



# SAINTS PERSPECTIVES

*Things Exceptional (Nobel Prizes)*

## The Nobel Prize in Medicine 2024

7 October 2024.

### The Nobel Prize Committee

Announced that the 2024 Nobel Prize in Physiology or Medicine

Is awarded jointly to

**Victor Ambros and Gary Ruvkun**

**for the discovery of microRNA and its role in post-transcriptional gene regulation**

### Description

Inside the nucleus of every human cell is a full set of instructions—the genome—for creating a person. A key question in biology is how the same set of genes and instructions can lead to such different types of cells in the body, from muscle to nerve to liver cells. The answer is that not all the genes within a nucleus are switched on. **Different types of cells follow their own developmental pathways by selecting only the genetic instructions that are relevant to their growth and development.** The selection necessary for each cell type is controlled by the miRNA molecules discovered by Professors Ambros and Ruvkun.

Micro-RNA (miRNA) are a class of small molecules composed of only 20 to 24 nucleotides (the A, C, G, T letters of the genome), and they play a key role in how cells work. They work primarily by binding to target parts of another molecule within cells, known as messenger RNA (mRNA)—which carries information from the DNA of the genome to the protein-making factories within cells. **By interfering with mRNA molecules, miRNA can alter or prevent the production of proteins.**

Prof Ambros, and Prof Ruvkun, both conducted their research on the nematode worm - *C. elegans*. They experimented on a mutant form of the worm that failed to develop some cell types, and eventually homed in on tiny pieces of genetic material or microRNAs that were essential for the worms' development.

### This is how it works:

- A gene or genetic instruction is contained within our DNA.
- Our cells make a copy, which is called messenger RNA or simply mRNA.
- This travels out of the cell's nucleus and instructs the cell's protein-making factories to start making a specific protein.
- But microRNAs get in the way by sticking to the messenger RNA and stop it working.
- In essence the microRNA has prevented the gene from being expressed in the cell.

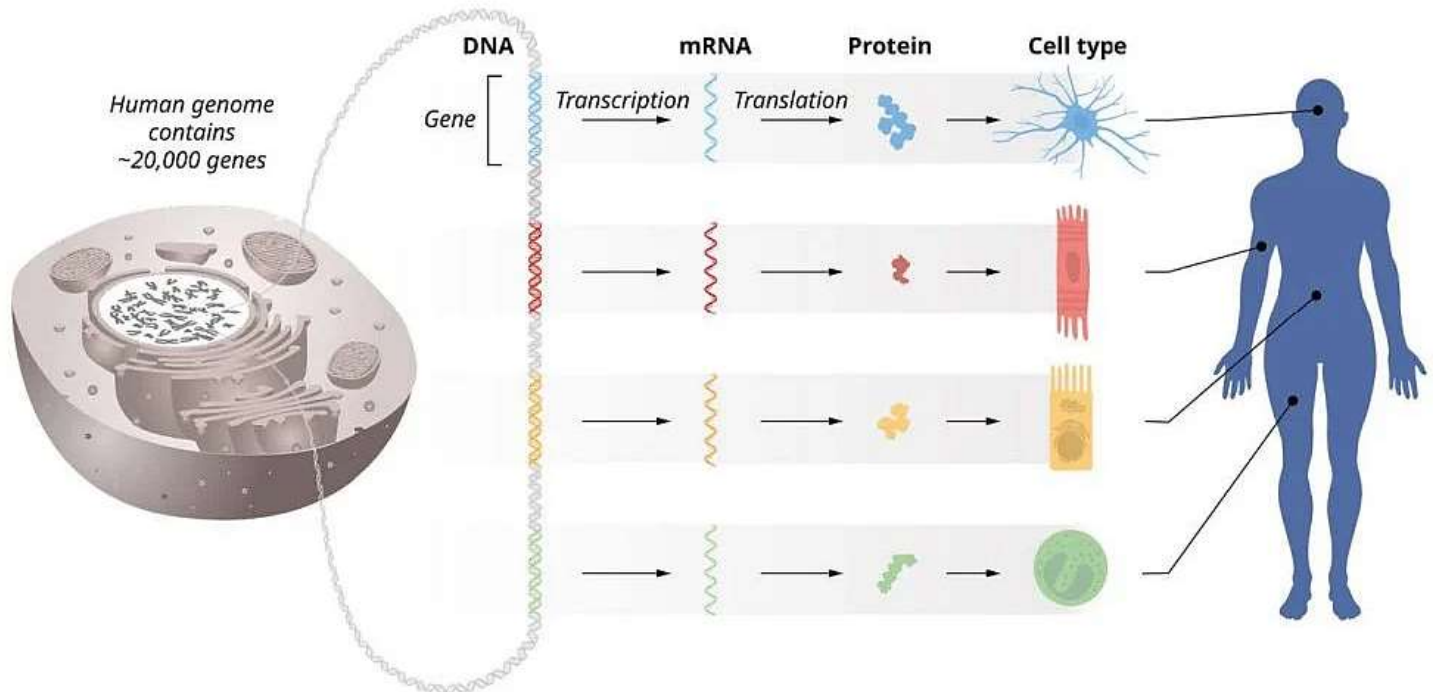


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Further work showed this was not a process unique to worms, but was a core component of life on Earth.

## Genes control cell diversity and function



Every cell contains an identical set of chromosomes and therefore, the exact same set of genes. Cell-type specific functions arise when only a select subset of these genes is activated within each cell type.

