(a) Theories of creationism

- They include special creationism and intelligent design.
- Based on religious doctrines and belief in supernatural intervention/being. ***That the world and life were created by a supernatural being called God.***
- This makes believers of this theories to reject/challenge fundamental scientific/biological principles like evolutionary theory or common ancestry of living organisms and extensive evidence for the origin of the Earth and life.
- However, biblical presuppositions, such as universe and life were created systematically and orderly universe provide a philosophical foundation for the scientific method/theory of evolution

Creationist Beliefs

- Primarily aimed at disapproving the theory of evolution in favour of special creation.
- Microevolution vs macroevolution: Generally, Creationists accept "microevolution" (changes within species or created "kinds") but reject "macroevolution" (evolution between different kinds and a common ancestor).
- **Age of the Earth**: that the earth is much younger (approximately 6,000 years old) thereby opposing scientific findings of an ancient Earth and universe.
- **Fossil Evidence**: although they oppose evolution theory, sometimes they cite findings like soft tissue in fossils as evidence for a young Earth but this is not accepted by mainstream science.

Limitations

- Many creationist ideas are considered untestable or unfalsifiable because they make definite predictions unlike scientific theories.
- Lack scientific contribution because they do not produce new, testable theories/hypotheses that can contribute to progression of biological science.
- **Misinterpretation of Scientific Data**: Arguments for creationism like "fine-tuning" of the universe or idea of human uniqueness are seen as attempts of interpreting scientific discoveries to fit their own pre-existing beliefs and have no genuine scientific contributions,

Contribution of creationist to science

1. Creationists founded modern science

- Francis Bacon (1561–1626) **founded the classical scientific method**;
- Gerardus Mercator (1512–1594) **contributed to cartography**, inventor of the Mercator map projection;
- Johann Kepler (1571–1630) and Galileo Galilei (1564–1642) contributed to physics, astronomy;
- Blaise Pascal (1623–1662) contributed to probability, hydrostatics, the barometer;
- Robert Boyle (1627–1691) contributed to chemistry, gas dynamics;
- John Ray (1627–1705) contributed to natural history;
- Nicolaus Steno, founder of stratigraphy (geology);

- Isaac Newton (1642–1727) founded dynamics, gravitation law, law of cooling, reflecting telescope, spectrum of light, co-inventor of calculus;
- Gottfried Wilhelm Leibnitz (1646–1716) contributed to mathematics, co-inventor of calculus;
- John Flamsteed (1646–1719) contributed to Greenwich Observatory Founder;
- Carolus Linnaeus (1707–1778) contributed to taxonomy, biological classification system;
- John Dalton (1766–1844) contributed to atomic theory, gas law. There are many others.

2. Presuppositions of creationist provide philosophical backbone to science

Biblical history in Genesis is appreciated because it plays a significant role in the development of modern scientific method. The following presuppositions from biblical Christianity contribute to modern science:

i. O*bjective truth.*
ii. The universe is *real*, because God created the heavens and the earth (Genesis 1).
iii. The universe is *orderly*, because God is a God of order, not of confusion—(1 Corinthians 14:33).
iv. Knowledge about the physical world is discovered by *investigating* and *experimenting*, rather than relying merely on thought (as the ancient Greeks did).
v. Man *can and should investigate* the world, because God gave us *dominion* over His creation (Genesis 1:28).
vi. Man can *initiate* thoughts and actions

3. Evolution does necessarily not contribute to scientific progress

High profile scientists have made it clear that it doesn't always follow that all evolutionary thinking contributed significantly to scientific progress.

However, majority of biologists agree with Theodosius Dobzhansky's dictum (1957) that **"Nothing in biology makes sense except in the light of evolution"**, while others can conduct their work quite happily without particular reference to evolutionary ideas'

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4. Evolution has been detrimental to scientific progress

Dead ends generated by evolutionary thinking has caused wastage of human and financial resources due to fruitless search for millions of non-existent transitional fossils or transitional forms or vestigial structures predicted by Darwinists.

Creationist achievements stand tall/
We might not even have had modern science as we know it without creationists!

Examples of modern era creationists that have contributed to present-day science include:

John Flamsteed (1646-1719)
Carolus Linnaeus (1707-1778)
John Dalton (1766-1844)

Professor Dr Bernard Brandstater
Pioneered anesthetics and assisted breathing of premature babies with prolonged intubation

Prof. Stuart Burgess
A world expert in biomimetic (i.e. imitation of design in nature).
He was Professor of Engineering Design, Department of Mechanical Engineering, and University of Bristol (UK) and leads the Design Engineering Research Group at the university.

