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Кафедра общей гигиены, экологии и радиационной медицины

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ЭКОЛОГИЧЕСКАЯ МЕДИЦИНА

Учебно-методическое пособие
для студентов 2 курса факультета по подготовке специалистов
для зарубежных стран, обучающихся на английском языке,
учреждений высшего медицинского образования

ECOLOGICAL MEDICINE

Teaching workbook
for 2nd year students of the Faculty for training specialists
for foreign countries, studying in English,
of higher medical education institutions

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Предназначено для студентов 2 курса факультета по подготовке специалистов для зарубежных стран, обучающихся на английском языке, учреждений высшего медицинского образования.

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LIST OF ABBREVIATIONS

AES	— agricultural ecosystem
BS	— biosphere
BGCC	— biogeochemical cycles
CNS	— central nervous system
CV	— Cardiovascular
DL	— dose limit
EES	— effectors of endocrine systems
EMF	— electromagnetic field
EPA	— Environmental Protection Agency
ES	— ecosystem;
FDA	— the Food and Drug Administration
FOC	— flying organic compositions
HF	— high frequency
IR	— ionizing radiation
LD50	— lethal dose
mkR	— micrororentgen
MED	— minimal erythema dose
NEMS	— National Environmental Monitoring System
RAL	— the Republican admissible levels
RB	— the Republic of Belarus
RCRCM	— Radiation Control and Environmental Monitoring
SanRaN	— sanitary Rules and Norms
SHM	— social-hygienic monitoring
UV	— ultra-violet
WHO	— The World Health Organization

THE FOREWORD

The manual «Medical ecology» describes the main principles of medical ecology (ecological medicine). This new direction of a medical science.

The ecological medicine tries to find out the reason of diseases in a direct connection with environment. Hence, the medical ecology can be defined as a subject considering interaction between risk factors of environment and health of the person. The big variety of ecological factors, nosological forms of diseases, genetic features of the person is thus considered.

Physical, chemical agents — usual pollutants of environment. Features of a way of life of the person (abusing alcohol, smoking) also can be included in the list of risk factors.

It is obvious that it is important to know and understand interrelation between anthropogenous influence on environment and disease of the person. The knowledge of these mechanisms will allow to plan and realize a complex of actions for preventive maintenance of ecologically dependent disease.

CHAPTER 1: «ECOLOGICAL MEDICINE (ENVIRONMENTAL MEDICINE): CONCEPTS, PURPOSES, TASKS»

The employment purpose:

1. To disassemble a role and an ecology place in modern system of knowledge, to familiarise with features of the ecological situation in Belarus.
2. To receive representation about laws of influence of a complex natural and socio-economic factors of environment on health of the person.

Employment tasks:

1. Concept about ecology as an independent discipline. A subject and development stages.
2. Concept about the biosphere, making biospheres.
3. The Ecosystem. Making ecosystems and their characteristic, types of ecosystems.
4. Ecological factors, classification.
5. Kinds of influence and law of influence of ecological factors.
6. Ecological medicine, the purpose, problems, a studying subject, research methods.
7. Ecologically dependent and ecologically caused diseases.

Practical skills:

- 1) Definition of correlation dependence between risk factors of conditions of residing and level of primary disease.
- 2) To Develop actions for inhabitancy optimisation.

Teaching material

Ecology (from Greek oikos — the house, dwelling and logos — the doctrine) — the biological science studying laws of vital activity of organisms at all levels of the organization (populations of organisms, kinds, biocenosis, ecosystem) in their nature dwelling in view of the changes made by man activity. To modern understanding more corresponds such definition as sciences about structure and functions of animate nature. The term is offered in 1869 by German zoologist E. Gekkel.

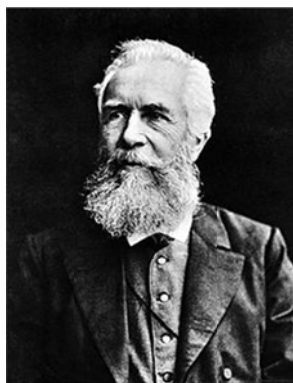


Figure 1 — German zoologist E. Gekkel

In the middle of 80th years the separate direction — medical ecology was generated (or the ecological medicine) is the complex scientific discipline studying influence of environmental factors on human health with accent of attention on so-called «environmental diseases». As criterion of the optimality of environmental conditions accept complex criterion — human health. By definition of the medical ecology, this concept includes not only absence of illnesses and corporal defects, but also a state of physical, mental and social well-being of the man.

Much more often, than illness, develops so-called "the third condition", so-called anthropoecological tension which is shown in bad state of health, infringement of a normal rhythm of sleep and wakefulness, decrease of workability, etc. nonspecific signs. The factors causing anthropoecological tension, can have the most various character, for example: change of climate or imbalance of the nutrition; life in narrowness or, on the contrary, in loneliness; entrance to organism of harmful chemical substances, etc.

Biosphere

Basis of ecology is the doctrine about biosphere (BS). The biosphere is the largest and the closest to the ideal in sense of "self-sufficiency" biosystem. The biosphere is the external environment of the Earth, area of distribution of life which includes all living organisms and all elements of animate nature forming the inhabitancy of living organisms. The biosphere includes the lower part of atmosphere, all hydrosphere (hydrobiosphere) — oceans, seas, superficial waters of land, terra biosphere — a surface of the land, and also lithosphere — the upper horizons of a hard the earth's crust. Borders of biosphere are determined by physical and chemical conditions of life existence. The lower border of biosphere — in deep into land 1–2 km and is lower 2–3 km than bottom of the ocean; top — the ozone cloud at height 20–25 km.

Due to reasonable activity of people BS should pass into new harmonious condition — the noosphere (covering of reason) (Le Rue, Teyar de Sharden).

Vernadskij V. I., the founder of the doctrine about BS, marked the following basic preconditions of creation of noosphere:

1) The mankind should become a single whole; 2) transformation of a communication and exchange facilities; 3) opening of new energy sources; 4) rise of well-being of people; 5) exception of wars from society life. Thus, "noosphere" is one of stages of development of biosphere when reasonable man activity is the dominate factor of development when there is a reasonable regulation of man-nature relations. Development of biosphere with formation of noosphere name noogenesis.

Ecosystem

In ecology the basic functional unit is ecosystem (ES). Term "ES" has been offered in 1935 by the English ecologist A. G. Tansley though representation about "ES" has arisen much earlier. "ES" — complex of in common living vari-

ous kinds of alive organisms and the conditions of their existence joint into functional whole. Ground ES frequently name biogeocenosis.

From definition ES it is visible, that it will consist from:

- 1) Biocenosis, i. e. sets of the interconnected alive organisms.
- 2) Ecotope, i. e. this place of biocenosis dwelling. Ecotope is a set climatic-soil- ground factors.
- 3) Interaction of biotic association with the physical environment.

All ES are open systems as should receive and give energy.

Artificial ecosystems we shall consider by the example of city and agricultural ecosystem.

Agricultural ecosystem (AES) have the following features:

1) They receive taking place under the human control the auxiliary energy supplementing or replacing solar.

2) As a result of man activity a variety of organisms is sharply reduced to receive the maximal interest of any one product (food or other), i.e. it is a monoculture more often. The organic substance is made in superfluous quantity for the given system.

3) Dominating kinds of plants and animals are exposed artificial, instead of to natural selection.

4) The AES is worse, than natural, keep in circulation the microelements; i.e. now for maintenance of productivity it is necessary to add to fertilizers track quantities of microelements.

In other words, the AES are organized and cope so that to direct as much as possible to solar and other energy on manufacture of agricultural products (in particular food stuffs).

Such intensive and specialized land tenure, as a rule, is accompanied by a soil erosion, pollution of water reservoirs because of washout of pesticides and the fertilizers, the increased sensitivity of system to pest.

City ES are incomplete, or heterotrophic. The city differs from natural heterotrophic systems:

- 1) More intensive metabolism on unit of the area.
- 2) The big requirements for receipt of substances from the outside.
- 3) More powerful and more poisonous stream of waste products.

The ecological factor is any element of the environment, capable to render direct or indirect action on alive organism even on one of stages of its individual development, or any condition of environment which the organism answers adaptive reactions.

Interactions between alive organisms can be homotypic and heterotypic. The most widespread type heterotypic(al) interactions between animals — predatoriness (preying on others). From other forms are known parasitism, commensalism (one organism eats the rest of the food or egests, for example, hyenas and signature stamps), neutralism, a competition, pollination of plants by animal (insects), i. e. carry by one kinds of others (for example, seeds of plants birds).

Table 1 — Classification of Ecological Factors

Abiotic factors	Biotic factors
<p>Climatic: solar radiation, light and light mode, temperature, humidity, atmospheric precipitation, pressure, etc.</p> <p>Edaphic: mechanical and chemistry structure of soil, a moisture capacity, a water, air and thermal mode of ground, structure of ground, a level of sub-soil waters, etc.</p> <p>Orographical: a relief, an exposition, height above sea level</p> <p>Hydrographic: factors of the water environment</p> <p>Chemical: gas structure of an atmosphere, salt structure of water</p>	<p>Phytogenous (influence of plants)</p> <p>Zoogenous (influence of animals)</p> <p>Anthropogenous — straight lines and indirect influences on environment, connected to human activity</p>

Ecological niche — set of all environmental factors in which existence of a kind in the nature is possible.

One of founders of agrochemistry — German scientist Justus Liebig (1803–1873) has formulated the law of the limiting factor: **"Vital opportunities limit ecological factors, the quantity and quality which are close to a necessary organism or ecosystem to a minimum.** The further decrease of the necessary factor conducts to destruction of the organism or ecosystem".

The limiting factor is any factor which limits development or existence of the organism, a kind or community. American zoologist V. Shelford (1877–1968) has come to a conclusion, that the limiting factor can be not only lack, but also surplus of such factors, as light, warmth, water. (Shelford's law of tolerance).

In sanitary protection of EN the top limits as environmental contamination is are important and there is excess of stability of the organism (definition of maximum concentration limit).

Initial production on the Earth is created in cells of green plants under influence of a solar energy (photosynthesis), and also some other organisms (bacteria owing to chemical processes — chemosynthesis). The essence of photosynthesis will be, that there is increase in free energy in organic substance due to transformation of energy of sunlight photon.

Special group chemosynthesis form nitrifying bacteria. They receive necessary energy due to oxidation of ammonia, hydrogen, connections of iron without participation of Sun energy.

The first trophic level occupies autotrophs (producers), the second - herbivorous animals (consumers of the first order), the third predators (consumers of the second order), and parasites of initial consumers. And, at last, secondary predators and parasites form the fourth level. The number of parts in a circuit can be various, but usually them it happens from 3 up to 5.

Producers — synthesize with the help of a sunlight from CO₂ and H₂O, and also mineral substances organic connections.

Consumers — animal organisms which eat ready organic substance of plants and animals.

Decomposer — oxidize dead organic remains into CO₂ and H₂O (bacteria, mushrooms, protozoa).

Flow of energy from its source through a number of organisms name a trophic circuit. At each carry the most part (80–90 %) potential energy is lost, passing in heat. Trophic level — complex of the alive organisms receiving solar or transformed chemical energy through identical number of intermediaries into trophic circuit.

Biogeochemical Cycles

BGCC — characteristic ways on which chemical elements circulate in biosphere from the environment in organisms and again into environment.

In each circulation allocate 2 funds:

— Reserve fund — a part of circulation of elements which physically or is chemically separated from organisms.

— Mobile or exchange collection — actively circulating fund, for it is characteristic a fast exchange between organisms and their direct environment.

On reserve fund BGHTS it is possible to subdivide on:

1) BGCC with reserve fund in atmosphere (N, O).

2) BGCC with reserve fund in hydrosphere (C).

They quickly compensate arising infringements.

3) BGCC with sedimentary reserve fund, i. e. reserve fund is in the earth's crust (S, P) — they are less subject to self-checking, are worse restored.

PRACTICAL WORK

Task 1. To establish correlation between the increased contents of harmful substances in atmospheric air and diseases of respiratory organs according to social-and-hygienic monitoring and reports on disease.

Task 2. To assess the received results.

Task 3. To offer actions on health improvement of the population.

Task 4. To issue results of work in a diary.

TASK

To establish correlation between air pollution by the increased concentration NO in Gomel and morbidity of respiratory organs in 1997–2001 years

Years	Diseases of respiratory organs	Concentration NO	dx	dy	dx ²	dy ²	dx.dy
1997	29.7	0.0054					
1998	30.8	0.0087					
1999	34.1	0.0156					
2000	32.9	0.0126					
2001	35.3	0.0179					

dx, dy — deviations from average level.

Correlation factor:

$$r_{xy} = \frac{\sum dx * dy}{\sqrt{\sum dx^2 * \sum dy^2}} .$$

TEST CONTROL

1. The ecology is a science about:

- a) patterns of mutual relations of organisms among themselves;
- b) patterns of mutual relations of organisms among themselves and with environment on organic, population-specific, biogeocenotic and biospheric levels;
- c) pattern of influence of environment on population health.

2. The ecology purpose:

- a) optimisation of mutual relations of organisms with environment;
- b) preservation of the environment;
- c) optimisation of mutual relations of organisms among themselves.

3. The subject of studying ecology is:

- a) ecosystem;
- b) animals, people, plants;
- c) biogeocenosis.

4. The biosphere is:

- a) elementary unit of a noosphere;
- b) the higher form of ecosystem;
- c) set of individuals of one kind.

5. The biogeocenosis is:

- a) a healthy variety of population;
- b) a homogeneous part of biosphere;
- c) elementary unit of biosphere.

6. Characteristics of biogeocenosis:

- a) layer age, self-regulation, efficiency;
- b) a specific variety, a population density, a biomass, layer age;
- c) a spatial locating, a succession.

7. The ecological niche is:

- a) one characteristics of biotope;
- b) a way of life and, first of all, a way of a food biogeocenosis;
- c) dwelling place of biogeocenosis.

8. Supply chains — is:

- a) biomass, a specific variety and homeostasis;
- b) chain of interconnected species, consistently retrieve the substance and energy;
- c) linked chain of one Ecological Niche.

9. Biological succession — is:

- a) change daily and annual activity of the body;
- b) serial replacement of one ecosystem by another;
- c) interaction of producers and consumers.

10. Artificial biogeocenosis is:

- a) biocenoses and biotones;
- b) autotrophs, heterotrophs, mixotrophs;
- c) anthropocenosis.

11. Type — is:

- a) a set of individuals, similar in morphology, freely interbreeding among themselves;
- b) set of the individuals similar to morphological, physiological and biochemical signs, freely crossed among themselves and occupying a certain area;
- c) elementary unit of biosphere.

12. The organism is:

- a) object and natural phenomenon;
- b) elementary structural unit of a type;
- c) ecological element of environment.

13. The ecological factor is:

- a) the element of environment influencing organisms and causing their adaptation;
- b) the component of environment providing vital activity of population;
- c) the basic structural component of an areal.

14. The medical ecology is:

- a) a science about interaction of the person with environment;
- b) the section of ecology studying adverse ecological factors;
- c) a science about preventive maintenance of occurrence of illnesses of a civilization.

15. To abiotic factors of air environment does not concern:

- a) viruses;
- b) humidity;
- c) a geomagnetic field.

CHAPTER 2: «ECOLOGICAL FACTORS. PHYSICAL FACTORS. INFLUENCE OF VISIBLE AREA OF A SOLAR SPECTRUM AND LIGHT EXPOSURE ON THE PERSON»

The employment purpose:

1. To disassemble a role and an ecology place in modern system of knowledge, to familiarise with features of an ecological situation in Belarus.
2. To receive representation about laws of influence of a complex natural and socio-economic factors of environment on health of the person.

Employment tasks:

1. Classification of physical ecological factors
2. Pathogenetic mechanisms of action of physical factors of environment on a human body.
3. Meteosensitivity: concept, classification by severity level of clinical displays.
4. Influence of visible area of a solar spectrum and light exposure on the person. «Winter depression (affective seasonal frustration) »: concept, the development reasons, clinical display, preventive maintenance and treatment.

Practical skills:

- 1) Definition of correlation dependence between risk factors of conditions of residing and level of primary disease.
- 2) To develop actions for inhabitancy optimisation.

Teaching material

Physical Characteristics

Exposure to UV occurs from both natural and artificial sources. The sun is the principal source of exposure for most people. Solar UV undergoes significant absorption by the atmosphere. With depletion of the stratospheric ozone people and the environment will be exposed to higher intensities of UV. The consequences of this added UV exposure are considered so serious that it was a major topic for discussion at the World Environment Conference, held in Rio de Janeiro in 1992. In Agenda 21, adopted by the Conference, it was specifically recommended to "undertake, as a matter of urgency, research on the effects on human health of the increasing ultraviolet radiation reaching the earth's surface as the consequence of depletion of the stratospheric ozone layer." It is this issue that underscores the current need to better understand the potential health and environmental risks of UV exposure.

UV is one of the non-ionizing radiations in the electromagnetic spectrum and lies within the range of wavelengths 100 nm (which corresponds to a photon

energy of approximately 12 eV) to 400 nm. The short wavelength limit of the UV region is often taken as the boundary between the ionizing radiation spectrum (wavelengths < 100 nm) and the non-ionizing radiation spectrum.

- UV-A, between 320 and 400 nm.
- UV-B, between 280 and 320 nm.
- UV-C, between 100 and 280 nm.

Influences on UV Radiation Reaching the Earth?

Although the ozone layer is the one constant defence against UV penetration, several other factors can have an effect:

Latitude:

The sun's rays are the most intense near the equator where they impact the Earth's surface at the most direct angle.

Season:

During winter months, the sun's rays strike at a more oblique angle than they do in the summer. This means that all solar radiation travels a longer path through the atmosphere to reach the Earth, and is therefore less intense.

Time of day:

Daily changes in the angle of the sun influence the amount of UV radiation that passes through the atmosphere. When the sun is low in the sky, its rays must travel a greater distance through the atmosphere and may be scattered and absorbed by water vapour and other atmospheric components. The greatest amount of UV reaches the Earth around midday when the sun is at its highest point.

Altitude:

The air is thinner and cleaner on a mountain top — more UV reaches there than at lower elevations.

Cloud cover:

Clouds can have a marked impact on the amount of UV radiation that reaches the Earth's surface; generally, thick clouds block more UV than thin cloud cover.

Rain:

Rainy conditions reduce the amount of UV transmission.

Air pollution:

Like clouds, urban smog can reduce the amount of UV radiation reaching the Earth.

Land cover:

Incoming UV radiation is reflected from most surfaces. Snow reflects up to 85 per cent, dry sand and concrete can reflect up to 12 %. Water reflects only five per cent. Reflected UV can damage people, plants, and animals just as direct UV does.

Beneficial effects

What meteosensitivity

Medicine refers to meteosensitivity pseudo-illnesses, including: motion sickness, hunger, thirst, exhaustion. This ailment is not caused by bacteria and viruses, and the reaction of the body's weakened. Man sensitive to changes in the weather when it weakened adaptive capacity.

What are the weather changes affect a person?

Not all weather changes can be seen by looking out the window. In the human body are:

- air temperature;
- atmospheric pressure (for a person positively 760 mm Hg);
- the movement of air masses (they form the weather);
- air humidity;
- air ionization (number of ions increases before the storm);
- magnetic radiation.

Who suffers from meteosensitivity

Only a third of people feel the weather changes, among them:

- people who are a little outdoors;
- people who spend all the time for a sit or mental work and do not engage in physical exercise;
- people with chronic diseases;
- people with choleric and melancholic character.

Most often, the townspeople found meteosensitivity

This is due to the fact that the air in the city is saturated with heavy ions, disrupted the natural water exchange (the asphalt does not absorb water as the earth), man-made factors: constant noise, work areas, etc.

Degrees meteosensitivity

Mild meteosensitivity

Appears only during strong weather changes, physiological condition of the body does not change, people just feel uncomfortable.

The average degree of meteosensitivity

Patients changing blood pressure, disrupted the activities of the cardiovascular system. Sharpens chronic diseases: arthritis, bronchitis, gastritis.

Severe meteosensitivity

Meteosensitivity all patients manifested in different ways, can cause insomnia, shortness of breath, general weakness, severe acute diseases.

Weather-sensitive depends on the age and sex.

By the changes in the weather are extremely sensitive babies — to adapt the system of their body is still developing. In the 14–20years age meteosensitivity minimal. But from the age of 50, most people become weather-sensitive, because the body is already weak and does not have time to react to changes of

the environment. More susceptible to weather women, they feel it is better to fluctuations. This is explained by hormonal women, and that women differently perceive what is happening.

Ironically, the farther man from nature, the more it is sensitive to fluctuations. In order not to suffer from the vagaries of nature, try to be closer to her: often open windows, relax on the weekends in the fresh air.

Winter depression is still a mystery to scientists who study it. But researchers agree that people who suffer from seasonal affective disorder are particularly sensitive to light, or the lack of it.

A wistful feeling comes over us in late autumn, as the last remaining leaves drop, morning frosts cover the ground, and the sun sets earlier each day. Hot cider and the warmth of a favorite old coat may be all you need to face the coming winter with good cheer, but for many people, fall melancholy deepens to winter depression.

Winter depression is still a mystery to scientists who study it. Many things, including brain chemicals, ions in the air, and genetics seem to be involved. But researchers agree that people who suffer from winter depression — also known as "seasonal affective disorder," a term that produces the cute acronym SAD — have one thing in common. They're particularly sensitive to light, or the lack of it.

Many studies have shown that people with seasonal affective disorder feel better after exposure to bright light. It seems simple enough: In higher latitudes, winter days are shorter, so you get less exposure to sunlight. Replace lost sunlight with bright artificial light, and your mood improves. But it's actually far more complex.

LABORATORY WORK

The test for definition of type of sensitivity of a skin.

For definition of type of sensitivity of a skin to UVR it is necessary to answer the following of 10 questions. Use ready variants of answers. Answers as follows are estimated: the first answer — 1 point, the second — 2, the third— 3, the fourth — 4. Combine all points and the received sum divide on 10. Approximate, by the existing rules, the received number. It also will be type of sensitivity of your skin. If, for example, as a result of division number 2,5, at your boundary value of type of sensitivity of a skin (between the second and the third) has turned out.

1. Color of your not suntanned skin?

- 1) Light pink, white-pink.
- 2) White.
- 3) Slightly swarthy.
- 4) Swarthy.

2. What color at you from a birth hair?

- 1) Red.
- 2) The Natural blonde.
- 3) From chestnut-colored to the brown.
- 4) From dark brown to the black.

3. What color your eyes?

- 1) Light blue, light grey or light green.
- 2) Blue, grey, green.
- 3) Light brown or dark grey.
- 4) Dark brown.

4. There are for you freckles?

- 1) It is a lot of.
- 2) Are available.
- 3) Individual.
- 4) No.

5. How the skin of your person reacts to a solar irradiation?

- 1) It is very sensitive, often there are solar burns.
- 2) It is sensitive, there can be solar burns.
- 3) It was not marked Special sensitivity, solar burns arise very seldom.
- 4) It is tolerant, solar burns are never formed.

6. As long you can be in the summer on the sun (width of Belarus) at mid-day. At a clear sky and not to receive solar burns?

- 1) 15 minutes there are less.
- 2) From 15 till 25 minutes.
- 3) From 25 till 40 minutes.
- 4) 40 minutes there are more.

