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"Chaudhary Moazzam"

Environmental Science

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Environmental Science

- The **environment is everything around us**
- **It includes** all of the living and the nonliving things with which we interact.
- And it includes a complex web of relationships that connect us with one another and with the world we live in.

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Environmental Science

- Despite our many scientific and technological advances, we are utterly dependent on the environment for air, water, food, shelter, energy, and everything else we need to stay alive and healthy

- As a result, we are part of, and not apart from, the rest of nature.

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Environmental Science

- **Environmental science,** an *interdisciplinary* study of how humans interact with the environment of living and nonliving things

- It integrates information and ideas from the *natural sciences, such as biology, chemistry, and geology,* the *social sciences, such as geography, economics, political* science, and demography, and the *humanities*, including philosophy and ethics

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Environmental Science

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Environmental Science

Major Fields of Study Related to Environmental Science

Major Fields	Subfields
Biology: study of living things (organisms)	**Ecology:** study of how organisms interact with one another and with their nonliving environment
	Botany: study of plants
	Zoology: study of animals
Chemistry: study of chemicals and their interactions	**Biochemistry:** study of the chemistry of living things
Earth science: study of the planet as a whole and its nonliving systems	**Climatology:** study of the earth's atmosphere and climate
	Geology: study of the earth's origin, history, surface, and interior processes
	Hydrology: study of the earth's water resources
	Paleontology: study of fossils and ancient life

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Social sciences: studies of human society	**Anthropology:** study of human cultures
	Demography: study of the characteristics of human populations
	Geography: study of the relationships between human populations and the earth's surface features
	Economics: study of the production, distribution, and consumption of goods and services
	Political Science: study of the principles, processes, and structure of government and political institutions
Humanities: study of the aspects of the human condition not covered by the physical and social sciences	**History:** study of information and ideas about humanity's past
	Ethics: study of moral values and concepts concerning right and wrong human behavior and responsibilities
	Philosophy: study of knowledge and wisdom about the nature of reality, values, and human conduct

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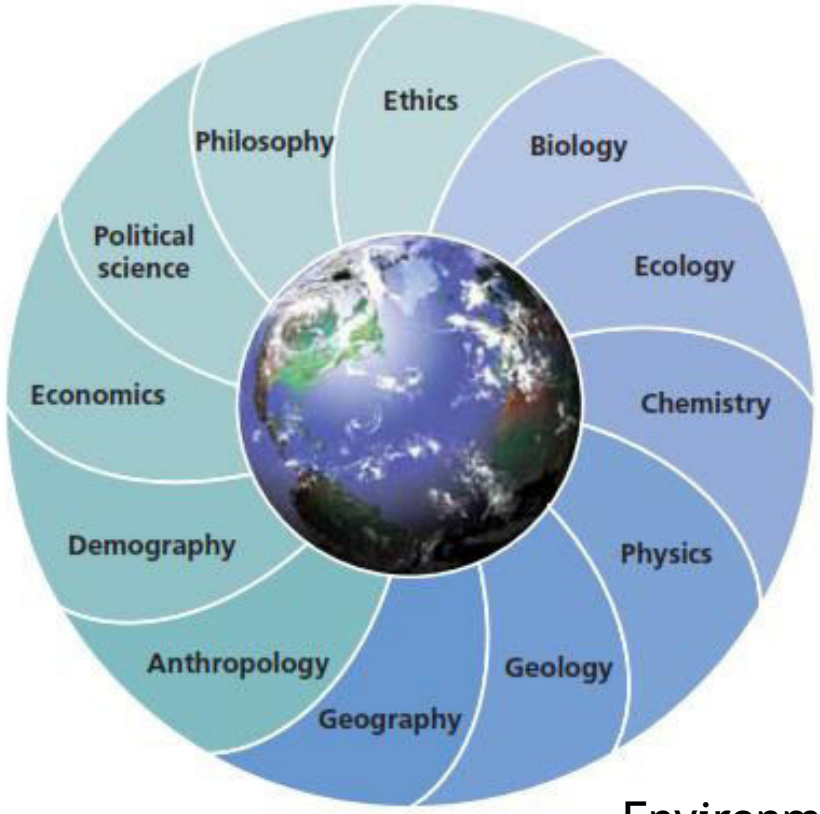

Environmental science is an interdisciplinary study of connections between the earth's life-support system and human activities.

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Environmental Science

- The goals of environmental science are to learn
  - *how nature works?*
  - *how the environment affects us?*
  - *how we affect the environment?*
  - *how to deal with environmental problems and live more sustainably?*

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Environmental Science

- A key subfield of environmental science is ecology, the biological science that studies how organisms, or living things, interact with their environment and with each other

- Every organism is a member of a certain species: a group of organisms with distinctive traits and, for sexually reproducing organisms, can mate and produce fertile offspring.

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Environmental Science

- For example, all humans are members of a species that biologists have named *Homo sapiens*. A major focus of ecology is the study of ecosystems

- An ecosystem is a set of organisms interacting with one another and with their environment of nonliving matter and energy within a defined area or volume.

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Environmental Science

- We should not confuse environmental science and ecology with **environmentalism, a social movement** dedicated to protecting the earth's life-support systems for us and all other forms of life.

- Environmentalism is practiced more in the political and ethical arenas than in the realm of science.

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Environmental Sustainability

- **Sustainability is the ability of the earth's various natural** systems and human cultural systems and economies to survive and adapt to changing environmental conditions indefinitely

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Sustainability

- A critical component of sustainability is **natural capital—the natural resources and natural services that** keep us and other forms of life alive and support our economies.

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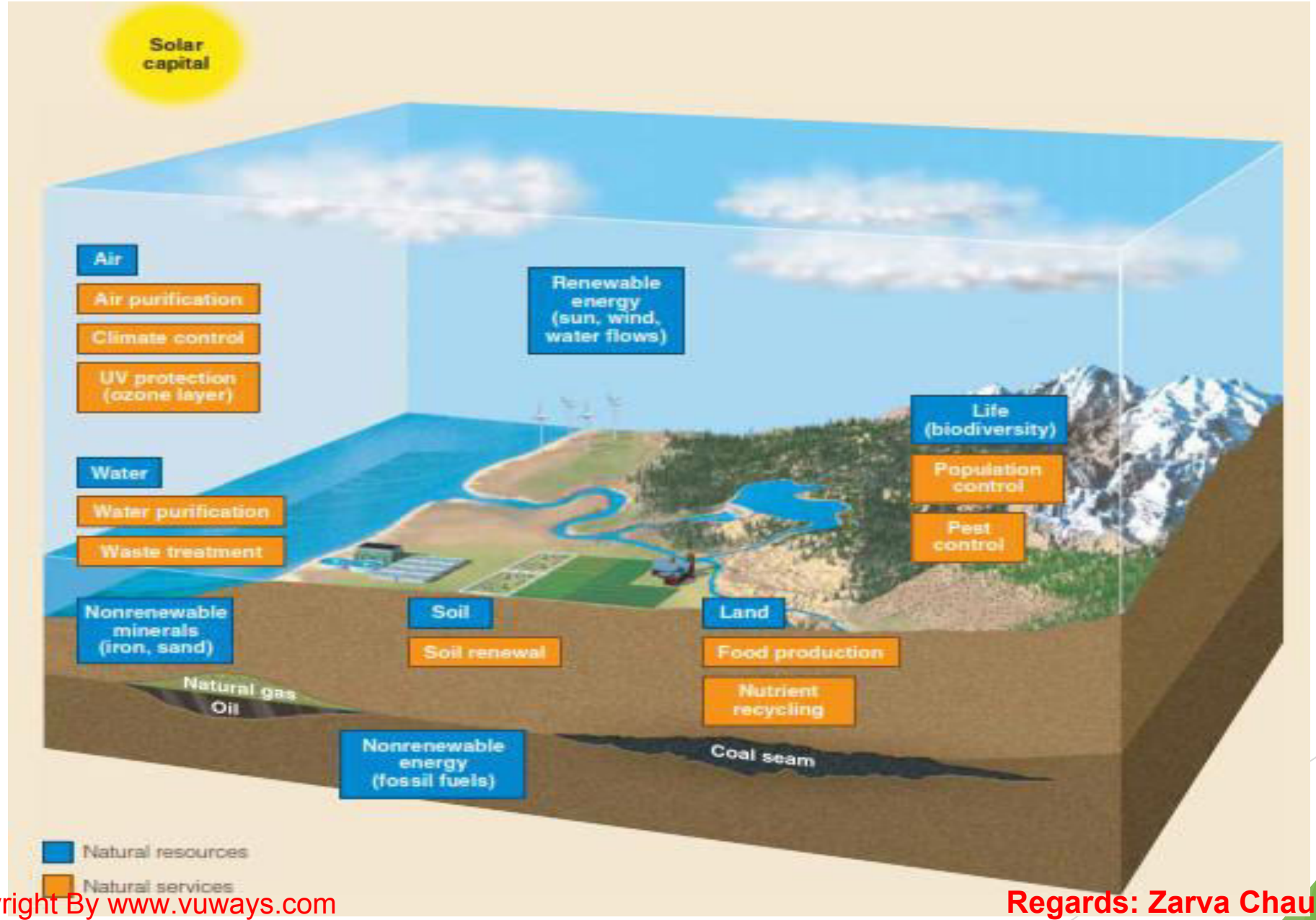

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Environmental Science

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Environmental Sustainability

- **Natural resources are materials** and energy in nature that are essential or useful to humans

- These resources are often classified as *renewable* (such as air, water, soil, plants, and wind) or *nonrenewable* (such as copper, oil, and coal).

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Environmental Sustainability

- **Natural services** are functions of nature, such as purification of air and water, which support life and human economies

- Ecosystems provide us with these essential services at no cost.

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Environmental Sustainability

- One vital natural service is **nutrient cycling, the** circulation of chemicals necessary for life, from the environment (mostly from soil and water) through organisms and back to the environment

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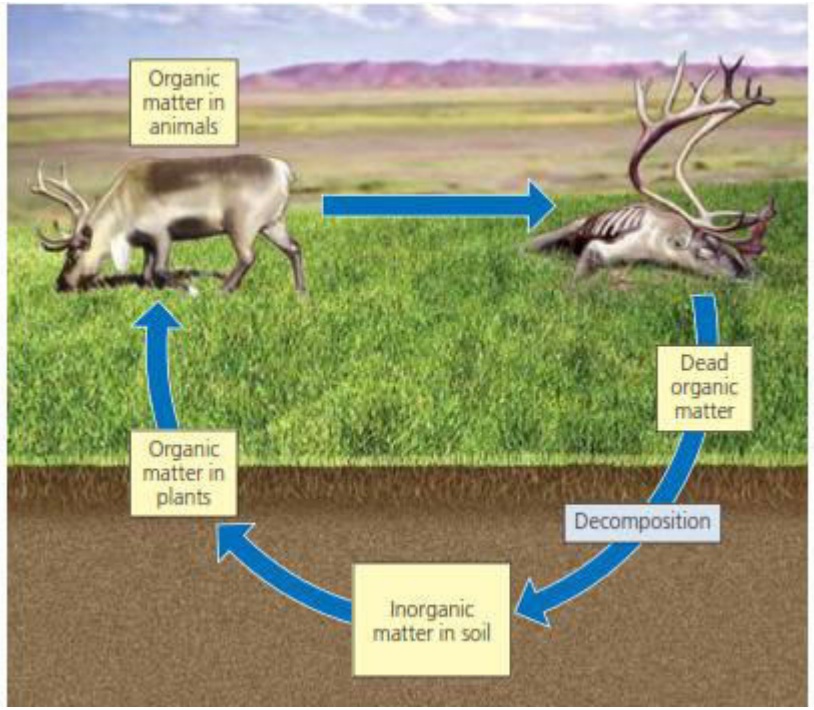
Environmental Sustainability



Nutrient cycling: an important natural service that recycles chemicals **needed by organisms from the environment (mostly from soil and water) through organisms and back to the environment.**

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Environmental Sustainability

- Natural capital is supported by solar capital: energy from the sun
- Take away solar energy, and all natural capital would collapse

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Environmental Sustainability

- Solar energy warms the planet and supports photosynthesis—a complex chemical process that plants use to provide food for themselves and for us and most other animals.

- This direct input of solar energy also produces indirect forms of renewable solar energy such as wind, flowing water, and biofuels made from plants and plant residues.

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Environmental Sustainability

- For example, *topsoil, the upper layer of the earth's crust,* provides the nutrients that support the plants, animals, and microorganisms that live on land; when they die and decay, they resupply the soil with these nutrients. Without this service, life as we know it could not exist.

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Environmental Sustainability

- Thus, our lives and economies depend on energy from the sun (solar capital) and natural resources and natural services (natural capital) provided by the earth

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Environmental Sustainability

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Environmental Sustainability

- A second component of sustainability is to recognize that many human activities can *degrade natural capital* by using normally renewable resources faster than nature can renew them
- For example, in parts of the world, we are clearing mature forests much faster than nature can replenish them
- We are also harvesting many species of ocean fish faster than they can replenish themselves

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Environmental Sustainability

- This leads us to a third component of sustainability
- Environmental scientists search for *solutions to problems* such as the degradation of natural capital

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Environmental Sustainability

- However, their work is limited to finding the scientific solutions, while the political solutions are left to political processes
- For example, scientific solutions might be to stop chopping down biologically diverse, mature forests, and to harvest fish no faster than they can replenish themselves
- But implementing such solutions could require government laws and regulations

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Environmental Sustainability

- The search for solutions often involves conflicts
- When scientists argue for protecting a diverse natural forest to help prevent the premature extinction of various life forms, for example, the timber company that had planned to harvest trees in that forest might protest.

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Environmental Sustainability

- Dealing with such conflicts often involves making trade-offs, or compromises a fourth component of sustainability

- In the case of the timber company, it might be persuaded to plant a tree farm in an area that had already been cleared or degraded, in exchange for preserving the natural forest

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Growth of Environmentally Sustainable Societies

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Growth of Environmentally Sustainable Societies

- Economic growth is an increase in a nation's output of goods and services
- It is usually measured by the percentage of change in a country's **gross domestic product (GDP): the annual market value of all goods** and services produced by all firms and organizations, foreign and domestic, operating within a country
- Changes in a country's economic growth per person are measured by **per capita GDP: the GDP divided by** the total population at midyear

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Growth of Environmentally Sustainable Societies

- The value of any country's currency changes when it is used in other countries
- Because of such differences, a basic unit of currency in one country can buy more of a particular thing than the basic unit of currency of another country can buy

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Growth of Environmentally Sustainable Societies

- Consumers in the rich country are said to have more purchasing power than consumers in the second country have
- To help compare countries, economists use a tool called purchasing power parity (PPP)
- By combining per capita GDP and PPP, for any given country, they arrive at a per capita GDP PPP—a measure of the amount of goods and services that a country's average citizen could buy

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Growth of Environmentally Sustainable Societies

- While economic growth provides people with more goods and services, **economic development has the** goal of using economic growth to improve living standards

- The United Nations classifies the world's countries as economically developed or developing based primarily on their degree of industrialization and their per capita GDP PPP.

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Growth of Environmentally Sustainable Societies

- The **developed countries** (with 1.2 billion people) include the United States, Canada, Japan, Australia, New Zealand, and most countries of Europe

- Most are highly industrialized and have a high per capita GDP PPP

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Growth of Environmentally Sustainable Societies

- All other nations (with 5.5 billion people) are classified as developing countries, most of them in Africa, Asia, and Latin America

- Some are middle-income, moderately developed countries such as China, India, Brazil, Turkey, Thailand, and Mexico. Others are low-income, least developed countries where per capita GDP PPP is steadily declining

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Growth of Environmentally Sustainable Societies

- Some economists call for continuing conventional economic growth, which has helped to increase food supplies, allowed people to live longer, and stimulated mass production of an array of useful goods and services for many people

- They also see such growth as a cure for poverty, maintaining that some of the resulting increase in wealth trickles down to countries and people near the bottom of the economic ladder

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Growth of Environmentally Sustainable Societies

- Other economists put much greater emphasis on environmentally sustainable economic development
- This involves using political and economic systems to discourage environmentally harmful and unsustainable forms of economic growth
- That degrade natural capital, and to encourage environmentally beneficial and sustainable forms of economic development that help sustain natural capital

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Affects of Ecological Footprints on the Earth

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Affects of Ecological Footprints on the Earth

- From a human standpoint, a resource is anything obtained from the environment to meet our needs and wants

- Conservation is the management of natural resources with the goal of minimizing resource waste and sustaining resource supplies for current and future generations

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Affects of Ecological Footprints on the Earth

- Some resources, such as solar energy, fresh air, wind, fresh surface water, fertile soil, and wild edible plants, are directly available for use

- Other resources such as petroleum, iron, water found underground, and cultivated crops, are not directly available

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Affects of Ecological Footprints on the Earth

- They become useful to us only with some effort and technological ingenuity.
- For example, petroleum was a mysterious fluid until we learned how to find, extract, and convert (refine) it into gasoline, heating oil, and other products that could be sold

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Affects of Ecological Footprints on the Earth

- Solar energy is called a perpetual resource because it is renewed continuously and is expected to last at least 6 billion years as the sun completes its life cycle

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Affects of Ecological Footprints on the Earth

- On a human time scale, a renewable resource can be replenished fairly quickly (from hours to hundreds of years) through natural processes as long as it is not used up faster than it is renewed

- Examples include forests, grasslands, fisheries, freshwater, fresh air, and fertile soil

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Affects of Ecological Footprints on the Earth

- The highest rate at which a renewable resource can be used indefinitely without reducing its available supply is called its sustainable yield

- When we exceed a renewable resource's natural replacement rate, the available supply begins to shrink, a process known as environmental degradation

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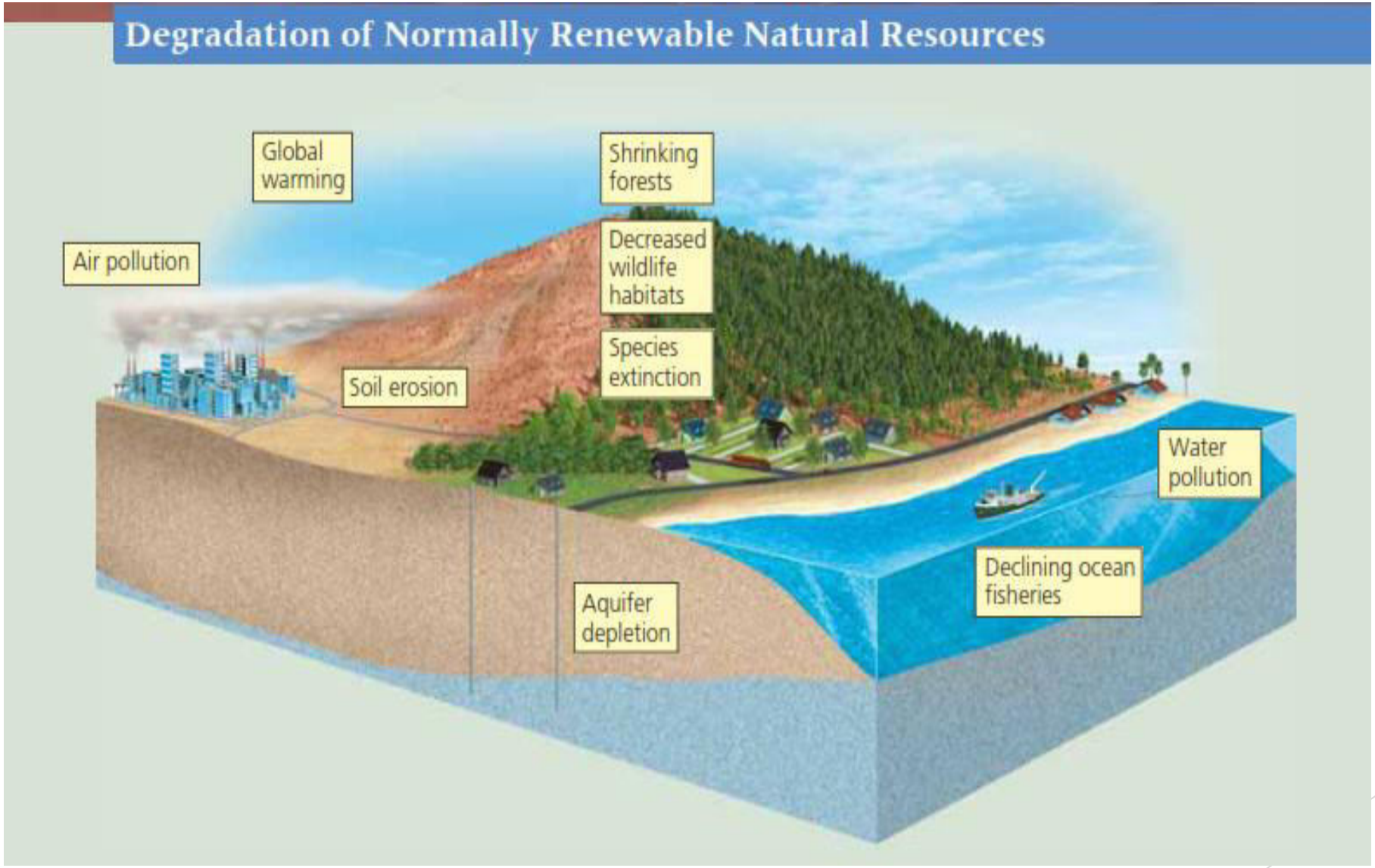

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Overexploitation of Commonly Shared Renewable Resources

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Overexploitation of Commonly Shared Renewable Resources

- There are three types of property or resource rights
  - 1- One is private property where individuals or firms own the rights to land, minerals, or other resources
  - 2- Another is common property where the rights to certain resources are held by large groups of individuals
  - 3- A third category consists of *open access renewable re-sources, owned by no one and available for use by anyone* at little or no charge

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Overexploitation of Commonly Shared Renewable Resources

- Many common property and open access renewable resources have been degraded
- In 1968, biologist Garrett Hardin (1915–2003) called such degradation the *tragedy of the commons*
- *It occurs because each user* of a shared common resource or open-access resource reasons, “If I do not use this resource, someone else will
- The little bit that I use or pollute is not enough to matter, and anyway, it’s a renewable resource.”

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Overexploitation of Commonly Shared Renewable Resources

- When the number of users is small, this logic works
- The cumulative effect of many people trying to exploit a shared resource can exhaust or ruin it
- Then no one can benefit from it

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Overexploitation of Commonly Shared Renewable Resources

- Such resource degradation results from the push to satisfy the short-term needs and wants of a growing number of people
- It threatens our ability to ensure the long-term economic and environmental sustainability of open-access resources such as clean air or an open ocean fishery

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Overexploitation of Commonly Shared Renewable Resources

- One solution is to use shared resources at rates well below their estimated sustainable yields by reducing use of the resources, regulating access to the resources, or doing both
- For example, the most common approach is for governments to establish laws and regulations limiting the annual harvests of various types of ocean fish that are being harvested at unsustainable levels in their coastal waters
- Another approach is for nations to enter into agreements that regulate access to open access renewable resources such as the fish in the open ocean

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Nonrenewable Resources

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Nonrenewable Resources

- Nonrenewable resources exist in a fixed quantity, or stock, in the earth's crust
- On a time scale of millions to billions of years, geological processes can renew such resources
- But on the much shorter human time scale of hundreds to thousands of years, these resources can be depleted much faster than they are formed

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Nonrenewable Resources

- Such exhaustible resources include energy resources (such as coal and oil), metallic mineral resources (such as copper and aluminum), and nonmetallic mineral resources (such as salt and sand)

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Nonrenewable Resources

- As such resources are depleted, human ingenuity can often find substitutes
- For example, during this century, a mix of renewable energy resources such as wind, the sun, flowing water, and the heat in the earth's interior could reduce our dependence on nonrenewable fossil fuels such as oil and coal
-

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Nonrenewable Resources

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Nonrenewable Resources

- Also, various types of plastics and composite materials can replace certain metals
- But sometimes there is no acceptable or affordable substitute

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Nonrenewable Resources

- Some nonrenewable resources, such as copper and aluminum, can be recycled or reused to extend supplies
- Reuse is using a resource over and over in the same form
- For example, glass bottles can be collected, washed, and refilled many times

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Nonrenewable Resources

- Recycling involves collecting waste materials and processing them into new materials
- For example, discarded aluminum cans can be crushed and melted to make new aluminum cans or other aluminum products
- But energy resources such as oil and coal cannot be recycled
- Once burned, their energy is no longer available to us

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Nonrenewable Resources

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Nonrenewable Resources

- Recycling nonrenewable metallic resources takes much less energy, water, and other resources and produces much less pollution and environmental degradation than exploiting virgin metallic resources

- Reusing such resources takes even less energy and other resources and produces less pollution and environmental degradation than recycling does

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Our Ecological Footprints Are Growing

- Many people in developing countries struggle to survive
- Their individual use of resources and the resulting environmental impact is low and is devoted mostly to meeting their basic needs
- By contrast, many individuals in more affluent nations consume large amounts of resources way beyond their basic needs

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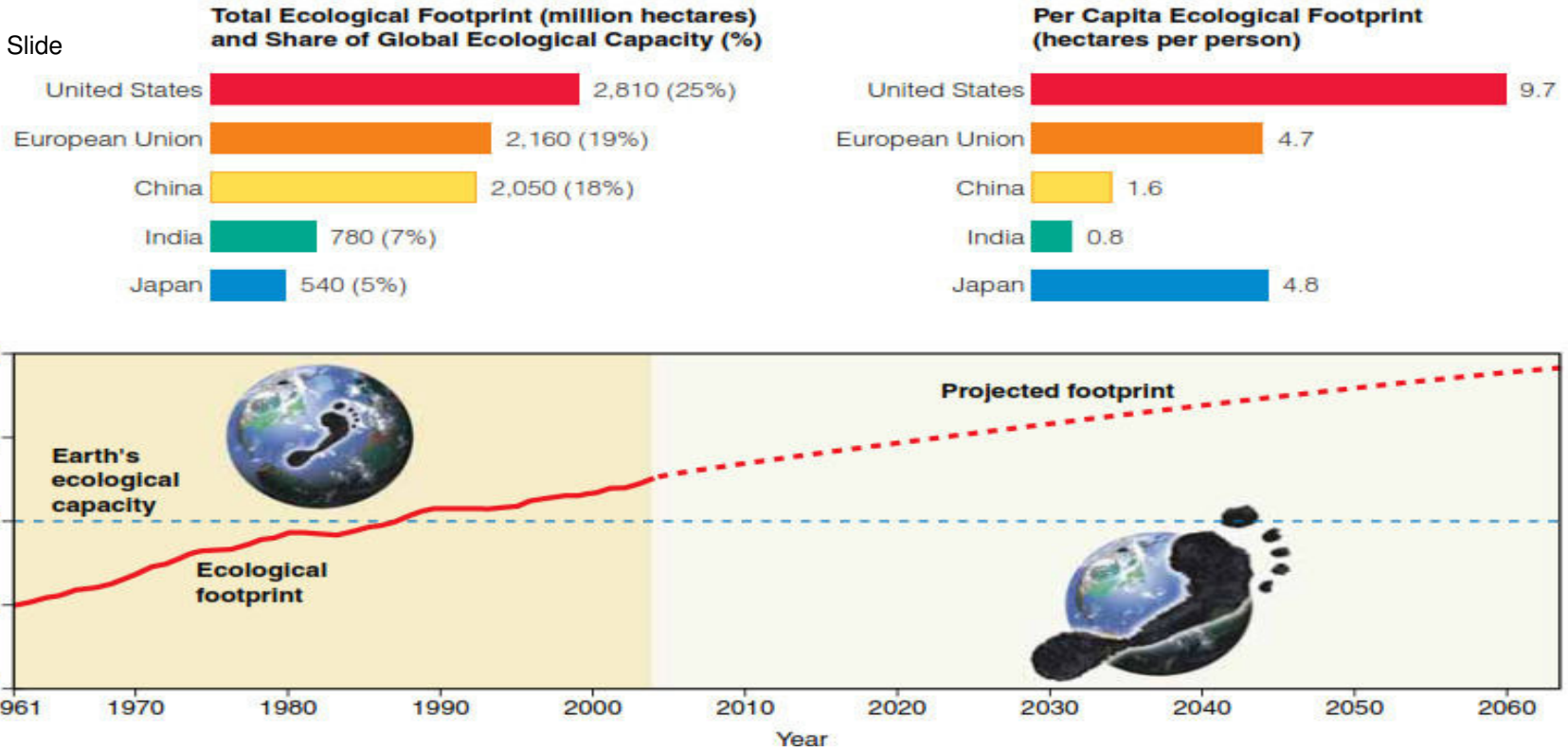

Natural capital use and degradation: total and per capita ecological footprints of selected countries (top). In 2003, humanity total or global ecological footprint was about 25% higher than the earth ecological capacity (bottom) and is projected to be twice the planet ecological capacity by 2050. **Question:** If we are living beyond the earth biological capacity, why do you think the human population and per capita resource consumption are still growing exponentially? (Data from Worldwide Fund for Nature, Global Footprint Network)

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Our Ecological Footprints Are Growing

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Our Ecological Footprints Are Growing

- Supplying people with resources and dealing with the resulting wastes and pollution can have a large environmental impact
- We can think of it as an ecological footprint—the amount of biologically productive land and water needed to supply the people in a particular country or area with resources and to absorb and recycle the wastes and pollution produced by such resource use
- The per capita ecological footprint is the average ecological footprint of an individual in a given country or area.

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Our Ecological Footprints Are Growing

- If a country's, or the world's, total ecological footprint is larger than its biological capacity to replenish its renewable resources and absorb the resulting waste products and pollution, it is said to have an ecological deficit.

- The World Wildlife Fund (WWF) and the Global Footprint Network estimated that in 2003 (the latest data available) humanity's global ecological footprint exceeded the earth's biological capacity by about 25%

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Our Ecological Footprints Are Growing

- The per capita ecological footprint is an estimate of how much of the earth's renewable resources an individual consumes
- After the oil-rich United Arab Emirates, the United States has the world's second largest per capita ecological footprint
- In 2003, its per capita ecological footprint was about 4.5 times the average global footprint per person, 6 times larger than China's per capita footprint, and 12 times the average per capita footprint in the world's low-income countries like Pakistan

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Our Ecological Footprints Are Growing

- According to William Rees and Mathis Wackernagel, the developers of the ecological footprint concept, it would take the land area of about five more planet earths for the rest of the world to reach current U.S. levels of consumption with existing technology

- Put another way, if everyone consumed as much as the average American does today, the earth's natural capital could support only about 1.3 billion people—not

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Our Ecological Footprints Are Growing

- In other words, we are living unsustainably by depleting and degrading some of the earth's irreplaceable natural capital and the natural renewable income it provides as our ecological footprints grow and spread across the earth's surface

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Introduction to Ecology

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Introduction to ecology

The word ‘ecology’ was first used by **Ernest Haeckel** in 1869.

Ecology is the scientific study of the interactions that determine the distribution and abundance of organisms in an environment.

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Introduction to ecology

All organisms have to interact with both living and non living things that surround them.

Both these living and non living factors contribute to the whole environment of organisms in which they live.

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Introduction to ecology

Ecology is a complex and an amazing field of biology that describes the richness of the biosphere.

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Introduction to ecology

The basic concept of ecology is that, “all organisms in an environment are interdependent”.

So environment is a main part of the relationship that occurs between organism and their natural and manmade environment.

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Introduction to ecology

Major components of ecology are

- Species
- Population
- Community
- Ecosystem
- Biome
- Biosphere

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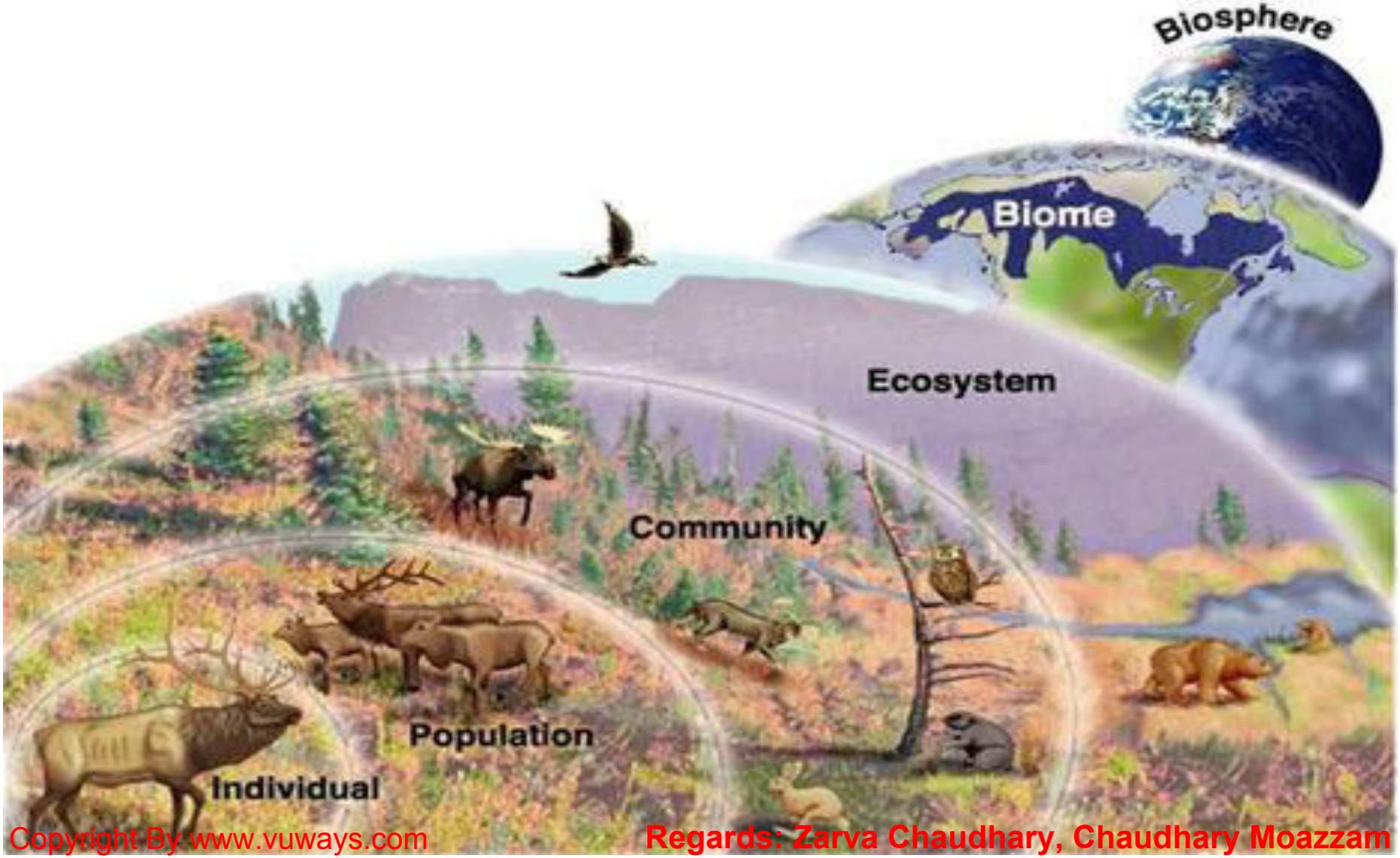
Introduction to ecology



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Introduction to ecology

Sub fields of ecology

- Organismal ecology
- Population ecology
- Community ecology
- Ecosystem ecology
- Landscape ecology
- Global ecology

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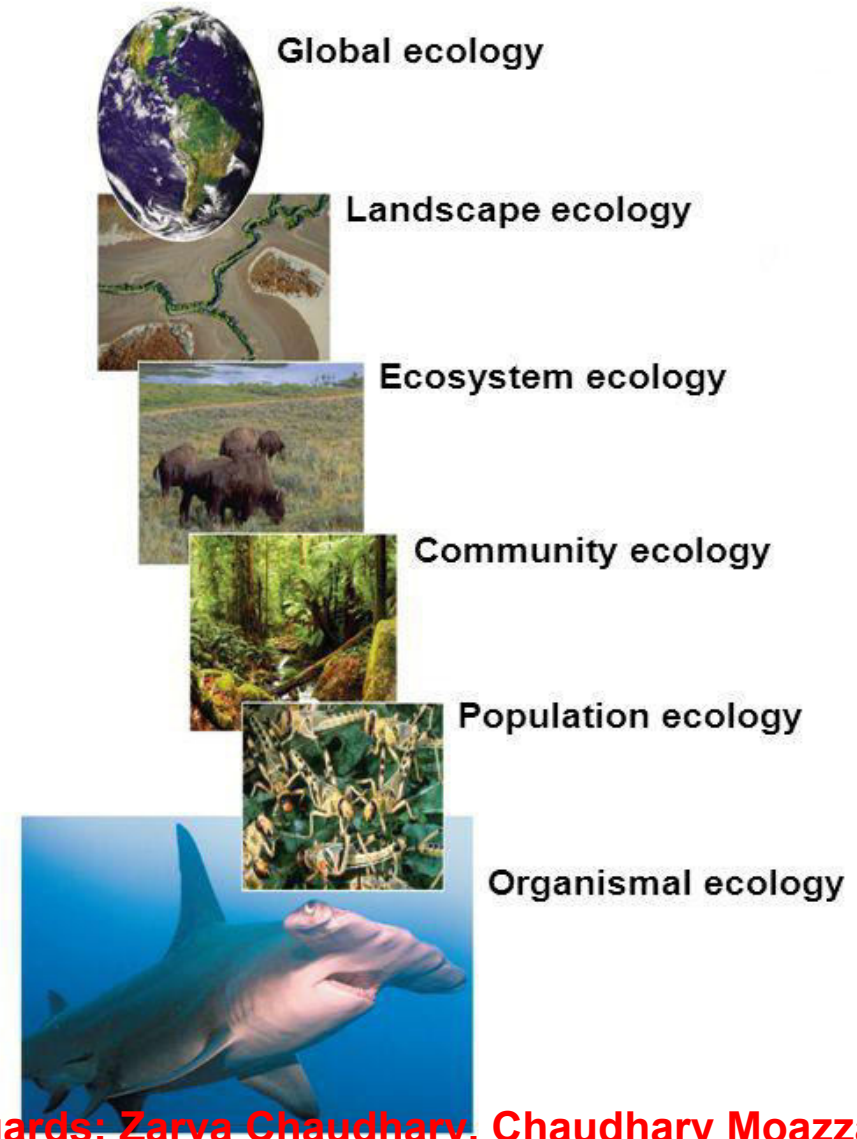
Introduction to ecology

Ecology subfields



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Ecosystem

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Ecosystem

The word ecosystem was coined by **Tansley in 1935.**

An ecosystem is a community of different species interacting with one another and with their nonliving environment of soil, water, other forms of matter, and energy, mostly from the sun.

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Ecosystem

Ecosystems can be natural or artificial (human created). Examples of artificial ecosystems are crop fields, tree farms, and reservoirs.

Ecosystems do not have clear boundaries and are not isolated from one another. Matter and energy move from one ecosystem to another.

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Ecosystem

For example, soil can wash from a grassland or crop field into a nearby river or lake. Water flows from forests into nearby rivers and crop fields.

Birds and various other species migrate from one ecosystem to another. Winds can blow pollen from a forest into a grassland.

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Ecosystem

Ecosystem is a basic structural and functional unit of ecology.

Structure of an ecosystem depends on **species diversity** as well as the energy that is required to maintain it.

If there is more species diversity then structure of ecosystem will be more complex and less energy will be needed to maintain the structure of ecosystem.

