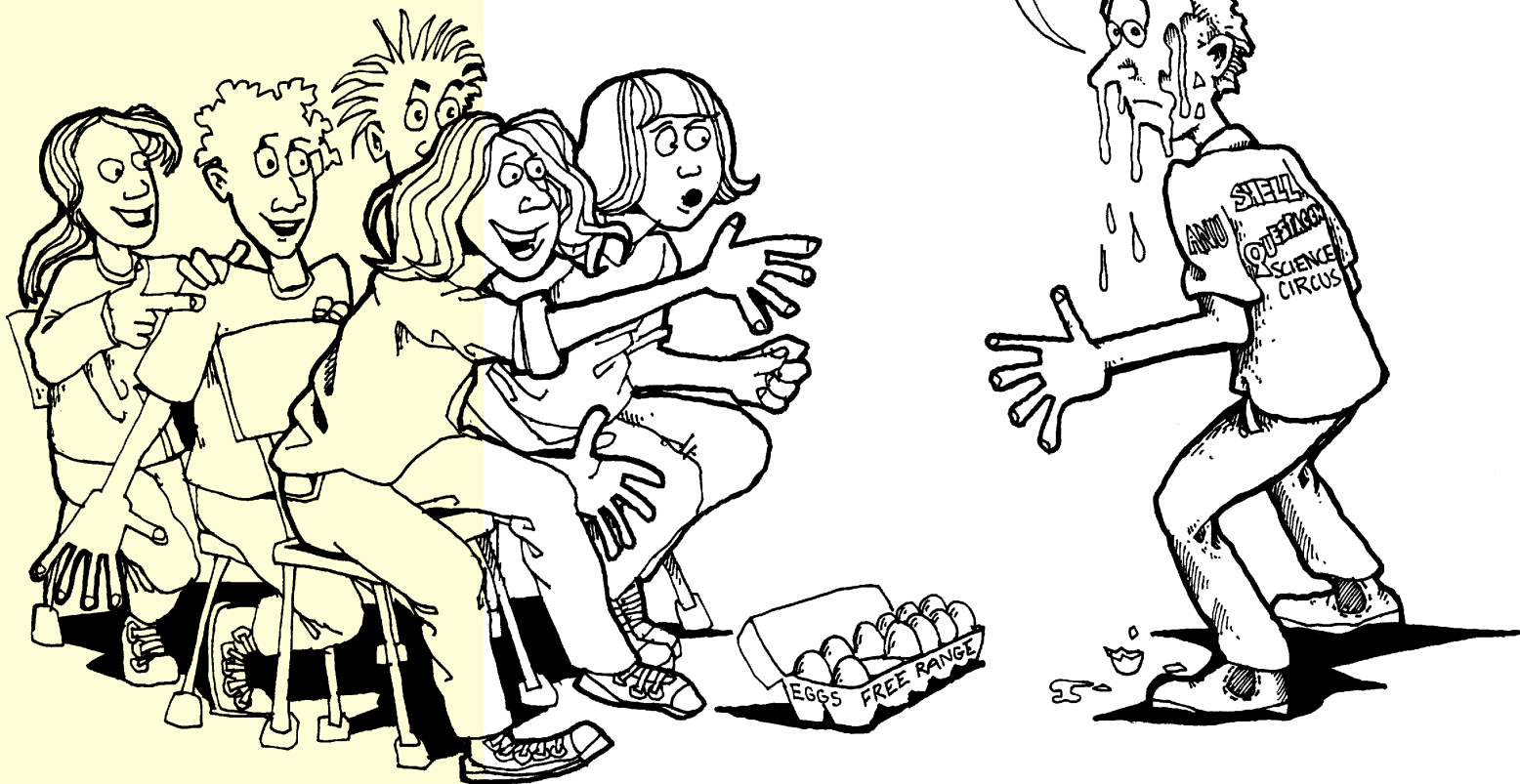




Post-visit
resource
for teachers

The Collisions 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 COLLISIONS SHOW

This show uses every day objects to stimulate ideas and questions about collisions. The demonstrations encourage the process of asking questions about energy and seeking answers with experiments.

