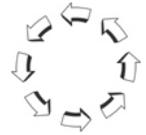
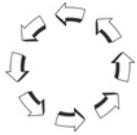


# BIOGEOCHEMICAL CYCLES

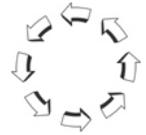


## Teacher's Instructions:

- 1) prep the students by talking about how ecosystems recycle resources and ask the students to think of all the things an ecosystem recycles
  - guide their answers to biomass, water, carbon, oxygen, nitrogen, etc.
- 2) review the hydrological cycle with students
  - ask students to tell you about the water cycle as you post what they say on the board
  - see if students can tell you the complete cycle
  - have students give you definitions for terms involved in the cycle (i.e. evaporation, condensation, precipitation, etc.)
  - provide students with the background information to fill in the gaps in their cycle if need be
- 3) go over tasks with students and examine the Water Cycle Examples (the diagram and write-up)
  - point out that the diagram takes up the entire page and that there are small pictures that show what each step is
  - also point out that the diagram is a complete, closed cycle, all steps are included and it does not have a start or finish
  - read over the hints that are given about the assignment
- 4) break students into groups and allow them to begin the assignment
- 5) after the students have completed the diagram and write-up get the groups back together and have the students teach each other the cycle they researched
  - walk around the room to ensure that accurate information is being passed
- 6) collect the diagrams and write-ups to ensure that they are correct, photocopy the best diagram and write-up for each cycle and put together a study package
- 7) hand out study packages and set date for a quiz
- 8) administer quiz in a later class (give students a couple of days to prepare and study)
- 9) collect quizzes, grade them, hand them back and go over problem areas (if any)



# BIOGEOCHEMICAL CYCLES



## OBJECTIVES:

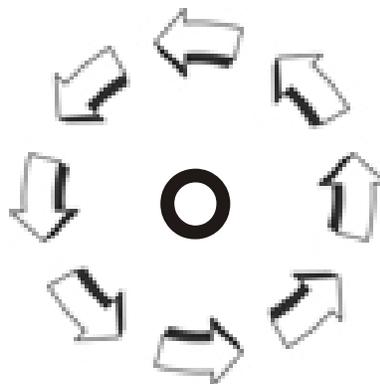
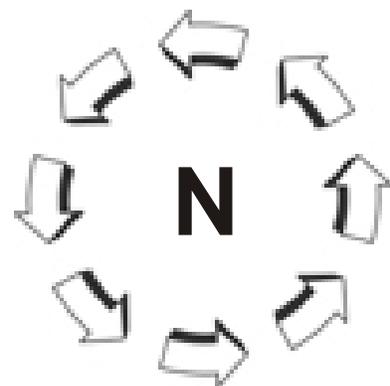
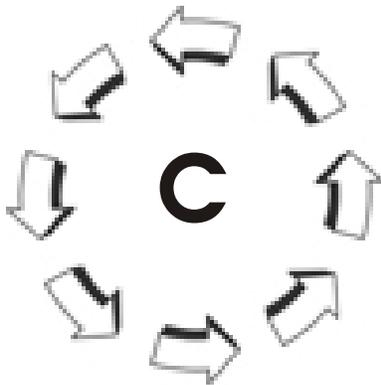
- to illustrate and explain how carbon, nitrogen and oxygen are cycled through an ecosystem

## TASKS:

- review the hydrological cycle (the water cycle)
- get into groups of three
- one member will research the carbon cycle, one will research the nitrogen cycle and one will research the oxygen cycle
- for each cycle, the group member will:
  - create a poster/diagram on 8.5 x 11 paper (black and white)
  - write at least a half-page report that outlines the cycle, defines all terminology and describes all steps involved in the cycle
  - also include at least two factors that would/could disrupt your cycle
- after each group member has completed their research they will return to their group to teach the other two members about his or her cycle

## KEY TERMS:

- terrestrial: relating to or composed of land
- fossil fuels: a hydrocarbon deposit that is made from organic matter over a long period of time and is used for fuel
- hydrocarbon: compound that contains only hydrogen and carbon
- organic: natural, living or used to be living
- legumes: pea or bean plants
- synthetic: not natural, prepared or made artificially



