






Botany is the branch of Biology that deals specifically with the study of plants. Botanists study the structure, growth, reproduction, metabolism, development, diseases, ecology, and evolution of plants. The Cranberry harvest in New Jersey.

Why study plants?

- Plants are fundamental to life on earth.

From single-celled algae to the planet's largest living organism, they all contribute to our world's biodiversity. Plus they have tasty leaves and fruits



Plants are a fundamental part of life on earth.

They generate the oxygen, food, fibers, fuel and medicine that allow higher life forms to exist.





Plants absorb carbon dioxide, and convert it to sugar through the process of photosynthesis.

Understanding plants is crucial to the future of human society

A Better knowledge of plants will allow us to:

- Feed the world
- Understand fundamental life processes
- Utilize medicine and materials
- Understand environmental changes

Plants Produce Medicines

- 25% of the medicines on the UK market are derived directly from plants.
- Drugs made from fungi (fungi are not plants but traditionally fall under the category of Botany) prevent the rejection of transplanted hearts and other organs.
- The active ingredient in aspirin was originally derived from willow bark.
- The rosy periwinkle yields drugs which help treat diabetes.
- The study of plants' internal biochemistry - their production and use of vitamins, for example - can inform us as to the actions of those compounds on the human body.

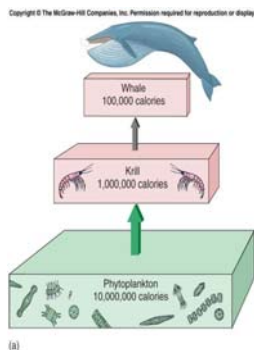


Plants are Producers

- Virtually all of the food we eat comes from plants, either directly from staple foods and other fruit and vegetables, or indirectly through livestock, which rely on plants for fodder.
- In other words, plants are at the base of nearly all food chains, or what ecologists call the first trophic level.

Flow of Energy

- Only 10% of the energy is passed from one trophic level to the next
- Energy is lost mostly as heat
- Energy cannot be recycled



As a Signpost to Environmental Changes

Plants can also help us understand changes in on our environment in many ways.

- Plant responses to ultraviolet radiation can help us monitor problems like the ozone depletion
- Analyzing pollen deposited by plants thousands or millions of years ago can help scientists to reconstruct past climates and predict future ones, an essential part of climate change research.
- Lichens, which are sensitive to atmospheric conditions, have been extensively used as pollution indicators.



- In many different ways, plants can act like the miners canary, acting as an early warning system alerting us to important changes in our environment.
- In addition to these practical and scientific reasons, plants are extremely valuable as recreation for millions of people who enjoy gardening, horticultural and culinary uses of plants every day.

Plants Have Influenced Civilization



Plants Have Influenced Civilization

- It was humanity's switch from nomadic hunting and gathering to a village centered agrarian society over 12,000 years ago that allowed us to develop into the modern urban centered civilization we now live in.
- The roots of farming began in the areas of present day Turkey and the Middle East.

The secure food source of cereals was the basis of all of the early civilizations:

- Maize = Incas, Aztecs and Mayans
- Rice = China, Japan and India
- Wheat = Egypt, Rome, Greece and Mesopotamia



Society and Culture

- It was the development of farming that allowed for the domestication of animals such as goats and sheep.
- As our ancestors learned by trial and error which plants needed to be planted during what time of year, they also began to understand ecology.
- They also began to exert an artificial selection pressure on plants, as they choose the plants with the traits we found desirable (number of kernels, flavor, etc)

Food Calories

- Most of the calories in our diet come from cereals such as wheat.
- Nearly 90% of our daily calories come from foods in the following categories:
 - Grains- wheat, rice, corn, oats
 - Tubers and root crops- potato, yams, sweet potato, cassava
 - Sugar crops- sugarcane, sugar beets
 - Protein seeds- beans, soybeans, peas, lentils, chick peas, peanuts
 - Oil seeds- olives, soybeans, peanuts, coconut
 - Fruits- citrus, mango
 - Vegetables- cabbage, lettuce

Vegetarians Beware

- **Vegetarians must make sure they combine a cereal (carbohydrates) with Legumes (protein) with leafy green vegetables (vitamins and minerals) and small amounts of oils for fats.**

Plants share characteristics with all living organisms.

