Environmental Science

CHY 1002

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Assistant Professor
VIT Bhopal

Syllabus

Module 1: Ecosystem: Key environmental problems and their basic causes; Ecosystem, earth – life support system and ecosystem components; Energy flow in ecosystem; Ecological succession; Nutrient, phosphorous, carbon, nitrogen, cycles; Effect of human activities on these cycles. Urban ecology.

Module 2: Biodiversity: Importance, types, mega-biodiversity; Species interaction – Extinct, endemic, endangered and rare species; Hot-spots; GM crops; Threats to biodiversity: Natural and anthropogenic activities; Conservation: Terrestrial and aquatic biodiversity.

Module 3: Environmental pollution and climate change Environmental hazards: Biological, Chemical, Nuclear; Risk and evaluation of hazards; Types of pollution: Air and water – Pollution sources, effects and mitigation. Water quality management and its conservation; Water footprint and virtual water, Solid waste management; Climate disruption and ozone depletion (Kyoto protocol, Carbon sequestration methods and Montreal Protocol –Effect of climate change on lives on earth. Carbon credit, carbon audit.

Syllabus

Module 4: Natural Resources Water resources – properties of water, pH, conductivity, colour, use of surface and subsurface water; Water contamination from industries, Domestic water pollution. Water management practices. Energy resources - oil, Natural gas, Coal, Nuclear energy. Energy efficiency and renewable energy. Solar energy, Hydroelectric power, Ocean thermal energy, Wind and geothermal energy. Energy from biomass, solar-Hydrogen revolution. Natural resources and economics of India.

Module5: Environmental Impact Assessment Introduction to environmental impact analysis. EIA guidelines, Notification of Government of India (Environmental Protection Act – Air, water, forest and wild life). Impact assessment methodologies. Public awareness. Environmental priorities in India and sustainable development. Importance of Agriculture.

Module 6: Human Population and Environment Urban environmental problems; Consumerism and waste products; Promotion of economic development – Impact of population age structure – Women and child welfare, Women empowerment. Sustaining human societies: Economics, environment, policies and education.

Text/Reference Books

Text Books

G. Tyler Miller and Scott E. Spoolman (2013), **Environmental Science, 14th Edition**, Cengage Learning.

Y K Singh (2006), **Environmental Science, 1st Edition**, New Age International.

A. Kaushik and C. P. Kaushik (2019), **Environmental Science, 1st Edition**, New Age International

Reference Books

D. M. Hassenzahl, M. C. Hager, and L. R. Berg (2011), **Visualizing Environmental Science, 4th Edition**, John Wiley & Sons, USA.

Environmental Science - Introduction

- What is environmental Science?
- What are the key problems associated with our environment?
- What is Ozone hole? Why this question is so important for our environment?
- What is global warming?
- What is acid rain?

Introduction-Environmental Science

Environmental science—an interdisciplinary study of how the earth works, how we interact with the earth, and how we can deal with the environmental problems we face. Because environmental issues affect every part of your life, the concepts, information, and various issues. This course will be useful to you now and throughout your life.

Introduction - Sustainability

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.

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."

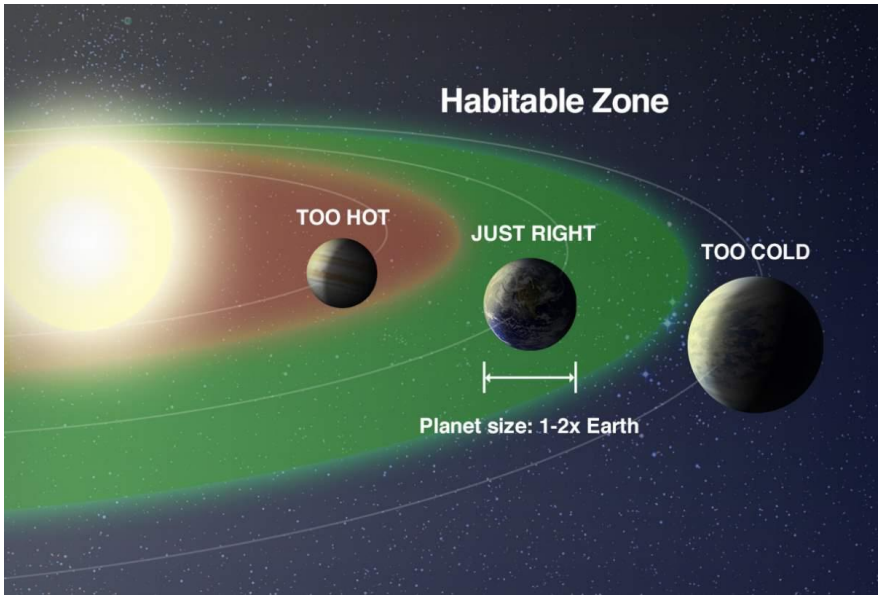
Scientific research reveals that life on the earth has sustained itself for at least 3.5 billion years despite being subjected to catastrophic changes in environmental conditions. These changes included collisions between the earth and gigantic meteorites, ice ages lasting for hundreds of millions of years, and warming periods during which melting ice raised sea levels and flooded vast areas

Three Key Factors

The long-term sustainability of life on this planet in the face of drastic environmental changes has depended on three key factors: **solar energy, biodiversity, and chemical cycling**

Environmental Changes - Three Key Factors

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

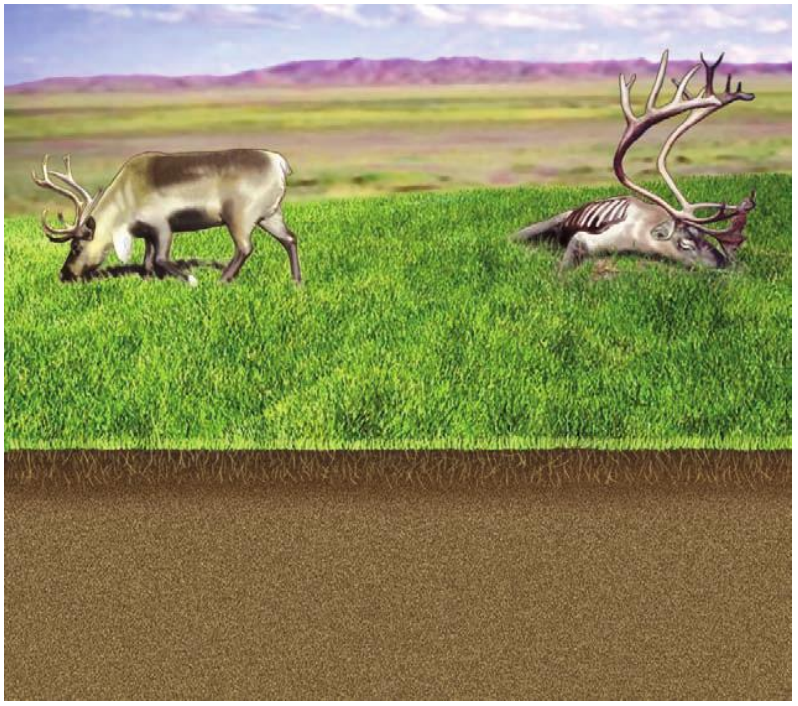


Reliance on solar energy: The sun warms the planet and provides energy that plants use to produce food for themselves and for us and most other animals. Without the sun, there would be no plants, no animals, and no food. The sun also powers indirect forms of solar energy such as wind and flowing water,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

Environmental Changes - Three Key Factors

Biodiversity: It includes the astounding variety of different organisms; the deserts, grasslands, forests, oceans, and other systems in which they exist and interact; and the free natural services, such as soil renewal, pest control, and air and water purification, that these species and systems provide. Without biodiversity, most life would have been wiped out long ago.

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.



Key environmental problems

Environmental Concerns: Mother Earth is currently facing a lot of environmental concerns. The 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 recognize 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.

