

## 6.4 Translation

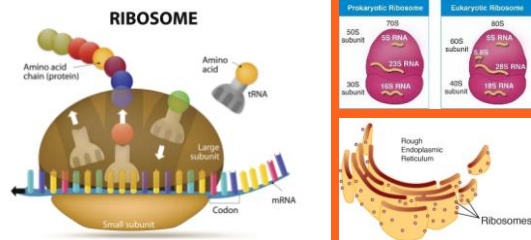
First letter	Second letter			Amino acid	First letter
	U	C	A		
U	UUU	UUU	UUU	Tyrosine	U
	UUC	UUC	UUC	Cysteine	C
	UUA	UUA	UUA	Leucine	A
C	CUU	CUU	CAU	Hisidine	U
	CUC	CUC	CAC	Glutamine	C
	CUA	CUA	CAA	Glutamine	A
A	AUU	AUU	AUU	Asparagine	U
	AUA	AUA	AUA	Asparagine	C
	AUA	AUA	AUA	Lysine	A
G	GUU	GUU	GAU	Aspartic acid	U
	GUC	GUC	GAC	Glycine	C
	GUA	GUA	GAA	Glycine	A

## ENDURING UNDERSTANDING

IST-1 Heritable information provides for continuity of life.

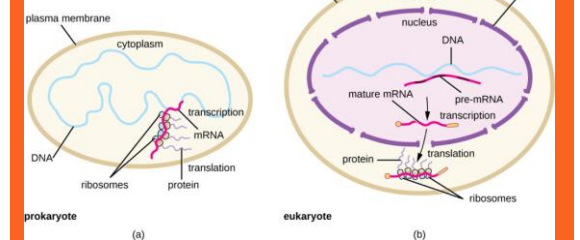
IST-1.O Describe how the phenotype of an organism is determined by its genotype

Translation of the mRNA to generate a polypeptide occurs on ribosomes that are present in the cytoplasm of both prokaryotic and eukaryotic cells and on the rough endoplasmic reticulum of eukaryotic cells.



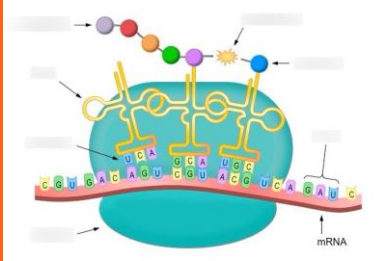
IST-1.O Describe how the phenotype of an organism is determined by its genotype

In prokaryotic organisms, translation of the mRNA molecule occurs while it is being transcribed.



IST-1.O Describe how the phenotype of an organism is determined by its genotype

Translation involves energy and many sequential steps, including initiation, elongation, and termination.



## How Genes Code for Amino Acids

- mRNA contains the **genetic code**.
- Codes for an amino acid or stops translation.
- Code is comprised of 64 codons.
- Codon** consists of 3 sequential nucleotide bases of mRNA. ( $4^3=64$ )

First letter	Second letter			Amino acid	First letter
	U	C	A		
U	UUU	UUU	UUU	Tyrosine	U
	UUC	UUC	UUC	Cysteine	C
	UUA	UUA	UUA	Leucine	A
C	CUU	CUU	CAU	Hisidine	U
	CUC	CUC	CAC	Glutamine	C
	CUA	CUA	CAA	Glutamine	A
A	AUU	AUU	AUU	Asparagine	U
	AUA	AUA	AUA	Asparagine	C
	AUA	AUA	AUA	Lysine	A
G	GUU	GUU	GAU	Aspartic acid	U
	GUC	GUC	GAC	Glycine	C
	GUA	GUA	GAA	Glycine	A

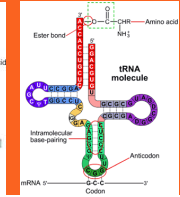
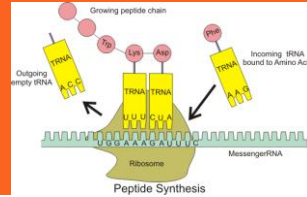
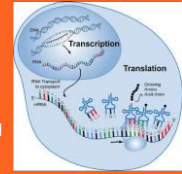
## How Genes Code for Amino Acids

- 64 mRNA triplets code for 20 amino acids.
- Each codon has only one meaning.
- There is one start codon and three stop codons.
- The Code Is Universal
  - Suggests the code dates to very first organisms.
  - Once established, changes would be very disruptive.

