

Credit - Drishti Ias

Nobel Prize in Physiology or Medicine 2025



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Why in News?

The **Nobel Assembly at Sweden's Karolinska Institutet** has awarded the **2025 Nobel Prize in Physiology or Medicine** to **Mary E. Brunkow (US)**, **Fred Ramsdell (US)**, and **Shimon Sakaguchi (Japan)**.

- They were recognized for their discoveries on peripheral immune tolerance, particularly regarding **regulatory T cells (Tregs)** and the **FOXP3 (Forkhead Box Protein P3) gene**.



Indian Nobel Laureate in Physiology or Medicine: In 1968, **Har Gobind Khorana** from India was awarded the **Nobel Prize in Physiology or Medicine**, along with Marshall Nirenberg and Robert Holley from the US, for their interpretation of the **genetic code and its function in protein synthesis**.

What are the Key Discoveries of the 2025 Nobel Laureates in Physiology or Medicine?

- **Shimon Sakaguchi (Japan):** Discovered the existence of **regulatory T cells (Tregs)** in 1995, showing that some **T cells act as "immune system security guards"** to prevent autoimmune attacks.

- **Mary Brunkow (USA) and Fred Ramsdell (USA):** In 2001, identified that mutations in the FOXP3 gene caused a rare autoimmune disease (IPEX) in humans and similar **immune dysfunctions in mice**.
- **Combined Contribution:** Sakaguchi later discovered that the **FOXP3 gene** controls the development of **regulatory T cells** , explaining how the immune system maintains **peripheral tolerance** .

Significance of Discoveries

- **Cancer therapy** : Targeting Tregs around tumors could make immune attacks on cancer cells more effective.
- **Autoimmune diseases** : Boosting Tregs may prevent the immune system from attacking the body.
- **Transplantation** : Better regulation of T cells reduces organ rejection.

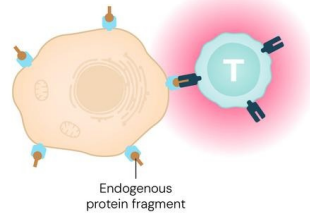
What are the Key Facts About the Human Immune System?

- **About:** The **immune system** is the body's defense mechanism against harmful invaders like **pathogens** (viruses, bacteria, fungi, parasites), as well as **abnormal cells** such as cancer cells.
 - The immune system can be broadly divided into **innate immunity** and **adaptive immunity** .
- **Innate Immunity (Non-Specific Defense):** It provides a rapid, generalized response against **pathogens through physical barriers (skin, mucous membranes), phagocytes (macrophages, neutrophils), and inflammation (helps isolate and destroy pathogens)**.
- **Adaptive Immunity (Specific Defense):** It provides a more targeted, specific response to pathogens and has a "memory" that enables the body to respond more efficiently if the same pathogen invades again.
 - **Key elements include:**
 - **T-cells** : Part of the adaptive immune response, T-cells are a type of white blood cell involved in recognizing and destroying infected cells.
 - **B-cells** : These cells produce antibodies (proteins) that specifically target and neutralize foreign antigens (e.g., viruses or bacteria).
- **Immune Tolerance:** The immune system **must distinguish harmful invaders from the body's own cells** , maintaining self-tolerance to **prevent autoimmune diseases** (conditions where the body attacks its own tissues).
- **Central Tolerance** : This occurs in primary lymphoid organs such as the bone marrow and the thymus, where self-reactive immune cells (cells that could attack the body's own tissues) are eliminated or rendered inactive.
- **Peripheral Tolerance** : This involves mechanisms in the body's tissues that prevent any remaining **self-reactive cells from becoming active**.
 - **Regulatory T cells (Tregs) are central to peripheral tolerance** , ensuring that the immune system does not attack its own tissues.
- **Role of Regulatory T Cells (Tregs):** Tregs are a specialized subset of T-cells that act as **"peacekeepers" of the immune system that suppress immune responses, helping to maintain immune tolerance**.
 - They are crucial in **preventing autoimmune diseases** . These cells help control immune responses to **avoid excessive inflammation and tissue damage** , and they play a critical role in preventing

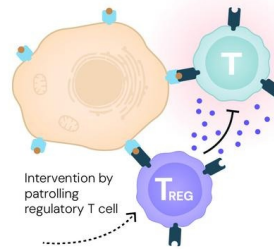
autoimmune disorders like rheumatoid arthritis, type 1 diabetes, and multiple sclerosis.