Show summary

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

Half a bounce

A few examples of balls are dropped and the amount they bounce back is observed. This is then related to the changes of energy in the ball, from potential or stored energy to kinetic or movement energy.

Where did the energy go?

The presenter explains that energy is never destroyed but is changed into different forms. As the ball is bounced again, the audience works out the forms of energy that result - sound, vibrations, heat and deformation.

Deformation dude

A toy made from either plasticine or a rubber sack of flour is used to better illustrate deformation or shape changing energy.

Two-ball collision

The audience is asked to predict how high two balls will bounce together. They are usually surprised when the second smaller ball takes off. This is an example of energy transfer.

Three-ball collision

This illustrates exactly the same concept with a far more spectacular result.

Human collision

This demonstration may be used to show that energy transfer can occur between any objects that collide, including people.

A small person giving a shove to a larger person has little effect. When reversed, however, the small person acts like the small ball in the two-ball collision with very little energy needed to be transferred for a result.

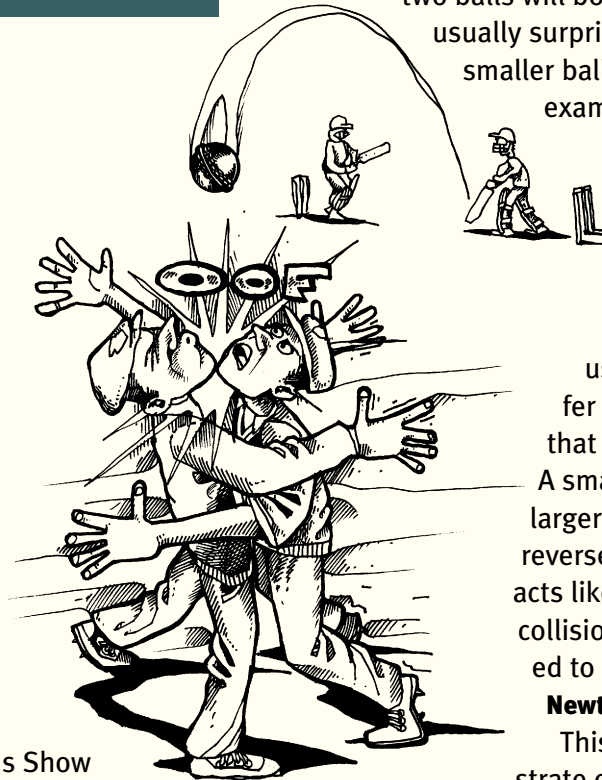
Newton's cradle

This model is used to demonstrate energy transfer. It illustrates conservation of energy as what goes in one side comes out the other side.

