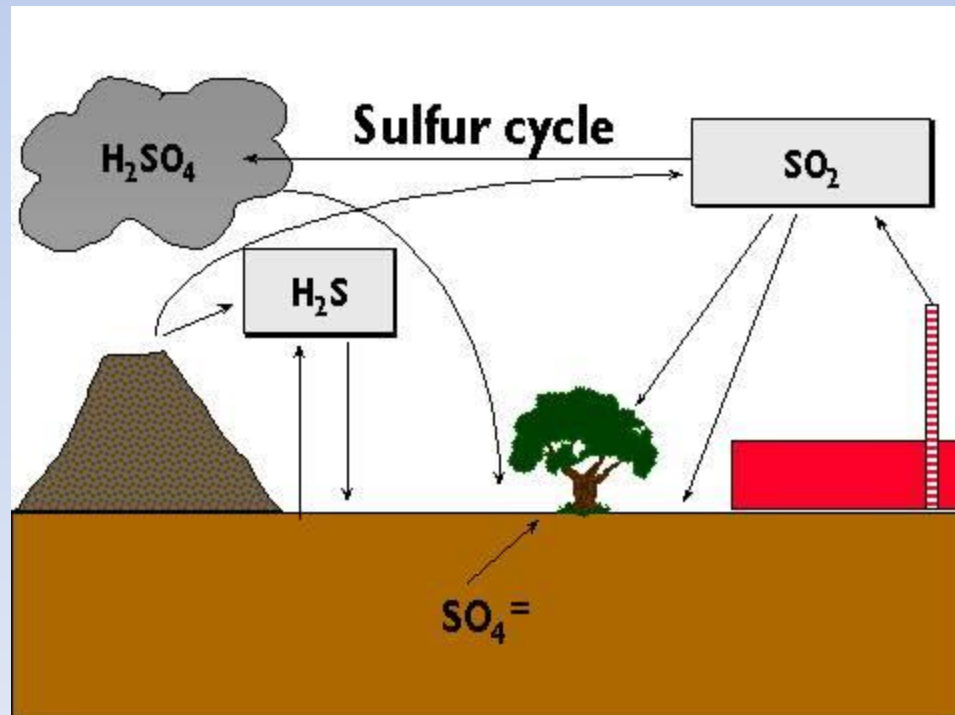


Biogeochemical Cycles

H_2O , C, N, and P in air/land/water

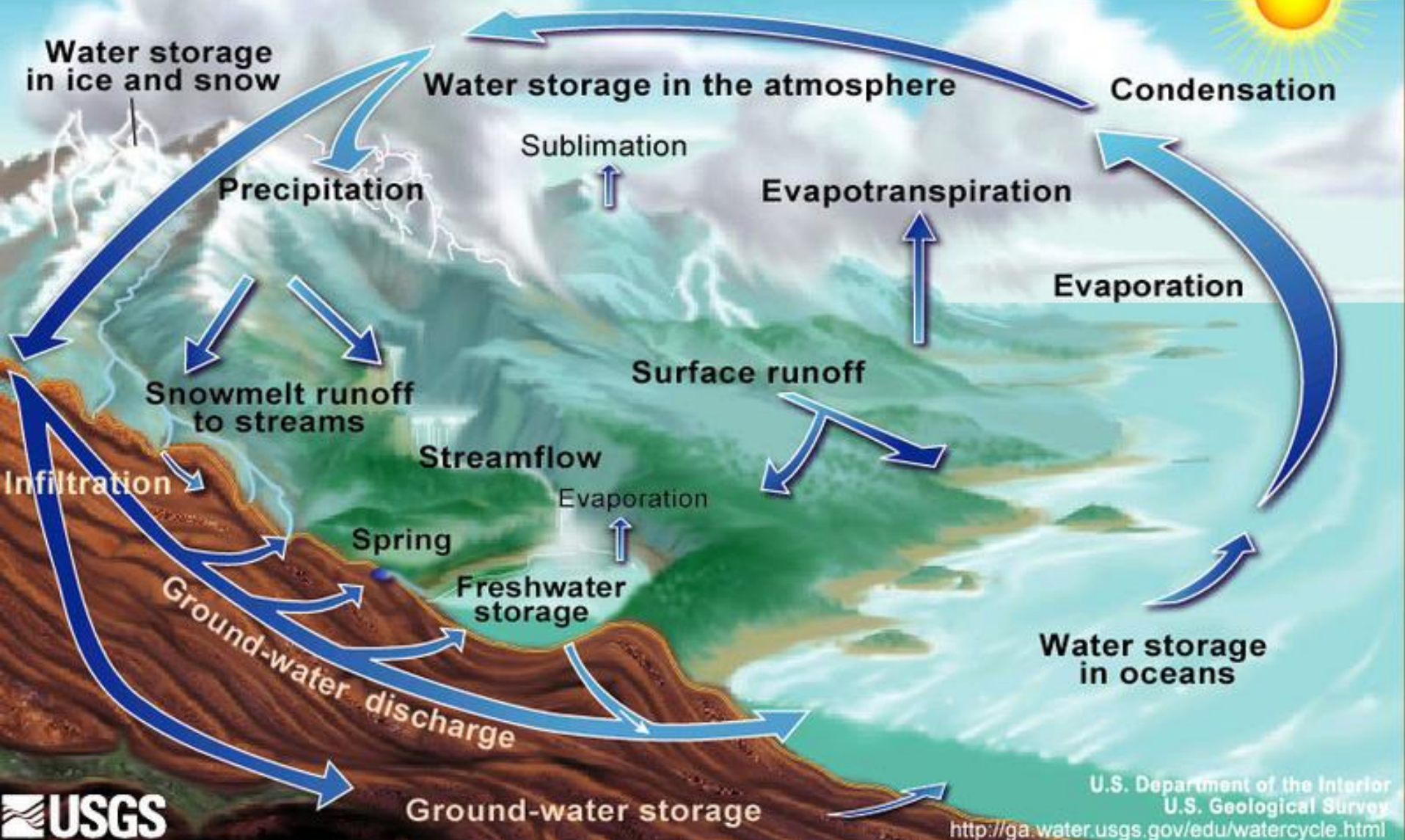
O_2 and CO_2 in water



Content Objectives

- SWBAT compare and contrast the four major biogeochemical cycles involved in the movement of necessary nutrients for living organisms.

