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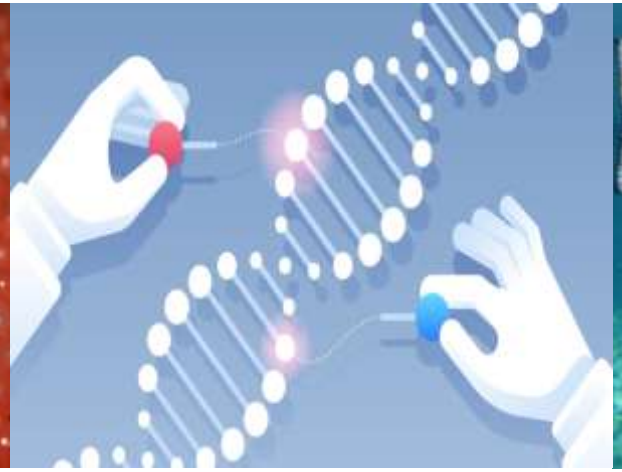
Genome editing - what is it about?

Diego Robledo

EFFAB and FABRE TP seminar on genome editing, 26th April 2022

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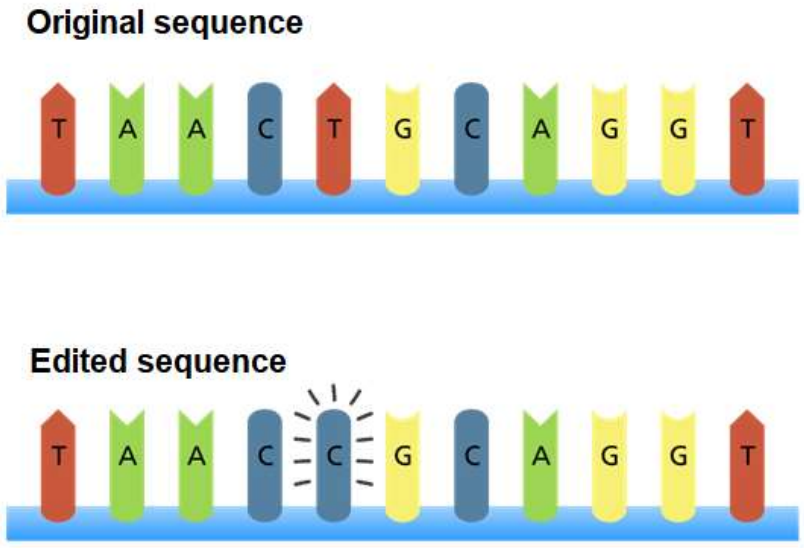
What is genome editing?

