Clean Air Classrooms

A CleanAir #STEAM PROJECT

HOW TO BUILD A UK DIY Air Cleaning Device #CorsiRosenthalBox

YouTube

For build demonstrations
www.tinyurl.com/UKDIYCRBoxExampleBuild

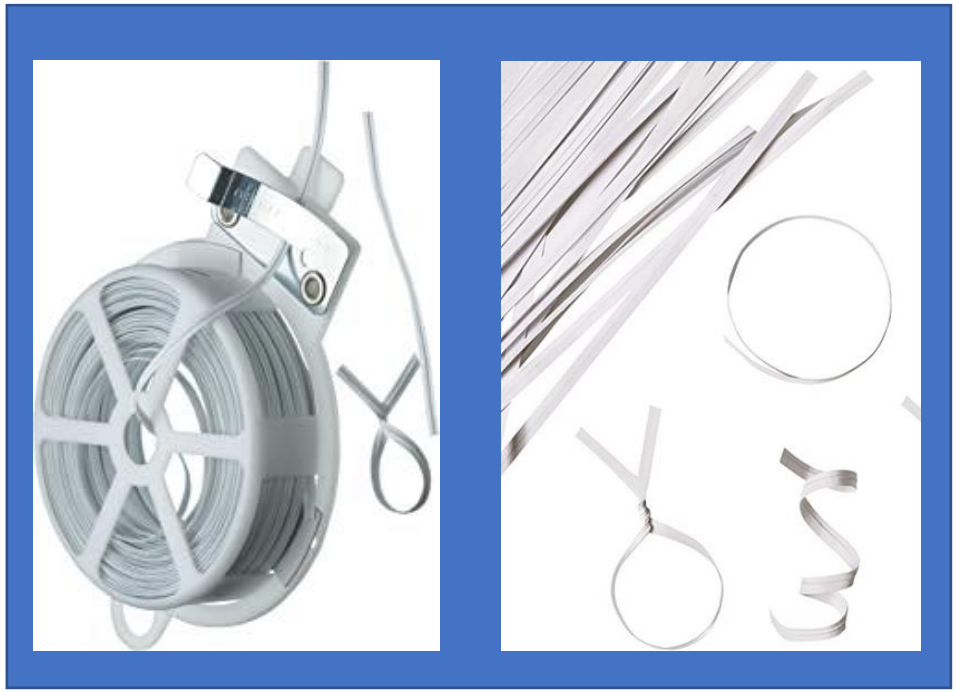
UK DIY Storyboard Build V5- 16/02/2023

@cleanairclassrm

Resources For the Air Cleaner

- **Fan :** *Vent Axia Box Fan* 14 inch
- **Filter Panels:** 4 x *3M Filtrete MPR1900* – 20 x 25 x 1 inches
- **Box Lid, Bottom & Legs**: Corrugated Cardboard, Re use the packaging
- **Tape:** Gaffa/Duct Tape
- **Tools:** Cutting blade & board, ruler, pencil, paper ,butterfly pin, screwdriver

Resources For Protective Enclosure



- **Perforated Board:** 4 x Ikea ‘Skadis’ Peg Boards 76cm x 56cm
  (re use corrugated strips for box legs)
- **PVC coated wire:** Garden wire Or Kitchen Freezer bag ties

The ‘CRBox’ Arrangement

Top: Fan

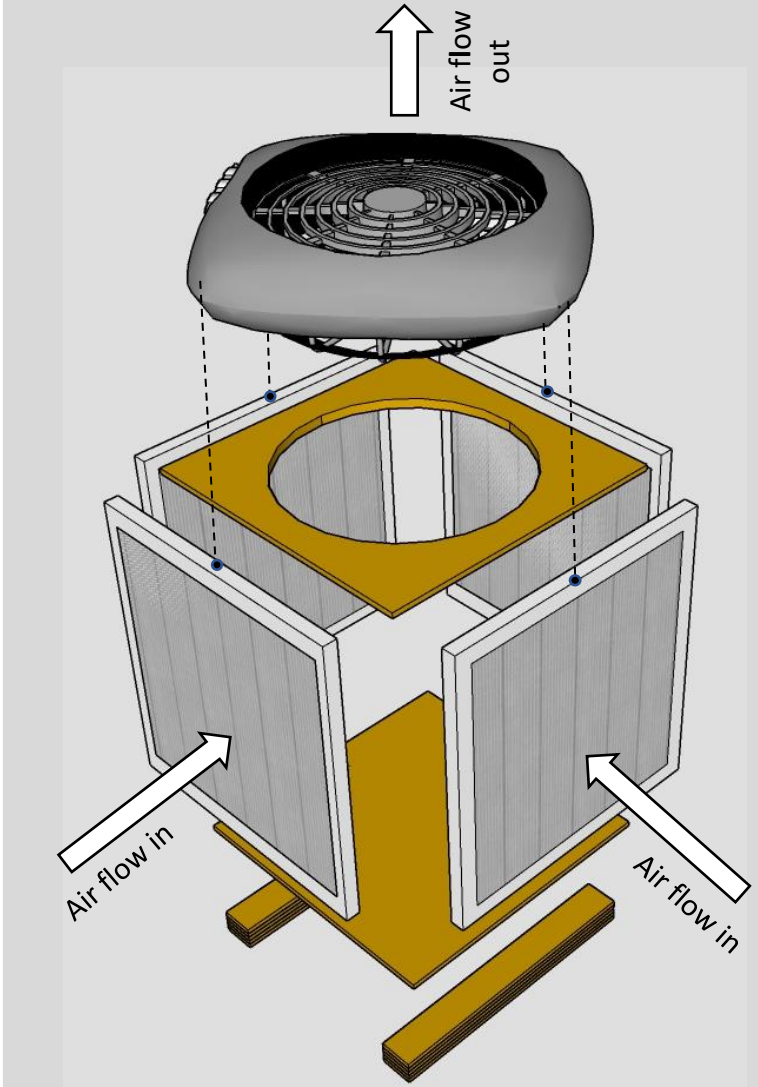
Box Lid:
Cardboard ‘shroud’ with
Circular cut out

