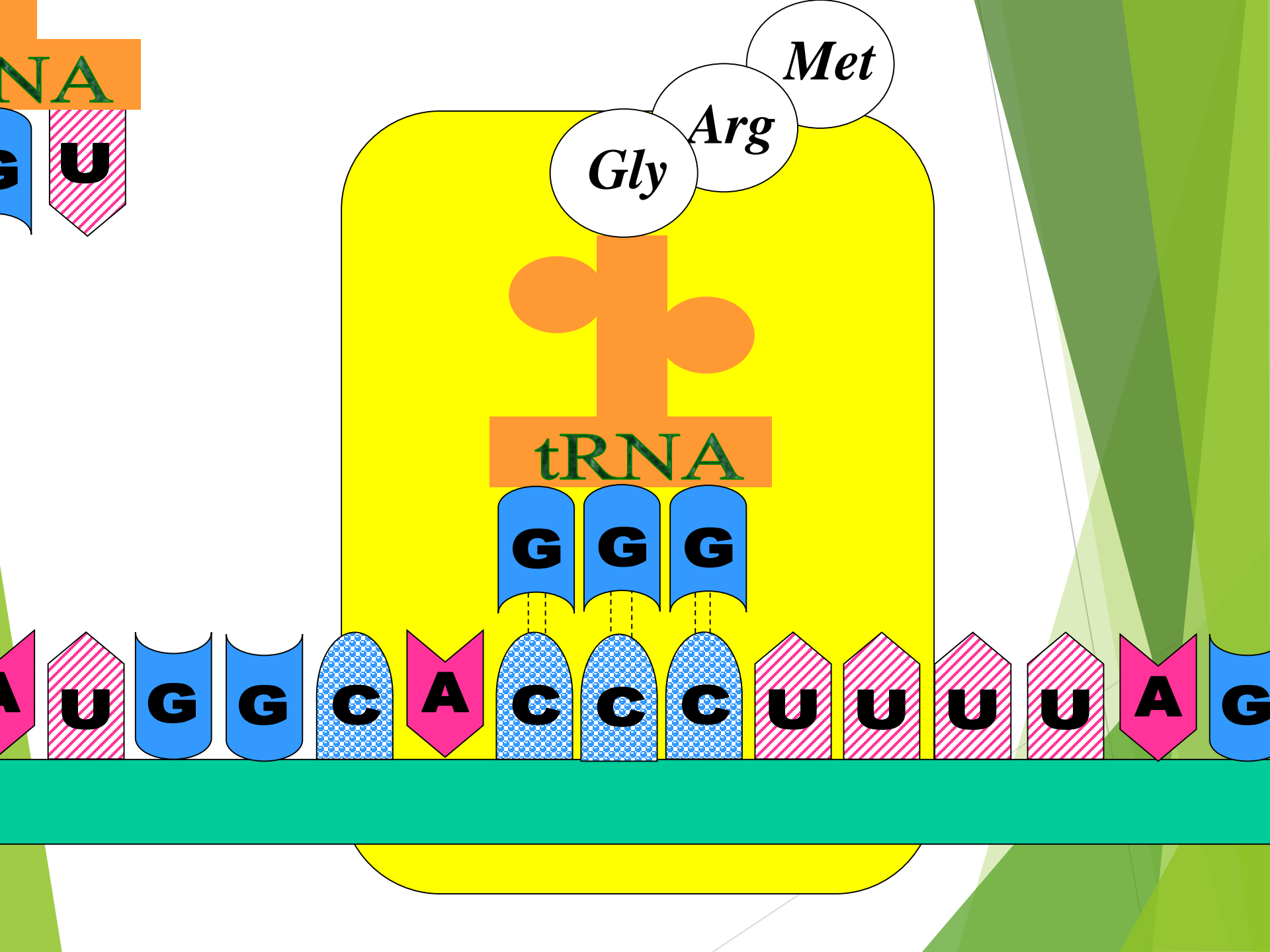
U

A

NA
U



A U G G C A C C C U U U U A



NA

U

Gly

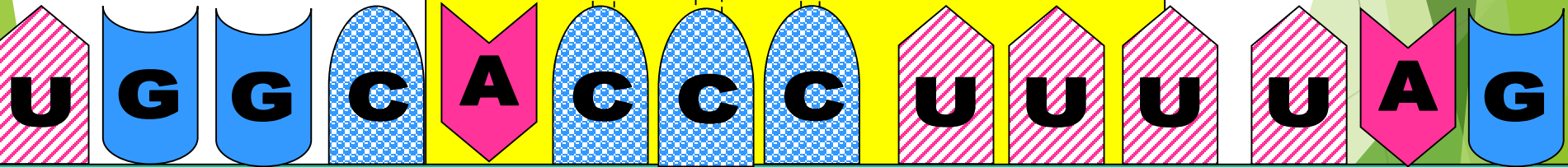
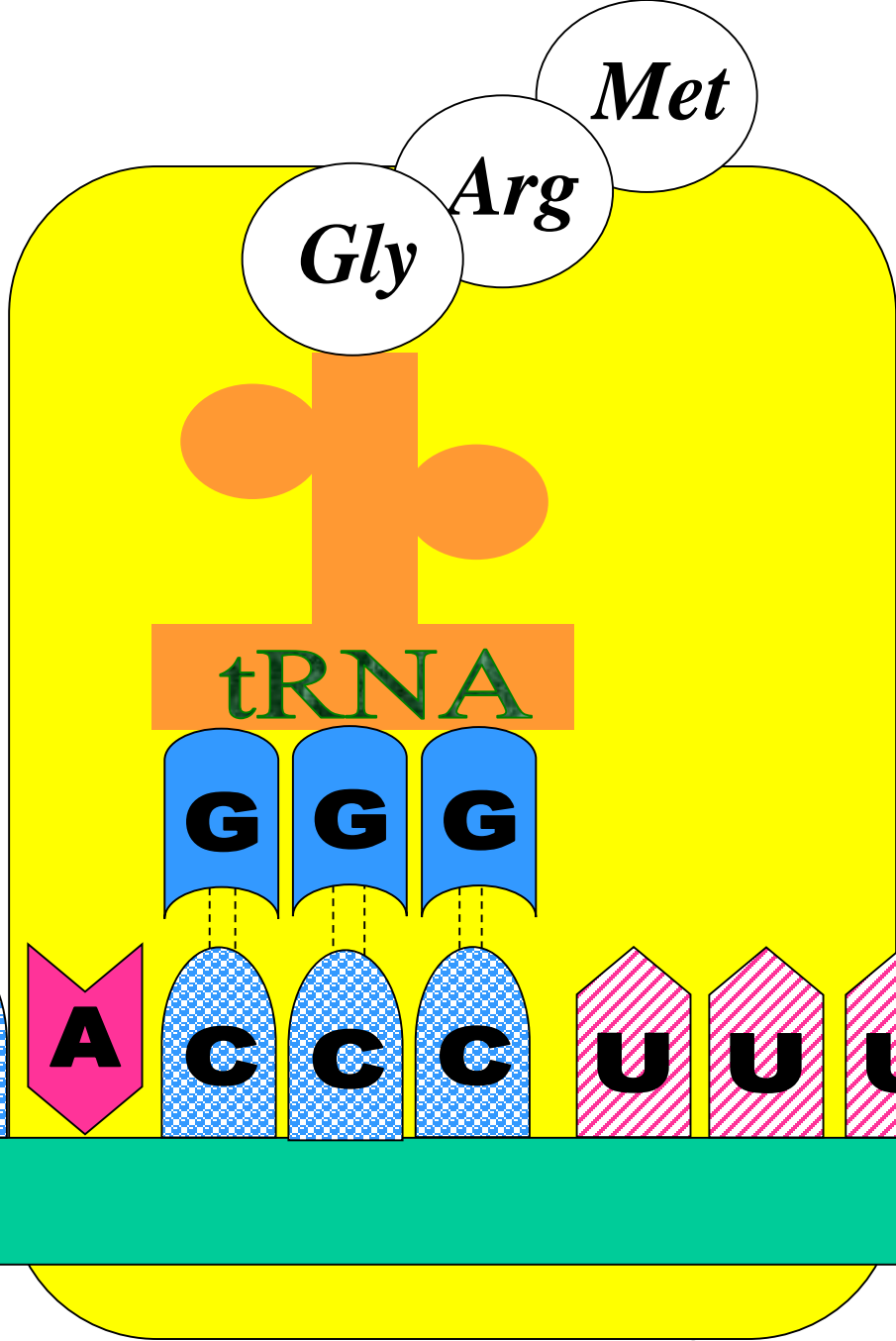
Arg

