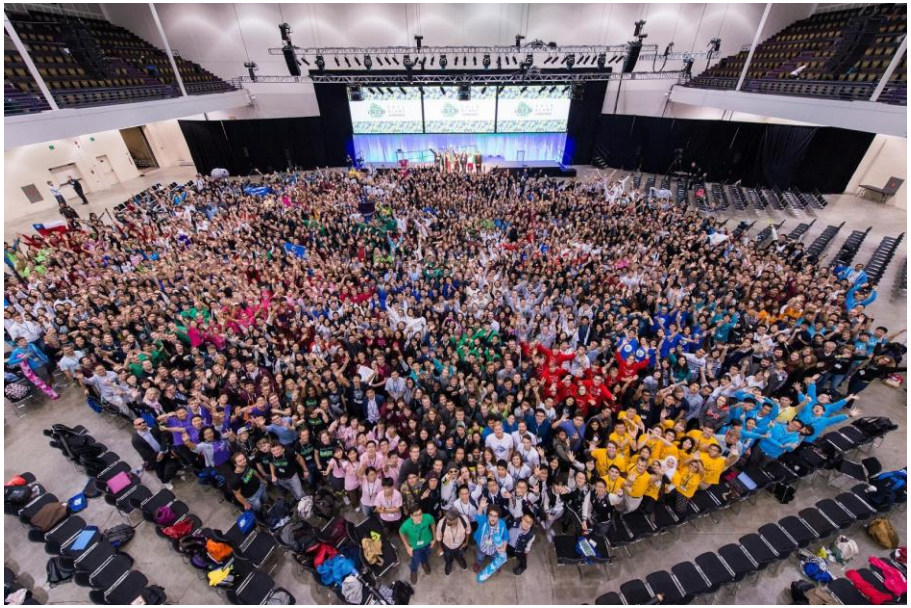
CRISPR-Cas System

Team NUS_Singapore-Sci
15th October 2018

What is iGEM

- The premiere synthetic biology competition for students all over the world.
- Present in October in **Boston, USA**



Our Team

CONTENT

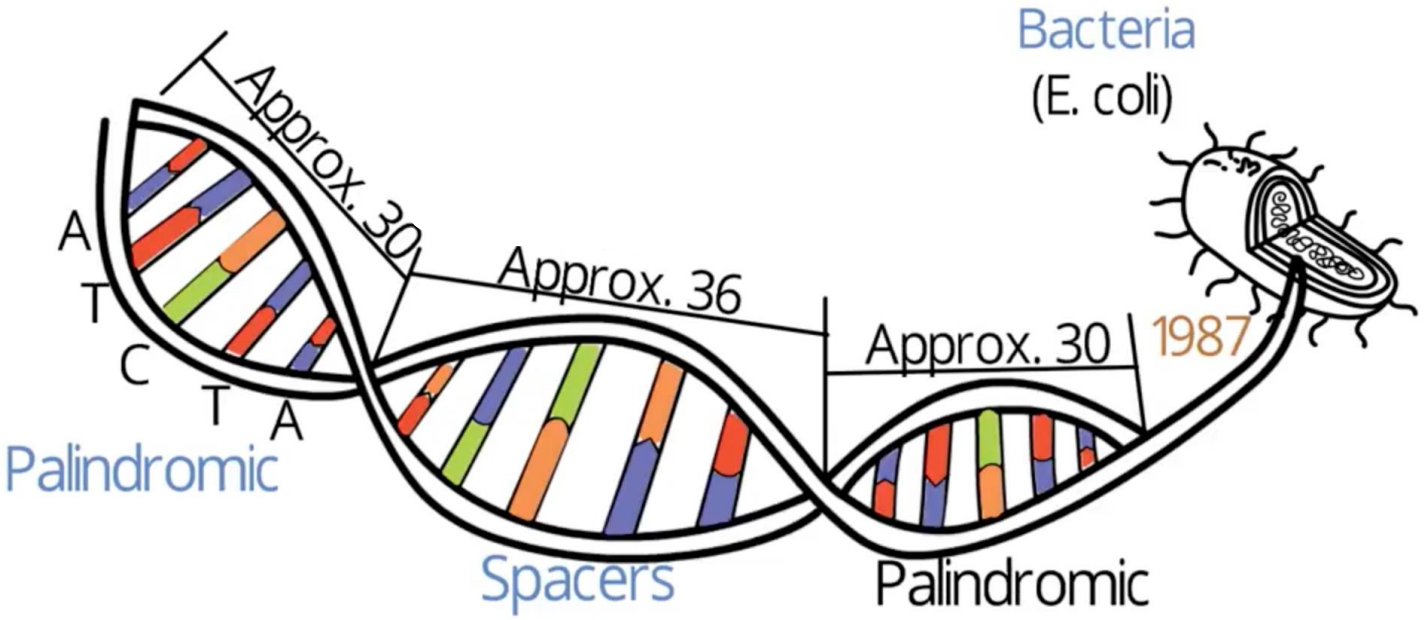
1. The discovery of CRISPR
2. Natural function of CRISPR
3. Application of CRISPR-Cas system
    - Gene editing and beyond
    - Case Study
    - Nucleic acid detection
    - RNA editing
4. Ethical Issues on gene editing

