

OUR PLACE IN THE GRAND SCHEME OF THINGS

- UNIVERSE IS NECESSARY FOR OUR EXISTENCE BUT HUMAN BEINGS HAVE A TENDENCY TO INVERT THIS - THAT UNIVERSE EXISTS FOR OUR BENEFIT; THAT WE MARK THE CENTRE OF THE UNIVERSE; THAT THE WHOLE OF CREATION REVOLVES AROUND US.

- EARTH IS CENTRE OF CREATION
- DOMINATION VS COHABITATION
- ANTHROPOCENTRISM → ARROGANCE

- WHERE DO WE REALLY STAND?

FIRST: COSMIC JOURNEY

Our [Physical] Place in the Grand Scheme of Things



To get a sense of our place in the Universe, I highly recommend that you stop to take the [The Power Of Ten](#) journey.

The Power of Ten is "a visual journey consisting of 42 images -- 42 powers of ten. At one end of the journey is the immensity of the known universe, some 10 000 000 000 years old and some 10 billion light years across. At the other end of the journey is a depiction of the three quarks within a proton."


To put the further scales in perspective, I have put together the following table showing our relative size in the grand scheme of things:

An Atom	Approx 10^{-10} meters	10 billionth the size of an average human being	} 10^{17}
A Cell	Approx 10^{-6} meters	A millionth the size of an average human being	
An Adult Human Being	Approx 10^0 meters	Order of magnitude size: 1 meter	
The Earth	Approx 10^{+7} meters	A ten million times larger than an average human	} 10^{17}
SUN The Solar System	Approx 10^{+12} meters	A trillion times larger than an average human	
The Milky Way Galaxy	Approx 10^{+20} meters	A hundred million trillion times larger than an average human A hundred million times larger than the entire solar system	
The Observable Universe	Approx 10^{+26} meters	Mind-bogglingly large!!	

SPATIAL SCALE:

ATOM	$\sim 1 \text{ \AA}$	10^{-8} cm	$\left. \begin{array}{l} 10^{-8} \\ 10^2 \\ 10^9 \end{array} \right\} 10^{10}$ $\left. \begin{array}{l} 10^{10} \\ 10^{17} \end{array} \right\} 10^{17}$
MAN	$\sim 1 \text{ m}$	10^2 cm	
EARTH	$\sim 10,000 \text{ km}$	10^9 cm	
SUN	$\sim 10^6 \text{ km}$	10^{11} cm	$\left. \begin{array}{l} 10^{11} \\ 10^{14} \\ 10^{22} \end{array} \right\} 10^{11}$ $\left. \begin{array}{l} 10^{11} \\ 10^{17} \end{array} \right\} 10^{17}$
SOLAR SYSTEM	$\sim 10^9 \text{ km}$	10^{14} cm	
GALAXY	$\sim 30,000 \text{ lt-yr}$	10^{22} cm	
	$[\text{lt-yr} = c \times (\Delta t)_{\text{YEAR}}]$ $= 3 \times 10^{10} \text{ cm/s} \times 3 \times 10^7 \text{ s/yr}$		
OBSERVABLE UNIVERSE	$\sim 10 \text{ BILLION lt-yr}$	10^{28} cm	



Okay, now consider the fact that if one reduces our galaxy (forget about the observable Universe, for a second) to the size of a typical adult human being, our solar system would be no bigger than an atom. From a galactic perspective, whether or not our solar system exists or not is completely and utterly irrelevant - just as whether or not a given atom exists or not is completely and utterly irrelevant to your existence. In fact, you shed millions of skin cells each day and each cell is made of a millions of atoms.

 And if that doesn't blow you away, consider that if you were to shrink our entire observable universe to the size of an average human, our galaxy would be no bigger than a cell and the solar system would be akin to a large atom.

If it's hard to grasp the size of the universe, it's equally hard to imagine its age. Astronomers calculate that the universe originated about 13.7 billion years ago.

Imagine that the history of the universe is compressed into one year - with the Big Bang occurring in the first seconds of New Year's Day, and all our known history occurring in the final seconds before midnight on December 31. The present time corresponding to 12:00 AM on New Year's Day of the next year.

