

# SLEEP BIOLOGY

# SEEKING SLEEP



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# INTRODUCTION



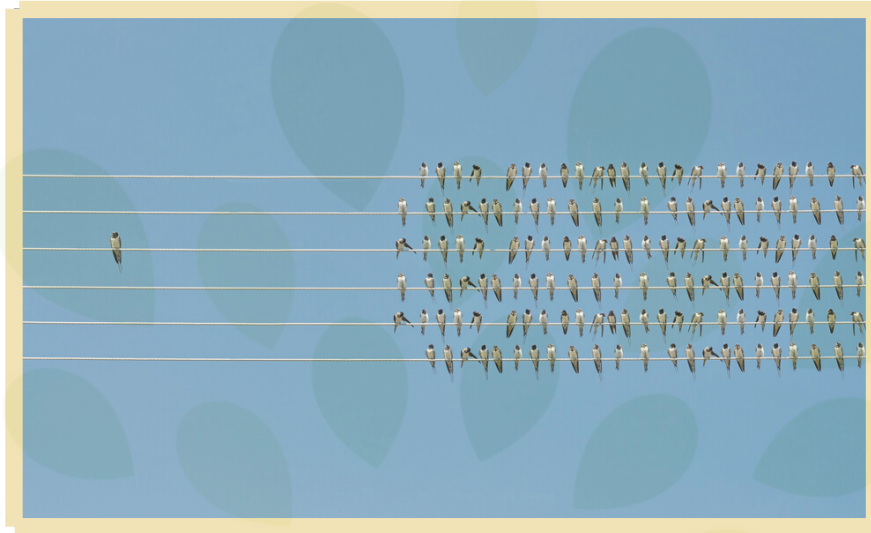
Sleep is complex. It is weaved into nearly every facet of your life. A good night's sleep puts a little kick in your step, while a poor night's sleep can make a day feel not quite as crisp—more like foggy and fatigued. Some people tolerate lack of sleep better than others and the amount of sleep each person needs to stay healthy and function well is different. One thing is for sure, everyone needs sleep. A life without it leads to poor health, poor choices and ultimately, chaos in the body. Sleep is protective. And a multitude of factors are involved with sleep, including genes, gender, gut microbiome, diet, neurotransmitters, hormones, and circadian rhythm. Environmental factors too, such as light and temperature. Every system in the body is somehow connected to sleep. There is a bidirectional flow where healthy systems lead to healthy sleep and healthy sleep supports healthy systems.

Insomnia is an acute or chronic sleep disorder where you may have trouble falling and/or staying asleep. Acute insomnia may be brief for just a night or two. Chronic insomnia can last for weeks or months and for some poor souls, may become a way of life. Intentionally, this guide doesn't review the health benefits or risks of sleep. Mostly, I think you know. Amping up the risks of insomnia, doesn't usually help insomnia.

The primary mission of this guide is to improve your sleep. The following pages cover five categories related to sleep. They provide a comprehensive approach to improve your sleep, quickly. They will get you where you need to go and in less time. But, sleep is one of those fascinating areas of the body, where you may still be curious, so, I have also provided you with a list of references if you'd like to take that deeper dive.

Before taking any supplement or herb for sleep, especially if you are taking medications, use prudence and consider consulting a physician.

# IT'S PERSONAL



I have my own story with sleep but I am not uncommon. The world is filled with the sleep deprived, hungering for some resolution. Despite each of your stories being unique to your own life and your own body, the solutions are universal. More and more, in the field of nutrition and medicine, we are learning the value of  $N = 1$ , meaning you are unique with your biochemistry, gut microbiome and genes. Therefore, you will have unique solutions to your health issues. The plethora of interactions between food, nutrients and the body, introduces a number of variables for solutions, simply because of the extraordinary number of interfaces.

**Sleep, however, is more simplistic in terms of solutions.**

Yes, sleep's hand in your body gets complicated, and some people may need more or less change for success. But, at the end of the day, the following solutions will help everyone, including YOU.

# MY HISTORY

I've never been a long sleeper. Even as a child or teenager I never slept more than eight hours a night or into the late hours of the morning. My recollection of my childhood sleep is non-eventful. In other words, I slept just fine and my body felt restored and energized by sleep. I seem to tolerate lack of sleep better than most people, too. But make no mistake, I don't have that kick in my step without enough sleep AND I know without enough sleep my body doesn't have the protection, that sleep provides.

Once I entered the sleepless nights of being a parent, sleep became more of a curiosity to me but still not an insomnia issue yet. That is to say, any lack of sleep was not for lack of trying. It was because of well-worth-it, parental, interrupted nights from my two boys when they were babies, and also work or other responsibilities. When I had the opportunity to sleep, my body would usually allow me to sleep. Fast forward a few years, a prolonged cerebrospinal leak led me to a world of periodic insomnia. Then years later, a two to three year stretch of consistent insomnia—pretty much two to four hours of sleep a night, sometimes no sleep and maybe for good measure, I'd get lucky with a longer six-hour night, which at least was a brief reminder that my body was capable of sleep. So the difference between this kind of sleep deprivation and my sleep deprivation as a young parent is that with the former, even with all of the uninterrupted sleep time available, my body wasn't cooperating and allowing me to enter one of life's seemingly effortless states of being.

So, in a quest to dig a little deeper with my own biology, I discovered that I have certain genes that interfere with my sleep. In other words, I am a “sensitive sleeper” by nature. But also on the positive side, I have certain genes that probably contribute to my tolerance for lack of sleep. The last twenty years has been a learning curve for me and my sleep. I have mostly figured out the do's and don'ts and what works to manage my sleep, even in the worst of times. I'm confident that you can too.

# 5 CATEGORIES TO BETTER SLEEP



- 1** BEHAVIOR & SLEEP HYGIENE
- 2** TIME IN BED/SLEEP RESTRICTION
- 3** SLEEP SUPPLEMENTS
- 4** DIET AND NUTRITION
- 5** FIVE BODY SYSTEMS AND SLEEP



# SLEEP HYGIENE

## THE BASICS

Sleep hygiene includes the aspects of our environment related to sleep that you can control. They are relatively easy first steps that can make a major improvement to help your body enter sleep “mode”. Many aspects of your life may be sleep depleting. This list is a good starting point to help build the platform for a restful night of sleep. Aim to practice as many of these tips as you are able. Each one by themselves may improve your sleep, but even better, all of them together work synergistically to improve your sleep.

