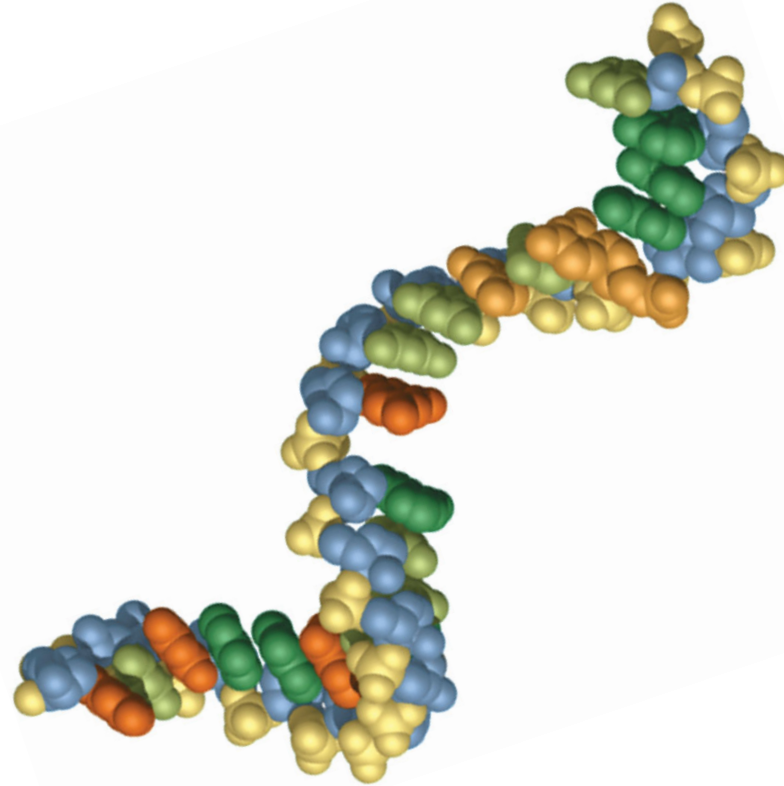


THE STRUCTURE OF THE GENETIC MATERIAL



Which of the following is listed correctly in order of increasing size? (smallest to largest)

A. chromosome < nucleotide < gene

B. gene < chromosome < nucleotide

C. gene < nucleotide < chromosome

D. nucleotide < gene < chromosome

Which of the following is listed correctly in order of increasing size? (i.e., smallest to largest)

A. chromosome < nucleotide < gene

B. gene < chromosome < nucleotide

C. gene < nucleotide < chromosome

D. nucleotide < gene < chromosome

**Draw A DNA Monomer
with as much detail as
possible.**

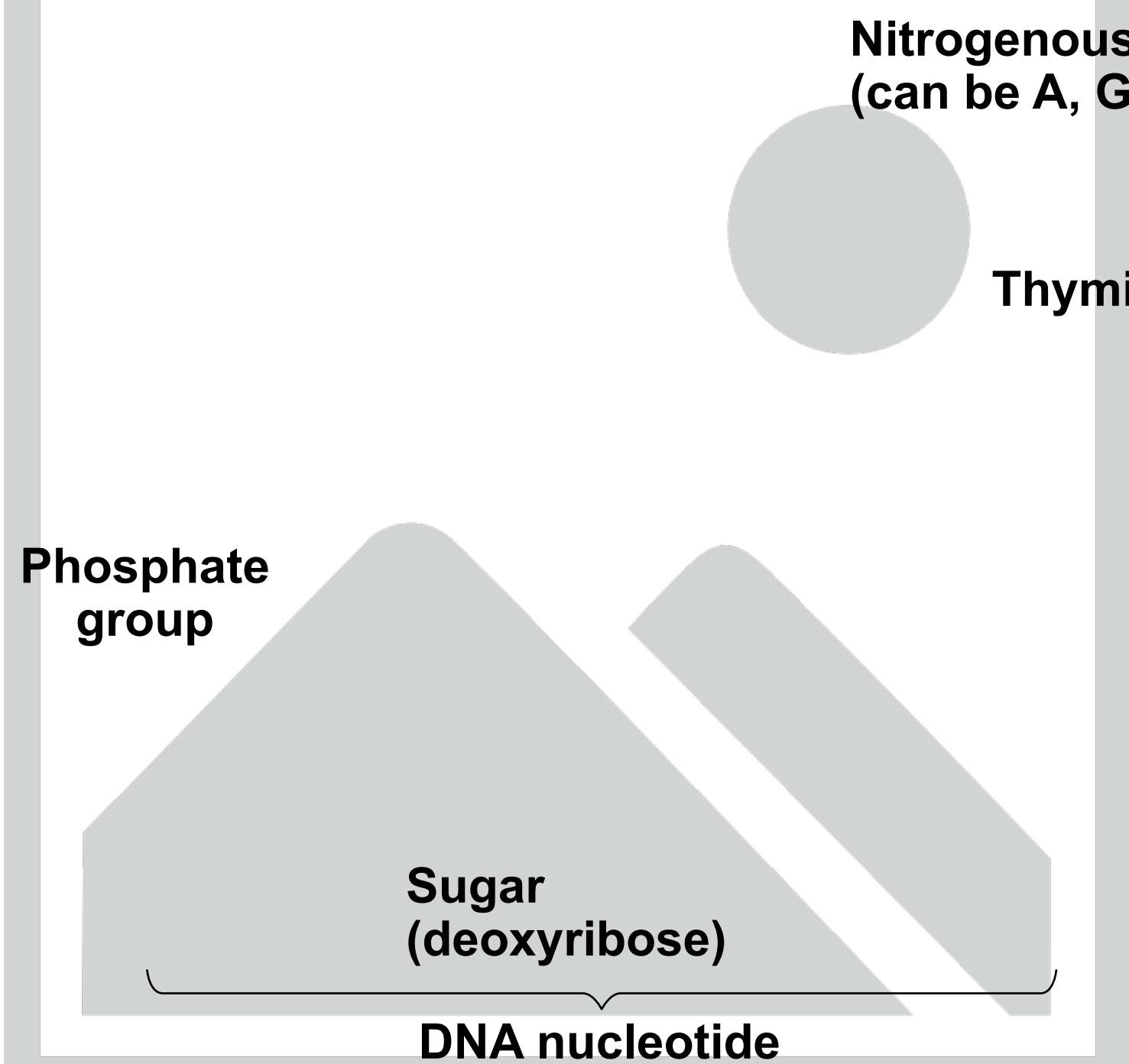
**Nitrogenous base
(can be A, G, C, or T)**

Thymine (T)

**Phosphate
group**

**Sugar
(deoxyribose)**

DNA nucleotide



1. The monomers of DNA and RNA are

- A) monosaccharaides.
 - B) nucleotides.
 - C) fatty acids.
 - D) nucleic acids.
-

2. Which of the following statements regarding DNA is *false*?

- A) DNA uses five different nitrogenous bases.
 - B) DNA uses the sugar deoxyribose.
 - C) One DNA molecule can include four different nucleotides in its structure.
 - D) DNA molecules have a sugar-phosphate backbone.
-

3. DNA differs from RNA because DNA

- A) contains the nitrogenous base thymine in place of uracil.
 - B) consists of a single rather than a double polynucleotide strand.
 - C) contains phosphate groups not found in RNA.
-

4. Which of the following statements regarding nucleotides is *false*?

- A) Nucleotides contain lipids.
- B) Nucleotides contain sugar molecules.
- C) Nucleotides can be linked together to form nucleic acids.
- D) Nucleotides contain nitrogenous bases.

ANSWER ON SOCRATIVE

1. The monomers of DNA and RNA are

A) monosaccharaides.

B) nucleotides.

C) fatty acids.

D) nucleic acids.

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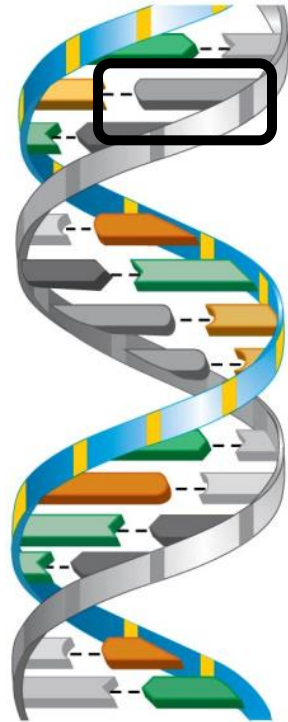
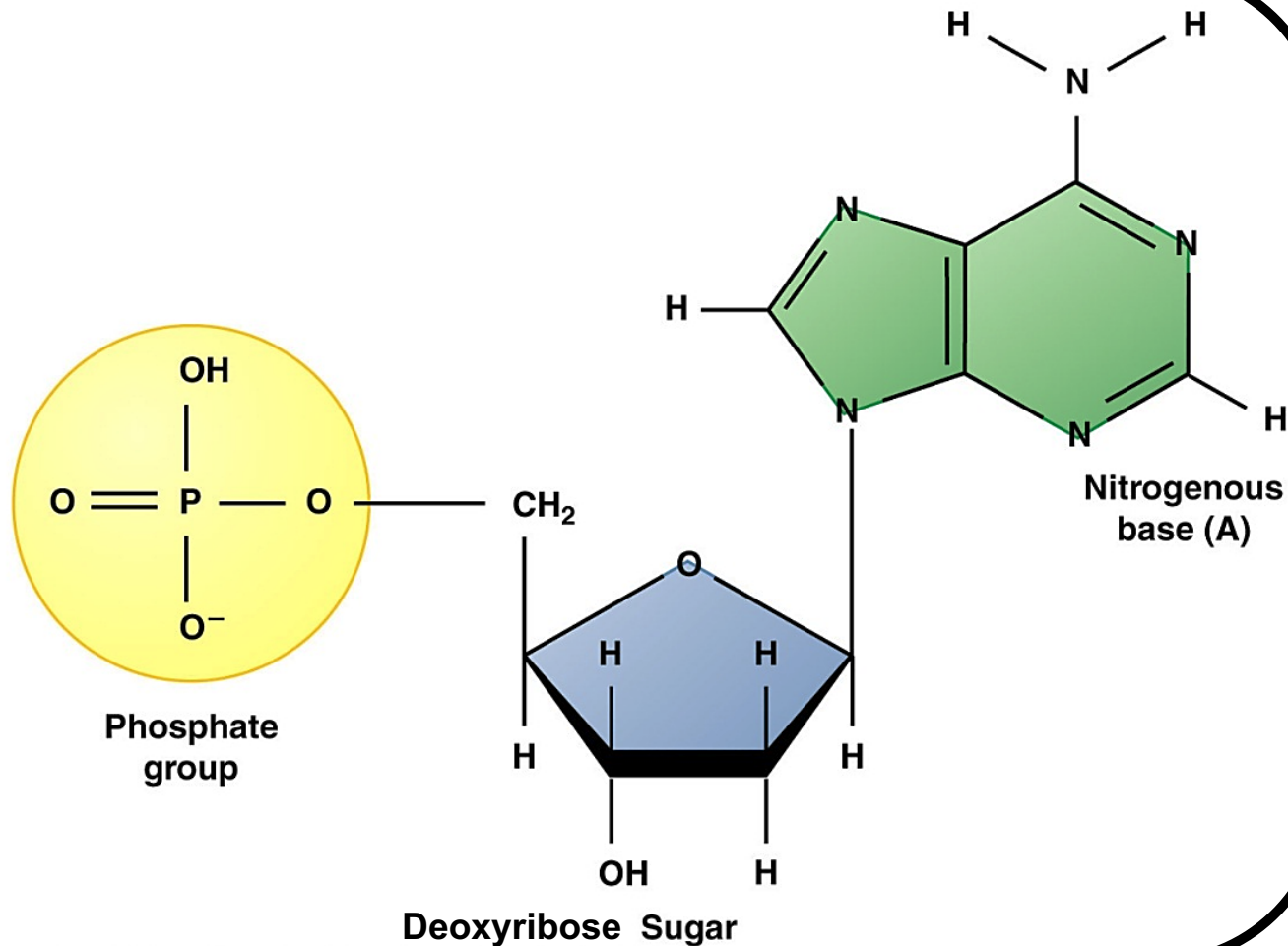
C) Nucleotides can be linked together to form nucleic acids.

D) Nucleotides contain nitrogenous bases.

