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# Plant Responses

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Hey guys,

Hope you are all keeping well and staying safe. Well done to those who have completed some of the exam questions.

The next topic we are moving onto is plant responses. There is quite a few definitions in this chapter so what I will do to make it a bit easier for you, is put all the definitions together on one or two slides, if you want to print them off separately.

# Key Definitions



**Stimulus:** is anything that causes a reaction in an organism or any of its parts.

**Response:** is the activity of a cell or organism as a result of a stimulus.

**Tropism:** is a change in the growth of a plant in response to an external stimulus.

**Phototropism:** is the change in growth of a plant in response to light, usually from one direction.

# Key Definitions

**Geotropism:** is the change in growth of a plant in response to gravity.

**Thigmotropism:** is the change in growth of a plant in response to touch.

**Hydrotropism:** is a change in growth of a plant in response to water.

**Chemotropism:** is a change in growth of a plant in response to chemicals.

**Growth regulator:** is a chemical that controls the growth of a plant.

# Structure required for response

The structures needed by organisms in order to allow them to respond include:

- a chemical or hormonal system

- a nerve or sense organ system

- a method of movement, which includes growth, and muscular and skeletal systems

- a defence or immune system

# Plant Responses

- Plants do not possess nervous systems so instead they depend on chemical coordination for their responses.
- Chemical coordination is much slower than nervous coordination.
- Plant responses often involve growth and changes in growth.
- These responses cause plants to move

# Growth Regulation

-The growth of flowering plants can be controlled by external and internal factors.

## External factors

- Light affects plant growth by providing the energy needed for photosynthesis.
- Day light plays a very significant role in causing the plants to flower.
- Gravity causes roots to grow down into the soil, while shoots grow upwards.
- Temperature affects the growth of plants mainly by affecting the rate of enzyme reactions.

# Growth Regulators

## Internal factors

- Plants produce a number of chemicals called growth regulators.
- These growth regulators are produced in the meristematic regions of the plant, such as the root tip or shoot tip regions.



# Tropisms

**Tropism:** is a change in the growth of a plant in response to an external stimulus.

- A positive tropism occurs when the growth is towards the stimulus.
- A negative tropism occurs when the growth is away from the stimulus.
- Tropism allow plants to obtain more favourable growing conditions.
- For example, stems grow towards light so they can produce more food by photosynthesis

# Tropisms

**Phototropism:** is the change in growth of a plant in response to light, usually from one direction.

- Stems are positively phototropic, which allows them to get more light.
- Many roots are negatively phototropic.

**Geotropism:** is the change in growth of a plant in response to gravity.

- Roots are positively geotropic as they grow towards gravity.
- Stems are negatively geotropic as they grow away from gravity.

# Tropisms

**Thigmotropism:** is the change in growth of a plant in response to touch.

-Climbing plants such as ivy produce specialised parts, called tendrils, which wrap around supporting structures.

-Tendrils exhibit positive thigmotropism as they grow around any object they touch.

**Hydrotropism:** is a change in growth of a plant in response to water.

-Roots and pollen tubes grow towards water.

# Tropisms

**Chemotropism:** is a change in growth of a plant in response to chemicals.

-Roots grow towards minerals in the soil therefore they are positively chemotropic.

-Pollen tubes grow towards chemicals released by the ovule therefore they are positively chemotropic.

-However, most roots are negatively chemotropic to acids and heavy metals (lead) in the soil.

# Growth regulators

**Growth regulator:** is a chemical that controls the growth of a plant.

-Most growth regulators are produced in small amounts in one part of a plant and transported to another part where they can cause effect.

The exact role of plant regulators is difficult to establish because:

-they are active in very small amounts

-their effects depend on their concentration and location in the plant in which they are acting

-different regulators interact in different ways.

# Growth promoters

## Auxins:

The most important auxin to note is indoleacetic acid (IAA). IAA is made in shoot tips, young leaves and seeds.

Auxins cause stem and root growth, along with fruit formation.

Auxin is produced in the meristematic tissue in the tips of shoots.

# Auxin

Functions of auxin:

- stimulating stem elongation
- stimulating root growth
- causing cells to form into different structures
- developing fruit
- causing phototropism and geotropism

# Auxin

Effects of auxin:

- auxin cause cell elongation and growth or bending

- apical dominance: the apex in the tip of the plant, if it is intact, auxin produced in the tip will pass down the stem and inhibit lateral buds.

- fruit formation: IAA made in developing seeds stimulates food to form in the fruit that surrounds the seeds

- root growth: IAA causes roots to grow



# Auxin

Role of IAA in phototropism:

1. IAA is produced in the growth tips of the stem
2. If the stem is exposed to light from one side IAA will diffuse down the shaded side
3. The concentration of IAA present in the shaded cells causes them to elongate more than the cells on the bright side of the stem
4. As a result of the uneven elongation, the stem bends towards the light

# Growth inhibitors

- Ethene is the only growth regulator that is a gas.
- It is made by plants in the stem nodes, ripe fruits and decaying leaves.
- It plays a major role in ripening fruits, stimulating leaves to fall in autumn and the ageing of plants.
- It causes fruit colour to form, fruit flavour to develop and fruit tissues to soften.
- Ethene is used commercially to ripen bananas.

