

### Lesson 16: Has the universe always been there?

#### Teachers' notes

The edge of the visible universe is estimated to be between 48 billion light years and 78 billion light years away from Earth. This distance is difficult to imagine without a little help.

#### **Starter**

The starter activity is designed to help students visualise just how big the universe is by getting them to sort several well known objects in space by their size. They are then told the relative sizes of the objects and are introduced/reintroduced to the term 'light years'.

(It is useful to get the students to calculate the size of a light year in kilometres. Slide 4 of the PowerPoint takes the students through this exercise in steps.)

For lower ability students it is often useful to use an analogy similar to the one below, though they should realise that the visible universe is still too large to be usefully included.

- If the Earth was the size of a golf ball in the centre of London, then:
- The moon would be approximately the size of the pea.
- The Solar System would be approximately the size of Greater London (it would easily fit inside the M25!).
- The Milky Way would be about the same size as the orbit of Jupiter (3 billion kilometres in diameter).
- The visible universe would be 1000 times larger than the real size of the entire solar system.

#### **Main Activity**

The main body of the lesson is split into two main parts:

- The first part deals with the theories that have been put forward to explain how the universe might have started and how it is changing.
- The second part deals with the evidence used to support the theories.

#### **Theories**

##### **PowerPoint slide 6**

The Background shows an image taken by the Hubble Space Telescope (HST) and is known as the 'Hubble Deep Field'. The telescope was directed towards a patch of the sky that was thought to be empty, as no objects had been seen by Earth based telescopes.

The students can see that there are clearly objects in this area. Each point in the picture is a galaxy whose light has travelled billions of light years to reach Earth.

Students should be encouraged to think about how all these galaxies were formed, or whether they have always been there.

### ***PowerPoint slide 7***

The timeline gives a brief outline of each of the main theories trying to explain the origins of the universe and when they were first proposed. (Below are slides that give more details on each theory.)

As the timeline is shown to the students the teacher should use the information provided (and any extra they feel necessary) to expand on the theories. Students are also given a handout that explores each theory in a little more detail.

The point should be made that there is a large period of time between the early theories and those proposed at the beginning of the last century. Students should be asked to think why they think this is the case.

### ***PowerPoint slide 8***

Students should work in small groups and each group needs to be provided with a set of theory cards. Each card contains a brief outline of the theory (as shown on the timeline slide).

The task requires students to sort the theories into groups (a suggestion is given).

**Students should be encouraged not just to sort the cards into groups of nearly equal sizes. It may be the case that most of the cards fall into one group and only one card falls into the other.**

### ***Evidence Slides***

These slides discuss the evidence that has been or is used to support the various theories discussed earlier in the presentation. The slides covering 'Red Shift' and 'The Cosmic Microwave Background' discuss material mentioned in the syllabus. It should be noted that this lesson is not intended for use to specifically teach these pieces of evidence and is best used to help students understand the importance of these pieces of evidence in our current view of the universe.

The task requires students to match the evidence cards to the theories they have discussed earlier and then fill in the worksheet that is included. **It should be made clear to the students that the evidence may support more than one theory.**

Students can discuss the questions posed and answer them on the back of the worksheet.