APPENDICES

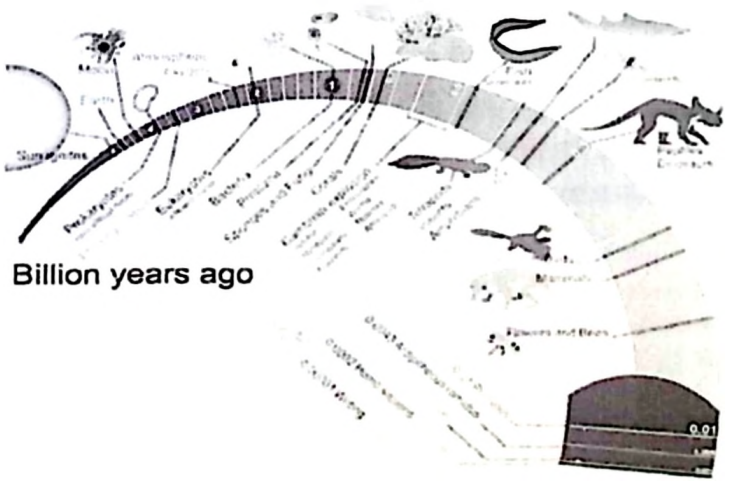
E-Content Package 01

Subject - Biology

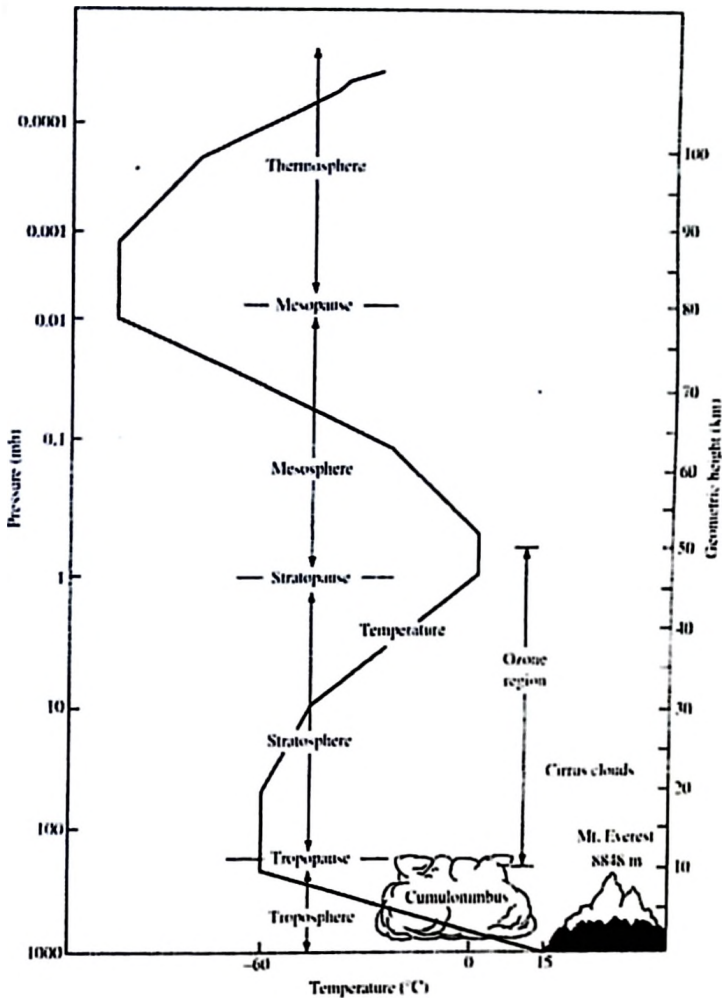
Topic - Introduction to Biological Sciences

Purpose - Supplementary Reading Material

Today life diversity on earth is the result of evolution. On Earth life began at least 4 billion years ago and it has been evolving every year. In the beginning all living things on earth were single celled organism, after several years multicellular organism evolved after that diversity in life on earth increased day by day. DNA (deoxyribonucleic acid) & its duplicate copies have coded information coiled up in almost all of the 100,000,000,000,000 (one hundred trillion) cells in your body. In human DNA has 46 segments; 23 segments received from father and 23 from mother. Each DNA contains exclusive information that determines what you look like, your personality and how your body cell is to function throughout your life.



Biopoiesis (origin of life), ecopoiesis (origin of ecosystems) and the first ecosystems (stromatolites and microbial mats), as well as eukaryopoiesis (origin of nucleated cells) have resulted in the complex & evolving earthian biosphere as is present today.



The atmosphere is held on Earth's surface by the gravitational attraction of the Earth. At any altitude, the downward force is related to the mass of the atmosphere above that point, Pressure (force per unit area) decreases with increasing altitude because the mass of the overlying atmosphere is smaller.

The biosphere and the atmosphere are intimately connected: the composition of the atmosphere is largely a result of the activities of the biosphere: on the other hand, the chemical and climatic characteristics of the atmosphere are essential for the support of life on Earth. Due to its relatively small mass compared to that of other components of the earth system, the atmosphere responds rapidly to changes in the input and output of both material and energy. This makes it valuable as a "fast-response sensor," but also makes it very susceptible to environmental impact from human activities. The large-scale change in surface characteristics due to tropical deforestation, desertification, and changing agricultural practices must be expected to substantially influence the transfer of both heat and water vapor at the Earth's surface. In the last five decades, human activities have resulted in the release of increasing quantities of greenhouse gasses, thus contributing to global climate

change by additional heating of the atmosphere. The world has warmed up by approximately 0.85 °C. In particular, the last decade has been the warmest since 1850, and the frequency & intensity of natural disasters (earthquakes, devastating storms, forest fires, prolonged heat waves, droughts, and floods) have increased manifold. Between 1998 and 2017, climate-related and geophysical disasters killed 1.3 million people and left a further 4.4 billion injured, homeless, displaced, or in need of emergency assistance. Climate change scenarios include a change in the spread of infectious diseases with warming and changes in outbreaks associated with extreme weather events after floods or as a result of water heating. Furthermore, warmer climates provide more favorable conditions for the survival and completion of the life cycle of the vector that transmits pathogens. Natural disasters and extreme events lead to traumatic deaths and injuries, mental illnesses, and infections, while global warming per se promotes heat-associated illnesses (cardiovascular strain, pulmonary diseases, exsiccosis, mental disorder). The World Health Organization expects approximately 250,000 additional deaths per year between 2030 and 2050 from extreme heat, natural disasters, and changing patterns of infections, mostly in people at risk (people living in coastal regions or mega cities, children, the elderly, people with multiple and/or severe comorbidities, and—last but not least—people living in regions with weak healthcare infrastructures). Effectively translating scientific knowledge into policy and practice is essential for helping humanity navigate contemporary environmental challenges.

