

Marshall Warren Nirenberg Biography

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Biography

Marshall Nirenberg is best known for first determining a relationship between a genetic code triplet (a *codon*) and its corresponding amino acid. He followed this by deciphering most of the entire genetic code, independent of the work of **Har Gobind Khorana**. For his work, Nirenberg shared the 1968 Nobel Prize for physiology and medicine with Khorana and Robert Holley.

Nirenberg was born in New York City, New York. After receiving bachelor's and master's degrees from the University of Florida, he earned his doctorate in biological chemistry from the University of Michigan in 1957. He then joined the U.S. National Institutes of Health, where he has spent his career.

When Nirenberg began his work, it was already known that a series of three nucleic acid nucleotides (or bases) carry the instruction that specifies a single amino acid. These three bases make up a codon. Messenger ribonucleic acid (mRNA), in the form of a triplet of bases complementary to the codon (called an *anticodon*) carries the DNA information from the DNA to ribosomes in the cytoplasm. The mRNA then binds with the ribosome. Proteins begin to be constructed when transfer ribonucleic acid (tRNA) binds with mRNA.

Nirenberg and his colleague J. H. Matthaei set out to determine which codons coded for the twenty amino acids necessary for protein production. First they synthesized artificial RNA (first developed by Severo Ochoa) composed entirely of the RNA nucleotide uracil (U) so that the only possible codon was UUU. Then they introduced the artificial RNA into a solution of ground bacteria containing all components: DNA, amino acids, enzymes, etc. The mixture produced phenylalanine, leading Nirenberg to conclude that UUU coded for this amino acid. This experiment was repeated for all possible combinations of codons. Using a combination of statistical analysis and chemical processes, Nirenberg and his colleagues found that some codons produced the same amino acid and that some did not code any amino acid. Chemical analysis showed that almost all of the 50 codons whose amino acids he predicted were accurate. Nirenberg and Philip Leder also showed that the three bases which make up a codon of tRNA must be in a specific order to bring the correct amino acid to the ribosome.

Besides the Nobel Prize, Nirenberg has also been honored by the National Medal of Science in 1965 and membership in the National Academy of Sciences in 1967.