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**Question**

**Q1**

Discuss the physiology of sleep.

**Q2**

Discuss the role of basal ganglia in coordinating movement.

**Q1** **Physiology of Sleep**

Sleep is a naturally recurring state of mind and body, characterized by altered consciousness, relatively inhibited sensory activity, reduced muscle activity and inhibition of nearly all voluntary muscles during rapid eye movement (REM) sleep, and reduced interactions with surroundings. Sleep is a state of reduced awareness and responsiveness. The most pronounced physiological changes in sleep occur in the brain. The brain uses significantly less energy during sleep than it does when awake, especially during non-REM sleep. In areas with reduced activity, the brain restores its supply of adenosine triphosphate(ATP), the molecule used for short-term storage and transport of energy.[[](https://en.m.wikipedia.org/wiki/Sleep#cite_note-8)Sleep consists of two different phases:

* Rapid eye movement (REM) sleep; and
* Non-REM sleep or slow wave sleep

**Rapid eye movement (REM) sleep**

REM sleep, also known as paradoxical sleep, represents a smaller portion of total sleep time. It is the main occasion for dreams (or nightmares), and is associated with desynchronized and fast brain waves, eye movements, loss of muscle tone, and suspension of homeostasis. During REM sleep a person’s threshold to be aroused by external stimuli is higher than during slow-wave sleep. Heart rate and breathing become irregular during REM sleep, a feature of the dream state. The brain is extremely active during REM sleep.

**Non- Rapid eye movement (REM) sleep**

Non-REM sleep occurs first and after a transitional period is called slow-wave sleep or deep sleep. During this phase, body temperature and heart rate fall, and the brain uses less energy. The duration of REM sleep episodes is longer earlier in the night when one is most tired. As one becomes more rested during the night, the duration of REM sleep episodes decreases. During non-REM sleep the blood pressure, breathing and metabolic rate are all depressed significantly. Bodily movements do not occur during non-REM sleep. Non-REM sleep is also referred to as **slow wave sleep** as during this period the brain waves are very strong and of a very low frequency (i.e. slow). While non-REM sleep is sometimes referred to as dreamless sleep, dreams and even nightmares can occur during non-REM sleep. These are not associated with movement and are not remembered as they are not consolidated to memory during this sleep phase.

**Sleep cycles**

The sleep cycle of alternate NREM and REM sleep takes an average of 90 minutes, occurring 4–6 times in a good night's sleep. Later into the night, the REM episodes become longer and non-REM sleep becomes shorter and lighter. Non-REM sleep can be defined as stage 1, 2, 3 or 4. Stages 1 and 2 are often referred to as light sleep and stages 3 and 4 as deep sleep, slow wave sleep or delta sleep.

**Sleep Disorders**

1. Insomnia refers to an inability to have sufficient or restful sleep despite an adequate opportunity for sleep. It is a subjective problem that occurs at one time or another in almost all adults. Insomnia can be relieved temporarily by sleeping pills, especially benzodiazepines. Prolonged use of these drugs can be habit-forming and can compromise day time performance.

2. Fatal familial insomnia is a serious disorder characterized by worsening insomnia, impaired autonomic and motor functions, dementia and eventually death. It is a progressive disease that occurs in both an inherited and a sporadic form.

3. Narcolepsy refers to an irresistible urge to sleep. As mentioned in the sleep cycle, in adults the sleep onset occurs with non-REM sleep, which is followed by REM sleep. However, in narcolepsy, REM sleep is entered directly from the waking states.

**Q2**

**Role of Basal Ganglia in Coordinating Movement**

The basal ganglia exert their role in motor control through constant interaction with the c**erebral cortex** and the corticospinal pathway. They get information mainly from the cerebral cortex and send out information. Almost all the motor and sensory nerve fibers that connect the cerebral cortex to the spinal cord pass between the major masses of the basal ganglia (**nucleus caudatus** and **putamen**) and are called the internal brain capsule.

In order to execute purposeful movements, a small number of motor plans in the brain need to be promoted and integrated, while others that impair or stop the execution of the desired movement must be suppressed. Action selection is facilitated by the nature of the parallel pathways, the number of neurons involved in the processing of information as it progresses through the basal ganglia, and the manner in which these neurons are arranged. The input and output nuclei generally contain the largest and smallest numbers of neurons, respectively. As information progresses through the basal ganglia, each neuron integrates information that has been transmitted from many other neurons in preceding nuclei; hence, the signal becomes increasingly focused and specific as it passes through the basal ganglia. The process of determining which signals are promoted occurs early in the basal ganglia circuit—at the striatum; the neuromodulator dopamine plays a key role in signal promotion.

Parallel pathways within the basal ganglia circuits facilitate signal promotion and signal inhibition. Neighbouring pathways carrying information about elements of the same desired movement successively amplify the promoted signal as it progresses through the basal ganglia. More often, however, neighbouring pathways act to reduce unwanted signals, ensuring that an accurate, precise, and optimized action plan is developed. In the absence of action selection, all motor plans are promoted and many muscles around the body are activated, leading to a failure to execute desired actions.