Ecology

Is the study of interactions that take place between organisms and their environment

Biodiversity

Is the variety of life on earth across all the biological organisms, it uses to describe the variety in the genetic makeup of a species, and the variety in ecosystem types, and it has 3 types

Species Diversity	Genetic Diversity	Ecological/Ecosystem Diversity
It the study of different species and the relative abundance of each species in a biological community	The amount of variation in the genetic material within a species or within a population	The variation in the ecosystems found in a region or the variation in ecosystems over the whole planet
EX: The variation in species that live in an ecosystem	**EX:** The variation in the genes that encode for hair color in humans	**EX:** The variation in ecosystems Such as deserts, forests, grasslands, wetlands, oceans

IMPORTANCE

- Provides us with arrays of foods & materials and contributes to economy
- Prevents diseases and help species to adapt to the environment
- They help scientists discovered medicines by looking on how organisms defend themselves
- It is important to the stability of an ecosystem as it helps it to maintain a steady state, even after disturbances, by keepings mechanisms and multiple organisms in place to prevent the effects of any disturbances
    - Because when there is a huge biodiversity, if we remove one species, another can make up for it

MEASURING BIODIVERSITY

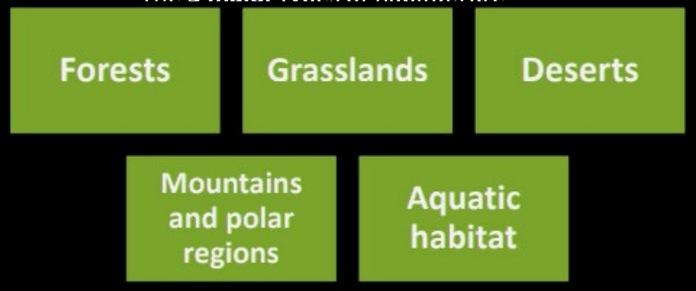
On earth, there are about 2-100 million species, with mammals making only a small fraction of it, and insects making the majority of it

Our knowledge about small organisms or those who are found in remote places (Volcanos, Caves, hot springs, and deeps see trenches) is poor.

HABITAT

is an ecological or environmental area that is inhabited by a particular species of animal, plant, or other type of organism.

The **5 major** types of habitats are

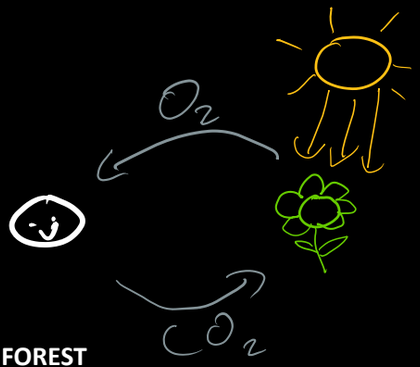


We said before that all organisms depend on each other and their interactions with each other, this is called "**interdependence**"

EXAMPLE 1

Humans survive depending on oxygen produced by photosynthetic organisms to do the biological functions

Photosynthetic organisms depends on CO_2 that are released in cellular respiration of Humans or during geochemical processes such as Volcanic eruptions.

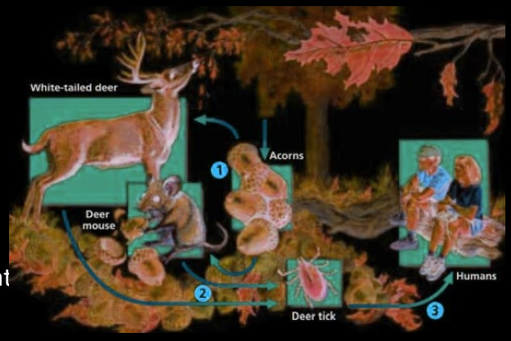


a habitat consist of two components

Abiotic	Biotic
they are non-living parts of an environment.	they are all living organisms that inhabit an environment.
Dead part of a habitat	Living part of a habitat

EXAMPLE 2 : FOREST

All the different species shown are interconnected in the forest, an Crop of acrons helps support a large population of deer & mice, the deer & mice help support a large population of ticks which carry the bacteria that gives the Lyme disease to the humans who visit the forest get



