

word cloud containing terms related to water and environmental engineering, including:

- suspended
- turbidity
- solids
- wastewater
- Oxygen
- waste
- sample
- total
- treatment
- filtration
- measure
- volume
- dissolved
- filter
- data
- samples
- temperature
- Sustainability
- may
- mass
- filter
- laboratory
- concentration
- mg/l
- fraction
- determine
- procedure
- most
- remove
- SOURCE
- books
- pressure
- apparatus
- Record
- crucible
- Introduction
- different
- particles
- PH
- sound
- constant
- effluent
- surface
- lake
- amount
- Equipment
- three
- place
- Lab
- results
- influent
- glass
- mg/l
- fraction
- determine
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- SOURCE
- books
- pressure
- apparatus
- Record
- crucible
- Introduction

environmental

Environmental Science

The **study of the processes**

- in water,
- air, and
- soil & organisms which **lead to pollution** or environmental damage.

the **scientific basis** for the establishment of a **standard** which can be considered acceptably **clean, safe and healthy for human beings** and the natural ecosystem.



Quantitative environmental science

- Environmental science is an **organized body of knowledge** about environmental relationships
- While quantitative environmental science is an organized collection of **mathematical theories** that may be used to describe and explore environmental relationships
- In this course, some mathematical theories that may be used to describe and explore environmental relationships will be discussed.

What is Environmental Engineering?

“The application of science and engineering principles to **minimize the adverse effects of human activity on the environment.**”

Water pollution

Solid waste

Air pollution

Hazardous waste

Environmental Science (understanding nature & the environment)



Environmental Engineering (applying the knowledge to improve the environment)



Environmental Engineering

- The Environmental Engineering Division of the American Society of Civil Engineers (ASCE) has published the following statement of purpose that may be used to show the relationship between environmental science and environmental engineering:

Environmental engineering is manifest by sound engineering thought and practice in the solution of problems of environmental sanitation, notably in the provision of safe, palatable, and ample public water supplies; the proper disposal of or recycle of wastewater and solid wastes; the adequate drainage of urban and rural areas for proper sanitation; and the control of water, soil, and atmospheric pollution, and the social and environmental impact of these solutions. Furthermore it is concerned with engineering problems in the field of public health, such as control of arthropod-borne diseases, the elimination of industrial health hazards, and the provision of adequate sanitation in urban, rural, and recreational areas, and the effect of technological advances on the environment (ASCE, 1977).

Environmental Engineering

- Concerned with the design, manufacture, installation and operation of the **engineering systems** that **sustain and control the environments** required by people and processes.
- **ENVIRONMENTAL ENGINEER**
 - is a professional trained in the art of **applying scientific principles** and technological means **to avoid or reduce forms of pollution by human activities**.
 - This includes possessing a knowledge of past and current engineering practice and an ability to innovate.

Environmental Engineering

- object-focused (problem focused), rather than tool-based
- In other areas of engineering, a **need** creates a **market** and the market drives **technology development**
- In environmental engineering, it starts with a **problem**, which drives **regulations**, regulations create the **market**, and the market drives the **technology**.
- It operates at four different levels:
 - **remediation** of contaminated sites (=fixing the past),
 - **treatment** of effluents (=dealing with present),
 - pollution **prevention**, and
 - **care for future** generations.

Operational levels of Environmental Engineering

- Environmental remediation (fixing the past)
 - Cleaning up contaminated areas after wastes have been released
 - focuses on **toxic and hazardous** substances
 - involves far **higher costs** than other levels
 - involves reaction, separation, or a combination of these
 - may be carried out either by removing contaminated material for treatment/disposal **at a centralized location** or in some cases may be accomplished **in place ("in situ")** without such removal

Operational levels of Environmental Engineering

- **Treatment** of effluents (=dealing with present)
 - Design and analysis of devices for treating polluted effluents.
 - Frequently, a given effluent treatment technology can be applied to **wastes arising from a wide diversity of processes**. (Eg. activated sludge treatment systems are largely the same whether the system is treating sewage or wastewater after manufacture of chemicals, paper or food products.)
 - Distinction needs to be made between **point and distributed** sources.
 - Treatment of effluent from distributed sources is far more complicated.