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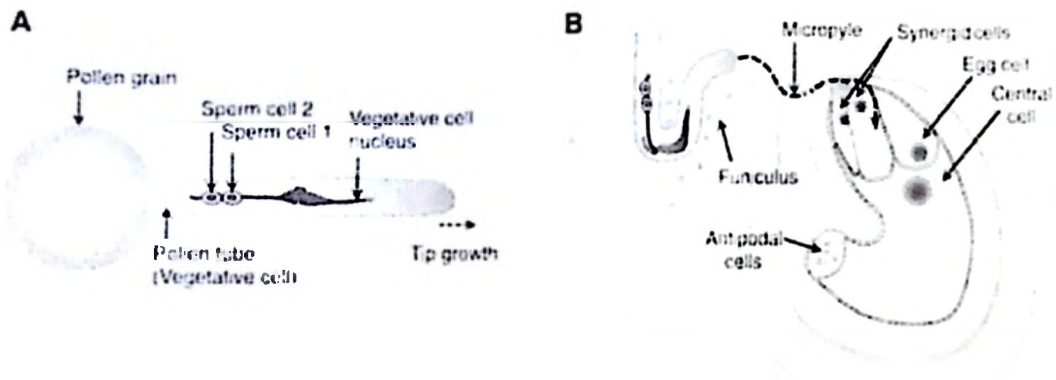
E - Content Package 02

Purpose - Supplementary learning resource
Chapter - Sexual Reproduction in Flowering Plants
Topic - Fertilization

Fertilization generally describes the fusion of haploid gametes to initiate the development of a new diploid organism. In animals an ovum or egg fuses with a motile sperm generating the diploid zygote, which further develops into an embryo. Current representatives of early-branching eukaryotes, including protozoa and fungi, produce mating types of opposite sex that generate a zygote after fusion. In contrast, gametes of flowering plants are not the direct products of meiosis. Instead sperm cells are formed after two additional mitotic cell divisions creating a three-celled male gametophyte, the pollen and pollen tube. The female gametophyte or embryo sac develops within the maternal organ called the ovule after three additional mitotic nuclear divisions of the functional megaspore. Following cellularization a seven-celled embryo sac is established in the majority of angiosperms containing two female gametes (egg and central cells) and accessory cells (synergids and antipodals, respectively) at both poles of the embryo sac. To reach the two female reproductive cells, sperm cells in angiosperms have to conquer distances of a few millimeters in species such as Arabidopsis or up to 30 centimeters in maize. While mosses and ferns still possess motile sperm, sperm cells of angiosperms have lost their motility and the pollen tube cell acts as a vehicle to transport the sperm pair deep through the maternal reproductive tissues. The tube cell grows at its tip with a speed of up to 1 cm per hour with its cargo at a short distance from the tip. During their journey the sperm cells are connected to each other and to the nucleus of the tube cell, moving as a male germ unit. Intensive communication takes place during the arduous pollen tube journey within the maternal tissues of the stigma, style, transmitting tract and ovule. These processes, collectively referred to as progamic phase. Upon its arrival at the ovule the directive communication continues with the female gametophyte (especially the synergid cells), guiding the pollen tube through the micropyle opening of the ovule and regulating the release of its cargo. The micropyle opening of flowering plant ovules enable sperm access and are reminiscent of the micropyle in many insect and fish eggshells. In the funnel-shaped micropyle a yet unknown sperm attractant around the opening and inside of the micropyle directs the motile spermatozoa into the micropyle and across the chorion to attach to the oocyte plasma membrane. The diameter of the inner aperture of the micropyle restricts the number of entering spermatozoa. Attraction of sperm to the micropyle opening appears to be

species-specific and dependent on extracellular Ca2+. During pollen tube reception in flowering plants the two sperm cells are released towards the cleft between the egg and central cell. Cell fusion (plasmogamy) then occurs, but only after successful sperm cell positioning, adhesion, and activation. With the exception of the Podostemaceae (Riverweed) family and some orchids where single fertilization occurs between the egg and a sperm (the second sperm cell is either not formed or disintegrates), in all other investigated angiosperm families one sperm cell fuses with the haploid egg cell generating the diploid embryo, while the second sperm cell fuses with the homo-diploid central cell forming the triploid endosperm.



(A) Diagram of the haploid male gametophyte (pollen) of Arabidopsis comprising the vegetative cell (producing the growing pollen tube) and two non-motile sperm cells enclosed within the a membrane of the vegetative tube cell. The sperm cells are connected to each other and to the nucleus of the vegetative pollen tube cell forming the "male germ unit". Nuclei in red, vegetative cell membrane in blue, sperm cell membranes in black.

(B) A pollen tube approaching the Arabidopsis ovule. The tube grows through the micropyle of the ovule along the funiculus towards the haploid female gametophyte that comprises the egg cell, central cell and accessory cells (synergid and antipodal cells). Secreted LURE peptides (orange dots) act as pollen tube attractants guiding the pollen tube through the micropyle. Other unknown ovule factors (olive dots) may be involved in guiding the pollen tube along the funiculus towards the micropyle.

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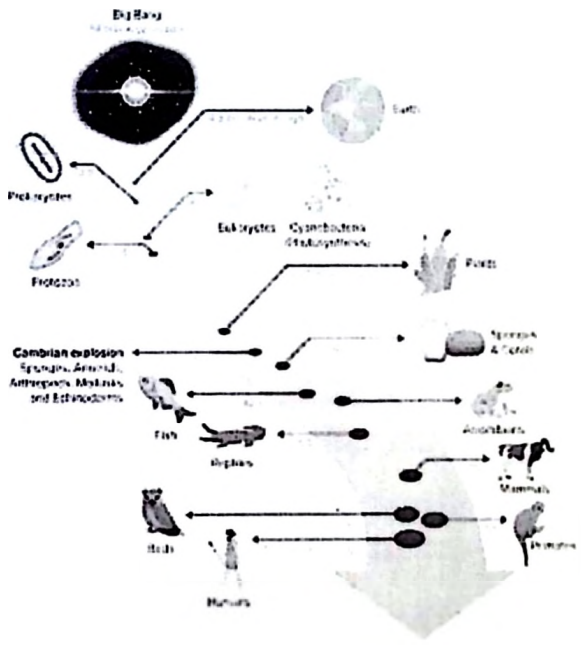
E- Content package No 3

Supplementary reading material



Today diversity of life on earth is the result of evolution.

On Earth life began at least 4 billion years ago and it has been evolving every year. In the beginning all living things on earth were single celled organism, after several years multicellular organism evolved after that diversity in life on earth increased day by day.

Scientists have estimated that there are around 8.7 million species of plants and animals in existence.

Over generations, all of the species that are currently alive today have evolved unique traits that make them distinct from other species. These differences are what scientists use to tell one species from another. Organisms that have evolved to be so different from one another that they can no longer reproduce with each other are considered different species. All organisms that can reproduce with each other fall into one species.

