

# Caring for your collections: Mould – how to salvage and prevent it

## Health warning:

**Moulds can be dangerous to people as well as collections.**

**Moulds are particularly harmful to those suffering from existing medical conditions, or taking a range of medications.**

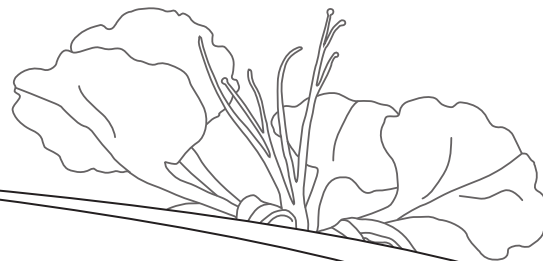
**Many moulds are potentially toxic.**

**Moulds are powerful sensitisers to people prone to allergies and asthma.**

- The damage to collections caused by mould can be irreversible and may also lead to human exposure to moulds, which are potentially harmful to health.
- Mould contamination may result in production of toxins (mycotoxins) that can be absorbed through the skin. These toxins have potential to be not only poisonous, but in some cases, are listed as possible cancer-causing agents.
- Humans can be exposed to moulds and their spores through breathing (inhalation) or through swallowing contaminated food or drink (ingestion). Hand to mouth exposure is a common route for uptake of mould.
- Most health complaints associated with mould exposure are as a result of allergy, however they can also cause infection.
- Mould spores are found everywhere in the environment but are usually at levels that are too low to create adverse health effects. Moisture and correct conditions allow mould spores to develop into mould and increase to hundreds or thousands of times baseline levels.
- Mould requires moisture, a source of food (organic products such as paper, leather and cloth are ideal nutrient sources for moulds) and oxygen to grow.
- Moisture can come from a water leak, flood, or even indoor air moisture. This makes mould a threat, especially in damp parts of buildings and in geographic areas with seasonal periods of high humidity, like many parts of Queensland.
- The majority of moulds affecting collections are “conidial” fungi that spread by releasing spores.
- Spores are between around 1 and 10 thousandths of a centimetre in diameter, and therefore can remain airborne for extended periods and travel considerable distances on indoor air currents before settling out in dust on surfaces.
- Under correct conditions, these spores germinate and develop into hyphae, which are thread-like multi-cellular structures that grow out from the spore.
- Hyphae exude substances including digestive enzymes at their tips which are absorbed onto paper or other suitable material. There the enzymes break down the cellulose and other substrates into the sugars and nutrients the mould needs to grow and produce more spores.
- Digestion of paper, cloth or leather weakens the material and causes permanent damage.
- Some of the substances produced such as melanin can stain paper, cloth or leather.
- Although good housekeeping and proper ventilation can help, it is not possible to eliminate mould from our environment.

## How to prevent mould:

- Mould is present everywhere, but certain conditions are conducive to growth and can favour different moulds. Some of the moulds that grow as a consequence of these conditions are potentially harmful to health, as well as damaging to a collection.
- Moisture is a key requirement for mould. If there is inadequate moisture, mould cannot grow.
- Outbreaks can occur surprisingly quickly.
- Mould grows in humid conditions. The most dangerous time of year for most parts of Queensland is during the wet, humid summer months.
- Monitor your collections closely to ensure small outbreaks are noticed before wide scale damage has occurred.
- Ideal conditions for mould growth are temperatures between 15 and 35°C, and relative humidity levels greater than 55%. Optimal conditions for mould growth are 25–30°C, with the rate of mould growth increasing with humidity levels.
- Always check your collection during and up to two weeks after heavy rainfall to ensure small outbreaks are noticed before wide-scale damage has occurred.
- The most effective prevention measure is to ensure conditions within your collection are hostile to mould growth. This is particularly challenging for those in most Queensland homes, during our hot, humid summers.
- Mould grows on damp items.
- Mould will also grow readily on objects that have become wet and have not been properly dried.
- If material becomes wet, dry it as quickly as possible using fans, provided it is within 48 hours of water damage.



## How to prevent mould (cont'd):

- Do not use fans in the event that water damage occurred more than 48 hours previously, as there is potential for mould growth and spore exposure after this time.
- Do not use heat, as this will encourage mould growth.
- Alternatively, use silica gel to remove moisture. Place the item in a wash-bag, the type that you use for small items in a washing machine. Place this inside a tightly sealed zip-lock bag or air-tight container that contains sufficient silica gel inside. Read all handling and safety instructions for using silica gel. If you purchase silica gel that changes colour as it takes up moisture, it can be refreshed in the oven and reused. Be sure to follow manufacturers' instructions.
- Avoid storing collections near sources of moisture or heat, such as bathrooms, kitchens or laundries.