Box Sides:
Filter panels
Note filter flow direction (see panel edge)

Air Flow Oriented INTO the box

Box Bottom: Cardboard

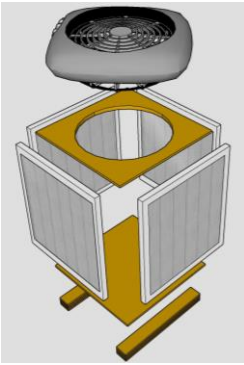
Box Legs: Cardboard



The Completed CR Box

A CR Box With Protective Enclosure (optional)

Step 1: Preparation- box lid & bottom



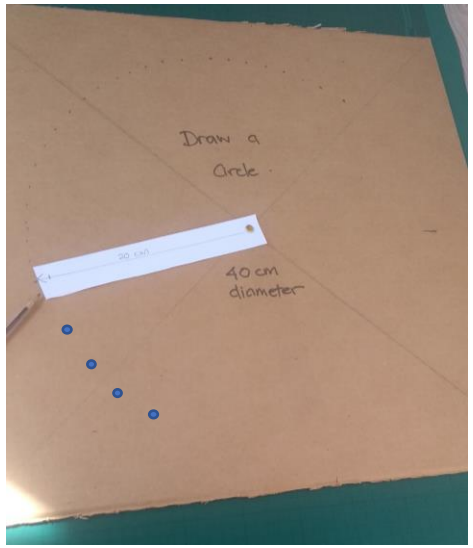
Box Bottom:
Cut 1 sheet 21inch x 21inch square

Box lid 'Shroud':
Cut 2 sheets (for rigidity)
of corrugated cardboard
21" x 21" square

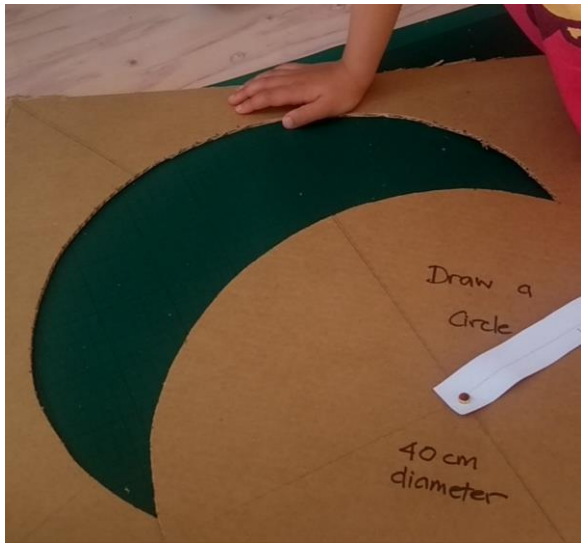
Draw the diagonals to
find the centre

Insert butterfly pin &
paper to mark out
20cm radius

Dot points on the board
Circa every 1cm apart
To mark the circle

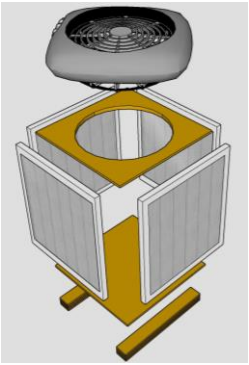


Cut out a rough circle
Following the dots



Use duct tape to seal 2 sheets
complete at the circular cut out
Tape at corners

Step 2: Preparation- box legs



Box legs:

Reuse 5 sheets corrugated cardboard from Ikea peg board packaging

Or

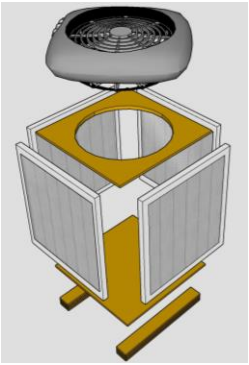
Cut corrugated sheets into strips 10cm x 53cm (21”) length

Form stacked layers at height approximately 10cm

10cm high

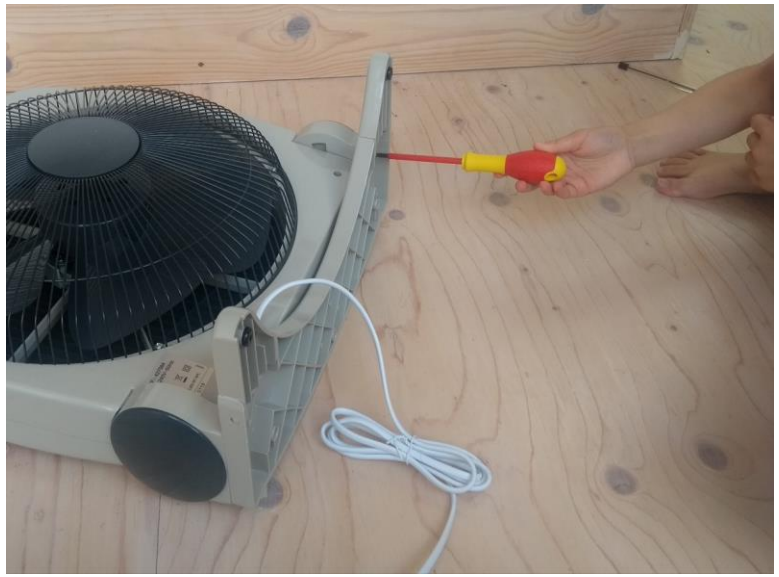
Duct tape all around at ends and middle to form 2 number box legs

Step 3:
Removal of plastic base from the fan

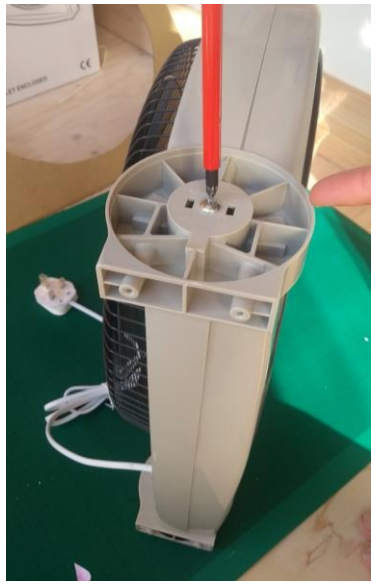


Vent Axia Box Fan:

Unscrew the plastic base

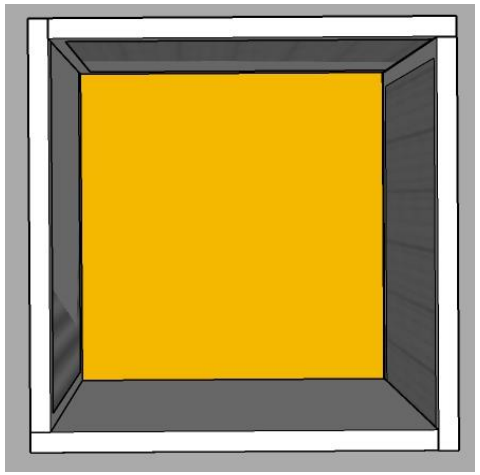


Pop of black caps and unscrew side circular component

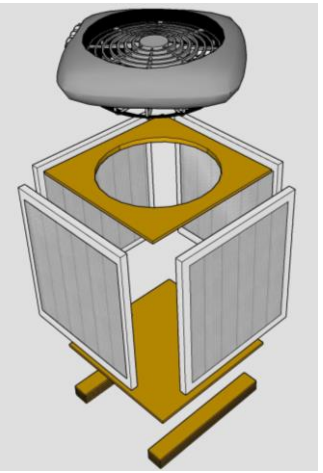


IMPORTANT NOTE –
NO alteration of electric wiring is involved.
Refer to manufacturers guide
Information on the fan https://www.vent-axia.com/file/2904/

Step 4: Box sides assembly



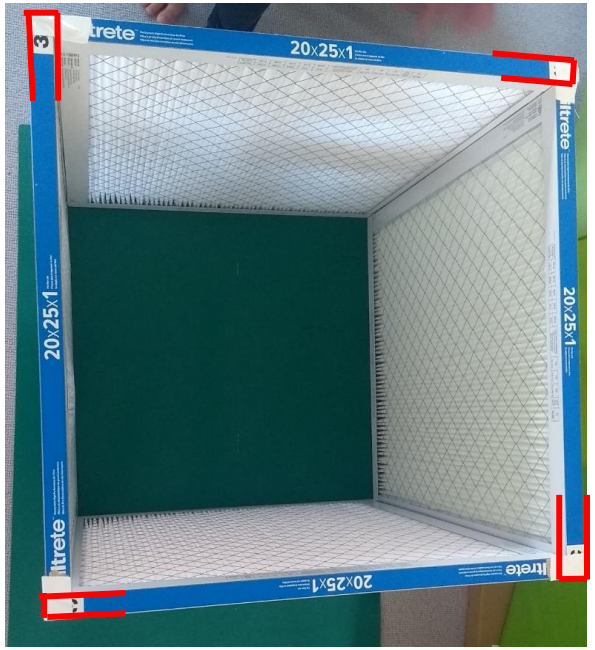
View from above showing
Box sides assembly arrangement



Note Direction
Of panel
Arrows face into the box

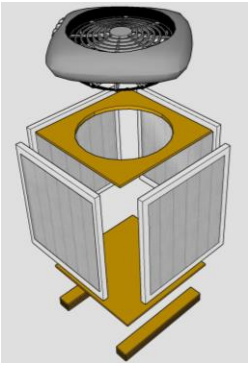
A chair can be used to prop the first panel

Join two edges of the panels
Tape top & bottom corners to put into place



Lap edge to edge the remaining panels, in clockwise fashion. Tape at the top & bottom corners to secure in place

Step 5: Box Bottom & Sides Assembly

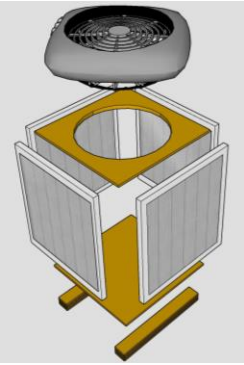


Place the square cardboard on top
Tape all four top edges.

Tape all four vertical side edges.

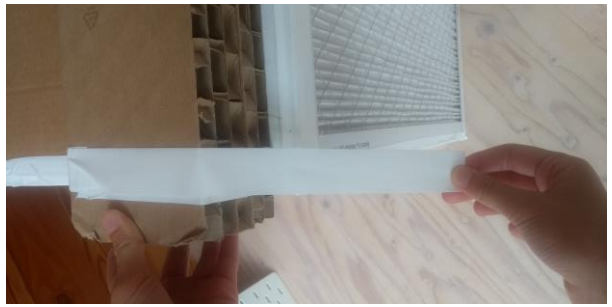
Ensure all gaps are sealed

Step 6: Box Legs



Place the legs on top

Tape secure



Turn box over
Tape & seal box lid
shroud to side panels

Step 7: Box lid & fan to finish

Position the box fan on top of circular aperture.
Important: 45 degree placement.
Ensure the corners of the fan box sit on the top centre of the side filter panels.
The weight of the fan must be supported by the side panels

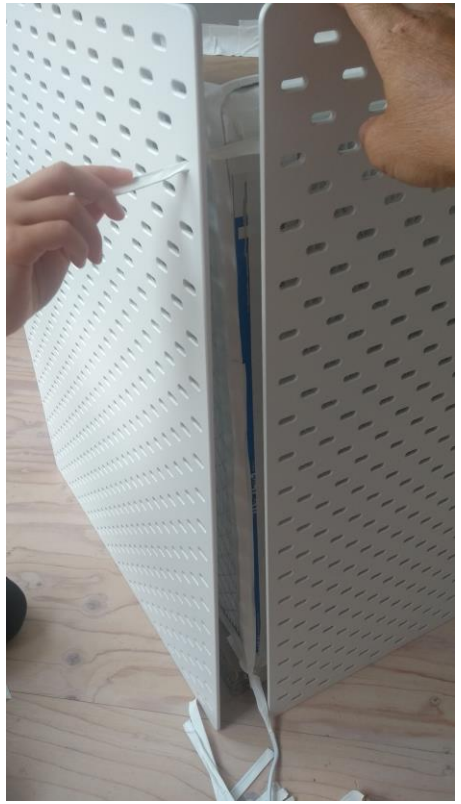
Tape all gaps between fan box & box lid.
The chord sits above the box lid and is fully taped to lid and down the vertical corner