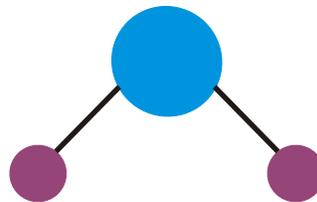
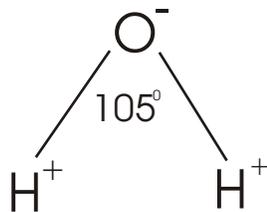


## WATER CYCLE

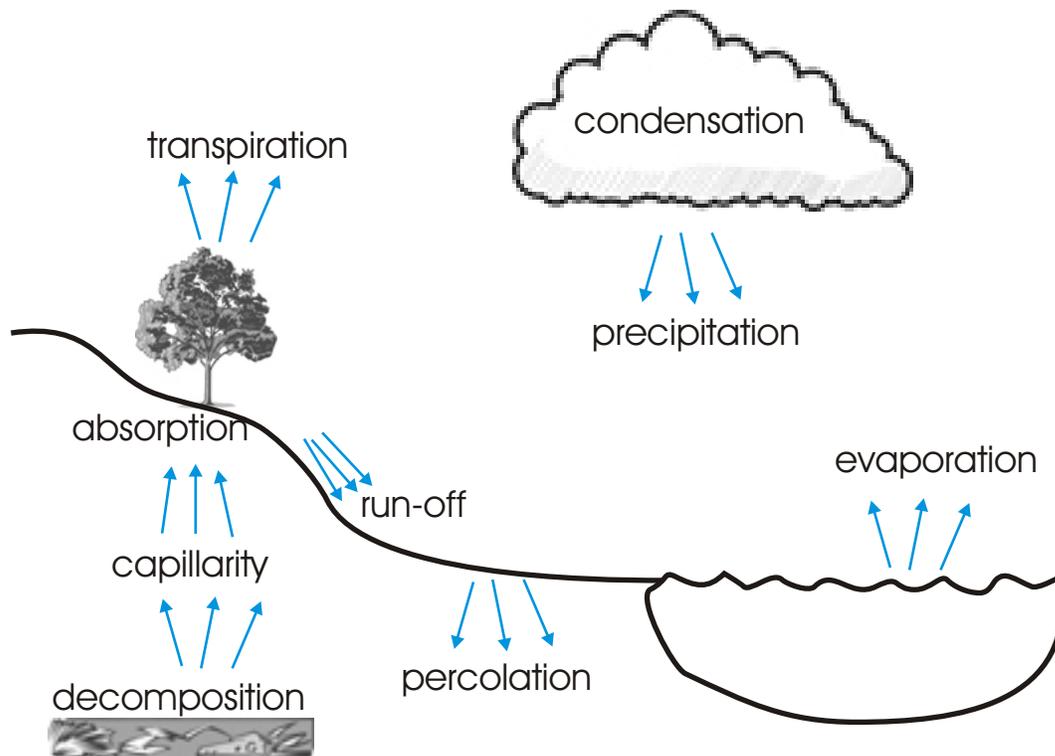
Water molecules are made of hydrogen and oxygen atoms. Hydrogen and oxygen are nutrients that organisms need. Clearly there is no problem obtaining these nutrients in aquatic ecosystems. However, they are sometimes in short supply in terrestrial ecosystems. The cycling of water in nature involves both aquatic and terrestrial ecosystems and the air above them. Let's see how this occurs:

Water vapour enters the atmosphere through transpiration from vegetation. **Transpiration** is the loss of water through pores in the leaves of plants. It also enters the atmosphere through **evaporation** from bodies of water and the soil. In the cool upper atmosphere this vapour **condenses**, forming clouds. In time, enough water collects in the clouds to cause **precipitation**. When this occurs, some of the water falling on the ground runs along the surface of the ground to a stream, pond or other body of water. This is called **surface runoff**. Some of the water also soaks into the ground by a process called **percolation**. Some water percolates down to the bedrock. Then it becomes ground water and gradually runs back to lakes and other bodies of water.

