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UNIVERSITY OF DUBROVNIK

ENGLISH FOR CONSERVATION AND RESTORATION

Jelena Dubčić

2

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FOR PUBLISHER

Prof. Nebojša Stojčić, PhD

REVIEWERS

Brankica Bošnjak Terzić, PhD, Senior Lecturer
Tea Glavaš, PhD, Senior Lecturer
Martina Hrnić, univ. spec. philol., Senior Lecturer

GRAPHIC AND TECHNICAL DESIGN

Katarina Banović, MA Econ

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ENGLISH FOR CONSERVATION AND RESTORATION 2

Jelena Dubčić, prof., Senior Lecturer

2026.

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INTRODUCTION

This textbook, *English for Conservation and Restoration 2*, is intended for undergraduate and graduate students of conservation and restoration, as well as early-career professionals requiring advanced technical English proficiency in the field.

Audience

Users are assumed to possess foundational knowledge of conservation principles. The present volume builds upon that foundation by providing direct engagement with authentic professional texts, primarily Canadian Conservation Institute (CCI) Notes and selected scholarly publications.

Structure and Use

Each unit follows a consistent pedagogical sequence: pre-reading questions, a core reading text, reading comprehension exercises, vocabulary exercises, grammar exercises, and creative or translation tasks. Units may be completed sequentially or selectively, though vocabulary and concepts recur across units to reinforce learning.

Expected Competencies

Upon completion of this textbook, students will be able to:

1. read and comprehend authentic conservation literature, including CCI Notes and scientific publications, with accuracy
2. employ technical vocabulary pertaining to the preservation of wood, metals, paper, books, textiles, and stone
3. recognise and produce grammatical structures prevalent in conservation writing, including the passive voice, conditional clauses and complex nominal constructions
4. compose professional documents such as treatment proposals, condition reports, storage protocols, and funding justifications
5. translate basic conservation texts between Croatian and English (applicable to Croatian academic contexts)
6. articulate preventive conservation principles to colleagues and institutional decision-makers using internationally standardised terminology

Professional Relevance

Conservation is an international discipline requiring fluency in English for conference participation, journal access, funding applications and collaborative research. The ability to read technical English precisely and to write clearly about one's own work constitutes a professional necessity.

A square opening in a wall with peeling, aged, light brown paint. Inside the opening is a solid purple square. The text "Unit 1" is written in white, sans-serif font on the purple square.

Unit 1

CARE AND CLEANING OF UNFINISHED WOOD – CANADIAN CONSERVATION INSTITUTE (CCI) NOTES 7/1¹

Pre-Reading Questions

1. Based on your knowledge of wood as a material, why might water be problematic for an untreated wooden surface?
2. What types of dirt or residue might accumulate on an old wooden object through decades of use?
3. If you were to clean a delicate wooden surface, what qualities would you look for in a cleaning tool?

Introduction

Cleaning bare wood surfaces is complicated by several factors. First, unfinished wood is relatively soft and can be damaged by some cleaning techniques. Wood degrades with time and use, so older wood surfaces may be even softer than new ones. Second, since bare wood readily absorbs water, wet cleaning methods are considered unsuitable, thus cleaning options are limited. Water and solvents can quickly swell wood fibres, raise the grain and cause unwanted dimensional change; they can also mobilize surface dirt, drawing it below the surface to cause staining. Finally, wood surfaces may include natural deterioration products and traces of substances that were applied or came in contact with the surface when the item was in use (these are collectively known as “patina”), which should be retained but are sometimes difficult to differentiate from dirt.

Before attempting to clean an unfinished wood surface for the purposes of conservation, it is important to evaluate the surface to determine whether or not cleaning is appropriate. Is the surface stable, or is it powdering, flaking or otherwise fragile? Is there a patina present such as the remains of a previous surface coating or residue associated with use? If the surface of the wood is unstable or if valuable historic surface deposits are suspected, cleaning should be referred to a professional conservator.

Having established if cleaning is appropriate, it is important to determine how much cleaning is necessary. Avoid patchy cleaning or overcleaning. Test cleaning methods on several inconspicuous areas of the surface before commencing in order to ensure that a consistent surface can be achieved with no hard delineations between contiguous areas.

¹ Canadian Conservation Institute (CCI) (2002) Care and Cleaning of Unfinished Wood -7/1, <https://www.canada.ca/en/conservation-institute/services/conservation-preservation-publications/canadian-conservation-institute-notes/care-unfinished-wood.html>. Pristupljeno 6. rujna 2025.

Techniques

The following techniques (listed in order from least to most aggressive) are recommended for cleaning bare wood:

- soft brush and vacuum cleaner
- stiff brush and vacuum cleaner
- smoke or chemical sponge
- erasing compounds
- erasers
- adhesive rubber product

Soft brush and vacuum cleaner

Most objects with firm, stable surfaces can be safely cleaned of loose dirt using a soft paintbrush and vacuum cleaner. If the brush has a metal ferrule, ensure that it does not scratch the surface of the wood by wrapping it with masking tape or twill tape and by holding the brush perpendicular to the surface. Brush the dust from the surface with a gentle flicking motion (rather than dragging it across the surface at a low angle) into a vacuum cleaner nozzle that is covered with a fine mesh filter (this will prevent loose or detached fragments from being accidentally taken up). A speed controller is useful for regulating suction, provided one can be used with the vacuum cleaner's motor. If an object has loose pieces, a powdery surface or delicate components, consider again whether or not cleaning will be safe. It may be possible to use a soft brush on such items, but do not use a vacuum cleaner.

Stiff brush and vacuum cleaner

If the surface is in good condition, a stiff bristle brush may be used to remove ingrained dirt. A round artist's stencil brush with a diameter of about 1 cm is ideal. This type of brush can be used as supplied or the bristles can be trimmed to increase their effectiveness. (If the bristles are shortened, they become less flexible and therefore more abrasive). In the manner described above for soft brush cleaning, use a vacuum cleaner to capture dislodged dirt. Proceed cautiously when cleaning with a stiff bristle brush. Wood is relatively soft, and the top layers of cells, particularly in degraded wood, can be easily damaged. Aggressive cleaning might exaggerate the grain pattern by wearing away softer areas (Figure 1). In furniture collections, this type of wear is most often seen in unfinished softwood pieces, such as dry sinks and rustic furnishings.

Smoke or chemical sponge

Also known as "dry cleaning or soot sponges," these vulcanized rubber sponge products with a small quantity of added detergent can be effective at picking up dirt from a bare wood surface. The sponge is gently pressed or rolled onto the surface. It

is important not to press too firmly, as too much pressure can embed loose particles in the surface. When the surface of the sponge becomes soiled, it can be cut away to reveal a fresh surface for continued cleaning.

Erasing compounds

Use of erasing compounds (also known as “eraser crumbs”) is a relatively gentle method of removing dirt from bare wood surfaces. Two effective products are Staedtler Mars Plastic and Eberhard Faber 1954 “Magic Rub” erasing compounds, available in several different grind sizes. A small amount of erasing compound is worked over the surface with a wad of absorbent cotton using a gentle, circular motion. Hard rubbing must be avoided. The erasing compound is no longer useful when it becomes grey with dirt, at which point it should be removed from the surface with a soft brush and captured by a vacuum cleaner nozzle covered with mesh. It must be cautioned that removing eraser crumbs from the surface of bare wood after cleaning can be challenging, especially on uneven surfaces or on wood surfaces with particularly open pore structures where eraser particles can become lodged in crevices.

Erasers

A solid gum eraser (art gum) can be used to successfully clean an unfinished wood surface. Gum erasers are made of natural rubber and are milder than those made of polyvinyl chloride (PVC) or filled rubber. Remove eraser crumbs as described above.

Soft vinyl erasers are also effective for cleaning bare wood, but it is important to choose a product that is not filled with harsh abrasives. Two effective products are Staedtler Mars Plastic and Eberhard Faber 1954 “Magic Rub” block erasers (in this solid block form, they provide a more aggressive cleaning method than the compound). These erasers can be trimmed with a scalpel or knife to a point in order to clean difficult-to-reach areas. The latter product is also available in a peel-off pencil form, which is slightly harder than the block version. Again, ensure that all eraser particles are cleared from the surface with a brush and vacuum after cleaning.

Adhesive rubber

Adhesive rubber (e.g. Groom/Stick) is a kneadable natural rubber product that is very sticky and attractive to dirt. Press it gently onto the surface (do not rub). A small piece can also be wrapped onto the tip of an applicator stick and gently rolled across the surface. This technique is very effective for controlled removal of dirt in areas with limited access for larger cleaning tools. As it becomes blackened by dirt, adhesive rubber can be torn open to reveal a fresh, tacky surface to work with. Work slowly, and regularly compare the cleaned surface with the untreated areas around it. The aim is for consistency in appearance. This material is very efficient, so be careful not to overclean. Because adhesive rubber is quite tacky, it may not be suitable for some, more friable, surfaces.

Summary

Before cleaning a bare wood surface, it is essential to decide why this needs to be done and what the surface will look like afterwards. Because all cleaning techniques have the potential to damage bare wood surfaces and will inevitably alter the surface to some degree, conduct preliminary tests on unobtrusive areas and clean slowly and carefully. It is important to practise preventive conservation measures in order to limit the need for cleaning. Unfinished wood artifacts should be handled with gloves or clean, dry hands and should be covered with drop cloths while in storage to prevent further soiling.

■ Reading Comprehension Exercises

Part 1: Multiple Choice Questions

Choose the single best answer for each question.

1. What is the primary reason wet cleaning methods are considered unsuitable for bare wood?
 - a) They soften older wood, making it too fragile to handle.
 - b) Water and solvents can quickly swell wood fibres and cause unwanted dimensional change.
 - c) The mobility of surface dirt causes it to become embedded below the surface, leading to staining.
 - d) They are the most aggressive method and should only be used by professionals.
2. According to the text, which characteristic of a bare wood surface must be retained but is sometimes difficult to differentiate from dirt?
 - a) softened wood cells
 - b) ingrained dirt
 - c) patina
 - d) raised grain
3. Which of the following cleaning methods is listed as the most aggressive of the recommended techniques?
 - a) smoke or chemical sponge
 - b) erasing compounds
 - c) erasers
 - d) adhesive rubber product
4. When should cleaning an unfinished wood surface be referred to a professional conservator?
 - a) Only if a stiff brush is necessary to remove ingrained dirt.
 - b) If the wood is too soft due to time and use.
 - c) If the surface is unstable (e.g., powdering or flaking) or if valuable historic surface deposits are suspected.
 - d) If a consistent surface cannot be achieved with preliminary test cleaning.

5. What is the main risk of cleaning too aggressively with a stiff bristle brush?
 - a) embedding loose particles in the surface
 - b) mobilizing surface dirt to cause staining
 - c) exaggerating the grain pattern by wearing away the softer early growth areas
 - d) accidentally taking up loose or detached fragments into the vacuum

Part 2: Short Answer Questions

Answer the following questions concisely using complete sentences.

1. List the three categories of factors that complicate the cleaning of bare wood surfaces, as outlined in the Introduction.
2. Explain the difference in cleaning aggressiveness between using erasing compounds (crumbs) and using the same product in a solid block form (erasers).
3. What specific precaution must be taken when using a soft brush that has a metal ferrule, and why is this precaution necessary?
4. When using a soft brush and vacuum cleaner, what is the purpose of covering the vacuum cleaner nozzle with a fine mesh filter?
5. Besides cleaning slowly and carefully, what two specific preventive conservation measures are recommended in the Summary to limit the future need for cleaning unfinished wood artifacts?

■ Vocabulary Exercises

Part 3: Match the following key terms from the text with their best-fitting definition.

Term	Definition
1. unfinished	a) easily crumbled or powdered; not stable.
2. mobilize	b) hidden or not drawing attention.
3. patina	c) the metal part of a brush that holds the bristles.
4. inconspicuous	d) not having a protective coating (like paint, varnish, or wax).
5. delineations	e) the act of preventing deterioration or damage.
6. contiguous	f) residues associated with use or natural deterioration products that should be retained.
7. ferrule	g) lines, borders, or clear boundaries.
8. ingrained	h) flexible fibers used for cleaning or painting.
9. bristles	i) side-by-side; touching or sharing a common border.
10. friable	j) deeply fixed, often into the pores or grain.
11. preventive conservation	k) to move or be capable of moving, such as dirt being drawn into the wood.

Part 4: Choose the best term from the box below to complete each sentence. Use each term only once.

ferrule	mobilize	inconspicuous	friable	delineations
contiguous	patina	ingrained	abrasive	unsuitable

1. Wet cleaning methods are considered _____ for bare wood because it readily absorbs water.
2. Water can _____ surface dirt, causing it to stain the wood as it is drawn below the surface.
3. The _____ on an old wood surface, which includes residues from use, should often be retained during cleaning.
4. Test cleaning methods on several _____ areas of the surface before starting the main work.
5. Avoid patchy cleaning, which can lead to hard _____ between cleaned and uncleaned areas.
6. Ensure that a consistent surface can be achieved with no hard lines between _____ areas.
7. The meta _____ of a brush should be covered to ensure it doesn't scratch the wood surface.
8. A stiff bristle brush is used to remove _____ dirt that is deep within the wood grain.
9. When trimming the bristles on a brush, they become less flexible and therefore more _____ .
10. The very tacky adhesive rubber may not be suitable for some, more _____ surfaces that might crumble easily.

■ Grammar Exercises

Part 5: The text often uses the passive voice to describe procedures and necessary actions (e.g., “wet cleaning methods are considered unsuitable”).

1. **Identify** two sentences in the text written in the **passive voice**.
2. **Rewrite** those two sentences into the **active voice**.

1. _____

2. _____

Part 6: The text uses **Conditional Clauses** to warn against potential damage or to outline required steps.

Instructions: Complete the following sentences using the First Conditional structure (If/When + Simple Present, followed by the consequence). Refer to the text for appropriate content.

1. If the surface of the wood is unstable or if valuable historic surface deposits are suspected, ...
2. If the brush has a metal ferrule, ...
3. If the bristles are shortened, ...
4. When the surface of the sponge becomes soiled, ...

Part 7: Creative Writing Prompt: The Conservator's Decision

You are a Junior Conservator specializing in wooden artifacts. A new object has arrived in your lab: a **200-year-old carved wooden dough bowl** found in an old farmhouse kitchen. It is an “unfinished wood” object.

The bowl is structurally stable, but it's covered in decades of dust, sticky kitchen residue, and a dark layer that you suspect is a valuable **patina** (perhaps from old yeast or cooking grease). Your supervisor needs a detailed plan outlining your approach before you begin.

Your Task: Write a “Treatment Proposal Memo”

Write a short memo (approximately 200-250 words) to your supervisor. Your memo should address the following points, using at least **four** of the bolded terms from the provided CCI text:

1. **Evaluation:** What are the risks of cleaning this object (referencing the nature of unfinished wood)?
2. **Initial Steps:** What is the least **abrasive** method you will use first to remove loose dirt?
3. **The Main Challenge:** If the soft brush fails, what next step will you take to remove the ingrained dirt, and how will you prevent potential **delineations** or damage?
4. **Patina:** What is your strategy for preserving the historical **patina** while still achieving a consistent surface?



Unit 2

CARE OF FURNITURE FINISHES – CANADIAN CONSERVATION INSTITUTE (CCI) NOTES 7/2²

Pre-Reading Questions

1. What do you understand by the term “finish” in the context of wooden furniture?
2. Why might the original finish on an antique piece of furniture be considered valuable?
3. What are some common liquids or substances that could damage a finished wooden surface in a domestic setting?

Introduction

The “finish” of a piece of wooden furniture refers to the surface of the wood and how it may have been changed cosmetically by the builder or altered through use. In most cases, the finish is a discrete coating that protects the wood from soiling, provides some moisture resistance and alters the appearance of the surface. Original furniture finishes have historical, aesthetic and financial value and, as such, should be maintained.

Prior to application, furniture finishes may be fluids, solids or semi-solids; in addition, the fluids may be single substances (e.g. oils) or they may take the form of solutions, emulsions or suspensions. Liquid and semi-solid finishes cure to solid form in a variety of ways. A finish may dry by solvent evaporation, by polymerization, by coalescence or by a combination of these processes. Because of this variety of types and the wide range of application techniques, discussions of surface finishes are very complex. A detailed discussion of all surface finishes is beyond the scope of this Note; however, general directions on basic preventive care and cleaning for certain types of coatings found on wooden furnishings are provided.

Dry pigment

One of the simplest ways to modify the surface of a wooden object is to apply raw pigment (examples include natural earth pigments such as ochres and umbers, black wood ash and white clay). These coatings have no binder; the pigment is applied either dry or in a slurry with water. Dry pigments initially adhere easily to wood because it is porous. They do not form an intact film so are unaffected by wood movement due to fluctuations in relative humidity.

² Canadian Conservation Institute (CCI) (2002) Care of Furniture Finishes 7/2, <https://www.canada.ca/en/conservation-institute/services/conservation-preservation-publications/canadian-conservation-institute-notes/care-furniture-finishes.html>. Pristupljeno 15. rujna 2025.

The surface of dry pigment finishes is often fragile and powdery and can be easily smeared or removed by handling. Because the surface is so vulnerable, furniture finished in this manner should not be handled directly but instead lifted and moved with a support such as a tray or trolley. Such furniture should also be covered to protect it from dust, which may become indistinguishable from the powdered pigment upon unaided visual inspection. As even light brushing to remove dust can loosen the pigment, only an experienced conservator should clean furniture with a dry pigment finish.

This kind of finish is rarely encountered on North American furniture, where any application of dry pigment was probably followed by the application of a binder.

