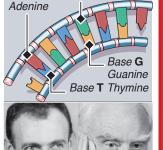


isolates nucleic acids

■ 1929: Phoebus Levene's study of nucleic acids shows four-letter code of DNA Base A Base C Cytosine



■ 1953: James D. Watson and Francis Crick use x-ray defraction data to propose spiral double helix structure of DNA

■ 1958-66. Genetic code cracked: Discovery that DNA's four-letter code can produce all 20 amino acids building blocks of proteins

■ 1968: Restriction enzymes - which can slice up DNA - isolated

■ 1977: Frederick Sanger develops techniques to sequence DNA molecules

■ 1985: Polymerase Chain Reaction invented. PCR enables unlimited copies of single DNA molecule

Quest for the "Book of Life"

Ten years ago this month, in what was heralded as the start of a new era in human biology and medicine, two rival teams of scientists published their first drafts of the human genome - the 25,000 genes that make up the blueprint for a human being

1990: *Human Genome Project* begins 🚣 with aim of decoding all 3 billion DNA base pairs that comprise 23 pairs of chromosomes found in every cell 1994: First genetically modified food,











2000

2005

ENTIRE SAMPL

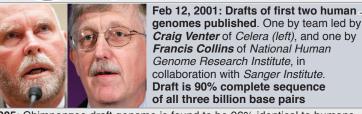
FlavrSavr tomato, goes on sale in U.S. 1996: Dolly the Sheep is first

mammal to be cloned 1998: Craig Venter founds Celera

Genomics and applies faster "shotgun" cloning method to sequence genome



COCCESSION OF THE COLOMBIA 1999: First human chromosome decoded. International team of over 200 researchers led by British-based Sanger Institute sequences chromosome 22 second smallest human chromosome



Francis Collins of National Human Genome Research Institute, in collaboration with Sanger Institute. Draft is 90% complete sequence of all three billion base pairs

2005: Chimpanzee draft genome is found to be 96% identical to humans. 2008: 1000 Genomes Project launched to sequence 2,500 whole

human genomes by end of 2012. 185 sequenced to date



2010: Researchers produce entire . Neanderthal genome from bones over 40,000 years old. Team concludes that 2% of genome of present-day humans was inherited from Neanderthals

2015: Goal set by Obama administration _ for cutting cost of decoding personal genome from \$50,000 today to \$1,000.

As more people have their genomes decoded, roots of genetic disease may eventually be understood and treatments developed

2010

2015