Ensure all gaps a fully taped & sealed

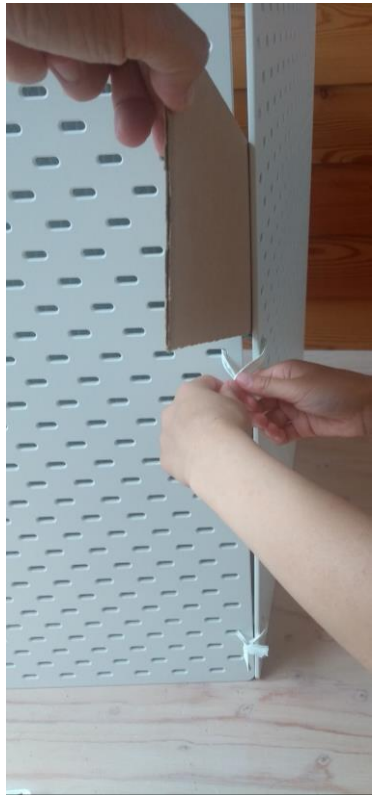
CR Box Completed

Step 8: Protective enclosure assembly (optional)

Position 2 perforated panels
In front of the CR box
Thread PVC wire at top, middle
And bottom



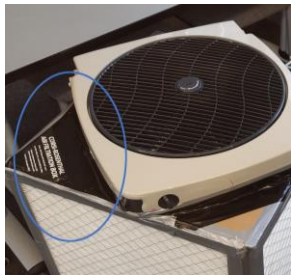
Use cardboard
To act as gap spacer



Leave final corner free
Position CR box into place
Prior tying the final panel

CR Box with protective enclosure

Step 9: Suggested labels to add at the top corners optional



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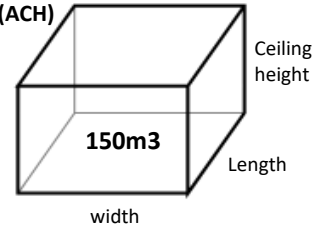
www.tinyurl.com/DIYCRBoxUK

HOW TO BUILD A
UK DIY Air Filtering Device
#CorsiRosenthalBox

A UK DIY Corsi-Rosenthal Box is capable of up to **6 Air Changes per Hour (ACH)**



Based on a typical classroom
Volume at 150m3 (1 ACH) x 6 = 900m3 CADR minimum required

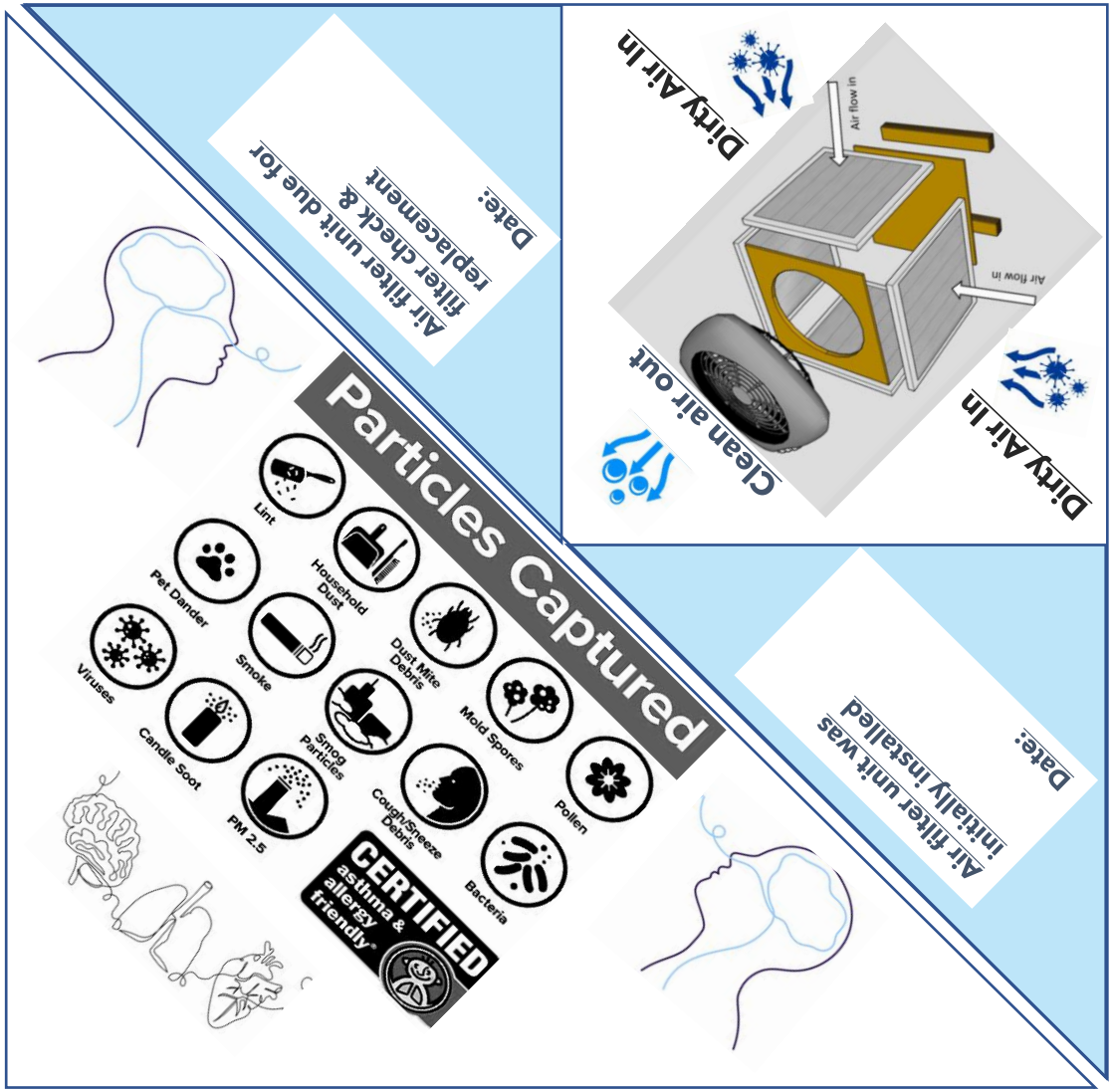
6 Air Changes per Hour (ACH) *High fan speed -Level 3*
5 ACH *Medium fan speed- Level 2*
4ACH *Low fan speed - Level 1*

