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Role of Air Filters for  
Air Pollution and  
pulmonary disease

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- Air filters play a crucial role in mitigating the effects of air pollution by capturing airborne particles and pollutants, thus contributing to improved indoor air quality and potentially reducing health risks associated with poor air quality.

Understanding how air filters work can help you decide which filter is best for a specific purpose. All air filters work in a similar fashion:

- Air passes through the filter screen.
- As the air passes through, the filter media (material) catches particulate matter such as pollen, dust, pet dander, dirt and allergens. Some types of air filters can even remove bacteria and viruses from the air
- Every second as air passes through the filter media contaminants build up. Eventually, the filter gets too clogged and airflow is reduced.
- Eventually, the filter gets too clogged and airflow is reduced.
- The air filter is then replaced, and the process continues.
- Where air filters differ most is the media that is used. Filter media quality and quantity influences the size of air particles that can be captured, how they are captured and airflow through the system.

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- The purity of air measured using an AQI thermometer that runs on a scale from 0 to 500. The **AQI refers to Air Quality Index**. It measures how pure or polluted the surrounding air is. If the numeric value on the scale is between 0-50, the quality of the surrounding air is considered healthy and satisfactory. As the values increase, the quality of the air decreases. If AQI is showing a value of 500, that means you are standing in a hazardous surrounding.

## • Clean Air Delivery Rate (CADR)

- The CADR is a key metric that indicates the volume of filtered air an air purifier delivers, with a higher CADR correlating to more efficient pollutant removal. When selecting an air purifier, it is important to consider the CADR to ensure it is appropriate for the size of the room or area where it will be used.

## Minimum Efficiency Reporting Value (MERV)

- MERV ratings are used to indicate the filter's ability to capture particles between 0.3 and 10 microns. A higher MERV rating means better filtration, which is crucial for capturing smaller particles that can be harmful to health.

# Types of Air Filters and Their Functions

**\*\*HEPA Filters\*\***: Capture particulate pollution effectively but do not remove gases or VOCs.

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**\*\*Activated Carbon Filters\*\***: Specialize in capturing hazardous gases and can capture even the tiniest pollutants, including smoke, chemicals, fumes, and odors.

**\*\*UV Filters\*\***: Use ultraviolet radiation to destroy tough microorganisms such as viruses, bacteria, mold, and yeast, but they take time to do so.

**\*\*Electrostatic Filters\*\***: Filter smaller pollutants and improve indoor air quality.

Despite their benefits, some air purifiers, particularly electronic air cleaners, can produce ozone gas and other pollutants that may be hazardous to health.

# HEPA

- **Pros of HEPA Air Purifiers**

- Effective purification against the small particulate matter dissolved in the air.
- No harmful byproducts during the whole process of air purification
- As the filters trap more pollutants, they become more effective in the filtration process
- HEPA filter technology can be combined with other air purification technologies also to give out a very powerful purification technology. Like, it can be combined with UV prefilters to kill the microbes dissolved in the air.

- **Cons Of HEPA Air Purifiers**

- High maintenance cost
- The HEPA filters don't last forever, they require replacement.
- In heavily polluted areas, the filters require rapid replacements.
- Can create inconveniences often
- HEPA purifiers don't eliminate the smell from the air.

# UV

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- **Pros Of An UV Air Purifier**

- The air purifiers target the airborne pollutants and kill them effectively
- Have a wide range of uses in various fields.
- Good at anti-viral and anti-bacterial cells removal
- Helpful in neutralizing the microbes in the air

- **Cons Of An UV Air Purifier**

- It forms the byproduct of ozone in the air purification process
- Only safe wavelengths of UV light are used in these air purifiers

# IONIZER

- **Pros Of Ionizer Air Purifiers**

- **They are filterless air purifiers**

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- **They don't need rapid and often replacements**

- **Low Maintenance costs**

- **Quieter in operating**

- **Cons Of Ionizer Air Purifiers**

- **They are less effective than the other air purifiers**

- **The air purifiers create a mess while purifying the air**

- **The ions can settle in the surfaces of the home which is no good at all**

- **The byproduct is ozone which is not good for health**

# OZONE

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- **Pros Of Ozone Generated Air Purifiers**
- In industries, the ozone air purifiers can be useful in killing microbes and disinfect the air
- Effective in destroying the biological contaminants
- **Cons Of Ozone Generated Air Purifiers**
- It creates a large amount of ozone which is not good at all
- It does not kill the small particulate matter in the air
- The purifier fails to eliminate bad smell

