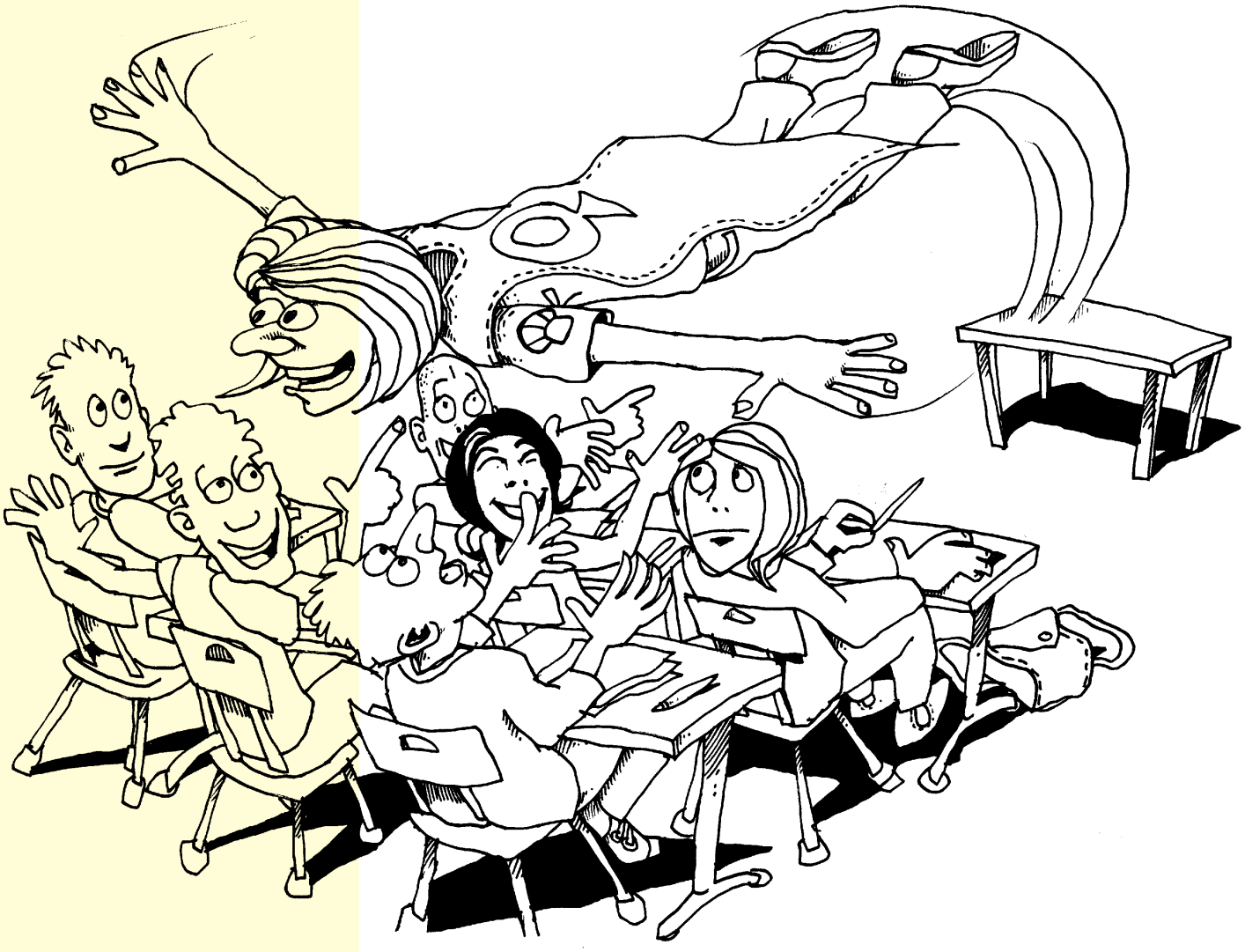
Shell Questacon Science Circus

THE AUSTRALIAN NATIONAL UNIVERSITY

Post-visit resource for teachers

The Flight 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?

