Big Bang Theory

. . . and how the Universe came to be

Expanding Universe

* The Universe is expanding, filled with galaxies that are moving away from one and other.

Expanding Universe

* Edwin Hubble first observed this when he identified individual stars inside the Andromeda galaxy and realized it was separate from the Milky Way.

Expanding Universe

* He also observed that all galaxies are moving away from each other, and the further a galaxy is the faster it travels.

Big Bang

* All matter and energy in the Universe expanded from one tiny dot.
* There was a hot dense expansion approximately 13.7 billion years ago.


Quarks
Neutron
Hydrogen nucleus
Hydrogen atom
Protogalaxy
Electron
Proton
Helium nucleus
Helium atom
Galaxy
THE BIG BANG THEORY
TIME BEGINS
ONE SECOND
PRESENT DAY
Time 10-43 sec.
Temperature
10-32 sec.
10 27 °C
10-6 sec.
10 13 °C
3 min.
10 8 °C
300,000 yrs.
10,000°C
1 billion yrs.
-200°C
15 billion yrs.
-270°C
1 The cosmos goes through a superfast "inflation," expanding from the size of an atom to that of a grapefruit in a tiny fraction of a second
2 Post-inflation, the universe is a seething, hot soup of electrons, quarks and other particles
3 A rapidly cooling cosmos permits quarks to clump into protons and neutrons
4 Still too hot to form into atoms, charged electrons and protons prevent light from shining; the universe is a superhot fog
5 Electrons combine with protons and neutrons to form atoms, mostly hydrogen and helium. Light can finally shine
6 Gravity makes hydrogen and helium gas coalesce to form the giant clouds that will become galaxies; smaller clumps of gas collapse to form the first stars
7 As galaxies cluster together under gravity, the first stars die and spew heavy elements into space; these will eventually form into new stars and planets
NOTE: The numbers in cosmology are so great and the numbers in subatomic physics are so small that it is often necessary to express them in exponential form. Ten multiplied by itself, or 100, is written as 10 2, One thousand is written as 10 3. Similarly, one-tenth is 10 -1, and one-hundredth is 10 -2.
Source: The Birth of the Universe; The Kingfisher Young People's Book of Space
TIME Graphic by Ed Gabel

Big Bang

* The Universe was extremely hot and energy spread outward very quickly.

Big Bang

* As the universe cooled, energy began turning into matter (mainly H)

Big Bang

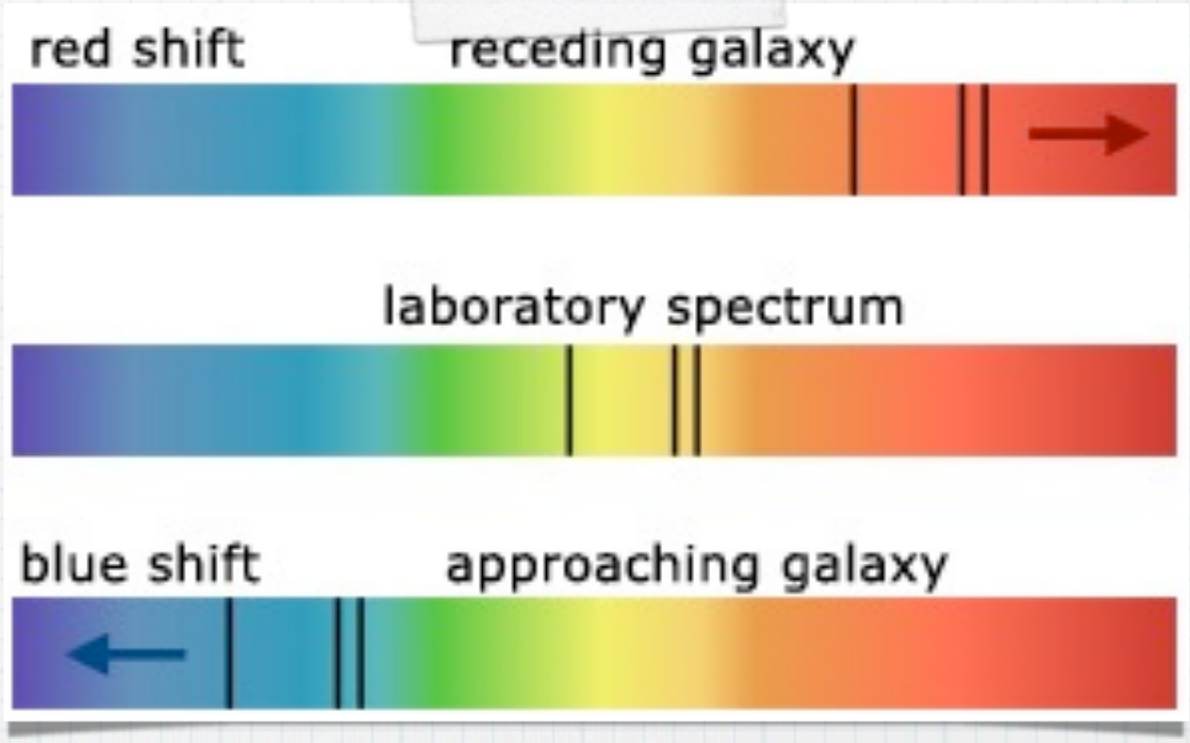
* Over thousands of years, this matter became clumps, which eventually became stars and galaxies.

Evidence for the Big Bang

* i) Static interference is actually radiation, remnants of energy released from the Big Bang.

Evidence for the Big Bang

* ii) **Red Shift:** As galaxies move, the light they emit shifts towards the red end of the light spectrum.



* Many distant galaxies exhibit red shift.