The healthy home

Most of us spend more than 90% of our lives indoors (National Research Council 1981) so it is worth thinking more closely about air quality in our homes. This article discusses the likely sources of indoor air pollutants and the possible associated health conditions. It provides advice and actions that you can take to protect the health of people living in your home. It will also help you make better informed decisions about health and indoor air quality issues when discussing a new building project or renovation with your architect, designer, builder or building material supplier.

An ounce of prevention is worth a pound of cure.

Indoor air quality and health

Poor indoor air quality may produce a range of health effects from mild and generally non-specific symptoms such as headaches, tiredness or lethargy, to more severe effects such as aggravation of asthma and allergic responses. Most of these conditions can also arise from a number of different causes other than the quality of the air in your home.

Consult your doctor if you are concerned about any of these health conditions.

Whether a source of air pollutants causes an indoor air quality problem or not depends on:

- the type of air pollutant
- the amount and rate at which it is released from its source
- the degree of ventilation available in the home to remove it from indoors.

Common sources of indoor air pollutants include:

- building operations and construction materials
- household products
- various human indoor activities
- external factors (from outdoors).

People are most commonly exposed to air pollutants when they breathe in an air pollutant or allergen; exposure by swallowing or through the skin may occur in some circumstances. The body has a range of defences against airborne substances (e.g. skin, liver, immune system). Some defences keep substances out of the body; others overcome substances once they enter the body.

We spend much of our lives indoors where fumes can accumulate.

What you do in the home can make the single biggest difference to the health of the indoor environment, e.g. avoid smoking indoors, don't let dust build up, don't leave the car running in the garage and be wary of all fumes — if it smells bad it probably is!

What you do in the home can make the single biggest difference to the health of the indoor environment.

Generally, the greater the amount of pollutant (exposure), the greater the health impact. The duration of exposure is also important: if low-level exposure occurs over a long period of time (perhaps many years) the total dose may be large.

Some groups of people in the community are more vulnerable to pollutants than others. These include:

- the very young
- the very old
- those with pre-existing respiratory or cardiovascular disease
- those who are sensitised to a substance.

Some of these groups are also more likely to spend more time indoors than the general population.

Don't let dust build up in living and bedroom areas.

Assessing your health

Before jumping to conclusions about whether or not your home is making you ill, look for clues and patterns:

- Do you notice any change in your health before and after a particular change in the home environment?
- Is there any change in your health after particular activities, like dusting or cleaning?
- Do your health problems occur at the same time each year?
- Do your health problems get better if you and your family are away from home for any extended periods, such as holidays?

Potentially hazardous air substances

There are many different types of airborne substances. Exposure to most substances indoors is generally low and of little or no health consequence. Discussed below are some important types of pollutants and allergens that might be found in Australian homes.

Lead

Lead is a concern when small particles or fumes are swallowed or inhaled. Many older building and household products contain lead but newer products no longer do. Items such as old paint, flashing, old plastic pipe and fittings, electrical cabling and glazed pottery can contain variable amounts of lead.

Contact with lead can arise from home renovation activities, particularly when stripping old paint, through some hobbies (e.g. lead-lighting, making fish sinkers or pottery glazing) or coming into contact with contaminated soil.

Take care when renovating. Avoid sanding, abrasive blasting or burning paint containing lead. Do not burn old painted wood in fireplaces or in barbeques. For further information on lead visit www.lead.org.au.

Major sources and health effects of various pollutants

Pollutant	Major source(s)	Health effects
Nitrogen dioxide	Gas combustion	Chronic respiratory disease
Carbon monoxide	Kerosene, gas and solid fuel combustion, cars idling in enclosed garage, cigarette smoke	Aggravation of cardiovascular disease, poor foetal development
Formaldehyde	Pressed wood products, consumer products, hobby, crafts	Eye, nose and throat irritation
Volatile organic compounds (VOCs)	New building products, cleaning products, office equipment, consumer products	Eye, nose and throat irritation, headache, lethargy
Passive smoke	Tobacco smoking	Eye, nose and throat irritation, aggravation of asthma, chronic respiratory disease, lung cancer
House dust mite allergens	Dust mites in bedding, carpets, furniture	Aggravation of asthma, nasal inflammation, eczema
Mould spores	Bathrooms, damp rooms, window sills, indoor plants, poorly ventilated areas	Aggravation of asthma, nasal irritation and inflammation
Lead in indoor dust	Pre-1970s paint, hobbies and renovations	Poor childhood intellectual development
Pet dander	Cats and dogs	Aggravation of asthma and hay fever

Asbestos

Asbestos was used widely in the construction, car and textile industries because of its strength and ability to resist heat and acid. It is no longer allowed to be used in building products for the home.

