Engage: DNA to Protein Synthesis Manipulative Activity

INSTRUCTOR:

No...reply@example.com

Objective: Students will model the process of protein synthesis using laminated manipulatives to create a polypeptide chain consisting of 10 amino acids and a stop codon.

Materials: Enough for 8 Groups

Laminated manipulatives of:

- DNA strand
- Nucleotides (Adenine, Thymine, Cytosine, Guanine)
- mRNA strand
- RNA Polymerase
- Cytoplasm
- Ribosome: large and small ribosomal subunits
- Codons (sets of three mRNA nucleotides)
- Anticodons (tRNA complementary to mRNA codons)
- rRNA (ribosomal RNA)
- tRNA
- Amino acids
- Peptide bonds

Tape or Velcro

Steps:

A. Preparation:

- ❑ Lay out all the laminated pieces on your desk or table.
- ❑ Make sure you have enough space to arrange the nucleus and cytoplasm separately

B. Starting Transcription:

- ❑ Place the nucleus piece on one side of your workspace.
- ❑ Inside the nucleus, place the DNA strand.
- ❑ Pick a part of the DNA that will be copied (transcribed).

C. Transcription Process:

- ❑ Attach RNA Polymerase to the DNA strand where the gene starts.
- ❑ Use the nucleotides (A, T, C, G) to match the bases as RNA Polymerase moves along the DNA, creating an mRNA strand.
- ❑ Remember, in RNA, Adenine pairs with Uracil (U) instead of Thymine.
- ❑ When the mRNA strand is finished, detach it from the DNA strand.

D. mRNA Processing:

- ❑ Move the mRNA strand out of the nucleus and into the cytoplasm.

E. Starting Translation:

- ❑ Place the large and small ribosomal subunits around the start codon (AUG) on the mRNA strand in the cytoplasm.
- ❑ Attach the first tRNA with the corresponding anticodon (UAC) carrying Methionine (the start amino acid) to the start codon on the mRNA.

F. Building the Polypeptide (Elongation):

- ❑ Match the mRNA codons with their corresponding tRNA anticodons.
- ❑ Each tRNA carries a specific amino acid.
- ❑ As the ribosome moves along the mRNA strand, attach the correct amino acids to form a polypeptide chain.
- ❑ Use the peptide bond pieces to connect the amino acids in the right order.

G. Ending Translation (Termination):

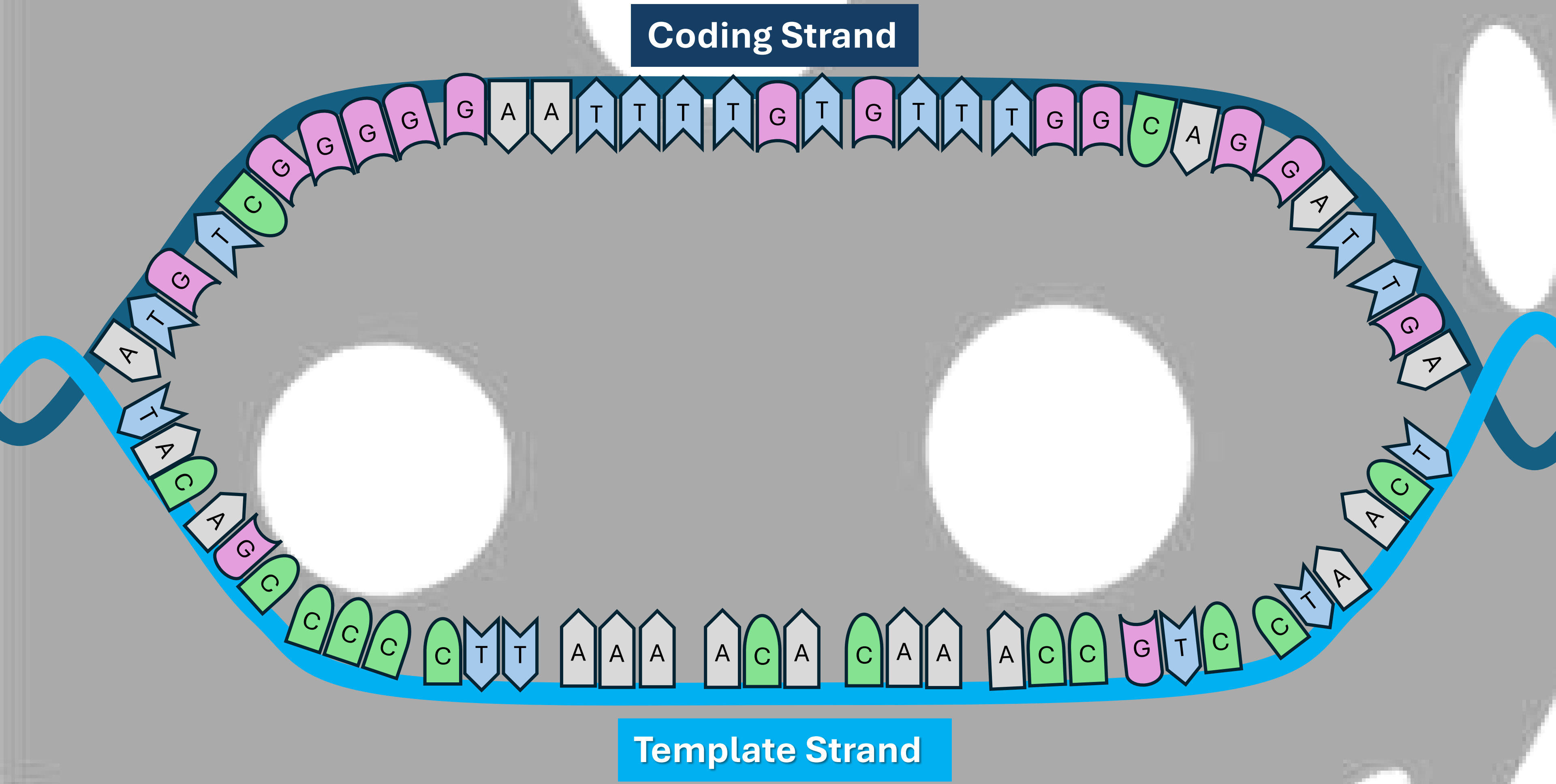
- ❑ Keep matching codons and anticodons until you reach the stop codon on the mRNA strand.
- ❑ The stop codon tells the process to end, and the completed polypeptide chain is released.

H. Finalizing:

- ❑ Check that your polypeptide chain has 10 amino acids and ends with a stop codon.
- ❑ Review the whole process to make sure you followed all the steps correctly.

I. Reflection and Discussion:

- ❑ Talk about the role of each part in the protein-making process.
- ❑ If you have any questions, ask your teacher for help.
- ❑ Compare your polypeptide chain with your classmates' to check for accuracy.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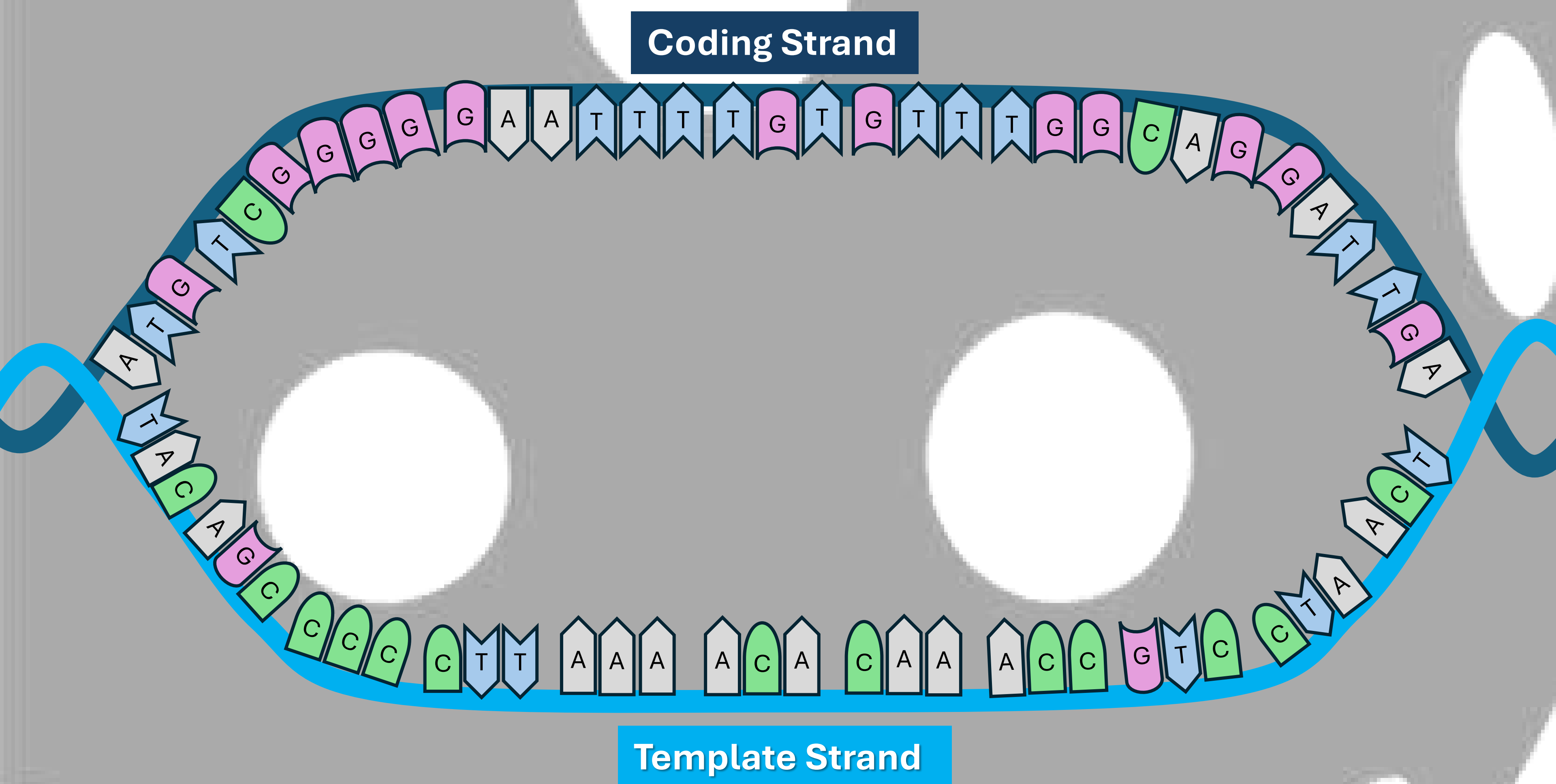
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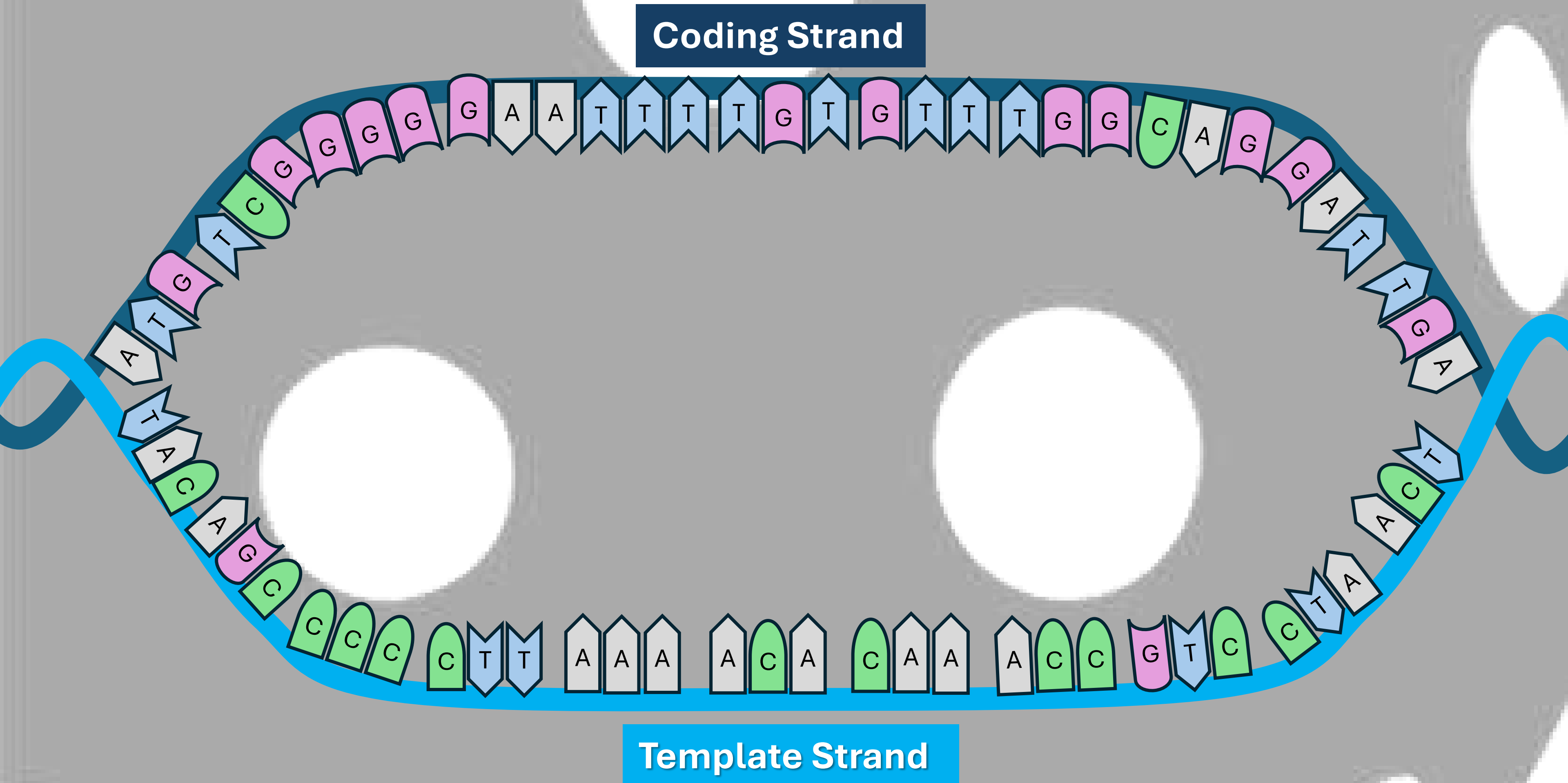
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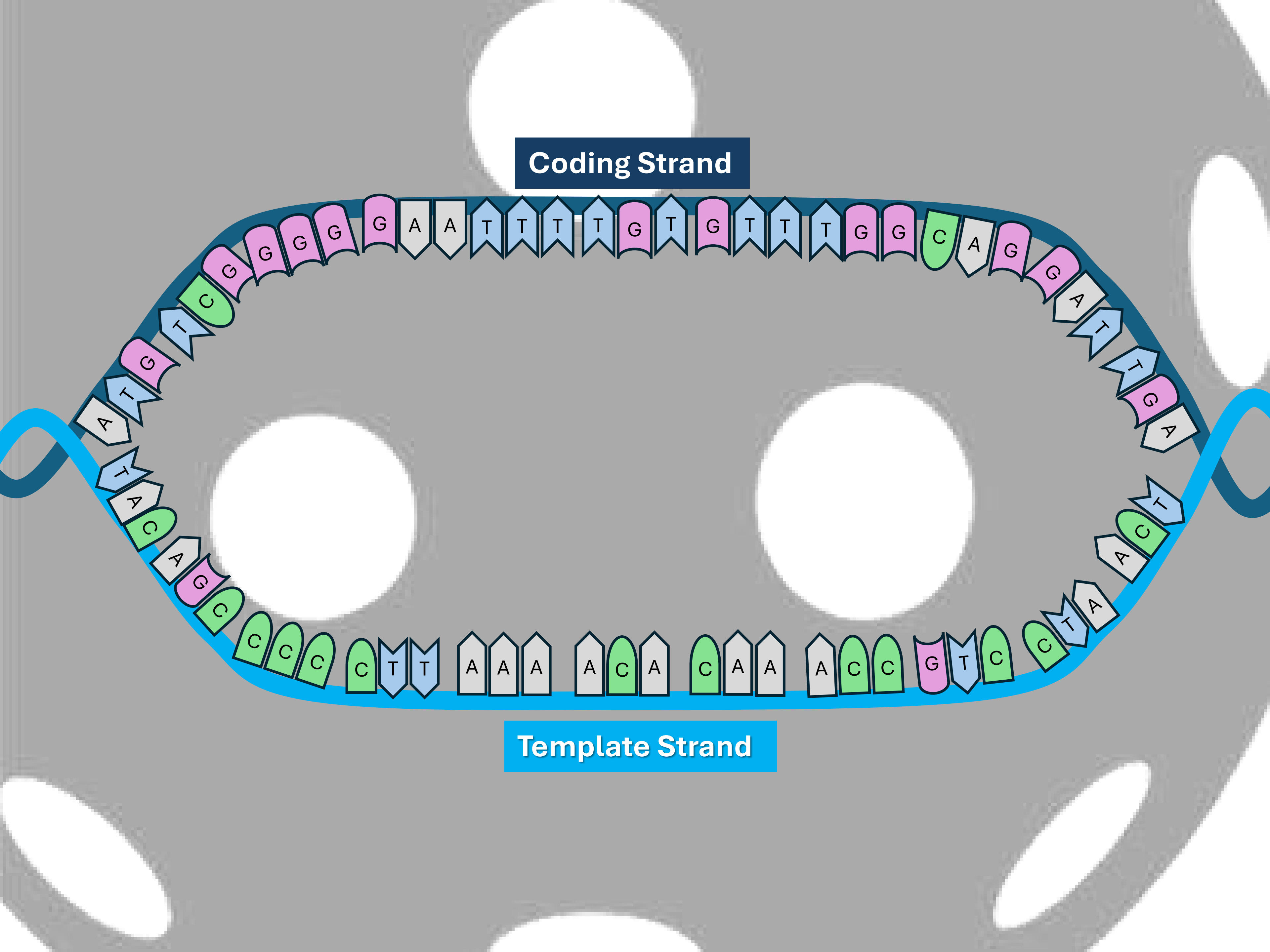
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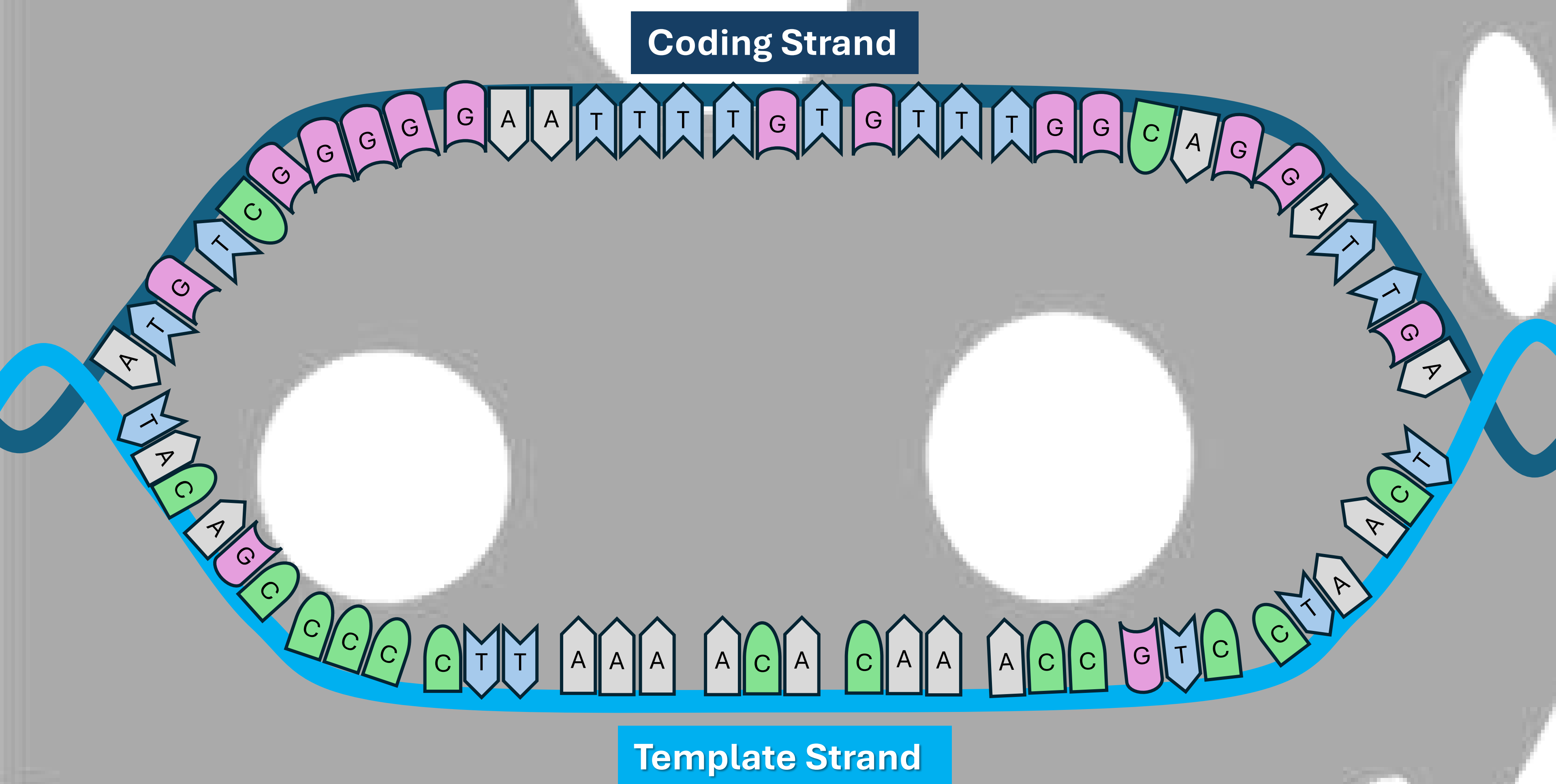