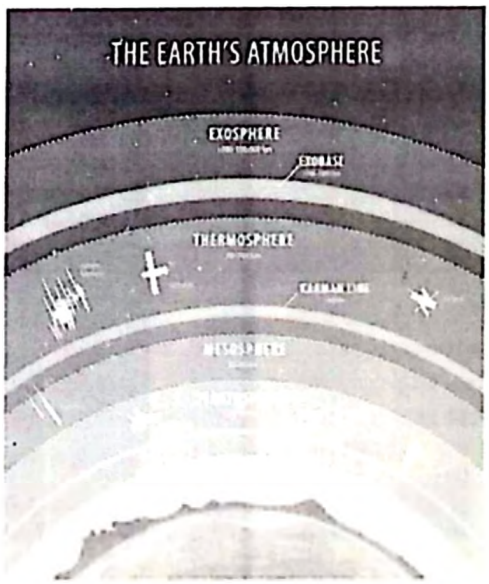
All of the Earth's species work together to survive and maintain their ecosystems. For example, the grass in pastures feeds cattle. Cattle then produce manure that returns nutrients to the soil, which helps to grow more grass. This manure can also be used to fertilize cropland. Many species provide important benefits to humans, including food, clothing, and medicine.

Much of the Earth's biodiversity, however, is in jeopardy due to human consumption and other activities that disturb and even destroy ecosystems. Pollution, climate change, and population growth are all threats to biodiversity. These threats have caused an unprecedented rise in the rate of species extinction.

Earth's atmosphere stretches from the surface of the planet up to as far as 10,000 kilometers (6,214 miles) above. After that, the atmosphere blends into space. Not all scientists agree where the actual upper boundary of the atmosphere is, but they can agree that the bulk of the atmosphere is located close to Earth's surface—up to a distance of around eight to 15 kilometers (five to nine miles).

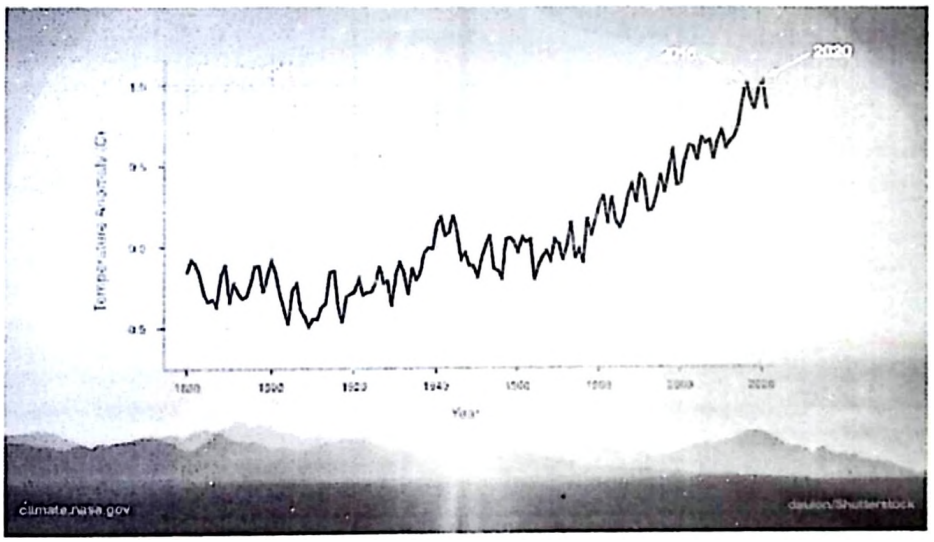
While oxygen is necessary for most life on Earth, the majority of Earth's atmosphere is not oxygen. Earth's atmosphere is composed of about 78 percent nitrogen, 21 percent oxygen, 0.9 percent argon, and 0.1 percent other gases. Trace amounts of carbon dioxide, methane, water vapor, and neon are some of the other gases that make up the remaining 0.1 percent.

Earth's atmosphere has six different layers. They go from the ground all the way to outer space.

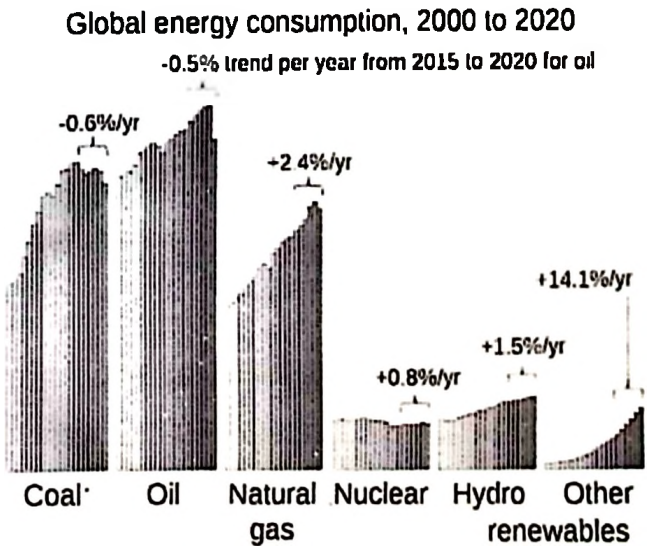


Global warming is the long-term heating of Earth's climate system observed since the pre-industrial period (between 1850 and 1900) due to human activities, primarily fossil fuel burning, which increases heat-trapping greenhouse gas levels in Earth's atmosphere.

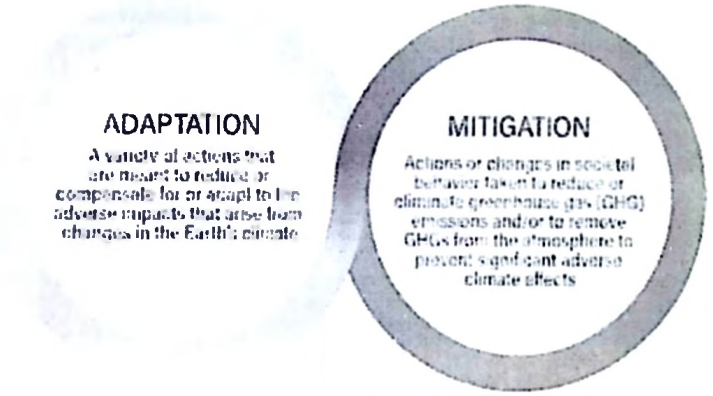
Since the pre-industrial period, human activities are estimated to have increased Earth's global average temperature by about 1 degree Celsius (1.8 degrees Fahrenheit), a number that is currently increasing by 0.2 degrees Celsius (0.36 degrees Fahrenheit) per decade. It is unequivocal that human influence has warmed the atmosphere, ocean, and land.

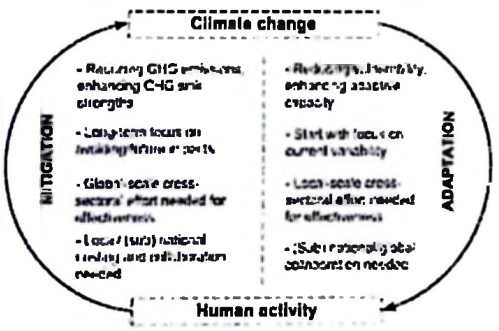


This graph illustrates the change in global surface temperature relative to 1951-1980 average temperatures.