Asbestos-containing products were rarely labelled. Products like cement sheet, roofing sheet, some textured paints, vinyl floor tiles, pipe lagging and fire-resistant boards and blankets used in the home before the mid-1980s may contain asbestos.

Generally, home building products containing asbestos are not a health risk but if asbestos is disturbed to produce fibres or dust, asbestos fibres may be released into the air and inhaled.

Always seek professional advice about managing asbestos in your home. Accurate identification can be difficult, and immediate removal is often not the best option.

Combustion products

Combustion products include smoke (small soot particles), ash and gases that can get inside your home from fireplaces and heaters burning wood, coal, gas or kerosene, gas cooking appliances, tobacco smoking, outdoor air, exhaust from cars in garages, and hobbies such as welding and soldering.

Combustion particles are so small they behave almost like a gas — they can enter or leave a home very easily. When you breathe them in they travel into the deepest part of the lungs. Under certain circumstances these particles and gases may cause ill health or, in extreme cases, even death.

To maintain good air quality when you have combustion sources:

- vent products to the outdoors (via a flue, chimney, exhaust fan or range hood) where possible
- keep flues and chimneys clean, and make sure any permanent ventilation openings are not blocked
- service heating or cooking appliances regularly to ensure they are working properly and are not leaking gases into your home
- ensure plenty of fresh outdoor air is coming into the room(s)
- make sure insulation has not obstructed a heater flue or ventilators in the wall or roof space
- always follow the appliance manufacturer's instructions — seek advice from the manufacturer, supplier or your gasfitter/plumber if you have any concerns
- ensure doors connecting garages to the house are tightly sealed
- minimise running time for vehicle engines in garages
- never use an appliance if it is damaged or not working properly
- do not use a gas oven or gas cooker to heat a room
- do not use barbeques or camp stoves indoors.

Volatile organic compounds

Volatile organic compounds (VOCs) are chemicals containing carbon that evaporate into the atmosphere at room temperature. They often have an odour and are present in a wide range of household products, construction materials and new furnishings. Household products that contain VOCs include paints, varnishes, adhesives, synthetic fabrics, cleaning agents, scents and sprays. VOCs can also result from personal activities, such as smoking.

When used in building products or other indoor items VOCs slowly make their way to the surface and 'off-gas' into the surrounding air. Most off-gassing occurs when products are new and/or freshly installed, after which it lessens dramatically over time.

Only a few specific VOCs have been studied in detail and little is known about the health hazards when VOCs mix with each other and other pollutants. The level of VOCs in the home can vary greatly, not only over time but also from room to room, especially if new VOC-containing products are frequently introduced.

Strategies to reduce VOC exposure in the home take two forms:

- Stop or reduce the use of products that contain VOCs.
- If you need to use the product, ensure adequate ventilation when using it: open doors and windows whenever practicable.

Air fresheners, cleaning sprays, polishes, spray deodorants and other toiletries are major sources of VOCs and should not be used excessively in non-ventilated areas. Building products are another source of VOCs. When selecting such products you should:

- look for building products that are pre-dried in the factory or are 'quick-drying'
- use surface coating products that are water based or classed as containing zero or low levels of VOCs
- seek advice from the supplier or manufacturer, particularly if the information displayed on the container is not clear — ask for the product's material safety data sheet (MSDS)
- when adding new furnishings or resurfacing walls and floors ensure rooms are fully ventilated until the odour reduces considerably or disappears.

Four steps to better air quality

Eliminate — Identify the source of air problems and wherever possible eliminate through better product selection and design.

Ventilate — If too little fresh air enters a home, pollutants can accumulate to levels that can pose health and comfort problems. Ventilate the home to remove these.

Separate — Separate problem materials from occupants by using air barriers or sealers such as coatings.

Absorb — Indoor plants can be used to improve the quality of the indoor environment, as well as add beauty.

