

# Proteomics Course

## LECTURE-2 Central Dogma: Basics of DNA, RNA, Proteins

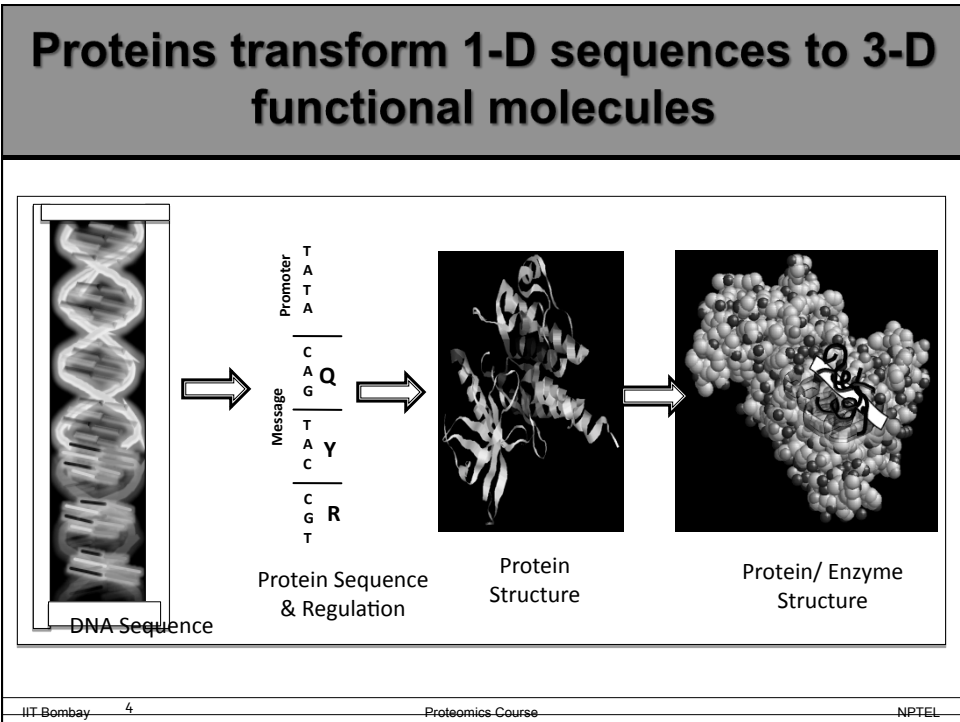
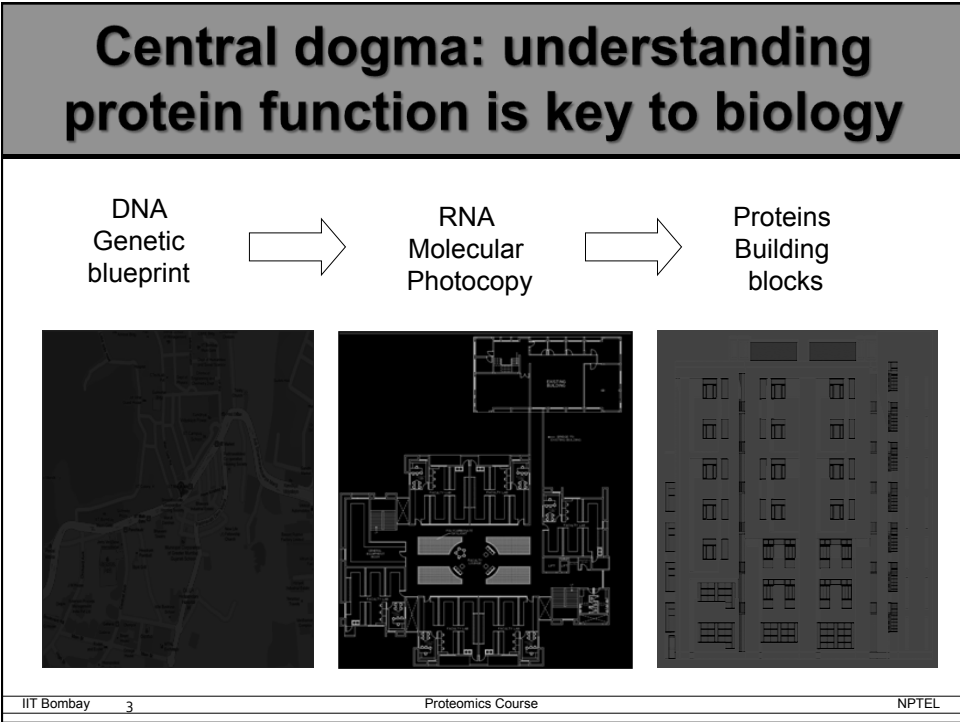


