

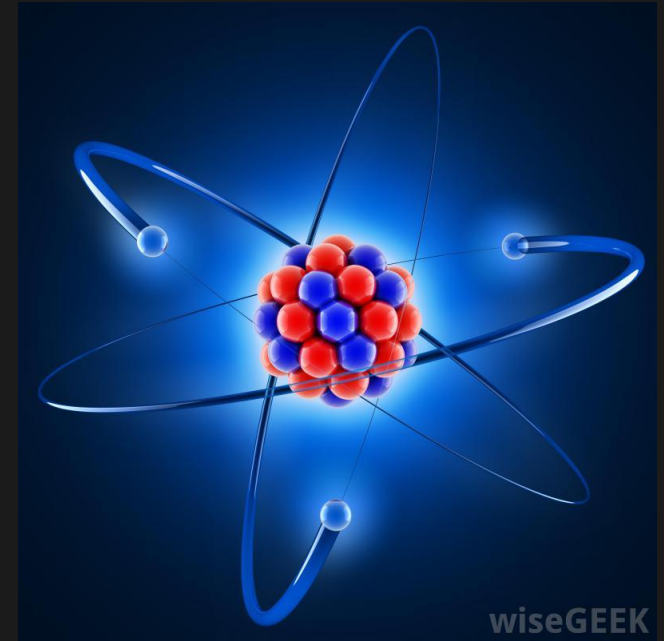


# Atoms, Elements, and Molecules

Subtitle

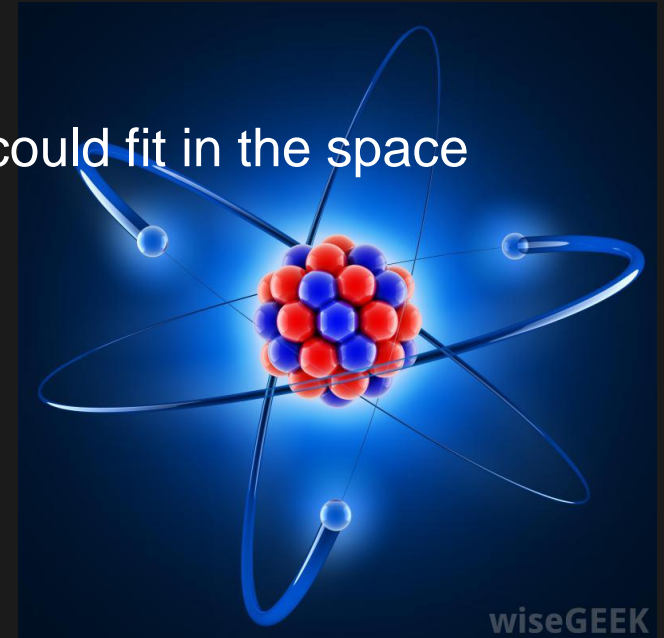
# Focus Question: How are all living things based on atoms and their interactions?

- Living things consist of **atoms** of different **elements**



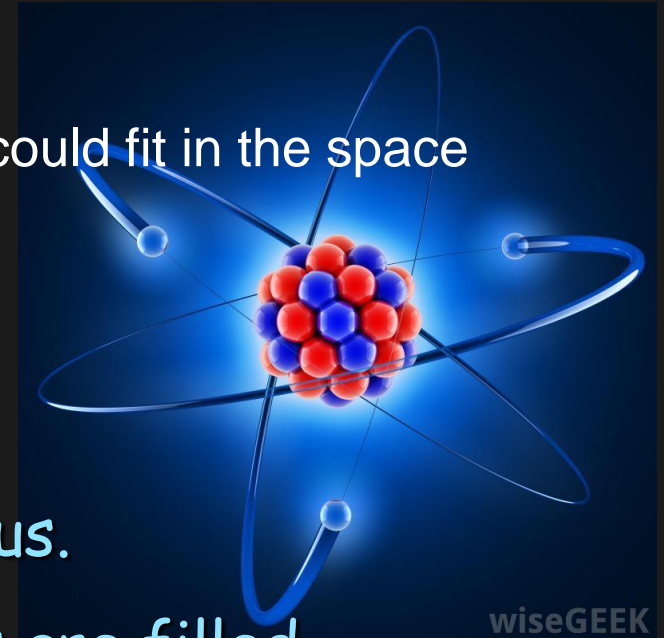
# Focus Question: How are all living things based on atoms and their interactions?

- Living things consist of **atoms** of different **elements**
- **Atoms** are the **smallest basic unit of matter**. Millions of atoms could fit in the space of the period at the end of this sentence



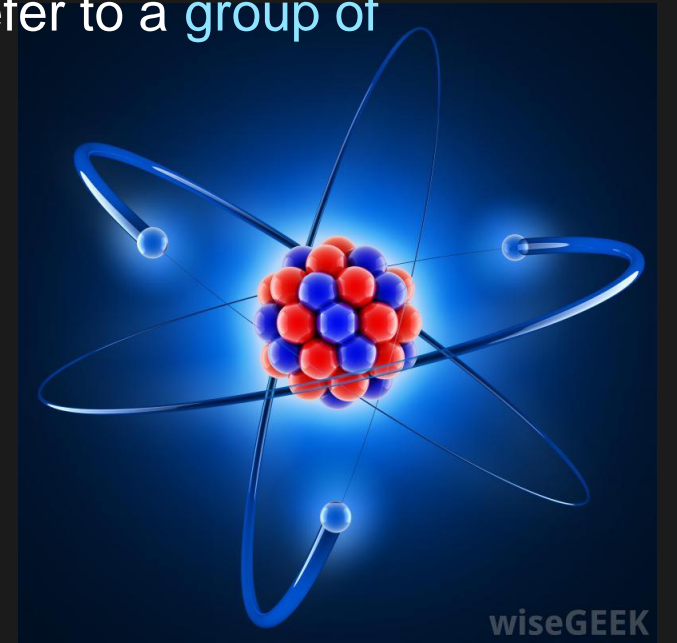
# Focus Question: How are all living things based on atoms and their interactions?

- Living things consist of **atoms** of different **elements**
  - **Atoms** are the smallest basic unit of matter. Millions of atoms could fit in the space of the period at the end of this sentence
  - **Neutral in charge.**
  - **Composed of nucleus with protons and neutrons.**
  - **Electrons found in energy shells around the nucleus.**
  - **Atoms are most stable when outer electron shells are filled.**



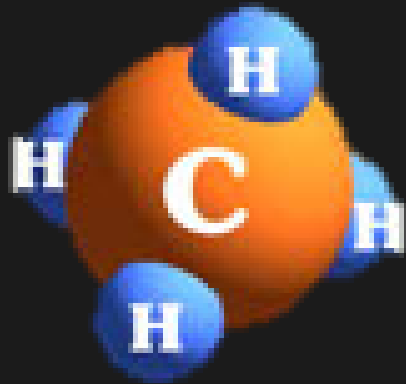
# Focus Question: How are all living things based on atoms and their interactions?

- Living things consist of **atoms** of different **elements**
- **Elements** are one particular type of atom and cannot be broken down into a simpler substance by ordinary chemical means. It can also refer to a group of atoms of the same type.

