TCE EIACP

EIACP Resource Partner

Thiagarajar College of Engineering

where quality and ethics matter

68 YEARS 1957-2025 Celebrating Academic Excellence

INSTITUTION'S INNOVATION COUNCIL

Mission LiFE

"தூய்மை" Mission

"The greatest threat to our planet is the belief that someone else will save it."

– Robert Swan

LiFE Lifestyle for Environment

Date: 14.08.2025 | Venue: TCE

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Waste Management Expert Speaker

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Methodology

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HISTORICAL CONTEXT

Palaeolithic Period
Period of fearing for nature

↓

Mesolithic Period
Period of realising nature

↓

Neolithic Period
Period of glorifying nature

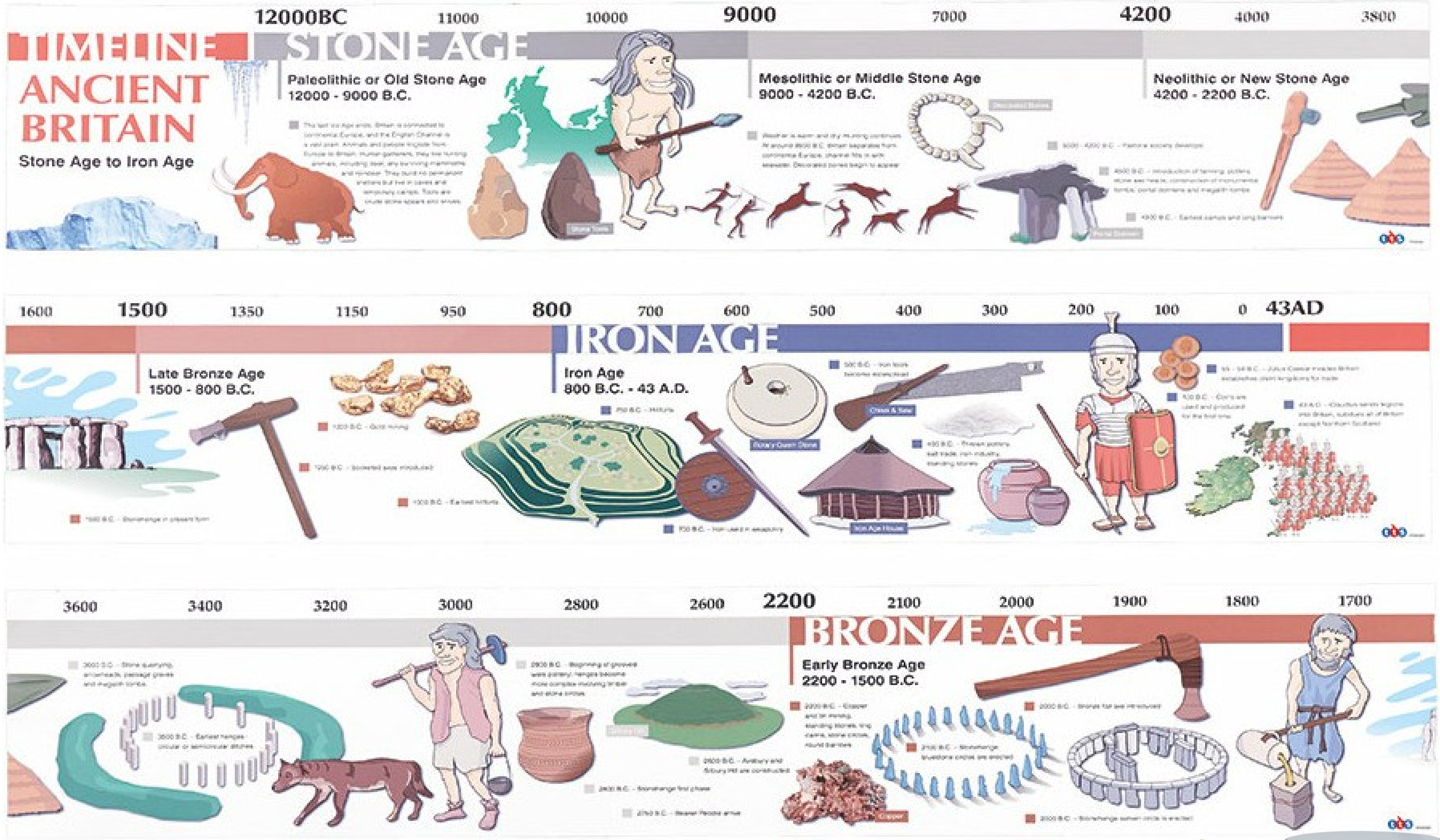
↓

Early Historic Period
Period of destruction of nature

HERMENEUTICAL ANALYSIS

Hinduism	Four Vedas Samhitas Brahmanas	Upanishads Twin Epics Puranas
Buddhism	Vinaya Pitaka Digha Nikaya Samyutta Nikaya Khuddaka Nikaya Jataka Tales	Sutta Pitaka Majjhima Nikaya Anguttara Nikaya Abhidhamma Pitaka
Jainism	Twelve Angas Six Chedasutras Four Mulasutras Ten Prakirnaka sutras Two Chulika sutras	

