



# **PROTEIN SYNTHESIS**

## **Introduction and Overview**

# **Protein Synthesis**

**How DNA directs how proteins are made**



**The variety of  
life on earth is  
due to different  
proteins.**



# Protein Synthesis



**You are different  
from the people  
around you because  
your proteins are  
different.**

# Protein Synthesis



**Your hair, muscles  
fibres in your skin  
are all made of  
proteins.**

# Protein Synthesis



**If you have straight hair, your protein is slightly different to someone who has curly hair**

# Protein Synthesis

- Proteins are made up of units called amino acids
- In our examples we will use a few amino acids to represent a protein
- Proteins are much larger and have more than 50 amino acids

# Protein Synthesis

Proteins are made up of units called amino acids.

Amino acids join together to make proteins.





# Protein Synthesis

Proteins differ from each other by the type (different shapes) and sequence (the order in which the shapes occur) of amino acids.



If this is the protein for straight hair



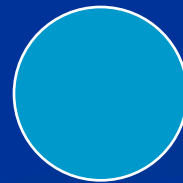
A single amino acid change results in curly hair

# Protein Synthesis

The proteins are different because the DNA for curly and straight hair is different.

There is a **THREE** letter DNA code (codon) for each amino acid.

Eg. TGG codes for



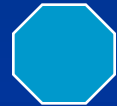
# Protein Synthesis

**In this example:**

**TAC** codes for a



**AGC** codes for a



**AAA** codes for a



**GGT** codes for a



**The code for this amino acid sequence is :**



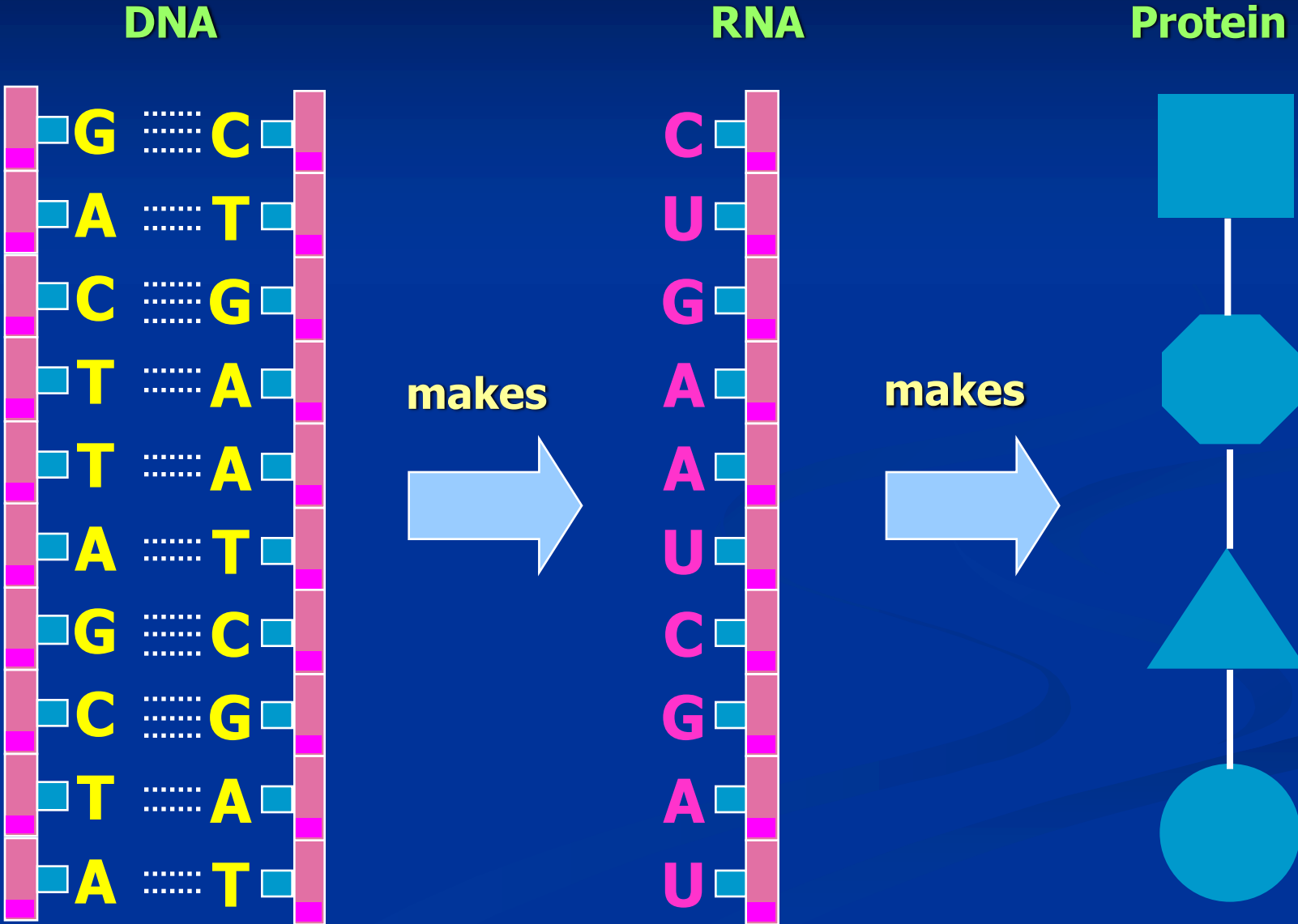
**AAA GGT GGT**

**What is the DNA code for this sequence?**



**TAC AGC GGT**

# Protein Synthesis: Overview of the Process



# DNA vs. RNA

## DNA

- deoxyribose sugar
- nitrogen bases
  - G, C, A, T
  - T : A
  - C : G
- double stranded



DNA

## RNA

- ribose sugar
- nitrogen bases
  - G, C, A, U
  - U : A
  - C : G
- single stranded



