



# **ACHIEVERS IAS ACADEMY**

## **SCIENCE AND TECHNOLOGY**

### **CRISPR CAS 9 AND TARGETED GENOME EDITING : The applications or advantages, cons and ethical concerns.**

### **GS Paper 3: SCIENCE AND TECHNOLOGY- developments and their applications; developing new technology; bio-technology.**

The CRISPR- CAS 9 is much faster, cheaper and accurate than any other existing genome editing methods. CRISPR stands for “clustered regularly interspaced short palindromic repeats.” CRISPR spacer sequences are transcribed into short RNA sequences capable of guiding the system to matching sequences of DNA. When the target DNA is found, CAS 9 – one of the enzymes produced by the crispr system binds to the DNA and cuts it, shutting the targeted gene off.

Genome editing, or genome engineering is a type of genetic engineering in which DNA is inserted, deleted, modified or replaced in the genome of a living organism. Unlike early genetic engineering techniques that randomly inserts genetic material into a host genome, genome editing targets the insertions to site specific locations.

#### **APPLICATIONS OF CRISPR**

**Making diseases self-destruct**

**Fighting cancer, HIV and genetic diseases**

**Improving IMF treatments**

**Equipping plants with resistance genes to pests**

**Production of seedless fruits**

**Creating bio fuel**

**Eliminates inherited diseases**

## **Relevant applications of CRISPR**

It helps extend life

- ✚ Fighting cancer: Picking apart cancer cells, researchers can decipher which genes are most important to the disease's survival. In 2016, Chinese scientists began testing CRISPR edited immune cells in lung cancer sufferers.
- ✚ Extracting HIV: One of the greatest triumphs so far has been the successful removal of HIV from human immune cells. When these cells were exposed to the virus at a later date, they were not re-infected.
- ✚ Making diseases self-destruct: Through a DNA slicing enzyme called CAS, CRISPR chops up the genes of invading bacterium. Then, a CRISPR laced bacteriophage (which infects bacteria) is inserted into the pathogen, rewiring it to destroy itself. The method kills off the targeted disease whilst leaving other beneficial bacteria intact.
- ✚ Improving IVF: Carrying out gene editing within human embryos could help to improve chances of pregnancy during IVF treatments. As well as benefitting IVF, scientists also hope to use CRISPR to reduce miscarriages.
- ✚ Eliminating malaria: Through CRISPR Cas 9, scientists can snip out genes that are vital to the spread of malaria within the mosquito population. In short, they could create mosquitos that were resistant to malaria. In 2015, the scientific journal Nature Biotechnology published a journal that announced the use of a new technique called 'gene drive'. This ensured that genetically modified mosquitos would pass on this resistance to almost all of their offspring, drastically reducing the number of malaria carrying insects.
- ✚ Higher yield from plants: Equipping plants with resistance genes could lead to reduced reliance on pesticides and herbicides. Scientists envisages resistance to drought, viruses, fungi and insects too.

## **Ethical concerns regarding genome editing/CRISPR**

<b><i>SUPERFLUITY</i></b>	Some researchers and bioethicists are concerned that any genome editing, even for therapeutic uses, will start us on a slippery slope to using it for non-therapeutic and enhancement purposes ( beauty, soccer skills, etc)
<b><i>NO INFORMED CHOICE</i></b>	Some people worry that it is impossible to obtain informed consent for germline therapy or genome editing because the patients affected by the edits are the embryo and future generations.
<b><i>BIOWEAPONS</i></b>	Compared to other genetic engineering tools, CRISPR technology is relatively inexpensive and simple, which could make it attractive to terrorist organizations. The technology can be used to genetically modify bacteria or viruses to wage biological attacks against humans.
<b><i>JUSTICE AND EQUITY</i></b>	As with many new technologies, there is concern that genome editing will only be accessible to the wealthy and will increase existing disparities in access to health care and other interventions.

### Cons of Crispr/ genome editing

- ✚ It can have irreversible side effects in the event that they replace other important genes instead of the mutated ones, other forms of diseases or health conditions are likely to develop.
- ✚ In the case of transgenic biotechnology, blending animal and human DNA can lead to creation of entities that possess degrees of intelligence or sentience atypical of non-human animal; might lead to increased suffering of transgenic organisms and possible creation of new diseases.
- ✚ It is a very expensive treatment option that could be afforded by a minority.
- ✚ Nature is adaptable. Eg: Growing resistance of pests to antibiotics. Gene therapies may be useful now but additional changes to genetic profiles could create unforeseen disorders in the future.

### Questions

1. What are the ethical concerns regarding genome editing?
2. Enumerate the pros and cons of CRISPR- CAS 9.



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