



Rolls-Royce Science Prize

The Universe Challenge For pupils aged 14 - 17

Teachers' extension activities



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

Universe Challenge

Background

In 2007 Mulberry School for Girls, London, won the runner-up award in the Rolls-Royce Science Prize with a project called the Universe Gallery.

The team's aim was to bring science to the heart of the school by producing a timeline of the history of the Universe down the length of a corridor. The timeline formed the basis of a series of learning opportunities that are explained in the following notes. Full details of the project can be found on the Rolls-Royce Science Prize website: www.rolls-royce.com/scienceprize

Several of the projects were collaborations with external practitioners. The Arts Catalyst, a science-art agency and other partner organisation provided introductions to practitioners, expertise and support throughout the project. See www.artscatalyst.org for more information about their work.

The project objectives were to:

- Build a vibrant and active learning environment which emphasises that learning goes on outside the classroom
- Promote a sense of awe, wonder and respect for the Universe through enhanced scientific understanding
- Provide opportunities to reflect on the nature of creativity in the physical universe and to respond creatively
- Facilitate participation of the whole school community
- Facilitate pupil creation and leadership of their own learning opportunities

Red shift: How do we know what we know?

Objectives

- Explore ways of demonstrating the red shift of light from distant galaxies
- Reflect on the nature of our information about the Universe
- Gain practical skills in electronics

Activities

Darken the room and provide an audio-visual stimulus for reflection as students enter e.g. www.hubblesite.org/gallery/movie_theater

Use stimulus material to discuss the red shift and wavelengths of light, drawing attention to the vast distances and time scales involved.

Discuss how this could be shown visually. Introduce the idea of using LEDs. This could also generate discussion about the nature of light as both photon and wave – the LEDs representing the particulate nature.

Pupils use red and blue LEDs to make a visual display which will inspire thinking about the red shift. LEDs are wired together and fixed inside trunking which will run the length of the science corridor, from big bang to formation of the Earth. LEDs are blue and close together at the big bang end and red and further apart at the Earth end.

- Students:**
- Calculate the number of LEDs required and how far apart they will be
 - Establish how the circuits will work, wire LEDs together, drill holes in plastic trunking and mount the LEDs

Outcomes

- Experience working collaboratively with adults and each other
- Use visual, auditory and kinaesthetic means to understand some big ideas
- Work practically with electronics
- Revise ideas about circuits

Notes

This display does not provide an accurate scientific model. It does provide a visual stimulus to thinking and imagination.

Engage external practitioners (artist, electronics expert, electrician, school premises manager, senior leadership) to enable pupils to experience the collaborative nature of building an installation for their school.

National Curriculum Links

Art & Design Especially **3.b** exploration of media, processes and techniques in 2D, 3D and new technologies 4g make links between art and design and other subjects and areas of the curriculum.

Science KS3 Especially **3.4b** astronomy and space science provide insight into the nature and observed motions of the sun, moon, stars, planets and other celestial bodies.

Science KS4 Especially **2.4c** the solar system is part of the Universe, which has changed since its origin and continues to show long-term changes.

D&T Especially **3 n,o,p** the practical application of systems and control in design proposals electrical, electronic, mechanical, microprocessor and computer control systems and how to use them effectively using systems and control to assemble sub systems into more complex systems.

Information panels: Collaboration with ICT

Objectives

- Explore the key processes and events in the history of the Universe
- Present and display information in an engaging and accessible way
- Use ICT creatively

Activities

This can be set up as a competition between small groups or classes. Explain that the best pieces of work will be professionally produced to make a unified series of information panels describing the history of the Universe. Introduce the topics and themes. These could include:

- Big bang
- Red shift
- Absorption spectra
- Distance and size in the Universe
- Galaxies
- Stars
- Supernova
- Tiamat (supernova which gave birth to our Sun)
- Sol
- Solar system

Challenge pupils to include representations of the idea of a billion in their displays e.g. What is the mass of a billion grains of rice? How far would you go if you walked a billion metres?