Met

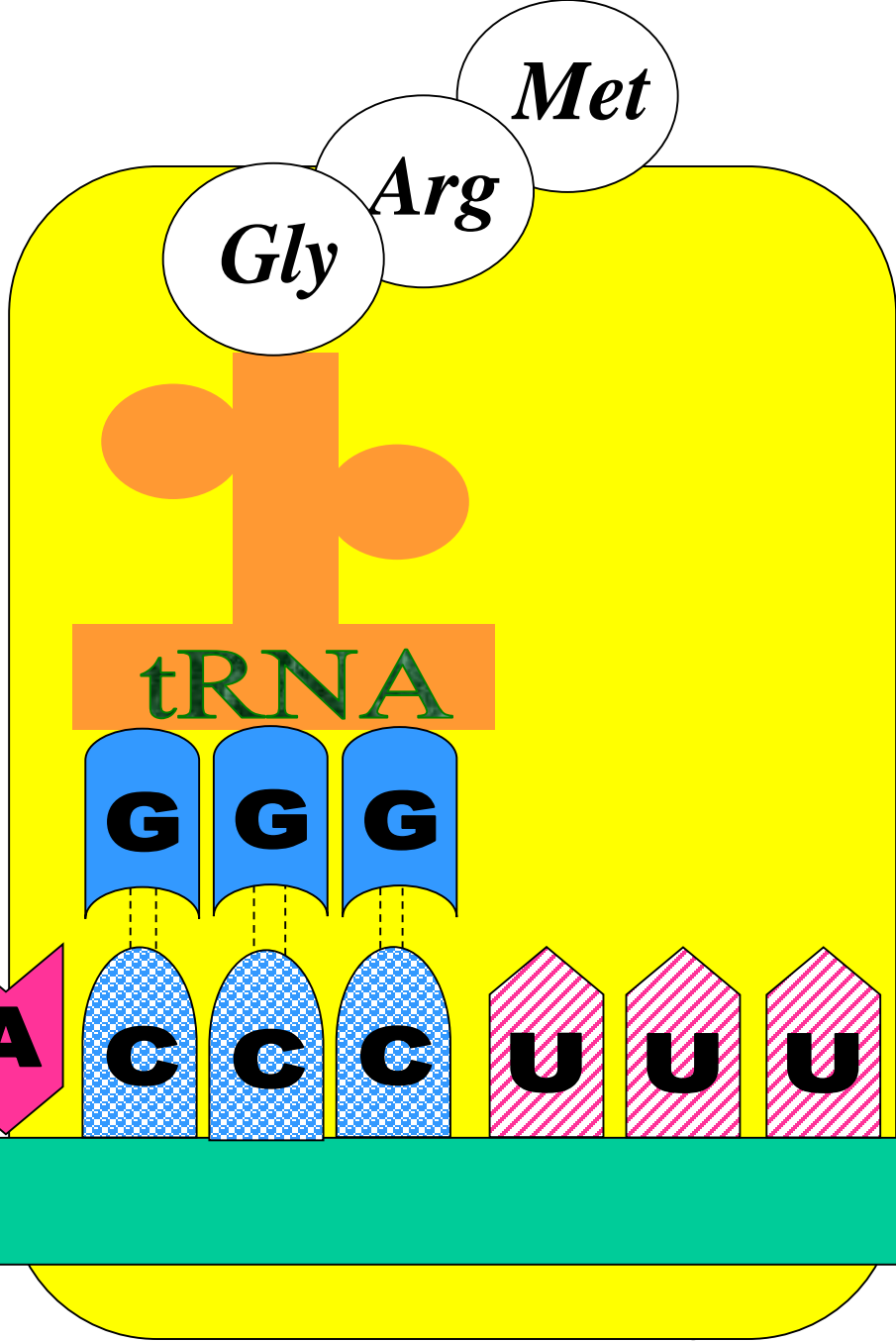
tRNA

G G G

A U G G C A C C C U U U U A G



NA
U



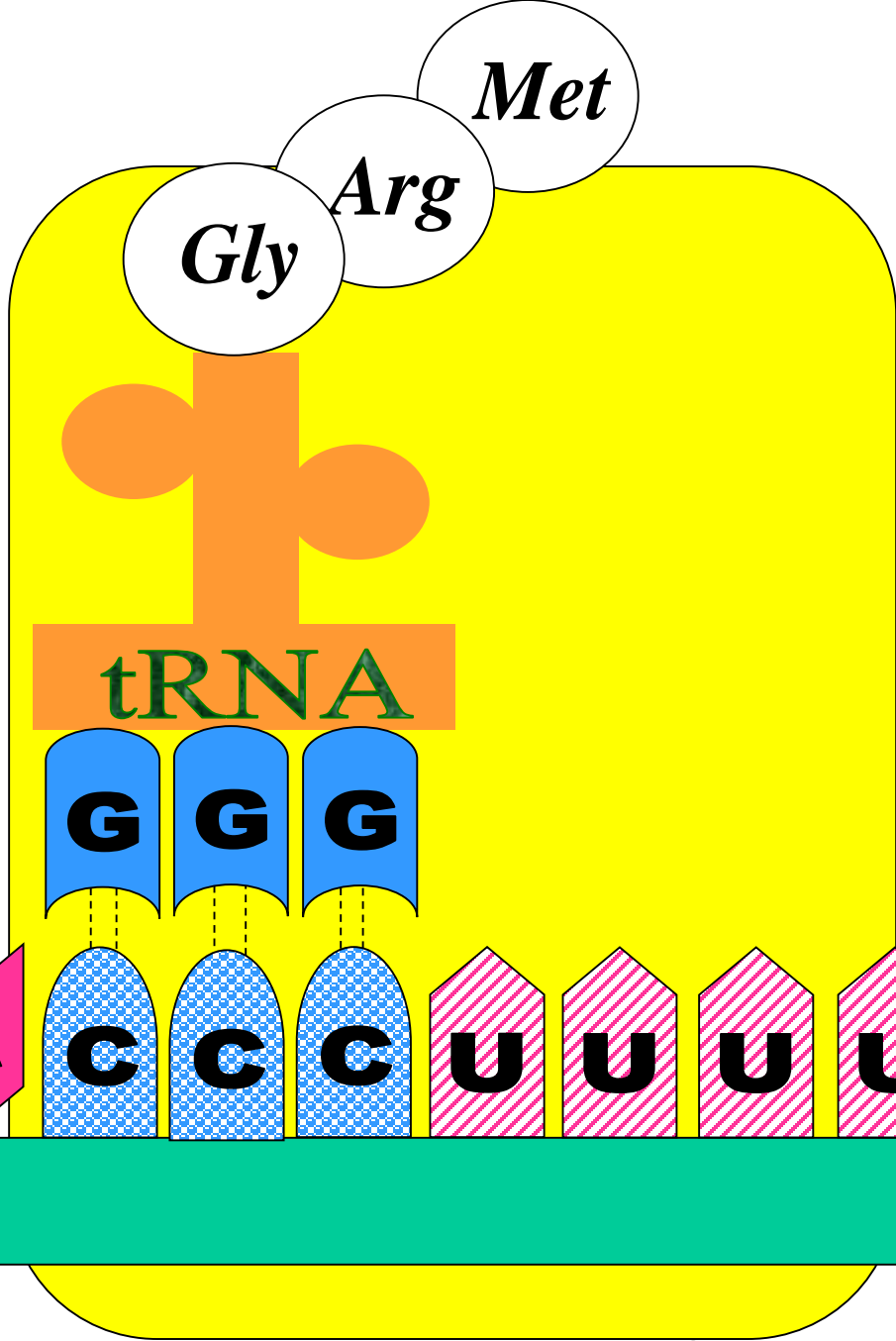
Met

Arg

Gly

G G C A C C C U U U U A G

NA
U



tRNA

G G G

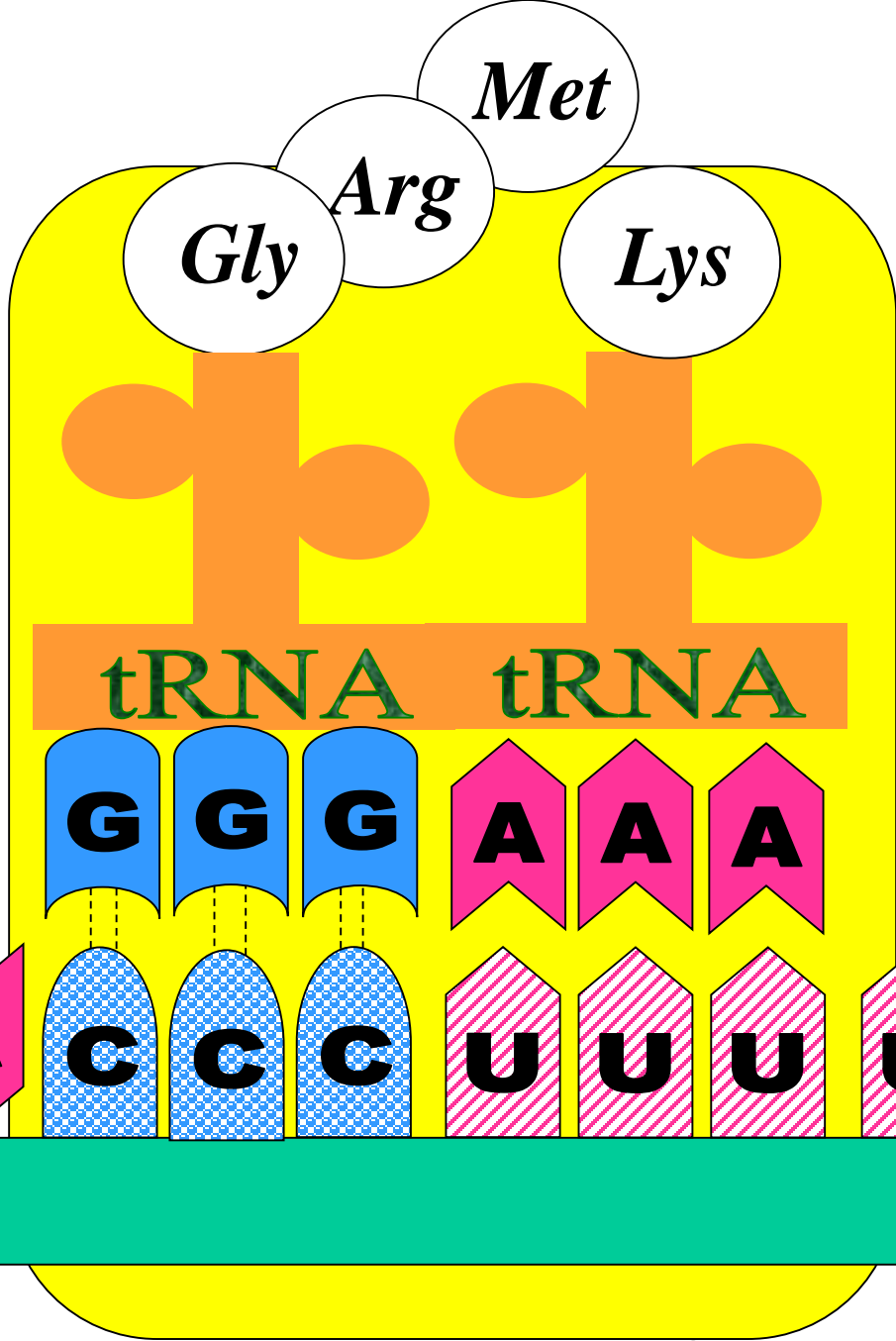
Gly

Arg

Met

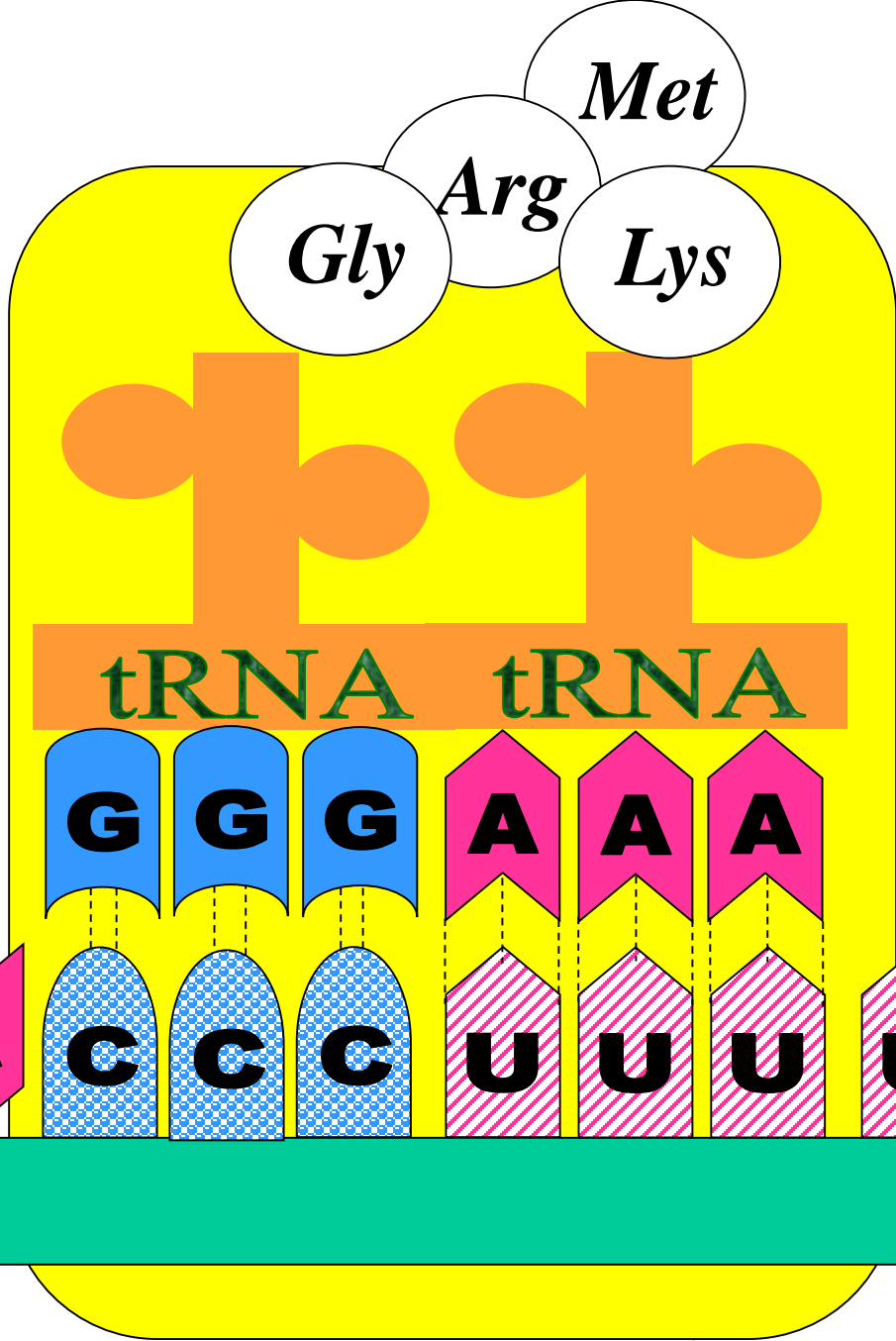
G G C A C C C U U U U A G

NA
G U



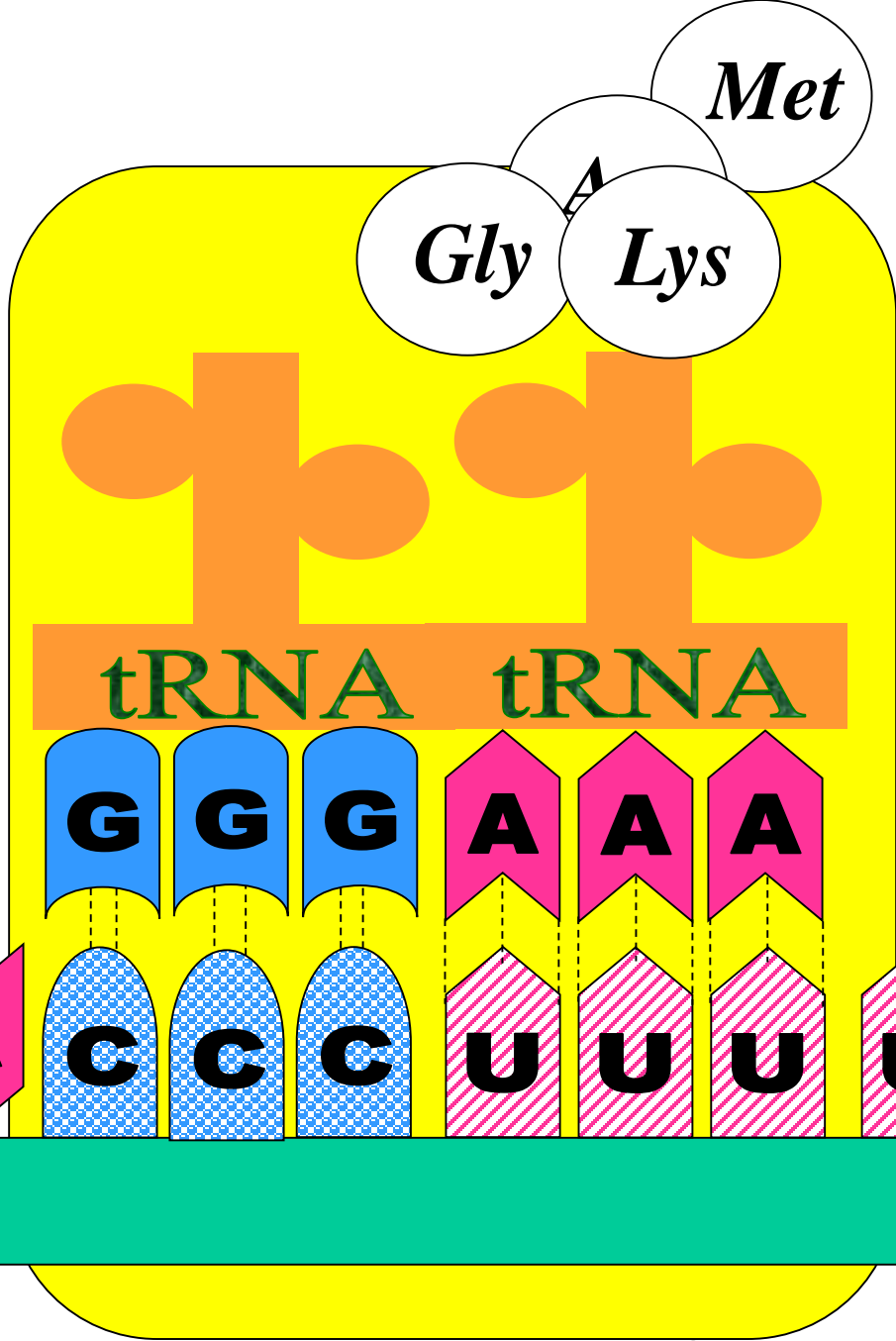