For optimum Clean Air Delivery Rate (CADR)
***Switch the air cleaner on the high fan speed Level 3* = 917m3/hour of clean air**

To achieve maximum reduction in transmission risk between occupants, the use of 2 CR Boxes for more than 6ACH, either end of a classroom, is advised

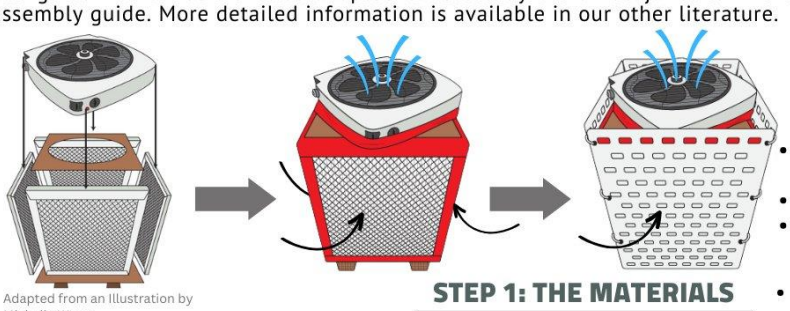
www.cleanairclassrooms.co.uk www.cleanaircrew.org www.cleanairstars.com

#CleanAir #STEAM PROJECT



HOW TO BUILD A CORSI-ROSENTHAL BOX

The Corsi-Rosenthal Box is an affordable air-cleaning system made with simple materials. The fan pulls air through the filters on the sides and blows out clean air. It's proven to reduce exposure to airborne particles, including those containing the virus that causes COVID-19. The box also reduces the levels of other particulate pollutants and allergens. The UK version was adapted & tested by Stefan Stojanovic. This sheet is only intended to be a simple assembly guide. More detailed information is available in our other literature.



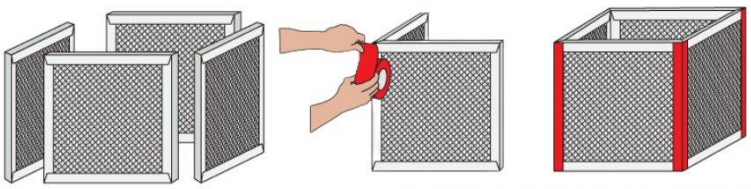
Adapted from an Illustration by Michelle Wong

- Filters can last up to a year used in a typical UK classroom/school hours.
- Keep away from walls and corners
- Fan should blow air upward

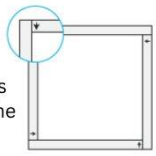
STEP 1: THE MATERIALS

- 4 filters: 3M MPR 1900 (20" x 25" x 1" or 20" x 20" x 1")
- Vent-Axia 14-inch Box Fan
- Scissors, Utility Knife, Duct Tape
- Screwdriver (preferably electric)
- Ruler and Pen
- Materials for protective enclosure:
  - 4 Ikea SKÅDIS pegboards 76x56 cm
  - PVC coated wire

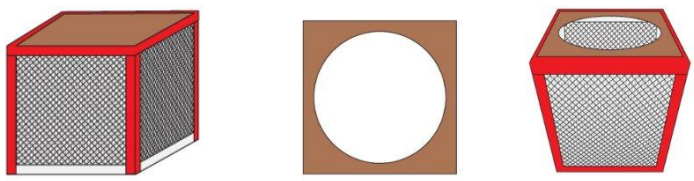
STEP 2: THE CUBE



- Arrange the filters to create a symmetrical structure
- Ensure the arrows are pointing inwards
- Duct tape the four edges
- Vertical orientation of the pleats is preferred

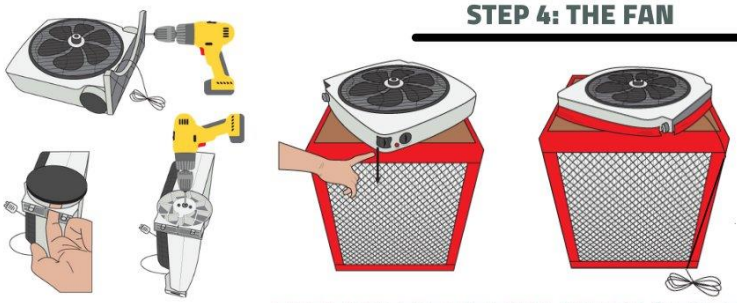


STEP 3: THE BASE + SHROUD



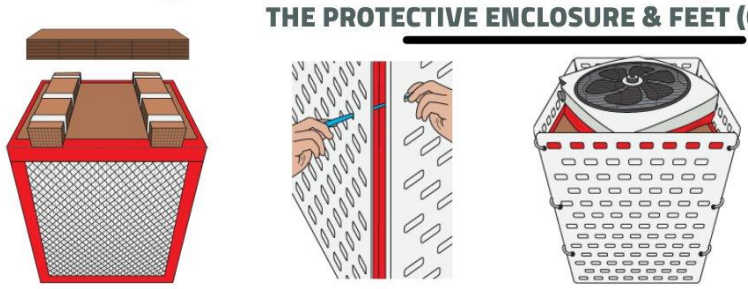
- Cut both sides of the fan's cardboard box to a size of 21" x 21"
- Tape one side to the base
- Check step 5 for optional protective enclosure and feet
- Using a 20cm paper strip pinned at the centre, mark dots 1 cm apart on the other piece. Cut along the dots.
- Use two streets for extra strength
- Turn the box over and tape the shroud

