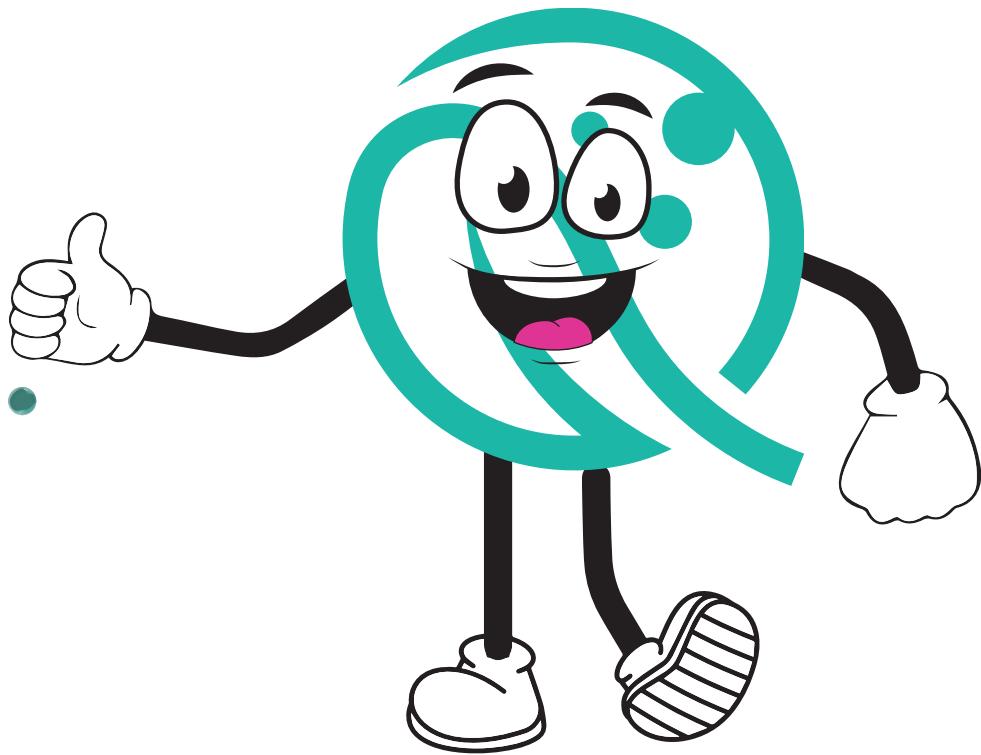


# WORKBOOK

## TO LEARN ABOUT THE iNDOOR AIR QUALiTY



EVIDENCE DRIVEN iNDOOR AIR QUALiTY IMPROVEMENT



THIS PROJECT HAS RECEIVED FUNDING FROM THE  
EUROPEAN UNION'S HORIZON EUROPE RESEARCH AND  
INNOVATION PROGRAMME UNDER THE GRANT  
AGREEMENT N°: 101057497

Developed by University of Seville within the EDIAQI Project.

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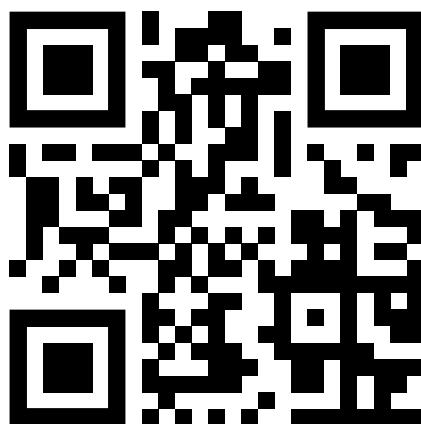
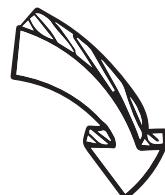


## What is EDIAQI?

EDIAQI is a research and innovation project that focuses on the study of indoor air pollution in European cities. Its main objective is to understand the sources, exposure pathways, and health effects of indoor air pollution.

The project brings together 18 organizations from 11 different European countries, providing a combination of interdisciplinary skills and expertise in various fields.

**Learn more about EDIAQI**



*EDIAQI Website*

# WELCOME!

Do you want to learn more about the pollutants present in the air around us? With the help of this workbook, you can engage in various activities to understand indoor air pollution.

