ChronoZoom

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| The Big Bang |
| 13.7 Ga |
| The Big Bang is the accepted scientific theory for the beginning of the Universe. Over the last 90 years scientists have developed an evidence-based understanding of the Big Bang and its significance. |
| The Birth of the Milky Way Galaxy |
| 13.2 Ga |
| The Milky Way galaxy, otherwise known as home to our Solar System is born. Its name originates from the appearance of a dim "milky" glowing band across the night sky, in which individual stars cannot be distinguished by the naked eye. This appearance results from the galaxy having a disk-shaped structure that is being viewed edge-on. |

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| Origins of Earth and the Solar System |
| 4.56 Ga |
| The Sun is the star at the center of the Solar System. It is almost perfectly spherical and consists of hot plasma interwoven with magnetic fields. It has a diameter of about 1,392,000 km, about 109 times that of Earth, and its mass (about 2×1030 kilograms, 330,000 times that of Earth) accounts for about 99.86% of the total mass of the Solar System. Chemically, about three quarters of the Sun's mass consists of hydrogen, while the rest is mostly helium. The remainder (1.69%, which nonetheless equals 5,628 times the mass of Earth) consists of heavier elements, including oxygen, carbon, neon, iron, and others. |
| The First Prokaryotes |
| 3.8 Ga |
| Prokaryotes are a group of organisms that lack a cell nucleus, or any other membrane-bound organelles. The current model of the evolution of the first living organisms is that these were some form of prokaryotes, which may have evolved out of protobionts. |

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| Aerobic Respiration |
| 2.5 Ga |
| It took over a billion years of evolution for photosynthesis to appear in the first life forms and for enough oxygen to be created to change the atmosphere of the planet. However, when the atmosphere did change, it had an enormous impact on life. This rock from early in the history of photosynthesis is rich in iron, and the red portions are oxidized iron (hematite, or Fe2O3) that record the production of oxygen as a byproduct of photosynthesis and its absorption by iron. The red columns are stromatolites, or structures produced by the photosynthetic bacteria that produced the oxygen. The penny shows the scale. |
| Eukaryotic Cells |
| 1.5 Ga |
| Eukaryote cells include a variety of membrane-bound structures, collectively referred to as the endomembrane system. Simple compartments, called vesicles or vacuoles, can form by budding off other membranes. Many cells ingest food and other materials through a process of endocytosis, where the outer membrane invaginates and then pinches off to form a vesicle. It is probable that most other membrane-bound organelles are ultimately derived from such vesicles. |

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| Sexual Reproduction |
| 1 Ga |
| Sexual reproduction enabled a greater amount of variation in cells. By combining the genetic information of two parent cells, the offspring were given a greater amount of genetic variability allowing them to cope with different environments and have a backup set of genes in case of damage. It also set the foundation for sexual selection which is now a very strong evolutionary force, creating a myriad of different organs, capabilities and behaviors. |
| Multicellular Life |
| 840 Ma |
| It is still unclear how the first multicellular life appeared. One hypothesis is that colonial protists congregated and began to specialize in their functionality. This specialization would have then proven more beneficial to each individual cell than living independently and at some point the colony started to act more like a single organism and began further specialization. Today the simplest multicellular animals are sponges. |

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| Vertebrates |
| 450 Ma |
| The first vertebrates appeared around 450 million years ago. They were small creatures, similar to today's hagfish. They had no jaws, they were small, and they were at the bottom of the food chain. They did however carry the blueprint for all vertebrates alive today and possessed some of the basic features present in modern vertebrates such as a dorsal nerve chord, a post-anal tail, pharyngeal gill slits and basic brains. Over time, they slowly grew in size and diversified into all the forms that we see today. |
| Life on Land |
| 400 Ma |
| The colonization of land provided life with a new set of challenges, though none insurmountable. By departing the seas, life had to face desiccation, additional radiation from the sun and gravity. Many adaptations that were suitable for a marine environment were not of much use on land. Plants were among the first pioneers to leave the seas. They developed an intricate vascular system for support and transport and eventually set the stage for animals to leave the ocean to carve out a living on land. |

