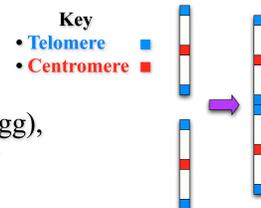


Did You Know?

On Our Ancestry



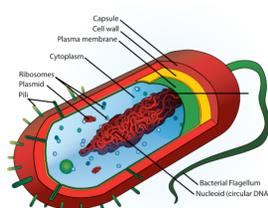
* The human genome contains about 3 billion base pairs, with human and bonobo DNA differing by only 1.6%.
 * Humans have 23 chromosome pairs, apes 24. The closest human relative, the bonobo, has almost identical DNA sequences to that of human chromosome #2, but they are found in two separate chromosomes. Chromosomes normally have one centromere, but human chromosome #2 has two, one of which is inactive. Exactly what one would expect to find if this chromosome is the result of a fusion of two separate chromosomes in our ancestral past. There is also a vestigial telomere in the middle of this chromosome, with telomeres normally appearing only at the ends of the chromosome. Again, this is what we'd expect to see if a fusion event occurred. Chromosome 2 provides strong evidence that we and the other apes share common descent.



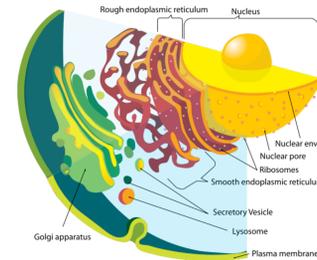
* Endogenous retroviruses (ERVs) are viral sequences within an organism's genome that were added at some point in the past, typically many generations ago. When the DNA produced by a retrovirus infects a germ line cell (cells that make sperm and egg), that DNA can become part of the genome of the offspring, and be passed on to each subsequent generation. When a particular viral sequence shows up at the same relative location in the genomes of different species, it strongly suggest that they share common ancestry. For instance, the probability of finding a particular viral sequence that has infected both the ape and human genomes, at the same relative location in both genomes, due strictly to a chance event, would be 1 in 3 billion. Finding one such ERV would be very strong evidence indeed that apes and humans share common descent; but it gets even better, as sixteen such ERVs have been identified, with the likelihood of this happening without common descent, being an astonishingly small 1 event in 4×10^{151} . ERVs offer irrefutable proof that humans and apes share common ancestry.

Timeline for a 4.5 billion year old Earth with approximate dates

- 3.8 billion years of simple cells (prokaryotes)
- 3 billion years of photosynthesis
- 2 billion years of complex cells (eukaryotes)
- 1 billion years of multicellular life
- 600 million years of simple animals
- 570 million years of arthropods (ancestors of insects, arachnids and crustaceans)
- 550 million years of complex animals
- 500 million years of fish and proto-amphibians
- 475 million years of land plants
- 400 million years of insects and seeds



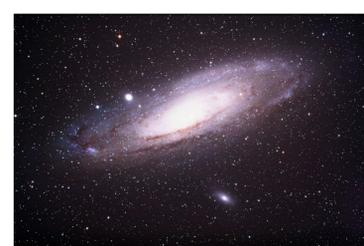
- 360 million years of amphibians
- 300 million years of reptiles
- 200 million years of mammals
- 150 million years of birds
- 130 million years of flowers
- 65 million years since the non-avian dinosaurs died out
- 2.5 million years since the appearance of Homo
- 200,000 years since humans started looking like they do today
- 25,000 years since Neanderthals died out.



Neil deGrasse Tyson PhD Astrophysicist's Top Ten Favorite Facts About the Universe



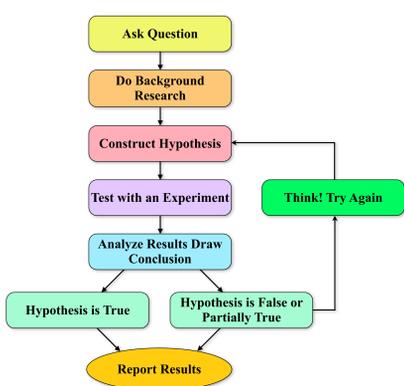
- * There are 100,000 times as many stars in the universe as sounds and words ever uttered by all humans who have ever lived.
- * Humans are genetically connected with life on Earth, chemically connected with life on other star systems and atomically connected with all matter in the universe.
- * Dark matter and dark energy make up 94 percent of the universe. We can measure their existence, yet we have no idea what they are.
- * Beneath a thick layer of surface ice, Jupiter's moon Europa likely harbors a liquid ocean kept warm by the gravitational stresses induced by Jupiter and by neighboring moons -- a potential haven for life.



