Presentation:

CE 4412 Lectures

Solid Waste Management

By

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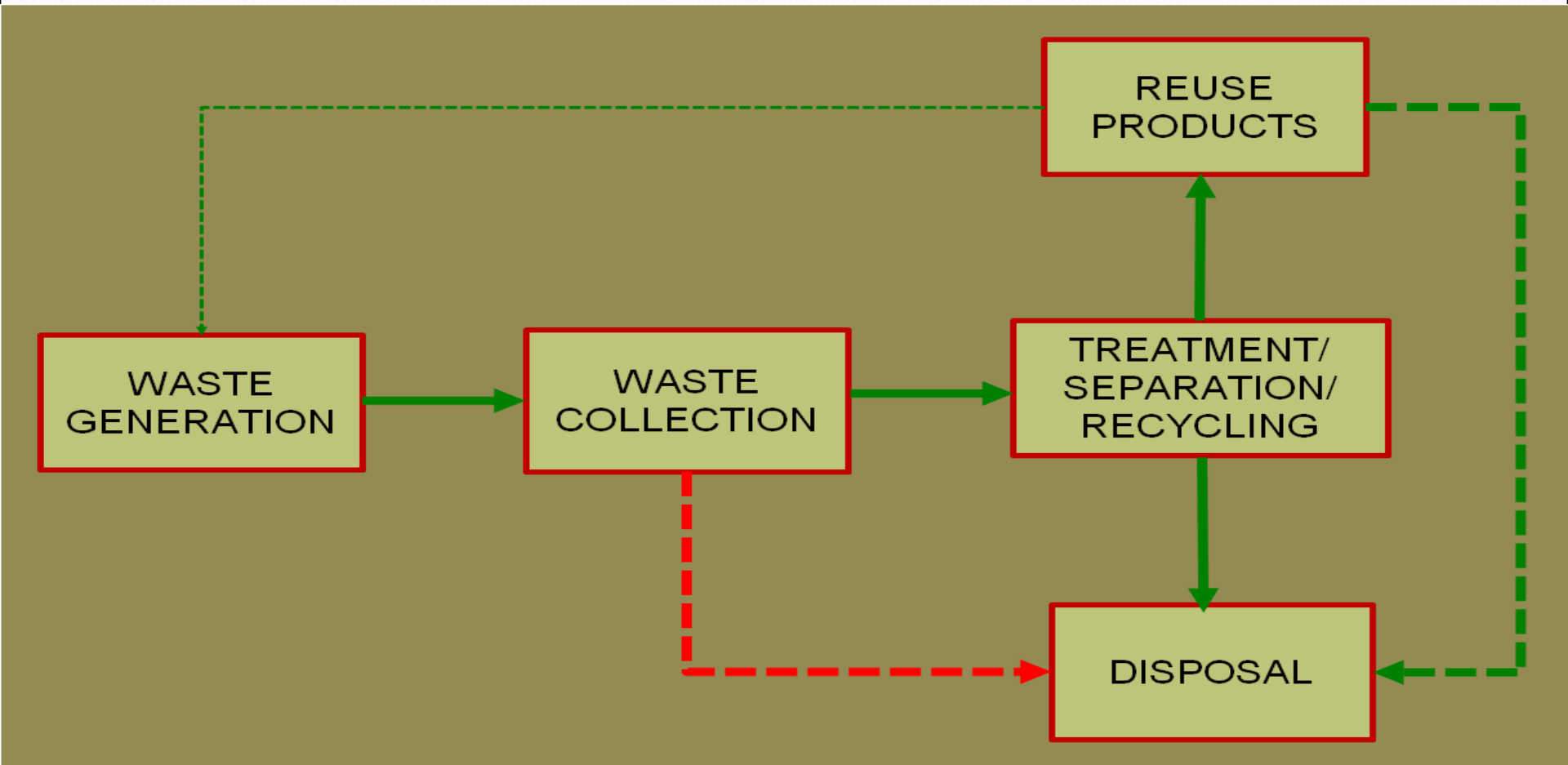
Course Objective

- Introduce students to solid waste management



Content

- Definitions
- Types
- Sources and Characteristics
- Significance of solid waste management
- Refuse storage and collection
- Treatment
- Disposal
- Hierarchy

