PHS 212 Environmental Health
BPH, Second Year, Third Semester

Course Description

This course offers an opportunity to understand and internalize emerging environmental health issues and problems locally and globally. The course is also expected to comprehend the major environmental health concerns and the implication of environmental health programs in the areas of public health. The course will also describe the conceptual knowledge on environmental health policy for understanding different human activities in deteriorating and exploiting the environment and find a sustainable way for improving human health.

Learning Objectives

- The purpose of course is to acquire essential knowledge on environment, environmental problems, environmental hazards and their impact on health, and ways of prevention and control of environmental related problems.

Upon the completion of the course, students will be able to:

- Explore the different types of environmental pollution and its public health impact,
- Role of sanitation in public health,
- Existing policy measures for the sustainable development, and
- Principles and stages of environmental health prevention.

Unit I: Concept of Environmental Health 8 hours

- Definition and scope of environmental health: Biological, chemical, physical, sociocultural
- Terminologies used in environmental health: Ambient air, contamination, effluent hazardous waste, parts per million, parts per billion, pesticide, pollution and sediment
- Historical development of environmental health and emergence of modern public health functions on environment protection
- Application of the DPSEEA framework
- Driving forces in environmental health: population, technology, economic growth, poverty and inequity

Unit II: Water Pollution and Health 8 hours

- Functions and importance of water in human body
- Sources and availability of water in Nepal
- Sources and health effects of water pollution
- River and ground water pollution
- Water and water related diseases
- Water purification
- WHO guidelines for drinking water quality
- Acts and policies for water resource management in Nepal

Unit III: Air pollution, Noise and Health 8 hours

- Functions and importance of air in human body
- Criteria air pollutants
- Sources of indoor air pollution (rural and urban)
- Sources of ambient air pollution
- Air pollution and health risks
- Management of air pollution: measurement, monitoring and control
- Definition of noise
- Sources of noise
- Noise levels and health effects
- Management of Noise

Unit IV: Human Excreta and Health 6 hours

- Present situation and practices
- Health hazard from human excreta
- Types/Methods of human excreta disposal
- Promotional activities of excreta disposal: at family and community
- National Sanitation Policy in Nepal

Unit V: Solid and Health Care Waste 8 hours

- Solid and liquid waste generation, treatment, and disposal
- Integrated management of solid waste
- Nature and types of healthcare waste
- Generation, management, treatment, and disposal of health care waste
- Health hazard of health care waste
- Waste and health risks
- Management of healthcare waste
- Waste water treatment technique

Unit VI: Environmental Health Management

4 hours

- Shelter and Human Health: Detrimental effect of poor housing; Principles of housing and health; Standards of housing
- Environmental monitoring and evaluation
- Environmental management in disaster

Unit VII: Prevention and Regulation in Environmental Health 8 hours

- Stages of Environmental health prevention
- Principles of environmental health prevention: sustainable development; precautionary principle; intergenerational equity; access to information and the decision-making process; integrated decision making; polluter pays principle
- Sustainable Development Agenda for Nepal in respect of environmental health
- Environment health related legislation, policies, plan, and programs in Nepal.

Reading Materials

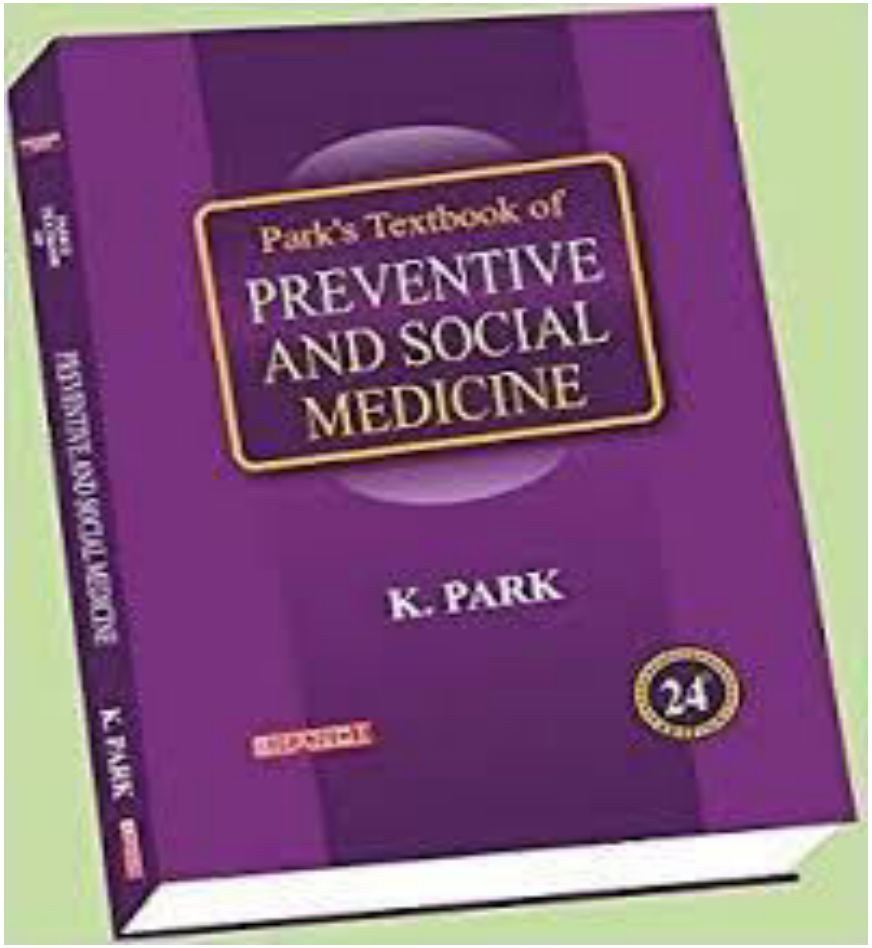
1. Allen. T.F.H. and T.W. Hoekstra, 1992. Towards a unified ecology. Columbia
University.
2. Baldwin. John. 1985 Environmental planning and management, Westview press, Boulder and London.
3. Capra. Frijof. 1982. The turning point: Science, society and the rising culture. Published by Fontana Paper backs.
4. Corson, W.H. 1990. The Global ecology handbook, beacon press, Boston. USA.
5. DOHS. 2016. Annual report of department of health services, Nepal
6. Odum. 1971. Fundamentals of ecology. Saunders College Publishing.
7. Wilson, E.O. 1988. Biodiversity, National Academy Press. Washington. D.C.