Professor Dr Ben Carson
Pioneer paediatric neurosurgeon.
He was the first surgeon to successfully separate conjoined twins joined at the head and also pioneered surgery to cure epilepsy in young children.
He was long-term director of pediatric neurosurgery at the Johns Hopkins Medical Institutions, America

Dr Raymond Damadian
Largely responsible for developing medical imaging using magnetic resonance (MRI).
Damadian discoverered that diseased tissue have a different signal from healthy ones.

Dr John Hartnett
Developed the world's most precise clocks used in research and industry around the globe.

Dr Raymond Jones
Solved the major problem of the indigestibility of *Leucaena* (a tropical legume) for grazing cattle in Australia.

Dr Felix Konotey-Ahulu
Pioneered significantly to sickle cell disease management.
Ironically, sickle cell disease is often incorrectly held up as a 'proof of evolution' in science textbooks.

Dr John Sanford
Contributed significantly to breeding and genetics.
His most significant scientific contributions involve three inventions namely (i) biolistic ('gene gun') process, (ii) pathogen-derived resistance, and (iii), genetic immunization. A large fraction of transgenic crops grown in the world today were genetically engineered using the gene gun technology

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Dr Wally (Siang Hwa) Tow
Pioneered Obstetrics-Gynaecologist.

(b) Contributions of Early Philosophers to Biology

(1) Plato, the ancient Greek born c. (428–423 BC, died 348/347 BC)

Made several significant contributions to science, particularly through his philosophical ideas and establishment of institutions that promoted scientific inquiry. Some of his key contributions to science include:

a) **Philosophical Framework for Nature and Theory of Forms**: "conceptualized biological entities as a reflection of perfect non-physical "forms" or ideas. Nature was seen as being orderly. This promoted scientific research on underlying principles and universal truths that govern the physical world.
b) **Influence on Mathematics**: emphasized importance of mathematics in understanding the universe. He believed that mathematical truths are eternal and unchanging/constant. This laid the groundwork for later developments in mathematics and its applications in science.
c) **Established an Academy/first university**: This was one of the first institutions of higher learning/ the first university in Europe, which served as a center for intellectual inquiry and research. This fostered philosophical and scientific research in subjects like biology, mathematics, astronomy, and political theory. It promoted interdisciplinary approach that contributed to the development of scientific thought and a platform for future scientific communities and scholars like Aristotle.
d) **Cosmology**: Plato presented a cosmological model that described the universe as a living being with a soul. He explored ideas about the nature of the cosmos, including the role of elements (earth, water, air, and fire) and the concept of a rational order in the universe.
e) **Ethics and Science**: His work interlinked ethics with science, suggesting that knowledge and virtues are connected. This perspective influenced integration of moral philosophy with scientific inquiry.

f) **Methodological Influence on Later Thinkers.** Platos dialogues and activities of his academy advocated for reasoned inquiry and search for knowledge through systematic thinking and discussions thereby laying a groundwork for scientific methodologies. He stressed the importance of a structured educational path and the value of an all-round education, which contributed to the development of academic institutions for scientific study.

Whereas Plato was not a scientist in the modern sense, his philosophical contributions;

i. Laid the groundwork for scientific thoughts and inquiry,
ii. Influenced generations of thinkers
iii. Shaped the course of present day intellectual history.
iv. Advanced a systematic, philosophical framework for understanding the natural world, rather than making direct scientific discoveries.

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(2) Aristotle

- A fourth-century thinker/philosopher who is remembered for his contributions to ethics, metaphysics, and politics.
- He was a student of Plato and a teacher of Alexander the Great.
- He also had an impact on science and significantly advanced modern biological science through the following contributions:

(a) **Father of Biology and Zoology:** Aristotle is widely considered as the father of biology and zoology because of his extensive work on the natural world.

(b) Championed the study of embryology

In the time of Aristotle, a popular belief was spontaneous generation i.e. idea that life could be created from non-living matter and to which he was a proponent. However, he also championed the study of embryology. He formed theories on the origin and formation of life, and his belief that organisms evolve from different forms paved the way for further study in developmental biology.

(c) **Classification and Taxonomy:** Pioneered classification systems by observing and categorizing/ranking animals based on their complexity.

He started by putting animals above plants since animals can move and have an awareness of their surroundings and continued by creating a hierarchy for animals themselves, separating them based on reproduction processes (live births ranked above eggs) and blood (warm blood was higher than cold which was higher than seemingly bloodless invertebrates).

Marine biology: He was extremely interested in ocean life and particularly in the anatomical features of marine organisms, most of which were remarkably accurate and helped form the basis for early anatomical knowledge of marine biology.

