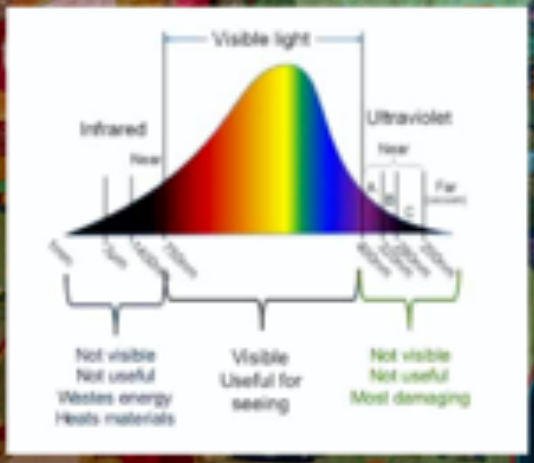
Treasure Caretaker Training
DIGITAL MONASTERY PROJECT



RISK ASSESSMENT: LIGHT

Treasure Caretaker Training
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PRESERVATION OF BUDDHIST TREASURES RESOURCE is the free online resource for monasteries and communities, with practical information on digital documentation, risk assessment and disaster recovery, safer storage, and preservation of thangka and other treasures. The resource comes from over 50 years of preservation work in monasteries.

Treasurecaretaker.com 0019022221467 treasurecaretaker@icloud.com

RISK ASSESSMENT: LIGHT

Ann Shaftel MA, MSc
Dalhousie University Adjunct Scholar
Fellow, American Institute for Conservation
Fellow, International Institute for Conservation
Canadian Association of Professional Conservators
ICOM, ICOMOS Member

Introduction

Monk and nun participants in Preservation of Monastery Treasures workshop talk about their own experiences with light damage in their home monasteries and communities

- "Light and UV cause fading and flaking of objects"
- "Fading of textile"
- "Sun and lights harm thangka and textile color"
- "Fading of paintings"

A monk was discussing how his monastery used to have "old-fashioned" incandescent lightbulbs, and then the government came to the monastery and gave them the fluorescent bulbs and tubes, and said, “Now you have to use these to be energy efficient." Now we know that fluorescent tube lights are damaging to treasures.

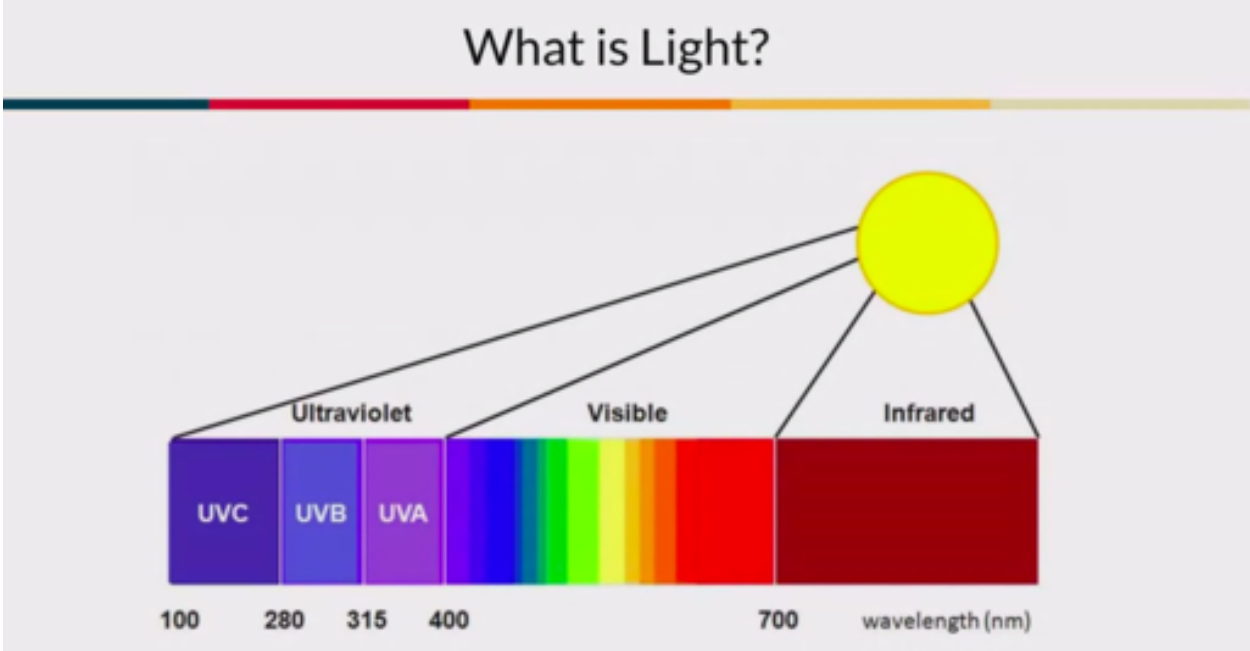
Light is an energy source, that has three parts: first is invisible but we can feel it, that is the heat aspect of light; second is the visible part of light that we can see, and helps us to see; and third is the very high energy invisible part of light that we cannot see. We can measure these on what is called a light spectrum wavelength. All three parts of light will damage objects.