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**1. Maintain regular sleep schedules.** Awaken and get out of bed at about the same time every day, even on weekends and even after a poor night’s sleep. Your margin of error here is about fifteen to thirty minutes and if you do go longer, don’t let it become a habit. Wake up and go to bed within the same fifteen to thirty minute time. More details about this topic in the next section, **“Sleep Restriction”**.

**2. Use natural, full spectrum light to build your melatonin and circadian sleep rhythm.** This is a big category and builds on point #1. Melatonin is built in the morning and released in the evening. In essence, expose yourself to five to thirty minutes of first morning light, and then later, watch the sunset. A few minutes of light exposure during the day is good too. The morning sunlight will help promote tyrosine and tryptophan production from the foods you eat. Tyrosine produces dopamine, which is a calming neurotransmitter. Tryptophan is an essential amino acid and a precursor to serotonin, necessary for melatonin production. To foster melatonin release, after sunset, dim the lights or use red lights in your surroundings. This will also help lower cortisol production.



## THE BASICS- CONT'D

**3. Keep it dark.** Limiting light at night helps to maintain melatonin levels through the night, as well as reducing stimulation to your sympathetic nervous system. Use light reducing shades in your bedroom and/or comfortable blinders around your eyes. More on melatonin later.

**4. Keep it quiet-** Everyone is different for how much noise may be too much noise to prevent falling and staying asleep. Don't wait ten years to try earplugs. They can be beneficial. They come in several forms including styrofoam, which may fall out more easily– to the wax type ear plugs that you can mold into the shape of your ear.

**5. Keep it cool.** Optimal room temperature for sleep is between ~ 60 F and 67 F. Individuality reins true with temperature too. A cool bedroom helps your core body temperature drop, which helps induce and maintain sleep. Body temperature falls at night by up to two degrees- part of the circadian circuit of temperature regulation. Some folks like to start off warm in bed. But keeping your core temp cool at night promotes deep sleep.

**6. Limit blue light a few hours before bedtime.** Blue light from computers and TV screens block melatonin release, may raise cortisol and may be stimulating in the evening. Use “dimmers” on your cell phone and computers, such as Twilight or Flux or even consider wearing tinted blue blocking glasses in the early evening.

**7. Limit anything stimulating within one to two hours of sleep:** Conversation, arguments, work, exercise– whatever might get you going, physically or mentally right up to sleep time. Sex may be the exception. Sex may actually help induce sleep for some folks, in part because of oxytocin release.

**8. Go to bed only when you are sleepy.** This doesn't mean, “I'm a little tired, I think I'll go to bed.” This means droopy eyelids, the virtual nod off, head drop. This is an indication that you have some sleep debt and a drive for sleep. More on that in the next section. Better to wait until you are sleepy than to go to bed sooner and take a longer time to fall asleep.



## THE BASICS- CONT'D

**9. Generally, no naps.** If you can't help yourself, limit naps to a maximum of twenty minutes. Naps, even short ones, especially in the early evening that enter deep sleep take away from your sleep debt and sleep drive that you are building over the course of the day, that help you fall asleep at bedtime.

**10. Consider a warm Epsom magnesium salt bath.** Warm baths raise body temperature and magnesium salts help relax muscles. The rise in body temperature will help instigate the later drop in core body temperature that brings on and maintains sleep.

**11. Keep a bedtime routine.** Bedtime routines help to get the mind and body ready for sleep. Generally, a bedtime routine, i.e. washing your face, brushing teeth, stretching, turning off "work", helps you switch gears to prepare for the next eight hours. Sounds simplistic, but it works.

**12. Turn off electronics one to two hours before bedtime.** Aside from the blue light, if the information you are reading or watching is stimulating, turn it off. Instead, read a non-stimulating book, stretch, meditate or even watch TV, providing its content helps you relax and disconnect.

**14. Invest in a comfortable mattress and pillow.** Comfort matters. You might think you can tough out sleeping on a mattress that contributes to back or neck pain. Chances are the investment in a good mattress and pillow are worth it. Everyone is different with their preferences. If possible, pay attention to comfortable mattresses that you discover when you are traveling, perhaps at a hotel or a friend's house. Find out the brand and seek where to buy it. That's how I came upon my mattress. A friend made a recommendation and what hotel used it. I booked a night and presto-what a difference it made for my back. I quickly purchased this mattress and it has been a positive tool in my sleep tool kit. Trying out a mattress in a store for a few

# THE BASICS- CONT'D

minutes doesn't reflect whether or not you can comfortably sleep on it. Before you purchase one, a real life trial run is easier versus buying and returning a mattress based on a ten minute trial in the store. Also, the sleep industry includes other temperature controlling products such as cooling mattress pads, weighted blankets etc. which may be viable tools to add to your sleep kit.

**14. Exercise-** Research shows regular physical activity can positively promote restful sleep by supporting falling asleep faster and promoting better sleep quality. Some people, however, should be cautious with vigorous exercise within one to two hours of bedtime because it can be stimulating. Find the time that works best for you.

**15. Keep a Sleep Diary.** Journaling any behavior can help you improve your goals around that behavior, whether it's diet, exercise or learning a new skill. The same applies with sleep. Keep track of your sleep—hours in bed, hours sleeping and how many times you awake and how was your day leading up to that night. You'd be surprised how journaling can lead to those light bulb moments of discovery that continue to benefit you years later.

## BUT, WHAT ABOUT- “IF YOU CAN'T SLEEP, GET OUT OF BED?” RULE?

Let's be clear to distinguish between whether you are tossing and turning in bed OR just resting and awake. For many people getting out of bed in the middle of the night can be fatiguing, stimulating and actually disruptive to helping the greater cause. Yet, so many sleep guidelines are strict to this rule to get out of bed if you are not sleeping. Not me! If your sleepless night persists and you are tossing and turning, then get up, – only if you believe it will help you. Otherwise, resting in bed, even if you are reading by dim light may be better. Especially if your time in bed is five hours or less.

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# TIME IN BED/SLEEP RESTRICTION

Now, for the real behavior change.

