Upon successful completion of this unit, you should be able to do the following:

1. Explain and describe how protein is made in the cell.

2. Explain the role of the following in protein formation:

<table>
<thead>
<tr>
<th>DNA</th>
<th>nucleus</th>
<th>cytoplasm</th>
<th>RNA</th>
<th>mRNA</th>
</tr>
</thead>
<tbody>
<tr>
<td>tRNA</td>
<td>rRNA</td>
<td>ribosome</td>
<td>amino acids</td>
<td></td>
</tr>
</tbody>
</table>
Protein Formation

3.3.3.2

Your body is made of protein. But how is the protein made in your body? Here is How It Happens.

Remember - DNA molecules are the molecules that hold the code to make all of the proteins for a cell. However DNA is trapped in the nucleus because it is so big, you do not want to damage your only copy of DNA by taking out of the protective nucleus. Proteins are made in the ribosomes which are outside of the nucleus in the cytoplasm. How does the code in the DNA get out of the nucleus and into the ribosome?

RNA is the answer. There are three types of RNA, messenger RNA (mRNA), transfer RNA (tRNA), and ribosomal RNA (rRNA). Each one plays a special role in making proteins.

In the nucleus, the DNA opens up and allows the code it has to be copied on a messenger RNA molecule. So the job of the messenger RNA is to copy and carry the code from the nucleus to the cytoplasm.

In the cytoplasm, the messenger RNA is attached to a ribosome, an
organelle that helps assemble proteins. The ribosomes are made partly of ribosomal RNA. So the job of rRNA is to make ribosomes and read the mRNA code. The ribosomes read the mRNA three bases (or letters) at a time. Each three-base code is called a Codon. Each codon stands for one of 20 different amino acids, the building blocks of protein. There are 64 possible codons, which means that some amino acids can have more than one codon. Luckily, you do not need to memorize which codons stand for which amino acid, because you can just look it up on the codon chart below!

The mRNA binds to the ribosomes. The ribosome reads each three-base codon from the mRNA. Then a third type of RNA called transfer RNA brings the correct amino acid to the ribosome. So the job of the tRNA is to carry the amino acids to the ribosomes where they can be attached in the correct order. How does the tRNA know which amino acid to bring? Well, the tRNA has a three-base anticodon that is complimentary to the codon on the mRNA. So mRNA codons pair up with tRNA anticodons.

The job of making a protein needs DNA to hold the code, mRNA to copy the code and carry it to the cytoplasm, rRNA to help make the protein, and tRNA to help bring the amino acids to the ribosomes. All of these processes take place in every living cell.

<table>
<thead>
<tr>
<th>1st base in codon</th>
<th>U</th>
<th>C</th>
<th>A</th>
<th>G</th>
</tr>
</thead>
<tbody>
<tr>
<td>2nd base in codon</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3rd base in codon</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

The Genetic Code
Protein Formation
3.3.3.2
Self Test

Matching

1. DNA  a. takes DNA code from nucleus to ribosomes
2. RNA  b. makes up ribosomes; reads mRNA codons
3. mRNA  c. delivers amino acid to ribosomes
4. tRNA  d. where DNA is found
5. rRNA  e. where proteins are made
6. protein  f. where the code for making proteins is stored
7. nucleus  g. a chain of amino acids
8. cytoplasm  h. molecules needed to get proteins made

True or False

1. DNA molecules give energy to the cell.
2. DNA molecules hold the code to make all of the cell’s proteins.
3. DNA is found in the nucleus of a cell.
4. DNA is found in the cytoplasm of a cell.
5. Proteins are made in the nucleus of a cell.
6. Proteins are made in the cytoplasm of a cell.
7. There are two types of RNA.
8. There are three types of RNA.
9. Messenger RNA is made in the nucleus when DNA opens up.
10. Messenger RNA must stay in the nucleus.
11. Messenger RNA carries the code from the DNA to the ribosomes.
12. In the cytoplasm, messenger RNA is attached to a ribosome.
13. A ribosome is an organelle that makes RNA.
14. A ribosome is an organelle that makes proteins.
15. Ribosomes are partly made of ribosomal RNA.
16. Ribosomes are partly made of transfer RNA.
17. Transfer RNA brings the correct amino acids to the nucleus.
18. Transfer RNA brings the correct amino acids to the ribosomes.
19. The ribosome attaches the amino acids in the correct order.
20. DNA, Messenger RNA, ribosomal RNA, and transfer RNA all are needed to make a cell’s proteins.
Fill in the Blank

1. The DNA in a cell holds the code for making all of the cells _____________.
2. The DNA is in the ______________ of the cell.
3. The proteins are made in the ________________
4. Since DNA cannot leave the nucleus, ___________ is used to copy the code and take it out to the cytoplasm.
5. The organelles at which proteins are made are the _________________.
6. The ribosomes are made partly of _________________.
7. The ribosomes read the code on the mRNA and the ________ bring the correct amino acid to the ribosomes.
8. Although ________________ holds the code for making a cell’s proteins, they cannot be made without RNA’s help.

Answer the Following

1. How is DNA involved in making proteins?
2. How is messenger RNA involved in making proteins?
3. How is ribosomal RNA involved in making proteins?
4. How is transfer RNA involved in making proteins?