7. What reaction is observed from outside skin at long stay on the sun?

- 1) Always there are solar burns.
- 2) Often there are solar burns.
- 3) There can be solar burns.
- 4) Solar burns arise very seldom or at all are absent.

8. Than solar burns are characterised at you?

- 1) It is expressed strong hyperemia, morbidity, blisters can be formed, then the skin starts to be shelled (to "climb down").
- 2) Arises hyperemia, then the skin starts to be shelled (to "climb down").
- 3) Small hyperemia, then the peeling can be observed.
- 4) Hyperemia does not arise, the peeling is absent.

9. Sunburn after unitary, but long stay on the sun Can be formed at you?

- 1) No, it is impossible.
- 2) Very seldom.
- 3) Often.
- 4) As a rule.

10. How sunburn after repeated solar baths is formed at you?

- 1) There Can be hardly appreciable sunburn or does not arise at all.
- 2) It is formed hardly.
- 3) Progressively increases.
- 4) Quickly there comes good sunburn.

TEST CONTROL

1. Solar radiation is:

- a) an integrated stream of electromagnetic fluctuations with a various wavelength;
- b) a stream of positively charged ions;
- c) a stream of ions of a different sign.

2. Wavelength UV — radiations, perniciously operate on live organisms:

- a) more than 290;
- b) less than 290;
- c) less than 400.

3. A wavelength of a visible part of solar radiation, (nanometer):

- a) 200–250;
- b) 400–760;
- c) 300–360.

4. The photoperiodism is:

- a) change of day and night;
- b) ability of organisms to react to natural light;
- c) ability of organisms to react to change of length of day.

5. Limits of temperatures, optimum for the person (°C).

- a) 15–25;
- b) 20–28;
- c) 12–30.

6. Limits of relative humidity, optimum for the person (%).

- a) 40–60;
- b) 30–75;
- c) 15–65.

7. Magnetic storms do not cause:

- a) activation of processes of inhibition in CNS;
- b) activation of processes of excitation in CNS;
- c) working capacity depression.

8. The size of a gradient of electric potential does not depend from:

- a) a season of year;
- b) solar radiation;
- c) weather conditions.

9. The biological effect of air speed is the influence on:

- a) peripheric nervous system;
- b) a physical thermoregulation;
- c) blood-vascular system.

10. Atmospheric pressure upon a sea level (mmHg).

- a) 740;
- b) 760;
- c) 780.

CHAPTER 3: «ECOLOGICAL FACTORS. PHYSICAL FACTORS. INFLUENCE OF ULTRA-VIOLET RADIATION ON THE PERSON»

The employment purpose:

1. To familiarise with features of biological action ultra-violet radiations on a human body.
2. To learn predict possible consequences of influence of ultra-violet radiation on a skin of the person.
3. To acquire a technique of an estimation of risk of development of a skin cancer.
4. To acquire a design procedure of time of the solar influence necessary for maintenance of daily requirement of the person in vitamin D₃.

Employment tasks:

1. Classification of physical ecological factors
2. Pathogenetic mechanisms of action of physical factors of environment on a human body.
3. Meteosensitivity: concept, classification by severity level of clinical displays and types meteorotropic reactions.

4. Influence of visible area of a solar spectrum and light exposure on the person. «Winter depression (affective seasonal frustration)»: concept, the development reasons, clinical display, preventive maintenance and treatment.

5. Concept definition a biological rhythm. Key parameters. Classification and a problem of desynchronization of a biological rhythm. Dynamic illnesses.

6. How the ultra-violet part of a spectrum of sunlight on character of biological action is subdivided?

7. What there are methods of measurement of UV-making solar radiation?

8. What is the biodose, the minimum daily preventive dose, an optimum dose? (To make definition of these concepts).

9. In what ultra-violet insufficiency how its preventive maintenance is carried out consists?

10. In what results an excessive irradiation of an organism beams UV of a spectrum; how him to warn?

Practical skills:

1. Definition of type of sensitivity of a skin.

2. The Estimation of risk of development of a skin cancer.

3. Calculation of time of the solar influence necessary for maintenance of daily requirement of the person in vitamin D₃.

Teaching material

Solar radiation owes its existence to all organic life on Earth. The nature of the effect of solar radiation on the body and health is determined by its spectral composition: visible light provides the function of the visual analyzer, infrared — provides thermal effect, UV — generally stimulating, biological, erythematosus, antirachitic, bactericidal effect. Rational use of solar radiation promotes health, enhance its reactivity and resistance to adverse environmental factors. Conversely, when there is insufficient insolation, especially in the UV-deficit at the level of human health is reduced, increased susceptibility to infectious diseases in children can develop rickets.

Visible light is a narrow band in the spectrum of electromagnetic radiation from the sun (from 400 to 760 nm), but the physiological and hygienic significance it holds a leading place among the environmental factors. Daylight has a beneficial effect on the body, it stimulates its vital functions, improve psycho-emotional state of a person (especially a patient). Under its influence increases metabolism in the body and stimulates the process of hematopoiesis, improves the function of the endocrine glands, etc. illumination mode plays an essential role in the regulation of biological rhythms. Almost all living beings from the simplest to the human condition and system functions vary rhythmically. These changes often meet daily rhythm associated with the rotation of the Earth, although there are other periodic oscillations corresponding to tidal, lunar, or annual cycles.

Biological rhythms — fluctuations intensity and change processes and physiological reactions. They are based on changes in the metabolism of biological systems, due to the influence of external and internal factors. Factors that affect the rhythm of the processes occurring in the living organism, dubbed the "synchro" or "timer". In nature, biological rhythm, inherent in every living organism, there are two components: exogenous and endogenous. Endogenous bio-rhythm component (circadian rhythm of physiological functions) genetically fixed and inherited, exogenous (any external factors) due to external sensors time.

The external factors include: changes in illumination (photoperiodism), temperature, the magnetic field, the intensity of cosmic radiation, tides, seasonal and solar-lunar influence; social influences characteristic of the person.

The internal factors include neurohumoral processes in particular, genetically fixed rate and rhythm.

The natural environment of contradictions between the components of the circadian rhythm does not occur. Artificial violation exogenous rhythm component (artificial illumination, sleep mode, night work, moving from one-time zone to another) is often a trigger violation of the organism adaptation to environmental conditions. Since the endogenous rhythms of only approximately correspond to the daily, they are called *circadian* (circadian) from the Latin words *circa* = about, and *dies* = day. In humans, more than 100 different physiological parameters vary cyclically with a period of 24 hours. Thus, the body temperature is minimal early in the morning and in the evening reaches the maximum, becoming approximately 1–1,5 °C higher. The most pronounced diurnal cycle sleep / wake, so many functional changes in the body, usually arising from the onset of sleep (e. g, reduction of body temperature, heart rate and respiration) were considered causally related to them.

Infra-red (thermal) radiation is most (~ 58 %) of the solar electromagnetic spectrum. It reaches the Earth's surface with infrared wavelength 760–3000 nm longer delayed atmosphere. IR, meeting on the way the atoms and molecules of different substances makes them oscillate and thus causes the thermal effect. It penetrates through the atmosphere, the water column and the soil, through the window glass and clothing. The shortest IR radiation (with a wavelength of 760–1000 nm) penetrates the tissue of the body, including through the skull bone to a depth of 4–5 cm. In case of local action on the fabric are several IR radiation accelerates the biochemical reaction, enzymatic and immuno-biological processes, cell growth and tissue regeneration, increases blood flow. The intensity of the warm-subcutaneous tissue and internal organs due to reduced circulation. With further exposure to irradiation amplified deep heating of tissue, which can lead to thermal (solar) stroke.

Active decay products that are formed on the skin under the influence of infrared radiation, and the nerve impulses coming from it, spread the local effect of radiation on the entire body. Under this influence (humoral and nervous) normal-

izes the tone of the autonomic nervous system, excessive voltage is removed, weakens muscle tone, blood vessels, achieved an analgesic and anti-inflammatory effect. This infrared radiation is used in medical practice (physiotherapy).

The intensity of the heat radiation in the SI is measured in joules (J), kilojoules (kJ), megajoules (MJ) per square meter per hour [$\text{MJ} / (\text{m}^2 \text{ h})$]. Non-systemic (old) unit [$\text{cal} / (\text{cm}^2 \text{ min})$] is found in old textbooks, reference books and the scales of measuring instruments — actinometers. The intensity of the total thermal radiation from the sun on the border with the Earth's atmosphere (solar constant) of $4.87 \text{ MJ} / (\text{m}^2 \text{ h})$ [$1.94 \text{ cal} / (\text{cm}^2 \text{ min})$]. On the surface of the Earth in temperate latitudes, it does not exceed $3.77 \text{ MJ} / (\text{m}^2 \text{ h})$ [$1.5 \text{ cal} / (\text{cm}^2 \text{ min})$] (Table 2.1.).

Table 2.1 — Galanin scale for subjective evaluation of the thermal radiation intensity

Radiation		
Intensity		Characteristic actions
$\text{MJ} / (\text{m}^2 \text{ hr})$	$\text{cal} / (\text{cm}^2 \text{ min})$	
1–2.0	0.4–0.8	Weak tolerated indefinitely
2.1–4.0	0.9–1.5	Moderate transferred 3–5 min
4.1–7.5	1.6–3.0	Average, transferred 25–60 seconds
7.6–12.0	3.0–4.0	Strong, transferred 10–12 sec
> 12.0	> 4	Very strong, transferred 2–5 seconds

The ultraviolet portion of the solar spectrum is most active biologically. The intensity and spectral composition of its constantly changing depending on the season, the state of the atmosphere, the amount of water vapor, aerosols, the height of the sun above the horizon, the level of dust and annual air pollution. One of the major characteristics — the wavelength (200 to 400 nm.), Except that there is a division into three groups, depending on the wavelengths:

- 1) UV-ray's region A — 400–320 nm;
- 2) the UV-ray's region B — 320–280 nm;
- 3) the UV-ray's region C — 280–200 nm.

UV radiation has a broad biological action. Penetrating the tissue at a depth of 0,5–1,0 mm, it actively influences the immunological resistance of the organism, increasing the activity of the hypothalamic-pituitary-adrenal system, it leads to the activation of biochemical processes, and thus, influences cell metabolism. Increased rate of chemical processes in the body, which in turn improves the metabolic and trophic processes, accelerates the growth and regeneration of tissues, increases the resistance to infections, in addition, improves physical and mental performance.

Under the influence of large doses of UV erythema occurs on the skin, reaching its maximum development in 18–20 hours, on the spot where there is a

7–9-day pigmentation — tan. Processes occurring in erythema education underlie the analgesic, anti-inflammatory, resolving the action.

The specific biological effect of UV radiation is the endogenous formation of vitamin D, which occurs in the skin under the influence of low doses of UV-A region with a wavelength of 315–365 nm. Dehydrocholesterol, located in the skin, into vitamin D becomes three. Last participates in the regulation of calcium and phosphorus metabolism in the body.

An important property of ultraviolet region C is a bactericidal effect. It is based on the direct effect of these rays on microorganisms. In the absorption of radiant energy in the past there are complex biochemical processes that lead to the eventual death of the microorganism.

Speaking about the biological effects of ultraviolet radiation, it should be recalled, and on its possible **side effects**. Thus, **when excess disposable UV irradiation is possible:**

- the occurrence of photochemical burns, which manifests itself in the form of erythema, blisters, bare in hydrochloric pain, possible photo ophthalmia. This results in increase in lipid peroxidation, which leads to damage cell membranes and the death of the cells;

- exacerbation of chronic diseases, rheumatism and et al., r. a. at strengthening the formation of melanin increases n of needs in essential amino acids, vitamins, salts of calcium that adversely affect the course of chronic of the first process;

- when exposed to UV-radiation field from long wavelength 200–280 nm is inactivation ho calciferol toxic in its derivative.

Prolonged exposure to excessive UV radiation may:

- the formation of peroxides and epoxy compounds, possessing mutagen action;

- induction of skin cancer;

- increase photosensitivity;

- the emergence of a group of people photoallergy.

Methods of measurement and regulation of ultraviolet radiation.

The beneficial effects of UV radiation can be achieved by adjusting the intensity and erythema dose of radiation, as well as precise control of the irradiation process. Currently used for this purpose three methods: biological, photochemical and photoelectric.

The biological method is widely used in medical practice. It is based on the definition of erythema — biological dose (*vitadose*) irradiance. *biodose* — is the least amount of UV irradiation (or the minimum exposure time) that causes (through 8–14 h) the emergence of subtle redness on untanned skin area (determined via Biodosimetry Gorbachev).

Dose warning hypo- and beriberi the D, disorders of calcium-phosphorus metabolism, and other undesirable effects of light starvation, called **prophylac-**

tic dose and is 1/8 erythematous dose. Physiological dose of ultraviolet radiation (from the point of view of its adaptogenic action) is $\frac{1}{4}$ of — $\frac{1}{2}$ erythema dose.

Erythematous biodose threshold is variable and depends on the sex, age, health status and other individual characteristics. Biodose established experimentally in each case, or partial — for the most frail individuals who are exposed to radiation.

Photochemical method for determining irradiance degree of erythema induced by UV radiation, the latter is based on the decomposition of uranyl nitrate in the presence of a titrated solution of oxalic acid. One erythematous dose of 4 mg corresponds decomposed oxalic acid per 1 cm² surface of the irradiated solution.

PV (physical) method is based on determining the intensity of UV radiation by means of special devices. These devices make it possible to determine the energy (physical) the amount of UV — irradiance level of energy to assess the intensity of the UV-radiation and the nature of its distribution on the surface in a volume of space. The measurement results are indicated in watts per square meter and derivatives watts (W / m² mW / m², mW / m²). Using these devices can be determined and the amount of exposure, i. e. energy dose of irradiance, the radiation dosage separately in erythematous (290–340 nm) and bactericidal (220–290 nm) range — W / (m² hour), mW / (m² hour), mW / (m² hour).

Indications and contraindications for UV irradiation by common indications include:

- prevention solar insufficiency, and at the same time, and vitamin deficiencies;
- prevention and treatment of rickets;
- prevention of lowering the overall conjugated resistance the body in winter-autumn period;
- prevention of infections;
- prevention of decrease mental and physical operability for **local indication** refers erythemotherapy inflammatory diseases of internal organs, such as:

- bronchitis;
- gastritis;
- rheumatism;
- tonsillitis;
- sore throat;
- bronchial asthma.

It is believed that UV treatment is most effective it is in childhood and adolescence, due to the fact that metabolic processes are still very labile and is not fully formed. In addition, UV-irradiation used in surgery, traumatology, dermatology.

Contraindications in the application of UV radiation include:

- malignant tumor;
- bleeding tendency;

- active pulmonary tuberculosis;
- blood diseases;
- cachexia;
- hyperthyroidism;
- systemic lupus erythematosus;
- circulatory failure I of, II of the degree.

In the development of disease following factors are value:

- radiation dose;
- the spectral characteristics of the radiation;
- individual sensitivity;
- exposure frequency.

It found that different spectral ranges of UVB not uniformly effect on human skin, wherein the main reaction is the development of erythema. For example, the skin is 100 times more sensitive to UV radiation with a wavelength of 298 nm than with $\lambda = 319$ nm. The contribution of different UVB ranges in the formation of erythema represents the so-called erythemal action spectrum (EDS), the values of which are expressed in capacity UVI flow per unit area (W / m^2). According to the recommendations of international organizations, the maximum value of the EDS should be considered as the value of $0.25 W / m^2$. In everyday practice, many countries use the UV index (UV index) for monitoring the level of ultra-violet radiation, which is reported to the public through the media. UV index is calculated by multiplying by a factor of 40. EDS According to this, the UV index at the maximum allowable exposure to UVB recommended with EDS of $0.25 W / m^2$ will be equal to 10 ($0.25 W / m^2 \times 40 = 10$).

The World Health Organization (WHO) recommends that the following graduation UV Index:

- 1–2 — low;
- 3–5 — medium;
- 6–7 — high;
- 8–10 — highly high;
- 11 and more — extreme.

In the summer, on the territory of the Republic of Belarus UV index ranges from 5 to 8. It is known that each person is characterized by the individual skin sensitivity to UV radiation effects. There are four main types of skin sensitivity. To determine the type of skin sensitivity are special test given hereinafter.

For a person quantity characterizing the impact of UV radiation is the minimal erythema dose (MED). It's a dose of ultraviolet radiation, which causes untanned skin after 8–10 hours to flushing or erythema. It is estimated that one unit corresponds to the energy DER $250 J / m^2$, and this effect is in individuals with type II skin sensitivity. Other types of skin sensitivity values have their flux density (Table 2.2.). Accordingly, the exposure control is calculated, expressed in relation to the dose of UV radiation for skin sensitivity type II.

When comparing the UV index values with EDR determined that 10 units of UV power index correspond erythemal dose of 4.3 MED / h. Hence, the UV-unit index is 0.43 MED / h.

Table 2.2 — Types of skin sensitivity

Skin Type	The dose of UVB, J / m ²	Control
I	200	0.8 EDR
II	250	1 MED
III	350	1.4 EDR
IV	450	1.8 EDR

Since each value UV is characterized by its index value flux density of UV radiation, a safe choice for the irradiation time necessary to calculate the duration sunbathing time, depending on the type of skin sensitivity.

According to the recommendations of international organizations for non-pigmented skin of all types of permissible level of sensitivity is a dose of 0.4 MED per day; for an individual with type II skin tanned UVB sensitivity control is a dose of 1 MED per day.

The methodology of calculation:

1. Calculate value power erythemal dose (MD) at this meaning the UV-index: MD (MED / h) = UV index × 0.43 (MED/h).

2. Calculate time in hours for which a given so Research Institute of the UV index and the type of skin sensitivity will be formed perm and May daily dose: t(h) = DU/MD.

3. The resulting time translate into minutes: t(min) = t(h) × 60.

Note that the maximum allowable cumulative (for one year), the value of EDR in the year for the II type of skin is recommended to consider the value of 50. For the third and fourth types — 70 and 90 respectively EDR.

Vitamin D

The Earth's atmosphere blocks UV radiation from penetrating through the atmosphere by 98.7 %. A positive effect of UVB exposure is that it induces the production of vitamin D in the skin. It has been estimated that tens of thousands of premature deaths occur in the United States annually from a range of cancers due to vitamin D deficiency. Another effect of vitamin D deficiency is poor absorption of calcium which can lead to bone diseases.

Some studies show most people get adequate Vitamin D through food and incidental exposure.

Many countries have fortified certain foods with Vitamin D to prevent deficiency. Eating fortified foods or taking a dietary supplement pill is usually preferred to UVB exposure, due to the increased risk of skin cancer from UV radiation.

However, the Vitamin D received from food, fortified or not, is minuscule when compared to how much the body makes when exposed to the sun for just 10 minutes. Recent research on Vitamin D indicates that the RDA for Vitamin D

of 400 IU is too low. With just 100 IU of Vitamin D in one cup of milk and similar levels in other foods, many studies show that food sources of Vitamin D are simply not adequate and therefore that taking it as a dietary supplement is preferable to relying only on food sources.

Medical applications

Ultraviolet radiation has other medical applications, in the treatment of skin conditions such as psoriasis and vitiligo. UVA radiation can be used in conjunction with psoralens system of water

UVB radiation is rarely used in conjunction with psoralens. In cases of psoriasis and vitiligo, UV light with wavelength of 311 nm is most effective.

Harmful effects

An overexposure to UVB radiation can cause sunburn and some forms of skin cancer. In humans, prolonged exposure to solar UV radiation may result in acute and chronic health effects on the skin, eye, and immune system. However the most deadly form — malignant melanoma — is mostly caused by the indirect DNA damage (free radicals and oxidative stress). This can be seen from the absence of a UV-signature mutation in 92 % of all melanoma.

UVC rays are the highest energy, most dangerous type of ultraviolet light. Little attention has been given to UVC rays in the past since they are filtered out by the atmosphere. However, their use in equipment such as pond sterilization units may pose an exposure risk, if the lamp is switched on outside of its enclosed pond sterilization unit.

Skin

Ultraviolet (UV) irradiation present in sunlight is an environmental human carcinogen. The toxic effects of UV from natural sunlight and therapeutic artificial lamps are a major concern for human health. The major acute effects of UV irradiation on normal human skin comprise sunburn inflammation erythema, tanning, and local or systemic immunosuppression.

UVA, UVB and UVC can all damage collagen fibers and thereby accelerate ageing of the skin. Both UVA and UVB destroy vitamin A in skin which may cause further damage. In the past, UVA was considered less harmful, but today it is known that it can contribute to skin cancer via indirect DNA damage (free radicals and reactive oxygen species). It penetrates deeply but it does not cause sunburn.

UVB light can cause direct DNA damage. The radiation excites DNA molecules in skin cells, causing aberrant covalent bonds to form between adjacent cytosine bases, producing a dimer. When DNA polymerase comes along to replicate this strand of DNA, it reads the dimer as "AA" and not the original "CC". This causes the DNA replication mechanism to add a "TT" on the growing strand. This is a mutation, which can result in cancerous growths and is known as a "classical C-T mutation".

The mutations that are caused by the direct DNA damage carry a UV signa-

ture mutation that is commonly seen in skin cancers. The mutagenicity of UV radiation can be easily observed in bacteria cultures. This cancer connection is one reason for concern about ozone depletion and the ozone hole. UVB causes some damage to collagen but at a very much slower rate than UVA.

Eye

High intensities of UVB light are hazardous to the eyes, and exposure can cause welder's flash (photokeratitis or arc eye) and may lead to cataracts, pterygium and pinguecula formation.

UV light is absorbed by molecules known as chromophores, which are present in the eye cells and tissues. Chromophores absorb light energy from the various wavelengths at different rates — a pattern known as absorption spectrum. If too much UV light is absorbed, eye structures such as the cornea, the lens and the retina can be damaged.

Skin types

The tone of human skin can vary from a dark brown to nearly a colorless pigmentation, which may appear reddish due to the blood in the skin. Europeans generally have lighter skin, hair, and eyes than any other group on Earth, although this is not always the case. For practical purposes, such as exposure time for sun tanning, six skin types are distinguished following Fitzgerald (1975).

Type I

Fair skin, blue or green eyes, little or no freckles. Burns and peels severely.

Type II

Fair skin, blue eyes, blond or brown hair. Burns severely and easily peels, tans minimally.

Type III

Fair skin, brown hair, brown eyes. Burns moderately, tans somewhat.

Type IV

Olive or light brown skin, dark brown hair, dark eyes. Burns minimally, tans easily.

Type V

Dark brown skin. Rarely burns, tans easily and substantially.

Type VI

Black or dark brown skin, brown eyes, black or dark brown hair. Burns only with severe exposure.

Practical skills:

1. Definition of type of sensitivity of a skin.
2. The Estimation of risk of development of a skin cancer.
3. Calculation of time of the solar influence necessary for maintenance of daily requirement of the person in vitamin D₃.

Practical skills:

1. Definition of type of sensitivity of a skin.
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LABORATORY WORK

Definition of correlation dependence between risk factors of conditions of residing and level of primary disease

Task 1. Define frequency of sharp respiratory diseases for a year.

Task 2. Define group of risk of conditions of residing of each student.

I. ECOLOGICAL CONDITIONS OF RESIDING:

1. You live in what city district?

2. During what time you live in the given city district?

(SPECIFY NUMBER OF YEARS)

3. Whether your house in the neighbourhood is located with:

The industrial enterprise 1

Parking place or large highway, automobile repair shop 2

Gasoline station 3

Station 4

The market, large shopping centre 5

The house is located in a quarter 6

4. Near to your house:

There are green plantings (square, park) 2

There are no green plantings 1

5. The house in which your family lives concern what type?

Panel 1

Brick 2

6. Whether you are satisfied by an accomplishment and a sanitary condition

Your area of residing?

