Examples:

- Certain species of epiphytic orchids of Western Ghats of India differ from the epiphytic orchids of South America. But they are epiphytes.
- Species of the grass lands of Western Ghats of India differ from the grass species of temperate grass lands of Steppe in North America. But they are all ecologically primary producers and fulfilling similar roles in their respective communities.

6.2 Ecological factors

Many organisms, co-exist in an environment. The environment (surrounding) includes physical, chemical and biological components. When a component surrounding an organism affects the life of an organism, it becomes a factor. All such factors together are called **environmental factors** or **ecological factors**. These factors can be classified into living (**biotic**) and non-living (**abiotic**) which make the environment of an organism. However the ecological factors are meaningfully grouped into four classes, which are as follows:

i. Climatic factors

ii. Edaphic factors

iii. Topographic factors

iv. Biotic factors

We will discuss the above factors in a concise manner.

Flowers of poppy, chicory, dog rose and many other plants, blossom before the break of dawn (4 – 5 am), evening primrose open up with the onset of dusk (5 – 6 pm) due to diurnal rhythm.

6.2.1 Climatic Factors

Climate is one of the important natural factors controlling the plant life. The climatic factors includes light, temperature, water, wind and fire.

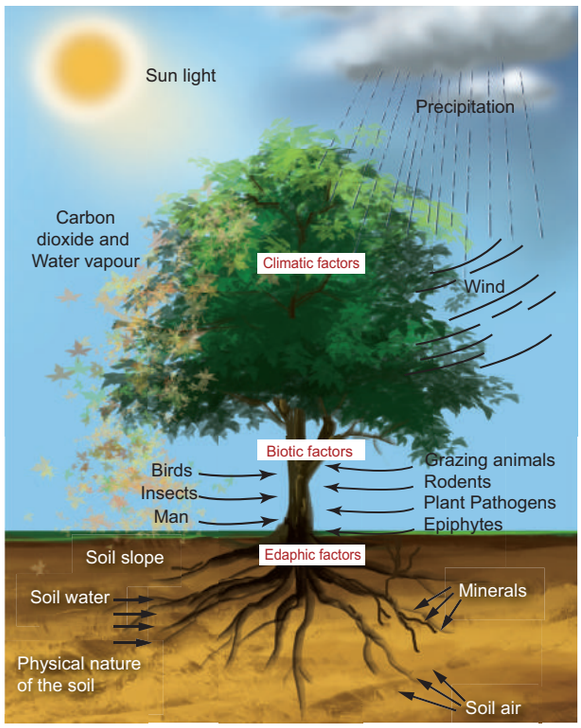

Figure 6.1: Environmental factors affecting a plant

a. Light

Light is a well known factor needed for the basic physiological processes of plants, such as photosynthesis, transpiration, seed germination and flowering. The portion of the sunlight which can be resolved by the human eye is called **visible light.** The visible part of light is made-up of wavelength from about 400 nm (**violet**) to 700 nm (**red**). The rate of photosynthesis is maximum at **blue** (400 – 500 nm) and **red** (600 – 700 nm). The **green** (500 – 600 nm) wave length of spectrum is less strongly absorbed by plants.

Effects of light on plants

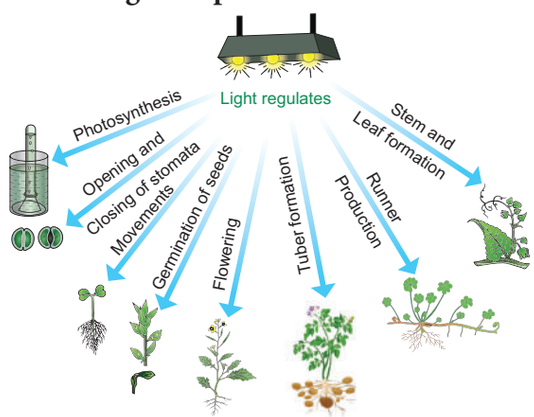

Figure 6.2: Various effects of light upon a green plant

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Based on the tolerance to intensities of light, the plants are divided into two types. They are

1. **Heliophytes** - Light loving plants. Example: Angiosperms.
2. **Sciophytes** - Shade loving plants. Example: Bryophytes and Pteridophytes.

In deep sea (>500m), the environment is dark and its inhabitants are not aware of the existence of celestial source of energy called Sun. What, then is their source of energy?