# ACTIVATED CARBON

- **Pros Of Activated Carbon / Absorbent Air Purifiers**
- No harmful byproducts in the air purification

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- Safe to use in the homes
- Can remove pesky smell and VOCs.
- The absorbent filters can be combined with the ionic as well as other purification technologies.
- Good at trapping the airborne pollutants
- **Cons Of Activated Carbon/ Absorbent Air Purifiers**
- It is not a stand-alone item or device
- Can't remove small particulate matter from the air
- There is an additional cost of pre filters with these purifiers.

# Sources of Indoor Air Pollution

Kerosene heater



Gas stove



Gas heater



Car exhaust from garage



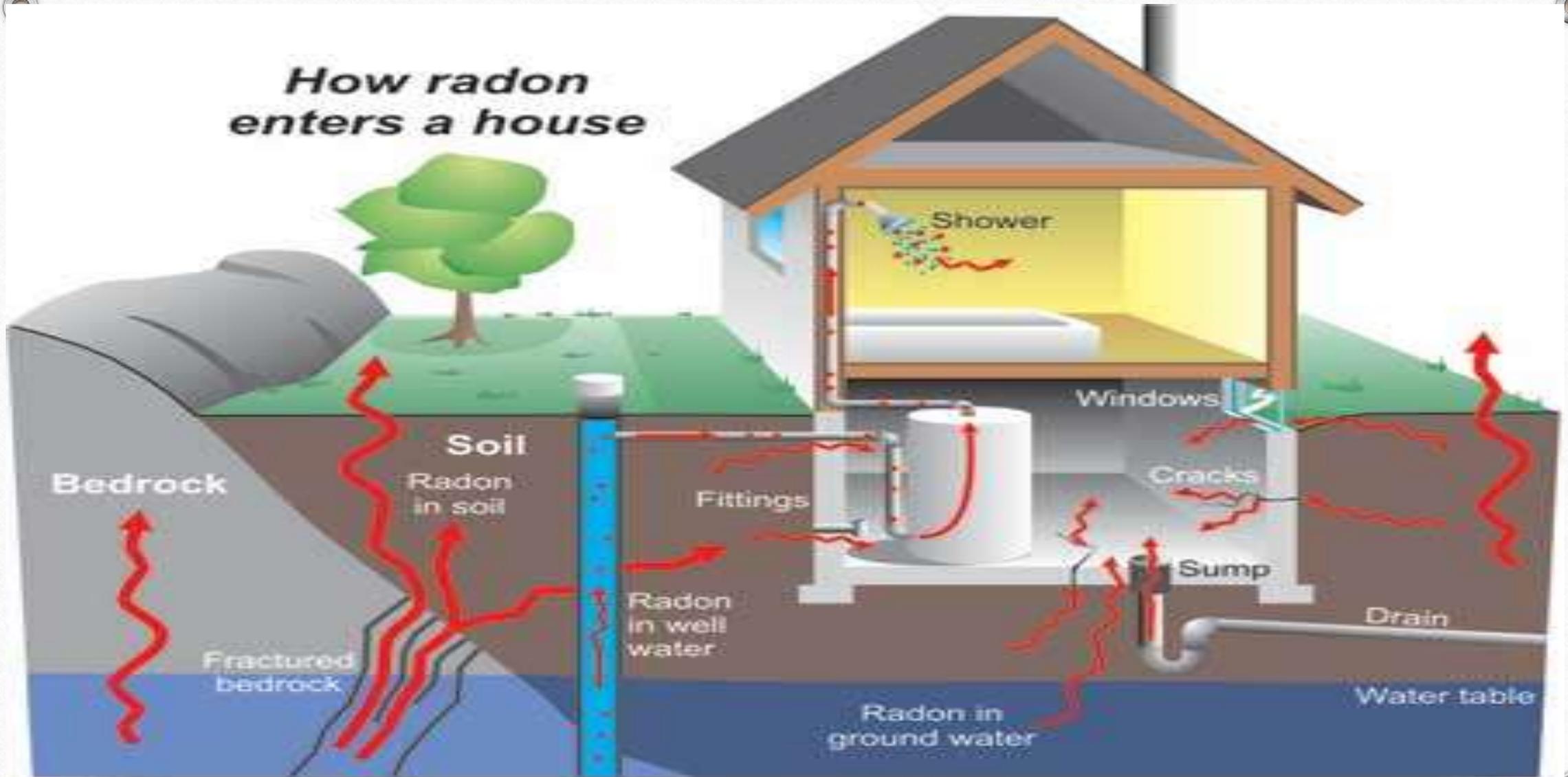
Fireplace

[www.3planesoft.com](http://www.3planesoft.com)