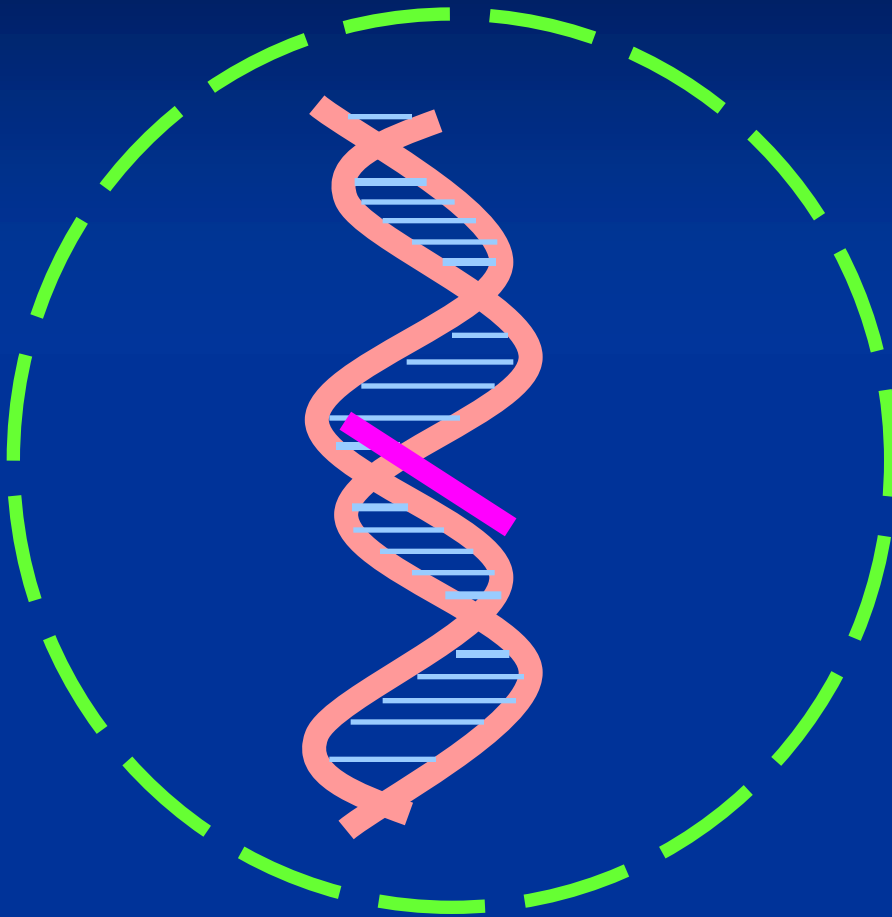
RNA

# Comparing RNA & DNA

The roles played by DNA and RNA are similar to the master plans and blueprints used by builders.

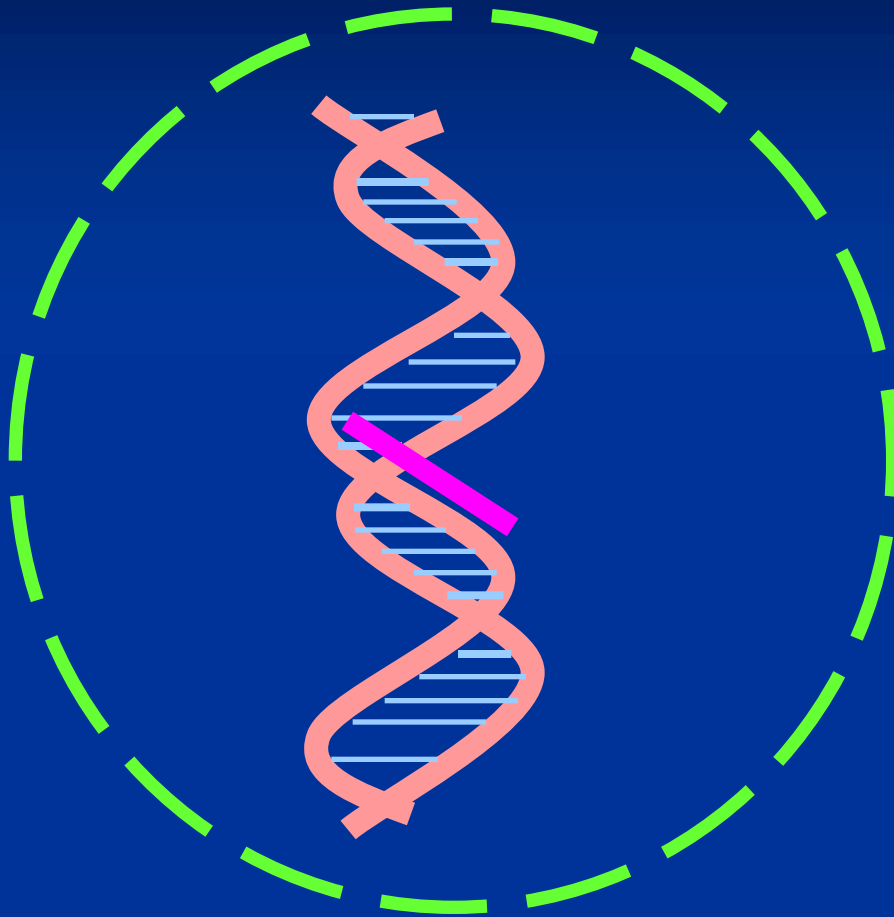


# Protein Synthesis: A closer look



Firstly, part of the  
DNA is copied into  
messenger RNA  
(mRNA)  
This is called  
**TRANSCRIPTION**

