Topic: The Solar System and the Wider Universe

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Issues tackled:

1. **Ideas and evidence - The Big Bang**.
2. **Investigative skills – Patterns in our solar system.**
3. **Applications, relevance and cross-curricular issues – Religious views on the beginning and end of the Universe.**

Issues 1 and 3 concentrate on the Higher level content at GCSE, for trainees working with Foundation groups the materials for KS3 Space may be more relevant.

Issue 1: Ideas and Evidence – The Big Bang

Prior knowledge and experience:

Possible tasks:

Preparation for tutorial:

1. Research and make a list of the evidence to support the Big Bang model for the start of the Universe.
2. Research evidence in support of alternative models for the start of the Universe.

Possible activities during tutorial:

1. Present the evidence and discuss what they understand. Discuss whether the evidence is sufficient.
2. Present the evidence which suggests that other models should be considered (e.g. steady state theory).

AST Input:

- Talk through and explain where Red Shift comes from in terms of the Doppler effect.
- Give a demonstration of Doppler shift; a whirly tube or loudspeaker on a rope connected to a signal generator.
- Link shift in pitch of sound to shift in colour of light.
- Reinforce the idea that the exam wants the evidence for the Big Bang, not why it may be true.
- Pupils may have strong beliefs to suggest otherwise.

Reading:

Subject knowledge and understanding

The Big Bang PPARC (Particle Physics and Astronomy Research Council) leaflet available to schools from www.pparc.ac.uk/Ed/pubs.asp and **Evidence for the Big Bang** wall poster from PPARC.

A level text published after 2000. For example Adams, S. and Allday, J., (2000), **Advanced Physics**, Oxford University Press, Oxford. Pages 548 – 549.

Cosmology; OCR Modular Physics, Cambridge.

Subject pedagogy

Useful websites and applications

There is lots of information on the PPARC web site at www.pparc.ac.uk/ - follow links to **schools and public** and then **PPARC Science**.

www.arachnoid.com/sky/redshift.html - this site has a sound clip of a police car demonstrating the Doppler effect.

There is a plethora of websites about the Big Bang and alternative theories.

Resources: **Tutorial**
Equipment to demonstrate the Doppler effect.

Issue 2: Investigative Skills – Patterns in our solar system

Prior knowledge and experience:

Possible tasks:

Preparation for tutorial:

1. Compile a spreadsheet of data about the planets in our solar system. Include as many fields as possible.
2. Prepare a worksheet for the class to use with a spreadsheet of planetary data working in a computer room.

Possible activities during tutorial:

1. Show the spreadsheet, then use it to create and analyse as many relationships as possible using graphs. For example distance and orbit time, size or mass and number of satellites, distance and density, day length and distance.
2. Demonstrate the worksheet and discuss the practicalities on bringing the class to the computer room.

AST Input:

- Discuss the various relationships which may be found and the theory behind them.
- Discuss how to create a 'TopTrumps' style card game using the data found for the spreadsheet.

Reading:

Subject knowledge and understanding

Johnson K. (1996), **Physics for You,** Stanley Thornes, Cheltenham.

Ryan, Johnson, Adamson and Williams, (2004) **Spotlight Science Pupil's Book 8,** Nelson Thornes, Cheltenham.

Both have tables of data about the planets.

Subject pedagogy

Useful websites and applications

www.nineplanets.org has lots of planetary data.

Multimedia science school, New Media (2002), has an activity and sheets for KS4 to do this in a computer room. For information on the package see www.new-media.co.uk

Resources:

Tasks 1 and **2** and the **Tutorial**
Computer and spreadsheet software.

Issue 3: Applications, relevance and cross-curricular issues – Religious views on the beginning and end of the Universe

Prior knowledge and experience:

Possible tasks:

Preparation for tutorial:

1. Research and be prepared to describe the three possible fates of the universe.
2. Research the (major) religious views of creation theory. Consider a strategy for the "My church believes….." question from a well meaning pupil.
3. Prepare a debate on "the Earth is at the centre of the Solar System".

Possible activities during tutorial:

1. Present research. Discuss whether "everything" will end, whether there was a defined "start".
2. Discuss strategies for dealing with other viewpoints. Refer to syllabus for exact wordings.
3. Discuss how to organise a debate for a class to join in.

AST Input:

- Clarify the meaning of density in order to explain the importance of critical density as the deciding factor on the future of the universe.
- Inform about recent research/ evidence for accelerating expansion of the universe.
- How did key figures use observation and evidence to further understanding? What were issues and problems facing scientists in their day?

Reading:

Subject knowledge and understanding

OCR **Cosmology** option book, Cambridge University Press, Cambridge.

The RE department may have information on creation theories covered in the statutory RE course at KS4.

The PPARC magazine **Frontiers**, received free in most schools, has recent articles on Space Research.

Subject pedagogy

Sang, D. and Wood-Robinson, V., **Teaching Secondary Scientific Enquiry**, John Murray, London. Section 7.14.

Useful websites and applications

The following two sites offer information about the future of the universe.
www.astronomytoday.com/cosmology/universe.html
www.slate.msn.com/id/2096491/entry/2096506

There is some information on creationism and the evolution/creation debate at
www.carm.org/evolution/evocreationism_helen.htm

Resources: