

HEALTHY AIR

Did you know that air pollution is a problem that can affect your health? You might have heard of air pollution outside, such as smelly exhaust fumes next to busy roads, but air pollution can be a problem inside as well. Children in the UK spend most of their time inside, in fact on average children spend only 68 minutes per day outside, so having clean air inside is important to keeping fit and healthy.

How much time did you spend outside today?

Is this more or less than the average of 68 minutes?

Pick a different day, maybe a weekend or a day with different weather conditions. How much time did you spend outside?



T D G V S D M K L G G W K M Y L T D D S
W J K X N W M P B J N J X C K Q Z R I Z
R B Q N F Y R O G Q R O G O V R D V F D
B E B F L N K Q L N T Y F H T R G F F U
R R D G V Q S X C D G U U B P B G M I N
A C E N T H Y P E R A C T I V I T Y C H
L U V A E Z G C M B H B C T C W Y F U I
L S F D T S F B K T S V V B J G L H L N
E I H K Q H S W S W Y D N Q S Y Y S T A
R C S V M M I O F G X L G Y H Q P Z Y T
G C H E S T I N F E C T I O N S T Z S T
Y D K P C M G M G T I C F V T J C M L E
W R B S F B S T W P H Z W T N M C P E N
T N E T Z G F W B B R E T H G Q B B E T
W D C B S F P G G K P O E C E C V R P I
R G Z V Q T T H S Q T Z B Y P E W K I O
D X E Y P G D M F Y K S M L E C Z L N N
B K M R E S R S H N K Q F N E S J E G I
E K A N J S K I N P R O B L E M S Z M N
S J T Z J D R P Z F R F L R Z P S W L R

The wordsearch includes different problems school age and pre-school children might experience that are sometimes caused or made worse by dirty air.

Pre-school

- Allergy
- Chest infections
- Skin problems
- Hyperactivity
- Inattention

School age

- Difficulty sleeping
- Redness of the eyes

Both

- Breathing problems
- Wheeze
- Eczema



Do you ever feel any of these things? Where do you feel them?

HEALTHY AIR



ANSWER SHEET

T	D	G	V	S	D	M	K	L	G	G	W	K	M	Y	L	T	D	D	S
W	J	K	X	N	W	M	P	B	J	N	J	X	C	K	Q	Z	R	I	Z
R	B	Q	N	F	Y	R	O	G	Q	R	O	G	O	V	R	D	V	F	D
B	E	B	F	L	N	K	Q	L	N	T	Y	F	H	T	R	G	F	F	U
R	R	D	G	V	Q	S	X	C	D	G	U	U	B	P	B	G	M	I	N
A	C	E	N	T	H	Y	P	E	R	A	C	T	I	V	I	T	Y	C	H
L	U	V	A	E	Z	G	C	M	B	H	B	C	T	C	W	Y	F	U	I
L	S	F	D	T	S	F	B	K	T	S	V	V	B	J	G	L	H	L	N
E	I	H	K	Q	H	S	W	S	W	Y	D	N	Q	S	Y	Y	S	T	A
R	C	S	V	M	M	I	O	F	G	X	L	G	Y	H	Q	P	Z	Y	T
G	C	H	E	S	T	I	N	F	E	C	T	I	O	N	S	T	Z	S	T
Y	D	K	P	C	M	G	M	G	T	I	C	F	V	T	J	C	M	L	E
W	R	B	S	F	B	S	T	W	P	H	Z	W	T	N	M	C	P	E	N
T	N	E	T	Z	G	F	W	B	B	R	E	T	H	G	Q	B	B	E	T
W	D	C	B	S	F	P	G	G	K	P	O	E	C	E	C	V	R	P	I
R	G	Z	V	Q	T	T	H	S	Q	T	Z	B	Y	P	E	W	K	I	O
D	X	E	Y	P	G	D	M	F	Y	K	S	M	L	E	C	Z	L	N	N
B	K	M	R	E	S	R	S	H	N	K	Q	F	N	E	S	J	E	G	I
E	K	A	N	J	S	K	I	N	P	R	O	B	L	E	M	S	Z	M	N
S	J	T	Z	J	D	R	P	Z	F	R	F	L	R	Z	P	S	W	L	R

About this worksheet: More information can be found in the RCPCH RCP 2020 publication *The Inside Story: Health effects of indoor air quality on children and young people*. Many of the Indoor Air Quality Working Party members were contributing authors to this publication and have produced these worksheets as a first step towards addressing this request from children and young people.

BUILDING BUNTING

Buildings are complicated environments, and different activities and objects in buildings can create substances that can be harmful if they reach high levels. Other substances are found outside. These substances can be gases, water vapour or tiny particles in the air.

Each of the triangles contain:

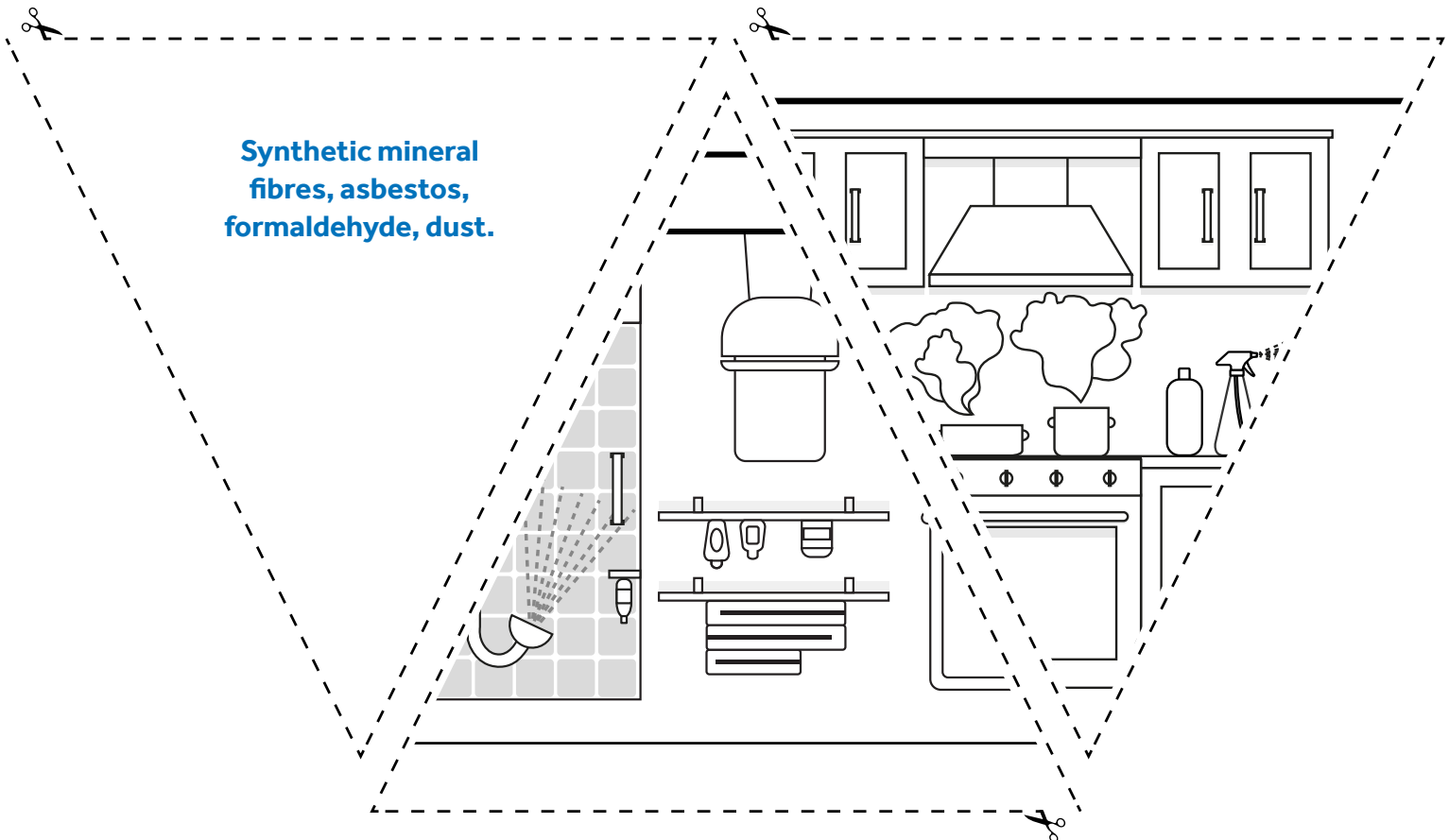
- A drawing of a room that you might have in your home; or
- A description of some substances and objects or activities that can be sources of potentially harmful indoor air pollution.

1. Cut out all the triangles and write the names of the rooms on the pictures. The rooms included are: **bedroom, bathroom, kitchen, attic, living room and garage.**

2. Next, match up the descriptions to the drawings. If you want, you can stick the description to the back of each drawing, colour the pictures in and join them together to make a set of bunting.



Synthetic mineral fibres, asbestos, formaldehyde, dust.



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BUILDING BUNTING

Dust and dust mites,
bacteria and viruses,
pet hair, and
chemicals from
personal care
products.

Gases and particles from
gas cooker, chemicals
from cleaning
products.