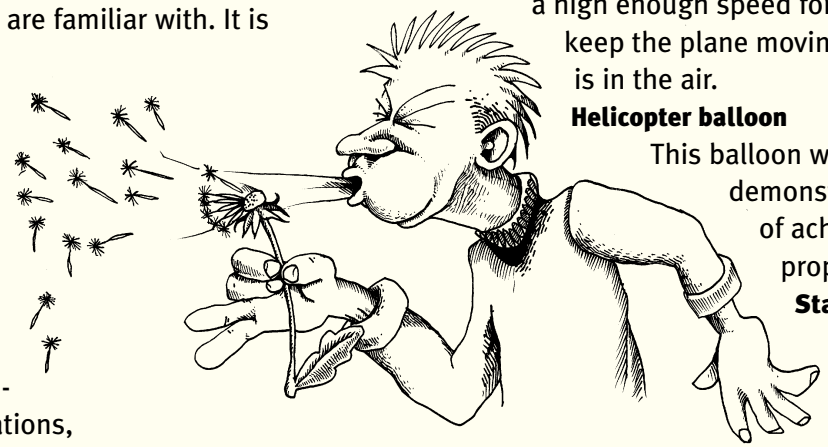
If so, you may be keen to extend the show with more activities. Enclosed is information to supplement your own ideas and resources with which to follow-up our visit.

The Flight Show

This show explores the fascinating principles of flight. The demonstrations illustrate various scientific aspects of flight which are relevant to phenomena most people are familiar with. It is intended to motivate students to explore the science of flight.

Show summary

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



Plants use flight to spread seeds

Tea bag rocket
An empty tea bag is burnt. As it burns, it heats the air inside it. This lowers its density and causes it to rise. Objects that are lighter than air tend to rise and float. This demonstration shows that hot air is less dense than cold air.

Blowing across paper
Fast moving air is at a lower pressure than slow moving air. This demonstration is a simple way of illustrating how differences in air pressure can cause lift.

Aerofoil
This demonstration experiments with a model aeroplane wing. The top of an aerofoil is curved while the bottom is flat.

Model aeroplane
A model is used to experiment with flight. It may be used to show the angle of attack of the wing, which is important for lift and flight. Another factor needed to achieve lift is speed and this is also demonstrated with the model aeroplane.

Rocket balloons
Different types of balloons may be used to demonstrate propulsion and Newton's Third Law. Propulsion is necessary to get the plane to a high enough speed for lift off and also to keep the plane moving forward once it is in the air.

Helicopter balloon
This balloon with rotor blades demonstrates another way of achieving lift and propulsion.

Starglider
Flaps on the wings of an aeroplane called ailerons are used to manoeuvre the aircraft. This glider has flaps to demonstrate how this is achieved. The model aeroplane may also be used to show where the various steering mechanisms are situated.

Prop top
Angling the prop top demonstrates how a helicopter manoeuvres.

Air resistance and parachutes
These experiments are used to illustrate how a greater surface area catches more air, slowing an object's fall by creating drag.

