

GE 2211 Environmental Science and Engineering

Unit – I

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Mineral Resources

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- mineral resources: environmental effects of extracting and using mineral resources, case studies

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Minerals

- Minerals include all materials extracted from the earth
 - (a) metallic minerals such as iron, copper, aluminium, lead, zinc, tin and others
 - (b) mineral fuels like coal, lignite, petroleum and natural gas
 - (c) non-metallic minerals like limestone, gypsum, sandstone, sand, clay and other materials.

Use of Mineral Resources

- Exploitation of mineral resources is essential.
- Iron and Steel is needed for the manufacture of machinery, locomotives, automobiles, ships and other equipment.
- Copper and aluminium are essential for transmission of electricity.
- Limestone is used for manufacture of cement.
- There is no economic activity, which can be performed without the use of mineral products.
- Developed nations consume large quantities of fuels and other minerals.
- The quantity of steel consumed per capita is often taken as a measure of economic development of a nation.

Mineral Resources in India

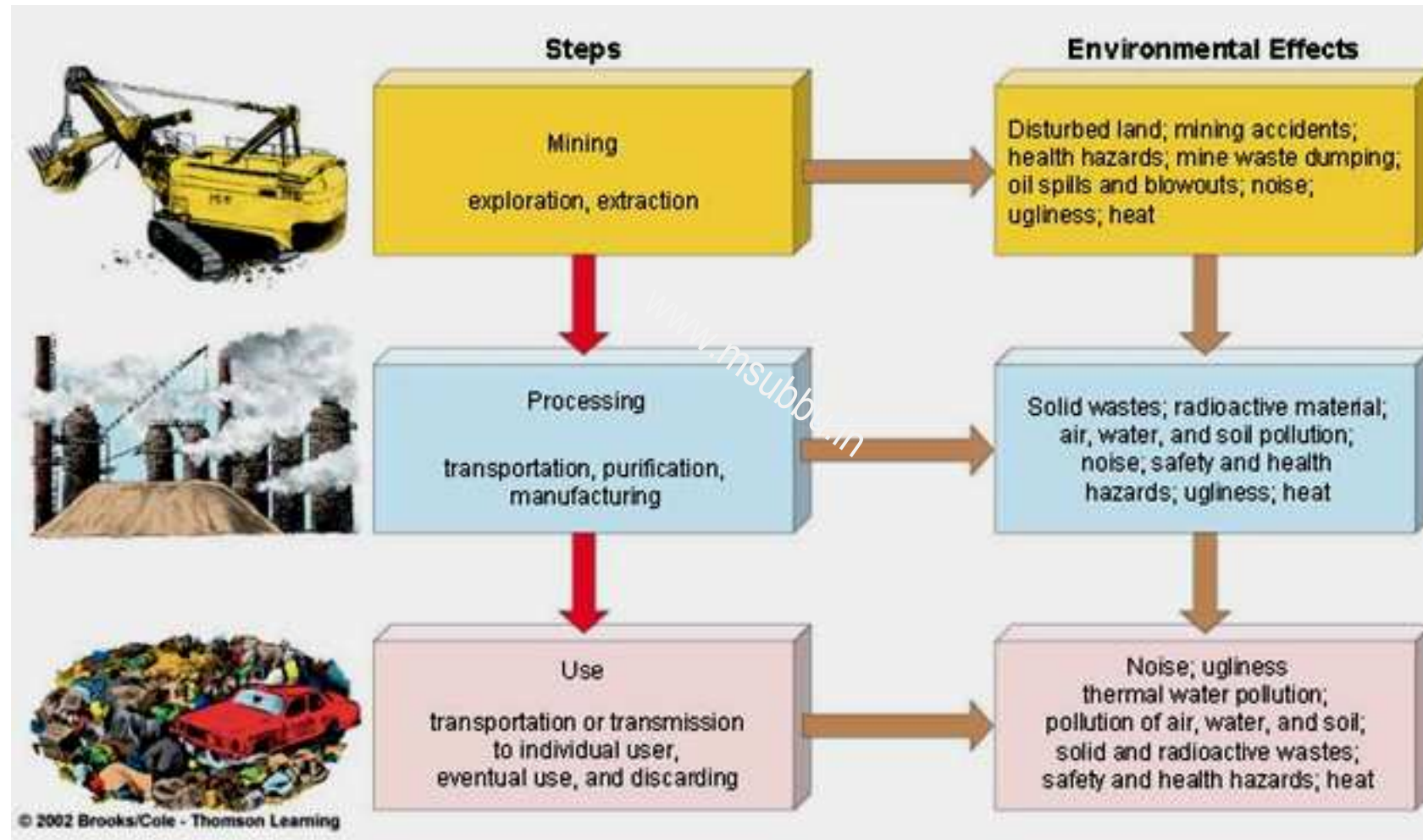
- India is rich in iron ores, manganese, chromite and titanium
- It has the world's largest reserves in mica and bauxite
- India possesses over 20% of the world's total reserve in iron (Orissa, Bihar, Madhya Pradesh)



