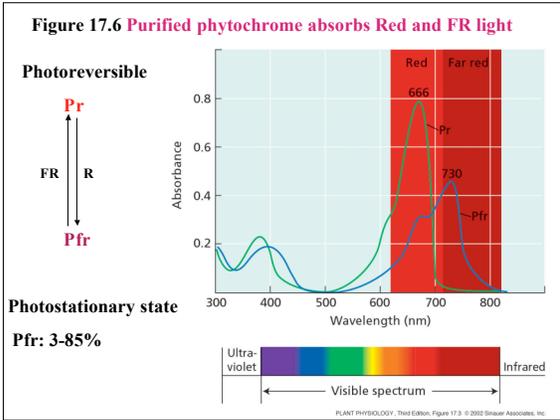
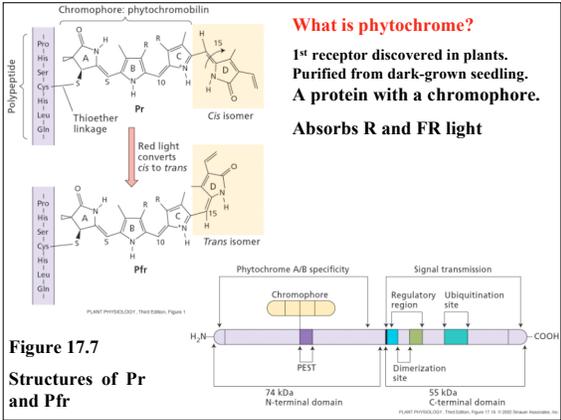
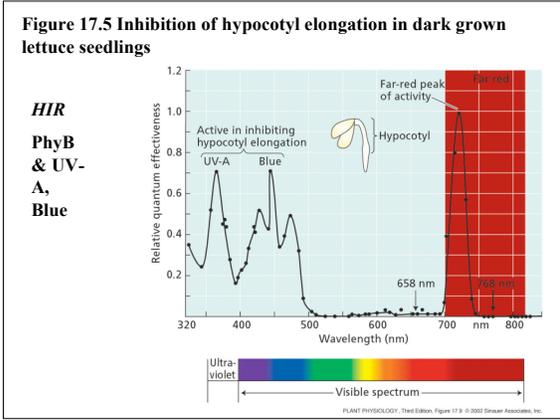
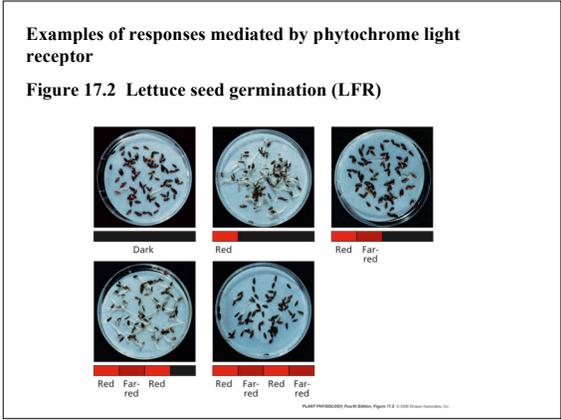
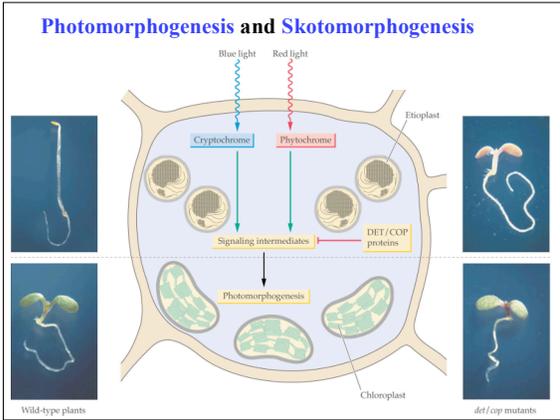
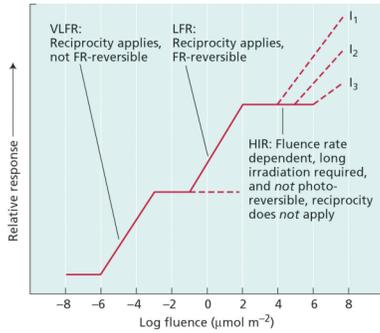