Light damage is cumulative and irreversible. Exposure to light can cause fading and color change and cause irreversible deterioration of your monastery treasures. There are two problems with light: the brightness and the wavelength, or its energy. High-frequency energy causes the most damage. It is the worst kind of energy for preservation. The atoms and molecules within your monastery treasures exceed their activation energy thresholds. It is the fast-moving energy in sunlight that ruins your skin and destroys your treasures. This is the same energy in fluorescent lights.

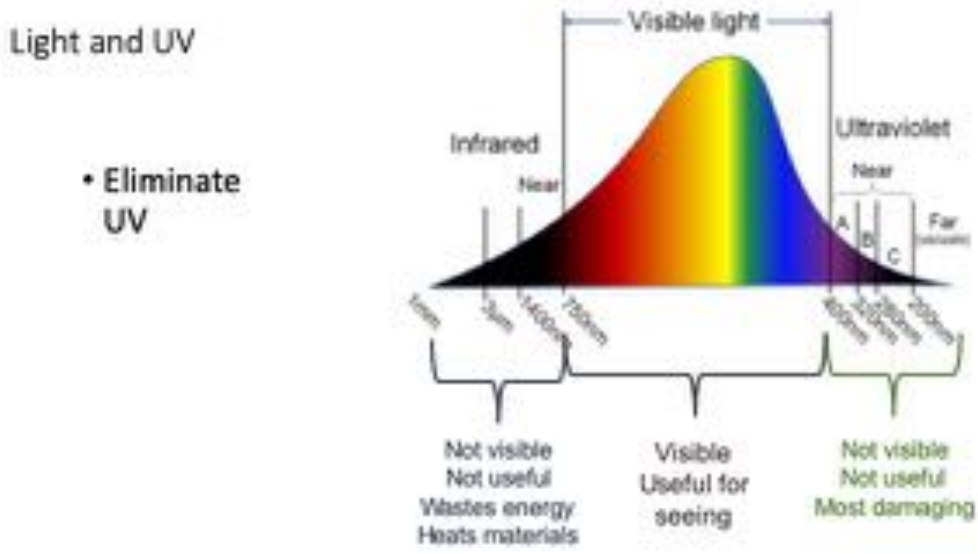
Causes of Light Damage in Monasteries: Science of Light

Which monastery treasures are sensitive to light damage? Silk, nylon, wood-pulp paper, color photographs, and certain dyes and pigments. This includes many treasures that would be found in a lhakhang, shedra, storage room, monastics’ rooms, and in the community.

The potential damage from light is twofold. One is the wavelength of the light. In essence, the only light you need to see is that which occupies the wavelength band from 380 nm to 760 nm. The harmful wavelength is in the short, blue wavelength spectrum, ultraviolet (UV). The longer energy waves at the other end of the spectrum can also damage your monastery treasures by causing localized heating.



