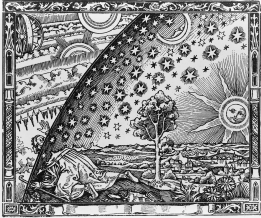


Education for the Future

James Mc Laughlin

Education is Lagging far Behind our Understanding - I (© [Understanding of the Cosmos](#))

Understanding of the Cosmos



“The image depicts a man crawling under the edge of the sky, depicted as if it were a solid hemisphere, to look at the [mysterious Empyrean beyond.](#)”

[From Wikipedia's Cosmos page:](#)

As we move forward, elementary- and high school education should keep pace with our understanding.

There are several areas where the picture of our place in the cosmos needs to be filled in substantially.

Disclaimer: I am not a specialist in area except mathematics, so specialists may find some errors in the details of what follows.

Education is Lagging far Behind our Understanding - II What should be taught in elementary- and high school should include the following:

- The history of the Universe, from The Big Bang to the far distant future.
- The origin and formation of the Earth and the rest of the solar system from a cloud of dust, its evolution into its present formation, its future evolution and eventual end.
- The origin of life on an Earth previously devoid of life around 3.8 billion years ago, how all present life forms have a common ancestor, including discussion of the possibility/probability of life elsewhere in the Universe, and the likelihood of (intelligent?) species developing elsewhere in the Universe.
- The evolution of humans and the development of major aspects of the human world from a time when none of these existed.
- The modern human world in all its complexity.
- Speculation as to whether the observable Universe lies inside something larger.

The Earth's Place in Our Universe

The Earth's Place in Our Universe.

What students should be taught about the place of the present Earth in the Cosmos, across space and time (both past and future).

How Big is the Universe?

1. Roughly speaking there are as many stars in the Universe as grains of sand in a pile of sand that would cover the United States (East Coast to West Coast, Canada to Mexico) to a depth of 60 miles.
Somewhere in this pile of sand would be the grain of sand corresponding to our sun.
2. Next, imagine expanding this pile of sand until the distance between each grain and each of its neighbours was around 50 miles.
3. Finally, do a further expansion, both the distances between grains and the grains themselves, until each grain was a million miles across.
4. Of course stars are not of uniform size, nor distributed uniformly throughout the Universe. There are galaxies of stars, clusters and super-clusters of galaxies, and also great starless voids.

How Big is the Universe?



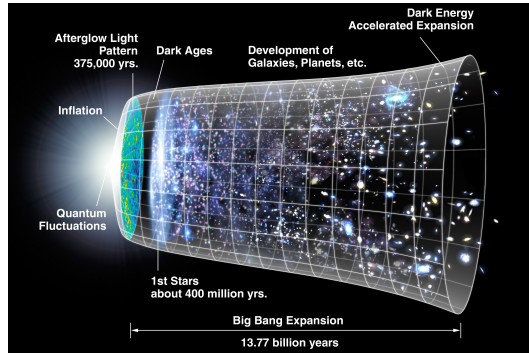
Hubble Ultra Deep Field, an image of a small segment of space in constellation Fornax (click on the image to open the video) *Constellation Fornax* (© Constellation Fornax)

[NASA - Hubble Space Telescope - Legacy Field Zoom Out](#)

Hubble Zoom Out (© Hubble Zoom Out)

“The deep-sky mosaic, created from nearly 7,500 individual exposures, provides a wide portrait of the distant universe, containing 265,000 galaxies that stretch back through 13.3 billion years of time to just 500 million years after the big bang.”

How Old is the Universe?

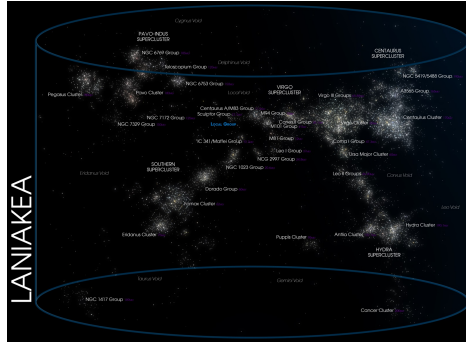


A representation of the evolution of the universe over 13.77 billion years.

Big Bang (© Big Bang)

1. It is estimated by science that the Universe is around 13.8 billion years old, having expanded from a singularity in “The Big Bang”.

Laniakea Supercluster



The Local Group's location within the Virgo Supercluster as part of the larger Laniakea Supercluster. *Laniakea* (© Laniakea)

2. Our galaxy started forming shortly after the Big Bang, with a recent idea being that it merged with another galaxy around 11 billion years ago.

Andromeda–Milky Way collision

3. By <5 billion years, the Andromeda galaxy and the Milky Way galaxy will have merged.

Andromeda–Milky Way



Figure 1: figure

The video is a NASA conception of the collision using computer-generated imagery. The video also shows the Triangulum galaxy, which will join in the collision and perhaps later merge with the Andromeda/Milky Way pair. (© [Andromeda–Milky Way](#))

From Wikipedia: “The Andromeda–Milky Way collision is a galactic collision predicted to occur in about 4.5 billion years between the two largest galaxies in the Local Group—the Milky Way (which contains the Solar System and Earth) and the Andromeda Galaxy.”

The Big Rip

4. By 22.3 billion years according to one estimate, the Universe will have ended in a “Big Rip” (one theory about how the Universe ends).

The Big Rip



Figure 2: The video shows an artistic recreation of the Big Rip. (© The Big Rip)

From Wikipedia: “In physical cosmology, the Big Rip is a hypothetical cosmological model concerning the ultimate fate of the universe, in which the matter of the universe, from stars and galaxies to atoms and subatomic particles, and even spacetime itself, is progressively torn apart by the expansion of the universe at a certain time in the future, until distances between particles will infinitely increase.”

Heat Death of the Universe

5. Other theories have the Universe dying a “heat death” over very, very long time spans ($\sim 10^{10^{50}}$ years), with stars dying, matter decaying, ...

Heat Death

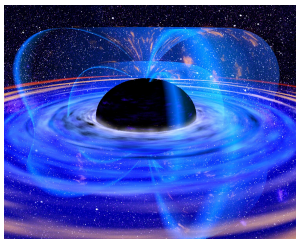


Figure 3: The supermassive black holes are all that remain of galaxies once all protons decay, but even these giants are not immortal. (© [Heat Death](#))

From Wikipedia: “The heat death of the universe (also known as the Big Chill or Big Freeze) is a hypothesis on the ultimate fate of the universe, which suggests the universe will evolve to a state of no thermodynamic free energy, and will therefore be unable to sustain processes that increase entropy. ”

The Origin of the Earth, and its Past and Future History

The Origin of the Earth, and its Past and Future History.

What students should be taught about how the Earth formed, how it evolved into its present form, and what the future likely holds for it.