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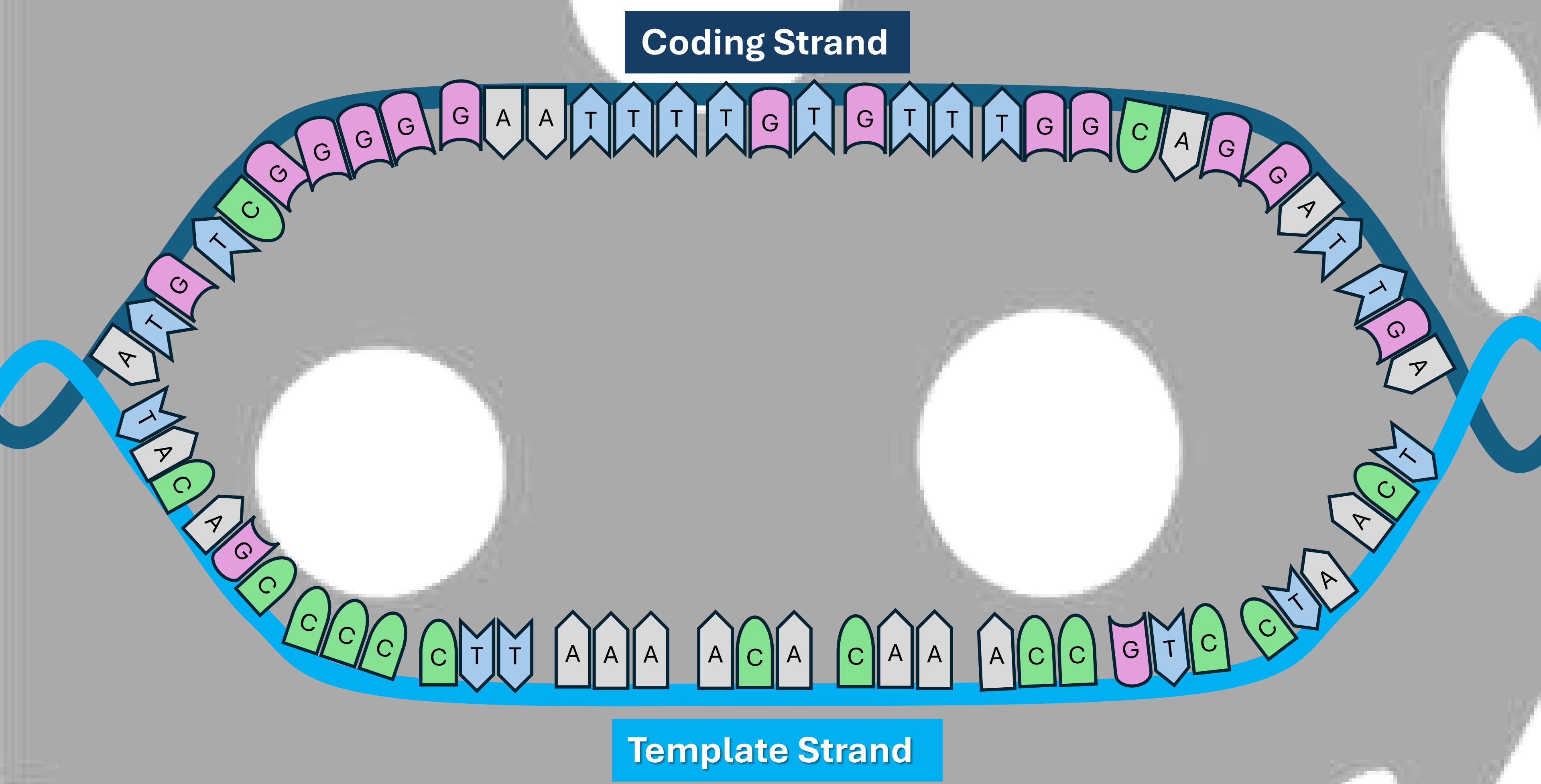
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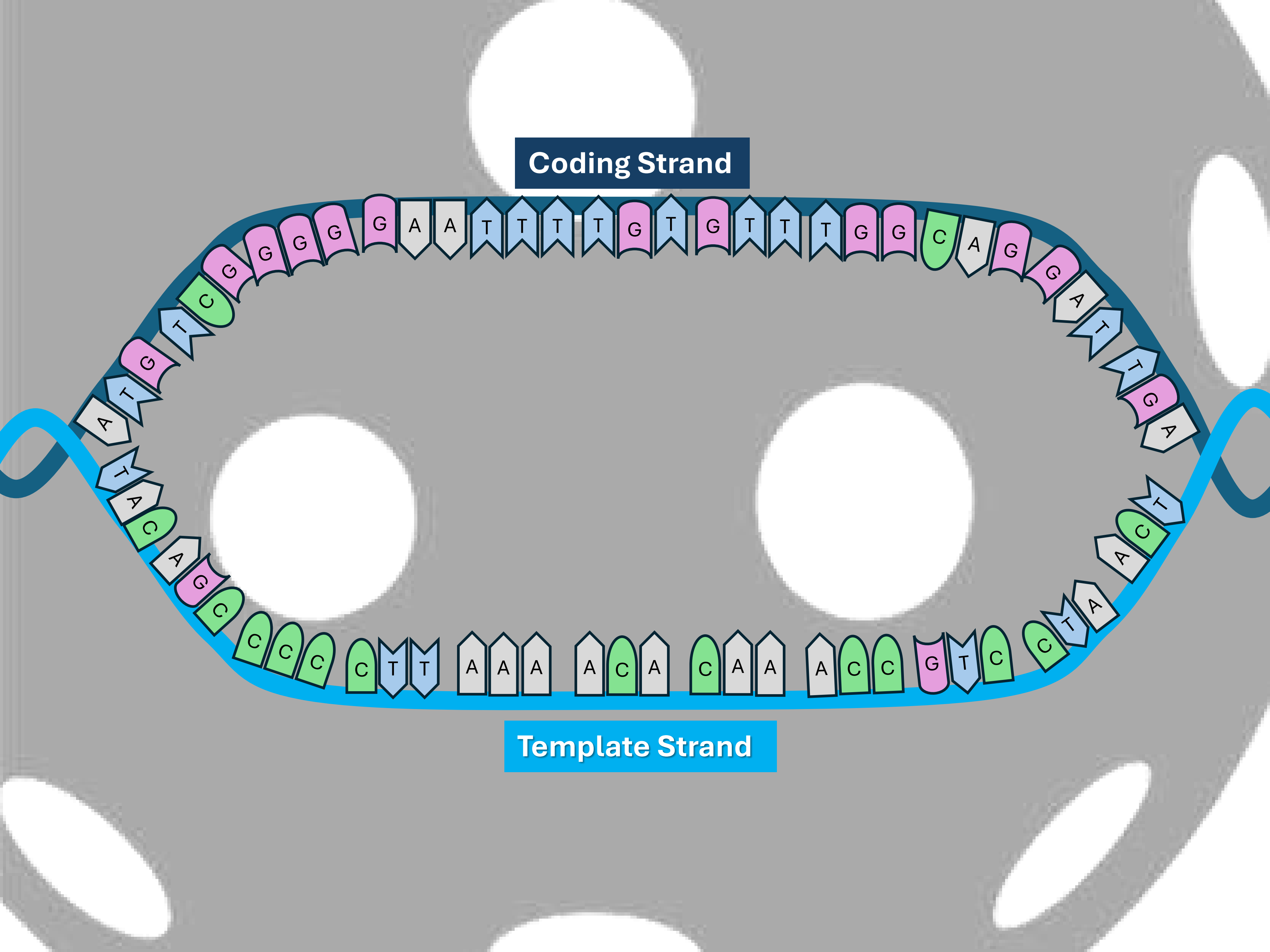