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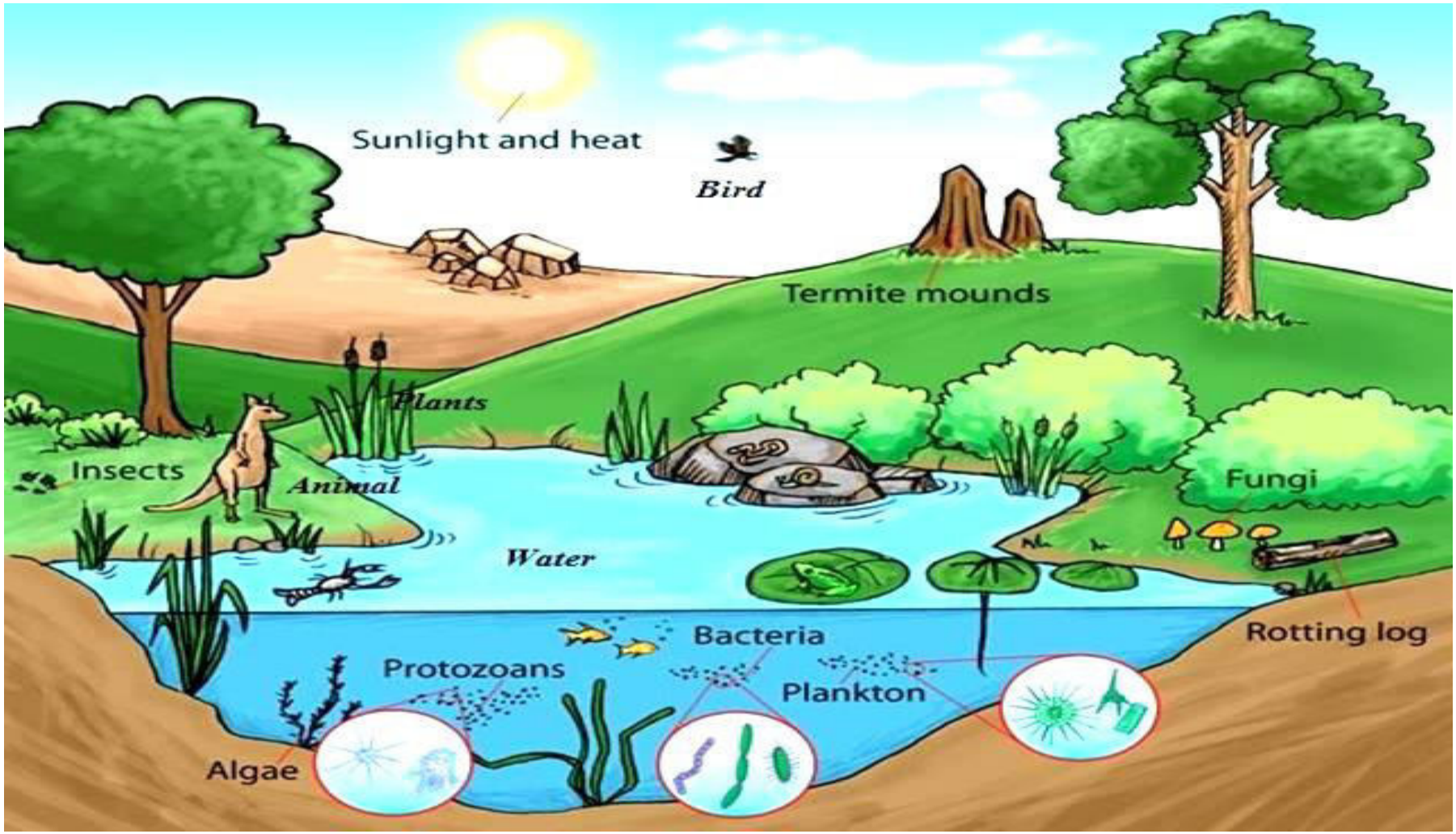
Ecosystem



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Ecosystem

An ecosystem consists of two major components

1. Biotic components
2. Abiotic components

The interactions between both these components constitutes an ecosystem.

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Ecosystem

Biotic components

Living components of an ecosystem

1. Producers : Green plants
2. Consumers: Animals
3. Decomposers: Bacteria and fungi

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Ecosystem

Abiotic components

Non living components of an ecosystem

Physical components:

1. Water
2. light
3. Temperature
4. Wind
5. Air
6. soil

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Ecosystem

Chemical components

1. Oxygen
2. Carbon
3. Nitrogen
4. Phosphorus
5. Sulphur.

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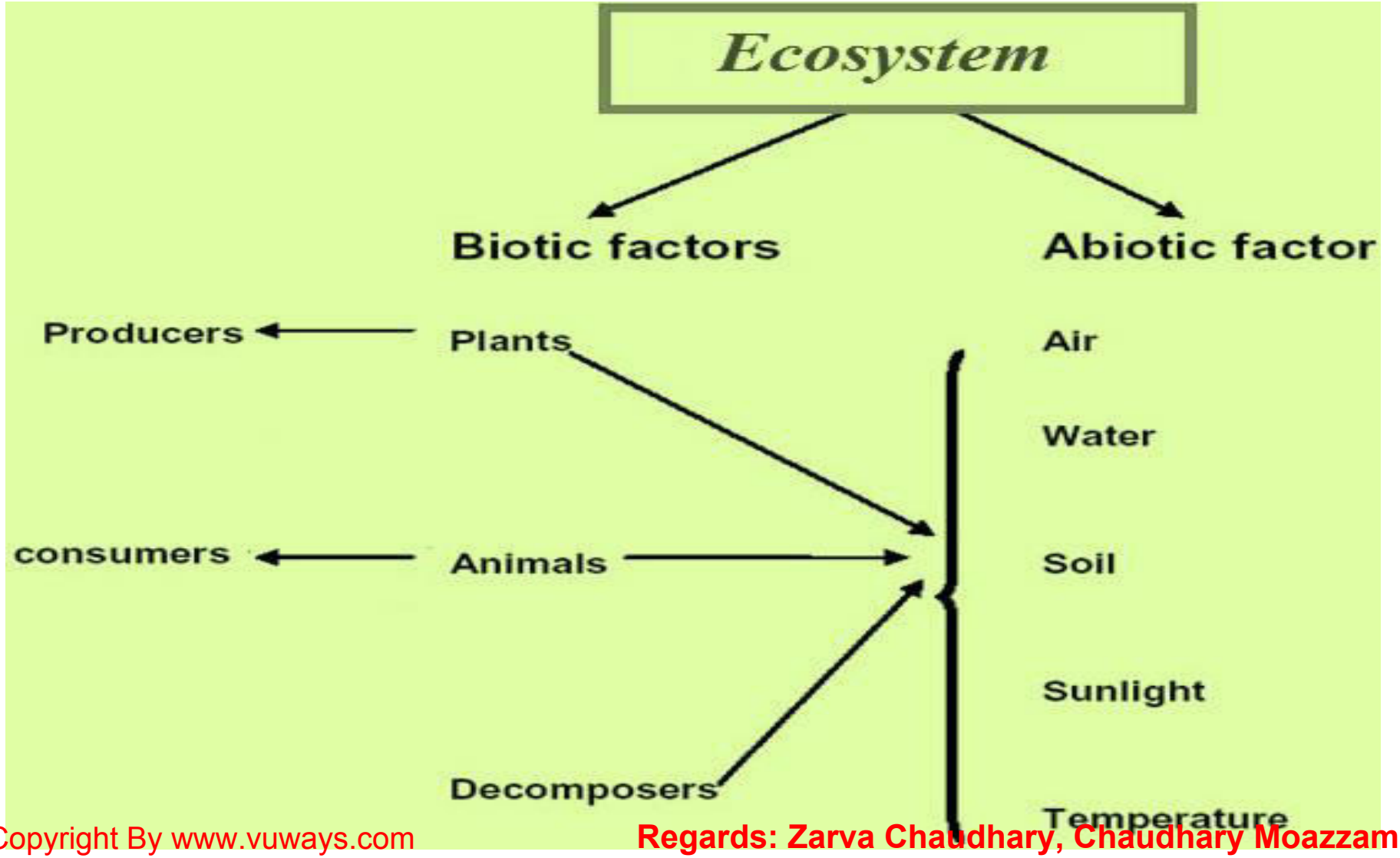
Ecosystem



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How Living systems are sustained

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How Living systems are sustained

All living systems from a cell to the biosphere are dynamic systems that are constantly changing in response to changing environmental conditions.

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How Living systems are sustained

The composition of communities and ecosystems changes due to

- Continents movement
- Climate changes
- Natural disturbances
- Succession

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How Living systems are sustained

Living systems contain complex networks of positive and negative feedback loops that interact to provide some degree of stability, or sustainability, over each system's expected life span.

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How Living systems are sustained

This stability, or capacity to withstand external stress and disturbance, is maintained only by constant change in response to changing environmental conditions.

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How Living systems are sustained

A positive feedback loop causes a system to change further in the same direction from which it is moving.

For example when vegetation is removed from a stream valley, flowing water from precipitation causes erosion and loss of nutrients, which causes more vegetation to die. With even less vegetation to hold soil in place, flowing water causes even more erosion and nutrient loss, which causes even more plants to die.

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How Living systems are sustained

A negative, or corrective, feedback loop causes a system to change in the opposite direction from which it is moving. A simple example is a thermostat, a device that controls how often, and how long a heating or cooling system runs.

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How Living systems are sustained

It is useful to distinguish among two aspects of stability in living systems.

1. **Inertia, or persistence**
2. **Resilience**

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How Living systems are sustained

Inertia, or persistence

The ability of a living system, such as a grassland or a forest, to survive in conditions of moderate disturbances.

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How Living systems are sustained

Resilience

The ability of a living system to be restored through secondary succession after a moderate disturbance.

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Level of organization: Cell

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Level of organization: Cell

Cell is the basic structural and functional unit of life.

All organisms are composed of cells which is the basic concept of cell theory.

Organisms may consist of single cell (unicellular) or many cells (multicellular).

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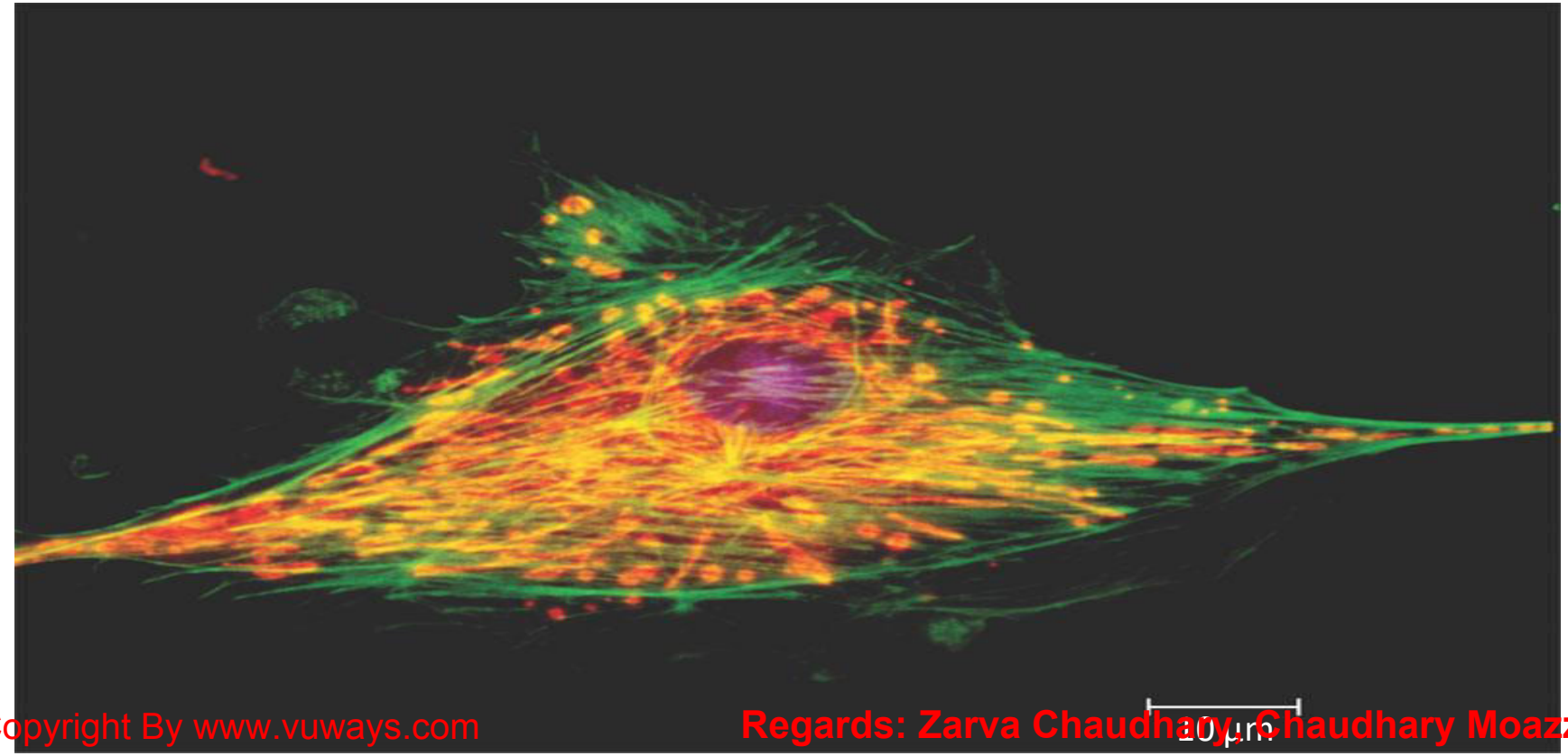
Level of organization: Cell

The cell is the simplest collection of matter that can live. Cell structure is correlated to cellular function.



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Level of organization: Cell

Organisms are divided into two types on the basis of their cell structure.

- Prokaryotes
- Eukaryotes

Prokaryotes consist of only unicellular organisms while Eukaryotes consist of both unicellular and multicellular organisms.

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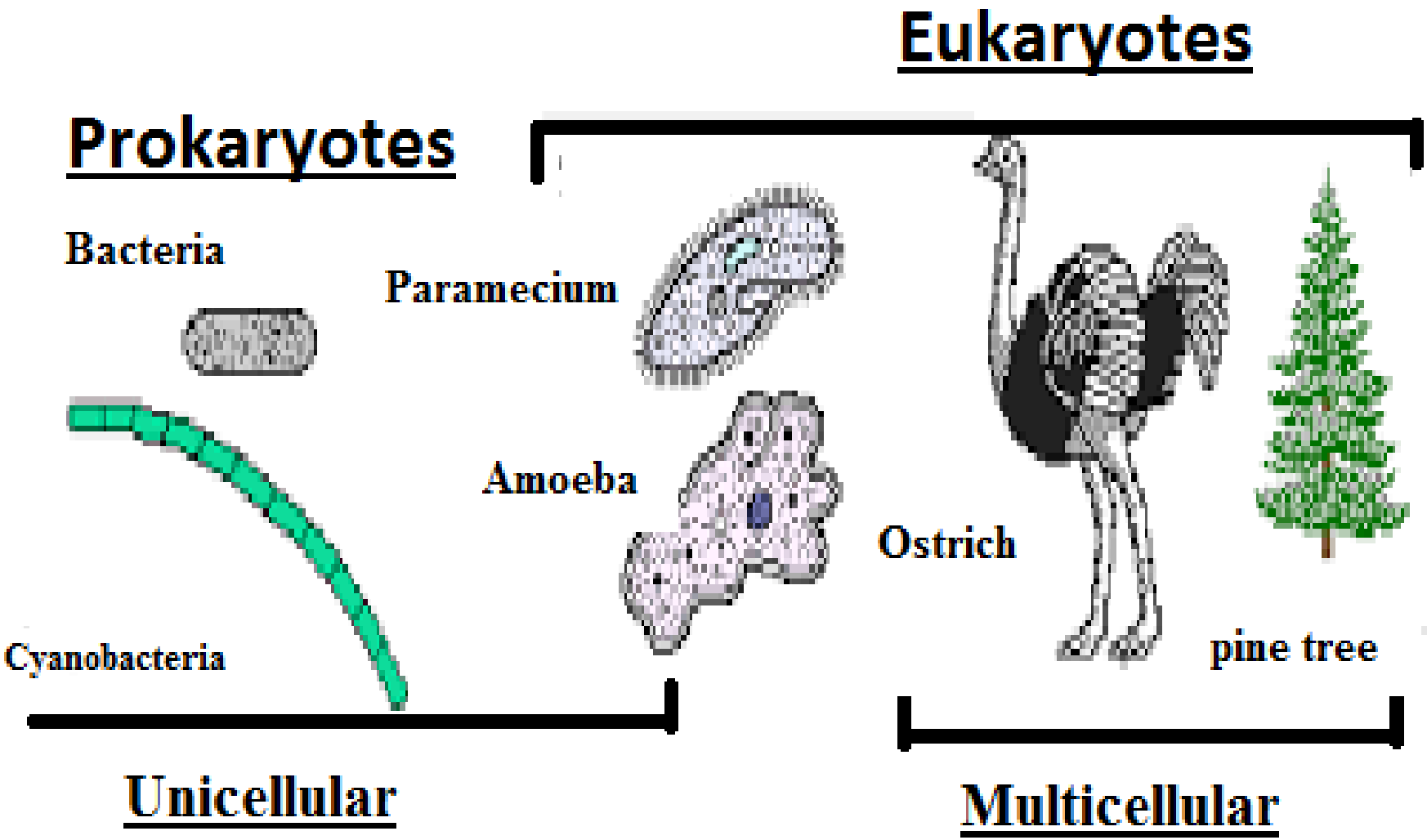
Level of organization: Cell



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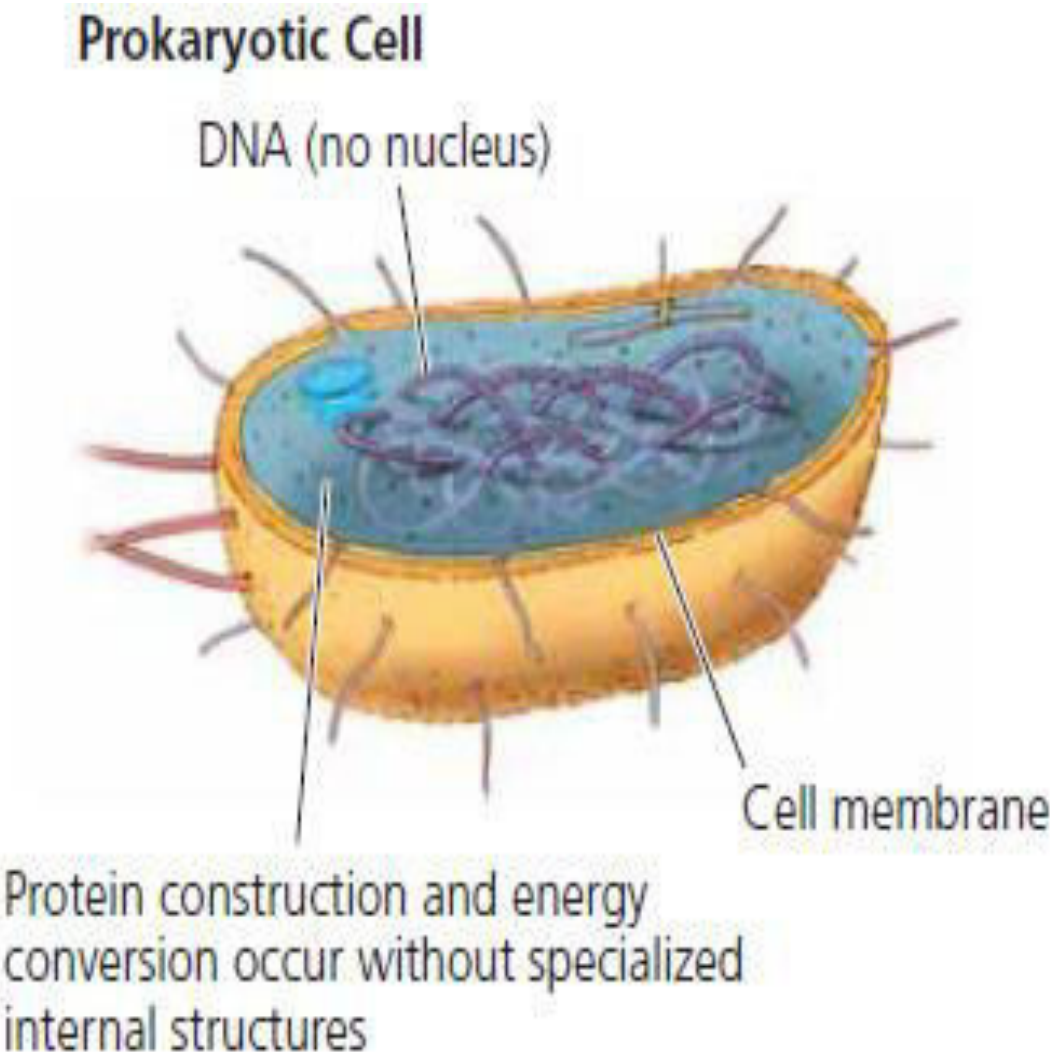
Level of organization: Cell

Prokaryotes

They lack well defined nucleus and also membrane bound organelles.



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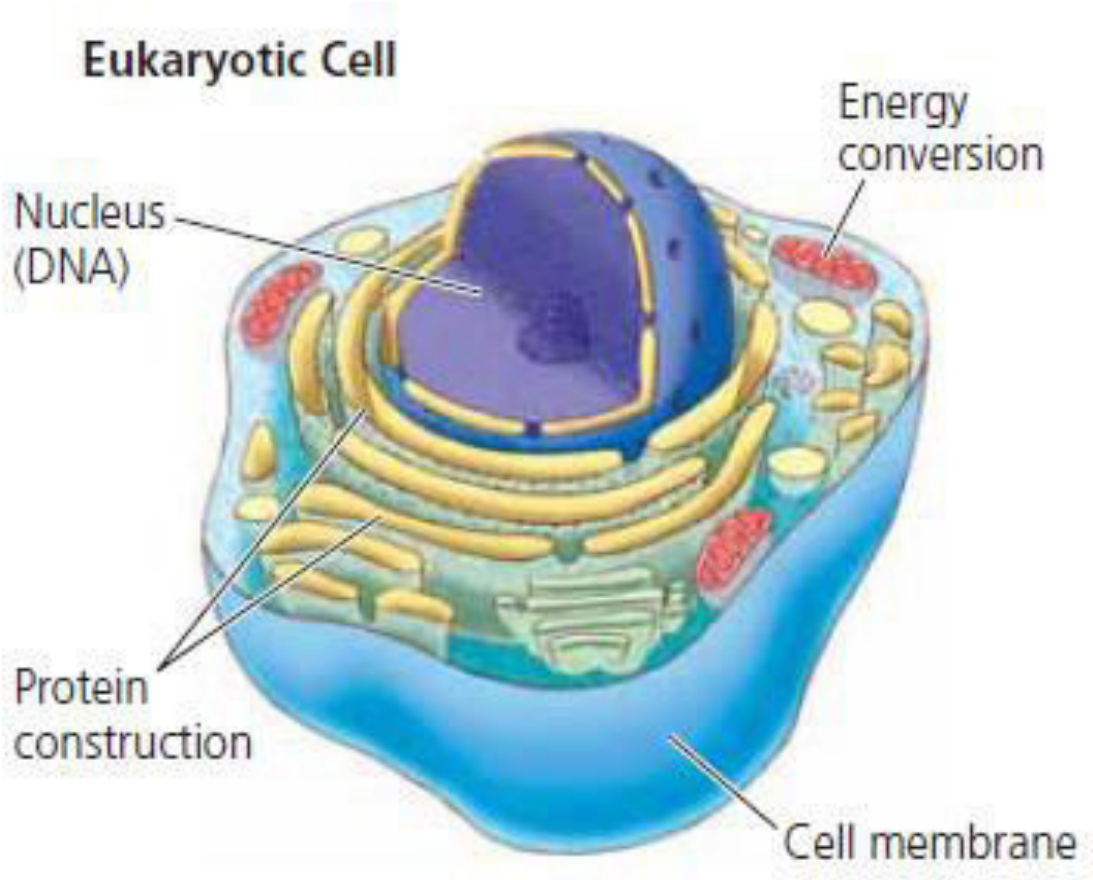
Level of organization: Cell

Eukaryotes

They have well defined nucleus and also have Membrane Bound organelles.



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Species

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Species

A group of sexually reproducing organisms, that can mate and produce fertile offspring. This is the biological concept of species.

Every organism is a member of a particular species with specific traits.

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Species

The species is the largest unit of population in which gene flow is possible.

It is defined by reproductive isolation from other species in natural environments.

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Species

Four basic concepts about species are

1. Biological species concept
2. Ecological species concept
3. Morphological species concept
4. Phylogenetic species concept

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Species

1. Biological concept of species

Defines species on the base of their interbreeding potential not on similarity or appearance.

For example, Western meadowlarks (*Sturnella neglecta*) and Eastern meadowlarks (*Sturnella magna*) look almost identical to one another, yet do not interbreed with each other—thus, they are separate species according to this definition.

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Species

The Western meadowlark (left) and the Eastern meadowlark (right) appear to be identical, and their ranges overlap, but their distinct songs prevent interbreeding.

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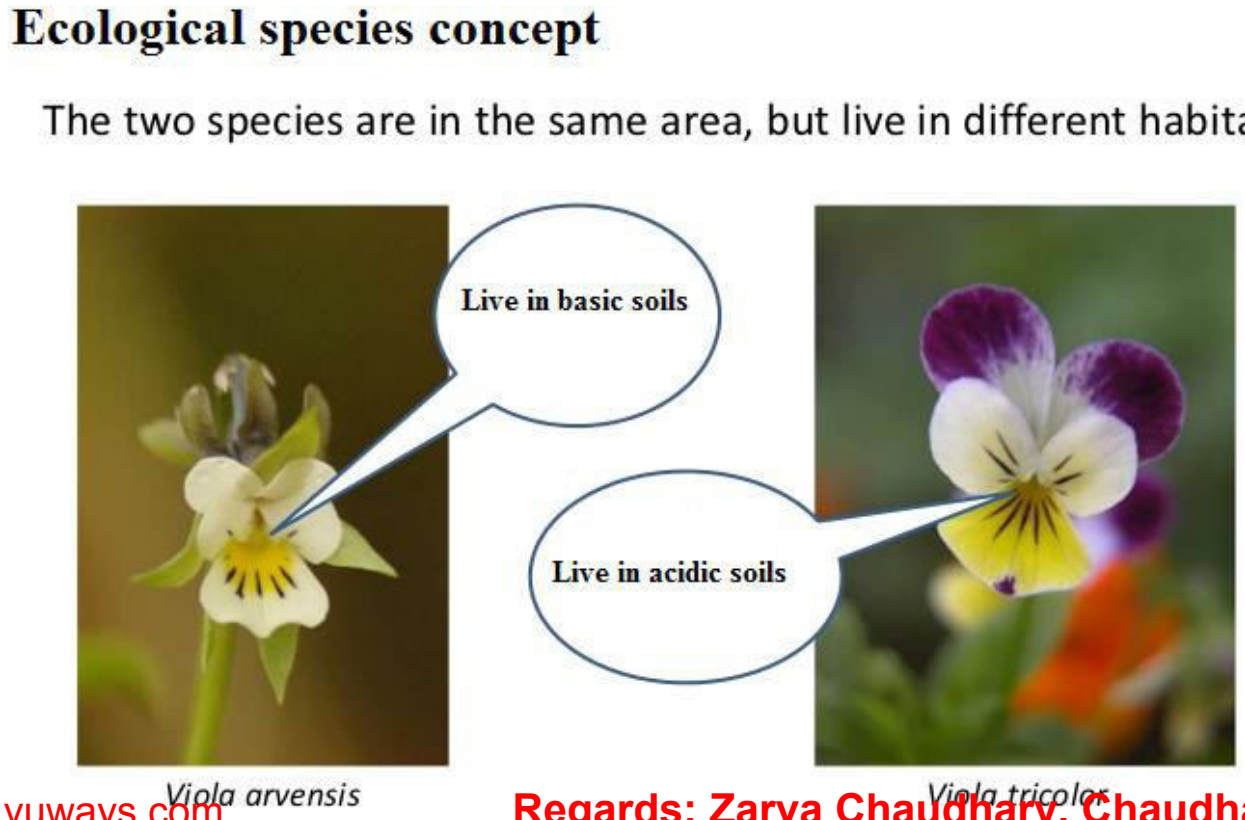
Species

2. Ecological species concept

Defines species in terms of its ecological niche.



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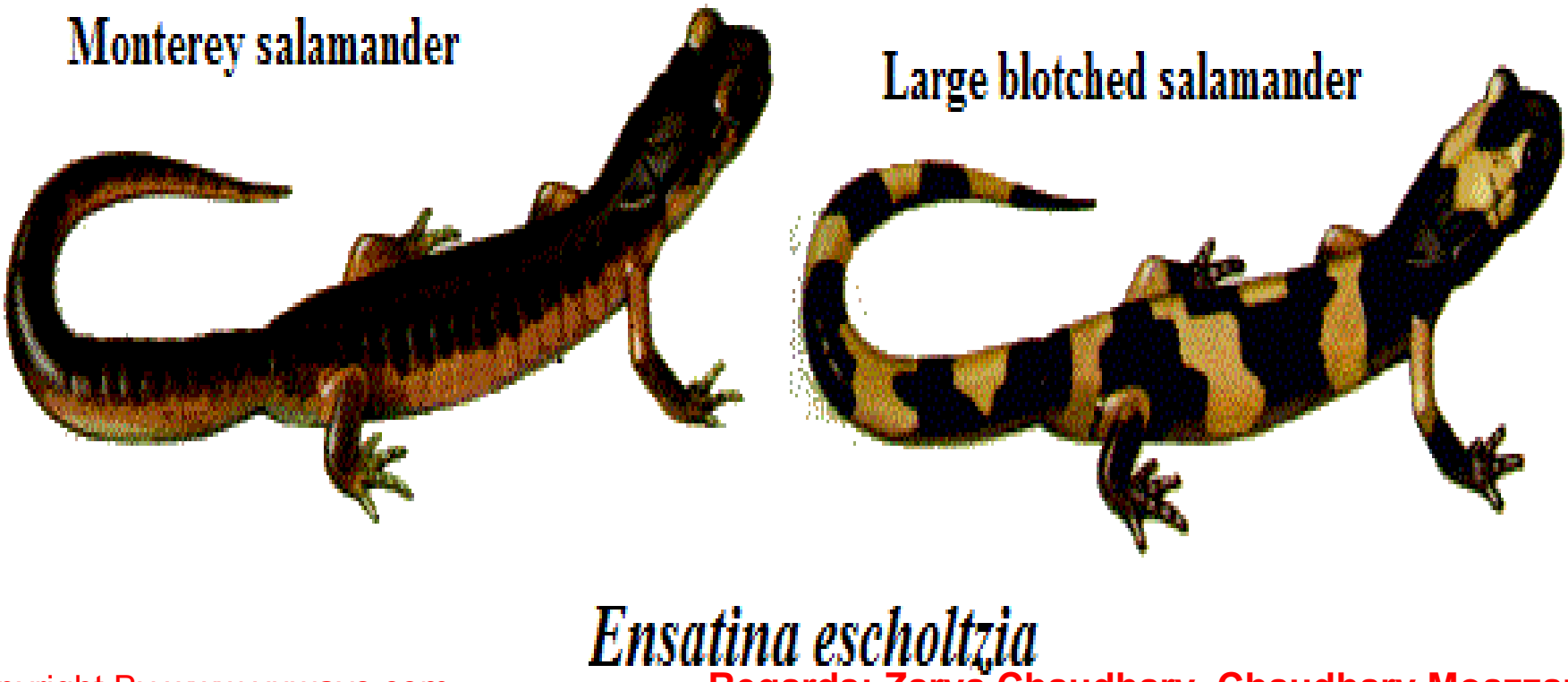
Species

3. Morphological species concept

Defines species by structural features.



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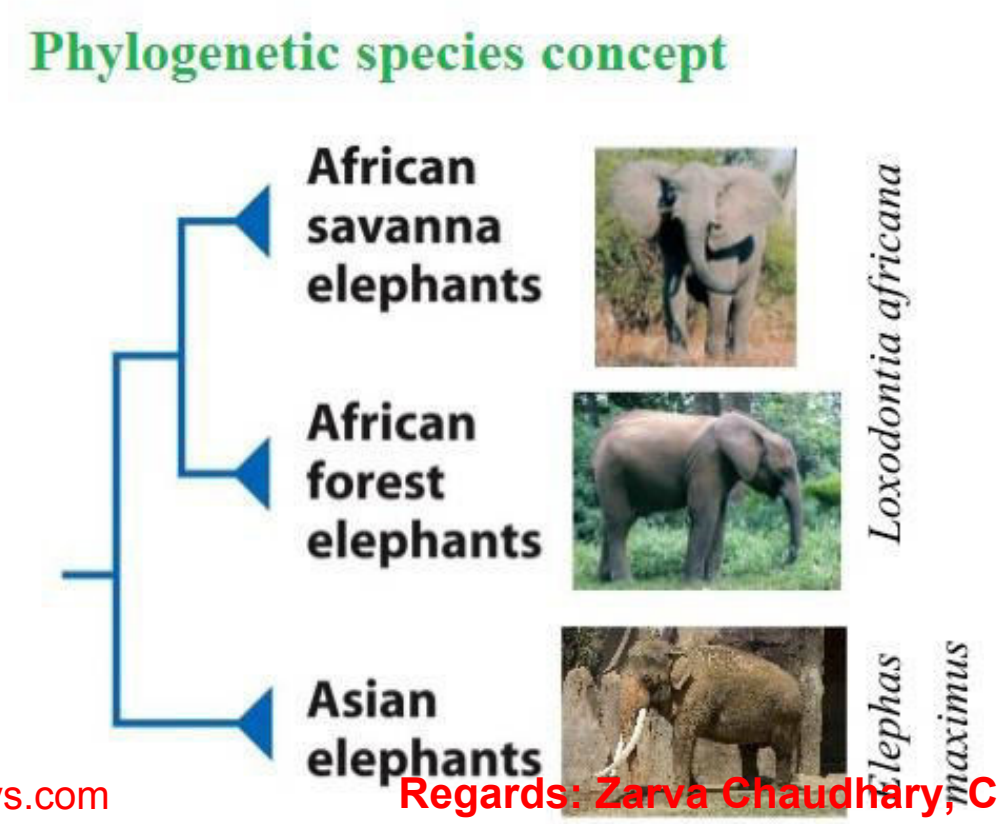
Species

4. Phylogenetic species concept

Defines species as the smallest group of individuals on a phylogenetic tree.



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Population

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Population

A group of same species located at the same place and same time is called as a population. Population biologists study groups in a specific area.

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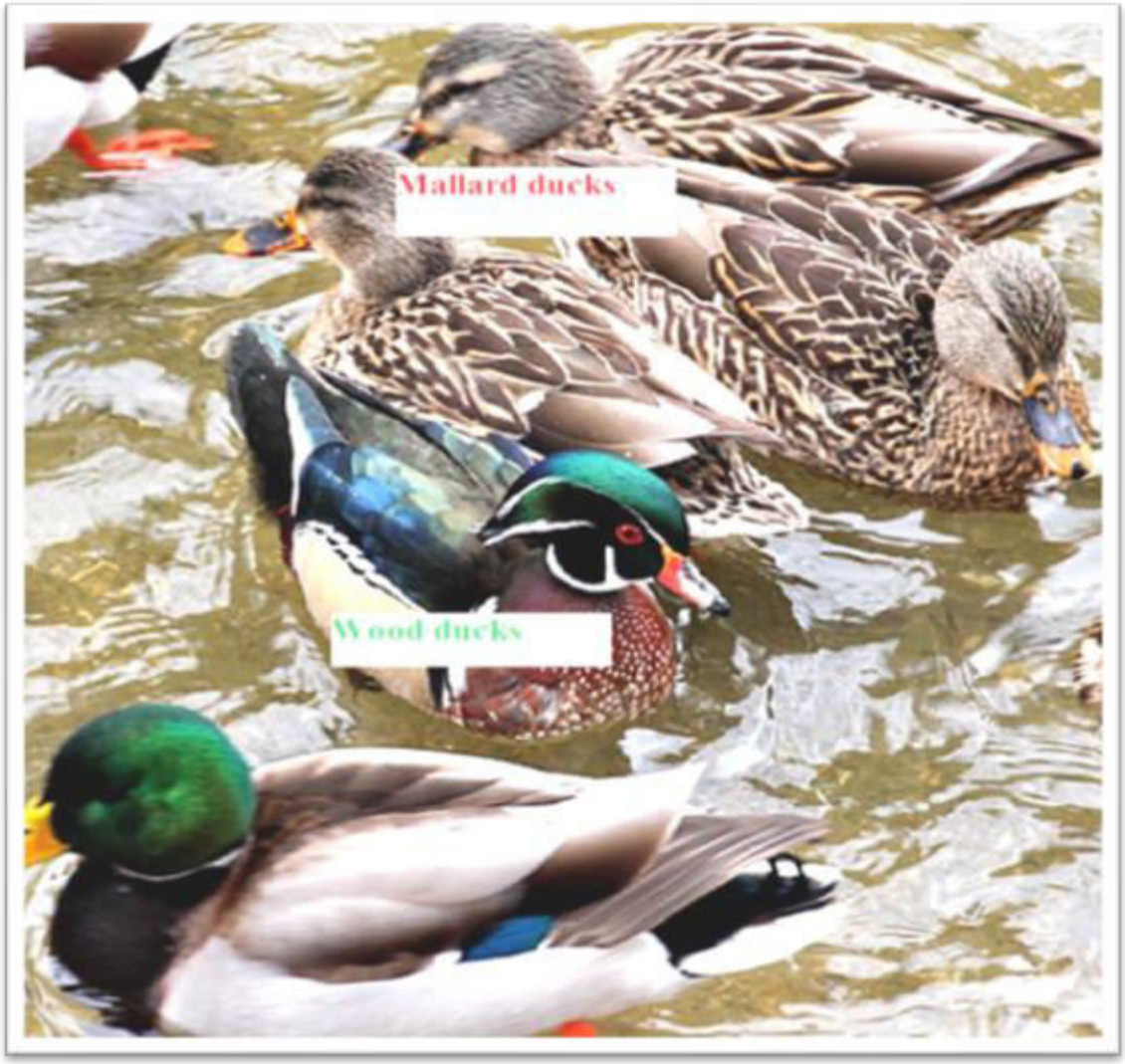
Population

A group of ducks would not be a population if there were mallard and wood ducks combined.

It means that there are two populations existing in the same area.



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Population

Every population has particular characteristics

- Population size
- Population growth
- Population distribution
- Population density

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Population

Organisms are born and the population size increases.

Other factors that will increase the size of a population are

- Reproductive fitness
- Good weather
- Medicine
- Geographic isolation
- No predators

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Population

Organisms will also die of old age and the population will decrease.

Populations can also decrease when there are more **predators** around, after a natural disaster, when **competition** is too great or when some of the organisms just leave the area (**migration**).

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Population

Physical limits

There are some **physical limits** for a population. Sometimes other environments are just bad places to live for a population. They may be too hot, too cold, or too dangerous.

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Population

Geographic limits

Geographic limits are also a main constraints that decreases the size of a population.

These above mentioned factors (Physical limits and geographic limits) are very important to address because they limit the population expansion.

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Population

Geographic limits

Geographic barriers like rivers, mountains or patches of water bodies limits the size of population

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Community

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Community

Community or biological community is the group of population of different species located in a particular area or place.

Communities are not only a random composition of species but they also have a unique organization.

A community is made up of many populations that interact in an area.

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Community

For example, a catfish species in a pond usually shares the pond with other fish species, and with plants, insects, ducks, and many other species that make up the community.

Many of the organisms in a community interact with one another in feeding and other relationship.

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Pond community

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Community

Communities, like all biological entities, require matter for their construction and energy for their activities.

The community is an assemblage of species populations that occur together in space and time.