Operational levels of Environmental Engineering

- pollution prevention
 - The concept of designing products and processes to minimize environmental impacts
- Example
 - analyzing the life cycle of a particular product
 - from resource extraction,
 - to manufacture (which may involve multiple steps)
 - use (often by individual consumers), and
 - disposal (including recycling)

Operational levels of Environmental Engineering

- care for future generations
 - The goal is to support human society **without depleting resource stocks** and **without accumulating wastes**.
 - society supported by sustainable resources will be the result of the development and **deployment of new processes and technologies** within the context of an understanding of the interaction between
 - resource utilization,
 - consumption patterns, and
 - environmental carrying capacity.



Engineers/Scientists



Development Boundary



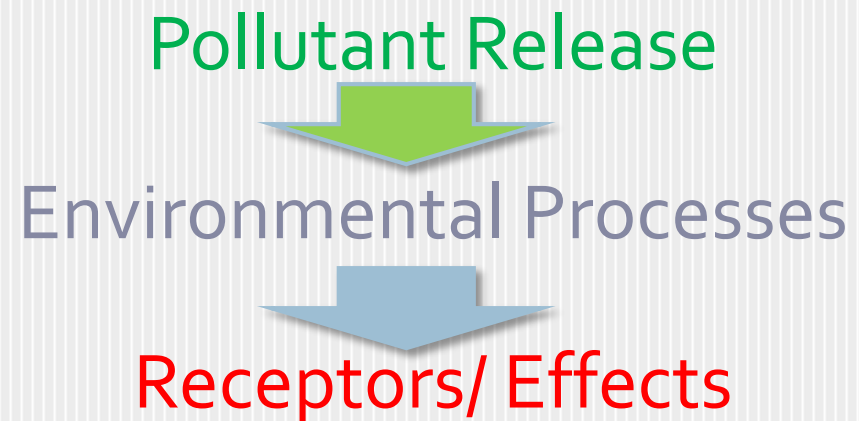
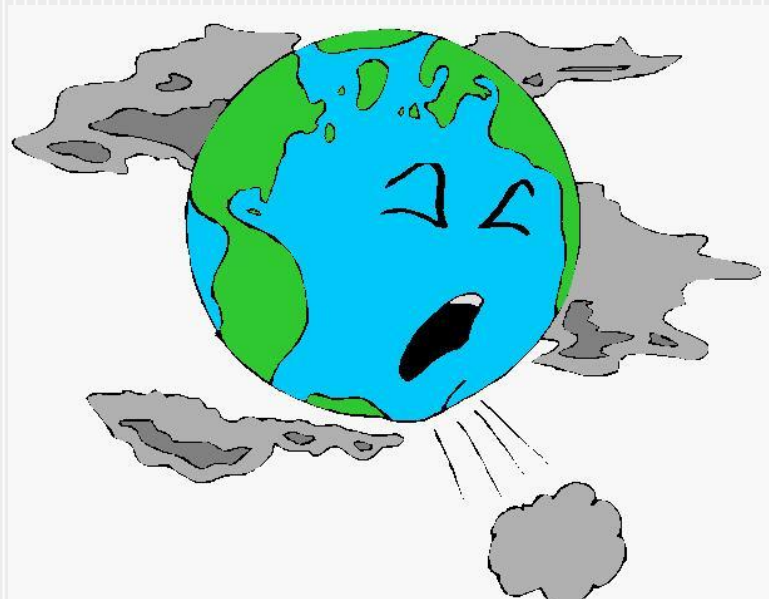
Constraints