FUNCTION: DNA is the genetic material

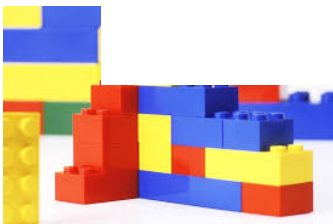
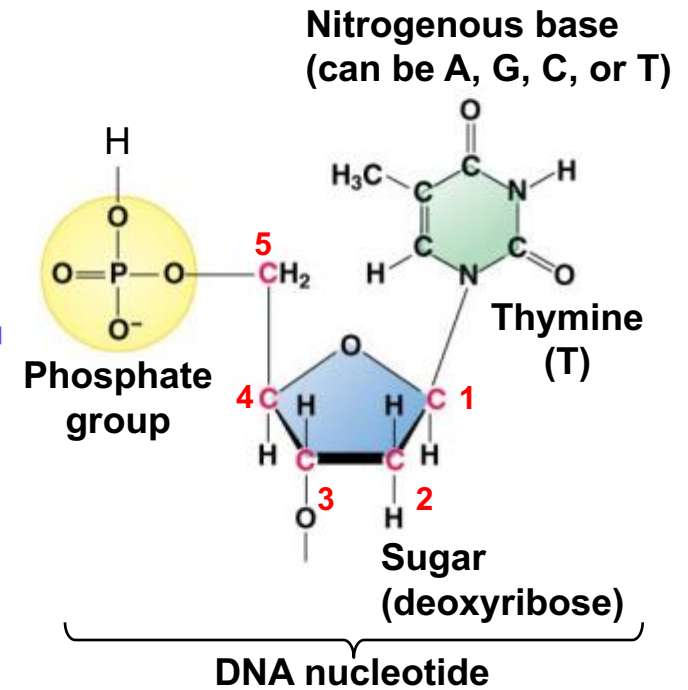
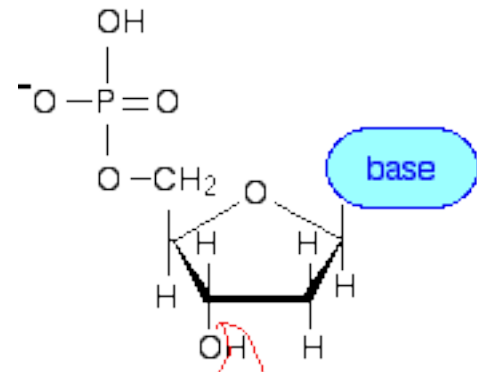
What is its **STRUCTURE**?

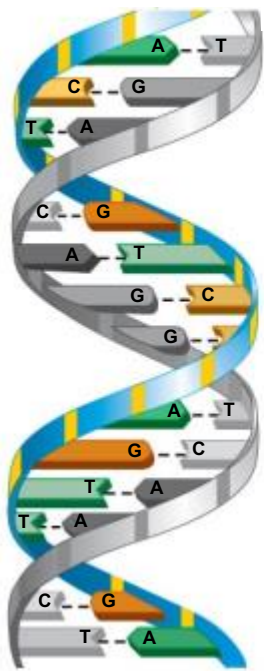
Nucleotide = monomers of Nucleic acids



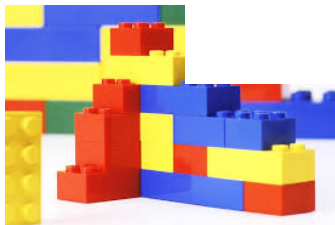
Nucleotide = Phosphate Group + Sugar + Nitrogenous base

DNA structure

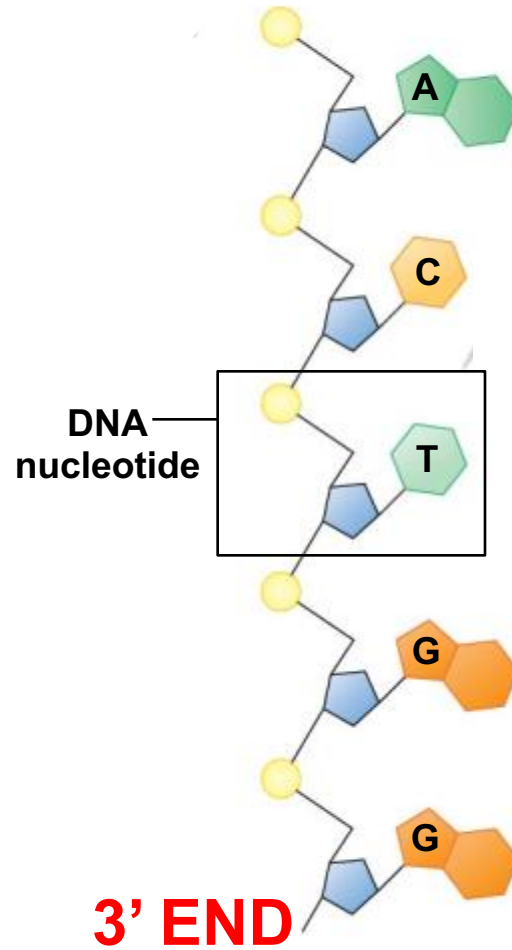




A DNA double helix



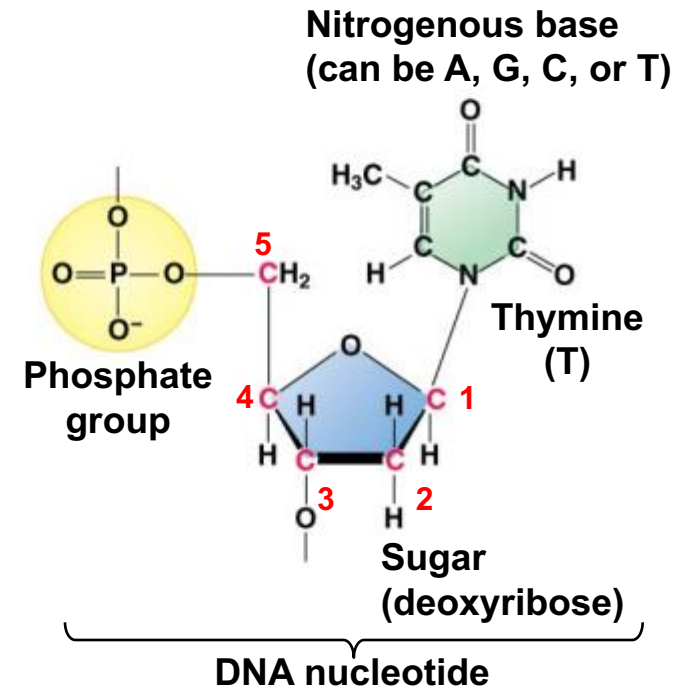
5' END



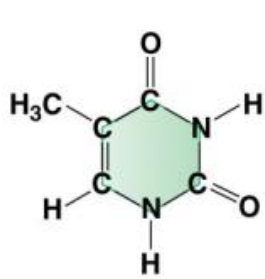
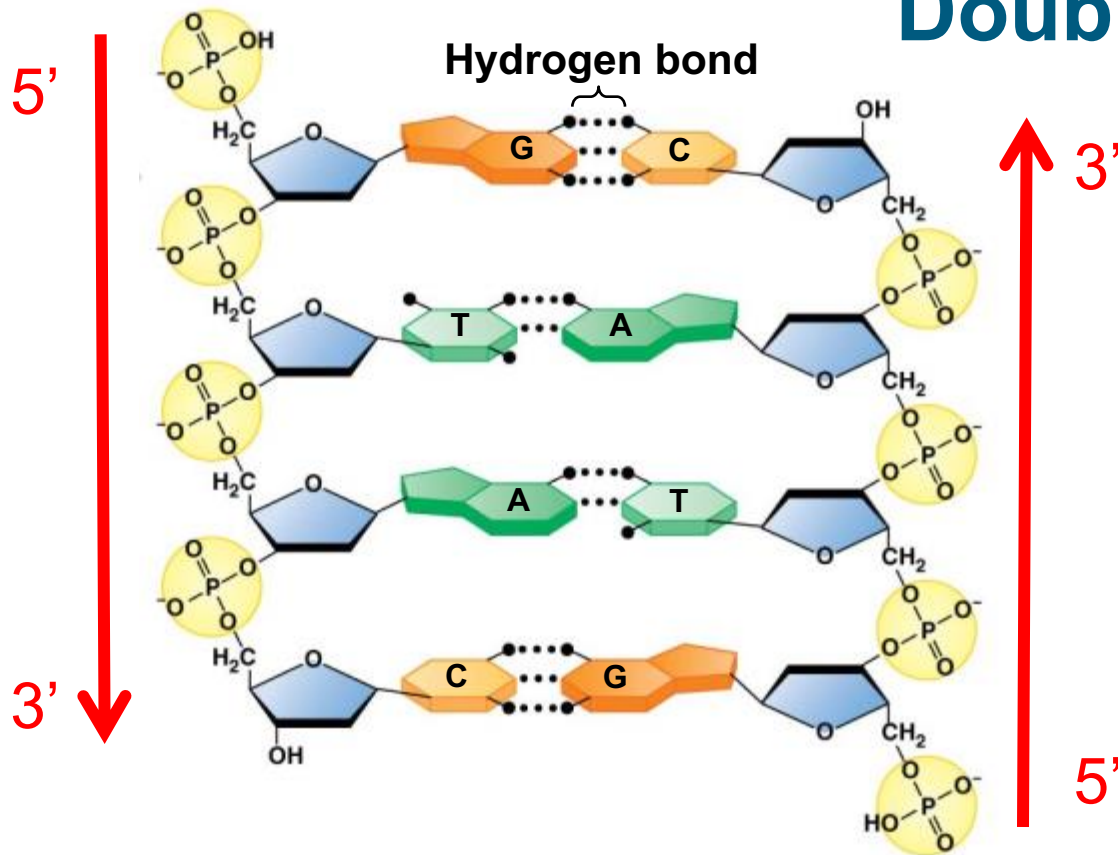
3' END

One strand

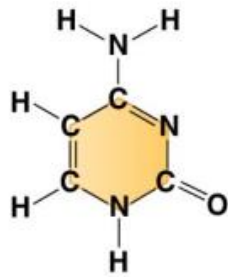
DNA structure



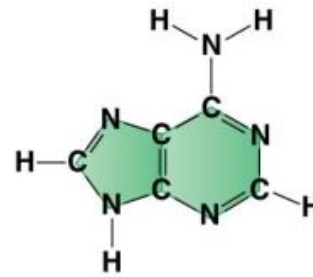
Double-stranded DNA



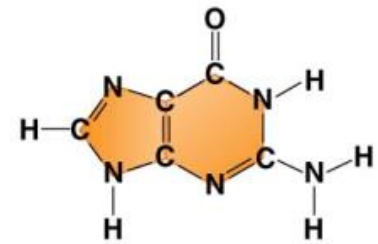
Thymine (T)



Cytosine (C)



Adenine (A)



Guanine (G)