Questions for a healthy home

Planning

What was the home site previously used for?

The land on which you intend to build (or have built) may have chemical residues from previous industrial or agricultural processes. Talk to local long-term residents about the land's former use. Visit the planning section of your local government. Get advice about legal searches that might show how the land was used.

What about current and future industrial or agricultural development?

Check how emissions from existing or future industries might affect your home. The closeness of a main road, bus depot, airport, orchard or industrial plant can affect the amount of airborne pollutants entering your home. Check with your local council about likely future land use in your area. The National Pollutant Inventory (NPI) is a database of national information on pollutant emissions and their sources.

Does the home's location make best use of the local climate?

Local topography, proximity of trees and nearness to water all influence air temperatures and wind patterns around your home. A home on top of an exposed hill will be affected differently to the same home in a deep valley or on an urban block with houses nearby. Design to enhance natural ventilation and shelter in a way that takes account of your home's specific location. (see *Choosing a site*; *Design for climate*)

If buying or moving to an established home, will major renovations be needed?

The materials used in some old homes, as well as the activities associated with renovation, can increase the health risks for renovators and anyone else in the home during the work. Assess the risks and manage them through safe work practices and clean-up.

Will the main types of plants in the area to which you intend moving make your hay fever worse?

Ask a local plant specialist about the main local vegetation types within a kilometre of your new home. Moving to the new home without investigating its surroundings might lead to future health problems.

Design

How effectively does the home's design use natural ventilation?

Good design and orientation can encourage breezes and convection currents to draw stale air out and fresher air in. If windows are closed for security or noise reasons, install fixed wall vents to ensure adequate ventilation. Strike a balance between the need to introduce fresh air, maintain comfortable room temperatures and conserve energy. (see *Orientation*; *Passive cooling*)

Does the home's design keep moisture to a minimum?

In brick homes, if a damp-proof course has not been fitted or has been broken, moisture may migrate from the ground into the wall. High and prolonged periods of humidity can increase the moisture within the building. Avoid mould growth by lessening moisture levels in your home.

Will building security compromise health outcomes?

Closing doors and windows may improve security but it reduces air exchange. Install security products that allow you to feel secure but also allow you to regulate the air flow between indoors and out.

Is mechanical ventilation a good idea?

Most Australian homes rely on openable windows and doors (and in older homes fixed wall vents) to provide ventilation. Ducted air systems may heat or cool recirculated indoor air but fail to introduce fresh air from outdoors or remove pollutants. Seek advice from a specialist engineer about mechanical ventilation systems. Evaporative cooling systems increase indoor

humidity and may increase levels of mould or dust mites. Make sure all units are regularly maintained. (see *Heating and cooling*)

Does your home 'design out' termites?

Termites are part of Australia's ecology. In the past, environmentally persistent organochlorines were used to kill them but these are now banned due to health and environmental concerns. The replacement — organophosphates — poses less of an ecological hazard and has less potential for long-term health risks. Specially designed physical barriers, such as mesh or crushed rock, reduce the need for extensive and repeated chemical treatment.

Can dust be easily removed from the rooms?

The visible and invisible dusts in your home are made up of many substances. While most of the dust will be benign, there may be a small proportion that, if inhaled or swallowed, could trigger a health response. Design and furnish your home with easy to clean and washable surfaces and/or fabrics.

Are there carpeted floors?

If new carpets are fixed with adhesives, these may contain VOCs. Underlay can also be a source. Ask to see carpets promoted by manufacturers as 'low emission' products. Make sure your supplier unrolls the carpet in a well-ventilated area and lets it air for several days before it is delivered and installed.

Trapped dust and microbiological pollutants can be a problem if they are released from the carpet into the air, or may be a direct problem for crawling babies and young children playing on carpets.

What about tiled, vinyl, linoleum or polished floors?

Smooth floor surfaces such as ceramic tiles, vinyl linoleum or polished wood can be easier to clean. Before specifying such products, check whether there are likely to be any VOCs present, either in the product itself or in other products used to lay it (e.g. adhesives) or to seal the floor covering (e.g. varnishes and paints) and for maintenance products such as cleaning fluids and polishes.

Is a wood-burning heater your best option?