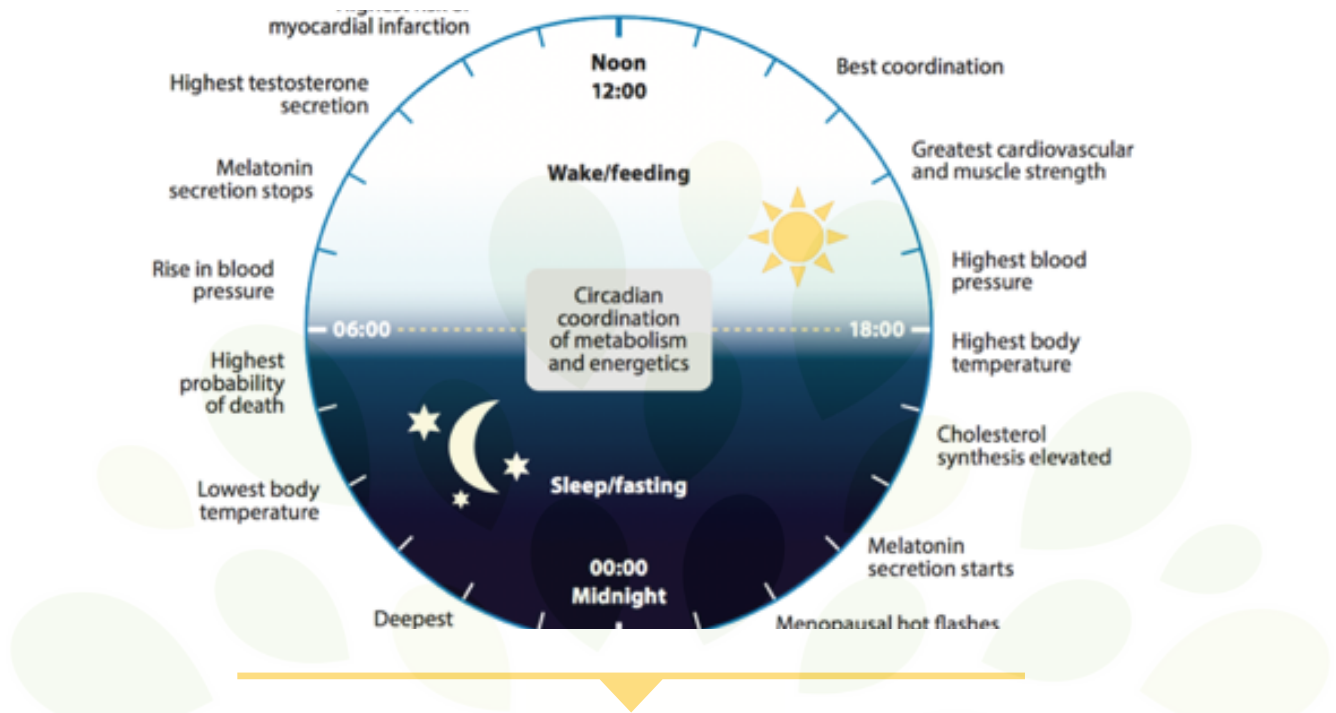
The time you spend in bed, the time you are actually sleeping and the time you spend out of bed are the next factors that can quickly improve your sleep, and they too are under YOUR control. They require no drugs or major, costly intervention.

Time in bed and time spent sleeping are fundamental parts of the sleep equation. We all have a different level of sleepiness and alertness throughout the day. This is related to **two factors**, which are different but connected.

- **Sleep/wake balance.** In other words, the longer you are awake, your body creates a **sleep debt and a sleep drive** or need for sleep. This gives balance to your wakefulness.

- **Biological clock or circadian rhythm.** This regulates **when** you sleep and **when** you feel wakeful. Your circadian rhythm ebbs and flows throughout the day.

# SLEEP WAKE BALANCE

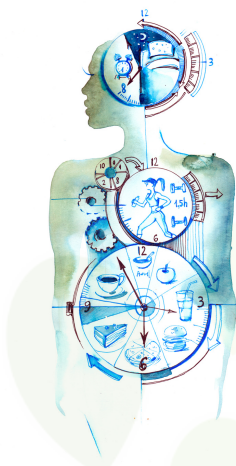


Although this “**sleep wake balance**” might seem obvious—there are some curious aspects to it that are different for some people. When you have been awake for a long period of time, your sleep/wake balance lets you know that your need for sleep is growing. You build “**sleep pressure**”. As this sleep pressure or sleep drive builds, it also helps you obtain enough sleep cycles through the night, both depth and length of cycles that balance your awake time during the day.

For sensitive sleepers, the sleep drive can be ahh, yes, sensitive. You might think as you build up a sleep debt by pulling an all nighter that of course you will easily fall asleep the next night. Maybe, but maybe not. Even when a sleep debt has accrued, some sensitive people don’t fall asleep. But, read on to see how to fix this.

And then there are the folks who are unaffected –who can fall asleep like clock work with no awakenings, be it thunderstorms, house break-ins, vacuum cleaners, concerts, you-name-it, no matter the noise, temperature, light etc. Okay, folks no bragging here if this is you. Maybe a bow. Just know you have a gift, that hopefully will keep on giving.

# BIOLOGICAL OR CIRCADIAN CLOCK



Your circadian clock dictates the whens of your sleepiness and wakefulness. Adults' strongest sleep drive generally occurs between 2:00-4:00 am and in the afternoon between 1:00-3:00 pm. There may be some variation depending on whether you describe yourself as a morning or evening person. If you do get adequate, restorative sleep through the night, you will not feel that sleep debt or sleep pressure during the day, especially between 1-3 pm, versus if you don't get adequate sleep at night. With adequate sleep, your sleep drive builds through the whole day and you don't start to feel it until the evening.

**Here you can see the bidirectional relationship between the sleep/wake balance and circadian rhythm of sleep.**

**Sleep/Wake**



**Circadium Rhythm**

Just to add, adolescence brings about changes to this circadian rhythm leading to a sleep phase delay—where teenagers may get a “second wind” and become energized and yes, like to stay up until the wee hours of the morning. I think I skipped this part. I have always been an early riser. These sleep guidelines will focus mostly on adults, but just to know this natural shift in teen's circadian clocks can make it difficult for them to obtain the sleep they need, considering their school and social lives may ask them to burn the candle on both ends.

