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FREE LEARNING NOTES FOR ZAMBIA

FORM 2

Biology

Auxins, phototropism and geotropism

Lesson notes for learners · Competence-Based Curriculum

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A plant growing near a classroom window bends towards the light, and a seed that falls on its side still sends its root down and its shoot up. Plants cannot move from place to place, but they respond to their surroundings by growing in a certain direction. In this note you learn how a plant hormone called auxin controls these responses.

AFTER THESE NOTES YOU SHOULD BE ABLE TO

- Say what a stimulus and a response are in plants
- Describe how light makes shoots bend towards it (phototropism)
- Describe how gravity makes roots grow down and shoots grow up (geotropism)
- Explain the role of auxin in shoots and in roots
- Plan a simple experiment on the effects of light and gravity

KEY WORDS

stimulus	a change in the surroundings, such as light or gravity, that a plant responds to
auxin	a plant hormone that coordinates growth responses
phototropism	growth of a plant part in response to light
geotropism	growth of a plant part in response to gravity
elongation	growth of cells in length

1 Stimulus, response and auxin

Plants adapt to changing conditions in their environment. A stimulus is a change such as light or gravity. The plant responds by growing in a certain direction. Chemical substances called hormones coordinate these growth responses. The hormone that does this in shoots and roots is auxin.

Auxin works differently in different organs. In shoots, auxin stimulates cells to elongate. In roots, a higher concentration of auxin inhibits cell elongation.

2 Light and phototropism

A plant near a window has its shoot bending towards the light. This is because the side of the shoot in the shade has more auxin, so its cells elongate more than the cells on the lit side. The shoot therefore bends towards the light.

Shoots grown in darkness become long, pale and weak. You can test this by growing seedlings in three ways: seedling A where it gets light evenly, seedling B in a cardboard box with a small opening on one side, and seedling C in a sealed box covered with foil. After 3 to 5 days, measure the shoot length and the angle of bending.

Organ	Effect of higher auxin	Result
Shoot (light from one side)	More auxin on shaded side stimulates elongation	Bends towards the light
Shoot (placed horizontally)	Auxin moves to the lower side, which grows faster	Bends upwards
Root (placed horizontally)	Auxin moves to the lower side and inhibits elongation, so the upper side grows faster	Bends downwards

Figure 1. Effect of auxin and the stimulus on shoots and roots

3 Gravity and geotropism

When a seedling lies on its side, gravity causes auxin to move towards the lower side of the organ. In the shoot, the lower side has more auxin and grows faster, so the shoot bends upwards. In the root, the high auxin on the lower side inhibits elongation, so the upper side grows faster and the root bends downwards.

To investigate, germinate seeds, place seedlings horizontally in a moist container, keep one still and put another on a slowly rotating turntable if you have one, and measure the angle of the shoots and roots over several days.

WORKED EXAMPLE

Look at the data: at 1 unit of auxin the root growth rate is high and the shoot growth rate is moderate. At 3 units the shoot growth rate is very high and the root growth rate is low. Which concentration is best for the root and which for the shoot?

Find the highest growth rate in the root column: high, at 1 unit

Find the highest growth rate in the shoot column: very high, at 3 units

So the best concentration for roots is 1 unit and for shoots is 3 units

TRY THIS

Put two potted plants in your classroom, one near a window and one in the middle of the room. After a few days, describe how the shoots have grown. Then lay a germinating bean seed on moist cotton wool on its side in a transparent container and watch which way the root and shoot grow over five days.

REMEMBER

- A stimulus such as light or gravity makes plants grow in a certain direction
- Auxin is a plant hormone that coordinates growth responses
- In shoots auxin stimulates cell elongation; in roots higher auxin inhibits it
- Shoots bend towards light because the shaded side has more auxin
- In gravity, auxin collects on the lower side: shoots bend up and roots bend down

? Check yourself

1. What is auxin?
2. What does auxin do in a shoot?
3. What does a high auxin concentration do in a root?
4. What do shoots grown in darkness look like?
5. Name the response of roots to gravity.
6. A potted plant stands near a window in a classroom at Kapoche school and its shoot bends towards the window. (a) What is the stimulus? (b) On which side of the shoot is there more auxin? (c) Explain why this makes the shoot bend towards the window.
7. A bean seedling is laid on its side in a moist container for five days. (a) Which way does the root bend and which way does the shoot bend? (b) Say where the auxin collects. (c) Explain why the root and the shoot respond differently.

ANSWERS

1. A plant hormone that coordinates growth responses.
2. It stimulates cells to elongate.
3. It inhibits cell elongation.
4. Long, pale and weak.
5. Geotropism; the roots grow downwards.
6. (a) Light. (b) The shaded side, away from the window. (c) Auxin stimulates elongation, so the shaded cells grow longer than the lit cells and the shoot bends towards the light.
7. (a) The root bends down and the shoot bends up. (b) On the lower side of both. (c) In the shoot more auxin stimulates growth on the lower side, but in the root the high auxin inhibits elongation, so the upper side grows faster.

Written by 25Schools to follow the Form 2 Biology syllabus of the Zambian competence-based curriculum. Free for learners to read, download and share. More notes and quizzes at 25schools.com.