



ECOLOGY

NQF 4

THINGS TO BRING

Getting ready

- Pen
- Notebook/ Workbook
- Water



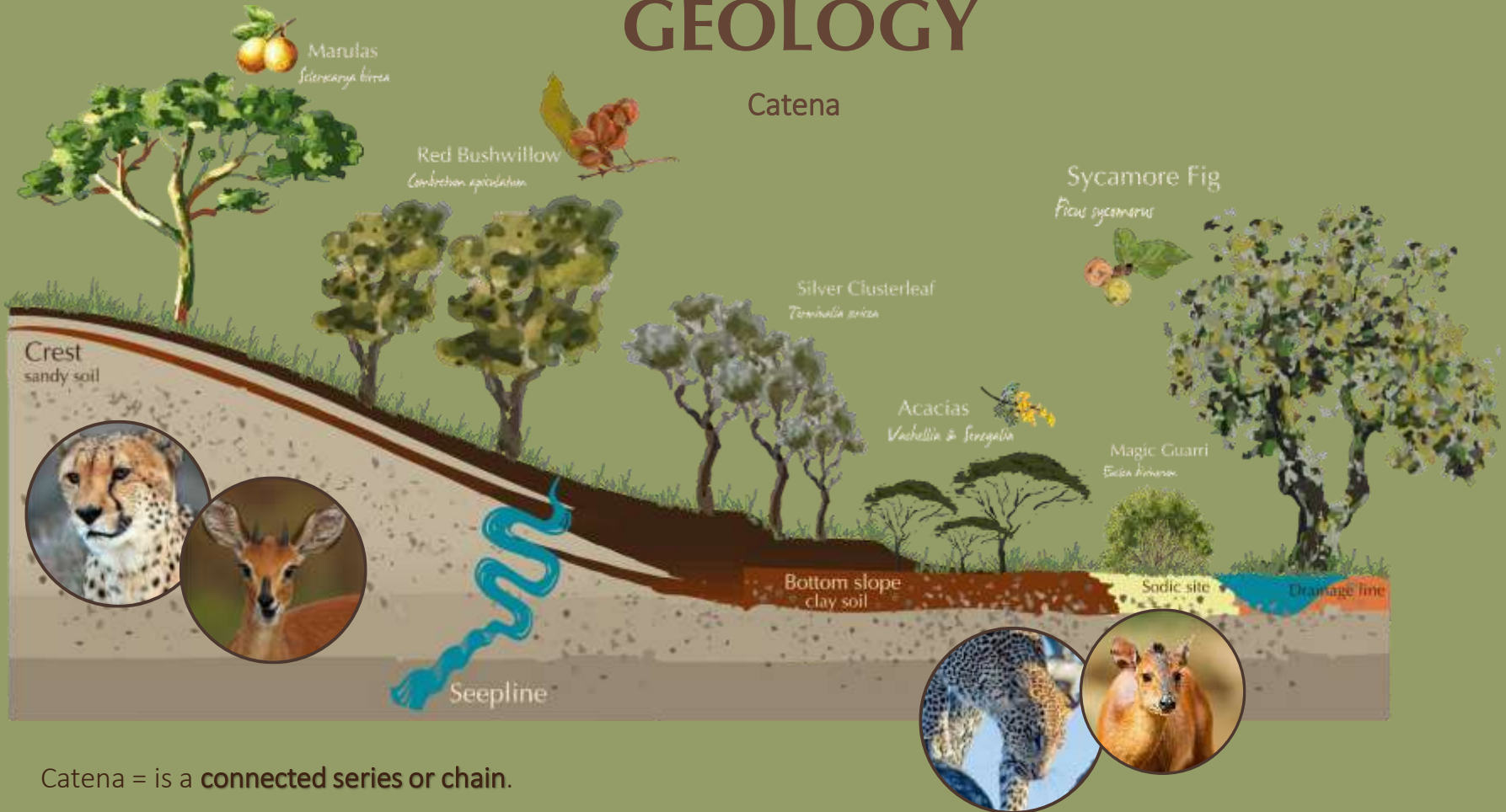
CONTENT

Duration: 1,5 h

1. The spheres of the Earth System
2. The Ecological Cycles
3. Ecology & its limits

GEOLOGY

Catena



Catena = is a **connected series** or chain.



THE SPHERES OF THE EARTH

- Geosphere
- Atmosphere
- Hydrosphere
- Cryosphere
- Biosphere
- Anthroposphere

THE SPHERES OF THE EARTH

Introduction



THE GEOSPHERE

Spheres of the earth

- Includes:
 - Rocks & Minerals
 - Surface landforms
 - Structures under the surface
- Highly active component of the earth's system
- Influences other spheres
 - Plant growth
 - Rivers shaping rock
 - Volcanic eruption
 - Mining



HOW DO WE HUMANS AFFECT THE GEOSPHERE?

THE ATMOSPHERE

Spheres of the earth

- Consists of gas molecules
 - Traps heat
 - Protects life on earth from UV light
- Interacts with all spheres on earth
 - Transports air (wind)
 - Transports water (rain)
- Without it there would be no life on earth!



HOW DO WE HUMANS AFFECT THE ATMOSPHERE?

THE HYDROSPHERE



Spheres of the earth

- The total of all water on earth
 - 97% salt water
 - Only 3% fresh water
 - unique surface waters on earth
- Influences other spheres
 - Rain
 - Rivers
 - Biodiversity



PALE BLUE DOT

Look again at that dot. That's here. That's home. That's us. On it everyone you love, everyone you know, everyone you ever heard of, every human being who ever was, lived out their lives. The aggregate of our joy and suffering, thousands of confident religions, ideologies, and economic doctrines, every hunter and forager, every hero and coward, every creator and destroyer of civilization, every king and peasant, every young couple in love, every mother and father, hopeful child, inventor and explorer, every teacher of morals, every corrupt politician, every "superstar," every "supreme leader," every saint and sinner in the history of our species lived there, on a mote of dust suspended in a sunbeam.



CARL SAGAN – astronomer, planetary scientist.

HOW DO WE HUMANS AFFECT THE HYDROSPHERE?

THE CRYOSPHERE



Spheres of the earth

- Total amount of frozen water
- Constant ice containing regions
 - Greenland, Antarctica
- Critical role for climate
 - Sunlight reflectivity (ALBEDO)
 - Salinity of water
 - Permafrost (ground frozen for 2 years or more)
 - Create whole ecosystems
 - Melting glaciers change sea level
 - last glaciation sea level 120m lower



A large, sculptural iceberg floats in the ocean under a cloudy sky. The iceberg has a prominent, jagged peak and a smaller, rounded section to its right. The water is calm, reflecting the sky and the ice. In the background, more icebergs and a distant shoreline are visible.

HOW DO WE HUMANS AFFECT THE CRYOSPHERE?