Paint

Paints also use pigments for colour and surface effect, but they include a binder such as a drying oil or a resin in solution to hold the pigment more firmly to the surface. A wide array of synthetic polymers have been used as binders since the middle of the 20th century. However, prior to that, most paints in Western cultures were made with boiled linseed oil or other drying oils as the basis for the binder, making them opaque varnishes. Casein protein from milk was another option that produced an equally intractable but more matte finish.

Painted wooden surfaces can be quite durable because the paint penetrates into the wood and produces a strong bond. However, because paint forms a complete film on wooden objects, it is prone to cracking and loosening as the wood expands and contracts in response to changes in environmental conditions. Adhesion between the paint and the surface may fail with time, causing flaking and loss. Deterioration of the binders in paints is primarily due to light (both visible light and ultraviolet [UV] radiation), which can cause breakdown of the film, powdering and changes in colour. It is therefore important to minimize the amount of light, both in intensity and hours of exposure, that is allowed to fall on a painted surface. Painted surfaces are also susceptible to changes in taste and fashion, and it is not uncommon to find painted furniture stripped and refinished with clear coatings.

If cleaning of the painted surface is deemed necessary and if, after close visual inspection, the surface is considered stable (no flaking or powdering paint), cleaning can be accomplished by removal of loose dust and dirt with a soft cotton cloth or by using a soft brush and vacuum. Refer to CCI Note 7/1 [Care and Cleaning of Unfinished Wood](#) for more information on dry cleaning techniques. Mechanical techniques may be all that is required for cleaning, but it may be determined that aqueous or solvent cleaning is also necessary to remove more stubborn deposits of dirt. Since many painted surfaces are sensitive to water and other solvents, aqueous and solvent cleaning should only be conducted by a conservation professional. Refer to CCI Note 10/1 [Cleaning Paintings: Precautions](#) for more information on cleaning painted surfaces.

Paint finishes that have deteriorated must be handled carefully to prevent loose pieces from being caught on gloves and clothing and subsequently lost. If the

flaking is suspected to be related to wood movement, control of relative humidity may be important; in such cases, it is best to seek advice from a conservator. Flaking paint surfaces can sometimes be consolidated by introducing a suitable consolidant under the flakes, but this should only be done by an experienced conservator with good facilities.

Natural resin coatings

Natural resins have been used to form coatings on wooden objects for millennia, with much evidence of their use in ancient Egypt and China. These transparent finishes were traditionally defined as either lacquers or varnishes: lacquers consisted of resins or gums deposited from solution; varnishes were similar but also contained drying oils. Today, these names do not have clearly separate definitions in furniture finishing, and these types of finishes are now categorized as being either evaporative finishes (also called solvent-release finishes) or reactive finishes. The first category of finishes dries by evaporation of the solvent and includes shellac and sandarac spirit varnishes; the second type cures, with or without solvent loss, by polymerization. Oil varnishes are a common example of a reactive finish. Natural resin coatings may include pigments or dyes to modify the colour of the surface – they differ from paints only in being transparent.

Characterizing old, natural resin coatings is very difficult because over the centuries many different recipes that include resins, waxes, dyes and oils have been used (many through boiling at very high temperature) in innumerable combinations to produce coloured and colourless transparent finishes, according to fashion. A common gloss finish frequently found on mahogany furniture from the 19th century is French polish, which consists of multiple layers of shellac applied by rubbing it on the wood surface with a wadded cloth. Another common 19th-century natural resin finish was copal oil varnish. In Asia, reactive finishes highly regarded for their rich lustre and durability were those based on the resins of “lacquer” trees from the Anacardiaceae family. One of the most well-known Asian lacquers is Japanese “urushi” lacquer.

Natural resin finishes form a complete film on wooden objects and are thus susceptible to cracking and loosening as the wood expands and contracts in response to changes in relative humidity. Exposure to light leads to slow and insidious degradation that eventually causes the finish to discolour, crack and become loose. As with painted surfaces, it is therefore important to minimize exposure to light. Water usually produces rapid and obvious damage. If furniture collections are in use for interpretation or in a living museum, it is important to avoid contact with water, for example, by spilling drinks or placing potted plants or flower vases on horizontal surfaces. Likewise, wet mopping floors or dampness rising through floors can create problems for the feet and legs of furniture finished in this manner.

Intact natural resin coatings can be quite durable and can often be successfully cleaned with both dry and wet cleaning methods. Dry cleaning should be conducted in the same manner as for painted surfaces. Highly degraded surfaces are likely to be more soluble than intact surfaces, and solubility can also vary widely between

original and repaired surfaces (and past interventions may be well hidden). Cleaning of degraded, natural resin coatings and Asian lacquered surfaces should always be referred to an experienced conservator.

A sound natural resin finish can sometimes be safely cleaned by damp dusting with a cotton swab or cloth and water; however, many of these finishes, especially in a degraded state, can be water-sensitive, so it is important to conduct a solubility test first. Begin by dampening a cotton swab in warm water. Squeeze excess moisture from the swab until it is almost dry, and then rub it gently on a small, unobtrusive area to test that the coating is not soluble in water. Check the swab for any finish residue (usually yellow to brown in colour), and wait several minutes for the area to dry to ensure that the surface does not blanch (turn white or cloudy). If no finish residue is visible on the swab and no blanching occurs, cleaning with a scant amount of water on a barely dampened cotton cloth or swab can proceed. A few drops of a mild detergent such as Orvus WA Paste may be added to the water to help lift more stubborn soiling; however, another solubility test with the altered cleaning solution should be conducted first. If detergent is used, it will be necessary to clear detergent residue from the surface by wiping or swabbing again with clear water only. It is very important that the surface is dried immediately after damp cleaning using a clean, cotton cloth.

Odourless paint thinner (e.g. Varsol or mineral spirits) may also be an appropriate option for cleaning many natural resin coatings in good condition. First, moisten a cotton swab with the solvent and roll it across the finish in a small, unobtrusive area. If it proves safe (i.e. there is no yellow to brown residue on the swab after several seconds), slightly dampen a cotton swab or soft, lint free cloth with the solvent and proceed as above, replacing swabs or cloths as they become dirty. Paint thinners will give off hazardous fumes, so it is very important to work in a well-ventilated area or outdoors, to refer to the relevant safety data sheet (SDS) and to use appropriate personal protective equipment (PPE). Paint thinner should lift off wax and greasy dirt; if dirt is not removed, discontinue the process.

As with painted surfaces, care must be taken when handling objects with loose or flaking varnish. For treatment of objects in this condition, it is best to consult a conservator. In some cases it may be possible to re-adhere delaminating lacquers and varnishes. Degraded resinous finishes can sometimes be polished or reamalgamated, thus re-establishing an intact surface. However, in recent years this approach has become more controversial as some conservators object to any alteration of the macroscopic surface characteristics of the original coating.

Oils

Drying oils are often applied to wooden objects to saturate the colour of the wood and to add a small measure of protection. The most common of the traditional finishes in the West was linseed oil, but tung oil (once called “China wood” oil) was also used, although more so in Asia. Linseed oil is inexpensive, needs no complicated equipment to apply, offers some protection to the surface and provides a pleasing yellow colour to light woods – although in time it turns darker woods almost black.

Tung oil serves the same purposes but without the dramatic colour changes. A wide range of other drying oils has recently become available.

Reapplying linseed oil to furniture originally finished with it was, and still is, a traditional method of care. Where there is no doubt that furniture was originally finished with linseed oil, continued use might be acceptable. Unfortunately, much old furniture that was not originally finished with linseed oil has been darkened and disfigured by ill-advised application; it is often seen poorly applied and thickly puddled, especially in cracks and low areas and around hardware.

Linseed oil and other similar drying oils change chemically over time by a process called "crosslinking." This lowers their solubility and can make them very difficult to remove. Treatment of surfaces finished with oil should be limited to the cleaning methods outlined above for resinous finishes. If more extensive cleaning is required, consult a conservator.

Waxes

The bare surfaces of some wooden objects are treated with wax after completion, and these are usually maintained during use with further coats of wax. A wide range of waxes (from hard materials such as carnauba to soft ones such as beeswax) can be used. Wax coatings are also commonly applied over existing furniture finishes such as French polish, varnishes and oil finishes.

Excess wax coatings that have built up around hardware, in carvings or in other less accessible areas can be removed with a wooden applicator stick. Old wax can be made more soluble with mineral spirits. If the whole surface of the piece has been heavily waxed, this method can be used to clean the entire object. When removing old wax with mineral spirits, follow the procedures outlined previously: test the procedure on a small unobtrusive area of the object and take adequate precautions with ventilation and handling of the solvent. Cleaning will be more effective if the hardware can be removed.

Re-waxing, if necessary and appropriate for the object, should be done with a soft, lint-free cloth, using a furniture paste wax that is free from colorants and perfumes. Apply the wax thinly and evenly, and rub it in well. Work in small sections. After the wax has dried to a matte appearance, buff it vigorously with a clean cloth, making sure to work well into less accessible areas. Wax polishing should not be done frequently; a thorough waxing will last for many years with only an occasional buff with a pure cotton cloth.

Commercial furniture finish restoration products and polishes

Application of commercial furniture restoration mixtures or polishes to museum wooden objects is not recommended. Contrary to what many of these product manufacturers claim, wood does not need to be "fed" with these mixtures to replenish "natural oils" or moisture. Although there are many furniture restorers'

nostrums available on the market today, they usually contain waxes, oils or silicones, which can create a sticky build-up on surfaces that attracts dust and dirt, leading to deterioration of the finish by in turn attracting atmospheric moisture and contaminants to the surface. These products can also create compatibility issues with additional coatings that may be applied to the surface during future conservation treatments.

Summary

A variety of materials have been used to protect the surface of wooden objects and to enhance and modify their appearance. Surfaces of furniture often show a great deal of previous intervention from the cleaning, polishing and refinishing they have received over the years. Preventive measures such as careful handling to avoid abrasions and limiting exposure to light and moisture should be taken to ensure the long-term preservation of historic furniture finishes. Before cleaning a coated wooden surface, it is necessary to determine what type of coating it is, whether or not it is stable, if it has been modified or refinished and what the effect of the cleaning technique will be. Effective cleaning and presentation of an acceptable appearance for a furniture finish in good condition can often be as simple as damp dusting followed by buffing, complemented with careful, infrequent waxing.

■ Reading Comprehension Exercises

Part 1: Based on the text, complete the table below by matching the finish type to its key characteristics and recommended care/prevention strategy.

Finish Type	Key Characteristics	Recommended Care/Prevention
1. dry pigment	a) transparent; traditionally defined as lacquers or varnishes; cures by polymerization or solvent evaporation.	i. clean with soft cotton cloth/brush and vacuum; minimize light exposure; aqueous/solvent cleaning by a professional.
2. paint	b) no binder; fragile, powdery surface; adheres due to wood porosity.	ii. avoid contact with water; minimize light exposure; cleaning by damp dusting (test first) or mineral spirits (test first).
3. natural resin coatings	c) contains pigment and a binder (oil or resin) to hold pigment; forms a complete film prone to cracking with wood movement.	iii. do not handle directly (use support); cover to protect from dust; cleaning only by experienced conservator.
4. oil (drying oils)	d) saturates wood color; changes chemically over time ("crosslinking"); difficult to remove.	iv. reapplying may be acceptable if original finish; cleaning limited to methods for resinous finishes.

Finish Type	Characteristic Match	Care/Prevention Match
1. dry pigment		
2. paint		
3. natural resin coatings		
4. oil (drying oils)		

Part 2: Answer the following questions based *only* on the provided text.

1. What are the primary causes of deterioration for the binders in paint finishes?
2. Why is “French polish” a common glossy finish, and what century is it frequently associated with?
3. Why does the text recommend against using commercial furniture restoration products or polishes on museum wooden objects?
4. Under what specific condition is using water and a mild detergent for cleaning a natural resin coating recommended?

■ Vocabulary Exercises

Part 3: Match the following technical terms from the text with their closest meaning.

Term	Definition
1. emulsions	a) the process of sticking together to form one mass.
2. intractable	b) a coating that is translucent.
3. coalescence	c) difficult or hard to control, manage, or manipulate.
4. subtleties	d) a system in which small droplets of one liquid are dispersed throughout another liquid.
5. transparent	e) fine distinctions or details.

Part 4: Fill in the blanks

Choose the most appropriate word to fill in the blank in the following sentences: *powdery, flaking, crosslinking, insidious, coalescence*.

1. A finish may dry by solvent evaporation, by polymerization, by _____ or by a combination of these processes.
2. The surface of dry pigment finishes is often fragile and _____ and can be easily smeared or removed by handling.
3. Adhesion between the paint and the surface may fail with time, causing _____ and loss.

4. Exposure to light leads to slow and _____ degradation that eventually causes the finish to discolour, crack and become loose.
5. Oils, such as linseed oil, change chemically over time by a process called "_____".

■ Grammar Exercises

Part 5: Identify and correct the grammatical error (Subject-Verb Agreement or Tense) in each sentence, based on the context provided in the text.

1. Prior to application, furniture finishes may is fluids, solids or semi-solids.
 - Correction:
2. The surface of dry pigment finishes are often fragile and powdery.
 - Correction:
3. Paint finishes that have deteriorated must be handles carefully to prevent loose pieces from being lost.
 - Correction:
4. Water usually produces rapid and obvious damage, and if collections are in use, it was important to avoid contact with it.
 - Correction:

Part 6: Conjunctions and Connectors

Choose the most appropriate conjunction or connector (e.g., *although*, *therefore*, *because*, *however*, *likewise*) to logically connect the ideas in the following pairs of sentences, based on the relationships described in the text.

1. Dry pigment coatings have no binder; _____ , the pigment is applied either dry or in a slurry with water.
2. Paint forms a complete film on wooden objects; _____ , it is prone to cracking and loosening as the wood expands and contracts.
3. Odourless paint thinner may be appropriate for cleaning many natural resin coatings in good condition; _____ , it will give off hazardous fumes.
4. A wide range of waxes can be used; _____ , wax coatings are also commonly applied over existing furniture finishes.

Part 7: Translation Exercise: Croatian to English

Translate the following sentences from Croatian into English. The sentences are based on the information provided in the original text about furniture finishes.

1. Završni sloj je diskretna prevlaka koja štiti drvo od prljanja i pruža određenu otpornost na vlagu.
2. Originalne završne obrade namještaja imaju povijesnu, estetsku i financijsku vrijednost i stoga ih treba održavati.
3. Suhi pigmenti se lako lijepe na drvo jer je ono porozno.
4. Kao i kod obojenih površina, važno je minimizirati izlaganje svjetlosti.
5. Adhezija između boje i površine može s vremenom popustiti, uzrokujući ljuštenje i gubitak.
6. Lakovi i uljane obrade su reaktivne završne obrade koje se stvrđavaju polimerizacijom.
7. Francuska politura sastoji se od višestrukih slojeva šelaka nanesenih trljanjem po površini drva.
8. Vodena para može stvarati probleme za namještaj koji je završen prirodnom smolom.
9. Laneno se ulje s vremenom kemijski mijenja procesom koji se naziva "unakrsno povezivanje".
10. Nanošenje komercijalnih smjesa za restauraciju namještaja se ne preporučuje.

Part 8: Creative Task

Imagine you are a professional furniture conservator. An old wooden chest has arrived at your workshop. You need to decide on the best treatment plan based on the following findings:

The Object: A mahogany chest, mid-19th century. **The Finish:** A transparent coating that is cracked and has yellowed significantly. A solubility test (as described in the text) shows that the coating has a faint yellow-brown residue on the swab when gently rolled with mineral spirits, but no blanching occurs with water. A thick, sticky, oily layer is built up around the decorative brass hardware. **The Damage:** Flaking of the transparent finish is observed near the edges, where the wood is expanding and contracting due to past environmental swings.

Your Task: Write a short (100–150 word) report outlining your recommended actions.



Unit 3

STORAGE OF METALS – CANADIAN CONSERVATION INSTITUTE (CCI) NOTES 9/2³

Pre-Reading Questions

1. What environmental conditions cause iron to rust more quickly?
2. Why might storing different metal objects together in the same drawer be problematic?
3. What types of storage materials would you instinctively avoid using for metal objects, and why?

Introduction

Most metals corrode: iron rusts, copper turns green, silver turns black, and lead disintegrates into a white powder. Stored improperly, most of the metals in a museum collection will slowly transform into oxides, sulphides, carbonates, or other compounds. The corrosion processes are faster on metal surfaces contaminated by salts, volatile organic acids (such as those from wooden storage cabinets), ammonia from cleaning fluids, or dust. The rate of corrosion can also be increased through galvanic corrosion, a process that occurs when objects made of different metals are in contact with each other in high relative humidity (RH) conditions. (For more detailed information, Selwyn 2004.)

For best protection of metal artifacts, museum storage areas must be clean and well-organized, have controlled RH, and have as clean air as possible.

This Note describes general guidelines for the proper storage of metals. It explains the role of RH, recommends general storage conditions and handling procedures, and discusses a few specific metals: aluminum, copper, iron, lead, plated objects, and silver. (For more detailed information, Drayman-Weisser 1992.)

Relative Humidity

Relative humidity is a key factor in metal corrosion because most metals corrode more quickly in moist conditions. (For more information on RH, Thomson 1994 and Tétreault 2003.) For ideal storage of metals, the RH should be as low as possible. However, this is rarely practical, especially for mixed collections.

³ Canadian Conservation Institute (CCI) (2002) Storage of Metals 9/2, <https://www.canada.ca/en/conservation-institute/services/conservation-preservation-publications/canadian-conservation-institute-notes/storage-metals.html>. Pristupljeno 22. rujna 2025.

