# UNIT 14 ENVIRONMENT AND HUMAN HEALTH—I

**Structure**



## 14.1 INTRODUCTION

In the previous units on pollution of air, water and soil you have learnt that man has polluted all the three realms of the earth — lithosphere, hydrosphere and atmosphere —for his own ends and according to his whims. Ironically, the increasing concern now for the protection of environment arises not because of man's love for nature but to a great extent to protect directly or indirectly, human health, well-being, comfort and to avoid illness and disease. The air we breathe, the water we drink, the food we eat, our working conditions, and even the high levels of noise around us endanger our health and well-being.

Research on cancer, respiratory diseases, and problems caused by contaminated food and water have shown that these are linked with pollutants thrown into the environment. In this unit, we will tell you about the ill effects of various pollutants on health, that we know from these studies.

We divide this unit into two parts. The first part begins with some definitions and explains the concept and importance of community health. The next section, deals with the influence of environment on an individual's health. The study of relationship of environmental contaminants with disease is discussed in the following section.

The second part of the unit covers the health problems arising out of the contaminants in food and water. Since these are agents spreading microbial infection, we have also included a small section on communicable diseases at the end of this unit.

Our discussion on health problems due to environment will be continued in the next unit. We shall then discuss the problems due to air pollution, occupational diseases and the effects of radiations and stress on health.

**Objectives**

After reading this unit, you should be able to :

- state the importance of community health,
- explain environment-health relations,
- describle the epidemiological approach used to study health problems related to environment,
- explain the effects of a toxin on body.

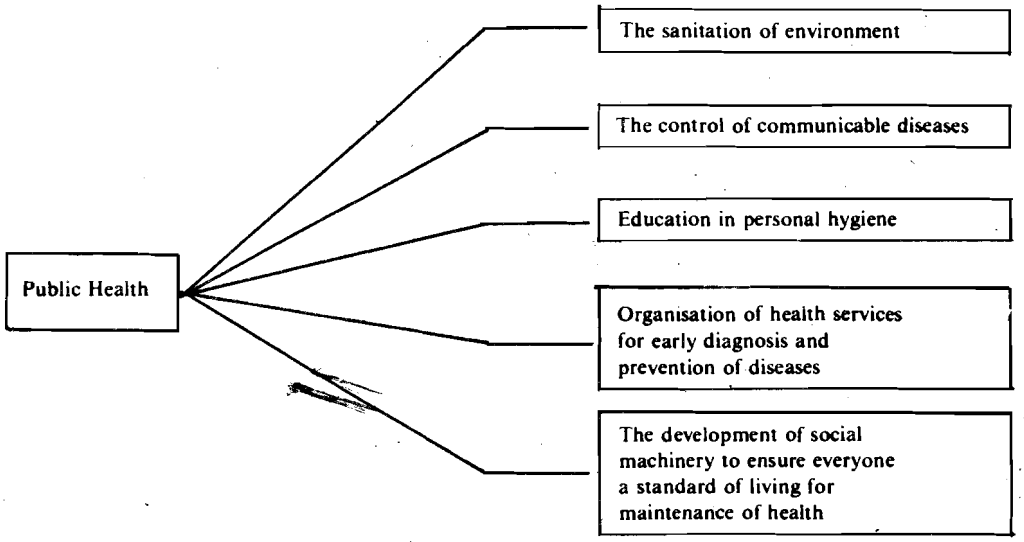
- discuss food and water related health problems and those that arise as a consequence of unplanned projects,
- discuss the mode of spread of communicable diseases.

## 14.2 INTRODUCTION TO ENVIRONMENTAL HEALTH

Before we define environmental health, let us first define health. People generally view health in terms of absence of disease or pain and the prolongation of life. Of course, not being sick is one aspect of healthy existence. But it also includes the quality of life and attainment of well-being that can only be achieved by sound health. In fact, health, like love and happiness, is a quality of life that is difficult to define and cannot be measured. However, a broader and widely used definition of health given by the World Health Organisation (WHO) is "a state of complete physical, mental and social well-being and not merely the absence of disease or infirmity". One measure of health is the ability to function effectively within a given environment. Since the physical, biological and social environment keeps on changing throughout the life of an individual, good health involves a process of continuous adaptation to such changes.

Environmental health can be defined as "the aspect of public health that is concerned with all external conditions such as all forms of life, substances, forces, problems and challenges and any other condition in the surroundings of man that may exert an influence on man's health and well-being". Disease, in this sense, represents a maladjustment of the human being to his environment.

Although ancient civilisations were aware of the effects of environment on health, the importance of clean environment in the modern times was realised in Europe only after the Industrial Revolution in 1842. It was known as "the great sanitary awakening". As a consequence, the discipline of Public Health was established. It was defined as the science and art of preventing disease, prolonging life and promoting health and efficiency through organised community effort. The objectives of public health are given below.




So far, in the developing countries like ours, significant success has not been achieved for such desirable goals of public health whereas, in developed countries, communicable diseases have been almost eradicated by improving sanitary conditions. So the emphasis in public health has moved to the preventive, therapeutic and rehabilitative aspects of chronic diseases and behavioural disorders, like smoking, drug abuse and alcoholism which are prevalent in these countries. Thus, today, public health gives emphasis on planning and evaluation of health activities, programmes and systems. With such challenges, public health is now termed 'Community Health'.

### 14.2.1 Community Health

Community health is defined more broadly and encompasses the entire gamut of community-organised efforts for maintaining, protecting and improving the health of the people. It involves motivation of the individual and groups to change the pattern of behaviour. In addition, it also seeks to plan medical care to achieve optimal health of the members of community as a whole. Previously, the subject of community health was covered in Hygiene, Public Health or Preventive and Social Medicine.

In community health, instead of studying individuals as a patients, it is essential to understand that :

- The patient represents the community.
- Diagnosis of disease in the community, (referred to as community diagnosis) is essential.
- Planning treatment for the community is the objective.

For example a single case of a cholera patient detected in a village is a danger signal. It shows that the disease is present in the community, there may be many cases of it and unless checked its spread will grip the whole village. So the appropriate measures for treatment and control of the disease are planned in advance. Since it is a water-borne disease, water sources—river, wells or underground water are examined for infection and accordingly treated. In addition, necessary treatment for the affected people and precautions such as vaccination for vulnerable people is also done. Community diagnosis may require relevant data such as given below. These are collected and interpreted.

- Age and sex distribution in the population under study and its distribution in social groups—in the community.
- Crude birth rate, infant mortality rate, maternal mortality rate, child death rate, prenatal mortality rate, and neonatal post-neonatal death rate, etc.
- Incidence and prevalence of certain diseases in the area.

