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New DFG Research Training Group at the University of Konstanz

How do our genes shape the way we respond to the environment, and how does the environment, in turn, shape our genes? And can this interplay be measured to better predict health risks? These questions lie at the heart of a new Research Training Group in Toxicology at the University of Konstanz, funded by the German Research Foundation (DFG) with approximately 7,8 million euros.

For many hazardous substances, exposure limits have been established to define the maximum levels considered safe in the environment, with the aim of preventing long-term health risks. Yet individuals can react very differently to the same level of exposure: some remain healthy, while others develop serious diseases. This is because whether a substance causes harm depends on more than just the intensity and duration of exposure.

For a long time, these differences between individuals were explained mainly by their genetic makeup. It has since become clear, however, that genes are not fixed parameters: they are themselves shaped by the environment. Genetic factors can alter how the body responds to a hazardous substance, and the exposure can in turn alter genes and how they are regulated. What ultimately determines a person's risk appears to be this complex two-way interplay between genes and environment.

A more accurate risk assessment therefore requires a better understanding of this interplay and ways to measure it. In April 2027, the Research Training Group "Molecular Signatures of Genes and Environment Interplay in the Toxic Response" will launch at the University of Konstanz to address precisely this challenge. It is one of eleven new Research Training Groups whose funding was announced by the German Research Foundation (DFG) on 16 November 2026. The Konstanz Research Training Group will receive around 7.8 million euros for the first five years.

The programme brings together a strong network of partners: leading international research institutions, including Johns Hopkins University (USA), the University of Oxford (UK), and the Karolinska Institute (Sweden); major chemical and life science companies; and regulatory authorities such as the German Federal Institute for Risk Assessment (BfR).

"I am grateful to the DFG for its trust in our scientific vision and our team," says Ivano Amelio, professor of systems toxicology at the University of Konstanz and spokesperson for the new Research Training Group. "Toxicology is changing. Instead of asking only how much of a substance is harmful, we are now asking for whom it is harmful, and particularly why. In Konstanz, we have the ideal team to drive this change. Together with our academic, industry and regulatory partners, we will train a new generation of toxicologists at the forefront of this transformation."

Snapshots from inside the cell

Every cell carries a record of what it has been exposed to and how it has responded. The researchers aim to read this record. Using state-of-the-art analytical methods, they will search for molecular signatures: characteristic patterns in the genome, gene activity, metabolism and proteins that capture the state of a cell at a given moment – and with it the current outcome of the interplay between genes and environment.

The projects focus on two major groups of diseases in which this interplay is particularly important: cancer and neurological disorders. Promising signatures will first be identified in experimental models and then tested for their relevance to human disease using samples from biobanks.

Taking such "molecular snapshots" at different points in time shows not only how healthy a cell is today, but also where it may be heading. The long-term goal is to understand why people respond so differently to the same exposure, and to recognise early on who is at increased risk of disease.

"Ideally, molecular signatures could serve as reliable biomarkers for predicting harmful health effects and disease risks, adding a powerful new tool to traditional toxicological risk assessment. In the long term, this could substantially improve the protection of public health against hazardous substances," concludes Amelio.

DFG support for Research Training Groups

The new Research Training Group in Konstanz is one of eleven newly approved Research Training Groups established by the DFG to further strengthen the early stages of academic careers. Research Training Groups provide a structured research and qualification programme for doctoral researchers to complete their doctorates at a high professional level. The new Research Training Groups will be funded with a total of around 72 million euros for an initial period of five years, starting at the beginning of 2027.

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Further information

- University of Konstanz