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Community

Community assembly

The species that assemble to make up a community are determined by:

- Dispersal constraints
- Environmental constraints
- Internal dynamics

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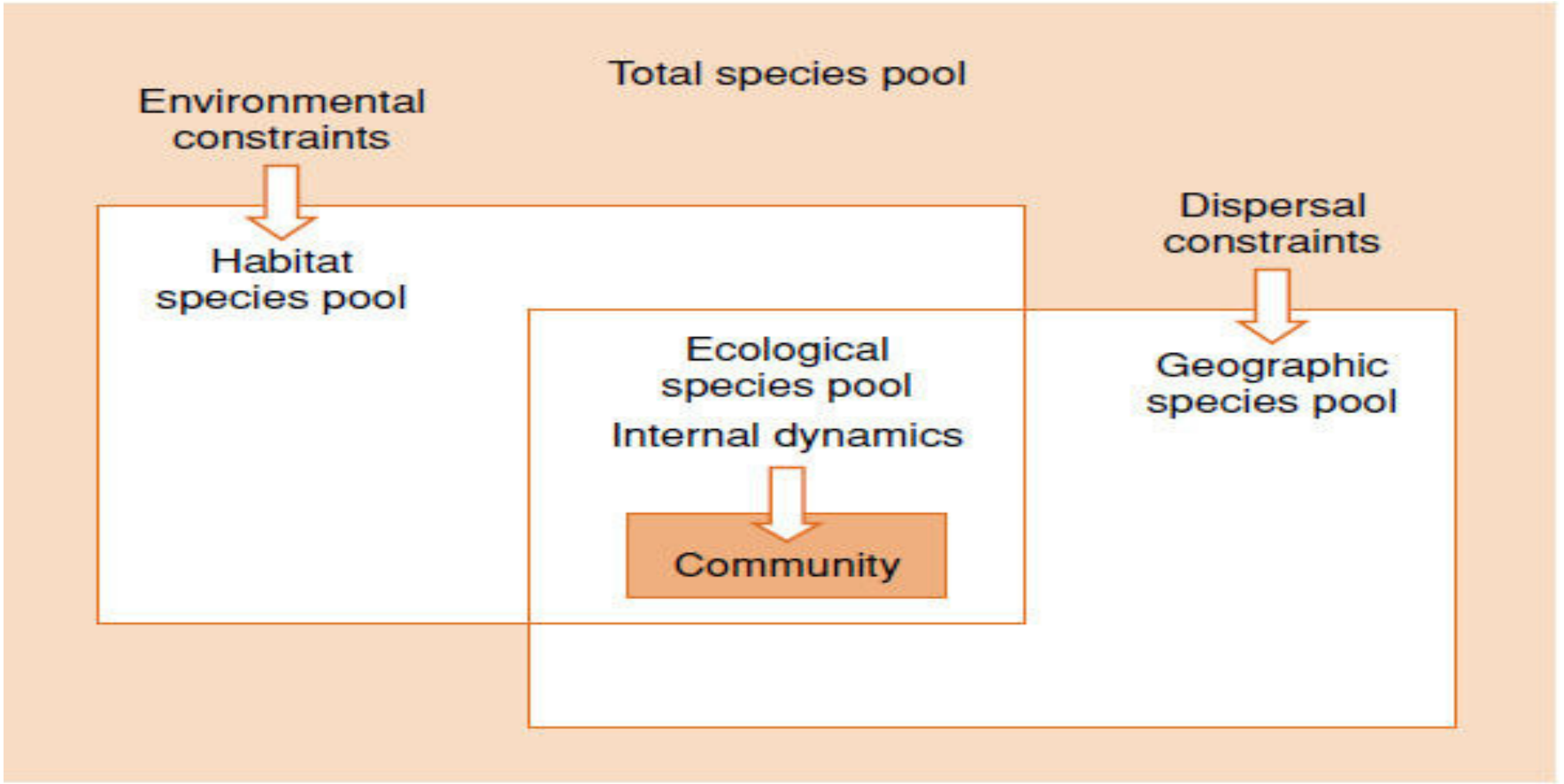
Community



The relationships among five types of species pools: the total pool of species in a region, the geographic pool (species able to arrive at a site), the habitat pool (species able to persist under the abiotic conditions of the site), the ecological pool (the overlapping set of species that can both arrive and persist) and the community (the pool that remains in the face of biotic interactions).

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Ecosystem

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Ecosystem

The word ecosystem was coined by **Tansley in 1935.**

An ecosystem is a community of different species interacting with one another and with their nonliving environment of soil, water, other forms of matter, and energy, mostly from the sun.

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Ecosystem

Ecosystems can be natural or artificial (human created). Examples of artificial ecosystems are crop fields, tree farms, and reservoirs.

Ecosystems do not have clear boundaries and are not isolated from one another. Matter and energy move from one ecosystem to another.

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Ecosystem

For example, soil can wash from a grassland or crop field into a nearby river or lake. Water flows from forests into nearby rivers and crop fields.

Birds and various other species migrate from one ecosystem to another. Winds can blow pollen from a forest into a grassland.

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Ecosystem

Ecosystem is a basic structural and functional unit of ecology.

Structure of an ecosystem depends on **species diversity** as well as the energy that is required to maintain it.

If there is more species diversity then structure of ecosystem will be more complex and less energy will be needed to maintain the structure of ecosystem.

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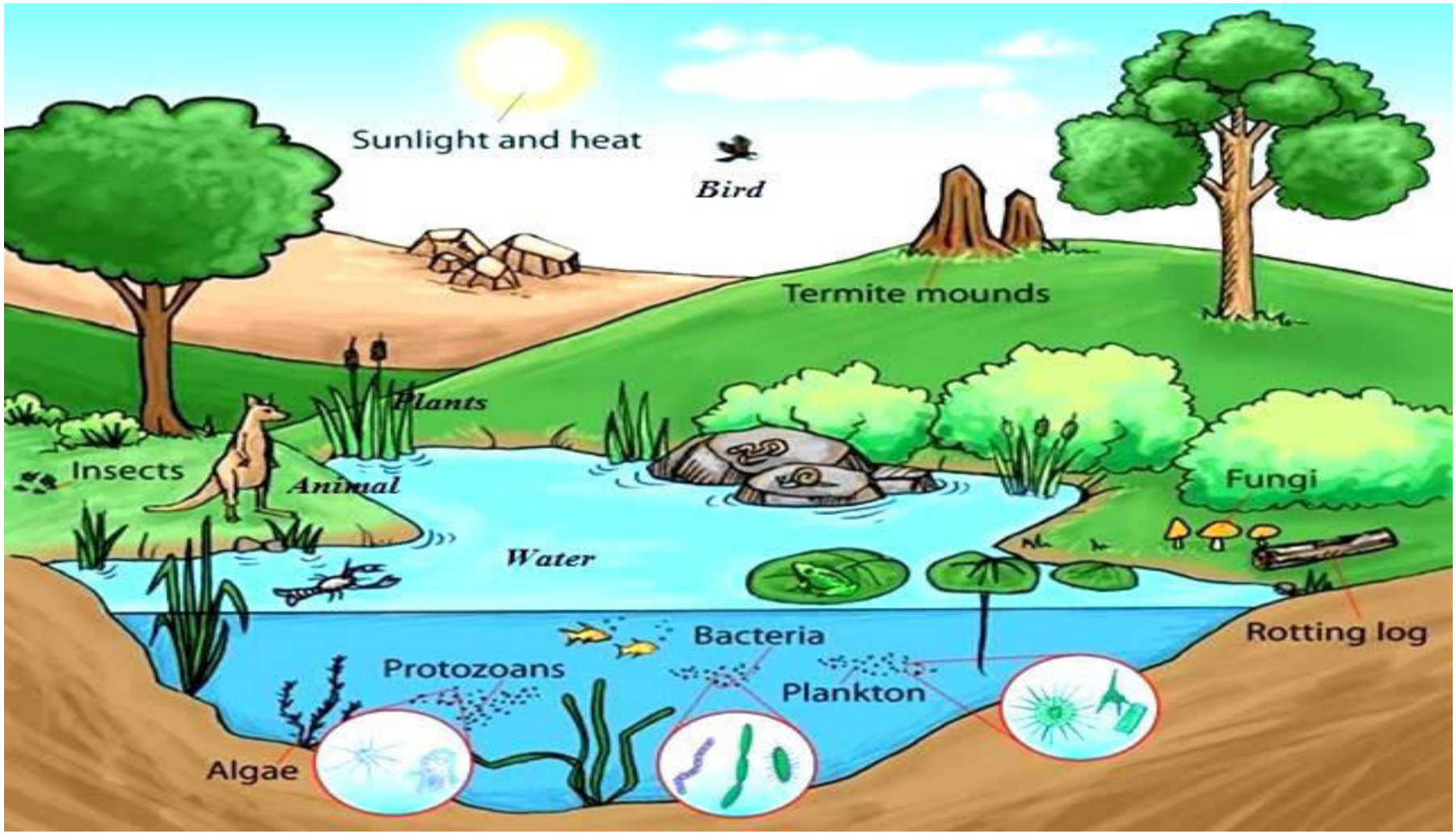
Ecosystem



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Ecosystem

An ecosystem consists of two major components

1. Biotic components
2. Abiotic components

The interactions between both these components constitutes an ecosystem.

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Ecosystem

Biotic components

Living components of an ecosystem

1. Producers : Green plants
2. Consumers: Animals
3. Decomposers: Bacteria and fungi

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Ecosystem

Abiotic components

Non living components of an ecosystem

Physical components:

1. Water
2. light
3. Temperature
4. Wind
5. Air
6. soil

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Ecosystem

Chemical components

1. Oxygen
2. Carbon
3. Nitrogen
4. Phosphorus
5. Sulphur.

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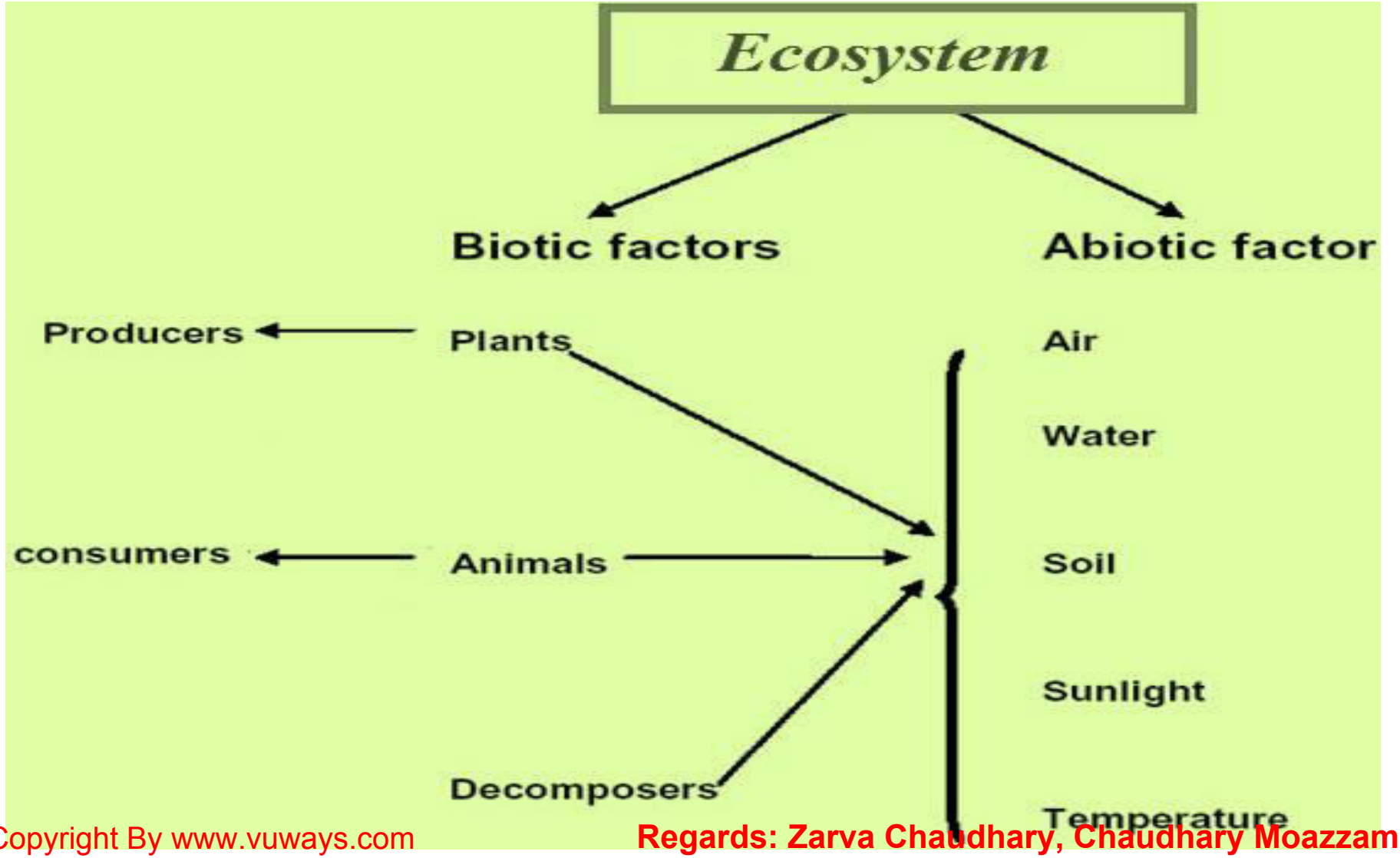
Ecosystem



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The ecological niche

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The ecological niche

The **ecological niche** is an important concept of community structure.

An important principle of ecology is that each species has a distinct role to play in the ecosystems where it is found.

So ecological niche is defined as the role that a species plays in its environment including behaviour and influence.

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The ecological niche

It is a species' way of life in a community and includes everything that affects its survival and reproduction, such as how much water and sunlight it needs, how much space it requires, and the temperatures it can tolerate.

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The ecological niche

A species' niche should not be confused with its habitat, which is the place where it lives. Niche is simply a pattern of living of species.

The ecological niche basically highlights the functional position of a species in its environment.

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The ecological niche

A typical niche describes;

1. The habitat which is the actual place of living of an organisms.
2. The activity pattern of an organism that is a time period in which an organism remains active.
3. The resources that an organism gains from the surrounding environment.

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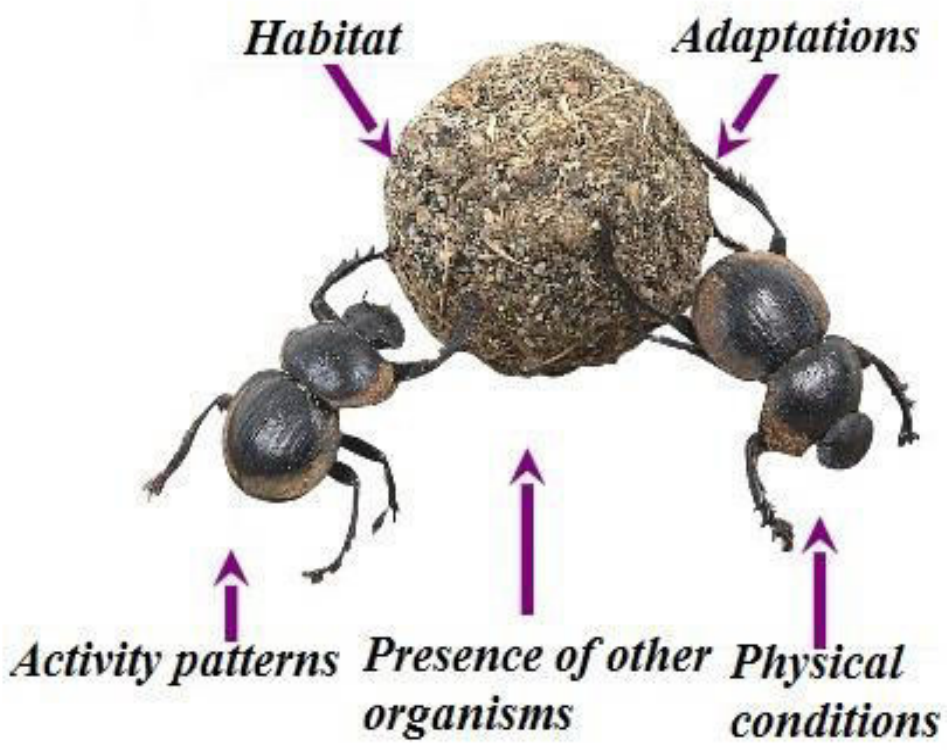
The ecological niche

Ecological niche



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The ecological niche

Bacteria from the genus Pseudomonas can grow in a broad variety of niches, which range from natural environments to human-associated ecosystems.

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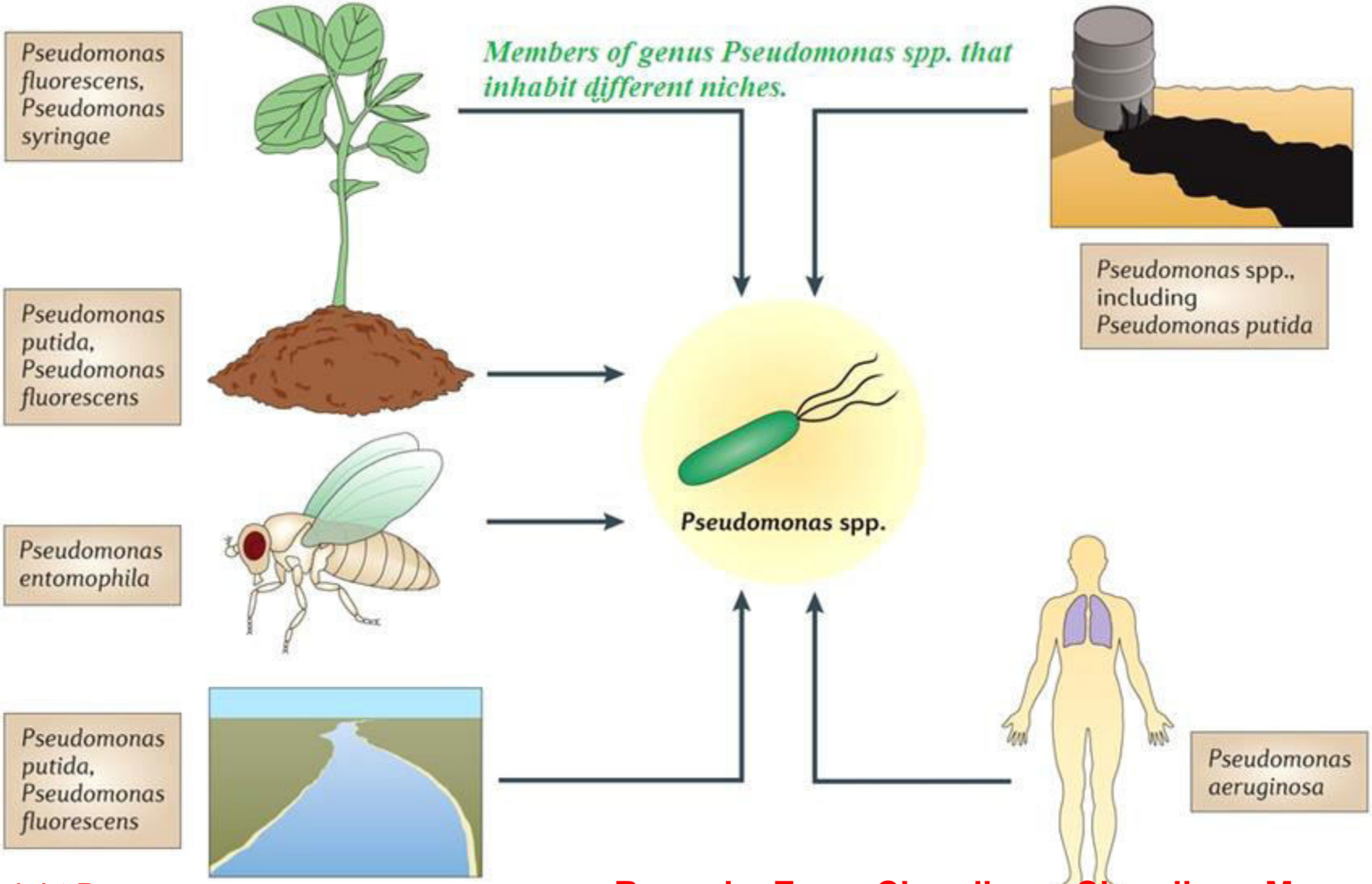
The ecological niche



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The ecological niche

Ecological niche of a black bear

Lives in forests

Feeds on nuts, blood sucking insects and parasites.

Carry seeds of berries in their digestive tract for long distances and then expel these seeds so that they can grow in a new place.

Hibernate during winter season.

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Generalist species

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Generalist species

Those species that have broad range of niches are known as generalist species.

They can live in many different places, eat a variety of foods, and often tolerate a wide range of environmental conditions.

Flies, cockroaches, mice, rats, white-tailed deer, raccoons, and humans are Generalist species.

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Generalist species

Cockroaches: Nature's Ultimate Survivors

Cockroaches are present on earth since **350 million years**.

One of brilliant example of evolution's great success because they are generalists.

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Generalist species

There are **3500 cockroach species**. They can eat almost anything, including algae, dead insects, fingernail, glue, Paper soap. They can also live and breed almost anywhere except in polar regions.

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Generalist species

- Some cockroach species can go for a month Without food, survive for a month on a drop of water from a dishrag, and withstand massive doses of radiation.
- One species can survive being frozen for **48 hours.**

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Generalist species

- They have high reproductive rates.
- In only a year, a single Asian cockroach and its offspring can add about 10 million new cockroaches to the world.
- Their high reproductive rate also helps them to quickly develop genetic resistance to almost any poison we throw at them.

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Generalist species

- About **25 species** of cockroach live in homes and can carry viruses and bacteria that cause diseases.
- On the other hand, cockroaches play a role in nature's food webs. They make a tasty meal for birds and lizards.

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Generalist species

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Specialist species

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Specialist species

Those species that occupy narrow range of niches are known as specialist species.

- They may be able to live in only one type of habitat, use one or a few types of food, or tolerate a narrow range of climatic and other environmental conditions.
- This makes specialists more prone to extinction when environmental conditions change.

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Specialist species

For example, tiger salamanders breed only in fishless ponds where their larvae will not be eaten. Some shorebirds occupy specialized niches, feeding on crustaceans, insects, and other organisms on sandy beaches and their adjoining coastal wetlands.

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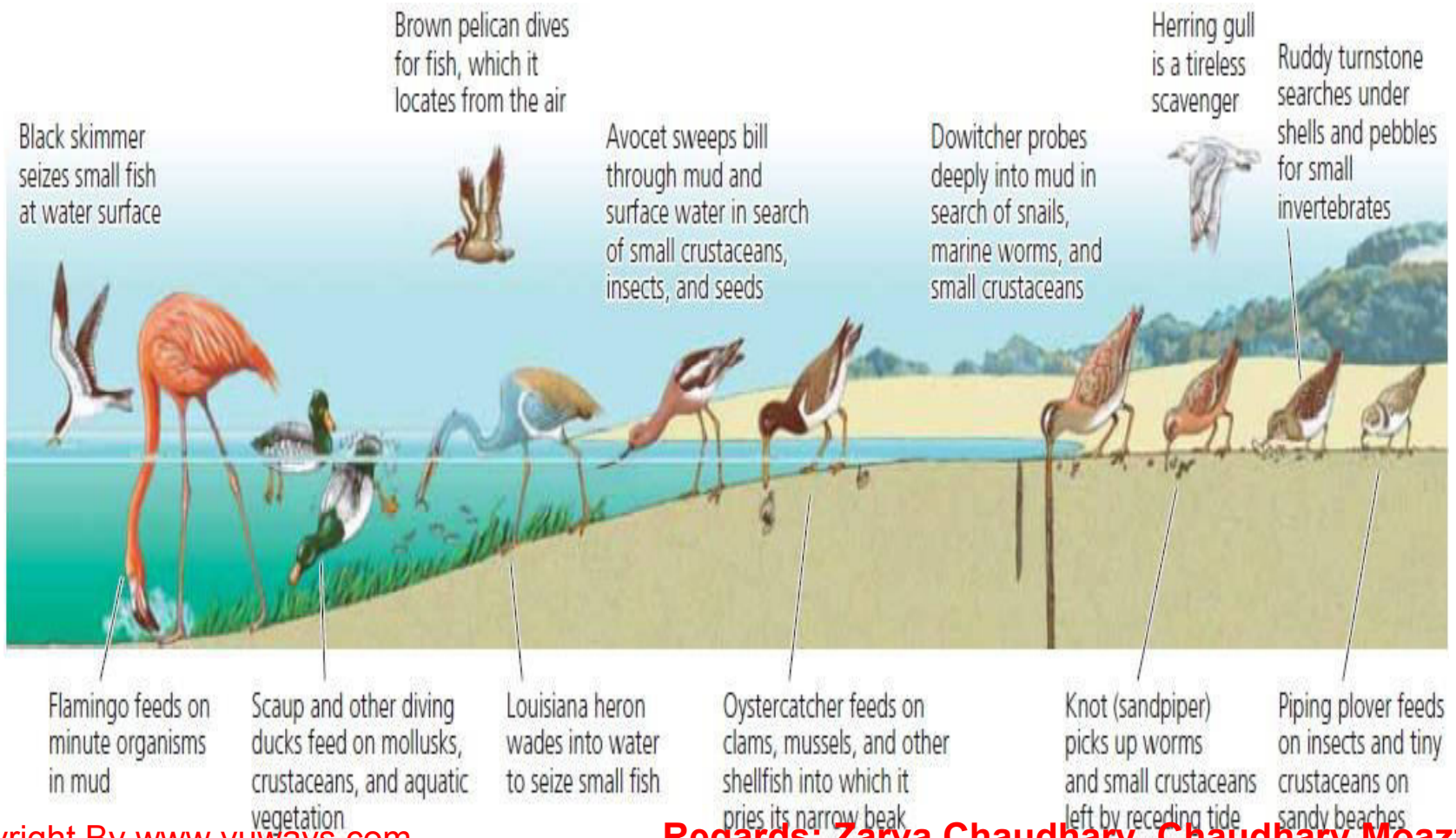
Specialist species

Specialized feeding niches of various bird species in a coastal wetland. This specialization Reduces competition and allows sharing of limited resources.



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Specialist species

Is it better to be a generalist or a specialist?

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Specialist species

It depends on environmental conditions. When environmental conditions are fairly constant, as in a tropical rain forest, specialists have an advantage because they have fewer competitors. But under rapidly changing environmental conditions, the generalist usually is better off than the specialist.

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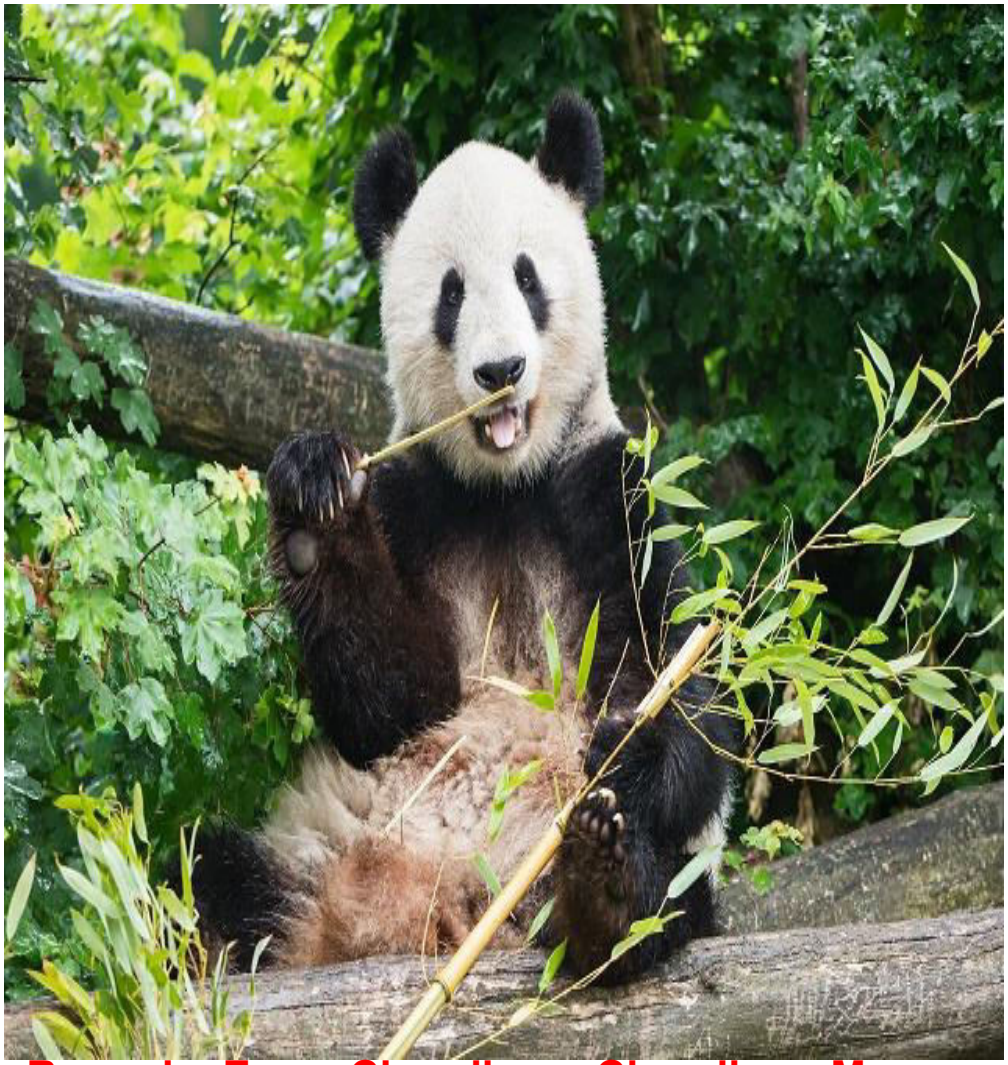
Specialist species

China's giant panda is highly endangered because of a combination of habitat loss, low birth rate, and its specialized diet consisting mostly of bamboo.



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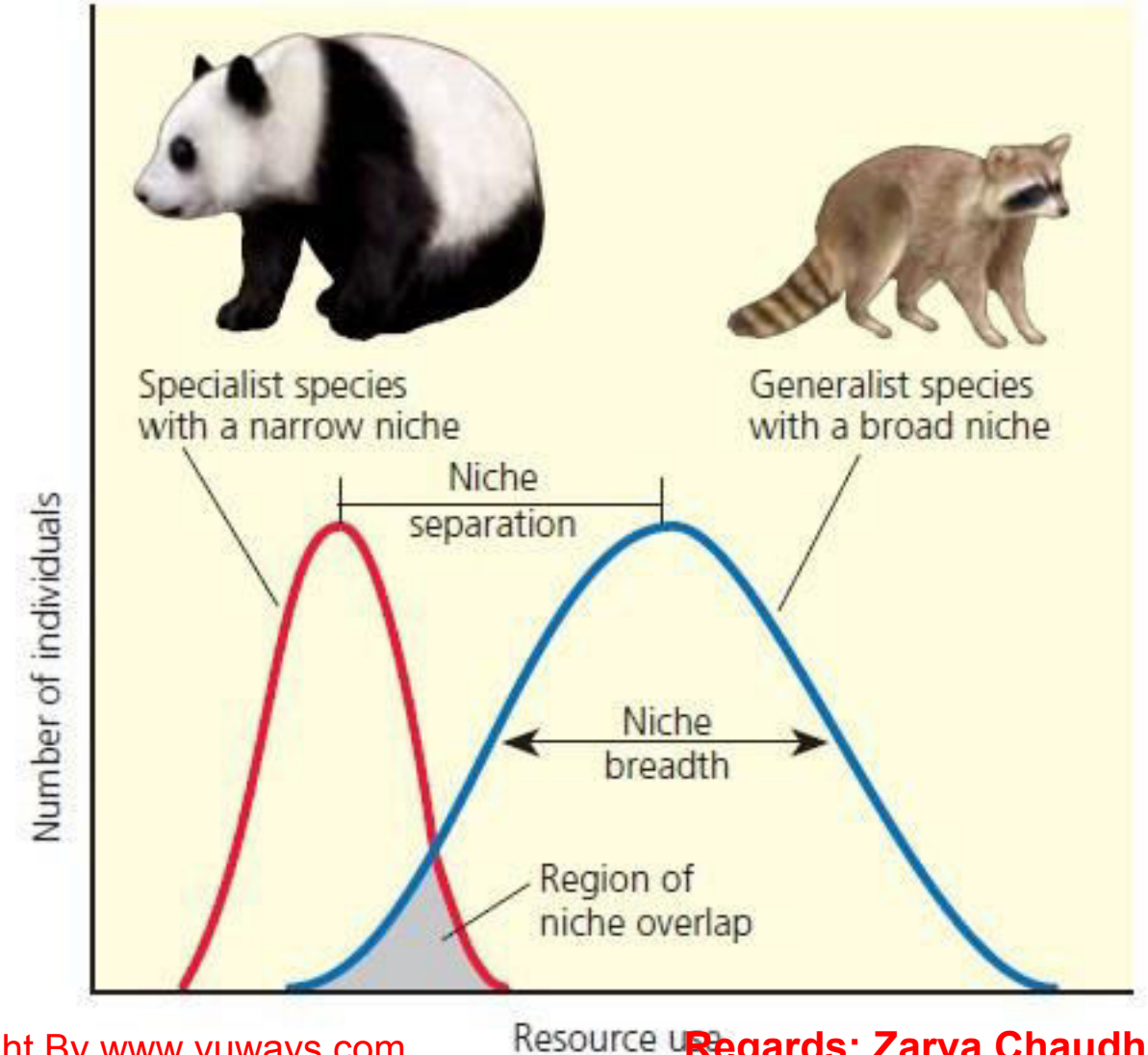
Generalist vs specialist



Specialist species such as the giant panda have a narrow niche (left) and generalist species such as a raccoon have a broad niche (right).

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Native species

Native species are those species that normally live and thrive in a particular ecosystem because of its soil, isolation and climatic conditions.

Native species occurs naturally within a region. They either evolve in that region or arrive and become established in that region without human assistance.

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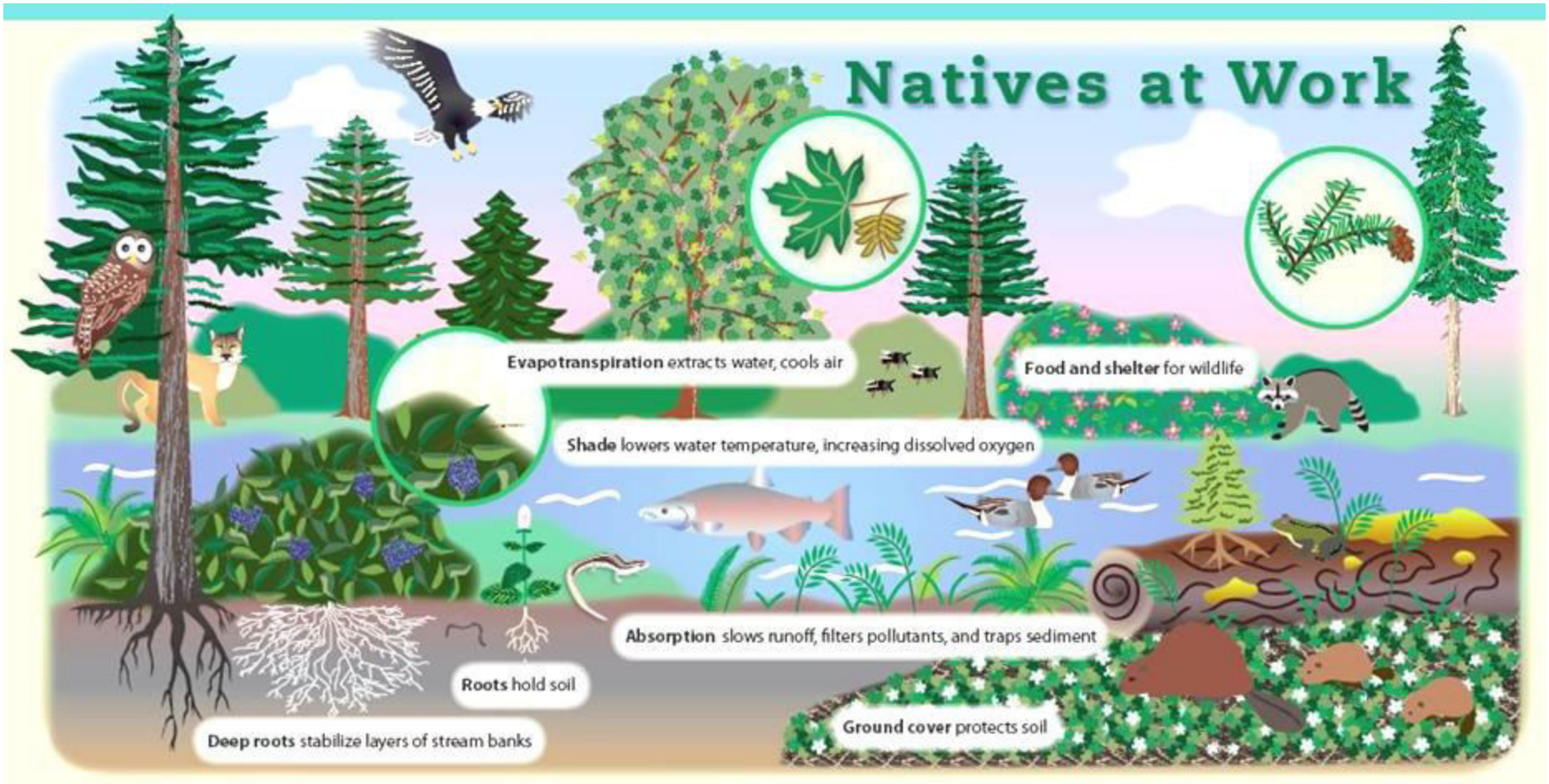
Native species



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Native species

Native species can be either endemic or indigenous.

1. Endemic species

These species are found within a specific part of world only.

2. Indigenous species

These are found within the region and elsewhere in the world also.

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Native species

Endemic species

Blind Indus dolphin is only found in Indus river of Pakistan.

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Native species

Red kangaroo is endemic to Australia only in the World.

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Native species

Indigenous species

Snow leopard is found in Pakistan, Nepal, India, Russia and in some other countries of central Asia.

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Non-native species

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Non-native species

Species that are non native to their environment and are deliberately or accidentally introduced into an ecosystem are called **non-native species.**

These are also named as invasive, alien, or exotic species.

An introduced species is occasionally successful in the new environment. Introduction of non native species is a major cause of species loss.

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Non-native species

Species are introduced in the new Environment by two ways intentional or Unintentional.

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Non-native species

Non native species that have a potential to cause economic or environmental harm to humans are termed as invasive species.

In fact, most introduced and domesticated species of crops and animals, such as chickens, cattle, and fish from around the world, are beneficial to us.

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Non-native species

Grass carp was introduced in Pakistan from china. It controls the growth of pond weeds as well as a great protein source.

Grass carp feeding on pond weeds

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Non-native species

However, some non-native species can threaten a community's native species and cause unintended and unexpected consequences.

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Non-native species

In 1957, for example, Brazil imported wild African bees to help increase honey production.

Instead, the bees displaced domestic honeybees and reduced the honey supply.

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Non-native species

Impact of non native species:

- Non-native species can spread rapidly if they find a new more favourable niche.
- In their new niches, these species often do not face the predators and diseases they faced before.

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Non-native species

- They may be able to out-compete some native species in their new niches.
- Causes habitat loss and ecosystem disturbance.