Formation of the Earth and Solar System



5. The Solar System, including our Earth, formed ~ 4.6 billion years ago.

“...began ... with the gravitational collapse of a small part of a giant molecular cloud. Most of the collapsing mass collected in the center, forming the Sun, while the rest flattened into a protoplanetary disk out of which the planets, moons, asteroids, and other small Solar System bodies formed.” *Solar System* (© Solar System)

Formation of the Moon



6. Formation of the Moon after the early Earth impacted with a Mars-sized planet around 4.5 billion years ago. *Moon* (© Moon)

Formation of the Earth's Crust



Artistic impression of the surface of the hot super-Earth Gliese 486 b, an exo-planet 26.4 light-years away in the constellation Virgo. The surface of the early Earth was likely very similar.

7. The early Earth was likely covered in magma oceans, which solidified into a crust as they cooled. *Magma Oceans* (© Magma Oceans)

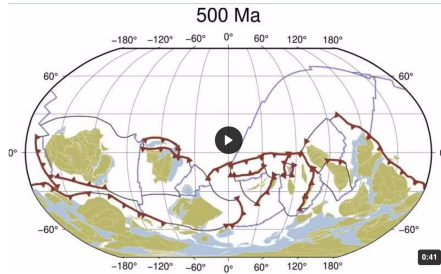
Formation of the Earth's Oceans



Artistic impression of the surface of the Earth, after the crust had mostly cooled.

8. Water released from rocky material began to collect to form the oceans a little over 3.8 billion years ago. *Early Oceans* (© Early Oceans)

Movement of Tectonic Plates Through Time



9. Movement of the tectonic plates over the last one billion years, as the continents moved into their present positions. *Movement Of Tectonic Plates* (© Movement Of Tectonic Plates)

Future Ice Ages Over the Next Few Million Years

1. future *ice ages* over the next few million years



Figure 4: The present period of glaciation (the Quaternary), began ~ 2.58 million years ago, and is ongoing, with the Earth presently being in an interglacial period. (© ice age)

Previous periods of glaciation lasted for periods lasting from 40 million years to more than 100 million years.

The glacial/interglacial cycle length is currently about 100,000 years.

The next return of the ice has likely been delayed by natural- and human-caused global warming until sometime between 50,000 and 100,000 years in the future.

Continued Movement of Tectonic Plates

2. Continued Movement of Tectonic Plates *Tectonic Plates*

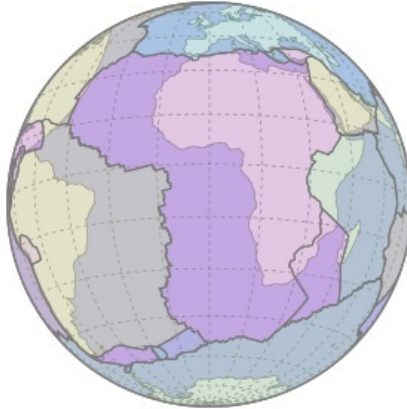


Figure 5: Around 50 million years in the future, Africa's collision with Europe will have closed the European basin, creating a new mountain range like the Himalayas. (© Tectonic Plates)

Continuing Slowdown in the Earth's Rotation and Consequent Increase in Day Length

3. By 180 million years ahead, a day on Earth will be one hour longer, due to the Earth's rotation slowing down. *daylength*



Figure 6: Around 4.5 billion years ago, the length of the day was around 5 hours, with tidal effects slowing down the Earth's rotation since then. (© [daylength](#))

Over the past 500 million years, the length of the day has increased as shown:

- 23 hours and 20 minutes around 100 million years ago
- 22 hours around 300 million years ago
- 20 hours and 40 minutes around 500 million years ago

A New Super Continent

4. By 250 - 350 million years ahead, the continents may have fused into a super continent, possible leading to a new glacial period. *Pangea Ultima*



Figure 7: Pangaea Ultima is a possible future supercontinent configuration that could form within the next 250 million years. (© [Pangea Ultima](#))

The Eventual Passing of All Lifeforms From Earth

5. About 600 million

years in the future conditions necessary to sustain life will have greatly deteriorated. *End of Life*



Figure 8: By 1.3 billion years ahead, only the simplest unicellular life forms will still exist on Earth. (© [End of Life](#))

From the [Wikipedia Future of Earth](#) page: “The luminosity of the Sun will steadily increase ... In about 600 million years from now, the level of carbon dioxide will fall below the level needed to sustain C3 carbon fixation photosynthesis used by trees. ... the long-term trend is for plant life to die off altogether. The extinction of plants will be the demise of almost all animal life”

Evaporation of the Oceans; Earth and Moon Fall into the Sun

6. By 3.5–4.5 billion years ahead, the Sun's luminosity will have increased by 35–40%, causing all water currently present in lakes and oceans to evaporate, if it had not done so earlier.

Red Giant

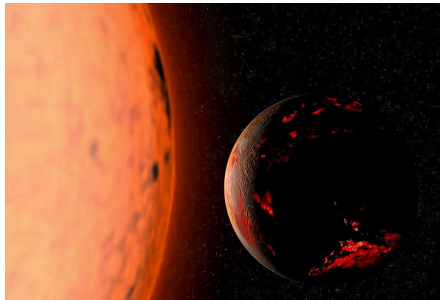


Figure 9: Artist's concept of the Earth 5–7.5 billion years from now, when the Sun has become a red giant. (© [Red Giant](#))

7. By 7.59 billion years, the Earth and Moon will have fallen into the sun.

The Origin of Life on Earth, and how all Life on Earth Evolved

The Origin of Life on Earth, and how all Life on Earth Evolved.

What students should be taught about the transition from the time Earth was completely devoid of life to the present time.

Appearance of the First Primitive Lifeforms



Stromatolites are layered sedimentary formations that are created mainly by photosynthetic microorganisms. These microorganisms produce adhesive compounds that cement sand and other rocky materials to form mineral "microbial mats".

8. The earliest primitive life forms probably appeared sometime around 3.8 billion years ago (the earliest definite forms are stromatolites found in 3.48 billion-year-old chert from Western Australia).

The last universal common ancestor (LUCA) of all life forms on Earth existed sometime between 3.5- and 3.8 billion years ago. *Stromatolites* (©Stromatolites)

Plants Moving from the Sea to Land

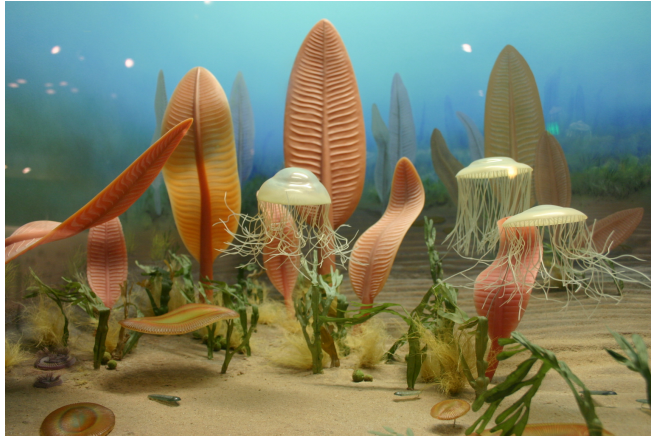


Artistic depiction of early Devonian (~400 million years ago) land-flora.

9. Land plants evolved from fresh-water algae, perhaps around 850 million years ago, with many features of plants today, such as roots and leaves having appeared by ~390 million years ago.