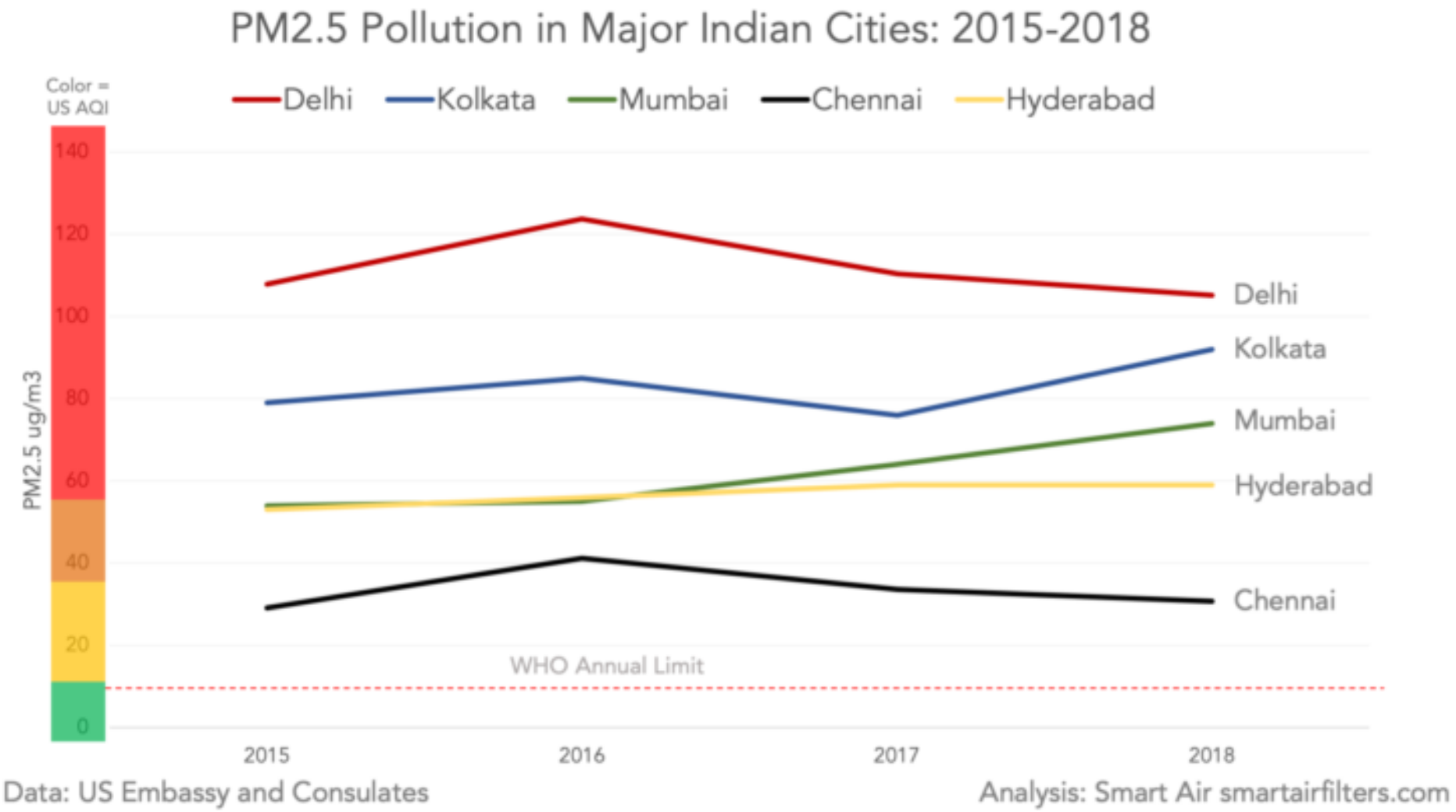
Eva Morales

Key environmental problems

Air Pollution

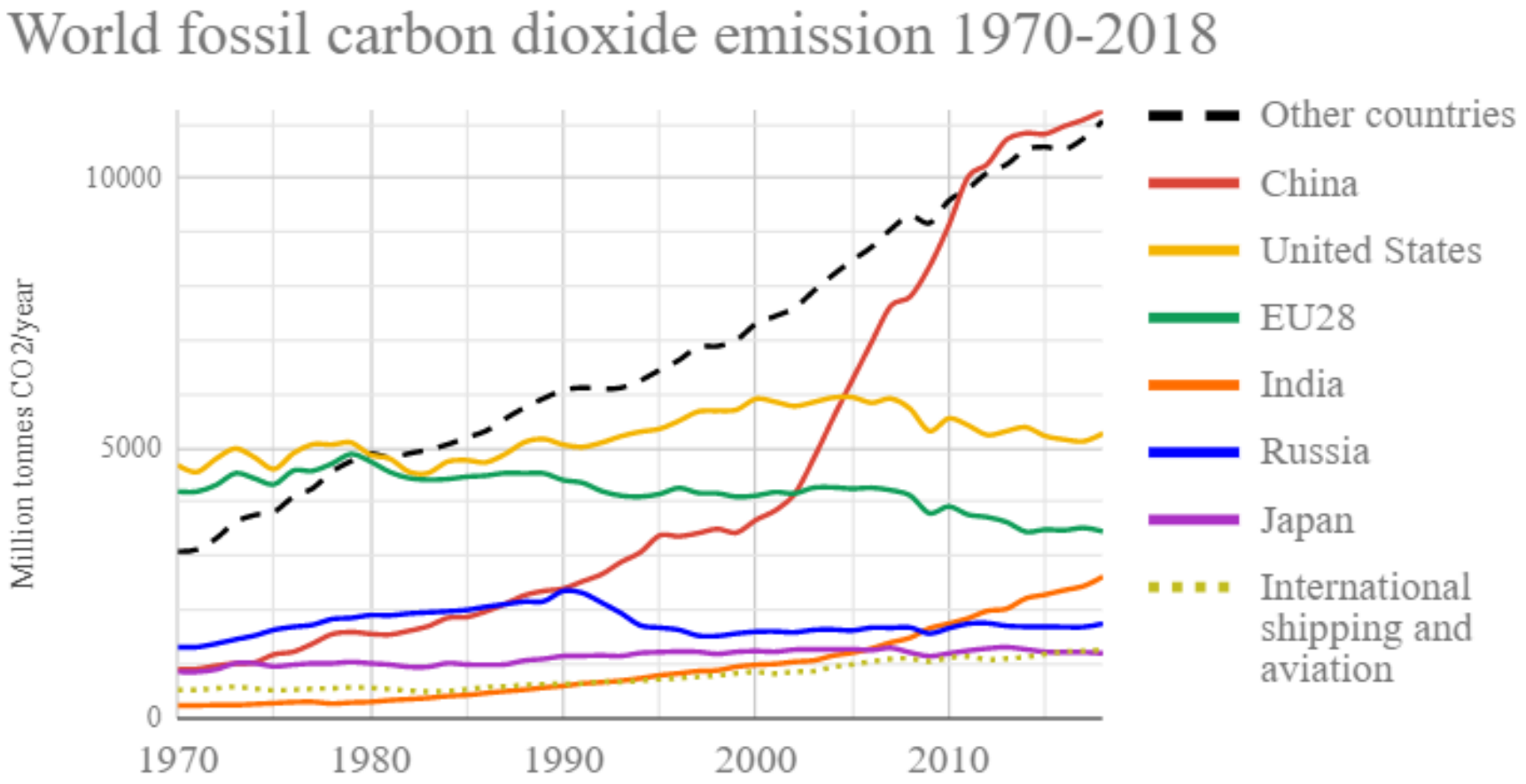
Key environmental problems

Air Pollution



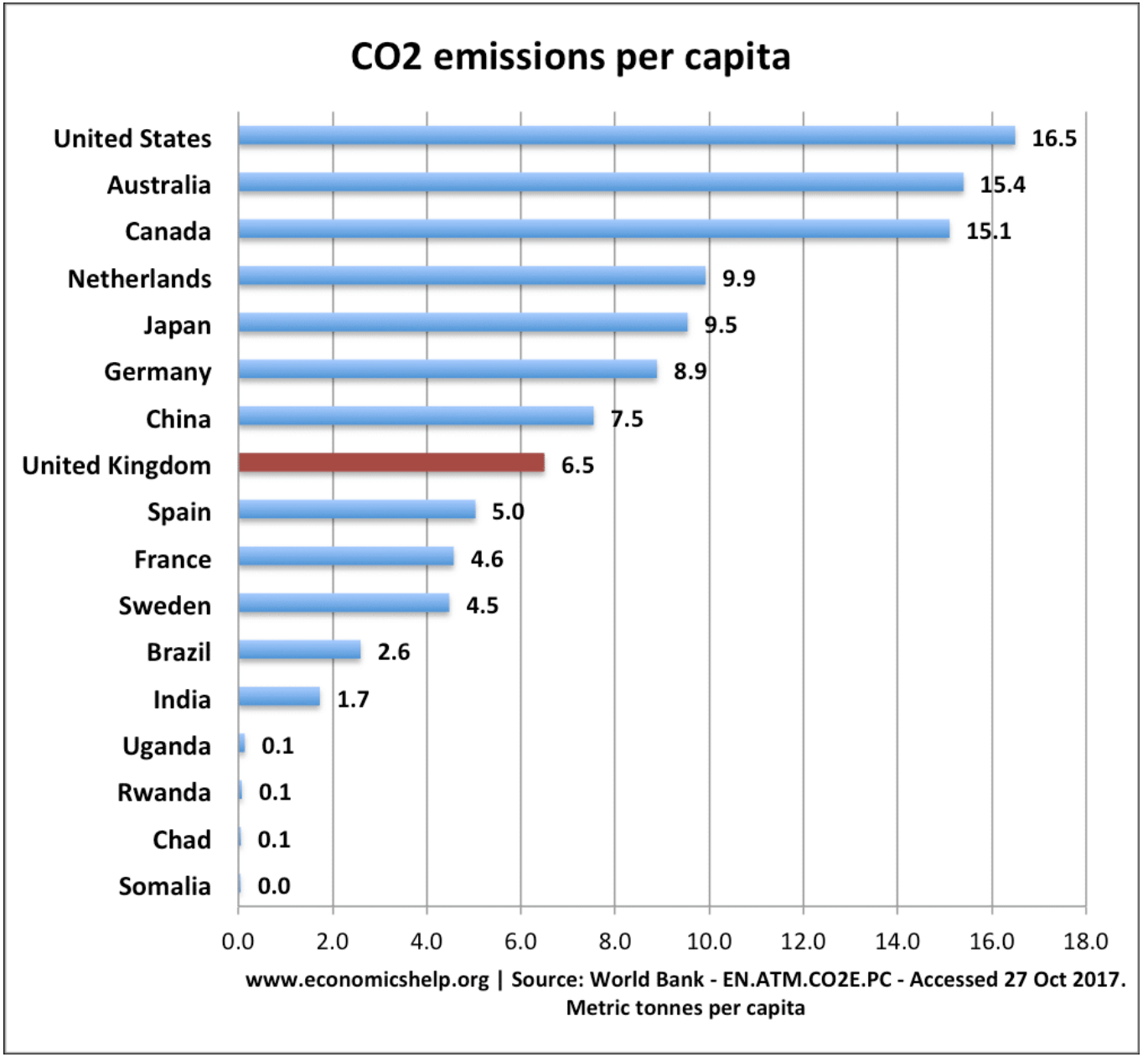
Key environmental problems

Air Pollution



Key environmental problems

Air Pollution

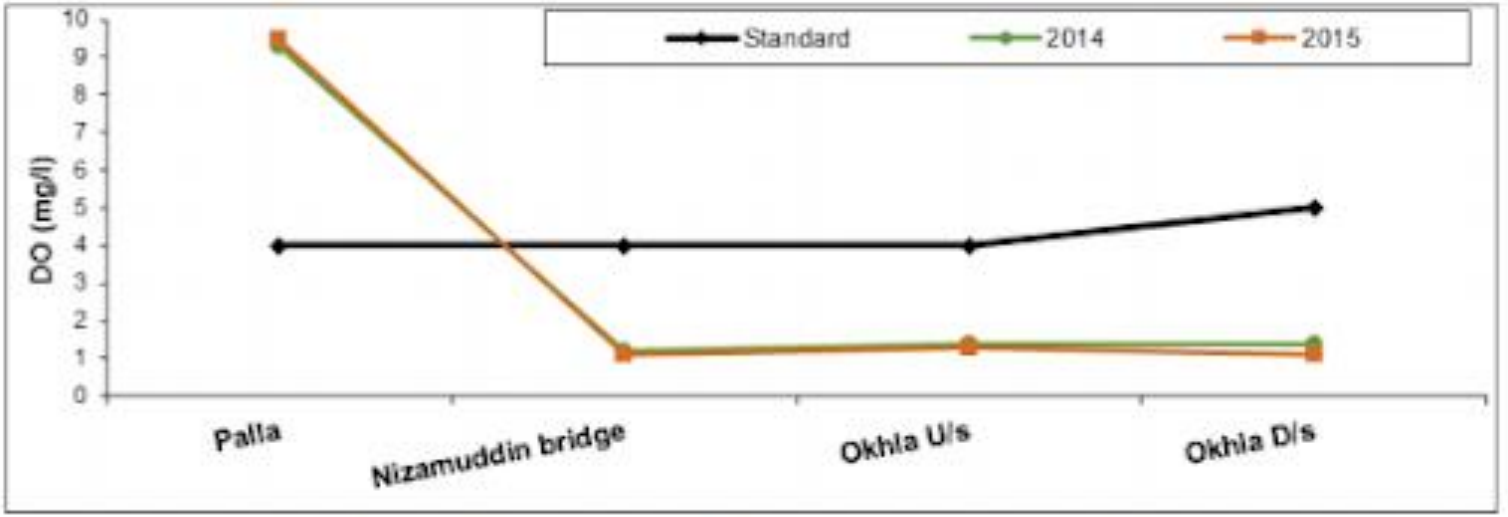


Key environmental problems

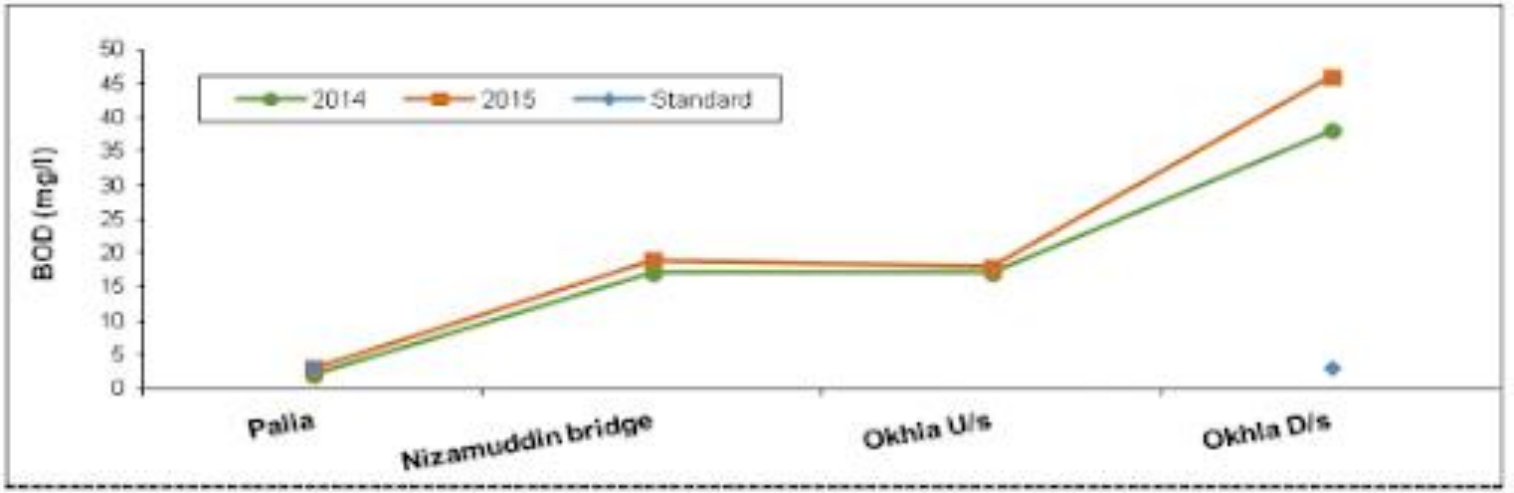
Water Pollution

Key environmental problems

Water Pollution

