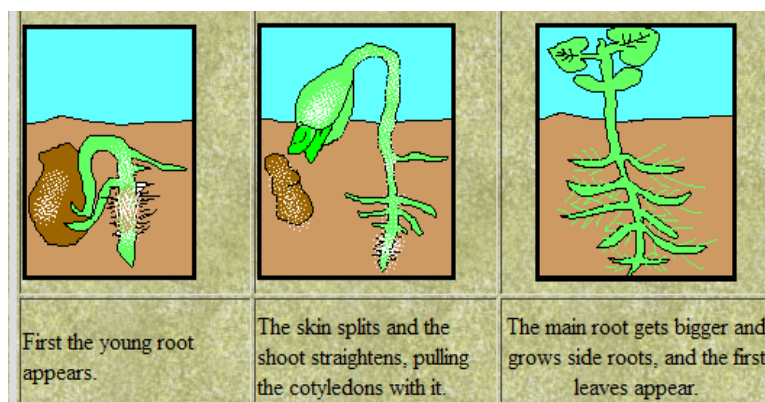


## How Plants Grow



Every root grows a mass of tiny hairs near its tip to absorb water from the soil.

Root hairs are cells. They take water to the main root. Then the main root brings the water to the main plant. The roots also help hold the plant in the ground. The inside of a root has four different parts. The epidermis is the outside part. It is like our skin. It protects the inside parts of the root. Plants take in water from the soil through their roots. The water passes through the vascular rays until it reaches the center of the root, the stele. This is where the veins are located. The veins are called xylem. They carry the water and food through the plant. Between the epidermis and the stele is the fleshy cortex.



## Germination

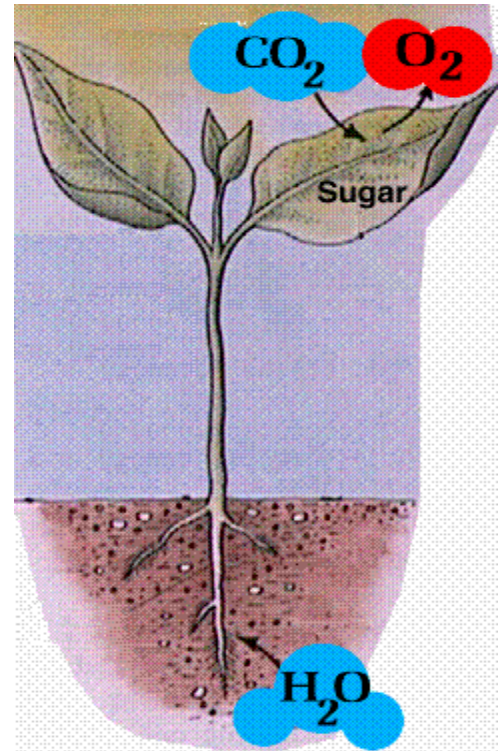
Germination is the resumption of growth of the embryo plant inside the seed. Seeds need water and oxygen to germinate, so are best started in a light, loose soil that will not compact, get soggy, or crust over. Free flow of water and air are necessary. The cotyledons store food for the baby plant inside the seed. When the seed starts to germinate, the first thing to come out is the main root. The skin starts to split and the tiny shoot straightens, carrying the cotyledon[s] with it. The main root gets bigger. Side roots appear and so do leaves. To grow, the seed's growing conditions usually have to be damp, warm, and dark, like springtime soil. A dry seed will stay dormant unless it soaks in some water. Then it will start to germinate.

### Requirements for germination:

1. Proper temperature
2. The presence of adequate water
3. Oxygen
4. A preceding period of dormancy (often).
5. Correct photoperiod (often).

### Photosynthesis

Photosynthesis is the process of converting light energy to chemical energy and storing it in the bonds of sugar. This process occurs in plants and some algae (Kingdom Protista). Plants need only light energy,  $\text{CO}_2$ , and  $\text{H}_2\text{O}$  to make sugar. The process of photosynthesis takes place in the chloroplasts, specifically using chlorophyll, the green pigment involved in photosynthesis.



Photosynthesis takes place primarily in plant leaves, and little to none occurs in stems, etc. The parts of a typical leaf include the upper and lower epidermis, the mesophyll, the vascular bundle(s) (veins), and the stomates. The upper and lower epidermal cells do not have chloroplasts, thus photosynthesis does not occur there. They serve primarily as protection for the rest of the leaf. The stomates are holes which occur primarily in the lower epidermis and are for air exchange: they let  $\text{CO}_2$  in and  $\text{O}_2$  out. The vascular bundles or veins in a leaf are part of the plant's transportation system, moving water and nutrients around the plant as needed. The mesophyll cells have chloroplasts and this is where photosynthesis occurs.

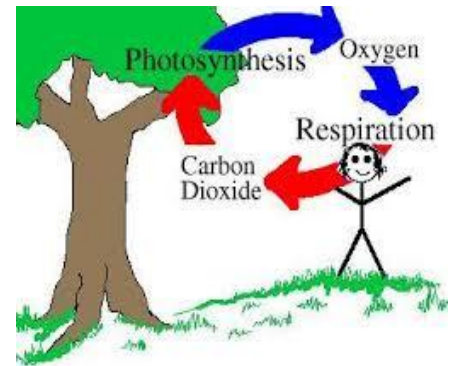
### Chlorophyll

Chlorophyll is the molecule that absorbs sunlight and uses its energy to synthesise carbohydrates from  $\text{CO}_2$  and water. This process is known as photosynthesis and is the basis for sustaining the

life processes of all plants. Since animals and humans obtain their food supply by eating plants, photosynthesis can be said to be the source of our life also. Chlorophyll looks green because it absorbs red and blue light, making these colors unavailable to be seen by our eyes. It is the green light which is NOT absorbed that finally reaches our eyes, making chlorophyll appear green. However, it is the energy from the red and blue light that are absorbed that is, thereby, able to be used to do photosynthesis. The green light we can see is not/cannot be absorbed by the plant, and thus cannot be used to do photosynthesis.

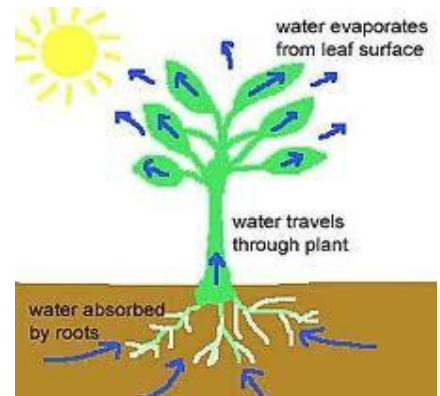
## Respiration

In *respiration*, plants (and animals) convert the sugars (photosynthates) back into energy for growth and other life processes (metabolic processes). The chemical equation for respiration shows that the photosynthates are combined with oxygen releasing energy, carbon dioxide, and water. A simple chemical equation for respiration is given below. Notice that the equation for respiration is the opposite of that for photosynthesis.



## Transpiration

Water in the roots is pulled through the plant by transpiration (loss of water vapor through the stomata of the leaves). Transpiration uses about 90% of the water that enters the plant. The other 10% is an ingredient in photosynthesis and cell growth.



Transpiration serves three essential roles:

- Movement of minerals
- Cooling
- Turgor pressure