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Prof Janosch Heller, from Dublin City University, said he was "delighted" to hear the prize had gone to Profs Ambros and Ruvkun. "Their pioneering work into gene regulation by microRNAs paved the way for groundbreaking research into novel therapies for devastating diseases such as epilepsy, but also opened our eyes to the wonderful machinery that is tightly controlling what is happening in our cells."

## Possible Applications

Finding miRNAs, in 1993, paved the way to the understanding, today, that there are over a thousand of these small molecules within our cells. The discovery has had far-reaching implications in biology. Abnormal regulation by miRNA molecules can contribute to cancer and epilepsy. Mutations in genes that code for miRNA molecules have been found to cause conditions such as congenital hearing loss and are thought to be involved in the pathology of many eye disorders, such as cataracts, glaucoma



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and macular degeneration. The miRNA molecules are also thought to be important in numerous bone diseases, such as osteoporosis, osteosarcoma and bone metastasis.

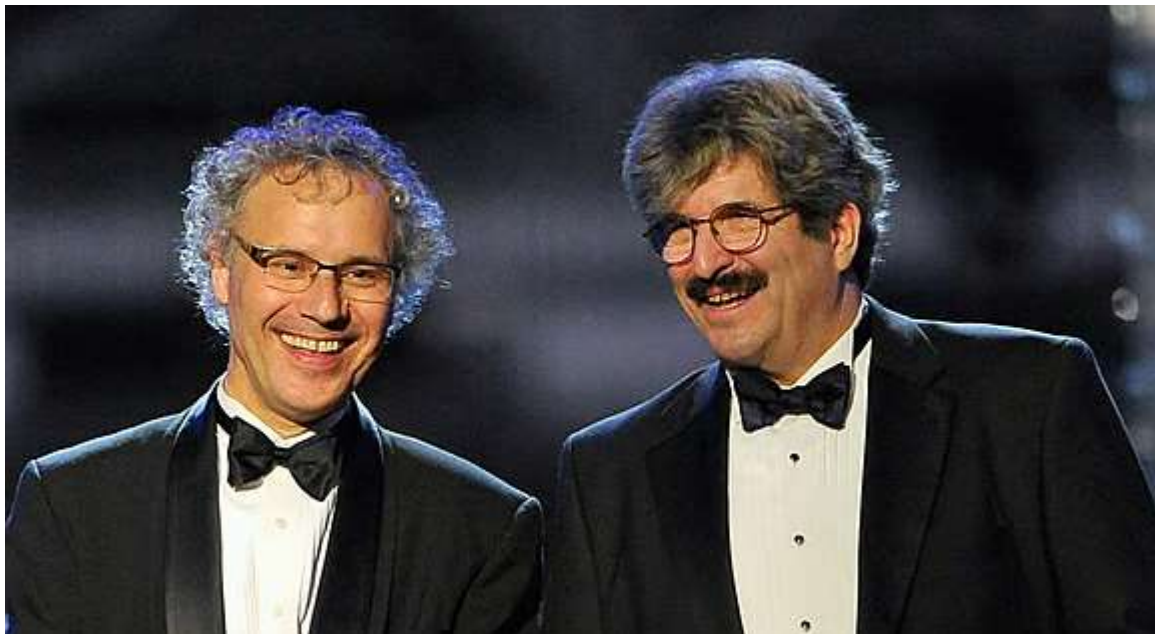
Underscoring the growing importance of this area of molecular biology, mRNA was itself the subject of the Nobel prize last year.

## Prize amount:

11 million Swedish kronor, to be shared equally between the Laureates.

## About the Winners

Professors Ambros 70, and Ruvkun 72, - worked at the same lab in the late 1980s at the Massachusetts Institute of Technology and went on to become professors at the University of Massachusetts Medical School and Harvard Medical School respectively.



Victor Ambros and Gary Ruvkun

## Previous Winners of the Nobel Prize in Medicine

- **2023** - Katalin Kariko and Drew Weissman for developing the technology that led to the mRNA Covid vaccines.



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- **2022** - Svante Paabo for his work on human evolution.
- **2021** - David Julius and Ardem Patapoutian for their work on how the body senses touch and temperature.
- **2020** - Michael Houghton, Harvey Alter and Charles Rice for the discovery of the virus Hepatitis C.
- **2019** - Sir Peter Ratcliffe, William Kaelin and Gregg Semenza for discovering how cells sense and adapt to oxygen levels.
- **2018** - James P Allison and Tasuku Honjo for discovering how to fight cancer using the body's immune system.
- **2017**- Jeffrey Hall, Michael Rosbash and Michael Young for unravelling how bodies keep a circadian rhythm or body clock.
- **2016** - Yoshinori Ohsumi for discovering how cells remain healthy by recycling waste.

## References

### **Nobel Prize in Physiology or Medicine 2024 goes to microRNA researchers**

James Gallagher, BBC News, Oct 7, 2024

<https://www.bbc.com/news/articles/c79nrgp97x9o>

### **A Nobel prize for the discovery of micro-RNA**

These tiny molecules regulate genes and control how cells develop and behave

The Economist, Oct 7th 2024

<https://www.economist.com/science-and-technology/2024/10/07/a-nobel-prize-for-the-discovery-of-micro-rna>

In 2021, the Economist published details of the mRNA Transcription process:

### **Covid-19 vaccines have alerted the world to the power of RNA therapies**

The Economist, Mar 27th 2021



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<https://www.economist.com/briefing/2021/03/27/covid-19-vaccines-have-alerted-the-world-to-the-power-of-rna-therapies>