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| Dinosaurs and Mammals |
| 250 Ma |
| After the Permian Mass-Extinction, the largest single mass extinction of all time, two important groups of vertebrates rose from the ashes and would come to shape and dominate the next two eras of planet earth. The first were the archosaurs, a group that used to be represented by the dinosaurs, but who today only consist of birds and crocodiles. For 185 million years they ruled the earth marking the Mesozoic as the “Age of the Dinosaurs”. The second important group of animals to arise came from small group of synapsids or mammal-like reptiles. Here we find our own origins. The first were small during the time of the dinosaurs, but once the asteroid hit, everything heavier than 50 pounds was wiped out leaving a huge vacuum of niches in the environment for mammals to grow into, allowing them to claim the Cenozoic as the “Age of Mammals”. Within a few million years, mammals had diversified into a myriad of forms, one of which was the common ancestor of all primates and human beings. |
| The Triassic |
| 220 Ma |
| This was the first period where evidence of dinosaurs is present, though they were not there at the very beginning. It began right after the Permian mass extinction which wiped out 90% of all life and marks the beginning of the Mesozoic Era. Although dinosaurs are present, they are not the dominant form of reptile at first and had to compete with close relatives such as the Rausuchians, which were crocodile-like creatures, and other mammal-like reptiles such as Placerias. In the end though, they were triumphant, and almost all the competition died out by the Jurassic. This is an image of Herrerasaurus, one of the first dinosaurs. |

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| The Jurassic |
| 180 Ma |
| The Jurassic period saw dinosaurs creep out from their small beginnings and flourish. The climate was favorable and the continents were breaking apart, creating fertile shallow seas and many miles of coast line which improved rain patterns. These conditions allowed dinosaurs to grow to enormous sizes, as both predator and prey attempted to gain the upper hand on one another. Sauropods were the extreme example, growing to sizes sometimes of over 100 feet in length, they used their size as a deterrent against predators and to control a niche in their environment that no other creature could access. They were eating machines designed to process huge amounts of foliage. And they did so so quickly that they had not time to chew. In fact, they ate small stones so that the plant matter would get ground up within their stomachs. Apatosaurus is probably the most well-known of all sauropods, but is likely known by its older name by many which is Brontosaurus. |
| The Cretaceous |
| 100 Ma |
| The Cretaceous saw the greatest diversification of dinosaurs and their complete specialization in occupying every possible niche in the environment. The emergence of birds and flowering plants are defining features of this period and mammals began to diversify to some degree as well. Ultimately all non-avian dinosaurs went extinct at the end of the Cretaceous because of an asteroid impact. Tyrannosaurus was at the tail end of the Cretaceous period and was the top predator of the time. |

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| Dinosaur Extinction |
| 65.5 Ma |
| The Cretaceous–Paleogene extinction event occurred approximately 65.5 million years ago (Ma) at the end of the Maastrichtian age of the Cretaceous period. It was a large-scale mass extinction of animal and plant species in a geologically short period of time. In 1980, a team of researchers consisting of Nobel prize–winning physicist Luis Alvarez, his son geologist Walter Alvarez, and chemists Frank Asaro and Helen Michel discovered that sedimentary layers found all over the world at the Cretaceous–Tertiary boundary contain a concentration of iridium many times greater than normal (30, 160 and 20 times in three sections originally studied). |
| Origins of Human Beings |
| 7 Ma |
| A meteorite that struck the Earth 65 million years ago exterminated the dinosaurs and opened up new niches for the surviving organisms. One of these surviving organisms was an ancestor that eventually gave rise to modern humans. |

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| “Lucy” |
| 3.2 Ma |
| "Lucy" (AL 288-1) was the name given to a fossil skeleton of Australopithecus afarensis discovered in 1974 in Ethiopia’s Afar Desert. Estimated to have lived 3.2 Ma, Lucy provided evidence of small skull capacity and bipedalism in early human evolution, among other notable characteristics. This replica of Lucy is on display in the Museo Nacional de Antropología in Mexico City. |
| Evidence of Earliest Stone Tools |
| 2.5 Ma |
| The appearance of stone tools in human prehistory is characteristic of the appearance of the genus  Homo, including early species such as H. rudolfensis, H. habilis, and H. ergaster. Discovered in the Olduvai Gorge in Tanzania, the earliest stone tools were called Olduwan. They have simple construction - usually a core stone that has been struck and fractured by a hammer stone to create sharp edges. |

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| First Evidence of Controlled Use of Fire |
| 1.5 Ma |
| The controlled use of fire represents an important step in the development of early humans. The first species that is believed to have tamed fire is Homo erectus around 1.5 Ma. Probably used primarily to cook and preserve food, fire distinguished humans from other animals and promoted human development in other areas such as social development and tool making. |
| Evidence of Humans on all Continents Apart from Antarctica |
| 13 ka |
| Humans migrated out of Africa and all over the world. 13,000 years ago, humans had already  settled on all continents except Antarctica. This process of global colonization, called extensification, refers to the increase in range of humans, but not in density. During the Paleolithic Era, humans were the first large land mammals to spread over much of the globe, showing their ability to adapt to a huge diversity of environments. |