# SUPRACHIASMATIC NUCLEUS (SCN)



Light vs dark. The circadian biological clock is controlled by a part of the brain in the hypothalamus called the **suprachiasmatic Nucleus (SCN)**, which responds to light and dark. Light travels to the SCN via the optic nerve of the eye, signaling the internal clock that it is time to be awake, “Okay, rise and shine—less melatonin release, more cortisol—let’s start this day.” Keep in mind, early morning light helps melatonin be produced, just not released.

As nighttime and darkness arrive, the eyes signal to the SCN, “Hey, time to wind down, release melatonin, produce less cortisol, so you can get a little shut eye.” As melatonin levels rise you begin to feel less alert and more sleepy. Being in a dimly lit room enhances this process. Blue light and brightly lit rooms in the evenings can reduce this response. Melatonin levels stay elevated all through the night and fall back to daytime levels by about 9 am. Morning daylight exposure sets the groundwork for the amino acids to build melatonin. The SCN also stimulates the brain to signal other parts of the brain that control hormones, body temperature and other sleep/awake related factors

**In order to release melatonin in the evening,  
you need to make melatonin in the morning.**

These two biological aspects of your sleep: sleep/wake balance and the circadian rhythm can be manipulated for better or worse. Irregular work hours, stress, poor diet, weight gain, all can disrupt these two factors. But, if you pay attention and with certain positive changes you can undoubtedly balance these factors for the better.

# RESTORATIVE SLEEP AND THE SLEEP CYCLE

## What happens once you enter the land of sleep?

Restorative sleep is obtained by getting both Non-REM and REM sleep, two parts of the sleep cycle. Although length of sleep cycles are individual, they average about ninety minutes and include both Non-REM sleep and REM sleep. Non-REM sleep has three stages with different levels of brain activity. A night of sleep includes repeating these stages of Non-REM, each followed by REM.

The first part of the night includes more Non-REM sleep and as morning approaches, more REM sleep. The number of full sleep cycles differs with each person too, but generally most people get five to six cycles per night. However, when these cycles become disrupted with frequent awakenings, you may actually feel better after just sleeping two or three full sleep cycles than awakening through five or six disrupted cycles.

**Non-Rem:** Three stages

**REM:** Follows Non-Rem

# 3 STAGES OF NON REM SLEEP

## STAGE 1

The first, short period (several minutes) of light sleep. All vitals slow down a bit: heartbeat, breathing and eye movements and muscles relax.

## STAGE 2

This stage includes the light sleep before you enter deeper sleep. Your vitals continue to slow: heartbeat and breathing, body temperature drops, muscles further relax and eye movement stops. You spend more time in this stage than any of the other sleep stages.

## STAGE 3

This is the period of deep sleep. Again, all vitals continue to slow and muscles relax. Deep sleep enables you to feel restored or energized the next day. The reduction in heart rate and blood pressure is helpful to cardiovascular health. Stage 3 lasts longer in the first half of the night.

## REM





# REM

REM sleep occurs about ninety minutes after falling asleep. As opposed to Non-REM sleep, body processes speed up with REM, including heart rate and breathing, eyes move more rapidly and brain wave activity increases. REM sleep includes most of your dreaming. As you age, less time is spent in REM sleep.

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## SLEEP EFFICIENCY AND SLEEP RESTRICTION

For people who have insomnia and other night awakenings, the natural response to a poor night of sleep is to go to bed earlier the next night or to sleep later the next morning. Yes, I used to do both. For a sensitive sleeper, both of these actions will only worsen long term sleep quality. Extending the time in bed, especially by going to bed earlier or staying in bed later—even on the weekends, can change that delicate sleep/wake balance and circadian clock.

Staying in bed to catch up on sleep may only “dilute” your sleep leading to shallow, fragmented sleep. Yes, you may catch an hour here or there but staying in bed for nine or ten hours and only sleeping five or six of those hours does not make for restorative sleep. Sleeping full, undisrupted sleep cycles, even if there are fewer sleep cycles—say from 11 PM-3 AM, will probably feel better and more restorative than being in bed from 9 pm to 7 AM and getting the same four hours of sleep but disrupted throughout the night.

How to manipulate these two vital sleep factors: circadian rhythm and sleep debt/sleep drive for better sleep? It’s all about sleep efficiency. How to get more efficient sleep? Well—ahh, yes, restrict your sleep.

## Short term sleep restriction leads to long term sleep efficiency.

Sleep clinics figure out your sleep efficiency and so can you. Sleep efficiency is the number taken from total sleep time divided by your time in bed. You want to have a high sleep efficiency. If you sleep for four and half hours and your time in bed is five hours—that's a 90% sleep efficiency. 90% or higher sleep efficiency is pretty good. If that efficiency begins to decline below 90%, then you need to think about less time in bed. If you wish, you can use a sleep app to help determine your sleep efficiency. Defining total amount of time in bed is debatable. I start counting with-lights out.

Understanding the sleep equation will help you restore and maintain healthy sleep patterns. **This may be the single most important factor to help improve and maintain healthy sleep patterns, especially for those people who are sleep challenged.**

Although it may seem counter productive to restrict the very precious thing (sleep)—that you are trying to improve, sleep restriction, when done properly promotes both sleep debt and sleep drive, which encourages your body into more restorative sleep. It may take as little as a week to up to three to six months to see its full value. Plus, it doesn't require medications and is under YOUR control.

Sleep restriction practices can be done on a variety of levels. These guidelines do not recommend going below the basic five hours of sleep per night, however, in more extreme cases, people may restrict more. Five to 5.5 hours is thought to be the “core” sleep requirements for most people where they can still function and perform. It may not be ideal long term, but most people can get by with a few nights or weeks even of five hours of sleep.

Try not to get hung up on the concept of getting eight hours of sleep each night. You are aiming for what feels 'right' for you. More importantly is the quality of sleep. Good sleep quality leads to sleep confidence. Confidence in anything leads to improvement.