EFFECTS ON INTERDEPENDENCE

A consequence of interdependence is that any change in the environment can spread to any and every organism in the environment

EXAMPLE:

If we increased the acorn production, more dears and mice, which means more ticks and more cases of Lyme disease increase

ECOLOGICAL MODELS

Are models used to represent and describe the components of an ecological system

Scientists recognized a hierarchy of different **levels of organization** within organisms

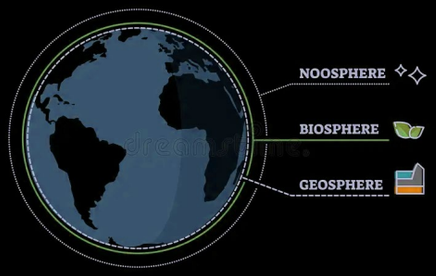
Each level has unique properties that results from the interactions of its components

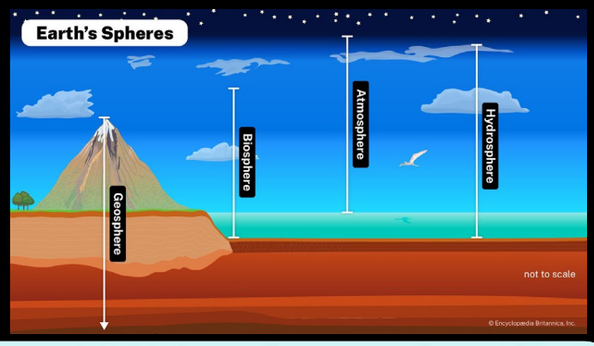
BIOSPHERE

It is the broadest most inclusive level of the organization, it takes in the thin volume of earth and its atmosphere that supports life

It's about 20km (13 mi) thick, from about 8 to 10 km (5 to 6 mi) to the greatest deep of the ocean.
Earth's diameter is 600 times the thickness of the biosphere.

It consists of smaller units called **ecosystems**



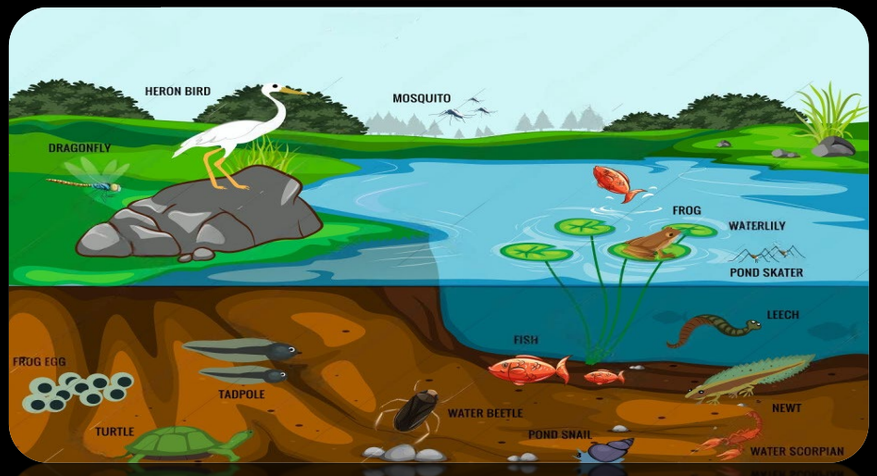


ECOSYSTEMS

It includes all of the organisms and the nonliving environment found in a place, it consists of units called communities

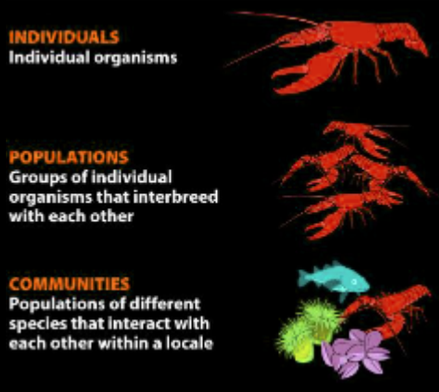
EXAMPLE

A pond ecosystem contains all the living things (Fish, turtles, aquatic plants, algae, insects & bacteria)
And the nonliving things (water, salts, etc.)



