In the domain of biology, particularly genetics, students are faced with the task of constructing working knowledge of subcellular processes like meiosis, the process that underlies Mendelian inheritance. Learning about such processes entails constructing models of how specific entities interact primarily from verbal descriptions, conventionalized diagrams, and visible manifestations of these processes. Here I report on results from two studies that bear on the issues of the role played by diagrams in reasoning about subcellular biological processes and the coevolution of process knowledge and diagrammatic skill. The first study resulted in the characterization of diagrammatic reasoning behaviors, including knowledge-dependent representational variability and systematic use of diagrams as “tools to think with” while reasoning, displayed by nine individuals with sophisticated understandings of meiosis. These results and their implications were explored in greater depth in the second study which included meiosis-reasoning interviews with six students who had varying degrees of instructional experience in the domain. The second study resulted in the characterization of diagrammatic tool use, the coevolution of meiosis knowledge and diagrammatic skill, and the development of knowledge-dependent representational variability. Major implications of this research are two-fold. With regard to biology education, the results support and provide guidelines for the design of instruction and assessment that explicitly deal with currently neglected diagrammatic skills. More broadly, these results provide a detailed empirical account of the role played by diagrams in learning and reasoning. (Orig.)

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