Devonian (© Devonian)

First multicellular animals in the seas 550 million years ago



Diorama of Ediacarian sealife.

10. Development of first multicellular animals in the seas between 580- and 530 million years ago. *Ediacaran* (© Ediacaran)

The Evolution of Fish



Reconstruction from the late Devonian period, $\sim 383 - 372$ million years ago.

11. Early sharks and various other kinds of fish evolved between 420 and 360 million years ago.
Fish (© Fish)

Recreation of a Pennsylvanian forest floor (323-299 Ma)



Recreation of a Pennsylvanian forest floor during the “Pennsylvanian” period (323-299 Ma)

12. From around 360 million years onwards, the Earth began to take on its present form (covered in vegetation, insects on land, sharks in the oceans,...).

Forest (© Forest)

Dinosaurs and Mammals I



Painting of a late Jurassic (201 - 145 Ma) Scene on one of the large island in the Lower Saxony basin in northern Germany.

13. The first dinosaurs and earliest mammals both appeared around 225 million years ago.

Dinosaurs and Mammals I (© Dinosaurs and Mammals I)

Dinosaurs and Mammals II



Recreation of a scene from Southern Britain during the Early Cretaceous (145 - 113 Ma).

14. Dinosaurs were the dominant land vertebrates until their extinction ~ 66 million years ago, with mammals occupying a much more restricted niche during this time. *Dinosaurs and Mammals II* (© Dinosaurs and Mammals II)

The Age of Mammals



Mural depicting the landscape, environment, plants, and animals known from Oregon, about 30 million years ago.

15. Around 66 million years ago the dinosaurs became extinct and mammals became the dominant group. *Mammals* (© Mammals)

Ancient Hominids



Image depicting an ape from Europe, ~7 million years ago, possibly the last common ancestor of chimps and humans.

16. The chimpanzee–human last common ancestor existed sometime between 4- and 7 million years ago. *Hominids* (© Hominids)

The Development of the Various Aspects of the Human World

The Development of the Various Aspects of the Human World.

What students should be taught about the origin and development of all the various aspects of the human world, from the time humans made little more impression on the Earth than their physical footprints, up until the present.

The aims here would be:

- a) to present students with a picture of how the complex human world today had its origin several million years ago in a time when the ancestors of modern humans had little to differentiate them from other primates living at the time and the earth was a wilderness planet without an evolved intelligent species,
- b) to present students with a fairly comprehensive picture of how all the various features of the present complex human world developed between that time and the present.

The picture of this transition should include the following:

1. The Transition from our more Ape-like Ancestors to Early Humans

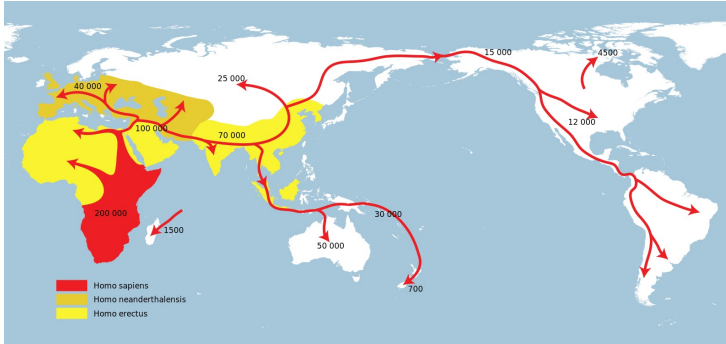


Reconstruction of early Homo sapiens from Morocco ~
315000 years ago.

Early Humans (© Early Humans)

17. Anatomically modern humans lived in various places in Africa between 300,000- and 100,000 years ago.

2. Human Migrations out of Africa



There were several migrations of early humans out of Africa, possibly beginning as early as 270,000 years ago.

18. The ancestors of modern humans living outside Africa mostly migrated out of Africa between 70,000 - 50,000 years ago. *Migrations* (© Migrations)

3. Population Growth

Early



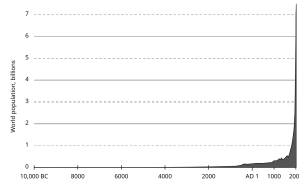
Human

Figure 10: Depiction of a small group of early humans, (© [Early Human](#))



Woodstock

Figure 11: Some of the more than 460,000 crowd at Woodstock , (© [Woodstock](#))



Population Growth

(© [Population Growth](#))

Figure 12: World population growth over the last 12,000 years.

4. The Development of Road- and Other Transport Networks

Natchez Trace I95 Maryland

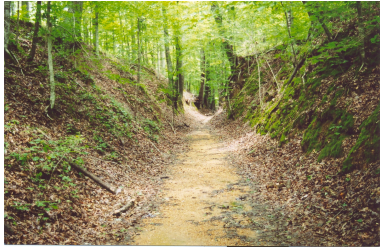


Figure 13: Sunken part of the Old Trace, Natchez Trace Parkway, (© [Natchez Trace](#))



Figure 14: View south along Interstate 95 from the overpass for Maryland State Route 175 , (© [I95 Maryland](#))

The development of road- and other transport networks from the time humans left only their footprints on the ground, up to the present.

5. Towns and Cities

19. Over the last 10,000 years humans have transformed the surface of the Earth into what it is today.



Modern World I (© Modern World I)



Modern World II (© Modern World II)

6. The Transition from Hunting/Gathering to Large-Scale Agriculture



Figure 15: Inuit seal hunters, c. 1821, *Inuit* (© Inuit)

The development of agriculture about 12,000 years ago meant that many groups of humans switched to living in permanent settlements.



Figure 16: Intensive farming of wheat in Lund, Sweden, *Wheat Fields* (© Wheat fields)

7. The Development of Tools and Technology



Figure 17: Oldowan choppers dating to 1.7 million years BP, from Melka Kunture, Ethiopia, *Olduwan* (© Olduwan)

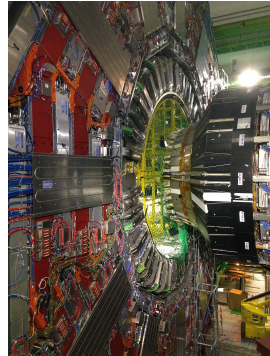


Figure 18: Compact Muon Solenoid detector for the Large Hadron Collider, *Wheat Fields* (© CMS at LHC)

The origins of all of modern technology goes back to the first human use of stone implements over 3 million years ago.

8. The Origin and Development of Clothing

Early

Human



clothing Venus

de

Lespugue

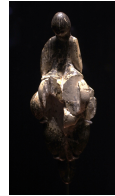


Figure 19: Estimates on when humans began wearing clothes have from 40,000 to 170,000 years ago, (© [Early Human clothing](#))

Figure 20: The 25,000-year-old Venus Figurine "Venus of Lespugue" depicts a cloth or twisted fiber skirt, (© [Venus de Lespugue](#))

In addition to evidence of animal hides and woven fibres, sewing needles have been dated to at least 50,000 years ago (Denisova Cave, Siberia)—and are likely to have been made by H. Denisova/H. Altai, about 10,000 years before the arrival of Neanderthal and human groups in the cave.

