



# WORKSHOP GUIDE

## **Do-It-Yourself (DIY) Air Cleaners: Building Community Resilience to Reduce Fire Smoke Exposure**

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PACIFIC INSTITUTE ON PATHOGENS,  
PANDEMICS AND SOCIETY (PIPPS)

# 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.

# THE DIY AIR CLEANER TEAM



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# Background

Since 2005 there has been a significant increase in the number of forest fires in British Columbia (BC). This trend 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. Wildfire smoke can travel long distances depending on weather patterns, but it has a long-term impact on air quality, affecting the rest of the population.



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 at comparable, or better, CADR rates to commercial units and also come at a much lower cost to build.

The 1x1 model air cleaner we use in the project is adopted from the Corsi-Rosenthale box, which was created to reduce exposure to COVID-19.

## 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% (Eykelbosh, 2023). 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, the cleaned air gets sucked back into the corners of the fan, slowing the amount of air being pushed out by the fan, and decreasing the CADR.



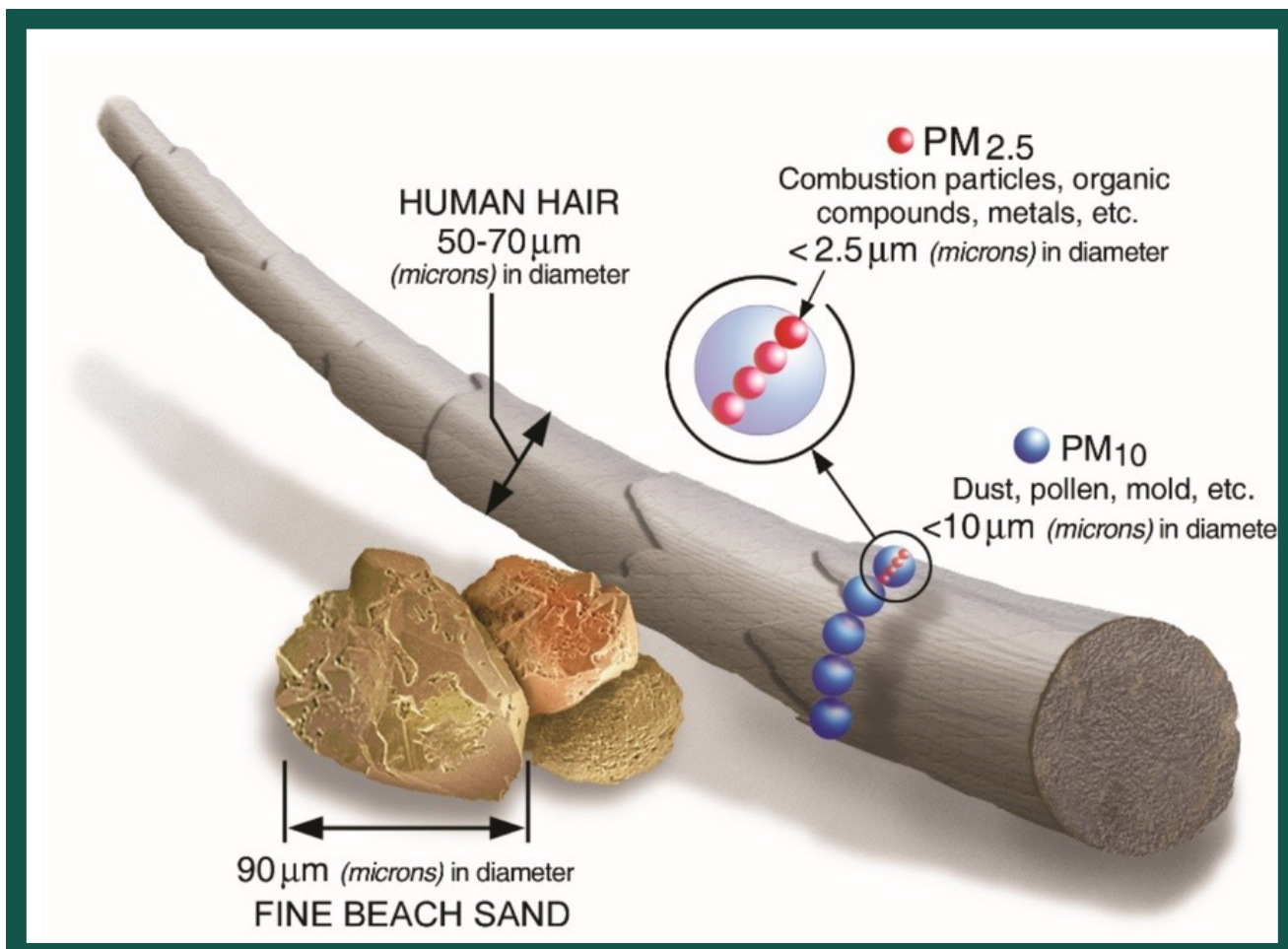


Image Reference: United States Environmental Protection Agency (US EPA). (2023, October). Why Wildfire Smoke is a Health Concern [Overviews and Factsheets]. <https://www.epa.gov/wildfire-smoke-course/why-wildfire-smoke-health-concern>

### iii. Use and Limitations

While these units are recommended for pollutants in the **0.3 to 1.0 micrometres range**, some pollutants fall out of this range. The pollutants that fall out of this range include radon, volatile organic compounds, carbon monoxide, and carbon dioxide. As a general rule, these units do not work for gaseous pollutants. These units also work well for infectious aerosol particulates such as COVID-19, and the flu.

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, should use DIY air cleaners as an immediate response. However, homeowners must 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 help, 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**. Heat will kill you significantly more quickly than poor air quality.

