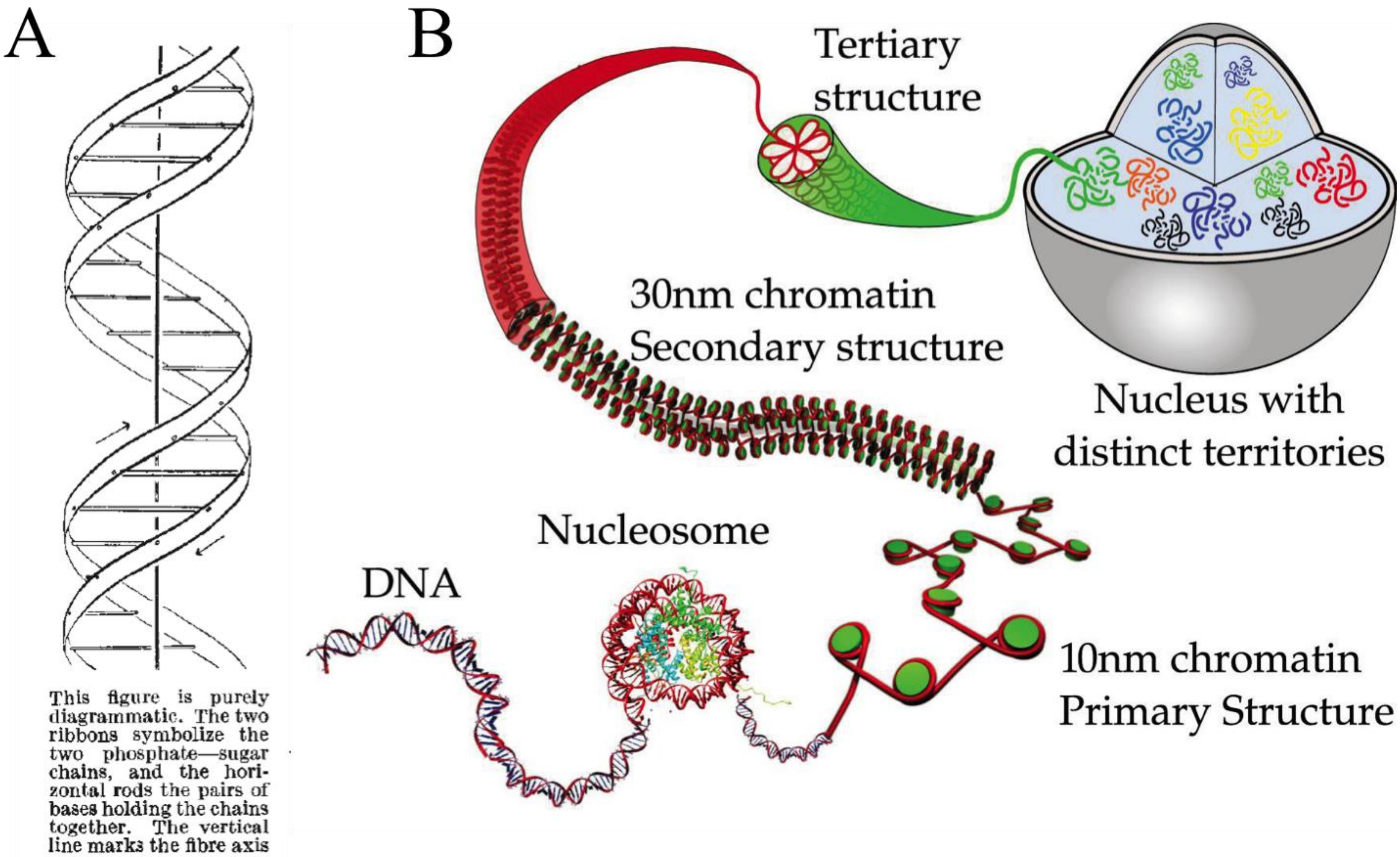
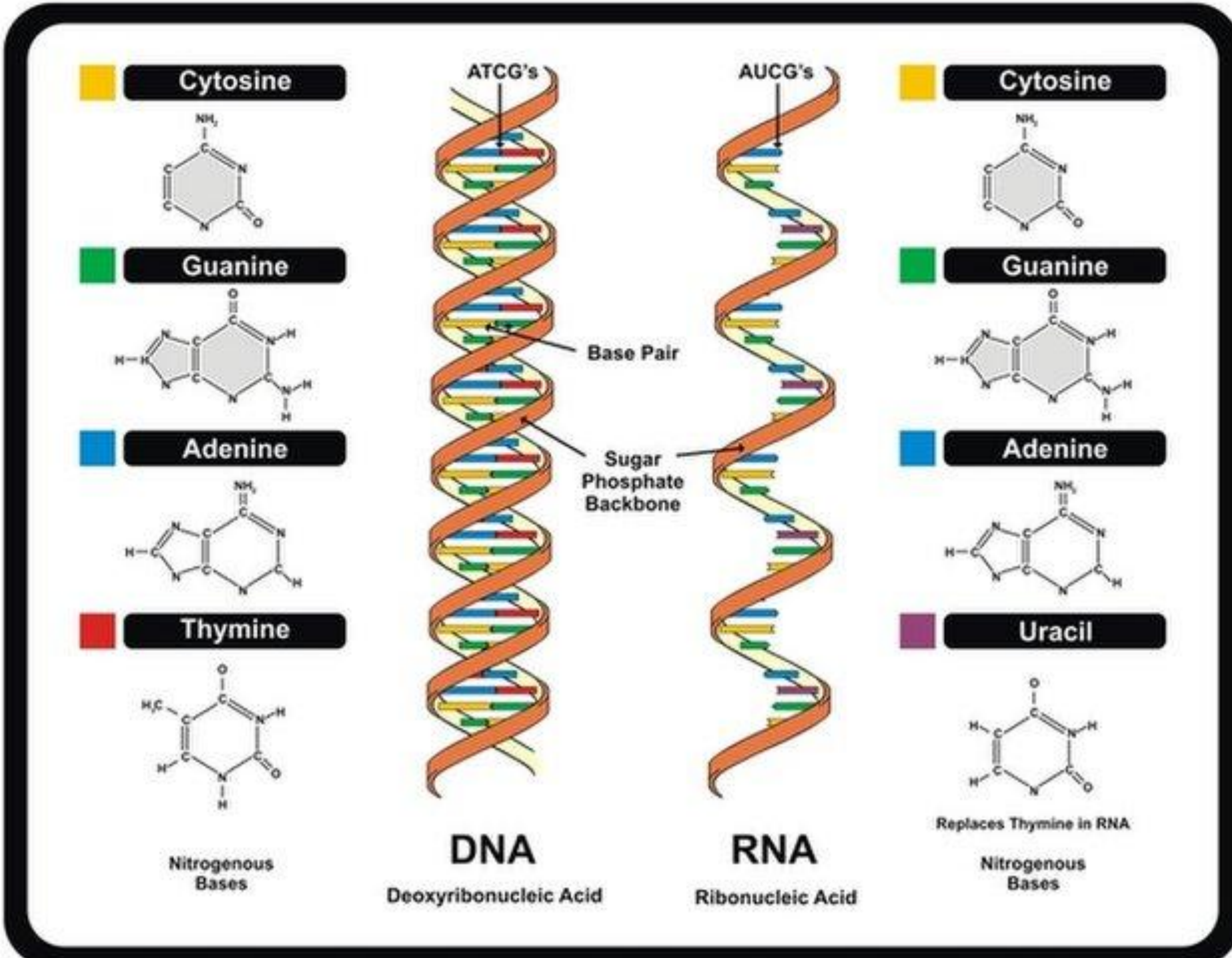
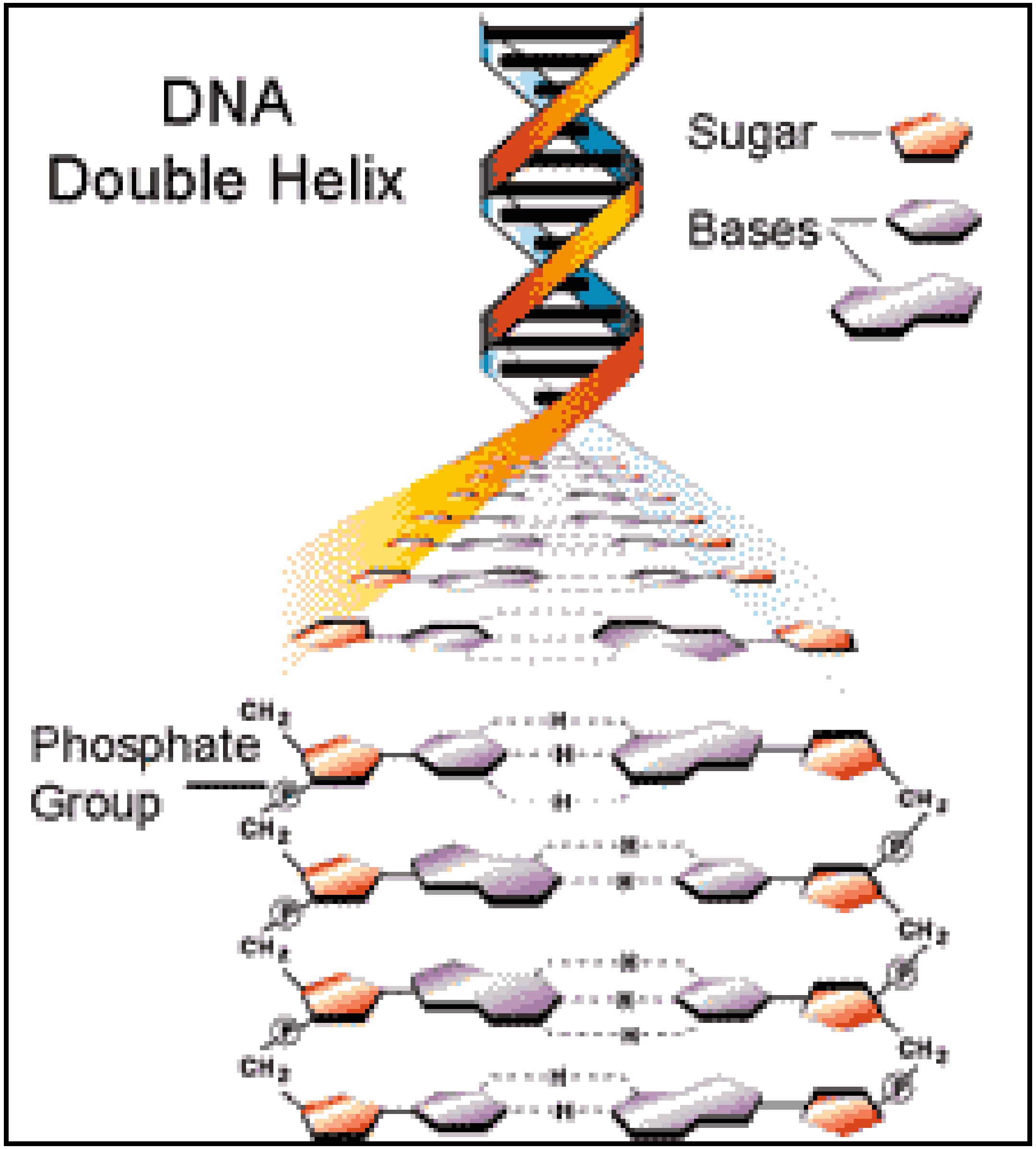