9. The Origin and Development of Speech and Language

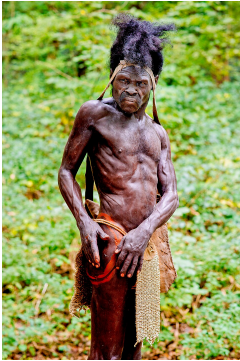


Figure 21: Reconstruction of early Homo *Speech Scroll* (©Speech Scroll)
sapiens from Jebel Irhoud, Morocco, c.
315,000 years BP, *Morocco* (©Morocco)



Figure 22: A mural in Teotihuacan, Mexico
(c. 2nd century) depicting a person emitting a
speech scroll from his mouth, symbolizing speech,

Somewhere along the evolution from our animal ancestry to the present, humans developed to the ability to speak, and the 5,000 to 7,000 languages that presently exist also developed.

10. The Development of Writing



Figure 23: Clay amulet, one of the Tartaria tablets, dated to c. 5300 BC, Tartaria (© Tartaria)

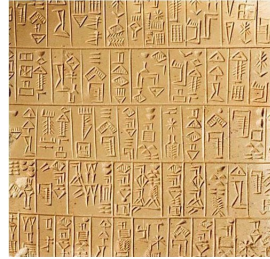


Figure 24: A Sumerian inscription in monumental archaic style, c. 26th century BC, Sumer (© Sumer)

From Wikipedia: “Four independent inventions of writing are most commonly recognized - in Mesopotamia c. 3400 - c. 3100 BC, in Egypt c. 3250 BC, in China before c. 1250 BC, and in Mesoamerica before c. 1 AD.”

11. The Origin and Development of Art

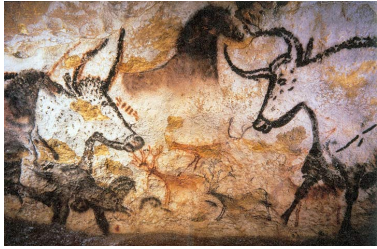


Figure 25: 16,000-year-old cave painting from Lascaux cave in France, *Lascaux* (© Lascaux)

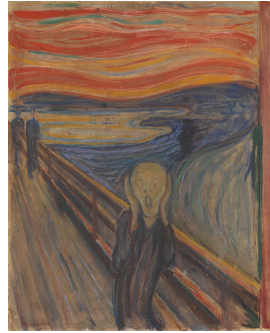


Figure 26: The Scream by Edvard Munch, 1893, *The Scream* (© The Scream)

Art, in all its forms, has developed in step with other aspects of the human world.

12. The Origin and Development of Music



Figure 27: Aurignacian flute made from an animal bone, 43,000 to 39,000 years old, *Aurignacian flute* (© Aurignacian flute)



Figure 28: Front cover of the Beatles' album Sgt. Pepper's Lonely Hearts Club Band, *Sgt. Pepper* (© Sgt. Pepper)

The history of music goes back at least 38,000 years.

13. The Origin and Development of Mathematics



Figure 29: The Ishango bone, dating to 20,000 years ago, has markings that are believed to be mathematical, *Ishango Bone* (© Ishango Bone)

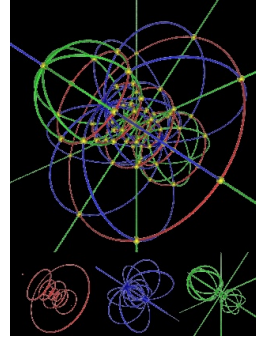


Figure 30: Stereographic projection of the hypersphere's parallels (red), meridians (blue) and hypermeridians (green), *Hypersphere* (© Hypersphere)

Mathematics, as well as being an entirely abstract subject, exerts its influence throughout the modern human world.

14. The Origins and Development of Religious Beliefs

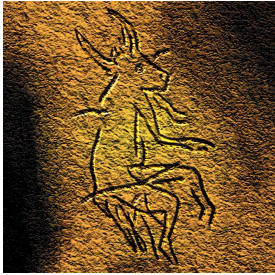


Figure 31: Picture of a half-animal half-human in a Paleolithic cave painting in Dordogne, France *Ancient Sorcerer* (© Ancient Sorcerer)

Religious beliefs go back at least 30,000 years.

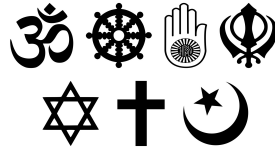


Figure 32: Icons of various religions. *Religious Beliefs* (© Religious Beliefs)

15. The Origins and Development of Abstract Thought, Ideas and Philosophy



Figure 33: Thoth, the Egyptian god of the Moon, wisdom, knowledge, writing, hieroglyphs, science, magic, art, and judgment. *Thoth* (© Thoth)

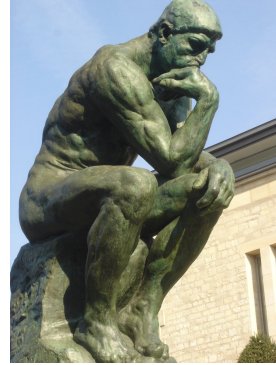


Figure 34: The Thinker by Auguste Rodin, *The Thinker* (© The Thinker)

The transition from animal mental reactions to human abstract thought possibly began very gradually sometime in the last 50,000 years.

16. The Origins and History of Warfare and Conflict



Figure 35: Cave painting of a battle between archers, Morella la Vella, Spain. *Morella* (© Morella)

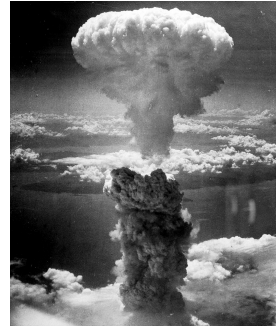


Figure 36: Mushroom cloud above Nagasaki after atomic bombing on August 9, 1945. *Nagasaki* (© Nagasaki)

Evidence of wars and conflicts between different groups of humans goes back at least 15,000 years.

17. The Struggle for Survival

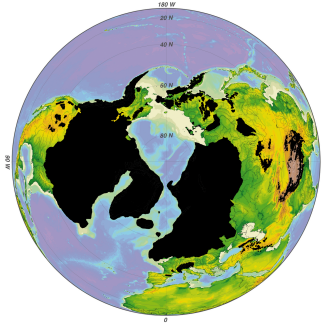


Figure 37: Extent of maximum glaciation (in black) in the Northern Hemisphere during the Pleistocene (c. 2.58 million to 11,700 years ago). *Ice Age* (© Ice Age)

Throughout their history, humans faced an intense struggle to survive against the effects of climate, natural disasters like the Toba super volcano eruption, plagues, famines and wars and other threats to existence.



