

TOPIC 2.7: TRANSCRIPTION & TRANSLATION

Transcription

Transcription is the synthesis of an RNA sequence from a DNA template

- This process occurs within the nucleus of a cell

Transcription is mediated by the enzyme RNA polymerase, which:

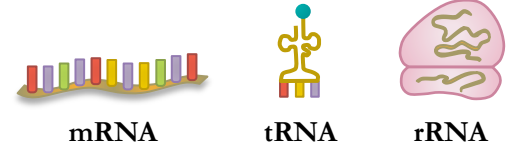
- Separates the DNA strands (breaks H bonds between base pairs)
- Covalently joins free complementary RNA nucleotides together

After transcription, the RNA is released to the cytoplasm (for translation) and the DNA remains within the nucleus and reforms a double helix

Types of RNA

Three main types of RNA may be produced:

- **mRNA** – Transcript used to make protein
- **tRNA** – Transfers amino acid to ribosome
- **rRNA** – Catalytic component of ribosome



Genetic Code

The genetic code is the set of rules by which information encoded in mRNA sequences is converted into a polypeptide sequence

Codons: Triplets of bases which correspond to a particular amino acid

The order of the codons determines the amino acid sequence for a protein

- A coding sequence always begins with a start codon (AUG)
- A coding sequence is terminated with a stop codon

The genetic code has two key features:

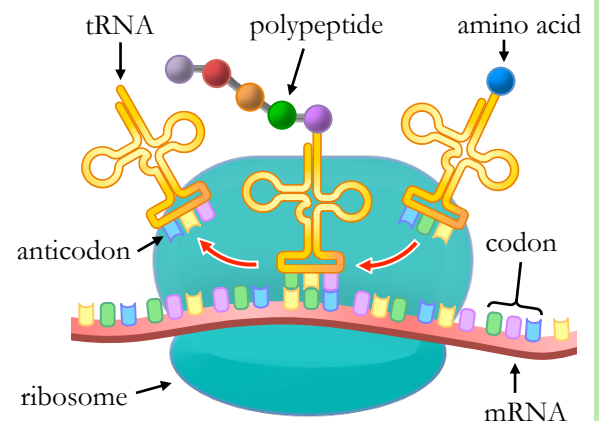
- **Universality** – All organisms use the same genetic code
- **Degeneracy** – Multiple codons may code for the same amino acid

UUU	Phe	UCU	Ser	UAU	Tyr	UGU	Cys
UUC		UCC		UAC		UGC	
UUA	Leu	UCA		UAA	STOP	UGA	STOP
UUG		UCG		UAG	STOP	UGG	Trp
CUU		CCU		CAU	His	CGU	Arg
CUC	Leu	CCC	Pro	CAC		CGC	
CUA		CCA		CAA	Gln	CGA	
CUG		CCG		CAG		CGG	
AUU		ACU		AAU	Asn	AGU	Ser
AUC	Ile	ACC	Thr	AAC		AGC	
AUA		ACA		AAA	Lys	AGA	Arg
AUG	Met	ACG		AAG		AGG	
GUU		GCU		GAU	Asp	GGU	Gly
GUC	Val	GCC	Ala	GAC		GGC	
GUA		GCA		GAA	Glu	GGA	
GUG		GCG		GAG		GGG	

Translation

Translation is the process of polypeptide synthesis by the ribosome

- Messenger RNA (mRNA) is transported to the ribosome
- A ribosome reads an mRNA sequence in base triplets called codons
- Each codon codes for a specific amino acid (as per the genetic code)
- Amino acids are transported to ribosomes by transfer RNA (tRNA)
- Each tRNA aligns opposite a codon via a complementary anticodon
- The ribosome moves along the mRNA sequence (5' → 3') and joins amino acids together with peptide bonds (condensation reaction)
- The synthesis of a polypeptide is initiated at a start codon (AUG) and is completed when the ribosome reaches a STOP codon



Gene → Protein

A gene is a sequence of DNA which encodes a polypeptide sequence

- One gene = one polypeptide (proteins may have multiple polypeptides)

There are exceptions to this fundamental relationship:

- Genes may be alternatively spliced (one gene = many polypeptides)
- Genes encoding tRNA or rRNA are transcribed but not translated
- Genes may be mutated to alter the original polypeptide product