G G C A C C C U U U U A G

NA
G U



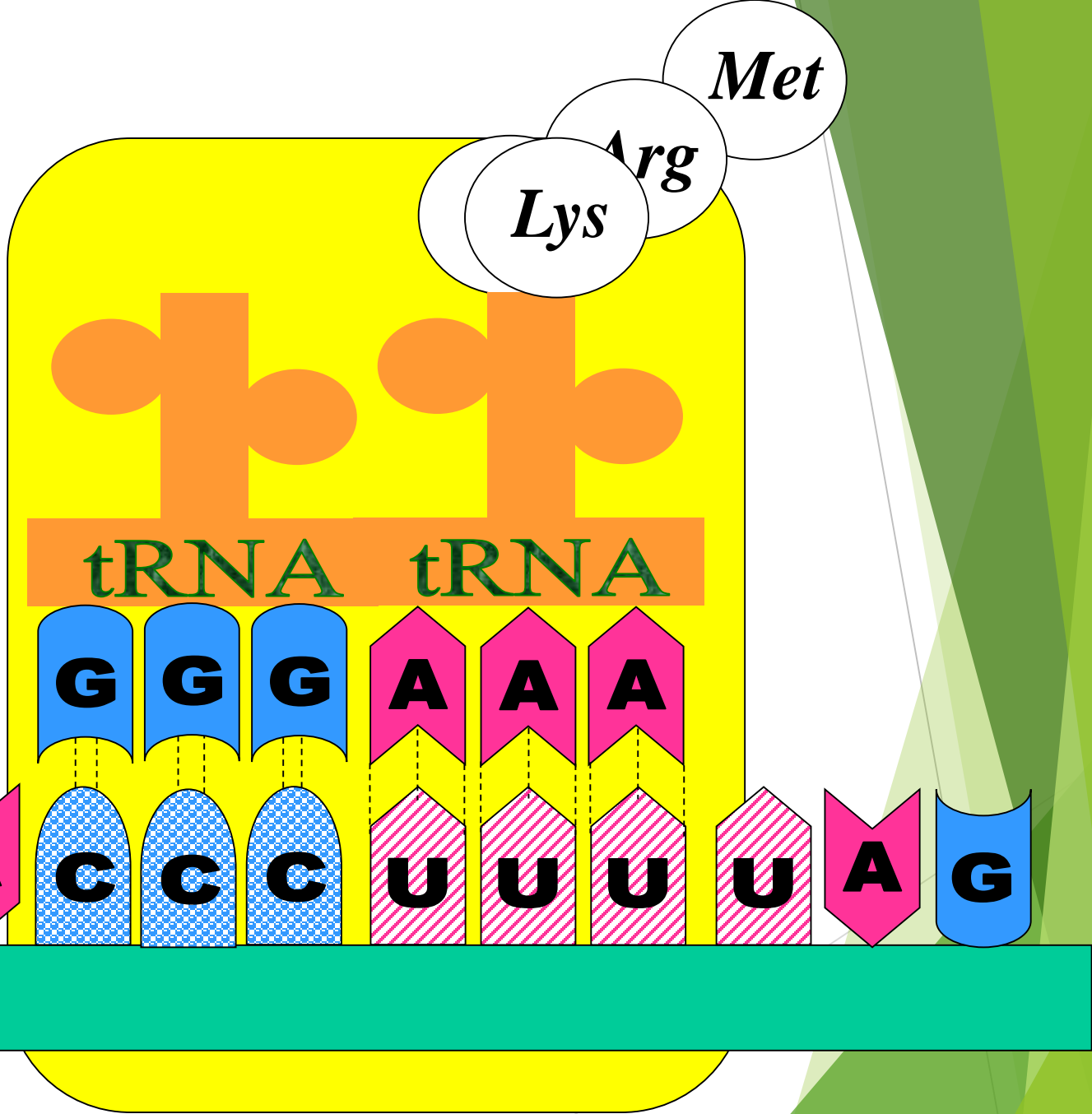
G G C A C C C U U U U A G

NA
G U



G G C A C C C U U U U A G

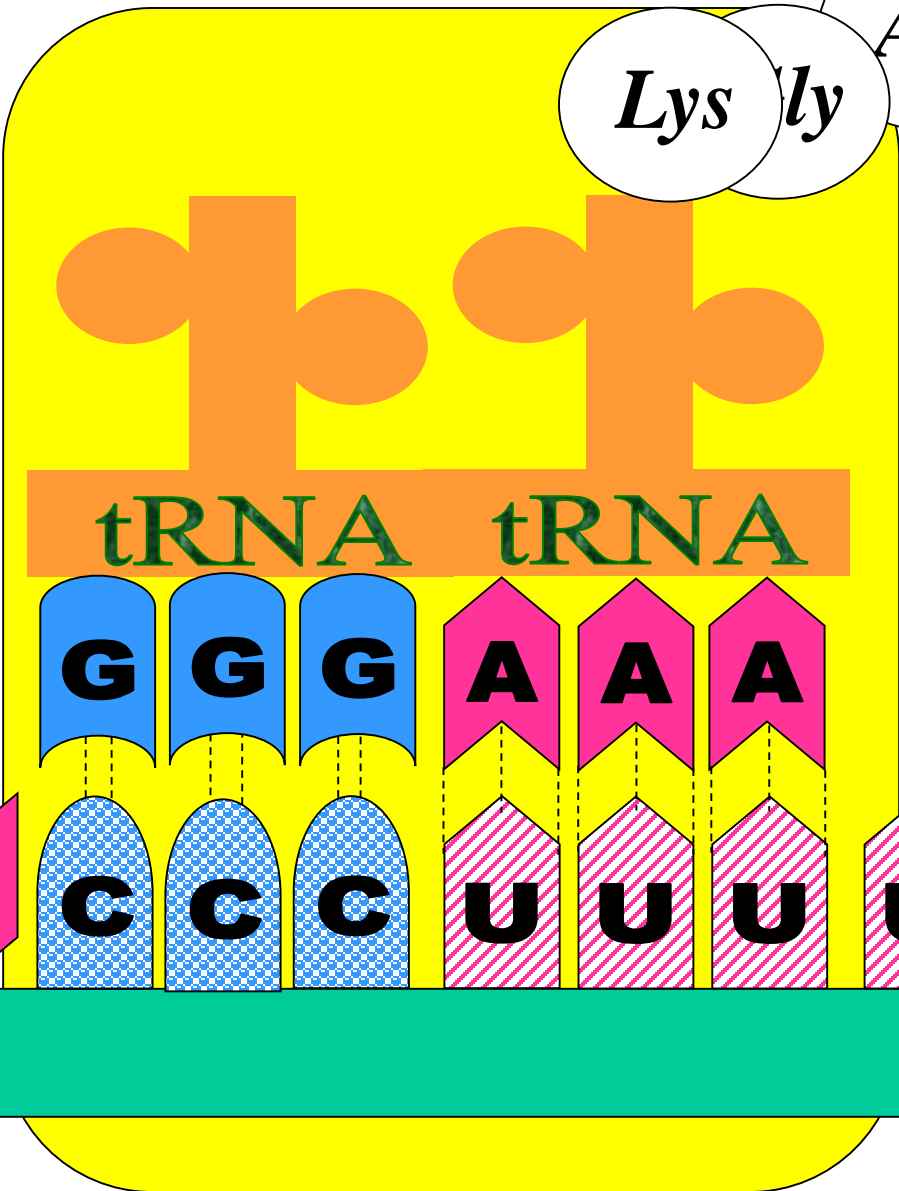
NA
G U



NA

G

U



tRNA tRNA

G G G

A A A

G G

C

A

C

C

C

U

U

U

U

A

G

Lys

Arg

Met

NA

G

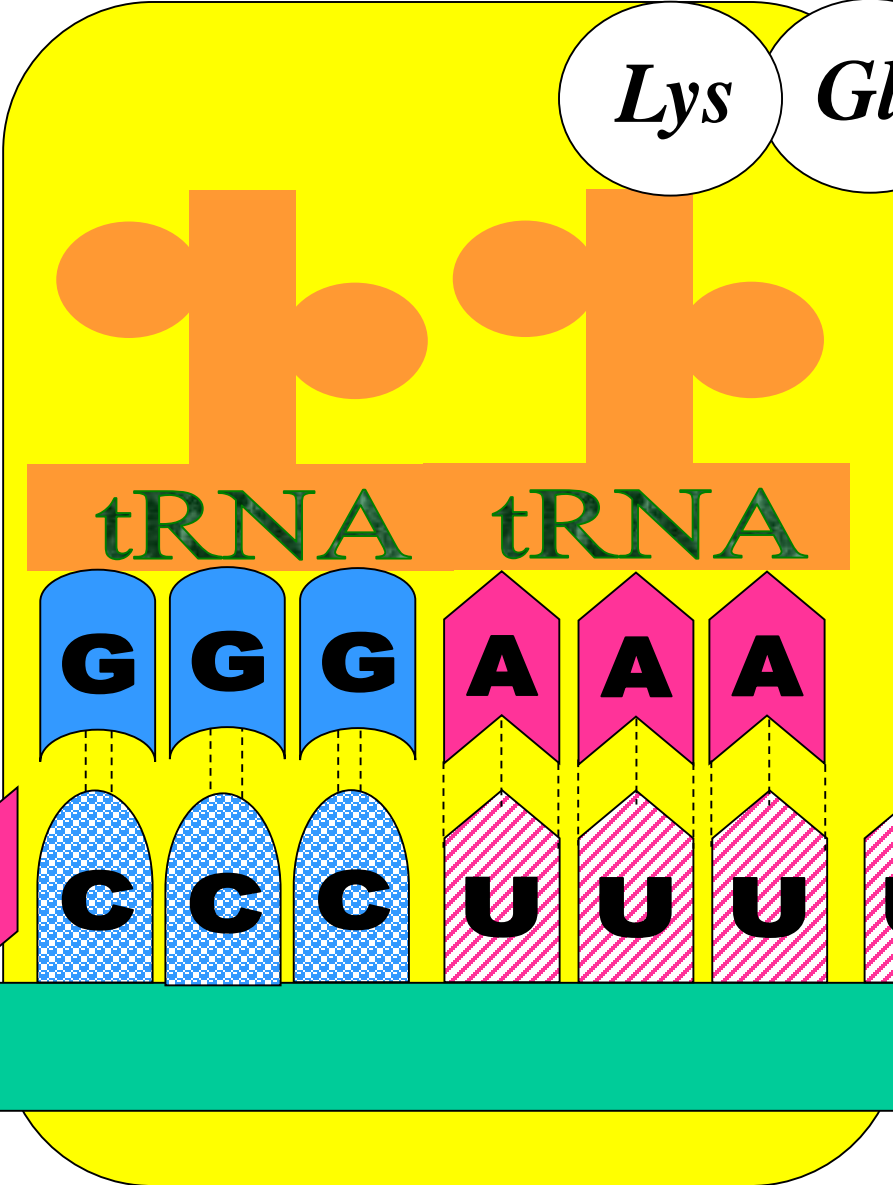
U

Met

Arg

Gly

Lys



