DNA and Protein Synthesis Notes

NAME_____ PERIOD_____

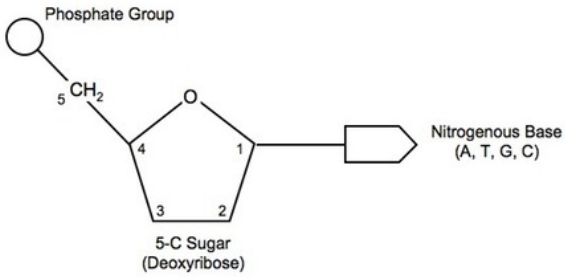
What is DNA?

Deoxyribonucleic Acid

DNA is made up of **nucleotide monomers**.

Nucleotides are made up of three parts

1. _____
2. _____
3. _____



Nitrogenous bases-There are 4 types of nitrogen containing bases found in DNA:

1. _____
2. _____
3. _____
4. _____

Nitrogenous bases that have two carbon rings are called _____ (adenine and guanine)

Nitrogenous bases that have a one carbon ring are called _____ (thymine and cytosine)

The nitrogenous bases pair in specific combinations.

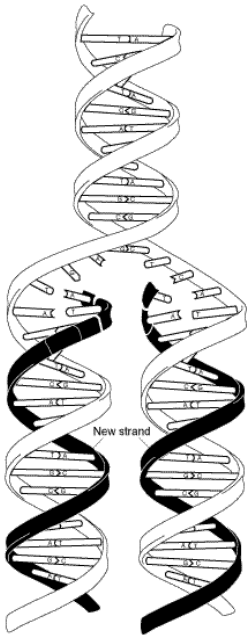
1. _____
2. _____

Double Helix: The shape of DNA was discovered in 1953 by _____

How is DNA made? Replication

The process of copying DNA in a cell is called _____.

1. The first step is when the two chains of DNA separate . The point at which they separate is called a replication fork. The chains are separated by enzymes called helicases.
2. Next, enzymes called _____ add complementary nucleotides to each strand.
3. End result-two copies of DNA that are identical to the original strand.



Replication occurs simultaneously at different sites along the DNA in order to speed up the replication process.

What is RNA? Ribonucleic Acid

- RNA is made up of _____ monomers.
- Only _____ chain of nucleotides
- Instead of thymine RNA uses _____.
- Types of RNA
    - _____ (messenger RNA) carries genetic information from the nucleus to the cytoplasm
    - _____ (transfer RNA) carries amino acids
    - _____ (ribosomal RNA) combined with proteins it forms ribosomes

How is RNA made? transcription

_____**:** The process by which genetic information is copied from DNA to RNA.

- Similar to DNA replication with a few exceptions:
- Only one side of the DNA strand is copied
- _____ is the enzyme that adds nucleotides to the strand.
- _____ is used in place of thymine.
- The whole DNA strand isn't copied transcription starts at a region of the DNA called the **promoter** and ends at a region called the **termination signal**.
- Transcription results in different types of RNA molecules (ex. mRNA, tRNA, rRNA)

How does RNA make protein? translation

Amino Acids are the monomers of proteins.

Vocabulary

- _____ Combination of three mRNA nucleotides that code for a specific amino acid.
- _____ AUG (methionine) signals for the ribosome to start translation
- **Stop Codon:** UAA, UAG, UGA signals for the ribosome to stop translation
- **Ribosomes**: composed of rRNA and protein and are found in the cytosol and on the RoughER.
- **Anticodon** Combination of three **tRNA** nucleotides that are complementary to and pairs with the mRNA codon

Steps of translation

1. Translation starts when a ribosome attaches to the start codon (AUG) on a strand of mRNA.
2. A tRNA with the anticodon UAC joins with the start codon (AUG) on the mRNA. The tRNA carries an amino acid (methionine)
3. The ribosome moves down the mRNA to the next codon and then a tRNA with the corresponding anticodon attaches to the mRNA.
4. The amino acids carried by the tRNA are joined together by a peptide bond.
5. The process repeats until the stop codon is reached and then the ribosome and amino acid chains

breaks away from the mRNA and translation is complete.

What about Mistakes?

a. DNA replication occurs with a high degree of accuracy-only 1 mistake per 10,000 base pairs.
    4. Proofreading enzymes detect and fix errors reducing rate to 1 per billion nucleotides.
    5. Still errors do occur.
b. Mutagens can damage DNA
    1. UV light
    2. chemicals

Mutations

_____: occur in gametes.

_____: occur in body cells.

_____: cause death often before birth

Point Mutations- involve segments of DNA or a single nucleotide in a codon.

