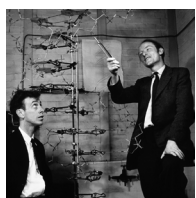


1950
1960
1970
1980
1990
2000
2010
2020

1953 - Watson and Crick propose model of double-stranded DNA



1956 - 46 human chromosomes counted



1950-60's - Central Dogma of molecular biology

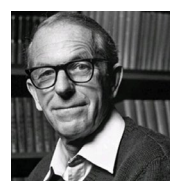
1970 - First restriction endonuclease enzyme reported by Wilcox and Smith

1974 - First description of a nucleosome as the repeating structural subunit of chromatin

1975 - Asilomar Conference addresses ethical issues related to recombinant DNA experiments

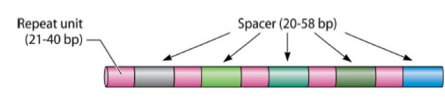
1977 - Fred Sanger describes method of sequencing DNA using dideoxy-nucleotide chain terminators

1970's - DNA cloning and genetic engineering



1983 - Kary Mullis Polymerase Chain Reaction technique to exponentially copy a particular DNA sequence

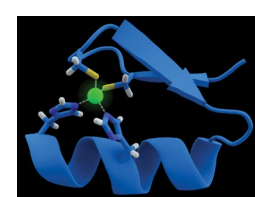
1987 - Pattern of short palindromic repeats reported in E.coli



1993 - Zinc finger proteins described

1993 - Near perfect palindromic repeats of CRISPR reported in salt-tolerant microbes

1998 - Polydactyl Zinc Fingers modified to target different double-stranded DNA sequences



2003 - An international research project to determine the nucleotide sequence of human genome.

2005 - CRISPR sequences reported to contain foreign DNA suggesting an adaptive immune system



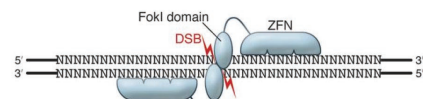
2007 - CRISPR provides acquired resistance against viruses in prokaryotes

2008 - CRISPR system cuts DNA of foreign pathogens



2010 - Transcription Activator Like Effector Nuclease Proteins (TALENs) used to target DNA sequences

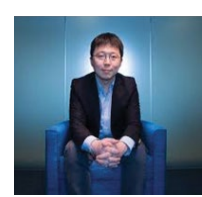
2012 - Charpentier and Doudna describe single-guide RNA



2013 - Targeting CCR5 in HIV-AIDS patients with ZFNs

2013 - Addgene distributes CRISPR reagents to 25,000 labs over next 3 years

2013 - Feng Zhang and others modifies CRISPR to edit mammalian genomes



2014 - The molecular structure of CRISPR Cas9 is reported by Jennifer Doudna's group

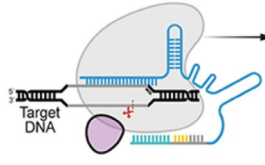


2015 - Asilomar 2 addresses ethical issues related to genome engineering

2016 - Programmable base editing in genomic DNA without double-stranded DNA cleavage



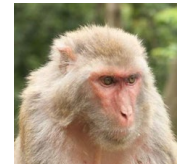
2019 - Prime editing without double-strand breaks or donor DNA



2020 - Nobel Prize in Chemistry to Jennifer Doudna and Emmanuelle Charpentier



2020 - CRISPR-Cas12-based detection of SARS-CoV-2



2021 - In vivo CRISPR base editing of PCSK9 durably lowers cholesterol in primates

2021 - CRISPR-Cas9 gene editing for sickle cell disease and beta-thalassemia