Time line for age evolution of mankind



Stone Age | Iron Age | Bronze Age

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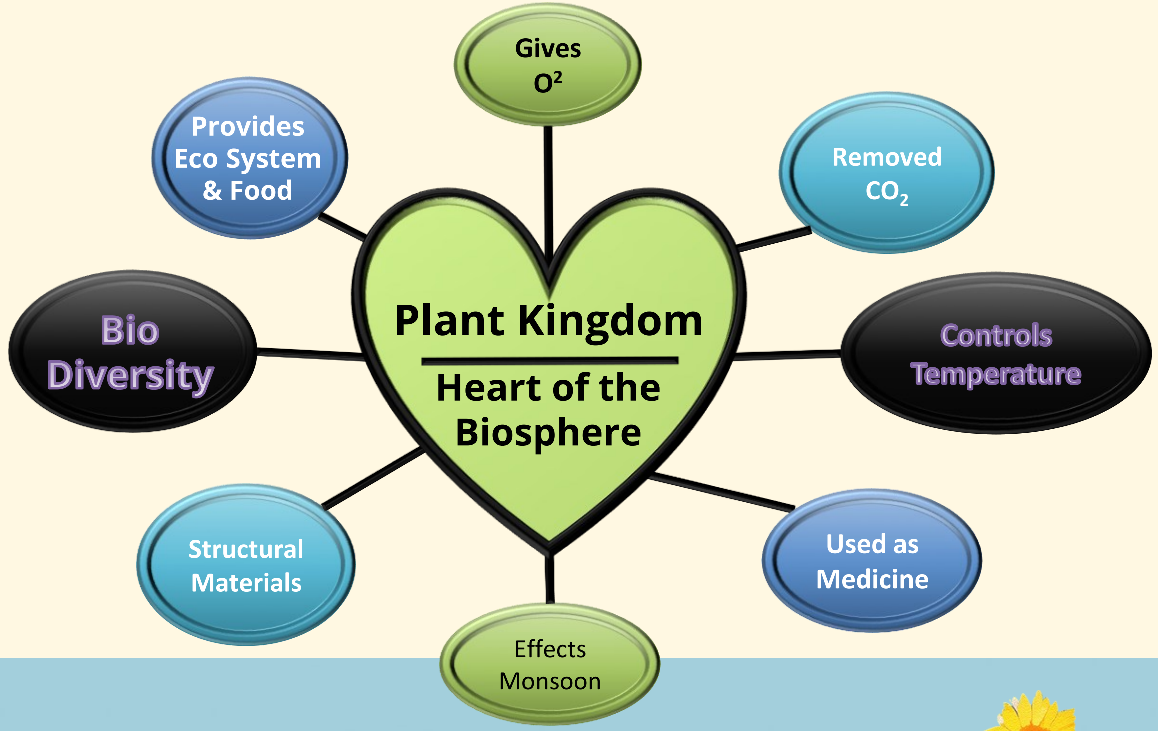
Creations – Life is not alone

Plant Kingdom:

- Heart of the land
- Produces Food and Medicines
- Removes Co2 & produces oxygen
- Help maintaining environmental Conditions like Temperature, Moisture etc,
- Useful as food for others



Man 1/84 Lakhs

- God's ambassador.
- To live in coordination with the nature and help
- Serve and evolve

Animal kingdom

- Helps to Maintain eco system and to sustains environment

Eco Yog - Awaking Mankind

LiFE
Lifestyle for Environment

- All life is Yog
- Everything is related to everything
- Strengthen and restore the natural values
- Be reverential to mother earth
- Each species is special in its own way
- Man is the ambassador to take care
- Yog is for both man and nature
- Non human beings are under stress

LiFE

Lifestyle for Environment

(MoEF & CC – ENVIS – PM)

Definition of Waste

DEFINE WASTE

- USELESS
- USED LESS
- UNWANTED
- DISCARDED IN STREETS
- MOST discomfort WORD TO HEAR
- MOST unhygienic WORD TO HEAR

What actually Waste is?????

