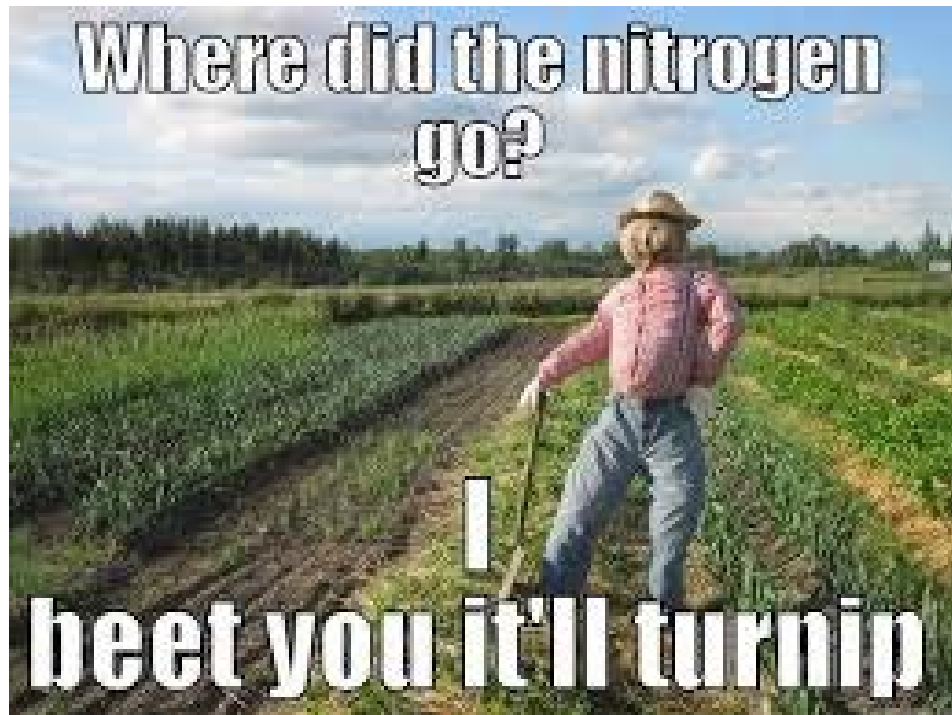


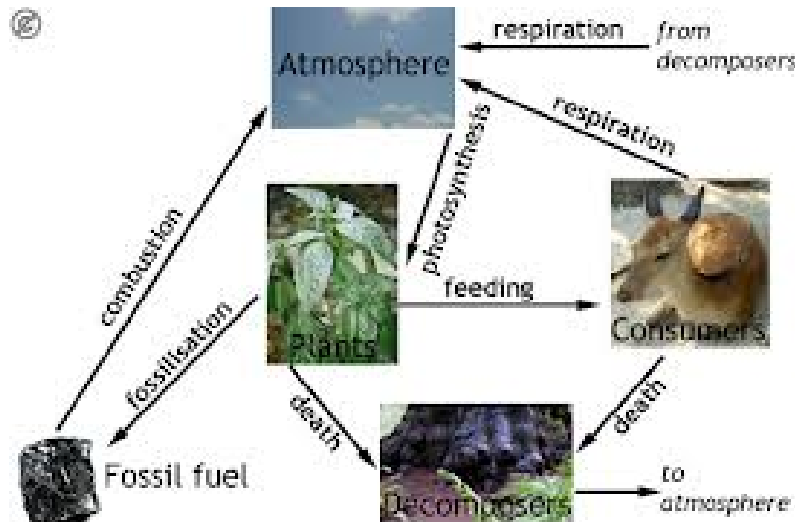
Biogeochemical Cycles



S2-1-01 Illustrate and explain how carbon, nitrogen, and oxygen are cycled through an ecosystem.

