



Environmental Sustainability

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1. What is Environmental Science?
2. *What are the major problems associated with our environment?*
3. *What is an Ozone hole? Why this question is so important for our environment?*
4. *What is global warming?*
5. *What is acid rain?*

Environmental Concerns: Our Mother Earth is currently facing a lot of environmental concerns. Environmental problems like global warming, acid rain, air pollution, urban sprawl, waste disposal, ozone layer depletion, water pollution, climate change and many more affect every human, animal, and nation on this planet

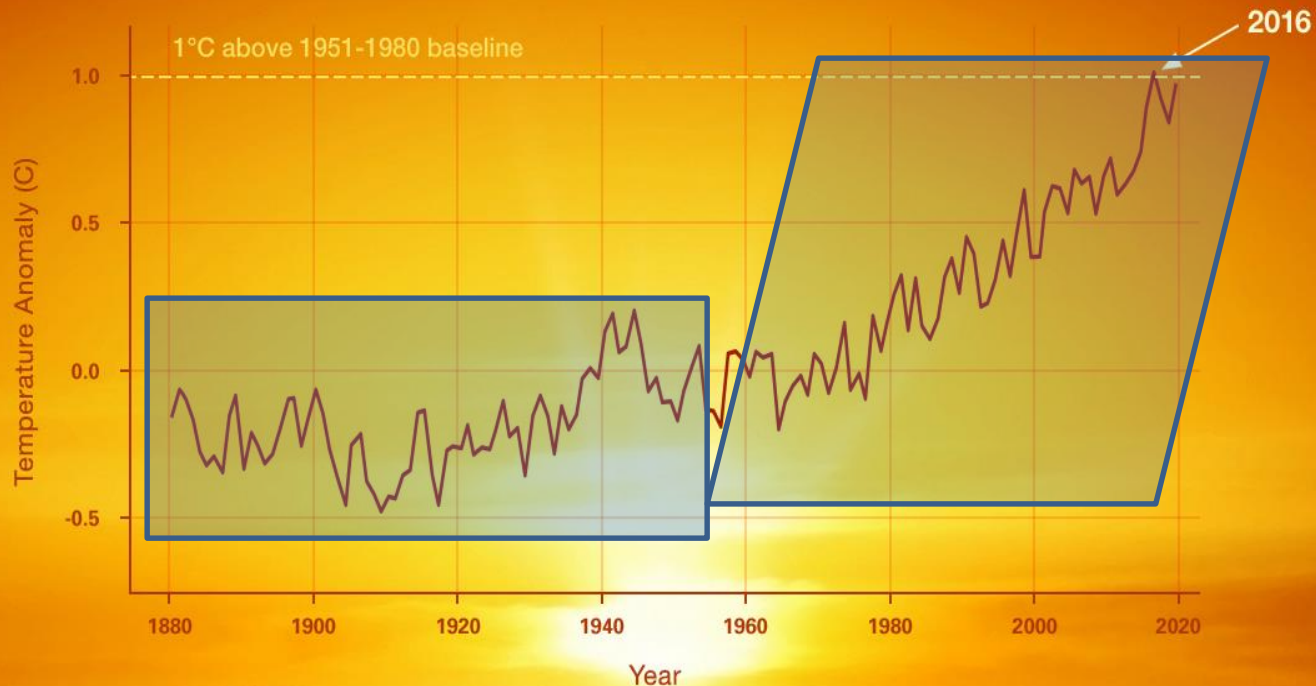
Sooner or later, we will have to recognise that the Earth has rights, too, to live without pollution. What mankind must know is that human beings cannot live without Mother Earth, but the planet can live without humans.

Eva Morales

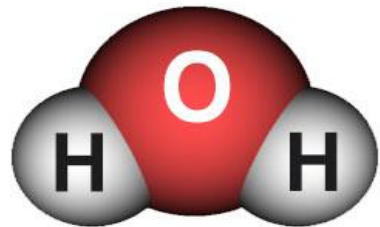
**LIST OF MAJOR
GLOBAL ISSUES....**

1. Global Warming

Global warming is the long-term heating of Earth's surface 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.

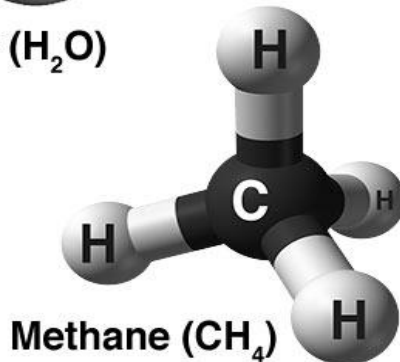
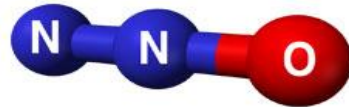


1. Global Warming

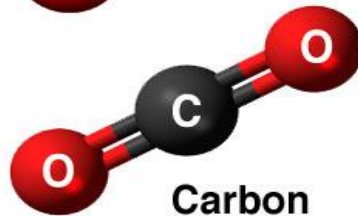


Water vapor (H_2O)

Nitrous oxide (N_2O)

