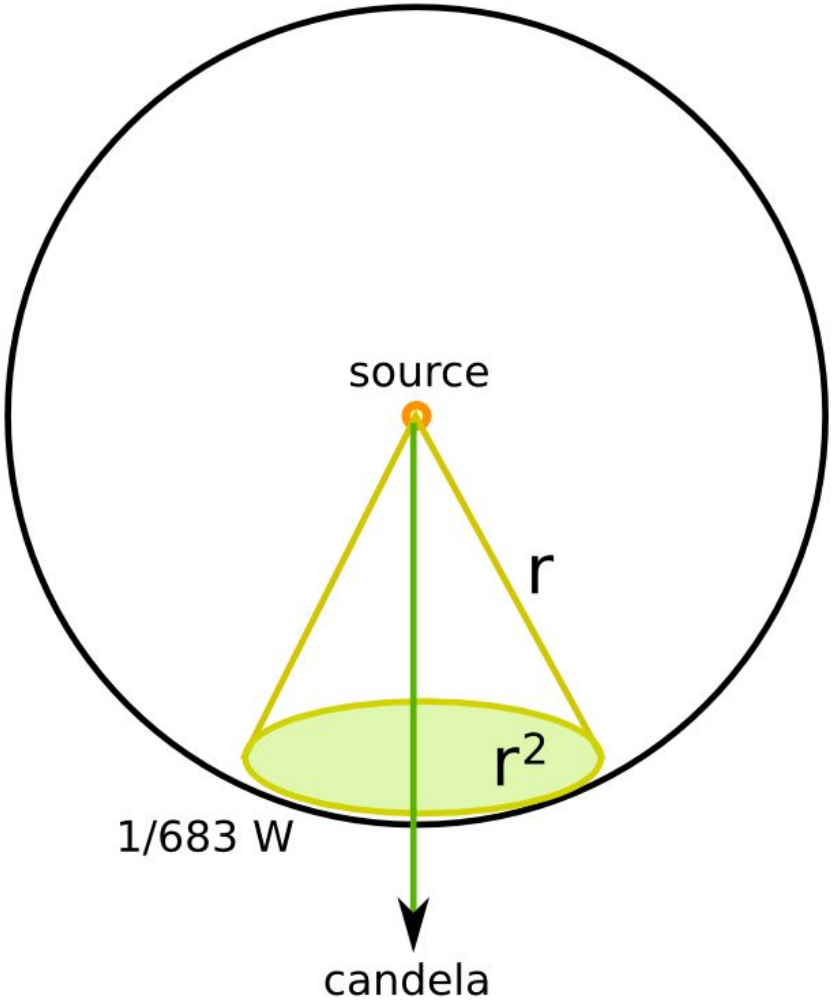
Preventive Conservation and Energy conservation

Units of light

Perception of colour

Damage by light

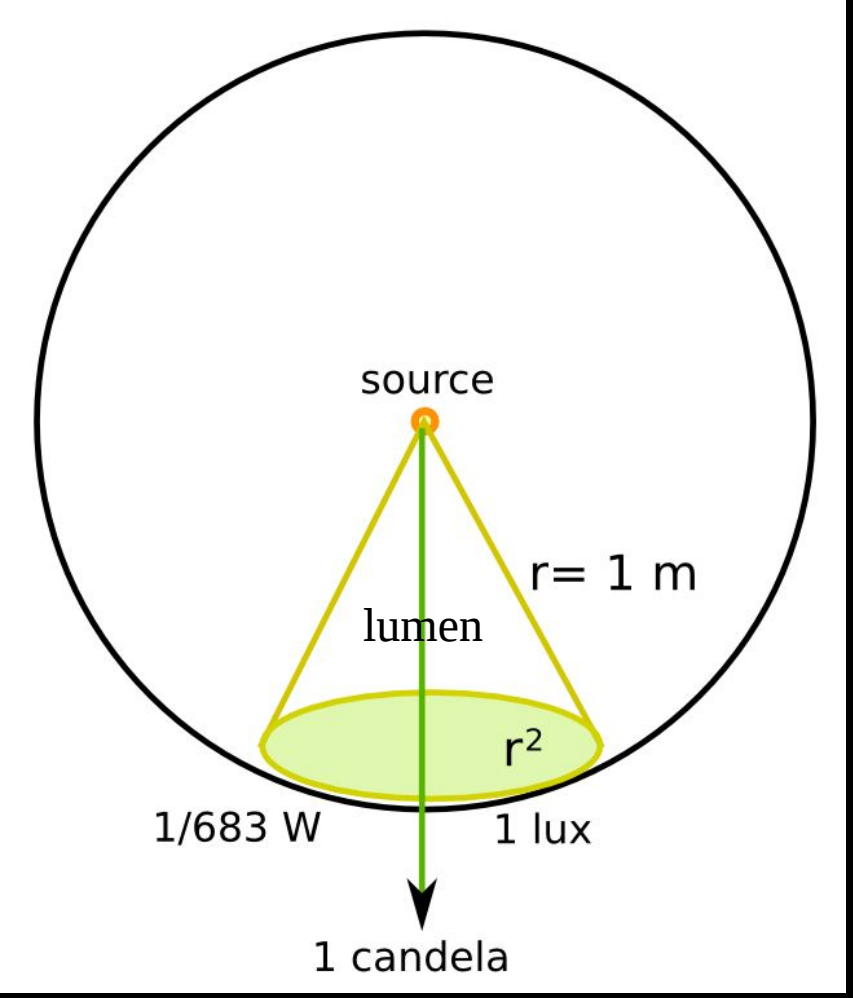
Energy used by lighting



The Candela is the SI base unit from
Which all other light units are derived

The intensity from a source emitting
1/683 W of radiation at 555 nm
uniformly over one steradian