It is reasonable to store stable metal artifacts – that is, metals that do not exhibit signs of active corrosion – with the rest of the collection in controlled storage conditions. The RH should be between 35% and 55%, the range generally recommended for storing and displaying mixed collections. If the RH exceeds 55%, consideration should be given to moving metal artifacts to proper humidity-controlled storage facilities.

Storage of Actively Corroding (Unstable) Metal

When examining a collection, look for metals that exhibit signs of active corrosion (consult CCI Notes 9/1 [Recognizing Active Corrosion](#)). Because actively corroding pieces create dust, chloride, or staining problems by scattering corrosion products, they should be removed from the main collection and stored in a separate area with an RH below 35%. The drier conditions will reduce the corrosion rate, but the source of the corrosion will still need to be addressed. Seek advice from a qualified conservator on the care and treatment of such objects.

Small, important pieces can be stored in desiccators containing silica gel that has been dried completely or conditioned to a low RH. (For more information on how to use silica gel, Lafontaine 1984 and Tétreault 2003.)

Large numbers of unstable metal objects can be stored together in a small room or in a cabinet where RH can be kept low with a dehumidifier. Small silica gel dehumidifiers are suitable for this purpose. Domestic dehumidifiers are not as effective as silica gel dehumidifiers because they cannot reduce the RH below 40%, but they are better than no dehumidifier at all. Lithium chloride dehumidifiers are not recommended because of the risk of contaminating artifacts with lithium chloride, which could make the corrosion worse. (For information on a low-cost unit for controlling RH, Michalski 1982.)

Humidity control systems require regular maintenance. Empty the water pans of dehumidifiers often, and check and recondition silica gel regularly.

Organizing Storage

Although not necessary, it can be useful to store artifacts composed of similar metals together. This makes examination and retrieval easy and systematic. If objects such as silver trophies, medals, coins, tools, etc. are stored in groups, shelving systems and storage containers can be standardized to some extent. However, the final decision on organizing storage depends on the collection and should be made by curatorial staff.

Whether storing metal artifacts in a separate room or with the main collection, select an area situated away from windows, doors, vents, and heating units. If windows cannot be avoided, ensure that they are tightly sealed to prevent leaks and condensation.

The storage area should have sufficient air circulation to maintain an even temperature and humidity and to prevent build-up of corrosive gases, such as volatile acidic or alkaline vapours. It is almost impossible to eliminate volatile substances from a museum collection. However, local high concentrations that will damage metal can be prevented if the room is adequately ventilated. Fans in the storage area will help to maintain airflow.

Storage of Stable Metals

Dust that settles on metal retains moisture. In urban areas, dust may contain pollutants, such as sulphur compounds, that tarnish silver. Any chlorides absorbed in the dust on metal objects will accelerate the corrosion of the metal. Storage areas should, therefore, be kept clean and dust-free. Seal concrete walls and floors to reduce dust levels.

Using chemically stable materials (e.g. shelving, cupboards, padding, wrapping) in storage areas will help to prevent problems because these materials last longer than unstable materials and will not damage the collection. Although expensive, metal storage cabinets and shelves with powder coatings are ideal. Other safe materials include polyethylene or clear food-grade polystyrene boxes, and acid-free unbuffered papers. Avoid wood and wood-pulp products because they release sulphur compounds and organic acid vapours (acetic and formic acid). Also avoid oil-based and alkyd paints because they release volatile materials for long periods. Rooms that have been freshly painted with oil or alkyd paints should be aired for at least four months before metals are stored in them. (For more information on coatings and on storage and display materials, Miles 1986; Padfield 1982; Tétreault 1994, 1999.) If there is doubt regarding the suitability of a material, contact Client Services at CCI for advice.

Ideally, metal objects should be stored in closed systems, such as cabinets with well-sealed doors or drawers. Closed systems will protect metals from dust, pollutants, and, to a degree, changes in RH. Dry silica gel can be placed in the drawers to maintain a low RH; the silica gel should be checked and reconditioned regularly. One hazard associated with closed storage is the tendency for volatile materials to build up slowly over time. To prevent this problem, choose storage systems made of inert materials, such as metal.

If open shelving is to be used for storing metals, the objects must be protected from dust and pollutants. Wrap artifacts in acid-free unbuffered paper or place them in acid-free boxes or in polyethylene bags. (For more information on constructing boxes, see CCI Notes 11/1 [Protective Enclosures for Books and Paper Artifacts](#).) As a further precaution, polyethylene or washed cotton dust covers can be draped over shelving units.

Never place metal objects directly on a storage shelf or drawer. Line shelves and drawers with closed-cell polyethylene foam such as Ethafoam, PolyPlank, Volara, Plastazote, or Nalgene. The foam lining also helps to protect the objects from shock or abrasion. Avoid urethane foams because they degrade easily.

Arrange each metal artifact on a shelf or in a drawer so that its weight is evenly supported and so that it can be retrieved without damaging neighbouring artifacts. For metals housed in drawers, place wads of acid-free unbuffered paper or strips of polyethylene foam between the individual objects to keep artifacts from moving when drawers are opened or closed. Alternatively, individual supports for metal artifacts can be carved from thick polyethylene foam (CCI Schlichting 1994). Metal objects can also be stored in clear plastic food-grade polystyrene boxes, polyolefin freezer containers (e.g. Tupperware), or polyethylene bags. Boxes and bags may need to be perforated to prevent the build-up of condensation on the inside in the event that the storage area is not well controlled for fluctuations in RH. Polyethylene bags can be punctured several times with a small sharp awl or punch although this will leave rough plastic projections on the inside of the bag that could catch on the artifact. Alternatively, the bag can be slit along the side with very small diagonal cuts. All holes must be small enough to prevent the artifact from falling out of the bag. Soft polyolefin boxes can be drilled through the sides (beneath the handles). Avoid Saran Wrap because it contains poly(vinylidene chloride). This slowly degrades to form hydrogen chloride (HCl) gas, which can damage metals. (For an excellent source of ideas and practical solutions to storage problems, Rose and de Torres 1992.)

Handling

When removing metals from storage, ensure that they are supported well. Transport fragile pieces in padded trays, boxes, or the artifact's own storage support.

Wear well-fitting plastic or clean cotton gloves when handling metals. (Cotton gloves absorb sweat and accumulate salts during use, so be sure to clean them regularly.) Highly polished metals, such as silver and copper, are particularly sensitive to the oils and salts in skin. Avoid handling silver with latex rubber gloves because the sulphur compounds from the rubber may tarnish the silver over the long term. Also, many pure metals and some alloys are soft and are therefore easily scratched or dented.

Storage and Care of Specific Metals

Aluminum

Aluminum resists corrosion because of the protective oxide layer that forms rapidly when aluminum is exposed to air. Normally, if the oxide layer is damaged by an abrasive action like scratching, it re-forms rapidly. Chloride ions prevent the oxide from re-forming and so cause pitting of the aluminum surface. Following the guidelines in this Note will help to prevent the accumulation of surface contaminants that lead to this problem.

Copper

Copper alloys are susceptible to corrosion by ammonia, acids, strong alkalis, chlorides, and sulphide gases. It is best to store small copper artifacts in clear plastic boxes padded with acid-free unbuffered paper, or in boxes made from acid-free

or neutral board. Larger artifacts can be wrapped in acid-free unbuffered paper, stored in carved Ethafoam supports, or placed on foam shelf-liners.

Bronze disease is a form of active corrosion that affects archaeological copper alloys. It is characterized by the eruption of a light-green powder in spots over the surface. Objects displaying bronze disease should be stored separately to keep the corrosion products away from other artifacts. The RH of the storage environment for these objects should be below 35%.

Iron

All iron rusts when the RH is over about 65%. Uncontaminated iron is stable at 50% RH, but iron contaminated with salts continues to corrode. Actively corroding iron should be separated from the rest of the collection, and stored in conditions where the RH is below 35%. (For more information on caring for iron objects, consult CCI Notes 9/6 [Care and Cleaning of Iron.](#))

Many of the general storage methods discussed here are not practical for large iron artifacts. Their storage is often dictated more by the availability of space than by environmental considerations. However, maintaining a clean storage environment and providing adequate storage supports for these artifacts contribute to their long-term preservation. (Details on the storage of large iron artifacts are given in CCI Notes 15/2 [Care of Machinery Artifacts Displayed or Stored Outside.](#))

Lead

Stable lead surfaces are generally dark grey, while actively corroding lead is usually covered with a loosely adherent white powder. Lead is particularly difficult to store safely because it is easily corroded by very small amounts of volatile organic acids, such as acetic or formic acid. These acids can act rapidly, destroying surface detail and weakening the object. Formaldehyde, a source of formic acid, is released from the adhesives used in certain plywoods and particle boards. (For more information, see Tétréault 2003.)

Inspect lead objects regularly for active corrosion because lead is particularly susceptible to damage in poorly ventilated areas. If an object is actively corroding, isolate it and store it at a low RH. At the same time, identify and, if possible, remove the corrosion source (often wood, paint, or adhesives) or provide better storage conditions.

To protect lead artifacts from harmful acids, wrap the objects with neutral and acid-free materials and store them in suitable containers. Envelopes made for the archival storage of coins are suitable for small lead objects or fragments. Polyethylene and food-grade polystyrene boxes are also safe for lead.

Plated Objects

Collections often contain numerous plated objects such as steel cans plated with tin, copper-based objects plated with silver, chrome-plated automobile parts, or iron buckets galvanized with zinc.

These objects may be prone to galvanic corrosion because the two metals are in contact with each other. Such corrosion can be stimulated if there are salts, foods, or other organic residues in the cans or buckets, or if there is polish residue on a silver-plated object. If there is a concern about the stability of plated objects, keep them in as low RH as possible.

Silver

Tarnishing of silver is caused by sulphur-containing gases, such as hydrogen sulphide. In museums, these tarnishing gases may come from air pollutants, certain foods, sulphur- contaminated water, or materials commonly found in storage areas such as natural or synthetic rubber (in stoppers, O-rings, and latex gloves), certain paints, and some textiles (e.g. wool or felt). Because the source of tarnishing may be difficult to isolate or control, the use of closed and, if possible, sealed storage containers is recommended. (For more information on the storage of silver, consult CCI Notes 9/7 [Silver – Care and Tarnish Removal](#).)

Conclusion

Proper storage conditions and good housekeeping are essential for the long-term preservation of metal artifacts. Environmental controls are important. No corrosion should occur on most stable metal objects in a mixed collection if the RH is maintained at or below 55% (although certain pollutants in the air will still cause silver to tarnish or lead to corrode). Serious damage can be minimized by inspecting the collection regularly and by removing any objects suspected of actively corroding. Isolate these objects and keep them at an RH below 35% until a conservator can be consulted.

Because many natural and synthetic products emit gases that can cause metal to corrode, use safe storage materials and proper air ventilation to minimize the build-up of these corrosive gases. Many metal objects are constructed of soft metals that are easily scratched or of brittle ones that are easily broken. Careful handling of and proper support for metals objects will also ensure their protection.

■ Reading Comprehension

Part 1: Multiple Choice: *Circle the best answer for each question.*

1. What is the primary reason for storing actively corroding metals separately from the main collection?
 - a) They are more valuable.
 - b) They can scatter harmful corrosion products onto other objects.
 - c) They require special lighting.
 - d) They are always made of iron.

2. According to the text, what is the generally recommended Relative Humidity (RH) range for storing stable metal artifacts within a mixed collection?
 - a) below 35%
 - b) between 35% and 55%
 - c) between 55% and 65%
 - d) above 65%
3. Which of the following materials is considered **unsafe** for storing metal artifacts because it releases harmful vapours?
 - a) polyethylene boxes
 - b) powder-coated metal shelves
 - c) acid-free unbuffered paper
 - d) wood and wood-pulp products
4. Why is it recommended to avoid using Saran Wrap for wrapping metal objects?
 - a) It is too expensive.
 - b) It is not transparent enough.
 - c) It degrades to form hydrogen chloride gas, which can damage metals.
 - d) It does not protect objects from dust.
5. Lead is particularly susceptible to corrosion from which of the following?
 - a) high levels of light
 - b) volatile organic acids (e.g., acetic or formic acid)
 - c) polyethylene bags
 - d) silica gel

Part 2: Short Answer: Answer the following questions in your own words, based on the text.

1. What are two advantages of storing metal artifacts in a “closed system” like a cabinet with sealed doors or drawers?
2. What are two specific actions you should take when handling metal artifacts to prevent damage?
3. What is “bronze disease,” and what special storage step should be taken for an object that has it?.
4. Why might a plated object (like silver-plated copper) be prone to galvanic corrosion?
5. Besides controlling RH, what are two other general strategies for ensuring the long-term preservation of metal artifacts in storage?

■ Vocabulary Exercises

Part 3: Match the vocabulary word on the left with its correct definition on the right by writing the corresponding letter in the middle column.

Term	Definition
1. Corrode	a) A substance that does not undergo a chemical change easily and is therefore safe for storage.
2. galvanic	b) To set apart from others; to keep separate.
3. Inert	c) A chemical reaction that destroys or damages a metal by oxidation.
4. Volatile	d) A substance that evaporates quickly at normal temperatures, often releasing gases.
5. Isolate	e) Relating to or involving electric currents produced by chemical action, especially when two different metals are in contact.

Part 4: Fill-in-the-Blank: Use the words from the box below to complete the sentences. You will not use all the words.

silica gel	pollutants	abrasion	tarnish	conservation
dehumidifier	ventilation	alloys	conservator	unstable

- To protect a highly polished silver spoon from fingerprints and _____, one should always wear gloves when handling it.
- A(n) _____ is a professional who can provide expert advice on the care and treatment of actively corroding objects.
- _____ in the air, such as sulphur compounds, can cause silver to turn black.
- Proper _____ in a storage room helps to prevent the build-up of corrosive gases.
- Objects that show signs of active corrosion are considered _____ and should be stored at a low RH.
- _____ can be placed in a drawer with metal artifacts to help maintain a low relative humidity.

■ Grammar Exercises

Part 5: Active vs. Passive Voice: The text uses both active and passive voice. Identify whether the following sentences from the text are written in the **Active (A)** or **Passive (P)** voice.

1. ___ “Most metals corrode.”
2. ___ “The corrosion processes are faster on metal surfaces contaminated by salts...”
3. ___ “Seal concrete walls and floors to reduce dust levels.”
4. ___ “Metal objects can also be stored in clear plastic food-grade polystyrene boxes...”
5. ___ “Wear well-fitting plastic or clean cotton gloves when handling metals.”

Part 6: Sentence Completion: Complete the following sentences using the correct form of the verb in parentheses, paying attention to conditional and passive structures.

1. If the relative humidity _____ (exceed) 55%, metal artifacts should be moved to a better location.
2. Dust that _____ (settle) on metal retains moisture and can accelerate corrosion.
3. Actively corroding iron should _____ (store) in conditions where the RH is below 35%.
4. If an object _____ (suspect) of actively corroding, it should be isolated immediately.
5. Serious damage can _____ (minimize) by inspecting the collection regularly.

Part 7: Creative Task

Task: Create a Storage Rule Poster

Design a simple poster for museum staff with three rules for storing metal objects.

Your poster must include one rule about **handling**, one rule about **materials** (what to store them on/in), and one rule about **inspecting** the collection.

Base your rules on the text. For example: “Always wear gloves when handling metal to protect it from skin oils.”

A square frame with a blue background and the text "Unit 4" inside, set against a background of peeling wallpaper.

Unit 4

RECOGNIZING ACTIVE CORROSION – CANADIAN CONSERVATION INSTITUTE (CCI) NOTES 9/1⁴

Pre-Reading Questions

1. What visual signs would lead you to suspect that a metal object is actively deteriorating rather than being stable?
2. Which metals in your everyday experience are prone to discolouration or surface change over time?
3. How might humidity levels affect the preservation of metal artifacts in a museum?

Introduction

Metal corrosion can be active or inactive. Some objects may be corroded but stable, and therefore inactive; others may be actively corroding. An important part of preventive maintenance of metals is to recognize the early stages of destructive, active corrosion. Very few shiny metal artifacts will remain in that condition. Only metals such as gold and platinum will retain a fully metallic or polished surface for a long time.

Inactive corrosion occurs as a stable oxide layer – a tarnish or colour change that slowly forms on metal artifacts and protects the underlying surface. The oxide layer is often considered to be a desirable patina, particularly if it has a pleasing appearance. Artificial patinas are often applied to the surface of a metal object to protect it and change its appearance. Artificially patinated surfaces on artifacts are found mostly on sculptures, medals, weapons, and tools.

By contrast, **active corrosion** causes a continuing loss of material from the object. Action must be taken to slow down or prevent further deterioration.

Examining a collection to identify corroding metal artifacts can reveal problems with environmental conditions. High relative humidity (RH) or pollutants can initiate many of the corrosion reactions.

Environmental factors that could contribute to active corrosion are discussed under each metal.

Only the metals most commonly found in museum collections are considered in this Note: iron, copper, copper alloys (such as brass and bronze), lead, silver, pewter, and plated metals.

⁴ Canadian Conservation Institute (CCI) (2002) Recognizing Active Corrosion 9/1, <https://www.canada.ca/en/conservation-institute/services/conservation-preservation-publications/canadian-conservation-institute-notes/recognizing-active-corrosion.html>. Pristupljeno 25. rujna 2025.

Identification

Active corrosion can be identified by a rapid expansion in volume as the metal alters to form a corrosion product. Flaking or powdering of the surface may occur. **Any metal artifact surrounded by flakes or by loose powder can be considered actively corroding.** Common signs of active corrosion in specific metals are noted below.

