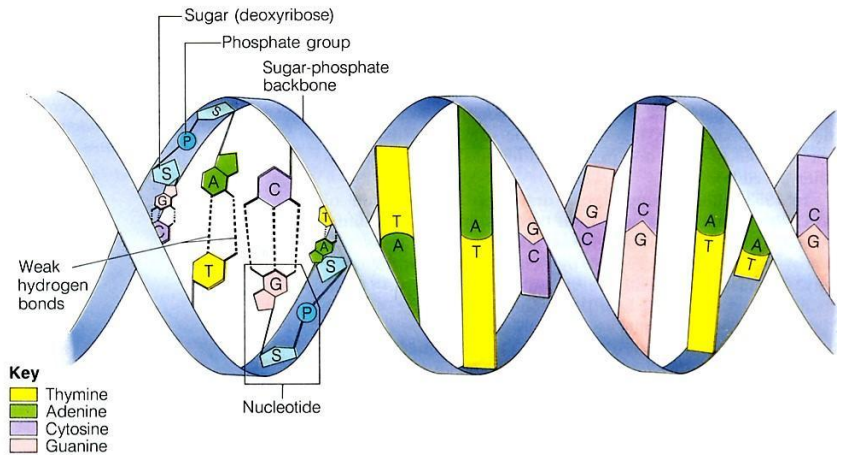


DNA and its Processes

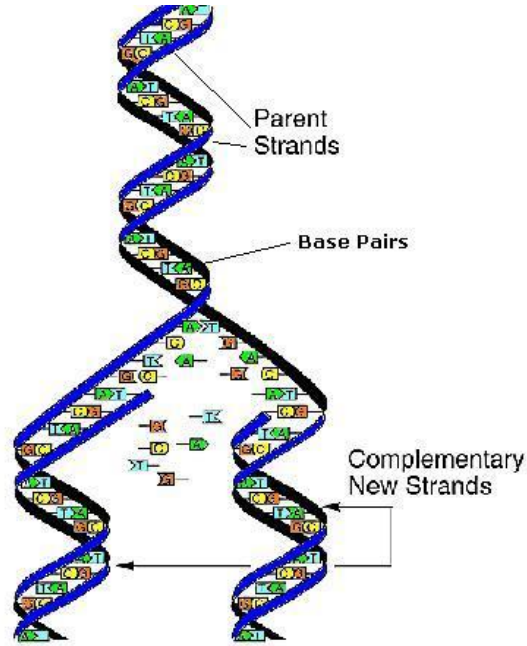
DNA Structure

Deoxyribonucleic acid (DNA) is an important biomolecule that contains our genetic code. Here is a diagram of the double helix model of DNA. Note that the monomers/building blocks of DNA are called nucleotides. Each nucleotide contains three parts

- Sugar (deoxyribose)
- Phosphate group
- Nitrogenous base (4 kinds)



DNA Replication



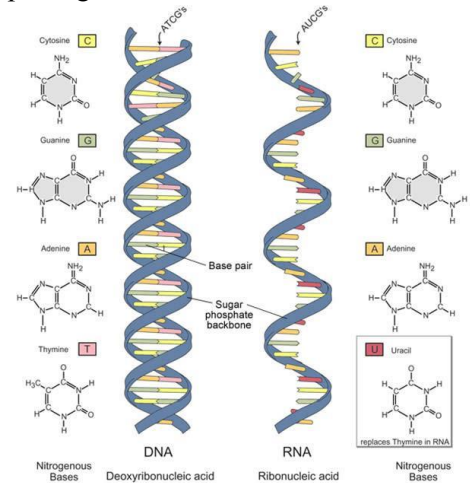
In order for new cells to pass on the genetic code, DNA must be copied inside of cells. In eukaryotic cells, this takes place inside of the nucleus, which stores the cell's DNA. In prokaryotes, the process of copying DNA occurs in the cytoplasm. Regardless of location, the process is known as replication. Two daughter strands are formed.

