

The Cosmos

Cosmology – the study of the
origin, structure, and future
of the universe

Let's look at our
universe



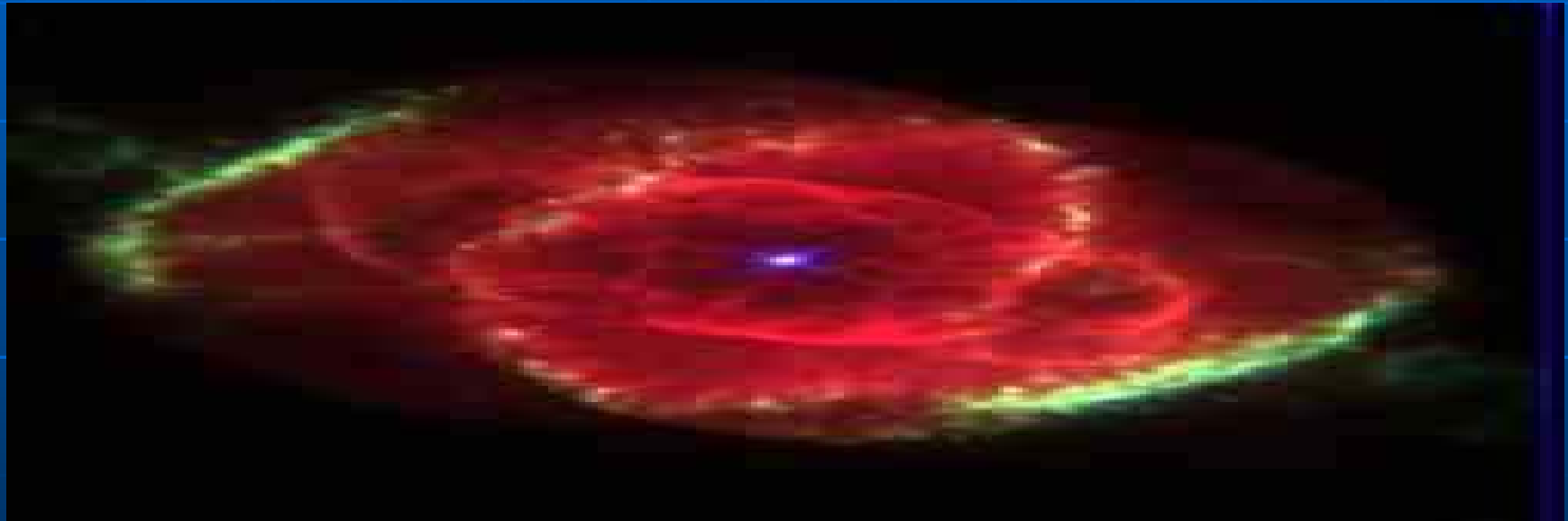
Cartwheel Galaxy



Ring Nebula



Cat's Eye Nebula



What does learning about the universe have to do with me?



IT IS YOU!!!

Big Bang Theory

The theory that ALL matter in the universe was compressed under extreme pressure, temperature, and density in a very tiny spot (less than the size of a superball).

Then, a sudden event called the big bang, sent all of the matter and energy outward in all directions.

As the universe rapidly expanded,
some of the matter came together in
clumps to form galaxies.

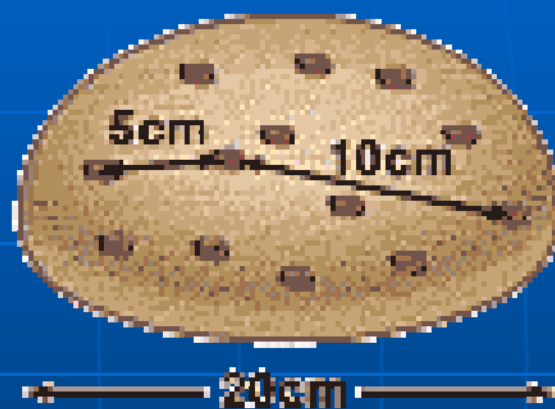
How Old Is The Universe?

- The universe is approximately 10-15 billion years old.

Raison-Bread Model

As bread dough warms and rises, it expands and all of the raisins begin to move apart from one another.

The universe, like the bread dough, is expanding. As the universe expands, galaxies move farther apart from one another.



Evidence for the Big Bang Theory

- Cosmic Background Radiation

In 1964, scientists found radiation coming from all directions in space. This radiation is thought to be the radiation left over from the Big Bang explosion. This is comparable to a kitchen filling up with heat after an oven door is left open.

Evidence for the Big Bang Theory

■ Red Shift

The universe is expanding. Measurements made by scientists indicate that clusters of galaxies are moving apart from one another. As galaxies move away, light waves emitted by the galaxy appear to have longer wavelengths and are shifted to the red end of the spectrum – red shift. Because light from all distant galaxies is red shifted, scientists conclude that the universe is expanding.

NOTE:

- Stars within the Milky Way are not moving away from each other. Why? Galaxy clusters are moving away from each other but the components of galaxies (stars and planets) are not moving apart from each other.

Let's look at some of the observations scientists have made about the universe. Notice the inferences they make regarding their observations. What do you know about inferences?

Observation	Inference
Almost all galaxies are red shifted.	Almost all galaxies are moving away from the Milky Way.
The most distant galaxies show the greatest red-shift.	The most distant galaxies are moving away the fastest.

Observation	Inference
The ratio of recessional velocity to distance is between 50 and 100 km/s per kiloparsec (Hubble Constant)	The Universe has been expanding for 8-15 billion years.
The Cosmic Background Explorer found that the temperature of intergalactic space was not zero.	The Universe has not yet cooled from the Big Bang.

Misconceptions about the Big Bang

The Big Bang was not an explosion that happened “somewhere in space”. Space and time did not exist before the Big Bang – they came into being with the Big Bang.

Misconceptions about the Big Bang

There is no center to the universe because the universe is not expanding into space – space itself is expanding.

Misconceptions about the Big Bang

We are not moving away from the point of the Big Bang because the Big Bang is happening everywhere.

Fate of the Universe

- The expansion of the universe depends on how much matter is in the universe.
- There are three possible scenarios for the fate of the universe...

Scenario 1

- Expansion will stop

Scientists predict that if there is enough matter in the universe, gravity could eventually stop the expansion.

(Remember that gravity is the attraction between two objects).

Scenario 2

- The universe collapses

Gravity could cause matter in the universe to recollapse into one single point – blue shift.

(Scientists call this the “Big Crunch”).

Scenario 3

- The universe expands forever

Stars will age and die and the universe will become cold and dark after many billions of years. Scientists believe that this is the most likely scenario.

Scientists do not believe there is enough matter in the universe to support the other two scenarios.

(Scientists call this scenario the “Big Chill”).

What does learning about the universe have to do with me?

