What is photoperiodism and how is it used in flowering ?

Phytochrome

- Photoperiod – relative lengths of night and day (light and dark)
- Phytochrome molecules are used by plants to detect sunlight and its duration.
- Phytochrome molecules are composed of proteins plus a light-absorbing part called a chromophore.

Phytochrome

- Phytochrome exists in two isometric forms: P_r and P_{fr}.
- P_r is phytochrome that absorbs red light with a wavelength of 660 nanometers.
- P_{fr} is phytochrome that absorbs far red light with a wavelength of 730 nanometers.
- The two forms revert back and forth depending on the type of light available.

Phytochrome

- P_r (Pred) in the presence of red light converts to P_{fr} (Pfar-red).
- P_{fr} (P(far-red) in the presence of far red light converts to P_r (Pred)
- Examples: Lettuce seed germination – lettuce seeds, when exposed to red light, begin to germinate. This is because P_r is coverted to $P_{fr.}$
- Apparently, P_{fr} is needed for seed germination to begin.

Phytochrome

- Example: Shade avoidance response of a tree
- In a shaded area, little red light reaches the forest floor because leaves absorb red light for photosynthesis. P_{fr} reacts to produce P_r.
- More P_r causes a tree to grow taller (stem tip growth) so it can ‘get out of the shade’
- More P_{fr} causes a the tree to grow more lateral branches so it can grow more horizontally and ‘claim more space’.

Use of phytochrome in flowering

- Circadian rhythms = physiological cycles with a frequency of 24 hours.
- P_{fr} appears to reset the circadian-rhythm clock.
- P_r is the form synthesized in plant cells.
- P_r and P_{fr} are in equilibrium during daylight hours.
- P_r accumulates at night. P_{fr} levels drop off and much of it is destroyed at night. Plants are able to respond to varying levels of the two forms of phytochrome.

Use of phytochrome in flowering

- Short-day (long-night) plants flower when night *exceeds a critical dark period.*. A flash of light interrupting the dark period prevents flowering.
- Chrysanthemums, poinsettias, and soybeans are short-day plants and bloom in spring or autumn.

Use of phytochrome in flowering

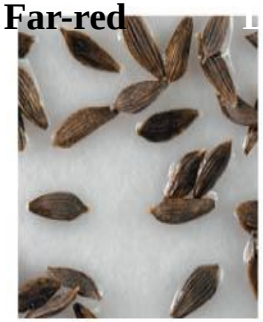
- Long-day (short night) plants flower only if the night is *shorter than a critical dark period.* They produce summer flowers.
- Spinach, radish, lettuce, iris and many cereal plants are long-day plants.

Use of phytochrome in flowering

- Day-neutral plants do not require a certain critical dark period to flower. Other environmental factors are necessary.
- Tomatoes, rice and dandelions can flower any time during the growing season.