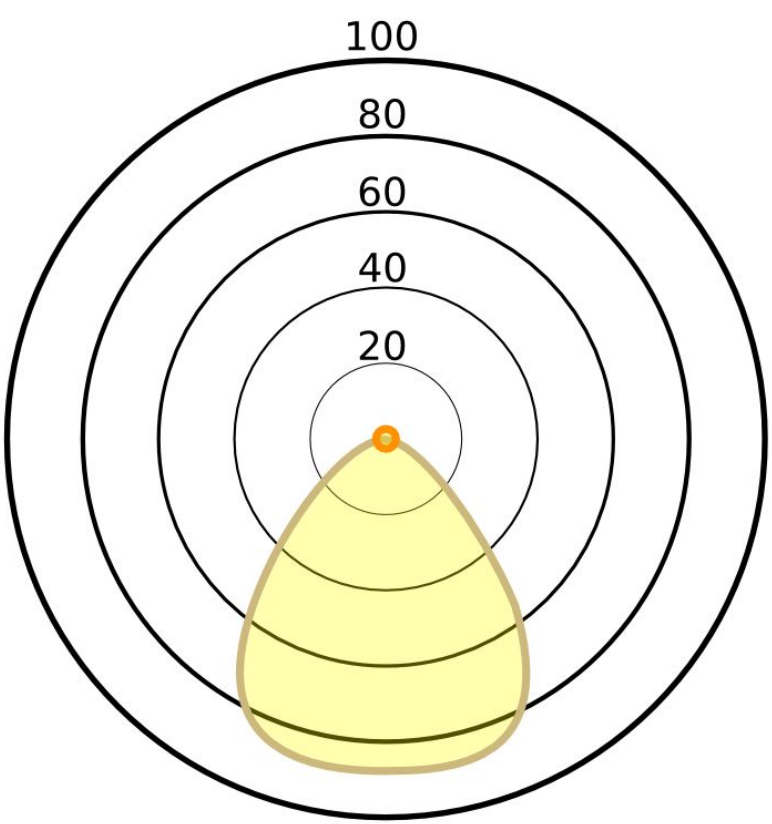
Start Point lighthouse
In Devon UK has a
Luminous intensity of
200,000 candela



The lumen is the light energy moving out through the steradian (the yellow-green area)

The lux is the light energy falling on a surface at one metre distance from the 1 candela source

Sunlight through glass gives
About 80,000 lux on surfaces



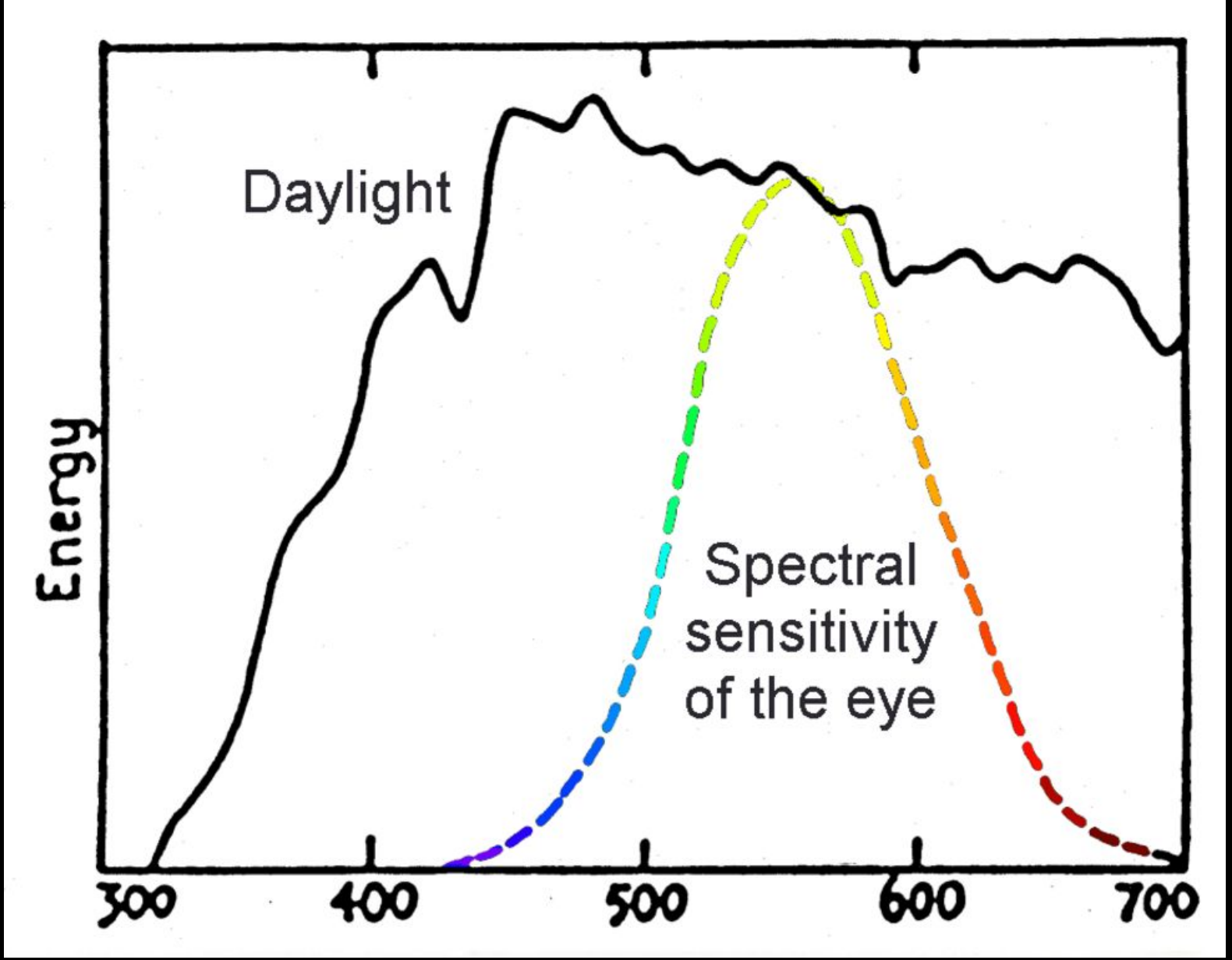
The linkage between candela, lumen and lux