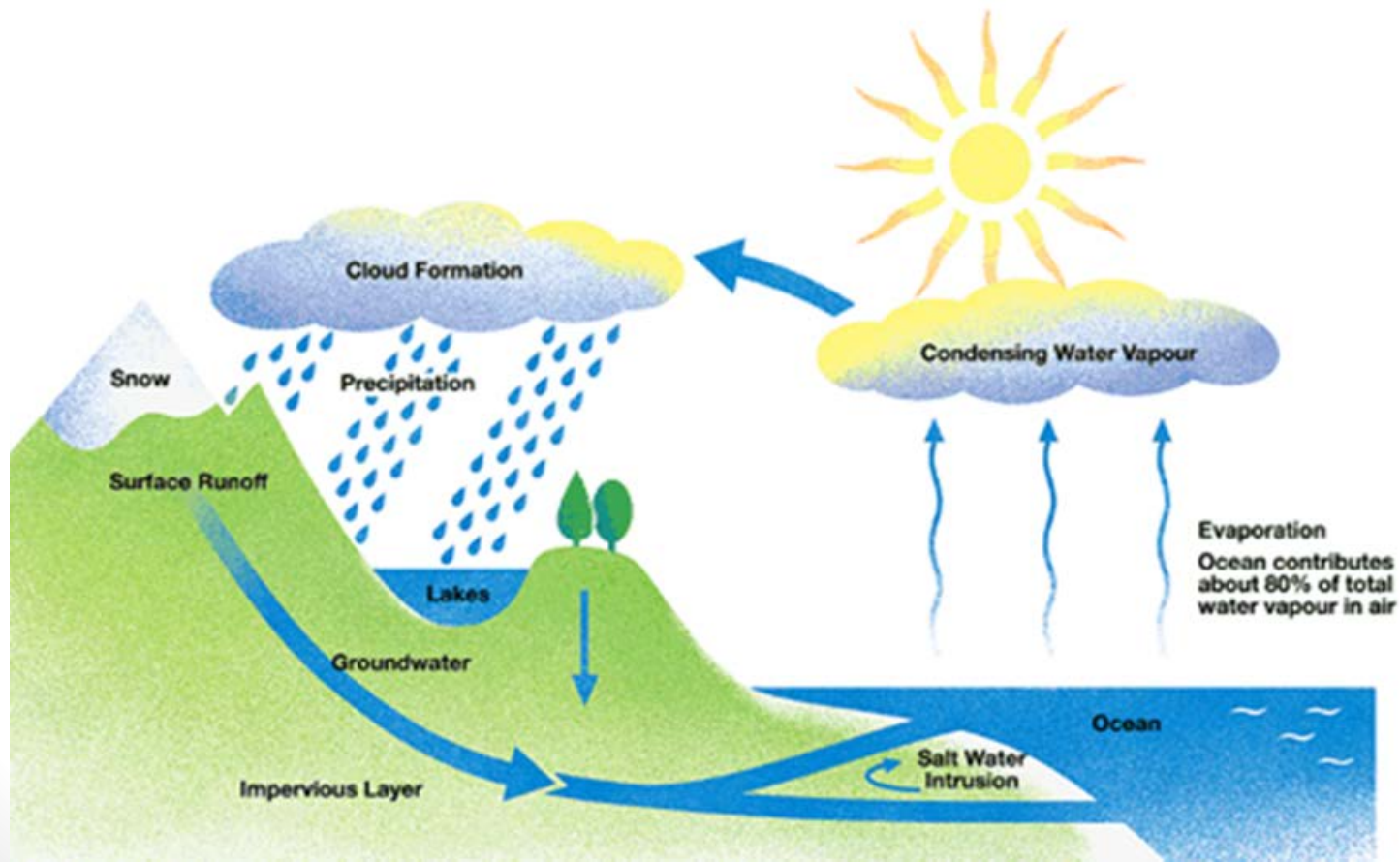
Biogeochemical Cycles...

- Let's take a closer look at the interactions between **LIVING THINGS** and the **PHYSICAL ENVIRONMENT** in an ecosystem.
- While **ENERGY** flows in a **ONE-WAY** direction through and ecosystem, **NUTRIENTS** are **RECYCLED** over and over again.
- Biogeochemical cycles are the processes by which **NUTRIENTS** move through **ORGANISMS** and the **ENVIRONMENT**.



Example: Water Cycle

You may be familiar with the water cycle in which water moves from the Earth's atmosphere to the surface (**PRECIPITATION**), and back to the atmosphere again (**CONDENSATION**). Other important nutrients that are recycled are **CARBON**, **OXYGEN** and **NITROGEN**.

