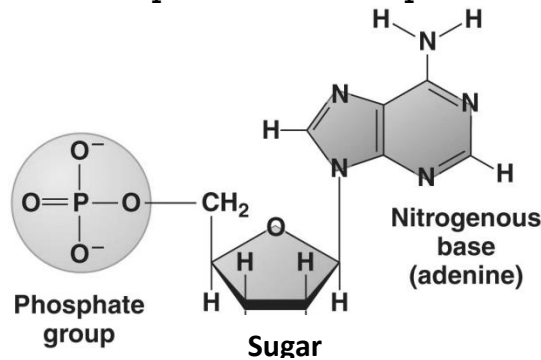


# Protein Synthesis Study Guide

Replication, Transcription & Translation

## DNA Basics:

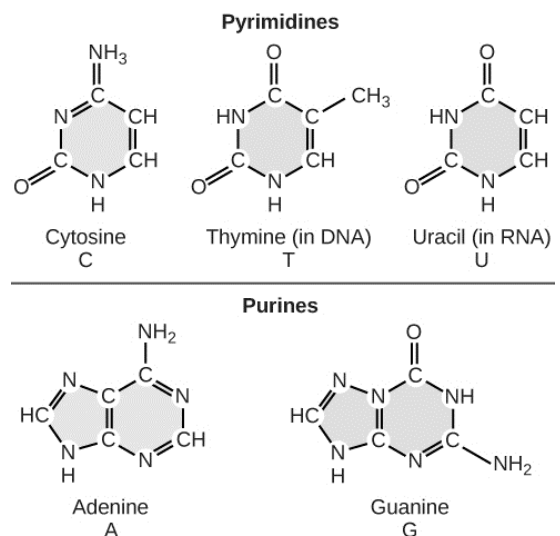
1. DNA and RNA belong to what macro/bio molecule? **Nucleic Acids**
2. What is the monomer (basic building blocks) of Nucleic Acids? **Nucleotides**
3. Label below the three basic parts that make up a nucleotide:



4. In 1950, a scientist by the name of Erwin Chargaff came up with a rule that he observed every organism had in their DNA, what was it?  
**Adenine and Thymine occur in equal percentages, and Guanine and Cytosine occur in equal percentages.**
5. Where is DNA found at in eukaryotic cells? **In the Nucleus**
6. Specifically, where is the genetic code found in DNA? **In the bases (the part with the letters)**
7. Define the words:
  - a. **Chromosome:** *found in the nucleus of most living cells, carrying genetic information in the form of genes.*
  - b. **Gene:** *What proteins code for*
  - c. **Amino Acids:** *Basic building blocks of proteins. Read in bases of three called CODONS*

## DNA Structure:

8. Watson and Crick built a model that demonstrated what about the DNA molecule?  
**Exact 3D model of DNA double Helix**
9. How is the structure of pyrimidines different from the structure of purines?



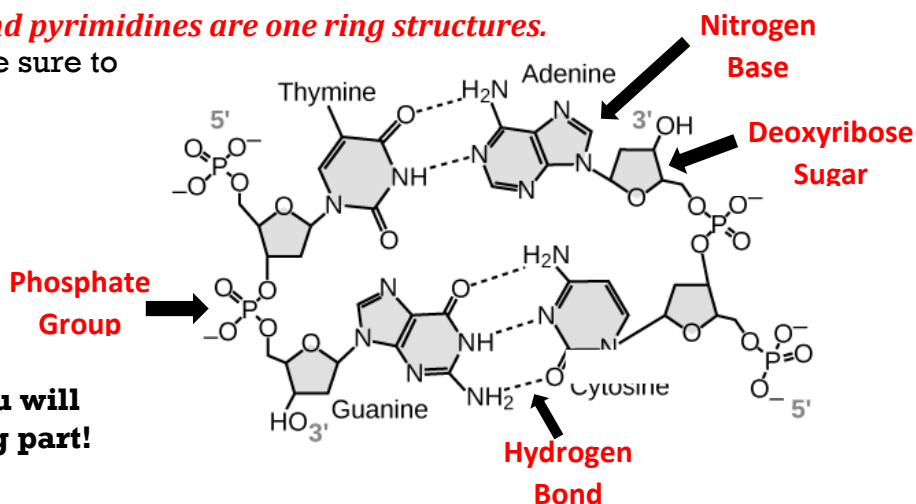
**Purines are two ring structures and pyrimidines are one ring structures.**

