Molecular mechanism and evolution of GNOM function in plant development

The development of a plant body, i.e., growth and the acquisition of an increasingly more complex body plan, is controlled by the plant hormone auxin. Local accumulation of auxin provides a signal which triggers cells to grow and divide in order to create new organs, for instance leaves, roots, or flowers. Similarly, inside developing organs such as leaves, channels of auxin flow instruct which cells should differentiate into vascular tissue, later visible on adult leaves as meticulously arranged veins. To create these instructive accumulation patterns during development, auxin is actively and directionally transported from cell to cell in a process known as polar auxin transport. Polar auxin transport is made possible by auxin transporters called PINs, which are found in plasma membranes of individual cells. PINs are often present only on a single cell side, and it is thanks to this crucial feature known as polarity that they help accumulate auxin at an appropriate time and place during development.

Studies of the mechanism of how PIN polarity, polar auxin transport, and ultimately, development instructed by auxin works revealed an important cellular regulator named GNOM with fundamental roles in these processes. GNOM has been named so due to the miniature and misshaped appearance of mutants lacking this protein, which are unable to correctly place organs, organize vascular tissue, and ultimately, grow and develop. To date, it is known that GNOM supports plant body development by, among other activities, instructing and coordinating PIN polarities of individual cells. To achieve this, GNOM likely regulates certain intracellular vesicular trafficking processes, but details of this mechanism are not well understood.

The mechanism of shaping the plant body by auxin and its regulated flow has been described in the model plant *Arabidopsis thaliana*, which belongs to flowering plants, the main plant group covering Earth's landmasses today. Yet, studies on plants which first conquered land in the distant past, such as mosses, indicates that plants began using auxin and its polar transport by PINs to shape their bodies already at the early stages of their evolution. However, it remains unknown whether these evolutionarily older plant groups employ regulators similar to GNOM to control these processes.

This project aims to provide a better understanding of how GNOM functions on the molecular level to support plant body development, and of how this GNOM function evolved in plants. To achieve this, the molecular environment of GNOM consisting of unknown proteins involved in its activity will be identified and characterized in *A. thaliana*. The evolution of GNOM will be studied by testing whether the various presumed GNOM isoforms found in diverse plants can substitute for GNOM in *A. thaliana.* This evolutionary comparison will also reveal the most important amino acid residues in GNOM protein necessary for its activity. Finally, to shed light on the involvement of GNOM in shaping morphologically diverse plant bodies throughout evolution, mutants of this regulator will be created and studied in distinct plant types such as grasses and moss.