"To die, to sleep --
To sleep, perchance to dream, ay there's the rub,
For in that sleep of death what dreams may come
When we have shuffled off this mortal coil,
Must give us pause; there's the respect
That makes calamity of so long life."

William Shakespeare, Hamlet
Sleep-wakefulness, a behavioral phenomenon, is one of the many rhythmic events experienced in our daily life. Rapid Eye Movement (REM) sleep is a unique phase within the sleep-wakefulness cycle. It is an active stage within sleep that is usually associated with dreaming. REM sleep is likely to have evolved about 300 million years ago. Mention of this stage can be traced to the ancient Hindu Vedic literature the Upanishads (11th century B.C.) and to the Greek epic Vigil’s Aeneid (19th century B.C.). REM sleep occupies only 10-15% of the total sleep time in adults though it occupies about 50% of the total sleep time in neonates. It is associated with increased activity in a group of neurons, the REM-ON neurons and decreased activity in certain other group, the REM-OFF neurons. These neurons are cholinergic and noradrenergic respectively. GABAergic interneurons have been proposed to modulate the activities of these REM-ON and REM-OFF neurons for REM sleep regulation.

The functions of REM sleep have been investigated by studying the effects of its deprivation on the parameter(s) under consideration. The importance of REM sleep can be understood by the fact that its prolonged deprivation may even cause death. REM sleep deprivation causes fatigue, increased irritability, aggressiveness, reduced memory consolidation and brain maturity. It alters the activities of several enzymes like acetylcholinesterase, monoamine oxidase, 5' nucleotidase and Na-K ATPase. REM sleep deprivation is also responsible for a decrease in threshold to seizures and electroconvulsive shock. Thus, it has been proposed that one of the important and basic function of REM sleep is to maintain brain and its neuronal excitability.

The neuronal excitability is known to be maintained by the enzyme Na-K ATPase. Previous studies from this lab have reported that its activity increases after REM sleep deprivation. Na-K ATPase has also been reported to maintain cellular volume. Hence, it was proposed that REM sleep deprivation might have some effect on neuronal
morphology. Moreover, REM sleep has been reported to play a role in brain maturation. During the maturation phase, REM sleep deprivation along with visual deafferentation was reported to decrease the size of neurons. Additionally, REM sleep is affected in some diseases like depression, narcolepsy and some other neurodegenerative disorders like Alzheimer's disease. Many of these diseases are associated with neuronal degeneration in parts of the brain. Further, some of the diseases like Alzheimer's disease are associated with loss of memory. One of the functions of REM sleep is memory consolidation and memory loss has been reported after REM sleep deprivation. Thus, the loss of REM sleep (deprivation) may have a role to play in neuronal degeneration observed in these diseases.

In the following study, the effect of REM sleep deprivation on neuronal morphology and degeneration has been investigated. Further, the study has been extended to the alterations in the concentration of neurotransmitter synthesizing enzymes and structural proteins after REM sleep deprivation. The thesis has been divided into four sections: review of the literature currently available, materials and methods, results and discussion of the results based on the existing knowledge.