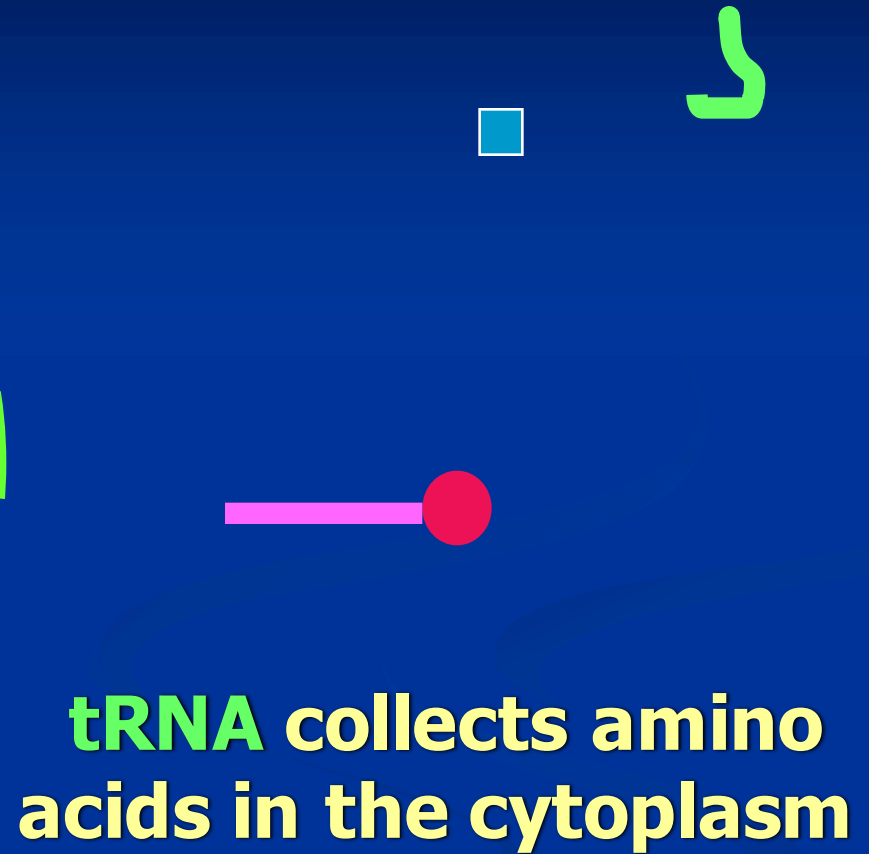
# Protein Synthesis: A closer look



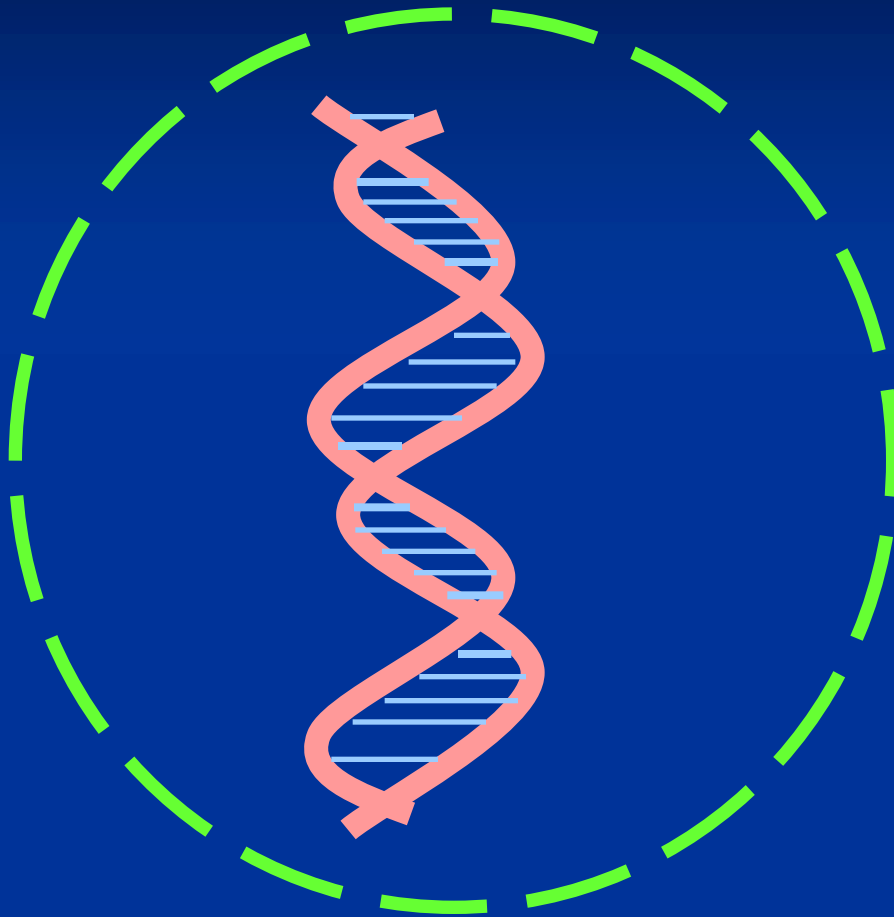
●  
The **mRNA** carries the message to make the protein to the cytoplasm and attaches to the ribosome



# Protein Synthesis: A closer look



# Protein Synthesis: A closer look



**TRANSLATION: tRNA**  
brings amino acids to  
the ribosome which  
link and form proteins

# **Protein Synthesis**

## **The Detailed Process**

# **TRANSCRIPTION**

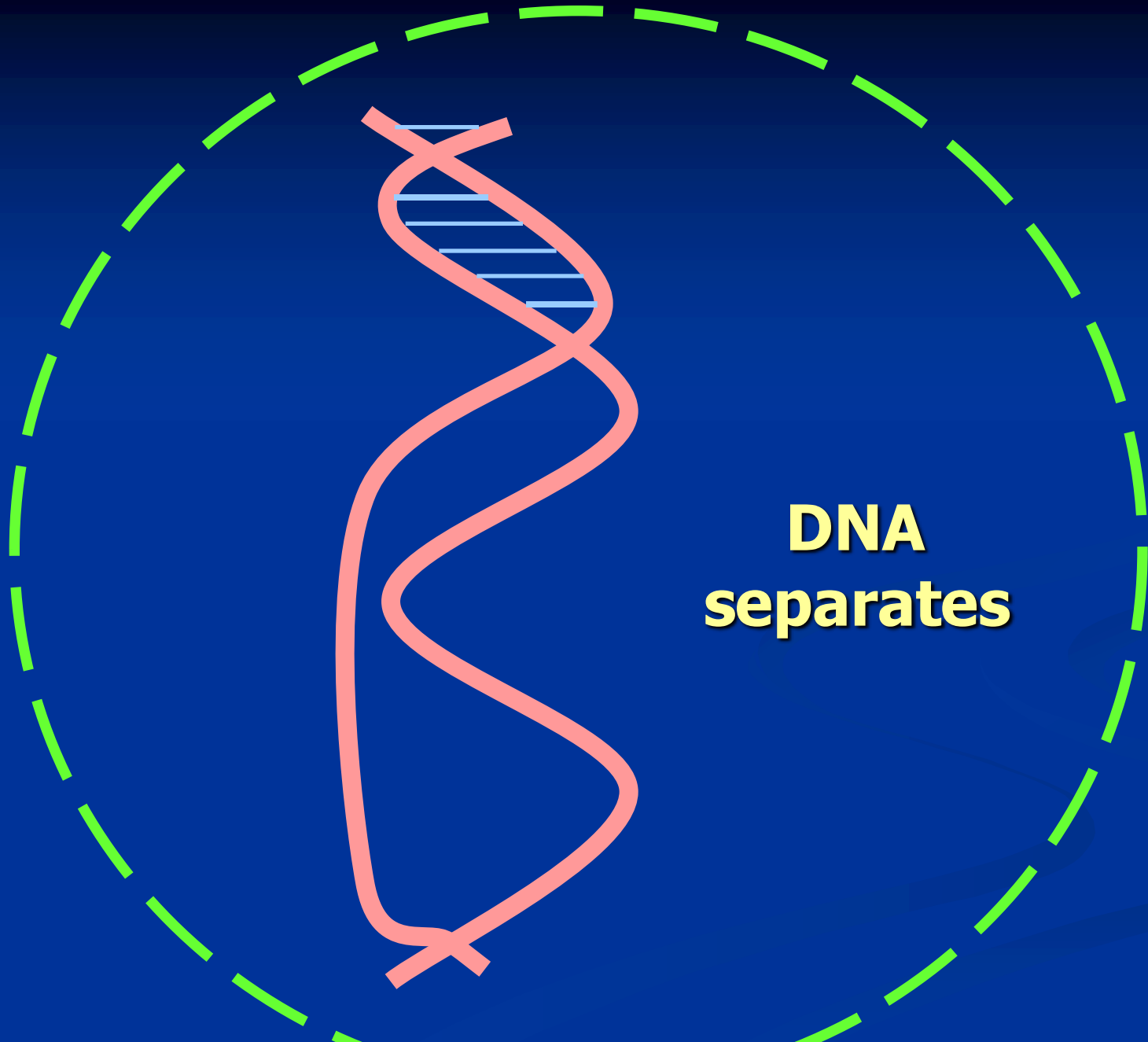
**A piece of DNA that codes for a protein is copied into mRNA**