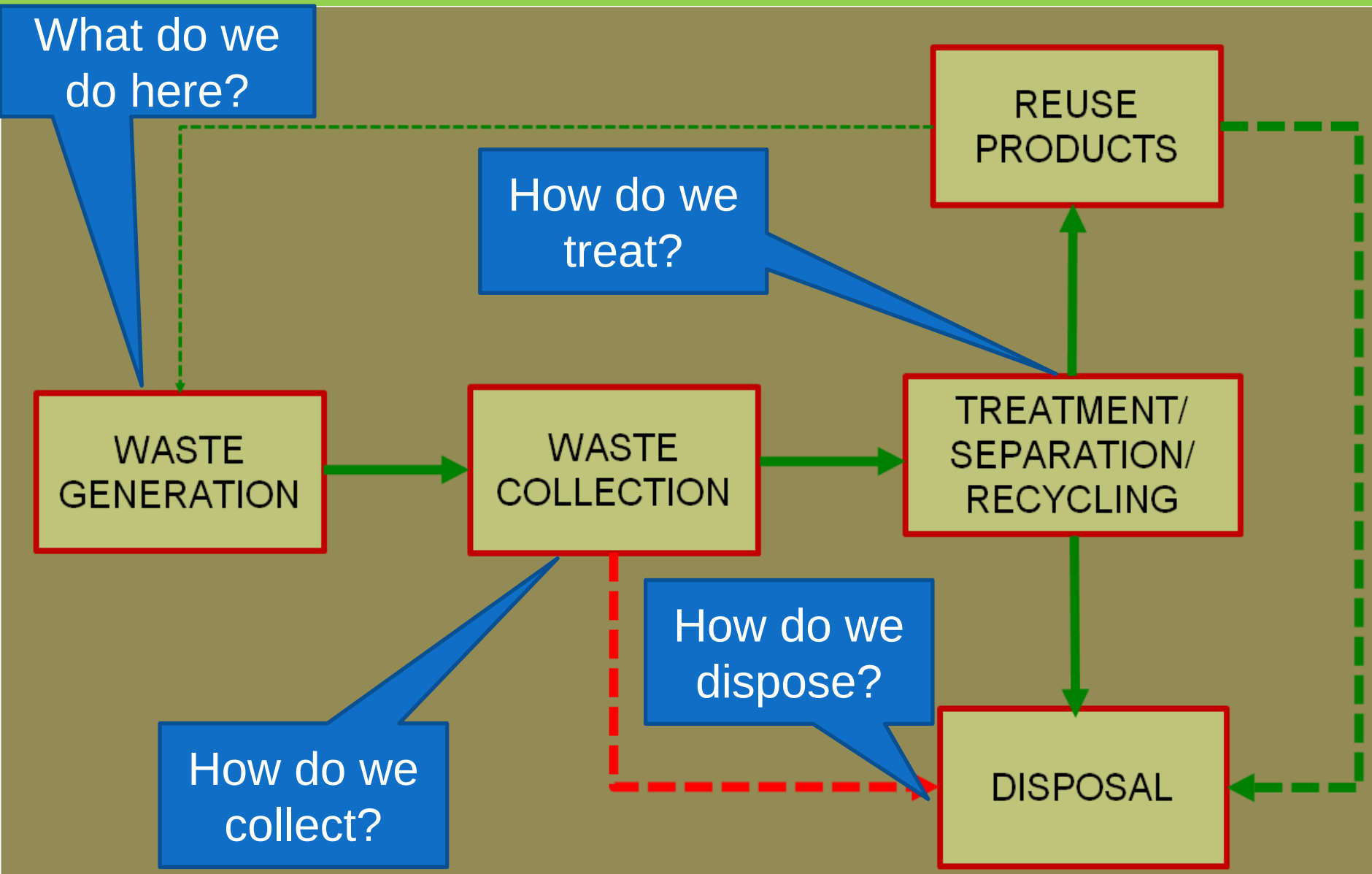
Definition

- Solid waste are all solids arising from human and animal activities which are discarded as they are no longer regarded as useful

- *It is important to note that solid waste also includes semi solid material like sludge from a wastewater treatment plant, Kitchen waste like food left-overs*

- Solid Waste Management: A systematic control of the generation, collection, storage, transport, source separation, processing, treatment, recovery, and disposal of solid waste.