In addition to learning about the types of pollutants, you will discover their sources, the effects they have on our health and the environment.

Best of all, you will also learn how you can contribute to ensuring that indoor spaces maintain good air quality!

**Are you reday?**

**Let's go!**

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# AIR QUALITY

## What is air?



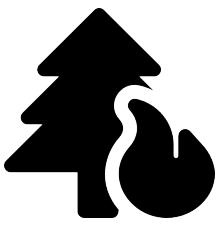
Air is a mixture of gases that form the atmosphere, which is why it's found everywhere. Have you ever stopped to think about how much and what kind of air we breathe?

On average, humans breathe between 5 and 6 liters of air per minute, which means that in 24 hours, a person breathes between 7,200 and 8,600 liters. The air we breathe contains the oxygen we need to live, and that's why it's essential to breathe air free of contaminants.

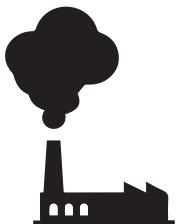


## How is outdoor air polluted?

Air can be contaminated in different ways, stemming from sources of natural origin (coming from the environment) and sources of artificial origin (produced by humans).



A small portion of pollution comes from natural sources, such as gases produced by volcanic eruptions or forest fires—events that we cannot control.



The majority of pollution is caused by contaminants produced by artificial sources. An example of these sources includes gases emitted by factories or vehicle exhaust gases, such as those from cars.

## What is air quality index?

Air can be contaminated to a greater or lesser extent. When the air is less contaminated, we say there is good air quality, and when the air is more polluted, we say there is poor air quality. Air quality is measured using the air quality index. Therefore, we refer to air quality when we want to classify how polluted the air is.



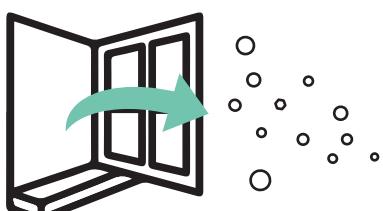
POOR AIR QUALITY



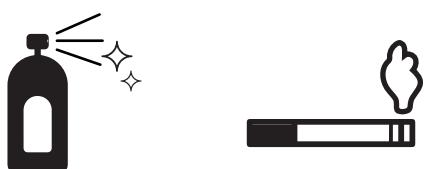
GOOD AIR QUALITY

## How is indoor air polluted?

Indoor air can become contaminated for various reasons:



If outdoor air is polluted, opening doors and windows allows the pollution to enter.



Due to the use of cleaning products, air fresheners, perfumes, tobacco, etc.



Through the use of printers, photocopiers, ionizers, etc.

## Why is it important to care for indoor air quality?

Outdoor air pollution in cities has increased in recent years. This directly impacts the air we breathe indoors, especially in densely populated areas like large cities.



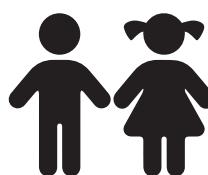
On average, people spend 90% of their time indoors, such as in school, at work, or at home.



## How does poor indoor air quality affect us?

Air pollution affects everyone, but it is particularly dangerous for children like you, pregnant women, and older individuals, such as your grandparents.

Additionally, people with respiratory or cardiovascular diseases are more vulnerable.

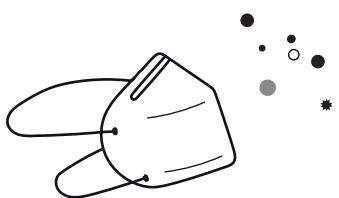


Breathing in polluted air can cause headaches, affect our lungs, and also impact our heart.

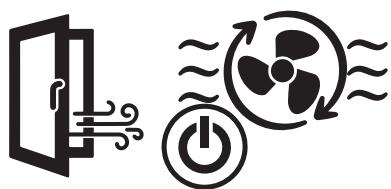


# RECOMMENDATIONS

## What to do if there is poor indoor air quality (IAQ)?



Use masks to avoid breathing in contaminants present in the air.