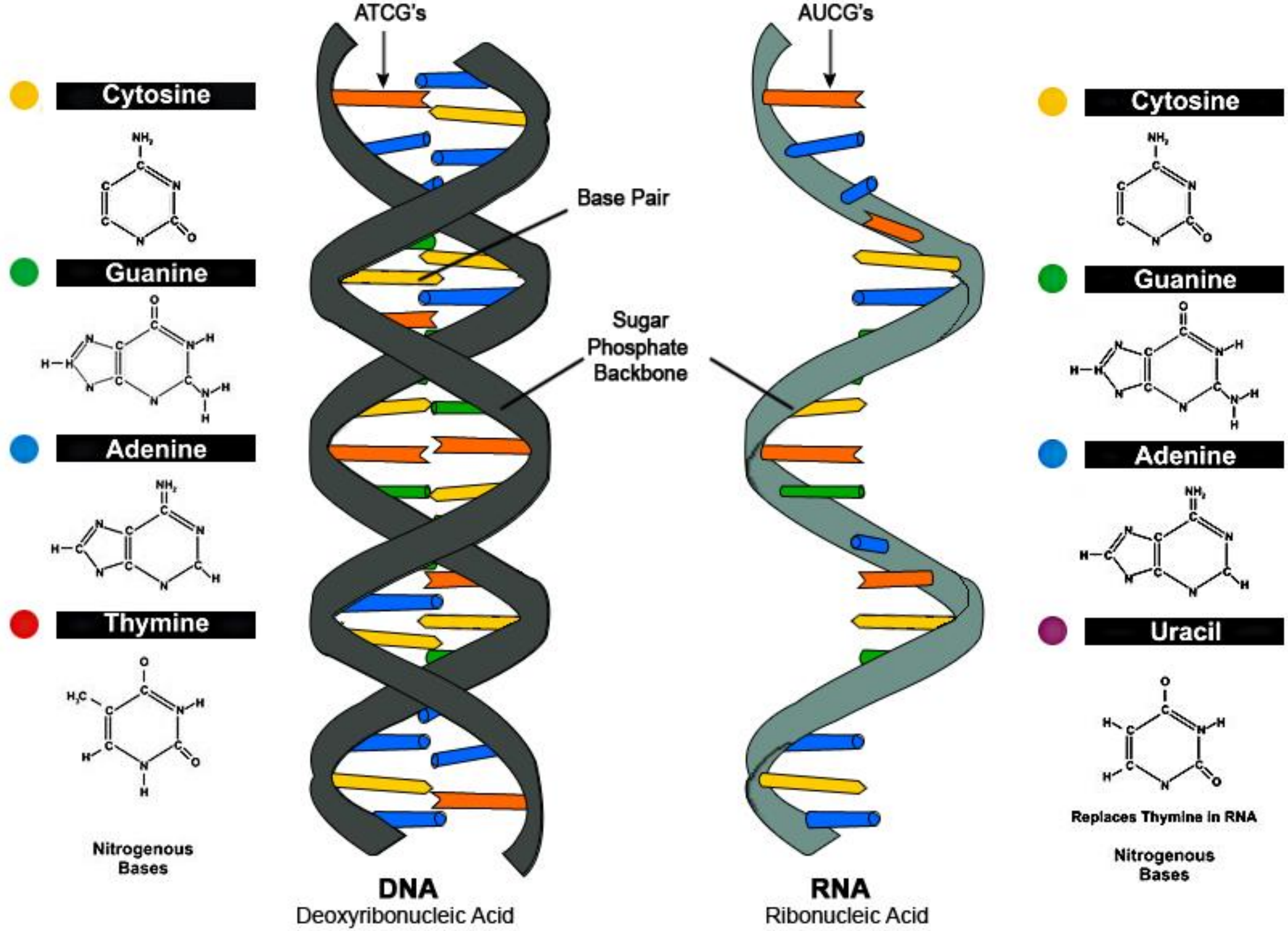
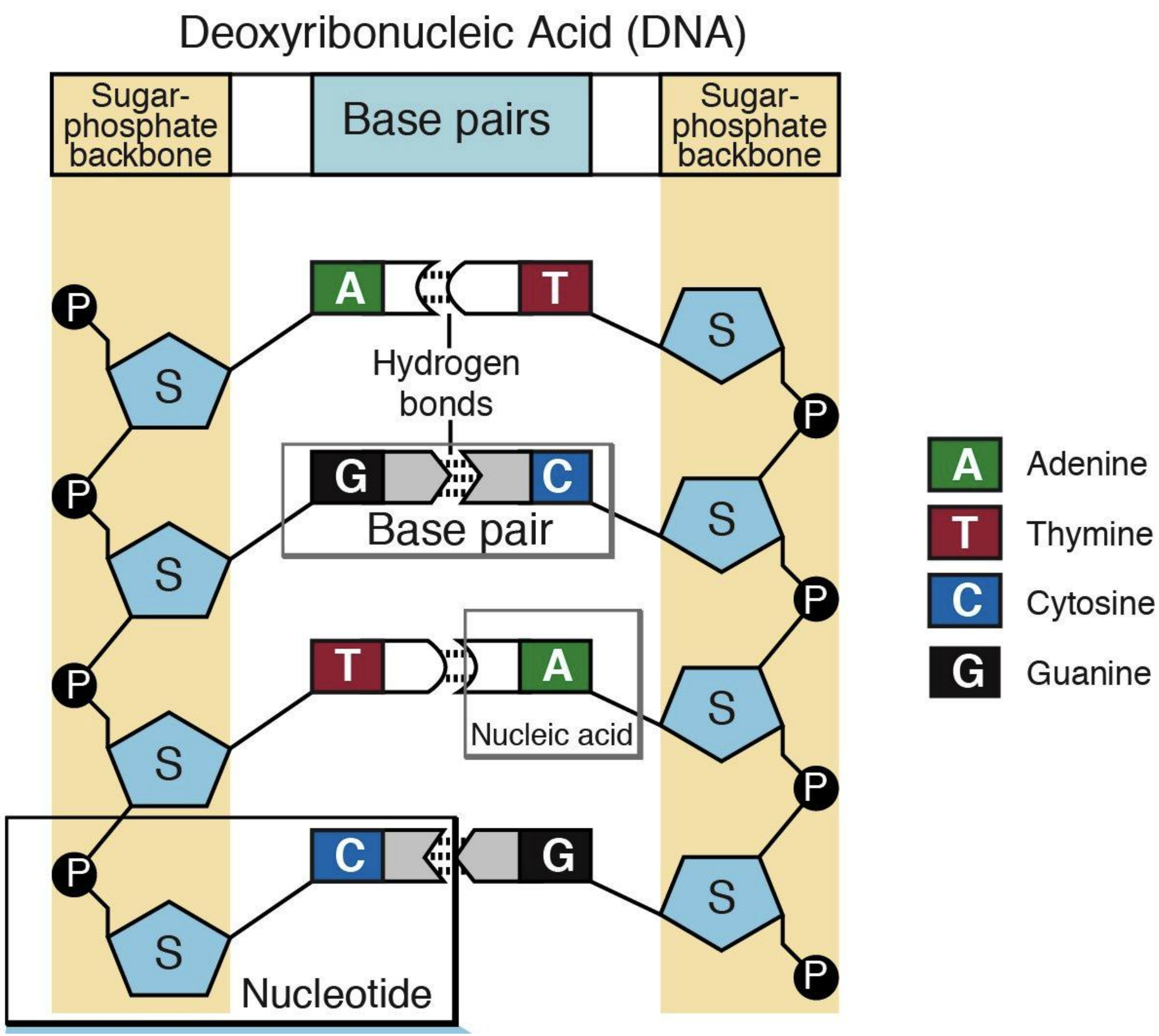

