



Good Light
Guide

May 2023

for healthy,
daytime-active
people

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Preface

The Good Light Group is committed to spreading knowledge and practical advice when it comes to our bodies' need for 'good light'. In years to come, we envision this knowledge reaching all who live and work during the day indoors and becoming a new building block to enable us to live in good spirits and health. We hope that you enjoy this first edition of the Good Light Guide, and that it inspires you to join the movement #goodlightgroup, to sign up for our newsletter at goodlightgroup.com and especially to share the knowledge in this guide with family, friends, neighbours and colleagues. If you are interested in doing more, please do reach out by email by writing us at: info@goodlightgroup.org.

This guide or parts of it may be used after notifying the Good **Light** Group and including the reference: www.goodlightgroup.org

*Photo on frontpage by DocuSign on Unsplash

1. Introduction

Good Light is the right light at the right time tailored to our activities and personal needs, every day of our life. Good Light is natural light, or electric lighting indoors that mimics the beneficial properties of natural light as much as possible.

The wrong light at the wrong time may result in problems such as mood disturbances, sleep problems, difficulties with learning and memory, problems with vision in the short term, and health problems in the long term.

Exposure to a stable and regular daily light-dark cycle has the following beneficial effects on the human body and brain:



Good Light revitalizes us

Good Light is essential for a properly synchronized biological clock and that clock is responsible for our day-night rhythm, and how well we sleep.



Good Light energizes us

Good Light makes us feel energetic, alert, and enables us to concentrate.



Good Light comforts us

Good Light makes us feel happy, welcome, cosy, relaxed and safe.



Good Light shows us

Good Light supports our vision, enabling us to see objects, colours, contrast, and motion.

There are four characteristics of Good Light that will be defined in more detail in this guide.

Good Light is:



Attractive

Good Light indoors is high quality and comfortable for the eyes.



Dynamic

Good Light indoors stimulates during the day with an intensity that is approximately 2-5x higher than the current norm for vision and relaxes during the evening with an intensity that is approximately 5x lower than the current norm for vision.



Optimized

Good Light indoors has spectral characteristics that vary according to the time of day, personal needs, and specific tasks.



Personal

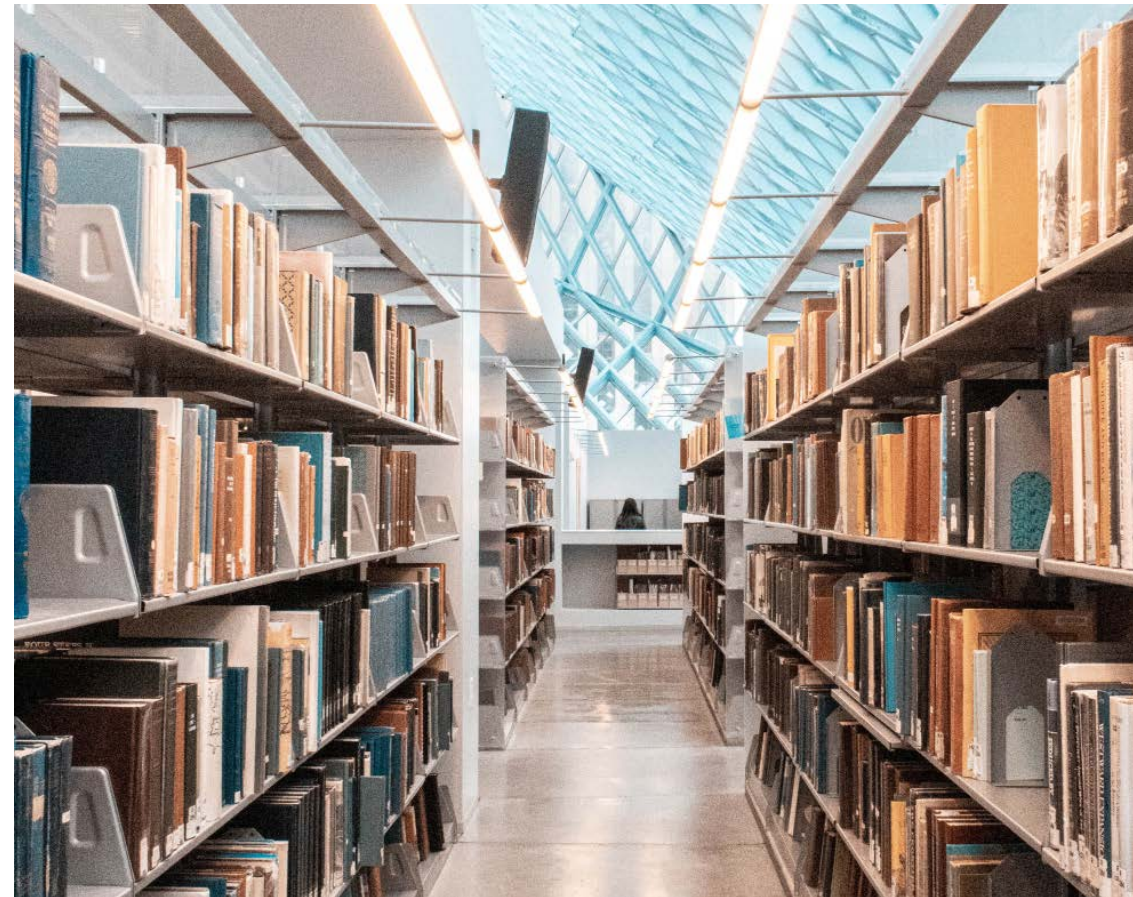
Good Light indoors can be adjusted by the user to suit their personal needs. A Good Light system safeguards that these personal adjustments are made within the boundaries of an optimal setting.

