What microbes can model

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Abstract

For the session: Microbes as Model Organisms (Bolker, O'Malley, Velicer, Travisano) We can learn much from microbial models. They are a powerful tool for studying evolution and ecology, because they enable studies of large populations over thousands of generations, and correlation of changes in ecological roles, individual phenotypes, and genomes. Microbes can model developmental phenomena that occur at cellular and intercellular levels within more complex organisms. Microbes can be selected or engineered to exhibit specific behaviors or functions that take place naturally in embryos; these phenomena can then be analyzed in a simpler, more accessible context. Finally, *in vitro* populations that represent naturally-occurring microbial communities (especially those of clinical significance) offer a substrate for experiments that enhance understanding of natural microbiota. What we learn about these populations in the laboratory can inform clinical strategies to monitor and manipulate microbial communities with key roles in health and disease. Each of these cases highlights specific questions about how we use models in different contexts; microbial models thus offer tractable, powerful systems not only for biological research, but also for framing epistemological issues common to all model-based science. One is the balance between tractability and representation: although the simplicity of microbial models makes them tractable, it constrains their ability to represent the full complexity of larger-scale organisms and ecosystems. Microbes' predominantly clonal reproduction offers practical advantages, but limits their power to model evolutionary processes that entail sexual reproduction. Exploring the tradeoffs between tractability and representation in microbial systems can yield generalizable insights: microbes thus serve as models for epistemological as well as biological research.

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