Definitions cont'



Types

- Domestic solid waste or garbage or refuse
- Commercial or trade solid waste
  - A combination of the above makes up Municipal Solid Waste
- Industrial solid waste
- Hazardous waste like hospital waste, nuclear waste

Sources

- Usually, the source is implied in the type of solid waste.
- Therefore domestic waste comes from residential areas, hospital waste from hospitals, commercial waste from commercial establishments and so on

- *Our course is confined to domestic solid waste*

Characteristics

- Important charatceristics of solid waste include
  - Generation rate
  - Density
  - Composition

- These characteristics will differ according to:
  - Countries according to levels of development
  - Affluence of the area (Low cost, medium cost, high cost)

Characteristics

- Generation rate will vary between 0.25 to 1.2 kg per capita per day (0.4-0.6 for Zambia (ECZ, 1996))
- Density ranges from 100 to 600kg/m^3 per cubic meter (Important in selecting type of vehicles)
- Volume may range from 0.001m^3 to 0.012m^3
- Composition is the same but proportion of the constituents is what changes

Composition of solid waste

- Composition determination waste is achieved through characterisation. Differs according to income levels
- The main constituents are the following:
  1. Organic constituents (Putrescibles)
  2. Paper
  3. Metal
  4. Glass
  5. Textile (Fabric)
  6. Plastic
  7. Others
- (Why characterise? To enhance management i.e. recycling/compositing/reuse/Transportation, etc)

What is the significance of solid waste?

- It is a hazard to human health
  - Through habouring vectors (flies, mosquitoes, rats)
- It can pollute the environment
  - Aesthetically degrades the environment
  - Pollution through leachate

What is the significance of solid waste?

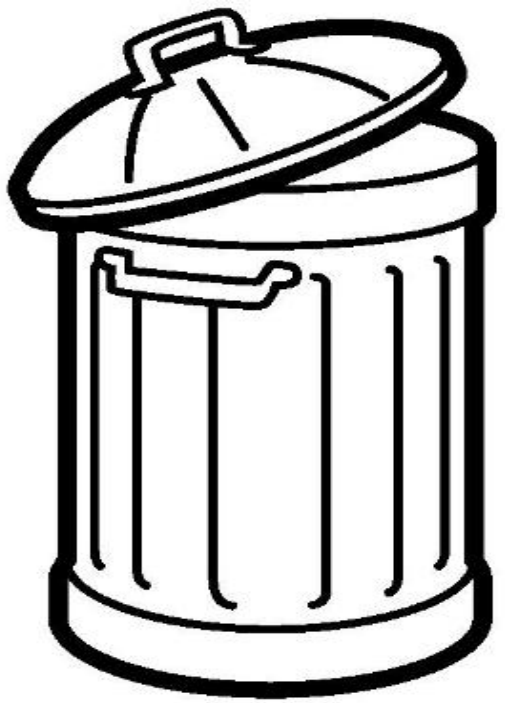
- It can pollute the environment (Cont')
  - Results in water pollution (Ground and surface) through leachate
  - *Where the waste contains industrial solid waste, the leachate may result in heavy metal contamination of the soil and water resources*
  - *This may lead to bio-accumulation of heavy metals in plants/grass and fish*
  - *Heavy metals are carcinogenic (cancer causing) when present in high concentrations*

What is the significance of solid waste?

- Results in air pollution: burning PVC at low temperatures results in emissions of gases like carbon monoxide, dioxins and furans into the environment.
  - Dioxins and furans are linked to cancer and respiratory diseases.

Solid waste storage and collection

- After generation of solid waste, it is normally first stored before collection
- In residential areas, storage is normally in bins
- Storage can also be in refuse plastic bags
- These will be put at points of collection periodically (Kerbside collection)



Bins to have secure lids

Solid waste storage and collection

- In other areas, especially peri-urban areas where collection from points of generation is impossible by vehicle, there will be need to store waste at point of collection then at another point from where it can be picked (Midden boxes and skips)

- In this case collection will be in two stages: Primary collection to secondary transfer station say by push cart

- Secondary collection to final point of disposal by refuse truck

Solid waste storage and collection

- Frequency of collection should never be less than twice per week to avoid degradation of the waste on site (Especially if it has high content of organic matter)

- Refuse collection transportation is by different means as illustrated

Solid waste storage and **collection**

Hand Cart

Tractors with trailers

❖Hand Carts are handy in collection of waste from areas that are inaccessible like in peri-urban area of Lusaka.

❖They may be hand drawn or animal drawn

Trucks

- **Important:** Where trucks are used, it is important to have a standardized fleet for easy maintenance

- "Ton Truck" Modified Construction Vehicle: Major challenge with this form of transport is:

1. Hygiene during transportation

2. Transportation of light weight waste

“Fore and Aft” Tipper Truck

Compactor Truck

Where do we use these?
Low density areas! Why?

