Introduction to Molecular Biology

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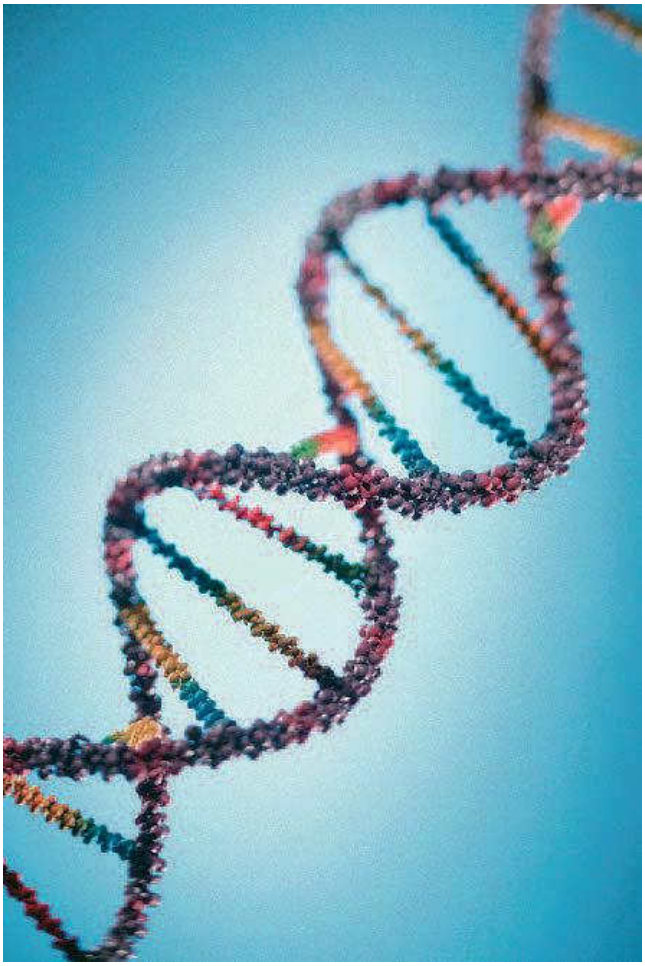


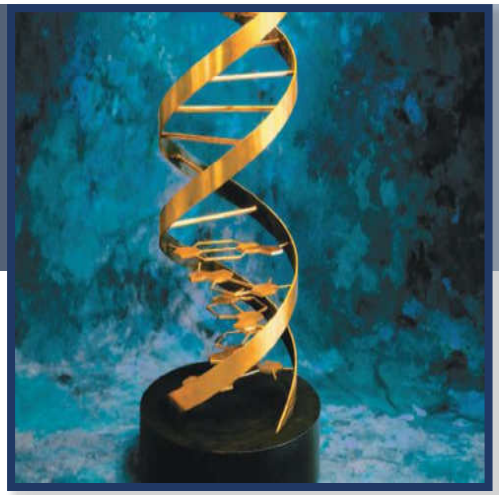
MOLECULAR BIOLOGY

ISLAMIC UNIVERSITY
DEPARTMENT OF CLINICAL LABORATORY INVESTIGATION TECHNIQUES

SECOND CLASS

HAIDER ALNAJI

PART 1 Molecular Biology



DNA is the genetic material. DNA bursts from this treated bacterial cell. The DNA in a human cell would unravel to nearly 6 feet, yet fit into a cell 6 millionths of a meter across

LECTURE 1

Introduction to Molecular Biology

Lecture Contents

1.1 Introduction

On April 25, 1953, in the British journal Nature, a paper, two columns in length, appeared. It was entitled "Molecular Structure of Nucleic Acids: A Structure for Deoxyribose Nucleic Acid" and was authored by the American James D. Watson and the Englishman Francis H. C. Crick. The structure they proposed has, they say in the first paragraph, "novel features which are of considerable biological interest." And at the end of the paper is the statement, "It has not escaped our notice that the specific pairing we have postulated immediately suggests a possible copying mechanism for the genetic material."

This paper was the culmination of work that stretched back 85 years to Friedrich Miescher, the German scientist who had reported his discovery of a nucleic acid. He called it nuclein because it was isolated from nuclei of pus cells and salmon sperm. Miescher reported his findings in 1871.

Figure 1–1 Friedrich Miescher

Figure 1–2 Gregor Mendel.

In 1866, Gregor Mendel had published his work that led to the principles of independent segregation and assortment of genes.

The late 1800s are considered the time of the birth of genetics. And at its birth, the new science was already started in two directions. Mendel's work would lay the foundation of what has been called classical genetics, and Miescher's had begun what is now called molecular genetics. The two scientists apparently worked without knowledge of the other's discoveries.

The classical geneticists have focused on how genes are transferred from one generation to the next (inheritance), gene location within chromosomes, chromosomal rearrangements, and the concept of dominance. The molecular geneticists, on the other hand. have focused on the structure of genes and on how genes work and are regulated.

For nearly a century, the work of trying to elucidate the structure of Miescher's nuclein went on. Nuclein's role in inheritance and in the metabolism of the cell was not universally accepted.

Watson and Crick's paper ended one search while simultaneously beginning another. The search for the molecular structure of inheritance had ended; the search for the molecular functions of the nucleic acid had begun. One of these functions, replication.

At the turn of the century, A. Kossel had demonstrated that a nucleic acid was composed of a nitrogenous base (adenine, guanine, cytosine, thymine, or uracil) (**Figure 1.3 a**) a sugar, and a phosphate group (**Figure 1.3 b**).

