CHAPTER 2 BASICS OF MOLECULAR BIOLOGY

SCIENTIFIC ENGLISH
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MOLECULAR BIOLOGY LICENSE

Légende

 Entrée du glossaire

 Abréviation

 Référence Bibliographique

 Référence générale

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Objectifs

The aims of this course are:

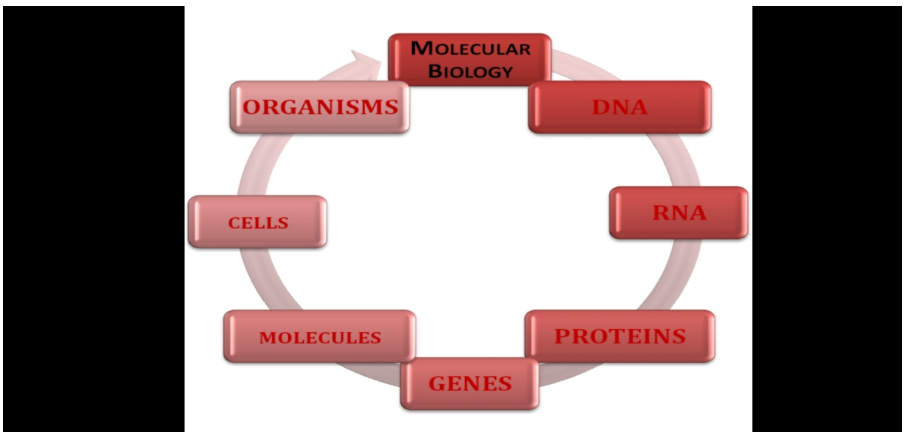
- Provide students with basic Molecular Biology in english
- Provide students with a general understanding of Scientific terminology.
- Understand the particular meaning of Scientific terms.
- Enrich their vocabulary in Scientific and Technical words

CHAPTER 2 BASICS OF MOLECULAR BIOLOGY

1. INTRODUCTION

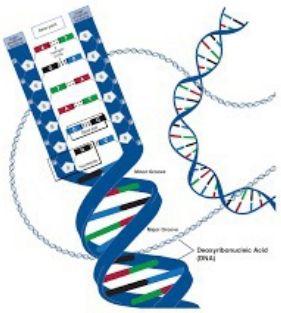
Molecular Biology is the field of biology that studies the composition, structure and interactions of cellular molecules – such as nucleic acids and proteins – that carry out the biological processes essential for the cell's functions and maintenance.

Since the late 1950s and early 1960s, *molecular biologists* have learned to characterize, isolate, and manipulate the molecular components of cells and organisms includes DNA *p.15* (Deoxyribonucleic Acid), the repository of genetic information; RNA *p.15* (Ribonucleic Acid), a close relative of DNA *p.15* ; and proteins, the major structural and enzymatic type of molecule in cells.



MOLECULAR BIOLOGY FIELDS

2. DNA DEOXYRIBONUCLEIC ACID



DNA

DNA is the chemical name for the molecule that carries genetic instructions in all living things. The DNA molecule consists of two strands that wind around one another to form a shape known as a double helix. Each strand has a backbone made of alternating *sugar (deoxyribose) and phosphate groups*. Attached to each sugar is one of four bases--*adenine (A), cytosine (C), guanine (G), and thymine (T).* The two strands are held together by bonds between the bases; *adenine bonds with thymine*, and *cytosine bonds with guanine*. The sequence of the bases along the backbones serves as instructions for assembling protein and RNA molecules.

DNA, or deoxyribonucleic acid, is the central information storage system of most animals and plants, and even some viruses. The name comes from its structure, which is a sugar and phosphate backbone which have bases sticking out from it--so-called bases. So that "deoxyribo" refers to the sugar and the *nucleic acid* refers to the phosphate and the bases. The bases go by the names of adenine, cytosine, thymine, and guanine, otherwise known as A, C, T, and G. DNA is a remarkably simple structure. It's a polymer of four bases--*A, C, T, and G* --but it allows enormous complexity to be encoded by the pattern of those bases, one after another. DNA is organized structurally into chromosomes and then wound around nucleosomes as part of those chromosomes. Functionally, it's organized into genes, of which are pieces of DNA, which lead to observable traits. And those traits come not from the DNA itself, but actually from the RNA that is made from the DNA, or most commonly of *proteins* that are made from the RNA which is made from the DNA. So the central dogma, so-called of molecular biology, is that genes, which are made of DNA, are made into messenger RNA s, which are then made into proteins. But for the most part, the observable traits of eye color or height or one thing or another of individuals come from individual *proteins*.