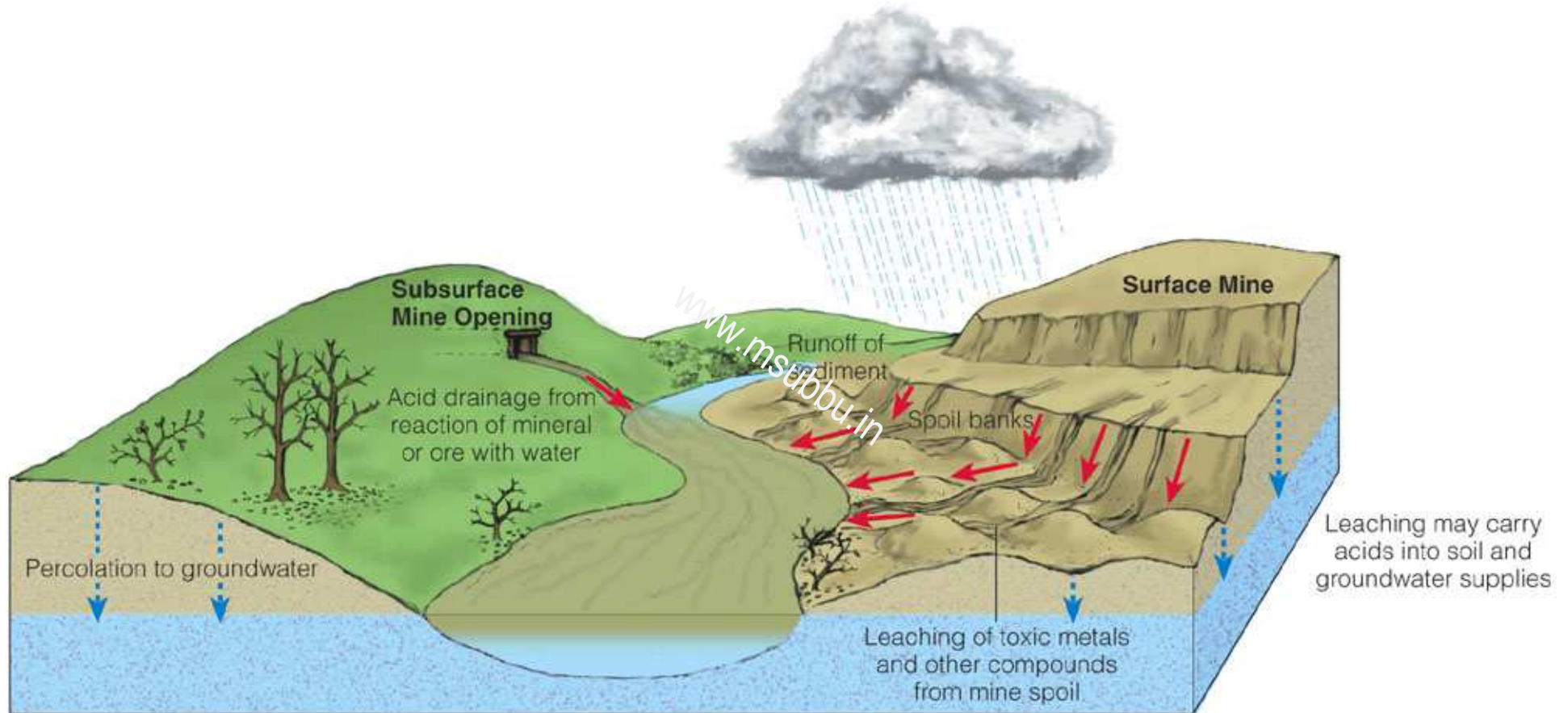
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Open-pit mining