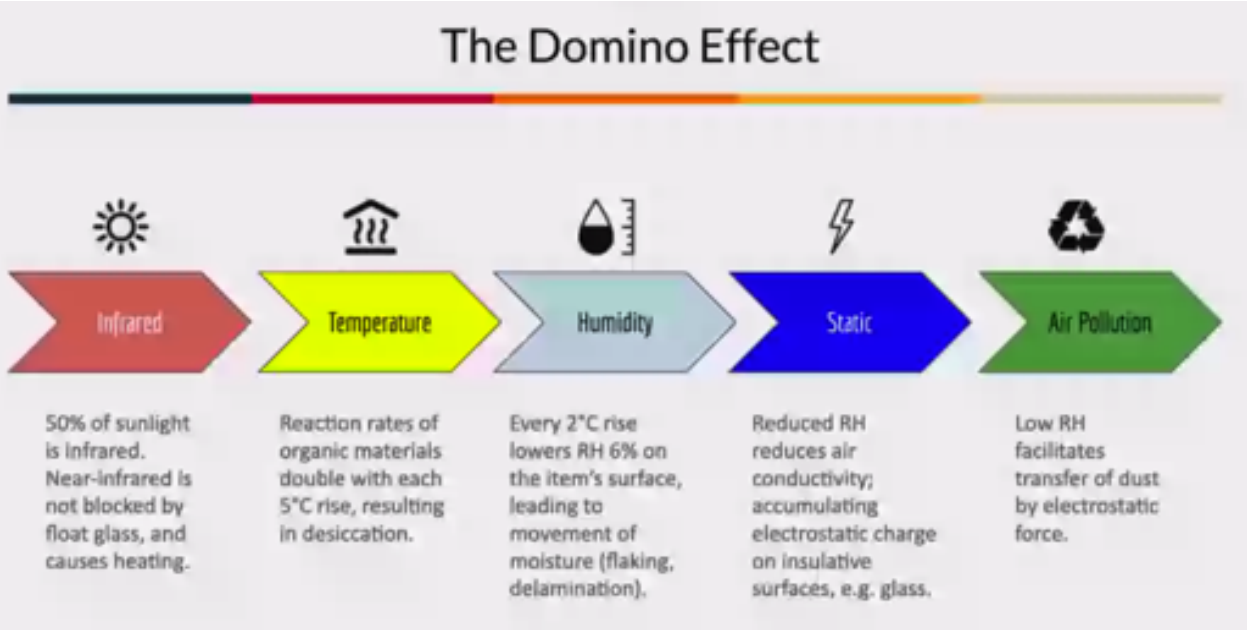
What Is Light? Image credit to ArtRatio.co.uk



What we call light is a form of visible energy of varied wavelengths

With light, it's not only how bright it is but what kind of light it is, what wavelength. These are all the wavelengths of light. Where it says "infrared," we are referring to the kind of light emitted from incandescent lightbulbs. Where it says "ultraviolet," on the right, that's the short blue wavelength that gives you skin cancer, and is what these fluorescent tubes have.

The lower range of light waves can also be damaging to monastery treasures. Up to 50% of sunlight is composed of infrared. For example, when infrared energy heats glass, with every 5 degrees rise in temperature, you get increased deterioration of organic materials, for example, through desiccation (BSI PAS 198:2012).



Effects of infrared. Image credit to ArtRatio.co.uk

The diagram depicts long infrared light--light you don't see, which creates a lot of heat.The old incandescent lightbulbs, which emitted infrared light, could become quite hot. But the old incandescent lightbulbs had a beautiful warm tone to them, more in the red spectrum than in the blue of the fluorescents. People looked healthy, everything looked warm.

The UV light waves from fluorescent tubes are the most damaging. And also, they're into the blue range of the spectrum so if you go into somebody's home and they have only fluorescent tubes, people don't look healthy. The colors of the home don't look

warm and welcoming. Everything looks cold. That's because not only is the bulb damaging your textiles and your paintings, but it doesn't give a very healthy, positive psychological colour.

Many monasteries, even ones that were built recently, have fluorescent lights in the form of tubes or lightbulb-shaped compact fluorescents (CFL). Fluorescent lights produce similar wavelengths as the sun. Consider again that the sun can give you skin cancer, it can cause your textile treasures to fade and deteriorate.

There are a lot of reasons why these fluorescent tubes should be removed. Not only for your mental and emotional health, not only because they're damaging textiles and paintings, but especially because they're poisonous when discarded. Fluorescent lights work because the mercury instigates a chemical reaction that makes light. These fluorescent lights cannot work without mercury. When they are put in the landfill, they can poison mother earth, and poison your water source. It is difficult to recycle them effectively.

This is a picture taken on the side of a package in Nepal. It is even available in the small street markets in Nepal. It's so important to change your lights.

