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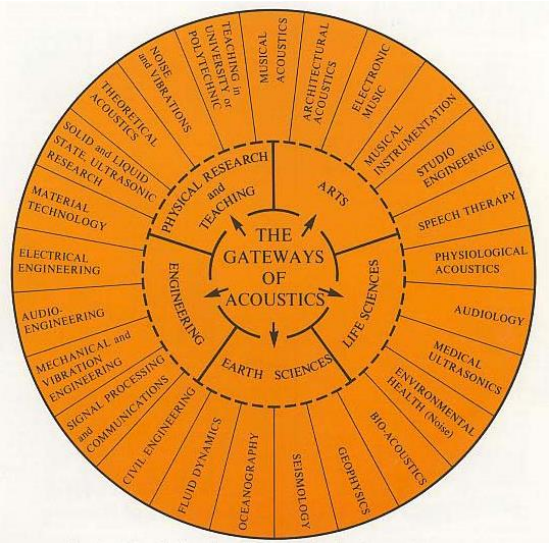
Knowledge Exchange Seminar Series (KESS)

...is a forum that encourages debate on a wide range of research findings, with the overall aim of promoting evidence-based policy and law-making within Northern Ireland



Acoustics for STEM and STEAM

Keith Attenborough

School of Engineering and Innovation

STEM Faculty

The Open University

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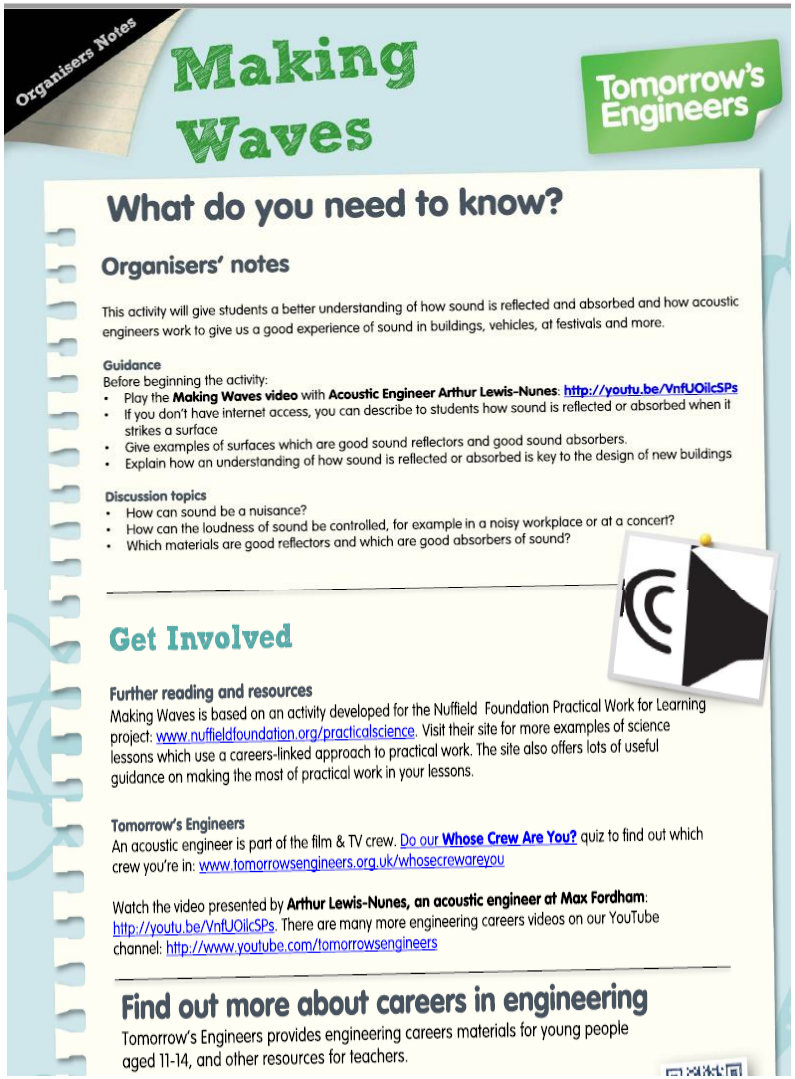
Tomorrow's Engineers