Fondamental

- *DNA* is the molecule that contains the instructions an organism needs to *Develop , Live and Reproduce*
- *DNA* is made up of Molecules called nucleotide contains a *Phosphate Group , a sugar Group*

and Nitrogen Base

3. Exercice

[solution n°1 p.12]

3.1. Exercice : DNA

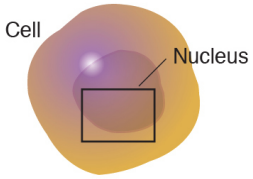
Which of the following does cytosine pair with?

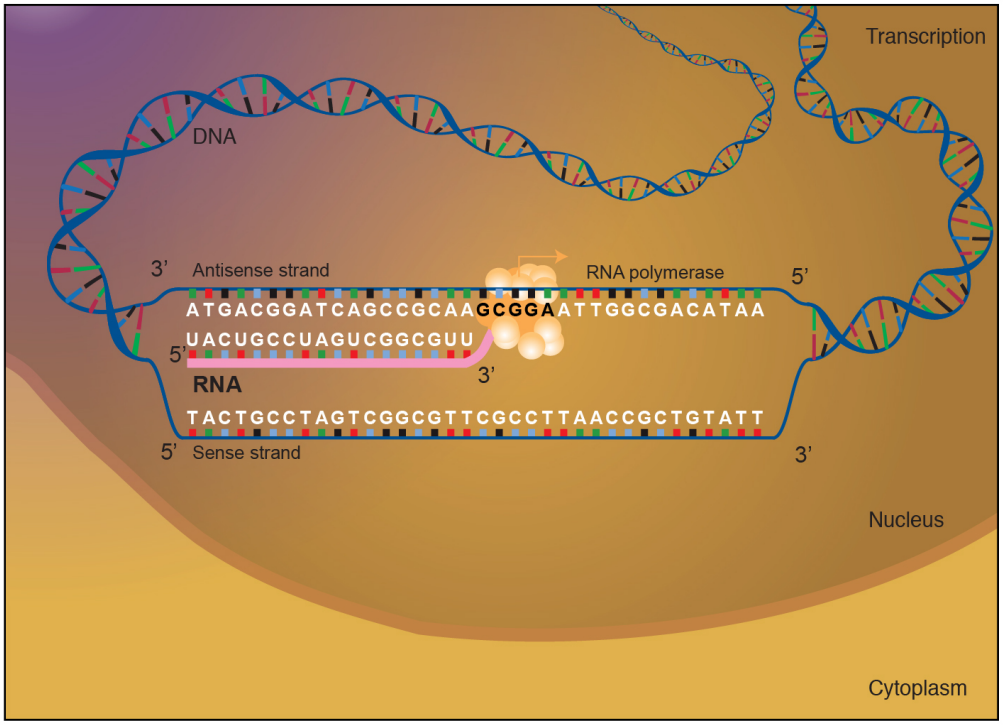
- ☐ guanine
- ☐ thymine
- ☐ adenine
- ☐ a pyrimidine

3.2. Exercice : DNA

Prokaryotes contain a _____chromosome, and eukaryotes contain _____ chromosomes.

4. RNA RIBONUCLEIC ACID





RNA

Ribonucleic acid (RNA p.15) is a molecule similar toDNA p.15 . Unlike DNA p.15 , RNA p.15 is single-stranded. An RNA p.15 strand has a backbone made of alternating *sugar (ribose)* and *phosphate groups.* Attached to each sugar is one of four bases--*adenine (A), uracil (U* p.15 *), cytosine (C), or guanine (G)*. Different types of RNA p.15 exist in the cell: *messenger RNA (mRNA), ribosomal RNA (rRNA)*, and *transfer RNA (tRNA*). More recently, some small *RNAs* have been found to be involved in regulating Gene p.14 expression.

The cell uses RNA p.15 for a number of different tasks, one of which is called *messenger RNA*, or *mRNA*. And that is the *nucleic acid* information molecule that transfers information from the genome p.14 into *proteins* by *translation*. Another form of RNA p.15 is *tRNA,* or *transfer RNA*, and these are non-protein encoding *RNA* molecules that physically carry *amino acids* to the *translation* site that allows them to be assembled into chains of *proteins* in the process of *translation.*

Fondamental

- RNA p.15 is a biologically important type of molecule that consists of a long chain of

nucleotide units.

- Each nucleotide consists of a nitrogenous base, a ribose sugar, and a phosphate.
- The four types of nitrogen bases are adenine (A p.15), uracil (U p.15), guanine (G p.15) and cytosine (C p.15).

5. Exercice

[solution n°2 p.12]

The following RNA strand was produced:

5′ AAA AUG AGU AAG 3′5' \text{ AAA AUG AGU AAG } 3'5′ AAA AUG AGU AAG 3′5, prime, start text, space, A, A, A, space, A, U, G, space, A, G, U, space, A, A, G, space, end text, 3, prime

Which of the following DNA strands could have been the template for this RNA?

