What does represent and what models (and others) represent

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Almost all arguments by philosophers arguing on the problem of representation, "what is scientific representation?" (e.g., Bailer-Jones 2003; Contessa 2007; Suarez 2004) refer to Hughes (1997, S325) by citing "[t]he characteristic -perhaps the only characteristic- that all theoretical models have in common is that they provide representations of parts of the world, or of the world as we describe it". Thus representation is important for considering scientific models because it is a necessary condition of them. I agree with Hughes and other philosophers in that all models probably represent something, and if scientific models did not represent anything, that would be useless. However, first, something other than scientific models represents the real world: Our minds can represent the real world and we have mental representation (e.g., Callender & Cohen 2006). Although mental representations are not scientific, we can also have scientific representation in different ways. According to Weisberg (2006), we can directly represent the real world in some cases not by using scientific models while scientific models indirectly represent the world. Moreover, scientific hypotheses also can represent the real world in a direct way: Phylogenetic trees are expected to represent the past evolutionary pattern while they are estimated hypotheses. Second, what scientific models or theories represent may be different among models and their users. Neutral or false theories, models and hypotheses (Nitecki & Hoffman 1987; Hubbell 2001; Wimsatt 1987) in biological sciences are not always expected to represent the real world. Moreover, models constructed on the assumption that they represent the real world can have different construals depending on users (e.g., Godfrey-Smith 2006): Some interpret a model as representing a causal mechanism of the phenomenon while others interpret the same model as a device for prediction. Through examining these arguments and some specific examples in biology and psychology, I will investigate the question of scientific representations in terms of what does represent the real world and what scientific models or others do represent.