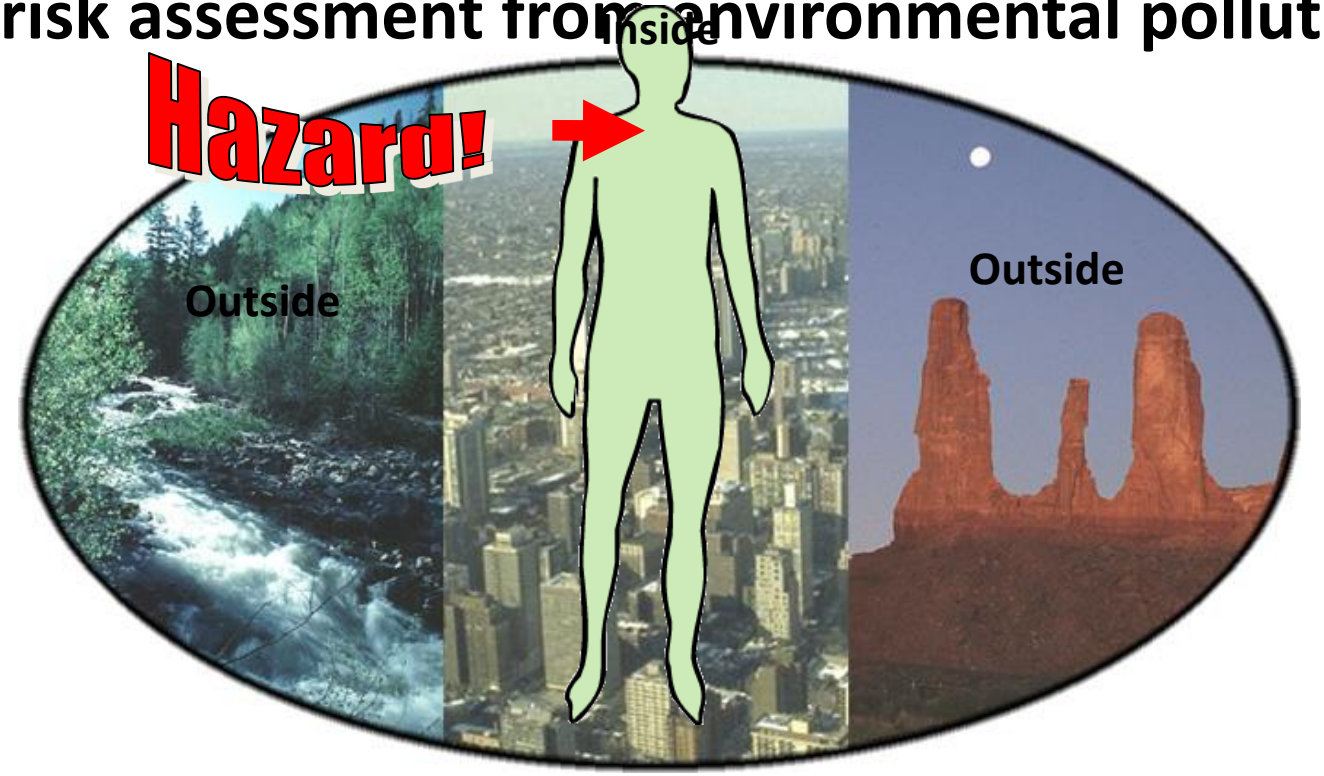
The Volgograd State Medical University
The Chair of hygiene and ecology

Lecture:

Environment and its hygienic value. Environmental factors and their impact on public health.

Health risk assessment from environmental pollution.