1. The double helix is opened up by breaking the weak hydrogen bonds
2. An enzyme (DNA polymerase) comes in and adds new bases to the open strand
 - a. It follows base pairing rules: Adenine pairs with Thymine (straight letters A-T go together) and Cytosine pairs with Guanine (curvy letters G-C go together)
3. At the end, two identical strands of DNA are formed.
4. These strands are said to be *complementary* to each other because they follow the base pairing rules

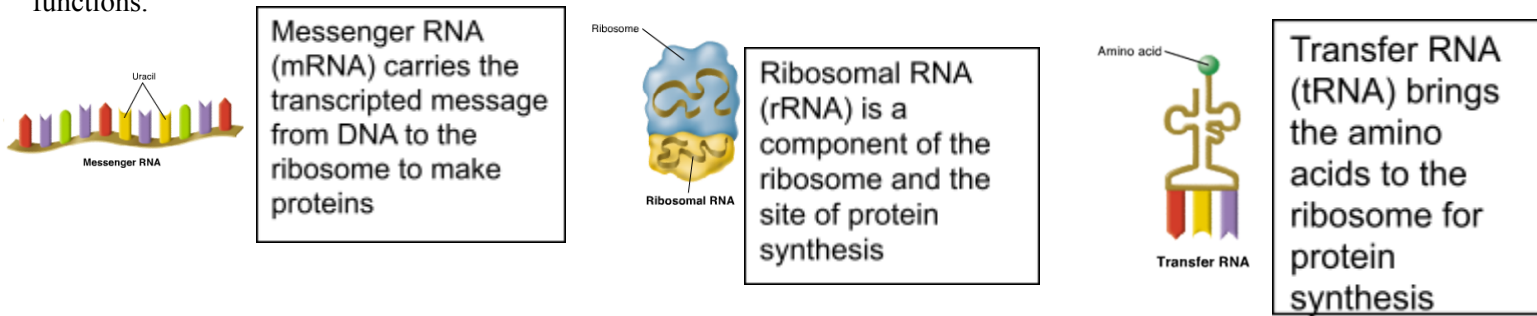
RNA Structure

Ribonucleic acid (RNA) is a similar molecule to DNA. However, it has some key differences.

	Deoxyribonucleic acid (DNA)	Ribonucleic acid (RNA)
Number of strands	2	1
Sugar	Deoxyribose	Ribose
Base pairs	A-T G-C	A-U G-C

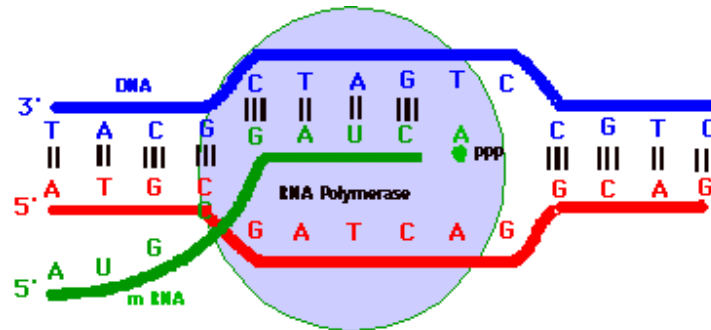


In addition to those differences, there are three different types of RNA. These different types have various shapes and functions.



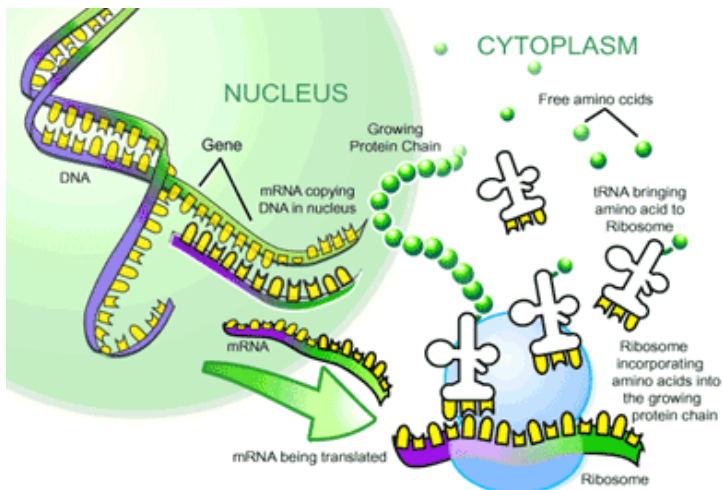
Transcription

This occurs in the nucleus of eukaryotes. In the process of transcription, an mRNA transcript is made using the double helix as a template. The double-stranded molecule of DNA separates along the hydrogen bonds. An enzyme called RNA polymerase adds in corresponding base pairs. However, instead of using Thymine to match up with Adenine, Uracil is used. For RNA, the base pairing rules are A-U and G-C. At the end of this process, one piece of mRNA is created. It is complementary to the strand of DNA it was formed from.



