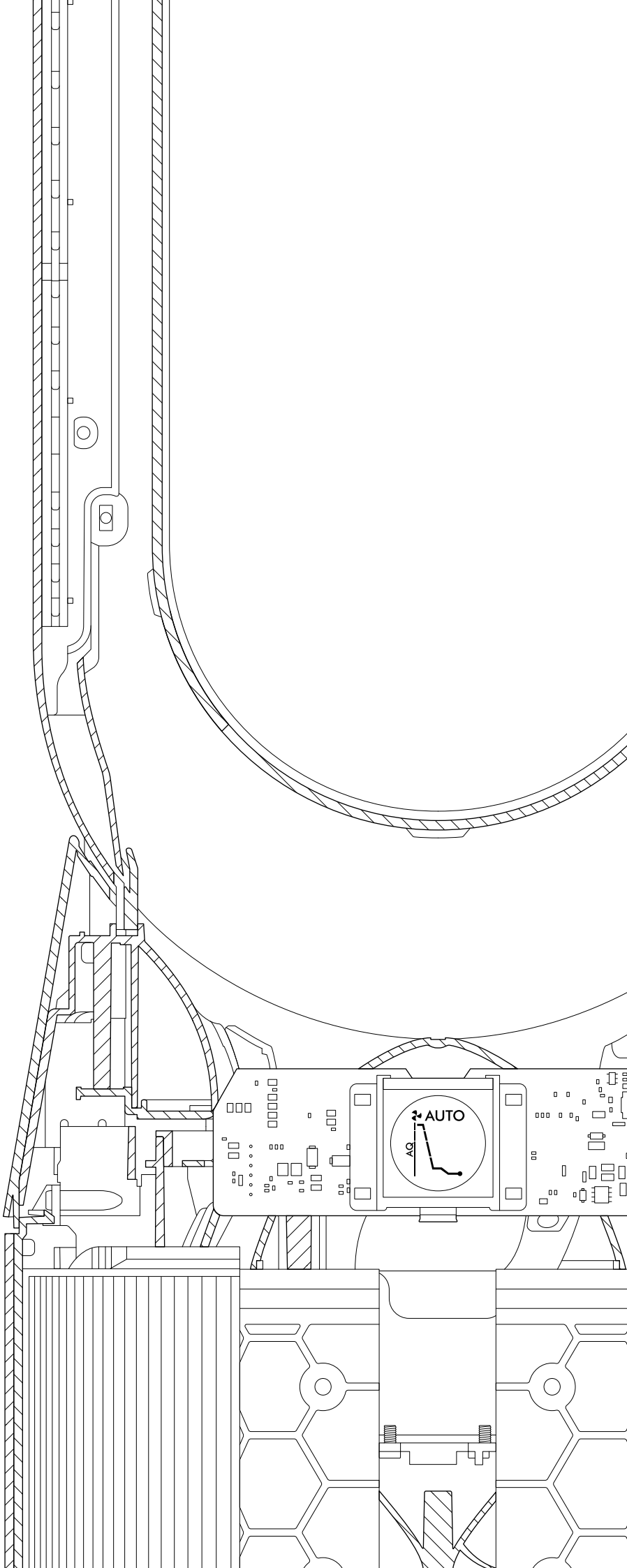
THE JAMES DYSON FOUNDATION

SUPPORT PACK

Engineering solutions: Air pollution



INTRODUCTION

As schools are currently closed, with students studying remotely, we've adapted our full Engineering Solutions: Air Pollution teacher's pack to enable students to complete lessons from home.

This pack contains the support sheets required for you to support your students working through the Engineering Solutions: Air Pollution student pack. Additional information can be found in the student pack information pages and supporting videos.

The Engineering Solutions: Air Pollution student pack contains reading and worksheets for students to work through, as well as a design and prototyping activity. The pack is complementary to both Science and Design and Technology curriculums at Key Stage 3 and 4.

In working through the pack, students will:

- Learn about air pollution and its global sources
- Consider their own exposure to air pollution
- Analyse data on air pollution
- Analyse the Dyson Pure Cool™ purifying fan
- Consider global engineering solutions to air pollution
- Develop, present and evaluate their own solution to air pollution

Students will need access to the pack and supporting videos. As the teacher, you should advise students of when and how you would like them to submit their work.

You can find the required support sheets on the pages below:

WORKSHEET 01: AIR POLLUTANTS AND THEIR SOURCES

Students are required to correctly match the air pollutant to its description and source. Below is a table of the correct pairings.

