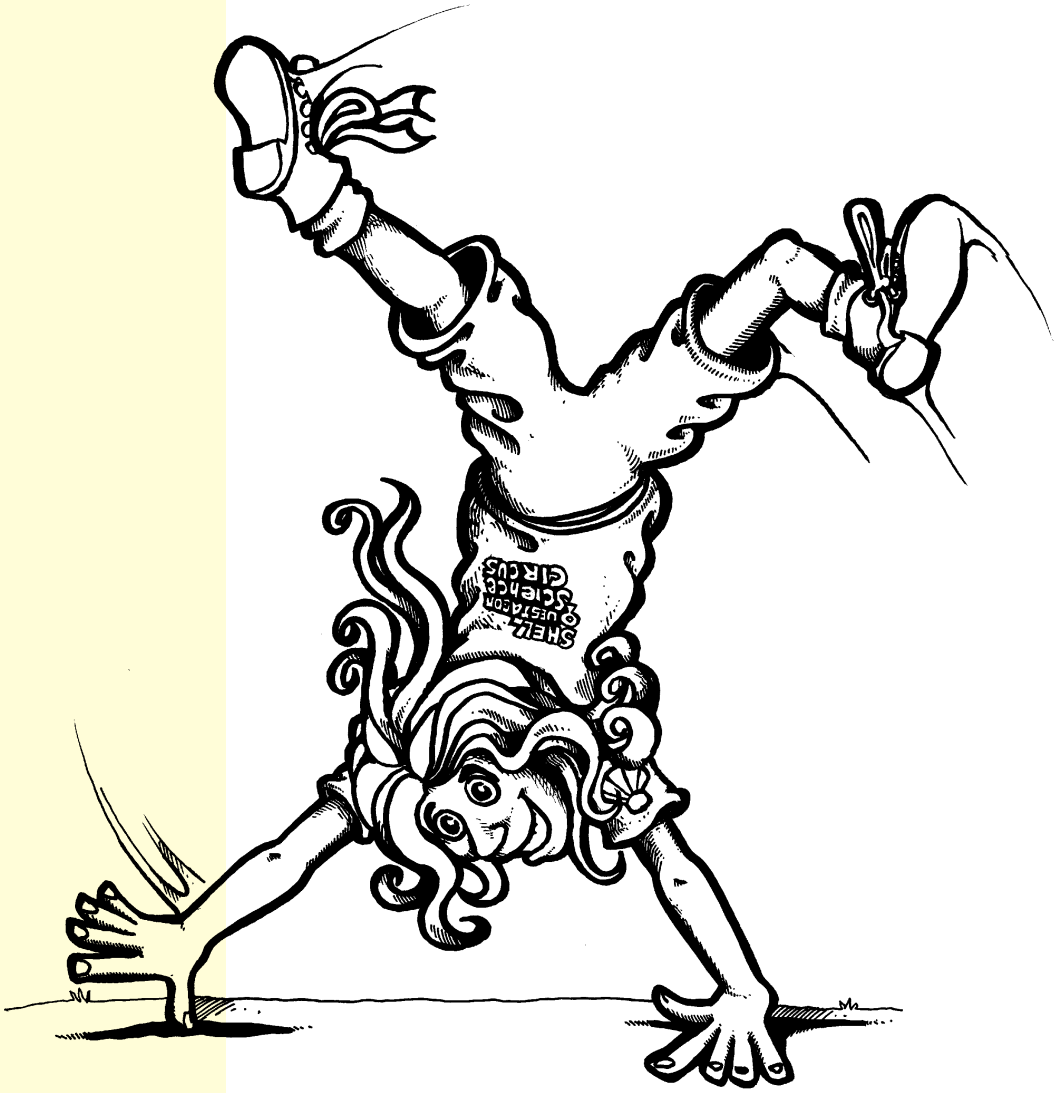
Shell Questacon Science Circus

THE AUSTRALIAN NATIONAL UNIVERSITY

Post-visit resource for teachers

Science Roundabout



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.