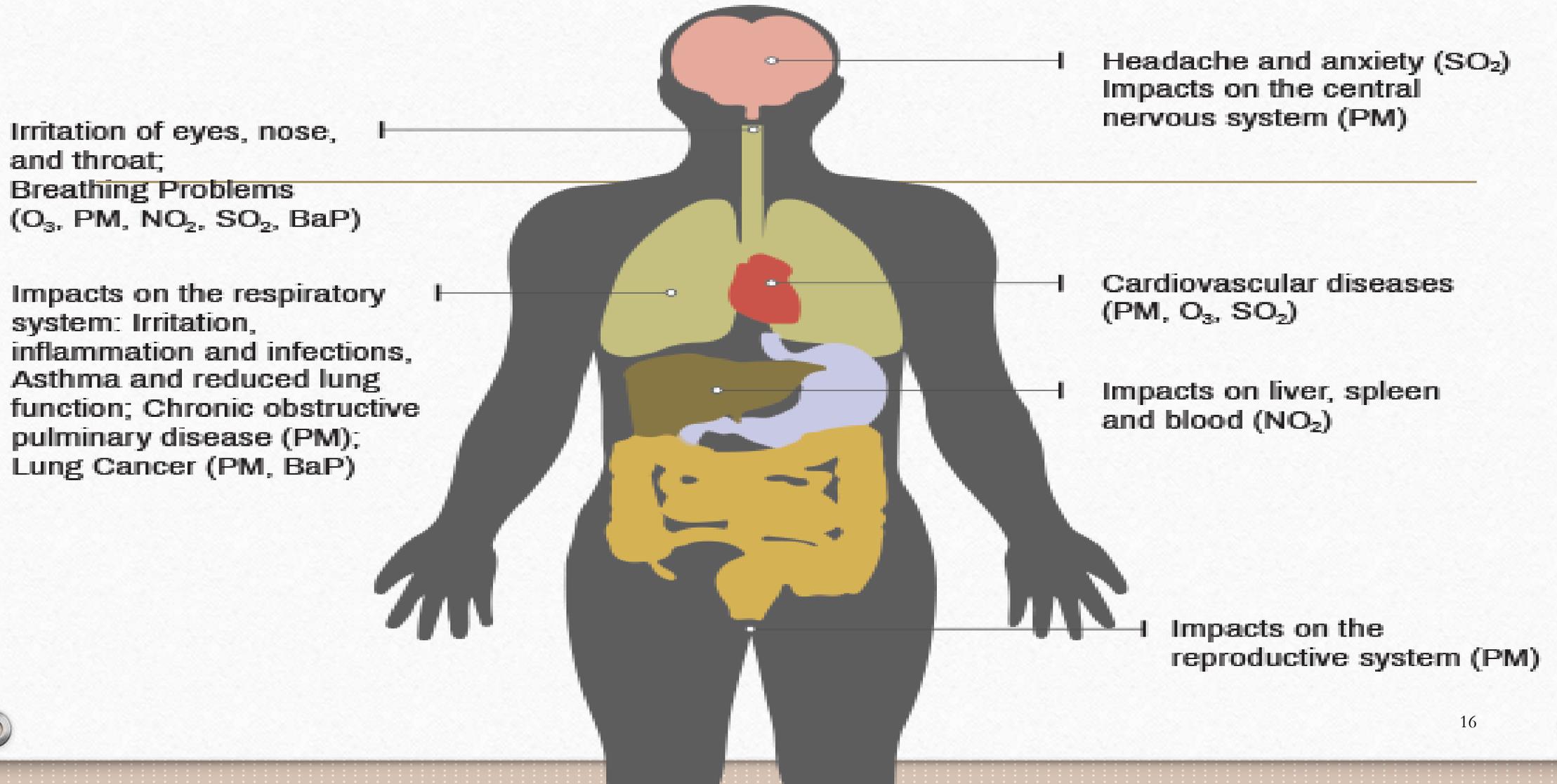
# Sources of Indoor Air Pollution



## How radon enters a house



# HEALTH EFFECTS OF AIR POLLUTION



# HEALTH BENEFITS OF AIR PURIFIER



Reduces respiratory diseases and air borne infections



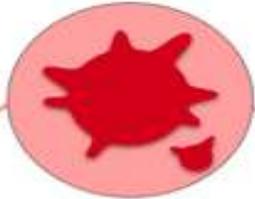
Improves air circulation and removes dust particles



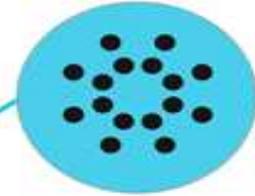
Eliminates allergy that causes pet hair fall and odour