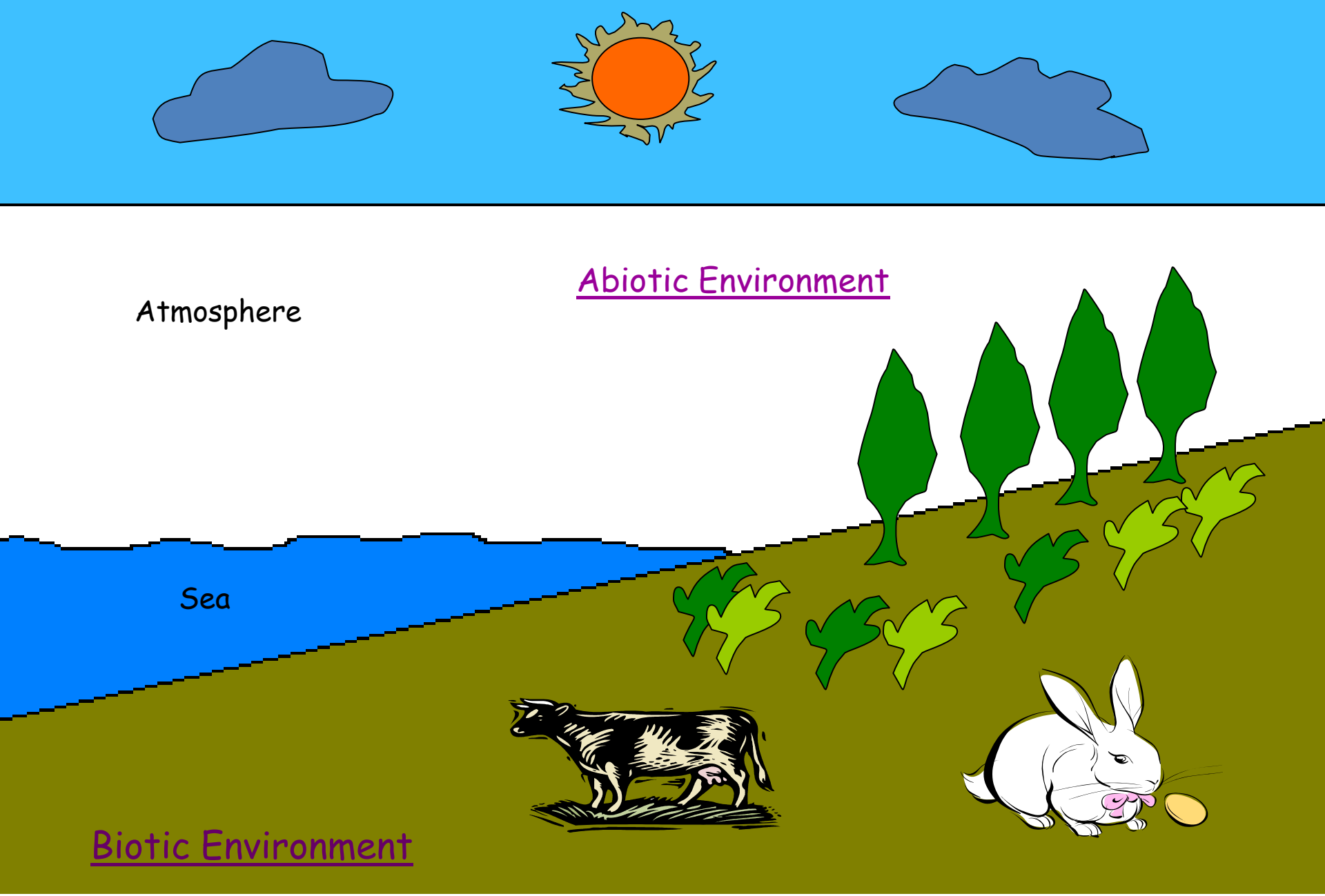
ECOLOGY

- is the study of the formation of biological systems and their interactions with the natural environment

Environment

is the place where a person lives and works

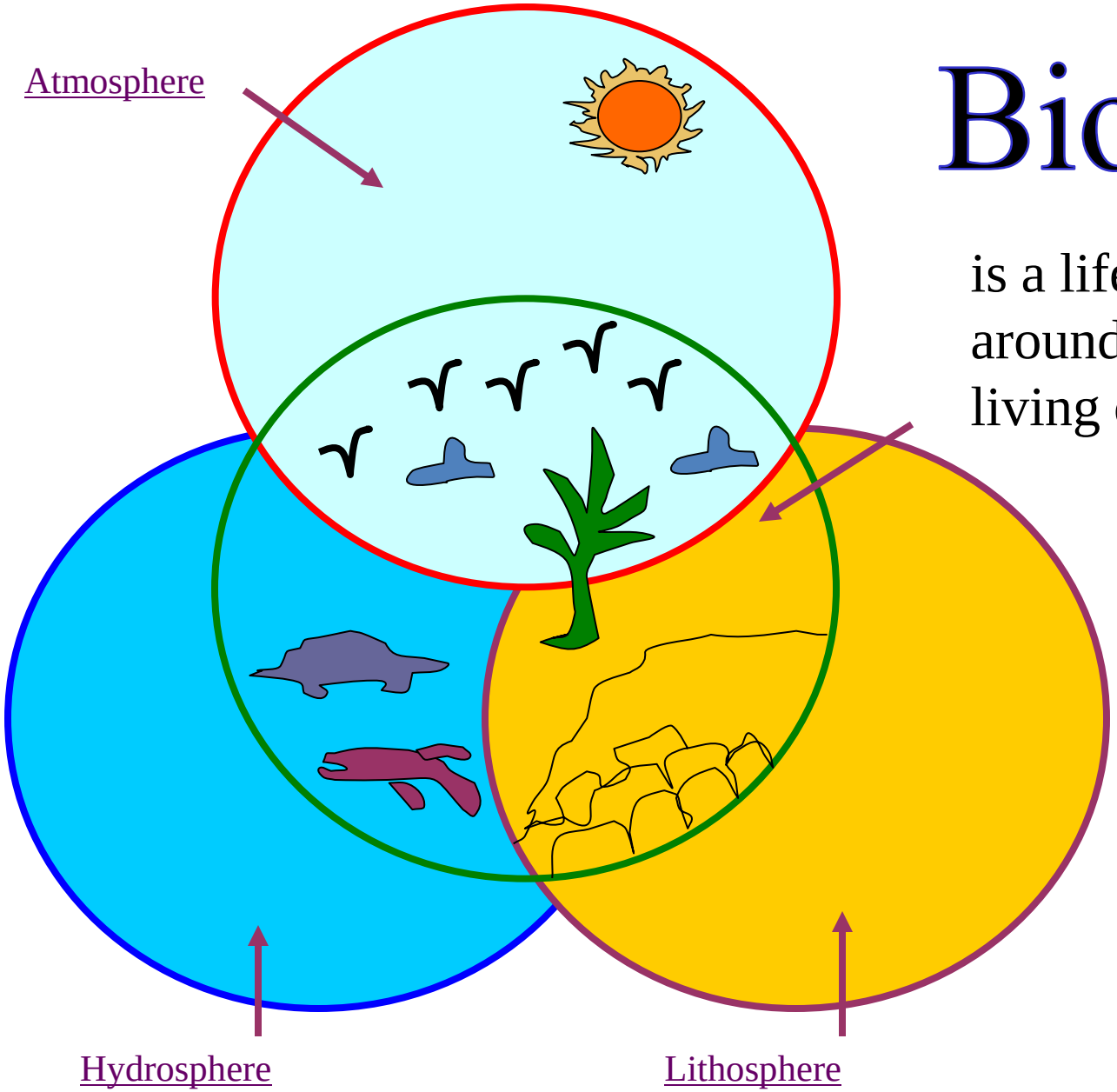
That which surrounds, the total sum of the condition of the surroundings within which an organism, or group, or an object exists (including the natural as modified by human activity & the artificial).