Dr. Sanjeeva Srivastava  
IIT Bombay



### Lecture outline

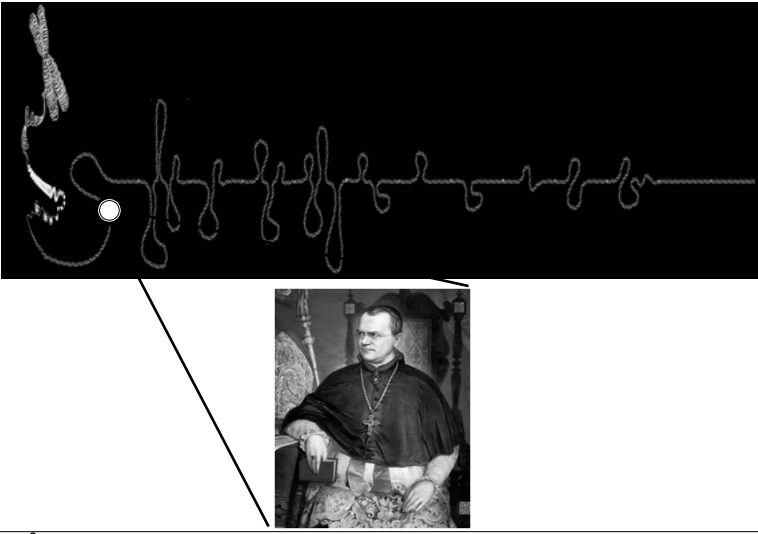
- Central Dogma
- DNA
- RNA
- Proteins



# Milestone Discoveries related to DNA

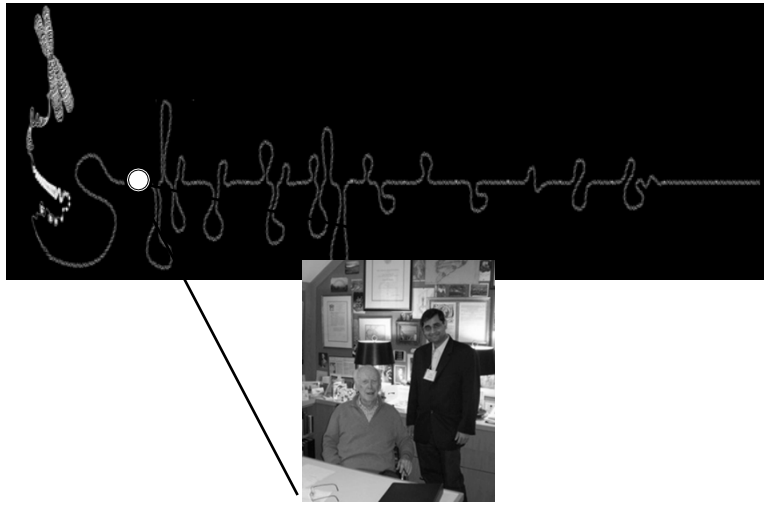
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## Mendel - laws of genetics (1865)



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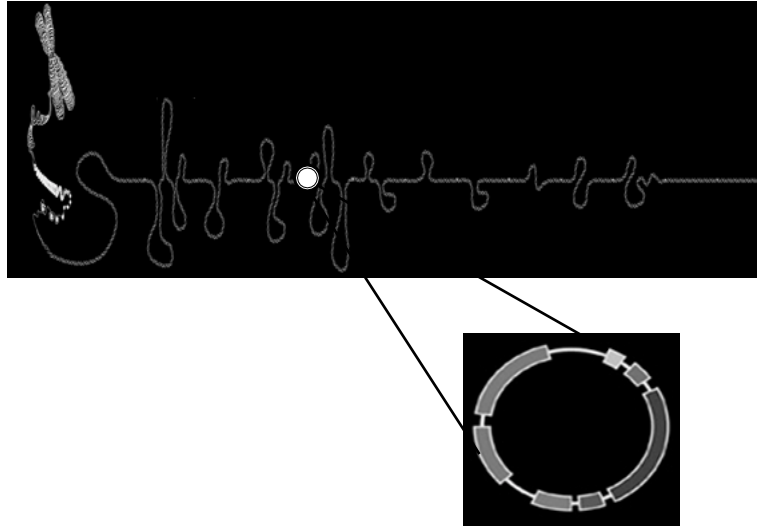
# DNA double helix structure - Watson and Crick (1953)