Yes 2

Is not present 1

7. You live in:

Hostel 1

To communal flat 2

To separate apartment 3

The private house 4

8. What floor space on one member of your family?

Less than 6 sq. m 1

6–12 sq. m 2

More than 12 sq. m	3
9. Presence of household conveniences:	
There are no conveniences (the central water drain and water supply)	1
There are no separate conveniences (Hot water and etc.)	2
There are all conveniences	3
10. Cook food on	
To gas cooker	1
To oven	2
To electric plate	3
11. Cooking occurs on kitchen	
Is not present	1
Yes	2
12. How do you estimate character of living conditions:	
Unsatisfactory	1
Satisfactory	2
13. Whether is there a separate room?	
Is not present	1
Yes	2
14. Whether the separate place for preparation of employment is taken away in your apartment?	
Is not present	1
The place is released	2
Yes	3
15. Whether there is smoke in your premises	
Yes	1
Sometimes	2
Is not present	3

To state an estimation to the received results.

The algorithm of processing of results of questioning provides a mark estimation in each block. Each chosen answer to a question has an estimated point, thus the highest point was appropriated to the answer containing the information which received a positive hygienic estimation. The total point allows to carry to this or that group of risk (the least, attention, the maximum risk) on residing conditions.

«Ecological conditions in residing»:

Group of the least risk —	more than 25 points
Attention group —	from 25 to 20 points
Group of the raised risk —	less than 20 points

Task 3. To generate a database for statistical processing of results.

№	X	Y	Dx	dy	dx ²	dy ²	dx *dy

x — quantity of the registered sharp diseases for a year; y — a total point of answers to questionnaire questions; dx — deviations from average value of all registered sharp diseases in research group; dy — deviations from average value of a total point on questioning of group of research.

Task 4. To Settle an invoice factor of correlation in the way of squares of Pirsona under the formula.

$$r = \frac{\sum(d_x \cdot d_y)}{\sqrt{\sum d_x^2 \cdot \sum d_y^2}}$$

Where x and at — signs between which communication is defined; d_x and d_y — deviations of everyone variants from the average size calculated among a sign x and among a sign at; Σ — a sum sign.

To establish force and a direction of communication with use of the tabular data

Force of communication / Character of communication	Straight line (-)	Return (-)
The full	1	-1
The strong	From 1 to 0,7	From -1 to -0,7
Average	From 0,7 to 0,3	From -0,7 to -0,3
The weak	From 0,3 to 0	From -0,3 to 0
No	0	0

TEST CONTROL

1. Ecological value of carbon dioxide:

- participation in formation of a photochemical smog;
- excitation of the respiratory center;
- absorption of infra-red radiation.

2. The inert gases which are a part of atmospheric air:

- argon, hydrogen, carbon dioxide;
- neon, xenon, carbon oxide;
- argon, neon, helium.

3. Impurity of air of a natural parentage concerns:

- ammonia;
- nitric oxide;
- helium.

4. The basic source of occurrence of microorganisms in air:

- soil;
- the industrial enterprises;
- hydrosphere.

5. In long-term human presence in an electromagnetic field can develop disease of what systems:

- a) the cardiovascular;
- b) the vascular;
- c) the respiratory.

CHAPTER 4: «ECOLOGICAL FACTORS. CHEMICAL FACTORS, BIOLOGICAL FACTORS EFFECTORY OF THE ENDOCRINE SYSTEM. HEREDITY AND THE ENVIRONMENT»

The general time of employment: 4 class hours.

The employment purpose:

1. To acquire the mechanism of influence of ecological factors on the person.
2. To acquire the mechanism of protection against an adverse effect of factors of environment.

Employment tasks:

1. Ecological factors. The basic concepts, classification.
2. The characteristic abiotic and biotic EF. Mechanisms of influence EF on the person.
3. Specific and nonspecific mechanisms of protection against an adverse effect of factors of environment. EF and population health.
4. Chemical substances: concept, classification, a general characteristic. Mechanisms of toxic action.
5. Effectors of endocrine system: concept, classification, properties, a metabolism and the action mechanism.
6. A heredity and environment. A role of genetic factors in occurrence of ecologically dependent pathology of the person.

Practical skills:

1. Acquisition of knowledge of mechanisms of formation and risks of ecologically caused pathology.
2. To show presence of interrelation "organism-environment".

Teaching material

The ecological factor is any element of the environment, capable to render direct or indirect influence on a live organism at least on one of stages of its individual development, or any condition of environment which the organism answers with adaptive reactions.

Classification of ecological factors:

I. Abiotic: climate-meteorological, orographical, hydrographic, geological, geophysical, chemical: acidity, chemical pollution of plants, animal.

II. Biotic: fauna, flora, microflora, biological components, biocoenosis.

III. Social and economic: the population, household factors, a sanitary-and-hygienic condition and the epidemic status, medical and veterinary services.

Kinds of influence of ecological factors on organisms.

1. They can be: irritants which promote occurrence of adaptive physiological and biochemical changes.

2. The terminators changing geographical distribution of organisms because of impossibility of existence in given conditions.

3. Modifiers which cause morphological and anatomic changes of organisms.

4. The signals testifying to change of other factors of environment.

The general laws of action of ecological factors:

1. The optimum Law — any EF has limits of positive influence on live organisms.

2. The Law of ecological individuality — ecological spectra of different kinds do not coincide; each kind is specific by the ecological possibilities.

3. The Law of the limiting factor — is most significant for an organism this factor which more all deviates its optimum value.

4. The Law of ambiguous action — action of each ecological factor ambiguously at different stages of development of an organism.

5. The Law of direct and indirect influence of factors on organisms.

6. The Law of interaction of ecological factors: the optimum zone and limits of endurance of organisms in relation to any factor can be displaced depending on that, in a combination to what other factors influence is carried out.

Interrelation «an organism — environment»

Intensive and chronic influence of ecologically adverse factors of environment is accompanied by an overstrain and infringement of adaptable possibilities of an organism that leads to adaptation failure, development of painful conditions and synchronisation of the basic pathological processes which thereof in essence are ecologically caused. *Characteristic signs ecological, in particular the chemical nature of disease:*

— Sudden flash of new disease.

— Specific symptoms (avenue typical for a poisoning with lead a triad; a lead border; lead colic).

— The combination of nonspecific signs not peculiar to known illnesses.

— Absence of contact ways of transfer.

— The general source of influence at all victims.

— Dependence detection «a dose — the answer».

— Characteristic geographic distribution of cases of diseases.

— Distribution of victims on age, sex (children appear the most subject).

- Time communication between disease and influence of factors.
- Disease communication by certain events: avenue the beginning of release of new substances.
- Detection in blood of victims of investigated chemical substance.

Pathogenetic mechanisms of action of chemical factors on a human body

The general representations

Action of chemical factors on a human body is caused by two principal causes.

Surplus or lack of the maintenance of natural chemical elements of environment. Both conditions are undesirable, can conduct to pathology development. Thus the lack essential, ie connections necessary for an organism conducts to scarce conditions, and surplus — to toxic effect. It does not concern other class of elements which are not involved in metabolic reactions and for them dose-dependent reaction will be a bit different. All told is well illustrated on an example of a lack of iodine in a number of areas of Byelorussia, interfaced to occurrence of a scarce condition — endemic cretinism.

Presence at environment of chemical elements unusual for it (xenobiotic) owing to anthropogenous influence.

Xenobiotic are called any alien connections for an organism which are capable to cause in it certain changes, including diseases and destruction.

The basic distinctive characteristic of xenobiotic action in ecological sense consists that their action on the person is carried out throughout rather long time intervals (years, ten years), thus their operating concentration can be so small what to find out them it is possible only the most sensitive modern methods. The ecological medicine differs radically with it from the hygienic disciplines, which characteristic feature — rationing, i. e. an establishment of threshold values (maximum concentration limit) which in hundreds and even millions times can exceed concentration of chemical factors really operating on the person. For example, radical changes in an organism of the child can be caused minimum (an order of several parts on trillion) concentration of hormone — like connections during pre-natal development.

The basic characteristics of the majority xenobiotic — lipophilic (water repellency), ability to get through membranes by means of simple diffusion to be transported in blood with the help of lipoproteins, to collect in a fatty fabric.

The basic mechanisms of xenobiotic action

Distinguish some the basic ways of realization of xenobiotic the toxic influence on a human body.

Change of a metabolism of cages or the fabrics, connected with infringements in an organism and occurrence of certain semiology.

Influence on cellular DNA, change of the genetic information and its realization in the form of malignant transformation of a cage. It is counted up that oncological disease develops not at once and after the cage will save up a little (from 4 to 10) DNA damages. Damages to structure of the chromosomes, caused

by xenobiotic action, can be transferred from generation to generation. For example, small doses nitrosamines, entered to pregnant mice induced typical tumours not only at mothers, but also in the subsequent generations though the posterity of mice in the subsequent had no contact with nitrosamines.

By imitation action of natural chemical compounds (for example, hormones), functioning in an organism. At such mechanism of xenobiotics action break normal growth and development of bodies, fabrics, including nervous and immune system.

By change of activity of immune system at the person. This influence includes the immune modulation expressed in change of activity of immune components (for example, numbers T - or B- lymphocytes in blood), hypersensitivity and stimulation development autoimmune processes in an organism. Similar action aromatic hydrocarbons differ; heavy metals (mercury); halogen derivative aromatic hydrocarbons (the polychlorinated connections); phosphororganic connections (pesticides); metalorganic tin connections; atmospheric oxidizers (ozone and nitrogen dioxide); polycyclic aromatic hydrocarbons (products of burning of coal, oil, garbage).

At the heart of all these mechanisms certain processes at various hierarchical levels which are necessary for considering in detail lie.

Description

Lead is a highly toxic metal found in small amounts in the earth's crust. Because of its abundance, low cost, and physical properties, lead and lead compounds have been used in a wide variety of products including paint, ceramics, pipes, solders, gasoline, batteries, and cosmetics. Since 1980, federal and state regulatory standards have helped to minimize or eliminate the amount of lead in consumer products and occupational settings. Today, the most common sources of lead exposure in the United States are lead-based paint in older homes, contaminated soil, household dust, drinking water, lead crystal, and lead-glazed pottery. While extreme lead exposure can cause a variety of neurological disorders such as lack of muscular coordination, convulsions and coma, much lower lead levels have been associated with measurable changes in children's mental development and behavior. These include hyperactivity; deficits in fine motor function, hand-eye coordination, and reaction time; and lowered performance on intelligence tests. Chronic lead exposure in adults can result in increased blood pressure, decreased fertility, cataracts, nerve disorders, muscle and joint pain, and memory or concentration problems.

Mercury, also known as quicksilver, is a naturally-occurring metal that is toxic to living organisms. Metallic or elemental mercury — an odorless, shiny, silver-white liquid — is commonly used in thermometers, barometers and fluorescent light bulbs. Metallic mercury is extremely dangerous with a few drops generating enough fumes to contaminate the air in a room. Furthermore, skin contact with the

metal results in the absorption of mercury into the blood stream and potential health problems. Mercury poisoning may include the following symptoms:

- Muscle weakness.
- Skin rashes.
- Mental disturbances such as mood swings and memory loss.
- Impairment of speech, hearing and peripheral vision.
- Impairment of coordinated movements such as walking or writing.
- Numbness and "pins and needles" feeling in the hands, feet and sometimes around the mouth.

• Mercury may be released naturally into the air from volcanoes and the earth's crust, but man-made sources include the incineration of waste and coal-burning power plants. Once these industrial activities release mercury into the air, it ultimately falls back to earth, is fixed by plankton into methylmercury and is concentrated up the food chain by the fish that eat them.

• NIEHS, the Food and Drug Administration (FDA) and the Environmental Protection Agency (EPA) have studied the physiological effects of methylmercury, a common form of organic mercury (mercury combined with carbon), on humans via fish consumption. Although fish and shellfish have many nutritional benefits, consuming large quantities of fish increases a person's exposure to mercury. Pregnant women who eat fish high in mercury on a regular basis run the risk of permanently damaging their developing fetuses. Children born to these mothers may exhibit motor difficulties, sensory problems and cognitive deficits.

• Hormones are substances secreted by the endocrine glands and collected by the circulation that act to produce effects upon specific organs and tissues. Hormones are effectors of the endocrine system

Effectors of endocrine systems (EES = Environmental Endocrine Disruptors)

One of the most studied mechanisms of xenobiotic action on a human body — action of effectors of endocrine systems (EES) (Environmental Endocrine Disruptors, EED) which cause a number of ecologically dependent diseases. The chemical compounds breaking normal hormonal balance in a human body and animals concern this xenobiotic group.

Majority EES possess ability to bioaccumulation, collecting in an internal and a fatty fabric of animals and the person. At joint influence the effect is summarised. Considerable danger represents EES for descendants of persons, exposed to influence of the given connections in the pre-natal period. In this case the great value has influence time: long action even in small amounts necessarily leads to damages.

EES share on 3 groups:

Natural EES.

Basically, contain in vegetative products owing to what they have received the name of "phytoestrogen". In the nature carry out regulating function, causing

barrenness and reducing during the necessary moments population of herbivores. Otherwise the balance between autotroph and heterotroph (herbivorous) would be broken.

Unlike many other connections, a phytoestrogen does not concentrate in a food chain, not cumulate in an organism, it is good metabolizing and egest. It allows to recommend them as connections with anticarcinogenic activity.

Medical EES.

An example of medicinal EES - nowadays not used medical product which was actively used for the prevention of spontaneous abortions in gynecologic practice with 1948 for 1970. Now it is forbidden, as its application has been connected with growth of number of tumours of a vagina at women, infringements of reproductive function at the born girls and infringements of sexual development in boys.

Other pharmacological means concerns this group — mestranol.

Anthropogenous EES.

Among them it is possible to allocate some the basic groups.

1. Hlororganic pesticides: chlordan, heptachlorine, aldrin, hexachlorobenzene, lindan, toxaphen, etc. Though these chemicals have been forbidden in the industrial countries, some from all of them are still made by the American corporations in developing countries where are widely used. Lindan it is used in England for protection of many grain crops.

2. Herbicides — alachlorine, atrasin, etc. were widely applied by the American armed forces during war in Vietnam.

3. Fungicides, used for processing of apples and bananas (benomil, maneb, sineb, etc.). The effect of fungicides of propiconazol is so powerful that some imidazole derivatives were considered in due time as possible preparations for man's contraception.

4. Dioxins and furans (undesirable by-products at burning of a waste; metallurgical and chemical plants).

5. Disintegration products of alkylphenols which are widely used in washing-up liquids, paints, herbicides and cosmetics.

Influence on reproductive function.

Adverse effect of factors of environment on reproductive function are shown in fruitfulness decrease, transplacental carcinogenesis, mutagen changes of sexual cages, spontaneous abortions, the congenital ugliness's, the lowered weight of a body of newborns, infringement of ability to training, menstrual infringements and decrease libido. The contribution of factors of environment to risk of development of congenital ugliness's estimate approximately in 5 %. Teratogenic effect gives marked mercury (a brain atrophy), lead (pregnancy interruption), low weight of a body of newborns, components of a tobacco smoke, pregnancy interruption. Environment factors render gonadotropic action on an organism of women and men: female and man's barrenness. Spermatogenesis

connection of infringements is established with smoking and chemical environmental contamination.

HEREDITY AND ENVIRONMENT

1. Hereditary diseases are those morbid conditions in which genetical component has the leading part. All morbid conditions have this or that hereditary contribution, however depending on degree of this contribution there is a division into monogene (monofactorial) hereditary diseases for which a determinantal factor are genetical infringements, and polygene (or multifactorial) diseases in which etiology the major importance belongs to various factors of exogenous nature. Genetical factors play one of key roles in occurrence and diffusion in populations of pathological processes and states, however the concrete contribution of hereditary factors to occurrence of this or that nosology forms is distinguished.

Set of diseases educe as a result of **influence of external disturbing factors** (including ecological) has hereditary predisposition. Exists as well the third type of diseases in which etiology the main role belongs to various exogenous factors (for example, infection contaminations or traumas). At these diseases the genotype role is circumscribed by regulation of degree of a sensibility of an organism, efficacy of the immune answer and possibilities of adaptation-compensatory reactions in reply to choronomic influence.

From the resulted classification of genetical diseases it is visible, that about 10 % of all forms of morbid conditions are the monofactorial illnesses, which cause exclusively genetical - breakages on gene or chromosome level. A heredity functional unit - a gene. Through sex cells of parents not signs, and the information about them are transferred \. Primary action of genes consists that they program biosynthesis of enzymes by a principle «one gene — one enzyme».

Fermental systems are supervised by the conforming complexes of genes and changes (mutation) in them of a gene involve chains of processes - variates or enzyme that leads to loss of the conforming step of metabolic reaction and, as consequence, to change or infringement of development of separate signs of an organism drops out, ie. Development of hereditary features goes under the scheme «a gene — enzyme — biochemical reaction — a sign». For monogene diseases sign exhibiting in the alternative form is characteristic: there is a genetically breakage — there is an illness, for example phenylketonuria, there is no breakage (defect of a genome) — there is no illness.

PATHOLOGY - studying of illness with the purpose of comprehensions of its causes and application of the received knowledge to treatment of the patient.

2. Mutagen action factors of the physical, chemical and biological nature possess.

Among physical factors the strongest mutant action ionising radiation has — X-ray, α - β - γ renders-beams has.

Chemical mutagen should possess following qualities:

- high inpouring ability;
- property to variate a colloidal state of chromosomes;
- certain action on a chromosome or gene state.

To the chemical materials invoking mutations, it is possible to carry organic and inorganic matters, such, as acids, alkalis, peroxides, salts of metals, formaldehyde, pesticides, defoliants, herbicides, a colchicine, etc.

For a substantiation of introduction of the legislative documents directed on check of factors of environment on mutagenicity, the social and economic understanding of their efficacy is necessary. However, the concept "risk-benefit" in this case is hardly applicable. Public health services members require scientific recommendations that on level of a hygienic setting to provide safety of medium in the genetical plan. Accurate representation should be an indispensable condition for legislative actions how to identify qualitative and quantitative genetical effects. Human populations are already burdened by a considerable load of harmful mutations. Therefore, would be an error to establish for genetical changes any tolerance level as the question on consequences of population changes in result of increase of mutational process is yet clear. Taking into consideration this circumstance, and also that fact, that for the majority of chemical cloudies (if not for all) is absent an action threshold, it is possible to believe, that maximum permissible "genetical-damaging" concentration for chemical cloudies, as well as doses of physical factors to exist should not.

At an assessment of danger of the mutagenesis arising under the influence of environmental factors, it is necessary to consider existence of natural antimutagens (for example, in nutrition). It to the full concerns and the person at whom application of artificial cloudies can variate speed spontaneous mutation in somatic cells.

3. Gene (point) mutations are changes of number and-or sequence of nucleotides in DNA (inserts, losses, moving's, replacements of nucleotides) within the separate genes, quantities leading to change or qualities of the conforming albuminous products. Base substitutions lead to appearance of three phylum of mutant Codonums: with the varied sense (misses-mutation), with not varied sense (neutral mutations) and senseless, or stop codons (nonsense mutation).

Mutations as changing of the nitrogenous establishments descend owing to following causes. First, there can be casual or under the influence of chemical agents, a change of frame of the establishment already included in a spiral of DNA. If such varied form of the establishment remains to the reparation not noticed by enzymes at the nearest round of replication it can attach to herself other nucleotide. Erroneous incorporation in a synthesized chain of DNA of the nucleotide bearing chemically varied form of the establishment or its analogue can be other cause of base substitution. Thus, change of frame of DNA as base substitution descends to or in the course of replication pristinely in one polynucleotide chains. Depending on character and a place of the happened

changing specific properties of protein variate in different degree, in some cases is essential. It is known, that changing of nucleotides in one triplet results in 25 % of cases in formation of triplets-synonyms, in 2–3 % — senseless triplets, in 75–70 % — to occurrence of true gene variations.

Chromosome mutations - (or aberrations) - changes in frame of chromosomes. At chromosomal level of the organisation the hereditary stuff possesses all characteristics of a substratum of a heredity and variability, including ability to acquisition of changes which can be transferred to new generation. Under the influence of various influences, the physical and chemical and morphological frame of chromosomes can variate. At the heart of change of frame of chromosomes pristine infringement of its integrity — breakages which, are accompanied by the various rearrangements, named chromosome mutations or aberrations, as a rule, lays.

Breakages of chromosomes can arise as under the influence of various external factors, more often physical (for example, an ionising radiation), some chemical compounds, viruses.

Any mutational changes in a hereditary stuff of gametes — generative mutations — become property of following generation if such gametes participate in a fertilization.

4. Somatic mutations — mutations in body cells (not gametes). If genes in somatic cells mutations show at the given organism variate and are not transferred to brooding at a syngensis. However, at an asexual reproduction if the organism educes from a cell or bunch of the cells having мутировавший a gene, mutation can be transferred to brooding. Such mutations are called as somatic. The term "mutation" has been introduced into genetics by one of the scientists who have rediscovered laws of Mendel, — de the Frieze). This term meant again arisen, without participation of crosses, hereditary changes.

Except classification of mutations by an occurrence mean, them categorise and to other signs.

1. Direct mutations are the mutations invoking a deflection from feral phylum. Reverse mutations are a returning to feral phylum.

2. If mutations arise in sex cells, the name generative mutations (from an armour. Generative — a birth), and if in other cells of an organism — Somatic mutations (from греч. A catfish — a body). Somatic mutations can be transferred to brooding at a Somatic propagation.

3. By results of a mutation divide on beneficial, neutral и harmful (including sterile, semi lethal and lethal). Semi lethal mutations are the harmful mutations strongly reducing viability, but not disastrous, but lethal — leading to death of an organism at this or that stage of development. Sterile mutations are what do not influence viability of an organism, but is sharp (often to zero) reduce its fruitfulness. Neutral mutations are mutations which do not change viability of an organism.

5. At normal biosynthesis of DNA or under the influence of various agents in DNA there can be damages. Many of them are corrected by means of special

REPARATION enzymes. The REPARATION (an armor repair — restoration) — peculiar to cells of all organism's process of restoration of connatural frame of DNA, damaged at normal biosynthesis of DNA in a cell, and also physical and chemical agents.

Pristinely ability to a repair has been found in the bacteria which are exposed to influence of ultra-violet beams (UVB). As a result of an irradiating integrity of molecules of DNA is broken, in it there are dimers — linked among themselves of next pyrimidine establishments. It can be dimers of a thymine, a thymine with cytosine, etc. However, the irradiated cells on light persist better, than in darkness. It has been shown, that on light in them there is a light repair (photoreactivation). It is carried out by the special enzyme, becoming more active in quanta of visible light. Enzyme is bridged to damaged DNA, separates the communications which have arisen in dimers and recovers integrity of a strand of DNA.

Later at cells property to liquidate damage to DNA without participation of visible light (exposition or a tempo repair) was revealed. At exposition repairs are eliminated the damages which have appeared under the influence of ionising radiation, chemical materials and other factors.

In a cell, despite a carried out repair, quantity of damages of frame of DNA remains high, in its DNA replication processes are quenched. The cell ceases to share, thanks to what does not transfer the arisen changes to brooding. Joint actions of enzymes of replication and repair provide low frequency of errors in DNA molecule.