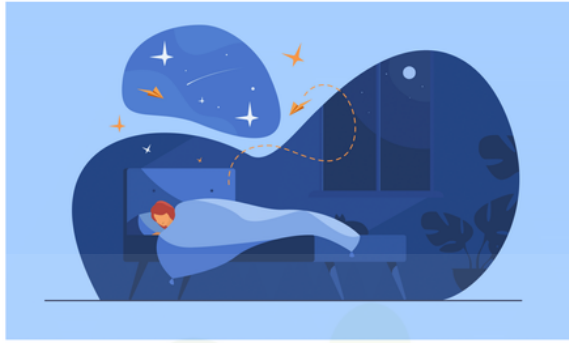
**Sleep restriction is now a fundamental component of most reputable sleep programs because the research supports its efficacy. It works. Even for people with various sleep disturbances.**

## **SLEEP RESTRICTION TO PROMOTE BETTER SLEEP: HERE'S HOW IT'S DONE.**



- 1. Start at five hours of sleep** and work your way up to six, seven or eight hours; whatever amount of sleep where you feel best.
- 2. Determine a time to wake up.** This is more important than time to bed because that first morning light is what sets the circadian tone in the morning. Also, most people will find time to awaken as the easiest time to stick to. So determine a time to wake up and stick to it. No matter!
- 3. Determine time to bed.** Time to bed may have more variables that influence it and harder to keep to the same time. Although the most success comes with sticking to this number too, you may have a little more wiggle room with varying time to bed—providing it's not earlier.

For example, if you are aiming to sleep an uninterrupted five hours of sleep and you choose to awaken at 5 AM, then the math says your only option is to go to bed at midnight.



Keep to these bedtime and awakening times until you are able to sleep a week with greater than 90 % sleep efficiency. Once you achieve that, then you can gradually increase time in bed by fifteen or thirty minutes at your choosing. Once you are able to sleep for six hours with greater than 90 % sleep efficiency, continue to your goal.

Again, it's better to determine your awakening time and stick with it. Any adjustments should be with your time to bed. As you continue these practices, you may find you have a little more leeway with you wake up time too. But, still, if you are a sensitive sleeper, I encourage not to veer too far off with mornings either. It can catch up with you.

Even today, after practicing sleep restriction for over five years now, if I fall into going to bed earlier—say 8:30 or 9 pm, over time, my sleep becomes disrupted. I correct it by consistently going to bed by 10:30 or 11 pm and getting up at 5:00 -6 AM and always, getting that first morning daylight. Within a day or so, my sleep efficiency improves.

**Short term sleep restriction leads to long term sleep efficiency.**



# SLEEP SUPPLEMENTS

Sleep supplements are big business. Research is recognizing that nutrients, botanicals and the hormone, melatonin can be beneficial to sleep and should be your first "go to" for sleep support versus a prescription drug. Supplements can support sleep because they include compounds that are functional to the biology of sleep and are usually low risk and non-addictive. They will gently help you fall and stay asleep and combined with sleep hygiene and sleep restriction, are a reliable solution for even the toughest of insomniacs.

Sleep supplements support sleep by supporting: the circadian cycle and balancing the inhibitory neurotransmitters such as serotonin and GABA with the excitatory neurotransmitters, epinephrine and glutamate, while also helping to modulate the hormone, cortisol.

One single substance may be beneficial but often small amounts of a combination of substances may work too. Most of these substances can be taken thirty to sixty minutes before bed.



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## The following is a list of nutrients and botanicals that are helpful in promoting healthier sleep. But first, the hormone, melatonin

### MELATONIN

Melatonin is one of the master metabolism regulators working along with the thyroid hormones. It is being studied for its cell protective roles; maintaining the integrity of mitochondria, regulating cell death and inflammation.

Aim to produce your own melatonin by obtaining adequate morning light and reducing blue light in the evening. Aging, however, reduces melatonin production, so supplements may give some benefit, particularly for post-menopausal women. Since it is a master hormone, exert caution with long term use with children, teenagers and young adults. Long term safety is unknown, although research does not suggest that supplemental use reduces the body's own production.

### DOSE

Most dosages of many commercial products cause melatonin levels in the blood to rise to much higher levels than are naturally produced in the body. Taking a typical dose (1 to 3 mg) may elevate your blood melatonin levels one to twenty times normal levels. Much higher levels of supplemental melatonin, 10-20 mg dosages are used in other areas of medicine including cancer treatment.

Start with the lowest dosage and if necessary, work your way up. For some people, melatonin can have a paradoxical-stimulatory effect at higher dosages. You may fall asleep but then wake up unable to fall back. Start with 200-300 ug and work up to 3 mg, if necessary. Avoid supplemental melatonin after 2 AM, since natural melatonin release decreases as the morning approaches. Experiment with taking it early in the evening up to thirty minutes before bed.

# THEANINE

Theanine is an amino acid that boosts GABA levels and the calming brain chemicals, serotonin and dopamine. Theanine is naturally found in tea. Increasing and supporting these neurotransmitters promotes relaxation, reduces stress and anxiety and can help with sleep quality without the “hangover” or strong sedative effects of other over-the-counter sleep drugs. Headache is the most common side effect of theanine for certain people.

Theanine also enhances alpha brain waves, which are present during REM sleep, meditation and calming activities.

## DOSE

100–200 mg



# GABA

Gamma-aminobutyric acid is the predominant inhibitory neurotransmitter in humans. It enables the brain/body to relax and prepare for sleep and stay asleep. Low GABA levels are associated with insomnia. Historically, supplemental GABA was not thought to cross the blood brain barrier and any benefit was believed to be a result of a placebo effect. Unfortunately, the research is meager on this topic, but what has been done may suggest that it does cross the BBB directly and/or have an effect on brain GABA levels via the enteric nervous system.

Higher dietary supplemental levels can have stimulatory effects and lower levels have been shown to improve anxiety in some studies. Some products are designed to affect GABAergic receptors to facilitate crossing the blood-brain more easily. The mechanism of action of GABA on the brain is unclear and needs more research considering it is the predominant inhibitory neurotransmitter, is readily available and may have a broad range of applications. Low levels are believed to be safe. Also, research shows GABA may work synergistically when given with theanine in improving sleep quality and duration.

