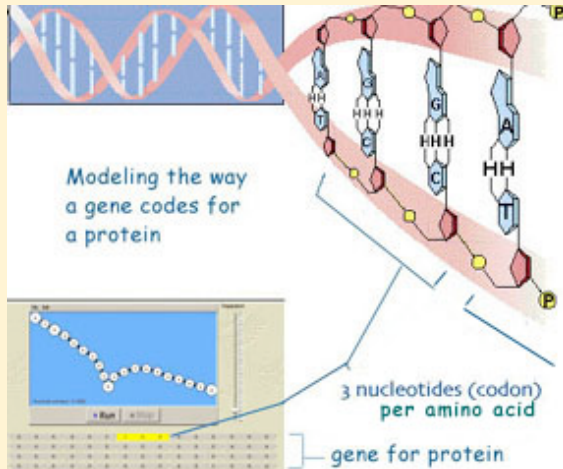


Activity 3 Worksheet

From Genetic Code to Protein Structure Worksheet Student version

A Brief Background on DNA



A linear polymer, DNA, is used by all living organisms on Earth to store and pass to the next generation the code for all proteins of the cell. To assemble a protein from amino acids, a cellular protein assembly line (a ribosome) reads the genetic code, which is written as a sequence of **nucleotides**.

DNA is a polymer made of millions of sequences of just four **nucleotides**: **A**, **T**, **C** and **G**. These nucleotides serve as letters in the genetic code of life, dictating which of the 20 amino acids should be placed at specific places in the growing protein chain.

One by one, the nucleotides cannot code 20 amino acids. Instead, triplets of nucleotides do this. From the four nucleotides of DNA, as many as 64 nucleotides triplets can be constructed, such as **TTT**, **ATA**, **CGC**. Every triplet of DNA is called a **codon**.



To make the code more secure, most of the amino acids are coded with two, three or even four different codons (in our life sometime 2-3 different words also may mean the same thing). Of these 64 **codons**, 61 are used to program the 20 amino acids. Three of the 64 codons are used as signals to start or stop the program.

In this activity you will explore the relationship between the codons and the shape of the protein. It is important to think about what this model shows, as well as what of the translation and transcription process it is not representing when answering the questions.

1. Open the From Genetic Code to Protein Structure model.

There are two ways to open the model.

1. From your browser. Click the link below.:

[Modeling Workbench: From Genetic Code to Protein Structure](http://xeon.concord.org:8080/modeler/webstart/protein/dna1.jnlp)
<http://xeon.concord.org:8080/modeler/webstart/protein/dna1.jnlp>

2. By going through the Molecular Workbench application on your computer (workbench.jar). Then you should click the following links: Student Pages, Protein Folding, From Genetic Code to Protein Structure

It may take a short while to launch the Molecular Workbench.

2. Explore the model by clicking on any of the amino acids (beads in the chain); you will see its respective nucleotide tripled (codon) flashing yellow in the table below the model. Notice that every triplet (codon) is written as three neighboring letters, while each letter is a shortcut (nickname) for a **nucleotide**.

3. Find the triplet (codon) for the first amino acid in the protein fragment (as you would read from left to right) and write its genetic code (for example, ATA).

4. One important difference between this model and the previous models is that here you can change the amino acid sequence by substituting one nucleotide for another, thereby changing both the codons and the amino acids for which they code.

Find the codon you would like to change and try changing it.

A. Choose, within the codon, a nucleotide you want to substitute, and point the cursor to it. Then Press **the left button** of the mouse to open a pull-down menu with the choice of nucleotides.

B. Select a new nucleotide by pointing the cursor on it, and press the left button.

C. You will observe that sometime a substitution of a nucleotide leads to the replacement of the amino acid. To find out the property of the replacement amino acid, place the cursor on it and press the right button on the computer mouse.

5. The following is a DNA sequence. Put the correct nucleotide sequence for each codon into the model:

CCA-CAA-AAT-AAT-GTT-AAA-ACC-CCA-CAA-GGA-TCT-ATG-TTC-GTT-AAA-ACC-CCA-TAT-GGT-G

6. Record the final protein sequence below.

7. Find all the amino acids that occur more than once in the chain. Record the location of the amino acid, the type of amino acid and the codon (nucleotide triplet) for that amino acid. (For example, the sixth amino acid from the left, proline, CCA)

8. Run the model. Draw the shape of the protein below:

9. Explain how the sequence of nucleotides can affect the shape of the protein. Describe the forces acting on the proteins.

10. What is missing in this model? The model only shows the DNA sequence and the protein fragment, but it may be better to include more steps between DNA and the formation of the protein shape. What should a revised model include?