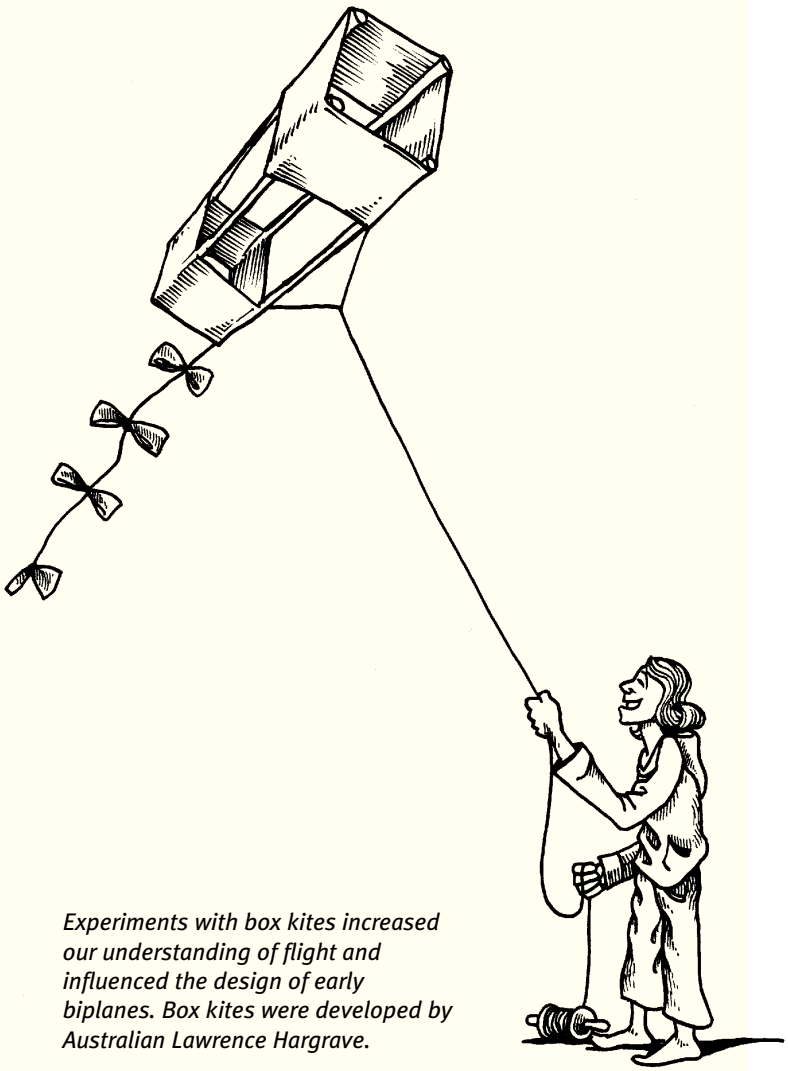
Whirlygigs
This is another simple model to show how larger surface areas catch more air and fall more slowly.

Seed dispersal
Many seeds have shapes designed to use air or wind for their dispersal.

Helium and hydrogen balloons
This demonstration extends the concept of objects lighter than air floating. Both helium and hydrogen are lighter or less dense than air. Helium is often used in balloons and blimps while hydrogen is no longer used as it is highly explosive!

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

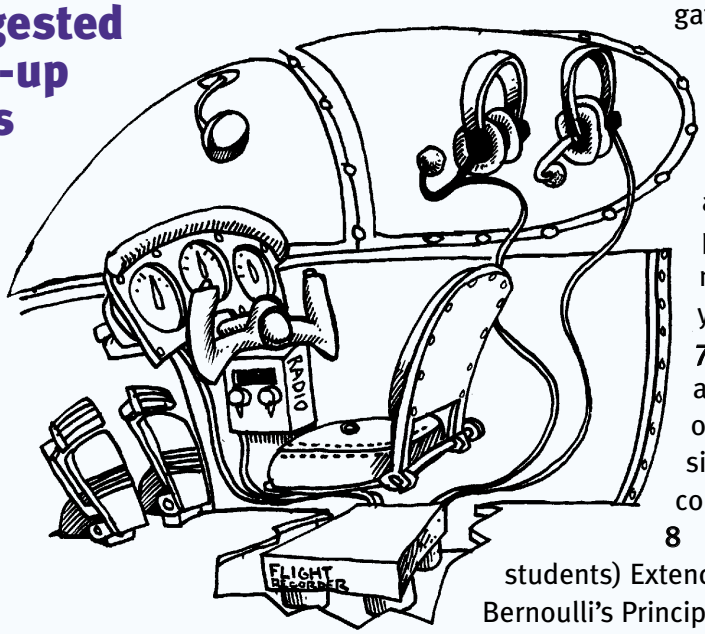


Experiments with box kites increased our understanding of flight and influenced the design of early biplanes. Box kites were developed by Australian Lawrence Hargrave.

