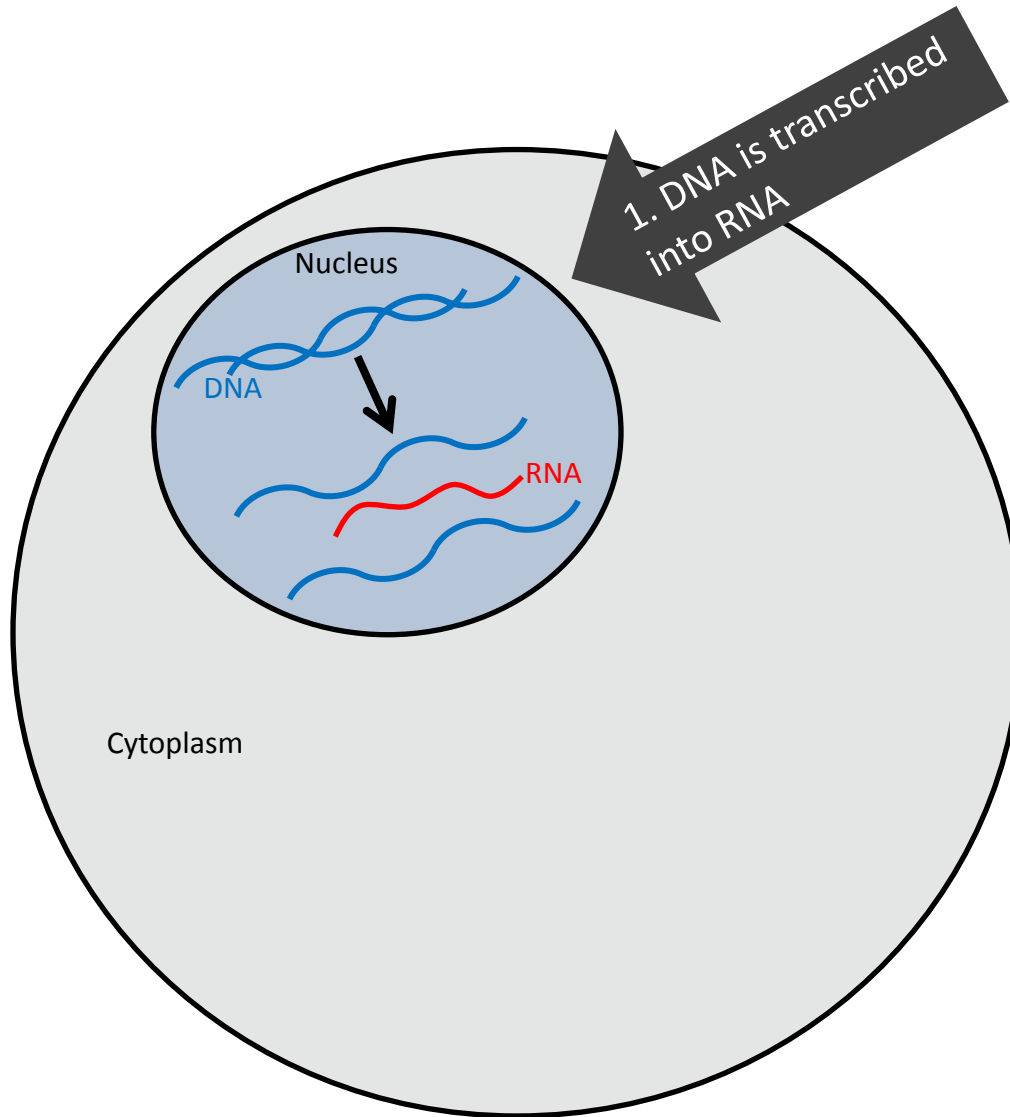


How are protein products made from a gene?

