Unit 6 PPT #2

Transcription and Translation
Central Dogma
Chapter 8.4 Transcription pgs 239-242

DNA carries the info to make Proteins. How does it work?

**DNA → RNA → Proteins**

Starts with DNA... transcribed into mRNA..... translated into proteins by tRNA

This process is known as:

**Central Dogma of Molecular Biology**
Segments of DNA (GENES) are the instructions that control the production of proteins.

Genetic messages can be decoded by copying part of the nucleotide sequence from DNA into RNA.

RNA contains coded information for making proteins

How does the DNA get made into RNA and that made into Protein???
Transcription

- Double stranded DNA must be **TRANSCRIBED**
- Into Single stranded RNA
DNA
1. sugar = deoxyribose
2. bases = A, C, G, T
3. double strand
4. stays in nucleus

RNA
1. sugar = ribose
2. Bases = A, C, G, U
3. single strand
4. leaves nucleus
What are the three main differences between DNA and RNA?
There are three main differences between RNA and DNA:

• The sugar in RNA is ribose instead of deoxyribose.
• RNA is generally single-stranded.
• RNA contains uracil in place of thymine.
3 Types of RNA are made from DNA

1. **mRNA** → “messenger”
   made from DNA in nucleus…travels out of nucleus and finds a ribosome.

2. **tRNA** → “transfer”
   brings amino acids to the ribosomes; found in cytoplasm

3. **rRNA** → “ribosomal”
   part of the ribosome; this is where proteins are made
**Messenger RNA** (mRNA) carries copies of instructions for assembling amino acids into proteins.
Ribosomes are made up of proteins and ribosomal RNA (rRNA).
During protein construction, **transfer RNA** (tRNA) transfers each amino acid to the ribosome.
Concept Map

RNA can be

- Messenger RNA also called mRNA which functions to Carry instructions from DNA to Ribosome
- Ribosomal RNA also called rRNA which functions to Combine with proteins to make up Ribosomes
- Transfer RNA also called tRNA which functions to Bring amino acids to ribosome

Ribosome
RNA molecules are produced by copying part of a nucleotide sequence of DNA into a complementary sequence in RNA. This process is called transcription.

Transcription requires the enzyme RNA polymerase.

Have we heard of another polymerase recently??
TRANSCRIPTION
How RNA is made from DNA
Transcription Steps

1. RNA polymerase binds to the promoter site (TATA box) (start) on the DNA
2. RNA polymerase adds RNA nucleotides complimentary to the DNA strand
3. mRNA building is complete when the RNA polymerase reaches a Termination (stop) site on the DNA
4. This strand of mRNA is EDITED before leaving the nucleus & carrying the code into the cytoplasm

✓ DNA never leaves the nucleus
Transcription

RNA polymerase

- Adenine (DNA and RNA)
- Cytosine (DNA and RNA)
- Guanine (DNA and RNA)
- Thymine (DNA only)
- Uracil (RNA only)
Don’t Confuse Replication with Transcription!

<table>
<thead>
<tr>
<th>DNA Replication</th>
<th>Transcription</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>DNA-DNA</strong></td>
<td><strong>DNA-mRNA</strong></td>
</tr>
<tr>
<td>A – T</td>
<td>A – U</td>
</tr>
<tr>
<td>C – G</td>
<td>C – G</td>
</tr>
<tr>
<td>G – C</td>
<td>G – C</td>
</tr>
<tr>
<td>T - A</td>
<td>T - A</td>
</tr>
</tbody>
</table>
Let's watch:

- https://www.youtube.com/watch?v=JZXT2uOcD2w
- https://www.youtube.com/watch?v=ztPkv7wc3yU
Is ALL the DNA transcribed into mRNA?

- **NO!!!**

- Only certain sections of the DNA are made (transcribed) into message (mRNA)
- AND...only part of the mRNA is actually used and sent out of the nucleus to meet up with a ribosome! This is EDITING!!
How is mRNA Edited?.
On a mRNA strand there are areas called: **Exons and Introns**

**Introns are cut out** before leaving the nucleus. **Exons are left**, and this shortened piece of mRNA leaves the nucleus and gets **Translated** into Proteins.
mRNA is EDITED

The introns are cut out of RNA molecules.

The exons are spliced together to form mRNA.
Now... to make proteins from the mRNA

- This is called: Translation
- The mRNA codes for certain amino acids
- Strings of amino acids are proteins.
Translation

What: Translation is the decoding of an mRNA message into a polypeptide chain (protein).

WHO: tRNA transfer RNA

Where: Translation takes place on ribosomes in the cytoplasm.

Why: During translation, the cell uses information from messenger mRNA to produce proteins.
TRANSLATION STEPS:

1. Messenger RNA is **transcribed in the nucleus**, and then enters the cytoplasm where it **attaches to a ribosome.** (to begin translation)
STEP 1: Initiation

Translation begins when an mRNA molecule attaches to a ribosome.

