



THE *BREATHE* PROJECT WORKSHOP GUIDE

Do-It-Yourself (DIY) Air Cleaners: Building Resilience to Emerging Airborne Threats and Heat Events

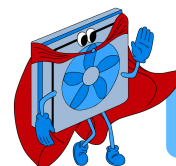
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Pacific Institute on Pathogens, Pandemics and Society

The Pacific Institute on Pathogens, Pandemics and Society (PIPPS) is a provincial research institute based at Simon Fraser University's (SFU) Burnaby campus. The Institute focuses on understanding the emergence and spread of new pathogens and responding to infectious disease events with pandemic potential that pose potentially severe risks to the health and well-being of populations.

PIPPS is a research and training platform that brings together B.C. scientists, educators, trainees and public health institutions with leading national and international experts. The Institute's interdisciplinary and population-level focus provides the opportunity to support whole-of-society and planetary health understandings of the wide-ranging determinants and impacts of major infectious disease events, and the multi-sectoral responses needed to enhance and maintain societal resilience.

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Background

Since 2005, there has been a significant increase in the number of forest fires in British Columbia (BC). This is considered to be the result of climate change and land use practices, creating a landscape more prone to wildfires. The number of wildfires burnt in an average year in BC has surpassed record levels, and our worst wildfire seasons have occurred in the past five years.

The total number of wildfires in 2017 was 1,352, burning 1.22 million hectares. This was easily surpassed in 2023, when a record-breaking number of 2,252 wildfires burned over 2.84 million hectares.

The increased number of wildfires in BC jeopardizes the health and well-being of individuals from wildfire smoke. It is the populations closest to wildfires who are exposed to the highest levels of wildfire smoke pollutants. However, wildfire smoke can also travel long distances depending on weather patterns, creating prolonged impacts on air quality that affect populations near and far.



Image Reference: Kulkarni, A., & Nelms, B. (2021, June 21). B.C.'s South Coast could soon see smoky skies, experts warn. CBC News. <https://www.cbc.ca/news/canada/british-columbia/metro-vancouver-wildfire-smoke-1.6109122>

Introduction

This Workshop Guide aims to provide a thorough manual for people, organizations, municipalities, or other groups interested in hosting their own DIY air cleaner workshops in their communities. This manual guides workshop leaders through the basics of DIY air cleaners and the planning and execution of a community workshop.



Who is This Guide For?

The Workshop Guide was created for emergency disaster management teams, environmental health experts, educators, public health officials, municipalities, and communities, to recreate DIY Air Cleaner workshops to build community resilience to climate change. This Workshop Guide aims to prepare teams and communities with the knowledge and tools to conduct DIY Air Cleaner workshops and create proactive preparedness to mitigate wildfire smoke-related health risks.

Knowing the Basics

i. Effectiveness

This project grew out of an evidence assessment conducted by Dr. Angela Eykelbosh of the National Collaborating Centre for Environmental Health (NCCEH). The study compared the performance of different models of DIY air cleaners to ones available commercially, most of which use high-efficiency particulate air (HEPA) filters. Performance was based on clean air delivery rate (CADR), which measures how fast the air cleaners can remove particles in an enclosed room. A higher CADR decreases the time it takes to change the air in a room, referred to as air changes per hour (ACH). Most commercially-available air cleaners filter out particles as small as 0.3 to 1.0 micrometers (Eykelbosh, 2023). This range covers a wide variety of indoor air pollutants, including viruses, wildfire smoke, mold spores, emissions from indoor wood burning, pollen, and sources of outdoor pollution that penetrate indoors (Eykelbosh, 2023). The evidence review suggests that DIY air cleaners performed comparable to or better than some commercial HEPA units, and were also less expensive to build than purchasing a commercial model.



ii. Shroud

To improve the efficiency of DIY air cleaners, it has been found that placing a **shroud** on the front of the fan improves its CADR by approximately 40% (Pistochini and McMurry, 2021). A shroud, made of either cardboard or duct tape, covers the borders of the front of the fan (see page 12 for shroud photos). The shroud increases the efficiency of air going through the filter. Without a shroud, dirty air gets sucked back into the corners of the fan and pushed out the centre without passing through the filter. The shroud helps to ensure that the air coming out of the fan has passed through the filter first.

iii. Use and Limitations

While DIY air cleaners can help to removed solid or particulate matter, the filter cannot trap gaseous pollutants, such as radon, VOCs, and carbon monoxide. These units are also thought to work well for removing infectious aerosol particulates such as COVID-19, and the flu, but the evidence has not shown whether this removal is large enough or fast enough to reduce the probability of infection.