Besides investigating health problems, it is also essential to find out the various social and economic factors in the area influencing the above data. This helps in identifying the basic health needs and health problems faced by the community. After studying all the problems, the priorities are established and community action is planned. This involves a health service system which plans for improvement of water supplies, immunisation, health education, control of specific diseases and it requires health legislations. Such health services are planned at individual level, family level and at the level of community. It is also essential that health care must be planned in such a way that it could be easily utilised by all and encourage people to participate. Another positive feature of community action is that it brings co-ordination between voluntary organisations and government agencies engaged in overcoming similar problems.

We hope that from the above text you can see the importance of community health in studying various environmental influences on human beings. This establishes the discipline of 'community medicine' which deals with the care of community both sick and healthy. It requires planning, organisation, delivery and evaluation of health services depending on the country's need and economy.

In recent years, another term which has come into vogue is "the Environmental Engineering". This refers to the study of man-environmental interrelationships and the modification of the environment for man's benefit and survival.

**SAQ 1**

a) List three external conditions that require understanding for the study of environmental health.

.....

.....

.....

b) What is the main objective of community health?

.....

.....

.....

## 14.3 ENVIRONMENT-HEALTH RELATIONS

We have already told you that an individual's health is the result of interaction of a large number of influences upon him or her. We can divide these influences into the following three groups : i) genetic influences, ii) behavioural influences and iii) environmental influences. We will now briefly describe these.

**1) Genetic Influences**

Some Common Genetic Diseases

Phenylketonuria
Haemophilia
Mongolism
Sickle-cell anaemia
Thalesemia

All organisms inherit a set of genes called genome from their parents. Genes determine the physical and physiological characteristics of an organism. That is why a child resembles his parents. We also find that some human beings are born with abnormalities. The inherited abnormalities are called hereditary diseases which are passed on from parents to the offsprings. Some examples of hereditary diseases are listed in the margin.

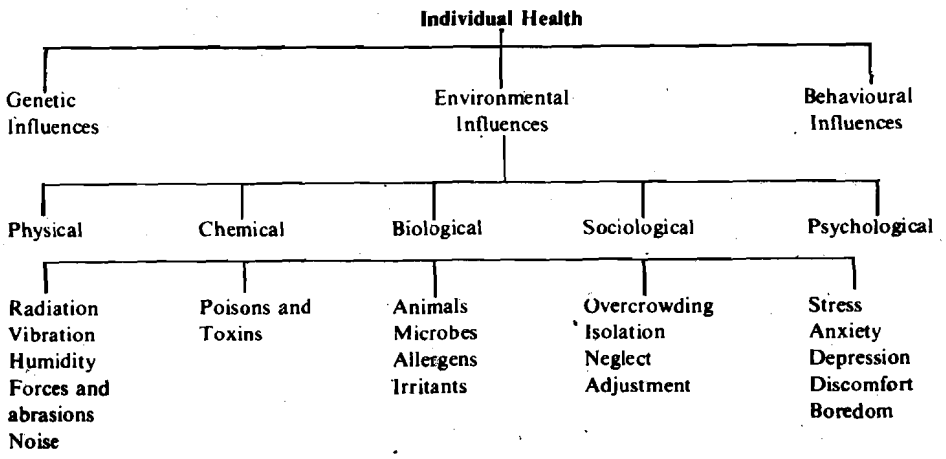
There are other diseases such as allergies, diabetes, hypertension, schizophrenia, etc. which cannot be regarded entirely genetic in the same sense as hereditary diseases. However, they are due to the **interaction of genes with environment.** These diseases are triggered and affected by nutrition, stress, emotion, hormones, drugs and other environmental interactions. In other words, they would not occur if the environment is favourable for the person, he will remain unaffected and healthy. Such diseases are referred to as due to genetic influences. The overall make up of a person may make him more prone to developing a particular diseases than a person with different genetic make up.

**2) Behavioural Influences**

Alcoholism, smoking, drugs, chewing tobacoo, or irregular food habits etc. result in various kinds of ill-health. The habits of a person change throughout ones life time. These depend upon self-responsibility, nutritional awareness, stress management, physical fitness and environmental sensitivity of an individual.

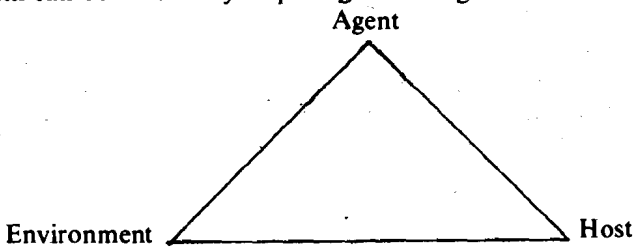
**3) Environmental Influences**

You know the various components of environment. All of them exert influences on our health. As shown below these are physical, chemical, biological, sociological and psychological.




To understand the effect of changing environment on human beings we need to study in detail the various aspects of the range of influences on human health. In the following text you will learn how they are studied.

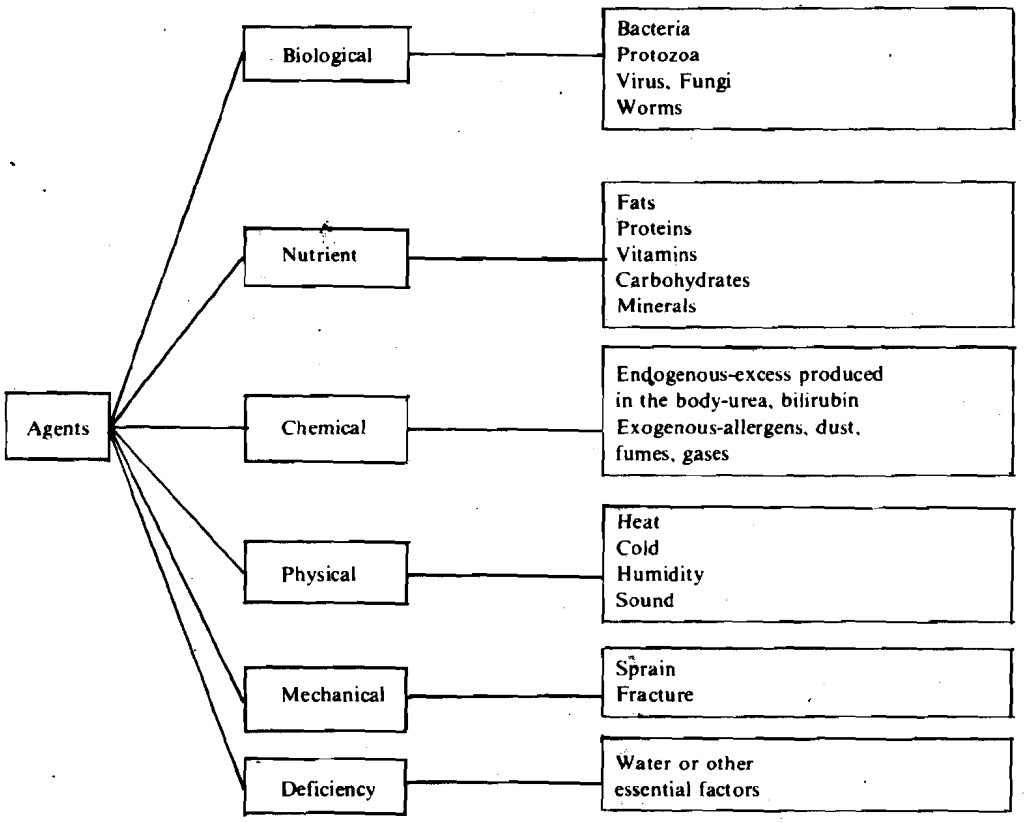
Ill-health is regarded as an interaction of the triad—agent, host and environment. A health problem can be studied by acquiring knowledge of this triad.




