View of the universe is changing—scales expanding
Our sense of time has changed
Universe began 15 billion years ago at the Big Bang
Matter began contracting
½ billion years later the first big star formed by hydrogen fusion
Oxygen, carbon, iron created and pulled into core of star
Detonation due to collapse—supernova

100 billion stars in the Milky Way
Gravity draws them together
Hydrogen and heavy supernova elements mixed by gravity
Clumps of gas became stars—clustered
Swirled, merged into large galaxies
Process continues today
Spinning clump became very thin dish

100 billion galaxies in visible universe
Milky Way galaxy is extremely flat, with a bulge in the center
Spiral arms along outskirt
300 million years for Sun to orbit galaxy, from 2/3 out one spiral arm
Center of galaxy so chaotic no life there: radiation, gravity, explosions

Stars traveling at 3,000,000 miles/hour at center of Milky Way
Gravity has created solar system and galaxy

Einstein imagined class of objects so massive that light could not escape
He called them 'dark stars', today known as 'Black Holes'
Neil Tyson describes the 'spaghettification' of objects as they are drawn into black holes—torn apart vertically with increasing acceleration
Chandra Observatory views galaxy—contains bright stars devouring other stars
It also has massive black hole
Inferred by enormous speed of stars orbiting the black hole

Universe being mapped by observers at Keck Telescope
Observes solar system sized area of stars with a black hole at center
Matter of black hole the size of a speck of dust is 3,000,000 times mass of Sun

Black hole at center of Milky Way is a hungry dragon devouring anything that strays into its gravity.
Perhaps massive size because it has consumed other black holes.
Dense star clusters and gases are flowing into the black hole.
Each star and cloud that enters increases its mass, becomes larger

Sun’s evolution
5 billion years from now Sun will become a Red Giant
10,000 times brighter than it is today
Expand to engulf the entire orbit of Earth
Gravity holds Sun together
Hydrogen fusion generates pressure that holds gas out from center
As Sun's core consumes core hydrogen, the burning area will expand
Sun's core 1,000,000 degrees as heavier elements fall into it
Will begin to fuse higher elements than helium
Earth's oceans will boil as Sun heats and expands
Fred Adams projects future of our solar system, and
Suggests we can save ourselves
Build space stations and go live somewhere else or
Steer our planet to more habitable climes of our solar system
by manipulation of our orbit by the gravity of asteroids

Another galaxy is approaching the Milky Way
Apache Point, NM mapping universe
Has located 1,000,000 galaxies
Grouped along 'spiderwebs' with lots of emptiness between

Milky Way is traveling toward Virgo Supercluster
Our 'local group' includes the Andromeda Galaxy—approaching us
Our closest neighbor, converging at 300,000 miles/hour
5-7 billion years from now, Milky Way and Andromeda will pass through
one another
Will begin to orbit one another
May fling much material out of both, rearrange stars in both into a
spherical galaxy
Cores of the two will orbit one another and eventually merge
25 billion years from the Big Bang until the 'collision' with the Andromeda galaxy
Our galaxy will change as stars begin to burn out—use up all hydrogen
Stars will be devoured by black holes
Black holes will consume one another
Black holes actually may evaporate one atom at a time
A google (that's 1 with a hundred zeroes) years from now, perhaps the entire
galaxy will be contained in a single enormous black hole