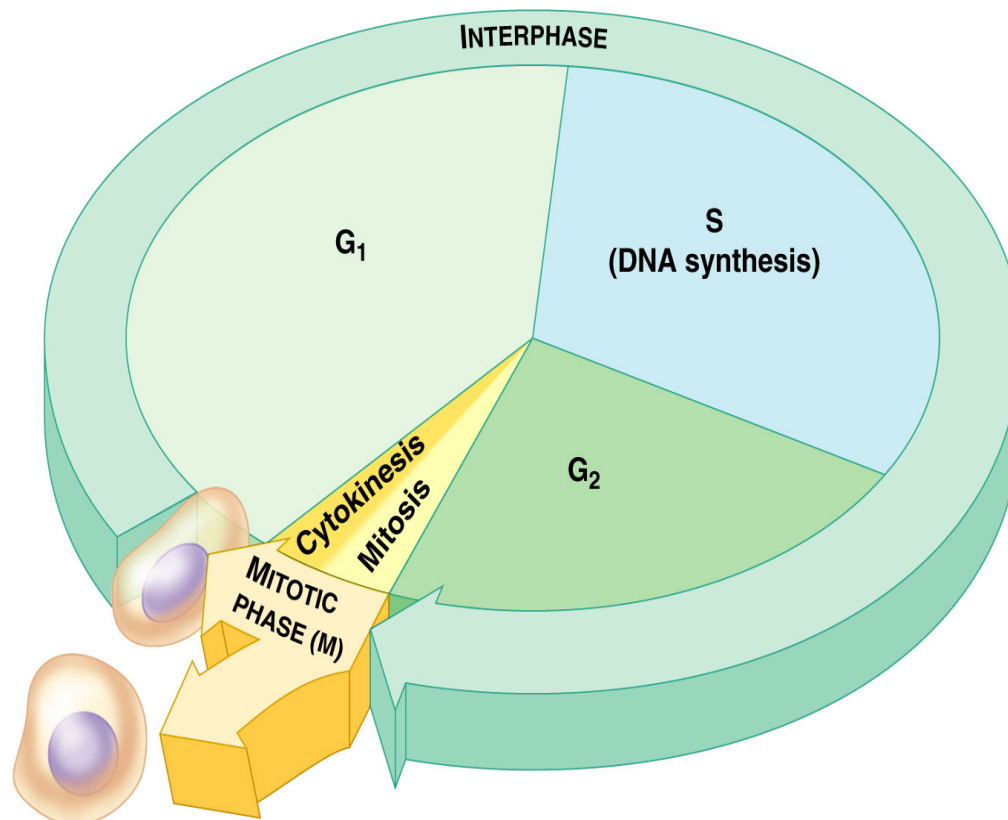
Pyrimidines

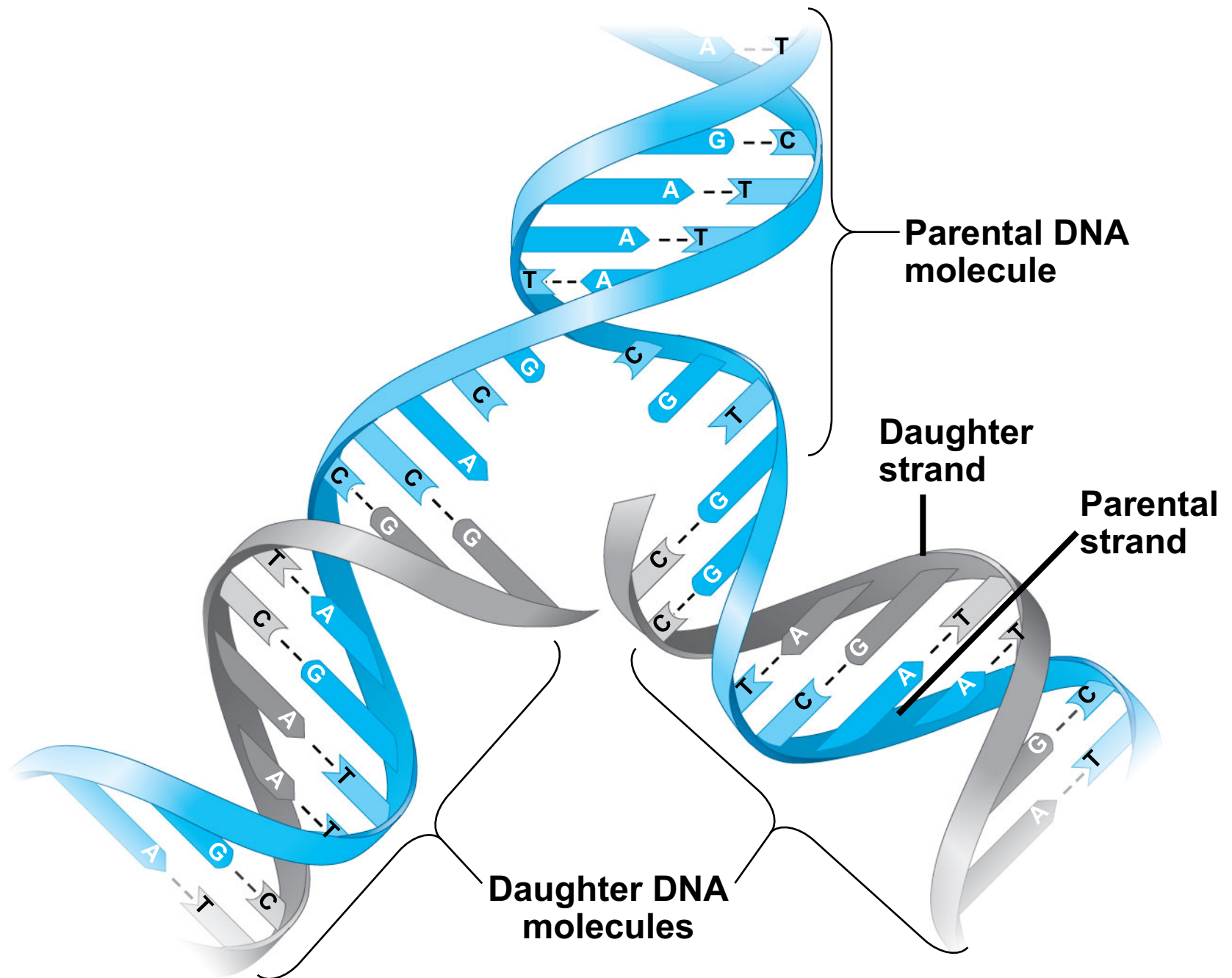
Purines

Now we know what DNA is made of. Take a minute and answer the following question.

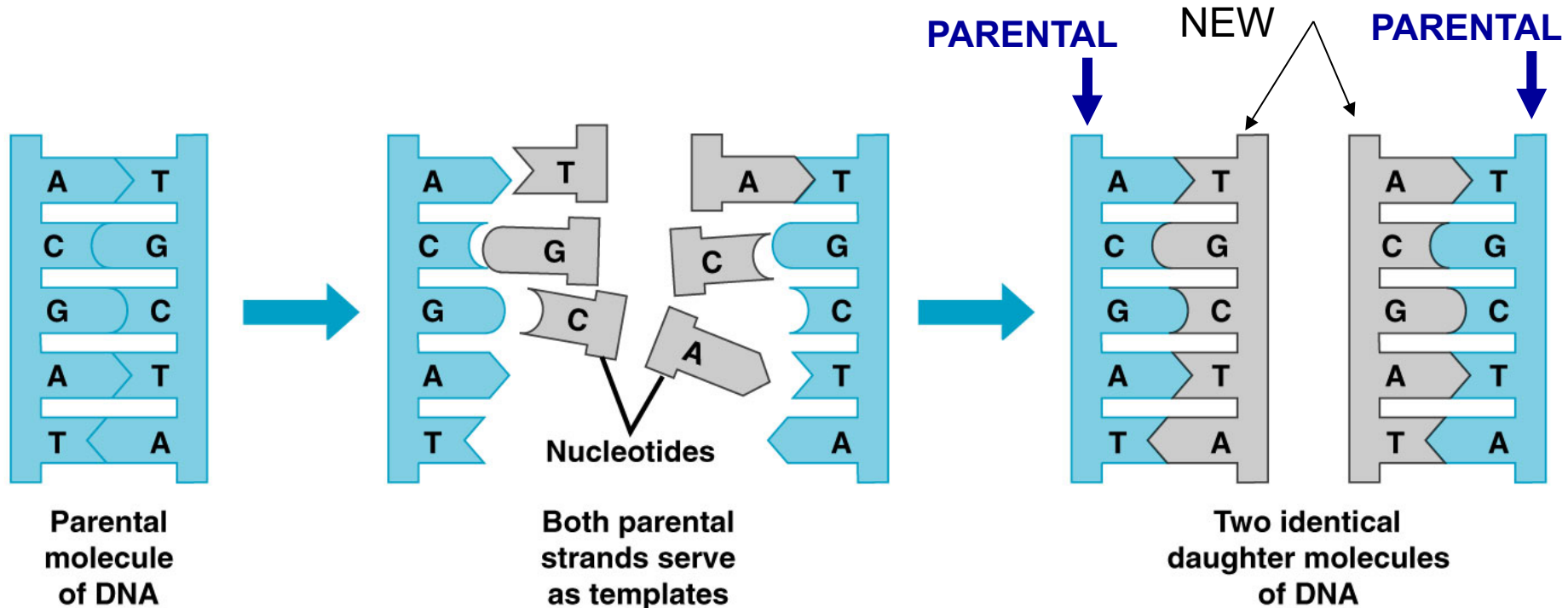
- When does DNA replicate? (1 minute)
- Discuss your answer with your neighbors (2 minutes)

DNA REPLICATION





DNA replication is Semiconservative



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Each strand is used as a template to produce a complementary strand

Each new DNA helix has one old strand with one new strand

When DNA molecule is replicated to make two Daughter DNA molecules, the Daughter DNA contains

- A) none of the parent DNA.
- B) 50% of the parent DNA.
- C) 75% of the parent DNA.
- D) 100% of the parent DNA

When DNA molecule is replicated to make two Daughter DNA molecules, the Daughter DNA contains

A) none of the parent DNA.

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Practice – Do on the worksheet

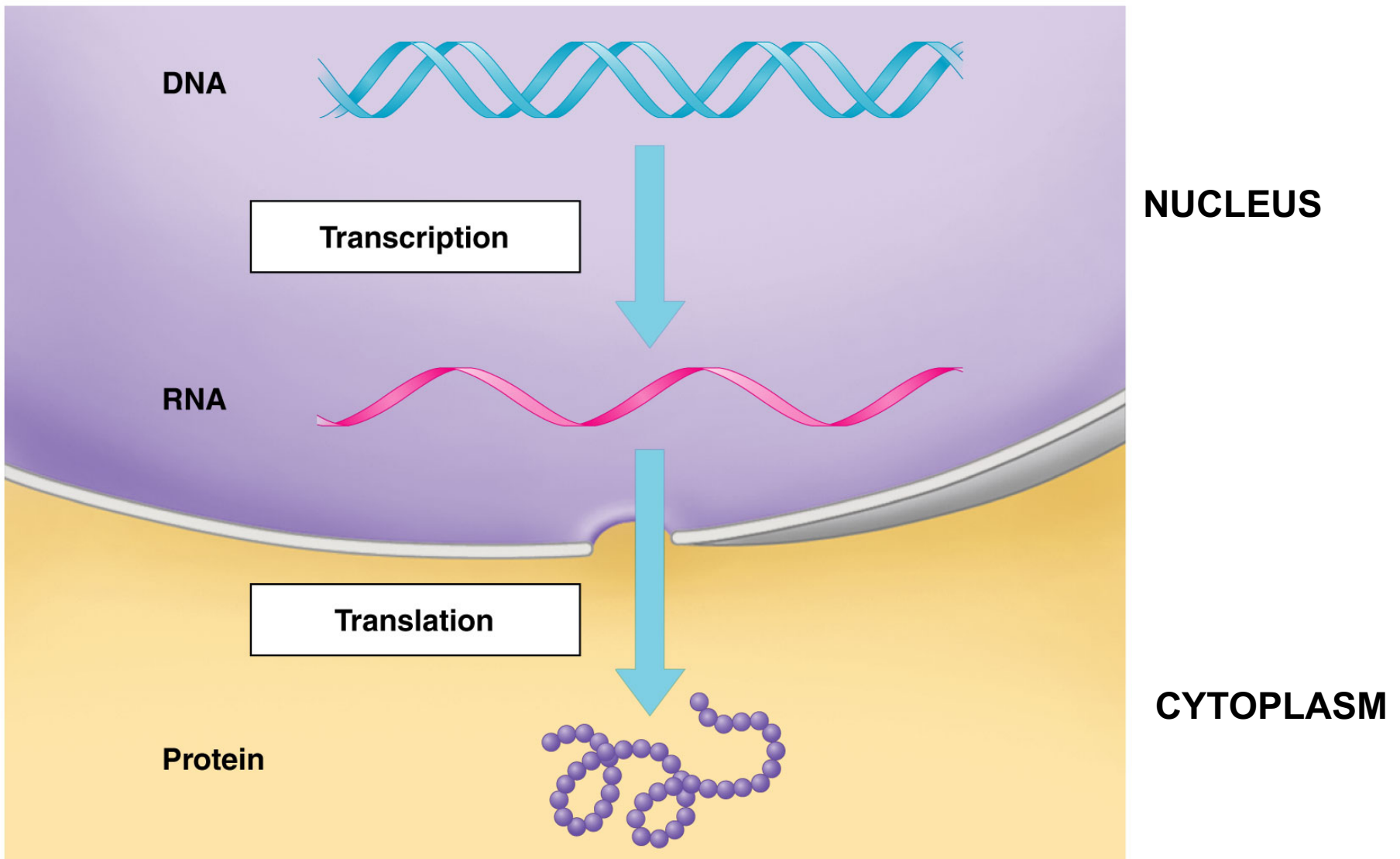
- One strand of the parent DNA molecule:

5' ATTCGGTTACCG 3'

What is the sequence of the complementary strand?