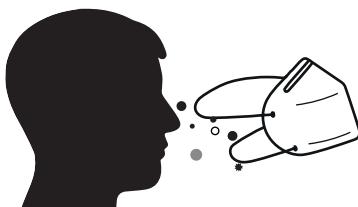


Turn on mechanical ventilation or open windows and doors to naturally ventilate the space.



Identify the possible source of contamination and remove it from the area.

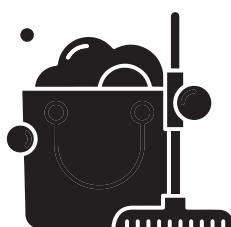
## How can we improve indoor air quality (IAQ)?



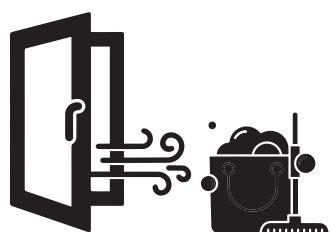
Use masks when in indoor spaces with many people, especially if they are sick, elderly, or pregnant. Additionally, always use a mask if you have a contagious disease like a cold or flu to prevent spreading the illness through the air.



Share what we have learned with our family and friends so they can also learn about air quality and contribute to its improvement.



Maintain good cleanliness of ventilation ducts and indoor spaces. Avoid the use of air fresheners.

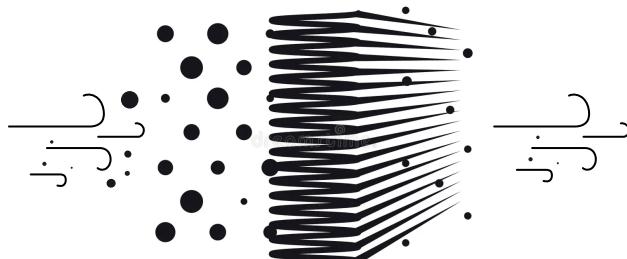


When performing cleaning tasks, open windows to prevent the concentration of contaminants from cleaning products.

# FILTRATION

## Ventilation and filtration

As we have learned, it is essential to ventilate to maintain good indoor air quality. However, what happens when natural ventilation is not possible or when the outdoor air quality is poor for natural ventilation?

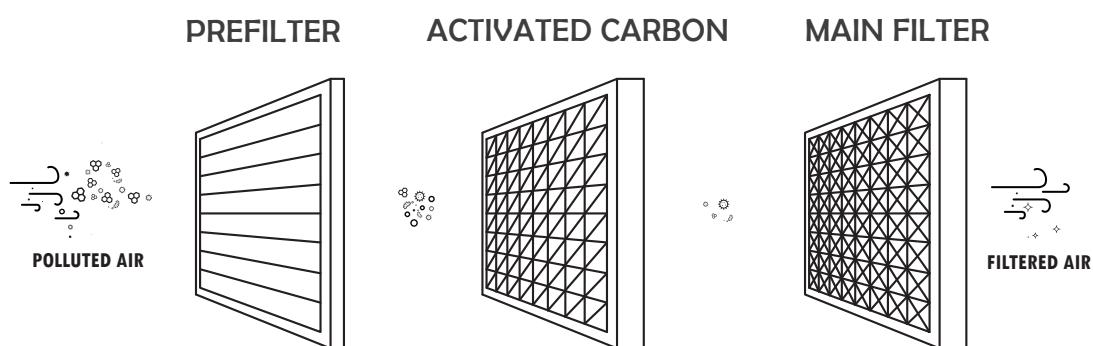


The purpose of filtration is to remove as many contaminants as possible from the ambient air. This process involves passing the air in a room through multiple filters several times, which are designed to trap the contaminants present in the air, retaining them as much as possible. There are different types of filters with varying degrees of filtration capacity.



## The process

The most basic portable equipment that we can currently find on the market consists of a pre-filter responsible for trapping larger particles (such as dust, lint, pollen), an activated carbon filter tasked with adsorbing gases, odors, VOCs, and the filter (EPA, HEPA, ULPA), which is responsible for trapping smaller particles (viruses, bacteria, pollen, fungi, aerosols).





