# BIOTECHNOLOGY TIMELINE CELEBRATING INNOVATION IN BIOTECHNOLOGY

# The Evolution of the Revolution

## 2,000 BC

Egyptians and Sumerians learn brewing and cheese making.



master the art of winemaking.

Dutch spectacle- Dutch student of maker Zacharias natural history Janssen invents the and microscope-

microscope.



In China, moldy soybean curds become the first antibiotic to treat infections and ailments

Leeuwenhoek

discovers bacteria.

maker Antonij van

Swedish chemist Jöns Jakob Berzelius discovers proteins.



isolated.



The Escherichia coli bacterium is discovered.

It later becomes a major research, Charles development and Darwin's production tool

The word biotechnology

is used in print for the first time.



landmark book for biotechnology. The Origin of Species is published.



Vaccine for Rabi's disease discovered. Pasteur vaccinated a young boy

who had been bitten by a rabid dog. This vaccine was made from the extract of the spinal column of a rabies infected rabbit. A modified version of this vaccination is still used today, and has saved thousands

of lives.

By carefully feeding cantaloupe mold in large tanks, American microbiologist Andrew Mover develops a technique of producing penicillin in large quantities,



A. Justin coins the n genetic discover insulin engineering, a technique involving the transfer of a select piece of genetic

material from one

organism to another



cell nucleus to the protein-making launching its career as a "wonder drug". machinery in the cell cytoplasm. For some time after the discovery

James Watson and genes to the cytoplasm to produce the first to describe the double helix structure of DNA.

1958

produced in

a test tube

for the first

DNA is



nformation from the DNA in the

of DNA's genetic role and the

structure (by Crick and Watson),

researchers remained perplexed

about how exactly the genetic

the proteins required for cellular

The French biologists Francois

the Nobel Prize in Physiology

or Medicine for their part in this

Jacob and Jacques Monod received

information was conveved from the

deciphering of its double-stranded

Discovery of messenger RNA 'tape copy' Messenger RNA plays a key role n protein synthesis. Messenger RNA, also known as mRNA, are RNA molecules that carry genetic



Marshall W. Nirenberg and Har Gobind Khorana win the Nobel Prize for deciphering the genetic codes of the 20 amino acids, leading researchers to later conclude that the genetic code is universal among all living things.





by cutting the birus DNA usina special restriction enzymes. These enzymes are now widely used in modern DNA technologie

1971

First complete synthesis of a gene. First gene-spliced DNA from different organisms.

1970

Swiss scientish

Werner Arber,

discover that

themselves

against viruses

bacterica defent

Stanley Cohen and Herbert Boyer develop recombinant DNA technology. Considered to be the birth of modern biotechnology, they complete the first successful genetic engineering experiment by inserting a gene from an African clawed toad into bacterial DNA.





## 1984

Genetic fingerprinting is discovered, which is used today to establish family relationships and to identify criminal



The first recombinant DNA vaccine for livestock is developed.



suspects.

The first genetically



1998

The roundworm C elegans becomes the first multi-cellular organism to have it genome complete sequenced.

cheese-making, becomes one of the first food products in Canada to be manufactured with recombinant techniques. Normally extracted from rennet, an enzyme complex found in the lining of a cow stomach, chymosin is now produced directly in agents such as e.coli bacteria.

Chymosin, an enzyme used in

identifies 20,000-25,000 genes.

The Human Genome Project is launched. This international 13-year effort to determine the sequences of the three billion chemical base pairs that make up the DNA of a person, eventually Vitamin A, thus



completed. Smith Genome Sciences Centre

in British Columbia are the first to sequence the SARS genome. 2005

The billionth biotech German and Swiss acre is planted by one of scientists develop 8.5 million farmers in one golden rice, fortified of 21 countries. with betacarotene, which stimulates production of

preventing form

of blindness.



The Human Genome Project is Researchers at Canada's Michael





researchers foresee a new antibody which Ouebecbased firm Medicago will be combined with other medication grows H5N1 (bird flu) vaccine to offer better protection against HIV/ in tobacco leaves. The product AIDS at a far cheaper price, thus allowing becomes the first plantbased influwider access to treatment in poorer enza vaccine to undergo human trials in Canada.

2010

First synthetic cell

## 2012

Human Trials of Malaria Vaccine Draft Genome for Wheat Human trials of a malaria vaccine are An international team nderway and showing positive results announces a draft of This cold be the first vaccine against a the wheat genome.

parasitic infection.