Removes pollens introduced by indoor and outdoor plants



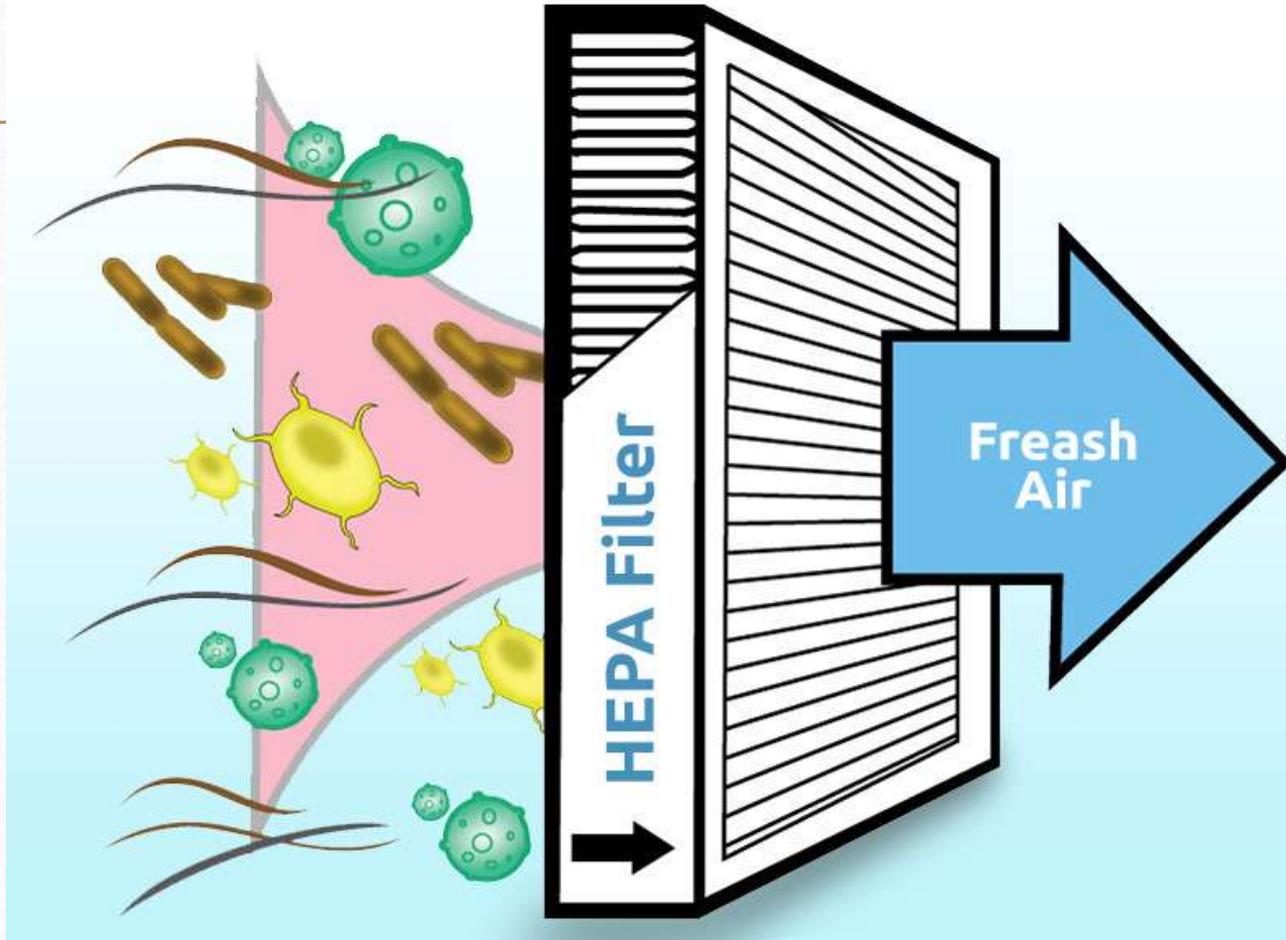
Removes dust and allergies



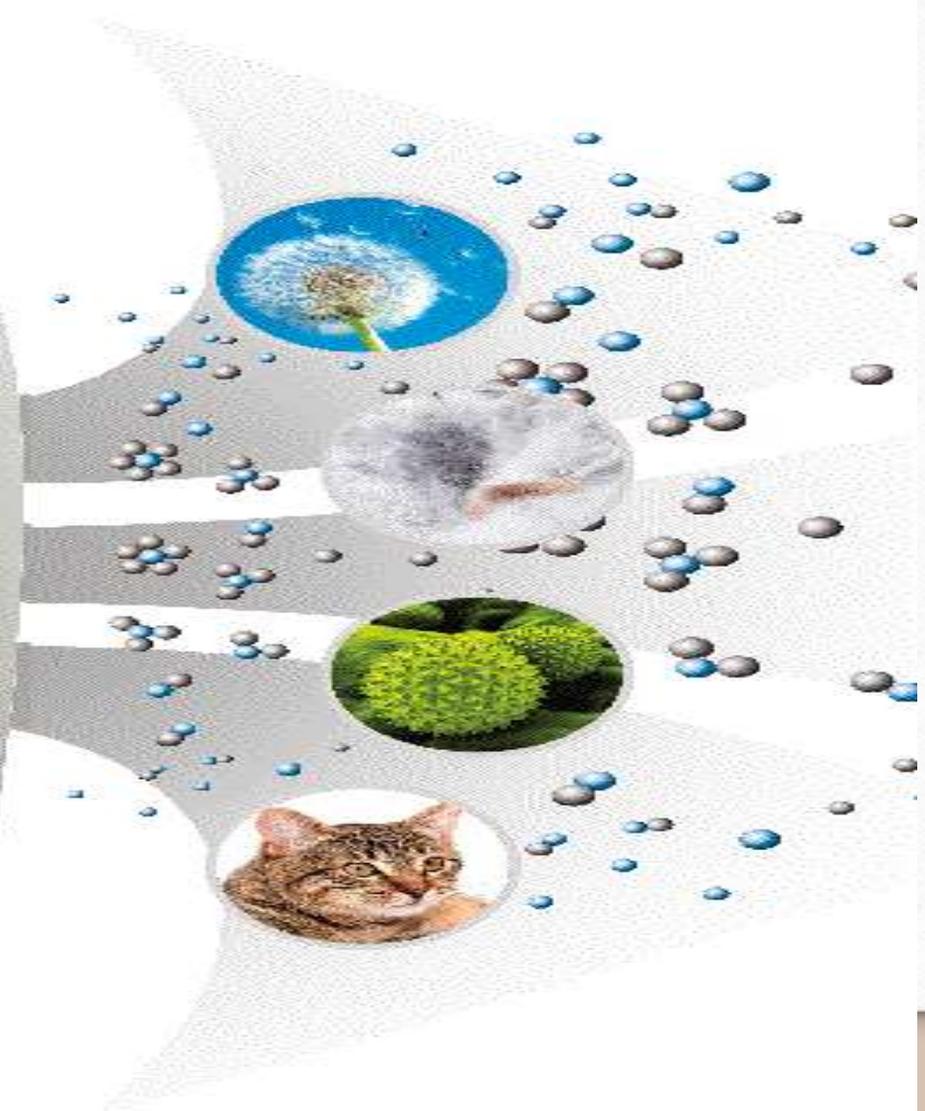
Filters out large airborne particles such as hair fibres, dusts and debris



# HEPA (high efficiency particulate) filters



# Working of Air purifiers



# Health Implications

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- Particle pollution, particularly from fine particulates (PM 2.5), poses significant health risks, including increased risk of heart disease, asthma, and low birth weight. Air filters can greatly reduce indoor air particle levels, which is especially important for sensitive groups such as children, older adults, and those with heart or respiratory problems.