tRNA tRNA

G G G

A A A

G G C

A

C C C

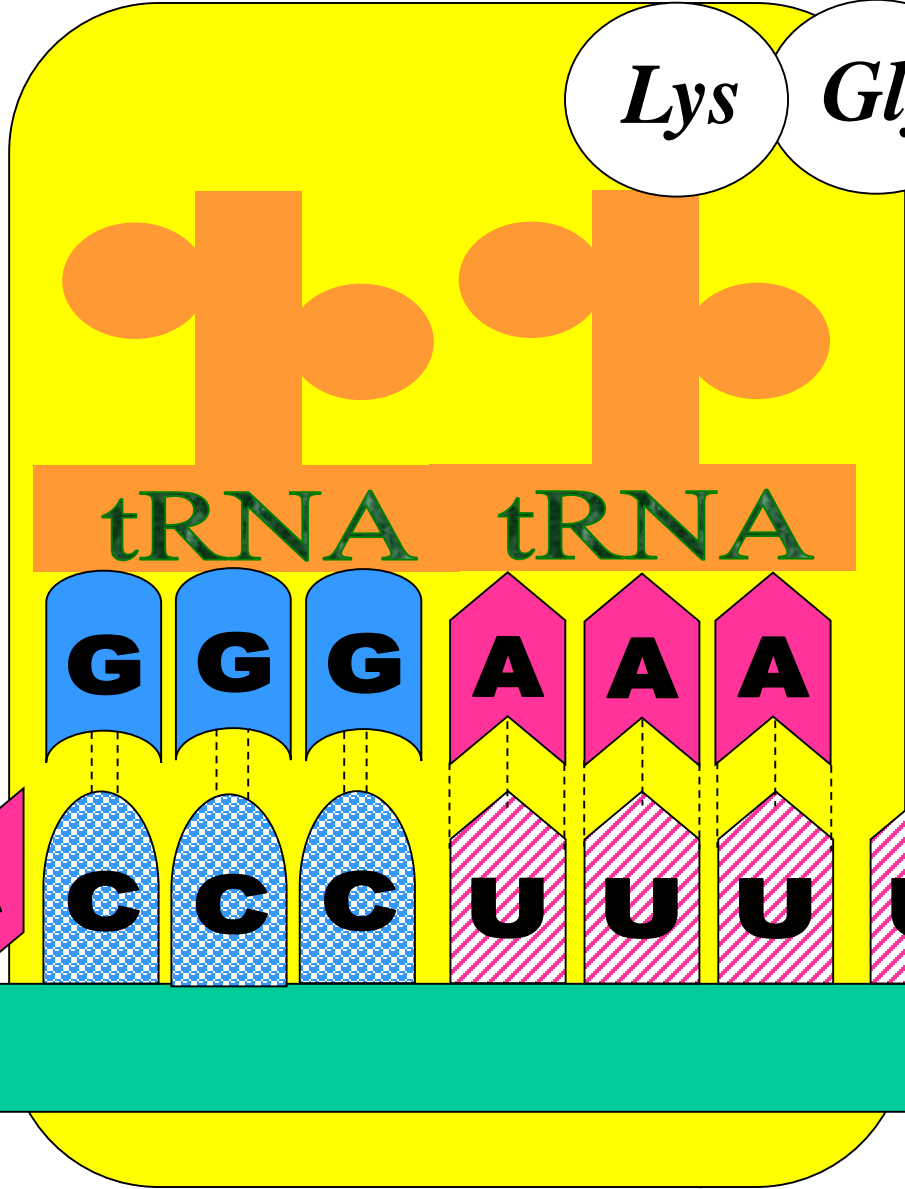
U U U

U

A

G

A
J



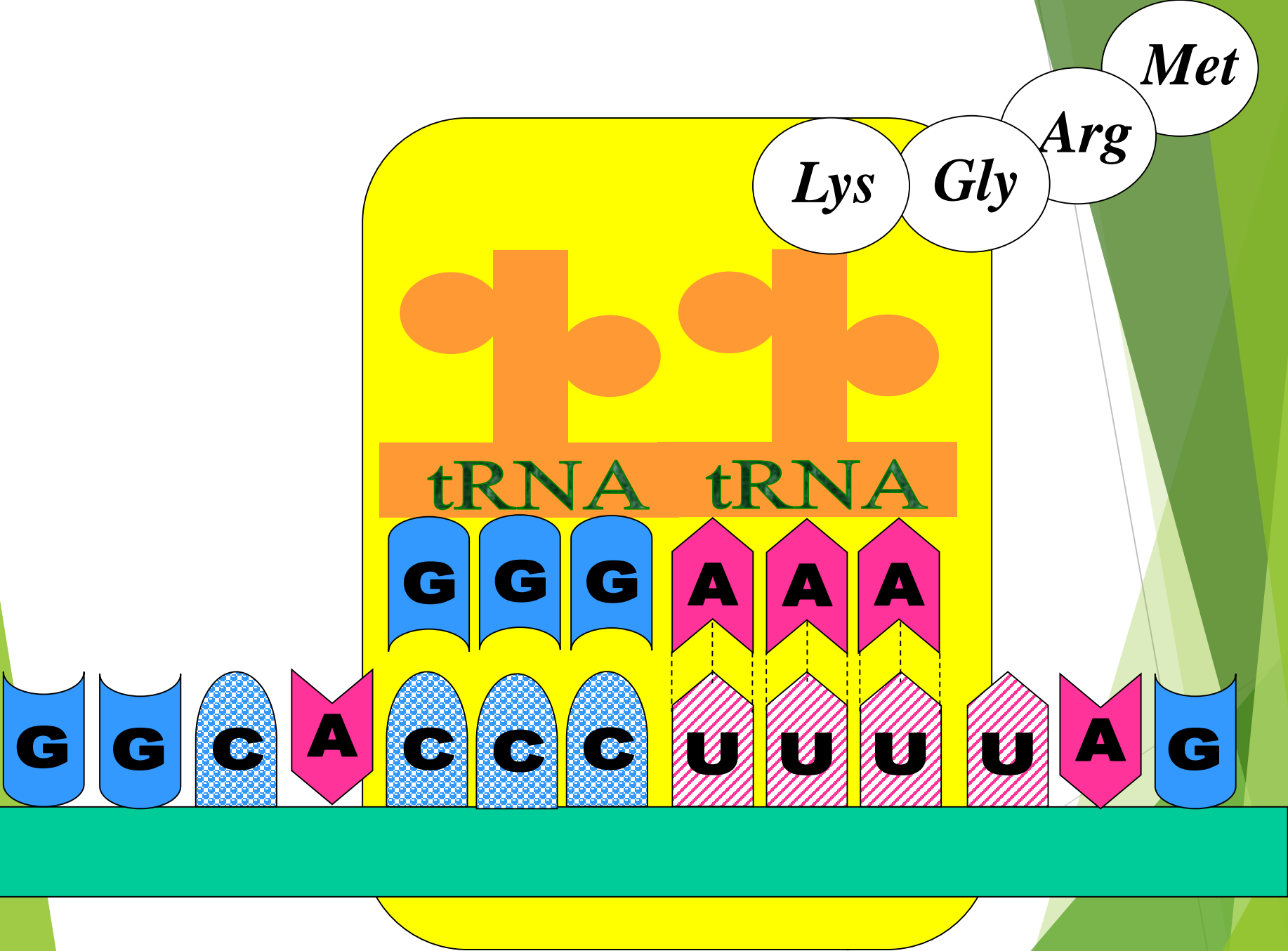
Lys

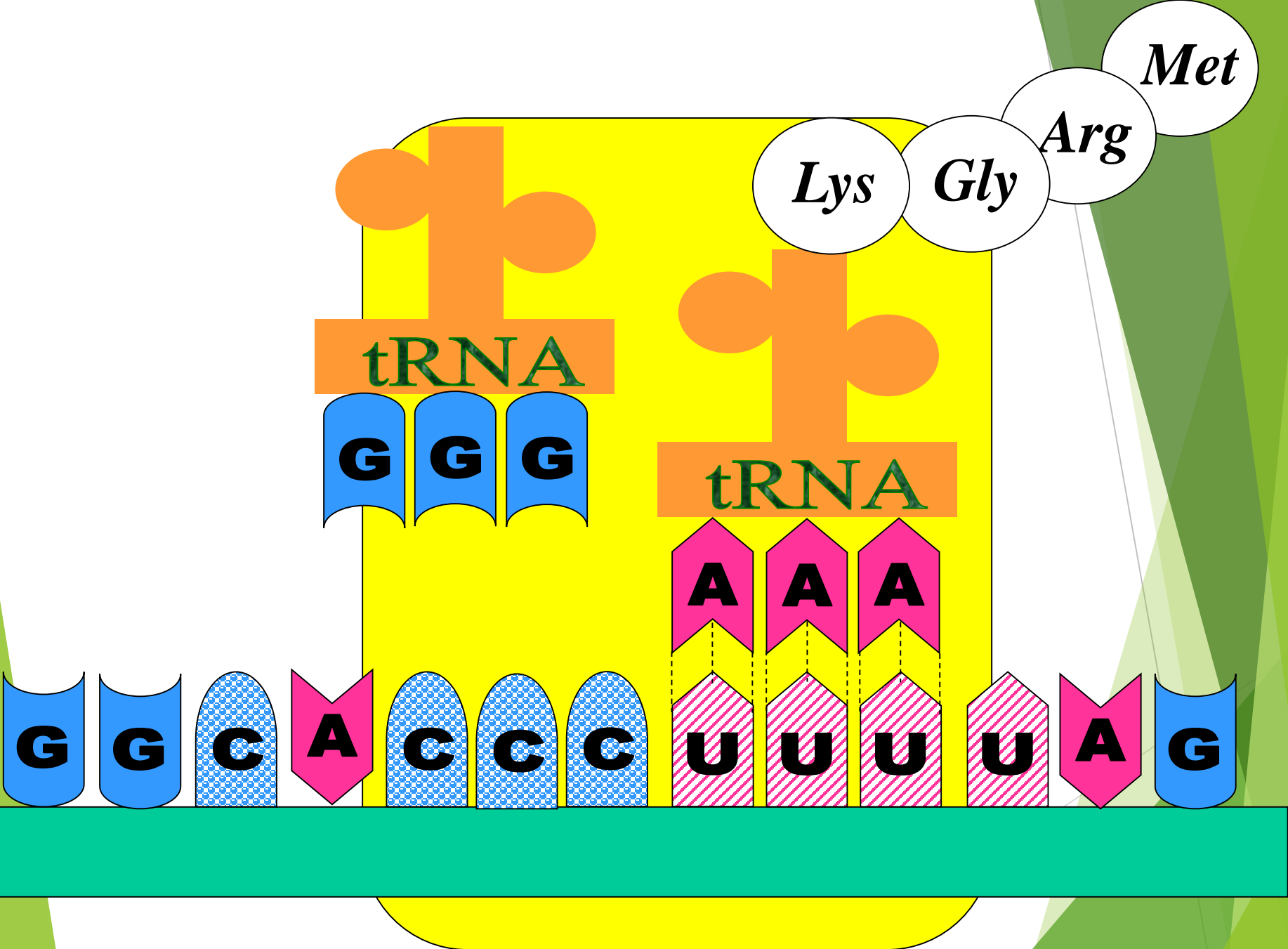
Gly

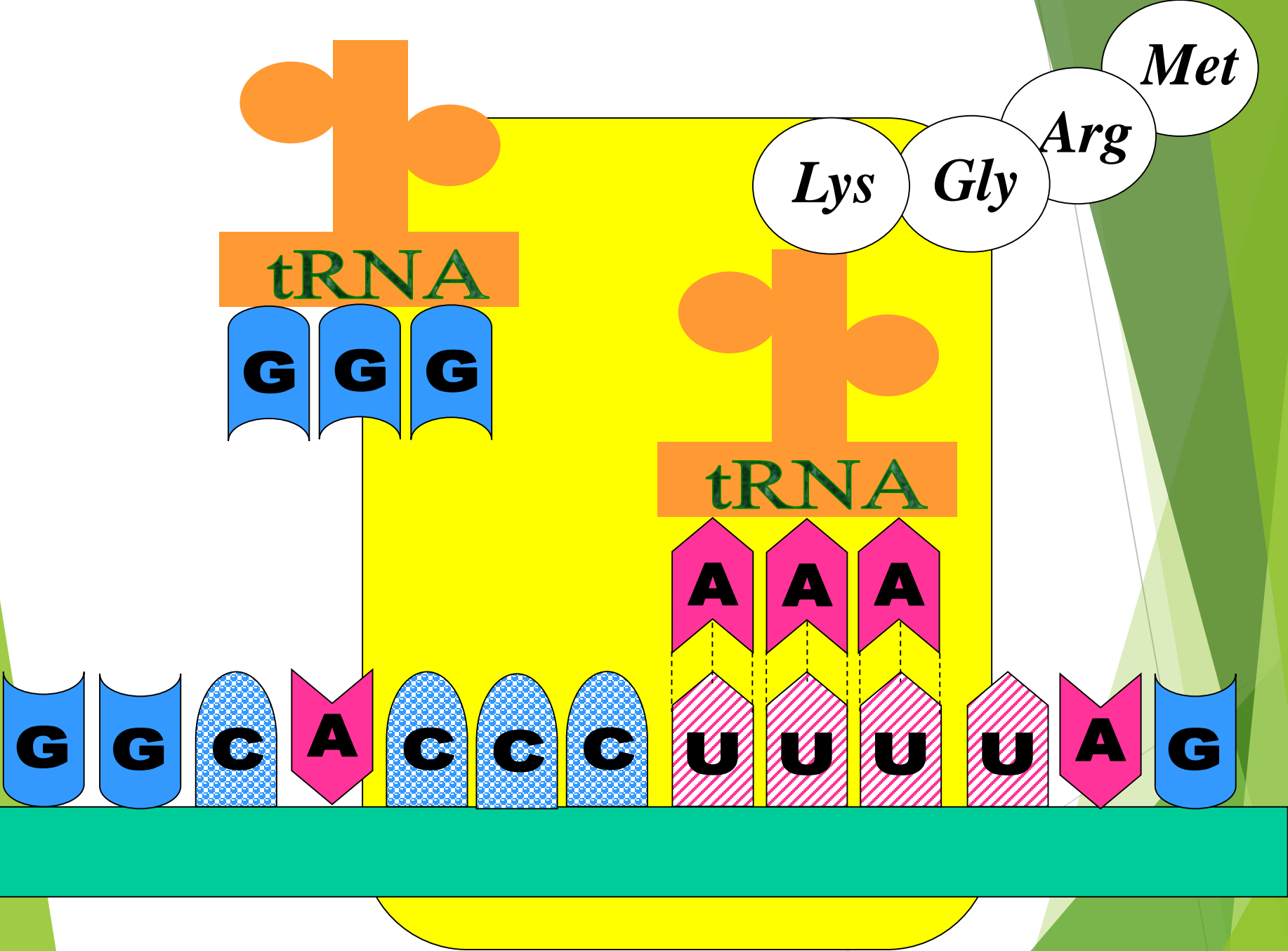
Arg

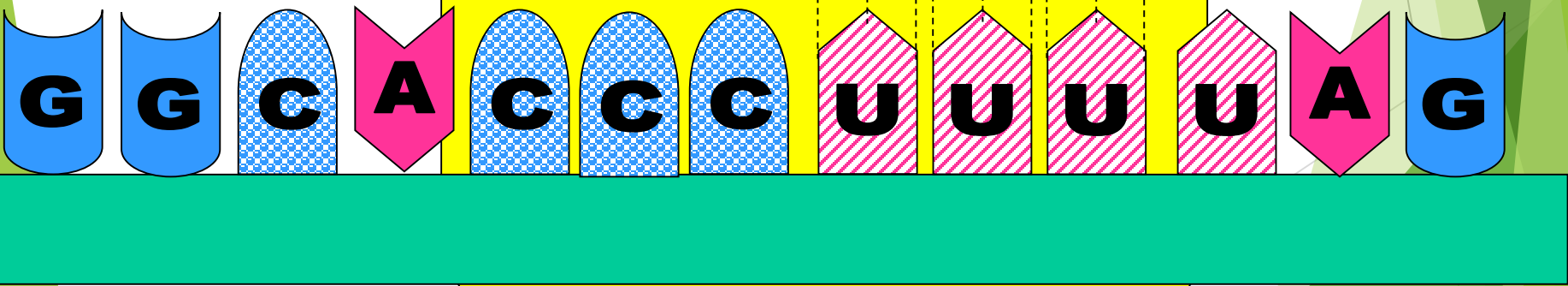
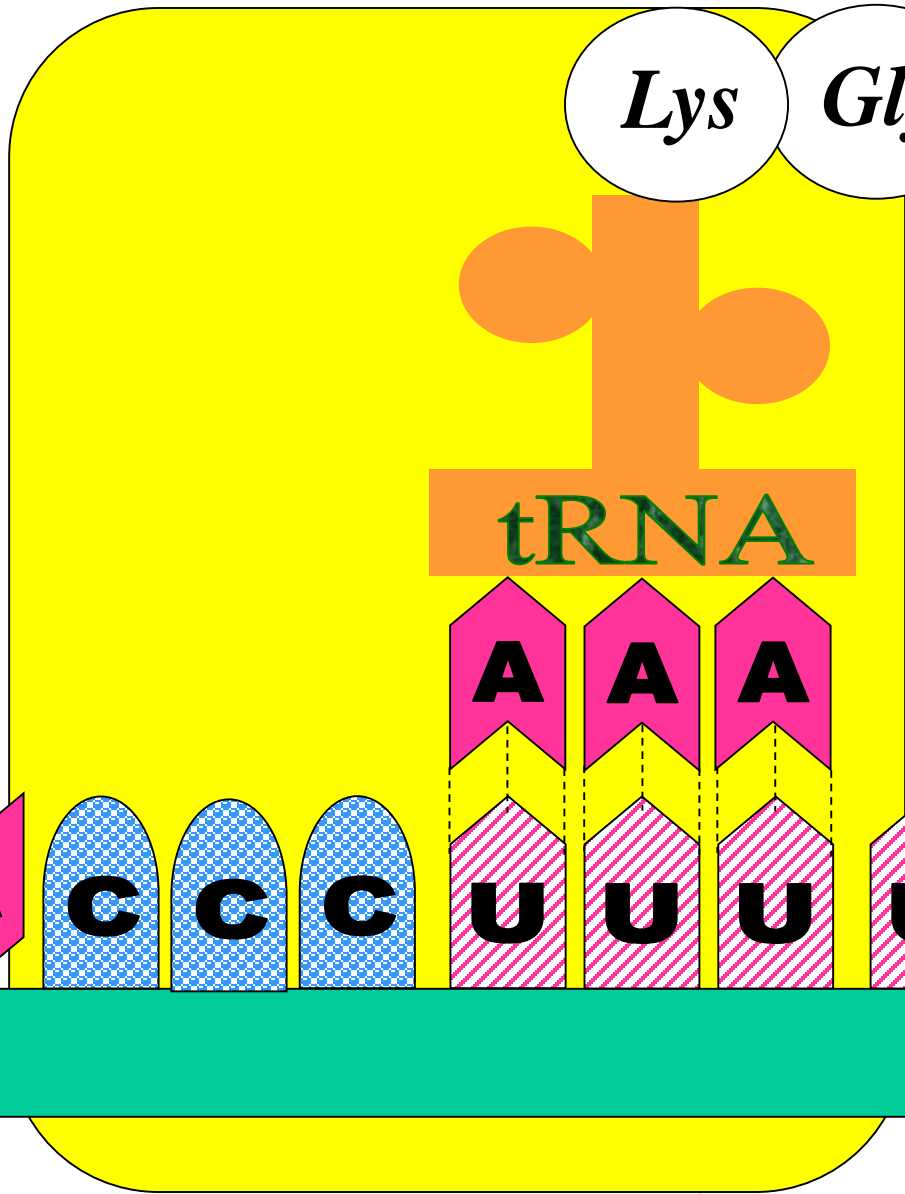
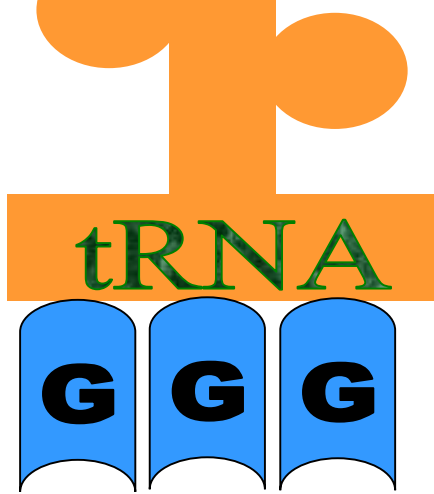
Met