- Nothing is called us waste
- One’s waste is other’s wealth
- Not knowing the potential
- Not Rethinking
- Wealth from Waste
- New Scenario
- Waste Management – Finding solution rather find the potential of the waste

Objectives of Waste Management

Waste Management – An art to be Enjoyed….

- Reducing and eliminating adverse impacts of waste materials on human health and the environment to support economic development and superior quality of life.
- This is to be done in the most efficient manner possible, to keep costs low and prevent waste buildup.
- Primarily to reduce pollution to the environment

Waste management

REDUCE – REUSE – RECYCLE – RETHINK – 4R'S

Reuse : Reusing waste in its current form.
Recycling : Processing waste to recover commercially valuable products.
Recover : Recovering energy from waste.
Residuals : Safe disposal in land fills.

How it is Managed….

Worst… or Best….

“In India, annual per capita cost of municipal solid waste management ranges from Rs 204 to Rs 900 for capital investment and from Rs 113 to Rs 269 for operation and maintenance”

Period / Era	Key Features	Waste Handling Methods
Pre-1800s (Ancient & Medieval Village Systems)	Self-contained agrarian economy; almost zero inorganic waste	• Organic waste: fed to livestock or composted (pazhayam kuzhi). • Night soil: collected manually, composted far from water sources. • Ash: used as soil amendment. • Animal scavenging: pigs, dogs, cattle consumed scraps.
1800–1850 (Early Colonial Period)	Introduction of new crops & tools; towns begin to expand	• Waste still mostly organic. Composting linked with Kudimaramathu tank-cleaning for silt reuse & Repair culture for metal, cloth, pottery.
1850–1940 (Late Colonial & Early Industrial Era)	Small-scale industry in towns; railways bring trade goods in new packaging	• Leaf, jute, and wooden packing reused in markets. • Night soil used as fertilizer for peri-urban farms & Municipal committees in Madras Presidency introduced waste collection carts.
1940–1970 (Post-Independence Agrarian Focus)	Green Revolution; increased inorganic materials (cement bags, plastics in 60s)	• Organic waste still cycled into farms, Inorganic waste burnt or buried informally, Village thotti system continued.
1970–1990 (Urban Expansion & Plastics Era)	Consumer goods boom; plastics become common	• Composting continues in villages, Plastics begin to choke drains in towns, Scrap dealers (irumbu kadai) collect metal, glass bottles for resale.
1990–2010 (Modernization & Decentralization)	Urban solid waste rules emerge; SHGs & NGOs in rural SWM	• Self Help Groups recycle plastics, First micro compost centers in towns, Panchayats experiment with door-to-door collection.
2010–Present (Integrated SWM & Sustainability)	Solid Waste Management Rules 2016; statewide SWM policy	• Thooimai Kaavalars in all villages, Segregation at source; MCCs & MRFs, Plastics to road-laying or recycling.- Biogas plants for wet waste, Temple waste composting.

Waste Management Evolution in Tamil Nadu

Pre-1800s

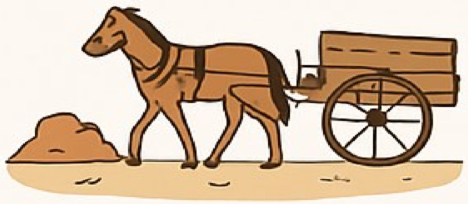
Village Systems

Organic waste fed to livestock or composted

Composting linked with tank cleaning (Kudimaramathu)

1800-1850

Early Colonial Period



Inceease ing inorganic waste, continued composting

Municipal waste collection carts introduced

1850-1940

Late Colonial & Industrial Era

Increase in inorganic waste, continued composting

Plastics begin to choke drains In towns

1940-1970

Post-Independence

Integrated SWM

Thooimai Kaavalars & MCCs for segregation

Key Takeaways

- **Old wisdom never left** — Tamil Nadu's SWM still builds on traditional composting, segregation, and reuse practices.
- **Main changes:** Hygiene, mechanization, and integration of new waste streams (plastics, e-waste).
- **Cultural continuity:** Temple waste composting, leaf-based packaging, tank cleaning, and livestock manure recycling are still core pillars.

