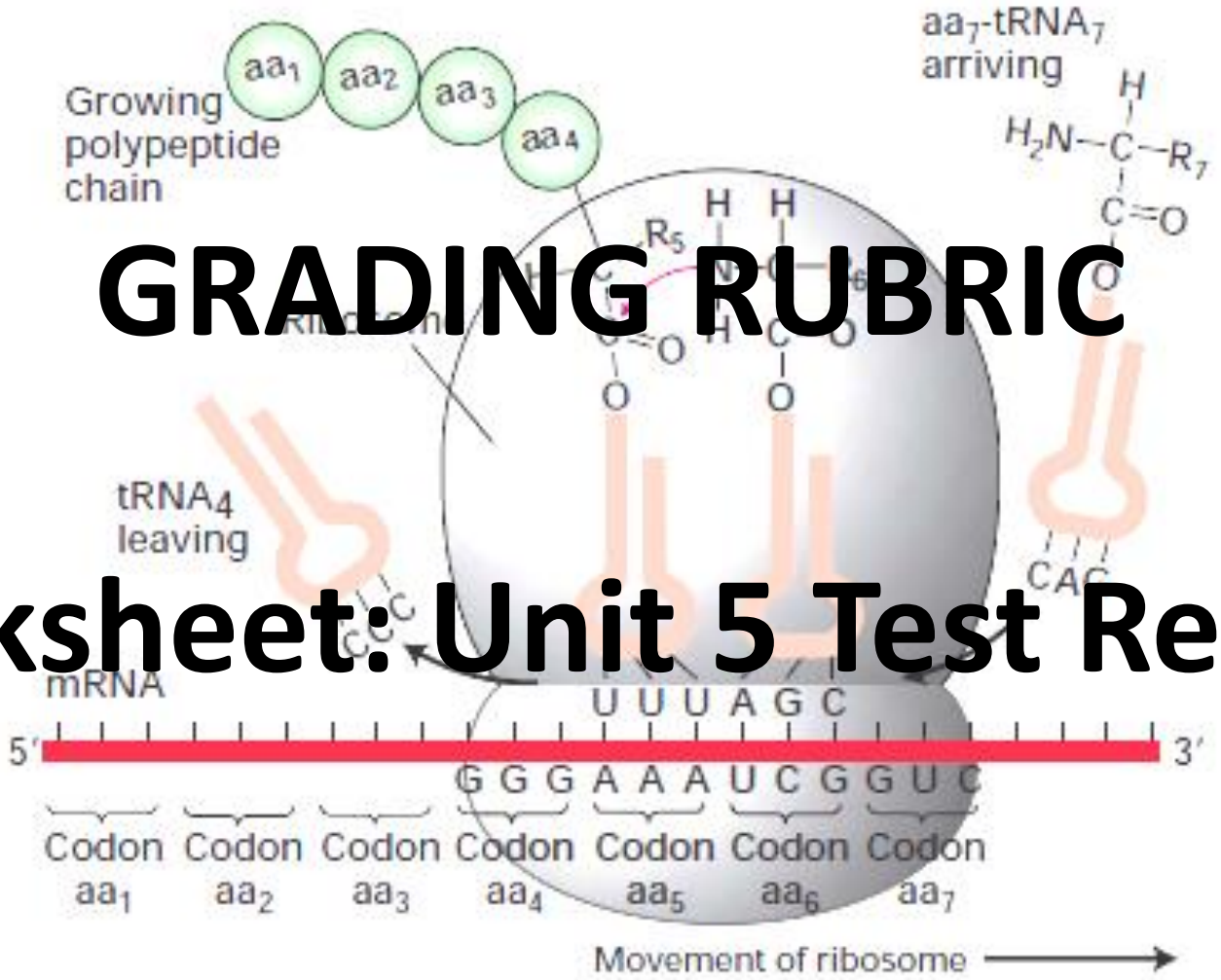
GRADING RUBRIC

Worksheet: Unit 5 Test Review

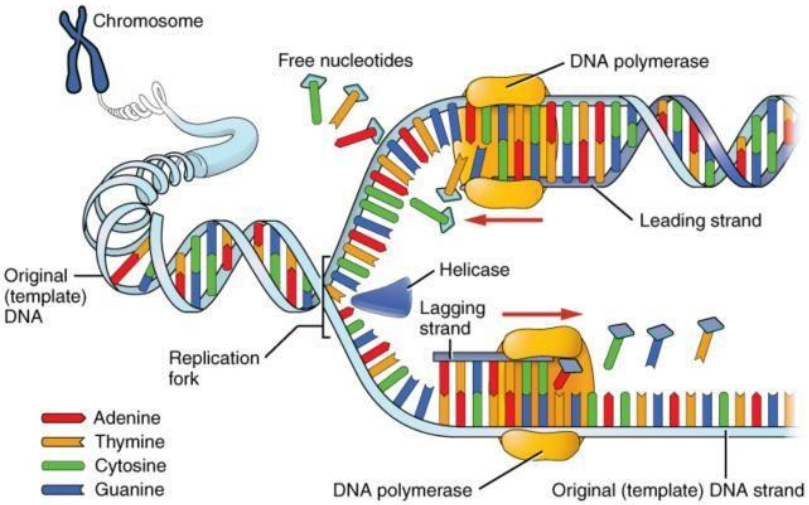


1. Describe and draw a diagram of the processes below *(include where it occurs, what molecules are involved, sequence of events, and what results from each process)*:

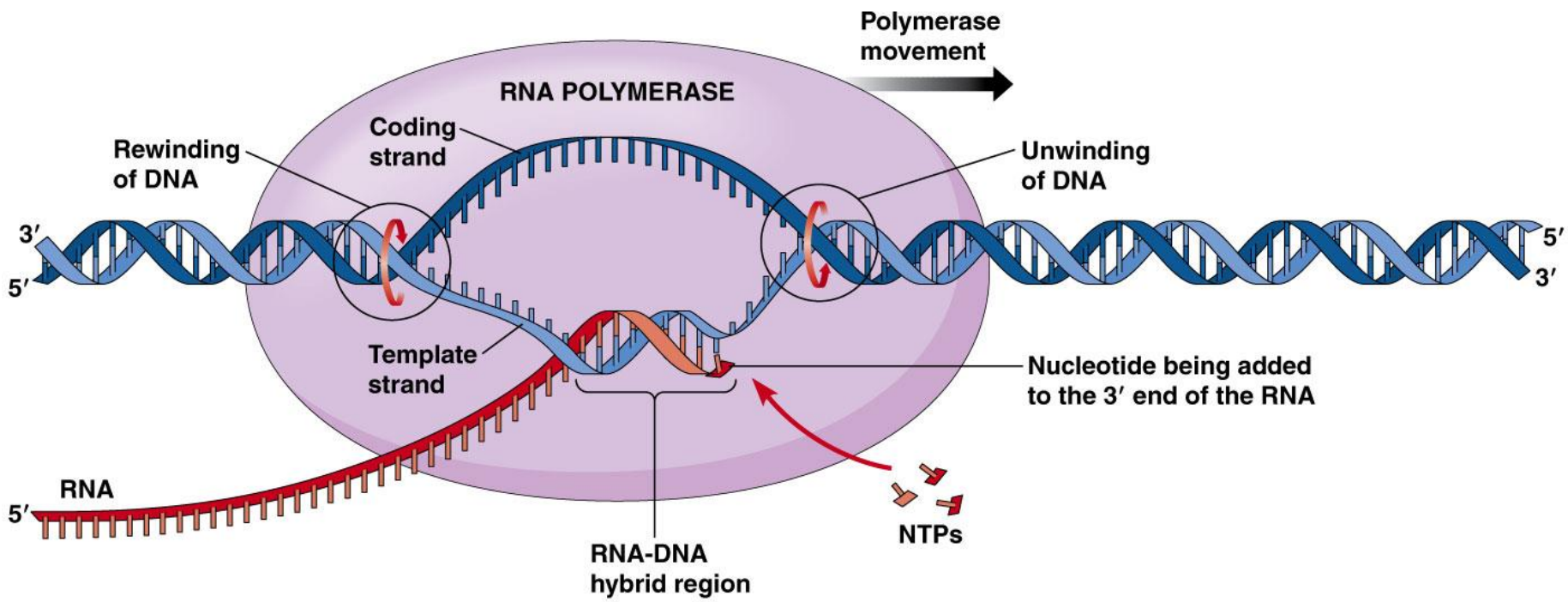
Replication: **DNA making DNA**. Making an exact copy of itself before cell division. Involves enzymes. Takes place in nucleus.

Steps:

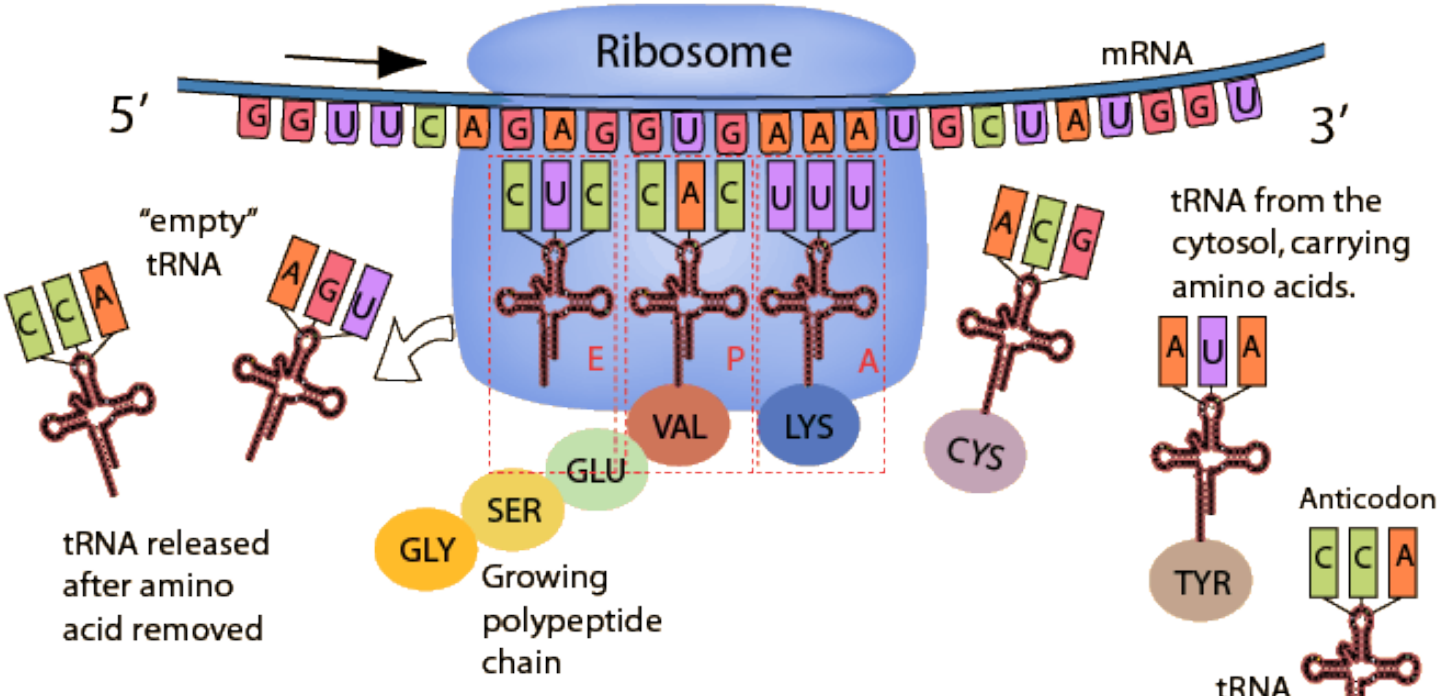
1. Enzyme begins to unzip DNA
2. Hydrogen bonds broken
3. Molecule separates exposing bases
4. Free-floating nucleotides pair up with complementary bases



Transcription: DNA making RNA. DNA used to make 'disposable' copy of <u>one genes</u> worth of information to travel to ribosome in cytoplasm to make protein. Takes place in <u>nucleus</u>.