Figure 38: Pieter Bruegel's *The Triumph of Death* depicts the social upheaval and terror that followed the plague in medieval Europe. *Triumph of Death* (© Triumph of Death)

The Present World Population and its Distribution

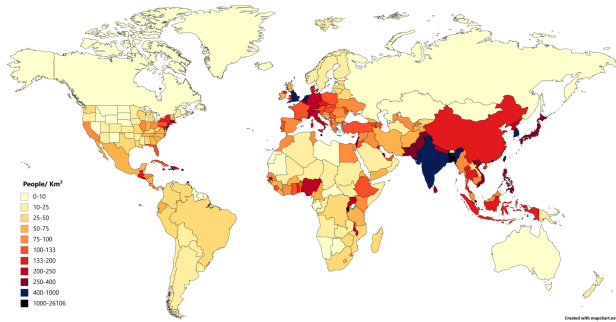


Figure 39: Population density (people per square kilometre) by country or U.S. state in 2019.
World Population (© World Population)

From Wikipedia: It was estimated by the United Nations that the world population exceeded 8 billion (8,000,000,000) on November 15, 2022. It took around 300,000 years of human prehistory and history for the human population to reach a billion and only 218 more years from there to reach 8 billion. As of 2026, the world population is approximately 8.3 billion.

The Physical Variety in Modern Humans



Figure 40: forensic facial reconstruction of *Homo habilis*, believed to be an ancestor of modern humans from around 2.4 million years ago. *Homo habilis* (© Homo habilis)

All modern humans, with all of their physical variations, are descended from the same group of hominid ancestors.



Figure 41: Wikimania 2025 group photograph at Trademark Hotel in Nairobi, Kenya. *Wikimania 2025* (© Wikimania 2025)

Modern Ethnic Groups and their Distribution



Figure 42: The racial diversity of Asia's ethnic groups (original caption: Asiatiska folk), Nordisk familjebok (1904). *Ethnic Groups* (© Ethnic Groups)

Estimates of the number of different ethnic groups in the world vary from over 5000 to around 24,000, depending on the method of classification.

[More details can be found on the Wikipedia List of lists of contemporary ethnic groups page.](#)

The Division of the World's Surface in Countries, States, Territories and the Sub-divisions of These

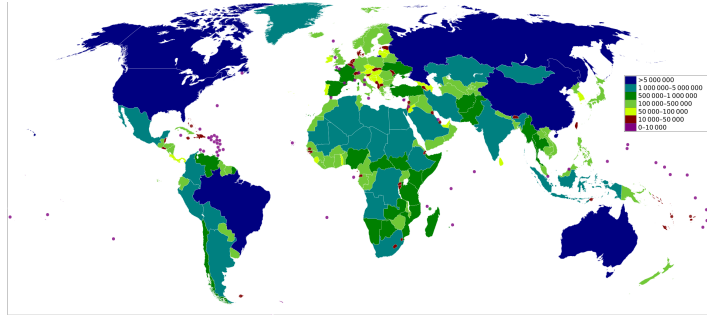


Figure 43: Countries of the world by area. *Countries* (© Countries)

From the Wikipedia page [List of sovereign states](#), the present world population is distributed in around 205 states.

Modern Languages, Their Number and Distribution

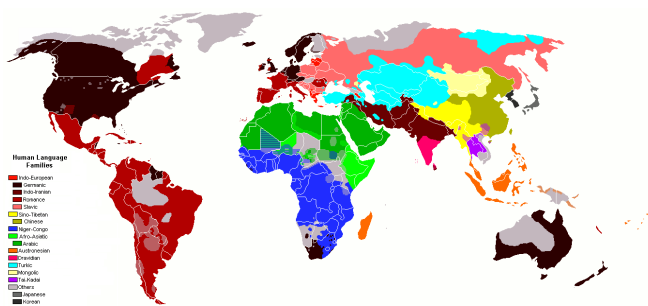


Figure 44: Current distribution of human language families. *Languages* (© Languages)

It is estimated that the number of human languages in the world is between 5000 and 7000. The development of language is speculated to have begun with primitive language-like systems sometime between 2.5 and 0.6 million years ago, with the development of language proper happening within the last 100,000 years, with all modern languages having their roots in this latter development.

Modern Religions and Belief Systems, and Their Distribution

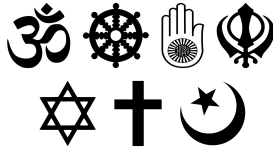


Figure 45: Icons of various religions. *Religious Beliefs Today* (© Religious Beliefs Today)

Religious beliefs go back at least 30,000 years.

From the Wikipedia page on Religion: “There are an estimated 10,000 distinct religions worldwide, though nearly all of them have regionally based, relatively small followings. Four religions—Christianity, Islam, Hinduism, and Buddhism—account for over 77% of the world’s population, and 92% of the world either follows one of those four religions or identifies as nonreligious, meaning that the vast majority of remaining religions account for only 8% of the population combined.”

The Modern World Economy

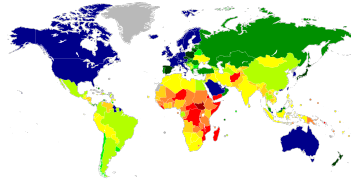


Figure 46: Gross domestic product per capita of countries (2024, PPP) *World Economy* (© World Economy)

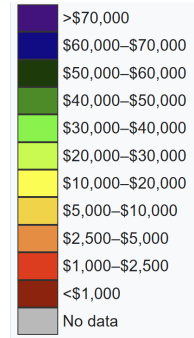


Figure 47:

From Wikipedia “The world economy or global economy is the economy of all humans in the world, referring to the global economic system, which includes all economic activities conducted both within and between nations, including production, consumption, economic management, work in general, financial transactions and trade of goods and services.”

Modern Political Systems and Their Distribution

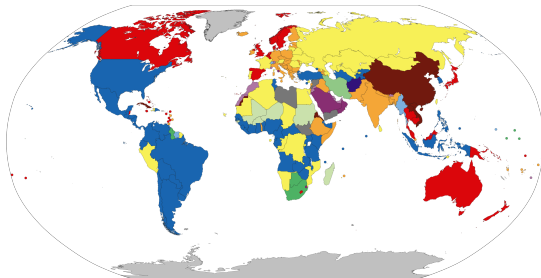
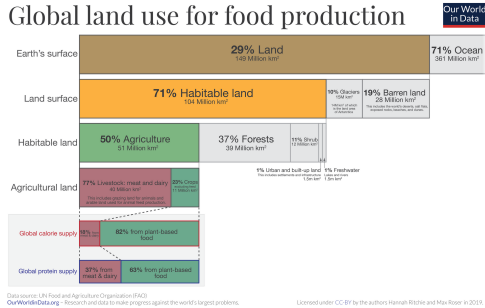


Figure 48: World's states colored by systems of government. *Government* (© Government)

- Constitutional monarchy
- Parliamentary republic with a ceremonial president
- Parliamentary republic with an executive president
- Presidential republic
- Semi-presidential republic
- Assembly-independent republic
- Theocratic republic
- Islamic theocracy
- Semi-constitutional monarchy
- Absolute monarchy
- One-party state
- Military junta
- Provisional government
- Dependent territories or places without governments

History has left us with the present distribution of forms of government.