Discovery of CRISPR

1987

Japanese scientist discovered palindromic sequences separated by spacer in bacteria E.Coli

They did not know the function



Discovery of CRISPR

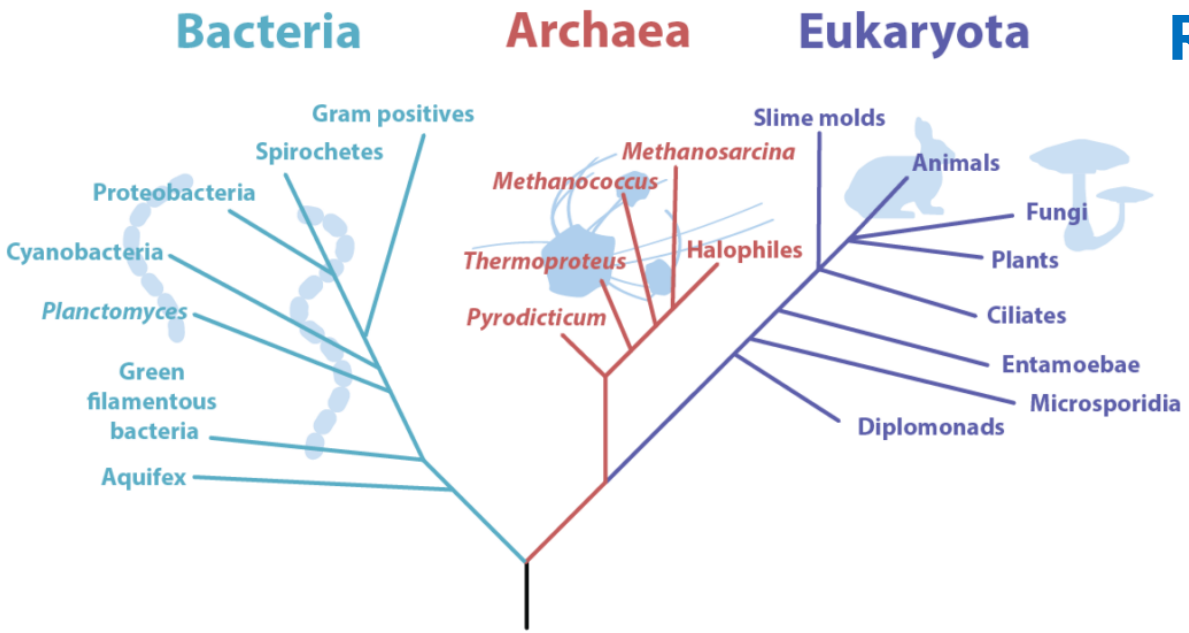
1990

Fransico Mojica discovered same palindromic sequences separated by spacer in Archaea

If both **Bacteria** and **Archaea** have..

