SUSTAINABILITY OF ECOSYSTEMS

Topic 7:

PESTS AND PESTICIDES


DO YOU ALSO EAT THESE WITH THAT MASK ON?!
seppo.net

What are pests?

Pest is any organism that man believes is undesirable, has a negative impact on the human environment, or is in competition with human use of a resource, either natural, or cultivated.

Examples:

- unwanted dandelions growing in the lawn;

- rodents or insects that eat fruits, vegetables or other crop species

Early Pesticide Use:

Pesticide refers to a substance used for destroying insects or other organisms harmful to cultivated plants or to animals. Early pesticides included the use of toxic inorganic metallic salts such as copper sulfate, lead salts, arsenic, or mercury which was used to kill pest

Fresh Fruit and Vegetables	Number of Samples Analyzed	Samples with Residues Detected	Percent of Samples with Detections	Different Pesticides Detected	Different Residues Detected	Total Residue Detections
Apples	774	727	98	33	41	2,619
Lettuce	743	657	88	47	57	1,985
Pears	741	643	87	31	35	1,309
Orange Juice	186	93	50	3	3	94

esticide Data Program (Feb 2006). "*Annual Summary Calendar Year 2005*" (pdf). USDA. Retrieved on 2006-07-24.

Problems caused by pesticides:

- killed other beneficial organisms,

- May disrupt the natural balance in ecosystems

- Most early pesticides were **non-biodegradable** (meaning that they were not broken down within the ecosystem). As a result, these early pesticides began to accumulate in the environment, contaminating water and soil resources, eventually poisoning humans.

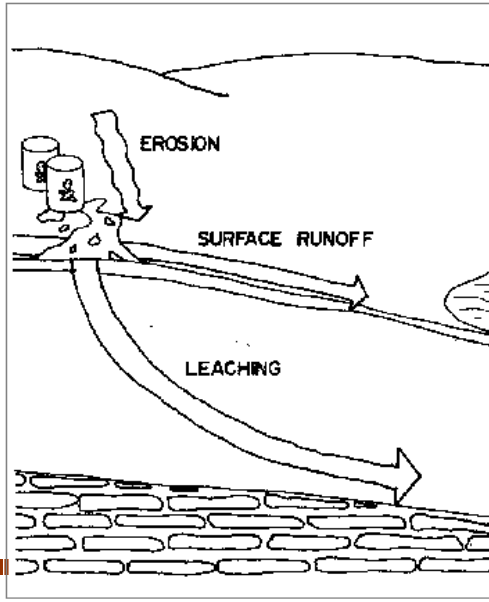


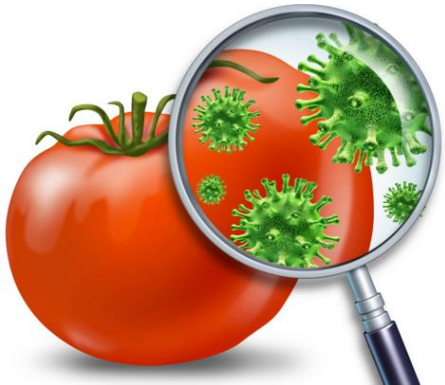
Figure 3. Pesticides can pollute water through either surface runoff or leaching.

Distinguishing between Pesticides

The most hazardous pesticides include those that can be distinguished on the basis of:

Water soluble pesticides are easily transported from the target area into ground water and streams since the pesticides get dissolved in the water. This means that the pesticides may run off to other areas and cause damage to un-targeted animals and plants in other places.

Fat soluble pesticides are readily absorbed in insects, fish, and other animals, often resulting in extended persistence in food chains



Classification of Pesticides:

Type of Pesticides	Target	Examples	Persistence
Insecticide	Insects	DDT	2-15 years
Herbicide	Weeds	Roundup	days to weeks
Fungicide	Moulds and other fungi	Captan	days
bactericide	Bacteria	Penicillin	days

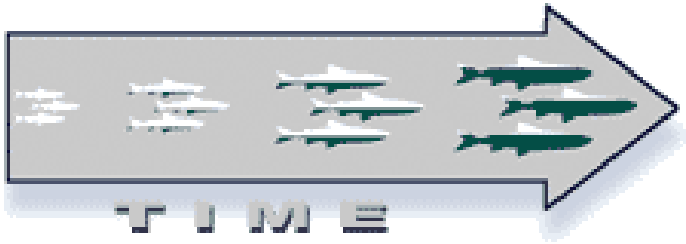
Effects Modern Pesticides:

By the twentieth century, chemists began to develop organic pesticides that were designed to be less toxic to man and more specific toward the intended pests.

Although this was initially believed to be a step in the right direction, man soon discovered that the organic pesticides also caused unexpected environmental effects. For example, some of these pesticides were fat soluble which caused:

Bioaccumulation is the increase in contaminant concentrations in an animals' body over time, as the animal grows older.

For example:



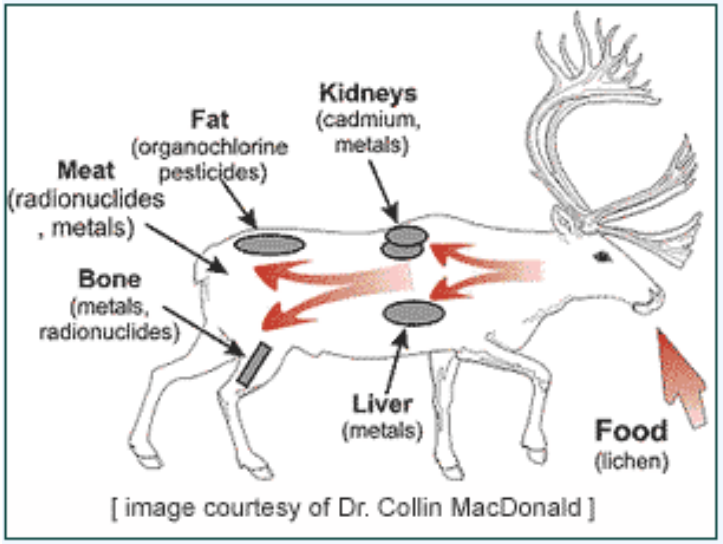
-PCBs are stored in fat.

-Cadmium is stored in kidneys.

-

- Mercury is stored in liver.

Where do we look for contaminants in caribou



[image courtesy of Dr. Collin MacDonald]

Tissues used for contaminant analysis:

Meat

Liver

Kidney

Bone

Fat

HEALTH WARNING

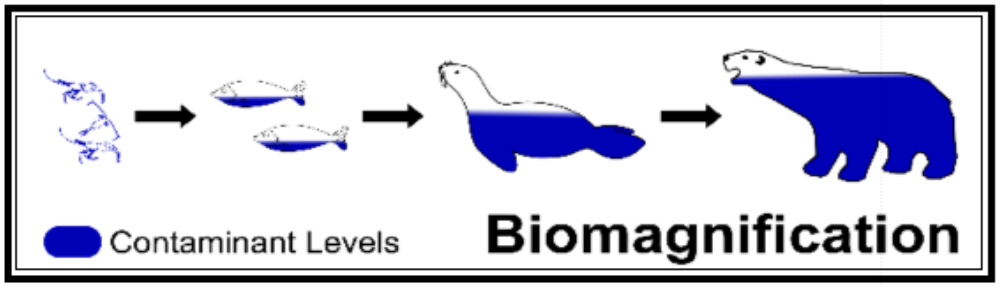
Cadmium in Moose/Caribou Livers and Kidneys

The Inland Fish and Wildlife Division, after consultation with the Department of Health, recommends the public not eat the liver or kidneys of moose or caribou.

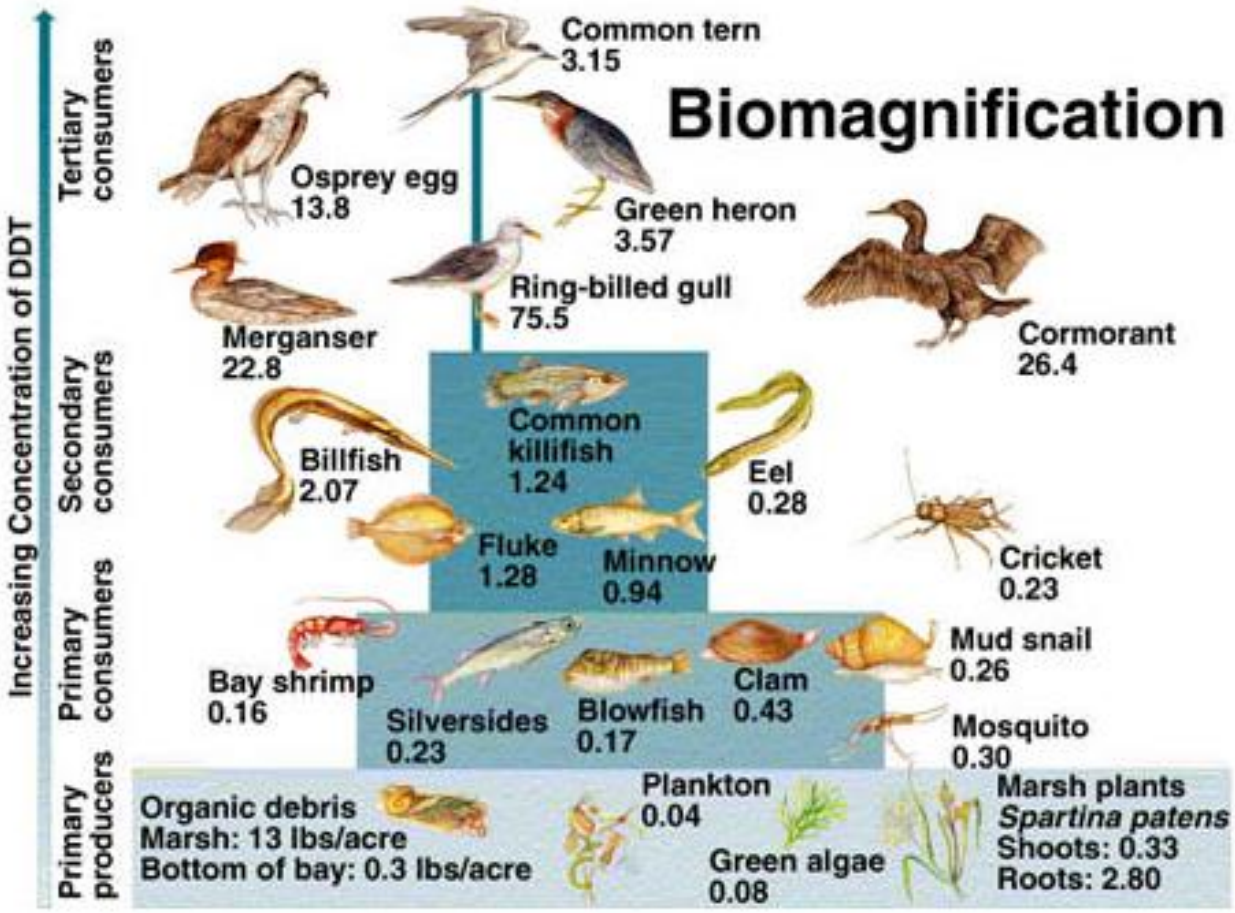
The cadmium contained in one meal of either liver or kidney, combined with a person's normal consumption of cadmium in other foods, would likely be more than the weekly allowable intake of cadmium as recommended by the World Health Organization.

Biomagnification (Bioamplification): refers to the increase in concentration of a contaminant at higher levels of the food chain.

Which means that the higher up on the food chain you are the more contaminants you are likely to have stored in your body



As each organism feeds on one lower in the food chain, the fat soluble pesticide began to be concentrated in ever higher amounts as one moved toward the top of the food pyramid. Since every organism eats far more than its own body mass in food, the tiny amounts found in each organism in the lower levels of the food web began to accumulate in greater concentrations in species located at higher trophic levels. This is referred to as


Biomagnification
Increasing Concentration of DDT
Tertiary consumers
Secondary consumers
Primary consumers
Primary producers
Common tern
3.15
Osprey egg
13.8
Green heron
3.57
Ring-billed gull
75.5
Merganser
22.8
Cormorant
26.4
Common killifish
1.24
Billfish
2.07
Eel
0.28
Fluke
1.28
Minnow
0.94
Cricket
0.23
Bay shrimp
0.16
Mud snail
0.26
Silversides
0.23
Blowfish
0.17
Clam
0.43
Mosquito
0.30
Organic debris
Marsh: 13 lbs/acre
Bottom of bay: 0.3 lbs/acre
Plankton
0.04
Green algae
0.08
Marsh plants
Spartina patens
Shoots: 0.33
Roots: 2.80

One example of this problem is illustrated by the damage done to predatory birds as a result of bioaccumulation of DDT. As a result of this problem DDT has been banned from use in North America.

Further study showed the culprit to be DDT, a pesticide introduced in 1946. Farmers were using it to kill insects that were eating their crops. Insects exposed to DDT were eaten by small birds; these small birds were in turn eaten by peregrines. Stored in body fat, DDT becomes ever more concentrated as it moves up the food chain from one animal to another. That's why predators at the top of the chain, like peregrines, were so severely affected by DDT and other chemicals. Toxic chemicals tend to remain in the fat and bones of peregrines, and although the birds are usually not killed directly, they produce fewer young. Many sterile eggs are laid, while those that are fertile have thin shells which are easily broken in the nest.

By 1972, DDT was banned for use in North America. However, many peregrines winter in Latin America, where DDT is still used. Even those birds that may not migrate to Latin America, still feed on other birds that do; therefore, they continue to pick up toxins. DDT is not the only chemical that is harmful to birds

Activit

- Read 2.2 "Case Study: Pesticides" on pages 52 - 57. Answer questions 1 - 10 from "Understanding Concepts," "Making Connections," and "Reflecting" on page 58.

TOPIC #8

Biogeochemical Cycles

illustrate the cycling of matter through biotic and abiotic components of an ecosystem by tracking carbon, nitrogen and oxygen

Elements of Life:

Biochemists ***are scientists who study the type of chemical compounds that are found in living things. They study the interaction of these compounds in an attempt to understand how life works at the chemical level.*** **The work of biochemists has lead to the realization that living organisms are composed of some of the same elements that are found in the air, water and soil.**

Only 6 elements make up 99.2% (rounded to 3 significant digits) of human or pumpkin tissues. The table below compares the relative abundance (percentage by weight) of a few selected elements found in the Earth's crust, human, and pumpkin.

