PLANT HORMONES

Lesson Description

In this lesson we:

- List the functions of the following:
  - Auxins
  - Gibberellins
  - Abscisic acid
- Describe the role of auxins in:
  - Geotropism
  - Phototropism
- Describe the control of weeds using plant hormones.
- State how each of the following is used by plants as defence:
  - Chemicals
  - Thorns
- Compare the effects of plant hormones, animal hormones and the nervous system

Summary

Hormones - Characteristics

- Chemical messengers
  - Generally secreted in one area and acts in another area
  - Required in small quantities
  - Long term, slow effects

- Plant hormones – not true “hormones” ..... Why????????
- Responses include:
  - Developmental transitions
    - Dormancy
    - Germination
    - Flowering
  - Growth
- Plants show growth responses which are called:
  - Tropisms
- The different responses are:
  - Phototropism
  - Geotropism
  - Hydro- or chemotropism
  - Thigmotropism
Positive tropism = growth towards the stimulus

Negative tropism = growth away from the stimulus.

The main plant growth substances are:
- Auxins (IAA)
- Gibberellins (GA)
- Abscisic acid
- Ethylene
- Cytokinins

<table>
<thead>
<tr>
<th>Auxins</th>
<th>Gibberellins</th>
<th>Abscisic acid</th>
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</thead>
<tbody>
<tr>
<td>Cell division</td>
<td>Stem elongation</td>
<td>Causes dormancy in apical and lateral buds in winter.</td>
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<tr>
<td>Cell elongation growth in stem length</td>
<td>Root growth</td>
<td>Controls seed dormancy by inhibiting germination</td>
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<tr>
<td>The development of fruit</td>
<td>The germination of seeds</td>
<td>Accelerate abscission in leaves and fruit. ABA is produced in ripe fruit and induced fruit fall.</td>
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<tr>
<td>Inhibits the abscission of leaves and fruit</td>
<td>Promotes flowering, budding and fruit development</td>
<td>Stimulates the closing of stomata in most plant species</td>
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<td>The development of adventitious root in stem cuttings</td>
<td></td>
<td></td>
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<tr>
<td>Tropic movement in stem and roots</td>
<td></td>
<td></td>
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<tr>
<td>Apical dominance - it suppress the growth of the lateral buds.</td>
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</tbody>
</table>
Phototropism

Auxin is made here.

Light

The auxin moves down the stem.

Auxin diffuses down the shoot stimulating growth.

If one side of the shoot is in the light, auxin diffuses away from the light.

The side of the shoot in the shade has more auxin, so grows faster, causing the shoot to bend towards the light.

(a) The phototropic signal is a chemical.

Light

Permeable agar: Shoot bends toward light

Impermeable mica: No bending

Chemical diffuses through agar.

(b) The hormone can cause bending in darkness.

Allow time for hormone to diffuse into agar block.

Offset blocks cause bending.

(c) The hormone causes bending by elongating cells.

Cells on the shady side elongate in response to the hormone.
Demonstrating Phototropism

Geotropism

If a plant is laid on its side, auxin gathers in the lower half of the stem and root.

Auxin stimulates growth in the shoot, so the stem curves upwards.

Auxin slows growth in the root, so the root curves downwards.
Demonstrating Geotropism

Apical dominance

Figure 7.6 Plant showing geotropism

plastic cover lined with moist blotting paper

seedling in X
in complete darkness
seedling in Y

lateral buds

apical bud removed
lateral branches

Courtesy Prof. Malcolm B. Wilkins

LEARN XTRA IS PROUDLY BROUGHT TO YOU BY MINDSET
Fighting Back….

“Sir, it’s the office plants. They’ve grouped together to form a garden. Here is a list of their demands…”
Response to Herbivores (animals eating plants)

1) Physical Barriers
   Thorns & spines

2) Chemical Defenses
   Distasteful or toxic compounds
Test Yourself

Select the most correct answer from the options given. Write down only the correct letter.

**Question 1**
Which of the following is a plant hormone?
A  Insulin
B  Abscisic Acid
C  Glucagon
D  Glycogen

**Question 2**
Which type of plants does a selective weed killer effect?
A  Narrow leaved
B  Broad leaved
C  Food crops
D  All plants

**Question 3**
Which hormone is used to increase fruit size?
A  Gibberellin
B  Auxin
C  Insulin
D  Abscisic Acid

**Question 4**
Auxins are produced at or near the tips of roots and stems in areas called:
A  Flowers
B  Lateral meristems
C  Leaves
D  Apical meristems

**Question 5**
The most important effect of auxins on plant cells is that they promote …
A  cell elongation.
B  ageing.
C  metabolism.
D  the absorption of water
QUESTIONS 6, 7 and 8 are based on the diagram below.