THE BIOSPHERE



Spheres of the earth

- All biomes containing ecosystems
 - Each ecosystem carries distinctive species
 - Everything from bacteria to whales
- All organisms
 - Can obtain energy
 - Acquire nutrients to build organic molecules
 - Reproduce
- 5-30 Mil. Spp (1.9 mil. Spp named)
- Extremophiles living in intense cold, hot or acidic habitats
- Phytomass (mass of plants)
 - 500-800 bil. tons of carbon
 - bacteria & archaea as much as plants
- 5 mass extinctions



HOW DO WE HUMANS AFFECT THE BIOSPHERE?

THE ANTHROPOSPHERE

Spheres of the earth

- Total human presence on earth
 - incl. culture, technology, built environment
- Anthropocene started with agriculture/ industrial revolution
- Our influence on the environment changed from mammals when:
 - Harnessing fire
 - Tool-making
 - Agriculture
- so far 75% of land surface have been altered



THE ANTHROPOSPHERE

Spheres of the earth





SO HOW DO WE CONTINUE IN THE FUTURE?



BIOMIMICRY 3.8



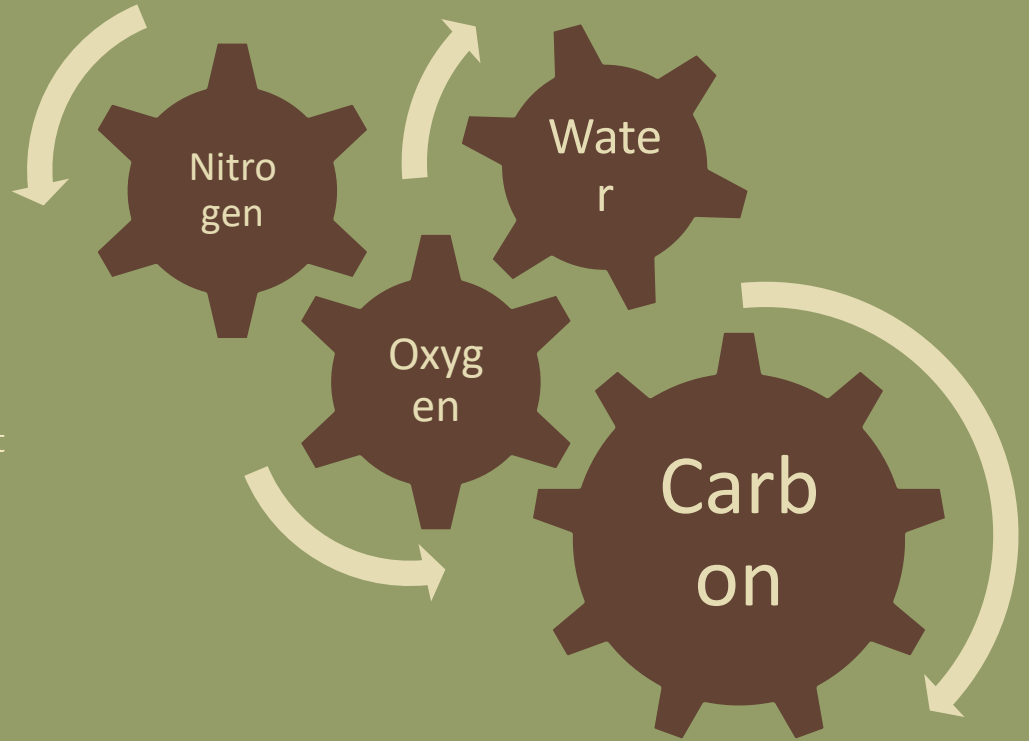


ECOLOGICAL CYCLES

- Hydrological cycle
- Carbon cycle
- Oxygen cycle
- Nitrogen cycle

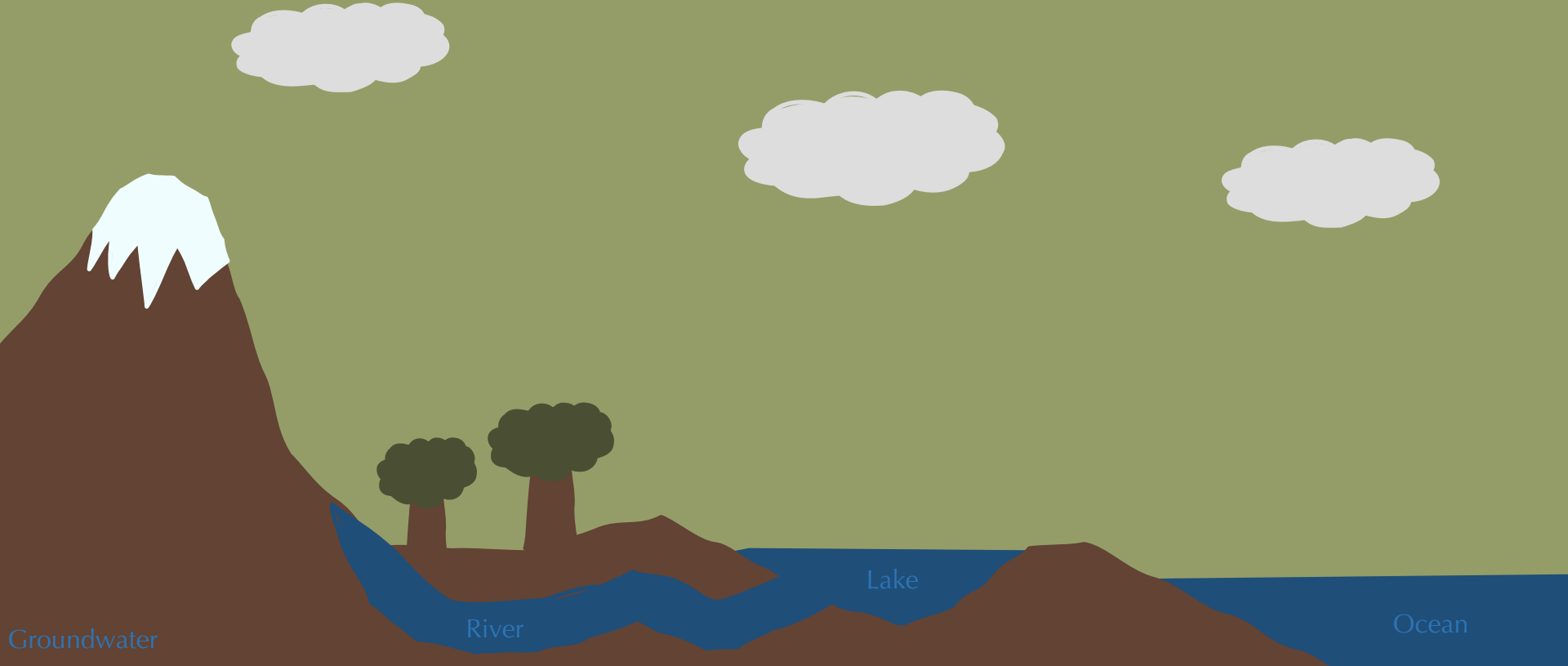
ECOLOGICAL CYCLES

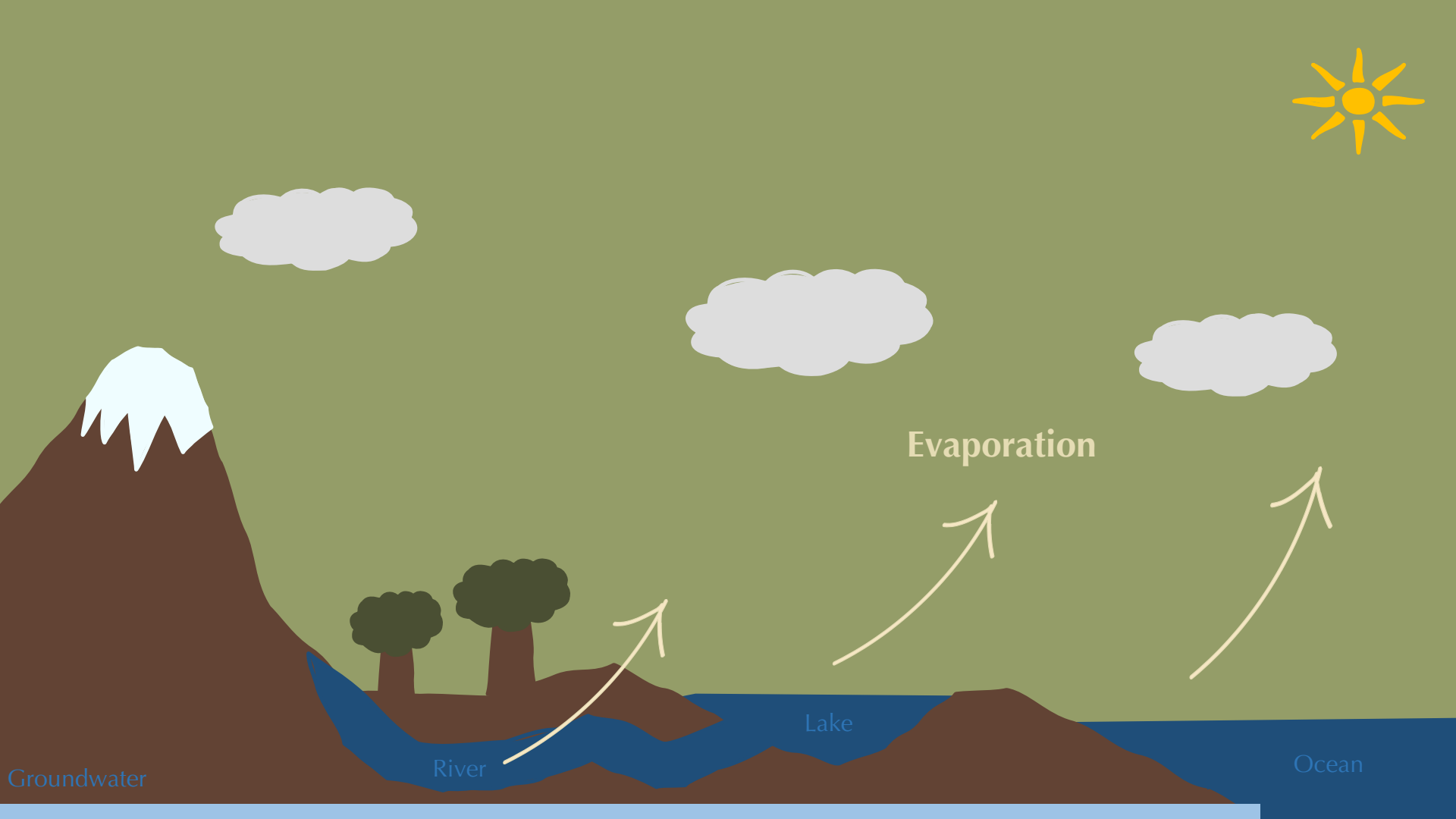
- Each cycle is unique
- Show how elements move between different spheres
- Movement of these cycles is essential for life