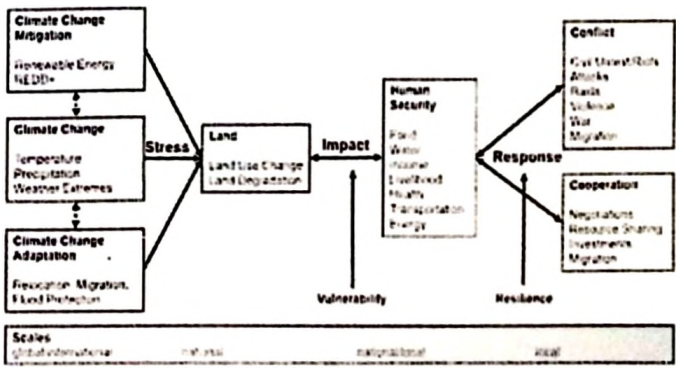


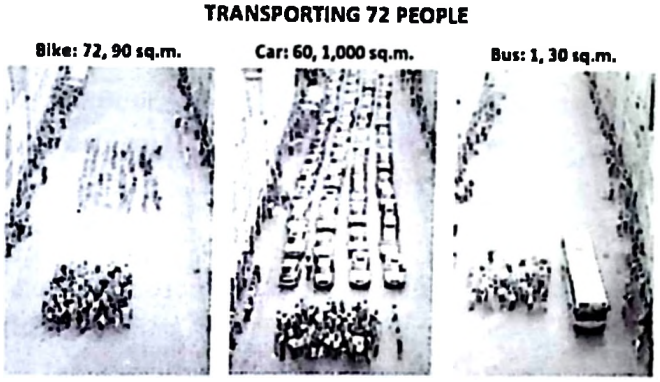
ADAPTATION VS. MITIGATION



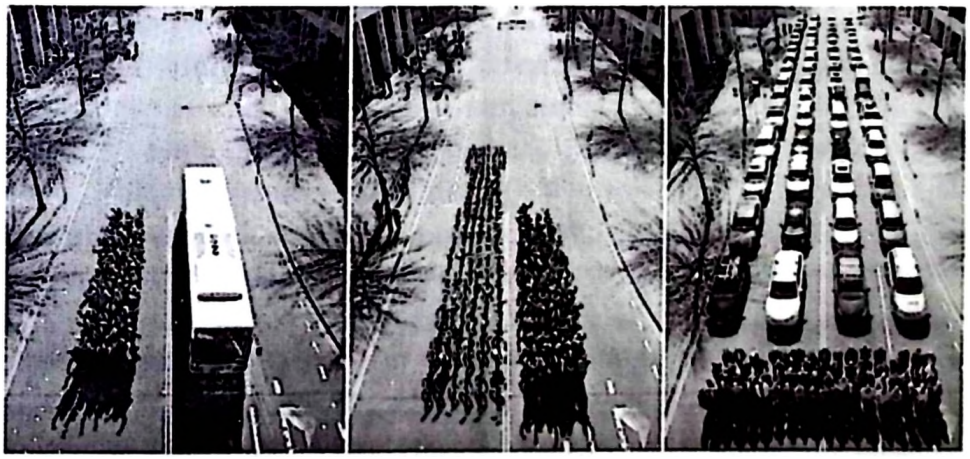


Mitigation strategies include retrofitting buildings to make them more energy efficient; adopting renewable energy sources like solar, wind and hydroelectric; helping cities develop more sustainable transport such as bus rapid transit, electric vehicles, and biofuels; and promoting more sustainable uses of land and forests.





Taking the bus instead of driving your car or motor bike is an eco-friendly, sustainable and inexpensive way of transportation.



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E - Content Package 04

Purpose - Supplementary learning resource
Chapter - Chapter 6 - Life Processes
Topic - What is life?

We can define life in very different ways depending on the context and the focus we want to give to the definition. For example, we can define life as the period from birth to death or as the condition that occurs only in living organisms. We can also say that life is a wonderful and ever-changing process that occurs in highly organized receptacles that we identify as living entities. There are numerous definitions of life formulated from different characteristics of living beings (replication, metabolism, evolution, energy, autopoiesis, etc.) and from different approaches (thermodynamic, chemical, philosophical, evolutionary, etc.). Often, definitions of life are biased by the research focus of the person making the definition; as a result, people studying different aspects of biology, physics, chemistry, or philosophy will draw the line between life and non-life at different positions. These strategies create a panoply of alternative definitions that makes it very difficult to reach a consensus on the best definition of life because they all have pros and cons. Along these lines, there is also the definition coined by NASA: "Life is a self-sustaining chemical system capable of Darwinian evolution". Life is a self-sufficient chemical system far from equilibrium, capable of processing, transforming and accumulating information acquired from the environment. Living organisms share seven traits: organic nature, high degree of organization, pre-programming, interaction (or collaboration), adaptation, reproduction and evolution, the last two being facultative as they are not present in all living beings.

Organic nature and highly organized structures

Living matter is organic because it is based on carbon chemistry and molecular interactions take place following the laws of chemistry. Almost every object we see, every material good we buy, every bite of food we consume, is based on element six. Every activity is influenced by carbon—work and sports, sleeping and waking, birthing and dying." Living organisms are highly organized structures that maintain low entropy (the vital order) by generating greater disorder in the environment, thus fulfilling the postulates of thermodynamics; when this vital order is lost, life disappears and the only way to restore life is to generate a new vital organized structure through reproduction. Living organisms resist entropy thanks to biochemical processes that transform the energy they obtain from nutrients, sun or

redox reactions. It could be said that vital order and energy are two sides of the same coin.

Pre-programming

Every living entity has a software (a pre-programme) in its genetic material that contains the instruction manual necessary for both its construction (morphology) and its functioning (physiology). This programme has been modified in the course of evolution, as a consequence of contingency and causality, so it is not a static or immutable program but a dynamic one. Furthermore, there is also another preestablished program called the principle of inexorability. Let me give a few examples, the shape of a ribosome is determined (pre-programmed) by the chemical bonds that are established between ribosomal proteins and rRNA. A similar example is the λ phage morphogenesis that depends only on interactions between protein–protein and protein-DNA. Evolutionary convergence or the need for wings to fly are other examples of this inexorability guided by the laws of nature.