- All living things must be able to:
 - Use and convert energy
 - Be made of one or more cells
 - Reproduce by passing on genetic information
 - Respond to a stimulus (called tropisms)
 - Maintain homeostasis

- Plants and Algae (a protist) are Autotrophs – meaning self feeding – so they are able to produce their own sugars using photosynthesis to fuel cellular respiration.
- Fungi and Animals are heterotrophs and they must obtain sugars from their environment to conduct cellular respiration.
- The major difference between a plant and an animal is the presence of two substances: chlorophyll and cellulose.

Plant Nutrition

Although plants are able to produce their own food they still need materials from the environment to survive

There are sixteen elements are absolutely necessary for normal plant growth.

Many of these elements are the same as those required by humans.

In addition to carbon, hydrogen, and oxygen, which the plant gets from the air and water, another thirteen elements are obtained from the soil.

These are usually divided into three classes:

- primary nutrients
- secondary nutrients
- micronutrients.

We apply fertilizers to provide plants with some of these essential nutrients for optimal growth.

Non-mineral Nutrients

Carbon, Hydrogen, Oxygen

- Carbon
- Primarily found in CO₂ which is an atmospheric gas
- Carbon is the major structural element of organic compounds.

Non-mineral Nutrients

Carbon, Hydrogen, Oxygen

- Hydrogen
- Primarily found in H₂O
- Used to build organic molecules

Non-mineral Nutrients

Carbon, Hydrogen, Oxygen

- Oxygen
- Plants get their Oxygen from CO₂ and H₂O
- Used to build organic molecules and perform cellular respiration

Non-mineral Nutrients

Carbon, Hydrogen, Oxygen

- Carbohydrates (sugars, starches, cellulose, etc) for the basic building blocks of cells and are made up of these three elements.
- These molecules are converted to more complex molecules (amino acids, proteins, lipids, enzymes, etc) by the addition of other nutrient elements.

Macronutrients

- **Primary nutrients (fertilizer elements) - Nitrogen, Phosphorus, and Potassium**
- **Nitrogen** is a primary constituent of amino acids and proteins. Since enzymes and membranes are protein-based structures, a nitrogen deficiency will curtail plant growth.
- **Phosphorus** is a constituent of ATP and ATP, the energy-containing molecules that are present in respiration and photosynthesis.
- **Potassium** is a salt. It is very mobile in the plant and seems to be involved in transport operations.

Secondary nutrients

- **Calcium, Magnesium, Sulfur**
- Calcium is a constituent of cell walls. Since cell division requires the building of new cell wall material, a deficiency of calcium will show up in the meristems.
- Magnesium is a component of chlorophyll. It is also present in vitamins.
- Sulfur is a component in certain amino acids and vitamins.

