Shell Questacon Science Circus

THE AUSTRALIAN NATIONAL UNIVERSITY

Post-visit resource for teachers

Balancing the Improbable

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.

Balancing the Improbable

This show investigates balance points (the centre of mass) of objects. The demonstrations are exciting and present a number of scientific concepts that are easily related to things and events we see every day.

Show summary

The content of Balancing the Improbable varies depending on the presenter's choice of demonstrations, time available, age of audience and available materials. Following is a summary of demonstrations usually included in the show.

Timber lift
An audience member picks up a length of timber near its centre. This is a simple demonstration of how we recognise the position of balance points and their usefulness almost subconsciously.

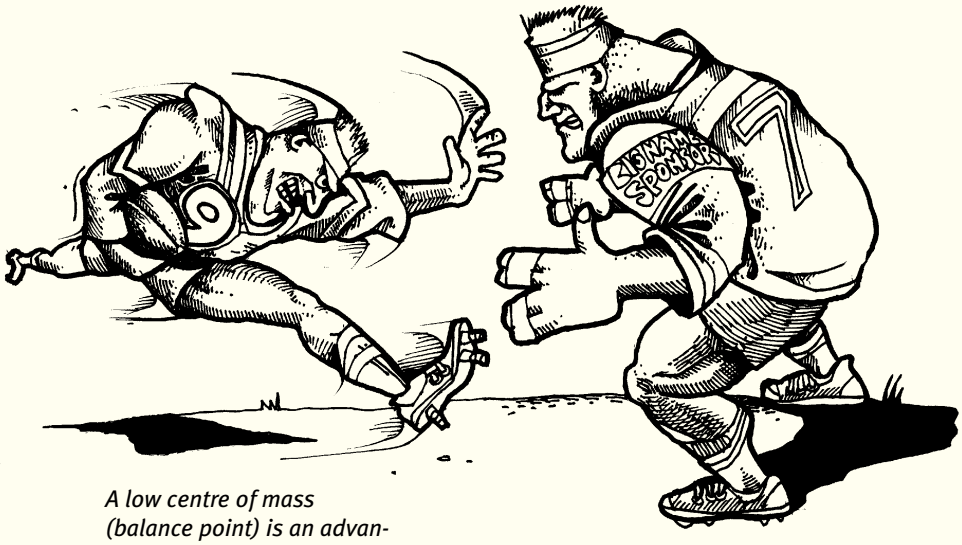
Pick up sticks
A number of different shaped sticks are used to demonstrate what the balance point of an object is and a simple method of finding it.

Australia in the balance
A solid template of Australia is used to show how to find the centre of mass (balance point) of an irregularly shaped object. This will always align itself somewhere directly below the hanging point of the object.

Boomerang
A similar demonstration to Australia in the Balance. It shows that the balance point of an object does not always lie inside the material of the object.

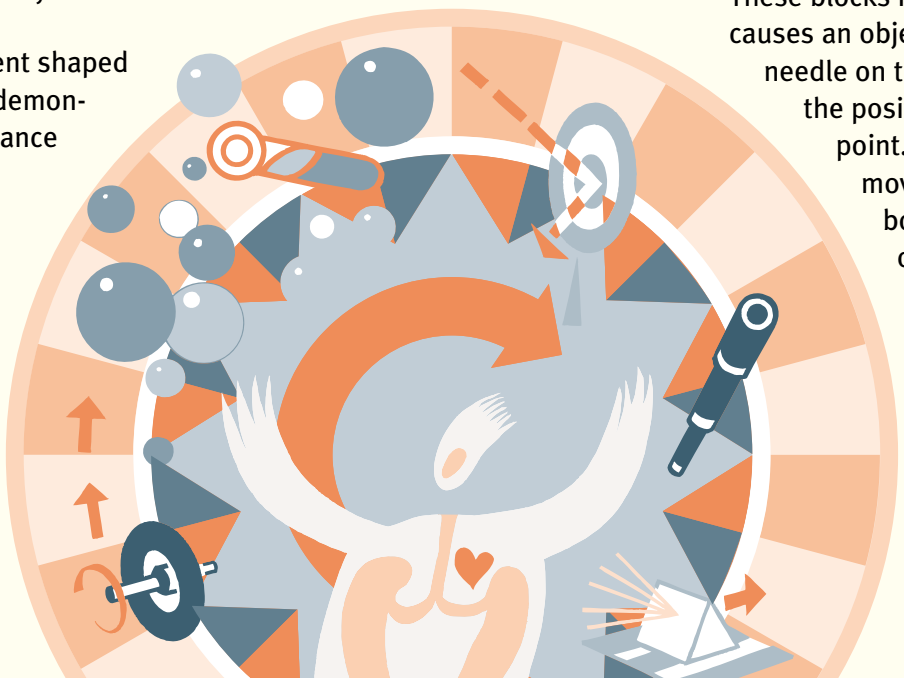
The death defying Barbie bike
A Barbie Bike with attached weights is used to show how the location of an object's balance point can affect its overall stability.