Visual Summary

- **Historic core principle:** Waste = Resource.
- **Colonial transition:** Organized street cleaning in towns.
- **Post-independence drift:** Rural systems intact but plastics emerge.
- **Modern approach:** Formalized systems that actually re-adopt traditional composting but add technology (biogas, MCC, road plastics).

Roles & Responsibilities of Engineers

Civil & Environmental Engineers

- **Waste System Planning** – Designing collection networks, transfer stations, sanitary landfills, and treatment facilities.
- **Environmental Impact Assessment (EIA)** – Evaluating potential effects of waste facilities on air, water, and soil.
- **Leachate & Drainage Systems** – Designing leachate control and stormwater management in landfills.
- **Structural Design** – Overseeing construction of compost plants, recycling centers, and incinerators.

Civil & Environmental Engineers in Waste Management

Waste System Planning

- Objective: Ensure efficient collection, transportation, and disposal of waste
- Mapping waste generation points us- ing GIS tools
- Designing collection routes for mini- mum fuel and time usage
- Planning transfer stations for temporary waste storage before final processing

Leachate & Drainage Systems

- Objective: Prevent groundwater contamination and flooding
- Designing leachate collection layers vith gravel, pioes, and sumps
- Using HDPE liners to prevent seepage into the soil
- Integrating stormwater diversion channels to reduce water infiltration into waste cell

Environmental Impact Assessment (EIA)

- Objective: Prevent environmental deg- radation from waste facilities
- Baseline environmental studies (air, water, soli, biodiversity)
- Modeling potential pollutant dispersion (dust, odors, leachate seepage)
- Engaging stakeholders in public consu- Itations for sustainable project approval

Structural Design

- Objective: Provide durable, safe, and effi- clent waste management intrastructure
- Designing reinforced concrete structures for compost pits, sorting platforms, and transfer stations
- Planning ventilation and odor control in enclosed facilities

Mechanical Engineers in Waste Management

Equipment Design & Selection

Objective: Ensure waste processing is efficient, safe, and reliable

- Designing shredders, compactors, too balers, and crushers for waste waste types
- Selecting durable materials resistant to corrosion, abrasion, and high temperatures

Material Recovery Systems

Objective: Maximize resource recovery and reduce landfill load

- Developing mechanical sěsseparation systems (screens, air classifiers, magnetic separators)
- Designing conveyors and sorting lines for recyclable material handiing

Maintenance & Reliability

Objective: Minimize downtime and extend equipment life

- Create prevenctive maintenance schedules for processing machinery
- Implementing predictive mintenance using secsors and vibrction monitoring

Pollution Control Integration

Objective: Ensure machinery meets environmental emission norms

- Designing mechanical cotcollectorrocress scrubbers, and filters
- Reducing noise and vibration levels from processing equipment

Computer Science & IT Engineers in Waste Management

Smart Waste Management

- Use digital technologies to improve waste collection, segregation, and monitoring

Key tasks

- Developing IoT-enabled smart bins with fill-level sensors
- Implementing real-time waste tracking systems for municipalities
- Integrating RFID tags and QR codes for waste source identification

Data Analytics & AI

- Predict and optimize waste handling operations using data

Key tasks

- Analyzing waste generation patterns using big data tools
- Creating AI algorithms to optimize collection routes and processing schedules
- Using machine learning models to forecast seasonal and event-based waste spikes

GIS Mapping

- Plan and manage waste disposal infrastructure effectively

Key tasks

- Mapping waste transport routes to minimize travel dist-ance and fuel use
- Identifying optimal Llandfill or recycling plant locations using spatial analysis

Roles and Responsibilities of Engineers in Waste Management

Civil & Environmental Engineers

- **Waste System Planning**
  Designing collection networks, transfer stations, sanitary lanıtfills, and treatment facilities
- **Environmental Impact Assessment**
  (EIA) Evaluating potential effects of waste facilities on air, water, and soil
- **Leachate & Drainage Systems**
  Designing leachate control and storm-water management in landffils
- **Structural Design**
  Overseeing construction f compost plants, recycling centers, and incinera'