STEP 2: As each codon (group of 3 nucleotides) of the mRNA molecule moves through the ribosome, the proper amino acid is brought into the ribosome by tRNA.

STEP 3: Elongation

In the ribosome, amino acids are transferred to the growing polypeptide chain by the action of the tRNA (elongation)

STEP 4: TERMINATION

When the “STOP” codon is reached the mRNA uncouples from the ribosome.
STEP 1:
Translation begins when an mRNA molecule attaches to a ribosome.

Ribosomes are made up of proteins and ribosomal RNA (rRNA).
During protein construction, **transfer RNA (tRNA)** transfers each amino acid to the ribosome.
STEP 4: The ribosome binds new tRNA molecules and amino acids as it moves along the mRNA.
More about tRNA

Each tRNA molecule carries only one kind of amino acid. (as determined by the anti-codon)

In addition to an amino acid, each tRNA molecule has three unpaired bases.

These bases, called the anticodon, are complementary to one mRNA codon.

To determine what Amino Acid is coded for you look at the Genetic Code codon chart:
Translation: Decoding the Message

FOR REVIEW

1. mRNA leave nucleus and enters ribosome
2. mRNA codons read & tRNA brings matching amino acid to the ribosome
3. The tRNA anticodon is complimentary to the mRNA codon
4. Amino acids are strung together like beads on a necklace
5. Amino Acids are held together by peptide bonds
6. 1000 or more Amino Acids = protein
• Lets watch!
• https://www.youtube.com/watch?v=5bLEDd-PSTQ
• https://www.youtube.com/watch?v=TfYf_rPWUdY
The Genetic Code

The genetic code is the “language” of mRNA instructions.

The code is written using four “letters” (the bases: A, U, C, and G).
Use the “Genetic Code”

Convert mRNA 3 letter groupings called **codons**

**Example:**

AUG = Methylamine (Start)

The mRNA Code tells us what **amino acid** each codon codes for.
The Genetic Code

12–3 RNA and Protein Synthesis
<table>
<thead>
<tr>
<th>First base (5' end)</th>
<th>Second base</th>
<th>Third base (3' end)</th>
</tr>
</thead>
<tbody>
<tr>
<td>U</td>
<td>UUU Phe</td>
<td>U</td>
</tr>
<tr>
<td>UUC</td>
<td>UCU Ser</td>
<td>C</td>
</tr>
<tr>
<td>UUA</td>
<td>UCA Stop</td>
<td>A</td>
</tr>
<tr>
<td>UUG</td>
<td>UCG</td>
<td>G</td>
</tr>
<tr>
<td>C</td>
<td>CUU Leu</td>
<td>U</td>
</tr>
<tr>
<td>CUC</td>
<td>CCC Pro</td>
<td>C</td>
</tr>
<tr>
<td>CUA</td>
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<td>A</td>
<td>AUU Ile</td>
<td>U</td>
</tr>
<tr>
<td>AUC</td>
<td>ACC Thr</td>
<td>C</td>
</tr>
<tr>
<td>AUA</td>
<td>ACA</td>
<td>A</td>
</tr>
<tr>
<td>AUG Met or start</td>
<td>ACG</td>
<td>G</td>
</tr>
<tr>
<td>G</td>
<td>GUU Val</td>
<td>U</td>
</tr>
<tr>
<td>GUC</td>
<td>GCU Ala</td>
<td>C</td>
</tr>
<tr>
<td>GUA</td>
<td>GCA Asp</td>
<td>A</td>
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<tr>
<td>GUG</td>
<td>GCG Gly</td>
<td>G</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Protein Synthesis

- mRNA
- Ribosome
- tRNA
- Lysine
- Translation direction
The process continues until the ribosome reaches a stop codon.
REVIEW!

- Watch these:
  - https://www.youtube.com/watch?v=gG7uCskUOrA
  - https://www.youtube.com/watch?v=28mgfg8nRT4
DNA -> Transcription -> mRNA -> Transport to cytoplasm -> Translation

- DNA: Nucleus
- mRNA: Cytoplasm
- tRNA: Cytoplasm
- Ribosome: Cytoplasm
- Protein: Cytoplasm

U.S. National Library of Medicine
The Roles of RNA and DNA

The cell uses the DNA “master plan” to prepare RNA “blueprints.” The DNA stays in the nucleus.

The RNA molecules go to the protein building sites in the cytoplasm—the ribosomes.
Transcribe and Translate this DNA Strand

without looking at your notes

TACAGTACCATAATC

NOW, Label the DNA, mRNA, tRNA, amino acid, codon, anticodon

Which part is transcription

Which is translation?
Vocabulary for ppt 2 Transcription and Translation
Chapter 8.4 and 8.5

- Genes
- DNA
- RNA
- Protein
- mRNA
- tRNA
- rRNA
- Transcription
- RNA Polymerase
- RNA bases
- Exon
- Intron
- Amino Acid
- Ribosome
- Translation
- Codon
- Anticodon
- Genetic Code Chart
- Start codon
- Stop Codons