

Humanism for Secondary School Pupils

S4 – 6



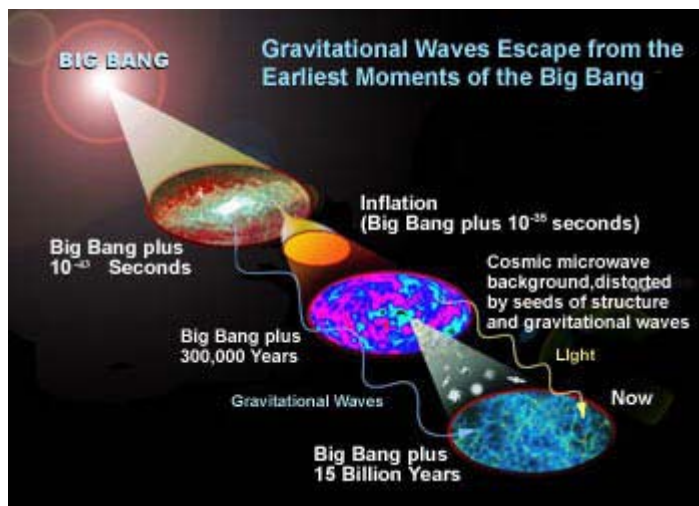
1. IN THE BEGINNING

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The Big Bang

“In the beginning the universe was created. This has made a lot of people very angry and been widely regarded as a bad move.”

Douglas Adams, author of 'A Hitchhikers Guide to the Galaxy'



Over the course of the last century great progress has been made in the fields of astronomy, physics and mathematics. It is now thought that about 15 billion (that's 15 thousand million) years ago a very small, very dense, very hot object called “a singularity” suddenly began to expand until it formed the universe.

A famous scientist called Fred Hoyle did not agree with this theory, which he ridiculed as “The Big Bang”, and the name has stuck.

Another way of describing it is to imagine a balloon inflating incredibly quickly, taking just one second to cool down from trillions and trillions of degrees Celsius to a few billion. This was cool enough to allow the synthesis of protons and neutrons followed by the formation of hydrogen and helium nuclei. After about 30 minutes the Big Bang was over.

If you find this hard to understand, don't worry – you're not alone. Only a very few scientists can follow the maths and physics involved. However, they all agree that this is the best explanation that fits the evidence; so until you come up with a better one...

The universe continued to expand and cool to temperatures where the helium nuclei could absorb electrons and form atoms. After about one billion years these atoms coalesced under the force of gravity to form gas clouds that would become stars.

Evidence

In 1965 scientists discovered cosmic microwave background radiation, a relic left over from the Big Bang. You can hear it yourself – it is the static you get when you try to tune in a radio or TV station.

It is important to realise that this was the beginning of space and time. To ask, “*what was there before the Big Bang?*” is meaningless because time did not exist.

What Can We See?

Powerful telescopes now allow us to see great distances, to the furthestmost corners of the universe. The distances are so vast that we can't use ordinary units of length to describe them.

The astronomical unit of length is based on the speed of light.

Light travels at an incredible 300,000km (186,000miles) per second so one light second is not a unit of time but a unit of length – 300,000 km - the distance light travels in one second.

A light year is the distance travelled by light in one year:

$$300,000 \times 60 \times 60 \times 24 \times 365 = 9,460,000,000,000 \text{ km}$$

The nearest star to us is called Proxima Centauri and it is 4 light years away. When we look at it through a telescope, the light entering our eye left that star 4 years ago. The further we look into space the older are the stars that we see.

The Furthest We Can See

Our most powerful telescope at the moment is The Hubble, named after a famous astronomer called Edwin Hubble.

The Hubble telescope orbits earth in space where its view of the skies is not obscured by our atmosphere. The most distant galaxy it has photographed is an astonishing 13 billion light years away and we are seeing it as it was, just 2 billion years after the Big Bang.





Hubble Ultra Deep Field



THE FORMATION OF OUR SOLAR SYSTEM

The Milky Way



In one spiral galaxy, which we now call the Milky Way, one star began to form where our sun is now and after consuming its usable hydrogen it exploded, forming a variety of elements and sending matter out in all directions. This material gradually coalesced to form all the planets and the asteroid belt.



At the same time, a smaller star began to form at the centre of the previous explosion and our sun started to generate energy again by fusing hydrogen atoms to form helium in a nuclear reaction which continues to the present day and should go on for several million years yet.

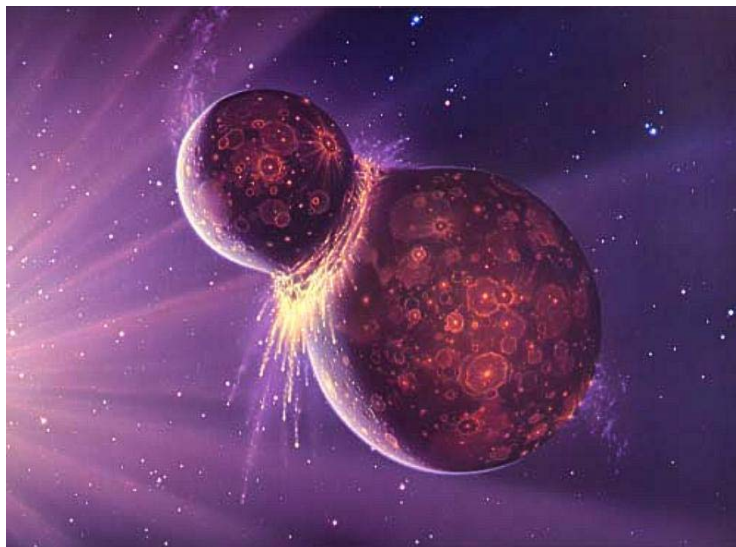
Formation of Earth

Although the Earth was just one of the planets formed in this way it is unique in several respects, one of which is that, due to its distance from the sun, the temperature on its surface ranges from -70 deg C to $+70$ deg C. This allows liquid water to exist.



Formation Of The Moon

Early in its life, Earth was involved in a collision with another planet, which caused huge amounts of matter to be thrown off into space. This coalesced to form the Moon.



2 The Early Earth

The earliest Earth was probably made up of mainly silicon compounds, oxides of iron and magnesium and smaller amounts of all the natural elements. It was subjected to a constant bombardment of other bodies that increased the mass of the Earth and as it got bigger, the extra gravity forced the mass to contract into a smaller volume, producing heat. Down to a depth of about 500km, the surface became so hot that the iron melted and sank under its own weight until it collected at the centre where it is found today as a solid core.

The Atmosphere

The first atmosphere was formed when gases trapped in the interior of the Earth escaped through vents. This process continues and can be seen today in volcanic eruptions. This early atmosphere was probably made up mainly of water vapour. As the planet cooled this condensed and fell as rain in a deluge of truly massive proportions to form the oceans. Other gases present included carbon dioxide and nitrogen.



The Land Mass

Lava flowing from the interior spread over the surface and solidified to form a thin crust which grew to form a continental land mass. This process probably lasted for the first 2 billion years of the Earth's existence.

The Hadean Era

The early Earth was a fairly inhospitable place so this era in its history has been named after the Greek name for hell, Hades. Nevertheless the scene was set for life to evolve...

Further research

This is a greatly simplified account of many very complex processes.

If any aspect has particularly interested you, then you might want to write a short essay and enter it into our **competition**.

Send your essay to us, education@humanism-scotland.org.uk

and we will post it on our web page with your name and school. At the end of the year – December 2008 - we will award a prize of £50 to the best effort and one of £25 to the runner-up. Entries should be about 500 words in length.