

# Understanding Biotechnology & its Applications

Schedule:

Tuesday, Wednesday 10:00 – 10:50 AM

Thursday 11:00 – 11:50 AM

Room #: 207

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# Why you are being taught this course?

- “Technology of hope”
- Applications in a wide range of fields to improve our life style
- Multidisciplinary
- Biotechnology industries are booming rapidly...



"Sequencing? No, this baby tells us how much we can charge for genome data."

# What is the broad objective of this course?

Broad objective of this course is to give an introduction to biotechnology and its applications in our daily life. This course will help you to get familiarized with various techniques that are used routinely towards this.

# What is the Syllabus?

**Unit 1 (1 hr):** Introduction to “biotechnology” and the history of biotechnological developments with major milestones.

**Unit 2 (3 hrs):** Basic biology: Brief introduction to genes and genomes.

**Unit 3 (5 hrs):** Introduction to recombinant DNA technology and its application to genomics.

**Unit 4 (4 hrs):** Introduction to proteins and their products.

**Unit 5 (5 hrs):** Microbial biotechnology.

**Unit 6 (5 hrs):** Plant biotechnology.

**Unit 7 (5 hrs):** Animal biotechnology.

**Unit 8 (5 hrs):** Bioremediation and environmental biotechnology.

**Unit 9 (5 hrs):** Medical biotechnology.

**Unit 10 (2 hrs):** Biotechnology regulations and ethics.

# Textbooks and References

## **Text Book:**

- Introduction to Biotechnology (3<sup>rd</sup> Edition) by William J. Thieman and Michael A. Palladino published by Benjamin-Cummings publishing company.

## **Other References:**

- Biotechnology for Beginners by Reinhard Renneberg published by Academic press.
- Basic Biotechnology 3<sup>rd</sup> Edition by Ratledge Colin published by Cambridge university press.

# Credits Distributions for IC136

Quiz 1:	20 %
Quiz 2:	25 %
Tutorial 1:	5 %
Final Exam:	50 %

# What is “Biotechnology”?

"Any technological application that uses biological systems, living organisms, or derivatives thereof, to make or modify products or processes for specific use."

Biotechnology is the manipulation of living organisms and organic material to serve human needs.

## Examples:

- Yeast in bread making and alcohol production

- Use of beneficial bacteria (penicillin) to kill harmful organisms

- Cloning of plants and animals

- Improving rice quality

# Biotechnology is drawn on...

- Pure biological sciences  
(genetics, microbiology, animal cell culture, molecular biology, biochemistry, embryology, cell biology, etc.)
- Knowledge and methods from outside biology  
(chemical engineering, bioprocess engineering, information technology, and biorobotics, etc.)



# Pioneers in Biotechnology

# Antony van Leeuwenhoek



- 1675
- Dutch tradesman
- Father of Microbiology
- Discovered bacteria using a simple microscope

Van Leeuwenhoek's main discoveries are:

- the [infusoria](#) ([protists](#) in modern [zoological](#) classification), in 1674
- the [bacteria](#), (e.g., large [Selenomonads](#) from the human mouth), in 1676
- the [vacuole](#) of the cell.
- the [spermatozoa](#) in 1677. Van Leeuwenhoek had troubles with Dutch theologians about his practice.
- the banded pattern of [muscular fibers](#), in 1682. [\[10\]](#)

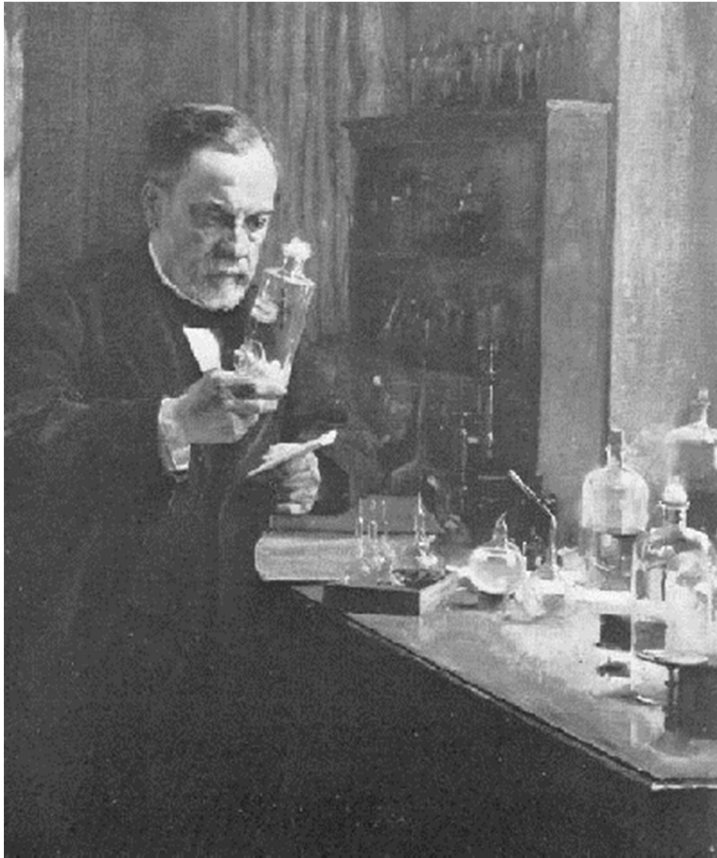
# Gregor Mendel

- 1863
- Austrian monk who conducted the first genetics experiments using pea plants in the mid 1800s.
- Often considered the founder of genetics.
- Mendel summarized his findings in two laws:
  - Law of Segregation
  - Law of Independent Assortment.



