Figure 12.1
(A) Schematic diagram of plant chloroplast, showing compartmentation of the organelle. (B) Transmission electron micrographs of plant chloroplast reveal its ultrastructure.

(A) Chloroplast
- Inner envelope
- Outer envelope
- Stroma

(B) Transmission electron micrographs showing chloroplast structure.
The binding of hormone to its receptor triggers activation of the α subunit of the heterotrimeric G protein, which activates the effector enzyme phosphodiesterase PDE. PDE catalyzes the breakdown of cyclic GMP, which inhibits the activity of the cyclic GMP-dependent protein kinase C. The activated protein kinase C then phosphorylates other proteins, leading to a cellular response. In animal cells, the inositol lipid pathway may also be coupled to receptor tyrosine kinases. (From Lodish et al. 1995.)
The Fluence Response of Phototropism

Phototropism involves two putative, opposing blue-light perception and differential cell elongation. The identity of the blue-light photoreceptor involved in phototropism was discussed in Chapter 10. There now is compelling evidence that a 114-kDa blue-light flavoprotein associated with the plasma membrane (NPH1) is the photoreceptor for phototropism (Ohlhauser et al., 1997). This protein becomes phosphorylated in response to blue light. As discussed in this chapter, differential cell elongation in response to unilateral light is thought to be caused by the lateral redistribution of auxin to the shaded side.

If phototropins were a simple photochemical reaction, one would expect the fluence response curve to rise from a threshold level of light to a plateau at which the photoreceptor becomes saturated. However, this is not what occurs. The figure shows a diagram of a typical fluence response curve, which is similar to what has been observed in a wide range of species, including Arabidopsis and maize (Sussman et al., 1994). Starting at the light threshold, there is a bell-shaped curve that has been termed the first positive curvature. The first positive curvature is followed by a neutral zone in which little or no measurable response is observed. Under certain conditions, however, coleoptiles may actually bend away from the light. In this range, a phenomenon referred to as the first negative curvature, both the first positive and the first negative curvatures (neutral zone) are restricted to the coleoptile tip. At higher light fluences, the curve is no longer, and this second bending response is termed the second positive curvature. The second positive curvature differs from the first positive curvature in that the bending occurs at the base rather than at the tip of the coleoptile.
Fig. 1. Physiological characteristics of cryptochrome and phototropin mutants. A. Blue light-dependent inhibition of hypocotyl elongation in wild-type (WT) and cry1, cry2, cry1cry2, cry1cry2 spl1 mutant Arabidopsis seedlings. Seedlings were grown for 3 days in continuous blue light from above (150 μmol m⁻² s⁻¹). B. Hypocotyl phototropism in 1-day-old wild-type and mutant seedlings exposed to 8 h of unilateral blue light (150 μmol m⁻² s⁻¹).
A pterin (fully oxidized)
Figure 1 (A) Inhibition of hypocotyl elongation induced by blue light in an etiolated seedling is rapid. The first 30 min of the inhibition is mediated by the photosynthetic light receptor, and thereafter the cryl receptor is important. This sketch is based on the results of Peña et al. (1992) and Peña and Eing (1995). (B) Blue light inhibits hypocotyl growth more slowly than blue light. (Note the differences in time scales.) The first 30 min of growth is response to red light is mediated by phyA. Thereafter, phyB is the controlling photosensor. This sketch is based on the results of Peña and Spalding (1999).

FIGURE 18.11 The action spectrum for blue light-stimulated stomatal opening (under a red-light background). (After Kar hson 1986.)

FIGURE 18.19 The absorption spectrum of ascorbic acid in ethanol.