Poorly installed or badly maintained wood-burning heaters and stoves can be a major source of fine combustion particles and gases from leaks and from opening of the door for refuelling. Before installing a wood-burning heater or stove check that your local government allows them. Compare safety and efficiency

Hard floors are easy to keep clean.

claims of competing manufacturers. Ensure the flue or vent is properly designed and installed and is regularly maintained. Burn only well-seasoned wood. (see *Heating and cooling*)

Are gas appliances vented to the outside?

Buy appliances that vent their combustion products to the outside. Gas cookers should be vented to the outside by an exhaust fan or a range hood.

Unvented mobile gas heaters are considered by some researchers to pose a health risk and have been associated with more frequent respiratory symptoms. If the use of unvented heaters is unavoidable, buy only low-NOx (nitrous oxide) appliances, and don't operate them in confined spaces for long periods of time. Ventilate the heated area with fixed wall vents (compulsory in some states). Ensure regular maintenance and servicing by a licensed gasfitter. Older heaters (pre-1990) are more likely to produce higher NOx values than new heaters. Consider replacing your old model with a new, flued (vented) model.

Is there a sealable door between the garage and the rest of your home?

The exhaust from conventional petrol and diesel engines contains many pollutants, including millions of very fine particles and a variety of toxic gases. Such engines should not be run in confined spaces (like a garage) for more than a few seconds, unless there is very good ventilation. Do not allow contaminated air from the garage to circulate through your home. Choose a garage that stands apart from your home. If it is attached, make sure the linking door is well fitted and able to be securely sealed against leaks.

In-use/maintenance

Do the kitchen, laundry or bathroom windows remain damp for more than 15 minutes after cooking or washing?

Depending on your home's original design or the impact of recent renovations there may not be enough 'air changes' to quickly remove cooking odours or moisture. The kitchen, laundry and bathrooms should have exhaust fans to vent moist air to the outside. Ask your fan supplier about energy efficient models. In the absence of exhaust fans, and where it is safe to do so, open kitchen and/or bathroom windows to 'flush' the air after cooking, washing clothes and bathing.

When was the kitchen exhaust fan or range hood last cleaned?

A well-sited kitchen exhaust fan and/or range hood that vents to the outside may remove many of the particles and gases that arise when cooking on gas stoves, but fat droplets settle within the vent. These deposits build up over time and can become both a fire hazard and a home for fungi and bacteria. Wash exhaust fans and range hoods regularly.

Is the floor properly cleaned?

Poorly cleaned carpets become reservoirs for dust and microbiological pollutants. Clean carpets regularly to minimise health risks. Invest in a vacuum cleaner with high filter efficiency (HEPA filters) and mechanical pile agitation. Carpets should be professionally cleaned every 18 months. Seek professional advice about the best way to clean your carpet — methods will vary depending on the type of carpet, its 'backing' and underlay, and the level of traffic and type of use. Smooth flooring should be cleared of dust before wet mopping so that the water does not simply spread the dust. Avoid cleaners that use fragranced products as they include VOCs.

How well does your vacuum cleaner capture fine particles?

Most modern mobile vacuum cleaners are good at picking up and retaining visible dusts. However, many struggle to remove all the particles trapped in carpets, and most machines let very fine particles pass through the filter/bag, back into the room's air.

If your health or that of your family seems to suffer after floors have been vacuumed, consider a central vacuum system which expels air outdoors. Alternatively, purchase a high filter efficiency (HEPA) vacuum cleaner, preferably with mechanical pile agitation (they cost more). If you are particularly sensitive to allergens, wear a face mask during vacuuming and for a short period afterwards.

Are doormats located at all entrance points?

Carried in on footwear, pollutants including lead particles from vehicle exhausts or contaminated soil can enter your home and become part of the breathable dust load. Doormats can reduce the amount of material brought into your home.

How good a fit is the 'fitted kitchen'?

Cockroaches seek tight spaces to squeeze into. With food, water and a snug place like the little cracks and crevices common in poorly fitted kitchens, cockroaches couldn't be happier. Plug all gaps between kitchen units, walls and floor. Ask your local hardware supplier about the types of non-toxic gap sealants available.

Kitchen cabinets should be well-fitted and all surfaces kept properly clean.

The wood you intend to burn: has it been chemically treated?