3' TAAGCCAATGGC 5'

Central Dogma of Molecular Biology



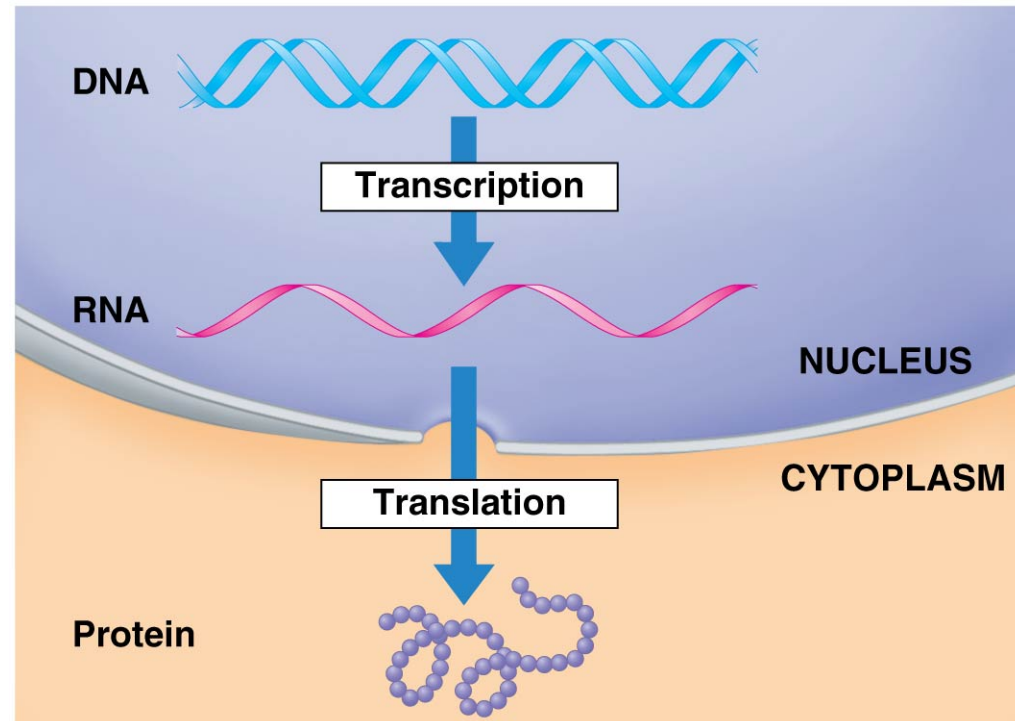
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DNA provides the instructions for the synthesis of proteins

Question:

While studying Mendelian genetics, you learned the terms *genotype* and *phenotype*. The figure diagrams the flow of genetic information in a eukaryote. Which of the following are the molecular-level equivalents of genotype and phenotype?

- | | <u>Genotype</u> | <u>Phenotype</u> |
|----|-----------------|------------------|
| a) | transcription | translation |
| b) | DNA | RNA |
| c) | DNA | protein |
| d) | RNA | protein |

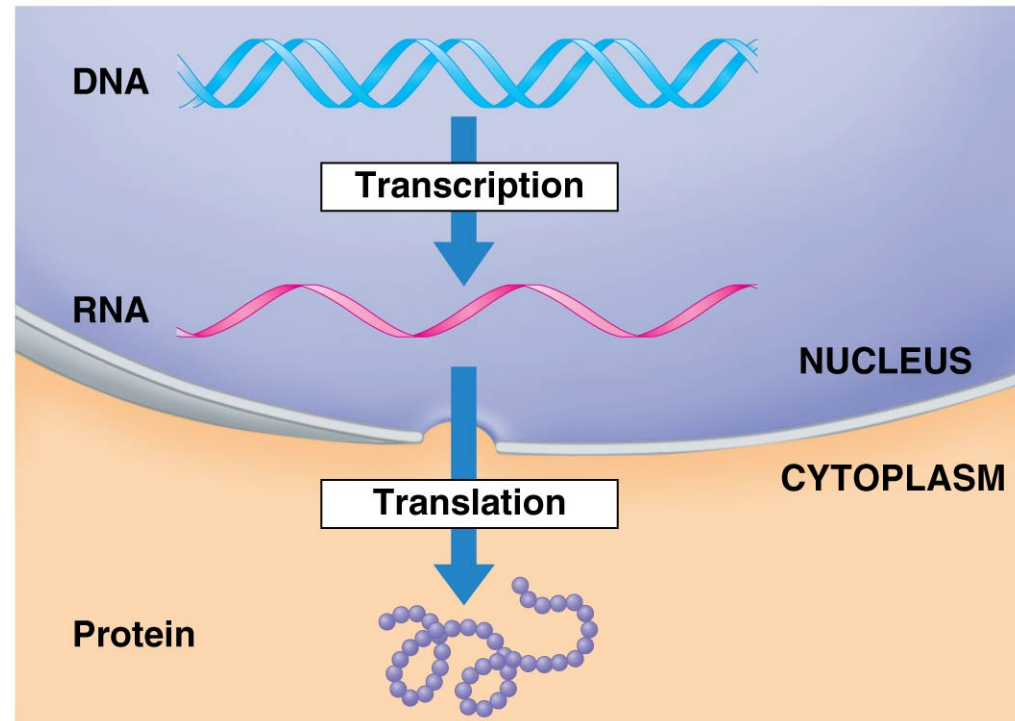


SOCRATIVE

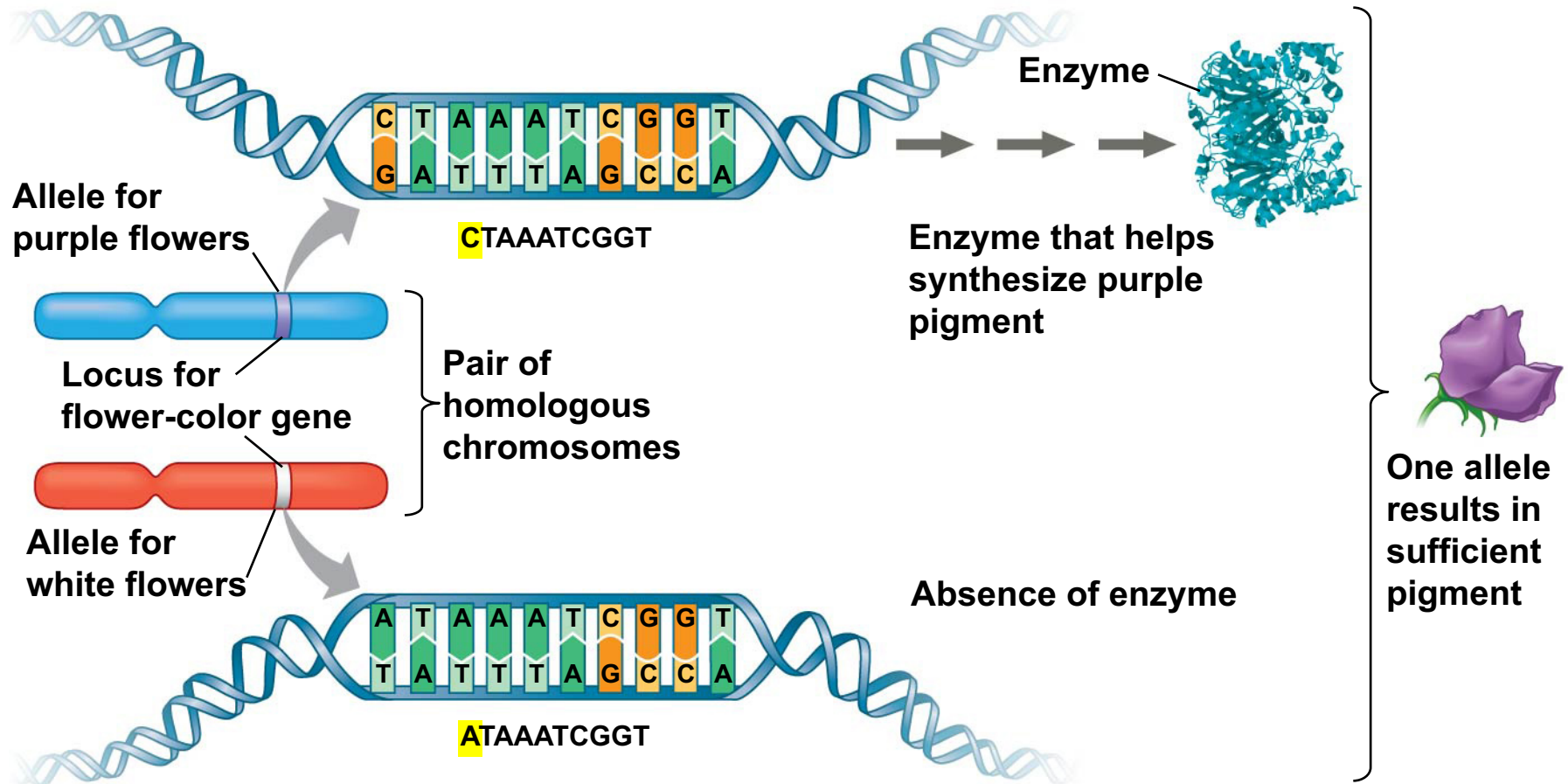
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|----|-----------------|------------------|
| a) | transcription | translation |
| b) | DNA | RNA |
| c) | DNA | protein |
| d) | RNA | protein |



Modern Genetics



Review your previous knowledge:

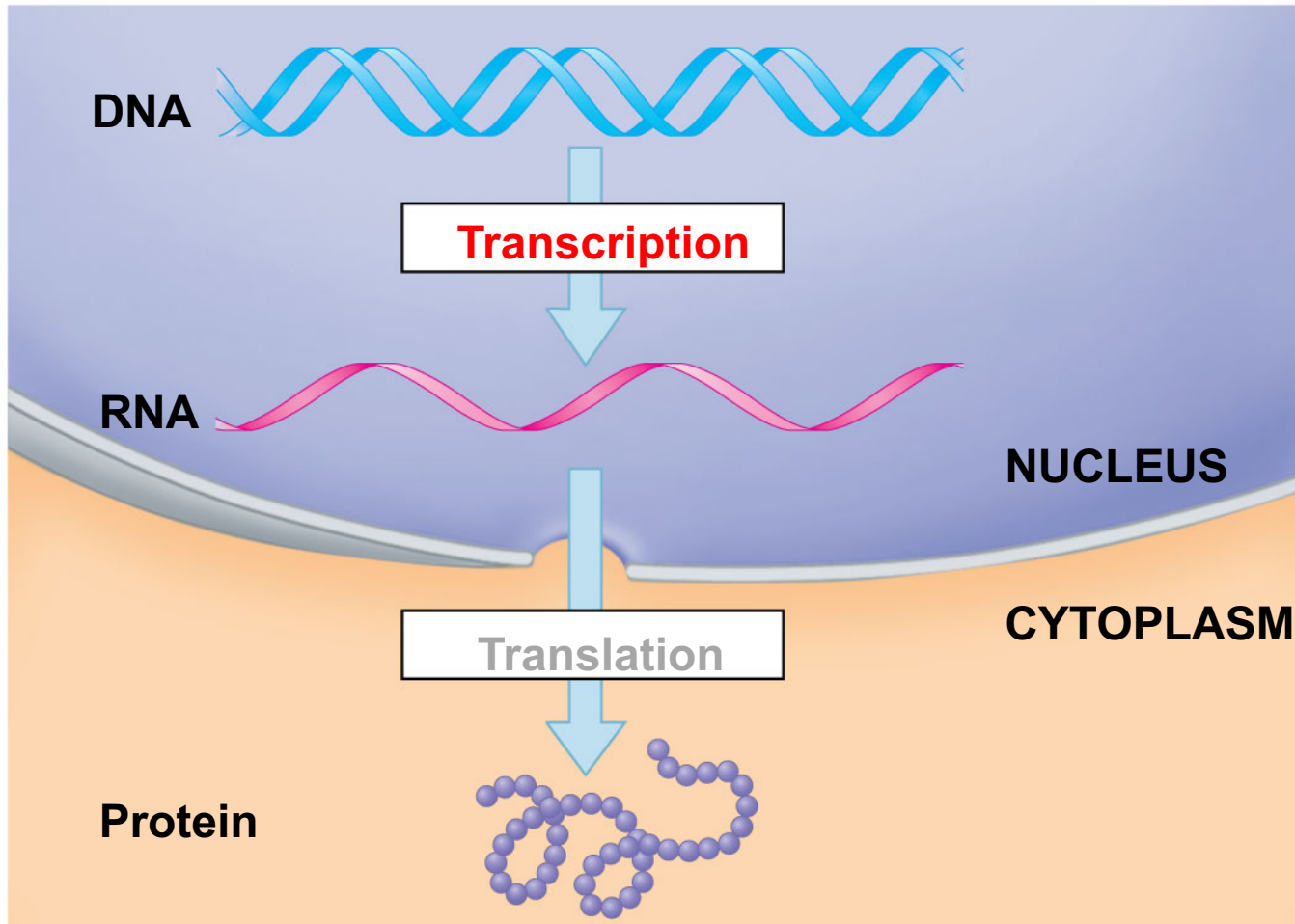
Where in an eukaryotic cell can **transcription** occur?

Where in an eukaryotic cell can **translation** occur?



