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Molecular biology: New interdisciplinary Research Training Group investigates cellular regulation

Cell division, cell differentiation, cell repair and cell death play fundamental roles in the human organism, its development, health and reproduction. Cellular transformation processes are governed by two regulatory mechanisms: chromatin modifications and cell signaling networks. The EpiSignal Research Training Group sheds light on the hitherto little-researched interplay between these two complex systems.

The German Research Foundation (DFG) has recently approved a further Research Training Group (RTG) at the University of Stuttgart. The Research Training Group "EpiSignal – Crosstalk of intracellular signaling pathways and chromatin modification networks" operates at the forefront of molecular biology and biomedicine. "Cells are controlled by two very complex regulatory networks. As part of the RTG, we will investigate how these networks interact and thus master challenging regulatory tasks," says Prof. Albert Jeltsch from the Institute of Biochemistry and Technical Biochemistry.

Jeltsch is the spokesperson for the new Research Training Group (RTG), a collaborative effort between the University of Stuttgart and the University of Tübingen. In total, the DFG is funding ten researchers with 5 million euros over five years as part of EpiSignal. The first doctoral projects are scheduled to start work in October 2025.

Human cells contain two interconnected control and regulation systems

Cells, the fundamental building blocks of all tissues and organs in the human body, are dynamic entities. Every cell can undergo transformative processes to help the body adapt to external influences. For example, cell division facilitates growth and regeneration. Cell repair or death of damaged cells keeps the body healthy. Cell differentiation leads to the formation of specialized cells that take on different functions in the body.

The human body controls cellular processes via two regulatory systems: epigenome chromatin modifications and cell signaling networks. Chromatin modifications are chemical changes to the DNA or the "DNA packaging" of a cell. They can permanently activate or deactivate individual genes and thus stimulate cell change processes. Cell signaling networks are like a communication system within the cell. Special receivers, so-called receptors, recognize incoming signals and trigger corresponding reactions in the cell. As there are a large number of signaling pathways, the cells can react in complex ways to external influences such as growth factors or hormones. Transient signals can also trigger chromatin modifications leading to permanent genetic "reprogramming" of the cell. This enables for example the continuous production of blood cells: Growth factors stimulate the specialization of precursor cells, allowing them to consistently generate various types of blood cells through cell division.

"The hematopoietic system is just one of many examples that show how closely chromatin modifications and cell signaling networks are linked and that both networks influence each other. Together they form a meta-network controlling cell regulation. How this meta-network works has hardly been researched to date. This is where the new EpiSignal Research Training Group puts its specific focus," says Prof. Jeltsch.

New RTG researches the "meta-network" of cell regulation

How do cells react to external signals, how do they transmit information to the inside of the cell? How do environmental influences affect cell properties and the activity of genes? Why do cells react differently to certain signals? How can transient signals cause permanent changes in cellular properties? "As part of ten doctoral projects, we want to uncover the molecular mechanisms that determine the interplay between chromatin modifications and cell signaling networks. With our work, we are making a significant contribution to understanding cellular decision-making and shedding light on the fundamental mechanisms underlying these processes," says Jeltsch. The researchers will also pay particular attention to pathogenic cell changes that are responsible for the development and progression of diseases.

Strong interdisciplinary focus

The RTG "EpiSignal" adopts a strongly interdisciplinary approach, bringing together PhD students from fields such as biochemistry, cell biology, genetics, systems biology, mathematics, and computer science to collaborate closely. “Our training concept was developed precisely for this interdisciplinary approach,” says Jeltsch. “This means for example that every doctoral student is supervised by two main researchers from complementary disciplines.”

All doctoral candidates participate in a structured qualification program, which includes special lectures, seminars, conferences, summer schools and continuing education courses. The training is structured around three core pillars: comprehensive experimental and theoretical training in the disciplines represented within EpiSignal, the development of interdisciplinary skills, and personalized supervision. “Our aim is to train networked, critical and task-oriented scientists.”

Research Training Groups
The aim of Research Training Groups is to strengthen early-career researchers. They offer doctoral researchers the opportunity to complete a doctorate in a structured research and qualification program at a high professional level. In November 2024, the German Research Foundation (DFG) approved twelve new Research Training Groups (RTGs), including the RTG "EpiSignal – Interaction of Intracellular Signaling Pathways and Chromatin Modification Networks," a collaboration between the University of Stuttgart and the University of Tübingen. The twelve new Research Training Groups (RTGs) will receive funding of approximately 82 million euros over five years, starting in October 2025.

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Further information

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