Interaction and adaptation

If we look at nature in its purest state or at the complex human society, we can see countless interactions between living beings and with their environment necessary for survival and reproduction. We can see interactions at the molecular level (e.g., allosteric interactions, metabolic pathways, cellular signaling, quorum sensing), in the relationships between organisms of the same or different species (e.g., sexual reproduction, symbiosis, infection, parasitism, predator–prey, or sound language), or between living forms and the environment (e.g., photosynthesis or physiological/anatomical interactions for swimming or flying). Interaction is collaboration, it is cooperation at all levels, the ecosystem being the best example of multiple collaborative interactions between very different organisms. In terms of adaptation, living organisms show a great capacity to adapt both to their surroundings and to environmental circumstances; furthermore, adaptations involving new biological characteristics can be seen as an opportunity to find a different way to evolve. In this sense, the evolutionary process reflects this continuous adaptation and anatomy, physiology and genome bear witness to this. Life is adaptive because species adapt to environmental changes modifying their physiology or metabolism, for instance reducing heartbeat during hibernation (e.g. the grizzly bear Ursus arctos horribilis) or synthesizing fat from excess sugar to increase the energy reserves of the body (e.g. Homo sapiens). In addition to these temporal adaptations in response to environmental changes, there are also changes in genotype or phenotype since the adaptation process is the result of natural selection acting upon heritable variations. Epigenetic variations also contribute to rapid adaptive responses.

Reproduction and Evolution

Another property of living beings is their ability to perpetuate themselves and thus make it possible for the species not to disappear and to evolve. Reproduction can be observed at the molecular (DNA replication), cellular (mitosis, meiosis, binary division), and organismal (sexual and asexual) levels. From a different perspective, reproduction is also the way to overcome the second law of thermodynamics and the tyranny of time because when we reproduce, we are creating a new order and resetting the vital clock to zero. What about individuals such as the mule or the male and female of a species, or the hermaphrodite that cannot self-fertilize, who cannot reproduce because they are sterile or because they need another member of their species to reproduce? Aren't these organisms living beings? Of course, they are! In this context, reproduction must be considered as a facultative trait because not all living organisms are fertile or can produce offspring on their own but maintain all other traits necessary for the life process. If an individual is sterile, the species will continue to exist because the evolutionary process must be analyzed at the population level, not at the level of individual organisms; obviously, if the entire population were sterile, then the species would disappear and there would be no life. All species have the capacity to evolve, and this property is unique to life. Evolution allows living beings to adapt to new circumstances and the best genomes are selected and transmitted to the next generations. The concept of evolution (reproduction with variations and permanence in time) allows us to interpret the reality of the life we observe now and to guess what it has been like in the past. We cannot predict the future because evolution is not a finalistic process, it is the fruit of chance and necessity.

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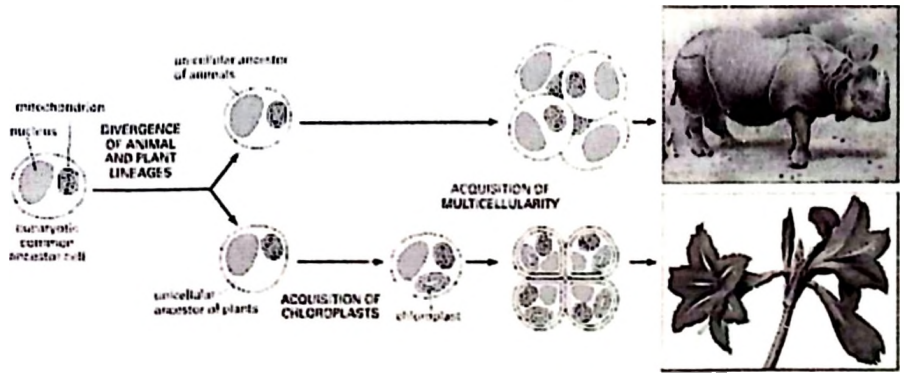
E - Content Package 05

Purpose - Supplementary learning resource
Chapter - Chapter 7 - Control and Coordination
Topic - Introduction to Control and Coordination in Plants and Animals

Although plants and animals are both eukaryotes, they have had separate evolutionary histories for more than a billion years. Their last common ancestor was a unicellular eukaryote that had mitochondria but no chloroplasts. The plant lineage acquired chloroplasts after plants and animals diverged. The earliest fossils of multicellular animals and plants date from almost 600 million years ago. Thus, it seems that plants and animals evolved multicellularity independently, each starting from a different unicellular eukaryote, sometime between 1.6 and 0.6 billion years ago. If multicellularity evolved independently in plants and animals, the molecules and mechanisms used for cell communication would have evolved separately and would be expected to be different. Some degree of resemblance is expected, however, as both plant and animal genes diverged from the set of genes contained by the unicellular eukaryote that was the last common ancestor of plants and animals. Nitric oxide and Ca2+ are widely used for signaling in both plants and animals. Much of what is known about the molecular mechanisms involved in signaling in plants has come from genetic studies on Arabidopsis. Although the specific molecules used in cell communication in plants often differ from those used in animals, the general strategies are frequently very similar.



Plants and animals are thought to have evolved multicellularity and cell communication mechanisms independently, each starting from a different unicellular eukaryote, which in turn evolved from a common unicellular eukaryotic ancestor. Not surprisingly, therefore, the mechanisms of signaling between cells in animals and plants have both similarities and differences. Whereas animals rely mainly on G-protein-linked surface receptors, for example, plants rely mainly on

enzyme-linked receptors of the receptor serine/threonine type, especially ones with extracellular leucine-rich repeats. A number of growth regulators, including ethylene, help coordinate plant development. Ethylene acts through receptor histidine kinases in a two-component signaling pathway that resembles the pathway used in bacterial chemotaxis. Light has an important role in regulating plant development. These light responses are mediated by a variety of light-sensitive photoproteins, including phytochromes, which are responsive to red light, and cryptochromes and phototropin, which are sensitive to blue light.

Various growth regulators (also called plant hormones) help to coordinate plant development. They include ethylene, auxin, cytokinins, gibberellins, and abscisic acid. Growth regulators are all small molecules made by most plant cells. They diffuse readily through cell walls and they can act locally or be transported to influence cells further away. Each growth regulator can have multiple effects. The specific effect depends on which other growth regulators are acting, on environmental conditions, on the nutritional state of the plant, and on the responsiveness of the target cell.

Plant development is greatly influenced by environmental conditions. Unlike animals, plants cannot move on when conditions become unfavorable; they have to adapt, or they die. The most important environmental influence is light, which is their energy source and has a major role throughout their entire life cycle—from germination, through seedling development, to flowering and senescence. Plants have evolved a large set of light-sensitive proteins to monitor the quantity, quality, direction, and duration of light.

