Biotechnology Timeline

8000-4000 B.C.E.

Humans domesticate crops and livestock.

Potatoes first cultivated for food.

Biotechnology Timeline

2000 B.C.E.

Biotechnology used to leaven bread and ferment beer, using yeast (Egypt).

Production of cheese, fermentation of wine begins (Sumeria, China, Egypt).

Biotechnology Timeline

500 B.C.E.

First antibiotic: Moldy soybean curds (tofu) used to treat boils (China).

Biotechnology Timeline

100 C.E.

First insecticide:

powdered chrysanthemums

(China)

Biotechnology Timeline

1797

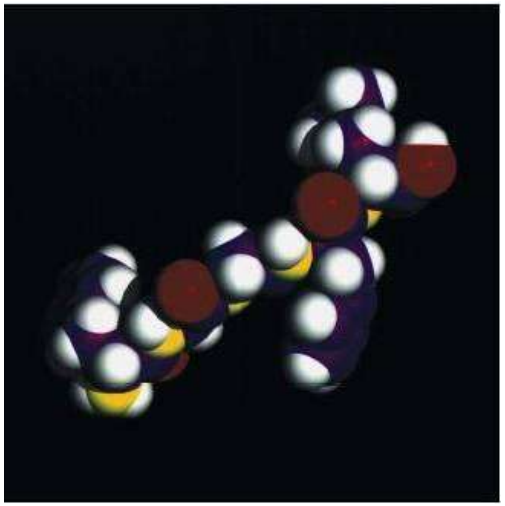
First vaccination

Edward Jenner takes pus
from a cowpox lesion,
inserts it
into an incision
on a boy's arm.

Biotechnology Timeline

1830-1833

1830 Proteins are discovered.



Model of a 5-peptide protein.

1833 First enzyme is discovered and isolated.

Biotechnology Timeline

1857

Louis Pasteur proposes that microbes cause fermentation. He later conducts experiments that support the germ theory of disease.

Biotechnology Timeline

1859

Charles Darwin publishes the theory of evolution by natural selection.

Biotechnology Timeline

1865

Gregor Mendel discovers the laws of inheritance by studying flowers in his garden. The science of genetics begins.

Biotechnology Timeline

1915

Phages — viruses
that only infect bacteria —
are discovered.

Biotechnology Timeline

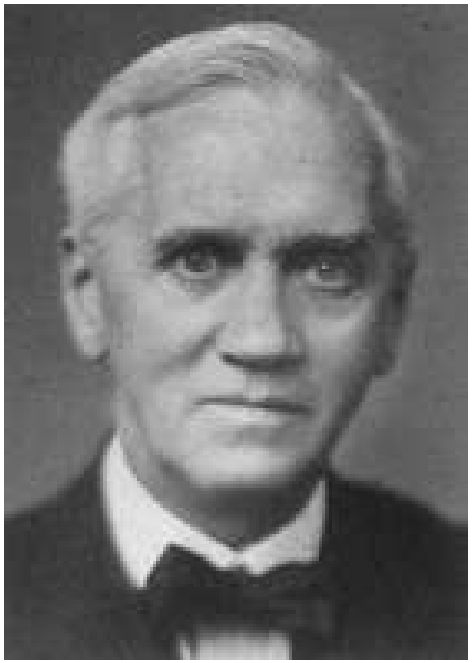
1927

Herman Muller discovers that radiation causes defects in chromosomes.

Biotechnology Timeline

1928

Sir Alexander Fleming discovers the antibiotic penicillin by chance when he realizes that Penicillium mold kills bacteria.



He shared the 1945 Nobel Prize in Medicine with Ernst Boris Chain and Sir Howard Walter Florey.

Biotechnology Timeline

1944

DNA is proven to carry genetic information

by Oswald Avery,

Colin MacLeod and Maclyn McCarty.

DNA model made out of LEGOs.

