DNA and PROTEIN SYNTHESIS

The identity of each cell is determined by a genetic code which is within the DNA molecule. DNA provides the blueprint for replicating cell structures and building organic compounds used in new cells. The following questions will review some of the major concepts in protein synthesis and DNA structure and function. Required reading for this section is Chapter 25: Molecular Basis of Inheritance (pp. 501 - 523.

DNA Compared to RNA

1. Using the chart below, compare DNA to RNA. *(pp. 41)*

	DNA	*RNA*
Type of compound		
Number of strands		
Type of bases		
Type of sugar		

Structure of DNA

(pp. 40), pp. 504)

DNA is the master molecule of the cell. Without DNA, cells would not grow and new cells could not be produced. Knowing the structure of DNA helps us understand more about cell function.

1. DNA is classified as what type of compound?

2. Look at *figs. 25.2* and *pages 504* and read the text on "structure of DNA" *pages 504* and answer the following questions:

   a. Describe DNA's shape.

   b. How many strands are contained within DNA?

   c. What type of bonds are holding the molecule together?

   d. What components make up the backbone of DNA?

   e. Name the 4 types of bases found in DNA.

   _____

   _____

   _____

   _____

f. What type of sugar is found in DNA?

3. In *fig. 25.2b page 504* you will see that each nitrogen base in sequence will have a partner or complementary base adjacent to it. Describe how the bases are paired in DNA. (*Note*: read the section on complementary base pairing rules on page 504 before answering this question).

4. Show that you understand complimentary base pairing rules by filling in the complementary strand for the following DNA strand:

DNA	*New Strand*
–A	–
–C	–
–G	–
–A	–
–T	–
–T	–
–A	–
–G	–

5. Adenine and Guanine are *purines*. Cytosine and Thymine are *pyrimidines*. Look at the DNA molecule shown in *fig 25.2 page 504* How are the purine and pyrimidines arranged within DNA?

6. Why does the number of purines always equal the number of pyrimidines in a DNA strand?

DNA Replication
(pp. 505)

DNA is capable of replicating identical copies of itself to produce new strands of DNA for each new cell being produced. In this way, the new cells receive the code from parent DNA. Otherwise skin cells would not know how to become skin cells! The following questions will help you understand DNA replication.

1. Look at *fig.25.3 page 505* DNA replication. (Read "Replication requires the following steps..." *page 505*). Write a summary list of the main events in DNA replication. Use the headings below to guide your ideas.

    a. unzipping of the molecule
    b. complimentary base pairing
    c. formation of the uprights
    d. end result

2. Let's see how well you learned about DNA replication from the video and the diagram. Below is a jumbled sequence of the events that occur during DNA replication. Place the statements below in the order that correctly represents DNA replication.

    _____ New complementary nucleotides move into place along the DNA template and base pair.
    _____ Two new DNA stands are now present, identical to each other.
    _____ DNA unzips as weak hydrogen bonds break.
    _____ Adjacent nucleotide sugar-phosphates bond together forming a chain.
    _____ DNA polymerase breaks the bonds on DNA.

3. Recognize and be able to explain the diagram *fig.25.3 p.505.*

Protein Synthesis: The Process

(p. 506-512

Cells continually make proteins by linking tegether amino acids into chains. The process of protein synthesis occurs in a series of steps. We will look how the body synthesizes protein in the following videos and written exercises.

1. Protein synthesis is divided up into two stages: *transcription* and *translation*. Define these terms. *(p. 508)-9*

    a. transcription:

    b. translation:

2. Note that there are 3 types of RNA's used in protein synthesis, they are listed below. Each of these 3 RNA's plays an important role in the making of a protein chain. Where in the cell are the following RNA's produced?