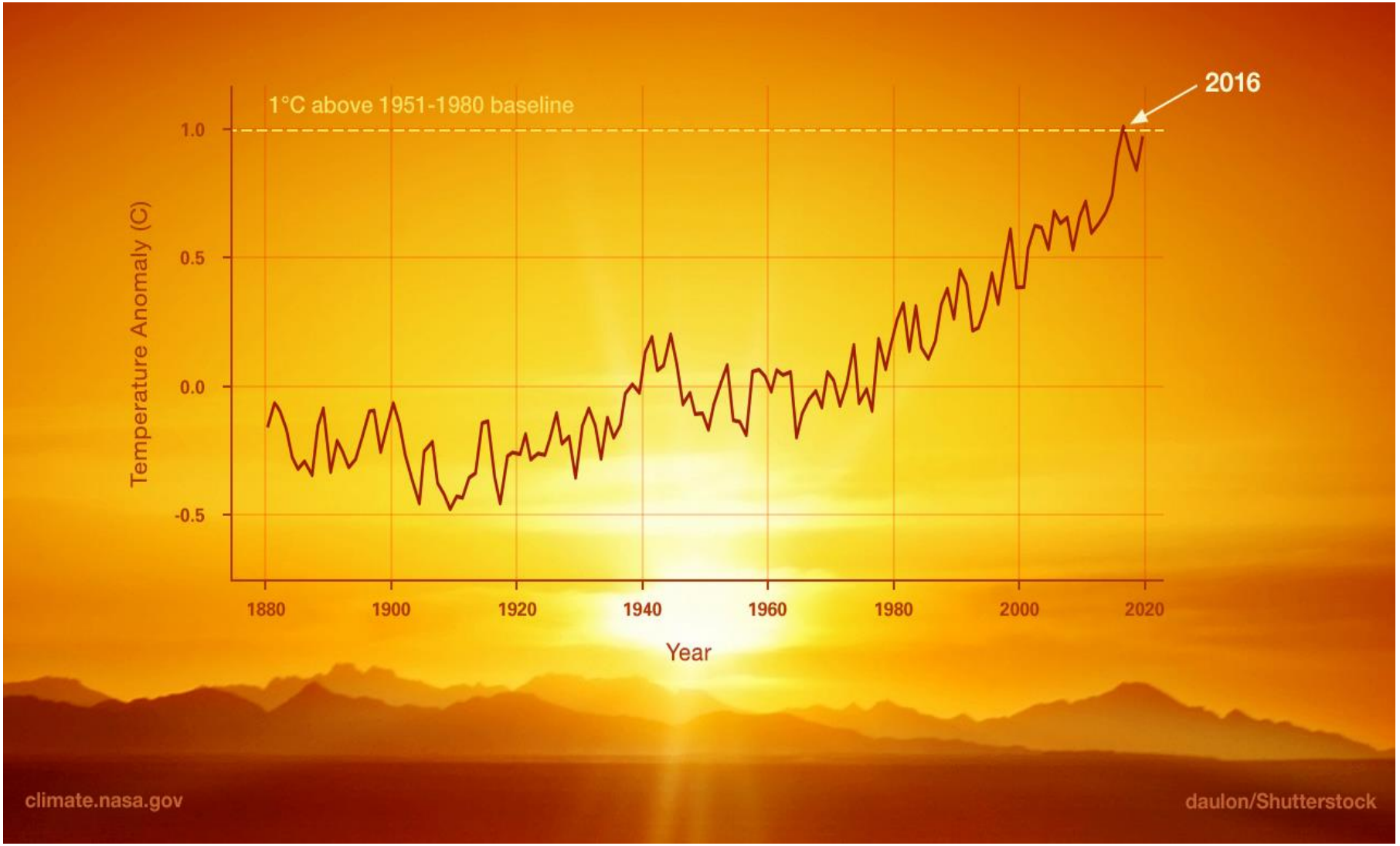


Water quality of river Yamuna in terms of DO



Key environmental problems

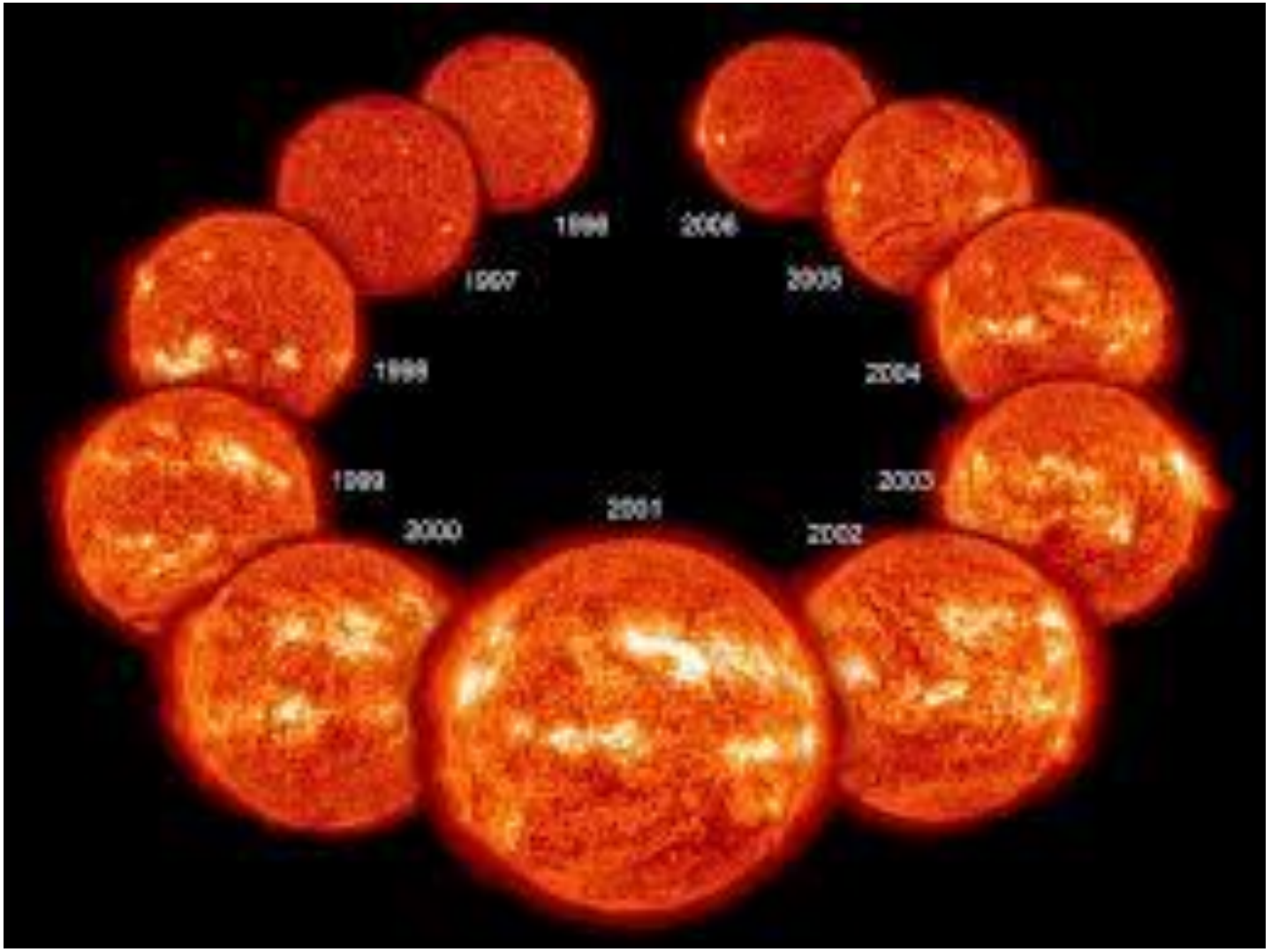
Global Warming



Key environmental problems

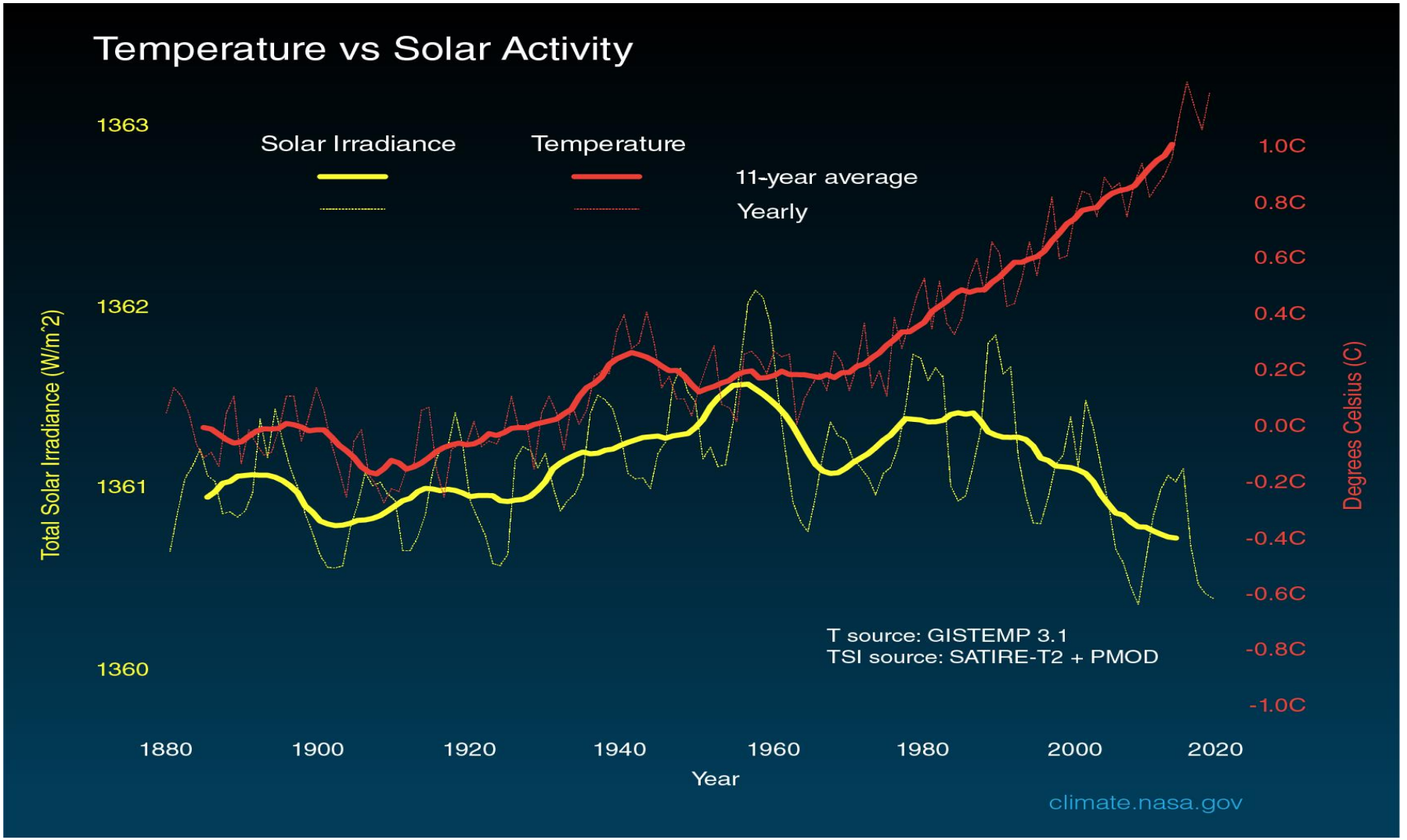
Global Warming

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



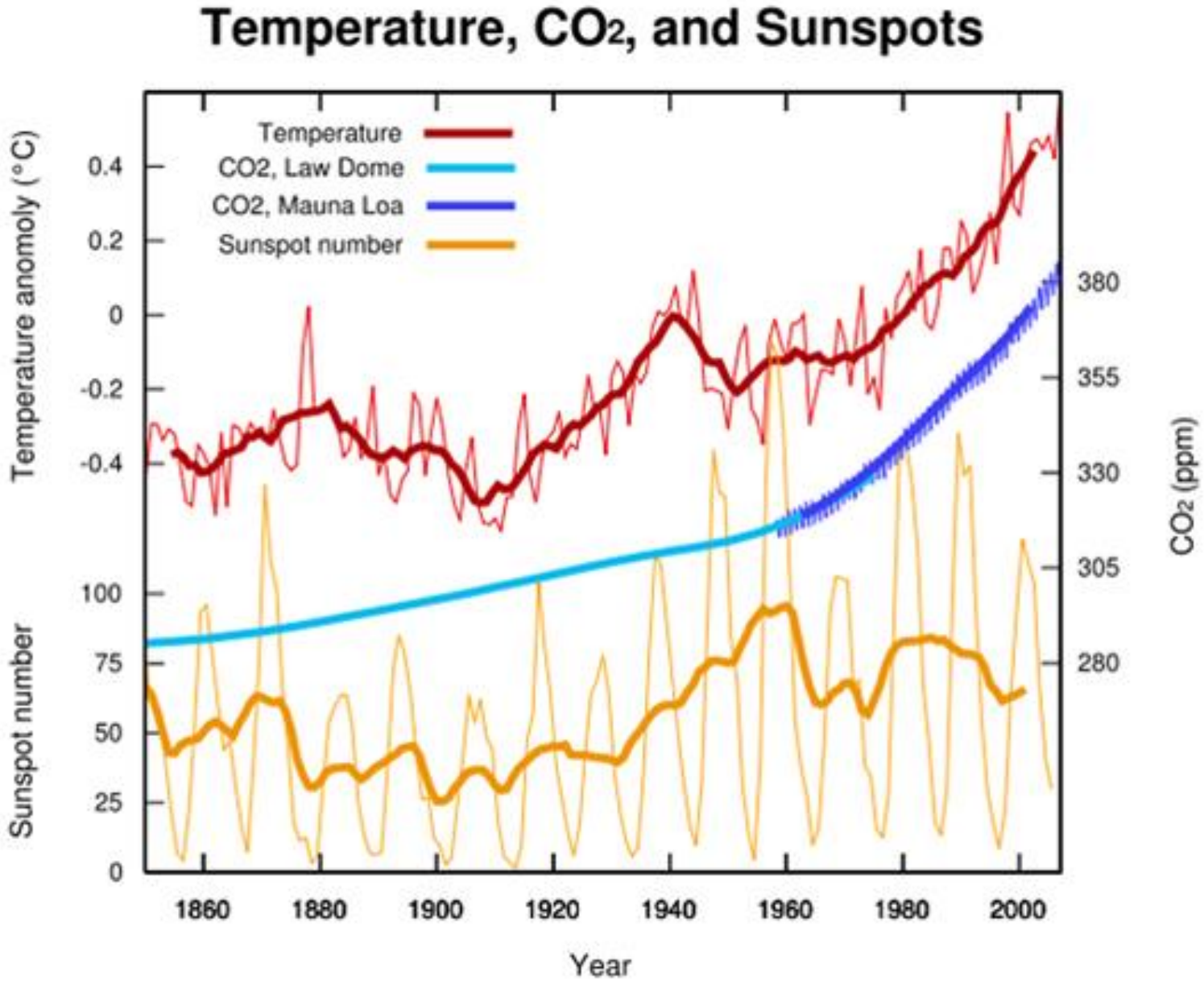
Key environmental problems

Global Warming



Key environmental problems

Global Warming

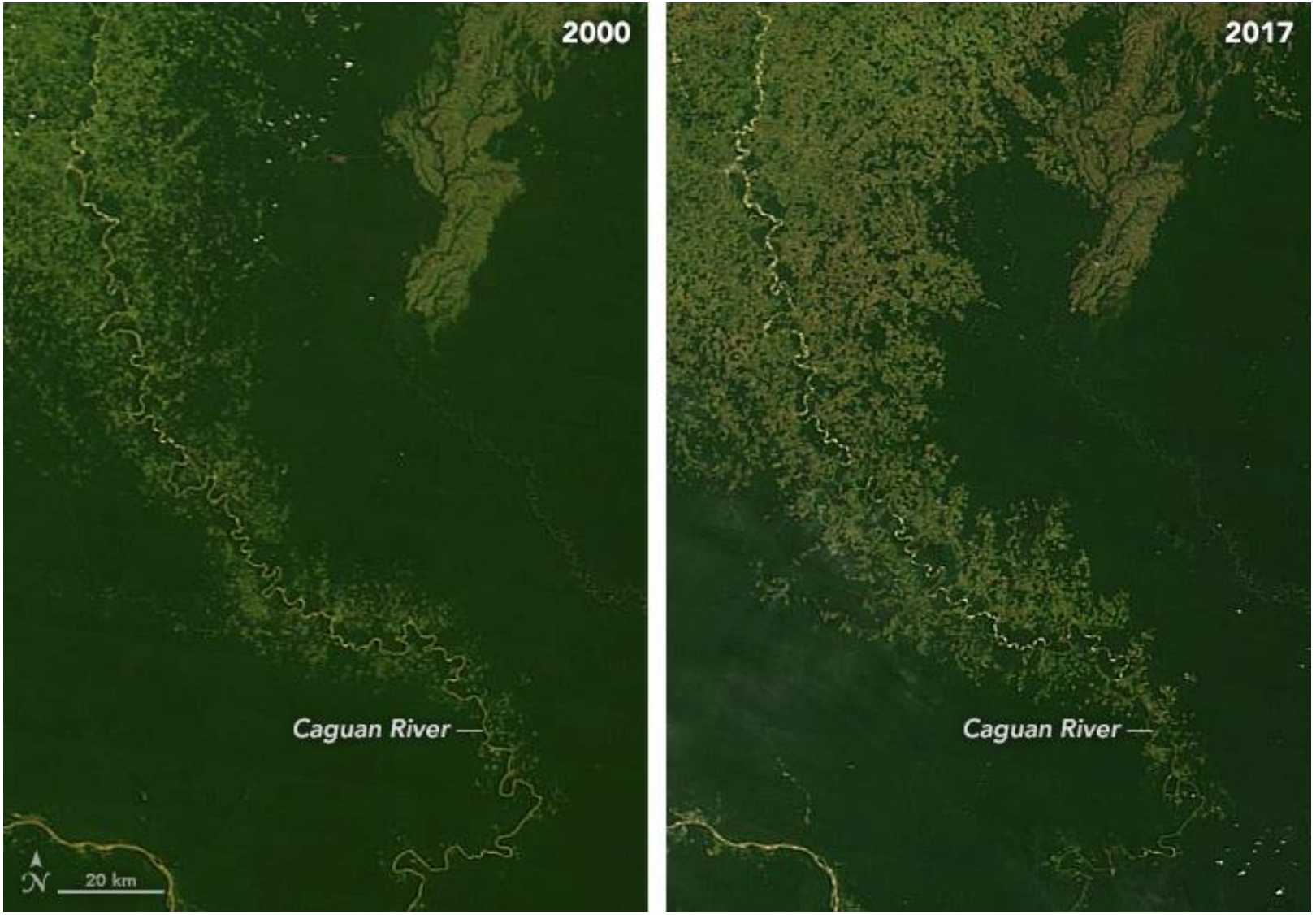