Interactions that affect the survival and inhabitance

- Insects and fish eat plants and turtles to eat fish and insects
- The chemical composition of the pond helps to determine what kind of organisms that live in the pond
- Physical factors like the amount of sunlit the pond receives, is the ultimate source of energy to the pond's inhabitants



Environmental Factors	
Abiotic	Biotic
are the physical and the chemical characteristics of the environment.	they are the living factors that affect the organism
Temperature, Humidity, pH, Salinity, Oxygen concentration, amount of sunlight, and availability of nitrogen.	Types of animals, number of bacteria, etc.

Organisms in a changing environment

each organism can survive under a limited range of environmental conditions for example, temperature, it can survive outside it but with low performance

Tolerance curve

A graph of performance versus values of environmental variables

If the organism can't survive under the conditions then those conditions are out its tolerance limit

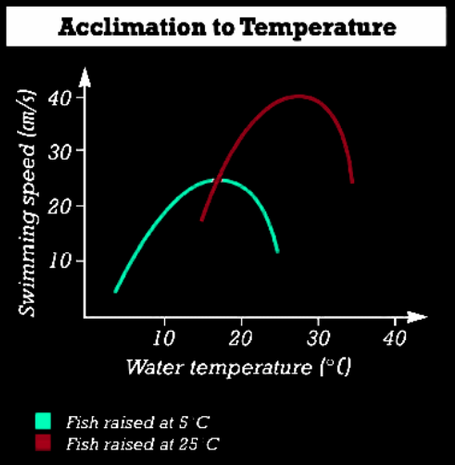
Range can be determined by the levels of the one or more factors (pH, salinity, temperature)

Acclimation

It occurs within a lifetime of an individual organism

Adaptation

Is a genetic change in a species or population that occurs from generation to generation overtime to handle specific environmental conditions



Adjusting tolerance to abiotic factors

You would see that when a gold fish was raised at different temperatures, it has different tolerance curves, as it started with different conditions

ADAPTING TO UNSUITABLE CONDITIONS

Environments fluctuate their conditions like temperature, light, moisture etc.

Conformers don't regulate their internal conditions and change as the external environment changes outside optimal conditions, if the environment remains in optimal range, then the conformers do not change

Regulators use energy to control their internal conditions within the optimal range over a wide variety of the environmental conditions

ESCAPE FROM UNSUITABLE CONDITIONS

Some creatures survive under the unsuitable conditions by escaping temporarily, it has two types

DORMANCY	MIGRATION
Long-term strategy to enter a state of reduced activity during periods of **unfavorable conditions (winter or drought)**	Seasonal movement to areas with better conditions
Hibernation for polar and grizzly bears	Bird migration, which spend spring and summer in cooler climates. They migrate to warmer climates in the fall.

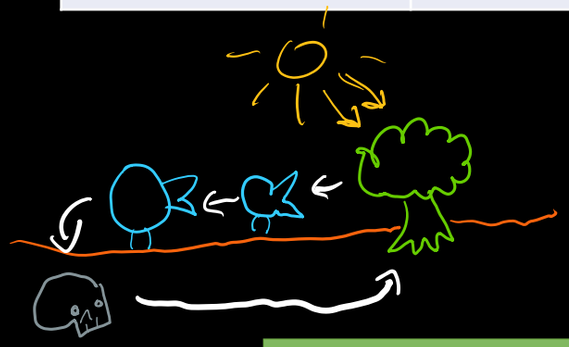
Habit	Niche
is the place where an organism live. It focuses on how the environment impacts the organism	the specific role in its habitat or th It includes the range of conditions species can tolerate, the resources methods by which it obtains resou of reproduction, and all other inte its environment. Focuses on hoe t impacts the environment.