Environment is the sum of biotic & abiotic component

Biosphere

is a life-supporting layer around the Earth containing living organisms



Biosphere Model

Or

The entire part of earth's land, soil, water & atmosphere in which living organism are found is called biosphere

Or

The combined area lithosphere, hydrosphere of & atmosphere is known as biosphere.

ANTHROPOGENIC ENVIRONMENT

- is the environment which includes vast numbers of life-forms and is characterized by certain anthropogenic factors.

- **ANTHROPOGENIC FACTOR** is the factor of the environment considered as the result of human action.

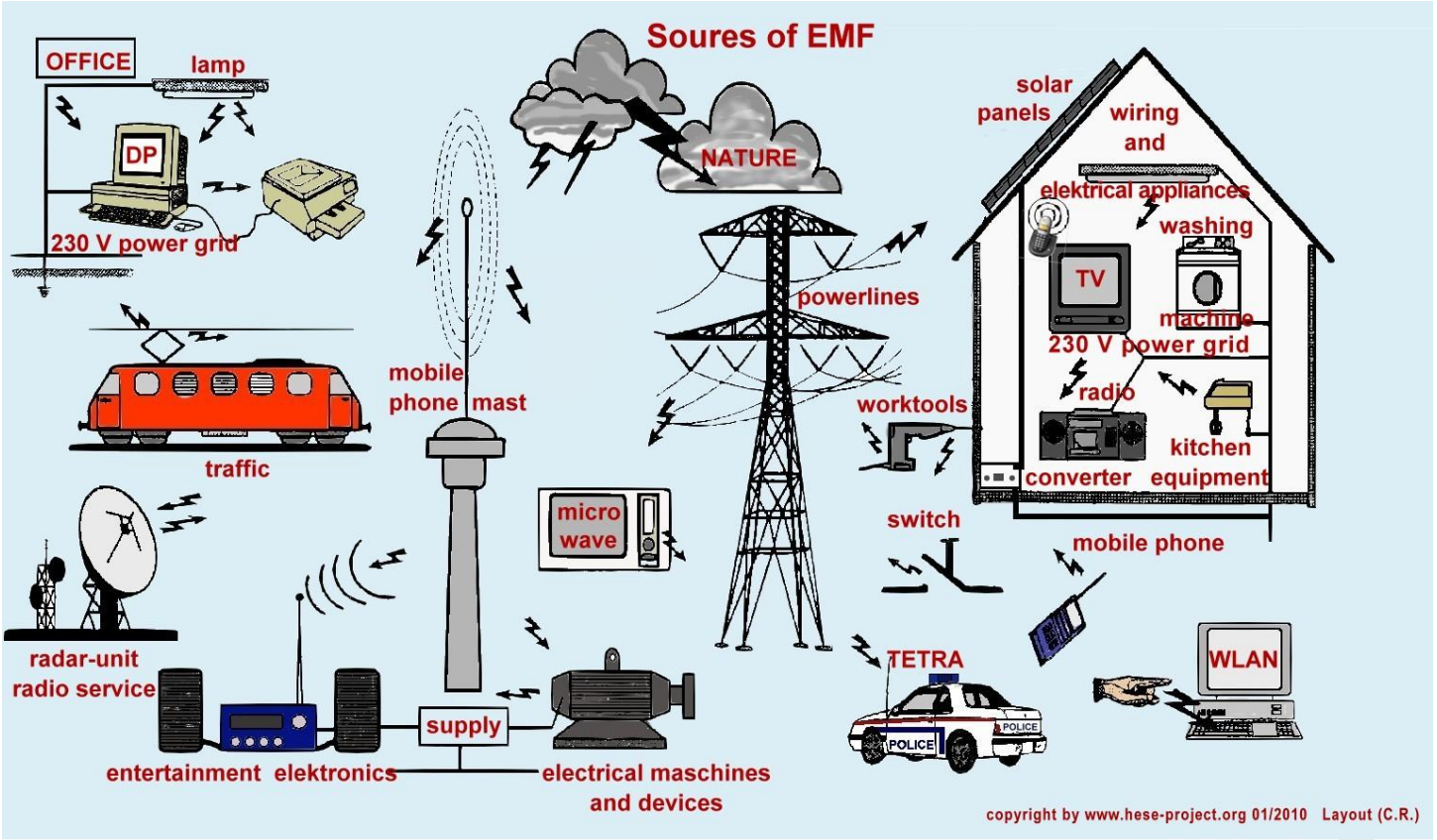
- The idea of global anthropogenic changes of the natural environment was developed first by the Russian scientist Academician **V.I. Vernadsky** and he was also the first who offered the term of **NOOSPHERE** (that is the environment modified or created by human activities)

Anthropogenic factors :

- Anthropogenic factors of **physical nature**
- Anthropogenic factors of **chemical nature**
- Anthropogenic factors of **biological nature**

Anthropogenic factors of physical nature

- city noise, vibrations, electromagnetic fields, etc.