https://www.engineeringuk.com/our-programmes/tomorrows-engineers/

- A programme of co-ordinated schools outreach and careers inspiration.
- Seeks to help young people from all backgrounds to understand the variety, excitement and opportunity presented by a career in engineering.
- The aim is for everyone between 11 and 14 to have at least one engineering experience with an employer and for equal number of girls and boys to aspire to become engineers.
- e.g. Arthur Lewis-Nunes (Max Fordham) talks about *sound design engineering*
- An associated resource for teachers is 'Making Waves' http://www.tomorrowsengineers.org.uk/articles/3558



Organisers Notes

Making Waves

Tomorrow's Engineers

What do you need to know?

Organisers' notes

This activity will give students a better understanding of how sound is reflected and absorbed and how acoustic engineers work to give us a good experience of sound in buildings, vehicles, at festivals and more.

Guidance

Before beginning the activity:

- Play the **Making Waves video** with **Acoustic Engineer Arthur Lewis-Nunes**: http://youtu.be/VnfUOilcSPs
- If you don't have internet access, you can describe to students how sound is reflected or absorbed when it strikes a surface
- Give examples of surfaces which are good sound reflectors and good sound absorbers.
- Explain how an understanding of how sound is reflected or absorbed is key to the design of new buildings

Discussion topics

- How can sound be a nuisance?
- How can the loudness of sound be controlled, for example in a noisy workplace or at a concert?
- Which materials are good reflectors and which are good absorbers of sound?

Get Involved

Further reading and resources

Making Waves is based on an activity developed for the Nuffield Foundation Practical Work for Learning project: www.nuffieldfoundation.org/practicalscience. Visit their site for more examples of science lessons which use a careers-linked approach to practical work. The site also offers lots of useful guidance on making the most of practical work in your lessons.

Tomorrow's Engineers

An acoustic engineer is part of the film & TV crew. Do our **Whose Crew Are You?** quiz to find out which crew you're in: www.tomorrowsengineers.org.uk/whosecrewareyou

Watch the video presented by **Arthur Lewis-Nunes, an acoustic engineer at Max Fordham**: http://youtu.be/VnfUOilcSPs. There are many more engineering careers videos on our YouTube channel: http://www.youtube.com/tomorrowsengineers

Find out more about careers in engineering

Tomorrow's Engineers provides engineering careers materials for young people aged 11-14, and other resources for teachers.