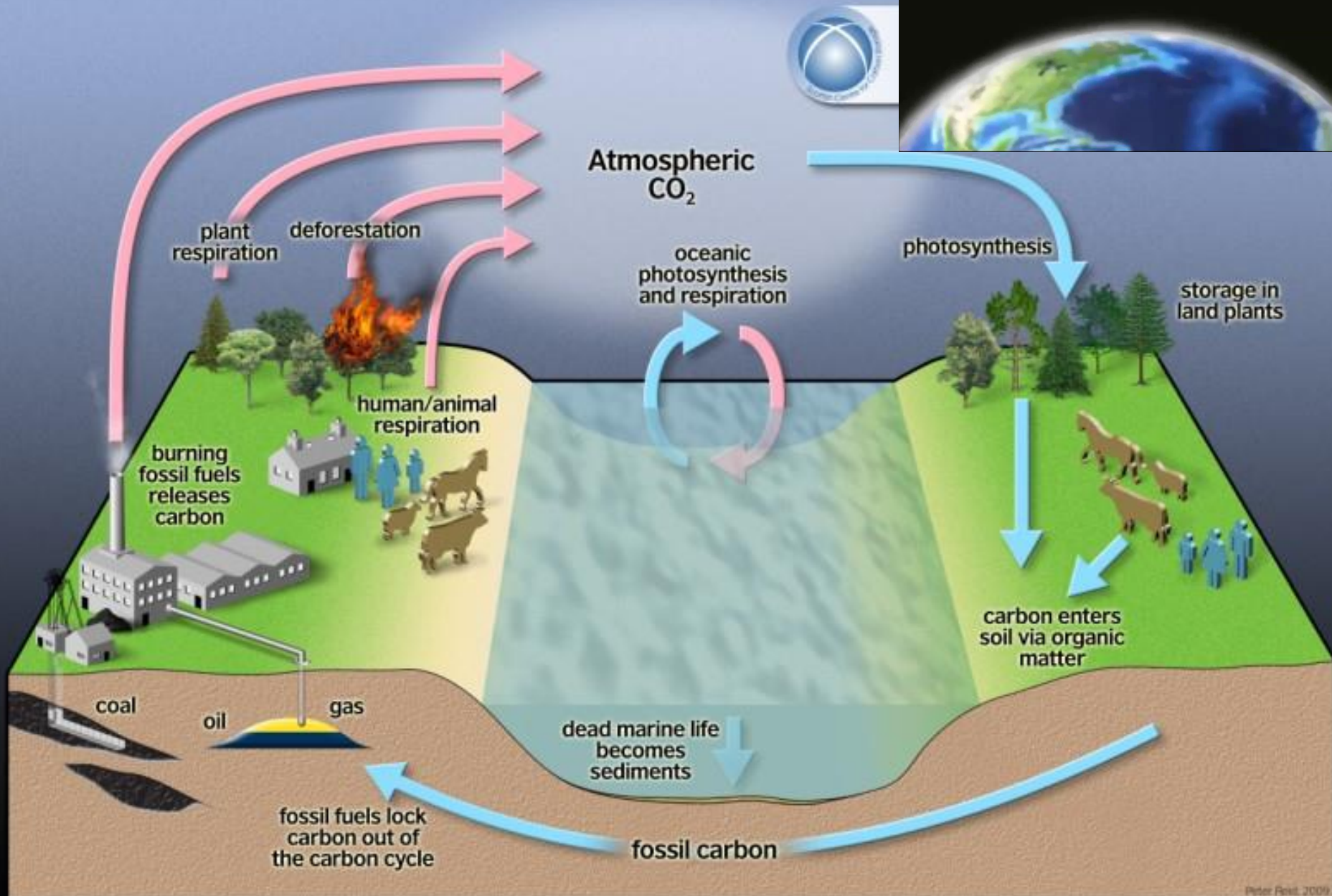
The Water Cycle



The Water Cycle



Carbon Cycle



