



Biosphere & Biogeochemical Cycles



Biosphere

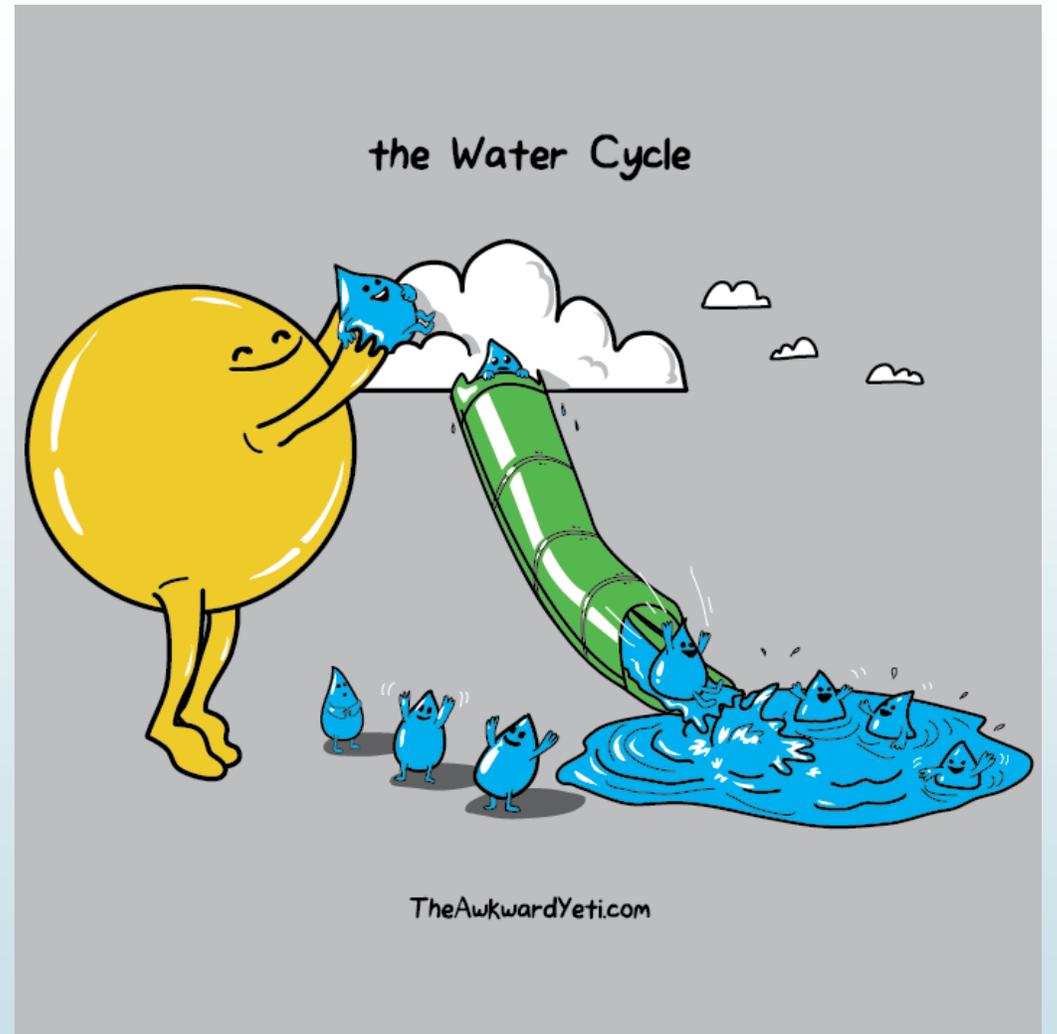
- ▶ Sphere of **living organisms**
 - ▶ All the regions of the **earth and its atmosphere** in which living organisms are **found or can live**.
- ▶ **Interacts** with all the other spheres
 - ▶ Lithosphere: **Land and nutrients** for land based organisms
 - ▶ Hydrosphere: **Water and habitat** for water based organisms
 - ▶ Atmosphere: Necessary gases for all living organisms (**respiration**)



Biogeochemical Cycles

- ▶ All living organisms require certain key **compounds/elements** to survive
- ▶ These chemicals are found in all of the spheres, and **move from sphere to sphere**.
 - ▶ Without this **cycling**, spheres would “**run out**” of these essential compounds/elements