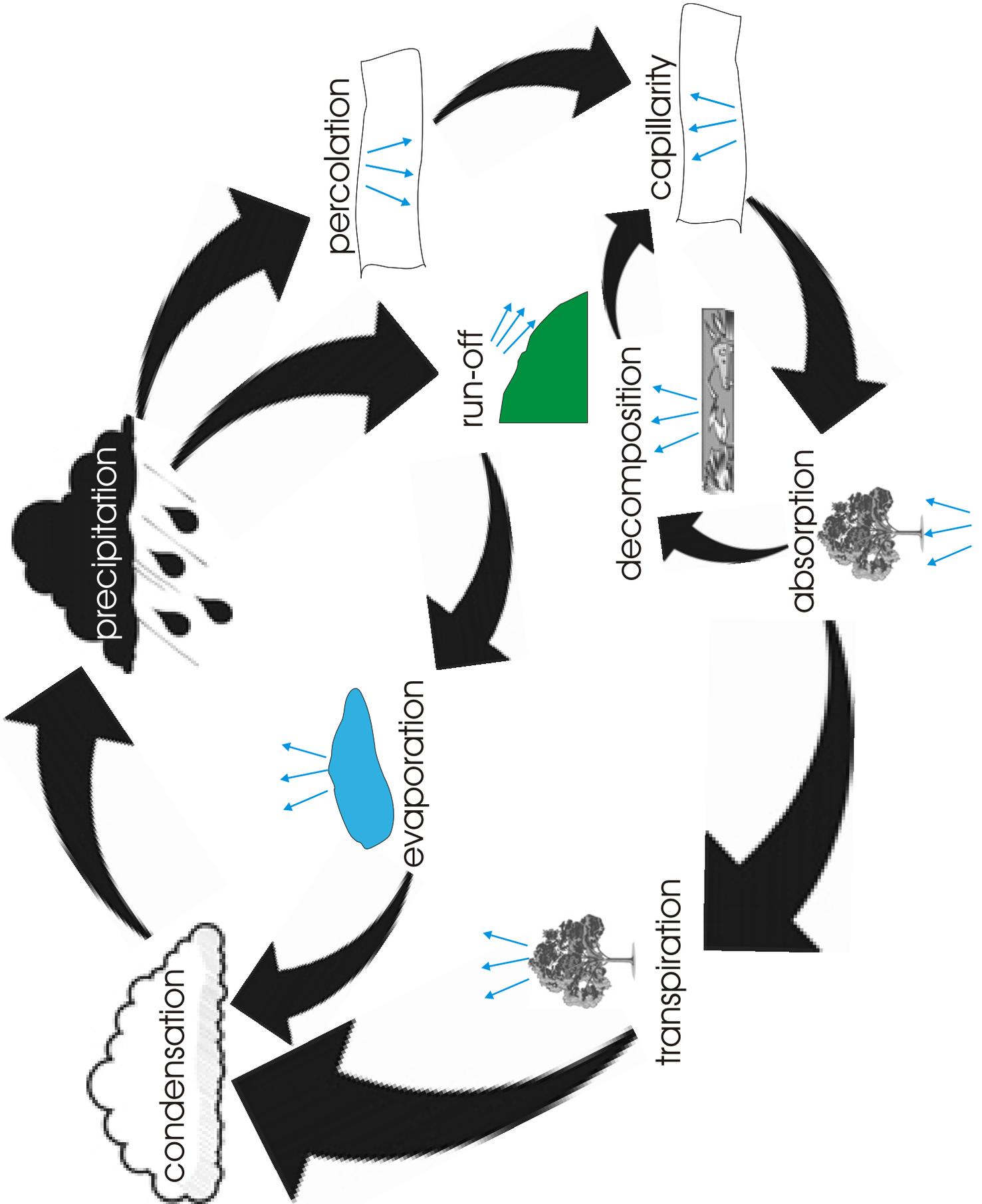
Some of the water in the soil moves up to the roots of plants by **capillarity**. The roots absorb the water. This is how most plants get the hydrogen and oxygen they need. Animals can obtain water by eating plants or by eating other animals. Of course, they can also obtain water by drinking it directly from a body of water. When plants and animals die, they **decompose**. During the **decomposition** process, the water present in their tissues is released into the environment.



### DIAGRAM:



**Water Cycle: Example of Diagram (10)**



## Water Cycle: Example of Write-up (10)

The water cycle consists of many phases. Let's begin with a body of water such as a lake. Water will evaporate and enter the atmosphere. Then, as the atmosphere cools the water, it condenses into water vapor. The water vapor collects in clouds until it falls back to the earth as precipitation. Some of the water that falls on the earth simply runs off and enters the streams or lakes again. Some of it may also percolate and enter the soil. Then, through capillarity, the water moves up the soil towards the roots of plants. The plants then absorb the water and some water leaves them through transpiration. Also, animals may eat the plants to get water or simply drink straight from a water source. When these plants and animals die, decomposition takes place and releases water to the environment.