must be something **important!**

Named
Clustered
Regular
Interspaced
Short
Palindromic
Repeats

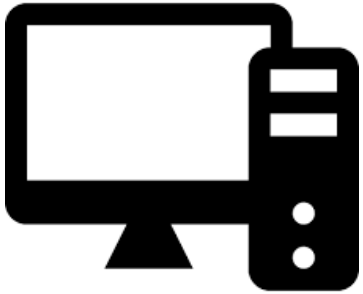


Discovery of CRISPR

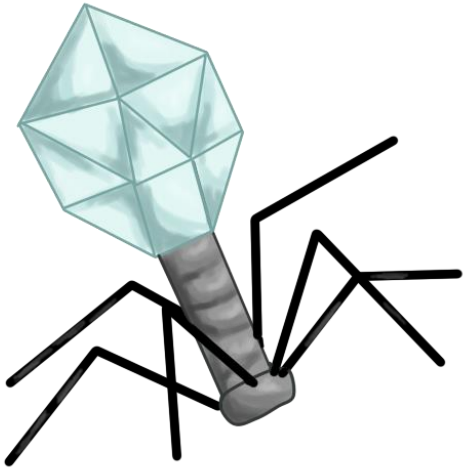
1990: Fransico Mojica

Why?
Protect bacteria against virus

Archaea spacer sequence



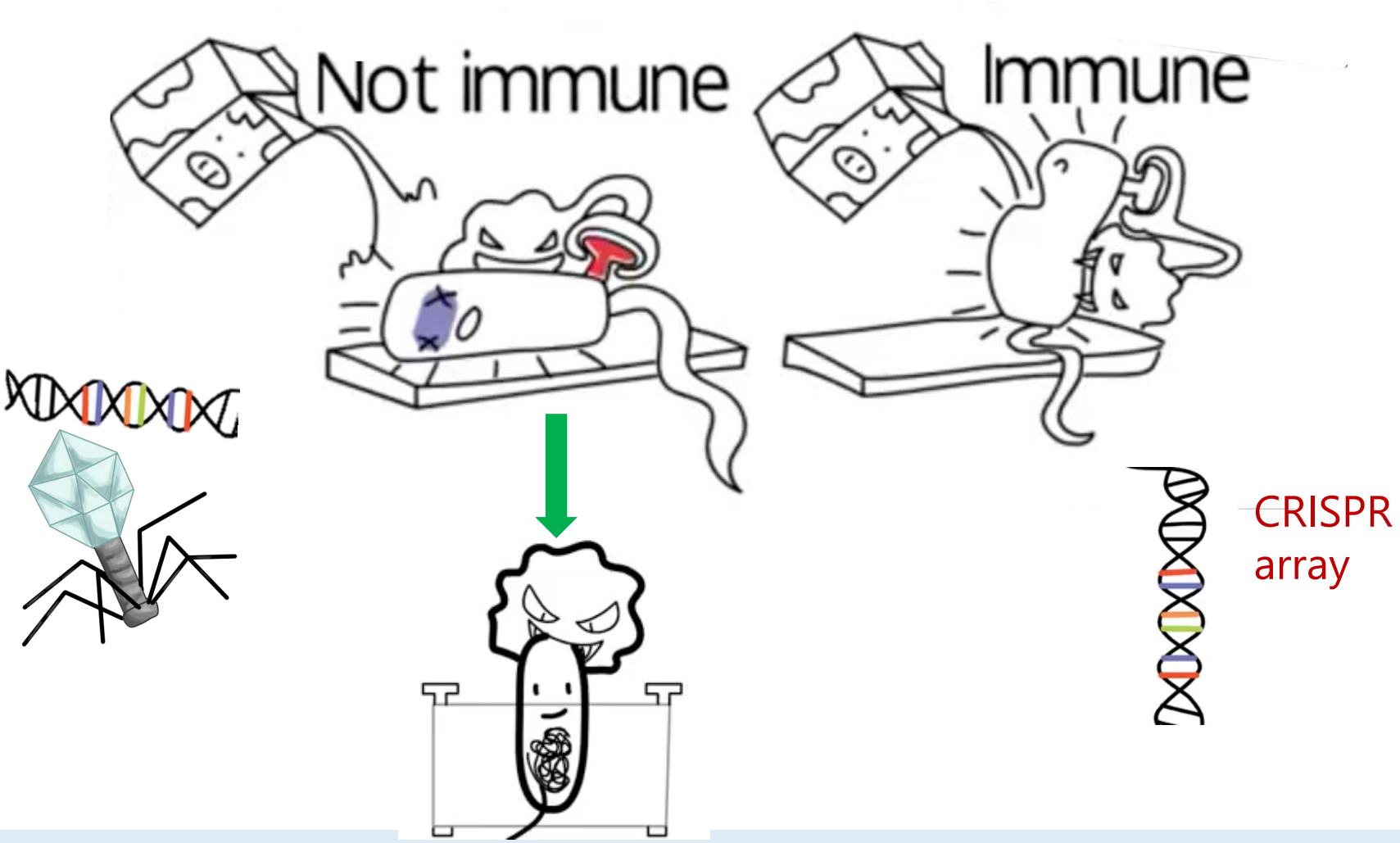
BLAST: search for similar DNA sequence in other organism