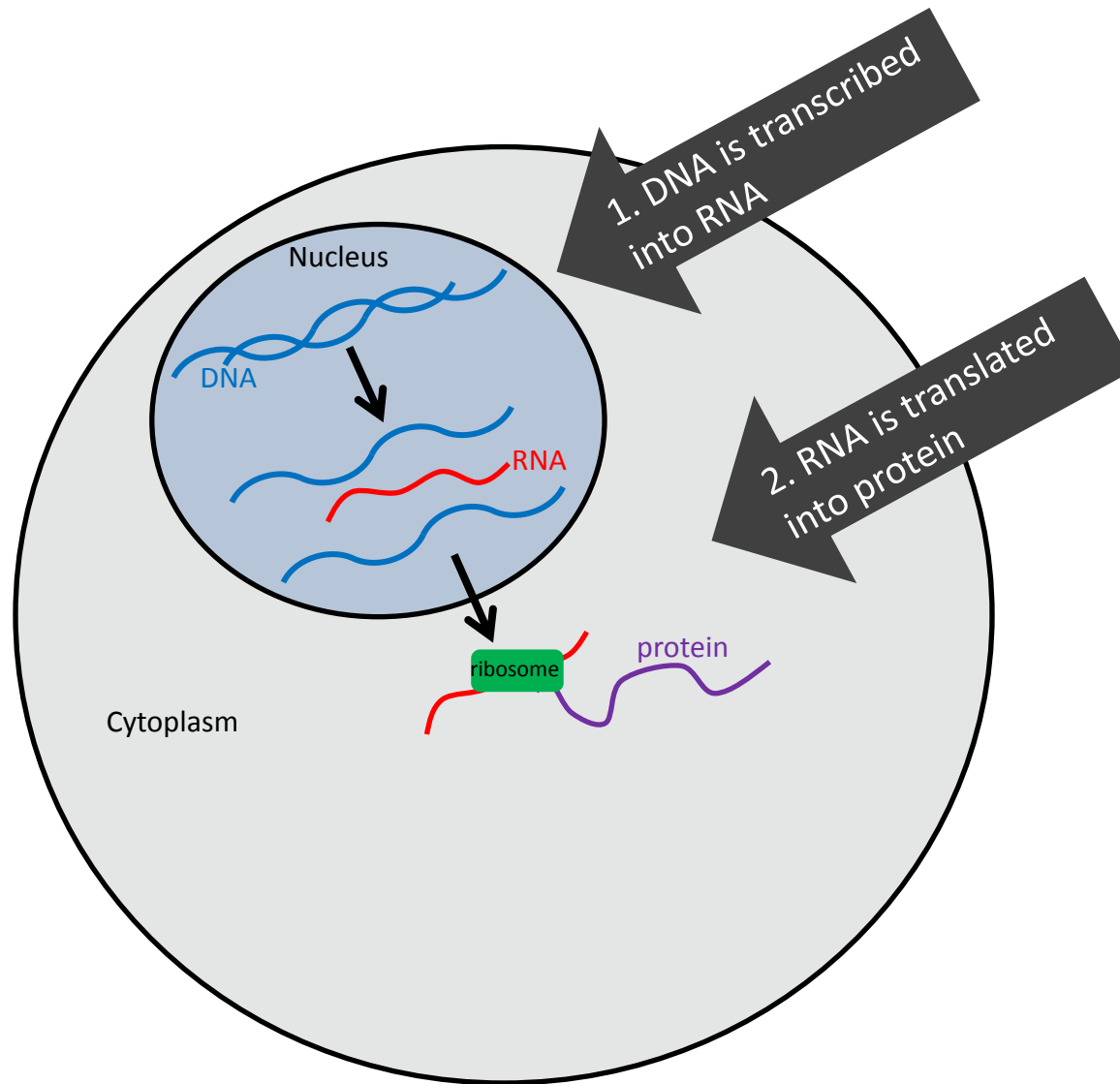


Step 1:

Deoxyribonucleic acid (DNA) is stored within the compartment of the cell called the nucleus.

DNA is a sequence made up of building blocks called nucleotides (more information can be found in “What is some basic information about DNA?”).

When a gene is expressed, the DNA opens up and is transcribed into RNA; this step is called transcription.