Two factors that could disrupt this cycle are pollution and global warming. Too much pollution in water can cause acid rain and this would decrease the amount of "good" water available for the cycle. Also, if temperatures continue to rise more water would be released into the cycle (from ice caps).

### KEY TERMS:

- evaporation: the process of changing water into vapor
- condensation: the process of changing vapor into water
- precipitation: any form of water that falls to the earth's surface
- run-off water that moves along the earth's surface, it is not absorbed
- percolation: draining or seeping of water into the earth
- capillarity: when water is moved towards the surface
- absorption: when plants take water from the ground
- transpiration: water leaving the pores from leaves on plants
- decomposition: breaking down organic matter, releases water to the environment

### HINTS:

#### FOR THE DIAGRAM:

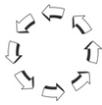
- ensure that the diagram is a closed cycle (no beginning, no end), of course, there may be a few exceptions in some cycles
- include small pictures for each step
- use the correct terminology for each step

#### FOR THE WRITE-UP:

- summarize cycle, select a starting point and take the reader through the entire cycle
- explain and describe all steps in the cycle
- define terms as they relate to your cycle

100%





## CARBON CYCLE

Carbon is another nutrient that all organisms need. In fact, it is the basic building block of all living things. Like water, carbon moves through an ecosystem in a cycle. Here is how the cycle works.

Carbon is present in the atmosphere as carbon dioxide. Water also contains carbon dioxide as it can dissolve it. Producers (plants and algae) use it to perform photosynthesis and make food. Now the carbon is in the producers. Herbivores eat the plants and carnivores eat the herbivores. Now the carbon is in animals. Both plants and animals respire. Their respiration returns carbon dioxide to the atmosphere. Decomposers break down dead plants and animals as well as animal waste. This too returns carbon dioxide to the atmosphere or soil.

Some organic matter does not decompose easily. Instead it builds up in the earth's crust. Oil and coal were formed from the build-up of plant matter millions of years ago.

At one time, the carbon cycle was almost a perfect cycle. That is, carbon was returned to the atmosphere as quickly as it was removed. Lately, however, the increased burning of fossil fuels has added carbon to the atmosphere faster than producers can remove it. Also, deforestation reduces the amount of carbon dioxide being used in photosynthesis. Further, the use of land for agriculture releases carbon dioxide into the environment.

Plants in water need carbon dioxide to perform photosynthesis and release oxygen. Fish use the oxygen to breathe and the plants for food. Thus, fish depend on the carbon dioxide cycle.

