جامعة المستقبل
AL MUSTAQBAL UNIVERSITY

كلية العلوم

قسم الادلة الجنائية

المحاضرة الثامنة

L

المادة : الخلية

The Cell

المرحلة : الأولى

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Chromosome

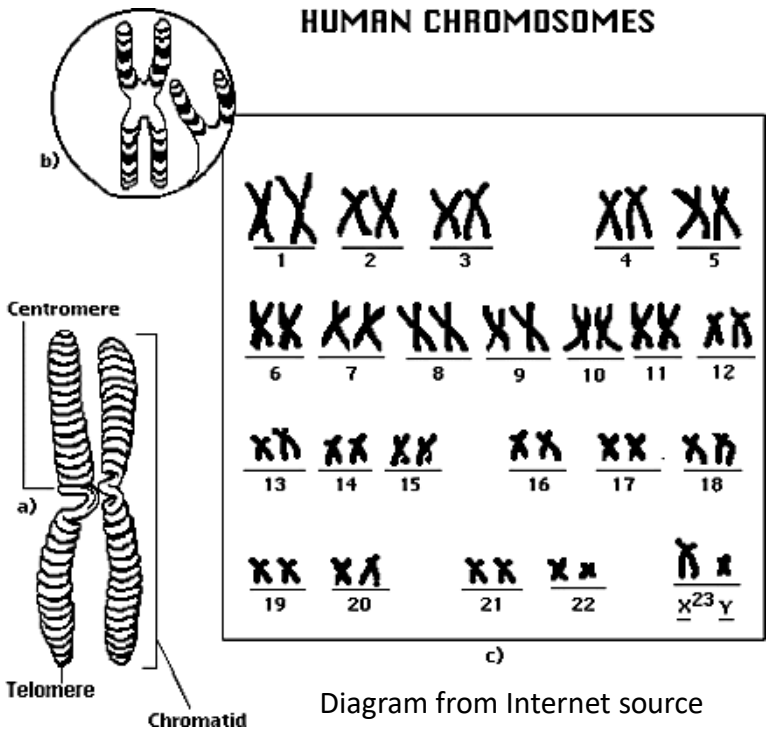


Diagram from Internet source

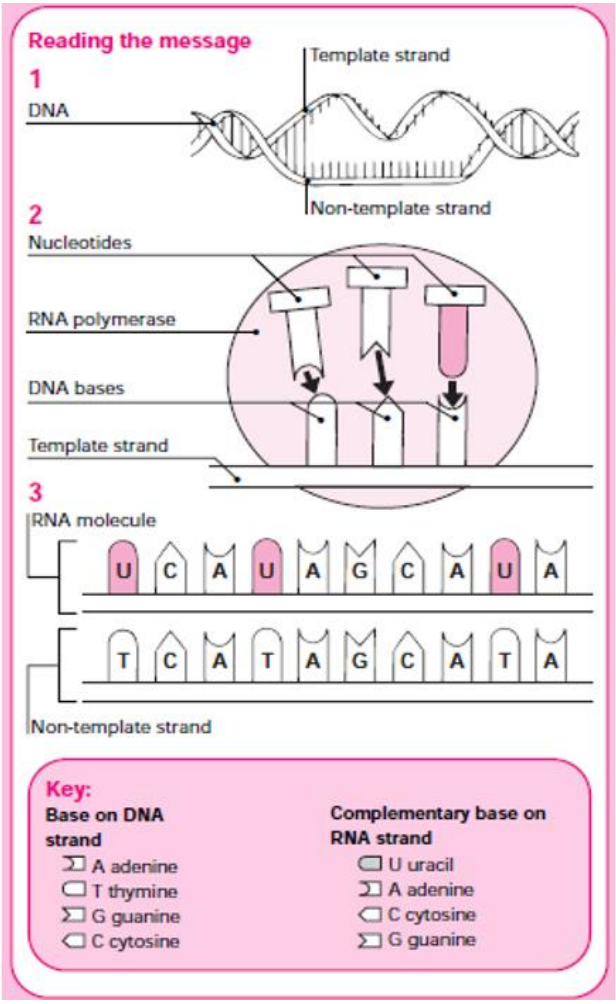
The Central Dogma

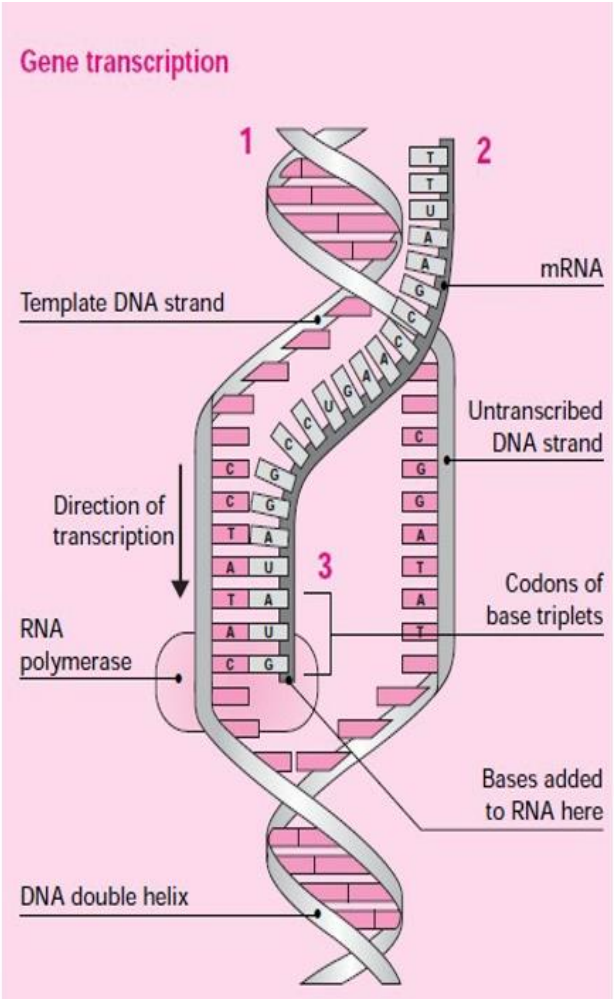
- DNA functions primarily by directing the production of **proteins**.
- Each DNA molecule can carry thousands of **genes** which in return plan for building a particular protein, or part of a particular protein.
- The type of produced decides everything about a cell and eventually the human body as a whole:
    - **The color of the hair and skin**
    - **Propensity to certain diseases**
    - **Unique ability**

- The "**Central dogma**" describes the flow of genetic information from DNA to protein.
- DNA makes ribonucleic acid (RNA), which coordinate polypeptide/ protein synthesis.
- This involves two main stages: a- Transcription (mRNA) b- Translation (Polypeptide)

Transcription

- The genetic information, the nucleotide sequence carried by one strand of the DNA helix is transcribed onto an **mRNA (messenger RNA).**
- The process of 'making' RNA from DNA
- The double helix become detached from each other and exposes the genes (sequences of bases).
- Just **one of the strands** serves as a template to produce the RNA strand.
- **RNA polymerase** binds to the DNA and moves along it, attaching free nucleotides making strand of mRNA.
- What is the sequence of mRNA that you expect?
- The **mRNA** consists of a single chain of nucleotides with that the base uracil (U) occurs instead of thymine (T).
- mRNA carries the genetic code, in the form of base triplets, or codons.
- What happen to the other strand of DNA?
- They are not transcribed