Key environmental problems

Deforestation

Key environmental problems

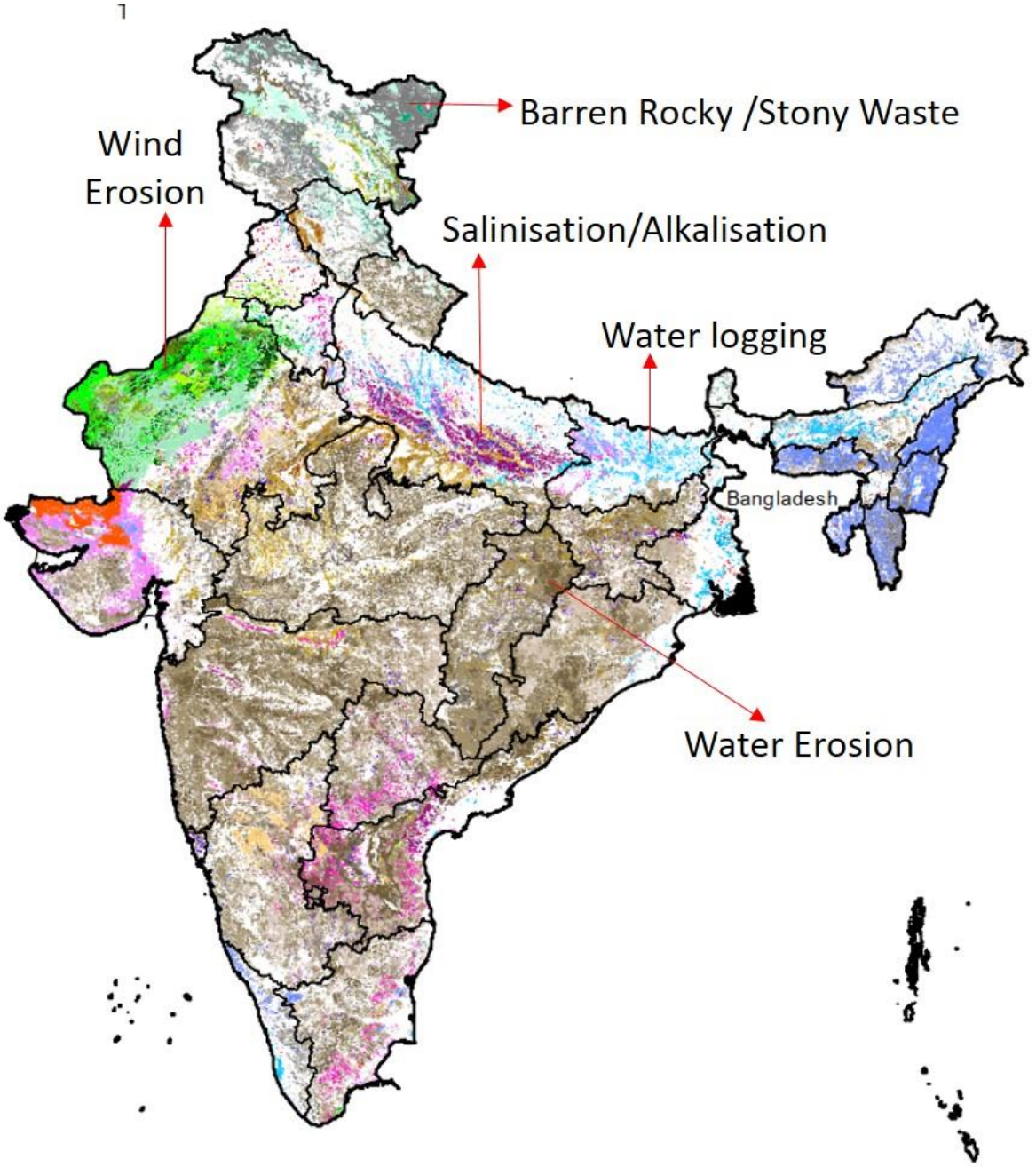
Deforestation



Key environmental problems

Soil Degradation

Key environmental problems



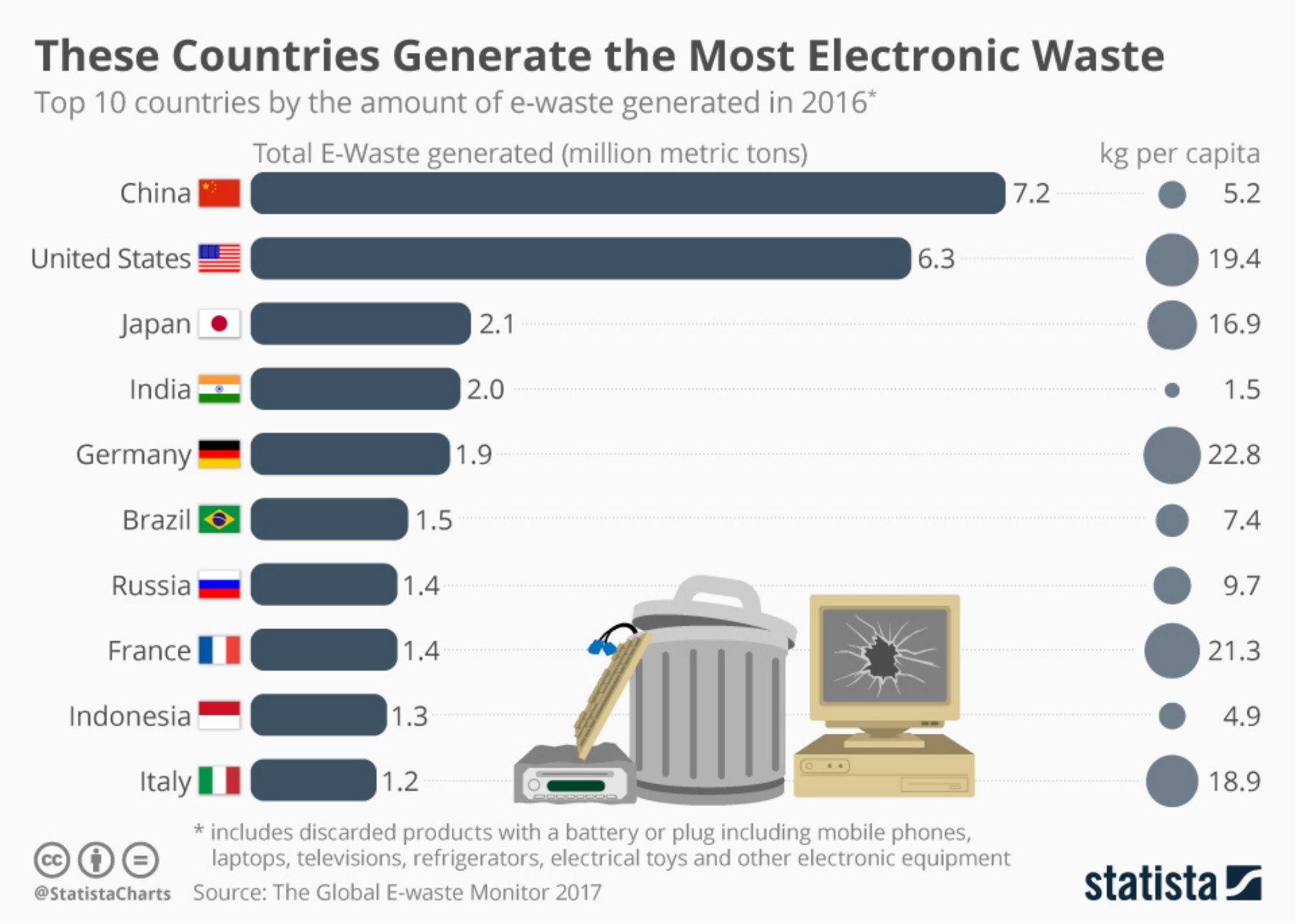
Soil Degradation

Key environmental problems

Waste production

Key environmental problems

Waste production



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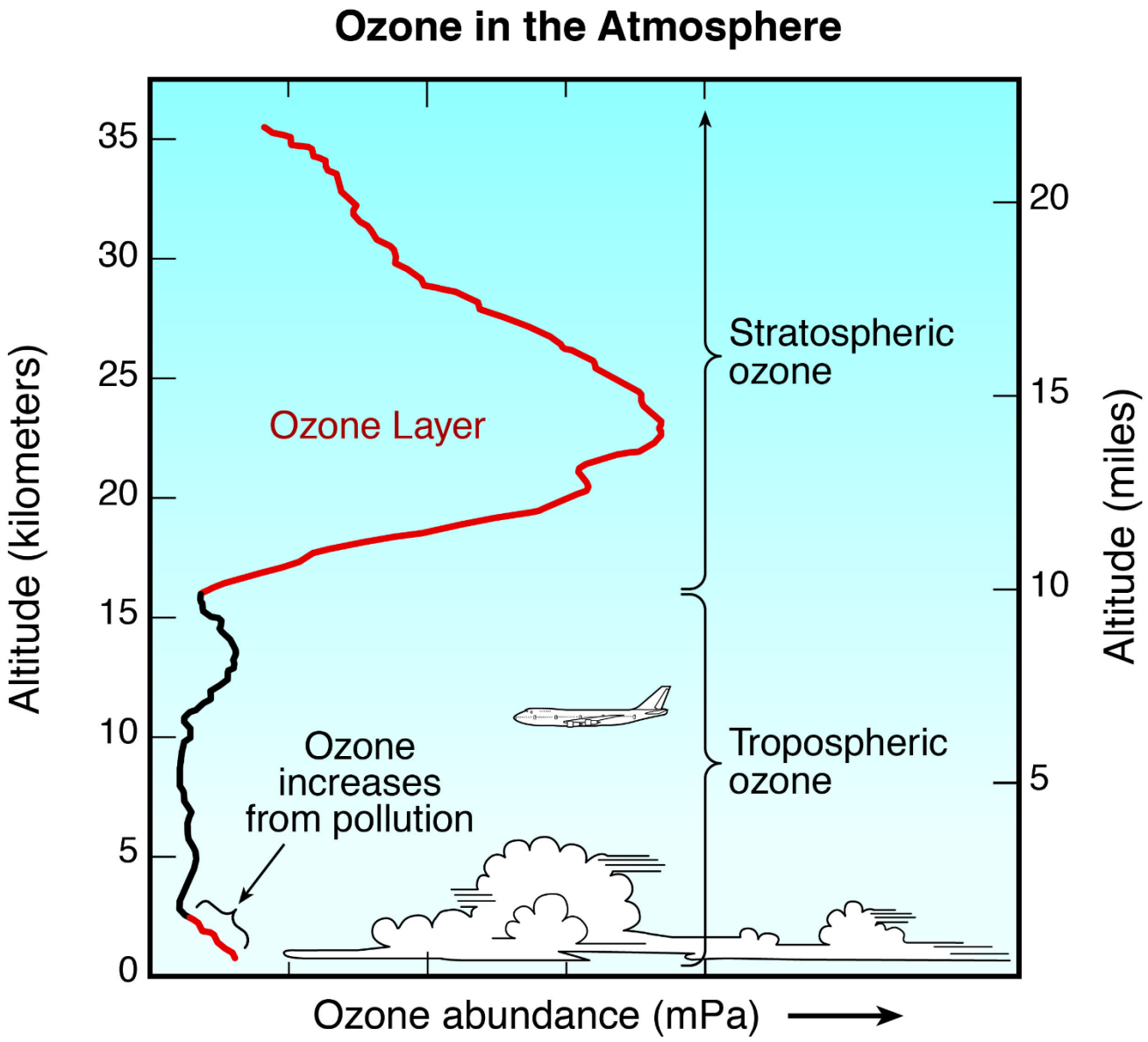
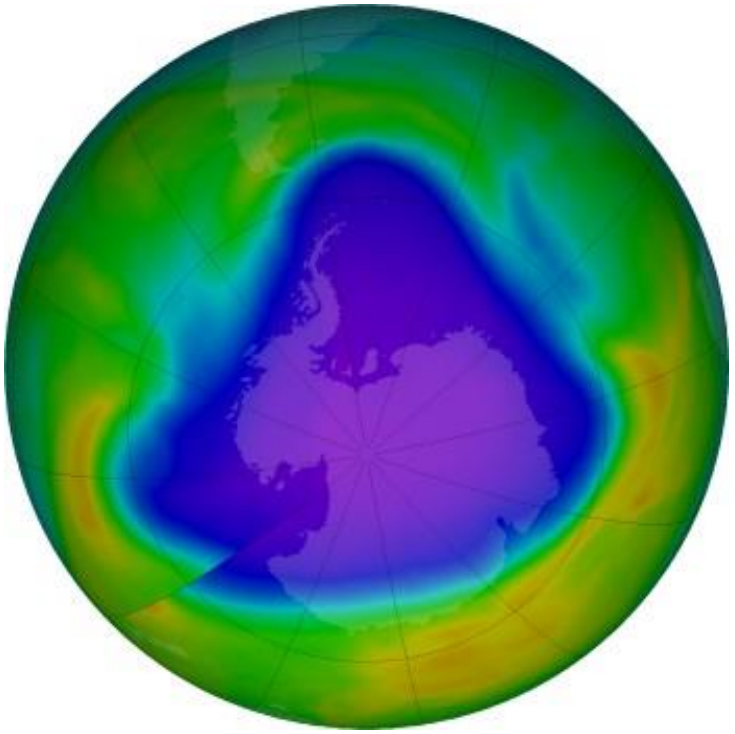