- air filters are a valuable tool in the fight against air pollution. They can significantly improve indoor air quality by removing particulate matter and, depending on the type of filter, gases and odors. they should be used as part of a comprehensive approach to air quality management that includes source control and ventilation. **Regular maintenance and appropriate** selection based on room size and specific contaminant types are essential

# Effectiveness of Air Filters

- Air filters, particularly those equipped with **HEPA (High-Efficiency Particulate Air) technology, are highly effective in capturing a wide range of particulate pollutants**, including viruses, pollen, dust, bacteria, and more. HEPA filters are recognized for their ability to remove 99.97% of pollutants and allergens from the air, with a high MERV (Minimum Efficiency Reporting Value) rating of about 16, indicating their high effectiveness in purifying indoor air.

# The Role of Air Purifiers in Indoor Air Quality

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Portable air purifiers can reduce indoor air pollution but cannot remove all pollutants from the air. They work by using fans to draw air through filters, trapping contaminants, and recirculating cleaner air. However, **no air purifier can eliminate 100% of pollutants**, and they should be used as part of a broader strategy for improving home air quality, which includes controlling the source of contaminants and improving home ventilation.

# HEPA Filters and Allergen Removal

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- HEPA filters are known for their ability to trap particles as small as 0.3 microns with a 99.97% efficiency, which includes most common allergens. Pollen, which is a common trigger for allergies, typically ranges in size from about 10 to 100 microns, making it a particle size that HEPA filters can effectively capture. Therefore, air purifiers equipped with HEPA filters should theoretically be able to remove pollen from the air.

# Recommendations for Allergy Sufferers

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- For those with allergies to pet dander, dust mites, and mold spores, using an air purifier with a high-quality HEPA filter is recommended due to its effectiveness in filtering small particles. However, it's important to use air purifiers as part of a broader allergy management strategy, which includes **source control**, **regular cleaning**, and **proper ventilation**.

# Expert Opinions on Air Purifiers and Allergies

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- Experts agree that air purifiers can help reduce allergens in the air and may alleviate symptoms for some individuals. However, they are not a standalone solution for seasonal allergies, especially in children, and may not always provide enough benefit to be considered worthwhile.

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- The effectiveness of air filters for pollution control depends on various factors, including the specific pollutants present, the size of the space, the efficiency of the air filter, and the maintenance of the filter. It's crucial to choose an air purifier with an appropriate Clean Air Delivery Rate (CADR) and to regularly replace or clean the filters as recommended by the manufacturer.

- It's important to note **that not all** air filters are designed to remove gases effectively. HEPA (High-Efficiency Particulate Air) filters, for example, are highly efficient at capturing particles **like dust, pollen, and pet dander**, but they are not designed to remove gases. To effectively remove gases, an air purifier should be equipped with a filter that includes **activated carbon**.

- it's worth mentioning that the effectiveness of air filters in removing gases can vary depending on factors such as the **concentration of gases, the size and type of the air purifier, and the specific gas being targeted**. Additionally, the lifespan and maintenance of the activated carbon filter can affect its efficiency in removing gases.

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- Activated carbon filters work by trapping and holding gas molecules within their pores. When air carrying harmful gases passes through the activated carbon filter, the harmful gases, such as formaldehyde and VOCs, are absorbed in the pores of the activated carbon. This process helps to reduce the concentration of these gases in the air, improving indoor air quality.

- 1. **Particle Filtration**: Air filters are designed to capture and remove particles from the air, such as dust, pollen, pet dander, and other allergens. This helps improve indoor air quality and reduces the presence of airborne particles that can trigger allergies or respiratory issues.

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- It's important to note that the specific functions of an air filter can vary depending on the type of filter and its intended use. Different filters may have additional features or specialized functions to address specific air quality concerns.

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- Remember to **regularly check and replace air filters** according to the manufacturer's recommendations to ensure optimal performance and effectiveness in maintaining indoor air quality. Air filters primarily function to improve indoor air quality by removing pollutants and allergens from the air.

air filters primarily function to improve indoor air quality, they **indirectly** play a role in maintaining lung health.