# Nirenberg, Khorana & Holly determined genetic code (1966)

	U	C	A	G	
U	Pho Leu	Ser	Tyr stop stop	Cys stop Trp	U C A G
C	Leu	Pro	His Gln	Arg	U C A G
A	Ile Met	Thr	Asn Lys	Ser Arg	U C A G
G	Val	Ala	Asp Glu	Gly	U C A G

## Cohen & Boyer developed Recombinant DNA technology (1972)

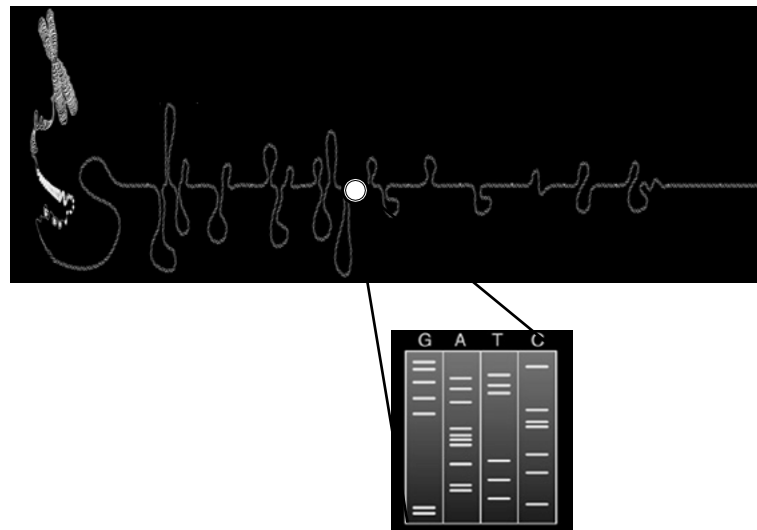


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## Sanger, Maxam and Gilbert developed DNA sequencing methods (1977)

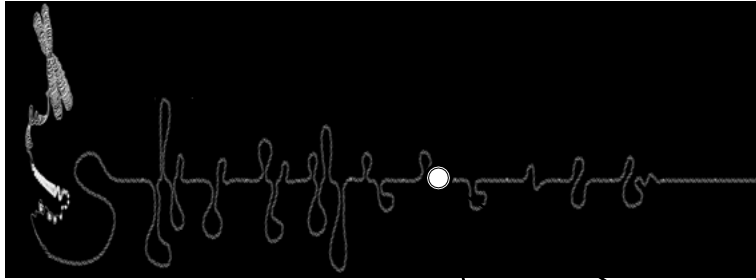


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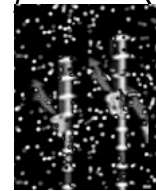
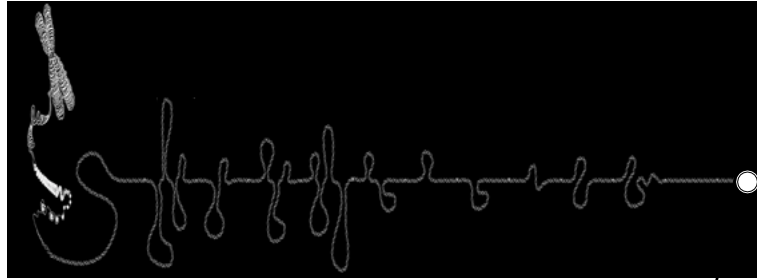
# Cloning (1997)



# Human Genome Project (2003)

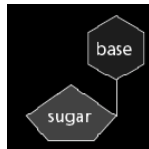


# Next Generation Sequencing

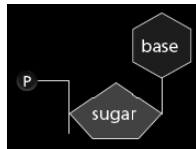


# Structure of DNA

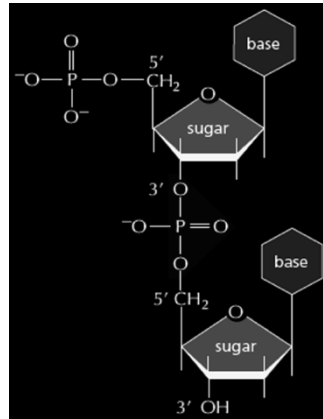
## Nucleoside, Nucleotide and Nucleic acid