A
This figure is purely diagrammatic. The two ribbons symbolize the two phosphate—sugar chains, and the horizontal rods the pairs of bases holding the chains together. The vertical line marks the fibre axis
B
Tertiary structure
30nm chromatin Secondary structure
Nucleus with distinct territories
Nucleosome
DNA
10nm chromatin Primary Structure


Cytosine
Guanine
Adenine
Thymine
Nitrogenous Bases
ATCG's
Base Pair
Sugar Phosphate Backbone
DNA
Deoxyribonucleic Acid
AUCG's
RNA
Ribonucleic Acid
Cytosine
Guanine
Adenine
Uracil
Replaces Thymine in RNA
Nitrogenous Bases

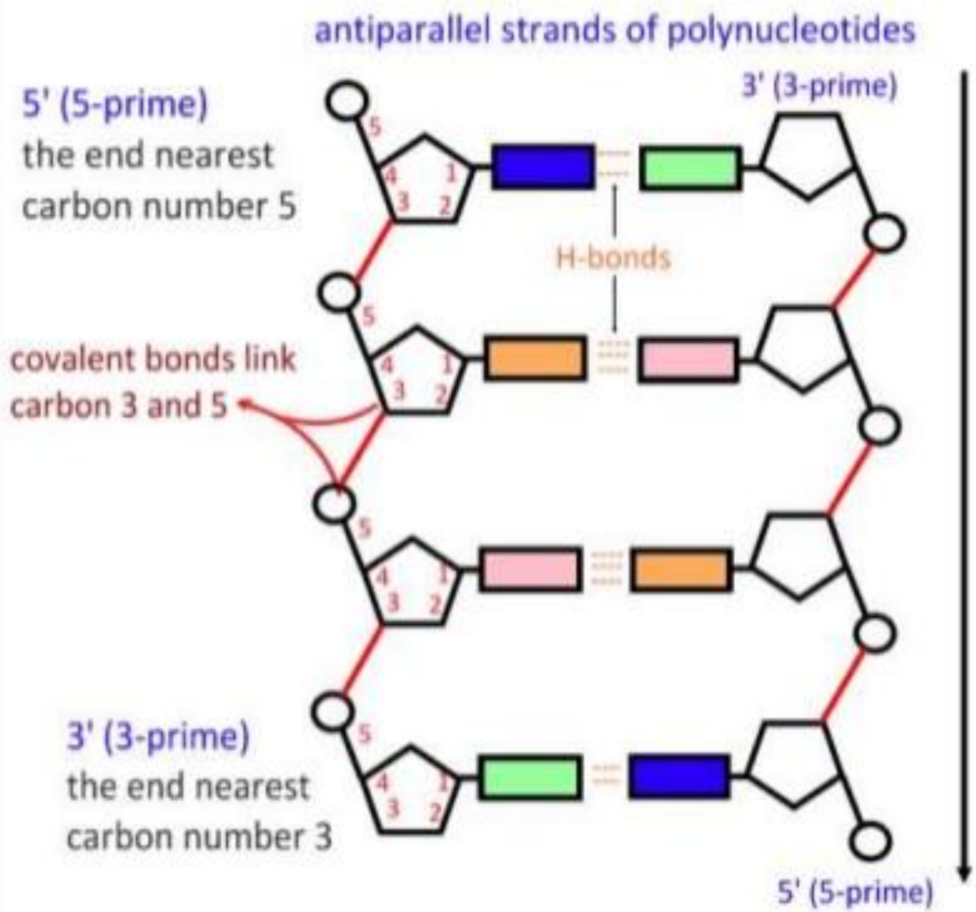

DNA
Double Helix
Sugar
Bases
Phosphate
Group
CH2
H

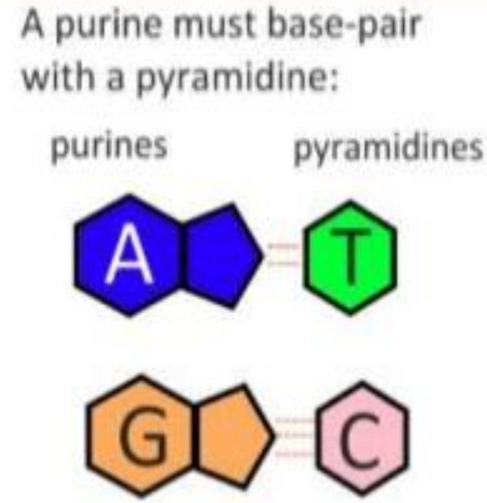


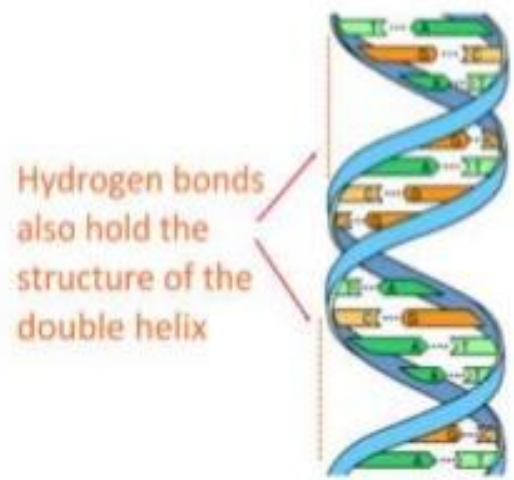
Cytosine
Guanine
Adenine
Thymine
Nitrogenous Bases
ATCG's
Base Pair
Sugar Phosphate Backbone
AUCG's
DNA
Deoxyribonucleic Acid
RNA
Ribonucleic Acid
Cytosine
Guanine
Adenine
Uracil
Replaces Thymine in RNA
Nitrogenous Bases


Deoxyribonucleic Acid (DNA)
Sugar-phosphate backbone
Base pairs
Sugar-phosphate backbone
A
T
Hydrogen bonds
G
C
Base pair
T
A
Nucleic acid
C
G
Nucleotide
P
S
A Adenine
T Thymine
C Cytosine
G Guanine

Core Review: 2.6.U3 DNA is a double helix made of two antiparallel strands of nucleotides linked by hydrogen bonding between complementary base pairs.







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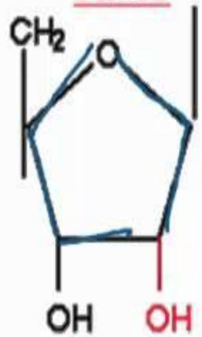
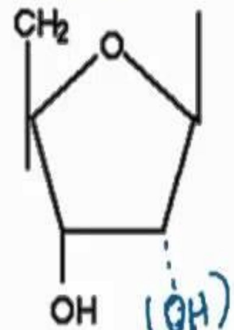
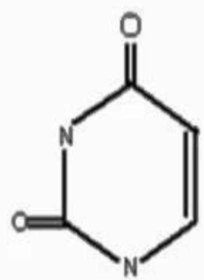
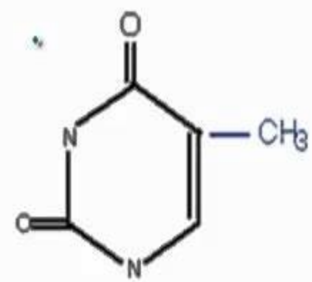
What makes DNA and RNA different?

	RNA	DNA
1) ribose sugar		
	(ribonucleic acid)	(deoxy ribonucleic acid)
2)T and U		
	uracyl	thymine
3) strand	single	double

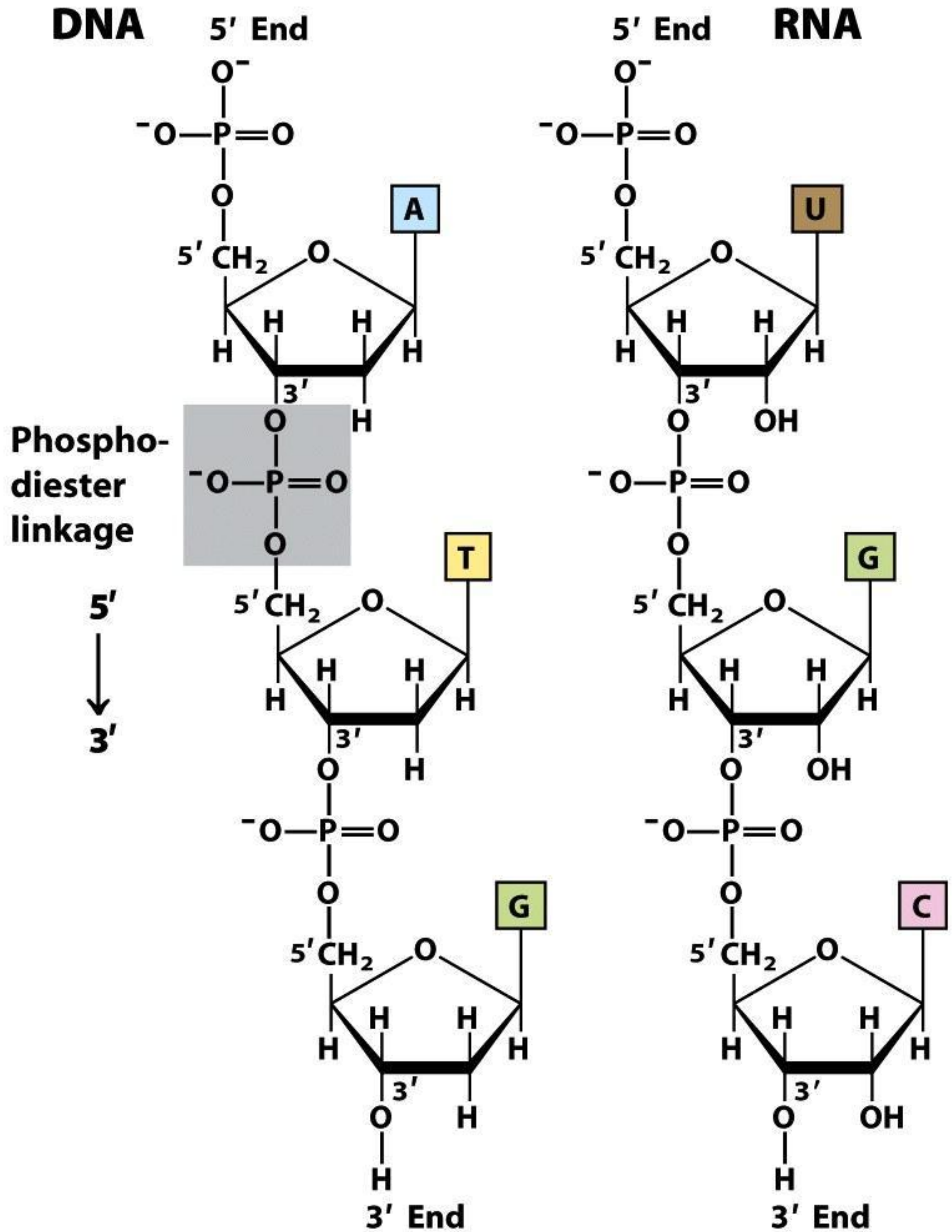
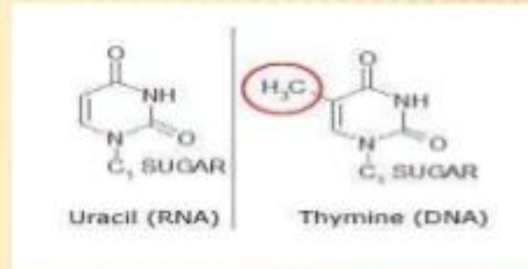


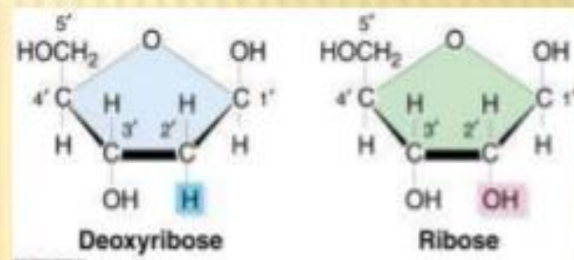
Figure 8-7

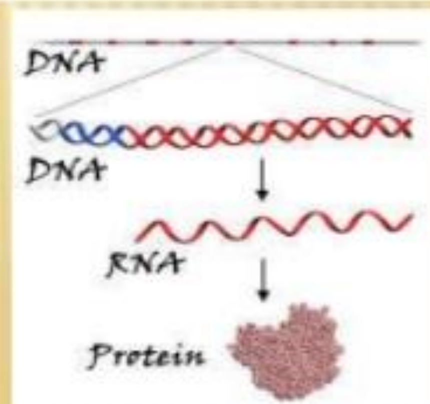
Lehninger Principles of Biochemistry, Fifth Edition

