The Environment of Manchester Airport

This online book and accompanying activities introduce children to the work of the Environment Team at Manchester Airport. The Environment Team looks at and tries to minimise the environmental impacts of the airport. The main areas they work in are air quality, water quality, noise, sustainability and landscape management.

The book is designed to be used on a white board. For each section of the book there are science experiments that teachers can try with their class. These follow the format of questions for children followed by practical experiments or investigations. The themes explored include:

- What causes global warming?
- What is a carbon footprint?
- Investigating sound
- Winter conditions at the airport
- Water resources
- Ecology and habitats.

We hope you enjoy using the book to look at the airport from a very different angle.

Big Book

Teachers' notes

Is global warming really happening?

There is currently strong discussion and debate about the causes of global warming. Some scientists think that it is part of a natural cycle that happens over millions of years. Others believe that it is a direct result of human activity.

In 2007 an international panel of experts, the Intergovernmental Panel on Climate Change (IPCC), met and decided that:

- global warming is happening
- it is evidenced through heat waves, very high and low temperatures that are not normal for the climate, heavy rains outside of normal expectation and tidal waves
- these events are becoming more frequent and will continue to do so
- global warming will cause sea levels to rise due to the melting of polar ice caps.

What causes global warming?

It is caused by an increase in greenhouse gases (methane, nitrogen oxide, fluorocarbons, water vapour and carbon dioxide). These gases collect in the atmosphere and change the way that the sun's rays come through the layers around the earth.

Nitrogen oxide results from burning fuel to power engines. It is the main air pollutant caused by transport connected to the airport and makes the air less healthy to breathe.

Carbon dioxide is produced by the actions that humans take to build and live in their world. Most carbon dioxide is caused by burning fossil fuels (coal, oil and gas) to provide electricity, heat our homes, and fuel transport and industry. This gas is thought to contribute most to global warming.

Questions for children

- How many different kinds of transport can you identify that are linked to the airport?

- Which do you think produces the most pollutants per person using them?
- Who will be affected by this pollution?
- Which types of transport could be used less?
- What else can be done to reduce the amount of fuel used by transport?
- What has the airport done so far to reduce the amount of pollution it generates?
- Will this make a difference? How?
- How can we check to make sure it is making a difference?

Practical tasks

Carbon dioxide is a colourless and odourless gas and makes up about 0.4% of the atmosphere. It is produced as a waste product when fuel is used to make energy and it is used as a raw material by plants to make their own food.

Try these investigations with children to help them explore carbon dioxide.

NB: Safety first! Health and safety must be documented with these ideas. There is useful guidance on the Association of Science Education website (ASE B Safe on www.ase.org.uk)

Investigation 1

- Fill a small plastic bottle with water and place it upside down in a tank with its neck under water.
- Hold it in position.
- Replace the cap on a 2-litre bottle of carbonated water with a cork or bung with tube attached through hole (wine makers equipment).
- Feed the tube under the water and into the neck of the submerged bottle.
- As the gas escapes the fizzy water, it will push the water out of the upturned bottle

(E1 M1 L1)

Investigation 2

- Light a candle and cover it with a glass jar.
- When the oxygen is used up, the candle will go out and the jar will be full of carbon dioxide produced in the burning.

- Light another candle and carefully move the jar over it.
- Because of the carbon dioxide in the jar, the candle will go out more quickly.
- Carbon dioxide is heavier than air and will fall out of the jar if care is not taken.

(M13 L12)

Investigation 3

- Bicarbonate of soda mixed with vinegar will produce carbon dioxide.
- To demonstrate this, hold the mixture above a candle flame.
- The heavy gas will fall onto the flame and put it out.
- This works best in an enclosed space, so demonstrate it using a small glass tank.

(M13 L12)

What is a carbon footprint?

A carbon footprint relates to the amount of greenhouse gases produced in our day-to-day lives through burning fossil fuels for electricity, heating and transportation, etc. The carbon footprint is a measurement of all greenhouse gases we individually produce and has units of tonnes (or kg) of carbon dioxide equivalent. You can calculate your own carbon footprint at the website www.carbonfootprint.com

Carbon is one of the materials that is used as a 'building block' for living things.
We can see it in many different forms in everyday life: inside a pencil, mixed with clay, burnt wood (charcoal), printing ink, filters (such as cooker extraction hoods), diamonds. It makes many other things when it is mixed with other 'building blocks' like oxygen and hydrogen, such as sugar, fuel, materials and plastics.

When substances containing carbon are burnt, the carbon comes out as a gas mixed with oxygen from the air. When the burning process is not quite finished the carbon can be seen as crumbly black ash. This is a permanent change that you can see from burning materials, e.g. burnt toast, paper, wood, cotton wool, etc

Questions for children

- How big do you think the airport's carbon footprint is?
- Where does it come from?
- What can be done to reduce the airports carbon footprint?