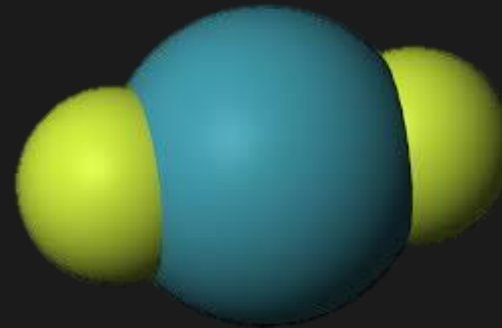


# Focus Question: How are all living things based on atoms and their interactions?

- A **bond** is a link, or connection, between atoms.
- **Compounds** are substances made of atoms of two or more elements held together by chemical bonds. **Molecules** are compounds held together by covalent bonds.



Methane CH<sub>4</sub>



Carbon dioxide CO<sub>2</sub>

# Question

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- How are elements different from compounds?

# Question

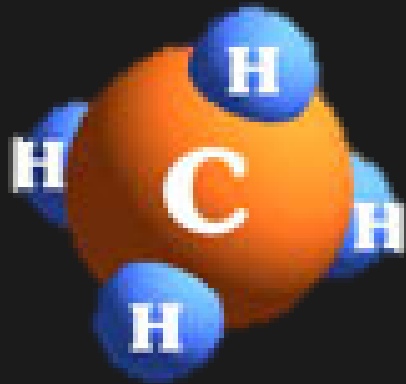
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- How are elements different from compounds?
- Elements are composed of only one type of atom; compounds are composed of different types of atoms.

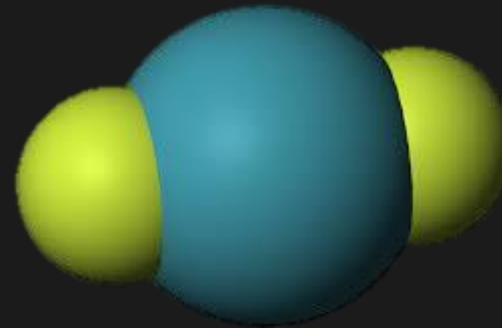


Focus Question: How are all living things based on atoms and their interactions?

- **BREAK:** Let's make some molecules!



Methane  $\text{CH}_4$



Carbon dioxide  $\text{CO}_2$

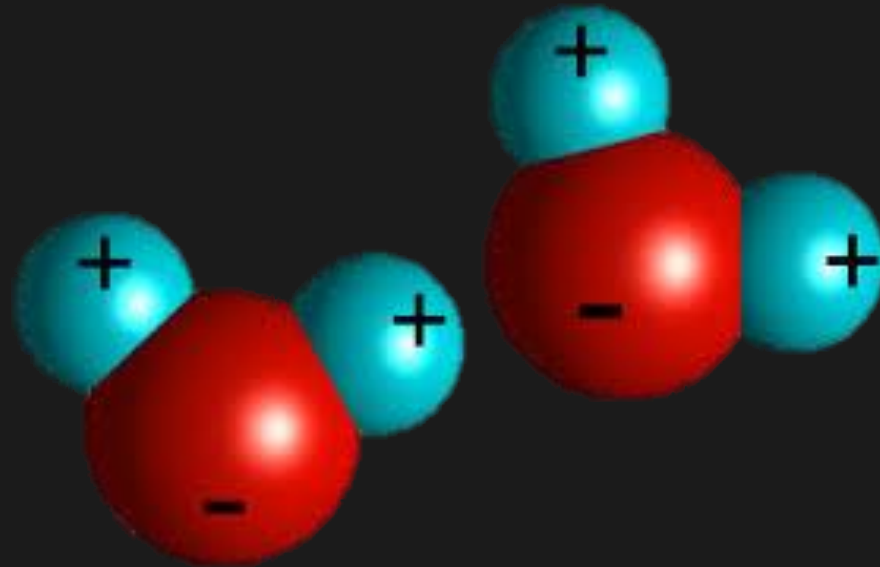


# Properties of Water

Water's unique properties allow life to exist on Earth

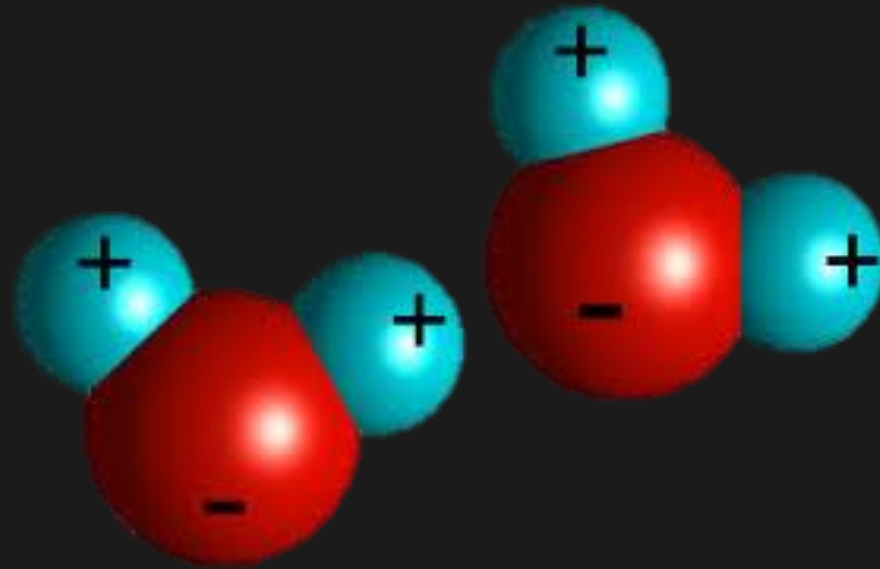
# Focus Question: How do water's unique properties allow life to exist on earth?

Water is a polar molecule. One region of the molecule is slightly positive in charge, and another is slightly negative.



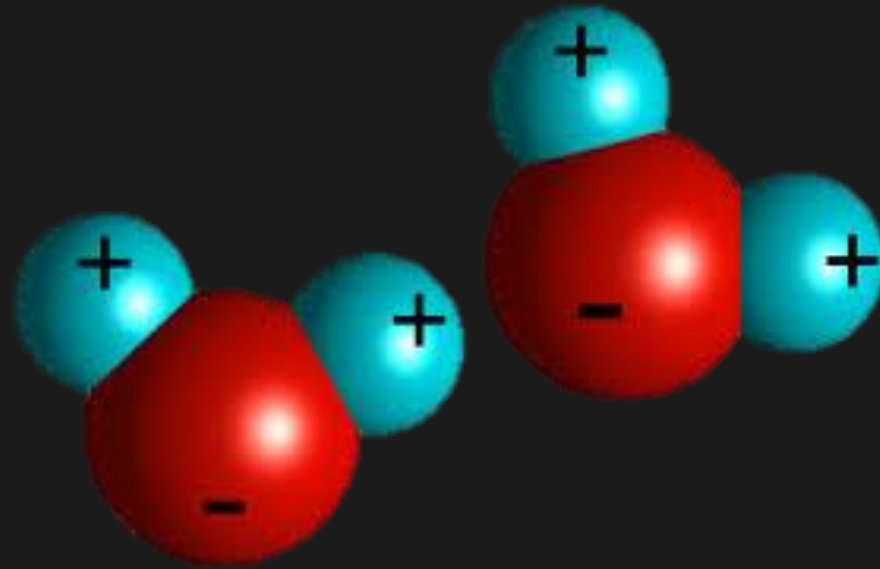
# Focus Question: How do water's unique properties allow life to exist on earth?