Now people are switching to LED light, light emitting diodes. In several countries, you can get your fluorescent tubes taken away, and get free LED lights in to replace them. You can also request from a donor to contribute funds towards upgrading your monastery's lighting.

So many monasteries put fluorescent lights in to save money. Many monasteries have them hanging directly over wall paintings, or near thangkas. Even last year people would say, "We can't get new LED lights in our local market." However, now you can buy these LED bulbs almost anywhere, even in small markets, at a range of prices. LED lights last as long as fluorescent tubes, but do not use as much electricity, and so are cheaper to use.

Damage from Sunlight

Light damage on this large textile thangka is revealed by light from the door and windows raking over it every day, and by viewing the sunlight coming through the thangka

This image shows a large textile thangka that was made fairly recently. This thangka is already suffering from serious light damage. The silk is shredding and tearing and the colors are fading. Every day, the light from windows above it, and the wide temple room door, sweeps across the thangka. The light shines through the silk from the front and then later the light comes through the back.

You can see sun damage everywhere in most monasteries.

This damage is from the sun. These nuns are showing textiles that have been outside in the sun for only one year and they have faded.

Damage from Fluorescents

Compact fluorescent tubes have been installed in monasteries to replace older incandescent tubes. It is time to replace these compact fluorescents with LED lights. Please check your wiring and light sockets at the same time.

Fluorescent tube lights are fading textiles and paintings in lhakhangs

Fluorescent tube lights are fading books and traditional texts in shedras and libraries

In museums, archives and throughout the community, treasures are damaged by light that is bright, intense, and sometimes, using light sources of damaging wavelengths.

This thangka was in a museum case, with a fluorescent tube light in the top of the case, for many years. The intensity of the light, and the ultraviolet content of the light coming from the fluorescent tube caused great damage to this thangka cover. The fine silk of the cover was so shredded by exposure to the fluorescent tube light in the exhibit case that if you just lightly touched it, it began to powder and fall apart.

*Monastery is exposing paintings and textiles to bright sunlight **and** fluorescent tube lights*

Intensity of Light

Another source of light damage is the intensity, how bright it is. The problem with these lights, even if they are newer LED lights, is how bright the concentrated spot of light is. That is the brightness, high light level, that can also destroy textiles and other organic materials.

Intensity of light is measured by lux or lumens. Light damage increases over time, the damaged cannot be reversed, and the brighter the light the greater the damage. Bright sunlight can equal 30,000 lux, but fading in dyes and textiles starts at 50 lux.

How Serious Is this Issue?

Lux Level	Typically found in:	Noticeable Fade in:	Almost Total Fade in:
100 Lux	Museums	From 7 months	From 15 years
500 Lux	Residential / Offices	From 7 weeks	From 5 years
1000 Lux	Retail	From 7 days	From 6 months
10,000+ Lux	Daylight	From 1 day	From 1 month

Light damage is irreversible and cumulative. Image credit to [ArtRatio.co.uk]

For example, a skillfully painted set of new thangkas was on display in a temple for the first time. Very bright spotlights are used to illuminate the gold details. However, the glare from the light is so bright that you could hardly even see the details of the thangkas, your eyes are blinded by the brightness of the concentrated spotlight. If you tried to photograph, you would notice a bright spot in the middle of the picture. The intensity of the light is too high and will cause permanent damage to these paintings where fine gold details are applied in layers above layers of flat colors and shading. Furthermore, the expensive brocade will be quickly faded by the intensity of the light.

Monastery exhibit of beautiful new thangkas was lit with overly bright spotlights glaring at the center of the paintings

Intense points of light so close to paintings and textiles is not completely safe, not even if LED lighting is used

Practical and Low-Cost Prevention of Light Damage to Monastery Treasures
Monks and Nuns offered these suggestions for their own monasteries:

- Replace compact fluorescent CFL bulbs with LED. The light spectrum of fluorescent lighting is very destructive to treasures made of organic materials including textiles and paintings. Fluorescent lighting has mercury in its structure that must be recycled and processed in a special way so as not to harm the environment.
- Do not hang thangkas inside windows. Sunlight, wind, and monsoon moisture can destroy colour and fabric.
- Use of inexpensive solar lights.
- Curtains or sunshades on windows help to limit light/UV damage.