10. **Label** the diagram to the right, be sure to

identify the following:

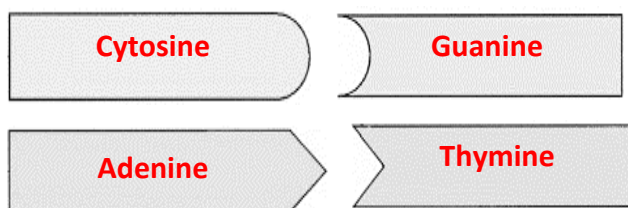
- Nitrogen bases
- Hydrogen bond
- Phosphate group
- Deoxyribose sugar

**On the exam, one may be missing you will need to be able to identify the missing part!**



## DNA Replication:

11. What are the 4 bases of DNA, and what always pairs with what?



12. What is the purpose of DNA replication? **To make an identical copy of DNA before the cell divides.**

13. Where in the cell does DNA replication take place? **In the nucleus**

14. The rules of base pairing would help you construct the other strand of DNA, because each strand could make the other, the strands are then called? **Complementary**

15. How many strands does DNA have? **Two (2)**

16. What does **semiconservative replication** refer to?

**At the end of replication the helix will contain one original strand and one new strand.**

17. What is a replication fork?

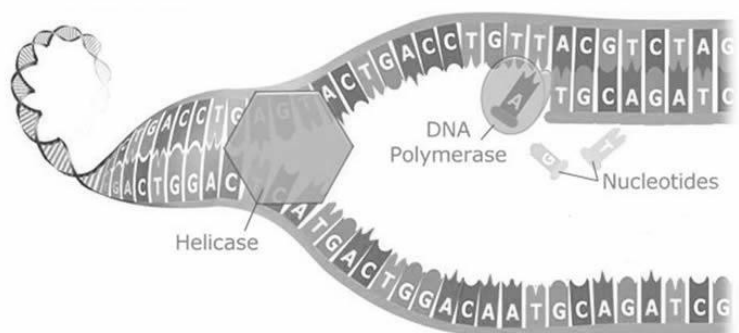
**The area of DNA where helicase opened the DNA helix**

18. Define what these very important

**enzymes** do during DNA replication:

**Be sure to know where they are located!**

- Helicase:** **The enzyme that “unzips” and “unwinds” the DNA strand.**
- DNA polymerase:** **The enzyme that synthesizes (makes) the DNA strand. Adds nucleotides one base at a time and proofreads the strand.**