Acoustical determination of water surface roughness

audible surface waves

Acoustic-Seismic coupling

Outdoor sound propagation

Non-invasive soil monitoring; buried landmine detection

Locating Acoustic and Seismic sources

Acoustical monitoring of bone

Plasma loudspeakers

Laser-generated high-intensity acoustic pulses

Additive manufacture of sound absorbers and insulators

Noise surveys

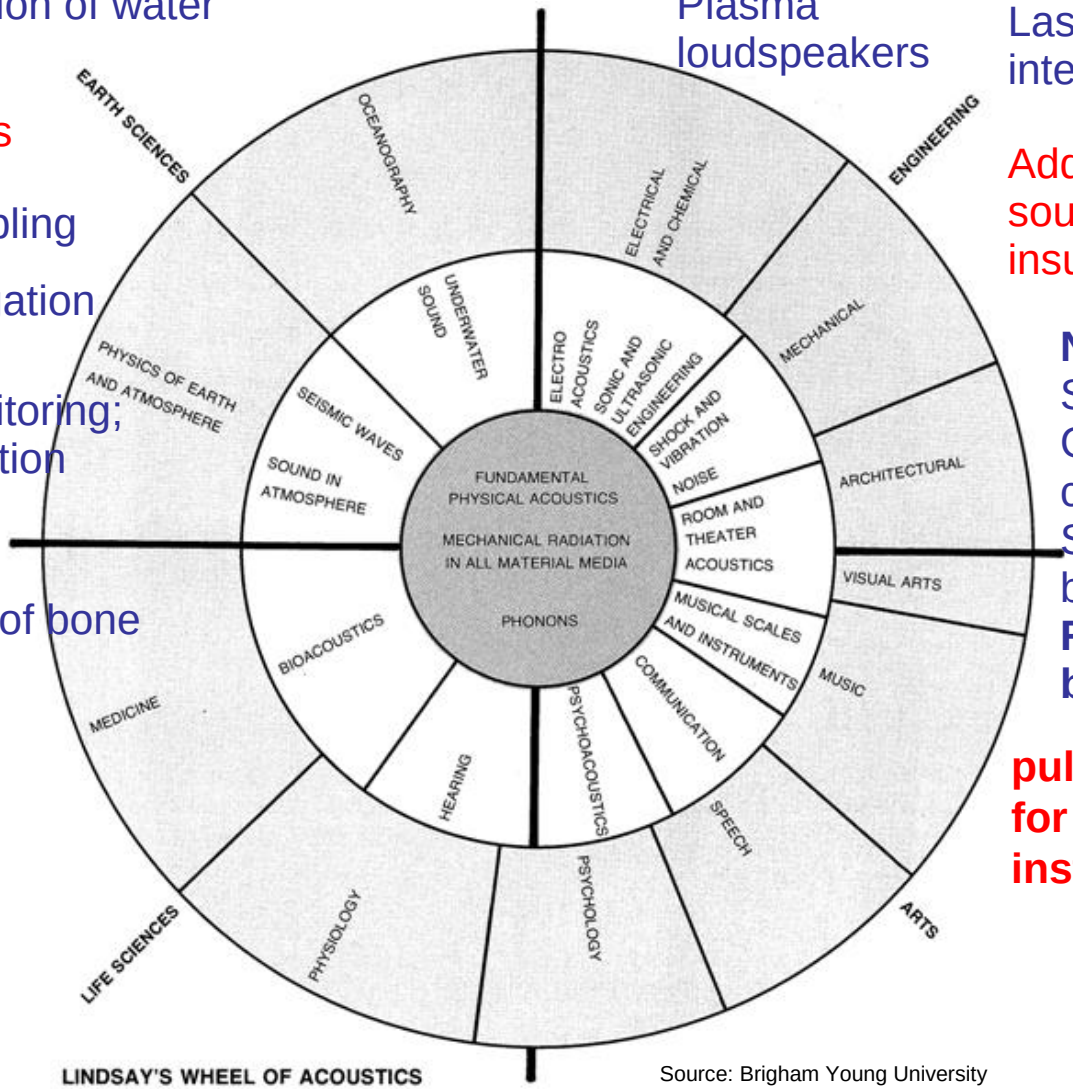
Sound in forests

Greening for noise control

Sonic crystal noise barriers

Rough surface barriers

