## Environmental Health:

The humans interact with the environment constantly in everywhere. These interactions affect quality of life, years of healthy life lived, and health challenges or deterioration. The World Health Organization (WHO) defines environment, as it relates to health, as:

"All the physical, chemical, and biological factors external to a person, and all the related behaviors."

**Everything which surrounds us may collectively be termed as the Environment.**

According to the WHO, an estimated 12.6 million people died as a result of living or working in an unhealthy environment in 2012 – nearly 1 in 4 of total global deaths, according to the latest estimates from WHO. Environmental risk factors, such as air, water and soil pollution, chemical exposures, climate change, and ultraviolet radiation, contribute to more than 100 diseases and injuries.

## Basic Components of the Environment:

Environment consists of all living and non-living things which surround us. Therefore, the basic components of the environment are:

### 1. Atmosphere or the Air:

The protective layer of gases (O2, N, CO2, argon, elements traces) surrounding the earth and what is living on it.

It has the following benefits

- It sustains life on the earth

- It saves it from danger of outer space
- It absorbs most of the radiation from sun light
- It allows and transmits only ultraviolet and visible near infrared light (300-2500 nm) and radiowaves

**2. Hydrosphere:** is the part represents all types of water resources (oceans, seas, rivers, lakes, etc)

**3. Lithosphere:** is the outer portion (mantle) of the solid earth. It consists of minerals in the earth surface and soil.

**4. Biosphere:** is the living portion of the sphere which includes all living organisms and their interaction with other environment kinds like atmosphere, hydrosphere and lithosphere

**Structure of Environment:**

1. **Physical Environment**

| **Category** | **Sphere** | **Type of Environment** |
|---|---|---|
| **Solid** | Lithosphere (Earth) | Lithosphere |
| **Liquid** | Hydrosphere (Water) | Hydrosphere |
| **Gas** | Atmosphere (Air) | Atmosphere |

2. **Biological Structure**

This consists of biotic environment:

a. Plants → Flora Environment

b. Animals → Fauna Environment

## General Types of Environment

1. Physical environment:

It refers to the geographical climate conditions. The human race affected by the local climate.

a. In the cold countries people have white skin.

b. In the hot countries people have dark skin.

2. Social and cultural environment: This includes

Social, Economical, Religion, Political conditions.

3. Psychological Environment: Kurt Lewin used the term "Life Space" explaining psychological environment to understand individual personality

## Elements of functional environments:

1. Physical elements:

These include space, land forms, water bodies (like rivers, oceans, seas), soil, rocks & minerals.

2. Biological elements:

These include plants, animals, microorganisms, and human being

3. Cultural elements:

These include economic, social and political and archeological

activities.

**Importance of Environmental Studies:**

1. Dealing with International environmental problems such as

global warming, ozone depletion, acid rain, marine pollution, biodiversity

2. Problems created in the wake of development due to the advancement in the:

- urbanization,

- industrial growth &

- transportation systems

3. Increasing in pollution: which has serious impact on the natural resources such as land causing soil problems: salinity, micronutrient deficiency, texture and organic matter reduction

4. Need for an alternative solutions:

Searching for goals on:

- how to solve environmental problems like moving bricks factory from residential area to the industrial areas

5. The need to save humanity by establishing safe life through setting environmental regulations.

6. The need for wise planning and development:

- Proper planning leads to safe environment.

example: making oil refinery far from the city and residential areas.

## Misra's report

Misra (1991) recognized 4 principles in Ecology:

- Holism, Ecosystem, Succession, Conversation

Holism is considered the real base for Ecology.

This base was described at hierarchial levels:

Individual < population < community < ecosystem < biome < biosphere

## Environmental Challenges:

1. Growing population
2. Poverty
3. Agricultural growth problems
4. Affecting ground water
5. Development and forests
6. Lands degradation
7. Reorientation of institutions
8. Reduction of genetic diversity
9. Negative consequences of urbanisation
10. soil, water and air pollution

**Environmental health** is the branch of public health that is concerned with all aspects of the natural and built (man-made) environment that may affect human health.

Other terms referring to or concerning environmental health are **environmental public health**, and **public health protection** / **environmental health protection**. Environmental health and environmental protection are very much related. The only difference between these terms is that: The environmental health focused on the natural and built environments for the benefit of human health, whereas environmental protection is concerned with protecting the natural environment for the benefit of **human health** and the **ecosystem**.

