



Transcription and RNA Processing

IST-1.N.1

The sequence of the RNA bases, together with the structure of the RNA molecule, determines RNA function—

- a. mRNA molecules carry information from DNA to the ribosome.



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IST-1.N.1

- b. Distinct tRNA molecules bind specific amino acids and have anti-codon sequences that base pair with the mRNA. tRNA is recruited to the ribosome during translation to generate the primary peptide sequence based on the mRNA sequence.**
- c. rRNA molecules are functional building blocks of ribosomes.**



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IST-1.N.2

Genetic information flows from a sequence of nucleotides in DNA to a sequence of bases in an mRNA molecule to a sequence of amino acids in a protein.

IST-1.N.3

RNA polymerases use a single template strand of DNA to direct the inclusion of bases in the newly formed RNA molecule. This process is known as transcription.



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IST-1.N.4

The DNA strand acting as the template strand is also referred to as the noncoding strand, minus strand, or antisense strand. Selection of which DNA strand serves as the template strand depends on the gene being transcribed.

IST-1.N.5

The enzyme RNA polymerase synthesizes mRNA molecules in the 5' to 3' direction by reading the template DNA strand in the 3' to 5' direction.



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IST-1.N.6

In eukaryotic cells the mRNA transcript undergoes a series of enzyme-regulated modifications—

- a. Addition of a poly-A tail.
- b. Addition of a GTP cap.
- c. Excision of introns & splicing & retention of exons.
- d. Excision of introns and splicing and retention of exons can generate different versions of the resulting mRNA molecule; this is known as alternative splicing.



Which RNA functions as site of protein synthesis?

- A. mRNA**
- B. rRNA**
- C. tRNA**

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Which RNA functions as site of protein synthesis?

B. rRNA



rRNA is the ribosomal RNA. Ribosomes, the site of protein synthesis, is composed of protein and rRNA.



Which RNA functions to bring amino acids to the ribosome?

- A. mRNA**
- B. rRNA**
- C. tRNA**

Which RNA functions to bring amino acids to the ribosome?

C. tRNA



tRNA is the transfer RNA. There are two important binding sites on the tRNAs. At one end, the tRNA is bound to an amino acid and the other end has an anticodon which pairs with the codon on the mRNA.



**Which RNA is the transcript
from DNA template?**

- A. mRNA**
- B. rRNA**
- C. tRNA**

Which RNA is the transcript from DNA template?

A. mRNA



mRNA is messenger RNA. It functions as a transcript of the DNA to carry the genetic code to the ribosome for protein synthesis.

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Which RNA has an anticodon that pairs with codon?

- A. mRNA**
- B. rRNA**
- C. tRNA**

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Which RNA has an anticodon that pairs with codon?

C. tRNA



tRNA is the transfer RNA. The main function of the tRNA is to bring amino acids to the ribosome. The tRNA has an anticodon that pairs with the mRNA codon to ensure the correct amino acid is added.



**Which RNA has the codons
sequence for translation?**

- A. mRNA**
- B. rRNA**
- C. tRNA**

Which RNA has the codons sequence for translation?

A. mRNA



mRNA is the messenger RNA. It is a transcript of the DNA to carry to message to the ribosome for protein synthesis. The triplet code of nucleotides on the mRNA is called a codon.

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Big picture, how do the three different RNA molecules work together?

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Big picture, how do the three different RNA molecules work together?



mRNA is the product of transcription in the nucleus. It brings the "message" from the nucleus about the order for protein synthesis.

mRNA binds to the small subunit of the ribosome.

tRNA brings the amino acids The tRNA has an anticodon at one end that base pairs with the codons on the mRNA and an amino acid on the other end. It binds to the large subunit of the ribosome.

rRNA is the site of protein synthesis. The rRNA binds with protein to form the ribosome.

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How does the location of transcription differ in prokaryotes vs. Eukaryotes?

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How does the location of transcription differ in prokaryotes vs. eukaryotes?



Due to the absence of a nuclear envelope, transcription occurs in the cytosol (nucleoid) of the prokaryote.

Due to the presence of a nuclear envelope, transcription occurs in the nucleus of an eukaryote.



**Which enzyme is responsible
for transcription?**

- A. Ligase**
- B. Primase**
- C. RNA Polymerase**
- D. Transcriptase**

**Which enzyme
is responsible
for transcription?**

C. RNA Polymerase



**RNA Polymerase is an enzyme
that binds to the DNA and
synthesizes a RNA strand.
Remember: enzymes tell you
what they do. RNA Polymerase
makes an RNA polymer.**

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**What is the name of the strand
read for transcription?**

What is the name of the strand read for transcription?



- > Template strand**
- > Noncoding strand**
- > Minus strand**
- > Antisense strand**

(Note: you should know all 4 of these terms as they are directly in the CED and can be used in the prompt.)



In transcription, which direction is DNA read?

- A. 3' to 5'**
- B. 5' to 3'**
- C. C terminus to N terminus**
- D. N terminus to C terminus**

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In transcription, which direction is DNA read?

A. 3' to 5'



DNA and RNA are antiparallel. The DNA is read 3' to 5' while the RNA is synthesized 5' to 3'. Remember the 3' is the hydroxyl group of the pentose sugar and the 5' is the phosphate.



**In transcription, which direction
is RNA made?**

- A. 3' to 5'**
- B. 5' to 3'**
- C. C terminus to N terminus**
- D. N terminus to C terminus**

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In transcription, which direction is RNA made?