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| Origins of Agriculture |
| 11 ka |
| The first humans to adopt the farming lifestyle probably did so by with their bare hands, sticks or stones. Tools such as knives, scythes, and wooden plows were eventually developed and dominated agriculture for thousands of years. In the early days of agriculture, almost everyone worked in agriculture, because each family could barely grow enough food for themselves with such limited technology. It was not until millennia later when developments in farming methods and technology brought about the possibility of surplus. |
| The Great Pyramids |
| 2494 BCE |
| The Great Pyramid of Giza (Pyramid of Khufu) is the oldest and largest of the three pyramids in the Giza Necropolis. It is the oldest of the Seven Wonders of the Ancient World, and the only one to remain largely intact. It was believed to be built as a tomb for fourth dynasty Egyptian Pharaoh Khufu over an approximate 20 year period, and stood as the tallest man-made structure in the world for over 3800 years. |

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| Mayan Writing is First Developed |
| 300 BCE |
| The Mayan writing system was developed around 300 BCE and continuously used until the arrival of the Spanish in the 16th century. The writing system is considered one of the most visually striking writing systems in the world. It is very complex, with hundreds of unique signs in the forms of humans, animals, objects, and abstract design. These signs are either logograms used to express meaning or syllabograms used to denote sound. This is an example of Mayan glyphs carved into stucco displayed at a museum in Palenque, Mexico. |
| Imperial Palace (Roman) |
| 114 CE |
| The Palazzo Imperiale was a brick- and reticulate-faced concrete structure which covered nearly three hectares. Of its original three stories, only the substructures and some of the first floor remain. The Palazzo‘s trapezoidal plan was dictated by the spur of land between the two basins on which it was situated. |

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| Tikal Becomes the Center of Mayan Civilization |
| 500 CE |
| Tikal, a city of the Mayan civilization, reached its height during the Classical Period. During this time, the city dominated much of the Maya region politically, economically, and militarily while interacting with other areas such as Teotihuacán. One of the most studied sites is the North Acropolis. The North Acropolis (pictured here) developed into a funerary complex for the ruling dynasty of the Classic Period. Each additional royal burial added new temples and pyramids on top of the existing structure. The North Acropolis continued to receive burials into the Post classic  Period. It is located in present day Guatemala; the site is part of Guatemala's Tikal National Park. |
| Origins of the Modern World |
| 1000 CE |
| Global exchange networks, competitive markets and increasing use of energy have accelerated the pace of change in recent decades. |

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| Birth of the Ottoman Empire |
| 1258 CE |
| The Ottoman Empire was one of the largest and longest lasting empires in history, existing from 1299 to 1923. Under the reign of Suleiman the Magnificent, the empire became the most powerful state in the world, a multinational, multilingual empire controlling much of southeast Europe, western Asia, and North Africa. For six centuries the Ottoman Empire's vast influence around the Mediterranean basin made it the center of interaction between the Eastern and Western worlds. After its capture in 1453, Constantinople became the capital city of the Ottoman Empire until its dissolution in the 20th century. |
| The Turtle Ship (Korea) |
| 1413 CE |
| The Turtle ship, also known as Geobukseon or Kobukson (거북선), was a type of large warship belonging to the Panokseon class in Korea that was used intermittently by the Royal Korean Navy during the Joseon Dynasty from the early 15th century up until the 19th century. The first references to older, first generation turtle ships, known as Gwiseon (귀선), come from 1413 and  1415 though they are more famous for their role in the Japanese Invasion of Korea in the 16th century. The turtle ship was the fastest and most maneuverable existing warship in the East Asian theater, as it was powered by two sails and 80 oarsmen taking turns to handle the ship's 16 oars. Its primary role was to cut deep into the enemy lines, cause havoc with its cannons, and destroy the enemy flag ship. |

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| The Helio-Centric Model |
| 1530 CE |
| The idea of a sun-centered, or heliocentric universe was first published by Polish astronomer Nicolaus Copernicus in 1543. This model ushered in a new age of astronomy. It positioned the Sun motionless near the center of the Universe with Earth and the other planets rotating around it in circular paths, modified by epicycles and at uniform speeds. The Copernican model departed from the Ptolemaic system that had prevailed in Western culture for centuries before. |
| The Invention of the First Pendulum Clock (Time Reform in Great Britain) |
| 1657 CE |
| Christiaan Huygens first made a pendulum clock in 1657. His invention is widely cited as the beginning of the Horological Revolution. The pendulum clock, and the other innovations that accompanied it thereafter, allowed for the production of clocks that were cheaper and more accurate. For the first time, people outside the aristocracy and royalty could afford to own clocks and even more importantly pocket watches, which allowed for personalized timekeeping. Prior to Huygens, clocks could not be relied on for accuracy beyond an expected error of 15 minutes per day. The pendulum helped reduce that margin of error to about 10-15 seconds. |