	Generalist	Specialist
Definition	Species with broad niches. Can eat a variety of food and thrive in a range of habitats.	Species with narrow niches. Have a limited diet and stricter habitat requirements.
Example	Virginia opossum Raccoons (Procyon Lotor)	Koala in Australia. (Herbivores that feed only on the leaves of the eucalyptus tree)

ENERGY TRANSFER

Any organism needs energy to carry out essential functions, in an ecosystem

- Energy arrives from the sun to the autotrophs
- Organisms eat the autotrophs
- Other organisms eat those organisms
- Those organisms decompose
- The nutrients are then taken by the autotrophs
- Cycle continues



PRODUCERS

Autotrophs that capture light and use it to make organic molecules

MAJOR PRODUCERS

- Terrestrial ecosystems: Plants.
- Aquatic ecosystems: Photosynthetic protists and bacteria

Some autotrophic bacteria don't use sunlight to make energy. They use energy stored in inorganic molecules to produce carbohydrates (a process called chemosynthesis)

MEASURING PRODUCTIVITY

Gross primary productivity is the rate at which producers in an ecosystem **capture sunlight energy** by producing organic compounds

Biomass is the organic material produced in an ecosystem, and it is the only stored energy that is available to other organisms, so organisms cannot transfer heat from one another, but they can transfer it as **sugars** for example

Net primary productivity is the rate at which biomass accumulates, and it equals

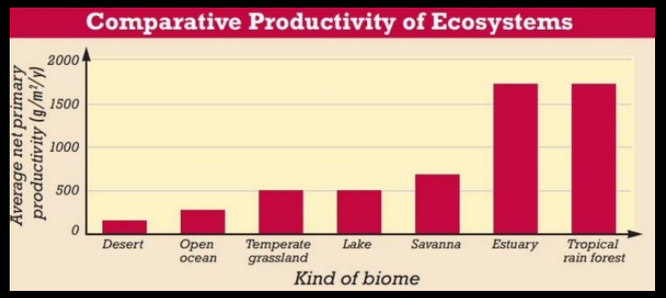
Net primary productivity = Gross primary productivity – Rate of respiration in producers

In terrestrial ecosystems, productivity is affected by 3 factors (temperature, light, precipitation)

- More light = better results
- Temperature, 37 optimal for photosynthesis
- Precipitation, good until it begins to overflow

In aquatic ecosystems, productivity is affected by 2 factors (light, nutrients)

- More light = better results
- More nutrients = better results



CONSUMERS

Heterotrophs that can't manufacture their own food, so they get energy by consuming other organisms or organic waste, they are grouped into 4 groups

- **Herbivores :** eat producers (plants) only
- **Carnivores :** eat other consumers only
- **Omnivores** : eat both
- **Detritivores** : eat the garbage of an ecosystem (recently dead organisms, fallen leaves, and animal wastes), for example, vultures

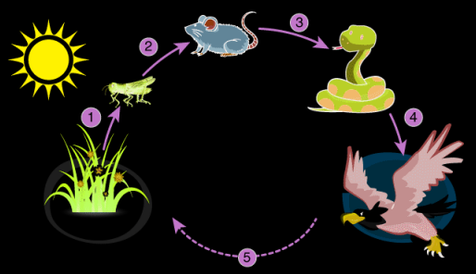
Decomposers are detritivore bacteria that cause decay by breaking down molecules, some are returned to the soil/water to be available to the **autotrophs** in the ecosystem

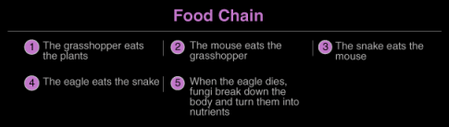
ENERGY FLOW

Energy flows in an ecosystem from **producers** to **consumers**, an organism trophic (hetero or auto, carnivores or omnivores or herbivores) indicate their positions in the sequence of energy transfer

Producers -> Herbivores -> carnivores

Most terrestrial ecosystems are simple (3 or 4 levels)
Marine ecosystems are complex (+4 levels)





FOOD CHAIN

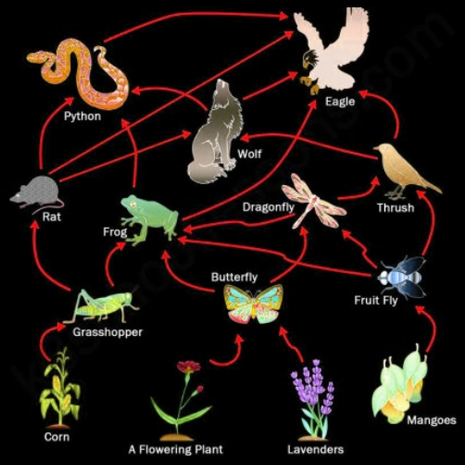
the order of events in an ecosystem, where one living organism eats another organism, and later that organism is consumed by another larger organism, and so on and so on

