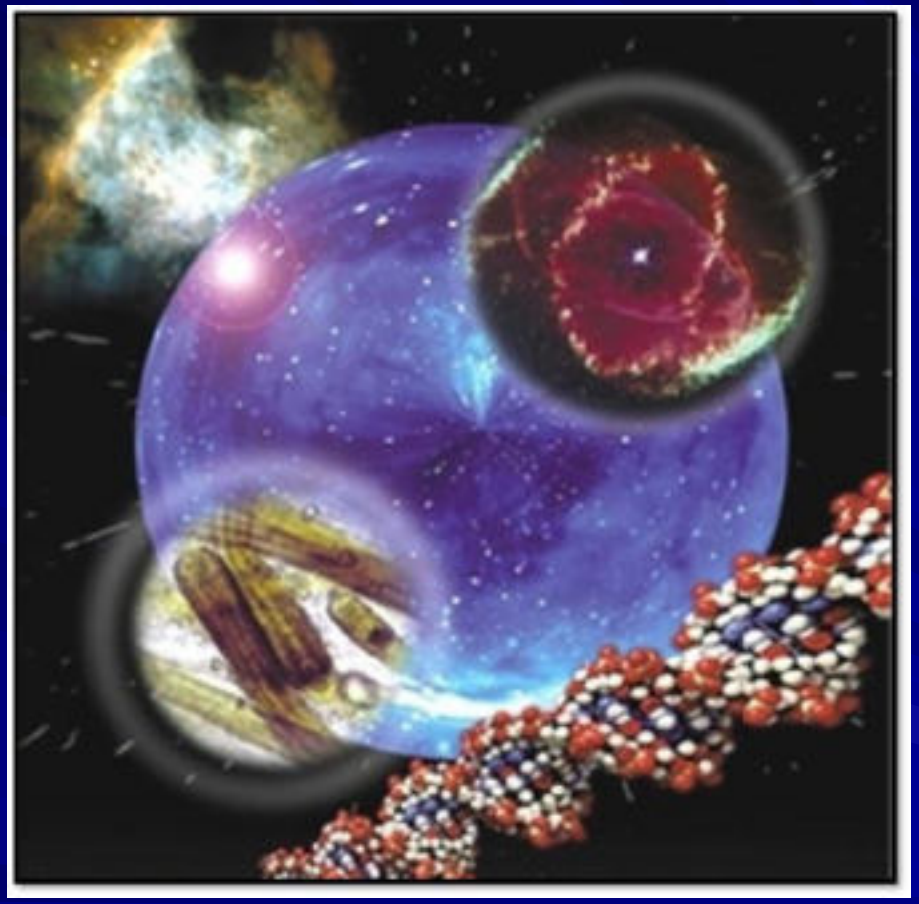
An Introduction to Molecular Biology



What is molecular biology?

- The attempt to understand biological phenomena in molecular terms
- The study of gene structure and function at the molecular level
- Molecular biology mainly concerns itself with understanding of interactions between the various systems of a cell, including the interactions between DNA, RNA and protein biosynthesis, learning how these interactions are regulated.

What is molecular biology?

As a result, it is the study of molecular basic of the process of

- replication
- transcription
- translation of the genetic material.

What is molecular biology?

- **Replication -** DNA replication is the process by which a double-stranded DNA molecule is copied to produce two identical DNA molecules. It is an essential process because, whenever a cell divides, the two new daughter cells must contain the same genetic information, or DNA, as the parent cell.
- **Transcription -** as related to genomics, is the process of making an RNA copy of a gene's DNA sequence.
- **Translation** - is the process in which ribosomes in the cytoplasm or ER synthesize proteins after the process of transcription of DNA to RNA in the cell's nucleus.

Molecular Biology

- This field overlaps with other areas of biology and chemistry, particularly genetics and biochemistry.
- It is the joining of aspects between genetics and biochemistry.

A Brief History

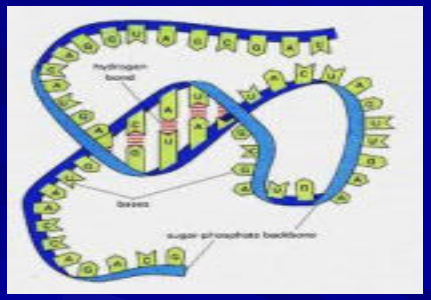
- Since the late 1950s and early 1960s, molecular biologists have learned to characterize, isolate, and manipulate the molecular components of cells and organisms, which are:

1. DNA, the storage of genetic information
2. RNA
3. Proteins, the major structural and enzymatic type of molecule in cells.