STEP 4: THE FAN



- Unscrew the plastic base of the fan (electric screwdriver recommended)
- Pop off black caps and unscrew side circular component
- Position the box fan on top of circular aperture (45 degree placement)
- Ensure the corners of the fan are placed on the centre of filter panels
- The cord is fully taped to shroud and down the vertical corner
- Ensure all gaps are fully taped & sealed

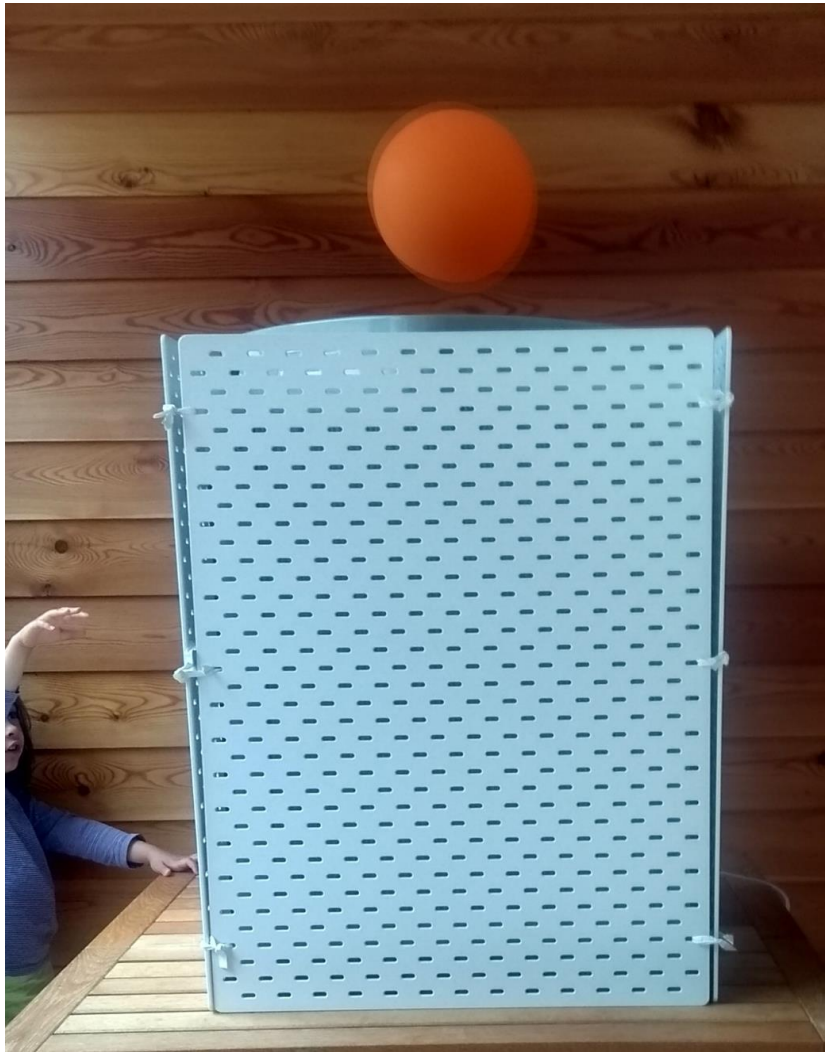
THE PROTECTIVE ENCLOSURE & FEET (OPTIONAL)



- After step 3: Tape 5 sheets of the Ikea packaging at ends and middle to form two legs with a height of 10cm each
- Securely tape legs to the base
- After step 4: Using PVC wire attach two perforated panels in front of the CR box
- Fasten ties loosely at first, allowing some tolerance for best fit
- Position CR box into place and then attach the final panel

Illustrator: Marija Mladenović Creator: Shiven Taneja

Clean Air Classrooms



Clean Air Delivered!

Watch the balloon hover & have fun!!!!

General Notes:

What is a DIY Corsi Rosenthal (CR) Box ? It is an air cleaner 'purifier' that uses a fan and HVAC filters to remove aerosol particles and other contaminants to deliver clean air. See further information https://cleanaircrew.org/box-fan-filters/

The output of clean air is quantified with a
Clean Air Delivery Rate (CADR)
Cubic metres per hour m3/hr - UK metric
Cubic feet per minute CFM – Imperial metric

What is the recommended minimum ventilation required for a classroom?
A total of **6 *equivalent* Air Changes per Hour** (eACH)
is the *minimum* recommended for a classroom
i.e a room's entire volume of air is replaced with new air 6 times in one hour

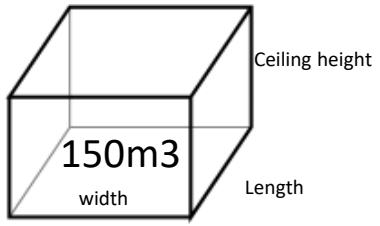
This eACH combines:
Existing ventilation ACH (via windows and/or mechanical system)
AND the ACH delivered by an air cleaner itself.
See an youtube explanation **https://youtu.be/bQg-JgUhlmU**
via www.cleanclassroomair.com

An air cleaner is an effective way to SUPPLEMENT ventilation especially when it is poor (e.g. difficult to open windows in winter, outdoor air is polluted) to significantly reduce Covid19 risks, asthma triggers, other respiratory illnesses & school absence. This supports pupil attendance & learning outcomes.

THE LANCET COVID-19 COMMISSION TASK FORCE ON SAFE WORK, SAFE SCHOOL, AND SAFE TRAVEL Designing infectious disease resilience into school buildings through improvements to ventilation and air cleaning April 2021
https://static1.squarespace.com/static/5ef3652ab722df11fcb2ba5d/t/60a3d1251fcec67243e91119/1621348646314/Safe+Work+TF+Desigining+infectious+disease+resilience+April+2021.pdf

Technical Data

One UK DIY CRBox can provide a typical classroom *with a Volume 150m3 (equates to 1 ACH):*



6 Air Changes per Hour (ACH) *High fan speed -Level 3*
5 ACH *Medium fan speed- Level 2*
4ACH *Low fan speed - Level 1*

For optimum Clean Air Delivery Rate (CADR) put the air cleaner on the highest fan Level 3

Example UK classroom Testing by @plasticfull

55m² floorspace x 2.7m tall = ~150m³

Air Changes Per Hour (ACH)	CADR	
1	150m3/hr	
2	300m3/hr	
3	450m3/hr	
4	600m3/hr	Minimum
5	750m3/hr	
6	900m3/hr	Recommended

