**ASSIGNMENT**

**QUESTION 1:** DISCUSS THE PHYSIOLOGY OF SLEEP

ANSWER

Humans spend about one-third of their lives asleep, yet most individuals know little about sleep. Although its function remains to be fully elucidated, sleep is a universal need of all higher life forms including humans, absence of which has serious physiological consequences.

SLEEP ARCHITECTURE

Sleep architecture refers to the basic structural organization of normal sleep. There are two types of sleep, non-rapid eye-movement ([NREM](https://www.ncbi.nlm.nih.gov/books/n/nap11617/glossary/def-item/gl82/)) sleep and rapid eye-movement ([REM](https://www.ncbi.nlm.nih.gov/books/n/nap11617/glossary/def-item/gl98/)) sleep. NREM sleep is divided into stages 1, 2, 3, and 4, representing a continuum of relative depth. Each has unique characteristics including variations in brain wave patterns, eye movements, and muscle tone. Sleep cycles and stages were uncovered with the use of electroencephalographic (EEG) recordings that trace the electrical patterns of brain activity.

TWO TYPES OF SLEEP

Over the course of a period of sleep, [NREM](https://www.ncbi.nlm.nih.gov/books/n/nap11617/glossary/def-item/gl82/) and [REM](https://www.ncbi.nlm.nih.gov/books/n/nap11617/glossary/def-item/gl98/) sleep alternate cyclically. The function of alternations between these two types of sleep is not yet understood, but irregular cycling and/or absent sleep stages are associated with sleep disorders. For example, instead of entering sleep through NREM, as is typical, individuals with narcolepsy enter sleep directly into REM sleep

A sleep episode begins with a short period of [NREM](https://www.ncbi.nlm.nih.gov/books/n/nap11617/glossary/def-item/gl82/) stage 1 progressing through stage 2, followed by stages 3 and 4 and finally to [REM](https://www.ncbi.nlm.nih.gov/books/n/nap11617/glossary/def-item/gl98/). However, individuals do not remain in REM sleep the remainder of the night but, rather, cycle between stages of NREM and REM throughout the night. NREM sleep constitutes about 75 to 80 percent of total time spent in sleep, and REM sleep constitutes the remaining 20 to 25 percent. The average length of the first NREM-REM sleep cycle is 70 to 100 minutes. The second, and later, cycles are longer lasting—approximately 90 to 120 minutes. In normal adults, REM sleep increases as the night progresses and is longest in the last one-third of the sleep episode. As the sleep episode progresses, stage 2 begins to account for the majority of NREM sleep, and stages 3 and 4 may sometimes altogether disappear.

FOUR STAGES OF NREM SLEEP

STAGE 1

stage 1 sleep serves a transitional role in sleep-stage cycling. Aside from newborns and those with narcolepsy and other specific neurological disorders, the average individual’s sleep episode begins in NREM stage 1. This stage usually lasts 1 to 7 minutes in the initial cycle, constituting 2 to 5 percent of total sleep, and is easily interrupted by a disruptive noise. Brain activity on the EEG in stage 1 transitions from wakefulness (marked by rhythmic alpha waves) to low-voltage, mixed-frequency waves. Alpha waves are associated with a wakeful relaxation state and are characterized by a frequency of 8 to 13 cycles per second

STAGE 2

Stage 2 sleep lasts approximately 10 to 25 minutes in the initial cycle and lengthens with each successive cycle, eventually constituting between 45 to 55 percent of the total sleep episode. An individual in stage 2 sleep requires more intense stimuli than in stage 1 to awaken. Brain activity on an EEG shows relatively low-voltage, mixed-frequency activity characterized by the presence of sleep spindles and K-complexes. It is hypothesized that sleep spindles are important for memory consolidation. Individuals who learn a new task have a significantly higher density of sleep spindles than those in a control group

STAGE 3&4

Sleep stages 3 and 4 are collectively referred to as slow-wave sleep ([SWS](https://www.ncbi.nlm.nih.gov/books/n/nap11617/glossary/def-item/gl113/)), most of which occurs during the first third of the night. Each has distinguishing characteristics. Stage 3 lasts only a few minutes and constitutes about 3 to 8 percent of sleep. The EEG shows increased high-voltage, slow-wave activity.