Pupils use ICT programs to produce their presentations. The best presentations are produced as large displays on foam board.

Outcomes

- Research a topic in depth
- Work collaboratively to present learning
- Develop their ICT skills

National Curriculum Links

Art & Design especially **3.b** exploration of media, processes and techniques in 2D, 3D and new technologies.

4g make links between art and design and other subjects and areas of the curriculum.

Science KS3 especially **3.4b** astronomy and space science provide insight into the nature and observed motions of the sun, moon, stars, planets and other celestial bodies.

Science KS4 especially **2.4c** the solar system is part of the Universe, which has changed since its origin and continues to show long-term changes.

Maths KS4 3.1 Number and algebra real numbers, their properties and their different representations rules of arithmetic applied to calculations and manipulations with real numbers, including standard index form and surds.

Gravity and the fabric of spacetime: Collaboration with external practitioner

Objectives

- Create a visual display to stimulate thinking about general relativity
- Provide opportunities for students to engage with scientific ideas which are beyond the curriculum

Activities

Discuss the strangeness of Einstein's ideas of gravity and spacetime. Show images of the warps in spacetime caused by large masses e.g. 'A new picture of gravity'

www.pbs.org/wgbh/nova/elegant/program.html

Encourage students to use their imagination to visualise ways of presenting this:

- Use wire netting, then add balls of different sizes to distort it. Write small chunks of explanatory text – some pieces on paper and some written on mirrors with lipstick. Attach the pieces of text to the netting. Viewers can see themselves as part of the Universe in the mirrors
- Knit some fabric with very large needles (10cm or more in diameter) and fluorescent material

Outcomes

- Use visualization and imagination in a scientific context
- Produce a high quality display piece which 'works' as both science and art

Notes

A text that could be used:

'Isaac Newton unified the heavens and the Earth by proposing that the same force that makes an apple fall also keeps the planets in orbit around the Sun. This idea was radical! It worked for 250 years. It still works today for launching rockets and landing people on the Moon.

There was a problem though. Newton failed to suggest a mechanism of action for gravity. Albert Einstein was not happy about this. He also realised that gravity could not act instantaneously as Newton assumed, because nothing can travel faster than the speed of light, not even a force.

So Einstein came up with a new picture. He imagined three dimensions of space and one of time as somehow unified in a fabric of spacetime. Like netting or knitting. Gravity is the warps and curves in this fabric caused by objects like planets, stars and black holes. We orbit the Sun because we are following a curve in spacetime caused by the Sun's mass.'

National Curriculum Links

Art & Design especially **3.b** exploration of media, processes and techniques in 2D, 3D and new technologies.

4g make links between art and design and other subjects and areas of the curriculum.

Science KS4 especially **2.4c** the solar system is part of the Universe, which has changed since its origin and continues to show long-term changes.

Sounds from the Stars: Collaboration with external practitioner

Objectives

- Use principles of amplitude modulation to create a piece of artwork
- Learn principles and practice of electronics
- Facilitate learning through discussion

Activities

Explain amplitude modulation (that sound can be transmitted using light) by demonstrating sending music along a laser beam. Students use this principle to transmit recordings through LEDs.

Students paint a display board to represent the dust and gas in star-forming regions of the Universe, and drill many holes in the patterns of galaxies and constellations. Wire LEDs and resistors into loops (each loop represents a 'channel') and glue into the holes. Leave some holes empty so that when they are backlit the light shines through to look like stars. Record space sounds, interviews, talks, discussions, music, interviews etc. gathered from many subject areas. e.g. interviews with scientists about faith could be done in Religious Studies, and poems in English.

Use a computer to edit the recordings. Connect sounds to the LED channels. Viewers pass a light sensor over the LEDs to hear the sounds.

