4

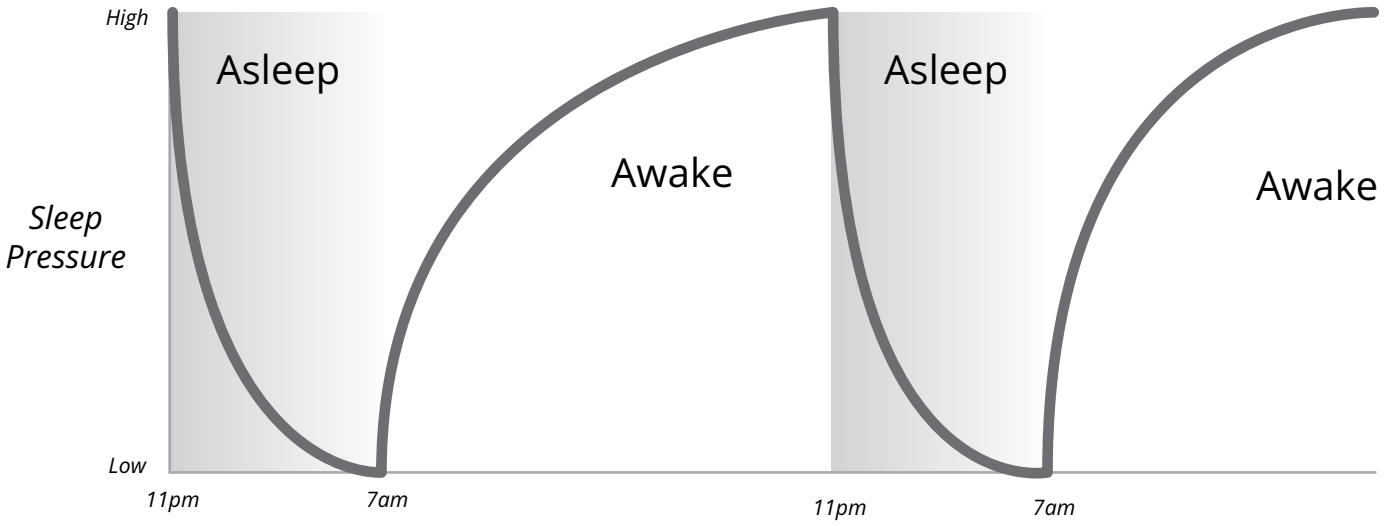
Why Do We Sleep At Night?

Now that you know what actually happens across the sleep period, let's look at what determines when we sleep. There are two biological determiners of sleep, sleep pressure and circadian rhythms.

Sleep Pressure

One process that makes us sleep operates like other biological drives – the longer you go without it, the stronger the pressure to get it. Just as the longer you go without food the hungrier you get, the longer without sleep the sleepier you will get. This is true for good sleepers as well as those with insomnia. Therefore, this sleep pressure mechanism is used in some of the therapies we describe later for Sleep Onset and Sleep Maintenance Insomnia (Chapters 10,11).

The Sleep Pressure mechanism can be illustrated in the drawing below:



If you have adequate sleep, it means that sleep pressure or drive has reduced to a very low level or close to zero. When you wake up and stay awake, sleep pressure steadily increases across the time you are awake (such from 7am until 11pm for a typical sleeper). Then when you sleep for the period from 11pm to 7am sleep pressure decreases. The decrease is rapid at first indicating

the effectiveness of the deeper sleep stages 3 and 4 in the early part of the night and less rapidly towards the end of the sleep period containing mainly lighter sleep.

The Water Bucket Model of Sleep Pressure

- The build up of sleep pressure the longer you stay awake is like the filling of a bucket with a dripping tap. When you wake in the morning, you have no sleep pressure, that is, you have emptied your 'sleep pressure' bucket. But as the day progresses sleep pressure builds as if a slowly dripping tap is steadily filling the water bucket.
- As you stay awake the water level gets higher and so does the water pressure at the bottom of the bucket equivalent to your getting sleepier.
- When you finally fall asleep, it is like opening a valve at the bottom of the bucket to release the water. With a full bucket (after a long day awake) the water spurts out of the bottom with a large force. This represents the deeper sleep in the first few hours of sleep. However, as the bucket empties over the sleep period, the water pressure reduces and the water escapes with less force through the valve at the bottom of the bucket. The water level drops more slowly, until the last bit of water just dribbles out of the bucket. This represents the lighter sleep of the last hour or two of the sleep period.