**Definitions:**

Environment refers to anything that is immediately surrounding us, affect our life or activity.

**Specific Definitions of Environment: Schools of Environment:**

1. Boring: The sum total of the stimulation received by human from his conception to his death.
2. Douglas and Holland: is all the external forces, effects and conditions affecting life, nature, growth, development and maturity of organism

**Environmental health** has been defined in a 1999 document by the WHO as:

Those aspects of the human health and disease that are determined by factors in the environment. It also refers to the theory and practice of assessing and controlling factors in the environment that can potentially harmful and affect health.

Environmental health as described by the WHO, includes:

A. the direct pathological effects of chemicals, radiation and some biological agents, and
B. the indirect effects on health and well being of the broad physical, psychological, social and cultural environment, which includes housing, urban development, land use and transport.

As of 2016 the WHO website on environmental health states "Environmental health addresses all health factors:

- Physical,
- Chemical,
- Biological factors external to a person, and
- Other related factors impacting behaviours.

It includes the assessment and control of those environmental factors that can potentially affect health. It is targeted towards preventing disease and creating health-supportive environments.

The WHO has also defined environmental health services as: "those services which implement environmental health policies through monitoring and control activities. They also carry out that role by promoting the improvement of

environmental parameters and by encouraging the use of environmentally friendly and healthy technologies and behaviors and developing and suggesting new policy areas.

**Disease:**

Any deviation from the normal structure or function of body part, organ, or system that is associated
with symptoms and signs and whose etiology, pathology,and prognosis may be known or unknown.

**Goal of Environmental Health:**

The goal of Environmental health is preventing or controlling disease, injury, and disability related to the interactions between people and their environment.

This goal can be achieved by focusing on the following elements of environmental health:

1. Outdoor air quality
2. Surface and ground water quality
3. Toxic substances and hazardous wastes
4. Homes and communities
5. Infrastructure and surveillance
6. Global environmental health

Outdoor Air Quality:

Poor air quality is linked to premature death, cancer, and long-term damage to respiratory and cardiovascular systems. Progress has been made to reduce unhealthy air emissions, but, in 2008, approximately 127 million people lived in U.S. counties that exceeded national air quality

standards. Decreasing air pollution is an important step in creating a healthy environment.

Surface and Ground Water:
Surface and ground water quality applies to both drinking water and recreational waters. Contamination by infectious agents or chemicals can cause mild to severe illness. Protecting water sources and minimizing exposure to contaminated water sources are important parts of environmental health.

Toxic Substances and Hazardous Wastes:
The health effects of toxic substances and hazardous wastes are not yet fully understood. Research to better understand how these exposures may impact health is ongoing. Meanwhile, efforts to reduce exposures continue. Reducing exposure to toxic substances and hazardous wastes is fundamental to environmental health.

Homes and Communities:
People spend most of their time at home, work, or school. Some of these environments may expose people to:

- Indoor air pollution
- Inadequate heating and sanitation
- Structural problems
- Electrical and fire hazards
- Lead-based paint hazards

Infrastructure and Surveillance:

Prevention of exposure to environmental hazards relies on many partners, including State (Government) and local health departments. Personnel, surveillance systems, and education are important resources for investigating and responding to disease, monitoring for hazards, and educating the public. Additional methods and greater capacity to measure and respond to environmental hazards are needed.

Global Environmental Health:

Water quality is an important global challenge. Diseases can be reduced by improving water quality and sanitation and increasing access to adequate water and sanitation facilities.

**Disciplines:**

Three basic disciplines generally contribute to the field of environmental health:

1. Environmental epidemiology,
2. Toxicology, and
3. Exposure science.

Each of these disciplines contributes different information to describe problems in environmental health, but there is some overlap among them.

- Environmental epidemiology studies the relationship between environmental exposures (including exposure to chemicals, radiation, microbiological agents, etc.) and human health. Observational studies, which simply observe exposures that people have already experienced, are common in environmental

epidemiology because humans cannot ethically be exposed to agents that are known or suspected to cause disease. While the inability to use experimental study designs is a limitation of environmental epidemiology, this discipline directly observes effects on human health rather than estimating effects from animal studies.