Element Name (Symbol)	Earth % weight	Human % weight	Pumpkin % weight
Oxygen (O)	46.6	65	85
Carbon (C)	0.19	18	3.3
Hydrogen (H)	trace	10	10.7
Nitrogen (N)	trace	3	0.16
Calcium (Ca)	3.6	2.0	0.02
Phosphorus (P)	trace	1.2	0.05
Potassium (K)	2.6	0.20	0.34
Sulfur (S)	trace	0.25	<0.05
Sodium (Na)	2.8	0.1	0.001
Magnesium (Mg)	2.1	0.05	0.01
Chlorine (Cl)	trace	0.15	<0.05
Iron (Fe)	5.0	trace	0.008
Copper (Cu)	trace	trace	0.0001
Iodine (I)	trace	trace	<0.05
Silicon (Si)	27.7	trace	trace

Energy Flow vs. Nutrient Cycling

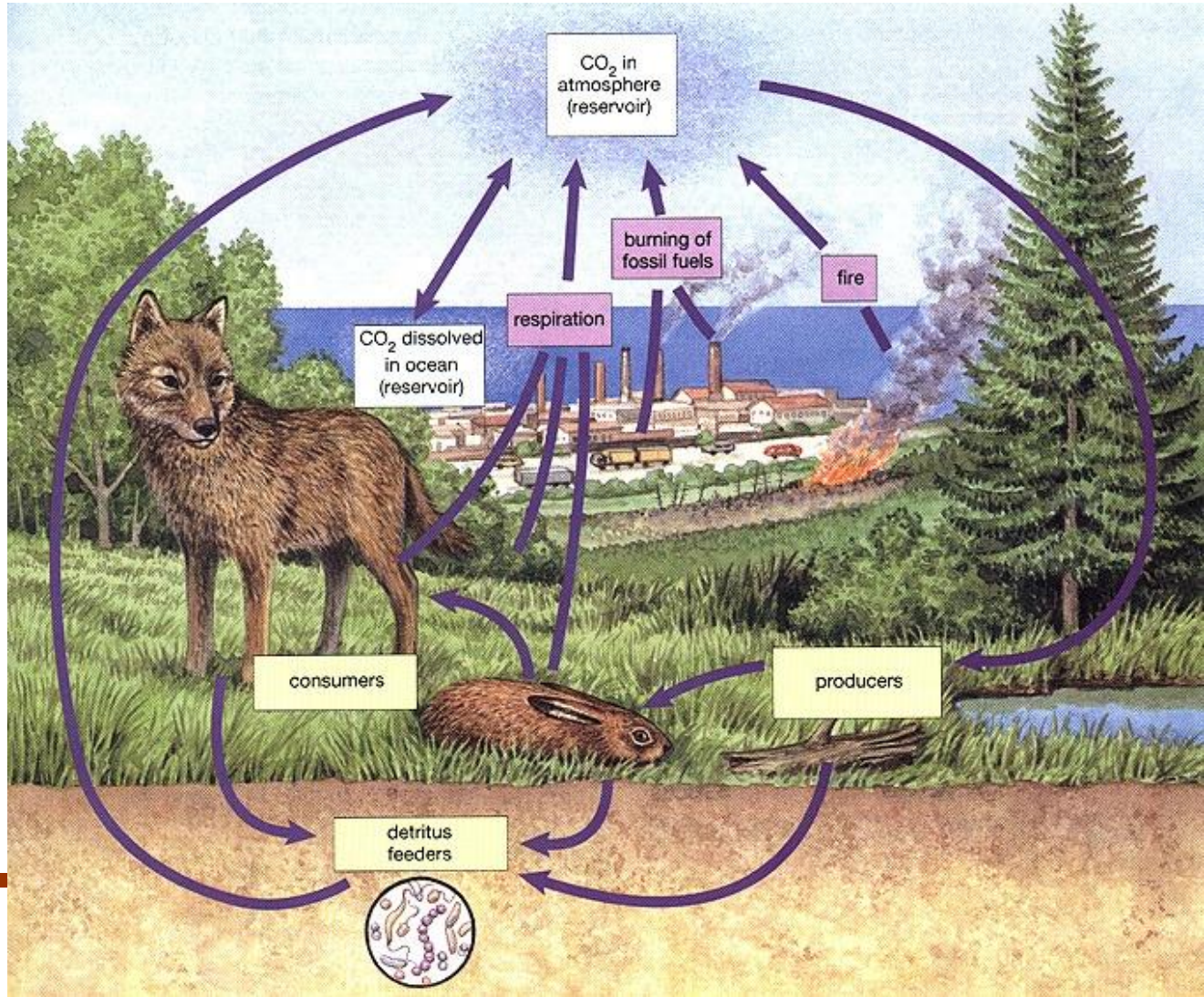
- Energy *flows through* ecosystems - that is, it enters the ecosystem via sunlight, is stored temporarily in complex molecules, and ultimately leaves it in the form of heat.

- Nutrients *cycle within* ecosystems - that is, they are atoms (Carbon, Nitrogen, Phosphorous…) that stay within the ecosystem and are found at different times in different parts of the system.

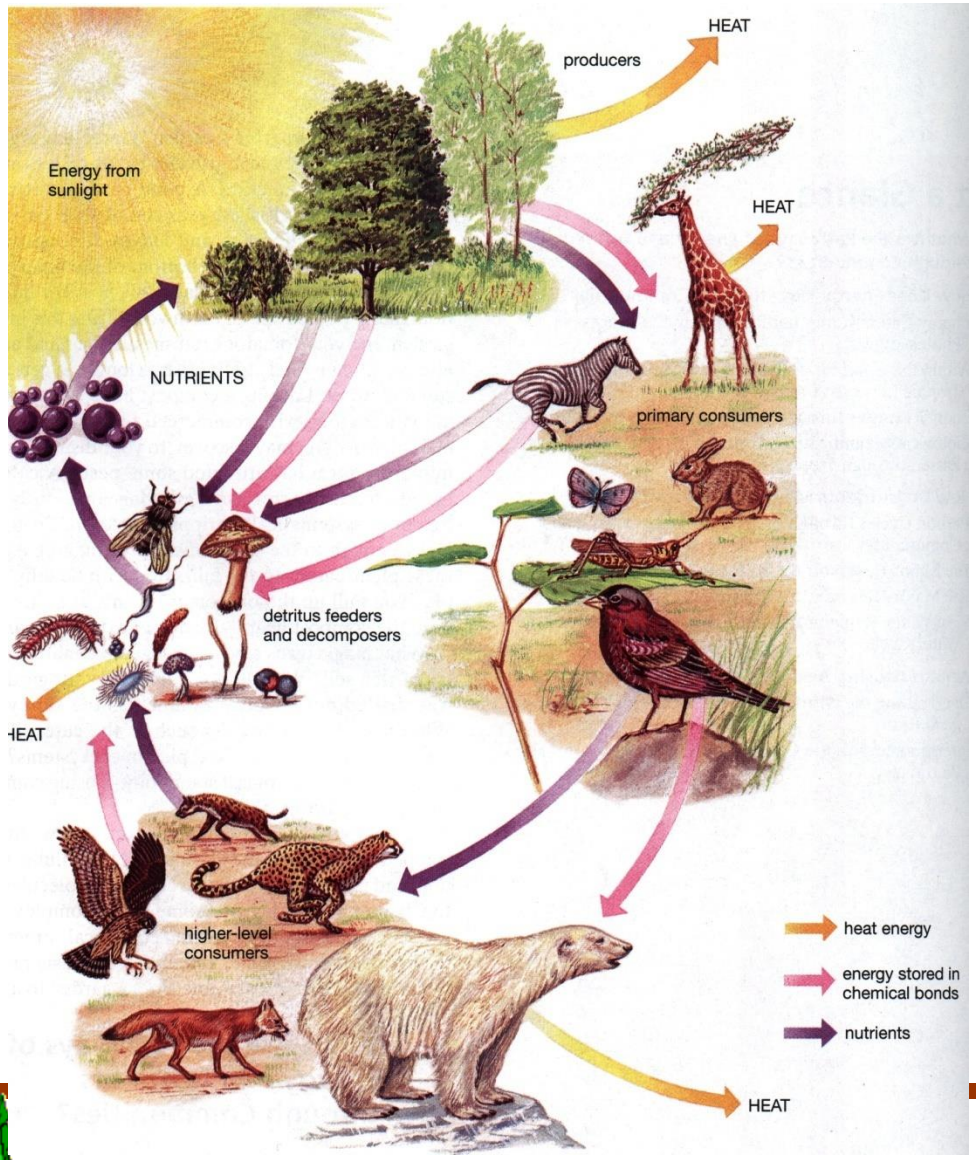
Nutrient Cycles

Inorganic nutrients (Carbon, Oxygen, Nitrogen) are recycled continually through ecosystems.

Plants and animals build structures from the nutrients and inorganic material.