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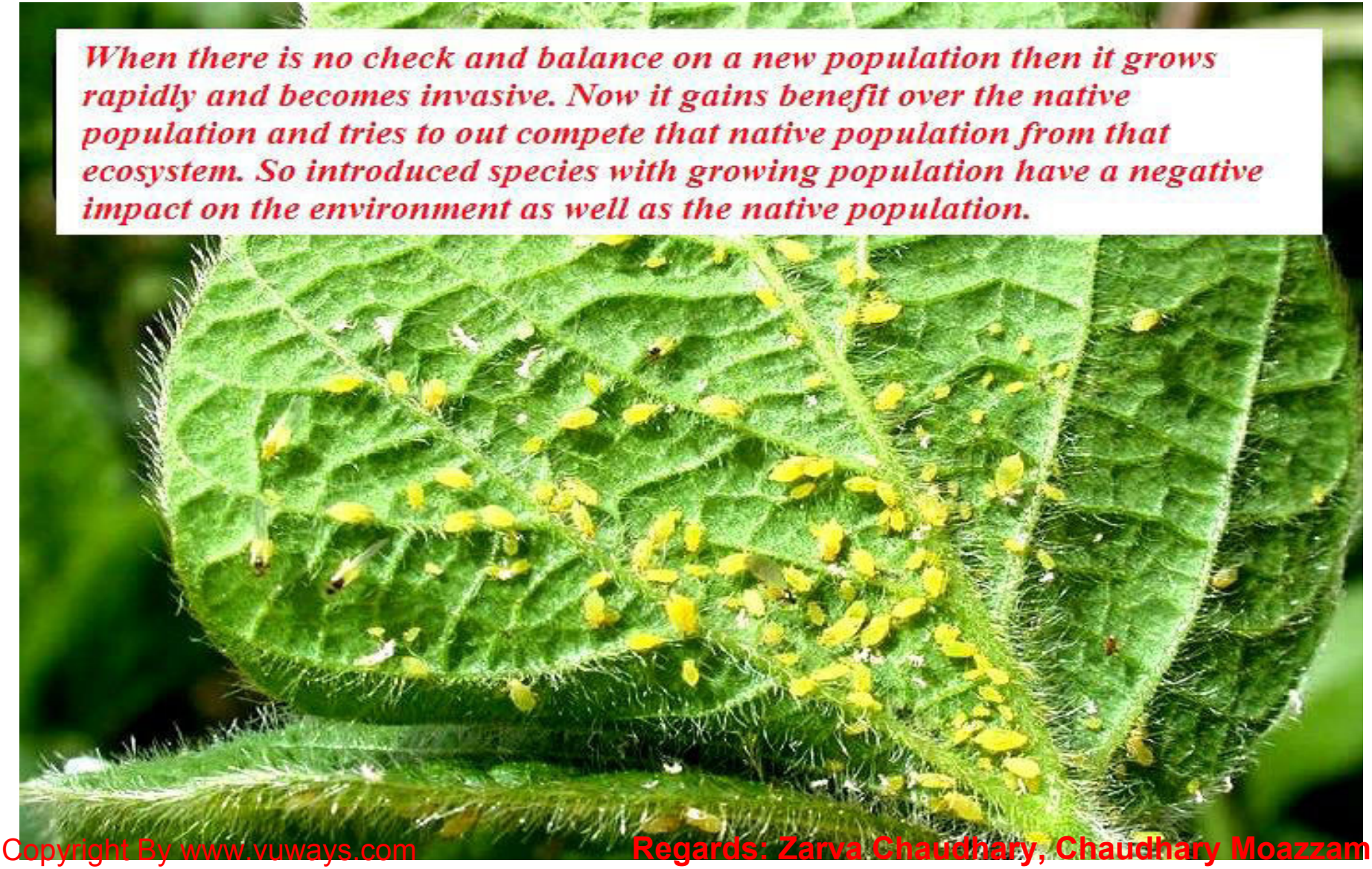
Non-native species



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Indicator species

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Indicator species

Species that provide early warnings of damage to a community or an ecosystem are called **indicator species.**

For example, the presence or absence of trout species in water at temperatures within their range of tolerance is an indicator of water quality because trout need clean water with high levels of dissolved oxygen.

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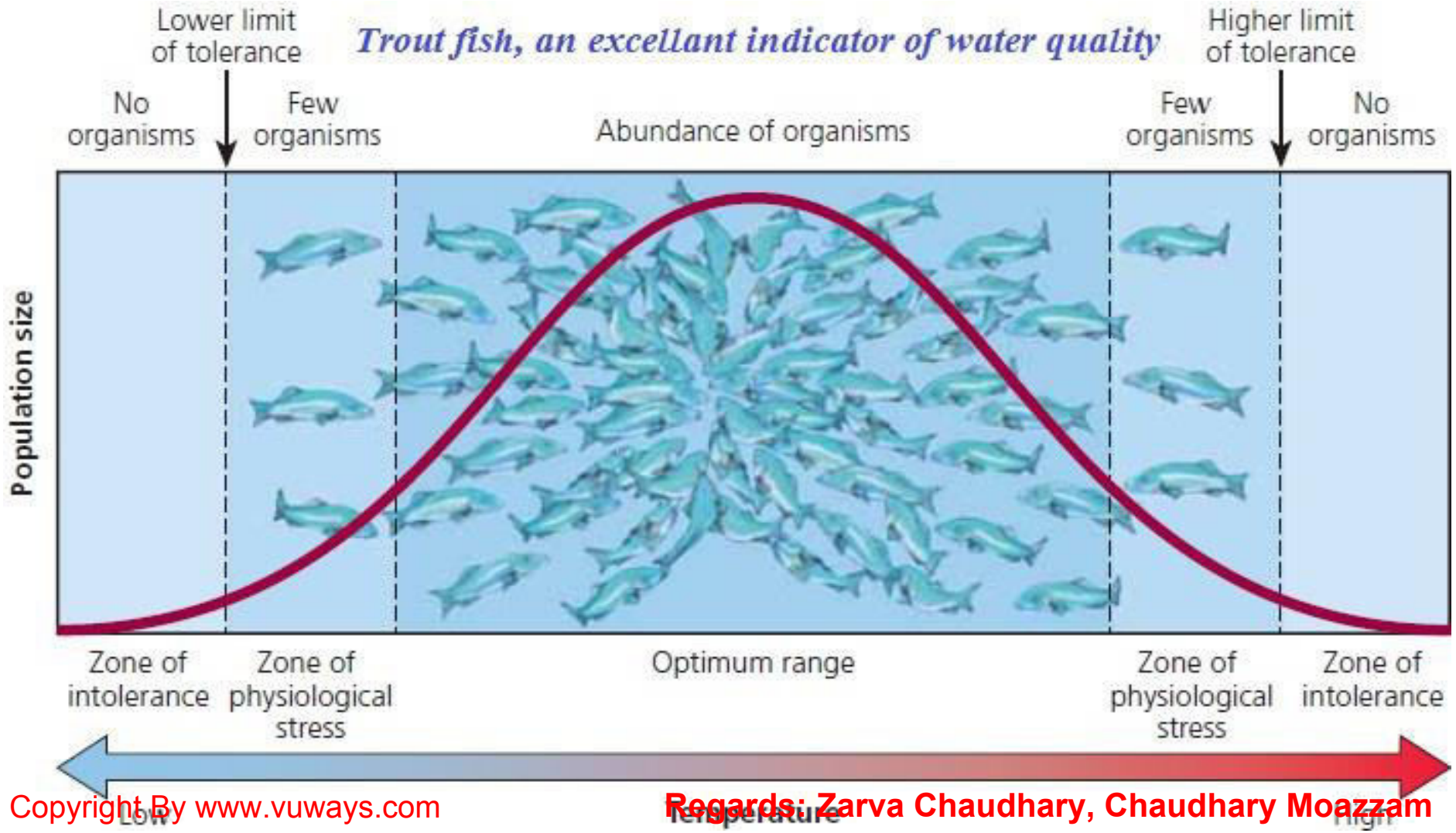
Indicator species



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Indicator species

Birds are excellent biological indicators because they are found almost everywhere and are affected quickly by environmental changes such as loss or fragmentation of their habitats and introduction of chemical pesticides. The populations of many bird species are declining.

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Indicator species

Butterflies are also good indicator species because their association with various plant species makes them vulnerable to habitat loss and fragmentation.

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Indicator species

During early 1900s, coal miners took caged canaries (songbirds) into mines to detect early-warning signals. These birds sing loudly and often. If they quit singing for a long period and appeared to be distressed, miners took this as an indicator of the presence of poisonous or explosive gases and got out of the mine.

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Indicator species

Some amphibians are also classified as indicator Species.

Amphibians (frogs, toads, and salamanders) live part of their lives in water and part on land. Populations of various frog species can decline because of the effects of harmful factors at different points in their life cycle.

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Indicator species

Such factors include habitat loss, drought, pollution, increased ultraviolet radiation, parasitism, disease, overhunting by humans, and non native predators and competitors.

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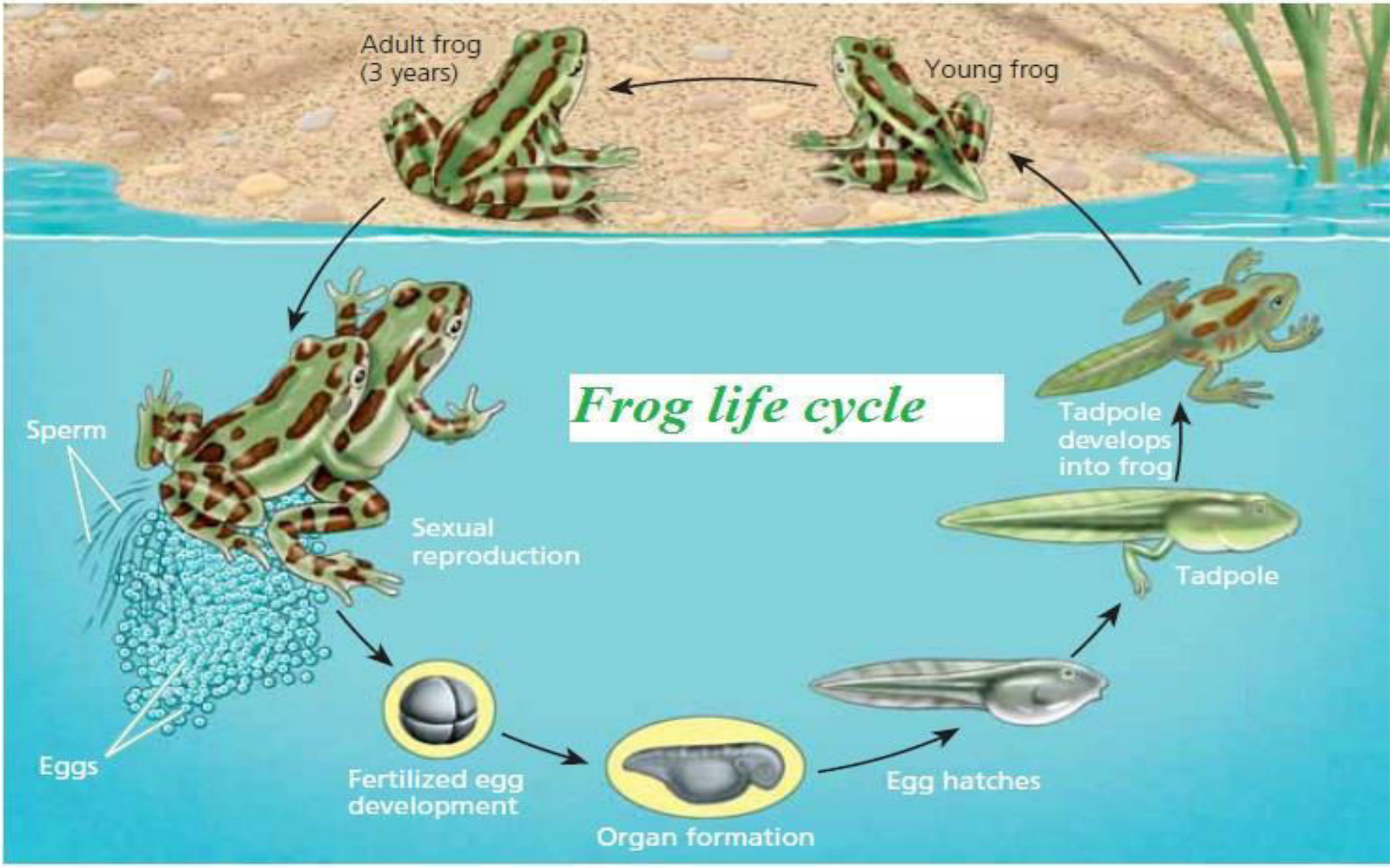
Indicator species



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Keystone species

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Keystone species

Some species play a key and crucial role in maintaining the structure of a biological community. They are called Keystone species because they have a large effect on the types and abundances of other species in an ecosystem.

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Keystone species

The effects that keystone species have in their ecosystems is often much larger than their numbers and because of their relatively limited numbers, some keystone species are more vulnerable to extinction than others.

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Keystone species

Keystone species can play several critical roles in helping to sustain an ecosystem. One such role is pollination of flowering plant species by bees, butterflies , hummingbirds, bats, and other species.

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Keystone species

The monarch butterfly, which feeds on pollen in a flower and other insects pollinate flowering plants that serve as food for many plant eaters.

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Keystone species

In addition, top predator keystone species feed on and help regulate the populations of other species. Examples are the alligator, wolf, leopard, lion, and some shark species.

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Keystone species

Ecologist Robert Paine studied the keystone role of the top-predator sea star *Pisaster ochraceus* in an intertidal zone community.

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Keystone species

Paine removed the mussel-eating Pisaster sea stars from one rocky shoreline community but not from an adjacent community, which served as a control group. Mussels took over and crowded out most other species in the community without the Piaster sea stars.

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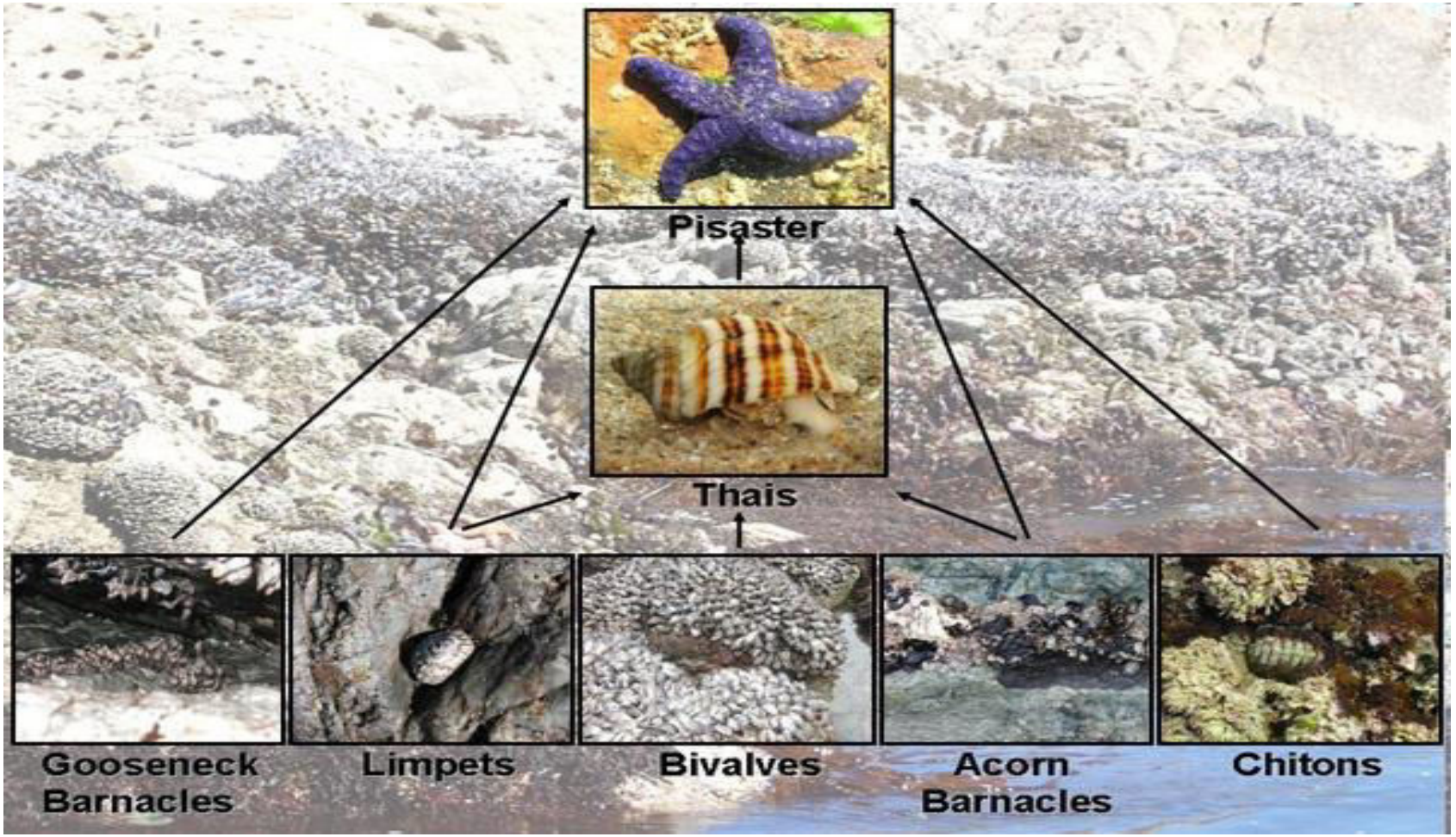
Keystone species



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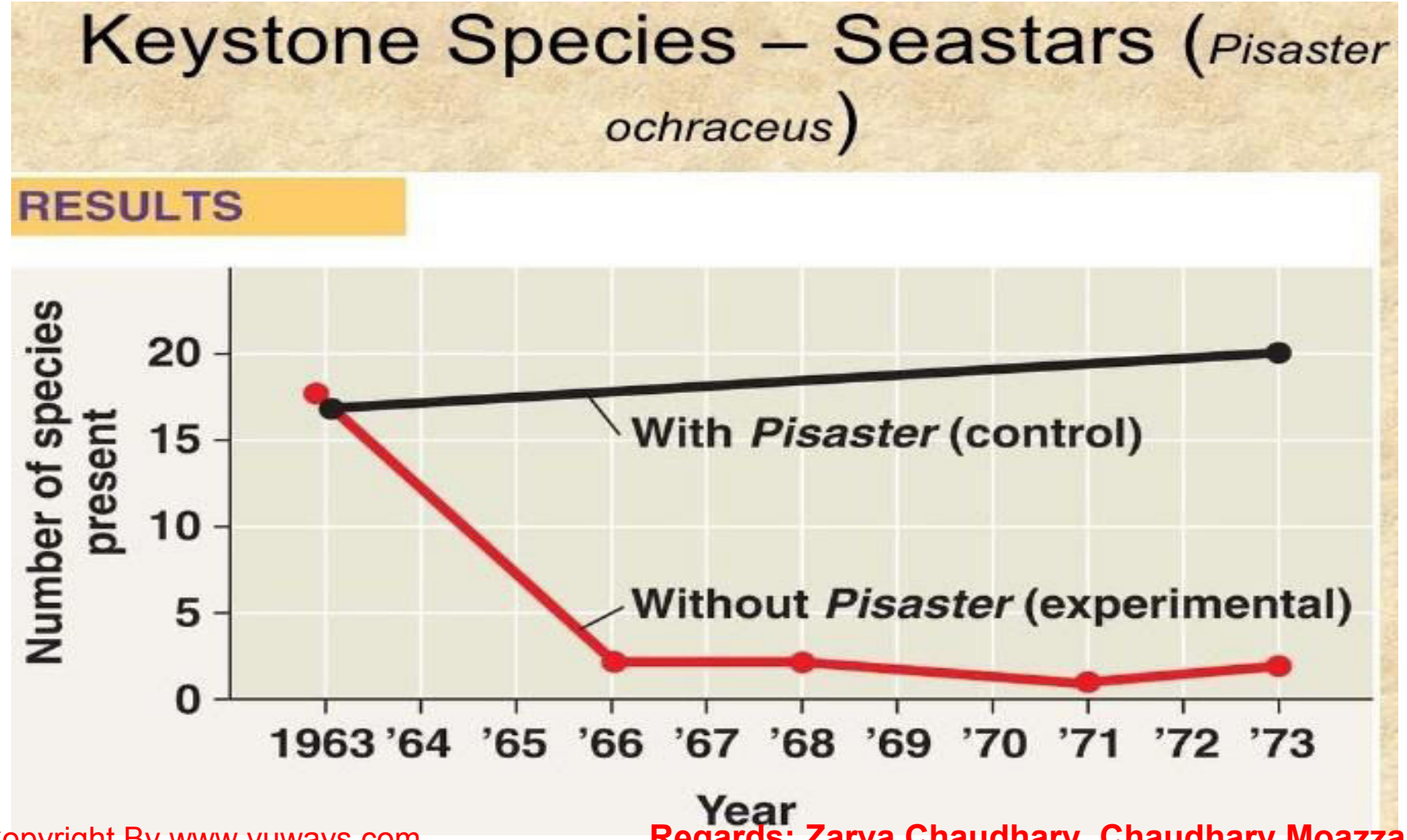
Keystone species



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Keystone species

Sharks are also a keystone species because they remove injured and sick animals from the ocean, and thus play an important ecological role.

Without the services provided by these keystone species, the oceans would be filled with dead and dying fish.

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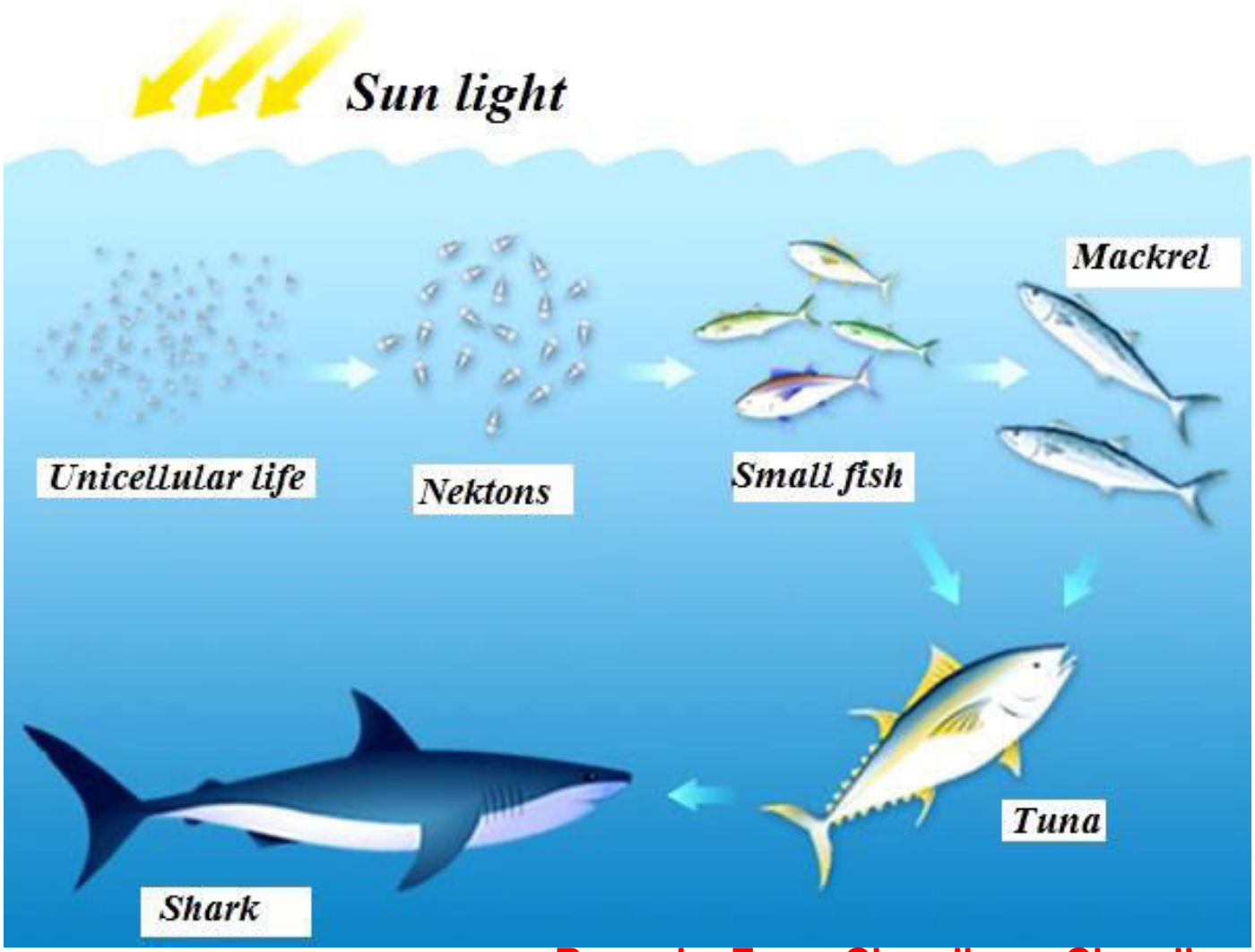
Keystone species



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Keystone species

The loss of a keystone species can lead to **population crashes** and **extinctions** of other species in a community that depends on it for certain services. This explains why it so important for scientists to identify and protect keystone species.

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Foundation species

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Foundation species

Foundation species, plays a major role in shaping communities.

They create and Enhance the habitats in ways that provides benefits to other species. They facilitate the survival and reproduction of other species in the community.

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Foundation species

For example, elephants push over, break, or uproot trees, creating forest openings in the grasslands and woodlands of Africa.

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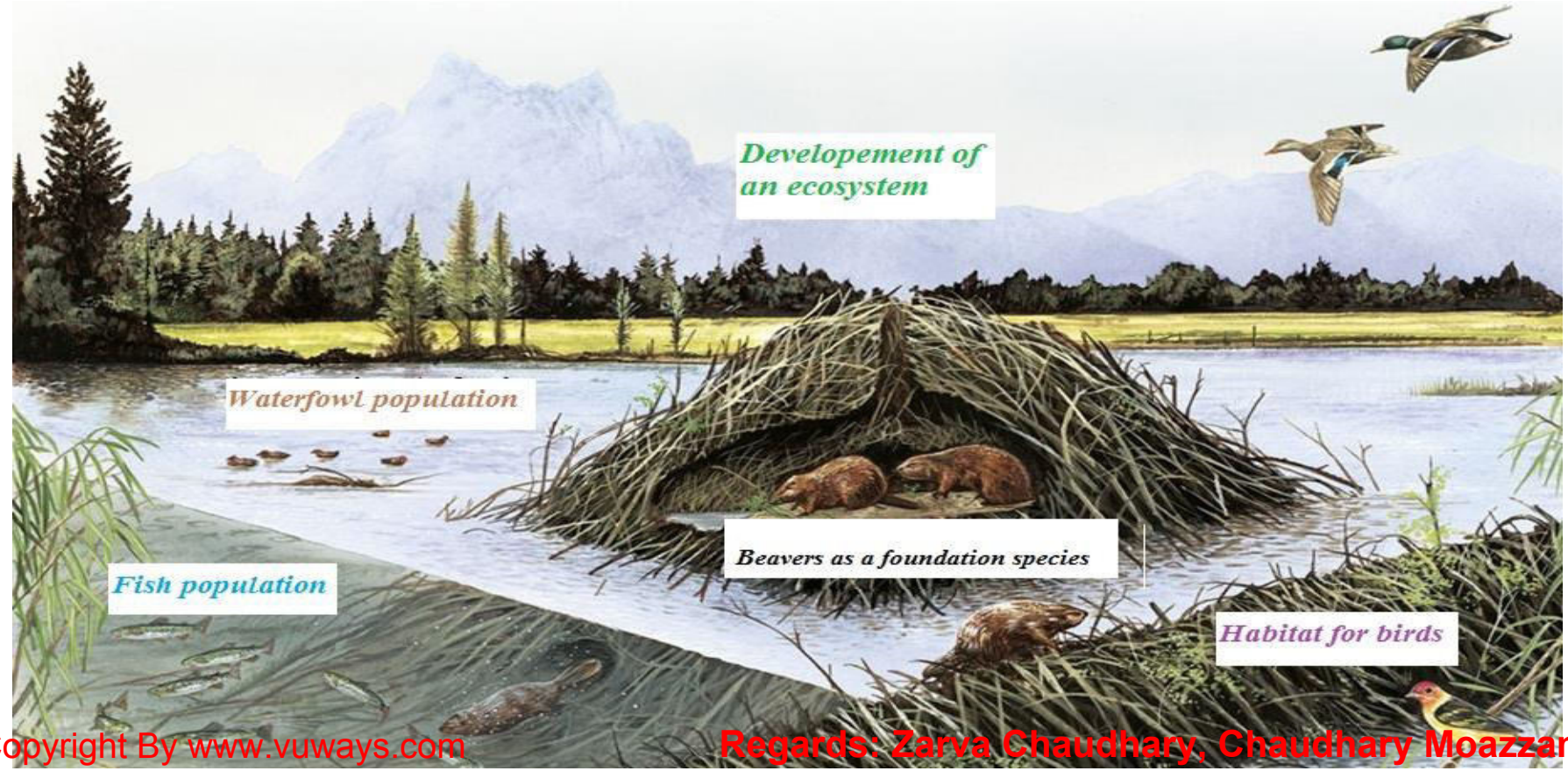
Foundation species

Beavers are another good example of a foundation species. Acting as "ecological engineers," they build dams in streams to create ponds and other wetlands used by other species.



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Foundation species

Some bat and bird foundation species help to regenerate deforested areas.

They spread fruit plants by depositing plant seeds in their droppings.

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Foundation species

Foundation vs keystone species

A foundation species creates or provide a foundation of an ecosystem while keystone species regulates and maintains that ecosystem.

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Ecological pyramids

An ecological pyramid is a graphical relationship among different trophic structures or levels in an ecosystem.

Trophic structure means the different feeding levels of organisms.

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Ecological pyramids

An ecological pyramid is further classified into three main types,

1. **Pyramid of number**
2. **Pyramid of biomass**
3. **Pyramid of energy**

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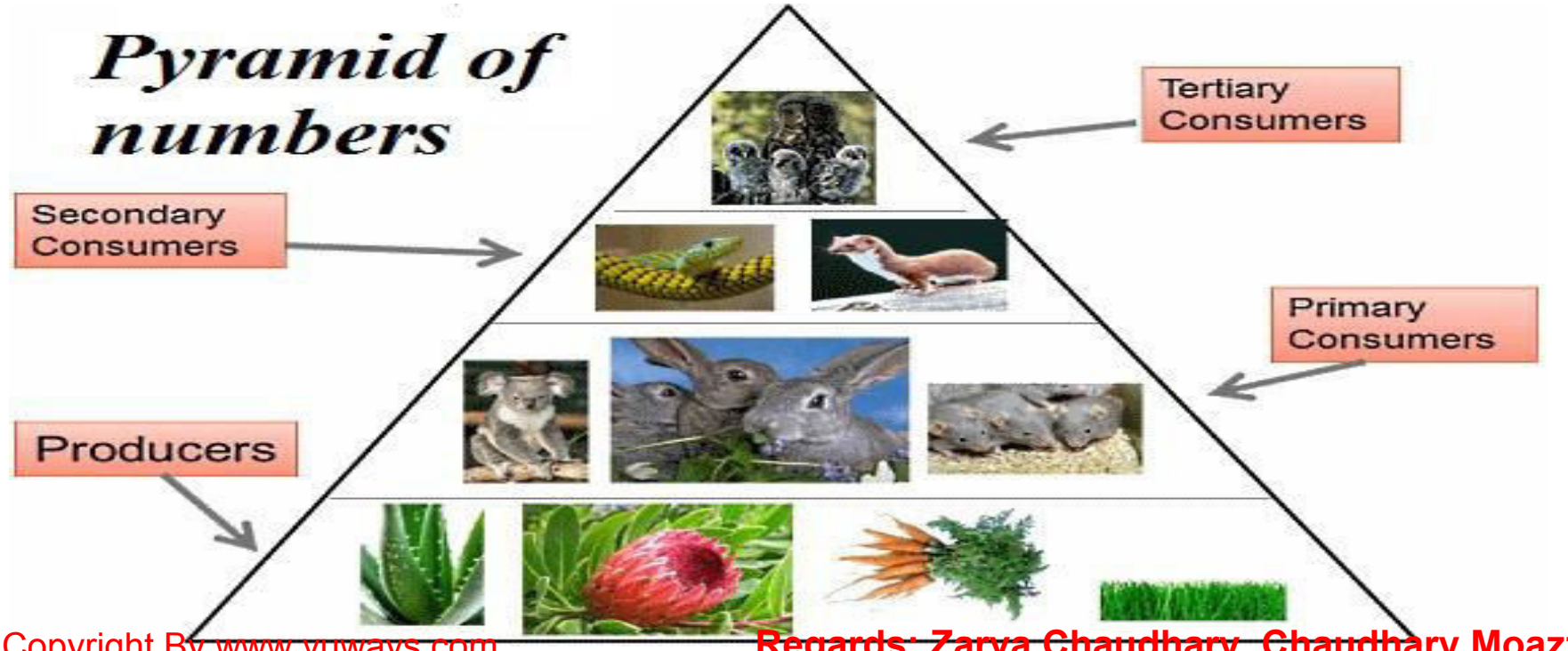
Ecological pyramids

1. Pyramid of number

It represents the number of individuals at each trophic level of an ecosystem. More number of individuals at base while a gradual decrease in number towards top of pyramid.



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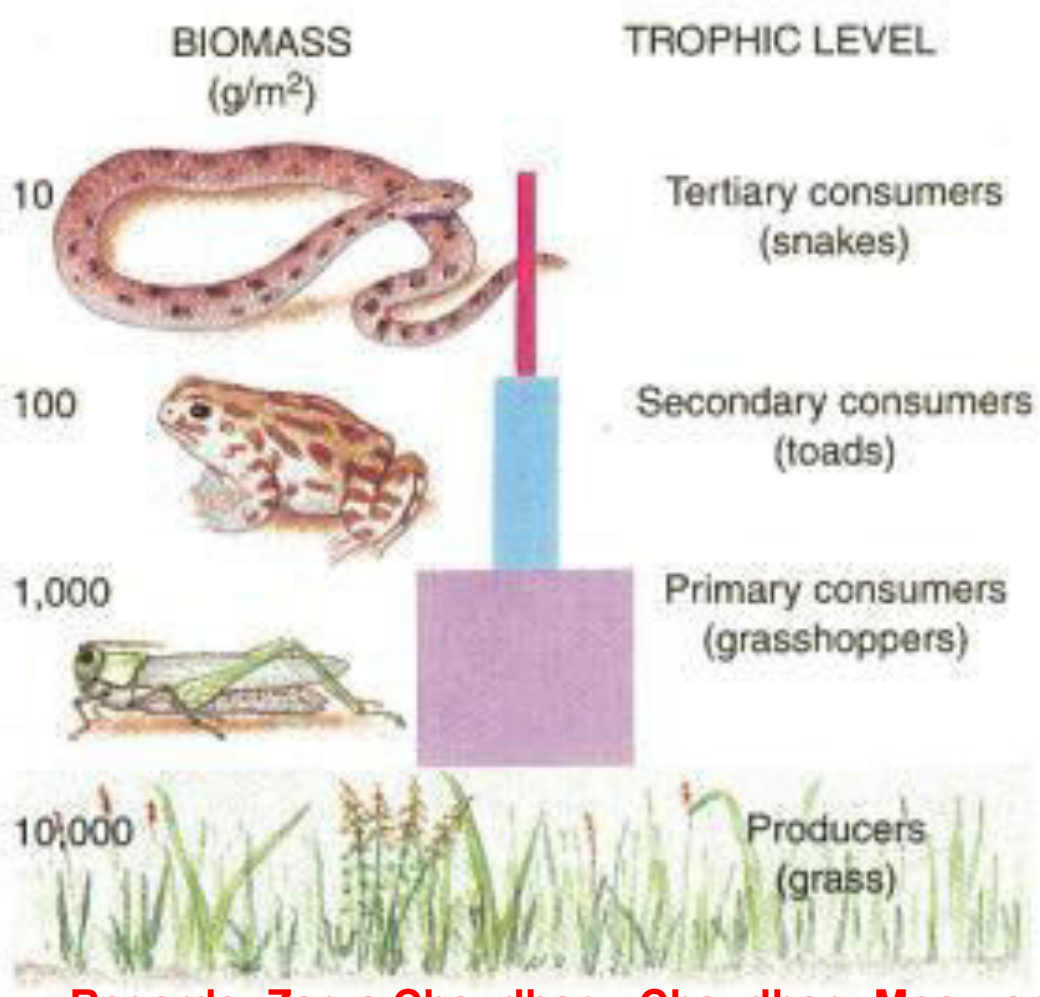
Ecological pyramids

2. Pyramid of biomass

It indicates mass of living matter at each trophic level of food chain.

High biomass at the base while lower at top of the pyramid.



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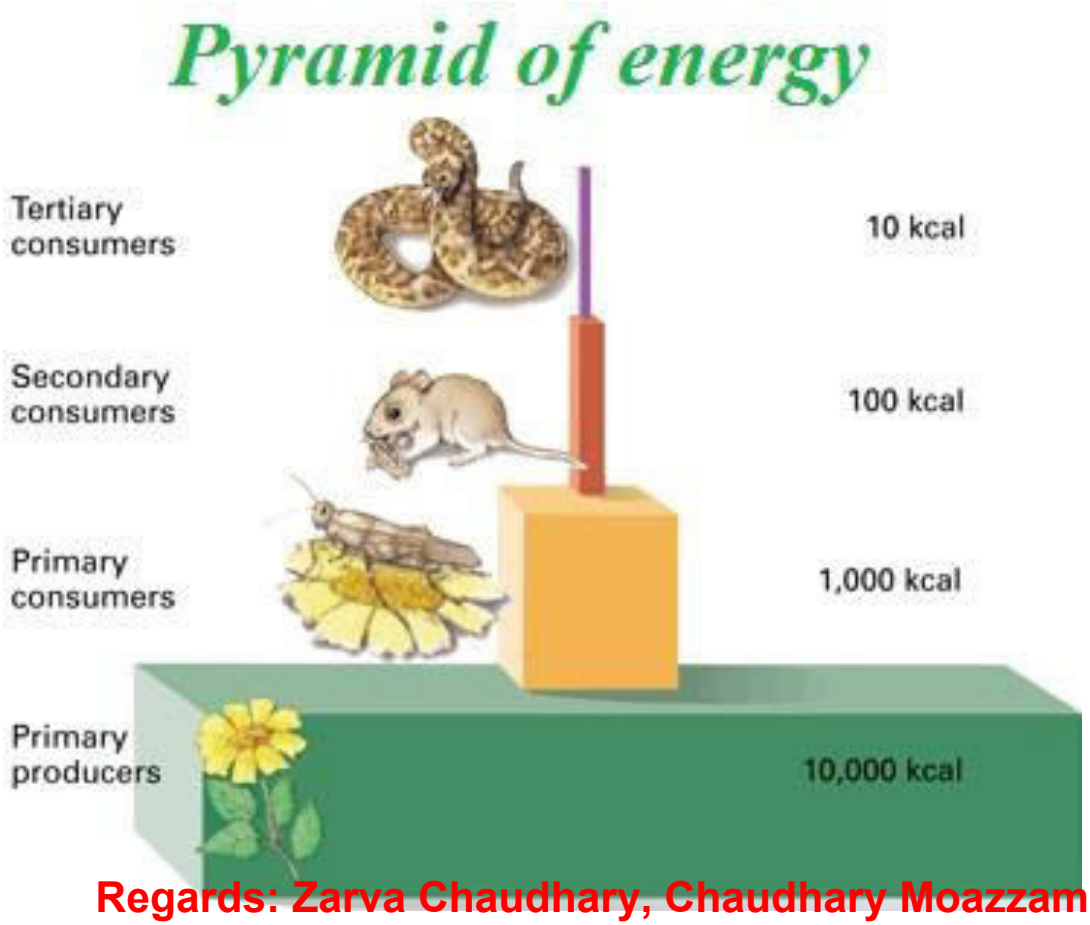
Ecological pyramids

3. Pyramid of energy

Determines the flow of energy through each trophic level in a food chain.



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Food pyramids

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Food pyramids

Energy supports the activities of all organisms in the ecosystem. It usually enters the ecosystem in the form of sunlight. It is incorporated into the chemical bonds of molecules within living and decaying tissues, and is eventually lost as heat.

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Food pyramids

A food pyramid is a graphical representation of flow of energy through different trophic levels of an ecosystem.

The highest level an organism occupies on a food chain is termed as trophic level.

