Planterra® Lighting Guide

FOR INTERIOR LANDSCAPE DESIGN

BY SHANE PLISKA

EDITION 1.0

Executive Summary

FROM LIVING WALLS AND atria to executive offices and luxury homes, interior design plans often include recommendations for live plant installations. And why not? Plants provide many benefits to humans—for aesthetics and for health. However, planning for adequate lighting and selecting plant species suitable for different environments requires careful consideration.

The Planterra Lighting Guide for Interior Landscape Design provides insight on light measurement, natural and artificial light parameters and sources, acclimatized foliage, plant placement, geographic considerations, benefits to plants and people and more. The guide also includes a list of plants based on their tolerance to low-, medium- and high-light environments.

Planterra created this white paper as a tool for architects, landscape architects, interior designers and other professionals looking to create environments where both plants and people can thrive. The comprehensive guide is also designed to help the reader optimize client investments in and the longevity of the interior landscapes they design.

PHOTO ©TONY FRANTZ

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Introduction

PROPER LIGHTING IS ESSENTIAL for the long-term health and aesthetics of interior landscape installations. Light plays the key role in photosynthesis, providing the energy plants need to transform carbon dioxide and water into the simplified sugars, starches and other substances plants need for nutrition.

When designing interior landscapes for commercial and residential applications, several lighting factors must be considered: natural light availability, artificial light options, light timing and duration, plant acclimatization and optimum plants based on the environment. Neglecting these considerations can compromise the beauty of and increase the cost to maintain the installation over time.

This guide pertains to interior landscapes that are designed, built and maintained for the aesthetic and biophilic qualities that enhance human enjoyment inside buildings. Lighting requirements for rearing seedlings, propagating or the growing of crops, herbs or flowers for harvest are not covered in this paper. The plants installed in buildings are grown and finished in greenhouses and shade house nurseries.

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Light For Subsistence vs. Growth

PLANTS GROWN AND ACCLIMATIZED for use in an interior landscape are installed as finished products. Unlike landscape designs for the outdoors that take into consideration room for growth, the interior landscape is designed for plants to be installed at the intended size and to look finished from day one. Therefore, the light intensity that an interior landscape requires is based on achieving sustenance and slow-to-moderate growth.

The ideal light intensity for an interior landscape to maintain plant life is one in which plants get enough light to remain healthy and attractive, but not so much that they outgrow the space or flower. With the exception of only a few species, such as the white bird of paradise or the anthurium, most plants that are part of a permanent interior landscape installation are not intended to bloom.

This is recommended for three reasons. First, plants are rarely placed in interior environments with enough light intensity or spectral quality to trigger a bloom. Second, the blooms on foliage plants are generally inconspicuous. Third, the ornamental quality of the foliage diminishes as the plant transfers and prioritizes energy from the foliage to the flower and eventually to the seed.

Flowers can, however, function as a significant component of interior landscape designs, specified as color rotations. These flowering plants are grown and budded in greenhouses and sent to the site location to be displayed only for the duration of the bloom cycle. Common examples include the orchid, bromeliad, azalea and the chrysanthemum. These plants are only on display for the duration

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UNITS OF MEASUREMENT: FOOT-CANDLES, LUX, LUMENS AND NANOMETERS

Foot-candle (fc): American unit of measure that quantifies the intensity or quantity of light—illumination—cast on an object. One foot-candle = the illuminance on a one square foot surface from a candle one foot away.

Lux: International unit of measure that quantifies illumination. One foot-candle = 10.76 lux.

Lumen: Unit of measure that quantifies the amount of energy emitted by a light source. One foot-candle = one lumen per square foot.

Nanometer (nm): Unit of linear measure that quantifies spectral quality in wavelengths of light supplied (color of light).

- Ultraviolet: 315–400 nm
- Blue light: 400–450 nm
- Red light: 640–700 nm
- Far red light: 705–740 nm

Foot-candles vary depending on the environment. For example, foot-candles outdoors can range from more than 10,000 fc on a bright, sunny day to less than 500 fc when it's overcast. Foot-candles in interior commercial spaces range between 50 fc under normal task lighting to more than 150 fc near windows.

Measuring the number of foot-candles available from natural light sources is an essential first step when planning for an existing indoor installation. Artificial light sources can be added when natural light is insufficient. To ensure plants thrive indoors, light evenly distributed across the canopy of the plant is recommended (i.e., multiple artificial lights are preferable to one light source).

Light For Subsistence vs. Growth

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of the bloom cycle and the lighting requirements for these specific species do not need to be factored into the lighting design. Of course, decorative lighting and spotlights to highlight the flowers are welcome features.