Water Cycle

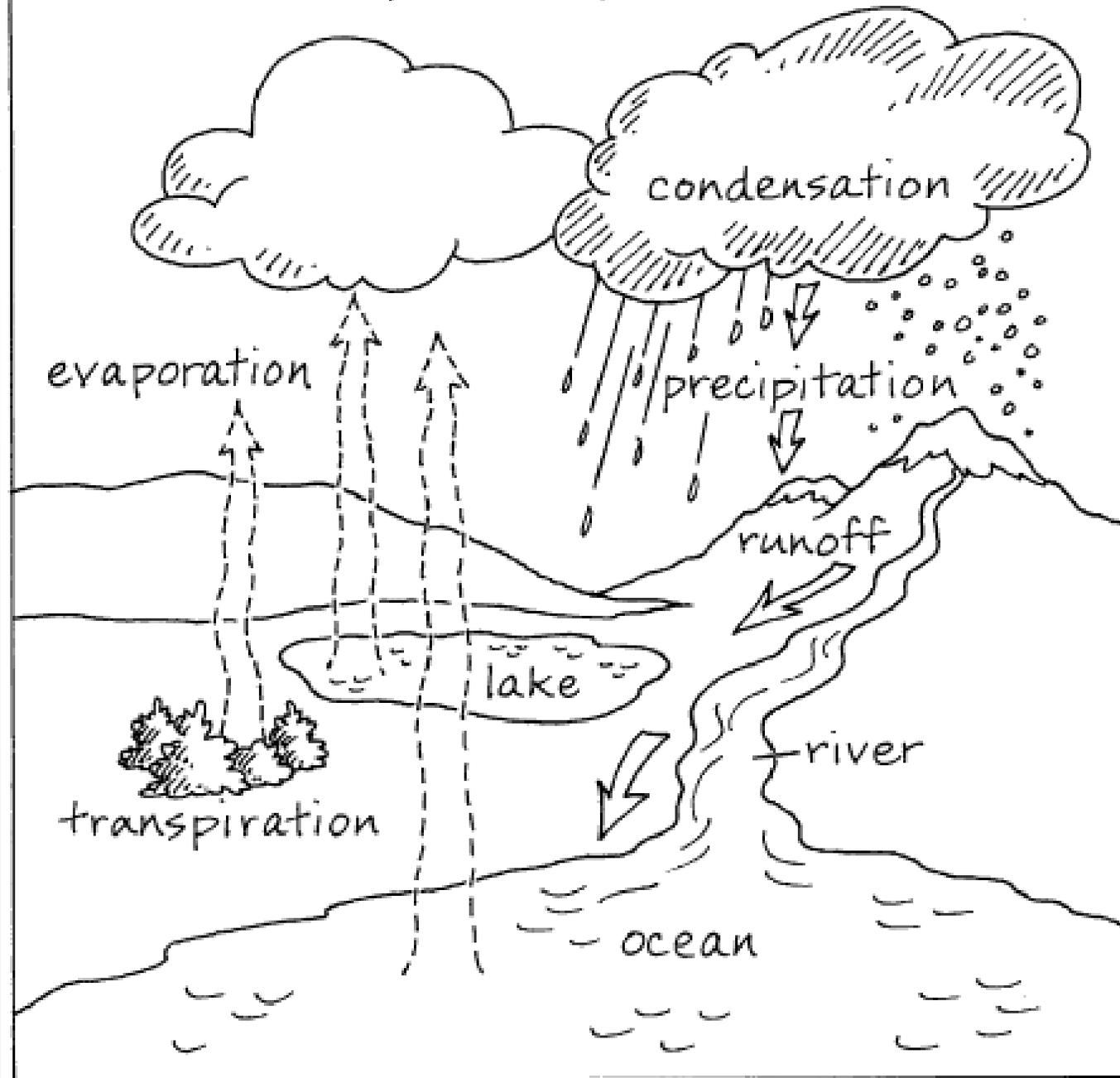




Water cycle

- ▶ Cycle where water goes from being on the **surface** of the Earth, to being in the **atmosphere**, and finally going back to the **surface** of the Earth
 - ▶ This cycle connects the **hydrosphere** and the **atmosphere**
- ▶ This cycle is possible thanks to **changes in state**

