# Difference Between CRISPR and RNAi

www.differencebetween.com

## Key Difference - CRISPR vs RNAi

Genome editing and gene modification are upcoming fields of interest in genetics and molecular biology. Gene modification is widely applicable for gene therapy studies and is also used to identify the properties of the gene, functionality of the gene and how mutations in the gene could affect its function. It is important to develop efficient and reliable ways to make precise, targeted changes to the genome of living cells. Techniques such as CRISPR and RNAi were used to modify genes with high precision. **CRISPR or Clustered Regularly Interspaced Short Palindromic Repeats is a naturally occurring prokaryotic immune defense mechanism that has been recently used for eukaryotic gene editing and modification. RNAi or RNA interference is a sequence-specific method to silence genes by introducing small double-stranded RNA which mediates with nucleic acids and regulate gene expression.** This is the **key difference** between CRISPR and RNAi.

## What is CRISPR?

The CRISPR system is a natural mechanism present in some bacteria including *E. coli* and archea. It is an adaptive immune protection against foreign DNA based invasions. It is a sequence-specific mechanism. The CRISPR system contains several DNA repeat elements. These elements are interspersed with short "spacer" sequences derived from foreign DNA and multiple Cas genes. Some of the Cas genes are nucleases. Thus the complete immune system is referred to as CRISPR/Cas system.

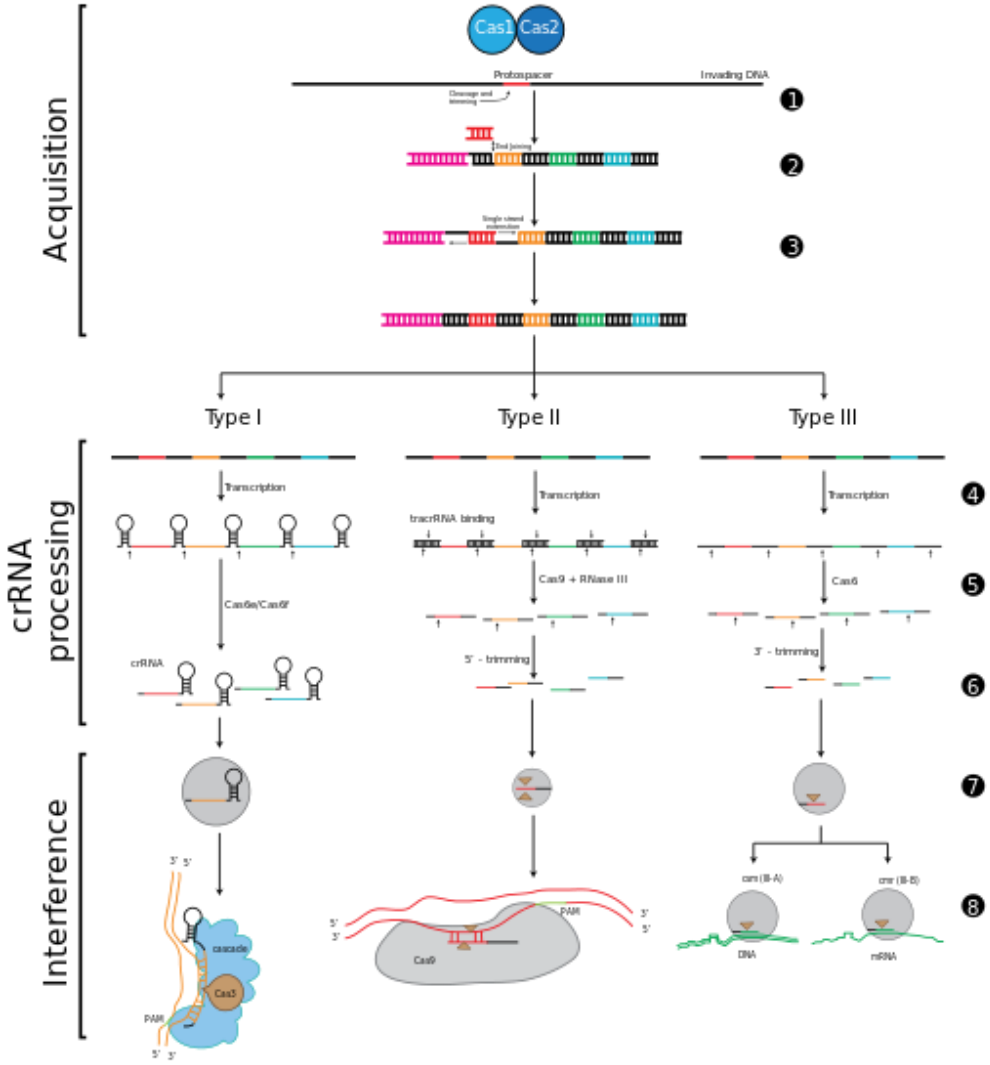


**Figure 01: CRISPR/ Cas system**

The CRISPR/Cas system functions in four steps.