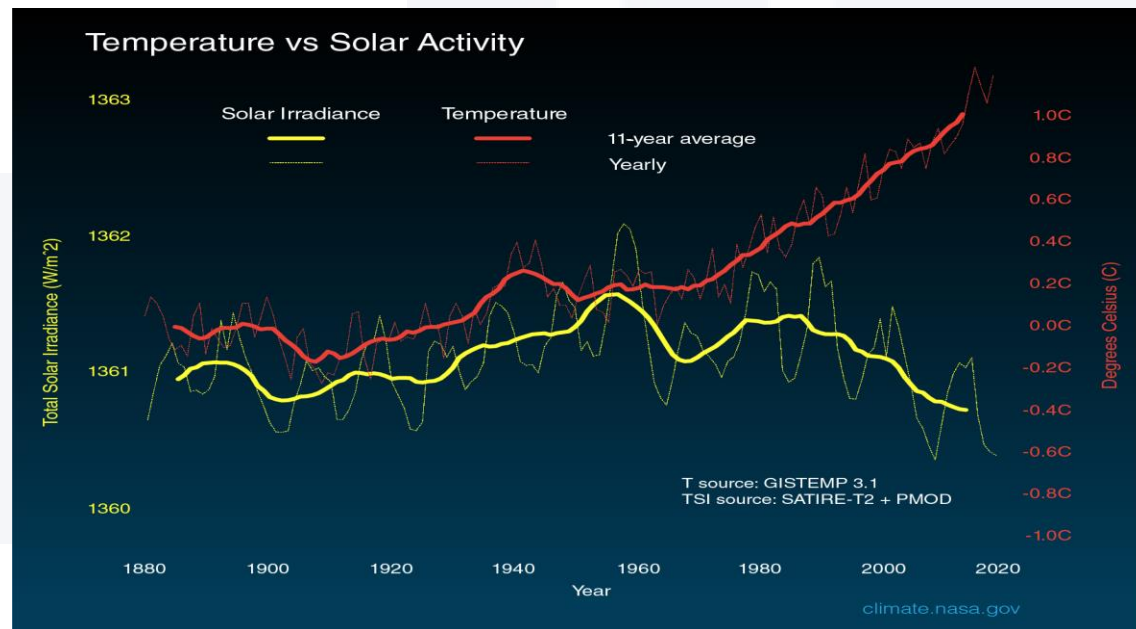


Methane (CH_4)



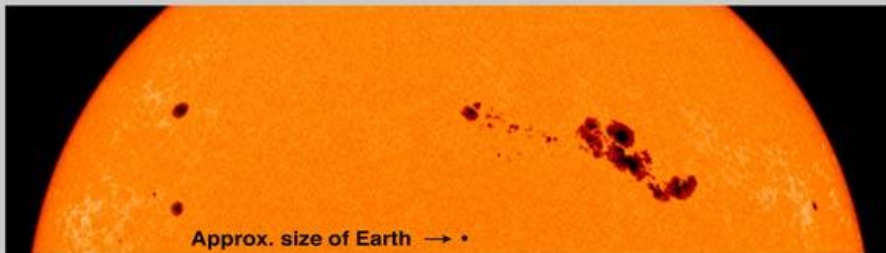
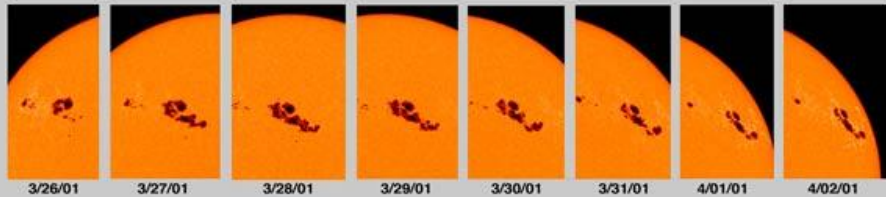
Carbon dioxide (CO_2)

Some researcher believes that Sun may also play role in global warming.

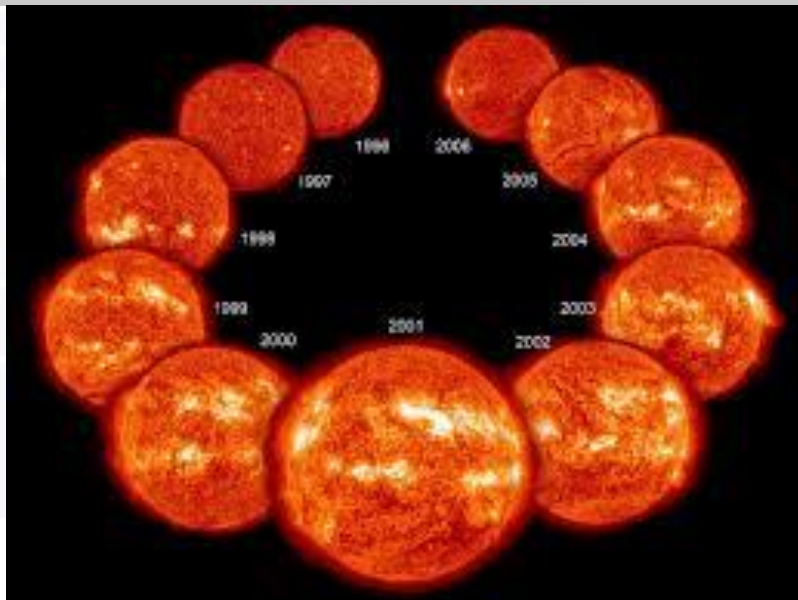


1. Global Warming

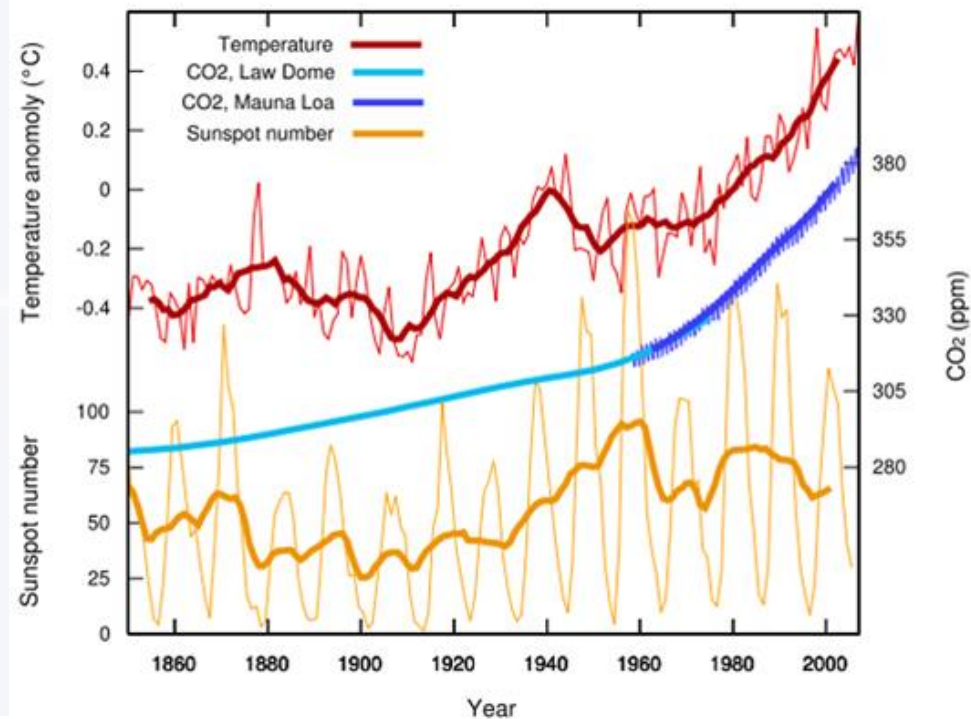
Some researcher believes that Sun may also play role in global warming.