The Present Extent of Human Transformation of the Earth's Surface



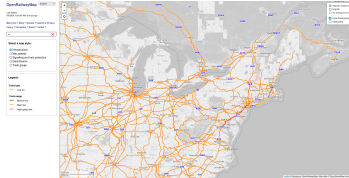
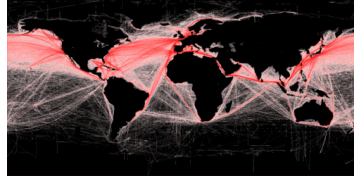
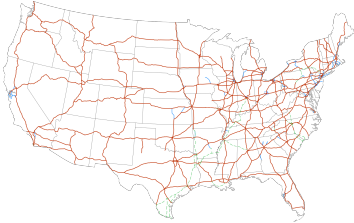
From Wikipedia:

Around 1000 years ago, less than 4% of habitable land was used for agriculture, compared with the 50% used to-day.

Figure 49: The various categories of land usage. *Land Cover* (© Land Cover)

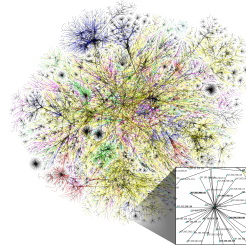
By some estimates, up to 83% of the planet's viable, ice-free land surface is directly affected by human activity, with around 1% being urban and built-up land (including settlements and infrastructure).

Modern Road-, Rail-, Air-, Sea and Canal Transportation Systems



The present world has several extensive transportation networks. Shown are US highways, world shipping routes, world airline routes (2024) , and rail routes northeastern US and southeastern Canada. *Road* (© Road, *Ship* (© Ship, *Air* (© Air, *Rail* (© Rail)

Modern Media and Communication Systems



There are presently several media allowing large-scale transmission of information. These include *Social Media* (© Social Media, *The World Wide Web* © The World Wide Web, *Print Media* © Print Media, *Broadcast Media* © Broadcast Media)

The Functioning of Modern Economies



Figure 50: Wikipedia: New York City, the world's principal fintech and financial center and the epicenter of the world's principal metropolitan economy *Economic Systems* (© Economic Systems)

From Wikipedia: “An economic system, or economic order, is a system of production, resource allocation and distribution of goods and services within an economy. It includes the combination of the various institutions, agencies, entities, decision-making processes, and patterns of consumption that comprise the economic structure of a given community.”

Modern Production and Supply of Food



Figure 51: Harvesting beetroot in the United Kingdom. *Food Production* (© Food Production)



Figure 52: Packaged food aisles at an American grocery store. *Food Supply* (© Food Supply)

From Wikipedia: “The food industry is a complex, global network of diverse businesses that supplies most of the food consumed by the world’s population. The food industry today has become highly diversified, with manufacturing ranging from small, traditional, family-run activities that are highly labour-intensive, to large, capital-intensive and highly mechanized industrial processes. Many food industries depend almost entirely on local agriculture, animal farms, produce, and/or fishing.”

Present-Day Culture and Entertainment



From Wikipedia: “Culture is a concept that encompasses the social behavior, institutions, and norms found in human societies, as well as the knowledge, beliefs, arts, laws, customs, capabilities, attitudes, and habits of the individuals in these groups. Culture often originates from or is attributed to a specific region or location.” Elements include clothing, gastronomy, literature, performing arts, visual arts, entertainment, games, sports, mass media, tradition and tourism.

Music (© Music, *Art* (© Art, *Sport* (© Sport, *Cinema* (© Cinema)

Modern Living - Work, Family, Leisure and Recreation, Education, ...



Family ©Family



Work ©Work



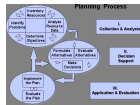
Class ©Class



Meals ©Meals



Leisure ©Leisure



Planning

©Planning



Commute

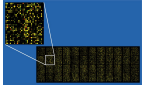
©Commute



Sleep ©Sleep

Modern life is a balance between various activities, including family time, work, education, meal times, leisure time, planning, the daily commute and sleep/dreaming.

Modern Science and Technology, Research and Development



Biotechnology Representation

©Biotechnology



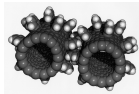
Energy Technology

©Energy

Technology

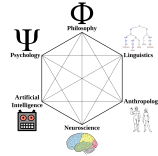


Computers ©Computers



Nanotechnology

©Nanotechnology



Cognitive Science ©Cognitive
Science



Astronomy ©Astronomy

As humans continue to move forward into the future, Research and Development in a variety of fields in science and technology, including astrophysics, cosmology, quantum chemistry, molecular biology, genetics, biotechnology, planetary science, quantum mechanics, materials science, computational economics, cognitive science, information science, nuclear technology, robotics, artificial intelligence, quantum computing, . . .

Modern Society and Interactions Between People



Figure 53: People in Times Square, New York City. Society (© Society)

People do not live in isolation and indeed are connected by a vast network of relationships. From Wikipedia: “A society is a group of individuals involved in persistent social interaction or a large social group sharing the same spatial or social territory, typically subject to the same political authority and dominant cultural expectations. ... Societies are characterized by patterns of relationships (social relations) between individuals who share a distinctive culture and institutions...”

Human social structures include family, religion, law, economy, and social class. Social stratification based on the factors already listed, as well as wealth, income, race, education, ethnicity, gender, occupation, social status, or derived power (social and political) play a part in both unifying and fragmenting society.

Problems in the Modern World - I

A number of problems persist as a legacy of past human history and the struggle to evolve.



Figure 54: Battle of the Somme, 1916. *War*
(© War)



Figure 55: Sandy Hook Elementary School.
Violence (© Violence)

Wikipedia pages:

[War](#),
[Violence](#)

Problems in the Modern World - II



Figure 56: Victims of the Great Famine of 1876–78 in India during British rule, pictured in 1877. *Famine* (© Famine)

Wikipedia pages:

[Famine](#),
[Food Security](#).

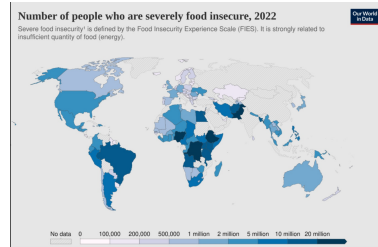


Figure 57: Food insecurity around the world.
Food Insecurity (© Food Insecurity)

Problems in the Modern World - III



Figure 58: Measles. This child shows a classic day-4 rash with measles. *Disease* (© Disease)

Wikipedia pages:

[Disease](#),

[Substance Abuse](#).



Figure 59: Two women and a man smoking in an opium den, late 19th century. *Substance use disorder* (© Substance use disorder)

Problems in the Modern World - IV



Figure 60: Children of migrant cotton field workers from Sweetwater, Oklahoma. *Poverty* (© Poverty)



Figure 61: Street in Camden, New Jersey, which has evident urban decay. *Social Inequality* (© Social Inequality)

Wikipedia pages:

[Poverty](#),
[Social Inequality](#).

Problems in the Modern World - V



Figure 62: A statue of the Buddha at Bamiyan before and after its March 2001 destruction by Taliban forces. *Religious Intolerance* (© Religious Intolerance)

Wikipedia pages:

[Religious Intolerance](#),
[Discrimination](#).