Photomorphogenesis: OUTLINE
Effect of light on Growth and Development
 -Light quality and quantity are the most significant environmental factors affecting plant development.
 -Light induces dramatic changes in morphology and biochemical (protein) composition.
 How does light induce such changes? e.g. increase in rubisco, LHC
A Simple Model of Signal-induced Responses
 1. Signal perception by a receptor
 2. Signal transduction
 a) Communicate signal to other cell parts
 b) Amplify the signal
 c) Network and cross talk
 3. Primary response
 e.g. Increase or decrease in gene expression
 e.g. Change from inactive protein → active protein
 4. Cellular and Physiological responses
Plants have 3 types of Photoreceptors
 1. **Phytochrome** 660 nm
 2. **Blue light receptor** ~400-500 nm
 3. **UV-B Receptors** ~300 nm



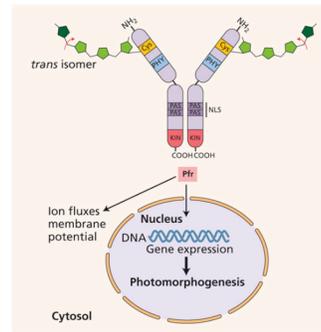
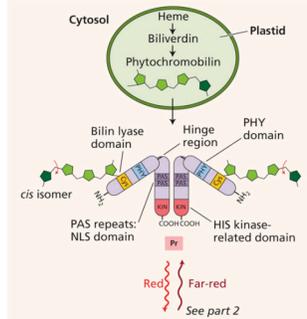
Light Quantity and Plant Development (Figure 17.4)



Light quantity matters

VLFR very low fluence	1-100 nmol/m ²	Induce gene expression LHCB Arabidopsis germination [not photoreversible]
LFR Low fluence	1-1000 umole/m ²	Promote lettuce seed germination [Photoreversible]
HIR High irradiance	>10,000 umole/m ² 10 mmole/m ²	Inhibit stem elongation synthesis of anthocyanin [not photoreversible]

Light induces conformational changes in the phytochrome molecule (Figure 17.8)



Phytochrome Family

Multiple phytochrome encoding genes

I. Light-labile form - PHYA Pfr,

Abundant in dark grown seedling
Unstable in light, degraded

II. Light-stable form - PHYB, stable form in green seedlings

PHYC, hypocotyl elongation

PHYD, petiole elongation

PHYE, seed germination in VLFR and petiole elongation in LFR

Figure 17.13 Difference in phytochrome gene family structure

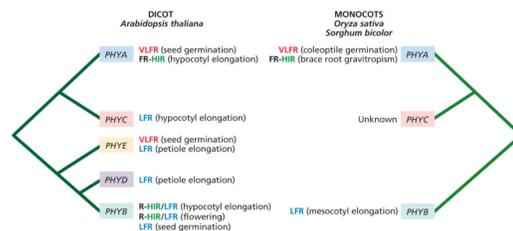
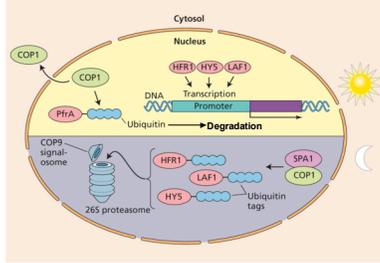


Figure 17.15 COP1 represses expression of light-regulated genes by targeting protein for degradation



COP1 = E3 Ubiquitin Ligase that targets proteins (HYS) for degradation
 HYS is a TF that binds to light-inducible promoters.
 In the dark, COP1 targets HYS for degradation.
 With light, COP1 leaves the nucleus. HYS binds and activates light-regulated genes.