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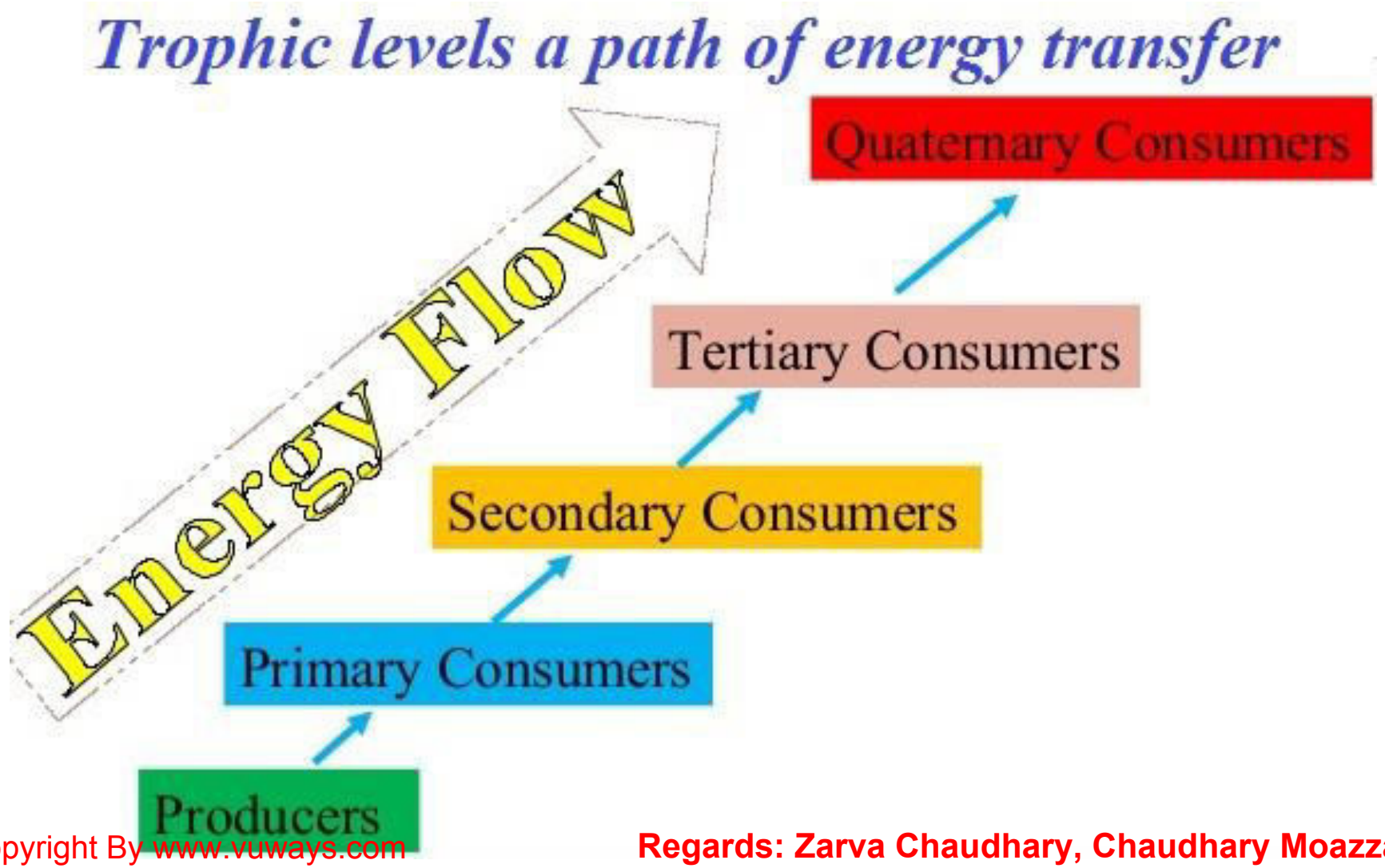
Food pyramids



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Food pyramids

A food pyramid is basically consists of producers and consumers that belongs to different life forms. Energy in the form of food is transferred from one organism to other through different trophic levels.

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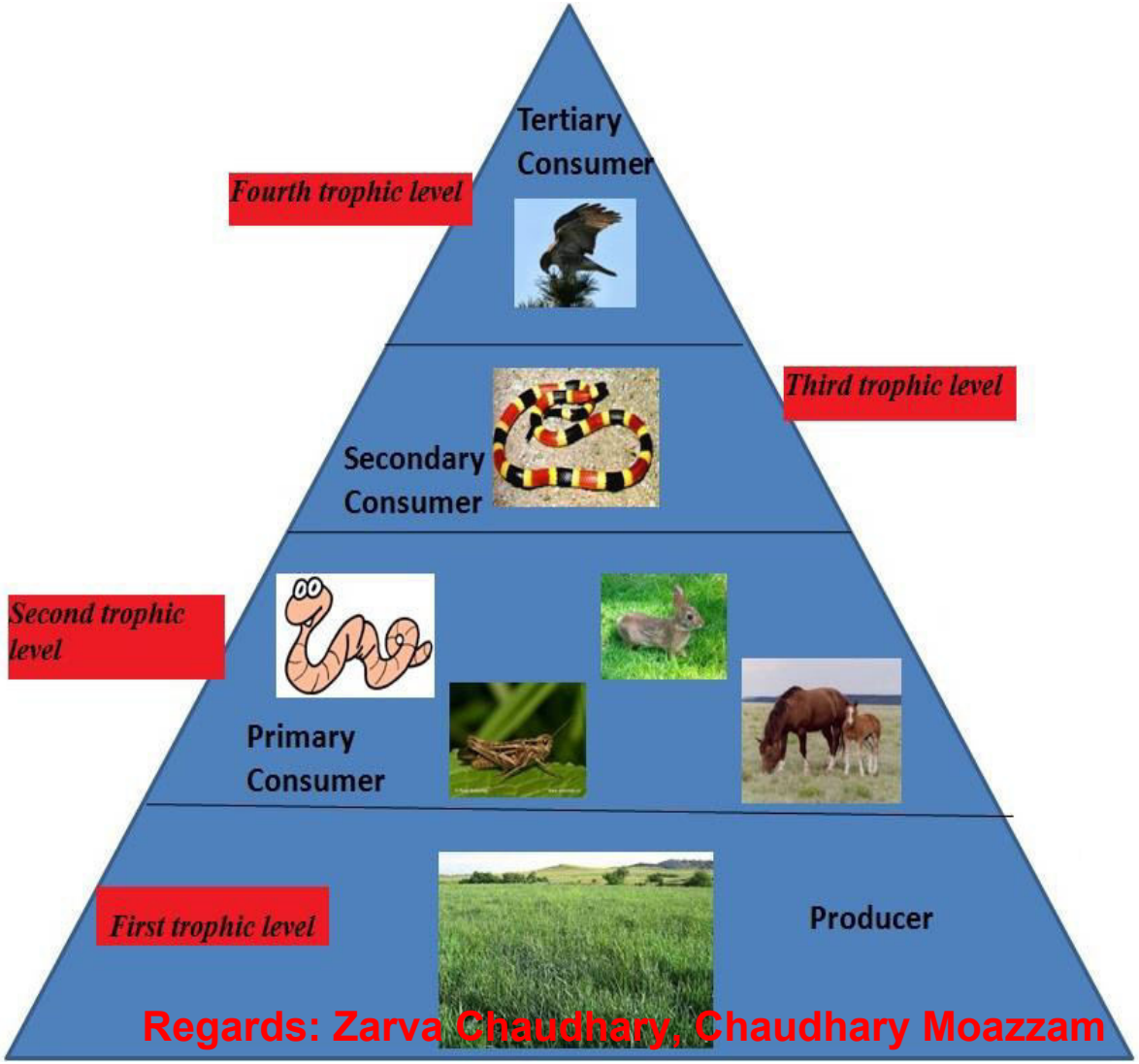
Food pyramids

A simple food pyramid showing the interconnection of different trophic levels.



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Organisms and environment

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Organisms and environment

Actual place of an organism where it lives is called its habitat or environment.

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Organisms and environment

An animal's habitat (environment) includes all living (biotic) and non-living (abiotic) characteristics of the area in which the animal lives.

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Organisms and environment

Animals always live within a certain range of values, called the **tolerance range,** for any environmental factor.

At either limit of the tolerance range, one or more essential functions cease.

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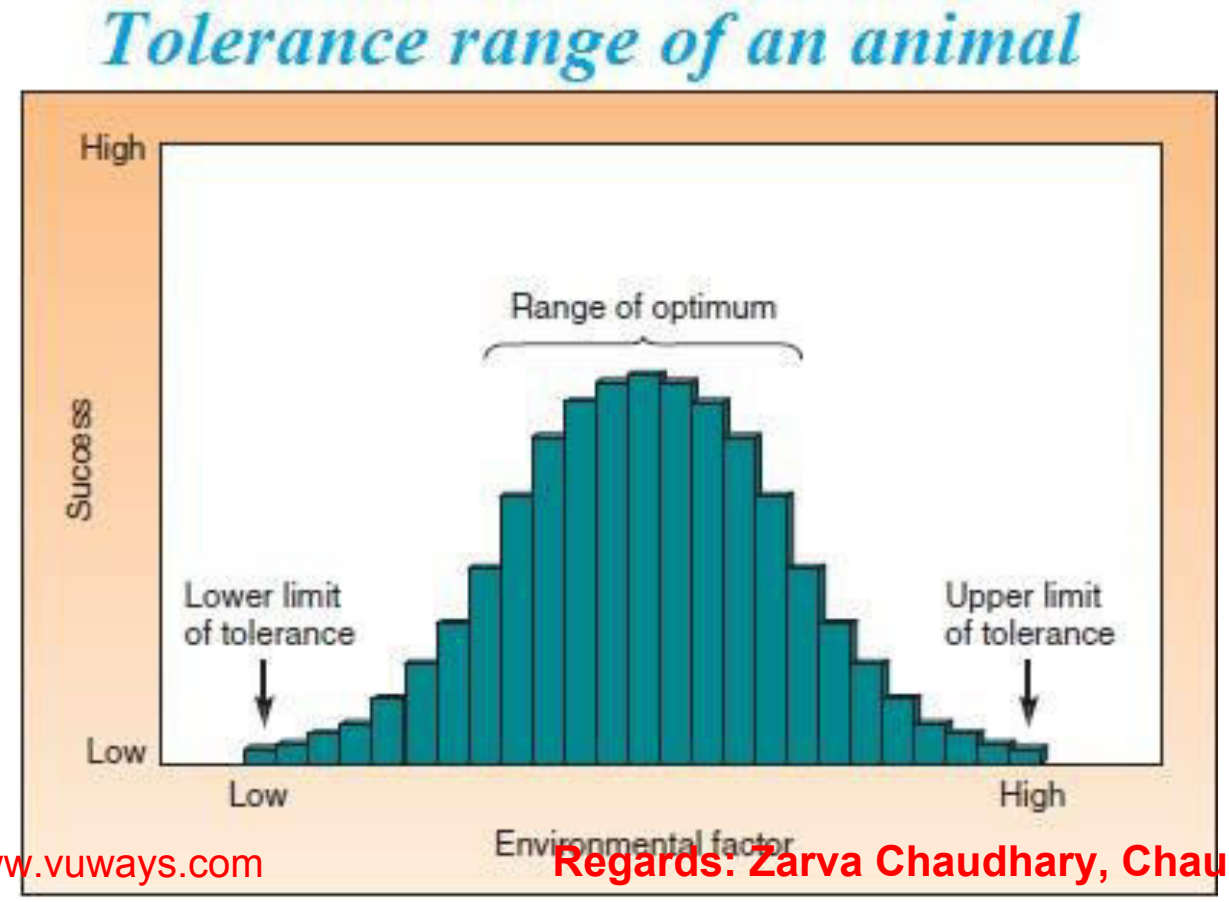
Organisms and environment

A certain range of values within the tolerance range is called the range of optimum.



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Organisms and environment

Range of optimum defines the conditions at which organisms are most successful in survival.

Organisms can performed their life activities well under these optimum conditions.

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Organisms and environment

Limiting factor

When an abiotic factor becomes out of an organism tolerance range then it is said to be a limiting factor. For example

- Oxygen
- Water
- Food

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Organisms and environment

Taxis

Response of an organism towards any abiotic factor is known as taxis. Basically organisms orient themselves to that response.

For example, a response of organism to light is called phototaxis.

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Food chain

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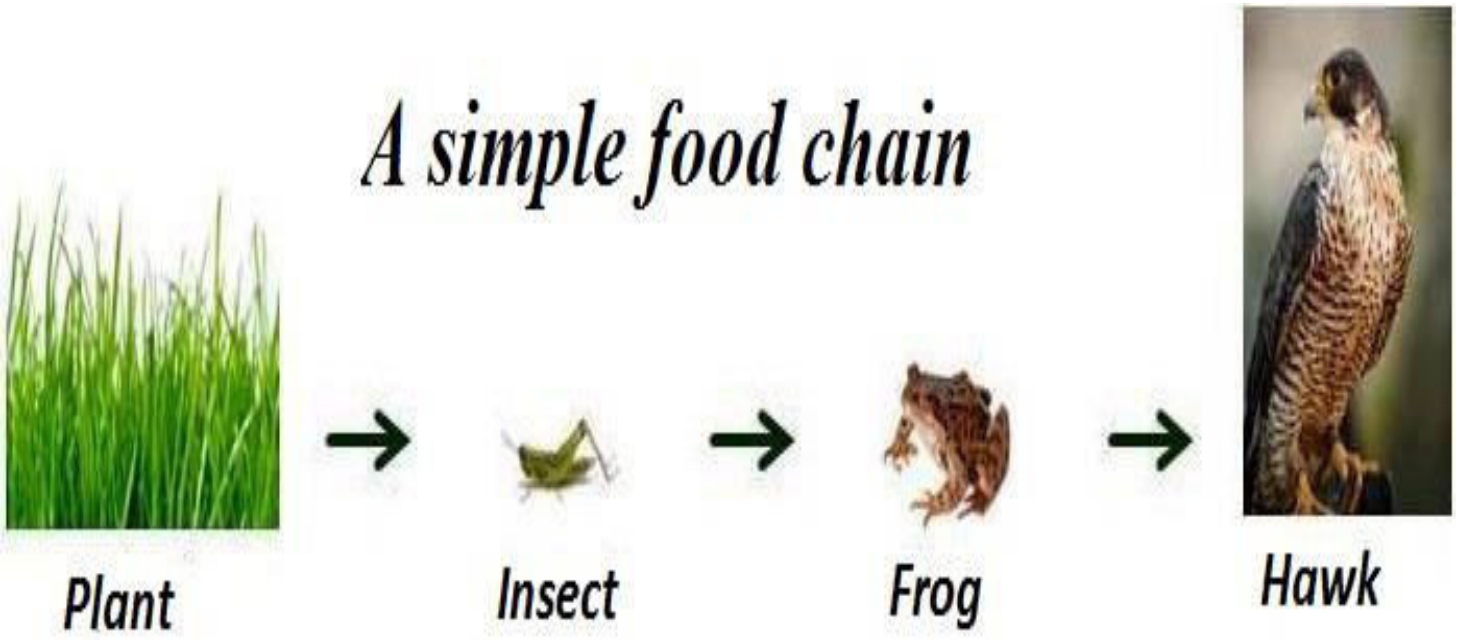
Food chain

The sequence of organisms through which energy moves in an ecosystem is a **food chain.**

An example of a simple food chain,



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Food chain

Decomposers and detritus feeders consume the leaf, caterpillar, frog, and hawk after they die and return their nutrients to the soil for reuse by producers.

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Food chain

The chemical energy stored as nutrients in the bodies and wastes of organisms flows through ecosystems from one trophic (feeding) level to another.

A food chain determines how chemical energy and nutrients move from one organism to another through the trophic levels in an ecosystem.

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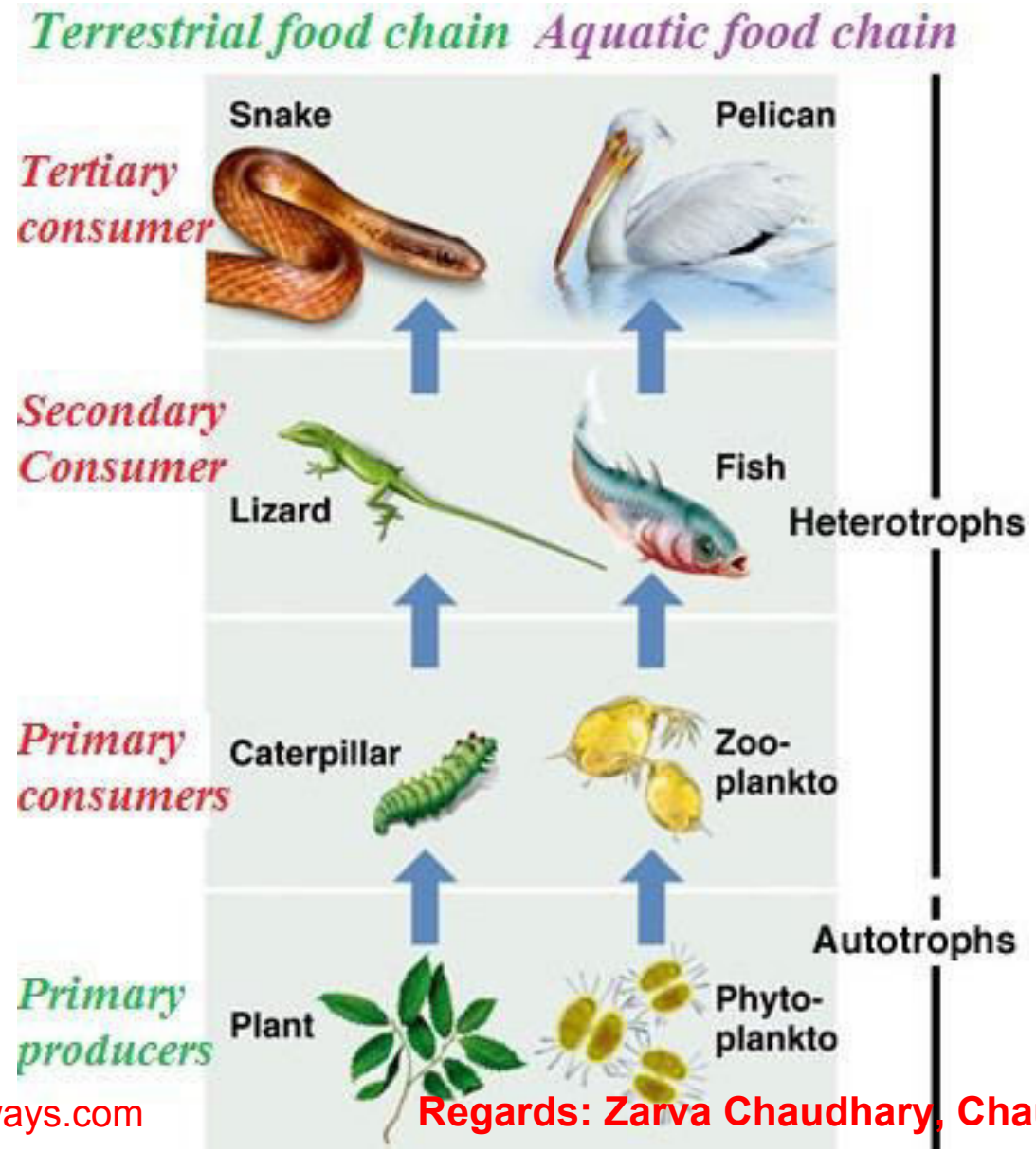
Food chain



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Food web

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Food web

In natural ecosystems, most consumers feed on more than one type of organism, and most organisms are eaten or decomposed by more than one type of consumer.

Because of this, organisms in most ecosystems form a complex network of interconnected food chains called a **food web**.

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Food web

Food chains and webs show how producers, consumers, and decomposers are connected to one another as energy flows through trophic levels in an ecosystem.

Provide stability to ecosystem.

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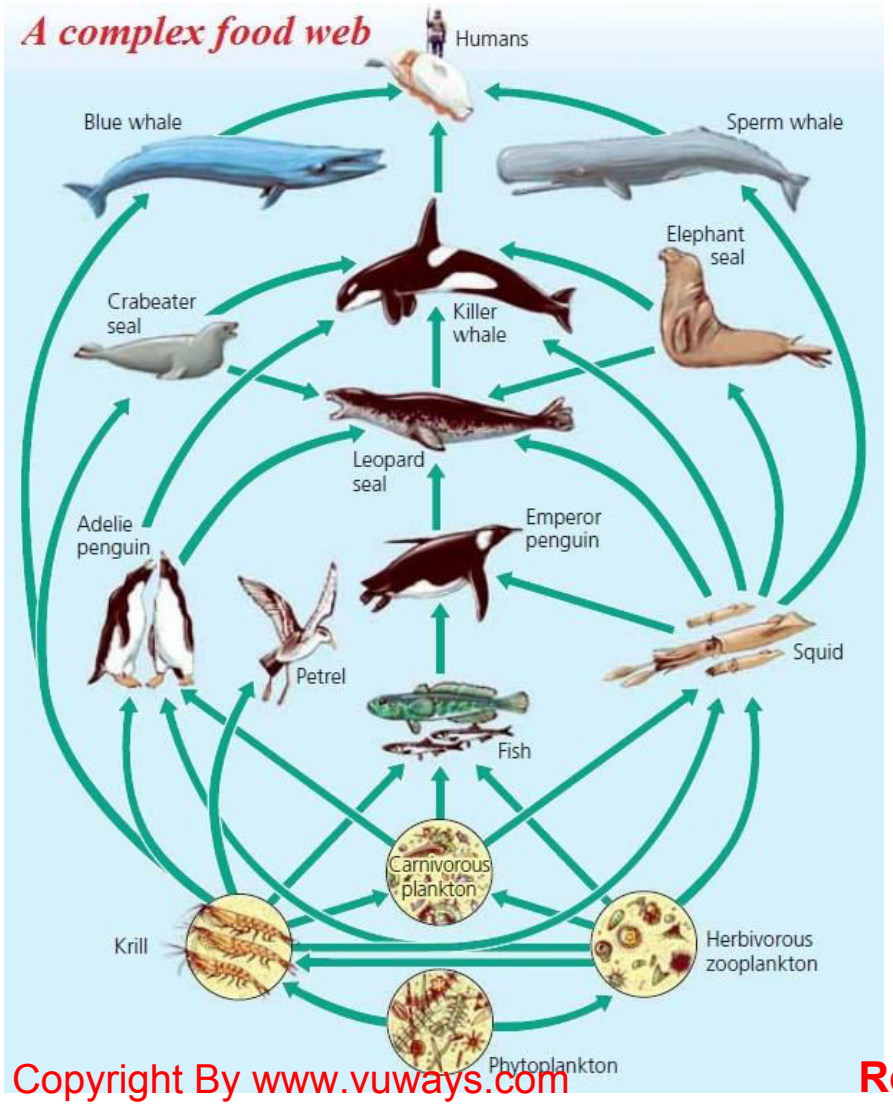
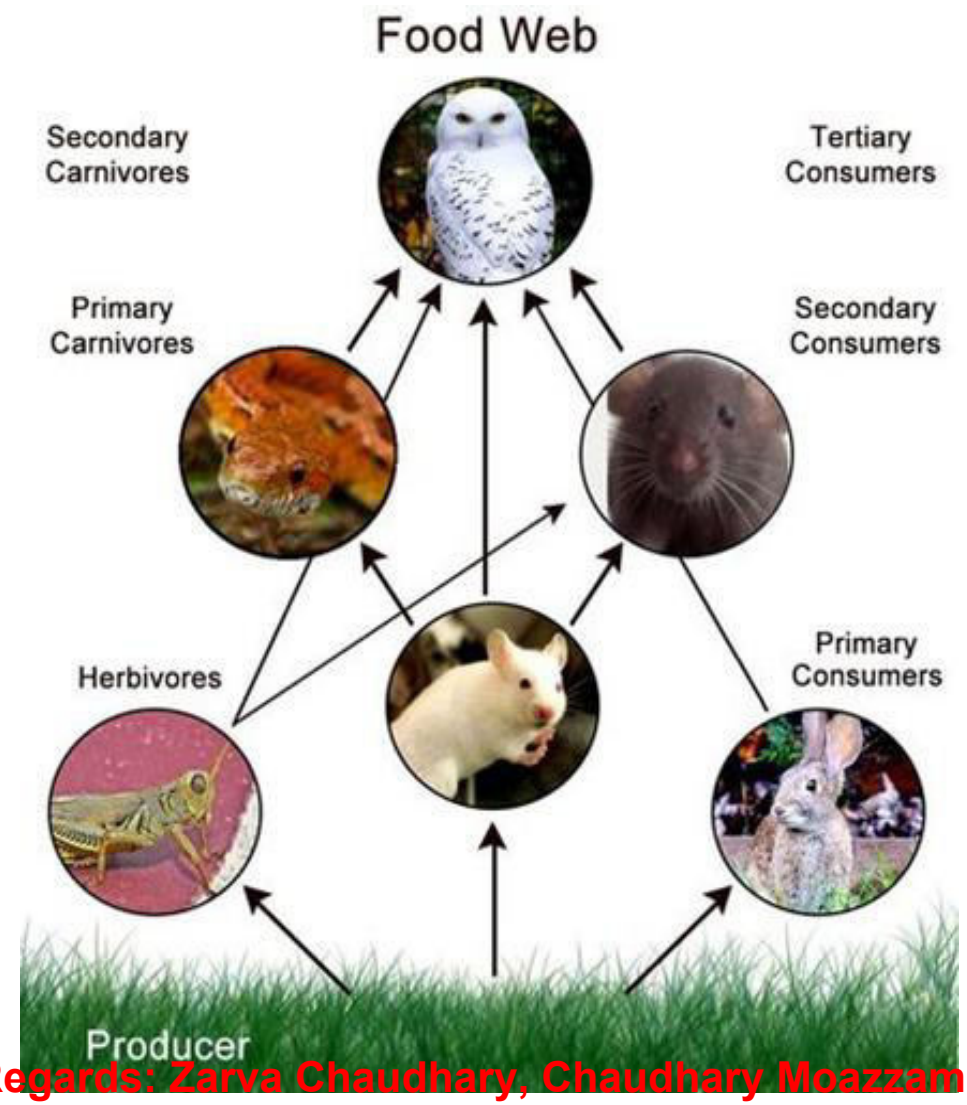
Food web





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Trophic levels

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Trophic levels

Because food webs are complex, so it is easy to group organisms according to the form of energy used. These groupings are called **trophic levels.**

Energy flows through these trophic levels in a food chain.

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Trophic levels

Producers (autotrophs) obtain nutrition (complex organic compounds) from inorganic materials as an energy source.

They form the first trophic level of an ecosystem. The most familiar producers are green plants.

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Trophic levels

Other trophic levels are made up of consumers (heterotrophs).

- Consumers eat other organisms to obtain energy.
- Herbivores (primary consumers) eat producers.
- Some carnivores (secondary consumers) eat herbivores, and other carnivores (tertiary consumers) eat the carnivores that ate the herbivores.

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Trophic levels

Consumers also include scavengers that feed on large chunks of dead and decaying organic matter.

Decomposers break down dead organisms and feces by digesting organic matter extracellularly and absorbing the products of digestion.

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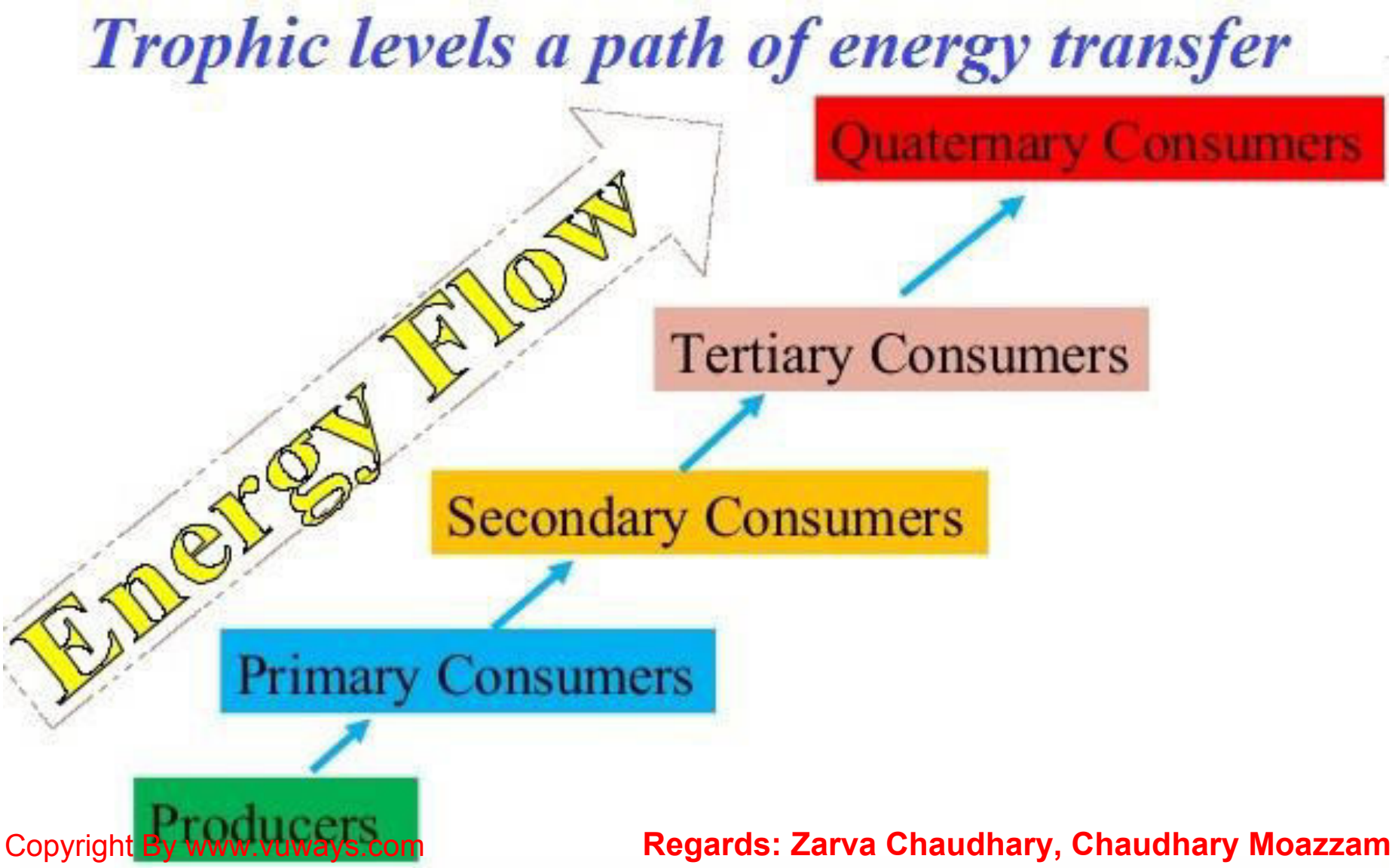
Trophic levels



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Producers

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Producers

Producers or autotrophs (self feeders),make the nutrients they need from compounds and energy obtained from their environment.

They can generate their own food and present the first trophic level of a food chain.

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Producers

Autotrophs are divided in to two types

Photoautotrophs

Chemoautotrophs

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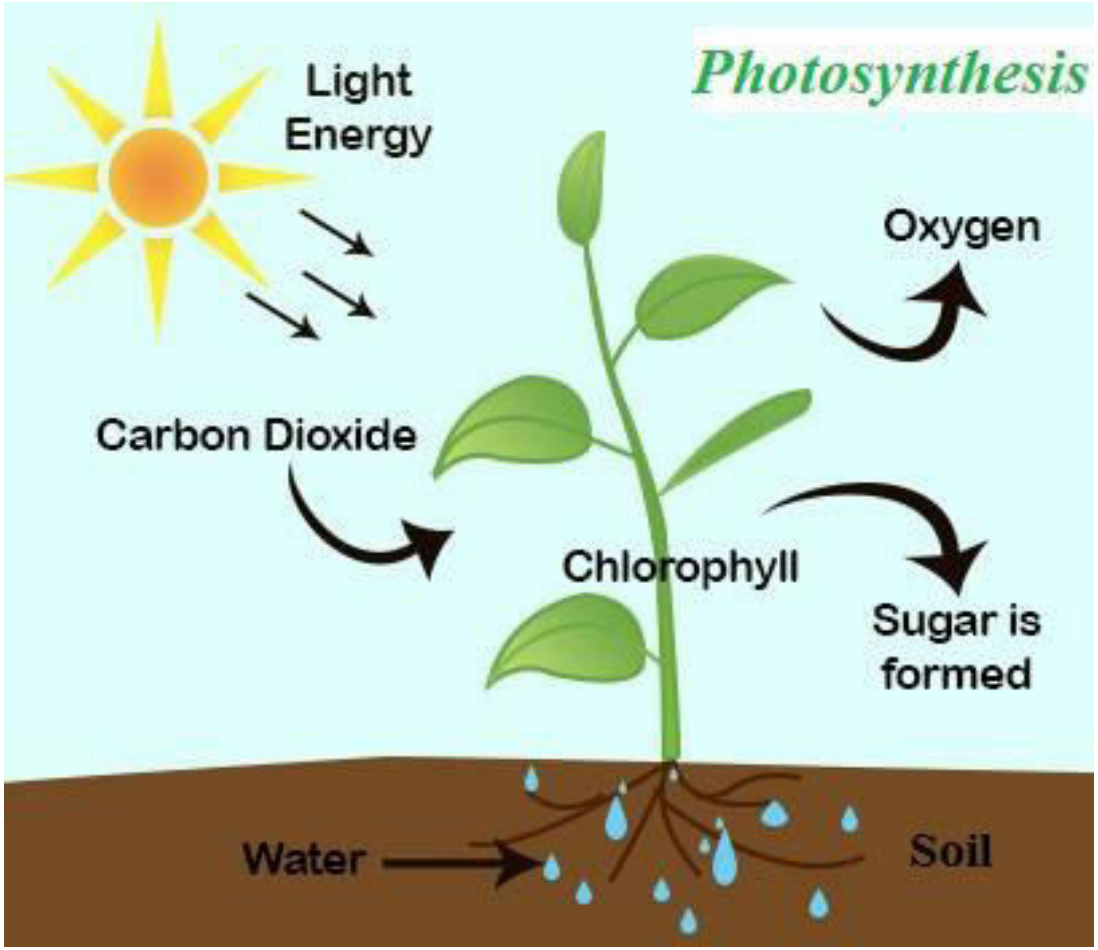
Producers

Photoautotrophs

Most producers capture sunlight to produce energy rich Carbohydrates (such as glucose) By **photosynthesis,** which is the way energy enters most ecosystems.



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Producers

Chemoautotrophs

Bacteria, can convert simple inorganic compounds from their environment into more complex nutrient compounds by using hydrogen sulphide instead of sunlight through a process called **chemosynthesis.**

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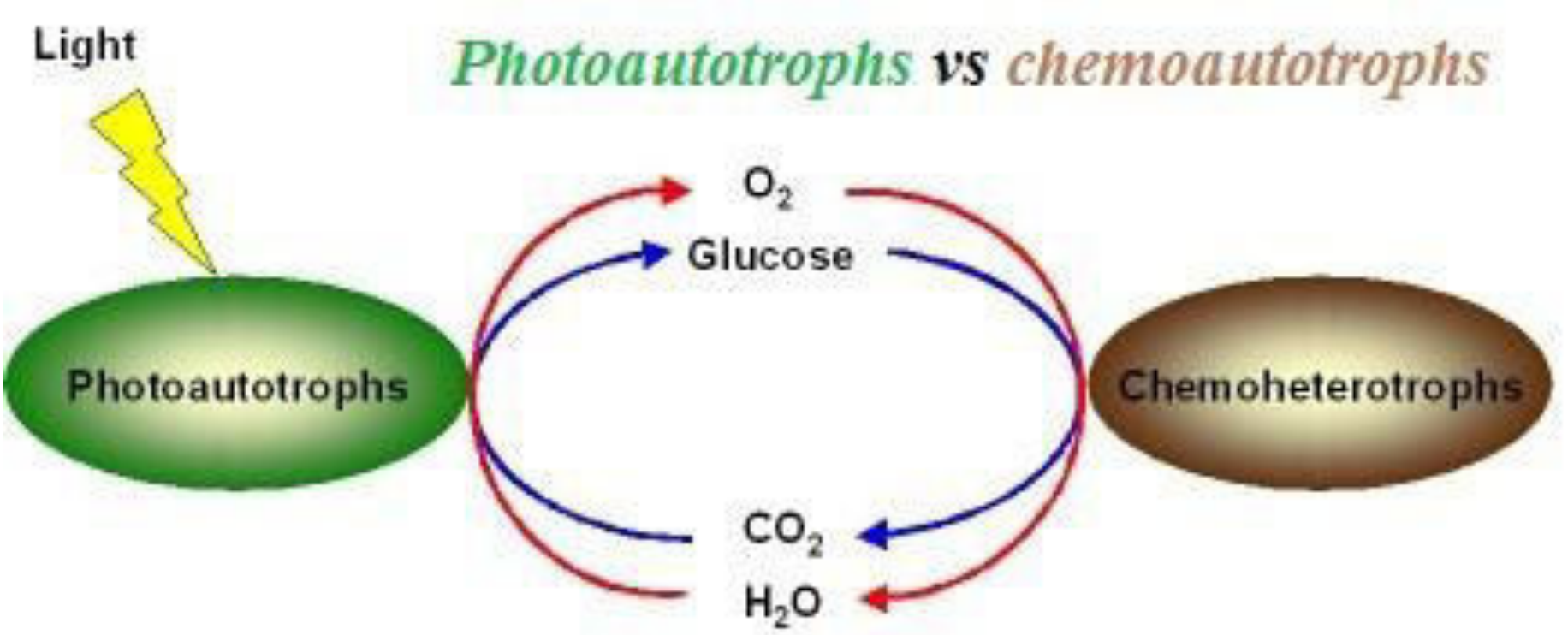
Producers

Nitrifying bacteria (Nitosomonas and Nitrobacter) are chemosynthetic in nature.



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Terrestrial producers

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Terrestrial producers

On land, most producers are green plants, which generally capture about 1% of the solar energy that falls on their leaves and convert it to chemical energy stored in organic molecules such as carbohydrates.

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Terrestrial producers

Terrestrial plants are self supportive plants, so they are strong and stiff in nature. They experience **Gravity** as a main environmental force while **Wind** as an external mechanical force.

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Terrestrial producers

Plants are the major habitat-structuring feature in terrestrial ecosystems. Their physical structure governs the patterns of physical environment, organism feeding and activity, and ecosystem processes.

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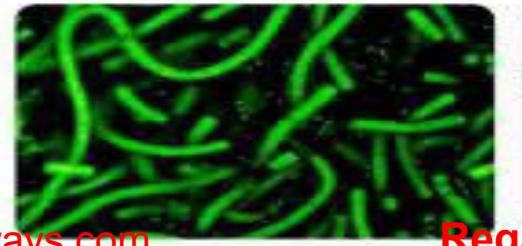
Terrestrial producers

Ecosystems with respective autotrophs

Type of Photoautotroph	Examples		Type of Ecosystem(s)
Plants	Trees	Grasses	Terrestrial
Algae	Diatoms	Seaweed	Aquatic
Bacteria	 Cyanobacteria	Purple Bacteria	Aquatic and Terrestrial

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Aquatic producers

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Aquatic producers

Organisms that manufacture food in aquatic environment.

In freshwater and marine ecosystems, algae and aquatic plants are the major producers. In open water, the dominant producers are *phytoplankton*.

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Aquatic producers

Phytoplankton

Microscopic organisms that float or drift in the water.

Phytoplankton, a great source of food for a wide range of aquatic creatures including whales, shrimp, snails, and jellyfish.