1. The system is genetically tethering invading phage and plasmid DNA segments (spacers) into CRISPR loci (called the spacer acquisition step).
2. crRNA maturation step - The host transcribes and processes CRISPR loci to generate mature CRISPR RNA (crRNA) containing both CRISPR repeat elements and the integrated spacer elements.
3. Detection of the crRNA – This is facilitated by complementary base pairing. This is important when an infection is present and an infectious agent is present.

4. Target interference step - crRNA detects foreign DNA, forms a complex with the foreign DNA and protects the host against the foreign DNA.

At present, CRISPR/Cas system is used to alter or modify mammalian genome by either transcription repression or activation. The mammalian cells can respond to CRISPR/Cas9 mediated DNA breaks by adopting repair mechanism. It can either be done using non - homologous end joining method (NHEJ) or homology directed repair (HDR). Both these repair mechanism take place by introducing double stranded breaks. This results in editing of the mammalian gene. Thus at present CRISPR/ Cas system is used in the fields of therapeutic, biomedical, agricultural and research applications.

# What is RNAi?

RNA interference is a double-stranded RNA mediated technique, which is used to regulate gene expression. The main compound involved is small interfering RNAs (siRNAs). The siRNAs are a special type of double-stranded RNAs with a 3' overhang of two nucleotides, and a 5' phosphate group. The RNA induced silencing complex (RISC) is formed during RNA interference which would result in the degradation of the gene bound to the siRNA.

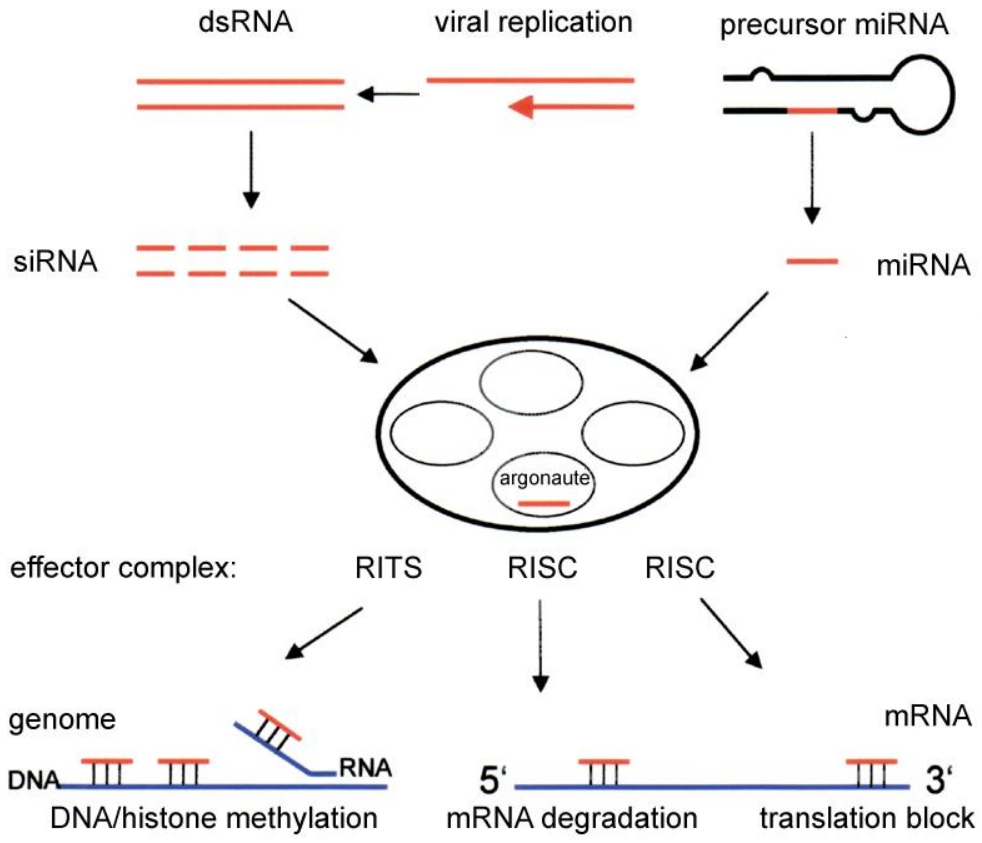


**Figure 02: RNAi**

The procedure of the RNAi is as follows.