Sleep Deprivation Experiments

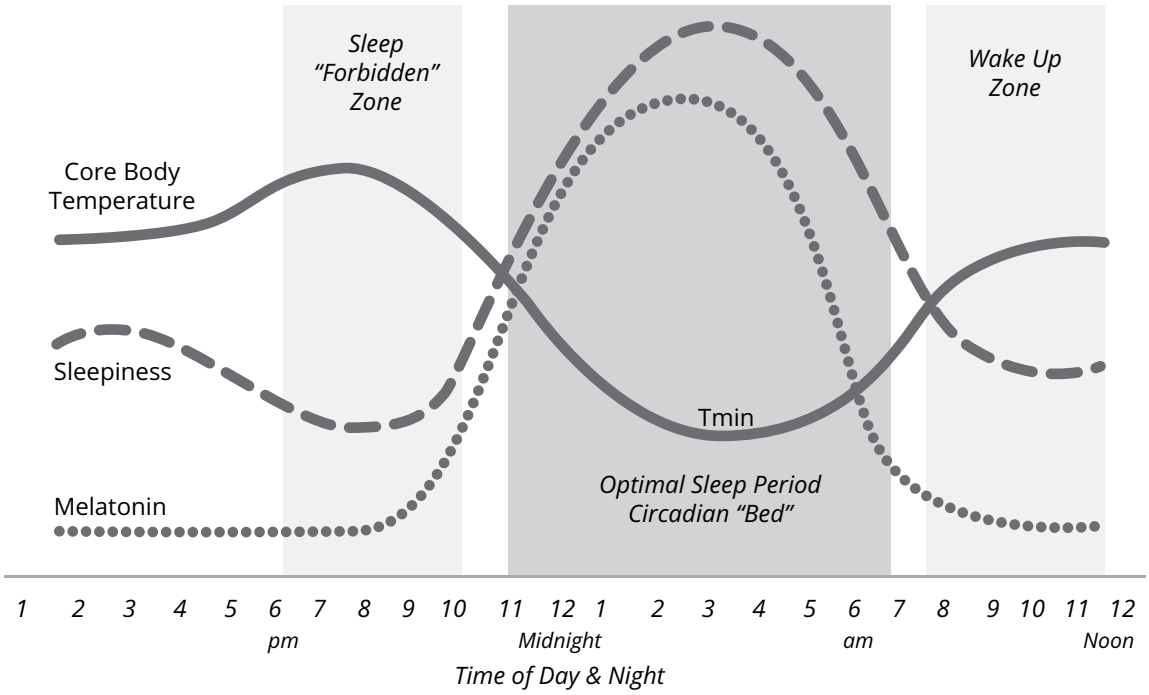
A lot of research experiments on healthy, good sleepers have been carried out to deprive them of sleep for one, two, and up to six days and nights. In fact the Guinness Book of Records lists Randy Gardner with eleven days and nights without sleep. Most of these studies have showed some detriments in mental performance tests that become more pronounced the longer the deprivation. However, these tests tend to be long and boring and require continuous attention to the test to score well. All of these performance losses can be attributed to loss of attention and micro-sleeps that are due to the increasing sleep pressure from the sleep deprivation. The obvious and pronounced effect of sleep loss is an increase in sleepiness and sleep pressure. After recovery sleep all of these effects disappear and performance returns to normal. Even Randy Gardner could still play exciting computer games at normal levels after many days of sleep loss. His recovery only required a few nights of extra sleep, much less (about 9 hours) than the amount he "lost" (90 hours).

People with insomnia also react to sleep loss in the same way. One of our own experimental studies required total sleep loss for 36 hours (from one morning to the beginning of the second night). Even though they reported an average of an hour to get to sleep before the experiment, during the sleep deprivation the time taken to fall asleep reduced down to about five minutes. Their recovery sleep on the second night was long, robust, and refreshing. Although we are not recommending this procedure since it is still experimental, we mention it to illustrate that even people with insomnia have a sleep mechanism that builds up sleep pressure with sleep loss and a subsequent recovery sleep.

Circadian Rhythms

The second biological process has an equally strong effect on our sleepiness and alertness.

- We all have a biological clock situated in our brain that influences the timing of all our bodily rhythms. Functions such as hormonal secretions, heart rate, and body temperature as well as our sleepiness and alertness vary regularly (up and down and up again) completing one cycle over a period of 24-hours. Therefore, these regular rhythms are called circadian (circa=about, dian=day) rhythms. The figure below shows the circadian rhythms of core body temperature, melatonin levels, and sleepiness across the 24-hour day for a person with a typical sleep period from 11pm to 7am.



- The timing of your circadian rhythm or body clock plays a very important role in the timing of your sleep period. For most people their body clock is timed conveniently so that they can fall