Reading Materials...

9. FAO/WHO (1997), Health and Environment in Sustainable Development WHO/EHG/97.8.
10. WHO (1996), Biodiversity, Biotechnology and Sustainable Development in Health and Agriculture: Emerging Connection. WHO
11. WHO (1999), HACCP (Hazard Analysis and Critical Control Point) Principle and Practice.
12. Frumkim, H. 2010, Environmental Health from Global to Local, John Wiley & Sons, Inc.
13. Miller, G.T.; Spoolman, S. (2009), Living in the Environment-Principles, Connections, and Solutions, Brooks/Cole, sixteenth edition

14. Miller, G.T.; Spoolman, S. (2010), Environmental Science, thirteenth edition
15. WHO (2017) Guidelines for drinking water quality. The fourth edition.
16. Government of Nepal. Central bureau of statistics (2015) Compendium of environment
statistics
17. ADB (2013) Solid waste management in Nepal. Current status and policy recommendation

Reference Books



Concept of Environment:

- French word- environ means to encircle.
- The term ‘environment’ is all-encompassing: it means essentially everything around us, including the conditions under which we live. It includes the following three components.

1. **Bio-physical**

land, water, and air including all layers of the atmosphere, All organic and inorganc matter and living organisms, and interacting natural systems (ecosystems)

2. Socio-economic and cultural

- **The social, economic, and cultural conditions influencing the lives of people and the communities they live in**

3. Built environment

- **Any building or structure built by people**

Environment

- Defined as circumstances or conditions that surround an **organism** or group of organisms.

or

- Complex of social or cultural conditions that affect an individual or community.

Contd…

- Environment is all of the external factors affecting an organism.
- Factors may be biotic and abiotic surrounding an individual or group.
- Biotic factors: plants and animals.
- Abiotic factors: inorganic and organic compounds. Temperature, moisture, wind, radiation etc.

Public Health Definition of "The Environment"

- „All that which is external to the individual host. It can be divided into physical, biological, social, and cultural factors, any or all of which can influence health status in populations.

–*Last, J. M. (Ed.). (1995). A Dictionary of Epidemiology (3rd ed.). New York: Oxford University Press.*

What is environmental health?

- **Environmental health is the study and management of environmental conditions that affect the health and well-being of humans.**

or

- **Environmental Health is the science that deals with the study of all the environmental factors that affect human health in any way**

WHO Definition of Environmental Health

- Environmental health comprises those aspects of human health, including quality of life, that are determined by physical, biological, social, and psychosocial factors in the environment. It also refers to the theory and practice of assessing, correcting, controlling, and preventing those factors in the environment that can potentially affect adversely the health of present and future generations.

The Public Health Definition of the Environment

All that which is external to the individual host. It can be divided into physical, biological, social, and cultural factors, any or all of which can influence health status in populations.

