Lec 1 \ Principles and Techniques for Deoxyribonucleic Acid (DNA)

قسم علوم التقنيات الاحيائية الطبية
المرحلة الاولى

اعداد

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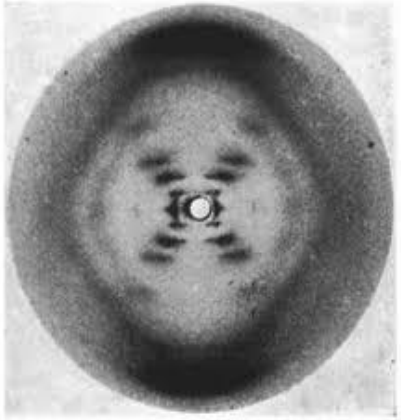
الايميل :
رمز الصف :

قصة (صورة Photo 51)



- في عام 1953 كان العالمان جيمس واتسون James Watsonوفرانسيس كريك Francis Crickيعملان في جامعة كامبريدج في بريطانيا، وكان العلماء في ذلك الوقت يحاولون فهم ما هو الجزيء الذي يحمل المعلومات الوراثية في الكائنات الحية .في نفس الفترة كانت العالمة روزاليند فرانكلين Rosalind Franklin تستخدم تقنية متقدمة تسمى حيود الأشعة السينية X-ray diffraction لدراسة تركيب الحمض النووي. التقطت صورة شهيرة سميت Photo 51أظهرت نمطاً مميزاً يشير إلى أن DNAله بنية حلزونية.

- هذا الاكتشاف كان ثورة علمية لأنه فسّر كيف يتم تخزين المعلومات الوراثية وكيف تنتقل من جيل إلى آخر .أهمية هذا الاكتشاف بفضل فهم تركيب DNAظهرت تقنيات حديثة مثل : تقنية PCRلتضاعف DNAالهندسة الوراثية تقنية CRISPR للتعديل الجيني الفحوصات الجينية والطب الشخصي

The structure of deoxyribonucleic acid

Deoxyribonucleic acid (DNA) is one of the **most** **important molecules** in living cells.

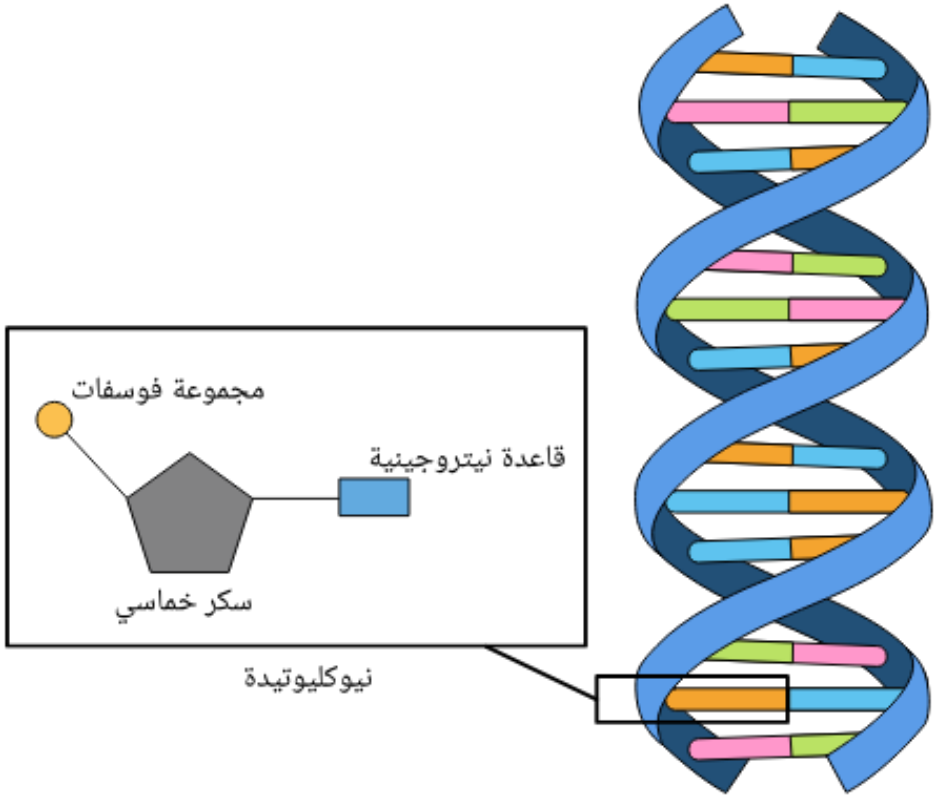
It encodes the instruction manual for life, so in **humans** this would be the DNA present in the **23 pairs** of chromosomes in the nucleus plus the relatively small mitochondrial genome. Humans have a **diploid** genome, inheriting one set of chromosomes from each parent. A complete and functioning diploid genome is required for normal development and to maintain life.