Both plants and animals use a variety of light-responsive proteins to sense light of different wavelengths. In plants, these are usually referred to as photoreceptors. However, because the term photoreceptor is also used for light-sensitive cells in the animal retina, we shall use the term photoprotein instead. All photoproteins sense light by means of a covalently attached light-absorbing chromophore, which changes its shape in response to light and then induces a change in the protein's conformation. Animals use some of the same photoprotein families used by plants. The best-known plant photoproteins are the phytochromes, which are present in all plants and in some algae. These are dimeric, cytoplasmic serine/threonine kinases that respond differentially and reversibly to red and far-red light: whereas red light usually activates the kinase activity of the phytochrome, far-red light inactivates it. When activated by red light, the phytochrome is thought to phosphorylate itself and then to phosphorylate one or more other proteins in the cell. In some light responses, the activated phytochrome migrates into the nucleus, where it interacts

with gene regulatory proteins to alter gene transcription. In other cases, the activated phytochrome activates a gene regulatory protein in the cytoplasm, which then migrates into the nucleus to regulate gene transcription. In still other cases, the photoprotein triggers signaling pathways in the cytosol that alter the cell's behavior without involving the nucleus. Plants sense blue light using two types of photoproteins, phototropin and cryptochromes. Phototropin is associated with the plasma membrane and is partly responsible for phototropism, the tendency of plants to grow toward light. Phototropism occurs by directional cell elongation, which is stimulated by the growth regulator auxin, but the links between phototropin and auxin are unknown. Cryptochromes are flavoproteins that are sensitive to blue light. They are structurally related to blue-light-sensitive enzymes called photolyases, which are involved in the repair of ultraviolet-induced DNA damage in all organisms, except most mammals. Unlike phytochromes, cryptochromes are also found in animals, where they have an important role in circadian clocks that operate in most cells and cycle with a 24-hour rhythm. The cryptochromes do not have a DNA repair activity, but they are thought to have evolved from the photolyases.

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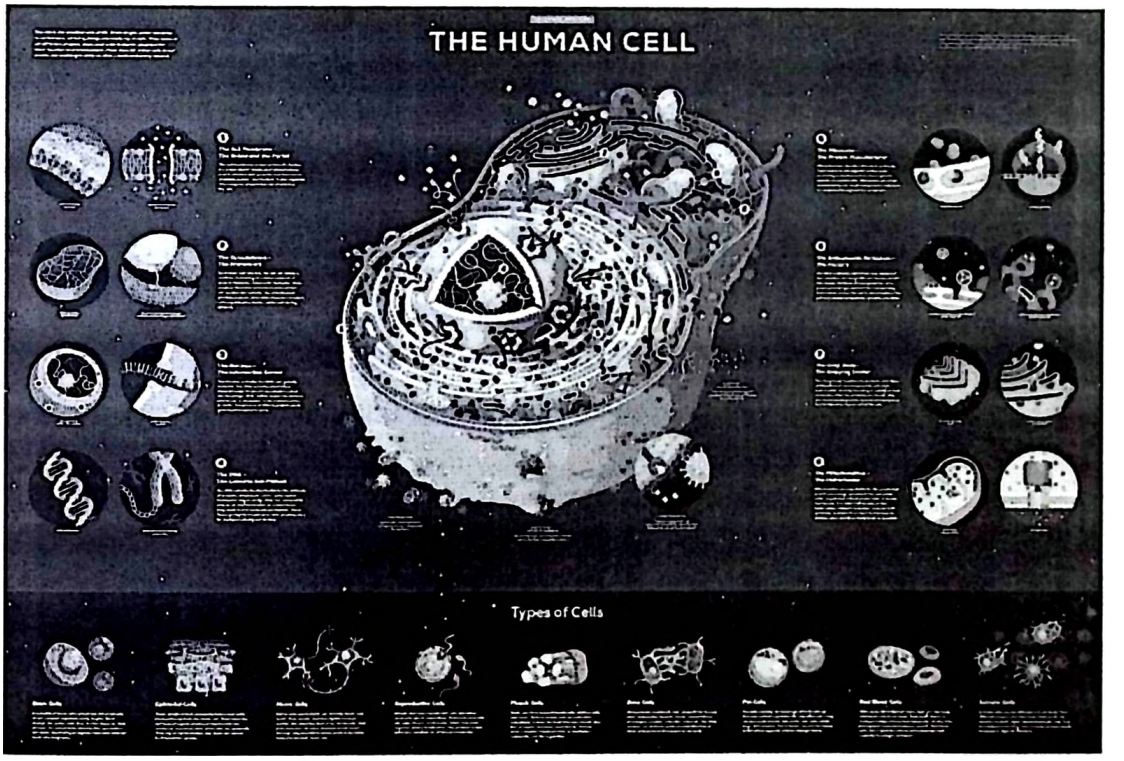
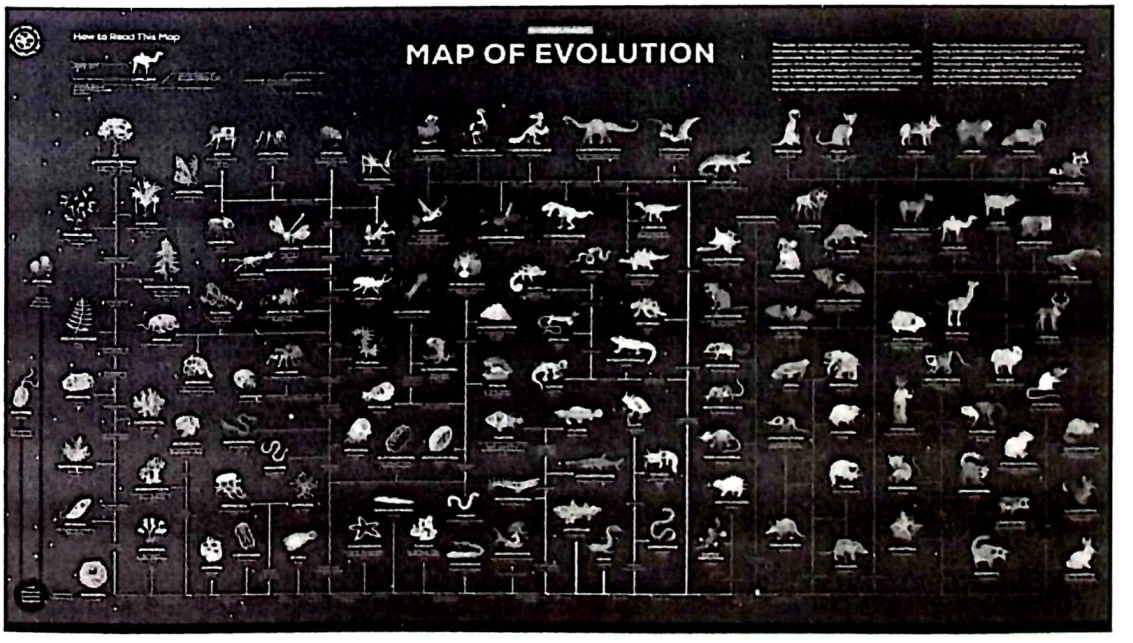
YOUTUBE VIDEOS, INFOGRAPHICS AND RELEVANT LINKS





(courtesy of kurzgesagt.org)

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20. https://www.youtube.com/watch?v=QImCld9YubE
21. https://www.youtube.com/watch?v=ck4RGieoHFko&t=3s
22. https://www.youtube.com/watch?v=wbR-5mHI6bo
23. https://www.youtube.com/watch?v=xaOJbozY_Is
24. https://www.youtube.com/watch?v=LxgMdjyw8uw
25. https://www.youtube.com/watch?v=Pj-h6MEgE7I
26. https://www.theskepticsguide.org/
27. https://globalchallenges.org/
28. https://gcrinstitute.org/
29. https://futureoflife.org/background/existential-risk/
30. https://www.cser.ac.uk/
31. https://www.fhi.ox.ac.uk/

PERSONAL DATA SHEET FOR RESPONDENTS

Email

Name

Gender

Father's Education

Father's Profession

Mother's Education

Mother's Profession

PRE ATTITUDE SCALE QUESTIONNAIRE

There are some (26) statements in this scale. Every statement has three alternatives: 'Agree', 'Indefinite' & 'Disagree'. If you agree with the statement - click 'Agree', if you are indefinite about the statement then select 'Indefinite' similarly if you disagree with the statement mark your disagreement. There is no time limit to complete the scale but I suggest you try to complete it as soon as possible.