Targeted changes to the DNA of a cell

The DNA is formed by > 500,000,000 pieces



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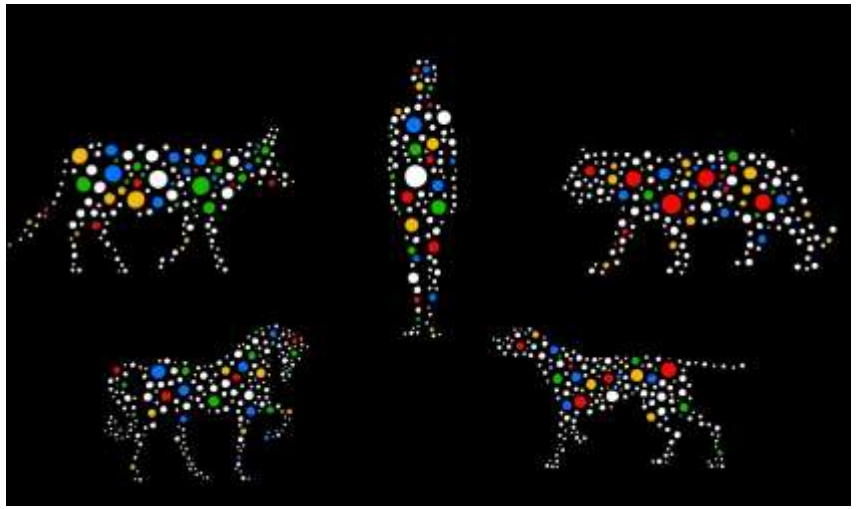
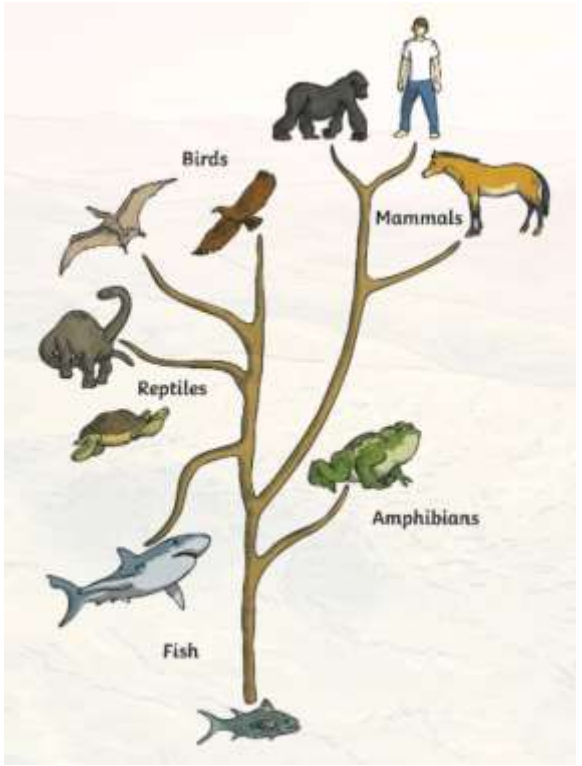
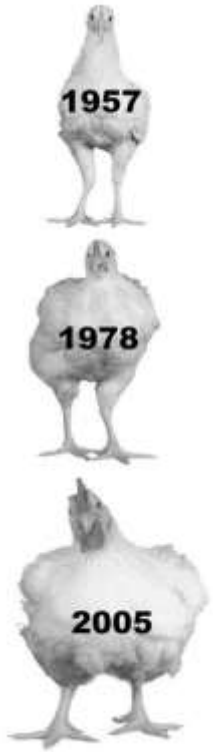
What is genome editing?