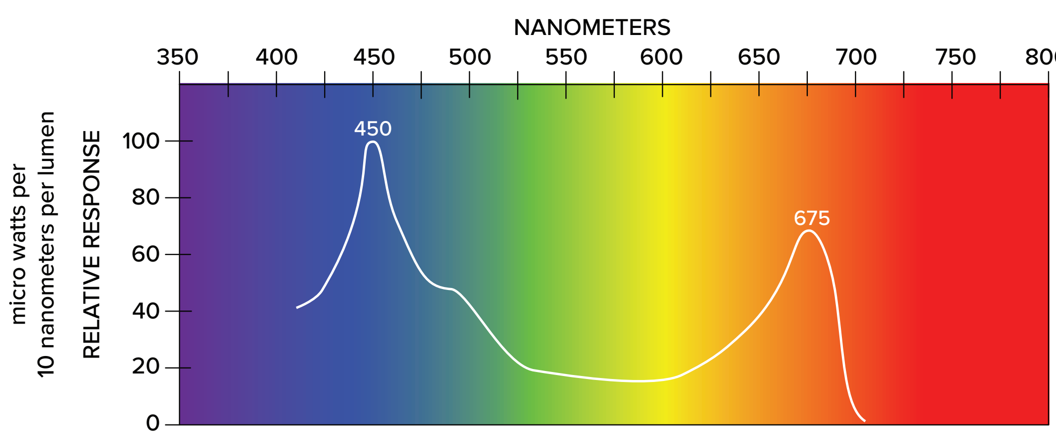
Spectral quality—or color—of light is also an important consideration. Plant installations need red and blue light to sustain plant life indoors. The spectral energy required for photosynthesis and for chlorophyll synthesis shown in the chart, indicates peaks in the 675 nanometer (red) and the 450 nanometer (blue) wavelengths. Ultraviolet (UV) at 380 nanometers is not needed for photosynthesis and interior landscapes don't need it to survive. This is welcome news, considering most architectural window glazing systems filter out UV from the transmitted light.

UV is commonly misunderstood when lighting is requested to grow plants inside buildings. Most fixtures marketed as grow lights, which include the UV spectrum, are utilized for growing flowers, herbs and food and not intended to be used for architectural lighting.

Evaluating the amount of available light—from natural and artificial sources—is an essential step when designing an interior landscape. Some plants simply need more light than others to thrive. An interior landscape design may include a variety of colors, textures and habits of growth. Invariably, such a multitude of species will have differing light tolerances. The higher the intensity of light, the wider the plant palette becomes. Mixing plants with differing light demands requires the growth and lifecycle of plants to be managed and replaced as necessary, as some will hang on, some will do well with minimal growth, and some will thrive and grow too fast.

PHOTO ©ISTOCK/PAMELAJOEMCFARLANE

Plants on rotation such as these orchids, budded in a greenhouse and on display for the duration of the bloom cycle, do not need to be factored into the lighting design, except for decorative considerations.



For foliage plants and trees, the optimal spectrum used for photosynthesis and chlorophyll synthesis peaks in the blue and red.

The Benefits of Acclimatized Shade-Grown Foliage

LEAVES OF PLANTS GROWING in direct sunlight contain multiple layers of cells that act as a protective barrier—similar to sunscreen—to shield the chlorophyllous structure from damage that high-intensity sunlight can produce. For example, a sun-grown Ficus will have two to three layers of cells.

Since light intensity is lower indoors, plants grown outdoors need to be acclimatized to survive the lower light intensity of the interior environment. During the acclimatization process, plants are grown under shade structures and gradually weaned to sustain foliage with less light. To maximize exposure in the lower light environment, the disks of the chlorophyll spread out, causing foliage to become wider and darker green as more chlorophyll is visible through the surface of the leaves.

To include trees taller than 12 feet in an interior installation, expect to reserve plants a year in advance.

Depending on the size and type of plant, acclimatization can take three to 18 months. To include trees taller than 12 feet in an interior installation, expect to reserve plants a year in advance to allow for the necessary 12 months of acclimatization. Acclimatized foliage is costlier, but failure to acclimatize plants typically leads to negative consequences, including defoliation, higher susceptibility to disease and pests, and plant death.

PHOTO ©SHANE PLISKA

Dracaena 'Lemon Lime' plants growing in a shade house in Florida will be acclimatized before shipping to interior landscape contractors.

PHOTO ©ISTOCK/NIKADA

Tall trees can require 18 months to acclimatize.

