

Environmental Science

An online resource to support students of A level Environmental Science (AQA)

Manchester Airport is the size of a mini-city and has all the environmental impacts of a mini-city. This resource provides an insight into the day-to-day work of the Environment Team and it explores their aim to make the airport carbon neutral by 2015. It also looks at the airport in the wider context of the air transport industry and the impact this sector of the economy has on the environment.

Independent industry experts from Centre for Air Transport and the Environment at Manchester Metropolitan University and Manchester Airport's team of Environment Advisers have provided the content for this site. It is designed to support teachers and pupils explore a number of topics covered in the Environmental Science A level.

The main topics of the site are:

- Sustainability
- Conservation
- Air and water quality
- Impact of noise
- Global climate change
- Sustainability
- Habitat management.

This resource may also be useful for teachers of:

- Environmental Science
- General Studies
- Environmental and Land-based Studies Diploma
- Citizenship

Structure of the site

The website has been structured to provide an overview of all of the environmental issues at Manchester Airport. Professor Callum Thomas of Manchester Metropolitan University Centre for Air Transport and the Environment is an authority on this subject and provides an overview of the political, social, economic and technological issues around the aviation industry and its environmental impacts. Manchester Airport's Environment Advisers then provide the detail of the day-to-day work that is carried out at the airport.

The website contains a wealth of information in a variety of formats from video interviews (including transcripts of all interviews) through to PowerPoint presentations, spreadsheets, corporate documents and case studies. Prof Callum Thomas's dissertation which explores the issues around future growth in the air transport industry is also included on the site.

Professor Thomas highlights the pros and cons of most arguments on the topic including the views of:

- Government

- Non-governmental organisations,
- Environmental pressure groups
- People living close the airport
- People who work at the airport
- The travelling public.

He focuses on the role of the airport, the need to be more sustainable if the air transport industry and the airport are to survive and the responsibility of the travelling public to do their bit to keep carbon emissions under control.

The site provides a lot of information and there are links to other sites that may be of interest.

What is on the site?

The content of this site may not be exactly what young people would expect.

When talking to young people about this resource, most thought the main issue for the airport would be aircraft emissions. The reality is the airport has no direct control over airlines once they have left the airport's air space. It can fine airlines if pilots exceed noise limits on take off but that is the extent of its direct power. The airport has to work with airlines, service providers and passengers to influence and persuade them to reduce their carbon footprint.

The airport focuses its efforts on the environmental impacts created by the 20 million + passengers who travel through the airport annually and 20,000 people who work on site.

- Operations on the airport site account for 79,000 tonnes of CO₂
- Aircraft movements on the ground account for 98,900 tonnes
- And transport to and from the site and on site account for 258,000 tonnes of CO₂.

The airport is working with the Carbon Trust to reduce its carbon footprint to zero by 2015.

The environment team focuses on

- Air quality
- Energy efficiency
- Ground transport
- Habitat management
- Noise
- Water quality
- Waste.

Air, water and noise quality

The airport monitors air, water and noise quality constantly. It works closely with the Environment Agency and the local Councils to ensure it does not exceed set limits. Data for each of these areas is available on Manchester Airport's website. www.manchesterairport.co.uk

Chris Paling is responsible for monitoring air quality at the Airport. The website contains an interview with Chris and links to other sites that may be of interest. Sue Hodnett is responsible for water quality and there are video interviews where Sue highlights the main issues around water quality and explains how she works with third parties, from contractors on site to the Environment Agency. David Foote is responsible for monitoring noise around the site and again students can watch a video interview where David talks about the main issues around noise and the monitoring equipment on site.

Ground transport

Around 74,000 journeys are made to or from the airport everyday and the majority are made by car. The airport has a ground transport strategy which combines providing a public transport hub and initiatives to encourage people out of their cars. Bob Longworth talks about the ground transport hub which has been developed at the airport. He also talks about the issues around trying to persuade people out of their cars.

Recycling

The airport is investing heavily in recycling initiatives. It currently recycles around 21% of all the waste produced on site and plans to recycle 50% by 2015. Sue Hodnett is responsible for recycling at the airport. The website contains video interviews with Sue and a couple of case studies showing how Sue is gradually encouraging people at the airport to recycle more.

Renewable sources of energy

The airport is also exploring renewable sources of energy and there is a test-bed at the Aviation Viewing Park. This includes solar water heating tubes and a biomass boiler.

Managing habitats

As part of the mitigation measures to allow the second runway to be built in 1992, the airport had to put in place measures to compensate for loss of habitats. The Environment Team created woodlands, ponds and alternative homes for protected species. The site includes an interview with Dr Tim Walmsley Head of the Environment Team at the airport who was responsible for this project and is still responsible for monitoring the new habitats and the protected species.

