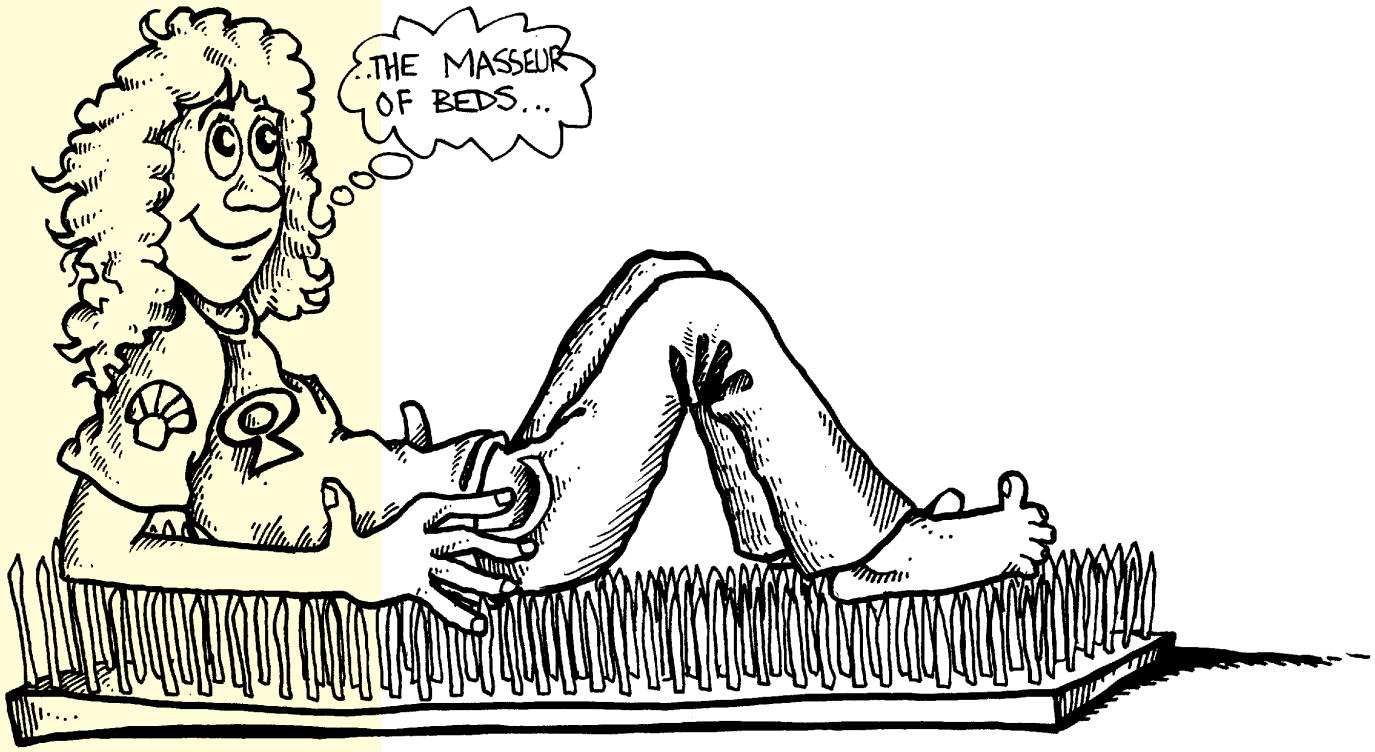
Shell Questacon Science Circus

THE AUSTRALIAN NATIONAL UNIVERSITY

Post-visit resource for teachers

The Pressure 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. Did they spark your students' curiosity?

If so, you may be keen to extend the show with more activities. Enclosed is information to supplement your own ideas and resources with which to follow-up our visit.

The Pressure Show

This show aims to excite an interest in something which affects every living and non-living thing—pressure. The demonstrations help to illustrate scientific properties of pressure in an entertaining way and motivate your students to extend their own knowledge by scientific inquiry.

We usually take atmospheric pressure on our bodies for granted. On a spacewalk, astronauts would instantly explode without their pressure suits.

Show summary

The content of the Pressure Show varies considerably depending on the presenter's choice of demonstrations, time available, age of audience and available materials. Demonstrations most likely to be included in the show are:

Hold this brick
This demonstration illustrates the definition of pressure as the amount of force per square unit area. A force is applied via a nail, to a brick, then to a volunteer's hand, the pressure at any one point is small. If the same force is applied with the brick and nail reversed, all the force is applied through one point, increasing the pressure.