New recordings can be made by subsequent groups of pupils.

Outcomes

- Gain expertise in electronics
- Research the history of the Universe and galaxy formation
- Deepen knowledge and engagement with physics through extended discussion

Notes

This project benefits from technical expertise and time investment. Local artist Antony Hall worked with a small group of students on a similar project with Mulberry School for Girls.

National Curriculum Links

Science KS4 2.3d radiations in the form of waves can be used for communication.

Religious Education 1.5 Meaning, purpose and truth:

Analysing and synthesising insights on ultimate questions that confront humanity.

4i explore the connections between RE and other subject areas.

Using film: Collaboration with external practitioner

Objectives

- Explore ways of using film to show scientific ideas and student creativity
- Explore ways of using film to develop imagination
- Use display to stimulate thinking

Activities

Make films of ideas, experiments, new learning.

For example:

- Add drops of food colouring to a ripple tank under different conditions and film the patterns
- Use text and image in the films rather than sound
- Collaborate with maths and ICT to explore fractal geometry

Outcomes

- Present learning in a visual way
- Explore patterns, shape and form
- Create artworks
- Make a teaching and learning resource for the school

Notes

Set up a projection space in a public area of the school. This is a good way to transform an otherwise empty wall/ceiling/floor space. Films can be looped, and if they are silent, imagination and visual learning is encouraged.

National Curriculum Links

Art & Design especially **3.b** exploration of media, processes and techniques in 2D, 3D and new technologies.

ICT KS4 2.3 Communicating information:

Use a range of ICT tools and media to share, exchange and present information effectively in a variety of contexts.

Create quality solutions that show they have considered how the information should be interpreted and presented in forms that suit audience, purpose and content.

Plasma screen

Objectives

- Explore ways of using ICT to show scientific ideas and student creativity
- Explore ways of using ICT to develop imagination
- Use display to stimulate thinking

Activities

Make ICT presentations an integral part of schemes of work. Students can be responsible for programming.

Outcomes

- Present learning in a visual way
- Develop ICT skills
- Take responsibility for display

Notes

Install a plasma screen in a public place in the science department. This is useful as a noticeboard and for quizzes etc. as well as display of work.

National Curriculum Links

Art & Design especially **3.b** exploration of media, processes and techniques in 2D, 3D and new technologies.

ICT KS4 2.3 Communicating information:

Use a range of ICT tools and media to share, exchange and present information effectively in a variety of contexts.

Create quality solutions that show they have considered how the information should be interpreted and presented in forms that suit audience, purpose and content.

Satellites to measure the time and space of my Universe: Collaboration with external practitioner

Objectives

- Investigate the use of satellites as a means of gathering information
- Find personal ways to reflect on the passage of time
- Establish an emotional/personal connection with scientific ideas and technology

Activities

An external practitioner worked with the students from Mulberry School for Girls on this project to share their professional experiences.

Present images and explanations of different satellites and learn some names. Relate what satellites can do to personal experience of time and space.

See notes below for a student description of the activity.

Use student collages to make a large image using a computer.

Outcomes

- Learn what satellites do
- Reflect on the passing of time from a personal perspective
- Contribute to a collaborative artwork

Notes

Mulberry School for Girls worked with Joanna Griffin. See her blog for details and images: www.aconnectiontoaremotepace.net

Here is an evaluation of the activity written by a year 7 student:

'Today's science lesson was all about satellites and it was taught by an artist called Joanna. There are many satellites and they all have names. Two I have learnt are called COBE (Cosmic Background Explorer) and WMAP. They look like small, bright dots in the sky, but if you look at them properly they have straight things like wings poking out which have solar cells on them so they can use the sun's energy. Our satellite dish that we installed at home to watch TV uses radio waves that come from the satellites in the sky. There are 6000 satellites in the sky. After we learnt about the satellites, we discussed two questions. One was 'How do we know time is passing?' We came up with ideas like 'we know time is passing when we get hungry, when we are growing up and when it's sunrise and sunset'. The other one was to remember a happy memory in your life. One of my happy memories was when my niece was born and the first time I held and saw her. We had to then write answers to the two different questions on two different pieces of paper. Our next task was to cut lots of pictures and some words from science magazines along with the words we wrote, then stick them on a piece of paper to make a collage in the shape of a satellite, then decorate it. I took pictures of planets and solar systems and words like 'Universe' and 'beautiful'. I found a small calendar in a magazine, therefore I stuck it on. I also put other pictures and words. I thought it was a very successful lesson as I finished a lot of work and learned quite a lot of information.'

National Curriculum Links

Science KS4 2.3d radiations in the form of waves can be used for communication.

1.4 Applications and implications of science:

Pupils should be taught about the use of contemporary scientific and technological developments and their benefits, drawbacks and risks.

Timeline: Collaboration with external practitioner

Objectives

- Make a timeline to show the nine billion years from the Big Bang to formation of the Sun and Earth
- Make links between science and art activities
- Demonstrate that our information about the Universe comes from electromagnetic radiation

Activities

Provide stimulus material of clouds of gas and dust and galaxies e.g. Hubble images from:
www.hubblesite.org

Reflect on patterns. Use marbling techniques (add coloured inks to trays of water, then float cartridge paper on the water) to make patterns. Different colour-ranges can be used to provide images at the blue and red end of the spectrum. Use a computer to transform images from many students into coloured circles. Use these to make a wave pattern along the display space to represent the red shift – blue circles close together at the big bang end, red circles further apart at the sun end. Add text and numbers / times to show key events in the history of the Universe.

Outcomes

- Contribute to a collaborative artwork
- Reflect on the nature of science and art
- Reflect on how we know what we know about the Universe

Notes

- Mulberry School for Girls worked with Joanna Griffin on this project. See her blog for details and images: www.aconnectiontoaremoteplace.net

National Curriculum Links

Art & Design

Especially **3.b** exploration of media, processes and techniques in 2D, 3D and new technologies.

4g Make links between art and design and other subjects and areas of the curriculum.

The Universe story: Collaboration with storytellers and the Drama department

Objectives

- Use storytelling and drama to present aspects of the history of the Universe and show how people have engaged with the Universe story

Activities

Give students a presentation/information on the story of the Universe as provided by science. Encourage students to research aspects of the story themselves. Teach important science facts such as the age of the Universe.

Workshop some storylines. Students write and perform their own material.

For example:

- The Restaurant at the End of the Universe. A primal star visits the restaurant and demands more and more food (hydrogen omelette, helium soufflé etc.) before going supernova and leaving the debris of larger elements all over the restaurant
- The story of the Reverend Robert Evans. An Australian priest and amateur astronomer who has discovered more supernovas than anyone else
- Dr Who visits the Big Bang

Outcomes

- Develop knowledge of the history of the Universe
- Write and present their own material
- Develop confidence and ability to express complex ideas

Notes

Mulberry School for Girls worked with Alex Somerville on this project.

See www.speakupstorytelling.com for storytelling by Alex Somerville

National Curriculum Links

English KS4 1.1 Competence

Expressing complex ideas and information clearly, precisely and accurately in spoken and written communication.

1.2 Creativity

Making fresh connections between ideas, experiences, texts and words, drawing on a rich experience of language and literature.

Space food: Collaboration with Food Technology

Objectives

- Reflect on space travel and what and how astronauts eat
- Bake galactic food

Activities

Research and present what astronauts eat. Explore how the food is prepared.

Make galactic food – baking star and spiral shapes etc. These can be preserved for display.

Mulberry School for Girls held an opening event for the Universe Gallery, with external visitors. Food Technology students made the refreshments – sandwiches, savouries and sweets all with galaxy-themed shapes and decorations.