There is another aspect to habitat management which is keeping the runways bird free. Birds are hazard to aircraft taking off and landing. Grassland around the runways is kept deliberately sterile to discourage small mammals and birds.

Lesson plans

Lesson plans are offered as starters for teachers. It may be more appropriate for students to explore some of the issues covered in the lesson plans as research topics or guided learning exercises.

Air Monitoring at Manchester Airport

Aims of the session

- To consider sources of air pollution and how they are monitored
- To show students how air monitoring happens around Manchester Airport
- To have students analyse data on nitrogen dioxide levels in the locality of Manchester Airport
- For students to look at air quality using nationally-available data and compare their school location with Manchester Airport

Resources

- Web resource at:
<http://www.magworld.co.uk/sr2009/communities/air/performance.html>
- Air quality quiz question sheet
- Diffusion tube
- Recent MA nitrogen dioxide monitoring results.
- Web resource at: www.airquality.co.uk
- Air quality national data activity sheet

Curriculum areas

- Air quality
- How science works
- Sustainable development

Session outline (60 minutes)

Time	Activity	Resources
Start	<p>Starter activity</p> <p>Have students work in pairs or threes to list as many types of air pollution and their sources as they can in two minutes.</p> <p>Review answers and discuss.</p> <p>Typical answers likely to include carbon dioxide, sulphur dioxide, nitrogen oxides, particulates. May also get methane from farmed animals.</p> <p>Which do they think is the most important air pollutant? Why do they think it is the most important / damaging? What are the main sources that cause this pollution?</p> <p>Answer to final question may be carbon dioxide as a cause of global warming / climate change. This could be tied in with contributions by transport and also electricity generation.</p>	
8 min	Monitoring Air Quality	Web resource at: www.ieltd.co.uk/

	<p>View the air quality section of the web site that has the Q and A interview with Chris Paling, Environment Adviser, Manchester Airport.</p> <p>Students use the Q and A clips to answer the questions in the Air Quality Quiz. Give students time limit of 10 minutes to find and record their answers.</p> <p>Conclude by reviewing answers.</p> <p>Discuss, what are the possible sources of air pollution.</p> <p>State that complexes such as Manchester Airport are required to monitor the levels of emissions they produce and remain within allowed limits. Is this the case with everyone? Do they know how much nitrogen dioxide they are responsible for when they use cars, buses or trains?</p>	<p>ema/jn_01.html</p> <p>Air quality quiz question sheet</p>
<p>25 min</p>	<p>Measuring nitrogen dioxide levels at the airport</p> <p>Manchester Airport monitors Air Quality in two ways. It uses diffusion tubes around the site and it uses a more sophisticated and expensive continuous monitoring system. Show diffusion tube and explain how it works. Tube has two caps to keep it sealed.</p> <p>When in use, the cap is removed from one end (usually the white cap) and this exposes the other end to air. This end contains an absorbent gauze which absorbs nitrogen dioxide over a period of time (usually one month).</p> <p>The tube is then sealed and sent to a laboratory where the amount of absorbed nitrogen dioxide can be determined.</p> <p>Use the website link to view the most recent graph of nitrogen dioxide levels (generally the previous completed month). Display the graph using the interactive whiteboard.</p> <p>What does the graph show?</p> <p>What does parts per million actually mean? Another measure of nitrogen dioxide concentrations is microgrammes per cubic metre ($\mu\text{g}/\text{m}^3$). Microgrammes = millionths of a gramme.</p> <p>How close to the limits is the nitrogen dioxide levels at the airport monitoring station?</p> <p>What factors could cause the small peaks and troughs in the graph?</p>	<p>Diffusion tube</p> <p>Web link to recent Manchester Airport nitrogen dioxide monitoring results</p>

30min	<p>Nitrogen dioxide in your location</p> <p>Look at data on air quality from the UK Air Quality Archive at: http://www.airquality.co.uk/index.php</p> <p>Click onto the map to see your school's location and choose the nearest monitoring station. Select the weekly data option to see day-to-day and 24-hour fluctuations.</p> <p>Compare nitrogen dioxide levels with those found around the airport. Are they higher or lower than your school's location?</p> <p>Make comparisons with data from urban and locations close to major motorways. Are they higher or lower than at the airport?</p>	Visit the Magworld site
45min	<p>What can you do to reduce nitrogen dioxide emissions around your school?</p> <p>In small groups think of ideas to reduce nitrogen dioxide emissions. How will you persuade other young people to take part in your scheme.</p>	
55 min	<p>Plenary</p> <p>Ask class to suggest the main causes of air pollution.</p> <p>Ask about the actions they would be prepared to take to reduce air pollution. What are the things that they may need to give up or reduce?</p>	
60 min	End	

Quality Monitoring at Manchester Airport

Listen to the video clips and answer the questions.