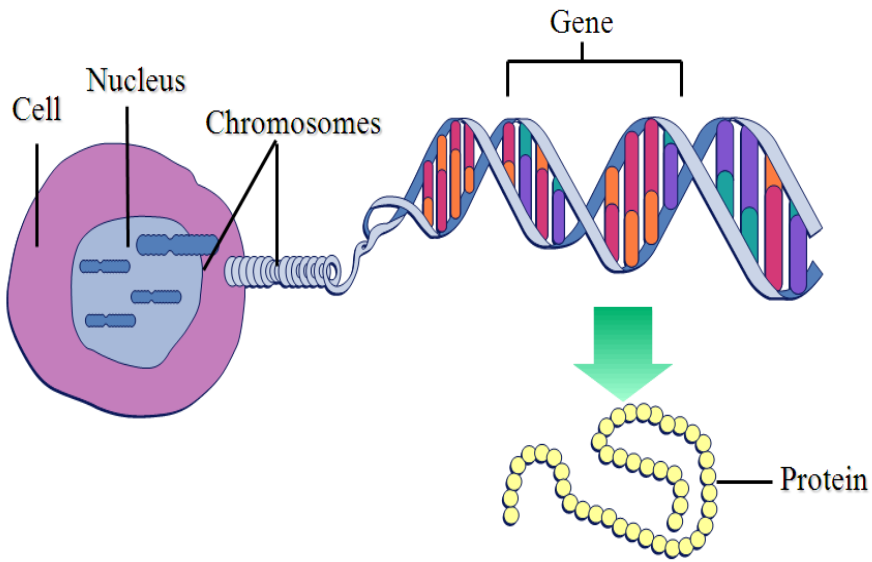
Translation: RNA making proteins. mRNA attaches to **ribosome** (*made of **rRNA***) and **tRNA** molecules transfer amino acids to ribosome to be bonded together and make into polypeptide (**protein**). Involves mRNA, tRNA, and rRNA.

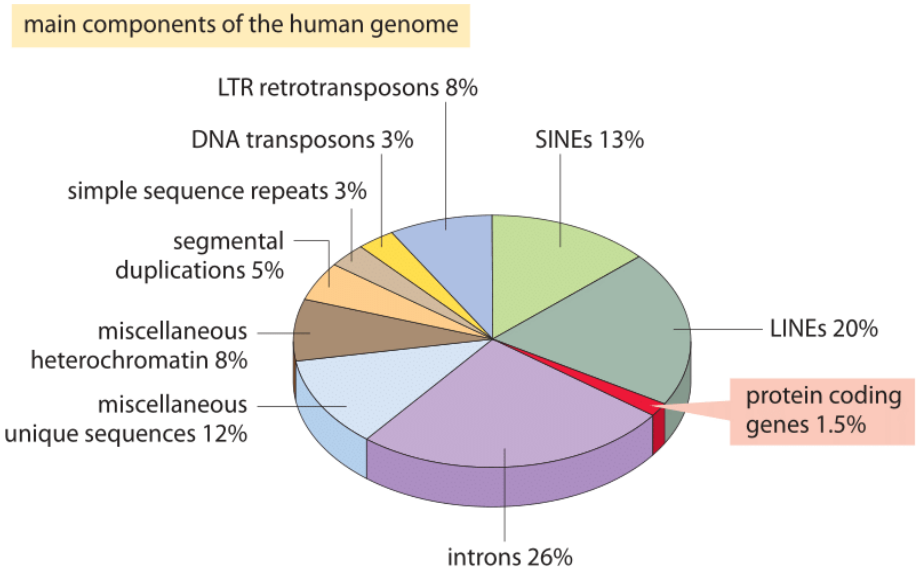


The translation process incorporates 20 different amino acids in the precise sequence dictated by the three-base codons built from and alphabet of four bases. The process in the ribosome builds the polypeptide chains tha will become proteins.

2. **Genes** contain instructions for producing **proteins**

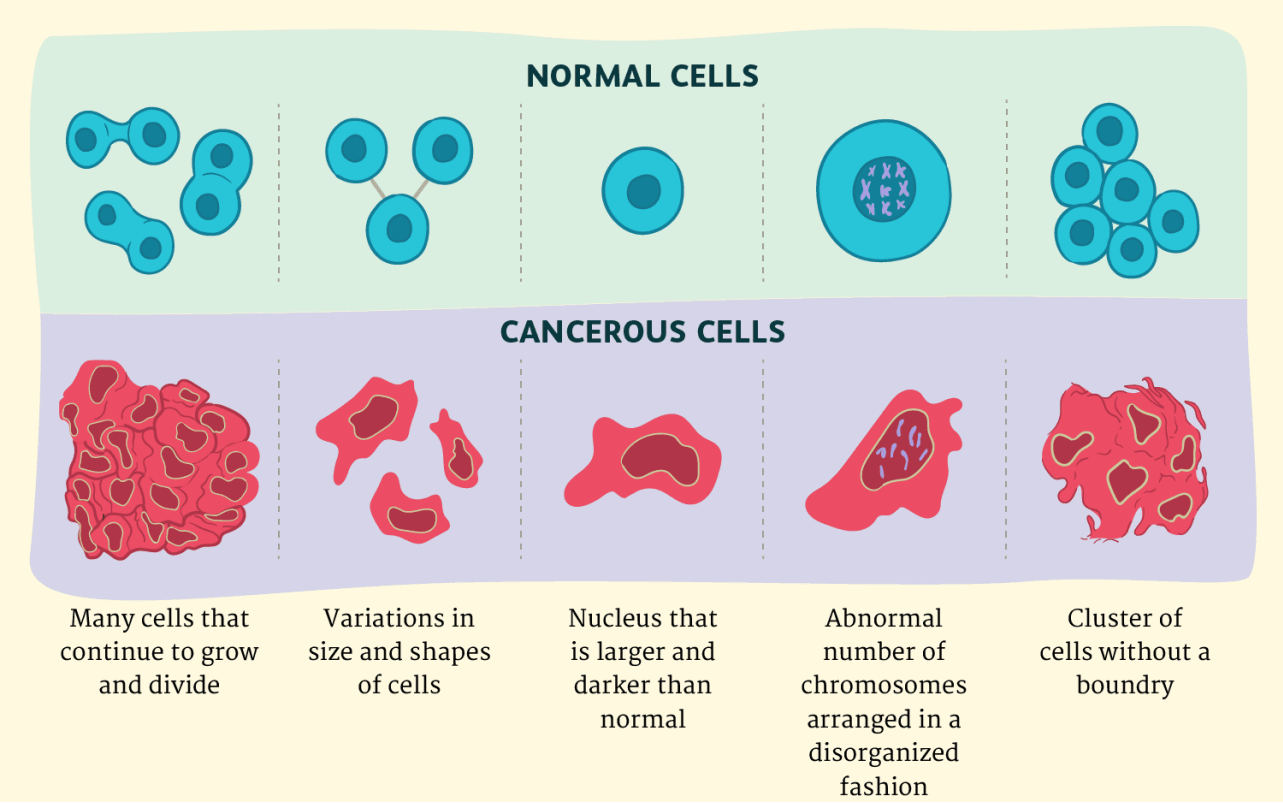
Human DNA contains about **22,000 genes**. Each codes for production of either structural or functional proteins. (*Protein coding DNA makes up on 2% of total DNA*)



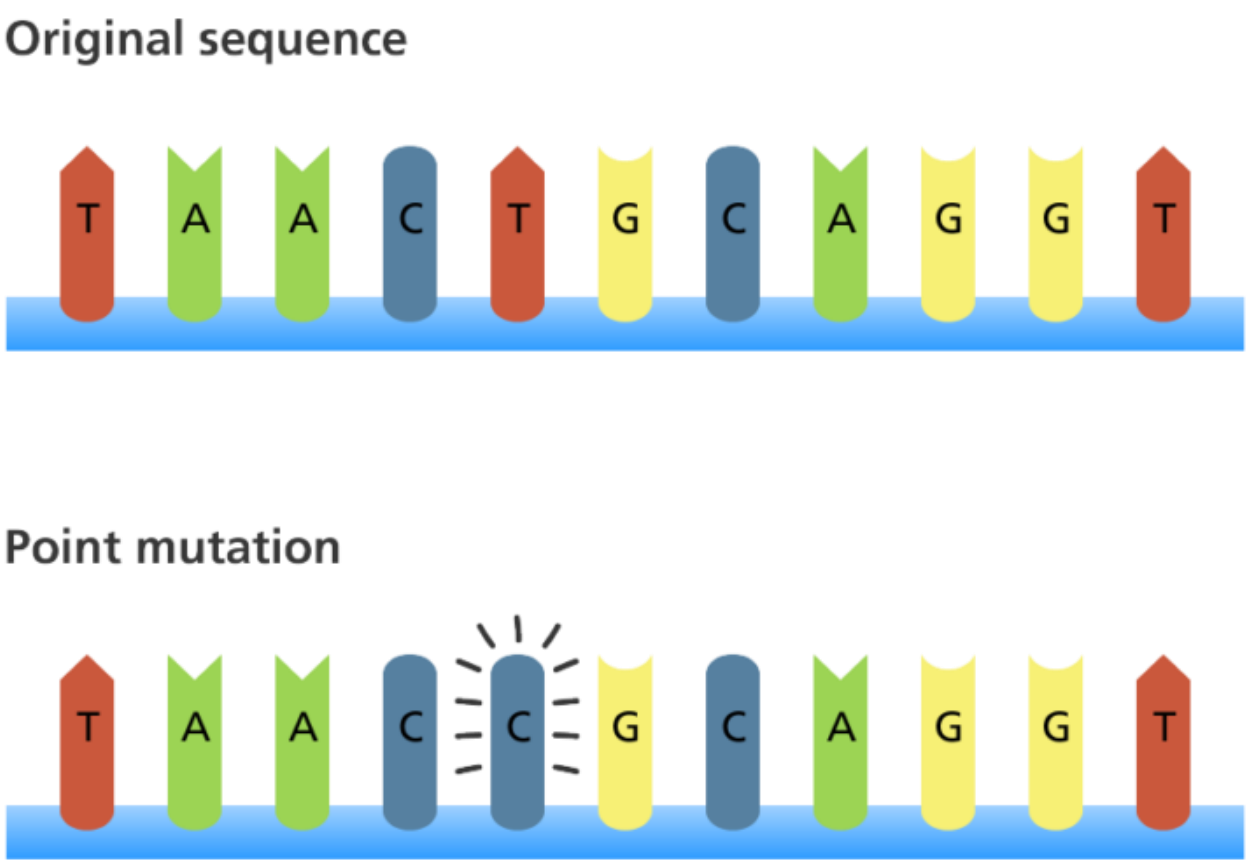


3. **Cancer** is a disorder in which some cells have lost the ability to control what? **To control cell division.**