## DOSE

**Prudent dosages: 25 ug to 400 mg/day**



# TRYPTOPHAN

Tryptophan is an essential amino acid. Since you don't make it naturally, you must get from either food or supplement. It is necessary for making neurotransmitters essential for optimal sleep and mood. Specifically, tryptophan is a precursor to making 5-HTP (5-hydroxytryptophan), which is a precursor to making serotonin and melatonin. Serotonin is an inhibitory neurotransmitter that plays an important role in mood, cognition and sleep. Melatonin is an important hormone in the sleep/wake circadian cycle.



Research has shown that people with low levels of tryptophan have increased anxiety, tension and feelings of nervousness vs those with higher levels. Numerous research concurs that many of the effects of high or low levels are due to its effects on serotonin or 5-HTP (precursor to serotonin) and then the subsequent ability to produce melatonin. In fact, research has shown that increasing tryptophan in the blood directly increases both serotonin and melatonin.

The daily nutritional requirement for L-tryptophan is modest (5 mg/kg) or about 341 mg/day for a 150 lb person. Alone and without other serotonin influencing drugs, a lower dose of tryptophan, 250-1000 mg/day is usually safe. But because supplemental tryptophan levels can stimulate the conversion to serotonin in neurons, higher doses of 4-5 g/d (60-70 mg/kg) or higher, may induce serotonin syndrome (tremor, nausea, and dizziness). Therefore, avoid taking high levels of supplemental tryptophan with other serotonin altering drugs.

# TRYPTOPHAN- CONT'D

Some people have gene polymorphisms (snps) such as tryptophan hydroxylase 2 (TPH2), that may interfere with how tryptophan is produced. This enzyme converts tryptophan to 5-HTP, the precursor of serotonin. Polymorphisms may may be associated with psychiatric diseases such as bipolar affective disorder and major depression and sleep disorders.

## DOSE

250 mg - 2 grams



# 5-HTP

5-hydroxytryptophan or 5-HTP is a compound made naturally in the body. It is a byproduct of the amino acid L-tryptophan. Since you don't make L-tryptophan naturally—you must absorb this essential amino acid from the foods you eat or in supplement form. As you age, natural levels of 5-HTP may decline. As previously stated, 5-HTP is a precursor to producing serotonin, a neurotransmitter that plays a key role in regulating mood and sleep-wake cycles. Healthy levels of serotonin contribute to a positive mood and also promotes restful sleep. Serotonin is a precursor to melatonin production, which is essential to maintain the circadian sleep clock. Research suggests that supplemental 5-HTP may help shorten the time it takes to fall asleep and increase sleep duration.

**Caution:** When tryptophan or 5-HTP are taken along with drugs that influence serotonin, such as antidepressants, including SSRIs, serotonin levels may excessively increase, leading to a condition called serotonin syndrome. Serotonin syndrome includes sweating, tremors, agitation and delirium. Usually, lower levels of 5-HTP **50-100 mg** are not a risk for serotonin syndrome but if you are taking any medications that affect your serotonin levels, consider consulting your physician before taking tryptophan or 5-HTP supplements.



**DOSE**

**50-200 mg**

# INOSITOL

Inositol is present in small quantities in a variety of foods. It plays a structural role in your body as a major component of cell membranes. Inositol can affect the neurotransmitters in your brain, especially GABA and serotonin. Research suggests high doses may be beneficial for anxiety disorders. Other research shows positive effects with glucose management. Doses of inositol supplements used in studies generally range from 500 mg to 18 grams per day.

## DOSE

Dosages for sleep: 500 mg - 2 grams.

# TAURINE

L-Taurine is produced from the amino acid L-cysteine. It is found in large amounts in the brain, retina, heart, and platelets and plays a vital role in nearly every cell in the body – notably in the heart, blood vessels, and muscle tissue. The best food sources are meat, fish, and eggs. Some research shows that taurine can decrease cortisol levels and increase the production of GABA, a major inhibitory neurotransmitter.

## DOSE

500-2000 mg

# MAGNESIUM

Magnesium is an essential mineral. You must either get in it your diet or via supplements. Research suggests nearly half of all adults in the United States are magnesium deficient. One of magnesium's most important roles is as an enabler of healthy enzyme functions, which occur in every system of the body (estimated to be over 300 different enzyme reactions).

In regard to sleep, magnesium may help increase the availability of GABAergic receptors by decreasing presynaptic glutamate release. Glutamate is a major excitatory neurotransmitter. Magnesium also helps to relax muscle cells by countering calcium, which stimulates muscle contractions. Research also shows some evidence with improving subjective anxiety, possibly by modulating the HPA (hypothalamic pituitary adrenal axis), a center point for the stress response.

Beneficial forms of magnesium for sleep include glycinate and L-threonate.

## DOSE

**100-600 mg/day**  
**Caution with advanced renal disease**

# PHOSPHATIDYLSERINE



Phosphatidylserine is a phospholipid located in cell membranes, particularly in the brain. It plays an important role in cell to cell communication. Aging is related to lower levels of phosphatidylserine. One of the major areas of research with phosphatidylserine, cognitive health and sleep is its role in cortisol regulation and preventing excessive cortisol production. Elevated cortisol, particularly later in the day and evening can be disruptive to sleep.

## DOSE

100-200 mg before bed.

# GLYCINE

Glycine is an amino acid, with multiple roles. It has a key role as a neurotransmitter with the ability to be both excitatory and inhibitory. In other words, it can stimulate the nervous system or calm it. Glycine's effect on sleep is via several pathways. Glycine helps the body make serotonin, a hormone and neurotransmitter that has significant effects on sleep and mood and is a precursor to melatonin production. Interestingly, glycine also has been found to increase blood flow to the body's extremities, which reduces core body temperature. A slight drop in body temperature enables falling asleep.

Glycine may help you fall asleep more quickly, improve sleep efficiency and promote more restorative, restful sleep, including more REM sleep. The body produces glycine on its own from serine, choline and threonine but we also can get it from food- a typical diet containing high protein foods including meat, fish, eggs, dairy and legumes will supply about 2 grams of glycine. Glycine for sleep is frequently sold in 3 grams powdered packets.

## DOSE

**3-5 grams of glycine before bed.**



# HERBS

Herbs or botanicals contain many compounds that exert pharmacological effects throughout the body. Certain herbs affect the nervous system, the brain and the ability to sleep. Many products contain smaller amounts of several herbs and other products contain single herbs. Dosages will differ depending on the herb and individual. Follow the dose on the label or start at a lower dose.