DIY air cleaners are not long-term solutions. Homes that have conditions that cause long-term indoor air pollutants, like mold growth and wood-burning stoves, can use DIY air cleaners as an immediate response. However, homeowners should make the necessary arrangements to remove the source of home air pollution.

DIY air cleaners are not a cooling solution - if the temperature is 35 degrees or above, the fan will not be enough to lower your core body temperature, and you need to relocate to a cooling centre. If you have to choose between immediately protecting yourself from high heat or air quality, you should always **prioritize the heat**. Extreme heat carries a much greater risk of immediate injury and death compared to smoke.

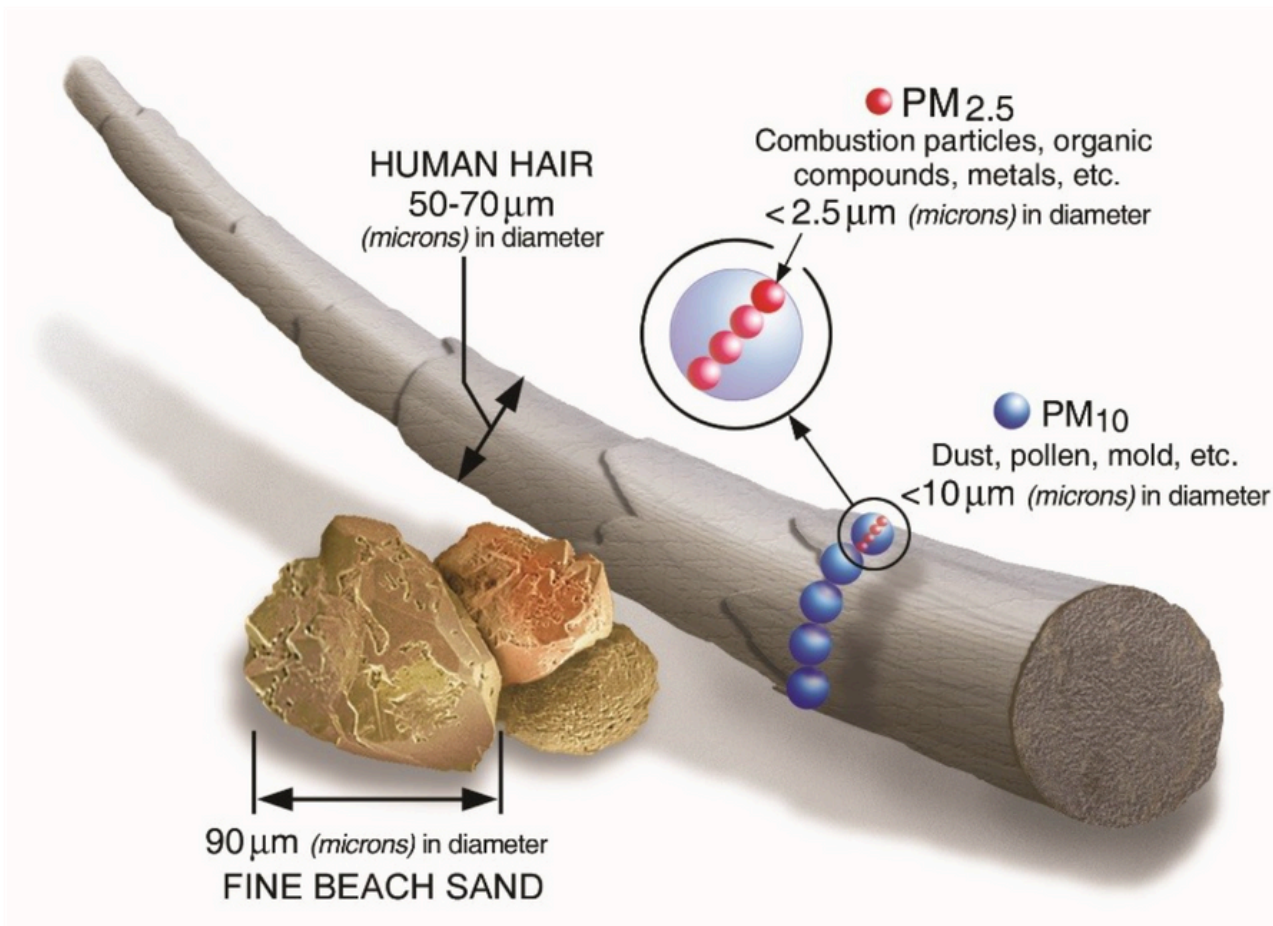


Image Reference: United States Environmental Protection Agency (US EPA). (2023, October). Why Wildfire Smoke is a Health Concern [Overviews and Factsheets]. <https://www.epa.gov/wildfire-smoke-course/why-wildfire-smoke-health-concern>

iv. Safely Operating a DIY Air Cleaner

When using a DIY air cleaner, simple precautions should be taken to avoid safety issues.

We strongly recommend instructing participants on the following:

- The air cleaner should be used with at least 4 feet of space away from walls, curtains, or furniture for air to flow through easily.
- To reduce wildfire smoke indoors, windows must be closed to prevent further smoke from entering the room.
- Air cleaners should not be left running unattended.
- The air cleaner should be plugged directly into the wall, not an extension cord.
- Place the air cleaner on a hard surface (i.e. not on a carpet) and stand it upright.
- Replace the air filter on the back when it is visibly dirty (gray or black).
- Do not cover the air cleaner with wet or dry towels, blankets, or other fabrics.

The United States Environment Protection Agency has conducted a rigorous review of DIY air cleaners' fire safety risks and has deemed them safe. **Wildfire Safety Report:** <https://chemicalinsights.org/wp-content/uploads/2022/03/DIY-Box-Fan-Report-2021.pdf>



DIY Air Cleaner Safety And Considerations

- 1 Air cleaner should be used with at least 4 feet of space away from walls, curtains or furniture for air to flow through easily.
- 2 When used to reduce wildfire smoke indoors, windows must be closed to prevent further smoke from entering the room.
- 3 Air cleaners should not be left running unattended.
- 4 The air cleaner should be plugged directly into the wall and not into an extension cord.