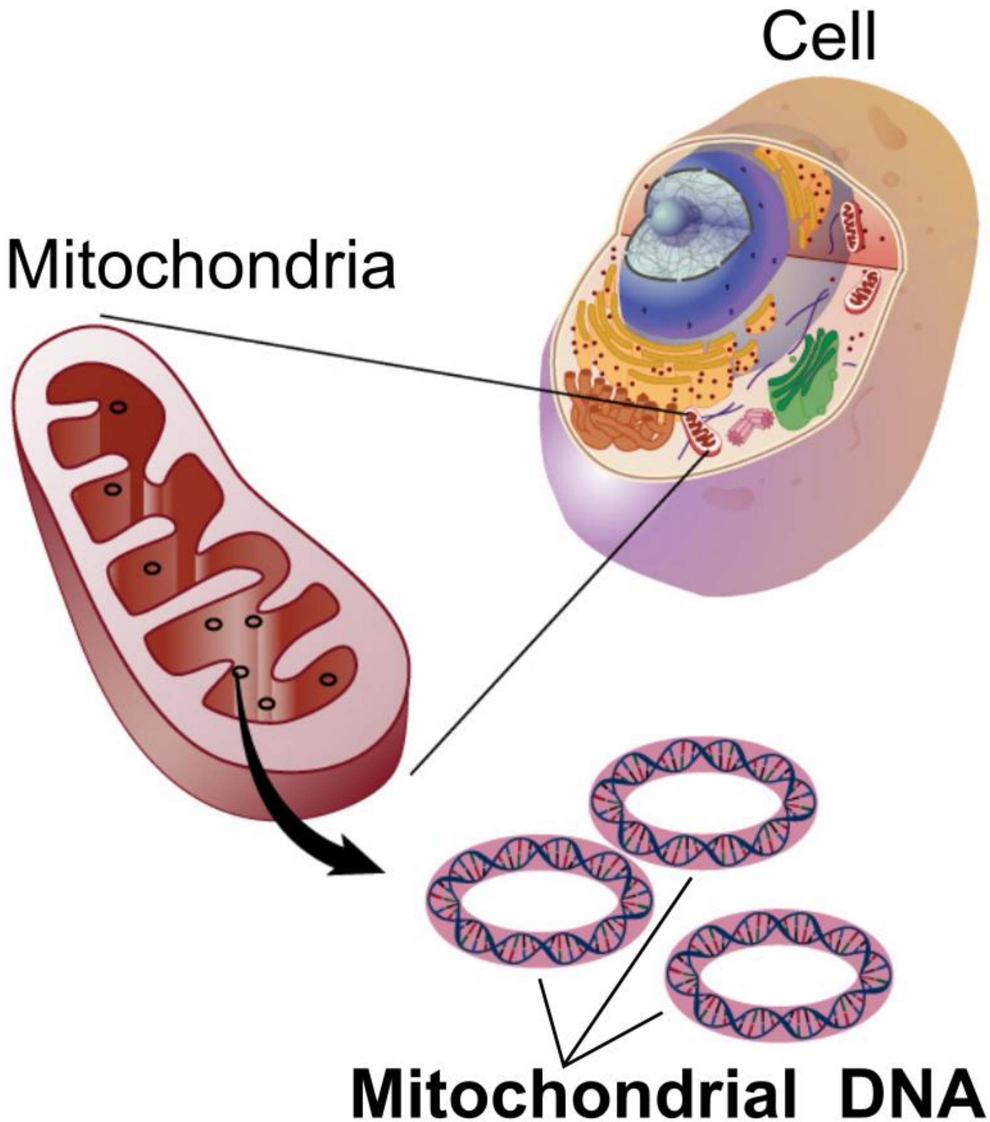
COMPARATIVE ACCOUNT :DNA AND RNA

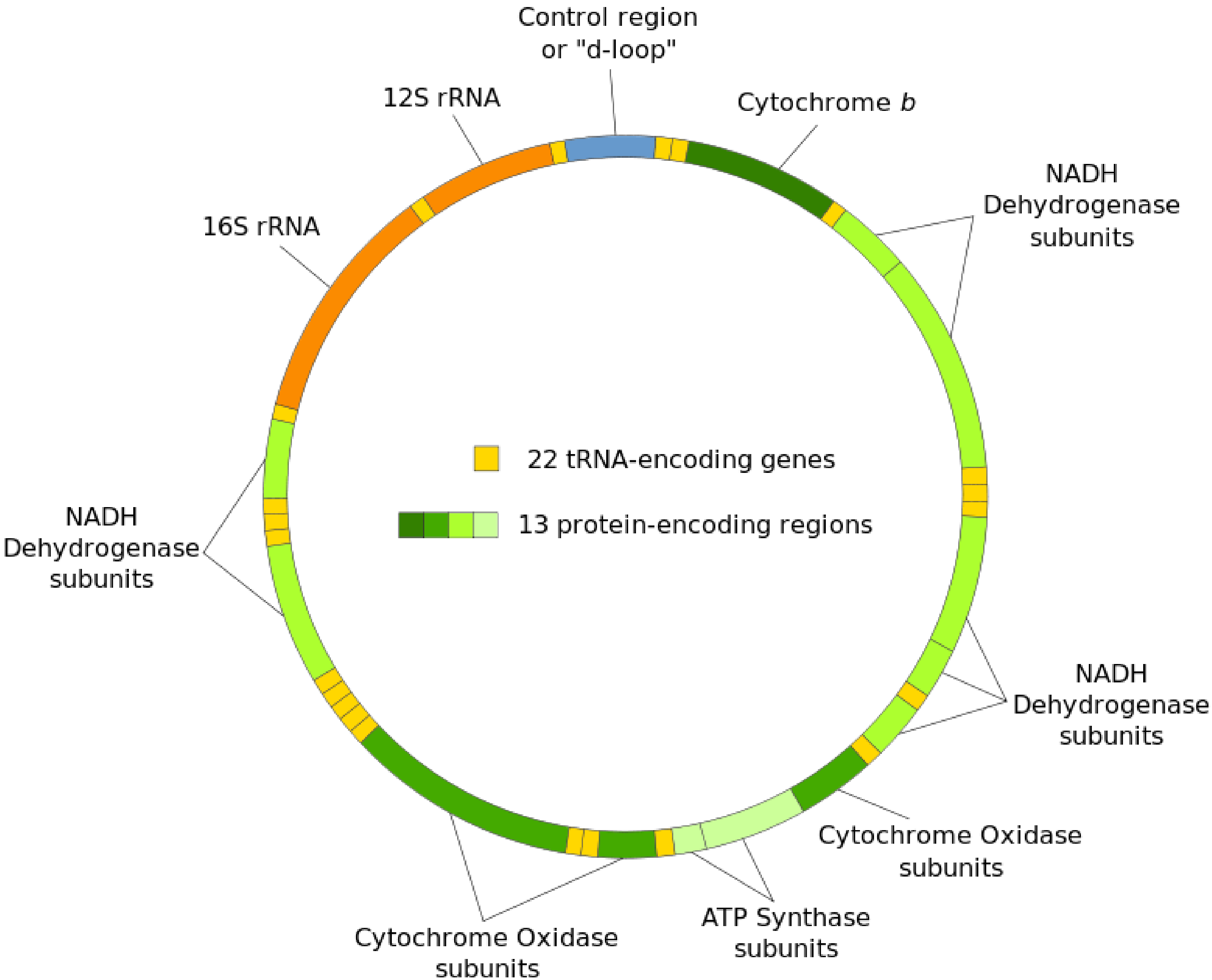
	DNA	RNA
Function	Medium of long-term storage and transmission of genetic information	Transfer the genetic code needed for the creation of proteins from the nucleus to the ribosome
Predominant structure	Double- stranded molecule	A single-stranded molecule
Bases	A, T, C, G	A, U, C, G
Sugar	2'- deoxyribose	ribose
Stability	Deoxyribose sugar in DNA is less reactive because of C-H bonds. Stable in alkaline conditions. DNA has smaller grooves, which makes it harder for enzymes to "attack" DNA.	Ribose sugar is more reactive because of C-OH (hydroxyl) bonds. Not stable in alkaline conditions. RNA has larger grooves, which makes it easier to be attacked by enzymes
Propagation	DNA is self-replicating.	RNA is synthesized from DNA when needed