Bases of medico-genetic consultation at mutagen influences consist of several positions:

1. Frequency of the induced mutations in formative cells depends on a stage of a cellular cycle. Therefore, at consultation in each case it is desirable to find the answer to a question: in what dose and at what stages of a cellular cycle formative cells were exposed to mutagen influence.

2. At medico-genetic consultation it is necessary to estimate influence not one, and several mutagen factors. The combined action of cloudies can conduct to additive, synergistic and to protective effects. In experiments on cells of the person in vitro at use of the big doses of cloudies observed all three phyla of responses at various combinations of cloudies (radiating and chemical, different chemical). However, in real situations of a dose of cloudies insignificant, therefore it makes sense to spend an assessment on the basis of a rule of additive effects. Synergistic and protective effects are possible only at very specific combinations and conditions, instead of in real life.

3. At an assessment of risk of mutagen influences it is necessary to take into consideration a difference in dynamics of a spermatogenesis and oogenesis at the person. Visible, character of these processes more frequent nondisjunction of chromosomes at mothers, than at fathers, and age dependence of frequency of

dominant mutations at fathers speaks. All oocytes from a primary bookmark before activation of their maturing are in a rest state. oogenesis proceeds in a short time interval before an ovulation. Thus the oocytes accumulate any mutations throughout all season from embryonal bookmarks to an ovulation. A spermatogenesis — more dynamical system, than oogenesis. Full innovation spermatogenic epithelium descends each 2–3 months, therefore eliminated the most part chromosomal and genomic mutations. Primary spermatogenesis can accumulate the induced gene variations throughout all life. As a result of repeated innovation the probability of erroneous replication increases.

4. Mutagen influence always supplements «burdened genetic» a married couple (spontaneous mutational and segregation load). Proceeding from it, at consultation it is necessary to estimate total risk which develops of "increase" of a lobe of risk from mutagen influence to available risk at the given married couple. An establishment of heterozygosity at parents is not varied by degrees of additional risk of mutagen influence. It is defined according to the probability theory.

5. The risk of mutagen influences can be individual and population. The same size of mutational risk can be insignificant for the concrete individual, and in populations the effect will be expressed and burdening. Certainly, that about population risk it is possible to speak only when the big populations are exposed to mutagen influences.

Medico-genetic consultation in case of mutagen influences on parents is an assessment of risk of a birth of the sick child which is carried out by the doctor-genetic. At recommendations of a birth of children in case of mutational influences in certain degree always there are "scissors" between individual council and population consequences. Actually here there are no big contradictions. Elimination of mutagen factors from medium of the person is the problem of hygienists solved with attraction of specific methods and approaches.

The practical doctor-genetic at medico-genetic consultation should define size of additional risk of a hereditary pathology in brooding from mutagen influence, estimate the general risk and give recommendations to spouses.

As we see, unfavorable influence of harmful factors of environment on health of the person in individual and population aspects is confirmed any more only by scientific researches, but also medical practice. On biological point of view, reactions of the person as biological kind on new ecological conditions can be expressed as follows:

- 1) differential death rate or fruitfulness in population as a whole or for specific genotypes (selection);
- 2) change of an expression of genes (eco genetic reactions);
- 3) heredity damage at all levels of its organisation (a teratogenesis, a mutagenesis).

All this complex of biological responses in dynamic population balance is necessary for predicting in connection with environment changes. It is natural, that finally it should not confine human population, and extend to all ecumene.

Model situational task
THE DECISION OF SITUATIONAL TASKS

To define types of skin sensitivity to UV taking into account color of eyes, a hair, a skin, presence of freckles, predisposition to sunburn.

1st type — especially sensitive skin. Individuals have blue or green eyes, freckles, often red hair. Badly or nearly so do not sunbathe.

2nd type — Sensitive skin. People have blue, green or grey eyes, light-brown or chestnut hair.

3rd type — Normal skin. Individuals have chestnut hair. Eyes are grey or light-hazel. Easily sunbathe.

4th type — the Tolerant skin. People have swarthy skin, dark eyes and dark hairs.

5th–6th types — never burn (dark skin, black hair).

Value of doses and tolerance levels of UVB for various types of skin

Skin types	UVB dose, J/m ²	Tolerance level, MED (minimum erythema dose)
1-st	200	0,8
2-nd	250	1,0
3-rd	350	1,4
4-th	450	1,8
5-th	550	2,2
6-th	600	2,4

1. The woman with 1st phylum of a skin is exposed to irradiating UVB in a dose 500 J/m². To state an assessment of influence of consequence UVB of an irradiating and to offer actions for their prevention.

2. The man with 4th phylum of a skin is exposed to irradiating UVB in a dose 575 J/m². To state an assessment of influence of consequence UVB of an irradiating and to offer actions for their prevention.

3. The man with 3rd phylum of a skin is exposed to irradiating UVB in a dose 320 J/m². To state an assessment of influence of consequence UVB of an irradiating and to offer actions for their prevention.

4. The woman with 2nd phylum of a skin is exposed to irradiating UVB in a dose 350 J/m². To state an assessment of influence of consequence UVB of an irradiating and to offer actions for their prevention.

5. The man with 5th phylum of a skin is exposed to irradiating UVB in a tolerance level 2.0. To state an assessment of influence of consequence UVB of an irradiating and to offer actions for their prevention.

6. The man with 4th phylum of a skin is exposed to irradiating UVB in a tolerance level 2.3. To state an assessment of influence of consequence UVB of an irradiating and to offer actions for their prevention.

7. The man with 2nd phylum of a skin is exposed to irradiating UVB in a tolerance level 1.5. To state an assessment of influence of consequence UVB of an irradiating and to offer actions for their prevention.

8. The man with 6th phylum of a skin is exposed to irradiating UVB in a tolerance level 2.5. To state an assessment of influence of consequence UVB of an irradiating and to offer actions for their prevention.

9. The man is exposed to mutagen factors of influence of pesticides. To state an assessment of influence of mutagen factors on an organism and to offer actions for their prevention.

10. The woman is exposed to mutagen factors of influence of herbicides. To state an assessment of influence of mutagen factors on an organism and to offer actions for their prevention.

11. The man is exposed to influence of chemical factors (aerosol) on an organism. To state an assessment of influence of chemical factors on an organism and to offer actions for their prevention.

12. The woman is exposed to influence of biological factors (viruses) on an organism. To state an assessment of influence of biological factors on an organism and to offer actions for their prevention.

13. The man is exposed to influence of steams of benzene. To state an assessment of influence of chemical factors on an organism and to offer actions for their prevention.

14. The woman is exposed to influence of steams of toluene. To state an assessment of influence of chemical factors on an organism and to offer actions for their prevention.

TEST CONTROL

1. Development of hereditary features goes under the scheme:

- 1) «a gene — enzyme — biochemical reaction — a sign»;
- 2) «a gene — biochemical reaction — a sign»;
- 3) «a gene — enzyme — a sign»;
- 4) «a gene — a sign»;
- 5) «gene — enzyme».

2. All hereditary diseases are divided:

- 1) monogene;
- 2) polygene;
- 3) monofactorial;
- 4) mendelian;
- 5) multifactorial.

3. Principle of enzymes biosynthesis program:

- 1) «one gene — one enzyme»
- 2) «a gene — biochemical reaction — a sign»
- 3) «a gene — enzyme — a sign»
- 4) «a gene — a sign»
- 5) « a gene — enzyme — biochemical reaction — a sign »

4. Mutagen factors:

- 1) physical;
- 2) chemical;
- 3) microorganisms;
- 4) biological;
- 5) animals.

5. Physical mutagen factors:

- 1) ionising radiation;
- 2) acids;
- 3) alkalis;
- 4) peroxides;
- 5) salts of metals.

6. Chemical mutagen factors:

- 1) pesticides;
- 2) formaldehyde;
- 3) alkalis;
- 4) peroxides;
- 5) salts of metals.

7. Kinds of mutations:

- 1) gene;
- 2) chromosome;
- 3) somatic;
- 4) biological;
- 5) animals.

CHAPTER 5: «ECOLOGICAL AND MEDICAL CONSEQUENCES OF ATMOSPHERE POLLUTION»

The employment purposes:

To disassemble ecological consequences of pollution of atmosphere, to give the characteristic of ecologically dangerous anthropogenous pollutants, to disassemble their transformations under the influence of various factors; to show influence of anthropogenous pollutants on ecosystems. To show presence of ecologically dependent disease of the population.

Employment tasks:

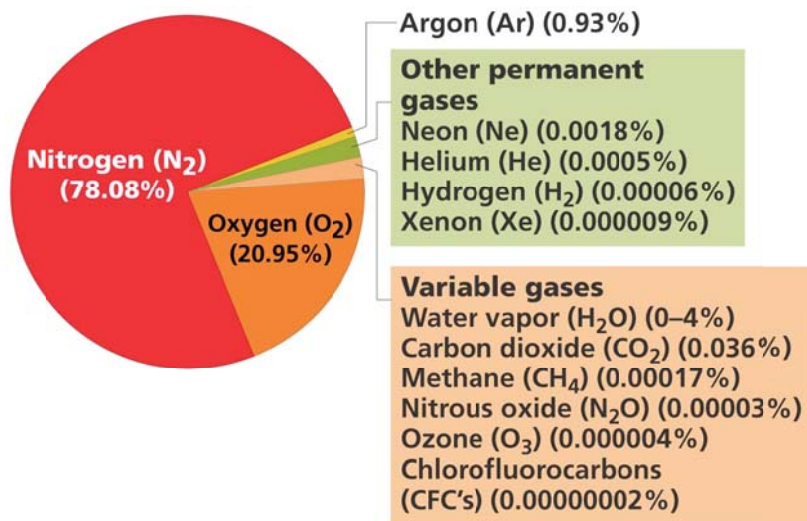
1. Concept about atmosphere, its structure and structure.
2. Sources of pollution of atmospheric air.
3. The basic pollutants of atmospheric air and their short characteristic.
4. Influence of anthropogenous activity of the person on gas structure of atmosphere.

5. Chemical transformations of pollutants into air and their consequences.
6. Influence of pollution of atmospheric air on health of the person and sanitary living conditions.
7. Pollution and protection of atmospheric air as an environmental problem in the conditions of scientific and technical progress.

Practical skills:

To study risk factors of pollution of atmospheric air

Teaching material



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Figure 2 —The Composition of Atmosphere

The atmosphere is the gas environment of the Earth, the disperse environment, consisting of a gases mix (nitrogen, oxygen, carbon dioxide, inert gases), the suspended aerosol particles, water vapor. It rotates together with our planet; therefore, atmosphere is in constant movement.

Layers of an atmosphere: troposphere, stratosphere, mesosphere, thermosphere (ionosphere) and exosphere. Three atmospheric areas contain ozone: troposphere, stratosphere and mesosphere. Problems of stratospheric and tropospheric ozone most sharply significant.

The basic function of stratospheric ozone is defense all living organisms from Sun rigid UV-irradiation (length of a wave of 200–320 nanometers).

Molecules of ozone as impurity to air are present at all heights from a surface of the Earth up to 100 km, the maximum quantity of ozone molecules are at heights 15-30 km which figuratively name "Ozone layer".

The sunlight with length of wave less 200 nms them is well absorbed by ozone molecules at the big heights not reaching up to stratosphere. With increase in length of a wave the factor of absorption quickly falls.

Tropospheric ozone as against stratospheric highly toxic composition for objects of the environment. Along with carbon dioxin tropospheric ozone absorbs infra-red radiation from the ground, playing an essential role in creation of

a hotbed effect. The mankind has faced the challenge the phenomenon called "ozone holes", i. e. sharp decrease of the contents of ozone during the spring period above Antarctica that will cause strengthened penetration rigid UVR up to an Earth surface.

Sources of Pollution of the Atmosphere

Divide on natural and anthropogenous.

Natural sources:

- A space dust.
- Eruption of volcanos (convulsion of nature).
- Dusty storms.
- Thunderstorm activity.
- Rock erodes.
- Products of living activity of organisms.

Anthropogenous sources:

- Industrial emissions.
- Firing.
- Transport exhaust.
- Agriculture (use of fertilizers, use of chemical pest-killers).
- Radioactive pollution.

The greatest value in atmosphere pollution have: carbon oxides, nitrogen, the sulfur, flying organic compositions (FOC), compositions of heavy metals, industrial dust, soot, radioactive substances.

The atmospheric precipitation characterizing by strongly acid reaction, refer to as acid rains or acid precipitation. The main sources of one are fluid combustion, shale oil, coals, gas in the industry, agriculture, in private life. Sulfur oxides, nitrogen, carbohydrates interact with water and turn into solutions of a mix sulfur, sulphuric, nitrous, nitric and carbonic acids. Acid precipitations render direct and indirect action.

The photochemical smog — a multicomponent mix of gases and aerosol particles of the primary and secondary origin. The structure of the basic smog components includes ozone, nitrogen oxides and sulfur, organic compositions — peroxidases, named photo oxidizers. Photochemical smog results from photochemical reactions under certain conditions:

- Presence in the atmosphere of high concentration nitrogen oxides, hydrocarbons, etc.
- Intensive solar radiation.
- Calm.
- The high temperature inversion.

Nitrogen oxide interact with olefins of exhaust in result ozone excess are formed. In turn ozone interacts with olefins in result in atmosphere peroxides

concentrate. They in some form photo oxidizers. Such phenomena — not rare phenomenon above London, Paris, New York, etc.

Greenhouse effect. All kinds of solar radiation (from UV-radiation up to infra-red) reach a green surface and heat up it. Last one over radiates the earlier collected thermal energy as IR-radiation in space. This radiation is intensively absorbed by some gases (CO₂, CH₄, NO₂, Freon's). These gases work similarly to glass in hotbed: they free pass to the Earth solar radiation, but detain thermal radiation of the Earth. In result temperature of its surface raises, weather and climate changes. The increase of global temperature of a planet is possible as a result of change of thermal balance, owing to gradual accumulation “hotbed gases” in an atmosphere.

Increase of level of World Ocean owing to global rise of temperature of a climate. Rise of temperature of a climate will be accompanied by increase of a degree of instability of weather, growth of number of storm and hurricanes.

The occurrence of **extreme climatic conditions** is quite probable: droughts, hurricanes. Amplification annual fluctuations of temperature of air with an establishment of lower temperatures per winter months is possible.

The change of climate can render negative influence on health of the people owing to amplification thermal stress in southern areas and distribution of many kinds of diseases. The direct effects of action of the changed climatic factors can at increase of temperature result in increase of volume of blood, increase of activity of narrow system of blood, increase of blood pressure. The increase of number of allergic diseases is predicted. The global increase of temperature will result in destruction of woods that they cannot quickly adapt to varied conditions. The perishing woods will release plenty of carbon dioxide. Last, in turn, will speed up global rise of temperature and destruction some more lot of woods. The increase of global temperature will be connected to droughts, reduction of stocks of drinking water and serious changes of an agriculture.

The acid rains (pH < 5,0). Oxides of sulfur and nitrogen at interaction with an atmospheric moisture form nitric, sulfuric acid. The negative influence of sour deposits is various: influence on ground, water ecosystems, plants, monuments of architecture etc. objects.

Effects of acid rain:

- Decreased soil and water pH.
- Increased fish mortality:
 - Partially due to aluminum toxicity brought on by acidity.
- Increased tree mortality:
 - Decreased leaf longevity.
 - Increased disease damage.
 - Increased soil nutrient leaching.

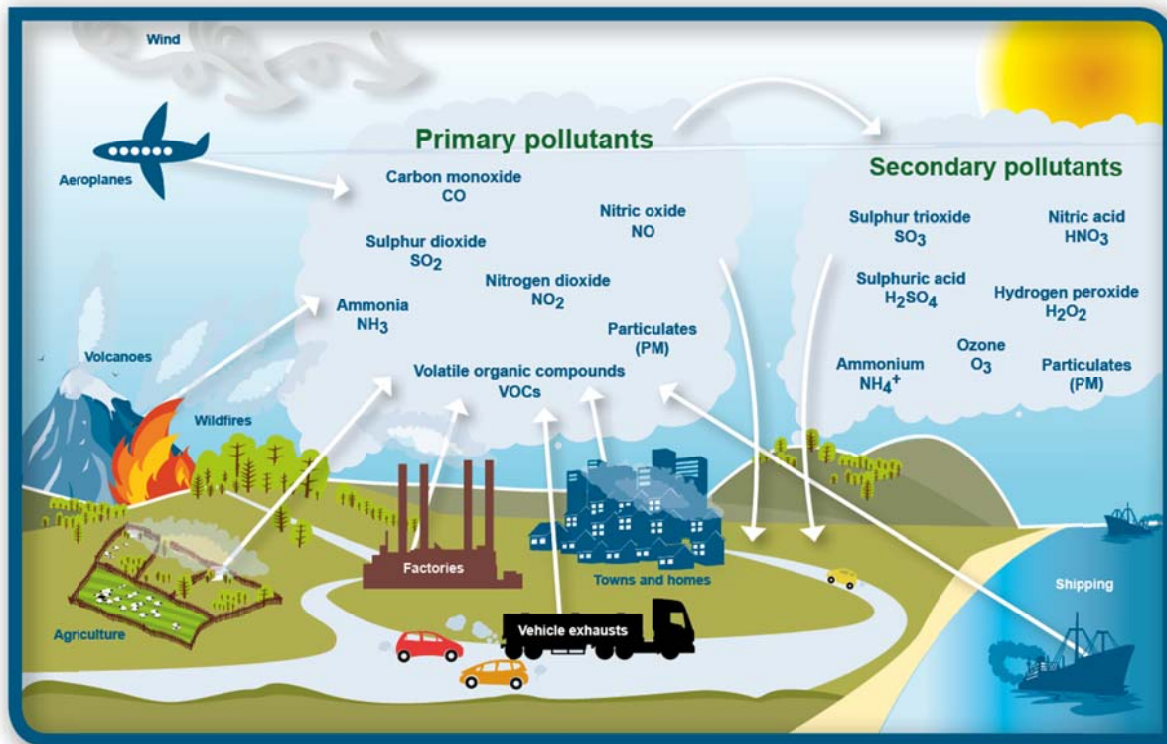


Figure 3 — Environment Pollution – Air Pollutants

Exhaustion of ozone layer. Last years the steady tendency of decrease of the contents of ozone in the top layers of an atmosphere is observed. Destruction of ozone layer promote oxides of nitrogen NO and NO₂, Freon's and others substance. The space, within the limits of which the appreciable reduction of concentration of ozone is registered, has received the name "*ozone hole*". Ozone hole are observed above Antarctic Continent and Arctic Region. The occurrence "of wandering holes" by the area from 10000 up to 100000 km² is marked, where the losses of ozone reach 20–40 % from a normal level (about 0,06 mg/m³). It entails deviations from climatic norms and extremely dangerously for the man and many animals (increase of number of diseases by a crawfish of a leather(skin) and cataract of eye).

From technogenic of the reasons of destruction of ozone layer name cutting down of woods, nuclear explosions in an atmosphere, large fires, flights of supersonic planes, start of space rockets.

From the natural phenomena destroying ozone layer, allocate: 11-year's cycles of solar activity, output of hydrogen and methane from breaks terrestrial crust, ascending whirlwinds above Antarctic Continent.

One of ecological problems is **photochemical could**. For its formation are necessary temperature inversion, solar light, presence oxides of nitrogen and organic connections in air. Components photochemical smog: ozone, free radicals, peroxide. The components of photochemical smog have irritating effect on mucous eyes, top respiratory ways, promotes development cause dryness mucous,

aggravation chronic sinusitis, cold, on the part of a skin dryness, irritation. General attributes of influence of photochemical smog on organism of the man: deterioration of state of health, weariness, nausea, aggravation of respiratory diseases.

The **protection** of an environment from pollution is a system of measures directed on elimination of negative influence of the man as emissions to air, dumps in water and dross in ground containing the new agents or exceeding their natural level. It will be carried out on many directions and includes performance legislative, technological, sanitary-technical, planning and organizational measures. The modern picture of protection of air pool includes development of the appropriate acts: the constitution RB, law “about protection of an environment” from 26.11.1992 г. № 1982-12, law “about protection of atmospheric air” from 15.04.1997 г. № 29-3, SanRaN № 3086-84, “LAC of polluting substances in atmospheric air of the occupied places”.

PRACTICAL WORK

1.1. Determination of air temperature

Equipment: thermometer TET-TS11

Work performance:

- a) the thermometer gauge to establish in investigated place;
- b) include the thermometer;
- c) through 30 sec to take readings at the screen of the measuring block;
- d) after work the thermometer to switch off.

1.2. Ecological estimation

The received parameters of atmospheric air temperature compare with optimum — 20 °C (15–25 °C).

1.3. Determination of relative humidity

Equipment: hygrometer.

Work performance:

- a) establish the hygrometer in investigated place;
- b) knock by finger on its glass;
- c) write down arrow indications.

1.4. Ecological estimation

The received parameters of relative humidity compare with optimum — 50 % (40–60 %)

1.5. Determination of speed of air movement

Equipment: anemometer AP-1.

Work performance:

- a) establish the anemometer it is perpendicular to direction of air currents in an investigated place;
- b) include the device;
- c) through 30 sec to take readings from the screen of measuring block.

1.6. Ecological estimation

The received parameters of speeds of air movement compare with optimum — 2.5 m/s (1–4 m/s).

1.7. Determination of atmospheric pressure

Equipment: barometer-aneroid.

Work performance:

- a) barometer to establish in an investigated place;
- b) knock by finger on its glass;
- c) write down the device reading.

1.8. Ecological estimation

The received parameters of atmospheric pressure compare with optimum — 760 mm hg (740–780 mm hg).

2. Determination of nitrogen oxides in air

The definition is based on formation of the painted connection at interaction in acid medium of nitrogen oxides with reactive of Greece.

Equipment: electro aspirator, absorbed devices, gas pipettes, conical flask, FEC.

Reactive: absorbed solution (0,1N NaOH), reactive of Greece in an acetic acid, standard solution NaNO₂ (basic), working solution NaNO₂.

Selection of tests:

1. Researched air is selected by the vacuum method in gas pipettes in capacity 250–500 ml, containing 4ml of 0,1N NaOH (the residual pressure makes 27–67 gPa).

2. In a place of selection of test, a clip is opened for 1 mines and closed again.

3. Maintain for 8 hours, periodically shake up.

Work performance:

1. Test in quantity 3 ml is transferred from the gas pipettes to the test tube.

2. 0,5 ml reactive of Greece is added.

3. Shake up and make measurement on FEC with green light filter № 6 through 30 mines.

4. The control is distilled water.

5. The contents of nitrogen oxides in air is considered under the formula:

$$X = (A \times C \times 1.17 \times 1000) : (B \times V_0),$$

where A — quantity of NO₂, found out in analyzed volume, mg;

B — volume of absorbed solution taken for the analysis, ml;

C — volume of absorbed solution in all test, ml;

1.17 — factor of recalculation NO₂ to N₂O₅;

V₀ — volume of researched air given in normal conditions, l.

The Ecological estimation is carried out by comparison with the specification (contents of nitrogen oxides in air daily average dose — 0.04 and maximum single dose — 0.085 mg/m³).

THE DECISION OF SITUATIONAL PROBLEMS

1. In settlement temperature of air $-20\text{ }^{\circ}\text{C}$, relative humidity of 70 %, speed of movement of air of 14 m/s. Assess physical parameters of atmospheric air and develop actions on optimization of ecologically adverse influence on an organism of the person.

