

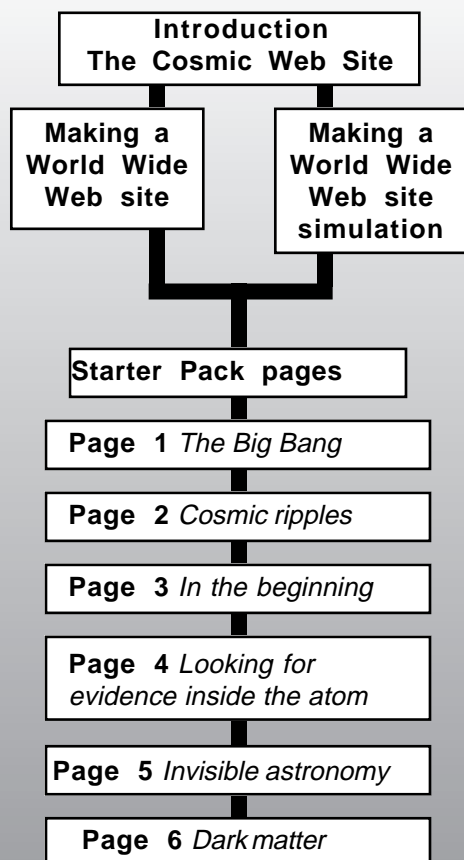
Pupil Research Brief

Teachers' Notes

Syllabus Coverage *Subject Knowledge and Understanding*

- ❑ theories of the origin of the Universe have to take into account:
 - that light from other galaxies is shifted towards the red end of the spectrum
 - that the further away the galaxies are, the bigger the 'Red Shift'
- ❑ one way of explaining this is:
 - that other galaxies are moving away from us very quickly
 - that the further away from us a galaxy is, the faster it is moving away from us
- ❑ this suggests that the whole Universe is expanding and that it might have started, billions of years ago, from one place with a huge explosion, or 'big bang'

Route through the Brief



Introduction

In this Brief pupils learn how to create a Web-site to explain the theory of the origin of the Universe known as the Big Bang.

They are provided with the basic text and are asked to:

- provide illustrations to go with the text
- identify words and phrases that need further explanations, and so one task will be to compile a glossary page for the text. Other words and phrases also may require explanations. Pupils are to identify these and allocate the tasks of providing hypertext pages between themselves. They are required to look for the information to be put onto these pages and to find suitable images to accompany the text. This information may come from textbooks, magazines and video programmes, or from the Internet itself. The whole exercise should provide a comprehensive explanation of the Big Bang theory and how research work currently being conducted is helping to shed light on the likely fate of the Universe.

This task is obviously not suitable for all, but some of the work can be carried out successfully by lower achieving pupils. The text that is provided can be trimmed to make the Brief shorter and more manageable.

The work can be done as a paper exercise, but the Brief was designed to be carried out using material

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downloaded from the Internet, and it is hoped that this is how pupils will do it wherever possible.

Prior knowledge

Before attempting the Brief, pupils should have a basic knowledge of stars and galaxies. An understanding of the structure of the atom would be a great advantage, as would having some experience of using the Internet.

Running the Brief

Pupil grouping

Pupils could work in a number of groupings during this Brief. Suggestions are:

Initial briefing and introduction - whole class; teacher introduces the topic and allocates tasks

Pages 1 to 6 - individuals, pairs or small groups; pupils are allocated the tasks of finding illustrations or creating hypertext pages

Timing

The Brief may require 3 or more hours of classroom time, depending on whether the work is done as a paper exercise or on computers, and also on the enthusiasm and ability of the pupils.

Activities

The teacher should issue the pupils with the **Study Guide** which provides pupils with a summary of what they should produce as they work through the Brief. It can also act as a checklist for pupils to monitor their own progress. The Brief is intended to provide a context for pupils to carry out background research using textbooks and any other resources available in school. The tasks they are to carry out can vary depending on the time available, but at the very least they should create hypertext pages for the following topics:

Galaxies

The information pupils might supply would be the size of a typical galaxy, the number of stars in a galaxy, details of the Hubble Classification of galaxies and clusters of galaxies, and the average mass of a galaxy.

Red Shift

Hubble measured the shift in the absorption lines in a galaxy's spectrum. As white light from a star's interior passes through the cooler, lower pressure gases of

the stellar atmosphere dark lines appear in the spectrum. When stars or galaxies move away relative to another body all the absorption lines shift towards the red end of the spectrum. The more higher achieving pupils should be able to understand this.

The Hubble Space Telescope

This page may include general information about the telescope as well as details of some of the discoveries made using the telescope. This could include any up-to-date news at the time the Brief is being run.

Albert Einstein

Einstein's contribution to the understanding of cosmology should be acknowledged and details about his life and achievements can be included on a separate page.

The Places where stars are formed

A page can be given over to an explanation of how stars are formed, and possibly the classification of stars (including the Hertzsprung-Russell diagram) and details of the nuclear fusion process that goes on inside a star.

CERN

Pupils may have a go at creating a page about the work of CERN and some of the discoveries made there.

Electromagnetic spectrum

The opportunity could be taken to get pupils to review work already done about the electromagnetic spectrum on a separate page, explaining the properties and uses of the different types of electromagnetic waves.

Radio telescopes

Pupils here could include information about the discoveries made over the years that radio telescopes have been used. They could mention specific telescopes, such as Jodrell Bank, Arecibo and the Very Large Array telescopes.

Quasars

Quasi-stellar radio sources were discovered in 1963. They are probably the most distant objects known, but some astronomers dispute that they are as far as their red-shift would suggest.

Pulsars

Jocelyn Bell (later Burnell) was a graduate student at Cambridge University in 1967 when she discovered pulsars. She and Professor Anthony Hewish at first thought that these regular pulses were signals from extraterrestrials, which is why they were at first called LGMs (for Little Green Men)! They are now known to be rotating neutron stars.

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Black holes

Pupils could explain that black holes are so called because they do not allow light to escape from them. They may also give information about where black holes may be located.

Fate of the Universe

The three main theories of what will happen to the Universe depend on how much mass there is. If there is less than a critical mass the Universe will continue to expand forever. A critical mass will lead to a situation where gravitational forces will slow down the expansion of the Universe until it comes to a halt. If the mass is greater than this, the Universe will eventually go into reverse; galaxies will begin to move back and the Universe will collapse back to a single point. This is the Big Crunch. Pupils should be asked to find a way of representing these three cases diagrammatically.

The text also contains other words and phrases that could be given separate pages to themselves, or a glossary of terms could be compiled, defining these words and phrases briefly.

Scottish syllabus coverage

Standard Grade Physics - *Space Physics*

Further pupil research opportunities

The results of cosmology research are regularly being published in magazines, newspapers, television and on the Internet. Pupils can update and extend their work on this topic using these sources of new information.