Environmental Effects of using Mineral Resources

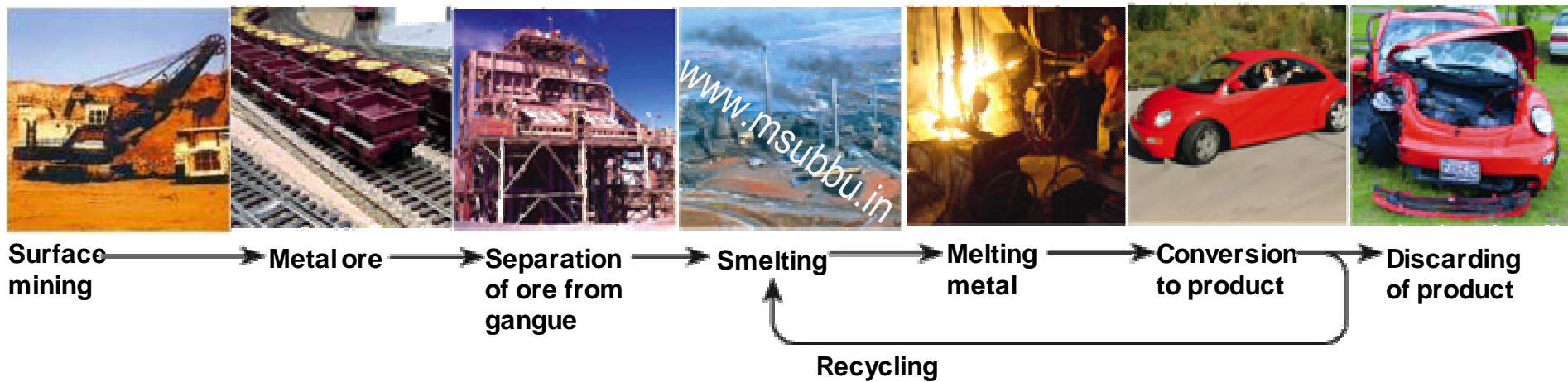