Natural Light: Window and Skylight Glazing and Exposure

GLAZING IS THE PROCESS by which windows are fitted with glass. Some of the windows manufactured today feature multiple panes (double and triple glazing), specialized coatings, layers of insulating gas contained between panes and other advancements. While most of these features were developed to improve energy efficiency, window glazing can also affect both the amount and spectral quality of natural light allowed to enter buildings. When addressing interior landscape projects, window and skylight glazing must be taken into account. Consider the following:

Clear glass is only used in greenhouse applications today. UV rays easily pass through clear glass to grow crops. Older buildings, which may not have been renovated, may have clear or less efficient glass windows that produce high heat gain, especially in western exposure. Plants requiring higher light exposure and those that are heat tolerant, such as the pencil cactus and jade plant, are more suitable for these environments.

Reflective, tinted or frosted glass is found in many commercial buildings. Reflective or tinted windows reduce light intensity passing through them, and depending on the wavelengths they filter, can also compromise the ideal spectrum needed to sustain plant life. Window frosting disperses light, which helps distribute light more evenly, much like clouds do on an overcast day. More uniform light distribution is beneficial to interior landscape installations. Frosting is rarely used in vertical (window) glazing because it eliminates visibility through the windows, however frosting can be extremely beneficial when used as skylight glazing by better distributing light within an interior space.

Windows with **low-emissivity (low-e)** glass are treated with a fine metallic coating during the manufacturing process. Low-e glass minimizes the amount of ultraviolet and infrared light able to penetrate glass without compromising visible light. The amount of visible transmittance

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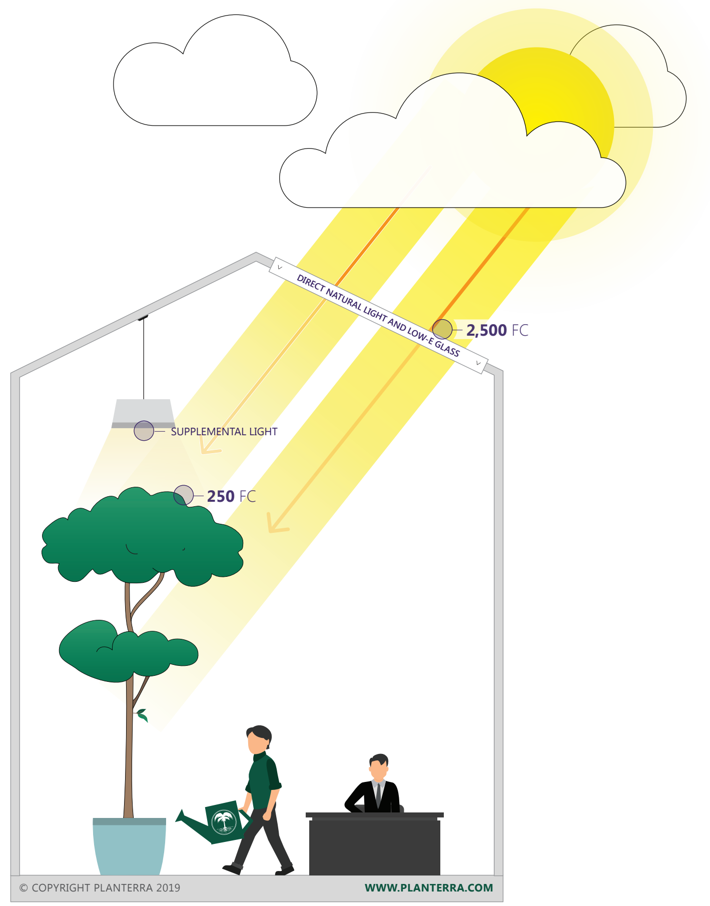
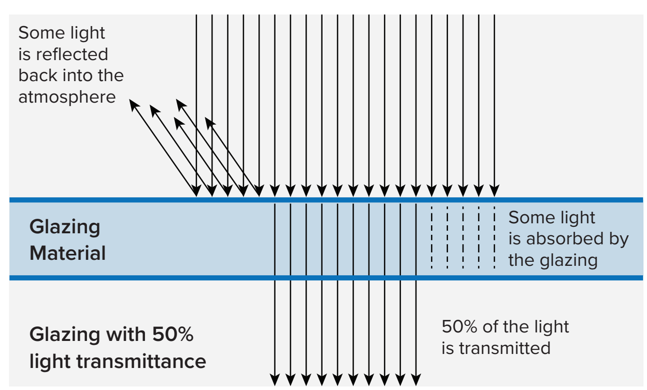


Skylights and windows can provide abundant natural light, but in many cases the angle of the windows or the amount of visible transmittance will require supplemental lighting.



With tinted or reflective glass, a certain percentage of light is absorbed and a certain percentage is reflected.