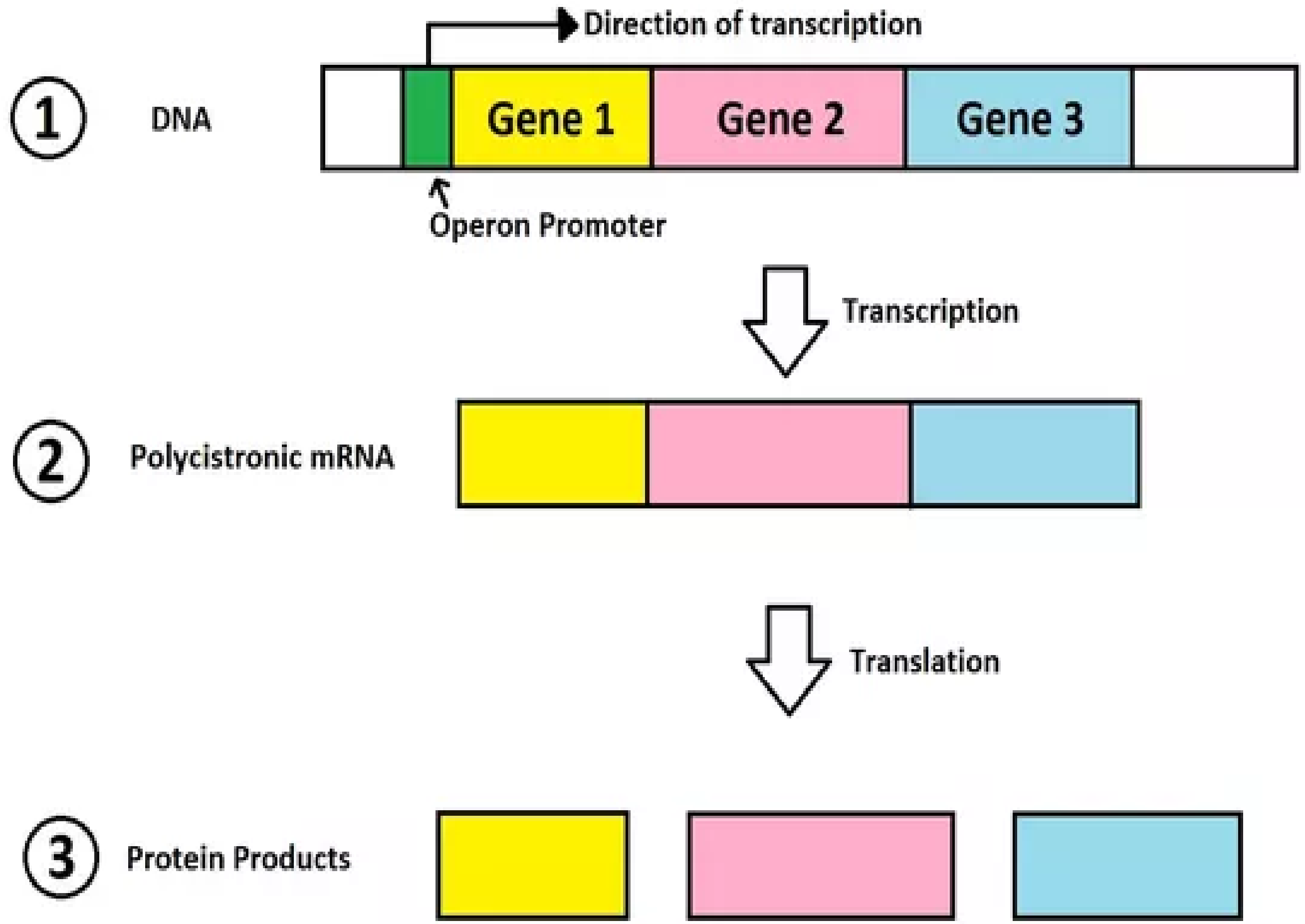




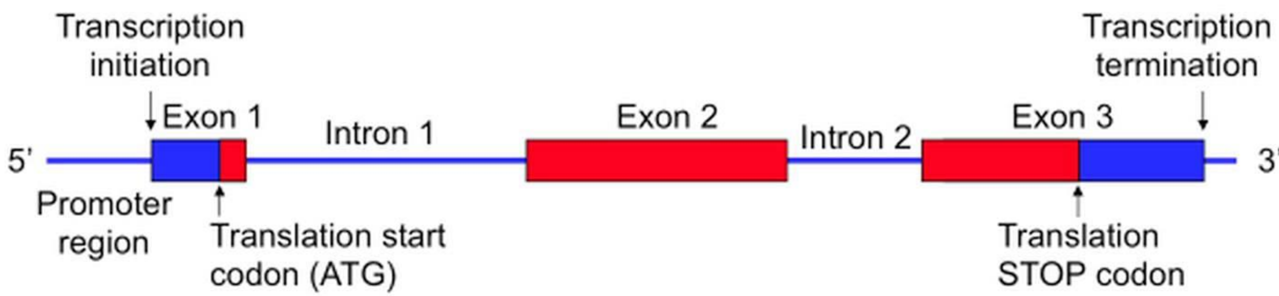

Cell
Mitochondria
Mitochondrial DNA

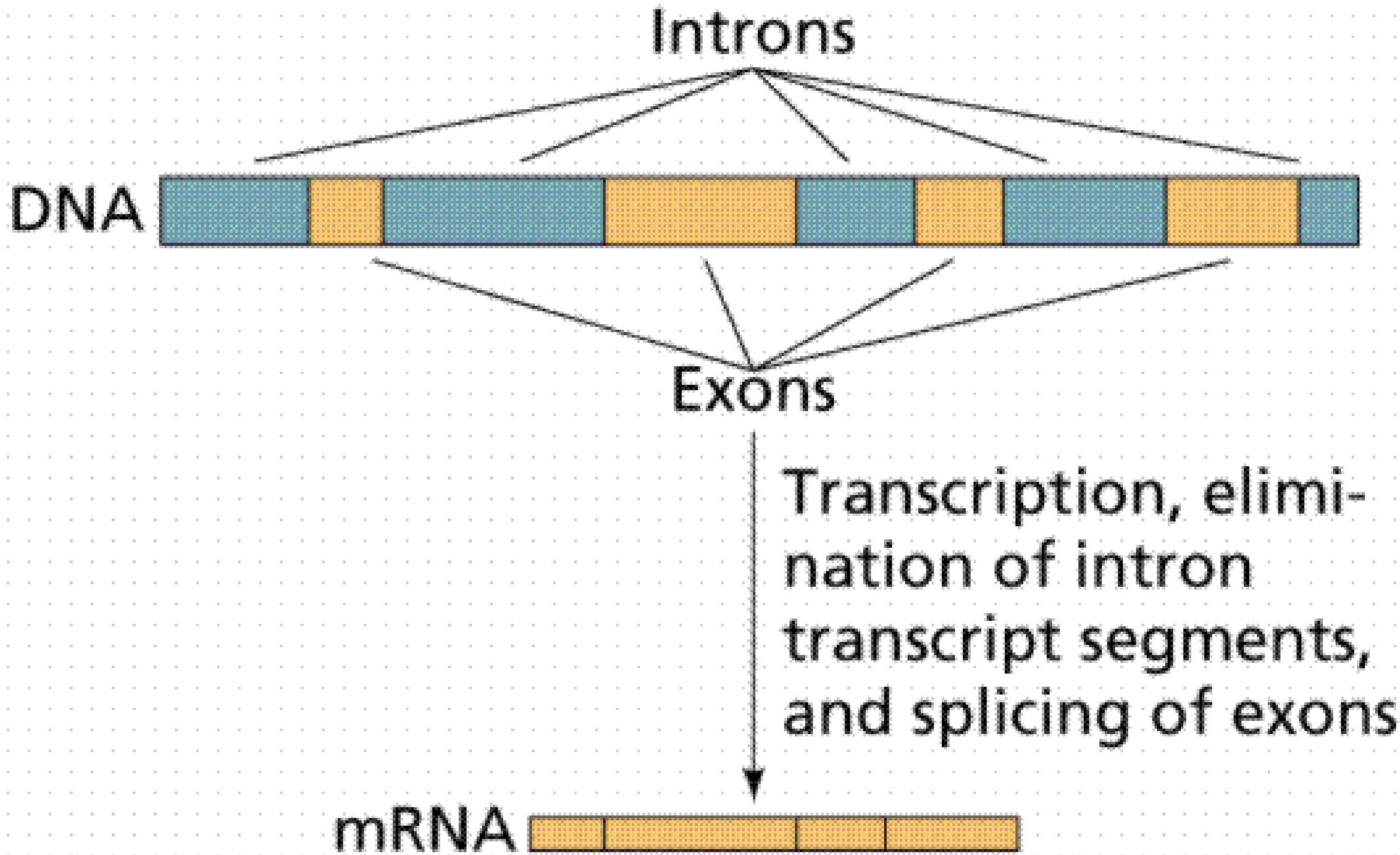


Control region
or "d-loop"
12S rRNA
Cytochrome *b*
NADH
Dehydrogenase
subunits
16S rRNA
22 tRNA-encoding genes
13 protein-encoding regions
NADH
Dehydrogenase
subunits
NADH
Dehydrogenase
subunits
Cytochrome Oxidase
subunits
ATP Synthase
subunits
Cytochrome Oxidase
subunits


Direction of transcription
1
DNA
Gene 1
Gene 2
Gene 3
Operon Promoter
Transcription
2
Polycistronic mRNA
Translation
3
Protein Products

Gene Structure




Introns
DNA
Exons
Transcription, elimination of intron transcript segments, and splicing of exons
mRNA

What is Exons and Introns?

Exons and Introns: In most eukaryotic genes, coding regions (exons) are interrupted by noncoding regions (introns). During transcription, the entire gene is copied into a pre-mRNA, which includes exons and introns. During the process of RNA splicing, introns are removed and exons joined to form a contiguous coding sequence. This "mature" mRNA is ready for translation.

Exons and introns are related to genes. An exon is termed as a nucleic acid sequence which is represented in the RNA molecule. Introns, on the other hand, are termed as nucleotide sequences seen within the genes which are removed through RNA splicing for generating a mature RNA molecule.

In simple words, exons can be termed as DNA bases which are translated into mRNA. Introns are also DNA bases that are found in-between exons.

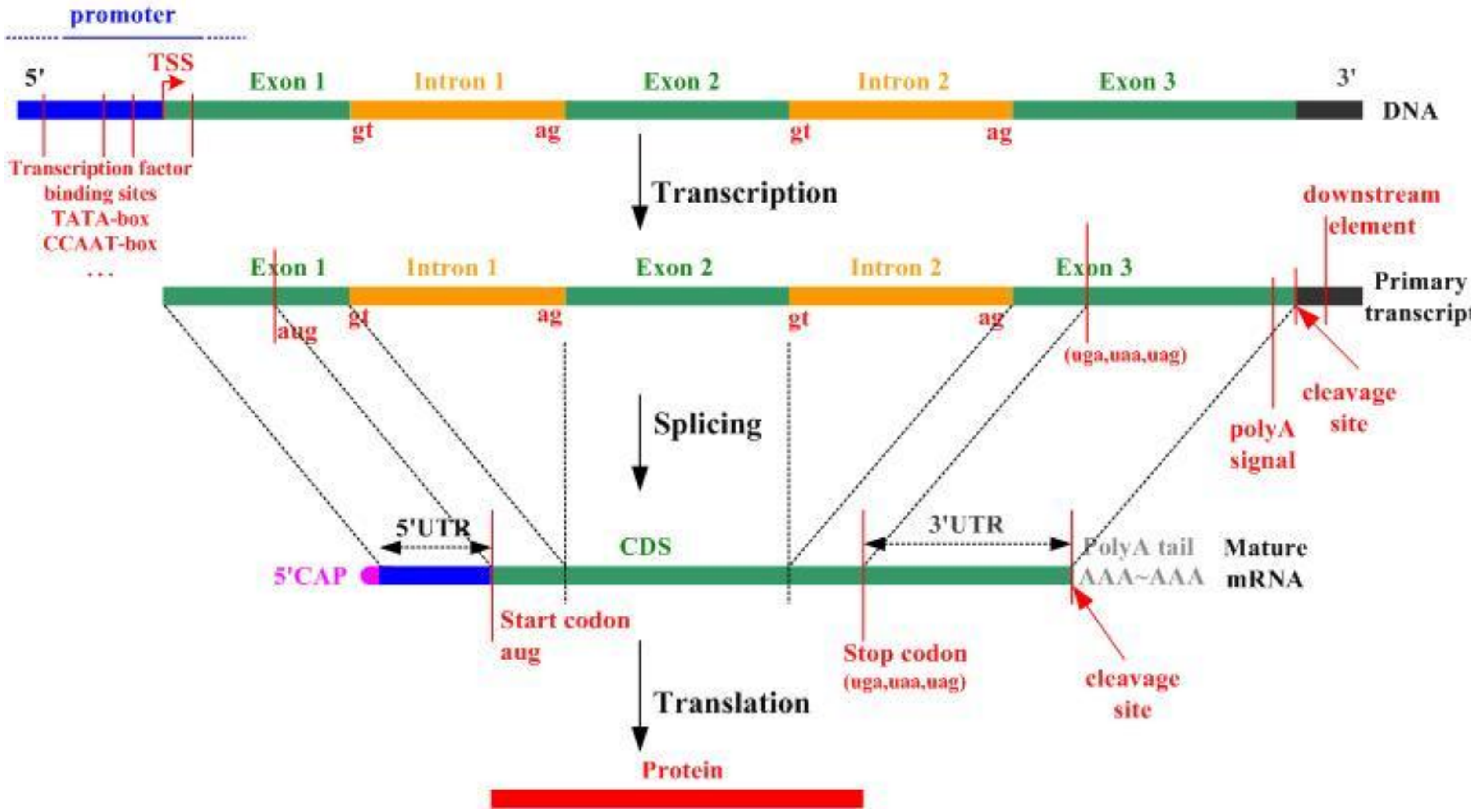
Introns and exons were discovered independently by American molecular biologists Richard Roberts and Phillip Sharp in 1977.

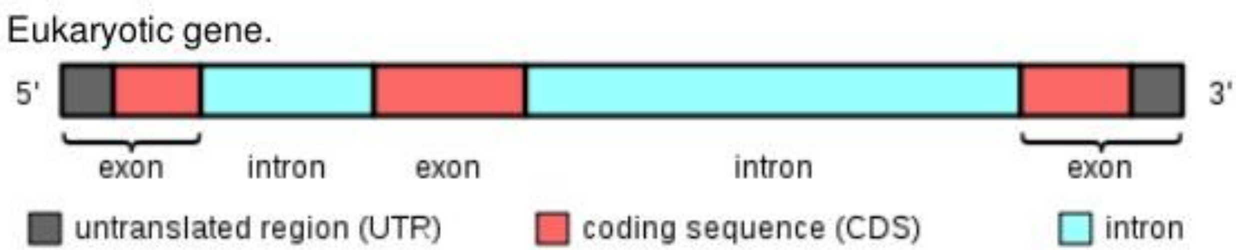
Introns are very much common in the genome of higher vertebrates such as human beings and mice. On the other hand, introns are unlikely to be seen in the genome of certain varieties of eukaryotic micro-organisms such as baker's yeast but are seen in archaegal and bacterial genes.