A **hydrogen bond** is formed between the positive region of one molecule and the negative region of a nearby molecule.



# Focus Question: How do water's unique properties allow life to exist on earth?

Hydrogen bonding gives water special properties.



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Such as:

High specific heat



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# Focus Question: How do water's unique properties allow life to exist on earth?

Hydrogen bonding gives water special properties.

Such as:

High specific heat

Adhesion

And cohesion





# Break – Water Demo



# Focus Question: How do water's unique properties allow life to exist on earth?

Many compounds dissolve in water. Molecules and atoms cannot take part in chemical processes inside cells unless they dissolve in water. Important materials such as oxygen and sugars cannot be transported from one part of an organism to another unless they are dissolved in blood, plant sap, or other water-based fluids.



# Focus Question: How do water's unique properties allow life to exist on earth?

A **solution** is formed when one substance dissolves in another. It is a mixture of substances that is the same throughout.



End

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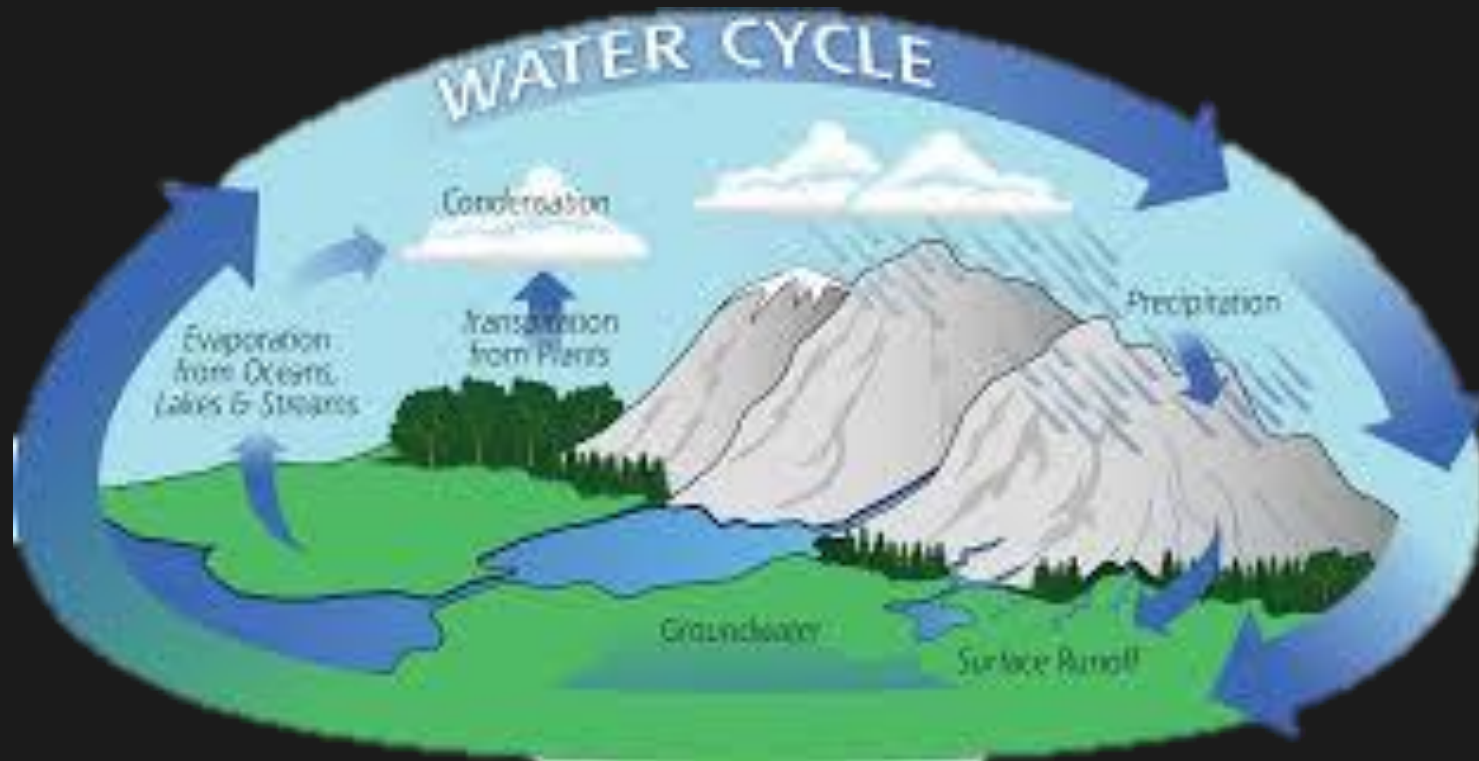
# Cycling of Matter

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Matter cycles in and out of ecosystems.

# Focus question: How do elements cycle through and ecosystem?

The hydrologic cycle, or **water cycle**, is an example of matter cycling through the environment. It is a circular pathway of water on Earth from the atmosphere to the surface, below ground, and back. Part of that pathway involve humans and other organisms, which all have bodies made mostly of water.



If the total amount of water on Earth does not change, why are there concerns about a global water shortage?