The last [NREM](https://www.ncbi.nlm.nih.gov/books/n/nap11617/glossary/def-item/gl82/) stage is stage 4, which lasts approximately 20 to 40 minutes in the first cycle and makes up about 10 to 15 percent of sleep. The arousal threshold is highest for all NREM stages in stage 4. This stage is characterized by increased amounts of high-voltage, slow-wave activity on the EEG

**REM SLEEP**

[REM](https://www.ncbi.nlm.nih.gov/books/n/nap11617/glossary/def-item/gl98/) sleep is defined by the presence of desynchronized (low-voltage, mixed-frequency) brain wave activity, muscle atonia, and bursts of rapid eye movements. “Sawtooth” wave forms, theta activity (3 to 7 counts per second), and slow alpha activity also characterize REM sleep. During the initial cycle, the REM period may last only 1 to 5 minutes; however, it becomes progressively prolonged as the sleep episode progresses

Dreaming is most often associated with [REM](https://www.ncbi.nlm.nih.gov/books/n/nap11617/glossary/def-item/gl98/) sleep. Loss of muscle tone and reflexes likely serves an important function because it prevents an individual from “acting out” their dreams or nightmares while sleeping. Approximately 80 percent of vivid dream recall results after arousal from this stage of sleep. REM sleep may also be important for memory consolidation

**AWAKENING**

Awakening can mean the end of sleep, or simply a moment to survey the environment and readjust body position before falling back asleep. Sleepers typically awaken soon after the end of a REM phase or sometimes in the middle of REM. Internal [circadian indicators](https://en.wikipedia.org/wiki/Circadian_clock), along with successful reduction of homeostatic sleep need, typically bring about awakening and the end of the sleep cycle. Awakening involves heightened electrical activation in the brain, beginning with the [thalamus](https://en.wikipedia.org/wiki/Thalamus) and spreading throughout the [cortex](https://en.wikipedia.org/wiki/Cerebral_cortex).

During a night's sleep, a small amount of time is usually spent in a waking state. As measured by electroencephalography, young females are awake for 0–1% of the larger sleeping period; young males are awake for 0–2%. In adults, wakefulness increases, especially in later cycles. One study found 3% awake time in the first ninety-minute sleep cycle, 8% in the second, 10% in the third, 12% in the fourth, and 13–14% in the fifth. Most of this awake time occurred shortly after REM sleep.

Today, many humans wake up with an [alarm clock](https://en.wikipedia.org/wiki/Alarm_clock); however, people can also reliably wake themselves up at a specific time with no need for an alarm. Many sleep quite differently on workdays versus days off, a pattern which can lead to chronic circadian desynchronization. Many people regularly look at television and other screens before going to bed, a factor which may exacerbate disruption of the circadian cycle. Scientific studies on sleep have shown that sleep stage at awakening is an important factor in amplifying [sleep inertia](https://en.wikipedia.org/wiki/Sleep_inertia).

**QUESTION 2:** DISCUSS THE ROLE OF BASAL GANGLIA IN COORDINATING MOVEMENT

Basal ganglia are strongly interconnected with the cerebral cortex, thalamus, and brainstem, as well as several other brain areas. The basal ganglia are associated with a variety of functions, including control of voluntary motor movements, procedural learning, habit learning, eye movements, cognition, and emotion.

One of the major roles of the basal ganglia is to participate in the control of complex patterns of motor activity such as: letter writing, cutting paper with scissors, throwing a ball into a basket, adding the ball in football, many aspects of vocalization, controlled eye movements, or literally all our other skilled movements.

One intensively studied function of the basal ganglia is its role in controlling eye movements. Eye movement is influenced by an extensive network of brain regions that converges on a midbrain area called the superior colliculus (SC). The SC is a layered structure whose layers form two-dimensional retinotopic maps of visual space. A "bump" of neural activity in the deep layers of the SC drives an eye movement directed toward the corresponding point in space.

The SC receives a strong inhibitory projection from the basal ganglia, originating in the substantia nigra pars reticulata (SNr). Neurons in the SNr usually fire continuously at high rates, but at the onset of an eye movement they "pause", thereby releasing the SC from inhibition. Eye movements of all types are associated with "pausing" in the SNr; however, individual SNr neurons may be more strongly associated with some types of movements than others. Neurons in some parts of the caudate nucleus also show activity related to eye movements. Since the great majority of caudate cells fire at very low rates, this activity almost always shows up as an increase in firing rate. Thus, eye movements begin with activation in the caudate nucleus, which inhibits the SNr via the direct GABAergic projections, which in turn disinhibits the SC.