G **G** **C** **A** **C** **C** **C** **U** **U** **U** **U** **A** **G**









Lys

Gly

Arg

Met

NA

G G

Met

Arg

Lys

Gly

tRNA

A

A

A

G

G

C

A

C

C

C

U

U

U

U

A

G

A

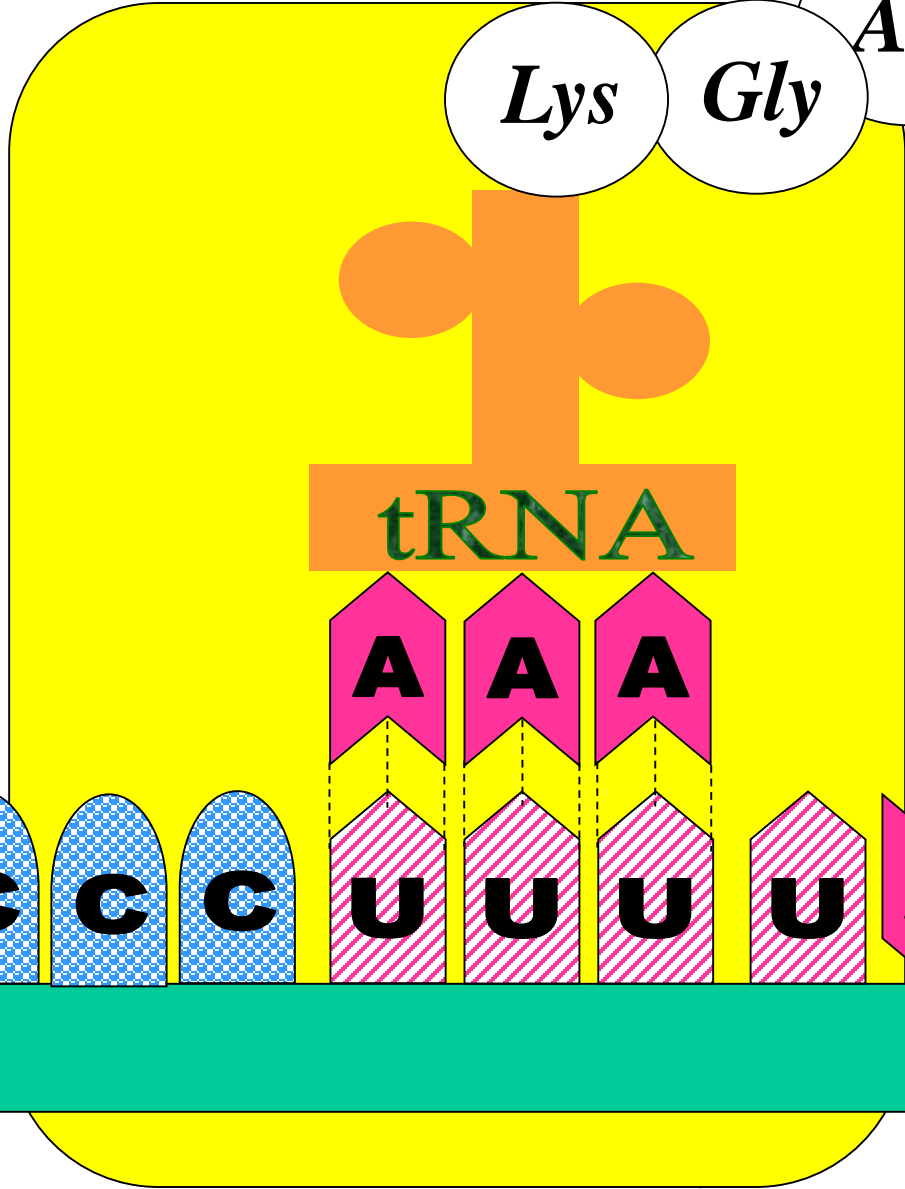
G

Met

Arg

Gly

Lys



tRNA

A

A

A

U

U

U

U

A

G

G

C

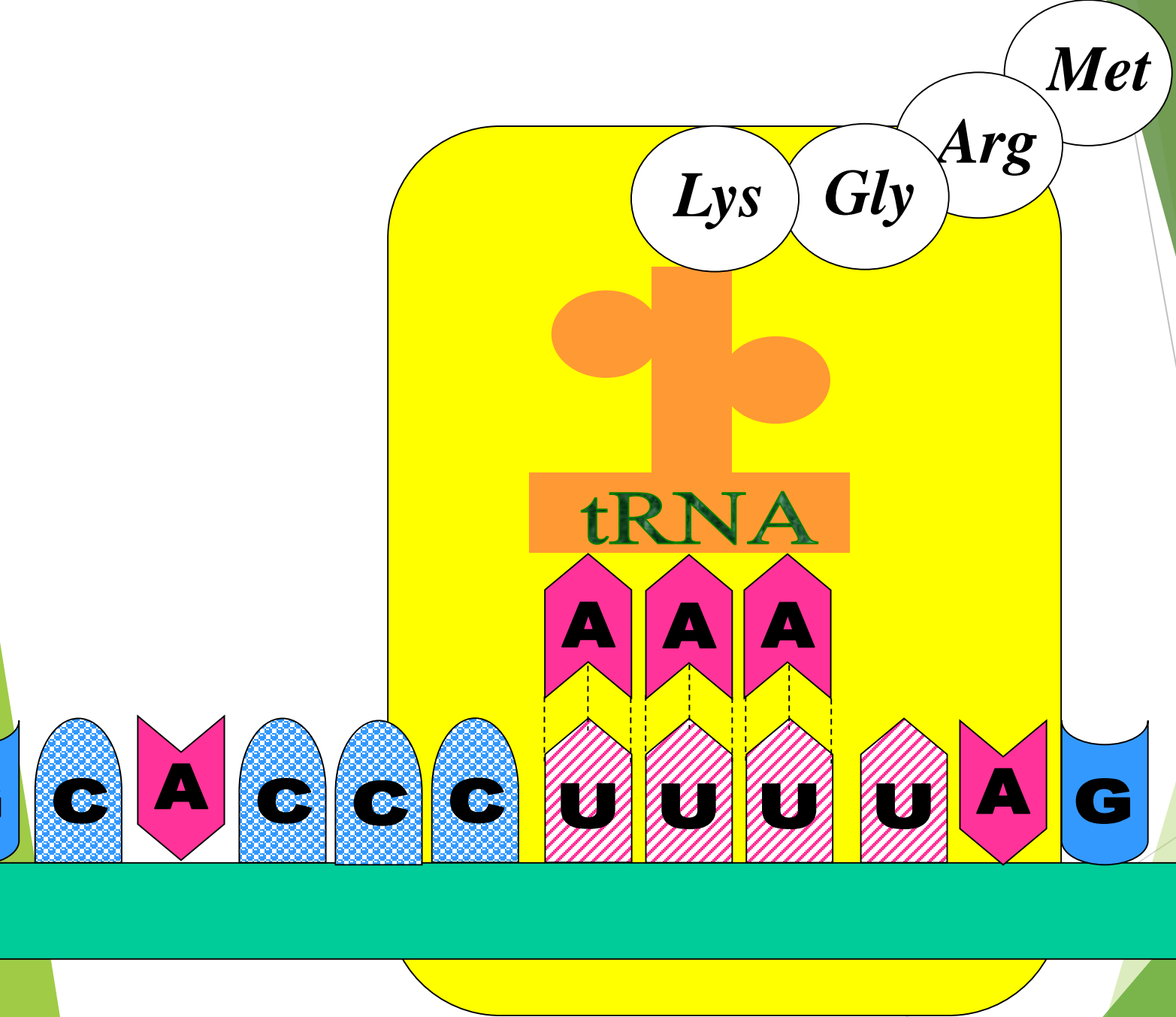
A

C