A light fitting will have an uneven distribution of luminous intensity(candela) in different directions. The integral of candela intensities over the entire sphere is the lumen output of the lamp. The lux is calculated from the candela in the direction of the object and the distance from the source

In reality, designers don't do this because there are usually several light sources contributing to the illumination of one object (The National Museum of Denmark, Brede)

So far, the radiation under discussion has been monochromatic at 555 nm

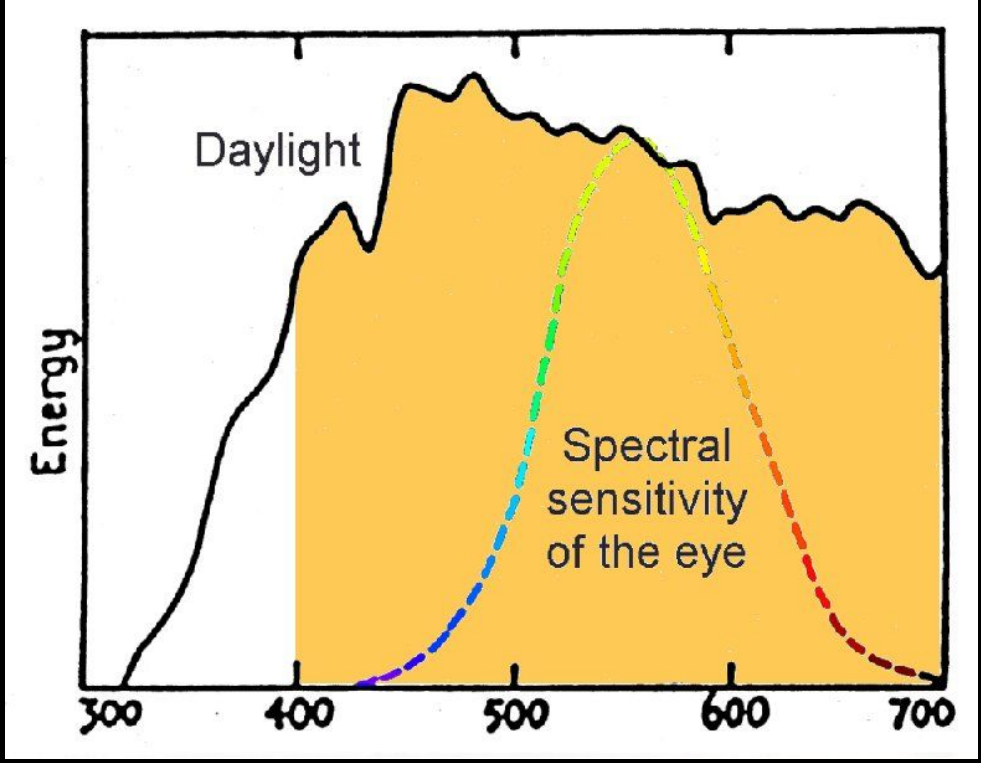
This is not too bad for the leaves at top right – but what colour is the building?



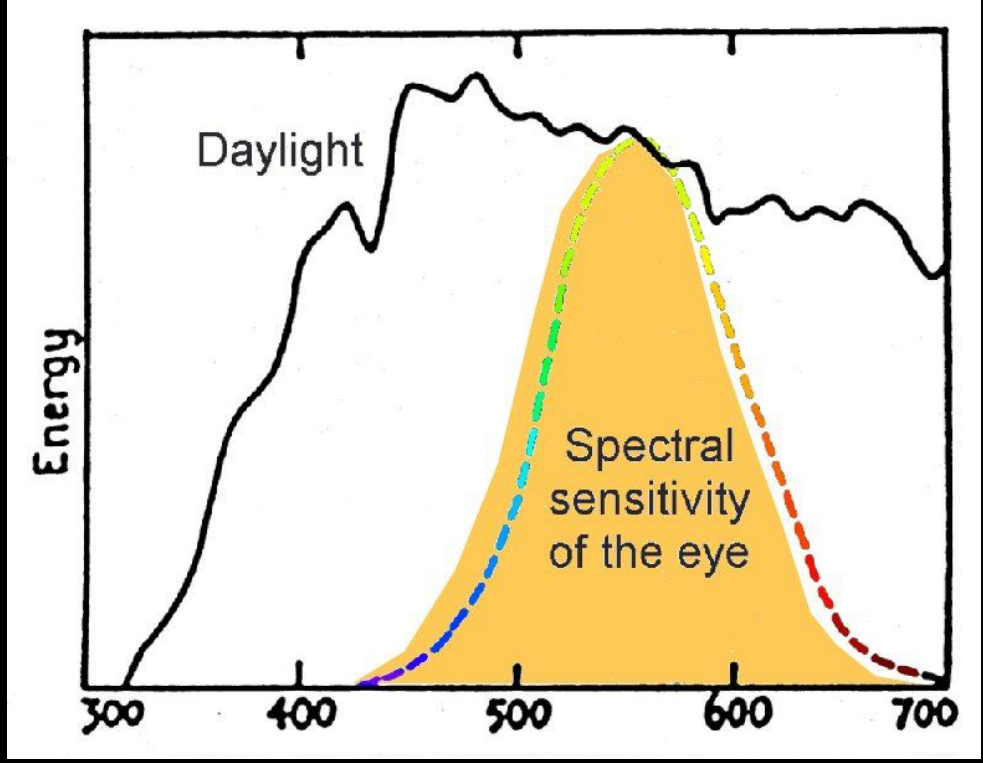
When the light source emits radiation over the range 400 – 700 nm we can see colours. But the sensitivity of the eye falls off towards The limits of the visible spectrum