DNA changes occur naturally within our cells



Substrate of evolution and selection





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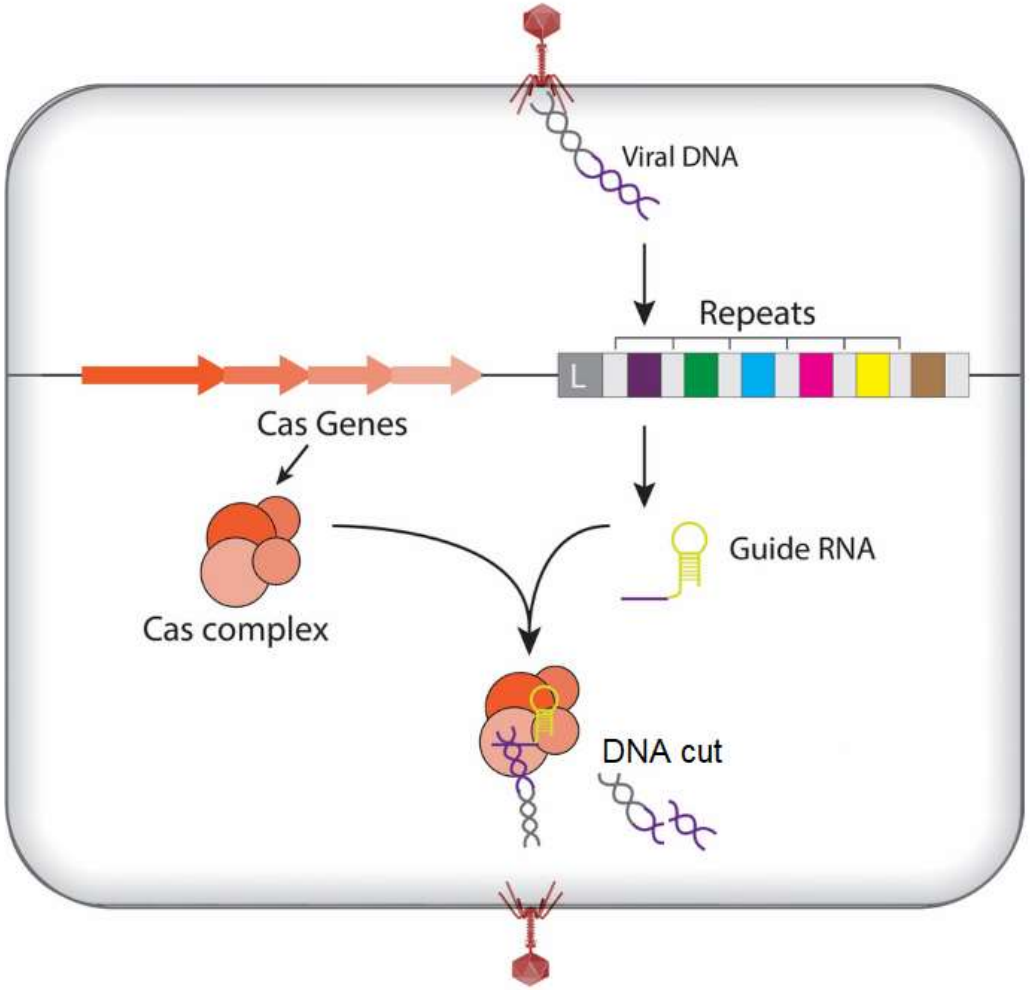
The origin of CRISPR-Cas systems

- **Where?** **Present in 50% of bacteria**
- **What?** **Defence mechanism against virus**
- **How?** **Natural DNA “scissors”**

