What is a 'hypothesis' in contemporary biology?

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Abstract

Indistinct conceptions of 'hypothesis' account for much confusion about the epistemology of contemporary biological research. Systems biology-particularly the omics disciplines (genomics, proteomics, metabolomics and the like)-challenges the received notion that all science is hypothesis-driven. Closer examination reveals multiple levels at which hypotheses or alternate-drivers can operate. Elsewhere I have suggested that contemporary biological research can be broadly categorized as either hypothesis-driven or non-hypothesis-driven. The latter is comprised of at least two subcategories, system-driven and data-driven. In system-driven research the complexity of a biological system is addressed directly; in data-driven research a collection of data already assembled is interrogated to find new information 'hidden' there. Omics research is system-driven research, ostensibly without a hypothesis. Yet, when asked, the omics researcher will contend that s/he has a hypothesis. Typically it is something like "there are numerous unidentified proteins in this system" or "multiple genes contribute to this cellular process". I propose that biological research involves a hierarchy of 'hypotheses'. First, as Kuhnian normal research, the research enterprise has a hypothesis locating it within its research paradigm. Secondly, it features what I call a *hunch* hypothesis: a broad motivation of the research project. Finally, there is an operational level immediately proximate to experimental design. For hypothesis-driven research, a detailed hypothesis governs experimental design. For system-driven research, the system being investigated directly informs experimental design. The character of 'hypothesis' in biology has been elusive because multiple layers of hypothesis are at work; however, what really counts is what governs experimental design.

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