_____: one nucleotide is replaced with a different nucleotide.

normal DNA: AATTCCGGA

mutated DNA: AAATCCGGA

_____: occurs when one or more nucleotides are added or deleted. Tend to have serious effects.

normal DNA: AATTCCGGA

mutated DNA: AAATTCCGGA

mutated DNA: ATTCCGGA

DNA/RNA Comparison

Attribute	DNA	RNA	Protein
1. Is it a nucleic acid?			
2. Is it a polymer?			
3. If so, name the monomer:			
4. What is the structure:		1. 2. 3.	
5. What is its sugar?			N/A
6. Name its nitrogen bases:	1. 2. 3. 4.	1. 2. 3. 4.	N/A
7. Where is it found?	Prokaryotes- Eukaryotes-	mRNA tRNA rRNA	
8. How is it made?			
9. What are its jobs?	1. 2. 3.	1. 2.	

(a) RNA Codons for the Twenty Amino Acids

First base	Second base U	Second base C	Second base A	Second base G	Third base
U	Phe	Ser	Tyr	Cys	U
	Phe	Ser	Tyr	Cys	C
	Leu	Ser	STOP	STOP	A
	Leu	Ser	STOP	Trp	G
C	Leu	Pro	His	Arg	U
	Leu	Pro	His	Arg	C
	Leu	Pro	Gln	Arg	A
	Leu	Pro	Gln	Arg	G
A	Ile	Thr	Asn	Ser	U
	Ile	Thr	Asn	Ser	C
	Ile	Thr	Lys	Arg	A
	Met (start)	Thr	Lys	Arg	G
G	Val	Ala	Asp	Gly	U
	Val	Ala	Asp	Gly	C
	Val	Ala	Glu	Gly	A
	Val	Ala	Glu	Gly	G

Amino-acid abbreviations

Ala = Alanine
Arg = Arginine
Asp = Aspartic acid
Asn = Asparagine
Cys = Cysteine
Glu = Glutamic acid
Gln = Glutamine
Gly = Glycine
His = Histidine
Ile = Isoleucine
Leu = Leucine
Lys = Lysine
Met = Methionine
Phe = Phenylalanine
Pro = Proline
Ser = Serine
Thr = Threonine
Trp = Tryptophan
Tyr = Tyrosine
Val = Valine

Transcription/Translation Practice

DNA	mRNA	tRNA	AMINO ACID
G	C	G	
T	A	U	
A	U	A	
C	G	C	
C	G	C	
T	A	U	
T	A	U	
G	C	G	
C	G	C	
A	U	A	
T	A	U	
C	G	C	

1. Which column has the codons?
2. Which column has the anticodons?
3. Which molecule carries the amino acid?

4. Look at the table above. What is the difference between columns 1 and 3?

5. How is transcription different than translation?

6. Protein synthesis can be compared to production in a factory:

   Information in the product blueprints (_____) is carried to the work site (_____) by messengers (_____). Carts (_____) deliver materials (_____) needed by the assembly line workers to produce the final product (_____).

7. How many different amino acids are there?

   Why do you think a codon is three nitrogen bases long?

   Would a system with two bases per codon work to code for amino acids?

8. How many codons code for the amino acid valine?Why do you think this is so?

Practice Test

1. List 2 differences between DNA and RNA. Say something about RNA and DNA for each answer.

2. Fill in the table below:

DNA	mRNA	tRNA	Amino Acid (pg 194)
	U		
G			
		U	

a. List the codon from the table above_____

b. List the anticodon from the table above _____

Matching

Match the correct answer(s) to each clue. There may be more than one answer for each clue.

a. DNA b. mRNA c. rRNA d. tRNA

1. _____ Directs which protein is being made
2. _____ Found in the cytoplasm
3. _____ When combined with protein it makes up a ribosome

4. _____ Found only in the nucleus
5. _____ Formed by transcription
6. _____ Involved in translation
7. _____ Contains codons
8. _____ Contains anticodons
9. _____ Formed by replication
10. _____ Contains thymine

Matching: Match the correct answer(s) to each clue. **There may be more than one answer for each clue.**

a. DNA b. RNA c. protein

1. the monomer is a nucleotide
2. contains adenine
3. contains amino acids
4. is formed by translation
5. contains uracil
6. is found in ribosomes
7. is formed by transcription

Short Answer

1. Why are STOP and START codons needed?

2. Which type of nitrogen base has a double ring?

3. Which enzyme is responsible for separating the two chains of DNA?

4. Which enzyme adds nucleotides during replication?

5. Which enzyme adds nucleotides during transcription?

6. What is the end result of transcription?

7. What is the end result of translation?

8 What is the end result of replication?

9. What do we call a polymer made up of amino acid monomers?

10. Where does protein synthesis occur?

11. Name the molecules that proofread DNA and fix errors during replication: _____

12. Name the 3 parts of a nucleotide_____

13. Name the 5 carbon sugar found in RNA _____

14. Name the 5 carbon sugar found in DNA _____

15. Name the parts of the nucleotide that make up the backbone of DNA (hint: licorice)

_____

16. Name the part of the nucleotide that make up the rungs of the DNA (hint: marshmallow)

_____

17. What is the shape of mRNA?

_____