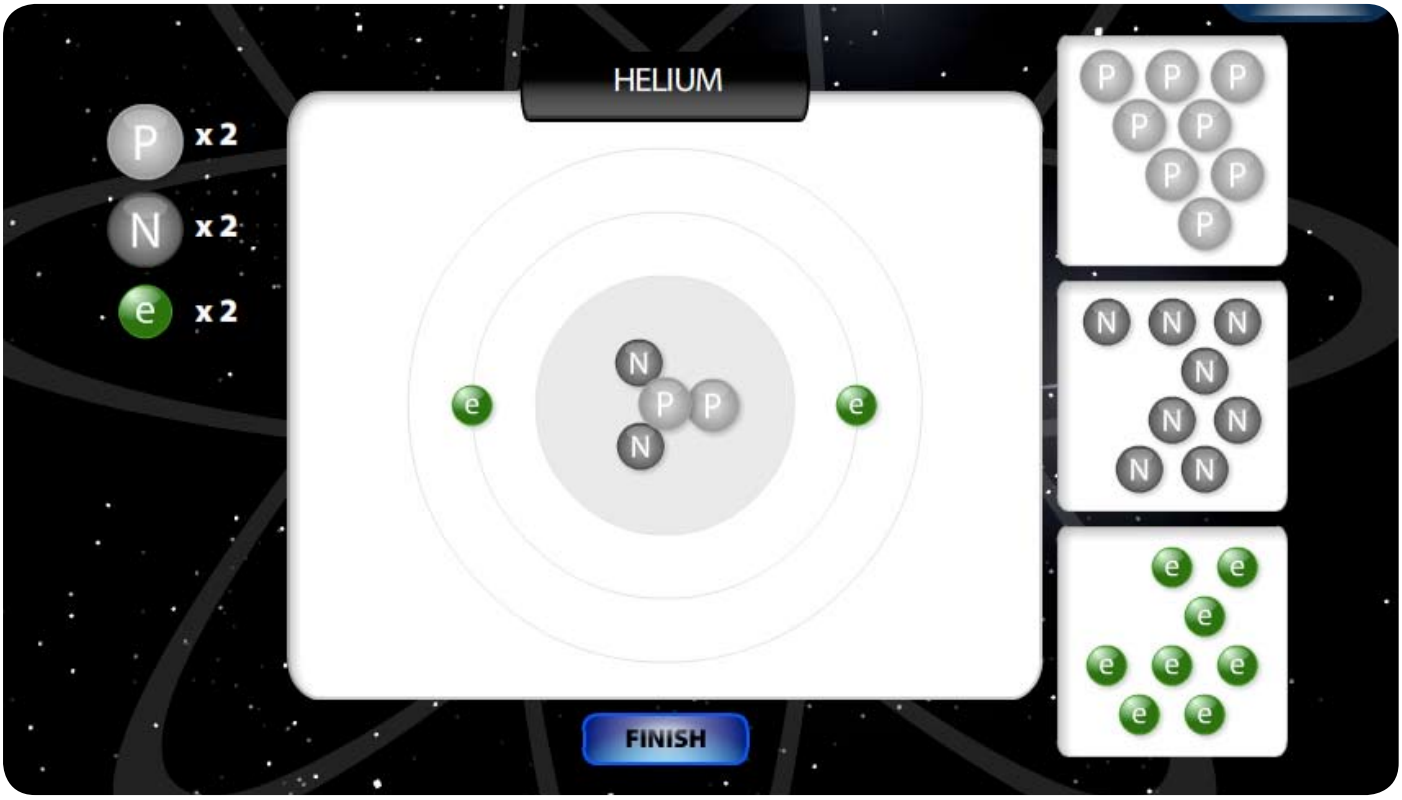
Rolls-Royce

Rolls-Royce Science Prize

The Universe Challenge

For pupils aged 14 - 17

Teachers' game play notes



Developed with the help of Mulberry School for Girls and the Association for Science Education