Translation

This process occurs in the cytoplasm. In the process of translation, the piece of mRNA is read by the ribosome in groups of three letters (codons). Each 3-letter portion of mRNA is referred to as a codon and codes for a specific amino acid. These codes match up to the anticodons on the bottom of the tRNA molecules. The corresponding tRNA molecule brings in the correct amino acid (building block of proteins). The ribosome joins the amino acids together to make a protein. The diagram on the left shows replication, transcription, and translation all happening in the cell. The diagram on the right shows a chart of the 64 codons that make up the genetic code and the 20 amino acids that match up. Each 3-letter portion of mRNA is referred to as a codon and codes for a specific amino acid. These codes match up to the anticodons on the bottom of the tRNA molecules.



		Second base				
		U	C	A	G	
First base	U	UUU } Phenylalanine UUC } UUA } Leucine UUG }	UCU } UCC } Serine UCA } UCG }	UAU } Tyrosine UAC } UAA } Stop codon UAG } Stop codon	UGU } Cysteine UGC } UGA } Stop codon UGG } Tryptophan	U C A G
	C	CUU } CUC } Leucine CUA } CUG }	CCU } CCC } Proline CCA } CCG }	CAU } Histidine CAC } CAA } Glutamine CAG }	CGU } CGC } Arginine CGA } CGG }	U C A G
	A	AUU } Isoleucine AUC } AUA } AUG } Methionine start codon	ACU } ACC } Threonine ACA } ACG }	AAU } Asparagine AAC } AAA } Lysine AAG }	AGU } Serine AGC } AGA } Arginine AGG }	U C A G
	G	GUU } GUC } Valine GUA } GUG }	GCU } GCC } Alanine GCA } GCG }	GAU } Aspartic acid GAC } GAA } Glutamic acid GAG }	GGU } GGC } Glycine GGA } GGG }	U C A G

Mutations

Many different types of mutations can occur. They can either affect a few nucleotides (point mutations) or affect large portions of DNA (chromosomal mutations). These will ultimately affect the shape and size of the protein constructed, and the appearance of the cell or organism.

(a) Point mutations and small deletions

Wild-type sequences

Amino acid	N-Phe	Arg	Trp	Ile	Ala	Asn-C
mRNA	5'-UUU	CGA	UGG	AUA	GCC	AAU-3'
DNA	3'-AAA	GCT	ACC	TAT	CGG	TTA-5'
	5'-TTT	CGA	TGG	ATA	GCC	AAT-3'

Missense

3'-AAT	GCT	ACC	TAT	CGG	TTA-5'
5'-TTA	CGA	TGG	ATA	GCC	AAT-3'
N-Leu	Arg	Trp	Ile	Ala	Asn-C

Nonsense

3'-AAA	GCT	ATC	TAT	CGG	TTA-5'
5'-TTT	CGA	TAG	ATA	GCC	AAT-3'
N-Phe	Arg	Stop			

Frameshift by addition

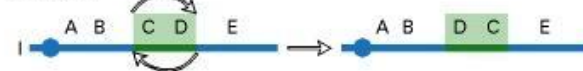
3'-AAA	GCT	ACC	ATA	TCG	GTT A-5'
5'-TTT	CGA	TGG	TAT	AGC	CAA T-3'
N-Phe	Arg	Trp	Tyr	Ser	Gln

Frameshift by deletion

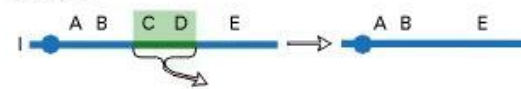
	GCTA				
	CGAT				
3'-AAA	↓ CCT	ATC	GGT	TA-5'	
5'-TTT	GGA	TAG	CCA	AT-3'	
N-Phe	Gly	Stop			

(b) Chromosomal abnormalities

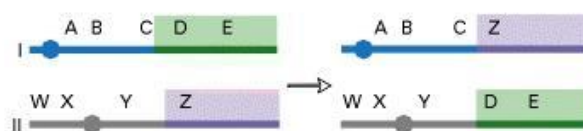
Inversion



Deletion



Balanced translocation



Insertion