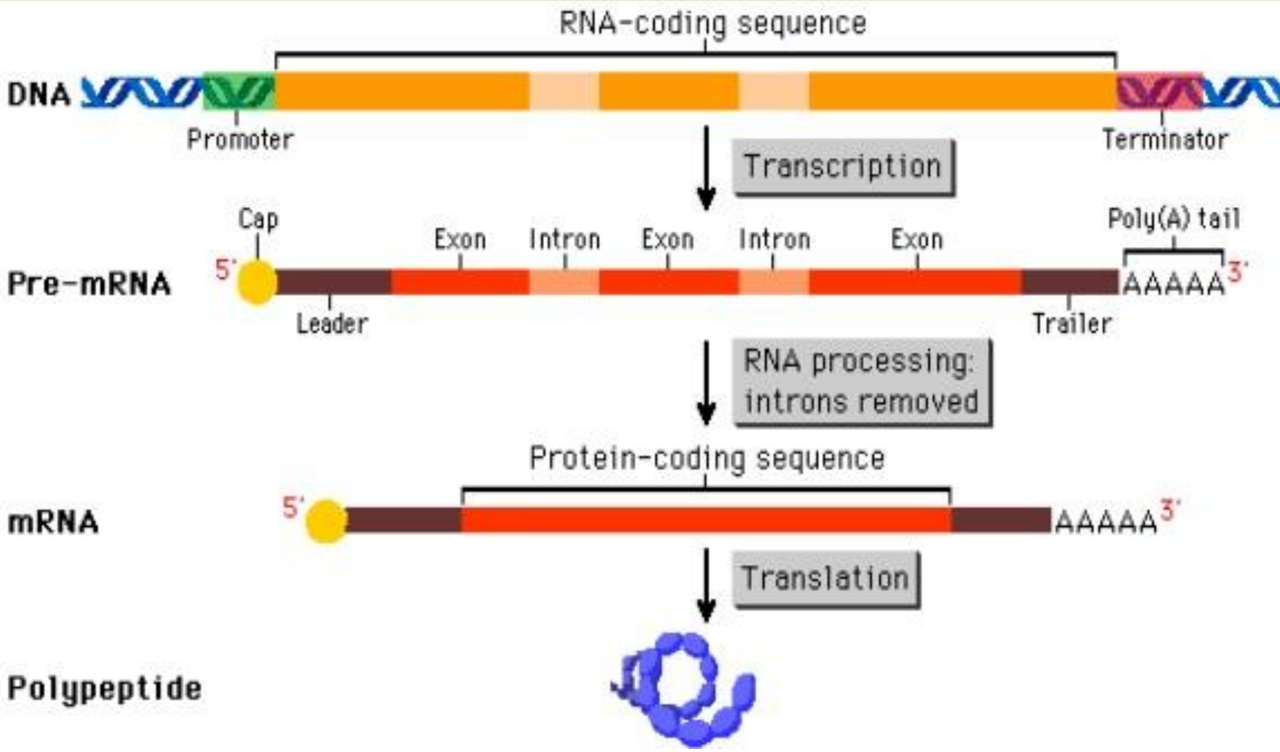
It can also be seen that introns are less conserved which means that their sequence changes very frequently over time. On the contrary, exons are very much conserved which means that their sequence does not change rapidly over time or in-between the species.

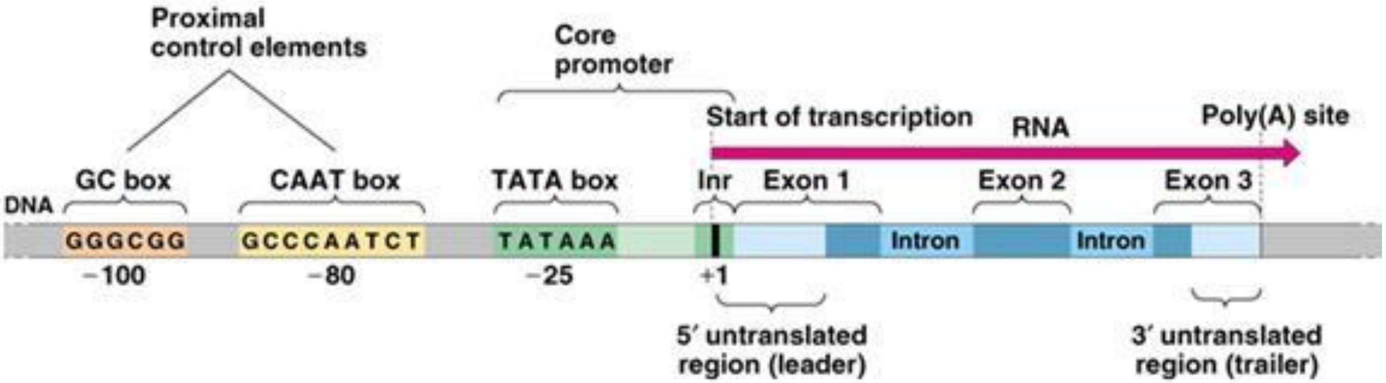
While exons are codes of proteins, introns are not at all implicated with the protein coding. So it can be said that exons are coding areas whereas introns are non-coding areas.

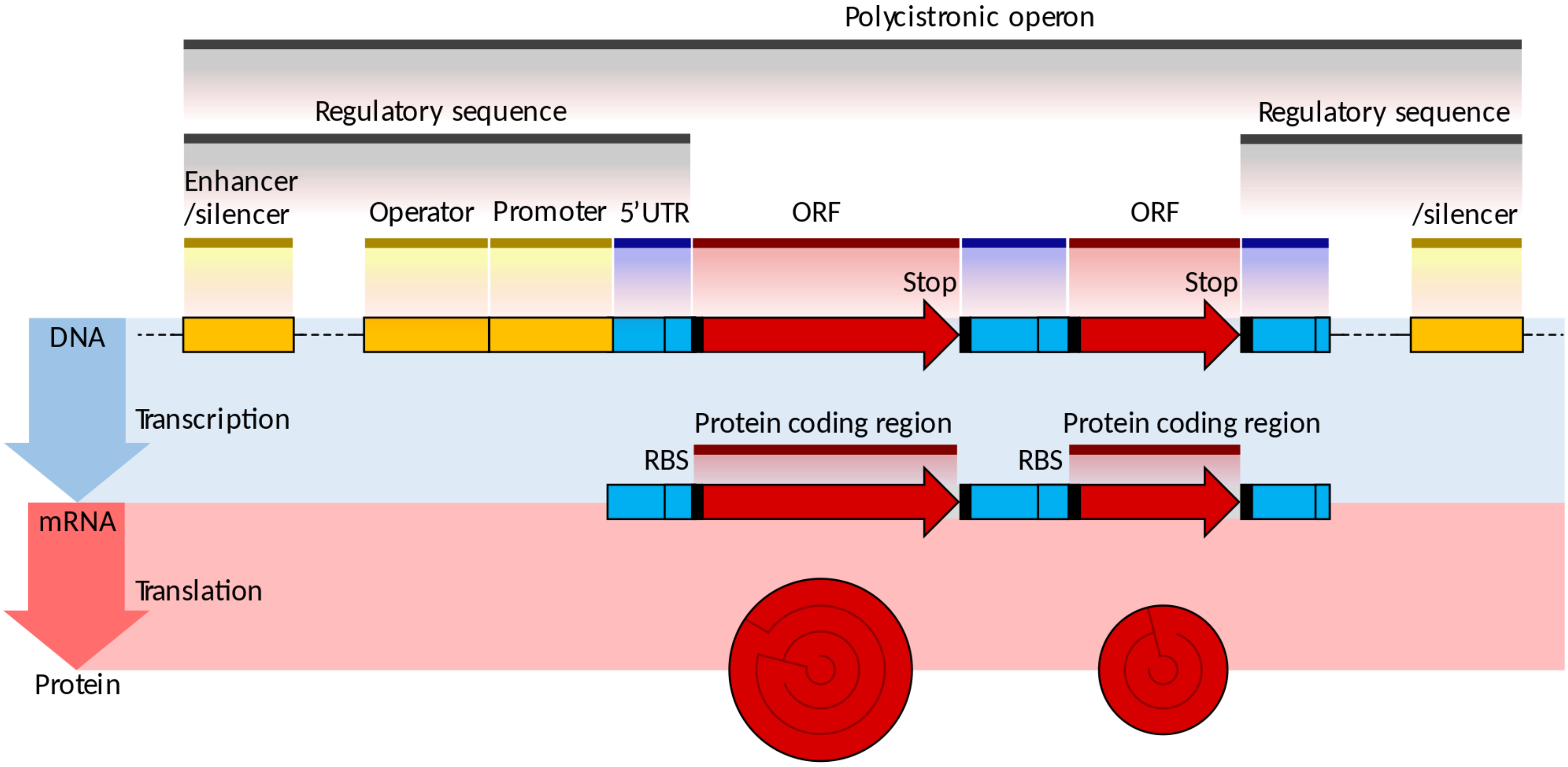
The term 'intron' was derived from 'intragenic region,' a region inside a gene. Introns are also sometimes termed as intervening sequences. 'Exon' is a term that is derived from 'expressed region.' Walter Gilbert, an American biochemist, coined the term.

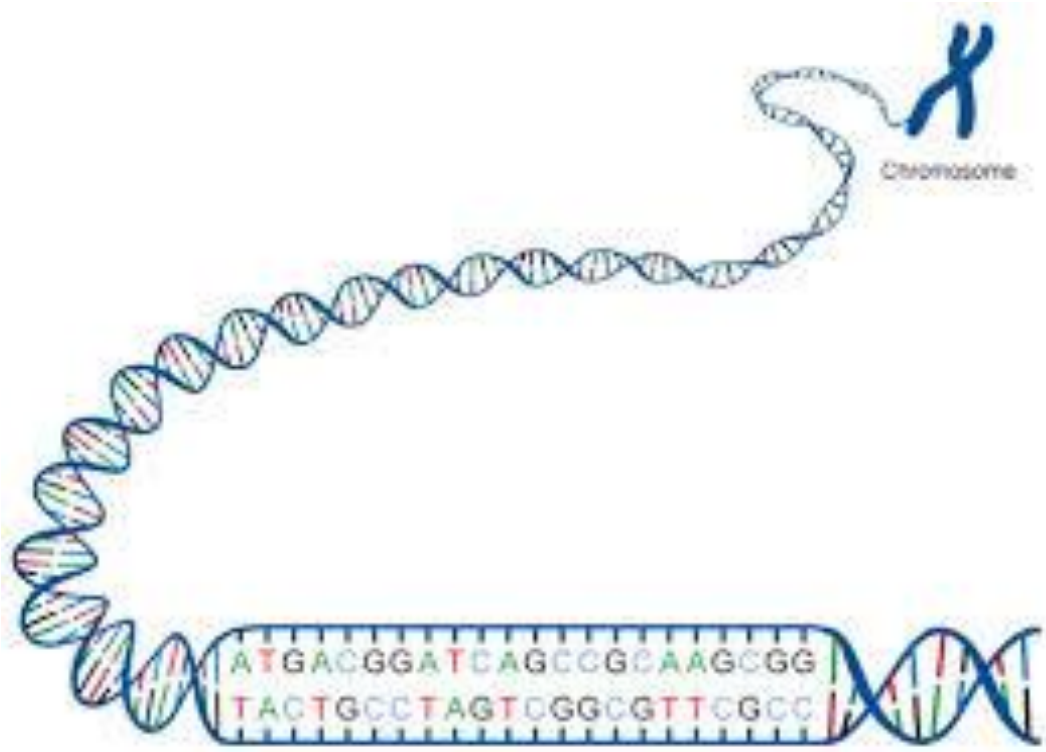

promoter
TSS
5'
Exon 1
Intron 1
Exon 2
Intron 2
Exon 3
3'
DNA
gt
ag
gt
ag
Transcription factor
binding sites
TATA-box
CCAAT-box
...
Transcription
downstream
element
Exon 1
Intron 1
Exon 2
Intron 2
Exon 3
Primary
transcript
aug
gt
ag
gt
ag
(uga,uaa,uag)
Splicing
cleavage
site
polyA
signal
5'UTR
3'UTR
CDS
PolyA tail
AAA~AAA
Mature
mRNA
5'CAP
Start codon
aug
Stop codon
(uga,uaa,uag)
cleavage
site
Translation
Protein


Eukaryotic gene.
5'
3'
exon
intron
exon
intron
exon
untranslated region (UTR)
coding sequence (CDS)
intron