Science Roundabout

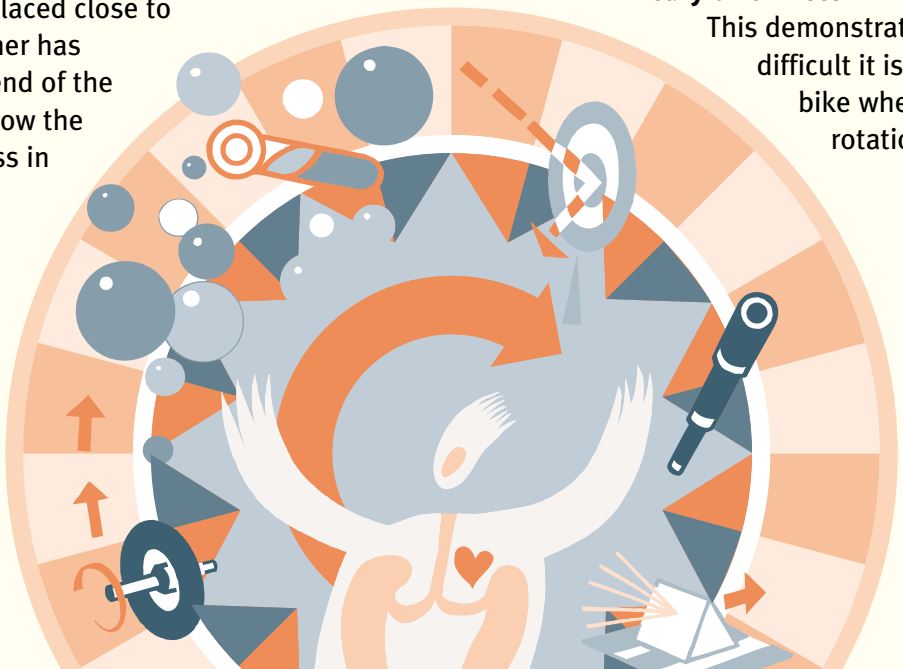
Science Roundabout is a show about things that spin. It aims to spark student's curiosity in rotational and circular motion in a fun way using familiar objects and actions which would not often be thought of as scientific.

Show Summary

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

Axis of rotation
A bicycle wheel is used to introduce the concept that anything spinning has an axis that it spins around.

Inertia rods
This demonstration uses two identical rods. One has weights placed close to the centre. The other has weights at either end of the rod. It illustrates how the distribution of mass in a rotating object affects the speed of rotation.



Volunteers find it more difficult to spin the rod with the weights further away from the centre and axis of rotation.

Ball on a stick
A stick with a ball on one end is easier to balance on one finger when the weight is at a distance from the finger compared to when the ball is adjacent to the finger. In each case, the ball and stick rotates around the finger as it topples. It rotates more rapidly when the mass is close to the finger.

Rotating chair
This is a fun example of the same concept. It also imitates the principle used by dancers and ice-skaters when they spin. Sitting on the chair, a volunteer spins slowly with spread arms and legs. When the volunteer's arms and legs are withdrawn, the speed of rotation increases.

Gymnasts and dancers
The presenter or volunteers somersault, cartwheel and spin to demonstrate the three axes of rotation that a person can turn around.

Roller race
A ring, ball and disk, all of the same mass and radius, are rolled down a ramp. Where the mass is located influences the rotation of the objects. The ball, with its mass concentrated towards its centre, wins every time.

Stable bike wheel
A bike wheel set spinning stays upright on the end of a rope attached to its axle. That is, rotating masses have a tendency to keep rotating in the same plane. However, it starts to turn around the presenters hand. This is due to a phenomenon known as 'precession'. Precession is caused by forces which would cause the wheel to topple if it were not spinning.

Heavy bike wheel
This demonstration illustrates how difficult it is to move a spinning bike wheel out of its rotational plane.

Spinning and flying
Throwing an object such as a frisbee or a football is much more effective and stable when it is spinning through the air.

Spinning plates
The inertia of rotating objects gives them an extra stability. This principle may be demonstrated by spinning a plate on the end of a sharp stick.

Billy tea
A container or cup of water can be spun upside down without spilling by using the principles of centripetal and centrifugal forces.