Biotechnology Timeline

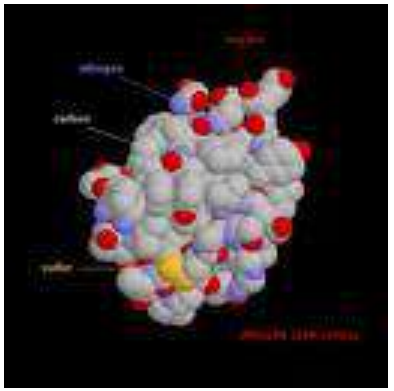
1953

James Watson
and Francis Crick describe
the double helical
structure of DNA. They shared
the 1962 Nobel Prize in
Medicine or Physiology with
Maurice Wilkins.

Biotechnology Timeline

1955

The amino acid sequence of insulin is discovered by Frederick Sanger.



3D model of insulin

Humulin®

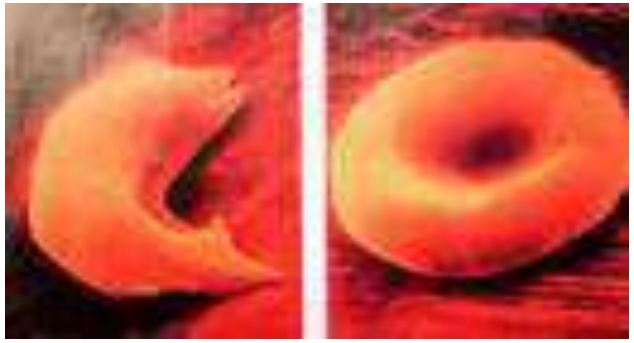
1982 Human insulin produced in genetically modified bacteria is the first biotech drug approved by the FDA.

Biotechnology Timeline

1958

- DNA is made in a test tube for the first time.

- Sickle cell disease is shown to occur due to a change in <u>one</u> amino acid.



Biotechnology Timeline

1966

The genetic code for DNA is cracked.

Three scientists shared the 1968 Nobel Prize in Physiology or Medicine for the discovery.

Marshall Nirenberg

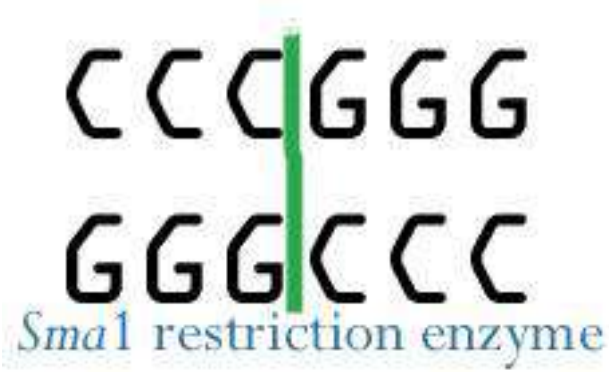
Robert Holley

Har Gobind Khorana

Biotechnology Timeline

1971

- The first complete synthesis of a gene occurs.
- Discovery of *restriction enzymes* that cut and splice genetic material very specifically occurs. This opens the way for gene cloning.



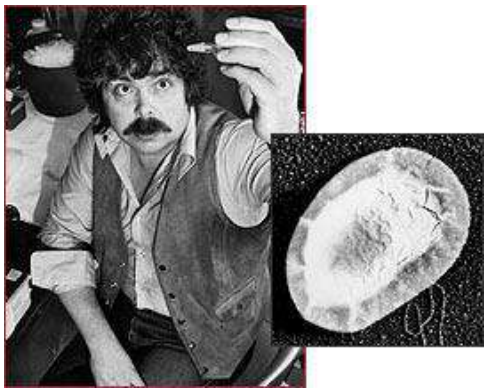
Biotechnology Timeline

1973

Stanley Cohen and Herbert Boyer perfect genetic engineering techniques to cut and paste DNA using restriction enzymes.

(1977 sees the first expression of a human gene in bacteria.)