- 5 Use air cleaner on a hard surface (i.e. not on carpet) and facing upright.
- 6 Replace the air filter when it is visibly dirty.
- 7 Do not cover the air cleaner with wet or dry towels, blankets, or other fabrics.

Note:
DIY air cleaners can help improve indoor air quality during emergency events. They are not a long-term solution to poor indoor air quality.
These fans do not reduce dangerous gaseous pollutants such as radon or carbon monoxide.

Where Should I Put My Air Cleaner?

Try to place your air cleaner away from obstructions, so that air can flow to and through your device easily.


Use the fan in the area that you spend the most time in.

The larger the space, the more units you may need (1 per 150-500 sq feet in a single room)



Choosing The Right Design


Cube air cleaner designs (4 filters, 1 fan) clean the air at a faster rate, but are costlier, noisier and take up more space.




1x1 2x1 4x1

When To Replace Your Filter


Filters should typically be replaced every 3-6 months, but watch out for these signs that your filter needs to be replaced:



Filter discoloration If dirt and dust is visible on the filter If air flow from your air cleaner has decreased



To learn more, scan here:



BREATHE DIY Air Cleaner Safety Considerations document. Available for digital download (including print-ready file option) at www.bclung.ca/diyaircleaners

Building a DIY Air Cleaner

i. Build a Demo Model

Before hosting your workshop, build a DIY air cleaner device to become familiar with the instructions and process of building. Refer to page 13 and the **DIY air cleaners shopping list** - all the materials can be purchased at your local hardware store.

When ordering from your local hardware store, there are a few critical things to note about the two main components of a DIY air cleaner, the MERV-13 filter and box fan. It is important to use a square 20"x20"x1" MERV-13 filter. The MERV rating of a filter indicates its filtration efficiency. A MERV-13 or MPR 1900 filter has a sufficiently high filtration efficiency that it can remove smoke particles in recirculated air. Filters with a lower MERV or MPR rating do not have a high enough filtration efficiency to clean the room air in a reasonable amount of time. This unit also requires a 75-Watt box fan for proper efficiency. Wattage is a measurement of how much energy an electronic device needs to run. The higher the wattage, the faster the fan speed will be. Most box fan filters are 75 to 80 Watts and will work best for this application.

