

Plant Growth and Development — Assignment 2

Class 11 Biology · Higher-difficulty challenge set + integrated problems · Answer key included · Narayan Gurukul Academy

Instructions: (1) Attempt all questions; start with the topic-wise challenge set, then attempt the integrated (multi-topic) problems.
(2) Give all answers with correct SI units. $g = 10 \text{ m/s}^2$ unless stated.
(3) A final answer key is provided at the end — try the full set before checking it.

Part A — Topic-wise challenge questions

Growth in Plants — Phases and Parameters

1. Distinguish between growth and development.
2. Name the parameters used to measure plant growth.
3. Describe the phases of growth in plants.

Growth Rates — Arithmetic and Geometric

1. Distinguish between arithmetic and geometric growth.
2. What is the sigmoid growth curve?
3. Explain arithmetic and geometric growth with graphs.

Conditions for Plant Growth

1. State the conditions necessary for plant growth.
2. How do light and temperature affect growth?
3. Explain the conditions necessary for plant growth.

Differentiation, Dedifferentiation and Redifferentiation

1. Distinguish between differentiation and dedifferentiation.
2. Give one example each of dedifferentiation and redifferentiation.
3. Explain differentiation, dedifferentiation and redifferentiation with examples.

Plant Growth Regulators — Phytohormones

1. Distinguish between growth promoters and growth inhibitors.
2. State two functions of auxin.
3. Give the physiological effects of auxins, gibberellins, cytokinins, ethylene and ABA.

Photoperiodism and Vernalisation

1. Distinguish between photoperiodism and vernalisation.
2. Classify plants based on photoperiod.
3. Explain photoperiodism with examples.

Part B — Integrated problems (multi-topic)

1. Describe the three phases of growth in plants and how growth is measured.
2. Distinguish between arithmetic and geometric growth, and sketch their growth curves.
3. Explain differentiation, dedifferentiation and redifferentiation with one example each.
4. Describe the role of auxins, gibberellins and cytokinins in plant growth.
5. Explain photoperiodism and its classification of plants.
6. Describe vernalisation and its significance in agriculture.

Answer Key

Growth in Plants — Phases and Parameters

Growth is an irreversible permanent increase in size; development is the sum of growth and differentiation. Growth is measured by length, area, volume, fresh weight and dry weight. Three phases: lag (slow), log (rapid) and stationary (slows down). The meristem regions (apical, lateral, intercalary) are the regions of active growth.

Growth Rates — Arithmetic and Geometric

Arithmetic growth: only one daughter cell continues to divide, giving a linear curve ($L_t = L_0 + rt$). Geometric growth: both daughter cells divide, giving exponential growth that plots as a sigmoid curve on a linear scale. Arithmetic growth gives a linear curve; geometric growth gives a sigmoid (S-shaped) curve with lag, log and stationary phases.

Conditions for Plant Growth

Growth needs water, oxygen, nutrients and an optimum temperature. Light affects growth through photosynthesis and photomorphogenesis; temperature sets the optimum range for enzyme activity; water is needed for cell expansion and turgidity; oxygen is needed for respiration. Internal factors include growth regulators and genetic make-up; external factors include light, temperature, water and nutrients.

Differentiation, Dedifferentiation and Redifferentiation

Differentiation: meristematic cells become specialised (e.g. root hair cells). Dedifferentiation: mature cells regain the ability to divide (e.g. cork cambium from cortical cells). Redifferentiation: dedifferentiated cells again lose the ability to divide and mature (e.g. secondary xylem and phloem). The sequence is: meristematic cell → differentiated cell → dedifferentiated cell → redifferentiated cell.

Plant Growth Regulators — Phytohormones

Growth promoters: auxins, gibberellins, cytokinins; growth inhibitors: ABA, ethylene (ethylene is a gaseous regulator). Auxin promotes cell elongation and apical dominance; gibberellin promotes stem elongation and seed germination; cytokinin promotes cell division; ethylene promotes fruit ripening; ABA promotes dormancy and stomatal closure. Auxins: cell elongation, apical dominance, rooting. Gibberellins: internode elongation, bolting, seed germination. Cytokinins: cell division, delay of senescence. Ethylene: fruit ripening, abscission. ABA: dormancy, stomatal closure, stress tolerance.

Photoperiodism and Vernalisation

Photoperiodism: response to the relative length of day and night; plants are long-day, short-day or day-neutral. Vernalisation: promotion of flowering by exposure to low temperature. Photoperiodism is perceived by leaves, which produce a flowering signal; plants are classified as long-day (e.g. wheat), short-day (e.g. soybean) and day-neutral. Vernalisation enables winter varieties to flower after a cold period.

Integrated problems

1: Lag, log, stationary phases; measured by length/area/volume/weight. 2: Arithmetic — one daughter cell divides (linear); geometric — both divide (sigmoid). 3: Differentiation (meristem → specialised), dedifferentiation (mature → dividing, e.g. cork cambium), redifferentiation (→ secondary xylem/phloem). 4: Auxin — elongation; gibberellin — stem elongation; cytokinin — cell division. 5: Photoperiodism — long-day (wheat), short-day (soybean), day-neutral. 6: Vernalisation — low-temperature treatment promotes flowering; used to grow winter wheat.