“you should have never told me horses sleep standing up...it gave me a mental block” – Mister Ed
Brain mechanisms for sleep and attention overlap extensively. For example, the cerebral cortex, where conscious perception is realized, undergoes radical changes in the patterning of synaptic potentials (as revealed by EEG/LFP recordings) between the lowest-attention state (stage ¾ non-REM sleep) and high attention states (waking, REM sleep).

Changes in sleep/wake state and attention are sometimes mediated by groups of neurons that are highly interconnected (brainstem reticular and thalamic reticular neurons).

The classroom can be very hot.

REM sleep appears to be associated with a maximal frequency of events associated with reorientation of attention (as in a startle response) while non-REM sleep is associated with a minimal frequency of such events. The frequency of such events in the waking state lies between the two sleep states. Oddly enough, a similar pattern is observed for brain metabolism.
what do we know so far?

A definition for sleep that can be universally applied is difficult to come by. However, by combining the use of arousal thresholds, behavioral measurements (e.g., amount of movement or posture), and electrophysiological measurements a reasonably complete definition can be attained. Still, we end up with two very different forms of sleep which stand at opposite ends of the spectrum of attention.

At the core of changes in the form of cortical EEG/LFPs that accompany changes in sleep/wake state (wake, non-REM sleep stages 1-4, REM sleep), are changes in the activity of brainstem reticular and thalamic reticular neurons.

Changes in thalamo-cortical activity patterns (as measured through cortical EEG) are brought about by changes in the activity of brainstem reticular neurons and neuromodulatory neurons (ACh, NE, HA, DA, 5-HT, orexin).

Dreams occur primarily during REM sleep when cortical EEG patterns are most like those of waking. Dreams themselves appear to arise from repeated bursts of activity in brainstem reticular neurons that drive bursts of activity in the thalamus and cortex and that resemble responses seen during attentional reorientation in waking (e.g., startle responses). One hypothesis is that dreams reflect the outcome of the cortex attempting to make sense of the noisy inputs it receives in REM sleep.

The lack of conscious experience in non-REM sleep appears to result from the repeated interruptions of cortical activity associated with spindles and slow-waves. Thus, conscious experience (essentially equivalent to that to which we have attention), demands a continuity of cortical activity across time.
phylogeny: amount of REM sleep during development and adulthood is related to position along a precocial-altricial axis

ontogeny: timing and amount of different types of sleep changes across the lifespan
even slow-waves fizzle in old age
brain maturation patterns somewhat parallel changes in sleep
sleep enhances changes in degree of ocular dominance in primary visual cortex induced by monocular deprivation

Following 6 hrs of monocular deprivation (MD6), a bias develops wherein more neurons respond more vigorously to input from the non-deprived eye ( ) than to the deprived eye ( ). Undisturbed sleep (MDS) in the dark for six hours after deprivation enhances this effect to the same extent as a full 12 hours of deprivation (MD12), but sleep-deprivation over the same six hours (MDSD) suppresses it.
a newer, and certainly unproven, idea concerning the function of REM sleep as it relates to development

**genetic reprogramming**

here, activation of cortex by PGO waves is thought to strengthen connections in the brain that are genetically determined and which determine core attributes of the individual’s personality, habits and perspectives

connections strengthened, during waking, as a result of interaction with the environment would be depressed during REM sleep

as a result, REM sleep would function to maintain differences among individuals despite extensive similarity in their environmental experience