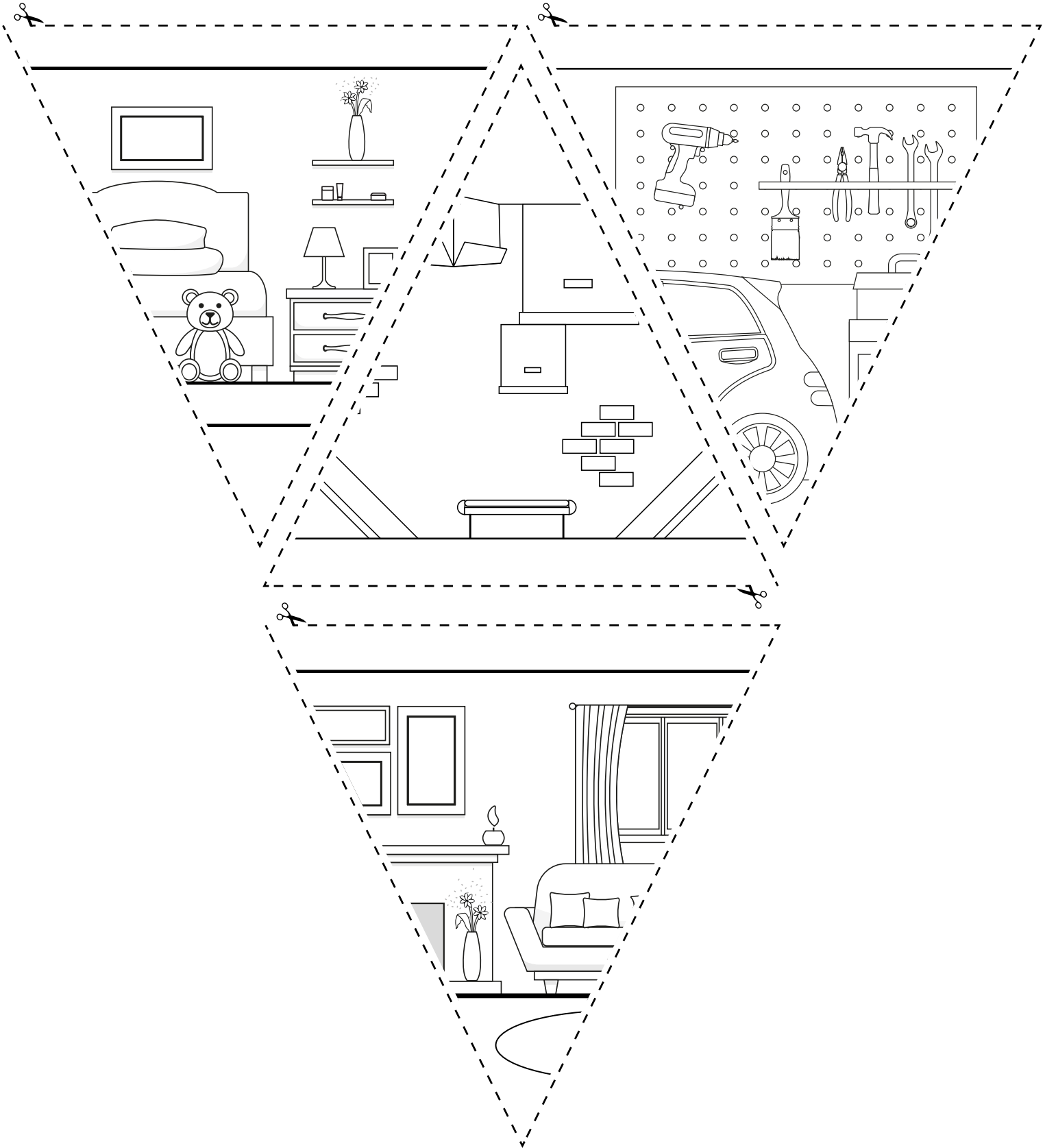
Mould and damp,
chemicals from cleaning
and personal care
products.

Gases from car exhaust,
damp and mould,
chemicals from
stored paints and
pesticides.

Radon gas from the ground in affected
areas, pollen from indoor plants,
gases from fires and wood-
burning stoves, chemicals
and formaldehyde from
carpets, paints, glues,
furniture and air
fresheners,
cigarette
smoke,
pet hair.

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BUILDING BUNTING

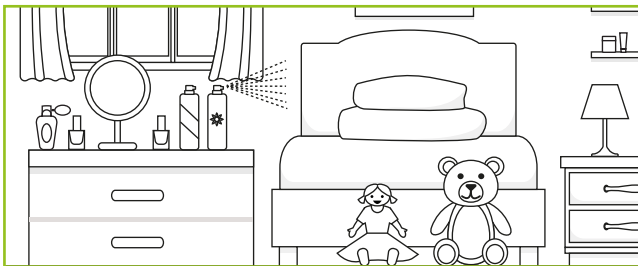


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BUILDING BUNTING



ANSWER SHEET



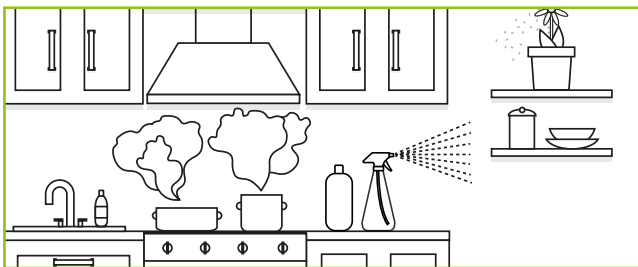
Bedroom

Dust and dust mites, bacteria and viruses, pet hair, and chemicals from personal care products.



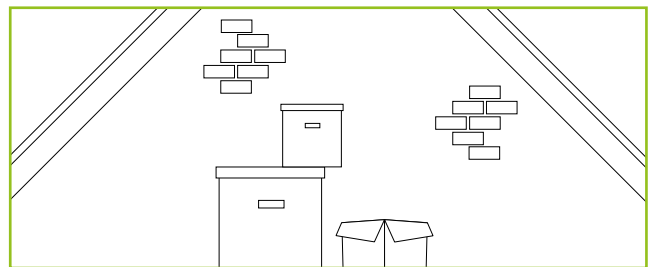
Bathroom

Mould and damp, chemicals from cleaning and personal care products.



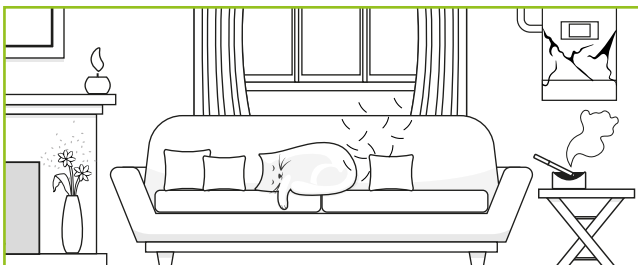
Kitchen

Gases and particles from gas cooker, chemicals from cleaning products.



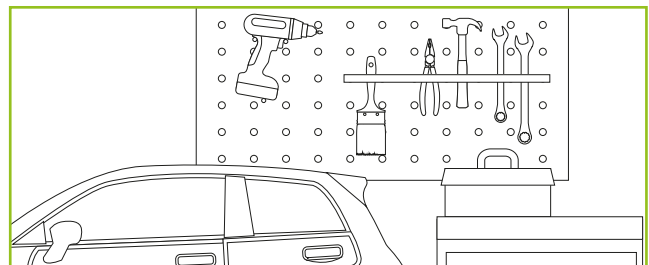
Attic

Synthetic mineral fibres, asbestos, formaldehyde, dust.



Living areas

Radon gas from the ground in affected areas, pollen from indoor plants, gases from fires and wood-burning stoves, chemicals and formaldehyde from carpets, paints, glues, furniture and air fresheners, cigarette smoke, pet hair.



Garage

Gases from car exhaust, damp and mould, chemicals from stored paints and pesticides.

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SPOT THE SIGNS

Common activities and objects found inside buildings can create or emit substances into the air that may be harmful to health at high levels. Indoor air scientists call these pollutant sources.



The picture shows 10 sources and signs of dirty indoor air, can you spot them all?

Write down why you think they might be a problem.



1		6	
2		7	
3		8	
4		9	
5		10	

SPOT THE SIGNS



ANSWER SHEET

<p>1</p>	<p>Burning food can be a source of particles and so you should avoid burning food if possible.</p>	<p>6</p>	<p>Personal care products can also release chemicals (VOCs) and particles into the air. If possible, use non-spray options, or use ventilation at the same time.</p>
<p>2</p>	<p>Soft furnishings such as rugs and carpets can collect dust, this can be released back into the air and can trigger allergies in some people.</p>	<p>7</p>	<p>Vacuuming is one of the easiest ways to clear dust, which is especially important for people with asthma. However, if it isn't emptied regularly and kept in good condition, a vacuum cleaner can release dust and particles back into the air.</p>
<p>3</p>	<p>If you have one it is best to use the cooker hood during cooking to extract any pollutants to outside. Putting lids on pans also reduces the amount of steam, which would help keep the humidity down.</p>	<p>8</p>	<p>Mould is more likely to form in cold damp environments. Cleaning off visible mould can help, if you have persistent mould in rented housing you can contact your landlord or environmental health department.</p>
<p>4</p>	<p>Pet hair and dander can trigger allergies for some people.</p>	<p>9</p>	<p>Drying clothes inside releases water vapour into the air, which can cause damp.</p>
<p>5</p>	<p>Cleaning products are a source of VOCs (chemicals). It can help to use one multi-purpose cleaner for everything to reduce the number of different chemicals in the air.</p>	<p>10</p>	<p>Opening windows is a simple way to improve indoor air by letting outside air in, if the outside air isn't polluted.</p>

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WHAT IS IN DIRTY AIR?