## 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 should 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 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. Here is the link to the report: [Wildfire Safety Report](https://chemicalinsights.org/wp-content/uploads/2022/03/DIY-Box-Fan-Report-2021.pdf): <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)





# Building Your Own DIY Air Cleaner

## i. Build a Demo Model

Before hosting your workshop, we highly recommend building a DIY air cleaner device to become familiar with the instructions and process of building. Refer to page 13 and our [DIY air cleaners shopping list](#), all the materials can be purchased at your local hardware store. Follow our instructions below.

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 filter and box fan. It is important to use a square 20x20x1 MERV-13 filter. MERV filters can trap both macroscopic and microscopic particles. This unit also requires a 75-watt box fan for proper efficiency. Watts is a measurement of how much energy an electronic needs to run. The higher the wattage for a fan, the faster the speeds will be.

Please refer to our [step-by-step instructions document](#) below, as well as our videos found on [bclung.ca/diyaircleaners](http://bclung.ca/diyaircleaners)

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## DIY Air Cleaner

### 1x1 Building Instructions

#### Materials You Will Need

  
1  
20x20" Box Fan  
(Min. 75 Watts)

  
1  
20x20" MERV 13 Filter  
(MFR 1900)

  
Duct Tape

  
Scissors Or  
Box Cutters

  
Pencil Or Pen

  
Ruler Or  
Measuring Tape

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

- 1. Take the fan out of its box.**  
Find the feet of the fan attached to the handle. Twist apart and forcefully slide into slots found on the bottom of the fan.  

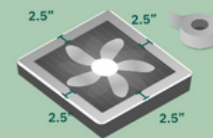
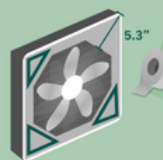
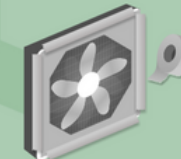
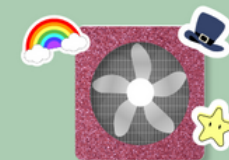
- 2. Find the directional arrow on the side of the filter. Place arrow facing the back of the fan.**  

- 3. Lay the fan face down.**  
Duct tape the filter directly to the back of the fan. Seal all sides thoroughly to prevent gaps.  


Tip: The front of the fan includes the logo

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### Using Duct Tape To Make The Shroud

- 4. Lay the fan face up on your desk.**  
Tape around the front of the fan, creating a border. Measure 2.5" from the outer edge of the unit on each side. Multiple strips of tape will be needed.  

- 5. Tape the corners of the front of the fan. Measure 5.3" from the outer edge.**  

- 6. Add more duct tape as needed to close all gaps around the edges and corners.**  

- 7. Personalize your air cleaner with stickers and decorative tape to make it uniquely yours.**  


#### What Is A Shroud?

The shroud stops air from being recaptured into the fan from the corners, which would reduce its effectiveness.