- Toxicology studies how environmental exposures lead to specific health outcomes, generally in animals, as a mean to understand possible health outcomes in humans. Toxicology has the advantage of being able to conduct randomized controlled trials and other experimental studies because they can use animal subjects. However there are many differences in animal and human biology, and there can be a lot of uncertainty when interpreting the results of animal studies for their implications for human health.
- Exposure science studies human exposure to environmental contaminants by both identifying and quantifying exposures. Exposure science can be used to support environmental epidemiology by better describing environmental exposures that may lead to a particular health outcome, identify common exposures whose health outcomes may be better understood through a toxicology study, or can be used in a risk assessment to determine whether current levels of exposure might exceed recommended levels. Exposure science has the advantage of being able to very accurately quantify exposures to specific chemicals, but

it does not generate any information about health outcomes like environmental epidemiology or toxicology.

Information from these three disciplines can be combined to conduct a risk assessment for specific chemicals, mixtures of chemicals or other risk factors to determine whether an exposure poses significant risk to human health (exposure would likely result in the development of pollution-related diseases). This can in turn be used to develop and implement environmental health policy that, for example, regulates chemical emissions, or imposes standards for proper sanitation.

Environmental health addresses all human-health-related aspects and concerns of the natural environment and the built environment. These concerns include:

- Air quality, including both outdoor and indoor air quality,
- Climate change and its effects on health.
- Disaster preparation.
- Food safety
- Hazardous materials management,
- Housing, including jails and prisons abatement
- Childhood lead poisoning prevention.
- Land use planning, including smart growth.
- Liquid waste disposal, including city waste water treatment plants and on-site waste water disposal

systems, such as septic tank systems and chemical toilets.

- Medical waste management and disposal.
- Noise pollution control.
- Occupational health and industrial hygiene.
- Radiological health, including exposure to ionizing radiation from X-rays or radioactive isotopes.
- Recreational water illness prevention, including from swimming pools, and ocean and freshwater bathing places.
- Safe drinking water.
- Solid waste management, including landfills, recycling facilities, composting and solid waste transfer stations.
- Toxic chemical exposure whether in consumer products, housing, workplaces, air, water or soil.
- Vector control, including the control of mosquitoes, rodents, flies, cockroaches and other animals that may transmit pathogens.

**Why Is Environmental Health Important?**

Maintaining a healthy environment is central to increasing quality of life and years of healthy life. Globally, nearly 25 percent of all deaths and the total disease burden can be attributed to environmental factors. Environmental factors are diverse and far reaching. They include:

1. Exposure to hazardous substances in the air, water, soil, and food
2. Natural and technological disasters
3. Physical hazards
4. Nutritional deficiencies
5. The built environment

## Emerging Issues in Environmental Health

Environmental health is a dynamic and evolving field. While not all complex environmental issues can be predicted, some known emerging issues in the field include:

Climate Change

Climate change is projected to impact sea level, patterns of infectious disease, air quality, and the severity of natural disasters such as floods, droughts, earth quicks and storms.

Disaster Preparedness

Preparedness for the environmental impact of natural disasters as well as disasters of human origin includes planning for human health needs and the impact on public infrastructure, such as water and roadways.

Nanotechnology

The potential impact of nanotechnology is significant and offers possible improvements to:

a. Disease prevention, detection, and treatment
b. Electronics
c. Clean energy
d. Manufacturing

e. Environmental risk assessment

However, nanotechnology may also present unintended health risks or changes to the environment.

The Built Environment

Features of the built environment appear to impact human health-influencing behaviors, physical activity patterns, social networks, and access to resources.

Exposure to Unknown Hazards

Finally, every year, hundreds of new chemicals are introduced to the international market. It is presumed that some of these chemicals may present new, unexpected challenges to human health, and, therefore, their safety should be evaluated prior to release.

Blood Lead Levels

The number of children with elevated blood lead levels in the developed countries is steadily decreasing but not in the undeveloped countries. In these countries, fuels combustion by old cars contributes to the public human health. Efforts must and will continue to reduce blood lead levels and to monitor the prevalence of children with elevated blood lead levels.