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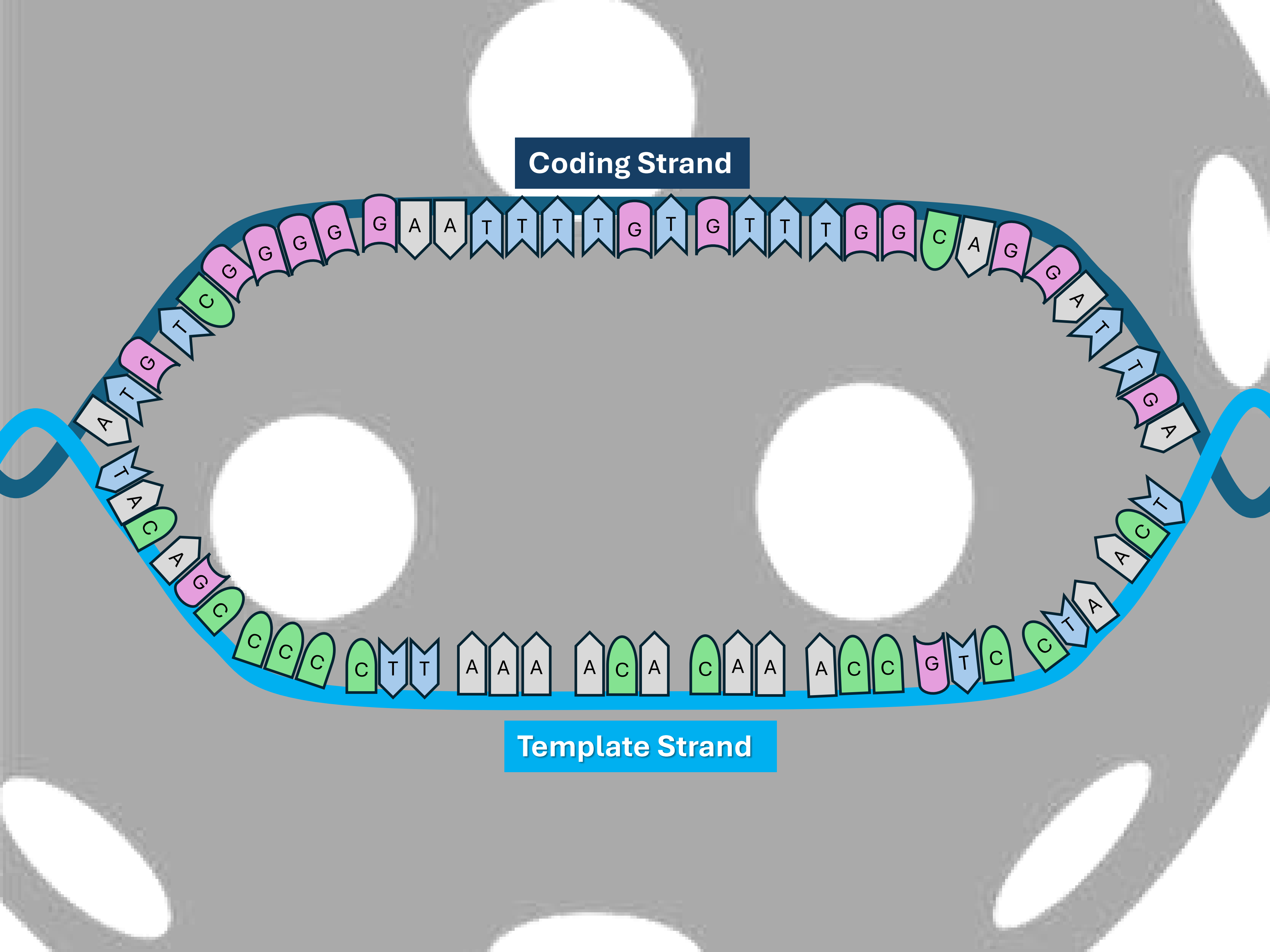
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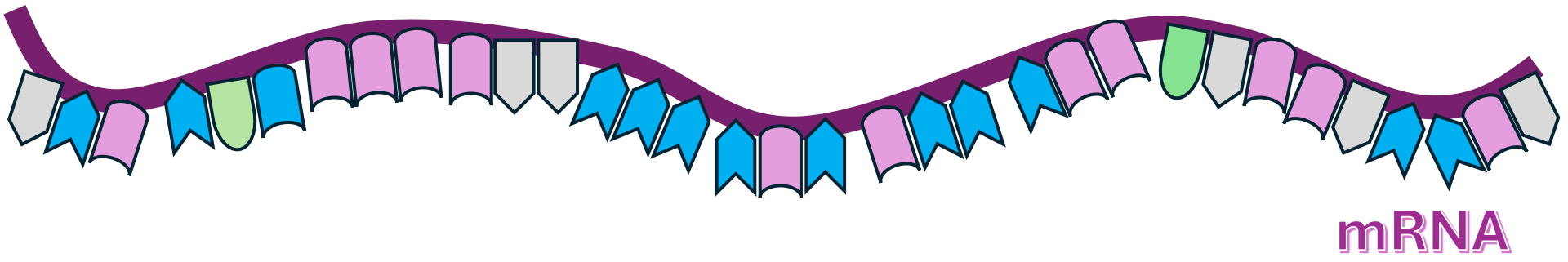
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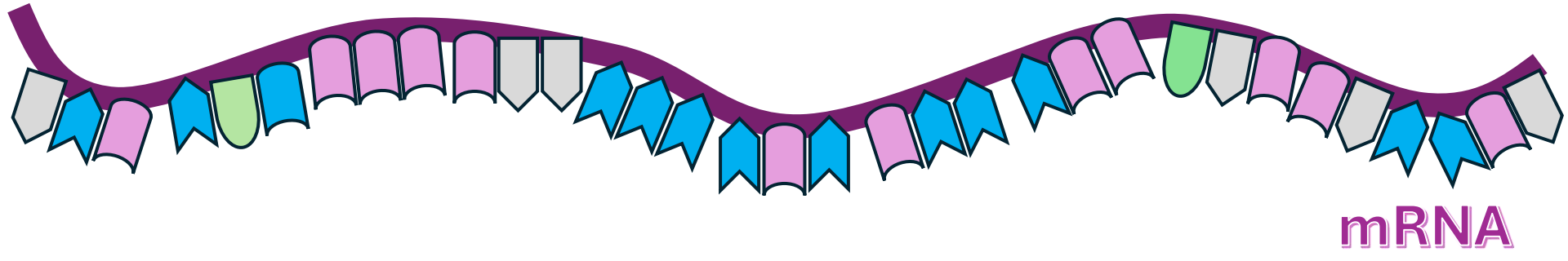
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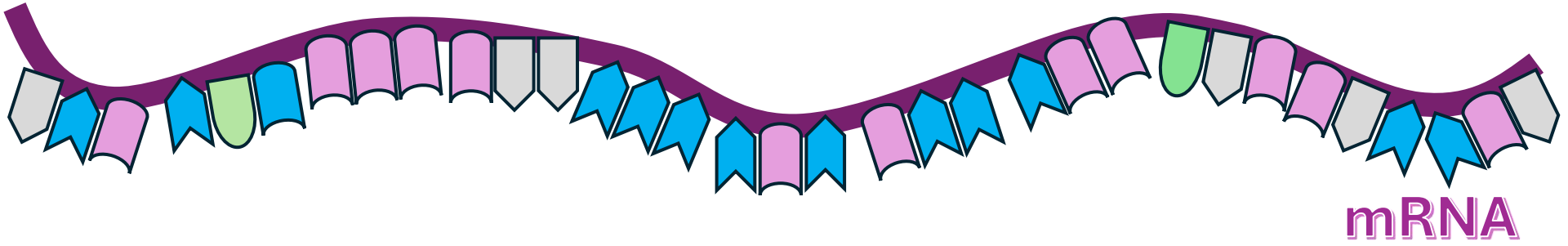
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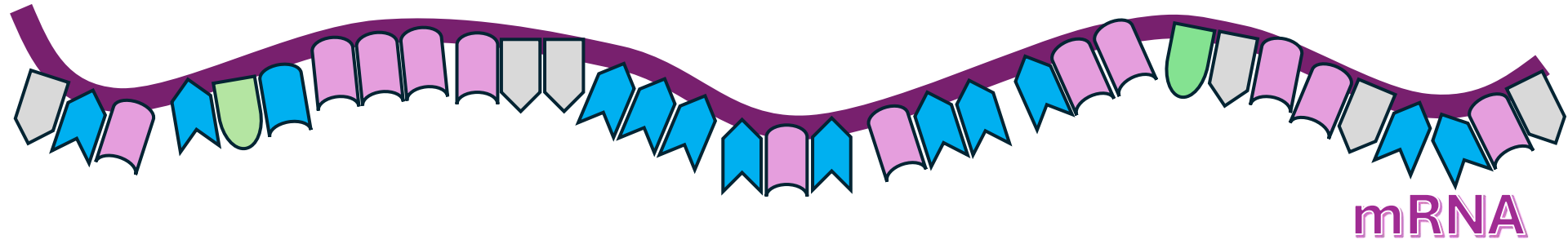
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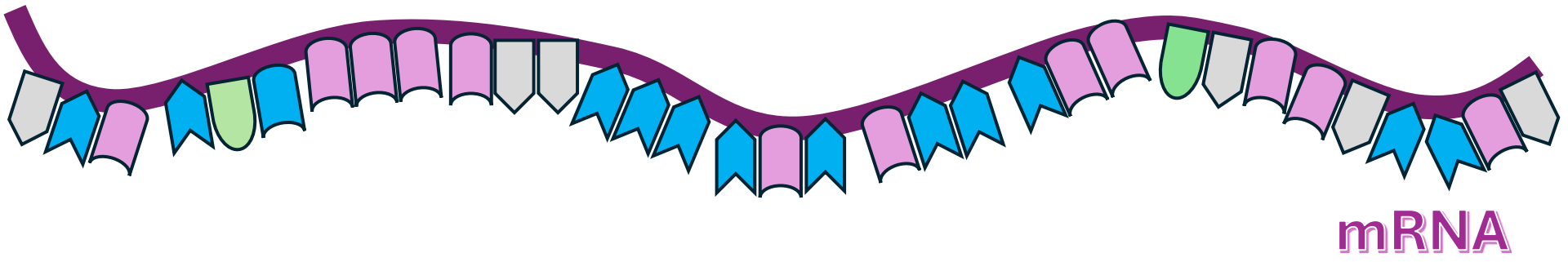
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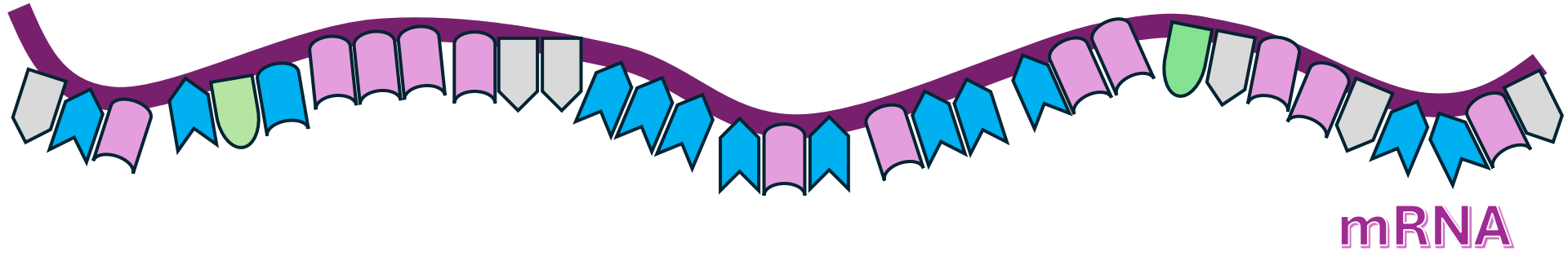
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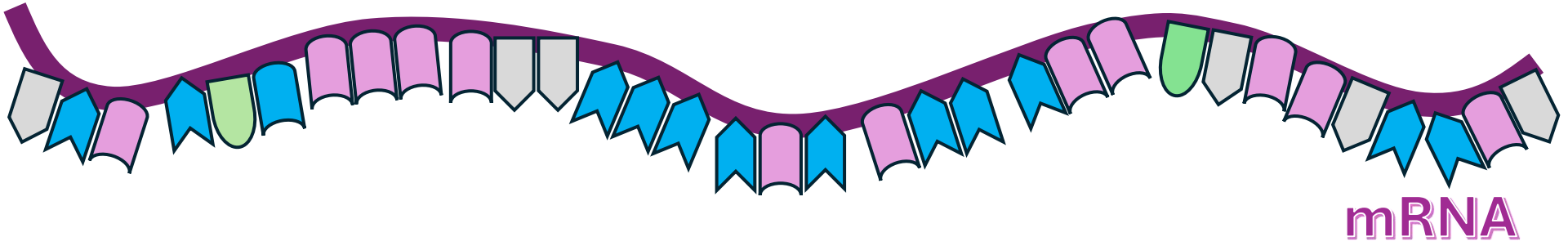
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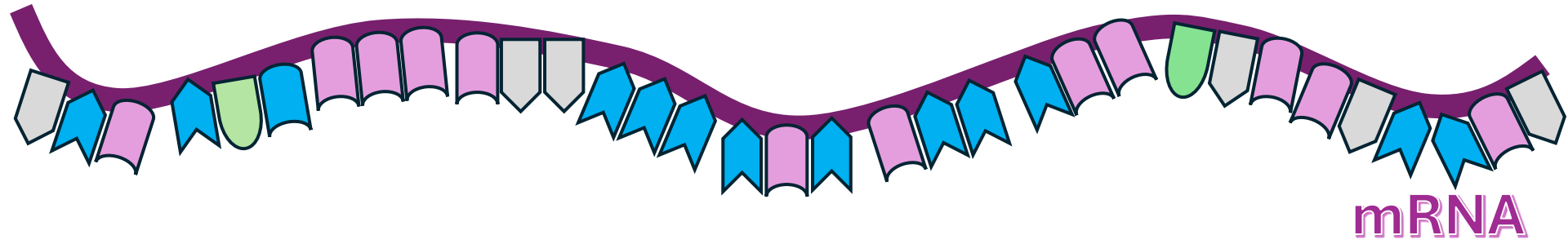
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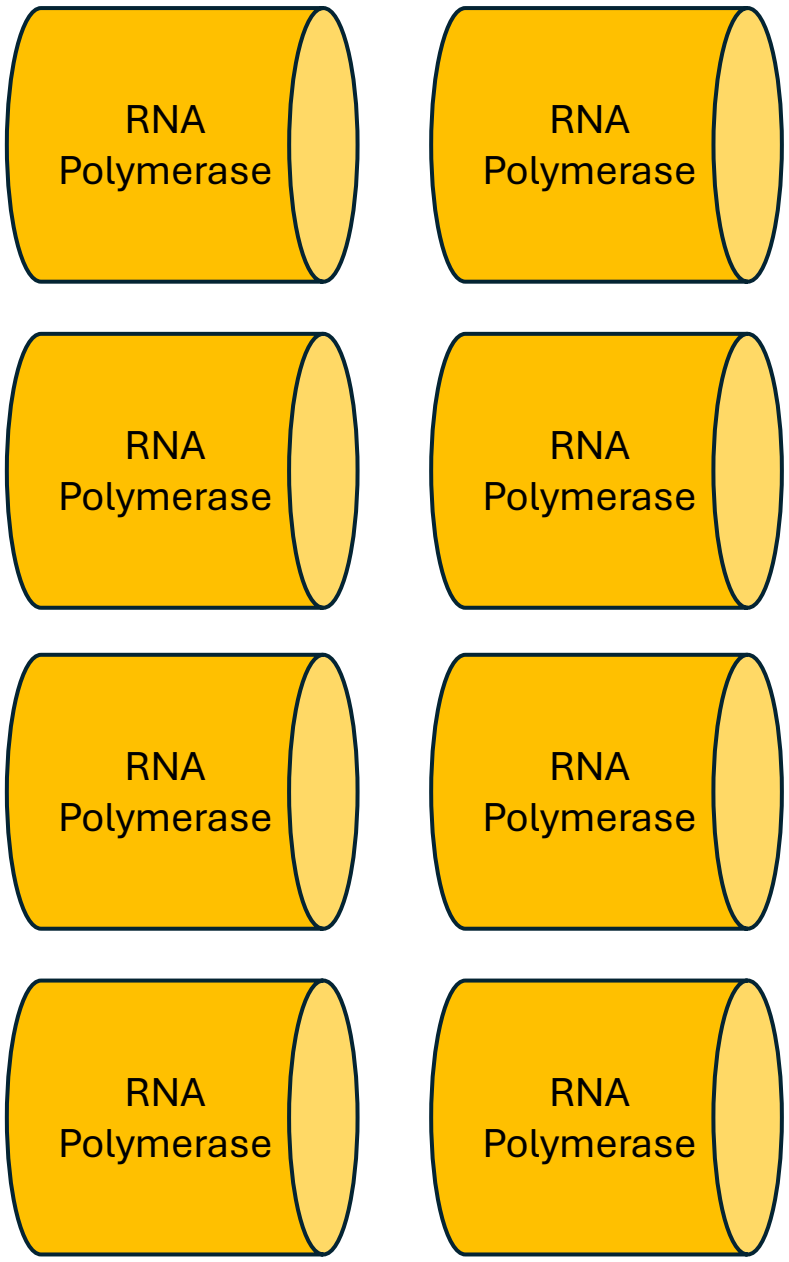

