

## ***PHYSIOLOGY & DEVELOPMENT (Module 2)***

### ***Lesson 2: Physiology of Sleep***

In this lesson, I will give you an overview of the physiology of sleep, so you can better understand why we suggest certain things and discourage others when we get more into the practical steps in this course.

During the first 6 months of life, there are some major changes that take place in a baby's brain that drastically affect their biological sleep mechanisms. Because many ongoing sleep issues stem from these physiological changes, understanding the basics of key developments will help you to understand your child's current sleep issues, even if your child is already over 1 year old.

#### **Circadian rhythm & homeostatic sleep drive**

The circadian rhythm & homeostatic sleep drive are the two main forces that regulate your child's sleep rhythm. The circadian rhythm is your child's internal biological clock, which is primarily reset and regulated by external factors such as light-darkness, timing of meals, social interaction, alarm clocks, etc (these are called "Zeitgebers" meaning "timer-tellers" in German). The homeostatic sleep drive on the other hand is understood simply as the internal pressure that naturally builds up in the body the longer your child is awake. This sleep drive also regulates the length and depth of sleep - that means, the longer your child is awake, the more tired they become. These two forces, the externally regulated circadian rhythm and the internally regulated homeostatic sleep drive, are what work together to control your child's sleep processes.

#### **Hormones and sleep**

- ***Melatonin***

There are various hormones that help our babies regulate sleep, and melatonin is one of the most important ones. Melatonin is only produced in the dark. A child's melatonin release is regulated by exposure during the day to light and dark, so that they naturally begin to feel tired at bedtime as the sun goes down. We can use this to our advantage by creating a sleep-conducive environment for your little one to sleep in! But more on that in Module 3.

- ***Serotonin***

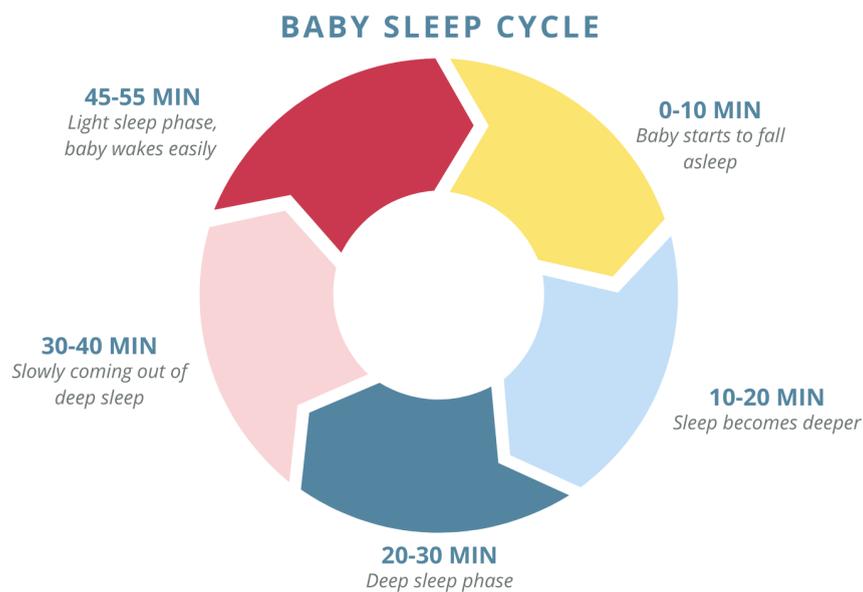
Serotonin, a mood boosting hormone also known as "the happy hormone", is another key ingredient involved in the regulation of sleep. Production of serotonin is encouraged by exposure to sunlight. As it gets dark, serotonin is converted into melatonin. So, practically speaking, a great way to encourage good sleep is to get out and about when your child is awake and get some sun!

- ***Adrenaline & Cortisol***

Overtiredness is one of the key factors we see that contributes to sleep issues in babies and children, because it causes increased production of stress hormones such as cortisol and adrenaline. These hormones make settling to sleep and sleeping long stretches of time much more difficult. Moreover, babies begin to cry and fuss more when overtired (even we as adults get cranky when we're tired!), making any changes to sleep habits all the more frustrating for them. In order to prevent overtiredness, it's crucial that your little one gets restorative naps throughout the day, and has a good day-night sleep balance.

## Day sleep cycles

By around 12 weeks of age, the 40-50 minute sleep cycle emerges due to the developing circadian rhythm (or internal clock). This is why many babies begin to struggle with falling asleep and catnapping around this time, only able to stay asleep for one sleep cycle. By 5 months of age your baby's physiological ability to connect sleep cycles will improve, and most babies will have a predictable and established circadian rhythm. This makes it easier to work on and improve on your baby's sleep around this age. However, if your child is used to connecting their sleep cycles only with some sort of help like rocking or nursing, it's likely that they will continue to only do short naps despite being developmentally ready for longer independent naps.



It is normal for newborns to do multiple 40-minute naps a day. However, as your little one gets older, the quality of the naps, not just the quantity, becomes more and more important. Encouraging your little one to do at least one longer nap of more than 1 sleep cycle after the age of 4 months is key to preventing overtiredness.

## Sleep stages

After going through the 4-month sleep regression (or rather "progression"!), your child will have 4 distinct stages of sleep: non-REM sleep (which in itself has 3 sleep stages

ranging from light to deep sleep), and REM (which stands for “rapid-eye-movement”) sleep. (Learn more about the 4-month sleep regression in [the Troubleshooting Module](#)).