This is Jean Nouvel's Serpentine Pavillion from 2010 (an annual event in London, open to architects who have not built in Britain)

The eye is not very sensitive to red light, even though it has a strong psychological effect

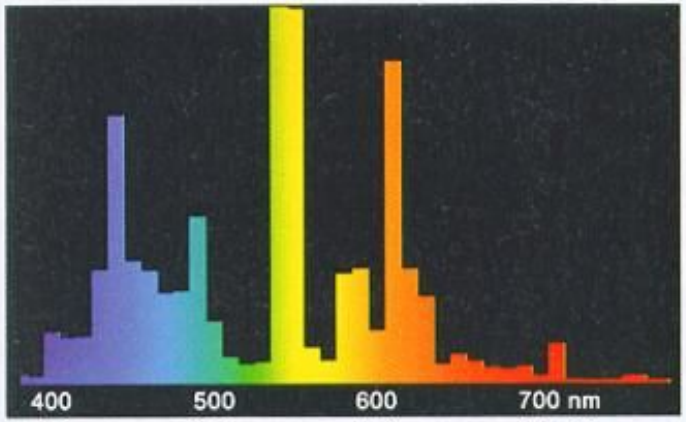


The power (rate of energy conversion) in watts of daylight is proportional to the yellow area under the spectral energy curve (assuming total elimination of UV and IR)

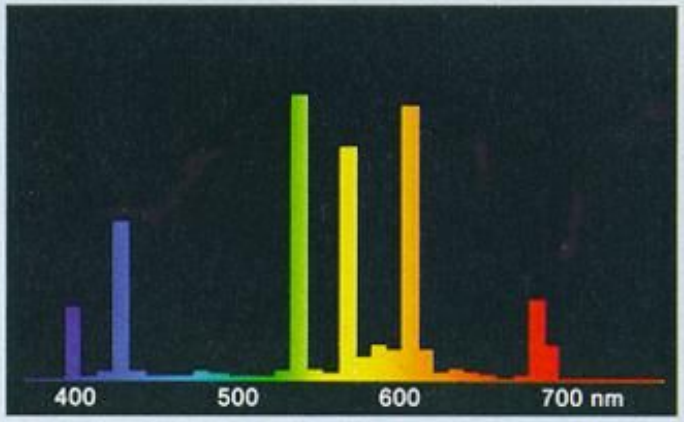


The power in lumens is the spectral watts multiplied by the sensitivity curve of the eye, the $V_M(\lambda)$ curve.

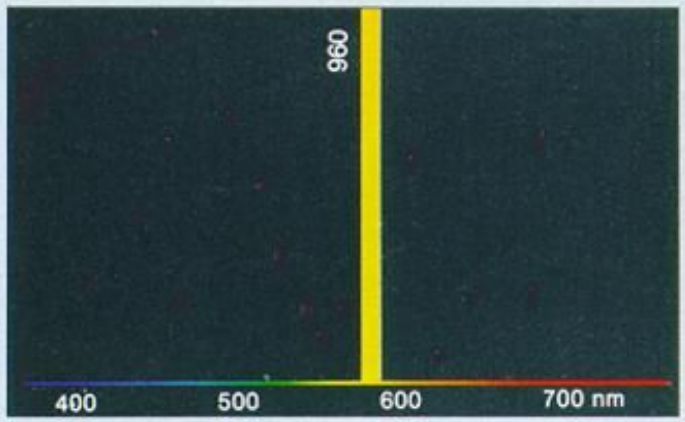
Daylight gives approximately 100 lumens per watt



