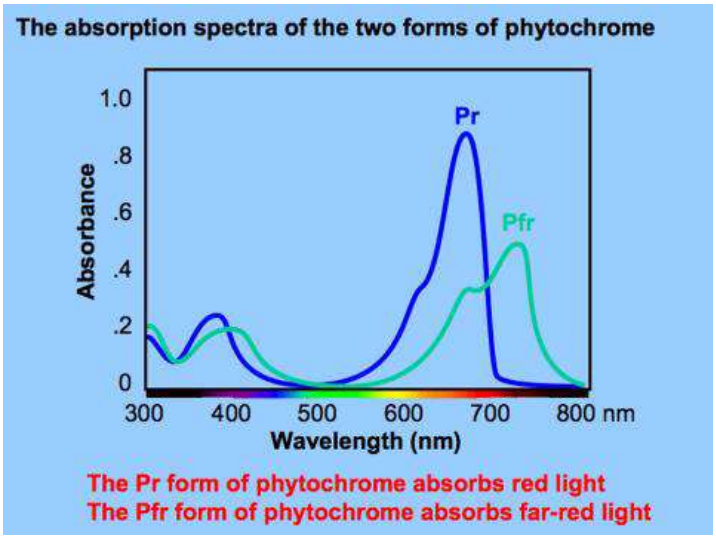
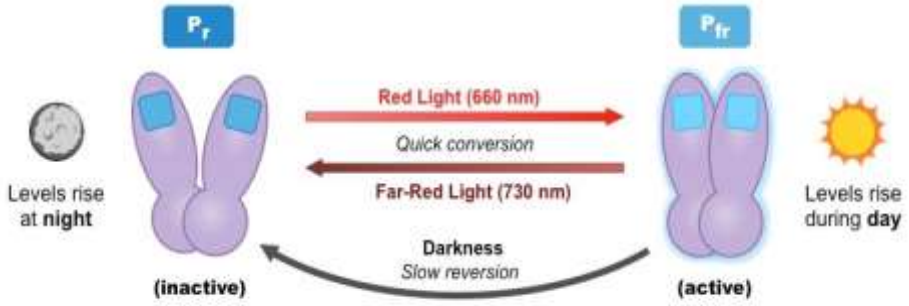
Phytochrome:

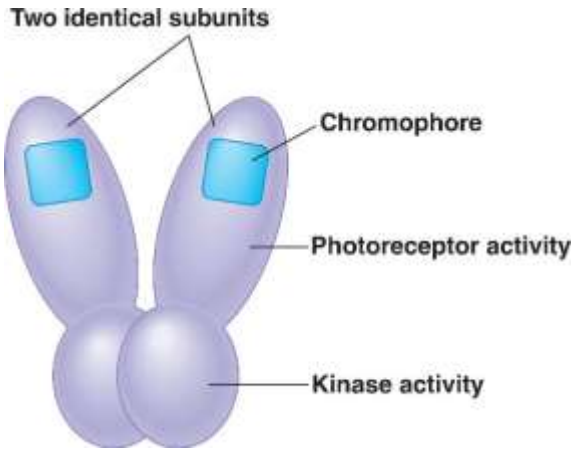
- **Definition**: Phytochrome refers to the photoreceptor pigment, which absorbs red and far-red light wavelengths to induce photomorphogenesis or a light-induced growth and development in various plants.
- **Forms of phytochrome**: Phytochromes exist in two forms:
    1. Phytochrome 660 (Pr) (Inactive form) which has an absorption peak at 660 nm and absorbs red light (part of visible spectrum)
    2. Phytochrome 730 (Pfr) (Active form) which has an absorption peak of 730 nm and absorbs far-red light (outside of the visible spectrum)



- Sunlight contains more light of wavelength 660 nm (red light) than 730 nm. Therefore during daylight Pr absorbs this 660nm red light and is converted to Pfr, which accumulates throughout the day.
- Pfr is unstable and during the hours of darkness slowly reverts back to Pr which then accumulates.



Structure: Phytochrome consists of two elements; a protein part (apoprotein) and a chromophore part.