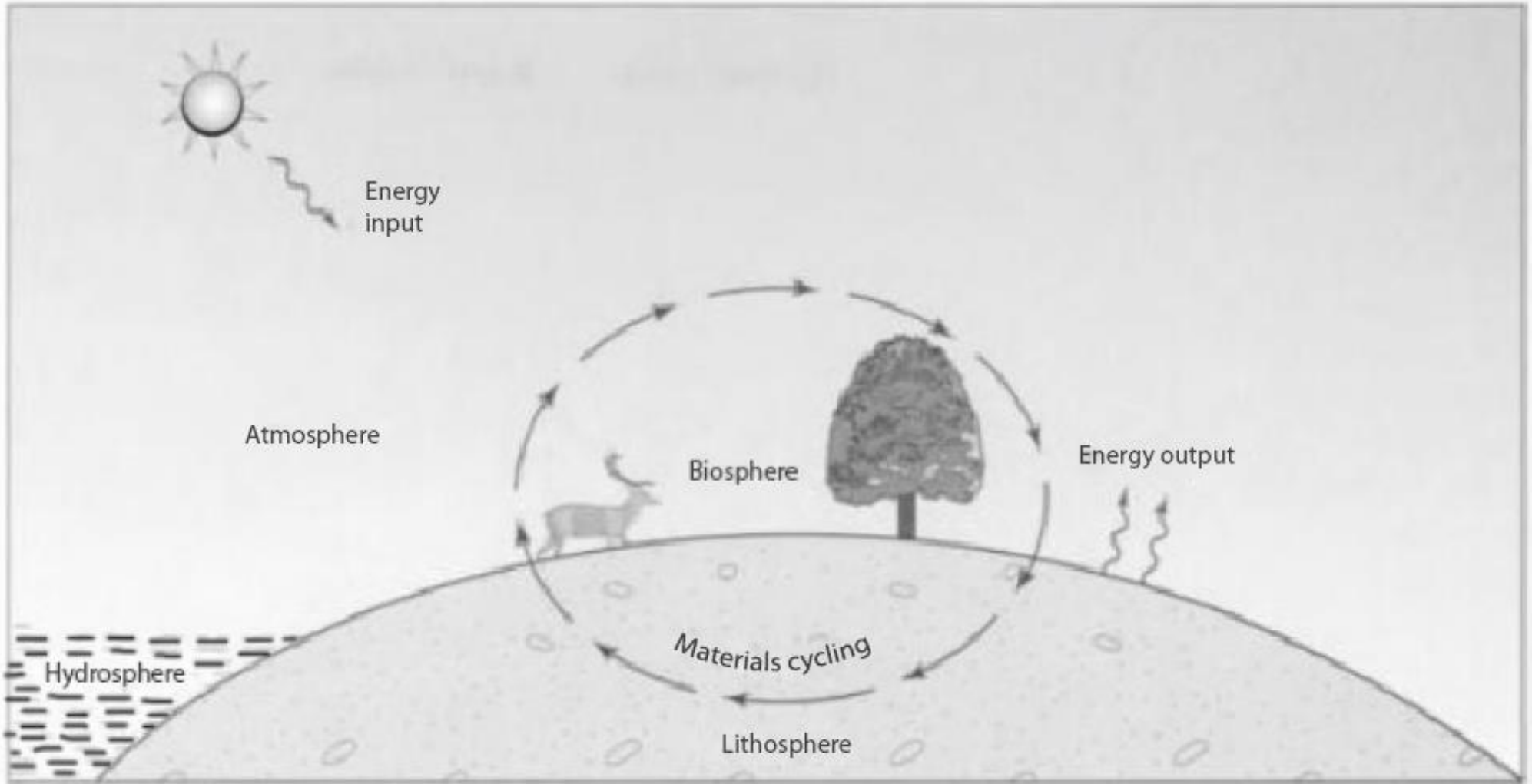
Pollution

Environmental pollution is

- *the **contamination** of the environment with substances that are **potentially injurious** to human, plant, and animal life or the quality of that life.*