- Cancerous cells continue to grow and produce masses called **tumors**.
- Can be **malignant** (*can spread*) or **benign** (*do not spread*)

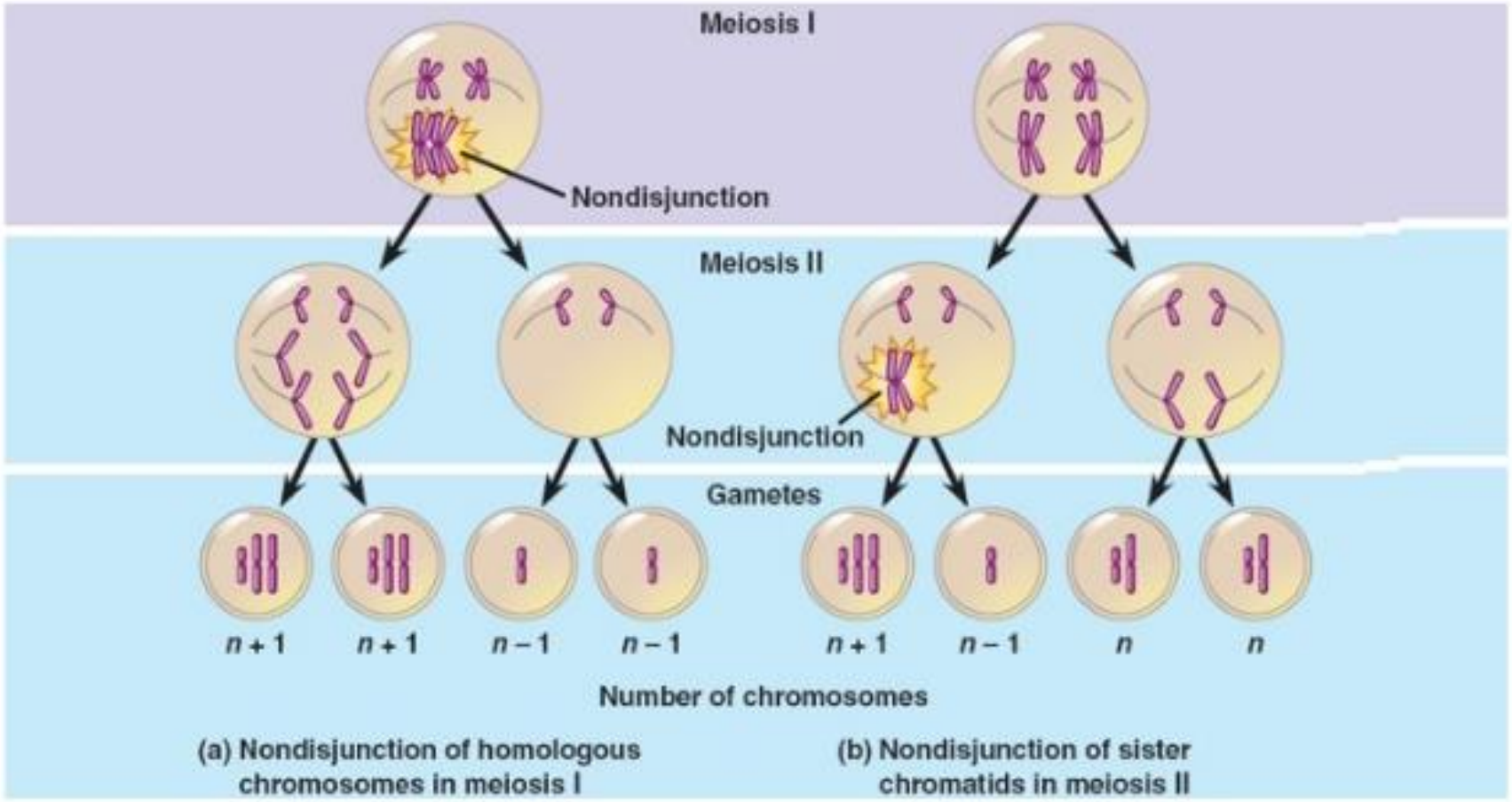


4. **Mutations** that affect a <u>single gene</u> normally occur during **DNA replication.** Can involve single base change (point mutation), or frameshift mutation. (*occurs in the S phase of the Cell Cycle*)



5. **Mutations** that affect <u>multiple genes</u> normally occur during **meiosis**

Nondisjunction can result in either extra chromosomes or missing chromosomes. **Crossing-over** can also create changes in offspring's DNA.



6. How might a **mutation** affect the resulting **protein** produced? **A mutation may or may not affect the resulting protein.**

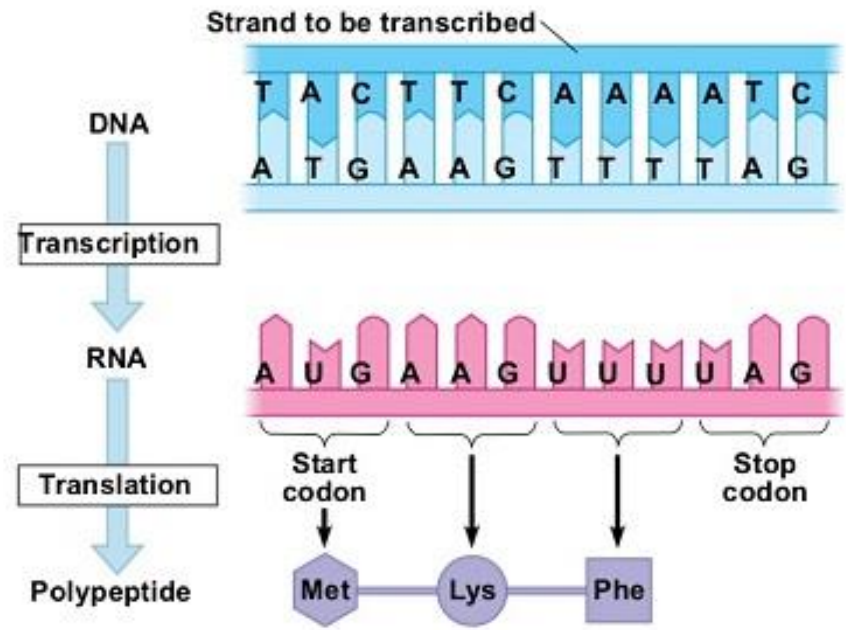
- A mutation may be **silent**
- A mutation may occur in a **noncoding** region
- A mutation may not affect **protein folding** or the **active site.**
- A mutation may cause a **premature stop codon**.
- A mutation may change protein **shape** or the **active site**
- A mutation may change **gene regulation**

7. What is a **codon** and what does it do? **A codon is a 3-letter 'code word' to specify one amino acid (**E.g. **<u>GAU</u>).**

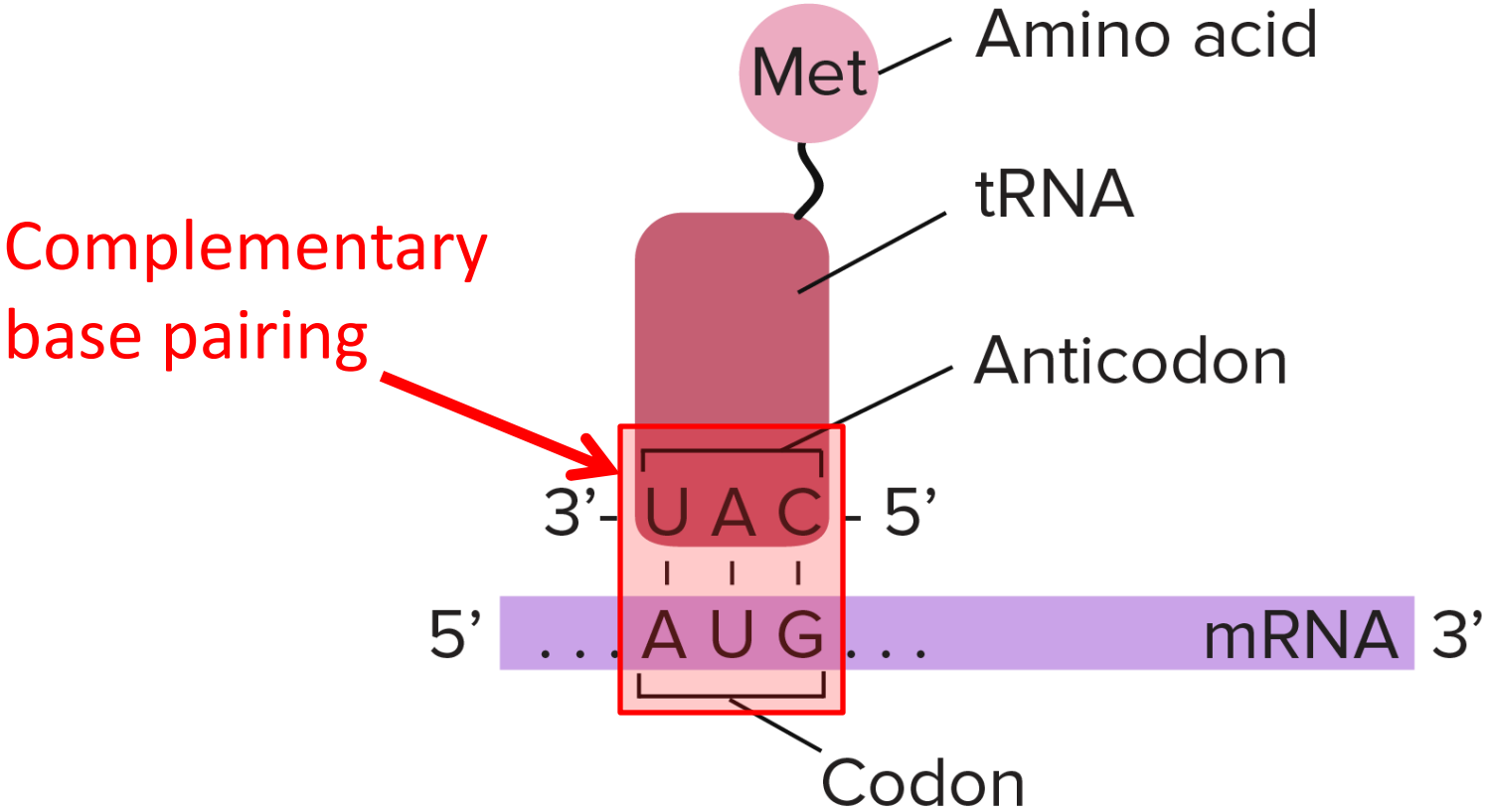
There are only 20 amino acids and 64 different codons.