What Is Medicinal plants

DNA is a polymer made of monomeric units called nucleotides,

a nucleotide comprises a carbon sugar deoxyribose, a nitrogenous base and one or more phosphate groups., so the DNA strand contains one phosphate group per nucleotide.

There are four different bases in DNA, the double-ring purine bases: adenine and guanine; and the single-ring pyrimidine bases: cytosine and thymine. The carbon within the deoxyribose ring are numbered 1′ to 5′.

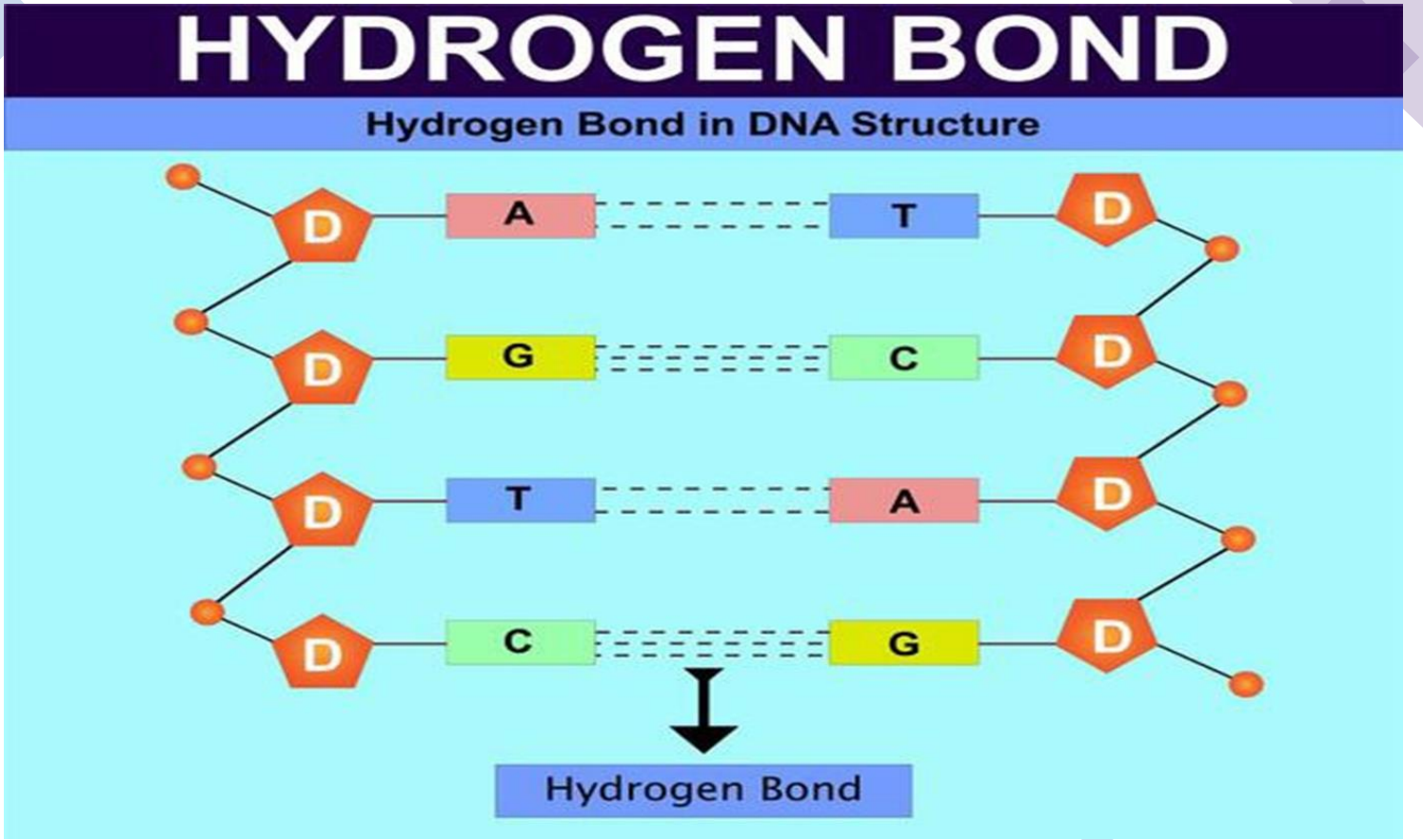

مجموعة فوسفات
قاعدة نيتروجينية
سكر خماسي
نيوكليوتيدة

Phoebus Levene (1920's)

- identified the 3 components of DNA molecule
  - deoxyribose sugars
  - phosphate groups
  - nitrogenous bases

- 4 nitrogenous bases identified by 1949

HYDROGEN BOND



Names of the bonds in DNA and their locations:

Phosphodiester Bond : Between the phosphate group of one nucleotide and the sugar

Hydrogen Bond :Between nitrogenous bases of the two opposite DNA strands (A–T and G–C).

Glycosidic Bond :Between the nitrogenous base and the deoxyribose sugar within a nucleotide.

