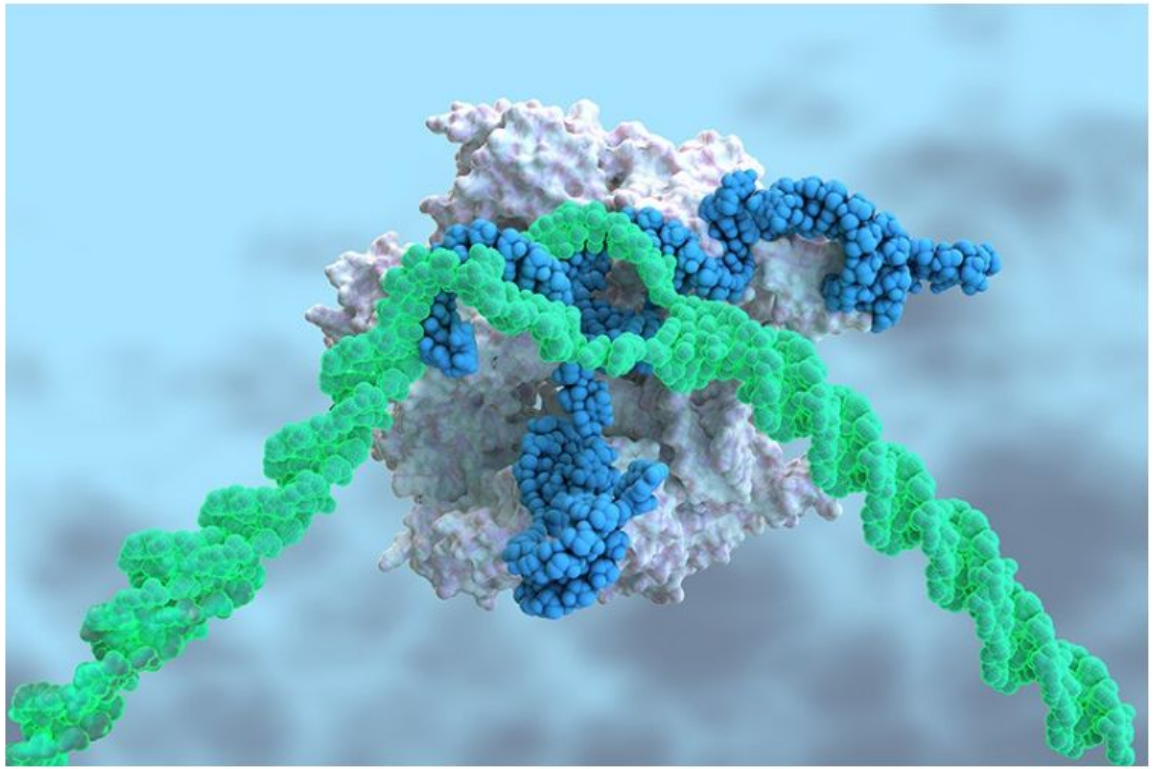


The CRISPR–Cas9 complex (white and blue) can cut DNA (green), disabling genes that cause disease. Credit: Ella Maru Studio/Science Photo Library

Why CRISPR technology is the greatest scientific breakthrough of the XXIst century

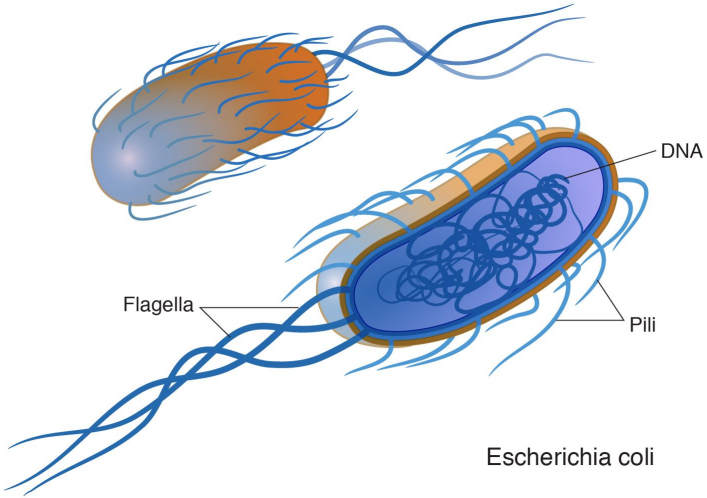
zacharielt@, May 2022, Sonoma CA

CRISPR - Clustered Regularly-Interspaced Short Palindromic Repeats of Bacterial DNA / RNA

Clustered Regularly-Interspaced

Short *Palindromic* Repeats

- CRISPR Sequences were first discovered in bacteria like e-Coli.
- **Spacer DNA** sequences are unique and of various length.



