Name: _____ Period: ___

How Does DNA Make Protein?

DNA directs your cells to make certain proteins. How does DNA make proteins? DNA is a model for making a molecule called messenger RNA (mRNA). Messenger RNA is much like DNA. RNA is made of substances, called nitrogen bases, that must match up with the nitrogen bases in DNA. These nitrogen bases will only match up in certain ways. The production of mRNA occurs in the nucleus. After it is formed, mRNA leaves the nucleus and attaches to a ribosome in the cytoplasm of the cell. Other RNA molecules, called transfer RNA (tRNA), bring protein parts to the mRNA on the ribosome. The two types of RNA molecules match up, join protein parts together, and make a protein. Figure 1 shows the steps involved in making a protein. DNA determines what proteins are produced.

In this exercise, you will:

- use models to show how DNA makes mRNA.
- use models to show how mRNA leaves the nucleus and causes tRNA to make proteins.

Define the following keywords:

- Amino Acid
- DNA
- mRNA
- Nucleus
- Protein
- Ribosome
- tRNA

Materials

- scissors
- colored pencils: red, blue and green

Procedure

1. Look at Figure 2 the DNA model on the next page. Notice that the DNA model has two sides. The sides of DNA are often compared to the upright sides of a ladder. The squares in the DNA model represent sugar molecules. The nitrogen bases A & T and C & G join together to connect the two sides.
2. Cut out the two sides of the DNA model in Figure 2.

