The Common Sense [senso comune], is that which judges of things offered up to it by the other senses. The ancient speculators have concluded that that part of man which constitutes his judgment is caused by a central organ to which the other five senses refer everything by means of impressibility [impressiva]; and to this centre they have given the name Common Sense. And they say that this Sense is situated in the centre of the head between Sensation and Memory. And this name of Common Sense is given to it solely because it is the common judge of all the other five senses i.e. Seeing, Hearing, Touch, Taste and Smell. This Common Sense is acted upon by means of Sensation which is placed as a medium between it and the senses. Sensation is acted upon by means of the images of things presented to it by the external instruments, that is to say the senses which are the medium between external things and Sensation. In the same way the senses are acted upon by objects. Surrounding things transmit their images to the senses and the senses transfer them to the Sensation. Sensation sends them to the Common Sense, and by it they are stamped upon the memory and are there more or less retained according to the importance or force of the impression. That sense is most rapid in its function which is nearest to the sensitive medium and the eye, being the highest is chief of the others. Of this then only we will speak, and the others we will leave in order not to make our matter too long. Experience tells us that the eye apprehends ten different natures of things, that is: Light and Darkness, one being the cause of the perception of the nine others, and the other its absence:--Colour and substance, form and place, distance and nearness, motion and stillness. – Leonardo Da Vinci
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 is very hot.

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.
the mysterious echidna, a member of the monotreme order of mammals

at first thought to be the only mammal to lack REM sleep

later, Siegel shows that echidna non-REM (slow-wave) sleep is punctuated by REM-like brainstem burst events such that sleep in the echidna is actually a mixture of REM sleep and non-REM sleep.
the basic patterns of cortical EEG/LFP activity in the cerebral cortex closely track sleep depth as assessed by arousal.

- awake with eyes open
- relaxed waking with eyes closed – ‘alpha’ activity
- stage-1 sleep – ‘transitional’
- stage-2 sleep – ‘spindle sleep’
- stage-3/4 sleep – ‘deep’ or ‘slow-wave’ sleep

Increasingly greater magnitude stimuli required for perception/arousal.
depressed activity of brainstem reticular formation neurons closely follows the production of spindle and slow-wave cortical EEG events

transitions between sleep and wake cortical EEG/LFPs involve interactions between:
- cerebral cortex
- specific thalamic nuclei
- thalamic reticular neurons
- brainstem reticular neurons
- brainstem/basal forebrain neuromodulatory neurons
the control of cortex-wide activity patterns in schematic

brainstem reticular formation

thalamic reticular nucleus

thalamus (specific nuclei)

superficial cortex (intra- and inter-region integration)

layer IV cortex (thalamic input)

deep cortex (output)

cerebral cortex in cross section

brainstem and basal forebrain neuromodulatory neurons

NE  ACh
5-HT  HA  DA
With reduction in depolarizing input from brainstem reticular neurons and neuromodulatory neurons, thalamic neurons respond to excitation by producing spindle oscillations. During non-REM sleep, when such reductions occur, thalamic reticular neurons are excited en masse by cortical neurons. The resulting spindle oscillations of thalamic reticular neurons entrain cortically-projecting thalamic neurons (of the specific nuclei).
‘PGO’ spikes differentiate the thalamic and cortical patterns of REM sleep and waking

NORMAL SLEEP

REM sleep is characterized by phasic events generated by bursting of brainstem reticular formation neurons – these ‘events’ may take the form of eye movements, twitches of non-axial musculature, and/or LFP events in the lateral geniculate nucleus that are called ‘PGO waves’

Steriade et al., 1990, J. Neuroscience
PGO spikes can also be elicited in waking states, but primarily in response to surprise stimuli (such as a hand clap) that attracts attention in the form of an orienting response.
But...what makes the brainstem reticular formation and neuromodulatory systems depress to initiate non-REM sleep?

And...what makes REM sleep a ‘sleep’ state?