There are a variety of agents of ill-health, physical, chemical or biological that can be detected and identified with the help of laboratory tests. The host is the human being who is available for observation. The agent-host interaction can be easily specified. However, the same cannot be said about the third component, the environment, which is complex and ever changing.

**1) Agents of Ill-health**

The agent of ill health or disease may be living or non-living matter, a tangible or intangible force, an excess or lack of a substance in the body. In some ailments like heart disease and peptic ulcer, etc. the causative agent is not known. By and large, these agents are classified as given below :




**2) The Human Host**

The study of human hosts and the treatment for the ailments varies with the factors listed below :

i) **Age :** Diseases vary from childhood to old age, e.g., infectious diseases like measles, chicken pox, polio, etc. are more prevalent in children, while diseases like hypertension, heart disease are seen predominantly in older persons.

ii) **Sex :** Disorders due to pregnancy, etc. are predominantly seen only in females.

iii) **Race :** Sickle cell anaemia is predominantly seen in Negroes.

iv) **Genetic Factors :** Predominantly of G-6PD deficiency in Parsi community. Haemophilia and Down's Syndrome (mongolism) are also the result of certain genetic defects.

**Host : The organism (here the man) which the parasites enter**

**Pathogen : Parasite which cause the disease**

v) **Marital Status :** Carcinoma of cervix of uterus more prevalent in married women than in the unmarried.

vi) **Nutrition :** Protein deficiency produces diseases like marasmus, in general, inadequate nutrition makes a person more vulnerable for infection.

vii) **Occupation :** Occupations and work environment give rise to a wide range of hazards and diseases like cancer, respiratory problems, deafness, and many others.

viii) **Immunity :** Immunity is resistance to fight against diseases. Lowered resistance makes a person more susceptible to disease.

ix) **Social Class :** Lower income groups suffer more frequently from rheumatic diseases, chronic bronchitis, while in high income group diseases like hypertension, heart disease are prevalent.

x) **Educational Status :** Related to social class.

xi) **Life Style :** Related to patterns of behaviour like smoking which causes lung cancer, and lack of exercise might lead to diseases of heart.

Aetiology : The study of the cause or origin of disease.

xii) **Mobility :** Rapid mode of travel is responsible for spreading diseases from one country to another during incubation period.

These are important factors studied in epidemiology, as they help in providing clues to aetiology of disease. We shall discuss epidemiology of disease in the next section.

### 3) The Environment

This concept is the most complex in the triad. We are primarily concerned with its influence on health. As you know certain environmental conditions like air, water and food are necessary for man's survival. Apart from their availability, their quality and quantity must be assured according to man's natural and acquired capacity for sustenance. Progress in industrialisation has brought environmental hazards such as air, water, noise and radiation pollution. These have caused many health problems and diseases. In the biological environment — virus, bacteria, worms, insects, and some other organisms constantly work for their survival and end up as disease-causing parasites, carriers of diseases or intermediate hosts. Since, they surround us, we cannot possibly escape from them altogether. However, various measures have been worked out to prevent diseases caused by them.

The psycho-social environment is a unique creation of man himself. Social and medical scientists have clearly established association between psychological environment and prevalence of certain diseases. For example, it has been shown that lung cancer is caused by chemical substances present in cigarette smoke but the habit of smoking is often due to psycho-social causes. You will learn about the various environmental influences on health, in detail, in this and the following unit.

### SAQ 2

a) Which among the following diseases are due to genetic influences.

| | | | |
|---|---|---|---|
| i) | Schizophrenia | ii) | Hypertension |
| iii) | Haemophilia | iv) | Diabetes |
| v) | Allergies | vi) | Sickle cell anaemia |
| vi) | Mongolism (Down's Syndrome) | viii) | Alcoholism |

b) Match the following types of environmental influences with their respective category

| | Environmental Influences | | Category |
|---|---|---|---|
| a) | Toxin | i) | Psychological |
| b) | Radiation | ii) | Biological |
| c) | Stress | iii) | Physical |
| d) | Microorganism | iv) | Sociological |
| e) | Neglect | v) | Chemical |

## 14.4 EPIDEMIOLOGY OF DISEASES

When you visit a physician with some complaint, he examines sign and symptoms and takes help of laboratory test to reach diagnosis. He writes the prescription from his knowledge about medicine and prescribes only those medicines that have been recommended by the scientists and approved by medical science authorities. In other words, diagnosis is the major skill of a physician while the scientists investigate causes of diseases and their cure. Scientists study human diseases using the following three approaches, which are complementary to each other.

1) The basic science approach
2) The clinical approach
3) The epidemiological approach

In the basic science approach, the cause of the disease — physical, chemical, biological or any other is investigated in detail. The clinical approach involves the study of sick people and the physiological symptoms due to disease and the conditions that will arrest or relieve the symptoms. The epidemiological approach examines the relative frequency of a disease within defined population or a fraction of it that may be large or small. Obviously, a group of people or community or larger population are exposed to a common environment, epidemiological approach is an important way of studying the influence of environmental contaminants on human beings. It encompasses two main areas :

**Epidemiology : Epi (upon) and demos (people), i.e. 'among people' study of a phenomena such as communicable diseases, non-communicable diseases, other causes of human morbidities or mortalities accidents, wars etc.**

a) **Descriptive Epidemiology :** in which a study of the distribution of disease or health hazards in the human population is conducted.

b) **Analytic Epidemiology :** in which a study of the determinants or underlying causes or risk factors of disease is undertaken.

The main objective of epidemiology is to understand or discover the cause of diseases and suggest best means of prevention of diseases or controlling their spread and provide guidance to Health Services.