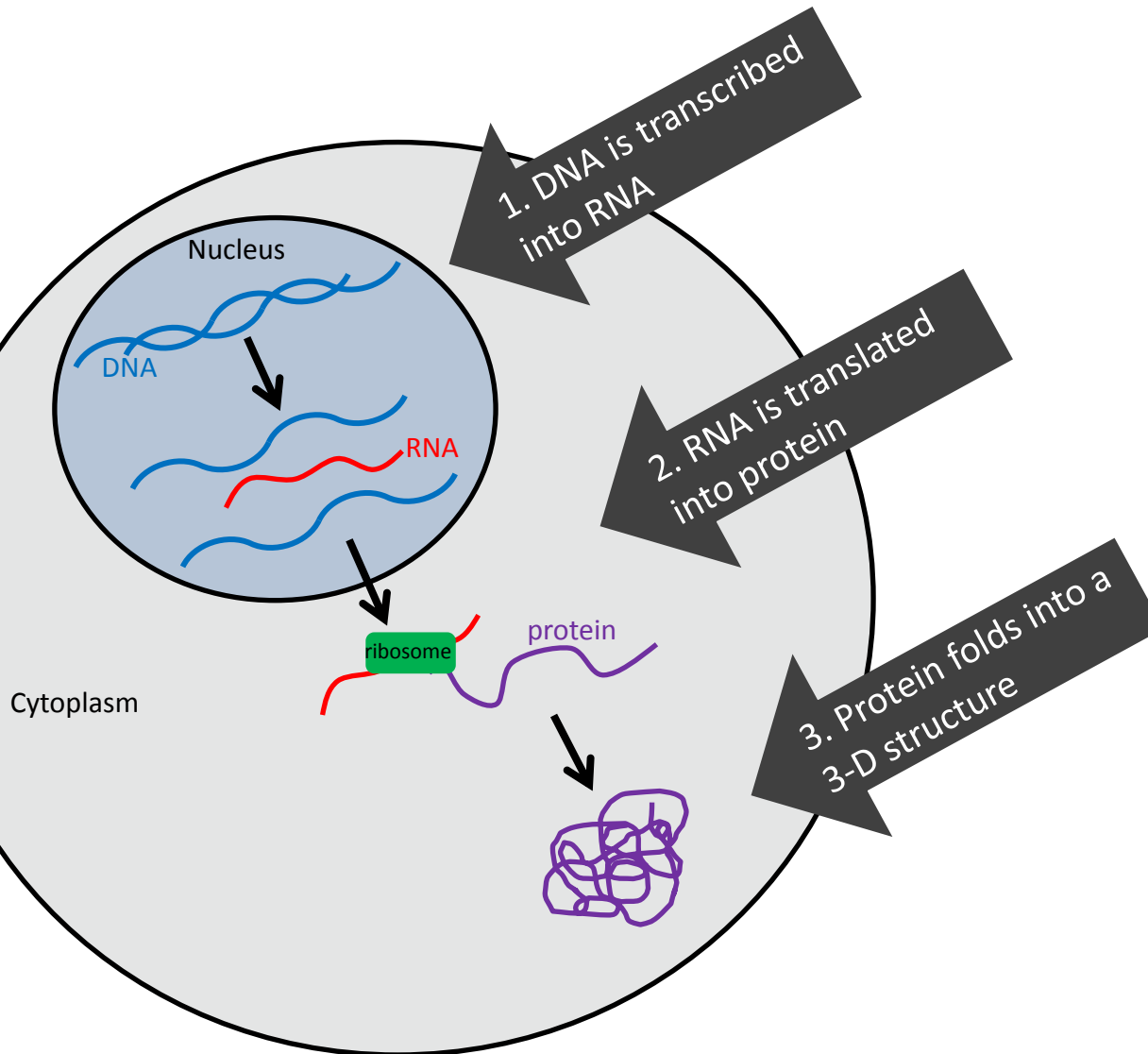


Step 2:

Ribonucleic acid (RNA) is created from transcribing DNA.

The RNA is exported from the nucleus into the large compartment of the cell called the cytoplasm.

A structure called the ribosome will read the RNA sequence; this step is called translation. In this step, an amino acid sequence will be generated. There are 20 amino acids used to make proteins (more details about DNA, RNA and amino acids can be found in “What is some basic information about DNA?”, “What is transcription?” and “What is translation?”).