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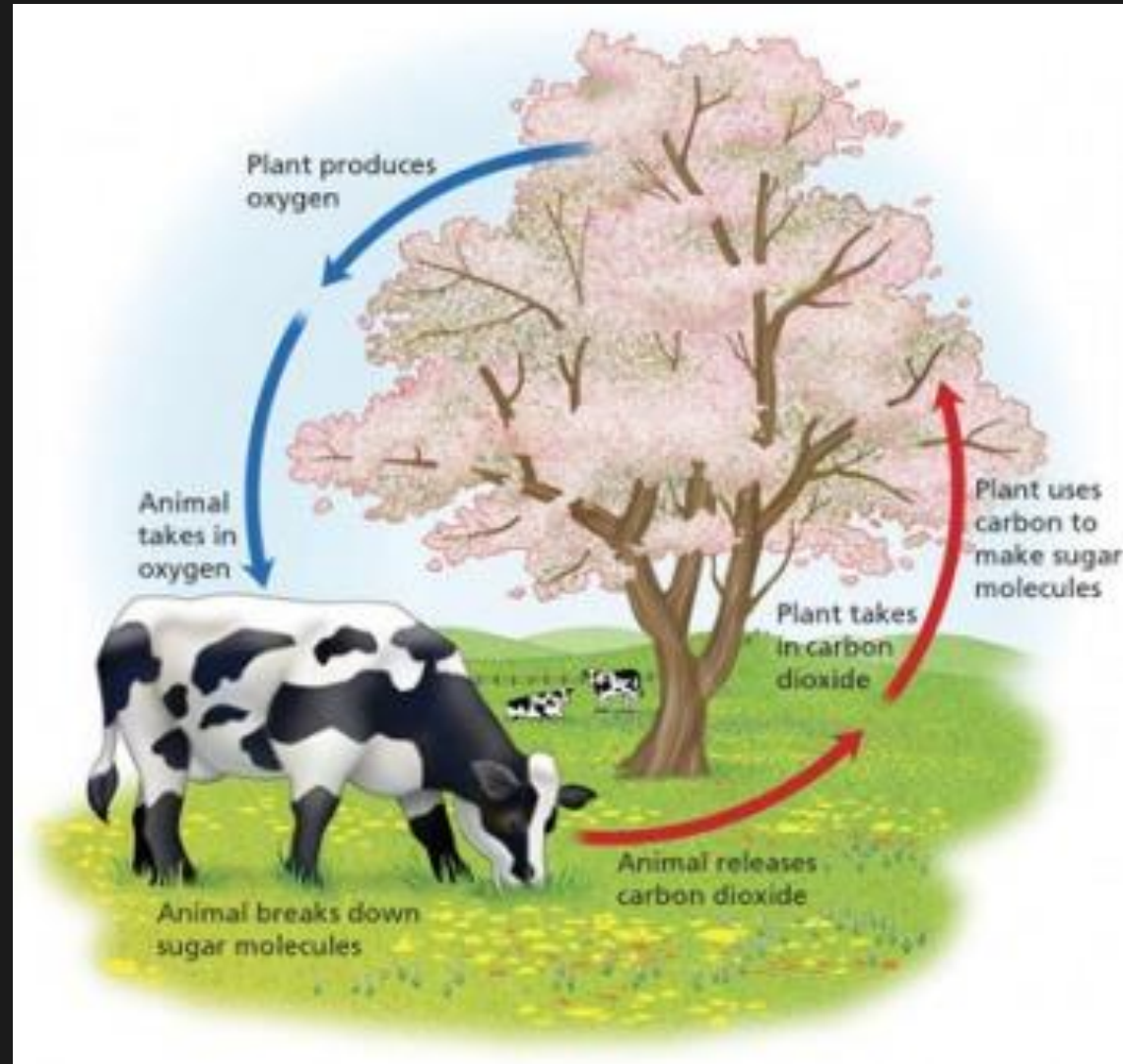
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So little of Earth's water is fresh water. Increasing population puts a strain on available supply.



# Focus question: How do elements cycle through and ecosystem?

Hydrogen and oxygen are both cycled in the water cycle. Oxygen is also cycled in the oxygen cycle.



# Focus question: How do elements cycle through and ecosystem?

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Other elements essential for life also cycle through ecosystems. Including...

# Focus question: How do elements cycle through and ecosystem?

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Other elements essential for life also cycle through ecosystems.  
Including...

- Carbon

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Including...

- Carbon
- Nitrogen
- Phosphorus

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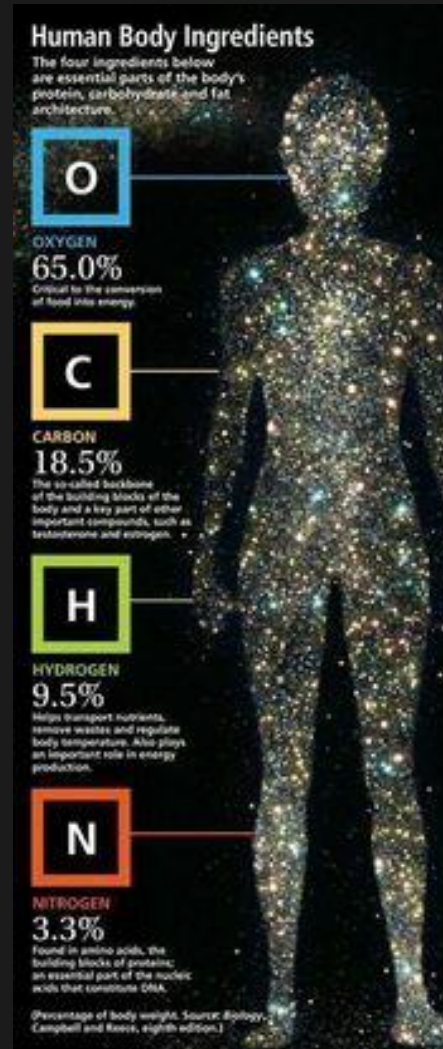
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Other elements essential for life also cycle through ecosystems.  
Including...

- Carbon
- Nitrogen
- Phosphorus
- Sulfur

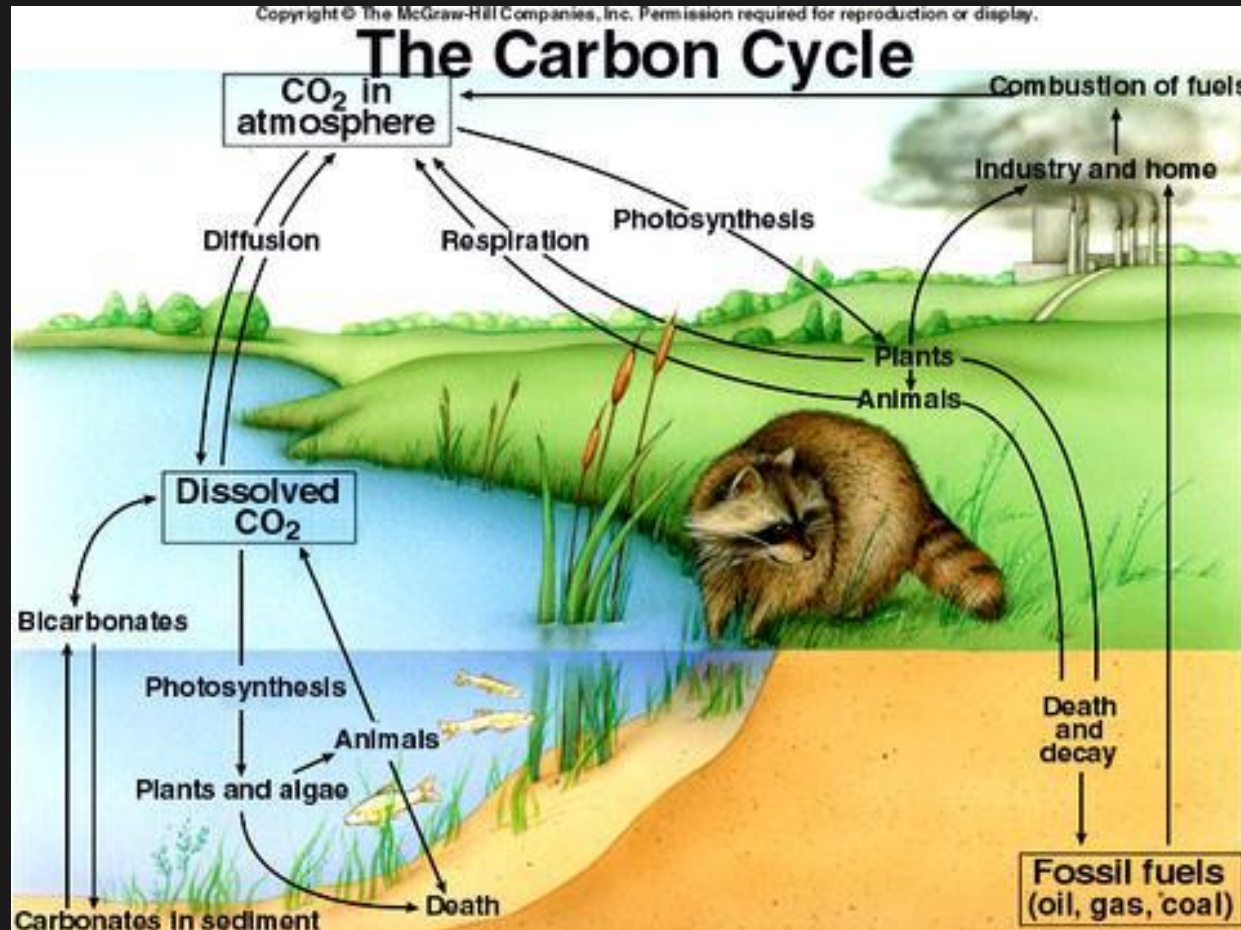
# Focus question: How do elements cycle through and ecosystem?