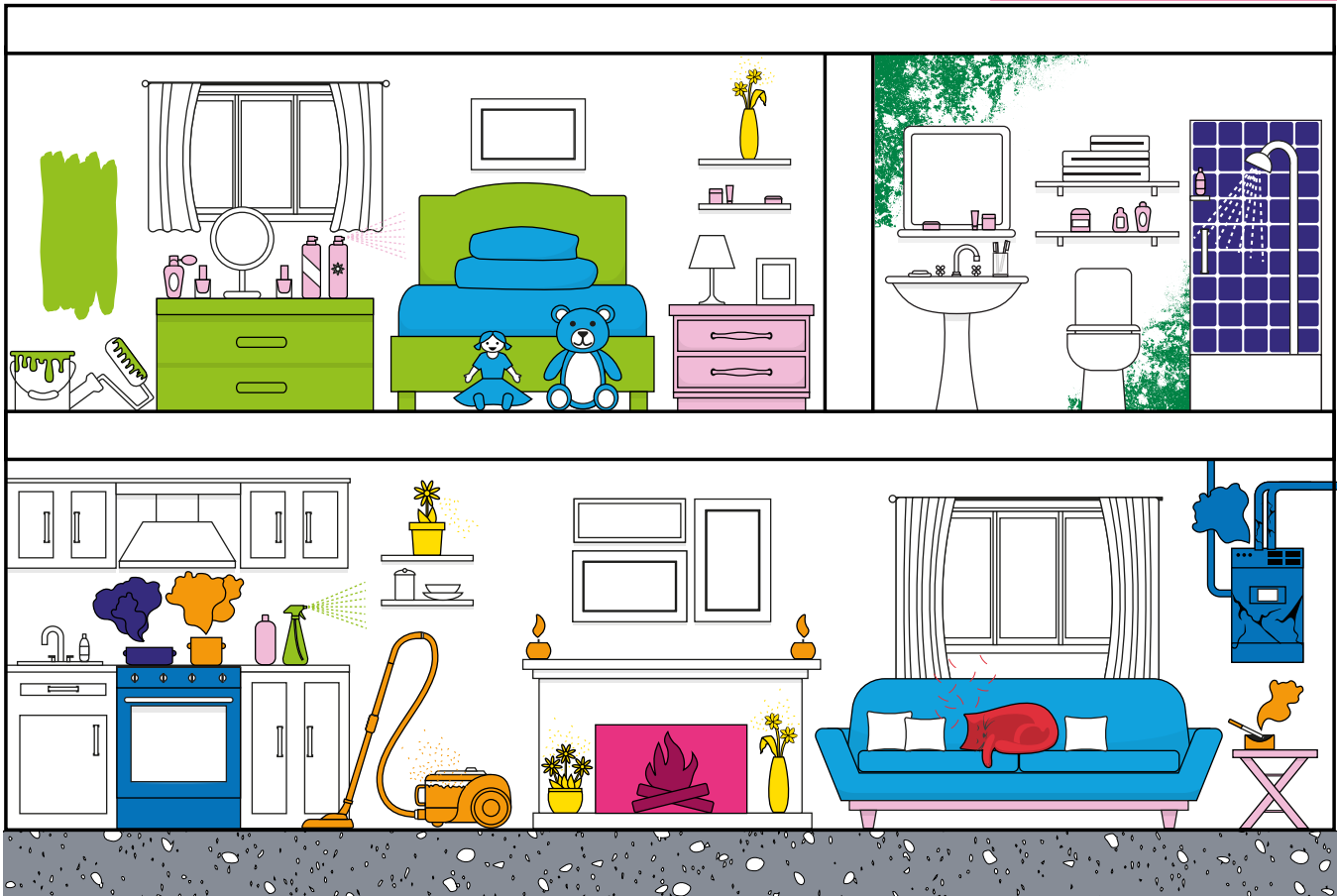
It is difficult to measure how clean or dirty the air is. One reason is because there can be many different substances in the air. Air is a mixture of gases, including oxygen and carbon dioxide, and can also contain water vapour, tiny particles that are too small to see, and other chemicals in gas or vapour form. Some substances are good for us, like oxygen which we need to breathe to live. Others, on their own in small amounts are not a problem but when they build up in the air and/or mix with other substances, they can cause health problems. These are called air pollutants.

The table gives the description of substances and activities that might cause these substances. See how many activities you can spot in the picture on the next page. Pick a colour to use and colour the sources in.

Marker	Description	Sources
PM_{2.5}	This is extremely small particles that measure less than 2.5 micrometres (µm) across. To help you understand how small this is, a human hair is about 75 µm thick, which is 30 times bigger than PM _{2.5} .	Indoor sources include cooking, smoking and burning anything such as candles or incense . Particles can also settle on surfaces and be released back into the air during activities such as vacuuming . Outdoor sources include car exhausts.
Volatile Organic Compounds (VOCs)	A wide variety of chemicals that are emitted as gases (from solids or liquids) at ordinary room temperatures. VOCs are everywhere and are released from a wide range of products and materials used in our everyday lives. Concentrations of these chemicals can be much higher indoors compared to outdoors.	Common sources of VOCs include building materials, furniture (wood preservatives), household consumer products including cleaning products , cosmetics such as hairspray and nail varnish, air fresheners, fragranced products .
Formaldehyde	Formaldehyde is a colourless strong-smelling gas that is used in many household products and building materials. Formaldehyde can be released into the air as a gas at normal room temperatures. This process is called off-gassing.	Key sources are building materials, DIY paints, cleaning products, furniture , flooring and carpets.
Carbon dioxide (CO₂)	A gas found naturally in the earth's atmosphere and is part of the air we breathe. We also breathe out carbon dioxide from our lungs (as a waste product of our body's metabolism). CO ₂ has no taste, smell or colour and cannot be detected by humans, even at high concentrations.	Indoor sources include human activities and burning wood, coal or gas . Outdoor sources include burning fossil fuels and industrial processes such as cement production.
Carbon monoxide (CO)	A poisonous gas. It has no taste, smell or colour and cannot be detected by humans. Carbon monoxide alarms should be fitted to detect dangerously high levels.	Damaged or faulty gas appliances such as boilers or stoves .
Nitrogen dioxide (NO₂)	A toxic gas that is mainly formed by burning fossil fuels at high temperatures. It is reddish-brown in colour and is a key part of outdoor air pollution	Indoor sources of nitrogen dioxide include burning gas, oil, paraffin, wood or coal in stoves, ovens, heaters and fireplaces , especially if these are poorly maintained.
Pollen	Pollen is a powder containing the tiny grains or spores which are released from plants during their reproductive cycle. Pollen grains can vary in size depending on the plant species.	Outdoor or indoor plants .
Humidity	Humidity is the amount of water vapour in the air. On its own humidity is not a pollutant, but too much humidity can cause condensation when warm humid air comes into contact with a colder surface. This can lead to damp and mould.	Boiling water, cooking, showering
House dust mites	House dust mites are tiny bugs which live in humid and warm environments. They are generally only visible with a microscope but are one of the most common indoor allergens. House dust mites mostly eat dead skin cells shed by humans.	House dust mites are found in bedding , carpets, mattresses , clothing, and soft furnishings such as sofas and soft toys .
Moulds/fungi	Mould in the home is a common problem often caused by poor ventilation and high levels of moisture in the air, which causes condensation on cold surfaces including walls. Mould can also form within buildings as a result of water damage.	Mould is most commonly found in damp areas of the home such as bathrooms , but mould can grow anywhere in the home.
Pet hair and dander	Pet dander is the small particles of skin shed by animals, such as cats, dogs, rodents and birds. The particles from dead skin or fur and feathers can cause reactions in people who are allergic to them	Animals including pets and pests, and places the animals have been, such as on carpets, on furniture, in dust and in the air.
Radon	Radon is a radioactive gas found at varying levels across the UK. Radon can build up indoors if there is not enough ventilation.	Outdoors radon appears naturally in some areas of the UK in soil, rocks and water. It enters a building through the ground.

WHAT IS IN DIRTY AIR?

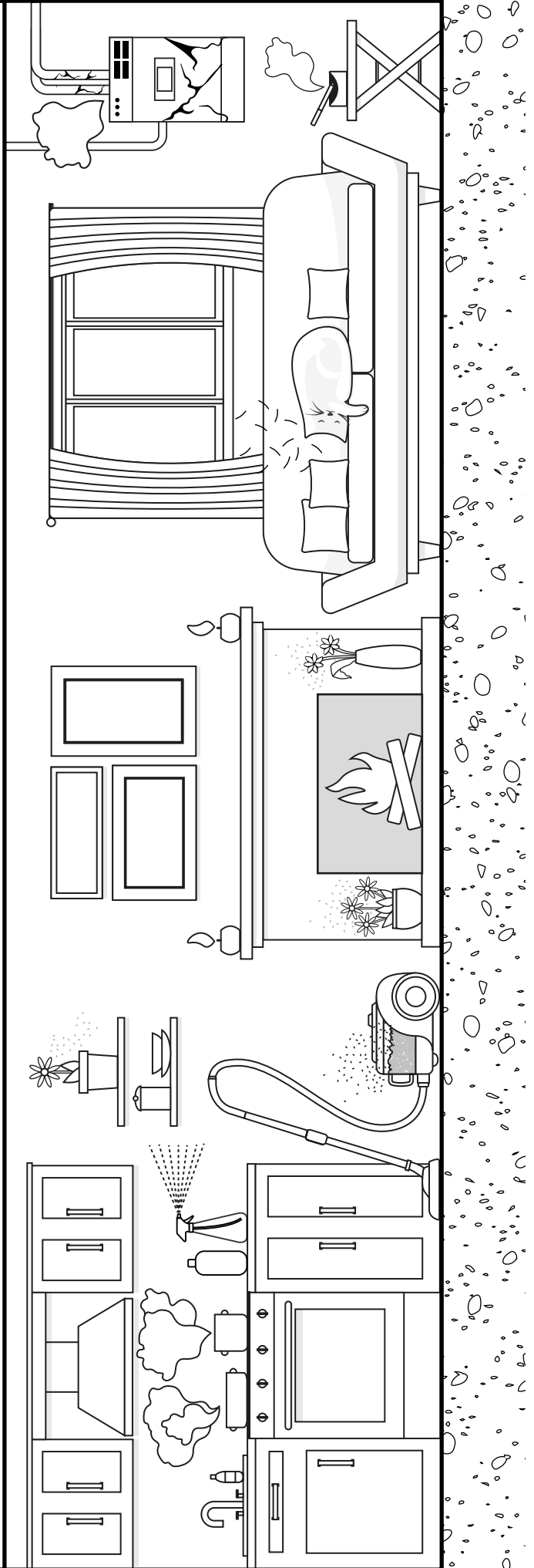
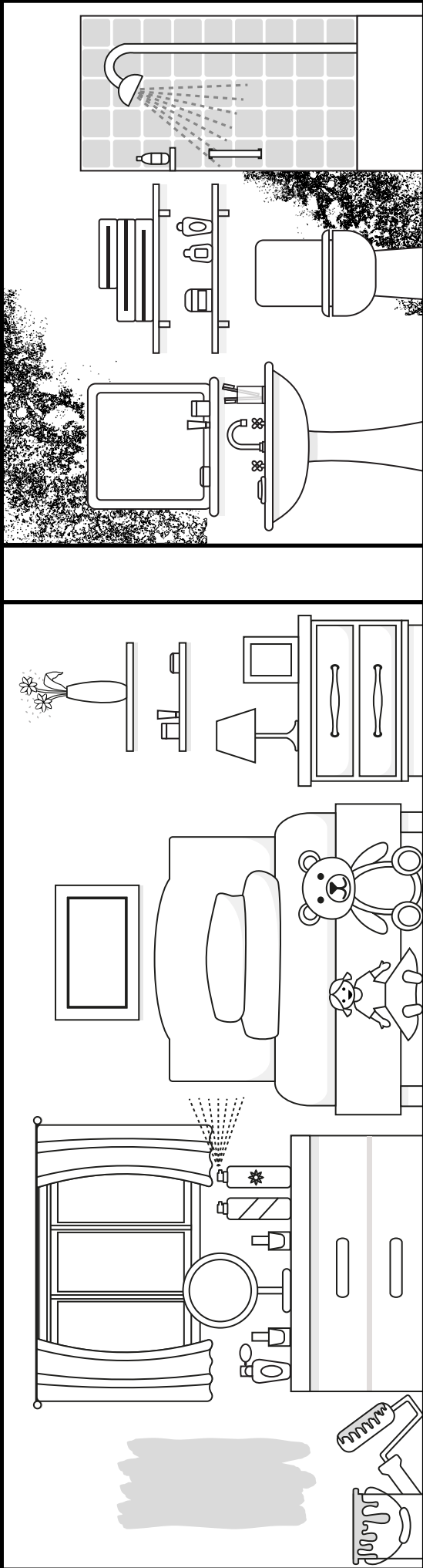
ANSWER SHEET