March 30, 2001



Temperature, CO₂, and Sunspots



2. Air pollution:

Air pollution is a mix of hazardous substances from both human-made and natural sources.



Air pollution causes various diseases, for example, cancer, cardiovascular, and respiratory

3. Ozone Depletion

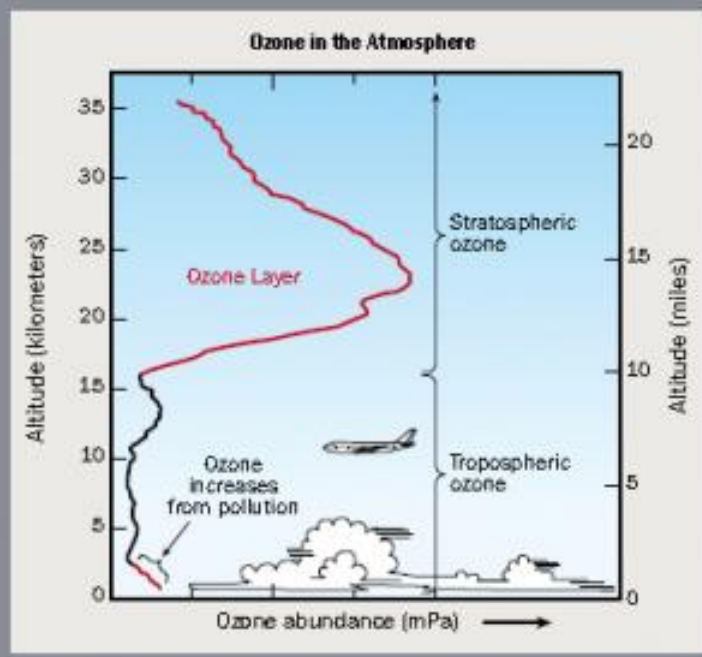


Figure Q1-2 Ozone in the atmosphere. Ozone is present throughout the troposphere and stratosphere. This profile shows schematically how ozone changes with altitude in the tropics. Most ozone resides in the stratospheric "ozone layer." The vertical extent or thickness of this layer varies from region to region and with season over the globe (see Q4). Increases in ozone occur near the surface as a result of pollution from human activities.

Most atmospheric ozone is concentrated in a layer in the stratosphere, about 9 to 18 miles (15 to 30 km) above the Earth's surface (see the figure). Ozone is a molecule that contains three oxygen atoms. At any given time, ozone molecules are constantly formed and destroyed in the stratosphere. The total amount has remained relatively stable during the decades that it has been measured.

The ozone layer in the stratosphere absorbs a portion of the radiation from the sun, preventing it from reaching the planet's surface. Most importantly, it absorbs the portion of UV. UV has been linked to many harmful effects including skin cancers, and harm to some crops and marine life.

3. Ozone Depletion

In the stratosphere, Ozone is found in a concentrated thick layer at varying heights from 16-40 km at different latitudes.