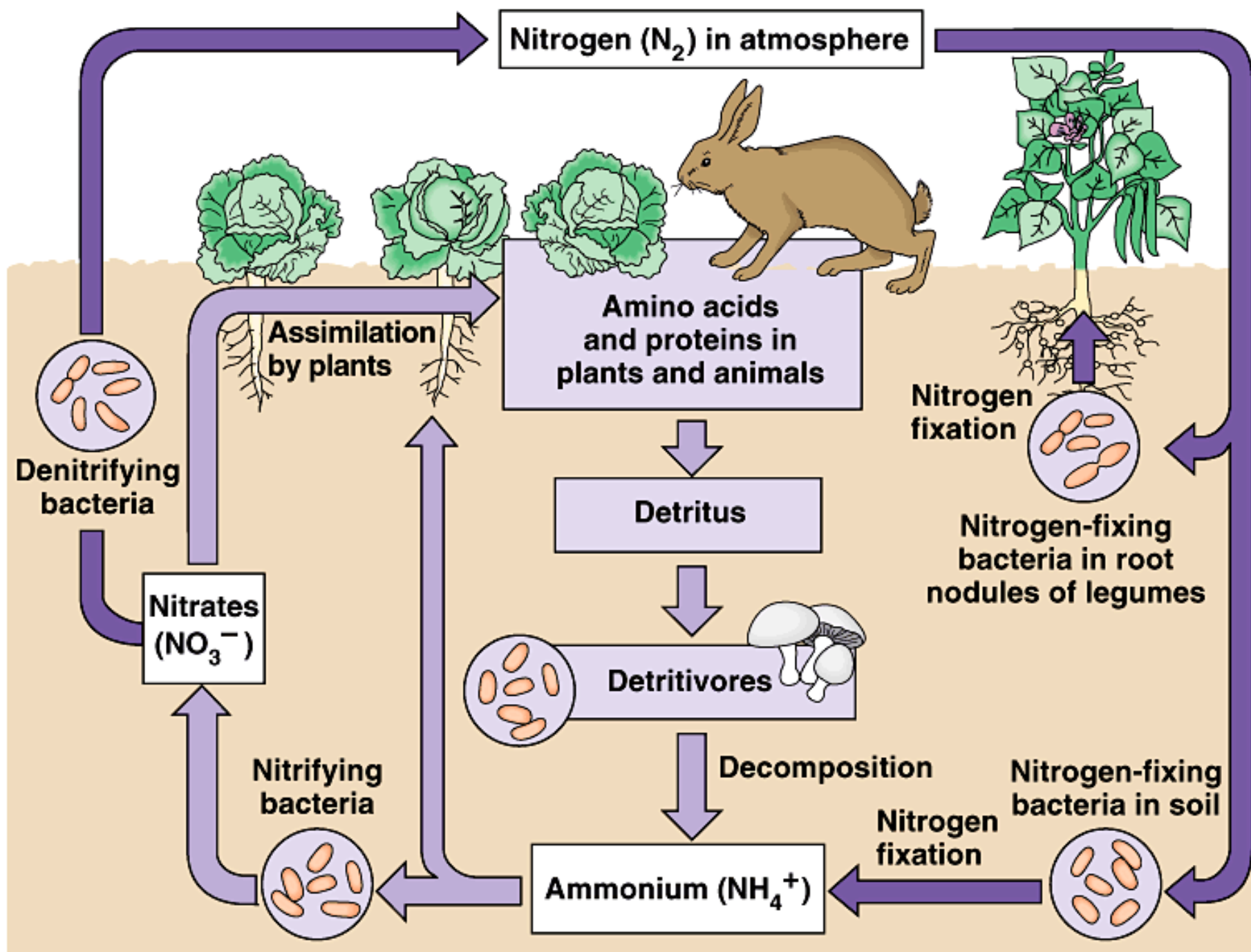
Name the 7 Primary and Secondary Nutrients for Plant Growth

