



# **Environmental Monitoring and Control**

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# Factors Affecting the Longevity of Collections

- Chemical and physical composition
- Environment
- Storage conditions
- Use and handling



# Creating a Protective Storage Environment

Temperature  
and  
Relative Humidity



Mold Control

Light



Insects and Pests



Atmospheric Pollutants



# Standards for Paper-Based Collections

Temperature:  
68-70 °F

Relative Humidity:  
35-45%



# Standards for Photographic Materials



- Temperature: Below 70° F
- Relative humidity: 35-45% RH
- Limit light exposure





# Storage & Handling: Magnetic Media

- 60 ° F, 30-40% RH, dark, dry & clean storage
- Use with preservation quality containers
- Store vertically
- Avoid sources of magnetic fields
- Make backups and reformat to new technology
- Never play masters, make service copies



# Storage & Handling: Optical Media

- 68 ° F, 40% RH, dry, dark and clean environment
- Store CDs and DVDs individually in “jewel cases”
- Do not use solvents to clean
- Use lint-free cotton cloth to wipe from center to outer edges
- Store vertically



# Low Cost Environmental Practices

- Turn off lights
- Close blinds
- Monitor conditions
- Improve circulation with fans
- Practice integrated pest management
- Employ good housekeeping
- Keep HVAC functioning and maintained





# Low Cost Preservation Initiatives

- Initiate a collection area cleaning project
- Institute a ban on food and drinks in collection areas
- Distribute plastic “rainy day bags” for circulating items
- Libraries: close book drops when the library is open
- Institute an environmental monitoring program



# Low Cost/No Cost Environmental Controls

- **Personal Habits**
  - **Shift work hours to off peak**
  - **Adjust the thermostat**
  - **Turn lights off when not in use**





# No Cost/Low Cost Environmental Improvements

- Temperature and Relative Humidity
  - Schedule Routine HVAC maintenance for optimal performance
  - Use Programmable thermostats
  - Cut drafts
  - Use water conserving plumbing
  - Use appropriate landscaping for the region
  - Insulate





# No Cost/Low Cost Environmental Improvements

## Low Cost--Light

- Think about the choices you have for lighting
- Use timers for lighting
- Motion sensor lights
- Window coverings including shades
- Install storm windows
- Consider UV filtering



# No Cost/Low Cost Environmental Improvements

## Low Cost--Energy

- Be aware of energy vampires
- Monitor and control
- Use Energy Star rated appliances and equipment



# Energy Vampires



# Kill-o-Watt and Smart Strip Surge Protectors

- Kill-o-Watt measures energy usage of appliances
- Smart Strip switches power on/off to save \$



# Why monitor the environment?

## Rationale and goals

- This good documentation and data can open the gates of communication between library/archive personnel and facilities management.
- Like many proactive preservation activities, environmental monitoring conveys good stewardship of collections.
- Keeping records and up-to-date data allows you to handle the problems before they start.
- Having this knowledge and ability to take action can be a big money saver in the long run.
- *Note the proactive theme here!*

# Methods of Monitoring: Light

- Spot measurements can be taken with light meters, UV meters, or color temperature meters.
- Measurements over time can be monitored by textile fading strips (blue wool cards), observation of damage, and photodocumentation.
- Without any equipment? Filter windows, sleeve fluorescent lights, bounce light versus direct light

# Light

- Visible light meters
- UV light meters
  - Elsec



# Light

- Blue wool cards



- These cards are comprised of eight strips of wool cloth dyed in different degrees of color-fastness.
- It takes about 3 times the amount of cumulative illumination to fade each strip as the strip that is directly above it.

# Light

- UV-blocking sleeves and film are available for fluorescent lights and windows, to block UV spectrum of light. Remember that although UV light is the most damaging, ALL light can damage and fade materials.
- These sleeves and films, dependent on use, lose filtering capacity in approximately 5-15 years. A UV monitor will be occasionally necessary to check the effectiveness.

# Light

- UV light is counted in microwatts per lumen
- 30= great
- 75 or below = best practice
- 300 = High
  
- Depends on what you are protecting/what is at stake as to how concerned you should be

# Particulates/Contaminants

- Contaminants can be from outside soot, from HVAC, or inside sources, like carpets, books, and people.
- Depending on where you live particulate from soot (carbon) may be visible as collection of dust on air supply grills. Must have a very aggressive air filtration system for this; not easily retrofitted.

# Contaminants

- Filters – buy the most you can afford if you are having issues with outside particulates.
  - Filters actually have a higher filtering capacity when they are full, because the particles have filled the larger holes in the filter material, leaving smaller holes to trap the smaller materials. But- they are less efficient to operate, which means more money.

# Methods of Monitoring: Particulates

- Gloves, particle counters, badge counters, observation (and documentation) of damage



# Contaminants

- Glove test:
  - Using a clean white glove, swipe finger against surface in question (be sure surface was not dirty from other pollution circumstances). Rub glove against itself (other finger). If surface is black or grey, it is soot. If it is brown or something that goes away when rubbed, it may be from the collection and not linked to HVAC. Soot may be linked to HVAC.

# Methods of Monitoring: Gaseous contaminants

- Monitor external and internal sources
- Look at regional pollutant data
- Silver coupons for passive reactivity monitoring
- Vinegar syndrome monitors for films
- Formaldehyde monitors- passive sampling badges



# Methods of Monitoring: T and RH

- If you have different monitoring equipment, bring them all into a room and see if they agree with each other!
- You are better off checking calibration with existing equipment and a few dataloggers than requesting calibration from the outside (\$\$)

# Dataloggers

- Pros:
  - Able to store and render data in a consistent manner
  - Cold Hard Facts. Well calibrated loggers present a objective view of the environment
- Cons:
  - Tells you two weeks later (or whenever you download data) that there is a problem. Would be good to know in a more timely manner and able to make those changes when they are happening.