- **Disadvantage:**

1. Expensive to buy
2. Costly to maintain

Treatment

- **Incineration:**
  - Significantly reduces volume of waste
  - Renders the waste inert

- However, this method is not effective in developing countries due to the following:
  - Nature of the waste – low calorific value and high moisture content implying that it may need fuel to operate
  - Also the process is complex and may require skilled manpower
  - Capital investment is high
  - Operational costs are high

Treatment

- **Composting:** A process of biodegrading the organic matter into a manure
- For this to work effectively, there should be source separation of the waste
- Also organic content needs to be high
- Controlled moisture content
- Process can be aerobic or anaerobic

Disposal

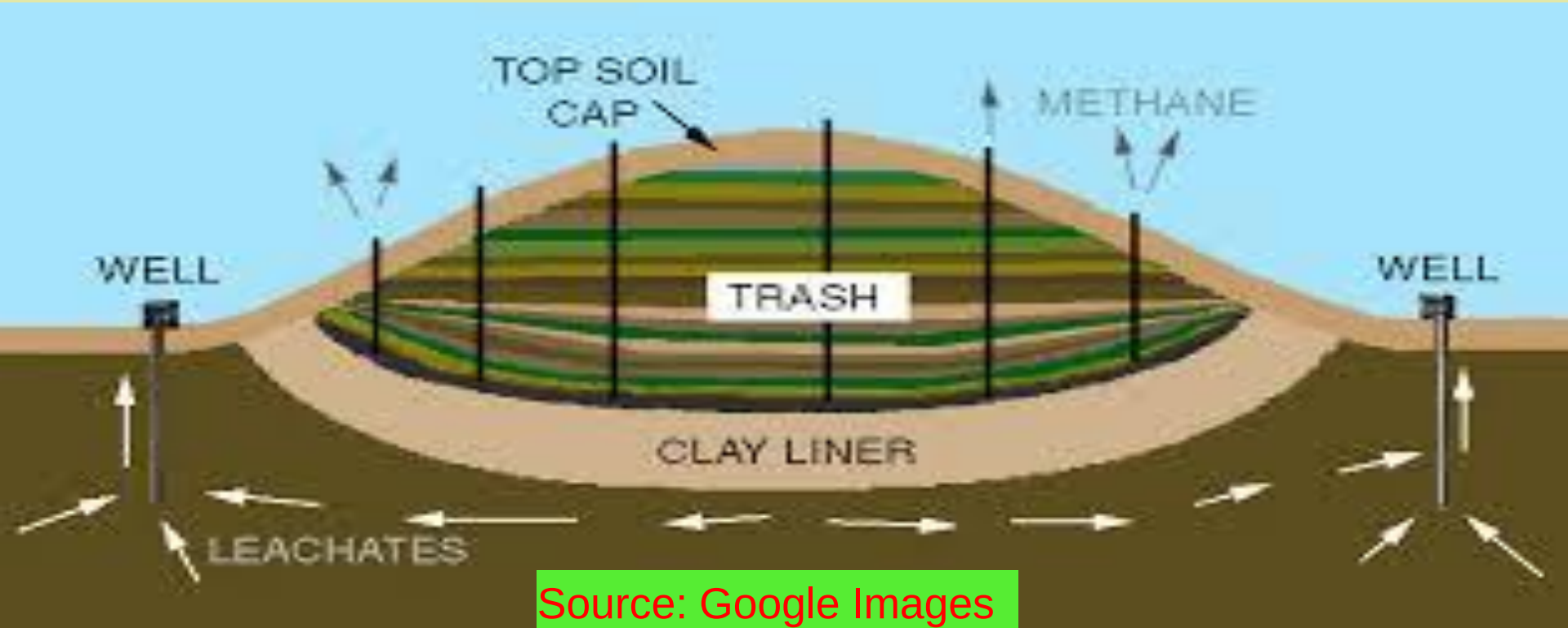
- Disposal can be through CRUDE Dumping or Controlled Dumping
- Crude dumping is where the solid waste is just dumped in an area without anything any control

Disposal

- Where crude dumping in practiced, the site of disposal is referred to as a “dump site”.
- This type of disposal is associated with Environmental degradation as already explained
- Associated with health risks
- Also attracts scavengers (Informal Solid Waste Pickers)
- Scavengers can play an important role in solid waste management in economies like ours – athough we continue to ignore them

Disposal

- Disposal can also be through a “Sanitary Land fill” or controlled tipping
- It is usually a means of land reclamation
- In this case, at the end of each shift, waste is compacted and covered with soil.



