

Some of the segments that are removed from mRNA during splicing are not always non-coding. When different coding regions of mRNA are **alternatively spliced** out, different variations of the protein will result, with differences in structure and function (Figure 10.28). This process results in a much larger variety of possible proteins and protein functions from a given genome. Humans, for example, have just over 20,000 genes, yet the human body produces over 80,000 different proteins.

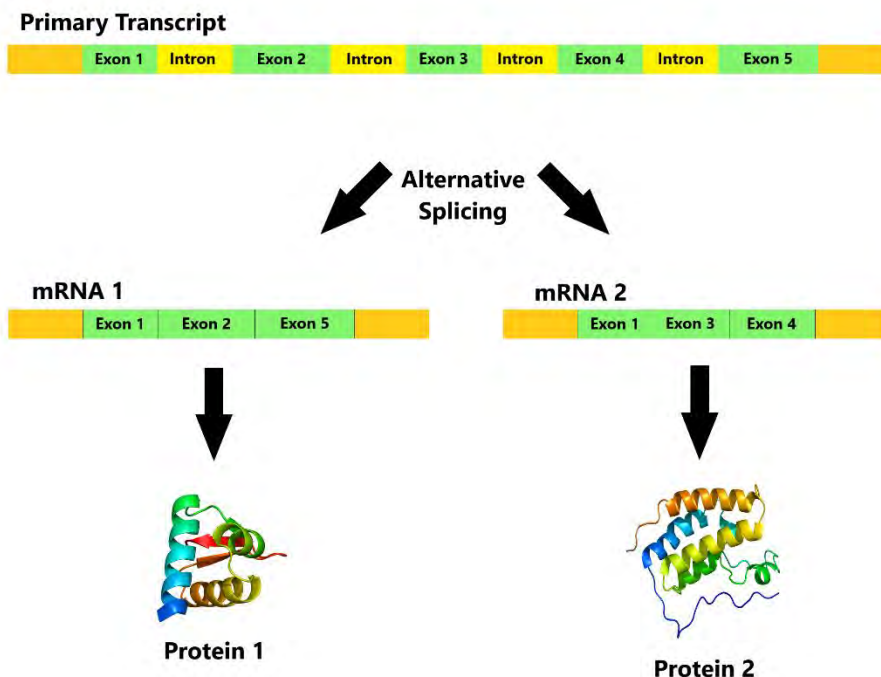


Figure 10.28 Alternative splicing of an mRNA primary transcript produces two different mRNA sequences, each of which results in a different protein. (credit: Jason Cashmore)

**CONCEPTS IN ACTION** – Observe alternate splicing in [this video](#).

## Section Summary

Cells use the genetic code stored within DNA to build proteins, which ultimately determine the structure and function of the cell. This genetic code lies in the particular sequence of nucleotides that make up each gene. To “read” this code, the cell must perform two sequential steps. In the first step, transcription, the DNA code is converted into an RNA code. mRNA synthesis is initiated at a promoter sequence on the DNA template. Elongation synthesizes a new mRNA transcript, and termination frees the mRNA. Newly transcribed eukaryotic mRNAs are modified with a cap and a poly-A tail. These structures protect the mature mRNA from degradation and help export it from the nucleus. Eukaryotic mRNAs also undergo splicing, in which introns are removed and exons are reconnected. Only finished mRNAs are exported from the nucleus to the cytoplasm.

## Exercises

1. A promoter is \_\_\_\_\_.
  - a. a specific sequence of DNA nucleotides
  - b. a specific sequence of RNA nucleotides
  - c. a protein that binds to DNA
  - d. an enzyme that synthesizes RNA
2. Portions of eukaryotic mRNA sequence that are removed during RNA processing are \_\_\_\_\_.
  - a. exons
  - b. caps
  - c. poly-A tails
  - d. introns
3. Which enzyme is used to synthesize RNA?
4. Compare and contrast the three types of RNA.

## Answers

1. (a)
2. (d)
3. RNA polymerase
4. All RNA is made up of nucleotides that consist of the sugar ribose, a phosphate group and a nitrogenous base. All RNA's use the bases adenine, uracil, guanine, and cytosine. All RNA's are synthesized in the nucleus. mRNA is used to carry the instructions on how to make protein from the nucleus to the cytoplasm. rRNA helps form ribosomes where proteins will be built in the cytoplasm. tRNA carry amino acids, the monomers of proteins, to the ribosome where the protein will be made.

## Glossary

**alternative RNA splicing:** a post-transcriptional gene regulation mechanism in eukaryotes in which multiple protein products are produced by a single gene through alternative splicing combinations of the RNA transcript

**central dogma:** The flow of genetic information in cells from DNA to mRNA to protein

**exon:** a sequence present in protein-coding mRNA after completion of pre-mRNA splicing

**intron:** non-protein-coding intervening sequences that are spliced from mRNA during processing

**messenger RNA (mRNA):** a form of RNA that carries the nucleotide sequence code for a protein sequence that is translated into a polypeptide sequence

**promoter:** a sequence on DNA to which RNA polymerase and associated factors bind and initiate transcription

**RNA polymerase:** an enzyme that synthesizes an RNA strand from a DNA template strand

**ribosomal RNA (rRNA):** molecules of RNA that combine to form part of the ribosome

**spliceosome:** a structure composed of various proteins and other molecules, which attaches to the mRNA transcript and “splices” or cuts out the non-coding, introns

**splicing:** the process of removing introns and reconnecting exons in a pre-mRNA

**transcription:** the synthesis of a strand of mRNA that is complementary to the gene of interest.

**transcription bubble:** the region of locally unwound DNA that allows for transcription of mRNA

**transfer RNA (tRNA):** an RNA molecule that contains a specific three-nucleotide anticodon sequence to pair with the mRNA codon and also binds to a specific amino acid

**translation:** the process of synthesizing a chain of amino acids called a polypeptide chains or proteins