Mechanical Engineers

- **Equipment Design & Selection**
  Designing/optimizing shredders, compacters, balers, sorting machines
- **Material Recovery Systems**
  Developing mechanical separation, conveyor, and nandling systems
- **Maintenance & Rellability**
  Establishing preventive maintene-schedules for waste processing machinery
- **Pollution Cortroration**
  Implementing mechanical automation in sorting and transfer systems

Chemical Engineers

- **Treatment Process Design**
  Designing anaerobic dipestion aposting, pyrolysis, and incineration proce
- **Automation & Control**
  Implementing SCADA, PLCSCs and IoT-based montionng systems
- **Sensor Technologies**
  Designing optical, intrer and magnetic sensors for waste sorring
- **Energy Recovery Systems**
  integrating tenewable energy *soourcrs* (solar, bloges generators) in waste

Electrical & Electronics Engineers

- **Power Systems**
  Managing ełectrical supply for waste processing plants
- **Automation & Control**
  Implementing SCADA, PLCs and Ibased monitoring systems
- **GIS Mapping**
  Planning waste transport and disposal sites using spatial data analysis

Computer Science & IT Engineers

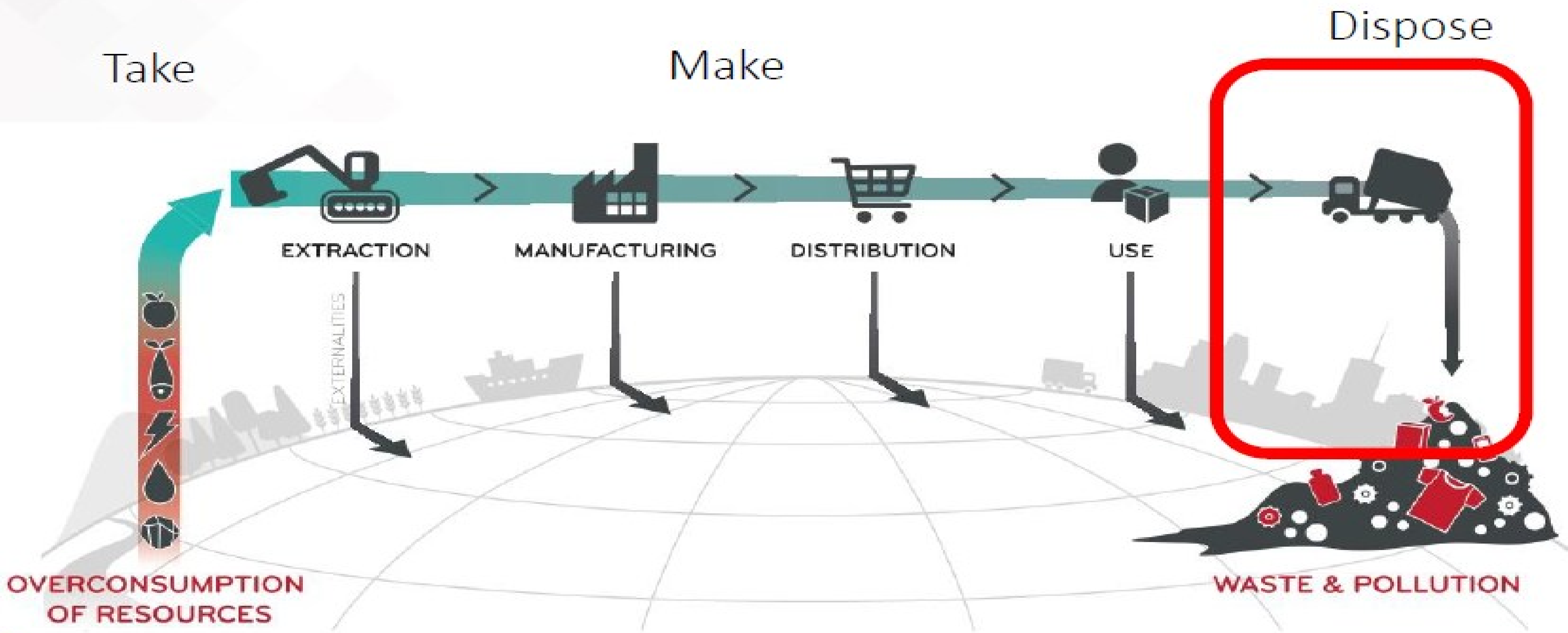
- **Smart Waste Management**
  Developing IoT-enabled smart bins and waste tracking systems
- **Data Analytics & AI**
  Predicting waste generation trends, optimizing collection routes
- **Digital Platforms**
  Creating apps for wanεiting rroteing

Safety Engineers

- **Risk Assessment**
  identifying hasards in waste handling, transport, and treatment
- **Worker Safety Protocols**
  Ensuring use of PPE, safe equεoemation and accident prevention
- **Regulatory Compilance**
  Meeting OSHA environmenticnd, municipal safety standards

Present Model not Working…..