Outcomes

- Take part in cross-curricular activity
- Research astronauts' food requirements
- Contribute to a whole school event

National Curriculum Links

KS3 D&T

3n How to prepare and assemble components to achieve functional results.

KS3 Science

3.3c Behaviour and health can be affected by diet.

Cam toys: Collaboration with Technology

Objectives

- Use science work on the Universe as the context for an established scheme of work in technology
- Learn about rotation and revolution through making mechanical toys

Activities

Make wooden cam toys and use the space theme to decorate them.

Apply ideas of rotation and revolution to the solar system.

Outcomes

- Think about their science work in technology
- Make toys to show ideas of rotation and revolution

National Curriculum Links

KS3 D&T

3n How to prepare and assemble components to achieve functional results.

Creation stories: Collaboration with English

Objectives

- Consider how people of different traditions and at different times in history have thought about origins
- Read, present and perform stories from different traditions
- Consider similarities and differences between creation stories and the scientific theory of the history of the Universe

Activities

Present students with a range of creation stories from different cultures.
Explain the scientific theory by personifying some of the key characters – stars, galaxies, supernovas etc.

Students research and present stories in groups.
Performances could be filmed for display.

Outcomes

- Consider the importance of story-making and story-telling in human culture
- Present their own versions of some creation stories
- Engage with the idea of science as inspiration for story-telling

National Curriculum Links

English KS4 1.1 Competence

Expressing complex ideas and information clearly, precisely and accurately in spoken and written communication.

1.2 Creativity

Making fresh connections between ideas, experiences, texts and words, drawing on a rich experience of language and literature.

Energy Transfers: Collaboration with Citizenship

Objectives

- Calculate the energy transferred by lights, heating and appliances in part of the school
- Use an online carbon footprint calculator to work out carbon dioxide emissions
- Explore the advantages and disadvantages of carbon offset and emissions trading schemes

Activities

Teach $P=IV$. Students find out the power ratings of all appliances and length of time they are used for. Calculate energy transferred. Make comparisons with energy in food e.g. how many Mars Bar equivalents does the Science department consume each day?

Use an online carbon calculator to find the carbon footprint. Calculate how many trees would have to be planted to offset the emissions.

Mulberry School for Girls did this for the whole Universe Gallery, including LEDs, lighting for display cabinets, computers, projector and plasma screen. A group of students formed an Energy Committee and decided to raise funds for a tree-planting project in the Rift Valley in Kenya.

Discuss climate change. Investigate ways the footprint could be reduced. Engage students in a debate about carbon offset schemes and emissions trading.

Join the eco schools initiative: www.eco-schools.org.uk

Outcomes

- Gain a practical understanding of the effects of using electrical appliances
- Raise their awareness of the causes of climate change
- Take action to reduce emissions of greenhouse gases
- Engage with national and global initiatives

National Curriculum Links

Science KS4

2.3 Energy, electricity and radiations.

In their study of science, the following should be covered:

Energy transfers can be measured and their efficiency calculated, which is important in considering the economic costs and environmental effects of energy use.

Research into creativity in learning: Collaboration with Creative Partnerships (Creativity Action Research Awards) and the Sociology Department.

Objectives

- Enable students to reflect on their learning and contribute to creation of their own learning opportunities
- Develop students' research skills
- Find out about the nature of creativity and creative learning

Activities

All or any of these projects could be the subject of an action research project on the nature of creativity in science.

Mulberry School for Girls trained Sociology students in action research skills. They wrote, distributed and analysed questionnaires, and interviewed students.

Film and photograph your work.

Run a focus group to explore students' perceptions of creativity in science and creative learning.

Outcomes

- Explore creative learning
- Gain research skills
- Contribute to the design of their own learning experiences
- Engage in meta-cognition of their learning

Notes

See www.capeuk.org for more information on CAPE UK and creativity action research awards.

See www.creative-partnerships.com for the work of Creative Partnerships.