There are multiple codons that code for same amino acid

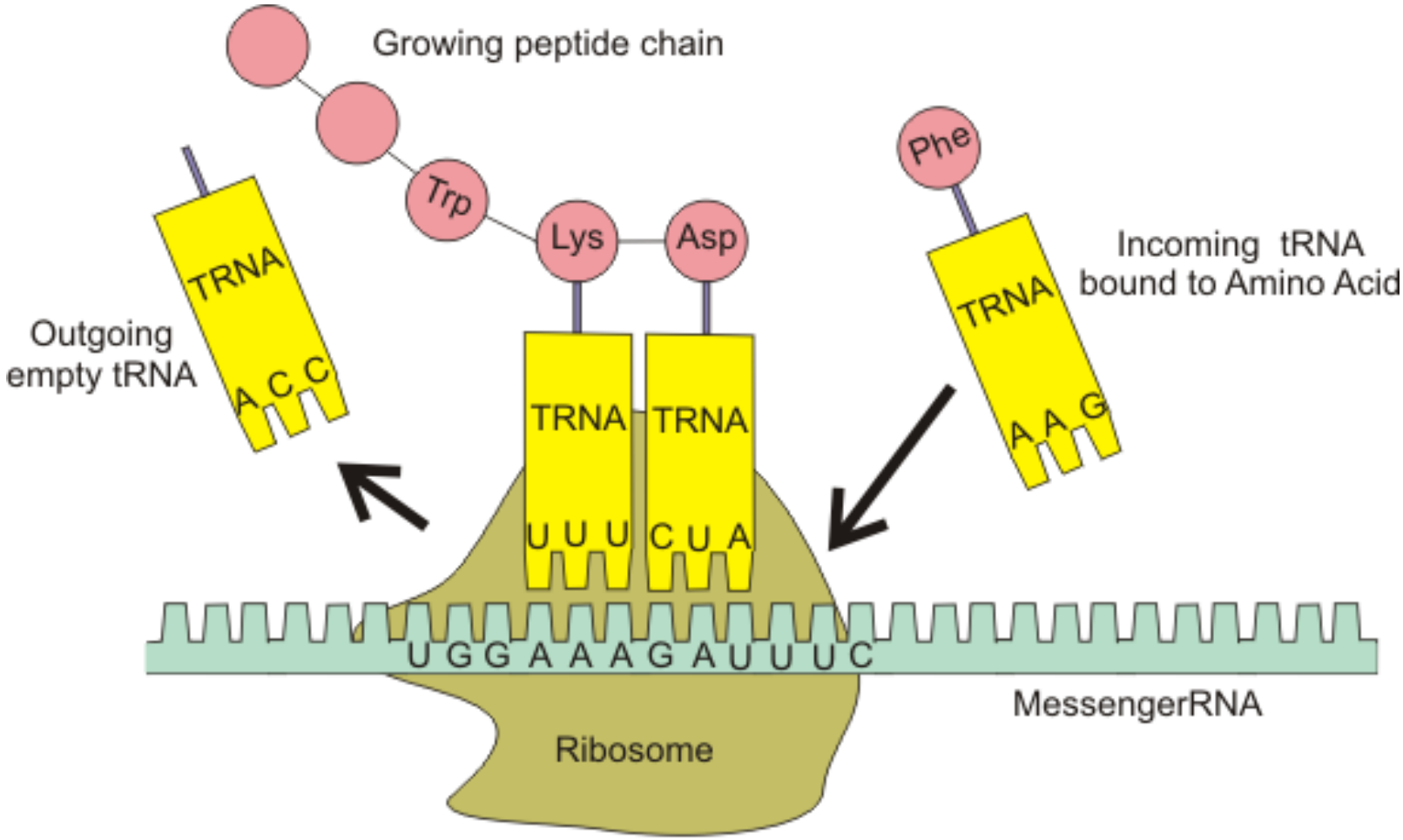
First letter	Second letter: U	Second letter: C	Second letter: A	Second letter: G	Third letter
U	UUU, UUC } Phe UUA, UUG } Leu	UCU, UCC, UCA, UCG } Ser	UAU, UAC } Tyr **UAA Stop** **UAG Stop**	UGU, UGC } Cys **UGA Stop** UGG Trp	U C A G
C	CUU, CUC, CUA, CUG } Leu	CCU, CCC, CCA, CCG } Pro	CAU, CAC } His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



8. What is an **anticodon** and what does it do? An **anticodon** is a **3-letter 'code word'** that is found on **tRNA** molecule. The anticodon is complementary to the codon. Complementary codons are A-U and C-G