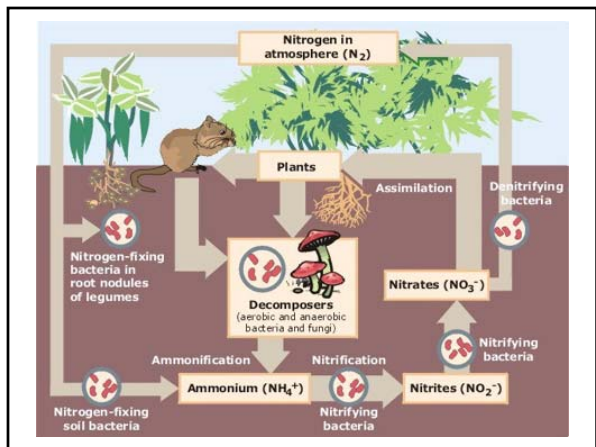
Micronutrients

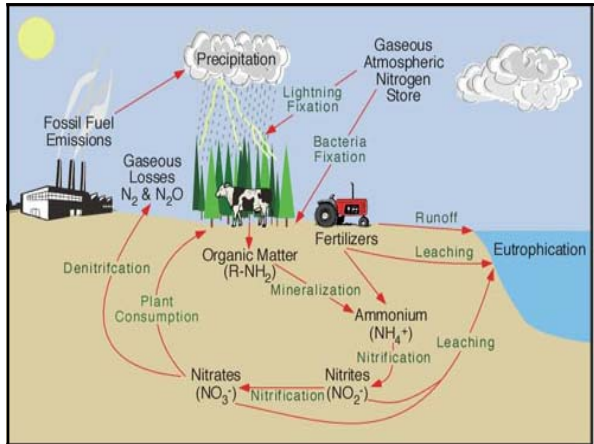
- **Boron, Chlorine, Copper, Iron, Manganese, Molybdenum, and Zinc**
- Boron - flowering, fruiting, and cell division
- Chlorine -
- Copper - Enzymes that are involved in the synthesis of chlorophyll
- Iron - A catalyst in chlorophyll formation
- Manganese - synthesis of chlorophyll
- Molybdenum - protein synthesis
- Zinc - needed for auxin and starch formation



The Nitrogen Cycle

- Most nitrogen occurs as an inert gas in the atmosphere
- Nitrogen fixation by soil bacteria creates useable nitrogen in the form of nitrates (NO_3^-)
- Ammonia (NH_3) is another form of environmental nitrogen (from animal wastes)
- Denitrification returns N_2 to the atmosphere

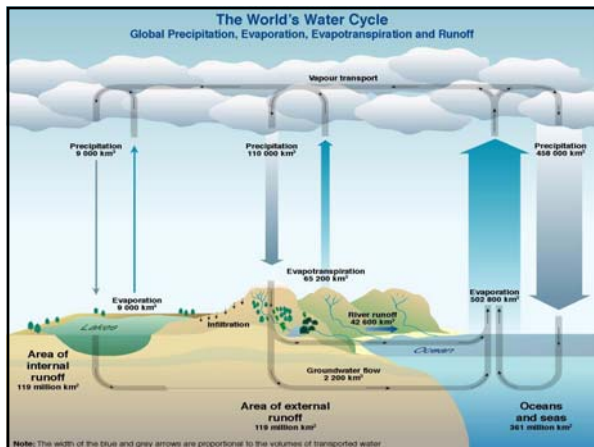


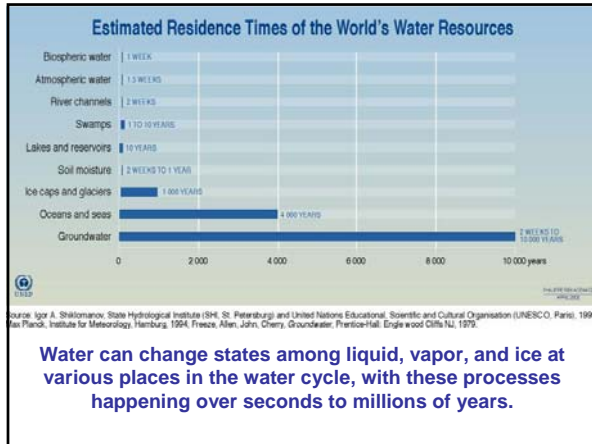


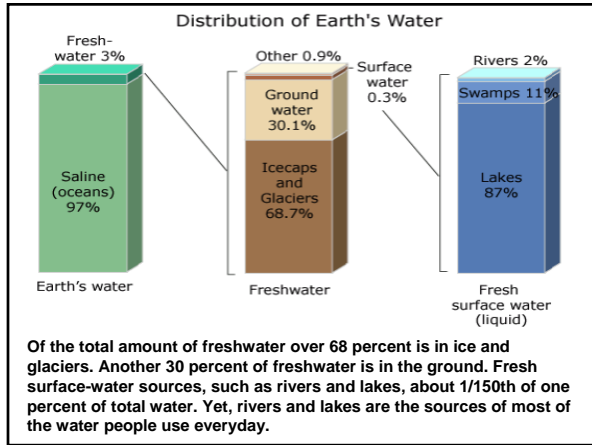
Water Cycle

The Earth's water is always in movement, and the water cycle describes the movement of water on, above, and below the surface of the Earth.

