

What is Sleep?

Sleep – Dream and Non-dream sleep

In the 1950s, the electroencephalogram (EEG) was first used in humans to measure brain wave activity. For the first time people could record the electrical activity of the brain during sleep and wake. Scientists realised that sleep was not a uniform or passive process but changed through the night.

The different stages of sleep are now well defined and as we become sleepy, we first briefly go through stage N1 sleep. During this stage we are very easy to wake and may not even realise we are asleep (or deny it if prodded while we are dozing in front of the television!). We then go into N2 sleep which has some specific EEG changes called sleep spindles and K complexes. This is still a light sleep stage from which we can easily be wakened. After about 30-40 minutes EEG changes again with large slow waves and this is associated with our deepest stage of sleep. It is often called slow wave sleep (SWS), in the sleep lab we stage it as N3. Heart rate, breathing and blood pressure are all at their lowest, the brain consumes least energy during this sleep stage and movements slow down. We turn and stretch every 15 minutes or so. We spend about 25% of the night as young adults in this sleep stage and this is the hardest stage of sleep to wake people from. If we are woken suddenly from this sleep stage we feel groggy and a bit uncoordinated, sometimes called “sleep drunk”. As we get older we have less slow wave sleep. This sleep stage is strongly associated with new learning and memory formation.

About 90-120 minutes into the night the EEG changes quite dramatically with fast activity that looks quite similar to the wake EEG but it comes alongside large rapid eye movements (REM). Muscle activity elsewhere in the body is switched off apart from the muscles of breathing and eye movements. Most of our dreams occur in this sleep stage, particularly the ones with strong emotion that we might remember. So although the brain is very active and dreaming, the body should be at its stillest. We spend about 25% of the night in this sleep stage as adults although newborn babies spend about 50% of the night dreaming. This is why dream sleep is also called REM sleep.

So if people come into a sleep laboratory and have an overnight sleep study (polysomnogram), we can see these changes as they move through the various sleep stages. Recording EEG through the night shows that we all change sleep states from non dream to dream to wake states every 90 minutes or so through the night. We have most of our deep slow wave sleep in the first half of the night and most of our dream sleep in the second half. This can be shown as a hypnogram (see below) and this hypnogram comes from one of our subjects in the sleep lab who has normal sleep. One thing becomes very obvious when we look at patients in the sleep lab each night; nobody “sleeps through”. Some people will perceive that they sleep all night without waking but everybody has some evidence of at least brief awakenings although it may be so brief that people do not realise they have woken. We are all most likely to wake every 90-120 minutes as we go between different sleep states. That is often why people with insomnia will describe small chunks of sleep through the night or describe the frustration of taking forever to fall asleep and then waking after 90 minutes.

Sleepstation

Typical hypnogram – a measure of how the EEG changes during a typical night of sleep.
This is an adult of 39 years of age.

W = wake

R = REM or dream sleep

N1 = the lightest stage of sleep

N2 = light non-dream sleep

N3 = deep slow wave sleep