Environmental Systems Overview



Three environmental systems

The water resource management system

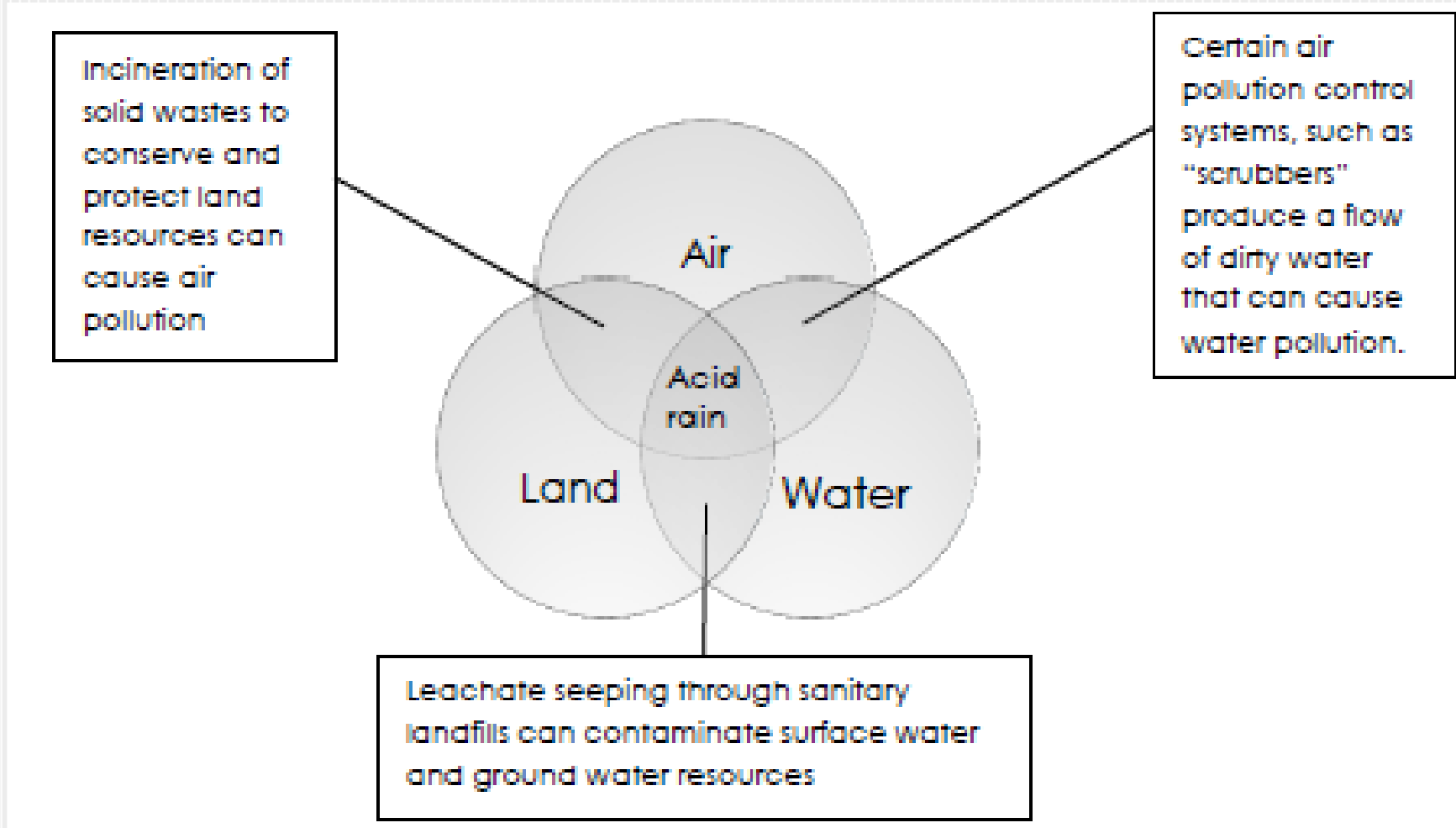
The air resource management system

The solid waste management system

Single-medium and multimedia pollution problems.