**Gregor Mendel**

# Louis Pasteur



- 1870's
- French Chemist and Microbiologist
- Disproved the notion of spontaneous generation, describing the role of bacteria in spoilage ("germ theory of disease") and the scientific basis for fermentation
- Created the rabies vaccine

# Robert Hooke

- 1665
- Invented the compound light microscope
- First to observe cells in cork

[Mechanics](#)

[Gravitation](#)

[Microscopy](#)

[Palaeontology](#)

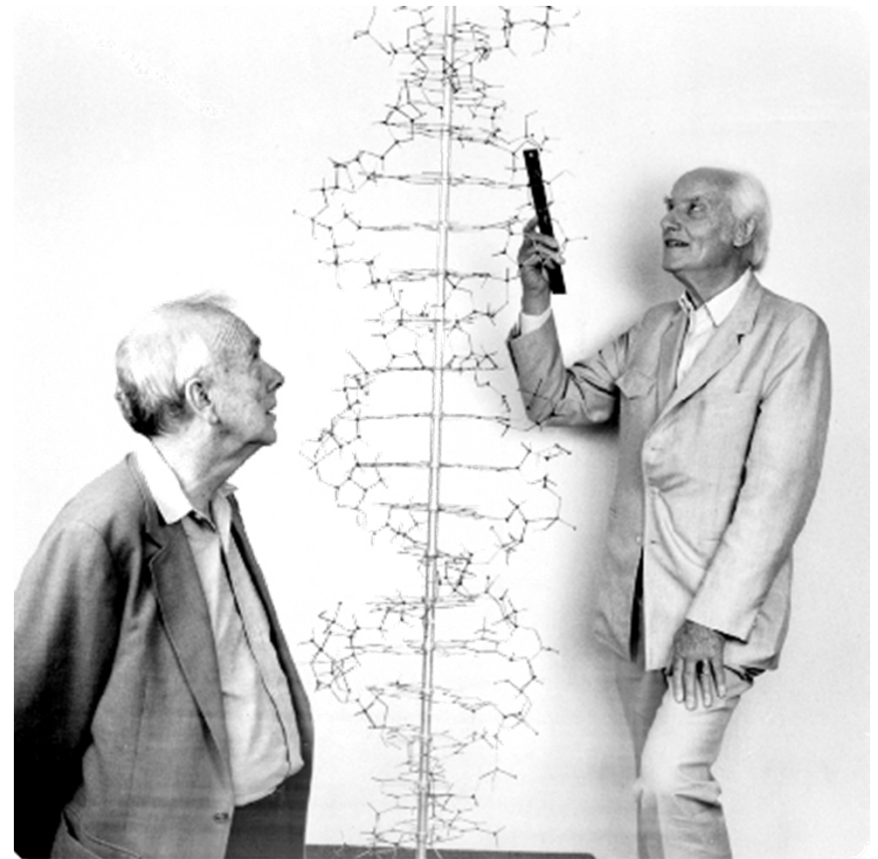
[Astronomy](#)

