15 Coordination and response in plants

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BIOLOGY

15.1 Coordination and response in plants

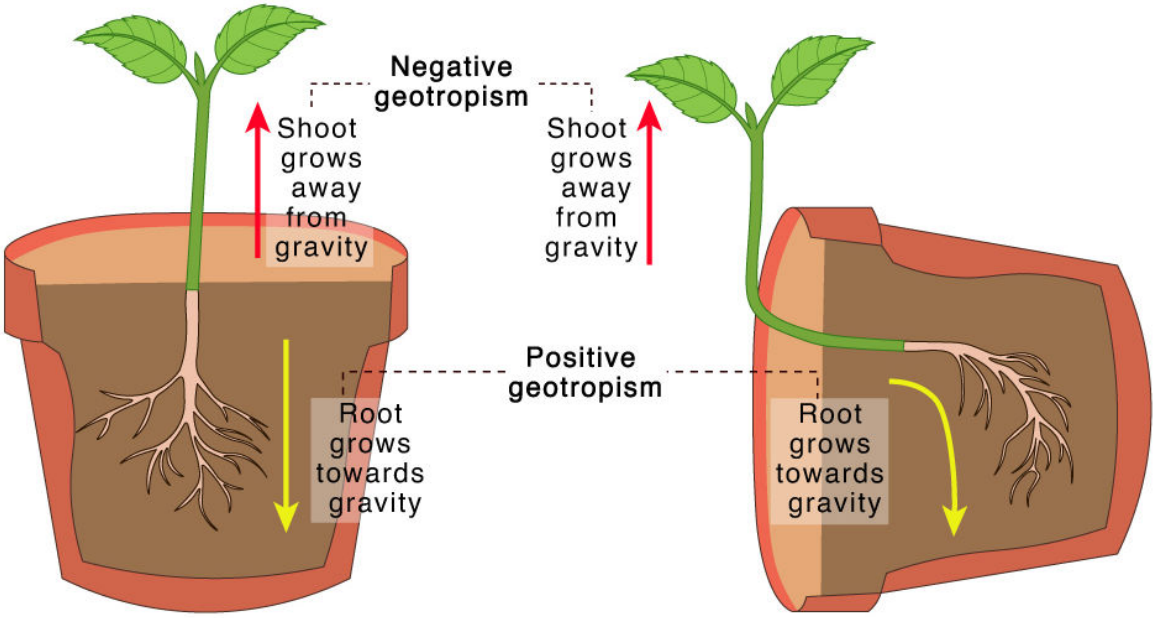
Describe gravitropism as a response in which parts of a plant grow towards or away from gravity.

Tropism

Tropism refers to the growth or movement of an organism or a part of an organism in response to a stimulus, such as light, gravity, or chemicals.