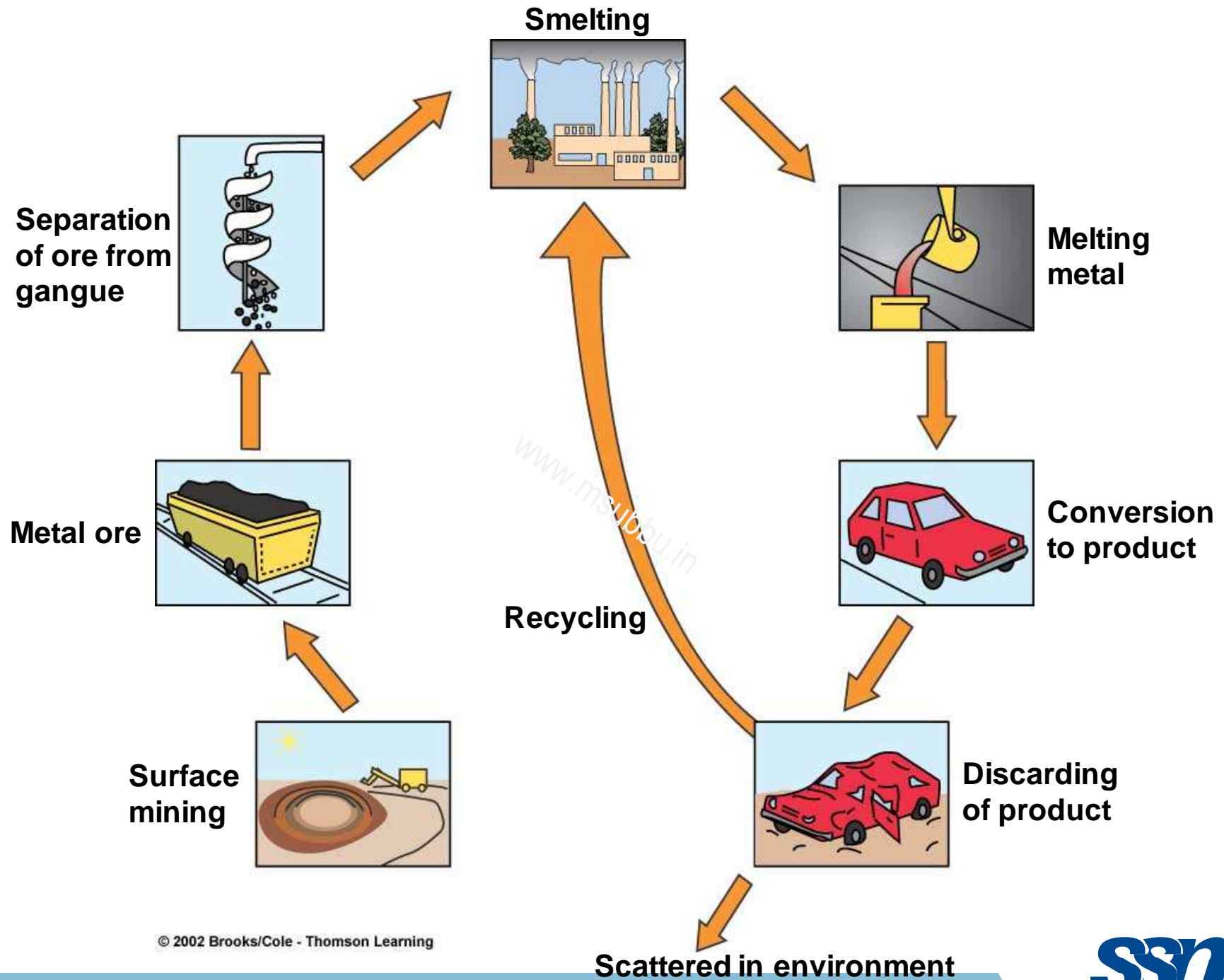
Environmental Effects of Mining Mineral Resources