pulse reflectometry for checking instruments



Source: Brigham Young University

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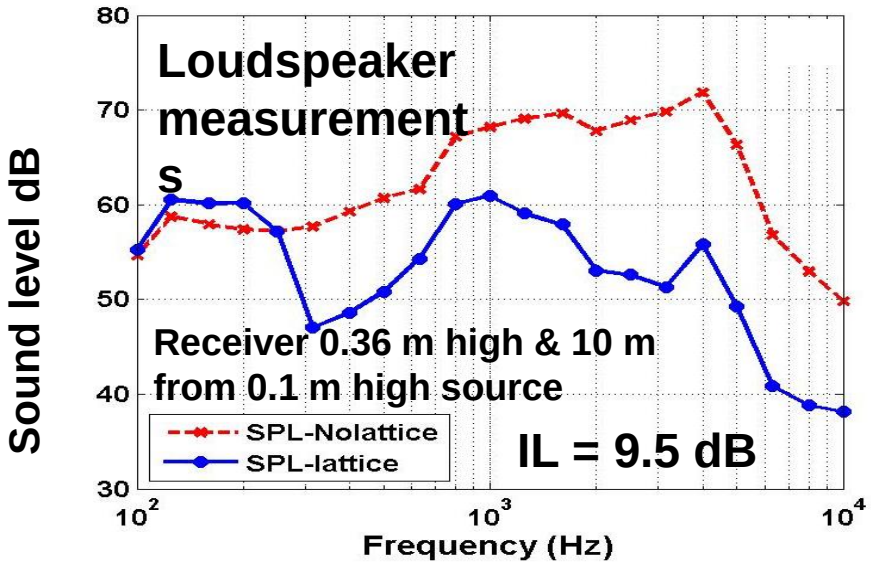
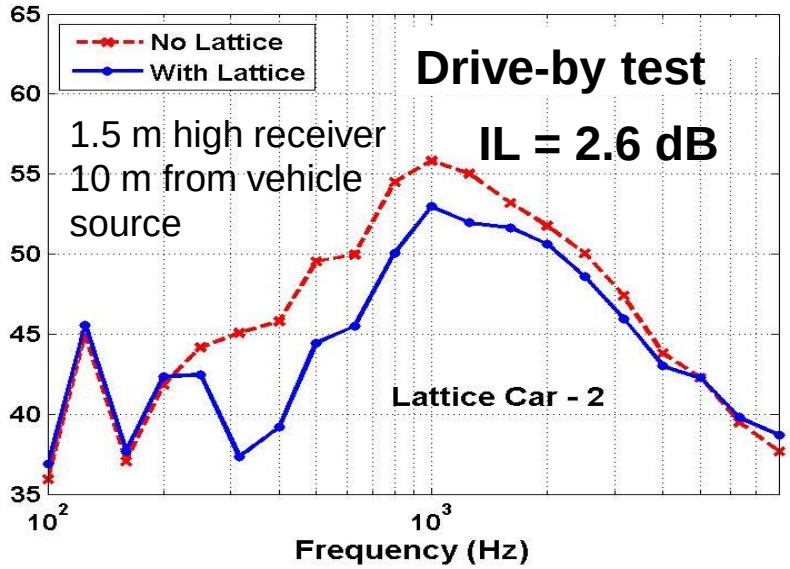
Roughness-based noise control

16 m long 2.3 m wide 0.2 m high lattice with 9 × 0.064 m thick rows, 0.28 m centre-to-centre spacing





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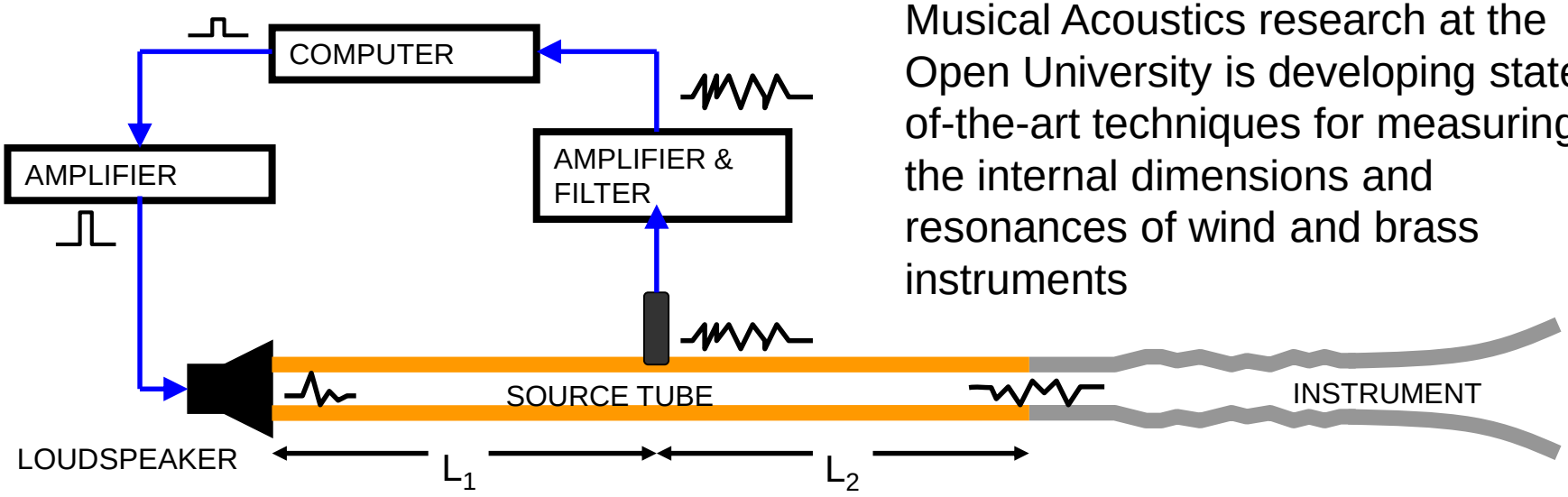
I Bashir et al *Reduction of Surface Transport Noise by Ground Roughness* Applied Acoustics, (2014)