Francisco Mojica – Discoverer of CRISPR.
Credit: Manuel Castells



Adapted from Golkar (2020) 10.1007/s13258-020-01002-x

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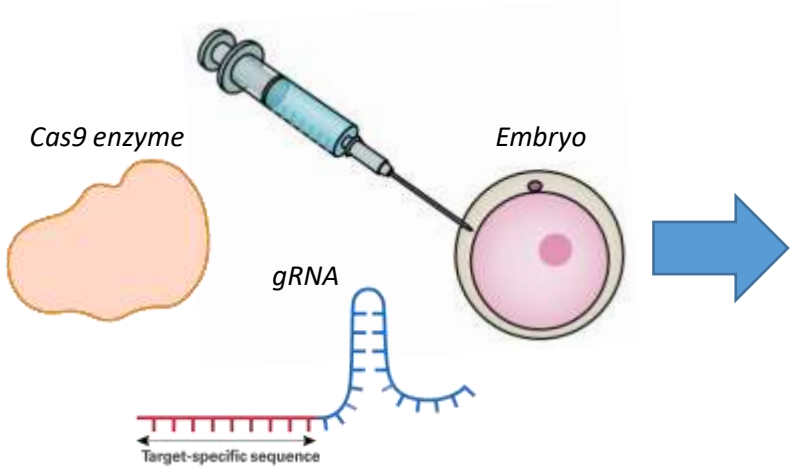
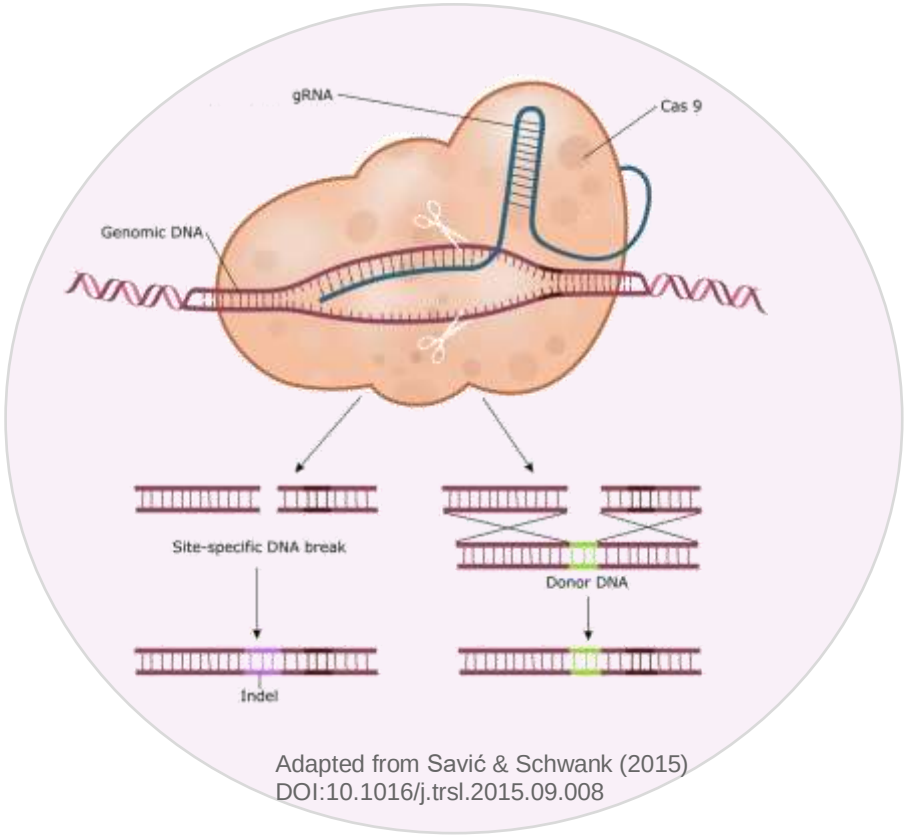
How does CRISPR-Cas genome editing work?

System repurposed to target specific DNA sequences / genes

Injection of Cas9 and guide RNA for the gene of interest into one-cell embryos





Adapted from Savić & Schwank (2015)
DOI:10.1016/j.trsl.2015.09.008

Jennifer Doudna and Emmanuelle Charpentier - 2020 Nobel chemistry prize. Credit: Alexander Heinel/Picture Alliance/DPA

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The potential of genome editing

- Ability to improve ANY trait
- Not limited to existing genetic variation

Hornless cattle

Fast-growing sea bream

PRRS virus resistant pigs

Benefits for:

- Food security
- Animal welfare
- Environment
- Human health

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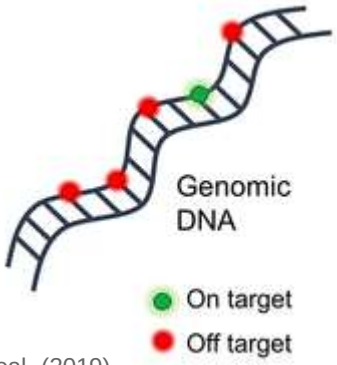
The challenges of genome editing

- **Find the right piece of DNA to edit among 500,000,000 – 3,000,000,000 pieces**

Although generally focused on genes, there are still 20,000-25,000 genes in each species

- **Off targets – can be assessed and controlled**



Adapted from Park & Beal (2019)
DOI: 10.1021/acs.biochem.9b00573

- **Interactions with wild populations and genetic diversity – RAS and sterility**

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Communicating genome editing to the general audience

Key positive messages:

- **Feed the world – availability and affordability of food**
- **Improve animal welfare – disease resistance and other traits**
- **Reduce environmental impact – less feeds or disease treatments**
- **Improve human health – reduce antibiotic use (AMR) and improve nutritional profile**

Key counter-arguments:

- **Targeted small changes that can occur naturally**
- **Impacts on wild populations can be fully avoided**

These two pictures differ in 1 of 200,000 pixels

Genome editing changes 1 in 1,000,000,000 DNA pieces

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Thank you

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