In the epidemiological approach, the following five basic questions have to be answered,

1) When does the disease occur? (Time)
2) Where does the disease occur? (Place)
3) Who are the people affected? (Persons involved)
4) Why has it happened? (Causes)
5) What should be done to prevent or control the disease? (Prevention, control and eradication)

Such approach helps in identifying the environmental causative of the disease and suggest the ways of its prevention. For example, in epidemiological study of respiratory disorders in an area, it was found that disease has been prevalent for some years, the affected people work in textile industry and show common symptoms of disease. Among the workers only those are affected who breathe in fibres. So fibres are linked with disease. After verification of such data, physical and medical means of control and prevention of disease can be planned.

Environmental factors are considered in the light of area of incidence and time of exposure. For example, a single event such as an accident in a chemical plant requires immediate instant study of factors different from a long-term hazard due to coal and zinc mining.

In the following section we will tell you the effects of toxic chemicals on our body.

## 14.5 TOXINS AND ENVIRONMENTAL HEALTH

You have learnt that chemicals are also the agents of ill-health. Chemicals that cause

some adverse effects on living organisms are called **toxins.** The effects of toxins are classified into two types. When the effect is immediate after exposure, it is called **acute effect.** This is short-lived and disappears after the toxin is removed. This often occurs if the victim is exposed to a high concentration of toxin for a brief period, for example, exposure to high concentration of carbon monoxide released from automobile exhausts when caught in traffic. When the effect of toxin appears after months or years it is called **chronic effect.** This is due to short-term exposure to a chemical over a long period. For example, smoking or chewing tobacco cause cancer of lung and mouth respectively. A toxin may show both acute and chronic effects.

Toxic substances exert their effect on cell constituents and interfere with their function. They may trigger the release of some hormones in quantities that could have adverse effect on the body.

Although various toxic substances often find their way into our body through air, water, food or through the skin, their toxic effect on the body depends upon the following four factors : i) route of entry, ii) amount of dose, iii) susceptibility of th individual, and iv) enhancement due to synergism.

**Synergism : (means working together) the combined effect of two chemicals is greater than the sum of the effects of two components taken individually.**

The toxicity of a substance entering the body is the highest if it immediately reaches circulation through cuts in the skin, by absorption or in some other way. This is because the toxin can immediately interfere with some vital functions of the body. You know that cyanide and carbon monoxide act as potent poisons because they interfere with the oxygen carrying capacity of blood. The dose is also an important factor, as certain toxins are not harmful at low doses. On the contrary, in some instances, they are essential for the body, becoming dangerous only when the dose is high. The amount at which the adverse effect is manifested is called the **threshold dose** and above the threshold dose the danger increases. A good example is flouride, which is necessary for healthy teeth. But a slight increase of flouride in water is enough to cause fluorosis. The effect of dose may vary from one individual to another depending on ones susceptibility. The action of toxic substances may be synergestic, thus resulting in enhancement in damage. For example, the risk of cancer is increased in people who are exposed to asbestos fibre and also smoke, than those who either only smoke or only are exposed to fibres.

**SAQ 3**

**In the following sentences, fill in the blank spaces with appropriate words.**

i) **The influences of environmental contaminants on human beings is studied by..... .....**

ii) **The effect of cyanide is severe because it reaches..... .....immediately.**

iii) **Interacting components of triad that are studied for ill-health are..... ..... and .....**

iv) **The asphyxia caused by exposure to carbon monoxide is..... effect.**

## 14.6 FOOD-RELATED HEALTH PROBLEMS

We all know that food is a potential source of infection. The moment we have a stomach upset we suspect it to be due to food. The contamination in food may be due to microorganism, microbial and non-microbial toxins, worms or by added chemicals that are not natural to the food itself. Food can get contaminated at any point during its journey from the producer to the consumer. Therefore, careful handling is necessary at every stage. Food hygiene in the widest sense implies hygiene in production, handling, distribution, cooking and serving of all types of food.

We can classify food-borne diseases as given in Table 14.1.

Table 14.1 : Classification of Food-borne Diseases

| Disease Agent | Examples |
|---|---|
| Virus | Viral hepatitis, Viral Gastroenteritis, Polio |
| Bacteria | Typhoid, Paratyphoid, Food poisoning, Botulism Infantile diarrhoea, Shigellosis, Bacterial dysentry Strepto and Staphylococcal infections, cholera, Salmonellosis |
| Worms | Pork tapworm, Whipworm, Pinworms, Hookworm, Round worm (Ascaris, Guinea worm |
| Natural toxins | Lathyrism, Epidemic Dropsy, Aflatoxins |
| Chemical Poisons (additive and adulterants) | Pesticides, some Food Additives and Adulterants |
| Metals | Mercury, Lead, Cadmium, Tin, Zinc |

Let us now discuss some of these disease-causing agents.

**1) Microorganisms**

Microbes, specifically bacteria, cause either food poisoning or food infection. You must have observed that food left at room temperature for long gets spoiled. This is because microbes are omnipresent and food is the growth medium where they flourish. They multiply over a period of time and, thus, are produced in large numbers. In their metabolic processes toxic substances are secreted. Some of the toxins are heat-labile i.e. they become harmless if food is sufficiently heated. But many are heat-stable. That is why, intake of such food results in **food poisoning.** We can often judge and reject such foods by the look, texture or foul smell. But some infections, like botulism, for example, cannot be identified by appearance. It is common in tinned food, particularly in cold meats when due care is not taken in preservation. The botulism toxin, though fatal, is heat-labile.

**Food infections,** on the other hand, are due to introduction of disease-causing bacteria in food by careless handling, cooking or serving. For instance, during coughing, the spray of aerosol introduces virus or bacteria in the food. These microbes do not multiply in food, instead they enter and multiply in the human body and cause severe illness. Even a few bacterial cells invading the body are enough to cause disease.

The symptoms of food-borne diseases in general are :

i) fever, ii) diarrhoea, iii) vomitting and pain in abdomen, iv) general weakness, and v) dehydration.

**2) Parasites**

These are generally worms which grow in the body. Actually, food gets contaminated by ova of worms that are released in the faeces. Ova can get into food by unhygienic handling of food or by using still or infected water that is a reservoir for infection. The ova hatch into worms in the body. For example, round worm disease. The female round worm (Ascaris) produces over 200,000 eggs per day in the intestine of infected person which are passed to the soil in faeces. These are hatched into larvae. Once larvae are consumed, they grow into tiny worms in the intestine.