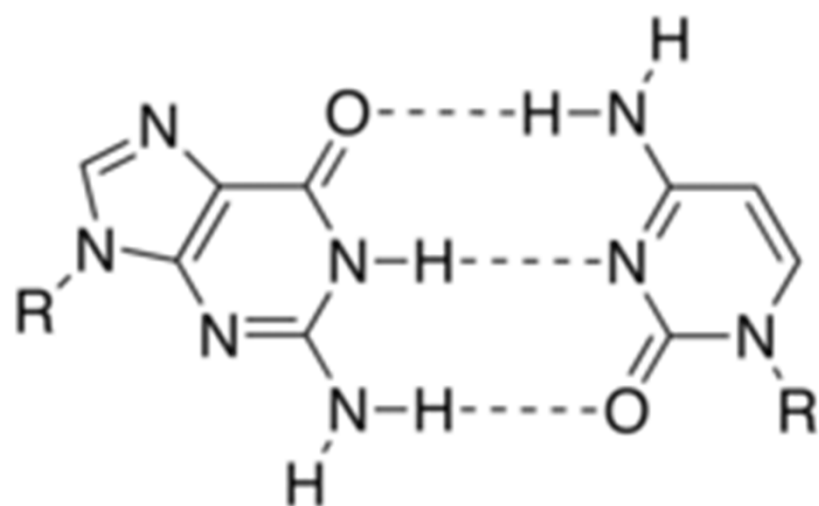




# James Watson & Francis Crick

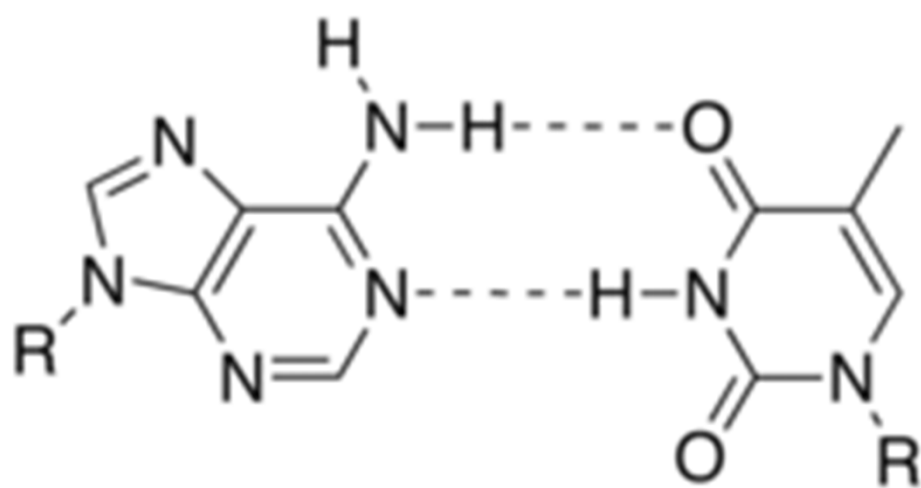
- 1953
- Englishmen responsible for the discovery of the double helix structure of DNA using X-ray diffraction data generated by Rosalind Franklin
- Watson and Crick base pairing
- Nobel Prize in 1962





Guanine

Cytosine



Adenine

Thymine

# Paul Berg



- 1972
- Stanford University scientist who first developed recombinant DNA technology, a method for insertion of genetic material from one organism into another.
- Used for the study of viral chromosomes



# **Historical Development of Biotechnology**

# 1750 B.C.

- Origins of “biotechnology” emerge in methods of food production and plant and animal breeding
  - Domestication of animal for use as livestock
  - Selective breeding eg corn
  - Use of bacteria to produce cheese (food preservation)
  - Use of natural enzymes in yogurt
  - Use of yeast to produce bread
  - Use of fermentation for producing wine and beer

# 1869

- DNA is discovered in trout sperm by Friedrich Miescher, an eminent physiological chemist from Basel, Switzerland
- DNA was isolated, analyzed and recognized as a unique macromolecule

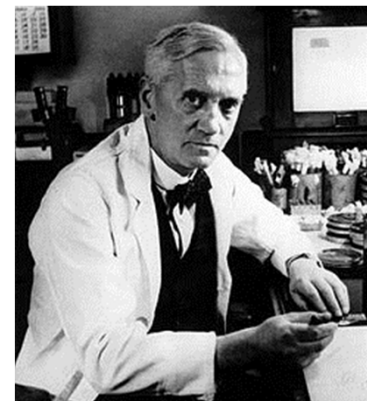


1919

- The word “biotechnology” is first used by a Hungarian agricultural engineer **Karl Ereky**.

# 1928

- Alexandar Flemming discovered and purified antibiotic Penicillin
- Discovered the mold *Penicillium* which inhibited the growth of bacterium called *Staphylococcus aureus*.
- **Accidental discovery**
- "When I woke up just after dawn on September 28, 1928, I certainly didn't plan to revolutionize all medicine by discovering the world's first antibiotic, or bacteria killer," Fleming would later say, "But I suppose that was exactly what I did."[\[2\]\[5\]](#)



## 1940's-1950's

- Widespread work is undertaken to investigate the structure and function of DNA



# 1980



- The U.S. Supreme Court approved the patenting of genetically altered organisms.

## 1980's-1990's

- A variety of GMO's and biotechnology techniques were introduced in fields from agriculture to medicine
  - Recombinant DNA technology-extracts DNA from one organism for use in another, allowing more rapid and specific improvements in plants and animals
  - Plant Tissue Culture-gains widespread acceptance as a method to quickly and cheaply produce genetically identical plants



## 1990's

- First transgenic organisms (GMO's) were introduced in widespread agricultural production, particularly in the area of crops.
  - Bt corn and soybeans are introduced offering “natural” insect resistance by the introduction of a gene from the bacterium *Baccillus thuringensis*

# 1997

- Dolly was the first animal cloned from diploid cells, produced in Scotland



## Late 1990's-Early 2000's

- Human cloning was outlawed in the U.S. and the first concerns over the use of human stem cells in research began to arise.

