Shell Questacon Science Circus

THE AUSTRALIAN NATIONAL UNIVERSITY

Post-visit resource for teachers

The Bubble 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 Bubble Show

Bubbles are intriguing to people of all ages. This show experiments with detergent films to discover what we can learn from bubbles. In the process it examines a broad range of scientific concepts such as surface tension, elasticity, adhesion and cohesion.

Show summary

The content of The Bubble Show varies depending on the presenter's choice of demonstrations, time available, age of audience and available materials. Our favourite demonstrations are summarised here.

(Not) Making bubbles with water
Water has strong cohesive forces and tends to cling together, making it impossible to stretch across a frame to form a bubble film.

Many foods are built from bubbles. Bread, beer, marshmallow, souffles, omelettes, cakes are just a few examples.

Bubbles
Adding detergent to water weakens its tendency to stick together. This allows it to stretch across a bubble frame and make bubbles.

Bubble trampoline
A demonstration of the elasticity of a detergent film. The film will always contract to the smallest possible surface area.

Jumping string
This is another demonstration of the previous concept. A thread tied loosely in a bubble frame, so that it can move freely, will divide a detergent film in two. When the lower side film is popped, the string jumps as it pulls upwards to create a new minimal surface area.

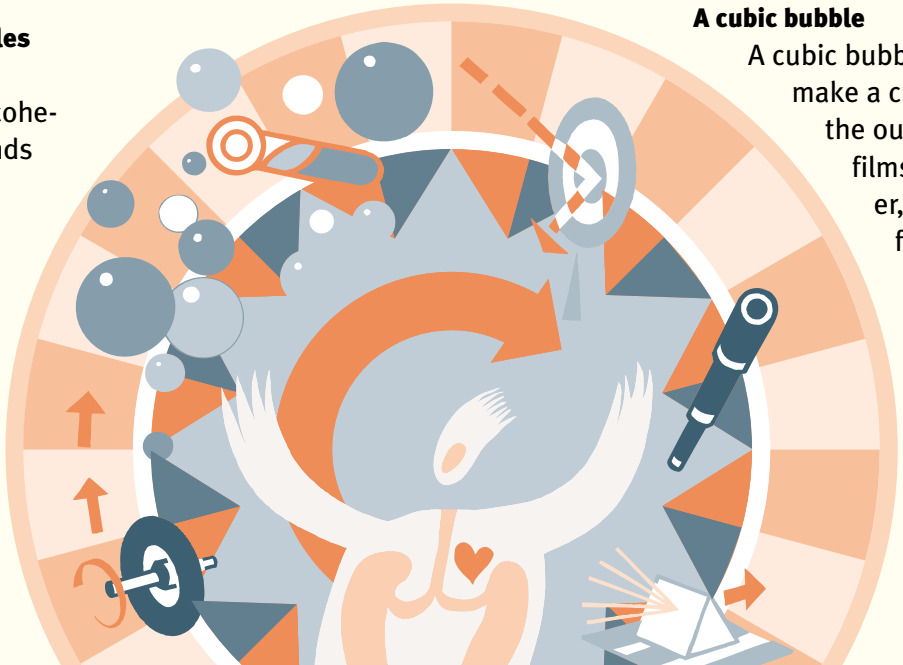
Bubble trumpet
The bubble trumpet also demonstrates how a detergent film always returns to its smallest possible surface area.

More bubbles
When enough air gets inside a detergent film, the film closes on itself and forms a bubble. This is a result of the film again stretching over a minimal surface area.

Popping bubbles
A bubble bursts when it meets anything dry or when it dries out. In humid conditions, bubbles last a lot longer.

Different shaped bubbles
A number of different shaped bubble frames are used to make bubbles but they are always spherical. This is because a sphere has the smallest surface area: volume ratio.

A cubic bubble
A cubic bubble frame appears to make a cubic bubble. When the outside detergent films are popped however, the inside bubble is found to be spherical. It appears cubic when the outside films stretch and distort it.