1. What are the fossil fuels used at the airport?

2. What emissions do the vehicles and aeroplanes produce?

3. What other things can produce these types of emissions?

4. What is the name of the equipment used to monitor nitrogen dioxide levels at the airport?

5. Why are nitrogen dioxide levels monitored inside and outside the airport?

6. Suggest some of the factors that could influence the air quality in and around the airport?

Air Quality Monitoring at Manchester Airport

Answers

1. What are the fossil fuels used at the airport?

Jet Fuel (Jet A1 which is similar to kerosene)
Petrol
Diesel

2. What emissions do the vehicles and aeroplanes produce?

Nitrogen dioxide
Sulphur dioxide
Particulates
Benzene

3. What other things can produce these types of emissions?

Anything that burns fossil fuels such as vehicles, boats, power stations.
May also want to suggest activities such as deforestation via slash and burn causes release of carbon dioxide.

Slightly less obvious but could tie in with volcanic eruptions (Icelandic volcano also disrupts due to ash in the atmosphere).

4. What is the name of the equipment used to monitor nitrogen dioxide levels at the airport?

Diffusion tube

5. Why are nitrogen dioxide levels monitored inside and outside the airport?

Air pollutants are clearly produced from a range of activities. Stations inside the airport can help to monitor those caused by airport activities. Monitoring outside has two purposes. To see the contribution from traffic on local roads and also to observe any movement of NO_x off the airport site.

6. Suggest some of the factors that could influence the air quality in and around the airport?

Range of things such as level of activity on the airport and on surrounding roads. Direction and strength of air movements.

Noise Monitoring at Manchester Airport

Aims of the session

- To examine sound is monitored
- To consider sources of noise and unwanted noise
- To look at the decibel scale and the sound levels of different activities
- To compare different sound waveforms

Resources

- Decibel scale worksheet
- Sound signatures sheet

Curriculum areas

- Sound
- Hearing
- How science works
- Assessing risks

Session outline (60 minutes)

Time	Activity	Resources
Start	<p>Starter</p> <p>Open the session with a discussion</p> <p>Why is noise an issue for airports?</p> <p>Is it possible to monitor noise around the airport site?</p> <p>What sorts of measures might be in place to monitor noise at the airport?</p> <p>Is it possible to differentiate aircraft noise from all other noise?</p> <p>Are there any issues around perceived noise levels and actually noise levels that are particularly relevant to an airport operation?</p> <p>List the responses to these questions and then watch the video clips on the Noise Monitoring Section of the website. Start with Callum Thomas talking about the Noise Tracking System.</p> <p>You can then watch the answers to specific questions put to David Foote.</p>	
15 min	<p>Research</p> <p>Ask students to divide into pairs. They will carry out research to debate the following issue. They can research the subject by visiting Manchester Airport's website (Community) and by reading the Runway Data Sheet. Encourage the students to debate in pairs, then in fours and finally a whole group.</p>	<p>Good sources of information</p> <p>www.manchesterairport.co.uk</p> <p>Environment Plan</p> <p>Noise case study</p> <p>Runway data sheet</p>
35 min	<p>The debate</p> <p>Noise</p> <p>Manchester Airport works hard to minimise noise levels on its neighbours</p> <p>Vs</p> <p>Manchester Airport creates too much noise, and should stop flying at night</p>	

Points to consider:

For

- Noise is monitored by Manchester Airport – aircraft exceeding noise levels on take off are fined and the money is distributed amongst community projects through the Community Fund
- There are Sound Insulation Grant Scheme for those homes most heavily affected by noise
- Economic benefits for the North West region
- Employment – over 19,000 people employed at Manchester Airport
- The motorway network close to Manchester Airport also creates a great deal of noise
- Manchester Airport offers a great access to Manchester and the North West. Would Manchester have been able to host the Commonwealth Games without Manchester Airport?
- No more than 7% of all aircraft movements are allowed at night.

Against

- Manchester Airport makes lots of noise during the day
- No more than 7% of all aircraft movements are allowed at night. This is around 10,150 flights in summer and 3,895 flights in winter
- Sleep disturbance can be detrimental
- Freight aircraft can be very old, large and noisy
- The more flights, the more pollution

Good websites for information:

www.manchesterairport.co.uk

Environment Plan

Noise case study.