Limitations:

The recommendations in this guide for Good Light are intended to be used by healthy people with a day-active schedule. It is not meant as a treatment for patients; people with eye- or skin diseases or who suffer from mood disorders are advised to seek medical advice. This guide is not intended for people who work shifts. Working in early shifts, late shifts, night shifts, forward or backward rotating shifts impacts your circadian rhythm. Light interventions to support shift workers need to be personalised and may depend on individual differences, shift work schedules and job demands [1].

The Good Light Group developed this practical guideline for Good Light based on scientific knowledge and/or best practices. These guidelines are subject to change and can be updated to incorporate new insights.

Photo by Shunya Koide on Unsplash



2. Natural daylight is the best light

Being outdoor during the day is very important for people. Daytime light intensities outdoor are always higher than indoor, by a factor of anywhere between x10 and x500. And the high light levels outdoor are full spectrum. Sunshine includes infrared (IR) which warms us, and ultraviolet (UV) which when it reaches the skin, supports Vitamin D production, important for calcium uptake for healthy bone structure, and the immune system [2] [3]. The high light intensities we get when outdoors during the day are also important for wellbeing, mood, performance, how we sleep at night and for reducing our sensitivity to light in the evening. Exposure to full spectrum, high intensity daylight in the morning prevents our biological clock from getting out of sync with the natural 24h light-dark cycle. It prevents our body from running late, and from fragmented sleep, waking frequently at night [4] [5]. The Good Light Group advises people to enjoy natural daylight as much as possible by being outside during the day. Because we are not able to be outdoors all day, every day, the Good Light Group has the following recommendations that should be applied at the same time each day, as far as possible:

- Unless you would like to fall asleep and wake up later, take measures to get a dose of natural daylight in the morning immediately after waking up for at least 30 minutes, e.g. by taking a walk or bicycle ride outdoors, or walking or biking to work or school. If it is dark when you wake, try to 'see' the first half hour of natural daylight after sunrise [6] [7].
- Take a walk at lunchtime spending at least 30 minutes outside in daylight.
- Play or exercise outside during the day.
- Especially for children, we recommend spending at least two hours outside in daylight every day [8].
- Studies recommend that for periods longer than 20-30 minutes on sunny and/or warm days, you should protect your skin and eyes in an appropriate way against an overdose of UV radiation from the sun [9]. The most common ways to do this is by wearing protective cloths, a cap, sunglasses, by using sunscreen and/or simply moving to the shadow. Wearing a cap reduces the light coming into your eyes by ~50%, wearing sunglasses reduces the light coming into your eyes by 5-95% depending on the type of glasses.
- If it is not possible to spend time outdoor, the next best alternative is to stay within one meter of a window and regularly look outside.



Photo by Joseph Chan on Unsplash

3. Indoor light for healthy daytime-active people

People worked and lived outside in natural daylight for many thousands of years. Since the industrial revolution this has changed significantly. Today, people spend 90% of their time indoors. That makes having Good Light indoors essential for our health and wellbeing.



Photo by Burst from Pexels

3.1 Good Light is Attractive

Just like in nature, indoor light should be attractive, comfortable and of high quality. This is achieved when indoor lighting shows colours naturally, does not cause too much glare, does not have unwanted artifacts or flicker, provides attractive contrast, lights the space comfortably, does not make noise and feels safe.