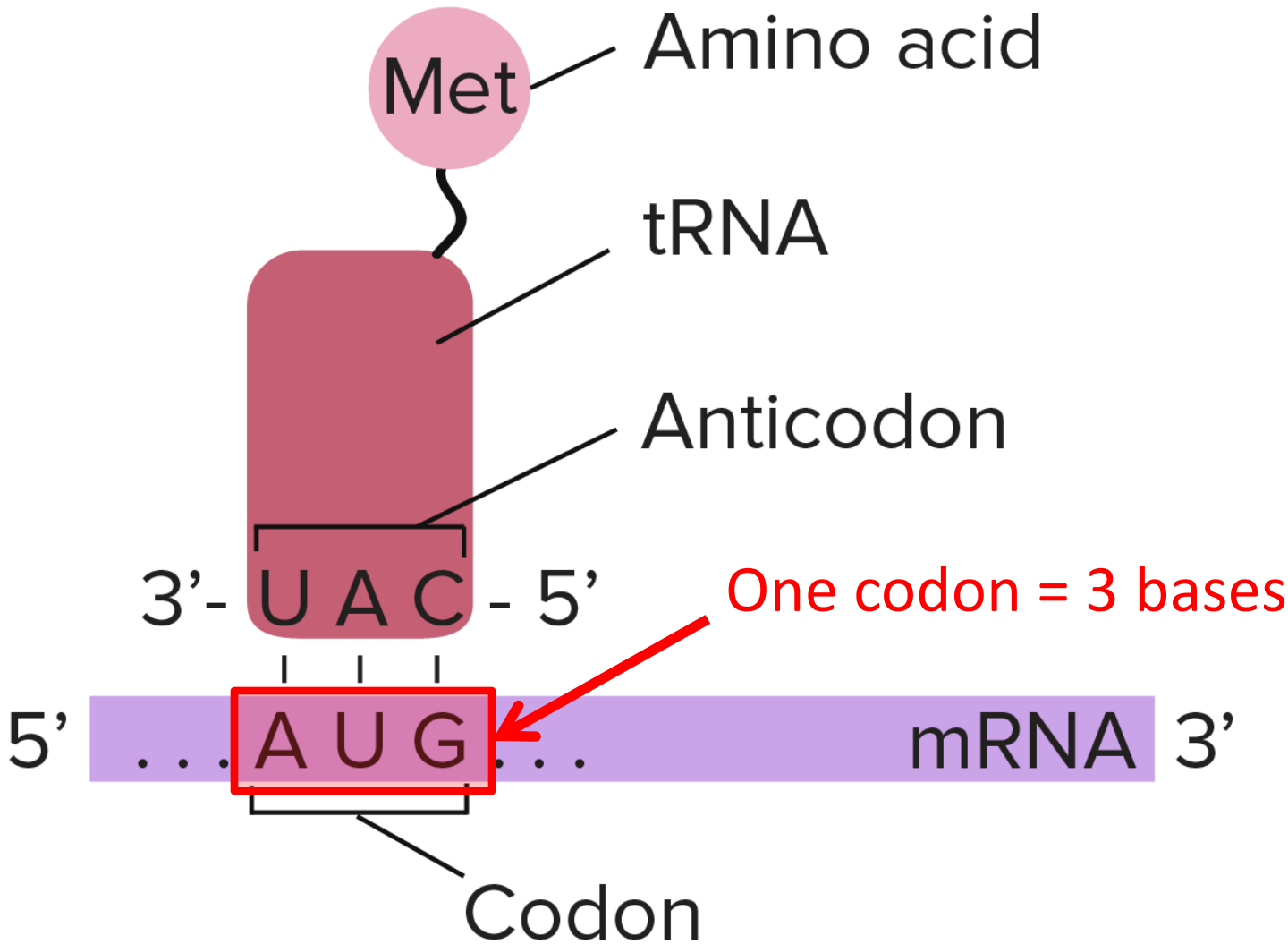


9. How many **codons** would it take to code for 5 amino acids? **Five.** Each codon codes for one **amino acid**.



Peptide Synthesis

10. How many **nitrogen bases** does it take to code for 5 amino acids? **15 bases**. 3 bases per codon x 5 = 15 bases



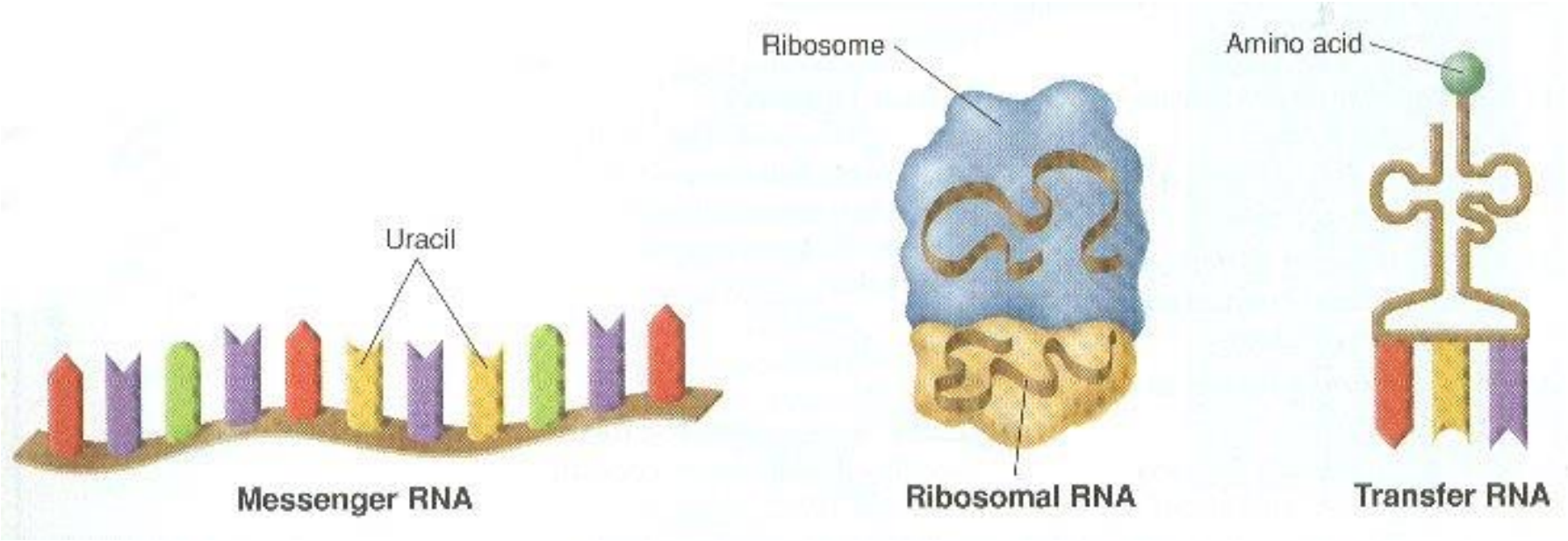
11. Why is it possible for an **amino acid** to be specified by more than one kind of codon? There are only **20 amino acids** but **64 possible 3-letter combinations** (codons)

Second letter

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

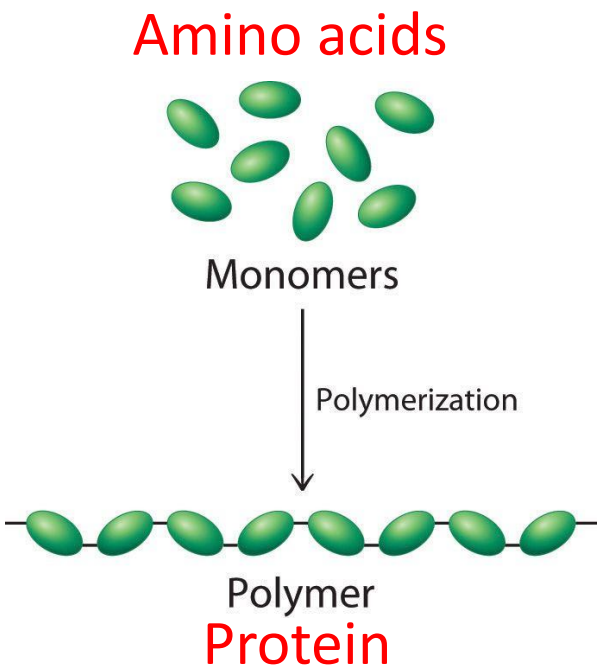
12. What are the <u>three</u> types of **RNA**, <u>where</u> are they found and <u>what</u> do they do?

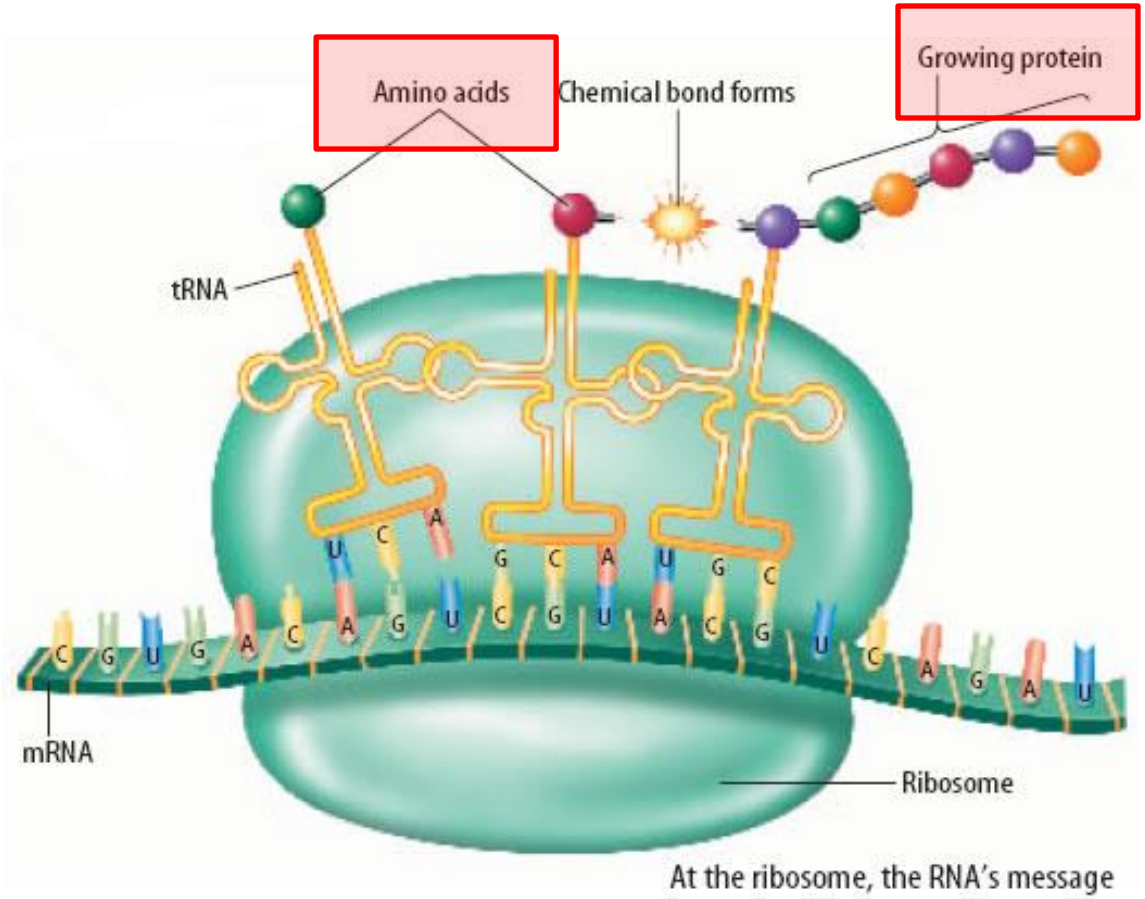
- **Messenger RNA (mRNA)-** code for translation
- **Ribosomal RNA (rRNA)-** forms part of ribosome
- **Transfer RNA (tRNA)-** brings amino acids from the cytoplasm to a ribosome to help make growing protein



13. What is the **monomer** of a **protein**? **amino acid.**

(There are 20 different amino acids that make up all proteins)

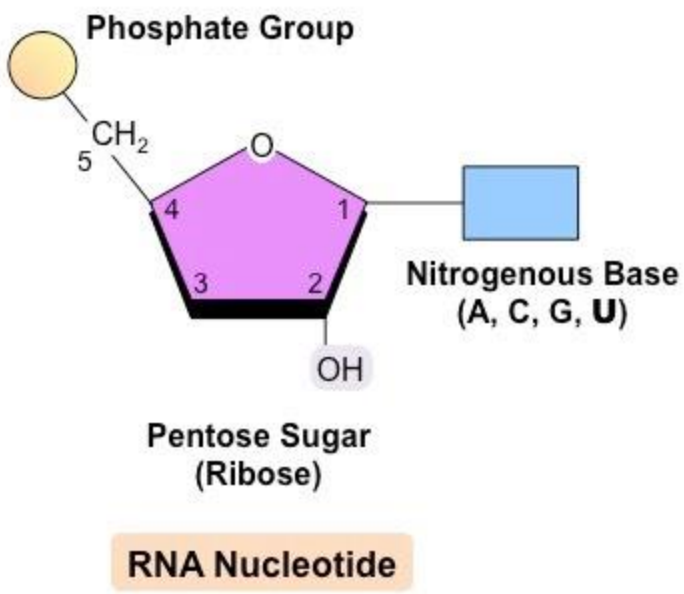


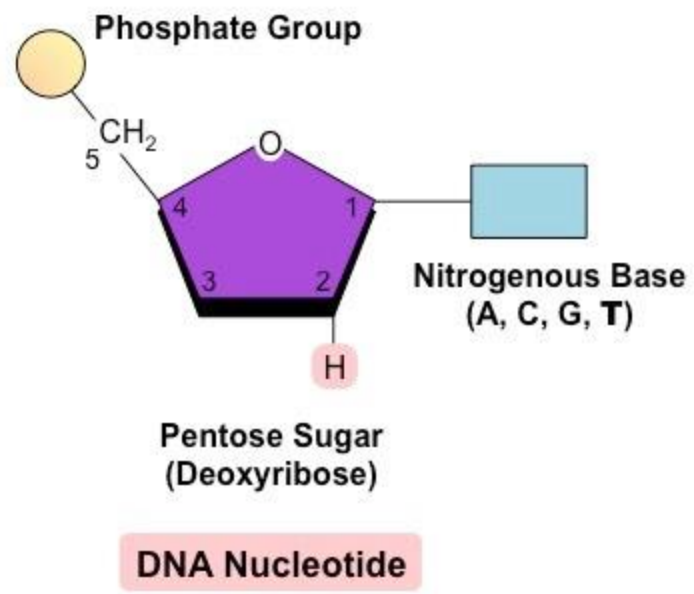


At the ribosome, the RNA's message is translated into a specific protein.

14. What is the **monomer** of a **nucleic acid**? A **nucleotide.**

- Nucleotides slightly different in DNA and RNA
- Sugars different
- One base different in RNA (*replace "T" with "U" in RNA*)





15. What are the similarities and differences of DNA and RNA?

Similarities:

- Both made of **nucleotides**
- Both made in the **nucleus** (in eukaryotes)
- Both carry **genetic code**
- Code read **3 bases at a time**

Differences: RNA differs from DNA in three significant ways

- **Sugar** in RNA is **ribose** not deoxyribose
- RNA has the base **uracil** in place of thymine
- RNA is **single stranded** not double

16. If one side of a DNA molecule contains the following sequence of nucleotides, **GCATTCGCA**, the complementary sequence on the other side would be:

GCATTCGCA

CGTAAGCGT

A's goes with **T's** and **C's** goes with **G's**

1 17. What would the mRNA molecule look like that is transcribed from the following DNA sequence?
GCATTCGCA

GCATTCGCA

CGUAAGCGU

A's goes with **U's** and **C** goes with **G's**

.