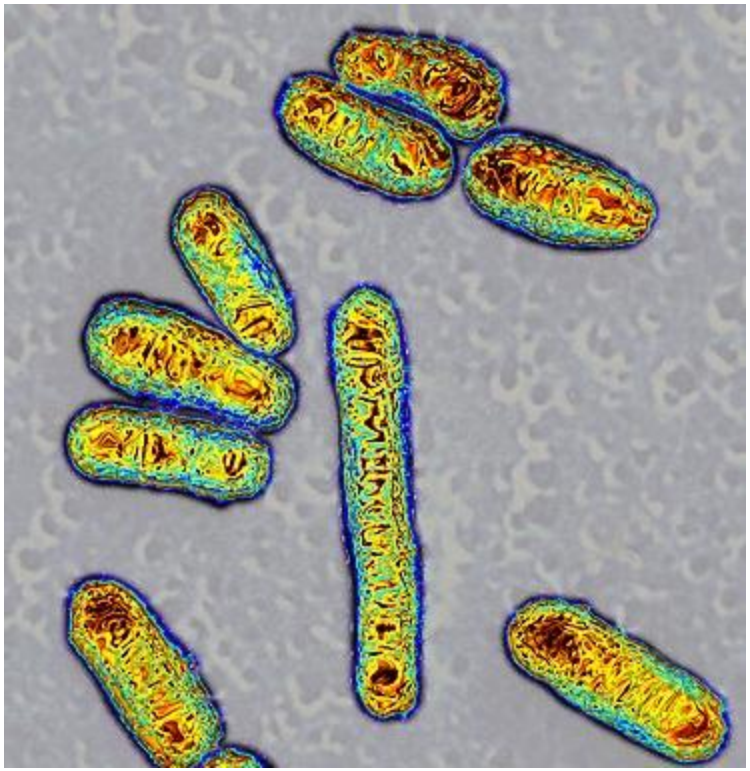


Chemical anthropogenic factors

- include chemical substances synthesized and produced for certain purposes and getting into the natural environment different ways, such as through the air, water and land.

Biological anthropogenic factors

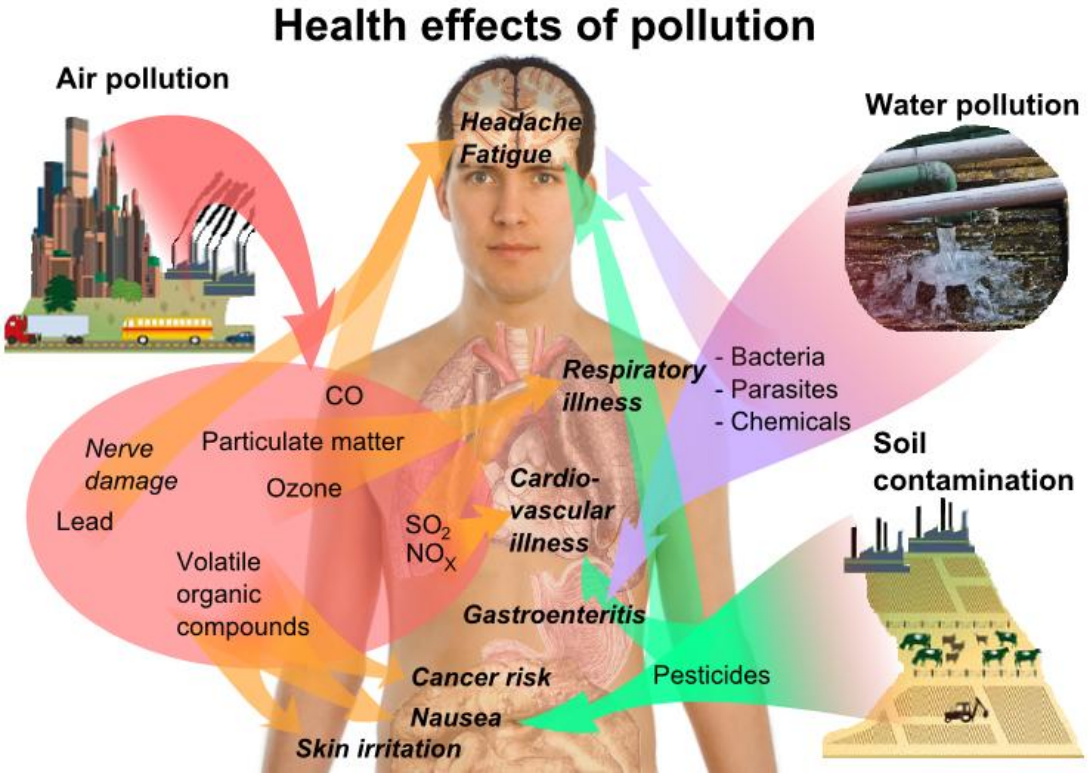
- include microorganisms modified by the action of some other anthropogenic factors, mainly chemical ones.



- According to experts of WHO environmental medicine is the part of medicine specializing in studding diseases and dysfunctions, which develop due to environmental factors.
- Environmental medicine develops methods of early diagnostics and control of diseases connected with the environment.

Pollution

- is the effect of undesirable changes in our surroundings that have harmful effects on plants, animals and human beings.