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## ii. Considerations When Building

For DIY air cleaners, two types of shrouds can be used, cardboard or tape. Depending on your target audience, a specific shroud should be used. Since the elderly and seniors are more prone to have dexterity challenges, the tape shroud is chosen in workshops. Even young and able-bodied individuals may find it difficult to cut the cardboard. Tape is also easier to apply and less physically demanding on the hands. Therefore, we would recommend the tape shroud, but we have included the cardboard version because it can appeal to people's aesthetic preferences.

**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. Creating a Budget

Setting a budget helps you figure out how many devices you will purchase and allocate to a workshop. Having a set number will indicate the amount of storage and workshop space needed to hold the fans. You should also set aside some funds to handle any unexpected costs. Approximately five to ten percent of your budget should be reserved for extra expenses or unexpected expenses.

When determining your DIY air cleaner workshop budget, start by listing out all workshop expenses and an estimated cost of each expense.

Here is a sample budget for our workshop costs from Summer 2023.

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

### Materials needed to build a DIY air cleaner:

- Box cutters or scissors
- Measurement tape
- Paper handouts
- Stickers (optional)

### Event costs can vary depending on the following costs:

- Workshop rental space
- Snacks and refreshments
- Storage space rentals
- Travel and van rentals

### Other costs to consider:

- First aid kit
- Gift cards for volunteers
- Childcare

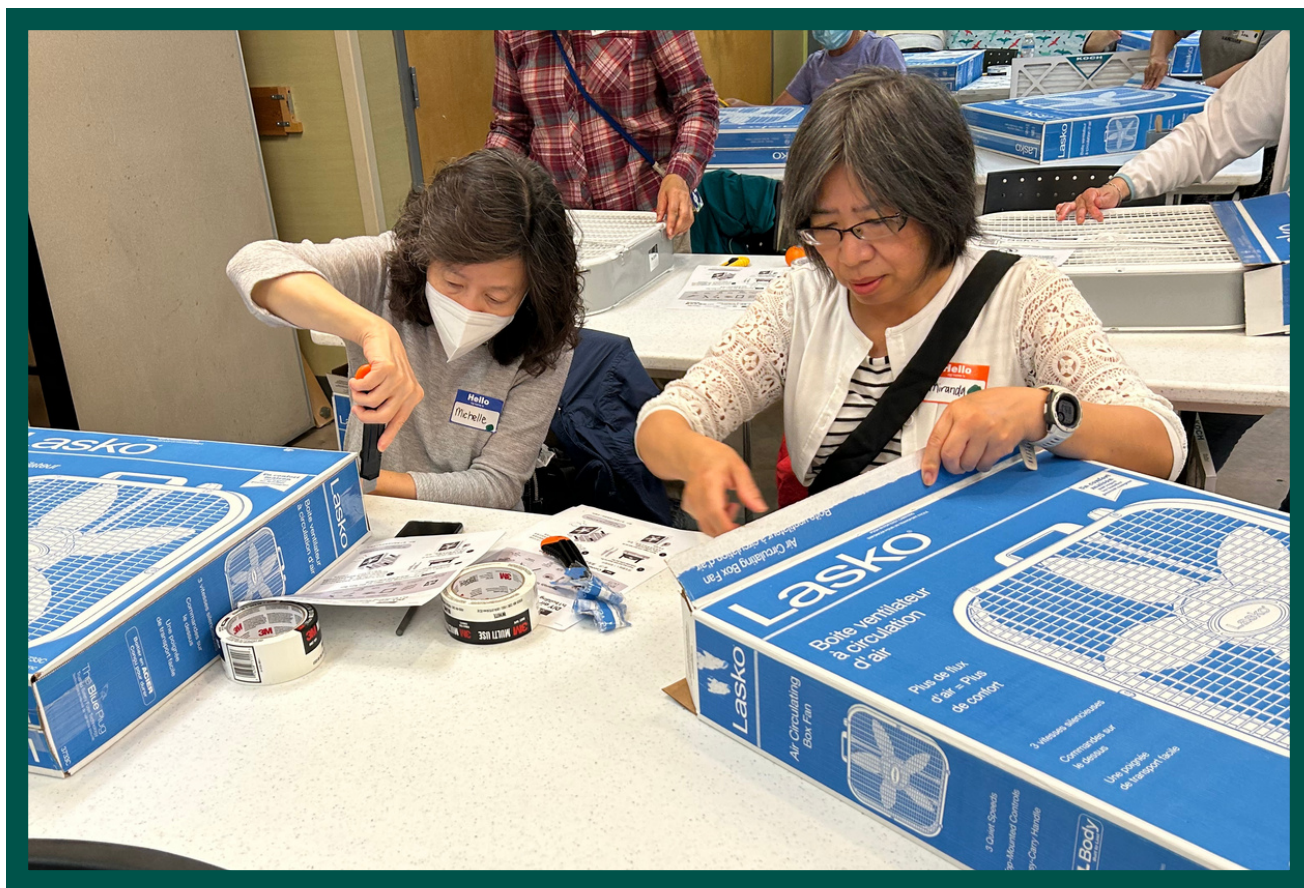


## ii. Storage and Inventory

Before the materials are purchased, you should find a place to store the materials and know how much can fit within that space. If you work with a community centre or organization, you may have a designated storage room to keep the boxes of the fans and filters. It is particularly convenient if you can ship the materials directly to the location where you will hold your workshop. This minimizes the time and money you will need to account for if you transport the fans and filters to the workshop. For our project, we held our materials in various locations such as an SFU lab and storage room, BC Lung, and in our home garages. Other possible options include renting out a self-storage unit with a monthly fee.