2. In city temperature of air $+26\text{ }^{\circ}\text{C}$, relative humidity of 60 %, speed of movement of air of 2.5 m/s. Assess physical parameters of atmospheric air and develop actions under the prevention of ecologically adverse influence on an organism of the person.

3. In settlement temperature of air $+25\text{ }^{\circ}\text{C}$, a level of thermal solar radiation $2.8\text{ cal sm}^2/\text{minutes}$. Assess physical abiological parameters of atmospheric air and offer actions under the prevention of ecologically adverse influence of these factors on an organism of the person.

4. In city temperature of air $+30\text{ }^{\circ}\text{C}$, relative humidity of 80 %, speed of movement of air of 0.7 m/s. To assess abiological factors and develop actions on optimization of ecological factors and preventions of their influence on an organism of the person.

5. In settlement temperature of air $+21\text{ }^{\circ}\text{C}$, relative humidity of 50 %, speed of movement of air of 2 m/s. Estimate physical parameters of an environment and offer actions on their optimization.

6. In city temperature of air $+15\text{ }^{\circ}\text{C}$, an electric field 160 V/m, speed of movement of air of 5 m/s, atmospheric pressure of 730 mm mercury item. Estimate physical parameters of an environment and offer actions on their optimization.

7. In settlement temperature of air $+20\text{ }^{\circ}\text{C}$, relative humidity of 75 %, atmospheric pressure of 760 mm mercury item. Assess abiological factors of an environment.

8. In city a radio-activity of air $5 \times 10^{-13}\text{ Ku/l}$, an exposition doze 26 mkR/hour. Assess physical factors of an environment and develop actions under the prevention of ecologically adverse influence on an organism of the person.

9. In city temperature of air $-32\text{ }^{\circ}\text{C}$, relative humidity of 28 %, speed of movement of air of 16 m/s, atmospheric pressure of 740 mm mercury item. Estimate abiological parameters abiological factors of an environment, offer actions under the prevention of their influence on an organism of the person.

10. In settlement temperature of air $+12\text{ }^{\circ}\text{C}$, relative humidity of 80 %, speed of movement of air of 18 m/s, atmospheric pressure of 780 mm mercury item. Assess abiological factors of an environment.

TEST CONTROL

1. Geospheres of the Earth:

- 1) a magnetosphere;
- 2) an atmosphere;
- 3) an earth's crust;

- 4) a cloak of the Earth;
- 5) a nucleus of the Earth.
2. Structure of an atmosphere:
 - 1) troposphere;
 - 2) a stratosphere;
 - 3) mesosphere;
 - 4) thermosphere;
 - 5) exosphere.
3. The conditional border of an atmosphere reaches height up to (km):
 - 1) 20;
 - 2) 4000;
 - 3) 2000;
 - 4) 50000;
 - 5) 10.
4. Abiotic factors of the air environment:
 - 1) temperature;
 - 2) viruses;
 - 3) disputes of mushrooms;
 - 4) humidity;
 - 5) a geomagnetic field.
5. Solar radiation is:
 - 1) an integrated stream of electromagnetic fluctuations with various length of a wave;
 - 2) a stream of positively charged ions;
 - 3) a stream of ions of a different sign;
 - 4) γ radiation;
 - 5) corpuscular radiation.
6. Length of a wave UF-radiations, perniciously I operate on alive organisms:
 - 1) more than 300;
 - 2) more than 290;
 - 3) less than 400;
 - 4) less than 290;
 - 5) more than 4000.
7. Length of a wave of a photosynthetic active part of solar radiation, (nm):
 - 1) 200–250;
 - 2) 380–710;
 - 3) 720–800;
 - 4) 400–760;
 - 5) 300–360.
8. Photoperiodism is:
 - 1) change of day and night;
 - 2) ability of organisms to react to natural light;

- 3) ability of organisms to react to change of length of day;
 - 4) preparation of organisms for winter;
 - 5) Duration of the period of growth of plants.
9. Limits of fluctuations of temperature on the Earth (°C):
- 1) -60 - + 60;
 - 2) -45 - + 70;
 - 3) -80 - + 69;
 - 4) -94 - + 63;
 - 5) -73 - + 66.
10. Limits of temperatures, optimum for the person (°C).
- 1) 12-28;
 - 2) 15-25;
 - 3) 16-26;
 - 4) 20-28;
 - 5) 12-30.
11. Limits of relative humidity, optimum for the person (%)
- 1) 40-60;
 - 2) 30-75;
 - 3) 20-40;
 - 4) 15-65;
 - 5) 45-65.
12. Limits of optimum atmospheric pressure, optimum for the person (mm mercurial item):
- 1) 720-740;
 - 2) 710-785;
 - 3) 715-790;
 - 4) 700-800;
 - 5) 470-780.
13. Speed limits of a wind, optimum for the person (km/s)
- 1) 5-10;
 - 2) 0.5-1;
 - 3) 1-4;
 - 4) 4-6;
 - 5) 0,01-0,05.
14. Value of a gradient of electric potential at a surface of the Earth (V, m):
- 1) 120;
 - 2) 10;
 - 3) 220;
 - 4) 150;
 - 5) 80.

15. Influence of magnetic storms on an organism of the person:
 - 1) amplifications of processes of braking in CNS;
 - 2) increase of frequency of aggravations of psychological diseases;
 - 3) deterioration of the general state of health;
 - 4) decrease in serviceability;
 - 5) reduction of frequency of an aggravation of cardiovascular diseases.
16. Value factor of unipolarity at Earth surfaces:
 - 1) 0.5–1;
 - 2) 0.1–2;
 - 3) 1.1–1.3;
 - 4) 1.4–2;
 - 5) 1.1–1.5.
17. The maintenance of easy ions in 1 ml of air in large industrial cities:
 - 1) 4000;
 - 2) 100–1000;
 - 3) 500–1500;
 - 4) 40–400;
 - 5) 4–20.
18. In relation to humidity organisms share on:
 - 1) hydrophytes;
 - 2) hygrophytes;
 - 3) mesophytes;
 - 4) xerophytes;
 - 5) heterophytes.
19. The radioactive background of the Earth develops from:
 - 1) ionization radiations of space beams;
 - 2) radiations diffused in Earth's crust, ground, an atmosphere, water of radioactive elements;
 - 3) radiations of the radioactive elements included in cells and fabrics of organisms;
 - 4) radiations of the radon penetrating from an earth's crust;
 - 5) solar radiation.
20. An external irradiation consist form:
 - 1) space radiation;
 - 2) radiation radioactive nuclides, diffused in biosphere;
 - 3) studying materials and the constructions created by the person;
 - 4) food stuffs;
 - 5) potable water.
21. By origin sources of pollution of atmospheric air share on:
 - 1) natural;
 - 2) primary;
 - 3) secondary;

- 4) anthropogenous;
 - 5) tertiary.
22. Anthropogenic sources of pollution of an atmosphere:
- 1) space dust;
 - 2) thermal power stations;
 - 3) eruption of volcanos;
 - 4) ferrous metallurgy;
 - 5) coal industry.
23. Aerosol pollutions of atmosphere:
- 1) ashes;
 - 2) soot;
 - 3) soot;
 - 4) aldehydes;
 - 5) solvents.
24. Gaseous pollutions of atmosphere
- 1) nitrogen oxide;
 - 2) carbon oxide;
 - 3) carbon dioxide;
 - 4) sulfur oxide;
 - 5) radioactive nuclide.
25. Consequences of pollution of biosphere:
- 1) medical-social;
 - 2) economic;
 - 3) ecological;
 - 4) spiritual-aesthetic;
 - 5) cybernetic.
26. Consequences of «hotbed effect»
- 1) changes of weather and a climate;
 - 2) increases of a level of dead ocean;
 - 3) growth of number of storm and hurricanes;
 - 4) thaw frozen ground;
 - 5) warming poles.
27. Sources of «acid rains»:
- 1) ozone;
 - 2) sulfur oxide;
 - 3) carbon dioxide;
 - 4) nitrogen oxide;
 - 5) carbon oxide.
28. To destruction of an ozone cloud promote
- 1) dust;
 - 2) biological pollution;
 - 3) water pairs;

- 4) nitrogen oxide;
 - 5) freons.
29. Technogenic reasons of destruction of an ozone cloud of an atmosphere:
- 1) cutting down of woods;
 - 2) nuclear explosions in an atmosphere;
 - 3) supersonic planes;
 - 4) start of space rockets;
 - 5) forest fires.
30. The natural phenomena destroying an ozone cloud:
- 1) hurricanes;
 - 2) dust storms;
 - 3) 11-years cycles of solar activity;
 - 4) output of hydrogen and methane from breaks of an earth's crust;
 - 5) flooding.
31. Protection of an atmosphere is carried out by way:
- 1) development of legislative base on protection of atmospheric air;
 - 2) ecologisation technological processes;
 - 3) organizations of sanitary-protective zones of the industrial enterprises;
 - 4) reduction of emissions of motor transport;
 - 5) catching a dust from gas emissions.

CHAPTER 6: «ECOLOGICAL AND MEDICAL CONSEQUENCES OF HYDROSPHERE POLLUTION»

The general time of employment: 4 class hours.

The employment purposes:

To acquire relationships of cause and effect between a condition of hydro-sphere and quality of potable water and development of a pathology on the person.

Employment tasks:

1. The origin and water functions on the Earth. A general characteristic and versions of hydroecosystems.
2. Factors and sources of natural and anthropogenous pollution of hydro-sphere.
3. Eutrophication of reservoirs: concept, the reasons of development, a consequence.
4. The Ecological estimation of a condition of water resources of RB. The diseases connected with pollution of water by live organisms.
5. The Characteristic and features of xenobiotic action, arriving in a human body with water, including features neurotoxicity and neurotropic.

6. The Characteristic of the xenobiotic cores, containing in water: lead, cadmium, fluorine, chlorine, flying organic connections. Specific early signs of their influence on a human body.

7. The Diseases connected with consumption of chemically polluted water. The basic ways of decrease in the maintenance xenobiotic in potable water.

8. Ecologically dependent disease of the population. Criteria of quality of potable water: epidemiological safety, harmlessness on a chemical compound, favorable organoleptic properties, radiating safety.

Practical skills:

1. To estimate organoleptic properties of potable water.
2. To solve situational problems according to quality of potable water.

Teaching material

Hydrosphere

Hydrosphere name complex of all waters of the Earth: continental (superficial, soil, deep), oceanic and atmospheric.

Water occupies almost 3/4 Earth surface making the seas and oceans. Water resources consist about 1,4 billion cube km. Salty sea water makes of all huge resources of water about 98 %, and fresh water — more than 2 % of all world reserve, about 70 % of fresh water is concentrate in glaciers and is inaccessible for man.

Sources of Ecological Trouble of Hydrosphere

1. Atmospheric waters. For example, 1 rain drop (weight 50 mg) falling from height 1 km washes 16 l of air. So various polluting substances will be easily washed out from air. As example, washing out of radioactive substances from the atmosphere resulted to spotty pollution of Belarus territory after accident on Chernobyl atomic station. Many gaseous compositions being dissolved in the atmospheric moisture form acid precipitations which break ecological balance of ground and water ecosystems.

2. Regulated run-off of the rivers by hydroconstruction leads to slowing down of rivers (reservoir storage). Slow sites of the river worse self-purify since the quantity of the dissolved oxygen necessary for processes of aerobic decomposition organic pollutants is reduced. At saturation of water by biogenic elements (eutrophication) begins mass development of phytoplankton, especially cyanobacteria (blue-green seaweed) - source of dangerous toxins.

3. The city sewage including domestic and municipal drains contains mass of organic substances, detergents (washing-up liquids), microorganisms, including pathogenic. Drains of infectious branches of hospitals are especially dangerous if they are not cleared and not disinfected.

4. Agriculture: sewage of farms, hen houses, use of mineral and organic fertilizers, pesticides.

5. Industrial sewage. With sewage in reservoirs is removed the huge amount of chemicals:

- Mineral oil.
- Toxic waste.
- Compounds of heavy metals.
- Pesticides.
- Washing-up liquids.
- Aromatic hydrocarbons.
- Nitrous-compounds.
- Radioactive substances.

Deficit in water of fluorine (less than 0,5 mg / l) conducts to caries. Endemic caries diseases occur in Belarus, Khabarovsk, Sochi, Kaunas, Arkhangelsk. Surplus of fluorine results to fluorosis (Tver, Tambov, area of South-East Asia).

Direct correlation between the contents of copper, cadmium, nitrates and level of cardiovascular diseases is proved to be true. Use very much hard water (2–2,5 g/l) renders negative influence on development of fetus, causes a pathology of secretory system, disease of a gastrointestinal tract.

Very much frequently, the mineral structure of water is caused by anthropogenic activity. High concentration of nitrates meets in potable water as consequence of pollution by nitric fertilizers. Nitrogen-containing compositions in water are capable to turn in cancerogenic nitrosamine promoting occurrence oncology disease of gastrointestinal tract.

Disinfecting of drinking water by chlorine is a source of formation in a waterpipe of dioxins — of the strongest toxic composition for warm-blooded organisms.

Oil and mineral oil cover a surface of water with a layer that breaks processes of photosynthesis and allocation O₂ phytoplankton, the water exchange and gas exchange between the atmosphere and hydrosphere is broken. Heavy metals, poisonous, hydrocarbons suppress living activity of water organisms, breaking processes of self-purification of a reservoir or causing extinction of the whole groups of organisms.

The first country which has felt negative influence of chemical pollution of the natural environment began Japan. In this country over 80 % of territory is pressed direct influence of industrial production. Examples with « Minamata illness » (intoxication by mercury) and « illness Itai – Itai » (poisoning with cadmium), arisen are characteristic as a result of wastes discharge of industrial enterprises.

Contact of the man to hydrosphere passes three ways:

1. Through respiratory tract.
2. Through a gastrointestinal tract.
3. Through skin.

Methods of Bioindication:

— passive monitoring – among freely living organisms visible physiological and biochemical damages or deviations from the norm being are investigated by attributes of stressful influence;

— active monitoring — at the tests — organisms which are taking place in researched territory in standardized conditions the same changes try to find out as in freely living organisms.

Bioindicators of pollutants are used at active monitoring:

Components of pollution	The bioindicator	Symptoms of influence
Ozone	Tobacco, spinach, grapes, string bean	Necrosis the top side of leaves, reduction of the contents of chlorophyll;
Combination of harmful substances in air ions P, Pb, Zn, Cd, Mn, Cu RN Sr-90 and Cs-137	Sheet and bushy lichens, fir, fur-tree, pine, bee melliferous, sheet of cabbage, hourse- hestnut	Reduction of the contents of living cells of seaweed, reduction of the contents of a chlorophyll, top necrosis of needles, accumulation in honey
Chlororganic composition (PCD)	Reindeer and the Icelandic moss, eggs of sea and day-time birds of prey	Accumulation in dry substance, thin shells, destruction of eggs
H ₂ SO ₄ (acid rains)	Coniferous	Reduction of chlorophyll

Indicators can be not only complete organisms or their systems, but also their most sensitive structures on the basis of which biosensor controls are created. They are based on ecologically safe natural components. The biosensor system will consist of a biological element of recognition of polluting substances and the measuring device providing transfer of signal.

Biosensor controls are suitable for definition of toxic and mutagen substances, phosphoorganic substanses, chlorinated hydrocarbons.

Sensor devices are created and used for measurement of biochemical parameters of agricultural crops, qualities of production of the food-processing industry (a sensor control of glucose — on a basis ferrocene — for the control of meat freshness, a sensor control peptides - for the control of process of milk proteins hydrolysis).

Biosensor controls was extended in the defensive industry in manufacture of the chemical and bacteriological weapon, the control of life-support systems in submarines.

Bioindication — a method of estimation abiotic and biotic factors of a habitat by means of biological systems. **Bioindicators** — organisms or their communities, which vital signs are closely connected to the certain factors of environment.

Water — the substance, most widespread in biosphere. It is a mineral, consisting of hydrogen and oxygen, dipole structure, capable to the polymerization. Water can be in liquid, firm and gaseous condition. Pure water in a nature is not present, the firm substances, gases are dissolved of it always, the insoluble con-

nections are weighed. It has carbonates, sulphates, chlorides etc. Rain water is purest (but contains nitrites and nitrates of ammonia, formed in a thunderstorm). By quantity of the dissolved salts distinguish fresh (0,5 g/l) and salty waters. Natural water as contains particles of sand, microorganisms (bacterium, mushrooms, elementary, seaweed), radioactive substances (uranium, thorium, radium, calcium), washed away from the mountain breeds. As a result of economic activity in water can appear various pollutants.

Water has no a smell, taste, is transparent, density 1 g/cm^3 is mobile, has high specific heat capacity, is slowly heated up and is cooled. Water cooperates with many substances, is environment for reaction, is neutral solvent, weak electrocast, has inactivation, self-cleaning.

Meaning of water in a nature, life of the man and economy: 1.protect. 2.climate-forming. 3.participation in circulation of substances. 4.environment-forming. 5. participations in geological, hydrolytic, power processes of the Earth. 6.source of hydrogen and oxygen. 7.provision of heat exchange. 8.tank of pollution. 9.transport way. 10. source of pollution of air, ground. 11.using for cultivation a/c production. 12. using in industrial manufacture. 13.aesthetic meaning.

Water — an inexhaustible resource. The global stocks of water form hydrosphere and are composed from liquid (salty and fresh), firm (fresh) and gaseous (fresh), include 1345 mln.km^3 . Volume of global ocean is 1338 mln.km^3 (96.5 % of all water), glaciers — 24 mln. km^3 (69 % of fresh waters), rivers — $2.1 \text{ thousand km}^3$, lakes - $176.4 \text{ thousand km}^3$, atmosphere — 12.9 ths.km^3 , underground waters — 23.4 mln. km^3 , alive organisms $1.1 \text{ thousand km}^3$. Fresh waters, suitable for all kinds of usage, make an insignificant part of all stocks. From them a major role the rivers play, owing to fast renewal (pair of atmosphere renew through 10 days, water of the rivers through 11 days, water of ground in 1 year). In renewal of stocks fresh waters the greatest meaning has the atmospheric precipitation. Volume of annually renewed fresh waters 45 ths. km^3 (total annual drain of the rivers in ocean). The resources of fresh water can be completely exhausted in 21 century.

Abiotic factors of water sphere are high density and the viscosity (pressure grows on 1 atm by everyone 10 m), mobility horizontal and vertical, stable temperature mode (lowest temperature $2 \text{ }^\circ\text{C}$, highest — $36 \text{ }^\circ\text{C}$), transparency and light mode dependent from depth, season, quantities of the weighed particles, salt mode (in fresh reservoirs up to $0,5 \text{ g/l}$ — hypotonic environment, in sea — up to 35 g/l —and hypertonic environment), oxygen mode (in the water, sated with oxygen, it in 21 times is less than in atmospheric air), carbon dioxide mode (in water CO_2 in 7000 times more, than in an atmosphere), pH of water (fresh waters with pH 3.7–4.7 are considered sour, 6.95–7.8 — neutral, pH > 7.8 — alkaline).

To the **physical factors** of water concern a smell, taste, coloring, transparency, muddition, temperature. Smell, taste, coloring, transparency and turbidity

are defined through sense organs and refer to as the organoleptic properties. Organoleptic properties of water depending from a number of the reasons. The development of water vegetation in small flowing reservoirs results in occurrence of coloring and smell. The specific smell of crude ground gives to water actinomycetus, smell rotten eggs — sulfuric iron and sulfur-hydrate. The presence in water of particles of sand and clay increases its turbidity. In the hot days temperature of water can raise under influence of solar radiation. In areas with strong mineralization ground water has salty or bitter — salty taste. Organoleptical properties concern to the rather important hygienic parameters of quality of drinking water, so they not only cause appearance of water, but also can specify on its pollution. Besides, muddy, opaque, painted in any color, warm, having a unpleasant smell and taste water causes feeling of disgust, negatively has an effect on a water-salt exchange, results in refusal from water supply.

The most important **chemical components** of water chlorides, sulphates and sulphites, phosphates, carbonates and hydro carbonates, iodine, iron, zinc, molibden, manganese, cobalt, fluorine, natrium, calium, calcium, magnesium, hydrogen, oxygen etc. Except for them, in water can be organic substances of a soil origin and inorganic impurity. Depending on quantity of mineral salts distinguish fresh (up to 1 g/l), similar-salty (1–2.5 g/l) and salty (waters are higher 2.5 g/l of mineral substances). High general mineralization of drinking water at the constant use results in frustration of digestion, decrease of appetite, occurrence of weakness, loss of work capacity, aggravation of chronic diseases of gastric-intestinal path. Strongly mineralization water causes the waterless in the organism, breaks acidity-alkaline balance, results to the weakness of activity of heart.

Influence of general mineralization of water on organism depends also from connections, included in it. The superfluous receipt in organism with drinking water chlorides causes an oppression gastric secretion, reduction of diuresis.

For, the increase of arterial pressure, sulphates — causes infringement of a water-salt exchange and dispepsical phenomenon. The essential influence on organism is rendered salts of calcium and magnesium, waters, causing natural rigidity. In rigid water vegetables and meat badly boil soft, the tea is badly insisted, the soap is badly washed. At the regular use of water with high rigidity at the man more often arises urine stone illness. The increased quantity of nitrates in drinking water can cause the children water-nitrate methemoglobinemia.

The biotic factors are caused of alive organisms of water and are shown at topic, trophic, generative, mutual relation as a competition, predation, parasitism, commensalism, mutualism, allelopathy, neutralism. Hydrobionts have adapted to mobility of water at the expense of strong deduction, burying in ground, form of a body, muscular movements, structure of skin; to density and pressure — for the account of inhabiting in superficial and deep-water layers (planctone, nectone, benthose); to light — presence of pigments (green, brown, red) or their absence at the deep-water forms, bioluminescence, breaking up of

leaves; salt — ability to osmoregulation; to oxygen — ability to live in aerobic and anaerobic environment. Besides hydrobiontes has orientation on sounds, echolocation, hydrostatic device, nutrition by a filtration, duplication by vegetative way, spreading of disputes and seeds by water etc. Man masters water environment, uses above water and underwater transport, adaptation for immersing etc.

Water contains a plenty of microorganisms (autotrophic a photo and chemosynthetic bacteria, heterotrophic bacterium, seaweed, mushrooms, elementary) and multicellular, mollusk, worms, fishes, plants. In natural water live also in insignificant quantity a pathogenic microorganisms, one of which quickly perish, and others can keep viability in water sphere about one year and more (abdominal typhus stick, cholera viruses). Autotrophic organisms absorb carbonic gas and enrich water by oxygen, heterotrophic take part in processes of self-cleaning. In too time the presence of a plenty organisms can worsen organoleptic properties of water, some mollusk and crayfish are the intermediate owners of some parasites.

In water are necessary to the man iodine, iron, zinc, magnesium, molybdenum, cobalt and other microelements, daily need in which water covers on 1–10 of %, and also fluorine and strontium, for which water is the basic source of receipt to the organism. Areas, where the surplus or lack of microelements of water, ground, plants called biogeochemical provinces, and diseases, connected with them, — biogeochemical endemics.