Using this scale of time, each month would equal a little over a billion years. Here's a closer look at when important events would occur when we imagine the universe in one year:

January	February	March	April	May	June	July	August	September	October	November	
											
New Year's Day: The Big Bang		Milky Way forms					Sun and planets form	Oldest known life (single celled).		First multi-cellular organisms	
December											
1	2	3	4	5	6	7	8	9	10	11	
12	13	14	15	16	17	18	19	20	21	22	
23	24	25	26	27	28	29	30	31			
Cambrian Explosion (burst of new life forms)		Emergence of first vertebrates		Early land plants		First four-limbed animals		Variety of insects begin to flourish			
		First dinosaurs appear		First mammalian ancestors appear		First known birds					
Dinosaurs wiped out by asteroid or comet				10:15am Apes appear		9:24pm First human ancestors to walk upright		10:48pm Homo erectus appears		11:54pm Anatomically modern humans appear	
				11:59:45pm Invention of writing		11:59:50pm Pyramids built in Egypt		1 second before midnight: Voyage of Christopher Columbus			

The Universe in One Year was inspired by the late astronomer, Carl Sagan (1934-1996). Sagan was the first person to explain the history of the universe in one year - as a "Cosmic Calendar" - in his television series, Cosmos.

Let us look at the calendar in a bit more detail:

The time that is indicated in hours, minutes and seconds represents that given moment on December 31st.

Cosmic Calendar (From The Dragons of Eden - Carl Sagan)

Pre-December Dates

Big Bang	January 1
Origin of Milky Way Galaxy	May 1
Origin of the solar system	September 9
Formation of the Earth	September 14
Origin of life on Earth	~ September 25
Formation of the oldest rocks known on Earth	October 2
Date of oldest fossils (bacteria and blue-green algae)	October 9
Invention of sex (by microorganisms)	~ November 1
Oldest fossil photosynthetic plants	November 12
Eukaryotes (first cells with nuclei) flourish	November 15

December

Sunday	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday
	1 Significant oxygen atmosphere begins to develop on Earth.	2	3	4	5 Extensive vulcanism and channel formation on Mars.	6
7	8	9	10	11	12	13
14	15	16 First Worms.	17 Precambrian ends. Paleozoic Era and Cambrian Period begin. Invertebrates flourish.	18 First oceanic plankton. Trilobites flourish.	19 Ordovician Period. First fish, first vertebrates.	20 Silurian Period. First vascular plants. Plants begin colonization of land.
21 Devonian Period begins. First insects. Animals begin colonization of land.	22 First amphibians. First winged insects.	23 Carboniferous Period. First trees. First reptiles.	24 Permian Period begins. First dinosaurs.	25 Paleozoic Era ends. Mesozoic Era Begins.	26 Triassic Period. First mammals.	27 Jurassic Period. First birds.
28 Cretaceous Period. First flowers. Dinosaurs become extinct.	29 Mesozoic Era ends. Cenozoic Era and Tertiary Period begin. First cetaceans. First primates.	30 First evolution of frontal lobes in the brains of primates. First hominids. Giant mammals flourish.	31 End of Pliocene Period. Quaternary (Pleistocene and Holocene) Period. First humans.			