If you plan to have materials stored in various spaces, ensure you keep track of all items. 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. Even if you only hold one workshop, finding a way to manage inventory will be helpful.



### iii. Procurement

There are several important factors when it comes to the MERV filter and box fan. When purchasing the MERV filter and box fan, ensure that you are selecting the ones with the correct requirements. Ensure you are purchasing a square (20x20) box fan that uses at least **75 watts** and square (20x20) MERV filters with a **MERV rating of 13** (MPR 1900) or greater. We recommend the Lasko brand box fan and it is found in many local hardware stores such as Canadian Tire and Home Depot. **Uline** is also a cost-effective supplier for bulk filter purchases. (Refer to pg [12] of resources for a list of the exact air cleaner specifications and 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. We found that later on in July, the number of fans in stock was limited. We also purchased a few extra fans and filters ahead of time to use as emergency backups, in case a fan was defective.



# 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.

Since our workshops occurred in the summer months, we emphasized using air cleaners for wildfire smoke. Based on past wildfire trends and frequent monitoring of local air quality advisories, we planned to hold our workshops in late July, August, and throughout September, when wildfires were most likely to be disruptive to daily life.



In British Columbia, 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. In the springtime, it could be allergies from pollen.

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.

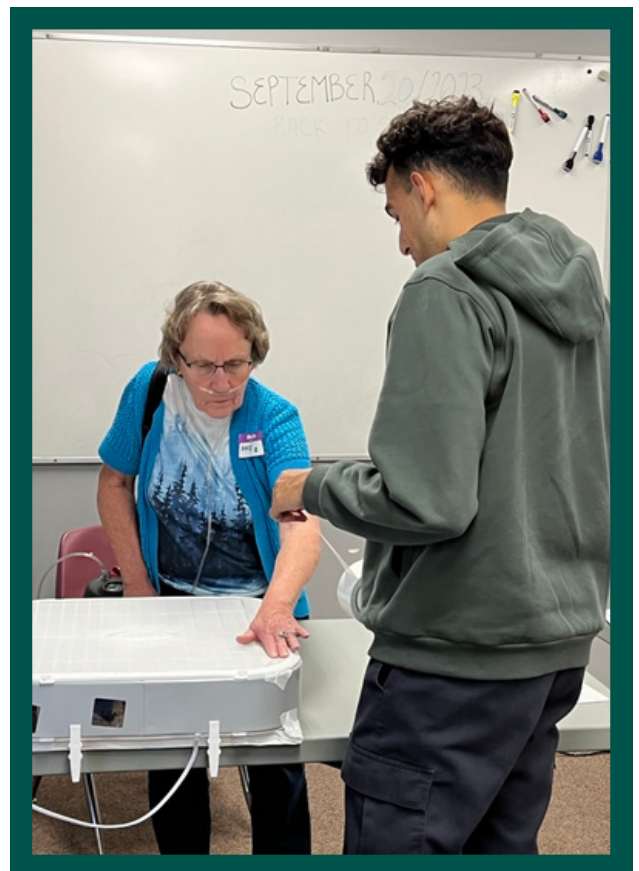


## i. Narrowing it down

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 you are holding the event.