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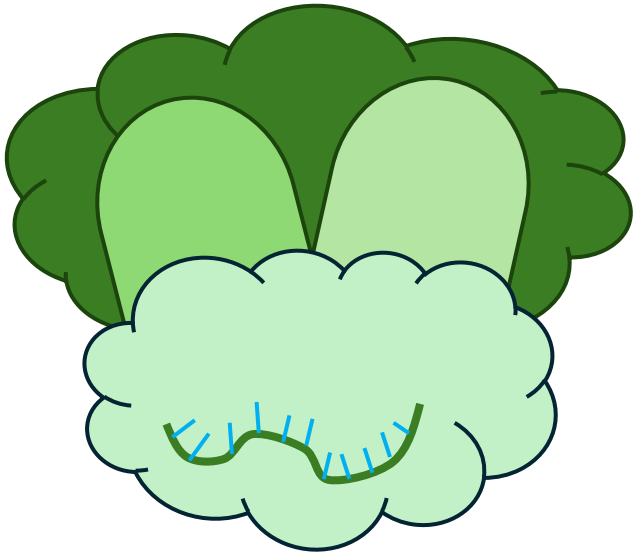

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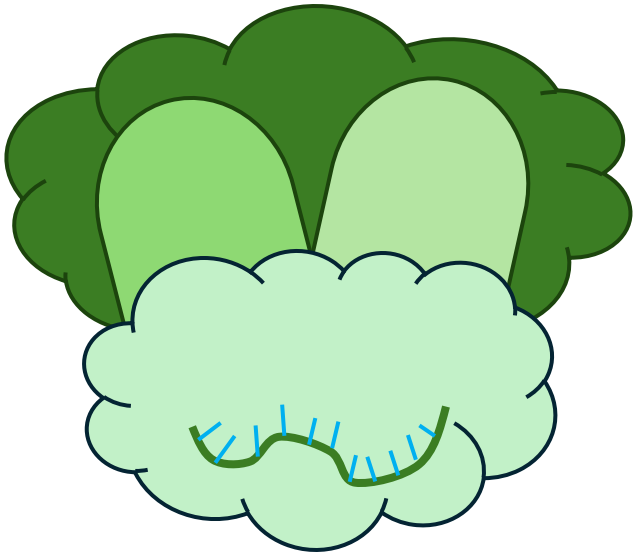

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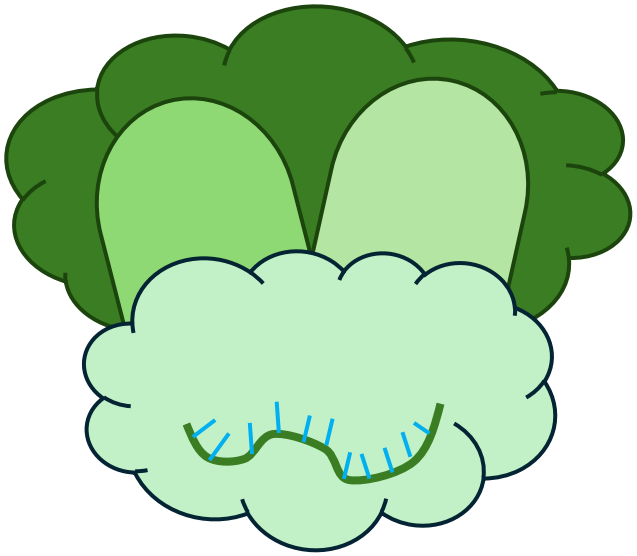

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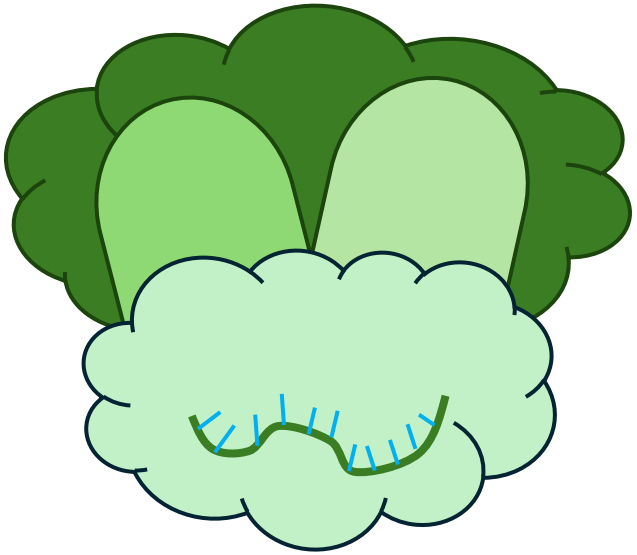

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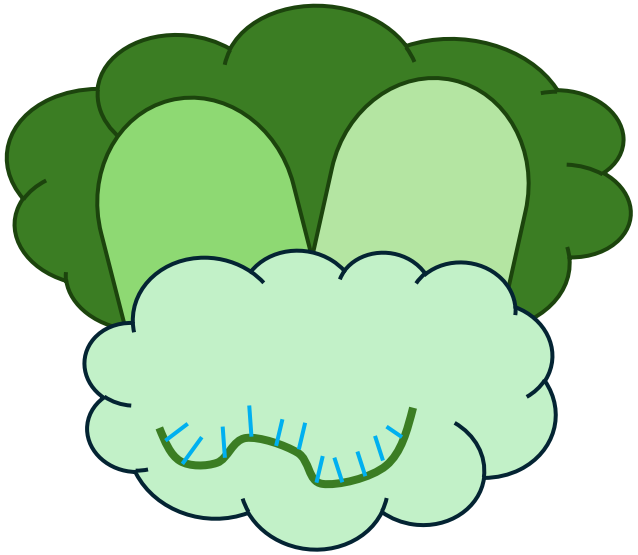

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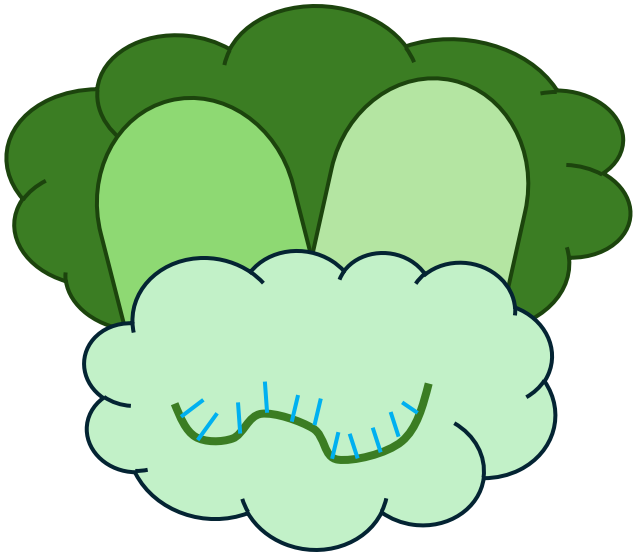

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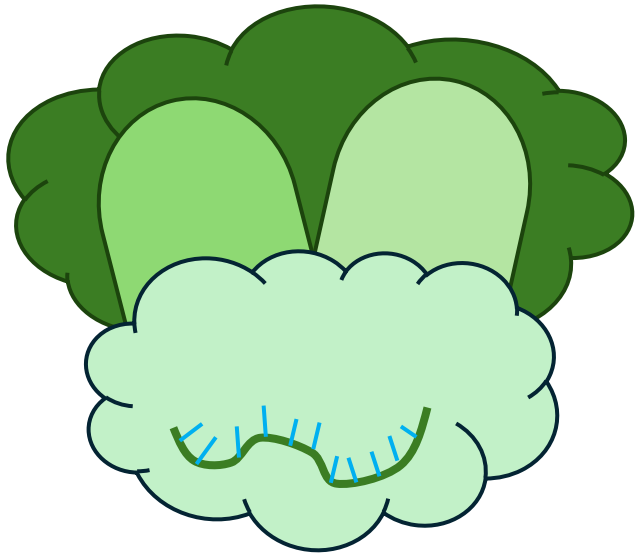

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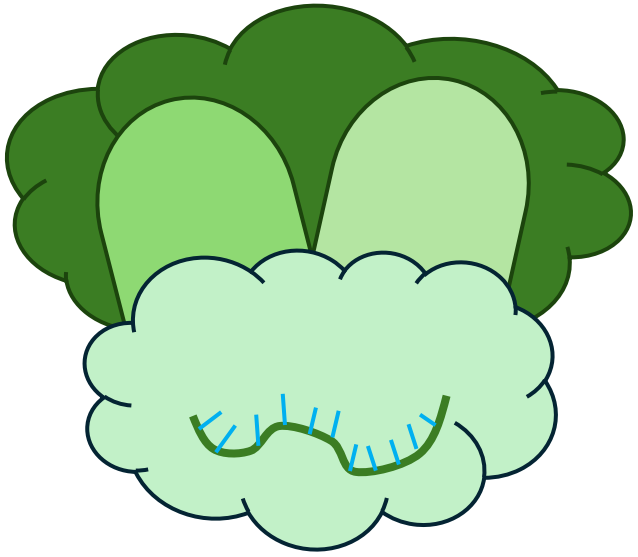

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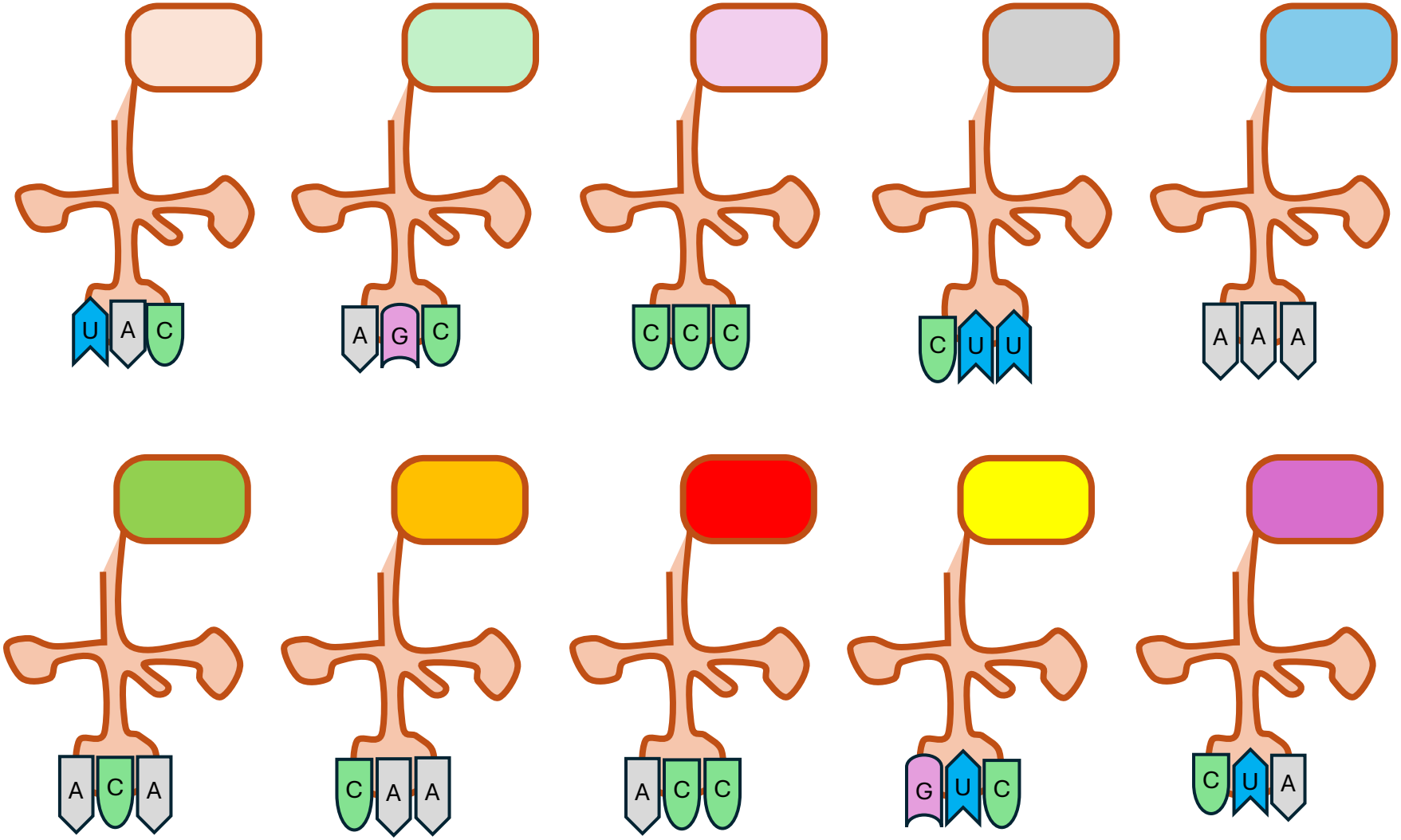