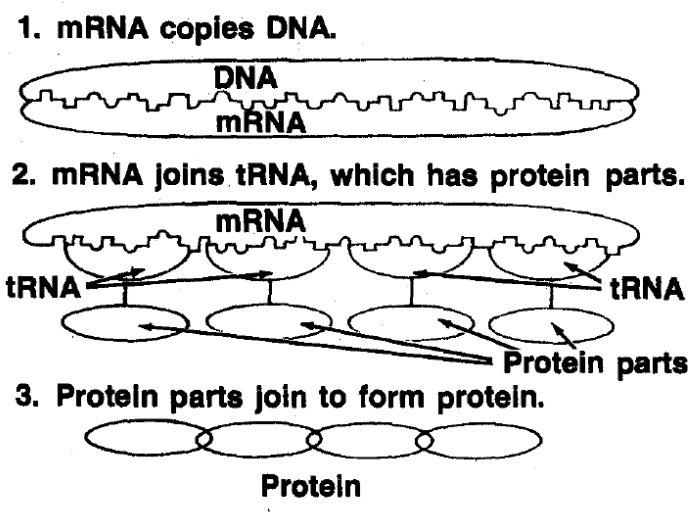

FIGURE 1. Formation of protein

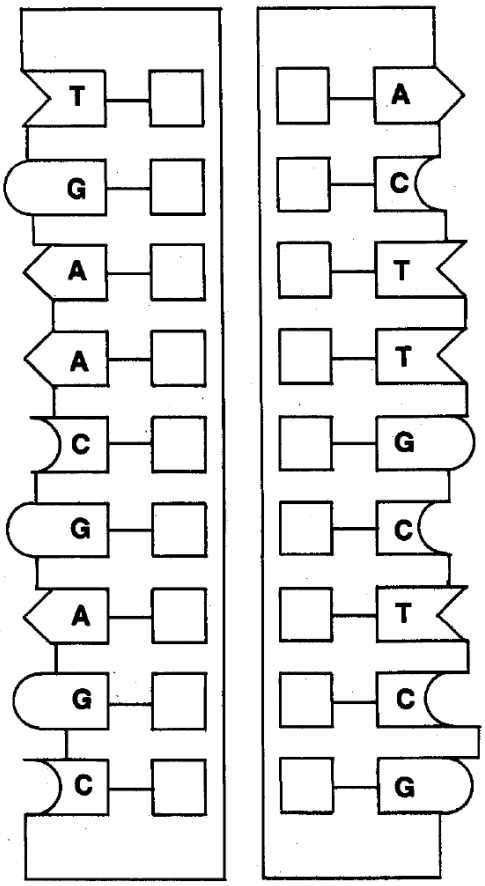

FIGURE 2. DNA molecule

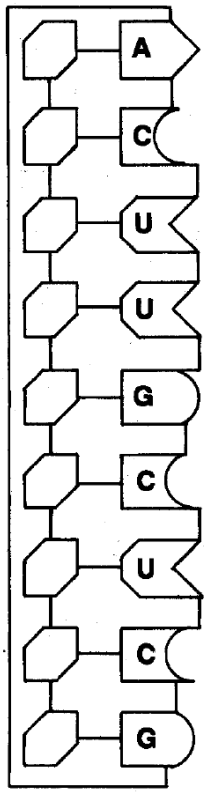

FIGURE 3. Messenger RNA

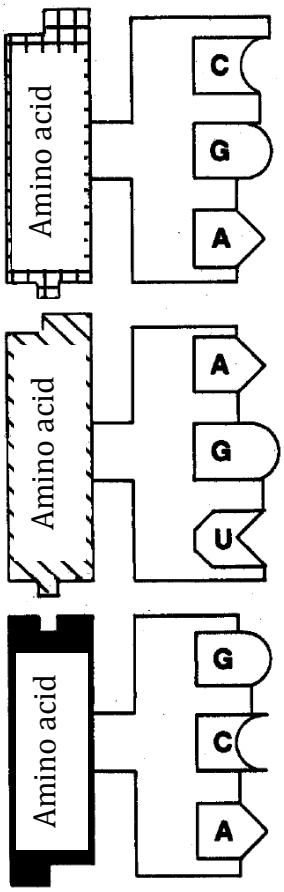

FIGURE 4. Transfer RNA

3. Color the square sugar molecules on both sides of the DNA model red.
4. Put the two sides of the DNA model together so that they fit together like the pieces of a puzzle.
5. Notice that the base Adenine only binds with Thymine and Guanine only bonds with Cytosine.
6. Examine Figure 5, a model of a cell. The nucleus is in the upper left corner.
7. Place the model of DNA in the nucleus. Remember that DNA carries the instructions for making cell proteins. The DNA code is controlled by the order in which the nitrogen bases appear.
8. Cut out the model of the mRNA molecule in Figure 3. This molecule has only one side.
9. Color the RNA model blue.
10. Observe that the sugar in the mRNA molecule is a different shape from the sugar in DNA. Also, notice that the nitrogen base U is present instead of T.
11. Separate the two sides of the red DNA model.
12. Place the mRNA molecule along one side of the DNA model. Note that its bases will fit only one side of the DNA. In an actual cell, the mRNA is assembled from small molecules to fit exactly along one side of the DNA. The nitrogen bases can only fit certain other bases because of their shape.
13. Move the mRNA molecule out of the nucleus to the cytoplasm by following the dotted line as a path. This shows that mRNA carries the code of the DNA to the ribosomes.
14. Move the mRNA to the cell part called the ribosome. Place it on the dashed lines at the ribosome.
15. Push the two sides of the DNA back together.
16. Cut out the three tRNA molecules shown in Figure 4.
17. Using a green pencil, color only the lower parts (that contain the letters: A , U , C , and G).

Name: _____ Period: ____

18. This type of RNA is different from mRNA in two ways. First, each tRNA molecule has only three nitrogen bases and second, each tRNA has a amino acid attached to it. Transfer RNA is found in the cytoplasm of the cell. The top of each tRNA has a specific protein part attached to it.
19. Fit the tRNA molecules to the mRNA molecule again, so the bases fit together tightly. Observe which bases of tRNA bind with which bases of mRNA (A with U, G with C).
20. With the tRNA molecules in place on the mRNA molecule, the protein parts can now join with each other. The linked protein parts carried by the tRNA make a chain. This chain separates from the tRNA molecules and leaves the ribosome to become a protein. The code of the DNA molecule directs certain steps in a cell for the process of forming a certain protein.

QUESTIONS

1. What do the letters DNA stand for?

2. In DNA, what nitrogen base always binds with A?

3. In DNA, what nitrogen base always binds with G?

4. How is mRNA different from DNA?

5. In mRNA, what nitrogen base binds with the DNA base A?_____ G? _____ T? _____ C _____

6. Where in the cell is mRNA made?

7. To what cell part does mRNA attach?

8. What carries the protein parts to the ribosome and the mRNA?

9. How are mRNA and tRNA alike?

10. What does tRNA have that mRNA does not have?

11. Where in the cell are proteins made?

12. What determines which proteins are produced?

Name: _____ Period: ___

FIGURE 5. Model of a cell