# Indoor air quality (IAQ)

Increasing energy costs and the arrival of the colder season means new challenges for balancing the need to save energy, maintain a comfortable indoor temperature, and still be able to take measures to improve the quality of indoor air within a setting.

This brief will outline the importance of good indoor air; lessons learned from the COVID-19 pandemic, and outline our recommendations for tackling this issue, as we move into the autumn/winter season.

# Why is indoor air quality so important?

We spend almost all our lives indoors, with most people being indoors about 90 per cent of the time. Unlike outdoor air, indoor air is continuously recycled, trapping and building the pollutants. Even if we keep indoor surfaces clean, air pollutants may still be present in large quantities.

## Indoor air quality and disease transmission

The COVID-19 pandemic brought home the importance of IAQ and underlined the role buildings and transport play in the transmission of disease. Transmission has been observed in poorly ventilated or crowded indoor settings, as aerosols can remain suspended in air or travel further than conversational distances. Understanding how COVID-19 is transmitted in various settings is still an area of ongoing research.

## Wider health issues

Indoor air pollution can cause a number of health issues, some of which can be severe. More mild health impacts include irritation to the eyes and respiratory systems, but prolonged exposure to poor air quality can result in developing chronic cardiovascular and respiratory diseases.

In January 2020, the Royal College of Paediatrics and the Royal College of Physicians carried out a systematic review to find scientific studies about effects of indoor pollution on children’s health. Over 80% of the research found links between indoor pollution and children’s respiratory health. There was also evidence of links to other conditions, which included eczema, dermatitis, greater hyperactivity, skin and eye irritations and difficulty sleeping.

## Indoor air quality and cognitive function

The build up of carbon dioxide and other indoor air pollutants can affect your concentration, with studies showing that better ventilation can help concentration, productivity and performance. Children may be affected more by higher CO**2** concentrations than an adult, due to their smaller body size.

A [Harvard University study](https://ehp.niehs.nih.gov/doi/10.1289/ehp.1510037#f2) published in 2016 found statistically significant declines in cognitive function scores when CO**2** concentrations were increased to levels that are common in indoor spaces. Cognitive function scores were 15% lower at around 945 ppm CO**2**, and 50% lower at around 1400 ppm CO**2**, when compared to “green” buildings with steady airflow from outside.

# Common indoor air pollutants

Poorly ventilated spaces not only increase the risk of disease transmission, but also risk the build-up of harmful pollutants, which can have a detrimental effect. Some common examples are

**Carbon dioxide (CO2)**: sources include exhaled air, inadequate ventilation, combustion processes. Health effects include dizziness, headache, fatigue, and confusion.

**Carbon monoxide (CO)**: sources include faulty, incorrectly installed, poorly maintained or poorly ventilated cooking or heating appliances which use fossil fuels. Low levels of expose can cause headaches, dizziness, disorientation, nausea and fatigue.

**Particulate matter**: this is made up of tiny particles and liquid droplets that can include chemicals, metals, dust and mould spores. Health effects include respiratory symptoms, skin and eye irritations, asthma, Cardiovascular Obstructive Pulmonary Disorder (COPD).

**VOC’s:** Volatile organic compoundssources include solvents, glues, cleaning agents, pesticides, paints, air fresheners, printers and copiers, and some building materials. Short-term exposure to volatile organic compounds can cause eye and respiratory tract irritation, headaches, dizziness, visual disorders, fatigue, loss of coordination, allergic skin reactions, nausea, and memory impairment.

# Tackling the issue

Take a holistic approach starting with reviewing the building as a whole. How does the building smell? Smelling stuffy room air is a sign that carbon dioxide concentration is high, and the ventilation is poor.

Consider areas where pollutants are produced in significant quantities – can they be extracted before they spread through the rest of the building? Examples could be kitchen and bathroom areas, or a metalwork/woodwork room in a school.

Consider any occasional activities, which might generate extra pollutants - for example fumes from painting.

# Practical controls

## Ventilation

Ventilation can be ‘natural’ (opening windows) or mechanical (using systems of ducts and fans to provide air to the building, usually ‘plumbed in’ to the building) or a combination of the two, for example an extract fan such as in a bathroom to remove ‘waste’ air with fresh air coming from openings in the building. (Most schools rely on this method).