Design tips to implement attractive light indoors:

- Let daylight in as much as you can through windows and skylights.
- Increase the overall brightness of the room, don't only light the work surface or task but light the surroundings e.g. the walls and the ceiling.
- Use accents of light to create attractive contrast.
- When you select lighting, choose for a Colour Rendering Index (CRI or R_g) of at least 80 [10].
- Avoid Discomfort Glare: design for a Unified Glare Rating (UGR) of 19 or less in long-stay areas (≥ 30 min) and for $UGR \leq 22$ in short-stay areas (< 30 min) [11].
- Avoid Temporal Light Artefacts: Flicker $P_{st}^{LM} \leq 1.0$ and Stroboscopic effects: Stroboscopic Visibility Measure (SVM) ≤ 1.0 [12] [13] [14] [15].
- Limit audible noise from the lighting installation to ≤ 24 dBA at 1m distance [16].



Photo by Andrew Neel from Unsplash

3.2 Good Light is Dynamic

The amount of daylight we are exposed to outdoors varies during the day both because daylight itself is ever changing and because we are moving around ourselves, changing what we look at and see, and making changes to the space we are in like sitting in the shade. It might be advantageous to mimic these changes to some extent indoors. People need high light levels during the day, and low light levels during the evening before going to sleep. Good Light indoors is stimulating during daytime with an intensity that preferably exceeds the traditional standards for indoor lighting by a factor 2 to 5, while during the evening the preferable light level is dimmed by a factor 5, provided it remains comfortable and safe.

For people 45-50 years and older, higher light intensities and probably spectral changes may be needed to support visual and non-visual (biological and emotional) needs [17] [18]. This is largely due to the normal degrading processes that happen in the eye. Many people recognize this as the time when they start needing reading glasses.

Design tips to implement dynamic light indoors:

- Use a lighting system that enables you to change the light level; dimming =reducing the light level and boosting =increasing the light level.
- Use lighting systems that enable you to change the distribution of light in the room during the day, effectively mimicking daylight.
- Provide horizontal and vertical light levels that ensure adequate visual performance and comfort, while simultaneously providing non-visual (biological and emotional) benefits.
- In the following table you will find our recommendations for horizontal light levels. These levels are based on the current knowledge, and a combination of best practices and scientific arguments [28]. Please note that these light levels must remain comfortable and adequate for the age of the user and the specific task. The horizontal intensity criterion also depends on the spectrum (see following paragraph), lighting design, and environment. Timing should be personalised so that it supports personal schedules.

Recommended minimal horizontal light levels	<30 years	~50 years	>75 years
Daytime (e.g. 7am-7pm)	≥1000 lux	≥1200 lux	≥1700 lux
Evening (e.g. 7pm-11pm)	≤40 lux	≤50 lux	≤70 lux
Nighttime (e.g. 11pm-7am)	≤5 lux	≤6 lux	≤8 lux