This laid a groundwork for taxonomy and comparative anatomy through detailed dissections and writings like *"History of Animals"*. He developed the first known systematic classification of animals, divided them based on characteristics like blood and bloodlessness, and establishing a hierarchy of life.

1579 drawing of the Great Chain of Being.

(d) **Empirical Observation:** Aristotle emphasized careful, empirical observation and proto-scientific experiments, such as dissecting bird eggs to study embryonic development. This is because Aristotle was taught the importance of hands-on learning, and his empirical methodology was revolutionary for the scientific community of the time. He advocated for naturalists to closely observe and even dissect organisms to understand their inner workings fully thereby setting a precedent for scientific study.

(e) **Comparative Anatomy:** His dissection of over 50 animal species led to the formulation of fundamental principles to comparative anatomy, including the idea of similar underlying structures (homology) and diverse structures with similar functions (analogy).

(f) **Teleology:** He introduced the concept of teleology (i.e study of evidence for natural design) which explained things in terms of their purpose or end goal. He linked this concept to the inherent "form" or soul of an organism.

Other early thinkers (i.e. such as Anaximander and Alcmaeon of Croton), explored the fundamental relationship between the brain and thought, and conducted early dissections thereby laying conceptual frameworks for later biological inquiry.

(3) **Alcmaeon of Croton (**Around 500 BCE)

- He conducted early dissections and vivisections
- Discovered the optic nerves and Eustachian tube, and was the first scientist to link thought to the brain.

(c) Modern biological theories of Nature and Origin of Life

Early theories proposed different mechanisms, such as formation of planets from a rotating cloud of gas and dust or from material pulled off from the sun by a passing star.
However, modern theories propose that our planet was born from a vast rotating cloud of gas and dust, known as the solar nebula, which also gave rise to the Sun. Such theories include

(i) Solar Nebular hypothesis
(ii) Disk Instability Theory
(iii) Core accretion theory

(i) The Solar Nebular Hypothesis and planet formation

Explains formation/origin of the entire solar system, including the Earth. That the solar system was formed from a massive, rotating cloud of gas and dust called the solar nebula. (Note: Solar nebula is believed to be a remnant from the formation of the Sun).
This hypothesis is largely supported by the **Big Bang Theory** which explains origin of the universe, and later, the nebular hypothesis explains how the solar system, including Earth, formed from the remaining material.

Big bang theory proposes that:

- Approximately **13.7 billion years ago**, all matter in the universe was concentrated in a single, tiny ball which had infinite temperature and density (i.e. this tiny ball was extremely hot and dense).
- This "tiny ball" exploded violently and created the universe which continues to expand today.
- As the universe cooled, some energy was converted into matter, and this also contributed to formation of the first atoms (primarily hydrogen and helium).
- Differences in gravitational forces caused matter and energy to clump together thereby forming galaxies. Stars were formed within galaxies approximately 5 to 6 billion years ago

Nebular Hypothesis (students to present and write their own notes)
Modern theories, primarily the **solar nebular hypothesis**, propose that our solar system was formed from a vast cloud of gas and dust that collapsed under its own gravity, flattening into a spinning disk. The material in the center of this disk coalesced to form the Sun, while the remaining gas and dust eventually flattened into a protoplanetary disk, clumped together to form planets and other celestial bodies.

The Solar Nebular Hypothesis and planet formation

- **Formation of the solar nebula**: Approximately 4.6 billion years ago, a nebula began to collapse under its own gravity.
- **Formation of the Sun**: As the cloud contracted, it rotated faster and flattened into a disk. The central core became denser and hotter, eventually igniting nuclear fusion to form the Sun.
- **Formation of planetesimals**: Matter in the surrounding disk began to clump together through accretion. Particles collided, stuck together due to static charges, and grew into larger bodies called planetesimals.
- **Accretion into planets**: These planetesimals continued to collide and merge, growing into protoplanets and eventually forming the planets we see today. The process was mostly complete within 10 to 20 million years.

Stages of formation

- **Gravitational collapse:** A large, interstellar cloud of gas and dust (a nebula) began to collapse under its own mass.
- **Formation of a disk:** As the nebula collapsed, it began to spin faster and flatten into a rotating, pancake-shaped disk called a protoplanetary disk.
- **Birth of the Sun:** The majority of the material collected in the center of the disk, where immense pressure and heat caused the hydrogen atoms to fuse and form helium, marking the birth of the Sun.

- **Formation of planets:** In the surrounding disk, dust particles and gas began to clump together, gradually growing into larger bodies through countless collisions.
- **Rocky vs. gas planets:** The inner, hotter part of the disk is where rocky planets like Earth formed, while the outer, colder part formed gases.