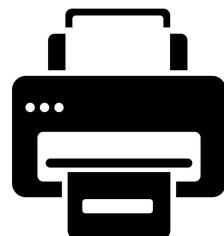
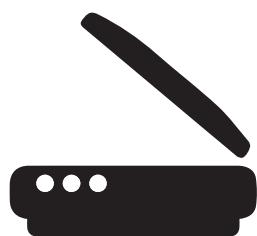
# INDOOR AIR POLLUTANTS

# OZONE

## What is it?

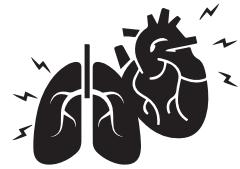
Ozone (O<sub>3</sub>) is a colorless and odorless gas, meaning we cannot see or smell it. At high levels in the atmosphere (stratospheric ozone), it protects us from the sun's rays and ultraviolet radiation. However, at low levels in the atmosphere where we live (tropospheric ozone), it acts as a greenhouse gas, trapping heat and having negative effects on our health.

In outdoor spaces, ozone is formed through a chemical reaction between other pollutants and sunlight. In indoor spaces, ozone is emitted by electronic equipment such as printers or scanners.



## Health Effects

Tropospheric ozone can cause coughing, irritation in the nose and eyes, respiratory diseases, and cardiovascular diseases.



NOW THAT YOU'VE LEARNED MORE ABOUT O<sub>3</sub>, LET'S DO an ACTIVITY!

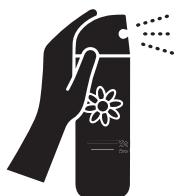
GO TO THE PAGE  
**19**

# VOLATILE ORGANIC COMPOUNDS

## What are they?

Volatile Organic Compounds (VOCs) are chemical substances (some of them toxic) found in a gaseous state in the air. VOCs are among the primary pollutants in indoor spaces. In most cases, there is a higher concentration of VOCs indoors than outdoors.

Examples of products we use in our daily lives that release VOCs into the air we breathe include perfumes, nail polish removers, some cleaning products, or air fresheners.



## Effects on health

Breathing in Volatile Organic Compounds (VOCs) can cause eye irritation, dizziness, fatigue, nausea, allergies, and damage to our liver or nervous system.



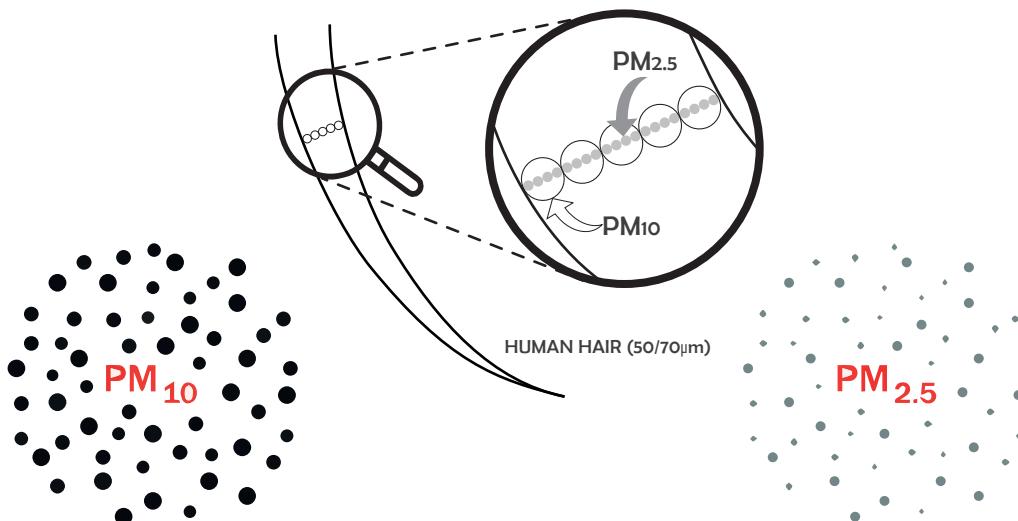
NOW THAT YOU'VE LEARNED MORE ABOUT VOCs, LET'S DO an ACTIVITY!

GO TO THE PAGE  
**20**

# PARTICULATE MATTER

## What is it?

Particulate Matter (PM) is composed of very small liquid and solid elements, almost imperceptible to our eyes, and therefore, we cannot see it in most cases. Particulate Matter is classified based on the size of its particles:



**PM<sub>10</sub>** Coarse particulate matter: It has a larger diameter and, when breathed in, it stays in our lungs. (Dust, pollen, mold, etc.)

