

Transcription

In order to translate the DNA code into a protein, a temporary copy of the code is needed. This first stage of protein synthesis is called transcription. **Transcription** is the process of copying a sequence of DNA to produce a complementary strand of RNA. In eukaryotes, transcription occurs in the nucleus of the cell.

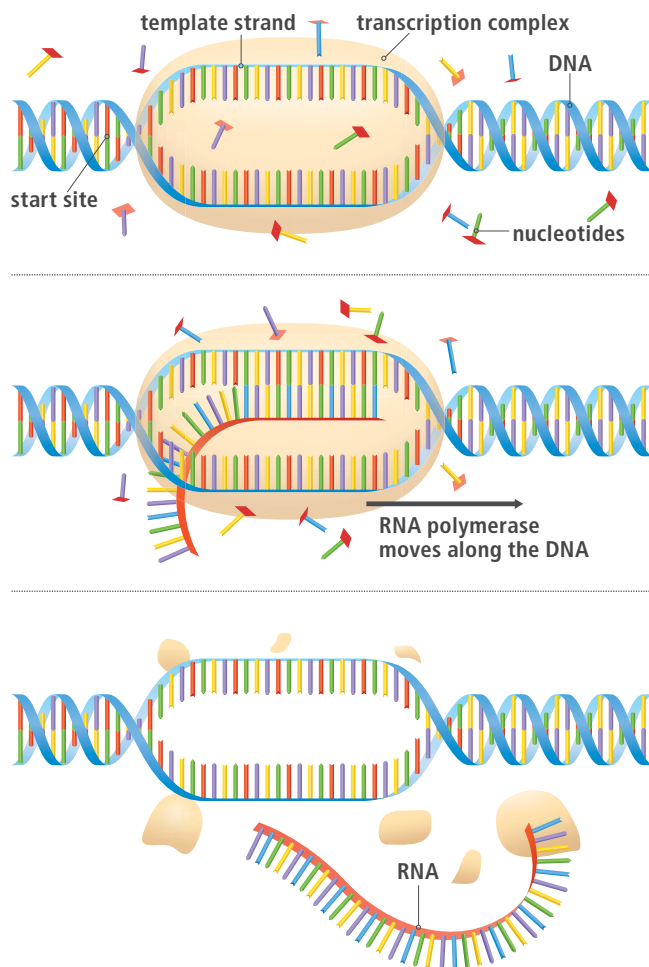
Steps of Transcription

During the process of transcription, a gene—not an entire chromosome—is transcribed into an RNA message. Transcription is catalyzed by RNA polymerases, enzymes that bond nucleotides together in a chain to make a new RNA molecule.

Predict Transcribe means to write. Why would we use the word transcribe to describe the process of making a complementary RNA sequence from a DNA template?

FIGURE 7: In transcription, enzymes use the DNA template to make a complementary strand of RNA.

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- 1 In eukaryotic cells, a large transcription initiation complex consisting of RNA polymerase and other proteins assembles on the DNA strand and begins to unwind a segment of the DNA molecule. The complex assembles at a specific sequence of nucleotides along the DNA molecule called a promoter.
- 2 RNA polymerase, using one strand of DNA as a template, strings together a complementary strand of RNA nucleotides. RNA base pairing follows the same rules as DNA base pairing, except that uracil, not thymine, pairs with adenine. So, U pairs with A and G pairs with C. The growing RNA strand hangs freely as it is transcribed, and the DNA helix zips back together.
- 3 Transcription continues until an entire gene has been converted to RNA. The RNA strand detaches completely from the DNA.



Structure and Function Explain how the structure of the DNA molecule determines the structure of an RNA molecule during transcription.

FIGURE 8: These growing RNA strands are being transcribed from a single DNA strand.




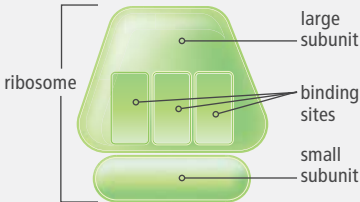
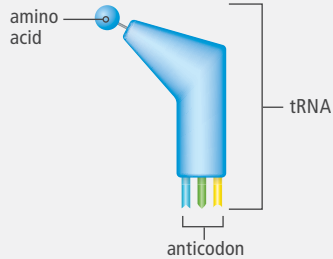
Transcription can produce hundreds or thousands of copies of mRNA depending on the cell's needs. Transcription enables a cell to adjust to changing demands by making a single-stranded complement of only a segment of DNA, and only when that particular segment is needed. Many RNA molecules can be transcribed from a single gene at the same time to help produce more protein. Once RNA polymerase has transcribed one portion of a gene and has moved on, another RNA polymerase can attach itself to the beginning of the gene and start the transcription process again. This process can occur over and over again.



Analyze Why is the ability to produce multiple RNA transcripts at the same time useful in maintaining homeostasis in a cell?

Transcription produces three main types of RNA molecules, each with a unique function. Only one, mRNA, actually codes for proteins. Once mRNA is bound to ribosomal RNA (rRNA) in a ribosome, it is read by transfer RNA (tRNA) molecules that carry amino acids to bind to the developing protein.

FIGURE 9: Transcription produces three main types of RNA.

Type of RNA	mRNA	rRNA	tRNA
Model			
Function	An intermediate message that is translated to form a protein.	Forms subunits of ribosomes, which are the cell's protein factories.	Carries, or "transfers" amino acids to the ribosome to help make the growing protein.



Model Write a complementary mRNA sequence for the DNA sequence below. Remember that RNA contains uracil instead of thymine.
DNA sequence: TCA GGT ACG CTT

The next main stage of protein synthesis—translation—can begin once transcription is complete. However, the RNA strand must be processed before it can exit the nucleus in eukaryotes. This step occurs during, or just after, transcription. We will examine RNA processing in another lesson.



Explain Transcription and DNA replication are often compared to one another because they have many similarities. However, they do not have the same functions. Make a graphic organizer to compare and contrast DNA replication and transcription in terms of their functions, inputs, and final products.