RNA	*Where they are produced*
mRNA	_____
tRNA	_____
rRNA	_____

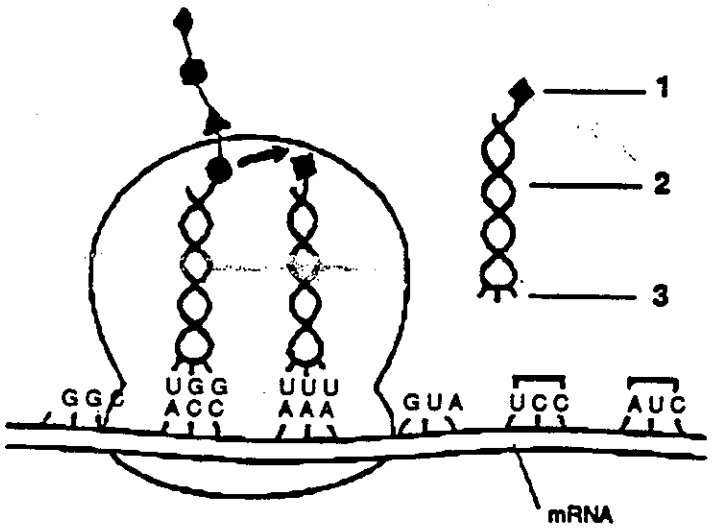
3. Explain the role of each in protein synthesis: *(p. 506)*
   a. mRNA
   b. tRNA
   c. rRNA

Features of RNA

RNA's play a very important role in protein making. There are three main types: Transfer RNA, Ribosomal RNA, and Messenger RNA.

1. Regarding *transfer RNA*: *(p.509)*
   a. Where in the cell is tRNA found?

   b. Identify the parts of tRNA from the diagram below:



   c. What is the role of the anticodon in tRNA?

d. Summarize the role of tRNA in protein synthesis.

2. Regarding messenger RNA: *(p.508)*

   a. How are they produced?

   b. What is the role of mRNA in protein synthesis?

3. Regarding ribosomal RNA: *(p.509)*

   a. How many components to ribosomal RNA?

   b. What is the chemical composition of rRNA?

   c. What is its role in protein synthesis?

Overview of Protein Synthesis

1. Protein synthesis occurs in two stages: (a) transcription and (b) translation. List the points that you would use to explain the process of transcription.

2. Translation occurs in a series of three stages: *initiation, elongation, and termination*. Read the overview of protein synthesis on *page 510* and list the major steps in translation.

3. Transcribe mRNA for the following DNA strand:

DNA

mRNA

   b. Using the codons on the above mRNA and *table 25.6* on *page 507* determine the amino acid sequence.

Mutations: Chromosomal and Gene

(pp. 516 .)

Mutations produce very specific changes to DNA. Evolution and change depend upon mutations.

1. Define the term *mutation*:

2. What is the difference between a chromosomal mutation and a gene mutation?

3. Identify the following types of chromosomal mutations:

   a. pieces of a chromosome are exchanged between non-homologous chromosomes.

   b. loss of a piece of chromosome.

   c. more than one copy of the same gene is produced.

   d. a portion of the chromosome breaks loose and rejoins with the ends reversed.

4. From your understanding of chromosomes, explain the genetic disorder Down's Syndrome.

5. Explain what a *gene mutation* is.

6. If one deletes or adds single nucleotide base to a DNA sequence what happens to the polypeptide?

7. Define and give an example of a:

   a. Carcinogen

   b. Mutagen

8. Two categories of mutagens are _____ and _____.

9. From your knowledge of DNA, how do you think radiation and chemical mutagens specifically affect DNA?

10. When do germinal mutations occur?

11. Name two genetic diseases that are "germinal mutations".

12. Define the terms:

    a. somatic mutations

    b. oncogene

Sample Exam Questions

1. Describe the main steps in protein synthesis using the following headings:

    a. transcription

    b. translation

2. Explain how mutations can affect chromosomal behaviour.
3. Describe the Watson-Crick model of DNA.
4. Use the Watson-Crick model to describe DNA replication.