# Dataloggers: Types

- PEM2 from the Image Permanence Institute
  - These monitors are perhaps the most well tuned in monitors for the Library, Archive, and Museum Community. They are very easy to use and data is stored on an external site so information can be loaded and shared as easy as providing a login and password.
  - Data and supporting information on T and RH and reactions with a variety of LAM materials is available directly through the pemdata site.

# Dataloggers: Types

- HOBO loggers from Onset Corporation
  - These loggers are less expensive and offer many models to choose from- some offering a light meter
  - Must purchase hoboware software to read data

# Humidity Indicator strips

- Are fairly accurate- may be better than some hygrometers
- Inexpensive
- Lose functionality after they get wet
- Can be used for spot checking among storage areas
- Keeps well if kept in a sealed aluminum vapor proof bag.

# Psychrometers

- Sling- not accurate enough. There can be issues with getting the bulb wet enough to produce accurate readings
- Aspirating- better. Wet bulb means thoroughly wet and dripping (one drop on/one drop off). Do not average readings- take the lowest reading- most accurate.

# Hygrothermograph

- A common way to measure T and RH
- Data can be viewed visually
- Circular HT are extremely hard to read!



# Hi/Low Loggers

- Inexpensive
- Some have ability to capture and store high and low temperatures for a 24 hour period
- At least they define extremes: check daily and reset



# Your HVAC

- Deferred maintenance = a crisis in the making.
- Use other institutions in your local area to compare for collections settings.
- NEDCC “Function from Design” Leaflet

# Methods of Monitoring: general

- Water leaks, condensation, air leaks and infiltration, equipment in storage rooms, noises- ozone, overcrowding, collection use policies, toxic contamination from arsenic and asbestos, look for patterns, events log with description, time, and location.

# Watching Your Collections

- Look for problems
  - In collections: mold, dust, discolored “halos” / splitting of wood, corrosion of metal- all can be indications that there may be an issue
  - Building Envelope: staining, leaking, efluorescence on exterior walls
  - Current operations: no clear maintenance procedure, monitoring reveals wide fluctuations, inability to get clear, consistent answers from facilities maintenance.



# Building Survey

- Construction/Renovation
- Condition
- Drainage
- Collection Storage
- Climate Control
- Pollutants
- Light
- Pest Control/Housekeeping





# Building Design

- Minimize air passages between floors
- Concrete flooring prevents fire from spreading
- Beware of concealed spaces
- Keep exits unobstructed
- Inspect electrical wiring
- Inspect storage areas
- Utilize Fire Marshall visits





# Effects of a Mold Outbreak

- Poses health risk to staff and patrons
- Causes staining and loss of materials
  - Permanent stains to book cloth
  - Weakening of materials
  - Irreversible damage to photographs
- Attracts and encourages pests
  - Mold is food for pests
  - Both mold and pests enjoy the same environment!





# Mold Assessment and Prevention

- Above all, watch heat and humidity levels
- Keep Collections Storage and Staff Areas clean
- Indoor plants and watering
- Inspect for mold regularly
- Find the source of moisture and remove it
- Regularly clean HVAC system
- Isolate incoming and infested collections
- **RESPOND QUICKLY TO WATER DAMAGE!**





# Mold: Initial Response

- Isolate affected materials
- Identify Species
  - Is the mold active or inactive
- Locate source of humidity
- Lower the humidity and temperature
- Increase air circulation
- Use Personal Protective Equipment or call an expert when in doubt





# Mold Removal

- Deactivate/Inactivate mold
- Clean the affected items
  - Vacuum residue using a HEPA vacuum
  - Take health precautions
- Clean and disinfect storage areas
- Follow up by monitoring affected materials and the environment





# Pest Risks and Control

- Seal routes of entry
- Control water sources
- Control food sources
- Clean collections storage rooms and look for signs of insects
- Isolate and examine incoming collections
- Do routine monitoring



# Sustainability

- Sustainability = Preventive Care





# Sustainability

## Temperature

- The comfort zone for people and artifacts is 68 F – 72 F
- It is better to be cooler rather than warmer. Try to maintain stability within the range
- Avoid rapid fluctuations, which lead to stress and damage over time

## Relative Humidity Levels

- RH no higher than 55%  $\pm$  3% in summer
- RH no lower than 38%  $\pm$  3% in winter
- Daily fluctuations no more than 3%
- Seasonal transitions no more than 5% per month



# Sustainability

## Recommended Light Levels

**Very Light Sensitive Objects      5 foot candles or 50 lux**

- **Examples: textiles and textile dyes, feathers, paper, some dyed leather, inks, paper, material of animal origin and some pigments.**

**Moderately Light Sensitive Objects      10 - 15 foot-candles or 100 - 150 lux**

- **Examples: paintings, polychrome objects, or architectural elements, Un-dyed and dyed leather, basketry, wood.**

**Objects with Low Light Sensitivity      25 - 30 foot candles or 250 - 300 lux**

- **Examples: stone, glass, metal, beads, ceramic, enamel**

**Maximum ultraviolet (UV) level:      75mW/lumen**

# Sustainability

- The Concept of Envelopes
  - Think about the largest envelope—the building itself!



# Sustainability

## Control smaller envelopes



# Sustainability

## Use of appropriate materials



## Making better choices



# Sustainability

- Develop an institutional vision statement for sustainability and energy use at your facilities



# How does all this help us preserve more with less?

- **Making better choices helps protect collections and save money**
- **Preventive care provides “bigger bang for the buck”**
- **You can provide more general care for more objects than conserving a single object**





# Questions?





# Instructor

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