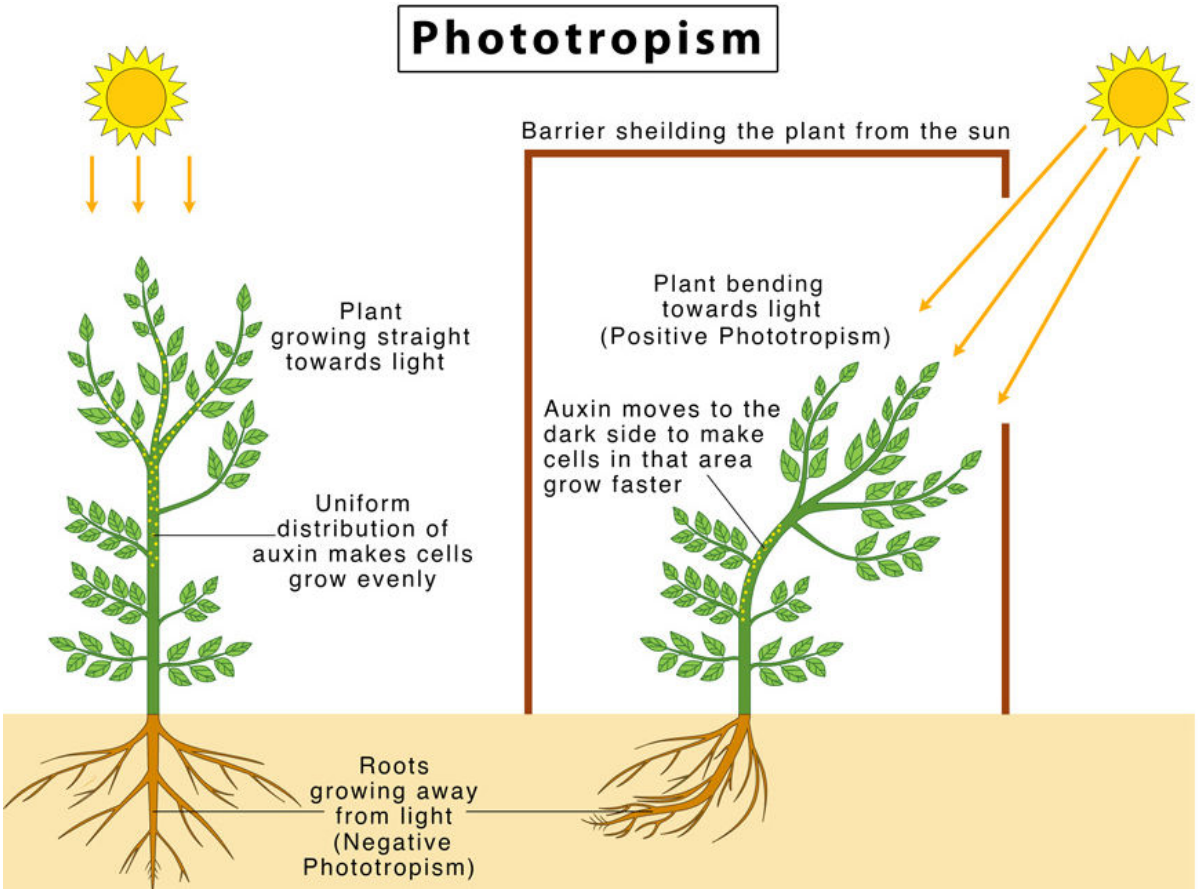
Gravitropism

It is a response in which parts of a plant grow towards or away from gravity. It is also known as geotropism. Stems exhibit negative gravitropism, growing upwards in opposition to gravity. This lifts the leaves and flowers above the ground and helps the plant to compete for light and carbon dioxide. The flowers are brought into a beneficial position for insect or wind pollination. Roots exhibit positive gravitropism, growing downwards towards the gravitational pull. Through this, plants anchor to the soil and obtain water and mineral ions.



