



Post-visit
resource
for teachers



The Music Show



Supplementary information for teachers whose classes have experienced the Shell Questacon Science Circus Shows

Thank you for hosting a team from the Shell Questacon Science Circus. We hope you enjoyed our visit.

Our science shows are designed to educate and entertain. We trust they sparked your students' curiosity and you are keen to extend the show experience with activities.

Enclosed is information to supplement your own ideas and resources on how to follow-up our visit.

THE MUSIC SHOW

This show aims to excite an interest in the science of sound. The demonstrations stimulate thought on the way sound is generated and transmitted. Concepts highlighted in the show relate to many experiences of everyday life. There is a special emphasis on music.

Show Summary

The Music Show is varied according to the level of audience and presenters' selection from a range of activities. A summary of demonstrations and concepts most often included in the show follow. The order, variety and number of activities vary from show to show.

Arm flapping and wobbly jelly

Sound is explained as being caused by vibrations. Vibrations can be described as a "wobbles in space and time" or as "when something moves back and forth". Flapping arms or wobbly jelly exemplify vibration.

Wobble boards and voice boxes

A number of demonstrations are used to visu-

alise the concept of vibration e.g. a wobble board; a tuning fork touched on water or a ping pong ball. Fingers placed on the throat feel vibrations in the larynx during speech. The vibration frequency determines if audible sound is produced. Between 20 and 20,000 vibrations per second produce sounds which most humans can hear. The higher the vibration frequency, the higher is the pitch of the sound.

People as particles

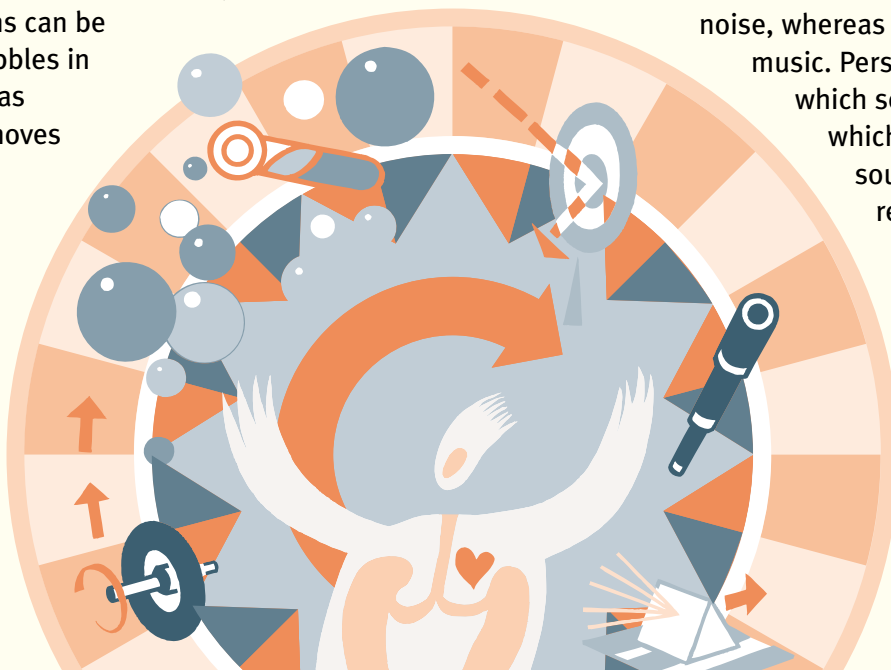
Transmission of energy as a wave is simulated using people. Each person represents a particle of matter. If a person at the end of a queue of several people in close contact is pushed, a wave of compression is generated. The person at the other end is eventually forced to wobble by energy which moves through the row of people. Similarly, sound consists of pressure waves which are patterns of compression and rarefaction which travel outward from their vibrating source. Individual particles move back and forth, but the sound only moves away from the source. A slinky is used to visualise the concept of sound waves moving away from their source.

Music or noise?