Natural Light: Window and Skylight Glazing and Exposure

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(VT) varies greatly and is sometimes unnecessarily low in order to conserve energy. Plants benefit from a high visible transmittance (VT) of light—the more the better. Low-e glass with a VT greater than 70 percent works best for interior landscapes.

Window orientation must also be considered when selecting plants for indoor environments. Consider the following guidelines during plant selection and placement:

Eastern Exposure: East-facing windows receive morning light when the sun's rays are weaker. Low- to medium-light tolerant plants are a good fit for windows with eastern exposure.

Western Exposure: Medium- to higher-light tolerant plants benefit from placement near windows with western exposure, thanks to full afternoon and evening sun.

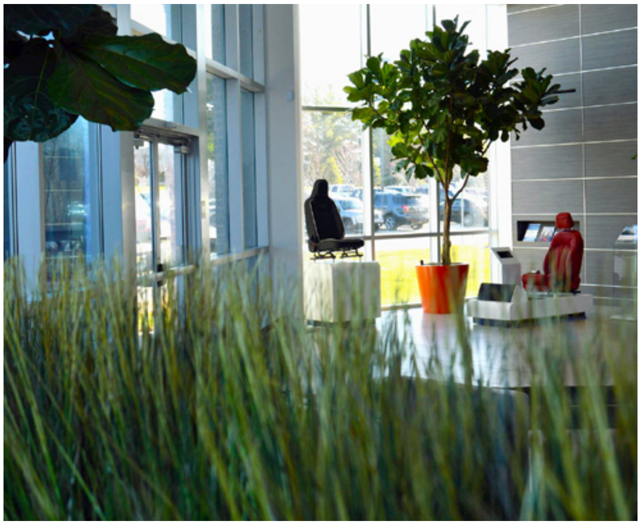
Northern Exposure: Low-light tolerant plants may fare well near north-facing windows during summer months. However, northern exposure can pose a challenge when trying to sustain plant life during winter months, so supplemental light is recommended.

Southern Exposure: Unblocked, south-facing windows receive the most sunlight. Plants tolerant of high light do best placed near windows with southern exposure.

PHOTO ©GEOFF GEORGE

Because the skylights in this LEED® Silver Certified hospital do not provide enough light to sustain the trees in this atrium, supplemental light fixtures were added.

Lighting Location and Plant Placement



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WHEN DEVELOPING LIGHTING PLANS for interior landscapes, the location of lighting sources must be considered. Outdoors, sunlight penetrates plants from the sky downward, entering through the surface of leaves at the canopy. Plants also use light coming from above in interior spaces, whether through skylights, windows or artificial light sources. Up-lighting should be utilized for decorative purposes only, and care must be taken to avoid using light fixtures that might produce enough heat to damage understory foliage or plant roots.

To optimize natural light, the top of the plant should be placed at least one foot below the top of a window. In an office environment with windows extending to the top of 8- to 12-foot ceiling heights, plants should be placed within 5 feet of windows to maximize the benefits of natural light. Window orientation is important to this discussion. In southern exposures, with the sun higher in the sky, plants must be relatively close to windows to get sunlight. In eastern and western exposures, they can be farther away from windows and still receive some direct sunlight.

For installations that use both natural and artificial light, ensuring plants receive adequate amounts of artificial light to accommodate for fluctuations in available natural light is essential. Hours of available sunlight can vary greatly based on geographic location, time of year and weather conditions.

For example, in Detroit, the longest day of the year—Summer Solstice—is 6 hours and 12 minutes longer than the shortest day of the year—Winter Solstice. Some regions of the United States also experience more cloudy days than others, reducing natural light availability. On average, Seattle experiences heavy clouds more than 60 percent of the time—or 226 days per year, while Phoenix boasts the most clear days, with an average of 211. Cloudiness also varies based on the time of year, location and weather. In January of 2017, Detroit endured 24 consecutive cloudy days during some of the shortest durations of daylight in the year.

However, buildings in the sunbelt from Phoenix to Orlando often utilize window glazing that filters out a higher intensity of solar light than in northern climates. In some cases, this reduces the VT far below the levels on a cloudy day in the north. Therefore, supplemental lighting is often needed in the sunniest cities, too. In downtown areas, shadows cast by neighboring buildings can also affect the quality of light inside.

Installing timers to run artificial lights 10–12 hours per day—during and beyond natural light hours—helps ensure plants get adequate light every day of the year.

CLOUDIEST U.S. CITIES

Cloud cover can significantly impact the quality of natural light available for interior plantscapes, especially in these major U.S. cities, where clouds cover over three quarters of the sky more than half of the year.

