# TREE MOVEMENTS

Trees appear **immobile** because they are **rooted** in one place. However, **time lapse photography reveals that parts of trees move frequently**. Trees move in response to several **environmental stimuli** such as: light, gravity and mechanical disturbances. These movements fall into two groups: **tropisms** and **nastic movements**.

## Tropism

A tropism is a plant movement that is determined by the direction of a biological stimulus. Movement toward an environmental stimulus is called a **positive tropism**, and movement away from a stimulus is called a **negative tropism**.

## Phototropism

The directional movement of a plant in **response to light** is called phototropism. When sunlight fells on only one side of the plant, the **auxin diffuses towards the shady side** of shoot. The concentration of auxin stimulates the cells to grow longer. Therefore, the stem appears to bend towards the source of light. Due to the presence of more auxin, the part of the plant stem in the **dark grows faster**, causing it to bend towards the source of light.

**Sunflowers** are a great example of **positive phototropism**, because not only do their stems curve toward the light but their flowers turn to face the sunlight as well.

## How is Phototropism important to plants?

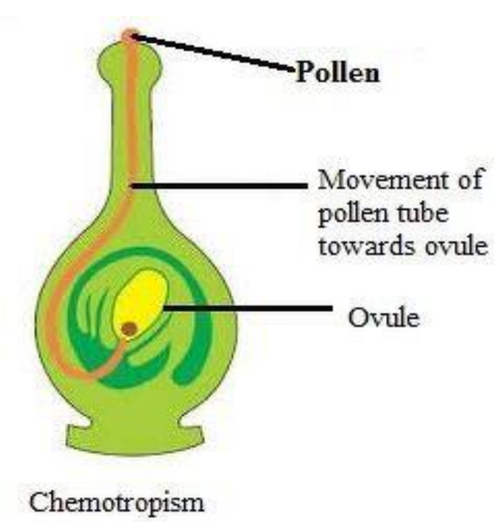
Phototropism is a growth response to a light stimulus. Positive phototropism causes the stems of plants to grow towards a light source causing the leaves of the plant to be pointing towards the light source. This allows the leaves to absorb more light which maximizes photosyntesis.

## Gravitropism

Gravitropism is a plant growth response to **gravity**. A **root** usually grows downward and a **stem** usually grows upward. Like phototropism, gravitropism appears to be **regulated by auxins**. It occurs when a seedling is placed horizontally, auxins accumulate along the lower sides of the root and the stem. This concentration of auxins stimulates cell elongation along the lower side of the stem, and the stem grows upward. A similar concentration of auxins inhibits cell elongation on the lower side of the root, and thus the root grows downward.

## Chemotropism

Chemotropism is a plant growth **response to a chemical**. For example, after a flower is pollinated, a pollen tube grows down through the stigma and style and enters the ovule through the micropyle to produce a seed.




Chemotropism

**Nastic Movements**

Some plants make nastic movements. Nastic movements differ from tropic movements in that the **direction of tropic responses depends on the direction of the stimulus, whereas the direction of nastic movements is independent of the stimulus's position.**

Nastic movements are **non-directional responses** to stimuli (e.g. temperature, humidity, light), and are usually associated with plants. The movement can be due to **changes in turgor or changes in growth**. The rate or frequency of these responses increases as intensity of the stimulus increases.

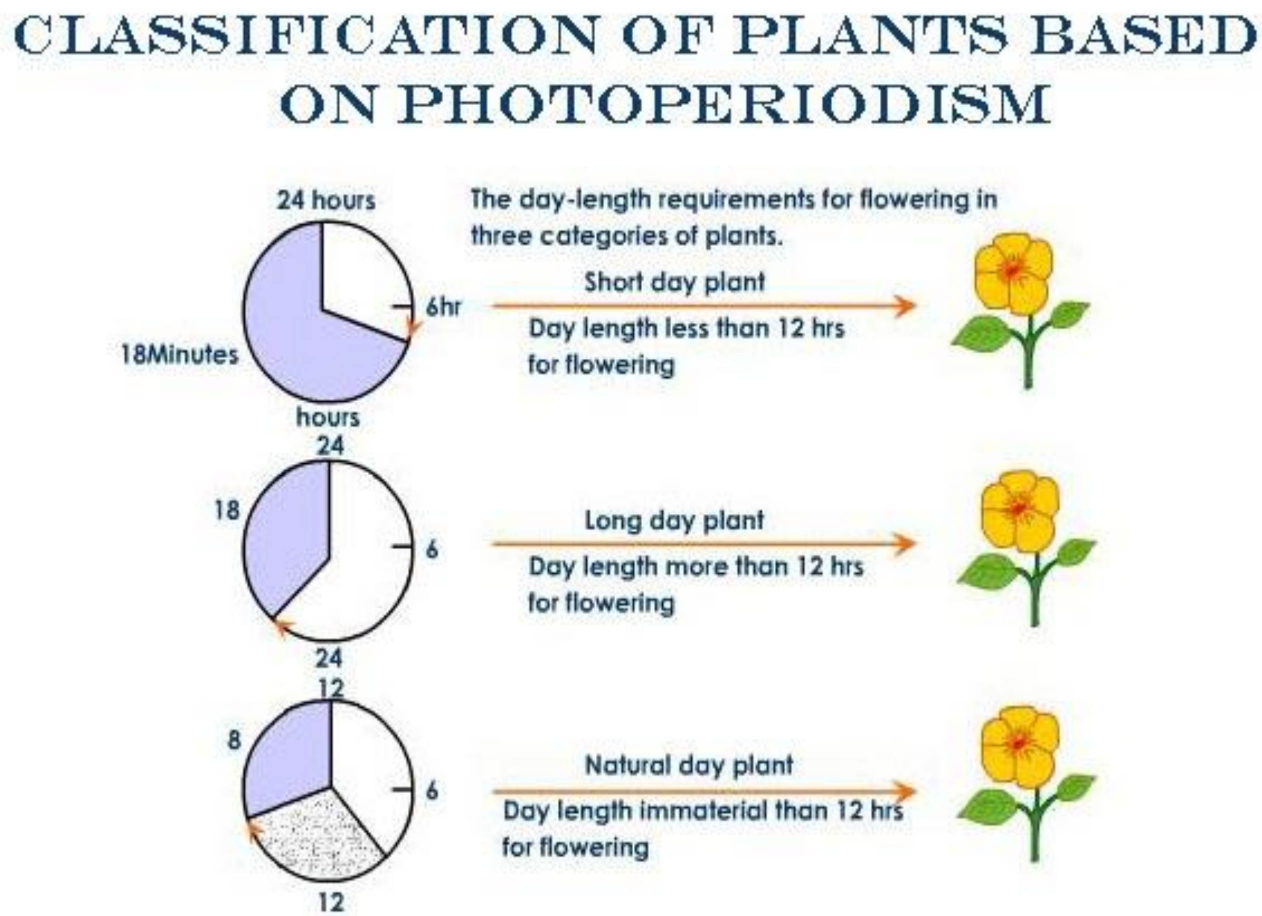
An example of such a response is the **opening and closing of flowers**. This movement is caused by the rapid loss of turgor pressure (water pressure) in certain cells, a process similar to that which occurs in guard cells in order to close stomata.

