

Name: \_\_\_\_\_

## Advanced Placement Environmental Science (APES) Summer 2022 Assignment

Welcome future APES students! This is an advanced science course that combines the disciplines of biology, chemistry, geology & physics to investigate environmental issues. We will discover how the Earth's systems function together & how humans have affected our planet. We will also examine our personal consumption & learn ways to be responsible global citizens in the face of serious environmental issues.



Because this is a college level course, you will be responsible for learning large amounts of material on your own. I will help you as you go, but it will be your responsibility to take notes, study & learn your vocabulary. The purpose of this summer assignment is to help you prepare for the APES content by getting familiar with some basic concepts for environmental science.

DUE: August 30<sup>th</sup> 2023

### ASSIGNMENT PART 1

#### CHEMISTRY:

Chemistry is a big part of environmental science.

Directions: For each of the following write out the chemical name that goes with the symbol.

<i>Formula</i> = $\text{CO}_2$ <i>Name</i> =	<i>Formula</i> = $\text{CO}$ <i>Name</i> =	<i>Formula</i> = $\text{C}_6\text{H}_{12}\text{O}_6$ <i>Name</i> =	<i>Formula</i> = $\text{CH}_4$ <i>Name</i> =	<i>Formula</i> = $\text{H}_2$ <i>Name</i> =
<i>Formula</i> = $\text{N}_2$ <i>Name</i> =	<i>Formula</i> = $\text{NO}_2$ <i>Name</i> =	<i>Formula</i> = $\text{NO}_3^-$ <i>Name</i> =	<i>Formula</i> = $\text{NH}_3$ <i>Name</i> =	<i>Formula</i> = $\text{NH}_4^+$ <i>Name</i> =
<i>Formula</i> = $\text{O}_2$ <i>Name</i> =	<i>Formula</i> = $\text{O}_3$ <i>Name</i> =	<i>Formula</i> = $\text{P}$ <i>Name</i> =	<i>Formula</i> = $\text{PO}_3^{4-}$ <i>Name</i> =	<i>Formula</i> = $\text{S}$ <i>Name</i> =
<i>Formula</i> = $\text{SO}_2$ <i>Name</i> =	<i>Formula</i> = $\text{SO}_3$ <i>Name</i> =	<i>Formula</i> = $\text{H}_2\text{SO}_4$ <i>Name</i> =	<i>Formula</i> = $\text{NaCl}$ <i>Name</i> =	<i>Formula</i> = $\text{Pb}$ <i>Name</i> =
<i>Formula</i> = $\text{U}$ <i>Name</i> =	<i>Formula</i> = $\text{Rn}$ <i>Name</i> =	<i>Formula</i> = $\text{Hg}$ <i>Name</i> =	<i>Formula</i> = $\text{Cl}$ <i>Name</i> =	<i>Formula</i> = $\text{H}_2\text{O}$ <i>Name</i> =

## ASSIGNMENT PART 2

### BIOMES:

A biome is a major regional group of distinctive plant + animal communities best adapted to the region's physical natural environment, latitude, altitude, and terrain. There are terrestrial biomes that occur on land and aquatic biomes that are found in the water.

Directions:

Use the internet to search each biome listed below and complete the table.

Biome	Plants	Animals	Countries	Climate
Desert				
Chaparral				
Tropical Rainforest				
Temperate Deciduous Forest				
Tundra				
Taiga				

Biome	Plants	Animals	Countries	Climate
Temperate Grasslands				
Tropical Savanna				
Estuary				
Intertidal Zone				
Coral Reef				

ASSIGNMENT 3  
*BIOGEOCHEMICAL CYCLES*

**Background Information**

Matter - such as water, carbon, nitrogen, and phosphorus - does not enter or leave the biosphere, but cycles within the biosphere in a variety of forms. Because the movement of matter within and between ecosystems involves cycles of biological, geological, and chemical processes, these cycles are known as biogeochemical cycles.