BREATHE
DIY Air Cleaner
1x1 Building Instructions

Materials You Will Need

- 20x20" Box Fan (Min. 75 Watts)
- 20x20" MERV 13 Filter (MPR 1900)
- Duct Tape
- Scissors Or Box Cutters

Note: Use a new, clean fan in good condition.

- Take the fan out of its box. Lay the fan face down. The front of the fan includes the logo. Find the feet of the fan attached to the handle. Twist apart and forcefully slide into slots found on the bottom of the fan.
- Find the directional arrow on the side of the filter. Place the filter down with the arrow pointing towards the fan.
- Duct tape the filter directly to the back of the fan. Seal all sides thoroughly to prevent gaps.

Have Questions?
Email: air-cleaners@sfu.ca
Website: bclung.ca/diyaircleaners
Follow us: @sfu_breathe on Instagram & Facebook

1

Use Duct Tape To Make A Shroud

- Lay the fan face up. Tape around the front of the fan, creating a border. Measure 2 1/2 inches from the outer edge of the unit on each side. Multiple strips of tape will be needed.
- What Is A Shroud? The shroud stops air from being recaptured into the fan from the corners, which would reduce its effectiveness.
- Tape the corners of the front of the fan. Measure 5 1/2 inches from the outer edge.
- Add more duct tape as needed to close all gaps around the edges and corners.
- Personalize your air cleaner with stickers and decorative tape to make it uniquely yours.

2

BREATHE DIY Air Cleaner Instructions. Available for digital download in English and 11 other translated languages (including a print-ready file option) at www.bclung.ca/diyaircleaners

ii. Considerations When Building

Two types of shrouds can be used to make a DIY air cleaner. Most DIY air cleaner instructions recommend a cardboard shroud cut out from the fan box.

However, a tape shroud, created by layering pieces of duct tape over the fan surface, may be easier to achieve for participants who find it difficult or painful to cut cardboard.

Cardboard Shroud



Dr. Vahid Hosseini, SFU Sustainable Energy Engineering, Collaborator

Tape Shroud



David Hunt, 312 Main, Community Partner

Planning

This section encompasses the steps required to plan for a workshop in your community. Whether you're a municipality, neighbourhood group, or high school, you may find similar issues in budgeting, procuring items, storage, or an array of other areas.

i. Unit Costing

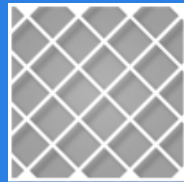
The air cleaner comprises the bulk of the cost of hosting a workshop, at approximately \$75 per unit.

Here is the unit cost breakdown, as well as a list of other costs that may arise. Your organization or community partner may provide some items in-kind.

DIY Air Cleaner – Required Materials



20x20" box fan



20x20" MERV 13 filter (MPR 1900)



Duct tape



Scissors or Box Cutter

Item	Cost Per
Lasko Box Fan	\$50
MERV-13 Filter:	
• Order >12 units in bulk	\$20
• Individually	\$25-30
1/2 Roll Duct Tape	\$5
Total Cost Per Unit (before tax)	~ \$75

Event costs can vary with the following considerations: workshop rental space, snacks and refreshments, storage space rentals, and travel/transportation rentals.

Other costs to consider: first aid kit, gift cards for volunteers, and childcare.

ii. Storage and Inventory

Before the materials are purchased, it is important to find a space large enough to store them until the workshop. If you work with a community centre or organization, they may be able to provide a storage room to keep the fans and filters until they are needed. It is particularly convenient to ship the materials directly to the location where you will hold your workshop. This minimizes the time and money you will need to allocate for transporting the fans and filters to the workshop (e.g., a van rental to move bulky boxes). Other possible options include renting out a self-storage unit with a monthly fee.



To keep track of inventory, create a sheet that displays when items were purchased, the shipment status/tracking number, storage location of materials, and the number of items available or used.



iii. Procurement

There are several important factors when it comes to the MERV-13 filter and box fan. When purchasing the MERV-13 filter and box fan, ensure that you are selecting the ones with the correct requirements. Ensure you are purchasing a square (20"x20" inch) box fan that uses at least **75 watts** and square (20"x20"x1" inch) **MERV-13** filters (MPR 1900). Higher MERV-rated filters can also be sourced, but at substantially greater cost. Bulk buying filters can reduce the cost of a filter by almost half. Refer to pg. 12 for a list of the exact air cleaner specifications and a materials list.