THE WATER CYCLE

Ecological cycles





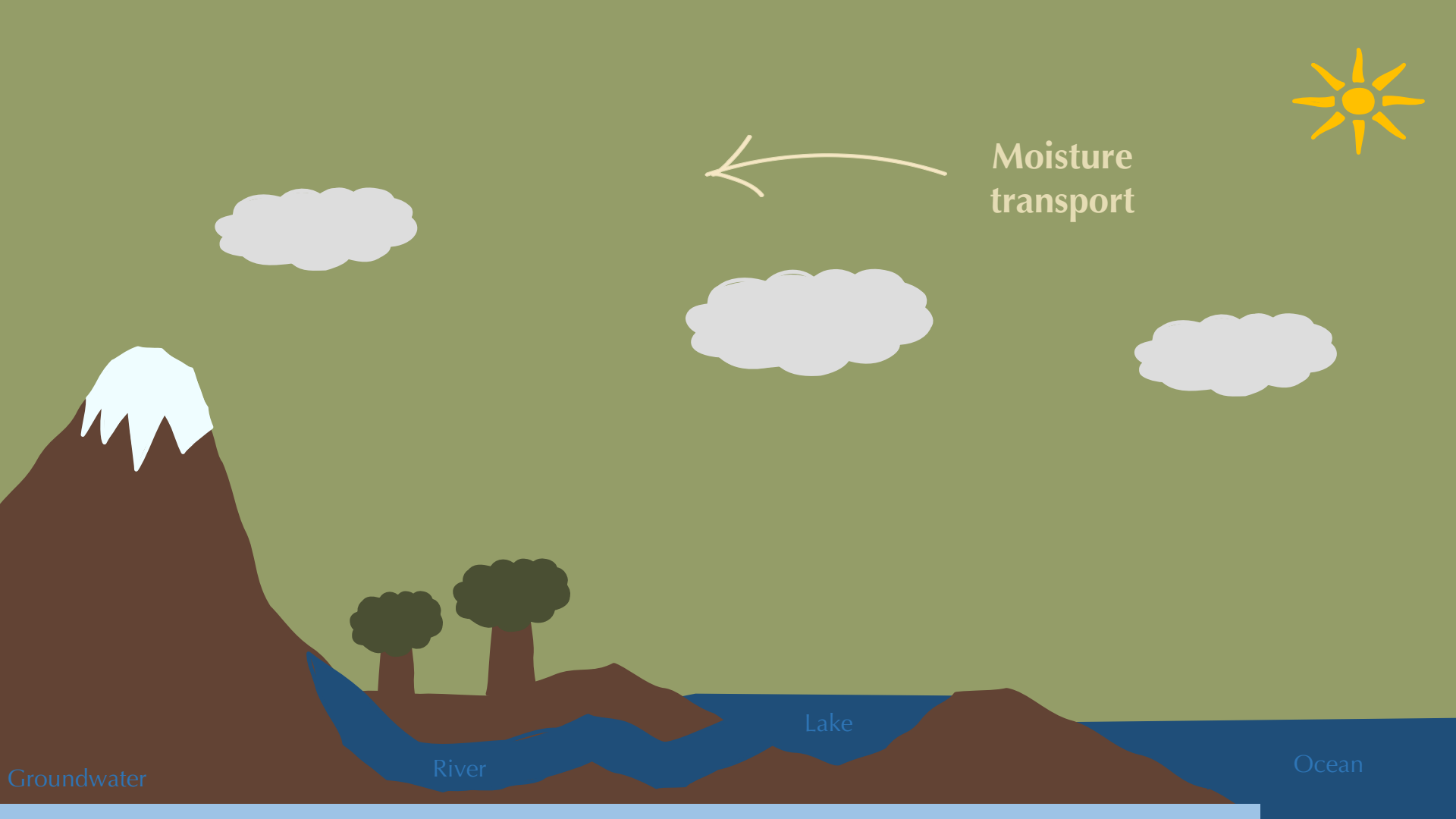
Evaporation

Groundwater

River

Lake

Ocean



Moisture
transport

Lake

River

Ocean

Groundwater

Precipitation



Groundwater

River

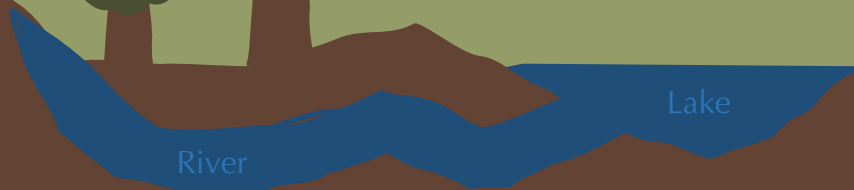
Lake

Ocean





Transpiration

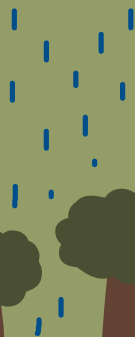


Lake

River

Ocean

Groundwater



1. Remains on surface
2. Runs off
3. Infiltrates

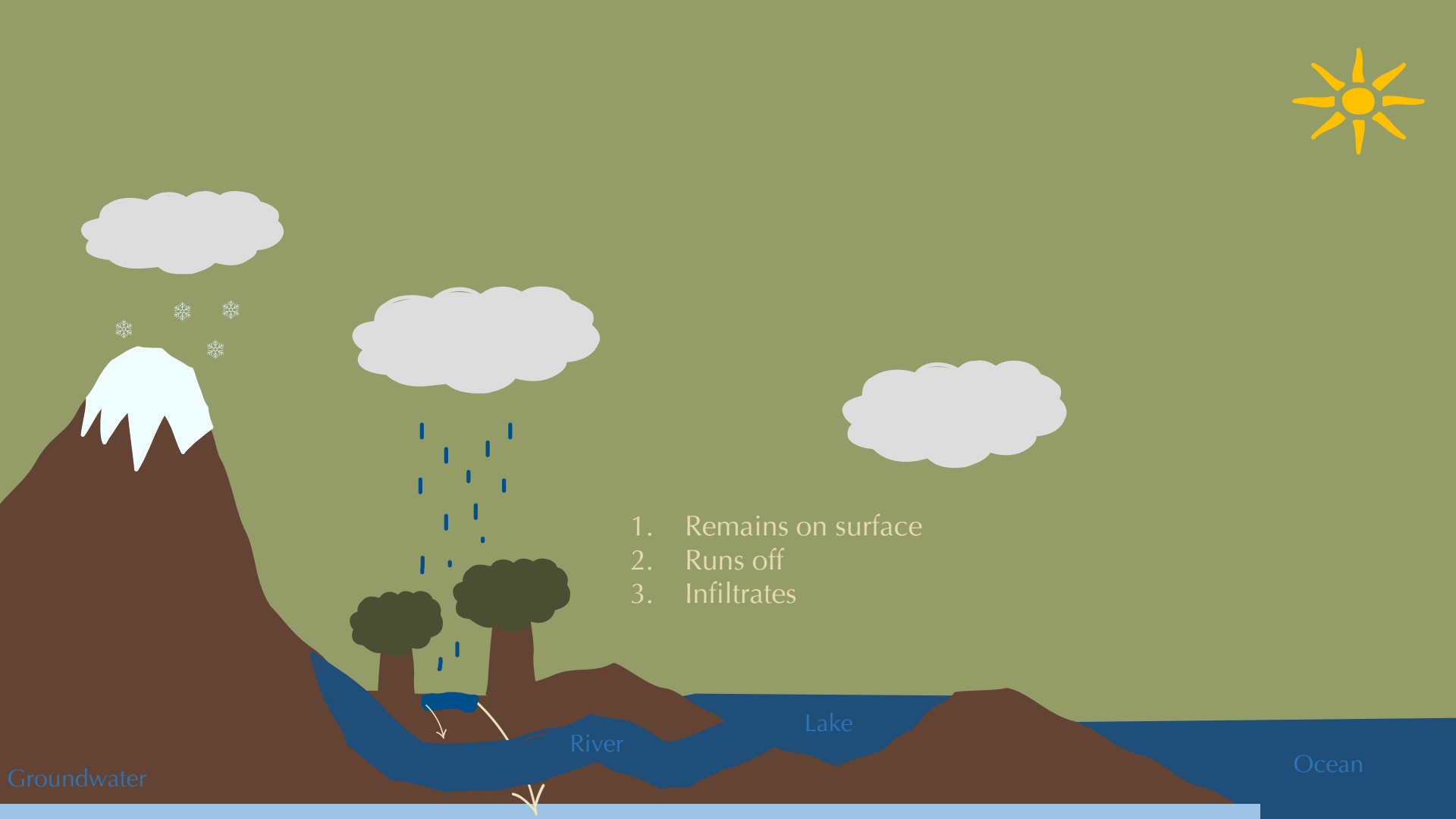


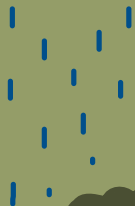
River

Lake

Ocean

Groundwater





Ground water flow



River

Lake



Ocean

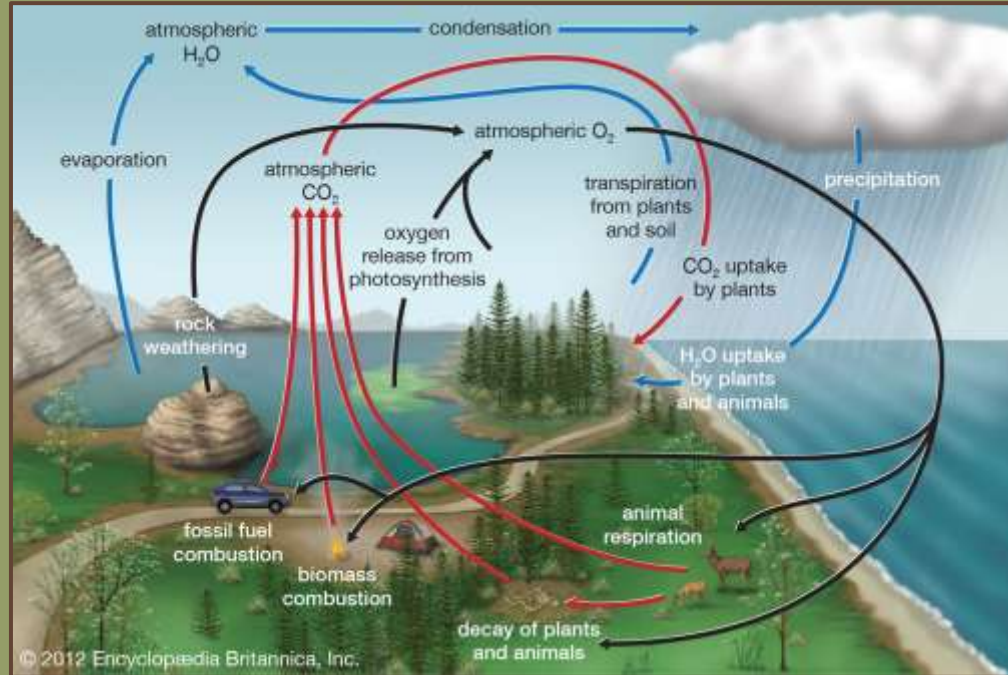
Groundwater

EARTH'S WATER BUDGET



THE OXYGEN CYCLE

Ecological cycles



THE OXYGEN CYCLE

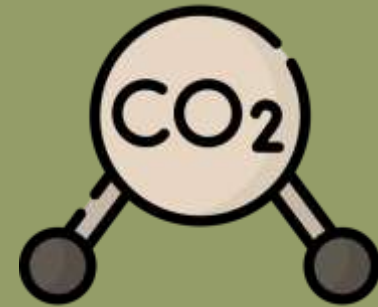
