

# Biotechnology: Evolution of Biotechnology

Year		Biotechnology event
3.6 million BC		Lucy and the hominids
2.0 million BC		Stone Age
150,000 BC	Eat or be eaten	The Dawn of Modern Humans ( <i>Homo sapiens</i> )
75,000 BC		<i>Homo sapiens</i> learn how to use clothes
50,000 BC		Ice Age, arrival of humans in Europe
9,000 BC	Agriculture Begins	Dawn of Civilization
6,000 BC		Fermentation used as a process
4,000 BC		Lactic acid bacteria used for making cheese
3,000 BC		Writing begins Bronze Age
1,000 BC		Iron Age
1-625		Roman Empire
1200	Aztec Civilization	Plants used for food Animals used for food and to do work Plants domesticated, selectively bred for desired characteristics
1500		Plant collection expeditions First plant gene banks Selection for disease resistance
1595	Zacharias Jansen invents the first microscope (added 8/30)	Zacharias Jansen invents the first microscope (added 8/30)
Prior to 1750:		Plants used for food Animals used for food and to do work Plants domesticated, selectively bred for desired characteristics Microorganisms used to make cheese, beverages, and bread by fermentation
1797:	Edward Jenner	Used living microorganisms to protect people from disease
1750-1850:		Increased cultivation of leguminous crops and crop rotations to increase yield and land use
1820:		Animal drawn machines
1850's:		Horse drawn harrows, seed drills, corn planters, horse hoes, 2-row cultivators, hay mowers, and rakes Industrially processed animal feed and inorganic fertilizer
1859:	Charles Darwin	Hypothesized that animal and plant populations adapt over time to best fit the environment
1864:	Louis Pasteur	Proved existence of microorganisms Showed that all living things are produced by other living things
1865:	Gregor Mendel	Investigated how traits are passed from generation to generation - called them factors

1869:	Johann Meischer	Isolated DNA from the nuclei of white blood cells
1880:		Steam engine to drive combine harvesters
1890:		Ammonia synthesis
1892:		Self-propelled tractor
1893:	Koch, Pasteur	Fermentation process patented
	Lister	Institutes Diphtheria antitoxin isolated
1902:	Walter Sutton	Coined the term "gene" Proposed that chromosomes carry genes (factors which Mendel said that could be passed from generation to generation)
1904:		Artificial "silks" developed
1910:	Thomas H. Morgan	Proved that genes are carried on chromosomes "Biotechnology" term coined
1918:		Germans Use acetone produced by plants to make bombs
		Yeast grown in large quantities for animal and glycerol
		Made activated sludge for sewage treatment process
1920:		Boom of rayon industry
1927:	Herman Mueller	Increased mutation rate in fruit flies by exposing them to x-rays
1928:	Frederick Griffiths	Noticed that a rough kind of bacterium changed to a smooth type when unknown "transforming principle" from smooth type was present
1928:	Alexander Fleming	Discovered antibiotic properties of certain molds
1920-1930:		Plant hybridization
1938:		Proteins and DNA studied by x-ray crystallography
		Term "molecular biology" coined
1941:	George Beadle	Proposed "one gene, one enzyme" hypothesis
	Edward Tatum	
1943-1953:	Linus Pauling	Described sickle cell anemia calling it a molecular disease Cortisone made in large amounts
		DNA is identified as the genetic material
1944:	Oswald Avery	Performed transformation experiment with Griffith's bacterium
1945:	Max Delbruck	Organized course to study a type of bacterial virus that consists of a protein coat containing DNA
Mid-1940's:		Penicillin produced
		Transition from animal power to mechanical power on farms
1950:	Erwin Chargaff	Determined that there is always a ratio of 1:1 adenine to thymine in DNA of many different organisms
		Artificial insemination of livestock
1952:	Alfred Hershey	Used radioactive labeling to determine that it is the
	Margaret Chase	DNA not protein which carries the instructions for assembling new phages
1953:	James Watson	Determined the double helix structure of DNA
	Francis Crick	
1956:	Dangr	Sequenced insulin (protein) from pork
1957:	Francis Crick	Explained how DNA functions to make protein
	George Gamov	
1958:	Coenberg	Discovered DNA polymerase
1960:		Isolation of m-RNA
1965:		Classification of the plasmids
1966:	Marshall Nirenberg	Determined that a sequence of three nucleotide
	Severo Ochoa	bases determine each of 20 amino acids
1970:		Isolation of reverse transcriptase
1971:		Discovery of restriction enzymes
1972:	Paul Berg	Cut sections of viral DNA and bacterial DNA with same restriction enzyme
		Spliced viral DNA to the bacterial DNA
1973:	Stanley Cohen	Produced first recombinant DNA organism
	Herbert Boyer	Beginning of genetic engineering
1975:		Moratorium on recombinant DNA techniques
1976:		National Institute of Health guidelines developed for study of recombinant DNA
1977:		First practical application of genetic engineering
		human growth hormone produced by bacterial cells

1978:	Genentech, Inc.	Genetic engineering techniques used to produce human insulin in <i>E. coli</i>
		First biotech company on NY stock exchange
	Stanford University	First successful transplantation of mammalian gene
		Discoverers of restriction enzymes receive Nobel Prize in medicine
1979:	Genentech, Inc.	Produce human growth hormone and two kinds of interferon DNA from malignant cells transformed a strain of cultured mouse cells - new tool for analyzing cancer genes
1980:		US. Supreme Court decided that manmade microbes could be patented
1983:	Genetech, Inc.	Licensed Eli Lilly to make insulin
		First transfer of foreign gene in plants
1985:		Plants can be patented
1986:		First field trials of DNA recombinant plants resistant to insects, viruses, bacteria
1988:		First living mammal was patented
1993:		Flavr savr tomatoes sold to public
1993		Kary Mullis receives Nobel Prize for PCR discovery
1997		Monsanto begins development of Roundup Ready wheat
1999		Europe does not want genetically modified products
2000		Human Genome sequenced (90%)
Dec. 14, 2000		Arabidopsis genome sequenced
Dec. 18, 2000		<a href="#">IBM unveils super computer to study the human genome</a>
Feb. 2001	Estimated 35,000 to 45,000 genes in the human genome	Celera and MIT announce and publish a draft (96% complete) of the human genome
July 2001		Banana genome sequenced
April 5, 2002		Rice genome sequenced
Oct. 5, 2002		Mosquito genome sequenced
Nov. 2002		Tom Ridge appointed head of the newly formed Department of Homeland Security.
Nov. 2002		Severe Acute Respiratory Syndrome (SARS) first appears in the southern province (Guangdong) in China
Dec. 2002		Mouse Genome is sequenced
Feb. 14, 2003		Dolly, suffering from viral induced lung cancer, was put to sleep by analgesic injection.
March 2003		Human Cloning Prohibition Act of 2003 (H.R. 534). H.R. 534 bans reproductive as well as therapeutic cloning. It also states that receiving or importing a cloned human embryo or any product derived from a cloned
April 2003	Human genome estimated to contain just under 30,000 genes	Human Genome Project announces a more complete (99%) and higher quality human genome sequence.
April 2003		New member of Coronavirus identified as the cause of SARS. Entire genome sequenced
May 2003		SARS Sequenced
April 2003		The Brown Norway Rat genome is sequenced
May 2004	Monsanto ceases development of Roundup Ready Wheat	European Union and Japan suggests that they will boycott all US wheat if it GM wheat is grown in the US.
October 2004		<a href="#">Maurice Wilkins</a> (1916-2004)
November 2004		Chicken genome sequenced

## Sources and Links

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