Virus

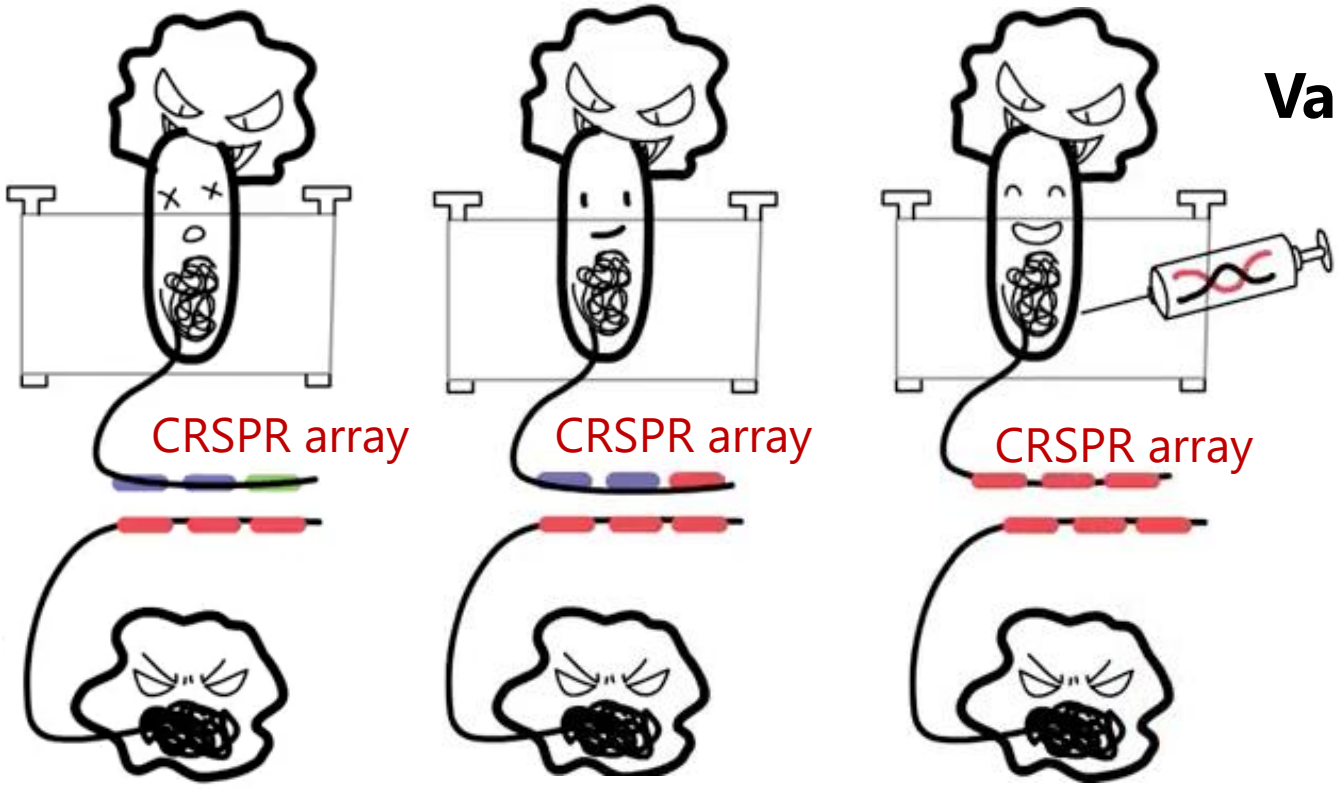
Discovery of CRISPR

2006: Discovery in yogurt factory

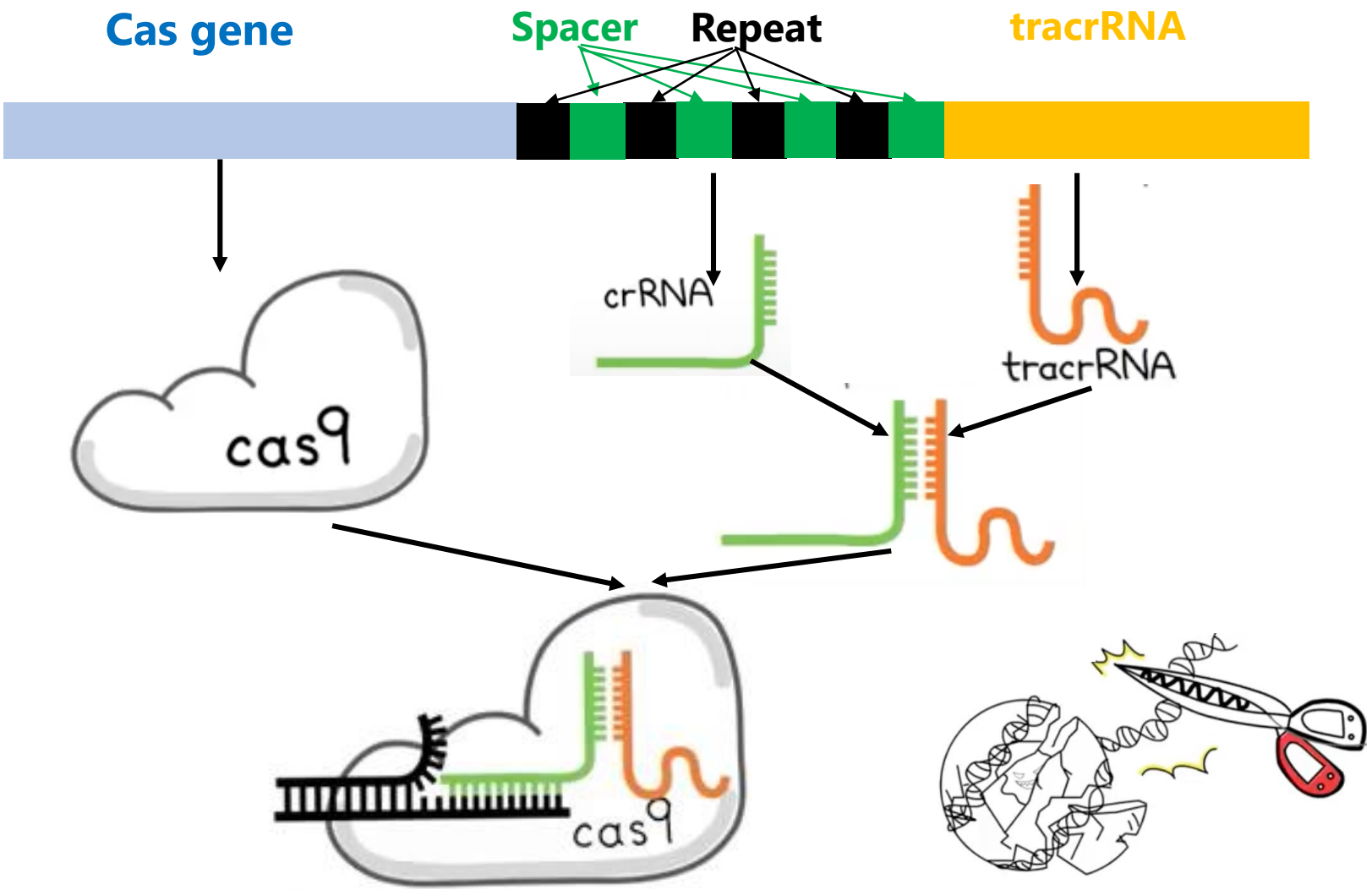


Discovery of CRISPR

2006: Discovery in yogurt factory