If you are hosting a workshop in the summer, plan to secure the fans early in the season as **supplies may run out** when wildfire smoke increases. Purchasing a few extra fans and filters ahead of time to use as emergency backups (e.g., in case fans are defective) is recommended.

Workshop Scheduling

Air cleaners can be used to reduce exposure to indoor particulate matter produced all year round. You can tailor the workshop to make it relevant to the common particulate matter sources during a specific season.

Workshops in the summer can emphasize air cleaner use for wildfire smoke. Because the wildfire season is now starting much earlier in Western Canada (i.e., late spring), it is advisable to begin workshop planning early so that community members will have their DIY air cleaners ready as smoke events begin to worsen over the summer months.

In BC, floods and respiratory pathogens like the flu and COVID-19 are common events during the winter. During this season, you can emphasize the use of air cleaners for viruses, bacteria, and mold. Although we do not know to what degree air cleaning reduces infection rates, removing infectious particles from the air is a helpful strategy in conjunction with other measures like hand-washing, covering coughs, and staying home while sick. Winter also brings an increase in woodstove smoke exposure as temperatures drop.

Selecting an appropriate workshop date involves considering various factors, such as the season and ongoing emergency events, to tailor your DIY air cleaner workshops to your audience.

i. Narrowing it Down

Once you have planned the general workshop date, it is time to narrow your workshop date to a specific time of day. Picking an effective workshop time can depend on the target population you want to reach and the area in which you are holding the event. For example, older adults and retirees may prefer workshops hosted during the day on weekdays, whereas other groups such as working family members may need evening or weekend scheduling. If the project intends to target families with young children, consider offering childcare or a child-friendly activity.

If you are hosting a workshop in a smaller town or community, make sure to familiarize yourself with any big events in the area, so you can avoid scheduling a workshop during that time.

Workshop Space

Community hubs such as community centers, community organizations, libraries and neighbourhood houses are great places to host your workshop. Since these locations host a variety of events for a diverse range of individuals, this is a fantastic way to reach out to the target audience interested in creating DIY air cleaners. They also tend to be centrally located or near to community groups that would benefit from these workshops.

Accessibility on-site is important to ensure everyone has equitable access to workshops. It's important when booking a space to see if there are ramps or elevators to access the space where the workshop is taking place. Since many participants in urban areas arrive by bus and will have to carry the devices home, it is important transit is nearby.



When selecting a workshop space, an average-sized classroom with capacity for 25 participants is sufficient. There should be enough room for 10 to 12 folding tables (two people per table). Furthermore, you want to ensure space for people to move around freely, especially if participants bring wheelchairs or an extra friend for assistance.

Selecting a Target Population

The first step in registering workshop participants is selecting your target population. Focusing on a target population can allow you to get the most benefit from your workshop and help you decide the best ways to reach that audience. It is important to understand what audience is mainly affected by wildfire smoke and indoor air pollutants to tailor workshops according to that target population. This includes seniors, people with disabilities, pregnant women, families with young or asthmatic children, and people living in substandard housing without proper ventilation. Targeted advertising at community centers and housing complexes is a possible way to gather participants.

i. Enrolling Participants

Registering participants prior to the workshop is important, as this ensures the workshop is neither over or under attended.





Volunteers

Although the workshop process is quite user-friendly, people will have many questions and may require support through the building process. Ideally, having 5 leaders per workshop, including both volunteers and staff, is best for an efficient workshop flow with adequate help for participants. It's also important to consider potential language barriers within your target demographic and find ways to provide support or resources in those languages.



Transporting Materials



Transportation of the filters and fans to workshops can be challenging.

Renting out vans can be a costly expense that is not always necessary.

Shipping materials directly to the location can save costs.





i. Transporting the Unit Home

If the workshop is held in a highly urbanized area, it is likely many participants will be walking, biking, or taking transit. Although the units weigh only about 5 lbs, people may struggle to carry them or get them onto transit. Some options to facilitate transport home include asking your host/partner whether they have a transit service or whether they can deliver the units to participants' homes. You can also use the remains of the box and some duct tape to create a carrying case for the finished air cleaner (see example below).