PM _{2.5}	Indoor sources include cooking, smoking and burning anything such as candles or incense. Particles can also settle on surfaces and be released back into the air during activities such as vacuuming. Outdoor sources include car exhausts.
Volatile Organic Compounds (VOCs)	Common sources of VOCs include building materials, furniture (wood preservatives), household consumer products including cleaning products, cosmetics such as hairspray and nail varnish, air fresheners, fragranced products.
Formaldehyde	Key sources are building materials, DIY paints, cleaning products, furniture, flooring and carpets.
Carbon dioxide (CO ₂)	Indoor sources include human activities and burning wood, coal or gas. Outdoor sources include burning fossil fuels and industrial processes such as cement production.
Carbon monoxide (CO)	Damaged or faulty gas appliances such as boilers or stoves.
Nitrogen dioxide (NO ₂)	Indoor sources of nitrogen dioxide include burning gas, oil, paraffin, wood or coal in stoves, ovens, heaters and fireplaces, especially if these are poorly maintained.
Pollen	Outdoor or indoor plants.
Humidity	Boiling water, cooking, showering
House dust mites	House dust mites are found in bedding, carpets, mattresses, clothing, and soft furnishings such as sofas and soft toys.
Moulds/fungi	Mould is most commonly found in damp areas of the home such as bathrooms, but mould can grow anywhere in the home.
Pet hair and dander	Animals including pets and pests, and places the animals have been, such as on carpets, on furniture, in dust and in the air.
Radon	Outdoors radon appears naturally in some areas of the UK in soil, rocks and water. It enters a building through the ground.

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Pick a colour to use and colour the sources in.



WHAT CAN YOU MEASURE?

Sometimes indoor air pollutants can build up to levels that cause health problems because of the environmental conditions. The humidity of the air can have an important impact on allergies. If the air in your home is too humid it can create a breeding ground for common allergens such as house dust mites and mould. Temperature and humidity can be used to help understand indoor environmental conditions that can affect the level of air pollutants indoors

If the humidity is high for long periods of time it can cause damp and mould. Damp and mould are linked to asthma and allergies in children, so we want to avoid creating these problems in our homes.



In your pack you should have a little sensor that can tell you the temperature (in °C) and percentage relative humidity (%). You can use this to investigate the temperature and humidity around your home. Pick one day you want to investigate and using the boxes (on this page and the next) to record the temperature and humidity when you are doing these activities. We've also left one empty box for you to choose another activity to investigate.

After you have measured the temperature and humidity, colour in the circles next to them using the colour scales. The values in the colour scales are a rough guide of the normal temperatures found in buildings.



Waking up or going to sleep

Location/room

Temperature

°C



Humidity

%



How many people are in the room?

What else is happening?

Temperature:

- **Cold**
Less than 17°C
- **Cool**
17°C – 19°C
- **Fine**
20 – 22°C
- **Warm**
23 – 24°C
- **Hot**
More than 24°C

Humidity:

- **Dry**
Less than 30%
- **Fine**
30% – 65%
- **Wet**
65% – 85%
- **Very Wet**
More than 85%

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WHAT CAN YOU MEASURE?

Eating food

Location/room

Temperature °C

Humidity %

How many people
are in the room?

What else is
happening?

Playing

Location/room

Temperature °C

Humidity %

How many people
are in the room?

What else is
happening?

Brushing teeth or after having a shower or bath

Location/room

Temperature °C

Humidity %

How many people
are in the room?

What else is
happening?

You pick:

Location/room


Temperature °C


Humidity %

How many people
are in the room?

What else is
happening?


Temperature:

 **Cold**
Less than 17°C


 **Cool**
17°C – 19°C


 **Fine**
20 – 22°C


 **Warm**
23 – 24°C


 **Hot**
More than 24°C

Humidity:

 **Dry**
Less than 30%

 **Fine**
30% – 65%

 **Wet**
65% – 85%

 **Very Wet**
More than 85%

What did you find? You could think about which room was the warmest and coldest, were there any activities that seemed to change the humidity?

CONTROL THE SOURCE

Scientists and engineers have known for a long time that the best way to improve the air in a building is to remove any objects or activities that could be a source of indoor air pollution. Max von Pettenkofer knew this in 1858:

"If there is a pile of dog poo in a room, don't try to get rid of the smell by opening a window. Take the dog poo outside"



Sometimes the activities are important, and we can't stop doing them, so instead we use ventilation to reduce the levels of pollutants inside. Ventilation is when clean air, usually from outside, is used to replace stale indoor air. This can be through natural ventilation, such as opening a window, or mechanical ventilation, where a fan is used to pump air in or out of a space.

Here are some common indoor sources of pollutants. For each of these activities would you remove the source and/or use ventilation to reduce the pollutant levels?



Cooking:

Remove Ventilate



Spraying perfume and deodorant:

Remove Ventilate



Spray air freshener:

Remove Ventilate



Someone else smoking:

Remove Ventilate



Burning food:

Remove Ventilate



Burning candles or incense:

Remove Ventilate



Drying clothes inside:

Remove Ventilate



Showering or bathing:

Remove Ventilate



New furniture:

Remove Ventilate



Repainting walls:

Remove Ventilate

CONTROL THE SOURCE



ANSWER SHEET

Activity	Remove	Ventilate	Explanation
Cooking			Cooking is an important activity that happens in most homes on most days, so the best way to reduce risk is to use ventilation during cooking and for 10 minutes afterwards.
Spraying perfume or deodorant			If possible, you should use non-spray alternatives. If that is not possible, then use ventilation during and afterwards
Spray air freshener			Despite the name, air freshener does not clean the air, it adds different chemicals into the air. These chemicals might smell nice but that doesn't mean they are good for your lungs.
Someone else smoking			Smoking inside causes secondary exposure when someone other than the person smoking breathes in the smoke.
Burning food			Burning food can be a source of particles so it is best to avoid burning food where possible. It might also set off your smoke alarm.
Burning candles or incense			Burning candles and incense, especially if they are scented, can increase the levels of VOCs indoors, so is best avoided if possible. Where it is not possible you should use extra ventilation.
Drying clothes inside			If you have the option to dry laundry outside, it is better to do so. If you don't have the choice, then using extra ventilation such as drying clothes next to an open window can help to keep the humidity down inside.
Showering or bathing			Showering or having a bath is important for keeping clean. People can't stop this activity, so instead ventilation is important to get rid of excess moisture, this is why many bathrooms have an extractor fan fitted.
New furniture			New furniture can release formaldehyde and VOCs into the air. If you need to buy furniture new, it is important to increase the ventilation rate to reduce the build-up of chemicals indoors.
Repainting walls			Have you ever been in a freshly painted room? If you have you might recognise the new paint smell. Household paints are a source of VOCs but you can buy paints labelled as low VOC and it is best to use these if possible.

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HOW DOES VENTILATION WORK?

Air and lots of air pollutants are invisible and don't smell, so it is difficult for humans to detect how ventilation works. In this activity you are going to use water and squash to demonstrate how clean air can be used to dilute the concentration of pollutants in dirty air. If you don't have squash, you could use juice, food colouring or even paint, **just please don't drink the water if you are using paint!**



You will need:

1. 3 cups, preferably transparent and about the same size
2. Squash, dark colours like blackcurrant flavour work best. If you don't have any squash, you could use juice, food colouring or paint.
3. Water
4. A sink to pour the liquid away if you don't want to drink it
5. One elastic (rubber) band
6. Optional: A piece of white paper

1



2



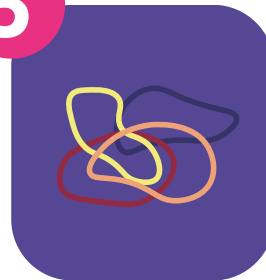
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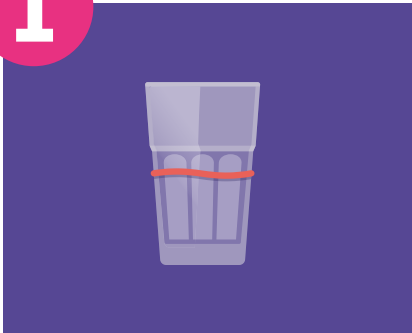


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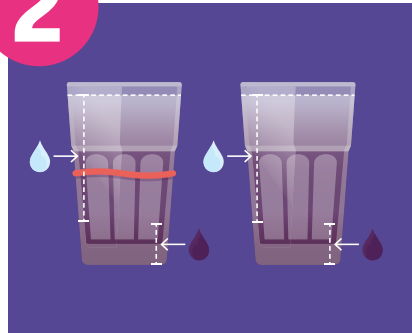
HOW DOES VENTILATION WORK?

