

## How to Salvage Wet Books

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Library emergencies often create water damage, whether it is the water used to fight fire, a flood from a storm, a bursting pipe, or a leaking roof. Water is a major hazard to the survival of books. It can deform paper, warp bindings, make inks run, and cause glossy papers to fuse together. Damage to books from water can be limited if proper steps are taken promptly after the books become wet.

This leaflet provides steps to minimize water damage to books during recovery. Bear in mind, however, that a book that has once gotten wet is likely always to show some signs of damage. Seek assistance from a professional book conservator for drying especially valuable books.

### Mold

Wet paper is highly susceptible to mold growth. Mold may start growing within 24-48 hours after the books become wet. If you cannot begin drying the books within that time, you should freeze them until you have adequate time to work on them. When air-drying books, implement measures such as increased air circulation to inhibit mold growth, and continue monitoring the formation of mold throughout the air-drying process. If you identify an outbreak of mold at any time, isolate moldy items in ziplock bags and seek help from a professional conservator. Freeze the book if getting help will take more than a day. Wear appropriate personal protective equipment when necessary.

### Source of water

Before handling wet books, consider carefully the source of water that has wet them.

- **Relatively clean water from pipes** – *handle with care*
- **Sewage or chemical contaminated water** – *do not handle*

DO NOT HANDLE books wet with sewage water or water that has dripped through contaminated areas (attics with animal droppings, sources of chemical contamination); contact local health authorities for advice before proceeding.

- **Salt water, rust, mud or soil** – *rinse if necessary*

In general, it is safest to clean a muddy book after it has dried. However, rinsing wet books only contaminated with rust, mud or salt water before drying helps to stop contaminants from penetrating into the paper fibers. Hold the book shut and place it under clean running water, using a sponge or rag to gently wipe away mud with a daubing motion; rubbing and brushing should be avoided. Do not open the book under water or attempt to wash the pages.

DO NOT PUT A BOOK IN AN OVEN OR MICROWAVE TO DRY. Heat will over-dry and warp the book and can melt the adhesives used in the binding. Microwaves cook the book rather than dry it and can also melt adhesives or singe paper.

### Air-Drying Wet Books

When salvaging a number of books, you should first assess and sort them into the following categories:

- wet books (dripping or thoroughly wet)
- partially wet books (noticeably wet partially; or with apparent physical deformation such as cockling)
- damp books (cool to touch; with high humidity mold growth may occur)
- pamphlets or thin, lightweight books
- books printed on coated (glossy) paper

### Materials & Equipment

- electric fan(s) to keep the air circulating

- electric dehumidifier(s)— useful, if available, to reduce ambient humidity
- plastic sheeting to protect tables
- paper towels—plain white or natural unbleached, avoid paper towels that contain color dyes, **or**
- UNPRINTED newsprint—available at packaging supply shops or art stores
- waxed paper—kitchen rolls or freezer wrap available at supermarkets
- sponges (small pieces)

### **Set up for air-drying**

Before you begin the procedures outlined below, arrange a space that is conducive to drying wet books. Ideally, the temperature should not be above 70° F, and the relative humidity should not be above 65%. Use fans to circulate air and, if necessary, portable dehumidifiers to take excess moisture out of the air. Cool, dry, circulating air will accelerate the drying process and discourage mold growth. Arrange to clean and dry the shelves and rooms to which the books will be returned, to inhibit additional damage and mold growth.

If weather conditions permit, books may be air-dried outdoors. Relative humidity should not be above 65%. Long-term exposure to the ultraviolet rays of the sun may cause books to fade and may accelerate aging, but setting a book in the sun for a day should not cause visible damage to most books. **DO NOT** leave books outside overnight because morning dew will dampen them. Arrange protocols for security.

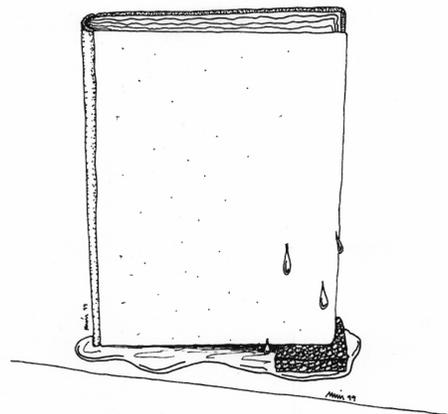
### **Create a work surface**

Use a table top or pieces of wood set up on cinderblocks, etc. Cover the work area first with a piece of plastic (to protect the work surface), then with several layers of absorbent paper such as strong, white paper towels or unprinted newsprint. The paper will absorb excess water from the books. Remove wet absorbent papers from the drying area promptly to help keep the ambient humidity down.