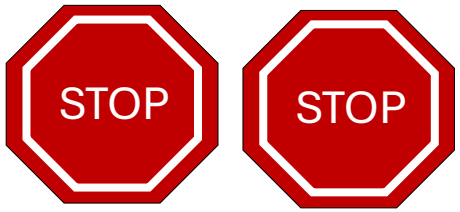

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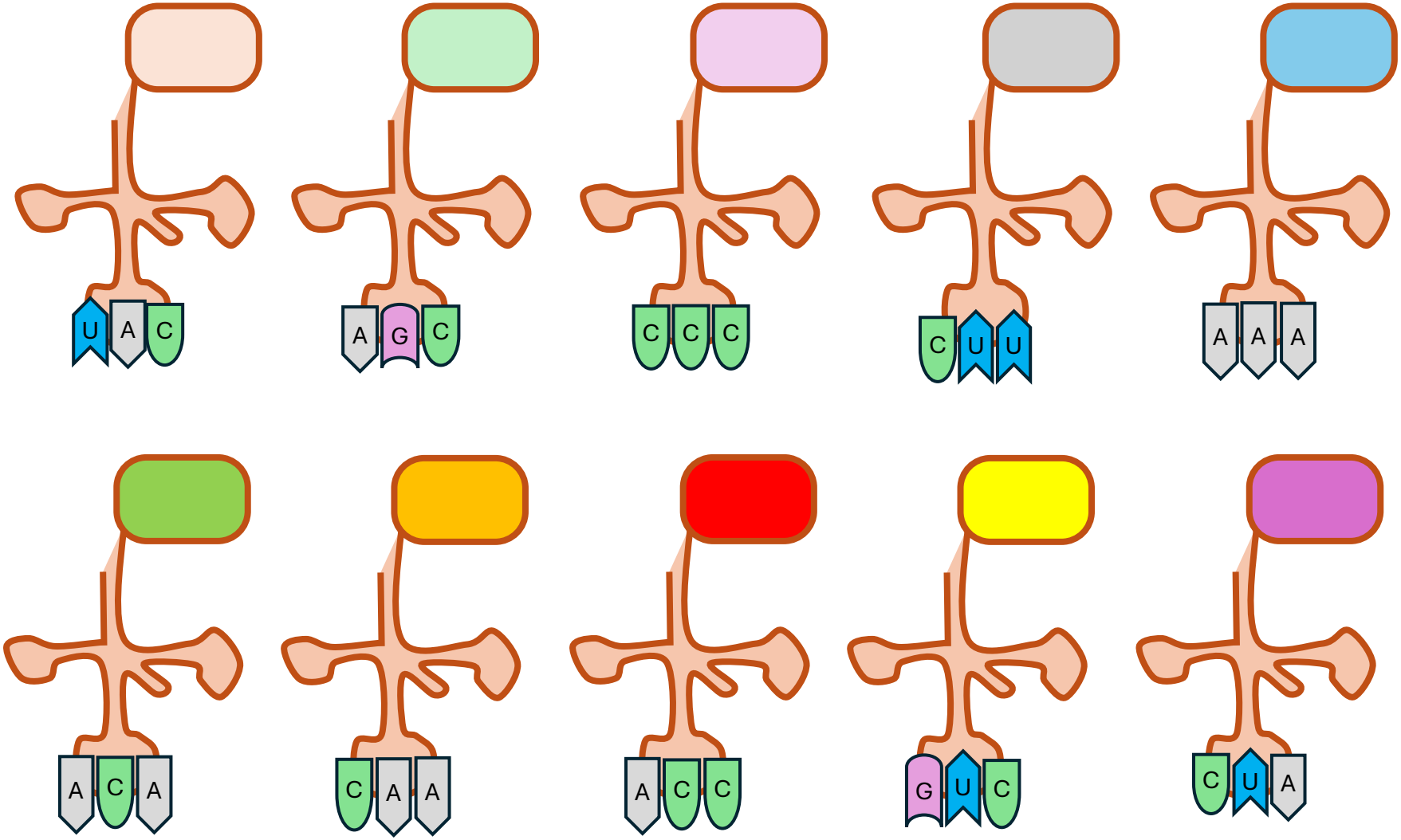

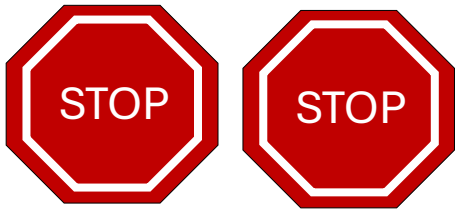

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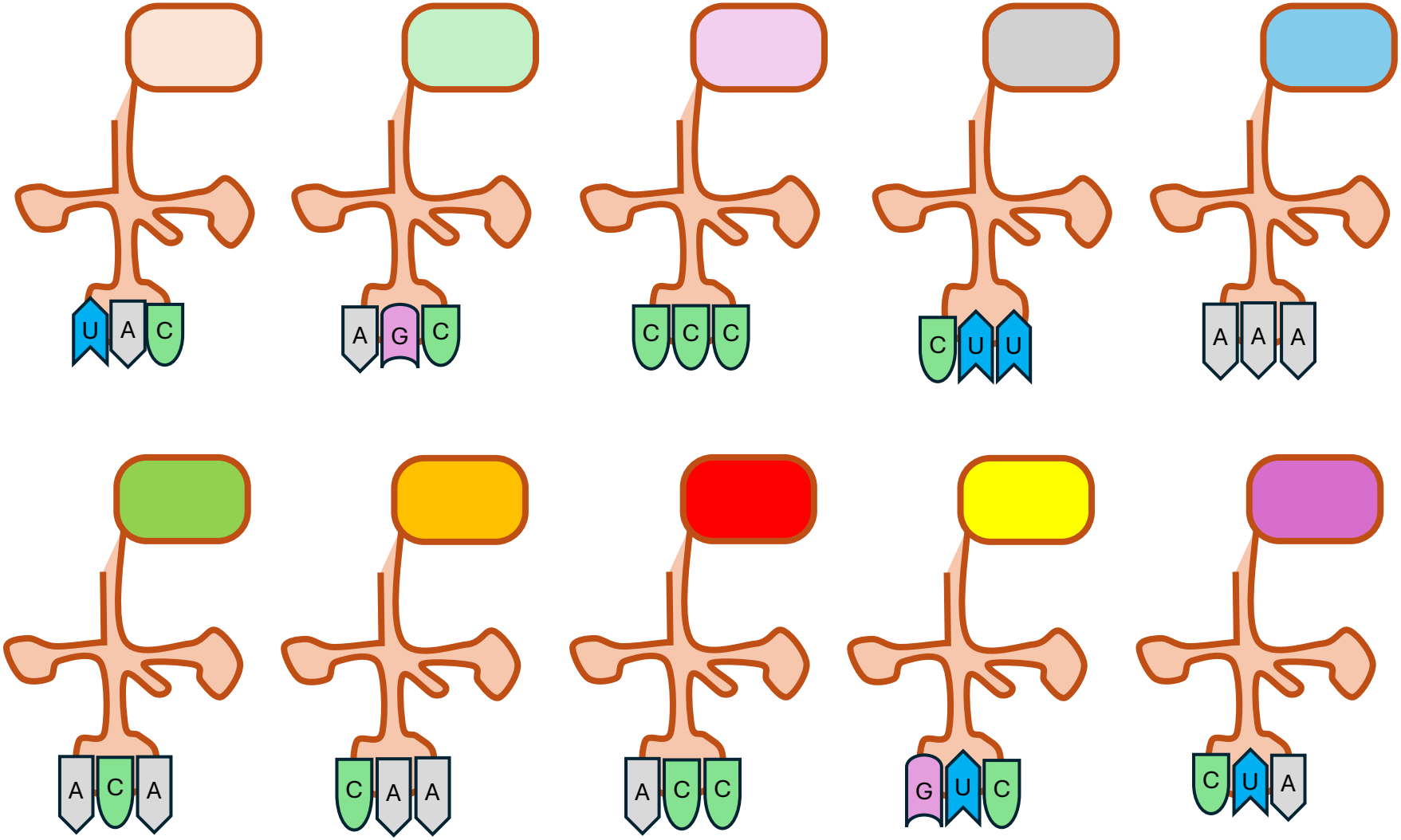

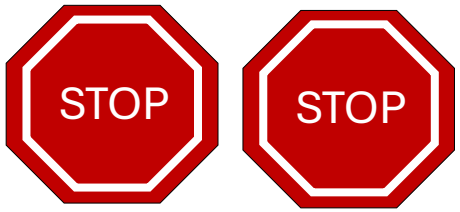

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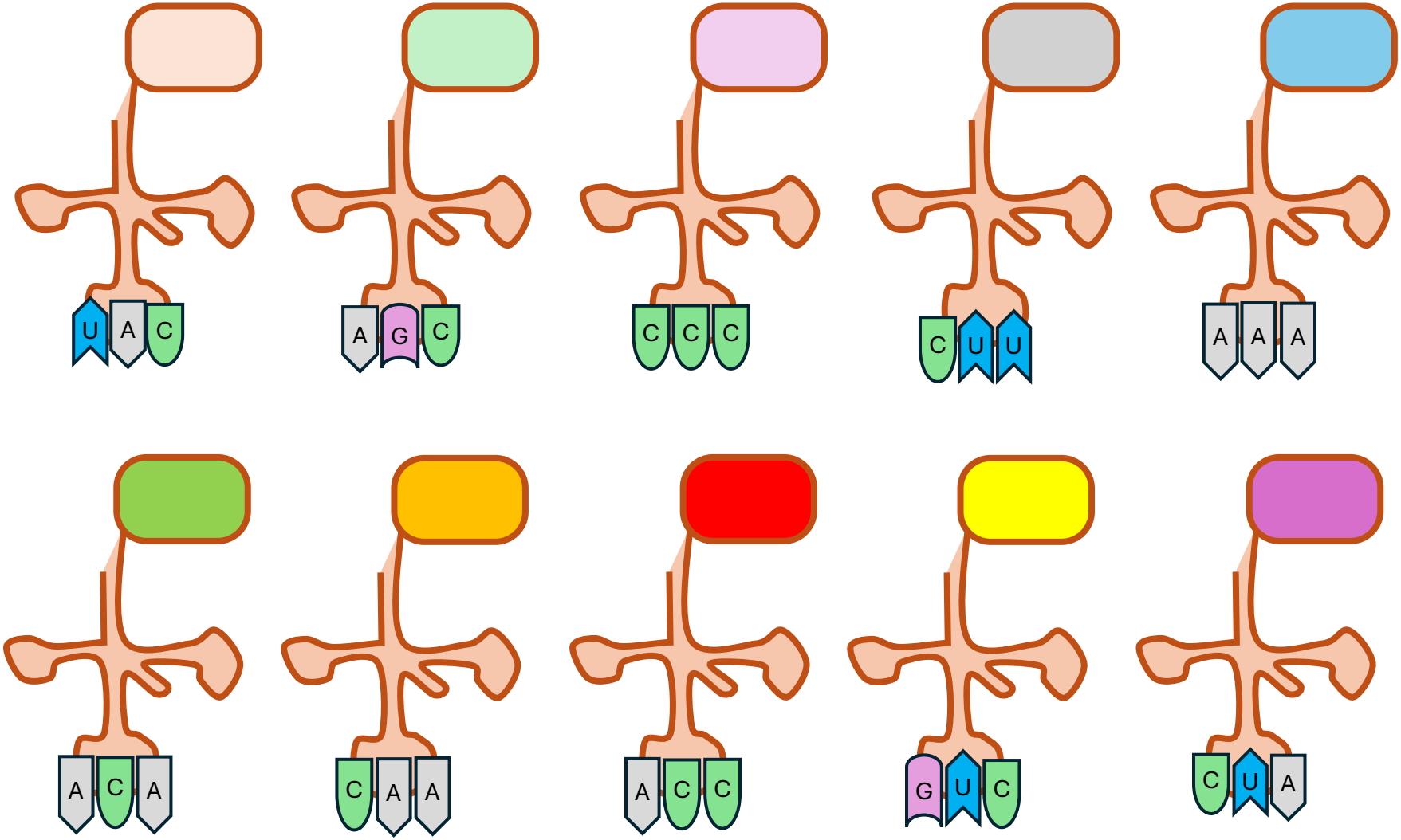