**Question 6**
Which substance, produced at the tip of the stem, will move in the direction indicated by the arrows?

A  Water  
B  Salts  
C  Hormones  
D  Cytoplasm

**Question 7**
If the plant is exposed to light equally from all sides, the stem will …

A  keep on growing in the direction shown.  
B  grow in the opposite direction.  
C  grow upright.  
D  die.

**Question 8**
The young stem bends towards the light …

(i)  to ensure that the leaves are exposed to light.  
(ii)  because cell elongation is greater on the side exposed to light.  
(iii)  because cell elongation is greater on the dark side.

A  Only (i) is correct  
B  (i) and (ii) are correct  
C  (i) and (iii) are correct  
D  Only (ii) is correct
Question 9
Indicate whether each of the statements in COLUMN I applies to A only, B only, both A and B or none of the items in COLUMN II...

<table>
<thead>
<tr>
<th>COLUMN I</th>
<th>COLUMN II</th>
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</thead>
<tbody>
<tr>
<td>1 Plant defence mechanisms</td>
<td>A: Thorns</td>
</tr>
<tr>
<td></td>
<td>B: Poisonous chemicals</td>
</tr>
<tr>
<td>2 Weed killer</td>
<td>A: Auxins</td>
</tr>
<tr>
<td></td>
<td>B: Abscisic acid</td>
</tr>
<tr>
<td>3 Promotes lateral bud dormancy</td>
<td>A: Gibberellins</td>
</tr>
<tr>
<td></td>
<td>B: Abscisic acid</td>
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</tbody>
</table>

Question 10
Give the correct biological term for each of the following descriptions. Write only the term next to the relevant question number.

1. A chemical substance that regulates growth and development in plants
2. The chemical substance in plants that is responsible for the germination of seeds
3. Growth of plants in response to external stimuli
4. The inhibition of the development of lateral buds.

Improve your Skills

Question 1
1.1 State THREE functions of each of the following plant “hormones”:
   a) Auxins
   b) Abscisic acid
1.2 A student grew a plant in an upright pot. She then put the pot in a horizontal position and left the plant in the dark for two days. Diagram 3 shows the potted plant after two days in the dark.

![Diagram 3 showing the potted plant after two days in the dark]

Explain fully why the plant responded in this way.
1.3 Describe how plants use each of the following as a defence mechanism:
   a) Chemicals
   b) Thorns
1.4 What is the phenomenon of apical dominance in plants? How can it be artificially eliminated?
Question 2

Investigations were conducted to determine the effect of unilateral light on stem growth. The following diagrams illustrate the results of the different investigations.

2.1 Name the hormone responsible for the above growth movements.

2.2 What is the term used to describe plant growth movements in response to light stimulus?.

2.3 EXPLAIN the results in A to D.

2.4 Suggest a reason for the different responses in E and F.

2.5 If the source of light is removed or changed, will the result change in G. Explain.

Question 3

(Adapted from March 2014 P2)

An investigation was carried out to determine the effect of two plant hormones (A and B) on the accumulation of starch in the cells of tobacco plants.

The investigation was set up as follows:

- 30 tobacco plants of the same species, size and age were used.
- They were divided into 3 groups, each treated in a different way as follows:
  - Group 1: 10 plants were treated with hormone A
  - Group 2: 10 plants were treated with hormone B
  - Group 3: 10 plants were given no hormone treatment
- All the plants were then left under the same conditions. The starch content in the cells was measured after every 6 hours for each group.

The graph below shows the results of the treatments for a period of 48 hours.
3.1 Explain the purpose of Group 3 in the investigation. (2)

3.2 Using the results, indicate the function of:
   (a) Plant hormone A (2)
   (b) Plant hormone B (2)

3.3 Provide a hypothesis for this investigation. (2)

3.4 Identify the independent variable in this investigation. (1)

3.5 Explain how the reliability of the results could be improved. (2)

3.6 Suggest a conclusion for this investigation. (2)

Question 4

Compare plant hormones to the endocrine system and the nervous system.

Links

- Phototropism: https://www.youtube.com/watch?v=zctM_TWg5lk
- Plant defence mechanisms: http://za.ask.com/youtube?qsrc=167&q=plant+defense+mechanisms&o=8644&l=sem