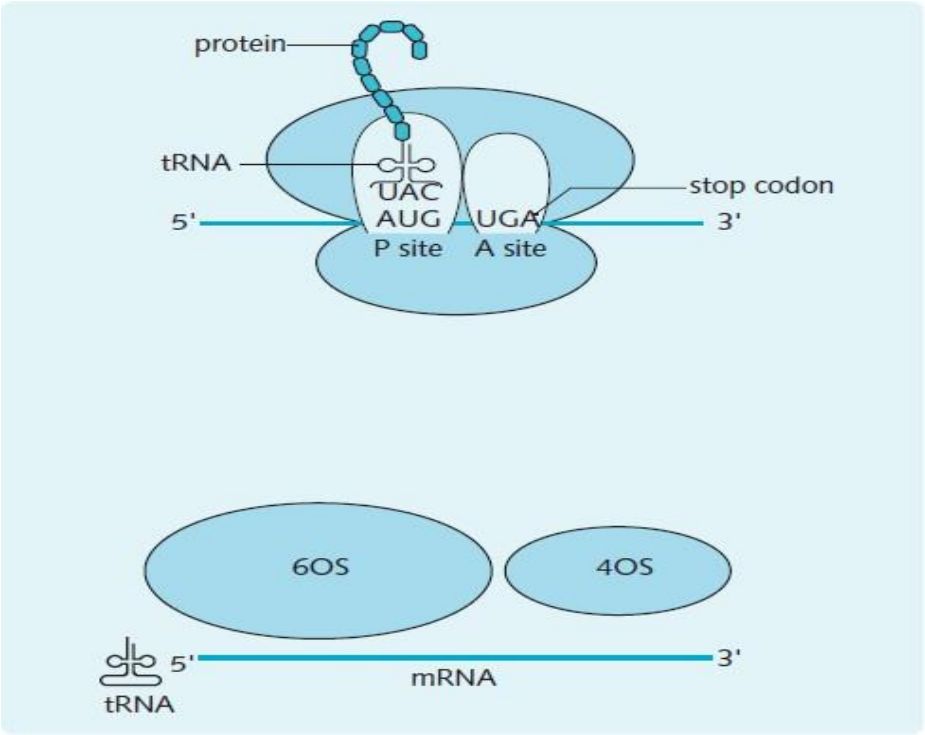


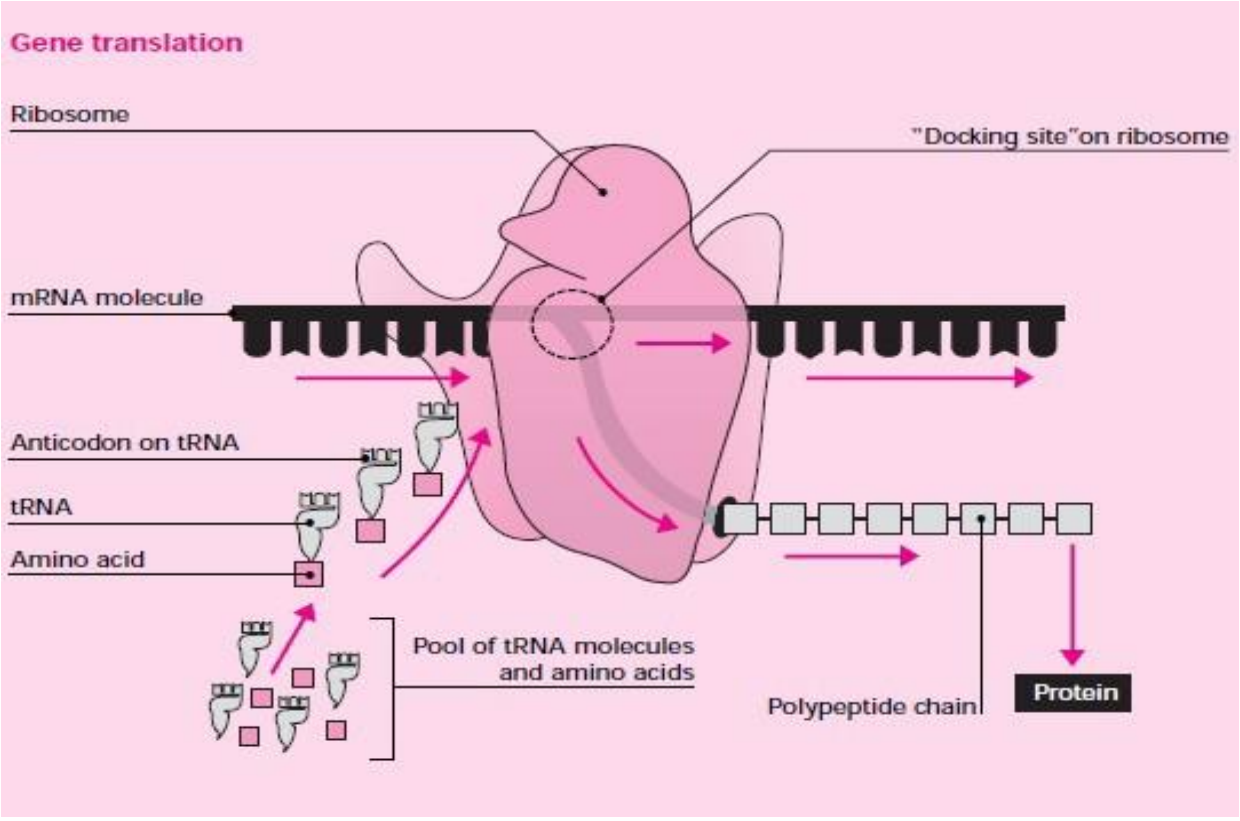


Translation

- The base sequence of each mRNA molecule is “read” by a ribosome.
- What is Ribosome?
- A third type of RNA, called **transfer RNA (tRNA)**, brings **amino acids** to the assembly site.
- As the mRNA molecule feeds through the **ribosome**, amino acids are added to the end of the growing polypeptide chain.
- Each type of **tRNA** bears an anticodon, which complements that of the mRNA codon currently inside the ribosome.

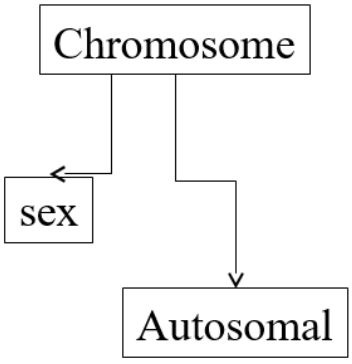
- Because of this, the **amino acids** are incorporated into the polypeptide chain in the correct order.
- What is the linkage that hold amino acids together?





