Clean Air for Everyone Everywhere

TEACHER SUMMARY SHEET

Introduction

Clean Air for Everyone Everywhere aims to educate students on the importance of pollution-free air and how it’s not equal for everyone. According to the UN Human Rights Council, having a clean, healthy and sustainable environment is a human right. Yet, many people around the world can’t access it. This lesson also aims to highlight what engineers can do to ensure clean air is accessible.

This activity was compiled by teaching professionals at SafeEdForAll to educate pupils about Air Quality and is based on a citizen science solution by HVAC expert Jim Rosenthal.

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<tr>
<th>Educational Aspect</th>
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<tr>
<td>Incorporate global issues into the classroom</td>
<td>Highlight key facts about Air Quality through a &quot;Did you know?&quot; sheet</td>
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<td>Provide careers-related learning to pupils</td>
<td>Highlight how engineering can help solve some of the major issues facing us today</td>
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<td>Use a hands-on activity to develop teamwork within the classroom in an educational setting</td>
<td>Develop practical skills and cement understanding of how engineers can improve people’s safety, health and quality of life</td>
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<tr>
<th>Pupil Learning Objective</th>
<th>Activity</th>
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<tr>
<td>Understand the importance of Air Quality and that access to Clean Air is not equal</td>
<td>Discussion – why is Clean Air important to you? (use tips from &quot;Did you know?&quot;)</td>
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<tr>
<td>Describe the role of the engineer in bringing about access to Clean Air</td>
<td>Discussion – What does an engineer do to ensure you get Clean Air? (use tips from &quot;Did you know?&quot;)</td>
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<tr>
<td>Activity</td>
<td>Plan, build and test using the activity sheet.</td>
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<tr>
<td>Build a working HEPA filter</td>
<td>Discussion – using the HEPA filter activity and the first two discussions, what may stop an engineer from helping communities get Clean Air?</td>
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Keyword suggestions to discuss with students

aerosols
airborne
CO₂
filtration
COVID-19
ventilation
pollution
HEPA
## Suggested lesson plan

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<th>Activity Summary</th>
<th>Notes</th>
<th>Resources</th>
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<tr>
<td><strong>STARTER</strong></td>
<td>Use starter questions to get pupils thinking about clean air. They could either discuss, draw a picture or write answers.</td>
<td>Suggested questions include: Why is clean air necessary? What stops air from being clean?</td>
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<td><strong>ACCESS ISSUES</strong></td>
<td>Ask children to think what it would be like if there were no policies for clean air in schools, workplaces and outdoors. Older pupils can discuss global issues. Talk about how countries protect people against air pollution and airborne viruses, like MERS and Covid, in shared indoor spaces like schools, offices and venues.</td>
<td>Suggested questions include: What would our cities be like with uncontrolled levels of air pollution? What would indoor life be like if indoor CO₂ levels and viruses, like COVID-19, weren’t controlled? How can communities with little money protect themselves from air pollution?</td>
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<tr>
<td><strong>ROLE OF ENGINEERS</strong></td>
<td>Ask children to think about what an engineer is and how an engineer and Air Quality are connected. Discuss with students how engineers can design cities, places and spaces to be cleaner, healthier and less polluted.</td>
<td>Suggested questions include: What does an engineer do? Why does an engineer get involved with air quality? How can engineers positively impact air quality indoors and outdoors?</td>
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<tr>
<td><strong>BUILDING A HEPA FILTER</strong></td>
<td>Students to build a HEPA filter to learn more about air filtration.</td>
<td>Students will be able to get practical and build an air filter that they can test in a real-world environment in their classrooms.</td>
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<td><strong>REFLECTION ACTIVITY AND STUDENT FEEDBACK</strong></td>
<td>Ask children to reflect on the practical activity and what they learnt, reinforcing that engineers help to provide communities with fresh air.</td>
<td>Suggested questions include: What did we learn? What do engineers do? How did the air filter make a difference in your classroom? Were there any ideas to improve on the design? How can we use what we’ve learnt to make a sustainable impact on more people in our communities?</td>
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Did you know?

Every year, air pollution causes up to 36,000 deaths in the UK.

According to the WHO and the UK government, air pollution is the most significant environmental health risk we face today.