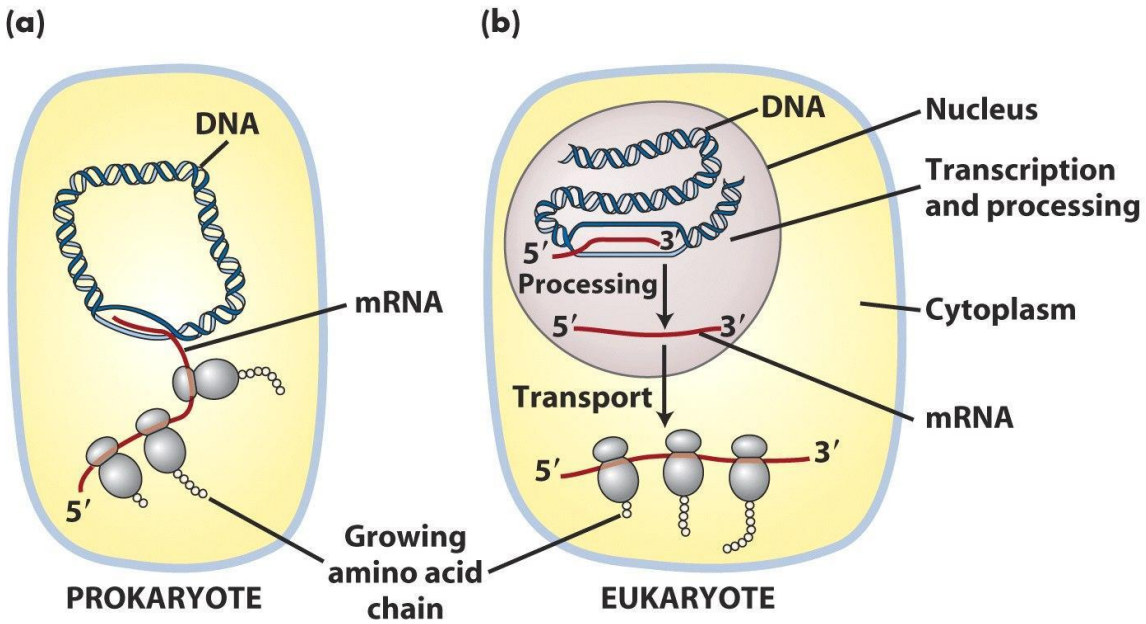
18. How do replication, transcription, and translation differ in **prokaryotes** and **eukaryotes**?

Prokaryotes

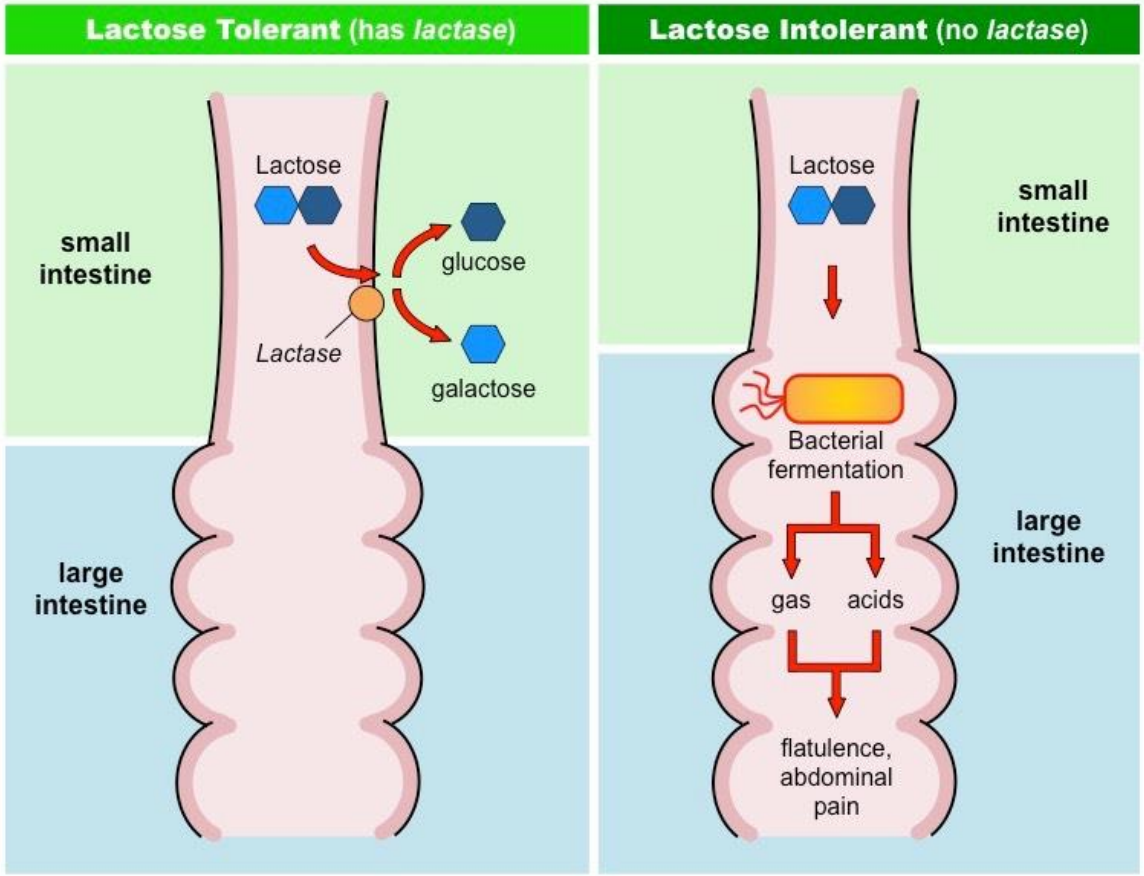
- **Replication**, **transcription** and **translation** occurs in cytoplasm (no nucleus)

Eukaryotes

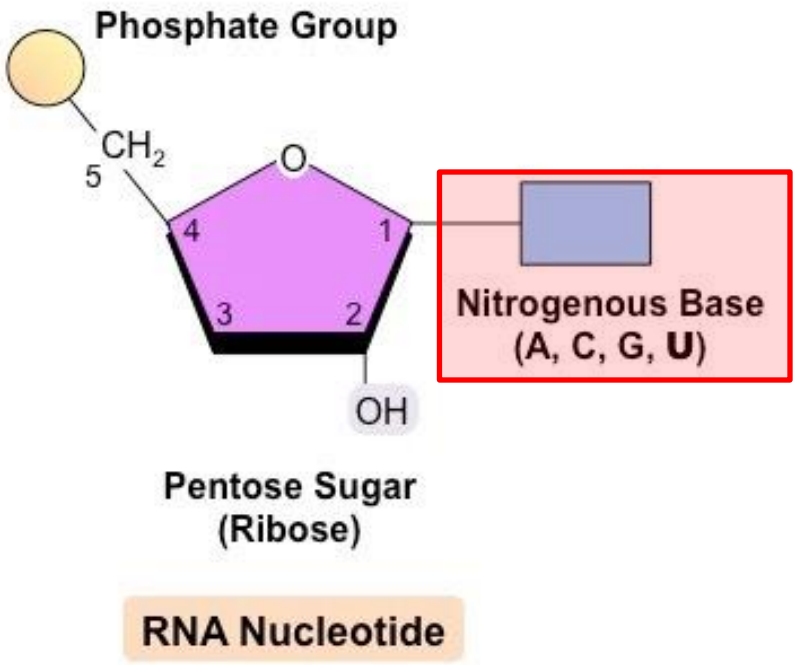
- **Replication** and **Transcription** in nucleus
- **Translation** occurs in cytoplasm

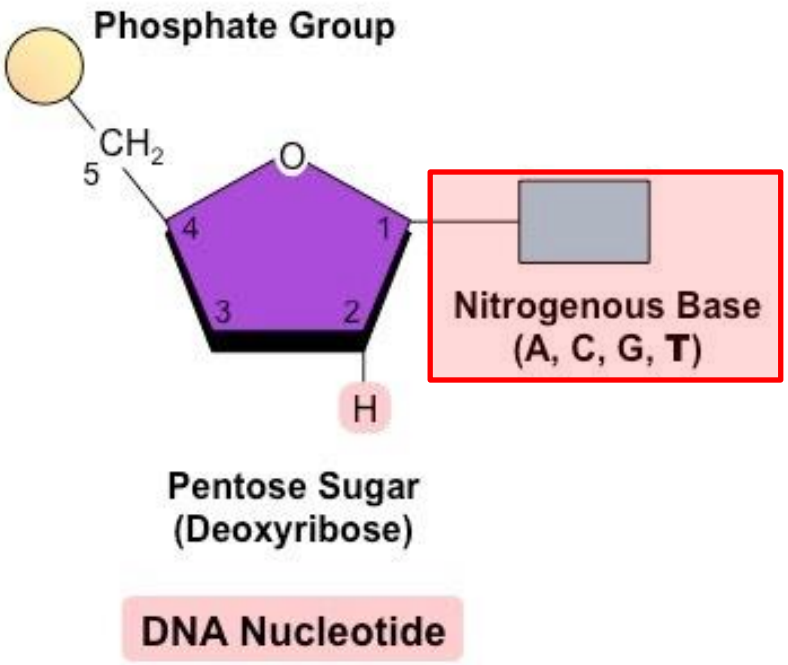


19. **Lactose tolerance**, also known as lactase persistence, is caused by? A **mutation** in the regulatory portion of the lactase gene causes the gene to stay "on" as adults allowing them to produce the enzyme lactase. The gene itself is unaffected.