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Aquatic producers

Phytoplankton are of two types

- Diatoms
- Dinoflagellates

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Aquatic producers

Diatoms

- Unicellular algae
- Shells having interlocking parts.
- Major producers of an aquatic system

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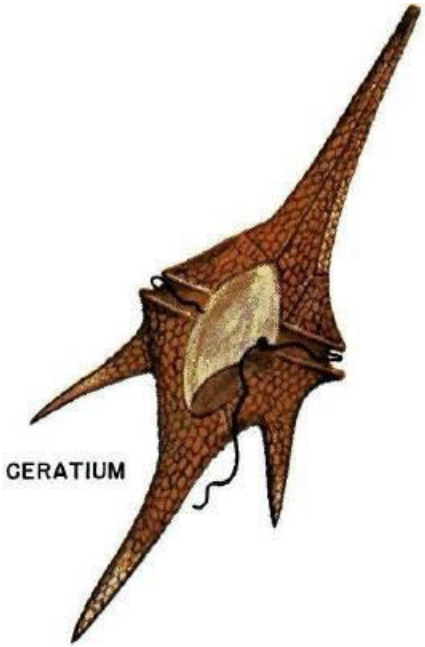
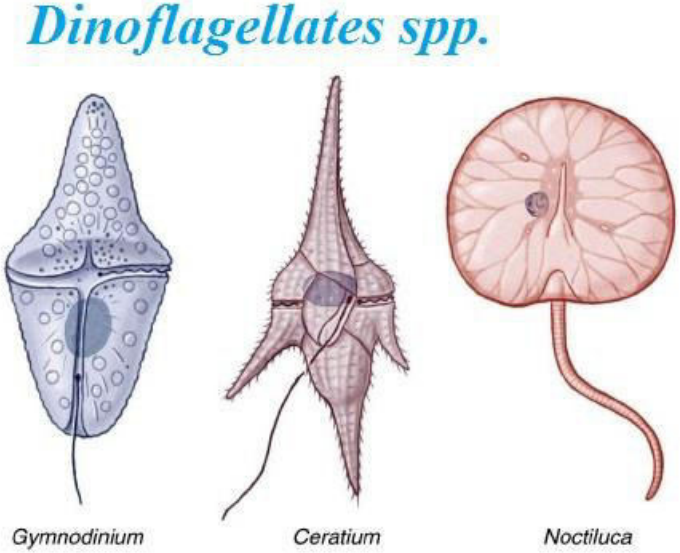
Aquatic producers

Dinoflagellates

- Unicellular
- Double flagella





- Second important

producers of aquatic systems

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Aquatic producers

Eutrophication

Too much nutrients causes harmful algal blooms (HABs) which are extremely toxic to living creatures (fish, shellfish, birds and mammals).

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Aquatic producers

Red tide

The harmful and toxic blooms of red Dinoflagellates causes the colour of sea water to become red.

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Photosynthesis

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Photosynthesis

Photosynthesis is the vital process by which producers manufacture food for organisms in an ecosystem.

Infact photosynthesis is a process that starts an ecological food web.

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Photosynthesis

Chlorophyll is the plant pigment that capture light energy directly from sun. It is converted into chemical energy , glucose.

Glucose is then used as a basic energy source by the primary consumers that feeds on plants.

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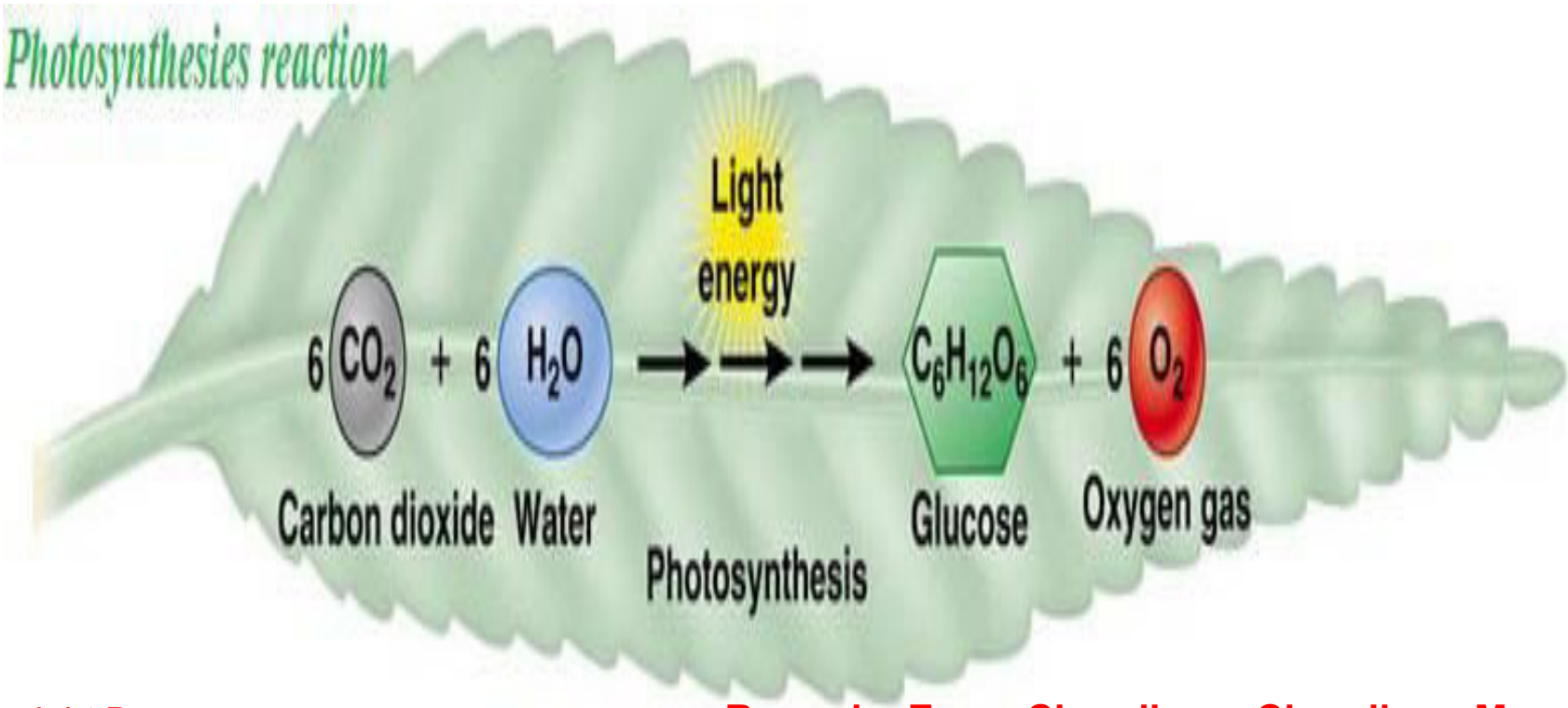
Photosynthesis

Although hundreds of chemical changes take place during photosynthesis, the overall reaction can be summarized as follows:



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Consumers

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Consumers

Organisms that depends on producers for purpose of food.

Also named heterotrophs because they can not able to manufacture their own food. They get their nutrients directly or indirectly from producers.

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Consumers

Types of consumers:

1. **Herbivores**
2. **Carnivores**
3. **Omnivores**

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Consumers

1. Herbivores

Primary consumers that feeds on plants directly.

Zooplankton,

Cow, zebra,

Rabbits,

Grasshoppers,

Deer etc.

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Consumers

2. Carnivores

Secondary consumers, or carnivores that feeds on meat of herbivores. Spiders, hyenas, birds, frogs, and some zooplankton-eating fish.

Tertiary consumers are carnivores that feed on the flesh of other carnivores. Tigers, wolves, mice-eating snakes, hawks, and killer whales.

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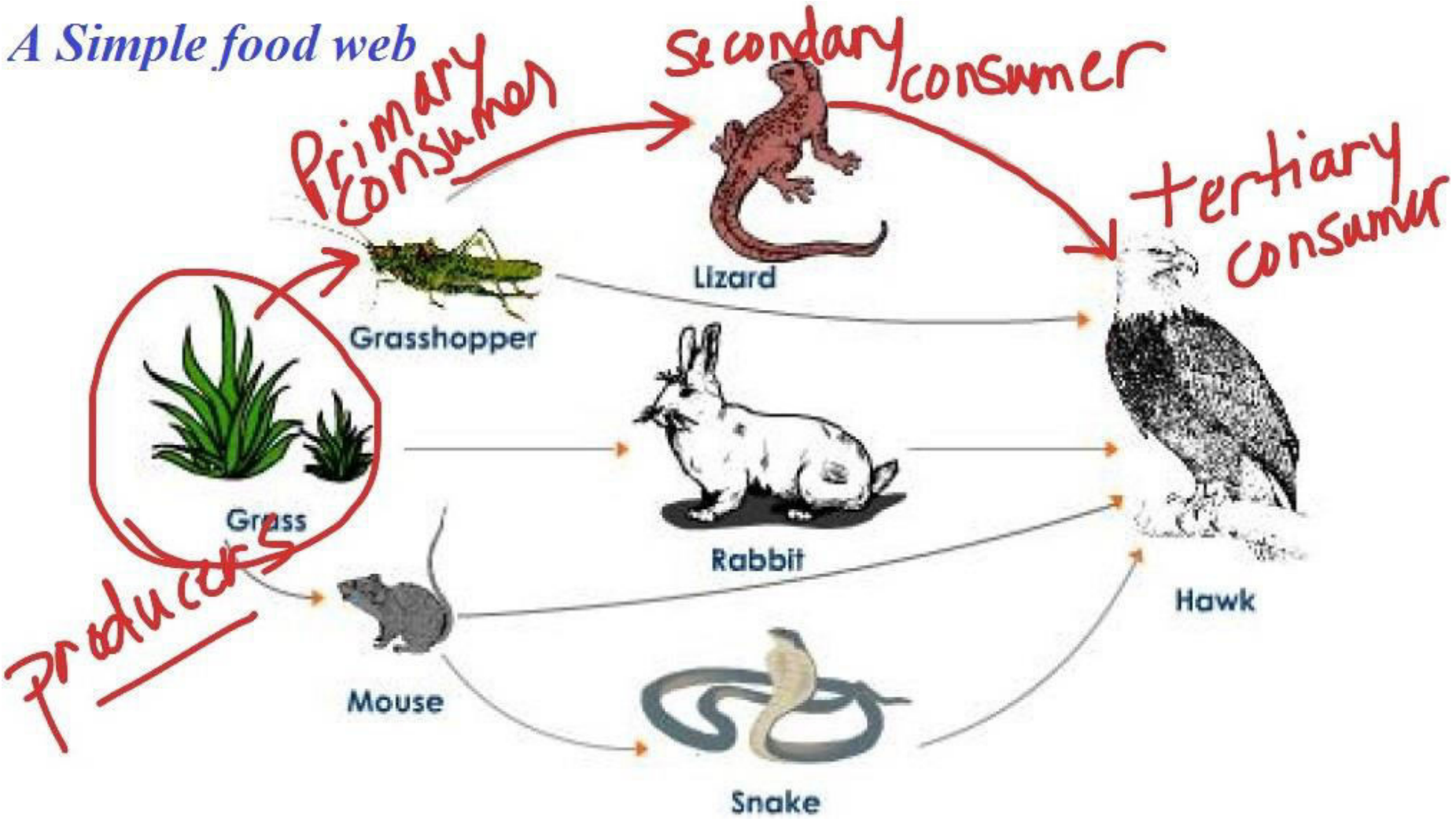
Consumers



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Consumers

3. Omnivores

Animals that feeds on both herbivores and carnivores. Humans pigs, foxes, cockroaches, common carp and tilapia.

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Primary Consumers

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Primary consumer

A plant-eating animal (an herbivore) that obtains organic molecules by eating producers (autotrophs) or their products.

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Primary consumer

Herbivores (primary consumers) eat producers (Green Plants)

Primary consumers, or herbivores (plant eaters), are animals such as rabbits, grasshoppers, deer, and zooplankton that eat producers, mostly by feeding on green plants.

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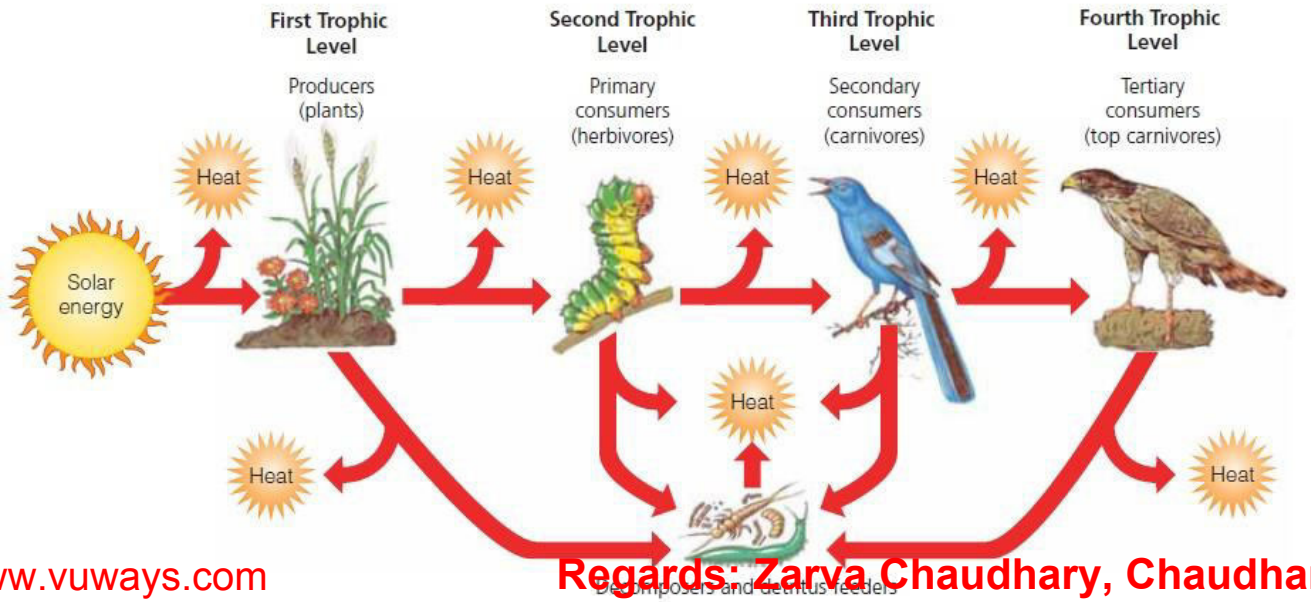
Primary consumer

- Herbivores are animals that eat only plants.
- They need a lot of energy to stay alive.
- Many have to eat all day long to get enough energy.
- Some herbivores have a special digestive system so they are able to eat/digest grasses.



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Primary consumer

Few Examples -Manatee

- Aquatic marine
- Herbivorous
- Eat 150 pounds of plants each day!

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Primary consumer

A rhinoceros eats grass, leaves, twigs and shrubs.

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Primary consumer

Cattle eat grass and hay.

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Primary consumer

Deer eat corn, twigs, shoots, acorns, fruit, berries, and green plants.

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Primary consumer

A giraffe lives in Africa and eats leaves from trees. They especially like the leaves of the Arcadia tree. A giraffe may eat 75 pounds of food each day.

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Secondary consumers

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Secondary consumer

An animal that preys on and eats a primary consumer. They are also called as **Carnivores** (Meat eaters).

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Secondary consumer

Spiders eat insects.

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Secondary consumer

A frog eats insects, earthworms, and spiders.

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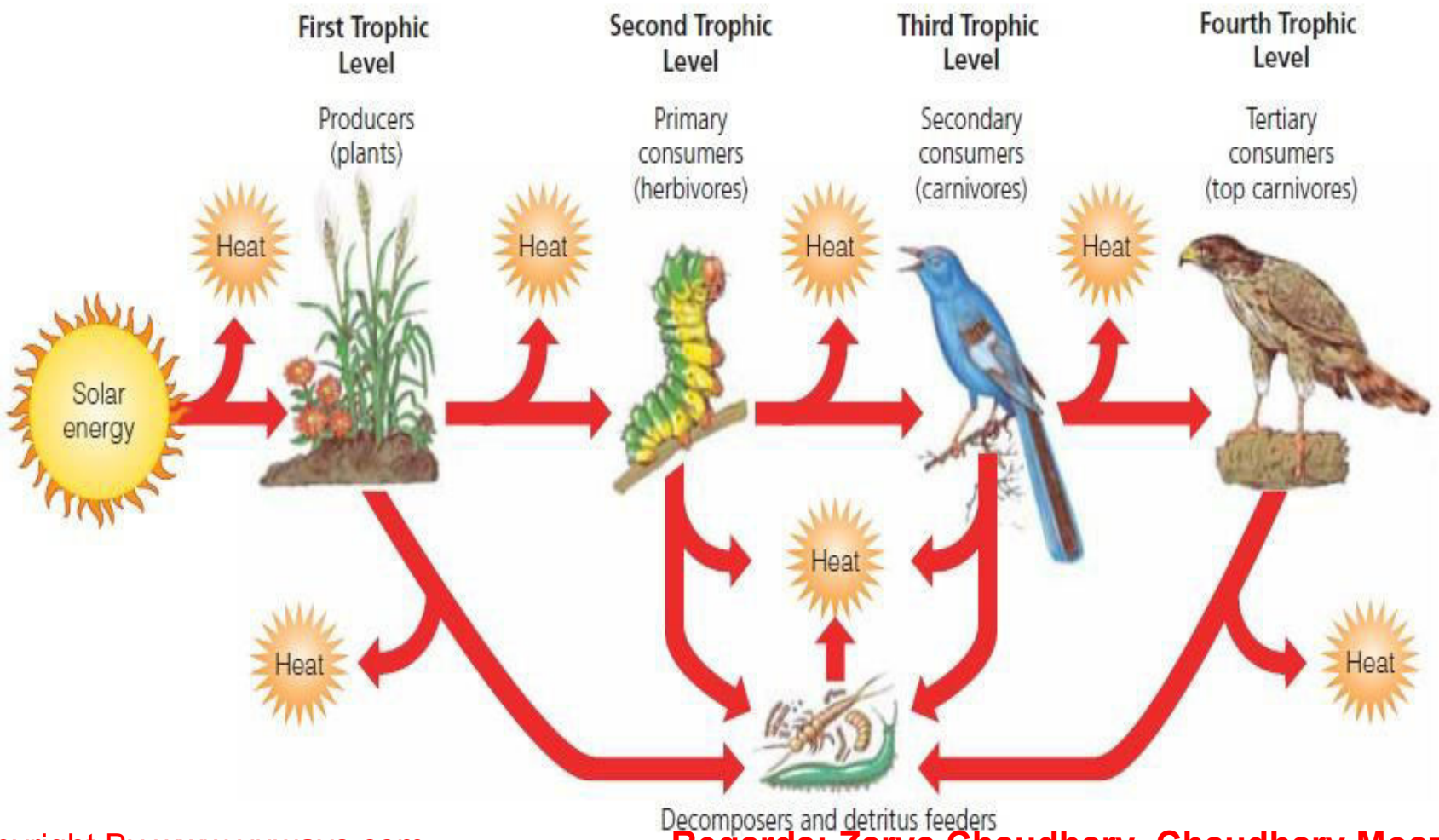
Secondary consumer



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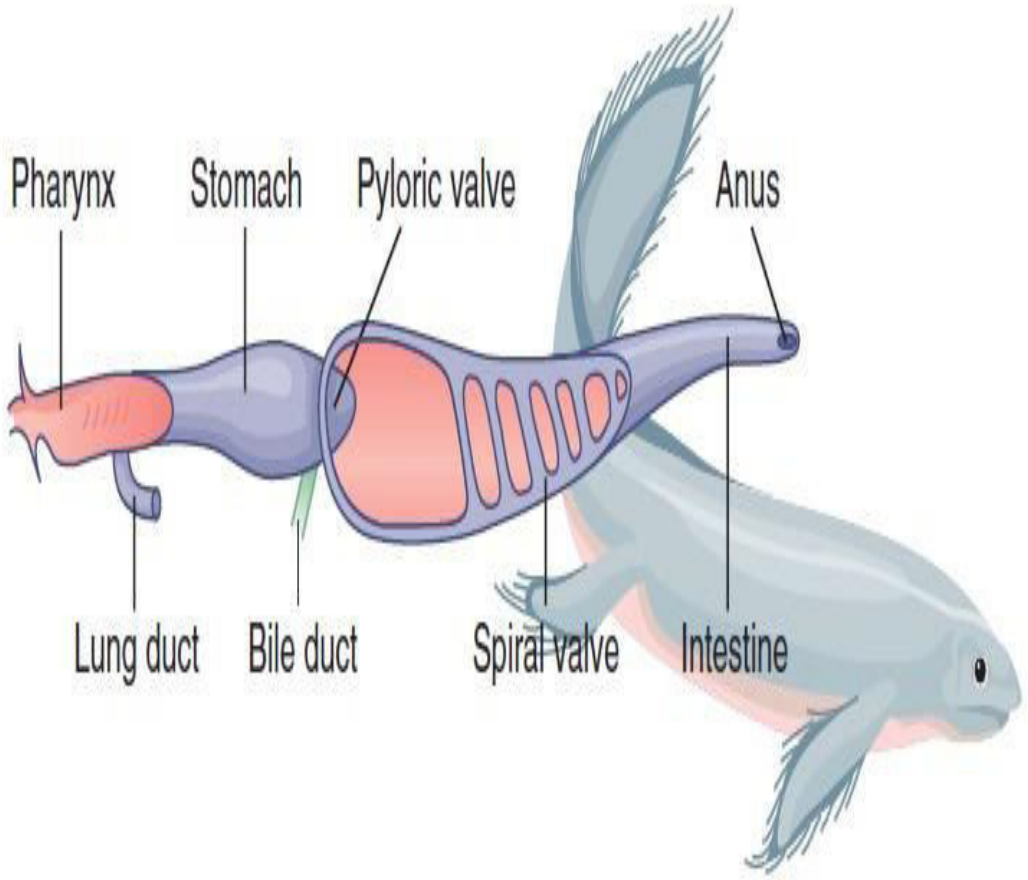
Secondary consumer

Carnivorous fishes possess long stomach and short intestine.



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Tertiary consumers

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Tertiary consumers

They are third- and higher-level consumers. Tertiary consumers eat the carnivores that ate the herbivores.

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Tertiary consumers

Examples

- Tigers
- Wolves
- Mice-eating snakes
- Hawks
- killer whales (orcas)

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Tertiary consumers

Lions eat other animals such as gazelles, antelopes, and zebras.

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Tertiary consumers

Eagles eat fish, mammals, birds, and snakes. They love fish!

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Tertiary consumers

A wolf eats deer, dogs, fish, mice, moose, birds, and other herbivores.

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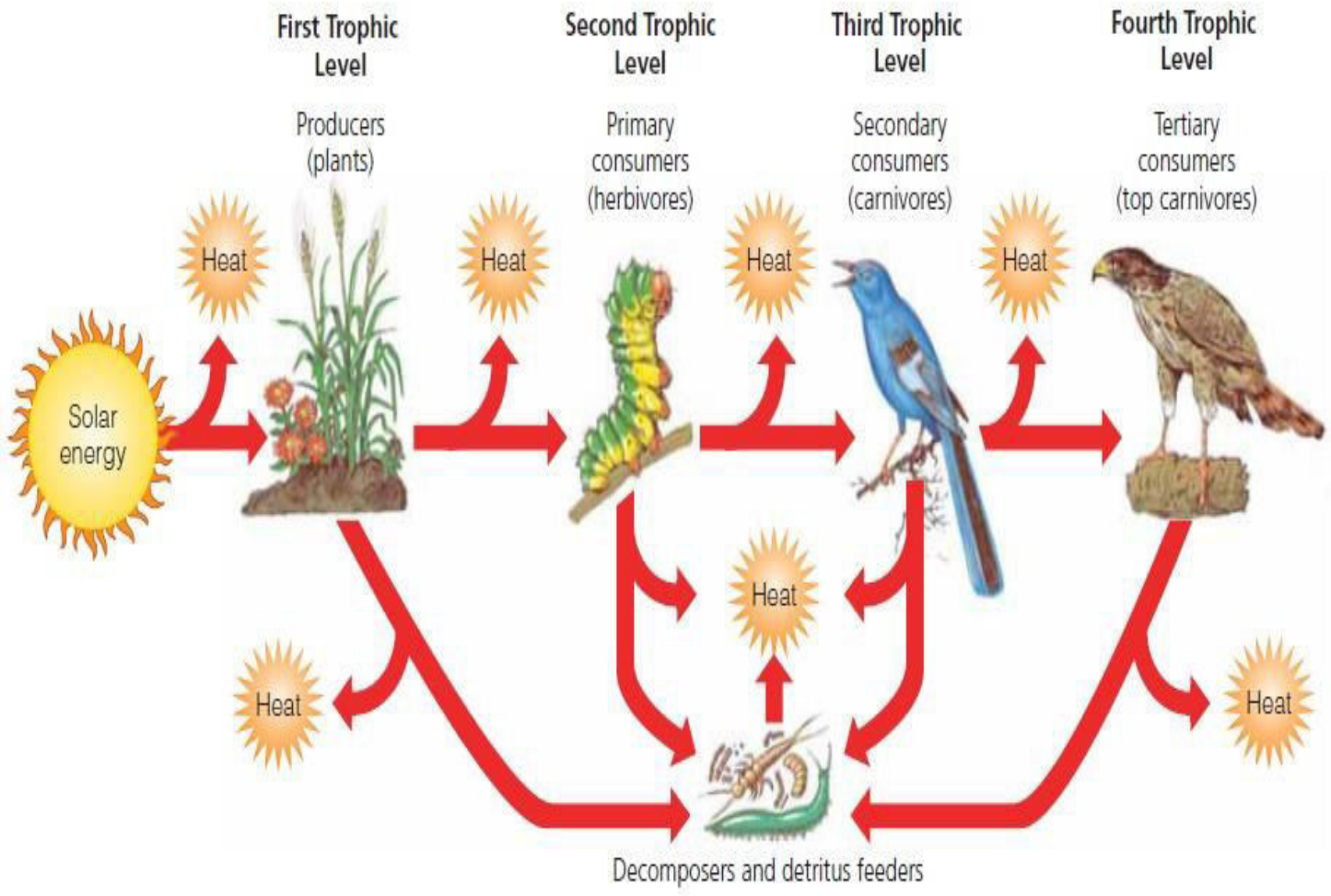
Tertiary consumers



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Omnivores

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Omnivores

Omnivores (*L. omnius*, all) means animal which eat everything.

Omnivores play dual roles by feeding on both plants and animals.

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Omnivores

Examples include

- Pigs
- Foxes
- Cockroaches
- Humans

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Omnivores

Dentition of Omnivores

Omnivores have teeth that can perform a number of tasks,

- Tearing
- Ripping
- Chiseling
- Grinding

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Omnivores

A pig eats fruit, eggs, corn, and earthworms.

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Omnivores

A grizzly bear usually eat things such as grasses, roots, berries, insects, fish, and small / large mammals.

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Omnivores

A raccoon eats almost anything including berries, acorns, baby mice, baby birds & eggs, frogs, fish, and even some snakes.

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Omnivores

Last but not least – Humans are omnivores!

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Decomposers

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Decomposers

Decomposers break down dead organisms and feces by digesting organic matter extracellularly and absorbing the products of digestion.

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Decomposers

Certain types of bacteria and fungi, are Decomposers.

They release nutrients from the dead bodies of plants and animals and return them to the soil, water, and air for reuse by producers.

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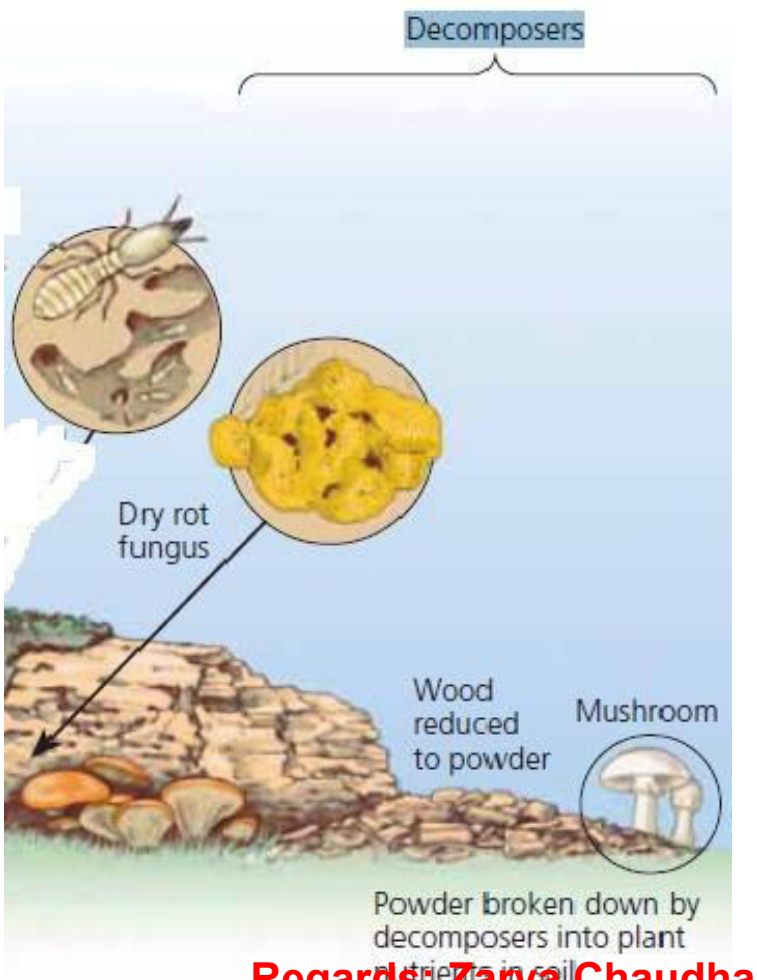
Decomposers



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Decomposers

Decomposers feed by secreting enzymes.

Enzymes speed up the break down of bodies of dead organisms into nutrient compounds such as water, carbon dioxide, minerals, and simpler organic compounds.

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Detritus feeders

or

detritivores

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Detritus feeders or **detritivores**

"di-TRI-tus" meaning debris.

Detritus feeders, or **detritivores,** feed on the wastes or dead bodies of other organisms, which is called as **detritus.**

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Detritus feeders or detritivores

Examples

Small organisms such as

- Mites
- Earthworms
- Some insects
- Catfish

Larger scavenger organisms

- Vultures.

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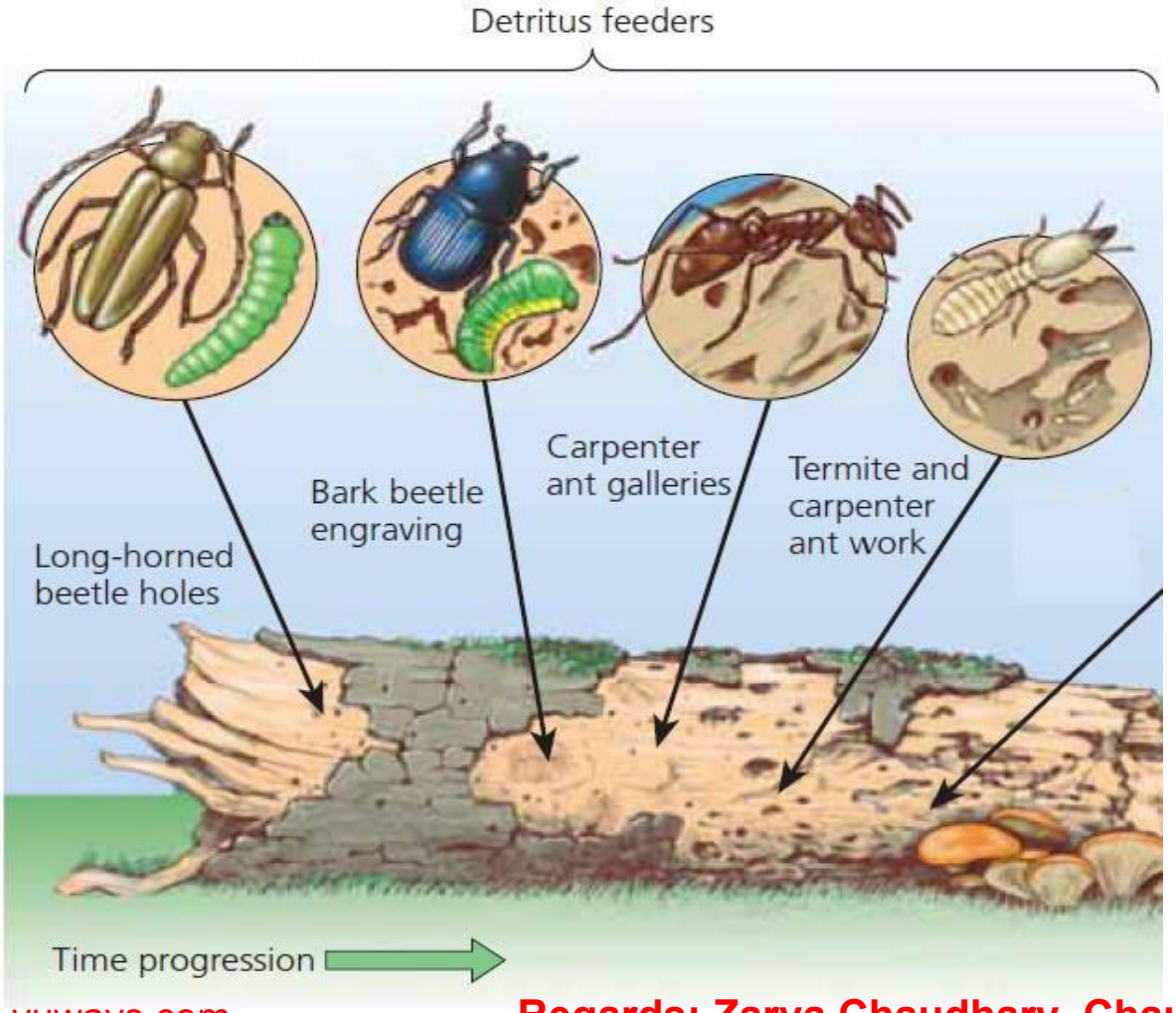
Detritus feeders or detritivores



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Detritus feeders or **detritivores**

Hordes of decomposers and detritus feeders can transform a fallen tree trunk into a powder and finally into simple inorganic molecules that plants can absorb as nutrients.

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Detritus feeders or detritivores

Conclusion

- Some organisms produce the nutrients they need.
- Some get their nutrients by consuming other organisms.
- Others recycle the nutrients in the wastes and remains of organisms so that producers can use them again.

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The Earth's Life-Support System

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Earth's life-support system

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

1. The atmosphere (air)
2. The hydrosphere (water)
3. The geosphere (rock, soil, sediment)
4. The biosphere (living things)

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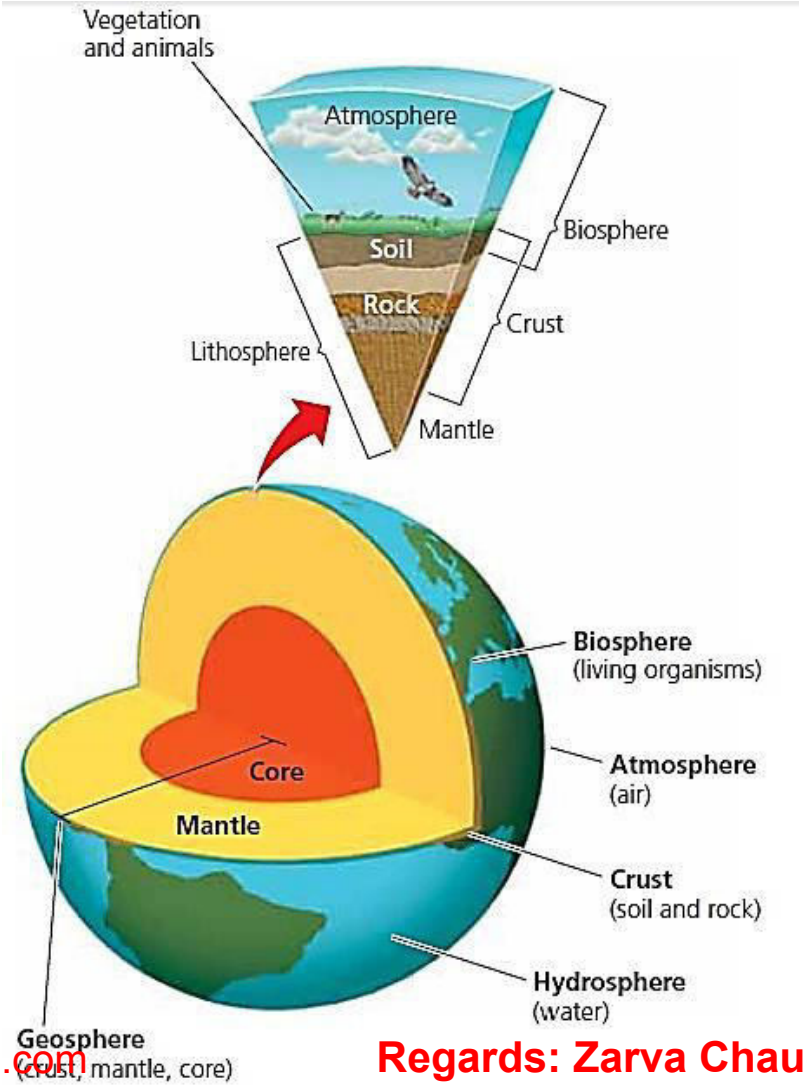
Earth's life-support system



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Earth's life-support system

1. Atmosphere

A thin spherical envelope of gases surrounding the earth's surface.

- Nitrogen (78% of the total volume)
- Oxygen (21%).
- 1% of the air includes water vapor, carbon dioxide, and methane, all of which are called **greenhouse gases,** because they trap heat and thus warm the lower atmosphere.

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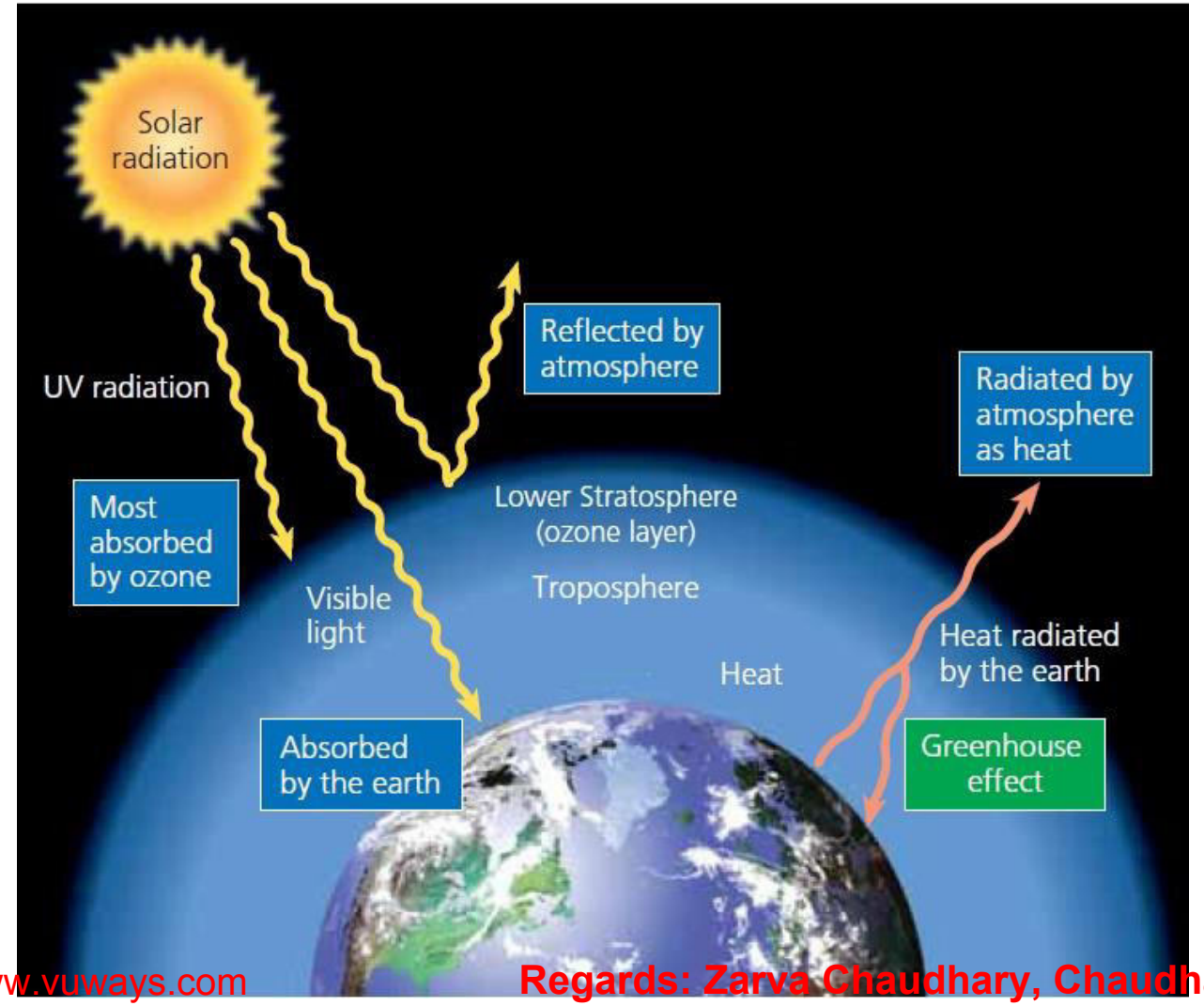
Earth's life-support system



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Earth's life-support system

2. Hydrosphere

Consists of all of the water on or near the earth's surface. It is found as liquid water (on the surface and underground), ice (polar ice, icebergs, and ice in frozen soil layers called permafrost), and water vapor in the atmosphere. Most of this water is in the oceans, which cover about 71% of the globe.