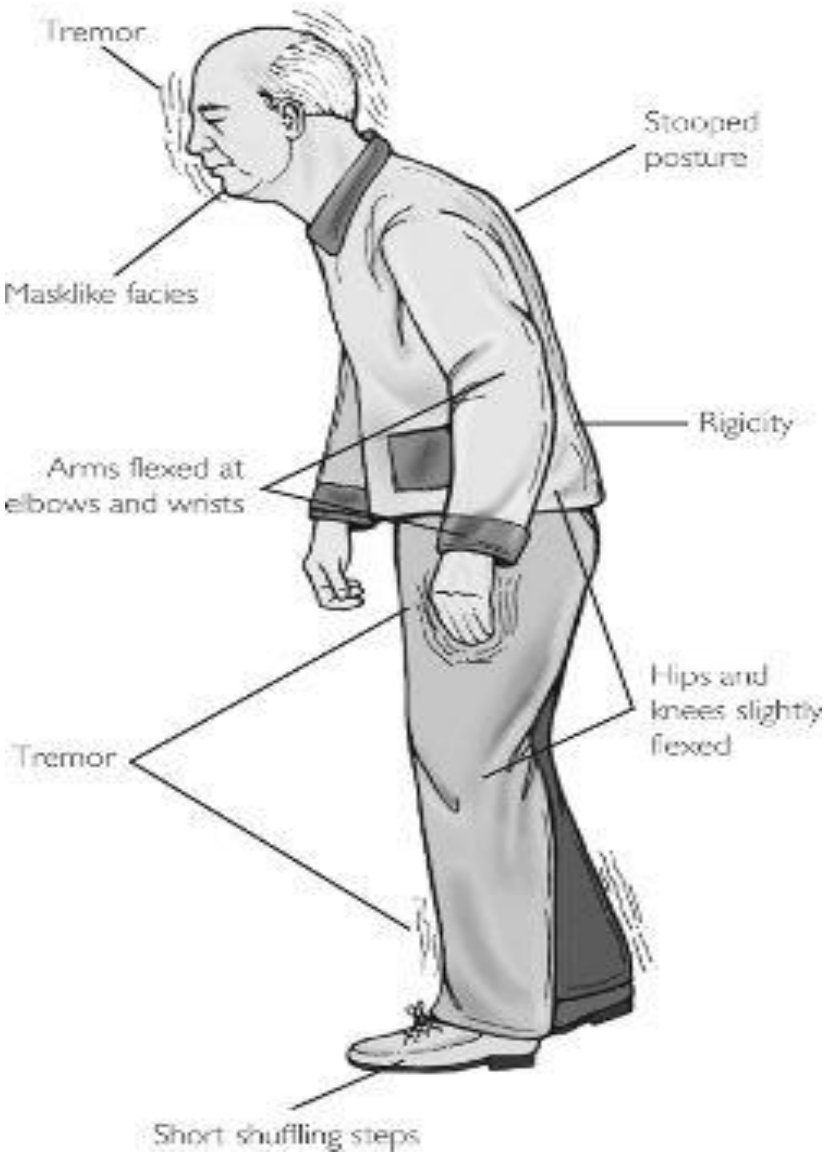
Minimata disease:

is determined by polluted sea and river fauna with mercury.

Minamata disease was first discovered in Minamata city,Japan in 1956. It was caused by the release of methylmercury in the industrial wastewater from the Chisso Corporation's chemical factory, which continued from 1932 to 1968. This highly toxic chemical bioaccumulated in shellfish and fish in Minamata Bay and the Shiranui Sea, which when eaten by the local population resulted in mercury poisoning.

Minimata disease

- Symptoms include ataxia, general muscle weakness, sensory disturbance in the hands and feet, damage to vision and hearing, weakness, and in extreme cases, paralysis and death.



Itai-itai disease :

- is conditioned by high level of cadmium in water which is used to water the rice fields

- was caused by cadmium poisoning due to mining in the mountains in Toyama Prefecture

- The cadmium poisoning caused ***softening of the bones and kidney failure***.
- Cadmium interferes with bone metabolism and promotes urinary calcium excretion (osteoporosis).

Patients with Itai Itai Disease

- From an ecological perspective **pollutants, classified as follows:**

- **- Degradable or non-persistent pollutants**

- **- Slowly degradable or persistent pollutants**

- **- Non-degradable pollutants**

- **Degradable or non-persistent pollutants**.
- These pollutants can be rapidly broken down by natural processes.
- Eg. domestic sewage, discarded vegetables, etc.

- **Slowly degradable or persistent pollutants**
- These pollutants remain in the environment for many years in an unchanged condition and take decades or longer to degrade.
- Eg: DDT and some kinds of plastics.

Non-degradable pollutants

These pollutants cannot be degraded by natural processes. Once they are released into the environment they are difficult to eradicate and continue to accumulate.

Eg: Toxic elements like lead or mercury.

- Pollutants that are emitted directly from identifiable sources are produced both by natural events (for example, dust storms and volcanic eruptions) and human activities (emission from vehicles, industries, etc.).