WATER CYCLE





Steps of the Water Cycle

1 – Evaporation and Evapotranspiration

a. Evaporation: Water in lakes, rivers and oceans **heat up** and turn into **water vapour** (gas). Water vapour goes into **atmosphere**

b. Evapotranspiration: Living things **exhale** and **sweat** water vapour. Water vapour goes into **atmosphere**



Steps of the Water Cycle

2 – Condensation – Cloud Formation

- ▶ Water vapour in atmosphere **cools** and **condenses** to form clouds
- ▶ Clouds are made up of **mini droplets** of water



Steps of the Water Cycle

3 – Precipitation – Rain, snow, hail

- ▶ Mini droplets get **bigger** until they are **too heavy** to remain in the atmosphere
- ▶ Water **falls back down** to Earth as **precipitation** (either rain, snow or hail)



Steps of the Water Cycle

4 – Runoff and infiltration (absorption)

- a. Runoff: Excess water **flows** to a key body of water (ex: lake)
- b. Infiltration: Precipitation seeps into the **ground** and into **underground waterways**



Carbon Cycle

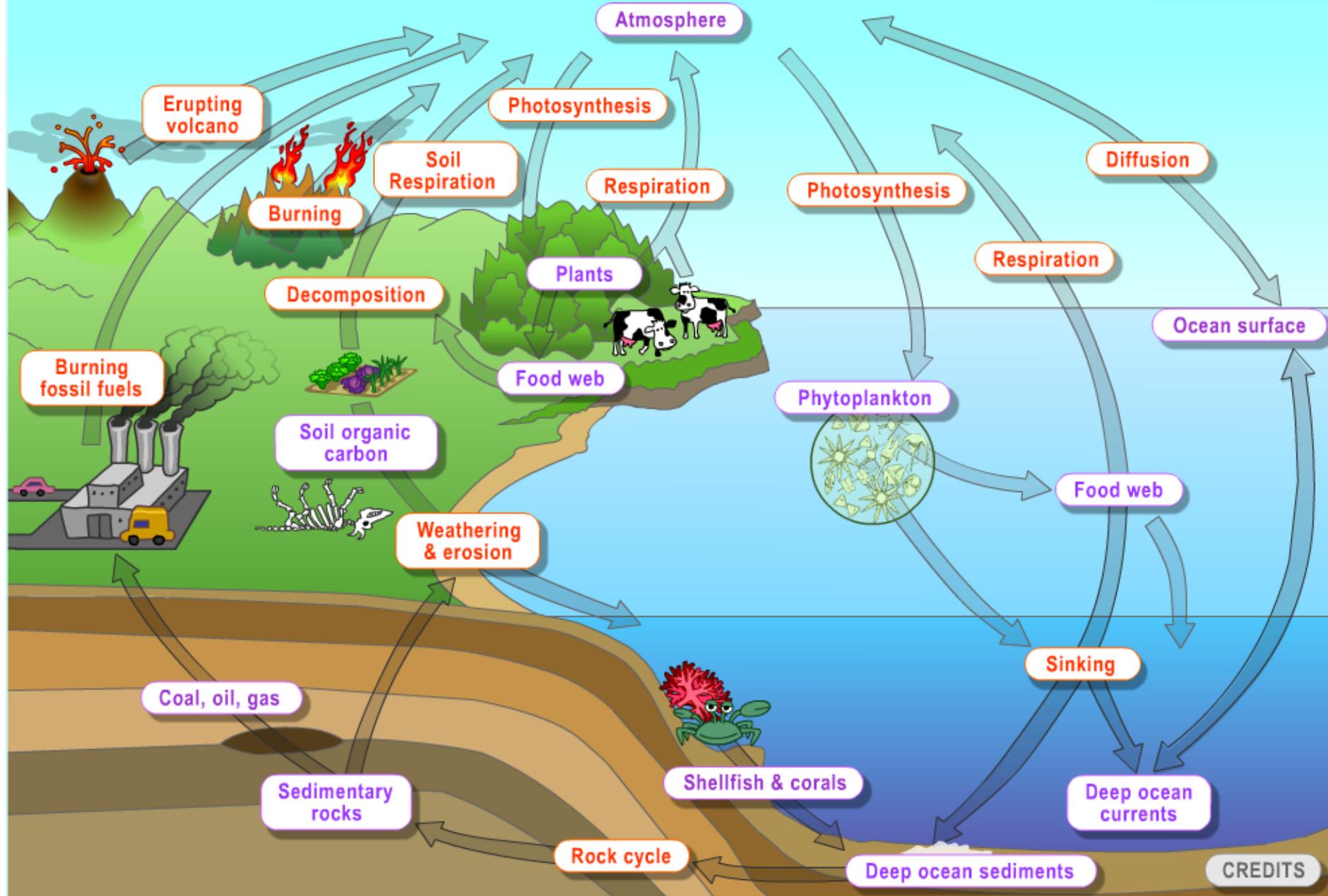


Carbon Cycle

- The cycling of **carbon** (in different forms) in the different spheres
- Carbon mostly cycles throughout the spheres in the form of **Carbon Dioxide (CO₂)**
 - Cycles through the spheres in its **gas form**