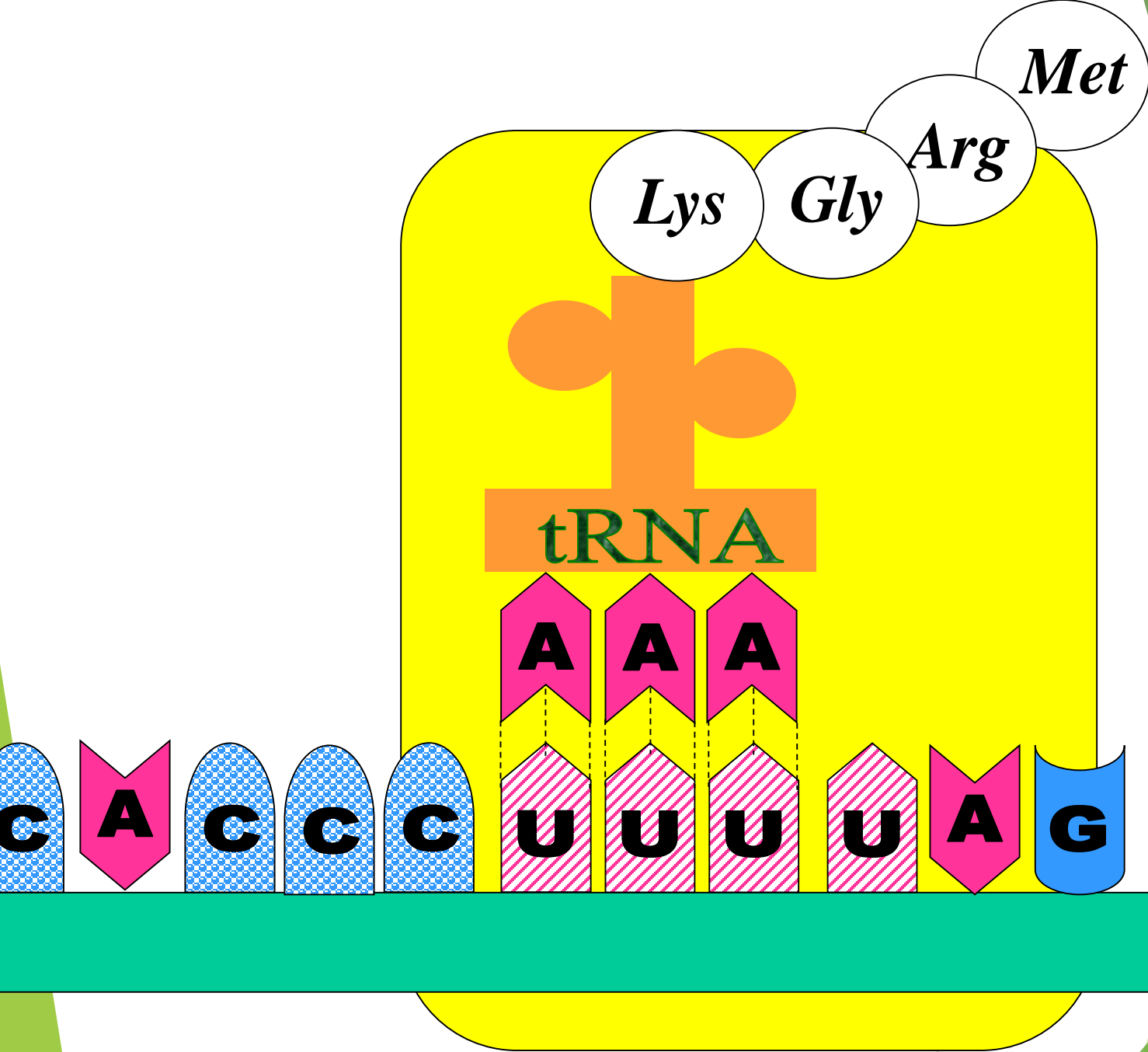
C

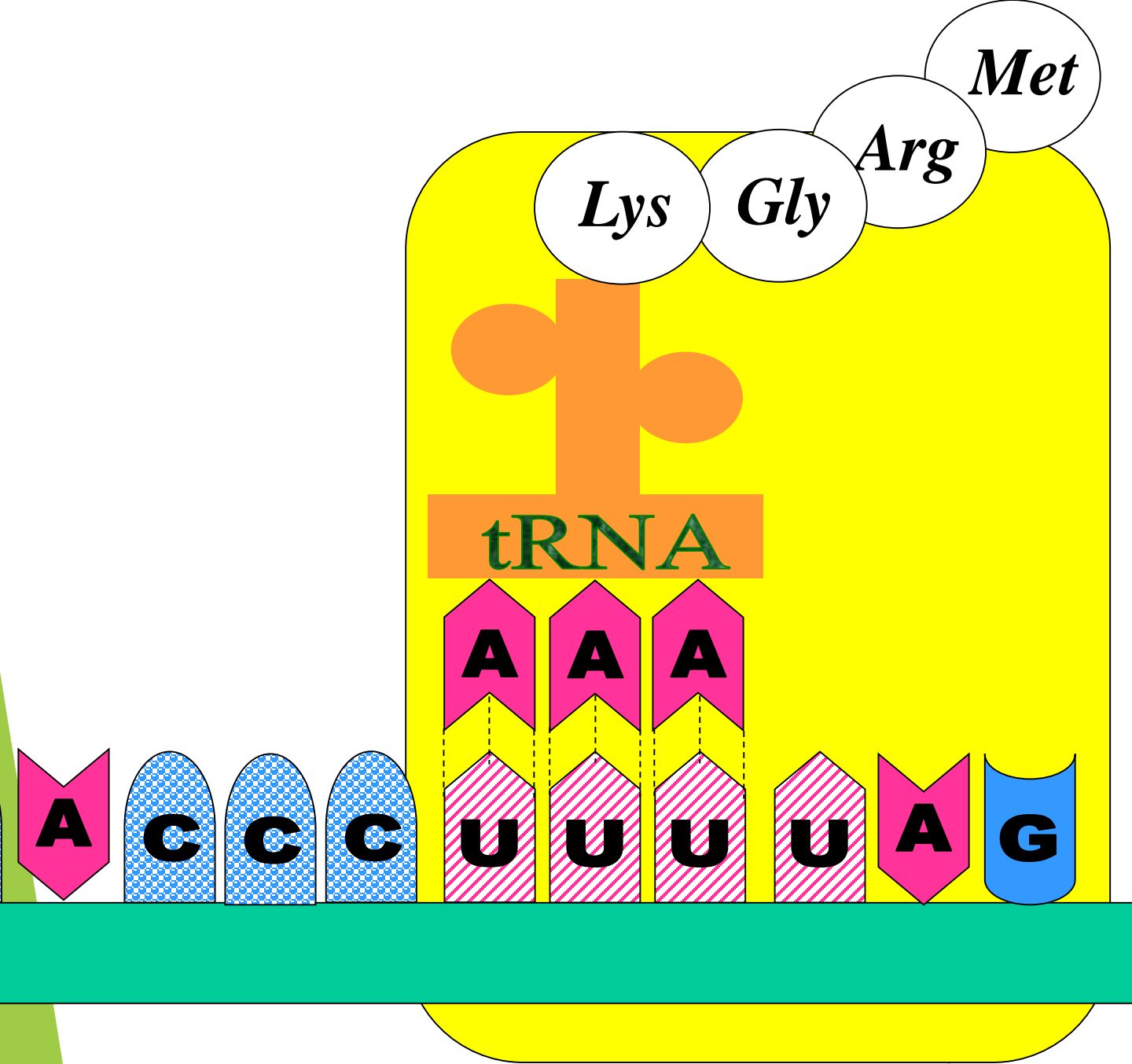
C





nd





A

C

C

C

A

A

A

U

U

U

U

A

G

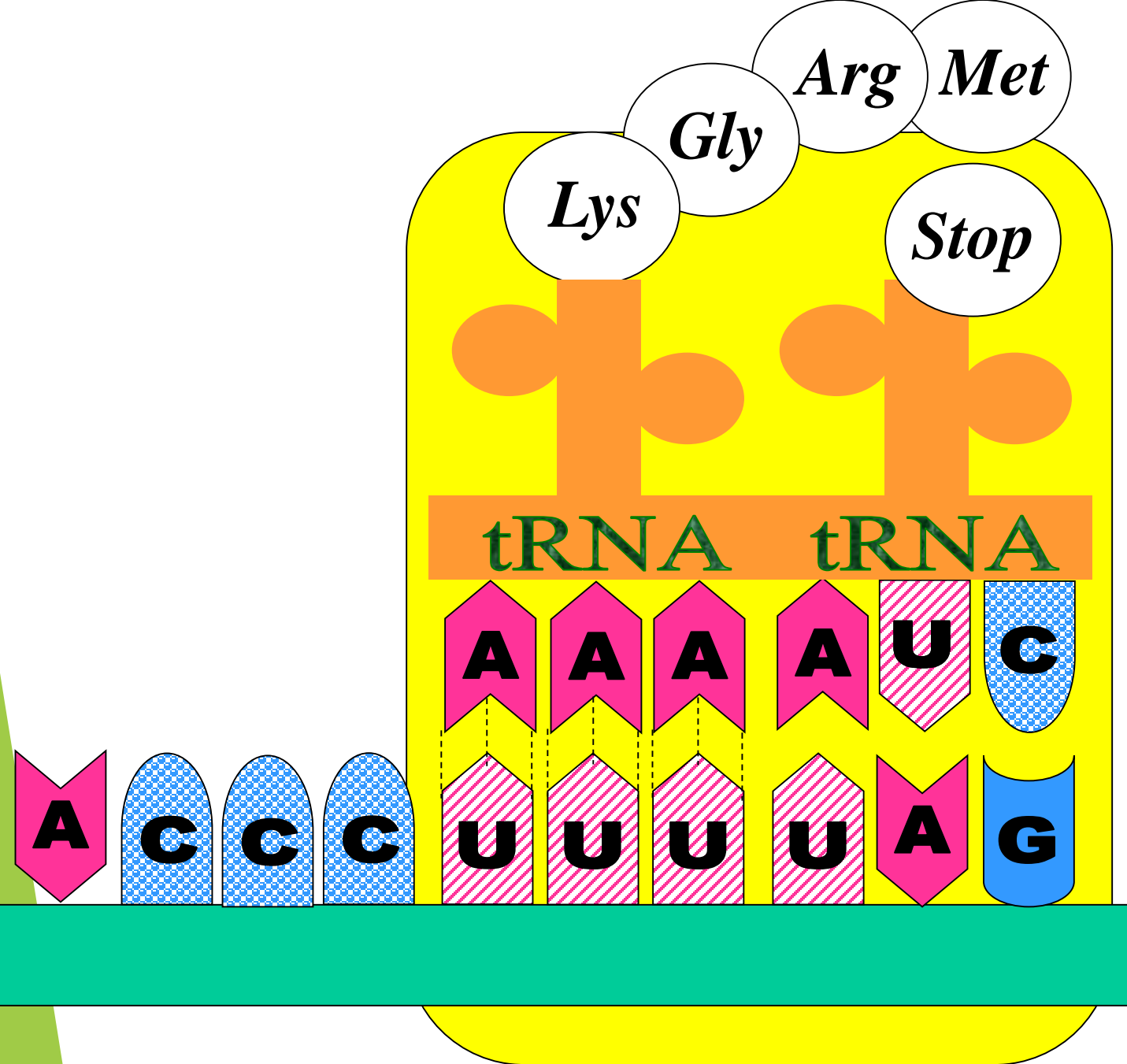
Lys

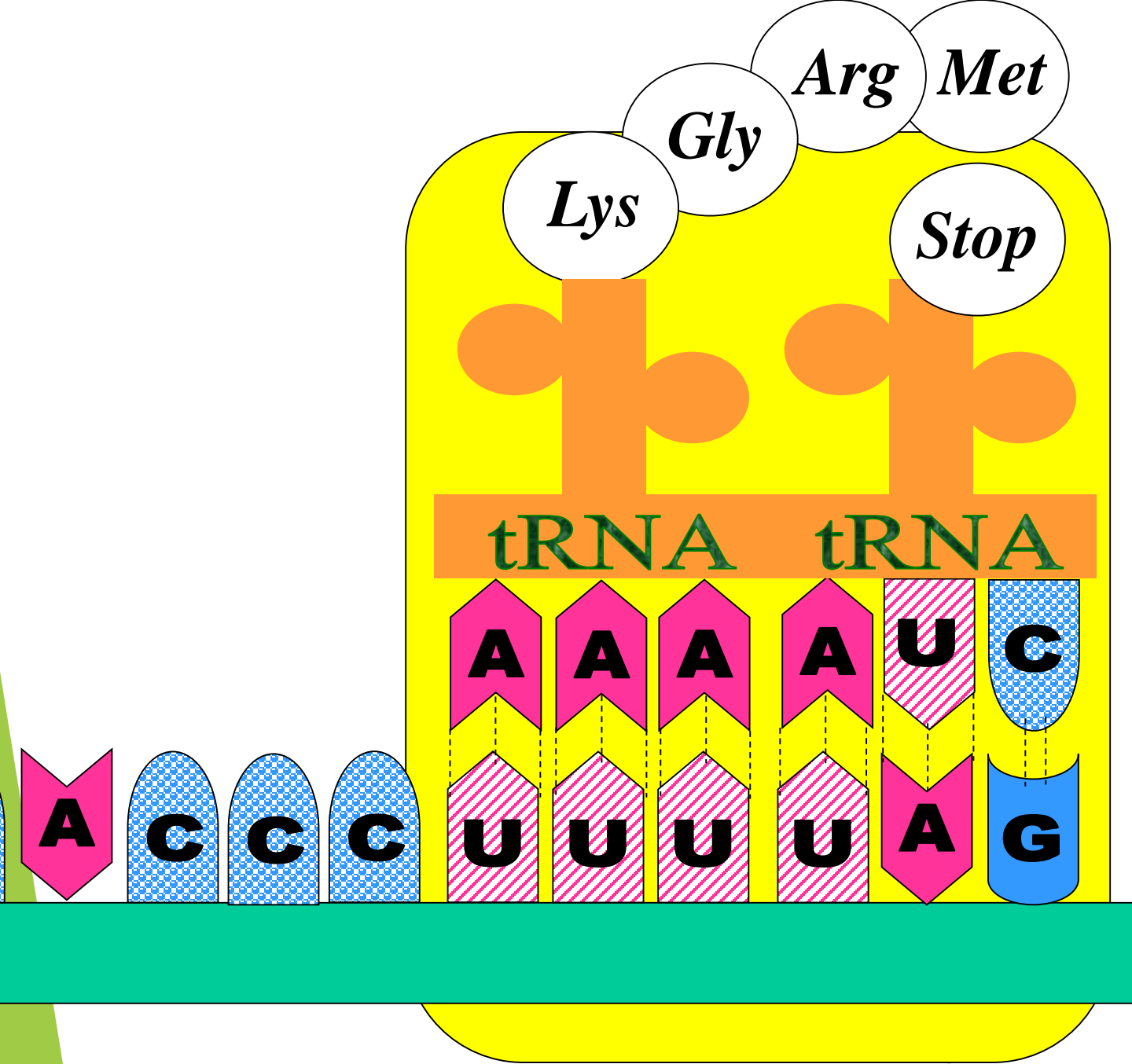
Gly

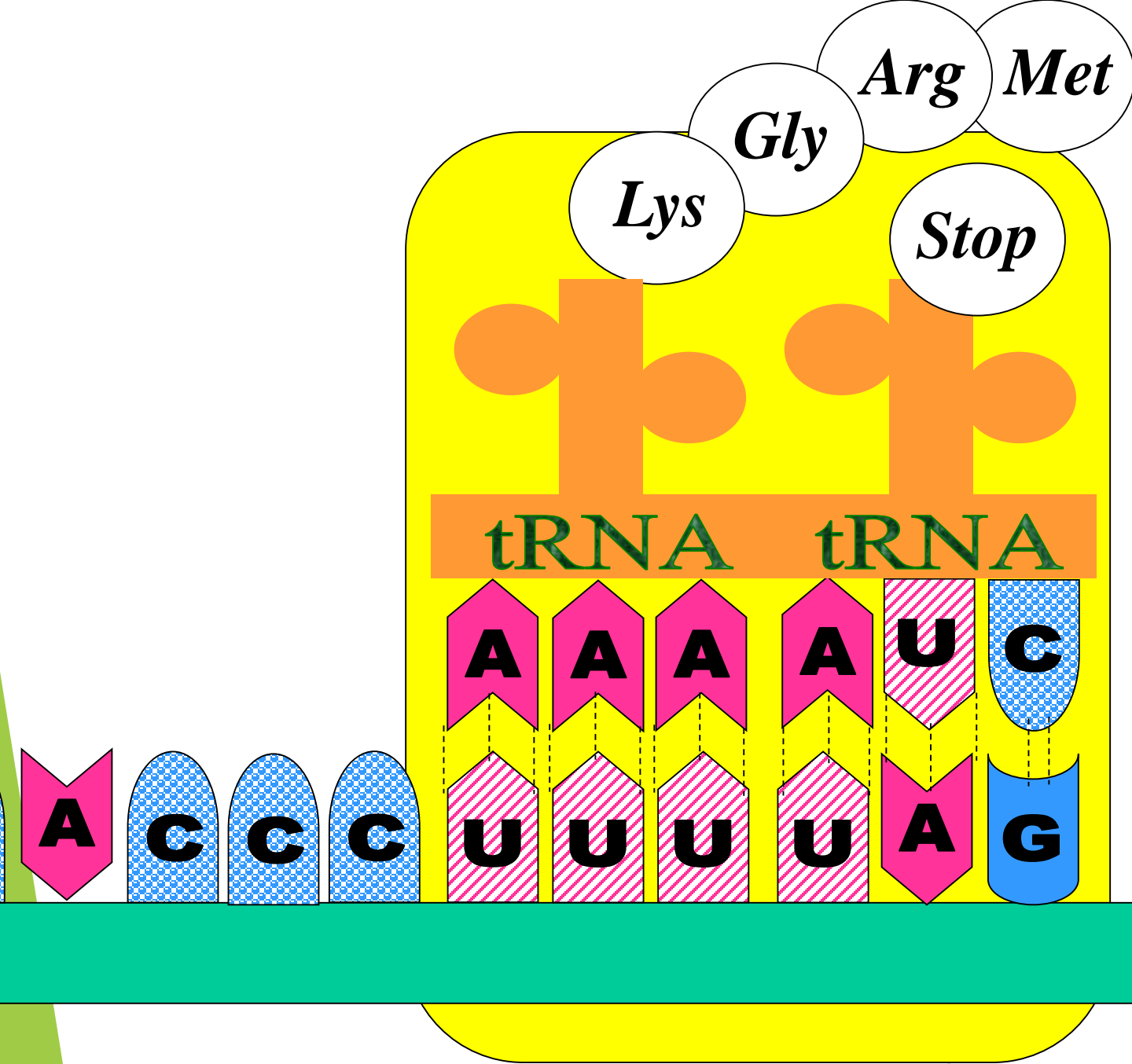
Arg

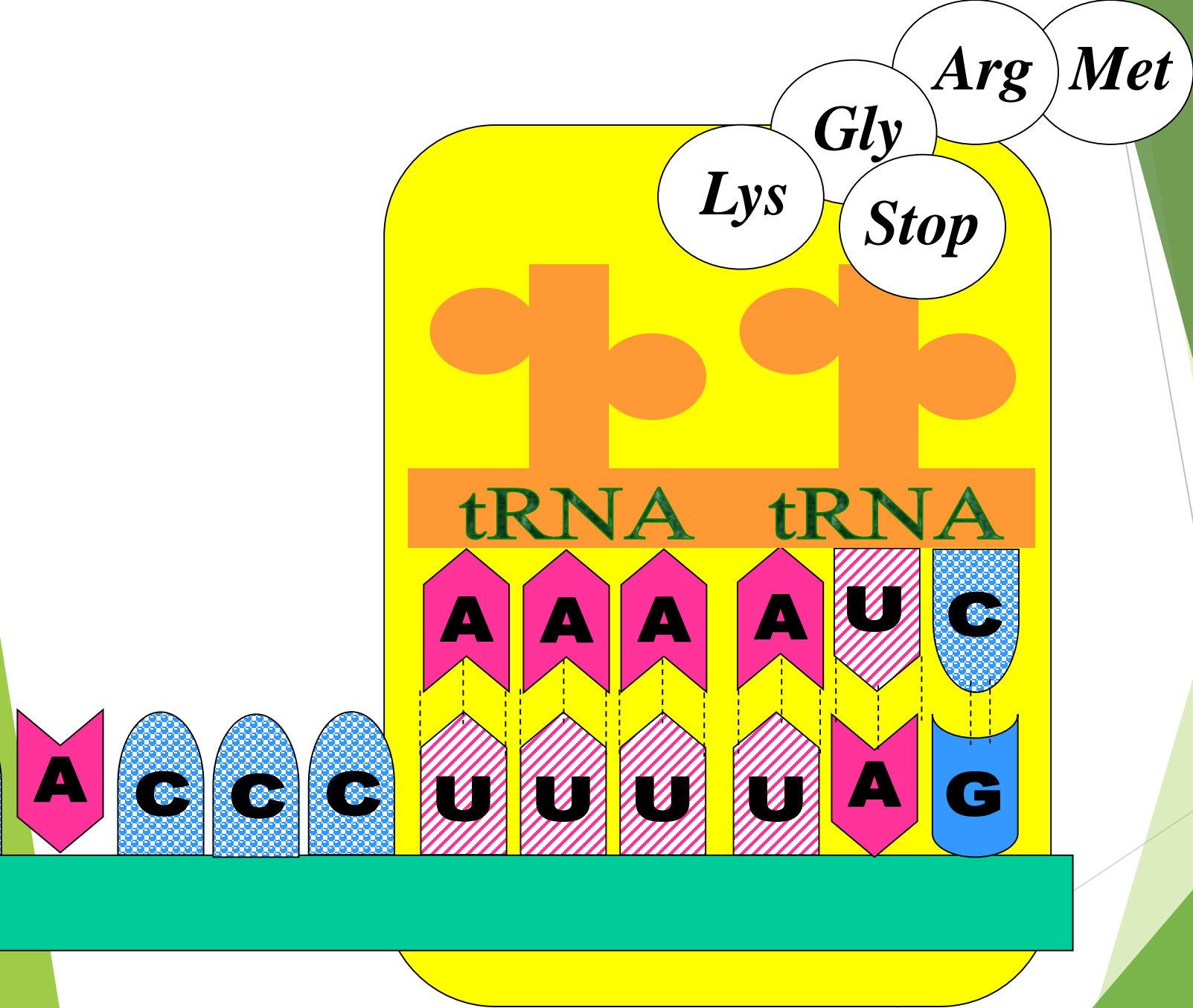
Met