## HOLISTIC (the whole) CONCEPT OF HEALTH:

**This concept recognizes the strength of social, economic, political and environmental influences on health**

## DETERMINANTS OF HEALTH:

The following principles are the determinant health factors

- Heredity (Individual genetics)
- Health and family welfare services
- Environment
- Life-style and Education (sanitation)
- Socio-economic conditions
- Food safety and security

## Impact of Environment on the daily life:

1. Food security
2. Climate change
3. Deforestation
4. Desertification
5. Land degradation
6. ozone depletion
7. Loss of biodiversity

Essential Resources for life and environment:

Natural Resources:

Are variety of goods and services provided by nature which are necessary for our daily life.

The major elements of natural resources

A). Abiotic elements: are non-living sources such as air, water, soil, minerals, climate and solar energy.

B). Biotic elements: are living sources such as plants, animals and microorganisms.

These elements are essential to the individual and community levels for physiological, social, economical and cultural daily need.

The above major elements (abiotic and biotic) can be classified or divided into two types:

1. Renewable Resources:

The natural resources which can be used and regenerated by natural processes.

Examples: water (Hydropower), wood (Biomass), solar energy, Geothermal energy, wave (tidal)

2. Nonrenewable Resources:

Are resource that do not renew itself at a sufficient rate for sustainable economic extraction for human use. An example is fossil fuel (such as coal, petroleum, and natural gas), nuclear energy.

There are 3 natural resources

1. **Water Resources**

- Water is renewable resource
- Water covers 70-75% of the earth surface

  - 97% of this water is found in ocean & seas

  - 3% is fresh water

    - 2% in polar ice caps

    - 1% in surface and subsurface (rivers, streams, lakes): 14 million cu Km out of

1400 = = = ($Km^3$)

**<u>Main Sources of Water for daily use:</u>**

1. Rainfall: is water of the rain. Based on amount of rain, it is divided into 3 regions worldwide:

   a. Rainy regions (zones)

   b. Semi-arid regions (zones)

   c. Arid regions (zones)

2. Groundwater: Is the water running under the soil surface for more than one meter.

3. Surface water: the water runs on the soil surface in the forms of river, lakes, streams

4. Spring and wells: water comes from inside the earth and makes surface water (fresh or minerals

**Water Consumption Patterns:**

- The consumption is increasing dramatically causing serious or scary threat to the inceasing world population.
- The consumption is doubling every 20 years more than twice the rate of human population.
- Currently, more than one billion people on earth lack access to fresh drinking water.
- By the year 2025, the demand for freshwater is expressed to rise to 56% above currently available water in the world.

**Problems caused by water shortage or stress:**

1. Health problems due to dehydration
2. Vegetative stress
3. Lack of agricultural crops and food products
4. Deforestation
5. Desertification
6. Conflict between countries sharing rivers
7. Environmental problem in the life of aquatic environment
8. Threat to the balance of biodiversity
9. Disappearance and/or migration of rare animals and birds.

**Reasons for decline of ground and surface water:**

1. Population Explosion: now more than 6 billions
2. Overuse of water: using more than necessary.
3. Deforestation: removal of forests can cause rainwater runs down the river in downhill areas
4. Hydrogen power generation: requires large amount
5. Building Dams for agriculture and power generation:

**Environmental Problems caused by large dams:**

1. More water loss due to surface evaporation.
2. Siltation of reservoir and salinity of surrounding
3. Impact of ecosystem
4. Socio-economical problems: like rehabitation
5. Fragmentation and transformation of rivers
6. Displacement of people
7. Disruption of fish movement and activities
8. Gas emission due to vegetation rottening
9. Natural disasters: vibrations due to reservoirs

**2. Food Resources**

- All our food comes from agriculture, animal and fish sources.
- FAO defined Sustainable Agriculture: <u>is the agriculture which conserve land, water, plant & animal genetic</u>

resources, and protect the environment and society and economically at acceptable level.

**Reasons for world food Problems of Environmental Health Concern:**

1. Population growth
2. Poor agricultural practices
3. Degradation of agricultural lands
4. Reduction in the fertile soil
5. Converting forest & wetland to agricultural use
6. Using GMO seeds affect the land ecosystem
7. Exhaustion of fish and other marine products
8. Variation and interruption in the nutritious food.
9. Loss of genetic diversity
10. Food high demand and low family income

**Food Security: can be defined as**

The ability of all people at all times to access enough food for an active and healthy life.