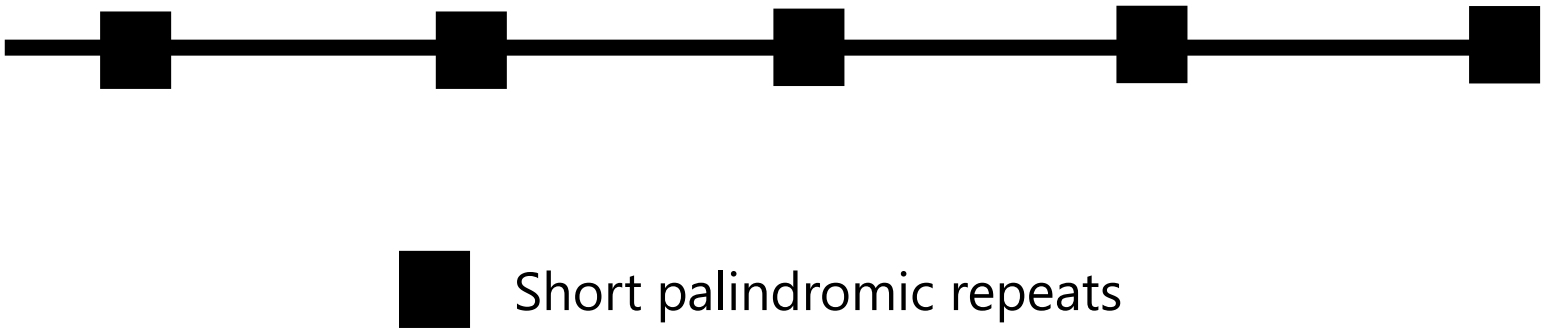


Discovery of CRISPR: Full CRSPR system



How does CRISPR help bacteria to defend against viral infection

- **C**lustered **R**egularly **I**nterspaced **S**hort **P**alindromic **R**epeats