The Association for Science Education

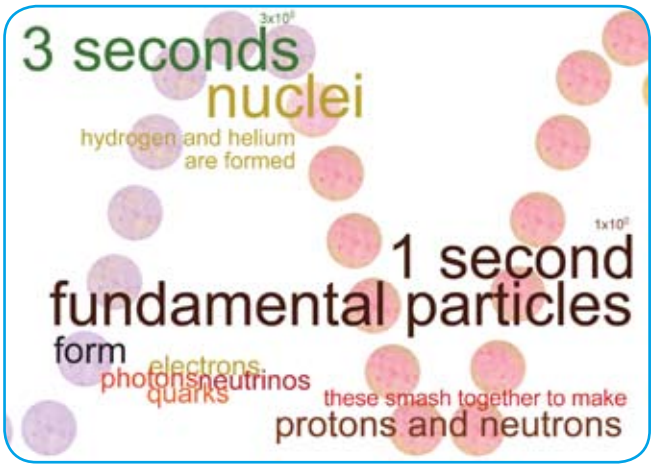
The Game

The Universe Challenge

The Universe Challenge is a game for two teams of pupils that includes interactive white board activities and desk based experiments. The following notes explain the game play and resources that you will need.

Game Objective

- Teams win points by completing nine challenges
- The challenges are selected at random by teams as they progress through the game
- Each challenge has an associated piece of printable artwork. When printed out these pieces of artwork map together to show a timeline of the history of the Universe since the Big Bang. Printer required.

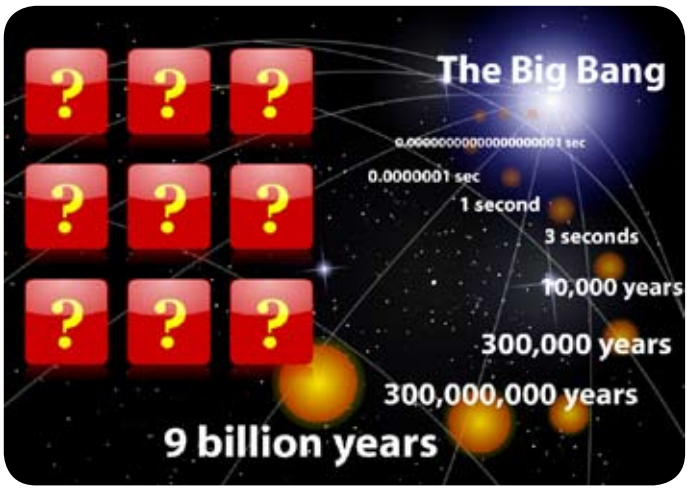


Game Play

Starting the game
Split the class into two teams.

Teams choose a team name and enter it on screen.

The first team is then invited to select a challenge by choosing an on-screen challenge box.



They then follow the instructions to win up to three points per challenge. For a desk challenge both teams participate and the teacher enters the points won by both teams on screen.

The six on-screen challenges:

The on-screen challenges are completed by three members of one team. They appear randomly so they cannot pick and choose which challenge to take.

Atomic Structure

Number of pupils involved:	3 (with the team supporting)
Number of tasks:	3
Number of points available:	3
Time to complete each task:	90 seconds

One member of the team comes to the front
The team member has to drag the correct number of protons, neutrons and electrons from the banks on the right hand side into the centre for the atom they are given.

They can change their mind and remove their choices as many times as they like within the time.
Once they are happy that they have done the task correctly they click on the **Finish** button.

One point is awarded for a correct answer. If the answer is incorrect they do not score a point for that task and the game continues to task 2.

Protons and neutrons must be placed in the centre of the atom with electrons in the correct orbit to be awarded a point.

This is then repeated by two more pupils.

Correct answers (Three of the four possibilities will appear randomly):

- **Hydrogen**
  One Proton (in the nucleus) and one electron (in the first orbit). Adding a neutron to create deuterium is classed as an incorrect answer
- **Helium**
  Two protons and two neutrons (in the nucleus) and two electrons (in the first orbit)
- **Carbon**
  Six protons and six neutrons (in the nucleus) and six electrons (two in the first orbit and four in the second orbit)
- **Oxygen**
  Eight protons and eight neutrons (in the nucleus) and eight electrons (two in the first orbit and six in the second orbit)

Discussion points

Discussion of isotopes, ions, electron shells/orbits etc.