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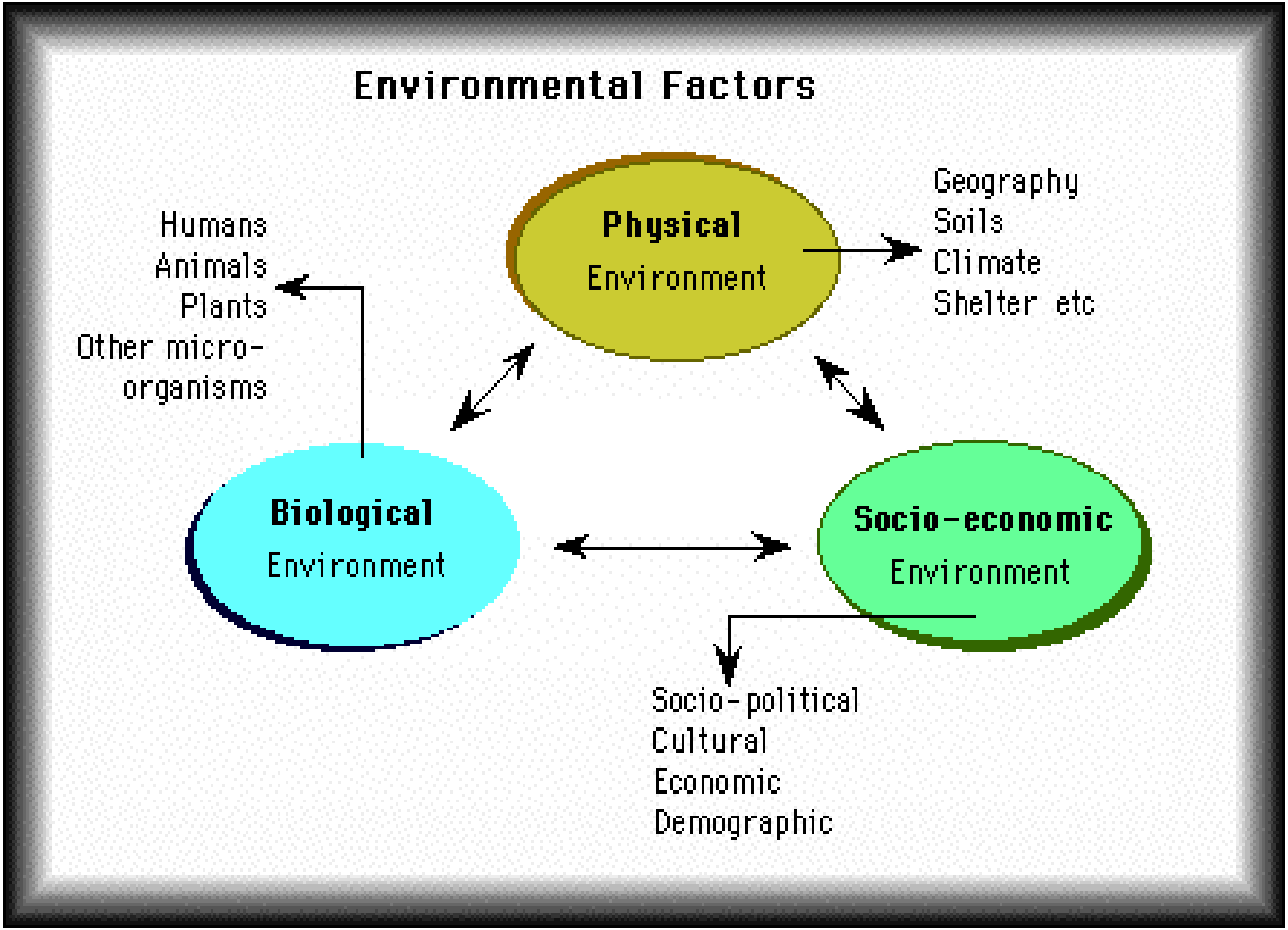
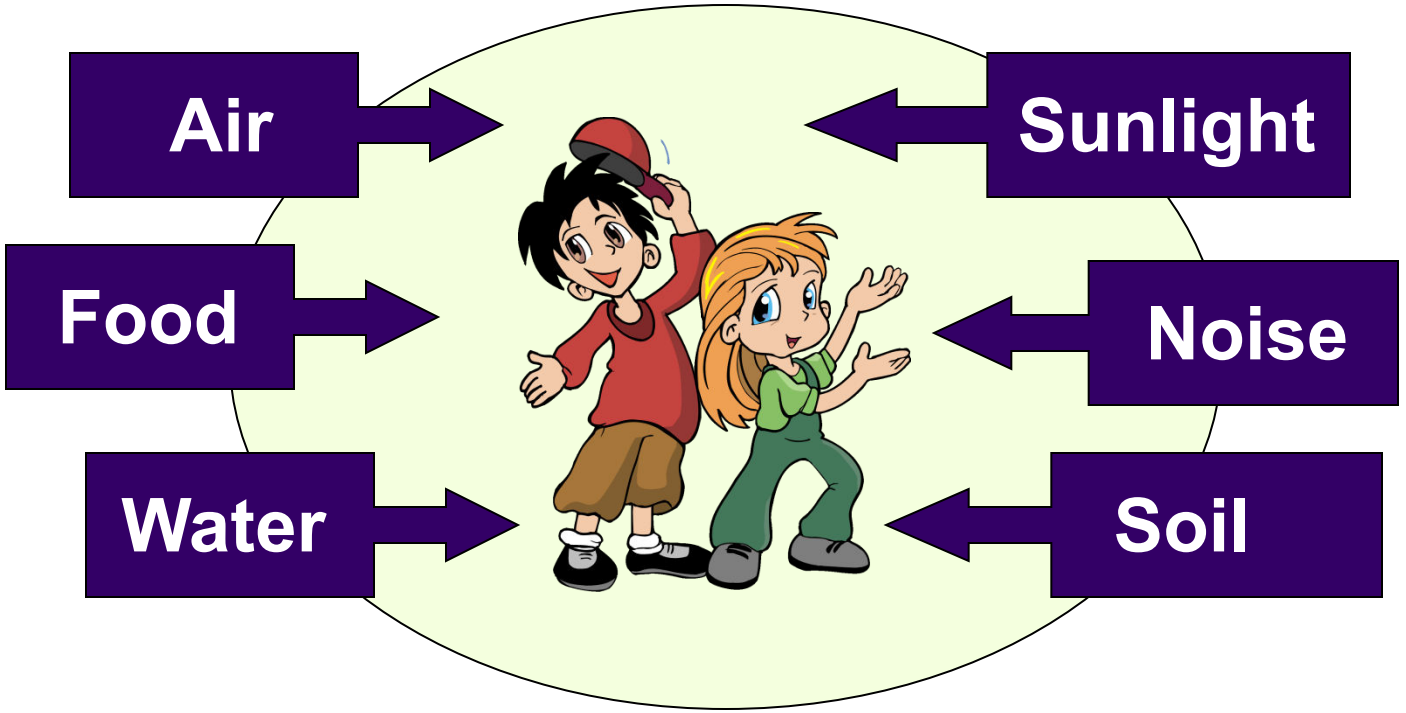