- 3′ AAA ATG AGT AAG 5′
- 3′ UUU TAC UCA UUC 5′
- 3′ TTT TAC TCA TTC 5′

6. DNA vs. RNA – A Comparison Chart

COMPARISON	DNA	RNA
Full Name	Deoxyribonucleic Acid	Ribonucleic Acid
Function	DNA replicates and stores genetic information. It is a blueprint for all genetic information contained within an organism	RNA converts the genetic information contained within DNA to a format used to build proteins, And then moves it to ribosomal protein factories.
Structure	DNA consists of two strands, arranged in a double helix. These strands are made up of subunits called nucleotides. Each nucleotide contains a phosphate, a 5-carbon sugar molecule and a nitrogenous base.	RNA only has one strand, but like DNA, is made up of nucleotides. RNA strands are shorter than DNA strands. RNA sometimes forms a secondary double helix structure, but Only intermittently.
Sugar	The sugar in DNA is deoxyribose, which contains one less hydroxyl group than RNA's ribose.	RNA contains ribose sugar molecules, without The hydroxyl modifications of deoxyribose
Bases	The bases in DNA are Adenine ('A'), Thymine ('T'), Guanine ('G') and Cytosine ('C').	RNA shares Adenine ('A'), Guanine ('G') and Cytosine ('C') With DNA, but contains Uracil ('U') rather than Thymine.
Base Pairs	Adenine and Thymine pair (A-T) Cytosine and Guanine pair (C-G)	Adenine and Uracil pair (A-U) Cytosine and Guanine pair (C-G)
Location	DNA is found in the nucleus, with a small amount of DNA also present in mitochondria.	RNA forms in the nucleolus, and then moves to specialised regions of the cytoplasm depending on the Type of RNA formed.

TABLE : DNA vs. RNA – A Comparison Chart

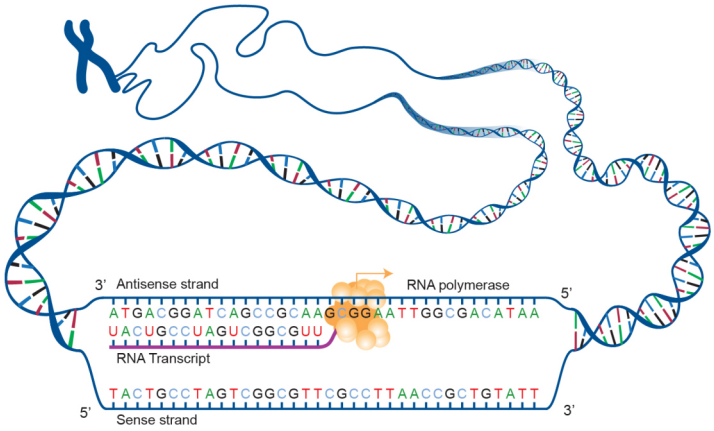
TO ACCESS THE VIDEO DNA Vs RNA CLICK *HERE*

7. PROTEINS SYNTHESIS

Proteins synthesis is a process that takes place in the cells of all living things: *PRODUCTION OF PROTEINS*. This process actually consists of two processes — *transcription* and *translation*. In eukaryotic cells, *transcription* takes place in the nucleus. During *transcription*, DNA p.15 is used as a template to make a molecule of messenger RNA p.15 (*mRNA)*. The molecule of *mRNA* then

leaves the nucleus and goes to a ribosome in the cytoplasm, where translation occurs. During translation, the genetic code in *mRNA* is read and used to make a *protein*. These two processes are summed up by the central dogma p.14 of molecular biology: *DNA* → *RNA* → *Protein*.