On-screen challenge

Energy in, Energy out

Number of pupils involved: 3 (with the team supporting)
Number of tasks: 3
Number of points available: 3
Time to complete each task: 60 seconds

One member of the team comes to the front
The team member then drags the type of energy to the spaces in the word equation. They can change their mind as many times as they like by dragging their answers out and replacing them. When they think they are correct they press **Test**.

All correctly placed words will remain in their boxes, incorrect words will go back to the starting point for the team member to try gain.
Once they are all correct the second part of the task is revealed and the team member must fill in the missing gap in the number equation. Once completed the **Finish** button must be pressed.

This is then repeated by two more pupils.

Correct answers (Three of the four possibilities will appear randomly):

- **Car**
  Chemical - Kinetic + Heat + Sound (In any order)
  100kJ - 20kJ + 74kJ + 6kJ

- **Wind Turbine Farm**
  Kinetic - Electrical + Heat + Sound (in any order)
  100MJ - 90MJ + 8MJ + 2MJ

- **Television**
  Electrical - Light + Sound + Heat (in any order)
  100kJ - 50kJ + 40kJ + 10kJ

- **Human**
  Chemical - Kinetic + Heat + Sound (in any order)
  100J - 1.4J + 98.5J + 0.1J

Discussion points

Efficiency, wasted energy.

On-screen challenge

Sound/Waves

Number of pupils involved:	3 (with the team supporting)
Number of tasks:	3
Number of points available:	3
Time to complete each task:	30 seconds

One member of the team comes to the front

The pupil must match the sound wave with the object or animal shown by first clicking on the sound then clicking the **Finish** button. It is worth reminding pupils about the range of human hearing (20Hz to 20kHz) and what a Hertz is.

This is repeated by two more pupils.

Correct answers (Three of the four possibilities will appear randomly):

- Cat: 2kHz
- Lion: 250Hz
- Grandfather clock: 1Hz
- Computer chip: 3GHz

On-screen challenge

Solar System

Number of pupils involved: 3 (with the team supporting)
Number of tasks: 3
Number of points available: 3
Time to complete each tast: 60 seconds

One member of the team comes to the front
The pupil must then drag the planets into the right order from the Sun. Once happy the pupil presses **Test**. Any planets in the w rong order will move back to their start positions and the pupil can try again. Once all the planets are in the correct position the **Finish** button must be pressed.

Task 1 correct answers:

Mercury	Venus	Earth	Mars	Jupiter	Saturn	Uranus	Neptune	Pluto

The second pupil must then place the average surface temperature under the correct planets. Once happy the pupil presses **Test**. Any temperatures in the wrong place move back to their start positions and the pupil can try again. Once all the temperatures are in the correct position the **Finish** button must be pressed.

Task 2 correct answers:

Mercury	Venus	Earth	Mars	Jupiter	Saturn	Uranus	Neptune	Pluto
179	449	7.2	-123	-153	-184	-185	-223	-234

The third pupil is then asked to drag the number of Earth days that each planet takes to orbit the Sun under the correct planet. Once happy the pupil presses **Test**. Any times in the wrong place move back to their start positions and the pupil can try again. Once all the times are in the correct position the **Finish** button must be pressed.

Task 3 correct answers:

Mercury	Venus	Earth	Mars	Jupiter	Saturn	Uranus	Neptune	Pluto
88	224	365	687	4,334	10,759	30,683	60,190	90,465

Discussion points

Pluto is included, but could be used to start a discussion on what makes an object a planet.

On-screen challenge

Gravity and Weight

Number of pupils involved: 3 (with the team supporting)
Number of tasks: 3
Number of points available: 3
Time to complete each task: 90 seconds

One member of the team comes to the front

The team member must drag the weights to the correct planets. Once happy the pupils presses **Test**. Any weights in the wrong order move back to their start positions and the pupil can try again. Once all the weights are in the correct position the **Finish** button must be pressed.