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

Any spinning object accelerates toward the centre of the circle. This generates a fictitious "centrifugal force" in an outward direction. This keeps the liquid in a spinning billy even when it is upside down.

Scientific principles demonstrated in Science Roundabout

- an axis of rotation is the line around which the mass of any spinning object rotates.
- the further away from the axis an object or an object's mass is, the greater the distance covered by that object and the greater its speed.
- the further an object's mass is from the axis of rotation, the harder it is to rotate as it takes more energy to move it the greater distance.
- the tendency of something to stay still or, if moving, to stay moving, is known as its inertia. The greater the moment of inertia, the more difficult it is to start an object rotating and, once rotating, the harder it is to stop.
- when there are no external forces acting, the principle of conservation of angular momentum holds that the product of rotational velocity and moment of inertia must remain the same.
- objects rolling down an inclined plane will travel faster if they use less energy for rotation. Objects with their mass closer to the axis of rotation will therefore roll faster.
- objects move in a circle only when a constant pull towards the centre is applied to them. This force on an object towards the centre is called the centripetal or 'centre-seeking' force. An object's inertia at any point in time would, if the force stops, propel it in a trajectory which is tangential to the circle.

Suggested follow-up activities

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

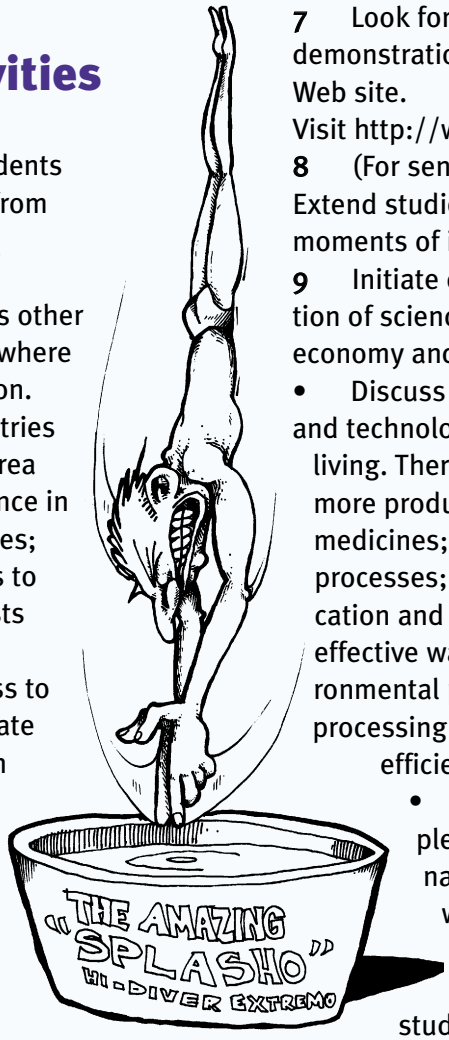
2 Ask students to explain and discuss other examples (from their own experiences) where they have seen or used a spinning motion.

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, washing machines; travelling around a corner in a car; visits to the circus or ballet, or watching gymnasts and ice-skaters on television.

4 If most of your students have access to a bicycle, a project could be to investigate some of the principles of circular motion and how they are applied when riding a bike.

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 stability of rotating objects; forces acting upon objects that move in a circle; axes of rotation.

6 Ask students to devise and carry out their own experiments on rotation or motion. 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.



High divers stretch and tuck their limbs to control their somersaults.

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 angular momentum and moments of inertia.

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 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.

Did you know?

Those multi-directional wheels found on high quality shopping trolleys were invented by a Sydney engineer called Harry Guile. They are made with small inbuilt rollers at right angles to the rim of the wheel. This allows movement in any direction, including sideways! Commercial production of the Ezekiel wheel began in 1991 and it can now be found in strollers, wheelchairs and skateboards.

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 the science of rotational inertia. For example, there is an fun exhibit called the rotating platform which shows how the distribution of mass around the axis affects the speed of rotation of spinning objects. There are numerous other fascinating exhibits which model scientific concepts, natural phenomena and inventions.
Tel. (02) 6270 2893 for group bookings.

Try this!