Linear Economy



+ population & the demand for resources is exponential

Categories of Waste

Category	Description	Examples
Biodegradable Waste	♻ Organic waste that decomposes naturally with the help of microorganisms. (Safe for composting)	🍌 Food waste: leftover rice, vegetable peels, fruit rinds, spoiled bread, coffee grounds 🌿 Garden waste: dry leaves, grass clippings, flowers, small branches, coconut husks 🧻 Paper napkins, sawdust, sugarcane bagasse
Non-Biodegradable Waste	🏭 Waste that does not decompose easily and can persist in the environment for decades or centuries. (Should be recycled)	🛍 Plastics: carry bags, bottles, food wrappers, straws 🥫 Metals: aluminium cans, steel utensils, copper wires 🍾 Glass: broken bottles, jars, mirrors 🧵 Synthetic fabrics, thermocol, rubber tyres
Hazardous Waste	⚠ Toxic, flammable, corrosive, or otherwise dangerous to humans, animals, or the environment. (Requires special disposal)	🧪 Chemicals: paint, varnish, pesticides, acids, solvents 💻 E-waste: old computers, mobile phones, printers, circuit boards 🔋 Batteries: lithium-ion cells, car batteries, button cells ☣ Industrial sludge, oil-soaked rags, fluorescent tubes (mercury)
Biomedical Waste	☣ Waste from healthcare facilities and laboratories that may carry infectious agents. (Requires incineration or specialized treatment)	💉 Medical materials: syringes, blood bags, IV tubes, surgical blades 😷 PPE: gloves, masks, face shields, gowns 🩸 Pathological waste: human tissues, blood-soaked cotton, bandages 🧫 Diagnostic swabs, culture plates, contaminated dressings

Growing Waste Problem in India & Globally

India:

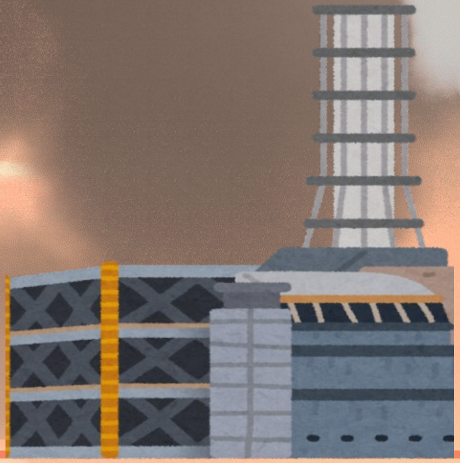
- India generates ~160,000 tonnes of municipal solid waste daily (CPCB, 2023), projected to double by 2035.
- Rapid urbanization, increasing population, and changing consumption patterns have caused a surge in plastic packaging waste, e-waste, and biomedical waste.
- Collection rates in urban areas average around 75–80%, but scientific disposal is often below 25%, leading to open dumping and burning.

Global Scenario:

- The world generates over 2.3 billion tonnes of municipal waste annually (World Bank, 2023).
- Only ~19% is recycled or composted globally; the rest ends up in landfills, dumpsites, or oceans.

By 2050, global waste is expected to rise by 70% if no urgent action is taken

Air Pollution and Health Risks



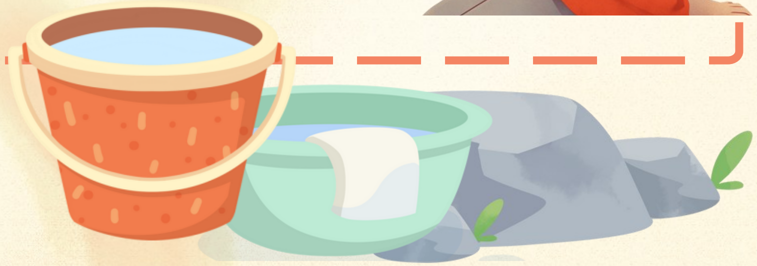
- Open burning of waste releases toxic gases like dioxins, furans, and particulate matter, affecting local air quality.
- Decomposing organic waste in anaerobic conditions emits methane, a potent greenhouse gas contributing to climate change.

