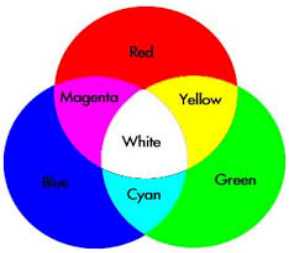
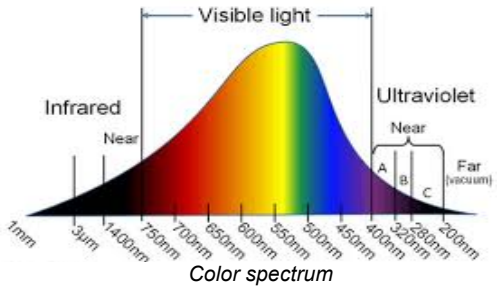
Lighting, iPads & Sleep

This FAQ will be a superficial review of light and sleep patterns. We often get asked about issues such as how does the computer screen (or iPad or iPhone) affect my kids, or affect the health of my eyes, or affect the need for glasses, etc.

Colors are usually described by a name (such as in the color wheel diagram, below). However, scientifically, colors are more accurately described by a wavelength or frequency (see the visible color spectrum plot, below). The visible spectrum extends from the red, 750nm frequencies to the blue/violet, 400nm frequencies.



Color wheel



Color spectrum

This color range can also be described as a temperature. This range is useful when discussing various hues of white. The warm (red/yellow end) is 2500°K (degrees Kelvin), the cool (bluish) end is 6000°K. These temperature ratings are most commonly seen on packages of light bulbs, especially LED and fluorescent bulbs.

Computer monitors are calibrated in degrees Kelvin. Daylight is said to be about 5000 to 5500°K. (I prefer 4300 to 4500°K as a daylight setting.) Unless you're involved in accurate color matching (photography, etc.), the actual setting is not too important.

Until the advent of electric bulbs and distributed electricity, people only had candlelight to illuminate their nighttime world. Our bodies cycle with natural light: our retina detects light and not only sends signals for vision but also triggers a circadian rhythm. This rhythm, when light levels are low, prepares us to sleep at night by lowering our body temperature and increasing melatonin and other hormones. At sunrise the opposite occurs: the light triggers hormones like cortisol to get us going.

The color temperature of light also seems to play a role. Research has shown that blue light increases our reaction times and our alertness (by increasing alpha brain waves), while simultaneously suppressing melatonin production and delta brain waves, which disturbs sleep. When blue light is blocked, allowing only warm colors through produced more melatonin.

Such studies have led many people to try to reduce the blue or cool light quality that we use at night. The old candlelights used in the past are much warmer than our warmest lights. Incandescent bulbs are 2500-3500°K while candlelight is 1000-2000°K. This means that both incandescent bulbs and candlelight are much warmer than blue LEDs.

Current research suggests that we reduce blue (cool) light exposure, as well as dimmer light levels, for 1 to 2 hours before sleeping. This means using no iPads, computers or brightly lit rooms. By dimming lights and keeping them on the red (warm) side, our bodies will more naturally prepare for sleep.

Apple Computer recently added a "Night Shift Mode" to their iOS. This will shift the display towards the warmer end of the spectrum. If you use these settings, and keep the display dimmed, you can continue reading closer to your sleep time without suppressing your melatonin and delta waves. Similarly, the settings can be applied to iPads and Android devices. Another suggestion if you're using a Kindle app on iOS or Android is to set the background to black and the text to white. This greatly reduces the illumination and glare when reading at night; it's like dimming the room lights.

So the next time you buy lights for your bedroom, look for LEDs in the 2000°K range rather than the over 3000°K range. This will give you the warmer levels of the older incandescent bulbs. The closer you can get to the 1000°K limit, the closer your bedroom will approach the candlelight color temperatures. Also, keep the wattages low or add dimmers so that the entire room is not too bright.

With regards to whether looking at a computer screen can damage our eyes, the short answer is “no.” The computer screen is much like any other object you’re looking at, particularly newer screens (older CRT screens did have issues of radiation that newer LCD/LED screens do not). You are focusing the entire time you’re looking at the screen, so hours of staring at a monitor will make the eyes tired. The internal focusing muscles contract when we look at near objects (within arm’s length) and relax when we look at distant objects (greater than 8 feet or so).

Do remember that when staring at anything for too long, whether a book or a monitor, people tend to blink less often. If you remember to blink more frequently, and better yet, take a “focusing break” by looking into the distance, you will replenish the surface tear film and relax the internal focusing muscles. This will allow you to read for longer periods of time with less fatigue.

People often use caffeine to stay awake. Certainly, if you’re planning on sleeping soon, taking drinks that contain caffeine is not a good idea (alcohol and nicotine also disrupt sleep). But how does caffeine keep us awake?

After we’ve been awake for some time, adenosine, a chemical in our brain, begins to increase in concentration. The increased adenosine inhibits the cells that keep us alert by binding (attaching) to special receptors. (Think of the adenosine as a key and the receptor as a lock.)

Caffeine blocks the adenosine receptors, preventing adenosine from binding to their receptors. This, in turn, prevents the adenosine from inhibiting the cells; so we stay more alert. The caffeine blocking is temporary, so we eventually get sleepy again. However, if we do sleep, caffeine affects the quality of our sleep. Caffeine reduces slow wave and REM sleep.

As mentioned above, alcohol also disrupts sleep. While alcohol initially can make us sleepy, metabolites of alcohol (produced as the alcohol is broken down before removal by the body) arouse us from sleep. These sleep arousals can lead to insomnia, all of which decidedly ruins our sleep cycle. Furthermore, if someone has sleep apnea, alcohol makes that worse too. And sleep apnea disrupts everyone’s sleep, especially those in the same room with the apneic person.