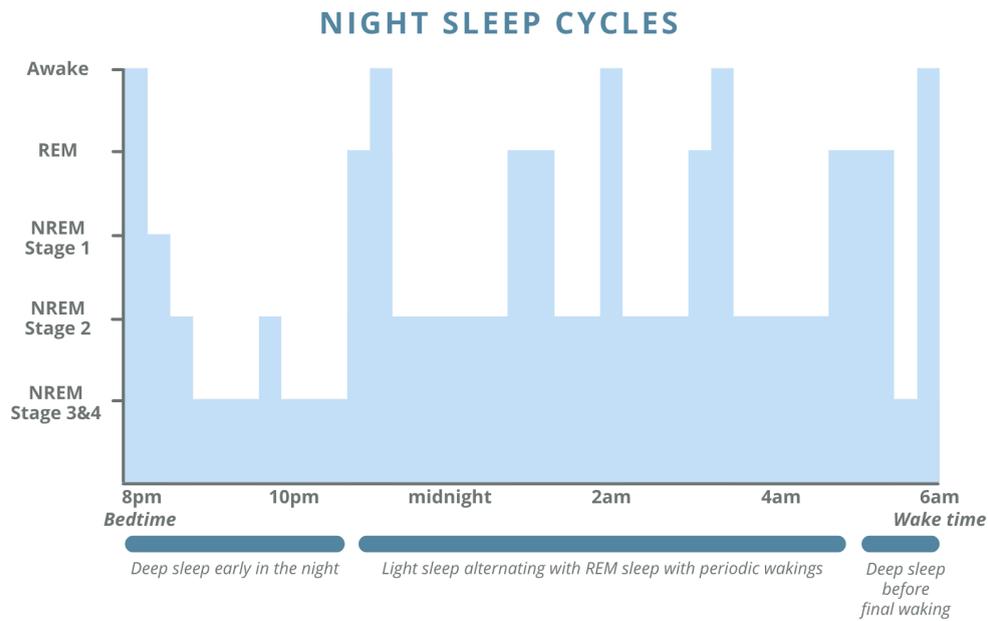
**During non-REM sleep (which is also known as “quiet” sleep):**

- ★ short-term memory is transferred to long-term memory
- ★ the blood flow to the muscles is increased
- ★ new brain synapses are formed
- ★ vision is sharpened
- ★ energy is restored
- ★ emotions are processed and stress is reduced

**During REM sleep (which is also called “active” or “dream” sleep):**

- ★ memory is consolidated
- ★ the immune system is strengthened
- ★ bones and tissues are repaired
- ★ dreaming takes place
- ★ appetite is regulated and growth occurs

Does any of the following sound familiar? Your little one sleeps great from 7/8pm till about 10/11pm, and then wakes 1-2 hourly throughout the rest of the night (particularly struggling to settle between 4-6am)!! What’s that all about?!



Looking at this graph, we can see that this is actually quite normal, as your child cycles through the various NREM and REM sleep stages during the night. Simply put, based on a 7pm-7am night, the deepest sleep of the night is between 7-11pm. After this your little one regularly goes through lighter sleep phases, until the early morning. The lightest sleep is between 4-6am, which is why your child may wake more easily in the early hours of the morning.

This natural sequence of different sleep stages and phases is why after the 4-month sleep regression, it becomes important how and where your child falls asleep. Now that your child is no longer a newborn, they are much more aware of their surroundings, and are creatures of habit. The way they are settled at the beginning of naps and at bedtime is the way that they expect to be re-settled in the middle of a nap, or in the middle of the night, respectively. This means that if your little one needs help falling asleep at the beginning of naptime or bedtime (for example, rocking or nursing to sleep), they will more than likely need help again to get back to sleep in order to connect their sleep cycles.

*We'll go into more detail on how this contributes to frequent night wake-ups in Module 6, and how to encourage independent self-settling in Module 7 and 8.*

## Nature vs. Nurture

Sleeping in and of itself is a physiological phenomenon, meaning every baby is born with the physical ability to sleep and the trajectory of sleep development is relatively the same for each child. However, the actual sleep patterns and habits your child develops over time (e.g. number of night-wakings, length of nights sleep, number and length of naps) is largely the result of their temperament and the child-parent-interactions. Babies are born with specific genetic defaults, which may make certain aspects of sleep less or more difficult. Plus, in an additional layer, each family, each society, each culture has their own habits and “norms” which affect the way sleep is approached.

Some babies are very aware of their surroundings, they have trouble shutting out stimulation and seem to need a lot of help to fall asleep as newborns. Other little ones seemingly couldn't care less if they are at home in their bed or in the stroller at a bustling train station, they just nap wherever and whenever. On top of this “nature” aspect though, at the end of the day all babies are also creatures of habit. The patterns and rituals we repeat as parents slowly become “normal” for them.

For example, when a highly-alert newborn is born, yes, they might actually need more help with rocking and nursing to fall asleep. But after 8 months of doing this, this pattern has become more of a learned habit, than an actual need. An 8 month old in general is much more able to shut out distractions and fall asleep more or less independently. However, if they've never done it before, it may seem as if they are not capable of it. This is where the parent-child interaction has built upon temperament and physiology, and begun to shape sleep behavior.

As you form the sleep plan for your child, we want you to consider both aspects. What is your little one's temperament like and how does that affect their sleep? And on the other side - what kind of habits have you helped form in the past in regards to sleep?

Go to your worksheets now and answer the questions for **Module 2, Lesson 2 - Nature vs. Nurture.**