**Part 1: The Hydrologic (Water) Cycle**

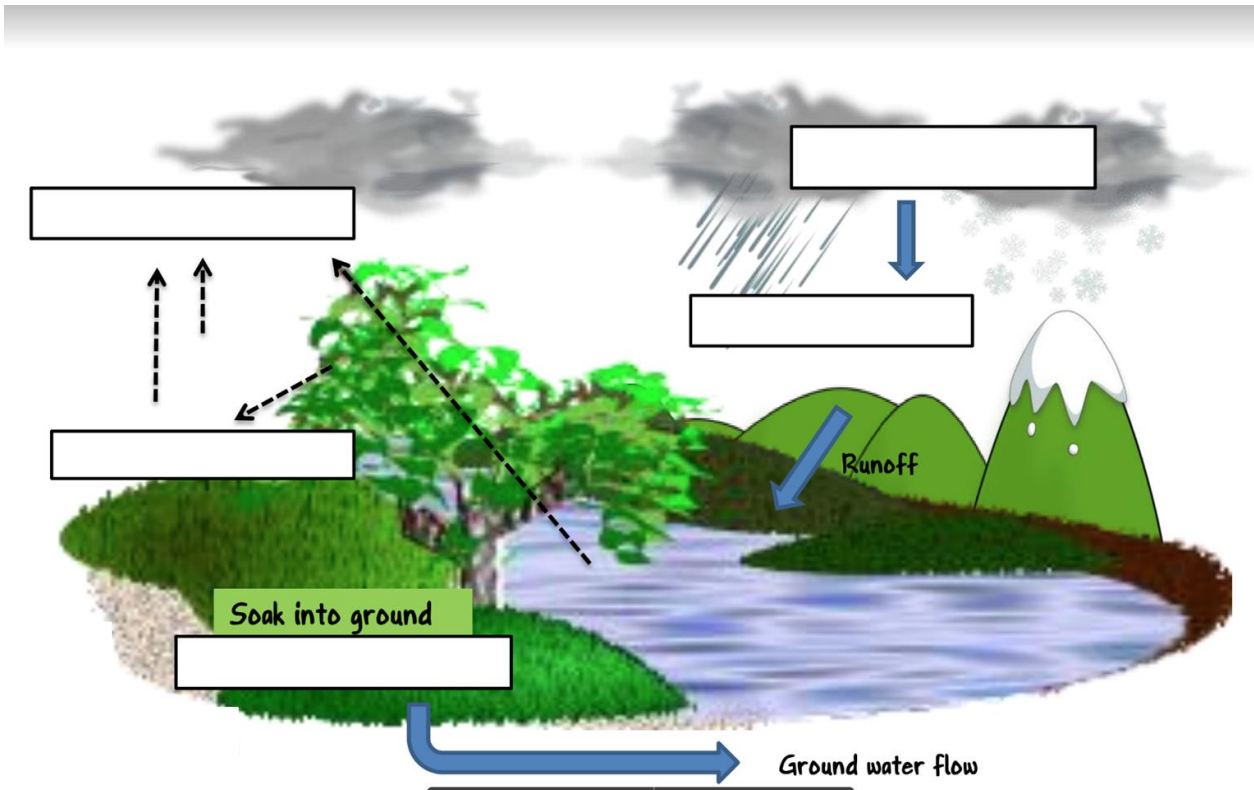
Heat from the sun causes water to evaporate from oceans, lakes, and soils. Solar energy also provides the energy for photosynthesis, during which plants release water from their leaves into the atmosphere - a process known as transpiration. The water that enters the atmosphere eventually cools and forms clouds, which in turn, produce precipitation - some of which falls back into the ocean, and some falls on land.