DIY approximate air changes per hour by setting level

Fan Speed LEVEL	Smoke ACH	PM2.5 ACH
LOW - 1	4	4
MEDIUM -2	5	6
HIGH - 3	6	7

Fan: Vent Axia 14" Box Fan **Filters:** 4x Filtrete MPR 1900 20x25x1"

Fan Speed LEVEL	Noise (@1 meter)	Smoke CADR (Cigarette)	PM2.5 CADR (7% Saline)	Power (@ 240V)
LOW - 1	41dB(A)	585m³/h	649m³/h	32W
MEDIUM -2	48dB(A)	790m³/h	924m³/h	42W
HIGH - 3	51dB(A)	917m³/h	1111m³/h	53W

Fan: Vent Axia 14" Box Fan **Filters: 3x** Filtrete MPR 1900 20x25x1"

Fan Speed LEVEL	Noise (@1 meter)	Smoke CADR (Cigarette)	PM2.5 CADR (7% Saline)	Power (@ 240V)
LOW - 1	41dB(A)	567m³/h	616m³/h	32W
MEDIUM -2	48dB(A)	775m³/h	912m³/h	42W
HIGH - 3	51dB(A)	906m³/h	1102m³/h	53W

*Smoke CADR -Smoke particle count reduction at 0.35-0.46µm particle size. To represent performance for the smallest respiratory particles.
**PM2.5 CADR To represent performance at typical range of respiratory particle sizes.
*** There is CADR reduction by 4% with peg board enclosure on the highest fan setting only. No affect on Medium /Low fan settings.
Filter replacement recommendation (see page 15 for general maintenance and risk assessment) Every 12 months for use 8 hours per day, 5 days per/week.
Note:

- The recommended filter replacement cycles may differ depending on the operating environment.
- Technical data may be changed in the course of further development without prior notice. CADR values are ±10% depending on mains voltage and placement.

General Notes: Maintenance & Safety information

TESTS & NOTES ON PEFORMANCE

FILTERS: 3M scientists endorsement of 3M Filtrete (HVAC filters) for use with #CorsiRosenthal Box /CR Box
https://news.3m.com/2022-02-24-3M-scientists-This-Corsi-Rosenthal-box-movement-is-legit

Virus Filtration Performance of HVAC filters:
'(1) High efficiency residential HVAC filters were found to be effective at capturing airborne virus particles.
(2) Filter viral filtration efficiency was found to be generally correlated to its MPR rating, i.e., the higher the MPR rating, the higher the viral filtration efficiency'
https://www.filtnews.com/virus-filtration-performance-of-residential-hvac-filters/

WhiteHouse Endorsement:
The Corsi Rosenthal Box is recognised as a temporary, affordable and effective measure to filter virus.
It is not a replacement for the need for mechanical ventilation upgrade and assessment
https://www.whitehouse.gov/ostp/news-updates/2022/03/23/lets-clear-the-air-on-covid/

Wild Fire Safety Research - An Evaluation of DIY Air Filtration- US Chemical Insights (CI) of Underwriters Laboratories /Office of Research and Development at U.S. Environmental Protection Agency – A study assessing the potential fire risks of operating DIY air cleaners https://chemicalinsights.org/wp-content/uploads/DIY-Box-Fan-Report-2021.pdf

European Based Assessment:
Prof Javier Ballester of LIFTEC and University Zaragoza
Page 7 & 14 Report DIY Air Cleaners – Tests and observations.
http://tinyurl.com/FannFilter

"In Spain and Europe, the EN 60335-2-80 is compulsory for this type of fans. This standard covers all safety conditions that must be complied

Other :

Characterizing the performance of a DIY air filter:
One Sentence Summary
A DIY air cleaner can effectively reduce aerosols in indoor spaces.
Rachael Dal Porto, Monet N. Kunz, Theresa Pistochini, Richard L. Corsi & Christopher D. Cappa
https://www.tandfonline.com/doi/full/10.1080/02786826.2022.2054674?scroll=top&needAccess=true

Can 10× cheaper, lower-efficiency particulate air filters and box fans complement High-Efficiency Particulate Air (HEPA) purifiers to help control the COVID-19 pandemic?
Devabhaktuni Srikrishna
https://www.sciencedirect.com/science/article/pii/S0048969722029813

UK DIY Version Corsi Rosenthal Box testing method:
https://twitter.com/PlasticFull/status/1553013972571492359

ADDITIONAL GENERAL NOTE - VENT AXIA FAN 'operating the fan'

Fan speed control
0= Off
1=Low speed
2= Medium speed
3= High speed

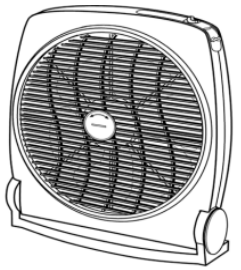
Louvre panel rotation control:

OFF: will stop the grille rotating
(for fixed direction of airflow)
ON: starts the grill rotating
(variable direction of airflow)

This switch whether 'off 'or 'on' does not impact the clean air delivery rate of DIY Corsi Rosenthal box

FAN: Vent Axia FanBox Manufacturers Information
https://www.vent-axia.com/file/2904/

14" BOX FAN USER LEAFLET



Please read these instructions carefully before operating the fan

TECHNICAL SPEC

RATED VOLTAGE: - 220-240V AC
RATED FREQUENCY: - 50Hz

IMPORTANT

- Ensure that the voltage marked on the fan agrees with your mains voltage.
- This fan must **NOT** be used in a bathroom.
- Always ensure that a fuse approved to BS 1362 is fitted and that it is the correct rating for the appliance.
- **IF IN DOUBT CONSULT A QUALIFIED ELECTRICIAN**

OPERATING THE FAN

Fold out the two feet from the base of the fan (see diagram opposite)

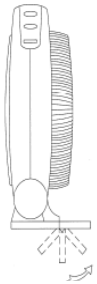
To control the louver on the front of the fan select the following:-

OFF will stop the grille rotating (for a fixed direction of airflow)
ON will start the grille rotating (for a variable direction of airflow)

Fan speed control:-

0 = OFF
1 = LOW SPEED
2 = MEDIUM SPEED
3 = HIGH SPEED

The fan pitch can be adjusted from 3 to 20 degrees, by holding the fan base and then moving the fan body forwards or backwards. The fan will click into the desired position.