**3) Natural Toxins**

You have already learnt about toxins produced by bacteria. Many molds that grow on food also produce toxins which are poisonous for man. For example, a field fungus Ergot infects food grains like bajra, wheat and rye during seed formation. Consumption of such infected grain results in ergotism which is characterised by acute episodes of nausea, repeated vomitting, giddiness, and drowsiness. In chronic cases painful cramps in limbs and gangrene occur. Another fungus *Aspergillus flavus* that infects groundnut grains, sweet potatoes and cotton seed and their cake, produces toxic substances known as aflatoxins. Among these, aflatoxin B is a potent carcinogen, producing liver cancer which ranks high in incidence in our country. Fungal toxins are called mycotoxins. Sometimes, food stuffs, especially grain, pulses and oil seeds are accidentally contaminated by poisonous seeds which are hazardous to health. For example, mustard seeds get mixed up with seeds of poisonous plant *Argemone mexicana* which causes dropsy. Millets similarly get contaminated with

**Gangrene means necrosis, usually death and decay of any part of body usually by obstructed circulation.**

In Kusumi block of Sarguja District of Madhya Pradesh, local population subsists on the millet (Gondhi) which often gets contaminated with *Crotalaria*.

seeds of *Crotalaria* which contains a toxic alkaloid. This causes Hepatotoxic jaundice and Ascites. Khesari dal — *Lathyrus sativus* causes lathyrism, a nervous system disease, characterised by paralysis of lower limbs, especially in males.

Many animals, mostly marine animals, contain toxins. There are about 500 species of fish that are known to be poisonous. Consumption of clams and mussel results at times in paralytic shellfish poisoning.

### 4) Chemicals in Food

The practice of adding colours, flavours or preservative to food is not new. Presently, more than 3,000 synthetic and natural chemicals are being used for various purposes. Most of the foods available in the market contain some chemicals termed as food additives. These are defined as "non-nutritious substances intentionally added to food, generally in small quantities to improve its appearance, flavour, texture or storage. Let us look at the different classes of food additives given in Table 14.2.

**Table 14.2 : Different classes of food additives**

| Type of additives and Purpose | Examples of Chemicals used |
|---|---|
| **Artificial Colours** | |
| Improve the appearance of the products and make it appealing for the customers | Saffron, Turmeric and many other natural and synthetic colours |
| **Flavouring Agents** | |
| Provide suitable flavour, make it more palatable and appetising, used to identify product for advertising purpose | Vanilla essence and other fruit flavours, many natural and synthetic chemicals. Two of the most common synthetic ones are monosodium glutamate and saccharin. |
| **Preservatives** | |
| Retard spoilage caused by the growth of bacteria or fungus | Benzoic acid, sodium benzoate, citric acid, sorbic acid, potassium sorbate, sodium nitrate. |
| **Bleaching Agents** | |
| Decolourise unwanted colour | chlorine gas |
| **Antioxidants** | |
| Maintain freshness by retarding chemical oxidation | Propyl gallate, butylated hydroxyanisole, butylated hydroxytoluen |
| **Sweetner** | |
| Provide desirable sweetness and taste | Cyclamates |
| **Emulsifiers** | |
| To blend food | Lecithin, glycerides, polysorbate |
| **Stabilisers and Thickners** | |
| Change texture, provide smooth consistency as in ice cream | Gelatin, dextrin, vegetable gum seaweed extracts |
| **Acidity Imparting Agents** | |
| Provide desirable taste and flavour, also used for pickling | Citric acid, acetic acid |
| **Nutritional Supplements** | |
| Added to some products to compensate for the deficiency of some essential nutrient in the diet. | Vitamins, minerals, amino acids, and proteins |

It must be pointed out that generally new food additives are introduced without adequate testing of their long-term physiological effects. In fact, testing of a chemical is a tedious, lengthy and very expensive process. It may sometimes require millions of rupees and many years of research. In India, generally, the new food additives are

introduced from the West. Even when their ill effects on health are found and they are banned in the western countries, their use in our country continues.

Uncontrolled or indiscriminate use of increasing number of food additives may pose health hazards among consumers. Hence food additives are subject to government regulation.

**5) Metals**

Toxic metals such as mercury, lead, tin, zinc, arsenic and antimony may get into the body through food, water or while breathing in an environment containing dust from these metals. Regardless of their mode of entry, we will discuss their effect on health in this section.

You know about the mass poisoning in Japan in the 1950s which resulted due to eating of fish taken from Minamata Bay where the water was polluted with methyl mercury. Practically all mercury in diet comes through consumption of fish poisoned by water containing mercury. The metal in the body kills cells and damages organs with which it comes in contact and thus impairs their functioning. Chronic exposure causes lesions in the mouth and skin and neurological problems. Inhalation of mercury vapours is more dangerous than its ingestion. The typical symptoms of poisoning by mercury vapours are : i) irritability, ii) excitability, iii) loss of memory, iv) insomnia, v) tremor and vi) gingivitis.

**Mercury Poisoning in Japan**

**The victims developed numbness of the limbs, lips and tongue and lost muscle control. In addition it caused deafness, blurring of vision, clumsiness, apathy and mental derangement.**

Another potent poison is lead which gets into food by the use of water from lead pipes, packing of food in lead containers, using machines for processing or packing food and use of pesticide spray containing lead. People working in the factories using lead may encounter it by inhaling active lead dust. Lead affects brain, and in developing children leads to mental retardation, lowered IQ, and behavioural abnormalities. It retards the formation of haemoglobin and damages kidneys.

Cadmium is widely used in industry. After ingestion or inhalation it gets deposited in the kidney. Long exposure to cadmium results in brittle bones, damaged kidneys, testes and liver. The Itai-itai disease first reported from Japan was shown to be due to cadmium toxicity.

The metals that enter food from cheap cooking utensils are antimony, zinc and tin. Preserved food are stored in tin cans. Cautious use of such foods is very essential. To some extent we can identify contamination of metals by change in colour or metallic taste. You may have noticed that acidic foods change the appearance of the surface of a metallic container. Acids react with the metal or the container and form compounds which get mixed with food. Finally, we must also point out that metals like iron, copper, magnesium, etc., that are essential in our body, can be utilised only in a specific chemical form and in a controlled amount, otherwise they may be harmful. For example, copper is necessary for the body but copper-contaminated foods are toxic.

**Metal Fume Fever**

**Breathing of fumes of toxic metals causes rise in temperature of the body. This is called metal fume fever. It is accompanied by dry throat, chest constriction, fatigue, headache, backache, nausea and muscular pain.**

**Food Adulteration**

An adulterant is any ingredient which when present in food is injurious to health. This definition has been given by the Indian Prevention of Food Adulteration Act (PFA) enacted in 1954. The commonly adulterated food stuffs are pulses, spices, coffee, tea leaves, edible oils, ghee, butter, flour, etc. Pulses are mixed with corresponding khesari pulse, roasted tamarind and date seeds are ground into coffee powder, exhausted tea leaves or coloured saw dust are mixed into fresh tea, cheap seeds are mixed with black pepper, cumin, cardamom and edible oils are adulterated with non-edible oils. We have mentioned before that seeds of *Argemone mexicana* are poisonous and get accidentally mixed with mustard seeds. It is unfortunate that oil from these seeds is extracted and is used to adulterate coconut, seasame and groundnut oils. Often it is seen that the so called fresh shelled peas sold in the market are actually, dry peas soaked in water that are coloured to give them the look of fresh peas. The dangers of such adulterants go unchecked. In the following subsection you will learn how you can assure the quality of a product available in the market.