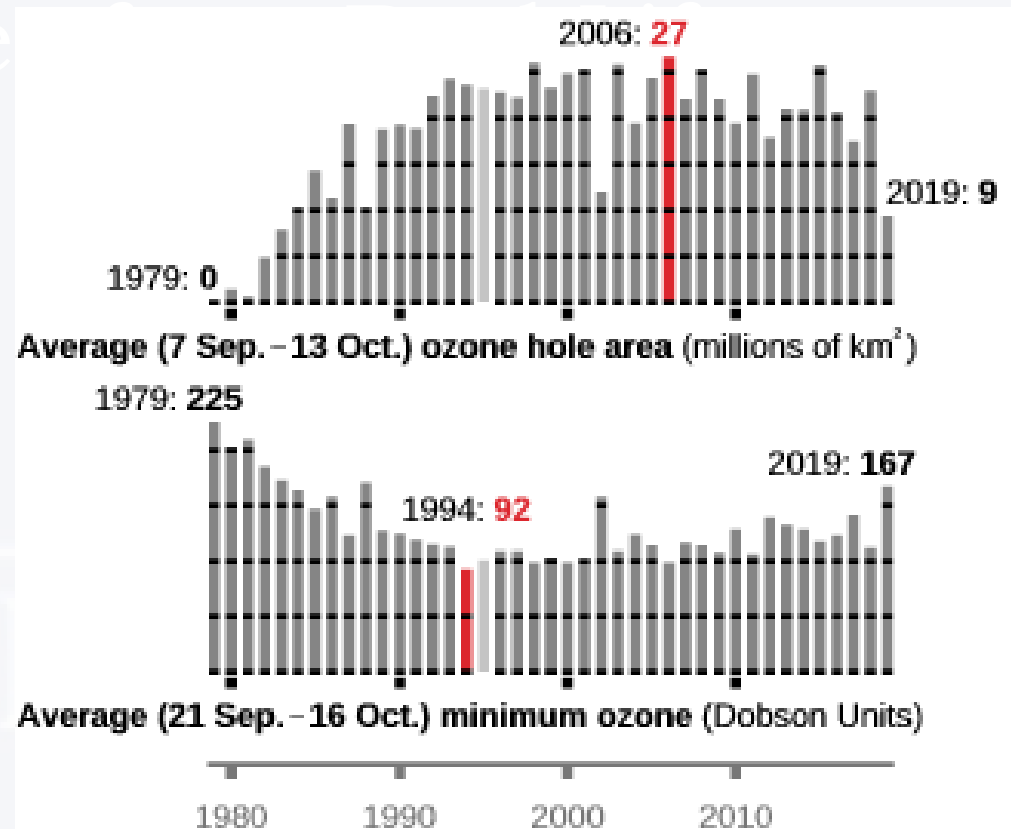
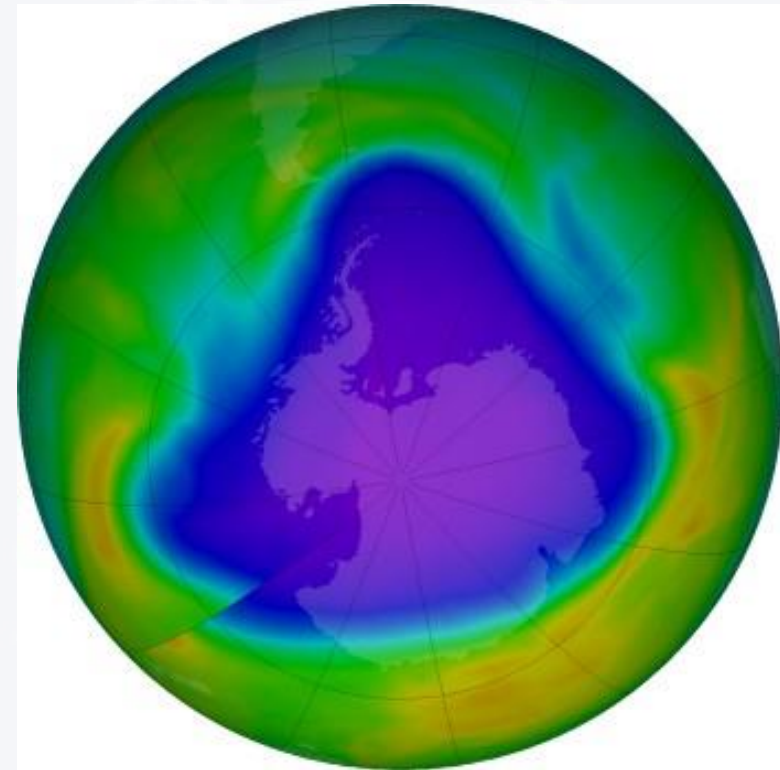
Its concentration at the troposphere is <1 ppm and then it starts increasing up to 8 ppm at about 30 km and then it again starts decreasing up to 2 ppm at 40 km and its value reaches 0 ppm at 100 km.

In the stratosphere, O_3 is formed naturally when oxygen is dissociated by UV radiations in the wavelength region of 80-240 nm.

The UV radiations in the region of 200-300 nm can also dissociate the Ozone.