~3 dB is a noticeable reduction

Pulse Reflectometry for Musical Instrument testing



Musical Acoustics research at the Open University is developing state-of-the-art techniques for measuring the internal dimensions and resonances of wind and brass instruments

- Measurements are used along with psychoacoustical testing to relate acoustical characteristics to playing properties.
- Also a real-time computer analysis system and both artificial and human 'blowing' are used for testing wall vibrations with different materials.

Acoustics Engineering Technician

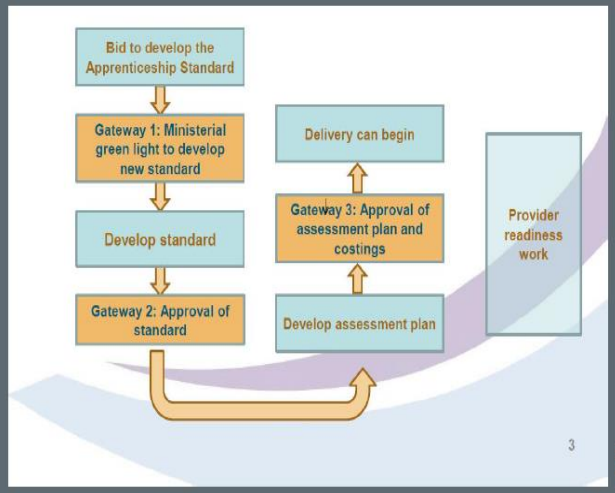
A Working Group, chaired by Richard Grove (BDP) have drafted a standard for a Level 4 Acoustics Engineering Technician standard which has been accepted by the Government's Trailblazer group.

The Benefits

- Increasing the profile of Acoustics in both education and the public eyes
- Increasing the number of candidates
- Combined vocational and campus based learning
- BTEC Level of learning leading to degree level in conjunction with lead provider
- Defined path to Engineering Council recognition of EngTech grade
- A clear training scheme for people coming into acoustics from other industries

BDP.

The Process



BDP.

- Architectural and Environmental acoustics technician
- Acoustics laboratory technician
- Acoustics calibration engineering technician
- Junior environmental health officer for noise
- Acoustics design technician
- Digital Signal Processing (DSP) technician

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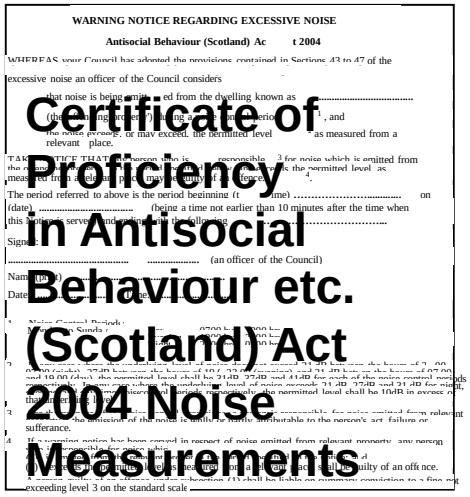
IOA EDUCATION & TRAINING