Most of our workshops were hosted on a weekday in the morning and/or the afternoon. We found that this was an effective time for low-income seniors and retired adults. However, we recognize that some groups, such as low-income families and those working during the day may not be available during this time. Therefore, you can consider scheduling for an evening or weekend session to allow for greater flexibility and if your workshop space is available during those times.

Based on our experiences with planning workshop dates, we found that Monday to Thursday in the morning and afternoon worked well. People were less likely to register for an event on a Friday evening and the mornings on the weekend. 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. **One of our workshops in Hope, BC, occurred at the same time as a free live concert, so a majority of the town were at the concert.**



# Workshop Space

After selecting when you would like to conduct a workshop it is important to pick an adequate location and room. To successfully hold a workshop, numerous aspects must be considered while selecting a location. For the workshops to be accessible for individuals, local community centers, organizations, 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. These spaces are frequently visited and people are familiar with the location, making it accessible for individuals.

Accessibility on-site is important to ensure everyone has equitable access to build air cleaners and take part in our workshop. It is important when booking a space, to see if there are ramps or elevators to access the space where the workshop is taking place. As well as, determining whether the location is accessible by transit. Since many participants arrive by bus and will have to carry the devices home, it is important transit is nearby and easily accessible from the workshop location.



When selecting a workshop space, we found that an average-sized classroom was sufficient for a capacity of around 20 to 25 participants per session. There should be enough room for 10 to 12 folding tables (two people per table). This will give you an idea of how many could fit into a room. 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. Our workshops prioritized equity-deserving communities since they are at a greater risk of poor indoor air quality. This includes seniors, people with disabilities, and people living in substandard housing without proper ventilation. Our community partners were best situated to gather participants. They used targeted advertising at housing complexes and community centres.



## i. Enrolling Participants

Enrolment of participants is critical for our workshops. It was important for people to pre-register with our community partners to ensure we had brought enough fans, filters and handouts for all attendees.



# Volunteers

Organizing and mobilizing volunteers before workshops is important. Although the workshop process is quite user-friendly, people will have many questions and may require support through the building phase. 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 recognize your demographic in the case of first languages. We ran workshops in traditional Chinese and had to search for volunteers who could translate for us. We found volunteers through our amazing community partners, S.U.C.C.E.S.S. and the Yarrow Intergenerational Society for Justice, both from Vancouver, BC.



# 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.

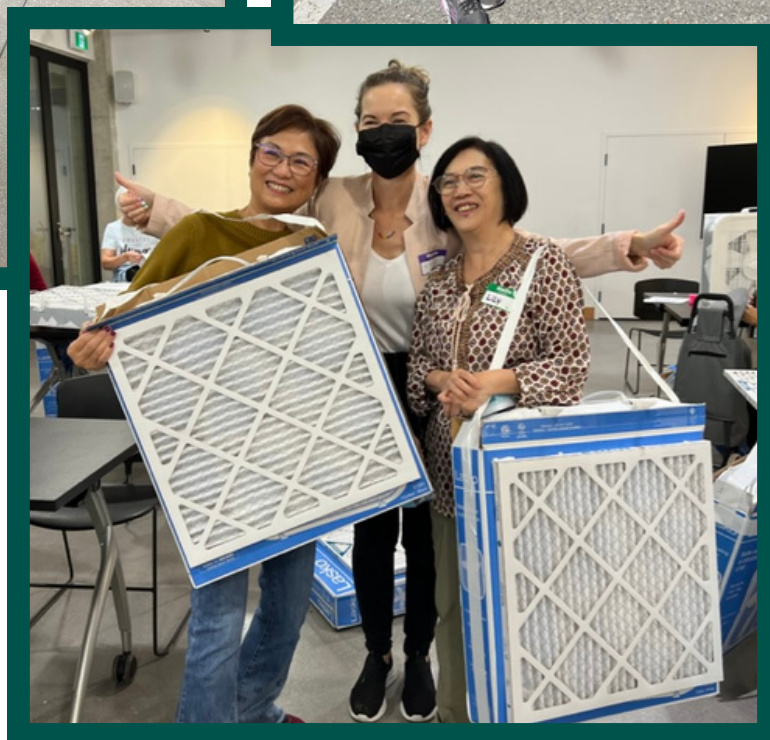
It's important to check for parking in urban areas, as well as space for loading out materials. Most downtown agencies have alleyway loading areas that can be used. When possible, our team ordered supplies to be delivered directly to our sites and worked with the community centre to receive the delivery.





