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TRANSCRIPTION AND CELL MEMBRANES ROLE IN COORDINATED CELLULAR PROCESS

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ABOUT THE STUDY

Transcription typically refers to the process in molecular biology where the information in a strand of DNA is used to synthesize a complementary RNA strand. Membranes, on the other hand, are structures that enclose and protect the contents of cells and cellular organelles.

Transcription: the synthesis of RNA from DNA

Transcription is a fundamental process that takes place in the nucleus of eukaryotic cells and the nucleoid region in prokaryotic cells. It involves the conversion of genetic information encoded in DNA into RNA. This RNA, called messenger RNA (mRNA), serves as a template for protein synthesis in a subsequent process called translation. Transcription is a finely regulated process, with various factors influencing when and how often a particular gene is transcribed. It plays a critical role in gene expression and the synthesis of proteins, the building blocks of cellular structures and functions.

Cellular membranes

Cellular membranes are essential structures that define the boundaries of cells and cellular organelles. These membranes consist of a lipid bilayer embedded with proteins, creating a selectively permeable barrier that regulates the passage of substances into and out of the cell. The major components of cellular membranes are phospholipids, proteins, cholesterol and carbohydrates.

Phospholipid bilayer: The basic structural unit of cellular membranes is the phospholipid bilayer. Phospholipids have a hydrophilic water-attracting head and hydrophobic water-repelling tails. In an aqueous environment, phospholipids arrange themselves into a bilayer, with the hydrophilic heads facing outward towards water and the hydrophobic tails oriented inward, away from water.

Proteins: Integral and peripheral proteins are embedded or associated with the lipid bilayer. Integral proteins span the membrane, serving as channels, receptors or transporters. Peripheral proteins are loosely attached to the membrane surface, often involved in signaling and structural support.

Cholesterol: Cholesterol molecules are interspersed within the lipid bilayer, modulating membrane fluidity and stability. Cholesterol ensures the membrane maintains appropriate flexibility, preventing it from becoming too rigid or too permeable.

Carbohydrates: Carbohydrates are often attached to proteins or lipids on the extracellular surface of the membrane. These structures form the glycocalyx, which plays a role in cell recognition, adhesion and signaling.

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Cellular membranes are dynamic structures, allowing cells to interact with their environment, communicate with other cells, and transport essential molecules. The endoplasmic reticulum, Golgi apparatus, mitochondria and the cell membrane itself are examples of membranes within eukaryotic cells.

Integration of transcription and membranes in cellular processes

The connection between transcription and cellular membranes lies in the coordination of cellular processes. Transcription in the nucleus results in the synthesis of RNA, including mRNA, which carries the genetic code for protein synthesis. The subsequent translation of mRNA into proteins occurs on ribosomes, often associated with the Endoplasmic Reticulum (ER).

Endoplasmic Reticulum (ER): The ER, an extensive membrane network, has two distinct regions: Rough Endoplasmic Reticulum (RER) and Smooth Endoplasmic Reticulum (SER). The RER is studded with ribosomes, where the synthesis of secretory and membrane proteins occurs. These proteins are transcribed in the nucleus, synthesized on ribosomes and then translocated into or across the ER membrane.

Golgi apparatus: After synthesis, proteins move through the endomembrane system, including the Golgi apparatus. The Golgi modifies, sorts, and packages proteins for transport to various cellular destinations. Membrane-bound vesicles containing these proteins bud off from the Golgi and move to their designated locations.

Plasma membrane: The final destination for many proteins is the cell membrane. Integral membrane proteins, synthesized through transcription and translation processes, become embedded in the lipid bilayer, contributing to the membrane's structure and functionality.

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