Lichtfarbe 11 LUMILUX® Tageslicht



HQL SUPER DE LUXE



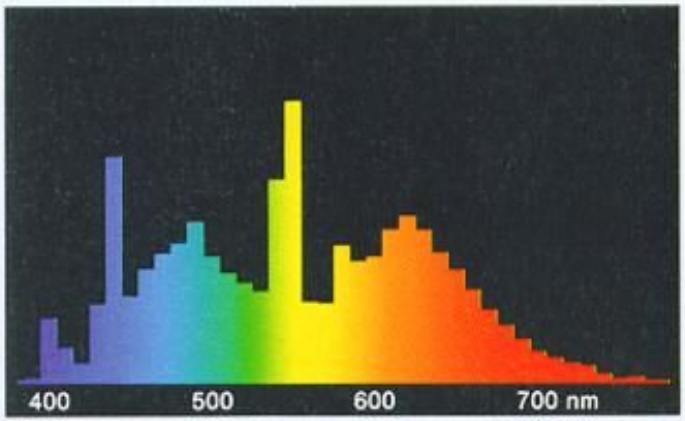
NA

Fluorescent lamps

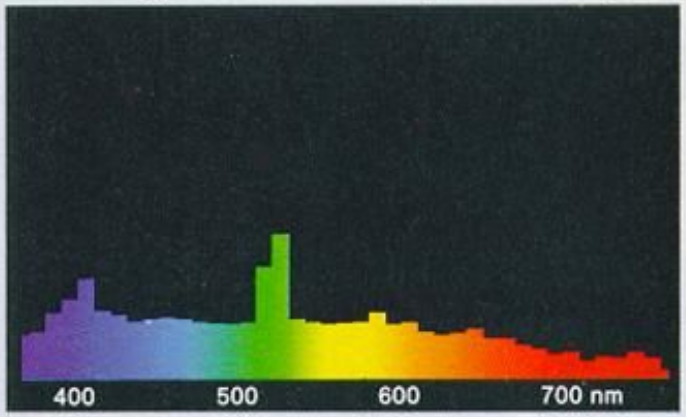
Mercury vapour lamp

Halogen - metal vapour lamp

Sodium lamps



Lichtfarbe 12 LUMILUX® DE LUXE Daylight



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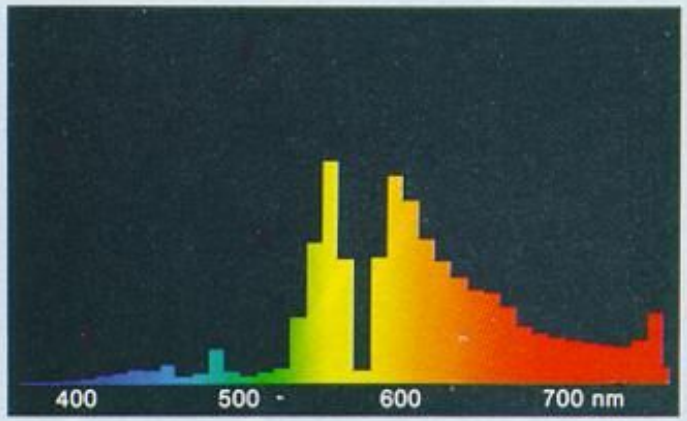


VIALOX® NAV DE LUXE

Artificial light sources have discontinuous or distorted spectral energy distribution compared with daylight. Some of them, however, can fool the eye/brain into believing they provide white light. This gives a higher lumens per watt, but worse colour rendering

Incandescent

Office fluorescent

Office fluorescent

(superior) LED

The office fluorescent is efficient, because there is plenty of yellow-green radiation, but reds turn brown and blue disappears. The LED emphasises the blue and hardly reproduces yellow

Good colour rendering lamps are inevitably less energy efficient than yellow-green lamps. But energy is wasted through avoidable exhibition design errors

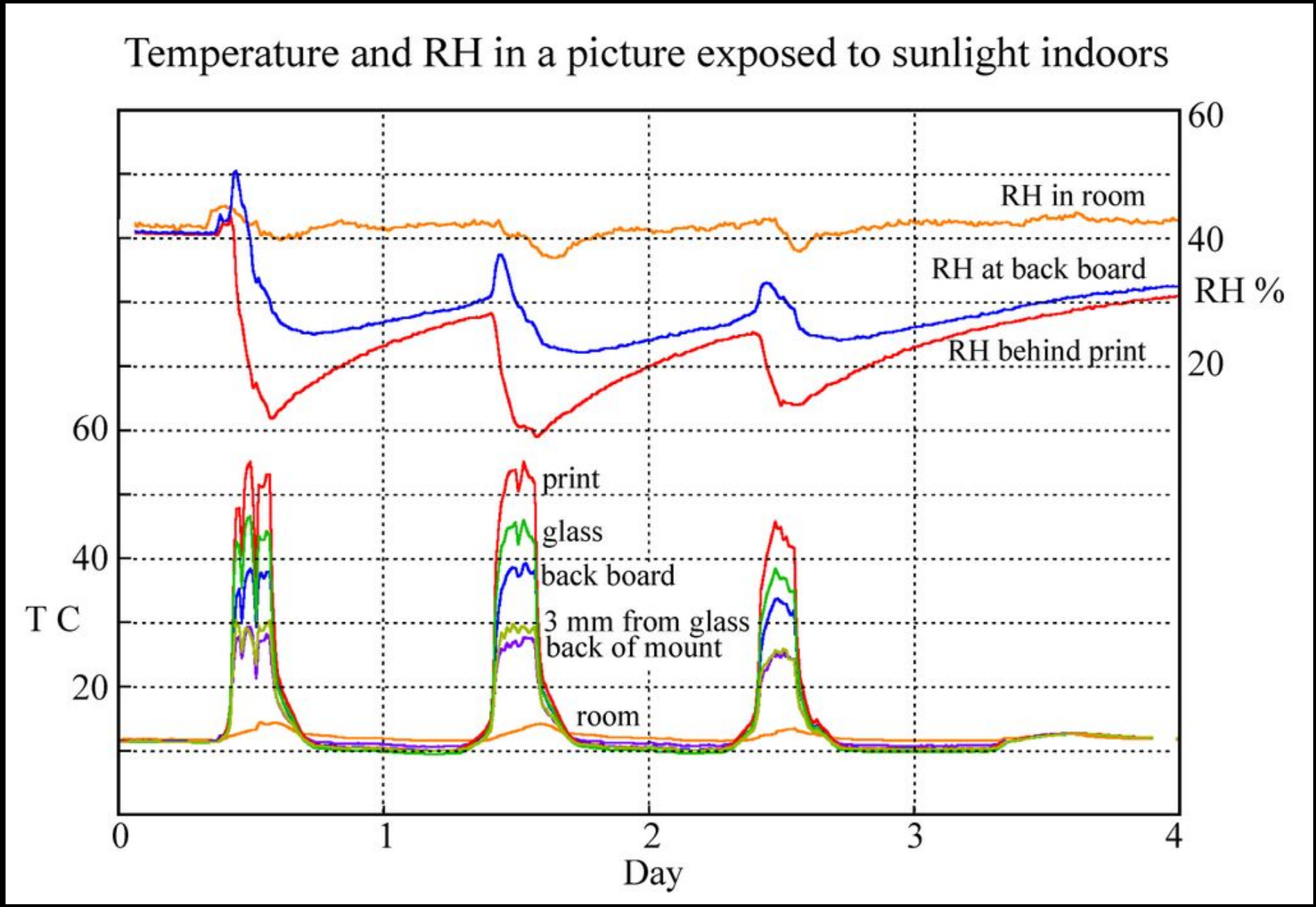
The eye accommodates to a dim light, but not if there is bright light within the field of view (Louisiana, Humlebæk, Copenhagen)

