Mercury rising: Unifying molecular principles of biological temperature sensing

Project ID: 319

Supervisory team

Main supervisor: Dr Vinod Kumar (University of Exeter)
Second supervisor: Dr Jonathan Phillips (University of Exeter)

Host institution: University of Exeter (Streatham)

Project description: Temperature is an important environmental factor that can profoundly impact cellular processes, physiological outputs, timing of life cycle events, and adaptive responses. Sensing and appropriately responding to these fluctuations is essential for maintaining cellular homeostasis. As sessile organisms, plants must detect and respond to even subtle temperature changes to optimize cellular functions, growth and development to suit the prevailing conditions as well as drive stress adaptations. But how do plants sense temperature? How do thermosensors influence biochemical and molecular dynamics across scales? These are fundamental questions that remains to be fully understood.While several molecules have been implicated in coordinating plant responses to temperature changes, the core principle of thermosensing in plants is still unknown. This project aims touncover that principle by investigating both established temperature-sensing molecules and novel thermosensory proteins in Arabidopsis thaliana recently identified by the Kumar lab. Through a combination of genetic, molecular, and biophysical analyses, this project will elucidate the molecular mechanisms of temperature sensing at the atomic level. The study will explore how these molecular events are transduced into biochemical signals, driving cellular responses to adapt to the thermal environment. Using advanced analyses of protein structural dynamics under varying temperatures, we will directly observe and explain at a sub-molecular level the biophysical principles that underpin temperature sensing. This atomic level understanding will address fundamental questions in biology and enable the engineering of biological systems to create temperature-sensitive switches. This knowledge will also pave the way for developing strategies to enhance climate resilience.Student training opportunities: In this multidisciplinary project the student will have the opportunity to develop a wide range of scientific and technical skills. These include molecular biology, genetics, plant phenotyping, structural proteomics, next generation sequencing, and bioinformatics. The student will be given full training in all technical and analytical aspects of the project. The project can be tailored according to the scientific interests of the student. In addition to the project specific elements, the student will receive generic training in Exeter, and discipline- specific training via training events. We are seeking a highly motivated and enthusiastic candidate with a strong interest in fundamental biology. A background in plant biology and/or molecular biology and bioinformatics would be desirable. Training will be provided in all techniques required for the project, but some practical experience in these techniques will be an advantage.

Our aim as the SWBio DTP is to support students from a range of backgrounds and circumstances. Where needed, we will work with you to take into consideration reasonable project adaptations (for example to support caring responsibilities, disabilities, other significant personal circumstances) as well as flexible working and part-time study requests, to enable greater access to a PhD. All our supervisors support us with this aim, so please feel comfortable in discussing further with the listed PhD project supervisor to see what is feasible.