Iron

Stable surfaces on iron are compact, adherent, and vary in colour between blue-black and red-brown.

One form of **active corrosion** is commonly found between the metal core of the artifact and its outer corrosion layer. Clear indications of active iron corrosion include fragments surrounding an object, depressions on the metal surface, and orange spots in the centres of these depressions.

Another form of particularly active corrosion of iron is recognized by “sweating” or “weeping”– yellow, brown, or orange droplets on the metal surface. Sweating or weeping occurs where the RH of the environment in which the iron is housed is high (i.e. 55% and above). At lower levels, around 50% RH, the weeping areas will desiccate to produce orange or brown blisters. (For more information on the care and storage of iron, and on composite objects with iron parts, consult CCI Notes 9/6 [Care and Cleaning of Iron](#). For more information on active iron corrosion, Turgoose 1982.)

Copper and Copper Alloys: Brass and Bronze

Stable surfaces on copper and copper alloy artifacts are characterized by a wide variety of natural and artificial patinas. Stable patinas on these metals are generally coherent, adherent, and smooth. Stable patinas vary in colour from red, brown, black, and blue to shades of green. Stable corrosion layers, which develop on archaeological copper artifacts, may appear rough and uneven.

Active corrosion of copper and copper alloys is characterized by the rapid development of a light green powder erupting in spots over the surface. This powder may surround an undisturbed object. This type of corrosion is most common on archaeological copper alloys and is known as “bronze disease.” As with sweating and weeping, bronze disease occurs where the RH is high (i.e. 55% and above). The corrosion reaction is progressive and may rapidly cause extensive damage. (For more information on bronze disease, Scott 1990.)

Active corrosion on copper and copper alloys may also appear as a loosely adherent, powdery layer over the surface, rather than as spots. These corrosion layers may be induced by atmospheric pollutants, most commonly airborne chloride particles (particularly in coastal areas) and acetic acid. Both pollutants produce a green surface layer. Ammonia, as a gaseous pollutant often found in window cleaning compounds, produces a bluer corrosion layer.

Lead and Pewter

Stable patina on lead is a darker grey than the stable patina of pewter. The colour may vary depending on the composition of the alloy, the object's past history, and its present storage conditions.

Active corrosion on lead and pewter is characterized by the formation of loosely adherent white powder. The powder may form evenly over the surface, but is often concentrated in pinpoint spots. Powder surrounding an undisturbed object is a clear indication of active corrosion. This white powder is basic lead carbonate (better known as lead white), and is most commonly induced by the vapours of weak organic acids. The most common sources of these acid vapours are wooden storage or display units (especially those made of oak), deteriorated cardboard and poor quality paper, and acetic acid from vinegar used in cleaning.

Silver

Silver in museum collections is generally expected to have a white metallic appearance. The black surface tarnish characteristic of silver corrosion is not usually considered to be a patina.

Tarnish forms as a dense, compact, and adherent layer when silver reacts with sulphide gases. These atmospheric pollutants are found in industrial areas, particularly those close to pulp mills, and are easily detected by their characteristic "rotten egg" smell. The corrosion reaction requires both sulphide gases and atmospheric humidity to begin. Most damage to silver from tarnishing is the result of the abrasion and polishing required to remove tarnish and repolish the silver.

Frequent polishing of plated objects can rapidly remove the silver plating (consult CCI Notes 9/7, [Silver – Care and Tarnish Removal](#)).

Plated Metals

Common combinations of plated metals are:

- copper and silver
- copper and gold
- copper and nickel
- copper and tin
- iron and tin
- iron and zinc ("galvanized" iron)
- iron and chromium (usually with copper and/or nickel in between)
- iron and nickel (usually with a copper "flash" in between, hence the green corrosion in the pit)
- cupronickel and silver

Metal platings present special problems and are particularly prone to corrosion. Two dissimilar metals in contact require only an electrolyte (i.e. a salt and atmospheric moisture) to start a corrosive reaction. When examining plated metal objects, it is often difficult to identify either the metal plating or the underlying metal.

Stable surfaces, particularly gold, silver, nickel, and chromium, often retain their original bright metallic appearance when kept under appropriate environmental conditions, although the shine may be obscured by dust or dirt (consult CCI Notes 9/3 [The Cleaning, Polishing, and Protective Waxing of Brass and Copper](#)).

Active corrosion on plated metals manifests itself in various ways. It is most often found in areas where the object has been damaged or has defective plating. The plating usually lifts as the corrosion products of the underlying metal expand. This lifting can be seen, for instance, on the blistered chrome parts of automobiles. Corrosion products from the underlying metal may also occur on top of the plating – often in the form of a compact corrosion layer.

Pitting also occurs on plated objects when the plating is perforated and corrosion products grow in the underlying metal.

All active corrosion on plated metals is accompanied by an expansion in volume, which leads to loose powder around the object, or to blisters of more coherent corrosion products on the surface.

Routine Inspection

Regularly inspecting objects is a vital part of their care. Because many corrosion reactions occur quickly, metal artifacts should be inspected monthly. Deterioration can then be noted at an early stage and preventive measures taken before damage becomes severe.

■ Reading Comprehension Exercises

Part 1: True, False, or Not Stated

Read the following statements and mark them as **T (True)**, **F (False)**, or **NS (Not Stated)** based on the text.

1. All metals, including gold, will eventually develop a patina.
2. An inactive corrosion layer can sometimes be intentionally applied to a metal object.
3. The presence of any powder or flakes around a metal object is a definitive sign of stability.
4. “Weeping” in iron is directly linked to high relative humidity and chloride contamination.
5. The text recommends using vinegar to clean lead and pewter objects.

6. For silver, the act of removing tarnish is often more damaging than the tarnish itself.
7. Plated metals are less prone to corrosion than pure, single-metal objects.
8. Monthly inspections are suggested because corrosion reactions can progress rapidly.

Part 2: Short Answer and Inference Questions

Answer the following questions based on the information in the text.

1. What is the primary functional difference between an inactive patina and active corrosion?
2. Besides relative humidity, what other general category of environmental factor can initiate active corrosion? Name one specific example for copper alloys.
3. Look at Figure 1 and its description. Based on the text, what is the white powder on the actively corroding lead tokens most likely composed of, and what common pollutant causes it?
4. Why might a chrome-plated car part from a coastal area be more susceptible to corrosion than one from a dry, inland area?
5. Based on the entire document, what is the main purpose of this CCI Note?

■ Vocabulary Exercises

Part 3: Matching Definitions

Match the vocabulary word from the text on the left with its correct definition on the right.

Vocabulary Word	Definition
1. patina	a) Sticking firmly to a surface.
2. pollutant	b) A substance that conducts electricity when dissolved in water, facilitating corrosion.
3. electrolyte	c) A surface layer, often greenish, that forms on metals through long-term exposure.
4. adherent	d) To dry out completely.
5. desiccate	e) A harmful substance introduced into the environment.
6. alloy	f) The central or most important part of an object.
7. core	g) A metal made by combining two or more metallic elements.
8. inert	h) having small holes or pits in a surface.
9. perforated	i) Lacking chemical reactivity; stable.
10. blister	j) A bubble-like swelling on the surface.

Part 4: Fill-in-the-Blanks

Complete the paragraphs using the words from the box below.

Word Bank:

adherent	alloy	blisters	desiccate	electrolyte
patina (2x)	perforated	weeping	plated	

Paragraph A:

The old bronze statue had developed a beautiful green _____ over the centuries, which was compact and _____, protecting the metal beneath. This stable layer meant the corrosion was inactive. In contrast, the archaeological iron nail next to it showed signs of active _____, with orange droplets on its surface, indicating it was contaminated with chlorides and needed to be kept in a dry environment to _____.

Paragraph B:

Pewter is an _____ primarily made of tin and lead. When exposed to acidic vapors from wood like oak, it can develop a white, powdery corrosion instead of a stable _____. On _____ metals, corrosion often starts where the thin plating is scratched or _____. The underlying iron then rusts, and the expanding corrosion products push the plating up, forming _____. This corrosive process requires moisture and an _____ to act as a bridge between the two dissimilar metals.

■ Grammar Exercises

Part 5: Active vs. Passive Voice

The text uses both active and passive voice to present information. Identify the following sentences from the text (or inspired by it) as either **Active (A)** or **Passive (P)**. Then, rewrite the passive sentences in the active voice and where possible active sentences in the passive voice.

Sentences:

1. Very few shiny metal artifacts will remain in that condition.
2. Artificial patinas are often applied to the surface of a metal object.
3. The white powder is most commonly induced by the vapours of weak organic acids.
4. Regularly inspecting objects is a vital part of their care.
5. The corrosion reaction may rapidly cause extensive damage.
6. Frequent polishing of plated objects can rapidly remove the silver plating.

Rewrites:

1. _____
2. _____
3. _____
4. _____
5. _____
6. _____

Part 6: Sentence Combining and Complex Structures

Combine the following short, simple sentences into one longer, more complex sentence. Use the grammatical structure suggested in parentheses.

1. The oxide layer is stable. It protects the underlying surface. It is often considered a patina. (Use a relative clause starting with “**which**”)
2. Active corrosion causes a loss of material. Action must be taken. Further deterioration must be prevented. (Use a compound sentence with “**and**” and an infinitive phrase)
3. The plating is damaged. The underlying metal corrodes. The corrosion products expand. The plating lifts. (Use a conditional structure starting with “**if**” and connect the consequences)
4. The iron was stored at a high RH. The iron began to weep. The conservator moved it to a drier environment. The weeping stopped. (Use a narrative sequence with “**After**” and “**so**”)

Part 7: Creative Task

Creative Task: Conservation Detective

You are a museum conservation detective! Your task is to examine a “newly discovered” artifact (you can choose one: an old iron key, a bronze statue, or a silver locket).

Write a short detective’s report (5-10 sentences) describing the object. Based on the clues from CCI Notes 9/1, determine if your artifact is stable or actively corroding. Describe the visual evidence you see (e.g., “a light green powder,” “white flakes,” “orange blisters”) and state your conclusion about its condition and what might be causing the problem.



Unit 5

Storing Works on Paper – Canadian Conservation Institute (CCI) Notes 11/2⁵

Pre-Reading Questions

1. What physical threats (e.g., folding, tearing) might damage a fragile paper document during storage?
2. Why would acidic or low-quality paper products be unsuitable for storing valuable works on paper?
3. What environmental factors in a room might accelerate the ageing of paper?

Introduction

Paper is vulnerable to physical and chemical deterioration. Works on paper require simple, careful storage under controlled conditions. The following are the most common causes of damage to works on paper:

- creases, tears, folds, abrasions, and stains caused by careless handling or crowded storage
- acidity resulting from poor-quality materials and methods used in the manufacture of some paper artifacts
- migration of impurities from poor-quality materials, such as adhesives, tapes, and cardboards, in contact with paper artifacts
- uncontrolled environment

Appropriate storage procedures, careful handling, and good housekeeping practices will help to minimize these problems.

Preparing Works on Paper for Storage

Examine and document works on paper to assess their condition and to determine the appropriate storage methods.

Remove loose dust and dirt by carefully dusting with a soft brush.

Remove any foreign materials that do not form part of the artifact. Plastic envelopes or sheeting, newspapers, acidic wrapping papers, cardboard mats or backings, dried adhesive tapes, metal fasteners such as paper clips, and other foreign substances contribute to the degradation and disfigurement of paper.

Examine artifacts for signs of biological infestation by mould or insects before housing them with the rest of the collection.

If works are to be stored together in a folder, drawer, or box, those on poor-quality paper should be separated from those on good-quality paper to avoid the transfer of acids and other contaminants.

⁵ Canadian Conservation Institute (CCI) (2002) Storing Works on Paper 11/2, <https://www.canada.ca/en/conservation-institute/services/conservation-preservation-publications/canadian-conservation-institute-notes/storing-works-paper.html>. Pristupljeno 1. listopada 2025.

Paper artifacts should be properly enclosed for protection in storage. Oversized works, works in a fragmentary or warped condition, or works with delicate images of pastel, charcoal, chalk, or flaking paint may require special containers or mats that are larger or deeper than usual to protect vulnerable surfaces and to preserve fragments.

If the work is in a frame that does not meet current conservation standards, consider replacing the frame.

There are many circumstances where caution is necessary, and it is advisable to consult with a paper conservator before proceeding.

Materials

Use only acid-free materials to store works on paper. Both neutral-pH and alkaline-buffered products are acceptable for storing most works on paper.

The boards and papers recommended for conservation purposes are those described by manufacturers as '100% rag', and are available either buffered (pH 7.5 to pH 8.5) or unbuffered (pH 7). Less expensive boards made from highly purified woodpulp buffered to pH 8.5 are an acceptable second choice. White or ivory boards are recommended.

Inert polyester film (Melinex 516) is available by the roll in thicknesses ranging from 2 mil to 7 mil. The most useful thickness is 3 mil. Mylar is also available in prepared folders, sheets, sleeves, and envelopes to store works on paper. Other types of plastic film should not be substituted. However, because it can pick up and hold an electrostatic charge, polyester film is not recommended for use with works of art on paper that may offset, such as charcoal, pastel, chalk drawings, and watercolours. Polyester film is generally recommended only for archival material such as maps, documents, posters, letters, etc.

Lightweight corrugated poly-propylene sheeting, such as Cor-X, Coroplast, or Poly Flute, is another inert storage material that may be useful.

Storage Methods

Interleaving

A simple way to protect works on paper is to interleave them with acid-free tissue or, for larger pieces, with heavier acid-free paper. To prevent the interleaving sheets from moving, cut them to fit the inside dimensions of the storage container. Place one sheet between each work.

Folders and Enclosures

Individual folders or enclosures provide even greater protection than that given by interleaving. Because they are heavier and enclose the artifact, folders and enclosures provide better support and safety when a work is moved. They are also useful as a surface

on which to record cataloguing and other information pertaining to the work. Folders and enclosures are available from archival suppliers in a variety of materials, styles, and sizes. Simple folders are easy to make using sturdy, acid-free paper or lightweight matboard (CCI Notes 11/1, [Protective Enclosures for Books and Paper Artifacts](#)).

Mats

The most suitable method of providing support and protection for works on paper is to mat them individually, provided that this is aesthetically appropriate. Mats reduce the risk of damage during handling. A window mat also protects the image surface (CCI Notes 11/5, [Matting Works on Paper](#)). For additional protection, a sheet of acid-free tissue or lightweight paper can be placed between the image and the window mat.

To facilitate flat storage, collections consisting of numerous works can be stored in mats cut to standard sizes. This allows the use of standard-sized frames for exhibition. Matted works can also be placed in boxes or in storage units for further protection.

Boxes

Works on paper that have been interleaved with tissue, or that have been placed in folders, mats, or polyester film, can be stored in acid-free boxes. This will further protect them from light, dust, atmospheric pollutants, and accidental damage. Boxes and other enclosures also act as buffers against fluctuations in humidity.

Acid-free boxes of various sizes, shapes, and constructions are available from archival suppliers. Some are made of lightweight card stock with reinforced corners. Others are made of sturdy corrugated board. Corrugated boxes are shipped and stored flat and can be folded into a box shape when needed. Inert materials, such as polypropylene (Cor-X, Coroplast), are also used to make archival boxes.

The strongest and most durable type of flat box is the Solander box. It is made of heavy board lined with good-quality paper and covered with cloth. It has a hinged back that opens flat, making it easy to lift works into and out of. The contents of each box can be listed on the exterior.

Housing the Collection

Works on paper should be stored in a clean, dust-free environment. Good housekeeping practices will help to eliminate the problems of dust, dirt, insects, and rodents.

The location of storage units is an important consideration. Avoid the following:

- attics and basements
- outside walls that may be subject to fluctuations in temperature and relative humidity
- radiators and heating ducts
- water pipes
- direct sunlight

Sturdy horizontal shelving made of enamelled steel is ideal for storing boxes containing works on paper. Wooden shelving can also be used, but should be painted with two coats of interior acrylic latex paint, or with one primer coat and one top coat, to retard the migration of volatile contaminants. It is recommended that the painted shelves be allowed to air for one month, to allow for any paint vapours to disperse, before being used. Stacking of boxes should be kept to a minimum. Map cabinets and shallow drawers can also be used to store works on paper, especially oversized works or those enclosed in folders.

Storage Environment

To retard the deterioration of paper, it is important to control temperature, relative humidity, and light. Any effort expended in controlling these factors will have a positive effect on the condition of the collection.

Temperature and Relative Humidity

A low temperature in the storage area slows the rate of deterioration of paper and increases the lifespan of paper. However, where human comfort and cost are a consideration, the maximum acceptable temperature is 21°C.

Relative humidity (RH) over 60% accelerates chemical and biological deterioration. It also promotes the distortion of paper. Therefore, the recommended RH level for general paper collections is below 50%.

Research supports the theory that at 20°C and 30% RH, the lifespan of a typical woodpulp paper is twice what it would be at 20°C and 50% RH. Many collections are in a state of chemical self-destruction, but low temperature and low RH can slow this process dramatically. While some variation in temperature and RH is acceptable, strive to maintain constant levels.

NOTE: Although lower RH and temperature may help to increase the lifespan of paper, keep in mind that they may also cause the paper to become more fragile. Therefore, even greater care should be exercised during handling under these conditions.

Light

Exposure to both natural and artificial light can cause photochemical deterioration of paper and of images on paper. This may result in pigments and dyes fading, and in the paper substrate discolouring. Filter out damaging ultraviolet rays present in sunlight and in fluorescent lights (CCI Notes 2/1, [Ultraviolet Filters](#)). Turn off lights in storage areas when the areas are not in use. In areas where paper artifacts are exposed to light, the ultraviolet component should not exceed 75 microwatts/lumen. Block light from windows with blinds or drapes. If windows cannot be blocked, use ultraviolet filtering material.