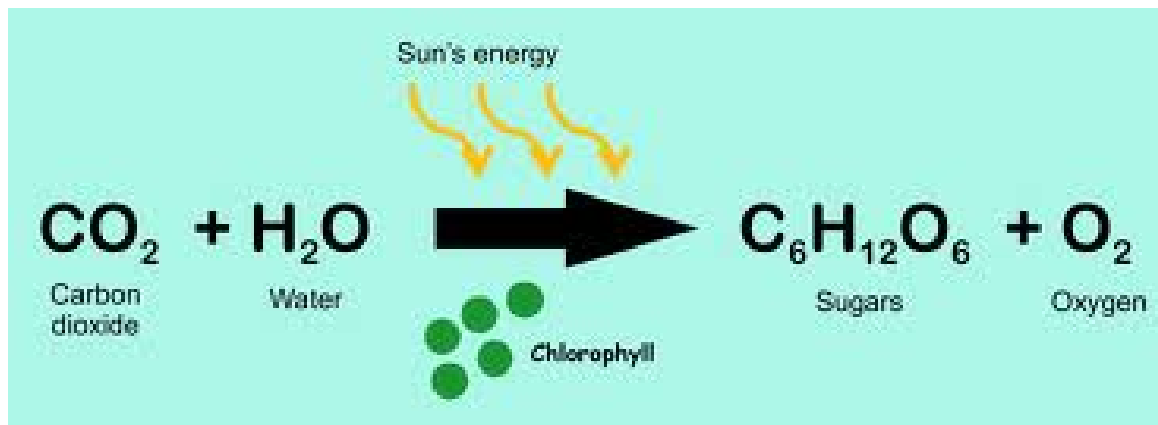


The Carbon Cycle

The process by which carbon moves through an ecosystem is called the carbon cycle.

Carbon is **REMOVED** from the atmosphere through **PHOTOSYNTHESIS**:

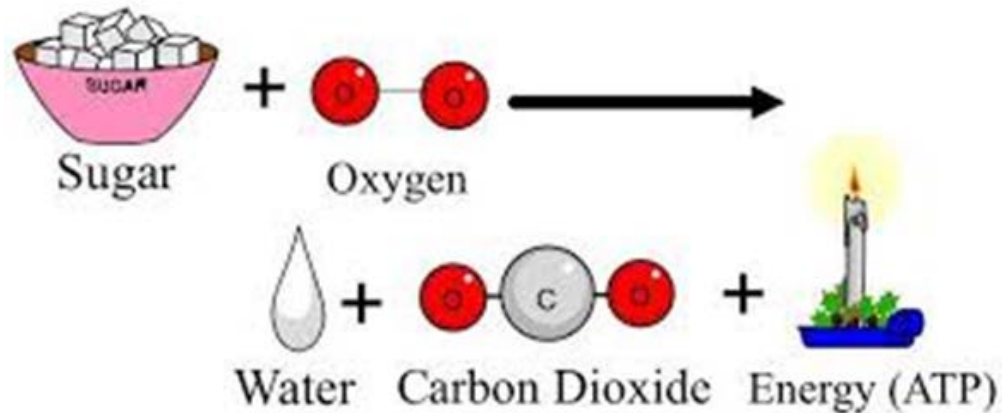
- Producers (green plants and algae) **TAKE IN** a carbon-containing nutrient known as **CARBON DIOXIDE** (CO_2) from the atmosphere.
- Energy from the sun is used to **CONVERT CARBON DIOXIDE INTO GLUCOSE** ($\text{C}_6\text{H}_{12}\text{O}_6$) a type of sugar.
- Plants then change glucose into other types of **CARBON COMPOUNDS**.



The Carbon Cycle

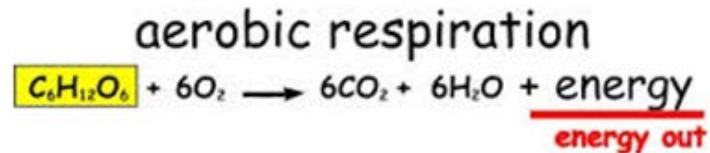
Carbon is **RETURNED** to the atmosphere through **CELLULAR RESPIRATION**:

- When **ANIMALS** eat plants and algae, the carbon compounds are converted into **GLUCOSE**.
- The **GLUCOSE** is then **CONVERTED** into **CARBON DIOXIDE** and energy
- The carbon dioxide is released into the **ATMOSPHERE**, and the cycle continues.