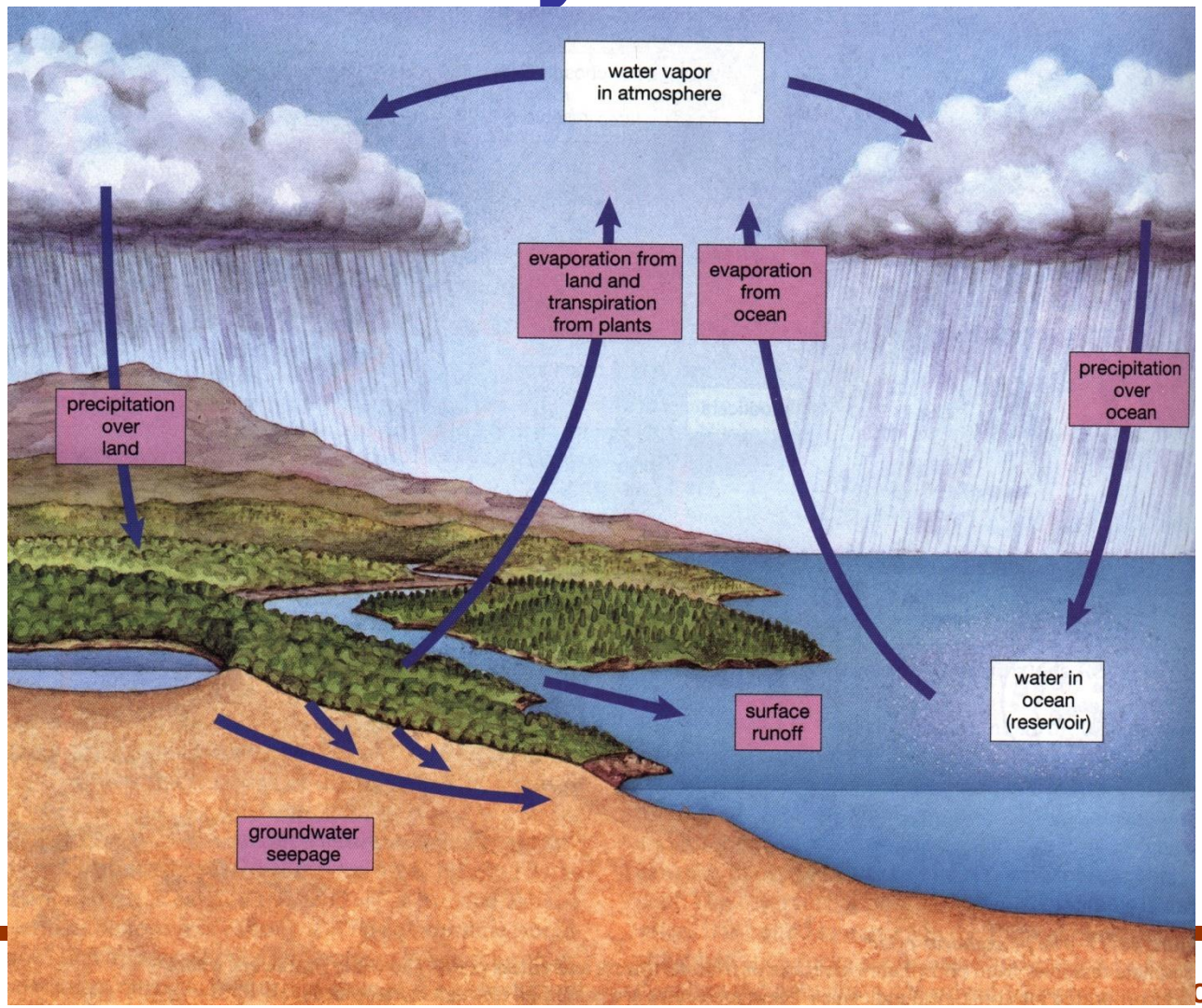
Nutrient Cycles



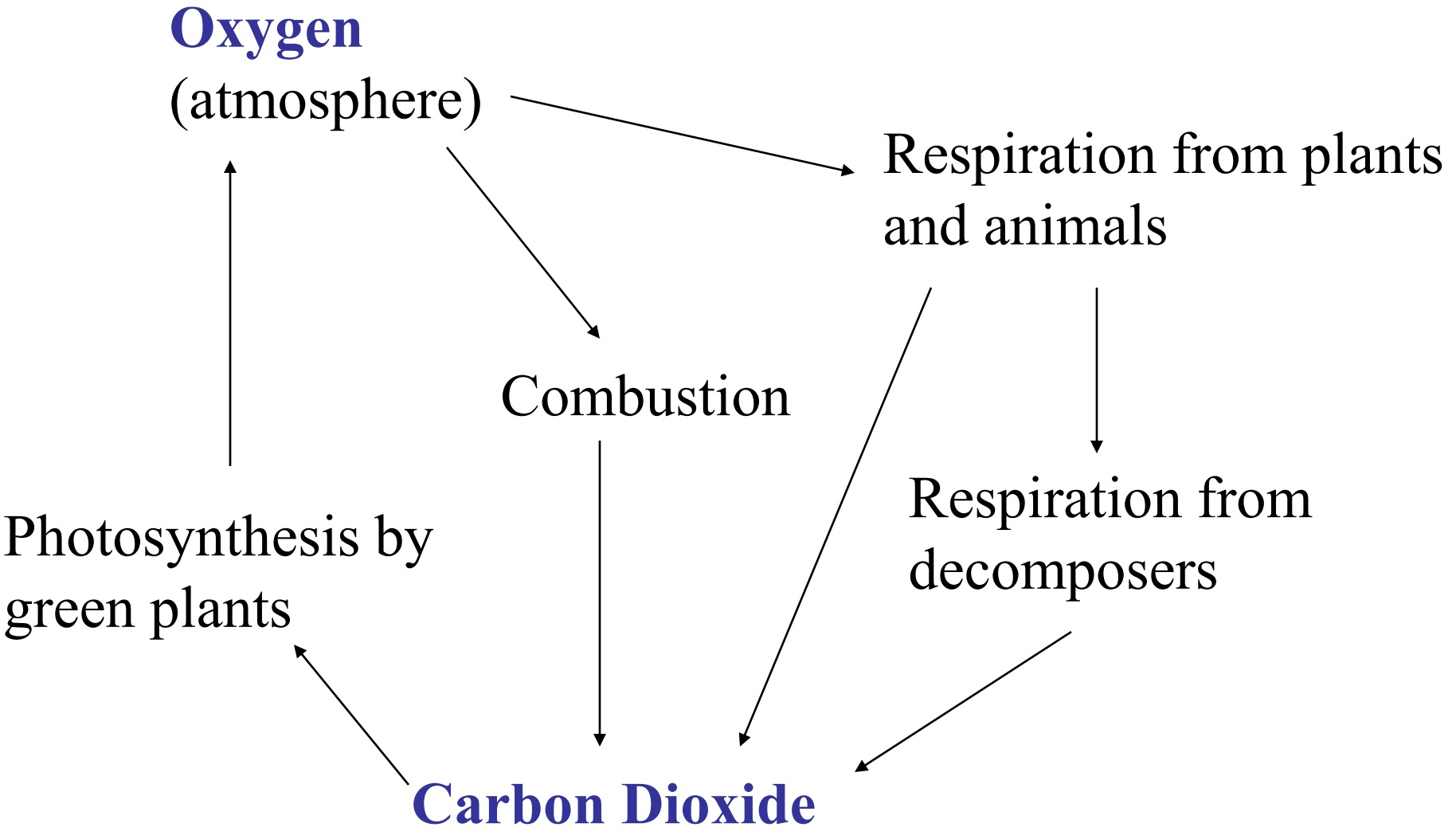
- **Nutrients (the basic chemical building blocks of all life) are recycled in a living system.**

- **The key nutrients are Carbon, Hydrogen, Oxygen, Nitrogen and Phosphorus. These constitute 95% of all living matter.**

Hydrogen and Oxygen (Water) Cycle



The Oxygen Cycle



Note: The complementary processes of photosynthesis and respiration ensure that not only oxygen, but also carbon and hydrogen are repeatedly cycled.

Photosynthesis:

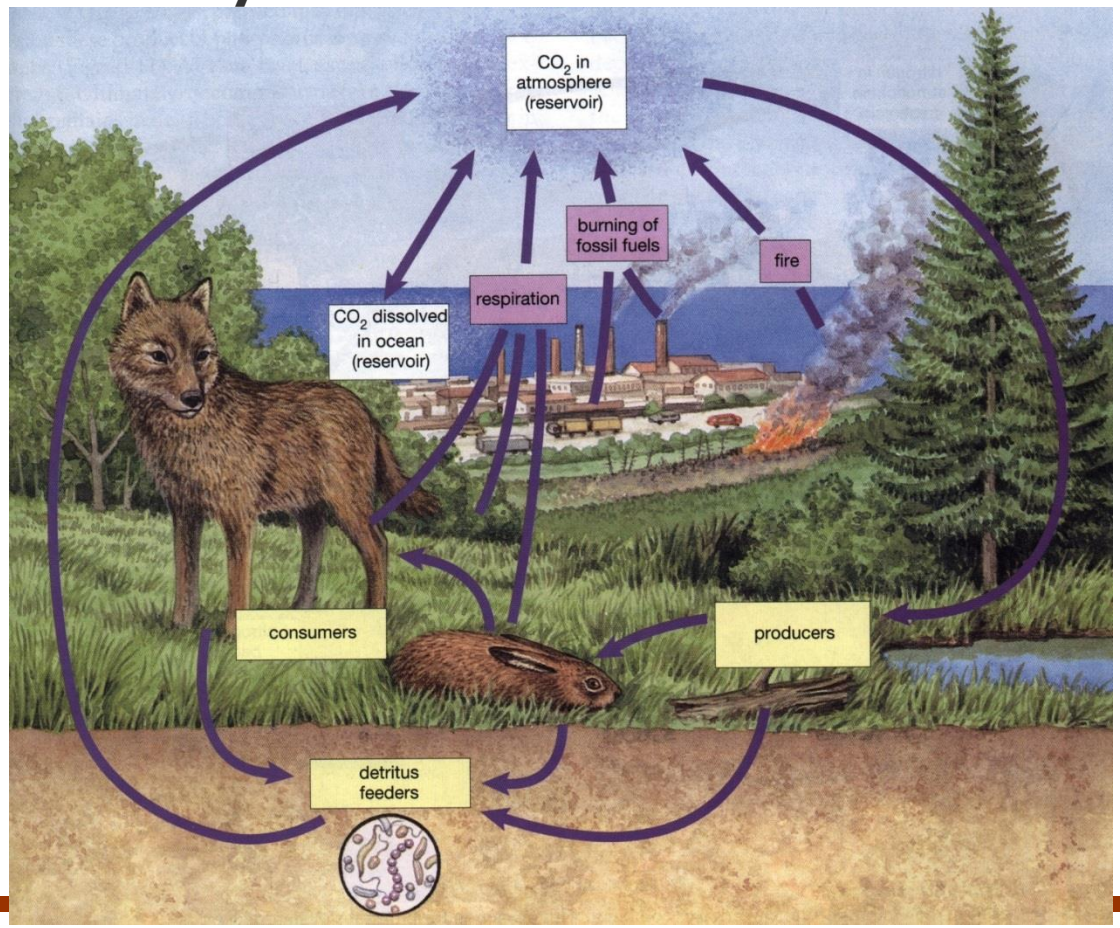
$6\ CO_2 + 6\ H_2O + \text{light} \text{ ------> } C_6H_{12}O_6 + 6O_2$

Respiration:

$C_6H_{12}O_6 + 6O_2 \text{ ------> } 6CO_2 + 6H_2O + \text{energy}$

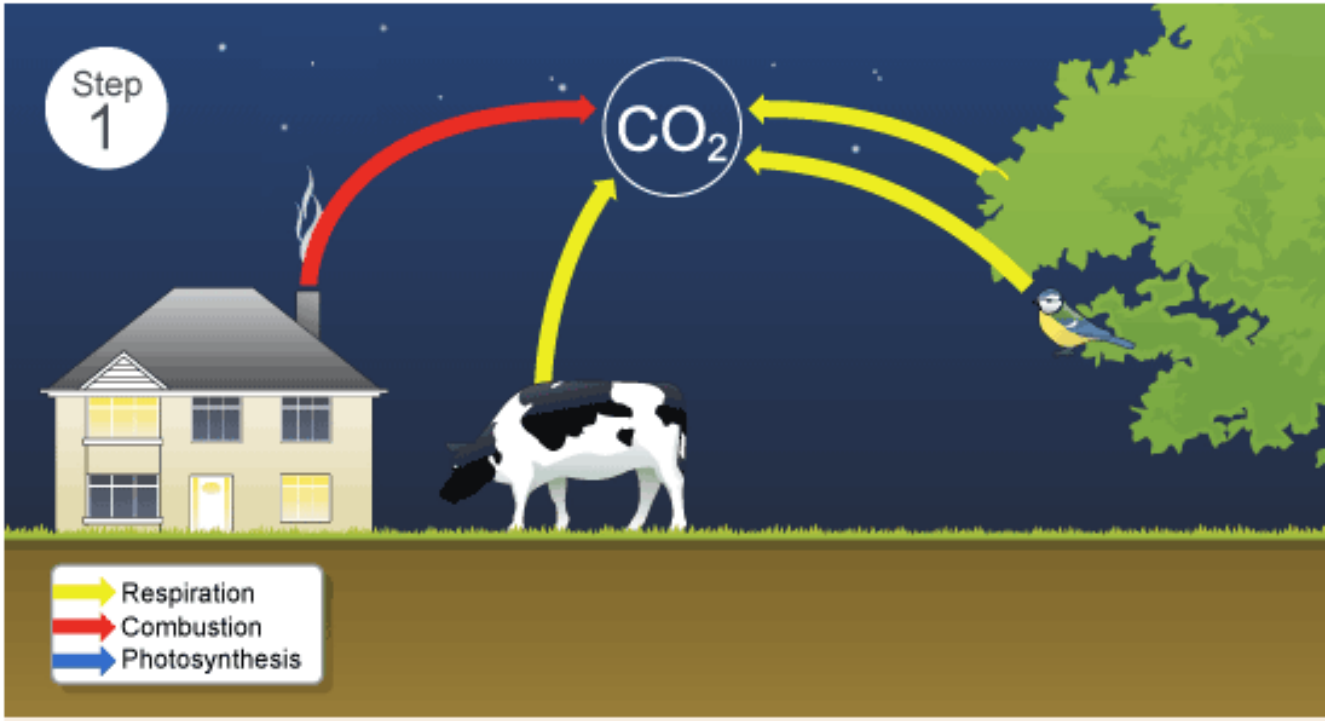
Carbon Cycle

Most of the chemicals that make up living tissue contain **carbon**. When organisms**die** the carbon is **recycled** so that it can be used by future generations. The model that describes the processes involved is called the **carbon cycle**.



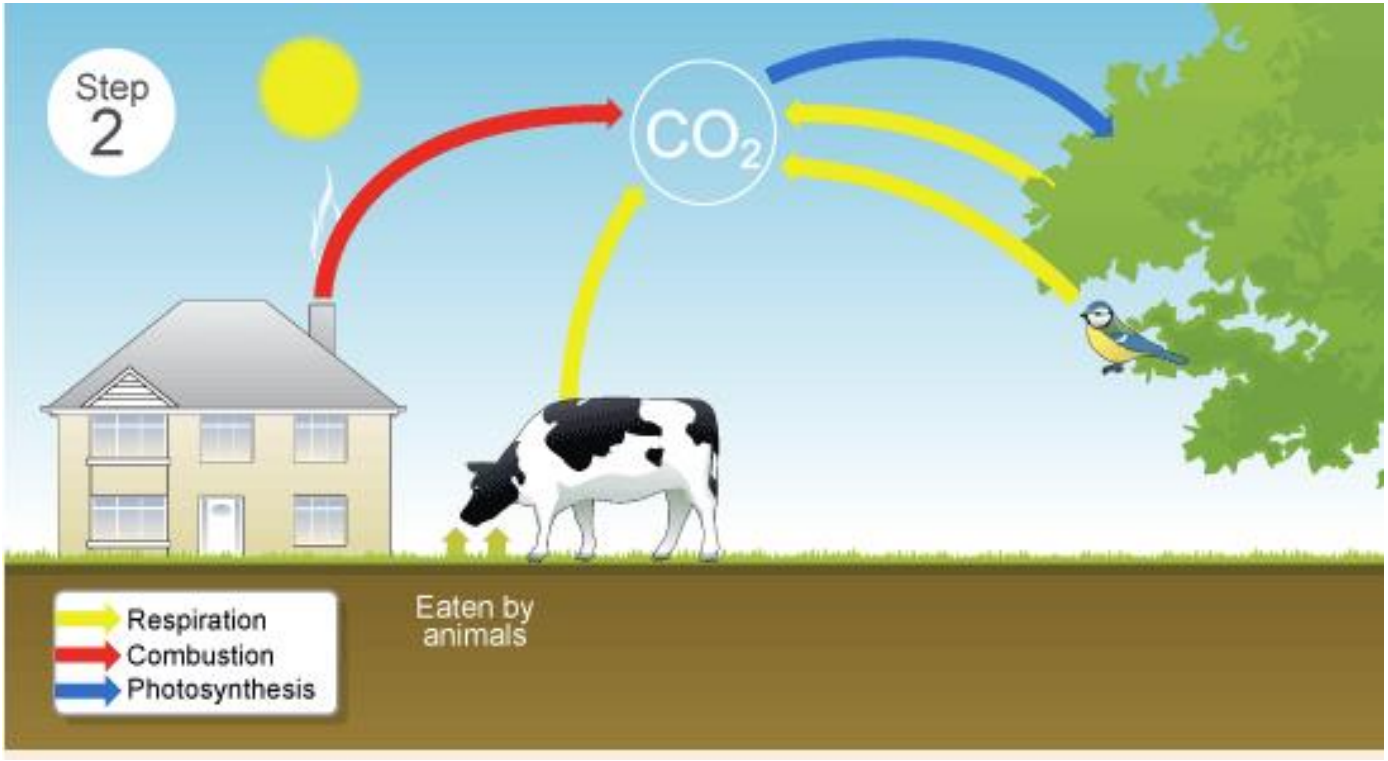
The Carbon Cycle

- In the carbon cycle, we use CO_2 from both biotic and abiotic sources:
- 1. **Biotic**: aerobic respiration (in the presence of O_2), and decomposition.
- Here, the organic reservoirs (storage areas) for carbon are the bodies of living things.
- 2. **Abiotic**: combustion and geological activity
- Here, the inorganic reservoirs for carbon are the atmosphere, the oceans, and the Earth's crust.
- See page 62, figure 1.