B. 5' to 3'



DNA and RNA are antiparallel. The RNA is synthesized 5' to 3' while the DNA is read 3' to 5'.

Remember the 3' is the hydroxyl group of the pentose sugar and the 5' is the phosphate.

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Describe the three changes made during post-transcription

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**Describe the three changes
made during post-
transcription**

- > **Guanine cap added to 5' end**
- > **Poly A tail added to 3' end**
- > **Introns are removed by
splicing**



Function of 5' Cap...

- A. Add phosphates to the RNA**
- B. Provide ATP for transcription**
- C, Protect from hydrolytic enzymes**
- D. Site of ribosome binding**

Function of 5' Cap...

D. Site of ribosome binding



The 5' Cap has two functions. It binds with the ribosome for translation (which reads the RNA 5' to 3') at the 5' end. It facilitates the mRNA leaving the nucleus.



Function of Poly A tail...

- A. Add phosphates to the RNA**
- B. Provide ATP for transcription**
- C. Protect from hydrolytic enzymes**
- D. Site of ribosome binding**

Function of Poly A tail...

C. Protect from hydrolytic enzymes



The poly-A tail is made up of multiple adenines at the end of the mRNA. As the hydrolytic enzymes in the cytosol hydrolyze the mRNA, it prolongs its "life" in the cytosol to maximize protein synthesized.

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**What process allows the
synthesis of different proteins
from same DNA**

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What process allows the synthesis of different proteins from same DNA



Alternative RNA splicing



What is the process of transcription?

- A. Synthesizing DNA under the direction of DNA**
- B. Synthesizing DNA under the direction of RNA**
- C. Synthesizing RNA under the direction of DNA**
- D. Synthesizing RNA under the direction of RNA**

What is the process of transcription?

C. Synthesizing RNA under the direction of DNA



Transcription is the process of synthesizing a RNA molecule from an DNA template. The DNA must be protected as its the genetic code for the cell, so the RNA is a disposable copy of the information for cellular usage.

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What is the order in the central dogma?

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What is the order in the central dogma?



DNA → RNA → polypeptide



What type of virus will violate the central dogma?

- A. Bacteriophage**
- B. DNA virus**
- C. Retrovirus**
- D. All of the above**

What type of virus will violate the central dogma?

C. Retrovirus



Retroviruses have a RNA genome. They have reverse transcriptase, enzyme that synthesizes DNA from RNA template. The central dogma states DNA \rightarrow RNA, but the retrovirus goes RNA \rightarrow DNA.

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What is the function of mRNA, rRNA, and tRNA?

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What is the function of mRNA, rRNA, and tRNA?

mRNA is the messenger RNA, which brings the information about the order of amino acids to the ribosomes and base pairs the codon with the anticodon (on the tRNA)

tRNA is the transfer RNA, which brings the amino acids to the ribosome and base pairs the anticodon with the codon (on the mRNA)

rRNA is the ribosomal RNA, which makes up the ribosome in addition to proteins.



What enzyme is responsible for transcription?

- A. DNA polymerase**
- B. Helicase**
- C. Primase**
- D. RNA polymerase**

What enzyme is responsible for transcription?

D. RNA polymerase



RNA polymerase is the enzyme that functions in transcription.

It will synthesize a RNA molecule from the DNA template.



Which strand is read for transcription?

- A. 3' to 5' coding strand**
- B. 5' to 3' coding strand**
- C. 3' to 5' noncoding strand**
- D. 5' to 3' noncoding strand**

Which strand is read for transcription?

C. 3' to 5' noncoding strand



DNA and RNA are antiparallel, so the DNA is read 3' to 5' and the RNA is synthesized 5' to 3'. Note: the DNA template strand can be called 4 different names: noncoding strand, minus strand, or antisense strand.



Which direction is RNA synthesized?

- A. 3' to 5'**
- B. 5' to 3'**

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Which direction is RNA synthesized?

B. 5' to 3'



DNA and RNA are antiparallel, so the RNA is synthesized 5' to 3' and DNA is read 3' to 5'. Recall: the 5' end is the site of the phosphate and the 3' end is the hydroxyl group of the pentose sugar.

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What three things happen to the mRNA before it leaves the nucleus?

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What three things happen to the mRNA before it leaves the nucleus?

- > **Add a 5' guanine cap**
- > **Add a poly A tail**
- > **Cut out introns**



What is the function of the poly A tail?

- A. Binds to the promoter region**
- B. Decrease degradation by hydrolytic enzymes**
- C. Remove noncoding information**
- D. Site of ribosome binding**

What is the function of the poly A tail?

B. Decrease degradation by hydrolytic enzymes



The poly-A tail is made up of multiple adenines at the end of the mRNA. As the hydrolytic enzymes in the cytosol hydrolyze the mRNA, it prolongs its "life" in the cytosol to maximize protein synthesized.



What is the function of the 5' cap?

- A. Binds to the promoter region**
- B. Decrease degradation by hydrolytic enzymes**
- C. Remove noncoding information**
- D. Site of ribosome binding**

What is the function of the 5' cap?

D. Site of ribosome binding



The 5' Cap has two functions. It binds with the ribosome for translation (which reads the RNA 5' to 3') at the 5' end. It facilitates the mRNA leaving the nucleus.

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How can you have the same DNA, but result in multiple different proteins?

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How can you have the same DNA, but result in multiple different proteins?



Alternative gene splicing