1. Money spent on science is well worth spending.
2. I get bored when watching science programs on TV at home.
3. Publication of new facts increases the existing body of knowledge.
4. Science is man's worst enemy.
5. I enjoy reading about things which disagree with my previous ideas.
6. Scientific discoveries are doing more harm than good.
7. A scientist should express his/her findings & inventions even if they are opposed by others.
8. I would rather agree with other people than do an experiment to find out for myself.
9. I would like to be given a science book or a piece of scientific equipment as a present.
10. I dislike reading books about science during my holidays.
11. Science is one of the most interesting academic subjects.
12. A career in science would be dull and boring.
13. I am curious about the world in which we live.
14. I would enjoy my education more if there were no science lessons.
15. I would prefer to do experiments than to read about them.
16. I dislike reading newspaper articles about science.
17. Immature but curious people can become scientists.
18. The materials covered in science lessons are uninteresting.
19. I would enjoy visiting a science park on weekends.
20. I am unwilling to change my ideas when evidence shows that the ideas are poor.
21. If conventional ideas are proved wrong by various tested evidence then people should be ready to accept these changes.
22. Talking to friends about science after formal educational hours would be boring.
23. Questioning and a skeptical attitude is useful before accepting any new situation.
24. Climatologists can only predict about the climate correctly (no-one else).
25. To understand a new situation the existing body of knowledge is the basis (to start with).
26. I would rather find out about things by asking an expert than by doing an experiment.

POST ATTITUDE SCALE QUESTIONNAIRE

1. I have observed scientific concepts from my textbook in real life situations.
2. I approach science with a feeling of hesitation.
3. Works of citizen scientists can be published in noted research journals.
4. The idea of studying science makes me feel uncomfortable, restless, irritable, and impatient.
5. Correlations in research findings necessarily does not always lead to causations behind the events.
6. It makes me nervous to perform a biology experiment.
7. Accepted facts are never universal and unchangeable.
8. When I hear the word biology, I have a feeling of dislike.
9. Exact conclusions can only be drawn by analysis of complete data.
10. I am always under a terrible strain in biology class.
11. Weightage should be given to scientific reasoning rather than adventurous stories and magic.
12. Social sciences is not actual science because of the lack of scientific reasoning and skeptical mindsets involved.
13. Knowing new things about the world we live in is interesting and pleasurable.
14. I am unwilling to accept basic scientific facts that are not in line with my previous ideas.
15. Farsighted people in the scientific community are an asset.
16. I am not interested in pursuing a career in the field of science.
17. Science fairs/ projects can give positive insights into scientific concepts and can sometimes lead to innovative ideas.
18. Science, among all fields of knowledge, always makes a positive contribution towards society.
19. Libraries/ e-libraries/ internet archives etc. are great places to search for genuine information.
20. It is important for the government to approve new scientific ideas before they can be widely accepted.
21. Presenting views in general discussions are a great way to receive genuine feedback.
22. To learn biology, I only need to memorize facts and definitions.
23. The general public misunderstands many biological ideas.
24. Learning biology does not change my ideas about how the natural world works.
25. There is usually more than one correct approach to solve a biological problem.
26. Learning biology that is not directly relevant/ applicable to human health is not worth my time.

PRE ACHIEVEMENT TEST QUESTIONNAIRE

Choose the most appropriate option out of four (only one of the four options is correct)

1. Every multicellular organism has come from a single cell. (**True** / False)

2. Organelle other than nucleus, containing DNA?
   - I. Endoplasmic reticulum
   - II. Golgi apparatus
   - **III. Mitochondria**
   - IV. Lysosomes

3. A person met with an accident in which two long bones of the hand were dislocated. Which among the following may be the possible reason?
   - I. Tendon break
   - II. Break of skeletal muscle
   - **III. Ligament break**
   - IV. Areolar tissue break

4. Fats are stored in the human body as?
   - I. Cuboidal epithelium
   - **II. Adipose Tissue**
   - III. Bones
   - IV. Cartilage

5. If you live in an overcrowded and poorly ventilated house, it is possible that you may suffer from which of the following diseases?
   - I. Cancer
   - II. AIDS
   - **III. Air borne diseases**
   - IV. Cholera

6. Which one of the following is not important for individual health?
   - I. Living in clean space
   - II. Good economic condition
   - III. Social equality and harmony
   - **IV. Living in a large and well furnished house**

7. You are familiar with the SARS CoV2 (COVID19) situation around you. You were vaccinated because
   - I. vaccination kills the COVID-19 causing microorganisms
   - II. prevents the entry of COVID-19 causing organism
   - **III. it creates immunity in the body**
   - IV. all the above

8. Find out the wrong statement from the following.
   I. White revolution is meant for increase in milk production
   II. Blue revolution is meant for increase in fish production
   III. Increasing food production without compromising with environmental quality is called as sustainable agriculture
   IV. None of the above

9. "Drones" in the honeybee colony are stingless and are unable to gather food. Their main role is to mate with queen bee, and help in breeding. Drones are born out from
   I. Fertilized eggs and well-nourished larvae
   II. Unfertilized eggs
   III. Fertilized eggs giving heat treatment
   IV. Same way as the worker bee is born

10. Wasting less food is a way to reduce greenhouse gas emissions. (**True** / False)

POST ACHIEVEMENT TEST QUESTIONNAIRE

1. Which of the following greenhouse gasses is most abundant in earth's atmosphere?

I.Carbon Dioxide
II.Methane
III.Nitrous Oxide
IV.Water Vapour

2. Of the microbes listed below, which kind is considered by many biologists to be non-living?

I.Viruses
II.Fungi
III.Bacteria
IV.Protists

3. Infectious diseases are less deadly today than 100 years ago because

I. Scientists have created many new diseases in their laboratories
II. Airplanes speed travel from place to place spreading diseases
III. Fresh food crops are not infected with microorganisms
IV. Of modern sanitation and hygienic behavior

4. Which of the following foods is not made with the help of microbes?

I.Ice Cream
II.Bread
III.Yogurt
IV.Cheese

5. A cool breeze after a hot day brings all of us considerable relief. This breeze is actually the moving air. What is the basic process that causes this movement of air?

