OVERVIEW OF ENVIRONMENT AND HEALTH
ENVIRONMENT
Atmosphere

- The atmosphere is the protective blanket of gases which is surrounding the earth. It protects the earth from the hostile environment of outer space.
- It absorbs IR radiations emitted by the sun and reemitted from the earth and thus controls the temperature of the earth.
- It allows transmission of significant amounts of radiation only in the regions of 300 – 2500 nm (near UV, Visible, and near IR) and 0.01 – 40 meters (radio waves), i.e. it filters tissue damaging UV radiation below 300 nm.
- It acts as a source for C0₂ for plant photosynthesis and 0₂ for respiration
- It acts as a source for nitrogen for nitrogen fixing bacteria and ammonia producing plants.
- The atmosphere transports water from ocean to land
The atmosphere surrounds Earth and protects us by blocking out dangerous rays from the sun. The atmosphere is a mixture of gases that becomes thinner until it gradually reaches space. It is composed of Nitrogen (78%), Oxygen (21%), and other gases (1%).
The hydrosphere is a collective term given to all different forms of water. It includes all types of water resources such as oceans, seas, rivers, lakes, streams, reservoirs, glaciers and ground waters. Only 1% of the total water supply is available as fresh water in the form of rivers, lakes, streams and ground water for human consumption and other uses.
The Word Lithosphere refers to the solid layers of rock material on the earths surface, both on continents and ocean floors. The lithosphere is composed of crust and upper mantle. The average thickness of lithosphere is about 100 kms.
Biosphere

- The biosphere refers to the realm of living organisms and their interactions with the environment (VIZ: atmosphere, hydrosphere and lithosphere)
- The biosphere is very large and complex and is divided into smaller units called ecosystems.
- Plants, animals and microorganisms which live in a definite zone along with physical factors such as soil, water and air constitute an ecosystem.
MAJOR TYPES OF POLLUTION

AIR POLLUTION

WATER POLLUTION

LAND POLLUTION

NOISE POLLUTION
AIR POLLUTION
Air pollution is the introduction of particulates, biological molecules, or other harmful materials into the Earth's atmosphere, causing disease, death to humans, damage to other living organisms such as food crops, or the natural or built environment.
MAJOR AIR POLLUTANTS

- CARBON DIOXIDE (CO2)
- SULPHUR OXIDES (SOx)
- NITROGEN OXIDES (NOx)
- CARBON MONOXIDE (CO)
- PARTICULATE MATTER (PM)
SOURCES OF AIR POLLUTION

- Emissions from Power stations
- Emissions from Industrial Processes
- Vehicular Emissions
- Emissions from Burning of Solid Waste
- Emissions from Natural Sources such as Volcanic Eruptions & Forest Fires
Control of air pollution

- Enforcement of Emission Standards by installing suitable Air Pollution Control Equipment.
- Greenbelt Development.
- Adaptation of new Technology.
Contributions to Greenhouse Effect

Carbon Dioxide

Methane

Nitrous Oxide

- Methane
- Carbon Dioxide
- Nitrous Oxide
The Greenhouse Effect

Some of the infrared radiation passes through the atmosphere, and some is absorbed and re-emitted in all directions by greenhouse gas molecules. The effect of this is to warm the Earth’s surface and the lower atmosphere.

Solar radiation passes through the clear atmosphere.

Some solar radiation is reflected by the Earth and the atmosphere.

Most radiation is absorbed by the Earth’s surface and warms it.

Infrared radiation is emitted from the Earth’s Surface.
Common Pollutants that are of Human Health Concern

- Carbon monoxide (CO)
- Nitrogen dioxide (NO₂)
- Lead (Pb)
- Sulfur dioxide (SO₂)
- Ozone (O₃)
- Particulate matter (PM₂.₅, PM₁₀)
Health Effects

- The mixtures of air pollutants produced by burning of fuels can:
  - Adversely affect human health
  - Promote climate change

- In addition
  - Climate change can influence air pollution, resulting in direct health effects
  - Climate change can affect other aspects of air quality, including smoke from agricultural or wildfires, and aero-allergens like pollen and mold spores
Carbon Monoxide

- Produced by incomplete combustion
- Inhibits the capacity of blood to carry oxygen to organs and tissues.
- People with chronic heart disease may experience chest pain when CO levels are high
- At very high levels, CO impairs vision, manual dexterity and learning ability, and can be fatal
Nitrogen Dioxide

- Produced from high-temperature combustion
- Affects lung function in persons with asthma
- Contributes to acid rain and secondary particle formation
- Is a precursor of ground-level ozone
Lead

- Retards intellectual development of children
- Lead in gasoline was historically the principal source
Sulfur Dioxide

