



Nobel Prize 2024 in Physiology or Medicine

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Why in News?

Recently, the **2024 Nobel Prize in Physiology or Medicine** was awarded to **Victor Ambros and Gary Ruvkun** by the **Nobel Assembly at Karolinska Institutet in Stockholm, Sweden**.

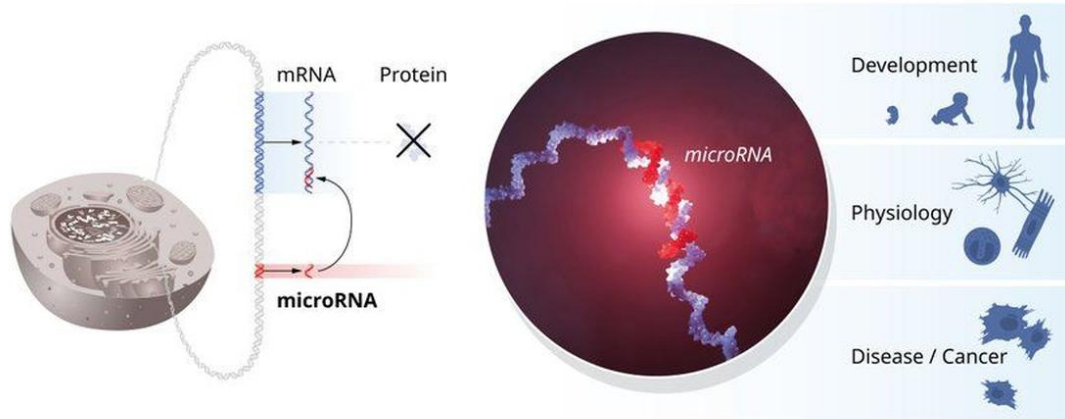
- The scientists won the esteemed prize for the **discovery of [microRNA](#) and its role in post-transcriptional gene regulation**.

Note:

- The **2023 Nobel Prize in Physiology or Medicine** was awarded to **Katalin Karikó and Drew Weissman** for their work on **[messenger Ribonucleic Acid \(mRNA\)](#)**.
- The **2024 Nobel Prize in Physics** has been awarded to **John J. Hopfield** and **Geoffrey E. Hinton**, for modern **[artificial neural networks \(ANNs\)](#)** and **[machine learning \(ML\)](#)**.

What Discovery of microRNA led to the Nobel Prize?

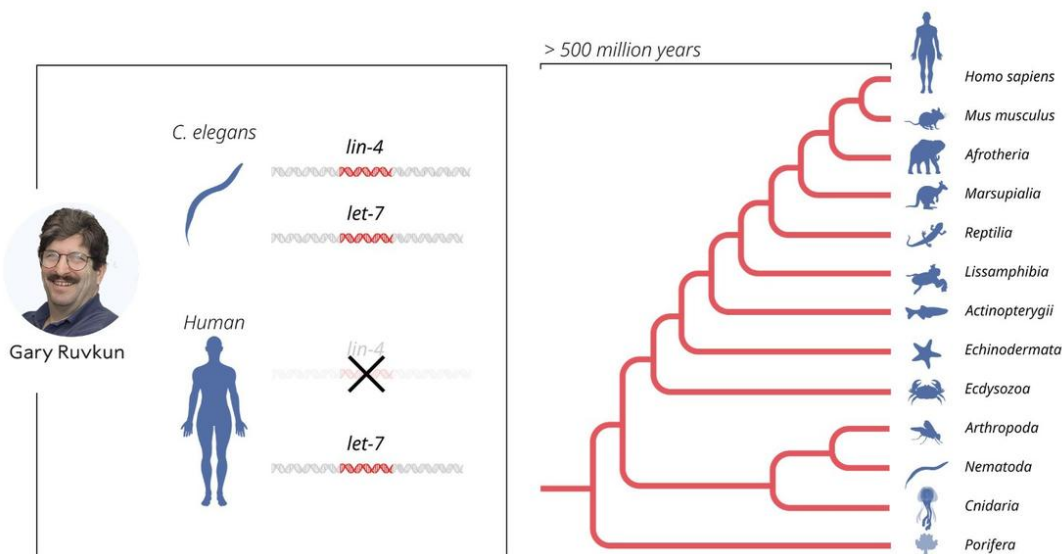
- **Early Research:**
 - **C. elegans Model:** Ambros and Ruvkun studied the **roundworm C. elegans** to understand tissue development.
 - **Mutant Strains:** They **analyzed mutant strains lin-4 and lin-14 with abnormalities** in their genetic programming.
- **Ambros' Research:**
 - Ambros found that **lin-4 suppressed lin-14 activity** but couldn't determine how.
 - He cloned **lin-4 and discovered a short RNA molecule** without protein-coding potential. It suggested the **RNA molecule might inhibit lin-14**.
- **Ruvkun's Research:**
 - He found that **lin-4 didn't block lin-14 mRNA production but regulated it later by inhibiting protein production**. A short lin-4 sequence matched key complementary segments in lin-14 mRNA.
- Ambros and Ruvkun found that **lin-4 microRNA attaches to lin-14 mRNA and blocks protein production**.
- **Significance:**
 - **let-7 discovery:** Ruvkun's group later discovered let-7, a microRNA present throughout the animal kingdom.
 - **Current understanding:** The microRNAs are abundant and play a crucial role in gene regulation across multicellular organisms.