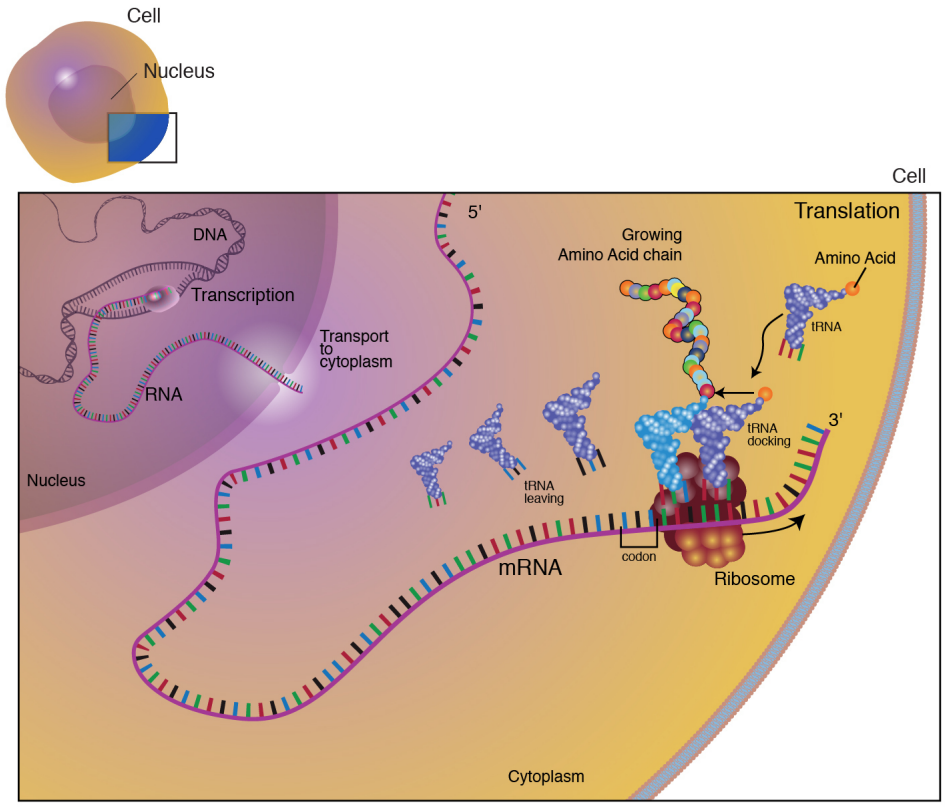
7.1. TRANSCRIPTION



Transcription

Transcription is the process of making an RNA p.15 copy of a Gene p.14 sequence. This copy, called a *messenger RNA (mRNA*) molecule, leaves the cell nucleus and enters the cytoplasm, where it directs the synthesis of the *protein*, which it encodes.

7.2. TRANSLATION



Translation

Translation is the process of translating the sequence of a *messenger RNA (mRNA)* molecule to a sequence of amino acids during protein synthesis. The genetic code describes the relationship between the sequence of base pairs in a Gene p.14 and the corresponding *amino acid* sequence that it encodes. In the cell cytoplasm, the ribosome reads the sequence of the *mRNA* in groups of three bases to assemble the protein.

8. Exercice

[solution n°3 p.12]

8.1. Exercice

Transcription takes place in three steps:.....,.....,and.....

8.2. Exercice

In eukaryotes, the new mRNA is not yet ready for ..... At this stage, it is called .....

Solutions des exercices

> **Solution** n°1

Exercice p. 7

Exercice : DNA

Which of the following does cytosine pair with?

- [x] guanine
- [ ] thymine
- [ ] adenine
- [ ] a pyrimidine

Exercice : DNA

Prokaryotes contain a _____chromosome, and eukaryotes contain _____ chromosomes.

Prokaryotes contain *a single, double-stranded circular* chromosome. Eukaryotes contain *double-stranded linear DNA molecules packaged into* chromosomes.

> **Solution** n°2

Exercice p. 9

The following RNA strand was produced:

5′ AAA AUG AGU AAG 3′5' \text{ AAA AUG AGU AAG } 3'5′ AAA AUG AGU AAG 3′5, prime, start text, space, A, A, A, space, A, U, G, space, A, G, U, space, A, A, G, space, end text, 3, prime

Which of the following DNA strands could have been the template for this RNA?

- ○ 3′ AAA ATG AGT AAG 5′
- ○ 3′ UUU TAC UCA UUC 5′
- ◉ 3′ TTT TAC TCA TTC 5′

Each nucleotide is appropriately paired according to the A-U/T-A and C-G pairing rules, so these are complementary strands.

> **Solution** n°3

Exercice p. 11

Exercice

Transcription takes place in three steps:.....,.....,and.....

Transcription takes place in three steps: i*nitiation, elongation, and termination*

Exercice

In eukaryotes, the new mRNA is not yet ready for ..... At this stage, it is called .....

In eukaryotes, the new mRNA is not yet ready for *TRANSLATION* At this stage, it is called *PRE-mRNA*.

Glossaire

Central Dogma

The central dogma of molecular biology is an explanation of the flow of genetic information within a biological system. It is often stated as "DNA makes RNA, and RNA makes protein", although this is not its original meaning. It was first stated by Francis Crick in 1957, then published in 1958.

Chromosome

A chromosome is a long DNA molecule with part or all of the genetic material of an organism.

Gene

A gene is the basic physical and functional unit of heredity. Genes are made up of DNA. Some genes act as instructions to make molecules called proteins. However, many genes do not code for proteins. In humans, genes vary in size from a few hundred DNA bases to more than 2 million bases.

Genome

A genome is all genetic material of an organism.

Abréviations

A : ADENINE

C : CYTOSINE

DNA : Deoxyribonucleic Acid

G : GUANINE

RNA : Ribonucleic Acid

T : THYMINE

U : URACIL

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