When water falls on land, it may take one of three distinct routes. It may return to the atmosphere by evaporation, or after being taken up by plant roots, transpiration. Alternatively, water can be absorbed by the soil and percolate/infiltrate down into the groundwater. Finally, water can move as runoff across the land surface and into streams and rivers, eventually reaching the ocean, which is the ultimate reservoir of water on Earth.

**A. Answer the following questions.**

1. The water cycle is also called the \_\_\_\_\_
2. \_\_\_\_\_ is the process that turns water vapor into liquid, which causes the formation of a cloud.
3. After it rains, the water can either end up on land or \_\_\_\_\_
4. When water evaporates from a leaf, this process is called \_\_\_\_\_
5. When water is heated in an ocean, the liquid water changes form and turns into \_\_\_\_\_
6. When water leaves a body of water after it is heated, the process is called \_\_\_\_\_
7. When water falls from the sky, the process is known as \_\_\_\_\_
8. When water hits land and is soaked into the ground, the water becomes \_\_\_\_\_
9. True or false: The water cycle is a continual process.
10. True or false: Transpiration is a process that occurs in plants and animals.

**B. Label the diagram of the water cycle with the following terms:** *precipitation, transpiration, evaporation, percolation/infiltration, and condensation.* Please note, this is a google drawing - click the image, then the word “edit” in the bottom left corner, and it will open the sketch pad. You can then type in the text boxes, then hit “save and close”. The screen will return to this document with your changes.



**C. Predict how these human (anthropogenic) activities impact the water cycle.**

Anthropogenic Activity	Portion of the Water Cycle Impacted	Your prediction: HOW is the cycle impacted?
Clear-cutting deforestation on a steep slope	Run-off	
Paving over land surfaces to build roads, businesses, and homes	Run-off	
Paving over land surfaces to build roads, businesses, and homes	Percolation and infiltration; groundwater recharge	
Diverting water to provide water for drinking, irrigation, and industrial use	Freshwater bodies	

## Part 2: The Carbon Cycle

Carbon is the basis of the long chains of organic molecules that form the membranes and walls of cells, constitute the backbones of proteins, and store energy for later use. Most molecules in the bodies of organisms contain carbon. The seven major processes that drive the carbon cycle include: photosynthesis, respiration, exchange, sedimentation, burial, extraction, and combustion. These processes can be categorized as relatively fast or relatively slow. The relatively fast processes involve living organisms. The relatively slow processes involve carbon held in rocks, soils, or as petroleum hydrocarbons (the materials we use as fossil fuels). Carbon may be stored in these forms for millions of years.

### Photosynthesis and Respiration

When producers photosynthesize (whether on land or in the water), they take in  $\text{CO}_2$  and incorporate the carbon into their tissues. Some of this carbon is returned as  $\text{CO}_2$  when organisms respire. After organisms die, decomposers break down the dead material, which returns  $\text{CO}_2$  to the water or air via respiration.

### Exchange, Sedimentation, and Burial

Carbon is exchanged between the atmosphere and the ocean. Some of the  $\text{CO}_2$  dissolved in the ocean enters the food web via photosynthesis by algae (phytoplankton). Another portion of the  $\text{CO}_2$  dissolved in the ocean combines with calcium ions in the water to form calcium carbonate. Small amounts of calcium carbonate sediment formed each year have accumulated over millions of years to produce a large carbon reservoir.

Some of the organic carbon in dead biomass is buried and incorporated into ocean sediments before it is decomposed. This organic matter becomes fossilized and may be transformed into fossil fuels over millions of years. Weathering of limestone and volcanic eruptions can return this carbon to the atmosphere.

### Extraction and Combustion

The extraction and subsequent combustion of fossil fuels (coal, oil, and natural gas) by humans releases carbon into the atmosphere as  $\text{CO}_2$  or into the soil as ash.