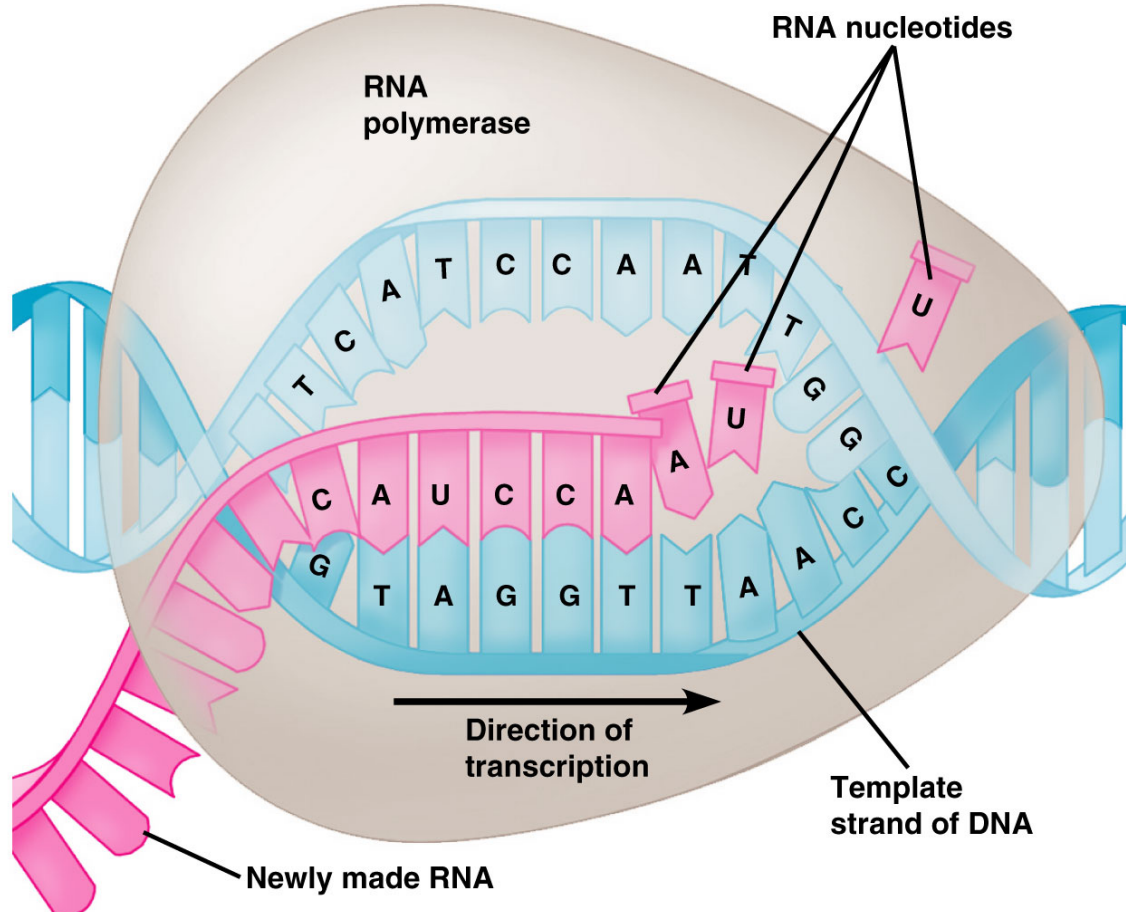
Transcription: from DNA to Messenger RNA

Transcription rewrites the DNA code into RNA

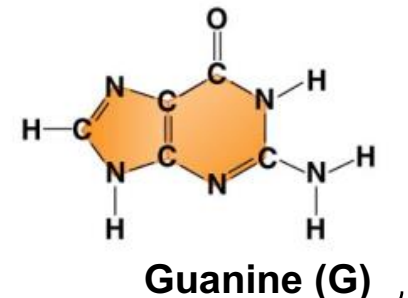
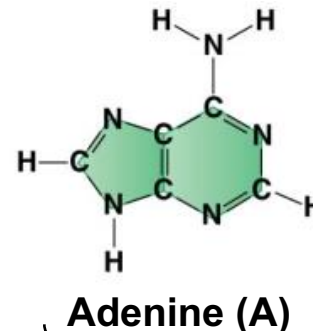
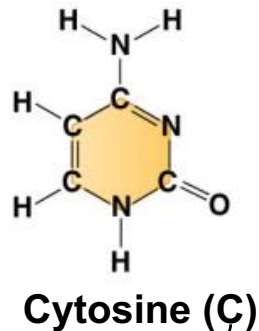
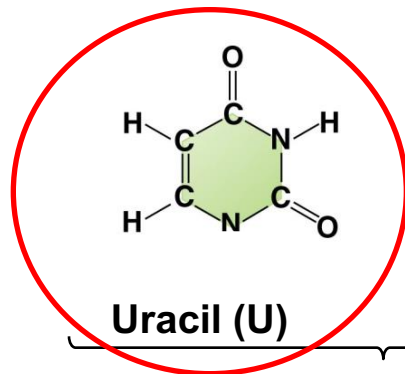
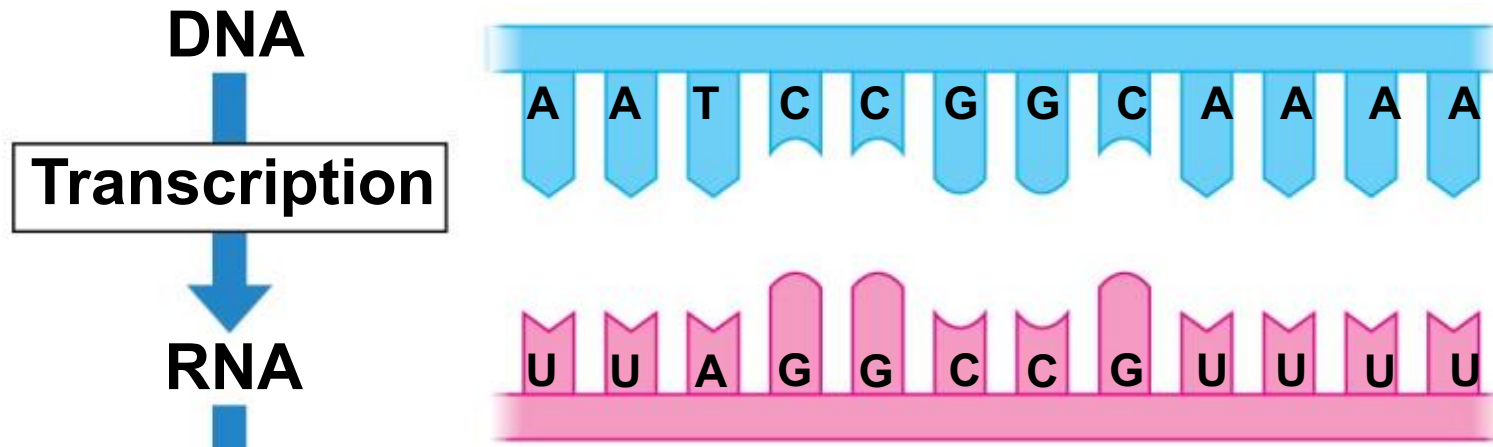


Transcription bubble:

DNA template is transcribed to **mRNA** in **5' to 3'** direction by **RNA polymerase**