I.Pressure difference between the air of two regions
II.Moving leaves of the plants
III.Temperature difference between the two regions
IV.Striking of air with the mountains

6. Mitochondria are the sites of respiration in the cell. They oxidize carbohydrates and fats present in the cell to produce carbon dioxide, water and a lot of energy. The energy so released is stored in the form of ATP molecules. Since mitochondria in the cell are used to synthesize energy so, they are also called:

I.Energy capital of the cell
II.Energy generator of the cell
III.Kitchen of the cell
IV.Powerhouse of the cell

7. A vacuole is a space or cavity within the cytoplasm of a cell, enclosed by a membrane and typically containing fluid. They are a kind of storage sacs that are very large sized in the plant cell as compared to that in the animal cell. Which among the following is not a function of the vacuole?

I.They help to store the toxic metabolic by-products of the plant cell.
II.They provide turgidity and rigidity to the plant cell.
III.They help to maintain the osmotic pressure in the cell.
IV.They help the plant in its growth by the process of cell division.

8. Water makes on average about 60% part of the human body and is necessary in every biochemical reaction occurring in the human body. Which of the following is a disease which is caused due to the loss of water in the body making the patient seriously ill in a very short time?

I.Rehydration
II.Hydration
III.Dehydration
IV.Hydrolysis

9. What does the "19" in "COVID-19" refer to?

I.There are 19 variants of the coronavirus
II.There are 19 symptoms of coronavirus disease
III.This is the 19th coronavirus pandemic
IV.The coronavirus and the disease it causes were identified in 2019

10. If the greenhouse effect is natural, then why is today's climate change a bad thing?

I.A small increase in greenhouse gas concentration can have a large effect of increased warming
II.Humans have altered a natural process and exaggerated changes that might normally occur over millions of years
III.Once released into the atmosphere, greenhouse gases remain potent for many years, making it difficult to reverse the process
IV.Abrupt changes to the climate system may have unintended outcomes that may pose challenges for societies, like more extreme weather, spread of diseases, a decline in marine life, or an alteration of ocean circulation patterns
V.All of the above

RAW DATA OF ACHIEVEMENT AND ATTITUDE SCORES

NAME OF PARTICIPATING SCHOOLS

1. KENDRIYA VIDYALAYA NO 1, GANDHI MARG, ANGUL, ODISHA, INDIA
2. KENDRIYA VIDYALAYA NO 2, RAILWAY COLONY, ANGUL, ODISHA, INDIA

PRE AND POST - ATTITUDE AND ACHIEVEMENT SCORES OF RESPONDENTS

Here G1 & G2 represent the gender of Group1 (Control) and Group2 (Experimental) where 1 is female and 2 is male. Similarly S1 and S2 represent pre and post tests respectively.

KENDRIYA VIDYALAYA NO 1 (CONTROL GROUP)

G1	Att G1S1	Att G1S2	Ach G1S1	Ach G1S2
2	44	44	20	70
1	50	41	90	100
1	50	38	70	80
1	39	38	70	90
2	50	38	70	80
1	50	38	70	80
1	40	45	70	60
2	28	42	80	50
2	28	41	90	100
2	49	42	90	100
2	28	37	80	50
2	28	28	40	70
2	45	46	90	50
2	35	26	30	70

KENDRIYA VIDYALAYA NO 2 (EXPERIMENTAL GROUP)

G2	Att G2S1	Att G2S2	Ach G2S1	Ach G2S2
1	46	40	90	80
1	37	42	90	60
1	38	37	80	70
1	42	42	80	90
1	31	32	90	80
1	40	46	90	100
2	43	26	80	100
2	41	42	90	30
1	43	37	70	100
1	46	38	100	90
2	43	44	60	70
2	39	39	80	70
1	42	39	80	100
2	36	41	90	90

1	35	40	90	80
2	29	25	100	40
2	48	36	70	70
1	48	42	90	60
1	42	34	40	50
1	42	39	80	90
2	42	38	80	50
1	52	29	60	40
1	44	45	60	20
1	44	40	70	70
2	35	34	80	80
1	47	36	90	60
2	47	37	60	40
1	47	23	80	100
1	47	28	60	80
2	47	31	90	100
1	47	32	50	40
2	41	35	90	30
1	41	35	80	30
1	36	30	90	20
1	40	29	100	70
1	40	37	90	90
1	41	35	70	60
1	43	26	70	80
2	43	32	70	50
2	38	42	80	90
2	49	44	70	100
1	30	37	70	60
1	46	41	70	80
2	31	41	100	60
2	36	34	30	50
2	46	40	60	90
1	52	42	80	90
2	42	42	80	70
1	49	38	80	80
2	30	40	90	80
1	44	36	70	70
1	50	33	70	70
1	40	31	70	90
1	43	34	40	90
2	39	35	90	80
1	36	37	70	70
1	33	38	50	90
1	38	42	90	50
1	42	34	80	50
2	46	38	100	30
2	35	37	100	70
2	46	32	90	20
1	44	33	90	40
1	39	23	100	90

1	49	24	70	70
1	35	44	70	80
1	35	33	70	80
1	35	31	70	70
2	46	23	90	70
1	46	36	90	70
2	50	43	70	80
1	42	32	80	90
2	42	26	50	60
2	38	38	80	70
1	28	32	100	70
2	28	37	80	40
1	37	30	70	90
1	41	42	80	90
1	41	36	90	70
1	41	35	90	100
2	40	40	80	80
2	40	40	40	90
1	46	34	90	80
1	46	36	80	80
1	46	40	60	60
1	39	33	80	50
1	45	37	80	100
1	45	33	90	100
2	26	40	90	50
2	46	26	50	100
2	44	35	80	80
1	42	40	90	60
1	45	42	80	70
1	33	37	90	90
1	41	42	80	80
1	37	32	80	100
1	43	46	70	100
1	37	26	80	30
1	44	42	70	100
1	47	37	70	90
1	32	38	100	70
2	40	44	100	70
1	34	39	90	100
2	37	39	70	90
2	44	41	60	90
2	34	42	90	100
1	40	44	90	60
1	44	37	60	80
1	37	41	10	60
1	42	41	70	50
1	42	34	80	90
1	41	40	90	90
1	41	42	70	70
1	39	42	80	80

2	26	44	90	70
2	26	41	90	50
2	47	38	90	70
1	48	38	80	80
2	48	38	90	40
1	42	38	80	70
1	40	45	20	60
1	40	42	90	50
1	32	41	70	90
2	44	42	70	50
1	50	37	70	40
1	50	28	70	20
1	39	46	70	70
2	50	26	80	80
1	50	40	90	60
1	40	25	90	40

1	43	38	20	80
1	41	40	80	70
1	44	36	60	70
1	44	33	60	90
2	40	31	40	90
1	40	34	70	80
1	46	35	80	70
1	39	37	40	90
1	30	38	40	50
1	45	42	70	50
1	42	34	60	30
1	39	38	90	70
2	45	37	80	20
2	36	32	80	40
2	48	33	70	90
1	36	23	70	100