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Note:

- **Lin-4:** It is a microRNA, identified from a study of **developmental timing in the nematode *Caenorhabditis elegans***. It was the first to be discovered of the miRNAs, a class of **non-coding RNAs involved in gene regulation**.
- **lin-14:** It is a **heterochronic gene that controls the timing of developmental events** in the nematode ***Caenorhabditis elegans***.
 - **Heterochronic genes** are genes that control the timing of cell and tissue development in an organism.



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What are microRNAs?

- The **body synthesizes proteins** through a complex process involving two main steps: **transcription and translation**.
- In the **transcription step**, a **Deoxyribonucleic acid (DNA) sequence** in the **cell nucleus is copied** into messenger **Ribonucleic Acid (mRNA)**.
 - The mRNA then exits the nucleus, moves through the cell fluid, and **attaches to a ribosome**.
- In the **translation step**, transfer RNA (**tRNA**) **delivers specific amino acids to the**

ribosome, where they are linked together in the sequence dictated by the mRNA to form the protein.

- **Micro RNA (miRNA) plays a regulatory role** in protein production by binding to and **silencing mRNA at a specific stage** in the process.
 - This regulation occurs through a mechanism called **post-transcriptional gene regulation**, ensuring protein synthesis is controlled.

About the Winners

- Ambros and Ruvkun are **both American biologists**. **Ambros** currently works at the Programme in **Molecular Medicine at the University of Massachusetts**.
- **Ruvkun** is a **professor of genetics at Harvard Medical School** and conducts research on microRNA and RNA interference.
- **H. Robert Horvitz**, under whom both biologists worked as postdoctoral fellows, **won the Nobel Prize in Physiology or Medicine in 2002**.
- **Ambros** was the **first to clone a microRNA**, and **Ruvkun cloned the second**, marking significant milestones in the field.

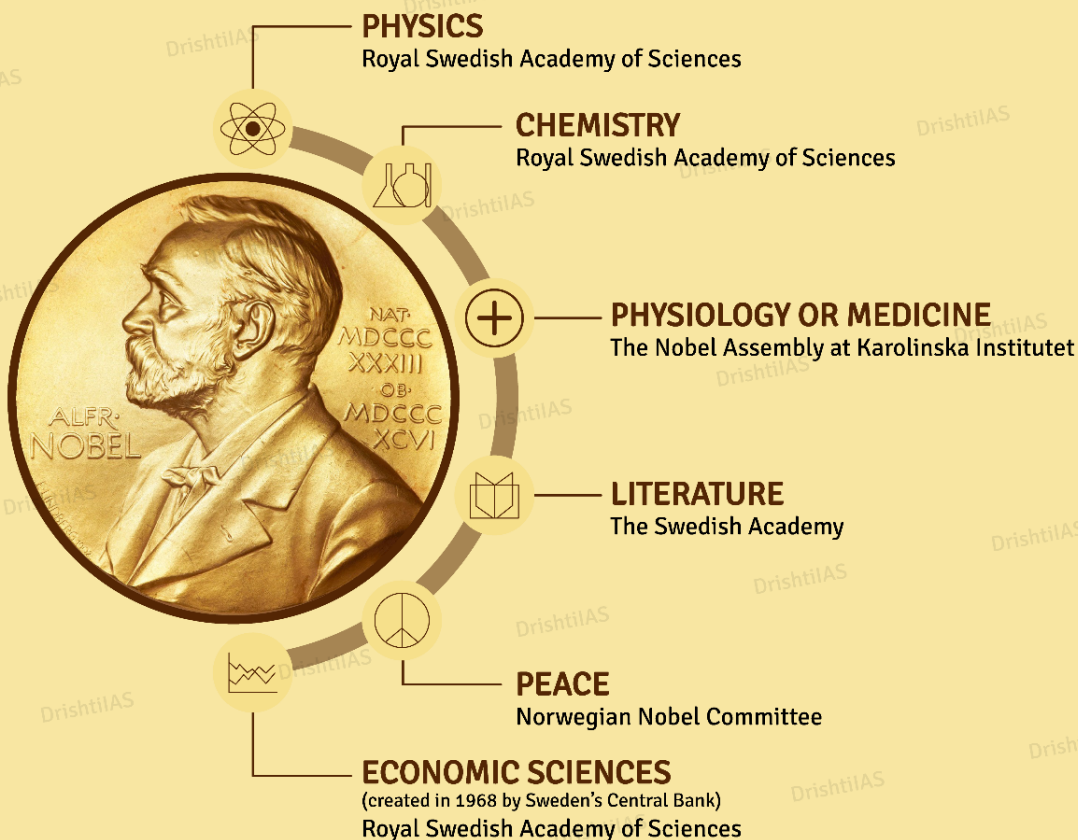


What are the applications of the Discovery?

- **Abnormal Regulation and Diseases:**
 - **Cancer: Abnormal microRNA** regulation can contribute to **cancer development**.
 - **Mutations:** Mutations in microRNA genes have been linked to conditions like **hearing loss, eye, and skeletal disorders**.
- **Future Applications:**
 - While **microRNAs hold great potential**, there are **currently no direct clinical applications**.
 - **Further research and a deeper understanding** of microRNAs are necessary for future applications.

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**



UPSC Civil Services Examination, Previous Year Question (PYQ)

Q. Who among the following discovered heavy water? (2008)

- (a) Heinrich Hertz
- (b) H.C. Urey
- (c) G. Mendel
- (d) Joseph Priestley

Ans: (b)

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