**Requirements for food security:**

1. Food must be available
2. Each person has access to the food.
3. The food should have nutritional value.

**Options to achieve food security:**

- Food security must be connected to population control through the family welfare program.

- It is also connected to the water availability for agriculture.

**Required Conditions helpful to achieve food security are**

1. Institutional support for small farmers
2. Supporting international trade policy
3. Protecting genetic diversity
4. Ensuring long term conserving wild plant species.
5. Applying environmental friendly farming methods
6. Fertilizing crops from waste household water.
7. Crop protection by controlling disease, insects and weeds
8. Prevention of water and land degradation.
9. Population control.
10. Public education on food nutrition & food security.
11. Changing of food habits.
12. Enhancing equal sharing of food between male and Female to have fair nutritional value.
13. Alternating food sources through crop rotations.

**3. Energy Resources:**

All energy sources are ultimately coming from:

1. Sun.
2. Moon.

3. Earth.

**Solar energy drives the following:**

A) The global climate system gives us

1. Wind power

2. Wave power

3. Hydroelectric power

4. Solar heating and solar lighting

B) The global ecosystem which gives biomass power such as wood.

- The earth in the ancient ecosystem store energy as fossil fuels.

- The moon gravitational energy is responsible for ideal effect which gives rise to tidal power.

- The earth is the key source of energy in:

- Gravitational energy for hydroelectric power.
- Chemical energy for nuclear power
- Geothermal power from the heat of lower crust.

**Types of Energy Resources:**

**1**. Renewable Energy Resources

2. Non-Renewable = =

3. Sustainable = =

Renewable Energy Resources includes:

- Wind power, wave power, ocean thermal, Exchange capacity, solar power, hydropower, fuel cells, and

Bio-Fuels: also known Biomass fuels such as:

Alcohol forms, sugar, methane from organic wastes or charcoal from trees, and Biodiesel.

- The key characteristics of renewable energies are the energy sources are continually available, still some cases such as hydropower and biomass require good management.

Examples: Trees planting, and river management

**Non-Renewable Resources:**

Include all the fossil fuels such as:

- Coal
- Oil
- Gas & their derivatives: such as petrol & Diesel

These resources are finite (Limited) and can be low or reduced gradually.

**Sustainable Energy:**

- This term is sometimes applied to nuclear power

- The supplies are not exactly renewable but they are lost in a long time because a great of electricity is produced from a small amount of radioactive material.

**The main differences (Advantages and Disadvantages) between the 3 types of energy resources can be summarized in the following table:**

| **Energy type** | **Advantages** | **Disadvantages** |
|---|---|---|
| **1. Renewable like: Solar power and Biomass fuel** | **- Lower running cost<br>- Low pollution** | **- produced in small quantities<br>- Very difficult to store** |
| **2. Non-renewable Examples: fuels Like: coal, gas, oil** | **- Reliable supply<br>- Easy to store<br>-Available in high concentration form** | **- Highly polluting<br>- High running costs<br>- Available only in few places** |
| **3. Sustainable (Nuclear power)** | **- Highly reliable<br>- Produces large amount of energy** | **- Risk of radioactivity<br>- High wastes disposal costs** |

**Example:**
**Radioactive materials with less $CO_2$ emission**

**Environmental Impact of Oil:**

- The extraction process (drilling, processing, transport, utilization) of oil and natural gas has serious environmental consequences such as leaks which pollute air, water and soil.
- During oil refining, solid wastes are produced such as salt and grease that can damage the environment.
- Accidental fires occur for days before control
- Oil slicks (leak) from offshore oil wells can pollute water and require costly cleaning especially if it due to shipwrecks (damaged ships).
- Air pollution in major cities with heavy traffic density caused by cars using oil that emit CO2, CO, Sulphure dioxide (SO2), nitrous oxide.
- New cars using unleaded fuels reduce these products. The main problem is the unleaded fuel contains carcinogenic compounds like benzene and butadiene.

**Environmental Impact of Coal:**

Coal: is the most harmful fossil fuels to the environment because it is the world's largest contributor of the greenhouse gases and most important causes of global warming.

- Burning coal also is a cause of producing SO2 and NO2 which combine with water to form the "Acid Rains".

This can kill forest vegetation and pollute water then effect human health.

