

Chapter 12: Molecular Biology of the Gene

1. Describe the properties a substance must possess in order to serve as the genetic material.
2. Describe the experiments and discoveries that demonstrated that DNA was the genetic material.
3. Explain and diagram the major features of DNA structure.
4. Explain how the replication of DNA is semiconservative.
5. Explain the major steps in DNA replication, including the enzymes needed for each step.
6. Compare DNA replication in prokaryotes and eukaryotes.
7. Examine how eukaryotic cells use telomerase to fully copy linear chromosomes.
8. Explain the central dogma of molecular biology.
9. Describe the structure and function of the three major classes of RNA.
10. Determine the amino acid sequence specified by an mRNA sequence.
11. Explain how the genetic code is degenerate, unambiguous, and universal.
12. Distinguish the events of transcription that occur during formation of an mRNA molecule.
13. Describe the three major modifications that occur during the processing of an mRNA.
14. Explain the potential evolutionary benefits of alternative mRNA splicing.
15. Describe the roles of mRNA, tRNA, and rRNA in translating the genetic code.
16. Describe the events that occur during the three major steps of translation.
17. Explain how DNA becomes sufficiently compacted to fit inside a nucleus.

Past AP Exam Essay Questions

1999 Question 4

Scientists seeking to determine which molecule is responsible for the transmission of characteristics from one generation to the next knew that the molecule must (1) copy itself precisely, (2) be stable but able to be changed, and (3) be complex enough to determine the organism's phenotype.

- Explain how DNA meets each of the three criteria stated above.
- Select one of the criteria above and describe experimental evidence used to determine that DNA is the hereditary material.

2003 Form B Question 1

A difference between prokaryotes and eukaryotes is seen in the organization of their genetic material.

- Discuss the organization of the genetic material in prokaryotes and eukaryotes.
- Contrast the following activities in prokaryotes and eukaryotes:
 - Replication of DNA
 - Transcription or translation
 - Cell division

2005 Question 2

The unit of genetic organization in all living organisms is the chromosome.

- Describe the structure and function of the parts of a eukaryotic chromosome. You may wish to include a diagram as part of your description.
- Describe the adaptive (evolutionary) significance of organizing genes into chromosomes.
- How does the function and structure of the chromosome differ in prokaryotes?

2005 Form B Question 3

Protein synthesis is vital for cell growth and metabolism.

- Describe transcription and translation.
- Identify similarities between transcription and translation.
- Identify differences between transcription and translation.
- Describe structural changes that can occur to a protein after translation to make it function properly.

2007 Form B Question 3

A molecule of messenger RNA (mRNA) has just been synthesized in the nucleus of a human cell.

- What types of modifications may occur to this RNA before it leaves the nucleus?
- Once in the cytoplasm, how is the mRNA translated to a protein?
- If the cell is a secretory cell, how is the protein from part (b) eventually targeted, packaged, and secreted to the exterior of the cell?

2012 Question 3

Information flow in cells can be regulated by various mechanisms.

- Describe the role of THREE of the following in the regulation of protein synthesis:
 - RNA splicing
 - repressor proteins
 - methylation
 - siRNA
- Information flow can be altered by mutation. Describe THREE different types of mutations and their effect on protein synthesis.
- Identify TWO environmental factors that increase the mutation rate in an organism, and discuss their effect on the genome of the organism.
- Epigenetics is the study of heritable changes in the phenotype caused by mechanisms other than changes in the DNA sequence. Describe ONE example of epigenetic inheritance.