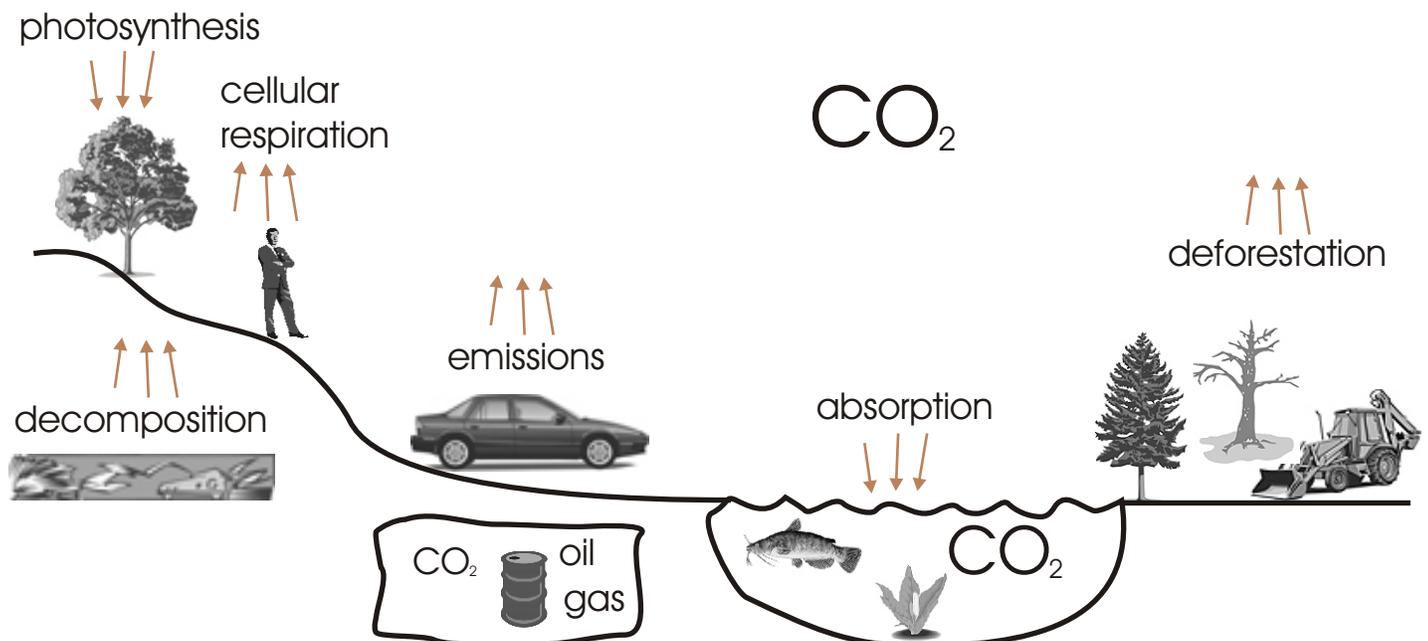
### Photosynthesis

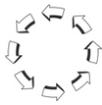


### Cellular Respiration



### DIAGRAM:





## NITROGEN CYCLE

Nitrogen is another important nutrient that all organisms need. All living things need nitrogen to make proteins. Let's see how this nutrient is recycled in ecosystems.

Almost 78% of the atmosphere is nitrogen. However, neither plants nor animals can use this form of nitrogen directly. Usually, the nitrogen must be in the form of chemicals called nitrate. Then the plant roots can absorb it. Lightning forms some nitrate by causing oxygen and nitrogen in the atmosphere to join. *Rhizobium* bacteria can do the same thing. This bacteria lives on the roots of plants called legumes such as beans, peas and