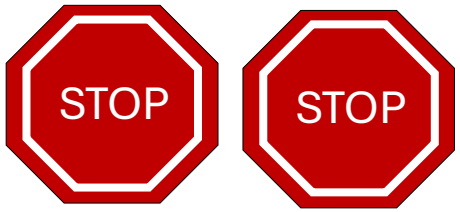

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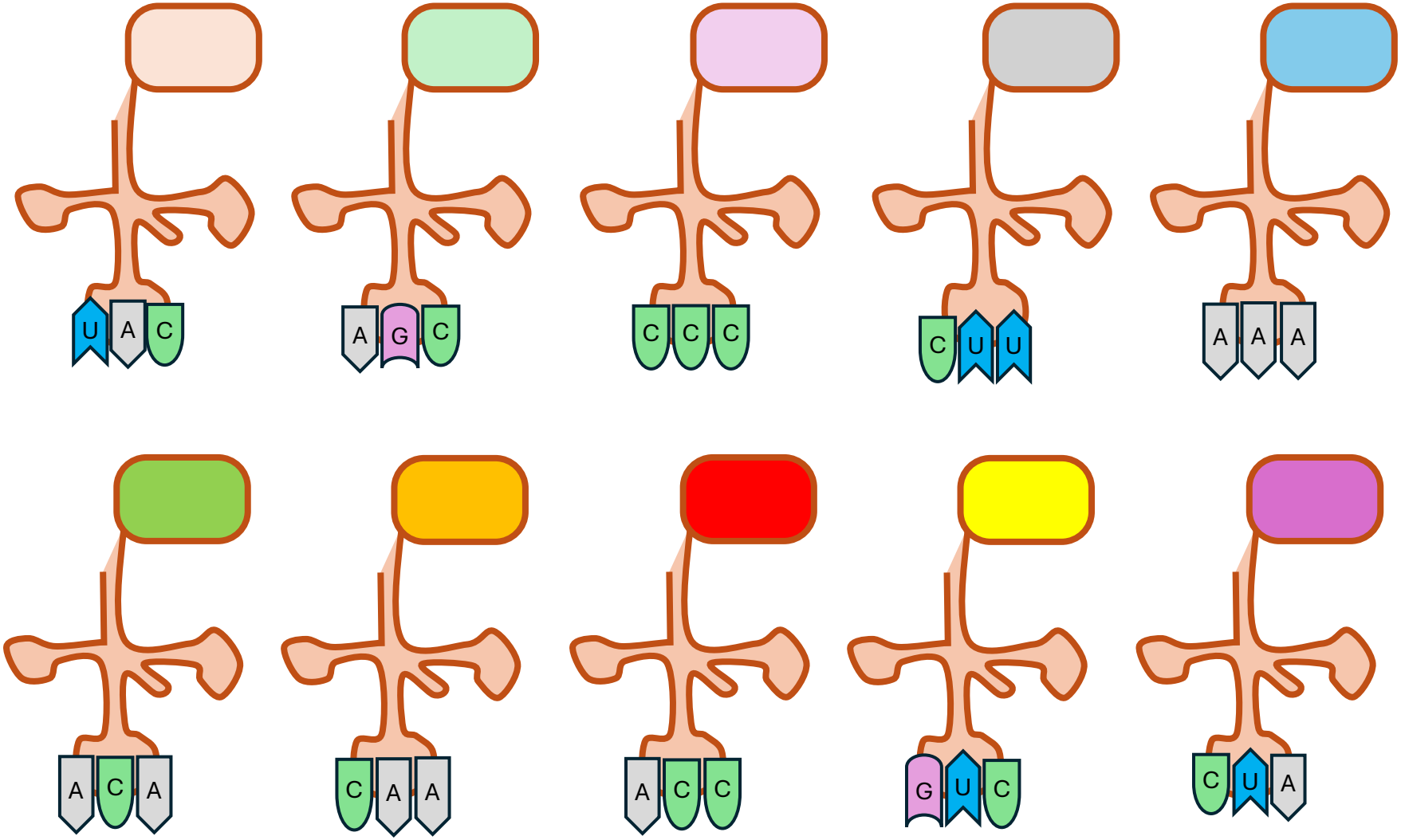

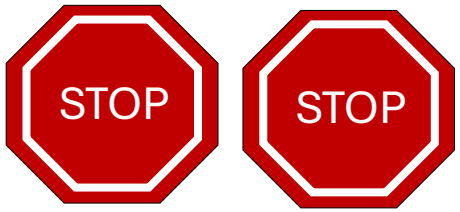

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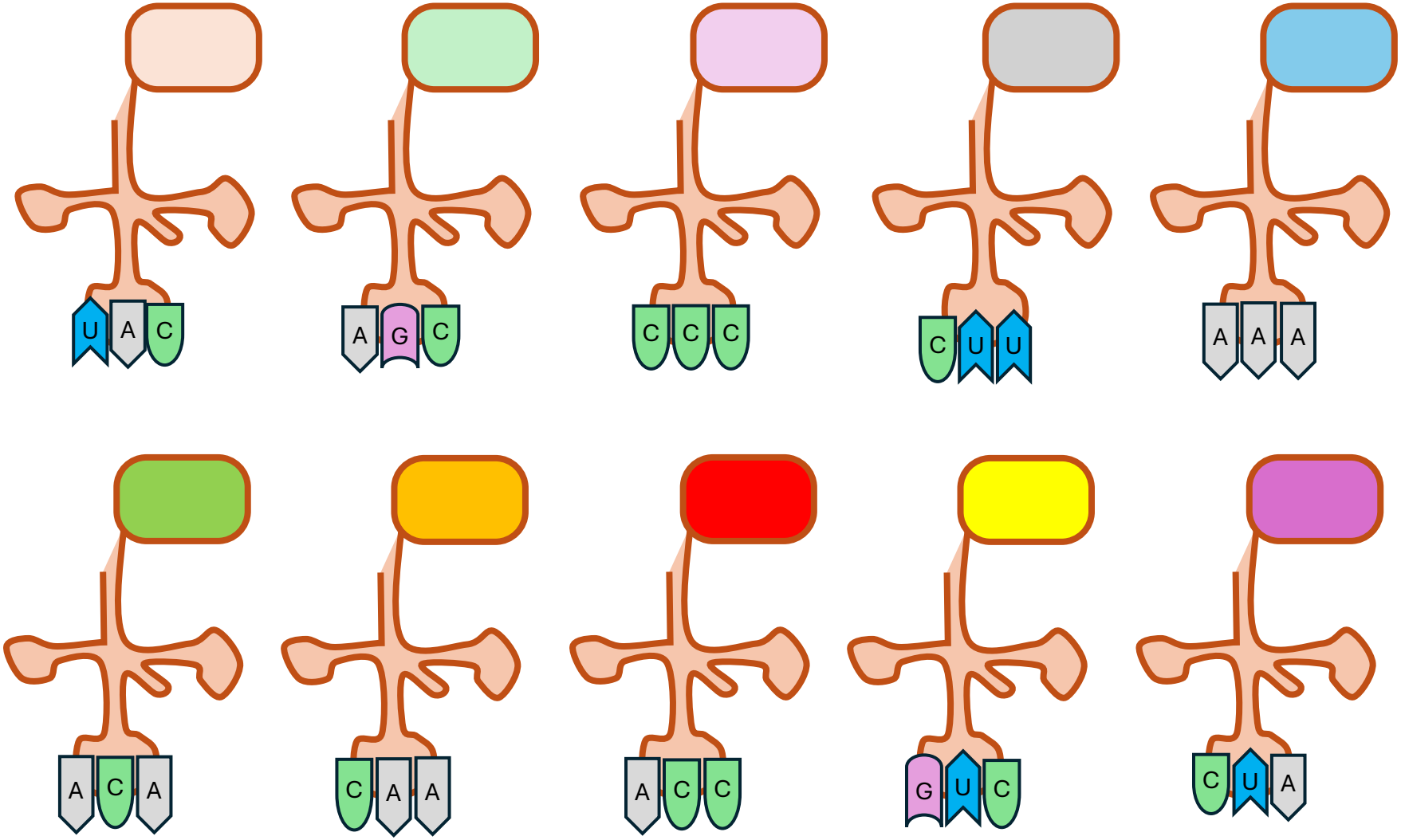

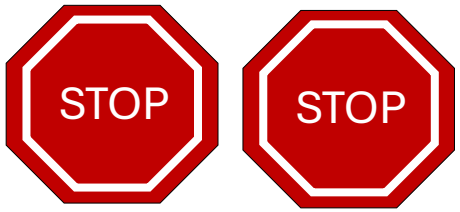

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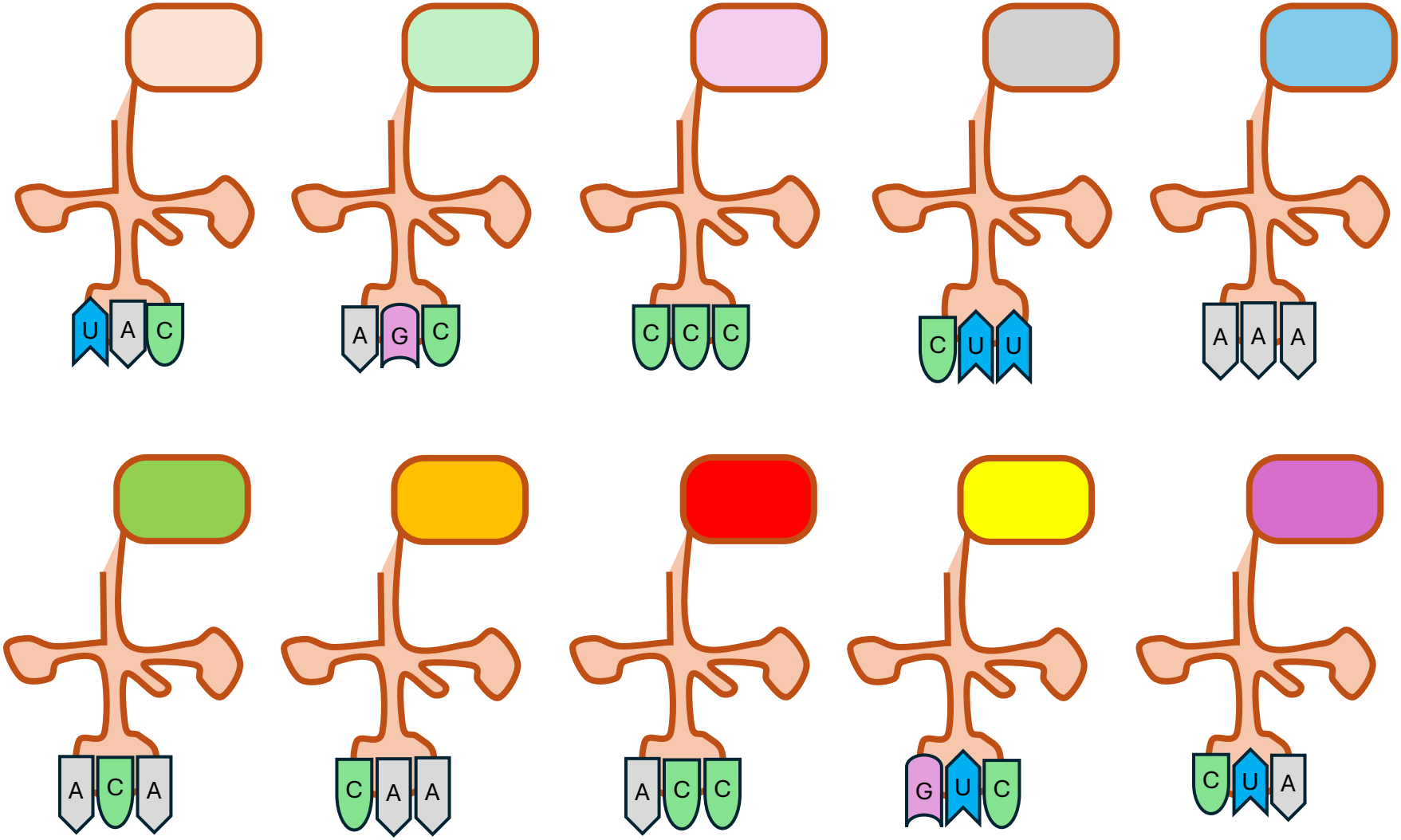

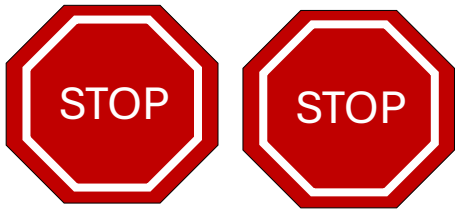

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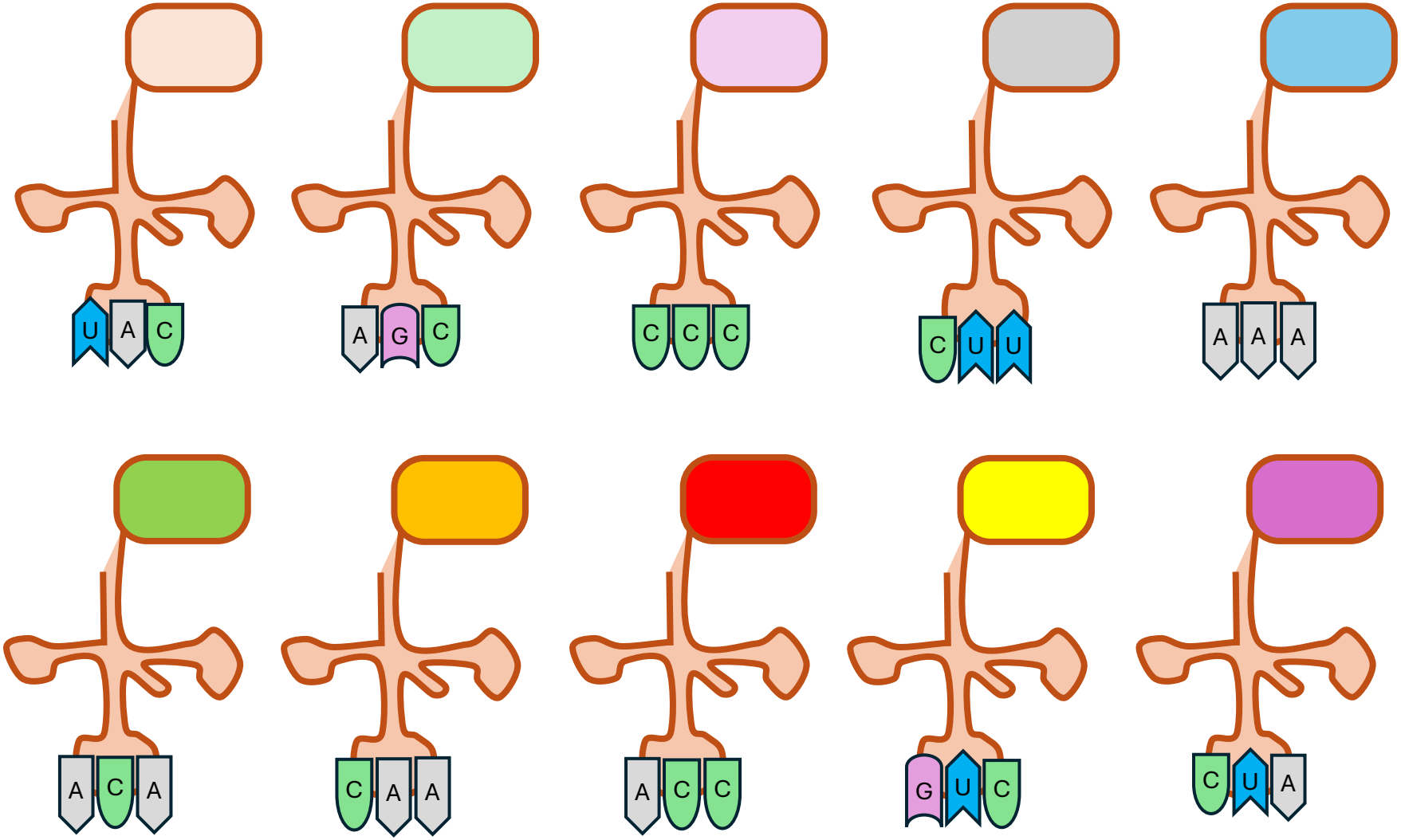