THE CARBON CYCLE

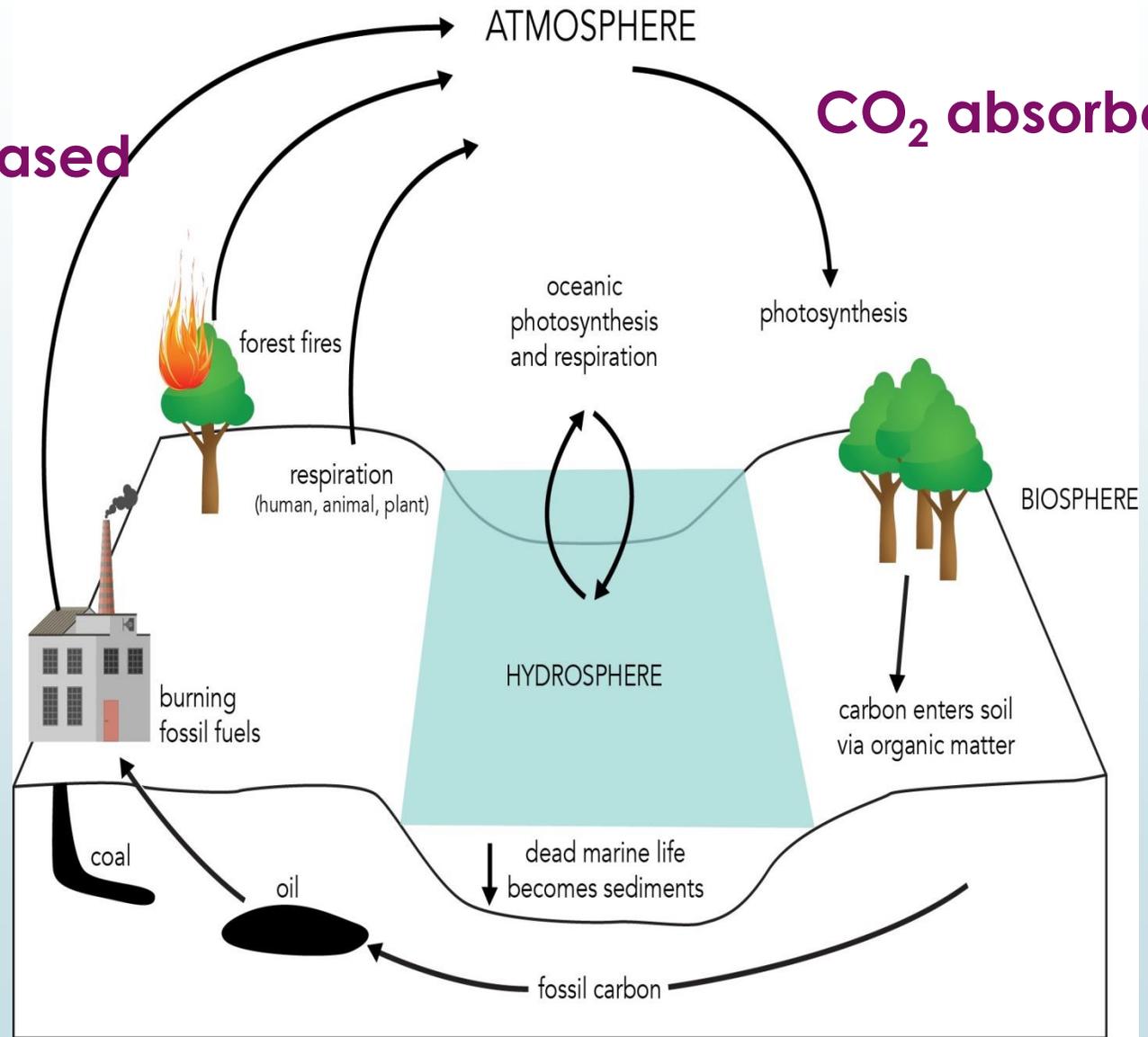
KEY
Process
Reservoir



CREDITS

CO₂ released

CO₂ absorbed



Combustion

Combustion gives off CO_2

Photosynthesis

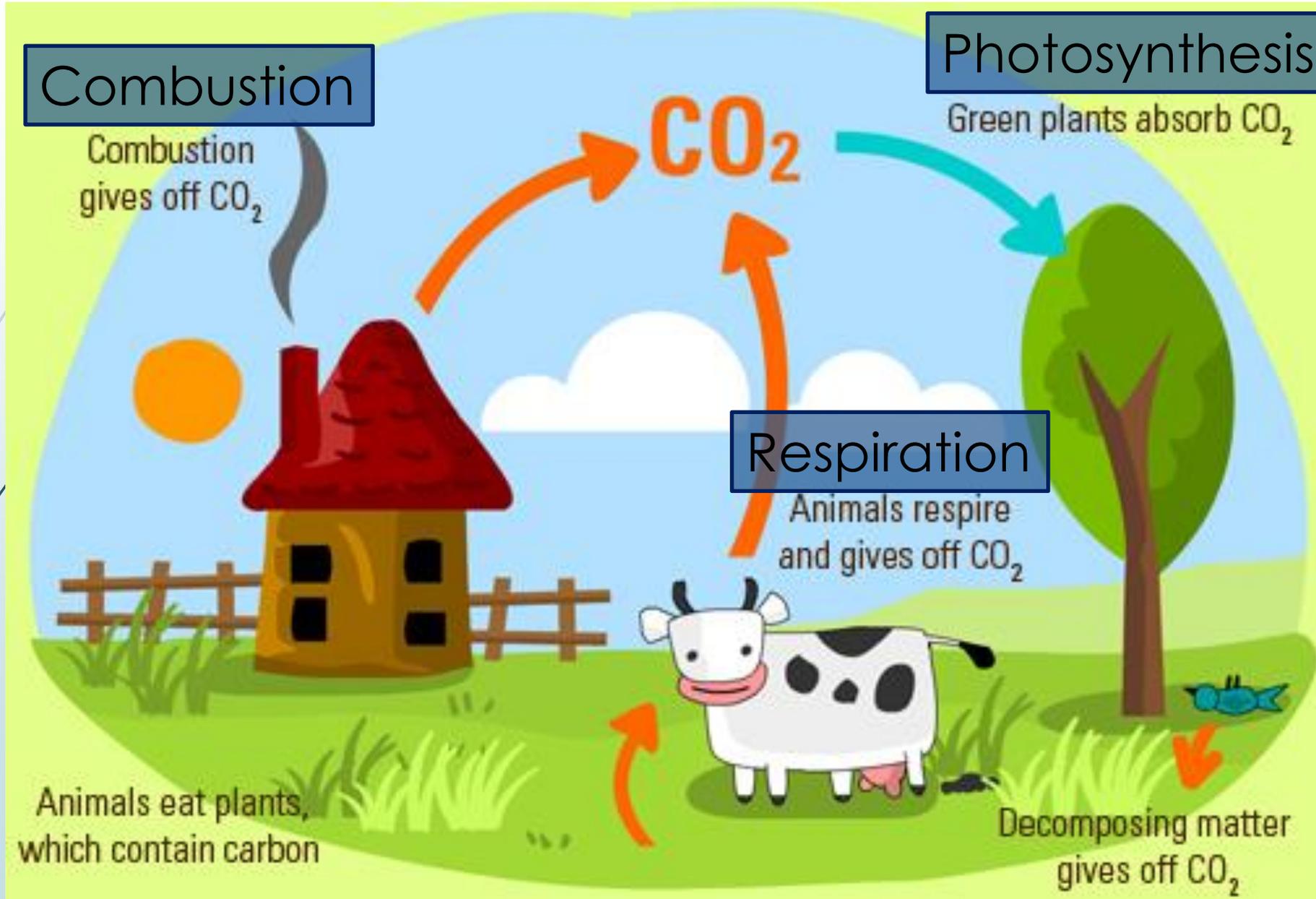
Green plants absorb CO_2

Respiration

Animals respire and gives off CO_2

Animals eat plants, which contain carbon

Decomposing matter gives off CO_2



A decorative graphic on the left side of the slide. It features a dark grey arrow pointing right at the top, with several thin, curved lines in shades of blue and grey extending downwards from the arrow's base.

Carbon Cycle

- **Things that put C into atmosphere**
 - **Respiration**
 - **Decomposition**
 - **Burning of fossil fuels/Forest Fires**
 - **Volcanoes**

And everyone's favourite...
Burps and farts!



Carbon Cycle

- **Things that take C out of atmosphere**