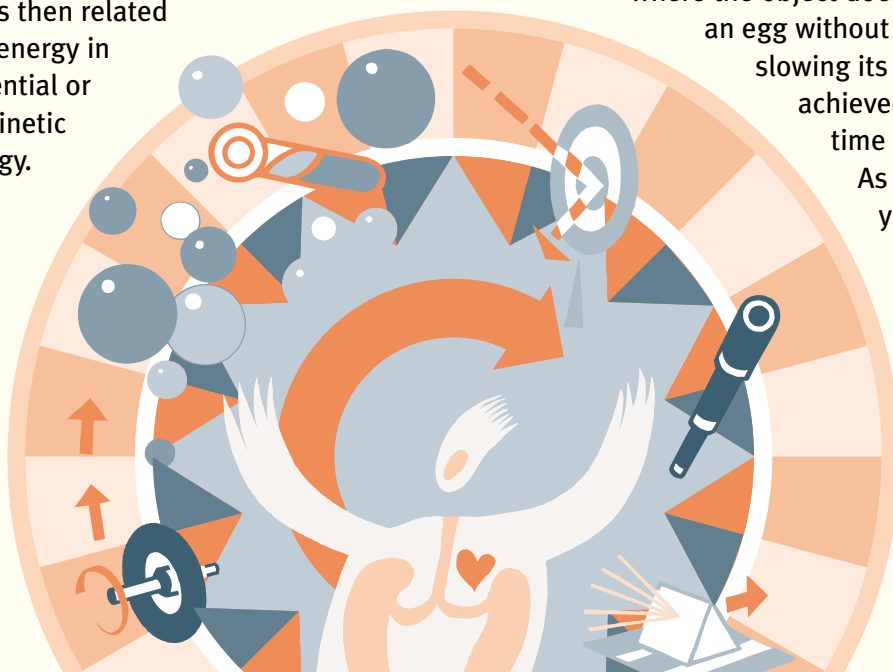
Throwing eggs

The show now moves on to collisions where the object doesn't bounce. Catching an egg without it cracking involves slowing its deceleration. This is achieved by increasing the time it takes to stop it.

As you catch the egg, your hands move back with it.



Elastic and inelastic collisions happen often in sports!



Crumple zones

A delicate object is placed under a paper cup which is then hit with a saucepan. Although the paper cup crumples, the object inside is saved. A model car with a foam crumple zone may also so be used to demonstrate reduction of impact.

Friction and spin

The presenter and a volunteer bounce a basketball to one another. The audience observes how the basketball starts to spin after it has collided with the floor. This is due to the frictional forces as the rubber grips the floor.

Upside down ping pong

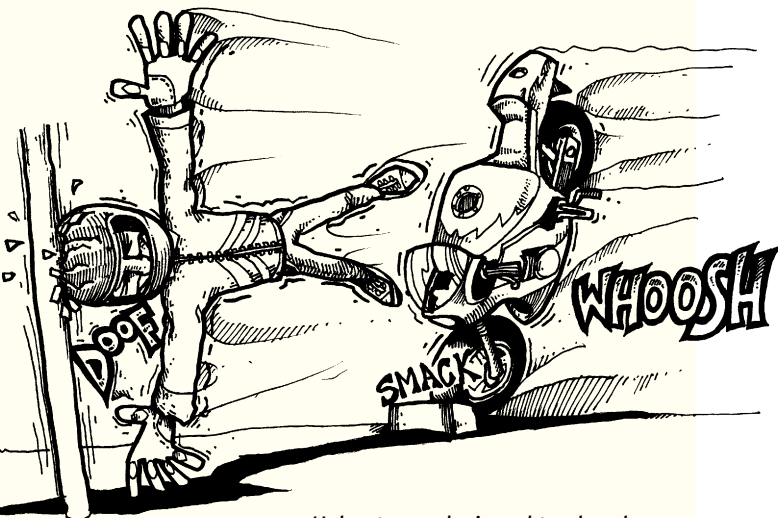
This demonstration involves someone bouncing a ball under a piece of perspex to the person on the opposite side. A ping pong ball doesn't grip very much and the ball moves through relatively easily. When a rubber superball is used, however, it grips and the spin causes it to bounce backwards. No matter how hard the volunteer tries to bounce the ball through, it keeps coming back! Wetting the ball reduces the grip and lets it bounce through.

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 Collisions Show

- potential energy is stored energy that depends on an object being lifted to a height. This changes to kinetic energy when the object begins to fall.
- the law of conservation of energy states that energy cannot be created or destroyed, but it can be transformed from one energy form to another.
- when a ball bounces, some energy is used to vibrate the floor, some produces sound and a small amount of heat energy will be formed. Much of the energy is used when the ball changes shape during and after impact.
- elastic is the term used to describe collisions that bounce perfectly, with negligible deformation or heat energy produced.
- when a collision occurs between a large ball and a small ball, only a small amount of energy is actually transferred when the small takes off. Conversely, as demonstrated with Newton's Cradle, when two balls are the same size, almost all of the first ball's energy is transferred to the second ball and the speeds are not increased.
- when there is no bounce in a collision, all of the energy of the moving object is absorbed by the object it hits.
- increasing the time that you take to stop a colliding object will reduce the impact that the object makes.
- the surface properties of a ball, or any other object, will determine how much it will grip, and the amount of spin put on the ball.



Helmets are designed to absorb energy and direct force away from the skull in collisions.