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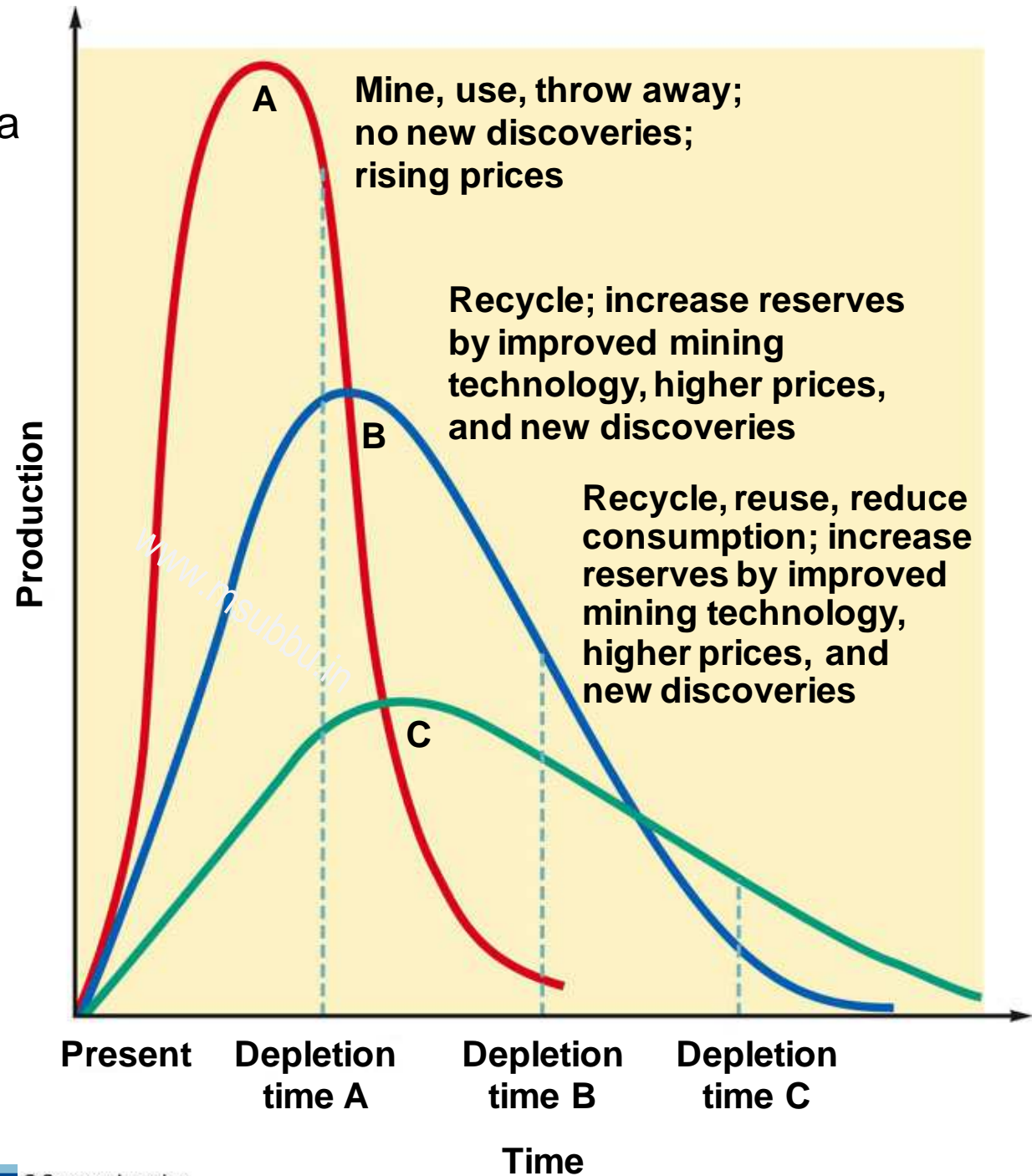
Life Cycle of a Metal Resource





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Depletion Curves for a Nonrenewable Resource



Sustainable Use of Nonrenewable Resources

- Materials revolution
 - Ceramics and plastics
- Recycle and reuse
 - Less environmental impact
- Decrease use and waste

SOLUTIONS

Sustainable Use of Nonrenewable Minerals

- Do not waste mineral resources.
- Recycle and reuse 60–80% of mineral resources.
- Include the harmful environmental costs of mining and processing minerals in the prices of items (full-cost pricing).
- Reduce mining subsidies.
- Increase subsidies for recycling, reuse, and finding substitutes.
- Redesign manufacturing processes to use less mineral resources and to produce less pollution and waste (cleaner production).
- Use mineral resource wastes of one manufacturing process as raw materials for other processes.
- Slow population growth.

Harmful Environmental Effects of Mining

- Disruption of land surface
- Subsidence
- Toxic-laced mining wastes
- Acid mine drainage
- Air pollution