Palaeoclimatology–Helps to reconstruct past climates of our planet and flora, fauna and ecosystem in which they lived. Example: Air bubbles trapped in ice for tens of thousands of years with fossilized pollen, coral, plant and animal debris.

b. Temperature

Temperature is one of the important factors which affect almost all the metabolic activities of an organism. Every physiological process in an organism requires an optimum temperature at which it shows the maximum metabolic rate. Three limits of temperature can be recognized for any organism. They are

1. **Minimum temperature** - Physiological activities are lowest.
2. **Optimum temperature** - Physiological activities are maximum.
3. **Maximum temperature** - Physiological activities will stop.

Based on the temperature prevailing in an area, **Raunkiaer** classified the world's vegetation into the following four types. They are megatherms, mesotherms, microtherms and hekistotherms. In thermal springs and deep sea hydrothermal vents where average temperature exceed 100°c.

Based on the range of **thermal tolerance**, organisms are divided into two types.

1. **Eurythermal:** Organisms which can tolerate a wide range of temperature fluctuations.

Example: *Zostera* (A marine Angiosperm) and *Artemisia tridentata*.

2. **Stenothermal:** Organisms which can tolerate only small range of temperature variations. Example: Mango and Palm (Terrestrial Angiosperms).

Mango plant donot and cannot grow in temperate countries like Canada and Germany.

Thermal Stratification

It is usually found in aquatic habitat. The change in the temperature profile with increasing depth in a water body is called **thermal stratification**. There are three kinds of thermal stratifications.

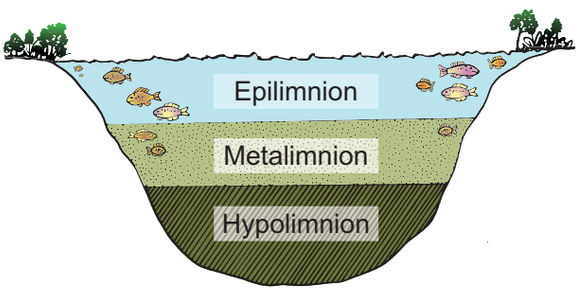

Figure 6.3: Thermal stratification of pond

1. **Epilimniotn** – The upper layer of warmer water.
2. **Metalimnion** – The middle layer with a zone of gradual decrease in temperature.
3. **Hypolimnion** - The bottom layer of colder water.

Temperature based zonation

Variations in **latitude** and **altitude** do affect the temperature and the vegetation on the earth surface. The latitudinal and altitudinal zonation of vegetation is illustrated below:

Latitude: Latitude is an angle which ranges from 0^0 at the equator to 90^0 at the poles.

Altitude: How high a place is located above the sea level is called the altitude of the place.

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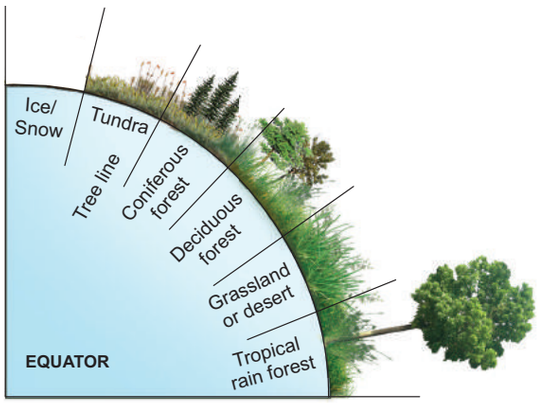

Figure 6.4: Latitudinal zonation of vegetation type

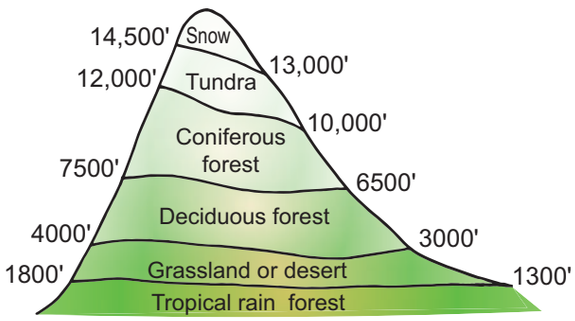

Figure 6.5: Altitudinal zonation of vegetation

Timber line / Tree line : It is an imaginary line in a mountain or higher areas of land that marks the level above which trees do not grow. The altitudinal limit of normal tree growth is about **3000** to **4000m.**

Effects of temperature

The following physiological processes are influenced by temperature:

- Temperature affects the enzymatic action of all the bio-chemical reactions in a plant body.
- It influences CO_2 and O_2 solubility in the biological systems. Increases respiration and stimulates growth of seedlings.
- Low temperature with high humidity can spread diseases to plants.
- The varying temperature with moisture determines the distribution of the vegetation types.

c. Water

Water is one of the most important climatic factors. It affects the vital processes of all living organisms. It is believed that even life had originated only in water during the evolution of Earth. Water covers more than 70% of the earth's surface. In nature, water is available to plants in three ways. They are **atmospheric moisture**, **precipitation** and **soil water**.