Environmental Factors
Physical
Environment
Geography
Soils
Climate
Shelter etc
Humans
Animals
Plants
Other micro-
organisms
Biological
Environment
Socio-economic
Environment
Socio-political
Cultural
Economic
Demographic

Environmental Health?



The study of how the environment affects your health.

Why environmental health?

- To have better understanding of the environmental factors
- To understand the consequences of the environmental factors from health point of view.
- To propose the prevention and control measures for the protection of healthy environment

Scope of Environment Health

- Water supplies
- Waste water treatment
- Waste management
- Vector control
- Prevention and control of land pollution
- Food hygiene and safety
- Air quality management
- Environmental radiation hazards
- Occupational health and safety
- Environmental noise management
- Accommodation establishments

Scope of Environment Health

- Environmental impact assessments
- Port health
- Accident prevention
- Environmental health aspects of public recreation and tourism
- Environmental health measures associated with
- epidemics, emergencies, disasters and migrations of populations
- Establishment of an effective environmental health
- surveillance and information system
- Research on environmental health issues

Terminologies used in environmental health

Ambient air

- Ambient air is atmospheric air in its natural state. It is what we breathe in when the atmosphere is not contaminated by air-borne pollutants.

- Ambient air is vital to the survival of humans and animals.
- The composition of ambient air varies depending on the elevation above sea level as well as human factors such as the level of pollution. The ambient air quality, therefore, is directly affected by the activities of people.

Ambient air

- Ambient air is typically 78% nitrogen and 21% oxygen. The extra 1% is made up of a combination of carbon, helium, methane, argon and hydrogen.

- The closer the air is to sea level, the higher the percentage of oxygen.

- Man's activities, particularly the manufacturing processes and the burning of fossil fuels, has directly impacted the ambient air quality due to the high level of industrial and chemical pollutants that have been released into the atmosphere.

Contamination

- **Contamination** is the presence of an unwanted constituent, contaminant or impurity in a material, physical body, natural environment, workplace, etc.

- Contaminants are biological, chemical, physical or radiological substance

Effluent hazardous waste

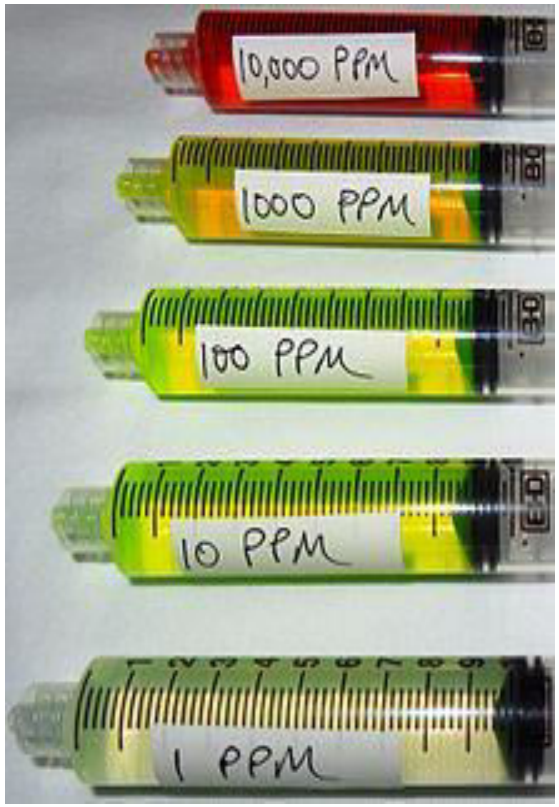
Effluent is an out flowing of water or gas to natural body of water, or from a manmade structure.
Effluent, in engineering, is the stream exiting a chemical reactor.