Hydrogen, Oxygen, Nitrogen, and Carbon make up 96% of the mass of the human body.



# Focus question: How do elements cycle through and ecosystem?

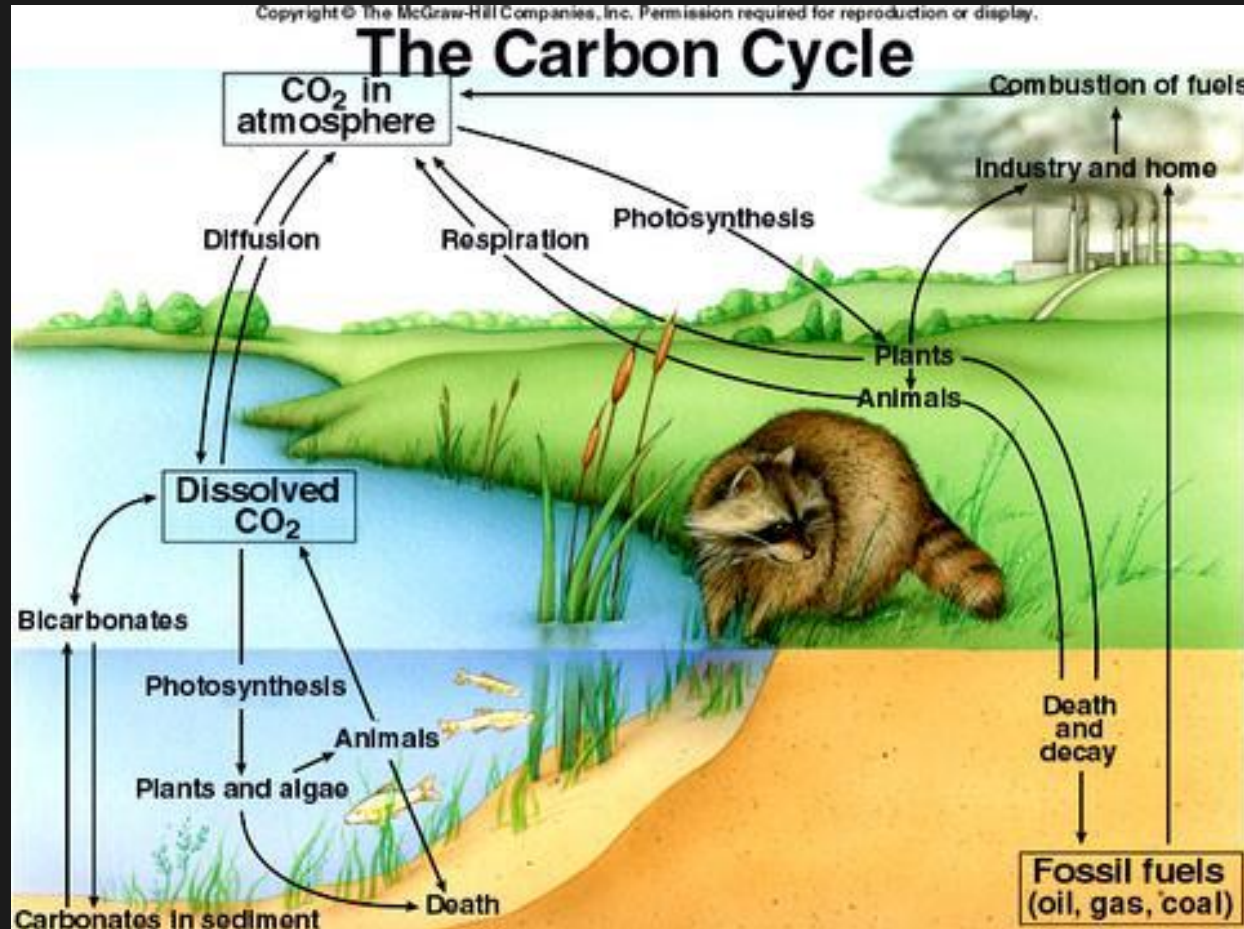
A **biogeochemical cycle** is the movement of a particular chemical through the biological (living) and geological (nonliving) parts of an ecosystem.





# Focus question: How do elements cycle through and ecosystem?

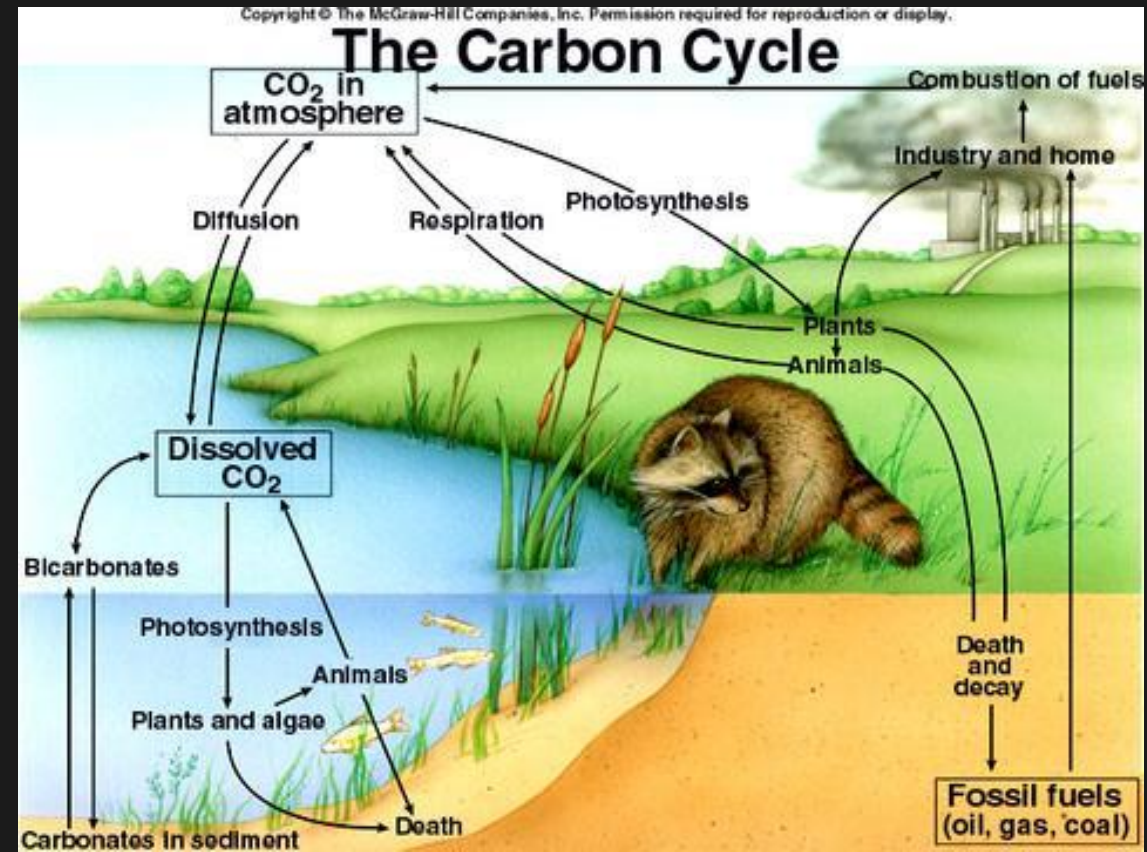
The **Carbon Cycle** is the movement of carbon through the biological (living) and geological (nonliving) parts of an ecosystem.