Stanley Cohen



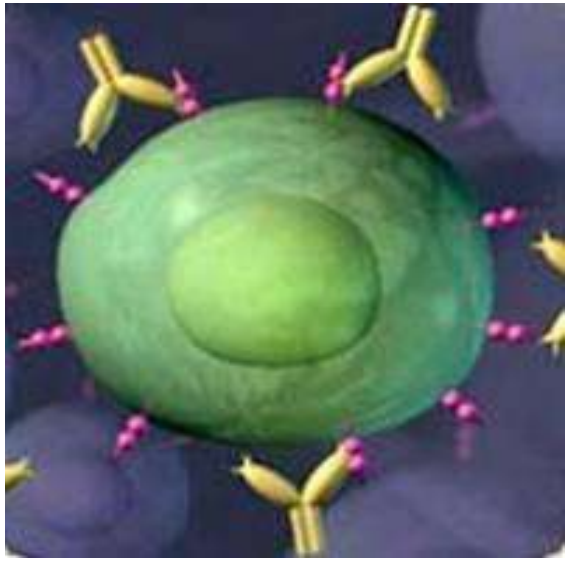
Herbert Boyer and a recombinant bacterium

Cohen won a Nobel Prize in 1986 for an unrelated discovery!

Biotechnology Timeline

1975

Georges Kohler and Cesar Milstein develop the technology to produce monoclonal antibodies — highly specific, purified antibodies derived from only one clone of cells that recognize only one antigen. They shared the 1984 Nobel Prize in Physiology or Medicine with Neils Jerne.



Biotechnology Timeline

1981

The first *transgenic animals* are produced by transferring genes from other animals into mice.

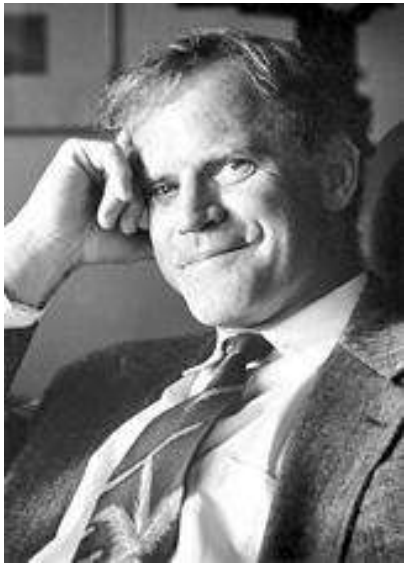
The first patent for a genetically modified organism is granted — for bacteria that can break down crude oil.

Biotechnology Timeline

1983

The polymerase chain reaction (PCR) technique, which makes unlimited copies of genes and gene fragments, is conceived.

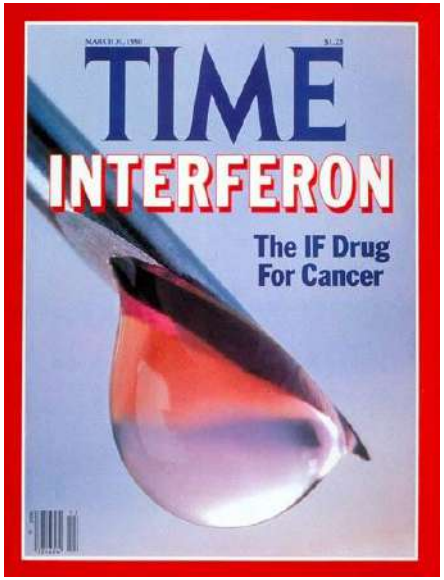
Kary Mullis, who was born in Lenoir, N.C., wins the 1993 Nobel Prize in Chemistry for the discovery. He became interested in science as a child when he received a chemistry set for Christmas.



Biotechnology Timeline

1986

First recombinant vaccine is approved for human use: hepatitis B.



First anti-cancer drug is produced through biotech: interferon.

Biotechnology Timeline

1987

First approval for field tests of a genetically modified food plant:

virus-resistant tomatoes.

1994 Genetically modified tomatoes are sold in the U.S. for the first time.

Biotechnology Timeline

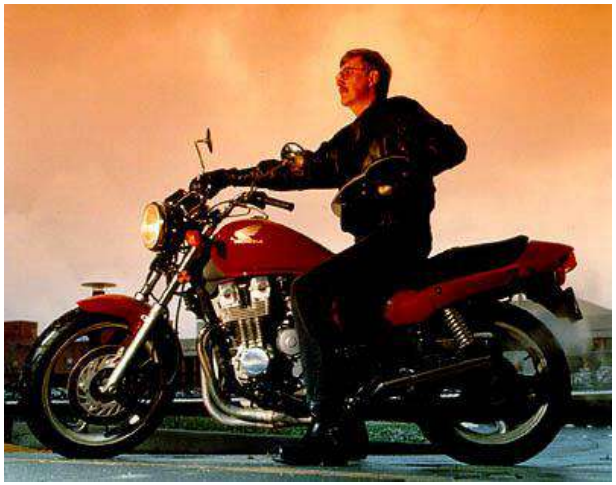
1990

The Human Genome Project — an international effort to maps all of the genes in the human genome — is launched.