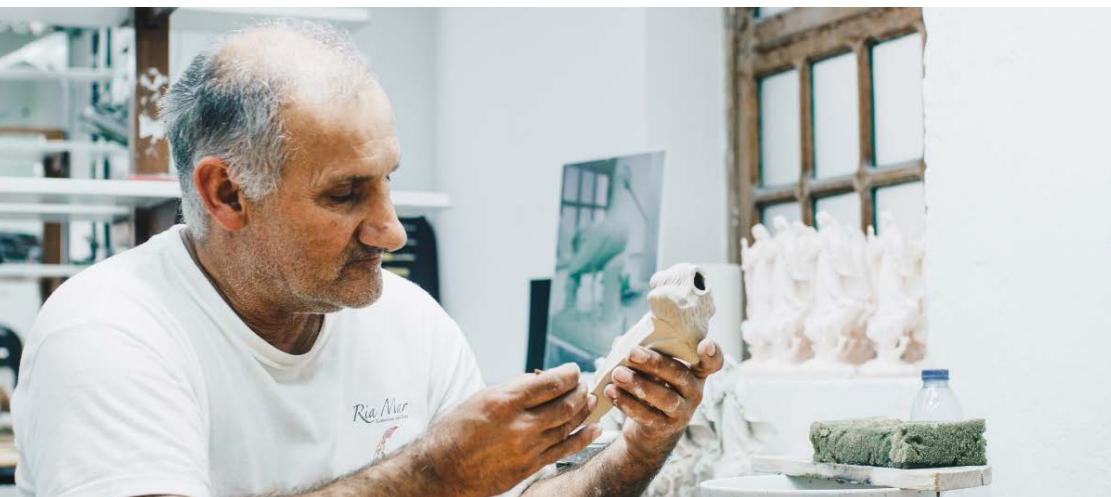


Photo by João Jesus from Pexels

3.3 Good Light is Optimized

Just like in nature, the spectral properties (colours) of ideal indoor light vary as a function of the time of day [19]. Light spectrum can be optimized to meet personal needs and preferences and to support specific tasks. During the day, the light spectrum should include a reasonable portion of short wavelengths (cyan light colour) to provide the energizing and revitalizing benefits of light. In the evening and at night, the amount of short wavelengths should be minimized to support winding down, enabling a good night's sleep and preventing disruption of the day-night rhythm [6] [20]. With age, from 45-50 years and older, the spectral characteristics required for optimal functioning may change because of changes in the eye, e.g. in the case of the development of cataracts [17] [21].

Design tips to implement optimized light indoors:

- Use lighting systems that are 'tuned' or 'tuneable' to support a specific activity. A lighting system is 'tuned' if the spectrum is selected to support a specific activity at a specific time of the day. A lighting system is considered 'tuneable' if the light spectrum can be changed. 'Tuneable white' systems are most common and can vary in Correlated Colour Temperature (CCT). Please note that CCT is only a proxy for spectral content: two light sources with the same CCT can have totally different spectra and therefore a totally different impact on the human non-visual system [22]. The real spectrum is more important than a CCT number. For this reason, you may also choose to use a more advanced 'tuneable colour' system. These systems vary not only in CCT, but also in spectral content and in colour.
- Although not very common yet, some have reported that it may be beneficial to use a lighting system with additional spectral benefits which can be found in the non-visual part of the spectrum, e.g. supporting Vitamin D production or photo-biomodulation [3].
- Design not only for horizontal light levels as suggested in most lighting application standards, but also for light on the eye. During most daytime activities, this is the vertical light level at sitting or standing height [6] [20] [23].
- The recommended levels in the table below are partly based on recent recommendations [20] of a group of scientists, and age corrections [24], and partly based on our own interpretation thereof.

Recommended minimal light levels on the eye in MEDI*	<30 years	~50 years	>75 years
Daytime (e.g. 7am-7pm)	MEDI ≥250 lux	MEDI ≥300 lux	MEDI ≥425 lux
Evening (e.g. 7pm-11pm)	MEDI ≤10 lux	MEDI ≤12 lux	MEDI ≤17 lux
Nighttime (e.g. 11pm-7am)	MEDI ≤1 lux	MEDI ≤1 lux	MEDI ≤2 lux

*Melanopic equivalent daylight illuminance (in the table abbreviated to MEDI) is one of the metrics defined in the international Standard CIE S026:218 [25] recommended to be used in measuring the non-visual effects of light [23]



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3.4 Good Light is Personal

Good Light indoors can be adapted by the user for personal needs based on suggestions by the system. Individuals may differ in light appreciation with respect to intensities and preference for warm or cool tones of (white) light. In addition, individuals can differ in the timing of their sleep-wake phase, also referred to as being a different chronotype. Early chronotypes have a morning preference and late chronotypes an evening preference [26]. This results in individual needs when it comes to the timing of the dynamic 24h pattern of light, and both its intensity and spectral characteristics. In addition, having personal control over the dynamics and spectral characteristics of light is highly appreciated by individuals.

Design tips to implement personal light indoors:

- Consider using a lighting system with a pre-programmed pattern over the day, and that provides the proper light intensity and spectrum at the proper time [6] [27].
- Consider using a lighting system that offers pre-programmed, task specific light settings to support a range of different activities.
- Many individual users appreciate having personal control over the dynamics and spectral characteristics of the light. The amount of control, or adaption ranges can be selected by the system and made time of day dependent.
- Consider using more advanced lighting systems which include environmental sensors beyond those applied to measure and control the lights. Incorporating sensors like temperature, noise detection, air quality can serve to safeguard and support health and wellbeing of the users. These types of Indoor Environmental Quality sensors should be connected to other building automation systems.

For examples of best practice projects and inspiration see also:

www.valueoflighting.eu

www.katlab.org/public-engagement

lightingforpeople.eu

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