# Focus question: How do elements cycle through and ecosystem?

Carbon is the building block of life (biotic).

- Carbohydrates
- Proteins
- Fats
- All other organic molecules



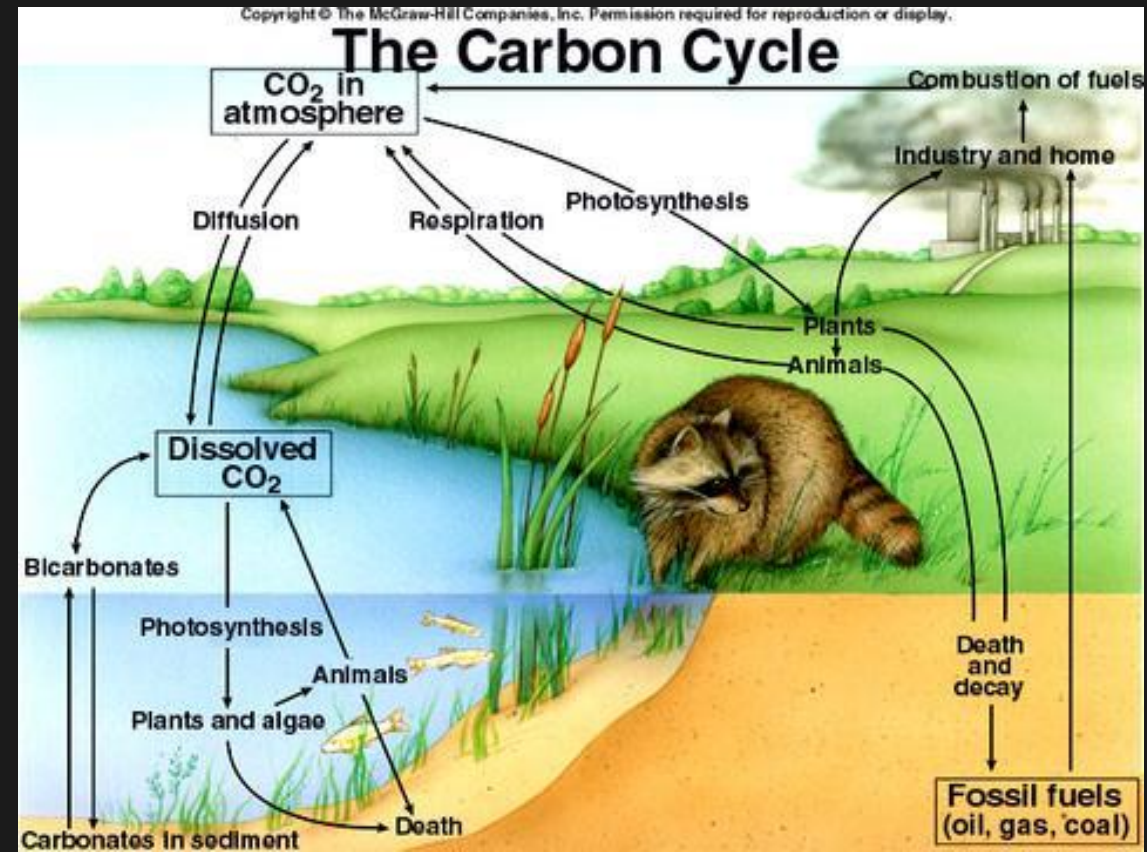
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Carbon is the building block of life (biotic).

- Carbohydrates
- Proteins
- Fats
- All other organic molecules

Also found in many nonliving (abiotic) forms

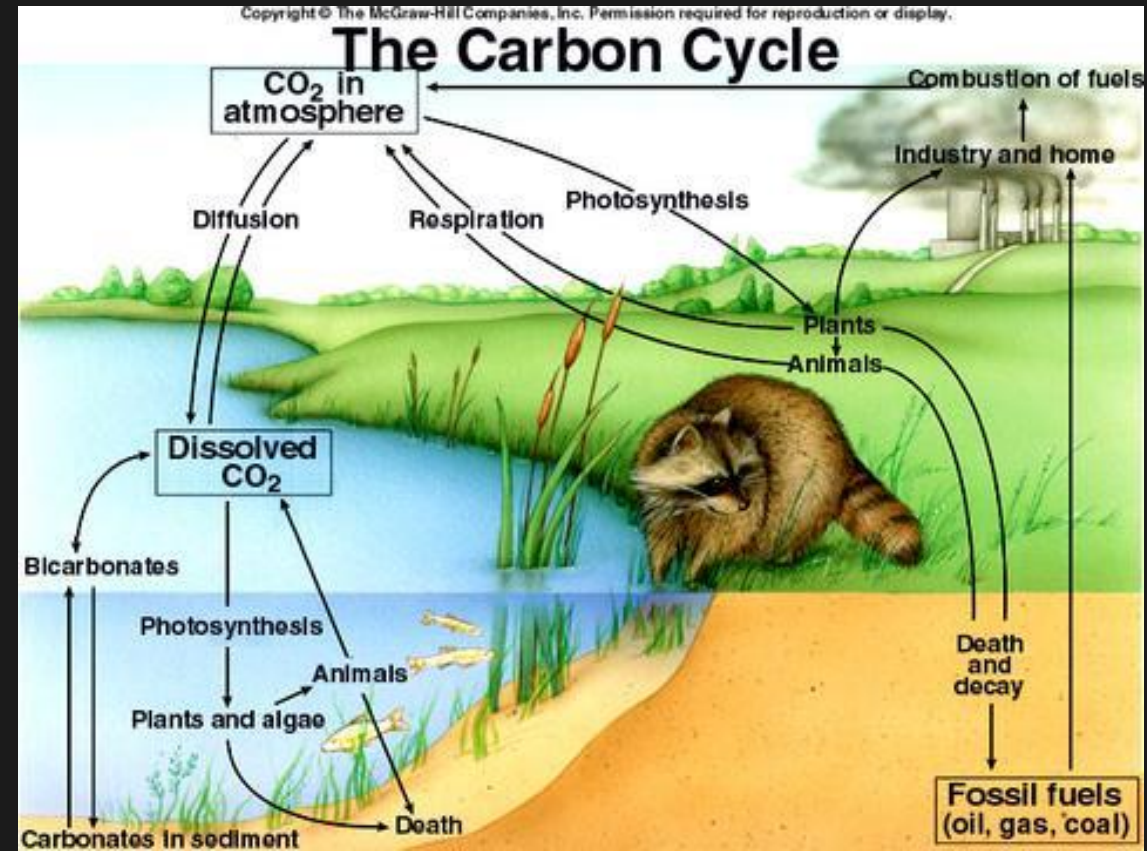
- Atmosphere –  $\text{CO}_2$
- In water – bicarbonate
- Fossil fuels
- Rocks and soil