Ecological cycles -Sun



THE OXYGEN CYCLE

Ecological cycles – CO₂ in the air

- CO₂ is a gas made from Oxygen and Carbon
 - Released from the ocean
 - Produced by combustion of fossil fuels
 - Eruption of volcanoes
 - Respiration of living things



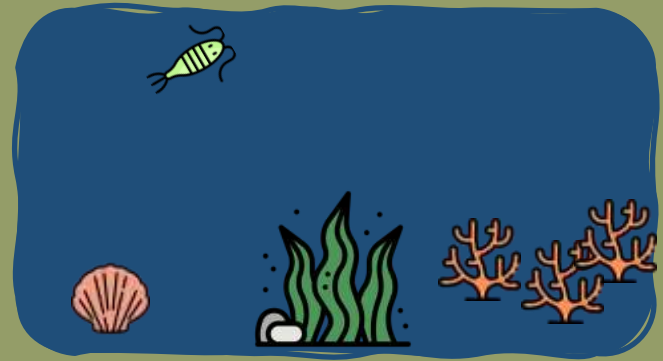
Essential for the survival of life.

- 23 mil. tons of CO₂ in the atmosphere

THE OXYGEN CYCLE

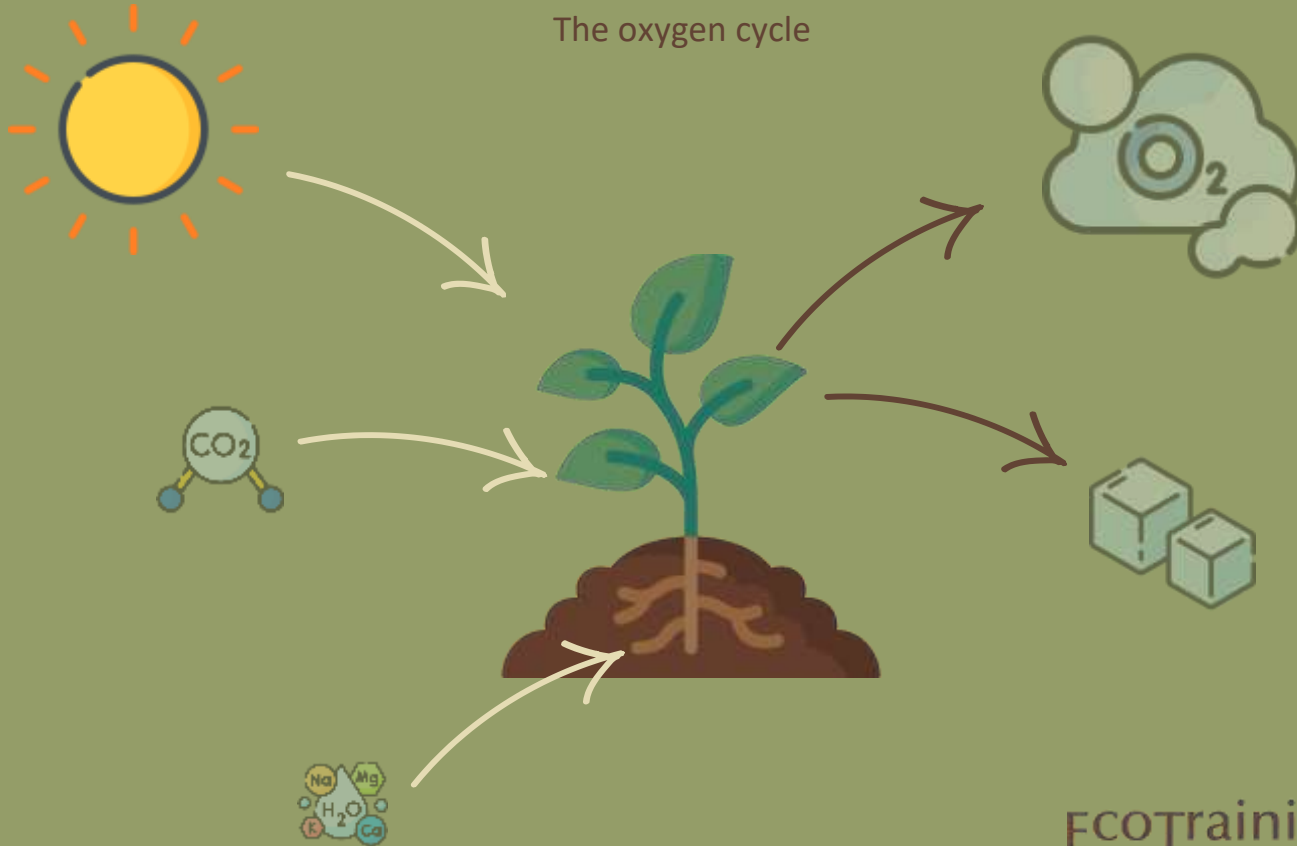
Ecological cycles – Oceans/Algae

- Oceans store 50x more CO₂ than the atmosphere
 - as gas and carbonate compound
- CO₂ is dissolved near the surface of the ocean
- Ocean absorbs more CO₂ when cold
- Phytoplankton – absorbs CO₂ & changes it into O₂ & food molecules (energy) by photosynthesis.