3. Ozone Depletion

30 Sept. 2020

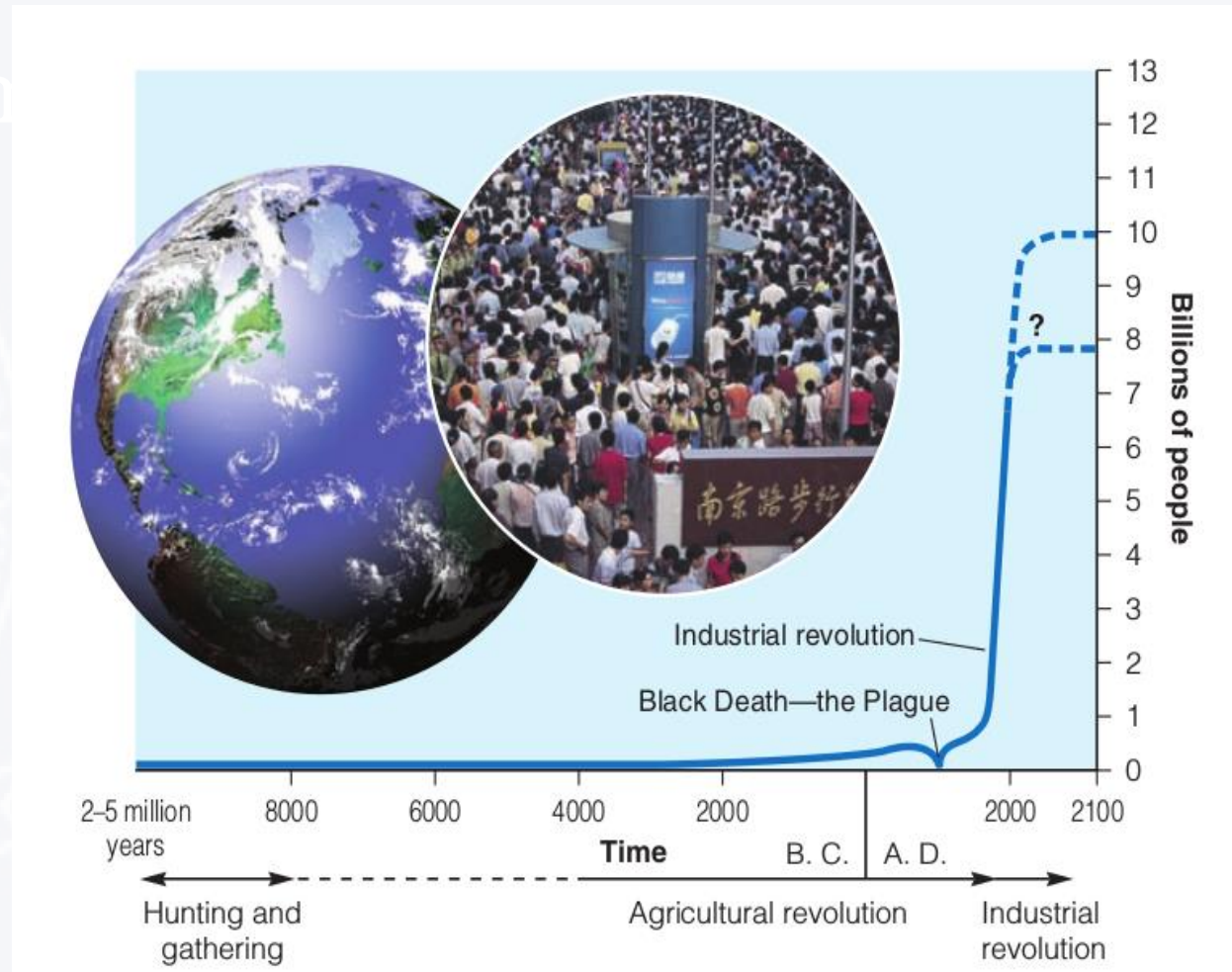


Note: No data were acquired during the 1995 season

4. Overpopulation

More Exa

More people means an increased demand for *food, water, housing, energy, healthcare, transportation, and more*. And all that consumption contributes to *ecological degradation, increased conflicts, and a higher risk of large-scale disasters like pandemics*.



Home Work: Please search for some other important global environmental issues, and write a report on them.



What is the Sustainability?

The ability of the earth's various natural systems and human cultural systems and economies to survive and adapt to changing environmental conditions indefinitely.

In simple words: Sustainability means meeting our own needs [as a mankind] without compromising the ability of future generations to meet their own needs

Why this is so important?

Because we are a species in the process of rapidly degrading our own life support system. In 2005, the United Nations Millennium Ecosystem Assessment, a 4-year study by 1,360 environmental experts from 95 countries warned that “human activity is putting such a strain on the natural functions of Earth that the ability of the planet's ecosystems to sustain future generations can no longer be taken for granted.”

Some other important reasons for the importance of sustainability are mentioned here.

- ✓ *Sustainability is key to preserving our planet*
- ✓ *Sustainability helps reduce pollution and conserve resources*
- ✓ *Sustainability creates jobs and stimulates the economy*
- ✓ *Sustainability improves public health*
- ✓ *Sustainability protects biodiversity*

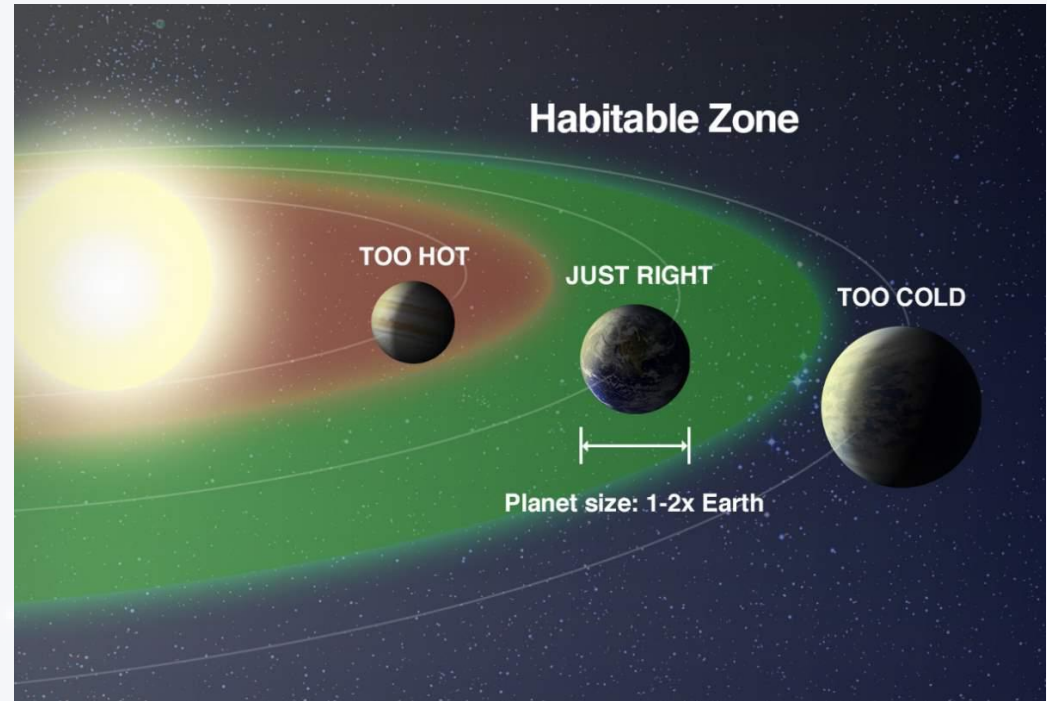
Sustainability: Three Main Factors

The long-term sustainability of life on this planet in the face of drastic environmental changes has depended on three key factors:

- 1. Solar energy**
- 2. Biodiversity**
- 3. Chemical cycling**



*Earth lies in the **habitable zone** from the Sun, therefore, **life exists on the Earth.***



Reliance on solar energy: The sun warms the planet and provides energy that plants use to produce food for themselves and for us and most other animals. ***Without the sun, there would be no plants, no animals, and no food. The sun also powers indirect forms of solar energy such as wind and flowing water, which can be used to produce electricity.***

A circular collage of various animals and plants surrounding a central globe, symbolizing biodiversity. The globe is blue and green, showing continents and oceans. Around it are illustrations of a butterfly, a scorpion, a shark, a zebra, a ladybug, a bee, a snail, a fish, a tree, and a butterfly. The background is a light green gradient.

Chemical Cycling: Natural processes recycle nutrients or chemicals that plants and animals need to stay alive and reproduce. Because the earth gets no new shipments of these chemicals, they must be continuously cycled from organisms to their non-living environment and back. without chemical cycling, there would be no air, no water, no soil, no food, and no life.