The important meaning for organism has fluorine, which participates in development of a skeleton, teeth, stimulates of blood creation, immunity. At superfluous receipt fluorine to the organism develops fluorosis, insufficient — caries. Iodine is necessary for functioning of thyroid gland; the lack it promotes development of endemically craw. Cobalt stimulates blood creation, participates in synthesis of fibers, in regulation of carbo-hydrate exchange, at its lack develops hypovitaminosis of B₁₂ and anemia. The iron participates in blood creation, breath, immunobiological and oxidize-restored reactions. At lack of iron arises iron-deficient anemia, surplus — hemochromatosis. The manganese influences on development of a skeleton, participates in reactions of immunity, in blood creation and fabric breath, at lack it there comes an exhaustion, delay of growth and development of a skeleton. Molybdenum enters into structure of ferments, influences growth, the surplus causes disease molybdenumouse. The zinc participates in processes blood creation, activity of internal secretion glands. At lack of zinc are observed delay of growth, decrease of fruitfulness, development of sugar diabetes. The preventive maintenance of endemically diseases includes the additive of necessary chemical elements in water, food, creating of special vitamin and mineral preparations (iodizing of the cooking salt, fluoridation of water, application of tooth pastes with fluorine), processing of water with the purpose of removal of surplus of microelements, supervision of the population in out-patient — policlinic establishments.

For needs the man uses basically only fresh water from open and underground **water sources**. The open sources (ground waters) are divided on natural (river, lakes, ponds) and artificial (reservoir, channels).

The rivers represent natural drains of springs, bogs, lakes, glaciers. Their waters are characterized by a plenty of the weighed substances, low durability and large amount of microbes. Lakes and ponds are of a various size and form of excavations, replenishing by water mainly at the expense of atmospheric precipitation and springs. They are subject to significant pollution by the chemical, physical and biological agents and have small ability to self-cleaning. The artificial reservoirs arrange on the rivers which have been partitioned off by dams. Qualities of water in reservoirs depend from a structure of river, thawed and earth waters participating in their formation, and sanitary preparation of bottom. In conditions of a stagnant mode, is especial in the summer, "flowering" reservoirs is observed at the expense of development of blue-green seaweed, products of which exchange (ammonia, phenols) worsen the organoleptic properties of water.

Water of open sources contains a plenty of the representatives flora and fauna. With the account of saprophytic of hydrobionts reservoirs or its sites are divided on poly-, mezo- and oligosaprobic. Polysaprobic zone is characterized by strong pollution of water, lack of oxygen, presence of restoring and absence of oxidizing processes, large contents of aluminous substances. In polysaprobic zone the insignificant number of the representatives of flora and fauna, water flower plant and the fishes are absent, the prevalence of one kind is characteristic which is steadiest to this conditions. For polysaprobic zone the plenty of microorganisms, measuring by many hundreds thousand and millions in 1 ml is characteristic. Oligosaprobic zone is characterized practically by pure water, in which there are no processes of restoring, organic substances completely mineralization, there is a lot of oxygen. The number of bacteria does not exceed 1000 in 1 ml of water, flora and fauna are rather various, various seaweed intensively develops, occur mollusk, crayfish, insects, there is a lot of flower plants and fishes. Mezosaprobic zone occupies an intermediate situation.

The underground sources are formed mainly at the expense of a filtration of atmospheric precipitation or water of open reservoirs. They include soil, earth and between-stratums waters. Soil waters is place near a terrestrial surface in first watercarring horizon, the protection as a waterproof layer have no, therefore structure them is subject to sharp changes. Most of all of soil waters collects in the spring. Earth waters accumulate on the first water-proof layer, have no a waterproof layer from above and consequently between them and soil waters occurs water exchange. Earth waters are formed at the expense of infiltration of atmospheric precipitation and their structure is subject to the large fluctuations depending on a season. They are colorless, are transparent, are free from microorganisms, are characterized by good taste. The depth of placing of earth waters changes from two up to several tens meters. Earth waters are used for economy drinking water supply of a countryside.

Between-stratums waters are made between two water-proof breeds. Its nutrition occurs in places of an output on a surface of water-carrying layer. Owing to deep of place between-stratums waters have the steady physical properties, chemical and microbic structure. Between-stratums waters are divided on pressure less and pressure head (artesian). Artesian waters move under pressure and can fountaining.

Two **systems of water supply** are used: decentralized, or local, and centralized. At the decentralized system the consumer himself takes water from a water source, and at the centralized system water moves in apartment houses, establishments and the enterprises, the decentralized water supply is carried out from wells and springs. The centralized water supply is carried out by the device of a water pipe from the underground or open water sources.

The water of used water sources should meet the requirements STST 2671–84 "Sources of the centralized economy-drinking water supply. The hygienic, technical requirements and rules of a choice": the dry rest — 1000, chlorides — 350, sulphates — 500 mg/l, general rigidity — 7 mg-ecv/l. In view of quality of water and required degree of processing with the purpose of finishing it up to norm the chosen sources are divided into 3 classes.

At underground sources 1 class coloring of water should be no more than 20⁰, turbidity 1.5 mg/l, pH 6–9, iron — 0.3, manganese — 0.1, fluorine — 1.5, oxidization of permanganate — 2 mg/l, number of bacteria of group intestinal sticks — 3/l. For superficial sources 1 class coloring of water should be no more than 35⁰, turbidity 20 mg/l, iron — 1, manganese — 0.1, phytoplankton — 1, oxidization of permanganate — 7, BCO complete — 3 mg/l, pH 6.5–8.5, number of lactose-positive intestinal sticks — 1000/l. The requirements to water 2 and 3 classes accordingly lower.

Water of sources of all three classes should not contain of activators of intestinal infections, and as toxic chemical substances and radionuclides in concentration exceeding the special specifications.

Controllable parameters of water of underground water source are organoleptic (smell, taste, turbidity, chromaticity, temperature), chemical (pH, weighed substances, chlorides, sulphates, iron, fluorine, etc.), biological (microbic number, coli-index). Organoleptic (smell, taste, turbidity, chromaticity, temperature), chemical (pH, the weighed substances, chlorides, sulphates, iron, fluorine, etc.), sanitary (ammonia, nitrates, nitrites,), biological (microbic number, coli-index) serve as indicators of water of a superficial water source.

SanRaN 10-113 RB 99 «Zones of sanitary protection of sources of water supply and water pipes of economic-drinking appointment»: in water of used water sources of all classes the dry rest should not exceed 1000, chlorides — 350, sulphates — 500 mg/dm³, the general rigidity — 7 mmol/dm³. Water also should not contain activators of intestinal infections, toxic chemical substances and radioactive nuclides in the concentration exceeding special specifications.

In water of sources of the decentralized water supply according to SanRaN 8-83 RB 98 «Requirements to quality of water at not centralized water supply. Sanitary protection of sources» indicators should meet the following requirements: turbidity — 2 mg/dm^3 , chromaticity — 30° , smell and smack — 2–3 points, coli-index 10, nitrates — 45 mg/dm^3 and other chemical substances according to special maximum concentration limits.

Ammonia presence in water causes suspicion about water pollution with fresh physiological excrements of the human and animals and possible infection of water with microbes. Ammonia detection in marshy, peat, ferriferous subsoil waters has no sanitary-indicative value. Nitrites are present at rain water and can be formed as a result of restoration of nitrates and ammonia nitrification. In the latter case they get the big sanitary-indicative value and testify to recent pollution by its organic substances of animal origin.

Nitrates are found out in marshy waters, and also can be formed from ammoniac and nitrite pollution. Presence of only nitrates specifies in old pollution of water by excrements of the human and animals, and the contents of nitrates, ammonia and nitrites simultaneously - on constant and long pollution of water. Presence of chlorides can be a soil origin, and also testify to pollution by economic-household sewage.

Quality of tap water is estimated on microbiological and parasitological indicators, the content of harmful chemical substances, organoleptic properties and radio-activity. SanRaN 10-124 PB 99 «Potable water. Hygienic requirements to quality of water of the centralized systems of drinking water supply. Quality assurance»: the dry rest — 1000, chlorides — 350, sulphates — 500 mg/dm^3 , the general rigidity — 7 mg-ekv/dm^3 , pH 6–9, iron — 0.3, manganese — 0.1, fluorine — 1.5, permanganate oxidability — 5 mg/dm^3 . Organoleptic indicators: chromaticity of water should be no more than 20° , turbidity 1.5 mg/dm^3 , smell — 2 marks. Radiating safety of water is marked on the general α -radio-activity — 0.1 BK/DM^3 and at the general ν -radio-activity — 1 Bk/dm^3 .

For improvement of quality of water use clearing, disinfecting and special methods of processing. Water treating is carried out mechanical (upholding), physical (filtering) and chemical (coagulation) by methods. For disinfecting water use chemical (chlorination by means of gaseous chlorine, chloric to exhaust, chlorine dioxide, application of ozone, iodine, silver) and physical (boiling, a ultraviolet irradiation, use of the pulse electric category, ultrasound, an ionizing radiation) methods. To special methods of processing concern deodorization (ozonization, chlorination, aeration), decontamination (aeration), softing (thermal ways), iron removal (aeration with the subsequent upholding, liming, a filtration), de-chlorination (sedimentation), deactivation (upholding, chemical ways).

All water sources are connected with surrounding environment. They are influenced with conditions of formation of superficial or underground water drain, the various natural phenomena.

Pollution of hydrosphere is addition of new, not characteristic components for it, or excess of their natural level. Under influence of pollutants the chemical, organoleptic and microbiological parameters of water are worsen. Pollution of water with the chemical substances, painting substances, sand, clay, heat leads to sharp deterioration of organoleptic properties, alkalis — leads to pH increase, acids — to its downturn. The use of the water polluted with the chemical substances leads to defeat of digestive, blood and nervous systems, to the remote cancer genic effects.

The basic sources of pollution of water are the industrial enterprises, household objects and the agriculture objects, dumping sewage with pollutants in reservoirs, the enterprises of the food-processing industry. The basic pollutants of the chemical nature are benzene, SAS, polycyclic and aromatic hydrocarbons, nitrosamines, arsenic, lead, mercury, pesticides, acids, alkalis. Pollutants of the physical nature are sand, clay, floating impurity, radionuclides, warmly; of the biological nature — bacteria, viruses, elementary, mushrooms, worms.

The sewage containing suspensions of an organic origin or dissolved organic substance, fatally influence the condition of reservoirs. Being besieged, suspensions fill in bottom and detain development or completely stop ability to live of the microorganisms participating during autopurification of waters, complicate penetration of light into depth and slow down process of photosynthesis, can form poison gases (hydrogen sulfide) — leads to pollution of all water.

Flying organic substances — water impurities which represent danger even when their concentration reaches insignificant levels. They are benzene, toluene, vinyl chloride, dichloroethane, etc. FOS get into water as a result of anthropogenous activity: because of industrial outflow, industrial failures and negligence. They can get in potable water, can render the following effects - damage of kidneys, liver, cancerogenic action

Oil and mineral oil are the most widespread polluting substances at world ocean. The greatest losses of oil are connected with its transportation areas of extraction, except for it on the rivers with household and storm drains. Getting in the sea environment, oil spreads in the form of film which changes the structure of spectrum and intensity of penetration of light into water. The film 30–40 microns completely absorbs infra-red radiation. The oil film causes destruction of sea organisms, fishes, dolphins.

Heavy metals (mercury, lead, zinc, copper, arsenic) concern to number of widespread and very toxic polluting substances. They it is widely applied in various industrial productions and the contents of their connections in sewage is high enough. Influence on organism of lead: after resorption in blood lead incorporates to hemoglobin and extends on all organism; it is capable to form in a bone fabric and a teeth almost insoluble substance phosphate of lead and to be there during long period. Even at the safe level in blood lead can cause neurologic semiology: irritability and deterioration of attention. Long influence of

lead leads to muscular weakness and falling of the level of hemoglobin (hypochromic anemia), lead gets through placental barrier. Displays of the chronic intoxication — weakness, headache, dizziness, unpleasant taste in mouth, tremor of extremities, reduction of body weight, pain in stomach.

Accumulation of cadmium causes degenerate changes of mucous membranes, heavy damage of kidneys, bony rarefaction, kidney arterial hypertension, mutagen (but not cancerogenic) effect.

Chronic influence of arsenic leads to loss of weight, depression and development of oncological diseases.

Copper possesses irritating action on digestive system, induces hepatic cirrhosis, easing of immunity, functional frustration of nervous system. Except for it copper gives metal taste to water. Mercury causes Minamata illness.

Thermal pollution of surface of reservoirs and coastal waters results from dump of hot sewage power stations and some industrial productions. Dump of hot waters causes rise in temperature of reservoirs on 6–8 °C, it interferes with water exchange between superficial and ground layers. Solubility of oxygen decreases, and its consumption increases. Specific variety of phytoplankton and all flora of seaweed amplifies.

Dumping is dump of waste in the sea with the purpose of burial place (ground, chisel slag, waste of the industry, building dust, firm waste, explosive and chemical substances, radioactive waste). The volume of burial places makes about 10 % from all weight of the polluting substances arriving in world ocean. As the basis for dumping serves the opportunity of the sea environment to the processing of a plenty of the organic and inorganic substances without special damage. However this ability is not boundless. Therefore dumping it is considered as the compelled measure. Influence of dumping: during dump the part of polluting substances passes in solution, changing quality of water; other part is sorbed and also passes in the given adjournment. Turbidity of waters raises, there is a fast charge of oxygen in water (and its full disappearance is frequent), accumulation of metals in the dissolved form, occurrence of hydrogen sulphide. All this brings to ruin or reduction of growth of inactive forms of benthos and to change of specific structure.

The radio-activity of underground waters is caused by presence of radioisotopes cesium, ruthenium. The radiochemical structure of underground waters depends on quantity of soluble radioactive substances which contain in ground, and also climate and meteorological conditions. The radio-activity of river water is caused by isotopes of radium and cesium. Radiating pollution occurs both due to fission products of heavy elements, and due to induced radiation as a result of test of the nuclear weapon, failures on atomic power stations, dumps of radioactive waste. The natural radiating background does not render adverse influence on alive organisms. However at increase of dose of natural irradiation plants and animals can have mutations, processes of individual development is disturbed,

stability to adverse environment factors is decreased. In conditions of the raised background at the person immunity decreases, nonspecific disease increases, there are stochastic effects.

Pollutants of the biological nature can cause occurrence at the person of intestinal infections (cholera, belly typhus, paratyphoid, dysentery), virus illnesses (infectious hepatitis, poliomyelitis, Coxsackie illness), zoonosis (icteric leptospirosis, brucellosis), protozoonosis (amebias).

Belarus is located in territory of the main reservoirs of the Black and Baltic seas, has approximately 2000 rivers and 10000 lakes. In Belarus in superficial reservoirs 1129 million m³ sewage, including household 69 % and industrial 28 %, is dumped nearby. The majority of the rivers of Belarus is moderately polluted with chemical substances, pure water is found out only on 10 % of territory. Especially strong pollution of the rivers is marked below on current after large cities. Dnepr, Zapadnaya Dvina, radionuclides - Pripyat and Dnepr, Svisloch is most polluted with biological substances. Underground waters on territory of Belarus become soiled bacteria, nitrates, pesticides, toxic waste. Superficial and underground waters are sensitive to pollution.

Modern problems of water are deficiency of fresh water which tests 1/3 population of planet (on imported water Algeria, Hong Kong lives), rational and economical use, exhaustion of stocks of fresh water, the industry, agriculture), pollution with industrial and household drains.

The state account of superficial and underground waters plays the leading role in protection of waters, which is carried out with a view of current and forward planning of rational use of water resources, their restoration and protection. The arches of the systematized data about water objects, water resources, mode, quality and use of waters, and also about water-users joins in *Water cadaster*. And challenge protection of superficial waters against pollution is important.

Protection of water from pollution is spent according to SanRaN № 4630–88 «Sanitary rules and norms of protection of superficial waters from pollution». At the industrial enterprises replacement of toxic products by less toxic and turn-around water supply are spent. Before dump of sewage in reservoirs the device of clearing constructions is provided, dumps are carried out at various times day. The important place in protection of water from pollution belongs to the organization and operation of zones of sanitary protection of sources of water supply and water pipes of economic-drinking water supply. Usually zones of sanitary protection will be organized in structure of three zones: the first zone (a strict mode), the second (a zone of restrictions for protection against possible microbe pollution), the third (a zone of restrictions for protection against possible chemical pollution).

With the purpose of protection of water a number of actions is provided:

1. Monitoring water objects.
2. Creation of water-security zones.

3. Development of without waste and waterless technologies.
4. Introduction of systems of turnaround water supply.
5. Clearing of industrial and household sewage.
6. Clearing and disinfecting of the superficial and underground waters used for the drinking purposes.
7. Presence of water-security wood plantings (up to 50 % coniferous breeds, linden, poplar).

Clearing of household sewage is carried out by the water drain — is a complex of nonproduction constructions and sanitary actions which provide gathering, removal, clearing, disinfecting and neutralization of sewage. Thus biological ponds, constructions of artificial biological clearing, bio filters are used. Disinfecting of sewage is made with the gaseous chlorine, chloric lame and hypochlorite sodium. Disinfecting with ozone, UV-beams the electropulse category takes root also.

Clearing of industrial sewage is made with the mechanical (special lattices, petro traps and sediment bowls for removal of the weighed particles), chemical (neutralization, oxidizing and regenerative methods), physical and chemical (coagulation, sorption, adsorption, ionic exchange) and biological (use of microbe communities for transformation of complex ecologically dangerous substances in simple, harmless) methods.

For improvement of quality of water use clearing, disinfecting and special methods of processing. Water treating is carried out mechanical (upholding), physical (filtering) and chemical (coagulation) by methods. For disinfecting water use chemical (chlorination by means of gaseous chlorine, chloric to exhaust, chlorine dioxide, application of ozone, iodine, silver) and physical (boiling, a ultraviolet irradiation, use of the pulse electric category, ultrasound, an ionizing radiation) methods. To special methods of processing concern deodorization (ozonization, chlorination, aeration), decontamination (aeration), softening (thermal ways), iron removal (aeration with the subsequent upholding, liming, a filtration), defluorination (sedimentation), deactivation (upholding, chemical ways).

General characteristic and versions of hydroecosystems.

The hydrosphere is understood as set of all water objects of the globe, including oceans, the seas, the rivers, lakes, water basins, bogs, underground waters, glaciers, a snow cover and the earth -liquid water which is a part of atmosphere. In most general view division of hydrosphere into world ocean, continental waters and underground waters is accepted.

Hydrosphere:

- Regulates a planet climate.
- Provides economic and industrial activity of people.
- Is a part of all live organisms, carrying out a role of solvent, the participant of biochemical processes, a regulator of heat exchange with environment.

As the water great bulk is concentrated in reservoirs of oceanic type, prop-

erties of the water environment usually consider on an example of world ocean. The ocean occupies 71 % of a surface of the Earth whereas on internal reservoirs it is necessary only about 5 %.

Continental reservoirs keep the most basic properties of the water environment, differing from system of the World ocean smaller depths and the big range of salinity. On character of mobility of water weights distinguish reservoirs standing and fluid. Standing reservoirs (lakes, ponds) are subdivided on fresh and salty; thus many continental reservoirs surpass oceanic waters in salinity. Fluid reservoirs conditionally subdivide on speed of a current, the ecological role of this factor is great.

Underground water sources impregnate thickness of earth crust approximately to depth of 13–14 km. Prominent features of underground waters is:

Close contact to soil and breeds of earth crust;

Level-by-level arrangements of the water horizons divided by water-proof layers of breed;

Weak communication with atmosphere (weak aeration);

Poor development of biological processes and poverty of forms of life;

Finding in the conditions of the raised temperature and pressure.

Underground waters happen good-quality is more often. Settling down on various depth have stable structure, contain the substances useful to a human body more (calcium, iodine, fluorine), become soiled a sewage, microorganisms less.

The most reliable, from the ecological point of view, are interplastic waters. Their thickness can be from 14 to 36 m. They more mineralized, than soil and, as a rule, are free from microorganisms.

The basic problems connected with hydrosphere of a planet, conditions of security of the population water, its quality and possibilities of its improvement are.

Sources of natural and anthropogenous pollution of hydrosphere.

The basic sources of ecological trouble of hydrosphere are:

1. Atmospheric waters.
2. Industrial sewage.
3. City sewage.
4. Agriculture.
5. Storm waters.
6. Acid deposits.

Negative consequences of anthropogenous intervention in water exchange processes in biosphere.

Correct diagnostics, treatment and preventive maintenance of the diseases connected with influence of factors of environment, demand from the practical doctor of knowledge of bases of hygienic diagnostics and a clinical picture of the known ecologically caused diseases. At symptoms or the syndromes, allowing to suspect influence of factors of environment, the doctor, in the course of analysis gathering, should pay attention to all possible risk factors (contact to

harmful factors in house conditions, on manufacture etc.). In case of need the doctor should request from the center of sanitary-and-epidemiologic supervision the additional data about quality of water, air, working conditions.

Allocate the known diseases connected with pollution of water, so-called ecologically dependent diseases: illness of Minamata, Kashin-Beka illness, illness Itaj-ilaj, etc.

The factor of the raised health hazard of the population is water chlorination.

Ecological estimation of a condition of water resources in Belarus

Belarus concerns regions in which water supply of almost all largest settlements and the industrial enterprises is in full or in part carried out at the expense of underground waters. Now the register of boreholes of Belarus considers some tens thousand operational hydro-geological chinks. The urgency of this question has especially strongly increased last years that is caused by following reasons:

Belarus is economically developed region with a considerable share of urban population.

Failure on Chernobyl atomic station in 1986 has led to radioactive pollution of a considerable part of territory of republic (especially within the Gomel and Mogilev areas).

Many rural settlements by means of wells maintain the first from a surface водоносные horizons, including and soil. However, excessive application of fertilizers has led to pollution of these aquiferous horizons various components.

In connection with high rates of development of engineering activity of the person there was a threat, and in many places already and there is a technogenic pollution of underground waters. As an example Soligorsk and Rechitsky areas, territory of the Gomel chemical factory can serve, etc.

All it causes of search and commissioning of new reliable sources of water supply.

The major direction in maintenance of sanitary-epidemic well-being of the population of the Gomel area is quality and safety of the potable water, submitted to the population.

Sanitary-and-hygienic estimation of quality of potable water.

One of the primary goals of ecohygiene in the field of hydrosphere is the estimation of quality of the water intended for drink, cooking and satisfaction of requirements of people. At the decision of this problem it is necessary to adhere to the certain plan. First of all, it is necessary to have accurate idea about the requirements shown to water of this or that appointment. Because quality of water is defined not only its properties at present, but also possibility of preservation of these properties during all time of operation of a water source, that is its reliability, it is necessary to find out a sanitary-engineering condition of a water source, a condition of a sanitary-topographical arrangement on districts and sanitary-and-epidemiologic conditions. Such information can be received on the basis of studying of corresponding documents and carrying out of researches.

And, at last, it is necessary to have the data about a chemical compound of water and its microbe seed. On the basis of this information the conclusion about quality of water and possibility of its use without processing or after correction of those lacks which in it are found out becomes.

