



12.10.2026 NEWS

» Unlocking the Secret Door of the Brain!

- Nobel Prize in Physiology or Medicine 2026 – Optogenetics. The human brain contains billions of nerve cells (neurons). These cells communicate with one another through electrical and chemical signals.
- However, identifying precisely which neurons are responsible for a particular memory, emotion, behaviour or disease has remained a challenge for a long time.
- To provide a new breakthrough in addressing this challenge, the 2026 Nobel Prize in Physiology or Medicine has reportedly been announced for three scientists : Karl Deisseroth, Peter Hegemann, Georg Nagel.
- These scientists contributed to the development of a scientific technique called Optogenetics, which enables researchers to control the activity of nerve cells using light.

» The Secret Discovered in Algae!

- The fascinating aspect of this discovery lies in a single-celled green alga called Chlamydomonas. This alga has the ability to swim towards a source of light. The reason behind this ability is a tiny structure called an eyespot.
- Although the eyespot is extremely simple compared with human eyes, it plays an important role in sensing light.
- The eyespot contains light-sensitive molecules associated with retinal. When light interacts with these molecules, it triggers a response inside the algal cell.
- Through this response, the alga can detect light and adjust its swimming direction. This naturally occurring light-sensitive mechanism laid the foundation for a major scientific breakthrough: controlling neurons in the brain using light.
- In 2005, American scientist Karl Deisseroth demonstrated the use of a protein called Channelrhodopsin-2 (ChR2) to control nerve cells.
- Using genetic engineering, scientists introduced the gene encoding this protein into neurons in the brains of mice.
- They demonstrated that the activity of these neurons could be controlled using light. This discovery also established the potential for applying similar techniques to human neurons in laboratory research.
- The use of light-sensitive proteins became the foundation of a new scientific field known as Optogenetics.

CHILD MARRIAGES IN FIVE STATES

- In India, the minimum legal age for marriage is 18 years for women and 21 years for men.
- To eliminate child marriage, the Central Government launched the Child Marriage Free India Campaign (Bal Vivah Mukh Bharat) in 2024.
- The campaign aims to completely eliminate child marriage by 2030.
- In India, more than 22 crore girls were reportedly married before reaching the age of 18.
- Among them, more than 9 crore girls were reportedly forced into marriage before reaching the age of 15.
- Globally, one in every three girls affected by child marriage is reportedly from India.
- More than half of all child marriages in India reportedly take place in just five states : 1. Uttar Pradesh, 2. Bihar, 3. West Bengal, 4. Maharashtra, 5. Madhya Pradesh
- Kerala and Lakshadweep have implemented effective measures to prevent child marriages.

- Normally, electrical stimulation can be used to activate neurons in the brain. However, electrical stimulation may also affect several neighbouring neurons at the same time.
- Therefore, scientists needed a method to control only selected groups of neurons with greater precision. The Channelrhodopsin protein found in algae provided a solution to this problem.

» Light-Controlled Proteins

- German scientists Peter Hegemann and Georg Nagel carried out important research related to optogenetics. Their studies helped scientists understand how channelrhodopsin proteins, used by certain microorganisms to respond to light, function.
- Some of these proteins open ion channels in the cell membrane when exposed to light. This allows electrically charged ions to enter or leave the cell.
- The process can be explained as follows : Light falls on a light-sensitive protein → Ion channels open in the cell membrane → Charged ions move into or out of the cell → Electrical activity of the neuron changes
- This was the crucial breakthrough. Scientists realised that light could be used as a kind of biological remote control.
- However, the neurons must first possess proteins that respond to this light. To achieve this, scientists introduced genes encoding channelrhodopsin proteins into selected neurons, making those neurons sensitive to light. They then delivered light of a specific wavelength to the targeted region of the brain. As a result, the selected neurons could be controlled by light. Understanding Optogenetics with an Example
- The process can be compared to operating a television using a remote control. Through genetic engineering, selected neurons are made to produce light-sensitive proteins.
- Just as a television remote uses a particular signal to control a television, scientists can use light of a suitable wavelength to control the activity of selected neurons. Certain light-sensitive proteins activate neurons when exposed to light, while others suppress neuronal activity.
- Thus, scientists can precisely switch selected neurons ON or OFF. This is the basic principle of the modern scientific technique called Optogenetics.

» New Treatments May Emerge

- One of the major challenges in understanding the brain is that thousands of neurons function simultaneously. Therefore, it is difficult to identify the specific contribution of a particular group of neurons.
- Optogenetics has transformed this situation. By activating only selected neurons using light, scientists can study how their activity influences an organism's behaviour.
- Similarly, researchers can temporarily inhibit the activity of these neurons and observe the resulting changes. For example, when an organism recalls a particular memory, which neurons become active in its brain?
- If only those neurons are activated using light, will the behaviour associated with that memory reappear?
- Alternatively, if a particular neural network is temporarily inhibited, will that behaviour disappear? Optogenetics has provided a new way to investigate such questions. Through this technology, scientists can study the neural networks responsible for various brain functions, including memory, emotions, movement, behaviour and sleep.
- Compared with earlier methods that used electrical stimulation to activate neurons, optogenetics has opened up new possibilities for precisely switching selected neurons ON or OFF using light. Today, this technology is being used in various research laboratories around the world.
- It has created new opportunities not only for understanding brain functions but also for conducting research into neurological disorders. Optogenetics offers opportunities to gain a deeper understanding of disorders such as : Parkinson's disease, Alzheimer's disease, Depression, Schizophrenia, Epilepsy, Drug addiction.
- It also offers possibilities for developing new treatments for certain conditions, such as hereditary blindness and congenital hearing loss. Thus, optogenetics has emerged as a promising scientific technology that could contribute significantly to future medical research and the development of innovative treatments.