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Modeling the mammalian circadian clock CRAIG JOLLEY, HIROKI UEDA, RIKEN Center for Developmental Biology, Laboratory for Systems Biology — In biology, important processes often depend on a temporal schedule. The 24-hour periodicity of solar illumination caused by the earth's rotation has consequences for environmental factors such as temperature and humidity as well as ecological factors such as the presence of food, predators, or potential mates. As a result, many organisms have evolved to develop a circadian clock that allows them to anticipate these environmental changes in the absence of direct temporal cues. In recent years, extensive efforts have been made to deconstruct the biological clockwork from various organisms, develop mathematical models of circadian function, and construct synthetic analogues to test our understanding. My present work has two major foci. First, we have used regulatory principles revealed by recent experimental work to construct a model of the core genetic oscillator of the mammalian circadian system that captures key system-level behaviors. Second, we are exploring the possibility of a post-translational phosphorylation-based oscillator that is coupled to the core oscillator, conferring enhanced robustness and stability on the complete system. A simple model of this post-translational oscillator reveals key design constraints that must be satisfied by any such oscillator.

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