Certificate of Competence in Building Acoustics Measurements


WARNING NOTICE REGARDING EXCESSIVE NOISE

Antisocial Behaviour (Scotland) Ac t 2004

Certificate of Proficiency in Antisocial Behaviour etc. (Scotland) Act 2004 Noise Measurements

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Schools activity – ‘You’re Banned’ – sound insulation experiment

- Pupils are asked to investigate the sound proofing of a rock band’s practice room using a model test frame and sheets of various materials while working within a budget.
- Each group of up to six pupils is given a test rig consisting of a drum and bass simulator, together with a framework into which they can fit a range of “costed” materials of differing density and absorption characteristics such as foam, sheet steel, plywood, hardboard, plastic and wadding.
- Each team gives a presentation explaining their choices and costing.
- The chosen design is tested in front of everyone.
- Each team’s design is scored and the winning design presented with a ‘prize’ and certificate.

Acoustics and Music Education

"Musicians create sound for a living. It's shocking that we are not better educated in the science of sound"
Georgia Browne, Senior flutist performer and flute teacher, Birmingham Conservatoire

- Only 3 out of 71 Higher Education institutions providing music education in the UK include any teaching and learning in acoustics.
- Courses should cover the nature of sound, the auditory system, hearing conservation, psycho-acoustics, acoustics of performance spaces and musical acoustics.
- An online survey of 31 institutions (including the most prominent) and a follow on in-depth interview with 21 senior academics strongly supports the introduction of acoustics teaching into music education
- Control of Noise at Work Regulations (2005): music training should convey the significant hearing risk incurred by the music profession.

Contact: Luis Gomez-Augustina (gomezagl@lsbu.ac.uk) at London South Bank University

Acoustics teaching at *Ulster University*

Ulster University BSc Environmental Health
teaching ranges across several areas including: - Food Safety, Microbiology, **Acoustics and Noise Control,** Statutory Nuisance, Housing, Regulatory Frameworks, and general Environmental Health.

Environmental Protection: Strategies for Sustainable Development
This module enables the student to explore interventions aimed at reducing and mitigating the impacts …of environmental protection stressors in relation to housing air, water and land and **the acoustic environment**, ….

Acoustics and Noise Control teaching has also been delivered to courses across the **School of the Built Environment** including Construction, Design and Management, Building Surveying, and Civil Engineering.

Acoustically-related Research at *Queens*

Past research in the Mechanical Engineering concerned acoustical design of generator sets – There's no current research in that department

http://www.qub.ac.uk/sites/drone/

Sonic Arts Research Centre
Founded in 2001, the SARC is a globally recognised institute for music-based practice and research, broadly conceived.

http://www.qub.ac.uk/Study/Course-Finder/PCF1718/PTCF1718/Course/ArtsandHumanitiesMResPGCert.html

The third talk today is clearly related to current thinking and research in respect of Soundscapes

Recomposing the City: How Sound Can Make Better Cities - How can sound artists, architects and planners working in collaboration generate new ways of analysing, understanding, and transforming urban spaces?

The following talk from QUB about **designing the built environment for autistic people** and will surely also touch on the **acoustic environment**

Concluding remarks

- Acoustics rarely features in school teaching or in university physics and engineering curricula.
- Acoustics offers opportunities for teaching and learning at all stages of education and for research.
- Sound can be used to exemplify aspects of waves in the GCSE physics syllabus and noise can be part of environmental studies.
- Acoustically-related research topics at the Open University include outdoor sound prediction, soil science, early diagnosis of osteoporosis and musical instrument technology.
- Musical acoustics gives a basis for introducing Arts into STEM curricula.
- Acoustics is a basis for introducing a STEM flavour into Arts (Music) education.

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