What is to be Sustained?

- **NATURE – Earth – Biodiversity – Ecosystems**
- **LIFE SUPPORT – Ecosystem – Services – Environment**
- **COMMUNITY – Cultures – Groups – Places**

What is to be developed?

- **PEOPLE - Child Survival - Life expectancy - Education – Equity - Equal Opportunity**
- **ECONOMY - Wealth - Productive - Sectors – Consumption**
- **SOCIETY - Institutions - Social Capital - States - Regions**

Sustainability can be categorized into various categories, namely, environmental, economic, business, and social sustainability.

Challenges in Environmental Sustainability

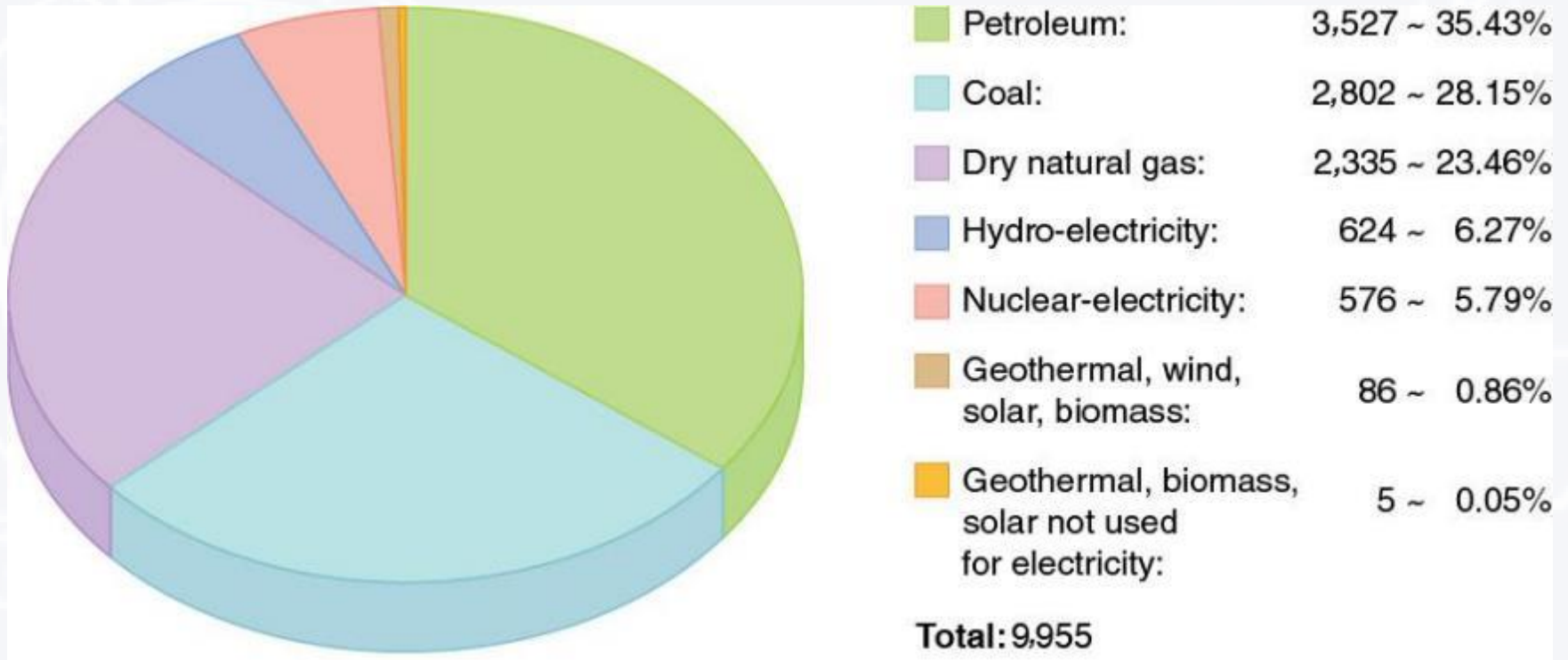
Global warming due to CO₂ emissions: Climate change is accelerating and threatens the whole global ecosystem by causing serious meteorological disasters like droughts, fires, and floods, which are becoming increasingly frequent and more extreme. So, it is strongly advised to mitigate climate change.

Air pollution and water contamination: Experts estimate that nearly 90% of humanity breathes polluted air. That's why, it is important to reduce air pollution and minimize the use of chemicals, treating more wastewater – to cut rates of respiratory illnesses, thus preventing seven million deaths a year. Contaminated water also causes major health problems.

Pollution of the oceans, seas, and inland waters: The oceans have become giant waste dumps for plastic and other synthetic materials. Due to the economic advancement of many economically underdeveloped regions – there are serious environmental problems related to the oceans such as damage to ecosystems from dumping pollutants, wastewater, and fuel spills.

