Extension: Day length and the control of flowering

Another effect of light on plant growth and development is its role in determining the switch from vegetative growth to the production of flowers (reproductive growth). You will be well aware that most plants flower at different and particular times of the year. In fact, most species have a precise season when flowers are produced. How is flowering switched on by this environmental condition? The answer is that day length provides important signals and these are mediated by a special pigment (Figure 8.42). *We need to examine this pigment first.*

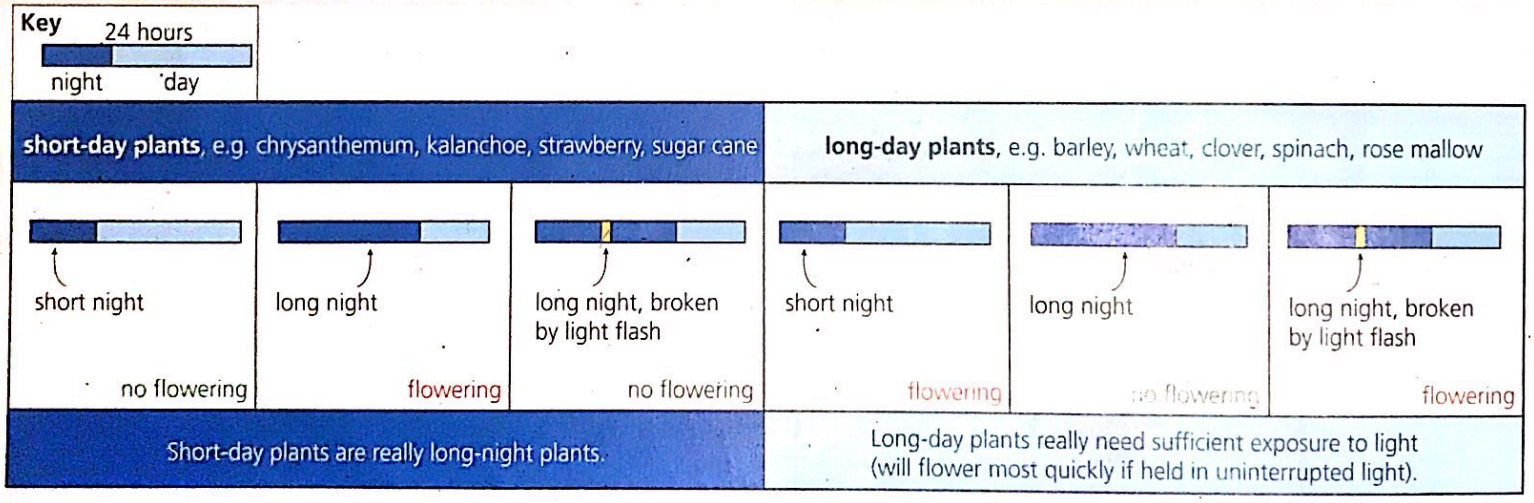

Figure 8.42 Flowering related to day length.

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Extension: Plant development and phytochrome

A blue–green pigment called **phytochrome** is present in green plants in very low concentrations. The amount of phytochrome is not sufficient to mask chlorophyll, and it has been difficult to isolate and purify the substance from plant tissue, although this has been done. Phytochrome is a very large conjugated protein (protein molecule and pigment molecule, combined), and it is a highly reactive molecule. It is not a plant growth substance, but it is a photoreceptor pigment, able to absorb light of particular wavelength, and change its structure as a consequence. It is likely to react with different molecules around it, according to its structure.

We know that phytochrome exists in two inter-convertible forms. One form, referred to as P_R, is a blue pigment that absorbs mainly red light of wavelength 660 nm (this is what 'R' stands for). The other form is P_{FR}, a blue–green pigment that absorbs mainly far-red light of wavelength 730 nm. When P_R is exposed to light (or red light on its own), it is converted to P_{FR}. In the dark (or if exposed to far-red light alone), it is converted back to P_R.

$$P_R \underset{\text{(slow) darkness (or far-red light alone)}}{\overset{\text{(slow)}}{\longleftarrow}} \underset{\text{light (or red light alone)}}{\overset{\text{(fast)}}{\longrightarrow}} P_{FR}$$

The influence of light on plant growth and development is known as **photomorphogenesis.** Phytochrome is the pigment system involved in photomorphogenesis. We know this because the red/far-red **absorption spectrum** of phytochrome corresponds to the **action spectrum** of some specific effects of light on development. (The terms 'absorption spectrum' and 'action spectrum' are often referred to in photosynthesis, concerning the pigment chlorophyll – you may have come across them in that connection. However, they are explained here in Activity 8.19.)

It appears that it is P_{FR} that is the active form of phytochrome in photomorphogenesis, stimulating some effects in plant development and inhibiting others. In particular, there are examples in the phenomenon of the control of the onset of flowering (Figure 8.43) (A* Extension 8.10).

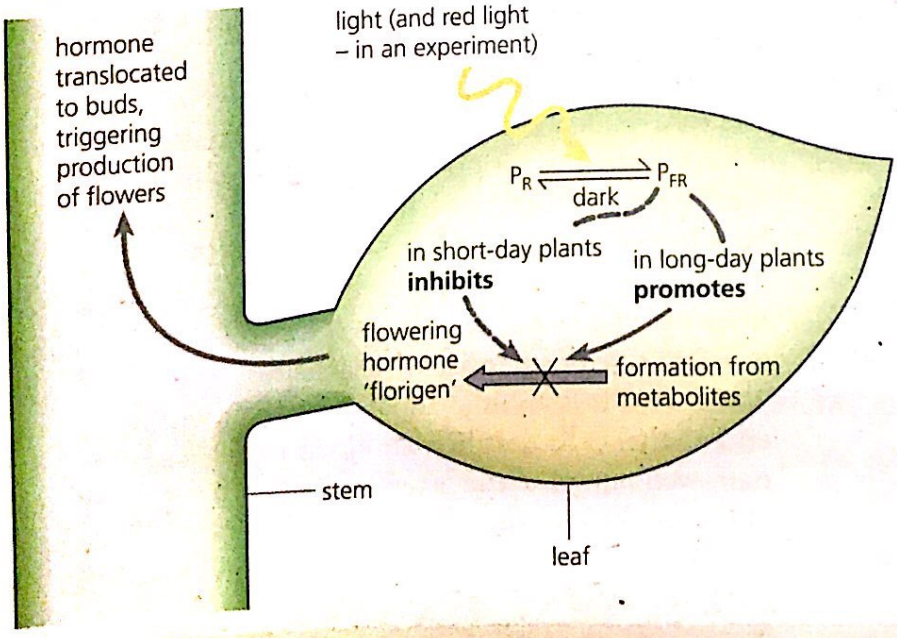

Figure 8.43 Phytochrome and flowering, a suggested hypothesis.

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