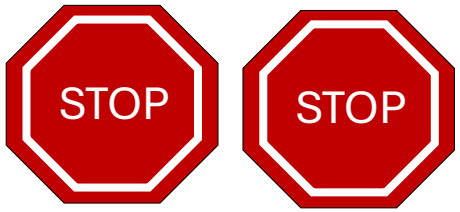

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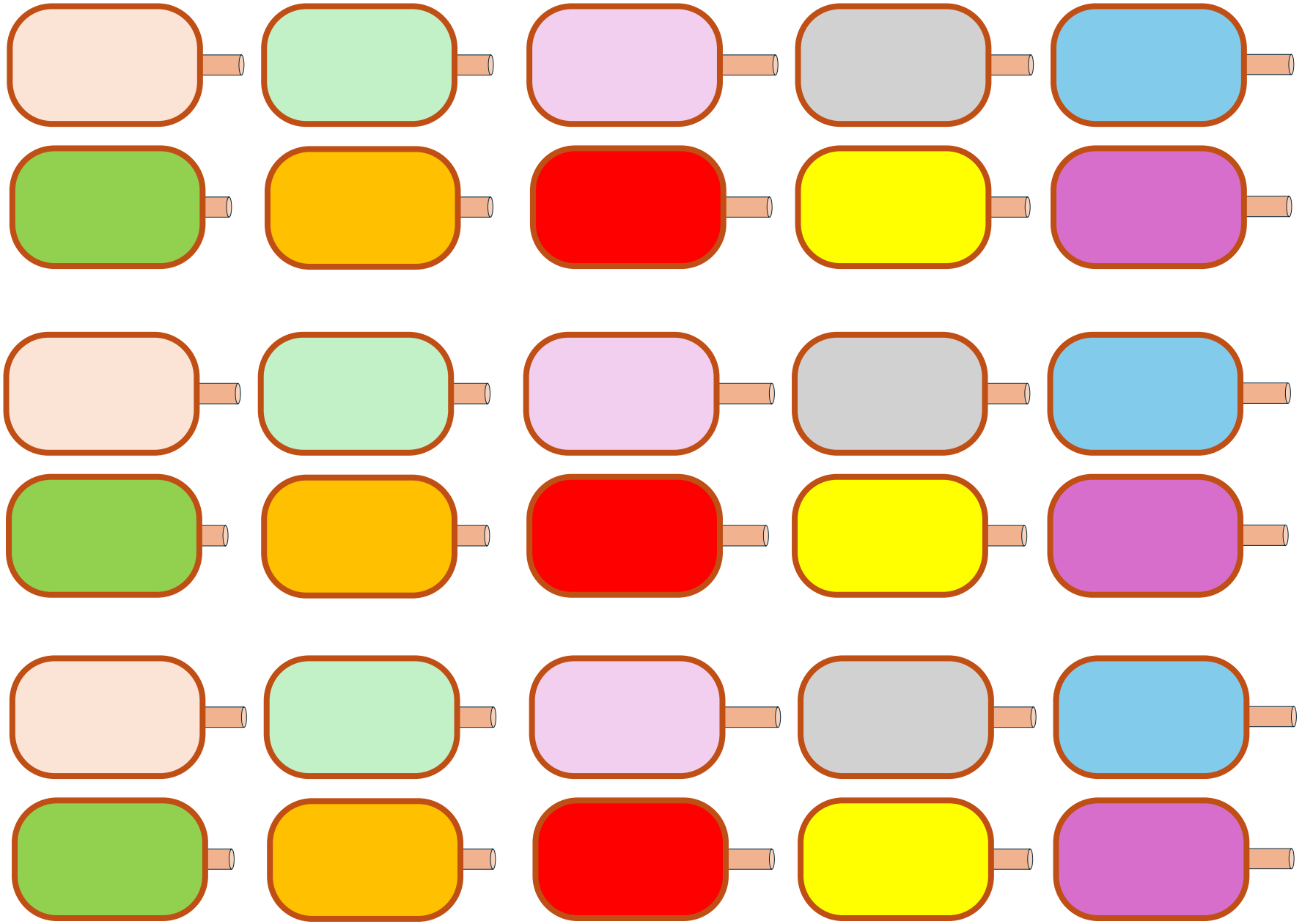

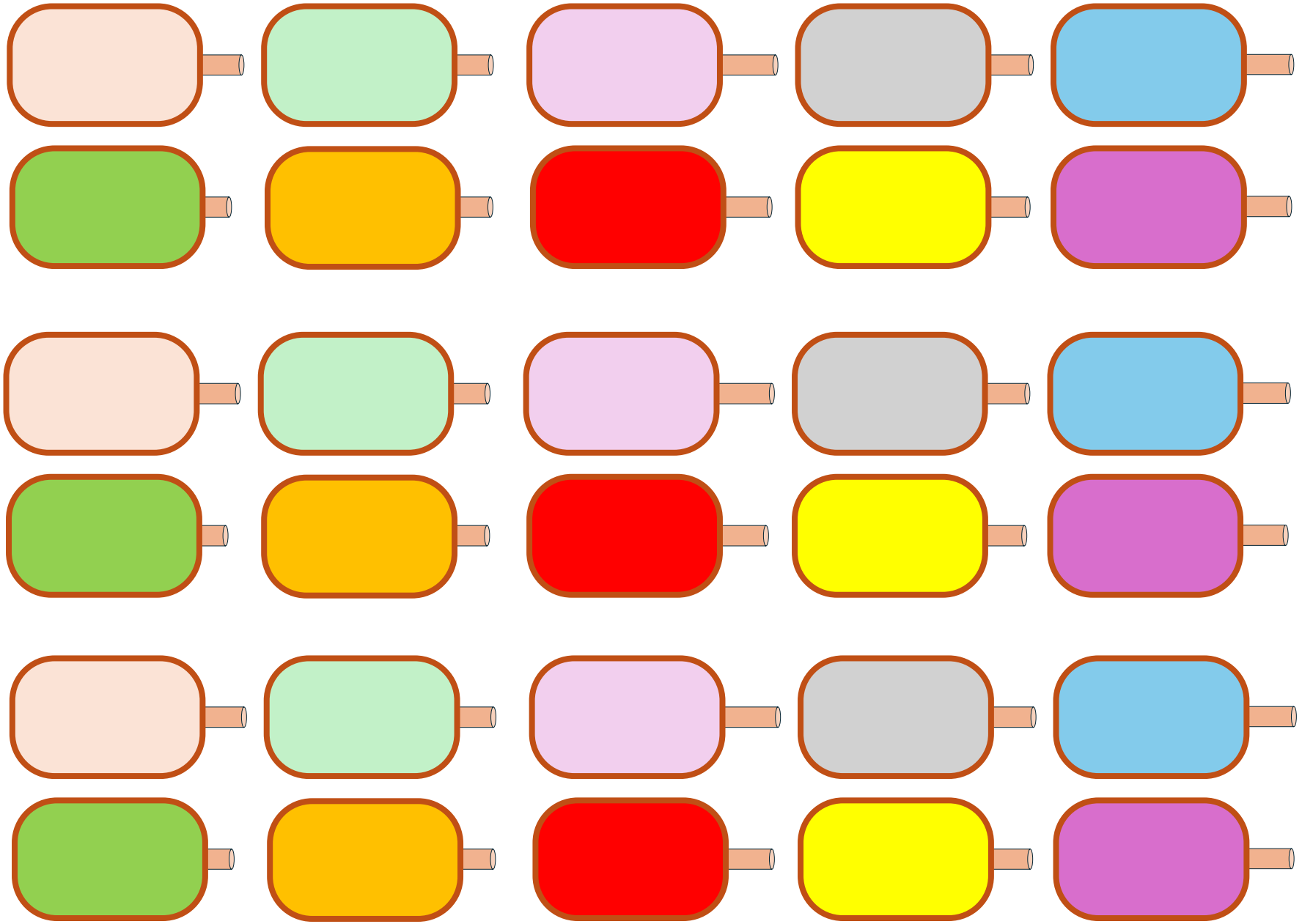

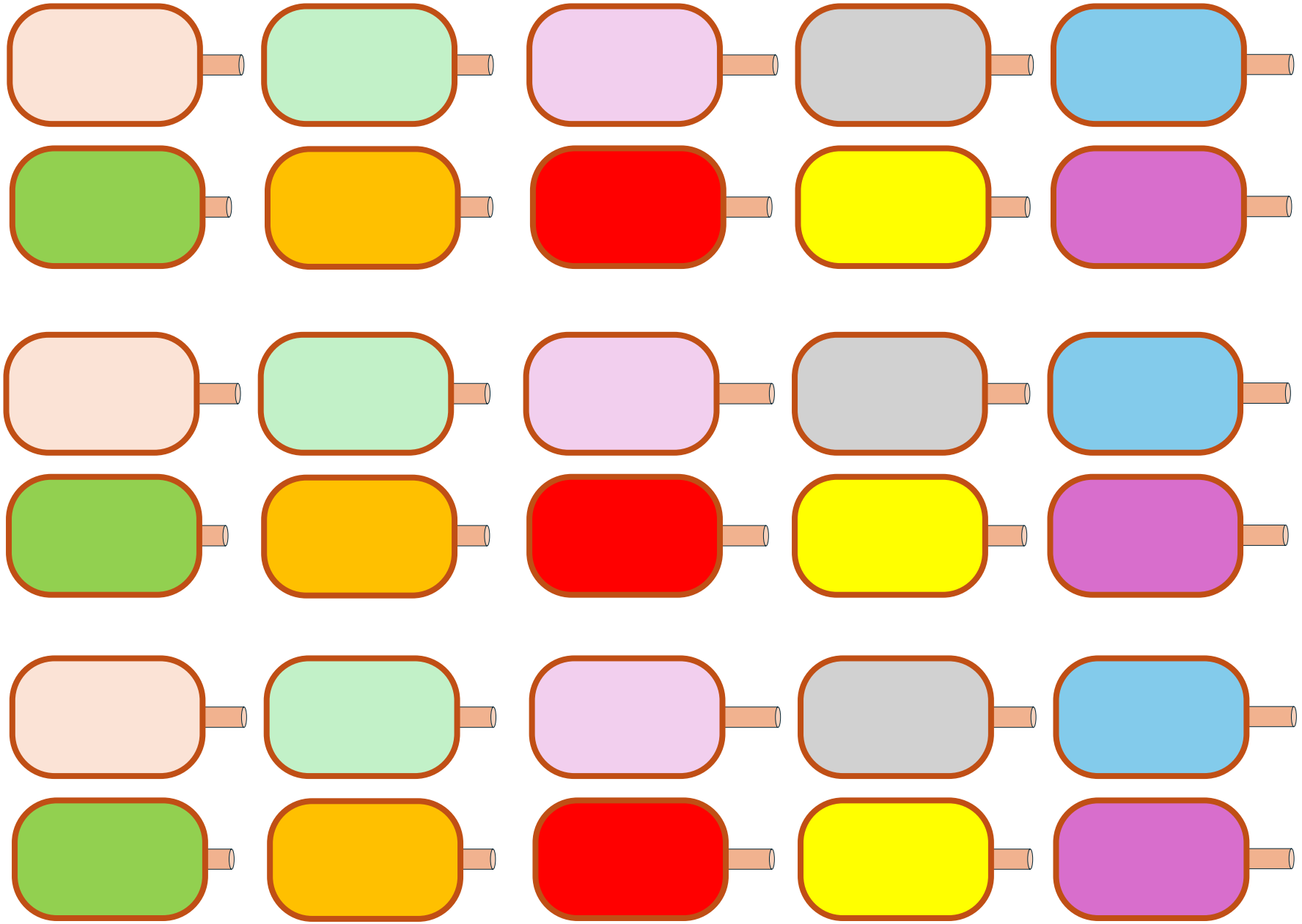

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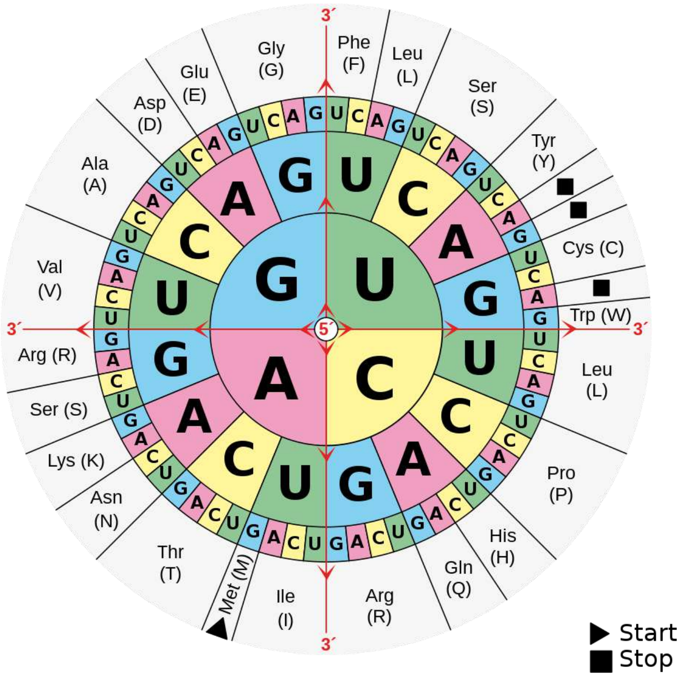

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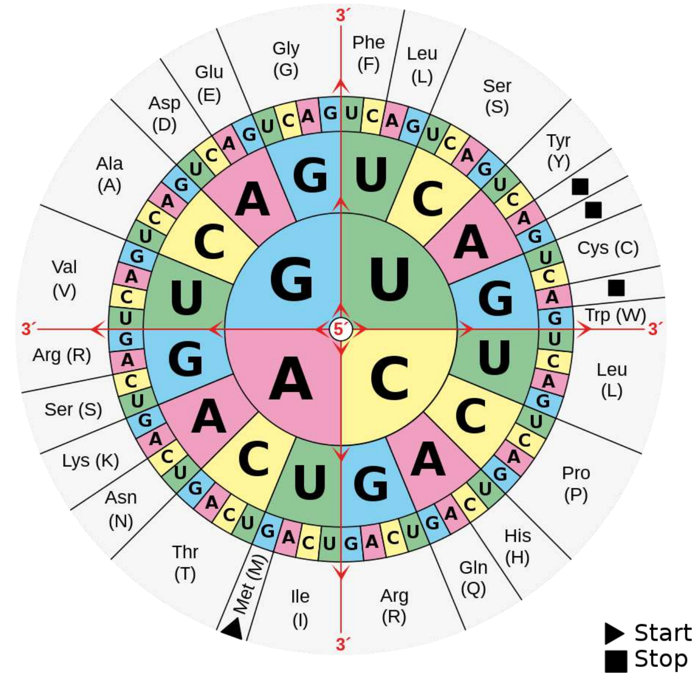