Nucleoside=  
Base + Sugar

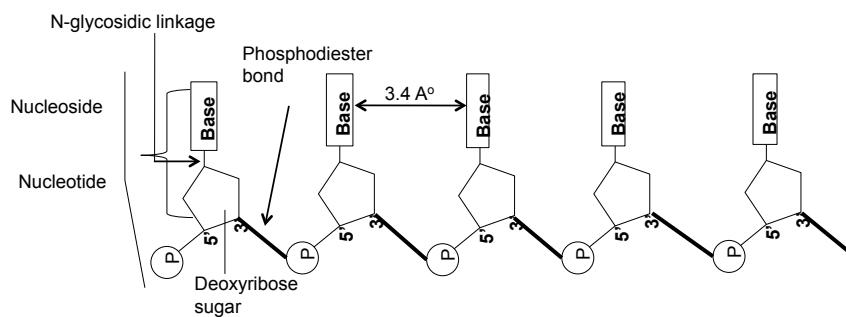


Nucleotide=  
Base + Sugar + Phosphate



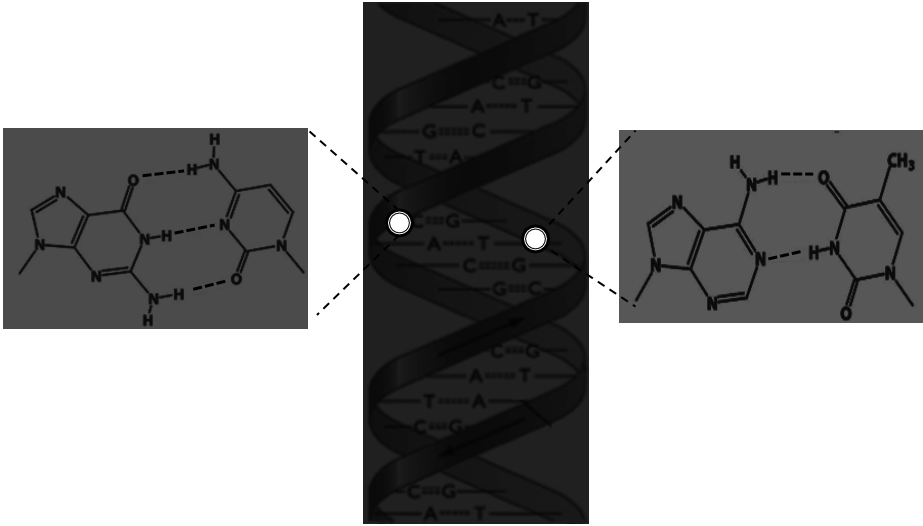
Nucleic Acids =  
Nucleotide joined by phosphodiester  
bonds