alfalfa). Many bacteria and blue-green algae also form nitrates. The changing of nitrogen to nitrates is called nitrogen fixation.

Plants use the nitrates that they absorb to make plant proteins. Animals get the nitrogen that they need to make proteins by eating plants or other animals.

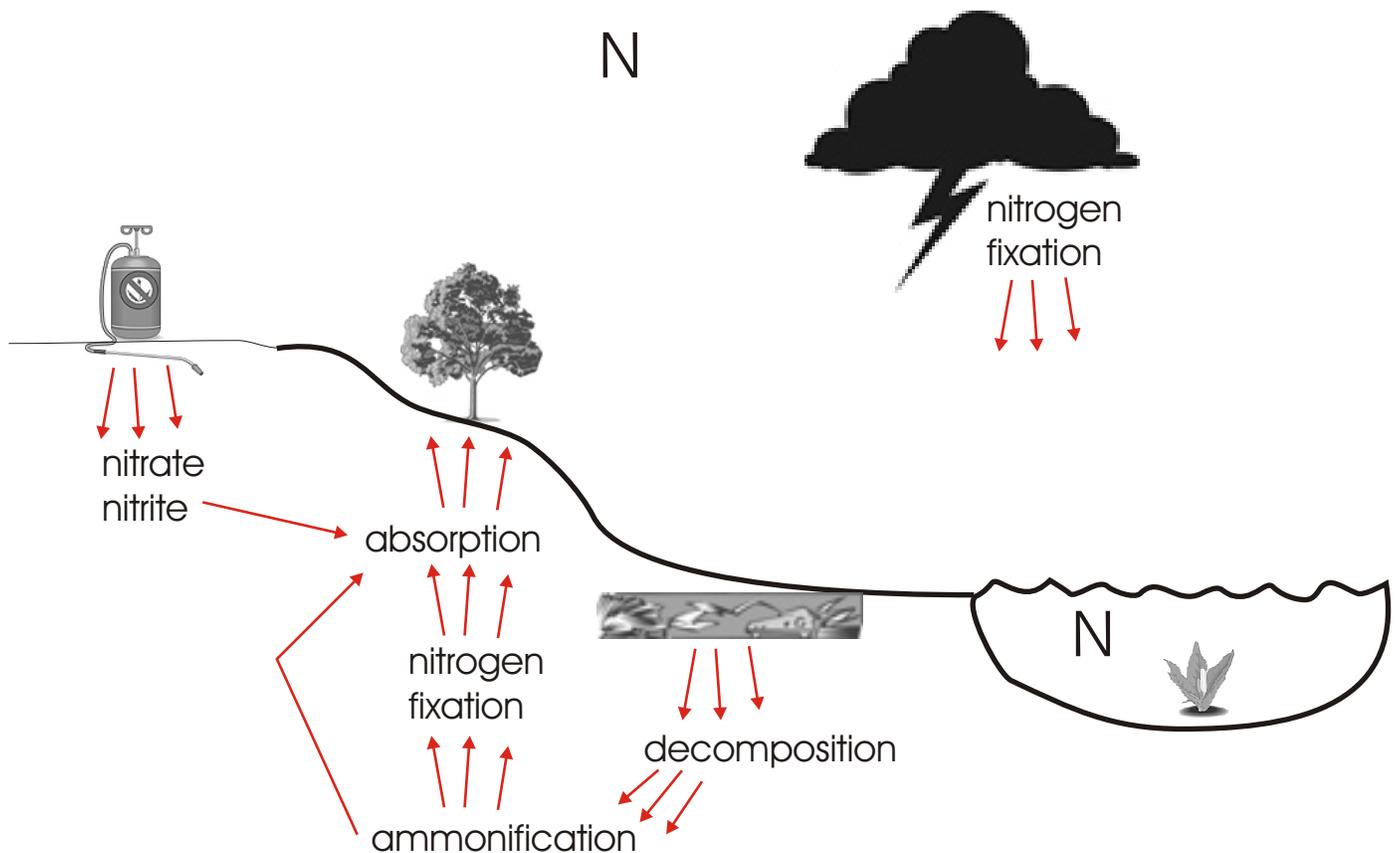
When plants and animals die, bacteria change their nitrogen content to ammonia. The nitrogen in the urine and fecal matter of animals is also changed to ammonia by bacteria. The pungent odour of outhouses, chicken pens, hog yards, cat litter boxes and wet baby diapers is ample evidence of this fact. Ammonia, in turn, is converted to nitrites and then to nitrates by bacteria. This process is called nitrification and completes the main part of the cycle.