## How to salvage mould affected material:

**As soon as you identify an outbreak, it is important that you protect yourself from exposure:**

- In the event of a localised outbreak affecting less than five items, and/or covering an area smaller than 1 square metre, it is possible to enter the area provided you are fully trained by qualified personnel in the use of the personal protective equipment (PPE) as described above and are wearing the items listed. In this event, cover the area where the items are housed with 6 mm plastic sheeting to prevent release of spores into the air and seek the advice of a conservator or professional Hygienist within 24 hours of discovering the contamination. Do not handle contaminated material until it has been examined and the mould identified by a professional trained in identification.
- In the event that mould has affected an area greater than this, or you do not have training in personal protective equipment, you should not enter the area and should call for specialist advice immediately. A hygienist and restorer will provide you with the information you need to decide the best way forward for your collection and your health.

## Understanding what caused the outbreak:

- In many cases there may be issues with air conditioning inlet points or operation, plumbing, building structure, or the location of your collection which may for example be close to cold surfaces such as an outside wall. These factors may be causing damage to your building fabric as well as your collection, so it is important to identify the source of moisture.
- Identifying the source(s) of the moisture is critical to managing the issue. Whilst these may appear obvious, professional advice is useful in establishing the source and protecting you and your collection from further damage. A professional can advise you on the likely cause of the outbreak, and make recommendations for safely preventing further problems.

## Understanding the hazards from the mould:

- It is not possible to determine how safe a mould is to handle without identification. Therefore it is not safe to handle mould contaminated items unprotected.

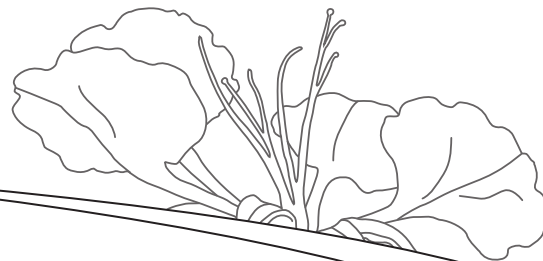
**Ensure proper safety precautions are followed when entering areas with mould affected material. The minimum protective clothing required when in contact with mould is a half-mask respirator fitted with a P2 (N95) filter, two pairs of nitrile or latex gloves (at the same time), safety glasses, and a mould resistant disposable suit. A decorators dust sheet or chemically resistant suit is not designed for mould protection. You require training in the proper fitting of respirators, as an improperly fitted respirator is ineffective and will not protect you.**

**Call an experienced conservator, Occupational or Environmental Hygienist or specialist restorer to assess the damage. Do not attempt to clean the books yourself.**

- It is possible to employ a restoration company who are trained in containing the contamination and in reducing spread through the building. If you plan to move the items yourself, you will require training in the use of PPE.
- It may be important to understand the type of spores that have been released from the affected items. This information will help to determine the clean-up strategy required for the area where the collection is stored. Much will depend on the extent, type and cause of the mould infestation.
- In the event that items are damaged in response to flooding, or water entering from outdoors for example, there may also be bacterial contamination of materials, which may contain disease-causing bacteria, as well as mould spores.
- The Hygienist may collect swabs and air samples and obtain identification of the moulds (and bacteria) from a qualified laboratory. They may also determine if the mould spore concentrations in the air have increased in response to the mould growth on the collection.

## Cleaning damaged items:

- Non-dormant moulds can cause infection if they are harmful; dormant moulds can cause infection if they are still viable, and allergies even if they are no longer able to germinate. It is therefore inadvisable to attempt cleaning of items, and better to seek assistance of a qualified conservator or Hygienist.



### Cleaning up after the event:

- Ensure firstly that the source of the contamination and/or moisture has been identified and rectified.
- If the mould has been found to be non-toxic, non-allergenic or non-pathogenic (disease causing) and is dormant, it is possible to clean surfaces provided you are trained in the use of, and wear full PPE as described. Fluffy or slimy mould is usually active, whilst dry and powdery mould is usually dormant.
- PPE is still required, as there may be low levels of unidentified mould present that were not detected during sampling. Dispose of gloves and overalls after cleaning and ensure that face masks are wiped with 80% white spirit vinegar or 70% methylated spirits after use (see below).
- Active mould and those dormant moulds that are still viable may be problematic as disease causing agents, especially to children, the elderly or those with existing medical conditions, or taking certain medications. Bacteria from outdoor water entry may also cause disease.
- Dormant mould spores, even those that can no longer germinate and are non-toxic, can cause allergic reactions. It is therefore vital that you wear PPE when cleaning mould from a surface.
- Avoid brushing spores from the surface, as this action creates an aerosol of spores that can then be carried on air to other areas or inhaled.
- HEPA filter vacuuming removes >99% of all particles down to 0.3 micrometres in diameter. This is effective for removing spores from surfaces. Pieces of fungal material smaller than this may be present, but these will remain airborne due to their small size.
- Proprietary antimicrobial agents are not all effective at destroying mould. Be wary of products claiming to kill moulds and bacteria, as the two are very different. Antifungal agents target moulds, and antibacterial agents target bacteria.
- Bleach is limited in its capacity to destroy mould, whilst it is effective at killing bacteria and inactivating many viruses. White spirit vinegar at 80% white spirit vinegar diluted with 20% water, or methylated spirits at 70% diluted with 30% water is highly effective in removing mould and preventing regrowth. Care must be taken to avoid breathing vinegar fumes, and methylated spirits is flammable. Therefore it is better not to spray these substances on surfaces, nor to store more than 200ml of methylated spirits, but to clean with these agents using a microfiber cloth.
- Have the air conditioning system cleaned and ducting replaced if it has become mould contaminated, especially if it is the source of the contamination.
- Ensure that the storage area is clean and dry prior to reintroducing the collection. It is recommended that the cleaned area is retested for mould prior to returning the collection.