Primary

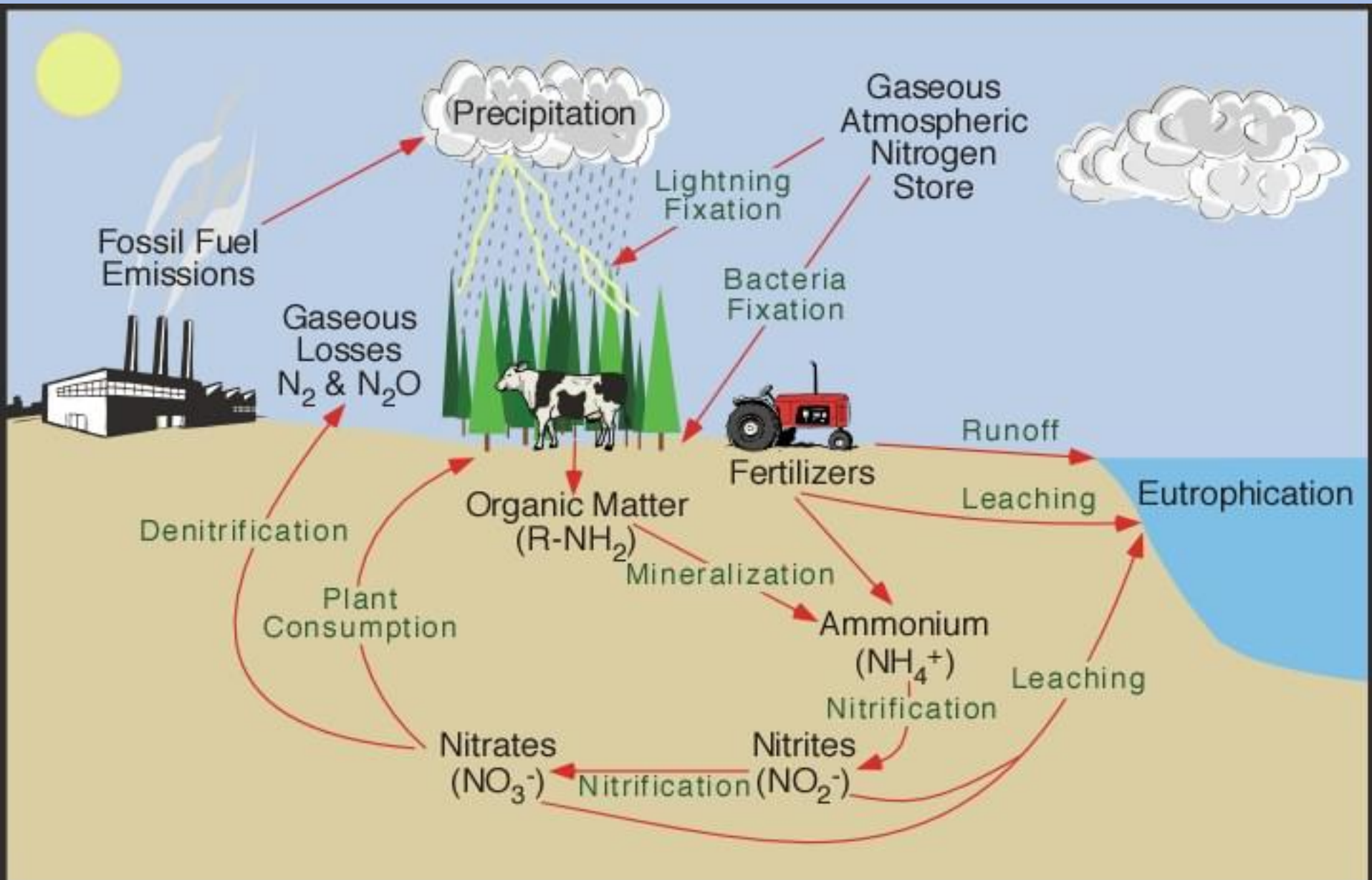
- Nitrogen
- Phosphorous
- Potassium

Secondary

- Calcium
 - Magnesium
 - Sodium
 - Sulfur
-
- Other than carbon and water....

