RECYCLING IN
THE BIOSPHERE
Unlike the one-way flow of energy, matter is recycled within and between ecosystems

Matter (elements, compounds, etc) is passed from one organism to another (or from one part of the biosphere to the other) through BIOGEOCHEMICAL CYCLES

Matter can be recycled because unlike energy, matter is not 'used up', rather it is transformed

EX.
Carbon atom (carbon dioxide) --> leaf --> photosynthesis --> carbohydrate (fruit) --> caribou --> waste --> dung beetle --> shrew --> owl --> exhalation --> atmosphere
THE WATER CYCLE

Water is important to the survival of all living things...where does it come from? It moves between the ocean, atmosphere and land.

**EVAPORATION:** water changes from liquid to atmospheric gas

**TRANSPIRATION:** Evaporation of water from the leaves of plants

Sun heats the atmosphere, moist air rises and cools condensing into water droplets forming clouds. The water returns to the Earth's surface in the form of precipitation (rain, snow, sleet or hail).
The precipitation runs along the surface of the ground until it enters a river or stream - carried to an ocean or lake. Rain can also seep into the soil, some deeply enough to become ground water- that water enters plants through roots and the whole process begins again...
NUTRIENT CYCLES

Every living organism needs nutrients to build tissues and carry out essential life functions. Nutrients are passed between organisms and the environment through biogeochemical cycles: the carbon cycle, nitrogen cycle and phosphorus cycle.
THE CARBON CYCLE

Carbon has many important roles in the biosphere:
- key ingredient in living tissue
- Important component of animal skeletons
- Found in many types of rocks
- Found in carbon dioxide which is important to photosynthesis and is released by both plants and animals during respiration
THE CARBON CYCLE

Four main types of processes move carbon through its cycle:

1. Biological processes: photosynthesis, respiration and decomposition

2. Geochemical processes: erosion and volcanic activity

3. Mixed biogeochemical processes: burial and decomposition of dead organisms

4. Human activities such as mining, cutting and burning forests and burning fossil fuels
In the atmosphere, carbon is present as carbon dioxide gas. Carbon is released into the atmosphere by volcanic activity, respiration, human activity and decomposition of organic matter.
Plants take in carbon dioxide and use the carbon to build carbohydrates during photosynthesis.

These carbohydrates are passed on to food webs to animals and other consumers.

Carbon is also found in the ocean in the form of calcium carbonate (CaCO$_3$) which accumulates in marine sediments and in the bones and shells of organisms - these compounds break down and carbon is returned to the atmosphere.
THE NITROGEN CYCLE

Organisms use nitrogen to make amino acids which are used to build proteins.

Where is nitrogen found?

1. Nitrogen gas (N₂) is found in the atmosphere (78%).
2. Ammonia (NH₃), nitrate ions (NO₃⁻) and nitrite ions (NO₂⁻) are found in waste produced by organisms and in dead and decaying matter.
3. Human activity - found in many plant fertilizers.
Even though nitrogen is in abundant supply on Earth, only certain types of bacteria can use it directly. Known as legumes, convert nitrogen gas into ammonia through a process known as NITROGEN FIXATION.

Other bacteria convert ammonia into the nitrate and nitrite ions, once these are available, producers use them to make proteins. Consumers eat the producers and reuse the nitrogen to make proteins.

When organisms die, decomposers return nitrogen to the soil as ammonia. Some soil bacteria use the process called DENITRIFICATION to convert nitrates into nitrogen gas which is then released back into the atmosphere.
THE PHOSPHORUS CYCLE

Phosphorus is important to living things as it forms part of molecules such as DNA and RNA.

Phosphorus is not very common in biosphere, it does not enter the atmosphere, instead it remains mostly on land in rock and soil minerals, as well as ocean sediments.

As rocks and sediment wear down, phosphate is released. On land, some of the phosphate washes into rivers and streams, where it dissolves, making its way to the oceans, where it is used by marine life.

Some phosphate stays on land and cycles between soil and organisms. Plants can absorb the phosphate from the soil/water and bind the phosphate into organic compounds. These move through the food web from producers to consumers.
NUTRIENT LIMITATION

PRIMARY PRODUCTIVITY: rate at which organic matter is created by producers

This rate of productivity can be influenced by the available nutrients, if a nutrient is in short supply it can limit an organism's growth, this is called the LIMITING NUTRIENT

Farmers are aware of this phenomenon as so they add fertilizers (containing N, P, and K) to their crops to boost their productivity, the nutrients help plants grow larger and more quickly then had they gone unfertilized