1



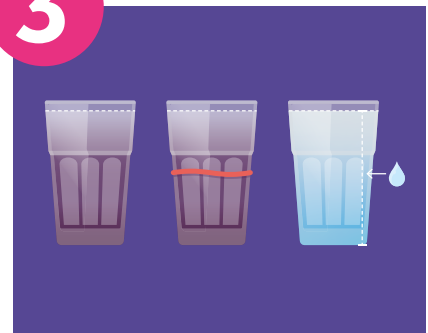
Step 1: Take one cup and put the elastic band around it about half way up. You will use this to measure the amount of liquid in the cup.

2



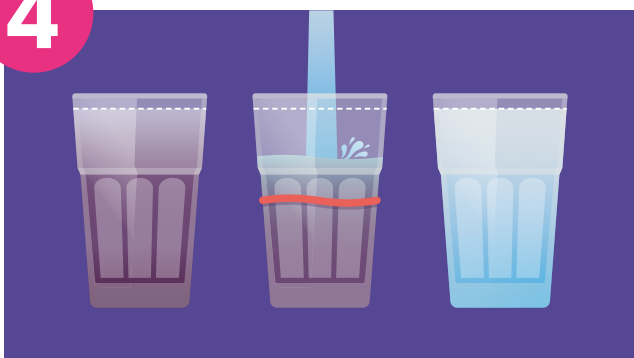
Step 2: Take this cup and one other and make up the squash in each using the instructions on the bottle. You should try to use exactly the same amount of squash and water in each so both cups of are identical.

3



Step 3: Fill the other empty cup with water. The two cups that don't have the elastic band around them are your controls, you can use these to compare to the middle cup with the elastic band after each step.

4



It might help to hold a piece of white paper behind the cups to see the colour better.

Step 4: Empty out or drink half of the squash in the cup with the elastic band, so that the contents comes up to the elastic band. Fill it back up to the top with clean water.

What has happened to the colour of the squash?

What does it taste like?

Compare it to the cup of squash and the one of water. What do you notice?

5

Step 5: Repeat step 4, emptying out half of the mixture and refilling it with water. After each time you do this, write down what has happened to the colour and the taste. Keep repeating it over and over until you have cleared the pollutant, keeping a tally of how many times you refilled with clean water:

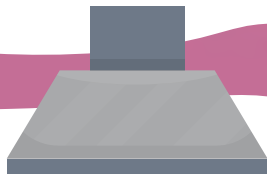
How many times did you have to replace the liquid to clear the 'pollutant'?

In this test a cup is used to model a room. The water is clean air and the squash (or food colouring) is a substance or pollutant that has been released into the air. Emptying out some of the liquid and replacing it with water is like what happens when you open a window or turn on a fan to provide ventilation. Using ventilation for longer is like half emptying the cup and refilling it more times.

HOME AIR SCAVENGER HUNT

Indoor environments are complicated and contain a lot of things that can **improve** the indoor air or **make it worse**. Most people don't notice all of these things, and maybe don't know how to use them effectively, so we have created a scavenger hunt of things for you to find around your home. Remember, every home is different so you won't find all of these things in your home!

Tick the items you find and use the notes page to record any answers you have to the investigative questions, or to record what you observe when you conduct the experiment.



Cooker hood

Each cooker hood will have their own care instructions. It is important the filters are cleaned, or replaced, as per manufacturer's instructions to ensure the ventilation works effectively so that pollutants are sucked up and vented outside the home.

INVESTIGATIVE QUESTIONS

- How high is the cooker hood above the stove?
- How does it turn on?
- Is it very loud?
- Touch the grease filter (the bit with holes in it on the bottom), does it feel clean?
(you must wash your hands straight after touching the filter, even if it does feel clean!)
- Can you find any information from the company about how this should be cleaned?

In the UK Cooker hoods should be 65–75 cm above the stove, unless the manufacturer states otherwise. If the cooker hood is higher, more pollutants from cooking will mix with room air instead of being sucked outside through the cooker hood.



Extractor fan (look in the kitchen or bathroom)

Extractor fans are important for ventilating the kitchen/bathroom, helping to remove damp or polluted air arising from domestic activities such as cooking and bathing.

INVESTIGATIVE QUESTIONS

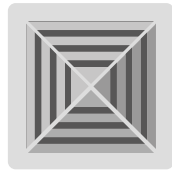
- Can you turn it on?
- When it's on, with an adult's help if you can't reach, put your hand in front of it, what do you feel?
- Where's the switch? Does it switch on with the light or is it a separate switch?

EXPERIMENTS

Take 1 square of toilet paper and put it flat over the fan with the fan on, what happens? What if you turn the fan off?

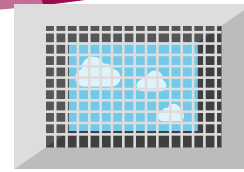


HOME AIR SCAVENGER HUNT



Mechanical air vents

Some buildings use fans and ducts to move air around a building.

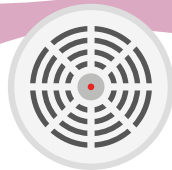


Air vents

YOU MIGHT FIND A VENT LIKE THIS IN YOUR KITCHEN, ESPECIALLY IN OLDER BUILDINGS.

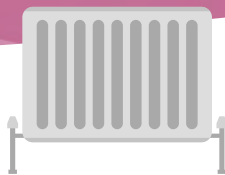
INVESTIGATIVE QUESTIONS

- Can you see the sky through it like in the illustration?
- What do you think that means?



Smoke alarm

Smoke alarms do not protect against dirty indoor air, but some sources **of indoor air pollution** that cause smoke might set them off.



Radiators or other heaters

Keeping the building warm in winter helps to prevent damp and mould.

INVESTIGATIVE QUESTIONS

- Ask an adult, how is your home heated?



Trickle vent

These are normally at the top of the window frame and let a small amount of air in and out without opening the window. Trickle vents are mainly found in new buildings.

INVESTIGATIVE QUESTIONS

- How does it open or close?

EXPERIMENTS

With it open, put your hand in front, what do you feel?

Air vents in the wall help to provide background ventilation and outside air when any windows are closed and extractor fans are switched off. Sometimes you can see the sky or light from outside through the vent, this means the vent is open and air can get through.

If you can't see the outside, it might mean:

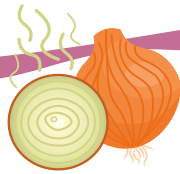
- the vent is blocked
- the vent is closed (look to see if there is an option to slide it open)
- there is a cover on the outside (try to find it on the outside of the building to see if this is the reason)

Sometimes these vents can be spotted outside the building, especially older buildings, at the level beneath a floor. The ventilation they provide reduces build up of condensation in the colder months.

Many people don't like the drafts and wish to save energy. One way to do this is to leave the vents in place and seal any gaps in the floor joists, so the draft remains under the floor.



HOME AIR SCAVENGER HUNT



Something with a strong smell

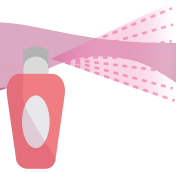
Be careful not to smell any household products. Always ask your guardian if unsure.



Condensation on a mirror or window in the bathroom

EXPERIMENT

Try timing how long it takes to clear after someone has a bath or shower? Is there anything you think would help it to clear faster?



Spray bottle such as hairspray or deodorant

INVESTIGATIVE QUESTIONS

- Make a tally chart of how many you find.
- **Choose one** and check the label on the back. Does it say use in well ventilated spaces?

YES / NO

Condensation on a mirror will disappear quicker if the room is well ventilated.

Try opening a window or turning on a dehumidifier if you have one.



Nail varnish or remover

INVESTIGATIVE QUESTIONS

- Check the label on the back. Does it say use in well ventilated spaces?

YES / NO

- Are there any ingredients listed on the label? Can you find any of these pollutants in the ingredients list?

Toluene Styrene Formaldehyde

You might want to look back at worksheet 4 *What is in dirty air?* which lists other sources of pollutants in homes.



Candles, incense or a fireplace

INVESTIGATIVE QUESTIONS

- Make a tally chart of how many you find.

Candles Incense Fireplace



Cooking smells

EXPERIMENT

When someone is cooking walk around your home and see how far the smell spreads. Are there any smells that spread further than others?

Gaps under doors

EXPERIMENTS

Using a ruler, measure how big the gap is.

The gap should be 1 cm to let air move between rooms. Sometimes carpets or flooring make this gap smaller.

HOME AIR SCAVENGER HUNT



Windows

Not all buildings use windows that open, some use mechanical ventilation instead.

INVESTIGATIVE QUESTIONS

- How many windows do you have that can open?



Use this box to make notes and record any data from your experiments.

Dust in the air in a sun beam

Indoor air pollutants can build up in indoor dust. When you move about or do things at home, such as cleaning, that dust can be disturbed. Once disturbed it can become suspended in the air. Sometimes you can see the suspended dust when a beam of light shines through and the rest of the room is in comparative darkness.

Household dust has been found to contain all sorts of pollutants from:

- shampoos and plastics
- paints and cleaning products
- some building materials, furniture, fabrics, carpets and electronics, especially those with flame retardants
- fragrances
- some fabrics and non-stick coatings
- house dust mites and other pests, pet allergens, mould and fungi
- pesticides

For more information on sources of household pollutants, take a look at Annex 8 p68 of RCPCH RCP (2020) *The Inside Story: Health effects of indoor air quality on children and young people*.

