The Central Dogma:  
“Getting the Information Out”

1) Replication

2) Transcription

DNA (polymer) → mRNA (polymer)

3) Translation

mRNA (polymer) → Protein* (polymer)

*Made from amino acids (monomers)
Translation: the process that converts or translates an mRNA message into a polypeptide (one/more polypeptides = a protein)


“language” of proteins = 20 amino acids

letters make words: nucleotides strung together to code for amino acids

all words – codons- made of three letters

Codon: a three-nucleotide sequence that codes for an amino acid.

RNA could code for 64 ($4^3$) amino acids used to build proteins in human body & most other organisms.
DNA
mRNA Transcription
Mature mRNA
Transport to cytoplasm for protein synthesis (translation)
mRNA
Base Pairing Rules:

mRNA → tRNA

- mRNA:
  - Adenine (A)
  - Uracil (U)
  - Guanine (G)
  - Cytosine (C)

- tRNA:
  - Uracil (U)
  - Adenine (A)
  - Cytosine (C)
  - Guanine (G)

3 Stop codons - signal end of amino acid chain
Start codon - signals start of translation and the amino acid methionine. *always starts w/ methionine but often removed later
mRNA nucleotides

3 nucleotides ("codon") = 1 amino acid

Amino Acid (1 of 20)
Reading Codons

- Read without spaces as series of 3 nucleotides
- order is called the reading frame – changing reading frame changes the protein
- clear “punctuation” – start/stop codons really important
- Genetic code almost universal: suggests common ancestor.
- Also means scientists can insert a gene from one organism into another organism to make a functional protein.
You already know:

- mRNA carries instructions from DNA in nucleus to cytoplasm
- mRNA message read in sets of 3 nucleotides (codons)

But how does a cell actually translate a codon into an amino acid?

- Uses ribosomes (site of protein synthesis - made of tRNA & proteins) & tRNA catalyze reactions that forms bonds between amino acids
- Small unit of tRNA holds onto mRNA strand, large subunit holds onto growing protein (tRNA acts as adaptor between mRNA & amino acids)
- tRNA (folded in shape of L) carry free floating amino acids from cytoplasm to ribosome – one side attached to amino acid, other end anticodon - set of 3 nucleotides that is complementary to an mRNA codon.
- Ex. Anticon CCC pairs w/ mRNA GGG
Process #3: **Translation**

Molecule(s) involved: DNA, mRNA  
Happens in cytoplasm  

**Steps taken:**

1. mRNA strand connects to the ribosome.  
2. First tRNA’s **anticodon** docks with the mRNA’s start **codon**.  
   
   (AUG (and always brings the amino acid *methionine* (met))  
3. Second tRNA “docks” with ribosome & mRNA strand.  
4. Amino acid from #2 tRNA attaches to amino acid from #1. (forms peptide bond)  
5. First tRNA returns to cytoplasm to be recharged with another amino acid.  
6. Whole assembly moves forward one codon (3 letters).  
7. Repeat process until mRNA’s “stop” codon is reached.  
   
   (UAG, UAA, or UGA)  
8. A **release factor** breaks up the party.
A Closer Look at Translation
<table>
<thead>
<tr>
<th>Location(s):</th>
<th>DNA</th>
<th>mRNA</th>
<th>tRNA</th>
<th>Protein</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nucleus</td>
<td>Nucleus</td>
<td>Nucleus</td>
<td>Cytoplasm</td>
<td>Cytoplasm</td>
</tr>
<tr>
<td>Cytoplasm</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Sugar</th>
<th>Deoxyribose</th>
<th>Ribose</th>
<th>Ribose</th>
<th>NA</th>
</tr>
</thead>
<tbody>
<tr>
<td>Phosphate</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>NA</td>
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</table>

<table>
<thead>
<tr>
<th>Chemical Bases</th>
<th>ATCG</th>
<th>AUCG</th>
<th>AUCG</th>
<th>NA</th>
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</table>

<table>
<thead>
<tr>
<th>Processes Involved</th>
<th>Replication, Transcription</th>
<th>Transcription, Translation</th>
<th>Translation</th>
<th>Translation</th>
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</thead>
</table>

<table>
<thead>
<tr>
<th>Interacts with Amino Acids</th>
<th>No</th>
<th>No</th>
<th>Yes</th>
<th>Yes</th>
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</thead>
</table>

<table>
<thead>
<tr>
<th>Structure</th>
<th>Double Stranded</th>
<th>Single Stranded</th>
<th>Triplet “Codon”</th>
<th>Single Stranded</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>“Handedness”</th>
<th>Left</th>
<th>Right</th>
<th>Left</th>
<th>NA</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>Purpose</th>
<th>Master blueprint of cell activities</th>
<th>Create new proteins: carry copy of DNA message to ribosome</th>
<th>Create new proteins: Carry amino acid to ribosome</th>
<th>Serve as structural parts of body and/or enzymes</th>
</tr>
</thead>
</table>
Crash Course: Transcription & Translation

- https://www.youtube.com/watch?v=itsb2SqR-R0