Music is sometimes described as "organised noise". The distinction between noise and music is subjective. Noise and music are both sound. We can investigate the difference by visualising sound as waves. Sound can be analysed in terms of waves with different frequencies measured in vibrations per second (Hertz or Hz). We hear certain combinations of frequencies as noise, whereas others we hear as music. Personal taste decides which sounds are noise and which are music, but sounds which have regular, predictable patterns are often perceived as music. Musical terms such as scales, notes, pitch and tone can be interpret-



Resonance can set objects vibrating a long distance from the sound source



ed by physics in terms of sound energy and waves. e.g. the note 'A' around which scales are based, is a sound wave of 440 Hz.

Musical coat-hangers

A coat-hanger and two pieces of string are used to show that sound moves through different media at different velocities. When heard via the air, a tapped coat-hanger sounds tinny and unimpressive. When heard via a solid such as string, a tapped coat-hanger sounds like a huge bell.

Tuning forks and clucking cups

A simple box and rubber bands (or a tuning fork and a table or something similar) show that sound can be amplified by forcing vibrations to develop in a large solid or body of air. Instruments such as the guitar or violin make use of this principle. The 'clucking cup' demonstrates amplification. A small piece of wet sponge is moved along a string attached to a plastic cup. Vibrations travel along the string and force the cup and the air in it to vibrate. A loud clucking sound is produced.

Singing chimney

The end of a metal pipe is held just above a Bunsen burner for a short time. It is removed and held vertically. A loud, eerie sound is produced. This effect is a spectacular example of resonance. The column of air in the pipe is isolated so its pressure can fluctuate. The fluctuations produced by the turbulent updraft of hot air result in forced vibrations of the column of air. These vibrations are affected by the natural frequencies of the air column.

Homemade music

A variety of different instruments are used to demonstrate different aspects of music. A favourite is the musical straw. The length of straw is shortened to produce a change in pitch. The pitch of sound corresponds to its wave frequency. High frequencies produce a high pitch. Low frequencies produce low pitch. As the straw is shortened, the pitch increases. 'Bottle organs' and 'thongaphones' also demonstrate the affect of changing pitch.

Safety caution and disclaimer

Questacon shows have been developed to be presented by science communicators with technical training. It is not implied by the provision of these notes or the show performance that the demonstrations are safe for untrained people to perform.

Scientific principles demonstrated in the Music Show

- Sounds are produced by the vibration of objects.
- Sound is a form of energy.
- Sound vibrations generate pressure waves in the air or other media.
- All sounds are caused by vibrations but not all vibrations cause sound.
- The pitch of sounds is determined by the frequency of waves.
- The loudness of sound is determined by the amplitude (size) of the waves
- Sound can travel through solid, liquid or gas but not through a vacuum. The type of material affects the speed at which sound travels.
- Every object has its own natural set of frequencies.
- Resonance occurs when an object is forced to vibrate at one of its own natural frequencies. This causes the sound to become much louder.