## Structure of DNA: basic components

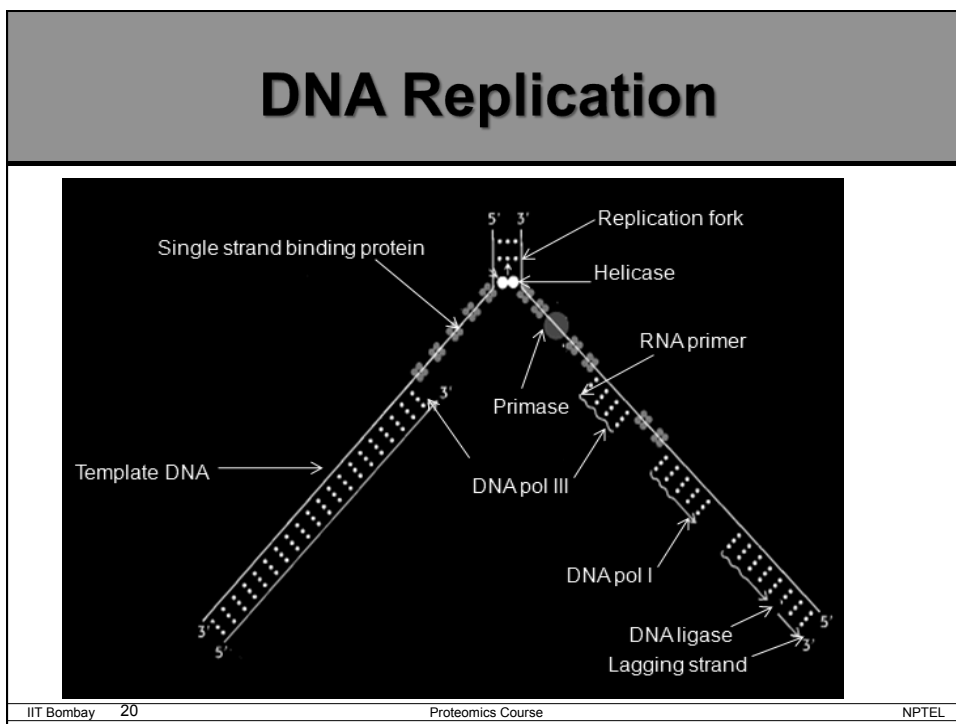
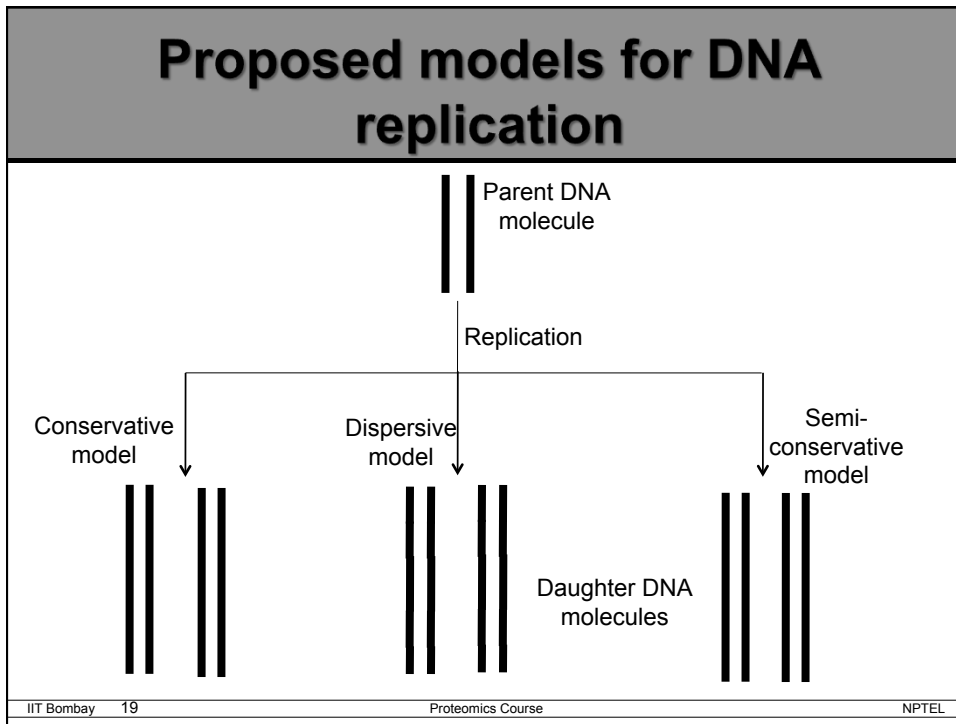




# DNA double helix structure



# Function of DNA



## Transcription of DNA: Prokaryotic

The diagram illustrates the initial steps of transcription in a prokaryotic cell. It shows a DNA double helix with a promoter region. In the 'Closed promoter complex' stage, RNA polymerase (labeled as  $\sigma$  factor) is bound to the DNA, but the DNA strands are still paired. An arrow points to the 'Open promoter complex' stage, where the DNA strands have separated at the promoter region, creating a transcription bubble. Labels include  $\sigma$  factor, RNA polymerase, and Promoter. The DNA strands are labeled with 5' and 3' ends.

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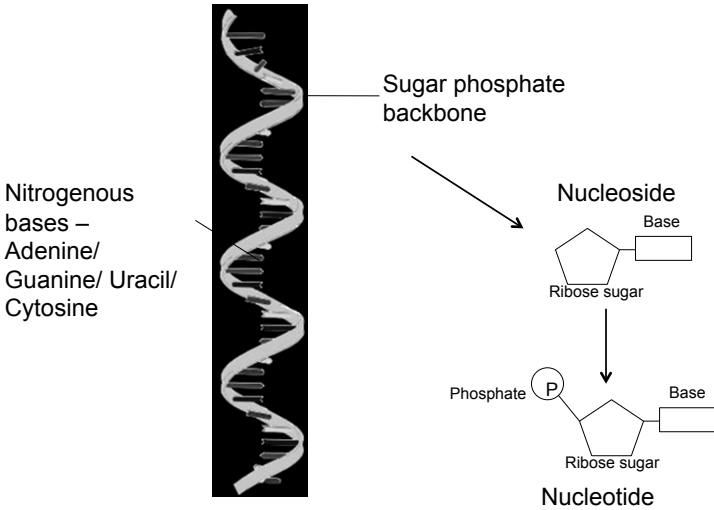
## Transcription of DNA: Eukaryotic