CITY	HEAVY CLOUD DAYS/YEAR
Seattle, WA	226
Portland, OR	222
Buffalo, NY	208
Pittsburgh, PA	203
Cleveland, OH	202
Rochester, NY	200
Columbus, OH	190
Cincinnati, OH	186
Detroit, MI	185

SOURCE: NOAA National Climatic Data Center

Artificial Light Parameters and Sources

FROM THE PLANT'S PERSPECTIVE, any electric light source is an artificial creation, which can be described as "manufactured sun." All plants evolved over millions of years to derive energy from light, with the sun as the single and consistent light source, where the light comes from above, and as the sun tracks across the sky.

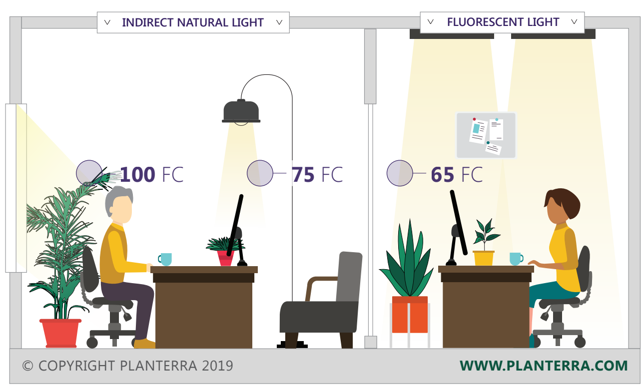
RECOMMENDED LIGHT PARAMETERS

When designing an artificial lighting plan for plants within an architectural space, consider it a challenge to replicate the sun:

1. **Provide electric lighting from above.** Light should originate from above because angled light causes glare and plants want to grow up toward light. This effect is called phototropism. Some plant species are more phototropic than others
2. **Provide sufficient intensity.** The fixture must project light from the source to the foliage at an intensity appropriate for the plant. This intensity can be calculated to determine the lumens required from the fixture to provide plant sustenance.
3. **Opt for the blue and red light spectrums.** The wavelengths in the blue and red light spectrums support photosynthesis and chlorophyll production, but the overall spectral quality must also be palatable for human comfort.
4. **Operate light fixtures for a 10- to 12-hour duration, like a full day of sun (over a yearly average).** This requirement cannot be cheated upon. Front loading, by providing a higher intensity of foot candles for a short period of time (i.e. less than 5 hours), is not recommended.
5. **Design for comfort and aesthetics.** The number of lumens needed to produce the proper light intensity varies greatly in different types of buildings and fixture mounting locations. Plan with care, as the light can end up being too bright for human comfort. This may require angling lights away from human view or setting bright lights on timers after hours. Beware that providing plant lighting after hours can be problematic. If plants get some useful light during the day but not enough for sustenance, then are given higher intensities after hours, the plants may not get sufficient rest between periods of light and dark, a phenomenon known as photoperiodism.

FORMER AND CURRENT SOURCES OF ARTIFICIAL LIGHT

The **incandescent light bulb** has been around since the late 19th century. However, it is no longer used for plant growth lighting due to its electrical inefficiency, short lamp life, high color temperature output and excessive heat generation.



All sources of lighting should be considered when selecting plants that can be sustained in a space. The lower the light level, the narrower the plant palette becomes.

Fluorescent lights, developed at the turn of the 20th century, came into popular usage in the 1920s and can still provide an adequate amount of blue and red wavelengths to support low-light tolerating plants in an office environment. In a commercial building with a standard 8- to 12-foot ceiling, the fluorescent fixture will not produce enough intensity as the sole light source to support plants

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Artificial Light Parameters and Sources

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with higher light requirements. However, when combined with light from a window, it is possible to support a wider range of plants with fluorescent lights. The intensity of fluorescent lights slowly diminishes over its life span. It is recommended that these lamps be replaced on a regular basis to keep the light intensity consistent, even when they seem to be working properly.

High Intensity Discharge (HID) lamps were developed over the latter decades of the 20th century as an improvement to incandescent and fluorescent sources in order to provide increased intensity, higher efficiency and longer lamp life. The earliest HID source, mercury vapor, emitted too cool a color temperature for either human or plant use indoors. A later HID source, high-pressure sodium, further improved lamp life and intensity but was too warm for either humans or plants. Both mercury vapor and high-pressure sodium were used primarily for street lighting due to their ability to provide very bright light and last many times longer than incandescent bulbs. The most recently developed HID lamp is metal halide, which finally produced a white light pleasing to people and horticulturally helpful to plants. It was the best architectural light source available to provide the proper intensity and color temperature for plants before LEDs were introduced. Metal halide fixtures are commonly used in commercial buildings, particularly as lighting sources in office building atria. This type of light is excellent for delivering the cooler spectrum for a clean white light, while offering an extended life span of 5,500 to 20,000 hours. The downside is that HIDs produce a considerable amount of heat and consume far more energy than LEDs.