**T  
R  
A  
N  
S  
C  
R  
I  
P  
T  
I  
O  
N**

**Part of the  
DNA  
molecule is  
unzipped by  
an enzyme**

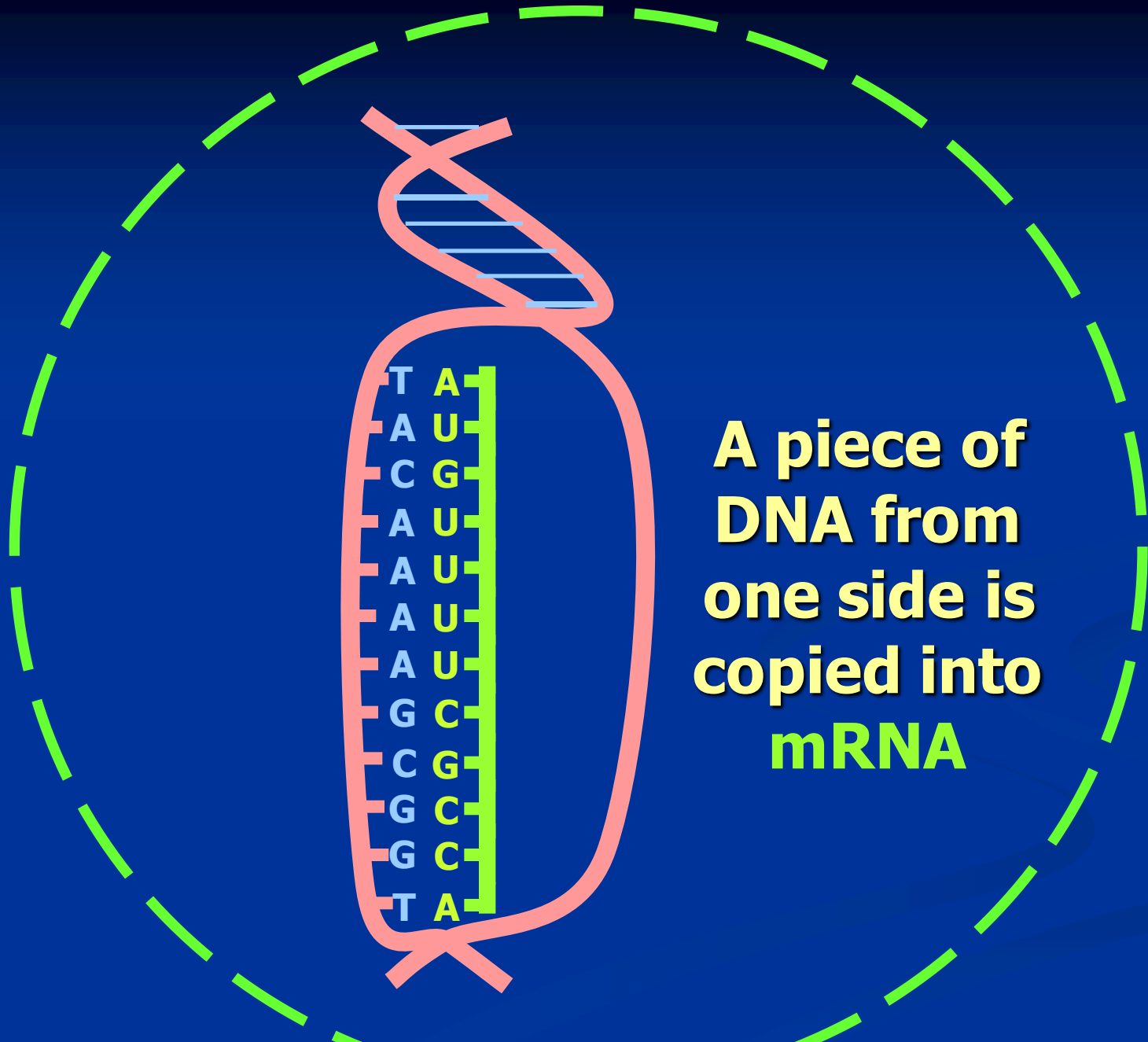


**T  
R  
A  
N  
S  
C  
R  
I  
P  
T  
I  
O  
N**



**DNA  
separates**

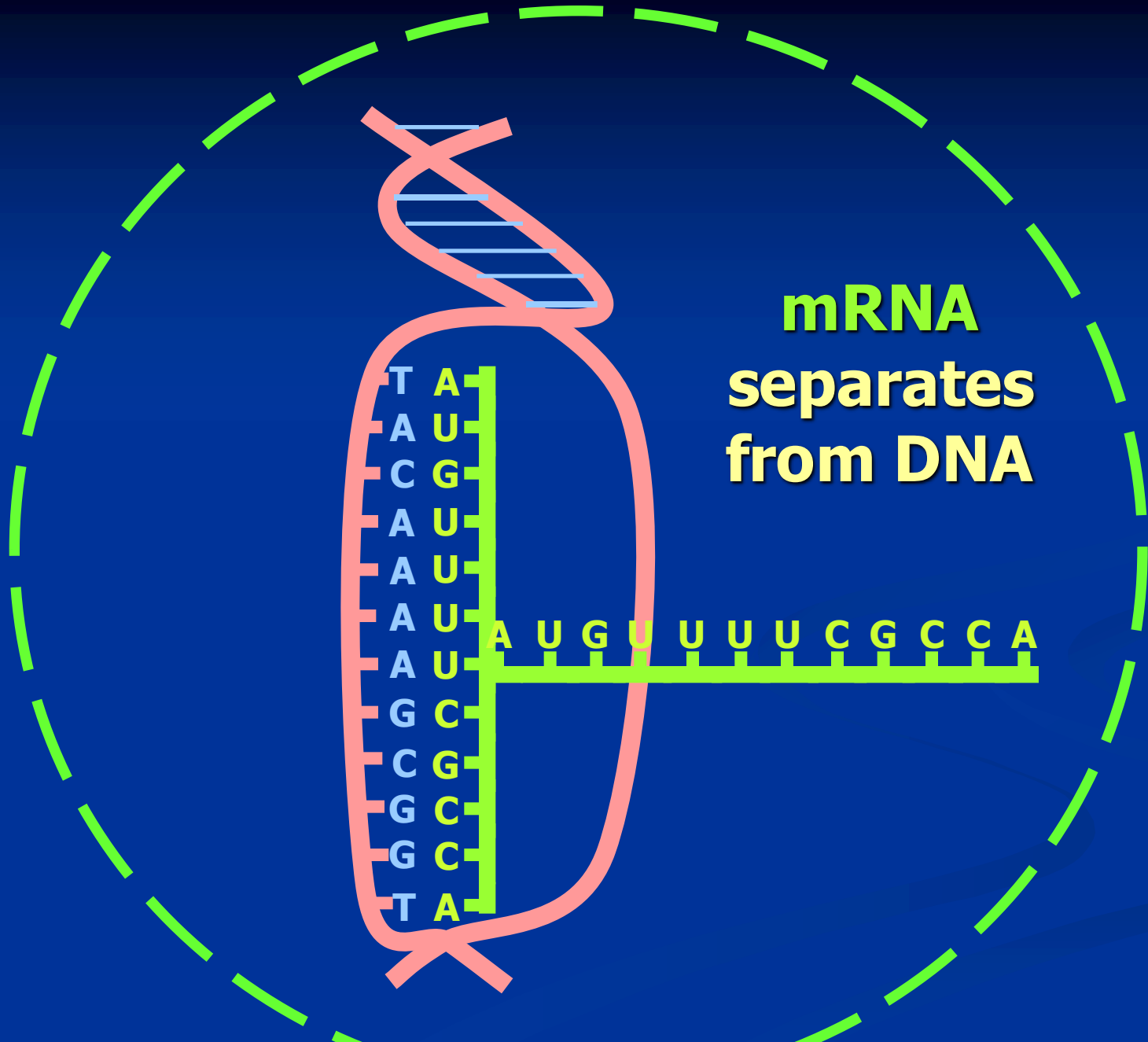
**T  
R  
A  
N  
S  
C  
R  
I  
P  
T  
I  
O  
N**



