

Nobel Prize in Physiology or Medicine 2026 - Optogenetics

Prelims: *Current events of national and international importance* | Others

Why in News?

Recently the 2026 Nobel Prize in Physiology or Medicine for discoveries concerning light-gated ion channels and optogenetics has been awarded.

Optogenetics

- **Optogenetics** - It is a technique that uses light to control specific genetically targeted nerve cells.
- **Enables** - Researchers to activate or inhibit neurons with high temporal and spatial precision.
- **Importance** - It has transformed neuroscience from merely observing brain activity to experimentally controlling specific neural circuits.

Light-Gated Ion Channels

- These are proteins in cell membranes that open or close in response to specific wavelengths of light.
- When activated, they allow ions to flow across the membrane, generating electrical signals.
- Channelrhodopsin-1 and Channelrhodopsin-2 (ChR2) were *identified from the green alga Chlamydomonas*.
- ChR2 became a key tool for optogenetics as it can rapidly activate nerve cells when exposed to blue light.

Contributions of the Laureates

Laureate	Contribution
Peter Hegemann	Discovered light-sensitive proteins in <i>Chlamydomonas</i> .
Georg Nagel	Demonstrated that these proteins function as light-gated ion channels.
Karl Deisseroth	Adapted channelrhodopsins for controlling neuronal activity, establishing optogenetics as a neuroscience tool.

- **Applications** - Optogenetics has helped study neural circuits associated with:
 - Memory and learning

- Pain and reward
- Sleep and circadian rhythm
- Appetite and thirst
- Social behaviour and emotions
- Depression, anxiety, Parkinson's and Alzheimer's diseases
- It is also being explored for restoring vision in retinal disorders and improving the precision of cochlear implants.


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NOBEL PRIZE IN PHYSIOLOGY OR MEDICINE 2026

For discoveries concerning light-gated ion channels and optogenetics

Why in News?

The 2026 Nobel Prize in Physiology or Medicine has been awarded for discoveries concerning **light-gated ion channels and optogenetics**.

What is Optogenetics?

A technique that uses **light** to control specific genetically targeted **nerve cells**.

- Enables researchers to activate or inhibit neurons with **high temporal and spatial precision**.
- Has transformed neuroscience from merely observing brain activity to **experimentally controlling specific neural circuits**.

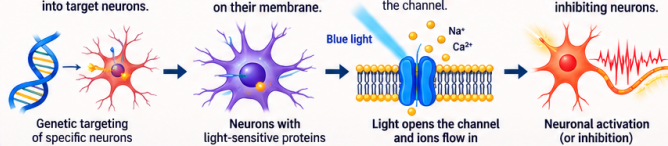
Light-Gated Ion Channels

- Proteins in cell membranes that open or close in response to **specific wavelengths of light**.
- When activated, they allow **ions to flow** across the membrane, generating **electrical signals**.
- Channelrhodopsin-1 and Channelrhodopsin-2 (ChR2) were identified from the green alga ***Chlamydomonas***.
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How Optogenetics Works?

- Gene for a light-gated ion channel is inserted into target neurons.
- Neurons express light-sensitive proteins (e.g. ChR2) on their membrane.
- Exposure to a specific wavelength of light (e.g. blue light) opens the channel.
- This generates electrical signals, activating or inhibiting neurons.



Contributions of the Laureates



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Key Features / Significance

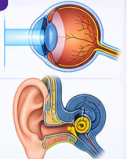
- High precision**: Control specific neurons with spatial and temporal accuracy.
- Causal insights**: Helps establish cause-effect relationships in brain function.
- Revolutionised neuroscience**: From observing brain activity to controlling neural circuits.
- Wide research and clinical potential**: Useful for basic research and therapeutic applications.

Applications

- Memory and learning
- Pain and reward
- Sleep and circadian rhythm
- Depression, anxiety, Parkinson's and Alzheimer's diseases
- Appetite and thirst
- Social behaviour and emotions

Other Emerging Uses

- Restoring vision**: Being explored for treating retinal disorders.
- Improving hearing**: Helps in enhancing the precision of cochlear implants.



Reference

[The Indian Express| Medicine Nobel goes to scientists who can 'control brain using light'](#)