Task 1 correct answers:

Mercury	Venus	Mars	Jupiter	Saturn	Uranus	Neptune	Pluto
361	883	375	2600	1120	1050	1330	61

The second pupil then puts the time a 2m pendulum takes to complete one oscillation under the correct planets. Once happy the pupil presses **Test**. Any times in the wrong order move back to their start positions and the pupil can try again. Once all the times are in the correct position the **Finish** button must be pressed.

Task 2 correct answers:

Mercury	Venus	Earth	Mars	Jupiter	Saturn	Uranus	Neptune	Pluto
4.67	2.99	2.84	4.59	1.7	2.65	2.74	2.44	11.37

The third pupil is asked to put the time taken for a ball to fall 20m on each planet in order. Once happy the pupil presses **Test.** Any times in the wrong order move back to their start positions and the pupil can try again. Once all the times are in the correct position the **Finish** button must be pressed.

Task 3 correct answers:

Mercury	Venus	Earth	Mars	Jupiter	Saturn	Uranus	Neptune	Pluto
3.33	2.13	2.02	3.27	1.24	1.89	1.95	1.73	8.1

Notes

The values have all been calculated using the following values of “surface” gravity for the planets in m/s^2

Mercury	Venus	Earth	Mars	Jupiter	Saturn	Uranus	Neptune	Pluto
3.61	8.83	9.8	3.75	26	11.2	10.5	13.3	0.61

Discussion points

Discussions about gravity, weight and mass. Look at how scientists calculate surface gravity and how this doesn’t necessarily follow the size of the planets.

On-screen challenge

Gas Tests

Number of pupils involved:	3 (with the team supporting)
Number of tasks:	3
Number of points available:	3
Time to complete each task:	60 seconds

One member of the team comes to the front
The pupil drags gas tests over the mystery gas canister until they know the name of the gas and then drag the name of the gas over the canister.

This is repeated with the other canisters. Note: Pupils can only use a total of **six gas tests** to name all three gases.

Correct answers: (each gas will only appear once)

- Oxygen relights glowing splint, does not change lit splint, limewater remains clear
- Hydrogen does not effect glowing splint, pops with lit splint, limewater remains clear
- Carbon Dioxide puts out glowing splint, puts out lit splint, limewater turns milky

Desk challenges:

When a team selects a desk challenge, both teams take part. Once completed the teacher adds the points scored for both teams using the on-screen scoring system.

Mirror Maze

Number of pupils involved:	Whole class
Number of tasks:	1
Number of points available:	Teachers' choice, up to 5 per team
Time to complete each task:	To be decided by the teacher

Equipment needed:

- Create a mirror maze (example attached)
- Ray/light boxes or other light source
- Plane mirrors

Extras:

- Pencil
- Protractors

Using a light box or torch and mirrors, pupils steer light through the maze without crossing any walls. Pupils can be involved holding mirrors, drawing the path of the light etc. Award points for how far the team manages to steer the light.

Extension activities

Pupils can draw the position of the mirrors and the route of the light and measure angles of incidence and reflection.

Floating and sinking

Number of pupils involved:	Whole class
Number of tasks:	1
Number of points available:	Depends on number of objects used
Time to complete challenge:	To be decided by the teacher