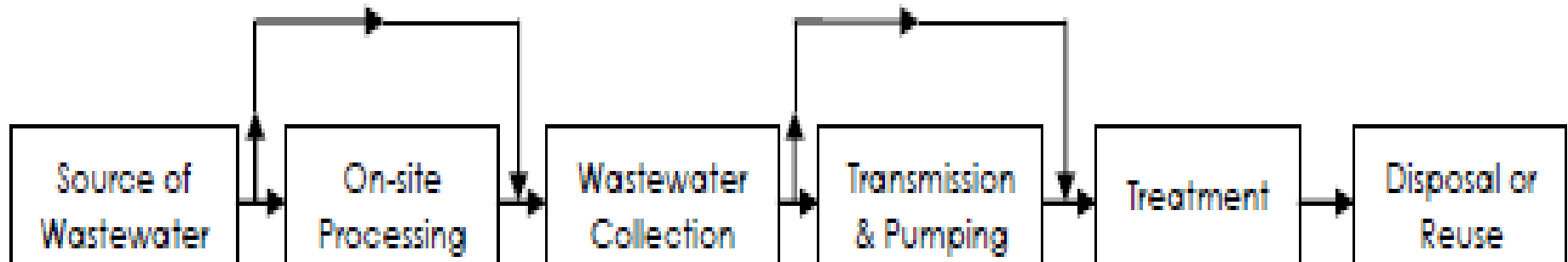
Three environmental systems

- Some problems can be *multimedia* pollution problems.



Three environmental systems

- *The water resource management system*
 - Water Supply Subsystem
 - Design and operation of the collection, purification, transmission & distribution work
 - Wastewater Disposal Subsystem