Perched parrot
A wooden parrot is used to demonstrate the difference between balancing and hanging. The lump of plasticine is used to lower the centre of mass below the perch or point of support. When the parrot is hanging, it is more stable.



A low centre of mass (balance point) is an advantage in sports such as rugby and sumo wrestling.

Tipping blocks
These blocks illustrate what causes an object to topple. The needle on the block indicates the position of the balance point. When this point moves outside the bounds of the object's support base, the object topples.



Sumo wrestler
A sumo wrestler spreads his legs wide and crouches before he clashes with his opponent. By widening his support base and lowering his balance point, a sumo wrestler makes himself as stable as possible.

Toddlers and golf sticks:
The presenter asks the audience to visualise the toddlers taking their first steps. It is explained that to walk or remain upright, we must learn to keep our balance point within the area of our support base or we will fall over. Moving balance points must remain above their support base or they will topple. This is demonstrated by balancing a golf club, broom or similar object on a hand or finger.

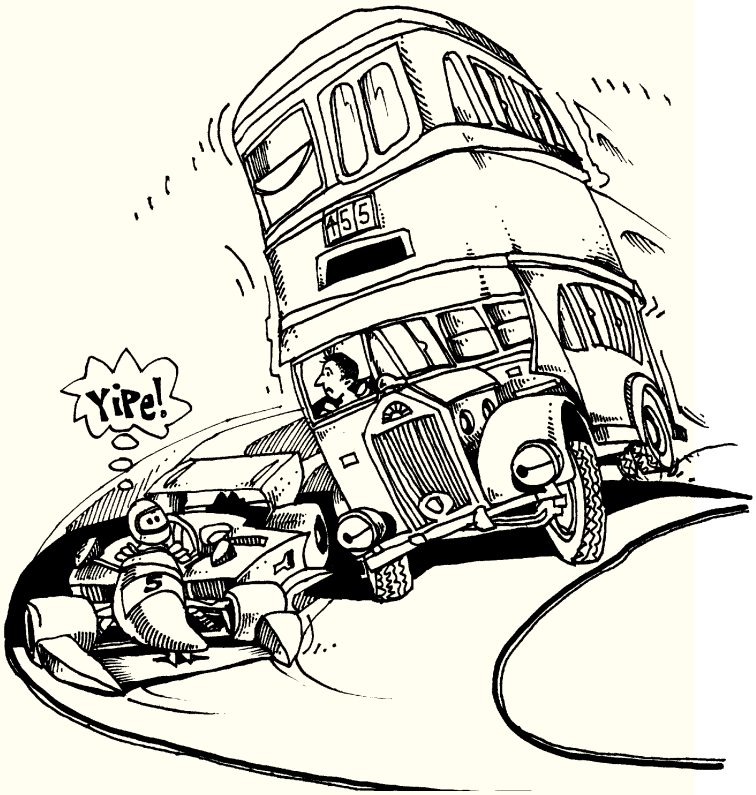
Toppling males
This demonstration is used to focus on the variable location of the centre of mass in men and women. Usually, when the male volunteer tries to touch the matchbox with his nose, he falls over, while the female will generally have more success. This is due to men tending to have a higher balance point than women.

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 Balancing the Improbable

- every object has a point through which its mass seems to be concentrated. This is called the centre of mass, centre of gravity or balance point of the object.
- the position of an object's centre of mass determines its stability. In turn, the object's centre of mass is determined by its shape and where most of its mass is situated.
- the further away from the centre of mass an object is picked up, the greater the force required to hold it up due to the turning effects created by gravity pulling the object downwards.
- when the balance point of an object is below its point of support, it is said to be hanging rather than balancing.
- the balance point of an object will always move to the lowest possible position. This principle is used to build tall yet stable buildings or to keep tall vehicles such as double decker buses stable. Such structures are made stable by locating the balance point at the lowest point possible.
- when an object is launched, its centre of mass will travel in a smooth parabolic path. A ball weighted on one side will wobble as it flies through the air. As the balance point follows this path, the rest of the ball moves around this point, creating the wobbling effect.