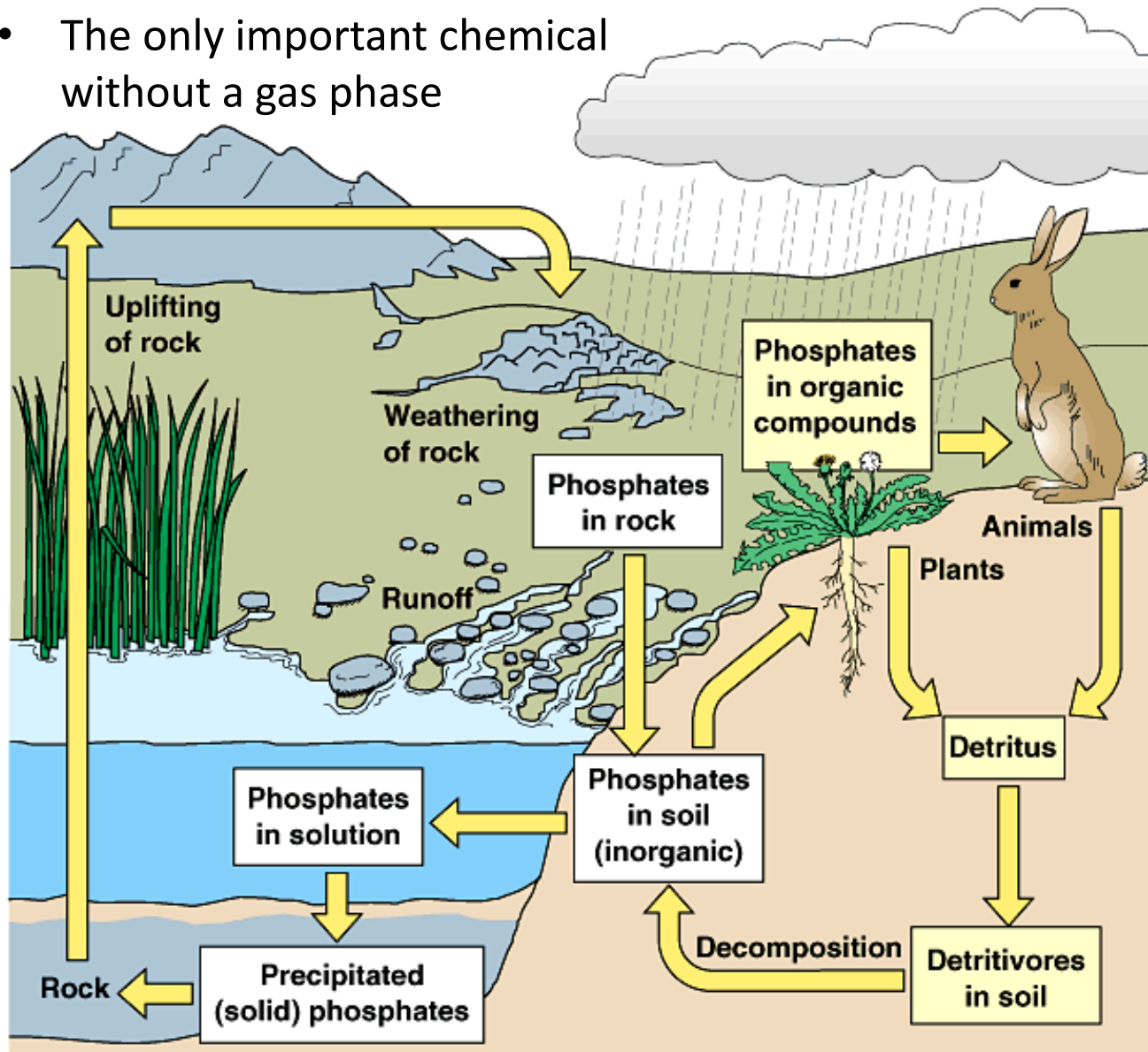


Nitrogen Cycle



Phosphorous Cycle

- The only important chemical without a gas phase



Key Secondary Nutrients

- Sodium, Calcium, Magnesium
- All of these are salts that are acquired in the soil from the base rocks. They are recycled back into the soil through decaying vegetation.
- Removing vegetation can cause these nutrients to leach out in the rain or blow away in the dust.



The Guano Islands: A Story of Nutrient Deposits

- For thousands of years, millions of seabirds would arrive on remote Pacific islands to nest, leaving thick rocky deposits of guano rich in nitrates, phosphates, and potassium.



The Guano Islands: A Story of Deposits of Nutrients

- These deposits of guano rich in nitrates, phosphates, and potassium which were mined for fertilizers.



Saltpeter for Explosives

Gunpowder is made with charcoal, sulfur, and saltpeter (KNO_3). Saltpeter was the most difficult substance to obtain, but was found in guano deposits.



