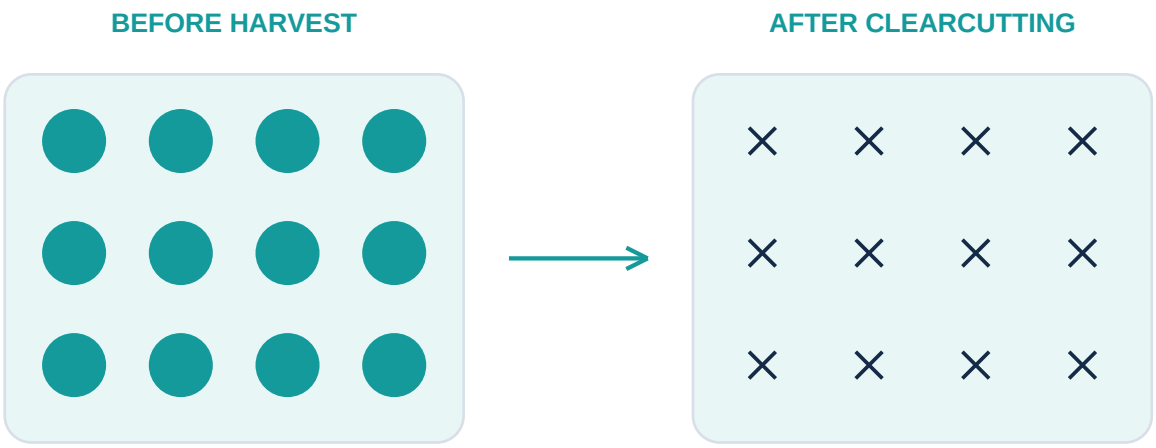
Clearcutting: one large harvest

Clearcutting removes most or all overstory trees in a defined area in one operation. Regeneration can follow through natural seeding, existing young growth or planting, often producing an even-aged stand.

1. WHAT CHANGES IN THE HARVEST AREA?



Plan-view schematic: circles represent tree crowns; crosses mark cut trees. This sketch shows complete overstory removal, not removal of every root, seedling or piece of woody debris.

2. WHY IS IT USED?

Harvesting many trees together can lower the cost per unit of timber, simplify machinery access and provide substantial wood for sale. The open conditions can favor regeneration of sun-loving tree species. Economic efficiency, however, does not measure the full environmental cost to soils, water, habitats or climate.

3. HARVEST METHOD IS NOT THE SAME AS LAND USE

Selective cutting removes chosen trees while retaining more of the stand. Clearcutting followed by forest regeneration is different from clearing land permanently for farms or buildings. Either harvest method can cause damage if poorly managed; selection is not automatically sustainable. Evaluate what remains, what regrows and how the site is treated.

Definition and regeneration: USDA National Agricultural Library, Clearcutting.
Economic and environmental trade-offs: College Board, EIN-2.B.1-2.

Scope: College Board AP Environmental Science CED, Topic 5.2, p. 96.

Soil and water: follow the links

Removing canopy cover changes shade and water movement. Logging roads, vehicle traffic and site preparation can add disturbance. Impacts depend on slope, rainfall, soil, retained vegetation and management.

1. THREE PATHWAYS FROM FOREST TO STREAM

Less canopy or streamside shade	→ More solar energy reaches surfaces	→ Higher soil and stream temperatures
Disturbed soil or compacted tracks	→ Greater erosion or surface runoff	→ Sediment reaches streams
Less interception and transpiration	→ More water may reach channels	→ Higher streamflow; flood risk can rise

Arrows show possible mechanisms, not equal-sized or inevitable effects. Flood response depends on the storm and the scale of the watershed.

2. ROOTS AND GROUND COVER DO NOT VANISH AT ONCE

Loss of canopy exposes the site, but remaining litter, vegetation and logging debris can still protect soil. Roots of felled trees gradually decay, reducing their reinforcing effect over time. Soil disturbance and poorly designed roads can greatly increase sediment delivery, especially on steep slopes.

3. WHY DO STREAM CHANGES MATTER?

Sediment reduces water clarity and can cover spawning gravel and aquatic habitat. Warmer water can stress cold-water organisms and holds less dissolved oxygen at saturation. Loss of nutrient-rich topsoil also reduces the land's capacity to support future growth.

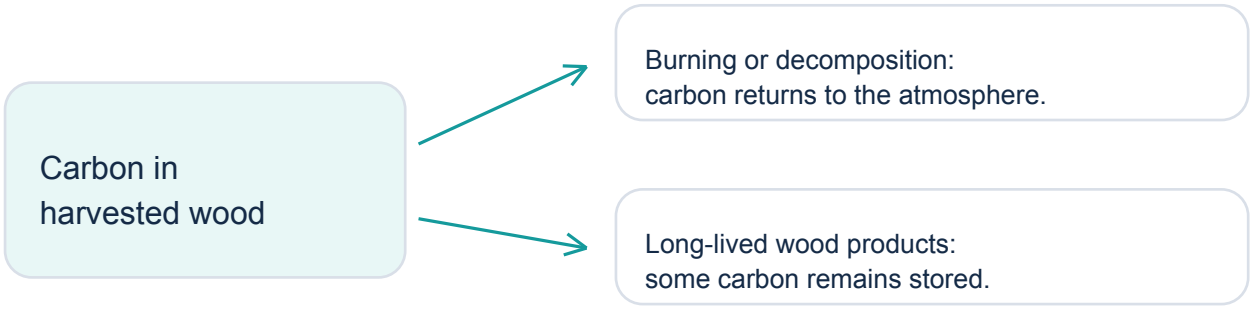
Roads, harvesting and sediment delivery: EPA, Nonpoint Source: Forestry.
Shade and stream protection: EPA, Riparian/Forested Buffer.

Scope: College Board AP Environmental Science CED, Topic 5.2, p. 96.

Carbon, habitat and recovery

Trees remove carbon dioxide through photosynthesis and store carbon in biomass; forests also retain carbon in dead material and soils. Leaves can remove some air pollutants, so canopy loss reduces this service.

1. TREE REMOVAL CHANGES CARBON STORAGE



Not all tree carbon becomes CO_2 immediately. Burning releases it rapidly; product decay takes time. Regrowth absorbs CO_2, but recovery of carbon stocks is not instant. Net climate effects depend on regrowth, soil disturbance, wood use and the time period considered.

2. REPLANTING DOES NOT RECREATE A MATURE FOREST

Canopy removal changes shade, shelter and nesting habitat. Mature-forest species can lose suitable conditions, while some early-successional species benefit from openings. Young trees do not immediately replace large old trees, cavities, layered vegetation or complex food webs. Recovery depends on surviving habitat, species diversity and time.

3. EXTENSION: REDUCE HARM AT THE SOURCE

Retain streamside forest buffers to preserve shade and intercept some sediment. Plan roads and drainage to limit erosion, avoid operating on saturated soils, and protect sensitive slopes. Support regeneration and retain important habitat features where appropriate. Buffers and replanting reduce some impacts; they do not erase all losses from harvesting.

Harvested wood carbon and time scales: USDA Climate Hubs, Carbon and Wood-based Bioenergy.
Habitat context: USDA Forest Service, Sustaining Young Forest Communities.
Streamside protection: EPA, Riparian/Forested Buffer.

Scope: College Board AP Environmental Science CED, Topic 5.2, p. 96.