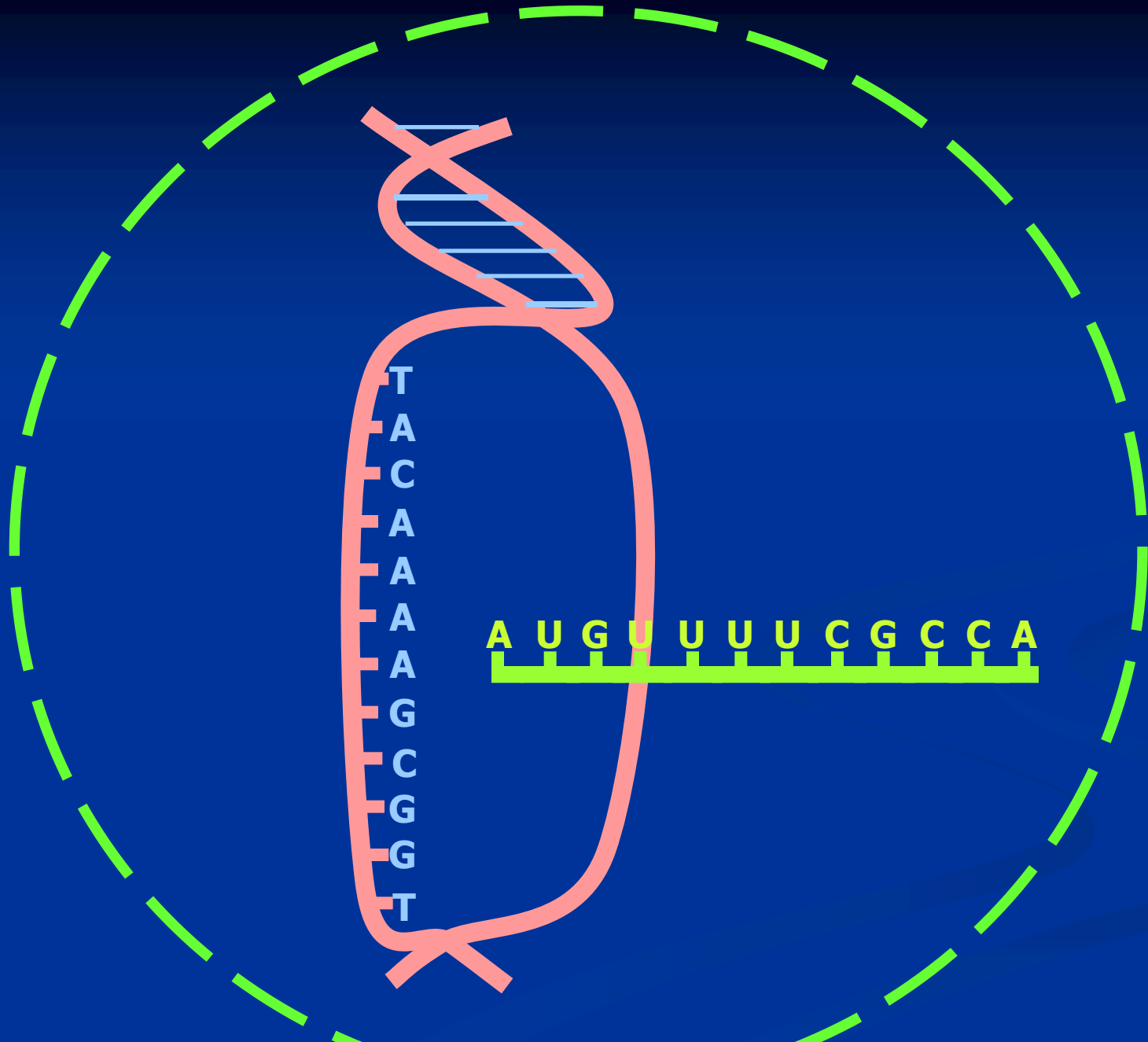
**A piece of DNA from one side is copied into mRNA**

