Big Data, Genes, and Medicine
Video #1.4

Slide #29
After considering the DNA, genes, and RNA in the previous lesson, we are now ready to take a closer look at the process by which genes in the DNA lead to the creation of RNA, or gene expressions.
Slide #30
In fact, when we talk about genetic information, we refer either to genomic information, as represented in the DNA, or to transcriptomic information, as represented in the RNA, also called the transcriptome. These are two sides of the same coin. Gene expression describes the process by which a product is created from a gene. Most often the product is a protein, however sometimes it is another molecule, for example rRNA. And transcription is the process of producing the transcriptome from the genome. DNA contains all the information necessary to create new macromolecules such as proteins and beyond new human beings.
Slide #31
In other words, the DNA encodes the data representing the blueprint of a particular person. The process by which a DNA is transcribed into corresponding RNA proceeds through a series of steps, much like a cooking recipe can be used to create a new dish. The analogy with a computer program is even stronger, where the DNA represents the data, and the biological process of transcription represents a computer program.
Slide #32
More precisely, transcription evolves through 4 steps:

- Initiation – the DNA macromolecule opens and an enzyme (RNA polymerase) binds with the promoter of the template strand.
- Elongation – RNA polymerase processes each nucleotide on the DNA template strand to produce an mRNA (messenger RNA).
- Termination – the transcription stops either when meeting a “Rho” protein factor or a loop at the end of the DNA strand.
- Processing – the newly created mRNA macromolecule is processed by removing the introns (non-coding sequences) and splicing the exons (coding sequences) together so that only regions coding for proteins are maintained.

Slide #33
This picture illustrates the process. We see the DNA being partially open by the RNA polymerase, and the new nucleotides being created matching the original DNA nucleotides, following an order 3’ to 5’ or 5’ to 3’.
Slide #34
During the transcription process, mRNA nucleotides are synthesized following a very strict process:

- DNA A → mRNA U
- DNA T → mRNA A
- DNA G → mRNA C
- DNA C → mRNA G.

It is like translating words between languages.
Slide #35
Here is a transcription example:

Given the sequence:
5’-CTGAATCGAT-3’

The mRNA sequence transcribed from this DNA sequence is obtained by substituting the nucleotides following the rule: C→ G, G → C, A→ U, T → A:

GACUUAGCUA

Also orientation can be either 5’-3’ or 3’-5’ since the DNA in the first place is double stranded.

I will end by showing a 3D animation of transcription by the DNA Learning Center.

https://www.dnalc.org/resources/3d/15-translation-basic.html