# Focus question: How do elements cycle through and ecosystem?

Processes by which carbon moves through ecosystems:

- Photosynthesis
- Eating
- Respiration
- Combustion (burning) of fossil fuels



# Break: Draw a simple carbon cycle diagram

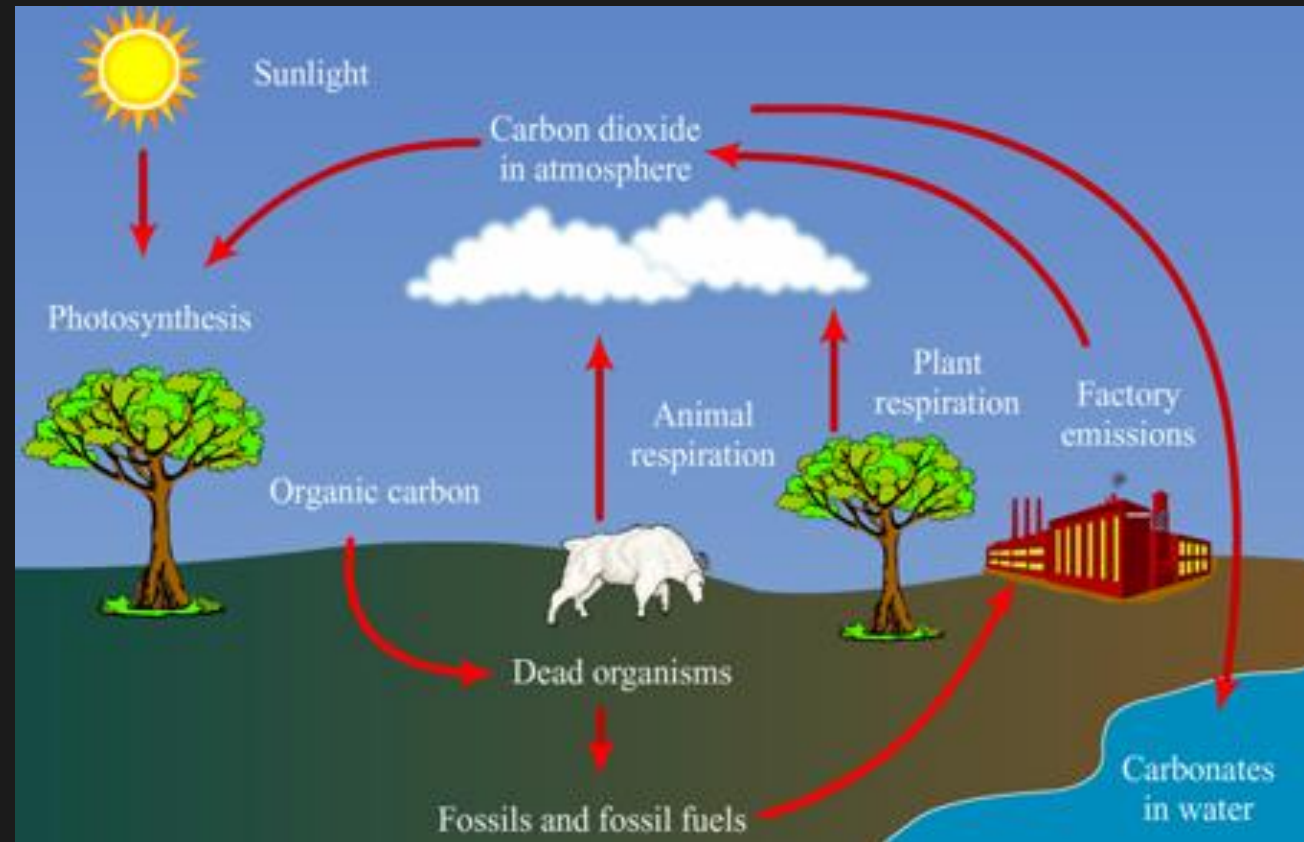
## Include:

- Two living organisms (one plant, one animal)
- Photosynthesis and respiration
- Decomposition
- Fossil fuels
- A factory
- A body of water
- Dissolved carbon
- Carbon in the atmosphere