Walking on bubble wrap
Japanese shoes, high heels or a bucket on the foot demonstrate the pressure applied on the bubble wrap. The Japanese shoes or heels will pop the bubble wrap due to the smaller surface area of the shoe whereas the bucket won't pop any.

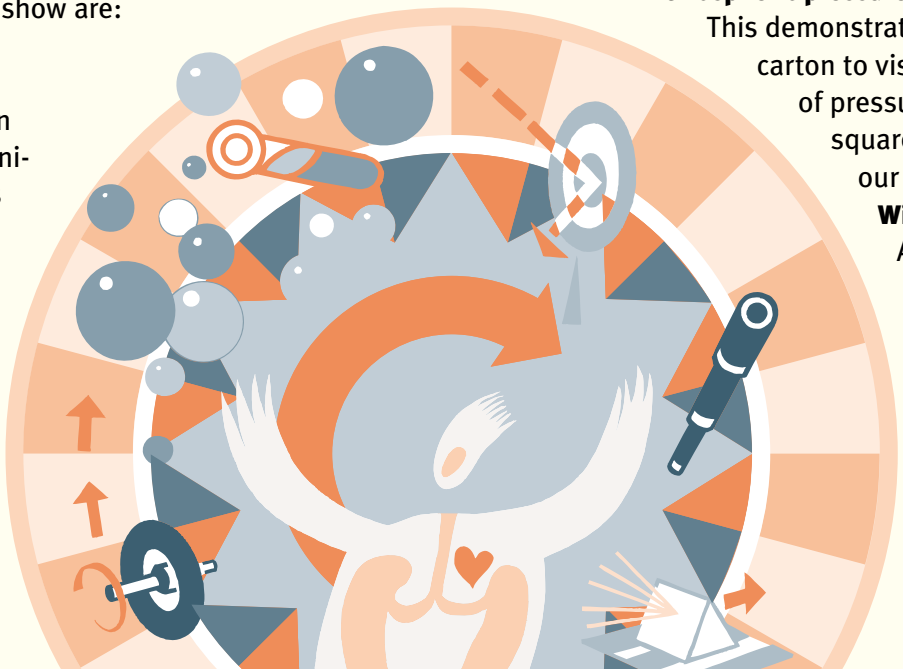
Bed of nails
This is a famous demonstration of the relationship of force, pressure and area. This is sensory comparison of the effect of sitting on numerous nails or just one nail! When the force is spread over many nails, the pressure on any one point is greatly reduced.

Leaky bottle
A plastic bottle full of water and with two holes in the side is used as evidence of how pressure increases with the depth of water. The stream of water from the lower hole appears to exit further, evidence that the lower layer of water is under greater pressure.

Lifting a book with lungs
To demonstrate that even though we can't see air, it can also exert pressure. An inflating balloon is used to lift a book.

Atmospheric pressure
This demonstration uses a milk carton to visualise the amount of pressure acting on each square centimetre of our bodies.

Without spilling a drop
Atmospheric pressure doesn't only push down. It acts in all directions. A



dramatic example of this is an inverted glass filled with water apparently contained only by a card.

Newspaper under pressure

The force exerted by atmospheric pressure is enough to hold a piece of newspaper flat while a ruler sticking out from under it is snapped.

The bathmat!

Was is it pushed or pulled? A bathmat does not stick to a surface. It is pushed onto the surface by atmospheric pressure if air is forced from under the suction caps.

Plunger and glazier's grips

These devices are used to illustrate a vacuum and differences in pressure. The plunger pushes air out from under the rubber cup, producing a lower pressure than outside the cup that feels like a suction or a vacuum between it and the table. The higher pressure on the outside pushes the plunger onto the table.

Drinking through a straw

Drinking through a straw seems simple enough but actually uses differences in pressure and atmospheric pressure to push liquid up through the straw.

Egg in a bottle

A burning paper in a bottle heats the air in the bottle, causing air to expand and pushing some of it out. The hard boiled egg prevents any more air entering the bottle so when the air cools again and starts to contract, a lower pressure is created in the bottle. The higher pressure outside the bottle then pushes the egg in.