Access to treatment for HIV/ AIDS

The United Nations adopts a political

declaration adopted committed to

expanding access to treatment for AIDS

for 15 million people by 2015. In Europe,

anti-HIV biotech medicine produced using

genetically modified tobacco- a first of its

kind study in the EU. If the Phase I study

is successful, larger trials will follow and

measures are already in place to achieve

A hybrid of three grasses, bread wheat has 3 genomes and ove 96 000 genes within one plant, making it particularly complex to decipher

The first bionic eye has seen the light of day in the United States, giving hope to Medical Products, the Argus I Retinal Prosthesis System has helped more than 60 people

Biotechnology begins, as humans begin choosing o altering plants and livestock so thev can be domesticated. Potatoes become the first cultivated

## Greeks develop grafting techniques





for plant breeding.



mathematician Robert Hooke discovers the existence of the



# First small pox vaccine is

Edward Jenner discovered the process of vaccination by inoculating a small

boy with cowpox and then trying to re-infect him with smallpox. The boy recovered from the weaker cowpox infection and thus became immune to smallpox. The cowpox

'Vacca'. This is how the word

'Vaccine' came into use.

Virchow declares: "Every virus was called 'Vaccinia', from the Latin word for cow,

German scientists Matthias Schleiden and Theodor Schwann propose that all organisms are composed of cells.

Prussian physician Rudolf

originates from another

# 1839-1855

by heating it to

microbes.

kill dangerous

French chemist Louis Pasteur develops pasteurization a process that protects food



famine.

thousands of pea plants Gregor Mendel publishe a description of rules governing how hereditary traits pass between generations, the foundation Ireland, ending the potato



After seven years of cultivating and testing



Botanist William James Beal

corn hybrid in the laboratory.

produces the first experimental

bacteriologist Sir Alexander Fleming discovers penicillin as an

Father of modern plant antibiotic. breeding Luther Burbank develops over 800 new strains of fruits, vegetables and flowers.

His blight-resistant Burbank potato is heavily planted across

Oswald Theodore Avery isolates pure

## 1962

research in 1965.

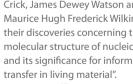
Nobel Prize for the discovery of the 'Double Helix' structure of DNA The Nobel Prize in Physiology or Medicine 1962 was awarded jointly to Francis Harry Compton Crick, James Dewey Watson and Maurice Hugh Frederick Wilkins "for their discoveries concerning the

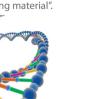


DNA.



molecular structure of nucleic acids and its significance for information





The sequence of nucleic acid base pairs that combine Norman Borlaug becomes the first plant breeder to win a Nobel Prize, for his work on to make DNA is determined for th new wheat varieties that increase yields by 70 per cent. This marks the beginning of the first time for a Green Revolution in world agriculture. specific gene.

American microbiologist Daniel Nathans discovers the first restriction enzyme that can cut DNA into pieces for various studies and applications. The restriction enzyme technique becomes a fundamental tool in modern genetic research, helping to create the biotechnology industry and providing the basis for the Human Genome

# 1976

bacteria to produce human insulin. The technique represents a significant and long term viability of from limited supplies of

Herbert Bover, founder of

# 1977

firm Genentech, uses E. coli improvement in the efficiency producing this vital medical therapy, formerly extracted animal tissues that could lead to allergic reactions. The vast majority of insulin used in the today is now produced

through this recombinant

method.

the pioneer biotechnology disease.

1989

Discovery of defective gene for cystic fibrosis by Dr. Lap-Chee Tsui at Toronto's Hospital for Sick Children. Similar discoveries later link specific genes to other disorders, such as autism, Huntington's Disease, and a rare heart problem known as Right Ventricular Cardiomyopathy. Each has added to a growing knowledge of the complex relationship between gene function and

The world meets Dolly the sheep, the first cloned mammal. UNESCO adopts the Universal Declaration on the Human Genome and Human Rights, recognizing the human genome as a common heritage that must be safeguarded

from inappropriate manipulation



2007

papillomavirus

human papillomavirus- a

## First Vaccine against human The first vaccine against

of Toronto develop a microchip with nanoscale components to detect chemical markers for cancer, a technique that could make diagnosis much faster.

A Canadian team of scientists and

engineers from the University



## this goal. European biotechnology scientists launched a clinical trial of an

the blind around the world. Developed by Second Sight recover partial sight, with some experiencing better results than others.

## 2013

In May 2010, J. Craig Venter Institute created the first fully synthetic, self-replicating bacterial cell, which was named Synthia. While the U.S. government has plugged \$430 million into synthetic biology since 2005, most of it has gone toward developing







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