# Growth inhibitors

Abscisic acid is produced in leaves, stems and root caps.

-It is often called the stress regulator of plants as it causes plants to respond to harmful conditions.

-In dry conditions, it causes stomata to close, which conserves water in the plant.

# Commercially prepared growth regulators

*Rooting powders:* often contain a synthetic growth regulator such as NAA (naphthylacetic acid).

-This stimulates rapid root formation on stem cuttings.

-Horticulturists use NAA to produce roots on cuttings more quickly than would naturally be the case.

*Ethene:* ripens bananas

# Experiment video

To investigate the effect of IAA growth regulator on plant tissue

[https://www.youtube.com/watch?v=cc\\_RBh\\_S9Pk](https://www.youtube.com/watch?v=cc_RBh_S9Pk)

# Plant Adaptations for protection

## Anatomical protective measures

-plants are enclosed by a physical barrier consisting of epidermis or bark, these layers prevent the entry of pathogens and reduce the loss of water from the plant.

-a shortage of water in a plant causes the guard to shrivel, this has the effect of closing the stomata and therefore reduces any further loss of water.

# Plant Adaptations for protection

## Chemical protective measures

-excessive heat may cause plant enzymes to lose shape and become denatured.

-many plants form special heat shock proteins once the temperature rises above about 40 degrees celsius.

-when a plant is infected by a microorganism the plant is sometimes able to produce stress proteins called phytoalexins.

# Summary Video

<https://www.youtube.com/watch?v=N5-CXjNjIM0>



# Higher Level Exam Questions

5. (a) What is an auxin?

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(b) With regard to auxins, state:

(i) A precise location in plants where they are produced.

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(ii) One example of an inhibitory function.

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(c) (i) Exactly how does an unequal concentration of auxin in the elongation zone affect the growth of either a shoot **or** a root?

Shoot. 

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OR

Root. 

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## 2018 q5

(ii) Suggest what could cause an unequal concentration of auxin in a shoot **or** in a root?

Shoot. \_\_\_\_\_

OR

Root. \_\_\_\_\_

(d) State **two** uses in horticulture of auxins or related compounds.

1. \_\_\_\_\_

2. \_\_\_\_\_

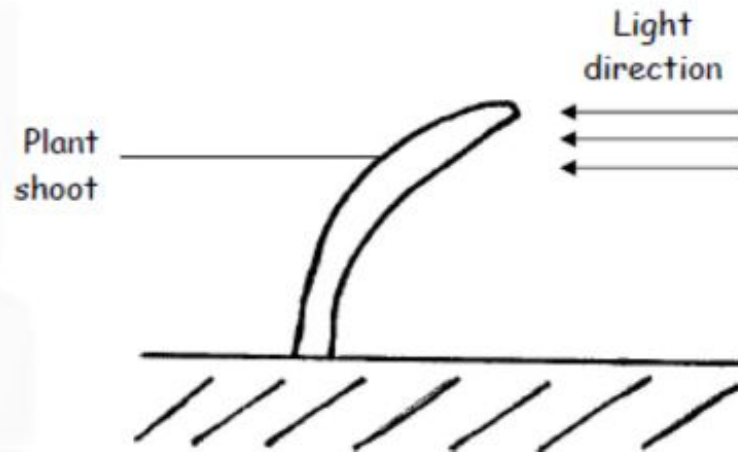
13. (a) Growth regulators are important substances found in plants. They play a role in responses to environmental factors.
- (i) What name is given to the regions of plants which secrete growth regulators?
  - (ii) Give an example of a growth regulator which has a negative effect on plant growth.
  - (iii) Explain the term *thigmotropism*.

## 2013 q10 c

- (c)
- (i) State **two** ways in which growth regulators in plants are similar to hormones in animals.
  - (ii) Name a plant growth regulator that promotes growth **and** give a precise location for a site of its action.
  - (iii) Through which part of a stem are growth promoters transported?
  - (iv) Outline **two** uses of growth promoters in horticulture.
  - (v) Give an example of a growth regulator that inhibits growth.

# Ordinary Level Exam Questions

(c) (i) What are tropisms?



- (ii) Which tropism is shown in the above diagram?
- (iii) Name **one** factor to which plants respond, other than light.
- (iv) Name **one** growth regulator in plants.
- (v) State **two** uses in horticulture of artificial growth regulators.
- (vi) How do thorns protect some plants?
- (vii) Give **two** other features that plants use to protect themselves.

## 2014 q12 a

12. (a) (i) Plants and animals respond to some outside stimuli. Name **two** stimuli to which plants respond.
- (ii) Give **one** example of a plant response to such a stimulus.

## 2012 q15 b

- (b) (i) In relation to plant responses:
1. What name is given to a plant's response to light?
  2. Name **one** growth regulator produced in plants.
  3. Where in a plant are growth regulators produced?
  4. Give **one** way by which plants can protect themselves from attack.