About this worksheet: More information can be found in the RCPCH RCP 2020 publication *The Inside Story: Health effects of indoor air quality on children and young people*. Many of the Indoor Air Quality Working Party members were contributing authors to this publication and have produced these worksheets as a first step towards addressing this request from children and young people.

#ASK ABOUT ASTHMA

Asthma is a long-term medical condition which affects many children and young people in the UK. It can affect every aspect of daily life from playing with friends and taking part in sport to concentrating and learning in school. It can even affect sleeping.

If you have asthma, the tubes that carry air in and out of the lungs as you breathe can be very sensitive. There are particular substances, known as "allergens" which can be mistaken by a person's immune system for something harmful. This can cause an allergic reaction. If the airways become inflamed and tighten as part of the allergic reaction, it can be difficult to breathe. Breathing dirty, polluted air in can trigger or aggravate asthma. Asthma inhalers can help to relax the muscles in the airways, making it easier to breathe again.

However, it would be best if we could all work to take away allergens, triggers and other causes of breathing problems, especially for those with asthma. In this worksheet you will learn about pollutants that cause or worsen asthma. Some of these pollutants come from dust and fumes from activities such as cleaning, cooking and decorating. There are sources of pollutants found inside buildings that can create, or emit, substances into the air that may be harmful to health at high levels.



P C B T J G Q P Q C K H W X R W R Q K P
 L A G N R K Z W L C K S K M B C D B R W
 Y Q R N I T R O G E N D I O X I D E F B
 R V D T H L N V H P X M B C T Y S R L C
 X X F U I G M L Q Z C P V K V S L Z F O
 T V C K S C D T M L Y J G P O L L E N C
 T R K H R T U L F Y P B Q L X M P Z Y K
 Y O D Y L L M L P J T W G B D O T Z B R
 K D B M C P J I A G L Z Y K C U L V W O
 H A J A Q F R L T T P F L S K L L U E A
 Q N M S C W P J F E E Y J K X D P F S C
 L D V G C C Z V S K S M X T C S W C V H
 P E B L X V O Z P Z B G A S N P L D F E
 K R Y T M R B S T Q Z Z S T R O X D J S
 J R R Y N P J G M S W Q Q E T R T Z B Y
 X L T P M L F M F O R M A L D E H Y D E
 T M D F B C Q P C N K Z S D R S R L Q P
 J I D Y P L Y T P D C E K T G T K Q M D
 C C F K E Y M J L Y K B Q X W B P P H Q
 Y E X L Z W K M N V J P K F V R W P C J

The wordsearch includes various allergens and triggers found indoors.

- cockroaches
- dander
- dust mites
- formaldehyde
- mice
- mould spores
- nitrogen dioxide
- particulate matter
- pollen
- tobacco smoke

Did you know that...

Did you know that bacteria can survive for up to two months in a vacuum cleaner chamber? That's why it is best to empty the chamber as soon as you've finished hoovering otherwise they might accidentally be released into the air when the vacuum cleaner is next used.

House dust mites are very tiny bugs which mostly eat dead skin cells shed by humans. You need a microscope to see them. They live in humid and warm environments. Drying washing on or near radiators creates a warm, humid environment where dust mites thrive.

They are found in bedding, carpets, mattresses, clothing and soft furnishings such as sofas and soft toys. They like living in bedding but if you wash bedding and covers at 60°C every 2 weeks it will help to kill dust mites and bacteria. You can also use allergen impermeable covers which help to seal in allergens so that they aren't breathed in whilst sleeping.

Did you know that formaldehyde is a colourless, strong-smelling gas that can evaporate at room temperature? Formaldehyde can cause irritation and inflammation of the respiratory system.

It is present in many building materials, coatings and finishes, furniture and household products such as scented candles and cleaning products. It is also found in tobacco smoke. It can also be emitted through cooking.

Increasing the humidity can increase release of formaldehyde from building materials and surfaces.

#ASK ABOUT ASTHMA



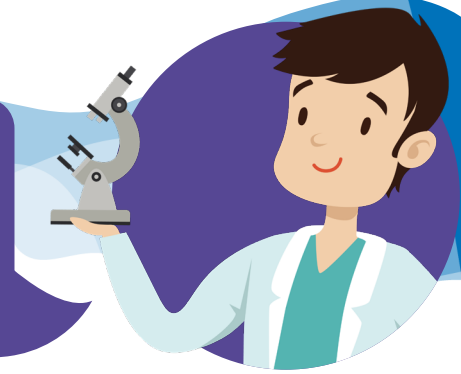
ANSWER SHEET

P	C	B	T	J	G	Q	P	Q	C	K	H	W	X	R	W	R	Q	K	P
L	A	G	N	R	K	Z	W	L	C	K	S	K	M	B	C	D	B	R	W
Y	Q	R	N	I	T	R	O	G	E	N	D	I	O	X	I	D	E	F	B
R	V	D	T	H	L	N	V	H	P	X	M	B	C	T	Y	S	R	L	C
X	X	F	U	I	G	M	L	Q	Z	C	P	V	K	V	S	L	Z	F	O
T	V	C	K	S	C	D	T	M	L	Y	J	G	P	O	L	L	E	N	C
T	R	K	H	R	T	U	L	F	Y	P	B	Q	L	X	M	P	Z	Y	K
Y	O	D	Y	L	L	M	L	P	J	T	W	G	B	D	O	T	Z	B	R
K	D	B	M	C	P	J	I	A	G	L	Z	Y	K	C	U	L	V	W	O
H	A	J	A	Q	F	R	L	T	T	P	F	L	S	K	L	L	U	E	A
Q	N	M	S	C	W	P	J	F	E	E	Y	J	K	X	D	P	F	S	C
L	D	V	G	C	C	Z	V	S	K	S	M	X	T	C	S	W	C	V	H
P	E	B	L	X	V	O	Z	P	Z	B	G	A	S	N	P	L	D	F	E
K	R	Y	T	M	R	B	S	T	Q	Z	Z	S	T	R	O	X	D	J	S
J	R	R	Y	N	P	J	G	M	S	W	Q	Q	E	T	R	T	Z	B	Y
X	L	T	P	M	L	F	M	F	O	R	M	A	L	D	E	H	Y	D	E
T	M	D	F	B	C	Q	P	C	N	K	Z	S	D	R	S	R	L	Q	P
J	I	D	Y	P	L	Y	T	P	D	C	E	K	T	G	T	K	Q	M	D
C	C	F	K	E	Y	M	J	L	Y	K	B	Q	X	W	B	P	P	H	Q
Y	E	X	L	Z	W	K	M	N	V	J	P	K	F	V	R	W	P	C	J

About this worksheet: More information can be found in the RCPCH RCP 2020 publication *The Inside Story: Health effects of indoor air quality on children and young people*. Many of the Indoor Air Quality Working Party members were contributing authors to this publication and have produced these worksheets as a first step towards addressing this request from children and young people.

SPOT THE TRIGGERS

We're still learning about what environmental conditions and pollutants inside buildings can cause or trigger asthma. It is vital that scientists and the medical community continue to investigate, understand and share their findings on how the environment, indoors and out, affects conditions such as asthma so that we can avoid and reduce negative health consequences for children.



Exercise 1: The picture shows 10 items or activities that could exacerbate asthma. Write down why you think they might be a problem.





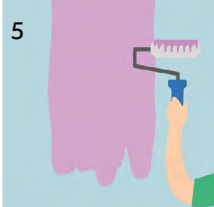
1	Avoid	Clean Regularly	Ventilate	6	Avoid	Clean Regularly	Ventilate
2	Avoid	Clean Regularly	Ventilate	7	Avoid	Clean Regularly	Ventilate
3	Avoid	Clean Regularly	Ventilate	8	Avoid	Clean Regularly	Ventilate
4	Avoid	Clean Regularly	Ventilate	9	Avoid	Clean Regularly	Ventilate
5	Avoid	Clean Regularly	Ventilate	10	Avoid	Clean Regularly	Ventilate

Exercise 2: Now go back and look at your answer. How would you reduce the risk they pose to someone with asthma? Would you avoid? Clean regularly? Or Ventilate? Sometimes you might want to use more than one method to reduce exposure.

SPOT THE TRIGGERS



ANSWER SHEET

	Exercise 1	Exercise 2
1 	<p>Pollen</p> <p>Pollen is a powder containing tiny grains or spores which are released from plants during their reproductive cycle. The grains can vary in size depending on the plant species. Smaller pollen grains can get further and deeper inside lungs. Some flowers generate less pollen than others.</p>	<p><input checked="" type="checkbox"/> Avoid <input type="checkbox"/> Clean Regularly <input checked="" type="checkbox"/> Ventilate</p> <p>Allergic reactions to pollen tend to be more severe the higher the concentration of pollen in the air. If you can, select plants that don't produce, or only produce small amounts of pollen. These tend to be plants pollinated by birds and insects. Male plants will produce more pollen than their female counterparts.</p> <p>Let fresh air in/filter the air to help reduce build up of pollen in the air.</p>
2 	<p>Soft toys and carpet/rug</p> <p>Soft toys and soft furnishings such as rugs and carpets can collect dust, this can be released back into the air and can trigger symptoms in some people.</p>	<p><input checked="" type="checkbox"/> Avoid <input checked="" type="checkbox"/> Clean Regularly <input type="checkbox"/> Ventilate</p> <p>Reducing items which collect dust such as soft toys and, if possible, replacing carpets with hard flooring can help reduce exposure to dust. For items which can't be removed, it can help to regularly Hoover or clean them, preferably when anyone who has asthma is not around.</p>
3 	<p>Cooking</p> <p>Cooking is a source of fine particles which can increase risk of asthma. It is also a potential source of moisture which can cause damp and mould.</p>	<p><input type="checkbox"/> Avoid <input type="checkbox"/> Clean Regularly <input checked="" type="checkbox"/> Ventilate</p> <p>Cooking is an important activity that happens in most homes on most days, so the best way to reduce risk is to use ventilation during cooking and for 10 minutes afterwards.</p> <p>If you have one, it is best to use the cooker hood during cooking to extract any pollutants to outside. Putting lids on pans also reduces the amount of steam, which would help keep the humidity down.</p>
4 	<p>Dusty fan</p> <p>If a fan is dusty or is used in a dusty room the dust in the air it moves can resuspend.</p>	<p><input type="checkbox"/> Avoid <input checked="" type="checkbox"/> Clean Regularly <input type="checkbox"/> Ventilate</p> <p>Cleaning the fan regularly, preferably with a damp cloth, to remove dust will help to prevent dust from getting into the air.</p>
5 	<p>Paint fumes</p> <p>Building and decorating materials, such as paint, and new furniture release chemicals into the air.</p>	<p><input checked="" type="checkbox"/> Avoid <input type="checkbox"/> Clean Regularly <input checked="" type="checkbox"/> Ventilate</p> <p>If possible, avoid doing DIY especially while anyone with asthma is around. These materials continue to release chemicals, including Volatile Organic Compounds (VOCs), for a long time so it is important to increase ventilation during and after using them. It may also be helpful to choose low VOC paints.</p>