Mode of action

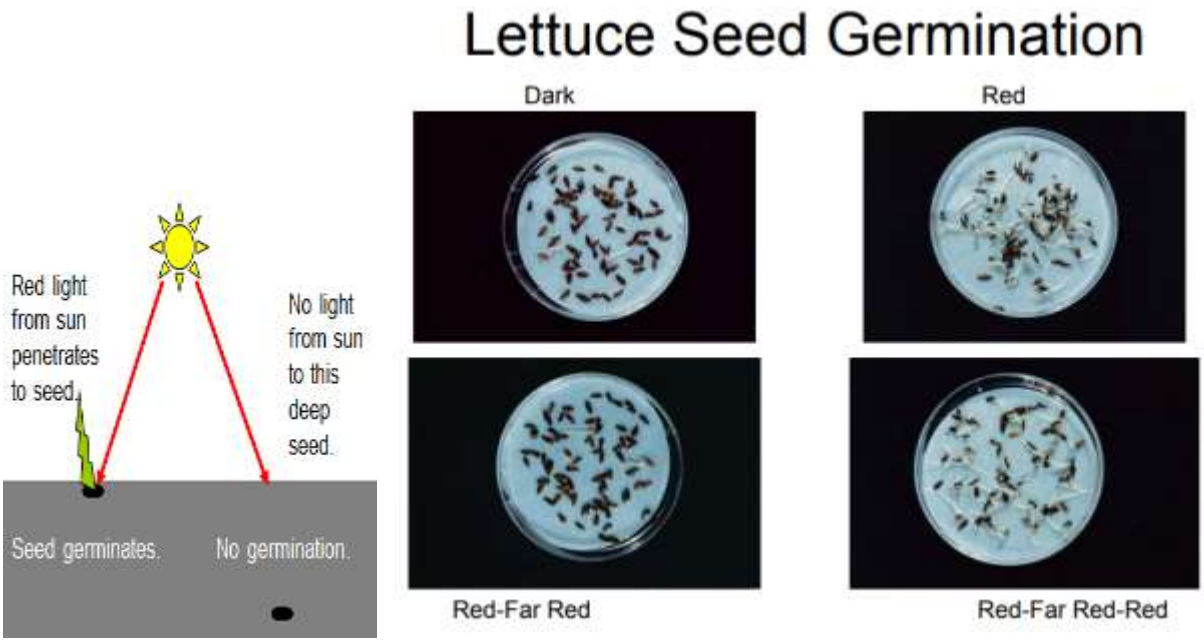
Phytochrome is normally found **in the cytoplasm of the plant cell**, but when it converts to the Pfr state, it moves to the nucleus and modulates the expression of many genes responsible for growth and shape of the plant. All phytochrome-regulated changes in plants begin with absorption of light by the pigment. After light absorption, the molecular properties of phytochrome are altered, probably affecting the interaction of the phytochrome protein with other cellular components that ultimately bring about changes in the growth, development, or position of an organ.

The Phytochrome System and Growth

The two photo-interconvertible forms are collectively known as the phytochrome system. The leaves in full sunlight are exposed to red light and have activated Pfr, which induces growth toward sunlit areas. Because competition for light is so fierce in a dense plant community, those plants that could grow toward light the fastest and most efficiently became the most successful. Pfr–the active form of phytochrome–can either directly activate other molecules in the cytoplasm or be transported to the nucleus, where it initiates or inhibits specific gene expression.

The Phytochrome System in Seeds

The control of seed germination by red and far-red light is one of the earliest documented phytochrome-mediated processes. For example, if lettuce seedlings germinated a centimeter under the soil surface, the seedling would exhaust its food resources and die before reaching the surface. A seed will only germinate if exposed to light at the surface of the soil, causing Pr to be converted to Pfr, signaling the start of germination. In the dark, phytochrome is in the inactive Pr form so the seed will not germinate.



Phytochrome and Flowering:

- Plants can be classed as short-day or long-day plants.
- Short-day plants flower when the days are short. In short-day plants, Pfr inhibits flowering and hence flowering requires low levels of Pfr.
- Long-day plants flower when the days are long. In long-day plants, Pfr activates flowering and hence flowering requires high levels of Pfr.
- At sunset, most of the phytochrome is in the Pfr form. During the night, Pfr gets converted back into Pr or breaks down.