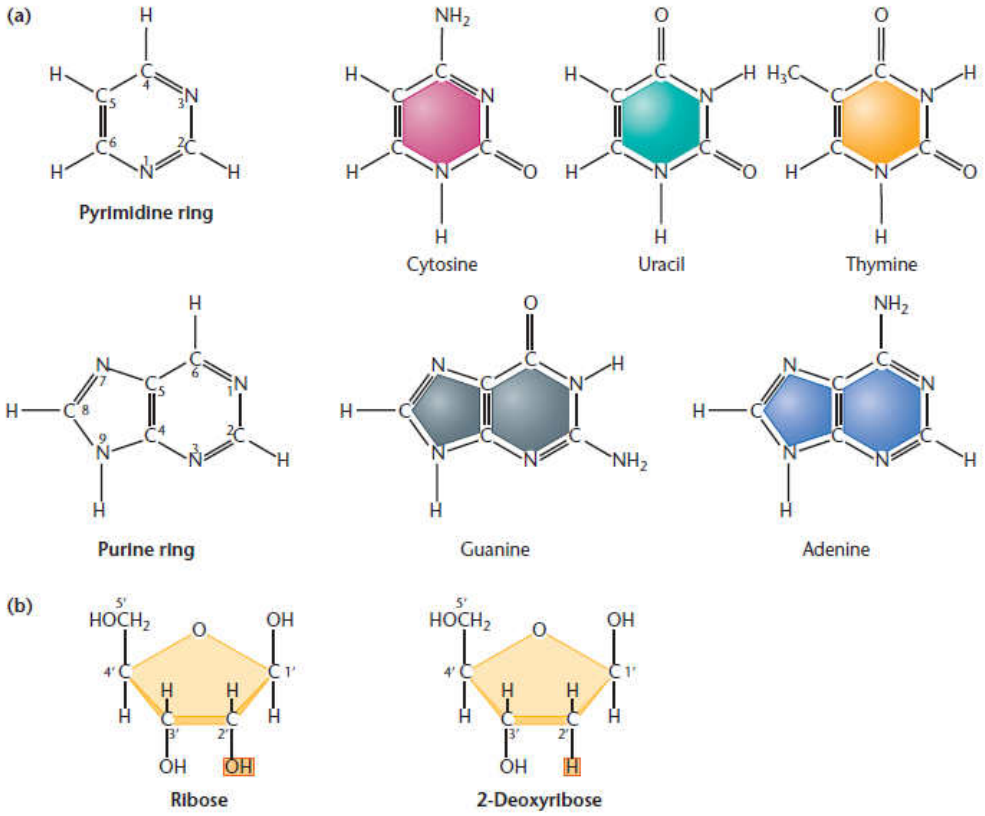


Figure 1–3 (a) Chemical structures of the pyrimidines and purines. (b) Chemical ring structures of ribose and 2-deoxyribose.

Then, by the early 1930s, largely as the result of the work of P. A. T. Levene, the arrangement of the bases. sugar, and phosphate was discovered. A single base is linked to the sugar, which in turn is linked to the phosphate. The resulting structure is a nucleotide (**Figure 1.4**), the fundamental unit of nucleic acids.

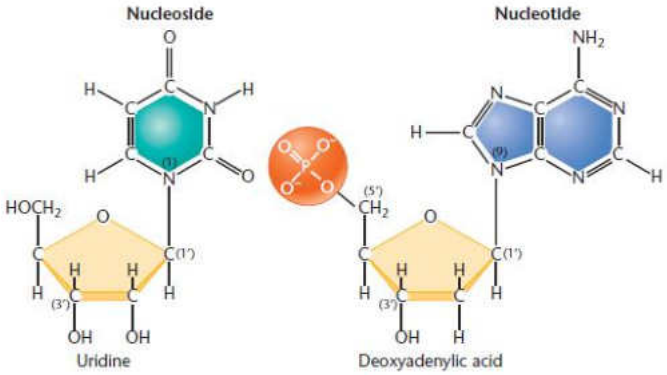


Figure 1–4 Structure of the nucleoside and nucleotide of RNA and DNA.

Levene, along with other workers, also discovered that ls the sugar of nuclein is deoxyribose. And he discovered that there are in fact two nucleic acids: ribonucleic acid, or to RNA (actually discovered by Kossel), and deoxyribonucleic acid, or DNA (Miescher's nuclein).

The discovery of the components of nucleic acids, in particular DNA, then led to the first models of the structure of DNA. Takahashi, in 1930, proposed the "tetranucleotide" structure for DNA. In this model, the nucleotides regular pattern. Thus, the idea that DNA is composed of simple of adenine, guanine, cytosine, and thymine repeat in a simple part arranged in a simple way was born.

1.2 Summary

The discovery of the genetic material, its chemical and physical properties, took nearly a century of work beginning with Miescher's work and culminating with the Watson and Crick double-helix model.

Essentially two tracks were taken in the study of the DNA.

- One involved studies that led to an understanding of the molecule's chemical and physical features,
- and the other was intended to determine DNA's biological characteristics.

The two tracks can be summarized as the "structure-function" concept familiar to all biologists.

The work of Levene, in the 1920s and 1930s, for example, showed that nucleotides were composed of bases (adenine, guanine, cytosine, and thymine), a sugar (deoxyribose), and a phosphate group.

1.3 Study Questions

1. Define: Nuclein, Classical genetics, Molecular Genetics
2. describe how Kossel demonstrate the nucleic acids.
3. draw chemical structure of nitrogenous bases
4. draw the fundamental unit of nucleic acids.

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