ACG*GCA*-TGGATTCA-**ACG*GCA***-GGTCCGTA-**ACG*GCA***-AATGGACA

Where do the spacer DNA sequences come from?

- Discovery: SPACER DNA Sequences perfectly match **bacteriophages'** DNA sequences

- **Bacteriophages** are virus that prey on Bacteria

- Essentially the spacer DNA sequences are used by the bacteria as a memory of the DNA of predatory viruses that they have been infected with

➢ CRISPR is an immune system that remembers the identity of viruses

CRISPR - CAS i

- CRISPR Sequences are always associated with a set of genes that edit the genetic sequences. These genes are called CRISPR Associated → CAS

- Those CAS proteins perform useful functions in editing genetic sequences.
  - Helicases → Unwind DNA
  - Nucleases → Cut DNA

{CAS GENE i,ii,iii} - ACG*GCA*-TGGATTCA-ACG*GCA*-GGTCCGTA

In **2012**, Jennifer Doudna & Emmanuel Charpentier publish a landmark article in Science

Science

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RESEARCH ARTICLE

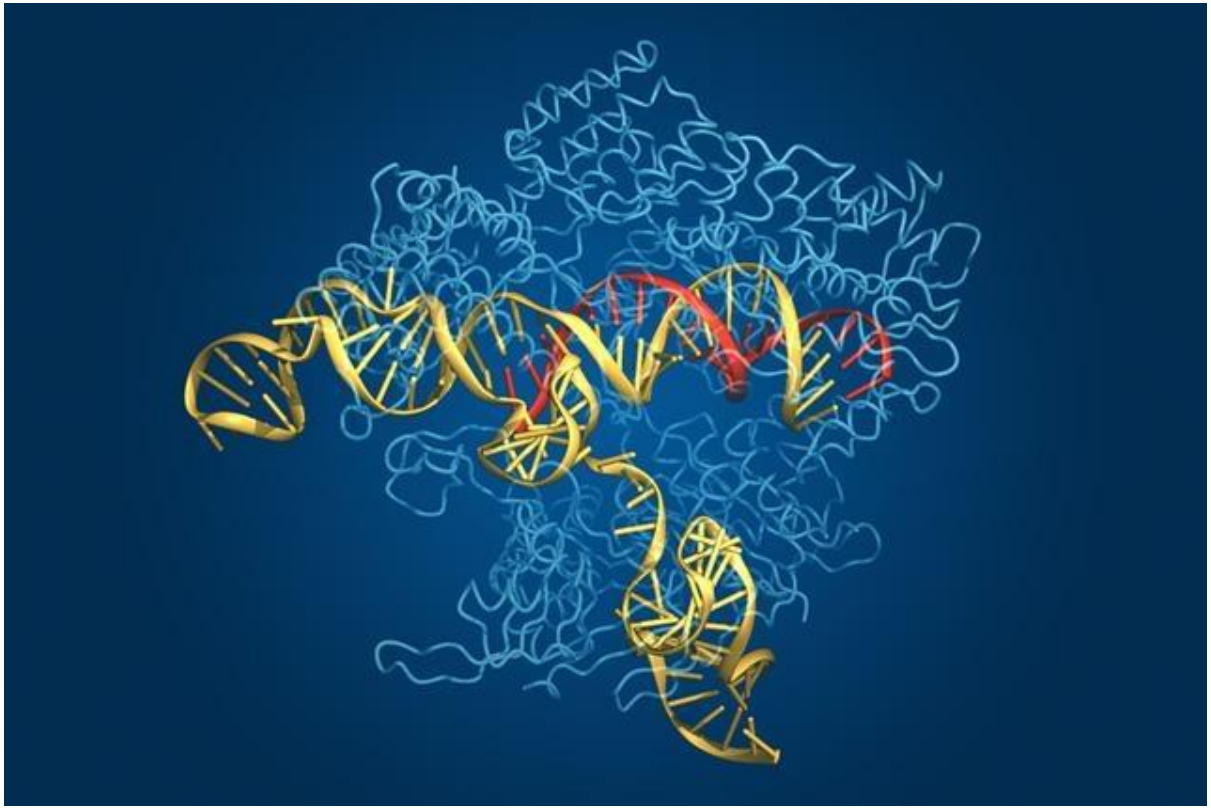
A Programmable Dual-RNA–Guided DNA Endonuclease in Adaptive Bacterial Immunity

MARTIN JINEK, KRZYSZTOF CHYLINSKI, INES FONFARA, MICHAEL HAUER, JENNIFER A. DOUDNA , AND , EMMANUELLE CHARPENTIER Authors Info & Affiliations

SCIENCE • 28 Jun 2012 • Vol 337, Issue 6096 • pp. 816-821 • DOI: 10.1126/science.1225829

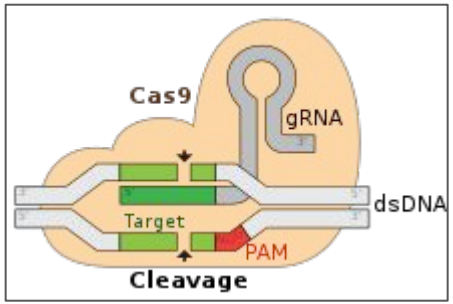
55,514 8,272

What does the CRISPR Complex looks like?