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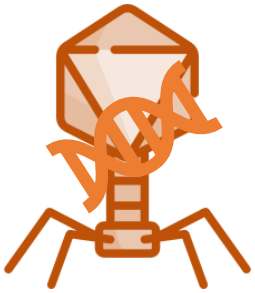

Short palindromic repeats

How does CRISPR help bacteria to defend against viral infection

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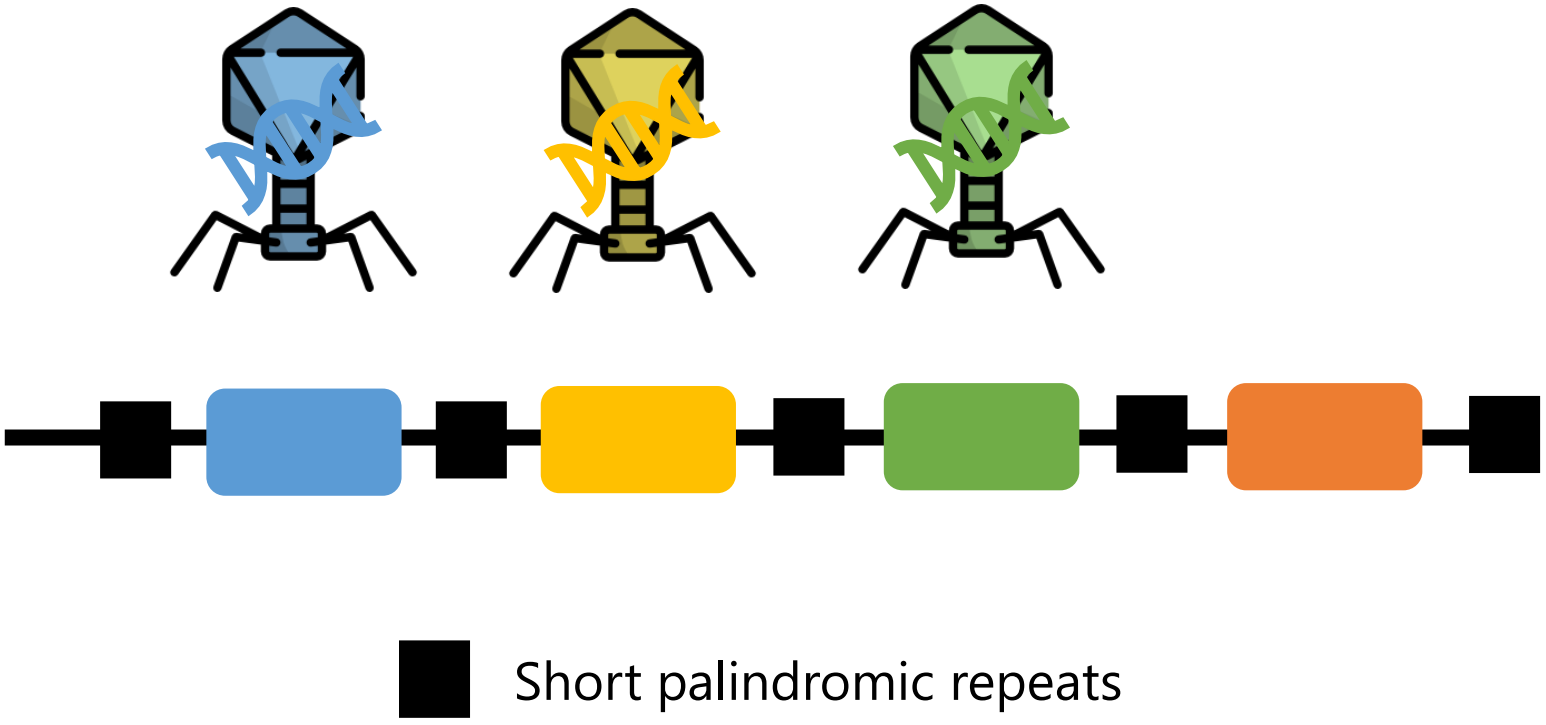

How does CRISPR help bacteria to defend against viral infection

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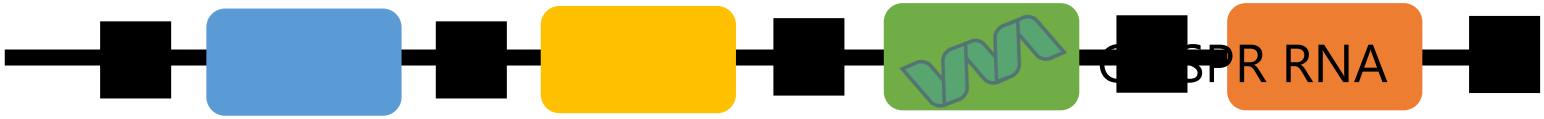