How regulatory T cells protect us

1 A T cell that has slipped through the test in the thymus reacts to a fragment from one of the body's proteins.



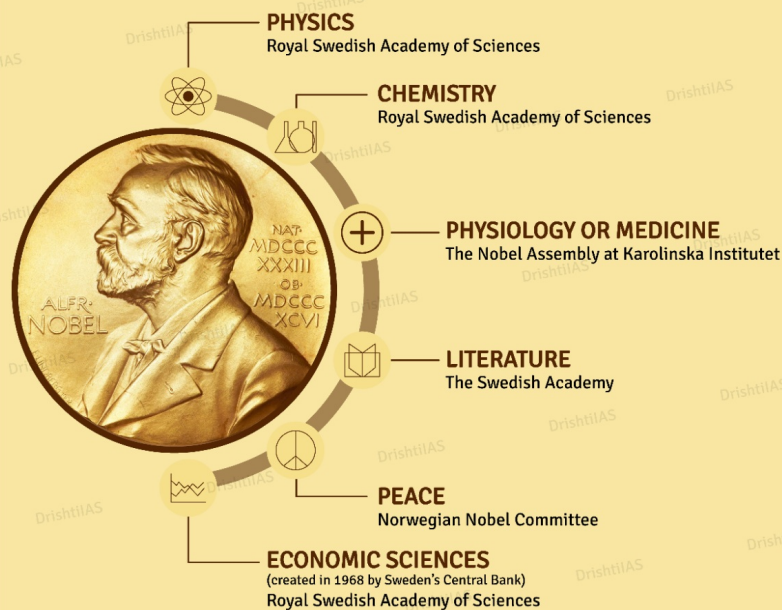
2 Regulatory T cells discover that the attack is a mistake and calm it down. This prevents autoimmune diseases.



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Nobel Prize

- ✦ Established by the will of Alfred Nobel (inventor of Dynamite)
- ✦ Awarded to those who have conferred the greatest benefit to humankind, during the preceding year
- ✦ First awards were handed out in 1901



- ✦ The Prize Ceremony is held in Stockholm, Sweden, in December every year
 - ▲ The Peace Prize is not awarded at Stockholm ceremony but presented annually in Oslo, Norway, on the same day
- ✦ Each Nobel laureate receives a gold medal, a diploma, and a monetary award
- ✦ Nobel Prize cannot be given posthumously (after death). Also, up to 3 people can share a Nobel Prize award between them

✦ First Indian Nobel Laureate: Rabindranath Tagore for Literature, 1913

▲ First Indian Woman Nobel Laureate: Mother Teresa for Peace, 1979



Frequently Asked Questions (FAQs)

1. **Who won the 2025 Nobel Prize in Physiology or Medicine?**

Mary E. Brunkow, Fred Ramsdell, and Shimon Sakaguchi won for discovering regulatory T cells (Tregs) and the FOXP3 gene involved in immune tolerance.

2. **What is the role of regulatory T cells (Tregs)?**

Tregs act as “peacekeepers” of the immune system, preventing autoimmune reactions by ensuring self-tolerance.

3. **What is peripheral immune tolerance?**

It is the mechanism by which the immune system prevents self-reactive cells from attacking the body’s own tissues, maintaining immune balance.

4. **Who is the only Indian Nobel Laureate in Physiology or Medicine?**

Har Gobind Khorana, awarded in 1968 for interpreting the genetic code and its function in protein synthesis.

[Watch Video on YouTube: [▶ https://www.youtube.com/embed/WygqE2ri5tl](https://www.youtube.com/embed/WygqE2ri5tl)]

UPSC Civil Services Examination, Previous Year Questions (PYQs)

Prelims

Q. Nobel Prize winning scientist James D. Watson is known for his work in which area? (2008)

- (a) Metallurgy
- (b) Meteorology
- (c) Environmental protection
- (d) Genetics

Ans: (d)