 - **Photosynthesis and ingestion**
 - Formation of **shells** (sea creatures)
 - Formation of **fossil fuels** (*takes millions of years*)
 - Formation of **carbonic rock** (*water*)



Stages that take CO₂ out of the atmosphere

- **Photosynthesis:** Plants take **atmospheric CO₂** from atmosphere with **sunlight** to produce **glucose**.
- **Diffusion:** Atmospheric CO₂ **dissolves** into bodies of water. It is transformed into **Calcium Carbonate (CaCO₃)** which is then ingested by aquatic organisms to form **skeletons and shells**



Stages that put CO_2 into the atmosphere (biotic)

- **Respiration:** living organisms **exhale CO_2** as a by-product of **cellular respiration**
- **Decomposition:** living organisms are **broken down** by decomposers, which produce **CO_2 and methane** (CH_4) as by-products



Stages that put CO_2 into the atmosphere (abiotic)

- ▶ **Volcanic eruptions:** Carbonic rock melting into magma produces CO_2 which is then **released during an eruption**
- ▶ **Forest fires:** C in the form of cellulose undergoes **combustion**, producing CO_2
- ▶ **Burning of fossil fuels:** C in the form of oil, natural gas and coal undergo **combustion**, producing CO_2



Stages that put CO₂ into the lithosphere

- **Decomposition:** Sometimes living organisms are covered before they are decomposed by scavengers. The organism then **decomposes underground**
- **Creation of fossil fuels:** Under the right conditions, the organism is covered in **sediment**, and slowly (through millions of years) transforms into **fossil fuels**
- **Creation of carbonic rock:** Aquatic organisms covered in sediment transform their exoskeleton and shells into **carbonic rock**.

