DNA & Protein Synthesis

BIO 105
Chapter 21

What does “DNA” stand for?

DNA is made of monomers called ________.

DNA is a double-stranded molecule that is twisted to form a spiral structure called a double helix.

Following the rules of complementary base pairing, adenine pairs only with thymine, and cytosine pairs only with guanine.

DNA is composed of four nucleotides.
What is needed for DNA replication?

Cast of characters:

- DNA
- Helicase
- Binding proteins
- DNA polymerase
- Nucleotides
If the DNA strand sequence to be replicated was:

3' TACGGCAATGCATT 5'

What would be the sequence of the complementary DNA strand produced during replication?

Sometimes mistakes occur

What happens when a mutation occurs?
1. Enzymes can repair the damage
2. The cell may commit “suicide” (apoptosis)
3. The cell may replicate and the mutation becomes permanent

Genes
- A gene is a specific segment of DNA that contains information for producing a specific protein or polypeptide.
- What are the parts of a gene?
- How do we make a protein from the information within a gene?
Protein Synthesis

- Transcription
  DNA → mRNA

- Translation
  mRNA → protein

**TABLE 21.2: Review of the Functions of RNA**

<table>
<thead>
<tr>
<th>Molecule</th>
<th>Functions</th>
</tr>
</thead>
<tbody>
<tr>
<td>Messenger RNA (mRNA)</td>
<td>Carries DNA's information in the sequence of its bases (codons) from the nucleus to the cytoplasm</td>
</tr>
<tr>
<td>Transfer RNA (tRNA)</td>
<td>Binds to a specific amino acid and transports it to be added, as appropriate, to a growing polypeptide chain</td>
</tr>
<tr>
<td>Ribosomal RNA (rRNA)</td>
<td>Combines with protein to form ribosomes (structures on which polypeptides are synthesized)</td>
</tr>
</tbody>
</table>

**Transcription**

Cast of characters:

- DNA
- Nucleotides
- RNA polymerase II
- Transcription factors
- ATP
Transcription Termination

Suppose a DNA strand has the following sequence:

3' TACGGCATGTACT 5'

What will be the sequence of the complementary mRNA strand?

RNA transcript (pre-mRNA)

- Most “coding” regions within a gene include regions that do not contribute to protein formation.
- Introns
- Exons

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Translation

• When mRNA enters the cytoplasm, it must associate with the protein synthesis “machinery”

Cast of characters:

mRNA
ribosomes
tRNA
amino acids
Same mRNA molecule.

**Large subunit Polypeptide**

**Small subunit Ribosome mRNA**

**Direction of transcription**

**Termination of translation**

**Step 1:** The small ribosomal subunit joins to mRNA at the start codon, AUG.

**Step 2:** A tRNA with complementary anticodon pairs with the start codon. Ribosomal subunits join to form a functional ribosome.

**Step 3:** The tRNA in the first binding site leaves the ribosome. The ribosome moves along the mRNA, exposing the next codon.

**Step 4:** Enzymes link the amino acids. The process is repeated many times.

**Step 1:** The stop codon moves into the ribosome.

**Step 2:** Release factors cause the release of the newly formed polypeptide and the separation of the ribosomal subunits and the mRNA.
If a mRNA sequences reads . . .

AUG ACA CAC UGU UGA

What will be the amino acid sequence in the polypeptide chain?