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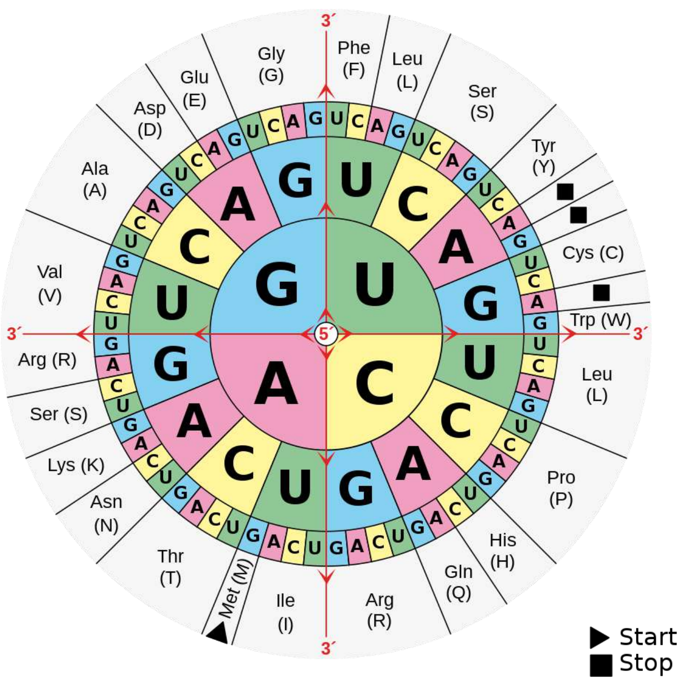

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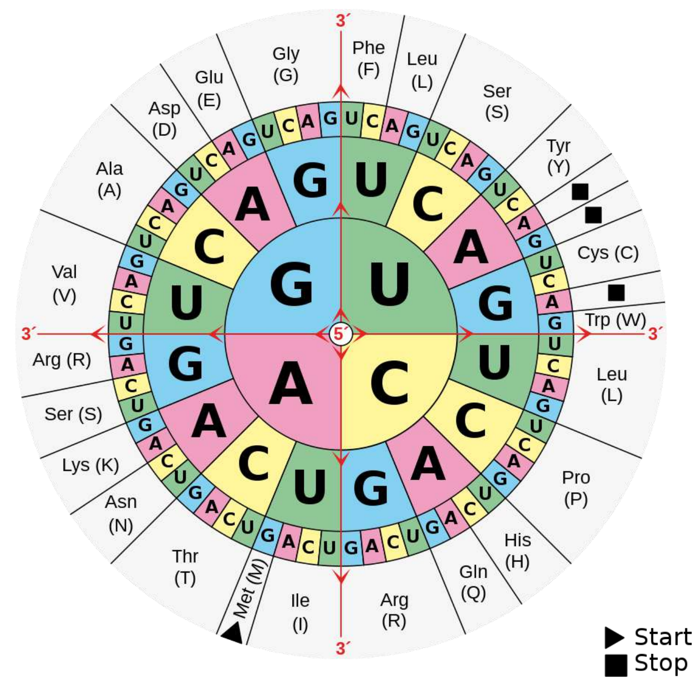

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Thr (T)
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Val (V)
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Asp (D)
Glu (E)
Gly (G)
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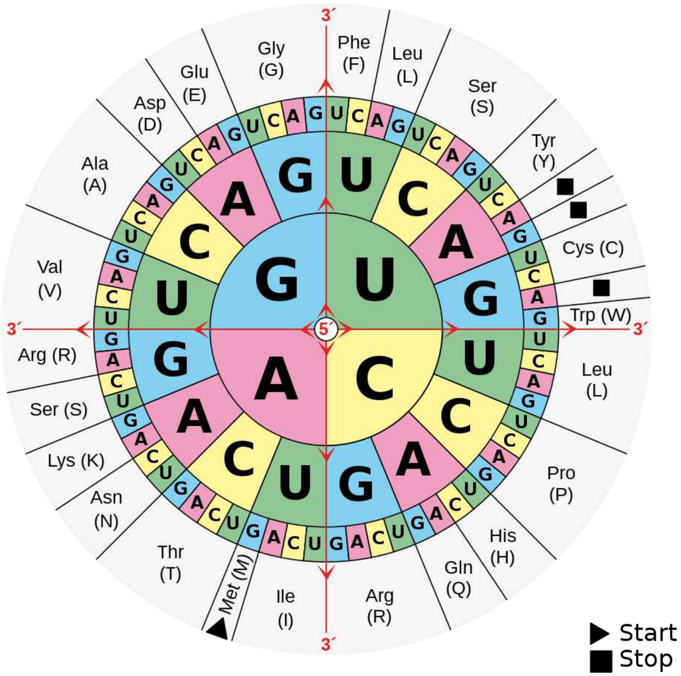
Stop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Asn (N)
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Asp (D)
Glu (E)
Gly (G)
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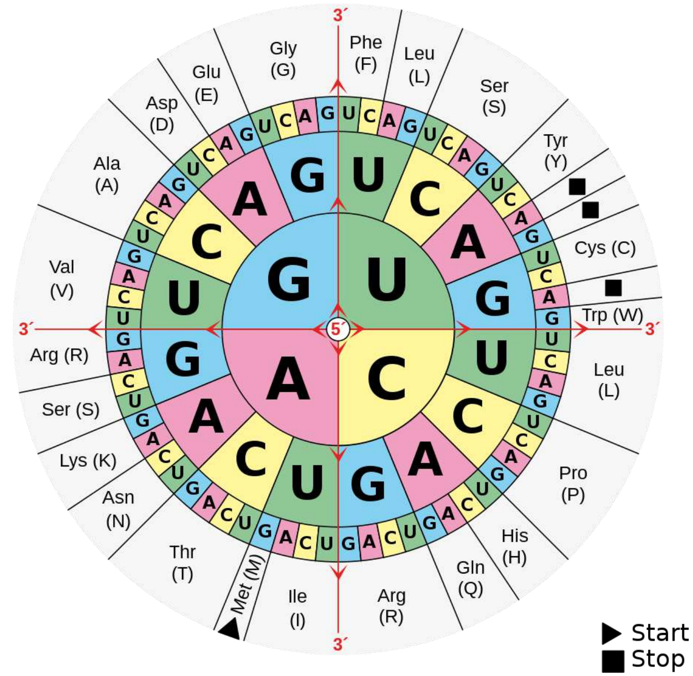
5′
Start
Stop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Val (V)
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Gly (G)
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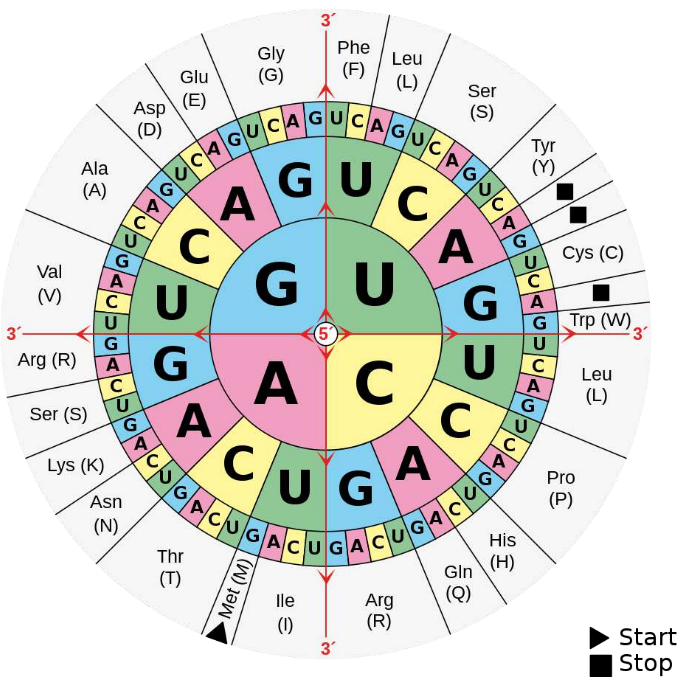
5′
Start
Stop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Asp (D)
Glu (E)
Gly (G)
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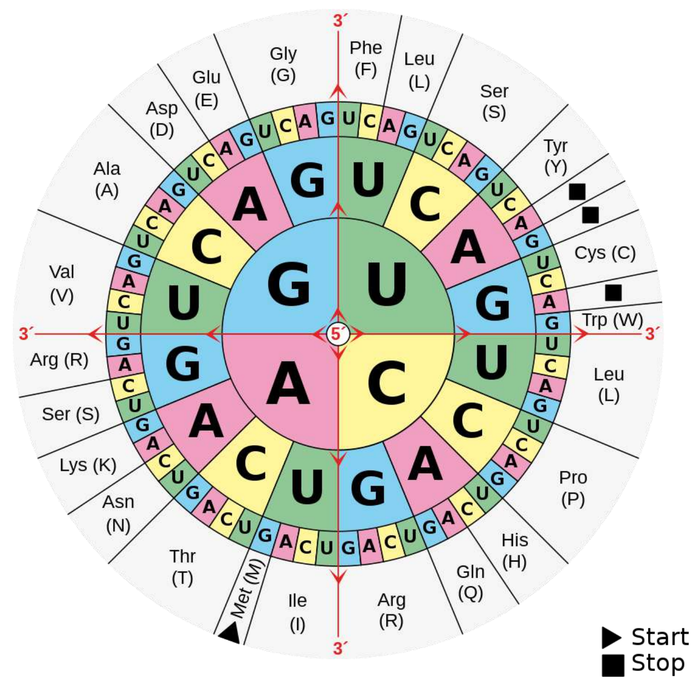
5′
Start
Stop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Ser (S)
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Val (V)
Ala (A)
Asp (D)
Glu (E)
Gly (G)
3′
5′
Start
Stop

mRNA Codon Chart

First Base	Second Base: U	Second Base: C	Second Base: A	Second Base: G	Third Base
U	Phenylalanine	Serine	Tyrosine	Cysteine	U
	Phenylalanine	Serine	Tyrosine	Cysteine	C
	Leucine	Serine	Stop	Stop	A
	Leucine	Serine	Stop	Tryptophan	G
C	Leucine	Proline	Histidine	Arginine	U
	Leucine	Proline	Histidine	Arginine	C
	Leucine	Proline	Glutamine	Arginine	A
	Leucine	Proline	Glutamine	Arginine	G
A	Isoleucine	Threonine	Asparagine	Serine	U
	Isoleucine	Threonine	Asparagine	Serine	C
	Isoleucine	Threonine	Lysine	Arginine	A
	Methionine	Threonine	Lysine	Arginine	G
G	Valine	Alanine	Aspartic Acid	Glycine	U
	Valine	Alanine	Aspartic Acid	Glycine	C
	Valine	Alanine	Glutamic Acid	Glycine	A
	Valine	Alanine	Glutamic Acid	Glycine	G

mRNA Codon Chart

First Base	Second Base: U	Second Base: C	Second Base: A	Second Base: G	Third Base
U	Phenylalanine	Serine	Tyrosine	Cysteine	U
	Phenylalanine	Serine	Tyrosine	Cysteine	C
	Leucine	Serine	Stop	Stop	A
	Leucine	Serine	Stop	Tryptophan	G
C	Leucine	Proline	Histidine	Arginine	U
	Leucine	Proline	Histidine	Arginine	C
	Leucine	Proline	Glutamine	Arginine	A
	Leucine	Proline	Glutamine	Arginine	G
A	Isoleucine	Threonine	Asparagine	Serine	U
	Isoleucine	Threonine	Asparagine	Serine	C
	Isoleucine	Threonine	Lysine	Arginine	A
	Methionine	Threonine	Lysine	Arginine	G
G	Valine	Alanine	Aspartic Acid	Glycine	U
	Valine	Alanine	Aspartic Acid	Glycine	C
	Valine	Alanine	Glutamic Acid	Glycine	A
	Valine	Alanine	Glutamic Acid	Glycine	G

mRNA Codon Chart

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	Phenylalanine	Serine	Tyrosine	Cysteine	C
	Leucine	Serine	Stop	Stop	A
	Leucine	Serine	Stop	Tryptophan	G
C	Leucine	Proline	Histidine	Arginine	U
	Leucine	Proline	Histidine	Arginine	C
	Leucine	Proline	Glutamine	Arginine	A
	Leucine	Proline	Glutamine	Arginine	G
A	Isoleucine	Threonine	Asparagine	Serine	U
	Isoleucine	Threonine	Asparagine	Serine	C
	Isoleucine	Threonine	Lysine	Arginine	A
	Methionine	Threonine	Lysine	Arginine	G
G	Valine	Alanine	Aspartic Acid	Glycine	U
	Valine	Alanine	Aspartic Acid	Glycine	C
	Valine	Alanine	Glutamic Acid	Glycine	A
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	Phenylalanine	Serine	Tyrosine	Cysteine	C
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	Leucine	Serine	Stop	Tryptophan	G
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	Leucine	Proline	Histidine	Arginine	C
	Leucine	Proline	Glutamine	Arginine	A
	Leucine	Proline	Glutamine	Arginine	G
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	Isoleucine	Threonine	Asparagine	Serine	C
	Isoleucine	Threonine	Lysine	Arginine	A
	Methionine	Threonine	Lysine	Arginine	G
G	Valine	Alanine	Aspartic Acid	Glycine	U
	Valine	Alanine	Aspartic Acid	Glycine	C
	Valine	Alanine	Glutamic Acid	Glycine	A
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	Leucine	Serine	Stop	Tryptophan	G
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	Leucine	Proline	Histidine	Arginine	C
	Leucine	Proline	Glutamine	Arginine	A
	Leucine	Proline	Glutamine	Arginine	G
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	Isoleucine	Threonine	Asparagine	Serine	C
	Isoleucine	Threonine	Lysine	Arginine	A
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	Leucine	Proline	Glutamine	Arginine	A
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	Isoleucine	Threonine	Asparagine	Serine	C
	Isoleucine	Threonine	Lysine	Arginine	A
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	Isoleucine	Threonine	Lysine	Arginine	A
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