Ozone depletion

Key environmental problems

Ozone depletion



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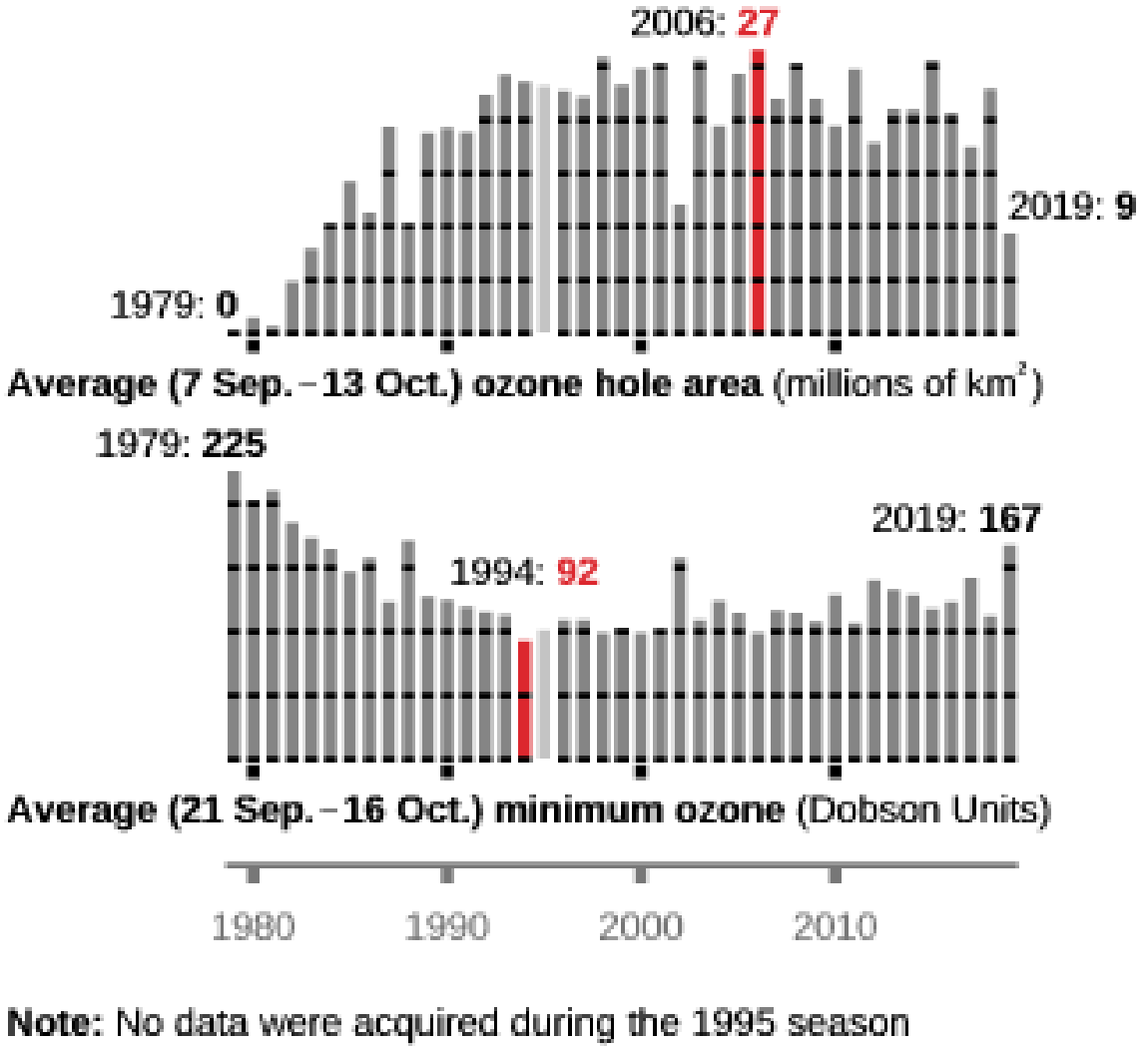
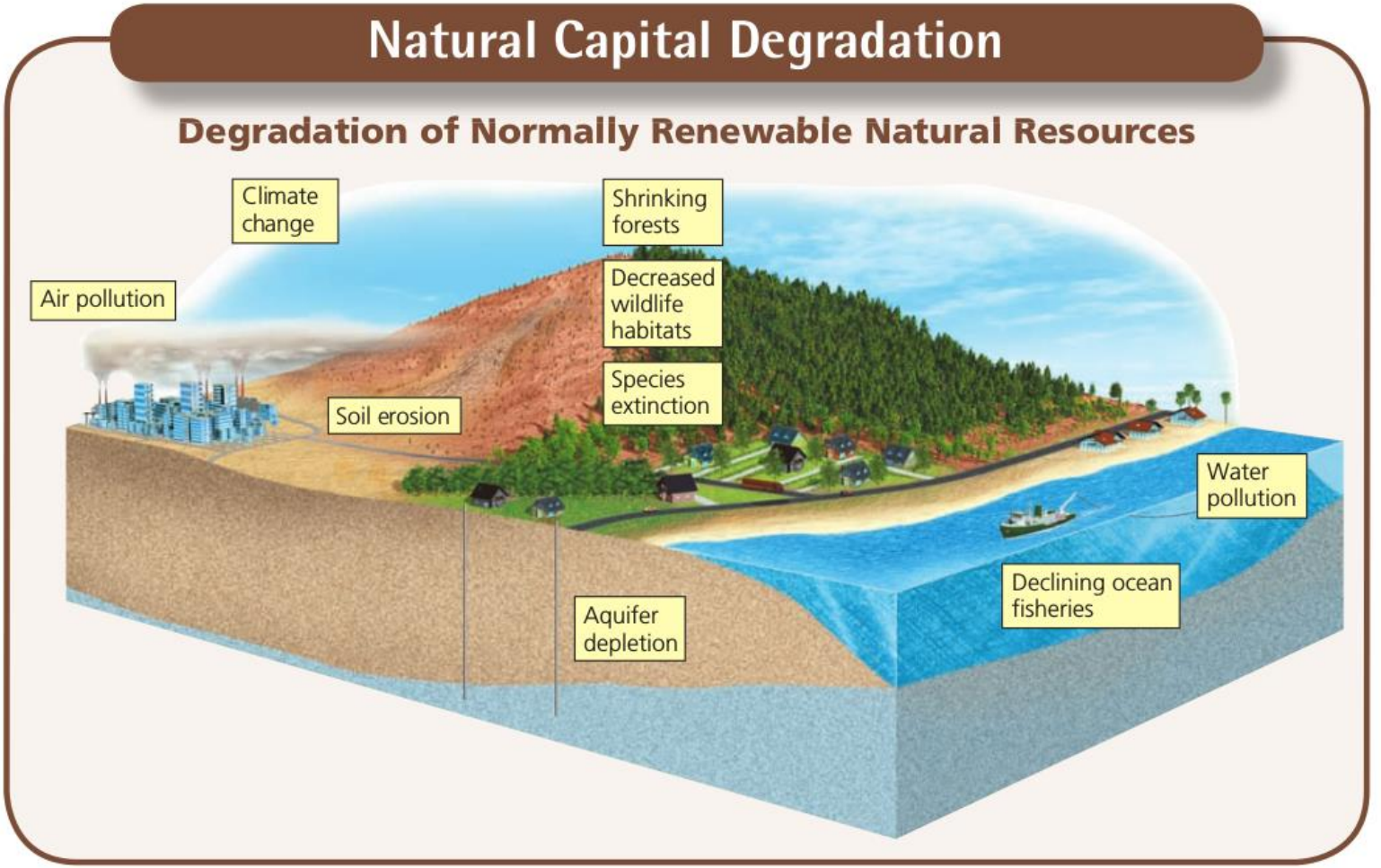


Note: No data were acquired during the 1995 season

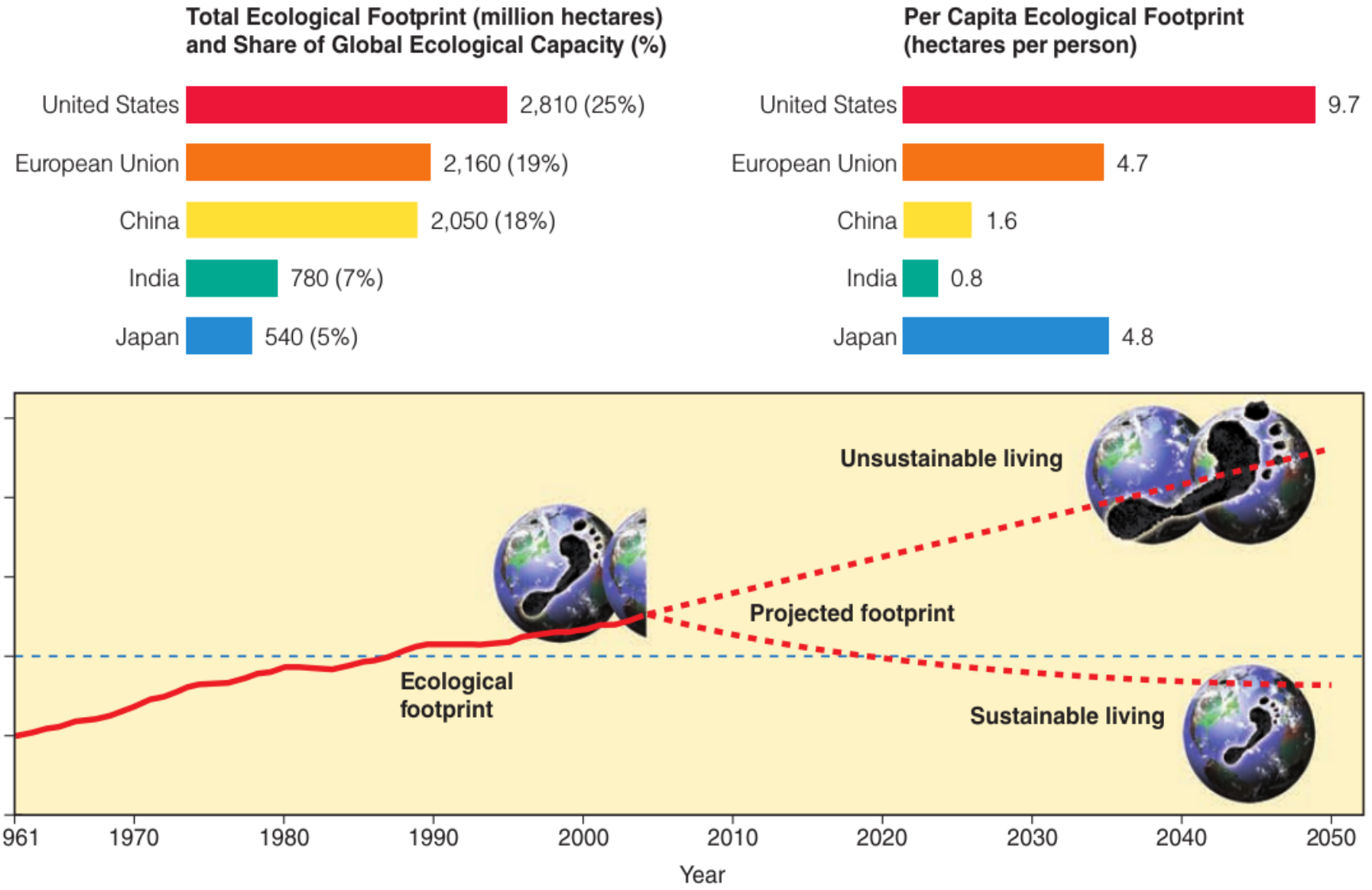
Key environmental problems

Natural Capital Degradation



Key environmental problems

Ecological footprints



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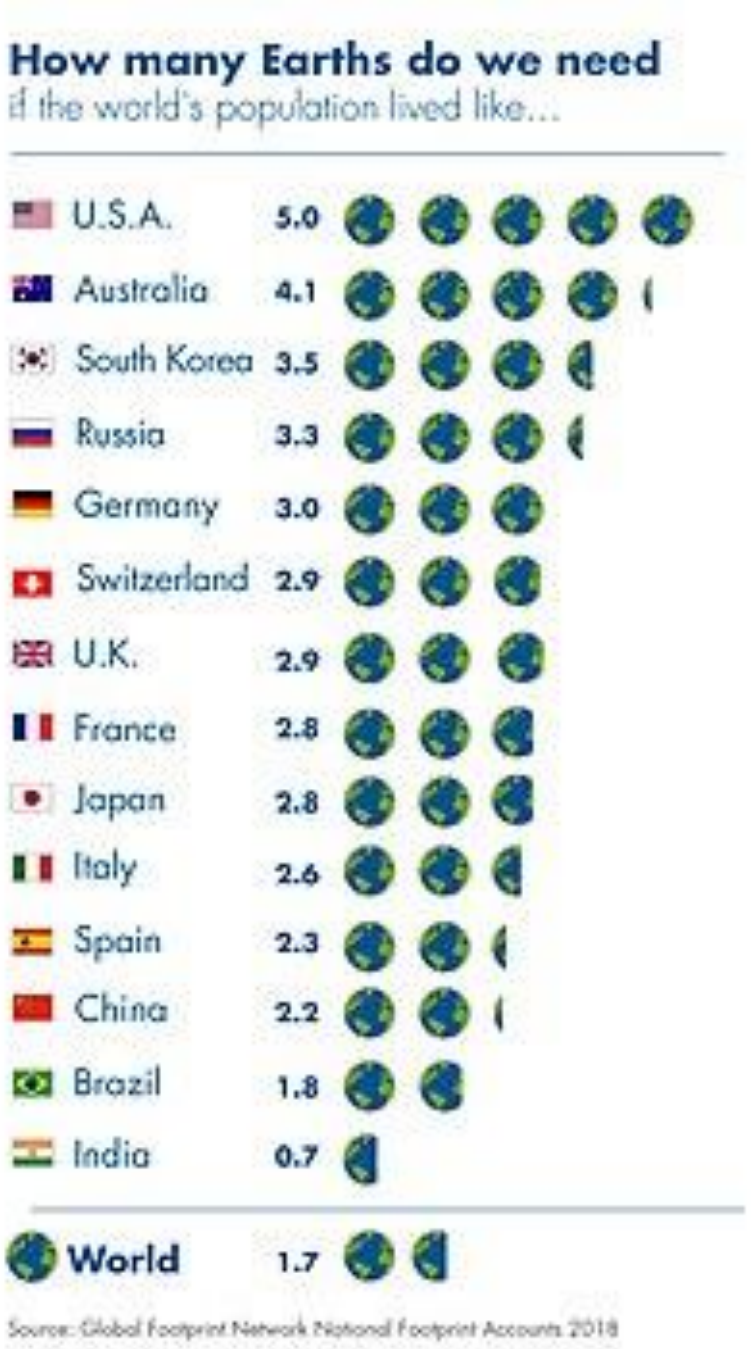

Ecological footprints

Key environmental problems

Causes

Ecosystem

An ecosystem is a geographic area where plants, animals, and other organisms, as well as weather and landscape, work together to form a bubble of life.

- Ecosystems contain biotic or living, parts, as well as abiotic factors, or non-living parts.
- Biotic factors include plants, animals, and other organisms.
- Abiotic factors include rocks, temperature, and humidity.
- The whole surface of Earth is a series of connected ecosystems.

Earth’s life support system

Earth’s life-support system consists of four main spherical systems that interact with one another

Atmosphere (air): A thin envelope of gases surrounding the earth’s surface.

- Inner layer of the atmosphere is called ***Troposphere***. It consists of breathing air (78% Nitrogen and 21% Oxygen), water vapours and green house gases.
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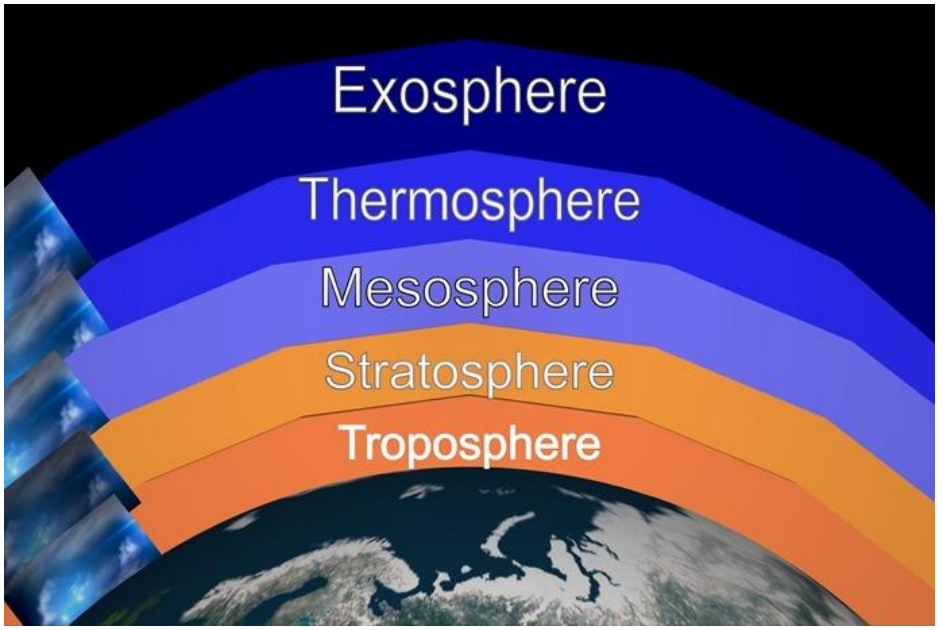

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Earth's life support system

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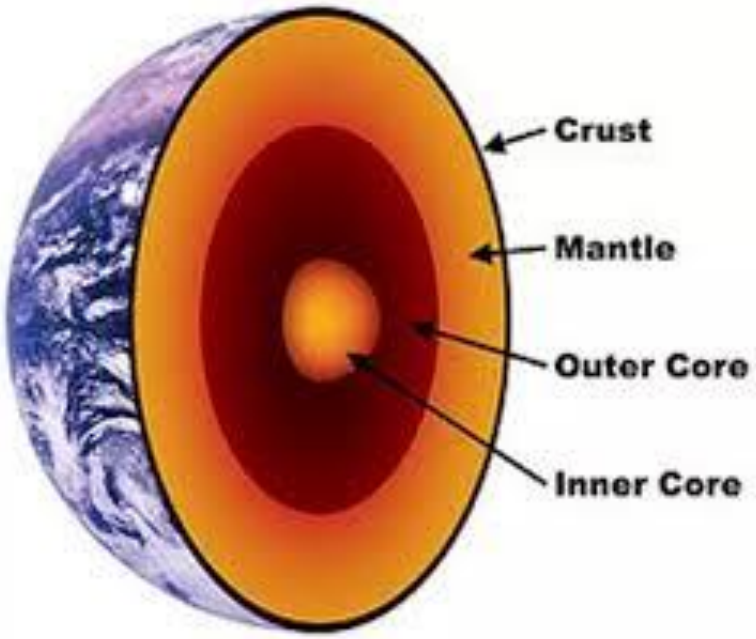