CLEANING

Plastic parts should only be cleaned with mild soap and a damp cloth or sponge. Never use solvent or abrasive cleaners.

NOTES FOR SAFE OPERATION

- Never insert any objects through the guard when the fan is running.
- Always disconnect the fan when removing the guard for cleaning.
- Make sure that the fan is on a stable surface when operating to avoid overturning.
- Do not use the fan near an open window or door. (Rain may create an electrical hazard).
- Do not use the fan in an area of high humidity, or a dusty environment.

General Notes: Maintenance & Safety Information

CONDUCT A LOCAL HEALTH & SAFETY RISK ASSESSMENT:

Undertake a Health and Safety risk assessment wherever a DIY air cleaner is proposed to be used and note the following points :

Installation

- After assembly of a new DIY air cleaner, the fan unit should be run for a minimum of half an hour to allow the motor to warm up. Consider screwing down the lourve grill panel if there is some rattling The fan should be monitored for excessive vibration or unusual noise emissions that could indicate a manufacturing fault. Always place and use the DIY air cleaner on a dry, stable, even and horizontal floor.
- Leave at least 30 cm of free space around the sides of the DIY air cleaner and is kept free of obstruction from objects e.g curtains Use of inline timer mains plugs can be used to ensure they switched off during unoccupied hours.
- If assessment indicates a risk from tampering with the filters or fan, a breathable enclosure should be considered, e.g perforated pegboard
- Try to place the unit near a mains socket
- Do not create trip hazards with chords. Keep away from walkways, Use of cable management floor/wall covers to prevent trip hazards.
- Any modifications to the specification of or build instructions presented for the DIY air cleaner, such as different filters, fan or enclosure specification, may result in performance less than indicated and unforeseen hazards.
- The DIY air cleaner must only be used in areas that undergo regular vacuum and surface cleaning to minimise environmental surface dust. Performance may otherwise deteriorate requiring increased frequency of filter replacement.

Assembly of air cleaner

- Ensure no gaps in the construction of the filter and fan, so that all air entering the fan is cleaned by the filters, otherwise excessive dust build up may occur within the fan. Which may result in reduced performance and result in damage to the fan over time.
- Box Fan refer to manufacturers information – see page 15 Do not tamper or alter with any electrical components. Do not disassemble, repair or modify the fan.

General Operation

- Only operate the DIY Air cleaner under adult supervision in the presence of children
- Do not use the DIY Air cleaner outdoors, keep away from wet, damp areas. Do not place in water. Do not use near open windows or doors
- Do not use in excessive humidity . This will prevent moisture buildup inside the air cleaner
- Keep away from heat sources
- Do not sit or place objects on the air cleaner, do not use as storage, do not insert objects in the fan guard or in the filters.
- Where local assessment indicates a risk build a breathable protective enclosure e.g perforated pegboard can help hinder knocks, bumps, tampering or touching of the filters
- Defective power cables pose a serious health risk. If the power cord is damaged, it must be replaced by the fan manufacturer, or qualified NICIEC Electrician. Refer to Manufacturer guidance (see page 15)
- PAT test periodically as required by organisational rules for electrical equipment.
- If the fan produces a strange noise, burning smell or smoke, immediately remove the power plug from the electrical outlet.
- If any part of the fan or filters are damaged, the DIY air cleaner should not be used.
- Do not subject the air cleaner to excessive force or bumps and bangs
- Do not use the DIY air cleaner in environments where high amounts of dust are produced. E.g. production facilities, workshops or on construction sites
- Do not use the DIY air cleaner in areas where flammable gases or combustible materials are used or stored.
- Do not use DIY air cleaners as a substitute for extraction hoods used for combustion or hazardous pollutants.
- The DIY air cleaner does not remove Volatile Organic Compounds (VOCs) carbon monoxide (CO) or radon (Rn). It cannot be used as a safety device upon accidents involving combustion processes and hazardous chemicals.

Filter removal, disposal and Cleaning:

- This is to be undertaken by an adult only
- Always Disconnect from the power socket prior any cleaning or maintenance
- See Box Fan manual for manufacturers information – page 15
- The condition of the fan should be checked and its blades should be cleaned of any dust before attaching replacement filters.
- When changing filters, dispose of any packaging that may present a choking hazard to children immediately.

Environmental Protection Agency USA

https://www.epa.gov/coronavirus/air-cleaners-hvac-filters-and-coronavirus-covid-19

" When changing the filter(s), wear gloves, an N-95 (FFP2) respirator or similar, and goggles (without holes) for personal protection. Remove the filters gently - outdoors if possible. Avoid shaking or banging the filters to minimize the release of accumulated dust. Dispose of the filters in garbage bags."

BESA Group guidance

https://www.thebesa.com/media/837990/besa-guidance-vg002-v4.pdf

'(HVAC) Filters should be changed with the system turned off, while wearing gloves, with respiratory protection, and disposed of in a sealed bag.'

People who use this DIY air cleaner specification must have read and understood the above safety information. Where used in a workplace setting, a health and safety risk assessment must be conducted by the employer in accordance with Health and Safety Executive Guidance

Suggested suppliers of key resources

Vent Axia Fan Box

https://www.ukelectricalsupplies.com/vent-axia-14-inch-box-fan.htm

https://www.fastlec.co.uk/vent-axia-14-box-floor-fan-oscillating

https://www.airconcentre.co.uk/products/vent-axia-14-box-fan-427584

https://www.amazon.co.uk/Vent-Axia-427584-White-Box/dp/B00942ZSS4

3M Filtrete 1900M 20” x 25” x 1” HVAC filters

https://www.amazon.co.uk/Filtrete-Ultimate-Allergen-Reduction-1-Inches/dp/B005GZ8JKC?th=1

https://www.digikey.co.uk/en/products/detail/3m/UA03-4/16499588