L18

Practical tasks

Investigation 4: What activities generate carbon dioxide?

- Arrange the class in pairs.
- Each pair has to think of two activities that generate CO_2.
- Double the pairs into fours and ask them to combine their ideas, If two ideas are the same, try to think of another one.
- Combine fours into eights and combine ideas.
- Feedback: which group has the most ideas? List ideas from each group on a flip chart.

Investigating sound

Aircraft engines generate a lot of noise. The local community is protected from noise pollution by pilots flying on designated routes away from houses on take-off.. These are called Preferred Noise Routes (PNRs) and are designed to contain the noise of aircraft for the initial potentially more noisy stages of flight. Aircraft are fined for creating too much noise on take off. The money goes into the Manchester Airport Community Fund Trust Fund to support local projects. Noise monitors are used to check and record the detail and noise level of each takeoff. Environment advisors can tell if the noise recorded at a noise monitor comes from an aircraft or another source from the sound signature.

E11 M10 L10

Questions for children

- What causes noise pollution?
- How long after an aeroplane passes over do you hear the sound?
- How far away does that make the aeroplane?
- How can the airport measure the noise produced by the planes?
- How far away can sound be heard?
- Can you stop sound from being heard?

Practical tasks

<u>Investigation 1: Measuring the speed of sound</u>

You will need the following equipment: stopwatch, 500-metre measure, something to generate a sharp sound (e.g. two flat surfaces to slap together such as blocks of wood or stones).

- Ask one pair of children to stand at one end of the 500-metre measure with the noise generating equipment. The distance can be measured using a roll along device used in athletics to lay out football fields. If one of these is unavailable, use as long a measuring tape as you can find.
- The other pair stands at the opposite end with a stopwatch.
- On an agreed command, (e.g. a visible signal or a third party half way between the two), the first pair make a noise by banging the items together once as hard as possible.
- At the same time as the noise is generated, the child with the stopwatch starts the timer and stops it when the sound is heard.

- The time should be recorded to the nearest tenth of a second.
- This investigation should be repeated to get an average time.

Speed of sound = distance divided by time

Investigation 2: To demonstrate how sound bounces around built up areas
The group of children stand a measured distance from a building that has a large, flat unobstructed outside wall. They make a sound. As the sound is made, an echo is heard as the sound travels to the wall and is reflected back toward the group. The child generating the noise synchronizes it with the echoes. The period between each noise is the time for the sound to make a round trip from the noise source to the far end of the echo. The time for, say, ten repeats is measured by the stopwatch. The speed of sound is then calculated by dividing twice the distance to the wall by 1/10th the time for the ten noise bursts.

This second alternative is quite complicated but could be used as an extension for more able children

Investigation 3: To show that sound travels through solids

- Ask children to sit in a circle. Ask them: how did you hear this instruction? Where did the sound start?
- The vibration made by your voice box vibrates tiny invisible particles in the air causing the sound vibration to cross through the air and vibrate in their eardrums. Sound doesn't just travel through air, but though other materials too. This can be investigated by putting their ear to a range of materials while they are tapped to make a noise. E.g. a wooden table top, a solid plastic block, a metal pipe. They should be able to hear the sound clearly through these hard materials.
- Next children can investigate a range of different materials. Introduce softer examples like books, clothes, cushions. Also mix materials using a hard material to make the sound but listen through the softer materials.
- The particles in the solid materials vibrate to carry the noise; the vibrations are absorbed in soft materials so that the noise does not travel do well.
- The particles in a liquid will transmit noise. If you put your head under water in a swimming pool, the movement of the water will distort the sound.
- This leads into the next investigation

Investigation 4: Protecting airport workers' ears from noise damage

- Ask children to suggest a way to do this. They should come up with the idea of ear protectors but which material would be best to make them?
- This can be investigated by a subjective assessment. The materials being tested are used to cover the ears and a sound is made; the tester then has to decide which material quietens the noise most.
- Children must decide how to design the investigation to be as fair as possible.
- To record more accurate data, you can use a sound sensor (e.g.Dataharvest). Use the insulating materials to sound proof a box and place the sensor inside the box to measure the sound. This will also give scope to extend this work into the idea of sound proofing buildings.

M3 – M5

Investigation 5: Traffic noise pollution

- Children can use sound sensors to carry out a survey of traffic around their school or to measure noise levels in different areas of the school grounds (NB: make sure that safety precautions and risk assessments are in place).

E13

Investigation 6: Making sounds

You will need the following equipment: a narrow tube or bottle, water and a short length of plastic straw

- Fill the test tube with water.
- Put the straw into the water.
- Blow across the top of the straw and listen to the sound it makes. The air in the straw vibrates to make the sound.
- Try moving the straw up and down as you blow across the top of it. Moving the straw changes the length of the column of air and the pitch of the sound changes

Coping with winter conditions.