This diagram details the eukaryotic transcription process. It is divided into two main sections: 'Eukaryotic transcription initiation' and 'Elongation'.  
**Initiation:** Shows the 'Closed promoter complex' where RNA polymerase II and various transcription factors (TFIIA, TFIIB, TFIIE, TFIIF) are bound to the DNA promoter. An arrow indicates the transition to the 'Open promoter complex', where the DNA strands are separated.  
**Elongation:** Shows the transcription bubble moving along the DNA. The 'Direction of movement' is indicated by an arrow. The 'Newly synthesized RNA' is shown emerging from the polymerase. The 'Template DNA strand' is used for synthesis. As the polymerase moves, 'Helix re-winding' occurs behind it, and 'Helix unwinding' occurs ahead. The process ends at a 'Terminator sequence' where 'Promoter clearance -  $\sigma$  factor dissociates'.  
 Labels include Promoter, Closed promoter complex, RNA polymerase II, Transcription factors, Open promoter complex, Direction of movement, Template DNA strand, Promoter clearance -  $\sigma$  factor dissociates, Helix re-winding, Helix unwinding, RNA transcript, and Terminator sequence. DNA strands are labeled with 5' and 3' ends.

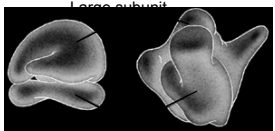
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# Structure and Function of RNA

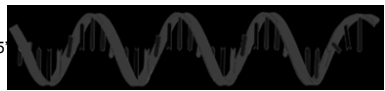
## RNA Structure



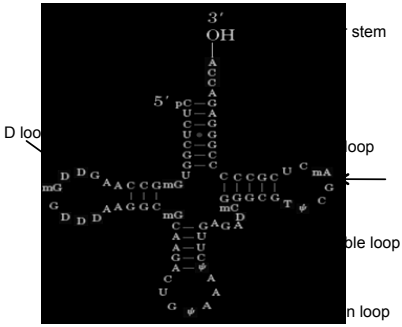
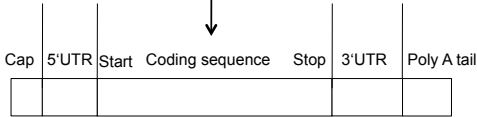
# Different Classes of RNA



Ribosomal RNA (rRNA)

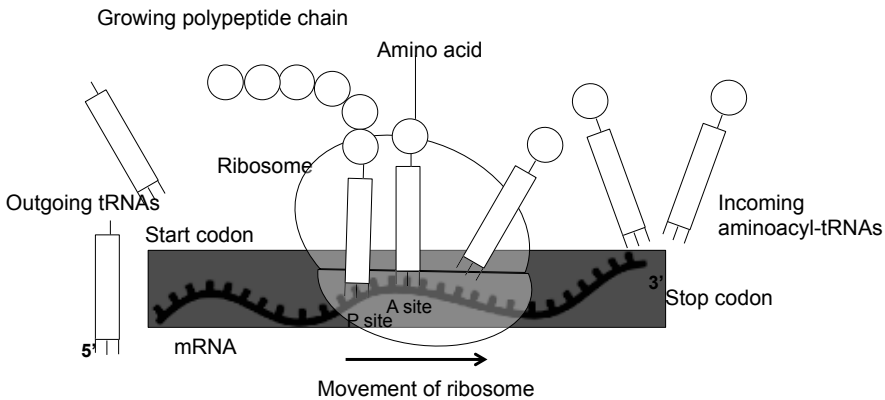


Messenger RNA (mRNA)



Transfer RNA (tRNA)

# Functions of different classes of RNA in protein synthesis



## Summary

- Central Dogma
- DNA
- RNA
- Proteins

## REFERENCES

- Berg J., Tymoczko J. & Stryer L., Biochemistry fifth ed., W. H. Freeman & company, 2002. ISBN: 0716746840.
- Lewin B., Gene VIII first ed., Pearson, 2003, ISBN: 0131239244.
- Nelson D. & Cox M., Lehninger, Principles of Biochemistry fourth ed., W. H. Freeman and company, 2004. ISBN: 023022699X.
- Voet D. & Voet J., Biochemistry fourth ed., Wiley, 2000. ISBN: 047158651X.