

## GCSE Physics

### Looking Back In Time to the Big Bang Theory

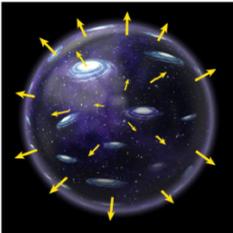
GCSE Physics  
Lesson Element

#### Looking Back In Time to the Big Bang Theory

Student Task Sheet 1

##### Looking Back In Time

The Big Bang theory says that the universe started out as a tiny point of concentrated energy about 13.5 billion years ago. The energy expanded and the universe has been expanding from this point ever since. Astronomers use telescopes to look at distant galaxies and the spectra of light from stars to look for evidence for the Big Bang theory. Astronomers have observed that almost all of the galaxies are moving away from each other.



This diagram shows the universe expanding.  
The larger the arrow, the faster the galaxy is moving.

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### Instructions and answers for teachers

#### The Activity:



*This activity offers an opportunity for English skills development.*

#### Associated materials:

'Looking back in time to the big bang theory' Student Task Sheet.

## Introduction to the task

Learners may have already studied red-shift and evidence for the Big Bang theory. This Lesson Element can be used as part of teaching this topic or as a consolidation. Learners should be introduced to at least one alternative theory to the Big Bang and reasons why the evidence supports the Big Bang rather than these other theories.

Common difficulties and misconceptions include learners thinking the Big Bang was an explosion and that it is how the universe came into being. It does not say how the expansion was caused, just what happened since it happened. Learners do not always think of the universe in 3D and that there is a centre. Learners may know of open and closed universe models and that theories such as the Big Crunch, but not understand what this means.

## Notes for teachers

### Activity 1: Looking Back In Time

This is a good consolidation activity or research activity to enable learners to try and grasp the enormity of the universe. It also requires learners to recall their knowledge of the expansion of the universe and red shift, and apply this knowledge to a spectrum from a distant star. Learners will need access to textbooks or the internet.

There are a couple of YouTube clips that could be shown to introduce the activity:

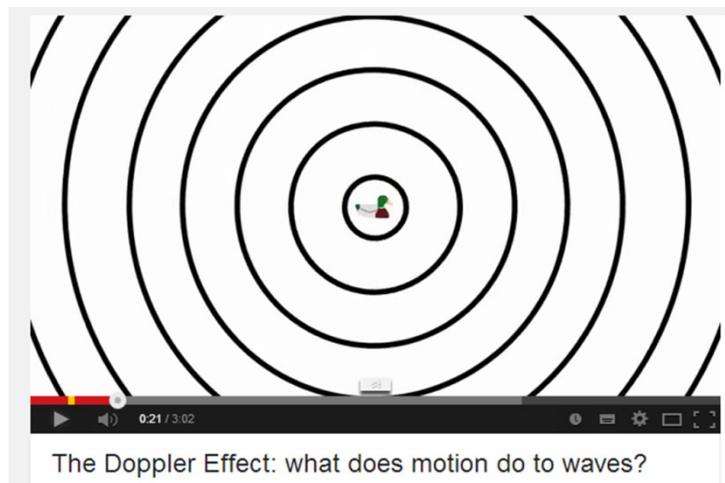
This clip is an introduction to the scale of the universe from a grain of sand:

<https://www.youtube.com/watch?v=MfsAuzmx-N4>



Whilst this one shows a summary of the Doppler Effect:

<https://www.youtube.com/watch?v=h4OnBYrbCjY>



Student Task Sheet 1 has a number of questions based on red-shift and the Big Bang theory. It also has the opportunity for learners to try and represent their ideas diagrammatically with a word limit. This can often prove challenging to higher ability learners who enjoy writing descriptions and not modelling, but also appeals to lower ability learners who find descriptive work challenging.

## Suggested answers to Student Task Sheet 1

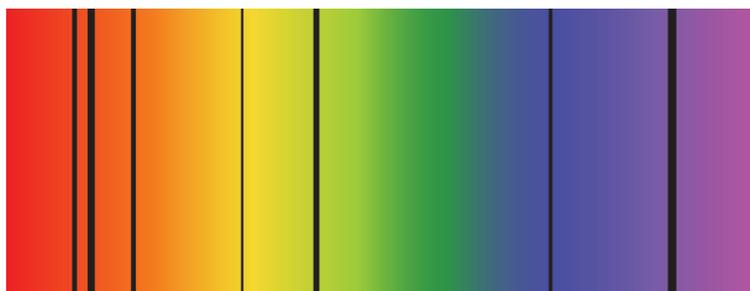
1. What is a galaxy?

A galaxy is a group of millions of stars held together by gravity

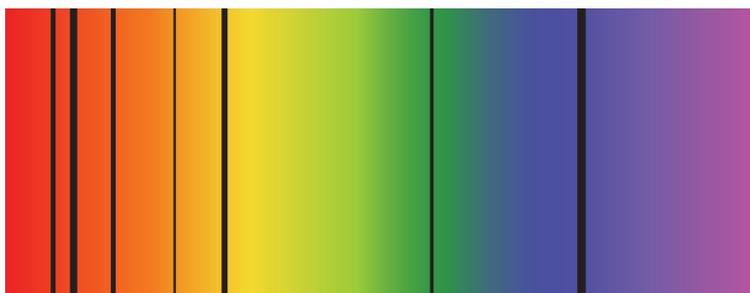
2. Which galaxies are moving the fastest?