Suggested follow-up activities

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

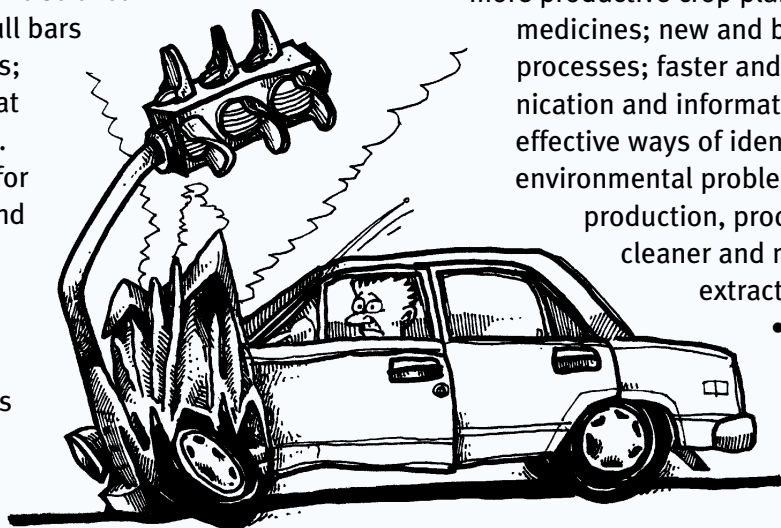
2 Ask students to explain and discuss other examples (from their own experiences) where they have seen collisions.

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, bull bars and crumple zones on cars; collisions in the sports that students play; tyre treads.

4 Set a design project for your students to devise and perhaps build a model stack hat for bike riding. Their designs will have to take into account the concepts from the show as well as practical ideas such as comfort and cost of materials.

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 the effects of friction; transfer of energy; types of forces and their effects.

6 Ask students to devise and carry out their own experiments on some aspect of collisions. 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.



The crumple zones of cars slow deceleration and reduce the force directed to driver and passengers.

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 forces, conservation and transfer of energy.

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.

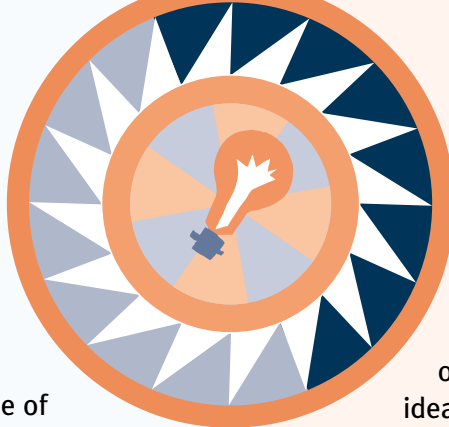
Did you know?

Bicycles convert stored energy in human bodies to kinetic energy with great efficiency.

Australian designers have devised one of the most efficient bicycles. The Australian Olympic Superbike constructed at RMIT in Victoria, is constructed from new composite materials.

Its shape and weight have enabled Australian cyclists to shatter world record times.

10 Arrange an excursion to Questacon: Australia's leading interactive Science and Technology Centre is Questacon in Canberra. Exhibitions are constantly changing. There are a number of remarkable exhibits which are exciting examples of the science of collisions. An entire gallery is devoted to exhibits on forces. There are numerous other fascinating exhibits which model scientific concepts, natural phenomena and inventions. Tel. (02) 6270 2893 for group bookings.



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
- *Scientrific 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.

Try this!

Warm a lump of plasticine in your hands so that it is soft. Roll it into three identical balls.

Drop one from knee height, one from shoulder height and one from as high as you can reach. Compare all three balls. What do you notice? Why are they different? What forces have acted on each of the three balls?

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

STRAND	Energy and Change	Working Scientifically
OUTCOMES* linked to The Collisions Show	5.4, 1.5, 2.5, 3.5, 1.6, 2.6, 4.6	1.13, 1.15, 2.16, 1.17, 3.18

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

Key scientific words and concepts

collision, energy, grip, transfer of energy, conservation of energy, spin, friction, impact, potential (stored) energy, kinetic (movement) energy, gravity, height, sound energy, absorb, heat energy, deformation energy

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>