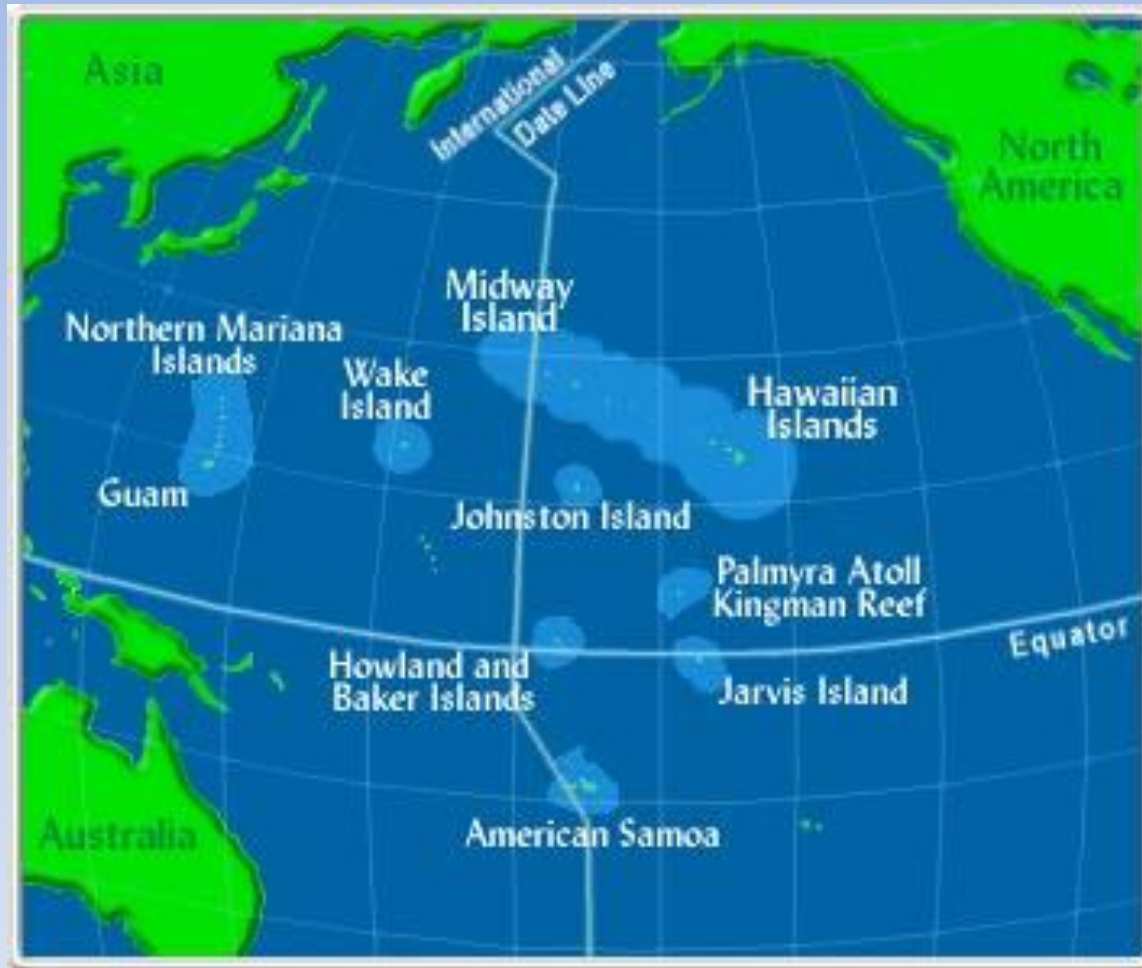
U.S. Guano Islands Act of 1856

- It allowed citizens or the military to claim islands around the world and put them under U.S. jurisdiction if they contained guano deposits.

Navassa Island in Caribbean



U.S. Owned Guano Islands



- The United States has the largest Exclusive Economic Zone (EEZ) in the world due to all of these islands.



Nitrogen and Phosphorous is Limiting

- In areas with sufficient rainfall, H_2O , CO_2 , and O_2 are in plentiful supply.
- Thus, the primary limiting factors for plant growth are the availability of N and P in the soil.
- But, sometimes it can be too much...
- Let's discuss why