Workshop Execution

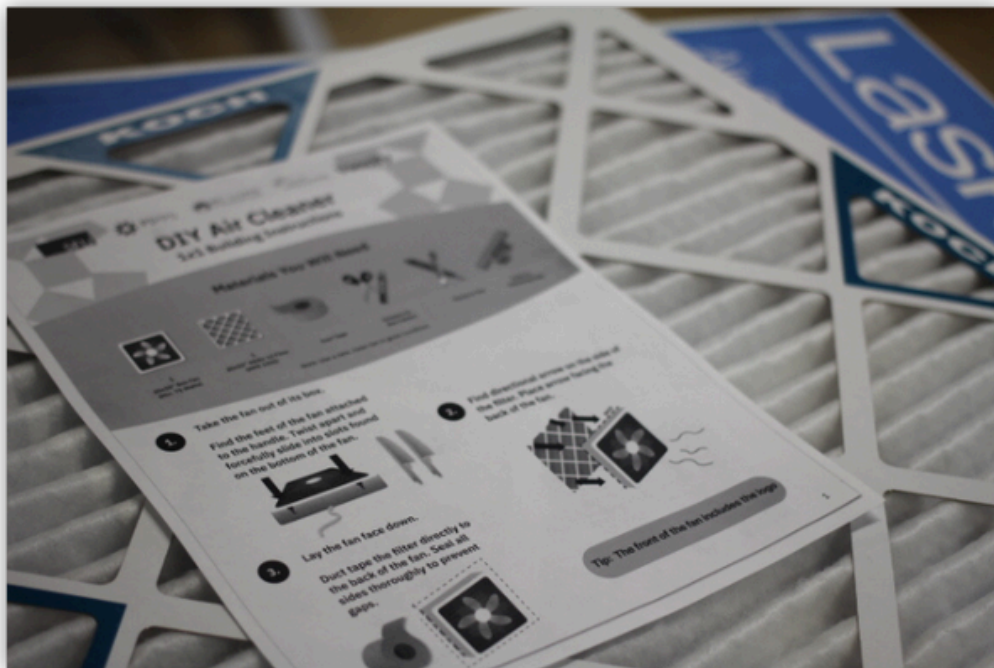
i. Facilitating the Workshop Process

Workshops offer an important opportunity to provide air quality education and other resources to participants. The workshop can begin with a group discussion about poor air quality and its risks to people's health. It may also be helpful to integrate resources and materials from local public health or other community partners that will complement DIY air cleaner use in terms of protecting overall health. For example, distributing local public health resources on extreme heat preparedness, or supplementary information on protecting against the health impacts of wildfire smoke.

Here is an example of how to prepare your workshop space:

- Set up folding tables, with two chairs at each
- Place two fans at each table, with a filter on top
- Ensure the following documents are placed on each workstation
 - Instruction manual
 - Safety document
 - Any additional materials

The workshop should take no longer than **2 hours** to complete, with some people finishing much faster than others depending on their ability. At the end of the workshop, ensure all participant's fans have been plugged in and are working sufficiently.



Useful Handouts for Workshops

i. Facilitating the Workshop Process

You can find all handouts mentioned in this workshop guide on the BC Lung website, including the instructions, safety precautions, and a full shopping list. Also available are instructional videos as well as a PowerPoint presentation that can be used for information sessions.



www.bclung.ca/diyaircleaners

Additional wildfire smoke health risk and prevention infographics can be found on the BCCDC website for printing or presentations.

BCCDC Wildfire Smoke Information:

<http://www.bccdc.ca/health-info/prevention-public-health/wildfire-smoke>

ii. Risk Assessment Tools and Information

Being aware of your local PM sensor not only helps to understand one's own individual response to outdoor particulate matter, but it is also a prompt to turn on the DIY air cleaner.

Map of community PM sensors supported by Environment and Climate Change Canada: <https://aqmap.ca/aqmap/#9/49.5902/-122.7557/L38/L40/L41>

iii. Effectiveness

The US Environmental Protection Agency also provides detailed resources and research on air cleaner safety and effectiveness. Additionally, some infographics can be printed for workshops from this site.

Research on DIY Air Cleaners to Reduce Wildfire Smoke from the United States Environmental Protection Agency:

<https://www.epa.gov/air-research/research-diy-air-cleaners-reduce-wildfire-smoke-indoors>

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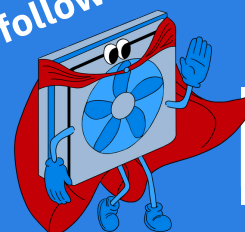


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