**T  
R  
A  
N  
S  
C  
R  
I  
P  
T  
I  
O  
N**

**mRNA  
separates  
from DNA**



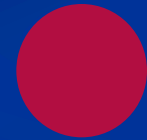
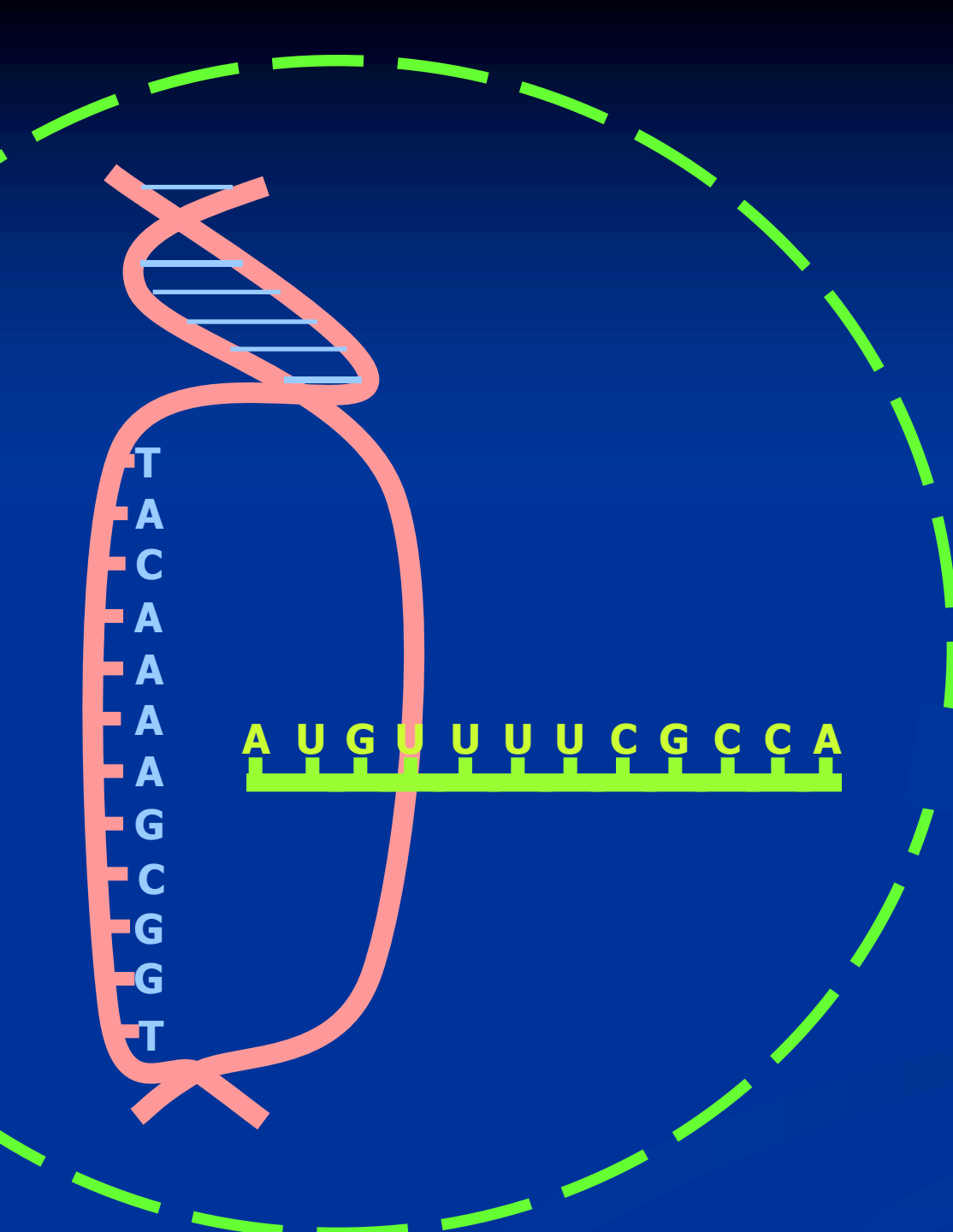




T  
A  
C  
A  
A  
A  
A  
G  
C  
G  
G  
T

A U G U U U C G C C A

**mRNA moves  
out of the  
nucleus to a  
ribosome in  
the cytoplasm**



**ribosome**

# mRNA attaches to a ribosome

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



The diagram shows a single-stranded mRNA molecule represented by a horizontal yellow line. Above the line, the nucleotide sequence G C C A A U G U U U U C G C C A is written in yellow capital letters. A large red circle is superimposed over the mRNA, centered on the start codon AUG. The circle overlaps the 'A' of the fourth codon (AUG) and the 'U' of the fifth codon (UUU). The background is a solid blue color.