Effluent is defined by the United States Environmental Protection Agency as "*wastewater - treated or untreated - that flows out of a treatment plant, sewer, or industrial outfall. Generally refers to wastes discharged into surface waters*".

The Compact Oxford English Dictionary defines effluent as "*liquid waste or sewage discharged into a river or the sea*".

Parts per million

This is a way of expressing very dilute concentrations of substances. Just as per cent means out of a hundred, so parts per million or ppm means out of a million. Usually describes the concentration of something in water or soil. One ppm is equivalent to 1 milligram of something per liter of water (mg/l) or 1 milligram of something per kilogram soil (mg/kg)



Parts per billion

- A unit of measure used for very small quantities, it is equal to the ratio of the weight or volume of one component of a mixture to a billion weights or volumes of the mixture.
- When based on weight (ppbw), it is equal to the weight or mass of the component divided by the total weight or mass in a given volume, multiplied by one billion.

Pesticide

A substance used for destroying insects or other organisms harmful to cultivated plants or to animals

Pollution

- **Pollution** is the introduction of contaminants into the natural environment that cause adverse change.
- Pollution can take the form of chemical substances or energy, such as noise, heat or light.
- Pollutants, the components of pollution, can be either foreign substances/energies or naturally occurring contaminants.
- Pollution is often classed as point source or nonpoint source pollution. In 2015, pollution killed 9 million people in the world
- **Pollution is the introduction of contaminants into the natural environment that cause adverse change. Pollution can take the form of chemical substances or energy, such as noise, heat or light**

Sediment

- Sediment is a naturally occurring material that is broken down by processes of weathering and erosion, and is subsequently transported by the action of wind, water, or ice, and/or by the force of gravity acting on the particles

Historical development of Environmental Health

Historical perspectives on hygiene and environmental health

- Hygiene and sanitation have a long history
- Along with the human civilization.
- It can divide the historical events into two periods:
  - The ancient
  - The modern.

The ancient civilization

- Religious laws, such as Moses' Law, writings in the Old and New Testaments and laws in the Koran, played major roles in the lives of ancient peoples.

- These laws mainly concentrated on the provision of personal hygiene.

Contd….

- Dead bodies and contaminated surfaces were known to be unclean or unhygienic to touch.
- The importance of burying human faeces was also strongly indicated.
- The importance of body cleanliness before praying was a motive for maintaining the integrity of hygiene with a religious practice.

The ancient civilization

- The importance of hygiene and sanitation flourished at the times of Greek, Roman and Egyptian civilisation.

- The use of private and public baths and latrines, cleaning of the body, shaving the head for protection from lice infestation, and the construction of water pipelines and sewage ditches were widely observed

- The transmission of schistosomiasis (bilharzia) was linked to bathing and swimming in the Nile River.

- In these civilizations, the focus was on personal hygiene (hygiene) and human waste management (sanitation).

Modern times

- A number of discoveries in the 19th century were important events for the understanding of communicable diseases.
- For example, the link between contaminated water and cholera was discovered by John Snow in 1854;
- the importance of hygienic handwashing before attending delivery of a baby was noted by Dr. Semmelweis in 1845;
- The discovery that **microorganisms** (very small organisms only visible under a microscope) cause disease was made by Louis Pasteur around this time.

Modern times

- the industrial revolution in Europe in the 19th century showed that improvements in sanitation, water supply and housing significantly reduced the occurrence of communicable diseases.

- The term ‘environmental health’ is used to describe human health in relation to environmental factors.

- **Environmental health** can be defined as the control of all the factors in a person’s physical environment that have, or can have, a damaging effect on their physical, mental or social wellbeing.

- The issue of environmental health is now a global matter under the guidance of the United Nations (UN) through the World Health Organization.

Modern times

- Although hygiene and infection are vital factors in environmental health, it is also good to be aware of emerging issues such as global warming
- The links between medical conditions such as cardio-vascular disease and our environment and lifestyles.
- Our **environment** is everything that surrounds us.
- It includes all the external influences and conditions that can affect our health, life and growth.
- These influences are constantly changing and the effects on our health may not be easily foreseen.

Thank You!

DPSEEA framework

- The DPSEEA framework was developed on behalf of the World Health Organization, initially as a basis for developing environmental health indicators.