PHYB directly regulates gene expression in nucleus

PIF3 is a master TF = [master switch]

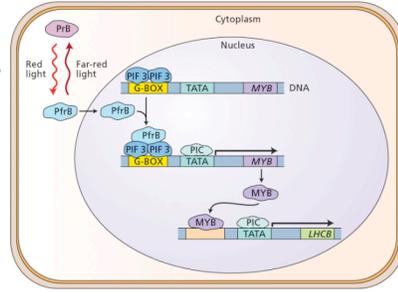
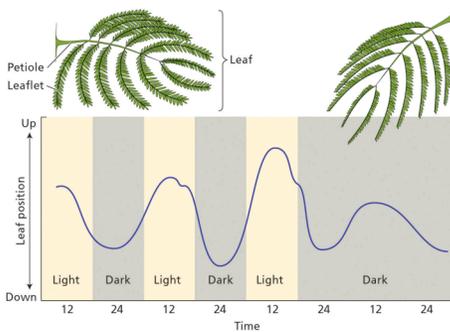


Figure 17.18 Circadian rhythm of *Albizia* leaf movement is controlled by phytochrome.



17.19 Leaf movement results from turgor changes in ventral and dorsal cells. Light alters ion fluxes.

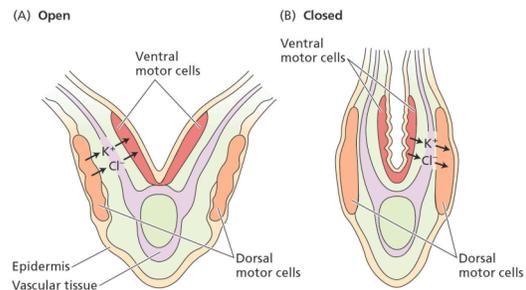
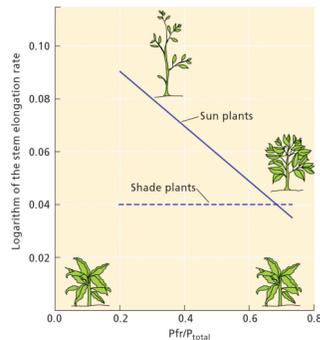


Figure 17.20 Inhibition of stem elongation by light. High IR

PhyB
 Ratio of *Pfr/Pr* is important.



Small seed germination

- high R:FR ration is required
- why large seeds can grow in the dark?
- phytochrome interactions are important

Summary- mode of action

1. Plant growth and developments is regulated by light.
2. Phytochromes are important photoreceptors.
PHYA: Pr → Pfr
PHYB is stable; senses P_{fr}/P_{total}
3. Mode of action
 - a. Fast responses- changes in ion fluxes
no gene expression;
activated by protein modification
 - b. Changes in gene expression
Early response genes: 1-5 min after stimuli
mostly TF

late response genes: seen later 3-10 min

Q1:

How can plants respond to light quality & quantity?

- Plant has several different photoreceptors.
- The specific response of each photoreceptor.

Q2:

How do you know if phytochrome is acting in a light-induced response?

1. The wavelength needed for the response (action spectrum)
2. Photoreversibility (Low fluence response)
3. Response is affected by ratio of Pfr/Pr

Q3:

What is the ecological significance of circadian rhythm?

1. Sleep movements of leaves
2. Shade perception and avoidance
3. Small seed germination

Related links:

Skotomorphogenesis:

<http://plantsinmotion.bio.indiana.edu/plantmotion/earlygrowth/germination/arabidopsis/atgermination.html#http://plantsinmotion.bio.indiana.edu/plantmotion/earlygrowth/germination/arabidopsis/atgermination.html%20>

Photomorphogenesis:

<http://plantsinmotion.bio.indiana.edu/plantmotion/earlygrowth/germination/arabidopsis/atgerminationlight.html>