- 1. **\*\*Reducing Exposure to Airborne Pollutants\*\***: Air filters help remove dust, pollen, allergens, and other particles from the air. By reducing the presence of these pollutants, air filters can help minimize exposure and potential harm to the respiratory system. This is particularly beneficial for individuals with respiratory conditions such as asthma or chronic obstructive pulmonary disease (COPD), as exposure to airborne irritants can trigger symptoms and exacerbate their conditions.

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- 2. **\*\*Preventing Respiratory Infections\*\***: **Air filters can help filter out bacteria, viruses, and other pathogens from the air.**

This can be especially important in environments where individuals are at a higher risk of respiratory infections, such as hospitals or areas with high population density. By reducing the transmission of airborne pathogens, air filters can help prevent respiratory infections and protect lung health.



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- 3. **\*\*Improving Indoor Air Quality\*\***: Indoor air quality can have a significant impact on respiratory health. Air filters in HVAC systems or portable air purifiers can help remove pollutants and allergens from indoor spaces, creating a healthier environment for individuals with respiratory conditions. By improving indoor air quality, air filters can contribute to better lung health and overall well-being.

# Randomized Clinical Trial of Air Cleaners to Improve Indoor Air Quality and Chronic Obstructive Pulmonary Disease Health

- ORIGINAL ARTICLE

- Results of the CLEAN AIR Study

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- A total of 116 participants were randomized, of which 84.5% completed the study. There

was **no statistically** significant difference in total SGRQ score, but the active filter group had greater reduction in SGRQ symptom subscale (b, 27.7 [95% confidence interval (CI), 215.0 to 20.37]) and respiratory symptoms (Breathlessness, Cough, and Sputum Scale, b, 20.8 [95% CI, 21.5 to 20.1]); and lower rate of moderate exacerbations (incidence rate ratio, 0.32 [95% CI, 0.12–0.91]) and rescue medication use (incidence rate ratio, 0.54 [95% CI, 0.33–0.86]) compared with sham group (all P , 0.05).

- In per-protocol analysis, there was a statistically significant difference in primary outcome between the active filter versus sham group (SGRQ, b 24.76 [95% CI, 29.2 to 20.34]) and in moderate exacerbation risk, Breathlessness, Cough, and Sputum Scale, and 6MWD. **Participants spending more time indoors were more likely to have treatment benefit.**

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- Use of air cleaners with HEPA and carbon filters in the homes of former smokers with COPD was associated with 61% greater reduction in indoor PM<sub>2.5</sub> concentrations and a 24% reduction in NO<sub>2</sub> concentrations at 6 months compared with homes with sham air cleaners.

# considerations regarding air filters for patients with respiratory diseases:

- 1. \*\*HEPA Filters\*\*: High-Efficiency Particulate Air (HEPA) filters are highly effective at capturing small particles, including allergens and pollutants. They can be particularly beneficial for individuals with allergies or asthma. HEPA filters can be used in portable air purifiers or HVAC systems.
- 2. **\*\*Activated Carbon Filters\*\***: Some air filters are equipped with activated carbon filters, which can help remove gases, odors, and volatile organic compounds (VOCs) from the air. This can be beneficial for individuals with sensitivities to certain chemicals or those living in areas with high levels of outdoor air pollution.

- Please consult with a pulmonologist for personalized advice and recommendations based on your specific respiratory condition and needs. are recommended:

- 1. **\*\*HEPA Filters\*\***: High-Efficiency Particulate Air (HEPA) filters are highly effective at capturing small particles, including allergens and pollutants. They are recommended by the U.S. Department of Health and provide the highest level of protection for your home. HEPA filters can remove at least 99.97% of airborne allergens and pollutants that are as small as 0.3 microns.

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- 2. **MERV 13 Filters**: Upgrading to a MERV 13 rated filter can help remove viruses and other contaminants, leading to better indoor air quality. However, it's important to consult with an HVAC professional to ensure that your system can handle a MERV 13 filter.

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- 3. **\*\*Activated Carbon Filters\*\***: Some air filters are equipped with activated carbon filters, which can help remove gases, odors, and volatile organic compounds (VOCs) from the air. These filters can be beneficial for individuals with sensitivities to certain chemicals or those living in areas with high levels of outdoor air pollution.

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