### A. Answer the following questions.

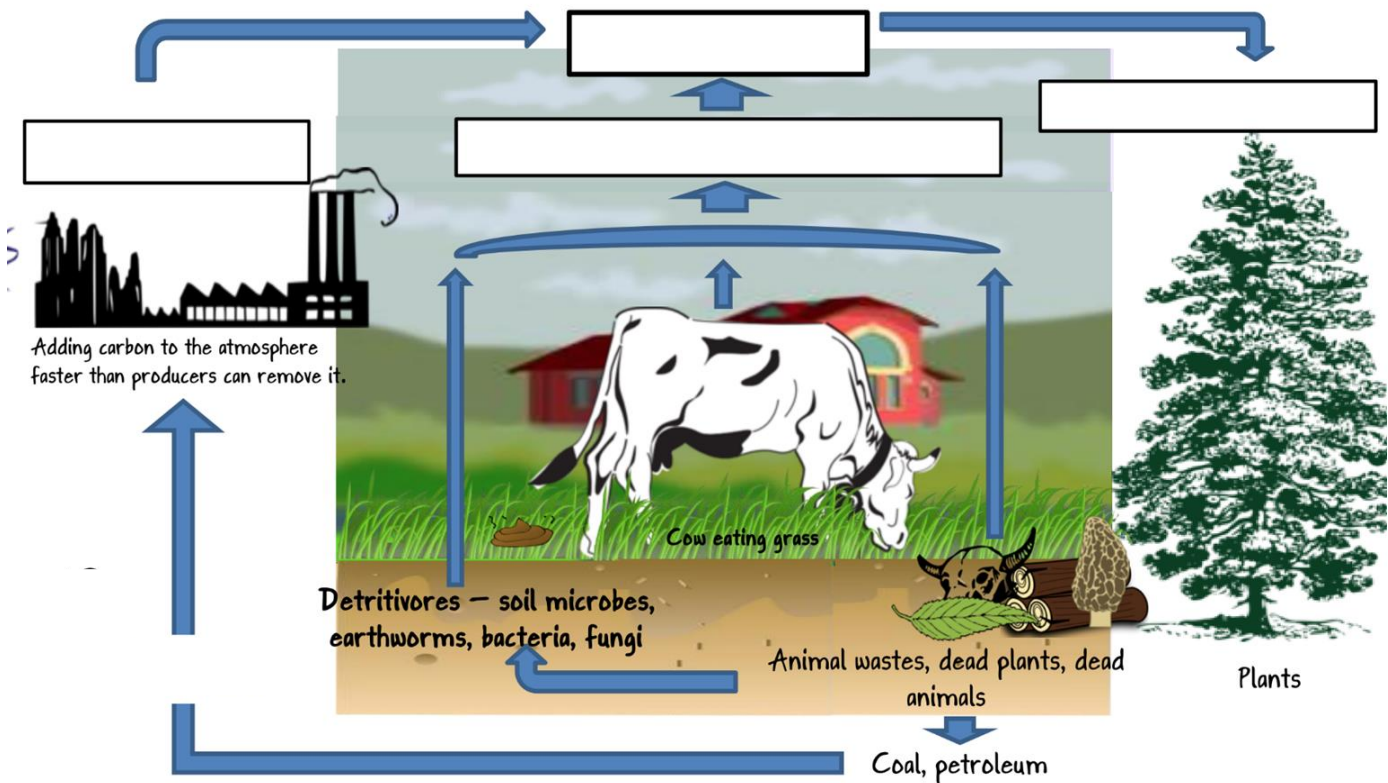
#### Answer Bank

Natural Gas    Photosynthesis (use 2x)    Oil    Phytoplankton    Coal    Sugar    Respiration

