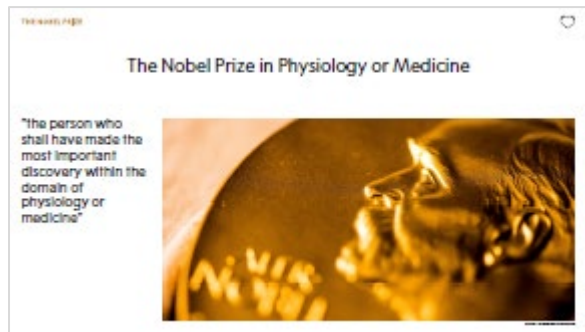


THE NOBEL PRIZE

Speaker's manuscript – 2024 medicine prize MicroRNA and its function

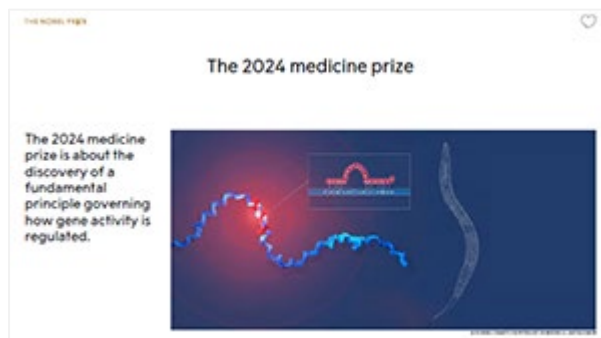
The Nobel Prize in Physiology or Medicine

- The Nobel Prize in Physiology or Medicine is one of the five prizes founded by Alfred Nobel and awarded on 10 December every year.
- Before Alfred Nobel died on 10 December 1896, he wrote in his will that the largest part of his fortune should be placed in a fund. The yearly interest on this fund would pay for a prize given to “those who, during the preceding year, shall have conferred the greatest benefit to humankind.”
- The Nobel Prize in Physiology or Medicine is thus awarded to people who have either made a discovery about how organisms work or have helped find a cure for a disease.



The 2024 medicine prize

- The 2024 medicine prize is about the discovery of a fundamental principle governing how gene activity is regulated – namely, which proteins each kind of cell chooses to produce. The laureates' pioneering discovery uncovered a new dimension to gene regulation that has been shown to be of vital importance to the way organisms develop and function.



2024 medicine laureates

- The prize is awarded to two researchers, Victor Ambros and Gary Ruvkun. Both are geneticists who are interested in how cells are formed and develop. They met in the 1980s and worked in the same research laboratory.



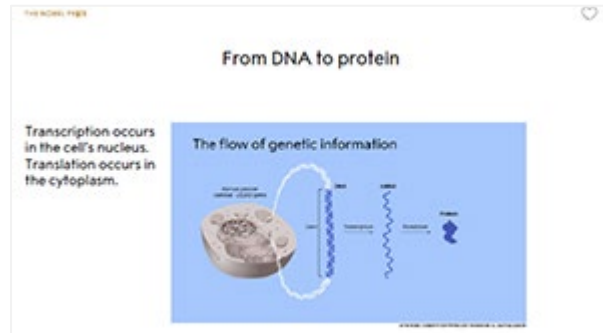
THE NOBEL PRIZE

They went separate ways after that, but each continued doing his own research. Although they worked at different universities, they maintained contact and shared their results with each other.

- Victor Ambros works at the University of Massachusetts Medical School in the United States.
- Gary Ruvkun works at Massachusetts General Hospital and at Harvard Medical School in the United States.

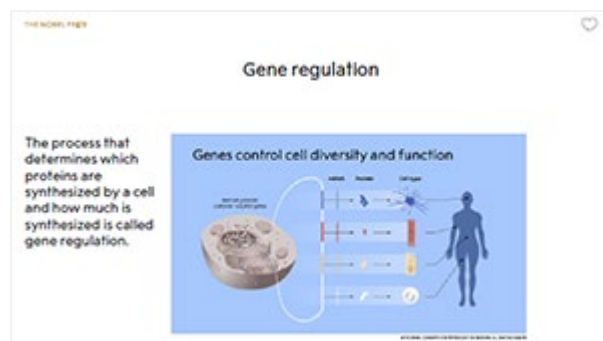
From DNA to protein

- Human beings are made up of 50–70 trillion (trillion = 10^{12}) cells. The nucleus of each cell holds our DNA, which is made up of 46 DNA molecules. In order for these to all fit, each molecule is packed tight into the form of a chromosome. Thus, each human cell has 46 chromosomes.
- Certain parts of a DNA molecule serve as recipes for the synthesis of specific proteins. These parts are what we call genes. Each DNA molecule includes several different genes – several different protein recipes.
- The DNA molecules never leave the cell nucleus. In order to get the genetic information out of the nucleus to the ribosomes, which make proteins, there is a process called transcription. First the information is transferred from the DNA to mRNA (messenger RNA). Then the mRNA molecule is transported to the ribosome, where the mRNA is translated into a specific protein. This protein is folded and transported out of the cell to perform its particular function somewhere in the body.