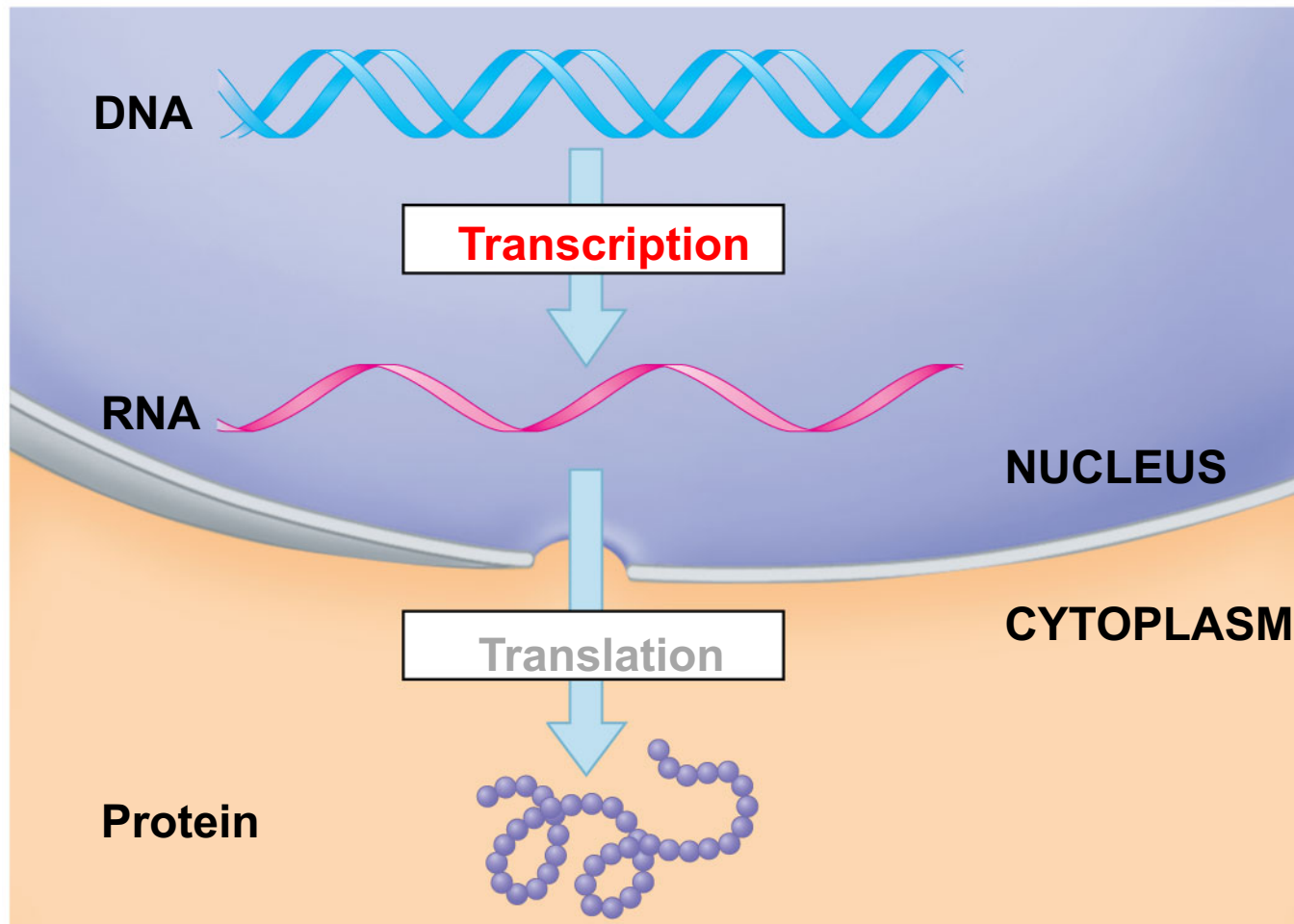
Molecular Basis of Transcription



Pyrimidines

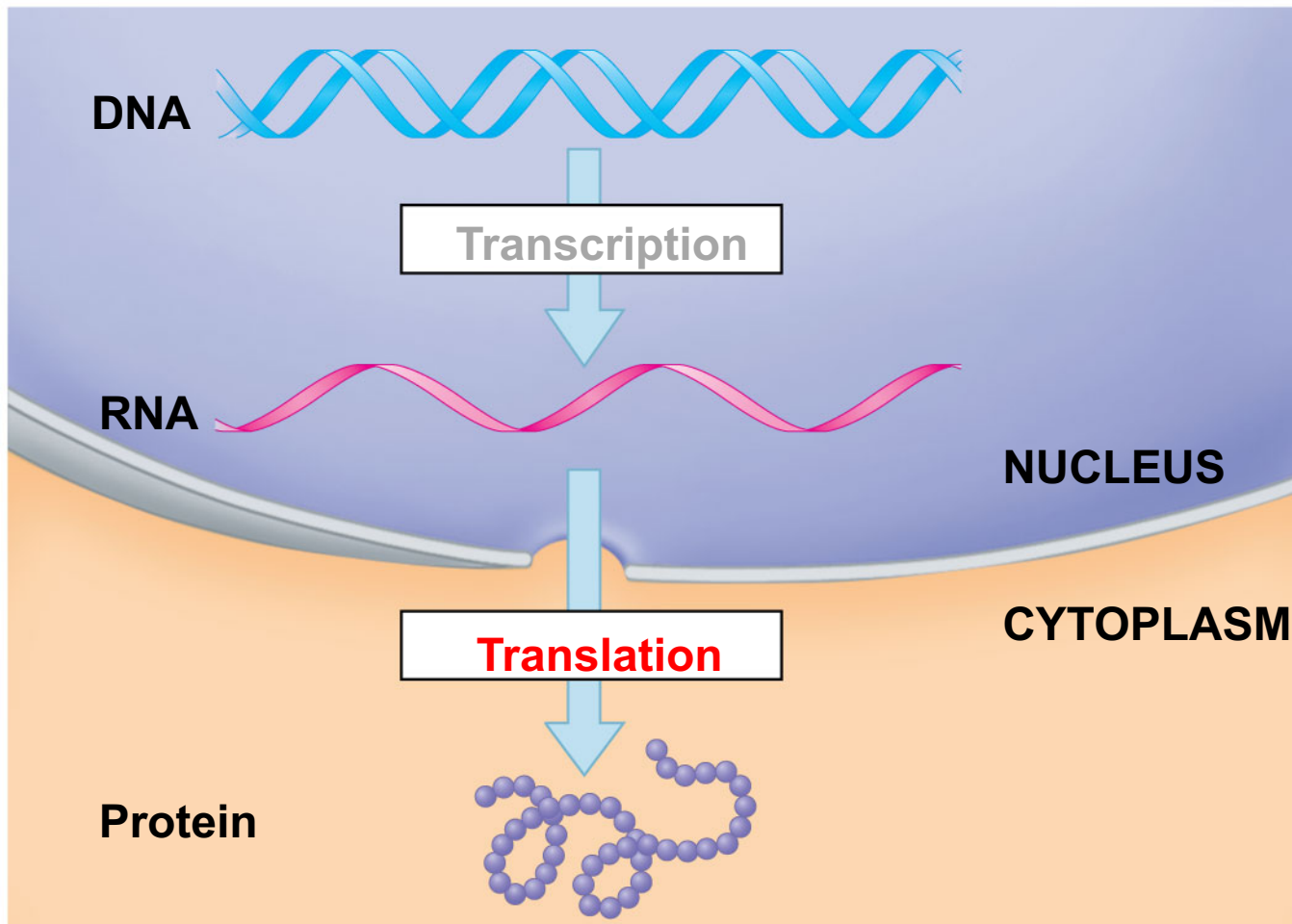
Purines

Eukaryotic RNA is processed before leaving the nucleus as mRNA

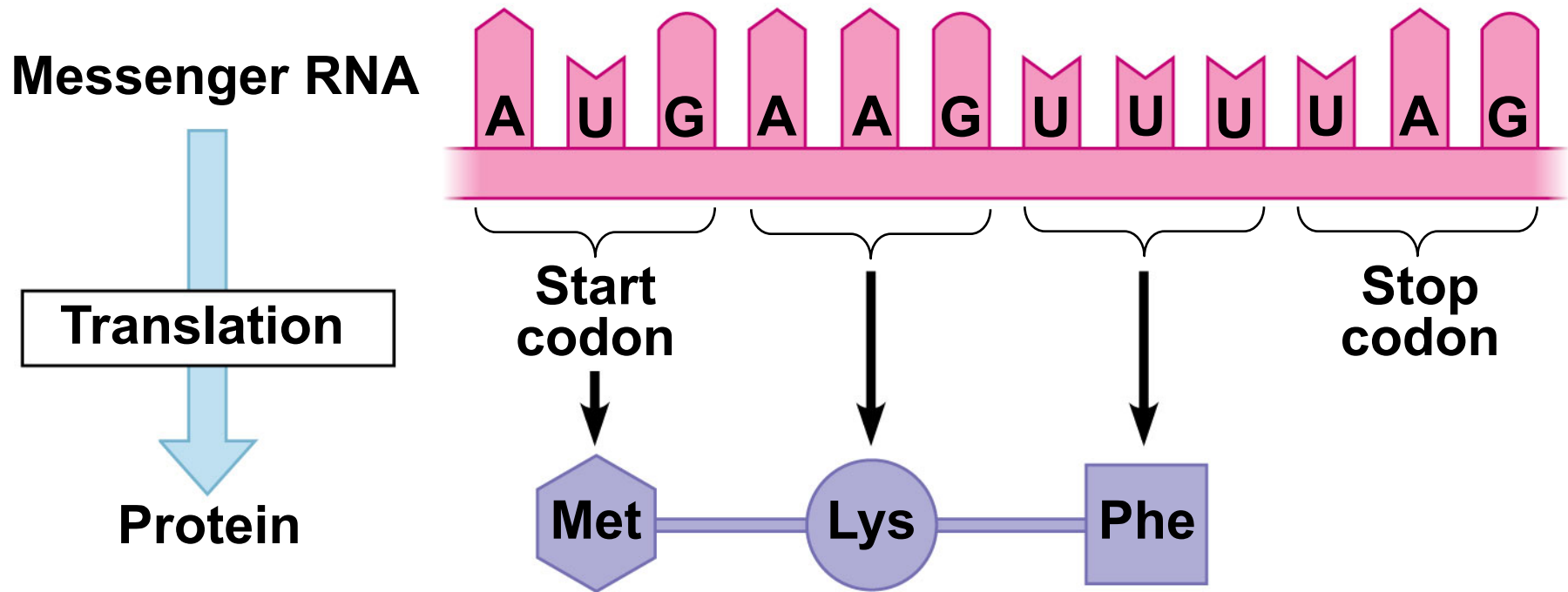


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Translation: Genetic information written in codons is translated into amino acid sequences



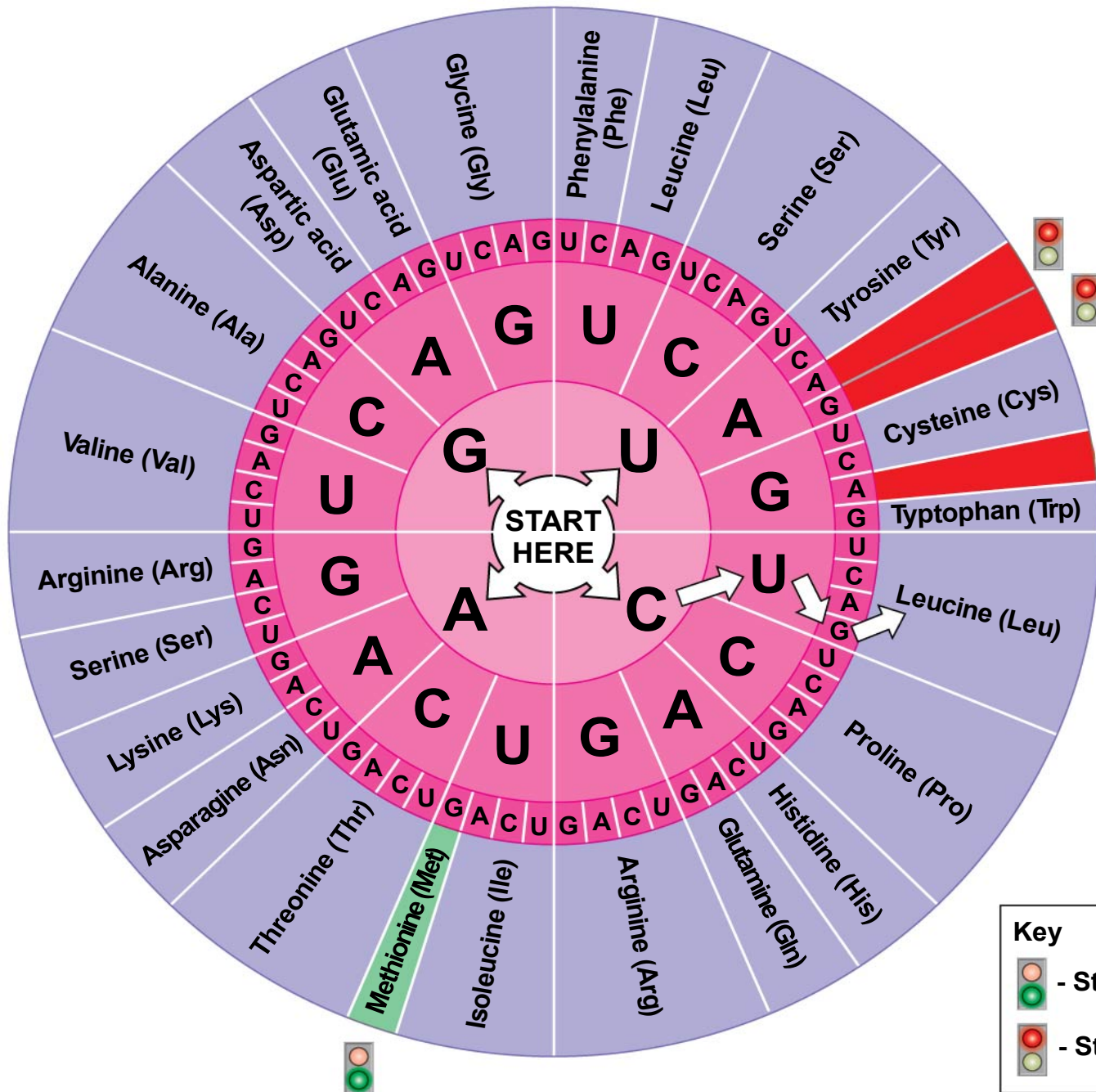
Translation: Genetic information written in codons is translated into amino acid sequences



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Q: How many nucleotides are needed to code for 20 amino acids?

Q: How many nucleotides **including a stop codon** are needed to code for 20 amino acids?

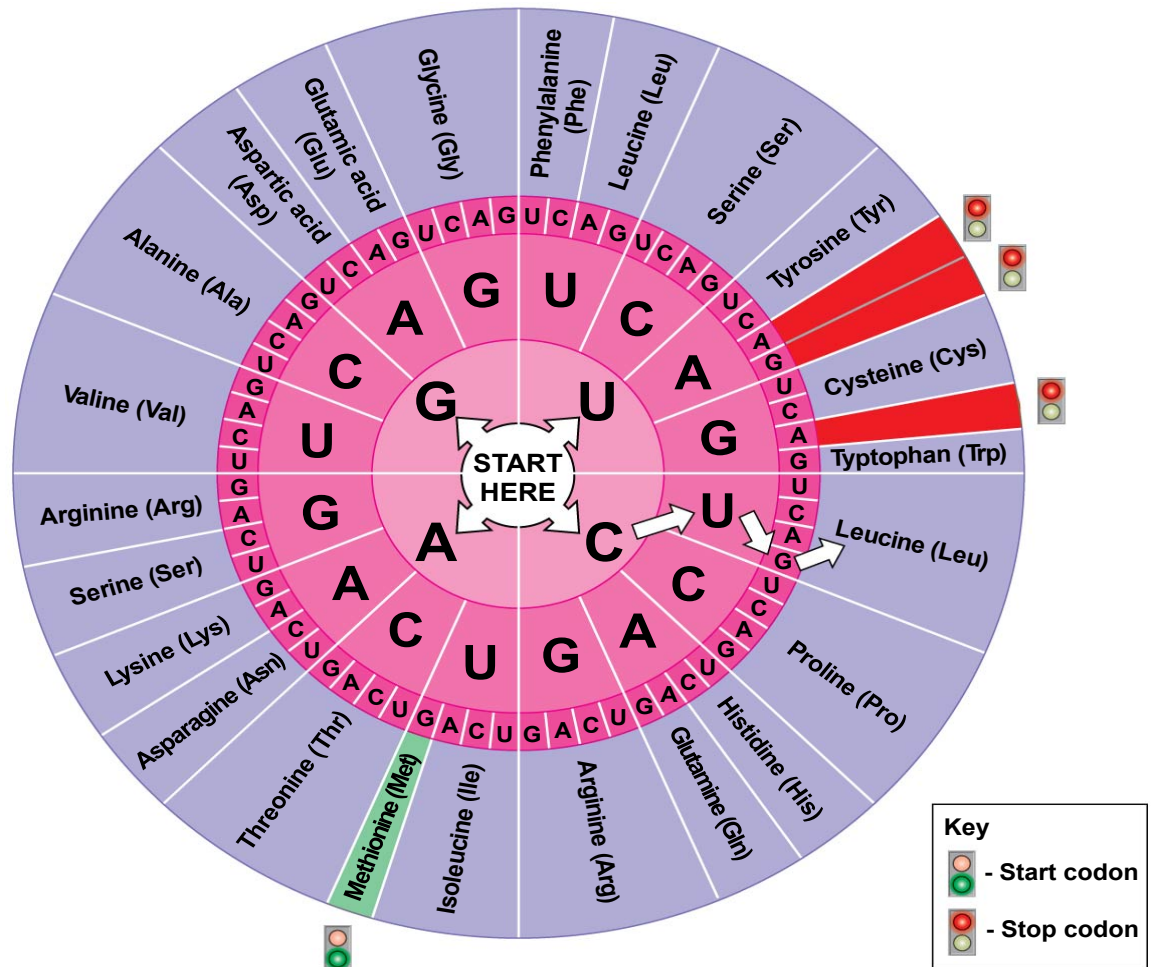


Transcribe then translate the following DNA template strand

DNA: 3' CCTACGATAAGCTA 5'

mRNA:

Amino Acid:



**Firefly and jellyfish
genes introduced into
plants and bacteria are
translated into proteins!**

Which theme does it
demonstrate?

the genetic code is universal



Which of the following options best depicts the flow of information when a gene directs the synthesis of a cellular component?