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SPOT THE TRIGGERS



ANSWER SHEET

	Exercise 1	Exercise 2
<p>6</p>	<p>Cleaning products</p> <p>Cleaning products can be a source of chemicals in the air which may worsen Asthma.</p>	<p><input checked="" type="checkbox"/> Avoid <input type="checkbox"/> Clean Regularly <input checked="" type="checkbox"/> Ventilate</p> <p>To avoid inhalation and dermal (skin) exposure to any harmful cleaning chemicals, use non-spray options if possible, ventilate the room during use, and try to completely remove cleaning products off surfaces after cleaning. Choosing unscented products may also help.</p>
<p>7</p>	<p>Mould</p> <p>Mould spores and fragments from different species can form spores that travel through the air, enabling mould to spread. Mould is more likely to form in cold damp environments.</p>	<p><input checked="" type="checkbox"/> Avoid <input checked="" type="checkbox"/> Clean Regularly <input checked="" type="checkbox"/> Ventilate</p> <p>Cleaning off visible mould can help. Avoiding activities that release moisture indoors, such as drying laundry, reduces the risk of damp, and therefore mould. Some moisture generating activities, such as cooking or cleaning, can't be avoided so ventilation is important to get rid of excess moisture.</p> <p>If you have persistent mould in rented housing you can contact your landlord or environmental health department.</p>
<p>8</p>	<p>Dust from vacuum cleaner</p>	<p><input type="checkbox"/> Avoid <input checked="" type="checkbox"/> Clean Regularly <input type="checkbox"/> Ventilate</p> <p>Vacuuming is one of the easiest ways to clear dust, which is especially important for people with asthma. However, if it isn't emptied regularly and kept in good condition, a vacuum cleaner can release dust and particles back into the air. Bacteria can survive for up to two months within these spaces and then be released into the air when the vacuum cleaner is used again.</p>
<p>9</p>	<p>Spray deodorants and perfumes</p> <p>Personal care products can also release chemicals, including VOCs, and small particles into the air.</p>	<p><input checked="" type="checkbox"/> Avoid <input type="checkbox"/> Clean Regularly <input checked="" type="checkbox"/> Ventilate</p> <p>If possible, use non-spray options, or use ventilation at the same time. It may also help to choose low scent or unscented products.</p>
<p>10</p>	<p>Pet hair, pests and dander</p> <p>Dander is the name for the particles from dead skin or fur and feathers. This can come from animals including pets and pests. These can cause reactions in people who are allergic to them.</p>	<p><input checked="" type="checkbox"/> Avoid <input checked="" type="checkbox"/> Clean Regularly <input type="checkbox"/> Ventilate</p> <p>If you or someone you know is sensitive to pets you might need to completely avoid some pets or choose low or no shedding pets. If you don't want to get rid of furry pets, it can help to keep them out of bedrooms, clean them regularly and regularly vacuum or clean floors and soft furnishings.</p> <p>Exposure to dander, particularly from pests such as mice, and their poos can worsen asthma. An adult will be able to contact the council to find out if they provide pest control services.</p>

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Activities for Teachers & Parents

MEASURING INDOOR AIR

If you have access to an indoor air quality monitor, we've devised a set of worksheets for you to explore air quality in the home environment.

There are activity sheets available for devices that can measure:

- Fine particles (**PM_{2.5}**)
- Volatile organic compounds (**VOCs**)
- Temperature (**°C**)

WORKSHEETS AVAILABLE INCLUDE:

- Relative humidity (**%RH**)
- What affects my home air?
- Particle source spot tests
- VOCs source spot tests
- Ventilation spot tests

We developed these activities for teachers to run at home, or (some) at school, and share the results with their class at school. They would also be suitable for parents to run with their children but are **not suitable for unsupervised children**.

Available from: <https://theinsidestory.health/worksheets/>



About this worksheet: More information can be found in the RCPCH RCP 2020 publication *The Inside Story: Health effects of indoor air quality on children and young people*. Many of the Indoor Air Quality Working Party members were contributing authors to this publication and have produced these worksheets as a first step towards addressing this request from children and young people.

Activities for Teachers & Parents

MEASURING INDOOR AIR

In recent years, a few companies have started to release indoor air quality monitors designed to be used by members of the public to measure the air quality in their own homes. These monitors, often called consumer monitors, are sometimes used by scientists to measure air quality in buildings, as they are cheaper than the research grade monitors. The activities included in this pack are designed to use one of these consumer monitors to explore air quality in the home.

We developed these activities for **teachers** to run at home, or (some) at school, and share the results with their class at school. They would also be suitable for **parents** to run with their children but are **not** suitable for unsupervised children.

Equipment
Fine particles (PM_{2.5})
Volatile organic compounds (VOCs)
Temperature (°C)
Relative humidity (%RH)

These activities were developed for a Foobot home, which has been evaluated by researchers¹. However, they may also work with other commercial indoor air monitors. The foobot measures fine particles (PM_{2.5}), total Volatile organic compounds (TVOC), temperature (°C) and relative humidity (%RH). There is an icon next to each activity to indicate which parameter is being measured. If you are using these activity sheets with another monitor, you can use these to cross check whether the activity is suitable.

Activity types

Two types of activity relate to two of the typical methods frequently used by scientists.

The first activity type is monitoring activities. Monitoring is used by scientists to investigate the air quality found in buildings such as homes under normal conditions. Scientists sometimes also perform an intervention, where they change something about the building or how it is used and monitor the air quality before and after the change to see if it improves the air quality. In this pack, we want you to monitor the air quality and record activities in the room to investigate which activities make the air quality better or worse.

The second activity type is controlled tests to directly compare the effect of different activities on pollutant concentrations. Scientists might carry out these tests in a specially designed room so they can estimate the emission rate. We have suggested a simplified method suitable for the home environment.

¹ Moreno-Rangel, A., Sharpe, T., Musau, F., and McGill, G.: Field evaluation of a low-cost indoor air quality monitor to quantify exposure to pollutants in residential environments, *J. Sens. Sens. Syst.*, 7, 373–388, <https://doi.org/10.5194/jsss-7-373-2018>

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WHAT AFFECTS MY HOME AIR?

The aim of this activity is to explore the typical concentrations of fine particulate matter (PM_{2.5}) or volatile organic compounds (VOCs) found in a home environment. It also introduces using a time-activity diary, a tool frequently used by scientists, to try to identify activities in the space that coincide with spikes in PM_{2.5} or VOC concentrations.

You will need:

- Air quality monitor
- Connected device to view the data from the air quality monitor
- 1 copy of the diary sheet for each measurement day
- Pen or pencil

On the measurement day:

- Try to behave as normally as possible. Try to avoid breathing directly onto the monitor.
- Complete the diary sheet by ticking any activities taking place in each hour period and noting the number of people in the space.

Set up:

1. Choose which room you want to measure. You could pick a bedroom, living space or the kitchen. You could think about where you spend the most time to help to pick a room.
2. Pick a measurement day. You could either choose a typical day or a day that might be interesting, for example if you are planning to do a lot of cleaning or cooking a big meal. You could also choose to monitor for multiple days. If this is the case, you will need multiple copies of the diary sheet.
3. The night before the measurement day, set up the monitor in this room. You should try to position the monitor:
 - a. Away from any potential sources of pollutants or moisture, such as the stove, kettle or microwave, fireplaces, candles, incense or plug in air freshener.
 - b. Away from heat sources, such as radiators.
 - c. Between about 1m and 1.5m above the floor. This is to measure in the breathing zone, as air is not always well mixed in the space.
To make it relevant to the class you could place the monitor at a height representing the average height of the class.
 - d. Away from ventilation openings, windows, or vents, to be sure that the monitor is measuring indoor air not air coming in from outside.
4. Somewhere that won't affect the way people normally behave in the room.
5. Set out the diary sheet and fill in the general room details at the top of the sheet.

Questions to think about when reviewing the data:

Fine Particles (PM_{2.5})

1. What was the highest level of fine particles?
2. When did it occur?
3. Using the diary sheet, were there any activities just before or during this time that might explain the increase in particle levels?
4. Compare the particle concentrations with the diary. How many peaks in particle concentrations are linked to higher particle levels?
5. Did any activities in other rooms increase the particle levels in the monitored room?

Volatile compounds (VOCs)

1. What was the highest level of volatile compounds (VOCs)?
2. When did it occur?
3. Using the diary sheet, were there any activities just before or during this time that might explain the increase in volatile compounds (VOCs) levels?
4. Compare the particle concentrations with the diary. How many peaks in particle concentrations are linked to higher volatile compounds (VOCs) levels?
5. Did any activities in other rooms increase the volatile compounds (VOCs) levels in the monitored room?
6. Look at times where there were more people in the room. Did the number of people appear to have an effect on the pollutant levels?