Figure 63: An African-American man drinking from a racially segregated water cooler marked "Colored", in Oklahoma City c. 1939. *Discrimination* (© Discrimination)

Problems in the Modern World - VI



Figure 64: Tents of homeless people in San Francisco, 2017. *Homelessness* (© Homelessness)



Figure 65: Unemployed men outside a soup kitchen in Depression-era Chicago, Illinois, United States, 1931. *Unemployment* (© Unemployment)

Wikipedia pages:

[Homelessness](#),
[Unemployment](#).

Problems in the Modern World - VII

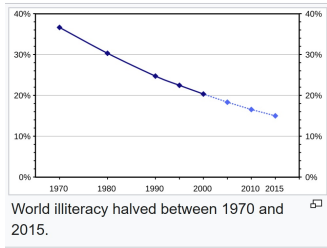


Figure 66: World illiteracy halved between 1970 and 2015. *Literacy* (© Literacy)

Wikipedia pages:

[Literacy](#),
[Social Isolation](#).



Figure 67: Nighthawks is a 1942 oil on canvas painting by the American artist Edward Hopper. *Social Isolation* (© Social Isolation)

Problems in the Modern World - VIII

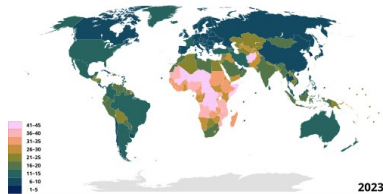


Figure 68: Countries by birth rate. *Birth Rate*
(© Birth Rate)

Wikipedia pages:

[Birth Rate](#),
[Corruption](#).

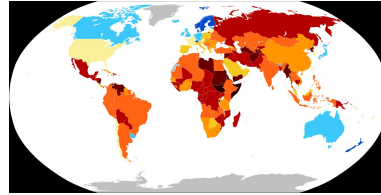
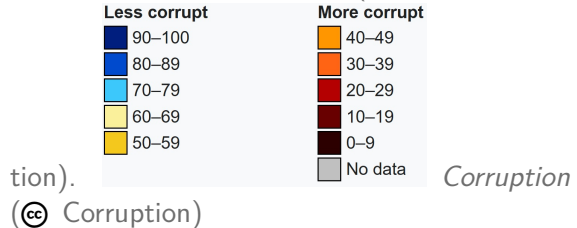


Figure 69: Map of the Corruption Perceptions Index, 2025, as scored by Transparency international. A higher score indicates greater transparency (i.e., less corrup-



Does The Observable Universe Lie Inside Something Bigger?

Does The Observable Universe Lie Inside Something Bigger?

What's it all about, if anything?

We don't know the answer to question such as

- Is the observable Universe just one aspect of a greater Cosmos?
- Is there a purpose or meaning to human existence?
- What is the ultimate nature of humans, regarded as entities across time?
- ...?
- ...?

These kinds of questions should be certainly discussed during the more senior years in high school, but need to be handled carefully.

The aim should be to present the complete range of possibilities that are theoretically possible extensions of the observable Universe.

An Infinite Number of Hubble Volumes?

1. An infinite number of Hubble volumes?

Hubble Volume

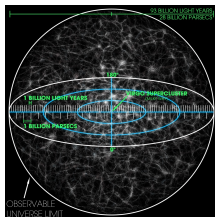


Figure 70: Visualization of the whole observable universe. The inner blue ring indicates the approximate size of the Hubble volume. (CC Hubble Volume)

From Wikipedia: “In cosmology, a Hubble volume ... is a spherical region of the observable universe surrounding an observer beyond which objects recede from that observer at a rate greater than the speed of light due to the expansion of the universe.”

If the Universe is infinite, there is an infinite number of Hubble volumes, each out of contact with all the others.

Our region of the Universe is in one of these Hubble volumes.

The Multiverse or Many-Worlds Interpretation of Quantum Mechanics

2. The multiverse or many-worlds interpretation of quantum mechanics

Many Worlds



Figure 71: The quantum-mechanical "Schrödinger's cat" paradox according to the many-worlds interpretation. In this interpretation, ...the cat is both alive and dead, even before the box is opened, but the "alive" and "dead" cats are in different branches of the multiverse. (© [Many Worlds](#))

From Wikipedia: "The many-worlds interpretation (MWI) is a philosophical position about how the mathematics used in quantum mechanics relates to physical reality. ... The many-worlds interpretation implies that there are most likely an uncountable number of universes."

Oscillatory Universe Theory

3. Oscillatory Universe theory *Cyclic Universe*



Figure 72: The video shows an animation of the expected behavior of a Big Crunch. (© Cyclic Universe)

From Wikipedia: “A cyclic model ... is any of several cosmological models in which the universe follows infinite, or indefinite, self-sustaining cycles. For example, the oscillating universe theory briefly considered by Albert Einstein in 1930 theorized a universe following an eternal series of oscillations, each beginning with a Big Bang and ending with a Big Crunch; in the interim, the universe would expand for a period of time before the gravitational attraction of matter causes it to collapse back in and undergo a bounce.”

The Brane Multiverse

4. The brane multiverse, which has the physical Universe existing on a membrane in hyperspace *Brane Multiverse*

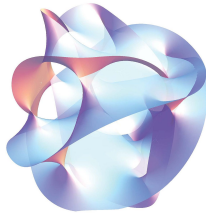


Figure 73: In one version of string theory known as the topological B-model, the D-branes are complex submanifolds of certain six-dimensional shapes called Calabi–Yau manifolds (© [Brane Multiverse](#))

From Wikipedia: “The brane multiverse version postulates that our entire universe exists on a membrane (brane) which floats in a higher dimension or "bulk". In this bulk, there are other membranes with their own universes. These universes can interact with one another, and when they collide, the violence and energy produced is more than enough to give rise to a big bang. ”

The Simulation Hypothesis

5. The Simulation hypothesis *Simulation Hypothesis*

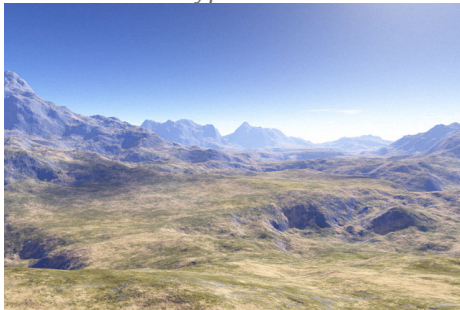


Figure 74: A fractal landscape created using the scenery generator program Terragen.

(© Simulation Hypothesis)

From Wikipedia: “The simulation hypothesis proposes that what humans experience as the world is actually a simulated reality, such as a computer simulation in which humans themselves are constructs. There has been much debate over this topic, ranging from philosophical discourse to practical applications in computing. ”

Black Hole Cosmology

6. Black hole cosmology *Black Hole Cosmology*

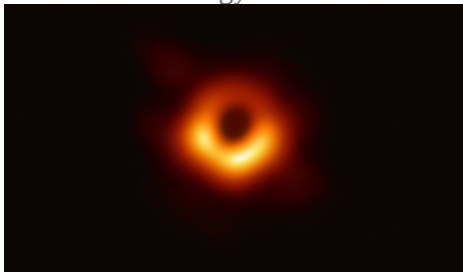


Figure 75: The first direct image of a supermassive black hole in Messier 87, a supergiant elliptical galaxy in the constellation Virgo. (© Black Hole Cosmology)

From Wikipedia: “A black hole cosmology (also called Schwarzschild cosmology or black hole cosmological model) is a cosmological model in which the observable universe is the interior of a black hole.