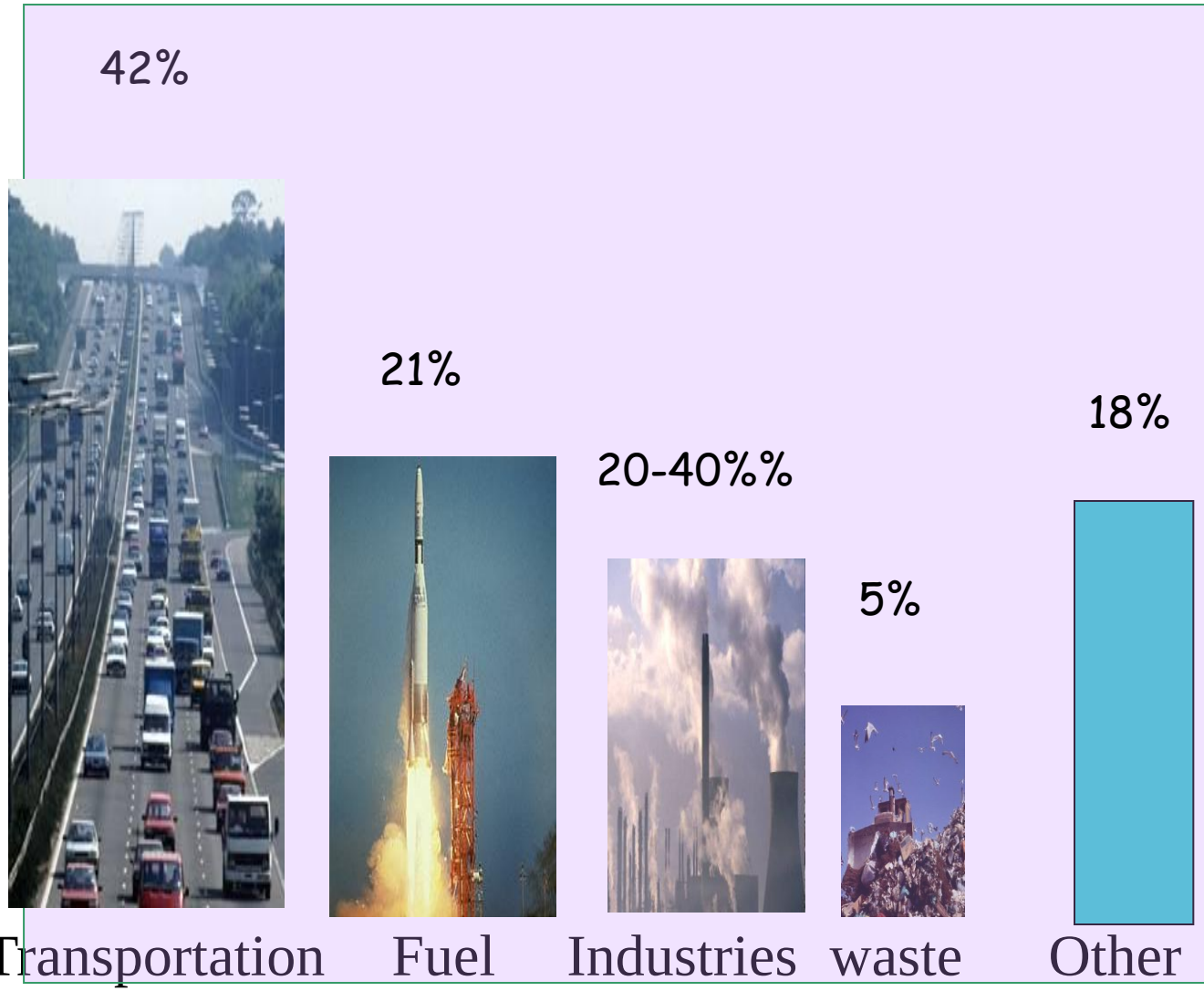
  These are called **Primary Pollutants**.

- **5 primary pollutants - 90 % of the global air pollution**.
  - Carbon oxides (CO & CO_2), nitrogen oxides, sulfur oxides, volatile organic compounds (mostly hydrocarbons) and suspended particulate matter.

- Pollutants that are produced in the atmosphere when certain chemical reactions take place among the primary pollutants are called **Secondary Pollutants**.

  Eg: sulfuric acid, nitric acid, carbonic acid, etc.

Air pollution sources



1.Modern industries

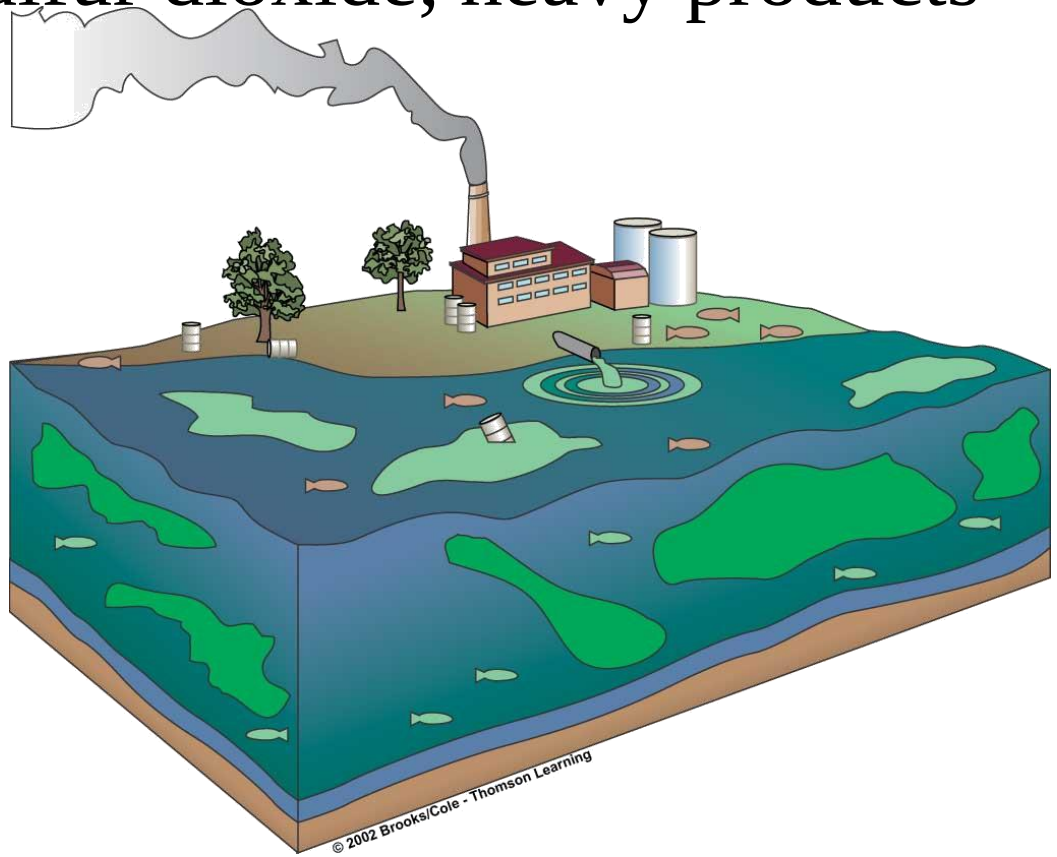
- It is metallurgical industries, cchemical and oil – chemical industries,factories producing modern building materials.
- All these industries affect the natural environment producing hazardous waste which contaminate land, water and air.
- 20 – 40%

2. Transport

- All means of **transport** which are driven with the internal –combustion engine. As the result of burning fuels tons of oxides in the form of *carbon dioxide, nitrogen dioxide, lead* and many other chemical substances added to petrol for improving its octane rating, are emitted into the atmosphere.
- An estimated 40 to 70% of all hazardous chemical substances being emitted into the air in a city, are produced by transport.

