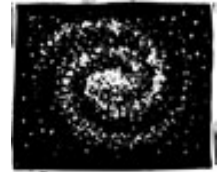


THE UNIVERSE

Galaxies

A **galaxy** is a huge group of stars, solar systems, dust and gas bound together by gravity. Astronomers classify most galaxies into the following three types: spiral, elliptical and irregular. **Spiral galaxies** are those that appear to have a bulge in the middle and arms that spiral outward like pinwheels. **Elliptical galaxies** look like round or flattened balls or discs. Galaxies that do not have regular shapes are known as **irregular galaxies**. **Quasars** are young, active galaxies with giant black holes at their centres.

Our solar system is located in a spiral galaxy called the Milky Way. The Milky Way is seen as a standard spiral galaxy. When you see the Milky Way on a clear night in the summer, you are looking towards the centre of our galaxy.



The Universe

Astronomers define the **universe** as all of space and everything in it. Beyond our galaxy are billions of other galaxies, many of which contain billions of stars.

The size of the universe and the distance between objects is immense. For example, the Andromeda galaxy is the most distant object that can be seen with the human eye. Light from this galaxy has travelled 3 million years before reaching Earth. When that light actually reaches your eye, you are seeing how the galaxy looked 3 million years ago. It is as though you are looking back in time! Astronomers have photographed galaxies that are billions of light years away from Earth. Light from these galaxies has travelled for billions of years before it reached Earth.



Astronomers have proposed that billions of years ago, the universe was no larger than a period at the end of this sentence. This tiny universe was an incredibly hot and dense point, called a **singularity**. The universe exploded in what astronomers call the **big bang**. The universe formed in an instant during this enormous cosmic explosion. Astronomers estimate that the big bang occurred about 13.7 billion years ago.

Evidence for the big bang comes from two different sources. Firstly, an American astronomer named **Edwin Hubble** first discovered that most of the galaxies are moving away from each other. Hubble also discovered a relationship between the distance to a galaxy and its speed. **Hubble's Law** states that the farther away a galaxy is, the faster it is moving away from us. Hubble's Law suggests a rapidly expanding universe.

Secondly, in 1965, two physicists accidentally discovered faint radiation on their radio telescope. This mysterious radiation, now called **cosmic background radiation (CBR)**, was coming from all directions in space. Scientists later concluded that this radiation is left over from the big bang.



What will happen to the universe in the future? One possibility is that it will continue to expand, as it is doing now. All of the stars will run out of fuel and burn out, and the universe will be cold and dark. Another possibility is that the force of gravity will begin to pull the galaxies back together. The result would be a reverse big bang, or "big crunch". All of the matter in the universe would be crushed into a gigantic black hole.

REVIEW QUESTIONS – THE UNIVERSE

1. What is a galaxy?

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Match each stage of a star with its definition.

_____ 2. spiral galaxy

a. Looks like a round or flattened ball or disk

_____ 3. elliptical galaxy

b. Does not have a classifiable shape

_____ 4. irregular galaxy

c. Has a bulge in the middle with arms that spiral outward like a pinwheel

5. A very bright, young galaxy with a giant black hole in the centre is called a _____.

6. What is the name of the galaxy we live in, and what type of galaxy is it?

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7. When did the big bang occur, approximately? _____

8. State Hubble's Law and describe how it shows evidence for big bang theory.

9. Radiation left over from the big bang is called _____.

10. Describe two possibilities of what will happen to the universe in the future.

a.	b.

11. Which possibility in question 10 do you think is more likely? Explain why.