Ice and snow can cause a lot of problems at the airport. Anti-icing agents are used but these can cause pollution in the water system when they are washed off by rain or melting snow. Salt grit is used on roads, solvents and other chemicals are used on the planes. The airport is looking for new agents and better technology to prevent pollution from these agents.

Questions for children

- What areas will the airport staff have to make sure are kept clear? (Make sure they are aware that this includes pavements, roads, runways, and the planes themselves.)
- What is de-icer? Explain that it is an antifreeze: something that makes the freezing point lower. Water freezes at 0°C, but adding a de-icer can lower this temperature so that the water will not freeze until the temperature is below this. E5
- Salt can be used as a de-icer on road surfaces. It would not be used on planes as it can cause metal corrosion.

Practical tasks

<u>Investigation 1: Using salt as a de-icer</u>

- Investigate how much salt is needed to melt ice.
- Carry out a fair test changing either the quantity or thickness of the ice or the amount of salt.
- How long does it take the ice to melt or how much water is produced in a set time?
- Data can be generated to produce an efficiency graph. E1 M1 L1
- What is the optimum ratio of salt to ice? It is important to use as little as possible to do the job because it is expensive and it pollutes the waterways.

<u>Investigation 2: Other forms of de-icer</u>

- An alternative investigation would be to use different concentrations of salt water or commercial antifreeze (check Bsafe for school regulations) and compare how long it takes the same volume of different concentrations to freeze.
- How concentrated does it have to be to stop it from freezing overnight?

Water resources

All water used by the airport is measured.

Water can be contaminated by maintenance operations such as oil, fuel, construction, fire training and storage. The airport tries to make sure that any pollutants are washed off into sewer outlets that go to treatment plants so that the water can be cleaned. Before any water is allowed to flow into a river it is monitored and checked for things that should not be there. If any contaminates are found then the water is directed for treatment. The airport carries out a number of tests including bio-chemical oxygen demand (BOD). This shows if there are materials in the water using up the oxygen e.g. micro organisms or harmful (oxidising) substances.

The airport uses 'grey water' (collected rain water) for some functions like flushing toilets.

Questions for children

- Where does water come from?
- Is water free?
- Does it cost anything to get it from a tap?
- Why is it important to use as little water as possible?
- What are water meters used for?
- Has anyone got a water meter at home? Has the school got one?

Technology Challenge M2 M6 – M9 M11 L19

<u>Investigation 1: Build a water meter</u>

- Use a piece of guttering to transport water from A to B.
- Design and construct a paddle mechanism that will be turned by the water passing along the gutter.
- Count the revolutions to measure water flow.
- Collect the water and measure the volume to see if this is a good representation of volume used.

This investigation can introduce systems control technology for older and more able children

<u>Investigation 2: Contamination control</u>

One way to lower levels of contamination would be to improve storage.

- Ask children to investigate the strength and durability of materials used for storage and to design a container that will hold liquids most efficiently in the storage area. E5 L8
- Cubes are easier to stack but have joints that will come under stress from the pressure of the liquid. Is there any way of stopping leaks from getting into the water system? Industrial sites have bund walls that contain the storage areas and stop leaks from going further.
- Cylinders don't have joints but are harder to stack.
- Investigate the best materials to use to build the storage. Some metals rust, those that do not are very expensive. Plastics can become brittle and crack. Carry out a survey of materials in use around the school to see how well they stand up to wear and tear.
- What else might affect the strength of a container? It may be affected by whatever is stored in it, by the weather, or possibly be damaged when being moved or knocked by vehicles moving around the site.

<u>Investigation 3: Water testing</u>

- Filter water samples to remove any solid particles. Sieves and filters with different sizes of hole will separate out the different sizes of particle.
- Try collecting rainwater to filter.
- Evaporating water completely will show any particles that were dissolved in it. Evaporation can be carried out from shallow open trays left in a warm place. Use clear plastic trays and place first on a black and then a white surface to see any residue. L8
- To demonstrate chemical testing, make an indicator solution by boiling up red cabbage and saving the coloured liquid. When added to an acid solution the colour will be red and when added to an alkaline solution it will be blue.

Ecology – habitats

Most children will not expect to see a wildlife trail at the airport.
Ask:
What sort of wildlife would you expect to see at the airport?
Show photographs of different habitats – children will probably not associate the wild flower meadows, arable land or even the river with an airport. M15
Show evidence of existing wildlife – how does this compare with local to school? E13
Practical activity
Pond dipping E4
Quadrat surveys at different locations (what can you find inside a square frame put down in a random location)
Butterfly diary
School habitat management to emulate the airport
Adding shrubs to attract specific insects L17
Flowers
Wild areas
Add insect houses
Bee feeders

Compare what is in the school grounds to surrounding area and to airport. Are there similarities/differences? What might explain the differences? Are they all due to airport activity M15

Habitat protection L8
Protection of existing wild life - newts project L8
Enhancement of habitats – otter holt, bat barns L18
Maintaining public right of way