Techniques for Studying DNA

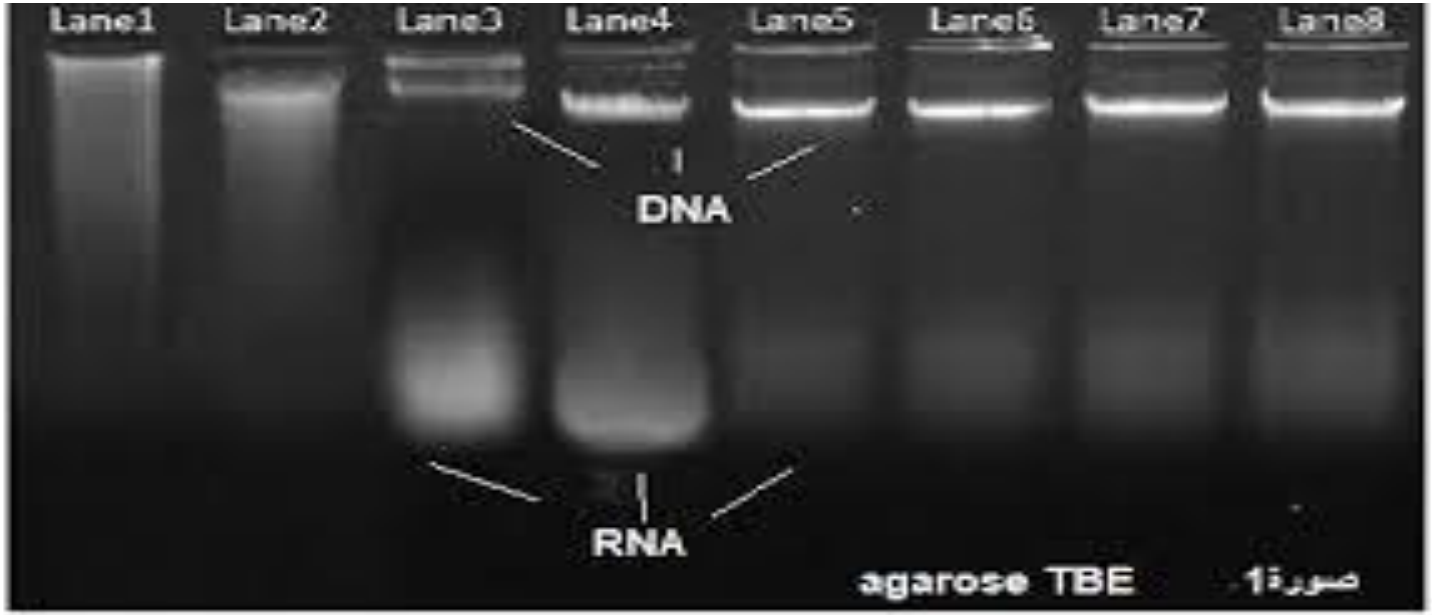
1. Gel Electrophoresis

-Used to **separate** DNA fragments based on size.

- The negatively charged DNA migrates toward the positive electrode through an **agarose gel** matrix.

-**Applications**:

DNA analysis, restriction fragment length polymorphism (RFLP)analysis, forensic DNA testing.


Lane1
Lane2
Lane3
Lane4
Lane5
Lane6
Lane7
Lane8
DNA
RNA
agarose TBE
صورة1

2. Polymerase Chain Reaction (PCR)

A technique to amplify specific DNA sequences

-Uses repeated cycles of denaturation, annealing, and extension to create millions of copies of a target DNA region.

-Applications:

Cloning, diagnostics (e.g., COVID-19 testing), genetic fingerprinting.

3. DNA Sequencing -Sanger Sequencing:

-Sanger Sequencing: The traditional method that uses chain-terminating nucleotides to determine the sequence of bases in a DNA fragment.

-Next-Generation Sequencing (NGS): Modern, high-throughput methods that allow sequencing of entire genomes quickly and affordably.

-Applications:

Genome mapping, disease research, personalized medicine.

4. CRISPR-Cas9 Gene Editing :

-A revolutionary method for editing specific DNA sequences in living organisms. -Utilizes the Cas9 protein and RNA guides to target and cut specific locations in the DNA for insertion or deletion.

-Applications:

Genetic modifications, gene therapy, agricultural improvements.

Applications of DNA Technologies

1-Forensic Science -DNA fingerprinting is used for criminal identification and paternity testing.

2-Medical and Clinical Applications -Genetic screening for inherited disorders, cancer detection, and gene therapy. -Personalized medicine based on an individual's genetic makeup.

3-Agriculture -Genetically modified organisms (GMOs) with desired traits such as pest resistance orincreased nutritional content.

4-Evolutionary Biology -DNA sequencing helps in understanding the evolutionary relationships among species. -Analysis of ancient DNA from fossils or preserved specimens.