Combustion of fossil fuels    Ocean    Decayed

1. Most available oxygen is made by \_\_\_\_\_ on the ocean's surface and green plants on the land via the process of \_\_\_\_\_
2. Plants use  $\text{CO}_2$  in the process of \_\_\_\_\_ to make \_\_\_\_\_ and oxygen.
3. All living things use oxygen in the process of \_\_\_\_\_ and make more  $\text{CO}_2$ .
4. The \_\_\_\_\_ is the main regulator of  $\text{CO}_2$  in the atmosphere because  $\text{CO}_2$  dissolves easily in it.
5. In the past, huge deposits were stored as dead plants and animals \_\_\_\_\_
6. Today, these deposits are burned as fossil fuels, which include (NEED 3):
7. More  $\text{CO}_2$  is released in the atmosphere today than in the past because of the \_\_\_\_\_

**B. Label the diagram of the carbon cycle with the following terms:** *CO<sub>2</sub> in the atmosphere, Combustion/Burning, Cellular Respiration, Photosynthesis.* Please note, this is a google drawing - click the image, then the word "edit" in the bottom left corner, and it will open the sketch pad. You can then type in the text boxes, then hit "save and close". The screen will return to this document with your changes.



**C. Predict how these human (anthropogenic) activities impact the carbon cycle.**

Anthropogenic Activity	Portion of the Carbon Cycle Impacted	Your prediction: HOW is the cycle impacted?
Combustion of fossil fuels	Concentration of Carbon in the Atmosphere	
Tree harvesting and slash-and-burn deforestation	Concentration of Carbon in the Atmosphere	

### Part 3: The Nitrogen Cycle

Living things need nitrogen in relatively high amounts - it is used to form the building blocks of proteins and nucleic acids. Because so much of it is required, nitrogen is often a limiting nutrient for producers. There are five major transformations in the nitrogen cycle: nitrogen fixation, nitrification, assimilation, mineralization, and denitrification.

#### Nitrogen Fixation

Earth's atmosphere is 80%  $N_2$  - this gaseous form of nitrogen is biologically unavailable to most producers. Nitrogen fixation is the process that converts nitrogen gas in the atmosphere ( $N_2$ ) into forms of nitrogen producers can use. Nitrogen-fixing bacteria on the roots of legumes can convert  $N_2$  into ammonia ( $NH_3$ ), which is rapidly converted into  $NH_4^+$  (ammonium). Alternatively,  $N_2$  can be fixed in the atmosphere by lightning or fires and the burning of fossil fuels - these processes convert  $N_2$  into  $NO_3^-$  (nitrate), which is usable by plants. Precipitation carries the nitrate to Earth's surface. Humans can use energy to synthetically fix nitrogen into ammonia or nitrate for plant fertilizers.

#### Nitrification

This is the conversion of ammonium ( $NH_4^+$ ) into nitrite ( $NO_2^-$ ) and then into nitrate ( $NO_3^-$ ). These conversions are conducted by specialized bacteria.

#### Assimilation

Once producers take up nitrogen in the form of ammonia, ammonium, nitrate, or nitrite, they incorporate the element into their tissues in a process called assimilation. When primary consumers feed on the producers, some of the producer's nitrogen is assimilated into the tissues of the consumers. The rest is eliminated in the consumer's waste.

#### Mineralization/Ammonification

Eventually, organisms die and their tissues decompose. In mineralization, fungal and bacterial decomposers break down organic matter in bodies and waste products, converting organic nitrogen compounds into ammonium ( $NH_4^+$ ).

#### Denitrification

This final step is the conversion of nitrate ( $NO_3^-$ ) into nitrous oxide ( $N_2O$ ) and eventually atmospheric nitrogen gas ( $N_2$ ). Denitrification is conducted by specialized bacteria that live in anaerobic (low oxygen) conditions, such as waterlogged soils or the bottom sediments of oceans and lakes.