Figure 31.13

Results



Red

Red Far-red

Red Far-red Red Dark

Red Far-red Red Far-red

Figure 31.16

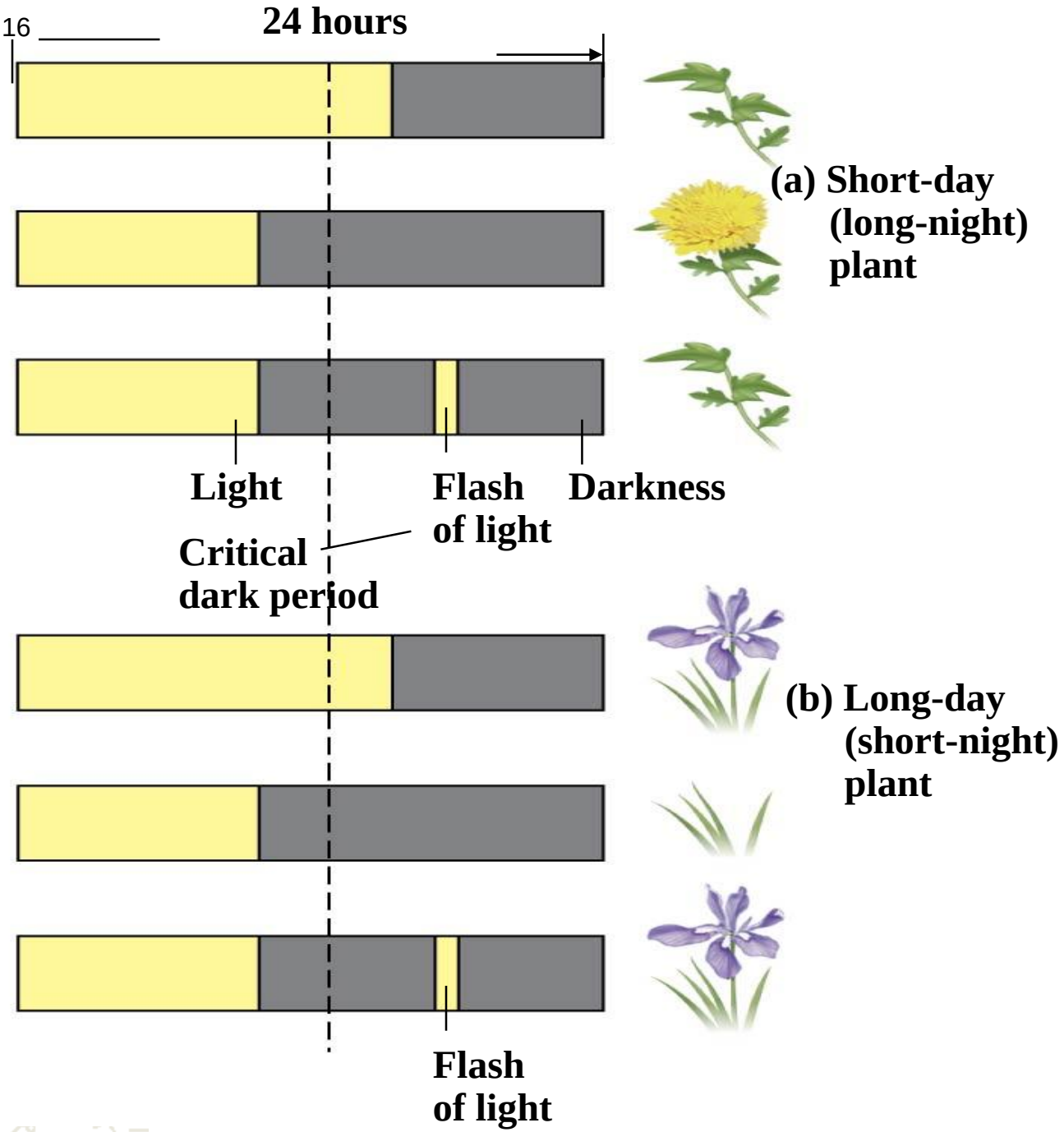
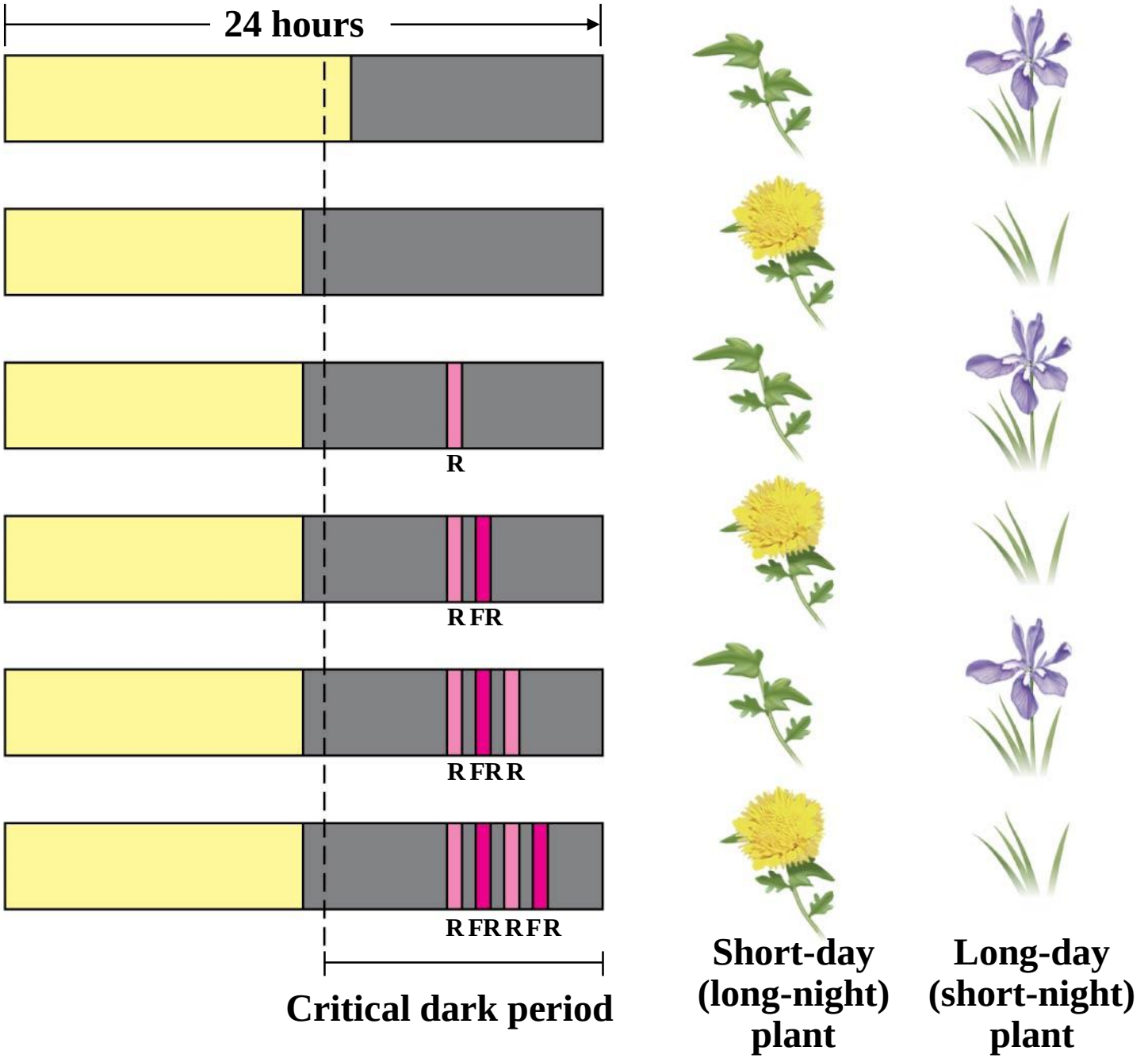