Do framing and glass enclosures prevent damage from light sources?
Most regular glass does not filter out damaging UV light frequencies, nor significantly limit damage from intensity.

These large sections of glass are intended to protect the lhakhang treasures from damage from theft and dust. The glass may not prevent damage from light.

Does glass protect your monastery treasures from damage from various sources of light? Is this thangka protected by its framing technique, or harmed?

The glass in this picture frame is intended to protect the thangka from damage from theft and dust. However, the glass will not prevent damage from the light shining on it, both from windows and from spotlights. There are types of glass/plastic that are designed especially for framing, to modulate damage from light, blocking most of the UV visible-energy frequency.

In addition, the glass is directly against the surface of the textile and painting, so changes in room temperature and relative humidity will cause condensation on the inside of the glass and thus damage the thangka. If monastery treasures are to be framed, there are simple ways that a frame can be constructed within the monastery to create a deeper space for the treasure, and the materials used in the frame can be selected and treated so that the wood acids are not transferred to the treasure, causing damage. Please contact treasurecaretaker.com for further information on safe framing techniques.

Throughout your monastery or shedra, once you begin to look at light you can realize how it can beautifully illuminate, and yet destroy your monastery treasures. You could have control over what lightbulbs you use in your monastery, but how can you have control over the sun? Especially if you're in a monastery building that is traditionally built. Here is one example how the monastics created protection in a low-cost and practical way. This is a nunnery where the nuns were concerned about the sun coming in and fading their thangkas and wall paintings. They put a cloth on the outside of the windows—it looks very nice, it's very traditional. Plus, it helps keep the insects and birds out.

Nuns created simple and effective window covers with locally sourced cloth in a traditional design

Window coverings, commercially available, are designed to reduce heat, intensity, and ultraviolet content of light coming through windows

Hanging thangkas in the windows, however, exposes them to constant changes in temperature and relative humidity, vibrations from city life, etc. Even with these protective window covers, hanging thangkas in windows is not ideal.

Measurement

You can measure the light that is affecting your treasures, there are meters/instruments that measure the ultraviolet content of the light, the intensity of the light, the rising and falling of the light throughout hours, days, weeks, and months.

You can use instruments that measure the intensity and UV content of the light in your monastery. Some of these tools can upload information of light exposure to your mobile device. The instrument shown measures temperature, relative humidity, and light intensity and the information can be read as chart or graph.

You can use instruments that measure the intensity and UV content of the light in your monastery. This simple instrument measures light intensity directly.

Summary
Bright sunlight can equal 30,000 lux, but dyes and textiles start to fade at 50 lux. In previous centuries in older monasteries, windows were smaller, and electric lighting was not available, or even invented, so the overall light exposure was significantly lower than it can be now. Rooms in which thangkas and other monastery treasures lived were darker! Museums work with the need for exhibit areas to keep light levels very low in order to protect museum treasures. Museums sometimes need to keep the light level as low as 50 lux, the point at which dyes and textiles begin to fade. Then how does a person from our times actually see anything in a dark room, as dark as in previous centuries, when we are so used to bright lights and large windows? This is how: your eyes adjust. It takes time for your eyes to adjust to a darker room. An area lit at 50 lux might seem dark when you first enter, but after a few minutes your eyes become adjusted, you become quite comfortable with the lower level of illumination, and you can see quite well.

How do you prevent light damage to your treasures? Filter the sun from outside, control your lighting inside, choose your lightbulbs carefully, and turn off the lights when no one is there. Cover the windows. Replace your old tube lights with LED lights. It's very simple. With light, as with other risks, prevention is the best cure.

Thank you to funders for ***Preservation of Buddhist Treasures Resource,*** including The Pema Chodron Foundation, Khyentse Foundation, Shambhala Trust, Shelley & Donald Rubin Foundation, Anne Thomas Donaghy, Henry Ming Shen, and many more.