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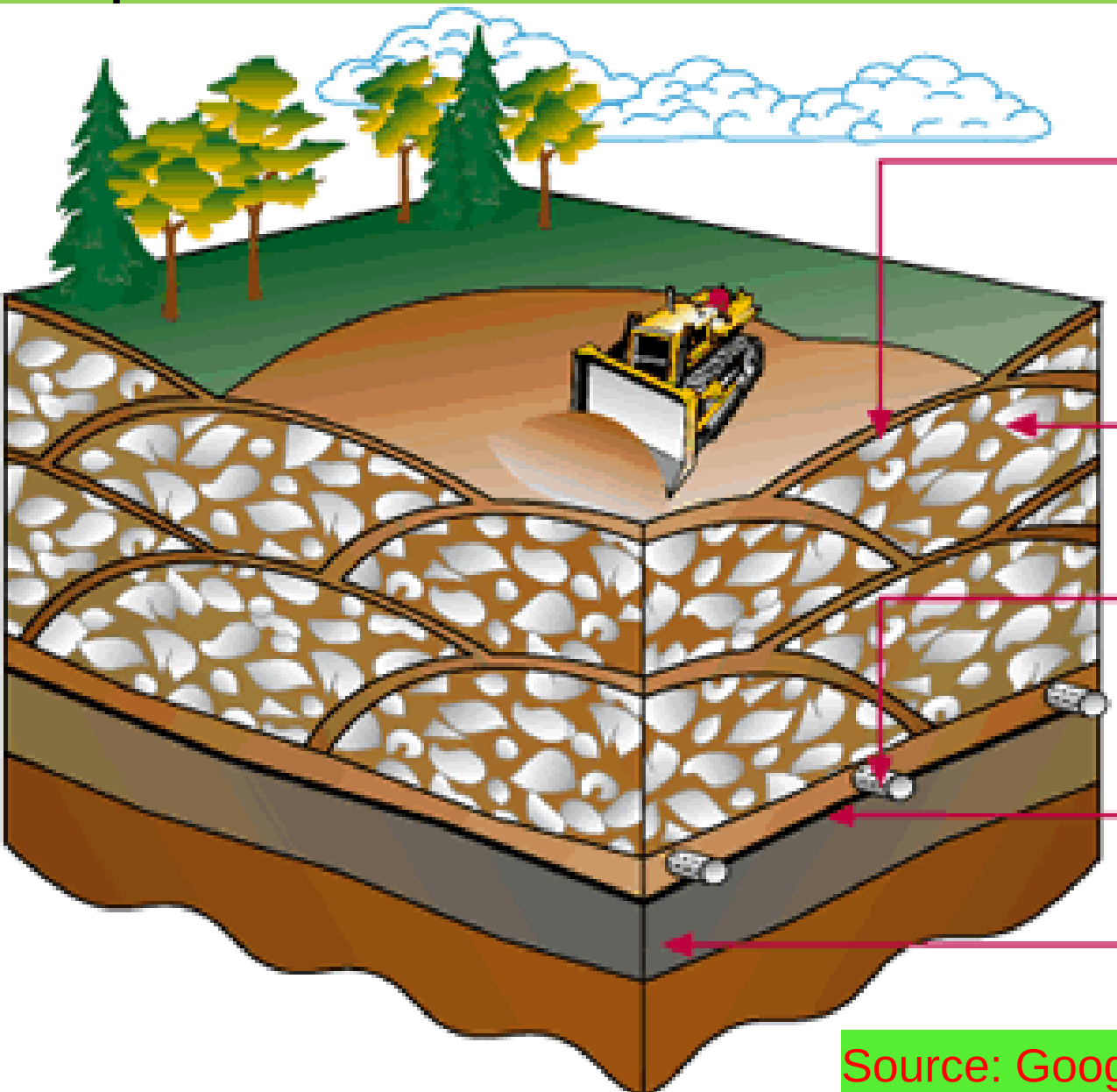
Disposal



Cross-section of an active landfill:

Daily cover
No landfill refuse is left exposed overnight - at the end of each day, all refuse is covered with at least six inches of compacted soil

Refuse cell
Compacted garbage surrounded by soil from daily cover

Leachate collection
Perforated pipes in a layer of sand collect rainwater that has filtered through the landfill (leachate)