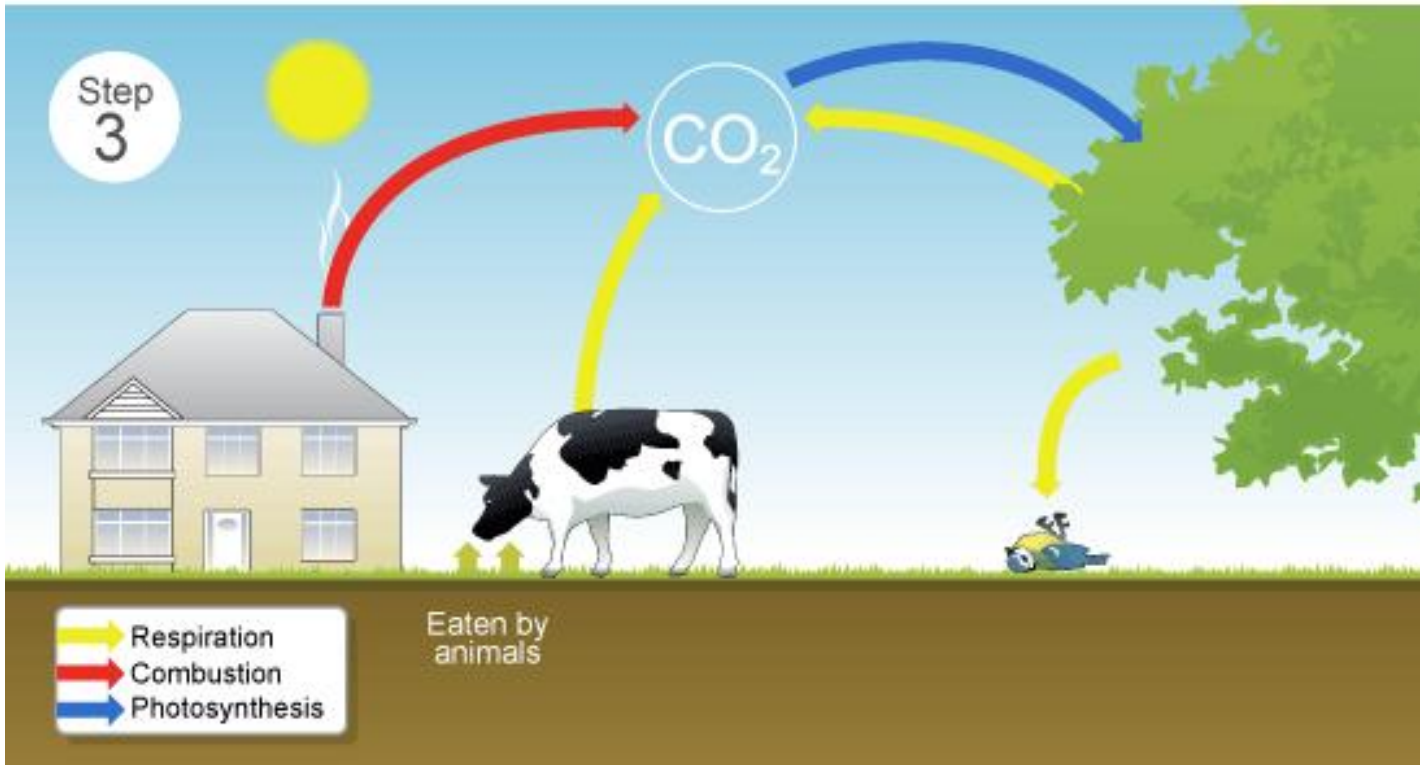


1. Carbon enters the atmosphere as carbon dioxide from

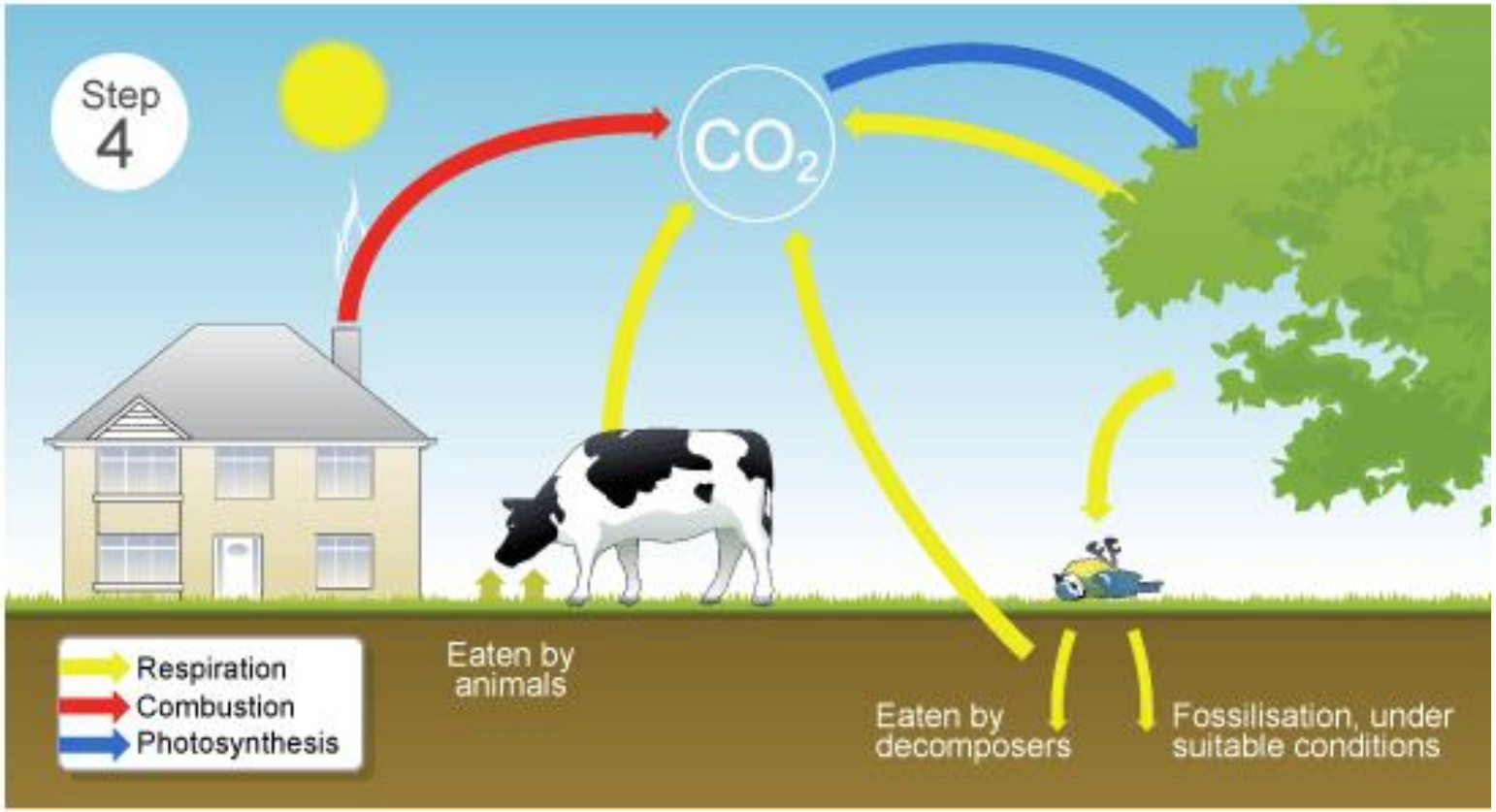
-Respiration
-Combustion (burning of fossil fuels)
- Volcanic Eurptions



2. Carbon dioxide is absorbed by producers to make sugar in photosynthesis.

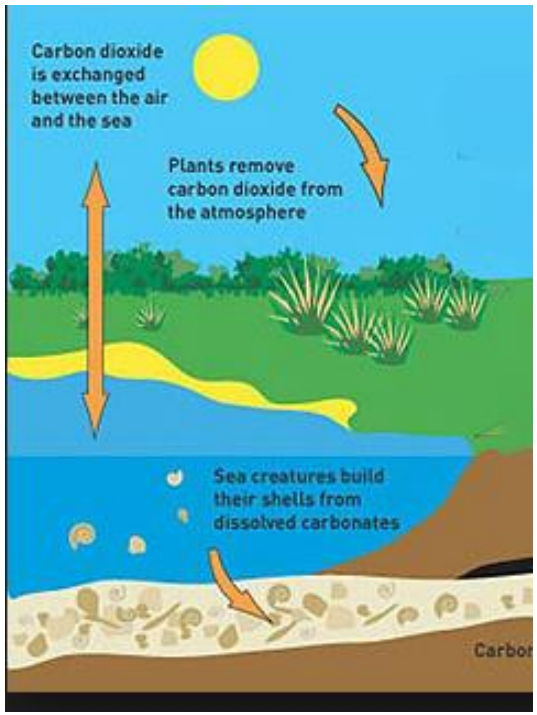


Animals feed on the plant passing the carbon compounds along the food chain. Most of the carbon they consume is exhaled as carbon dioxide formed during respiration. The animals and plants eventually die.

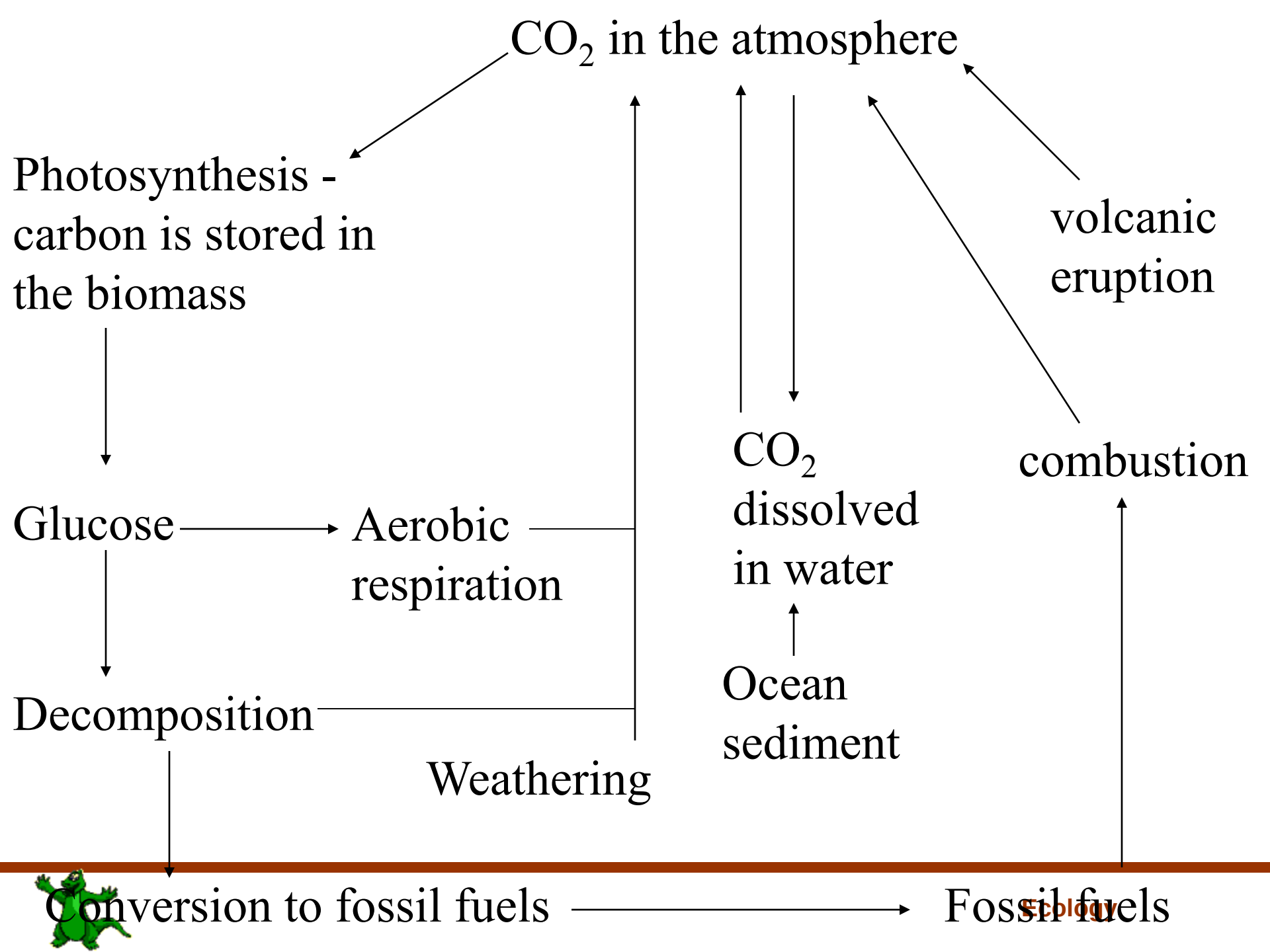


3. The dead organisms are eaten by decomposers and the carbon in their bodies is returned to the atmosphere as carbon dioxide. In some conditions decomposition is blocked. The plant and animal material may then be available as fossil fuel in the future for combustion.

Carbon Cycle In the Sea



In the sea, marine animals may convert some of the carbon in their diet to calcium carbonate which is used to make their shells. Over time the shells of dead organisms collect on the seabed and form limestone. Due to Earth movements this limestone may eventually become exposed to the air where it's weathered and the carbon is released back into the atmosphere as carbon dioxide. Volcanic action may also release carbon dioxide.


CO_2 in the atmosphere
Photosynthesis - carbon is stored in the biomass
volcanic eruption
CO_2 dissolved in water
combustion
Glucose
Aerobic respiration
Decomposition
Ocean sediment
Weathering
Conversion to fossil fuels
Fossil fuels

What Human Activities Affect the Carbon Cycle?

Burning of Fossil Fuels

Natural gas, oil and coal are fossil fuels that are commonly burned to generate electricity in power plants, for transportation, in homes and in other industrial complexes. The primary industrial activities that emit carbon dioxide and affect the carbon cycle are petroleum refining, paper, food and mineral production, mining and the production of chemicals.