Preservation of Buddhist Treasures

RISK ASSESSMENT ཉེན་ཁ་དཔྱད་ཞིབ།

- **Pandemic** ཡོངས་གྲྭལ་རིམས་ནད།
- **Earthquake** ས་ཡོམ།
- **Fire** མེ།
- **Water** ཆུ།
- **Theft** རྐྱན་མ།
- **Pests** གཙོད་འཚུ།
- **Temperature and Relative Humidity** དྲོད་ཚད་དང་སྐྱོམ་འཁོལ་ཀྱི་འཛའ་ཚན།
- **Human Choices** མིའི་འདམ་གཏ།
- **Pollution** འཚགས་བཙོག།
- **Light** སྐྱག་མེ།

EMERGENCY PLANNING AND DISASTER MITIGATION ཚ་དྲག་འཐར་གཞི་དང་རྒྱན་ངན་ཞི་འཐབ།

SAFE STORAGE ཉེན་མེད་ངོས་ཁང་།

DOCUMENTATION ཡིག་ཆ་ཐོ་བཀོད།

Basic Elements of Emergency Plan for Monasteries and Communities

1. People First

2. Who Do You Call?
   - Who is in charge?
   - Emergency phone numbers
   - Full monastery residence list, to text, WeChat, WhatsApp, etc.

3. Who Should Salvage Collections?
   - Monastery Treasures Salvage Team (trained previously)

4. Where to Bring Damaged Treasures
   - Another monastery?
   - Your monastery dining room, classrooms, etc.

5. What Do You Salvage First?
   - Decide your priorities, preferably before an emergency
   - Mark the location of these priority treasures on floor plans

6. Where Are the Emergency Supplies?
   - Stockpile supplies before an emergency occurs
   - Mark the location of supplies on floor plans
   - Contact local vendors for additional supplies

7. Who Provides Security During an Emergency?
   - Monastics, community members, or government?

8. What Information Technology Will You Need to Replace?
   - Survey your hardware and software currently in use
   - Store monastery files in "cloud" or duplicated offsite

9. Do You Have Insurance?

10. Who Has the Plan?
    - Make a list of who has copies of your Emergency Plan
    - Update Emergency Plan and Team

treasurecaretaker@icloud.com

Smithsonian American Art Museum

SCOTT ROSENFELD,
LIGHTING DESIGNER

SCOTT'S "HOW TO CHANGE A LIGHTBULB" CHECKLIST

LEDs are likely the best energy-efficient source for most museum applications. Below is a list of lighting qualities to help museums maintain the quality they enjoyed using their incandescent track systems.

Intensity

- Are the new energy-efficient lights bright enough for each application in your museum?
- Are the lights still bright enough after you add lenses?
- Will the electronics from the new lights overheat inside a sealed can?
- Is dimming large quantities of fixtures as a group necessary? Are the new lights dimmable with your existing system or do you need to match a new dimming system to your new lights?

Distribution

- Spotlights: Do the new lights provide the same beam angles as your existing system? I typically use every beam spread available when I light exhibits - including 4, 8, 15 and 25 lamps.
- Wall wash: Can the lighting fixtures produce an asymmetric (rectangular or cigar-shaped) light so the illumination on the wall is flat (without scallops)?

Color

- Do the lights produce the desired color? For most installations, the choice of a specific color temperature is less important than matching the color of the adjacent lighting sources.
- How important is color rendering to your application? Assessing color rendition is complicated and mockups on colored surfaces are useful, in addition to checking metrics like color rendering index (CRI) or IES's TM-30. Some LED's with CRI's in the low 80's produce light with excellent color rendering characteristics, although they may not render reds quite brightly as LEDs with a high CRI (<90). CRI values less than 10 points may not be noticeable and don't forget that the intensity light will have a significant impact on color rendition.
- Ultraviolet light needs to be eliminated or reduced to minimal levels (75 microwatts per lumen). Most LEDs don't create UV, but for the most light-sensitive materials (equivalent to ISO blue wool 1-4) it is best to avoid high CCT lamps (above 4000K).
- Are there, appropriate, opportunities to use colored light?

Movement

- Do the new energy-efficient lights flicker? Flicker is common when LEDs are improperly dimmed or when the electronics were poorly constructed. Check DOE and IEEE websites for more information. Flicker impacts people susceptible to migraines, photo-sensitive epilepsy and people on the autism spectrum.