The Modern Earth and its Evolution

After formation of the planet, the earth went through several stages to become a habitable world that supports life today.

- **Molten stage**

Initially, the early earth was a hot, molten ball due to heat produced from collisions and radioactive decay.

- **Planetary differentiation**

Formation of layered structures of the earth.
Denser, heavier materials like iron sank to the centre to form the core, while lighter materials formed the mantle and, eventually, the crust.
Solidification: the surface of the earth cooled and solidified forming the crust.

- **Formation of the Moon**

The Giant-Impact Hypothesis proposes that a Mars-sized body collided with the early Earth and ejecting material that eventually coalesced/clumped together to form the Moon.

- **Formation of the atmosphere**

The first atmosphere comprising of hydrogen and helium was lost due to intense solar winds.
The second atmosphere was formed through release of gases and water vapor from molten interior of the earth through volcanic eruptions. This type of atmosphere was rich in carbon dioxide, nitrogen, and water vapor.

- **Formation of the oceans**

As the earth cooled down, water vapor in the atmosphere condensed, rained for millions of years and collected in depressions to form the first oceans.

- **Evolution of life**

Emergence of single-celled organisms, such as cyanobacteria occurred approximately 3.8 billion years ago and led to the process of photosynthesis. This process released oxygen and dramatically changed the atmosphere thereby paving way for development of more complex lifeforms.

(ii) Disk Instability Theory

That massive disks of gas and dust could have rapidly cooled, forming self-gravitating clumps/masses that became planets in a shorter timeframe.

(iii) Core Accretion Theory

The core of a planet forms first from accumulation of dust and gas while the outer layers developed from leftover material.

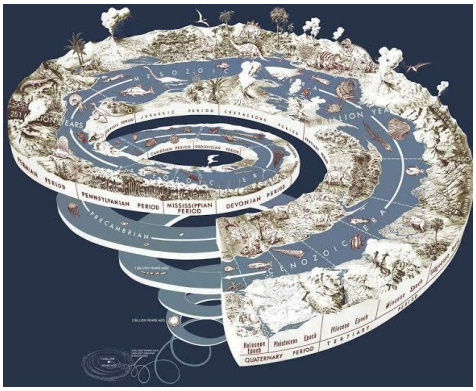
Supporting Evidence of Modern theories of Earth Formation

- **Planetary orbits:** All planets in the solar system orbit the Sun in the same plane and direction pointing to a similar rotation of the original disk.
- **Age of bodies:** Radiometric dating of rocks from the Earth, Moon, Mars, and meteorites shows that they all have approximately the same age (i.e. approximately 4.56 billion years), suggesting that they have a shared origin.

- **Direct observation:** Scientists have directly observed other "baby" solar systems forming. This shows similar disks of gas and dust thereby providing a strong support for this theory.

History of Earth Timelines (Refer to online Videos:

Earth's Evolution in 10 Minutes YouTube·What If·9 Jul 2023 **)**



History of the earth is a timeline of major geological and biological events, beginning with its formation about 4.6 billion years ago. Key milestones include (a) formation of the Moon and oceans, (b) the appearance of the first life (around 3.85 billion years ago),(c) Great Oxygenation Event, (d) rise and fall of dinosaurs, and (e) eventual appearance of modern humans around 300,000 years ago. All these events are organized into eons, eras, and periods for study.

Early Earth and the Precambrian

- **4.6 billion years ago:** Earth forms, followed by the formation of its core and crust.
- **4.5 billion years ago:** The Moon is formed after a massive impact with a celestial body called Theia.
- **4.4 billion years ago:** The first oceans form as Earth cools.
- **3.85 billion years ago:** The first life appears, likely in the oceans.
- **2.7 to 2.46 billion years ago:** Photosynthetic cyanobacteria begin producing oxygen, leading to the Great Oxygenation Event and a significant change in the atmosphere.

Refer to online video that explains early history of the Earth and emergence of life:

57s

Kaoru GreenEmerald
YouTube • 7 Jun 2019

The Phanerozoic Eon (541 million years ago to present)
This eon is divided into three eras:

- **Paleozoic Era (541 to 252 million years ago):**
  - **Cambrian Explosion:** A rapid diversification of animal life occurs.
  - First land plants appear.
  - First vertebrates (jawless fish) and amphibians appear.
  - The era ends with the massive Permian-Triassic extinction event.
- **Mesozoic Era (252 to 66 million years ago):**
  - The age of dinosaurs.
  - Ends with the Cretaceous-Paleogene extinction event that wiped out the non-avian dinosaurs.
- **Cenozoic Era (66 million years ago to present):**
  - Mammals diversify and rise to prominence.
  - Hominids evolve.
  - **~300,000 years ago:** Modern humans (Homo sapiens) appear.
  - **~10,000 years ago:** Earliest farmers emerge, marking a shift from nomadic life.
  - The Industrial Revolution begins around 250 years ago.