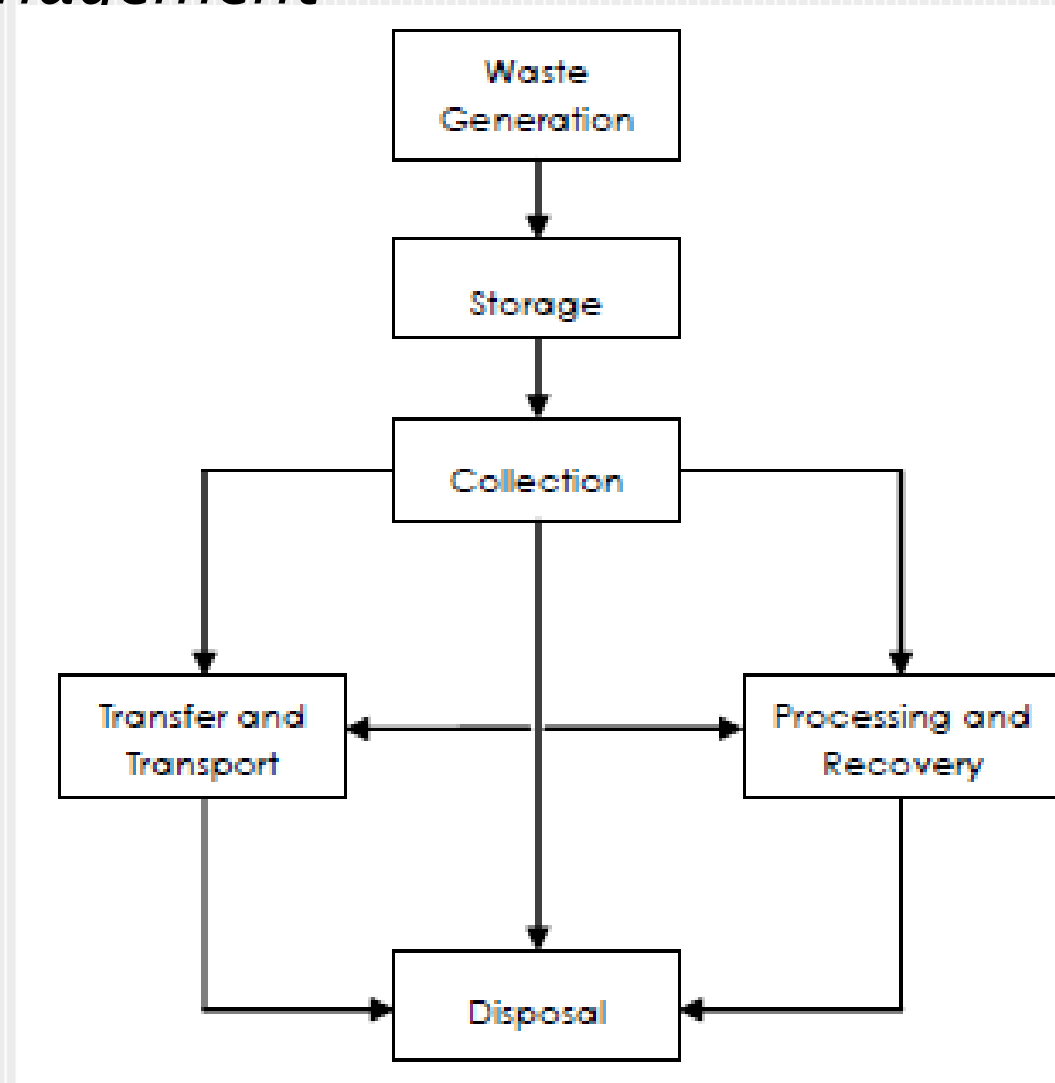


Three environmental systems

- *Air Resource Management System*
 - It involves the balance of cost and benefit to obtain a desired quality of air.
 - Air resource management programs are instituted for a **variety of reasons**. The most defensive reasons are that
 1. air quality has deteriorated, and
 2. the potential for a future problem is strong.

Three environmental systems

- *Solid Waste Management*





Example Activities of Environmental Engineers

- *Remediation of soil contaminated by a gasoline leak*
 - *Permit application based on atmospheric dispersion estimates*
 - *Improving environmental performance after an audit*
 - *Preparation of an environmental impact assessment*
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Environmental policies and legislations


- *Problem* ⇒ regulations and policies
- Environmental law consists of all legal guidelines that are intended to protect our environment.
- Environmental law helps
 - To protect the environment and prevent/minimize pollution
 - To keep environmental quality
 - Promote sustainable development

Key Environmental Laws

Year	Title	Purpose
1963	Clean Air Act (CAA)	Legislation to restrict emission levels of air pollutants from automobiles.
1974	Safe Drinking Water Act (SDWA)	Drinking water regulation to protect public health which specified the MCLs .
1976	Resource Conservation and Recovery Act (RCRA)	To protect the public from harm caused by waste disposal, to encourage reuse, reduction, and recycling , and to clean up spilled or improperly stored wastes.
1977	Clean Water Act (CWA)	Legislation for BAT (Best Available Treatment) requirement for toxic substances and BCT requirement for conventional pollutants.
1980	Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA)	Created to protect public health from heavily contaminated toxic waste sites that have been abandoned.



Environmental Ethics

- *Ethics is the systematic analysis of morality.*
 - Morality is the **perceptions we have of what is right** and wrong, good or bad, or just or unjust.
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An Environmental Code of Ethics

1. Use knowledge and skill for the enhancement and protection of the environment.
2. Hold paramount the health, safety and welfare of the environment.
3. Perform services only in areas of personal expertise.
4. Be honest and impartial in serving the public, your employers, your clients and the environment.
5. Issue public statements only in an objective and truthful manner.



Reading assignment

Read about historical perspective of environmental engineering and environmental awareness.



Be nice to Earth
as you are to yourself!