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| James Watt Invents Steam Engine Replacing Newcomen Engines |
| 1776 CE |
| This is the original patent for James Watt's steam engine, a vastly improved successor to the earlier Newcomen steam engine. The Newcomen engine featured only a single chamber, into which jets of steam and cold water were alternately injected. This cycle of heating and cooling proved to be inefficient, and much of the steam potential was lost. Watt created a separate condensation chamber connected to the main chamber. Cold water was injected only into the condenser, allowing for condensation without significant heat loss and far greater fuel efficiency than the Newcomen engine. |
| Recognition of universal, equal, and natural human rights by Jefferson and the American  Congress |
| 1776 CE |
| The Declaration of Independence was a statement adopted by the Continental Congress on July 4, 1776, which announced that the thirteen American colonies then at war with Great Britain regarded themselves as independent states, and no longer a part of the British Empire. John Adams put forth a resolution earlier in the year which made a formal declaration inevitable. |

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| The Great Stink of 1858 |
| 1858 CE |
| The Great Stink, or the Big Stink, was a time in the summer of 1858 which the smell of untreated human waste was very strong in central London. Until the late 16th century London citizens relied on water from shallow wells, the River Thames, its tributaries, or natural springs so the water was not abstracted for unauthorized commercial or industrial purposes. For seven years human waste was dumped into the Thames and then potentially pumped back to the same households for drinking, cooking and bathing. |
| Battle of Gettysburg |
| 1863 CE |
| The Battle of Gettysburg, fought July 1—3, 1863 near Gettysburg, Pennsylvania. This battle resulted in the largest number of casualties of the American Civil War with over 46,000 killed, wounded, captured or missing. This is considered the turning-point in the Civil War with the North taking the lead after a strong victory here. |

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| Bone Wars (Discovery of Dinosaurs) |
| 1877 CE |
| During the late 1800's, North America saw an explosion of new discoveries of dinosaurs, some of which are the most well-known and complete specimens to date. This was largely due to two people, Othniel Charles Marsh and Edward Drinker Cope. They were both wealthy men who used their wealth to finance expeditions into the Midwest. Between the two of them, over 130 new dinosaur species were discovered and named. This intense competition between the two often led to them destroying each other's finds and using underhanded means to gain an advantage over the other. |
| Einstein’s Theory of General Relativity |
| 1916 CE |
| General relativity is the geometric theory of gravitation published by Albert Einstein in 1916. It is the current description of gravitation in modern physics. General relativity generalizes special relativity and Newton's law of universal gravitation, providing a unified description of gravity as a geometric property of space and time, or space-time. In particular, the curvature of space-time is directly related to the four-momentum (mass-energy and linear momentum) of whatever matter and radiation are present. The relation is specified by the Einstein field equations, a system of partial differential equations. |

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| Nobel Prize for the Discovery of Insulin |
| 1923 CE |
| In 1923, Frederick Grant Banting and John James Rickard Macleod were awarded the Nobel Prize in Physiology or Medicine for their discovery of insulin at the University of Toronto. Banting chose to share half of the prize money with his colleague, Charles Best, who was not recognized for his work. |
| President Roosevelt Signs Executive Order 9066 |
| 1942 CE |
| Exclusion Order posted at First and Front Streets in San Francisco, California. The Exclusion Order called for the evacuation of all persons of Japanese descent due to Executive Order 9066. The executive order was signed and issued during World War II by U.S. President Franklin D. Roosevelt authorizing the Secretary of War to prescribe areas as military zones. The Order eventually cleared the way for the relocation of Japanese Americans to internment camps. |

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| The Birth of the Internet |
| 1957 CE |
| Research into packet switching started in the early 1960s and packet switched networks such as ARPANET, Mark I at NPL in the UK, CYCLADES, Merit Network, Tymnet, and Telenet, were developed in the late 1960s and early 1970s using a variety of protocols. The ARPANET in particular led to the development of protocols for internetworking, where multiple separate networks  could be joined together into a network of networks. (http://en.wikipedia.org/wiki/ History\_of\_the\_Internet) |
| ChronoZoom Version 1 Released |
| 2010 CE |
| ChronoZoom is an online program that visualizes time on the broadest possible scale from the Big  Bang to the present day. Conceived by Professor Walter Alvarez and Roland Saekow and developed by the department of Earth and Planetary Science at the University of California, Berkeley in collaboration with Microsoft Research and Moscow State University, Alvarez unveiled the first ChronoZoom prototype at UC Berkeley's 2010 Faculty Research Lecture. That demo is available to the public online, and a second version rewritten in HTML5 is now available and open source in beta form. ChronoZoom was inspired by the study of Big History, and it approaches the documentation and visualization of time and history in the same way that Google Earth deals with geography. ChronoZoom allows users to see the true scale of time over cosmic, geologic, biological and social periods. |