- Emitted from combustion of sulfur-containing coal and oil, and from metal smelting operations
- Reversible declines in lung function of people with asthma, and exacerbates respiratory symptoms in sensitive individuals
- Also contributes to acid rain and to formation of PM2.5 through atmospheric reactions
- Emissions reduced using scrubbers
Ozone

- Main pollutant responsible for photochemical smog, formed via reactions in the atmosphere from primary pollutants ($\text{NO}_x$ and VOCs) in the presence of sunlight
- Higher temperatures favor ozone formation
- Strong oxidant that damages cells lining the respiratory system, resulting in a variety of adverse health outcomes, including lung function decrease, asthma attacks, and premature death
- Ozone is also a greenhouse gas
Ozone and Asthma Attacks

Hundreds of published studies from around the world all show the same results: More ozone pollution exposure leads to more asthma attacks. Dose = Response relationship
Airway Obstruction

Normal

Asthma

- Mucus in airway
- Mucosal edema
- Increased mucous glands
- Contracted hypertrophied muscle
Ozone Causes Asthma

Exercising children exposed to ozone: a cohort study

time outdoors = asthma

Ozone: Other Effects

- allergy symptoms
- respiratory infections
- ear infections
- emphysema attacks
- overall death rates
Ground-level Ozone Formation

Ozone formation

Sunlight

Oxygen (O₂) + Volatile Organic Compounds (VOC) + Nitrogen Oxides (NOx) → Ozone (O₃)
Particulate Matter (PM$_{2.5}$, PM$_{10}$)

- Can be either primary or secondary; produced by combustion, atmospheric reactions, and mechanical processes
- Wide range of physical/chemical properties
- Wide range of human health impacts, including premature death
- Higher temperatures may favor secondary formation
- Some particle types contribute to climate warming; others to climate cooling
Particulate Physiology

Penetrate deeply into lungs to alveoli
Irritate lung linings-more asthma
Stimulate immune system 
inflammatory proteins
Particulates and Asthma

- Multiple studies show direct correlation between exposure to particulates and increases in asthma attacks and hospitalization rates
- Effects seen in adults and especially pronounced in children
Particulates: Cardiac Effects

- Vascular inflammation
- Blood clotting protein levels
- Cardiac arrhythmias
- Blood pressure
- Heart rate variability
- Alters cardiac conduction
Smog

- Smog refers to a noxious mixture of gases and particles that often appears as a haze in the air. It has been linked to a number of adverse effects on health and the environment.

- The two primary pollutants in smog are ground-level ozone (O₃) and particulate matter (PM). High levels of smog are typically associated with the summer due to the presence of sunlight and warmer temperatures. However, the smog problem actually occurs throughout the year, with winter smog (due to particulate matter contributions rather than ozone) being a serious concern when stagnant air causes a build up of pollutants in the air. This is usually caused by increased wood heating and vehicle usage in the winter months.
Annual average fine particle data for 2001 from the Look Rock station of the Tennessee Valley Authority.
Health Effects of Air Pollution

- Historical experience provides strong evidence for causal relationship between air pollution and premature death
- Modern epidemiology studies have consistently found significant associations
- Let’s look at the evidence for particle health effects...
Acute Mortality Responses to PM in US, Europe, and Asia

Exposure Response

Huizenga et al., 2005
American Cancer Society Study

Lung Cancer, Cardiopulmonary Mortality, and Long-term Exposure to Fine Particulate Air Pollution

Source: Pope et al., 2002
American Cancer Study

Conclusion

“Long-term exposure to combustion-related fine particle air pollution is an important environmental risk factor for cardiopulmonary and lung cancer mortality”

Pope et al., 2002
Review

- The mixtures of air pollutants produced by burning of fuels can
  - Adversely affect human health
  - Promote climate change

- In addition
  - Climate change can influence air pollution, resulting in direct health effects
  - Climate change can affect other aspects of air quality, including smoke from agricultural or wild fires, and aero-allergens like pollen and mold spores
Furthermore

- There are other “air pollutants” besides the ones which come out of tail pipes and smoke stacks which have important impacts on human health, and for which climate change is causing changes...
Water pollution refers to the contamination of water bodies. These may include lakes, rivers, oceans, aquifers and groundwater.
WATER POLLUTION
from a Chemical Plant
MAJOR WATER POLLUTANTS

- Organic Contaminants (Detergents, Herbicides, etc)
- Inorganic Contaminants (Heavy Metals, Ammonia, etc)
- Solid Waste (Plastics, Paper, Food waste)
- Thermal Pollution (Discharge of warm water into water bodies by factories)
SOURCES OF WATER POLLUTION

- Sewage
- Runoff of Pesticides & Fertilizers
- Solid Waste Disposal
- Untreated Effluents from Industrial and other activities
- Chemical and Oil Spills
LABORATORY TEST TO DETERMINE WATER QUALITY