**Quality Control**

The Codex Alimentarius are international standards set by FAO/WHO for all

principal foods. In India, the food standards are prescribed in accordance with it, with some necessary modifications. You would have seen the ISI mark on several goods in the market which means standards set by the Indian Standard Institution. Food additives are subject to ISI standards. Although there are many organisations that control the quality of food stuffs its production and distribution, yet numerous adulterated foods are sold in the market. The following legislations prescribe quality standards for food stuffs in India:

The Agricultural Produce Grading and Marketing (Agmark) Act provides grading and marketing of agricultural and other products.

The Food Products Order (FPO) lays down the minimum standards relating to the quality of packed fruits and vegetables.

**Agmark grades a food as A, B, C, D or as 1,2,3,4, which you can look for the grade on the products you buy in the market.**

Meat Product Order controls the production quality and distribution of raw and processed meat.

The Vegetable Oil Control Order provides standards for the production, distribution and quality of extracted oil.

Now that you have finished more than half of this unit take a break for tea. Afterwards you will be learning about the effects of water pollution on health.

**SAQ 4**

a) Match the causative factor for diseases given in column 2 with the corresponding reasons given in column 1.

| | Column 1 Diseases | | Column 2 Reasons |
|---|---|---|---|
| a) | Spastic paralysis of lower limb | i) | Food infection |
| b) | Typhoid | ii) | Food poisoning |
| c) | Liver cancer | iii) | Khesari dal |
| d) | Ergotism | iv) | Aflatoxin |
| e) | Botulism | v) | Fungus infected cereals |

b) List two chemical substances each used to:
i) improve appearance, ii) improve health, iii) retard spoilage.

.....

.....

c) Match the toxic metals listed in column 1 with their effect on human health described in column 2.

| | Column 1 Metals | | Column 2 Health Effects |
|---|---|---|---|
| a) | Cadmium | i) | Mental retardation, lowered IQ and behavioural abnormalities in children |
| b) | Lead | ii) | Damages testes and affects liver functions |
| c) | Mercury | iii) | Kills body cells which come in contact and impairs the functioning of organs |

## 14.7 WATER-RELATED HEALTH PROBLEMS

You have already learnt about water pollution resulting from sewage and industrial and agricultural wastes. Sewage contains decomposible organic matter and pathogenic agents. Industrial wastes and agricultural wastes contain toxic chemicals. We can broadly categorise water pollutants into two kinds; i) chemical agents—polyphenyls, phenols, fertilisers, pesticides, complex organic chemicals, metals, etc. ii) biological agents—bacteria, virus, protozoa, worms and their eggs and other parasites. We will describe the effects of these water pollutants now.

## 14.7.1 Chemical Hazards

These are mainly due to various chemical substances from industry which get into public water supply. Usually they contain solvents, detergents, heavy metals, dyes, pigments, sulphides, organic substances etc. These chemicals may affect directly, by contact, to produce severe skin diseases, allergies or eczemoid reaction or chemical burns. Some toxins produce acute effects while others produce chronic effects. Sometimes, the chemicals are ingested by workers if they do not wash their hands before taking food. Table 14.3 shows various toxic chemicals, and their effects on health. One may come in contact with them through other means besides water.

**Table 14.3 : Effect of Toxic Pollutants on Health**

| Sl. No. | Name of the toxin | Source | Effects on Health |
|---|---|---|---|
| 1) | Polychlorinated biphenyls (PCBs) | Used for manufacturing transformers and other electric appliances, also used in the production of plastic containers, epoxy resins, various types of walls and upholstery covering. Ingredients in soap, cream, paint glue, paper, waxes and many other products | Fatigue, vomitting, skin blemishes, abdominal pain, disorders of the intestine, temporary blindness, stillbirths, suspected carcinogen. |
| 2) | Vinyl chloride | Used in plastics as polyvinyl chloride (P.V.C.) | Damage to liver, bone and circulatory system, cancer of liver, brain, lymphatic system, birth anomalies. |
| 3) | Benzene | Used for art and craft, detergents, moldings, fibres, insecticide and gas additives | Anaemia, bone marrow damage and leukemia |
| 4) | Phthalates | Plasticisers (added to plastic resins) | Damage central nervous system |
| 5) | Nitrosamine | Produced by chemical reaction of nitrites with other amines present in food. Nitrates are used for curing meats, salami, and also in smoked fish. | Carcinogenic |
| 6) | DDT | Insecticide | Causes tremors, degradation of central nervous system, suspected carcinogen |
| 7) | Aldrin/dieldrin | Insecticide | Causes tremors, convulsions, damage to kidney, suspected carcinogen. |
| 8) | Dioxin | Herbicide | Powerful carcinogen, causes persistent and severe form of acne, and other adverse health effects |
| 9) | Chlorinated organic compounds | Produced on chlorination of waste water and find their way in drinking water. | Carcinogens |
| 10) | Nitrates and Nitrites | Come from septic tanks, barnyards, heavily fertilised crops and sewage treatment plants, Nitrates get converted to nitrites in intestines of humans | Nitrites combine with haemoglobin and reduce its oxygen carrying capacity. Fatal for infants younger than three months. The disease is called methyl-nitrosomania |

**In 1968 the accidental contamination of cooking oil with PCBs in Japan caused several thousand people to suffer from enlarged liver, discorders of the intestine and lymphatic system.**

Water-borne Diseases
Gastric problems
Cholera
Typhoid
Dysentery (bacterial)
Dysentery (amoebic)
Round worm
Guinea worm
Jaundice
Polio

## 14.7.2 Biological Hazards

Water-borne infections are problems of immense proportion in India and other less developed countries. Eighty per cent of the diseases in these countries are linked with contaminated water. The list of water-borne diseases is given in the margin. Our health is affected by drinking polluted water either directly or by use of such water in cooking or for other personal purposes. The microorganisms of these diseases multiply in the body of the infected person. The infection is excreted with stool or urine. Therefore, improper disposal of human excreta is the chief cause of contamination of water of rivers, wells, lakes and shallow hand pumps and results in the spreading of these diseases. Table 14.4 shows the extent of contamination in some Indian rivers estimated by fecal coliform.