Deforestation

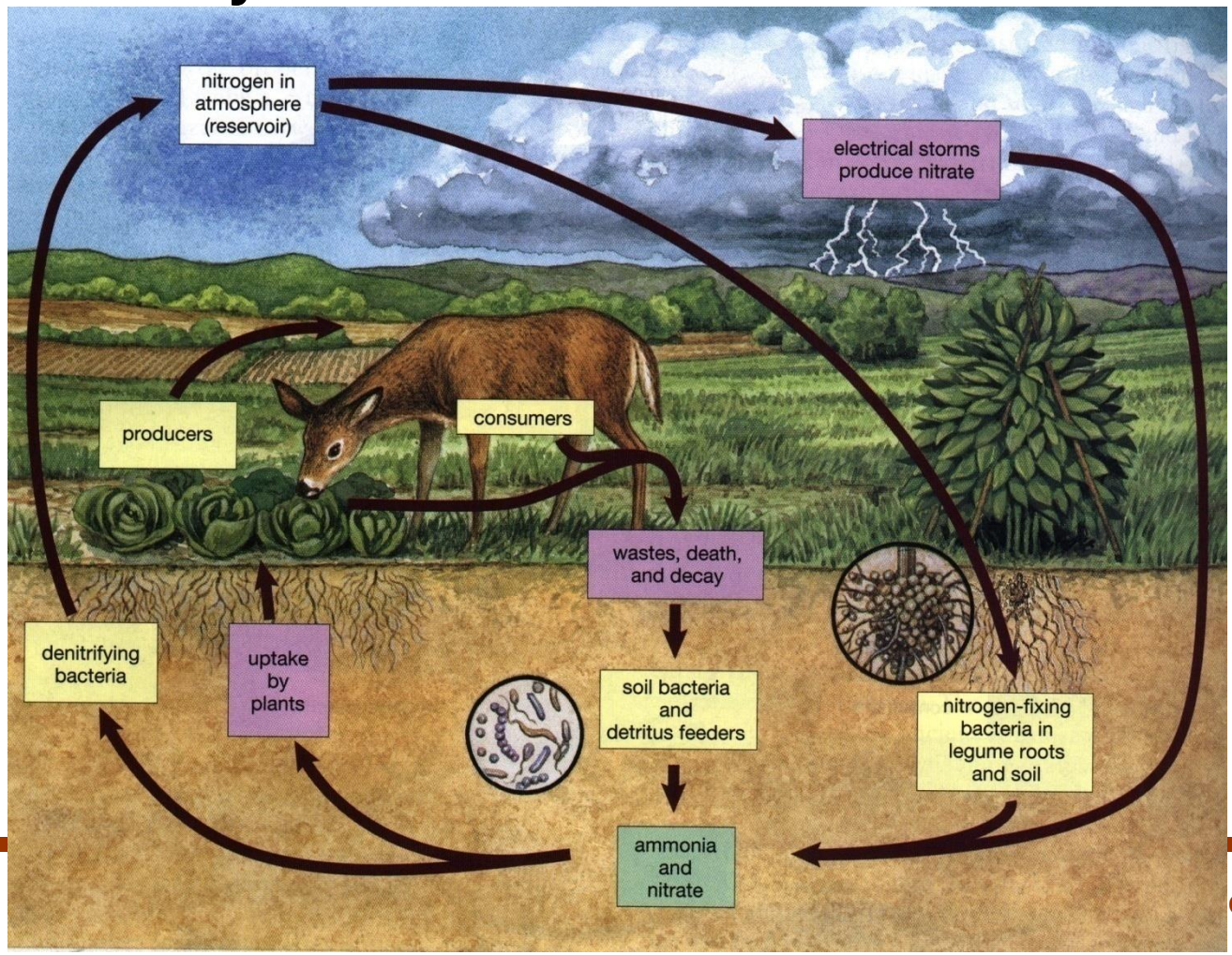
Deforestation is the permanent removal of trees from forests. Permanent removal of the trees means new trees will not be replanted. This large-scale removal of trees from forests by people results in increased levels of carbon dioxide in the atmosphere because trees are no longer absorbing carbon dioxide for photosynthesis.

Activit

- Read 2.5 "The Carbon Cycle" on pages 62 - 65. Answer questions 1 - 7 from "Understanding Concepts" and "Making Connections" on page 65.

Nitrogen Cycle

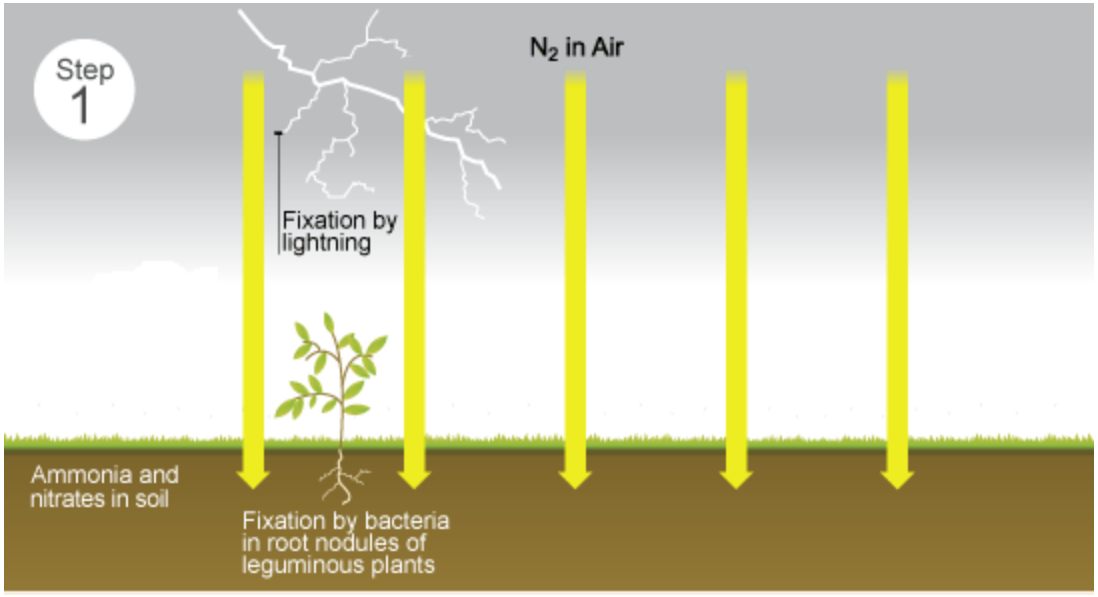
Nitrogen is essential for the formation of amino acids in proteins. The nitrogen cycle is a model that explains how nitrogen is recycled.



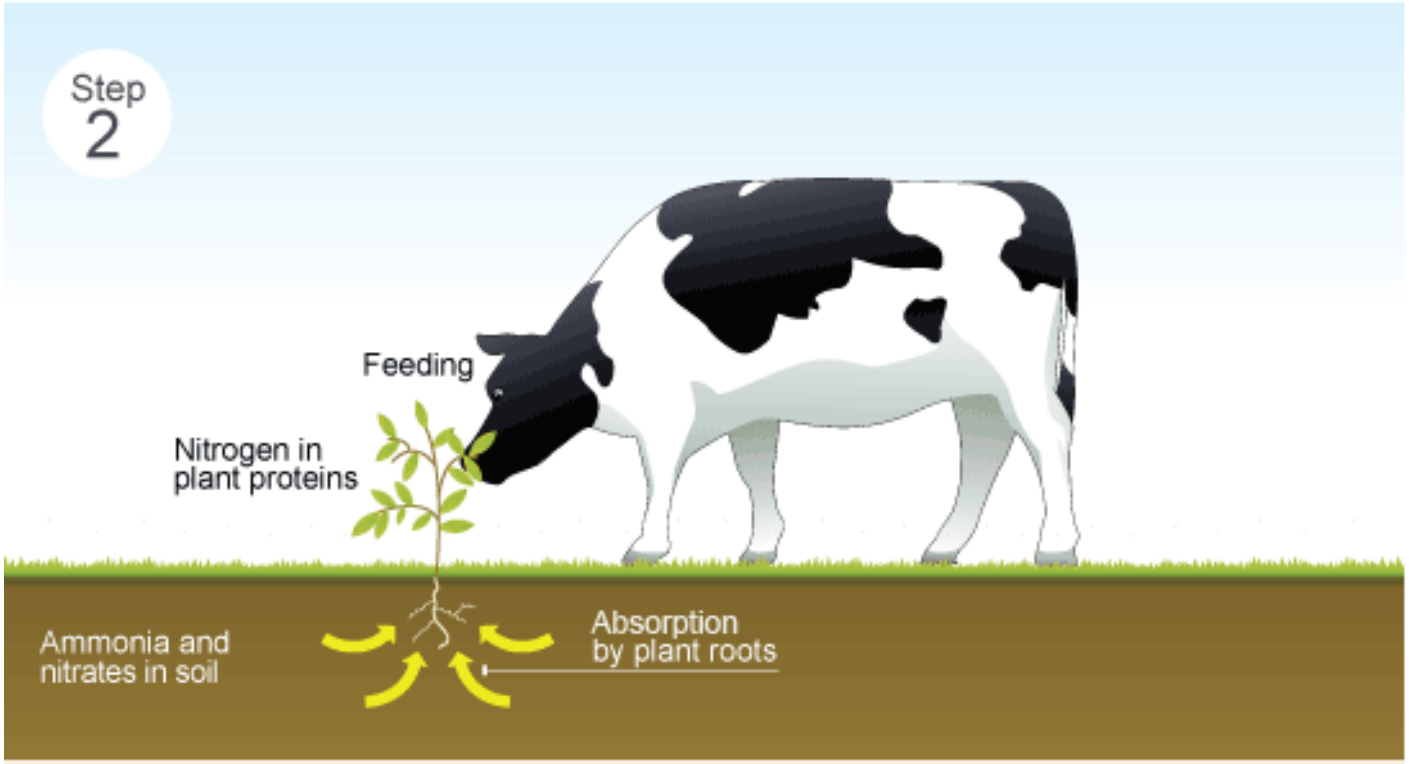
The Nitrogen Cycle

- The movement of nitrogen through the ecosystems, the soil, and the atmosphere is called the **nitrogen cycle**. Nitrogen gas composes 79% of the Earth's atmosphere.
- Because nitrogen is so unreactive, it cannot be used directly by plants to make protein. Only nitrates are useful to plants, so we are dependent on other processes to convert nitrogen to nitrates in the soil.

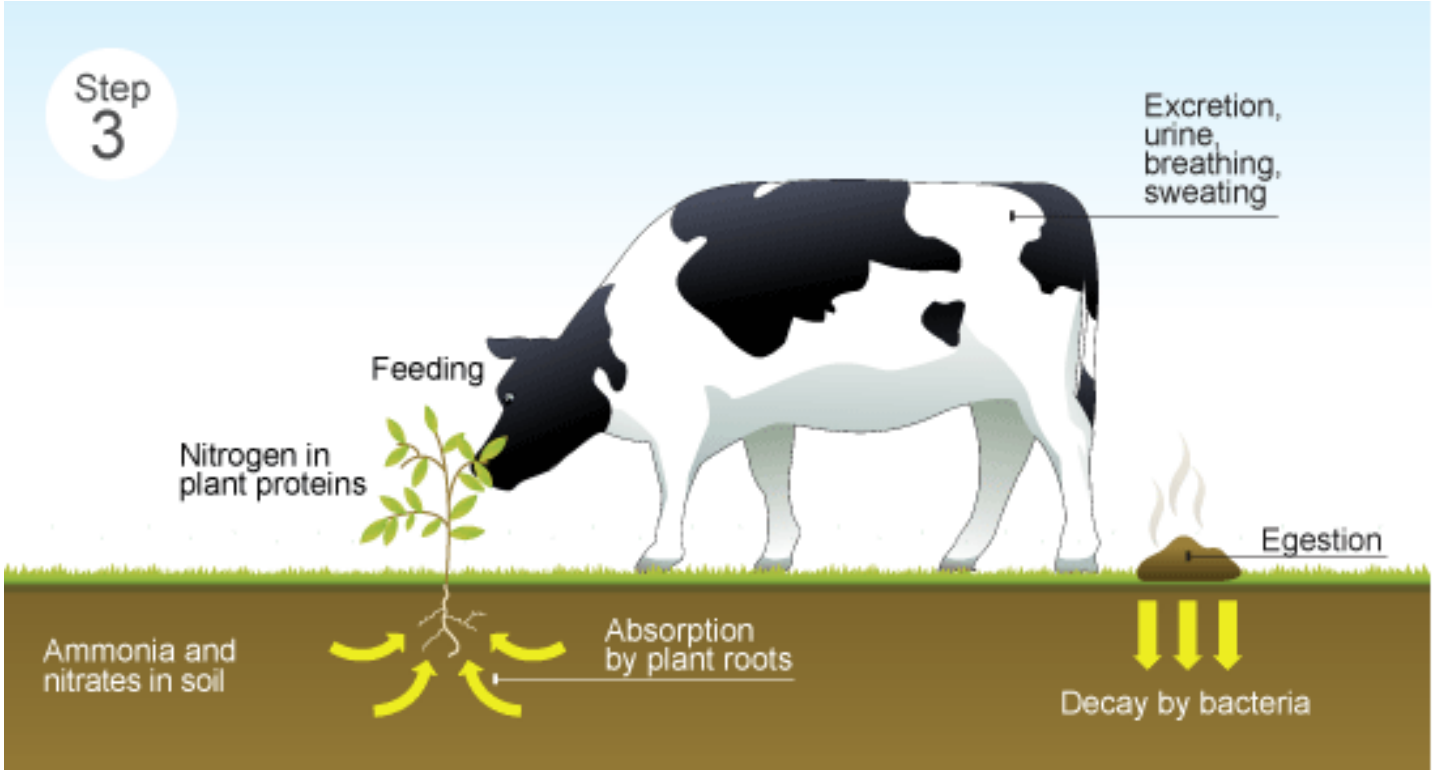
- In order for nitrogen to be useful to organisms, it must be available as a **nitrate ion (NO_3^-)**. Atmospheric nitrogen is converted into nitrates by the process of **nitrogen fixation**, or **nitrification**, either by lightning or by bacteria in the soil.



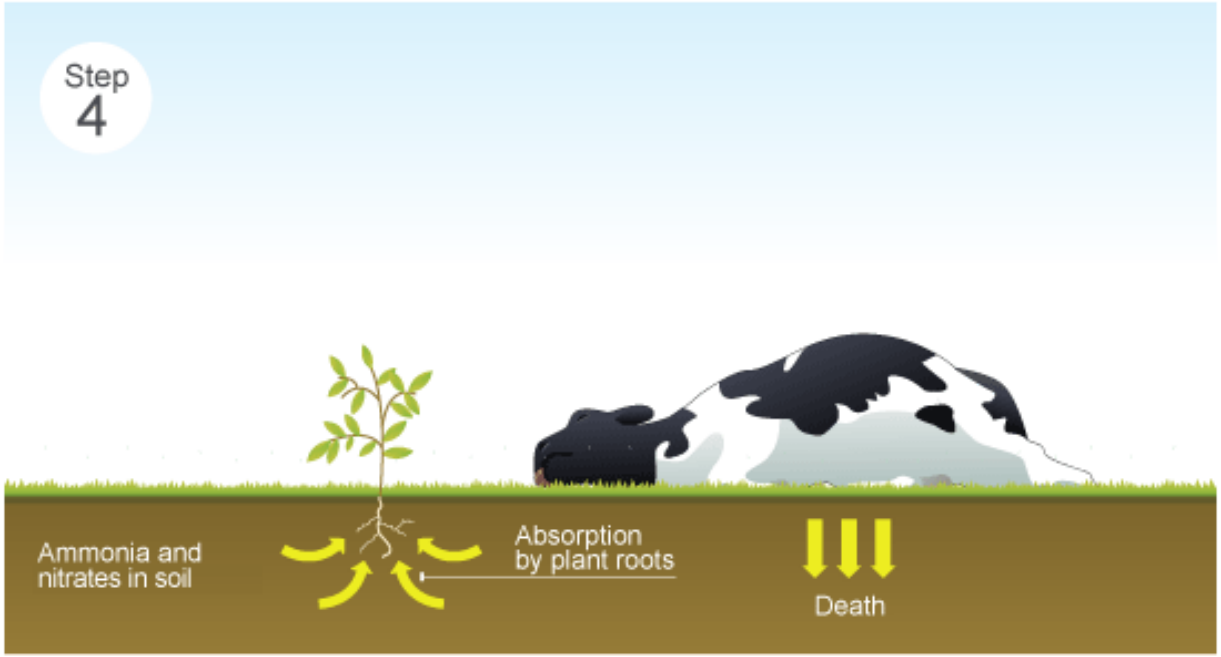
Nitrogen gas is converted to nitrate compounds by nitrogen-fixing bacteria in soil or root nodules. Lightning also converts nitrogen gas to nitrate compounds.