- Temperature
- PH
- Conductivity
- TDS
- TSS
- COD
- Coliform
Land pollution refers to the deposition of solid or liquid waste materials on land or underground in a manner that can contaminate the soil and groundwater, threaten public health, and cause unsightly conditions and nuisances.
SOURCES OF LAND POLLUTION

- Domestic Solid Waste (Garbage, Rubbish, Trash)
- Construction and Demolition Waste
- Agricultural Waste
- Industrial Waste
Green Building

- Carefully choosing site location
- Limiting environmental impacts of construction and renovation practices
- Conserving water and energy in building operations
- Using building materials safe for occupants
- Designing sites to capture and reuse stormwater

Photo source: Calderoliver via Wikipedia Commons
The Built Environment Has Direct and Indirect Effects on the Natural Environment

Exhibit 1-2: Direct and indirect effects of the built environment.
NOISE POLLUTION

- Noise is generally defined as unwanted sound.
- Sound affects man physically, psychologically and socially.
- Noise may be continuous or intermittent and may be of high frequency or a low frequency.
SOURCES OF NOISE POLLUTION

- Industrial (power plants, stone crushing, metal workshops, cabinet making);
- Multipurpose halls including wedding halls;
- Bungalows along the coast;
- Places of entertainment, including night clubs;
- Road traffic e.g. moving trucks, automobiles, buses, especially those with modified silencer system;
- Community noise e.g. radio/TV, loudspeakers, pool houses and alarms;
- Animals e.g. dogs, cats, crows;
- Use of loud speaker, amplifier, musical instrument, electrical or mechanical device for religious activities;
- Aircrafts and speed boats;
- Neighbourhood;
- Machinery (generator sets, compressors, air conditioning units, boilers, pumps, motors);
- Others, including construction works, road infrastructural works, public gathering, vibration, ice cream sellers, vendor shouts.
HEALTH EFFECTS OF NOISE POLLUTION

- Hearing Loss (including occupational hearing loss)
- Stress
- High Blood pressure
- Sleep Loss
- Distraction
- Productivity Loss
- Cause Irritability,
- headache
- Annoying and interfere with communications.
An integrated approach is adopted towards noise pollution control through:

- Mass sensitization;
- Enforcement of the existing Noise Regulations;
- Use of Noise Abatement Technologies;
- Research in Novel Technologies;
NOISE REGULATIONS IN MAURITIUS

Environmental Standards for Noise (Amendment) Regulations 2003

<table>
<thead>
<tr>
<th>Schedule</th>
<th>Noise Exposure Limits</th>
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### Industrial Noise

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<th>Time Period</th>
<th>Noise Level</th>
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<tbody>
<tr>
<td>07.00 - 21.00 hrs</td>
<td>60*dB(A) Leq</td>
</tr>
<tr>
<td>21.00 - 07.00 hrs</td>
<td>55*dB(A) Leq</td>
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### Neighbourhood Noise

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<th>Time Period</th>
<th>Noise Level</th>
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<tbody>
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<td>07.00 - 18.00 hrs</td>
<td>60 dB(A) Leq</td>
</tr>
<tr>
<td>18.00 - 21.00 hrs</td>
<td>55 dB(A) Leq</td>
</tr>
<tr>
<td>21.00 - 07.00 hrs</td>
<td>50 dB(A) Leq</td>
</tr>
</tbody>
</table>

### Power Station Noise

- In residential area -
  - 07.00 - 21.00 hrs ... 60 dB(A) Leq
  - 21.00 - 07.00 hrs ... 55 dB(A) Leq

- In any other area -
  - At any time ... ... 70 dB(A) Leq

A Sound Level Meter is Used To Measure Noise Levels.
NOISE ABATEMENT TECHNOLOGIES

- Installation of barriers between the noise source and the receiver
- Use of acoustics in the design of building such as double glazing
- Installation of panels or enclosures
- Green belt development such as the attenuation of sound levels by plantation of trees and shrubs can
Potential Climate Change Impacts

Climate Changes
- Temperature
- Precipitation
- Sea Level Rise

Health Impacts
- Weather-related Mortality
- Infectious Diseases
- Air Quality-Respiratory Illnesses

Agriculture Impacts
- Crop yields
- Irrigation demands

Forest Impacts
- Change in forest composition
- Shift geographic range of forests
- Forest Health and Productivity

Water Resource Impacts
- Changes in water supply
- Water quality
- Increased Competition for water

Impacts on Coastal Areas
- Erosion of beaches
- Inundate coastal lands
- Costs to defend coastal communities

Species and Natural Areas
- Shift in ecological zones
- Loss of habitat and species
WE NEED EVERYONE'S HELP TO STOP POLLUTION

IT'S YOUR WORLD... HELP KEEP IT CLEAN!
Sustainable development

- Development that meets the needs of the present without compromising the ability of future generations to meet their own need.