Poor air quality causes heart and lung diseases. It is linked to low birth weight and can impede children's lung development. It may even contribute to mental health issues.

Ensuring proper ventilation with outside air can help reduce the concentration of airborne contaminants, including viruses, indoors.

Letting fresh air into indoor spaces can help remove air that contains virus particles and prevent the spread of COVID-19.

As virus particles are carried in the air we breathe out, we can judge how safe a space is by measuring CO₂ levels in a room.

Outdoor CO₂ levels are around 400 parts per million (ppm). Indoors, a consistent CO₂ value less than 800ppm indicates that a space is well ventilated. An average of 1500ppm CO₂ shows poor ventilation.
Build your own HEPA filter

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<tr>
<td>Assign team members tasks: design, project management, procurement, construction, testing, maintenance</td>
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<td>Decide on your budget for the box/es</td>
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<tr>
<td>Check out: <a href="https://cleanaircrew.org/box-fan-filters/">https://cleanaircrew.org/box-fan-filters/</a></td>
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<tr>
<td>How can you improve on the design within your budget?</td>
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<tr>
<td>Use a CO₂ monitor to test your filters.</td>
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What is a HEPA filter?
HEPA stands for high-efficiency particulate air. A HEPA filter is a type of mechanical air filter.

How does it work?
It forces air through a fine mesh that traps harmful particles such as pollen, pet dander, dust mites and tobacco smoke. You can find HEPA filters in most air purifiers.

The Corsi-Rosenthal Box
HEPA filtration can be expensive. So, during the first year of the pandemic, Richard Corsi, Dean of Engineering at the University of California, put out a Twitter STEM challenge: to create an accessible and affordable way to reduce levels of airborne viral particles in indoor settings.

HVAC specialist, Jim Rosenthal, responded with a design that is known as the Corsi-Rosenthal Box. This DIY method of building your own air filter with MERV13 furnace filters and a box fan is an easy and cost-effective way to help clear indoor air from airborne contamitantes, including coronavirus particles, wildfire smoke, pollen and dust.

MATERIALS

Jim’s original design with a square box fan
A. One 20-inch box fan
B. Four 20”x20” furnace filters (MERV 13/Filtrete MPR 1900, or MERV 11)
C. One fan shroud made from the fan box
D. On fan bottom made from the fan box
👉 Plenty of duct tape to seal everything together

An adapted design for the UK using a cage fan
A. One 18-inch metal cage fan
B. One 20”x20” MERV 13 filter (3M Filtrete MPR 1900)
C. Flexible plastic for shroud
D. Optional: binder clips
👉 Plenty of duct tape to seal everything together

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Corsi-Rosenthal Box

Materials:
(A) 1x 20"x20" box fan
(B) 4x 20"x20"x1" furnace filters
(MERV 13*/Filtrete MPR 900
("can use MERV 11 if not available)
(C) 1 fan shroud made of fan box
(D) 1 fan bottom made of fan box
- lots of duct tape to seal everything super well

References:
Twitter: @corsiAQ, @jimrosenthal4, @koratherB8
The “filter-on-a-fan” DIY Air Purifier
(1-filter design)

Parts list:
20"x20"x1" MERV 13 filter (3M Filtrete MPR 1900 used)
18" (450mm) metal “cage” fan
Duct tape
Flexible plastic for shroud
Optional: binder clips

Mount options: Floor/table/wall

Development notes:
Development status: V1.0 (un-certified prototype)
Future development: Reduce noise, anti-tamper protection, build to CE spec
Flow and sound tests performed by: @JBCLiﬁtec
Flow test: ISO 5801 calibrated flow test
Sound test: Type 2 SP meter
Info card by: Amanda Hu (@ughberta)
The “UK CR Box” DIY Air Purifier
(4-filter design)

Parts list:
4x 20”x20”x1” MERV 13 filter (Filterbuy filters used)
18” Metal “cage” fan
Fan box, other cardboard
Duct tape

Mount options: Floor/table

Development notes:
Development status: V1.0 (un-certified prototype)
Future development: Reduce noise, anti-tamper protection, build to CE spec
Flow and sound tests performed by: @JBCLittle
Flow test: ISO 5801 calibrated flow test
Sound test: Type 2 SP meter
Info card by: Amanda Hu (@ughberta)