

Jacob-Monod Hypothesis Encyclopedia Article

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Jacob-Monod Hypothesis

In 1961, François Jacob and Jaques Monod, two French biologists, publicized their two part theory that was later coined the Jacob-Monod hypothesis. They postulated that ribosomes were not manufactured anew each time a protein was made and that the ribosomes did not contain the template necessary for the manufacture of the chains of amino acids and hence the proteins.

Jacob and Monod proposed that ribosomes are general structures which, when supplied with the appropriate instructions, can manufacture any proteins. They are merely assembly areas. Primary to the hypothesis was the idea that each deoxyribonucleic acid (DNA) cistron (a length of functional DNA) produced a short-lived piece of ribonucleic acid (RNA). The produced RNA would have the amino acid sequence coded within its nucleotide sequence and would then move from its production site within the nucleus to the main body of the cell. Once there, it would join into temporary association with a ribosome, and then the ribosome would read the message on the RNA and use the information contained to produce a protein. Because of its specialized role in the cell, this type of RNA was termed messenger RNA (mRNA). After the manufacture of several molecules of protein, the mRNA template becomes worn out and the molecule disassociates. This allows the ribosome to accept another piece of mRNA and produce another protein.

The Jacob-Monod hypothesis accommodated the observed characteristics of protein synthesis and the arrangement of the cell. The ribosomes were known to be constant, unchanging structures within the cytoplasm and, yet, also capable of manufacturing all the proteins necessary for the functioning of the cell and the organism as a whole. The proposal that the ribosomes were factories that worked on the blueprint, which was provided by DNA through the intermediate mRNA, aligned with what was already understood about their function. The rapid and sometimes short-lived production of protein was also explained by this theory.

At the time the theory was introduced, mRNA was not known as a separate molecule, but before the end of 1961, its existence was independently proven by several scientists. The Jacob-Monod hypothesis is now accepted as the paradigm for the processes that occur within the cell as part of the transcription and translation process.

In 1965, Jacob and Monod, along with Andre Lwoff, were awarded the Nobel Prize in physiology or medicine for their contribution to molecular biology.