A. DNA \rightarrow RNA \rightarrow mRNA \rightarrow protein

B. DNA \rightarrow RNA \rightarrow protein

C. protein \rightarrow RNA \rightarrow DNA

D. DNA \rightarrow tRNA \rightarrow mRNA \rightarrow protein

Which of the following options best depicts the flow of information when a gene directs the synthesis of a cellular component?

A. DNA \rightarrow RNA \rightarrow mRNA \rightarrow protein

B. DNA \rightarrow RNA \rightarrow protein

C. protein \rightarrow RNA \rightarrow DNA

D. DNA \rightarrow tRNA \rightarrow mRNA \rightarrow protein

The Process of Translation:

Components (Ingredients) required for Translation

1) Ribosome

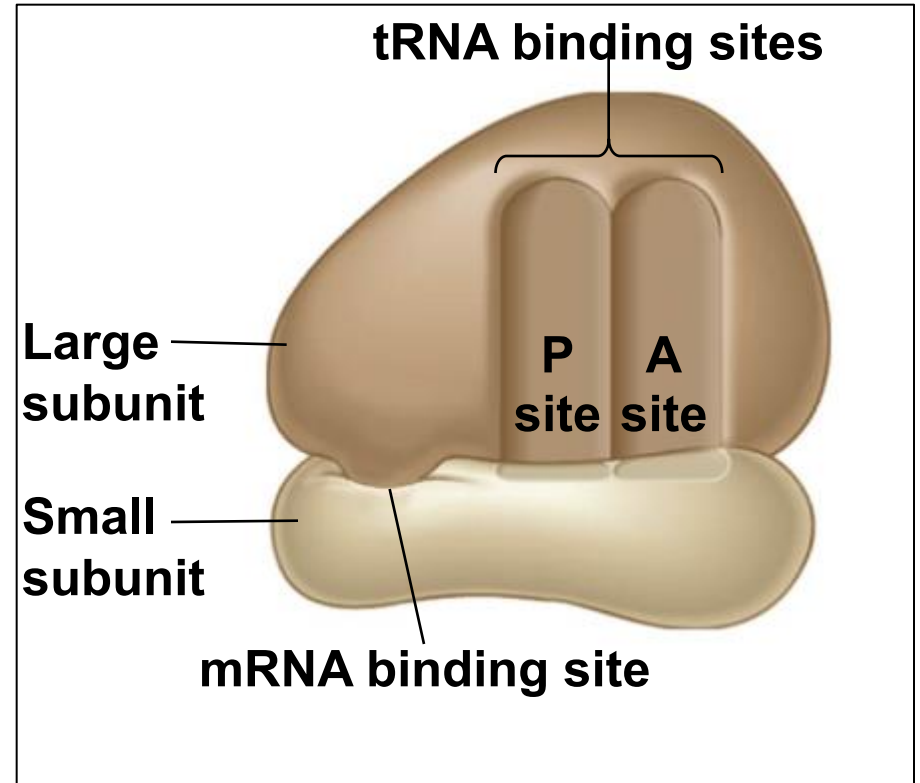
Made of rRNA and proteins

Small subunit

Large Subunit

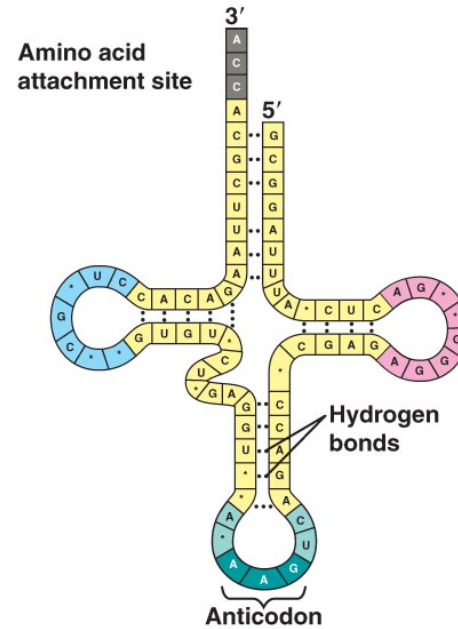
2) mRNA

3) tRNA

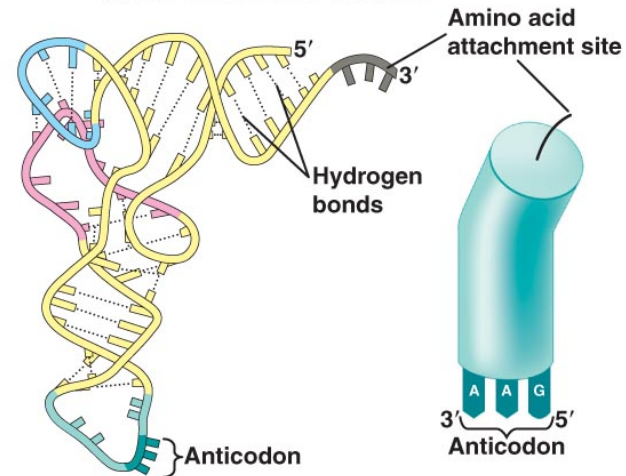


Transfer RNA

Each tRNA is a folded molecule bearing an **anticodon** on one end and a specific amino acid attachment site at the other end.



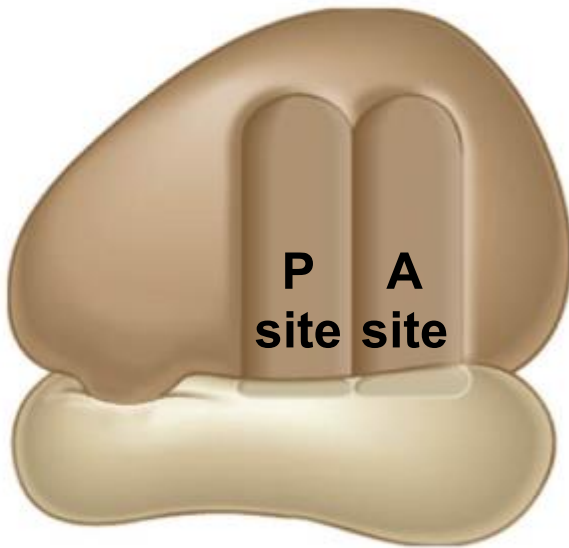
(a) Two-dimensional structure



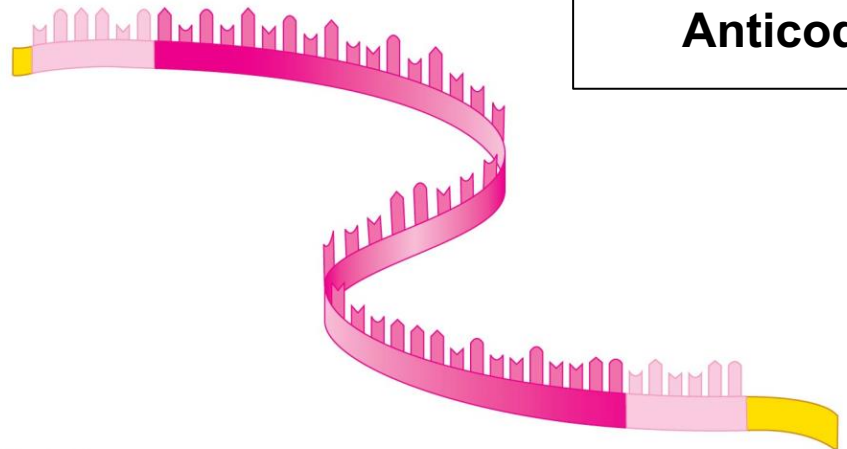
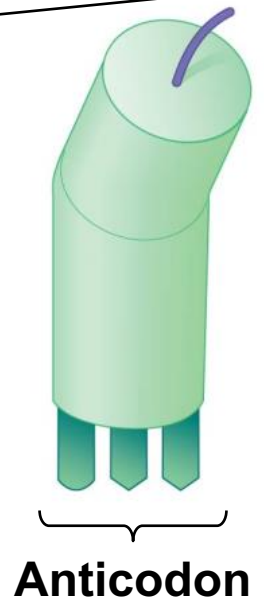
(b) Three-dimensional structure (c) Symbol used in this book

The Process of Translation

Initiation brings together **mRNA**, **transfer RNA**, and the two subunits of a **ribosome**



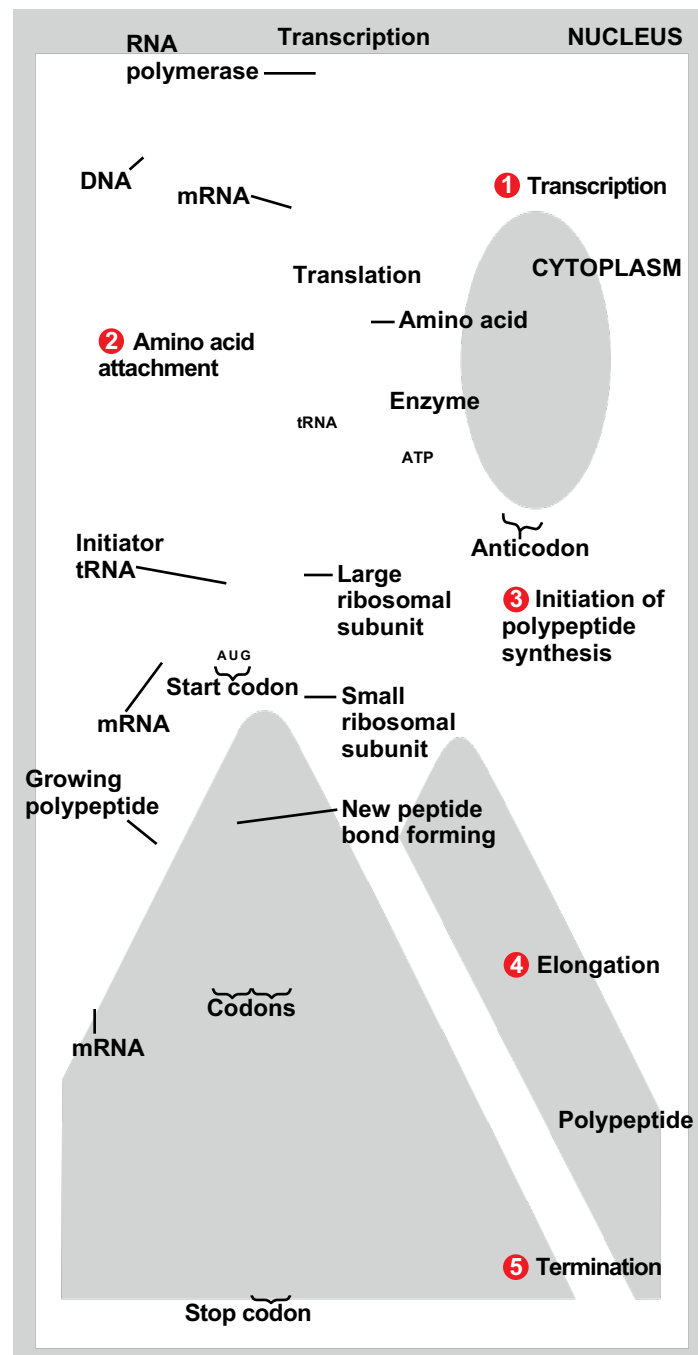
**Amino acid
attachment site**



Translation

While watching, please identify the three steps in the process of translation.