Connecting to Collections Care

How to Change a Lightbulb: LED Lighting for Museums

November 21, 2019

Presenter
Scott Rosenfeld, Lighting Designer
srosenfe@si.edu

Additional Resources

Downloadable Materials and Links to Support Education About IES TM-30-15: IES Method for Evaluating Light Source Color Rendition
http://www.personal.psu.edu/kwh101/TM30/main.htm

Related Past Connecting to Collectons Care Webinars

Introduction to LED Lighting (March 29, 2012) with Rick Kerschner ***http://bit.ly/331mzc4***

C2C Care Course: Preservation Methods and Materials for Exhibitions, W ebinar One: Museum Lighting: Balancing Display and Preservation with Scott Rosenfeld LC, IES (October 25, 2019) ***https://vimeo.com/297577018***

LIGHT LEVELS

https://www.youtube.com/watch?

v=j3lgz8F5OgY&list=PLKsvb3AsMnZSsmOROOXNHTVnGQuVOYeVG&index=7

Canadian Conservation Institute (CCI) Notes

- N2/1 Ultraviolet Filters (2015) (PDF Version, 300 KB)
- N2/2 Measurement of Ultraviolet Radiation (2015) (PDF Version, 466 KB)
- N2/3 Track Lighting (1992) (PDF Version, 630 KB)

Tools to Measure UV Light

https://www.talasonline.com/UV-Light-Meter

This handheld UV light meter measures both UVA & UVB light, in a compact and accurate unit.

This instrument is designed to measure ultraviolet light in the range from 280 to 400 nanometers (UV AB). The illumination range of the meter allows users to conduct the most precise quantitative measurements of ultraviolet radiation for radiometry and laboratory requirements, UV-curing in offset printing, lamp UV intensity & aging, industrial process monitoring, semiconductor fabrication, sunlight UV intensity to prevent skin damage, sterilization and environmental monitoring.

- Backlit LCD with 4 digit dual display
- High and Low measurements
- Range in a unit mW/cm2 or uW/cm2
- Socket for tripod mounting
- Automatic measuring
- Low battery indicator
- Magnetic mount
- 20 point memory
- Over Range Indication
- Zero Adjust
- Auto Record
- Includes Certificate of Traceable Calibration
- ROHS, CE, WEEE

Includes:
- 1 "9 V" battery, UV sensor probe, Instruction Manual, Hard carrying case

Unit Specifications:
- Spectrum Range: 280 ~ 400nm UV, AB Calibration Point: 365nm
- Illumination Range:
Low: 1 uW/cm2 ~ 1999 uW/cm2
High: 0.01 mW/cm2 ~ 40.00 mW/cm2
- Accuracy: 23 ±5ºC (73.5 ±9ºF) ±4% ±1 digit
- Sample Time: Approx. 0.3 sec.
- Memory: 20 points and 1 for interval time
- Operation Temperature: 32º to 122ºF (0º to 50ºC); 10~90% RH
- Weight: Approx. 3.2oz (90 g)
- Dimension: 5.51" x 1.93" x 1.14" (140 x 49 x 29 cm)
- Power Source: "9V" battery (included)

Tools to Measure Light Intensity

https://www.talasonline.com/Digital-Light-Meter

Digital Light Meter

A convenient and easy-to-use meter for measuring visible light. Unit switches between LUX and foot candle readings; LUX range: 0-200,2000,20000 with an accuracy of 3% of rdg. (5% at 20000), and FC range: 0-20,200,2000 with an accuracy of 3% of rdg. (5% at 2000). Carrying case has separate compartment for processor and sensor. Uses one 9v battery.

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དཔོན་ཁའི་གནས་བདངོས་གཅེས་སྐྱོང་གྲོང་བཙན་ཚོགས།

Digital inventory འཕྲལ་ཆས་མོག་རལ་བཏོལ་ཐོག་འཛིན།
Risk assessment and disaster mitigation ཉེན་ཁྲོན་འགོག་དང་ཚབ་བྱ་གཏོང་ལེན།
Recording digital interviews with elders མིན་རབས་དང་འཕྲལ་ཆས་མོག་རལ་བཅར་འཇུག་སྤྱད་བྱེད་པ།
Scientific research ཚད་རིག་ཉམས་ཞིབ།

Current project དཔྱིལ་ས་འཆར།
Free online preservation resource for communities and monasteries
དཔོན་པ་དང་གྲྭ་ཚོགས་ཀྱི་ཉེར་དུ་གནས་དགོས་པའི་གནང་སྐབས་ལས། ཞིན་རང་རྒྱུ་མོག་ལིན་ཚེད་དུ་སྤྲལ་བ།

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