## i. Transporting the Unit Home

Our preliminary research found that approximately 60% of participants walked or took transit to our workshops, so it is important that they can be easily taken home. Although the units are quite light, about 5 lbs, they are wide, and people may struggle to carry them along with their personal belongings. In some venues, our partners had delivery vans that could bring the units to people's homes. When this wasn't possible, we created shoulder straps for people using tape and the original box. This is an important consideration to take into account when planning.





# Workshop Execution

## i. Facilitating the Workshop Process

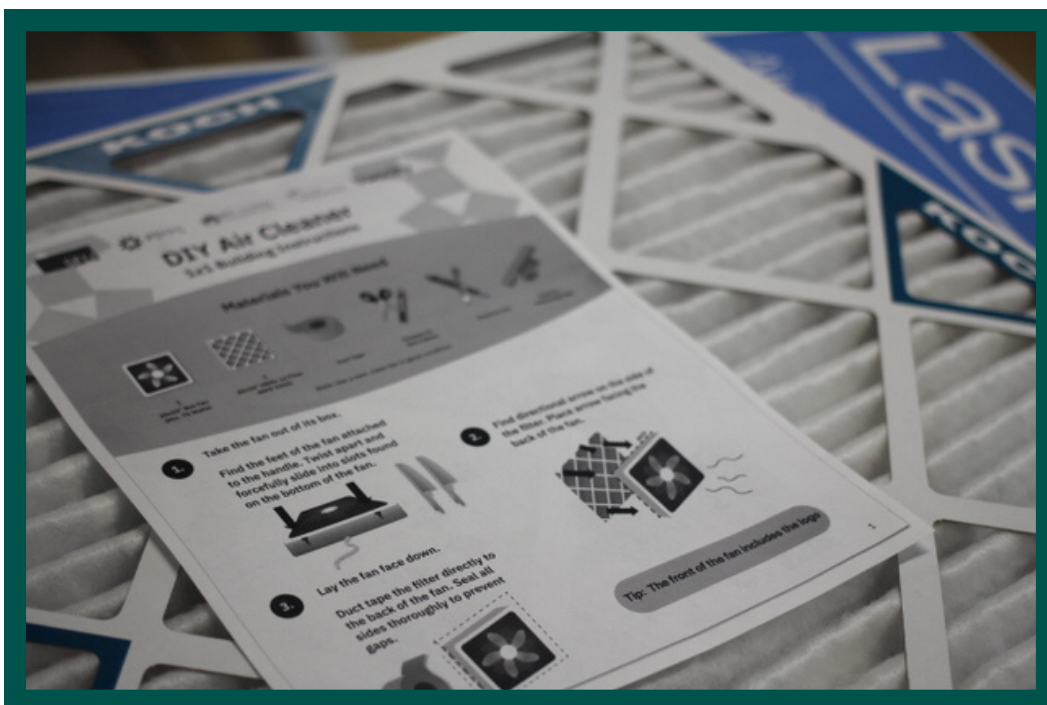
We began our workshops with a land acknowledgment and a group discussion about poor air quality and its risks to people's health. This is an opportunity to provide important education to your participants. This workshop also provides a unique occasion to **co-locate** other health emergency preparedness education. For example, some of our community partners had existing materials to distribute on **extreme heat** preparedness educational information.

Before participants arrived, our team took these steps to ensure a smooth start to each workshop:

- 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. Additionally, make sure participants are capable of carrying fans home depending on their mode of transportation. We also feel it is valuable to provide participants with educational resources and contact information of the organizer of the workshop if they have any questions or concerns.



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