December 31

Origin of <i>Proconsul</i> and <i>Ramapithecus</i> , probable ancestors of apes and men	~ 1:30 p.m.
First humans	~ 10:30 p.m.
Widespread use of stone tools	11:00 p.m.
Domestication of fire by Peking man	11:46 p.m.
Beginning of most recent glacial period	11:56 p.m.
Seafarers settle Australia	11:58 p.m.
Extensive cave painting in Europe	11:59 p.m.
Invention of agriculture	11:59:20 p.m.
Neolithic civilization; first cities	11:59:35 p.m.
First dynasties in Sumer, Ebla and Egypt; development of astronomy	11:59:50 p.m.
Invention of the alphabet; Akkadian Empire	11:59:51 p.m.
Hammurabic legal codes in Babylon; Middle Kingdom in Egypt	11:59:52 p.m.
Bronze metallurgy; Mycenaean culture; Trojan War; Olmec culture; invention of the compass	11:59:53 p.m.
Iron metallurgy; First Assyrian Empire; Kingdom of Israel; founding of Carthage by Phoenicia	11:59:54 p.m.
Asokan India; Ch'in Dynasty China; Periclean Athens; birth of Buddha	11:59:55 p.m.
Euclidean geometry; Archimedean physics; Ptolemaic astronomy; Roman Empire; birth of Christ	11:59:56 p.m.
Zero and decimals invented in Indian arithmetic; Rome falls; Birth of Islam and the Islamic Civilization	11:59:57 p.m.
Mayan civilization; Sung Dynasty China; Byzantine empire; Mongol invasion; Crusades	11:59:58 p.m.
Renaissance in Europe; voyages of discovery from Europe and from Ming Dynasty China; emergence of the experimental method in science	11:59:59 p.m.
Widespread development of science and technology; emergence of global culture; acquisition of the means of self-destruction of the human species; first steps in spacecraft planetary exploration and the search of extraterrestrial intelligence	Now: The first second of New Year's Day

Within the scheme of the Cosmic Calendar, an average human life of 70-80 years is equivalent to approximately 0.16 cosmic second!

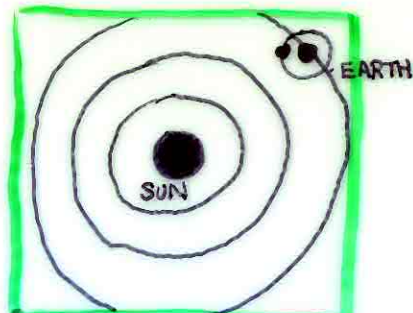
As one can see, human beings made their appearance rather late in the "game". For the most part, the Universe went merrily along - evolving according to the dictates of the laws of physics - without any human presence. And even now, the human beings can hardly claim to affect the course of Cosmic evolution.

TEMPORAL SCALE

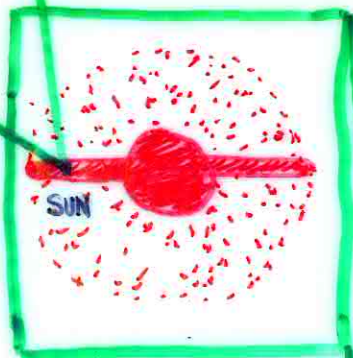
THIS LECTURE	~ 1 HR	$\sim 10^3$ s	} 10^6
HUMAN LIFETIME	~ 100 yr	10^9 s	

HUMAN CIVILIZATION	10,000 yr	10^{11} s	} 10^6
LIFE ON EARTH	3 billion yr	} 10^{16}	
EARTH/SOLAR SYSTEM	5 billion yr		
UNIVERSE	10-15 billion yr	10^{17} s	

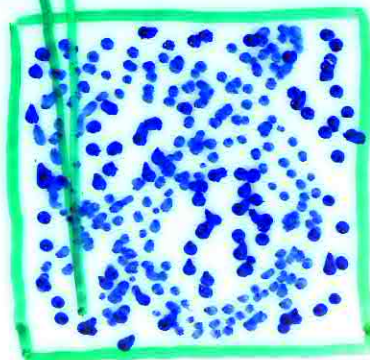
SPATIAL SIGNIFICANCE:



EARTH : A SMALLISH PLANET ; ONE OF NINE
: ORBITS THE SUN ($v \sim 20 \text{ km/s}$)



SUN : G3 STAR
: ONE OF 100 BILLION STAR
: SUN ZIPPING AROUND
GALACTIC CENTRE AT $v \sim 200 \text{ km/s}$



MILKY WAY : ONE OF
2 BILLION+ GALAXIES
IN KNOWN UNIVERSE
: MEDIUM-SIZED
: ZIPPING THRU
COSMOS AT
 $v \sim 600 \text{ km/s}$

* PLANETARY SYSTEMS ARE COMMON!

* COSMOS SHOULD BE TEEMING WITH LIFE
[CONSCIOUS, SENTIENT, INTELLIGENT LIFE?]

* LIFE : FRAGILE / TENACIOUS