Another cause of wasted energy, and source of unwanted heat, is too much light. Daylight is efficient in lumens per watt, but if the lumen flux is unnecessarily high energy is wasted cooling down the room

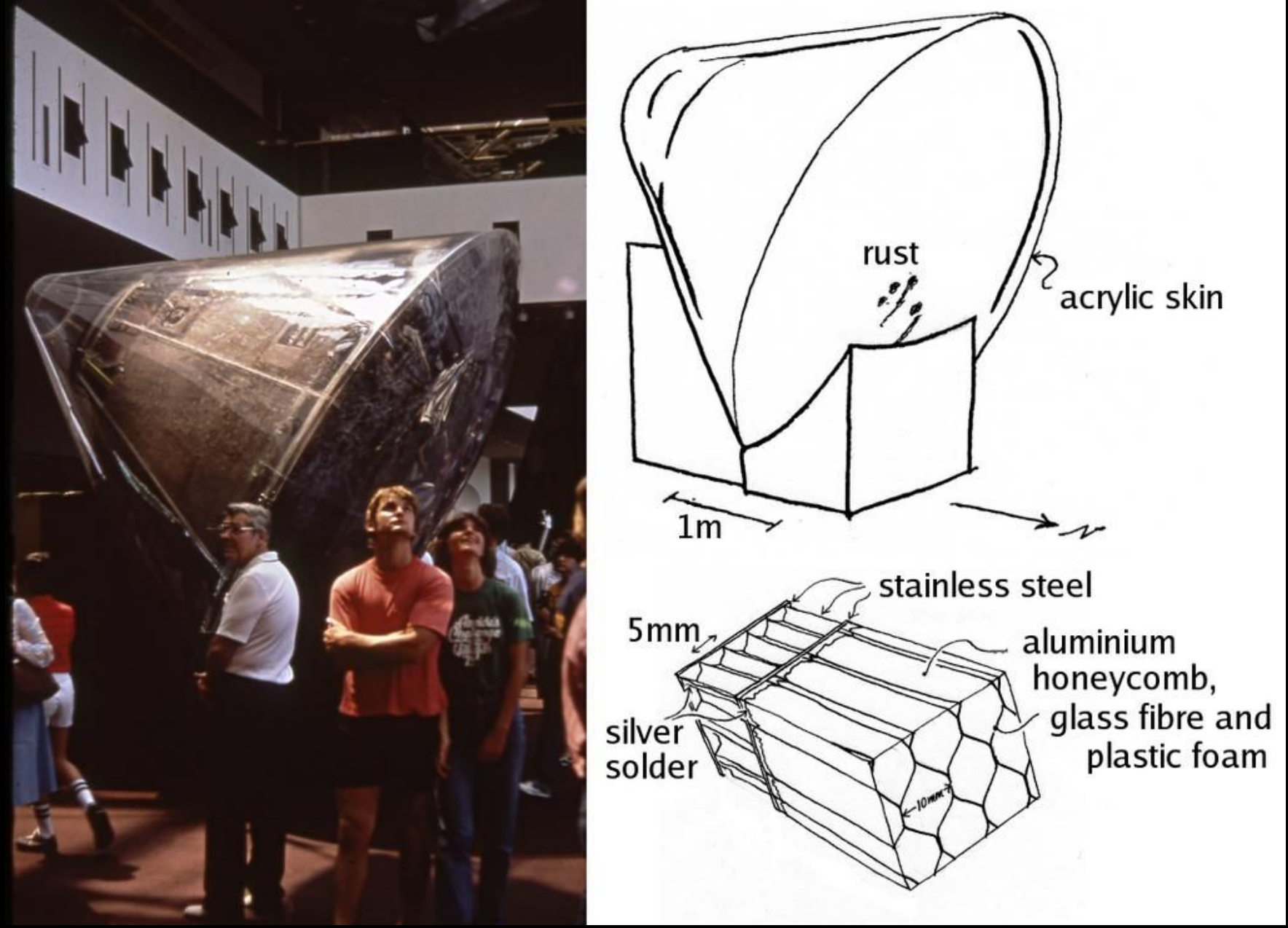
(National Museum of Denmark)

Visibility is reduced by glare

Can you detect the object displayed in this showcase?