DO YOU KNOW?

Evergreen forests – Found where heavy rainfall occurs throughout the year.

Sclerophyllous forests – Found where heavy rainfall occurs during winter and low rainfall during summer.

The productivity and distribution of plants depend upon the availability of water. Further the quality of water is also important especially for the aquatic organisms. The total amount of water salinity in different water bodies are :i).5% in inland water (Fresh water) ii).30 – 35% in sea water and iii). More than 100% in hypersaline water (**Lagoons**)

Based on the range of tolerance of salinity, organisms are divided into two types.

1. Euryhaline: Organisms which can live in water with wide range of salinity. Examples: Marine algae and marina angiosperms

2. Stenohaline: Organisms which can withstand only small range of salinity. Example: Plants of estuaries.

Terminology		Environmental factor
Stenothermal	Eurythermal	Temperature
Stenohaline	Euryhaline	Salinity
Stenoecious	Euryoecious	Habitat selection (niche)
Stenohydric	Euryhydric	Water
Stenophagic	Euryphagic	Food
Stenobathic	Eurybathic	Depth of water / habitat

Table 6.2: Tolerance of Environmental factor

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Examples of tolerance to toxicity

i. Soyabean and tomato manage to tolerate presence of cadmium poisoning by isolating cadmium and storing into few group of cells and prevent cadmium affecting other cells .

ii. Rice and *Eichhornia* (water hyacinth) tolerate cadmium by binding it to their proteins.

These plants otherwise can also be used to remove cadmium from contaminated soil ,this is known as **Phytoremediation.**

d. Wind

Air in motion is called wind. It is also a vital ecological factor. The atmospheric air contains a number of gases, particles and other constituents. The composition of gases in atmosphere is as follows: Nitrogen -78% , Oxygen -21%, Carbon-di-oxide -0.03%, Argon and other gases - 0.93%. The other components of wind are water vapour, gaseous pollutants, dust, smoke particles, microorganisms, pollen grains, spores, etc. **Anemometer** is the instrument used to measure the speed of wind.

Green House Effect
Albedo Effect

Gases let out to atmosphere causes climatic change. Emission of dust and aerosols (small solids or liquid particles in suspension in the atmosphere) from industries, automobiles, forest fire, So_2 and DMS (dimethyl sulphur) play an important role in disturbing the temperature level of any region. Aerosols with small particles is reflecting the solar radiation entering the atmosphere. This is known as **Albedo effect**. So it reduces the temperature (cooling) limits, photosynthesis and respiration. The sulphur compounds are responsible for **acid rain** due to acidification of rain water and destroy the ozone.

Effects of wind

- Wind is an important factor for the formation of rain
- Causes wave formation in lakes and ocean, which promotes aeration of water
- Strong wind causes soil erosion and reduces soil fertility
- Increases the rate of transpiration
- Helps in pollination in anemophilous plants
- It also helps in dispersal of many fruits, seeds, spores, etc.
- Strong wind may cause up-rooting of big trees
- Unidirectional wind stimulates the development of **flag forms** in trees.

Figure 6.6: Flag form in trees

e. Fire

Fire is an exothermic factor caused due to the chemical process of combustion, releasing heat and light. It is mostly man-made and sometimes develops naturally due to the friction between the tree surfaces. Fire is generally divided into

1. **Ground fire** – Which is flameless and subterranean.
2. **Surface fire** – Which consumes the herbs and shrubs.
3. **Crown fire** – Which burns the forest canopy.

Effects of fire

- Fire has a direct lethal effect on plants
- Burning scars are the suitable places for the entry of parasitic fungi and insects
- It brings out the alteration of light, rainfall, nutrient cycle, fertility of soil, pH, soil flora and fauna
- Some fungi which grow in soil of burnt areas called pyrophilous.
  Example: *Pyronema confluens*.

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