Example Questions- C Cycle

1. Which of the following processes **does not** cycle carbon dioxide (CO₂) back into the atmosphere?

A) Photosynthesis

B) Decomposition of waste

C) Forest fires

D) Volcanic eruptions



Example Questions- C Cycle

2. Photosynthesis is the process by which plants...

A) Release CO_2 into the atmosphere

B) Turn CO_2 into sugar

C) Turn sugar into energy

D) None of the above

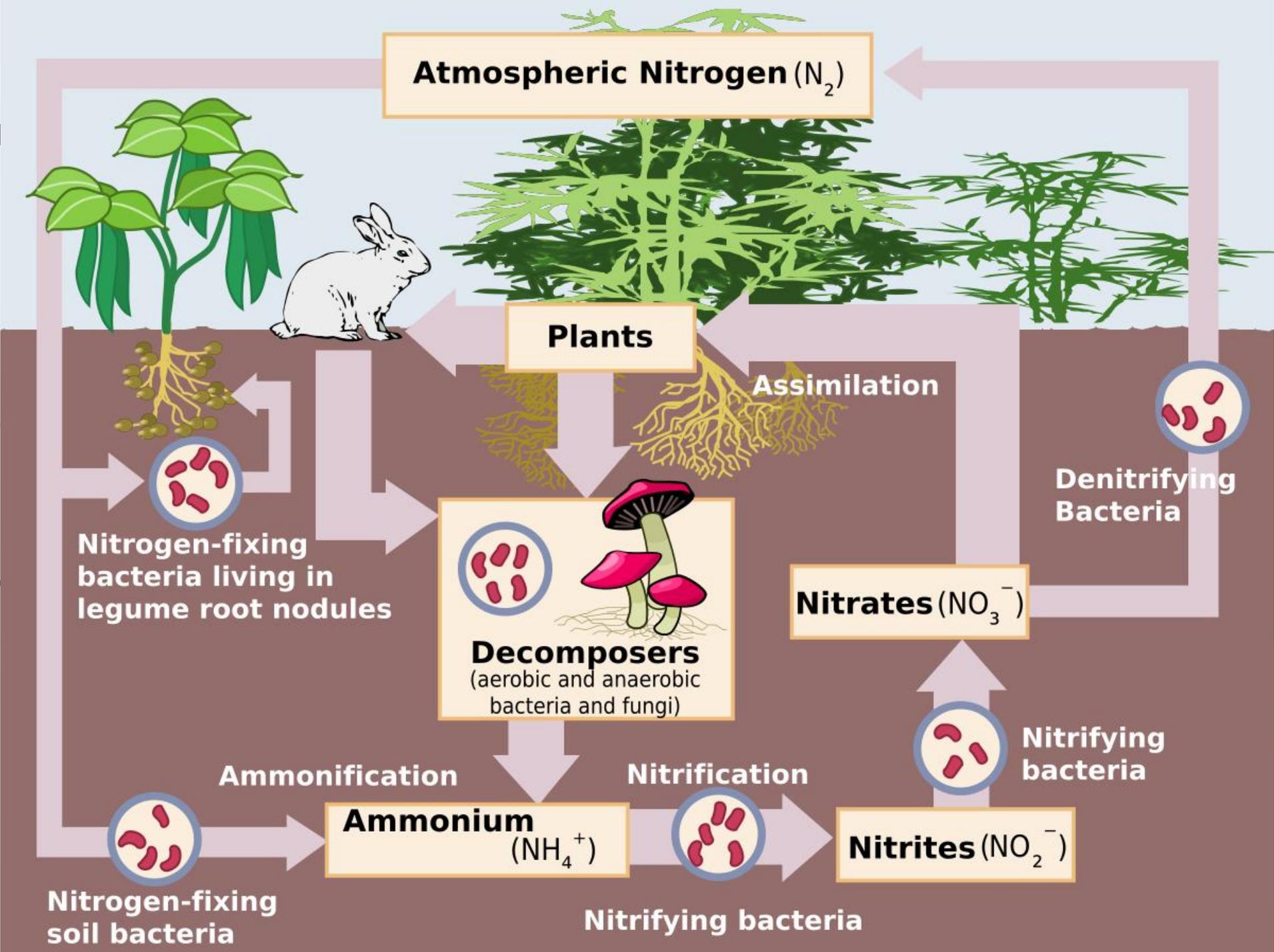


Nitrogen Cycle



Nitrogen Cycle

- ▶ The cycling of **nitrogen** (in different forms) in the different spheres
- ▶ Nitrogen is needed by living organisms for the manufacture of **proteins and DNA**
 - ▶ **78% of the air** is made up of **N₂** but we **cannot absorb** it in this form!





Nitrogen Cycle

➡ 1) Nitrogen fixation

➡ **Bacteria** absorb the **N₂** from the air and **convert it** into a biological form that most other living organisms can actually use

➡ They convert the **N₂ into NH₃**
(**ammonia**)



Nitrogen Cycle

➡ 2) Assimilation

- ➡ **Plants** can now absorb the **ammonia** and use it to make other organic molecules
- ➡ When **animals** then eat the plants they can then also take up the **nitrogen-containing molecules**



Nitrogen Cycle

➡ 3) Nitrification

➡ **Bacteria** then convert the ammonia into nitrites and nitrates

➡ 4) Denitrification

➡ **Other bacteria** then convert the nitrites/nitrates back into N_2 gas



Nitrogen Cycle

► Note:

► When things **die and decompose** they often also release **ammonia** in a process called **ammonification and decomposition**



Nitrogen Cycle - Summary

- **N₂ fixation**

- Bacteria convert **N₂ into ammonia**

- **Nitrification**

- Bacteria convert **ammonia to nitrates and nitrites**

- **Denitrification**

- Bacteria convert **nitrates back into N₂**