24 hours
(a) Short-day (long-night) plant
Light
Flash of light
Darkness
Critical dark period
(b) Long-day (short-night) plant
Flash of light

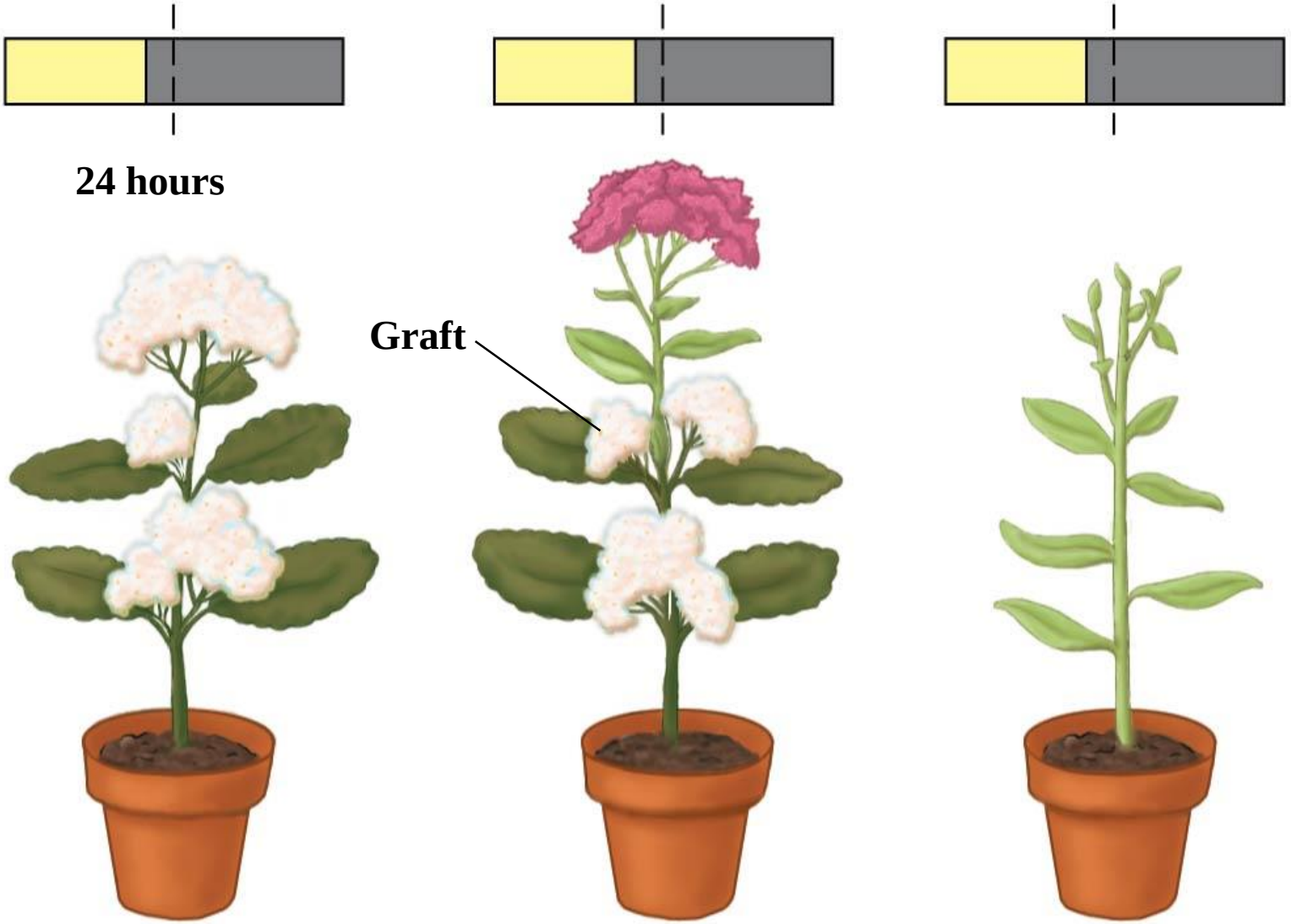
Figure 31.17


24 hours
R
R FR
R FR R
R FR R FR
Critical dark period
Short-day (long-night) plant
Long-day (short-night) plant

Use of phytochrome in flowering

- Red light has the greatest affect on setting a photoperiod. Far red light cancels out the effect of red light.
- Leaves have phytochrome but flower buds produce flowers. Leaves must somehow let the buds know when to start growing. A flowering hormone (florigen ?) is suspected but has not been found yet.

Figure 31.18


24 hours
Graft
Short-day plant
Long-day plant grafted to short-day plant
Long-day plant