		Second letter						
		U	C	A	G			
U	UUU	Phenylalanine	UCU	Serine	UAU	Tyrosine	UGU	Cysteine
	UUC		UCC		UAC		UGC	
	UUA		UCA		UAG	Stop codon	UGA	Stop codon
C	CUU	Leucine	CCU	Proline	CAU	Histidine	CGU	Arginine
	CUC		CCC		CAU		CGA	
	CUA		CCA		CAA	Glutamine	CGG	
A	AUU	Isoleucine	ACU	Threonine	AUU	Asparagine	AUU	Serine
	AUA		ACC		AUA		AUG	
	AUG	Methionine; initiation codon	ACA		AAA	Lysine	AGA	Arginine
G	GUU	Valine	GAU	Aspartic acid	GAU	Aspartic acid	GGU	Glycine
	GUC		GCC		GAC		GGA	
	GUA		GCA		GAA	Glutamic acid	GGG	

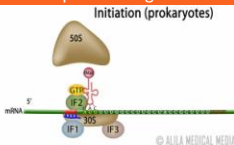
## Translation

- Takes place in cytoplasm
- One language (nucleic acids) is translated into another language (protein)
- Transfer RNA
  - Transfers amino acids to the ribosomes.
  - One end binds to amino acid; other end has an anticodon that binds to mRNA codon



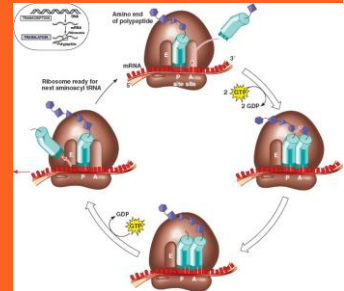
## Chain Initiation

- Small ribosomal subunit attaches to mRNA at the start codon (AUG).
- First or initiator tRNA pairs with this codon; then large ribosomal subunit joins to small subunit
- Initiation factor proteins are required to bring necessary components together



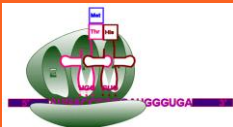
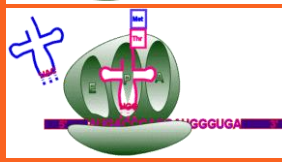
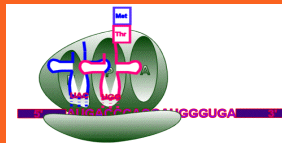
## Chain Elongation

- New tRNA arrives at A site
- Amino acid at P site is attached by a peptide bond to the newly arrived amino acid.
- Reaction is catalyzed by GTP on the larger subunit.



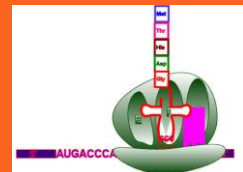
## Chain Elongation

- The tRNA molecule in the P site leaves.
- Translocation occurs when tRNA moves from site A to P.
- As ribosome has moved forward three nucleotides, there is new codon located at empty A site.



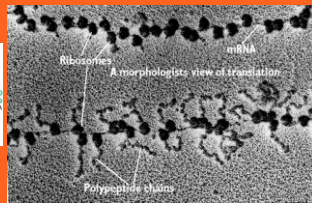
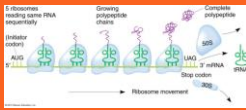
## Chain Termination

- Occurs at stop codon that does not code for amino acid.
- Release factor protein binds to stop codon.
- The polypeptide is enzymatically cleaved from the last tRNA.
- tRNA and polypeptide leave the ribosome, which dissociates into its two subunits.



## Polyribosomes

- **Remember-** Proteins are not synthesized one at a time as each protein finishes production.
- Polyribosomes are clusters of several ribosomes synthesizing the same protein



## IST-1.0 Describe how the phenotype of an organism is determined by its genotype

- Genetic information in retroviruses is a special case and has an alternate flow of information:

- From RNA to DNA
- By reverse transcriptase, an enzyme that copies the viral RNA genome into DNA.
- This DNA integrates into the host genome and becomes transcribed and translated for the assembly of new viral progeny.