**The top herbs that may support better sleep include:**

- Valerian
- Hops
- Magnolia
- Passionflower
- Lemon Balm
- Holy Basil
- Ashwagandha
- Lavender
- Chamomile

## PRODUCT NAMES

There are numerous sleep supportive supplements available.  
Here are a few tried and true.

- Jarrow Sleep Optimizer
- Pure Encapsulations- Best Rest
- Thorne- Pharma GABA
- Gaia Herbs- SleepThru
- Klaire 1 + 3mg melatonin loz
- Klaire Melatonin SR (slow release)
- Hyland's Calm Forte
- Pure Encapsulation- Seditol
- Integrative Therapeutics- Cortisol Manager





# DIET AND SLEEP

The foods you eat affect your sleep for a variety of reasons. Managing any of these categories can improve sleep.



**1. Blood glucose regulation** The optimal calorie intake and optimal balance of macronutrients for health is different for everyone and this is also true for sleep. Carbohydrates are required for glucose to enter the brain, which also helps carry tryptophan across the blood-brain barrier. Recall, adequate tryptophan helps for adequate serotonin and melatonin production at night. Inadequate carbohydrates may make it difficult to fall asleep and in some people elevate cortisol. Dinnertime to bedtime is an important time period to eat a balance of well tolerated protein, low-glycemic carbohydrates, and adequate fat.

**2. GI Tolerance:** GI distress may cause bloating, pain, diarrhea or constipation, all which can interfere with sleep. Seek to determine the root cause of any acute or chronic GI conditions.

**3. Food Sensitivities and Histamine Intolerance:** Any food can cause a negative immune response in any individual. Excessive histamine breakdown from histamine found in foods and or SIBO may have stimulating effects and disrupt sleep.

**4. Stimulatory foods:** Caffeine stimulates the central nervous system. Major sources are coffee, tea and chocolate. Read labels if you are caffeine sensitive as it can be added to some foods. CYP1A2 gene is responsible for caffeine metabolism. Some people with variants of this gene may be “slow caffeine metabolizers” and need to limit caffeine. Other stimulants found in foods include glutamate i.e. MSG. and various herbs, including ginsengs. Limit these foods in the afternoon and all together if you are sensitive.

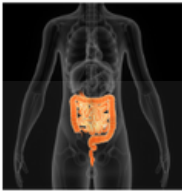
**5. Inhibitory foods: i.e. tryptophan and melatonin.** Food Sources of tryptophan: Dairy products, poultry, seafood, nuts and seeds, apples, bananas, and peaches. Naturally occurring melatonin can be found in foods such as: tart cherries, pomegranates, asparagus, tomatoes, olives, grapes, broccoli, walnuts, peanuts, sunflower seeds, mustard seeds, and flaxseed. These foods may help some people with sleep, but others may benefit from supplementation.





# FIVE SYSTEMS AND SLEEP

GI



Cardio



Immune



Hormones



Brain/CNS

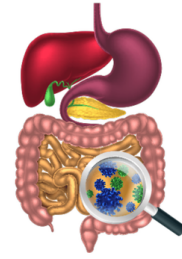


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Five major systems of the body (GI, Cardiovascular, Immune, Hormones and Nervous) each have their own unique influence on sleep. These systems may have a bidirectional relationship with sleep, in other words, the system integrity can affect sleep and also sleep can affect the integrity of the system. Understanding their effects will help you understand the biology of sleep and what helps and hinders a good night's sleep.

- 1 DIGESTIVE/GI
- 2 CARDIOVASCULAR
- 3 IMMUNE
- 4 HORMONES
- 5 NERVOUS SYSTEM

# DIGESTIVE/GI

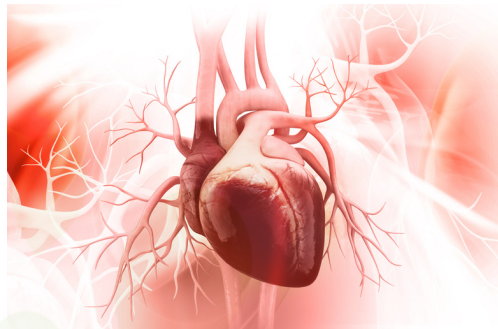


The health of the digestive track is related to the health of the entire body. It comprises six key ingredients or characteristics that make it such a unique system. (See Six Key Ingredients document).

- **The gut microbiome**
- **Large presence of immune cells**
- **Permeable membrane**
- **Access to two major circulatory systems: Portal and Splanchnic**
- **Largest Endocrine Organ**
- **Enteric Nervous System**

The enteric nervous system holds a vast network of nerves, including the 10th cranial nerve, the vagus nerve which connects the gut to the brain. Research shows that the gut microbiota influences how much and how GI cells produce serotonin. The stomach and intestinal EC cells produce the majority of the body's serotonin, which affects a multitude of bodily functions, including bowel movements, appetite, mood, blood clotting and even bone health. Low levels of serotonin and high levels of cortisol and epinephrine are connected to sleep problems including less non-REM sleep. Balanced serotonin levels can also mean less anxiety, depression, which may aid sleep.

# CARDIOVASCULAR



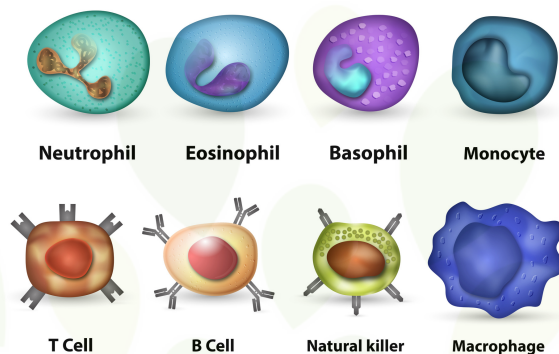
The cardiovascular system includes your heart, vessels and blood. Anything that may affect these components may affect sleep, including arrhythmias and respiratory conditions that may result in shortness of breath.

Obstructive sleep apnea is a potentially serious sleep disorder. Breathing can stop and start during sleep. Throat muscles periodically relax and block your airway during sleep, contributing to a “subclinical” type of oxygen debt making people feel less refreshed despite thinking they had a full night’s sleep. Obstructive sleep apnea can also increase blood pressure, one of the major risk factors for CVD.