Land Pollution

- Unmanaged landfills lead to soil contamination from leachate containing heavy metals, plastics, and chemicals.
- Occupation of large tracts of land for dumping reduces agricultural productivity and degrades ecosystems.

Water Pollution

- Leachate from dumps seeps into groundwater and surface water, contaminating drinking sources.
- Plastics in rivers and oceans harm aquatic life and enter the food chain as microplastics

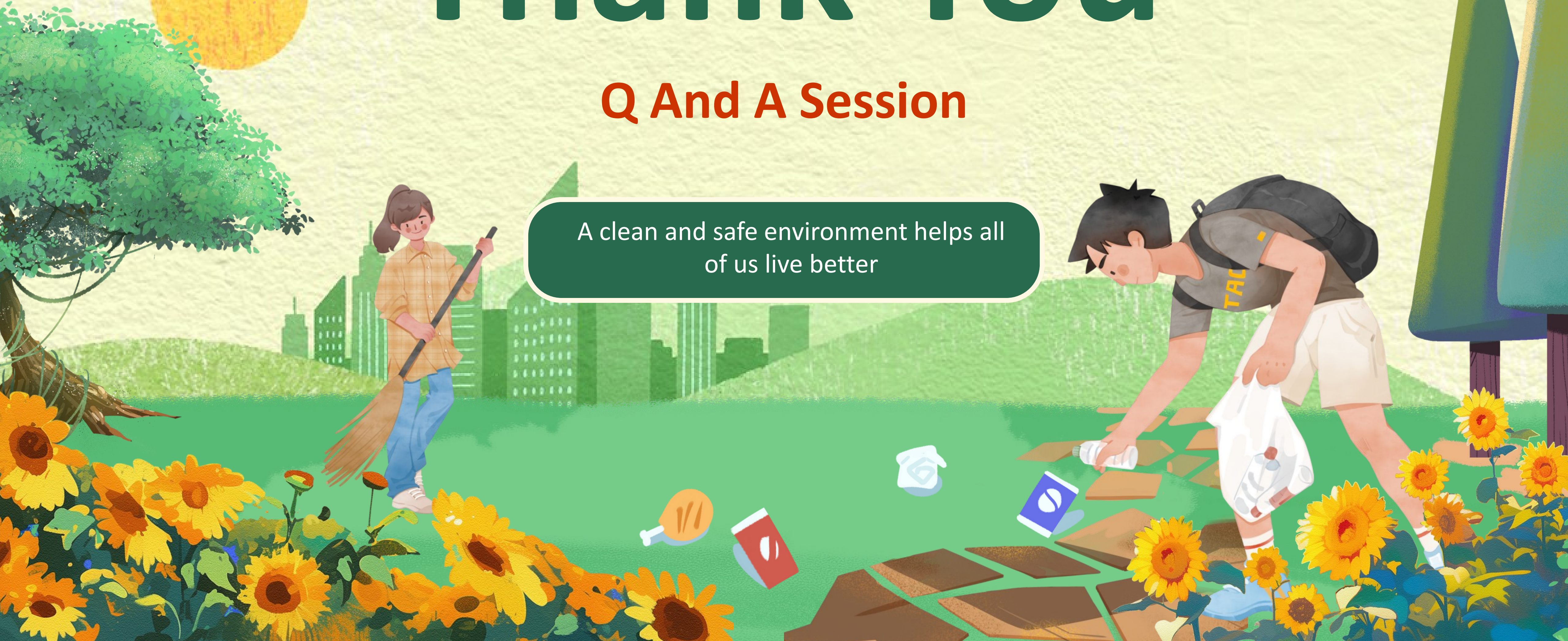


Health Hazards of Poor Waste Disposal

- **Vector-borne diseases:** Open dumps attract rats, flies, and mosquitoes, spreading dengue, malaria, and leptospirosis.
- **Respiratory issues:** Inhalation of smoke from burning waste leads to asthma, bronchitis, and other chronic illnesses.
- **Chemical poisoning:** Exposure to heavy metals (lead, mercury, cadmium) in improperly disposed e-waste can cause neurological, kidney, and developmental problems.
- **Infectious diseases:** Improper biomedical waste handling spreads infections like hepatitis, HIV, and COVID-19.

Thank You

Q And A Session



A clean and safe environment helps all of us live better