19. The enzymes above belong to which macro/biomolecule group? **Proteins**

20. Be sure you know how to **replicate** a strand of DNA such as: T T A A C G C G C A T A C G

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

### RNA Structure:

21. What is RNA? **Ribonucleic**

**Acid: single stranded nucleic acid that work together with DNA to make proteins.**

22. What are the monomer/basic building block of RNA? **Nucleotides: Phosphate group + ribose sugar + a nitrogen base**

23. What is the 5-carbon sugar found in RNA? **Ribose**

24. What are the 4 nucleotides found in RNA?

**Guanine (G), Cytosine (C), Adenine (A), and Uracil (U)**

25. What are the 3 types of RNA molecules and what are their roles?

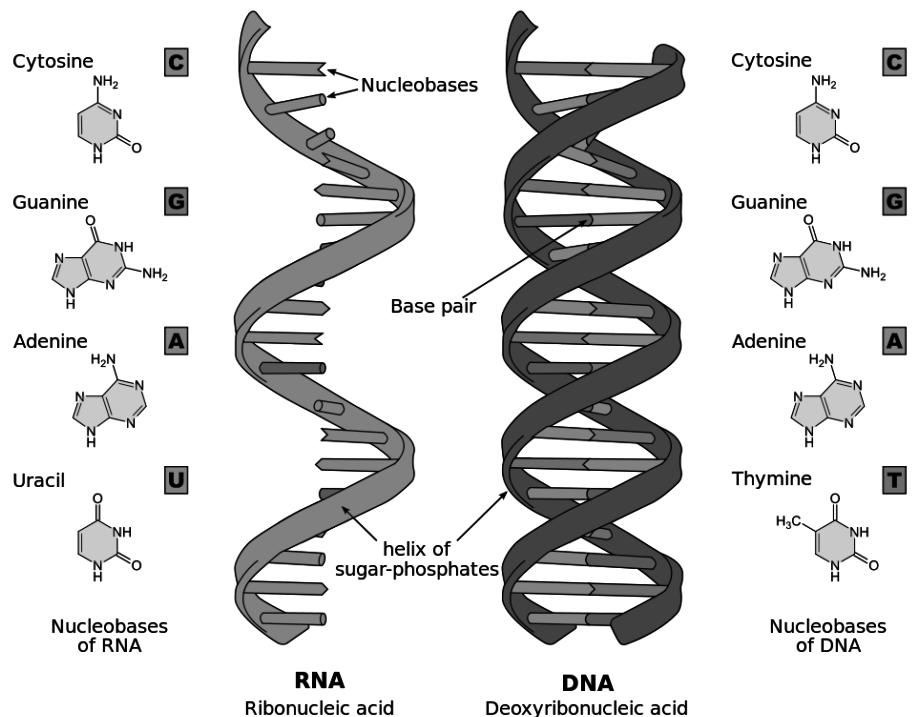
- mRNA: Carries message from DNA: contains the "language" of the genetic code**
- rRNA: forms ribosomes and assembles polypeptides (chains of amino acids)-Helps build the protein.**
- tRNA: transfers amino acids to ribosomes-It is the "translator" in protein synthesis. Brings the anticodon to mRNA to code for proteins.**

### Transcription:

26. What is transcription? **Transcription is the process that produces RNA from a sequence of DNA. The sequence of nitrogen bases on DNA is copied to a strand of RNA (mRNA).**

27. Where does transcription take place inside of the cell? **Inside the nucleus**

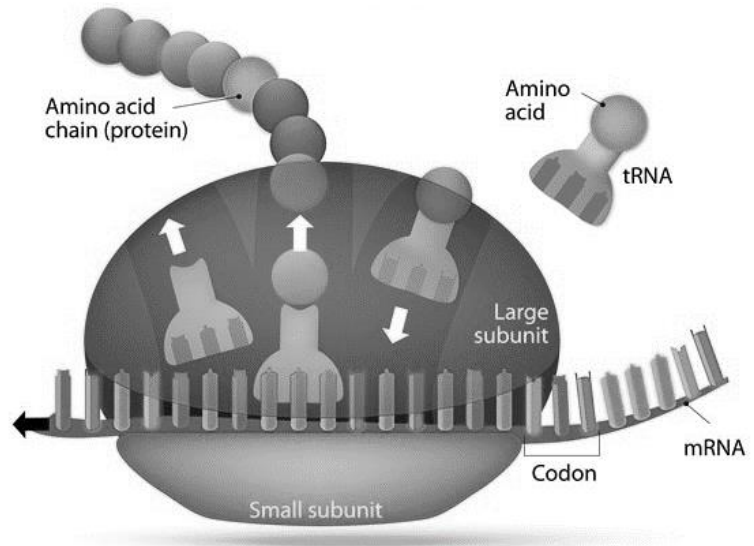
28. What is RNA polymerase? **The enzyme that transcribes RNA from DNA. It binds to DNA and the promoter and begins to insert individual nucleotides until a gene is transcribed.**



29. How does RNA polymerase know when to start transcribing a gene?

*When it comes across a specific area on DNA called promoter regions.*

30. What are **introns**? What are **exons**? *During RNA editing, introns are regions of RNA that are cut and discarded (known as the “junk”), while exons are spliced back together coding for proteins.*