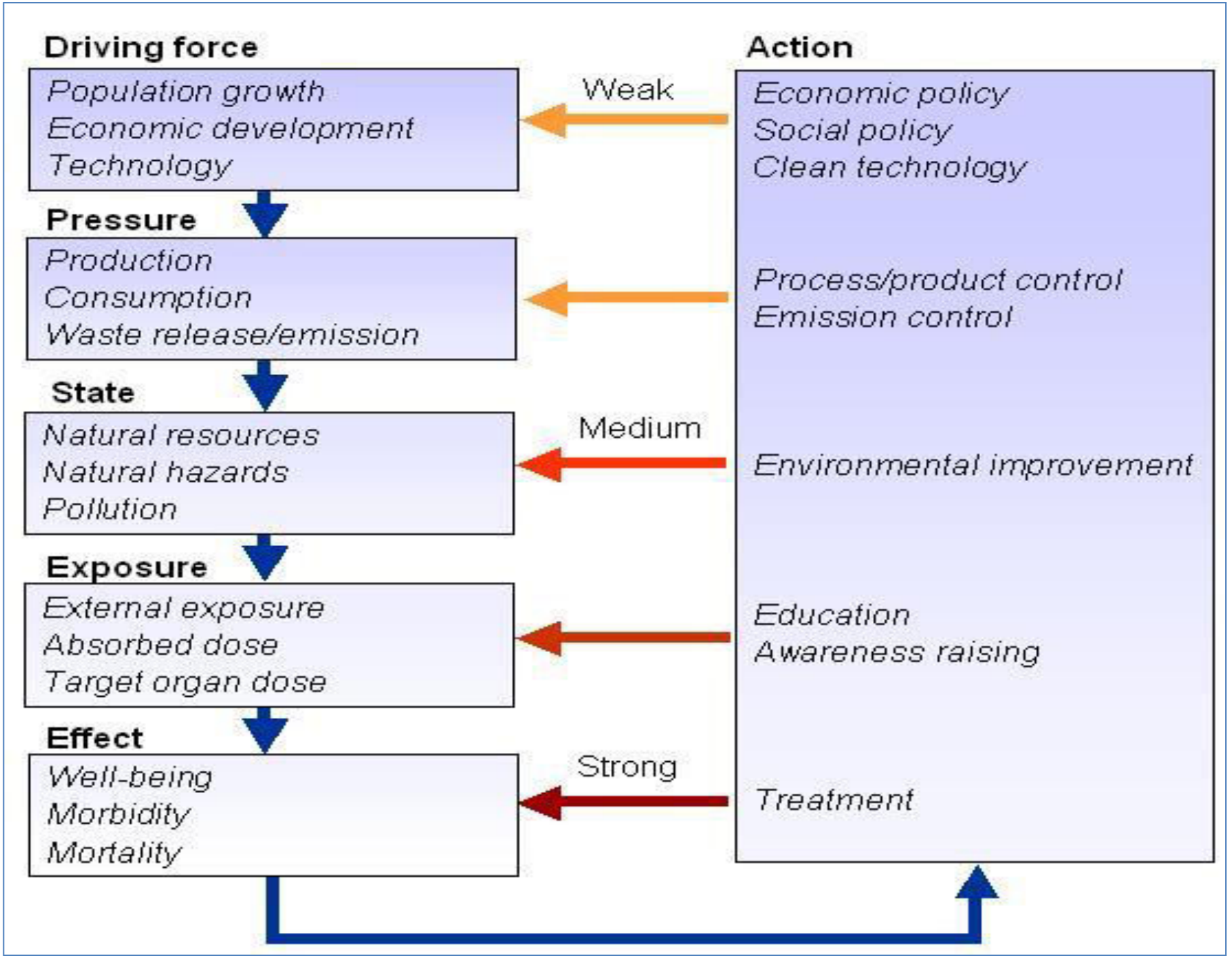
- It adapted the DPSIR (driver, pressure, state, impact, responses) framework primarily by recognizing the links from state of the environment through exposures to health effects; responses were relabeled as actions.

- It also extended the concept of driving forces backwards to represent the role of more remote, contextual factors such as social and economic development.

Application of the DPSEEA framework

- D-P-S-E-E-A Framework in the context of human health impacts, both exposures and the resulting health effects must be represented.

- These aspects are taken into account in a further adaptation of Health in Sustainable Development.


Driving force
Population growth
Economic development
Technology
Pressure
Production
Consumption
Waste release/emission
State
Natural resources
Natural hazards
Pollution
Exposure
External exposure
Absorbed dose
Target organ dose
Effect
Well-being
Morbidity
Mortality
Weak
Medium
Strong
Action
Economic policy
Social policy
Clean technology
Process/product control
Emission control
Environmental improvement
Education
Awareness raising
Treatment

Contd….