The galaxies that are further away are moving the fastest

3. The Doppler Effect: Draw in a series of diagrams in the 4 boxes which show how light can appear to be blue shifted and red shifted. You can use a maximum of 8 words in the whole comic strip.
4. This is the spectrum of light from a star. The star contains helium. The helium causes black lines in the spectrum, where the helium has absorbed light.



This is the spectrum of light from a star that is further away.



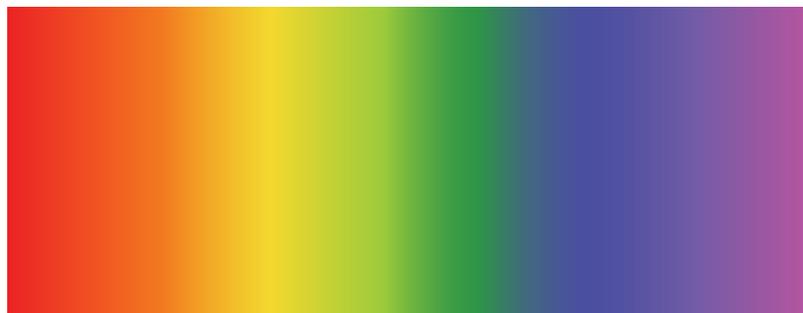
- a) What do you notice about the black lines in the second spectrum?

The black lines have moved towards the red end of the spectrum.

- b) What is this effect called?

This effect is called red-shift.

- c) This spectrum is from a star that is even further away. Draw on the spectrum where you would expect the lines to be.



All of the black lines must be shown as moving nearer to the red end of the spectrum.

- d) What causes the black lines to move?

The black lines move because the wavelength of light gets longer as the star moves further away.

- e) Do you think that this evidence supports or opposes the Big Bang theory?

This evidence supports the Big Bang theory, because it shows that the stars are moving away. If the universe started as an explosion, and then expanded, you would expect the stars to be moving away.

## Activity 2: Evidence for the Big Bang theory

This task would work well as the basis for group work or lead to whole class discussion. Learners may have additional opinions about this topic that they want to add to a class discussion.

Learners are to research the statements to determine whether or not they support the Big Bang theory.

### Extension ideas:

Learners could debate evidence for and against the Big Bang theory, after researching some of the alternative theories, such as the Steady State theory.

## Suggested answers to Student Task Sheet 2

The statements in **bold** support the Big Bang theory:

**The universe began as an expansion from a single point and has been expanding ever since.**

The universe has always been expanding, and will continue to expand.

**Astronomers have observed galaxies moving away from our galaxy.**

**The light from distant galaxies is red-shifted.**

**The light from galaxies that are further away is more red-shifted.**

Our universe is one of a number of universes that first expand then contract again.

**Cosmic microwave background radiation predicted by the Big Bang theory has been detected using radio telescopes.**

The more blue shifted the light is from a galaxy the slower it is moving towards our own galaxy

Cosmic microwave background radiation will eventually be detected as visible light

(b) The Big Bang theory describes how the universe began to expand about 13.5 billion years ago, and is still expanding today. The evidence for this is that the spectra from distant stars are red-shifted, meaning that they are moving away from us. Also, the universe has cosmic microwave background radiation, which was caused by the Big Bang.

### Supporting information

There are opportunities for independent, pair and group work with both of these tasks, as well as links to ICT, English skills, and presentation skills. You can also link this work to how science works. The red-shift analysis task gives learners an opportunity to relate what they have learned to a real life scenario. The evidence for the Big Bang task gives learners an opportunity to voice their opinions about the Big Bang theory. For example, some religious groups do not like this theory of the beginnings of our universe.

There is also scope to discuss ongoing scientific research, such as what is happening at the LHC and how recent discoveries by the LHC, such as the Higgs boson, are developing our understanding of how the universe works.

There are many good websites about red-shift and cosmic microwave background (CMB), including some good videos. Here are some good places to start:

[http://www.bbc.co.uk/schools/gcsebitesize/science/ocr\\_gateway/energy\\_resources/big\\_bangrev2.shtml](http://www.bbc.co.uk/schools/gcsebitesize/science/ocr_gateway/energy_resources/big_bangrev2.shtml)

<http://physicsnet.co.uk/gcse-physics/red-shift/>

[http://www.bbc.co.uk/science/space/universe/sights/cosmic\\_microwave\\_background\\_radiation](http://www.bbc.co.uk/science/space/universe/sights/cosmic_microwave_background_radiation)

<http://www.youtube.com/watch?v=8FPVIV-LzYM> A short video on red-shift.

Here are some good websites and videos about the Big Bang theory:

[http://www.bbc.co.uk/science/space/universe/questions\\_and\\_ideas/big\\_bang/](http://www.bbc.co.uk/science/space/universe/questions_and_ideas/big_bang/)

<http://resources.schoolscience.co.uk/STFC/bang/bang.htm>

<http://www.youtube.com/watch?v=gs-y+WMuBNr4> (A short video on the Big Bang theory.)

Be aware that there are a number of sites claiming that the Big Bang theory is wrong. You may wish to point learners to the above websites as a good starting point.

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