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Earth's life-support system

3. Geosphere

The geosphere consists of

- The earth's intensely hot *core*
- A thick *mantle* composed mostly of rock
- A thin outer *crust*.

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Earth's life-support system

4. Biosphere

The biosphere occupies those parts of the atmosphere, hydrosphere, and geosphere where life exists.

This thin layer of the earth extends from about 9 kilometers (6 miles) above the earth's surface down to the bottom of the ocean.

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Population ecology: Dynamics

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Population ecology: Dynamics

Populations differ in factors such as their

I. Distribution

II. Numbers

III. Age structure

IV. Density

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Population ecology: Dynamics

Population dynamics is a study of how these characteristics of populations change in response to changes in environmental conditions.

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Population ecology: Dynamics

Such environmental conditions are

- Temperature
- Presence of disease organisms or harmful chemicals
- Resource availability
- Arrival or disappearance of competing species.

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Population ecology: Dynamics

General patterns of population distribution or dispersion

1. Clumping
2. Uniform dispersion
3. Random dispersion

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Population ecology: Dynamics

1. Clumping

Individuals are found in form of groups or clusters due to uneven distribution of resources.

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Population ecology: Dynamics

2. Uniform dispersion

The tendency for populations to be found evenly distributed about their habitat.

This is generally caused by a species ability to survive anywhere in their habitat. They use the resources found immediately around them, and spread out as to use all of the available resources.

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Population ecology: Dynamics

3. Random dispersion

Distribution of populations in a random fashion through out their habitat.

Generally randomly distributed populations are rare while clumped distribution is common.

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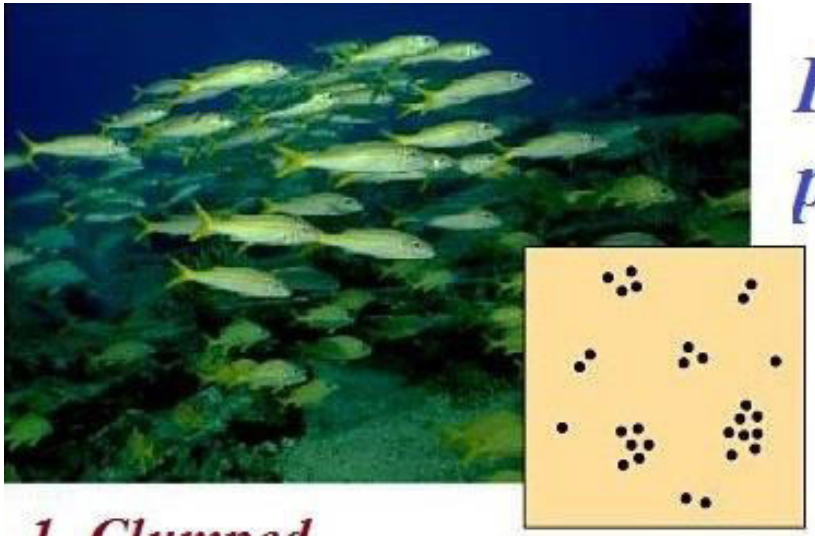
Population ecology: Dynamics



Population distribution patterns

1. Clumped

3. Random

2. Uniform

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Population growth

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Population growth

Animal populations change over time as a result of

- Birth
- Death
- Dispersal

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Population growth

Biotic potential

Ability of a population to grow under ideal conditions.

Low biotic potential

Large individuals, such as elephants and blue whales.

High biotic potential

Small individuals, such as bacteria and insects.

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Population growth

Intrinsic rate of increase (*r*)

The rate at which the population of a species would grow if it had unlimited resources. Individuals in populations with a high intrinsic rate of growth typically,

- Reproduce early in life
- Short generation times (the time between successive generations)
- Reproduce many times
- Have many offspring each time they reproduce

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Population growth

Environmental resistance

The constraints that climate, food, space, and other environmental factors place on a population is called **environmental resistance.**

It is the combination of all factors that act to limit the growth of a population. Together, biotic potential and environmental resistance determine the **carrying capacity** (K).

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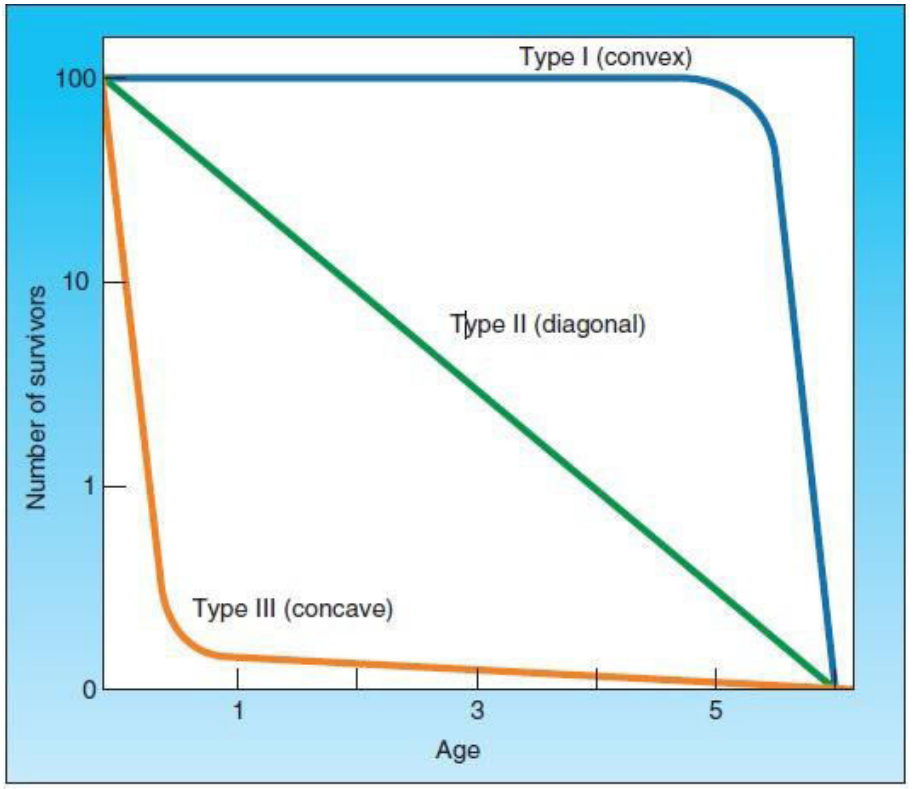
Population growth

Survivorship curves are a plot of number of survivors (usually a logarithmic plot) versus age.

Type I curves apply to populations in which individuals are likely to live out their potential life span.

Type II curves apply to populations in which mortality rates are constant throughout age classes.

Type III curves apply to populations in which mortality rates are highest for the youngest cohorts (Group of individuals having same characters).



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Population growth

A population increases by **birth and immigration** (arrival of individuals from outside the population) and decreases by **death and emigration** (departure of individuals from the population).

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Population growth

A population's age structure has a strong effect on population growth. Age structure of a population is usually discussed as

- The **pre-reproductive age**: Not mature enough to reproduce
- The **reproductive stage**: Those capable of reproduction
- The **post-reproductive stage**: Those too old to reproduce

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Population growth

The size of a population will likely increase if it is made up mostly of individuals in their **reproductive stage or soon to enter this stage**. In contrast, a population dominated by individuals past their reproductive stage will tend to decrease over time.

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Carrying capacity

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Carrying capacity

Carrying capacity (*K*)

The maximum population of a given species that a particular habitat can sustain without being degraded.

The carrying capacity of an area or volume is not fixed.

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Carrying capacity

Factors that influence carrying capacity are,

- Food availability
- Water
- Space
- Environmental conditions

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Carrying capacity

The growth rate of a population decreases as its size comes near the carrying capacity of its environment because resources such as food, water, and space begin to decrease.

A drought can decrease the amount of vegetation growing in an area supporting deer and other herbivores, and this would decrease the normal carrying capacity for those species.

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Carrying capacity

Carrying capacity plays a vital role in sustainability and protection of an environment.

when a population exceeds the carrying capacity of an area, it causes damage that reduces the area's carrying capacity.

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Exponential growth

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Exponential growth

A rapid increase in number of individuals of a population at a constant rate of growth. ***Exponential*** **or** ***geometric growth*** starts slowly but then accelerates as the population increases, because the base size of the population is increasing.

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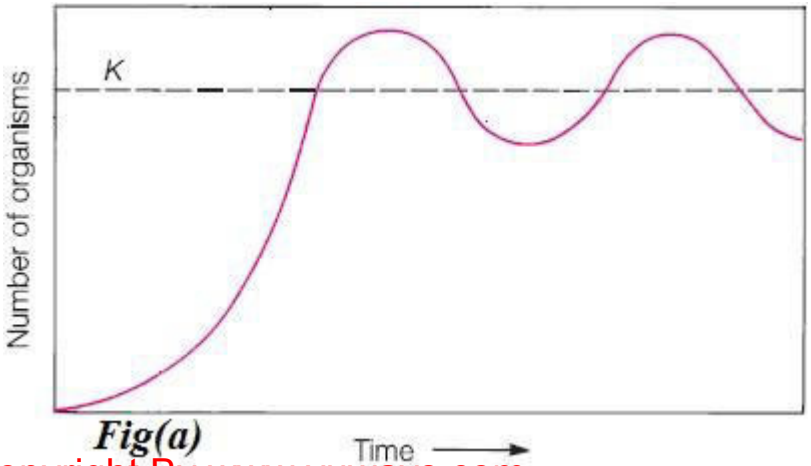
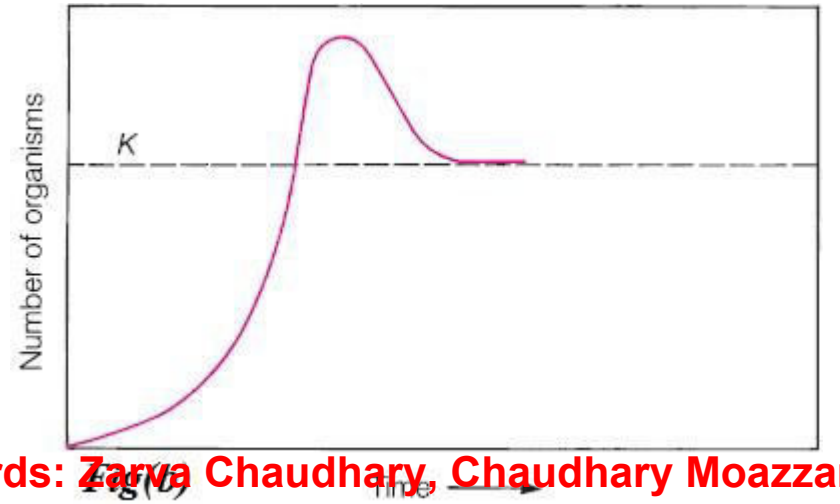
Exponential growth

During its exponential growth phase, a population may overshoot carrying capacity because demand on resources may lag behind population growth. When that happens, numbers may cycle on either side of *K fig(a),* or form a J-shaped curve fig*(b).*



Fig(a)



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Exponential growth

Reproductive potential

Ability of individuals to reproduce under ideal or optimum conditions. Exponential growth cannot occur indefinitely.

Factors influencing reproductive potential

- Number of offspring produced
- The likelihood of survival to reproductive age
- Duration of the reproductive period
- Length of time it takes to reach maturity

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Logistic population growth

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Logistic population growth

Decrease in growth of rapidly growing populations due to limited resources, until they reach their carrying capacity is termed as logistic population growth.

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Logistic population growth

Logistic growth involves rapid exponential population growth followed by a steady decrease in population growth until the population size levels off.

After leveling off, a population with this type of growth typically fluctuates slightly above and below the carrying capacity.

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Logistic population growth

This slowdown occurs as the population encounters environmental resistance from declining resources and other environmental factors and approaches the carrying capacity of its environment.

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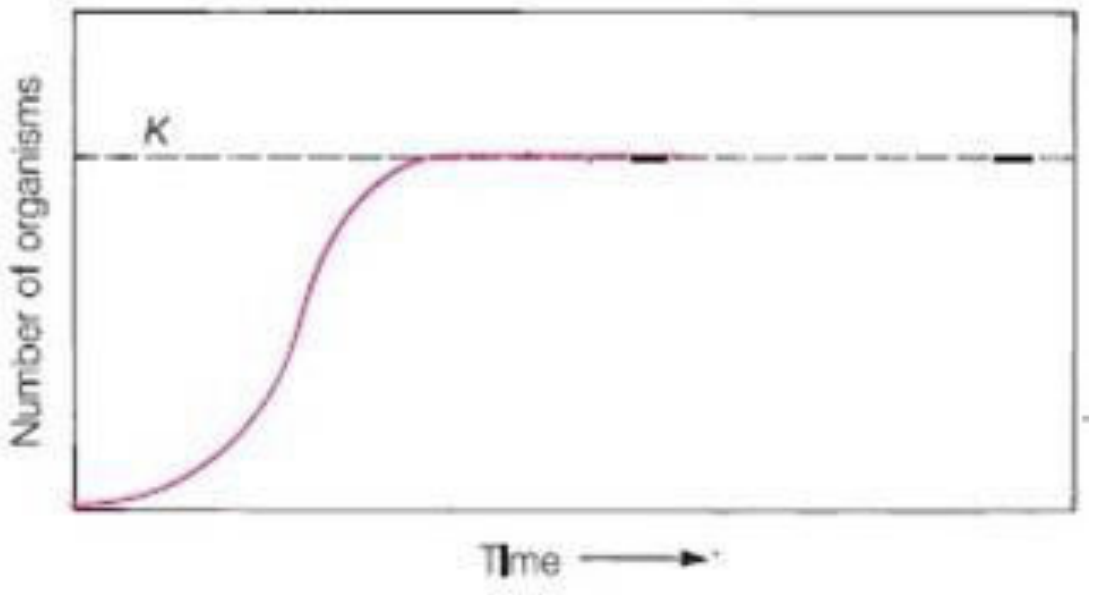
Logistic population growth

Logistic growth curves reflect limited resources placing an upper limit on population size.



At carrying capacity *(K)*, population growth levels off, creating an S-shaped curve.

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Population regulation

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Population regulation

Demography

Study of human population and the factors that regulate the growth of population.

Population of any ecosystem is regulated by certain biotic and a biotic factors which are necessary for the growth of population.

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Population regulation

Factors regulating population,

- Birth rate
- Death rate
- Food
- Climate
- Water

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Population regulation

- Competition
- Predators
- Emigration
- Immigration
- Disease

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Population regulation

Metapopulation

A group of populations of same species which are separated by space. Individuals can move from one population to other. Extinction and colonization are the main process that regulate the Metapopulation.

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Population density

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Population density

Population density is the number of individuals in a population found in a particular area.

Population density and population size are the two main factors which are used to study any population in an ecosystem.

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Population density

Higher population density

- May help sexually reproducing individuals find mates, but it can also lead to increased competition for mates, food, living space, water, sunlight, and other resources.

- Help to shield some members from predators, but it can also make large groups such as schools of fish vulnerable to human harvesting methods.

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Population density

- Close contact among individuals in dense populations can increase the transmission of parasites and infectious diseases.
- Smaller organisms have high population density than larger organisms.

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Population density

Low population density

- Less competition for food, living space, water, sunlight, and other resources.
- Individuals with low population density face difficulty in finding mates as compared to individuals with higher population density.
- Less adaptability to environmental changes.

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Density-independent factors

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Density-independent factors

Factors that influence the number of animals in a population and their effect is not dependent on the density of the population.

So density independent factors exert a strong effect on population size instead of population density of a particular area.

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Density-independent factors

Some of these factors are,

- Weather
- Earthquake
- Floods
- Hurricanes

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Density-independent factors

- Fire
- Pollution
- Habitat destruction
- Climate changes

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Density-independent factors

Weather conditions often limit populations.

A severe freeze in late spring can kill many individuals in a plant population or a population of monarch butterflies regardless of their density.

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Density-independent factors

An extremely cold winter with little snow cover may devastate a population of lizards hidden beneath the litter of the forest floor.

Human activities, such as construction and deforestation, often affect animal populations in a similar fashion.

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Impact of human population on environment

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Impact of human population on environment

Human population is increasing day by day and at present it is about **7.4 billion**.

This increase in human population has increased the demand of natural resources like food, space, water and energy etc. Due to overconsumption, natural resources are decreasing at an alarming rate.

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Impact of human population on environment

Human population growth has severally affected the environment By putting pressure on the natural resources.

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Impact of human population on environment

Human impact on environmental health,

- Habitat destruction
- Habitat fragmentation
- Deforestation
- Pollution

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Impact of human population on environment

- Soil erosion
- Ozone layer destruction
- Invasive species
- Oil spillage
- Coral reef destruction

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Atmosphere; Its Composition and role in ecosystem

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Atmosphere;
Its Composition and role in ecosystem

The mixture of gases that surrounds the solid earth is called the atmosphere.

Although it represents a very small fraction of the weight of the earth, it is very important because it is essential to life and is highly reactive.

Circulates and plays an important role in the evolution of landscapes.

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Atmosphere;
Its Composition and role in ecosystem

Composition

- Nitrogen (78% of the total volume of air)
- Oxygen (21%).
- 1% of the air includes water vapor, carbon dioxide, and methane, all of which are called greenhouse gases, because they trap heat and thus warm the lower atmosphere.

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Atmosphere;
Its Composition and role in ecosystem

Nitrogen

- 78% of the total volume of air
- Relatively inert
- Unavailable to plants directly; therefore it must undergo chemical changes to make it useful to producers (plants).

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Atmosphere;
Its Composition and role in ecosystem

Oxygen

Oxygen is chemically reactive and important in the

- Breathing
- Weathering of rocks
- The decay of organic matter
- Combustion.

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Atmosphere;
Its Composition and role in ecosystem

Carbon dioxide

Carbon dioxide plays an important role by

- Tapping heat
- Causing the greenhouse effect, which keeps the earth warm and livable, for the most part.
- Raw material for photosynthesis

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Atmosphere;
Its Composition and role in ecosystem

Water vapor

- Water vapor plays an extremely important role in the hydrological cycle.
- Water vapors are highly variable. Air in desert areas may contain only 1 percent vapor by volume; in tropical areas, however, where the air is warm and moist, the content can be as high as 4 percent.

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Water (abiotic factor)

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Water (abiotic factor)

Water is medium of life. Without water life is impossible.

About **71%** of earth surface is covered with water. **97%** of this water is saltwater present in oceans while only **3%** is available as freshwater.

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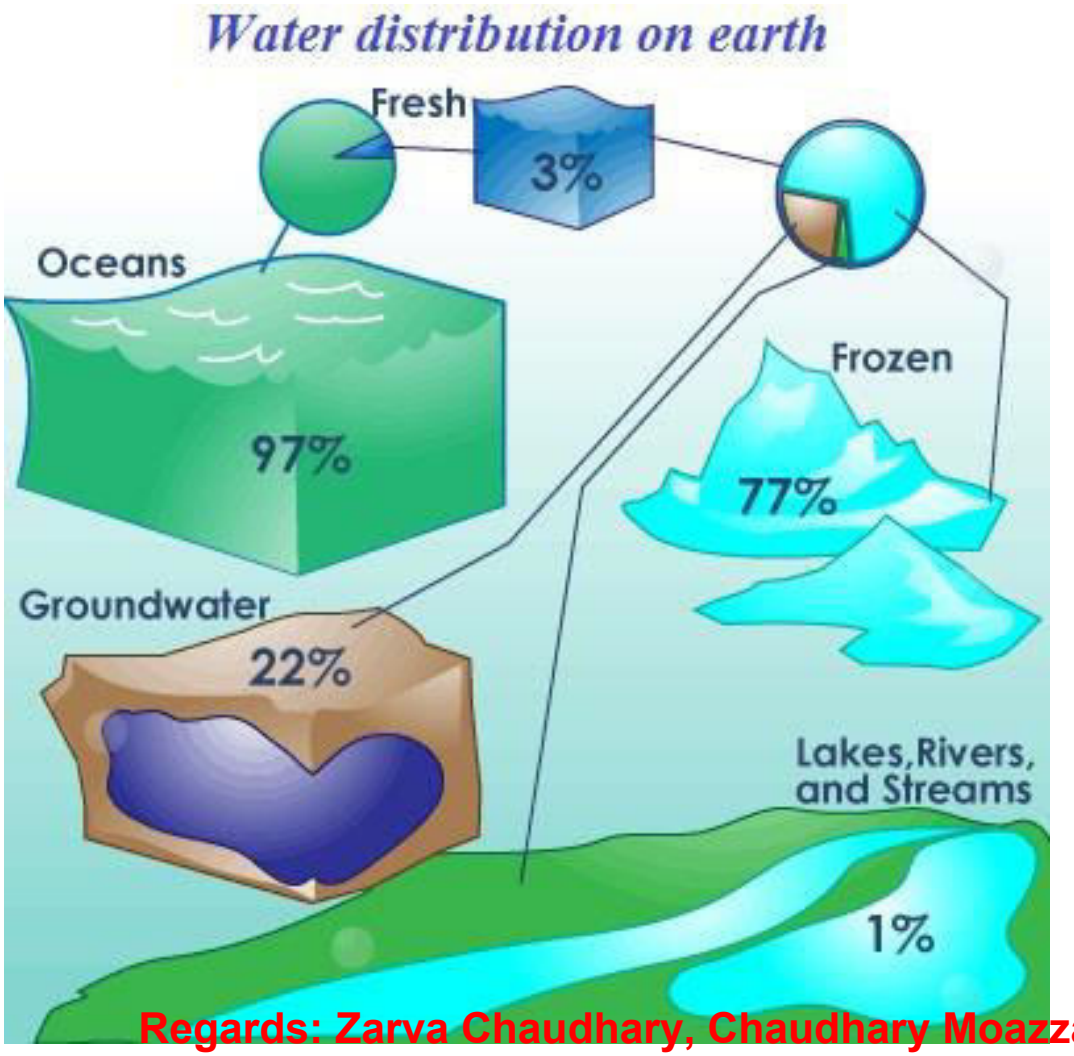
Water (abiotic factor)

The overall distribution of water on the earth surface is depicted by this diagram.



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Water (abiotic factor)

Water importance

- Photosynthesis
- Irrigation
- Domestic use
- Industrial use for power generation
- Recreational purpose

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Water (abiotic factor)

- Drinking
- Transport of nutrients throughout body
- Removal of waste from body
- Lubricate body tissues
- Maintains the temperature of body
- Essential for proper functioning of body
- Maintenance of pH

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Freshwater ecosystem

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Freshwater ecosystem

Freshwater Division

Freshwater ecosystem includes

1. **Lentic water bodies or systems**
2. **Lotic water bodies or systems**

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Freshwater ecosystem

- Cover almost about **3%** of the earth's surface.
- They provide a number of important ecological and economic services to humans.
- Possess diverse flora and fauna.

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Freshwater ecosystem

Freshwater Systems

Ecological Services

- Climate moderation
- Nutrient cycling
- Waste treatment
- Flood control
- Groundwater recharge
- Habitats for many species
- Genetic resources and biodiversity
- Scientific information

Economic Services

- Food
- Drinking water
- Irrigation water
- Hydroelectricity
- Transportation corridors
- Recreation
- Employment

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Lotic water bodies

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Lotic water bodies

The study of freshwater is known as limnology.

Those water bodies that hold running water are termed as lotic water bodies.

High dissolved oxygen due to continuous flow of water

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Lotic water bodies

Examples of lotic water bodies are

1. Rivers
2. Streams
3. Springs

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Lotic water bodies

Lotic water bodies receive water supply from

- Precipitation
- Snow melt
- Springs

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Lotic water bodies

Rivers

A deep fast flowing freshwater body with high dissolved oxygen content.

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Lotic water bodies

Streams

A shallow fast flowing water body smaller than rivers.

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Lotic water bodies

Springs

A freshwater body in which water flows out of the ground.

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Streams

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Streams

A small, shallow and fast moving water body that supports variety of aquatic flora and fauna.

A watershed, or drainage basin, is the land area that delivers runoff, sediment, and dissolved substances to a stream.

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Streams

In many areas, streams begin in mountainous or hilly areas that collect and release water falling to the earth's surface as rain or snow melts during warm seasons.

Streams have low depth and narrow banks.

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Streams

Streams receive nutrients from

- Falling leaves
- Animal feces
- Insects
- Biomass washed into streams during heavy rainstorms or by melting snow.

Thus, the levels and types of nutrients in a stream depend on what is happening in the stream's watershed.

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Streams

Streams receive their water from

- Precipitation
- Melting snow
- Groundwater

They lose water by

- Evaporation
- Sinking into the ground
- Discharge at their terminus or mouth.

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Streams

The velocity of a stream depends on following factors

i. Volume of water

ii. Stream channel width and depth

iii. Slope or gradient of stream

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Rivers

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Rivers

Small streams join to form rivers, and rivers flow downhill to the ocean. Rivers and streams are powerful transporting agents as they roll and push material on their bed down the channel. The suspended matter give river water a muddy look.

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Rivers

The downward flow of surface water and groundwater from mountain to the sea typically takes place in three zones characterized by different environmental conditions:

- Source zone
- Transition zone
- Floodplain zone

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Rivers

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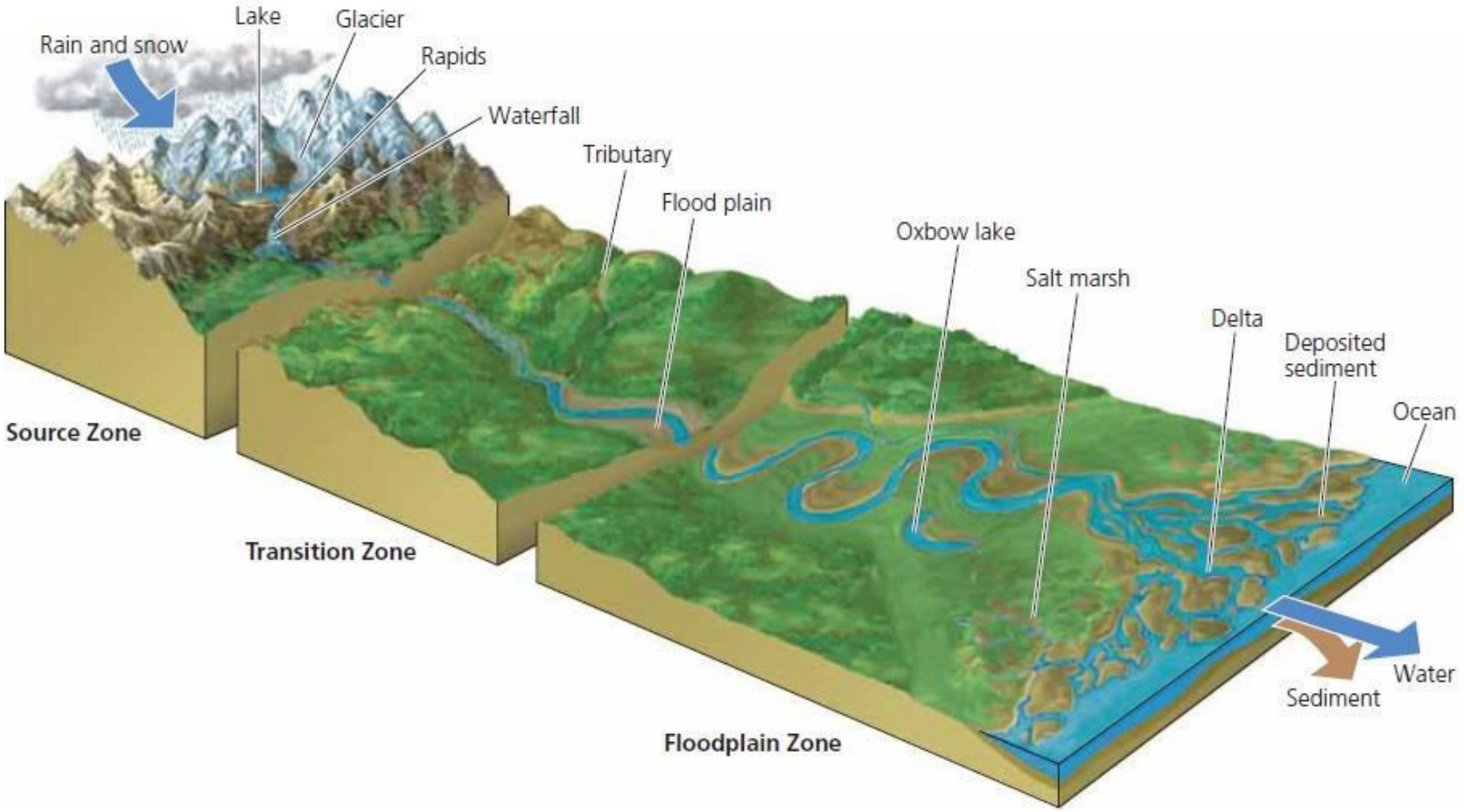

Three zones in the downhill flow of water:

- *Source zone* containing mountain (headwater) streams
- *Transition zone* containing wider, lower-elevation streams
- *Floodplain zone* containing rivers which empty into the ocean

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Lentic water bodies

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Lentic water bodies

Standing bodies of freshwater that supports variety of life.

Wind action is very vital in these water bodies because it increases the content of dissolve oxygen that is necessary for the aquatic life in these water bodies.

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Lentic water bodies

Examples of such water systems are

Ponds

Lakes

Wetlands

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Lentic water bodies

These still water bodies possess following zones,

- Littoral zone
- Limnetic zone
- Profundal zone
- Benthic zone

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Lentic water bodies

Overturn

The mixing of water from the bottom of the lake with the water close to the surface of lake.

This occurs during spring and fall. Lake overturn enhances the dissolve oxygen content of lake that is necessary for survival of life present in the lake water.

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Lakes

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Lakes

Lakes are large natural bodies of standing freshwater formed when precipitation, runoff, or groundwater seepage fills depressions in the earth's surface.

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Lakes

Lake formation

Factors that are vital in lake formation are

- Glaciation
- Crustal displacement
- Volcanic activity

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Lakes

Freshwater lakes vary tremendously in

- Size
- Depth
- Nutrient content

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Lakes

Deep lakes normally consist of four distinct zones

1. Littoral
2. Limnetic
3. Profundal
4. Benthic

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Lakes

Littoral zone:

A shallow water area near the shore where maximum light can penetrate.

Littoral zone possess

- High biological diversity
- Ample sunlight
- Inputs of nutrients

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Lakes

Limnetic zone:

Open water area away from shore where still enough light can penetrate.

- Main photosynthetic body
- Produces food and oxygen for consumers
- Most abundant organisms are microscopic phytoplankton and zooplankton

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Lakes

Profundal zone

A deep zone of standing body of water where light can not penetrate.

- No photosynthesis.
- Oxygen levels are often low
- Cool and dark water with fish species is found

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Lakes

Benthic zone

The bottom of the lake Containing organisms called benthos.

- ❖Decomposers
- ❖Detritus feeders
- ❖Invertebrates
- ❖Some fishes

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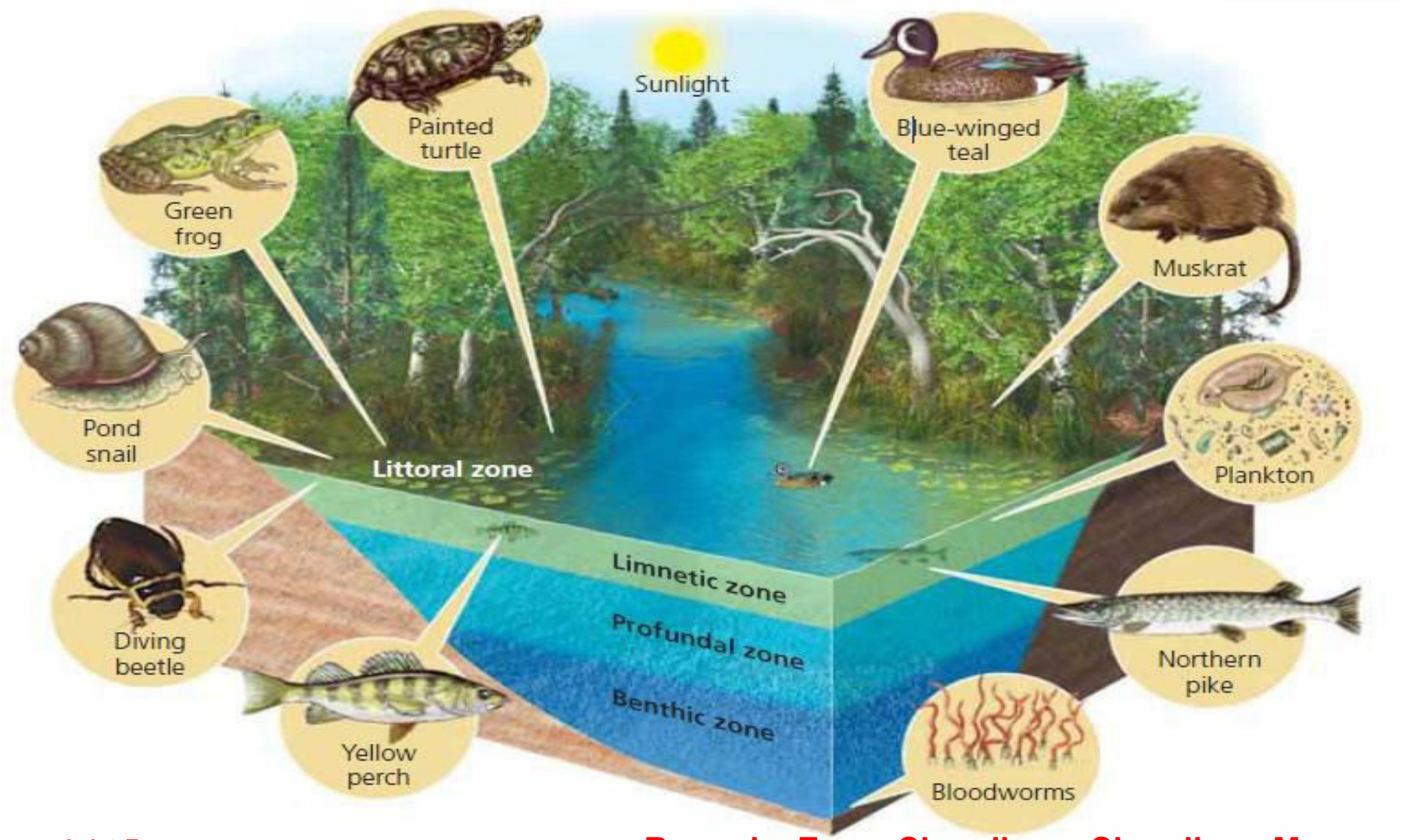
Lakes



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Oligotrophic lakes

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Oligotrophic lakes

Ecologists classify lakes according to their

1. Nutrient content
2. Primary productivity.

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Oligotrophic lakes

Lakes that have a small supply of plant nutrients are called **oligotrophic lakes.**

Oligotrophic lakes are poorly nourished lakes.

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Oligotrophic lakes

- Often deep
- Steep banks
- Glaciers and mountain streams supply water
- Little sediment or microscopic life
- Crystal-clear water
- Small populations of phytoplankton and fishes such as smallmouth bass and trout
- Low net primary productivity.

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Oligotrophic lakes

Over time, sediment, organic material, and inorganic nutrients wash into most oligotrophic lakes, and plants grow and decompose to form bottom sediments.

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Oligotrophic lakes

Crater Lake in the U.S. state of Oregon is an example of an *oligotrophic lake* that is low in nutrients. Because of the low density of plankton, its water is quite clear.

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Eutrophic lake

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Eutrophic lake

A lake with a large supply of nutrients needed by producers is called a **eutrophic lake.**

They are also designated as well-nourished lakes because they receive maximum nutrients.

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Eutrophic lake

Eutrophic lake usually have

- Shallow depth
- Murky brown or green water
- High turbidity
- High net primary productivity.

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Eutrophic lake

Cultural eutrophication

Human inputs of nutrients from the atmosphere and from nearby urban and agricultural areas can enhance the biological activity of lakes by a process called **cultural eutrophication or simply eutrophication.**

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Eutrophic lake

Hypertrophic lake

Lake having excessive amounts of dissolved nutrients.

Mesotrophic lake

Alake having moderate amounts of dissolved nutrients.

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Eutrophic lake

A *eutrophic lake* having an excess of plant nutrients. Its surface is covered with mats of algae and cyanobacteria.

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Inland wetlands

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Inland wetlands

Inland wetlands are lands covered with freshwater all or part of the time (excluding lakes, reservoirs, and streams) and located away from coastal areas.

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Inland wetlands

Some examples of inland wetlands are

- Marshes
- Swamps
- Prairie potholes
- Floodplains

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Inland wetlands

Some wetlands are covered with water year-round.

Some wetlands stay dry for years before water covers them again.

Scientists use the composition of the soil or the presence of certain plants to determine that a particular area is a wetland.

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Inland wetlands

Seasonal wetlands

Remain under water for only a short time each year.

- Prairie potholes
- Floodplain wetlands
- Bottomland hardwood swamps

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Inland wetlands

Wetlands are important habitats for

- Game fishes
- Muskrats
- Otters
- Beavers
- Migratory waterfowl

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Ecological and economic services of a wetland

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Ecological and economic services of a wetland

Wetlands are vary valuable natural habitats in different areas of world. They provide a number of free ecological and economic services to humans and other living organisms.

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Ecological and economic services of a wetland

Wetland services

- Filtering and degrading toxic wastes and pollutants
- Reducing flooding and erosion
- Helps to replenish stream flows during dry periods
- Helps to recharge groundwater aquifers

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Ecological and economic services of a wetland

- Helps to maintain biodiversity
- Provide habitats for a variety of species
- Supply valuable products such as fishes and shellfish, blueberries, cranberries, wild rice, and timber
- Provide recreation for birdwatchers, nature photographers, boaters, anglers, and waterfowl hunters.

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Brackish water

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Brackish water

Estuary

A semi-enclosed body of mixed water where salt water from the sea mixes with fresh water from the land.

That mixture of water is known as **estuarine water or brackish water.**

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Brackish water

In an estuary, the amount of water mixing depends on the

- Amount of runoff from the land
- The tidal range
- The wind

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Brackish water

Freshwater inflow provides a rich basis for life, making opportunities for commercial and recreational fishing for finfish, molluscs, and crustaceans.