**Sustainable solutions to the environmental problems:**

- We must develop solutions that protect both our quality of life and the environment
- Organic agriculture Technology
- Reduces pollution
- Biodiversity to Protect species
- Waste disposal by Recycling
- Alternative fuel

**Risk Assessment and Management:**

In the term of impact of environment on human health, there are always materials (solid, liquid, gases) have effect on human health. The effect or impact of such materials depends on the exposure of human body to the concentration of the dose that exceeds the standard limit.

**What is Risk Assessment?**

−The determination of the probability that an adverse effect will result from a defined exposure to an agent.

- What is the definition of Exposure?

Exposure: is any condition which provides an opportunity for an external environmental agent to enter the body

**Risk management** (science and value judgements)

The process of weighing policy alternatives and selecting the most appropriate intervention strategy based on the results

of risk assessment and social, economic, and political concerns

Factors influencing environmental health problems and their solutions are both technical/scientific and non-scientific in character!

**Risk Assessment Activities:** It relies (considers) on the following aspects:

1. Hazard identification

Characterize the innate toxic effect of the toxic and/or infectious agent.

2. Exposure assessment

Measure or estimate the intensity, frequency, and duration of human exposure to the agent

3. Dose-response assessment

Characterize the relationships between varying doses and incidences of adverse effects in exposed populations

4. Risk characterization

Estimate the incidence of health effects under the various actual conditions of human exposure

**Exposure Assessment:** it includes the following principles

- Characterization of the exposure setting
- Identification of the exposure pathway
- Quantification of exposure

**Exposure Calculation:**

**Exposure** = Intensity x Frequency x Duration

**Exposure** = How much x How often x How long

The 3 HOWs:

How much= Intensity

How often= Frequency

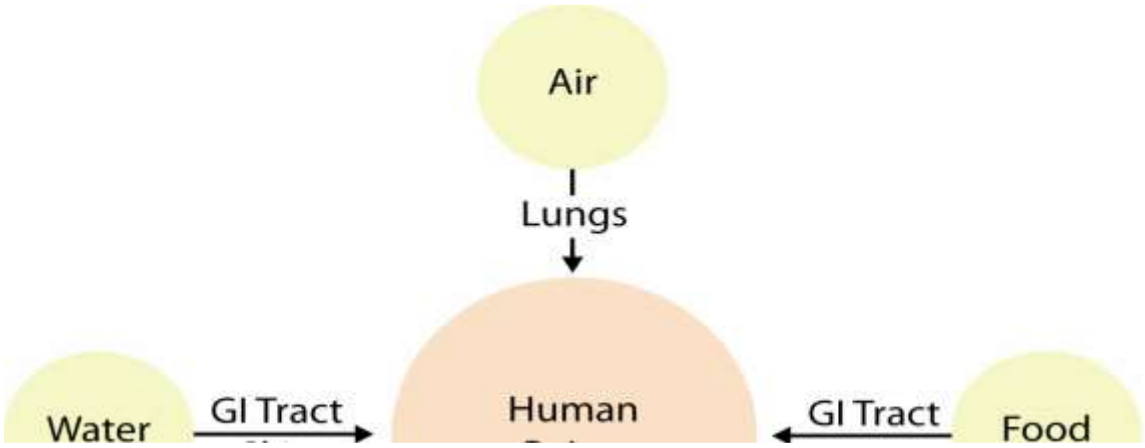
How long= Duration

**Patterns of Exposure**

1. Continuous
2. Intermittent
3. Cyclic
4. Random
5. Concentrated

**Vectors for Exposure**

1. Air is the vector to target the lung of the human body
2. Water is the vector to target the Gastro-Intestinal (GI) Tract and skin
3. Food is the vector to target the GI tract
4. Soil is the vector (GI) Tract and skin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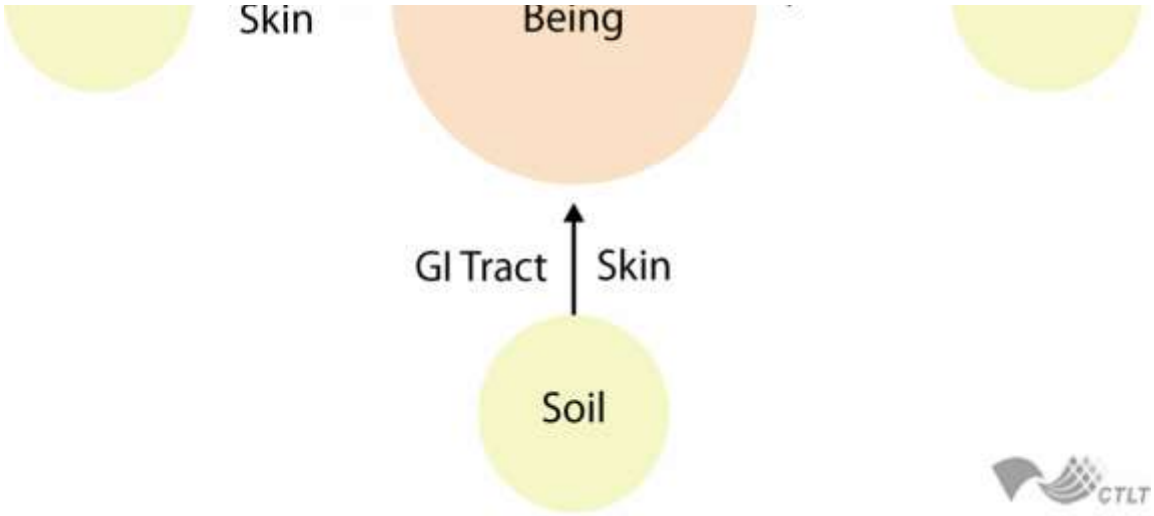


**Air: Liquid and Solid Suspensions:**

**Aerosols**

- Characterized by particle size, which influences physical interactions (coagulation, dispersion, sedimentation, impaction)
- Aerodynamic properties depend on dimensions, shape and density
    - Dust—mechanical division of bulk material
    - Smoke—condensation of combustion products
    - Mist—mechanical shearing of a bulk liquid
    - Fog—condensation of water vapor on atmospheric nuclei
    - Smog—combination of smoke and fog

**Air: Gases and Vapors**

- **True solutions**

−Present as discrete molecules; vapors are the gaseous phase of a substance that is normally a solid or liquid at room temperature

−Generally form mixtures so dilute that physical properties (e.g., density, viscosity) are indistinguishable from those of clean air

−All molecules of a given compound dispersed in air are essentially equivalent in their size and capture properties

**Water and Soil**

- Chemical contaminants in solution or as hydrosols
- − Immiscible solid or liquid particles in suspension;

liquid particles in suspension = emulsion (water equivalent of an aerosol)

- Dissolved contaminants
- − Solids, gases, and suspended particles
- − Behavior is like that of water

- Soil
- − Intrinsic biological or physical agent
- − Chemical contaminants

## Food

- Toxic agents can be acquired during production, harvesting, processing, packaging, transportation, storage, cooking, serving

- Agents are naturally occurring toxicants or those that become toxicants on conversion by chemical reactions (with other constituents or additives) or by thermal or microbiological conversion

## Examples of Exposure

- Contaminated groundwater

−Ingestion (drinking water)

−Dermal contact (bathing)

−Inhalation of VOCs (during showering)

- Contaminated surface water

−Incidental ingestion or dermal absorption of chemical or biological contaminant

- Contaminated surface soil

−Ingestion or dermal absorption of contaminants

- Contaminated food

−Ingestion of contaminated muscle tissue or vegetables and fruits grown in contaminated soil or covered with contaminated dust

- Contaminated air

−Inhalation of “fugitive dusts”or VOC emissions by nearby residents or on-site workers

**Important Issues**

- Distinction between exposure and dose

−Exposure is “outside”the body

−Dose is “inside”the body

- Definition of response
- − Change in structure or function, morbidity, or mortality in the living organisms due to biological effect of toxic agent.
- Definition of Dose
- − Refers to the amount of agent actually deposited within the body

**General Toxicological Paradigms (Models)**

- − The relationship between previous exposure to an environmental agent and subsequent development of

clinical disease can be represented as a six-stage “toxicological paradigm”:

1. Exposure
2. Internal dose
3. Biological effective dose
4. Early Biological effect
5. Altered Structure and Function
6. Clinical Disease

- Consideration of the toxicological paradigm leads to a general “public health paradigm, ”which can be directly related to a corresponding “environmental health paradigm”

−The activities or stages in this paradigm may be broadly grouped into “risk assessment” and “risk management”