*Know that the large and small subunits in the diagram make up a RIBOSOME!*

31. **Transcribe** the following DNA code: TTA GCG ATG GCT . *Remember to change to RNA*  
AAU CGC UAC CGA

**Translation:** *Protein synthesis*

32. What is translation? *The process that takes the code from DNA to mRNA then to assemble amino acids in a specified sequence to make a polypeptide (protein).*

33. Where does translation occur? *On/In the ribosome, located in the CYTOPLASM.*

34. What organelle inside of the cell helps with protein synthesis? *The RIBOSOME, the organelle the builds proteins.*

35. How does translation occur? *A strand of mRNA goes to the ribosome. The ribosome reads the message on the mRNA codon by matching the anticodons on the tRNA molecules. The ribosome forms bonds (polypeptides) between the amino acids.*

36. What are codons? *Codons are the nitrogen bases on mRNA grouped into clusters of three.*

37. How many codons are there? *With 4 different nitrogen bases grouped into groups of three, there are 64 different combinations; therefore, there are 64 different codons.*

38. What are anticodons? *Anticodons are three nitrogen bases on tRNA that have complementary matches on the mRNA. The anticodons distinguishes one tRNA from the other and helps build amino acids into proteins.*
39. What is the relationship between codons (mRNA) and anticodons (tRNA)? *The two are considered complementary as mRNA provides information on the order of amino acids and tRNA brings the anticodon with the specific code that matches up and codes for a particular amino acid, thus building proteins.*
40. How many **amino acids** are found in nature? *20 different ones.*
41. Why is the sequence of amino acids important? *The sequence of amino acids determine the TYPE of protein being made.*
42. What type of bond forms between the amino acids? *Polypeptide bonds.*

## Mutations:

43. What are mutations? *Changes that occur to the sequence of nitrogen bases on DNA that code for a protein. Causes permanent changes in a gene (what determines our traits).*
44. A mutation in the DNA usually occurs during which process? **Cell Division, Replication, Transcription or Translation?**
45. Why do mutations occur? *Mutations occur because of exogenous (outside) factors such as too much exposure to the sun or chemical/substance abuse or endogenous (internal) factors such as errors that happen in the cellular machinery.*
46. What are the two types of mutations? *Gene mutations and chromosomal mutations.*
47. What are the three types of **gene mutations**?  
*Substitution, insertion, and deletions*
48. What is a point mutation? What causes it?

*A point mutation is a form of a gene mutation where only a specific amino acids is affected. Happens in one or a few nucleotides. When nitrogen bases are replaced by a different nitrogen*

		2nd base in codon				3rd base in codon
1st base in codon		U	C	A	G	
	U	Phe Phe Leu Leu	Ser Ser Ser Ser	Tyr Tyr STOP STOP	Cys Cys STOP Trp	
	C	Leu Leu Leu Leu	Pro Pro Pro Pro	His His Gln Gln	Arg Arg Arg Arg	
	A	Ile Ile Ile Met	Thr Thr Thr Thr	Asn Asn Lys Lys	Ser Ser Arg Arg	
	G	Val Val Val Val	Ala Ala Ala Ala	Asp Asp Glu Glu	Gly Gly Gly Gly	

*base (substitution), a point mutation occurs for example.*

49. What is a frameshift mutation? What causes it?

*Frameshift mutations are mutations that change the entire sequence of codons when the DNA is transcribed. This changes ALL of the amino acids from the point of mutation. Deletion and insertions cause frameshift mutations.*

50. What are the 4 types of chromosomal mutations?

*Duplication, deletion, inversion, and translocation.*

51. How can mutations be harmful?

*Most mutations lead to CANCER. Other mutations, depending on its severity can cause death and deformities.*

52. How can mutations be beneficial? *Mutations lead to genetic diversity. Genetic diversity provides variations in organisms that could lead to better "fitness" in an environment or stronger, healthier, more productive crops.*