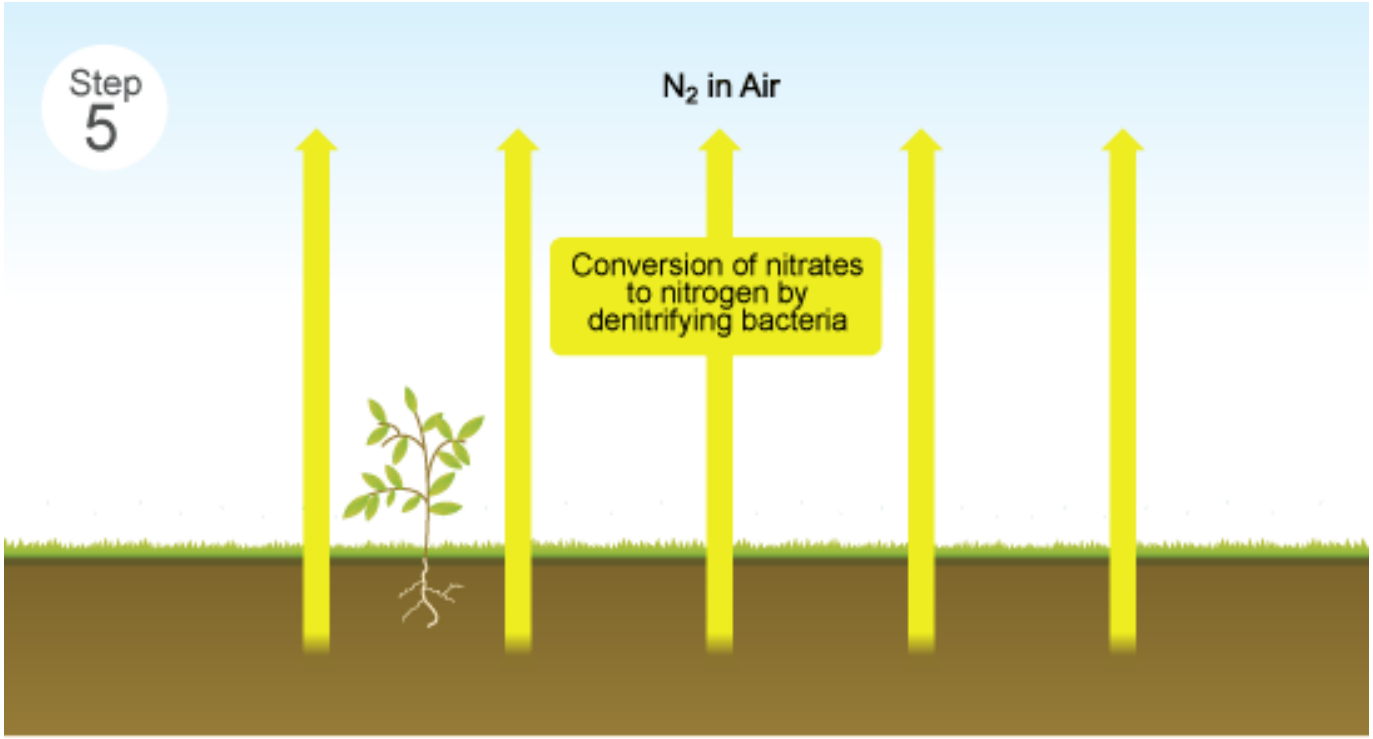
Plants absorb nitrates from the soil and use these to build up proteins. The plant may be eaten by an animal, and is used to produce animal protein.



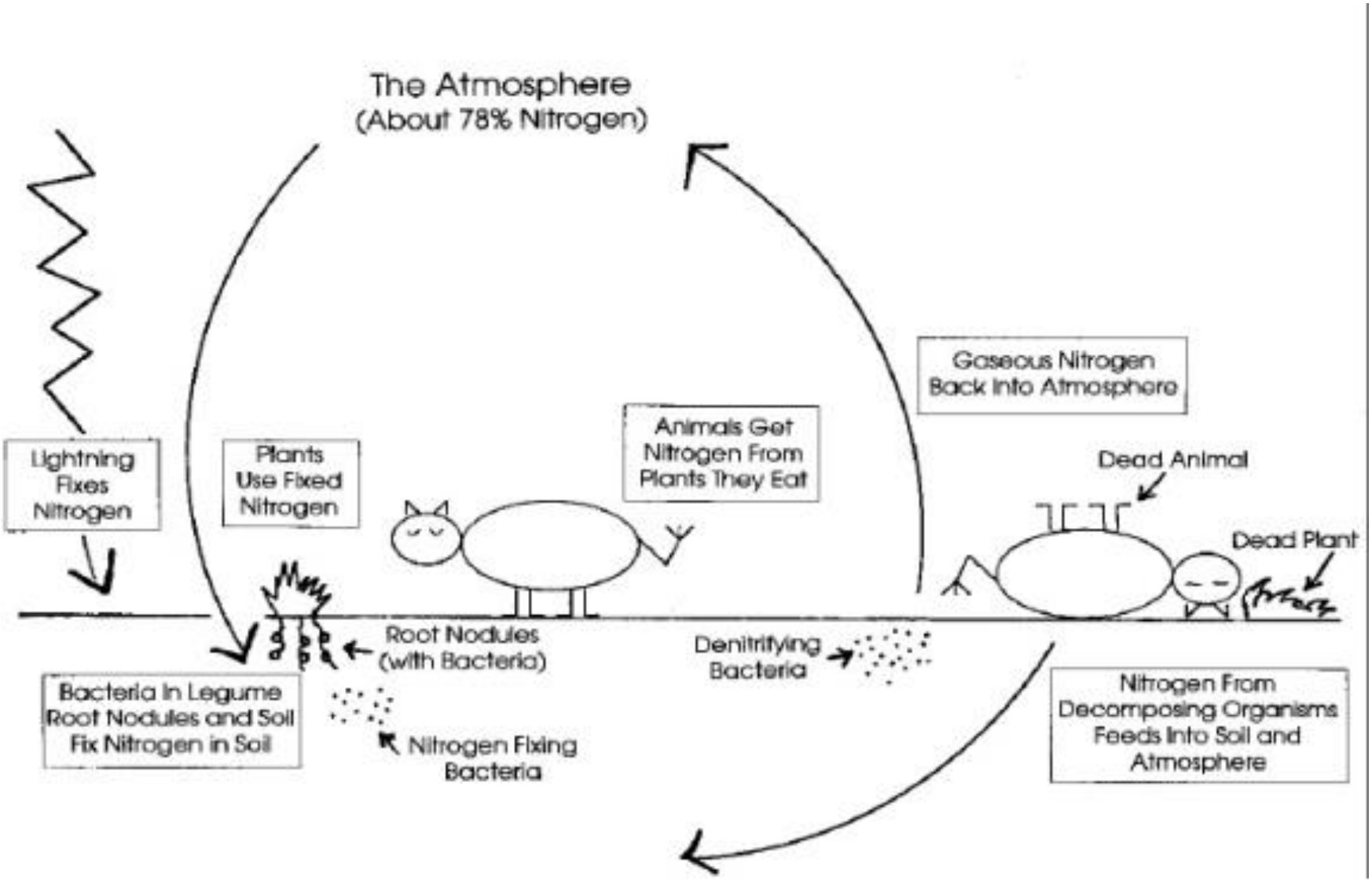
Urea and egested material is broken down by decomposers. This results in nitrogen being returned to the soil as ammonia.



Decomposers also break down the bodies of dead organisms resulting in nitrogen being returned to the soil as ammonia. When plants and animals eventually die, the nitrogen compounds are broken down giving ammonia **(ammonification)**



In some conditions denitrifying bacteria in the soil break down nitrates and return nitrogen to the air.


The Atmosphere
(About 78% Nitrogen)
Lightning Fixes Nitrogen
Plants Use Fixed Nitrogen
Animals Get Nitrogen From Plants They Eat
Gaseous Nitrogen Back Into Atmosphere
Dead Animal
Dead Plant
Root Nodules (with Bacteria)
Denitrifying Bacteria
Bacteria In Legume Root Nodules and Soil Fix Nitrogen in Soil
Nitrogen Fixing Bacteria
Nitrogen From Decomposing Organisms Feeds Into Soil and Atmosphere

TOPIC #10

The Importance of Oxygen

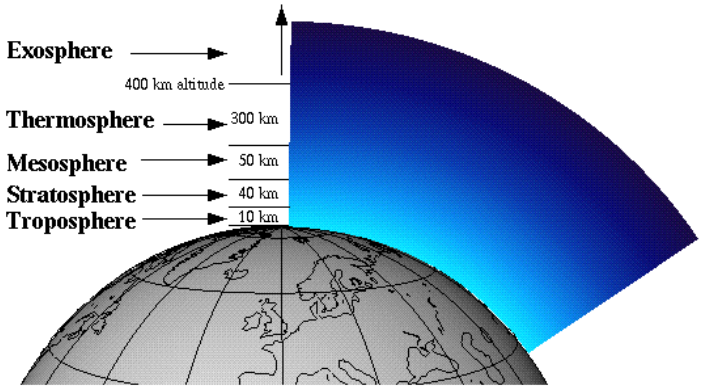
Oxygen is important because:

- It is recycled as part of the carbon, hydrogen, and oxygen cycles.
- It is cycled between the atmosphere and the living organisms of both aquatic and terrestrial ecosystems.
- It is absorbed by the water in aquatic ecosystems.
- It is produced as a byproduct of the photosynthetic organisms that live in the aquatic ecosystems.
- Heterotrophs (consumers) living in aquatic ecosystems require oxygen for cellular respiration but they receive their oxygen from the dissolved oxygen in the water.

Ozone Protects Life from UV Radiation:

The atmosphere is a mixture of particles and gases which provides air, retains heat that warms the Earth, and has a layer of ozone that protects us from UV radiation.

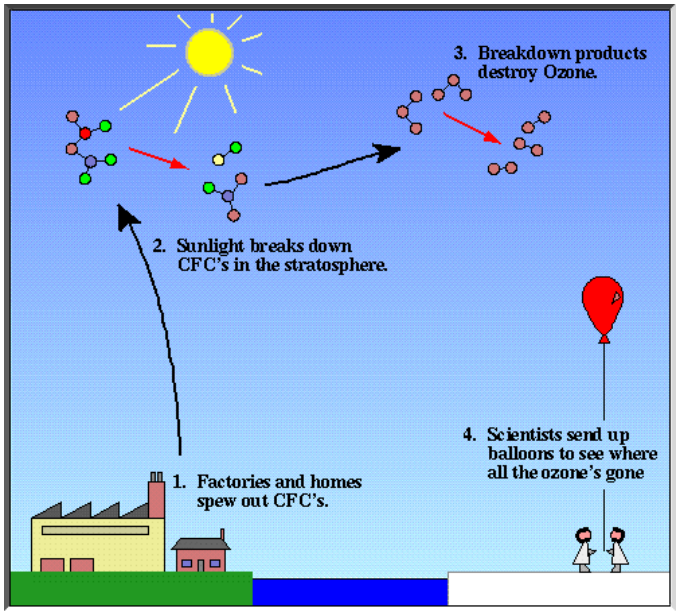
Ozone is a form of oxygen. In the atmosphere oxygen is found in three forms: O, O_2, and O_3 (ozone). Ozone is created when solar rays hit a molecule of O_2 and cause it to split apart. If one of these free atoms hits another O_2, ozone (O_3) is formed. Ozone serves as a protective layer, filtering out the harmful UV radiation and thereby protecting life here on Earth from the harmful effects of UV radiation. In recent years, human activities have lead to the destruction of the ozone layer. This environmental problem is known as ozone depletion.



What is depleting the ozone layer?

Chlorofluorocarbons (CFCs) account for approximately 80% of stratospheric ozone depletion. They belong to a group called industrial halocarbons. These compounds are used in refrigerators, furniture foam, fire extinguishers, etc.