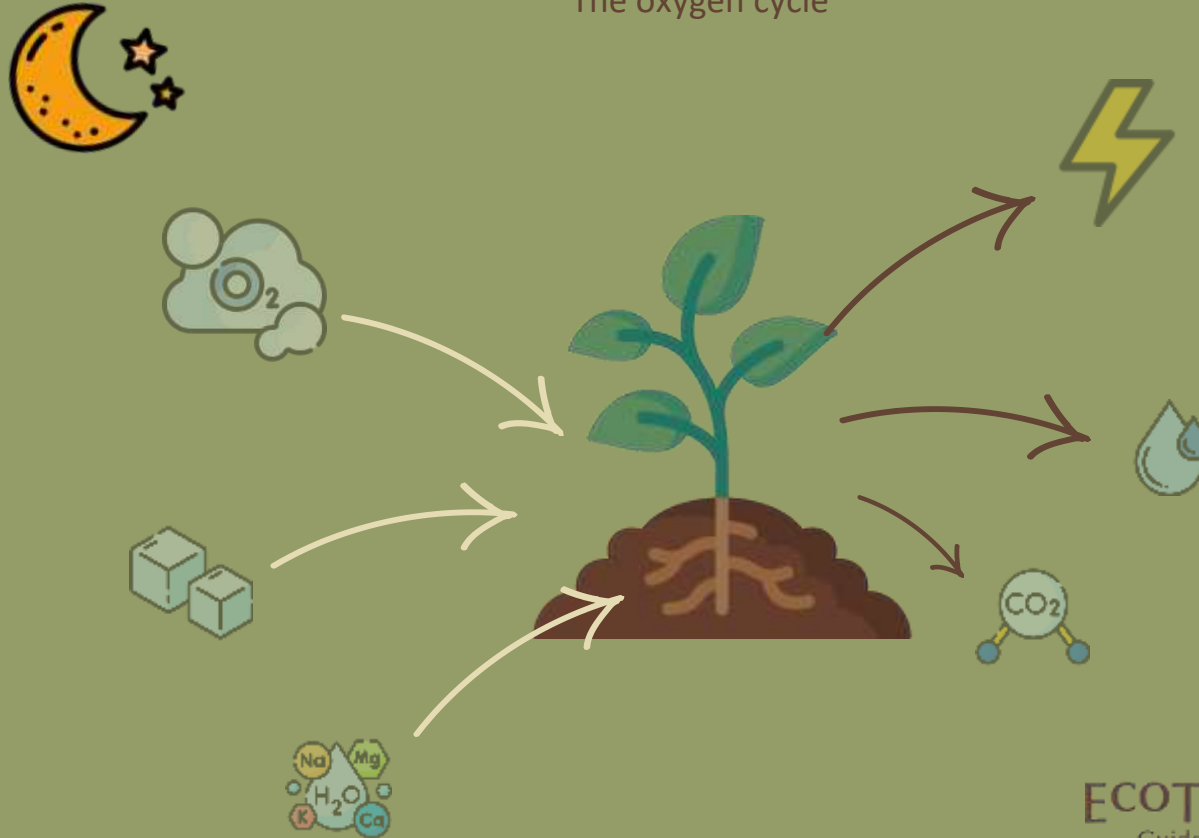
PHOTOSYNTHESIS

The oxygen cycle



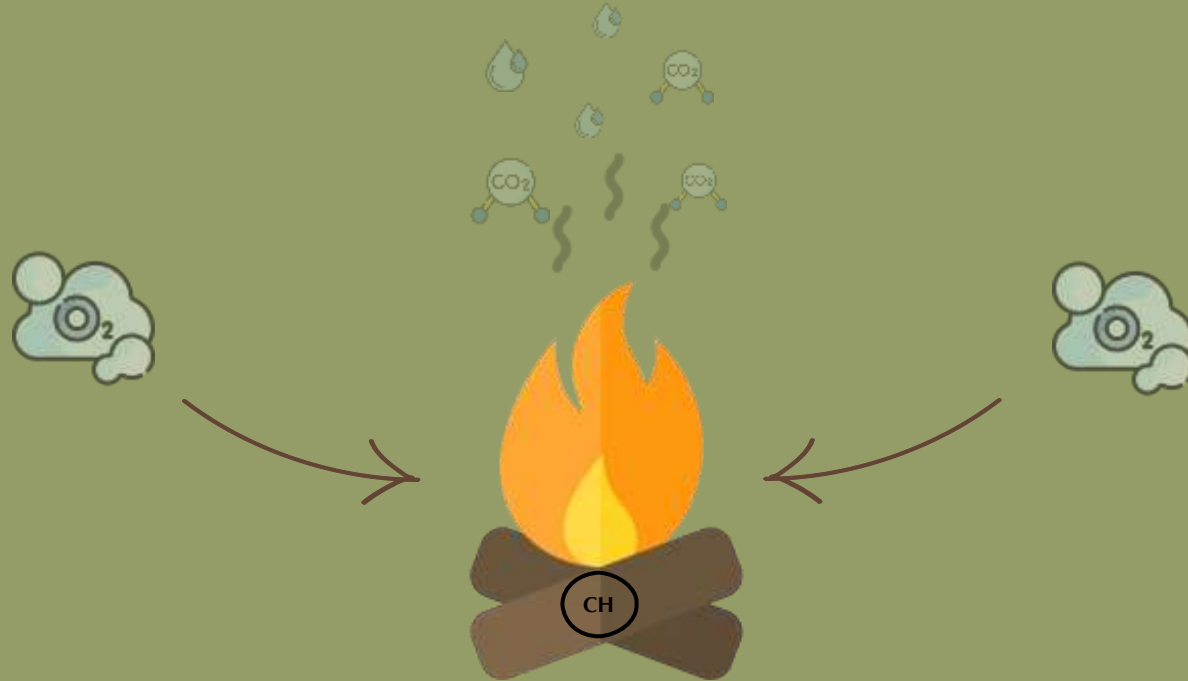
CELLULAR RESPIRATION

The oxygen cycle



COMBUSTION

The oxygen cycle



THE CARBON CYCLE

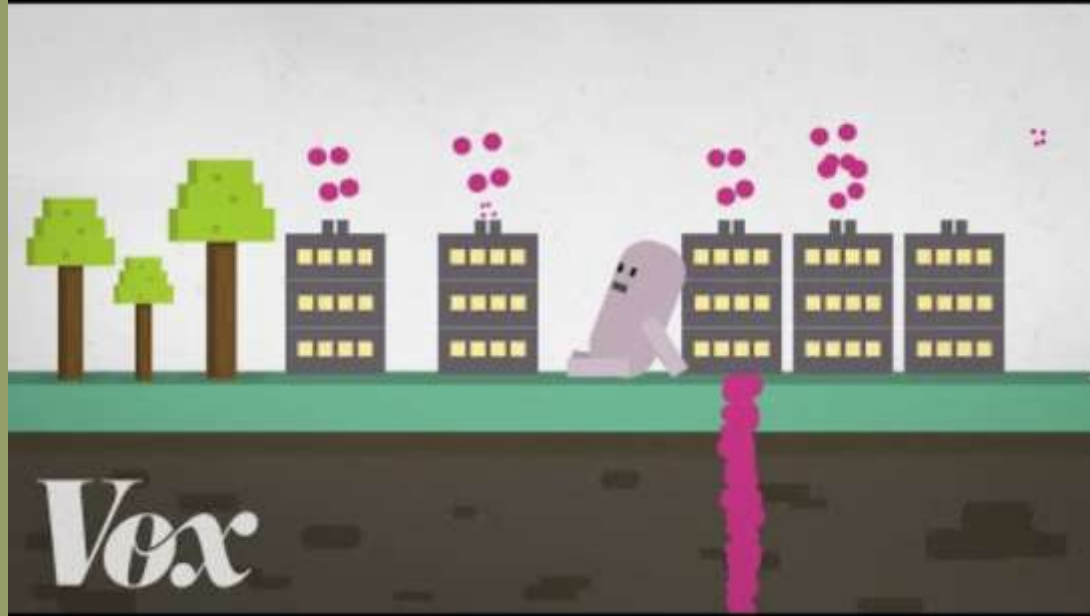
Ecological cycles

- All life is based on the element carbon!
- Stored in
 - Organic molecules
 - As CO₂ in the atmosphere
 - Organic matter in soil
 - Fossil fuels and sedimentary rock
 - Ocean