#### A. Answer the following questions.

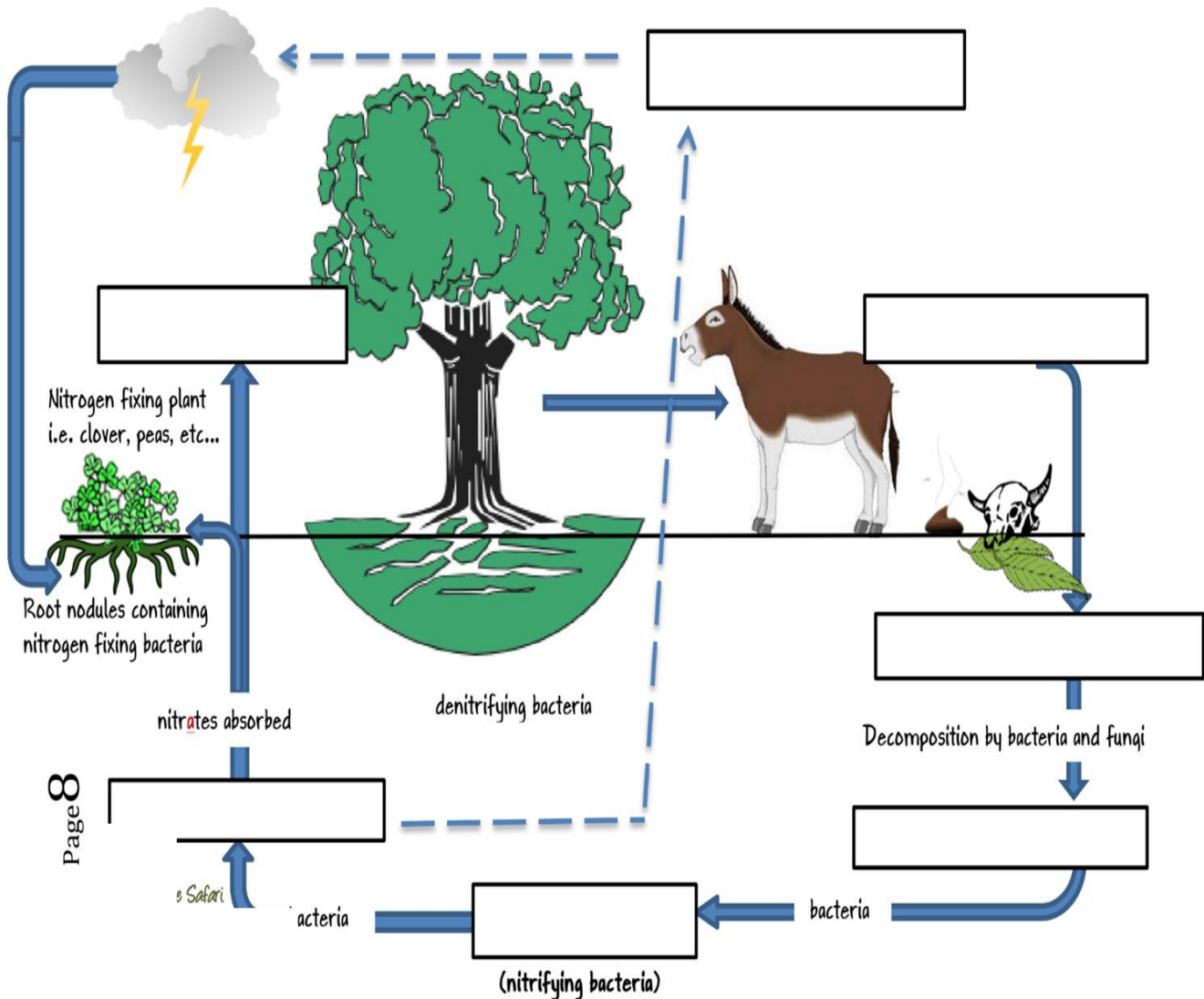
Answer Bank						
Atmosphere	80%	ammonia	proteins	denitrification	nitrate	
	nitrogen-fixing	plants	(use 2x)	animals	waste	