**PM<sub>2.5</sub>** Fine particulate matter: It has a smaller diameter and, when breathed in, can enter our bloodstream. (Particles from car exhaust pipes, etc.)

## Effects on health

Particulate Matter affects the health of more people than any other pollutant and can cause respiratory and cardiovascular diseases, as well as damage to the central nervous system.



NOW THAT YOU'VE LEARNED MORE ABOUT PM, LET'S DO an ACTIVITY!

GO TO THE PAGE  
**21**

# CARBON DIOXIDE

## What is it?

Carbon Dioxide (CO<sub>2</sub>) is a gas that we cannot see or smell. All humans exhale carbon dioxide when we breathe. While carbon dioxide is not an air pollutant, it serves as an indirect indicator of the relative humidity level, the presence of aerosols, particles, viruses, and bacteria in the air we breathe. Therefore, it is crucial to know its value as it allows us to regulate ventilation indoors.

## Effects on health

High concentrations of carbon dioxide influence our respiratory system, cardiovascular system, and cognitive system.

Depending on the concentration of carbon dioxide, we may experience symptoms such as a sore throat, eye irritation, sneezing, increased blood pressure, decreased concentration and performance, among others.

## Learn a bit more...

The concentration of CO<sub>2</sub> in the air is measured in parts per million (PPM). Outdoors, carbon dioxide levels are usually around 420 PPM. In closed environments, such as schools or homes, there are no unified limits for all countries on the maximum CO<sub>2</sub> concentration, but there are recommended values. The recommended values for indoor carbon dioxide concentration are indicative and are commonly around:



>1200 PPM



>800 PPM



<600 PPM

NOW THAT YOU'VE LEARNED MORE ABOUT CO<sub>2</sub>, LET'S DO an ACTIVITY!

GO TO THE PAGE  
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# ACTiViTiEs

# RESEARCH ONE POLLUTANT

There are many pollutants that affect the quality of our air we breathe. Individually or in groups choose one type of pollutants to research it.