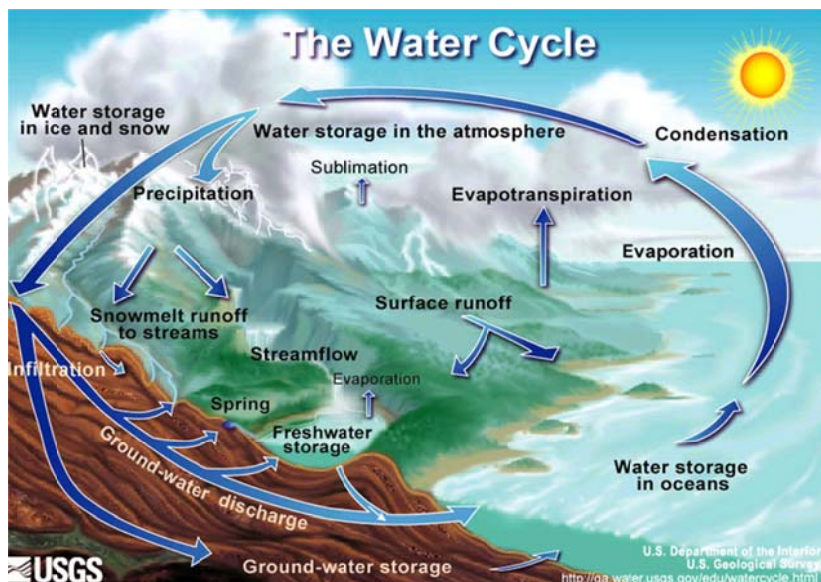


Figure 4 — The water cycle

Sampling of water.

The equipment: batometer.

a) The tests of water from open reservoirs, and also wells are taken in that place and on that depth, where it is planned or the gathering of water by the population is already carried out.

a.a) For the chemical analysis water is taken in quantity 2–5 l, in clean flacons, washed with distilled water and in addition by that water, which taken for the analysis. After the sampling flagon is numbered and applied with the accompanying form about the name of water source, from which the test is taken, location, temperature of water and condition of weather at the moment of the sampling. The definition of physical properties of water is desirable for making at waters source.

a.b) For the bacteriological analysis the sampling of water is carried out in the special sterile utensils in quantity 400–500 ml from the depth 15–20 cm from the surface of water by the batometer. At the sampling of water from the water tap or well with the pump it is necessary to burn the edges of the tap and to lower the stood too long water. The taken tests should be subjected to the analysis not later than in 2 hours.

a.c) For the helminthological analysis of water of open reservoirs the sampling of water is taken not less than 3–5 tests in the morning, in the afternoon and evening so that the total volume of water would not less than 50 l.

Definition of water smell.

The equipment: flask, electrotile, hour glass.

Work performance:

a. The sampling of water is carried out in flask, close with plug, shake up it and, having opened plug, define the smell.

b. For strengthening of the smell 100 sm² of investigated water is poured in flask, cover with hour glass, warm up it up to 50–60 °C.

c. The flask is removed, water is shaken up, hour glass is removed.

d. The character (chemist's, earthy, chloral, etc.) and intensity of smell are defined on five-point system:

— there is no smell — 0 points;

— very weak, found out by the habitual observer — 1 point;

— weak, found out at the reference on it of attention — 2 points;

— appreciable, causing the disapproving responses — 3 points;

— distinct, sometimes causing refusal of drink — 4 points;

— very strong, water is not suitable for drink — 5 points.

The smell of water of the centralized sources should not exceed 2 points, decentralized — 2–3 points.

Definition of water taste

The equipment: chemical glasses.

Work performance:

a. The water is taken in a mouth in the small portions, hold in a mouth in some seconds and taste is defined, not swallowing it.

b. The characteristic of taste is described according to sensation as salty, bitter, sweet, sour. After-taste are characterized any way: fish, metal, etc.

c. Intensity of taste and after-taste are estimated on five-point system:

— there is no smack — 0 points;

— very weak — 1 point;

— weak — 2 points;

— appreciable — 3 points;

— distinct — 4 points;

— very strong — 5 points.

Taste of obviously harmless water is defined during the moment of the sampling of water. In case of suspicion on pollution definition of taste is made in the boiled and cooled water.

Potable water should be pleasant freshening taste. Intensity of taste and after-taste of water of the centralized sources should not exceed 2 points, decentralized — 2–3 points

Definition of water coloring

The equipment: FEC, membrane filter, conical flask, distilled water.

Work performance:

a. The researched water is filtered through the membrane filter.

- b. 5–10 ml is poured in the dish and seen with dark blue light filter.
- c. Coloring of test is estimated on the diagram. The control — distilled water.

Definition of the water turbidity

The equipment: FEC, chemical glasses, distilled water.

Work performance:

- a. The researched water is well shaken up.
- b. 5–10 ml is poured in the dish and seen with green light filter. The control — distilled water.

The hygienic estimation of the water coloring and turbidity will be spent by comparison with the specifications (coloring for the centralized sources 20°, for decentralized — 30°, turbidity for the centralized sources - no more than 1.5 mg/l, for decentralized — no more than 2 mg/l).

Model situational task

Condition:

1. Water in artesian chink (1 class) has an original source chromaticity 30°, turbidity 3 mg/l, number lactose positive sticks (microbe number) makes 1006, coli-index — 4. To state the ecological estimation of the source of water supply and to develop actions on improvement of quality of water, its protection from pollution.

Solution:

Parameters of quality of water sources of centralized economic-drinking water supply:

<u>Underground</u>	<u>1 class</u>	<u>2 class</u>	<u>3 class</u>
<i>Chromaticity</i>	20°	20°	50°
<i>Turbidity</i>	15 mg/dm ³	15 mg/dm ³	10 mg/dm ³
<i>Coli-index</i>	3	3	3
<i>Iron</i>	0,3 mg/dm ³	10 mg/dm ³	20 mg/dm ³
<i>Manganese</i>	0,1 mg/dm ³	1 mg/dm ³	2 mg/dm ³
<i>Fluorine</i>	1,5 mg/dm ³	1,2 mg/dm ³	5 mg/dm ³
<i>Water oxidizability</i>	2 mg/dm ³	5 mg/dm ³	15 mg/dm ³
<i>Number of lactose positive intestinal sticks</i>	3 in 1 dm ³	100	1000
<u>Superficial</u>			
<i>Chromaticity</i>	35°	120°	200°
<i>Turbidity</i>	20 mg/dm ³	1500 mg/dm ³	10000 mg/dm ³
<i>Coli-index</i>	3	3	3
<i>Iron</i>	1 mg/dm ³	3 mg/dm ³	5 mg/dm ³
<i>Manganese</i>	0,1 mg/dm ³	1 mg/dm ³	2 mg/dm ³
<i>Fluorine</i>	1,5 mg/dm ³	1,2 mg/dm ³	5 mg/dm ³
<i>Water oxidizability</i>	7 mg/dm ³	15 mg/dm ³	20 mg/dm ³
<i>Number of lactose positive intestinal sticks</i>	1000 in 1 dm ³	10000	50000

Water of the chink does not correspond to sanitary-ecological requirements: chromaticity, turbidity is exceeded, the quantity of lactose positive intestinal sticks

is exceeded, coli-index above norms that can cause various infectious diseases of the population. Chlorination is possible to disinfect water. It is necessary to reveal a source of pollution and to plan actions on protection of water resources:

- 1) planning: zones of sanitary protection;
- 2) technological: closed manufacture, application of less toxic products;
- 3) sanitary-engineering: clearing constructions;
- 4) organizational — dumps at various times day;

It is used not only for superficial waters, but also for protection of internal filtration layers of ground.

Definition of ammonia content in water

The definition is based on ability of ammonia to form the colored connection with the reactive of Nessler. For deduction in the solution of calcium, magnesium, iron and manganese, is added signet salt.

The equipment: FEC, test-tubes, pipettes, conical flasks, eye pipettes.

Reactive: reactive of Nessler, signet salt.

Work performance:

- a) 3–4 drops of signet salt is added to 10 ml of researched water, to mix;
- b) 3–4 drops of reactive of Nessler is added into the solution;
- c) through 10 mm to lead measurement of optical density of the solution on FEC with dark blue light filter № 4. The control is distilled water;
- d) the ammonia content in researched water is defined on the diagram.

Definition of nitrites content in water

The definition is based on ability of salts of nitric acid at presence of reactive of Griess to give the colored connection.

The equipment: FEC, test-tubes, pipettes, conical flasks.

Reactives: Griess's reagent, distilled water.

Work performance:

- a) 0,5 ml of the Griess's reagent is added to 10 ml of test researched water;
- b) the test is seeing on FEC in 10 minutes, using the green light-filter № 6. The control is distilled water.
- c) the nitrites content in researched water is defined on the diagram.

The hygienic estimation of the ammonia and nitrites content in water is spent by comparison with the specification (2 mg/l and 3.3 mg/l accordingly).

Definition of nitrates content in water

The equipment: porcelain cup, pipettes, conical flasks.

Reactives: the concentrated sulfuric acid, diphenylamine.

Work performance:

- a) 2 ml of researched water is taken into porcelain cup;
- b) Some drops of the concentrated sulfuric acid with diphenylamine are added.

The hygienic estimation of the nitrates content in drinking water is made on coloring (at presence in water of nitrate-ions there is the dark blue or violet coloring).

Model situational task

Condition:

Water in artesian chinks (1 class) has 450 mg/dm³ chlorides, 480 mg/dm³ of sulfates. To assess the ecology-sanitary condition of water and to offer actions on improvement of parameters of water in the water source.

Solution:

Potable water does not corresponds to ecology-sanitary norms: it has less sulfates (500), chlorides it is a lot of (350 mg/dm³).

It is necessary to reveal a source of pollution and to plan actions on protection of water resources:

- 1) planning: zones of sanitary protection;
- 2) technological: manufacture without dross, application of less toxic products;
- 3) sanitary-technical: clearing constructions;
- 4) organizational: dumps at various times day;
- 5) legislative: laws on protection.

It is used not only for superficial waters, but also for protection of internal filtration layers of ground.

THE DECISION OF SITUATIONAL PROBLEMS

2. Water in the river (a water source 2 classes) has a smell 4 points, chromaticity 35°; turbidity 2,5 mg/dm³, number lactose positive intestinal sticks 10300, a coli-index 12. To assess an ecology-sanitary condition of a water source and to offer actions on improvement of quality of water.

3. Water of a water basin (a water source of 1 class) has chromaticity 35°; turbidity 3 mg/dm³, number lactose positive intestinal sticks 1020, a coli-index 8. To estimate ecology-sanitary conditions of water and to develop actions on improvement of quality of water.

4. Water of the river (a water source 3 classes) has chromaticity 45°; turbidity 5 mg/dm³, a coli-index 12, a smell and smack — 4 points. To assess a ecology-sanitary condition of a reservoir and to offer actions on its optimization.

5. Water of a water basin (a water source of 1 class) has chromaticity 25°; turbidity 2 mg/dm³, number lactose positive intestinal sticks 1000, a smell and smack — 2 points. To estimate an ecological condition of water and to develop actions on improvement of quality of water.

6. Water of an artesian chink (an original source 1 class) has a smell and smack — 3 points, chromaticity 38°, turbidity 3 mg/l, a coli-index — 12. Offer actions on improvement of quality of water and assess an ecological condition of a water source.

7. Water of lake (a water source 3 classes) has chromaticity 120°; turbidity 10000 mg/dm³, a smell and smack — 5 points, number lactose positive intestinal sticks equally 50080. To give the ecology-sanitary characteristic of a water source and to offer actions on improvement of quality of water.

8. Water of the river (a water source 2 classes) has number lactose positive

intestinal sticks 1020, a smell and smack on 4 points, chromaticity 40°; turbidity 15 mg/dm³. To assess conditions of a reservoir and to develop actions on improvement of quality of water.

9. Water of the river (a water source 2 classes) has chromaticity 130°; turbidity 1600 mg/dm³, a coli-index 15, number lactose positive intestinal sticks 12. To give the sanitary-ecological characteristic of a reservoir and to develop actions on optimization of adverse parameters of a water source.

10. Water of an artesian chink (an original source 1 class) has taste and a smell — 3 points, chromaticity 25°, turbidity 3 mg/l, a coli-index — 5. To assess conditions of water and to develop ecology-sanitary actions on improvement of quality of water.

11. Water in artesian chinks (1 class) has source of chlorides of 450 mg/dm³, sulfates of 480 mg/dm³. To assess the ecology-sanitary condition of water and to offer actions on improvement of parameters of water in a water source.

12. Water in artesian chinks (1 class) contains nitrates of 45 mg/dm³, sulfates of 600 mg/dm³, chlorides — 400 mg/l. To assess ecology-sanitary condition of the reservoir and to offer actions on improvement of qualities of water.

13. Water (2 classes) contains in the river of chlorides — 450 mg/dm³, nitrates — 50 mg/dm³, ammonia — 3 mg/dm³. To state the ecology-sanitary estimation of the water source and to offer actions on improvement of quality of water.

14. Water (2 classes) contains in the river of iron — 10 mg/dm³, nitrates — 78 mg/dm³, sulfates — 450 mg/dm³. To estimate the ecology-sanitary condition of the water source and to offer actions on improvement of quality of water.

15. Water of the water basin (1 class) contains nitrates of 25 mg/dm³, sulfates of 550 mg/dm³, chlorides — 400 mg/l, iron of 2 mg/dm³. To assess the ecological condition of the water basin and to develop actions on optimization of adverse factors.

16. Water of lake (3 classes) contains nitrates of 90 mg/dm³, nitrites — 5 mg/dm³, ammonia — 4 mg/dm³. To give the ecology-sanitary characteristic of the water source and to offer actions on optimization of adverse factors.

17. Water in artesian chinks (1 class) contains the source of chlorides — 400 mg/l, iron of — 1 mg/dm³, ammonia of — 2.2 mg/dm³. To assess the sanitary condition of the water source and to develop actions on optimization of ecological chemical properties of water.

18. Water of lake (3 classes) contains nitrates of 87 mg/dm³, nitrites — 6.2 mg/dm³, chlorides — 400 mg/dm³. To assess the ecology-sanitary condition of the water source and to offer actions on optimization of adverse chemical properties.

19. Water of the artesian chink (1 class) contains ammonia — 4 mg/dm³, iron — 5 mg/dm³, sulfates — 560 mg/dm³. To assess the ecology-sanitary condition of the reservoir and to offer actions on improvement of quality of water.

20. Water of lake (3 classes) contains nitrates of 60 mg/dm^3 , nitrites — 5 mg/dm^3 , ammonia — 4 mg/dm^3 . To assess the ecological condition of the water source and to offer actions on optimization.

TEST CONTROL

Variant 1

1. In natural water contain:
 - 1) particles of sand;
 - 2) microorganisms;
 - 3) radioactive substances;
 - 4) aeroplankton;
 - 5) particles of silt.
2. World reserves of water, million km^3 :
 - 1) 300;
 - 2) 1345;
 - 3) 1020;
 - 4) 2500;
 - 5) 3000.
3. Abiotic factors of water sphere:
 - 1) high density and viscosity;
 - 2) horizontal and vertical mobility;
 - 3) temperature mode;
 - 4) transparency and light mode;
 - 5) salt mode.
4. Biological factors of water sphere:
 - 1) oxygen mode;
 - 2) carbon-dioxide mode;
 - 3) microorganisms;
 - 4) plants;
 - 5) animals.
5. Modern problems of hydrosphere:
 - 1) exhaustion of stocks of fresh water;
 - 2) pollution by industrial drains;
 - 3) pollution by household drains;
 - 4) reduction of water content of the rivers;
 - 5) increase of water content of the rivers.
6. Ecological meaning of water:
 - 1) climate forming;
 - 2) participation in circulation of substances;
 - 3) environment forming;
 - 4) source of hydrogen and oxygen;
 - 5) protective.

7. Physical abiotic factors:
 - 1) smell;
 - 2) color;
 - 3) coli titer;
 - 4) turbidity;
 - 5) pH.
8. The microorganisms contained in water:
 - 1) hemolytic streptococci;
 - 2) chemosynthetic bacteria;
 - 3) photosynthetic bacteria;
 - 4) *Pseudomonas aeruginosa*;
 - 5) heterotrophic bacteria.
9. Open sources of water supply:
 - 1) rivers;
 - 2) lakes;
 - 3) ponds;
 - 4) water basins;
 - 5) springs.
10. Products of exchange of blue-green seaweed:
 - 1) oxygen;
 - 2) ammonia;
 - 3) indole;
 - 4) skatole;
 - 5) phenols.
11. Polysaprobic zone of reservoir is characterized:
 - 1) weak pollution of water;
 - 2) strong pollution of water;
 - 3) surplus of oxygen;
 - 4) absence of oxidizing processes;
 - 5) the big maintenance of albumens.
12. Oligosaprobic zone is characterized:
 - 1) pure water;
 - 2) plenty of oxygen;
 - 3) full mineralization of organic substances;
 - 4) presence of processes of restoration;
 - 5) insignificant number of representatives of flora and fauna.
13. The characteristic of soil waters:
 - 1) close be deposited to a terrestrial surface;
 - 2) have no protection as layer waterproof;
 - 3) have protection as layer waterproof;
 - 4) the structure is subject to sharp impurity;
 - 5) contains many microorganisms.

14. The characteristic of underground sources of 1 class:
 - 1) chromaticity no more than 20°;
 - 2) turbidity — 1,5 mg/l;
 - 3) pH — 6–9;
 - 4) iron — 3 mg/l;
 - 5) oxidability permanganate — 5 mg/l.
15. The characteristic of superficial sources of 1 class:
 - 1) chromaticity no more than 40°;
 - 2) turbidity — 20 mg/l;
 - 3) iron — 1 mg/l;
 - 4) manganese — 0,1 mg/l;
 - 5) pH — 6,5–8,5.
16. Sources of pollution of water:
 - 1) household objects;
 - 2) industrial enterprises;
 - 3) municipal objects;
 - 4) the enterprises of an agriculture;
 - 5) sailing charter.
17. Pollutants of superficial sources of water supply:
 - 1) farmyards;
 - 2) fields of sewage disposal;
 - 3) benzene;
 - 4) lead;
 - 5) pesticides.
18. Pollution of sources of water supply results to:
 - 1) to pollution of ground;
 - 2) to pollution of an atmosphere;
 - 3) salinization;
 - 4) to infringement of thermal balance of a planet;
 - 5) destructions animal plankton.
19. Biological pollution of water can cause at the person:
 - 1) intestinal infections;
 - 2) virus diseases;
 - 3) anthroozoonosis;
 - 4) protozoonosis;
 - 5) illnesses of a civilization.
20. Physical abiotic pollutants of waters:
 - 1) bacteria;
 - 2) warmly;
 - 3) pesticides;
 - 4) radioactive nuclides;
 - 5) nitrozamins.

Variant 2

1. Sources of pollution of water
 - 1) household and municipal objects;
 - 2) industrial enterprises;
 - 3) radio nuclides;
 - 4) enterprises an agriculture;
 - 5) water transport.
2. The basic pollutants of waters of the chemical nature:
 - 1) Benzene;
 - 2) Mineral oil;
 - 3) Superficially-active substances;
 - 4) Heavy metals;
 - 5) Acids alkalis.
3. Pollutants of waters of the physical nature:
 - 1) Warm;
 - 2) radio nuclides;
 - 3) Pesticides;
 - 4) nitrosamines;
 - 5) Clay.
4. Pollutants of waters of the biotic nature:
 - 1) Bacteria;
 - 2) Viruses;
 - 3) Animals;
 - 4) Mushrooms;
 - 5) Warm.
5. Influence of pollutants on organic origin on hydrosphere:
 - 1) Delay photosynthesis;
 - 2) Acceleration photosynthesis;
 - 3) Delay processes of autopurification;
 - 4) Acceleration processes of autopurification;
 - 5) A poisoning fishes.
6. Under influence of pollutants following parameters of water worsen:
 - 1) Chemical;
 - 2) Physical;
 - 3) Biological;
 - 4) Microbiological;
 - 5) organoleptic.
7. Organic pollutants can have on the person following an effect:
 - 1) Cancerogenic;
 - 2) Irritating;
 - 3) Sedative;
 - 4) Toxic;
 - 5) Mutagen.

8. The use of water polluted by heavy metals can lead destroy:
 - 1) Blood systems;
 - 2) Digestive systems;
 - 3) Nervous systems;
 - 4) Respiratory systems;
 - 5) parenchymal organs.
9. The use of water with the raised contents of cadmium can cause in the person:
 - 1) hypochromic anemia;
 - 2) osteomalacia;
 - 3) bony rarefication;
 - 4) Mutagen effect;
 - 5) Cancerogenic effect.
10. The superfluous contents of chlorine in potable water:
 - 1) Worsens taste;
 - 2) Worsens a smell;
 - 3) Increases chromaticity;
 - 4) Increases turbidity;
 - 5) Reduces turbidity.
11. Pollutants of waters of the biological nature can cause:
 - 1) Intestinal infections;
 - 2) Virus illnesses;
 - 3) zoonosis;
 - 4) helmintosis;
 - 5) Fungoid illnesses.
12. Thermal pollution of water leads:
 - 1) To decrease water exchange of a superficial and ground layer;
 - 2) Increase solubilities of oxygen;
 - 3) Decrease solubilities of oxygen;
 - 4) Increase consumption of oxygen;
 - 5) Decrease consumption of oxygen.
13. Damping can lead:
 - 1) Increase turbidity;
 - 2) Accumulation metals in the soluble form;
 - 3) Fast to the charge of oxygen;
 - 4) Slow to the charge of oxygen;
 - 5) To occurrence hydrogen sulphide.
14. Pollution of water by nitrates speaks about:
 - 1) Increase rigidity of water;
 - 2) Flowering a reservoir;
 - 3) Bogging a reservoir;
 - 4) Presence of old faecal pollution;
 - 5) Fresh faecal pollution.

15. Surplus of fluorine in water causes:
- 1) fluorosis;
 - 2) Caries;
 - 3) endemic crow;
 - 4) A gout;
 - 5) A pneumonia.
16. The control over a condition of water resources carries out:
- 1) Geological service RB;
 - 2) forestry;
 - 3) hydromet;
 - 4) san epidem service.
17. Industrial sewage of cities contain:
- 1) Mineral oil;
 - 2) Heavy metals;
 - 3) Phenols;
 - 4) Pesticides;
 - 5) Fertilizers.
18. Quantity of zones of sanitary protection of sources of water supply:
- 1) 3–4;
 - 2) 1;
 - 3) 2;
 - 4) 5;
 - 5) 2–3.
19. In territory of the first zone of sanitary protection of a water source are
- 1) A water-fence;
 - 2) Water-elevating the device;
 - 3) Head constructions;
 - 4) Water-spending the channel;
 - 5) A source water supply.
20. Detection of ammonia in marshy, peat, ferriferous subsoil waters:
- 1) Has sanitary-indicative value;
 - 2) Not has sanitary-indicative value;
 - 3) Testifies about fecal pollution of water;
 - 4) Testifies about microbe pollution of water;
 - 5) Testifies about pollution by economic-household sewage.

CHAPTER 7: «INFLUENCE OF THE CONDITION OF LITHOSPHERE AND QUALITIES OF FOODSTUFFS ON THE HEALTH OF POPULATION. NITRATES, NITRITES AND NITROSE COMMISSURE IN THE PATHOLOGY OF THE PERSON. XENOBIOTIC DISINTOXICATION»

The employment purposes:

1. To develop at students understanding of the importance lithosphere merit, as one of the defining factors forming inhabitancy of the person.
2. To confirm in the importance of working out and realisation of the actions directed on a non-admission of hit of harmful substances from soil in foodstuff for the purpose of preventive maintenance of medical consequences of consumption of polluted products.