- The framework thus sees health impacts as originating in these driving forces (D)
- D lead to pressures on the environment (P) in the form of production, consumption, waste generation etc, and their consequent releases into the environment
- These contribute to changes in the state of the environment (S) - for example as environmental pollution or increased risks of natural hazards.
- Exposures (E1) occur when humans come into contact with these hazards, leading to potential health effects (E2).
- Policy and other actions (A) are taken to control adverse health effects. These may be targeted at different points in the causal chain.

DPSEEA indicators in environmental health

Driving forces

- Number of key factors on the macro scale broadly affect the environmental processes that may ultimately affect human health.

- For example, macroeconomic policies may have major effects on the environment and on people's health.

- Trade and fiscal policies may indirectly impact on human health by affecting income levels and distribution, and agricultural or energy policy may affect health by impacting on land, air and water resources.

DRIVING FORCE" INDICATORS

- Total fertility rate
- Population growth rate
- Urban growth rate
- Annual energy consumption levels
- GDP per capita and growth rate
- Income levels, distribution/trends
- Adult literacy rate
- Primary and secondary school enrolment rates
- Employment rate
- Population below poverty line
- Social equity index

PRESSURES

- The various driving forces considered may result in pressures on the environment.

- Many factors however, including policy context, social attitudes and economic infrastructure, affect the extent to which driving forces are translated into actual pressures on the environment.

- Pressures are generated by all sectors of economic activity, such as transport, energy, housing, agriculture, industry, tourism and so forth

Contd…..

- Pressures can occur from resource extraction, processing of materials and the production, distribution, consumption and release of waste products.

- An important pressure from the point of view of human health is the release of pollutants into the environment.

Contd…..

- Health and environment indicators at this level of the framework are important for addressing the root causes of problems, such as the release of pollutants or wastes or certain infrastructural developments which may manifest themselves only much later as effects on the state of the environment.

INDICATORS ASSOCIATED WITH VARIOUS PRESSURES

"Pressure" indicators: Air

- Number and type of polluting industries
- Levels of domestic consumption of gas, coal and biomass
- Production and consumption of ozone-depleting substances such as chlorofluorocarbons (CFCs)
- Consumption levels of leaded gasoline
- Average road traffic volume and density
- Annual emissions of: sulfur and nitrogen oxides particulates, toxics and heavy metals carbon monoxide and volatile organic compounds (VOCs)

Contd….

- Annual national and global emissions of greenhouse gases (for example carbon dioxide) by source
- Annual emissions from major industrial facilities by source
- Annual emissions from mobile sources, for example transport
- Annual emissions of radionuclides from nuclear facilities
- Emissions of chlorinated dioxins, furans, mercury and other harmful pollutants from waste-burning facilities
- Accidental releases of toxic chemicals and radioactive substances

“Pressure” Indicators: Water

- Availability of water resources per capita
- Water consumption by use per capita
- Domestic consumption of water per capita
- Water recirculation levels in industry
- Amount of fresh water and coastal waste water discharges
- Amount of industrial/municipal effluent (treated and untreated) discharged
- Tonnes of sewage discharged into water bodies
- Discharges of domestic and industrial waste-water into surface water

“Pressure” Indicators: Waste

- Annual tonnage of hazardous and medical waste produced, by class
- Imports and exports of hazardous waste (tonnes/year)
- Toxic constituents of hazardous waste produced
- Amount of radioactive materials used
- Amount of municipal, agricultural, industrial and nuclear waste generated
- Annual amount of domestic waste produced/disposed of per household/per person
- Quantities of toxic chemicals in waste streams released, disposed of, treated or combusted for recovery
- Amount of untreated waste produced
- Amount of stored radioactive waste, by class
- Amount of radioactive waste not meeting waste disposal standards
- Amount of waste not collected, illegally dumped
- Proportion of hazardous wastes disposed to open dumps
- Proportion of sewage treated to secondary level
- Amount of waste re-used
- Percentage of domestic waste collected for recycling
- Frequency of waste collection in residential areas

STATE

- The state (quality) of the environment may be affected by the various pressures exerted. Some changes may be complex and widespread, affecting almost all aspects of the environment and resulting in effects such as desertification, marine pollution or climate change.

- The frequency or magnitude of natural hazards may be increased (for example floods, soil erosion), natural resources may be negatively affected (for example biodiversity, soil fertility) or the quality of air and water may be affected by pollution.

INDICATORS OF THE STATE OF THE ENVIRONMENT

"State" Indicators: Air

- Pollutant concentrations (for example sulfur dioxide, nitrogen oxides, ozone, particulates, lead) in urban air
- Concentrations of carbon monoxide and volatile organic compounds in urban air
- Number of hours/days per year during which pollutants exceed standards
- Total suspended particulates, PM10/PM2.5/black smoke excedance of guidelines or standards
- Concentrations of ozone-depleting substances in air
- Global atmospheric concentration levels of greenhouse gases
- Indoor air pollution levels
- Annual number of severe pollution incidents

Contd….