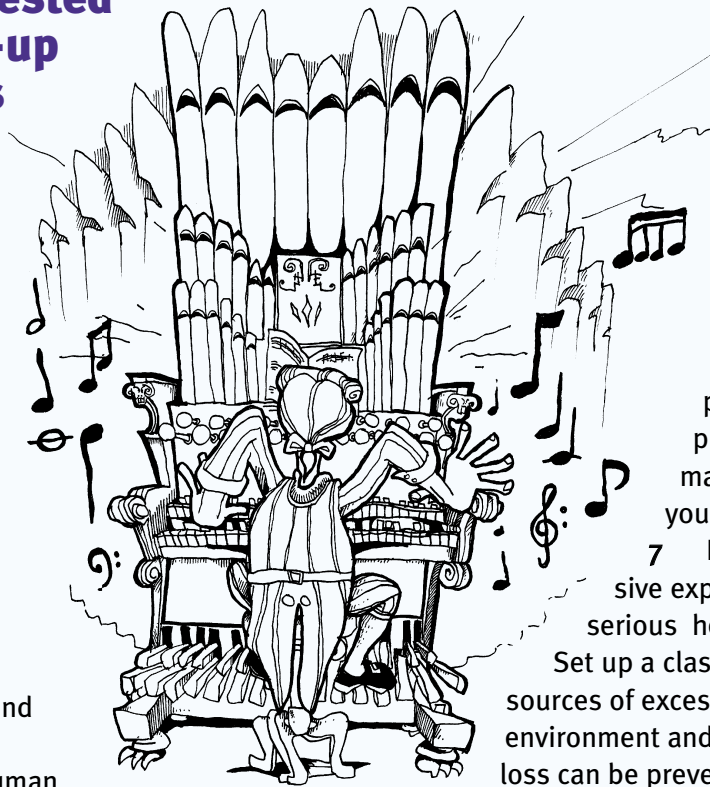


*Music or noise?
Individual perception
makes this a
subjective decision.*



Suggested follow-up activities

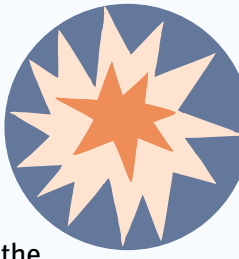
- 1 Review the Science Circus presentation by having your students describe their favourite demonstration from The Music Show. The Show Summary in this document may be useful for this exercise.
- 2 Ask students to explain and discuss other examples from their own experiences where they have heard or experienced any of the ideas about sound or music seen in the show.
- 3 Discuss or indicate human inventions or natural phenomena from your local area which are applications of the science in the show. For example, sound reduction technology in buildings or vehicles; bat sonar; megaphones; musical instruments. Think about and discuss how these things work. Follow-up with library and Internet research.
- 4 Humans have invented musical instruments of numerous shapes and sizes in different parts of the world throughout history. Set a design project for your students to devise and perhaps build a model of a completely new kind of musical instrument.
- 5 Provide time and materials for students to explore and extend their knowledge of how resonance and amplification are needed to enable musical instruments to work.
- 6 Ask students to devise and carry out their own experiments on music and other sounds. Divide your class into groups (research teams) of 3 for experiment planning. You may like to allocate specific roles eg recorder, equipment manager, communicator within each group. Emphasise the cooperative nature of laboratory work. Teamwork is essential in science! Include a good



The awe-inspiring sound of an organ is generated by vibrating air columns

Did you know?

The Fairlight Computer Musical Instrument (music synthesiser) is an Australian invention. The first Fairlight was made by Kim Ryrle and Peter Vogel in the mid 1970's. The Fairlight digitises sound and enables people to digitally create new sounds or modify sounds from other sources. The Fairlight combines a keyboard, a video graphic display monitor and a 'light pen' to draw music on a monitor screen. The Fairlight was named after a Sydney Harbour ferry. (Reference: McPhee, M.(1993) The Dictionary of Australian Inventions and Discoveries)



reader in each group. Safety is paramount in any project.

Textbooks and the Internet are useful starting points. Encourage students to gather as much information as they can before they begin to do anything. Before any practical work begins, provide a few, basic project management guide lines for your students.

- 7 Hearing loss due to excessive exposure to loud sounds is a serious health problem in Australia. Set up a class research project on sources of excessively loud sounds in our environment and methods by which hearing loss can be prevented. Extend this research to technology and techniques used to overcome deafness e.g. the Australian invention, the cochlear implant (bionic ear)

- 8 Look for science activities and demonstrations on the Questacon Web site.

Visit <http://www.questacon.edu.au/>

- 9 For senior secondary students) Extend studies of the use of computer technology to the production and recording of music.

- 10 Initiate discussion on the general contribution of science and scientists to our culture, economy and environment. For example:

- discuss or find examples of how science and technology have improved our standard of living. There are numerous examples including more productive crop plants; more effective medicines; new and better materials and processes; faster and more reliable communication and information technology; more effective ways of identifying and treating environmental problems; better food production, processing and storage; cleaner and more efficient mineral extraction methods.

- research the lives and achievements of some of Australia's past and present outstanding scientists. There are numerous people who could be included. eg Graeme Clark; Macfarlane Burnet; Carolyn Mountford; Gustav Nossal; Peter Doherty; John Eccles; Mark Oliphant; Don Metcalfe; Frank Fenner; William Farrer; Peter Medawar; Kate Helms; Helen Newton Turner; Howard Florey; Nancy Millis; Ernest Titterton; Bede Morris; Nancy Burbidge; Paul Wild; Susan Serjeantson; Peter Bishop; Elizabeth Truswell; and Kerin O'Dea.