1. Our atmosphere is \_\_\_\_\_ nitrogen gas.
2. Animals and plants cannot directly use all the nitrogen found in our \_\_\_\_\_
3. Only special bacteria can directly use nitrogen in our atmosphere and "fix" it so other organisms can benefit. The bacteria are called \_\_\_\_\_ bacteria.
4. Many living things use nitrogen to make their \_\_\_\_\_



- Animal wastes decay by the action of bacteria which create \_\_\_\_\_ and \_\_\_\_\_ products rich in nitrogen, which are useful for plants.
- \_\_\_\_\_ bacteria in the soil can break down the ammonia into the gaseous form of nitrogen, which is not available for use by plants or animals.
- In another part of the cycle, animals eat \_\_\_\_\_ containing nitrogen, which is again returned to the soil by animal \_\_\_\_\_ or decaying \_\_\_\_\_ and \_\_\_\_\_.

**B. Label the diagram of the nitrogen cycle with the following terms:**  $N_2$  Nitrogen in the atmosphere, plant made protein, animal protein, nitrates, nitrites, dead plants and animals, ammonia. Please note, this is a google drawing - click the image, then the word "edit" in the bottom left corner, and it will open the sketch pad. You can then type in the text boxes, then hit "save and close". The screen will return to this document with your changes.



**C. Predict how these human (anthropogenic) activities impact the nitrogen cycle.**

<b>Anthropogenic Activity</b>	<b>Portion of the Nitrogen Cycle Impacted</b>	<b>Your prediction: HOW is the cycle impacted?</b>
Adding nitrogen to soil with fertilizer	Concentration of nitrogen in the atmosphere	
Adding nitrogen to soil with fertilizer	Nutrient availability in nearby streams and groundwater	

**Part 4: The Phosphorus Cycle**

Organisms need phosphorus to make nucleic acids as well as ATP (the energy currency for cells). Phosphorus is a limiting nutrient - it is required for the growth of an organism. It primarily cycles between land and water - unlike the other biogeochemical cycles, there is no significant atmospheric phase of the phosphorus cycle.

Assimilation and Mineralization

Producers on land or in the water take up phosphate ( $PO_4^{3-}$ ) and assimilate the phosphorus into their tissues. The waste products and eventual dead bodies of these organisms are decomposed by fungi and bacteria, which causes the mineralization of organic phosphorus back to inorganic phosphate.

Sedimentation, Geologic Uplift, and Weathering

The abiotic processes of the phosphorus cycle involve movements between the water and the land. Most phosphorus in the ocean precipitates into sediments. Over time, geologic processes can lift these ocean layers up and they become mountains. The phosphate rocks in the mountains are slowly weathered by rainfall and this weathering brings phosphorus to terrestrial and aquatic habitats. Very little dissolved phosphorus is naturally available in streams, rivers, and lakes. As a result, phosphorus is a limiting nutrient in many aquatic systems.