"State" indicators: Water

- Exceedance of standards and guidelines for:
  - drinking-water
  - recreational fresh and marine waters
  - aquaculture water
  - irrigation water
- Proportion of inland surface water not meeting standards for the preparation of drinking-water

Contd….

- Proportion of recreational surface waters not meeting bathing-water quality standards
- Faecal coliform levels in fresh water
- Percentage of rivers, streams, lakes and reservoirs providing water that is not safe for use without treatment
- Concentrations of nitrogen and sulfur oxides in precipitation
- Water hardness, colour, taste, pH, biological oxygen demand, chemical oxygen demand, optical density, total organic compounds, volatile organic compounds
- Concentrations of nitrates, nitrites, phosphates in drinking-water
- Levels of pesticide residues in drinking-water

Contd….

"State" indicators: Other media

- Levels of radiation/radionuclides in environmental media
- Levels of lead, cadmium, arsenic, mercury in air, drinking-water, soil, dust, food
- Concentrations of polychlorinated biphenyls, dioxins in food, air, water
- Frequency of illegal pesticide residues in food and water
- Levels of faecal coliforms and Escherichia coli in food, water
- Area of land/number of sites contaminated by hazardous waste
- Community and occupational noise levels exceeding standards

EXPOSURES

Many factors determine whether an individual will be exposed, for example, to pollution in the environment.

Pollution levels vary from place to place and over time, and people's activities and behavioural patterns may influence the extent to which they come into contact with the environment. An environmental factor may play a major or a minor role in influencing a disease outcome.

With low levels of exposure the factors concerned may more often play a contributory rather than a primary role in causing disease.

DIRECT AND INDIRECT INDICATORS OF EXPOSURES

“Exposure” indicators: Air

- Proportion of population living in proximity of sources of air pollution (traffic, industrial activities)
- Proportion of population with elevated personal exposures to air pollutants such as particulate matter with a diameter of less than 10 micrometres
- Proportion of population exposed to elevated levels of pollutants in microenvironments, and estimates of time spent in different microenvironments
- Proportion of population exposed to air quality in excess of standards
- Proportion of population exposed to high levels of radon or of dust lead levels in their homes
- Proportion of population exposed to indoor pollution from burning coal or biomass
- Proportion of children exposed to high levels of environmental tobacco smoke
- Proportion of population who smoke (children, adolescents and adults)
- Carboxyhaemoglobin concentrations in blood
- Proportion of population with raised blood lead levels

Contd…..

“Exposure” indicators: Water

- Proportion of population whose homes are not connected to a water supply system (urban versus rural)
- Proportion of population served by drinking-water systems without source water protection
- Proportion of population without access to safe drinking-water
- Proportion of population whose drinking-water supplies do not meet health standards
- Proportion of population not receiving safe water in the home (or within 15 minutes’ walking distance of the home)
- Proportion of population with no safe drinking-water within reasonable walking distance

Contd….

"Exposure" indicators: General

- Proportion of population living in poor housing conditions
- Proportion of population homeless
- Proportion of population living in substandard housing
- Proportion of dwellings disconnected from water, electricity, gas supplies
- Average number of persons per room in occupied housing units, distribution according to density
- Proportion of population without access to a sewerage system, septic tank or other hygienic means of sewage disposal
- Proportion of population with inadequate sanitation facilities in the home or immediate vicinity
- Proportion of population with inadequate excreta disposal facilities
- Proportion of population with raised blood lead levels

HEALTH EFFECTS

- Once a person has been exposed to an environmental hazard, health effects may manifest themselves which may vary in type, intensity and magnitude depending on the type of hazard, the level of exposure and other factors.

- The ill-health effects of environmental exposures may be acute, occurring relatively soon after exposure (from a single large dose due to an accident or a spill for example), or they may be chronic, occurring as a result of cumulative exposures over time.

HEALTH EFFECT INDICATORS

Environment-related (or suspected)

- Number of outbreaks of food borne disease (for example Salmonella, E. coli, listeria) and waterborne disease (for example cholera, typhoid, giardia, shigella)
- Work-related mortality and morbidity (for example in respect of asbestosis, mesothelioma, silicosis, heavy metal poisonings, fatal and non-fatal injuries)
- Mortality and morbidity associated with motor vehicle accidents
- Number of deaths from drowning
- Mortality and morbidity associated with non-work-related injuries and poisonings (for example pesticides)
- Environment-related cancer morbidity and mortality (for example lung cancer in non-smokers)

Contd….

- Morbidity and mortality associated with typhoid, malaria, polio, cholera, hepatitis A and other infectious/parasitic diseases
- Morbidity and mortality associated with diarrhoea in young children
- Morbidity and mortality associated with acute respiratory infections/pneumonia in young children
- Morbidity and mortality associated with asthma
- Mortality and morbidity associated with chronic respiratory disease

ACTIONS

- An approach to the control and prevention of health hazards which focuses on hazards of human origin is useful in that it addresses potentially remediable problems.

Thank You!