Light Emitting Diode (LED) lamps have in the last five to 10 years become the preferred interior light source for their versatility and energy efficiency, offering a lifespan of 50,000+ hours and lower maintenance costs too. LEDs are a great source of blue and red light because they can be custom ordered to produce the exact wavelengths an interior landscape requires. LEDs provide a unique opportunity to design a lighting plan that is compatible with the needs of illumination for both human comfort and interior plants.

The best designed interior landscapes will typically be illuminated with natural light, but since this is rarely possible, a combination of natural and artificial light can best address the needs of the architecture and occupants—people and plants alike.

PHOTO ©TONY FRANTZ

In this atrium, carefully tuned LED lights combined with natural light play a crucial role in sustaining trees.

Light Benefits For Plants and People

A PLANT IS LIKE THE canary for the modern workplace. If there is enough light to support plant life, there is enough light to support a healthy and productive environment for people, too.

Plants derive their energy from the red and blue wavelengths of the light spectrum—and so do people. Obviously, humans do not photosynthesize, but our bodies do respond to light, which helps regulate our sleep-awake cycles, a phenomenon known as the circadian rhythm.

During the day, exposure to the blue wavelength suppresses the release of the hormone melatonin in our bodies, which makes us feel alert. LED lamps that produce white light are generally in the blue spectrum. Red is the longest visible wavelength on the spectrum. At sunset and sunrise, red light is revealed because the sun is low on the horizon and farther away. When the light shifts from blue to red, the brain's pineal gland is triggered to release melatonin, which prepares the body for a rest cycle. Studies have shown that exposure to red light is important for overall sleep quality.

Advances in both window glazing technology and LED lighting have greatly diminished the conflict between energy efficiency and filling a space with high quality, visible light.

It is only in recent human history that people shifted from spending most of their time outdoors to most of their time indoors. This shift has had an impact on human health that is yet to be fully understood. Office workplaces without natural light, which have light levels at or below the Occupational Safety and Health Administration


PHOTO ©ISTOCK/NICKYLLOYD

With appropriate lighting design, plants as well as people can be happier and healthier in commercial and institutional environments.

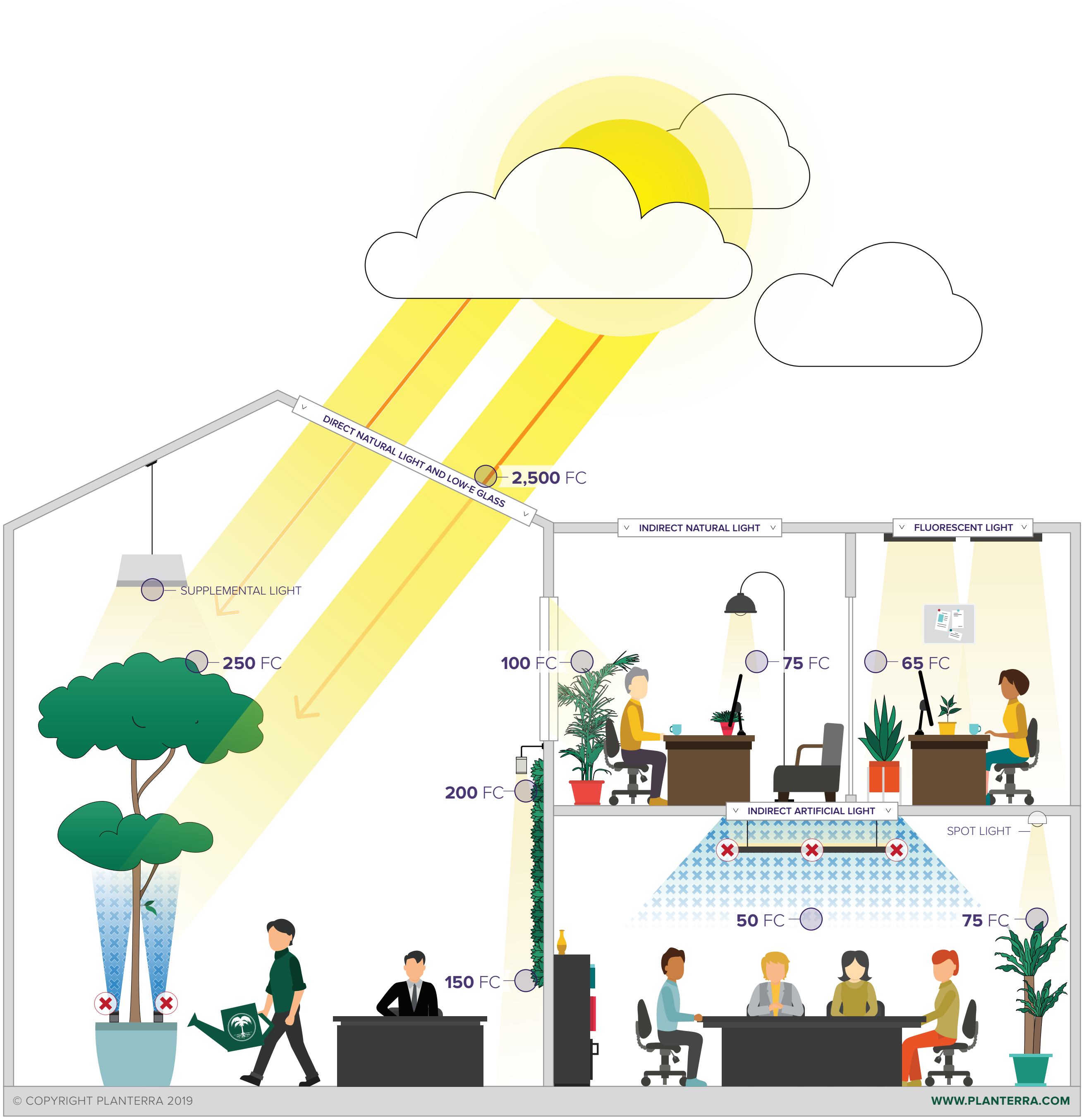
(OSHA) minimum of 30 fc, have been linked to health complaints, absenteeism and lower productivity. Even the lowest light tolerant plant will eventually die in an environment with light levels below 30 fc.