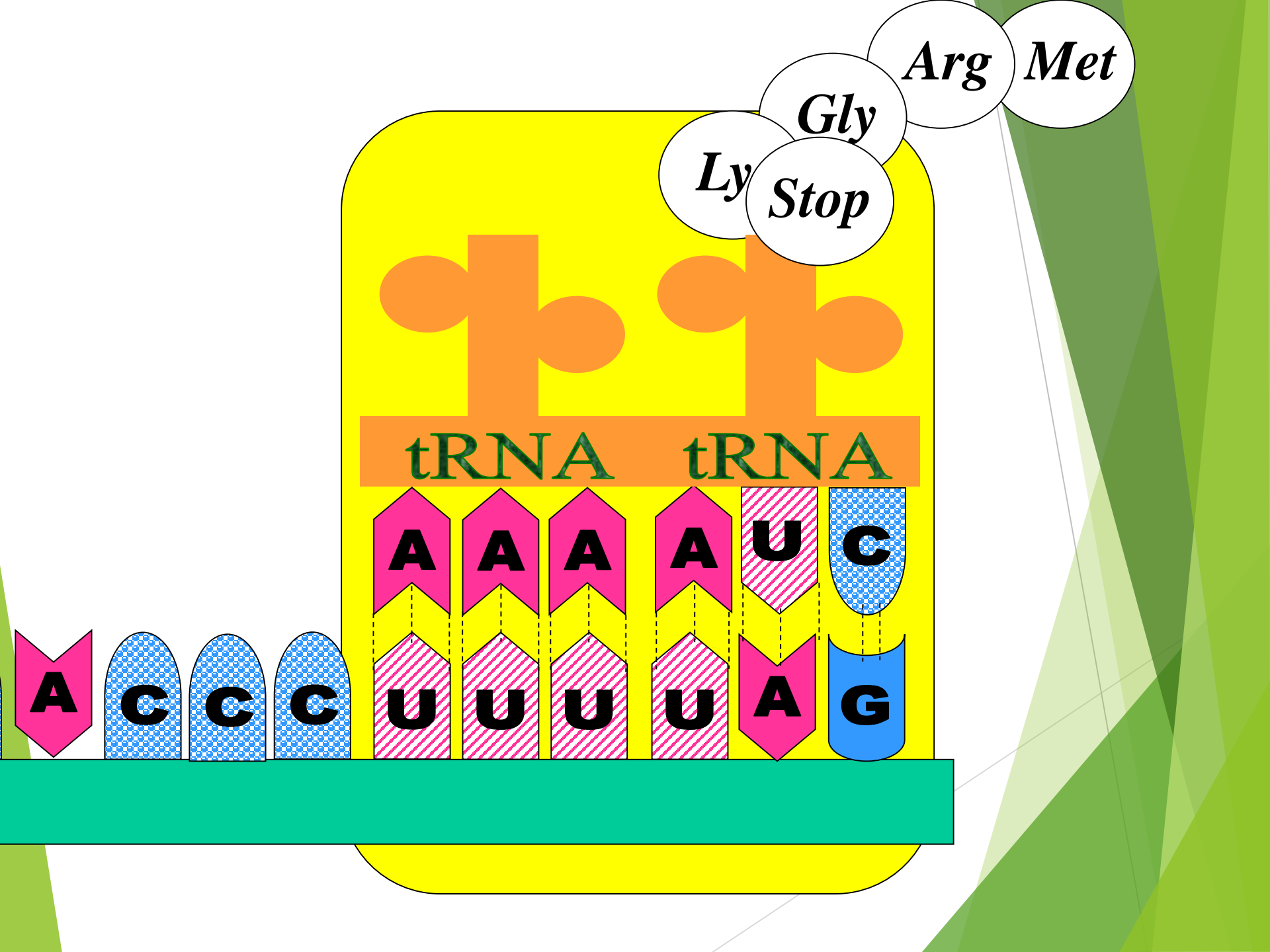
tRNA

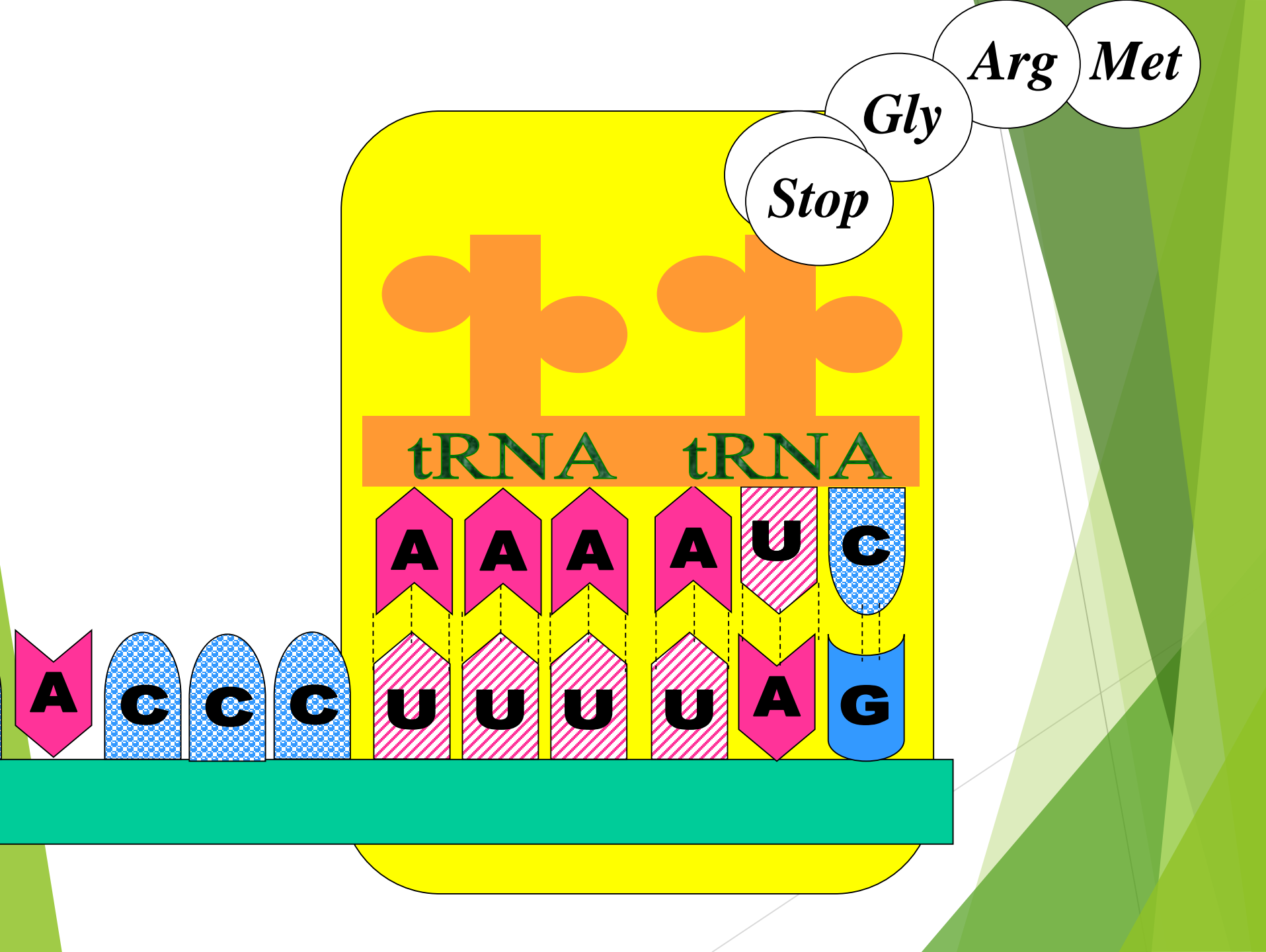


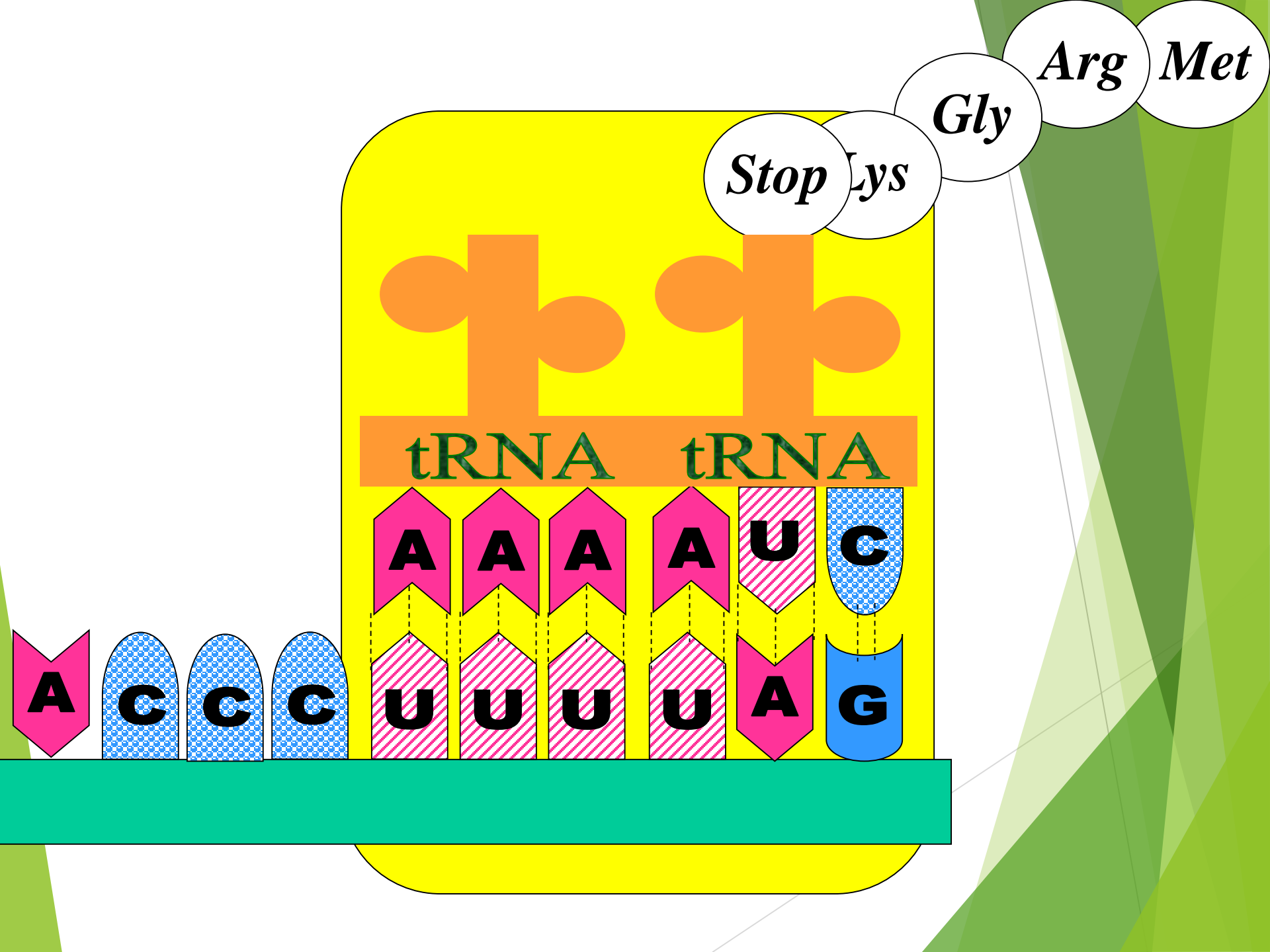












Stop

Lys

Gly

Arg

Met

tRNA

tRNA

A

A

A

A

U

C

A

C

C

C

U

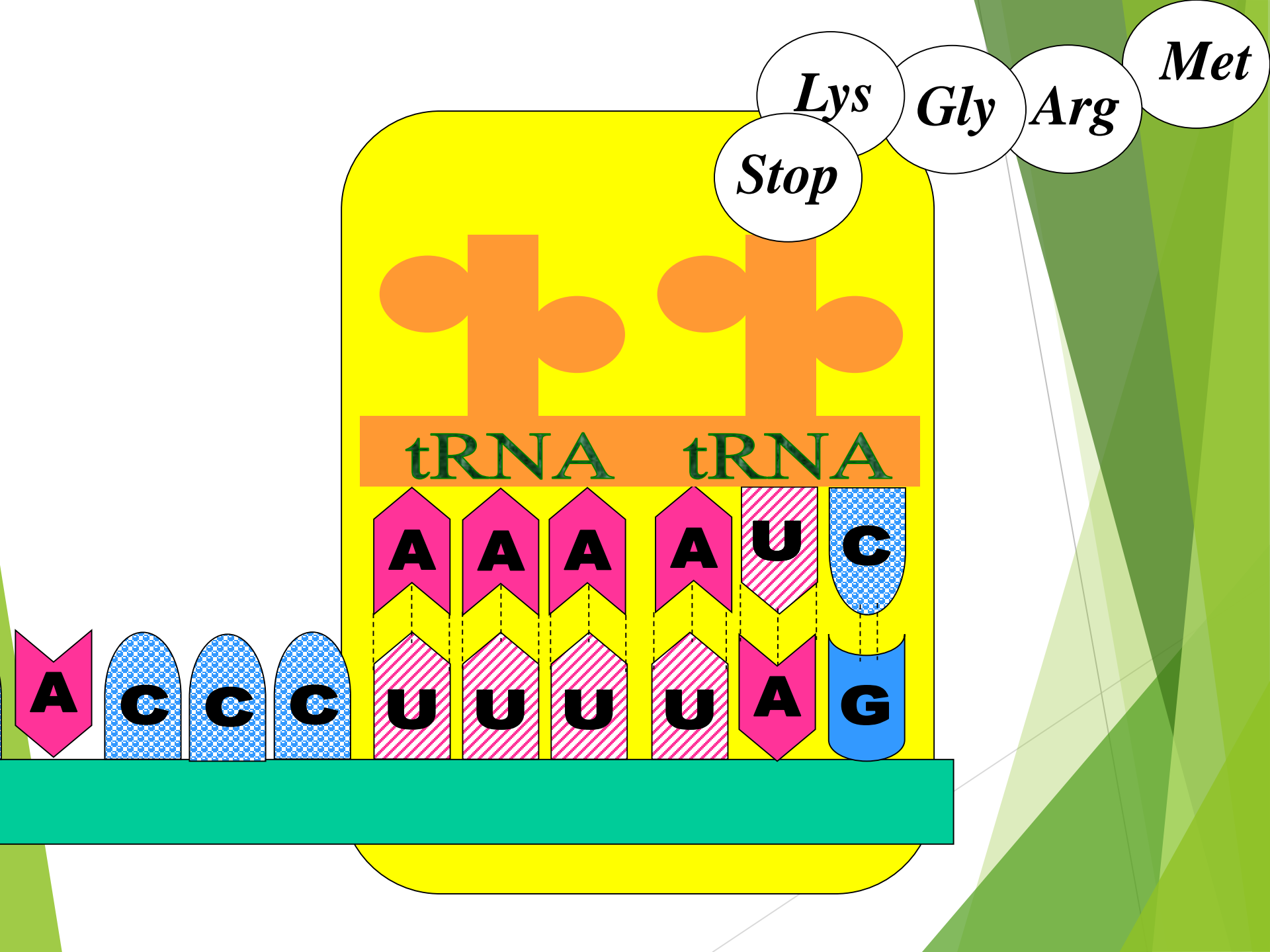
U

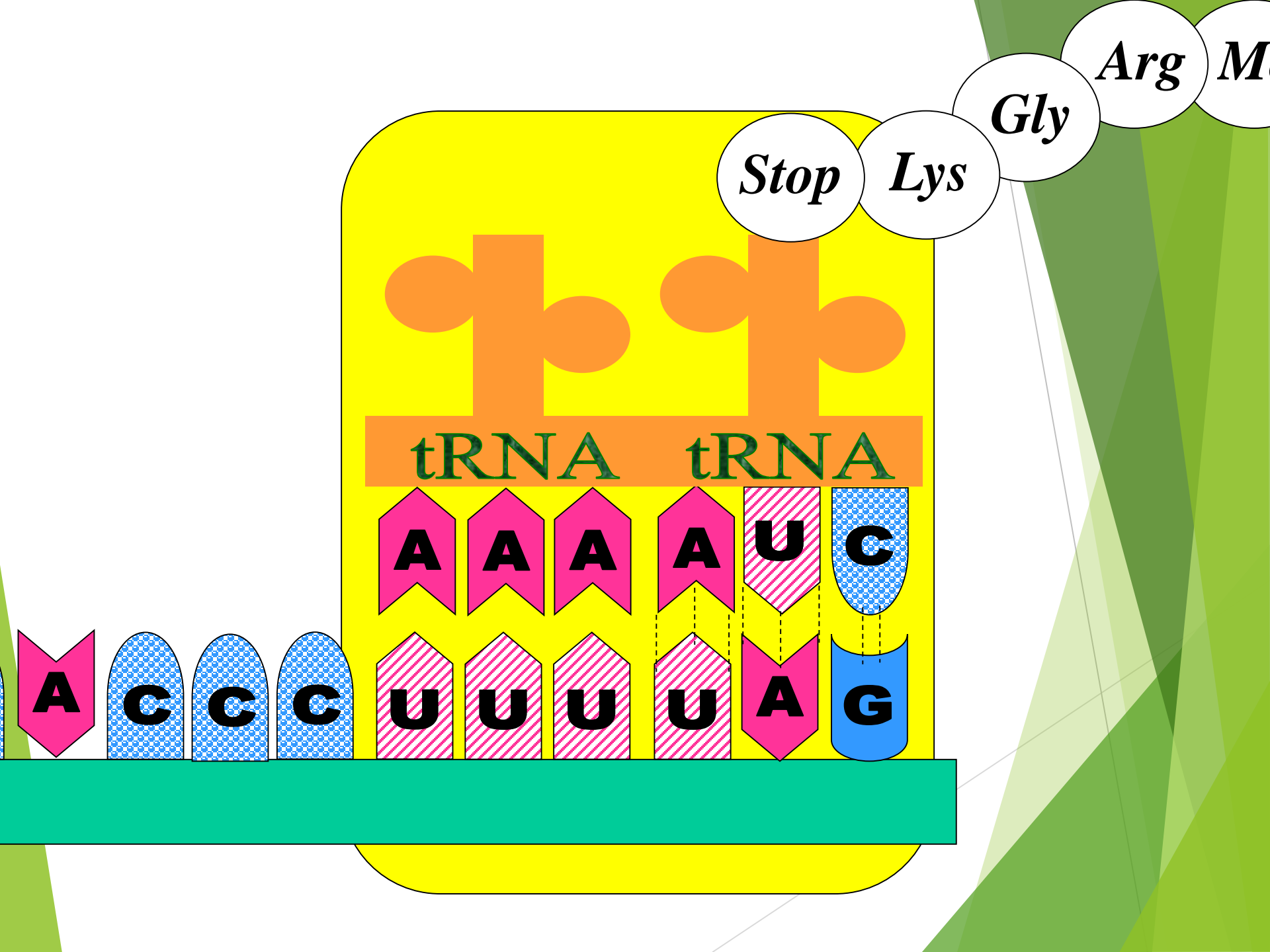
U

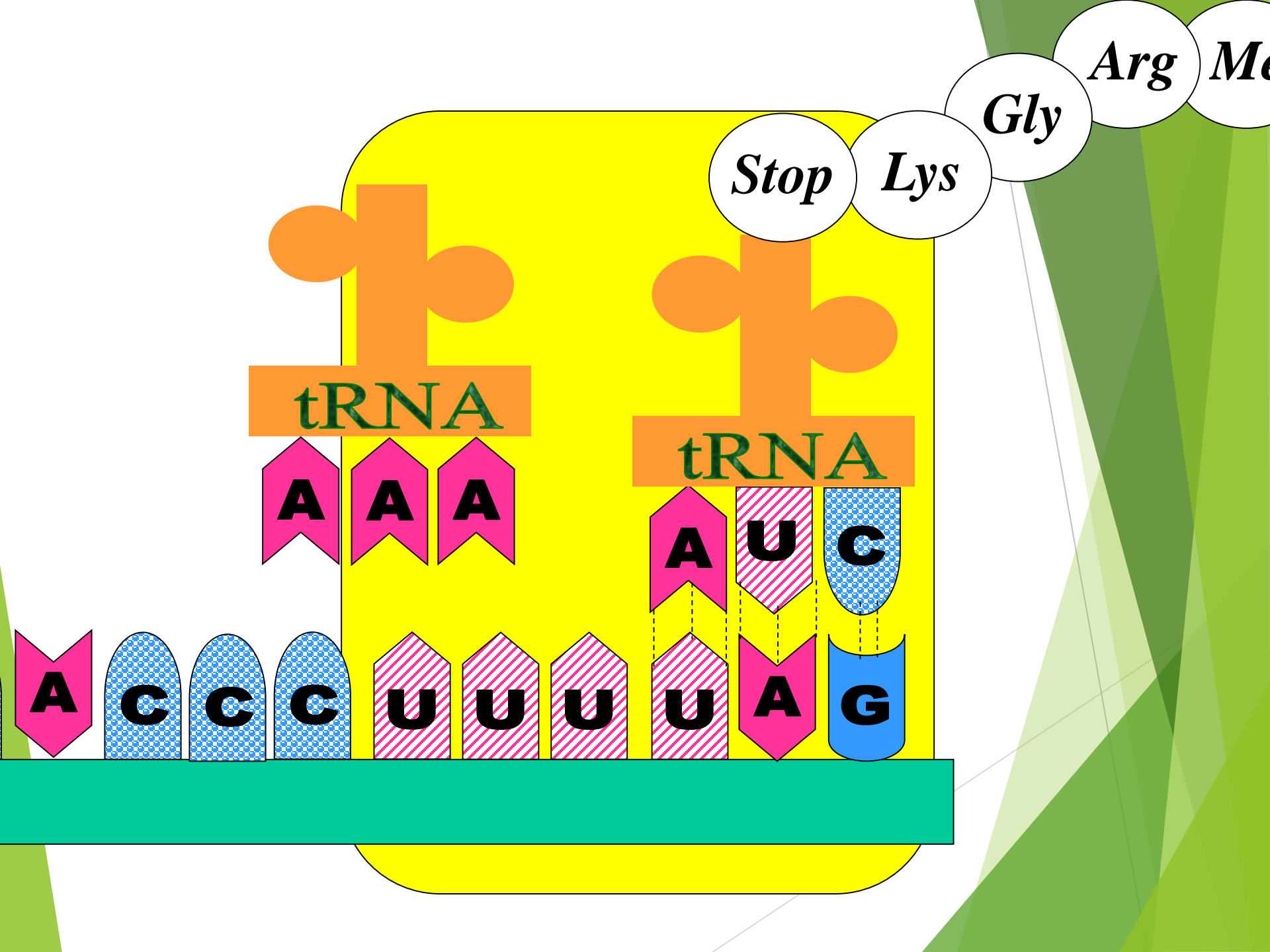
U