Hook a wire coat hanger over your finger. Carefully balance a coin on the bottom of the hanger, directly under the hook. If this is too difficult, flatten the wire a little or add a small support. See if you can swing the hanger back and forth without losing the coin. Can you swing it in a complete circle? What forces hold the coin in place?

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

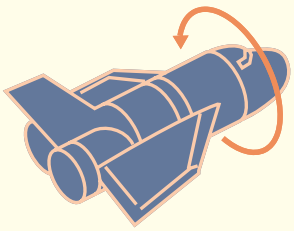
Presenters vary the show according to the age and level of audience. Accordingly, curriculum links will also differ on each occasion. The following table indicates which outcomes can be achieved with Science Roundabout depending on the level and content that is emphasised.

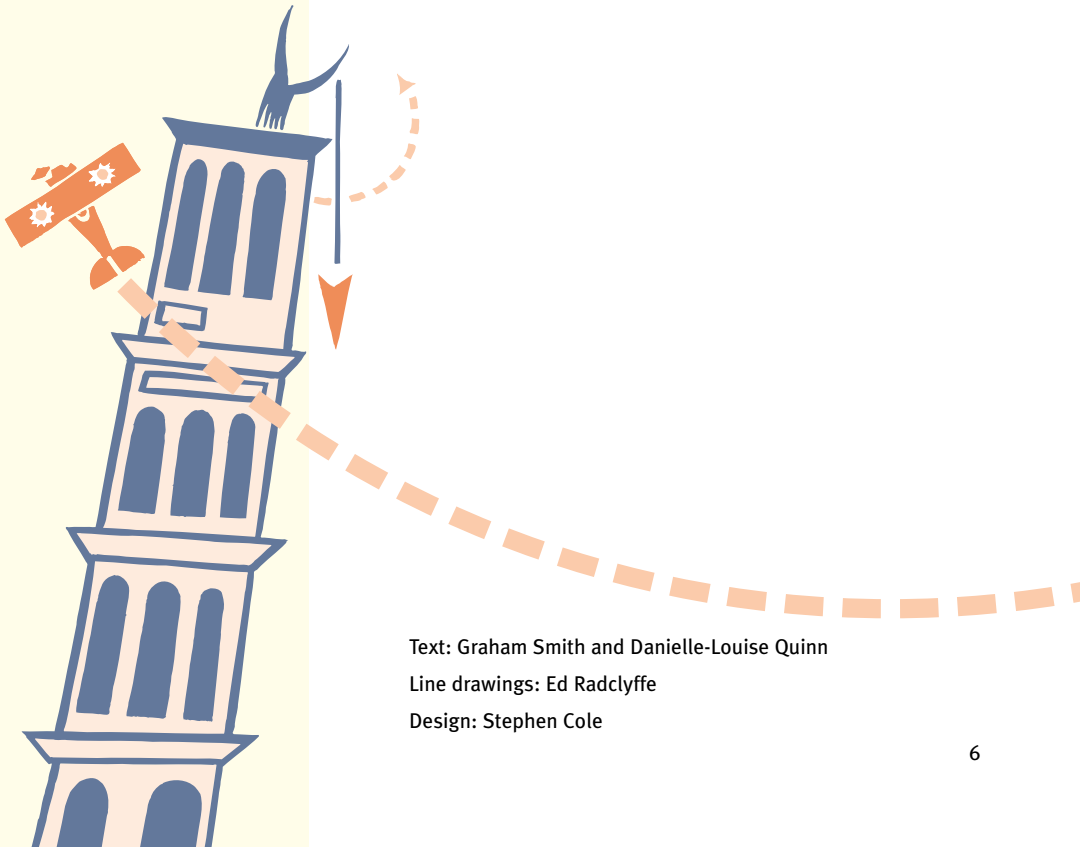
Key scientific words and concepts

spinning, motion, speed, rotating, velocity, inertia, momentum, moment of inertia, angular momentum, conservation of angular momentum, stability, force, centripetal force, centrifugal force, mass, rotational or angular velocity, axes of rotation, distribution of mass

STRAND	**Energy and Change**	**Working Scientifically**
OUTCOMES* linked to Science Roundabout	5.4, 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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