Just as plants struggle in the shorter and darker days of December and January, research suggests that people do, too. This is reflected in changes to our energy and mood. Some people are so affected by the lack of light that the diagnosable medical condition Seasonal Affective Disorder (SAD) was named by the medical community. The treatment for SAD is similar to the solution for plants: Light therapy delivered via supplemental, artificial light sources. For many people, this treatment is regarded to be as effective as antidepressants.

It comes as no surprise that most people prefer workspaces with abundant natural light. Advances in both window glazing technology and LED lighting have greatly diminished the conflict between energy efficiency and filling a space with high quality, visible light. In addition, the costs of these technologies continue to come down, making it feasible to build, renovate and rehab spaces with lighting conditions that are heathier for both people and plants.

BASIC LIGHTING RECOMMENDATIONS FOR INTERIOR LANDSCAPES

- Light intensity minimums:
  - Office with low-light tolerant plants > 75 fc
  - Living wall > 150 fc
  - Atrium with trees > 250 fc
- Even distribution of light.
- Light from above.
- Window glazing visible transmittance (VT) > 70 percent is best.
- Choose plants amenable to exposure.
- Where daylight is insufficient, provide supplemental light to ensure 10–12 hours of light exposure per day.
- Supplemental lighting is recommended to be white with a color temperature between 4,500 and 6,000 K.
- ✖ **Up-lighting and indirect artificial light do not support plant life.**



PLANT SPECIES RECOMMENDATIONS BY LIGHT TOLERANCE LEVELS

The following light levels are based on acclimatized foliage receiving 12 hours of light per day within the environment of a building interior. The three categories of light levels as low, medium and high is a simplification, as the light needs of each plant can differ. There are numerous cultivars for each species. Cultivars that are variegated or lighter in color require more light than the dark green varietal.

Note: many interior landscape specimens are known commonly by their botanical names.

LOW-LIGHT TOLERANT PLANTS (50–100 FC)		MEDIUM-LIGHT TOLERANT PLANTS (100–250 FC)	
COMMON NAME	BOTANICAL NAME	COMMON NAME	BOTANICAL NAME
Cast Iron Plant	*Aspidistra elatior*	Arboricola (Dwarf Schefflera)	*Schefflera arboricola*
Chinese Evergreen	*Aglaonema*	Algerian Ivy	*Hedera canariensis*
Heart-leaf Philodendron	*Philodendron cordatum*	Bamboo Palm	*Chamaedorea erumpens*
Janet Craig Dracaena	*Dracaena deremensis* 'Janet Craig'	Bird's Nest Fern	*Asplenium nidus*
Janet Craig Compacta	*Dracaena fragrans* 'Janet Craig Compacta'	Dragon Tree	*Dracaena marginata*
Mass Cane (Corn Plant)	*Dracaena fragrans* 'Massangeana'	Kentia Palm	*Howea forsteriana*
Peace Lily	*Spathiphyllum*	Lady Palm	*Rhapis excelsa*
Pothos	*Epipremnum*	Natal Mahogany	*Trichilla dregeana*
Snake Plant	*Sansevieria*	Pleomele	*Dracaena reflexa*
ZZ Plant	*Zamioculcus zamifolia*	Rubber Plant	*Ficus elastica*
		Schefflera Amate, Umbrella Plant	*Brassaia actinophylla*
		Spider Plant	*Chlorophytum comosum*
		Striped Dracaena	*Dracaena deremensis* 'Warneckii'