55 min	Summarise the main arguments and vote for the most persuasive argument.	
60 min	End	

Recycling

Aims of the session

- To explore salvaging and recycling
- To consider sources of waste

Resources

- Recycling PowerPoint
- Recycling case study

Curriculum areas

- Environmental Science: Pollution

Session outline (60 minutes)

Time	Activity	Resources
Start	<p>Starter</p> <p>In small groups, ask students to discuss why the airport needs to recycle.</p> <p>Environmental plan</p> <p>Savings (cost of landfill is £48 per tonne)</p> <p>And what sorts of materials do they think the airport recycles.</p> <p>Use the PowerPoint to give an overview of the airport's recycling activity or select specific responses from Sue Hodnett's interview.</p> <p>What are the students' views on this?</p> <p>Do they think the airport could do more?</p>	
15 min	<p>Case Study</p> <p>There are two case studies in the waste section of the airport: one describing the airport's response to the liquid ban which generated a huge waste problem over night and a second case study which looks at the design of recycling bins in the airport.</p> <p>Ask students to read the case studies, highlight any key issues, areas that could have been handled better etc.</p> <p>Can they look at how they might introduce a recycling scheme at</p>	<p>Good sources of information</p> <p>www.manchesterairport.co.uk</p> <p>Environment Plan</p> <p>Noise case study</p> <p>Runway data sheet</p>

	school or at home. They could consider a general scheme like the recycling bins or a scheme for one specific material like the liquid ban.	
45 min	Feedback their findings on the case study and their ideas for a recycling scheme at school or at home	
55 min	Vote on the most persuasive scheme	
60 min	End	

Ground Transport

Aims of the session

- To consider sources of air pollution
- To explore transport systems
- To explore awareness raising in the community

Resources

- Web resource, Ground transport section
- Ground transport PowerPoint presentation

Curriculum areas

- Sustainability

Session outline (60 minutes)

Time	Activity	Resources
Start	<p>Starter activity</p> <p>In pairs ask students to consider:</p> <p>What are main limiting factors on the growth of the aviation industry and Manchester Airport in particular?</p> <p>What are the arguments in favour and against airport growth?</p> <p>Ground access is one of the main drivers on airport capacity. If people can't access the airport or the local area the airport can't grow.</p> <p>Is it important for the airport to be able to grow?</p>	
8 min	<p>Research project</p> <p>Run through the PowerPoint presentation which highlights the ground transport issues from the airport's perspective. The last slide summaries the challenges.</p> <p>For more information students can watch the video interview with Bob Longworth and carry out further research.</p> <p>What are the main challenges facing the airport in terms of ground access? Ask students to choose one or two of these challenges and explain how they would tackle these if they were responsible for ground access the airport.</p>	<p>Web resource</p> <p>Ground Transport PowerPoint</p>
45min	Feedback and debate	

60 min	End	

This exercise can be repeated/duplicated at a later stage using the school setting. How might students persuade students and teachers out of their cars?

Further ideas for research and debate

Recycling

Manchester Airport should continue to work with business partners to educate them about recycling

Vs

Manchester Airport should fine on-site businesses which fail to comply with set recycling standards.

Transport

Manchester Airport should continue to improve and market green transport options such as buses, trains, cycle schemes, walking and car sharing

Vs

Manchester Airport should just tell passengers and staff not to bring cars to the airport.

It is the responsibility of passengers to offset the carbon emissions for each flight (including any emissions from ground transport to and from the airport)

Vs

It is the responsibility of the airport and airlines to offset the carbon emissions for each flight.

Climate change

Is it possible to justify an air transport industry in view of all the scientific evidence for climate change?

Personal or corporate responsibility?

Who is responsible for the environmental effects of the air transport industry: airports, airlines, the travelling public?

Young people can use the site to research:

What are the main issues?

Consider the airport's ambition to be carbon neutral by 2015.

What is the young person's view of the topic being debated?

There are number of other sites with differing views that can also be used to research this topic.

Sustainability

What is sustainability? (young people's perspective?)

What would you do to make the Airport sustainable?

What could you do to make your school or college more sustainable?

What is the airport doing to make the Airport sustainable?

- Energy conservation and usage
- Waste Management
- Protection of species
- Working with service partners
- Working with colleagues
- Working with the public

Waste and recycling

Manchester Airport is aiming to increase the amount of waste it recycles from 21% to 40 % by 2015. Read the two case studies. Are there any other major areas of recycling that could be tackled at the airport? How would you persuade service partners to support recycling initiatives?

What are the main sources of waste at school/college. Would it be possible to set up a recycling system at school. What sort of materials could be collected? How would you involve the school community?

Collecting data

The airport collects data to monitor pollutants and to survey passengers and employees.

Young people may like to design surveys to collect data on transport methods to and from school, how many young people have travelled by plane this year, what are their views of the impacts of aviation and how would they be prepared to change their behaviour?

Questions for young people

Why collect data?

What data would you collect?

We would welcome your feedback on the site and any suggestions for project ideas or examples of work that you have carried out.