3. Enterprises of thermal energy.

- **Enterprises of thermal energy (Thermal Discharges)** emit carbon dioxide, sulfur dioxide, heavy products



4.Agricultural human activities which widely use chemical substances in fighting against pests.

5. Household chemical goods which include detergents,dyes, preparations for fighting against insects.

6. Chemical, pharmaceutical and cosmetic goods

- Chemical substances which are being emitted into natural environment may spread over large distances. This is called **migration of chemical substances .**

- *The **greatest migration*** is accomplished through the air .
- *The **least migration*** of chemical substances is possible through land.

  (as soon as they get into land,they remain there for quiet a long period of time).

- *A higher rate of migration is possible through water.*
- There are 3 main ways of getting chemical substances into water: with rain, with groundwater and sewage.

- If we release liquid waste into the river, the hazardous waste will spread with the stream over hundreds of kilometers.
- The amount of chemical substances in water is gradually declining, though they may accumulate at the bottom of the river and in plankton, which serves as a source of food for small organisms living in water,which serve as prey for predators in the grazing food web.

1. Inhalation

In this method chemical substances are taken into the nose or mouth with the inhaled air. Toxic gases, vapors, aerosols and dust are usually taken this way. The large surface of the air sacs in the lungs (about 90 m^2) provides an intensive absorption of the chemical substances into the bloodstream and their immediate effect.

2. Chemical substances may be also transferred to organisms through the skin

- Some gases, such as hydrogen sulphide, carbon monoxide, etc. may diffuse through the skin. The transfer of chemical substances through the skin is also possible in skin contamination also possible in skin contamination with toxic solutions and dust.

3. Chemical substances are transferred to organisms through the gastrointestinal tract.

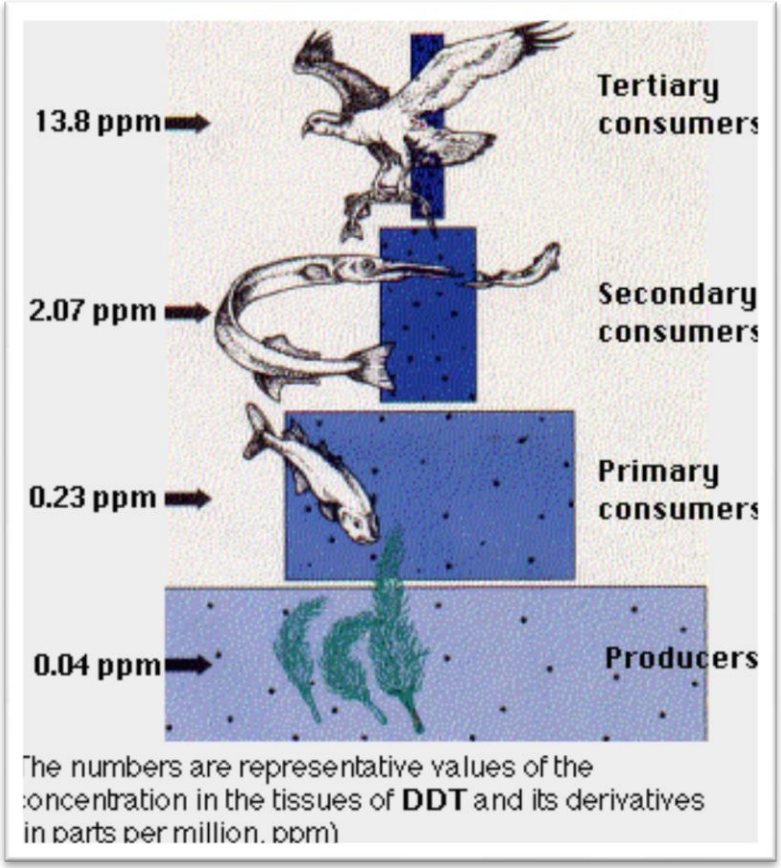
For example, toxicants in water and foods may transfer from the environment to organisms this way.