There are a couple of reasons why industrial halocarbons are very effective at ozone depletion:

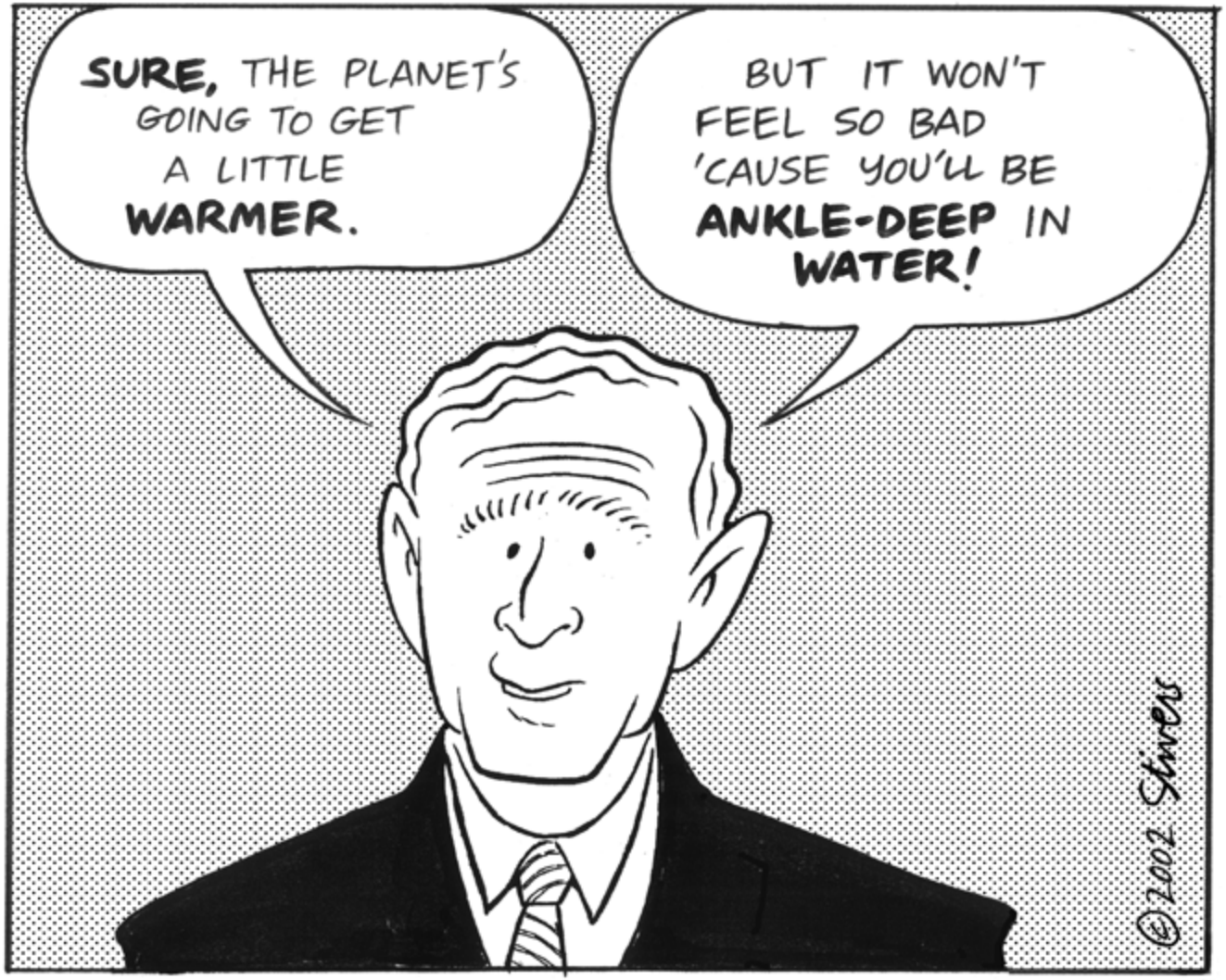


1) **They survive long enough to reach the stratosphere**
2) **They help natural reactions that destroy ozone. Once in the stratosphere, UV-C radiation breaks up compounds releasing chlorine and bromine.**

The gradual disappearance of the ozone layer is also the result of, deforestation, fertilizer use, and fossil fuel combustion.

TOPIC #11

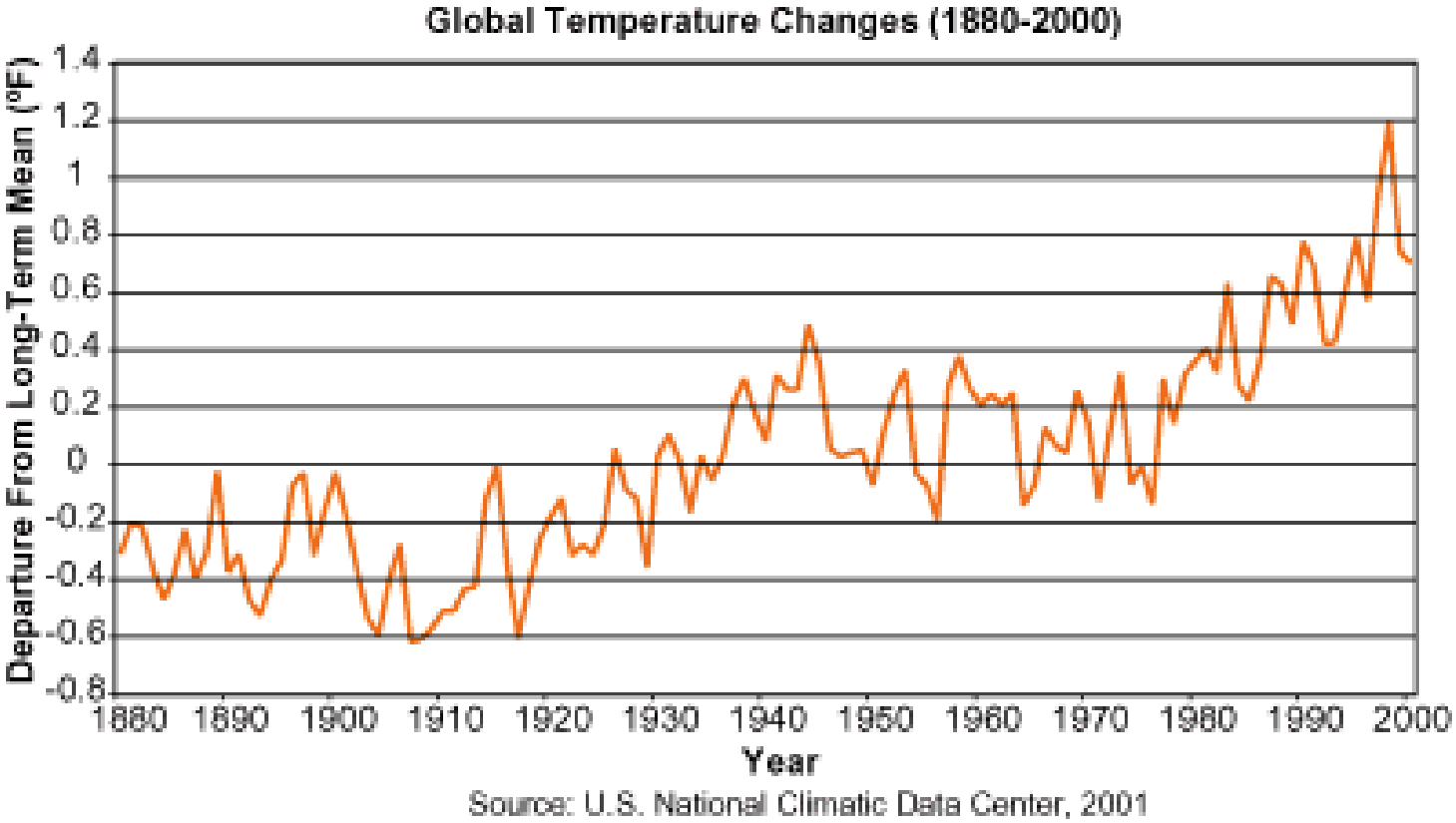
Global Warming and Aquatic Eutrophication


SURE, THE PLANET'S GOING TO GET A LITTLE WARMER.
BUT IT WON'T FEEL SO BAD 'CAUSE YOU'LL BE ANKLE-DEEP IN WATER!
©2002 Stivers

Enhanced Global warming is the term given to describe the recent increase of the earth's temperature as a whole.

The earth's weather and climate is controlled by energy from the sun, which warms the surface of the earth as it, in turn, deflects the energy back into space. Some of this deflected energy is retained within the atmosphere of the earth by **greenhouse gases** which prevent the energy from passing into space, thereby preserving heat. It is this process that results in the earth having a temperature which supports life.

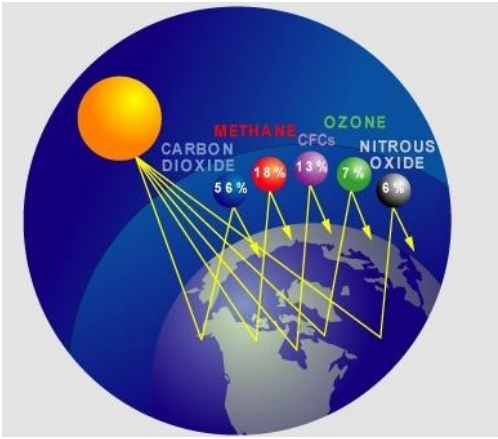
Global warming has occurred since the 1980's, and during this time, the seven warmest years in global meteorological history have been recorded. If the earth's warming trend continues into the next decade the earth may enter a period of climate change unlike any of the past.



If the earth's warming trend continues into the next decade the earth may enter a period of climate change unlike any of the past. Changes in the concentration of heat-trapping gases "greenhouse gases" have played a major role, because these gases trap the heat and does not let it escape, therefore causing global warming or an increase in climate temperatures.

The three primary greenhouse gases which are responsible for this warming include:

1) carbon dioxide 2) methane 3) nitrous oxide



Causes of excess greenhouse gases include:

-Carbon dioxide is released into the atmosphere by the combustion of solid waste, fossil fuels, wood and wood products.

-Methane emissions are a direct result of the production and transportation of coal, natural gas, and oil. The raising of livestock, and the decomposition of organic waste also contribute to the amount of methane emitted into the atmosphere.

-Nitrous oxide emissions are a result of agricultural and industrial activities as well as the burning of solid waste and fossil fuels.

A major issue which is causing concern is that of our own health. Throughout the world, the occurrence of particular diseases and other threats to human health depend largely on the local climate. For example:

1) **extreme temperatures can directly cause the loss of life (although it has the greatest toll on very old and very young people),**

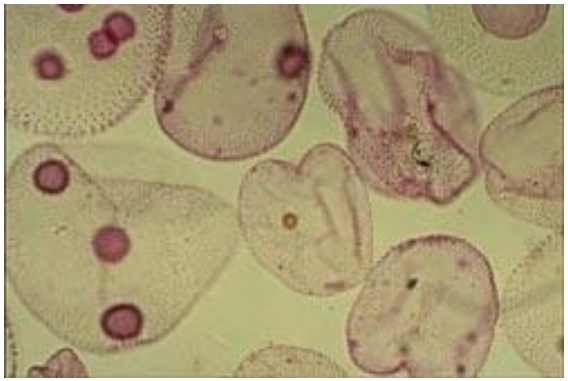
2) **many severe diseases are only found in warm areas,**

3) **warmer temperatures have been shown to increase air and water pollution.**

In July of 1995, a heat wave killed more than 700 people in the Chicago area alone.

Aquatic Eutrophication

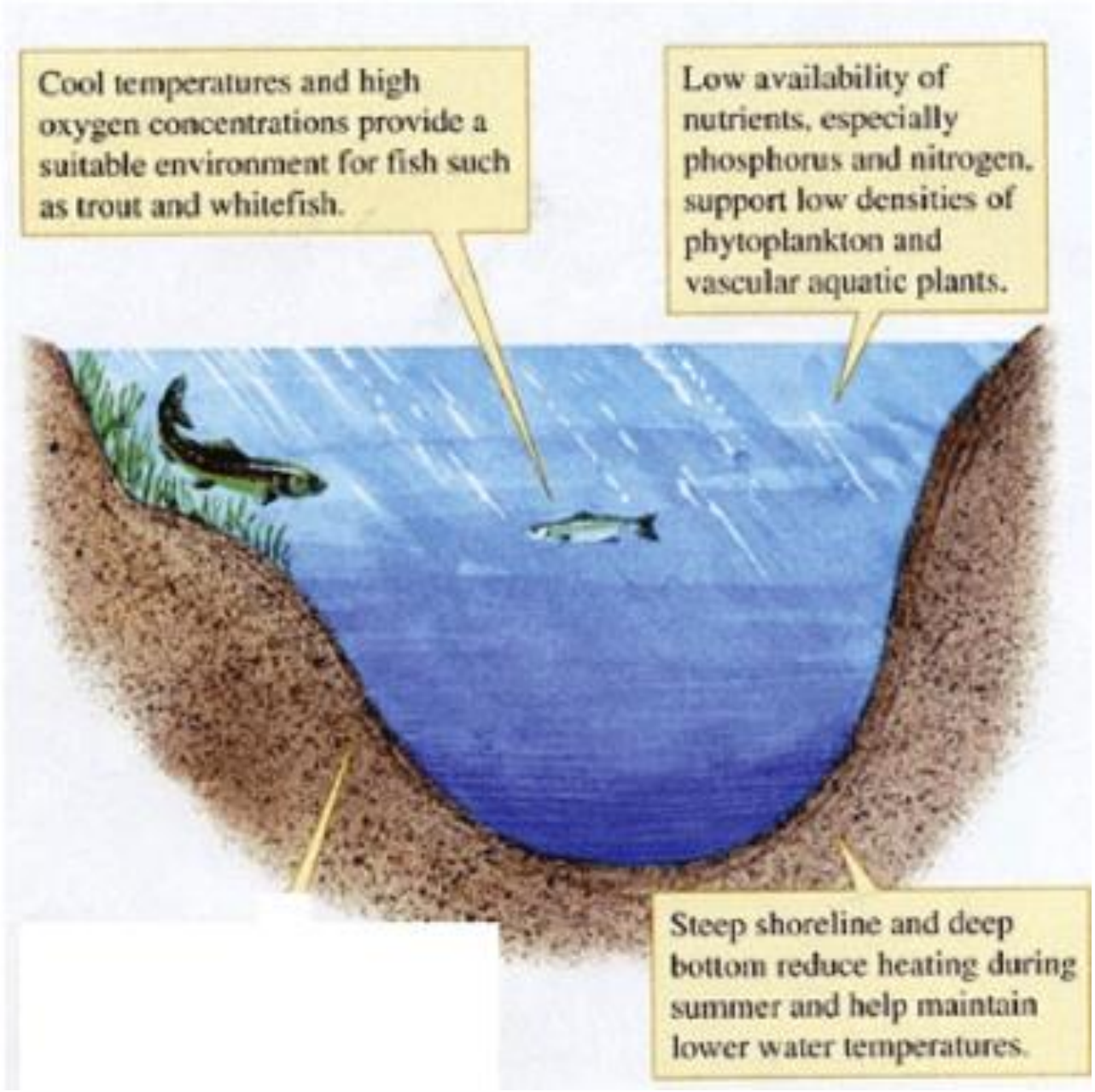
If you look at a drop of pond water under a microscope you will discover an entire world of very tiny organisms. Some are photosynthetic such as the microscopic algae, but many are heterotrophic like the animals that live on land.