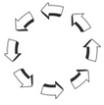
Many plants are able to use ammonia directly. Therefore all of it does not have to be converted to nitrate before plants absorb it.

When people use synthetic fertilizers they add nitrite or nitrate into the soil. This skips most of the nitrogen cycle and thus the bacteria and microorganisms lose their food source.

Plants and algae in the water need nitrogen to grow. Some fish species depend on these plants for food.

### DIAGRAM:





## OXYGEN CYCLE

Oxygen is another nutrient which is important to all living things. Note that the carbon and oxygen cycles are independent but very closely related. Oxygen is present in our atmosphere in the form of ozone, water vapour, pure oxygen and carbon dioxide. Plants and algae perform photosynthesis which removes carbon dioxide and adds oxygen to the atmosphere. Animals perform cellular respiration which removes oxygen from the atmosphere and adds carbon dioxide.

When plants and animals die, decomposers use oxygen to break down organic material and release carbon dioxide. Also, water dissolves oxygen and the aquatic life use this oxygen for photosynthesis and cellular respiration.

Fish need oxygen in the water to perform cellular respiration.

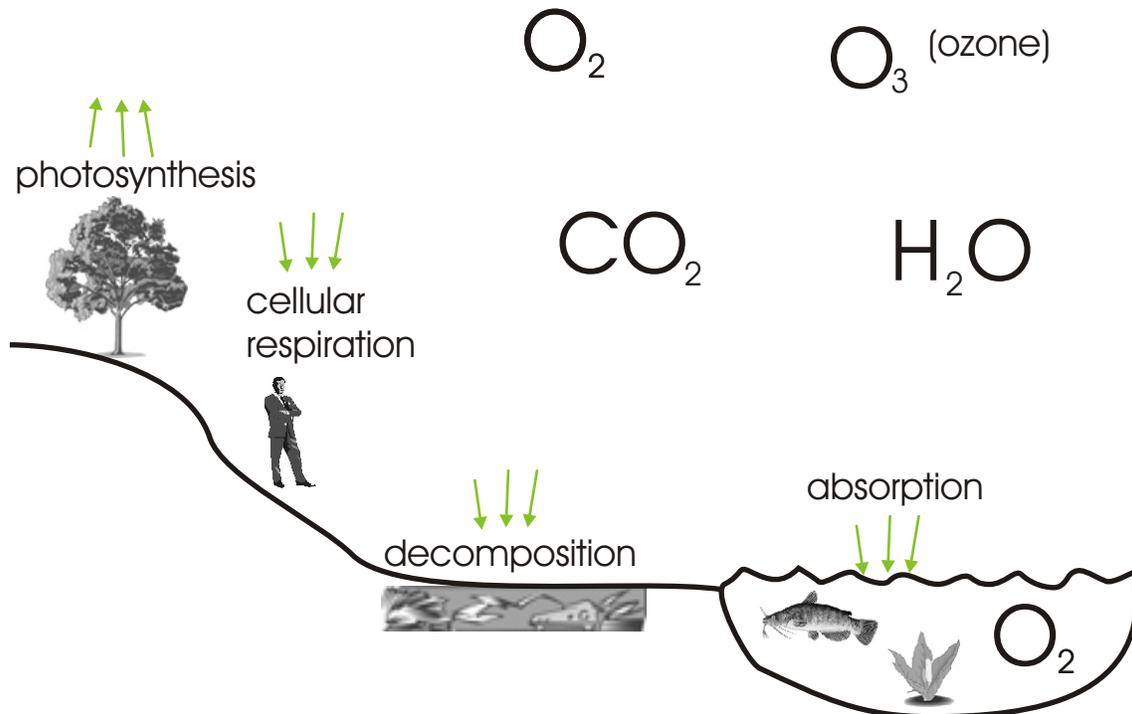
### Photosynthesis



### Cellular Respiration



### DIAGRAM:



## QUIZ (15)

Part A) Circle the correct word to fill in the blanks for the carbon cycle. (5)

- 1) When plants perform (photosynthesis OR cellular respiration) they take carbon dioxide out of the atmosphere and release oxygen.
- 2) When animals perform (photosynthesis OR cellular respiration) they take oxygen out of the atmosphere and release carbon dioxide.
- 3) Deforestation and the burning of fossil fuels (increases OR decreases) the amount of carbon dioxide in the atmosphere.
- 4) Decomposition (releases OR uses) carbon dioxide.
- 5) Water (releases OR absorbs) carbon dioxide.

Part B) Draw a diagram of the nitrogen cycle. No pictures needed, just use the correct terms. Give a brief description of each step. (5)

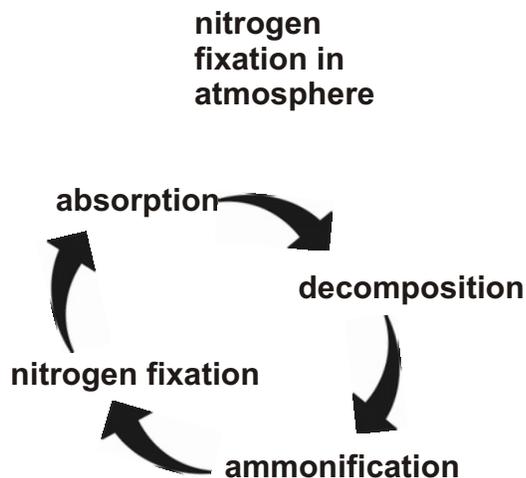
Part C) Describe the oxygen cycle. Use the appropriate terms and give a brief description of each step. (5)

## ANSWER KEY FOR QUIZ (15)

Part A) Circle the correct word to fill in the blanks for the carbon cycle. (5)

- 1) When plants perform (photosynthesis) OR cellular respiration) they take carbon dioxide out of the atmosphere and release oxygen.
- 2) When animals perform (photosynthesis) OR (cellular respiration) they take oxygen out of the atmosphere and release carbon dioxide.
- 3) Deforestation and the burning of fossil fuels (increases) OR decreases) the amount of carbon dioxide in the atmosphere.
- 4) Decomposition (releases) OR uses) carbon dioxide.
- 5) Water (releases) OR (absorbs) carbon dioxide.

Part B) Draw a diagram of the nitrogen cycle. No pictures needed, just use the correct terms. Give a brief description of each step. (5)



**nitrogen fixation: micro-bacteria and lightning causes oxygen and nitrogen to join**

**absorption: plants absorb nitrogen**

**decomposition: releases nitrogen**

**ammonification: bacteria convert nitrogen to ammonia**

Part C) Describe the oxygen cycle. Use the appropriate terms and give a brief description of each step. (5)

**Oxygen is in the atmosphere. Plants perform photosynthesis and add oxygen to the air. Animals perform cellular respiration and remove oxygen from the atmosphere. When plants and animals die decomposition takes place and uses up oxygen. Water also absorbs oxygen.**