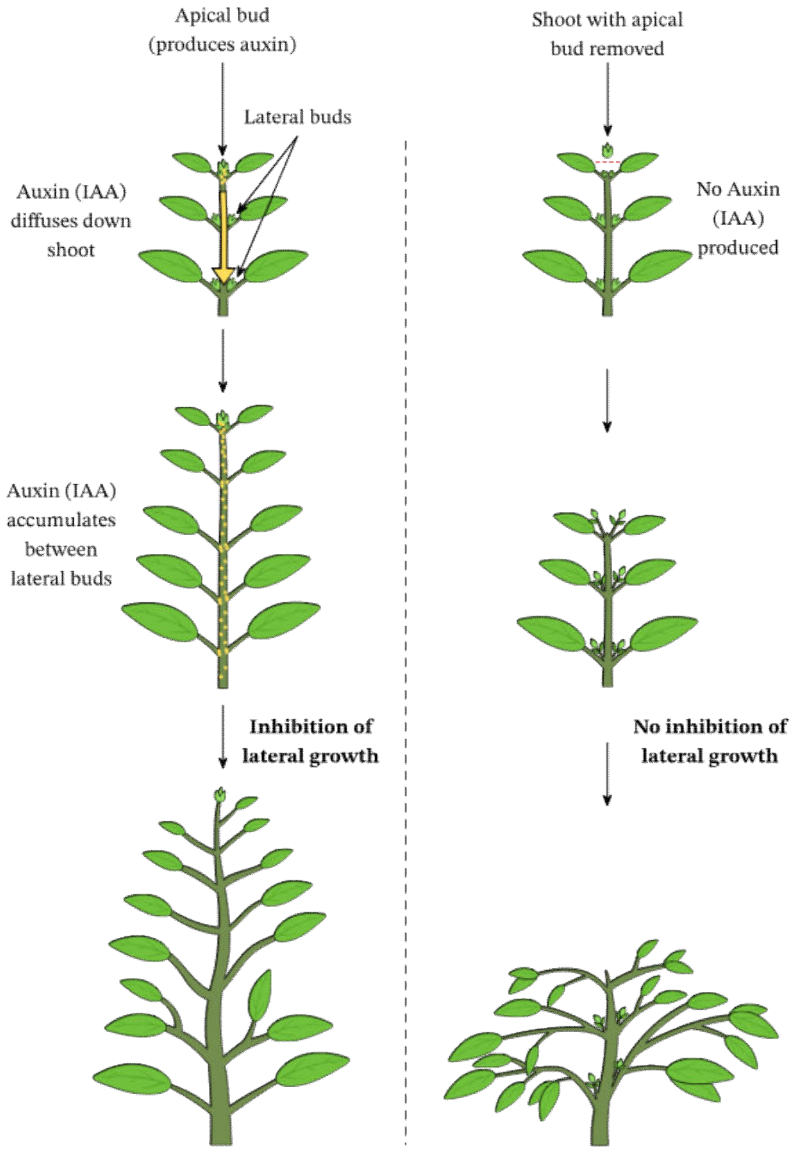
Describe phototropism as a response in which parts of a plant grow towards or away from light.

Phototropism.
Phototropism is the growth or movement of an organism or a part of an organism in response to light. In plants, phototropism typically involves the bending or curvature of stems or leaves towards a source of light. This response allows plants to maximize their exposure to light for photosynthesis, a process essential for their growth and development. In phototropism, plant cells on the shaded side of the stem or leaf elongate more rapidly than those on the illuminated side, causing the plant to bend or curve towards the light source. This response is mediated by the plant hormone auxin, which accumulates on the shaded side and stimulates cell elongation, resulting in the bending of the plant towards the light. By exhibiting phototropism, plants can optimize their exposure to light for photosynthesis, thereby maximizing their growth and survival in their natural habitat.



Explain the role of auxin in controlling shoot growth, limited to: (a) auxin is made in the shoot tip (b) auxin spreads through the plant from the shoot tip (c) auxin is unequally distributed in response to light and gravity (d) auxin stimulates cell elongation.