**Name of pollutant**

**WHERE IS COME FROM?**

**HEALTH EFFECTS**

**UPPER LIMIT VALUES IN YOUR COUNTRY**

**AND IN ANOTHER COUNTRIES?**

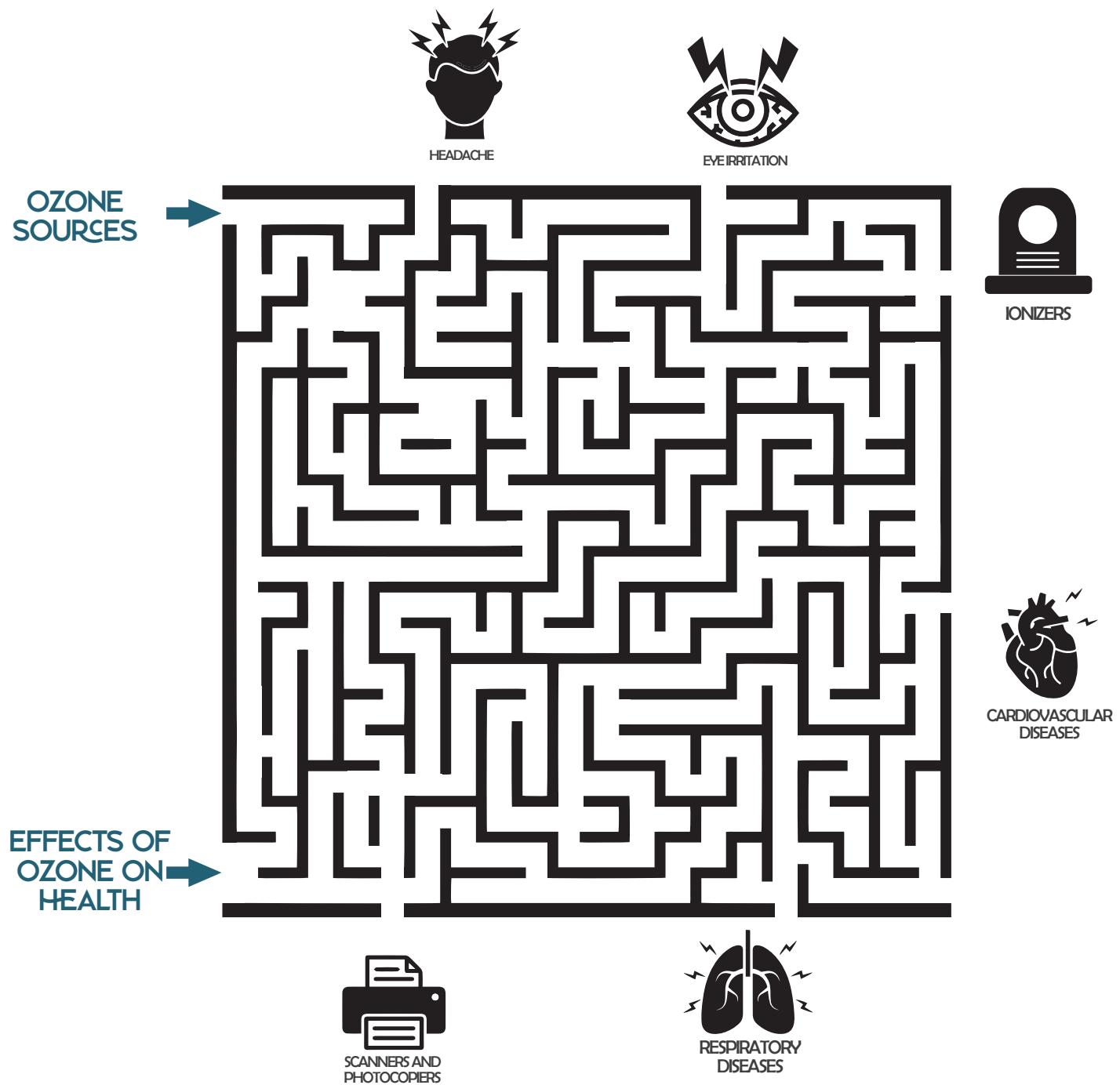
**SOLUTIONS/RECOMMENDATIONS TO IMPROVE THE POLLUTION**

**WHY NOT DESIGN A POSTER WITH THIS INFORMATION TO DISPLAY TO WHOLE SCHOOL?**

# THE MAZE

As we have learned, ozone causes various negative effects on our health and comes from different sources. Would you be able to find the correct path to the effects and sources?

Let's go!



# VOCs SOURCES

As we've learned, many products we use emit volatile organic compounds (VOCs) into the air we breathe. Can you find the 5 elements that pollute indoor air by emitting VOCs?



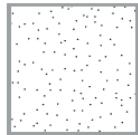
# SURFACE CLEANING

Through this activity, we will determine the amount of particulate matter in our surroundings. Particulate matter in the air settles on the surfaces of the objects around us.

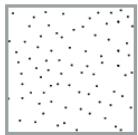
## Pollution Level



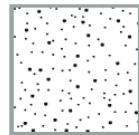
**1**  
NOT  
CONTAMINATED



**2**  
SOMEWHAT  
CONTAMINATED



**3**  
CONTAMINATED



**4**  
FAIRLY  
CONTAMINATED



**5**  
VERY  
CONTAMINATED

Take the cotton balls dampened with water. Collect samples from different elements at various heights, such as walls, doors, or furniture. Simply drag the cotton ball over the surface of the element as if you were cleaning it.

### Surface 1:

HEIGHT

PLACE YOUR SAMPLE HERE

LEVEL 1-5



90 cm



60 cm



30 cm  
cm = centimeters

## Surface 2:

HEIGHT

PLACE YOUR SAMPLE HERE

LEVEL 1-5



90 cm



60 cm



30 cm

## Surface 3:

HEIGHT

PLACE YOUR SAMPLE HERE

LEVEL 1-5



90 cm



60 cm



30 cm

# CO<sub>2</sub> CONCENTRATION

Since we know humans exhale carbon dioxide when we breathe, the more people in an unventilated indoor space, the higher the concentration of this gas.