### **A. Wet (dripping) books – start at Step 1**

**Step 1.** Do not open thoroughly wet books. Wet paper is extremely delicate and will tear easily. Do not remove covers or bindings unless absolutely necessary.

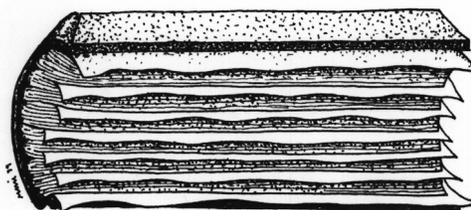
**Step 2.** Place the wet book, closed, on its head (top edge) on the absorbent paper. Place small pieces of sponge under the fore-edge of the book to allow water to drain from the book more efficiently. Do not fan the pages open. You may place paper towels or unprinted newsprint between the cover and the textblock to further help with water absorption. Replace the absorbent paper when it becomes damp. **DO NOT** use this process with books that contain coated (glossy) paper; see **Section E, Coated (glossy) paper**.



**Step 3.** Continue draining the book until water is no longer dripping and you do not see free water on the pages if they are gently opened. At this stage the book may be advanced to Step 4.

### **B. Moderately wet books – start at Step 4**

**Step 4.** Cut paper towels or unprinted newsprint slightly larger than the size of the pages in the book. Older guidelines on the salvage of wet books recommended paper impregnated with thymol to control mold; *do not use thymol*, which is now known to be a carcinogen. Very carefully, open the book and insert a sheet of paper between the textblock and the cover and additional sheets every quarter inch (20–30 pages) to absorb excess water. Be careful not to insert too many pieces of paper, which may cause the spine to become concave and will distort the book. Right-handed people may find it easiest to start inserting sheets from the back of the book working to the front. Lay the book on its side on the table. As the sheets of paper



become wet, they should be removed and replaced with dry sheets. Turn the book over on the other side each time sheets are replaced.

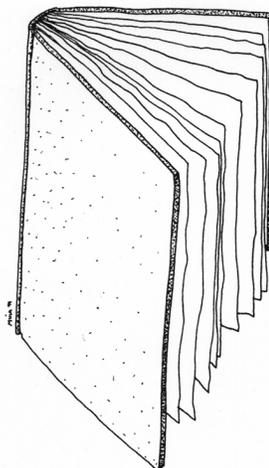
Take care at this stage to keep the book square and in shape, which will help minimize permanent damage to the binding.

**Step 5.** Continue exchanging the interleaving of the book (vary the location of the absorbent sheets at each exchange) until the paper is just slightly damp rather than wet. At this stage the book may be advanced to Step 6. The dryer the book is before moving to Step 6, the less cockling (rippling) of the paper.

### **C. Damp books – start at Step 6**

**Step 6.** Stand a damp book on its head (top edge) on the work surface and open the book, slightly fanning the pages. Don't force the book open more than about 60°. Electric fans circulating the air should not be allowed to flap the pages. Let the book stand until it is dry—check the book for dryness in several locations by feeling the gutter as deeply as possible between pages. It may take days or even a week or more for wet books to dry.

**Step 7.** Pressing can reduce cockling (rippling) of the dried pages. Manipulate the dry book into square and even shape and place it in a press or under weight (other books, a clean brick covered with cloth or paper) for a few days to a few weeks.



### **D. Pamphlets and small paperbacks**

Damp pamphlets and small paperbacks that cannot support themselves when fanned open may be supported upright to dry with the aid of bookends, or kept flat on the work surface during interleaving. If space permits, they may also be hung over fishing line to dry. Fishing line is not recommended for thoroughly wet items—it can cut the paper.

1. Start drying thoroughly wet pamphlets by laying them flat on absorbent paper; change the paper as it gets wet. Small paperback books that are thoroughly wet should be dried by following steps for **Wet (dripping) books**, above; bookends or wooden blocks may be used for support during the draining process.

2. If the pamphlet is only moderately wet or is no longer dripping, insert paper towels or unprinted newsprint cut slightly larger than the size of the pamphlet between every few pages, as described in **Steps 4-5**, above.