It is indeed disheartening that after more than four decades of independence, our country has not succeeded in providing water, especially drinking water in rural and many urban areas, though we often hear claims of progress on all fronts. Table 14.5 shows the sanitation and drinking water available to the people of India, Sri Lanka and Bangladesh. Many diseases like trachoma, scabies, skin sepsis and fungal infection are not water-borne but their incidence depends more on the quantity of water available for use.

Among the water related diseases diarrhoea, jaundice, guinea worm, Japanese encephalitis, malaria, filariasis, knock-knees are prevalent in our country. The incidence of some of these has increased due to implementation of developmental projects, as you will study below.

So far diarrhoea has remained a permanent epidemic in the country. Its major victims are infants and children. Diarrhoea along with malnutrition is a vicious killer. A part of the increase in the incidence of diarrhoea amongst infants may also be due to the modern practice of bottle feeding encouraged by advertisements of milk powder agencies.

Guinea worm affects about 1.7 million Indians of almost 8,000 villages. The larvae of the worm get into the body through drinking water containing small microscopic shrimp-like crustaceans called *cyclops*. The cyclops actually pick up the larvae from

**Table 14.4 : Toxicity of River Water**

| Country | River | Faecal Coliform (Number/100 millilitres) |
|---|---|---|
| Bangladesh | Brahmaputra | 2,606 |
| | Lower Ganges | 1,963 |
| | Meghna | 3,193 |
| India | Mahi | 550,000 |
| | Narmada | 260,000 |
| | Tapi | 37,000 |
| | Wainganga | 3,699 |
| | Cauveri | 439 |
| | Krishna | 57 |
| | Godavari | 7 |
| | Periyar | 767 |
| | Sabarmati | 1,147 |
| Pakistan | Indus | 120 |

**Table 14.5 : Availability of Drinking Water and Sanitation Facility in India and its Neighbouring Countries**

| | Drinking Water | | | Sanitation | | |
|---|---|---|---|---|---|---|
| Country | Per cent population with access to safe drinking water | | | Per cent Population with access to safe drinking water | | |
| | Total | Urban | Rural | Total | Urban | Rural |
| India | 55 | 80 | 47 | 8 | 30 | 1 |
| Pakistan | 40 | 78 | 24 | 20 | 53 | 6 |
| Sri Lanka | 37 | 76 | 26 | 67 | 80 | 63 |
| Bangladesh | 41 | 29 | 43 | 4 | 21 | 2 |

**Source** : World Resources 1987 : A report by International for Environment Development and the World Resource Institute, New York, Basic Books Inc., 1987.

water and transmit them to human beings. Alternately, the cyclop may be eaten by fish, which then transmit the larvae. In the body the larva grows into worms about as long as 1.7 metre.

Another danger of infection that has come to notice is in the water taken from taps of intermittent water supply. The sewer water from the nearby leaking pipes enters the empty water pipes when water is at low pressure. That is why the incidence of jaundice is on the rise in big cities.

### 14.7.3 Developmental Activities and Diseases

Developmental activities, specially irrigation projects have contributed to the spread of diseases like malaria, dengue fever, Japanese encephalitis and the problem of knock-knees. These diseases have spread in larger areas due to developmental activities.

During 1952 to 1965, cases of malaria declined from 100 million to about 100 thousand by extensive use of the pesticide DDT. When malaria was controlled in the Tarai region, it facilitated the opening of new areas for agriculture. But one of the worst consequences of increased irrigation was the resurgence of malaria in 1976 with cases upto 6.4 million. The mosquitoes developed resistance due to the excessive use of pesticides. Now, the mosquitoes have developed multiple resistance to insecticides. In addition, the malarial parasites also developed chloroquine drug resistance.

Japanese encephalitis is a new disease in India and its incidence has been increasing steadily. As the name suggests the disease initially originated in Japan and has been spreading across South East Asia. This is a viral disease, popularly called brain fever. It is mostly fatal, killing one out of the two affected persons. The virus is spread by mosquitoes which breed in rice fields. The expansion of rice fields had led to the expansion in the habitat and increase in the population of mosquitoes. Ordinarily, the mosquito transmits the virus to pigs but people who rear pigs accidentally become its victims. Thus the disease is socio-economic and affects poor people.

Another mosquito-trasmitted disease is filariasis which has spread in the country over the last three decades. This is due to increase in the water supply in an area without adequate drainage facilities. The unsanitary water pools thus became the breeding ground for the mosquitoes. In its final stage the disease appears similar to elephantiasis. It is reported that by 1986 about 38 million people were protected against it through National Filaria Programme. However, many millions are still suffering from it.

We have already mentioned about knock-knees disease which occurs due to high uptake of flouride in water. The victims are people living around the command area of Nagarjunasagar in Andhra Pradesh. The studies have shown that the irrigation projects has led to many interrelated changes in the area. Due to seepage of water from the dam's reservoirs and canals, the level of sub-soil water has increased. As a consequence, change in the alkalinity of the soil has led to high uptake of heavy metals by sorghum plant. Sorghum is the staple diet of the villagers and the intake of such plants leads to deficiency of copper which is one of the essential trace metals for our body. It is found that deficiency of copper is associated with high uptake of flouride leading to skeletal fluorosis. The deformity of knees results in total incapability to move. Thus we find that one event is linked to the other, and eventually the people of the area have paid a crippling cost for big dams.

In 1965, it was reported that the accumulation of DDT in the body tissue is the highest among Indians. This was probably due to large consumption in their diet of cereals, vegetables, fruits, etc. which have a high level of pesticide residue. The pesticide is not easily removed on washing, cooking or boiling. One of the worst effects of the pesticide came to light through the case study of the disease called Endemic Familial Arthritis which affected poor Harijans of Malnad in Karnataka in 1975. The disease began with intermittent pain in the hip and knee joints which later became continuous until some people could hardly stand up. It was found that at one time the victims of the disease could not afford cereals, so they had to survive on crabs which were caught from the rice fields sprayed with insecticides for growing high yielding varieties.

It is indeed unfortunate that in most instances, we find that it is the poor and exploited sections of our society who suffer due to unplanned development and mismanaged environment.

**SAQ 5**

a) Fill in the blanks in the following sentences with the name of toxic pollutant.

i) ..... is used in plastic resin and causes damage to central nervous system.

ii) ..... is used for making plastic containers but it is a suspected carcinogen.

iii) ..... is used in art and craft and can cause anaemia and leukemia.

iv) ..... can cause methylnitrosomania in infants.

v) ..... ..... and..... insecticides are suspected carcinogens.

vi) ..... causes persistent and severe form of acne.

b) Which among the following diseases are a result of developmental activities.

i) Guinea worm ii) Filariasis

iii) Japanese encephalitis iv) Diarrhoea

v) Knock-knees vi) Malaria

vii) Typhoid

## 14.8 COMMUNICABLE DISEASES

We have already learnt that many of the disease-causing agents enter the body through food and water. Many of these diseases are communicable. A communicable disease is defined as a disease resulting from infection or infestation that can be transmitted directly or indirectly from man to man, animal to man or animal to animal through air, dust, soil, water, food, etc. The common examples are typhoid, cholera, malaria, chicken pox, guinea worm, etc. There are three links in the chain of transmission : 1) reservoir of infection, 2) modes of transmission, and 3) the host. You will be able to understand each link from the details given below.