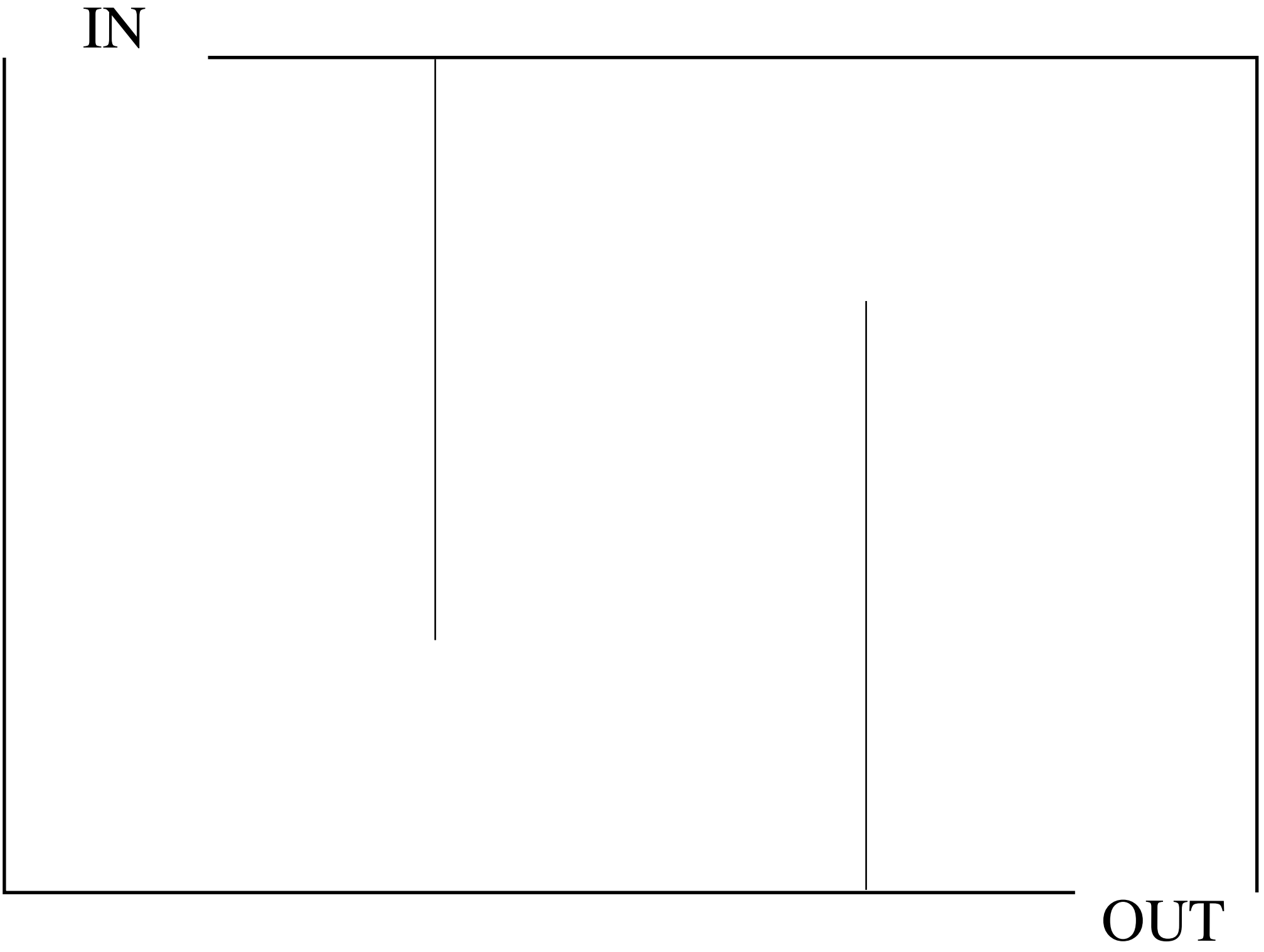
Equipment needed:

- Bowl or large beaker of water
- Items to place in water-fruit, cork, plasticine etc

Teams decide if items will float or sink. Points awarded for correct answers.

Discussion points

Discussion of density.


IN
OUT

Final Challenge:
The Big Bang

The Big Bang Wordsearch

Number of pupils involved: Whole class
Number of tasks: 1
Number of points available: 17
Not timed

For the final challenge both teams compete to find words in the on-screen wordsearch.

When a team member from either team finds a word they come to the board, click on their team's name then press the first and last letter in the word. If correct the word is crossed out and the team is awarded a point. The team cannot send another team member up to the board until the first person has sat back down.

These notes have been compiled for Rolls-Royce plc with the help of Mulberry School for Girls, London and the Association for Science Education.

Special thanks to Deborah Colvin and Nick Swift.

Further information about Mulberry School for Girls' prize winning entry is available on-line at:
www.rolls-royce.com/scienceprize

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The interactive games and accompanying teachers' notes hosted on the Rolls-Royce Science Prize website are to be used for the benefit of schools and colleges only and a third party must obtain the written approval of Rolls-Royce plc if they intend to use any of the resources.

Helpline for teachers:
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