The role of sleep in brain development

February 21 2010

At the annual meeting of the American Association for the Advancement of Science, Marcos Frank, PhD, associate professor of Neuroscience at the University of Pennsylvania School of Medicine, will present information on early brain development and the importance of sleep during early life when the brain is rapidly maturing and highly changeable.

Building on his research that the brain during sleep is fundamentally different from the brain during wakefulness, Dr. Frank has found that cellular changes in the sleeping brain that may promote the formation of memories. "This is the first real direct insight into how the brain, on a cellular level, changes the strength of its connections during sleep," Frank says.

When an animal goes to sleep it's like a switch is thrown, everything is turned on that's necessary for making synaptic changes that form the basis of memory formation. The team used an animal model of cortical plasticity - the making and breaking of neural connections in response to life experiences. They found that once the brain is triggered to reorganize its neural networks in wakefulness (by visual deprivation, for instance), intra- and intercellular communication pathways engage, setting a series of enzymes into action within the reorganizing neurons during sleep.

The key cellular player in this process is a molecule called N-methyl D-aspartate receptor (NMDAR), which acts like a combination listening post and gate-keeper. It both receives extracellular signals in the form of

glutamate and regulates the flow of calcium ions into cells.

"As soon as the animal had a chance to sleep, we saw all the machinery of memory start to engage." Frank will discuss recent experiments and how these relate to memory formation at the molecular level, why humans need sleep, and why they are so affected by the lack of it.

Provided by University of Pennsylvania School of Medicine