The Carbon Cycle

Notice that photosynthesis and respiration are essentially opposites of each other:

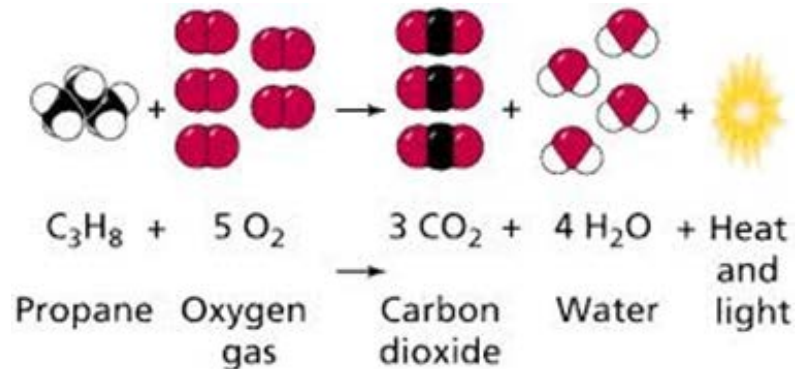


- Plants (producers) perform **PHOTOSYNTHESIS** and **CELLULAR RESPIRATION**.
- Animals (consumers) can only perform **CELLULAR RESPIRATION**.
- Carbon gets cycled back and forth between photosynthesis and cellular respiration (carbon gets cycles back and forth between **CO₂** and **C₆H₁₂O₆**).