PARTICLE SOURCE SPOT TESTS (PM_{2.5})

The aim of this activity is to investigate and compare common sources of fine particles and volatile organic compounds that are found in everyday environments. During this test, the goal is not to measure the pollutant levels that might be typically found in rooms. Instead, the monitor is placed a fixed distance from the sources so you can compare the peak concentrations between sources.

Safety Notice

Indoor air pollutants are associated with a range of health effects in people of all ages. Some of these effects are acute, which means they are triggered by a short-term increase in concentrations. Other effects are chronic, from exposure to slightly higher concentrations over extended time periods, perhaps years or decades. For this reason, it is important that you take steps to make sure you do not make the air quality inside worse because of these activities. To do this, you should:

1. Only pick activities or sources from the list that you would normally use in your home.
2. Pick a space where you can easily increase the ventilation rate after the activity to remove any pollutants in the air.
3. Do not decrease the ventilation below normal background levels during the activities. This means leaving windows or vents open if they are normally open, and leaving any mechanical ventilation running if it would normally be on.

You will need:

- Air quality monitor, set up and connected to device
- Ruler
- Indoor sources, choose from the list
- Pen and paper to record results
- Stopwatch (optional)

Indoor activities to test
Toasting bread
Stir frying vegetables
Frying meat (chicken, burger, bacon)
Making popcorn in the microwave
Burning candles
Burning incense
Vacuuuming
Sweeping

Method:

1. Pick 3–5 possible sources from the table above.
2. Set up the air quality monitor 50 cm away from where you are going to be testing the possible sources. Follow the set-up instructions for your monitor and check that you can view the concentrations.
3. Note down the fine particle concentration at the start of your test. This is the background concentration, and for you to make a fair comparison between sources it is important the background level is the same before you test each source.
4. Use the first potential source from your list. For some sources it may be helpful to time how long it lasts or decide how long you think it should last. For example, if you are burning candles or incense, you may want to pick how long you should burn them for before starting.
5. Write down the highest particle concentration during the source activity.
6. Increase the ventilation rate until the particle concentration drops down to background levels.
7. Repeat steps 4–6 for the remaining sources.

PARTICLE SOURCE SPOT TESTS (PM_{2.5})

Results table

Background concentration: _____

Activity	Peak concentration (µg/m ³)	Length of activity (seconds)

Questions to think about

1. Which source reached the highest concentration?
2. How could you present the findings?

Measuring particles

PM_{2.5} is all particles with a diameter of less than 2.5 micrometres (µm), and so includes particles of a range of sizes. Some commercial monitors have been found to be more sensitive to larger particles within this range, and some didn't detect any increase in particle concentrations during events which mostly emitted particles smaller than 0.3µm across. For this reason, you might measure no increase in particle concentrations during some activities that scientists have found to emit particles.

Indoor activities to investigate were identified using the following papers:

Dacunto et al. Real-time particle monitor calibration factors and PM_{2.5} emission factors for multiple indoor sources. *Environmental Science: Processes & Impacts*. 2013; 15, 1511–1519. DOI: 10.1039/c3em00209h

Singer BC, Delp WW. Response of consumer and research grade indoor air quality monitors to residential sources of fine particles. *Indoor Air*. 2018;28:624–639. DOI: 10.1111/ina.12463

Farmer, D. K. et al. Overview of HOMEChem: House Observations of Microbial and Environmental Chemistry. *Environmental Science: Processes & Impacts*. 2019; ISSN: 2050-7887. doi:10.1039/C9EM00228F

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VOCs SOURCE SPOT TESTS (VOCs)

The aim of this activity is to investigate and compare common sources of chemicals called volatile organic compounds (VOCs) that are found in everyday environments. During this test, the goal is not to measure the pollutant levels that might be typically found in rooms. Instead, the monitor is placed a fixed distance from the sources so you can compare the peak concentrations between sources.

Safety Notice

Indoor air pollutants are associated with a range of health effects in people of all ages. Some of these effects are acute, which means they are triggered by a short-term increase in concentrations. Other effects are chronic, from exposure to slightly higher concentrations over extended time periods, perhaps years or decades. For this reason, it is important that you take steps to make sure you do not make the air quality inside worse because of these activities. To do this, you should:

1. Only pick activities or sources from the list that you would normally use in your home.
2. Pick a space where you can easily increase the ventilation rate after the activity to remove any pollutants in the air.
3. Do not decrease the ventilation below normal background levels during the activities. This means leaving windows or vents open if they are normally open, and leaving any mechanical ventilation running if it would normally be on.

You will need:

- Air quality monitor, set up and connected to device
- Ruler
- Indoor sources, choose from the list
- Pen and paper to record results
- Stopwatch (optional)

Indoor activities to test
Toasting bread
Frying pancakes
Spraying perfume
Spraying deodorant
Spraying hairspray
Spraying air freshener
Spraying cleaner
Using nail varnish

Method:

1. Pick 3–5 possible sources from the table above.
2. Set up the air quality monitor 50 cm away from where you are going to be testing the possible sources. Follow the set-up instructions for your monitor and check that you can view the concentrations.
3. Note down the fine particle concentration at the start of your test. This is the background concentration, and for you to make a fair comparison between sources it is important the background level is the same before you test each source.
4. Use the first potential source from your list. For some sources it may be helpful to time how long it lasts or decide how long you think it should last. For example, if you are burning candles or incense, you may want to pick how long you should burn them for before starting.
5. Write down the highest particle concentration during the source activity.
6. Increase the ventilation rate until the particle concentration drops down to background levels.
7. Repeat steps 4–6 for the remaining sources.

VOCs SOURCE SPOT TESTS (VOCs)

Results table

Background concentration: _____

Activity	Peak concentration (ppb)	Length of activity (seconds)

Questions to think about

1. Which source reached the highest concentration?
2. How could you present the findings?

Measuring VOCs

Volatile Organic Compounds (VOCs) are a group of chemicals found in the indoor environment. Most consumer sensors give a measure of total VOCs (TVOCs), which is an indication of the combined concentration of VOCs. There are very wide range of VOCs, with and without known health effects. The exact VOCs being measured by your monitor will depend on the type of sensor fitted in the monitor, so any concentrations you measure will only be an indication of what is emitted.

Indoor activities to investigate were identified using the following papers:

Dacunto et al. Real-time particle monitor calibration factors and PM_{2.5} emission factors for multiple indoor sources. *Environmental Science: Processes & Impacts*. 2013; 15, 1511–1519. DOI: 10.1039/c3em00209h

Singer BC, Delp WW. Response of consumer and research grade indoor air quality monitors to residential sources of fine particles. *Indoor Air*. 2018;28:624–639. DOI: 10.1111/ina.12463

Farmer, D. K. et al. Overview of HOMEChem: House Observations of Microbial and Environmental Chemistry. *Environmental Science: Processes & Impacts*. 2019; ISSN: 2050-7887. doi:10.1039/C9EM00228F

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VENTILATION SPOT TESTS (PM_{2.5}) (VOCs)

The aim of this activity is to investigate how ventilation methods in the home can be used to reduce the concentrations of fine particles or VOCs in a space. You have the freedom to choose any activity from the particle or VOCs spot test activities, depending on what you have in your home and what your air quality monitor measures.

Safety Notice

Indoor air pollutants are associated with a range of health effects in people of all ages. Some of these effects are acute, which means they are triggered by a short-term increase in concentrations. Other effects are chronic, from exposure to slightly higher concentrations over extended time periods, perhaps years or decades. For this reason, it is important that you take steps to make sure you do not make the air quality inside worse because of these activities. To do this, you should:

1. Only pick activities or sources from the list that you would normally use in your home.
2. Pick a space where you can easily increase the ventilation rate after the activity to remove any pollutants in the air.
3. Do not decrease the ventilation below normal background levels during the activities. This means leaving windows or vents open if they are normally open, and leaving any mechanical ventilation running if it would normally be on.

You will need:

- Air quality monitor, set up and connected to device
- Ruler
- Indoor sources, choose from the list
- Pen and paper to record results
- Stopwatch (optional)

Ventilation conditions to test
Normal
Open a window
Open an external door
Extractor fan on
Cooker hood on low
Cooker hood on low
Cooker hood on high

Method:

1. Investigate the ventilation options available in your kitchen. Select some different ventilation conditions from the table above that are available in your kitchen to investigate.
2. Select a single source from either the list of VOC or particle sources in the activities. Preferably it should be a source that you have already investigated and know increases the concentrations.
3. Set up the air quality monitor away from where you are going to be doing the activity, so you are measuring the general room air.
4. Note down the fine particle and/or VOC concentration at the start of your test. This is the background concentration, and for you to make a fair comparison between sources it is important the background level is the same before you test each source.
5. Set the ventilation to how you normally use it.
6. Carry out your chosen source activity. If appropriate, standardise the length of the activity, for example spray deodorant for 3 seconds.
7. Write down the highest particle and/or VOC concentration during the source activity.
8. Increase the ventilation rate until the particle concentration drops down to background levels.
9. Repeat steps 5–8 for the remaining ventilation conditions.

VENTILATION SPOT TESTS (PM_{2.5}) (VOCs)

Results table

Background particle concentration: _____

Background VOC concentration: _____

Ventilation conditions	Peak particle concentration (µg/m ³)	Peak VOC concentration (ppb)

Questions to think about

1. Did the peak concentration change between ventilation conditions?
2. Look at the overall shape of concentrations over time for each test, can you see any differences between each ventilation condition?
3. How could you present the findings?

Conditions to investigate were identified using the following papers:

Dacunto et al. Real-time particle monitor calibration factors and PM_{2.5} emission factors for multiple indoor sources. *Environmental Science: Processes & Impacts*. 2013; 15, 1511–1519. DOI: 10.1039/c3em00209h

Singer BC, Delp WW. Response of consumer and research grade indoor air quality monitors to residential sources of fine particles. *Indoor Air*. 2018;28:624–639. DOI: 10.1111/ina.12463

Farmer, D. K. et al. Overview of HOMEChem: House Observations of Microbial and Environmental Chemistry. *Environmental Science: Processes & Impacts*. 2019; ISSN: 2050-7887. doi:10.1039/C9EM00228F

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