Cold Water Can Dissolve More Gases Than Warm Water

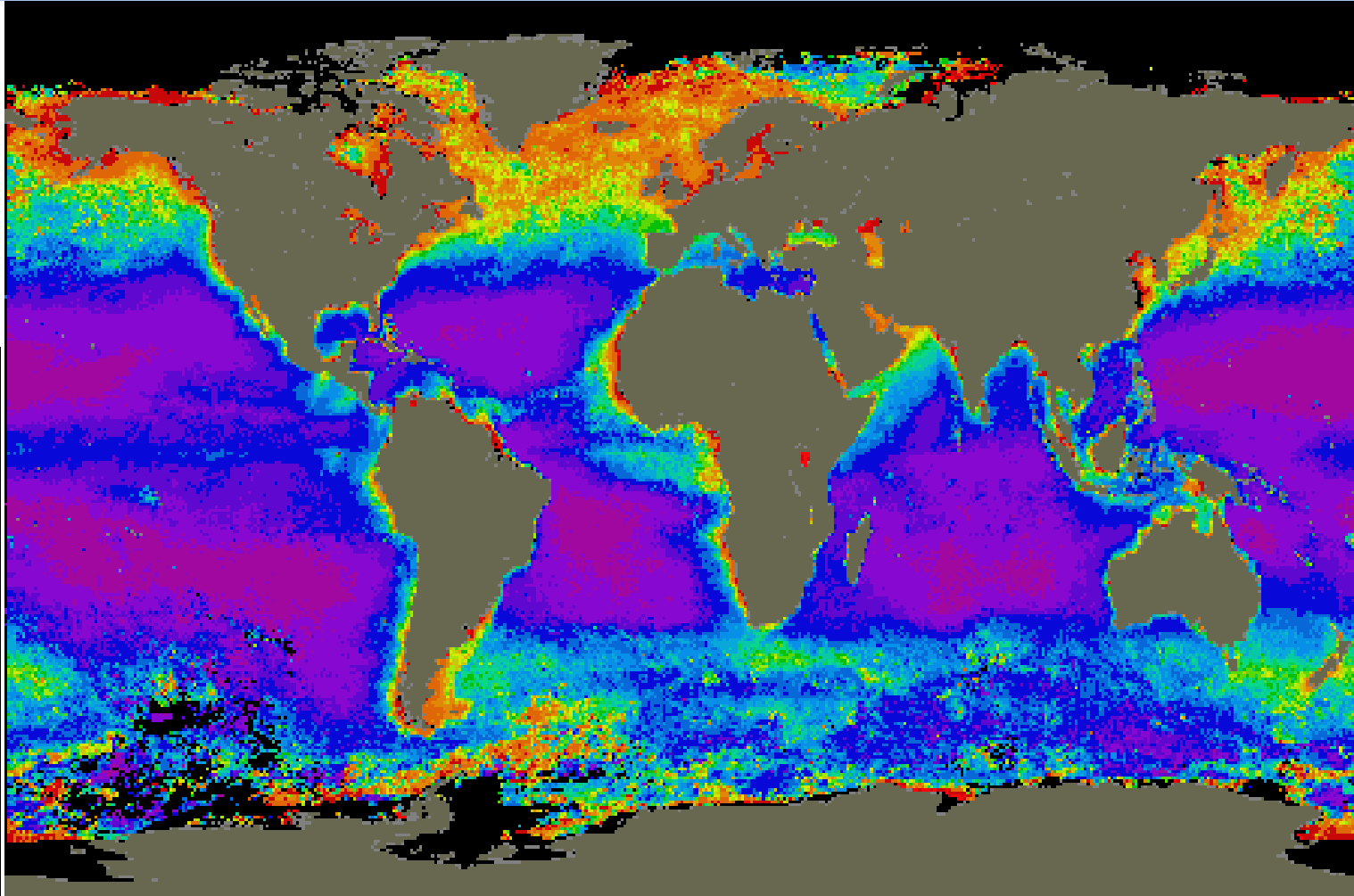
- Cold water holds more O_2 and CO_2 .
- This is due to lower molecular motion and thus dipole-induced dipole interactions are stronger in holding non-polar gases in solution.



World Ocean Productivity

More CO₂ for Algae

More O₂ for
plankton and fish



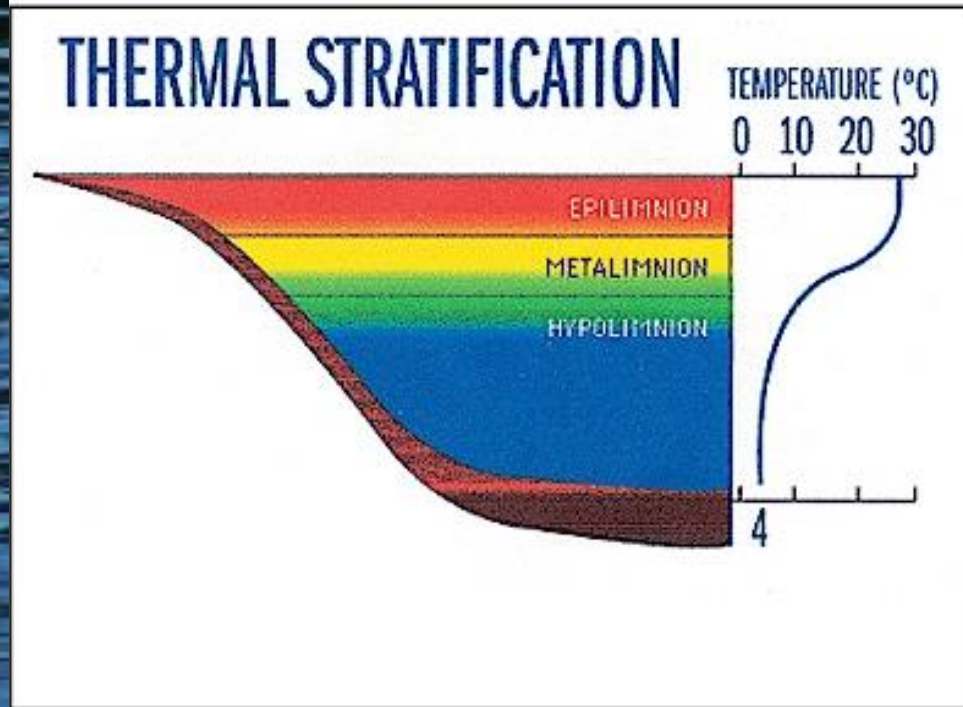
Deadliest Catch

- Where is it filmed?



Thermocline

- Sometimes the top layer of the water feels warm only to be freezing a few inches below.
- Without adequate mixing, these temperature layers can develop.



Algae Growth and Death

- Algae do photosynthesis and produce oxygen.
- But, they only live a few weeks and then die.
- As bacteria feed on the dead algae, they consume oxygen from the water.