- * An asteroid the size of Mount Everest slammed into Earth 65 million years ago. The ensuing global climatic catastrophe left 70 percent of all the world's species extinct, including the ferocious dinosaurs.
- * There are more molecules of water in a cup of water than cups of water in all the world's oceans. This means that some molecules in every cup of water you drink passed through the kidneys of Genghis Khan, Napoleon, Abe Lincoln or any other historical person of your choosing. Same goes for air: There are more molecules of air in a single breath of air than there are breaths of air in Earth's entire atmosphere. Therefore, some molecules of air you inhale passed through the lungs of Billy the Kid, Joan of Arc, Beethoven, Socrates or any other historical person of your choosing.
- * The laws of physics, as measured here on Earth, apply everywhere else in the universe -- across space and time.
- * Since light takes time to travel from one place to another, the farther out in space you look, the farther back in time you see. With our most powerful telescopes, we can observe the universe all the way back to its earliest moments -- all the way back to the Big Bang itself.
- * With Mars likely to have been wet and fertile before Earth in the early solar system; with known bacteria that can survive extremes of temperature, pressure and radiation; with asteroid impacts that can cast into space rocks that contain bacterial stowaways, allowing life to move between planets, it may be that life on Earth was seeded by life from Mars, making all of us descendants of Martians.
- * With chemical elements forged over 14 billion years in the fires of high-mass stars that exploded into space, and with these elements enriching subsequent generations of stars with carbon, oxygen, nitrogen and other basic ingredients of life itself, we are not just figuratively but literally made of stardust.

More Facts about the Universe

- * There are more stars than all of the grains of sand on earth.
- * There are an estimated 50 thousand million galaxies in the universe, with the typical galaxy containing 50 thousand million to 100 thousand million stars. It is estimated that there are 10^{22} stars in total in the universe.
- * Astronomers believe that the universe contains one atom for every 88 gallons of space.
- * A galaxy of typical size, about 100 billion suns produces less energy than a single Quasar.
- * As late as 1820, the universe was thought by European scientists to be 6,000 years old. It is now thought to be about 13,700,000,000 years old
- * The matter in the universe is so thinly dispersed that the universe can be compared with a building twenty miles long, twenty miles wide, and twenty miles high, containing only a single grain of sand.
- * A massive star has a shorter lifetime than a less massive star. The more massive a star, the more tightly its gravity pulls it together, the hotter it must be to keep it from collapsing, and the more rapidly it uses up its hydrogen fuel. The reason there are so few really massive stars is that they do not live very long, as little as a million years. For comparison, our sun has an expected lifetime of about 11,000 million years.
- * The star Betelgeuse, a bright star in the constellation of Orion, is estimated to have a diameter of around 700 million miles. If it were placed at the centre of our solar system, it would extend beyond the orbit of Jupiter.
- * The Milky Way has a radius of about 50,000 light years.
- * The most distant object ever observed is estimated to be around 13,000,000,000 light-years away. Discovered by the Hubble Space Telescope in 2004, it is located behind the galactic cluster Abell 2218, which bends the object's light. It is a small, energetic galaxy whose light that is seen now would have set out when the universe was just 750 million years old.
- * Brighter stars emit blue light, and cooler stars emit red light.
- * A black hole is a region of space in which the gravitational field is so powerful that nothing, not even light, can escape. The black hole has a one-way surface, called an event horizon, into which objects can fall, but out of which nothing can come. It is called "black" because it absorbs all the light that hits it.
- * A supernova is a stellar explosion, which is extremely luminous, and causes a burst of radiation that often briefly outshines an entire galaxy, before fading from view over several weeks or months. During this short interval, a supernova can radiate as much energy as the sun could emit over its life span.
- * A Comet's tail always points away from the sun.
- * The three most common elements in the universe are 1) hydrogen; 2) helium; 3) oxygen.
- * Our sun and the surrounding planets orbit around the center of the Milky Way galaxy once every 250 million years.
- * A day on earth one billion years ago was 18 hours.
- * On its trip around the sun, the earth travels over a million and a half miles per day.
- * The sun burns an estimated 600 million metric tons of hydrogen every second.



Scientific method

The scientific method is a body of techniques for investigating phenomena and acquiring new knowledge, as well as for correcting and integrating previous knowledge. It is based on observable, empirical, measurable evidence, and subject to laws of reasoning. Although specialized procedures vary from one field of inquiry to another, there are identifiable features that distinguish scientific inquiry from other methods of developing knowledge. Scientific researchers propose specific hypotheses as explanations of natural phenomena, and design experimental studies that test these prediction.