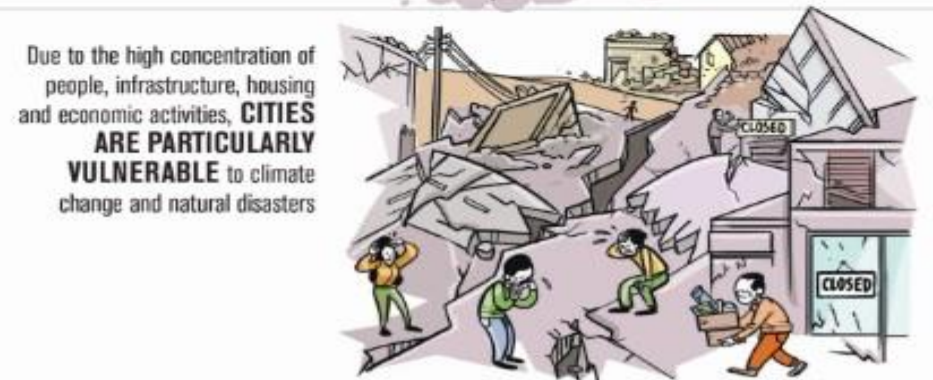
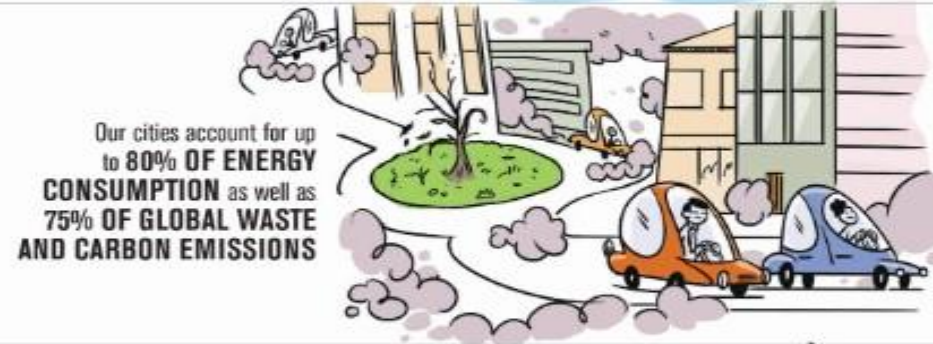
Challenges in Environmental Sustainability

Insufficient share of renewable energy: We depend on fossil fuels in various sectors. This situation requires an energy transition towards a cleaner, more accessible, and efficient model based on the use of renewable energy sources to build communities that are more sustainable.



Challenges in Environmental Sustainability

Unplanned Urbanization: The growth of cities, which will need to accommodate around 5 billion people by 2030, will be another of the decade's big environmental challenges. The metropolises of the future will need to be compact, safe, inclusive, ecological and energy efficient, with more green spaces, more environmentally friendly buildings and more sustainable methods of transport which put the needs of pedestrians above those of traffic. *Due to such circumstances, there is a necessity to create and maintain sustainable urban development and mobility.*



Challenges in Environmental Sustainability

Uncompromising food production harms: Overexploitation of natural resources and disturbance of the environment depletes the soil and damages the marine ecosystems. *It requires focus and consideration in order to change the food production model and food habits, including a more plant-based diet featuring local ingredients to save energy and reduce gas emissions.*

Overpopulation and waste management:

The world population is expected to exceed 8.5 billion by 2030, forcing us to considerably reduce the amount of waste we generate through prevention, reduction, reuse, and recycling as part of the ***circular economy, with the aim of minimizing the impact on health and the environment.***



Technology is the reason behind most environmental issues we face today, but it's also the solution. By transforming the technologies that our civilization depends on in a manner that doesn't compromise nature, we get to continue enjoying a higher quality of life without destroying our planet.

Improving efficiency across industries: A fundamental factor in achieving environmental sustainability is doing everything more efficiently. If transportation, manufacturing, energy generation, and all other industries operated at a significantly higher efficiency, we will be eliminating waste and drastically reducing our collective carbon footprint.

Automation: Waste reduction: Cost-efficiency

Data collection and management: Data plays an essential role in achieving environmental sustainability. *It's data gathered by researchers that give birth to technological breakthroughs. In turn, new pieces of technology allow researchers to obtain data more easily and more accurately.*

We can perform a good estimate of how much carbon is released into the atmosphere. It is through this knowledge that they are then able to set goals and formulate sustainable development strategies.

Making clean fuel viable: Among the biggest roadblocks in environmental sustainability is making clean fuel feasible. *Technologies such as hydrogen fuel cells and other green fuels already exist but using them on a wider scale is not feasible.* They will remain relegated to small-scale applications until breakthroughs can be made in their application.

Activity: Write a report on the working principle of Hydrogen Fuel. Also explain, why we can't use hydrogen fuel on a larger scale.

Recycling technology: The importance of recycling waste has been emphasized for decades, and while large strides have been made, there's still vast room for improvement. *The types of waste material we can recycle today* are limited and *even if we can recycle something, the end result isn't always valuable.*

Case Study 1: H&M Let's Close the Gap: Deposit scheme for gathering raw material.

Here's a not-so-fun fact: Today, less than 1% of the materials used to make clothes get recycled each year. This means that thousands of tonnes of textiles end up in landfills. By reusing or recycling fashion, we can turn that around.

In 2021, we consumed 1.7 times more resources than Earth generates annually because our economic outlook is based on production, use and disposal. Such an economy is not sustainable and that is the reason why the concept of circular economy (CE) is trending nowadays



CE Principle: Use trash as a raw material for production through innovation, recycling, or repairing and reusing existing products.

H&M's "Let's Close the Gap" project began in 2013 as a CE best practice that collects and categorizes discarded clothing from customers.

- *If the garment is in decent condition, they will restore it and find a new owner for it.*
- *If a garment reaches the end of its useful life, H&M will recycle it and reuse the material in new goods.*

Customers who bring in their old clothes are rewarded with tokens that can be used to get a discount at H&M shops. Incentivizing customers creates a complete CE loop.

In 2019, 57% of H&M's raw materials were sustainable, according to Forbes. By 2030, the company hopes to improve it by 100 percent.



Case Study 2: Tata Power (solar plants on the roofs)

Rooftops offer a lot of empty space that can be used to install solar panels. Such initiatives have been taken in various parts of the world. *Tata Power does it in India and generates green electricity by using idle places of buildings.*



In 2021, Tata Power was able to spread their program throughout 90 Indian cities, producing 421 million watts of electricity, which is equivalent to nearly 40 thousand homes' yearly electricity use in the US.

We expect that in the near future the cooperation between energy and construction companies will enhance the use of idle places in buildings in a more effective way. Such an industrial symbiosis reduces both sectors' ESG risk.

Human Environmental Interactions can be defined as interactions between the human social system and (the “rest” of) the ecosystem.



