



## Expanding Universe - Teacher's Notes

### The Beginning of the Universe

According to the **Big Bang Theory**, (the scientific theory, not the TV show) about 13.7 billion years ago an explosion blew a hot plasma away from a single point to fill Space. In the first moments it was too hot to form atoms but it released light. As it cooled the hydrogen from which all matter was formed appeared as atoms. The Universe began to assemble.

Light released back then is still travelling through our Universe now. Astronomers call it cosmic microwave radiation. Using an optical microscope, the astronomer Edwin Hubble measured how much light was being stretched as galaxies moved away from the origin. When white light



is stretched or travels through a medium it separates out into its different wavelengths or colours. The longer it travels or the denser the medium it travels through, the more the light separates into its different colours. This is known as "red shift". From Hubble's calculations the beginning of the

Universe was estimated as 13.7 billion years ago.

Using a radio telescope, Goddard Space Flight Centre scientists in 2003 looked at maps of background microwave radiation and noticed patterns that mark the beginning, and have since estimated that it took a further 200 million years before the first stars began to shine.

We can estimate that our Solar System was formed about 5 billion years ago by measuring the age of meteorites by radioactive decay. Planet Earth became solid about 4.56 billion years ago, but the oldest rocks we can measure are only around 3.8 billion years old. Early Earth was bombarded



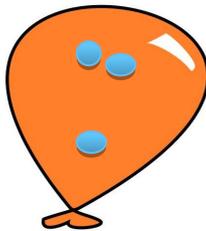


## Expanding Universe - Teacher's Notes

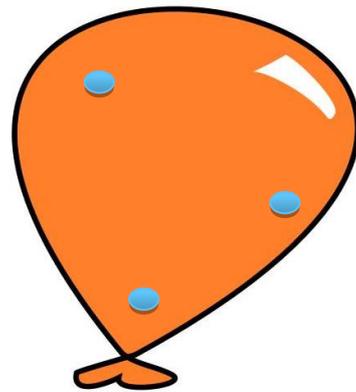
by asteroids and meteors melting the surface many times. Some minerals, such as the zircons found in rocks near Jack Hills in WA can be dated back to 4.2 billion years old.

### Expanding Universe - Teacher Demonstration

The expansion of a Universe with unchanging mass/matter can be illustrated if the teacher makes many little dots on the surface of a deflated balloon with a permanent marker and then inflates it. The same amount of matter is still there. The dots in the expanded universe are just further apart and fill a greater space.



**Before**



**After**

Scientists are still measuring the movement of stars today and they all still appear to be moving away from that same point. Indeed some estimate that rather than their movement slowing, it is actually speeding up.

It is from these original dispersed hydrogen atoms that the galaxies, solar systems, stars, planets, moons and other space debris that we have now were created. Most of Space however is still empty space and the most common element in the Universe is still hydrogen.



Santos & ESWA supporting earth science education