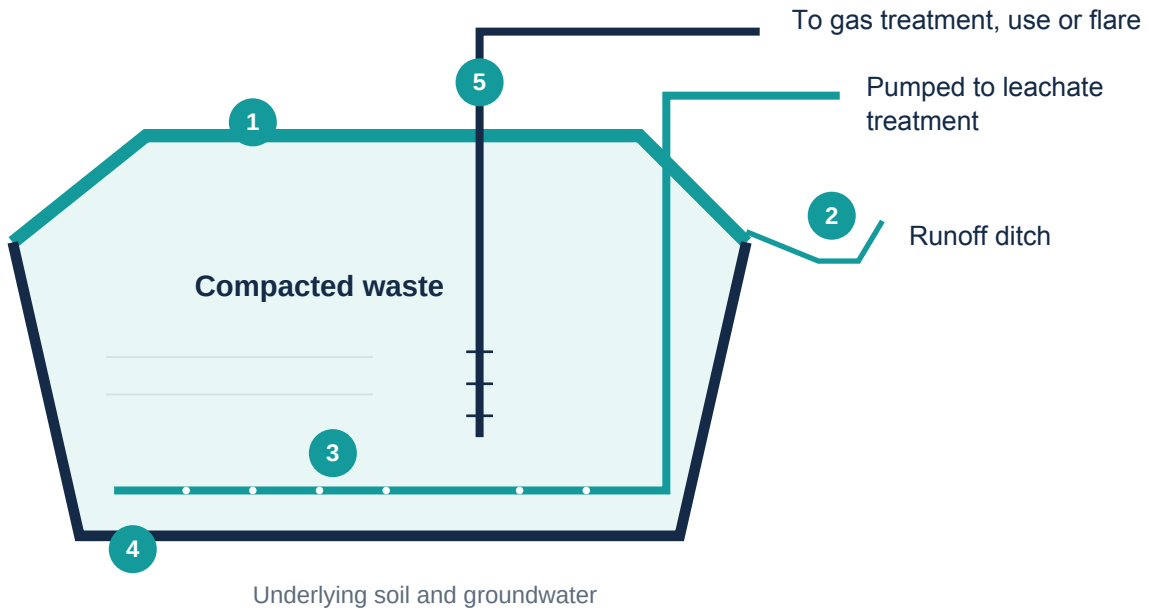
A landfill is an engineered barrier

Solid waste includes discarded materials from homes, businesses, industry and agriculture. A sanitary landfill contains waste and manages its outputs; it does not make the material disappear.

1. A CLOSED LANDFILL CELL: SCHEMATIC, NOT TO SCALE



1. **Cap**
   Limits rain infiltration after closure.
2. **Stormwater drainage**
   Diverts surface runoff away from waste.
3. **Leachate collection**
   Removes contaminated liquid above the liner for treatment.
4. **Bottom and side liner**
   Plastic and/or compacted clay restrict liquid escape.
5. **Gas collection**
   Routes landfill gas to treatment, energy use or controlled flaring.

Engineered protection reduces risk, not the need for care. Groundwater monitoring and maintenance remain important after a cell closes.

Liners, leachate, cover and monitoring: US EPA, Municipal Solid Waste Landfills.
Gas collection and treatment: US EPA, Basic Information about Landfill Gas.

Scope: College Board AP Environmental Science CED, Topic 8.9, pp. 166-167.

Follow the liquid, gas and ash

Disposal transfers or transforms materials. Compare what a method contains, what it releases, and what still needs treatment or long-term management.

1. DECOMPOSITION DEPENDS ON CONDITIONS

Food, paper and other biodegradable materials can support microbial activity. Waste composition, moisture, temperature and oxygen availability affect breakdown. After oxygen is depleted, anaerobic decomposition produces methane and carbon dioxide. Dry conditions can slow decay; buried waste does not all break down at the same rate.

2. LEACHATE AND LANDFILL GAS ARE DIFFERENT

Water passing through waste can carry dissolved or suspended contaminants: this liquid is leachate. Escapes can pollute soil and groundwater. Landfill gas is a separate gaseous output; methane contributes to warming and can pose a fire hazard. Collection systems reduce releases but require operation and maintenance.

3. INCINERATION: SMALLER VOLUME, REMAINING OUTPUTS

Controlled high-temperature burning reduces the volume requiring disposal. Waste-to-energy systems can use the heat to make steam and generate electricity.

Useful heat	Can supply energy; recovery is not the same as material recycling.
Flue gas	Needs emission controls for pollutants such as particles and acid gases.
Ash residue	Bottom ash and captured fly ash still need testing and suitable handling or disposal; composition depends on the waste burned.

Burning does not destroy chemical elements. A smaller residue volume is not proof that the residue is harmless or that air emissions are zero.

Decomposition and gas management: US EPA, Basic Information about Landfill Gas.
Groundwater protection: US EPA, Municipal Solid Waste Landfills.
Energy recovery and residues: US EPA, Combustion of Municipal Solid Waste.

Scope: College Board AP Environmental Science CED, Topic 8.9, pp. 166-167.

Waste outside a managed system

Some materials need separate collection or treatment. Moving unwanted waste to another place can shift the harm rather than solve the disposal problem.

1. ELECTRONIC WASTE

E-waste includes discarded phones, computers and televisions. Some components contain hazardous substances such as lead, mercury or cadmium. Poor handling can expose people and contaminate the environment. Suitable reuse, collection and qualified recycling routes help keep these materials out of uncontrolled dumping.

2. ILLEGAL DUMPING AND DISCARDED TIRES

Facility acceptance rules vary, so some waste needs a designated collection route. Illegal tire piles can trap rainwater, creating mosquito-breeding habitat and increasing disease-vector risk. The mechanism is standing water inside the tires, not the rubber itself producing mosquitoes.

3. OCEAN DISPOSAL AND MARINE DEBRIS

Direct dumping, land-based litter carried by runoff, and lost fishing gear all add debris to water. Wildlife can ingest waste or become entangled, causing injury or death. Currents concentrate floating debris in accumulation zones. A garbage patch is not a solid island: much of it consists of small, dispersed plastic pieces mixed through surface waters.

4. USE DATA TO DESCRIBE A TRADE-OFF

Illustrative case: 1,000 m^3 of incoming waste leaves 150 m^3 of ash.
Volume reduction = (1,000 - 150) / 1,000 × 100 = 85%.
This does not imply an 85% reduction in mass, toxicity or total pollution. Compare air emissions, ash management, energy recovery and costs as well.

E-waste components and handling: US EPA, Electronic Waste and Demolition.
Ingestion and entanglement: NOAA, What is marine debris?
Garbage-patch structure: NOAA, What is the Great Pacific Garbage Patch?

Scope: College Board AP Environmental Science CED, Topic 8.9, pp. 166-167.