Central sleep apnea occurs when your brain doesn't send proper signals to the respiratory muscles that control breathing. Central sleep apnea is less common than obstructive sleep apnea but still important to recognize and treat.

Treatment for sleep apneas depend on the type you have. Obstructive may include weight loss and/or use of an apnea machine. Apnea machines vary and include continuous positive airway (CPAP), BiPAP, APAP.

# IMMUNE



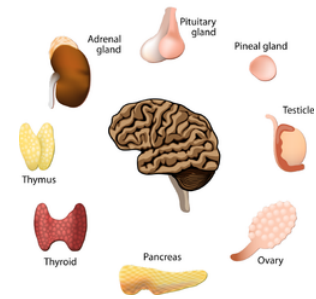
As with the cardiovascular system, adequate sleep helps promote a strong, healthy immune system. Research shows that good sleep improves how T-cells protect and attach to their target. T cells are WBC that are part of your adaptive immunity. They fight off intracellular pathogens such as viruses, i.e. herpes and influenza and also cancer cells.

Melatonin is a master anti-oxidant and mitochondria regulator. As such, maintaining healthy melatonin levels by managing your light exposure to optimally produce and release melatonin has a natural down stream effect of supporting healthy immunity.

A healthy immune system is one that is free of autoimmunity or cancers. Preventing these conditions can help promote better sleep simply by reducing the side effects of these conditions. Immune imbalances can promote poor sleep and poor sleep can promote reduced immune function.

# HORMONES

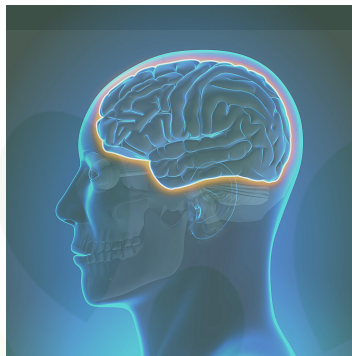
## ENDOCRINE SYSTEM



Hormones imbalances can promote poor sleep and poor sleep can exacerbate hormone imbalances. Are you noticing a pattern here? Imbalances with the major hormones: melatonin, insulin, cortisol, and thyroid can lead to sleep disturbances.

- **Melatonin:** As mentioned throughout these guidelines, melatonin is a master metabolism regulator, working along with thyroid hormones. It is produced in the pineal gland and is crucial to sleep. It responds to light—the highest amount of melatonin is secreted in the evening, lowest secreted in the morning but exposure to early morning light begins its production.
- **Cortisol:** Excessively high cortisol levels at night can cause wakefulness. Cortisol follows a circadian rhythm where it rises in the morning and reaches a peak by noon and then begins to decline. By evening, cortisol should be at its lowest to allow you to sleep. Stress and medications such as steroids may elevate cortisol and disturb sleep. Relaxation techniques can be beneficial in lowering the sympathetic response.
- **Thyroid hormones** can increase metabolic rate and cause arrhythmias, both which can disrupt sleep.
- **Exaggerated adrenal response** because of stress or disease can potentiate the hypothalamic adrenal axis, creating imbalances with the sympathetic nervous system.
- **The sex hormones:** Estrogen, progesterone and testosterone imbalances can affect sleep. Estrogen can contribute to hot flashes; excessive testosterone contributes to agitation and elevated cortisol.
- **Progesterone** can be supportive of sleep by increasing production of GABA, an inhibitory neurotransmitter. Low progesterone levels can bring about anxiety, restlessness and disruptive sleep.

# NERVOUS



- Anything that influences the central nervous system, which includes the brain and the blood brain barrier and anything that may affect the peripheral nervous system may help or disrupt sleep.
- Sympathetic and parasympathetic nervous system balance is key. Excessive sympathetic stimulation as seen in disruption of the HPA axis, particularly, if it becomes chronic can lead to sleep issues.
- Enteric Nervous system and GI imbalances as previously mentioned will affect sleep.
- Stimulation of sympathetic nervous system by a food sensitivity, or anxiety or exercise too close to bedtime may affect sleep.
- Pain- Anything that promotes pain of any kind can disrupt sleep and also promote further imbalances in nervous and immune function. Pain is sometimes referred to as the **sixth vital sign**.
- Disruption of neurotransmitter production from circadian rhythm imbalances. i.e. Seek that early morning light and restrict excessive blue light in evening.



# FINAL THOUGHTS

Sleep is a complex and necessary component of life for health and happiness. Sleep affects the function of every system of the body and in turn, the integrity of each body system affects sleep. Each individual is unique—owning a unique microbiome and unique genes. Despite the complexity of sleep and individualism of sleep patterns, these foundational guidelines can be universally applied to everyone. How each guideline is applied may slightly differ, but each recommendation can offer benefit with almost zero risk.

Aim for sleep quality and not so much a certain number of hours of sleep each night. This will also reduce the pressure on yourself each night to perform. This isn't a race. Perhaps most importantly, fear not those sleepless nights. Worry and anxiety over loss of sleep leads to...drum roll.....sleepless nights! Remember, your body wants to sleep at night. Understanding your own sleep biology will lead you to better sleep. You just need to provide it with a roadmap and the proper ingredients and it will find its way home.

My best for your best sleep!

*Cindy*

# SLEEP JOURNAL

**Be an observer of your sleep. Keep track noting patterns with exercise, food, stress etc. Note supplements and medications. Calculate your sleep efficiency. Aim for > 90 %. Use this tool to inform yourself, not to promote anxiety. Sleep well!**

Date	TIME TO BED + TIME AWAKE	Food	Supplement	HOURS SLEEP + SLEEP EFFICIENCY

# RECOMMENDATIONS & REFERENCES

## GOOD READS FOR BETTER SLEEP

- Sleep Right In Five Nights by James Perl
- SHUT I Sleep app
- The Sleep Foundation [www.sleepfoundation.org](http://www.sleepfoundation.org)
- Say Good Night To Insomnia by Gregg D. Jacobs
- The Insomnia Answer by Paul Glovinsky and Arthur Spielman
- Desperately Seeking Snoozin by John Wiedman
- Benefits of Sunlight: A Bright Spot For Human Health; Environmental Health Perspectives; volume 116, number 4; April 2008.



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## System Biology

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