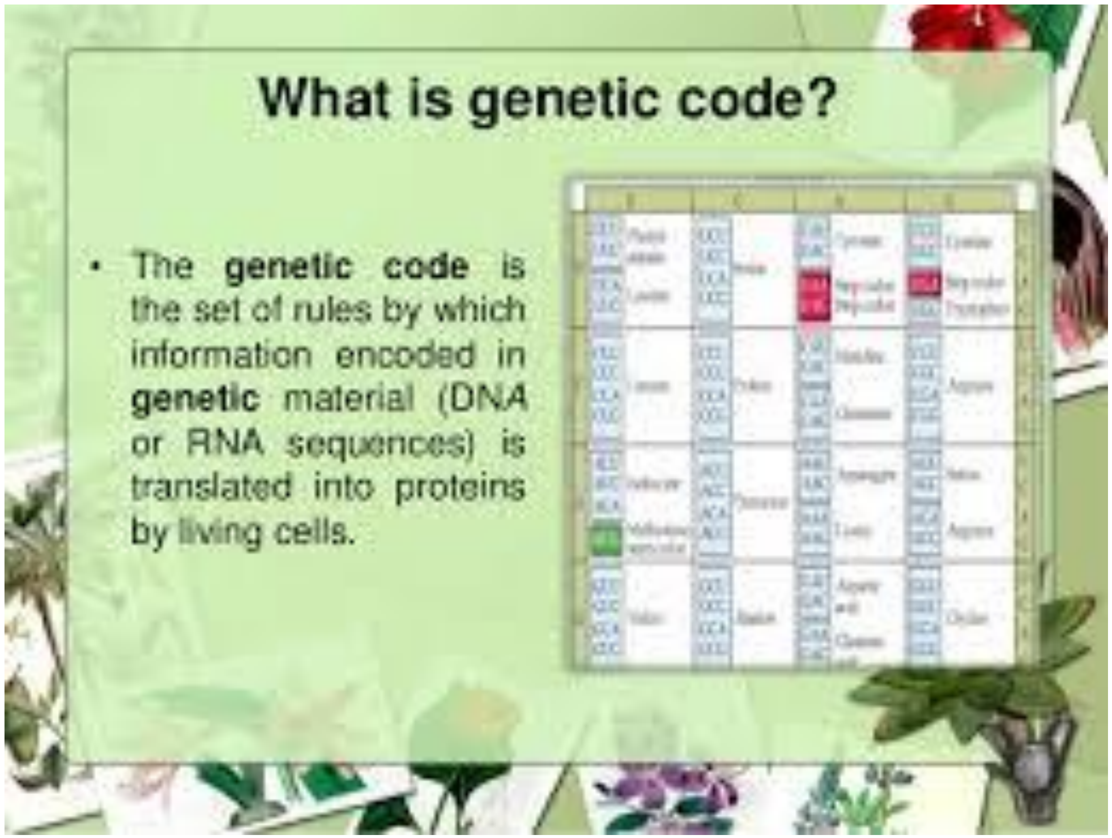

RNA-coding sequence
DNA
Promoter
Terminator
Transcription
Cap
Exon
Intron
Exon
Intron
Exon
Poly(A) tail
Pre-mRNA
5'
AAAAA
3'
Leader
Trailer
RNA processing: introns removed
Protein-coding sequence
mRNA
5'
AAAAA
3'
Translation
Polypeptide

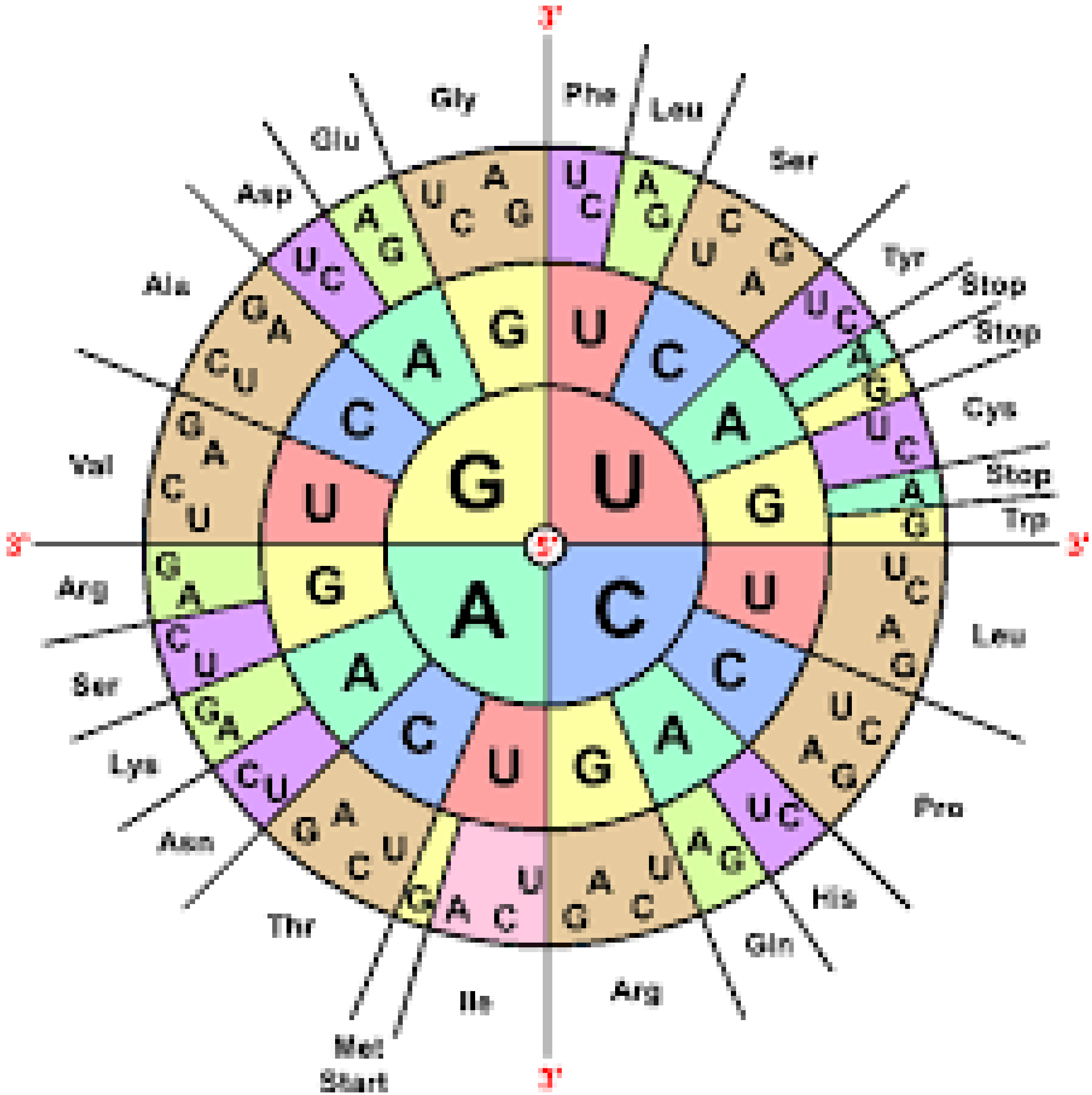

Proximal
control elements
Core
promoter
Start of transcription
RNA
Poly(A) site
GC box
CAAT box
TATA box
Inr
Exon 1
Exon 2
Exon 3
DNA
GGGCGG
GCCCAATCT
TATAAA
Intron
Intron
−100
−80
−25
+1
5′ untranslated
region (leader)
3′ untranslated
region (trailer)


Polycistronic operon
Regulatory sequence
Regulatory sequence
Enhancer
/silencer
Operator
Promoter
5'UTR
ORF
ORF
/silencer
Stop
Stop
DNA
Transcription
Protein coding region
Protein coding region
RBS
RBS
mRNA
Translation
Protein


Chromosome
ATGACGGATCAGCCGCAAGCGG
TACTGCCTAGTCGGCGTTCGCC

Genetic code is a set of rules by which information encoded in genetic material (DNA or RNA) is translated into protein by living cells.




5'
3'
3'
3'
3'
Phe
Leu
Ser
Tyr
Stop
Stop
Cys
Stop
Trp
Leu
Pro
His
Gln
Arg
Ile
Met
Start
Thr
Asn
Lys
Ser
Arg
Val
Ala
Asp
Glu
Gly

4 bases and 3 positions:
4x4x4= 64 Codons

Twenty amino acids (Val, Lys, Arg etc) bind either one/more than one codons

AUG-Met-Start Codon
UAA, UGA and UAG are stop codon

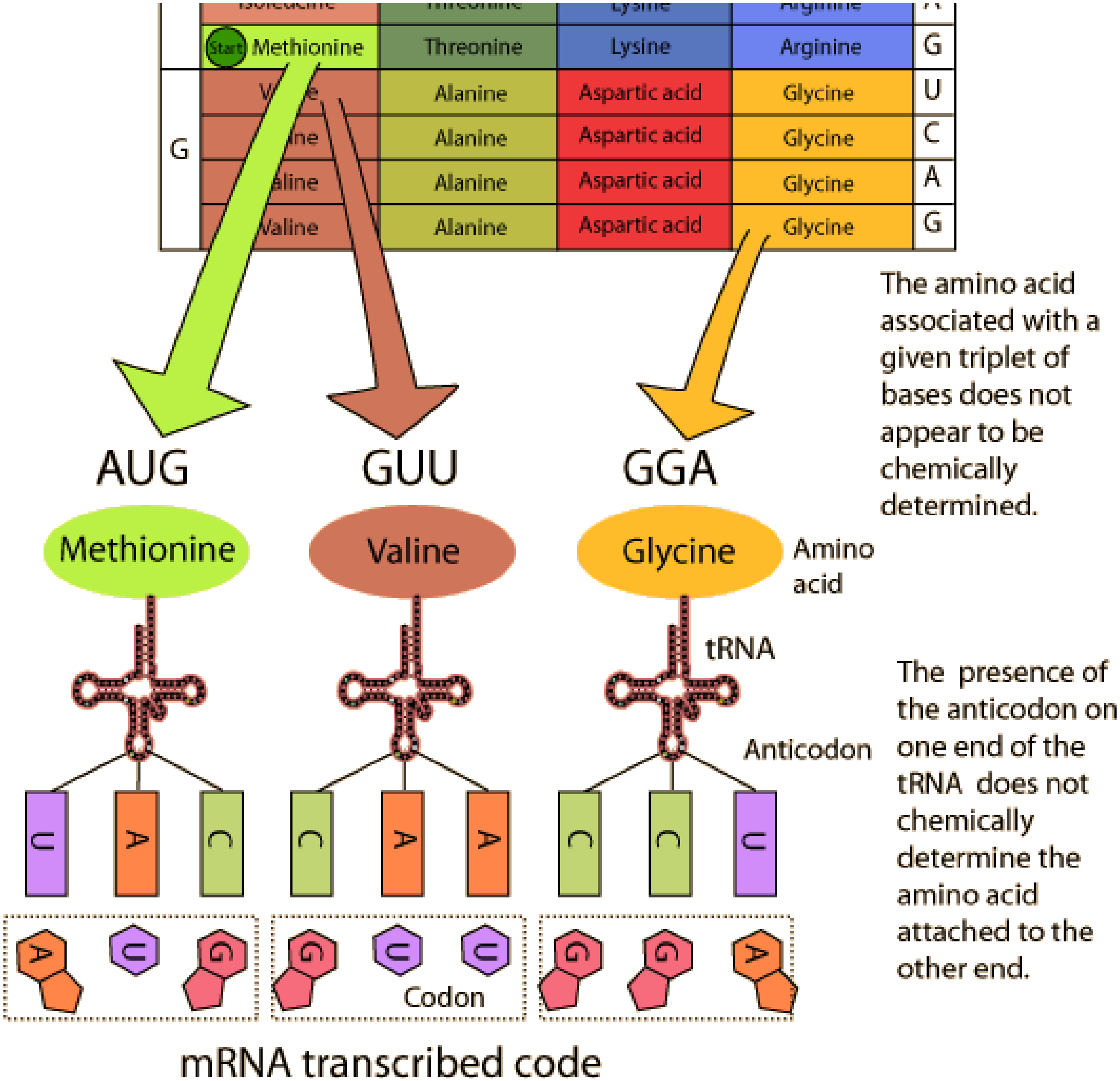
Characteristics:

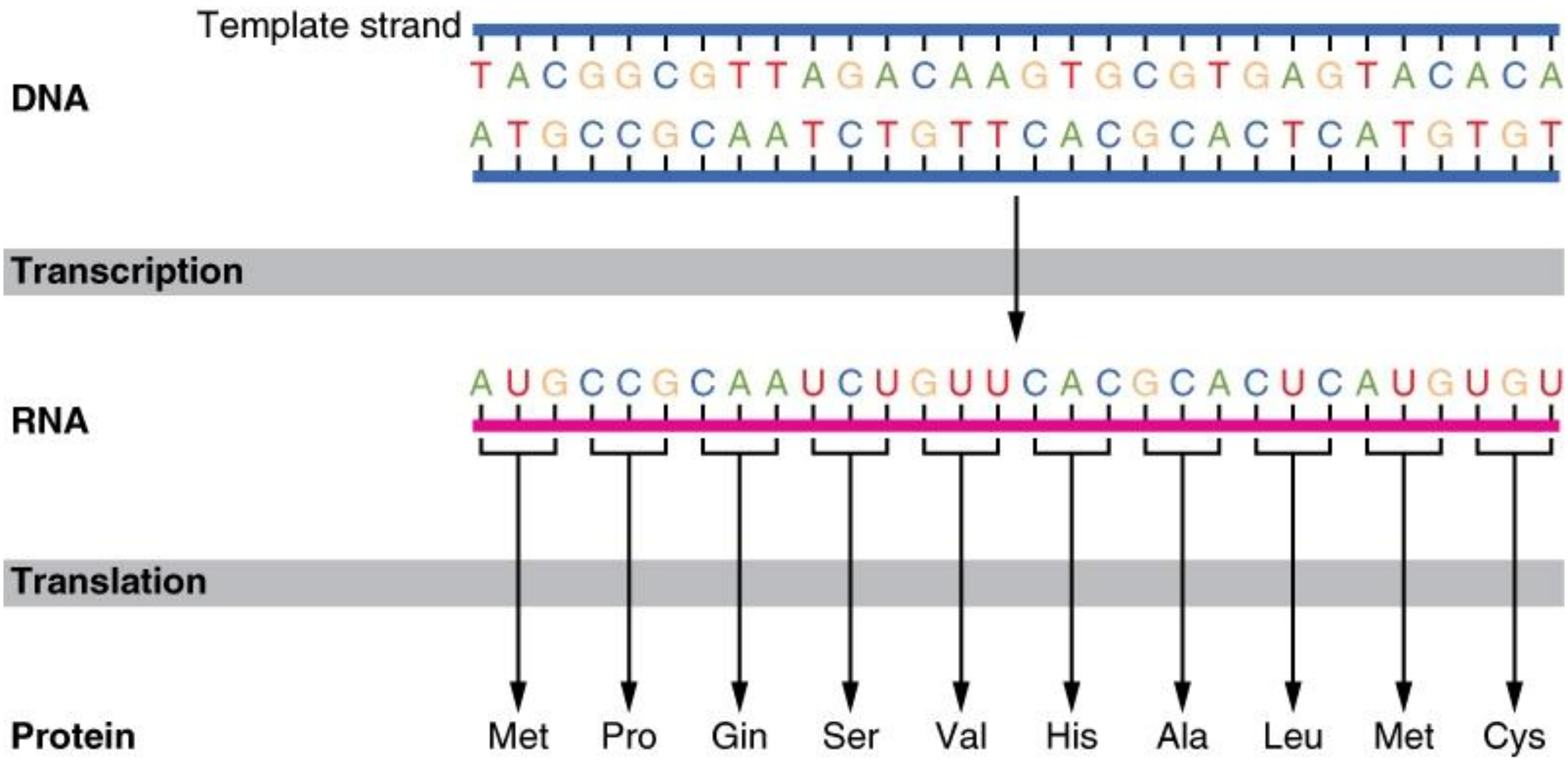
1. In general, codons are universal in all organism with few exception
2. Use to prepare energy i.e. protein

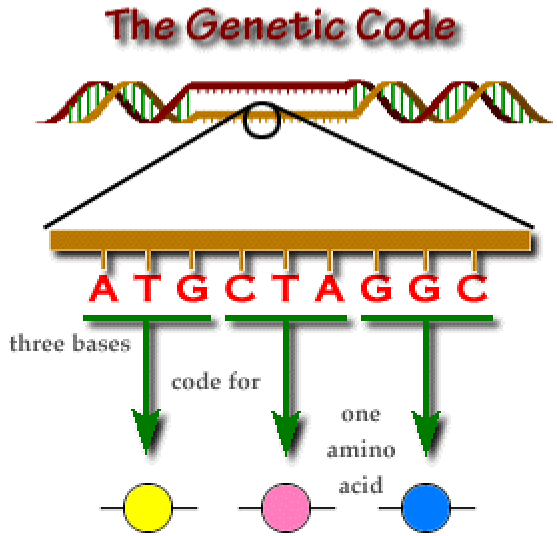
Genetic Code- Table

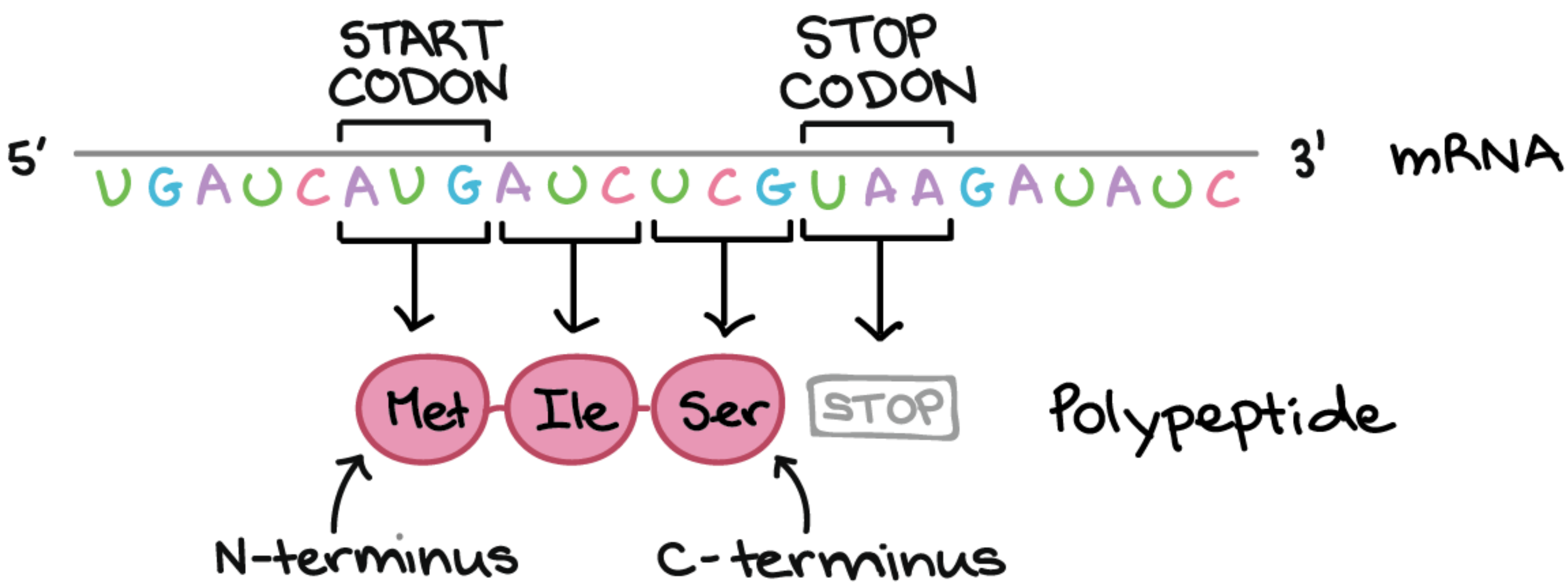
Second Letter

1st letter	U		C		A		G		3rd letter
U	UUU	Phe	UCU		UAU	Tyr	UGU	Cys	U
	UUC		UCC	Ser	UAC		UGC		C
	UUA	Leu	UCA		UAA	Stop	UGA	Stop	A
	UUG		UCG		UAG	Stop	UGG	Trp	G
C	CUU		CCU		CAU	His	CGU		U
	CUC	Leu	CCC	Pro	CAC		CGC	Arg	C
	CUA		CCA		CAA	Gln	CGA		A
	CUG		CCG		CAG		CGG		G
A	AUU		ACU		AAU	Asn	AGU	Ser	U
	AUC	Ile	ACC	Thr	AAC		AGC		C
	AUA		ACA		AAA	Lys	AGA	Arg	A
	AUG	Met	ACG		AAG		AGG		G
G	GUU		GCU		GAU	Asp	GGU		U
	GUC	Val	GCC	Ala	GAC		GGC	Gly	C
	GUA		GCA		GAA	Glu	GGA		A
	GUG		GCG		GAG		GGG		G


Start
Methionine
Threonine
Lysine
Arginine
G
Valine
Alanine
Aspartic acid
Glycine
U
C
A
G
The amino acid associated with a given triplet of bases does not appear to be chemically determined.
AUG
GUU
GGA
Methionine
Valine
Glycine
Amino acid
tRNA
Anticodon
The presence of the anticodon on one end of the tRNA does not chemically determine the amino acid attached to the other end.
U
A
C
C
A
A
C
C
U
A
U
G
G
U
U
G
G
A
Codon
mRNA transcribed code


Template strand
DNA
T A C G G C G T T A G A C A A G T G C G T G A G T A C A C A
A T G C C G C A A T C T G T T C A C G C A C T C A T G T G T
Transcription
RNA
A U G C C G C A A U C U G U U C A C G C A C U C A U G U G U
Translation
Protein
Met Pro Gin Ser Val His Ala Leu Met Cys


The Genetic Code
A T G C T A G G C
three bases
code for
one
amino
acid


START
CODON
STOP
CODON
5'
U G A U C A U G A U C U C G U A A G A U A U C
3'
mRNA
Met
Ile
Ser
STOP
Polypeptide
N-terminus
C-terminus

Genetic Code

- The genetic code is the set of rules by which information encoded in genetic material is translated into proteins by living cells.
- The information in DNA is in the form of triplet codons.
- It is first transcribed into RNA and then into proteins.
- Every triplet codon in the DNA specifies one amino acid in the protein.