# Draw a simple carbon cycle diagram

## Include:

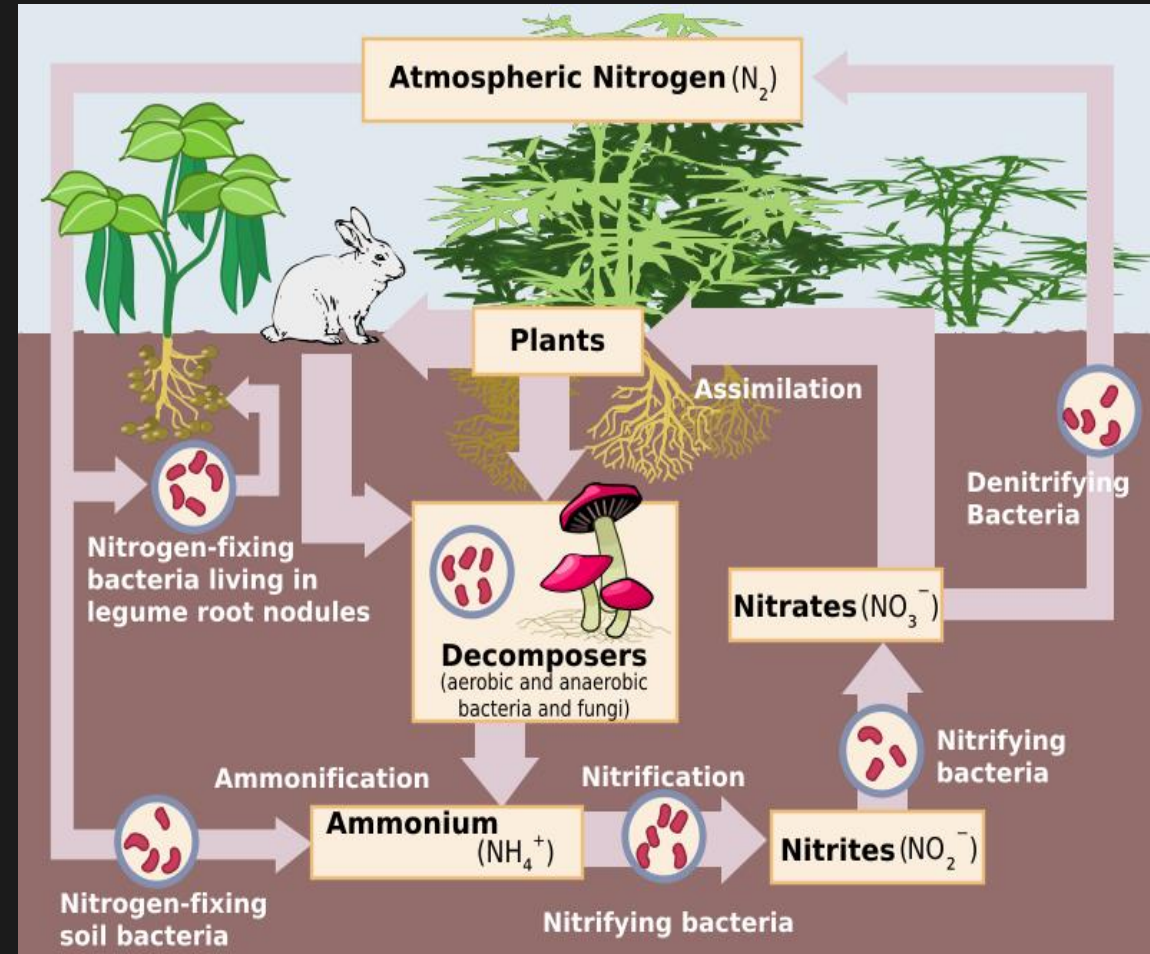
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# Focus question: How do elements cycle through and ecosystem?

## The Nitrogen cycle

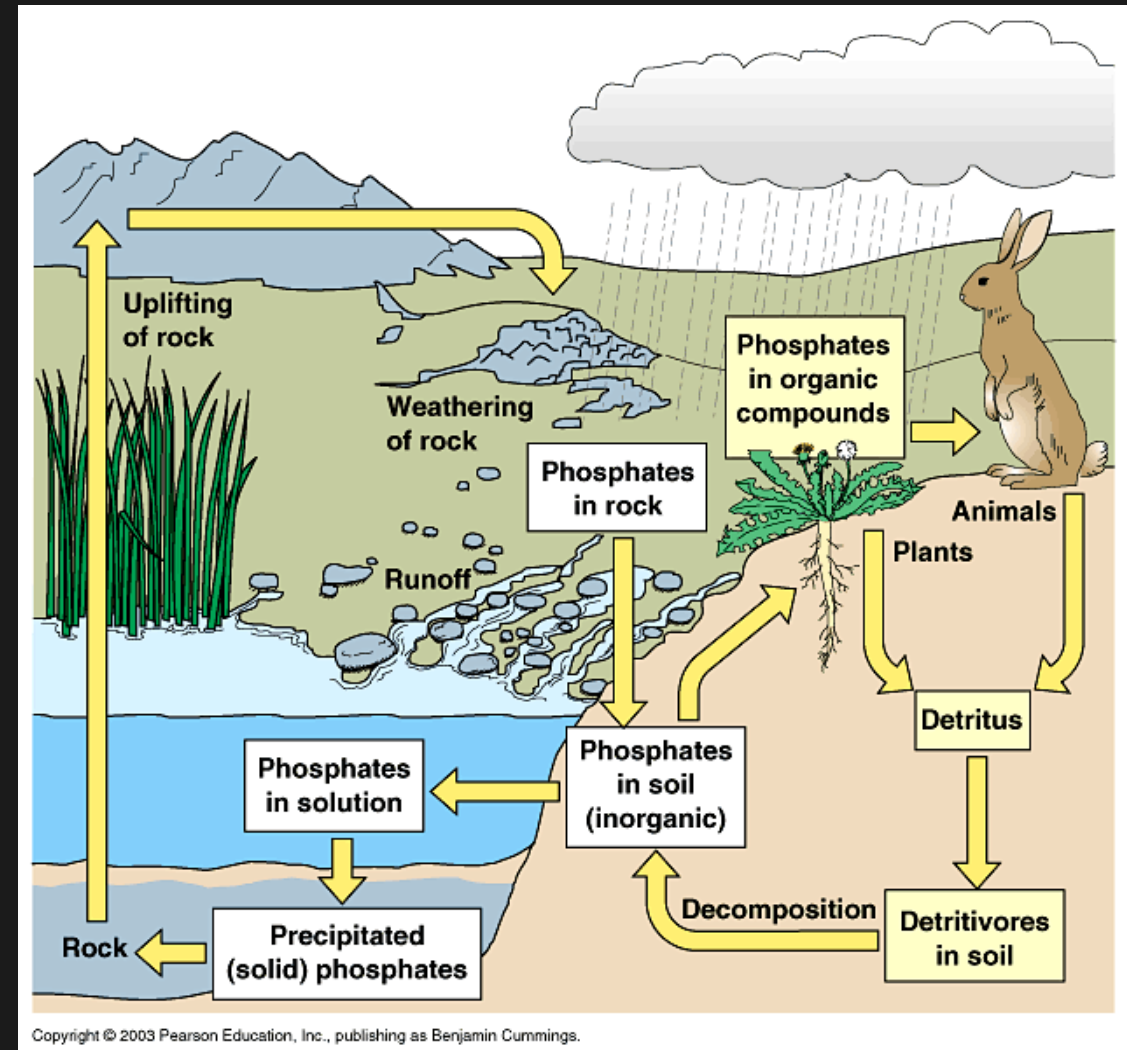
- 78% of the atmosphere is nitrogen gas ( $N_2$ )
- Organisms use ammonium ( $NH_4^+$ ) or nitrate ( $NO_3^-$ )
- Much of the cycle takes place underground
- **Nitrogen fixation** is the process by which certain bacteria turn atmospheric nitrogen into ammonia ( $NH_3$ )



# Focus question: How do elements cycle through and ecosystem?

## The Phosphorus Cycle

- Does not take place in the atmosphere
- Phosphorus in rocks is released by weathering
- Phosphorus is taken up by plants and fungi
- Moves through the food web and returns to the soil when organisms die





# Let's make another biogeochemical cycle poster!

## Nitrogen cycle

- Nitrogen in atmosphere
- Nitrogen-fixing bacteria in roots
- Nitrogen-fixing bacteria in soil
- Plants and animals
- Decomposers
- Ammonium
- Ammonification
- Nitrifying bacteria
- Nitrites
- Nitrates
- Denitrifying bacteria

## Phosphorus cycle

- Rain
- Plants and animals
- Decomposers
- Phosphate in soil
- Leaching
- Phosphate in solution
- Sedimentation
- Geologic uplifting
- Weathering of phosphate from rocks
- Runoff

End

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