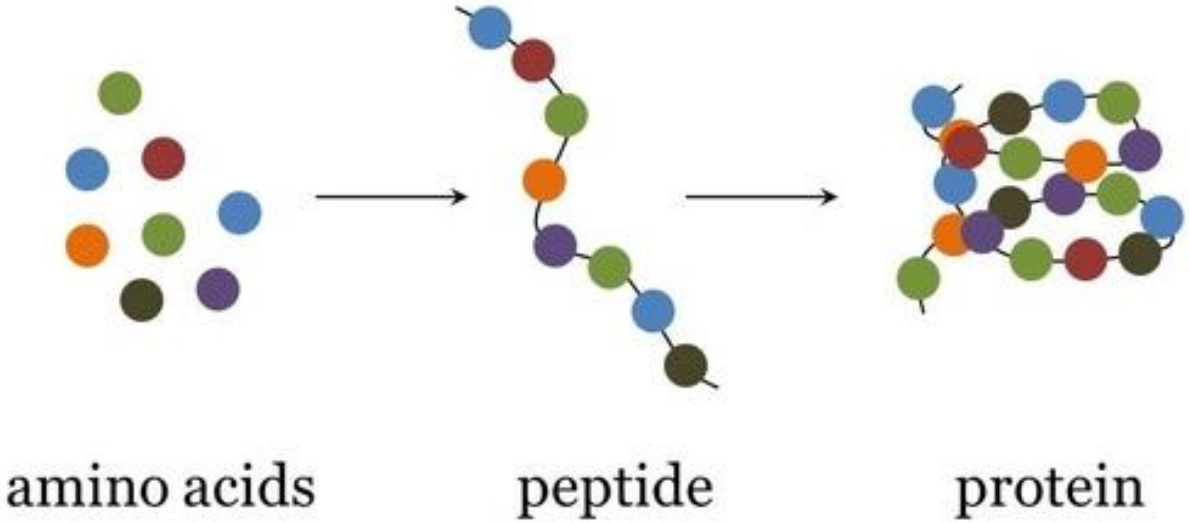


20. What is the <u>variable</u> portion of a **nucleotide**? The **nitrogen bases** differs. (*DNA: ATCG. RNA: AUCG*)



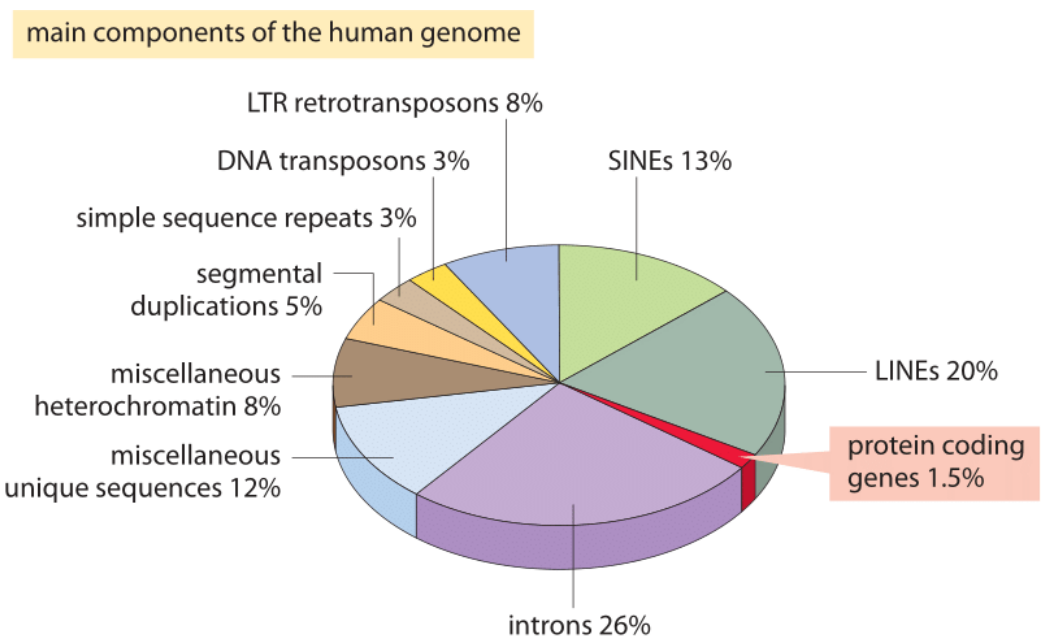


21. Even though there are only 20 amino acids thousands of different types of proteins can be made in the human body. How is this possible? The order and number of **amino acids** determines the specific protein structure. (*like spelling different words in English language*)
Each protein will 'fold' into a unique shape based on order of amino acids (*they form hydrogen bonds between specific amino acids and produce unique 3-D shape)*



22. Why is it possible that a **mutation** may <u>not</u> affect the **phenotype** of an individual?

- A mutation may be **silent**
- A mutation may <u>occur</u> in a **noncoding** region
- A mutation may <u>not</u> affect **protein folding** or the **active site.**
- A **point mutation** may still code for the same amino acid



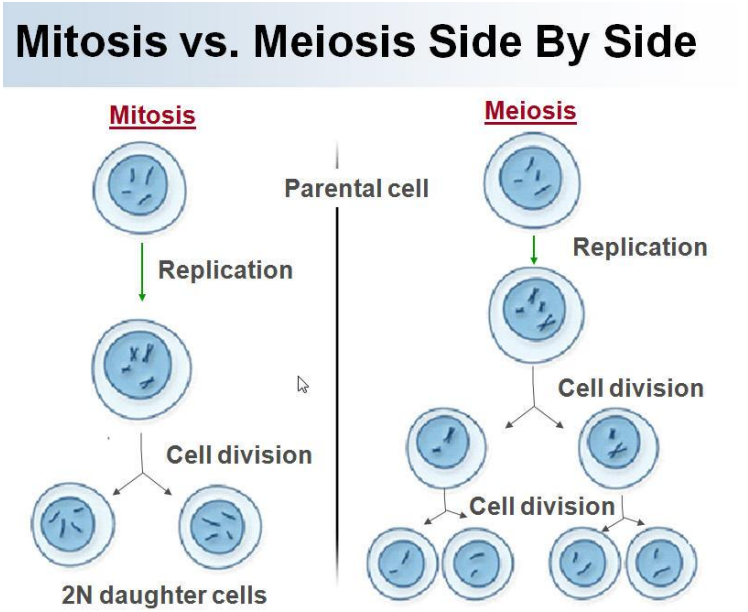
Second letter

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

23. What is the difference between a **germ cell** and a **somatic cell**? (Where are they found and how are they made?

Germ Cells: cells in your reproductive organs, the ovaries and testes. Germ cells undergo **meiosis** and develop into gametes (called sex cells). Form egg and sperm cells.

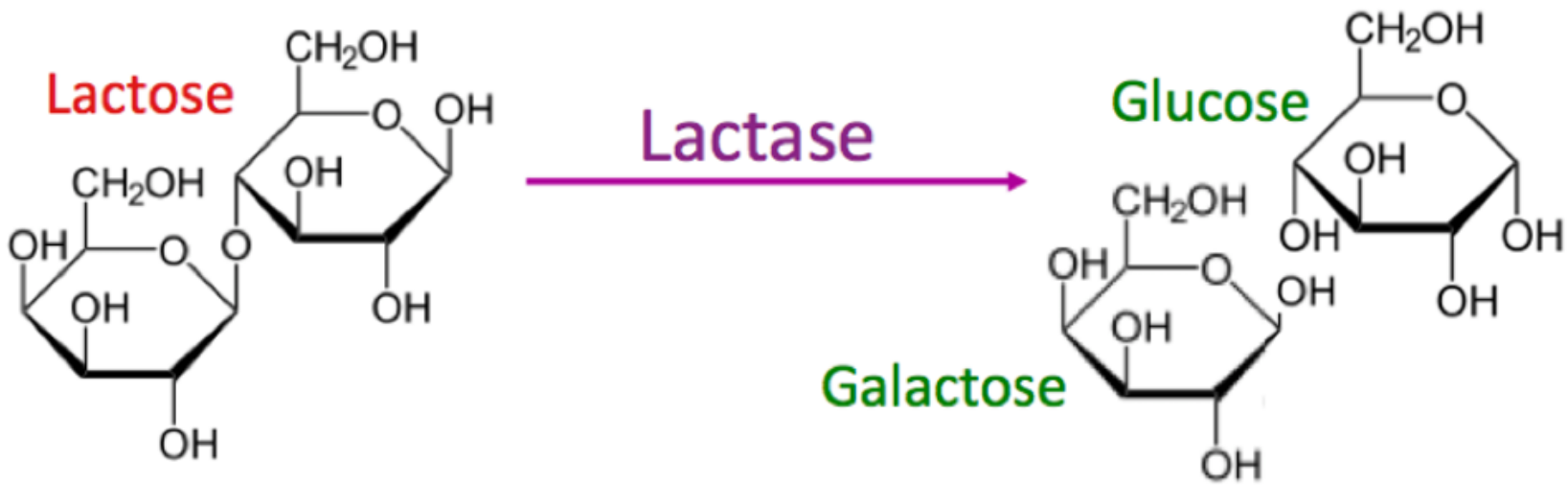
Somatic Cells: Also known body cells. They make up most of your body tissues and organs. Somatic cells produced by **mitosis**



24. What type of organic molecule is **lactose**?

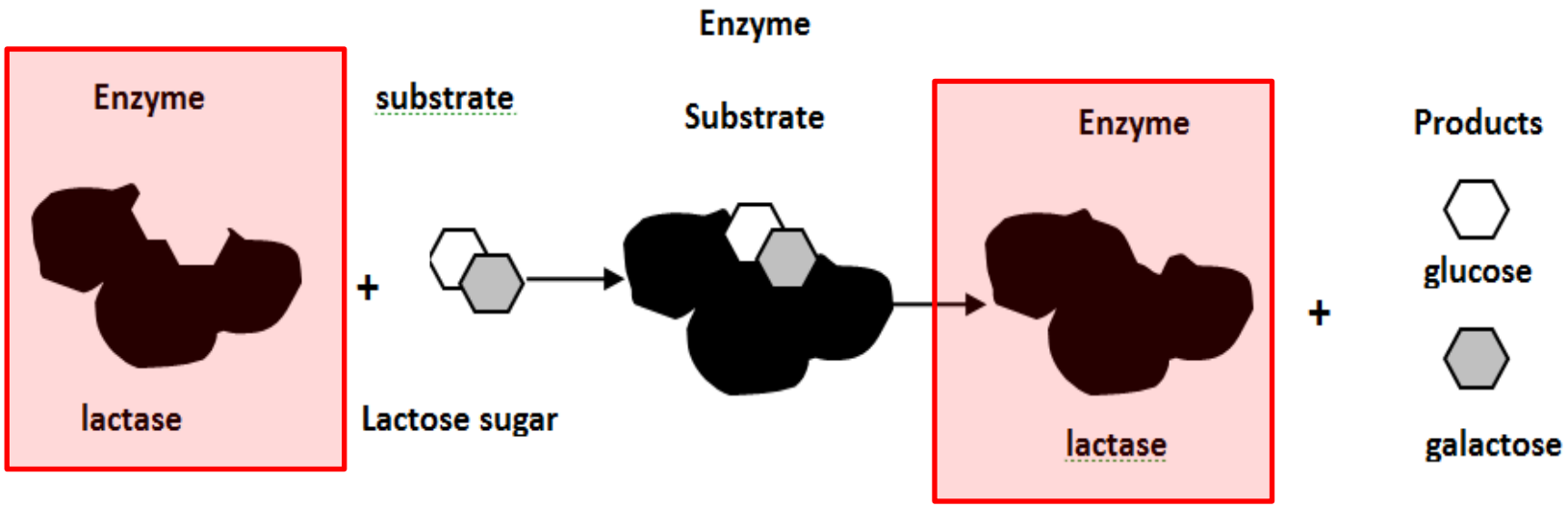
A carbohydrate

(*specifically lactose is a disaccharide. Sugars like lactose usually end in "…ose" whereas enzymes end in "…ase"*)



