



## Part 1 – How far away are the stars?

For many years astronomers believed that our galaxy, the Milky Way, was the only galaxy in the universe. In fact they thought that the Milky Way was the whole universe. We now know that it is just one of millions of galaxies and the universe is much bigger than previously imagined.

All the stars in the universe are different. Some give off large amounts of light (they are highly luminous), others do not emit as much light. A small star that is relatively close to us may appear the same brightness as a larger star that is much further away. Because of this, you cannot judge the distance of a star by its apparent brightness.

In the 1920s, Edwin Hubble detected objects called variable stars in fuzzy patches known as nebulae. These variable stars expanded and contracted regularly in a pulsating manner and were similar to other celestial objects known as the Cepheid variable stars (sometimes spelt as Cepheid). It had been shown that there was a tight correlation between the time taken for one complete pulse and the luminosity of the star (how much light is actually emitted by the star). Hubble, by measuring the period of these stars, was able to calculate the luminosity of the variable stars. By comparing this calculated luminosity with their apparent brightness in the sky, he could judge their distance away from the earth. He showed that these nebulae were not clouds within our own galaxy, but were external galaxies far beyond the edge of the Milky Way.

## Questions

1. Explain the difference between luminosity and apparent brightness.
2. Why is it not possible to judge the distance of a star from earth by how bright it appears in the sky?
3. Why were variable stars given this name?
4. What does the 'period of a variable star' mean?
5. Describe the correlation that helped Hubble estimate the distance of a star from the earth.
6. What was Hubble's conclusion from these observations?