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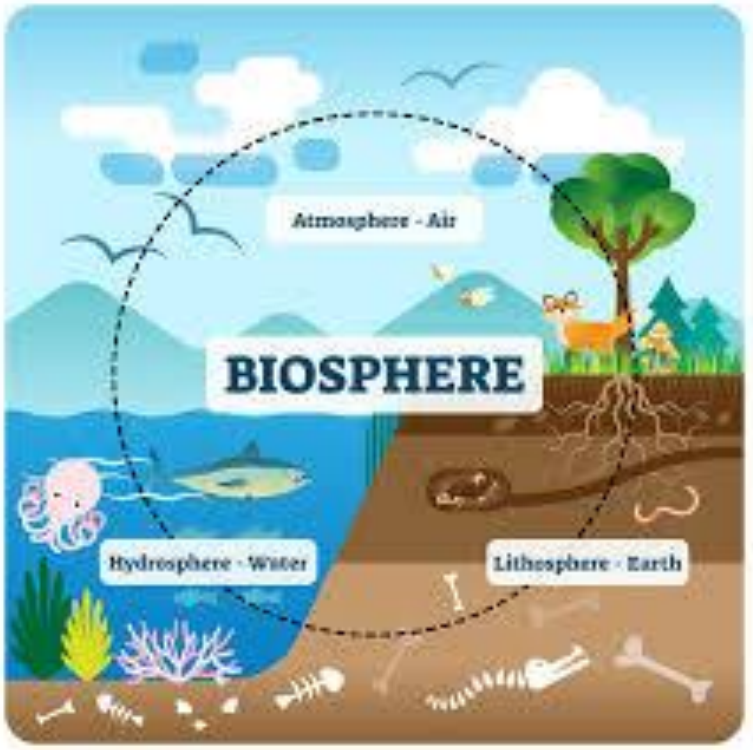

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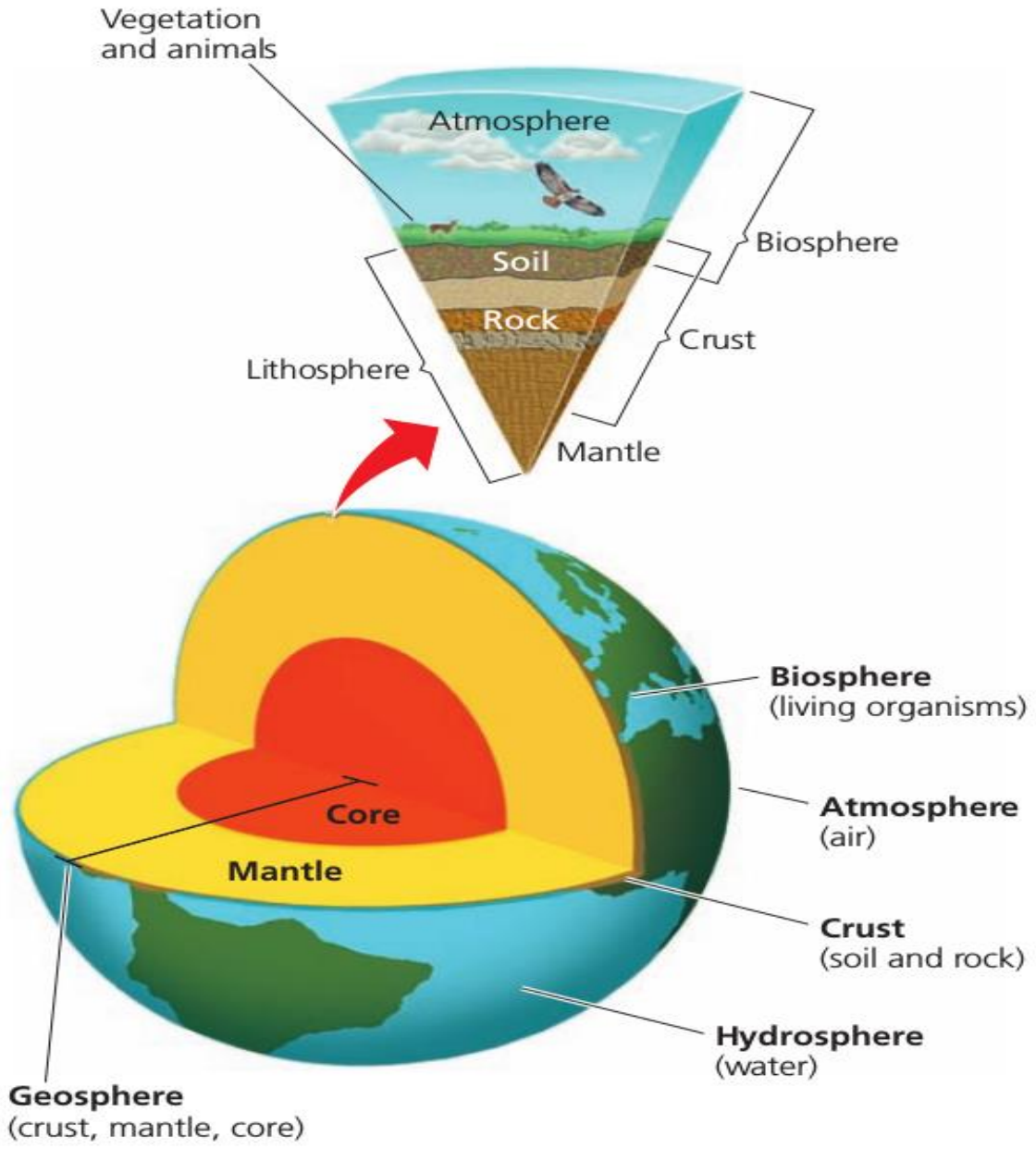

Factors sustaining earth's life

- ***Unidirectional flow of solar energy***: The sun warms the earth and Supplies the energy for **photosynthesis**, the process used by green plants and some bacteria to synthesize compounds that keep them alive and feed other organisms. Solar energy powers the cycling of matter cycles and drives the climate and weather systems that distribute heat and fresh water over the earth's system.

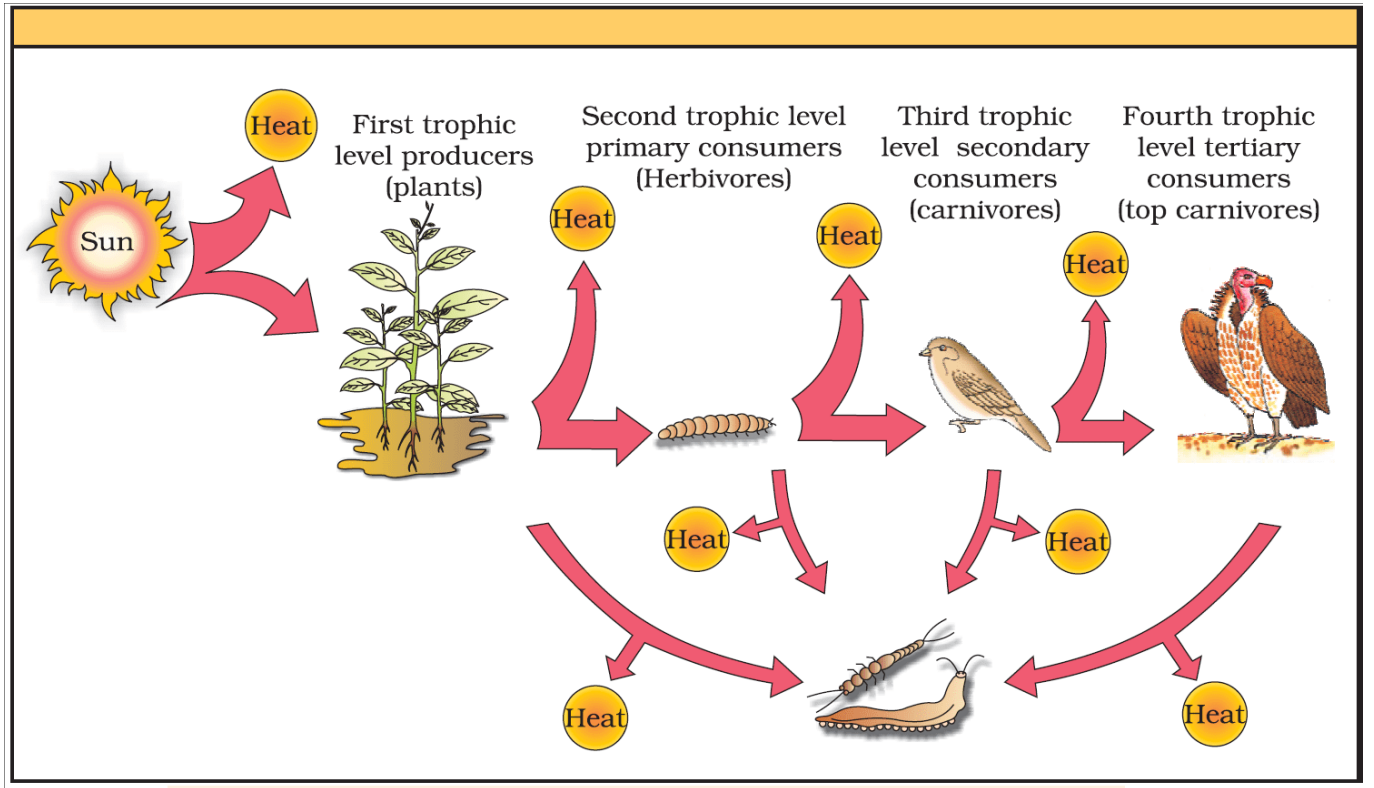

Figure-Energy flow through different trophic levels

Factors sustaining earth's life

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- ***Gravity***: It allows the planet to hold onto its atmosphere and helps to enable the movement and cycling of chemicals through the air, water, soil, and organisms.

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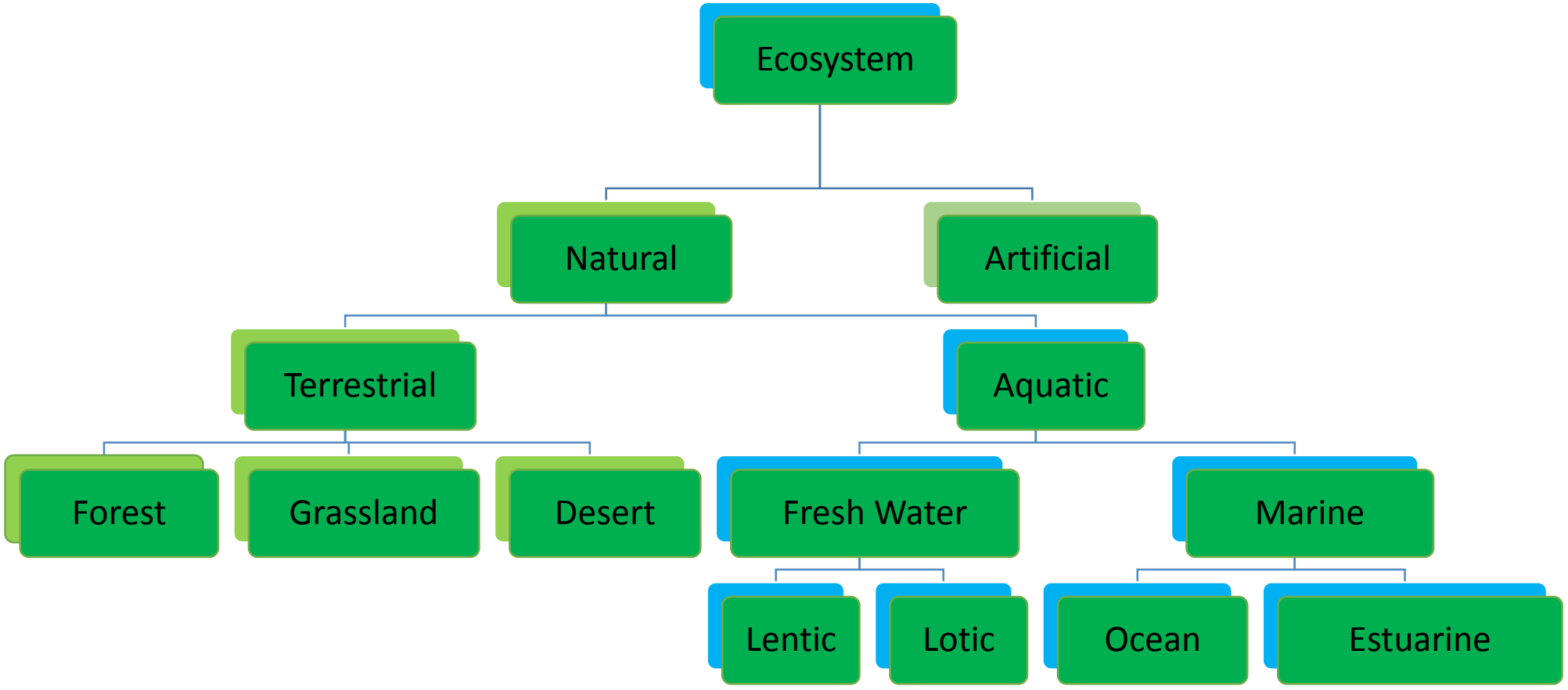
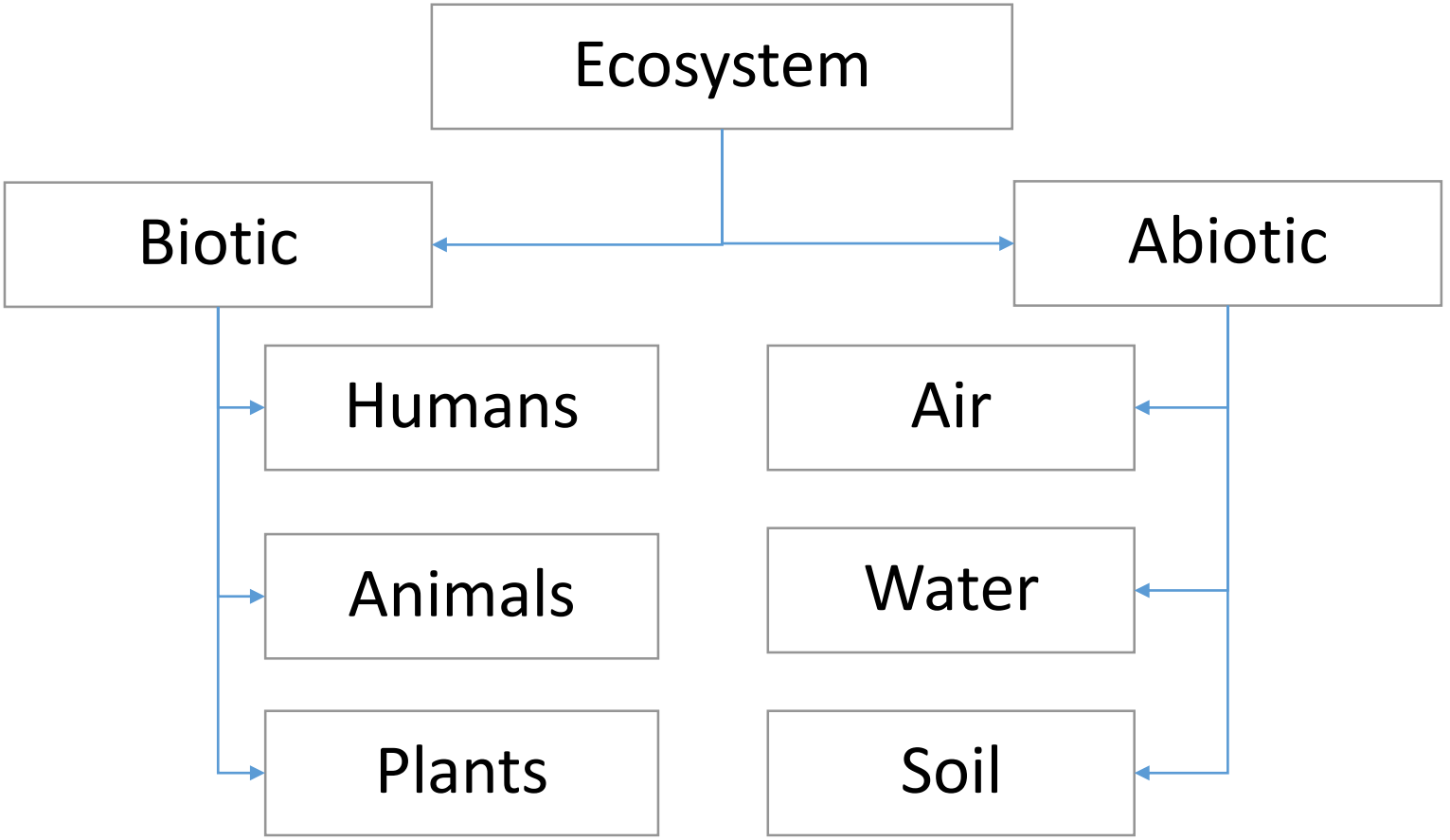
Ecosystem