<https://www.youtube.com/watch?v=5bLEDd-PSTQ>



The Processes of Translation

INITIATION

Initiation brings together **mRNA**, **transfer RNA**, and the two subunits of a **ribosome**

ELONGATION

Elongation adds amino acids to the polypeptide chain until a stop codon **terminates** translation

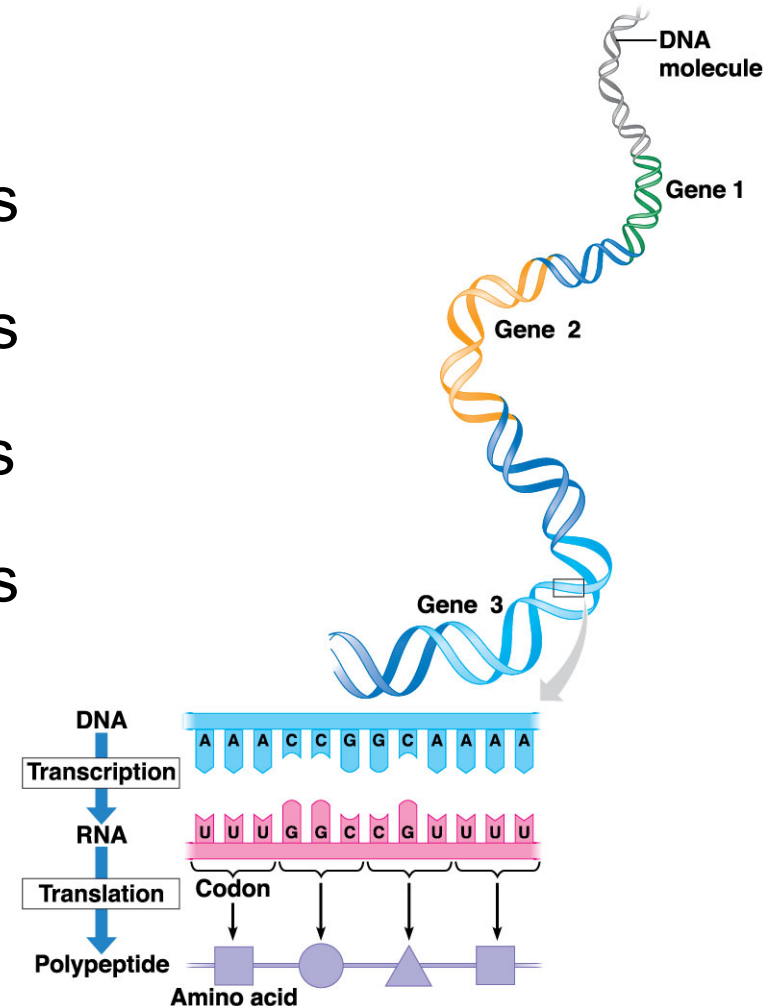
TERMINATION

Polypeptide

Question:

An organism's genetic information is stored within the sequence of _____. This information is transcribed into a sequence of _____, which are then translated into a sequence of _____.

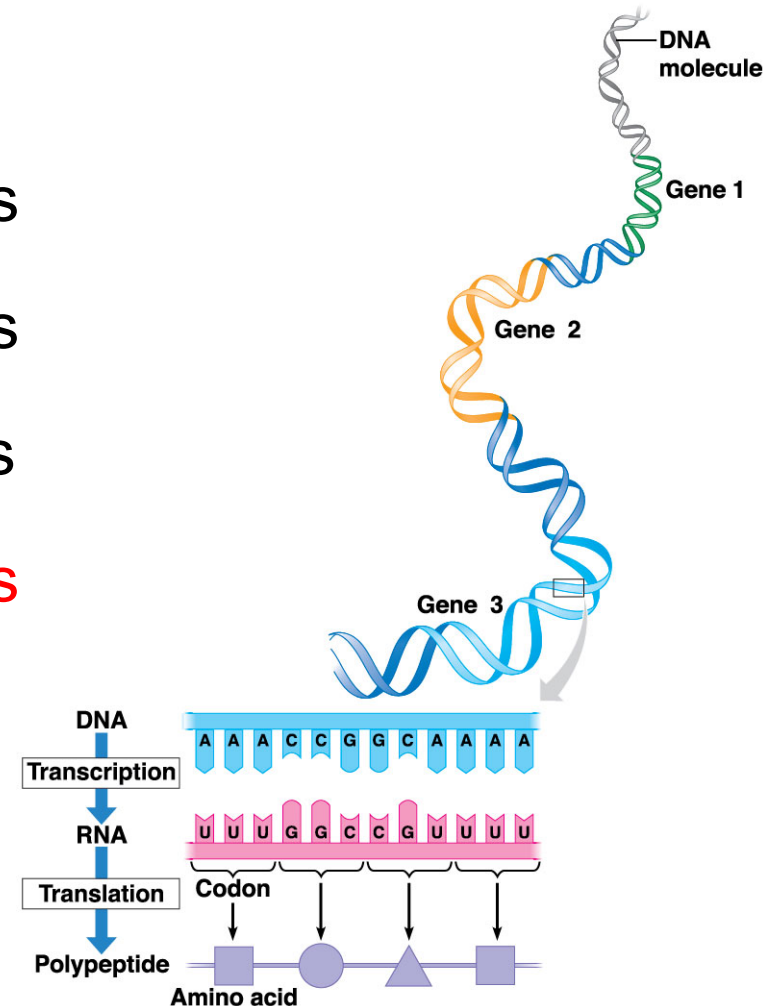
- a) DNA bases; amino acids; RNA bases
- b) RNA bases; DNA bases; amino acids
- c) amino acids; DNA bases; RNA bases
- d) DNA bases; RNA bases; amino acids



Question:

An organism's genetic information is stored within the sequence of _____. This information is transcribed into a sequence of _____, which are then translated into a sequence of _____.

- a) DNA bases; amino acids; RNA bases
- b) RNA bases; DNA bases; amino acids
- c) amino acids; DNA bases; RNA bases
- d) DNA bases; RNA bases; amino acids



Question:

It is possible to synthesize proteins *in vitro* (in a test tube) without the use of living cells. If starting from a mature mRNA transcript, which of the following components would *not* be needed to do this?

- A) nucleotides
- B) amino acids
- C) tRNAs
- D) ribosomes

Question:

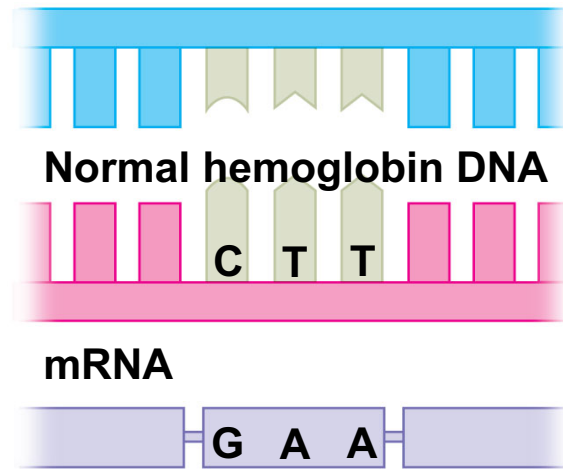
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- C) tRNAs
- D) ribosomes

Mutations can affect genes

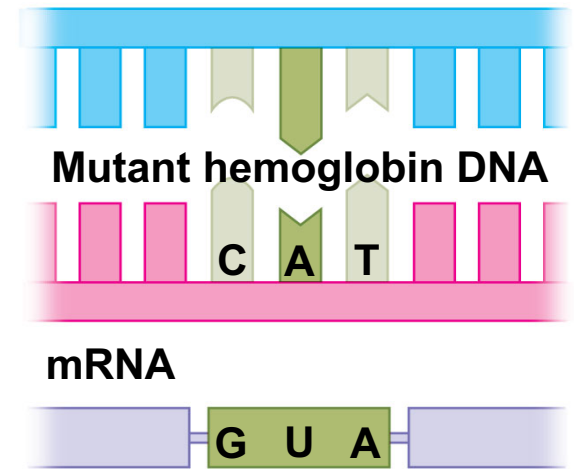
- **Mutations** are changes in the genetic information of a cell or virus, caused by errors in DNA replication or recombination, or by physical or chemical agents called **mutagens**.
- Substituting, inserting, or deleting nucleotides alters a gene, with varying effects.

Mutations can change the meaning of genes



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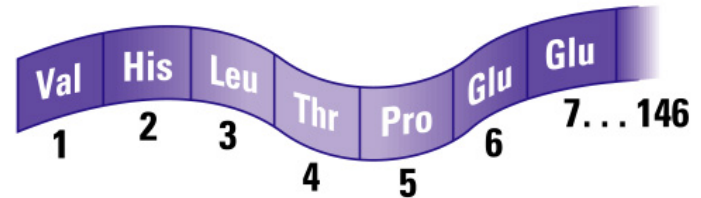
Normal hemoglobin
Glu



Sickle-cell hemoglobin
Val



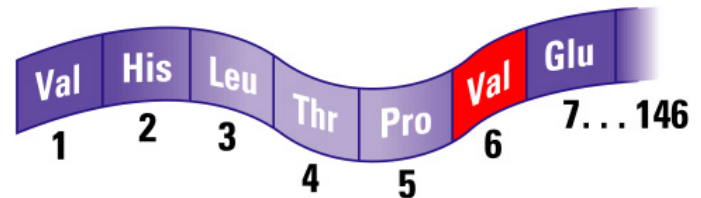
(a) Normal red blood cell



Normal hemoglobin



(b) Sickled red blood cell



Sickle-cell hemoglobin

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Figure 10.UN03

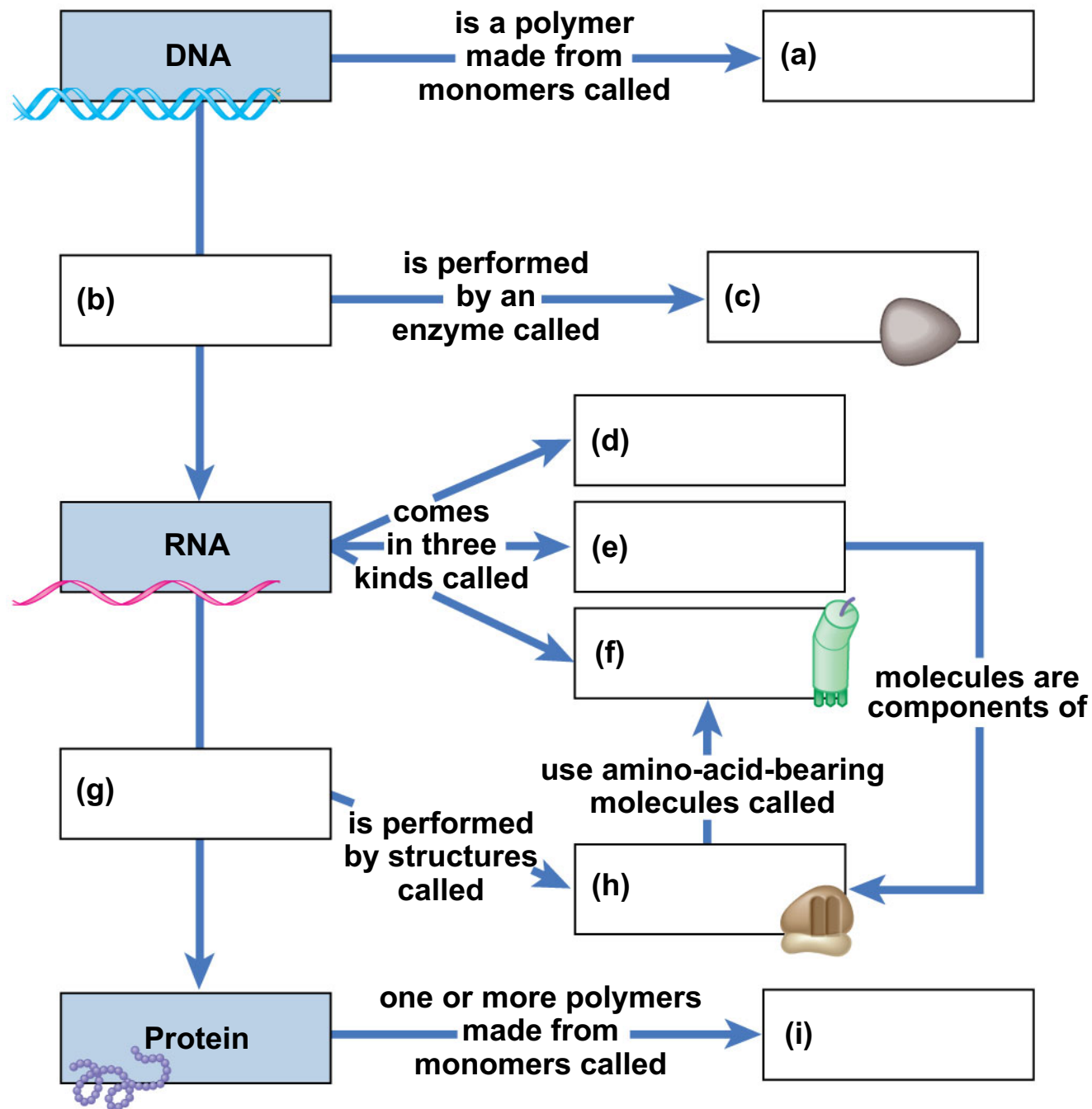


Figure 10.UN03