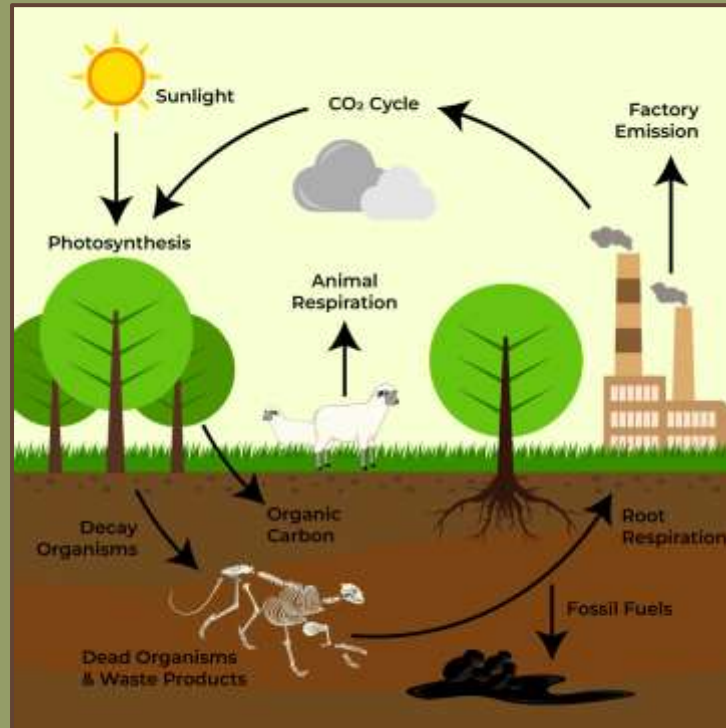
THE CARBON CYCLE

Ecological cycles



THE CARBON CYCLE

Ecological cycles



THE NITROGEN CYCLE

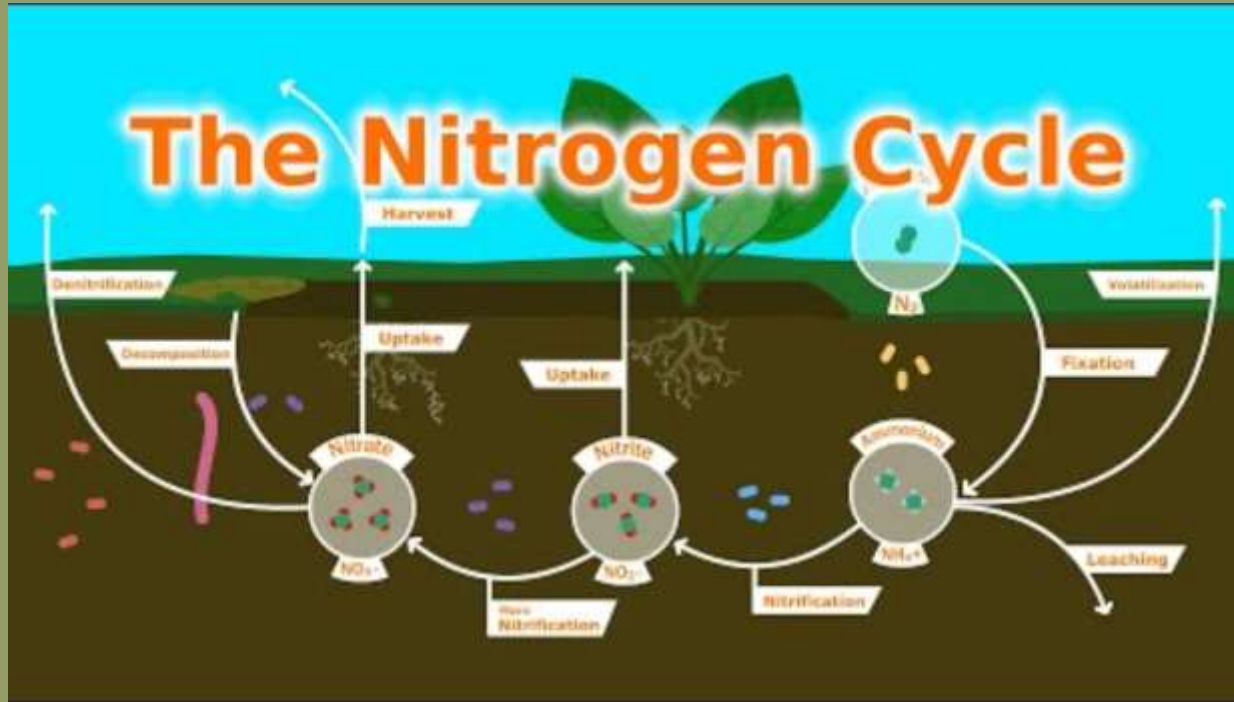
Ecological cycles

- Most important nutrient cycle in terrestrial ecosystems
- Stored in
 - Atmosphere (78%)
 - Living organisms (Nitrogen fixing Bacteria converting ammonium in nitrites & nitrates (**Nitrification**))
 - Soil (rain & lightning plus biochemical fixing bacteria)
 - Oceans
- Nitrogen is used to produce complex organic molecules:
 - Amino acids, proteins, nucleic acids
- Needed for:
 - Metabolism, growth & reproduction of living organisms
 - Most limiting nutrient in plant growth