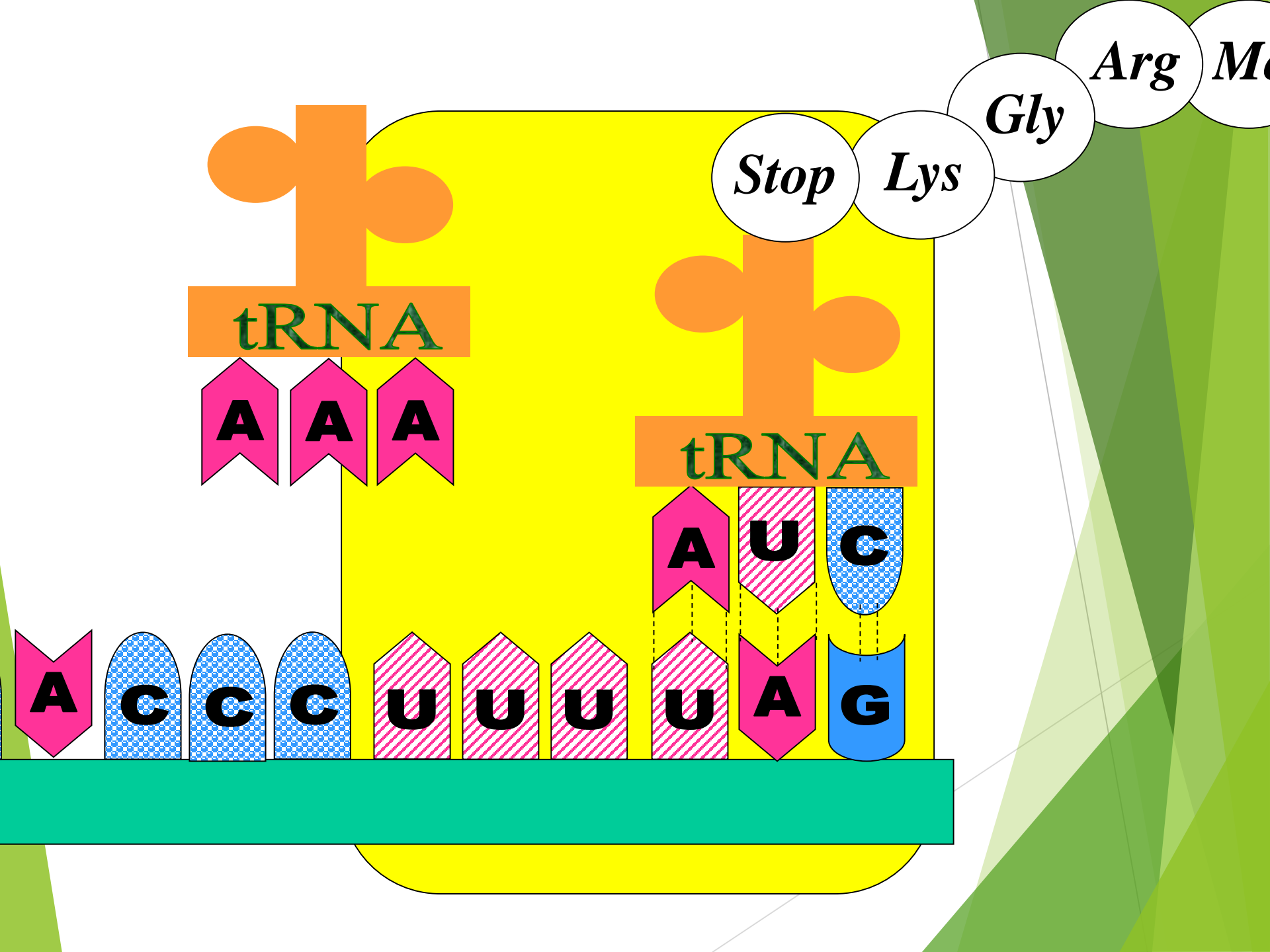
A

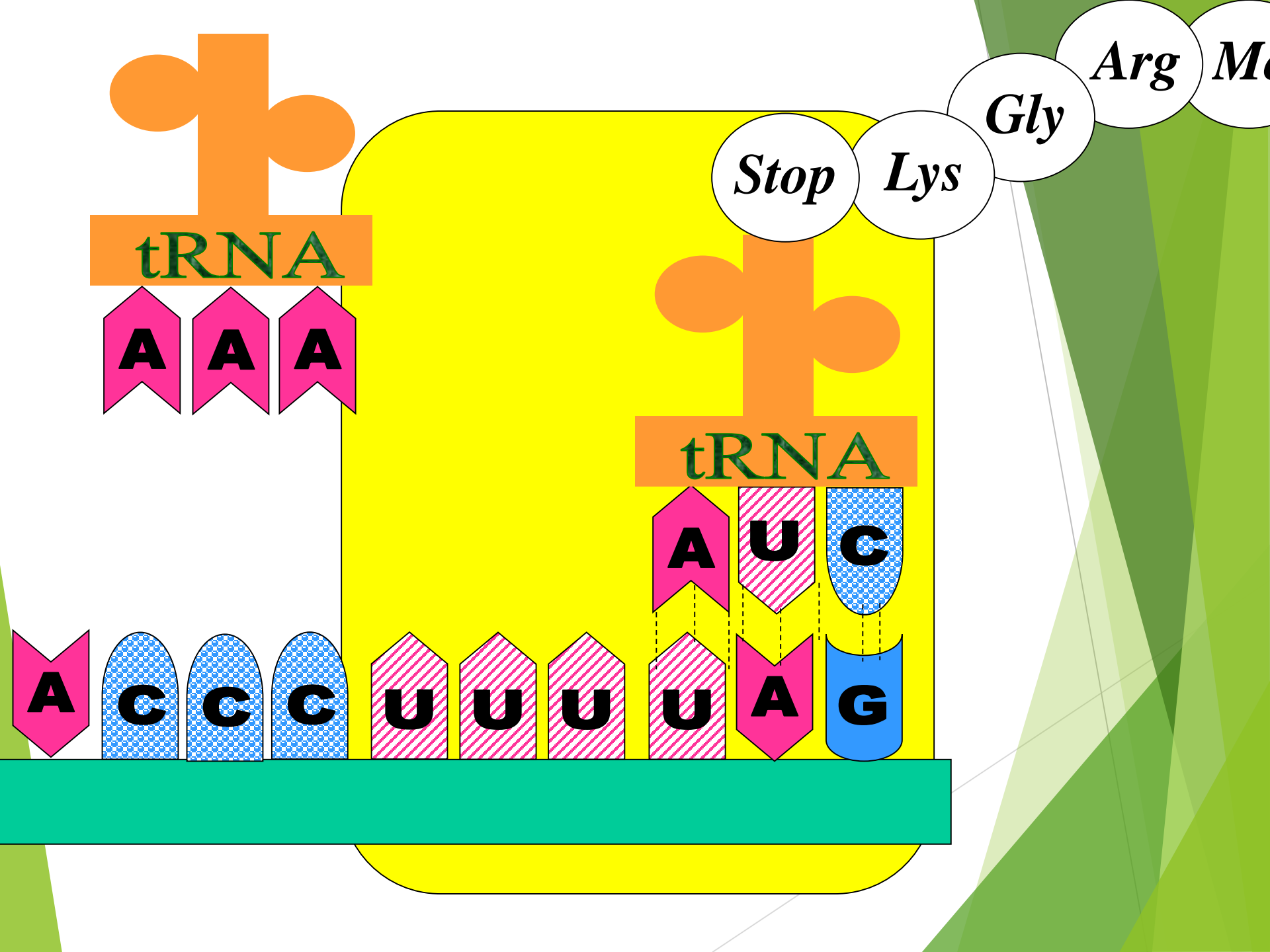
G





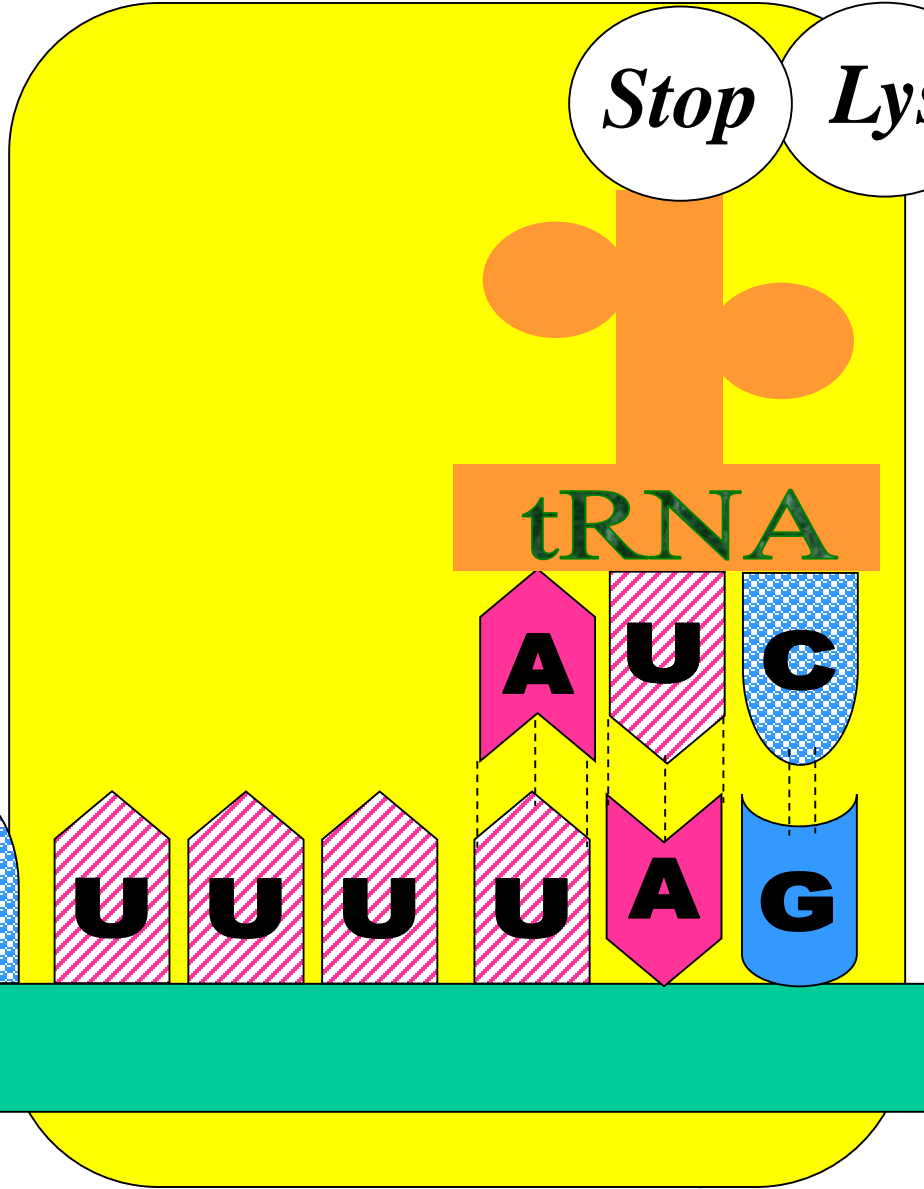








AAA



Stop

Lys

Gly

Arg

Met

tRNA

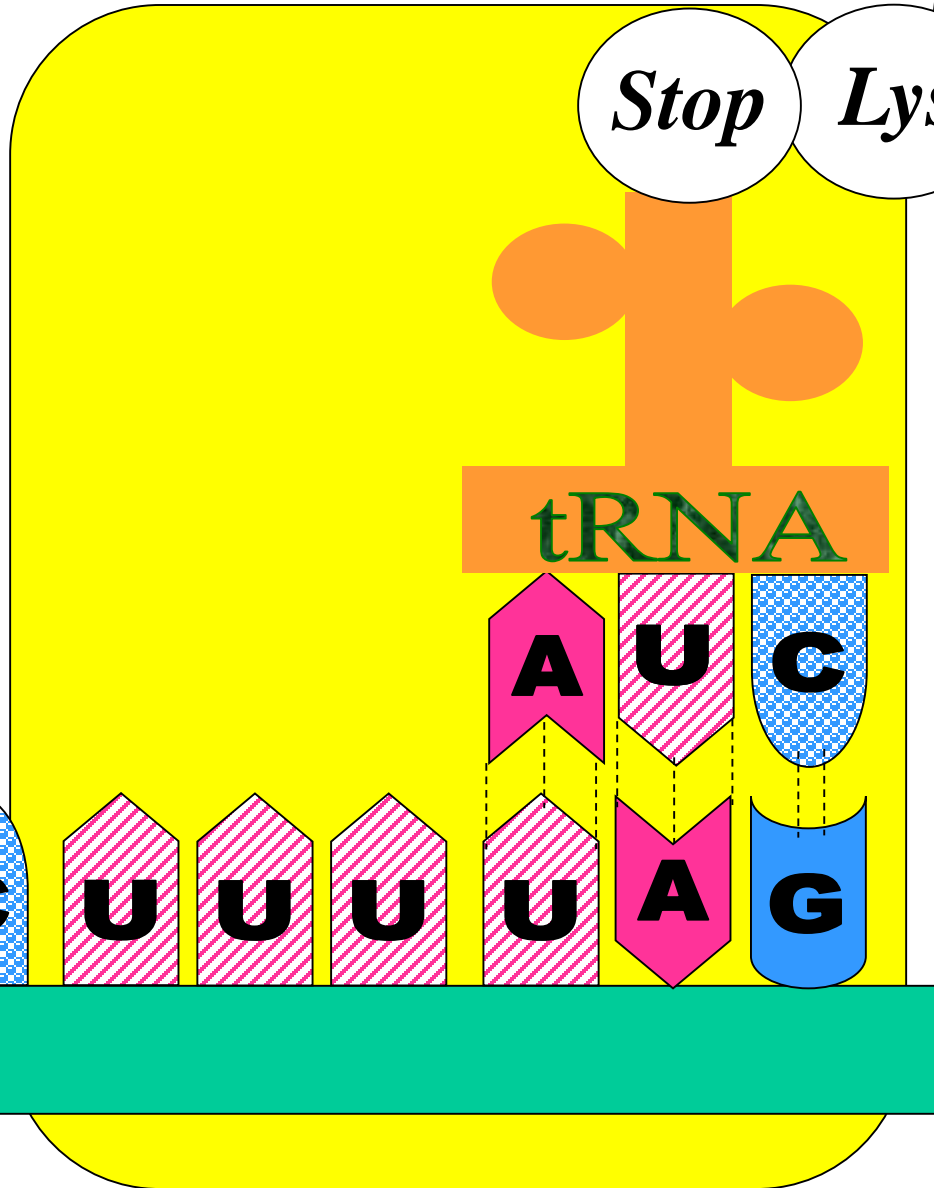
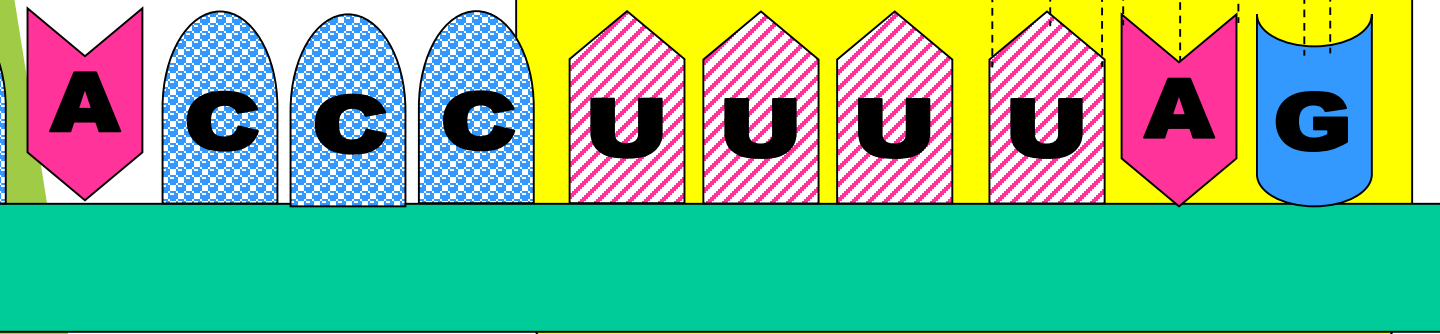
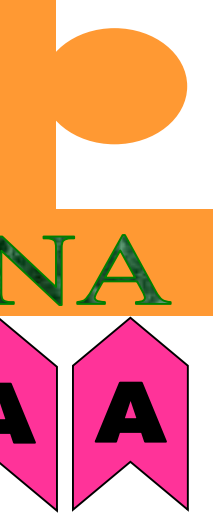
AUC

A C C C

U U U

U A G





Stop

Lys

Gly

Arg

M