Marshmallow astronauts

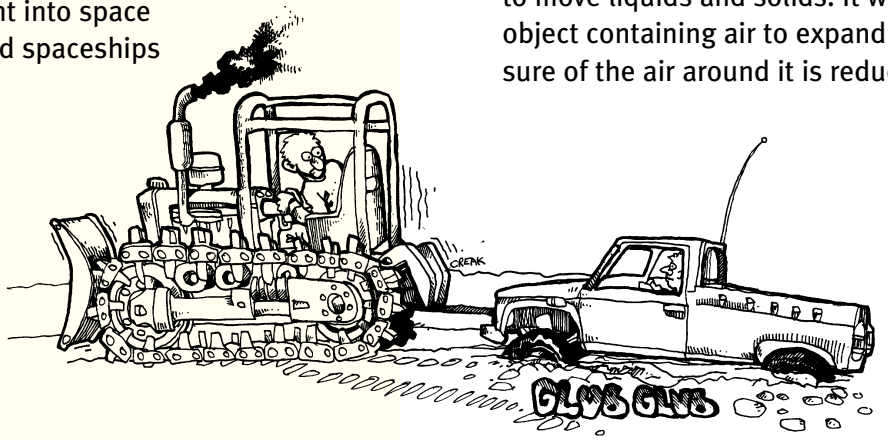
A marshmallow has air in pockets within it. When it is placed in a flask and the air is removed, a reduction in pressure causes it to expand. This is an illustration of what would happen to us if we went into space without properly sealed spaceships or spacesuits.

Safety caution and disclaimer

This show has been developed to be presented by scientists with technical training. It is not implied by the provision of these notes or the show performance that the demonstrations are safe for students or teachers to perform. Teachers should carry out their own health and safety assessments of materials and techniques before using them

Scientific principles demonstrated in the Pressure Show

- pressure is defined as force per square unit area. The important components of pressure therefore are the size of the force as well as how much area it is applied over.
- the effect of a force is minimised if it is applied over a large area and is maximised if it is applied over a smaller area.
- pressure can be exerted by solids, liquids and gases. Liquids and gases are collectively called fluids.
- fluids in a container exert forces against the walls of that container and on anything floating or immersed in the fluid.
- fluids exert pressure which increases with depth. This is because the weight of the upper layers pushes down on the lower layers, increasing their pressure.
- the atmosphere is constantly exerting a sizeable pressure on us. Atmospheric pressure at sea level is approximately 10N per square centimetre. This is approximately equal to the weight of a full l litre milk carton.
- atmospheric pressure acts in all directions, as does pressure in any fluid.
- when you remove air from something, but maintain the same volume, the pressure inside is reduced. Increasing the volume of a fixed mass air also decreases the pressure. Air at a higher pressure outside will push towards the lower pressure.
- the movement of air from an area of high pressure to an area of low pressure can be used to move liquids and solids. It will also cause an object containing air to expand when the pressure of the air around it is reduced.



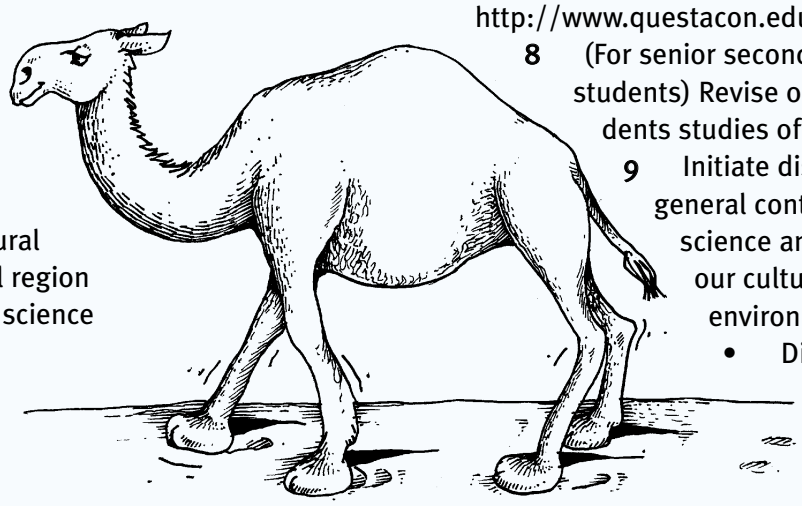
Caterpillar tracks reduce pressure by spreading the vehicle's weight over a larger area.