Knowing the recommended concentrations of CO<sub>2</sub> in indoor spaces, can you guess at what concentration levels you think there will be in these unventilated indoor spaces?



>1200 PPM



# WORD SEARCH

## Identify Contaminants

Can you find the 10 types of indoor air pollutants hidden in this word search?  
Give it a try!

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

1. AIR FRESHENER

4. DEODORANT

7. COLOGNE

2. PRINTER

5. DUST

8. TOBACCO

3. SCANNER

6. MOLD

9. CHALK

# MAKE YOUR OWN FILTER

We already know the importance of filtering indoor air, but HEPA air purifiers can be expensive, making them inaccessible to everyone. That's why, prompted by the situation caused by the COVID-19 pandemic, in 2020, Richard Corsi (an environmental engineer and Dean of Engineering at the University of California, Davis) came up with the idea of combining air filters with a square fan to improve the efficiency of air purifier designs with the goal of reducing levels of small particles that can transmit viruses through the air indoors.

Although it was designed with the aim of preventing airborne virus transmission turned out to be an air purifier that can be built by anyone at a low cost.

Currently, this design has evolved into the Comparetto cube, which utilizes four filters and a cardboard base, making it possible to place directly on the floor. Subsequently, a cardboard cover was incorporated to shield the corners of the fan, thereby enhancing its efficiency.



Image extracted of WIKIPEDIA

## Materials



MERV-13 AIR FILTERS  
20 x 20 x 2 cm  
x4



BOX FAN



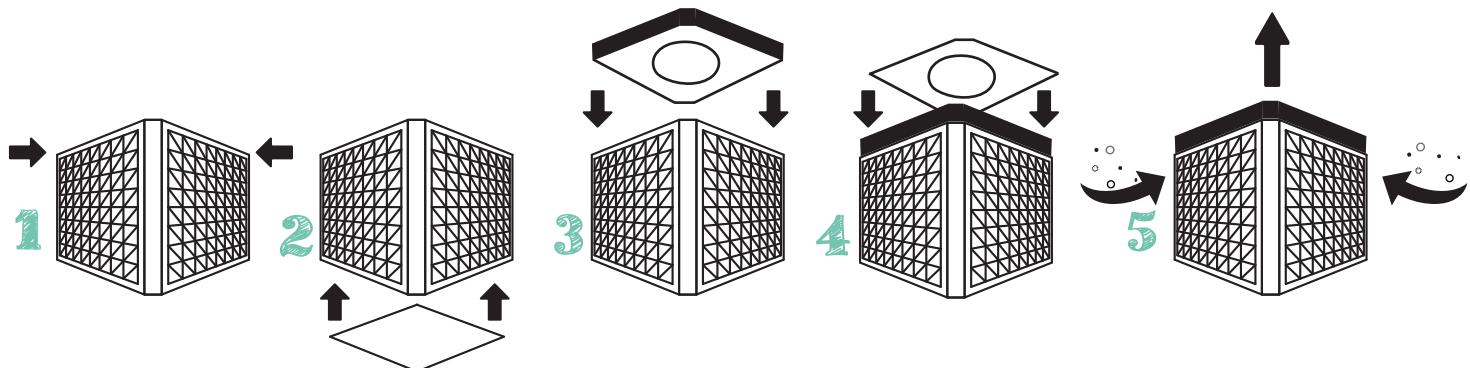
SQUARE FAN BOX OR OTHER



SCISSORS AND ROLL TAPE

## Steps

- 1 Making sure the air flow arrows point inward, align the corners of two air filters. Secure the corners with tape and repeat with the other filters to create a box shape.
- 2 Flip over your box and attach your large cardboard square to the bottom with long strips of tape that cover the length of each side.
- 3 Flip your box back over. Now you can place your box fan on the top of the cube. You want the fan to be blowing air out of the box. Tape each side of the fan, making sure to cover any holes between the box and the fan.
- 4 Place your four or one cardboard piece/s on the inner corners of your box and secure them with tape.
- 5 DONE! Now you can turn on the fan and now you have an air filter! The contaminated air will enter through the sides where the filters are located, and will be filtered out through the top.





## EVIDENCE DRIVEN INDOOR AIR QUALITY IMPROVEMENT



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