Ecosystem
Natural
Artificial
Terrestrial
Aquatic
Forest
Grassland
Desert
Fresh Water
Marine
Lentic
Lotic
Ocean
Estuarine

Ecosystem


Ecosystem
Biotic
Abiotic
Humans
Animals
Plants
Air
Water
Soil

Abiotic components of ecosystem

Abiotic components of an ecosystem include all the physical and chemical elements.

Physical components are:

- Light, temperature, altitude and depth etc.

Chemical components are:

- Inorganic substance includes C, H, N, K, P, and S etc.

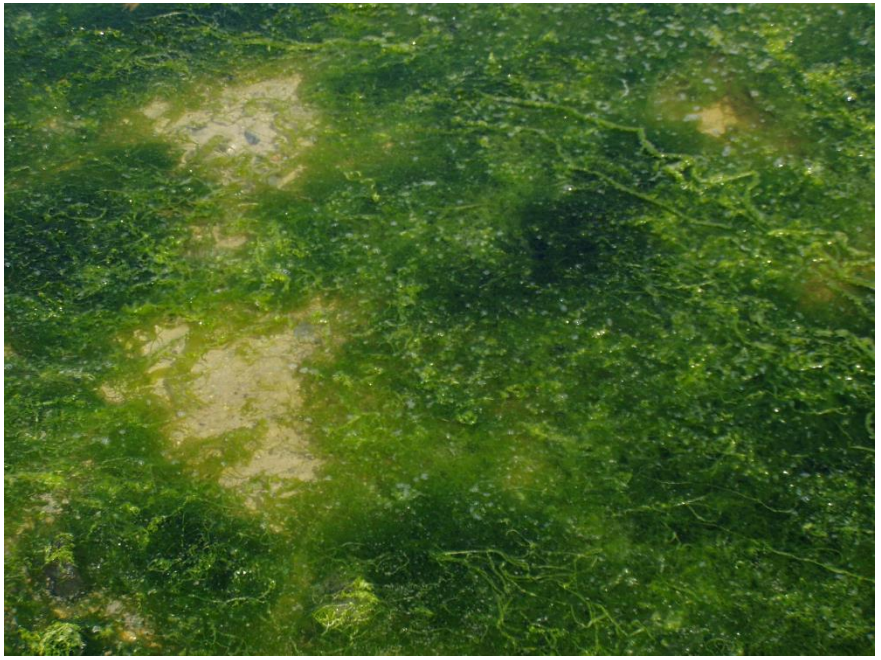
- Organic substances are carbohydrates, lipids, proteins and humus etc., present in the biomass or environment.

Biotic components of ecosystem

Biotic components of an ecosystem include living species. Biotic components can further be divvied into two categories

Autotrophs:

- Also known as producers. These are the organism that can utilize solar energy and other simple chemical compounds to produce the food.



Biotic components of ecosystem

Heterotrophs:

- Heterotrophs are organism that derives its nutrition from other sources.

- In the food chain, heterotrophs are secondary and tertiary consumers.

Decomposers :

- They breakdown the complex chemicals from the produce and consumer into simpler chemical elements.

Earth’s life support system

Earth’s life-support system consists of four main spherical systems that interact with one another

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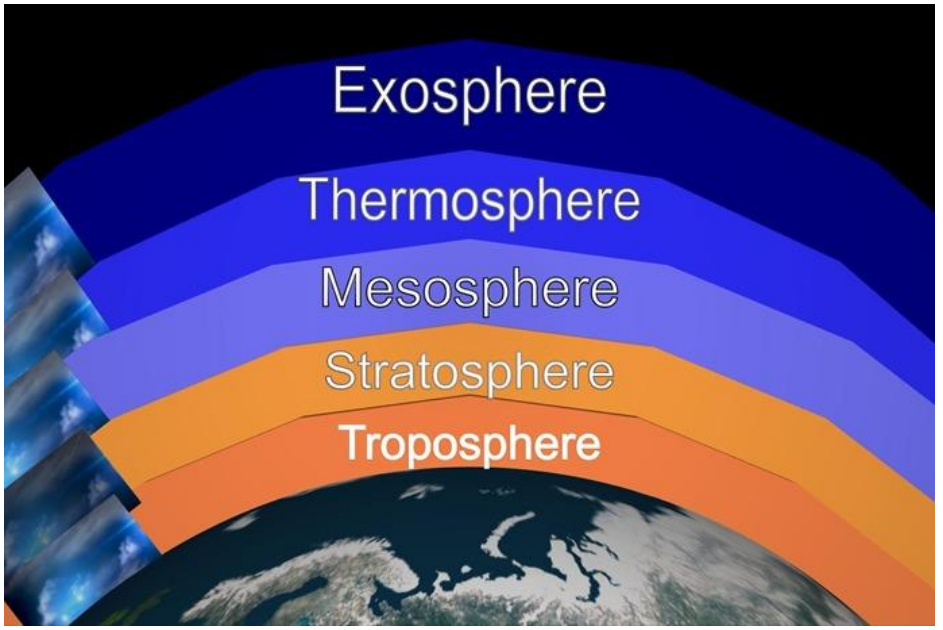

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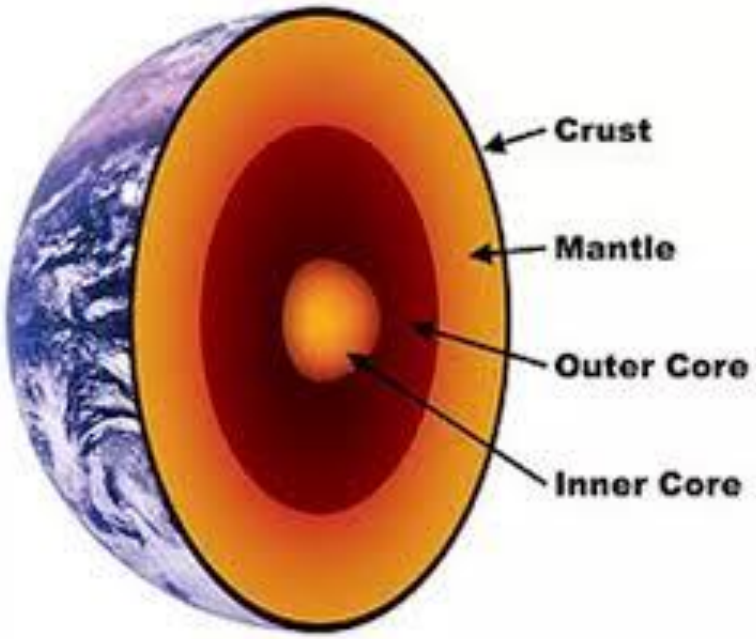

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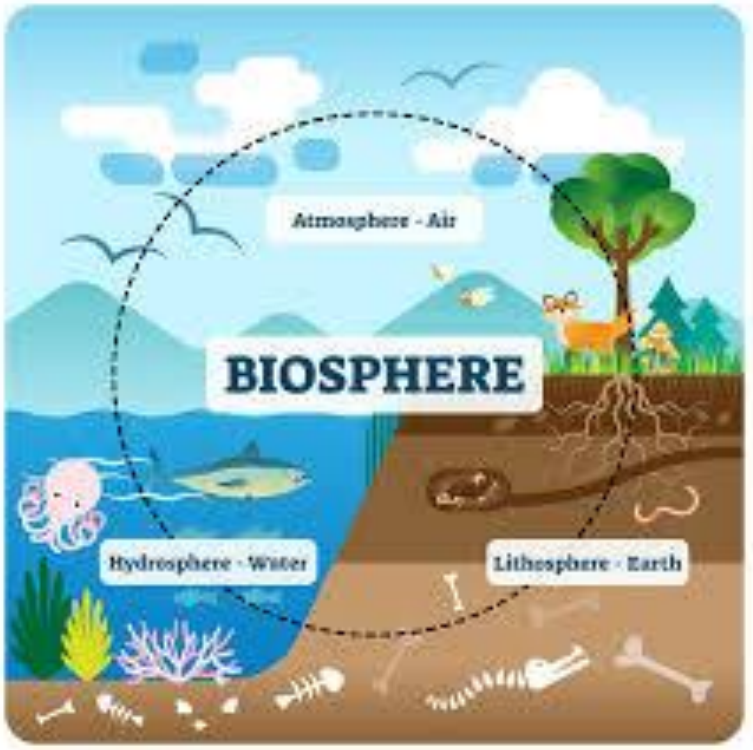
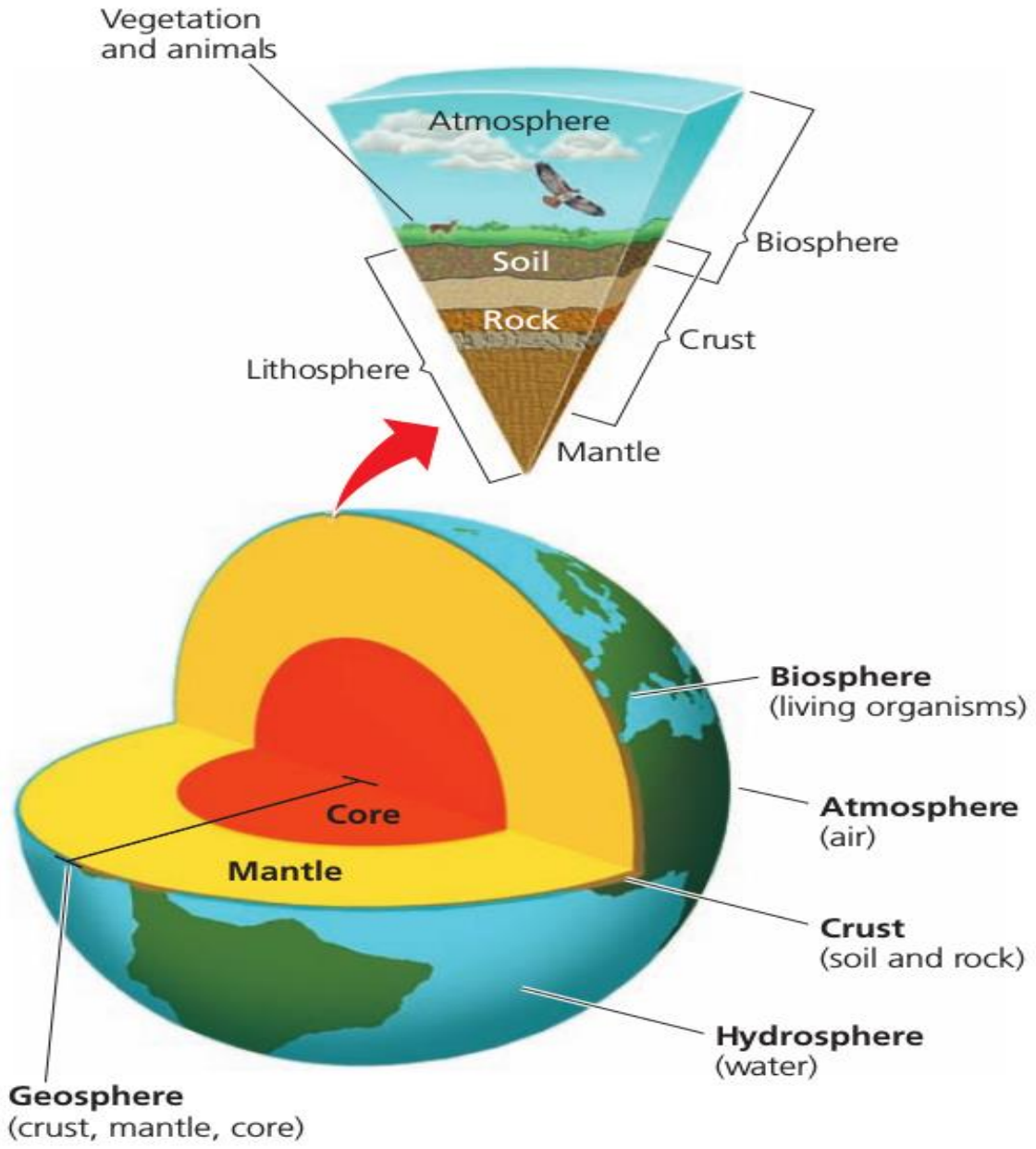