Scientific principles demonstrated in the Flight Show

- density is a function of volume and mass. Hot air, helium and hydrogen are all less dense than cool air and therefore they float.
- fast flowing air has a lower pressure than slow moving air. This is known as Bernoulli's Principle.
- different explanations can be given for how wings provide lift. This is an interesting example of science in action. Observations can be interpreted in different ways.
- air will always move from an area of high pressure to an area of low pressure, as demonstrated when you release the valve of a tyre and the air rushes out. The relatively slow moving air under a wing is at a higher pressure than the faster moving air above the wing. As this air moves upwards towards the area of lower pressure, it creates lift.
- differences in pressure alone are thought not to be enough to generate lift for flight. The wing's angle of attack, or the angle at which it meets oncoming air, is also very important.
- Newton's Third Law states that 'every action has an equal and opposite reaction'. Propulsion demonstrated with balloons is an example of this. As air rushes out one end, it pushes the balloon in the opposite direction.
- helicopter blades also have an aerofoil shape and are set at an angle of attack. When they rotate, lift is generated across the blades. Helicopters also rely on blasting air downwards so they move upwards (Newton's Third Law again).
- the manoeuvring sections on aeroplanes, the ailerons, elevators and rudder, all rely on deflection of air. For example, when both aileron flaps are bent upwards, air travelling over the wing hits the flap and is forced upwards. This in turn pushes the back of the aircraft down and tilts the nose up.
- when an object falls , it accelerates due to gravity until it reaches terminal velocity. This is the point where the object stops accelerating due to air resistance.
- objects with a large surface area will catch more air and will fall more slowly than objects with a small surface area. Parachutes are designed to maximise air resistance.

Suggested follow-up activities



Black box flight memory recorders are carried on all commercial aircraft to automatically record flight information. Australian Dr David Warren invented the black box recorder but it was commercially developed by British and American companies.

1 Review the show by having students describe their favourite demonstration from The Flight 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 the principles of flight.

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, plants in the area with wind-dispersed seeds; aircraft at the local air field; local flying or gliding animals.

4 The history of flight can be fascinating, especially when compared to today's technology. Students could be asked to look at different aircraft designs and perhaps model the principles used and simple improvements.

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 speeds required for take-off; angles of attack; other uses of air resistance and how it is reduced when speed is required.

6 Ask students to devise and carry out their own experiments on flight. 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) Extend studies of air pressure and Bernoulli's Principle.

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?

In 1914, Australian inventor David Unaipon used the principles of boomerang flight to anticipate the invention of the helicopter. He invented an improved handpiece for sheepshearing, a centrifugal motor and a multi-radialwheel. David of the Ngarringdjeri people was the first Aboriginal writer to be published

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!

Make a simple paper aeroplane. Make flaps on the wings and investigate what happens when both flaps are up, both flaps are down, and when one flap is up and the other is down. Try investigating aeroplanes of different sizes and shape, or with different types of flaps.

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

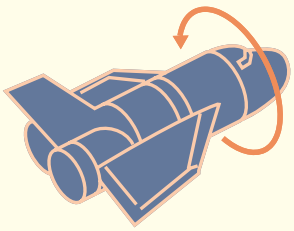
Presenters vary the show according to the age and level of audience. Accordingly, curriculum links will also differ on each occasion. The following table indicates which outcomes can be achieved with The Flight Show depending on the level and content that is emphasised.

Key scientific words and concepts

flight, lift, buoyancy, thrust, air resistance, gravity, force, drag, air pressure, fuel, low pressure, density, high pressure, aerofoil, angle of attack, propulsion, deflection, Newton's Third Law, manoeuvring, surface area

STRAND	**Energy and Change**	**Working Scientifically**
OUTCOMES* linked to The Flight Show	1.4, 5.4, 1.5, 2.6, 5.6	1.13, 1.15, 2.15, 3.15, 1.16, 2.16, 3.16, 1.17, 2.17

*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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