Vehicles topple if their balance point moves beyond their base. How can designers reduce the chance of this happening?

Suggested follow-up activities

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

2 Ask students to explain and discuss other examples (from their own experiences) where they have relied upon balance or been affected by it.

3 Discuss products, industries or natural phenomena from your local area which exemplify any of the specific science in the show. For example, the structure of tall towers; the position of motorcycle racers turning a corner; high jumpers and the Fossbury Flop; where signs are situated warning trucks to slow down. Setting up a display of toys which rely on the physics of balance points is fun and informative.

4 Stability is very important in most sports, including motor sports. Ask your students to investigate the features of various vehicles and perhaps design a racing car for optimum stability.

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 properties that make a structure stable; the effect of altering an objects centre of mass; how the build of various animals affects their behaviour.

6 Ask students to devise and carry out their own experiments on balance. 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.

Did you know?

The returning boomerang devised by Australian Aboriginal people can provide a fascinating way to study balance points and flight. When thrown, the boomerang first travels in a vertical plane. It then sweeps upwards in a horizontal plane to fly in a large circle as well as several smaller circles before dropping to ground near the thrower.

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

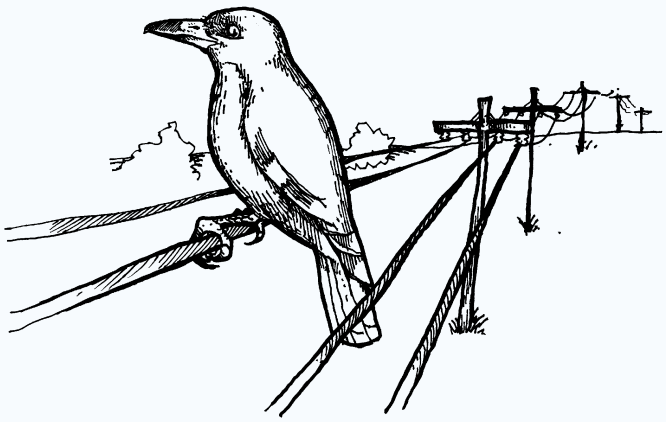
8 (For senior secondary students) Extend studies of centres of mass; the relationship between balance point and the path of a flying object.

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 a number of remarkable exhibits which are exciting examples of balance and stability. For example, there is an exhibit called Balancing Nails which provides an excellent challenge that draws on the concepts covered in this show. There are numerous other fascinating exhibits which model scientific concepts, natural phenomena and inventions. Tel. (02) 6270 2893 for group bookings.



Watch a bird sitting on a power line. They prevent toppling by adjusting their balance point using the position of their tail and head.

Try this!

Here's a challenge! Get a cork and push a pin halfway into the top of it. Can you balance the cork on the pinhead on the top of an upturned glass? It's pretty tricky! To make it easier, stick a fork in either side of the cork so that the handles hang below the pin. You should now be able to balance the toy - even if you tip it or spin it! Think of ways to use this idea to design and create your own toy.

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 Balancing the Improbable depending on the level and content that is emphasised.

STRAND	Life and Living	Working Scientifically
OUTCOMES* linked to Balancing the Improbable	1.8, 2.8	1.13, 1.15, 3.15, 1.16, 2.16, 3.16, 1.17, 2.17

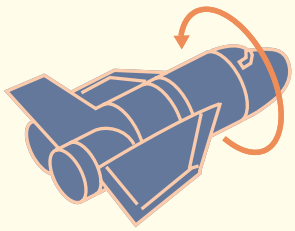
*Cross reference to Science-a curriculum profile for Australian schools (1994) Curriculum Corporation

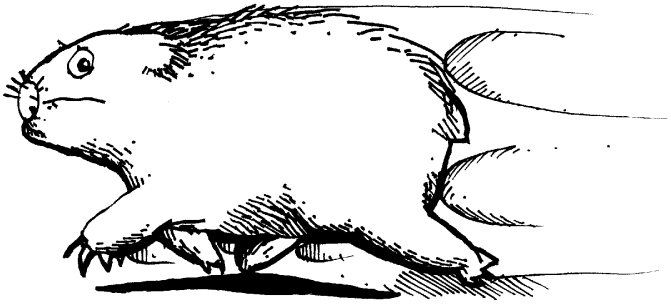
Key scientific words and concepts

balance, balance point, centre of mass, support, support base, point of support, hanging, hanging point, centre, friction, weight, stability, topple, parabola, parabolic path

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





A wombat has a low centre of mass. Would it be more or less likely to topple than a brolga?

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