
Non-rapid Eye Movement and Rapid Eye Movement Sleep

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Sleep is a naturally reoccurring state in which there is an absence of conscious awareness, a marked reduction in response to sensory stimuli, and a substantial change in voluntary muscular activity ranging from decreased activity to the marked atonia that characterizes rapid eye movement (REM) sleep. Sleep is distinguished from hibernation, coma, or death, in that it is cyclic and easily reversible. During sleep there is increased anabolic activity, the purpose of which seems to be to promote growth and regeneration of the immune system, nervous system, and musculoskeletal system. Sleep has been observed in all mammals, birds, some reptiles, amphibians, and fish and has even been studied in invertebrates (Figures 5-1 and 5-2). In fact, much of the current understanding of sleep has come from study of sleep in the animal kingdom (Figure 5-3). The function of sleep is not completely clear and continues to be an area of significant research. Current theories regarding the function of sleep will be discussed, but in order to understand the potential purpose of sleep, it is important to study the mechanisms by which sleep occurs.

Sleep is a cyclical event and consists of non-rapid eye movement (NREM) and REM sleep phases. In a normal sleeper, these phases proceed in a relatively orderly and predictable fashion throughout the night. The normal order of sleep stages is wakefulness → N1 → N2 → N3 → N2 → REM → natural awakening (see Figure 2-23).

In normal sleep architecture, there is greater slow-wave sleep (SWS; N3) earlier in the night and proportionately greater amounts of REM sleep later in the night. The cycling of NREM and REM takes on a characteristic appearance. As the understanding of normal sleep architecture increases, it sheds light upon disordered sleep. The

study of the impact of disordered sleep has helped to clarify some of the functions of normal sleep. It is increasingly clear that the normal cycling of sleep between NREM and REM is important for normal physiological functioning. It is therefore important to understand the differences between NREM and REM sleep.

ONSET OF SLEEP

The hallmark of the onset of sleep is a behavioral disengagement from the environment and a substantial reduction in responsiveness to sensory stimuli compared to that of wakefulness. Normally sleep onset occurs when the individual enters NREM stage 1 sleep from wakefulness. It is most common to experience an increase in alpha wave activity, which occurs during drowsy wakefulness with eyes closed prior to sleep. It can be difficult to pinpoint the moment of transition into sleep unless one is attached to an electroencephalogram (EEG). Sleep is initiated as N1 sleep and transitions fairly rapidly to descending stages of sleep until one reaches N3 (consisting of N3 and N4 SWS). Infants may enter sleep going directly into REM sleep, but a normal adult sleeper never does this. In fact, if one finds onset of REM sleep immediately from wakefulness in an adult, one must consider the possibility of a narcolepsy diagnosis.

Constantin von Economo first postulated an ascending arousal system in the 1920s as a result of studies he carried out during an outbreak of encephalitis.¹ The ascending arousal system is located between the brain stem and basal forebrain that regulates sleep. von Economo established