Whether in storage or on display, it is necessary to reduce the amount of light and restrict the exposure time for paper artifacts. The recommended level of illumination for sensitive materials, such as watercolours, coloured prints, and works on poor-quality paper, is 50 lux or as low as possible. A maximum level of 150 lux is recommended for works without light-sensitive materials, such as stable carbon inks on good-quality paper.

■ Reading Comprehension Exercises

Part 1: True, False, or Not Stated

Read the following statements and decide if they are **True (T)**, **False (F)**, or **Not Stated (NS)** according to the text.

1. Polyester film is unsuitable for storing charcoal drawings because of its electrostatic charge.
2. All works on paper must be professionally matted before being placed in storage boxes.
3. Lowering the relative humidity in a storage area can both extend the lifespan of paper and increase its fragility.
4. The maximum recommended illumination level for a stable document like a text written in carbon ink is 150 lux.
5. Unbuffered acid-free boards have a neutral pH, while buffered boards are slightly alkaline.
6. It is explicitly stated that attics are worse for storage than basements.
7. A key advantage of using individual folders is that they provide a surface for cataloguing information.

Part 2: Short Answer

Answer the following questions based on the text.

1. According to the text, what are the four main categories of threats to works on paper?
2. Why might a conservator recommend a storage mat that is “deeper than usual” for a specific artwork?
3. The text states that boxes “act as buffers against fluctuations in humidity.” What does this mean in practical terms?
4. Based on the recommendations for light levels, which would require a more controlled lighting environment: a collection of 19th-century letters in black ink or a collection of vintage watercolour posters? Explain your reasoning.

■ Vocabulary Exercises

Part 3: Definition Matching

Match the vocabulary word from the text on the left with its correct definition on the right.

Vocabulary Word	Definition
1. Deterioration	a) A substance that minimizes the effect of a sudden change, such as in humidity.
2. Inert	b) The process of becoming worse in quality or strength.
3. Migration	c) Not chemically active; unreactive.
4. Buffer (noun)	d) The recommended maximum level for relative humidity to prevent distortion of paper.
5. Fluctuations	e) The movement of substances, like acids, from one material to another.
6. Vulnerability	f) Irregular rises and falls in level or value.
7. 60% RH	g) The susceptibility to physical or chemical damage.

Part 4: Fill in the Blanks

Complete the sentences using the correct form of the words from the box below.

deteriorate	contaminant	interleave	ultraviolet	acidic
-------------	-------------	------------	-------------	--------

- One simple preservation strategy is to _____ delicate drawings with acid-free tissue paper to prevent surface abrasion.
- Over time, paper that is inherently _____ will become brittle and discolour.
- Exposure to _____ radiation from sunlight is a major cause of fading in pigments and dyes.
- Without a stable environment, the condition of the collection will continue to _____.
- Removing poor-quality backing boards is essential to prevent _____ from damaging the artifact.

Part 5: Synonyms and Antonyms

For the words listed below, provide one Synonym and one Antonym from the context of the text or based on your understanding.

Word	Synonym	Antonym
1. Vulnerable		
2. Deteriorate		
3. Inert		

■ Grammar Exercises

Part 6: Active to Passive Voice Transformation

Rewrite the following sentences from the text in the passive voice. Omit the agent (the “doer” of the action) if it is not important.

1. Careless handling causes creases and tears.
2. You should remove any foreign materials that do not form part of the artifact.
3. A low temperature in the storage area slows the rate of deterioration of paper.
4. Block light from windows with blinds or drapes.

Part 7: Conditional Sentences Completion

Complete the following sentences based on the information in the text, using the correct conditional form (zero, first, second, or third).

1. (Zero Conditional) If the relative humidity _____ (exceed) 60%, it accelerates chemical deterioration.
2. (Second Conditional) If I _____ (have) a valuable pastel drawing, I _____ (not/store) it in a polyester sleeve.
3. (First Conditional) If we _____ (purchase) acid-free boxes, we _____ (be able to) protect the documents from dust and light.
4. (Third Conditional) If the previous curator _____ (remove) the acidic backings, the prints _____ (not/become) so discoloured.

Part 8: Error Correction

Each of the following sentences contains one grammatical error. Identify and correct the error.

1. Works on paper requires simple, careful storage under controlled conditions.
2. The contents of each box can be listed on the exterior, which are very helpful for curators.
3. A low temperature and low relative humidity can slows the process of deterioration dramatically.

Part 9: Creative Task

Scenario: You are the Collections Manager at the “Regional Art & History Archive.” Your annual budget proposal is due, and you must justify a significant investment in upgrading the storage for your works on paper. The current storage is overcrowded and uses mixed-quality materials.

Task: Write a **formal funding proposal introduction** (approximately 250-300 words) directed to the Archive’s Board of Directors.



Unit 6

Display Methods for Books – Canadian Conservation Institute (CCI) Notes 11/8⁶

Pre-Reading Questions

1. What stresses are placed on a book's binding when it is opened flat or displayed upright?
2. Why might an old, fragile book require more support than a new one when placed on display?
3. What are the potential consequences of displaying a book under bright light for extended periods?

Introduction

When displaying books, it is important to ensure adequate support. Almost all books are designed to be read. They are not static objects, and to prevent damage, accommodations must be made for the binding structure. Display aspects that will influence the final choice of how you support the book include the proposed environment, whether the book's position will shift over the course of an exhibition, the book's binding and the desired angle of display. This CCI Note was written to offer an introduction to book display methods and to provide references for further reading.

Support methods

Books require adequate support to prevent damage during handling or display. The methods used can be complex or improvised. A few simple and inexpensive display techniques can provide support for a book and help to prolong its life.

Materials

You can make a book mount using a variety of materials. These include the following:

- acid-free matboard (100% rag or highly purified wood pulp);
- acrylic sheet, such as Plexiglas;
- thermoplastic polymer sheet, such as Vivak;
- lightweight, inert plastic board, such as Coroplast (polypropylene twinwall plastic panel) or Hi-Core (polycarbonate twinwall profile sheet);
- archival corrugated board; and
- binder's board covered in cloth or paper.

⁶ Canadian Conservation Institute (CCI) (2002) Display Methods for Books 11/8, <https://www.canada.ca/en/conservation-institute/services/conservation-preservation-publications/canadian-conservation-institute-notes/display-methods-books.html>. Pristupljeno 15. listopada 2025.

You may also purchase ready-made options from conservation suppliers or improvise using common materials. Examples include

- ready-made soft book pillows or beanbags;
- modular synthetic foam wedges;
- rolled textiles, such as a towel; and
- soft-covered weights.

Wood is not typically recommended as a material for displaying books in exhibitions. If this is unavoidable, you can seal the wood and face it with acid-free matboard to provide a buffer.

Book mounts

Mounts must always account for both the binding structure and the weight of the book. Do not display volumes upright with their covers open without proper support underneath the textblock, because the weight can distort and damage the binding structure. When displaying a book on an angle, ensure proper support along the thickness of the textblock by including a ledge or lip on the mount.

Books opened to the title page, or to the first or last section of text, require support under the front or back cover to prevent the endpaper and binding material from splitting along the joint.

Polyethylene or polypropylene straps may be needed to support page openings. These are preferred over polyester terephthalate straps (Mylar-type), whose firmer edges may cut into the book materials. Be mindful of the physical limitations of the binding when applying strapping. Higher angles of display require significantly more support to prevent damage to the binding. Without support, gravity will pull on the binding and will likely cause significant damage to the sewing as well as the covering materials.

You can join the straps using a small piece of double-sided tape (3M #415), while taking care that the tape does not come into contact with the book. The straps should be wide enough for the size and thickness of the book and should not be fastened too tightly around the pages. You can also use small, lightweight rare-earth magnets covered in a protective material to hold pages open. However, if the magnets are too strong or left uncovered, they can cause damage to the textblock.

A book that is displayed fully open or that does not open easily due to the structural limitations of its binding requires a wide, V-shaped mount made of stronger, rigid materials like Plexiglas (acrylic plastic sheet), Vivak, metal, cloth-covered matboard or corrugated board (Figure 3). The vast majority of books do not open flat and will be damaged if forced into a 180-degree opening.

The angle of a V-shaped mount (or book cradle) should be customized to the desired opening for display.

In the absence of a constructed V-shaped mount, you may use improvised or ready-made options to protect a book's opening on display. Examples of these are listed in the [Materials](#) section. The most important aspect is to control the angle of opening so that the binding is supported.

Display conditions

Ideally, books should be displayed in a specially constructed display case that protects them from dust and from extreme fluctuations in temperature and relative humidity (RH). Do not display volumes near a heat source, such as a hot air vent, or in direct incandescent or natural light.

Do not display books with sensitive images (such as those containing inks, watercolours or coloured pencil) in direct light. The colourants are extremely sensitive to light, and permanent display under high light levels will cause the ink and pigments to fade or darken. To control the amount of light to which books are exposed, keep display lights on only when required and set the lights to the lowest intensity possible.

If a volume is to be displayed for long periods of time, it is beneficial to consider displaying more than one opening in the book to limit exposure and damage. Wood pulp papers may contain lignin that will also darken with light exposure. Depending on the book, you may require multiple book cradles to support multiple page openings.

Books bound in parchment or books with a parchment textblock will require time to return to a closed position if they are kept open for any length of time. They are much more susceptible to a change and fluctuations in RH and are prone to physical distortion. They can be damaged if forced closed after a lengthy exhibition.

Conclusion

Books require support that accommodates their physical characteristics and limitations. A thoughtful approach to supporting a bound volume on display will help to preserve it. For a general overview of mount-making, consult *Mount-making for Museum Objects*. Other sources listed in the [Further reading](#) section describe alternate options for the display of books.

■ Reading Comprehension Exercises

Part 1: True, False, or Not Stated

Read the following statements. Mark **T (True)**, **F (False)**, or **NS (Not Stated)** based on the information in the text.

1. Books are designed as static objects and do not require special support when displayed.
2. The choice of display method is influenced by the book's binding and the desired display angle.
3. Wood is the most highly recommended material for constructing book mounts.
4. Displaying a book upright with its covers open is safe if done for short periods.

5. Books with sensitive images should never be displayed in direct light.
6. All books can be safely opened to a 180-degree angle without damage.
7. Parchment-bound books are less sensitive to humidity changes than other bindings.
8. It can be beneficial to display multiple openings of the same book during a long exhibition.

Part 2: Short Answer Questions

Answer the following questions in your own words.

1. What are the two main functions of a book mount or support?
2. Why should polyester terephthalate (Mylar-type) straps be avoided for holding pages open?
3. Describe one improvised material that can be used for book support.
4. What are two environmental factors that a display case helps to control?

■ Vocabulary Exercises

Part 3: Word Meaning from Context

Find and write down a word or phrase from the text that matches each definition below.

1. A long, narrow, flat piece of material used for fastening or supporting something. (Paragraph under "Book mounts")
2. Likely to be harmed or affected by something. (Paragraph under "Display conditions")
3. A support that holds something at an angle. (Section: "Materials")
4. Made from man-made substances rather than natural ones. (Section: "Materials")
5. To change shape or become distorted. (Paragraph under "Book mounts")
6. A substance added to something to reduce damage from an external source. (Section: "Materials")
7. Not active or reactive; chemically stable. (Section: "Materials")
8. A joining point or seam in a book's binding. (Figure 2 description)
9. To make changes or provisions for something. (Introduction)
10. To last for a long time or indefinitely. ("Support Methods")

Part 4: Technical Terminology

Match the term on the left with its correct description on the right.

1. Textblock	a) A synthetic sheet material like Plexiglas.
2. Acid-free matboard	b) The core block of pages in a book.
3. Parchment	c) A V-shaped support for an open book.
4. Endpaper	d) A board that will not cause chemical degradation to paper.
5. Book cradle	e) Animal skin prepared for writing or binding.
6. Acrylic sheet	f) The paper pasted to the inside of a book's cover.

■ Grammar Exercises

Part 5: Passive Voice

The text frequently uses the passive voice to describe processes and requirements (e.g., “support must be provided”). Rewrite the following active voice sentences in the passive voice, as if they were instructions from the text.

1. You should prevent gravity from pulling on the binding.
2. You must control the angle of opening.
3. You can join the straps using double-sided tape.
4. They should cover magnets in a protective material.

Part 6: Imperatives for Instruction

Find and write down **five** imperative verbs (commands or instructions) used in the text. Example: “ensure”

1. _____
2. _____
3. _____
4. _____
5. _____

Part 7: Creative Task

Museum Curator's Proposal

You are a curator preparing a rare, illustrated 18th-century book for a 6-month exhibition. The book has a fragile leather binding and contains watercolour paintings. Using the principles from the text, write a short proposal (150-200 words) outlining:

- The type of mount/cradle you would use and why.
- The materials you would choose for the mount and any strapping.
- The specific display conditions (light, case, environment) you would require.
- Any special considerations for handling this particular book.



Unit 7

TEXTILES AND THE ENVIRONMENT – CANADIAN CONSERVATION INSTITUTE (CCI) NOTES 13/1⁷

Pre-Reading Questions

1. Why are natural fibres such as wool and cotton more vulnerable to environmental damage than many synthetic materials?
2. What types of insects or pests are known to damage fabric and clothing in storage?
3. How might temperature and humidity fluctuations affect the physical structure of a woven textile?

Introduction

Textiles are among the most sensitive objects in museum collections due to their organic nature. Their long-term preservation is affected by numerous agents of deterioration, including light, incorrect relative humidity (RH), incorrect temperature, pests, physical forces and pollutants. General guidelines on these issues for all collections, including textiles, can be found on the Canadian Conservation Institute (CCI) website under [Caring For: Collections - 10 Agents of Deterioration](#) and the [“Climate guidelines overview”](#) section in *Climates Guidelines*.

This Note presents ideals towards which an institution can strive, with some guidelines for improving the environmental conditions of storage and display areas containing textiles. Even small efforts to control the most damaging agents of deterioration to textiles, notably light, incorrect RH, incorrect temperature, pests, physical forces and pollutants, will have positive long-term effects on a collection.

Light, Ultraviolet and Infrared

Light is essential to viewing and appreciating textiles, but it fades colours and weakens fibres. Light is the visible part of electromagnetic radiation, a form of energy. It extends from violet through to red. Wavelengths beyond the violet end of the visible spectrum, i.e. ultraviolet (UV), are more energetic and more damaging to textiles than wavelengths beyond the red end, i.e. infrared (IR), which are less energetic. UV and visible radiation have the potential to cause photochemical damage, whereas IR radiation can only produce radiant heat. Damage to textiles depends on the intensity of the light, the proportion of UV radiation, and the length of exposure. The UV radiation in daylight, sunlight, and some electric light sources is a major cause of yellowing and weakening of fibres. Along with light, UV also causes fading or change in colour of many textile dyes, including natural and synthetic dyes.

⁷ Canadian Conservation Institute (CCI) (2002) Textiles and the Environment 13/1, <https://www.canada.ca/en/conservation-institute/services/conservation-preservation-publications/canadian-conservation-institute-notes/textiles-environment.html>. Pristupljeno 3. studenog 2025.

Mitigating the damaging effects of light and ultraviolet radiation

Light damage is cumulative and irreversible. It is the total light exposure that is important. Total exposure can be understood as **illuminance (lux) multiplied by length of exposure (hours)**. The illuminance, or light intensity, is measured in lux. The object will incur the same amount of damage from exposure to bright light for a brief period of time as from low light for a long period of time. For example, exposure at 100 lux for 400 hours will result in the same damage as exposure at 50 lux for 800 hours. Thus, light damage can be reduced by half by reducing light levels by half (e.g. from 100 lux to 50 lux) or by decreasing the duration of light exposure by half.

Textiles should be exhibited under the lowest light intensity that allows for their aesthetic appreciation. The traditional 50 lux benchmark is adequate for someone under 30 years of age viewing details on light-coloured objects, if very high light levels are not adjacent, and if they are given time to adjust to ambient light, depending on the sensitivity of colourants used on textiles.

Ideally, textiles should not be exposed to any UV radiation from daylight or from unfiltered, UV emitting lamps. If it is not possible to block or eliminate the UV component, levels should not exceed 75 $\mu\text{W}/\text{lm}$ (microwatts of UV per lumen of light).

The vulnerability of textile colourants to light varies. To minimize the damaging effects of light on textiles, avoid extremes of light exposure. Eliminate natural light from windows in display and storage areas by covering the windows. Note that the clear, UV-absorbing films available for windowpanes can reduce the amount of UV radiation **without** reducing visible light. It is important to verify the performance of UV filters and films for lamps and windows before installation, and periodically thereafter.

Turn off lights in display areas during non-visiting hours, and only display textiles for limited time periods, e.g. a three-month maximum. Use visitor-activated light switches. To better control the intensity of light, use lower-wattage bulbs, place dimmers on light switches, and increase the distance between the light source and the textile. Keep a record of the time the textile is on display, the lux level, and the environmental conditions as these will assist in determining annual exposure levels.

Lights should be kept off in storage areas, but lighting for access needs to be at typical office light levels to allow safe and rapid pest inspections and curatorial searches. Storing textiles in closed cabinets or drawers protects them completely from light and UV.

There is currently a confusing array of lamps available on the market. Each type has characteristics that may or may not be suitable for museum display. Lighting for displays is complex and choices should be considered carefully.