Short palindromic repeats

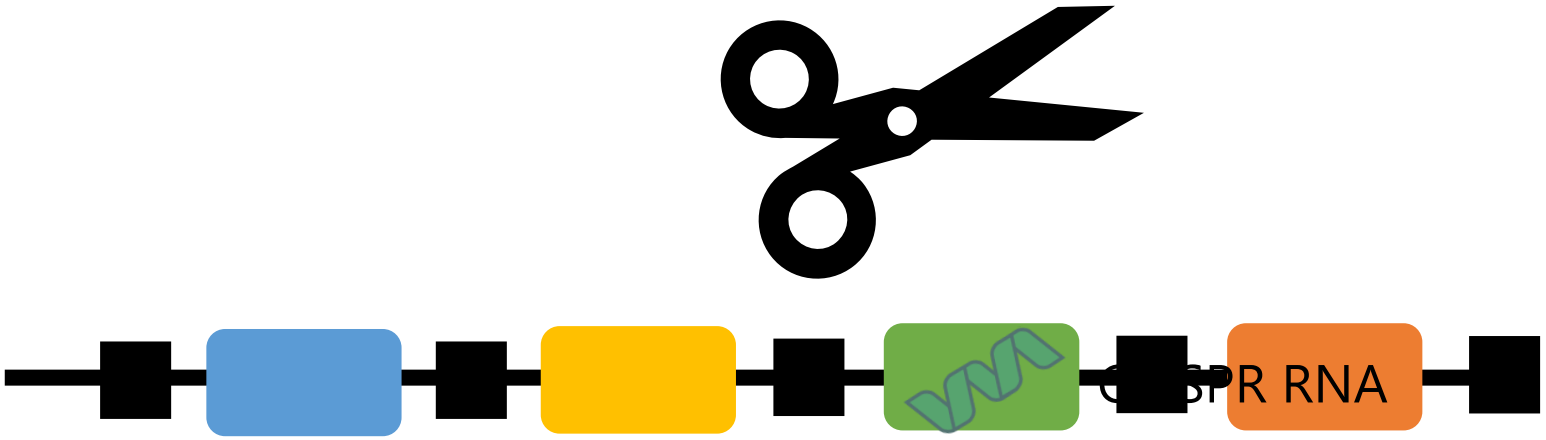
But… how does it defend against the viral infection?

Introducing…

Cas9

Cas9

- **C**RISPR-**as**sociated protein **9**
- **RNA guided** DNA endonuclease enzyme



Cas9

- **C**RISPR-**as**sociated protein **9**
- RNA guided **DNA endonuclease** enzyme

Cas9 acts as molecular scissors to cleave DNA strands

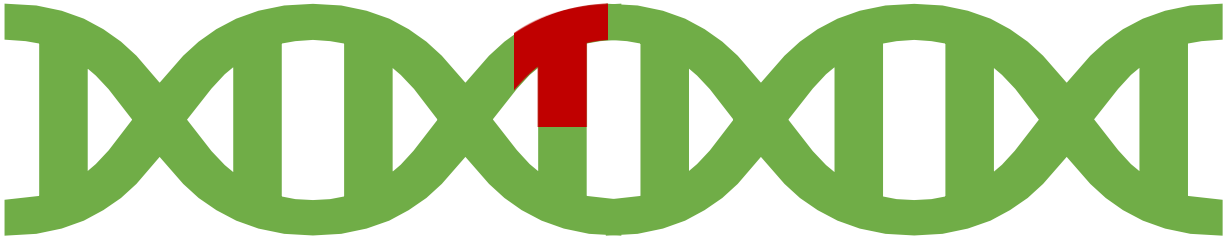
What is dCas9?

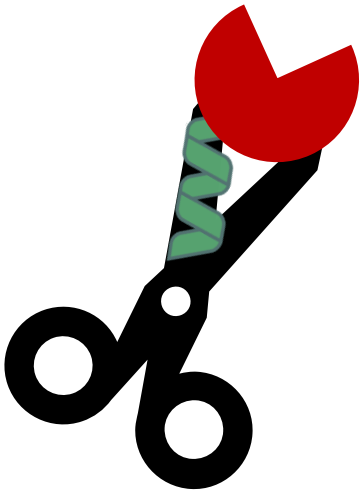
dCas9

What about dCas?