11 Arrange an excursion to Questacon: Australia's leading interactive science and technology centre-Questacon in Canberra. Exhibitions are constantly changing. There are remarkable exhibits which enable you to experiment with the science of sound. For example, there is the fascinating light harp which enables you invent your own music by breaking beams of light! There are numerous other fascinating exhibits which model scientific concepts, natural phenomena and inventions. Tel. (02) 6270 2893 for group bookings.



Student and teacher resources

There are many resources available for inspiration and information. Some of our favourites which contain up to date ideas are:

- *Questacon Exsciter Science kits*. These contain numerous tried and tested ideas and materials for hands-on activities. Tel (02) 6270 2807 for details.
- *Questacon's award winning web site:* <http://www.questacon.edu.au/>
- *Ingenious CD* Tel. (02) 6270 2807 for details
- *Questacon Mag* Tel. (02) 6270 2855 for subscription details
- *Australian Science (incorporating Search)* Tel. (03) 9824 1699 for subscription details
- *Science Australia* by the Curriculum Corporation (national secondary science texts) Tel 1800 337 405
- *Primary Investigations* by the Australian Academy of Science (national primary science texts) Tel (02) 6247 5777 for a free information package.
- *New Scientist* Tel 1300 360127 for subscription details
- *Scientriffic magazine* Tel. (02) 6276 6643 for subscription details
- *The Helix magazine* Tel. (02) 6276 6643 for subscription details
- *Australian Innovation Magazine* Department of Industry, Science and Resources GPO Box 9389 Canberra ACT Australia 2601 Tel. (02) 6213 6304 or fax (02) 6213 6818
- *Australian Academy of Science web site:* <http://www.science.org.au/nova/>
- Contact ASTA, PO Box 334 Deakin West ACT 2600 Tel (02) 6282 9377 email: asta@asta.edu.au for information about professional associations.
- An extensive range of kits, books and fascinating science teaching resources are available from the Questacon shop in Canberra or by mail order from Questacon, King Edward Terrace, Canberra ACT 2600 Request a catalogue by Fax (02) 6273 5100 or Tel (02) 6270 2807.

Try this!

You will need water in a container and a small soft drink bottle. Blow across the top of the empty bottle. A sound with a particular pitch is produced. Predict what will happen to the pitch as water is poured into the bottle. Will it increase or decrease? Test your prediction with an experiment. Repeat the procedure, but this time, produce the sound by tapping the bottle with a spoon or a similar object.

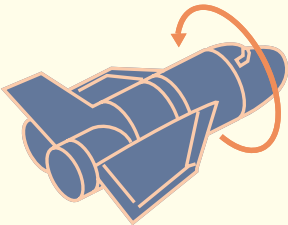
National curriculum links

Presentations are adjusted to the age and level of audience. Accordingly, curriculum links will also vary. The following table indicates a range of outcomes* which can be achieved with the content of The Music Show.

STRAND	Energy and Change	Natural and Processed Materials	Working Scientifically
OUTCOMES* linked to the Music Show	1.4 1.5 1.6 2.5 3.5 4.6	1.11 2.10 4.10 5.10 7.10	1.15 1.16 1.17 2.17 4.16 4.17 4.18

*Cross reference to Science-a curriculum profile for Australian schools (1994) Curriculum Corporation

Topics relevant to the music show include the nature of matter, energy transfer or transformation, energy in different forms, sound- pitch and loudness, sound and vibration.



Key terms and concepts

sound, noise, energy, music, vibration, waves, resonance, transmission, energy, wavelength, amplitude, frequency, particles, loudness, pitch, amplification

The Shell Questacon Science Circus

The Shell Questacon Science Circus is one of several national Outreach Programs of Questacon–The National Science and Technology Centre. It is staffed by science graduates who are completing a Graduate Diploma in Scientific Communication at the

Australian National University. The Science Circus takes the fascination and enjoyment of science throughout Australia by exhibiting in public venues and presenting shows in schools and other community places. Our other Outreach Education Programs include the Questacon Science Squad, Questacon Maths Centre, Starlab and NRMA RoadZone. Information about our Outreach Programs can be obtained by phoning (02) 6270 2820 or by visiting our Internet site <http://questacon.edu.edu.au>



Hearing loss is a major health problem in Australia. Excessively loud music can permanently damage the inner ear.