### In the event that you cannot find help quickly:

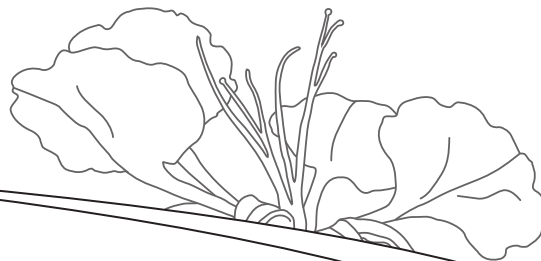
- It is possible to temporarily prevent further spread of mould by isolating items into two layers of sealed plastic (bags) sealed using packing tape, and placing in a freezer. The freezer should not contain food, and at no point should you go near food wearing PPE that has been worn in a contaminated area. It is appreciated that in many cases power may not be available at the time of the incident.

### Protection against future mould intrusion:

- Stabilise the environment
- Mould will only become dormant if the environmental conditions that activated the outbreak are altered by lowering the relative humidity ideally to below 55% coupled to temperatures below 20°C.
- Contact a conservator or air conditioning engineer to obtain advice on dehumidification techniques appropriate to your situation.
- If you were unable to identify the source, or improve environmental conditions, you may have to remove collections to an alternative location where the designated conditions can be met.

### Remain vigilant

- It is important to remember that it is extremely difficult to kill mould.
- Once conditions are conducive, growth may resume. The risk is increased for objects with porous surfaces such as paper, cloth, photographic emulsion, wood and leather, as mould spores become embedded and are difficult to remove.
- It is therefore important to regularly monitor conditions on the area and act quickly if new growth is detected.
- Inspect collections regularly.
- Keep area clean. Dust build-up will encourage mould and insect activity.
- Before bringing new objects into the area, quarantine first to check for the presence of mould.
- If the area is air conditioned, ensure that the system is well maintained and air filters are changed regularly.



## Dealing with a major outbreak

- Safe management of any mould outbreak requires specialist assistance. This will be especially important if the outbreak is widespread and severe (over 1 square metre of total mould area).
- It is not possible to know whether toxic mould is present without a formal assessment by a Hygienist working alongside a mycology laboratory.
- There are companies who specialise in disaster recovery, who can assist in the clean-up if the collections and the building.
- In the event that there is an external problem associated with the building, such as problem with plumbing, ventilation, air conditioning or structural integrity, it is important that this problem is properly evaluated, and any repairs completed by a qualified professional in that area.
- Research the companies thoroughly and ask for a comprehensive outline of their treatment approach including any solutions being applied to your collection, as some treatments can adversely affect objects.
- Badly affected or valuable collections should be treated by a qualified conservator. They will ensure that methods are not harmful and can provide advice on the best way to prevent future infestations.

**A list of private conservators working in Australia can be found on the Australian Institute for the Conservation of Cultural Materials website [www.aiccm.org.au](http://www.aiccm.org.au)**

*The State Library of Queensland has provided this information to members of the public based on their best understanding of the risks and causes associated with mould infestation of collections. The State Library of Queensland takes no responsibility for changes to insurability of the collector, collection, their premises or other, problems to health, injury, damage to collections, buildings or other associated matters arising as a result of its contents, nor of an individual's interpretation of them.*

## Further Reading:

Australian Institute for the Conservation of Cultural Materials (AICCM)  
**[www.aiccm.org.au](http://www.aiccm.org.au)**

Conservation OnLine (CoOL)  
**[cool.conservation-us.org](http://cool.conservation-us.org)**

An invaluable general conservation site providing excellent links to a number of sites on mould control.

Oxford University Library Services- Conservation and Collection Care — Mould:  
**[www.bodley.ox.ac.uk/dept/preservation/training/mould/intro.htm](http://www.bodley.ox.ac.uk/dept/preservation/training/mould/intro.htm)**

## Need further information?

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