Ancient Theories about the Origin of Life

Student Assignment: Read and write 1-page notes on **Ancient Theories about the Origin of Life**

Modern theories for the origin of life

The origin of life on Earth stands as one of the great mysteries of science. Various answers have been proposed but all remain unverified.

(a) A biogenesis

- A leading theory
- That life arose from nonliving/inorganic matter through natural chemical processes. This theory suggests early conditions of the earth may have supported formation of organic building blocks (like amino acids) from simple inorganic molecules. Such building blocks then assembled into complex polymers (like proteins and RNA) which eventually organized into self-replicating structures and primitive cells.

Key concepts in the theory of abiogenesis

- **Primordial Soup:** Atmospheric energy sources like lightning or UV radiations may have converted inorganic molecules into simple organic compounds, which accumulated in the oceans, forming a "primordial soup".
- **Formation of Polymers:** The building blocks in the soup may have polymerized to form larger molecules like proteins and nucleic acids (like RNA).
- **RNA World:** "RNA" formed DNA and proteins, where RNA acted both as a genetic material and catalyst for its own replication.
- **Formation of Cells:** These complex molecules may have been enclosed by membranes thereby creating protocells with a distinct internal environment capable of supporting replication and metabolism.

Alternative and supporting hypotheses of Abiogenesis

(i) Stanley Miller and Harold Urey Experiments on primordial soup

- In 1952, Stanley Miller and Harold Urey performed a famous experiment which explored idea that life formed in a primordial soup.
- They injected ammonia, methane and water vapor into an enclosed glass container to simulate conditions of the early atmosphere of the Then they passed electrical sparks through the container to simulate lightning and formed amino acids (i.e. building blocks of proteins). This process could have paved way for the molecules needed to produce life.
- Whereas current scientists believe that ancient atmospheric conditions may have had a different chemical makeup from Miller and Urey's recipe, their experiment gave rise to a new scientific field called prebiotic or abiotic chemistry as a chemistry that preceded the origin of life.

(ii) **Chemosynthetic and Oparin-Haldane theories**

- Life emerged from a primordial soup of inorganic molecules under existing conditions on early Earth, which lacked free oxygen.
- Energy from sources like lightning or UV radiation caused a series of chemical reactions, forming simple organic molecules like amino acids from gases such as methane, ammonia, water vapor, and hydrogen.
- **Supported by t**he Miller-Urey experiment which successfully produced amino acids under simulated early Earth conditions thereby demonstrating that organic molecules could have been formed from inorganic precursors.

(iii) **Deep Sea Hydrothermal Vent Hypothesis**

- That life began in deep-sea/ at the bottom of the ocean near hydrothermal vents, where chemical energy from volcanic activity (which also released scorching gases and minerals) could have fueled necessary reactions and formed protocells
- **Evidence:** Researchers have been able to reproduce conditions similar to deep-sea vents in the lab and produce protocells.

(iv) Nuclear Geyser Theory

- That natural nuclear reactors on early earth may have provided energy required to drive chemical reactions thereby creating geysers that sprayed activated molecules responsible for life.

(v) RNA world hypothesis

- RNA (but not DNA) was the original genetic material and catalyst for life.

- RNA molecules stored genetic information and catalyzed biochemical reactions. At the moment, this role is performed by both DNA and proteins.
- Ability of RNA to store information and act as a ribozyme (an enzyme made of RNA) makes it a potential candidate early life form.

(b) Panspermia

- Life originated elsewhere and was delivered to Earth via meteorites. This is supported by the discovery of organic compounds, including amino acids, in meteorites.
- Some of the important molecules that constitute life may have been produced outside the Earth. That such raw ingredients/molecules of life may have come from the space, they served as seed and were transported to the earth by meteriotes.
- For instance, in 1969, the Murchison meteorite that fell in Australia contained dozens of different amino acids—the building blocks of life.
- In 2019, a team of researchers in France and Italy reported the finding of extraterrestrial organic materials preserved in 3.3 billion-year-old sediments of Barberton, South Africa.

Metabolism / metabolite theory

Student assignment: Read and write 5-sentence notes on Metabolism / metabolite theory

Evidences of evolution, nature of fossil and geological records as well as role of genetics, human ancestry and life forms