CRISPR-Cas genome editing and Beyond? (1:37)

Changing CRISPR/dCas for Base Editing





Applications of CRISPR/Cas System and its Potential

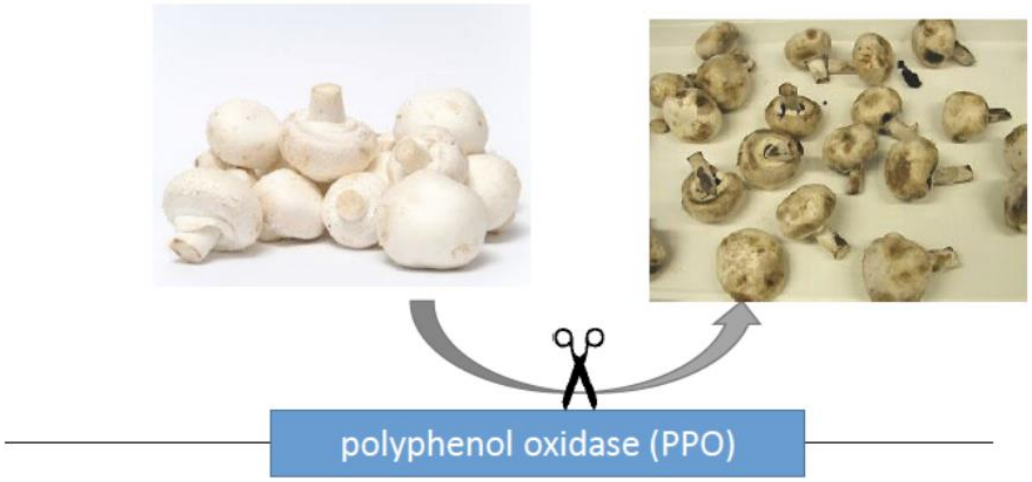
Genetic Engineering Will Change Everything Forever – CRISPR (6:35-7:53)

Gene Editing Misconceptions and Ethical Concerns

CRISPR not consider as GMO?

NATURE | NEWS

Gene-edited CRISPR mushroom escapes US regulation



- Polyphenol oxidase (PPO) causes browning of mushrooms during storage
- CRISPR to introduce mutations to 1 out of 6 *PPO* genes
- 30% reduced activity
- Prolonged storage time

Waltz, Nature 2016

NATURE | NEWS

Gene-edited CRISPR mushroom escapes US regulation

- US Department of Agriculture (USDA) will not regulate a CRISPR modified mushroom ("*No foreign DNA present*")
- Cultivated and sold without passing through the agency's regulatory process
- First CRISPR-edited organism to be approved

Waltz, Nature 2016

Kahoot time!

Please take out your phones!
go to kahoot.it

Common misconceptions

#1 MISCONCEPTION :

Gene functions do not affect each other and changes are predictable

#2 MISCONCEPTION :

Gene editing can make changes to all DNA in the cell.

#3 MISCONCEPTION :

DNA bases in a gene cannot be changed or altered in our body.

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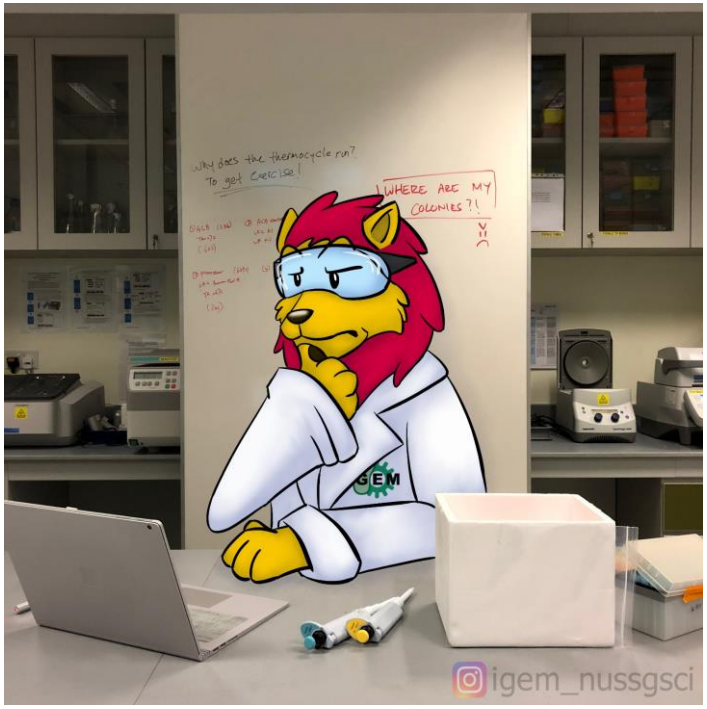

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