Strong illumination also heats the object, reducing the surface RH

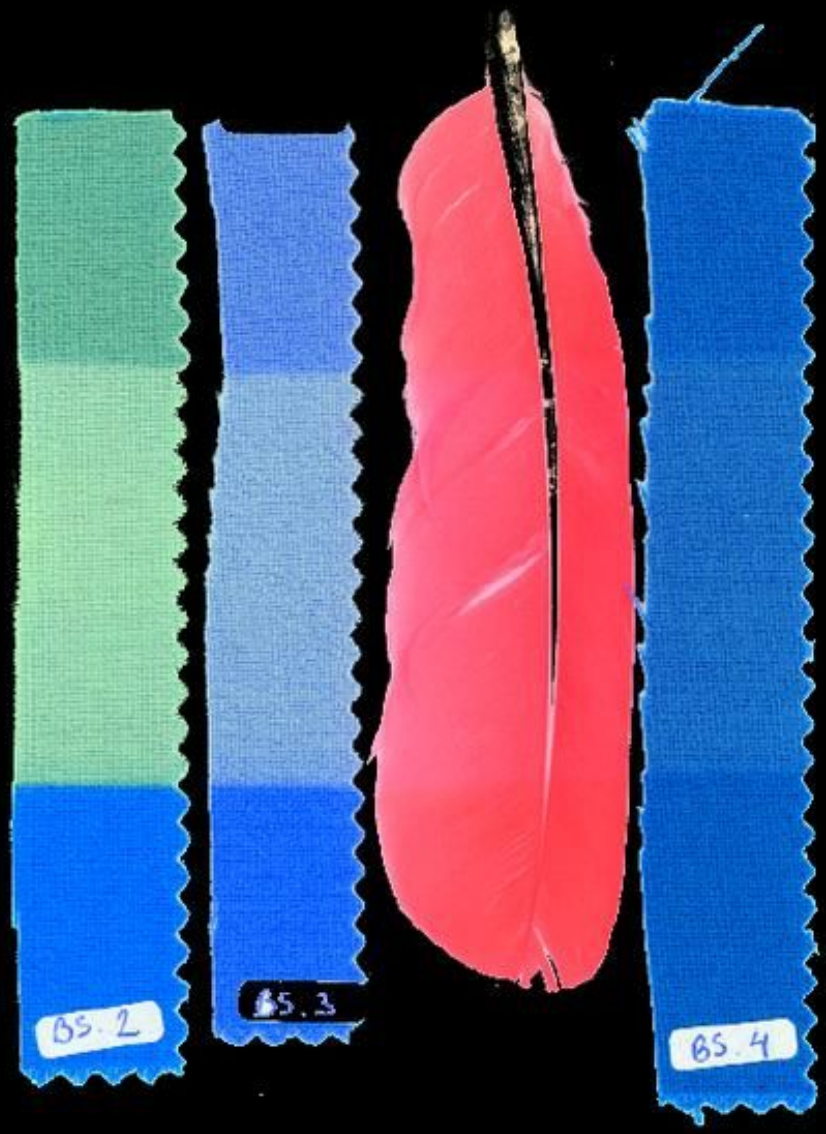


Uneven strong illumination causes migration of moisture.
Corrosion caused by condensation on a shaded portion of an exhibit exposed to sunlight. (National Air and Space Museum, Washington D.C.)

Even uniform illumination can cause concentration of condensation if the object illuminated has uneven absorption of light

Evening sun distils water from the paper to condense on the glass, particularly where the glass is cooler opposite the white lettering.

(Jaegersborg Station, Copenhagen)



A flamingo feather garment brightly lit to entice visitors. Its light fastness is 4.
(National Museum of Denmark)