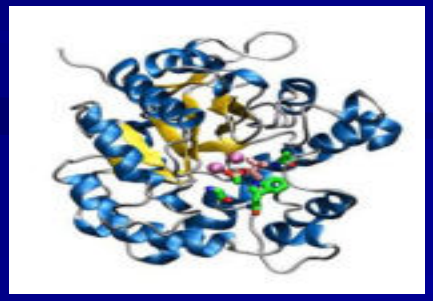
Components involve in Molecular biology

All Life depends on 3 critical molecules

DNA



RNA



Protein

Molecular Biology – A Journey

- Microscopic biology began in 1665
- Robert Hooke (1635-1703) discovered organisms are made up of cells

Robert Hooke

- Matthias Schleiden (1804-1881) and Theodor Schwann (1810-1882) further expanded the study of cells in 1830s

Matthias Schleiden

Theodor Schwann

Major events in the history of Molecular Biology 1800 - 1870

- 1865 Gregor Mendel discover the basic rules of heredity of garden pea.
  - An individual organism has two alternative heredity units for a given trait (dominant trait vs. recessive trait)

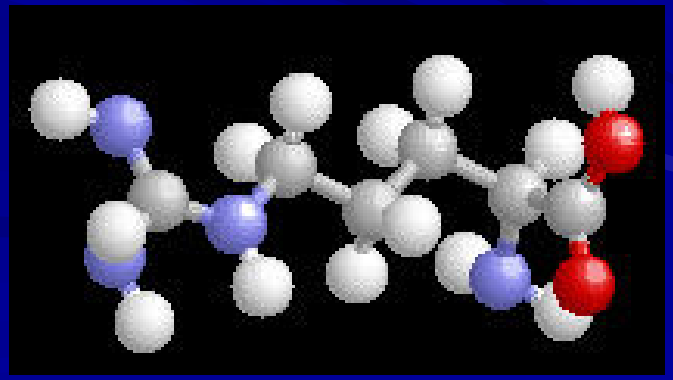
Mendel: The Father of Genetics

- 1869 Johann Friedrich Miescher discovered DNA and named it nuclein.

Johann Miescher

Major events in the history of Molecular Biology 1880 - 1900

- 1881 Edward Zacharias showed chromosomes are composed of nuclein.
- 1899 Richard Altmann renamed nuclein to nucleic acid.
- By 1900, chemical structures of all 20 amino acids had been identified

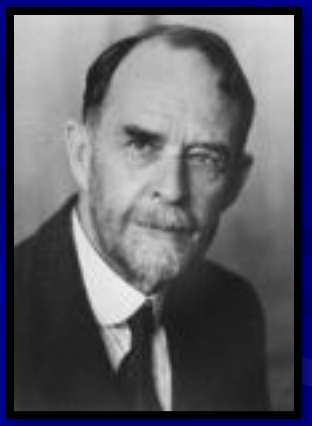


Major events in the history of Molecular Biology 1900-1911

- 1902 - Emil Hermann Fischer wins Nobel prize: showed amino acids are linked and form proteins

Emil Fischer

- 1911 – Thomas Hunt Morgan discovers genes on chromosomes are the discrete units of heredity

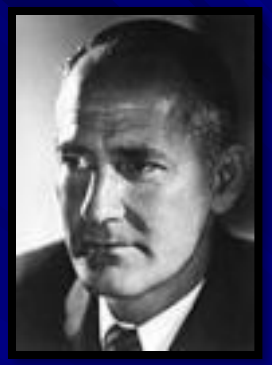


Thomas Morgan

- 1911 Pheobus Aaron Theodore Lerene discovers RNA

Major events in the history of Molecular Biology 1940 - 1950

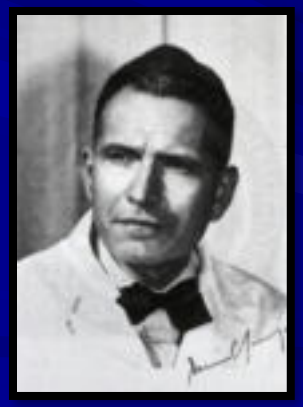
- 1941 – George Beadle and Edward Tatum identify that genes make proteins



George Beadle

Edward Tatum

- 1950 – Edwin Chargaff find Cytosine complements Guanine and Adenine complements Thymine



Edwin Chargaff

Major events in the history of Molecular Biology 1952 - 1960

- 1952-1953 James D. Watson and Francis H. C. Crick deduced the double helical structure of DNA

James Watson and Francis Crick

- 1956 George Emil Palade showed the site of enzymes manufacturing in the cytoplasm is made on RNA organelles called ribosomes.

George Emil Palade

Major events in the history of Molecular Biology 1986 - 1995

- 1986 Leroy Hood: Developed automated sequencing mechanism

Leroy Hood

- 1986 Human Genome Initiative announced

- 1995 Moderate-resolution maps of chromosomes 3, 11, 12, and 22 were published
- These maps provide the locations of "markers" on each chromosome to make locating genes easier

Major events in the history of Molecular Biology 1995-1996

- 1995 John Craig Venter: First bacterial genomes sequenced
- 1995 Automated fluorescent sequencing instruments and robotic operations
- 1996 First eukaryotic genome-yeast-sequenced

John Craig Venter

Major events in the history of Molecular Biology

- **Molecular Biology 1997-1999**
  - 1999 First human chromosome (number 22) sequenced

- **Molecular Biology 2000-2001**
  - 2001 International Human Genome Sequencing published the first draft of the sequence of the human genome

Major events in the history of Molecular Biology 2003- Present

- April 2003 Human Genome Project Completed
- Mouse genome is sequenced.
- April 2004 Rat genome sequenced.
- Next-generation sequencing – genomes being sequenced by the dozen

Some Terminology

- Nucleic acid: Biological molecules (RNA and DNA) that allow organisms to reproduce
- Gene:
- Basic physical and functional units of heredity located on the chromosomes consisting of specific sequences of DNA bases. Gens encode instructions on how to make proteins
- Genotype: the genetic makeup of an organism
- Phenotype: the physical expressed traits of an organism


Thank you