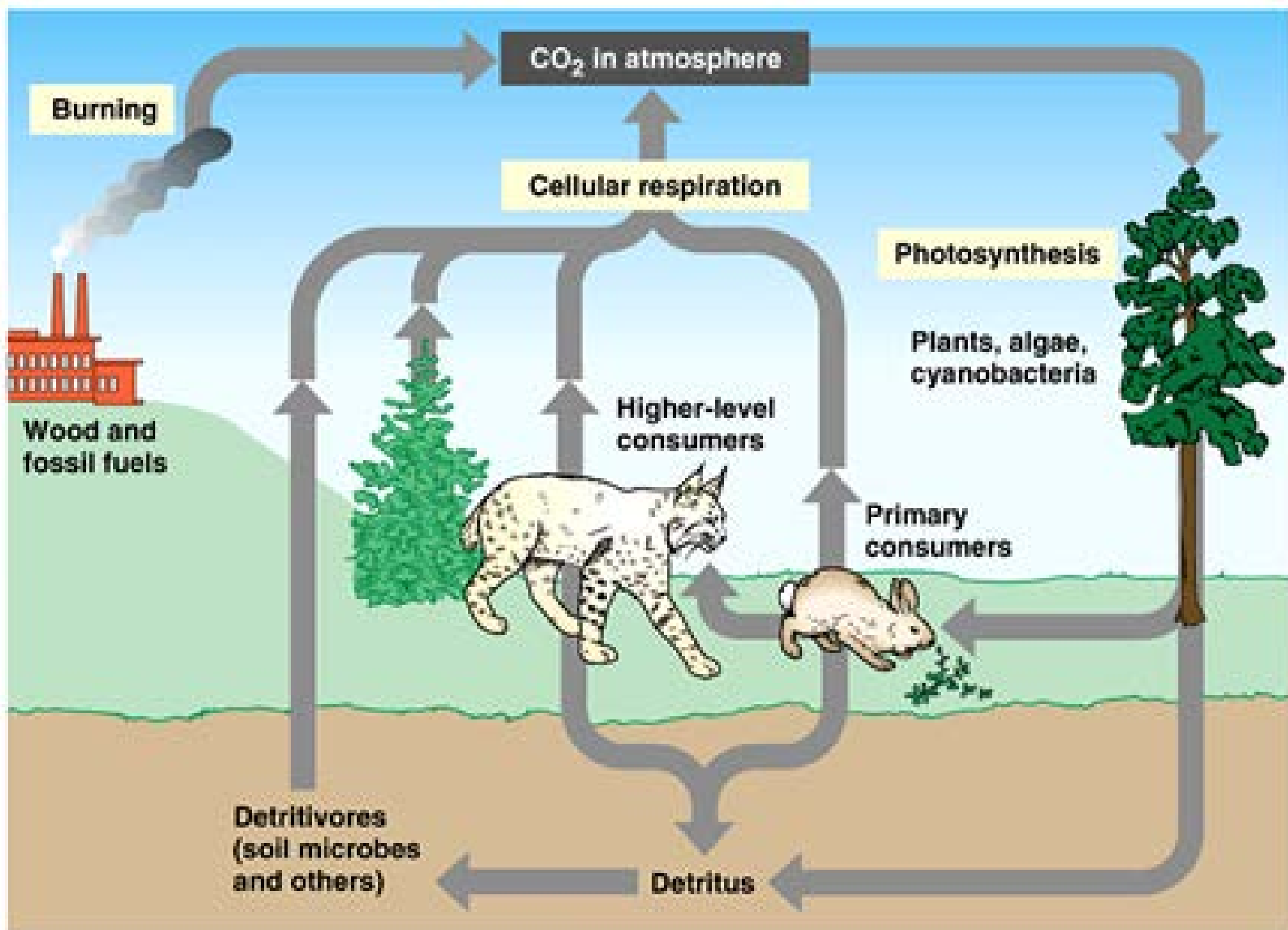
The Carbon Cycle

Carbon is also **RETURNED** to the atmosphere through **COMBUSTION**

- The **COMBUSTION** of fossil fuels also releases carbon dioxide into to Earth's atmosphere.
- **FOSSIL FUELS** are carbon-containing compounds such as petroleum, coal and natural gas that are burned by humans to produce energy.