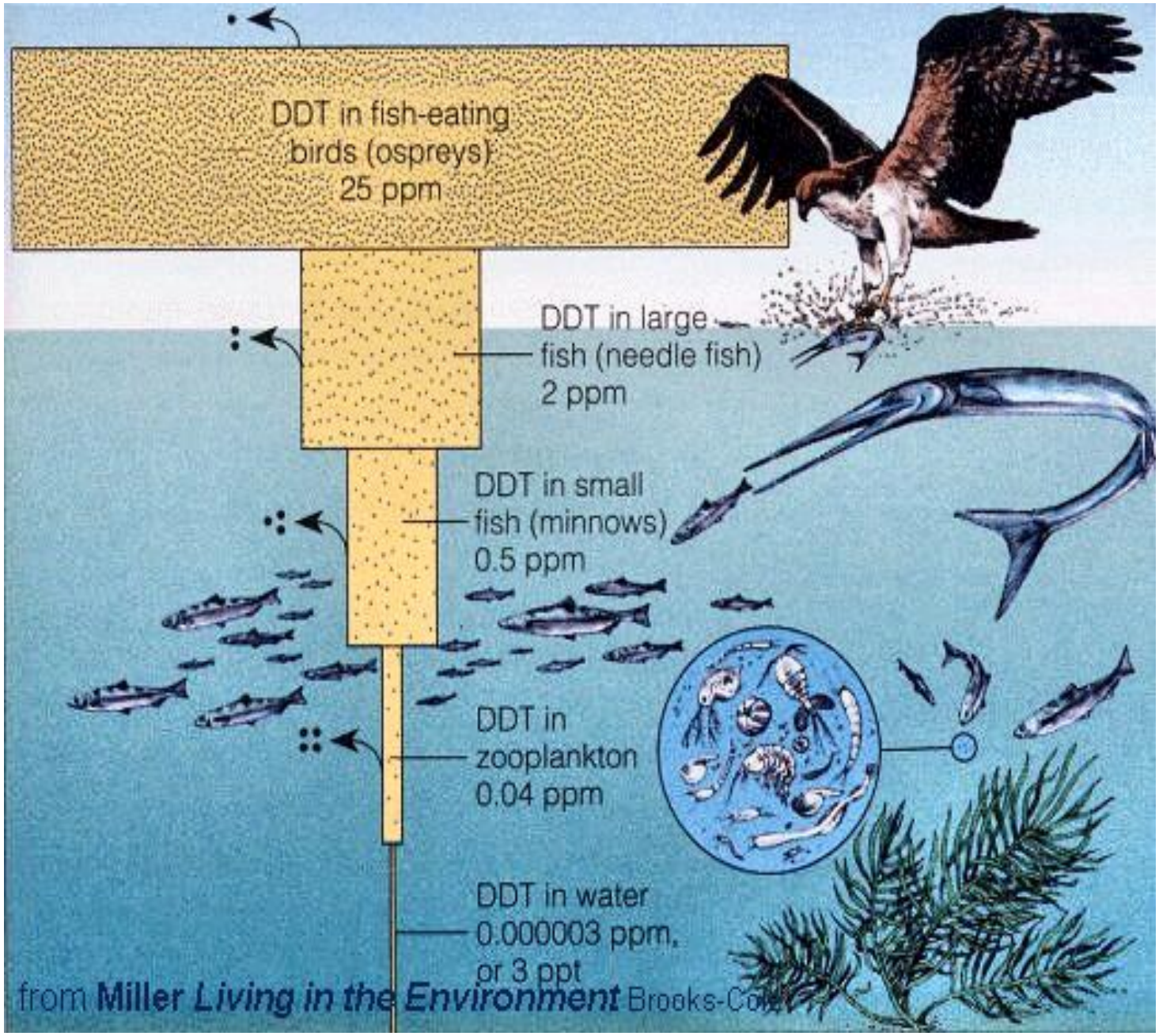
- **There are some stages of interactions between living organisms and chemical substances.**
- the first stage consists in absorption of toxic substances on the surface of the cells.
- the next stage toxic substances are transported into cellular membranes.
- The final stage of these interactions is accumulation of the chemical substance in a living cell.

- **Bioaccumulation** is the process by which substances not readily broken down or excreted can build up and be stored in living tissue (usually in fatty tissue.)
- **Biomagnification** is the process by which substances become more concentrated in the bodies of consumers as one moves up the food chain (trophic levels).

Case Study: DDT

- DDT is a pesticide that was widely used until being banned in 1972
- DDT accumulates in living tissue, particularly in fat tissue
- DDT concentrations are increased from plankton to fish to fish-eating birds.
- High concentrations in some bird species caused failure of eggs by thinning the shells




DDT in fish-eating birds (ospreys) 25 ppm
DDT in large fish (needle fish) 2 ppm
DDT in small fish (minnows) 0.5 ppm
DDT in zooplankton 0.04 ppm
DDT in water 0.000003 ppm, or 3 ppt
from Miller Living in the Environment Brooks-Cole

- It has proved that one of the global environmental problems is the accumulation of chemical substances in living organisms.
- The most crucial problems at present are the problems of accumulation of pesticides, heavy metals, radioactive waste, industrial and household hazardous waste.

Toxic substances may be excreted from the body in 2 types: changed and unchanged.

The process of excretion of toxic substances is called **elimination**.

The main ways of chemical substances excretion from the body

- lungs
- kidneys
- intestine.

Some pesticides may excrete *with breast milk.*

Most of chemical substances have **additive and synergistic effects**

It means that the total effect can be calculated by summarizing the actual effects of each substance, though in some cases some toxic substances may increase the effect of the others.

- In such cases one can develop a negative effect , though maximum permissible concentrations of the substances are followed. The chemical substances in this case are called **toxic factors of low intensity.**

The most vulnerable to the effects of the pollution seem to be children and pregnant women.

Why children?

It is due to a number of *specific functions* of the child organism:

- *Increased permeability* of the skin, mucous membranes of the airways and gastrointestional tract
- *low acidity of gastric juice*
- *high intensity of synthesis of nucleic acids*
- *Immaturity of ferments in the liver*
- *Immaturity of systemic and local immunity*

The health of a child is affected antenatally

The embryo may develop ***embryotoxic and teratogen effect*** of chemical substances which seem to be present in the natural environment.

The development of the ***hereditory diseases and congenital malformations*** may be due to the pollution of the environment.

On average the incidence of congenital malformations in the regions with polluted environment is 80% higher than that in the regions where the environment is clear.

General disease incidence in the regions with pollute environment is much higher than that in the other regions.

Anthropogenic factors decrease the body´s resistence to infectious agents which leads to a great number of acute in

Environment pollution has a negative effect on reproduction

Thus, the number of miscarriages, cases of female sterility and mortinatality is increasing.

Pregnant women more and more often suffer from gestoses, anemia.

- Anthropogenic factors **decrease the body´s resistance to infectious agents** which leads to a great number of acute infectious diseases.
- The cases of **suppression of immunological reactivity** and the incidence of moderate secondary immune deficiency are wide-spread in the **regions with polluted environment.**