

28-1 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.

INTERPRETATION

OBJECTIVES

In this exercise, you will:

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

KEYWORDS

Define the following keywords:

DNA _____

mRNA _____

protein _____

tRNA _____

MATERIALS



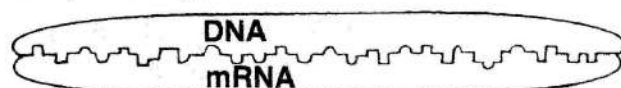
scissors

colored pencils: red, blue and green

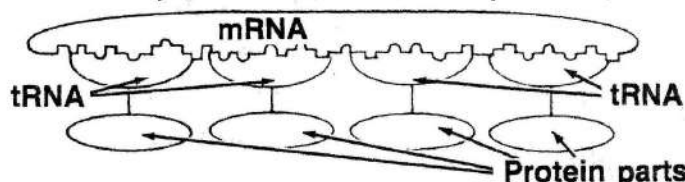
PROCEDURE

1. Examine Figure 2, a model of a DNA molecule. DNA has two main sides. These sides are often compared with the upright sides of a ladder. The squares in the model represent sugar molecules. The nitrogen bases A, C, G, and T join to connect the two sides.

1. mRNA copies DNA.



2. mRNA joins tRNA, which has protein parts.



3. Protein parts join to form protein.

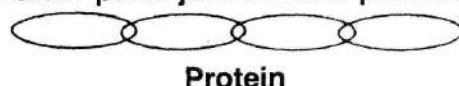


FIGURE 1. Formation of protein

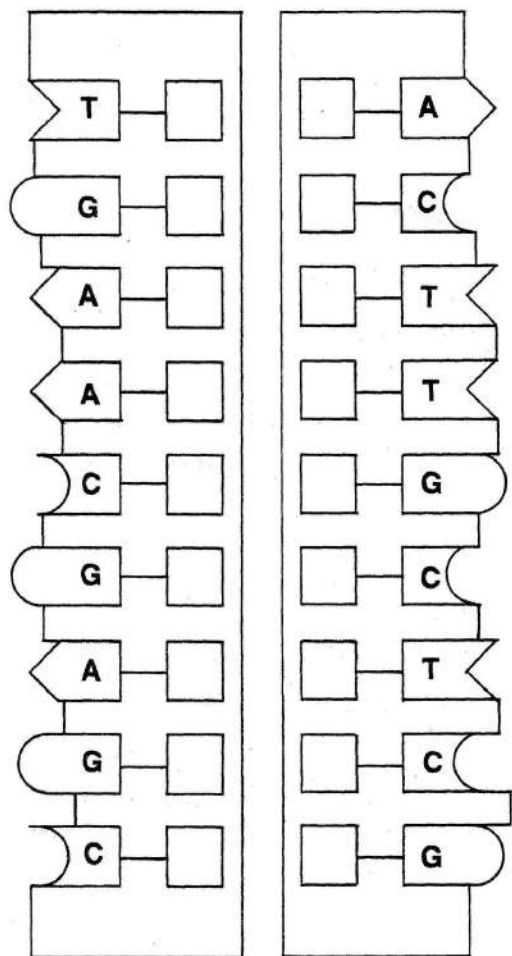


FIGURE 2. DNA molecule

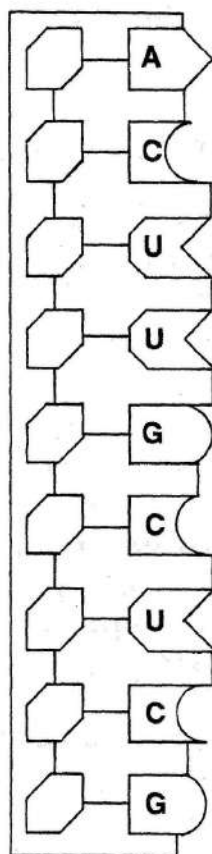


FIGURE 3. Messenger RNA

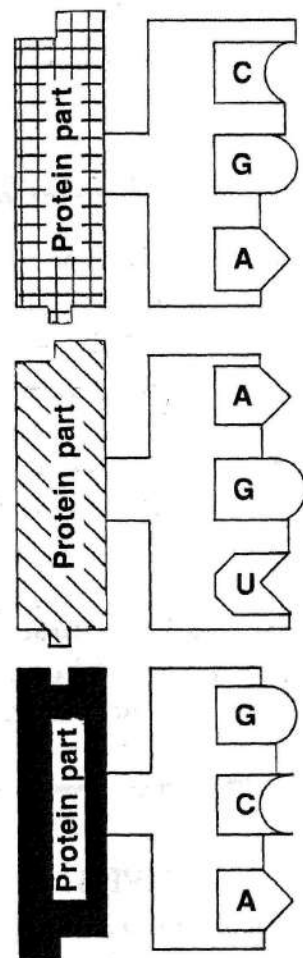


FIGURE 4. Transfer RNA

2. Cut out the two sides of the DNA model in Figure 2.
3. Color the two sides red.
4. Put the two sides together so that they fit together like the pieces of a puzzle. Note that nitrogen base A only binds with T and base G only with C.
5. Examine Figure 5, a model of a cell. The nucleus is in the upper left corner. Place the model of DNA in the nucleus. DNA carries the code for making cell proteins. That code is the order in which the nitrogen bases appear.
6. Cut out the model of the mRNA molecule in Figure 3. This molecule has only one side.
7. Color this model blue. Observe that the sugar in the mRNA molecule is different from the sugar in DNA. Also, the nitrogen base U is present instead of T.
8. Open the two sides of the DNA model.
9. 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. mRNA copies the code of DNA.
10. 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.
11. Move the mRNA to the cell part called the ribosome. Place it on the dashed lines at the ribosome.

12. Put the DNA model sides back together.
13. Cut out the three tRNA molecules shown in Figure 4. Using a green pencil, color only the lower parts (that contain the letters A, U, C, and G). This type of RNA is different from mRNA in two ways. First, each tRNA molecule has only three nitrogen bases and second, a certain protein part is 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.
14. 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).
15. 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? _____ G? _____
3. How is mRNA different from DNA? _____

4. In mRNA, what nitrogen base binds with the DNA base
A? _____ G? _____ T? _____
5. Where in the cell is mRNA made? _____
6. To what cell part does mRNA attach? _____
7. What carries the protein parts to the ribosome and the mRNA? _____
8. How are mRNA and tRNA alike? _____

9. What does tRNA have that mRNA does not have? _____
10. Where in the cell are proteins made? _____
11. What determines which proteins are produced? _____

FIGURE 5. Model of a cell