Pollutants	Description	Source
PM10	10µm in width, or less. They are normally large enough to be caught by nose hairs and mucus, enabling us to cough or sneeze them out. However, they can impact people's breathing and have long-term health effects.	– Black smoke – Soil – Dust from roads and building sites – Pollen – Mould spores
PM2.5	2.5µm in width, or less. They are so small they can only be seen with an electron microscope. Their size means they can bypass our bodies' natural barriers and get into the lungs.	– Bacteria – Fungi – Emissions from coal, gas and oil-powered industries
PM0.1	Ultrafine particles with a diameter of 0.1µm or less. They are small enough to bypass the lung tissue and enter the bloodstream.	– Vehicle exhaust emissions – Wood smoke – Tobacco smoke
Volatile Organic Compounds (VOCs)	A group of gases or airborne liquids that can be toxic.	– Cigarettes – Paints – Cleaning products – Scented candles – Furniture polish
Formaldehyde	Known for its distinct and overpowering smell as well as its flammable nature.	– Mass-manufactured wood products – Varnishes – Paints – Glues
Nitrogen dioxide – NO_2	A reddish-brown gas with a strong smell that causes smog and acid rain.	– Diesel car exhaust fumes – Fires – Coal factories – Domestic heating
Carbon monoxide – CO	An odourless, tasteless and colourless gas.	– The inefficient burning of fuels in gas and wood-burning heaters
Sulphur dioxide – SO_2	A toxic gas with a strong smell that is emitted by volcanoes.	– Burning fossil fuels – Volcanoes – Forest fires
Ground-level ozone – O_3	A colourless and highly irritating gas that forms just above the earth's surface.	–Formed when NO_2 reacts with VOCs and sunlight

WORKSHEET 02:
AIR QUALITY AROUND SCHOOL

Students will use the data on air pollution collected by Dyson engineers to draw two graphs which outline the levels of gas and particulate matter pollution in a school.

Students will be asked questions based on the graphs. You can encourage them to think about all the sources of air pollution in a school using the prompts below.

Dust

VOCs from cooking smelly food

Food particles from toasters, fryers and grills

Gas hobs for cooking

Pollen

Vehicle emissions from surrounding roads

Science experiments which use chemicals

D&T classroom materials such as wood and glue

Matter kicked up from the road by cars

Cleaning products

Aerosols such as deodorant

WORKSHEET 05: DESIGNING A FILTER

The table below provides guidance for the questions students need to answer when completing **Worksheet 05: Designing a filter.**

The activity should highlight that engineers have to work to specifications when designing solutions to problems. These specifications can relate to size, cost and performance. Students should understand that engineers needed to make sure the filter in Dyson purifying fans captured air pollutants without compromising airflow, while still meeting these specifications.

Question		Support notes
2a	What do you notice about the size of the two pieces of paper compared with the flat paper?	Students should comment on the different heights and lengths of the paper and how that impacts the space they take up.
2b	What has happened to the surface area?	The surface area will remain the same. This can be further explained by asking the students to lay each sheet out flat again, to the size of the original A4 page.
2c	Why is this significant?	When engineers design a filter, they must optimise the number of pleats, pleat pitch and pleat depth to fit into the space constraints of the machine. A flat sheet would mean the final machine dimensions would be very large. A pleated sheet would require greater depth but may allow for smaller dimensions. The filtration team must work with lots of other teams such as motors, electronics and design engineers to understand how each of the different elements will fit together to produce a final machine that is functional while also being aesthetically pleasing. **Please note:** Increasing surface area also reduces the pressure drop and face velocity of the filter, so you may choose to elaborate further if appropriate.
3c	Why is this significant? Why do you think engineers would want to maximise the surface area of the filter they create?	Air is pulled into the purifier, through the filter and pushed back out into the room by a motor. Pulling air through the filter takes energy and, as it clogs up with particles, more energy is required to pull the same amount of air through the filter. This can increase the noise of the motor, as well as its energy consumption. Packing as much surface area as possible into the filter results in fewer particles travelling through each unit of filtration media. This means we can reduce the energy consumption and noise to deliver cleaner air to the room, while also extending the life of both the motor and the filter.
3d	What limitations, apart from space, might there be on the maximum surface area of the filter used?	A smaller pleat pitch would result in an even greater surface area of filtration media. But filtration media is expensive. Engineers must balance performance with cost to ensure the final machine is both high performing and commercially viable.

WORKSHEET 08:
DESIGN AND BUILD A SOLUTION TO AIR POLLUTION BRIEF

This worksheet tasks students to meet a brief by designing and building their own solution to air pollution. It'll teach students about the design process practiced by engineers.

Once students have built their design solution, you can get them to present their work to you or to their classmates using the platforms or facilities available to you. This will enable students to collate feedback on their design solution, identify strengths and weaknesses, as well as prompthem to think about how they can improve it.