Earth's life support system



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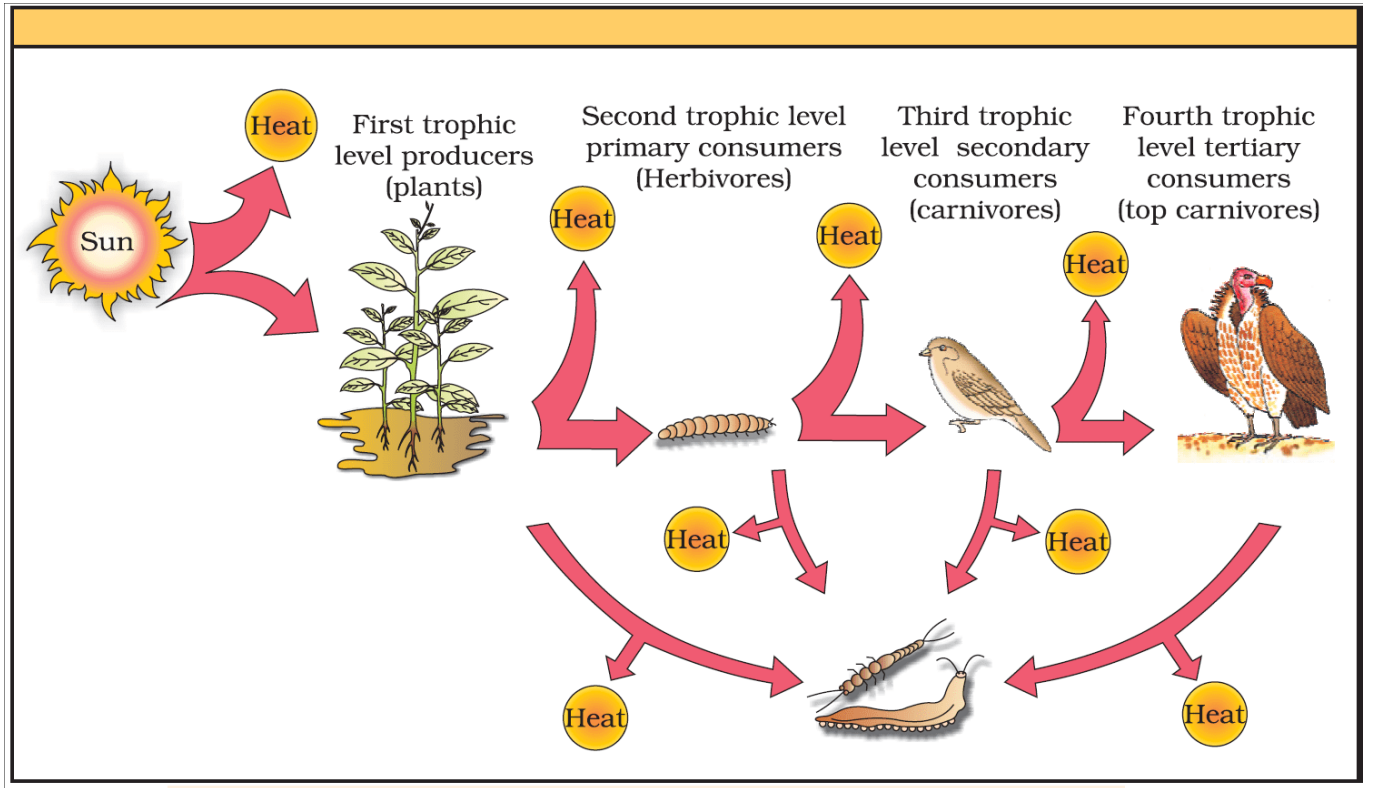

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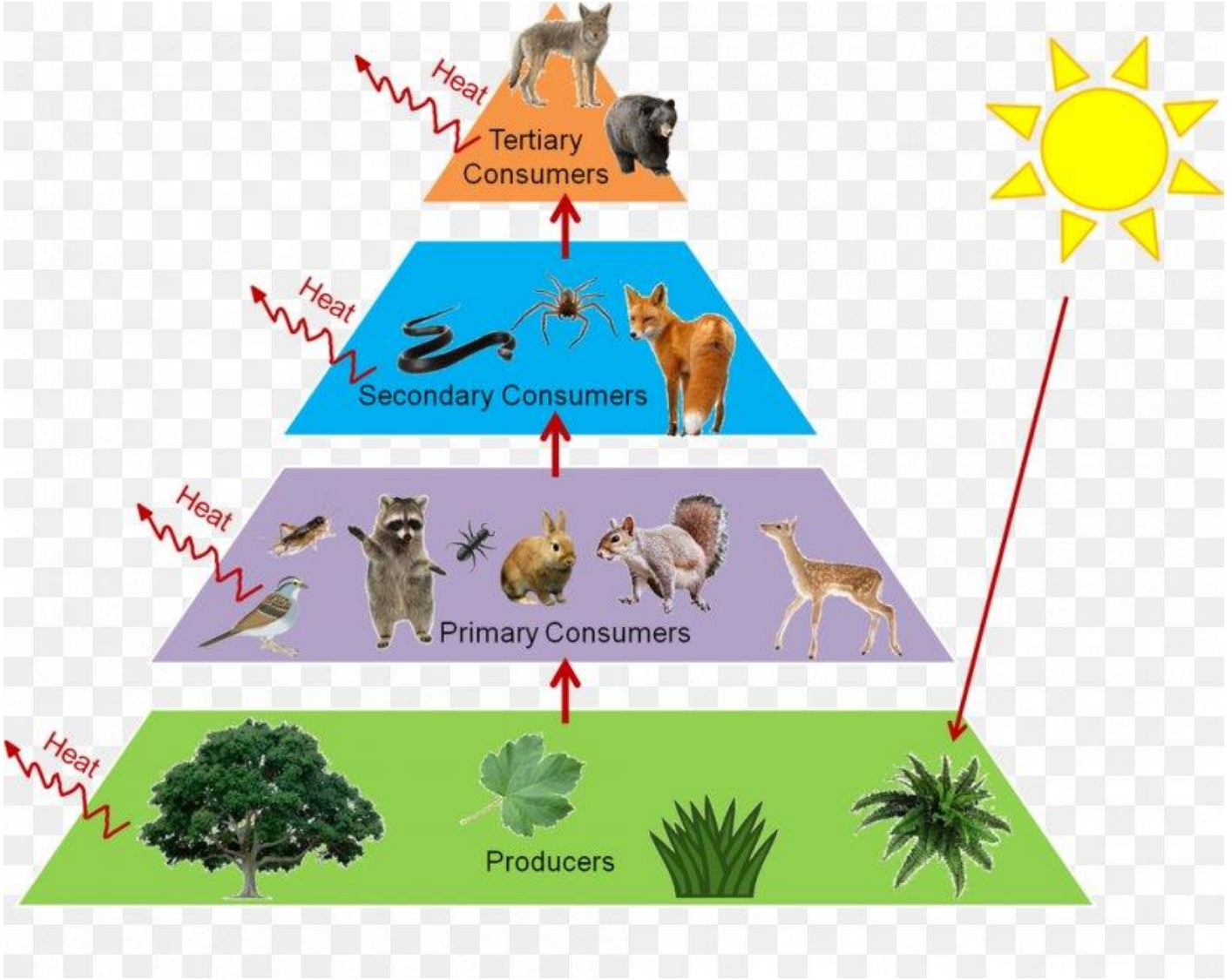
Ecological pyramid

An ecological pyramid is a graphical representation of the relationship between different organisms in an ecosystem.



Energy flow in the ecosystem

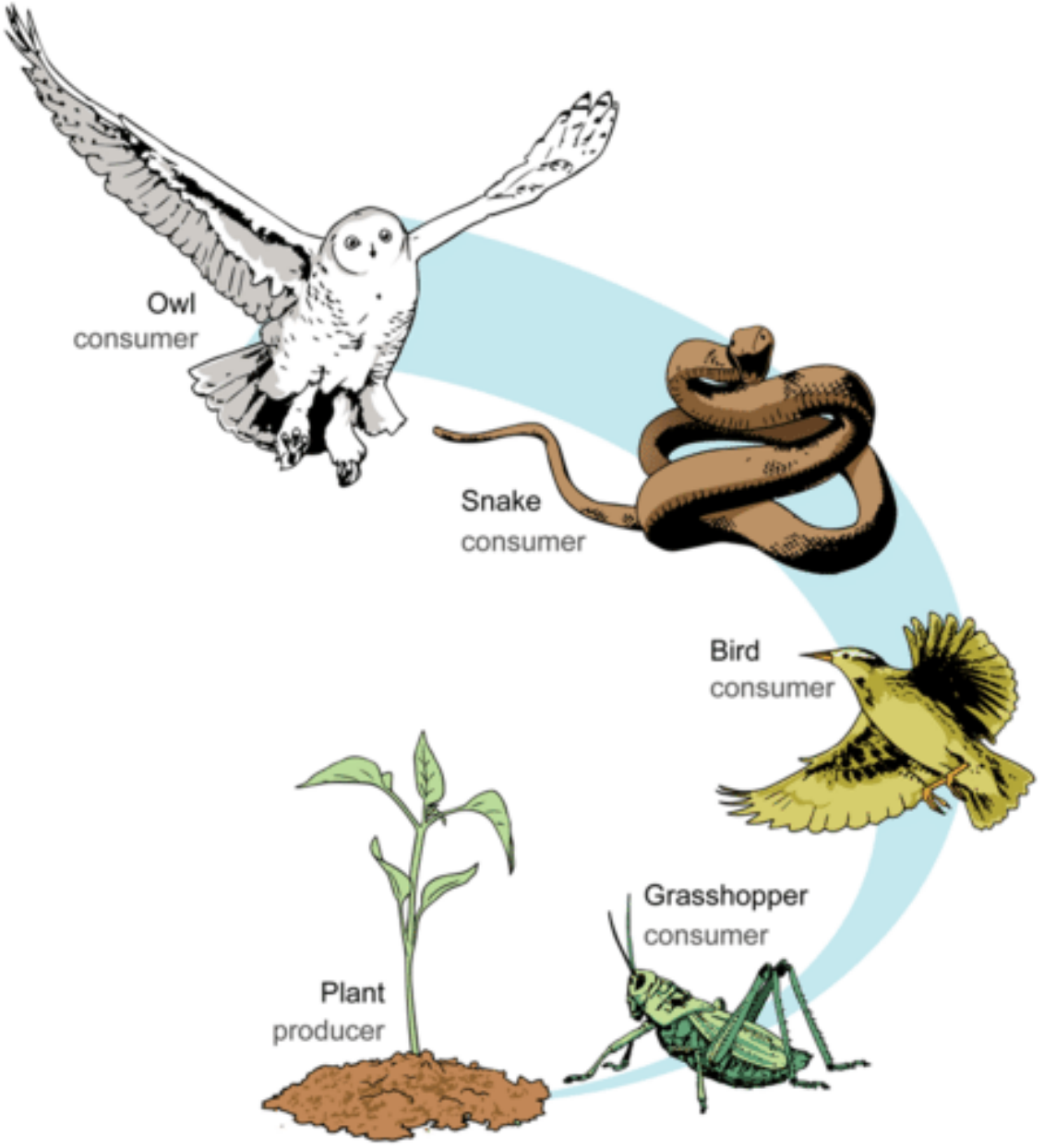
Chemical nutrition (chemical energy of food) is the main source of energy in the ecosystem. This flow of energy is governed by the two thermodynamic laws

1. Energy can neither be created nor destroyed, it can only change from one form to another.
2. Conversion of the energy at every trophical level is less than 100%, i.e., energy is wasted during the conversion.

Trophic level: It defines the position a species in a food chain or ecological pyramid according to its feeding level or energy consumption

Level 1: Producers (Plants)
Level 2: Primary consumer (Herbivores)
Level 3: Primary carnivores
Level 4: Top carnivores

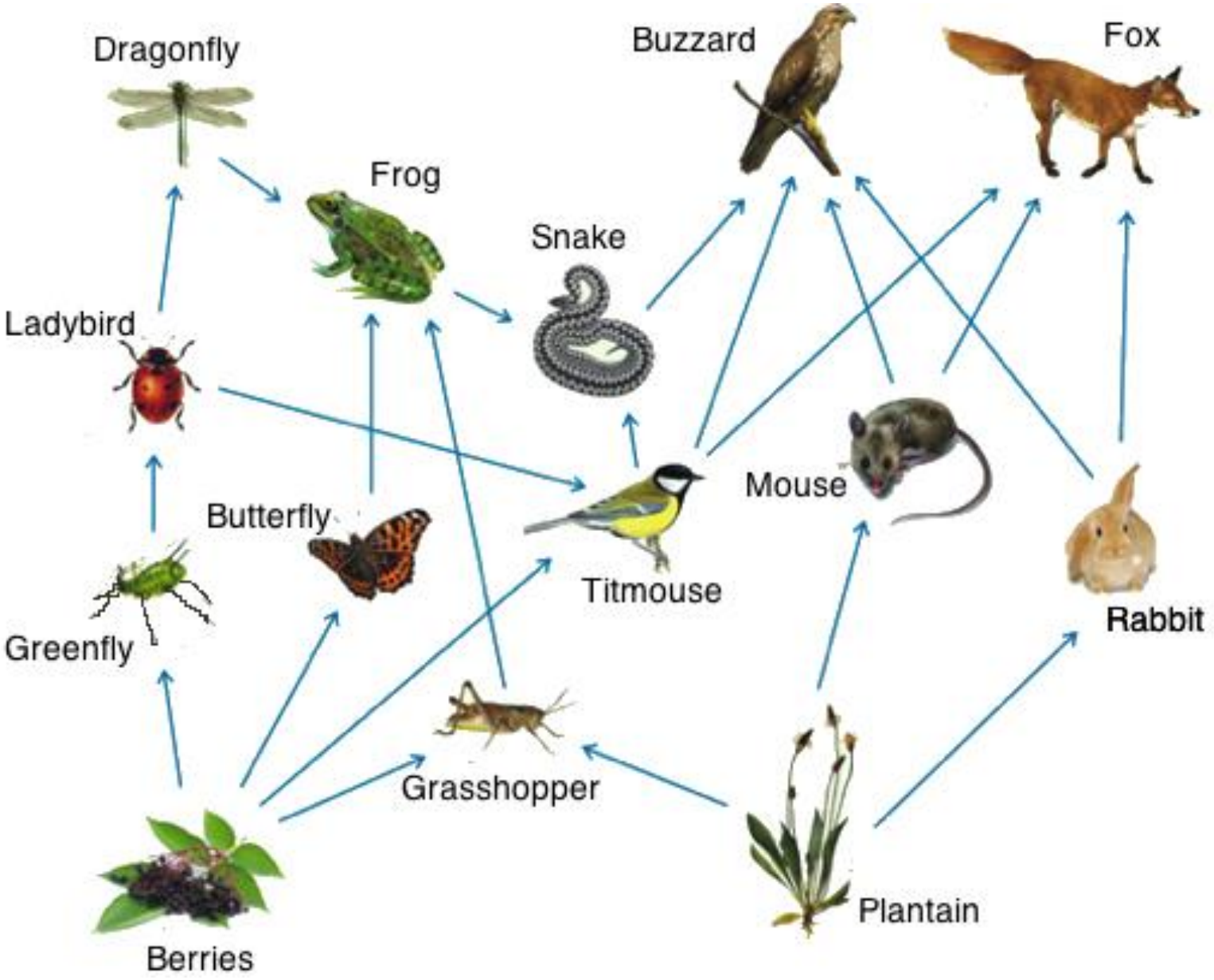
Energy flow in the ecosystem



Food chain

Energy flow in the ecosystem

Food web



Energy flow in the ecosystem