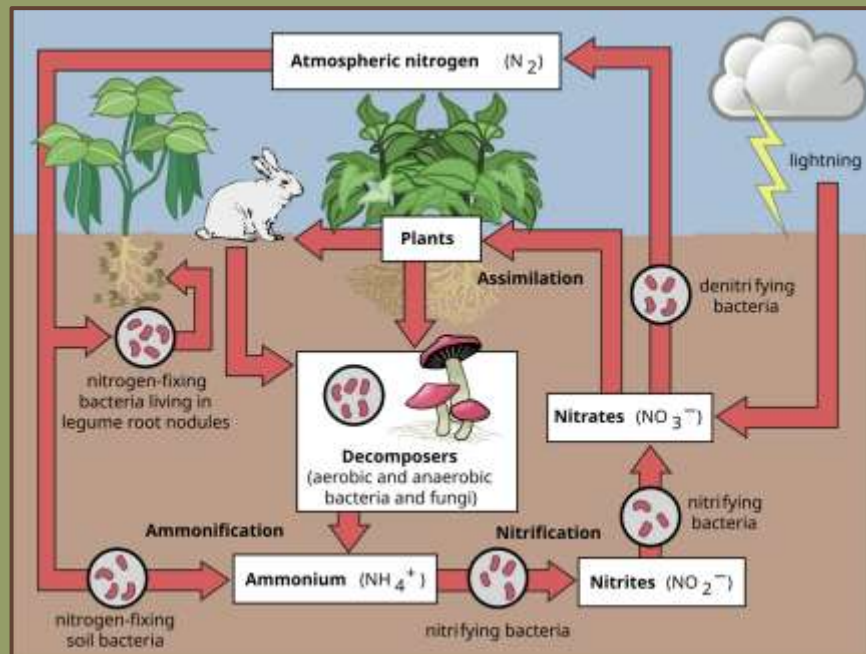
THE NITROGEN CYCLE

Ecological cycles



THE NITROGEN CYCLE

Ecological cycles





ECOLOGY & ITS LIMITS

- Ecological Niches
- Limiting factors
- Ecological Tolerance

ECOLOGICAL NICHE

Definition

- How does an organism fit into its physical & biological environment?
- Product of evolution (so called “profession”)
- Once a niche is occupied, no other animal can exploit exactly the same resources
- Shows how adaptable a species is (survival of the fittest)



ECOLOGICAL NICHE

Fundamental niche

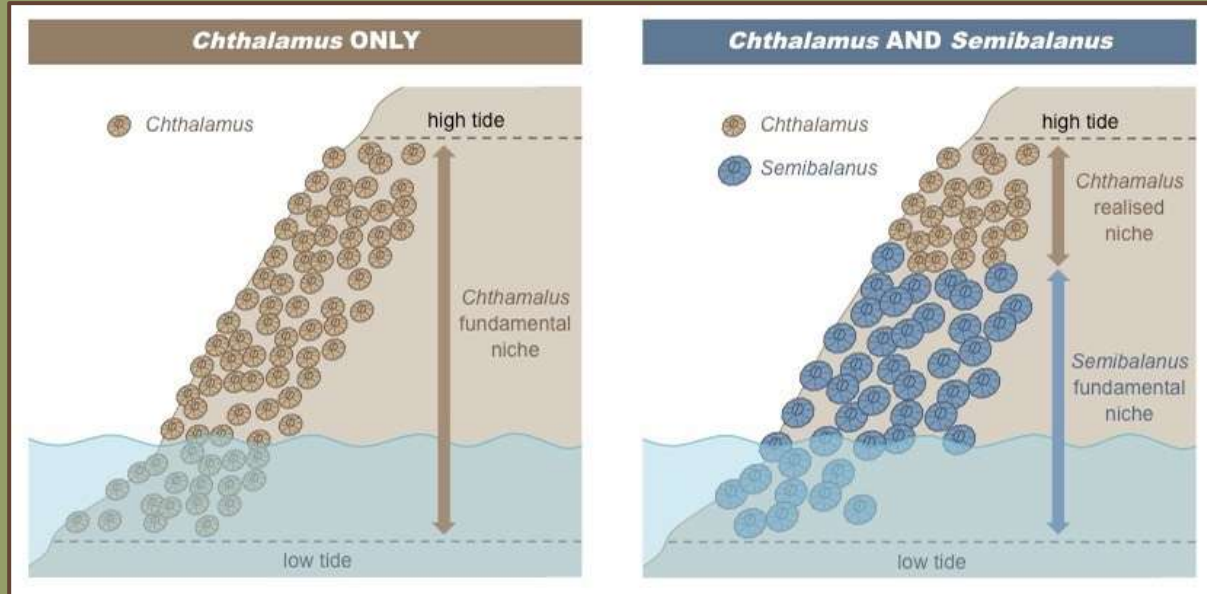
Total range of environmental conditions that are suitable for existing & reproducing. Biological potential of a population. No interspecific competition or predation

Realised niche

The actual set of conditions under which an organism population exists. The outcome of an interaction to that potential with a given set of biotic and abiotic conditions.



EXAMPLE: ECOLOGICAL NICHE



LIMITING FACTORS

for ecosystems

LIGHT



SOIL



TOXINS



CLIMATE



FIRE



Organisms' life style is determined by its total package of adaptations e.g. structural, physiological and behavioural

SHELFORD'S LAW

of ecological tolerance

1. Populations have optimal survival conditions withing min & max threshold
2. As population is exposed to extremes – survival rates drop

Optimal Zone

Conditions for max. reproduction & survival

Zones of stress

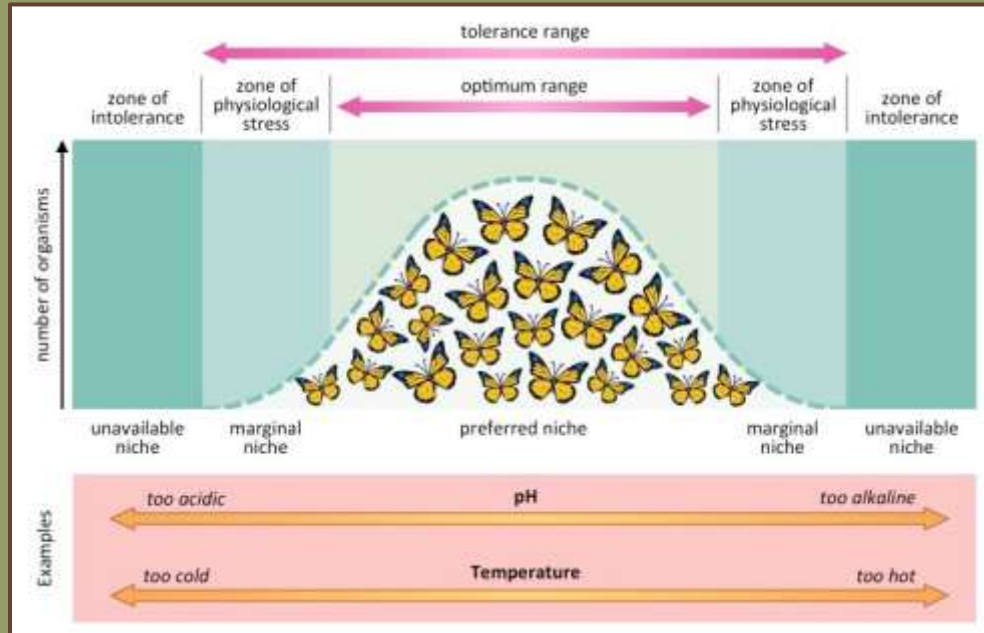
Can survive but less reproduction

Zones of intolerance

Can't survive

SHELFORD'S LAW

of ecological tolerance



‘The Law of Minimum’ states – that the growth of each organism is limited by whatever factor essential to it, is in shortest supply or is present in harmful access.

Q&A