Incorrect Relative Humidity

Textiles can tolerate a wide range of RH conditions. It is only the extremes in RH that threaten textile collections. At high RH, fibres swell as they absorb water vapour and, at low RH, fibres shrink as they release it. This dilation occurs primarily in the fibre diameter. Most woven textiles turn this response upside down: the swelling

of fibres causes a woven textile to shrink, especially along the warp threads. Nineteenth-century machine-made textiles are especially prone to this form of high RH shrinkage. Aged, embrittled textiles that are restrained, such as framed embroideries, upholstered furniture, and paper maps with fabric backings, may be incapable of withstanding the shrinkage caused by high RH.

High RH allows mould to grow on textiles. At 70% RH, it takes three months or more for mould to develop. At 90% RH, however, mould develops in only a few days. Mould often appears as a white-coloured velvety growth and is sometimes accompanied by a musty odour. Both cellulosic and proteinaceous textiles are at risk. Soils, stains or fabric finishes, such as starch, are attractive to microorganisms as sustenance. The growth of microorganisms causes coloured staining that is often impossible to remove and weakens textile fibres, sometimes to the point of disintegration.

High RH greatly accelerates corrosion of base metals, particularly iron and copper compounds. Brass buttons, steel hooks, eyelets, zippers, etc., especially when associated with salt from human contact or marine environments, can change from being stable for decades to actively corroding within days when RH climbs above 75%.

During winter months, heating without humidification leads to low RH. Between 40% RH and 5% RH, textiles become increasingly brittle, and thus more fragile to handle. On the other hand, low RH has significant benefits for textiles. Light fading is slower, dropping by almost half between 60% RH and 10% RH for some dyes. Insect attack is much less frequent below 40% RH. For wool, this is a particularly important reduction in risk. As long as one refrains from handling weak textiles (such as degraded silks), then low RH is an overall benefit to textile preservation, as demonstrated by the long-term survival of ancient textiles only in arid regions of the world.

In summary, the only form of incorrect RH that should always be avoided in textile collections is damp (over 70% RH). Without damp, there can be no mould, no shrinkage of woven materials (hence no tearing of textiles under tension), no rapid corrosion of associated metal elements, and less of a tendency for dust to cement the fibres. Low RH has significant benefits in terms of reduced pest and light damage, but there is a trade-off with mechanical risks. These mechanical risks can, in turn, be mitigated by careful handling. Avoidance of low RH becomes necessary only where textiles are mixed with other objects that are likely to deform or fracture when exposed to low RH.

The only way to be certain of the environmental conditions in a display or storage area is to measure them using instruments. A hygrothermograph or data-logger is recommended for continuous recording of RH and temperature fluctuations throughout seasonal cycles.

Incorrect Temperature

High temperatures increase the rate of chemical decay of all materials: double the rate, half the life, for every increase of 5°C. This phenomenon becomes of practical significance only for textiles that are chemically unstable. The classic example in Canadian textile collections are weighted silks of the 19th century. For them, self-destruction is usually already complete (but one can find samples in good condition that were probably kept

cold much of their existence). Less vulnerable, but perhaps more prevalent, are cellulosic textiles (cotton, linen, jute) that have become acidified by pollution (and have not been washed), plus all of the 20th century synthetic textiles (rayon, nylon) that can develop acidity internally. While these materials may maintain adequate strength for perhaps a century at 20°C, their lifetime will drop to only two decades at 30°C.

Low temperatures (5°C and lower) have many benefits for textiles. Besides reducing chemical decay, pest frequency is greatly reduced. There is no known danger of even extreme Canadian winter temperatures. In fact, -30°C is the preferred method of non-toxic pest treatment for textile collections, and several studies have failed to find any harmful side effects.

In practical terms, low temperature becomes a problem only when it causes high RH and damp. This usually occurs when textiles are stored in a poorly ventilated space (without airtight bags) and one of two things happens:

1. the whole space experiences a sudden temperature drop, for example, a poorly insulated house experiences a warm humid afternoon followed by a cold snap at night; or
2. textiles are stored in cabinets pushed against a cold exterior wall, such as a basement in summer, or a ground floor in winter.

In summary, in order of importance, watch low temperature situations for damp, and avoid high temperature situations with all of your chemically unstable textiles (e.g. weighted silks, many synthetics, and all unwashed natural fibres with a history of long exposure to air pollution).

Pests

Pests are living organisms, such as insects, rodents and mould, which are able to damage materials. Textile and costume collections are often housed in undisturbed, dark environments, which can provide an ideal habitat for insects. Larvae of the clothes moth and the carpet beetle are particularly damaging because they perforate and consume keratinous protein fibre, such as wool. They will attack silk, cotton and synthetics if soils are present or if these fabrics block the way to a food source. Signs of the presence of insects include the actual larvae, their webs and casings (often containing fecal pellets, which may be the same colour as the textile), eggs, and adult insects. Silverfish may damage fabrics en route to a source of food such as the starch sizing on some cottons. Rodents and other animals will gnaw, shred and soil textiles.

Strategies for dealing with pests in a museum include preventive measures like good housekeeping and building maintenance. Avoid using, storing or leaving beverages or foodstuffs in display and collection storage rooms. All new acquisitions and loans should be quarantined, examined and monitored before being introduced into the collection. This allows staff to detect mould and insects.

Physical Forces

Tears, losses, splits and wear can result from previous use, internal stresses inherent in the object, and handling. Sharp creases along fold lines have the potential to become splits because the fibres in these areas are under considerable strain.

Some damage to textiles can be prevented. Historic textiles often appear deceptively strong and resistant, but they are vulnerable not only due to their past history – age, fragility or composition, including combinations of heavy with lightweight materials – but also because they are familiar objects. Handling increases the potential for damage to costumes and textiles. Limit handling textiles and, whenever possible, handle the support or mount rather than the object itself.

Textiles and costumes on display or in storage without adequate support may become distorted by gravity. Custom mannequins for displaying costumes, or padded mounts for storing them, help prevent damage from physical forces. Ensure that mannequins are stable by providing an adequate base or one that can be secured to the display surface. Oversized textiles, such as tapestries, may require custom supports for display and storage, and two or more people to transport or install them.

In transit and shipping, physical forces, such as vibration, impact, pressure, abrasion or shocks, can result in damage. Ensure that textiles are cushioned and secured to their mounts, and provide proper packaging.

Pollutants

Gases resulting from industrial, vehicle and other emissions cause degradative chemical reactions, which affect fibre properties. Some products within the museum, such as wood, coatings, acidic tissue paper and other historic objects, can emit harmful gases. Acidity of fibres can also result from the deterioration of the fibre itself and from manufacturing and finishing processes.

Solid particles, such as dust from clothing and soil from the immediate environment, are harmful because they can become trapped in the spaces within and between threads, and on irregular fibre surfaces. Sharp, gritty particles of silica, commonly found in dust, can cut through fibres when handled during storage, display or transit. At higher temperatures and RH, fine dust will cement itself to fibres within a short period and become very difficult to remove. Some particulates absorb pollutants from the environment, which may lead to a harmful chemical reaction to the fibre or the dye under high humidity. Some soils are food sources for mould, insects and other damaging biological activity. Oils deposited from improper handling, water and food stains, and soils from use can oxidize and become set over time, causing disfigurement, weakening and breakage of fibres.

Keep windows and doors closed to minimize problems due to atmospheric pollutants. Any openings to the exterior should be properly sealed. Atmospheric pollutants within the museum can be controlled to some extent by using recommended products (e.g. stable paints on walls and carpeting that does not emit harmful gases) and by enforcing a non-smoking policy. Chemicals, such as paints and cleaning agents, should be stored in a space away from collection storage or display.

Conclusion

Every museum should practice a routine of thorough, methodical inspection and meticulous cleaning. The cleaner the storage and display area, the less chance there

is of mould, insects, chemical damage or abrasion occurring. Mounts used to support artifacts in storage and on display should be constructed from stable materials. Objects can be protected from light and dust by covering them temporarily when they are not being viewed.

■ Reading Comprehension Exercises

Part 1: Multiple Choice

Select the best answer (a, b, c, or d) based on a detailed understanding of the text.

1. The principle that light damage is “cumulative and irreversible” is best explained by which of the following statements?
 - a) The damage is immediately visible and cannot be stopped once it begins.
 - b) The total photochemical degradation is a product of illuminance and exposure time, and the chemical changes are permanent.
 - c) Only ultraviolet light causes permanent damage, while visible light causes temporary fading.
 - d) Textiles can only tolerate a finite number of hours under light before they disintegrate completely.
2. According to the text, what is the nuanced relationship between low relative humidity (RH) and textile preservation?
 - a) Low RH is universally detrimental as it causes all fibres to become irreversibly brittle.
 - b) Low RH is beneficial for pest control and slowing photochemical damage but requires careful handling to mitigate mechanical risks.
 - c) Low RH should be avoided because it accelerates the chemical decay of synthetic fibres.
 - d) Low RH is only acceptable for protein-based fibres like wool and silk.
3. The text identifies high temperature as a significant threat to “chemically unstable” textiles. Which of the following is NOT listed as an example of such an unstable textile?
 - a) 19th-century weighted silks.
 - b) Unwashed, acidified cellulosic textiles (e.g., cotton, linen).
 - c) All 20th-century synthetic textiles (e.g., rayon, nylon).
 - d) Historically significant, but stable, woollen tapestries.
4. What is the primary mechanism by which solid pollutants, like dust, cause physical damage to textiles?
 - a) They emit harmful gases that weaken the molecular structure of fibres.
 - b) Their sharp, gritty particles can abrade and cut fibres during handling.
 - c) They immediately attract mould and insect pests upon contact.
 - d) They reflect light, thereby increasing the object’s total light exposure.

5. The text suggests that the most effective approach to managing the museum environment for textiles is:
 - a) To maintain a single, constant temperature and RH level at all costs.
 - b) To prioritize the elimination of high RH and dampness above all other factors.
 - c) To understand the trade-offs between different agents and implement targeted, practical strategies.
 - d) To focus exclusively on pest control and physical handling, as these pose the most immediate risk.

Part 2: True, False, or Not Stated

Indicate whether the statement is **True (T)**, **False (F)**, or if the information is **Not Stated (NS)** in the text.

1. A textile displayed at 75 lux for one year will sustain significantly more damage than one displayed at 50 lux for the same duration of exposure.
2. A framed embroidery from the 19th century is at a high risk of tearing if the relative humidity consistently rises above 70%.
3. Storing textiles in a cold, airtight vault is a risk-free preservation method.
4. Silverfish are primarily a threat to textiles because they consume protein-based fibres like wool.
5. Using low-wattage bulbs and dimmers is a more effective preservation strategy than simply reducing the daily hours of illumination.

■ Vocabulary Exercises

Part 3: Matching

Match the specialized vocabulary word from the text with its most accurate definition.

Vocabulary Word	Definition
1. cumulative	a) a period of isolation to prevent the spread of contamination or pests.
2. embrittled	b) the amount of light falling on a surface, measured in lux.
3. illuminance	c) to make or become less severe, harmful, or painful.
4. mitigate	d) increased by successive additions.
5. quarantine	e) made fragile and easily broken.
6. vulnerable	f) tiny separate particles, such as those found in dust.
7. particulates	g) susceptible to physical or emotional harm.
8. dilation	h) the action of becoming wider, larger, or more open.

Part 4: Fill in the Blanks

Complete the paragraph using the most suitable words from the box below. You will not need all the words.

aesthetic	ambient	cumulative	dilation	emitting
inherent	mitigate	particulates	quarantine	vulnerable

Textile conservation requires a proactive approach. Due to their organic nature, historical textiles are highly (1) _____ to a range of dangers. The (2) _____ nature of light damage means that even low-level, long-term exposure is detrimental. To (3) _____ this risk, conservators control (4) _____ light levels and eliminate their sources (5) _____ ultraviolet radiation. Furthermore, all new acquisitions must undergo a strict (6) _____ period to ensure they do not introduce pests to the collection.

Part 5: Synonyms

Replace the underlined word or phrase in each sentence with a more precise synonym from the vocabulary list used in these exercises.

1. The old silk was very fragile and prone to breaking.
 - The old silk was _____.
2. We need to lessen the harmful effects of fluctuating humidity.
 - We need to _____ the harmful effects of fluctuating humidity.
3. The gradual building-up effect of pollutants can be surprising.
 - The _____ effect of pollutants can be surprising.
4. The swelling of the fibres was noticeable under the microscope.
 - The _____ of the fibres was noticeable under the microscope.

■ Grammar Exercises

Part 6: Sentence Transformation (Active/Passive)

Rewrite the following sentences, changing them from the passive voice to the active voice. You may need to invent a logical subject (e.g., “Conservators,” “Museum staff”).

1. The damaging effects of light are considered cumulative and irreversible by conservators.
2. Textiles should be protected from high relative humidity at all times.

3. New acquisitions must be quarantined and examined by staff before integration.
4. The illuminance levels were measured and recorded by the intern.

Part 7: Linking Words

Choose the most appropriate linking word or phrase from the options to logically connect the ideas.

1. Light is essential for viewing textiles; _____, it is a potent agent of deterioration. (consequently / however / for instance)
2. High RH can cause mould growth. _____, it accelerates the corrosion of any metal components on a textile artifact. (Therefore / Furthermore / Conversely)
3. Low temperatures are generally beneficial. _____, they can lead to problematic condensation if the environment is not properly controlled. (As a result / In summary / However)
4. Textiles may appear strong, _____ they are often fragile due to their age and composition. (and / but / so)

Part 8: Creative Task: The Conservator's Proposal

Scenario: Your museum has been offered a prestigious but sensitive collection of early 20th-century couture dresses, many made from weighted silk and delicate, light-fugitive dyes. The current display gallery has large south-facing windows. The acquisition committee has asked for a preliminary report on the environmental challenges.

Task: Write a formal proposal (approx. 200-250 words) to the acquisition committee.

Your proposal must:

- Identify **three specific agents of deterioration** that pose the highest risk to this collection.
- For each agent, provide a **brief, justified recommendation** for its mitigation, explaining why it is necessary with reference to the text.



Unit 8

FLAT STORAGE FOR TEXTILES – CANADIAN CONSERVATION INSTITUTE (CCI) NOTES 13/2⁸

Pre-Reading Questions

1. What are the advantages of storing a delicate garment flat rather than hanging it?
2. Before placing a textile into long-term storage, what condition checks should be performed?
3. Why might stacking multiple textiles directly on top of one another be problematic?

Introduction

Flat storage is ideal for most textiles because it provides support for the entire textile, thus freeing the textile fibres from the stress of supporting their own weight. When flat storage is enclosed, it also protects the artifact from water damage, dust, and light. When storing textiles flat, it is important to keep folding to a minimum. Consequently, flat storage occupies more space than other storage methods, so it may be necessary to reserve flat storage for selected pieces: very fragile items; heavily decorated textiles, such as beaded dresses; and garments with weak shoulder seams, made from stretchy knits, or those cut on the bias.

Preparing the Textile for Storage

Before placing a textile into storage, examine it thoroughly for any sign of insect infestation or mould. If either of these conditions is detected, place infested textiles in sealed, clean, polyethylene bags and isolate them from the rest of the collection.

Remove paper wrappings other than acid-free tissue, especially coloured paper from which dyes could transfer. Before discarding wrappings or attachments such as old accession numbers or dry-cleaning tags, examine them for information that should be documented. Retain and store separately original packaging material such as hat boxes.

Remove pins and staples. These put stress on the fabric and are almost certain to rust. Isolate any corroded metal fasteners by covering them with acid-free tissue or with clean white cotton.

Textiles should be clean when stored. Soil invites infestation, which can endanger the entire collection. Unless textiles are in a very fragile condition, they can be safely surface cleaned by gentle brushing and by vacuuming through a screen. If necessary, white cotton or linen textiles in sound condition may also be washed.

⁸ Canadian Conservation Institute (CCI) (2002) Flat Storage for Textiles 13/2, <https://www.canada.ca/en/conservation-institute/services/conservation-preservation-publications/canadian-conservation-institute-notes/flat-storage-textiles.html>. Pristupljeno 12. studenog 2025.

Types of Flat Storage Units

Flat storage units may use drawers, trays, shelves, or boxes. Whatever system is used, it should allow textiles to be moved into and out of storage easily and safely without direct handling.

When purchasing or constructing storage units, it is important to select materials that will have no adverse effect on the textiles. Wood and wood products emit harmful volatiles, and should not be used unless they are sealed or coated. Baked enamel metal units, although expensive, are a good investment. They are durable and easy to clean, and the enamel coating is chemically stable. Unbaked painted coatings may give off solvents or other volatile components. Several manufacturers are aware of the concerns museums have with volatile chemicals being released from paints, and can provide information on this. For advice about appropriate storage materials, contact the Canadian Conservation Institute.

Drawer units

Drawer units, customized to meet the needs of the collection, are ideal. There are several storage units on the market. It is best to consult major institutions that use such units for advice, based on their experience, about which type would be most appropriate for your situation.

Large metal map cabinets are also very useful because the drawers are usually large enough to permit flat storage with minimal folding.

With any drawer unit, it is important that the drawers push in and pull out smoothly to prevent the contents from moving.

Cabinets with removable shelves or trays

Cabinets equipped with shelves or trays of suitable sizes are another option. If cabinets are constructed in-house, ensure that the materials used are not harmful to the artifacts. Advantages of these systems are that the shelves or trays can be removed from the unit to transport the textiles, and that the space between shelves can be adjusted easily to suit the needs of the collection. If the cabinet does not have doors, it must be fitted with curtains to protect the contents from dust and light.