Plastic liner
Prevents soil and water contamination

Clay barrier
Prevents soil and water contamination

Source: Google Images

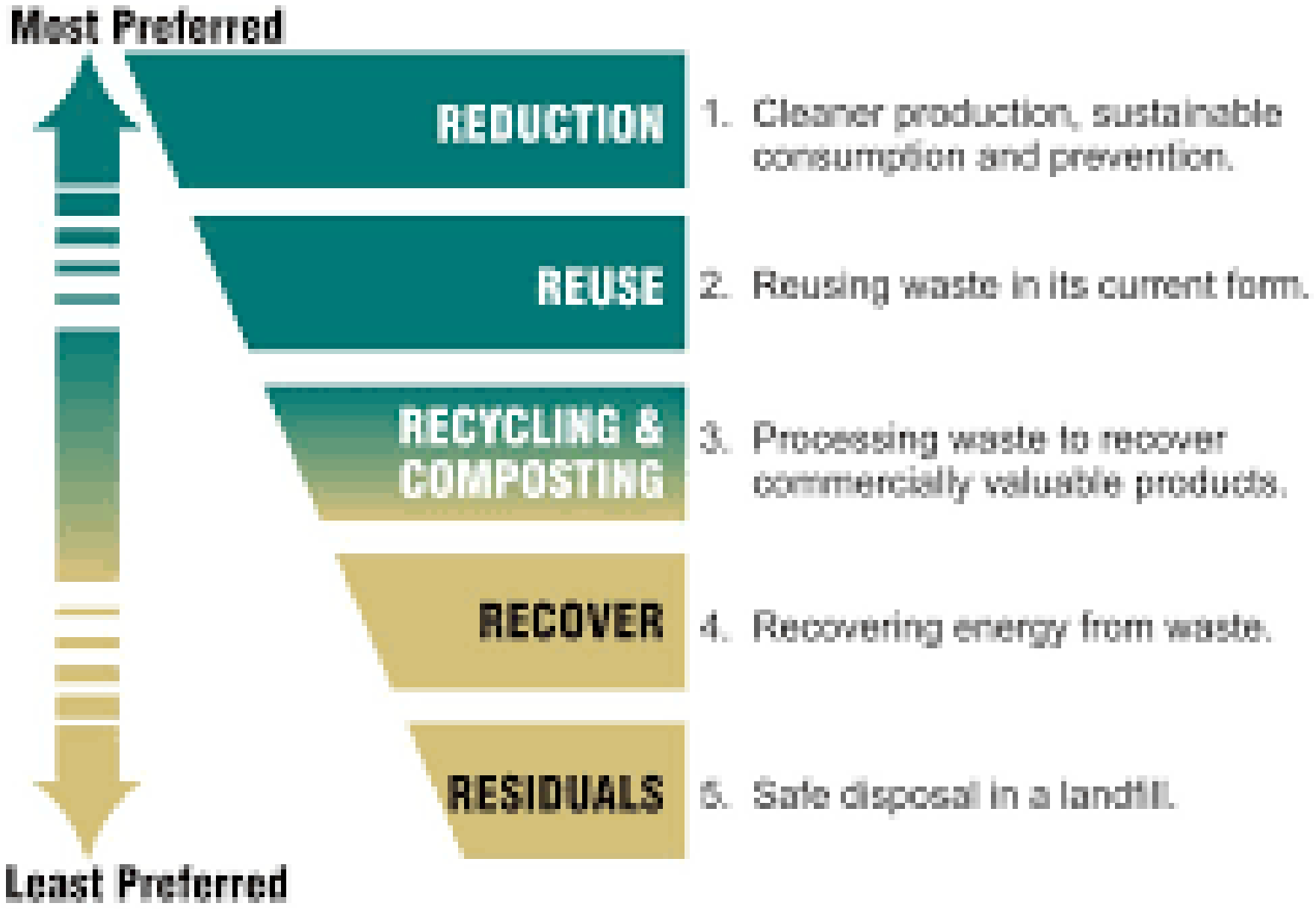
Disposal

- Where controlled tipping is practiced:
  - Aesthetic degradation is minimised (through covering)
  - Ground and surface water pollution controlled (Location, construction and the covering prevents access by water)
  - Vectors and smell controlled by covering
  - Covering also results in temp. induced mortality of germs
  - Scavenging at the site is reduced or completely curbed

Disposal

- **Site selection:**
  - To consider location (Not too far, western side prefered)
  - Hydrogeological conditions (Avoid high water table area and areas with a “porous geology”)
  - Cost considerations

The hierarchy of Integrated Solid waste Management (The 5Rs)



The hierarchy of waste Management