Harmful Environmental Effects of Removing Metals from Ores

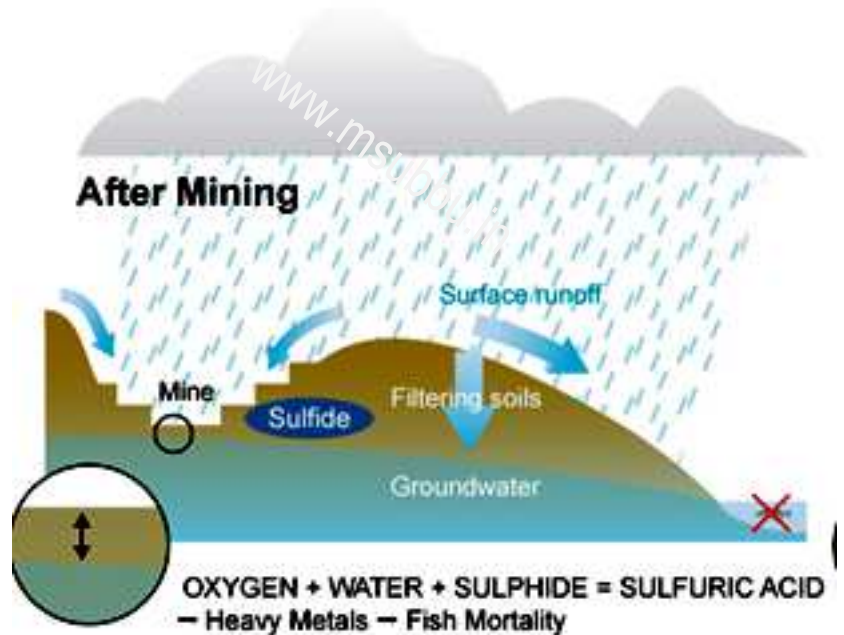
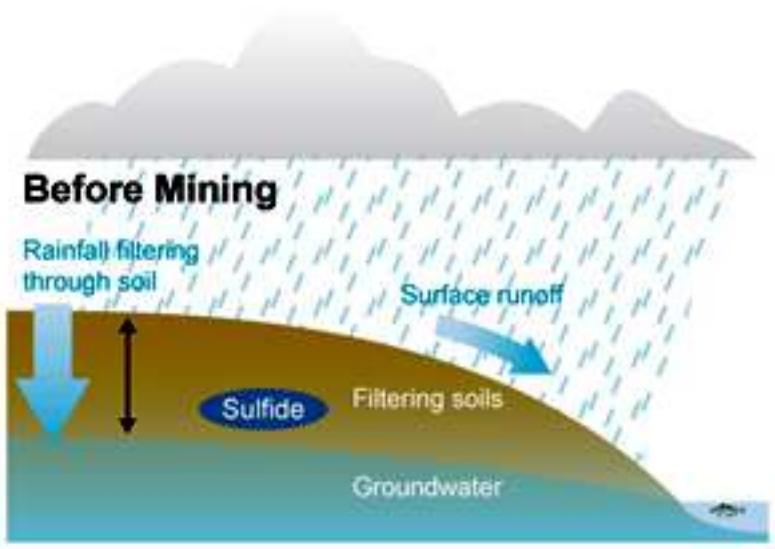
- Ore mineral – desired metal; Gangue – waste material
- Smelting
 - Air polluting by-products
- Chemical removal processes
- Toxic holding ponds

Acid Mine Drainage (AMD)

- **AMD** is the most serious environmental problem in mining today. It results from the formation of **sulfuric acid** caused by mining of sulfur-based materials, particularly high-sulfur coal and metalsulfide ores.
- AMD occurs when oxygen-rich water percolates through sulfur-bearing minerals exposed by mining. Water containing sulfuric acid drains out of the mine.



AMD in Rio tinto river, Spain



Extraction decreases groundwater depth and natural filtration, and increases the groundwater contamination.

Impacts of Surface Mining

- The main impacts of surface mining operations are scarring and altering of the landscape, soil erosion, and increased mud and silt in rivers and streams (which impacts river ecosystems, irrigation, and drinking water supplies)
- Strip-mining and open pit-mining operations scar and alter large areas of land. The only way to mitigate these effects is to back-fill and replant the areas after mining is completed.

Mine Land Reclamation

- In the past mining companies could abandon mines after using the site, leaving badly scarred land and possible toxic side effects (such as AMD). Regulations today force companies to return the land to a more natural state after using it, and to prevent toxic byproducts from entering the environment



The “before” (left) and “after” (right) photographs above illustrate a successful land reclamation project (from the Copper Basin, Tennessee, Georgia).