Boxes

Never leave textiles uncovered on open shelving. Place them in boxes of appropriate sizes with lids. Boxes made of moulded polypropylene and polypropylene/polyethylene are commercially available in a variety of sizes, the largest of which are suitable for storing garments. Look for the letters PP and PE, which often appear inside the symbol indicating recyclable material. Boxes made of acid-free card are also commercially available. Alternatively, suitable storage boxes may be made from sheets of corrugated polypropylene/polyethylene (Coroplast, Cor-X). Detailed information on these materials can be found in Technical Bulletin N° 14 [Working with Polyethylene Foam and Fluted](#)

Plastic Sheet. It is also useful to consult large institutions that have had textile storage boxes mass produced out of corrugated polypropylene/polyethylene to see if it is possible to purchase the same type of box from the fabricator.

Storing the Textile

Select a container that is large enough to accommodate the textile with minimal folding. Line the container with either prewashed cotton sheeting or unbuffered acid-free (neutral-pH) paper or tissue. A single piece of paper or tissue, such as one cut from a large roll, is easier to work with than multiple small sheets.

Cut a piece of the lining material large enough to cover the bottom of the container as well as to fold over and completely cover the textile. The lining material can be used to lift the artifact into and out of the box or drawer. Cotton fabric has the advantage that it can be washed periodically and reused. Papers and tissues should be replaced when they become acidic. Test them periodically with a pH-testing pen.

Place the textile in the prepared container, taking care to ensure that there are as few folds as possible. Pad any folds with accordion-pleated, unbuffered, acid-free tissue, rolled polyethylene sheet, polyethylene foam tubing, or “sausages” made from polyester batting covered with cotton stockinette. This will prevent damaging creases from forming. Reposition folded textiles regularly to redistribute folds.

If possible, do not place textiles one on top of the other. The accumulated weight may crush and damage the textile beneath. If, for lack of space, layering cannot be avoided, place heavier items on the bottom and interleave the textiles with prewashed cotton sheeting or unbuffered acid-free paper or tissue.

■ Reading Comprehension Exercises

Part 1: Based on the text, categorize each statement as **True (T)**, **False (F)**, or an inference that is **Not Stated (NS)**

1. ___ A closed, flat storage container on its own can protect against all major risks of damage, including physical stress and exposure to light.
2. ___ Soil can cause biological damage to textiles by encouraging pests or mold.
3. ___ Using unpainted, unfired storage units is recommended because they are cheap and chemically stable.
4. ___ Stacking textiles in a single container without protective layers between them is widely accepted as a space-saving method.
5. ___ It is wise to consult major institutions before buying specialized storage furniture.

Part 2: Synthesis and Paraphrasing

Complete the following synthesized summary by selecting appropriate word.

minimal	support	creases	inert	infestation
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The implementation of flat storage constitutes a preservation strategy principally indicated for artifacts exhibiting particular vulnerabilities, such as inherent fragility or structural delicacy inherent in bias-cut garments. This methodology affords comprehensive (1) _____, thereby obviating gravitational stress on fibrous structures. A paramount preliminary step involves a meticulous inspection for indications of biological activity, specifically (2) _____, necessitating immediate isolation protocols. Critically, storage infrastructure must be composed of (3) _____ materials, with baked enamel metal being preferable to unsealed wood, which emits deleterious volatile compounds. Within the storage microclimate, textiles must be situated with (4) _____ folds; where inevitable, such folds require padding with inert materials to preclude the formation of permanent (5) _____.

■ Vocabulary Exercises

Part 3: Match the words with their most accurate contextual definitions (1-5).

Word	Definition
1. artefact	a) a substance or compound capable of readily vaporizing, often with potential detrimental effects
2. volatile	b) to insert layers of a protective material between adjacent objects to prevent abrasion or transfer
3. interleave	c) a human-made object, typically one of cultural or historical significance requiring preservation
4. inert	d) chemically inactive or non-reactive; lacking the power to affect other materials
5. mitigation	e) the action of reducing the severity, seriousness or painfulness of something

Part 4: Word Families

Complete the following table with the correct morphological derivatives.

Verb	Noun	Adjective
To infest		
To deteriorate		
To corrode		
To accumulate		
To conserve		

■ Grammar Exercises

Part 5: Passive Voice Transformation

Transform the following active-voice directives into the passive voice

1. Conservators must isolate artifacts displaying signs of active mould growth.
 - Artifacts displaying signs of active mould growth _____
_____.
2. One should pad unavoidable folds with acid-free tissue to distribute pressure.
 - Unavoidable folds _____
to distribute pressure.
3. The institution may commission customized storage units to accommodate the collection's specific dimensions.
 - Customized storage units _____
to accommodate the collection's specific dimensions.

Part 6: Application of Modal Verbs

Fill in the blanks with the most appropriate modal verb from the following options: **must**, **should**, **may**, **ought to**, **can**, **might**. Multiple correct answers are possible.

1. Prior to acquisition, storage materials _____ be vetted for chemical stability to prevent off-gassing.
2. If a textile has been improperly stored with metal pins, one _____ discover corrosion upon examination.
3. While cotton sheeting _____ be laundered and reused, acid-free paper _____ be replaced once it becomes acidic.
4. In the absence of ideal cabinets, a curator _____ resort to layered box storage, albeit with stringent interleaving protocols.

Part 7: Creative Task

Design a Storage Guide Label

Imagine you are preparing a flat storage box for a very fragile, beaded dress from the 1920s. Design a simple label or instruction sheet that would be attached to the **outside** of the box. It should quickly inform a museum worker about:

- The artifact inside.
- **Two** specific handling instructions (e.g., how to move it).
- **One** specific condition warning (e.g., what to check for).



Unit 9

STONE DECAY ⁹

Pre-Reading Questions

1. What natural forces (weather, plants, water) can cause stone to deteriorate over time?
2. Why are ancient stone monuments and sculptures considered irreplaceable cultural records?
3. How might human industrial activity accelerate the decay of stone buildings compared to natural weathering alone?

An important part of our culture is chiseled in stone, and we are in danger of losing it.

Stone, in its broadest sense, includes all those inorganic, non-metallic, hard solids that are, or have been, employed by humans for recording, embellishing, advertising or preserving the facts of their lives and their spiritual and artistic visions, as well as to satisfy their practical needs for shelter, protection, and secure storage.

It is in the facts, dates, stories, and pictorial representations carved in, or painted on, stone that we have our most authentic records of the history, customs, and ideas of ancient cultures, such as the Sumerians, Hittites, Etruscans, Celts, Aztecs, Mayas, Incas, etc.

It is the stone sculptures of Praxiteles, Michelangelo, and numerous other long-deceased artists, and the temples, tumuli, pyramids, and other edifices of vanished societies that seem to us today to be as compellingly awe-inspiring and thrilling as they were to all the many generations that have preceded us since their creation.

Shakespeare's "sermons in stones" speak to us in many voices, and teach us about our own and other cultures.

But this heritage we have of the past and present glories of human creativity is slipping away – slowly, silently, but inexorably and at an increasing rate. The voices of many artistic and historic stone works have already fallen silent, and many more are in imminent danger.

Stone decay is not a new phenomenon. It starts as soon as an artifact or structure has been completed, and continues progressively for as long as the object is in contact with any kind of environment. Artistic merit or historic significance does not, after all, exclude these objects from the workings of the Second Law of Thermodynamics!

⁹ Amoroso, G. G., & Fassina, V. (1983). *Stone decay and conservation: Atmospheric pollution, cleaning, consolidation and protection*. Elsevier.

The deterioration of the stone of exposed sculptures and buildings has been evident to many concerned observers throughout the centuries, and mention was already made by ancient Greek and Roman writers (e.g., Vitruvius) of efforts to intervene in the decay processes. Although interest in the conservation of stone has a venerable history, its emergence as a specialized craft began slowly and tentatively in the nineteenth century. The conservation and preservation of works in stone gradually acquired increasing numbers of practitioners in the early part of the twentieth century, as interest in the collection and appreciation of antiquities spread among those with the requisite leisure and funds. Much of this interest was stimulated by the dramatic discoveries of the treasures of Minos, Egypt, and Pompeii.

Napoleon's campaign in Egypt brought the beauty and significance of the archaeological stone artifacts of that ancient culture to the attention of French scientists, and stimulated several, most notably Berthelot, to undertake to apply the science of their day to the investigation of the technology and condition of these objects.

In England, the burgeoning of the British Empire was accompanied by a fever of construction of grandiose edifices, such as the Houses of Parliament, but the Industrial Revolution which made all this possible simultaneously created a highly aggressive environment that rapidly took its toll on the exposed stone. The manifestations were so dramatic as to enlist the interest of the best scientists of that time, including Humphrey Davy and Michael Faraday.

However, the problems of the deterioration of exposed stone proved to be intractable to the science and technology of the nineteenth century. It was not until about the second and third decades of the twentieth century that it is justified to speak of a science of stone conservation as beginning to take form. By about 1950, several of the major museums in the world had established laboratories in their facilities staffed by one or a few scientists whose mission was to analyze the nature and condition of museum objects, including antiquities, and to carry out restoration and preservation procedures – or, more usually, to recommend to curators the type of procedure the skilled craftsman should employ.

The classic work summarizing the techniques and experience of the British Museum's Research Laboratory was written by Harold J. Plenderleith, and published in 1956. In this work of 373 pages, a total of only 31 pages was devoted to stone, and 6 pages more to ceramics. Plenderleith, who was as knowledgeable about stone conservation as anyone in the field at that time, wrote, in 1956:

“Since early in the present century the preservation of stone has engaged the attention of scientists the world over. The phenomena of decay are commonly to be

seen on public buildings and outdoor monuments: weathering, which weakens the stone though it may sometimes enhance its appearance; staining, which may result in permanent disfigurement; and the crystallization of salts, which in some cases may cause powdering of the surface, cracking, and even complete disintegration. Deterioration may be traced to bad technique such as carelessness, or lack of knowledge or experience in the handling of stone by architects or builders, but it is more often due to natural causes. In this case, the most that can be done is to try to find a way of mitigating the damage, by washing, or periodic steam cleaning, or, it may be, by some form of impregnation.” (The Conservation of Antiquities and Works of Art, Oxford, 1956, p. 294)

In the quarter century since that was written there has developed an extensive scientific literature dealing with the conservation of stone. There is now a bit more than the sense of futility expressed by Plenderleith. Much can now be done to protect and preserve exposed stone from the onslaughts of its surroundings; and we are learning more all the time.

■ Reading Comprehension Exercises

Part 1: Multiple Choice Questions

Select the best answer for each question.

1. According to the text, what is the broad definition of “stone” used by the author?
 - a) Only granite and marble used for sculptures.
 - b) Inorganic, non-metallic, hard solids used by humans for various purposes.
 - c) Materials used exclusively for building shelters.
 - d) Any material that can preserve paint.
2. What does the author imply by mentioning Shakespeare’s “sermons in stones”?
 - a) Stones were used to build churches in Shakespeare’s time.
 - b) Stone works communicate and teach us about cultures.
 - c) Shakespeare was an expert in stone conservation.
 - d) All important historical lessons are physically carved in stone.
3. Why is stone decay considered inevitable?
 - a) Because modern conservation techniques are ineffective.
 - b) Because it is subject to the Second Law of Thermodynamics.
 - c) Because ancient builders used poor-quality stone.
 - d) Because it only happens in polluted industrial areas.

4. What event in the 19th century helped stimulate scientific interest in stone conservation?
 - a) The publication of Plenderleith's book.
 - b) The construction of the Houses of Parliament.
 - c) Napoleon's campaign in Egypt.
 - d) The discovery of electricity by Faraday.
5. What was the author's primary purpose in writing this text?
 - a) To criticize modern architects for using stone.
 - b) To provide a step-by-step guide for restoring statues.
 - c) To trace the history and importance of stone conservation.
 - d) To argue that stone artifacts are no longer relevant.

Part 2: Short Answer Questions

Answer in your own words based on the text.

1. List **two** reasons why stone artifacts are important for understanding ancient cultures.
2. According to Plenderleith (1956), what are **two** common visible phenomena of stone decay?
3. How did the Industrial Revolution in England negatively affect stone buildings?
4. What significant shift began to happen in major museums around 1950 regarding stone artifacts?
5. How does the author's view on the possibility of stone conservation in the 1980s differ from the sense of futility expressed by Plenderleith in 1956?

■ Vocabulary Exercises

Part 3: Word in Context

From the list below, choose the correct word to complete each sentence. Use each word only once.

inorganic, embellishing, edifices, imminent, inexorable, phenomenon, tractable, mitigating, impregnation, onslaughts

1. The ancient _____, like pyramids and temples, still dominate the landscape.
2. The threat of coastal erosion is _____; it continues slowly and cannot be stopped.

3. Scientists are focused on _____ the damage from acid rain, not completely reversing it.
4. A common _____ in large cities is the rapid darkening of building façades due to pollution.
5. The _____ nature of stone means it was not formed from living matter.
6. The _____ of a water-repellent solution is a common conservation technique.
7. The intricate carvings on the cathedral door were aimed at _____ its surface and telling stories.
8. With the storm clouds gathering, the danger to the old monument was _____.
9. The problem of decay proved not to be _____ to 19th-century science; they could not solve it easily.
10. Historical structures face constant _____ from weather, pollution, and time itself.

Part 4: Synonyms & Definitions

Match the word from the text on the left with its correct definition on the right.

Word	Definition
1. venerable (adj)	a) impossible to prevent or stop
2. grandiose (adj)	b) a burial mound; a barrow
3. tumuli (n)	c) deserving respect because of age, character, or importance
4. intractable (adj)	d) inspiring a sense of awe and wonder
5. compellingly (adv)	e) in a way that demands attention and interest
6. requisite (adj)	f) impossible to manage or control; difficult to solve
7. awe-inspiring (adj)	g) required or necessary for a particular purpose
8. disfigurement (n)	h) the process of becoming worse in condition or quality
9. deterioration (n)	i) intended to be impressively large or magnificent
10. inexorable (adj)	j) the act of spoiling the appearance of something

■ Grammar Exercises

Part 5: Verb Tense Analysis

The text uses a variety of verb tenses. Underline the main verb in the following sentences from the text and identify its tense (e.g., Present Simple, Present Perfect, Past Simple, Past Perfect).

1. Stone decay is not a new phenomenon.
2. It starts as soon as an artifact or structure has been completed.
3. Napoleon's campaign in Egypt brought the beauty and significance of the archaeological stone to the attention of French scientists.
4. An extensive scientific literature dealing with the conservation of stone has developed.
5. Much can now be done to protect and preserve exposed stone.

Part 6: Passive Voice

Several sentences in the text use the passive voice. Rewrite the following active voice sentences in the passive voice, as if they were part of the text.

Example:

Active: Humans employ stone for recording facts.

Passive: Stone is employed by humans for recording facts.

1. Ancient cultures carved facts and stories in stone.
2. The Industrial Revolution created a highly aggressive environment.
3. Scientists are now learning more all the time.
4. Polluted air has damaged the marble statue.
5. Curators must oversee all restoration procedures.

Part 7: Creative Task

The Conservator's Report

You are a stone conservator working for a national museum. Write a **brief report about (150-200 words)** addressed to the museum director. Your report should:

- Describe **one major threat** (e.g., pollution, weathering, tourism, salt crystallization) currently facing the stone of your chosen site.
- Propose **one specific action** to help mitigate this threat, based on ideas suggested in the text (e.g., cleaning, impregnation, controlled environment).
- Explain **why** preserving this particular site is important for human culture, using the text's themes as a guide.



Unit 10

WEATHERING ENVIRONMENT¹⁰

Pre-Reading Questions

1. Why might two stone monuments of different rock types located in the same city decay at very different rates?
2. What analogy might be drawn between diagnosing stone decay and diagnosing a human illness?
3. Why would a conservator need to understand chemistry and physics, not just craftsmanship, when treating decaying stone?

A significant degree of understanding of the nature and mechanism of action of the various decay processes has been developed, and detailed understanding can be expected to be followed by successful techniques of intervention. The present is, therefore, a propitious time to survey the state of our knowledge, to inventory the treatment methods that have been proposed and tried out, and to consider what needs to be further explored, and what experience teaches us not to repeat. The phenomena of monument decay and stone deterioration embrace those factors which operate to alter the appearance, strength coherence, dimensions, or chemical behavior of the material, either as individual elements, or as parts of structures. These factors include:

(1) Chemical attack, i.e., etching, erosion, and dissolution, of alkaline stones by acidic substances, both natural (atmospheric CO₂, volcanic gases, rain water) and man-made (combustion products, industrial emissions).

(2) Mechanical disruption caused by expansive forces generated in pores, channels, and cracks by the freezing of imbibed water, by the growth of crystals, or by the corrosion of embedded metals (e.g., iron) or minerals (e.g., pyrites).

(3) Disfigurement, due to migration into stone of colored matter from adjacent materials (e.g., rust and copper staining), or alteration of the original color or texture by selective leaching from the stone of one of its components, or by the etching and roughening of the polished surface.

(4) Abrasion, attrition, and stress-cracking due to wind-driven particulates, seismic shocks, vibrations induced by vehicular traffic, accidents, human contacts, etc.

(5) Disfigurement as well as chemical and mechanical disruption resulting from the biological activities of microorganisms, fungi, algae, mosses, and higher organisms including, *inter alia*, pigeons.

¹⁰ Amoroso, G. G., & Fassina, V. (1983). *Stone decay and conservation: Atmospheric pollution, cleaning, consolidation and protection*. Elsevier.

(6) Exfoliation and disintegration resulting from inappropriate design and construction, such as the placing of sedimentary stone with its bedding planes parallel to the direction of large stresses, or the use of a too strong mortar (e.g., Portland cement between softer stones or bricks).