3. When the pamphlet or small paperback is dry enough to hang over fishing line without ripping, it may be hung up to dry completely. Otherwise, place dry pamphlets under a light weight to flatten the paper. Use fans to keep the air circulating in the drying area but do not let the breeze flap or dislodge the pamphlets.

### **E. Coated (glossy) paper**

Sort out the books printed with coated paper; many art books, journals, and magazines are printed on coated paper, and some use coated or glossy paper for sections of illustrations. The basic components of coatings contain pigments and adhesive binders. Water solubilizes the coating components, which fuses the adjacent pages together as it dries. If two sheets of coated paper dry together, it is impossible, even for professionals, to separate them. If you cannot dry coated paper immediately, freeze the book within 6 hours after it becomes wet. Place the book in a plastic ziplock bag or rewet it to prevent it from drying before being frozen. Literature recommends freeze-drying (sublimation) as the best way to dry coated paper.

If the books with coated paper can be dried immediately, follow the instructions below:

1. Cut waxed paper, paper towels, or unprinted newsprint to the approximate size of the pages in the book. Carefully separate *each* coated page in the book and place a sheet of separation paper between *each* page. It is important to place a sheet of paper between each coated page so the pages will not be able to dry together. As soon as the interleaving sheets become wet, they should be removed and replaced with dry sheets.

2. Once the pages are merely damp, the interleaving paper may be removed and the book fanned open to finish drying (Steps 6 - 7, above). Check frequently to be sure the pages are not sticking.

## Freezing a Book

Freezing a book temporarily is a viable option if you do not have the time or resources to air-dry wet books immediately, or you need extra time to find professional help. Freezing prevents further damage such as cockling, blocking and bleeding of ink. A book may safely remain frozen for months.

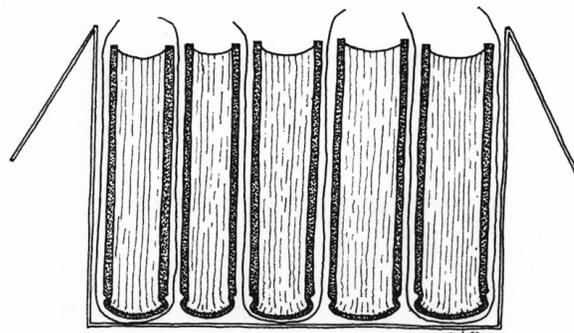
Freezer-drying occurs naturally in a frost-free freezer. Frost-free freezers—freezers that have regular automatic defrost cycles—can dry out wet books by the same process that produces “freezer burn” on frozen foods. The drying process is slow and can take weeks to over a year, depending on the thickness and wetness of the book. There are also commercial techniques for freeze-drying (by sublimation), which is different than freezer-drying. This can only be achieved through contracting with a company that specializes in drying services.

### Materials

- Paper towels or unprinted newsprint
- Freezer or wax paper
- Plastic bags
- Cardboard boxes or ventilated crates

### To freeze the book

1. Separate books with a sheet of freezer or wax paper folded around the book's cover. Place the book in a plastic bag if it needs an extra layer of protection from its surroundings. Avoid completely sealing the book in plastic so that water vapor can escape from the book by sublimation. Note that this is different from long-term cold storage and insect eradication treatment, where the frozen items should be sealed in plastic bags.



2. If processing large quantities of books, pad the cardboard boxes or ventilated crates with paper towels or unprinted newsprint. Pack books (flat on their sides or *spine down*) in the container. Remember to label the book or the container with the date and wetness so others will know what it is.

3. Place the book or box of books in a freezer. If you have a choice, use the coldest freezer available: optimal temperature is in the range -20° to -40° F. Domestic chest freezers are usually about 0° F; refrigerator ice boxes are usually just below freezing (32° F). Any of these will do, if necessary. Use plastic bags and careful placement to separate the wet book from other contents in the freezer so neither will contaminate the other if there is a power failure.

### To thaw the book

1. Remove the book from the freezer. Work with small batches from the freezer at a time.
2. Let the book come back up to room temperature. This step will take anywhere from 2 to 48 hours. Assess the wetness of the book when it thaws. Stand books on end with the boards fanned open with good air circulation. Turn books head to tail daily. Use bookends for support during this process.
3. Thoroughly dry the book, according to the instructions for **Air-Drying Wet Books** above. The amount of time it takes to dry the book will vary depending on how wet or damp it was when it was placed in the freezer and how long it was placed in the freezer.