

Light damage is cumulative and irreversible; however, it is probably the easiest of the ten agents of deterioration to control. By knowing how sensitive an object is to light, we can control the rate of damage by limiting its exposure to light. The dilemma lies in the need to find a balance between having enough light to see while limiting the amount of light damage so that future generations will also be able to view the object.

What causes the damage?

There are three factors to consider when understanding light damage:

- The amount of ultra violet light in the light source
- The intensity of the illumination (how bright the light is)
- The amount of time the item is exposed to the light source

At the high energy end of the radiation spectrum is ultra violet (UV) radiation, at the low end is infrared radiation (IR). It is the ultra violet radiation which causes the most damage to collection items. However, over time, UV, visible light and IR wavelengths can all cause damage.

The most obvious damage caused by light is fading. This mainly affects organic materials, particularly those which are painted, dyed or coloured including textiles, water colours, prints, photographs, coloured timbers, manuscripts and plastics. As well as causing fading UV radiation can induce damaging chemical reactions within the structure of some materials. This is particularly the case with plastics and acidic paper. While IR is less damaging in terms of fading, it is the associated heat which needs to be taken into account.

Ultraviolet (UV) is measured in microwatts per lumen ($\mu\text{w}/\text{lumen}$). The amount of UV radiation will depend on the light source being used. Generally speaking daylight has a high UV component, halogen and fluorescent lights have a substantial UV component while tungsten, incandescent lights, CFL (compact fluorescent) and LED (light emitting diodes) emit very low UV levels. With sensitive materials it is recommended that UV levels are kept below $75 \mu\text{w}/\text{lumen}$.

Light intensity is measured in lux (lumen/square metre). The more intense the light, the higher the lux level. Lux levels are reduced as the light source moves further from the item being lit. With sensitive materials such as water colours and textiles, it is recommended that light levels are kept below 50 lux. With items of medium sensitivity such as oil paintings and ivory, it is recommended that light levels are kept below 200 lux.

The amount of time an item is exposed to light will directly affect its rate of deterioration. For example, a photographic flash, or the flash from a photocopier produces a very high light level. However, as the item is only exposed for a second or less, the amount of damage from one flash photo is minimal. On the other hand, an item on constant exhibition for ten years at 50 lux will probably show some signs of deterioration. When thinking about the amount of time items are exposed to light, you need to think about your opening hours and also any other times the exhibition areas are lit such as for openings, receptions or research time. One of the advantages many smaller cultural bodies have over larger institutions is that the shorter opening hours mean that collection items are exposed to light for shorter periods of time.

Categories of Sensitivity

<i>Level of Sensitivity</i>	<i>Types of Material</i>	<i>Suggested maximum lux level</i>
Very light sensitive	<ul style="list-style-type: none"> • Paper (prints, drawing, manuscripts) • Watercolours, gouache and pastels • Photographs and films • Vegetable dyed material • Parchment and vellum • Textiles • Plastics and rubbers • Natural history specimens • Dyed leather 	50 lux
Moderate sensitivity	<ul style="list-style-type: none"> • Oil, tempera and acrylic paintings • Timber • Bone, ivory and horn • Undyed leather • Archaeological materials • Oriental lacquer (Urushi) • Painted or lacquered metals 	200 lux
Insensitive	<ul style="list-style-type: none"> • Metals • Stone • Ceramics • Glass 	Although light levels are not an issue, it is suggested that an upper level of 1000 lux is used indoors

Light control

Good lighting is a necessity for any exhibition, however, light can cause damage to collections. There are a number of solutions which can be explored when looking at the best way to control light in the exhibition space.

- Reduce daylight. Apart from the damage caused by the high UV component of sunlight, it creates difficulty in controlling light levels as the intensity will fluctuate continuously depending on the time of day, time of year and the weather. Daylight can be controlled using heavy curtains, diffusing blinds, exterior shutters, UV filtering material applied to windows or attaching boards to the windows.
- When purchasing or designing display cases, ensure that the lighting system is external, i.e. not inside the case. This helps prevent heat building up inside the case and increase the distance between the object and the light source.
- Research the UV output of artificial light sources. While halogen lights do have a UV component they are generally supplied with UV filters (although this should be checked prior to installation). LED lighting comes in a wide arrange of formats, from fluorescent tubes to bulbs. Almost all have low UV levels.
- UV absorbing Perspex can be used in framing watercolours and prints or in construction of display cases to filter out UV from the light sources in the exhibition space.
- Dimmers can be fitted to light switches to further reduce light levels.
- The exhibition space can be designed so that light levels are slowly reduced as people move through the space. This will give people's eyes time to adjust to lower light levels. For example the visitor may enter a foyer at 500 lux, move through to a general exhibition area of 200 lux and finally to an exhibition of illuminated manuscripts at 50 lux.
- Use movement switches or timers to control the amount of time vulnerable material is lit. A more traditional approach is to place heavy cloth over display cases which the visitor lifts up to look at the exhibition.
- Limit the amount of time vulnerable material is on display. Many galleries and museums put limits on the amount of time vulnerable material is on display. For example they may suggest that a watercolour should only be on display for three months per year. This does not necessarily mean that the item can only be displayed for three months but that if it is on display for a year it should not be displayed for the next three years.

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Canadian Conservation Institute

<https://www.canada.ca/en/conservation-institute/services/agents-deterioration.html>

Tour of the Canadian Conservation Institute's Online Light Damage Calculator

Connecting to Collections webinar, 2012

<https://connectingtocollections.org/lightcalculatorrecording/>

Guidelines for Selecting Solid-State Lighting for Museums, 2012

<https://www.getty.edu/projects/museum-lighting-research/guidelines-for-selecting-solid-state-lighting-for-museums/>