Prof. Dr. Annette Upmeier zu Belzen
Biology Education

Department of Biology, Faculty of Life Sciences,
Humboldt-Universität zu Berlin

Unter den Linden 6, 10099 Berlin
annette.upmeier@biologie.hu-berlin.de

Annette Upmeier zu Belzen is a Professor at the Faculty of Life Sciences at Humboldt-Universität zu Berlin, and head of the Biology Education research group. She earned her State Exam in Biology, Education, and Psychology and her doctoral degree at Westfälische Wilhelms-Universität Münster. She is a member of the Interdisciplinary Centre of Educational Research and the Humboldt-ProMINT-Kolleg. Annette Upmeier zu Belzen works on processes of scientific inquiry, e. g., on models and modeling by using large-scale assessments and individual diagnosis, videos, eye tracking devices, think aloud protocols in combination with investigations on validity.

Scientific Reasoning in Model Construction and Model Application

Since modeling generates understanding of complexity, it is important for reasoning on biological phenomena. Modeling is conceptualized as the iterative process of model construction and application. Model construction is the retrodictive part of modeling where preliminary plausible explanations for a phenomenon are generated and selected. These explanations are understood as models. Model application is the predictive part of modeling where empirical evidence on the models' explanatory power is generated by deriving hypotheses and testing them with scientific inquiry methods.
Model construction connects to abductive reasoning which is described as the generation of and selection between causal explanations for a phenomenon by referring to creativity and prior knowledge. *Creative abduction* refers to phenomena where explanations for the phenomenon are not known to the modeler. Thus, in creative abduction, modelers need to generate novel explanations. This means that modelers transfer their knowledge from other phenomena to construct a plausible explanation, e.g., by creating analogies. In *selective abduction*, modelers refer to knowledge-based approaches that might plausibly explain the phenomenon, but they need to apply their knowledge to select the most plausible ones.
Our work aims at examining the relevance and kind of knowledge for creative and selective abduction in biological model construction. This will help to further explore how biological content knowledge affects model construction and the transition from model construction to model application for biological phenomena which is a basis to generate inferences on how to foster learners' engagement in modeling biological phenomena.