It is believed that the **folding** of a plant's leaves in response to **touch is to discourage insect feeding.**

**Photoperiodism**

Many angiosperms **flower** at about the **same time every year**. This occurs even though they may have started growing at different times. Their flowering is a response to the **changing length of day and night** as the season progresses. The phenomenon is called photoperiodism. It also helps **promote cross pollination**.

Photoperiodism is the mechanism by which many of our **hardwood trees regulate** their various **life processes**, including **preparing for winter**. Many plants have the ability to adjust their cycles to the changes in the amount of available daylight.




**Nyctinastic Movements**

Nyctinastic movements are **plant movements in response to the daily cycle of light and dark**. Examples of trees that demonstrate these movements include honey locust and silk trees. Both trees move their **leaf blades horizontally during daylight** hours and **vertically at night**. The nyctinastic movements involve the **osmotic** mechanism, but the changes in turgor pressure are more gradual.

**SEASONAL RESPONSES**

In **non-tropical areas**, tree responses are strongly influenced by **seasonal changes**. For example, many trees shed their **leaves** in the **fall**, and most trees **flower** only at certain times of the year. Trees are able to sense seasonal changes. Although temperature changes are involved in some case and to certain degrees, trees mark the seasons primarily by sensing changes in night length.

**SENESCENCE**

**Why do leaves turn color in the autumn?** Senescence is the process that occurs when **chlorophyll production drops off** as **day length decreases** and the tree prepares for **dormancy**. As the **photoperiod decreases**, the plants **ability to synthesize chlorophyll becomes reduced**. The **green part** of the light spectrum is **no longer reflected** and other compounds, chemicals called "**anthocyanins**" (reds), "**xanthophyll's**" (oranges), and "**carotenoids**" (yellows), become the **dominant** pigments in the leaves. The leaves are changed and everything but the cell walls and nutrient depleted protoplasm are gradually drawn into the stems and roots in a very efficient manner. Additionally, senescing cells in **oaks** contain **high quantities of tannins** in the leaves which are responsible for **brown colors.**

The **intensity or brilliance of the color** change is influenced by **weather conditions** during the period of declining chlorophyll production. **Moist soils** following a good growing season contribute to better displays of vibrant colors. A series of **sunny days** and **cool nights** that remain above freezing will also result in a more **colorful display**. On the other hand, the **warm days of autumn weather will generally reduce the color quality**.

**DORMANCY**

Dormancy is a period in a plant's life of **decreased metabolism**. In the **deciduous hardwoods** of the **temperate regions**, this period is usually referred to by the non-technical term "winter". In **preparation for winter** and to prevent or **minimize damage from the cold**, plant cells switch from **production of chlorophyll** for growth, to **production of sugars** and **amino acids**, which act as **antifreeze** for the plant. As already mentioned, chemicals in the **leaves** are **drawn into the stems** and eventually to the **roots** during this process.

The cold temperatures prevent trees and plants from functioning in at least three ways:

1. Water would **freeze** in the plant **tissues**, causing cell **rupture**.
2. **Water** in the **upper soil** layers often **freezes**, making **absorption impossible**.
3. Finally, the low temperatures are far below what is necessary for the proper **function of the enzymes** that control a tree's metabolic processes, such as photosynthesis and respiration.

To avoid these environmental limitations, trees prepare for dormancy in the autumn:

a) **Suberized cells** which are waxy and impermeable, are formed on the tree side to act as a protective seal.
b) Eventually, the **vascular bundles** (the **veins** of the leaf), are the only things that **hold the leaf to the tree**. The vascular bundles **eventually break**, or are **torn by the wind**, and the **leaf falls**, leaving what is called a **bundle scar**, and a **bud** for next year's growth

Most **conifers** that have **different strategies to maintain their green parts** during the winter and **they have needles** with a much different structure than broad leaves. However, in the case of conifers, the needles that have grown **old after two to three years**, **no longer receive as much light** and are **shed** each autumn.