In order to analyze Human Environmental Interactions it is important to be aware of *specific characteristics of the human social system.*

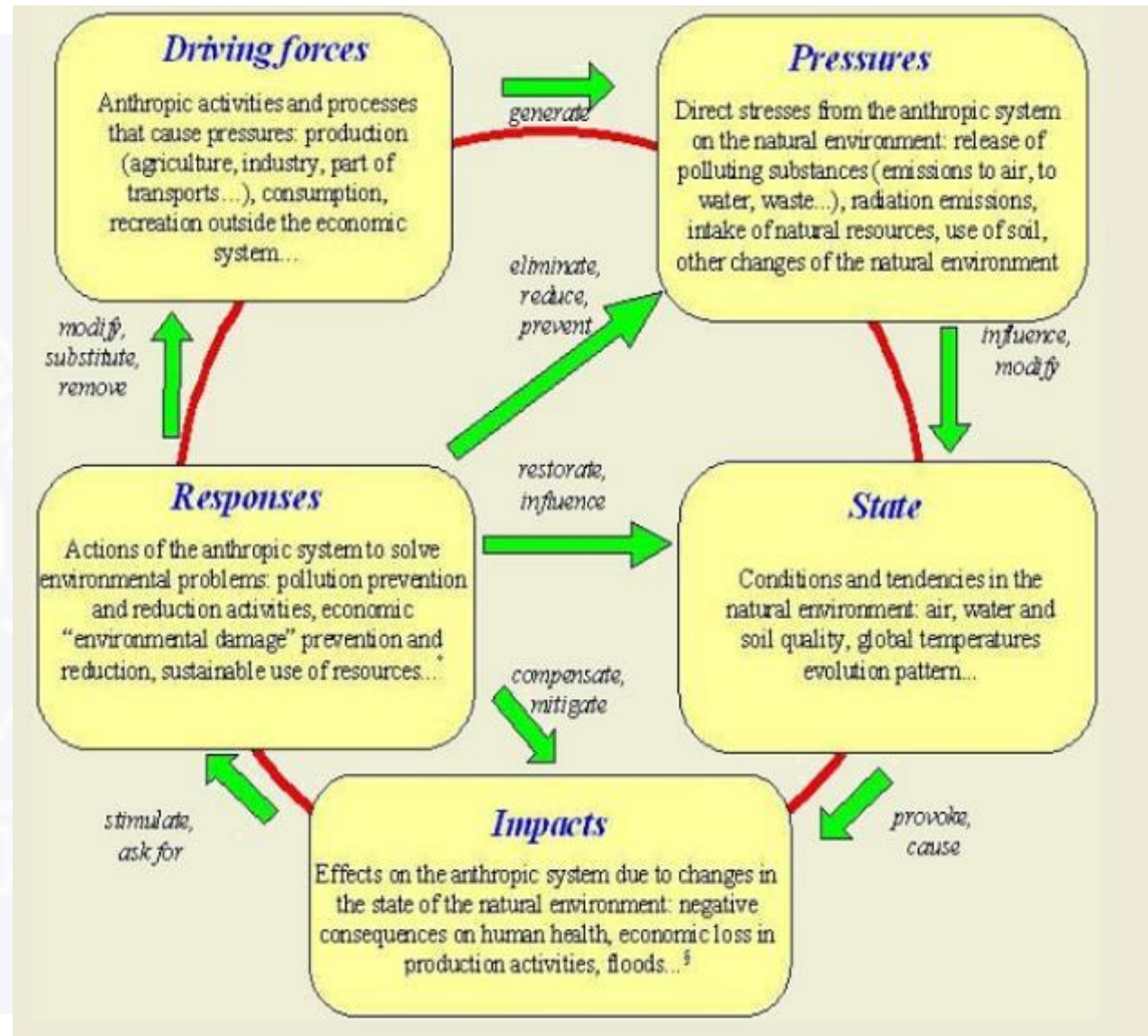
The **type of society** strongly influences peoples attitudes towards nature, their behavior, and therefore their **impact on ecosystems.** *Important characteristics of human social systems are population size, social organization, values, technology, wealth, education, knowledge, and many more.*

Human activities are affecting the environment. Humans modify the environment for their purposes and obtain benefits from it: ***Ecosystem Services***



These **Ecosystem Services** are essential for **human well-being** and include for example the provision of resources like water, timber, food, energy, information, land for farming and many more. Obviously by using these resources people affect the environment in a lot of ways. *Furthermore people often reorganize existing ecosystems to achieve new ones that seem to be more effective in serving their needs.*

The Drivers-Pressures-State-Impact-Response (DPSIR) model was originally developed by the European Environmental Agency (EEA) and is used to assess and manage environmental problems.



Consumerism and its Impact

To better understand the concept of Consumerism, let's first understand what a consumer is.
The consumer is the final person who consumes any goods or services



Consumerism is the theory that individuals *who consume goods, and services in large quantities will be better off*

Some economists believe that *consumer spending stimulates the production and economic growth.*

Hyper-consumerism has been widely criticized for its economic, social, environmental, and psychological consequences.

Consumerism and its Impact

Pollution: As the companies start producing products in large numbers and many new companies also enter the market, because of the making of products and other activities involved in making a product, a lot of waste is generated and pollutes the environment.



Natural resource depletion: To produce more products, more resources will be required, and because of that, after some time, it will lead to a scarcity of resources. If there is a scarcity of resources and the demand is high, then the product prices will also get higher, causing inflation in the market.

Poor Labour Standards: Consumerism also promotes poor labour standards and pay for workers. When companies' products are in high demand, they produce more products but within the end users' budgets; they do so by keeping production costs low. As a result, companies do not pay the labour sufficient or reasonable wages, and because of that, the quality of the labours' standard fall, and they sometimes suffer.

Climate Change: A new study published in the *Journal of Industrial Ecology* shows that the stuff we consume is responsible for up to **60 percent of global greenhouse gas emissions and between 50 and 80 percent of total land, material, and water use.**

We all like to put the blame on someone else, the government, or businesses. ... But between 60-80 percent of the impacts on the planet come from household consumption. If we change our consumption habits, this would have a drastic effect on our environmental footprint as well