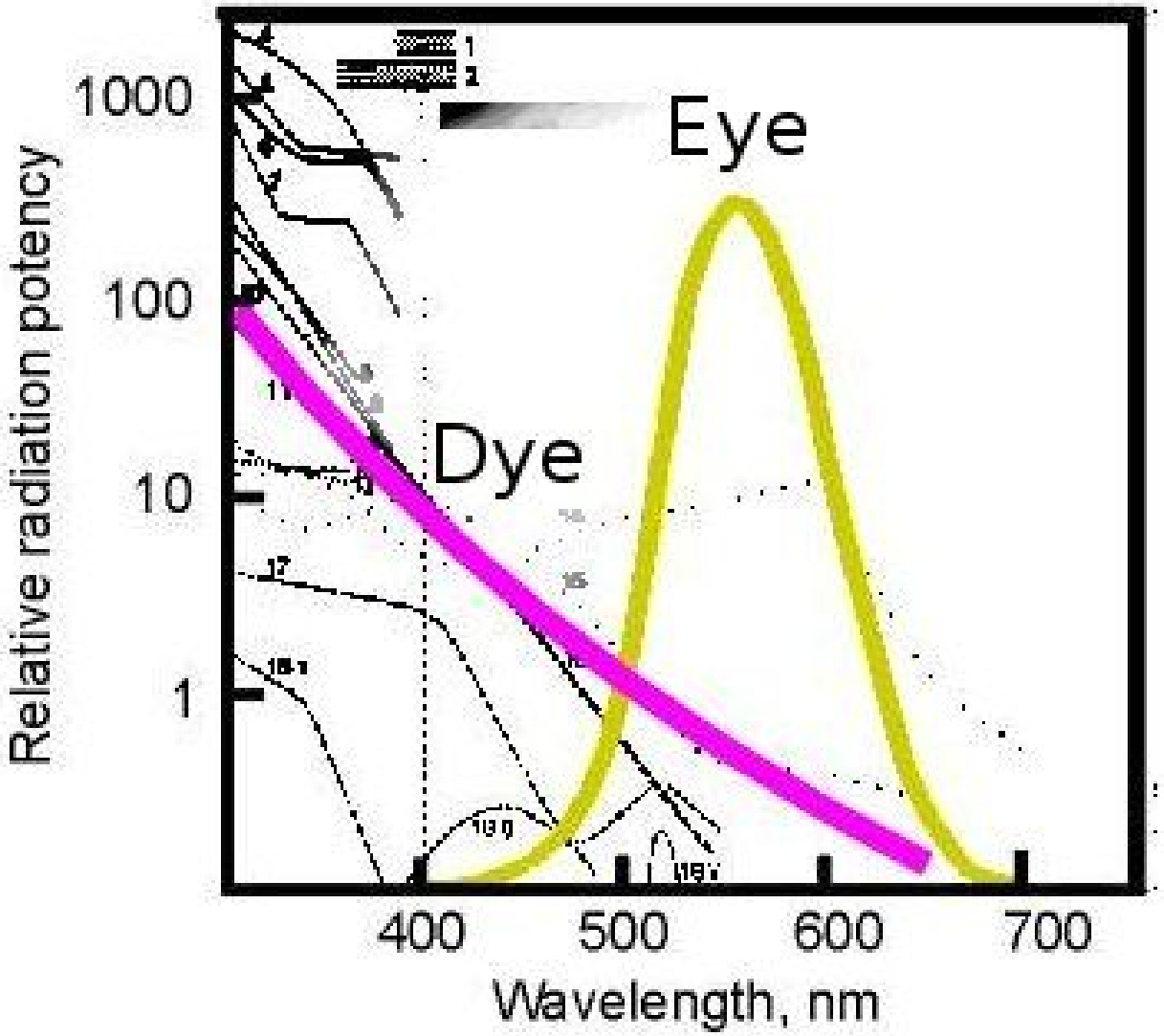
Household management in olden times was better than in modern museums

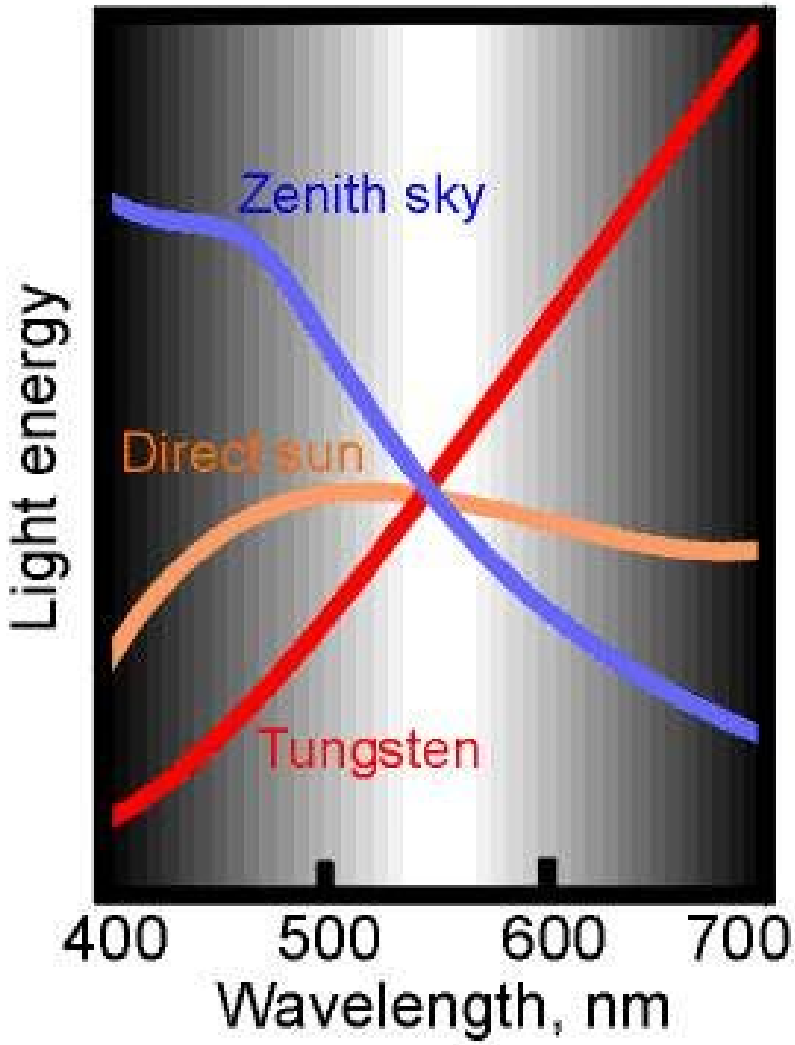
(Woman reading by Gabriel Metzu, 17th C)

Mluxhours
8
36
91

Light is a major cause of deterioration of museum objects

Fading of the natural dyes. 50 Mlxh will cause visible fading.





Photochemical damage is largely caused by uv radiation and blue light

compendium of spectral damage potential
(Stefan Michalski)

Spectral energy distribution
of light sources

Summary

Light uses energy twice: directly for lighting and indirectly by forcing cooling to remove the heat

Light causes photochemical degradation

Heating by light reduces the immediately adjacent RH by about 3% per °C and accelerates thermal degradation

Light intensity is impossible to monitor, in the same way we keep track of temperature and humidity