# **TRANSLATION**

**The ribosome encodes  
mRNA to form a new  
protein**

**tRNA brings a specific amino acid which links mRNA**

**Amino Acid**

**tRNA**



**U A C**

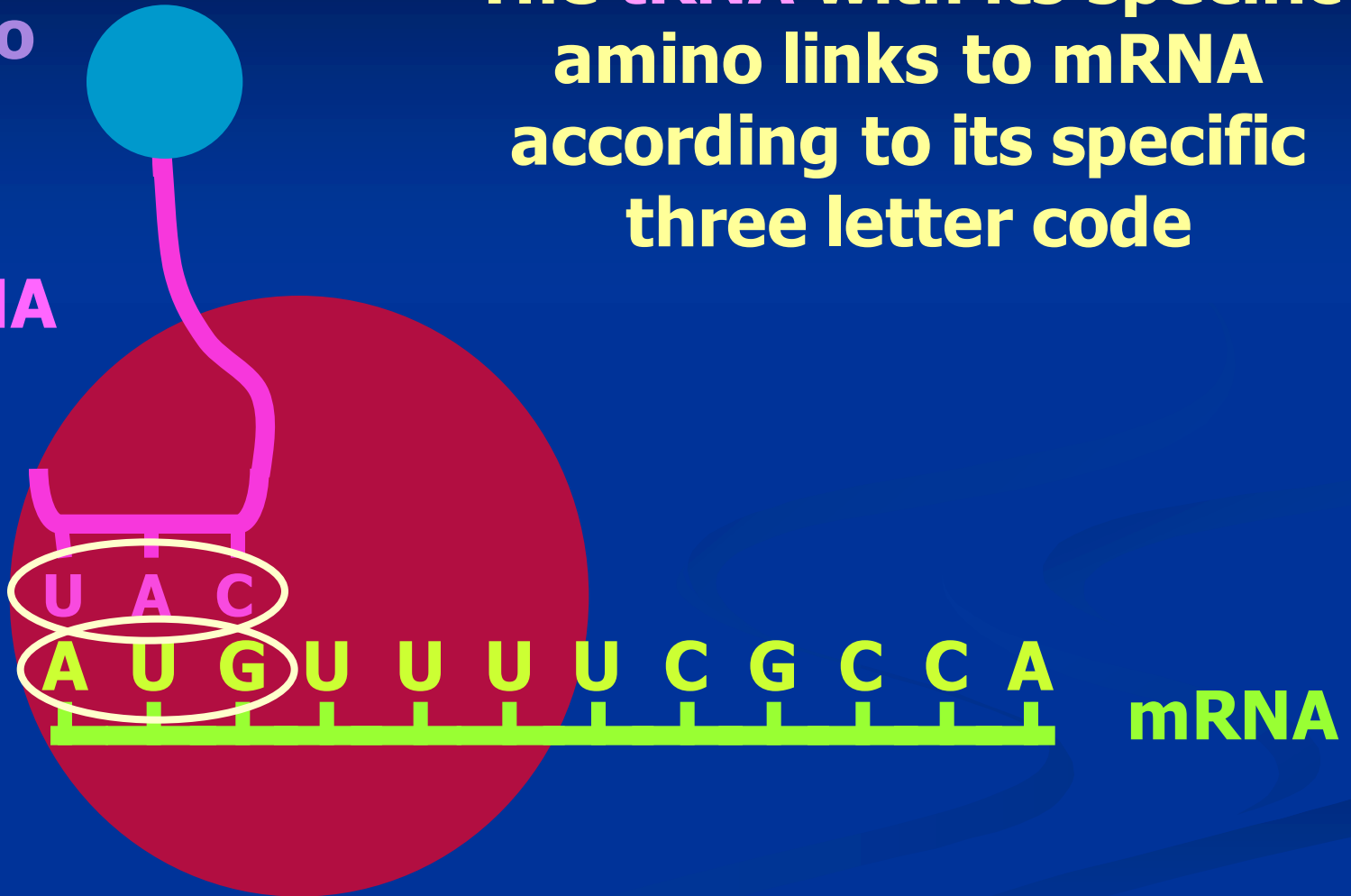
**A U G U U U U C G C C A**

**mRNA**

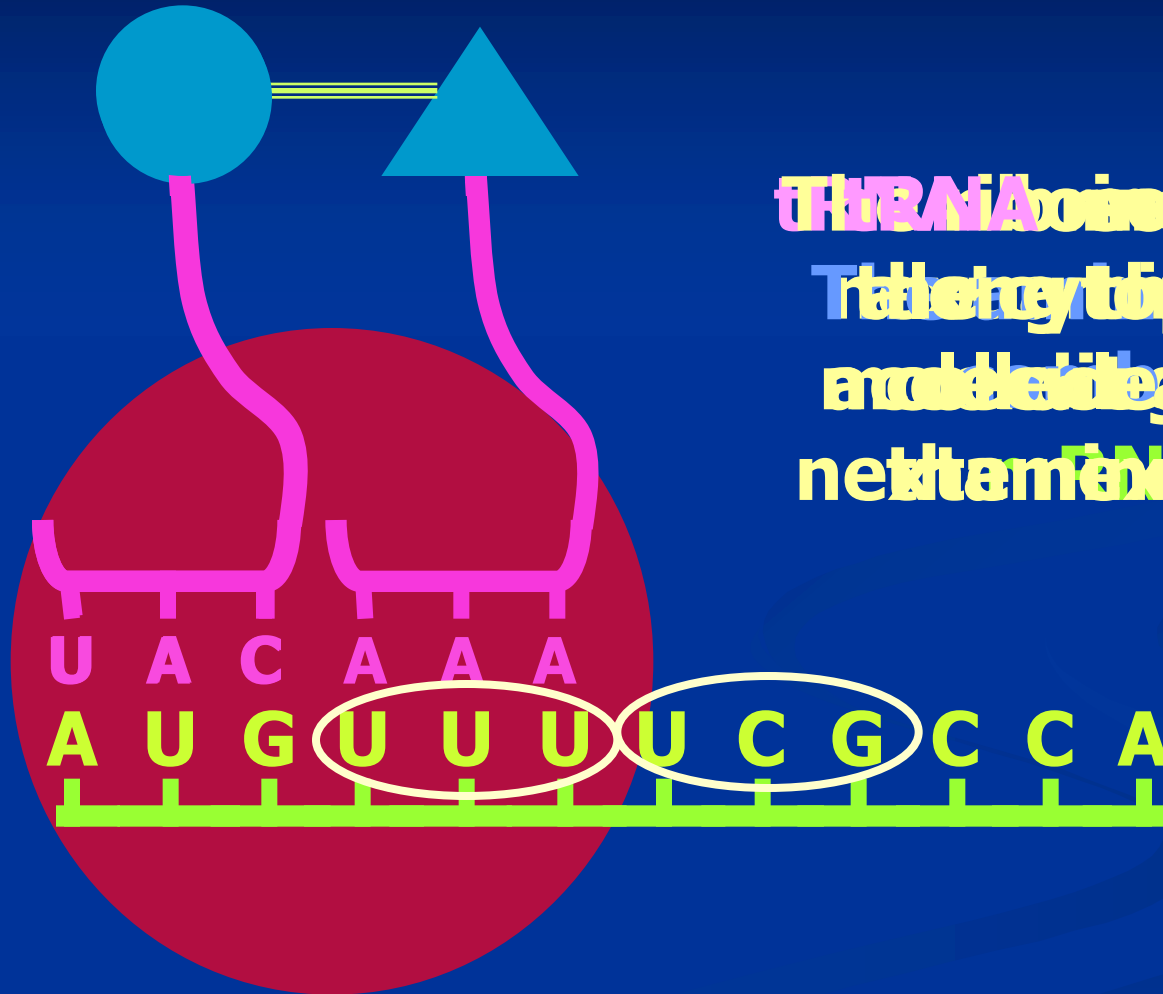
The tRNA with its specific amino links to mRNA according to its specific three letter code