Algae Growth and Death

- How much oxygen is available for bacteria AND fish is based on the water temperature.
- Higher temps increase decomposition rates
- Higher temps also means less oxygen



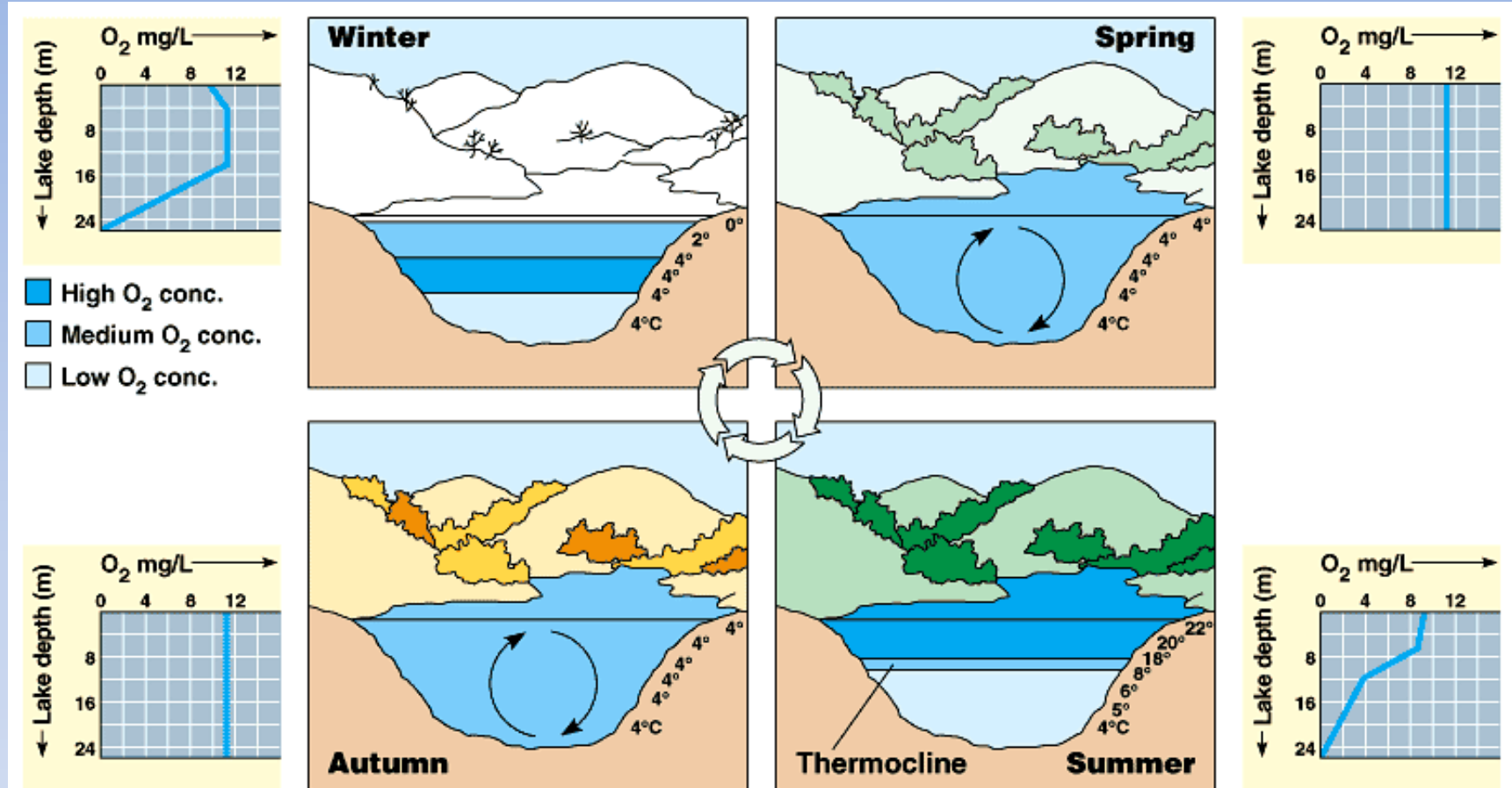
Thermoclines Mean Less Oxygen

- Without adequate mixing, these warm thermoclines result in surface layers that lack O_2 .
- That can result in dead zones near the surface where decaying algae absorb all of the available O_2 .

Lake Erie Develops Dead Zones Every Summer



Seasonal Cycling in Lakes



1. Describe the seasonal pattern of cycling:
2. Describe the effects on dissolved oxygen:
3. Describe the effects on nutrient-levels:
4. Describe the effects on temperature:

Classification of Freshwater Environments

Based on their production of organic matter



Oligotrophic

- Nutrient-poor (limits phytoplankton)
- Clear water
- Oxygen-rich
- Supports diverse fish and invertebrates

Eutrophic

- Nutrient-rich (productive phytoplankton)
- Murky and cloudy
- Low oxygen levels

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