Since the water cycle is truly a "cycle," there is no beginning or end.







Rainforest Water Cycle

- Water is taken up by the roots and rain is intercepted as it falls - much of it at the canopy level.
- The next day, as the rainforest heats up, the water given off by the plants and trees evaporates into the atmosphere - where it forms into clouds to make the next day's rain. This is called **convective rainfall**.

Amazon Basin Cycle

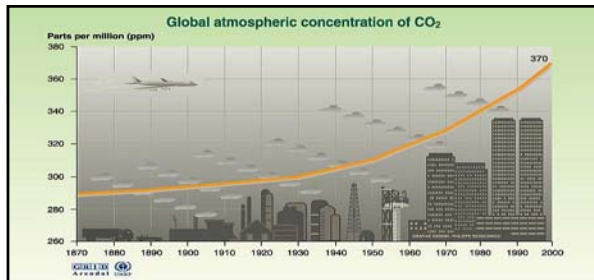
Most people have heard about climate change, they might even express a real concern about it, but how many would actually consider it a threat? Because the changes can be slow and sometimes difficult to identify within the normal variation of climatic conditions, many of us think they will not affect our lives.

However, some parts of the world are already being severely affected by climatic change – both the people and the environment. And unfortunately, it appears that many developing countries bear the brunt of global warming, when the problem is mostly due to the actions of developed countries.

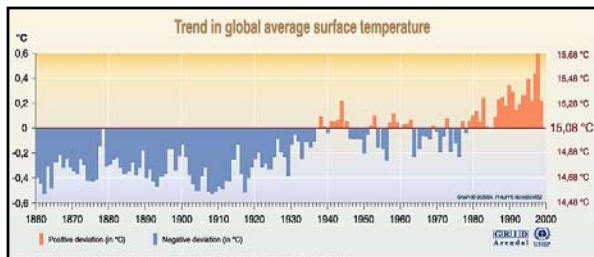
What do most scientists agree upon?

As in any scientific debate, there are uncertainties, but most scientists agree on the following:

- The average temperature of the Earth has been increasing more than natural climatic cycles would explain. This episode of "global warming" is due to human activity.
- It began with the industrial revolution, two centuries ago, and accelerated over the last 50 years.
- Fossil fuel burning is mostly responsible, because it releases gases (particularly carbon dioxide) that trap infrared radiation. This "greenhouse effect" creates a whole system disturbance, that we call climate change.



Atmospheric CO₂ has increased from a pre-industrial concentration of about 280 ppmv to about 367 ppmv at present (ppmv= parts per million by volume). CO₂ concentration data from before 1958 are from ice core measurements taken in Antarctica and from 1958 onwards are from the Mauna Loa measurement site. The smooth curve is based on a hundred year running mean. It is evident that the rapid increase in CO₂ concentrations has been occurring since the onset of industrialization. The increase has closely followed the increase in CO₂ emissions from fossil fuels.



The figure shows the combined land-surface air and sea surface temperatures (degrees Centigrade) 1861 to 1998, relative to the average temperature between 1961 and 1990

Recent years have been among the warmest since 1860 - the period for which instrumental records are available.

It should also be noted that the warming has not been globally uniform. Some areas such as the North Atlantic Ocean have cooled in the recent decades.



Dengue (DF) and dengue hemorrhagic fever (DHF) are caused by one of four closely related, but antigenically distinct, virus serotypes. Infection with one of these serotypes provides immunity to only that serotype for life, so persons living in a dengue-endemic area can have more than one dengue infection during their lifetime. DF and DHF are primarily diseases of tropical and sub tropical areas, and the four different dengue serotypes are maintained in a cycle that involves humans and the *Aedes* mosquito. Infections produce a spectrum of clinical illness ranging from a nonspecific viral syndrome to severe and fatal hemorrhagic disease.

No dengue vaccine is available.

Prospects for reversing the recent trend of increased epidemic activity and geographic expansion of dengue are not promising.