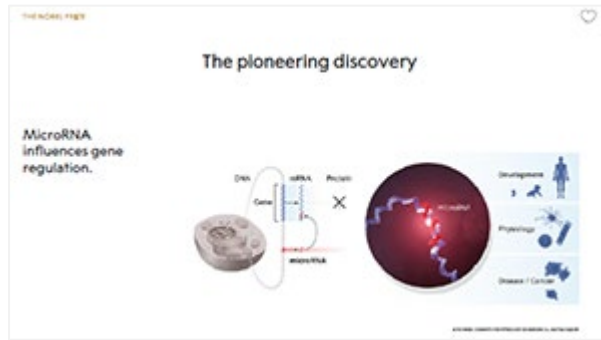
Gene regulation

- Our bodies are made up of many different types of cells, such as nerve cells, muscle cells, intestine cells and white blood cells. Because every cell includes all 46 chromosomes, each one has all the recipes for making all the proteins the body needs.
- However, the cells have different functions. For each type of cell, only the genes that produce the specific proteins those cells need are active. In other words, each type of cell works from a particular recipe. The process that determines which proteins are synthesized by a cell and how much is synthesized is called gene regulation.



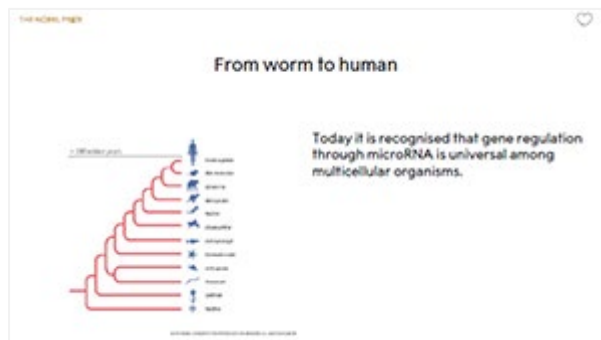
The pioneering discovery

- Through their discoveries, the two medicine laureates have described a new layer of gene regulation. They discovered that DNA molecules also include genes with the codes for very short RNA molecules, which they called microRNA.
- The laureates also discovered that each microRNA binds to a specific site on an mRNA molecule, and this inhibits the translation of the specific gene encoded at that site on that mRNA molecule. At the same time, there are other mRNA molecules that don't have that microRNA attached, so the translation can occur – in other words, that gene is expressed. In this way, the cells can fine-tune gene regulation and the type and amount of proteins produced.
- Gene regulation through microRNA is vital for keeping the body's functions working in balance.



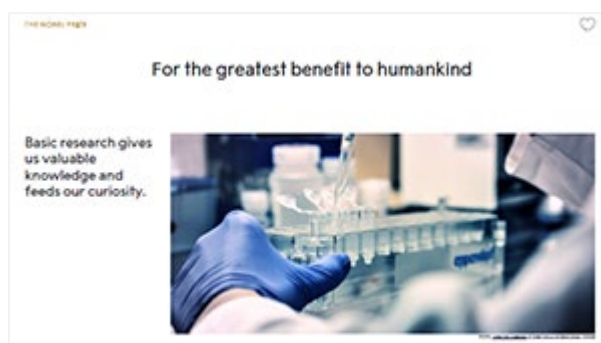
From worm to human

- Victor Ambros and Gary Ruvkun began their research by studying *C. elegans*, a one-millimetre-long roundworm. Though it is extremely small, it still has many of the cell types found in much more advanced organisms, including humans.
- Only when they discovered that microRNA is also found in humans and other complex animals did they attract the attention of the rest of the research world.
- Today we know that there are more than a thousand different genes for microRNA in humans and that gene regulation through microRNA is universal among all multicellular organisms.



For the greatest benefit to humankind

- The laureates' research has given us knowledge of a previously unknown mechanism. Gene regulation through microRNA has existed for hundreds of millions of years and made possible the development of increasingly complex organisms. From genetic research, we now know that mature cells and tissue do not develop normally without microRNA.



THE NOBEL PRIZE

- This year's prize is awarded for basic research – that is, for research that has no direct application. The purpose of basic research is to expand our knowledge and understanding and to satisfy our curiosity. Applied research, on the other hand, can be applied directly toward an end such as curing a disease.

“It’s a completely new physiological mechanism. Completely out of the blue.”

- In an interview given in conjunction with the announcement of the 2024 medicine prize, Professor Olle Kämpe commented on the discoveries that are being recognised with this year's prize. “They were looking at two worms that looked a bit funny and decided to understand why,” he said. “And then they discovered an entirely new mechanism for gene regulation. I think that’s beautiful.”