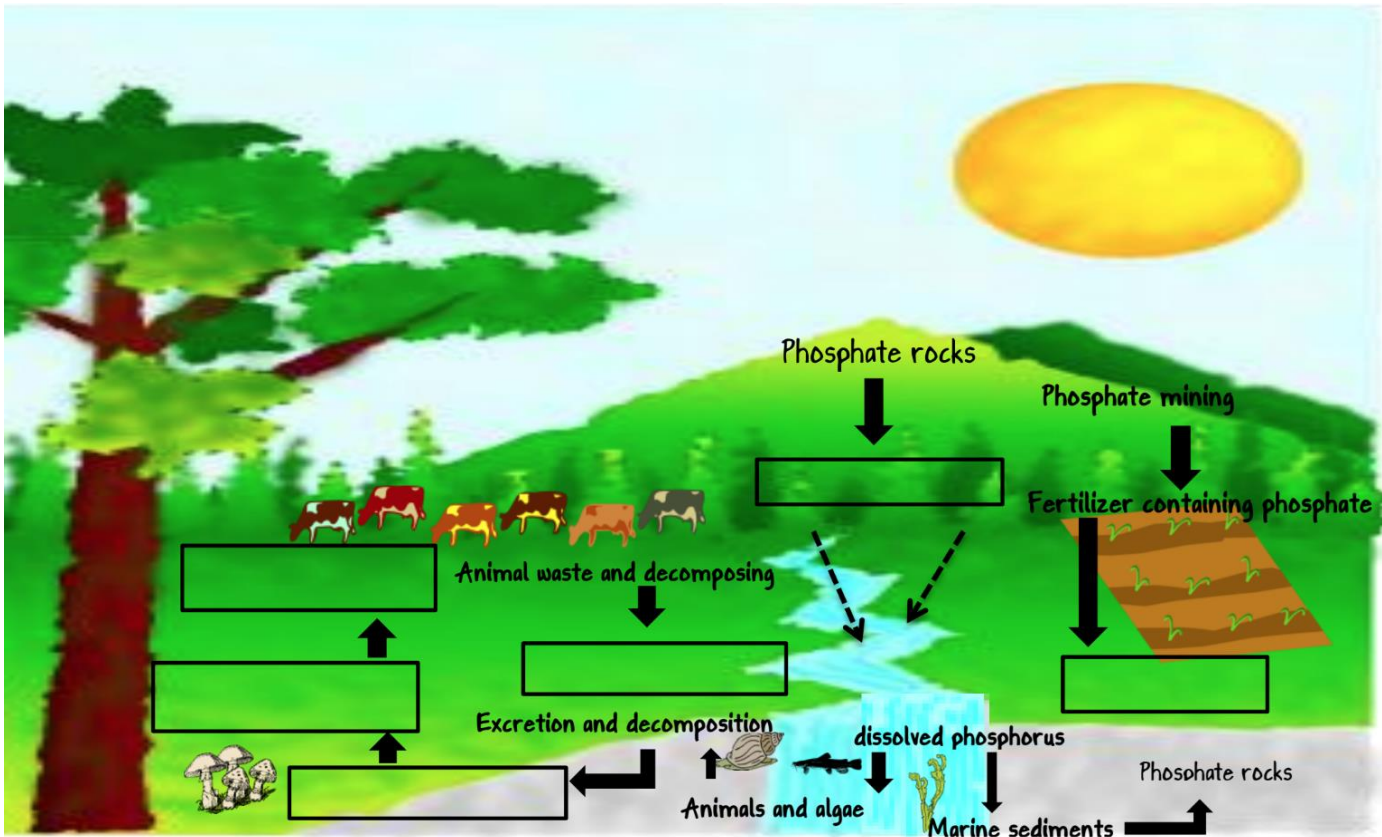
**A. Answer the following questions.**

<b>Answer Bank</b>						
Pollution	rocks	minerals	waste	DNA	overgrowth	plants

1. Phosphorus is NOT found in the free state in nature but is contained mostly in \_\_\_\_\_ and \_\_\_\_\_.
2. It is an essential nutrient for life, as it makes up important chemicals such as \_\_\_\_\_.
3. In the phosphorus cycle, phosphorus moves between the soil and \_\_\_\_\_ which are eaten by animals. Animals use phosphorus, and then their products help return the phosphorus to the soil.

4. Some of the phosphorus in soils can runoff, creating water \_\_\_\_\_
5. Too much phosphorus in the water leads to plant \_\_\_\_\_ outcompeting other species in the water.

**B. Label the diagram of the phosphorus cycle with the following terms:** *erosion, crops, plants, decomposers, soil phosphate, animals*. Please note, this is a google drawing - click the image, then the word "edit" in the bottom left corner, and it will open the sketch pad. You can then type in the text boxes, then hit "save and close". The screen will return to this document with your changes.



**C. Predict how these human (anthropogenic) activities impact the phosphorus cycle.**

Anthropogenic Activity	Research the Impact
Using phosphorus in fertilizer to grow crops	
Mining for phosphate rock	