

Unit 7: Genetics - Protein Synthesis Notes



Cells are remarkable – they “know” how to do a great deal

- Cells transport materials, _____, produce _____ and _____.
- Cells are preinstructed by a code or programmed how to do these functions.
- A genetic code must be able to _____ itself quickly and accurately and must also have a means of being decoded and put into effect.

DNA: The Molecule of Heredity

The genetic information held in the molecules of DNA ultimately determines an organism's traits. DNA is the information for life – _____. Living things contain proteins in skin, muscle, bone etc. All actions, such as eating, running, and even thinking, _____. Enzymes are critical for an organism's function because they control the chemical reactions needed for life.

DNA Structure

DNA is a polymer (long chain) of _____ located in chromosomes in the nucleus of cells.

Nucleotides have 3 parts:

1. _____
 - The simple sugar in DNA is called _____.
2. _____
 - The phosphate group is composed of one phosphorus surrounded by four oxygens.
3. _____
 - A nitrogen base is a _____.
 - There are four possible nitrogen bases which attach to the 5-carbon sugar: _____ (A), _____ (G), _____ (C), and _____ (T)



Watson and Crick

In 1953, James Watson and Francis Crick published a journal article proposing the following ideas:

1. That DNA is made of _____ joined together by nitrogen bases. The nitrogen bases of the nucleotides hold the two strands of DNA together with _____.
2. The two strands can be held together in this way because they are _____. The two bonded bases are called _____.
 - _____ pair together and _____ pair together

3. _____, its shape is called a _____
_____. More than 6ft of DNA is coiled into the 46 chromosomes of each cell.
4. All organisms are made of these 4 nucleotides, but their genetic information is different because a nucleotide sequence A – T – T – G – A – C carries different information than the sequence T – C – C – A – A – A. The closer the relationship between two organisms, the _____.

Replication of DNA

A sperm cell and an egg cell of a fruit fly, both produced through _____, unite to form a fertilized egg. From one fertilized egg, a fruit fly with billions of cells is produced by the process of _____. Each cell has a _____ that was in the original fertilized egg. The DNA in the chromosomes is copied in a process called _____.

During replication, _____
_____.

Steps of DNA Replication:

1. An _____ breaks the hydrogen bonds between nitrogen bases that hold the two strands together, thus _____.
2. As the DNA continues to unzip, new nucleotides floating free _____
_____. Another enzyme bonds these new nucleotides into a chain.
3. This process continues until the entire molecule has been unzipped and replicated. Each new strand formed is a _____ of one of the original, or parent, strands.
4. The result is _____.

From DNA to Protein

The double helix structure explains how DNA can replicate, but it does not explain how information is contained in the molecule or how the information is put to use.

The information that DNA transfers to RNA directs protein synthesis. Why proteins and not other molecules? _____.

For instance, some proteins:

- _____
- become walls of _____
- _____
- direct the synthesis of _____
_____, and cell structures

Other proteins such as enzymes, control chemical reactions that perform life functions like:

- breaking down glucose molecules in _____ and respiration
- digesting food
- making _____ fibers during _____

You have learned that proteins are _____. The _____ in each gene contains information for assembling the string of amino acids that _____.

RNA: ribonucleic acid

RNA structure:

- _____
- contains the sugar _____
- contains the bases _____ (A), _____ (G), _____ (C), and _____ (U)

Differences Between DNA and RNA

1. DNA is _____ stranded, RNA is _____ stranded
2. DNA contains the sugar _____, RNA contains the sugar _____
3. DNA uses bases A, G, C, and T, RNA uses bases A, G, C, and U
4. DNA _____ leave the nucleus, RNA _____ leave the nucleus

There are 3 types of RNA

1. _____ RNA (mRNA)
 - brings information from the DNA in the nucleus to the cytoplasm
2. _____ RNA (rRNA)
 - clamps onto the mRNA and use its information to assemble the amino acids in the correct order
3. _____ RNA (tRNA)
 - reads the mRNA and transports amino acids to the ribosome to be assembled into a protein

Transcription

Process in which the base sequence of DNA is transferred to a molecule of RNA.

Enzymes make a mRNA copy from the DNA strand in the process of _____ which is similar to that of DNA replication.

Steps in Transcription:

1. An _____ double helix and RNA bases come in and pair forming a single strand of RNA.

2. The mRNA single strand leaves the nucleus and goes to the _____
_____.
3. This single strand of mRNA has copied (transcribed) and carried the DNA information from the nucleus to the _____ – the site of protein synthesis.

The Genetic Code

- The nucleotide sequence transcribed from DNA to a strand of mRNA acts as a genetic message, the _____.
- This genetic message is written in a language that uses _____ as its alphabet.
- Every 3 nucleotides is called a _____ and codes for _____.
(words)
- The _____ in the nucleotides will determine the type and order of amino acids in a protein. (Sentence)
- Proteins are built from _____. There are _____, but only _____ types of bases.
- _____ is the start codon to start the formation of a protein. UAA, UAG, UGA are all stop codons which indicate that the protein is complete.

Translation

Translation: the process of converting the information in a sequence of nitrogen bases in mRNA into a sequence of _____ that makes up a protein.

- Translation takes place at the _____ in the _____.
- _____ leaves the _____ and travels to the cytoplasm where ribosomes attach to them.
- tRNA brings the amino acids to the ribosomes. Each tRNA attaches to only 1 type of amino acid.
- On the _____. The anticodon contains the bases that pair up with each codon of mRNA, therefore placing the amino acids in the appropriate order to make the protein.
- The _____ forms a temporary bond with the _____ of the mRNA strand.
- The ribosome slides down to the next codon and a new tRNA brings another amino acid.

- The _____, the first tRNA releases it's amino acid and detaches from the mRNA.
- When a _____ is reached translation ends.

Answer the following Questions:

1. Draw and describe the structure of a nucleotide.
2. How do the nucleotides in DNA pair?
3. Why is DNA replication necessary to life?
4. The sequence of bases on one strand is GGCAGTTCATGC. What would be the complimentary sequence of bases on the complimentary strand?
5. Sequence the steps that occur during DNA replication.
6. What is the function of RNA?

7. What are the 3 differences between RNA and DNA?

8. What is a codon and what does it represent?

9. What is the role of transfer RNA in protein synthesis?

10. Why is it important that a signal to stop DNA replication be part of the cell cycle?

11. Using the base pairing rules, identify the bases on the mRNA strand that are transcribed from the following DNA strands: ACCGTCAC, TCGCACGT.

12. Sequence the steps involved in protein synthesis, from the production of mRNA to the final translation of the DNA code.

13. The following is a sequence of bases on one strand of a DNA molecule:
A A A T G C C A T C C G T C A
- Write the sequence of bases that make up the complimentary DNA strand.
 - Draw this DNA molecule.
 - What bases sequence in mRNA would the first DNA strand code for?
 - What sequence of amino acids would this mRNA strand code for?
14. Suppose your DNA model began with the sequence ATCCTCGGA. Consider what would happen when the mRNA was translated. Why would your sequence be an unlikely one for DNA? Show your work.