One of the factors that determines how many of these microscopic organisms live in the water is the availability of nutrients.

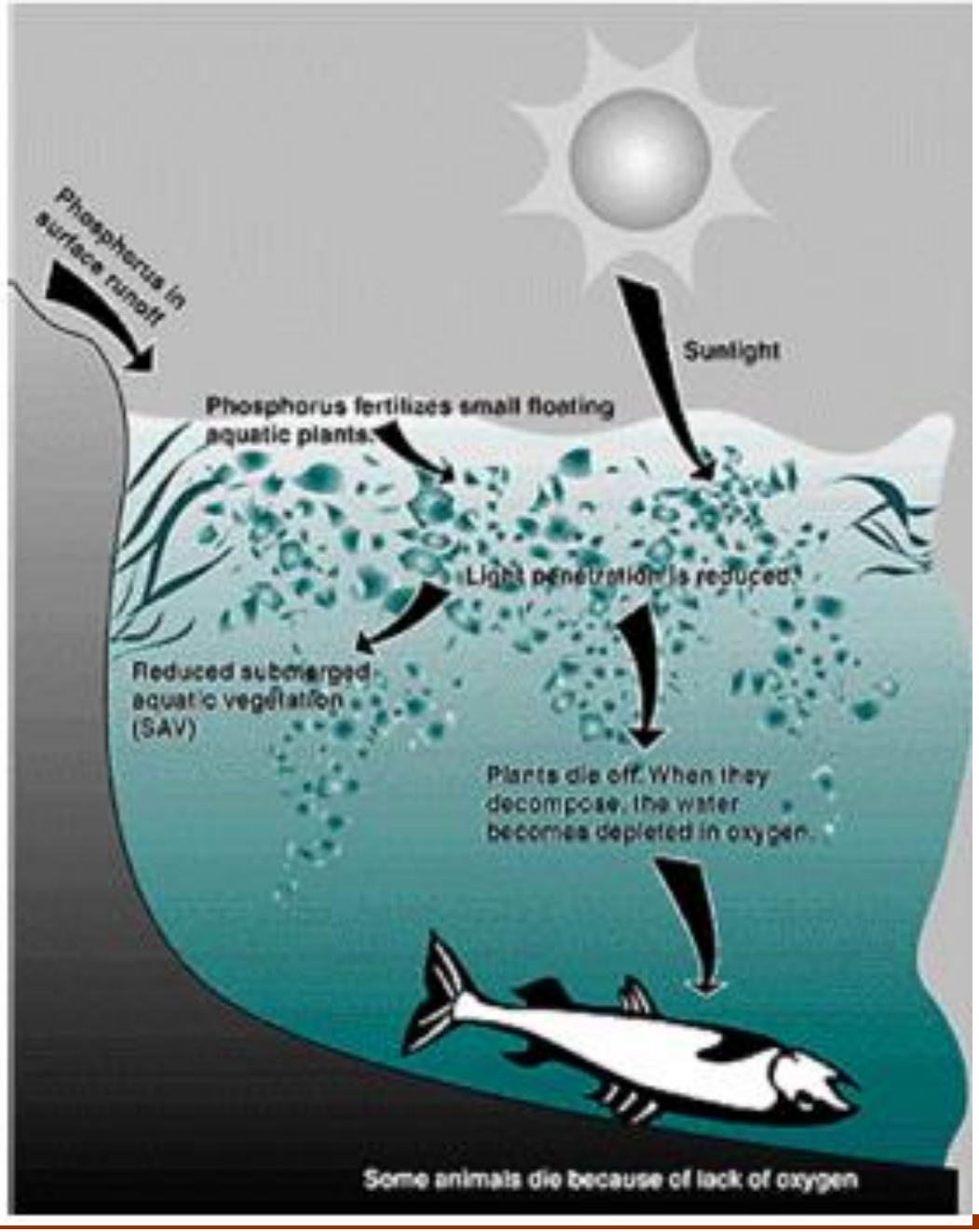
Low levels of nitrates and phosphates reduce the number of micro-organisms. The water appears clear and sunlight can penetrate deeper supporting the production of oxygen by photosynthetic organisms.

Under these conditions, the pond or lake can support large populations of fish and other organisms that are adapted to relatively high levels of oxygen. Such a lake in which oxygen levels are relatively high is known as an **oligotrophic** lake.


Cool temperatures and high oxygen concentrations provide a suitable environment for fish such as trout and whitefish.
Low availability of nutrients, especially phosphorus and nitrogen, support low densities of phytoplankton and vascular aquatic plants.
Steep shoreline and deep bottom reduce heating during summer and help maintain lower water temperatures.

Enrichment, the fertilization of a body of water, by nitrates and phosphates mainly from agricultural lands and from untreated human or animal sewage causes the number of micro-organisms to increase to the point that the water actually appears turbid (cloudy). As a result of the bacteria, less light is able to penetrate the water and oxygen concentrations tend to be reduced. Such a lake is said to be eutrophic

Eutrophic lakes are generally shallower and warmer than oligotrophic lakes and because there is a lower oxygen concentration in the water, they are unable to support the same type of fish populations as found in oligotrophic lakes. Fish that tend to require relatively high levels of dissolved oxygen, such as pike or trout, tend to die out and are replaced by fish species, like catfish or carp, that can survive in lower levels of oxygen.


Phosphorus in surface runoff
Sunlight
Phosphorus fertilizes small floating aquatic plants.
Light penetration is reduced.
Reduced submerged aquatic vegetation (SAV)
Plants die off. When they decompose, the water becomes depleted in oxygen.
Some animals die because of lack of oxygen

Eutrophication and Algal Blooms

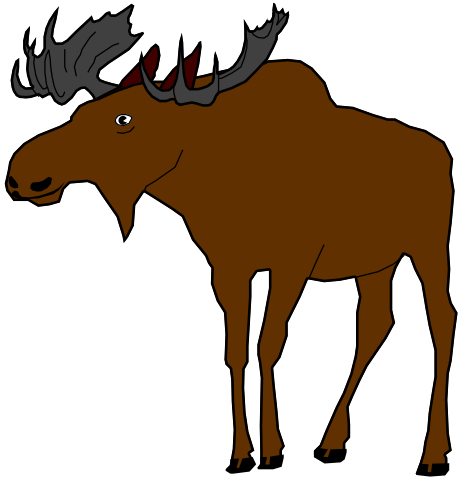
Eutrophication often occurs when rainfall that runs off of highly fertilized farmland, golf courses, playing fields and lawns enters a stream, lake, ocean or another body of water.

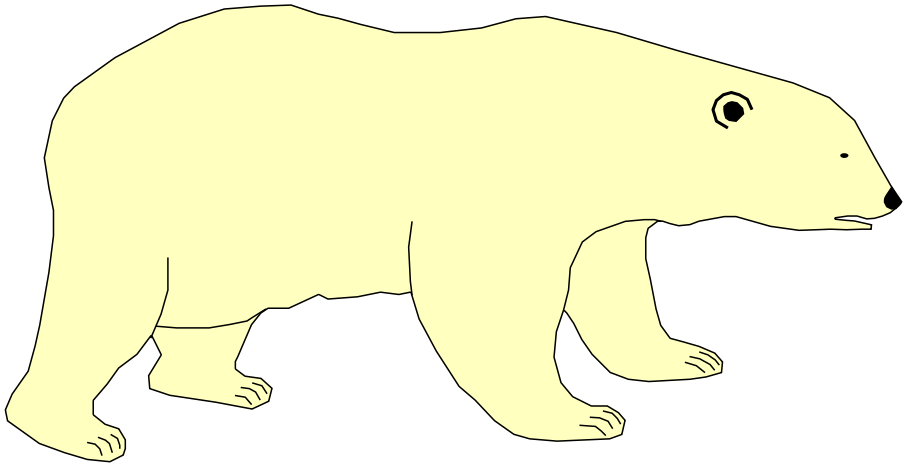
All of these sources of nutrient-rich runoff are great fertilizer for plants, but when these nutrients enter the water, they fuel a population boom among algae and other organisms.

The result is an algal bloom, which looks exactly like it sounds -- streams, lakes and oceans that used to be clear are suddenly green with algae.

Aquatic & Terrestrial Biomes

Science 1206





Biomes

There are *two major types of ecosystems*:

- **Aquatic**
- **Terrestrial**

Each can be subdivided further.

Terrestrial

Are subdivided into:

- Grassland
- Forests (boreal, coniferous, etc.)
- Tundra, etc.

These are divided based upon the predominant vegetation, such as grasses or trees, etc.

These major terrestrial ecosystems are often referred to as **Biomes**.

Biomes

A **Biome** is a large geographical region that has a particular type of **climax community**.

In the case of terrestrial (land) biomes, the climax community is defined by the dominant plant species.

The major land biomes are encountered with changes in latitude as one moves from the equator towards the poles. This concept is referred to as **latitudinal succession**.

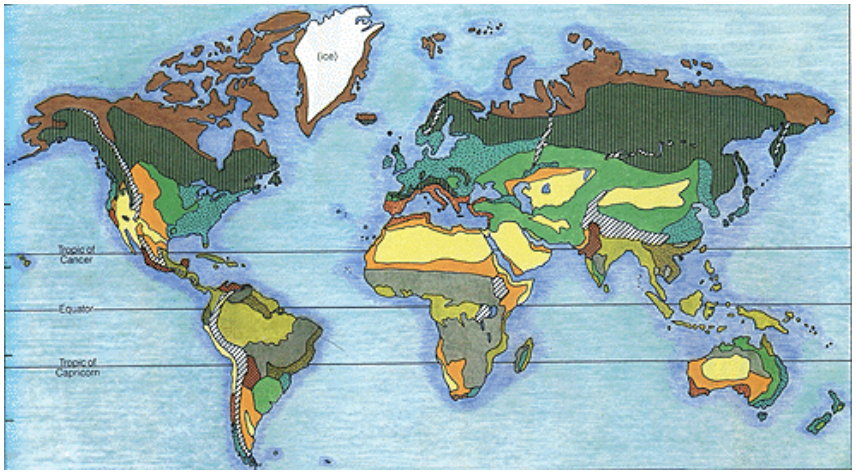
Biomes

The key to the concept is to realize that the different lines of latitude receive different amounts of solar radiation, which affects temperature and precipitation.

As one moves over lines of latitude, changes in climate occur that impact the types of organisms to be found in any given biome.

Terrestrial Biomes found in Canada

- **Tundra**
- **Boreal Forest (Taiga) or the Coniferous Forest**
- **Temperate Deciduous Forest**
- **Grasslands (The Prairies)**




Treeless Arctic Tundra
Boreal Forest
Pacific Coastal Forest
Rocky Mountain Evergreen Forest
Great Plains Grasslands
Eastern Mixed Forest
Cool Desert
Eastern Deciduous Forest
California Chaparral

The Tundra

Location:

South of the ice caps of the Arctic extending across North America

The Tundra Climate

Low average temperature.

Average yearly precipitation of 10-12 cm.
Due to low evaporation, the region is wet with ponds and bogs during the short, warm summer (poor drainage).

Short growing season of about 60 days.

The Tundra Plants

- **Mosses**
- **Lichens (reindeer moss)**
- **Grasses**
- **Sedges**
- **Shrubs.**

The word tundra means “marshy plain”.

The Tundra Animals

- Musk oxen
- Caribou
- Wolves
- Arctic hares
- Arctic fox
- Lemmings
- Snowy owls

- Insects include black flies and mosquitoes.

The Tundra Soil

Permafrost (permanently frozen soil) is present.

This makes the growth of large plants impossible.

It ranges in depth from a few inches to several feet.

Boreal Coniferous Forest (Taiga)

Location:

South of the tundra extending across North America.

Newfoundland is considered part of the boreal forest biome.

Boreal Forest Climate

- Cold winters with the ground covered in snow and warm summers causing the ground to thaw completely.
- Average precipitation of 50-100 cm.
- Growing season is about 120 days.

Boreal Forest Plants

- **Conifers** (pine, fir, spruce)
- **Deciduous conifers** (tamarack)
- Some deciduous trees (birch, maple)
- Blueberry & cranberry shrubs
- Ferns
- Moss, etc.

Boreal Forest Animals

- Moose
- Bears
- Marten (Pine martin)
- Lynx
- Snowshoe hares
- Foxes
- Beavers

- Variety of birds such as warblers (coniferous nesters).
- Wide variety of insects, including pests of trees like the sawflies and Spruce budworms (defoliators).

Boreal Forest Soil

A deep litter layer and slow decomposition.

Acidic and mineral deficient, due to large amounts of water moving through the soil.

Temperate Deciduous Forest

Location:

South of the boreal forest.

Temperate Deciduous Forest Climate

- Cold winters with hot summers.
- Average precipitation of 75 to 150 cm.
- Growing season is about 180 days.

Temperate Deciduous Forest Plants

- Deciduous trees (maple, birch, chestnut, hickory, beech, oak)

- Well developed and diversified shrubs, ferns, moss, etc.

Temperate Deciduous Forest Animals

- White-tailed deer
- Black bear
- Gray fox
- Squirrels
- Chipmunks
- Skunk
- Racoons
- Mice

- Wide variety of birds including wild turkeys and woodpeckers.

- Amphibians, reptiles and insects are also abundant and diverse.

Temperate Deciduous Forest Soils

- Brown forest soils.
- Thin surface litter layer due to rapid decomposition, earthworms being active.
- Upper soil is mildly acidic due to the litter layer. Acidity decreases with depth.
- More fertile than Taiga soils because of high levels of nitrates and other soil nutrients held by clays.

Grasslands

Location:

Interior of North America.

Usually referred to in Canada as “the Prairies”.

Grassland Climate

- Very cold winters with hot summers.
- Average precipitation of 25 to 75 cm.
- Growing season is about 180 days.

Grassland Plants

- Grasses
- Wild flowers
- Trees are limited to low valleys and low mountains.

Grassland Animals

- Snakes
- Badgers, prairie dogs, ground squirrel (burrowers)
- Bison were once numerous.
- Antelope, elk, coyote, wolves.

- Grassland birds are limited due to the vegetation, such as sparrows, rodent-eating hawks.

- Most abundant insect is the grasshopper.

Grassland Soils

- Soil is deep and rich (fertile) causing this biome to become the most productive farmland on Earth.

- Called chernozem soils, or black earths, organic matter accumulates in the upper portion of the soil, making it dark.

- Neutral or slightly alkaline soil.