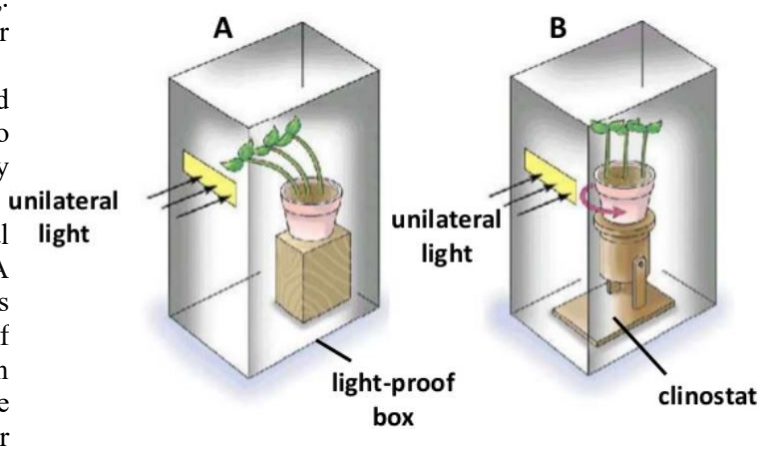
Auxin is produced at the tips of actively growing roots and shoots and moves by diffusion to the regions of extension where it stimulates cell enlargement. This movement allows auxin to spread throughout the plant, influencing growth processes in various regions. Auxin distribution within the shoot is regulated by external stimuli such as light and gravity. For example, in phototropism, auxin accumulates on the shaded side of the shoot, promoting cell elongation and causing the shoot to bend towards the light source. Similarly, in gravitropism, auxin redistributes in response to gravity, resulting in differential growth rates that influence shoot orientation. Auxin distribution within the shoot is regulated by external stimuli such as light and gravity. For example, in phototropism, auxin accumulates on the shaded side of the shoot, promoting cell elongation and causing the shoot to bend towards the light source. Similarly, in gravitropism, auxin redistributes in response to gravity, resulting in differential growth rates that influence shoot orientation.



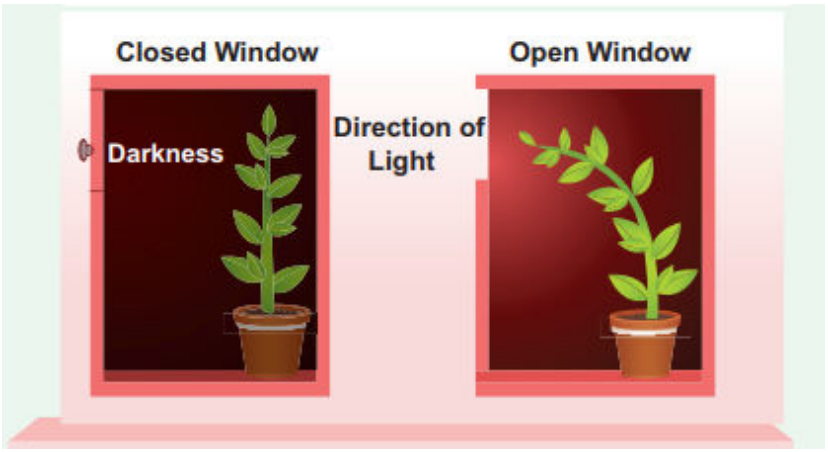
Investigate gravitropism and phototropism in shoots and roots.

Phototropism in shoots:

Select two potted seedlings (e.g. sunflower or runner bean) of similar size and water them both.
Place one of them under a cardboard box with a window cut in one side so that light reaches the shoot from only one direction as shown in figure. Place the other plant in an identical situation but on a clinostat (A clinostat is a device which uses rotation to negate the effects of gravitational pull on plant growth and development.). This will rotate the plant about four times per hour and expose each side of the shoot equally to the source of light. This is the control.



Result
After 1 or 2 days, the two plants are removed from the boxes and compared. It will be found that the stem of the plant with one-sided illumination has changed its direction of growth and is growing towards the light. The control shoot has continued to grow vertically.



Gravitropism in pea radicles:

Ideally this experiment uses a piece of apparatus called a clinostat. A clinostat is a clockwork or electric turntable, which can be set to rotate slowly about four times an hour.

Soak about 20 peas in water for a day and then let them germinate in a vertical roll of moist blotting paper.

After 3 days, choose 12 seedlings with straight radicles and pin six of these to the turntable of a clinostat so that the radicles are horizontal. Although gravity is pulling sideways on their roots, it will pull equally on all sides as they rotate.

Pin another six seedlings to a cork that will fit in a wide-mouthed jar. Leave the jar on its side.

Place the jar and the clinostat in the same conditions of lighting or leave them in darkness for 2 days.

Result

The radicles in the clinostat will continue to grow horizontally, but those in the jar will have changed their direction of growth to grow vertically downwards.