## Filtration

If you cannot get enough outside air in, or the outside air is not good/clean, the air can be run through a HEPA filter. There is an online calculator available (see link under additional resources) to tell you how much clean air is needed, based on the size of the space and the number of occupants (based recommendations from Unison and HSE). We appreciate that there are cost and resource implications to using filters – the message is if you can consider filtration then do, and if it is not possible to meet the recommended HEPA filtration, any filtration is better than none.

## Using CO**2** Monitors

CO**2** measurements should be used as a broad guide/proxy measure for the quality of air within a space, rather than treating them as ’safe thresholds’ as CO**2** monitors do not specifically measure levels of other pollutants. However, they do help check there is enough fresh air getting into the room (providing the room is occupied, as you need people breathing to generate the CO**2** being measured). If the monitor shows consistently high levels, indicating stale air accumulation, then look at other measures to bring it down. As of 24 June 2022, the Government had supplied over 386,000 CO**2** monitors to state funded education settings to support them in being able to assess ventilation needs in their setting.

# Balancing the need for good indoor air quality with thermal comfort and rising energy costs

There is no easy answer to this, and there will be some potential trade-offs between maintaining/improving indoor air quality in a comfortable temperature, whilst trying not to impact on energy costs. However, there are things that can be done to make the most of ventilation for comfort and infection risk, whilst balancing the need to save energy.

* Bear in mind that in winter when it’s cold and windy it is easier to ventilate as you can get away with smaller openings or opening occasionally (bigger temperature differences between indoors and outdoors creates more airflow).
* Open windows and doors at key times (i.e. after certain activities, between classes, or for 10 minutes a few times a day). Be strategic, i.e. if near a busy road, don’t open at busy times.
* Opening high up windows can help reduce cold draughts. If any windows are painted shut, get them unstuck.
* Ensure existing ventilation such as vents fans, ducts, air bricks etc. are maintained, cleaned and unblocked.
* Ensure existing ventilation systems are maintained and everyone knows how to use them - keep instructions displayed.
* Keep everything under review, especially if the occupancy or use of the building changes in any way.

Please contact us with any questions, concerns or comments at [dph@northyorks.gov.uk](mailto:dph@northyorks.gov.uk)

# Additional resources and information

Royal College of Paediatrics and Child Health (Jan 2020) The inside story: Health effects of indoor air quality on children and young people  
[the-inside-story-report\_january-2020.pdf (rcpch.ac.uk)](https://www.rcpch.ac.uk/sites/default/files/2020-01/the-inside-story-report_january-2020.pdf)

The PROTECT COVID-19 National Core Study on transmission and environment  
[PROTECT COVID-19 National Core Study | (manchester.ac.uk)](https://sites.manchester.ac.uk/covid19-national-project/)

Building Bulletin 101: Ventilation, thermal comfort and indoor air quality 2018 <https://www.gov.uk/government/publications/building-bulletin-101-ventilation-for-school-buildings>

[Summary of CO2 monitors and air cleaning units survey findings and applications for DfE-funded air cleaning units (publishing.service.gov.uk)](https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/1086631/FINAL_ACU_CO2_Evaluation_30_June_2022.pdf)

Clean air resources for schools  
<https://www.actionforcleanair.org.uk/schools>

HEPA filter online calculator  
<https://cleanairstars.com/filters>

GOV.UK guidance on Ventilation to reduce the spread of respiratory infections, including COVID-19 [Ventilation to reduce the spread of respiratory infections, including COVID-19 - GOV.UK (www.gov.uk)](https://www.gov.uk/guidance/ventilation-to-reduce-the-spread-of-respiratory-infections-including-covid-19?utm_medium=email&utm_campaign=govuk-notifications-topic&utm_source=4f649d27-e789-4a62-ad0e-74899732045f&utm_content=daily)

Health & Safety Executive (HSE) guidance on ventilation in the workplace  
[Ventilation in the workplace (hse.gov.uk)](https://www.hse.gov.uk/ventilation/)

Harvard University research

[Poor indoor air quality may dull cognitive abilities | News | Harvard T.H. Chan School of Public Health](https://www.hsph.harvard.edu/news/hsph-in-the-news/indoor-air-quality-cognitive-abilities/)

Schools Week article ‘School hopes fresh air will help clear exam minds’.

[School plans to keep its windows open after CO2 levels soar (schoolsweek.co.uk)](https://schoolsweek.co.uk/school-hopes-fresh-air-will-help-clear-exam-minds/)