1. The double-stranded RNA will be processed in the cytoplasm by a RNase III-type endoribonuclease called Dicer to generate ~21 nucleotide long siRNAs
2. Transfer of siRNA bound Dicer to Argonaute, with the help of double-stranded RNA binding proteins (dsRNABP).
3. Binding of Argonaute to one strand of the duplex (guide strand). This will displace the other strand. This results in a whole protein – RNA complex which is called RISC.
4. The pairing of the RISC complex with single-stranded guide RNA bound to the Argonaute.
5. The pairing of the homologous RNA target with the guide RNA.
6. Activation of Argonaute resulting in the degradation of the target RNA

## What is the Similarity Between CRISPR and RNAi?

- Both are used as gene expression modifying research tools

## What is the Difference Between CRISPR and RNAi?

| CRISPR vs Stem RNAi | |
|---|---|
| CRISPR is an immune defense mechanism that has been recently used for eukaryotic gene editing and modification. | RNAi is a sequence-specific method to silence genes by introducing small double-stranded |
| **Targeting Sequence** | |
| Synthetic RNA (guide RNA) is the targeting sequence of CRISPR. | siRNA is the targeting sequence of RNAi. |
| **Efficiency in gene suppression** | |
| Low in CRISPR | High in RNAi |
| **Effects** | |
| Knockdown of genes occurs in CRISPR. | Knockout / silencing occurs in RNAi. |

## Summary - CRISPR vs RNAi

CRISPR or Clustered Regularly Interspaced Short Palindromic Repeats is a naturally occurring prokaryotic immune defense mechanism that has been recently used for eukaryotic gene editing and modification. RNAi or RNA interference is a sequence-specific method to silence genes by introducing small double-stranded RNA which mediates with nucleic acids and regulate gene

expression. This can be taken as the basic difference between CRISPR and RNAi. Both the techniques, CRISPR/Cas and RNAi, are powerful tools for gene manipulations although CRISPR/Cas is certainly more superior to RNAi as it can be used to induce both insertions and deletions. The specificity is also high in CRISPR/ Cas system.

**Reference:**

1.Biolabs, New England. “CRISPR/Cas9 and Targeted Genome Editing: A New Era in Molecular Biology.” CRISPR/Cas9 and Targeted Genome Editing: A New Era in Molecular Biology | NEB. Accessed 22 Sept. 2017. Available here
2.“RNA Interference (RNAi).” National Center for Biotechnology Information, U.S. National Library of Medicine. Accessed 22 Sept. 2017. Available here
3.Unniyampurath, Unnikrishnan, et al. “RNA Interference in the Age of CRISPR: Will CRISPR Interfere with RNAi?” International Journal of Molecular Sciences, MDPI, Mar. 2016. Accessed 22 Sept. 2017. Available here

**Image Courtesy:**

1.'The Stages of CRISPR immunity'By CtSkennerton - Own work, (CC BY-SA 4.0) via Commons Wikimedia
2.'RNAi-simplified'By This figure is adapted from one by Matzke MA, Matzke AJM - This figure is adapted from one by Matzke MA, Matzke AJM (2004) Planting the Seeds of a New Paradigm. PLoS Biol 2(5). (CC BY 2.5) via Commons Wikimedia

**How to Cite this Article?**

APA: Difference Between CRISPR and RNAi. (2017, October 12). Retrieved (date), from http://differencebetween.com/ difference-between-crispr-and-vs-rnai/

MLA: "Difference Between CRISPR and RNAi "Difference Between.Com. 12 October 2017. Web.

Chicago: “Difference Between CRISPR and RNAi.” Difference Between.Com. http://differencebetween.com/ difference-between-crispr-and-vs-rnai/accessed (accessed [date]).