**A) Reservoir of Infection**

Man is usually the reservoir or source of infection. The infecting agent—bacteria, virus or ova of worms—are released from the body through cough, stool, vomit, sputum or urine. You must be aware that an infected person suffering from a communicable disease can transmit infection. However, even a healthy person who does not show the sign of infection, but harbours the infective agent can also transmit it to the host. Such a healthy person is called a "carrier".

**B) Modes of Transmission**

The different modes of transmission are described below. Some diseases can be transmitted only by a single route, while others may spread by various routes.

**1) Contact transmission**

This could be i) direct or ii) indirect.

i) **Direct Transmission :** This can occur from an infected person to the others during physical contact. Some examples are, syphilis, gonorrhea, eye diseases.

ii) **Indirect Transmission :** The infective agent can be transmitted to host by means of infected articles, clothes, spoons, cups, etc., e.g., typhoid, infective hepatitis.

**2) Vehicle Transmission**

When disease agents are transmitted through water, food, milk, ice, serum, etc., it is called vehicle transmission. Water is drawn from a common source. If the source is infected, it results in the spread of the infection to a large population. Diseases such as typhoid fever, cholera, polio, hepatitis, worm infections, etc. are spread by vehicle transmission.

**3) Vector Transmission**

Insects such as mosquitoes, housefly, and tse-tse fly, that transfer the disease agents are called vectors. The transfer of infection occurs by i) biting, ii) regurgitation, iii) scratching, and contamination of host with body fluids or vectors, e.g., malaria, guinea worm, dysentery, Japanese encephalitis, rabies.

**4) Air-borne Transmission**

When an infected person coughs, sneezes or speaks loudly, droplets of saliva or sputum are thrown in the atmosphere upto extent of 5 to 10 metres. Such droplets in atmosphere, if inhaled along with air by a host, result in infection. This is also called droplet infection. Examples are tuberculosis, influenza, measles, diptheria, mumps, etc. Most viral infections are air borne.

**5) Vertical Transmission**

When an infected mother transmits infection to foetus via placenta, it is called vertical transmission. For example AIDS and syphilis are transmitted to the foetus through mother.

**C) Host**

The third link is usually the man who receives the infecting agent. The agent multiplies in the host body which may become diseased. The host can be susceptible to disease and may suffer from it. The agent is able to spread the disease, if it gets some exit to the environment through nose, mouth, faeces, or urine e.g., typhoid, influenza, diptheria, measles. When there is no exit to environment, then it becomes a dead end disease as in the case of rabies.

Communicable diseases are spread rapidly in the community. A more explicit discussion is presented in Unit 22 of the FST course. We advise you to go through that unit.

We had mentioned in the beginning that communicable diseases are great problems only in the developing countries. Besides, massive preventive programmes, a comprehensive health education programme comprising sanitary awakening, good habits, personal hygiene, and involvement of each and every individual is required to eradicate them.

**SAQ 6**

Match the communicable disease listed in Column 1 with their mode of transmission given in Column 2.

| Column 1<br>Diseases | Column 2<br>Modes of Transmission |
|---|---|
| a) Hepatitis | i) Air-borne |
| b) Japanese encephalitis | ii) Vehicle |
| c) Influenza | iii) Vector |
| d) Syphilis | iv) Contact |

## 14.9 SUMMARY

In this unit you have learnt that:

- The health of an individual is affected by genetic, behavioural and environmental influences. Disease represents a maladjustment of human beings to their environment.
- Since the individuals of a community share a common environment, their health problems are generally common. Therefore, these are investigated and the health care planned at the community level.
- Illness involves interaction of a triad—agent, host and environment. An extensive knowledge of these is obtained in order to understand a health problem in the community.
- The epidemiological approach is used to study the influence of environmental contaminants.

- Various toxic chemicals get into our body daily through food, water and air. However, the extent of harm they will cause to the body depends upon the amount of toxin, the part of body they reach, the susceptibility of individual and their synergism.
- Some of the food additives and adulterants are toxic and show adverse effects on health.
- Chemicals like polychlorinated biphenyls, dioxine, DDT, nitrosamine, heavy metals and many others that have been introduced in the environment in the last few decades are extremely harmful for health.
- Unplanned development projects and mismanaged environment have brought in Japanese encephalitis, filariasis, knock-knees, fluorosis, return of malaria, dengue fever, etc.
- The environment also contains disease-causing microorganism and other pathogen that result in infectious diseases. Mismanaged environment helps in the spread of communicable diseases.

## 14.10 TERMINAL QUESTIONS

1) Why is it necessary to study community health in order to understand environmental health?

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2) How can we study a disease due to environmental contaminants on human beings?

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3) Doctors warn against taking tranquilisers along with alcoholic drinks. Can you reason why?

.....

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## 14.11 ANSWERS

**Self Assessment Questions**

1) a) i) All forms of life

ii) Physical and chemical forces and

iii) Social environment

b) The main objective is to look after the health of every member of the community and to provide optimum health standards.

2) a) i), ii), iv), v).

b) a) v, b) iii, c) i, d) ii, and e) iv.

3) i) Epidemiological approach
   ii) Blood circulation
   iii) Agent, host, environment
   iv) acute

4) a) a) iii, b) i, c) iv, d) v, and e) ii.
   b) i) Saffron, colouring agents
   ii) Vitamins and amino acids
   iii) Benzoic acid, potassium sodium nitrate
   c) a) ii, b) i, c) iii.

5) a) i) Phthalate, ii) Polychlorinated biphenyls
   iii) Benzene iv) Nitrates and nitrites
   v) DDT, 2 - 4 D, Aldrin vi) Dioxin
   b) ii, iii, v.

6) a) ii), b) iii). c) i), d) iv)

**Terminal Questions**

1) Since the individual members of a community to a great extent experience the same environment, their health problems can be studied, therefore, at the community level and appropriate action is planned accordingly at the community level.

2) This can be studied by epidemiological approach. The effect of contaminant is studied in the population exposed to it. The relative frequency of disease, the kind of affected people i.e. age, sex, social group, etc. and the cause of disease or risk factor is investigated.

3) The synergisms i.e. the combined effect of tranquiliser and alcoholic drinks is very severe.