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Brackish water

Types of Estuary,

1. Bar built estuary
2. Fjords
3. Tectonic estuary
4. Coastal plain estuary

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Brackish water

Fjords

A type of estuary that is formed in river valleys due to the action of valley glaciers. Mostly found in Norway.

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Coastal wetlands

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Coastal wetlands

A productive waterlogged area present between land and open sea is known as **coastal wetland**. These coastal aquatic systems provide important ecological and economic services.

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Coastal wetlands

Mangrove forest

They are some of the earth's most productive ecosystems because of,

- High nutrient inputs from rivers and nearby land
- Rapid circulation of nutrients by tidal flows
- Ample sunlight penetrating the shallow waters

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Coastal wetlands

The tangled roots and dense vegetation of mangrove forests act like shock absorbers to reduce damage from storms. They also provide a highly complex habitat for a diversity of invertebrates and fishes.

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Coastal wetlands

Sea grass beds

Another component of coastal marine biodiversity.

- Support at least 60 species of plants that grow underwater.
- Highly productive and physically complex systems that support a variety of marine species.
- Stabilize shorelines and reduce wave impacts.

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Coastal wetlands

Importance of coastal wetlands

- Maintain water quality
- Filter toxic pollutants, excess plant nutrients, and sediments,
- They provide food,
- Habitats, and nursery sites for a variety of aquatic and terrestrial species.
- They also reduce storm damage and coastal erosion by absorbing waves .
- Supply timber and fuel wood to coastal communities.

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Marine-water ecosystem

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Marine-water ecosystem

Marine aquatic systems are a great source of biodiversity. They include many different ecosystems, which host a great variety of species, genes, biological and chemical processes that occur in this ecosystem.

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Marine-water ecosystem

Marine water ecosystem sustains four major components of the earth's biodiversity.

1. Ecological diversity
2. Functional diversity
3. Species diversity
4. Genetic diversity

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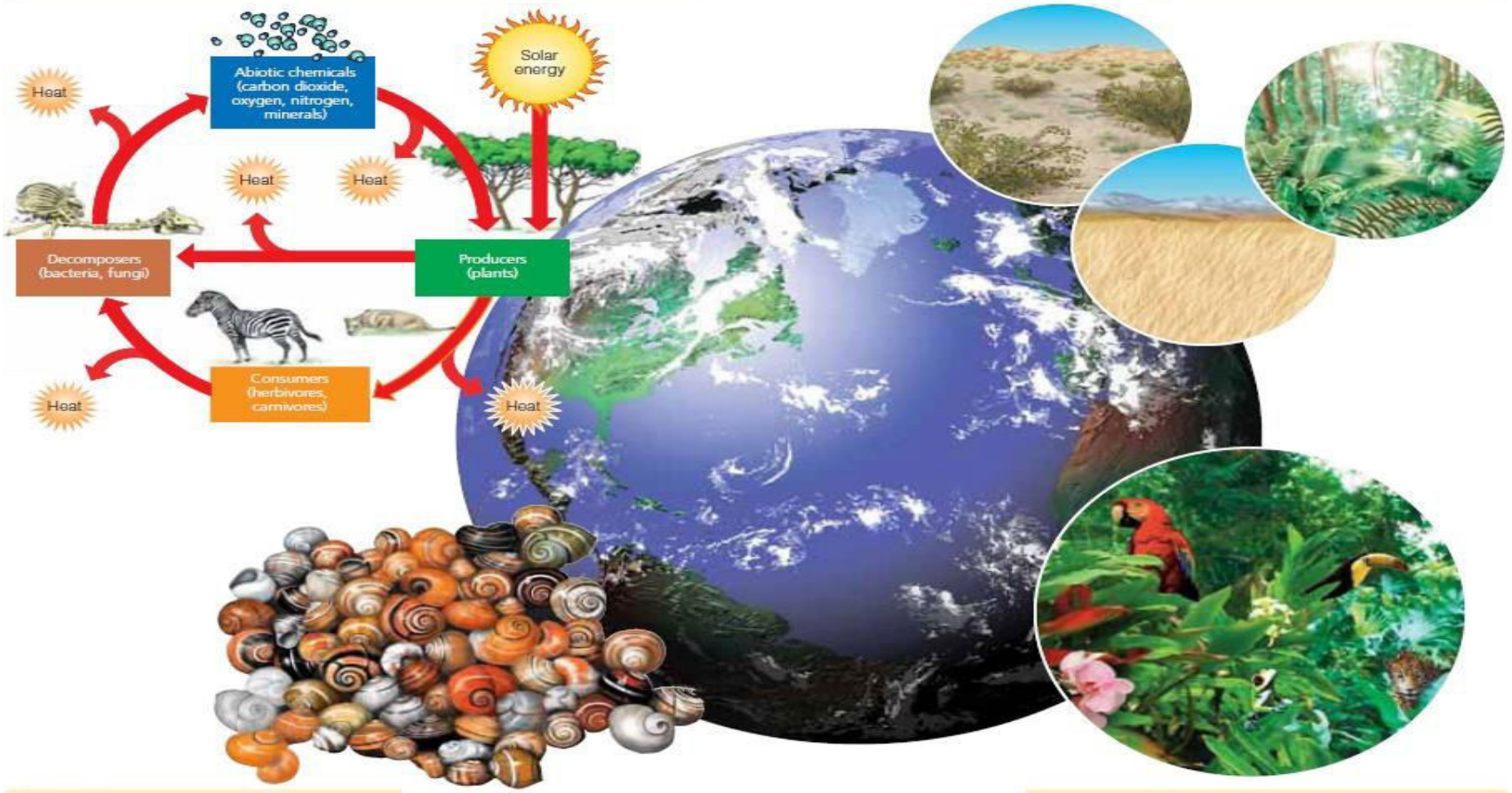
Marine-water ecosystem

Functional Diversity
The biological and chemical processes such as energy flow and matter recycling needed for the survival of species, communities, and ecosystems.

Ecological Diversity
The variety of terrestrial and aquatic ecosystems found in an area or on the earth.



Genetic Diversity
The variety of genetic material within a species or a population.

Species Diversity
The number and abundance of species present in different communities.

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Marine water life zones

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Marine water life zones

Marine life is found in three major life zones:

1) **The coastal zone**

2) **Open sea**

3) **Ocean bottom**

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Marine water life zones

1. Coastal zone

- Warm
- Nutrient-rich
- Shallow water
- Makes up less than 10% of the world's ocean
- Contains 90% of all marine species

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Marine water life zones

2. Open ocean

The part of ocean that is deep and away from the coastal zone is termed as open ocean. On the basis of the light penetration open ocean is divided into three vertical zones.

1. Euphotic zone
2. Bathyal zone
3. Abyssal zone

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Marine water life zones

Euphotic zone

Upper part of open ocean where maximum light can penetrate.

- Phytoplankton carry out about 40% of the world's photosynthetic activity
- High level of dissolve oxygen
- Fish species found in this zone are swordfish, sharks, and bluefin tuna

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Marine water life zones

Bathyal zone

Middle part of open ocean that receive a very little amount of sunlight.

-Very little or no photosynthetic activity

-Zooplankton and smaller fishes are the inhabitants of this zone.

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Marine water life zones

Abyssal zone

The deepest zone of ocean that contains cold and dark water.

-No photosynthetic activity.

-Contains enough nutrients to support large number of species

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Marine water life zones

3. Ocean floor

The base of an ocean where most organisms of the deep waters get their food from marine snow.

Showers of dead and decaying organisms drifting downward from upper lighted levels of the ocean are known as **marine snow**.

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Marine water life zones

Deposit feeders

some of organisms found in deep ocean are deposit feeders. These organisms, take mud into their guts and extract nutrients from it. some worms species are deposit feeders.

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Marine water life zones

Filter feeders

Other organisms found in deep oceans are filter feeders. They take in large amount of water into the body and then filter nutrients from it. Organisms like oysters, clams, and sponges are filter feeders.

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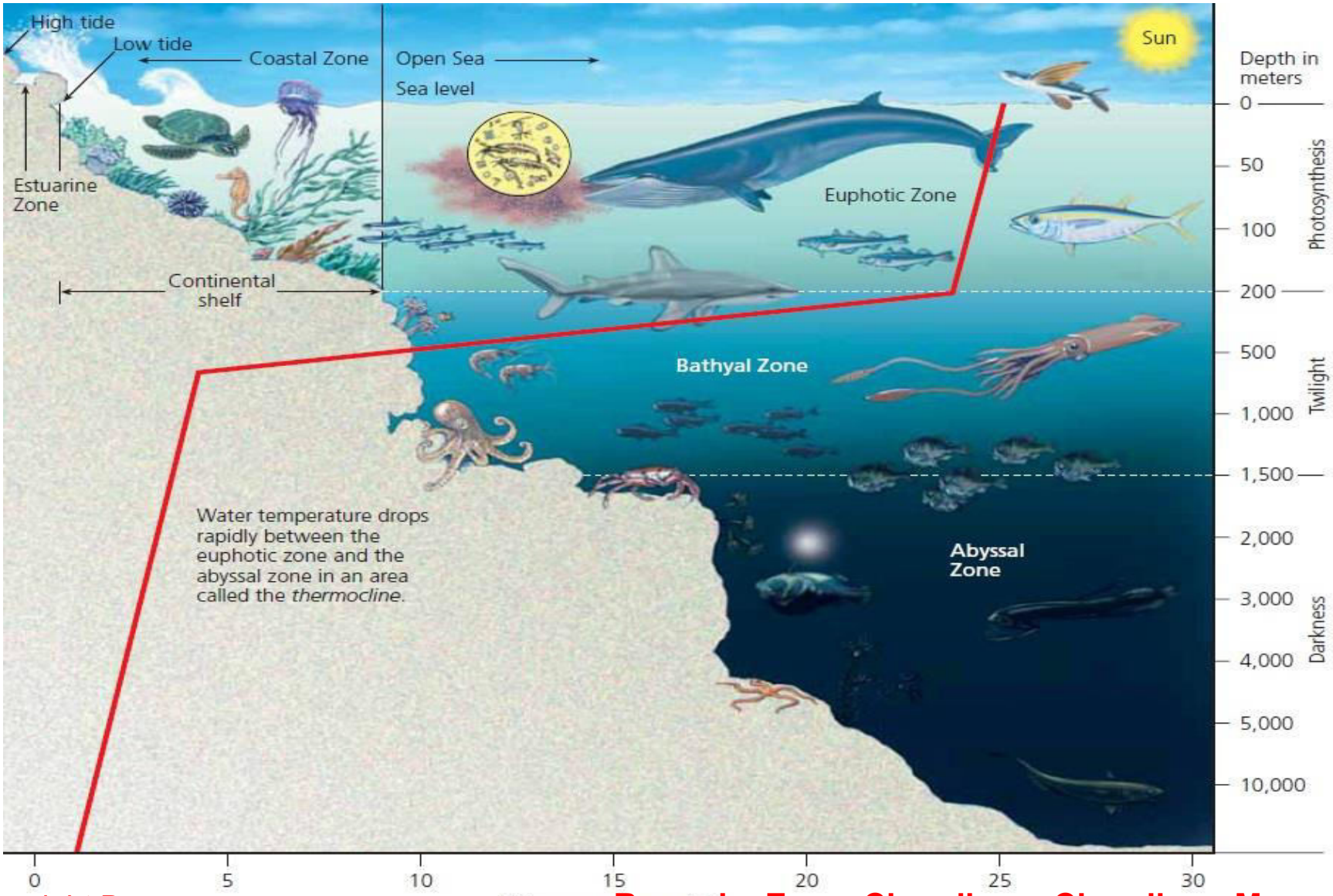
Marine water life zones



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Importance of marine ecosystems

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Importance of marine ecosystems

About **97%** of total volume of water on earth surface belongs to sea water.

Oceans provide valuable ecological and economic services. The overall economic benefit from marine coastal ecosystems is over **$12 trillion** per year.

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Importance of marine ecosystems

Ecological services

- Climate moderation
- CO2 absorption
- Nutrient cycling
- Waste treatment

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Importance of marine ecosystems

- Reduced storm impact (mangroves, barrier islands, coastal wetlands)
- Habitats and nursery areas
- Genetic resources and biodiversity
- Scientific information

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Importance of marine ecosystems

Economic services

- Food
- Animal and pet feed
- Pharmaceuticals
- Harbors and transportation routes
- Minerals

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Importance of marine ecosystems

- Oil and natural gas
- Building materials
- Coastal habitats for humans
- Recreation
- Employment

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Aquatic life zones

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Aquatic life zones

Saltwater and freshwater life zones possess several major types of organisms. Most Aquatic Species Live in top ,middle, or bottom Layers of Water.

- **Plankton**
- **Nekton**
- **Benthos**
- **Decomposers**

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Aquatic life zones

Plankton

A microscopic swimming and free floating organisms in water are termed as planktons.

- Phytoplankton
- Zooplankton
- ultraplankton

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Aquatic life zones

Phytoplankton

Microscopic free floating plants are called as phytoplankton.

Includes different types of algae that act as a producer and supports most aquatic food webs.

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Aquatic life zones

Zooplankton

A microscopic drifting animals are known as zooplankton.

- Primary consumers (herbivores) that feed on phytoplankton
- Secondary consumers that feed on other zooplankton.
- They range from single-celled protozoa to large invertebrates such as jellyfish.

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Aquatic life zones

Ultraplankton

A very small drifting plankton having size less than 2 micrometer are called as ultraplankton.

Includes small photosynthetic bacteria that carry out 70% of the primary productivity near the ocean surface.

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Aquatic life zones

Nekton

This class of organisms include active swimmers that act as a consumers.

Important examples of nektons are fish, turtles and whales.

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Aquatic life zones

Benthos

- Bottom dwellers
- Oysters, which anchor themselves to one spot
- Clams and worms, which burrow into the sand or mud
- Lobsters and crabs, which walk about on the sea floor

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Aquatic life zones

Decomposers

Mainly bacteria and fungi that break down dead and decaying organic matter and release nutrients. These nutrients in turn are used by the primary producers for manufacturing food.

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Coral reefs

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Coral reefs

Corals are tiny living animals that belong to group of organisms called Cnidarian.

There are two main types of corals

- Soft corals
- Hard corals

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Coral reefs

Coral reefs are produced by the large mass of calcium carbonate that is secreted by the corals in marine water.

Coral reefs are an amazing centre of aquatic biodiversity.

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Coral reefs

A coral reef with a large number of different species.

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Coral reefs

Importance of coral reefs

- Provide natural habitat
- Economic benefits
- Food
- Medicine
- Recreation
- Breeding grounds
- Nursing grounds

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Rocky and sandy shores

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Rocky and sandy shores

The area of shoreline between low and high tides is called the **intertidal zone**. These low and high tides are produced due to gravitational pull of moon and sun. organisms in this zone must be able to survive against the wave impact and changing levels of salinity.

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Rocky and sandy shores

Rocky shores

Rocky shores face a huge impact of waves, so a large number of species occupy different niches in the intertidal zone in response to following changing environmental conditions,

- Temperature
- Water flow
- Salinity

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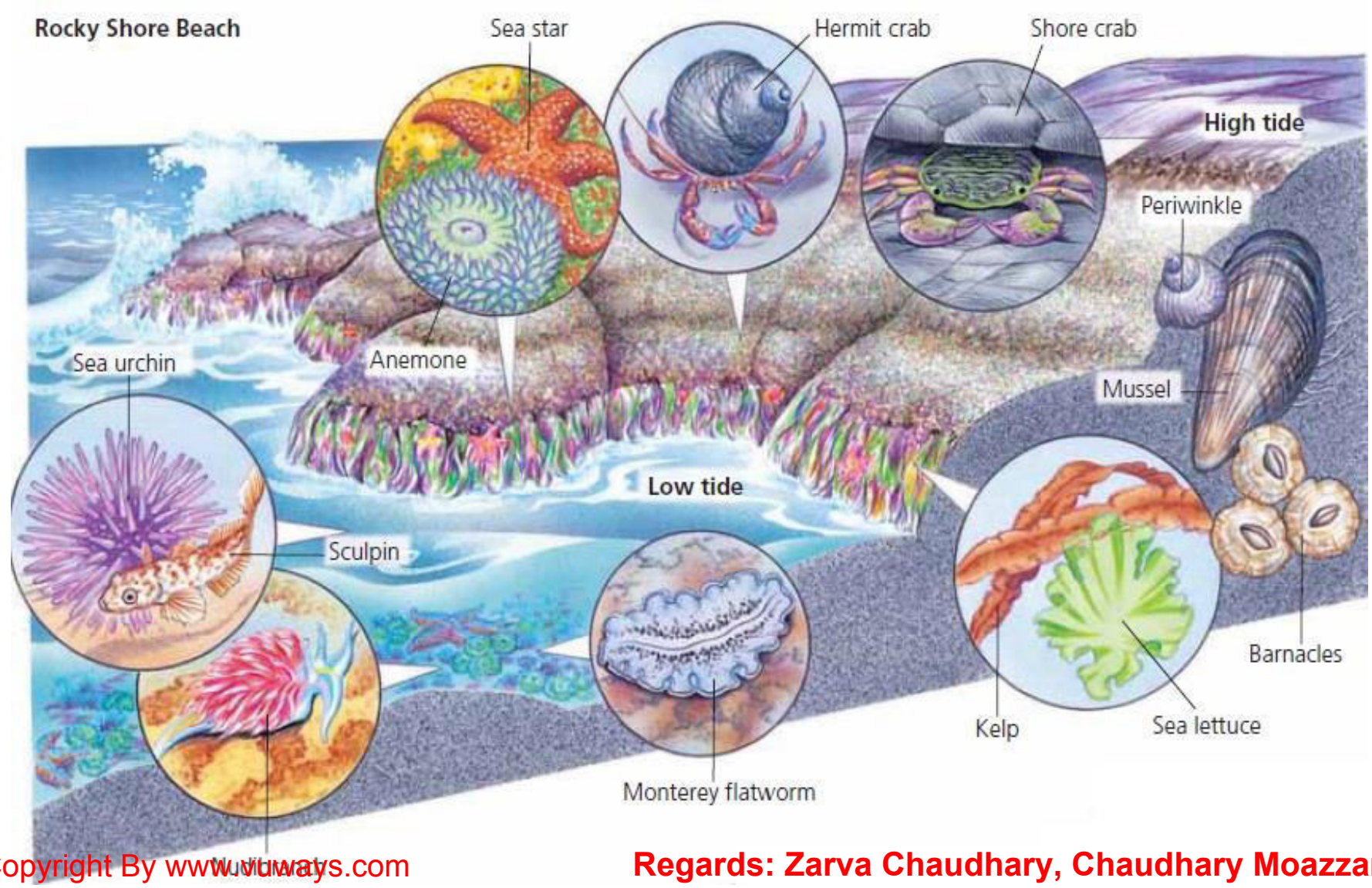
Rocky and sandy shores



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Rocky and sandy shores

Sandy shore

Sandy beaches and their adjoining coastal wetlands are a home to a variety of shorebirds that feed in specialized niches on crustaceans, insects, and other organisms.

Many of these species also live on ***barrier islands***-

Low, narrow, sandy islands that form offshore, parallel to some coastlines.

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Rocky and sandy shores

In sandy shore areas organisms can survive by adopting following adaptations,

- Burrowing in sand
- Digging in sand
- Tunnelling in sand

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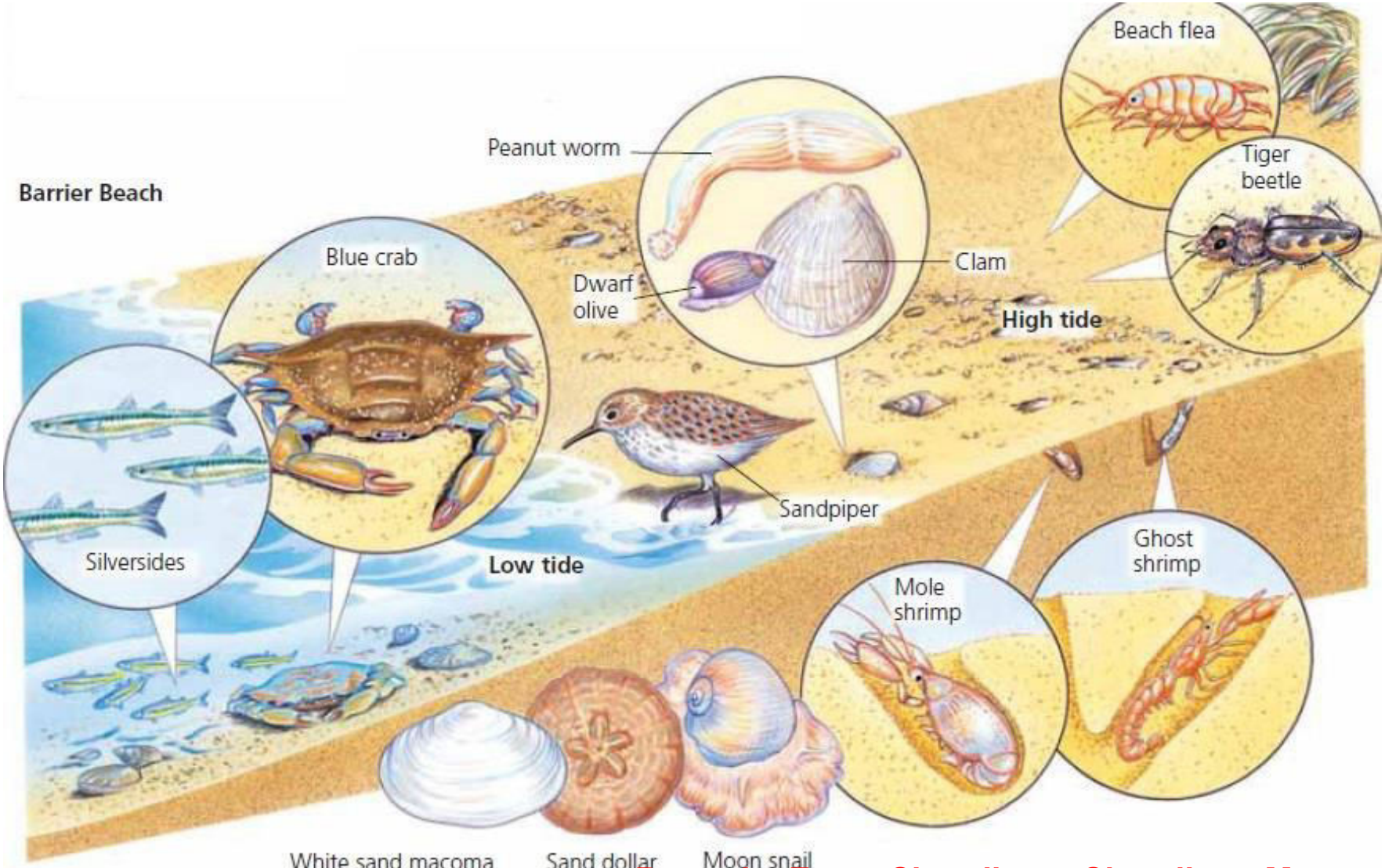
Rocky and sandy shores



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Soil (abiotic factor)

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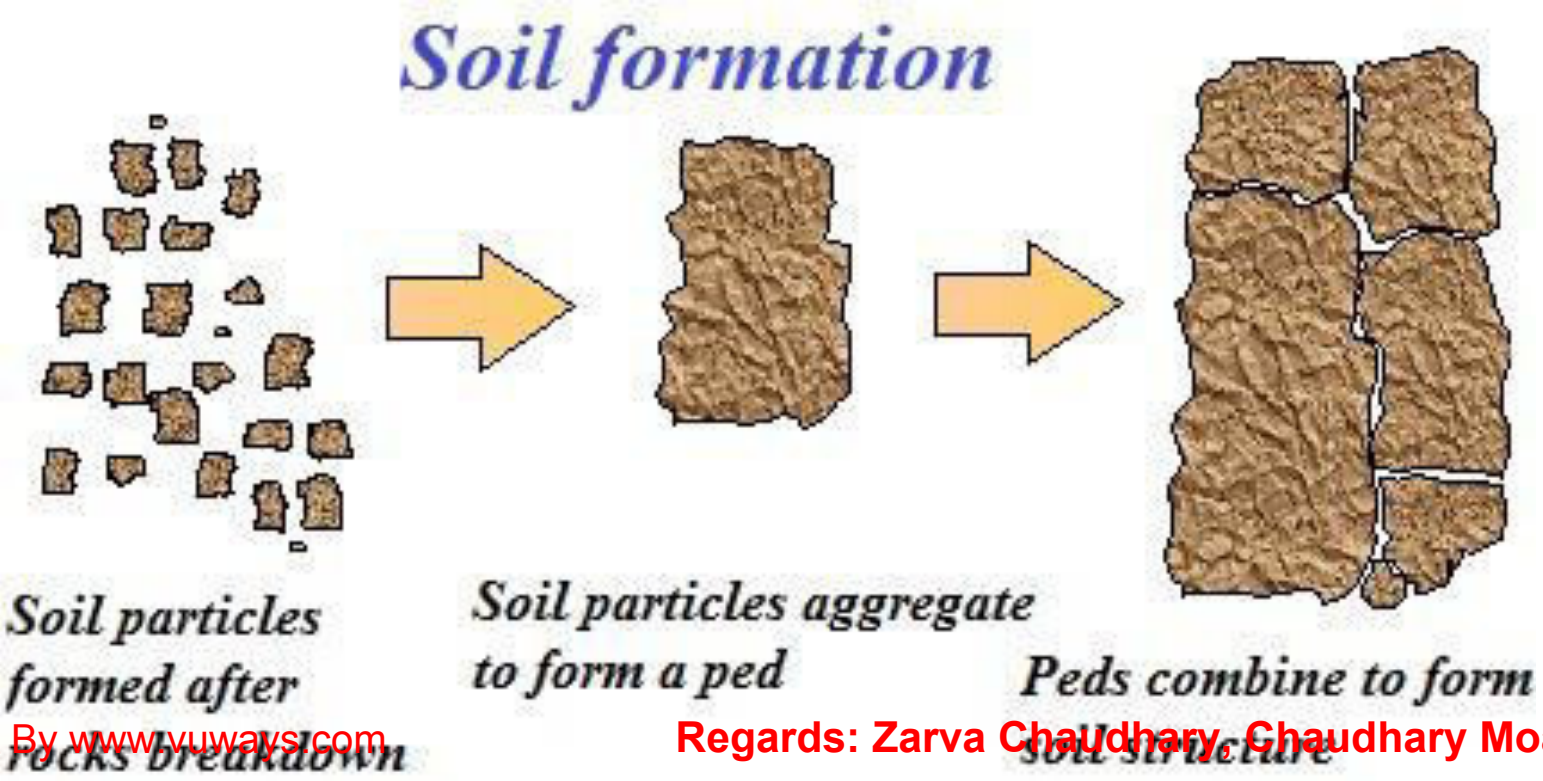
Soil (abiotic factor)

Residual product of the chemical, physical and biological breakdown of rock material that supports plant growth.



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Soil (abiotic factor)

Weathering is an important phenomenon in soil forming process.

Weathering

Process of decomposition and disintegration that causes the rocks to break down in a natural way.

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Soil (abiotic factor)

- Chemical weathering
- Mechanical weathering
- Biological weathering

In cold climates mechanical weathering is dominant, while in tropical climates chemical weathering is dominant.

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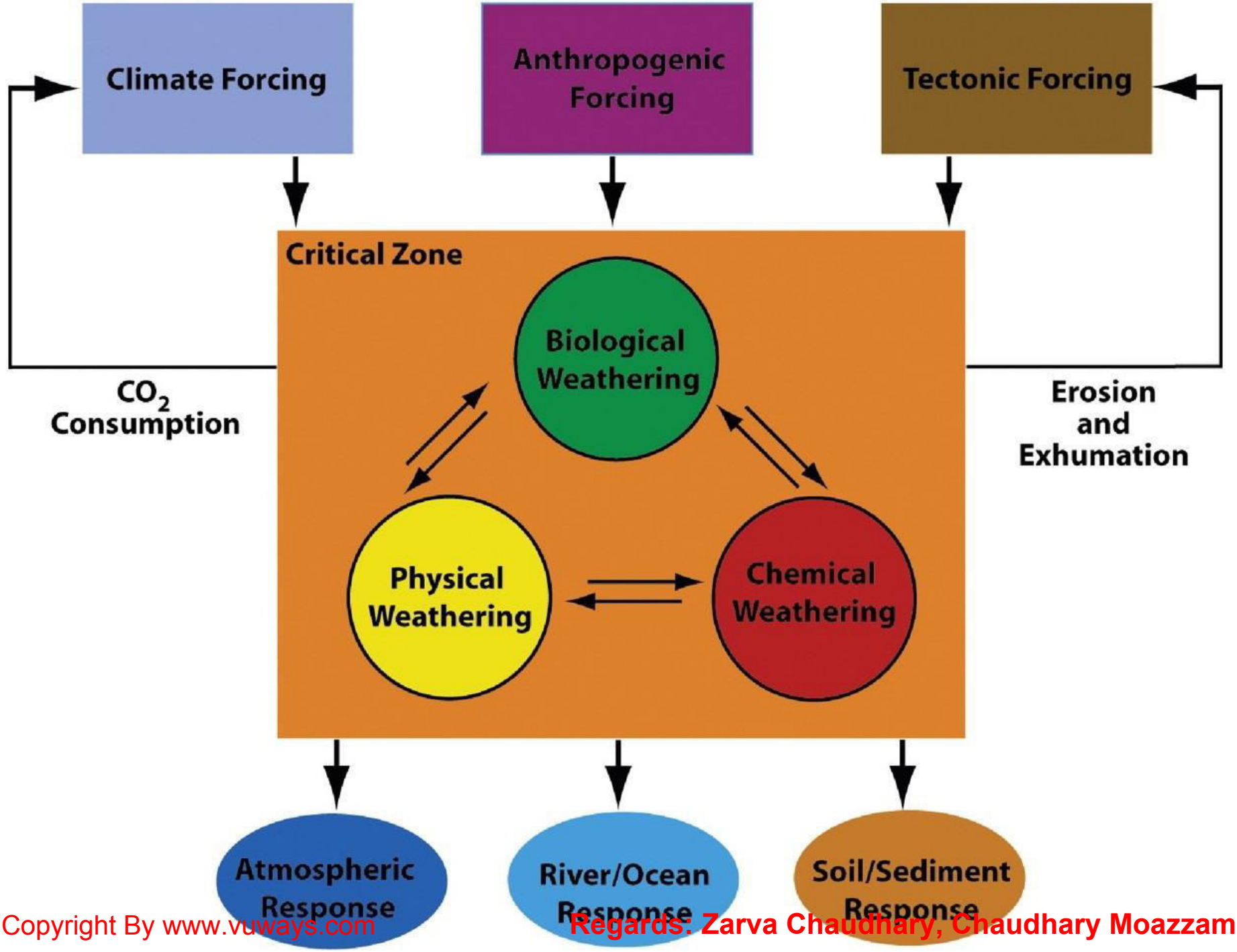

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Soil (abiotic factor)

As rocks break down, Lichens are the pioneers to occupy succeeded by mosses and quickly by other plants that take the opportunity to grow in cracks and crevices.

As the plants decay they aid in the soil-forming process.

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Soil (abiotic factor)

Soil importance:

- Nutrients
- Water
- Habitat
- Seed germination
- Biological productivity

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Soil types

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Soil types

Type of a soil can be determined by,

- Composition of the material
- Topography
- Climate
- Time length

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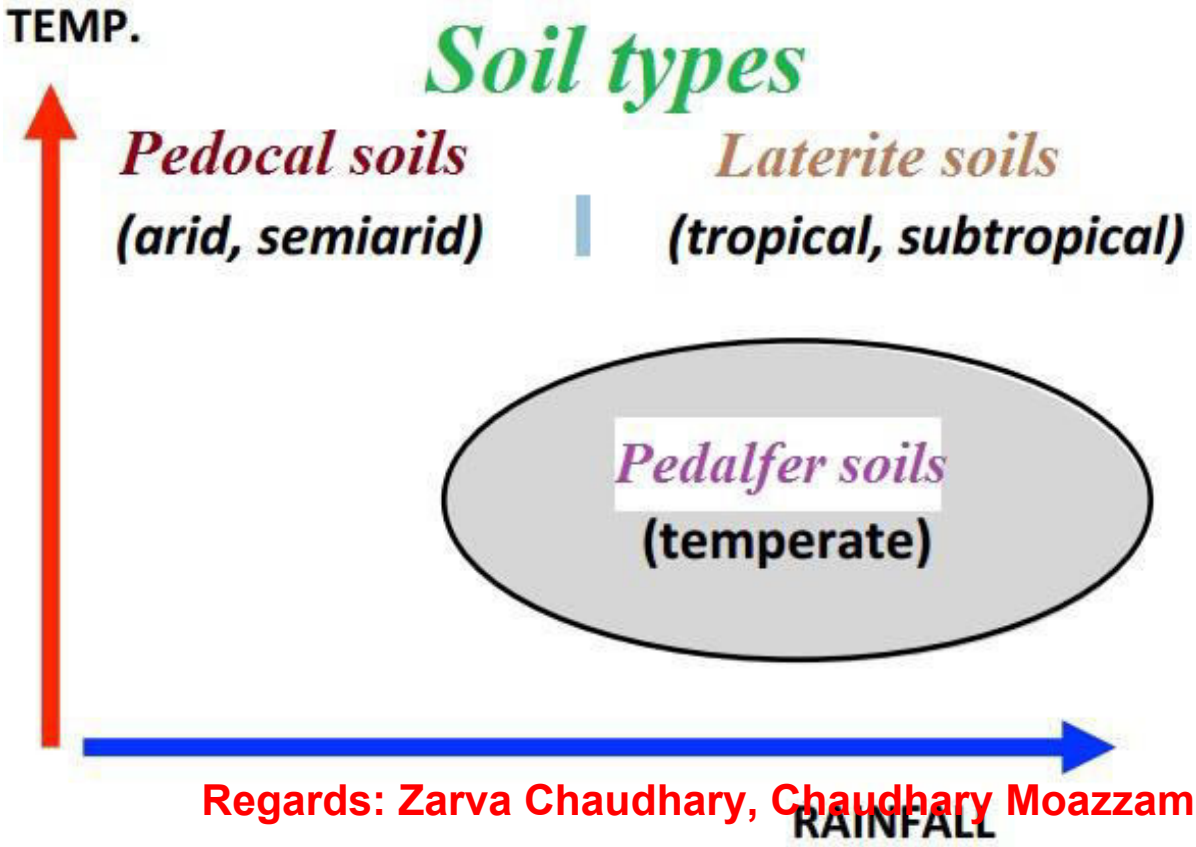
Soil types

In general soils are classified into two main groups on the base of climate,

1. **Pedalfer soils**
2. **Pedocal soils**



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Soil types

1. Pedalfer soils

The term *Pedalfer* is a combination of *ped* (soil), *al* (aluminium), and *fer* (iron).

- Acidic soils formed in temperate (wet) climates.
- Extensive leaching activity.
- Supports growth of deciduous forests and tall grasses.

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Soil types

2. Pedocal soils

ped for soil, *cal* for calcium carbonate.

- Soils that are formed in dry (arid and semiarid) climates and are basic in nature.
- Less leaching activity.
- Promotes growth of desert shrubs and small and medium grasses.

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Soil types

Laterite soil

A special type of Pedocal that is bright red and forms in tropical and subtropical climates with heavy rain and high temperature.

Caliche

A tough cemented layer developed by the dense mass of calcium carbonate.

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Soil Profile

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Soil Profile

A vertical section of soil that tells about various layers of the soils as zones. These zones are named as soil horizons.

In a typical soil profile, four zones are exposed,

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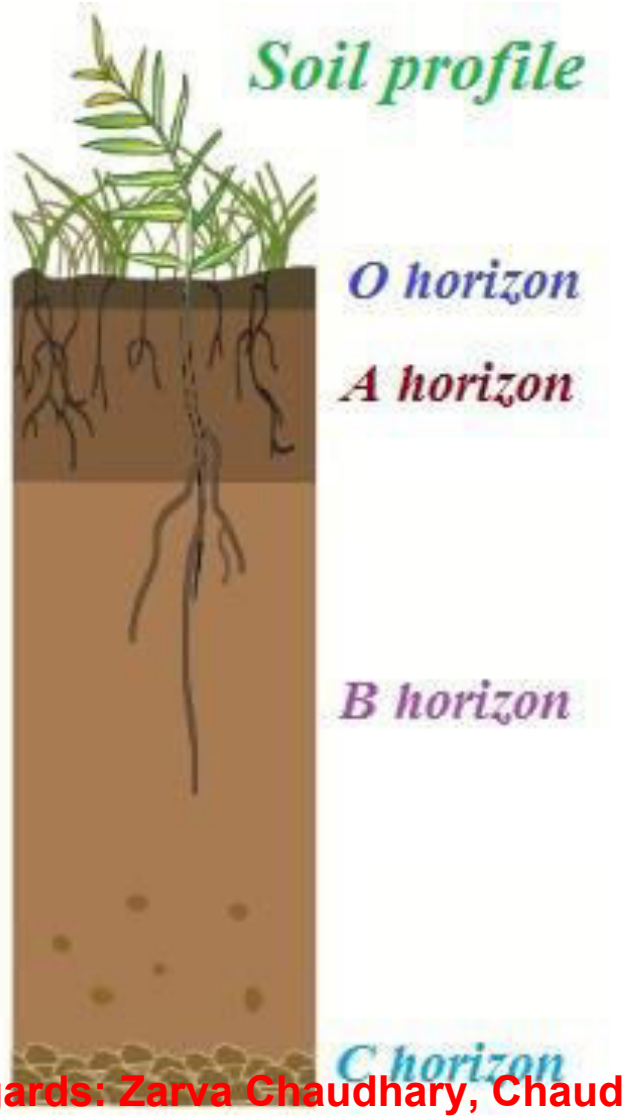
Soil Profile

1. O-horizon
2. A-horizon
3. B-horizon
4. C-horizon



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Soil Profile

O-horizon

Uppermost zone of soil surface where fallen leaves and other plant matter is deposited.

A-horizon

Zone of leaching because percolating rain picks up the soluble materials and transport it downward to B-horizon

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Soil Profile

B-horizon

Zone of accumulation because all the leaching materials are accumulated in horizon.

C-horizon

it is composed of broken bedrock material that is merged with underlying solid and hard bedrock material.

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Soil Profile

Factors that influence these horizons are,

- Erosion
- Wind
- Precipitation
- Human activity
- Topography

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Temperature (abiotic factor)

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Temperature (abiotic factor)

Temperature controls metabolic rate as well as overall activity of an individual. For example normal body temperature of humans, goat and birds is, ***98.6°F, 103°F, 105°F*** respectively.

Temperature regulates the activity of cold blooded and warm blooded animals.

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Temperature (abiotic factor)

Warm blooded animals

Animals that maintain their internal body temperature constant.

Also named homeotherms because they are able to stabilize their body temperature. Birds and mammals.

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Temperature (abiotic factor)

Cold blooded animals

Animals whose internal body temperature changes with respect to external environmental temperature. Also called Poikilotherms because they are at mercy of environmental temperature. Amphibians, fish and reptiles

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Temperature (abiotic factor)

Importance of temperature

- Metabolism
- Seed germination
- Opening and closing of flowers
- Seasonal falling of tree leaves

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Temperature (abiotic factor)

- Growth and development
- Animals migration due to seasonal changes in temperature
- Reproduction
- Temperatures changes in desert ecosystem

(hot day and cool nights)

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Thermoregulation

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Thermoregulation

Ability of an organism to regulate its body temperature.

Temperature influences many body activities,

- Metabolism
- Growth
- Reproduction

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Thermoregulation

Mechanism of thermoregulation is influenced by

- Availability of food
- Water
- Shelter

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Thermoregulation

Animals are adapted to various activities for regulation of body temperature during unfavourable environment.

1. **Endotherms**
2. **Ectotherms**

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Thermoregulation

Enzymes a biological catalyst need a specific temperature called optimum temperature for their proper functioning.

Improper temperature makes the enzymes unable to perform their catalytic activity. In high temperatures the three dimensional structure of enzymes may denature.

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