(7) Damage, both mechanical and chemical, arising from ill-advised efforts at repair and restoration with substances that are not stable to prolonged exposure, or whose physical properties (e.g., thermal expansivity) do not match those of the stone.

(8) Disfigurement due to adventitious surface deposits of soot, dirt, grease, paints, etc.

The types of stone encountered in artistic and historic works, as well as in more prosaic building construction, cover the gamut of available materials, ranging from porous, friable tuffs (e.g., Goreme in Turkey) and zeolites (e.g., Castel dell'Ovo in Naples) to dense, hard basalts and quartzites. The kinds of environments to which stones are subjected are similarly varied, ranging from desert to marine to rain forest; from rural to urban; from tropical to frigid. Hence, the dominant form of stone decay in a particular place depends upon the physical and chemical nature of the stone that is involved, and upon the kind of external or *in situ* insults to which it is subjected.

The first stage in attempting the conservation of stone must be a diagnosis of the "disease" – which may be rampant and visually evident, or dormant and capable of breaking out at any time the local conditions change. Just as there are no universal panaceas for human diseases, there are none for the problems afflicting different types of stones in different locations, and having gone through different histories. It is the appreciation of the need for specific diagnosis performed in the light of a thorough understanding of the physics and chemistry of the interaction of stone with air, water, and a variety of chemical substances that distinguishes the modern scientific conservator from the craftsman restorer of the nineteenth century.

The range of materials currently available for stone treatment is large, and growing. It includes solvents, resins, plastics, adhesives, pigments, cleaning agents, reactants that modify or alter surface properties or porosity, etc. Rational and discriminating selection of the materials to be employed for a given conservation problem requires some understanding of the chemical and physical properties of these materials, as well as of their long-term behavior under the conditions of outdoor weathering. Some of the chemicals that have been and are employed in conservation work are toxic; some are carcinogenic. This does not preclude their use where they are effective, but it is essential that the conservator be sufficiently well-informed in the safety precautions of the modern laboratory scientist that he will employ those handling and disposal techniques that are appropriate for self preservation as well as protection of the public.

It is for all these reasons that scientifically oriented monographs addressed to those engaged in, or preparing for work in stone conservation are important. The present work is one such, and it should prove to be especially helpful. It presents a thorough, detailed exposition of the current state of knowledge with respect to many of the factors responsible for stone decay. It describes the techniques that have been employed for stone conservation, and the scientific investigations that have been carried out to test their efficacy and longevity. It details the chemical and physical properties of the various polymeric substances that are available for stone treatment.

Two features of this book are particularly valuable. One is the thoroughness of the bibliographies, which cite substantially all of the relevant recent literature – much of which is not available in many libraries. This will enable the beginner to see the subject as a whole, and to get a “feel” for what are the most active areas of current investigation. It will make it possible for him to find the more detailed information he may want on specific topics in the original literature. And it will equally be helpful to the specialist in updating his acquaintance with areas peripheral to, but nonetheless important for, his own.

The other especially valuable feature is the citations of specific monuments and the types of conservation intervention (i.e., inorganic or organic impregnant) they have received. Newcomers to the field will be well advised to note these cases, and to inspect them from time to time, in order to observe for themselves whether the long-term effect of each of the various techniques proves to be good, indifferent, or deleterious.

■ Reading Comprehension Exercises

Part 1: Multiple Choice

Read the text and choose the best answer for each question.

1. What does the author suggest is a key development that makes the present time “propitious” for this survey?
 - a) A decrease in pollution levels
 - b) Significant funding for restoration projects
 - c) A developed understanding of decay processes leading to potential intervention
 - d) The discovery of new, universal treatment chemicals
2. According to the text, which factor is NOT listed as a cause of mechanical disruption?
 - a) Freezing of imbibed water
 - b) Growth of crystals
 - c) Seismic shocks
 - d) Corrosion of embedded metals

3. What is described as a primary difference between the modern scientific conservator and the 19th-century craftsman restorer?
 - a) The use of more advanced tools
 - b) The appreciation for specific diagnosis based on scientific understanding
 - c) A greater focus on aesthetic appearance over structural integrity
 - d) Access to a wider range of commercially available resins
4. What are the two features of the book highlighted as “particularly valuable”?
 - a) Color photographs and a glossary of terms
 - b) Step-by-step repair guides and safety manuals
 - c) Thorough bibliographies and citations of specific case studies
 - d) Lists of suppliers and cost estimates for treatments

Part 2: True/False/Not Stated

Based on the text, decide if the following statements are **True (T)**, **False (F)**, or if the information is **Not Stated (NS)** in the text.

1. The dominant form of stone decay depends only on the type of stone, not its environment.
2. The text implies that universal solutions for stone conservation exist but are very expensive.
3. The use of Portland cement mortar between softer stones is given as an example of inappropriate construction.
4. All chemicals used in conservation work are toxic and must be avoided.
5. The book referenced in the text is intended to serve as a universal, non-scientific guide for amateur restorers.

■ Vocabulary Exercises

Part 3: Word Definitions

Match the vocabulary word from the text (1-10) with its correct definition (a-j).

Words: 1. Propitious 2. Coherence 3. Adventitious 4. Friable 5. Exfoliation 6. Gamut 7. Rampant 8. Panaceas 9. Deleterious 10. Peripheral

Definitions:

- a) The complete range or scope of something.
- b) Causing harm or damage.
- c) Favorable; indicating a good chance of success.
- d) The act of peeling off in layers.

- e) Additional; coming from an external source; not inherent.
- f) A universal remedy for all diseases or problems.
- g) Uncontrolled; widespread.
- h) The logical or natural connection of parts; sticking together.
- i) Easily crumbled or reduced to powder.
- j) Of secondary or minor importance; marginal.

Part 4: Word in Context

Fill in the blanks in the sentences below using the words from the list. You will not use all the words.

Word List: disfigurement, imbibed, in situ, attrition, etching, prosaic, leaching, efficacy, phenomena, monolithic

1. The constant rubbing of visitors' hands caused noticeable _____ on the statue's surface over centuries.
2. Scientists study the _____ of stone decay to understand their complex causes.
3. The _____ of minerals from the sandstone by acidic rain altered its color and weakened its structure.
4. Before any treatment, conservators must test the _____ of a new resin to ensure it works and lasts.
5. The _____ of the marble façade was caused by dark biological growth and rust stains running down from iron fixtures.
6. Unlike the grand cathedral, the _____ farmhouse was built from simple, local fieldstone.

■ Grammar Exercises

Part 5: Passive Voice

The text frequently uses the passive voice to describe processes that happen to stone. Rewrite the following active voice sentences into the passive voice.

1. Acidic rain etches the limestone surface.
2. Expansive forces from freezing water cause mechanical disruption.
3. Ill-advised restoration efforts have damaged many monuments.
4. The author will cite specific monuments in the book.

Part 6: Complex Noun Phrases

The text uses many complex noun phrases (e.g., “the physics and chemistry of the interaction”). Identify and underline the main noun in each of the following phrases from the text.

1. a significant degree of understanding
2. the phenomena of monument decay
3. the migration into stone of colored matter
4. the rational and discriminating selection of the materials
5. their long-term behavior under the conditions of outdoor weathering

Part 7: Creative Task

Imagine you are a stone conservator. You have been asked to assess a historic sandstone monument in a busy, polluted city. Based on the decay factors listed in the text (1-8), write a short **observation report** (approx. 150-200 words) describing:

- The likely **three most significant threats** to the stone in this environment.
- Your **diagnostic approach** (what you would look for/analyze).
- **One caution** you would have about potential treatments, based on the text's warnings.

GLOSSARY OF CONSERVATION TERMS

This glossary includes key technical terms from the vocabulary exercises in Units 1–10. Definitions are provided in the context of conservation and restoration.

A

abrasive – having a rough surface or texture that can wear away material by friction; in cleaning, a more aggressive method that may damage soft surfaces.

acidic – having a pH below 7; paper or materials with acidic content can deteriorate and damage adjacent artifacts over time.

adherent – sticking firmly to a surface; a stable corrosion layer that does not flake off easily.

adventitious – coming from an external source; not inherent to the material itself (e.g., soot or dirt deposits on stone).

alloy – a metal made by combining two or more metallic elements (e.g., bronze is an alloy of copper and tin).

artefact – a human-made object, typically one of cultural or historical significance requiring preservation.

attrition – the process of wearing away by friction or rubbing (e.g., damage caused by wind-driven particles or visitor contact).

awe-inspiring – inspiring a feeling of reverence, wonder, or admiration.

B

blister – a bubble-like swelling on a surface, often caused by expanding corrosion products beneath a coating or plating.

bristles – flexible fibers (natural or synthetic) used for cleaning or painting; brush hairs.

buffer – a substance or material that minimizes the effect of a sudden change, such as in humidity or pH; acid-free materials can act as buffers.

C

coalescence – the process of sticking together or fusing to form one mass; a method by which liquid finishes cure into a solid film.

coherence – the logical or natural connection of parts; the structural integrity of a material.

compellingly – in a way that demands attention and interest.

conservation – the profession and practice of preserving cultural heritage through examination, documentation, preventive care, and treatment.

conservator – a professional who provides expert advice on the care, treatment, and preservation of cultural artifacts.

contiguous – side-by-side; touching or sharing a common border (e.g., cleaned and uncleaned areas of a surface).

contaminant – a harmful or unwanted substance introduced into a material or environment.

core – the central or most important part of an object; in metal corrosion, the original metal beneath corrosion layers.

corrode – to undergo a chemical reaction that destroys or damages a metal, typically by oxidation (e.g., rusting of iron).

cumulative – increased by successive additions; total light damage is cumulative over time.

D

deleterious – causing harm or damage.

delineations – lines, borders, or clear boundaries between different areas (e.g., between cleaned and uncleaned surfaces).

desiccate – to dry out completely; to remove moisture.

deteriorate – to become progressively worse in quality, condition, or strength.

deterioration – the process of becoming worse in quality or strength.

dilation – the action of becoming wider, larger, or more open; swelling of fibres in response to moisture.

disfigurement – the act of spoiling the appearance of something; permanent damage to visual integrity.

E

edifice – a large, impressive building or structure.

electrolyte – a substance that conducts electricity when dissolved in water, facilitating galvanic corrosion between dissimilar metals.

embellishing – decorating or adding ornamental details to a surface.

embrittled – made fragile, stiff, and easily broken, often due to chemical deterioration or age.

emulsions – systems in which small droplets of one liquid are dispersed throughout another liquid (e.g., certain finishes).

etching – the process of wearing away a surface through chemical reaction, often by acidic substances.

exfoliation – the act of peeling off in layers, as seen in some forms of stone decay.

F

ferrule – the metal part of a brush that holds the bristles; can scratch surfaces if not covered.

flaking – peeling or coming off in thin pieces or layers (e.g., paint or varnish detachment).

fluctuations – irregular rises and falls in level or value (e.g., changes in temperature or relative humidity).

friable – easily crumbled, broken down, or reduced to powder; not mechanically stable.

G

galvanic – relating to or involving electric currents produced by chemical action, especially when two different metals are in contact in the presence of an electrolyte.

gamut – the complete range or scope of something (e.g., the gamut of stone types).

grandiose – intended to be impressively large, magnificent, or ambitious in scale.

I

illuminance – the amount of light falling on a surface, measured in lux.

imbibed – absorbed or taken in (e.g., water absorbed into stone pores).

imminent – about to happen; threatening to occur soon.

impregnation – the process of saturating a porous material (e.g., stone) with a solution to strengthen or protect it.

in situ – in its original place or position (e.g., studying decay on the monument itself).

inconspicuous – hidden or not drawing attention; unobtrusive (e.g., test areas on an object).

inexorable – impossible to prevent or stop; relentless.

inert – chemically inactive or non-reactive; lacking the power to affect other materials; safe for storage.

ingrained – deeply fixed, often into the pores or grain of a material (e.g., ingrained dirt).

inorganic – not derived from living matter; mineral-based.

insidious – proceeding in a gradual, subtle, but harmful way (e.g., light degradation).

interleave – to insert layers of protective material between adjacent objects to prevent abrasion, transfer, or sticking.

intractable – difficult to manage, control, or solve; resistant to treatment.

isolate – to set apart from others; to keep separate, especially to prevent contamination or spread of corrosion/pests.

M

migration – the movement of substances (e.g., acids, impurities) from one material to another through direct contact.

mitigate – to make or become less severe, harmful, or painful; to reduce the impact of deterioration.

mitigation – the action of reducing the severity, seriousness, or painfulness of something.

mobilize – to move or be capable of moving (e.g., dirt being drawn into wood by moisture).

O

onslaught – a fierce or destructive attack (e.g., weathering onslaughts on stone).

P

panacea – a universal remedy for all diseases or problems (used negatively in conservation).

particulates – tiny separate particles of solid matter, such as those found in dust or pollution.

patina – surface residues associated with use, age, or natural deterioration that are often desirable and should be retained.

perforated – having small holes or pits in a surface; pierced.

peripheral – of secondary or minor importance; marginal.

phenomenon – an observable fact or event (plural: phenomena).

pollutant – a harmful substance introduced into the environment (air, water, or materials).

preventive conservation – actions taken to prevent or minimize future deterioration rather than treating existing damage.

propitious – favorable; indicating a good chance of success.

Q

quarantine – a period of isolation to prevent the spread of contamination, pests, or active corrosion.

R

rampant – uncontrolled; widespread (e.g., rampant decay).

requisite – required or necessary for a particular purpose.

S

subtleties – fine distinctions, delicate details, or nuanced characteristics.

T

tarnish – a dull or discolored layer formed on the surface of a metal (especially silver) through reaction with sulfur compounds.

tractable – easily managed, controlled, or solved.

transparent – allowing light to pass through; a coating that is see-through rather than opaque.

tumuli – burial mounds; barrows (plural of tumulus).

U

ultraviolet (UV) – electromagnetic radiation with wavelengths shorter than visible light; a major cause of fading and fiber weakening.

unfinished – not having a protective coating (e.g., paint, varnish, or wax); bare wood.

unsuitable – not appropriate or fit for a particular purpose (e.g., wet cleaning for bare wood).

V

venerable – deserving respect because of age, character, or historical importance.

ventilation – the provision of fresh air circulation to prevent buildup of corrosive or harmful gases.

volatile – a substance that evaporates quickly at normal temperatures, often releasing potentially harmful gases (e.g., volatile organic acids from wood).

vulnerability – the susceptibility to physical or chemical damage.

vulnerable – susceptible to physical or emotional harm; at risk.

W

weeping – a form of active iron corrosion characterized by yellow, brown, or orange droplets on the metal surface, associated with high RH and chloride contamination.

ENGLISH–CROATIAN DICTIONARY OF CONSERVATION TERMS

A

abrasive – abrazivan, koji trlja
acidic – kiseo
adherent – prijanjajući
adventitious – vanjski, dodani
alloy – legura
artefact – artefakt, predmet
attrition – trošenje habanjem
awe-inspiring – koji ulijeva strahopoštovanje

B

blister – mjehur
bristles – vlakna (četke)
buffer – pufer, tampon

C

coalescence – sjedinjavanje, koalescencija
coherence – koherentnost, povezanost
compellingly – uvjerljivo
conservation – konzervacija, konzerviranje
conservator – konzervator
contiguous – dodirni, susjedni
contaminant – onečišćivač
core – jezgra
corrode – korodirati
cumulative – kumulativan

D

deleterious – štetan
delineations – granice, crte razgraničenja
desiccate – osušiti
deteriorate – propadati, raspadati se
deterioration – propadanje
dilation – širenje
disfigurement – unakaženje

E

edifice – građevina
electrolyte – elektrolit
embellishing – ukrašavanje

embrittled – okrhnut, krhak
emulsions – emulzije
etching – nagrivanje
exfoliation – ljuštenje

F

ferrule – ferula, metalni dio četke
flaking – ljuštenje, otpadanje ljuskica
fluctuations – fluktuacije, kolebanja
friable – mrvljiv

G

galvanic – galvanski
gamut – čitav raspon
grandiose – grandiozan

I

illuminance – osvjetljenost
imbibed – upijen, apsorbiran
imminent – neizbježan, prijeteći
impregnation – impregnacija
in situ – na mjestu
inconspicuous – neupadljiv
inexorable – nezaustavljiv
inert – inertan
ingrained – ukorijenjen, duboko usađen
inorganic – anorganski
insidious – podmukao
interleave – umetnuti zaštitni list
intractable – tvrdokoran, nepopustljiv
isolate – izolirati

M

migration – migracija, prijelaz
mitigate – ublažiti
mitigation – ublažavanje
mobilize – pokrenuti

O

onslaught – napad

P

panacea – univerzalni lijek
particulates – čestice
patina – patina
perforated – perforiran, probušen

peripheral – periferan, sporedan
phenomenon – fenomen, pojava
pollutant – onečišćivač, zagađivač
preventive conservation – preventivna konzervacija
propitious – povoljan

Q

quarantine – karantena

R

rampant – nekontroliran
requisite – potreban

S

subtleties – suptilnosti

T

tarnish – potamnjenje (korozija srebra)
tractable – rješiv
transparent – proziran
tumuli – tumuli (grobnice)

U

ultraviolet (UV) – ultraljubičasto (UV)
unfinished – neobrađen, bez zaštitnog sloja
unsuitable – neprikladan

V

venerable – dostojan poštovanja
ventilation – ventilacija
volatile – hlapljiv
vulnerability – ranjivost
vulnerable – ranjiv

W

weeping – “plakanje” metala (aktivna korozija željeza)

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