National Curriculum Links

Citizenship

- 3i Policies and practices for sustainable development and their impact on the environment.
- 4j Make links between citizenship and work in other subjects and areas of the curriculum.

Exploring beliefs and evidence about origins: Collaboration with Religious Studies

Objectives

- Explore aspects of science and faith
- Participate in the dialogue between religious and scientific views about the origins of the Universe
- Develop and present arguments for particular viewpoints
- Engage with public figures from the worlds of science and religion

Activities

The Science and Religion in Schools Project provides an excellent resource base: www.srsp.net
Reframe the 'science – religion debate' as the 'science-religion dialogue'.
Invite scientists of various faiths or none to speak to students.

Students interview scientists about their beliefs. They could make a film documentary, audio recording or podcast.

Outcomes

- Become better informed
- Take part in debate
- Hear about a wide range of views
- Present their learning in a variety of ways

National Curriculum Links

Religious Education 1.5 Meaning, purpose and truth

Analysing and synthesising insights on ultimate questions that confront humanity.

4i Explore the connections between RE and other subject areas.

Constellations: What are they?

Objectives

- Learn to explore the night sky using tools such as Google Earth 4.2 and Celestia
- Understand how the orientation of constellations changes with viewing positions on Earth
- Understand that constellations are illusions caused by our position in the Universe and that they have been the source of imagery throughout history

Activities

Build a model constellation using small spheres of aluminium foil hanging on threads. Use a constellation pattern to make holes in a card disc.

See www.teachingk-8.com/archives/departments/integrating_science_in_your_classroom for ideas.

Log on to Google Earth 4.2 or later and use the Sky button to explore the night sky and change the viewing position to see what the stars look like from other places on Earth.

Study the history and imagery of constellations and create a display of images linked to constellations.

Use the patterns of constellations to invent new imagery that reflects our own culture.

Outcomes

- Use Google Earth and similar applications to explore the night sky
- Learn about the history and imagery of constellations
- Understand more about the geometry of the Universe

Notes

The Celestia and Orbiter applications require a high degree of familiarisation by teachers before offering as tools for students. Google is easier to use.

National Curriculum Links

Science KS4

The solar system is part of the Universe, which has changed since its origin and continues to show long-term changes.

Planet and star observation

Objectives

- Understand how planets and stars differ in the night sky
- Explore animations of planetary orbits and their paths through the sky

Activities

Make simple observations of planets over a term or a year in relation to stars.

Use the internet as an aid to find and identify planets using a compass.

Use Google Earth to track planet paths in real time.

Outcomes

- Find and use astronomy websites with animations of planetary motion
- Discuss the ideas and language used in astrology
- Understand more about the geometry of the Universe
- Understand the optical difference between stars and planets

Notes

Animations software applications require a high degree of familiarisation by teachers before offering as tools for students.

National Curriculum Links

Science KS4

The solar system is part of the Universe, which has changed since its origin and continues to show long-term changes.

Looking at Fraunhofer lines

Objectives

- Understand some basic ideas about spectra-that light can be dispersed into the colours of the rainbow
- Explore Fraunhofer lines in sunlight-a rainbow with dark lines in it

Activities

Look at sunlight through a pocket spectroscope and observe dark absorption lines.

Look at light from an incandescent bulb and notice that there are no lines.

Find stellar spectra online.

Create a display of stellar spectra from web sites with notes on what the lines mean.

Outcomes

- Experience the fact that light from our Sun has gaps in its spectrum
- Relate this to spectra from other stars and appreciate that you need expensive instruments to measure such dim light
- Understand why astronomers look at spectral “fingerprints” from stars

Notes

These topics might normally be regarded as advanced for KS4. However the observation of gaps in sunlight is a simple direct experience that there is something strange about sunlight. The fact that the light from stars has the same strange lines is confirmation that stars are like our sun; they are made of the same stuff and are similarly hot. The red shift measurements made by astronomers use these spectral lines.