This image of the Cas9 Complex depicts the Cas9 protein (in light blue), along with its guide RNA (yellow), and target DNA (Red).

Source: MIT News, 2014.



Nov 2018: He Jianku, a researcher at the Southern University of Science in Shenzen announces to the world the birth of two babies whose genome was edited using CRISPR.

CRISPR-Cas9 Gene Editing for Sickle Cell Disease and β-Thalassemia

Haydar Frangoul, M.D., David Altshuler, M.D., Ph.D., M. Domenica Cappellini, M.D., Yi-Shan Chen, Ph.D., Jennifer Domm, M.D., Brenda K. Eustace, Ph.D., Juergen Foell, M.D., Josu de la Fuente, M.D., Ph.D., Stephan Grupp, M.D., Ph.D., Rupert Handgretinger, M.D., Tony W. Ho, M.D., Antonis Kattamis, M.D., et al.

January 21, 2021
N Engl J Med 2021; 384:252-260
DOI: 10.1056/NEJMoa2031054
Chinese Translation 中文翻译

Summary

Sickle Cell Disease is the largest genetic disease in the world with an estimated 25 Million people affected worldwide.

How CRISPR is transforming drug discovery

Gene editing is quietly revolutionizing the search for new drugs.

Andrew Scott

https://allianceforscience.cornell.edu/blog/2022/01/5-ways-gene-editing-is-making-crops-climate-resilient/

5 ways gene editing is making crops climate-resilient

1. Enhancing drought-tolerance
2. Disease management
3. Increasing yields
4. Surviving soil salinity
5. Fighting weeds

BY JOSEPH MAINA

JANUARY 11, 2022

CARIBOU BIOSCIENCES

Caribou Biosciences Announces Positive Initial Data for CB-010 Anti-CD19 Allogeneic CAR-T Cell Therapy

May 12, 2022 10:00 ET | Source: Caribou Biosciences, Inc.

CRISPR enabled gene editing is accelerating the development of Immunotherapies against many forms of cancer.

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NEWS | 29 June 2021

Landmark CRISPR trial shows promise against deadly disease

Administering gene-editing treatment directly into the body could be a safe and effective way to treat a rare, life-threatening condition.

Heidi Ledford

In **2020**, Doudna & Charpentier shared the **Nobel Prize in Chemistry** for Developing CRISPR Technology

The Nobel Prize in Chemistry 2020

© Nobel Prize Outreach. Photo: Bernhard Ludewig

Emmanuelle Charpentier

Prize share: 1/2

© Nobel Prize Outreach. Photo: Brittany Hosea-Small

Jennifer A. Doudna

Prize share: 1/2

Emmanuelle Charpentier's Nobel Lecture:

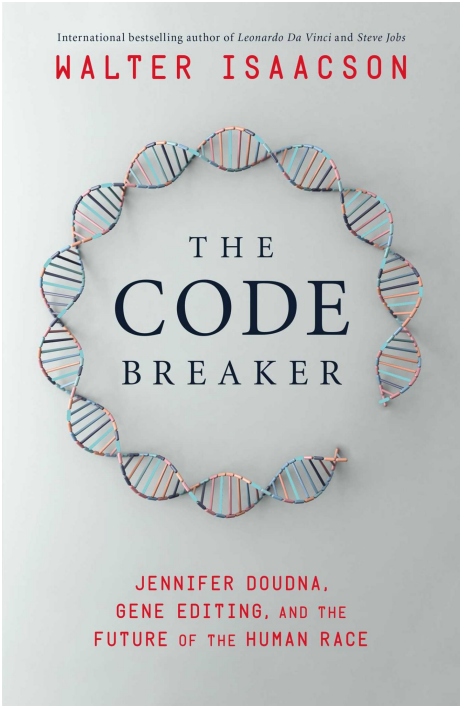
https://youtu.be/3POrtQEpV2s

Jennifer Doudna's Nobel Lecture:

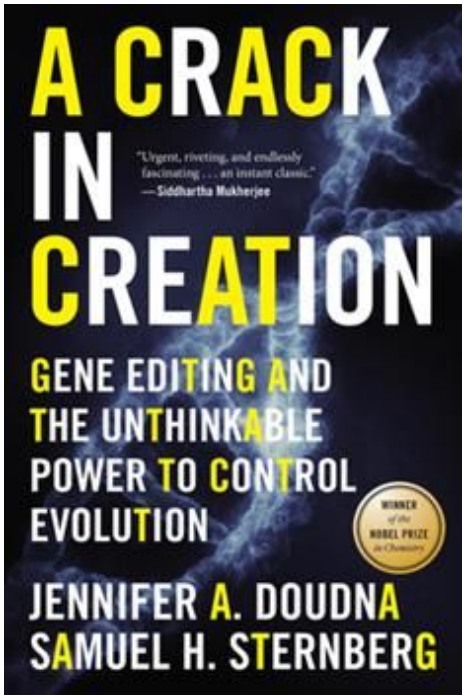
https://youtu.be/KSrSIErIxMQ

The Nobel Prize in Chemistry 2020 was awarded jointly to Emmanuelle Charpentier and Jennifer A. Doudna "for the development of a method for genome editing."

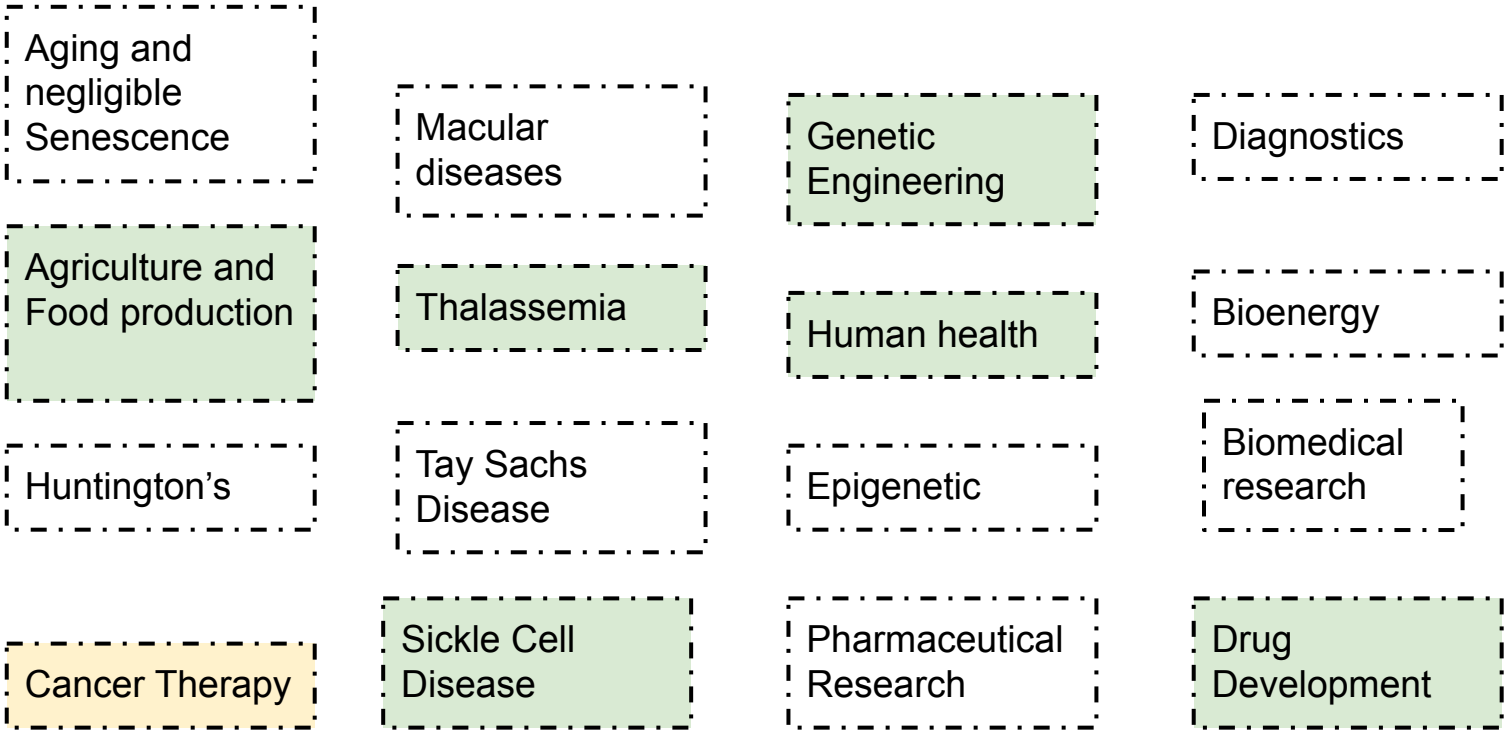
To learn more about CRISPR



The history of the discovery of CRISP by Walter Isaacson



The technology of CRISPR by Doudna & Sternberg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Tay Sachs Disease
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