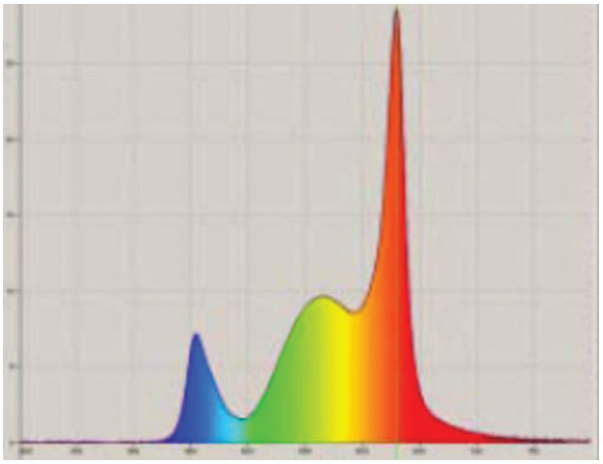
THE LIGHT

LIGHT IS HUMAN

Light has several aspects: Human because it is its perception by the Human that defines the light, either with a medical or artistic approach. And technical because light has a vibrational aspect that we will explain to you (without talking about its corpuscular aspects and its photons). Light is human; it is the unique of the 7 units of the International System that is defined in relation with Human. Thus, candela (cn) measures the light. It can be described as a light energy flow, perceived by Human eye in its axis for the wavelength that it sees well.

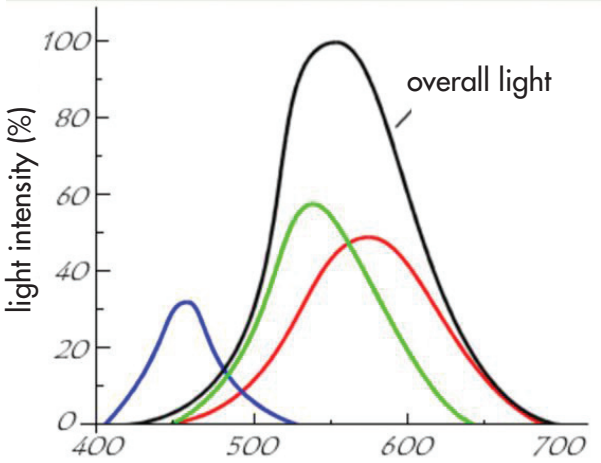
LIGHT IS TECHNICAL



Technically, light is a spectrum
Various power according to the frequency

Light is a mix: as the sound, light received by our eye is a mix of different colors (frequency, wavelength) from red to purple of a rainbow, with for each one, a different intensity. The range of frequencies and intensities is called a spectrum. For the sound, music is also a spectrum, but our hearing sensors are more precise than our light sensors.

HUMAN RESPONDS TO THE TECHNIQUE



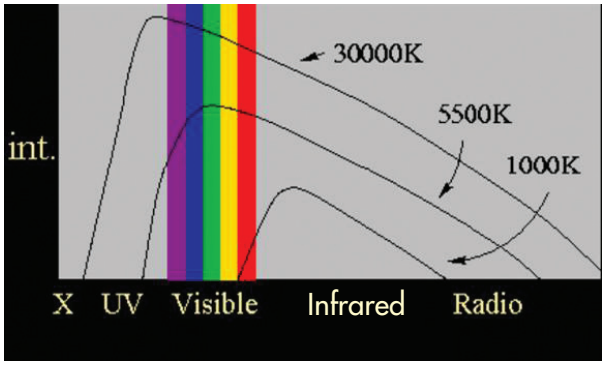
Colors and Intensities

Our eye contains 3 type of receptors of different sensibility according to the color. Our eye analyses the light. Indeed it contains 3 types of receptors that are not sensible to all wavelengths. We evoked candela: it is defined by the green wavelength because our 3 receptors receive it. That color is the most intense for us. Our 3 types of receptors have also different sensibilities, and it modifies our perception. Receptors are completed with an other but less precise way (blurred and on all wavelengths) used in case of darkness, and to detect movements.

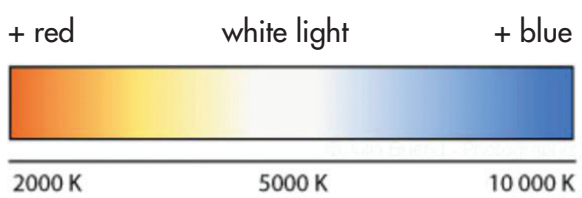
Colors and white shades

For instance, a pink or taupe color would be a mix of different vibrations, as well as the white. White is varied and approximately characterized by a color temperature in Kelvin K degree. This temperature is defined by the eye that perceives the same shade color than for the light emitted by a black body heated: it varies from glowing, around 2,000K, to bluish around 10,000K. Natural light color of the sun varies from 2,000K, during the sunset, to 5,700K (sun itself) or 6,500K (a mix of sun

light and a covered sky). Because although the sun emits visible spectrum, diffraction of the atmosphere changes the light color that we receive. Other light sources generate for instance a 1,800K light for a candle, 2,700K for a warm white electrical source (slightly yellow like a sun at the evening or like old incandescent lightbulb or car headlight), 5.000K for a pure white or 6,500K for a cold white (slightly bluish like a covered sky or in our interiors like LEDs or the most famous fluorescent tubes). But how to talk about colors? : Each person preferences and harmonies are different. The choice of color temperature is highly personal. It is design.