2002 The draft version of the human genome is published.

Francis Collins, M.D., Ph.D.

Director, Human Genome Project



Biotechnology Timeline

1997

Scientists report the birth of Dolly, the first animal cloned from an adult cell.

Dolly (1996-2003) as an adult

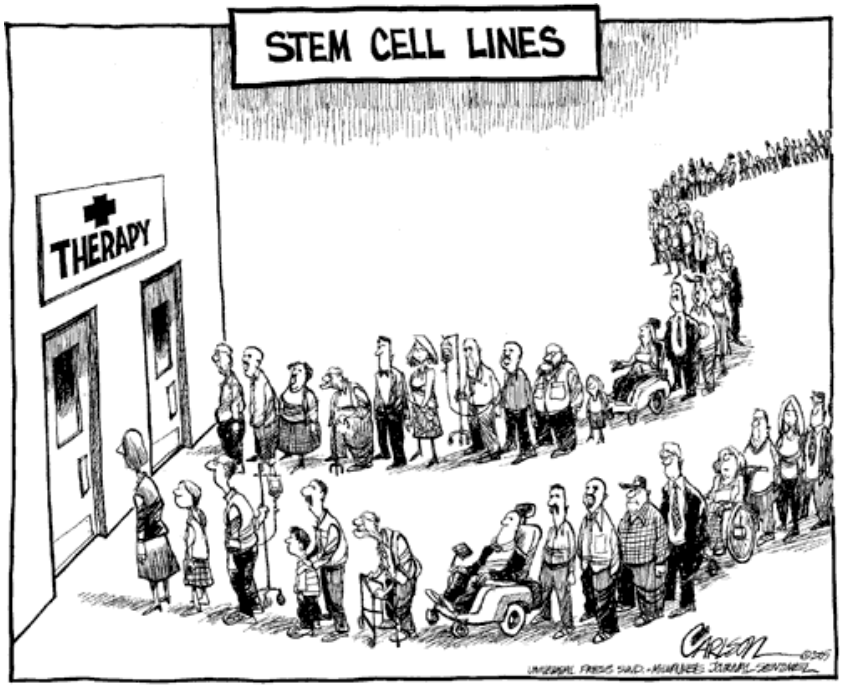
Dolly and her surrogate mother

Biotechnology Timeline

1998

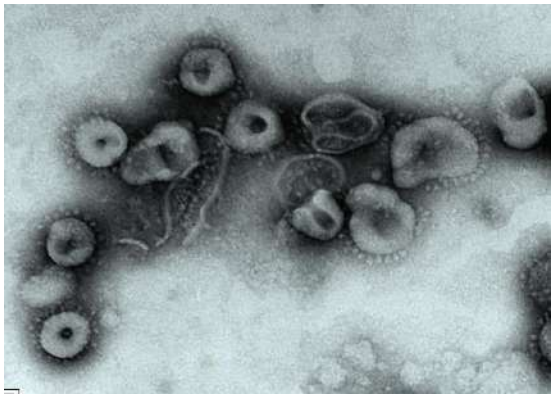
Human embryonic stem cell lines are established.

They offer hope to many because they may be able to replace diseased or dysfunctional cells.



Biotechnology Timeline

2003



The SARS (severe acute respiratory syndrome) virus is sequenced <u>three weeks</u> after its discovery.

SARS, which began in China, spreads quickly — and spreads fear throughout the Far East and the world. The last reported cases occurred in 2004 and resulted from laboratory-acquired infections.

Biotechnology Timeline

2004

The first cloned pet — a kitten — is delivered to its owner.

She is called CopyCat (or Cc for short).

Biotechnology Timeline

2006

A recombinant vaccine against human papillomavirus (HPV) receives FDA approval.

The virus causes genital warts and can cause cervical cancer.