The Carbon Cycle

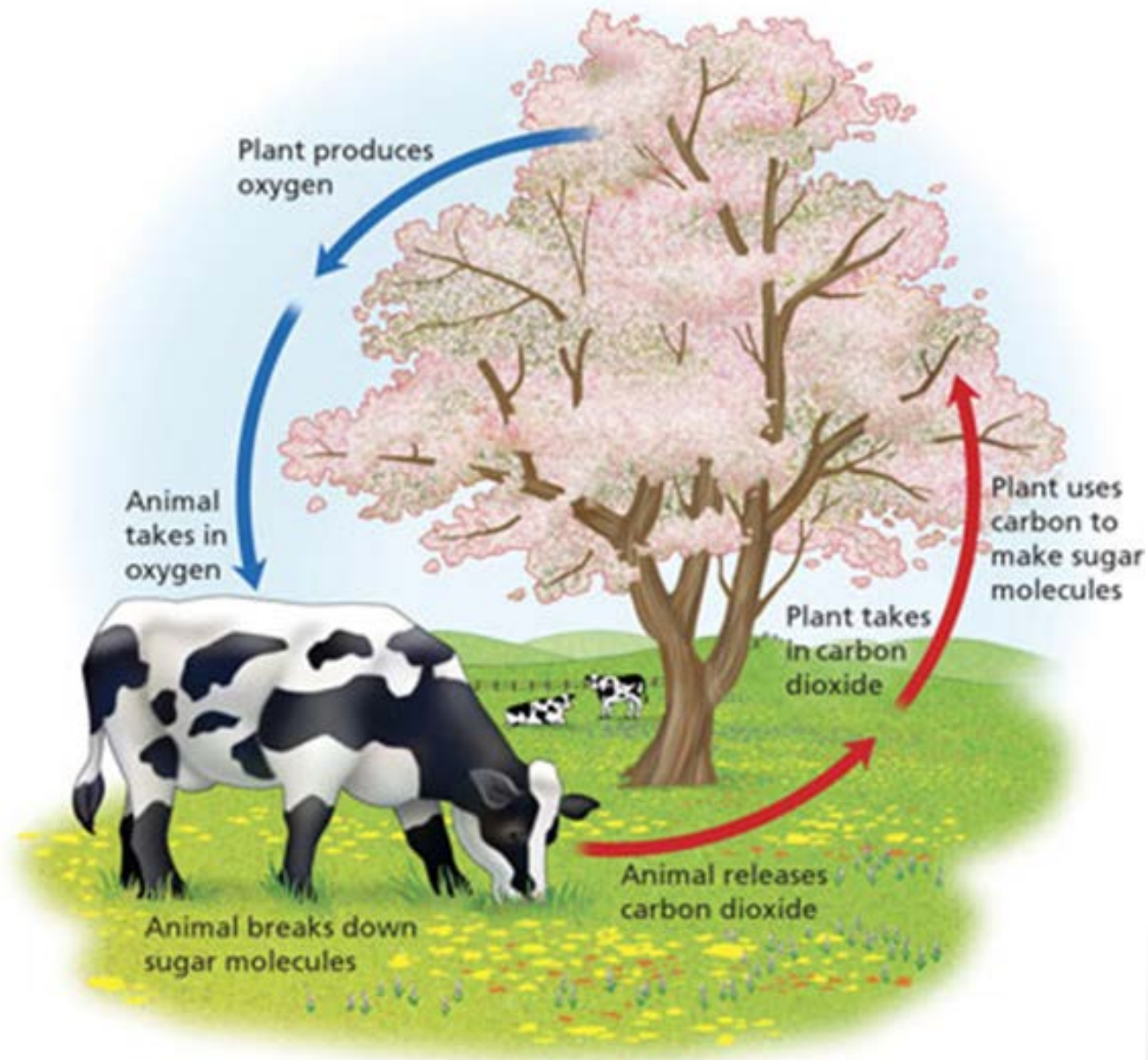


The Oxygen Cycle

The oxygen cycle, which moves oxygen through an ecosystem, is closely linked to the carbon cycle.

1. Plants use water during **PHOTOSYNTHESIS** and release **OXYGEN GAS** (O_2) into the atmosphere.
2. **ORGANISMS** then **USE** the **OXYGEN** gas during **CELLULAR RESPIRATION** and release water into the atmosphere.
3. The cycle continues as **PLANTS PRODUCE OXYGEN** during **PHOTOSYNTHESIS**, which is then used by organisms in cellular respiration.

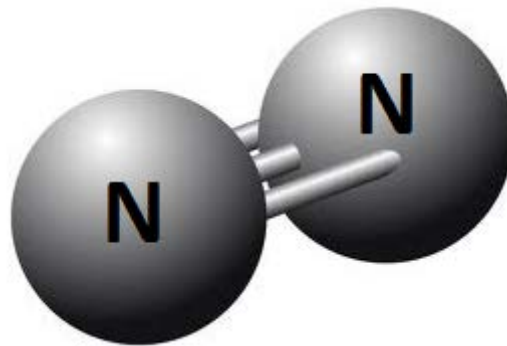
The Oxygen Cycle



The Nitrogen Cycle

The process by which nitrogen moves through an ecosystem is known as the nitrogen cycle. Nitrogen is an important nutrient found in all living things and is used to build **PROTEINS**.

- **NITROGEN GAS** (N_2) makes up about 78% of the Earth's atmosphere, most living things **CANNOT** use it in this form.



In all of the examples of the Nitrogen Cycle notice the processes of **NITROGEN FIXATION** and **DENITRIFICATION** are required to maintain the cycle.

- **NITROGEN FIXATION** is needed to change **ATMOSPHERIC** nitrogen into a form plants can use.
- **DENITRIFICATION** breaks down nitrogen containing compounds and returns the nitrogen to the **ATMOSPHERE**.

The Nitrogen Cycle

NITROGEN FIXATION

is required to change NITROGEN in the atmosphere into NITRATES and AMMONIA (a form of nitrogen that plants CAN use).

There are 2 methods for nitrogen fixation:

1. LIGHTNING

- energy from the lightning causes the nitrogen gas (N_2) and oxygen gas (O_2) in the atmosphere to react and form NITRATE.
- the nitrate DISSOLVES into the RAIN and falls into the soil

2. CERTAIN BACTERIA

- change nitrogen gas into NITRATE and AMMONIA. NH₃
- The process occurs in BACTERIA that live in the ROOTS of LEGUME plants.
 - Legumes include CLOVER, ALFALFA, BEANS and PEAS.
- The process CAN occur in SOME BACTERIA that are FREE in the soil also.

ALL PLANTS then CONVERT the NITRATE and AMMONIA produced into a variety of plant proteins.

The Nitrogen Cycle

When **ANIMALS** eat plants, they **CONVERT PLANT PROTEIN** into animal protein.

- For example, when you eat meat or foods containing plant matter (bread, pasta, etc.), your body converts the protein into muscle, hair, fingernails and other animal proteins.

When plants and animals die, **DECOMPOSERS** break down their remains.

Some **BACTERIA** and **FUNGI** cause **PROTEINS** to decay into **NITRATE** and **AMMONIA**, which can then be **TAKEN UP AGAIN** by plants and used to make proteins.

Denitrification

- Other bacteria will convert **NITRATE** and **AMMONIA** back into **NITROGEN GAS** in a process is known as **DENITRIFICATION**.
- This process also occurs when **BACTERIA CONVERT ANIMAL WASTE** (e.g. sewage), and **PLANT WASTE** (e.g. dead leaves) into nitrogen gas.

The Nitrogen Cycle

