

Sleep- What is it good for?

Sleep is highly conserved throughout evolution. Indeed, even single-cell organisms exhibit circadian-like cycles that dictate a “wake” and a “sleep” state. The precise role of sleep remains a contentious topic in neuroscience even though the importance of “quality sleep” is becoming increasingly recognized as a critical contributor to general health, neurological disorders, and mortality. A pervasive view argues that sleep in higher organisms takes place exclusively for the benefit of the CNS (e.g. *Hobson JA (2005) Sleep is of the brain, by the brain and for the brain. Nature 437:1254–1256.*), where the “classic” view of sleep function describes the plasticity-mediated consolidation of memories through the pruning of synapses; in other words “we dream to forget” (*Crick, F and Mitchison, G (1983). The function of dream sleep. Nature, 304, 111–114.*). However, a highly publicized finding in 2013 (*Science. 2013 Oct 18;342(6156):373-7*) posits that sleep facilitates increased clearance of toxins from the brain; thus arguing that the restorative function of sleep is mediated via the removal of neurotoxic compounds.

You are required to evaluate what is known about the role of sleep (circuitry, physiology, plasticity, and molecular biology), identify and discuss an area of controversy in sleep research, and discuss the potential implications of disrupting a gene known to regulate circadian rhythm in the context of what is known about sleep.

Your answer will be in the form of a four-part response:

- 1) Critically review and discuss the neurological circuitry and molecular biology underlying sleep (30%)
- 2) Discuss the two opposing views on the role of sleep (e.g. toxin clearance versus synaptic pruning) and address the following question in your discussion: are these functions mutually exclusive or can such seemingly disparate mechanisms serve similar purposes? (30%). Clearly state your position and provide references from the literature supporting your stance.
- 3) There are a plethora of disorders that affect sleep, and the pathobiology and etiology of these disorders provide insight in to the regulation and function of sleep. Familial advanced sleep-phase syndrome (FASPS) is caused by a genetic mutation in the clock protein *Per2*. Moreover, disruption of *Per2* is associated with neurological disorders such as autism spectrum disorders (ASD). Briefly discuss the molecular mechanisms by which *Per2* regulates sleep and the consequences of *Per2* disruption (20%)
- 4) Based on your review of the literature and response to the above questions, provide a hypothesis describing how changes in *Per2* function may contribute to ASD. State your hypothesis clearly and provide empirical support for your hypothesis (20%).

Additional details:

Please limit your answer to 10-15 pages, double spaced, excluding references.

Be sure to support your statements with proper literature citations.