In the version as originally proposed ... the observable universe is the interior of a black hole existing as one of possibly many inside a larger parent universe, or multiverse. ”

Anima Mundi

1. Anima Mundi - The Cosmos is a living creature endowed with soul and reason.

Anima Mundi



Illustration of the correspondences
between all parts of the created
cosmos, with the anima mundi
depicted as a woman

(© Anima Mundi)

From Wikipedia “The anima mundi or world soul is, according to several systems of thought, an intrinsic connection between all living beings, which relates to the world in much the same way as the soul is connected to the human body. ...

... Plato adhered to this idea, identifying the universe as a living being:

"Thus, then, in accordance with the likely account, we must declare that this Cosmos has verily come into existence as a Living Creature endowed with soul and reason [...] a Living Creature, one and visible, containing within itself all the living creatures which are by nature akin to itself." "

Spiritualism (philosophy)

2. Spiritualism - There is an immaterial reality that cannot be perceived by the senses.

Spiritualism

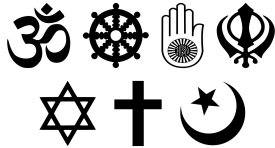


Figure 76: icons of various religions.
(© [Spiritualism](#))

From Wikipedia: “In philosophy, spiritualism is the notion, shared by a wide variety of systems of thought, that there is an immaterial reality that cannot be perceived by the senses. This includes philosophies that postulate a personal God, the immortality of the soul, or the immortality of the intellect or will, as well as any systems of thought that assume a universal mind or cosmic forces lying beyond the reach of purely materialistic interpretations. Generally, any philosophical position, be it dualism, monism, atheism, theism, pantheism, idealism or any other, is compatible with spiritualism as long as it allows for a reality beyond matter. ”

Digital Physics

3. Digital Physics - The Universe can be conceived of as a vast, digital computation device, or as the output of a deterministic or probabilistic computer program.

Digital Physics

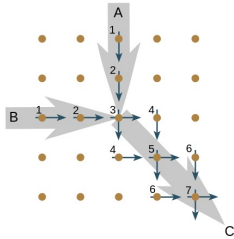


Figure 77: An elementary process in Zuse's Calculating Space: Two digital particles A and B form a new digital particle C. (© Digital Physics)

From Wikipedia: "Digital physics is a speculative idea that the universe can be conceived of as a vast, digital computation device, or as the output of a deterministic or probabilistic computer program. The hypothesis that the universe is a digital computer was proposed by Konrad Zuse in his 1969 book *Rechnender Raum* ("Calculating-space").

Digital physics suggests that there exists, at least in principle, a program for a universal computer that computes the evolution of the universe. The computer could be, for example, a huge cellular automaton. "

Creation

1. Creation - The Universe was created from nothing by a supreme being.

Creation

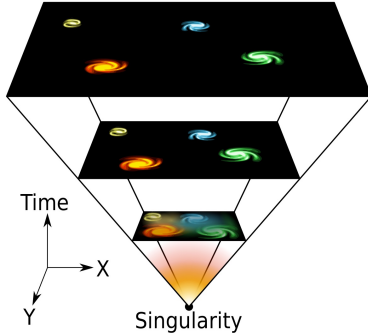


Figure 78: Some modern religious beliefs regard the Big Bang as the moment of creation. (© Creation)

From Wikipedia: "Since the emergence of the Big Bang theory as the dominant physical cosmological paradigm, there have been a variety of reactions by religious groups regarding its implications for religious cosmologies.

Some accept the scientific evidence at face value, some seek to harmonize the Big Bang with their religious tenets, and some reject or ignore the evidence for the Big Bang theory."

Religious Cosmology

2. Religious cosmology and Other Realms - The physical Universe is just one of several realms/planes such as “Heaven”, “Hell”, “The Underworld”, “The Afterlife”, ...

Religious Cosmology



Figure 79: God rests with his creation. Julius Schnorr von Carolsfeld 1860 (© Religious Cosmology)

From Wikipedia: “Religious cosmology is an explanation of the origin, evolution, and eventual fate of the universe from a religious perspective. ... Religious cosmologies describe the spatial lay-out of the universe in terms of the world in which people typically dwell as well as other dimensions, such as the seven dimensions of religion; these are ritual, experiential and emotional, narrative and mythical, doctrinal, ethical, social, and material. ”

Deities and Other Supernatural Beings

3. Supernatural Beings - The physical universe and other realms contain various supernatural beings such as Gods, Demons, Angels, Ghosts etc., etc.

Supernatural Beings



Figure 80: In ancient Celtic and Gallo-Roman religion, Cernunnos or Carnonos is a god depicted with antlers, seated cross-legged, and is associated with stags, horned serpents, dogs and bulls. (CC Supernatural Beings)

From Wikipedia: "A deity or god is a supernatural being considered to be sacred and worthy of worship due to having authority over the universe, nature or human life. "

Non-physical entities also include things such as angels, demons, souls, and ghosts.

Pantheism

4. Pantheism - Reality, the universe and the cosmos are identical to divinity and a supreme being or entity, possibly that the physical Universe is like the layer of dead skin cells that surround a living human.

Pantheism

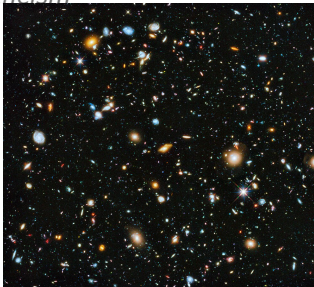


Figure 81: Pantheists believe that the universe itself and everything in it forms a single, all-encompassing deity. (© [Pantheism](#))

From Wikipedia: “Pantheism is the philosophical religious belief that reality, the universe, and nature are identical to divinity or a supreme entity. The physical universe is thus understood as an immanent deity, still expanding and creating, which has existed since the beginning of time. The term pantheist designates one who holds both that everything constitutes a unity and that this unity is divine, consisting of an all-encompassing, manifested god or goddess. All astronomical objects are thence viewed as parts of a sole deity.”

Transcendence

5. Transcendence - The aspect of existence that is completely independent of the material universe, beyond all known physical laws.

Transcendence



Figure 82: Stained glass window in Holy Family Roman Catholic Church, Annacloy Road, Teconnaught/Annacloy, County Down, Northern Ireland.

[Transcendence](#))

From Wikipedia: “In religion, transcendence is the aspect of existence that is completely independent of the material universe, beyond all known physical laws. This is related to the nature and power of deities as well as other spiritual or supernatural beings and forces. This is contrasted with immanence, where a god is said to be fully present in the physical world and thus accessible to creatures in various ways. In religious experience, transcendence is a state of being that has overcome the limitations of physical existence, and by some definitions, has also become independent of it. This is typically manifested in prayer, rituals, meditation, psychedelics and paranormal "visions".”

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