An ecosystem in nature, is too complex to be represented by a food chain, that's why wee use Food web

FOOD WEBS

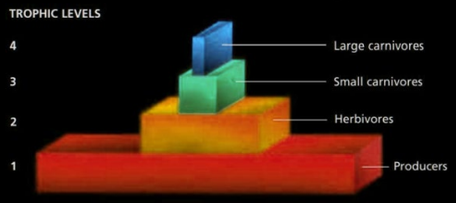
the natural interconnection of food chains and a graphical representation of what-eats-what in an ecological community.

It tells us that many consumers eat many type of food, and in addition, more than one species of a consumer May be fed on the same organism



ENERGY TRANSFER (PYRAMID OF ENERGY)

The pyramid shape indicates the low percentage of energy transfer from one level to another as most of the energy is lost as other forms like heat, so no energy transfer can be 100% efficient

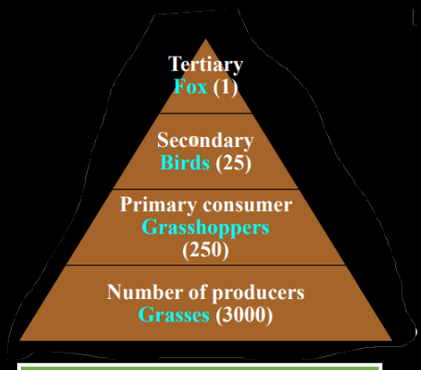


Reasons for low percentage of energy transfer

- Some organisms in a trophic level escape being eaten, and then die and become food for decomposers, so their energy doesn't go to the higher trophic levels
- When an organism is eaten, some of the molecules in it are unconsumable by the consumer, for example, A cougar can't extract energy from the antlers, hooves, and hair in a deer

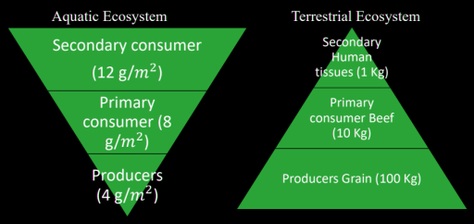
Pyramid of number

Because the low energy transfer from thing to thing The number of organisms is decreasing by going from one trophic level to another



Pyramid of biomass

A pyramid of the amount of organic stuff generated by the organism



The first consumer of the producer is called a **primary**

The consumer of the primary consumer is called a **secondary**

The consumer of the secondary consumer is called a **tertiary**

ECOSYSTEM DISRUPTION

Human impacts on air, climate, land, and water are happening at the same time contribute to ecosystem disruption**,** which sometimes might cause **extinctions**

EXTINCTION

The death of every member in a species

It happens in many ways

- Habitat Destruction, humans cut down forests, dam rivers, drain swamps, surface mine, clear lands which destroys the habitat
- Hunting
- Harvesting
- Invasive species that take over the nutrition

The current situation indicates that 20% of the Earth's plants and animals will extinct in the next 50 years.

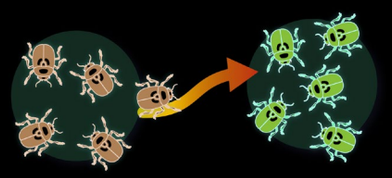
Ecosystem imbalances

Some species are critical for the functioning of the ecosystem, once that species disappear, they affect the whole chain and cause
An death of the other consumers when there are no species to take its place

Keystone species are species that affect many others in a community

When the keystone species die or disappear, the whole ecosystem would collapse and die

BIOLOGICAL EVOLUTION



is the process whereby earth's life changes over time through changes in the genes of populations.
It was proposed by Charles Darwin and Alfred Russel Wallace

The mechanism of evolution is **natural selection**
It works by when a there is a group of creatures with random traits, the creatures with the most helpful survival trait is going to
live on and reproduce and send its trait to the next generation, after multiple generation of the same process, the new generation
Is going to have a lot of new and different traits than the old
generation that It can be considered a different species