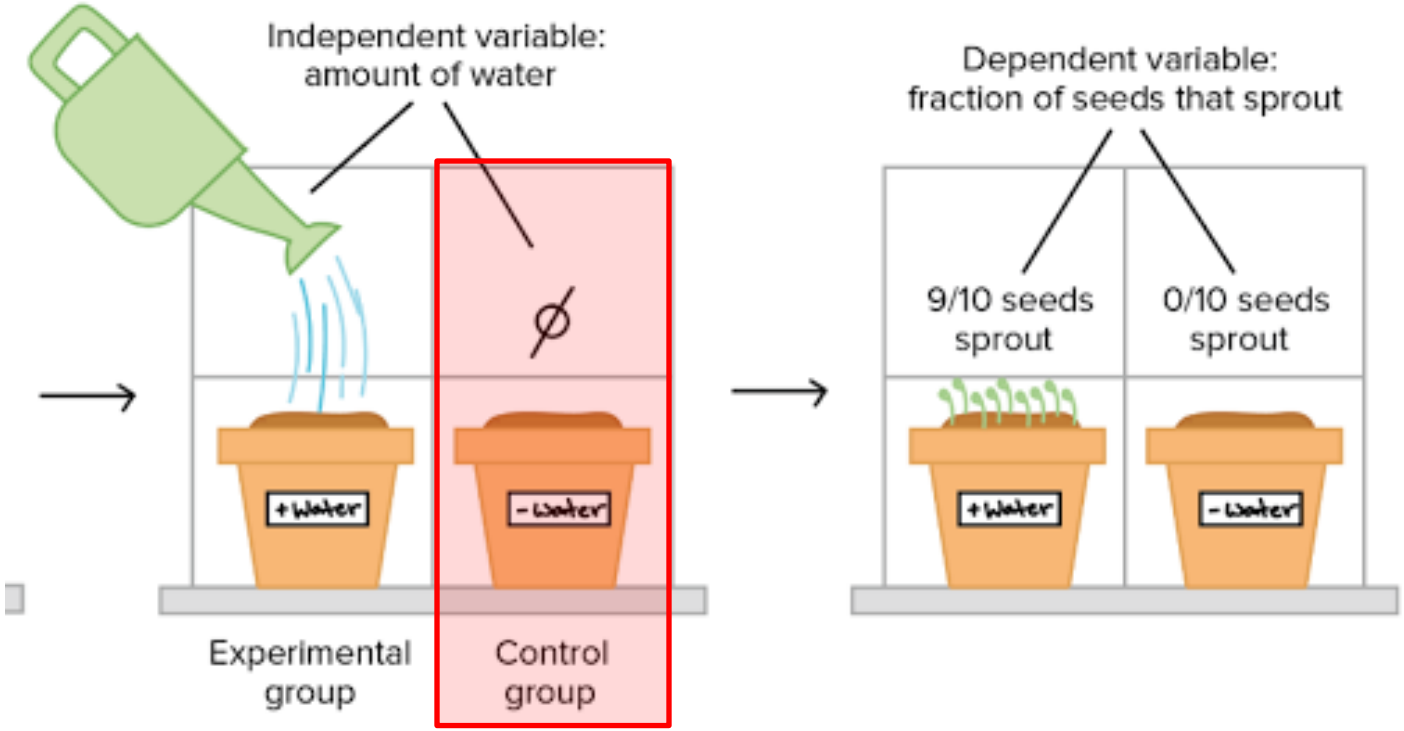
25. What type of organic molecule is **lactase**? **A protein.**
Lactase is an functional protein (*enzyme*).

(*Enzymes are not used up in reaction. They can be used over and over again*)



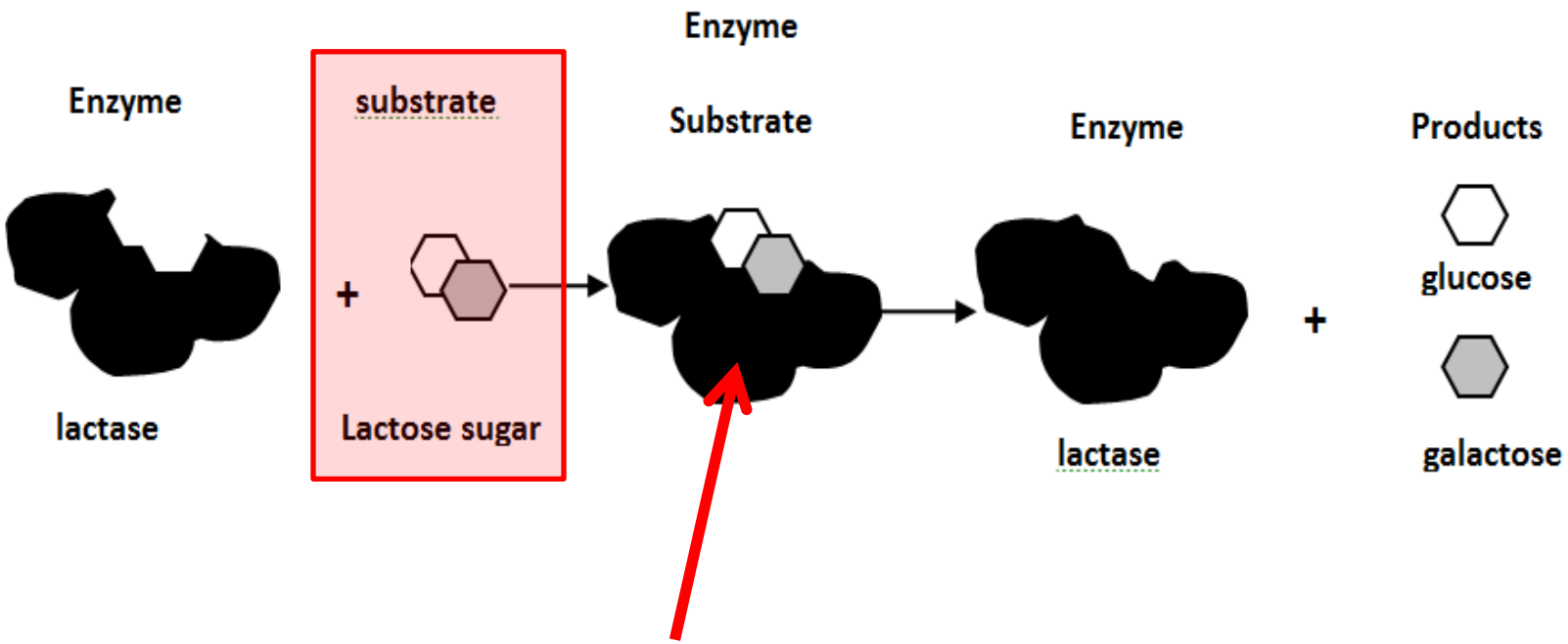
26. What was the **control** in the Lactose Intolerance lab?

Milk *(Milk was tested so we could compare results when lactase was added to the milk. It set a benchmark to compare with)*



In this experiment one of the plants is not given water so you can compare with plant that did.

127. Which molecule was the **substrate** in the Lactose Intolerance lab? **Lactose**

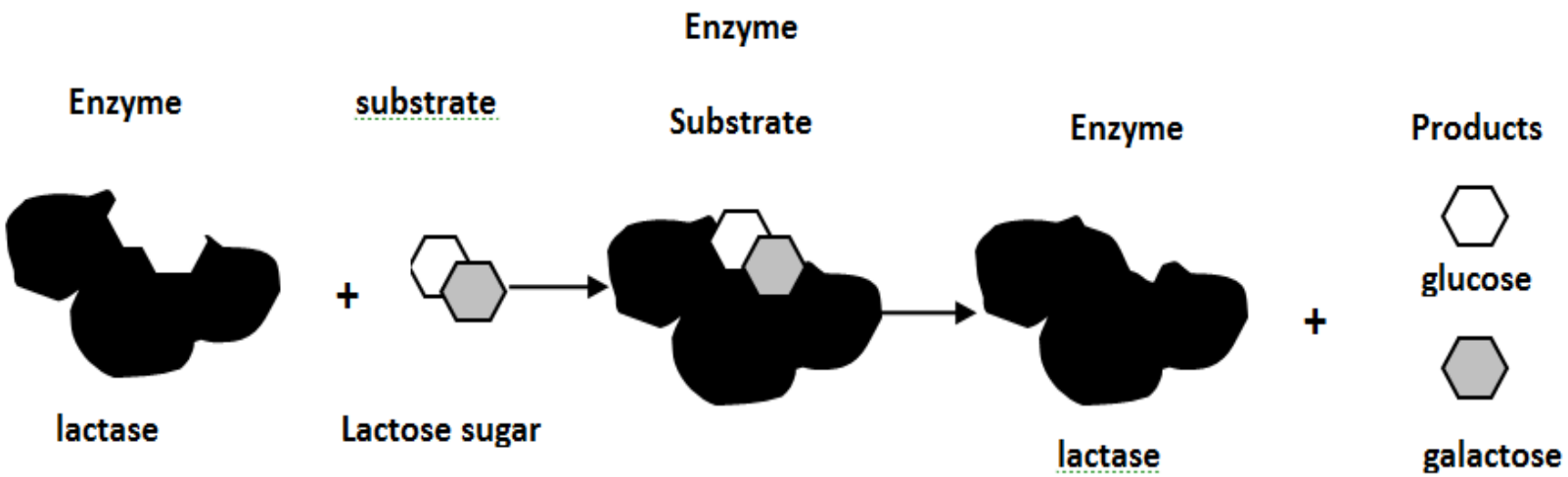


Unique 3-D shape of substrate matches unique 3-D shape of enzyme forming enzyme-substrate complex

28. Write a “word” **equation** for the breakdown of lactose. (*Include all reactants and products*.)

Lactase + lactose → lactase + glucose + galactose

Enzyme is both reactant and product



29. Why is **lactose tolerance** also called **lactase persistence**? A **mutation** caused the lactase gene to remain 'turned on' as an adult. These people are able to digest lactose (*lactose tolerant*) because the lactase gene is still turned on.