Environment & Ecology · GS - III

Each year a large amount of plant material, cellulose, is deposited on the surface of Planet Earth. What are the natural processes this cellulose undergoes before yielding carbon dioxide, water and other end products?

EXAM YEAR	PAPER	SUBJECT
2022	GS - III	Environment & Ecology

MARKS	WORD LIMIT
10	~150 words

Answer Hint

Cellulose is a complex structural carbohydrate in plant cell walls. Its conversion into simpler substances occurs through decomposition, enzymatic hydrolysis and microbial metabolism. Fungi, bacteria and other decomposers facilitate mineralisation, releasing carbon dioxide, water and nutrients, while anaerobic conditions may produce methane.

Model Answer

Introduction

Cellulose is a polysaccharide composed of glucose units linked by β-1,4-glycosidic bonds. Its breakdown is an essential part of the carbon cycle.

Natural Processes Involved

1. Fragmentation: Soil fauna, such as termites and earthworms, break plant litter into smaller pieces, increasing the surface area available for decomposers.

2. Enzymatic Hydrolysis: Cellulase enzymes produced by fungi and bacteria break cellulose into simpler sugars, including cellobiose and glucose.

3. Microbial Decomposition: Microorganisms metabolise these sugars through respiration under aerobic conditions, releasing carbon dioxide and water.

4. Anaerobic Breakdown: In oxygen-deficient environments, microbial fermentation and subsequent methanogenesis may produce methane, carbon dioxide and other compounds.

5. Humification and Mineralisation: Some partially decomposed organic matter forms humus, while continued microbial activity releases nutrients and converts organic carbon into inorganic forms.

Conclusion

Cellulose undergoes physical fragmentation, enzymatic hydrolysis and microbial decomposition before its carbon is released through mineralisation and respiration. These processes recycle carbon and nutrients, maintain soil fertility and sustain ecosystem functioning.

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