Amino Acid

tRNA

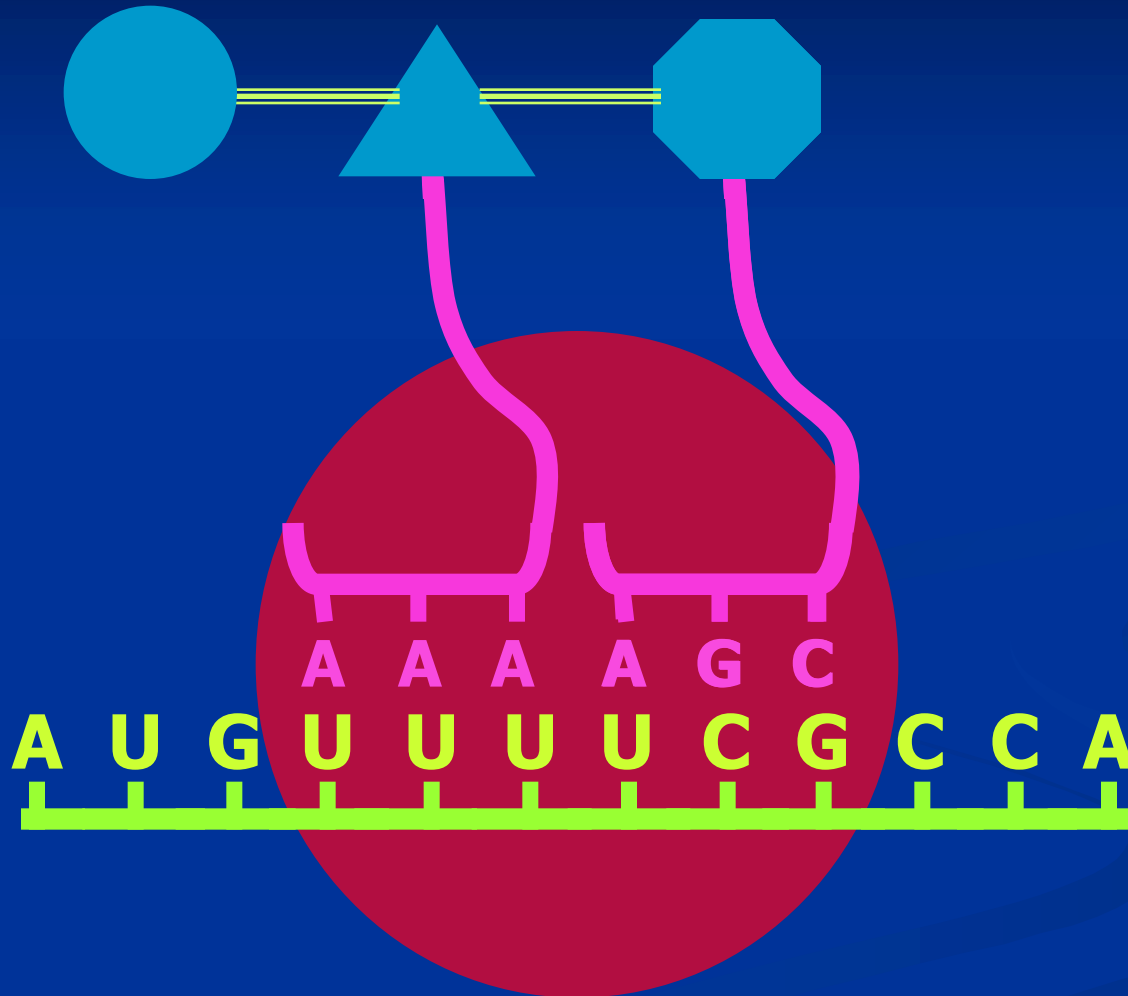


Corresponding tRNA code (anticodon)



The tRNA brings amino acids  
 to the ribosome to  
 assemble the growing  
 polypeptide chain

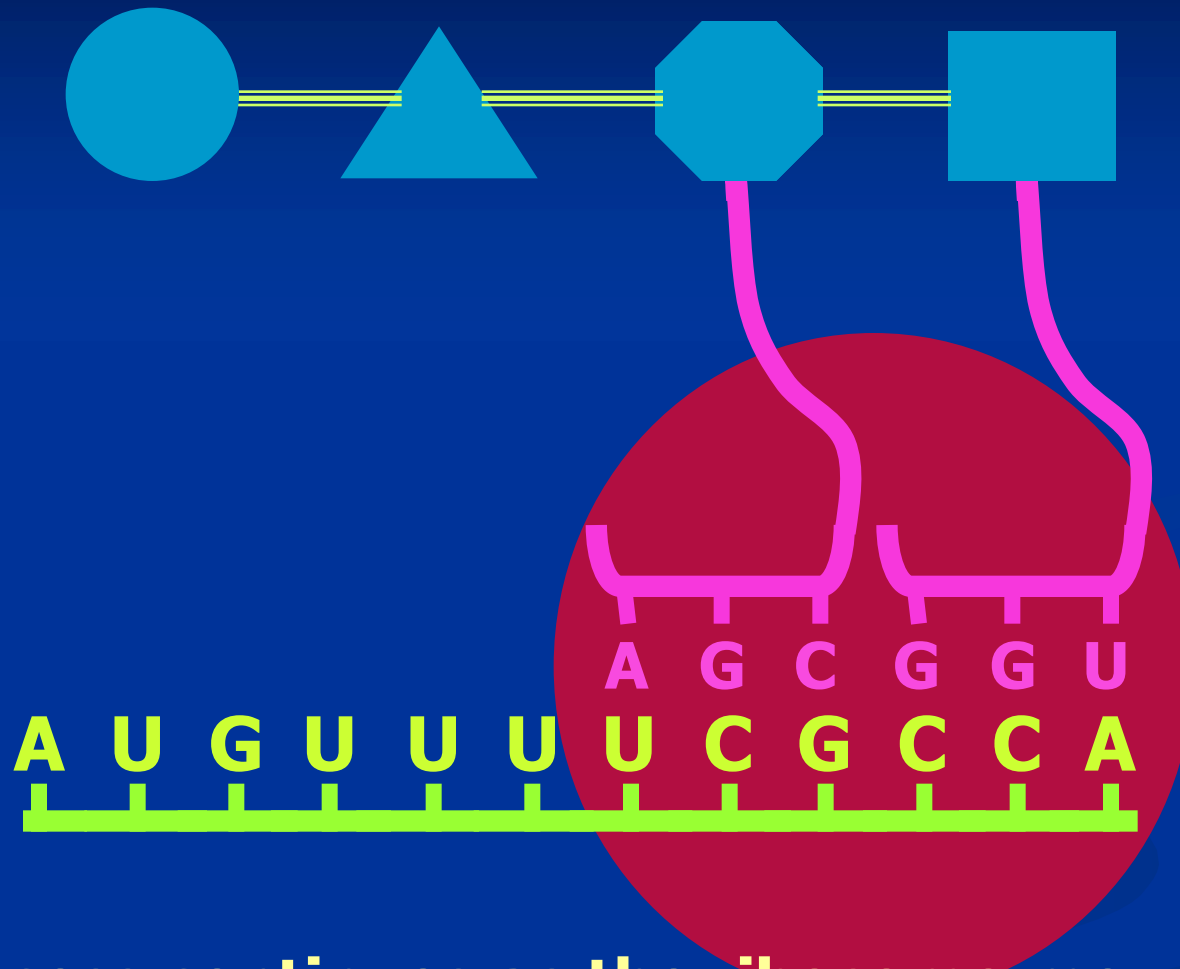
**tRNAs bring in another amino acids to extend the protein chain**



**The process continues as the ribosome moves along mRNA exposing the next codon**

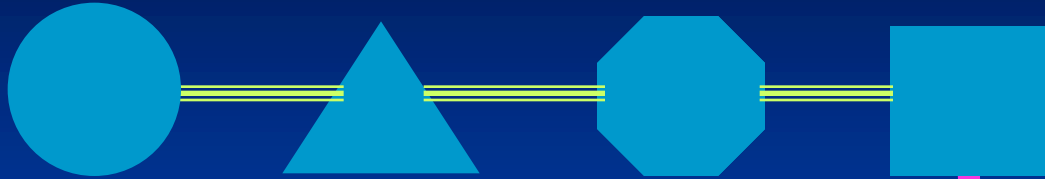


**tRNAs bring in another amino acids to extend the protein chain**



**The process continues as the ribosome moves along mRNA exposing the next codon**

# TERMINATION: Ribosome and mRNA separate



**NEW "Protein" is formed**



# In Summary ...

**DNA**

T A C | A A A | A G C | G G T

**makes**

**RNA**

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

**makes**

**Protein**