HIGH-LIGHT TOLERANT PLANTS (250+ FC)			
COMMON NAME	BOTANICAL NAME	COMMON NAME	BOTANICAL NAME
Amstel King Fig	*Ficus benjamina* 'Amstel King'	Ming Aralia	*Polyscias fruticosa*
Areca Palm	*Dypsis lutescens*	Pencil Cactus	*Euphorbia tirucalli*
Bamboo	Many genera and species	Peruvian Cactus	*Cereus peruvianus*
Bird of paradise	*Strelitzia reginae*	Ponytail Palm	*Beaucarnea recurvata*
Black Olive Tree	*Bucida buceras*	Pygmy Date Palm	*Phoenix roebellini*
Christmas Palm	*Adonidia merrillii*	Sago Palm	*Cycas revoluta*
Croton	*Codiaeum variegatum*	Weeping Fig Tree	*Ficus benjamina*
Fiddle Leaf Fig	*Ficus lyrate*	White Bird of Paradise	*Strelitzia nicolai*
Fishtail Palm	*Caryota mitis*	Yucca Plant	*Yucca gigantea*
Jade Plant	*Crassula ovata*		

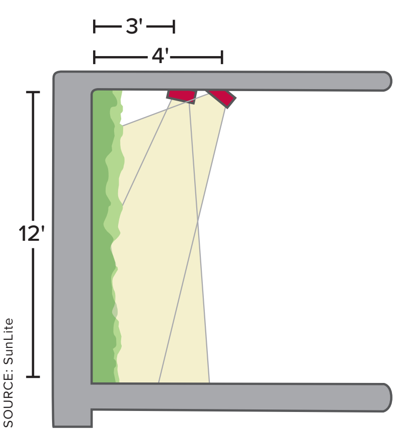
LIGHTING FOR LIVING WALLS: SPECIAL CONSIDERATIONS

SAMPLE CONFIGURATION FOR A LIVING WALL

MINIMUM FOOT CANDLE/UNIFORMITY (MIN/AVG) MATRIX					
		LIVING WALL HEIGHT			
		4 FEET	8 FEET	12 FEET	16 FEET
LIVING WALL WIDTH	4 FEET	186/0.7	91/0.6	52/0.5	30/0.3
	8 FEET	249/0.9	123/0.6	82/0.5	53/0.4
	12 FEET	235/0.9	145/0.7	94/0.6	63/0.5
	16 FEET	265/0.9	165/0.7	114/0.7	69/0.6

SOURCE: SunLite

In this example, a single row of 5500K fixtures are placed 4 feet away from a wall. If a single row does not meet the required minimum foot candle, an additional row is recommended.



Typical layout (two rows of fixtures)

CONCLUSION

DESIGNING INTERIOR ENVIRONMENTS WITH living plants requires careful planning. Proper lighting is essential to ensure plants thrive and protect investments made in interior landscapes over the long-term. In addition, the same lighting that allows plants to flourish offers numerous health and productivity benefits for people as well. To ensure you create an environment that is both plant and people friendly, turn to plant and lighting experts for advice. The interior landscape specialists at Planterra can provide the expert insight that architects, landscape architects and interior designers need to simplify the process.

ABOUT SHANE PLISKA

Shane Pliska is president of Planterra, a nationally-known interior landscaping business that provides design-build solutions and maintains office plants for corporate and institutional spaces. He also serves as president of Planterra Conservatory, an award-winning botanical garden wedding and event venue in West Bloomfield, Michigan. Shane is available as a speaker on various topics related to interior landscaping, living walls and biophilia.

ABOUT PLANTERRA

Founded in 1973 by Larry Pliska, Planterra is a leading provider of interior landscape services for commercial buildings, offering design-build, horticulture maintenance and project consulting. Family-owned and operated, Planterra has extensive expertise In assisting architects, designers and building owners on projects that incorporate live and replica plants into architecture. For more information please visit www.planterra.com.

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A PDF download of this white paper is available at www.planterra.com/light.

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