Fraunhofer lines can be observed without looking directly at the sun, even on a cloudy day.

There is a close match to new GCSE Physics syllabuses.

National Curriculum Links

Science KS4

The solar system is part of the Universe, which has changed since its origin and continues to show long-term changes.

Measuring the Moon and distance to stars

Objectives

- Measure either the diameter of the Moon or the distance to the Moon using similar triangles
- Make parallax measurements and relate to astronomical parallax

Activities

Use a broom handle or metre rule to occlude the Moon with a small disc stuck at a known distance from your eye.

Use the maths of similar triangles to work out the diameter of the Moon, given its distance from the Earth or vice versa.

Learn about using parallax to measure distances and relate to astronomical parallax using the Earth's movement over six months.

Take photos of outdoor measurement activities and combine with geometrical drawings to create a display of "How we measured the Universe".

Outcomes

- Learn that simple rough calculations can help understand the scales of the solar system
- Understand how astronomers work out distances using big triangles

Notes

Using right angled triangles a distance can be measure to distant objects near the school or on playing fields. This can then be directly related to astronomical parallax measurements.

These are normally regarded as advanced ideas, but the geometry is simple and can be modelled in the school grounds and locality.

National Curriculum Links

Science KS4

The solar system is part of the Universe, which has changed since its origin and continues to show long-term changes.

Maths KS4

3.2 Geometry and measures properties and mensuration of 2D and 3D shapes.

Space technology time line

Objectives

- Create a time line display of space history and space future

Activities

Research the history of space travel using the internet. Create a display using archive news graphics.

Make a Sputnik model.

Use prints to create a wall time line that runs into the future.

Use their imagination to predict what space technology could achieve in the future and create display graphics to illustrate those ideas.

Outcomes

- Learn how space travel sprang from World War Two technology
- Learn about the “space race”
- Appreciate modern space technology of satellites, their costs and benefits

Notes

Use their imagination to predict what space technology could achieve in the future.

National Curriculum Links

KS3 History

1. Use ICT to research information about the past, process historical data, and select, categorise, organise and present their findings.
2. Make links between history and other subjects and areas of the curriculum, including citizenship.

Space closer to home-GPS systems

Objectives

- Investigate Global Positioning Satellite systems, their cost and applications

Activities

Experiment with a handheld GPS system and investigate the technology using simplified treatment of speed distance and time calculations.

Use the internet to find out about GPS satellites and how the system works.

Take photos of the GPS system and combine with internet based illustrations to create a GPS display.

Make a display of the people who benefit from GPS.

Outcomes

- Understand the relevance of the speed of light to GPS calculations
- Appreciate the costs and international collaboration in creating the new European GPS system
- Understand some of the science behind “SAT NAV”

Notes

GPS systems are explained very clearly on www.howstuffworks.com

GPS offers the opportunity to find out more about triangulation, and the speed of light.

GPS systems are quite cheap, but they depend on multi-billion investments by governments.

National Curriculum Links

Maths KS4 Curriculum opportunities

Work on problems that arise in other subjects and in contexts beyond the school.

Work on tasks that bring together different aspects of concepts, processes and mathematical content.

Work collaboratively as well as independently in a range of contexts become familiar with a range of resources, including ICT, so that they can select appropriately.

Science KS4

1.4 Applications and implications of science

Pupils should be taught about the use of contemporary scientific and technological developments and their benefits, drawbacks and risks.

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:

0800 028 07659

www.rolls-royce.com/scienceprize
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Rolls-Royce is a world-leading provider of power systems and services for use on land, at sea and in the air. We operate in four global markets – civil aerospace, defence aerospace, marine and energy. We employ 38,000 people in our business worldwide and operate in 50 countries.

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- Raise standards
- Promote engineering, science and technology
- Develop our employees
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- Support future resourcing needs

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