Do not burn chemically treated wood, indoors or out. Do not burn wood with varnish, paint or other visible chemical treatment, like creosote, or chromated copper arsenate (CCA). If in doubt, don't burn. Well-seasoned, clean wood is best for burning in heaters and stoves.

Thinking of buying new fixtures made of pressed wood products?

Most modern furniture is made wholly or partly from plywood, particleboard or medium-density fibreboard (MDF). The resins in these products can off-gas formaldehyde for many years. Australian manufacturers produce low emission products: they are marked low formaldehyde emission LFE (E1) or LFE (E0) and their emissions are certified through product quality assurance programs. Some imported products may have high emission levels. Check the origin and emission class with your retailer or contact the Australian Wood Panels Association.

Do the new soft furnishings have low gas emissions?

Many soft furnishings contain foams or other synthetics. These can release various unhealthy gases over time. Some manufacturers are working to reduce off-gassing. Ask suppliers for details about the chemicals used in the product, particularly VOCs, and their advice on possible health effects. Try to find products with low-emission labels.

Is that fragrant product such a good idea?

Most liquid cleaning agents, many personal hygiene products, air fresheners and perfumed toiletries contain VOCs. Some people's health rapidly deteriorates after smelling or coming into contact with one or more of these types of product, even for just a few seconds.

Are you looking after your compost heap properly?

A compost heap needs regular maintenance and should be located well away from living areas. Unless the heap is managed correctly, not only will it attract unwanted vermin, such as rats, mice and cockroaches, but it may also increase the numbers of fungal spores in the air close to your home. Most gardening books and nurseries provide good information on how best to look after your compost heap.

Has the potting mix been stored in a cool place?

Sealed bags of soil potting mix have been known to contain high levels of the bacteria responsible for legionnaires' disease. Store unopened bags in a cool, dark place. When opening a bag for the first time, do so in a well-ventilated area and avoid breathing the dust. Wear a face mask.

Renovation

Does the paint you intend to remove contain lead?

Lead paint is most likely to be found in homes built before 1970. Paints containing up to 50% lead were commonly used on the inside and outside of houses built before 1950. Up to the late 1960s paint with more than 1% lead was still being used. Regulations have reduced the levels of lead in paint to 0.1%.

Commercial home test kits are available from some hardware stores. For more reliable results, use the services of an analytical laboratory. If you do find lead in or around your home, phone your state or territory public health unit for advice.

What precautions are you or your painting contractor taking when sanding back existing paint?

Rubbing existing paint with an abrasive, such as sandpaper, creates a lot of fine particles. This is a potential health risk, both when the particles are in the air (where they can be inhaled) and when they settle on a surface (where children or pets may swallow them).

The risk increases if the paint contains more than very small amounts of lead or other metals. Contractors know how to capture the dust before it travels any distance through or into your home and should take care in cleaning up residues. Without appropriate equipment, vacuuming of lead paint dust is not recommended.

References and additional reading

Asthma Australia. www.asthmaaustralia.org.au

Australasian Society of Clinical Immunology and Allergy. www.allergy.org.au

D'Alessio, V. 2002. Allergy free home: a practical guide to creating a healthy environment. New Holland, Sydney.

Department of Education, Employment and Workplace Relations, Office of Asbestos Safety. www.deewr.gov.au

Department of Health and Ageing. 2004. Healthy homes: a guide to indoor air quality in the home for buyers, builders and renovators. DHA, Canberra. www.health.gov.au

Gelder, J and Onyon, L. 2001. An introduction to chemical risks in the built environment. Environment design guide, PRO 4. Australian Institute of Architects, Melbourne. www.environmentdesignguide.com.au

Lead Education and Abatement Design Group. www.lead.org.au

MSDS. 2011. Material safety data sheets. www.msds.com.au

National Research Council. 1981. Indoor air pollutants. National Academy Press, Washington DC.

Spengler, J, McCarthy, J and Samet, J (eds). 2001. Indoor air quality handbook. McGraw-Hill, New York.

Total Environment Centre. 2011. Safer solutions: keeping your home healthy and green. Total Environment Centre, Sydney South. www.safersolutions.org.au

Authors

This article has been adapted from *Healthy homes: A guide to indoor air quality in the home for buyers, builders and renovators*, Department of Health and Ageing, 2003.

Updated by Department of Resources, Energy and Tourism, 2013