Suggested follow-up activities

1 Review the show by having students describe their favourite demonstration from the Pressure Show and explain what it showed.

2 Ask students to explain and discuss other examples (from their own experiences) where they have experienced or used pressure.

3 Discuss or indicate products, industries or natural phenomena from your local region which exemplify any of the science or technology in the show. For example, the change in pressure when you fly or go under water; compression of gases for storage; weather patterns.



A camel's large feet spreads the animal's weight over a greater area than would small, cloven hoofs. The same weight over a larger area means less pressure and makes it easier for the animal to walk on soft surfaces.

4 As astronauts travel toward space, the air pressure becomes less and less. Set a research project for your students to find out what mechanisms are used to counteract this lower pressure in spacecraft and spacesuits. They could also devise and perhaps build a model of a spacecraft.

5 Provide time and materials for students to extend their knowledge of some of the phenomena, concepts and inventions mentioned in the show. Examples include movement of air between regions of different pressure; decompression chambers used for divers with the bends; ways of reducing the pressure exerted by an object.

6 Ask students to devise and carry out their own experiments on pressure. 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, as is safety! Include a good reader in each group. 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 guidelines for your students.

7 Look for science activities and demonstrations on the Questacon Web site. Visit http://www.questacon.edu.au

8 (For senior secondary students) Revise or extend your students studies of the gas laws.

9 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.
- Discuss past and present examples of people being curious about nature and how scientific study is one way of satisfying our curiosity. For example, compare ancient and modern ways of explaining and studying the weather or the night sky.
- Discuss the skills we need to develop for doing experiments. For example, observing, imagining, recording, discussing, interpreting, and designing are a few of the things we need to practice in science. Model building is one of these skills.
- Research the lives and achievements of some of Australia's past and present outstanding scientists. There are numerous people who could be included. eg Macfarlane Burnet; Carolyn Mountford; Gustav Nossal; Peter Doherty; John Eccles; Mark

Did you know?

The inflatable escape slide raft for aircraft emergency landings is an Australian invention. It was invented in 1965 by Jack Grant, Operations Safety Superintendent for Qantas. Slide rafts are now standard equipment on all major world airlines. Slide rafts are an excellent example of technology based on the science of pressure. They operate when aircraft doors are opened in an emergency. They automatically inflate with gas from pressurised bottles.

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.

10 Arrange an excursion to Questacon: Australia's leading interactive Science and Technology Centre is Questacon in Canberra. Exhibitions are constantly changing. There are numerous other fascinating exhibits which model scientific concepts, natural phenomena and inventions. Tel. (02) 6270 2893 for group bookings.

Try this!

Weigh yourself in Newtons (1kg = 10N). Trace around your feet on 1cm X 1cm graph paper and calculate the area covered by your feet. Use these two measurements to work out how much pressure your body is exerting when you are standing. Use the formula: pressure (Pa) = (weight (N) X 10 000) area (sq. cm). You may also like to calculate how much pressure you exert when you sit on a chair or when you stand on tip-toes.

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.

National curriculum links

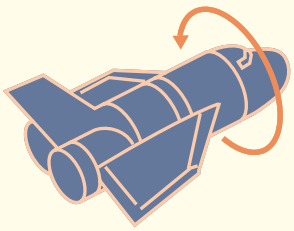
Presenters vary the show according to the age and level of audience. Accordingly, curriculum links will also differ on each occasion. The following table indicates which outcomes can be achieved with the Pressure Show depending on the level and content that is emphasised.

Key scientific words and concepts

Pressure, force, liquids, air pressure, solids, atmospheric pressure, high pressure, gases, low pressure, area, volume, vacuum, outer space, boiling points

STRAND	**Earth and Beyond**	**Energy and Change**	**Natural and Processed Materials**	**Working Scientifically**
OUTCOMES* linked to The Pressure Show	1.1, 2.1, 4.1, 4.2, 5.3	5.6	4.11, 1.12	2.13, 2.14, 1.15, 3.15, 1.16, 1.17, 2.17, 2.18

*Source: Science – a curriculum profile for Australian schools (1994), Curriculum Corporation.



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

Nature never sucks! The drink is pushed through the straw by atmospheric pressure when it is greater than pressure inside the mouth. Fluids flow from an area of high pressure to an area of low pressure.

Text: Graham Smith and Danielle-Louise Quinn
Line drawings: Ed Radclyffe
Design: Stephen Cole