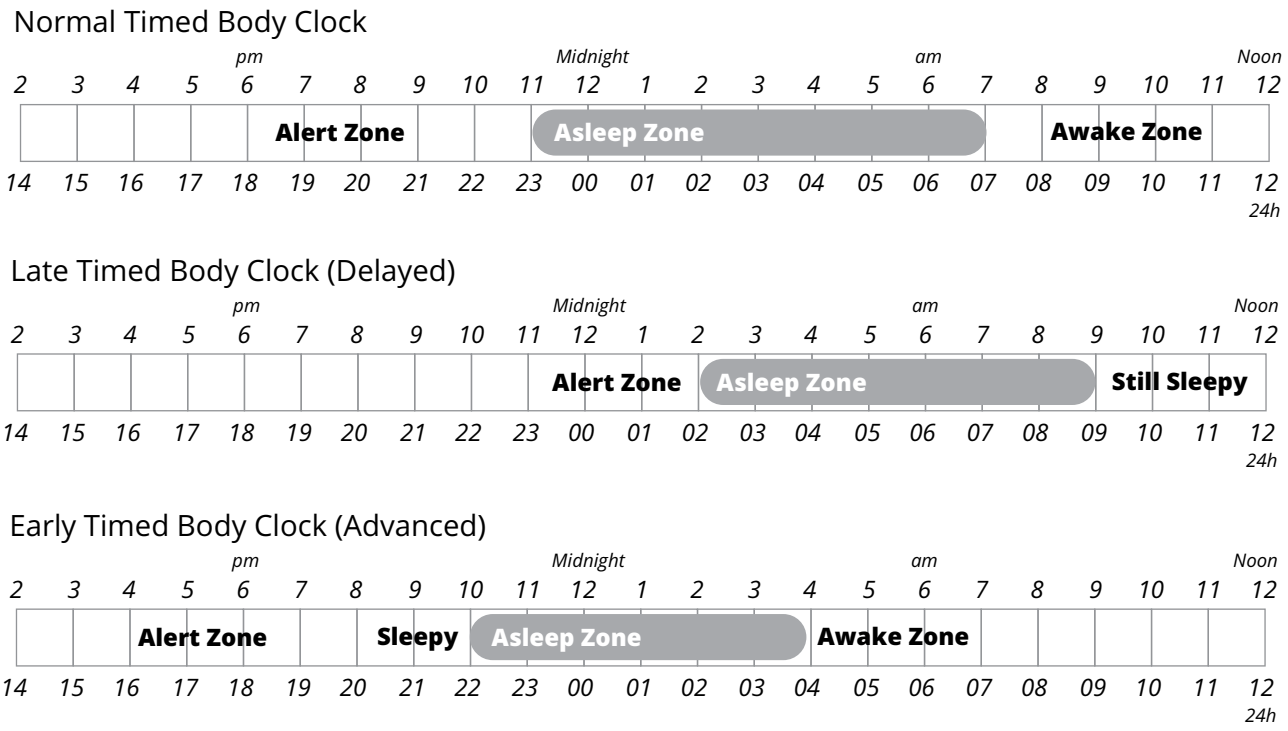
asleep easily at about 11p.m. and sleep until about 7a.m. (as in the figure above). If you are trying to sleep at a time that is not compatible with your internal body clock, this can cause a sleeping difficulty that could develop into insomnia.

- Some people have a late timed (delayed) body clock and may sleep best between, for example, 2 a.m. and 10 a.m. (as in the figure below). This can cause problems if they try to go to bed at 11 p.m. They would be trying to sleep in their later timed alert or 'Sleep Forbidden' zone, making it difficult to fall asleep. Getting up at 7 a.m. in time for work or school will also be difficult as they have only had 5 hours sleep plus they will still be in their circadian sleep zone.

On the other hand, some people have an early timed (advanced) body clock. They feel very sleepy in the early evening and usually fall asleep in front of the television. When they finally go to bed (still at an early hour), they fall asleep quickly. However, they will wake early (e.g. 3-4 a.m.) in their 'Awake' zone. They too may suffer insufficient sleep.

- Others who experience difficulties with the timing of their body clock are overseas travellers who experience jet lag and night shift workers who can have difficulty sleeping during the day because their attempted day time sleep period is 'out of sync' with their circadian body clock.

Graphical representation of the sleep patterns of a normally timed, late timed, and early timed body clock



'Owls' and 'Larks'

Not all biological clocks are set to the same time.

People who have clocks timed later are evening types, or 'owls'. Most owls enjoy the evenings when they feel the best. Perhaps that explains why they like to stay up even later - to prolong this good feeling. When attempting to get to sleep at an earlier, more conventional time, owls can find themselves lying awake for a long time before falling asleep. However, in the mornings owls tend to be lethargic and sleepy and only become gradually more alert and energetic later in the day. People with a late body clock may have Delayed Sleep Phase (see chapter 7 – Sleep Onset Insomnia). This is particularly a problem for those who wish to fit into the 9 a.m. to 5 p.m. daytime schedule but find it very difficult to do so. The owl is consulting with friends on his Wi Fi screen device late at night with the likely result it will delay his body clock even further.

People with a clock that has an early setting are called 'larks' or morning types. They have the opposite experience. They tend to feel most alert and energetic in the morning soon after waking. However, they get sleepy and lethargic in the evenings and enjoy going to bed early. They may have a sleep problem of waking earlier than intended and not get sufficient sleep. These individuals may have Advanced Sleep Phase (see chapter 8 – Early Morning Awakening Insomnia).

❓ *Questions?*

We invite you to contact us with any questions relating to the content of this book:
http://re-timer.com