Chromosome Structure and DNA packaging

- Genes are organized into structures called **chromosomes**, which serve as vehicles for transmitting genetic information.
- In eukaryotes, nuclear chromosomes are packaged by proteins into a condensed structure called **chromatin**.
- This allows the very long DNA molecules to fit into the cell nucleus.
- Chromosomes are usually diffuse, threadlike structures, not easily distinguishable from each other within the nucleus.
- Just before and during cell division the chromosomes condense (become shorter and fatter), so that their different shapes become visible under a microscope.
- The chromosome also copies itself, making two identical chromatids that meet at a narrow point called the centromere.
- Human cells contain **two** sex **chromosomes**.
- If you're female, you have **two X chromosomes**, and if you're male, you have an **X and a Y chromosome**.



- Autosomal simply refers to **non-sex chromosomes**.
- So, sticking with the human example, do the math, and you can see that humans have **44 autosomal chromosomes**.
- In humans, chromosomes come in **pairs**.

- In the nucleus of a normal human cell, there are **46 chromosomes** each containing 48–240 million bases of DNA.
- **Watson and Crick's** double helix model predicts that each chromosome would have a contour length of 1.6–8.2 cm.
- Two types of chromatin can be seen with electron microscopy. **Heterochromatin** and **Euchromatin**
- **Heterochromatin:** Is an electron dense and distributed around the periphery of the nucleus and in discrete masses within the nucleus.
- **Heterochromatin:** The DNA is in close association with nucleoproteins, and it is not active in RNA synthesis.
- **Euchromatin:** Is an electron lucent and represents DNA that is actually or potentially active in RNA synthesis
- **Nucleosome** is formed by 146 bp of DNA wound twice around an octamer (Eight) of histone proteins.
- **Centromeres** consist of hundreds of kilobases of repetitive DNA and are responsible for the movement of chromosomes at cell division.
- **Centromeres** Each centromere divides the chromosome into **short (p)** and **long (q)** arms.
- **Telomeres :** The ends of chromosomes are protected by DNA structures called telomeres.
- **Telomeres** are tandem repeats of the hexameric sequence 'TTAGGG' and loops back on itself to form the T-loop

- **Telomeres have several functions in preserving chromosome stability:**

1. Preventing abnormal end-to-end fusion of chromosomes.
2. Protecting the ends of chromosomes from degradation
3. Ensuring complete DNA replication
4. Having a role in chromosome pairing during meiosis.

Gene: A discrete unit of hereditary information consisting of a specific nucleotide sequence in DNA (or RNA, in some viruses).

Locus: A specific place along the length of a chromosome where a given gene is located.

Gamete: A haploid reproductive cell, such as an egg or sperm. Gametes unite during sexual reproduction to produce a diploid zygote.

The Structure of DNA

- DNA is composed of nucleotides, each containing: **adenine**, **cytosine**, **thymine**, or **guanine**.
- The amounts of A = T, G = C, and purines = pyrimidines [Chargaff's Rule].
- DNA is a double-stranded helix with antiparallel strands [Watson and Crick]. Nucleotides in each strand are linked by 5'-3' phosphodiester bonds
- Bases on opposite strands are linked by hydrogen bonding: **A with T**, and **G with C**.
- Since the two strands of DNA are complementary each strand acts as a template for building a new strand in replication.

- **RNA primase** synthesizes primer on DNA strand.
- **DNA polymerase** adds nucleotides to the 3' end of the growing strand.
- Genetic information is encoded as a sequence of base triplets, or codons
- Codons: 3 base code for the production of a specific amino acid, sequence of three of the four different nucleotides
- Since there are 4 bases and 3 positions in each codon, there are 4 x 4 x 4 = 64 possible codons
- 64 codons but only 20 amino acids, therefore most have more than 1 codon
- 3 of the 64 codons are used as STOP signals; they are found at the end of every gene and mark the end of the protein
- One codon is used as a START signal: it is at the start of every protein
- The **AUG** start codon is recognized by methionyl-tRNA or Met
- Once the start codon has been identified, the ribosome incorporates amino acids into a polypeptide chain
- RNA is decoded by tRNA (transfer RNA) molecules, which each transport specific amino acids to the growing chain
- **Translation ends** when a **stop codon (UAA, UAG, UGA)** is reached
- Point mutations involve alterations in the structure or location of a single gene. Generally, only one or a few base pairs are involved.
- **Point mutations** can significantly affect protein structure and function
- **Point mutations** may be caused by physical damage to the DNA from radiation or chemicals, or may occur spontaneously
- **Point mutations** are often caused by mutagens
- The DNA segments that carries genetic information are called **genes**.