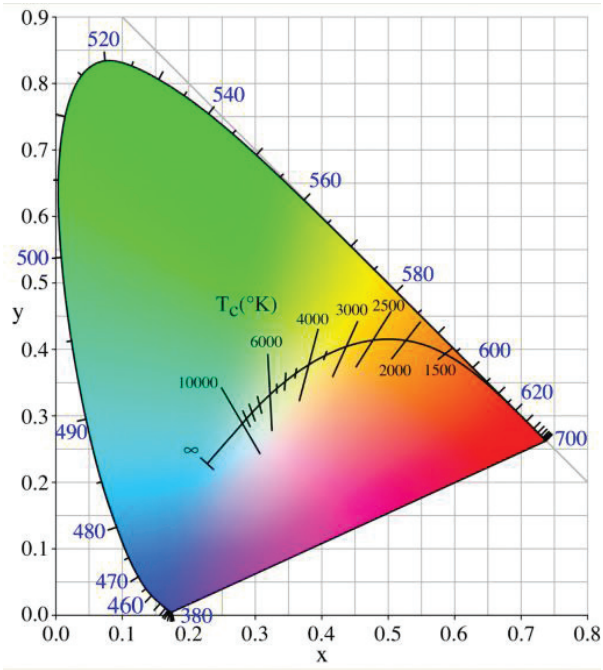


A black body heated emits all frequencies that characterize different white shades according to the temperature.



That are white shades we have according to the temperature of the black body heated.

Chromatic diagram



The chromatic diagram is a useful representation to define a color (with its proportion in red and green).

It is a common method used to represent all colors perceived by our eye, based on eye analogy with a simple mix of three primary colors. Colors that our eye perceives for all light are the same of colors it perceives when it receives only a mix of three colors, and we identify as primary colors red blue and green: x and y are proportions of red and green (base being blue). Especially, rainbow colors along the curve, purple on the segment of below, heated black colors are along the curve of colors temperature. Theoretical white is on the middle (x=y=0.33), on the same point of sun temperature (5,700K) on colors temperatures curve.

This method to define colors is useful in lighting. For other sectors, (paint, design ...) the trend is sometimes to use ranges of references as RAL or Pantone color chart.

Light aesthetic

We can also use an other measure to determine spectrum coverage: The Color-Rendering index CRI. It is the percentage of spectrum coverage, visible by a lighting point. This tool allows to estimate if objects and people will be visible under an artificial light as well as under the sun light.

Measure the light

Obviously, intensity is a key element. Light is a radiative energy identical to heat. Lighting is heating, as the sun does with Earth. As it was said before, we measure intensity keeping in mind that our eye that our eye perceives light power differently depending on the frequency in the spectrum.

You will find and measures for emission sources: the luminous intensity of a source in a direction candela (cd) is defined as the light intensity in one direction of a monochromatic light source having an energy intensity of 1.5 MW / sr and the most visible frequency to humans (ie a greenish yellow). It is the light intensity of a candle. You'll find power measurements using lumen (lm). One lumen is the power emitted by a source of one candela in a steradian (1LM = 1cd * 1sr), the steradian is the solid angle of a cone env.65 ° representing about 8% of the space. And for the light received, you will find measures: luminance that characterizes a source in a direction given by the received intensity as a function of the apparent surface of the source cd / m2 and especially illumination in lux lx, that is to say the light flux incident on a surface (1LX = 1LM / m2). Recap: as you understand, the light that interests man is a mixture of visible frequencies, each with a different intensity, if possible without invisible light (ultraviolet and infrared). We got used to characterize and simplify by some numbers:

- Its light intensity. We see at 1 lux a full moon at 10,000 lux sunlight summer. It is nice for example to have 5 lux to tag and walk in a corridor during the night, 70 lux for a mood light, 300lx for a working light on a desk or kitchen table.

- The color temperature (K) and the Color Rendering Index (in%).

These two measures of the quality of the light produced, participate in its beauty.

Play with light effects

Also, for certain projects, you may take advantage of various light effects: polarization, prism or hole diffraction, iridescence, fluorescence, refraction, reflection, light attenuation and so many more light effect that the human eye and brain understand

HOW TO WORKOUT LIGHTING?

Staging in space

But a concept is missing: its staging. It is made by choosing light sources locations, their orientations and angles (by lenses, lampshades, reflectors, these elements defining more or less sharp angles). This staging in a room or a volume take account of your taste, customs of the place, decoration (colors of the objects, the saturation of the colors that is to say the proportion of black, shiny or matte surfaces in the room). You get a room illuminated beauty, highlighting your decoration, people in it, and making pleasant all their activities. This light sources placement is the main factor of energy efficiency lighting, long as you use modern sources that have mostly good yield (fluorescent and LEDs gradually replacing incandescent lamps, halogen and discharge). Other parameters also play a role: the high color temperatures have better energy efficiency, technology (Heat dissipation, the installation according to the rules electrical and optical).

Method and experimentation

With these different theoretical references in mind, we recommend to experiment yourself or entrusting Semeur d'étoiles the design of your lighting: the specifications describe only briefly the light, the parameters are numerous. More than a technical aspect, light is related to human and perception.