Coloured bubbles
The layers of detergent and water in the bubble's film, and its variable thickness, cause light to separate into the colours of the spectrum.

Home-made bubble makers
Many items from around the home can be used to make bubbles.

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

Foam to smother fires is an example of bubbles being put to use on a large scale.

Scientific principles demonstrated in The Bubble Show

- water has strong cohesive forces. ie. It is attracted to itself and tends to cling together. For this reason, water on its own will not stretch to form a film or bubble.
- adding detergent to water weakens its tendency to stick together and allows it to form a film. This property of being more stretchy is due to a reduction of the surface tension.
- apart from reducing the surface tension of water, detergent molecules also add stabilising elastic properties to the liquid structure. After a detergent film stretches it can also contract to the size it was before.
- detergent films are elastic and will always minimise their surface area. As it takes energy to stretch a film, when released a film will return to a contracted, low energy state.
- the spherical shape of bubbles is due to a balance between the air inside the bubble pushing out and the films tendency to reduce its surface area pushing in.
- for a given volume, a sphere is the shape with the least surface area.
- the detergent film of bubbles consists of a thin layer of water molecules sandwiched between two thin layers of detergent molecules. When the water layer evaporates the bubble pops.
- light waves are reflected by both the inside and outside surfaces of the bubble film. This results in some wavelengths cancelling each other out, producing iridescence or the colours in bubbles.

Suggested follow-up activities

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

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

3 Discuss or indicate products, industries or natural phenomena from your local area which exemplify any of the specific science in the show. For example, where detergents are used in industry or in the home; pond creatures and their adaptations; froth flotation; volcanic rocks.

4 Bubbles are always fun. Students could be challenged to design a way of producing the largest bubble or the bubble that lasts the longest without popping. To do this they would have to take into account the properties of bubbles and the perfect conditions for producing them.

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 other bubbles, apart from those produced with soap; surface tension; diffraction of light and the colour spectrum.

6 Ask students to devise and carry out their own experiments on bubbles or surface tension. 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 reader in each group. Safety is paramount in any science project, especially experiments with chemicals, including detergents. 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.

Did you know?

In the late 1970s, John Ralston of the Department of Applied Chemistry at the Swinbourne Institute of Technology, invented a surface tension meter. The meter has been used internationally in the manufacture of soaps, detergents, paints, glues and perfumes.

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

8 (For senior secondary students) Extend studies of surface tension and molecular structures.

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.
- 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 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!

Making bubbles is always fun!
We recommend using a mixture of three parts detergent (Morning Fresh seems to make the best bubbles) to seven parts warm water plus one part glycerine. Give it a good, slow stir and let it sit for as long as possible before use. You could also investigate surface tension. Sprinkle pepper onto the surface of some water. Add a small drop of detergent or soap and watch what happens! The soap reduces the surface tension of the water, causing the pepper to scatter.

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 Bubble Show depending on the level and content that is emphasised.

Key scientific words and concepts

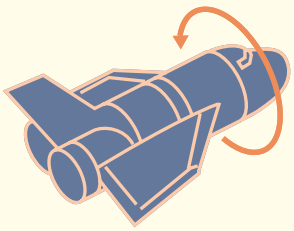
Bubbles, detergent films, molecular attraction (hydrophilic behaviour) of water, elasticity, spheres, surface tension, water molecules, shapes of bubbles, surface area, reflection and diffraction of light, area minimisation, evaporation, iridescence.

STRAND	**Energy and Change**	**Natural and Processed Materials**	**Working Scientifically**
OUTCOMES* linked to The Bubble Show	2.5	3.10, 4.10, 1.11, 2.11, 3.11, 4.11, 1.12	2.13, 2.14, 1.15, 1.16, 2.16, 3.16, 1.17, 2.17, 2.18

*Cross reference to 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



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