Nobel Prize for Chemistry 2020

Why in News

Recently, **Emmanuelle Charpentier of France** and **Jennifer A Doudna of the USA** have been awarded the **2020 Nobel Prize in Chemistry** for developing **CRISPR/Cas9 genetic scissors,** one of gene technology's sharpest tools.

- It is for the **first time a Nobel science prize has gone to a women-only team.**
- **Nobel Prize for Medicine/Physiology, 2020**: To Harvey J Alter and Charles M Rice from the USA and Michael Houghton from the UK for the discovery of the **Hepatitis** C Virus.
- **Nobel Prize in Physics 2020**: To three astrophysicists Roger Penrose from the UK, Reinhard Genzel from Germany, and Andrea Ghez from the USA for discoveries related to **blackholes.**

Key Points

- The **CRISPR/Cas9 genetic scissors** can be used to change the **deoxyribonucleic acid** (DNA) of animals, plants and microorganisms with extremely high precision.
    - The CRISPR/Cas9 tool has already **contributed to significant gains in crop resilience,** altering their genetic code to **better withstand drought and pests.**
    - This technology has had a **revolutionary impact on the life sciences** and **contributes to new cancer therapies.** It has the potential of curing inherited diseases.

- **Discovery:**
    - Charpentier, while studying the ***Streptococcus pyogenes***, a harmful bacterium, discovered a previously unknown molecule, **tracrRNA.**
    - TracrRNA was part of bacteria's ancient immune system, **CRISPR/Cas,** that **disarmed viruses by cleaving** (cutting) **their DNA.**
        TracrRNA is programmed to **locate the particular problematic sequence on the DNA strand,** and a special protein called Cas9 (also known as genetic scissor) is used to **break and remove** the problematic sequence.
    - Both scientists collaborated and succeeded in **recreating the bacteria's genetic scissors in a test tube** and **simplifying** the scissors' molecular components making it easier to use.
    - In their **natural form,** the scissors **recognise DNA from viruses** but the duo **reprogrammed them so that they could be controlled** and **can cut any DNA molecule at a predetermined site.**

CRISPR Technology

- The CRISPR (short for **Clustered Regularly Interspaced Short Palindromic Repeats**) technology for gene-editing was **first developed in 2012.**
- It makes **gene sequencing very easy, simple and extremely efficient** providing nearly endless possibilities.
    Editing, or modifying, gene sequences is not new and has been happening for several decades now, particularly in the **field of agriculture, where several crops have been genetically modified to provide particular traits.**
- The technology **replicates a natural defence mechanism in *Streptococcus pyogenes*** that use a similar method to protect itself from virus attacks.
    - A DNA strand, when broken, has a **natural tendency to repair itself** but the **auto-repair mechanism can lead to the re-growth of a problematic sequence.**
    - Scientists **intervene during this auto-repair process** by supplying the desired sequence of genetic codes, which replaces the original sequence.

- **Concerns:**
  - **Ethical Concerns:** Ease of altering DNA will allow **more people to choose the characteristics of their progeny and this will hamper the natural process.**
    - In November 2018, a Chinese researcher claimed to have altered the genes of a human embryo that eventually resulted in the birth of twin baby girls. It was the first documented case of a **'designer babies'** being produced using gene-editing tools like CRISPR.
    - It was probably done **without any regulatory permission or oversight** which makes it even worse.
  - **Not Fully Accurate:** Few scientists have pointed out that CRISPR technology is **not 100% accurate,** and it is possible that some other genes could also get altered by mistake.
  - **Lack of Rules and Guidelines:** Doudna has been campaigning for the **development of international rules and guidelines** for the use of CRISPR technology and has also **advocated a general pause** on these kinds of applications till such time.

Source: DTE