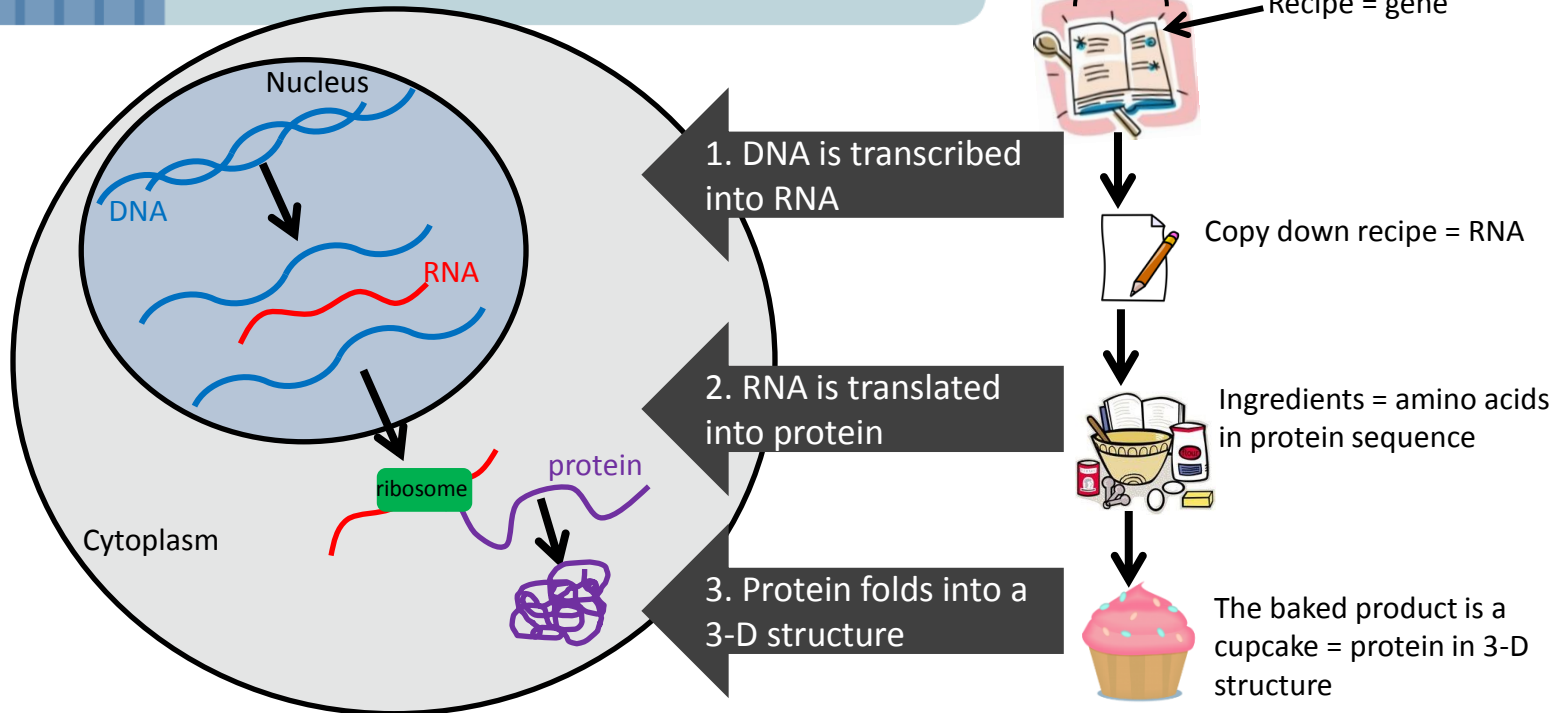


Step 3:

Once the amino acid sequence is generated, the molecule will fold into a three-dimensional (3-D) structure.

The protein may go through other processing, but essentially is ready to perform its function.

Proteins are abundant in cells and can have diverse functions. For example, the protein keratin provides structure in hair and nails. Another example is hemoglobin, a protein in the red blood cell that binds and transports oxygen in the bloodstream.



Cells are like bakeries

**Analogy:** Steps 1-3 of the diagram can be described in a different way: DNA is like a cookbook, with each recipe being equivalent to a gene. If a recipe is copied down so someone can go to the store and buy the ingredients, this is like making RNA. The ingredients are mixed together, and prior to being baked, we can equate this to the sequence of amino acids created from the RNA template. Baking the ingredients makes a cupcake, which is like the 3-D protein. So, the cell is like a bakery. Different bakeries (cells) have different recipes (genes expressed) which make different baked goods (proteins), giving the bakeries (cells) distinct functions.

**Overall Summary:** The process of going from DNA, to RNA, to protein has many regulatory steps or checkpoints. A gene has other DNA sequence (that ultimately does not code for a protein product) that can regulate the expression of a gene. So, in general, the cell will not produce a protein product that it shouldn't. One exception to this rule is a cancer cell. More detailed information about gene expression can be found in "What is transcription?" and "What is translation?"