Employment tasks:

1. The Basic indicators important for the hygienic characteristic of soils.
2. Features of soils of Belarus.
3. Sources of receipt of harmful substances in soil. Their characteristic.
4. The Conditions promoting receipt of harmful substances in foodstuff.
5. Xenobiotic classification, containing in foodstuff.
6. Nitrates, nitrites, nitrosamines. Sources of their receipt in foodstuff, the mechanism of pathological action. Preventive maintenance measures.
7. Pesticides. Classification. The properties of pesticides having hygienic value.
8. The Mechanism of action of various pesticides and medical consequences of consumption of the foodstuff containing their different concentration.
9. Metals, their toxic action on an organism. Sources of receipt of salts of heavy metals in foodstuff. The mechanism of action of the basic representatives of this xenobiotic group.
10. Polychlorinated biphenyls, sources and ways of receipt to an organism, the mechanism of pathological action.
11. Biogeochemical provinces, definition, the basic characteristics. Endemic diseases in Belarus.
12. Iodine deficiency of a condition, the reason, clinical displays, preventive maintenance.
13. Selenium both its biological and physiological value. Ways of preventive maintenance of insufficient receipt of selenium.
14. Features of hit xenobiotic in various products of a vegetative and animal origin.

Practical skills:

1. Calculation nitrate loadings at the expense of the nitrates containing in products of a phyto-genesis, used within a week.
2. The Estimation of the received results.

Teaching material

Lithosphere — outside the scope of the "solid" Earth, including the Earth's crust and upper mantle part. The mantle of the Earth — the shell located between the crust and the core. Soil, or earth — natural formation, which lies between the atmosphere and the underlying rocks. The thickness of the soil from a few centimeters up to two meters or more. The soil as an integral part of the ecological system is an essential component of the habitat of humans and animals.

Soil types vary certain combinations of soil horizons. Depending on the ratio of sand and clay soils are divided into all the sand, loam, clay, loam and sod podzolic. On the territory of the Republic of Belarus there are different types of soil, but the soil is dominated sod podzolic. Such soils are more common in the Gomel region.

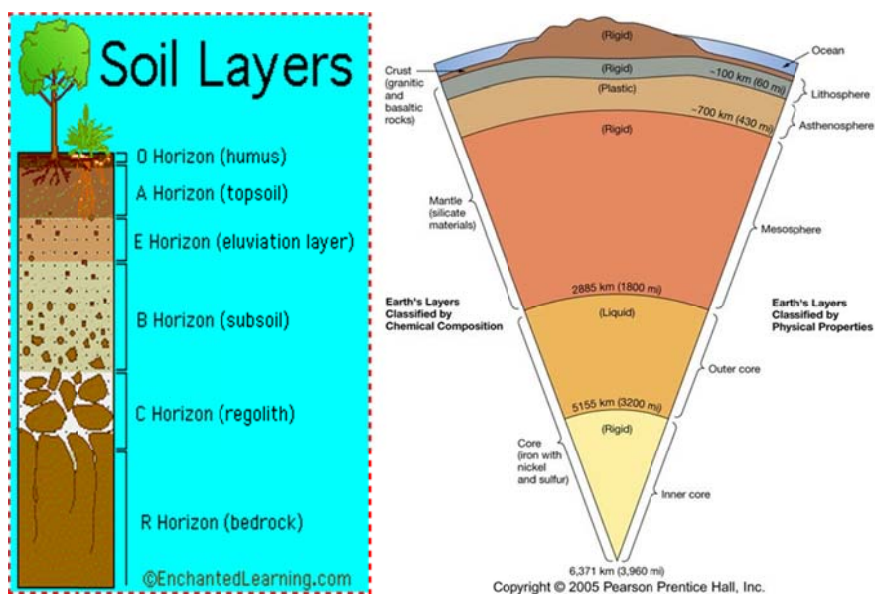


Figure 5 — Soil Layers

The chemical composition of the soil is very complex, it has a mineral (inorganic) and organic matter. Mineral compounds (90–99 %) of salt include calcium, silicon, magnesium, aluminum, and others. In the mineral composition of the soil include a smaller or larger amount almost all elements of the Periodic DI Mendeleev.

Depending on the behavior in living systems 9 microelements (iron, iodine, copper, chromium, cobalt, molybdenum, manganese, zinc, selenium) recognized with essential (vital). With a lack of these elements occur in functional disorders of the body. Conditionally essential trace elements include fluorine, nickel, vanadium, arsenic, silicon, lithium, boron and bromine.

The group includes toxic elements aluminum, cadmium, lead, mercury, beryllium, barium, bismuth, thallium and others.). In the soil, live and die pathogenic bacteria, viruses, protozoa and helminth eggs. She is one of the main routes of transmission of infectious and noninfectious diseases. Lack or excess of trace elements in the soil can lead to endemic diseases.

Since the soil is closely related and in the presence of certain elements of agricultural products such as vegetable and animal origin, quality, safety and usefulness.

In recent years, special significance is the anthropogenic pollution of soil, ie, the appearance in it of chemical compounds that are not part of its natural and unusual for this type of soil.

Soil chemical and organic fertilizers, pesticides, it hit industrial waste, sewage of various origin, the adsorption of toxic substances from air contaminated including vehicle exhaust gases is carried out to all its increasing contamination. A lot of research shows the value of toxic contamination of soil, from which the so-called food chain, that is, products of plant and animal origin, these harmful substances into the human body, giving him an adverse effect. The most significant of these are xenobiotic.

Xenobiotic or foreign harmful substances that can be ingested with food, conventionally divided into three main groups:

1. Natural food ingredients that have a detrimental effect.
2. The substances from the environment with harmful effects (Conti and Nantes).
3. Substances that are made specifically for technological reasons.

In turn, the foreign substances can be of different nature, both chemical and biological (table 6.1.).

Table 6.1. — Classification of foreign substances

alien substances	
chemical nature	biological nature
Toxic elements: Lead, cadmium, mercury, arsenic, zinc, copper, iron, tin, chromium. Pesticides: organochlorines, triazines, organic nitrites, nitrosamines Histamine Benzo (a) pyrene Polychlorinated drugs Radionuclides	Mycotoxins: Alfatoxin B, D, F, vomitoxin, T-2 toxin, ochratoxin A, sterigmatotsestin. Antibiotics. Coliform bacteria (coliforms) E. coli. Staph. aureus, Bac. cereus, bacteria of the genus Proteus, Clostridium sulfite), pathogens (including Salmonella), yeasts, molds. Viruses Helminths and protozoa insects

One of the most important physiological and hygienic requirements for human nutrition — food harmlessness.

Consumption of food should be free from harmful chemicals and biological agents, or keep them in the amounts (concentrations) and forms that are not able to have a negative impact on human health and its progeny.

Infection of food as a result of anthropogenic pollution of the environment, as well as violations of sanitary norms and rules at different stages of the movement of food from production facilities prior to their use in food can cause food poisoning microbial nature (food toxicity and poisoning), infections (typhoid, paratyphoid A and B, and other salmonellosis, dysentery, brucellosis, tuberculosis, foot and mouth disease, tularemia, etc.) and helminth infections (taeniasis, trichinosis, diphyllorhynchiasis, opistorhynchiasis, ascariasis, and others.).

No less important indicator of the safety of food is its degree of contamination of harmful alien chemicals — xenobiotic. Contamination of food alien substances (pesticides, salts of heavy metals, radionuclides, nitrates and nitrites, nitrosamines, synthetic chemical compounds, polycyclic aromatic hydrocarbons, and other mycotoxins.) Depends on the environmental situation, and in particular from the quality of the soil.

Xenobiotic from the environment to the human body come primarily with food. Thus, nitrates enter the human body mainly from vegetables (about 70 %) and the remaining water fall, meat products with nitrites, radionuclides (94 %) food of vegetable and animal origin.

Persistent pesticides in the environment enter the body with food (95 %), water (47 %), atmospheric air (only 0.3 %) and very minor amounts of them penetrate the skin.

Alien chemicals get into the body through the chain "soil-vegetation-man" or "soil-vegetation-animal-man." The bulk migration of xenobiotic on the food chain takes place in all kinds of biological terrestrial and aquatic ecosystems.

However, there is a significant accumulation of xenobiotic in the aquatic food chain. This is due to the fact that aquatic organisms (fish, molluscs, crustaceans, etc.) are not only deprived of a mechanism that protects them from the harmful accumulation of foreign chemicals, but they accumulate and vigorously. Pollution degree alien chemicals increases with increasing trophic position of certain types of ecosystems. For example, the concentration of xenobiotic in tissues predatory fish, birds and animals higher in comparison with those species that they eat.

All foods as original sources are substances in the biosphere. Man is the final link in the numerous prevailing in the course of a long evolution of the food chain, in which some organisms are food for others.

At the present time to increase food supply and improve the quality of products in the agricultural and industrial production are widely used by a variety of substances, effects of which on the person can be very unfavorable. Some of them are carriers of toxic, mutagenic, carcinogenic, teratogenic properties or precursors of compounds with such properties. Acquire them they are also in violation of regulations to use them.

Agrochemicals that are now widely used to intensification of agricultural production are non-toxic compounds capable of accumulating in the food and have an adverse effect on the human body. But in case of violation of regulations on the number of applications, timing of application, multiplicity, maturity expectations derived food raw materials may contain a relatively high concentration of primarily nitrogen compounds, which include nitrates.

The presence of nitrates in plants — is normal. But the admission of nitrates in quantities exceeding the needs of organic synthesis, they begin to accumulate in the roots, leaves, and most importantly, in the fruit of various crops, either directly used in the human food and forage crops, going for animal feed. Their excesses not processed under the influence of nitrate - enzyme contained in plant tissues are reduced to nitrites, which have adverse effects with these compounds under the influence of the microflora already directly in the mouth and then into the gastrointestinal tract. Because agricultural products are the main suppliers of potatoes and vegetables. nitrate accumulation in vegetable crops is largely determined by their biological characteristics. For vegetables, characterized by the ability to accumulate large amounts of nitrates are green - iceberg lettuce, spinach, fennel, kohlrabi cabbage, rhubarb, radishes and beetroot especially prone to this are squash, pumpkin. Nitrate they range from 1200 to 5000 mg / kg fresh weight. The middle position is occupied eggplant, melon, cabbage, carrots, cucumbers, parsley, celery, garlic, beans — 100–1000 mg / kg. The relatively low concentration of them featured in watermelon, green peas, potatoes, onions, peppers, tomatoes —60–90 mg / kg. The concentration of nitrate in vegetables grown in greenhouses typically twice larger than in the open. In various parts of the nitrate content of plants is different. The skin of the fruit and the superficial layers of the nitrate content is significantly higher. In cabbage nitrates most upper leaves and stalks, in beets and in the upper part of the tail, carrots — in the central part.

Nitrate absorption occurs primarily in the stomach. During 8 hours of urine is allocated 90 % of nitrates received. If you receive large amounts of nitrates, as a result of the use of products containing 800–1300 mg / kg of nitrate ions (beetroot puree, spinach, other vegetables are not fresh) may be acute poisoning. Clinical signs of poisoning appear within 1–6 hours after their introduction into the body and are characterized by dyspeptic disorders in conjunction with enlargement of the liver, its tenderness. There are also symptoms of the nervous system — general weakness, dizziness, darkening of the eyes, impaired motor coordination. Nitrate vasodilator effect leads to lower blood pressure, sinus arrhythmia, chest pain, shortness of breath.

Nitrates themselves are not the adjustable methemoglobin. However, already in the dishes with incorrect storage, the development of microflora in them, as well as part of the digestive tract nitrate is recovered in a toxic compound — nitrite — nitrite and the subsequent development of carbohemia low gastric acidity in infants may contribute to this process.

Immediately nitrites can be ingested with food products processed animal feed, in particular meat products and cheese.

In the production of sausages and ham products, sodium nitrite is used in technology to save pink meat products and partly as a preservative. For the same purpose nitrites used in cheese production.

After intake of nitrate increased doses at 1 hour indicated the maximum level of methemoglobin in the blood. When the content of its 8–10 % can be observed asymptomatic cyanosis; at 30 % and more — symptoms of acute hypoxia (shortness of breath, tachycardia, brown-gray cyanosis, hypotension, weakness, headache).

But the greatest danger of nitrogen compounds are nitrosamines. These compounds may be formed directly in food and in the body at a high concentration nitrite in the stomach. A prerequisite is the presence of free amino groups of the protein.

The main danger of nitrosamines is that they are carcinogenic, mutagenic, teratogenic and embryotoxic properties, the carcinogenic effect is decisive. N-nitrosamines are found in almost all meat, dairy and fish products, malt beer.

Currently, the production of agricultural produce of both vegetable and animal origin are widely used by a variety of chemical compounds are combined in a group called pesticides. Pesticides — are substances of chemical and biological origin intended for chemical protection of plants and animals. The use of pesticides is still a significant risk of environmental impact and health risk. Environmental risk is the inevitable pollution of not only cultivated areas, and the global spread of pesticides in the biosphere and lithosphere in particular. Once in the soil, and then in crop and livestock products are commonly in contact with a large part of the population, including children, pregnant and nursing women.

Currently there are different classifications of pesticides, industrial, chemical, hygienic.

The industrial classification is based on pesticides name, purpose and direction of their use:

- insecticides and miticides — for the destruction of insect pests;
- molluscicides — to kill slugs;
- nematicides — to kill nematodes (worms);
- rodenticides — for the destruction of rodents;
- Repellent — to repel rodents;
- fungicides — to kill molds and fungi;
- herbicides — to kill weeds;
- defoliant and desiccants — for pre-harvest removal of leaves from the crop;
- pheromones — the insect control method of capture;
- entomophages — insect population regulation.

Based on the chemical structure of organochlorine distinguish, phosphorous, mercury, arsenic, carbamic acid derivatives, urea and guanidine derivatives, and other heterocyclic compounds.

Hygienic classification provides for separation of pesticides by toxicity, ability to cumulation, accumulation, persistence in the environment — time expansion into non-toxic elements, the availability of long-term effects of the action, the action on the fetus and allergenicity. According to the parameters of the sanitary classification, they are divided into 4 classes. Most pesticides are compounds 2 and 3 hazard class. Currently it used about 600 drugs that are based on 300 active substances.

Violation of hygiene storage, transportation and use of pesticides leads to their accumulation in the feed, food raw materials and food products. Getting in the human body, they have diversified toxic effects depending on the particular chemical structure and dose of receipt.

Especially dangerous effects of pesticides for its long-term consequences and effects on the fetus. Each of them can have one or more of the following actions: carcinogenicity, mutagenicity, teratogenicity, embryotoxicity, gonadotropic, allergenicity.

Most pesticides are a group of relatively safe and have a high toxicity (phosphorus, mercury, arsenic), or have a high resistance and cumulation (organochlorine, carbamates). They can cause and long-term consequences. In case of contact pesticides into the body depending on the dose they can cause acute, subacute and chronic toxicity. Moreover, all pesticides have xenobiotic and cause the body's adaptive changes.

The mechanisms of the biological basis of (toxic) effects of low doses are violations of antioxidant protection, the stability of the structural and functional characteristics of biological membranes, which leads to disruption of the structure and function of cells. All of this eventually leads to changes in various systems of the body, violation of protective and adaptive mechanisms to the development of secondary immunodeficiency.

Pesticide poisoning develops in stages and has:

— Latent period (from the time of exposure to onset of the first manifestations of intoxication) — from a few hours to acute poisoning to a few days in subacute);

— The period of precursors, which are characterized by non-specific, the same type of exposure to many chemical compounds symptoms (nausea, vomiting, weakness, headache);

— A period of severe intoxication, when along with common to many chemical changes manifest specific signs of poison effects on the body.

For subacute poisoning is characterized by less violent reaction than in acute poisoning and a longer course of the pathological process.

Chronic poisoning develop after prolonged entry into the body small doses of pesticides and accumulation in tropic organs.

Of great importance is the fact that is especially sensitive to pesticides differ children, adolescents, the sick and weakened persons.

Of particular danger they represent for pregnant women and nursing mothers. Many pesticides are getting into the body, cross the placental barrier and can have toxic effects on the fetus, putting embryotoxic and teratogenic effects. Getting to the mother's milk in the body of an infant, they can also cause his intoxication.

The results of monitoring in recent years show an increase in the total content of pesticides in products of plant and animal origin, including fish. This is especially true of products such as potatoes, onions, cabbage, tomatoes, cucumbers, carrots, beets, apples, grapes, wheat, barley, fish ponds, reservoirs, milk. They found the most wide range of pesticides.

Chemical elements are well distributed in nature and a variety of ways, especially from the soil may enter the agricultural raw materials from food and the human body.

Most of the chemical elements, including metals vital man, with some role in the organism already known for others it remains to be determined. It should be borne in mind that the macro-and micronutrients exhibit biological and physiological effects only in certain quantities. In large quantities, they already have a toxic effect on the body. Sources of food contamination by chemical elements are industrial waste, exhaust fumes of vehicles, the development of mineral resources. The list of the most important elements in regard to toxic chemicals included 8 mercury, cadmium, lead, copper, zinc, iron, strontium, arsenic.

Currently, there is no tendency to reduce the contamination of food by xenobiotic, including salts of heavy metals. This is due to man-made pollution of the environment, violation of existing rules and regulations in the manufacture of products.

Priority from the hygienic viewpoint of the metals are mercury, lead and cadmium, and arsenic (traditionally viewed in the complex).

These elements are in addition to the high toxicity of have the ability to accumulate in the body during prolonged admission, even in small doses and cause long-term effects — mutagenic and carcinogenic (for arsenic and lead). Other heavy metals can enter into the products during their manufacture.

Tin and chromium in canned foods in their packaging in a prefabricated tin and chrome container, and nickel products with hydrogenated fat (margarine, culinary and confectionery fats), iron and copper in the long-term stored fat foods Zinc in pectin.

Particularly high probability of salts of heavy metals entering the food raw materials obtained in the areas of geochemical anomalies with their high content of the soil in the areas of location of enterprises in the metallurgical, machine-building, chemical industry, as well as near major highways and industrial cities.

The degree of accumulation of xenobiotic in the agricultural products affected by a number of conditions. On the one hand, the level of soil contamination, and on the other — biological characteristics of plants. The main points of the selective toxicity of heavy metals and arsenic is the epithelium of the kid-

neys, liver and intestines, red blood cells and nerve cells, so nephropathy, toxic liver, severe neurological symptoms and hemolysis often prevail in the clinic of the poisoning.

Thus, when the lead toxicosis affects primarily organs of hematopoiesis (anemia), nervous system (encephalopathy and neuropathy), kidney (nephropathy).

In the early stages of chronic lead intoxication observed decrease in the body's adaptive capacity and resilience to the toxic effects of infectious and other disease agents. Later joined by general weakness, headache, dizziness, unpleasant taste in the mouth, loss of appetite, tremor of limbs, weight loss, constipation, abdominal pain, signs of anemia.

Cadmium, referring to highly poisonous substances for acute toxicity can cause nausea, vomiting, diarrhea, abdominal cramps, in severe cases — a shock. In chronic poisoning affects the bones (osteoporosis), kidneys, developing hypertension, anemia. The consequence of damage to the nervous system are tremors, dizziness, headache, dermatographism.

Chronic lesions are characterized by mercury lesion of the central and autonomic nervous system, liver and excretory organs: kidneys, intestines, accompanied by headache, fatigue, memory loss, anxiety, feeling, apathy, poor appetite, weight loss. In severe cases, reduced sensitivity of the skin on the legs, paresthesia appears around the lips, narrow field of vision disorder emotional sphere. Mercury has gonado- and embryotoxic, teratogenic and mutagenic effects.

Clinic poisoning occurs with other metals with similar manifestations. In contrast, in chronic arsenic poisoning clinical picture is very polymorphic. After these initial symptoms such as loss of appetite, nausea, vomiting, diarrhea phenomenon appears symmetric warty keratoses of the palms and soles, melasma in combination with areas of skin depigmentation, atrophy and brittle nails (diagnostic significance line Mayo — transverse white lines on nails) hair loss. Manifest neurological symptoms — intellectual and speech disorders, depression, polyneuritis ending paresis followed by atrophy of the muscles, the taste and smell.

A powerful source of contamination of the environment with arsenic emissions are power plants, industrial effluents, pesticides, arsenic. In the body it comes from animal products, including fish and seafood.

By anthropogenic xenobiotic include a group of polychlorinated biphenyls, which includes dioxin and furan. They get into the environment as a result of various industries related to the processing of waste, as a result of the combustion of fuels, production of a number of petrochemical, pulp and paper and iron and steel products, synthetic materials. A feature of these compounds is that virtually without collapsing in the environment, they are stored in different media, especially in the bottom sediment and water, and concentrated progressively along the food chain.

The main way they are received in the body — alimentary. Polychlorinated biphenyls are carcinogens. It noted sensitizing, hepatotoxic effect, as well as the

ability to cause secondary immunodeficiency. In individuals with chronic load of these substances marked increase in the incidence of cancer of various localization, endocrine diseases (diabetes) and cardiovascular system, the occurrence of genetic and reproductive disorders. These substances can accumulate and enter the body with almost any animal products, focusing more fatty foods and their components. From the wide range of products are the most dangerous in this respect, fish and seafood. However, these substances may be contained in a fairly dangerous concentrations in meat and dairy products, where their marked ability to accumulate in milk where their content can be 40–200 times higher than animal tissues. Acceptable daily intake of these substances for humans, according to WHO recommendations — 10 ng / kg.

The variety of landscapes and natural areas determines the characteristics of circulation and accumulation of atoms of various chemical elements in the soil. Accordingly, AP Vinogradov proved the doctrine of biogeochemical provinces — the uneven distribution of chemical elements on earth according to the geological features and soil-forming factors. As a result, in some areas the soil and the resulting agricultural products is low in certain micronutrients, in other their contrary more. Deficiency, excess or imbalance of trace elements content can lead to the development of specific diseases, known as geochemical endemias.

There are certain regularity in the distribution of iodine in the atmosphere, water and soil. His greatest number are concentrated in sea water, air and soil coastal regions. It also noted the highest content in plant foods — grains, vegetables, fruits and animal products — meat, milk, eggs. Many of iodine in marine fish, seaweed and other seafood.

Marked dependence of iodine in the environment of the content of organic matter in the soil, which is important for the appearance of geographic areas with low iodine content in the environment, including soil and consequently in foods.

Lack of iodine in the body leads to diseases such as goiter — a visible increase in the thyroid gland. Areas in which a significant portion of the population has clinical manifestations of this disease is considered endemic. Endemic goiter found in the mountainous regions (the Alps, the Altai, the Himalayas, the Carpathians, etc.), And in the plains (Western Ukraine, the upper reaches of the Volga, a number of Far East and Trans-Baikal regions, Polesie, and other). These areas include a large part of the territory of Belarus.

As a result of iodine deficiency in the diet of children formed syndrome characterized by impairments in the mental and physical development, up to cretinism and dwarfism. In adults, iodine deficiency is characterized by the development of endemic goiter, resulting in a decrease in thyroid function.

In areas contaminated with halogenated organic compounds can be created the same conditions as in the centers of endemic goiter and iodine deficiency. High concentrations of nitrates in drinking water are also an aggravating factor in the etiology of endemic goiter in the background even mild deficiency.

All of the above factors can both enhance iodine deficiency in the body at the deficit and reduce the result of its further introduction in the diet, that is, to influence the effectiveness of programs of iodine prophylaxis and treatment of complex iodine dependent diseases.

As a rule, carried out in this regard, government programs consist of components such as the exchange of information, improving the system of ensuring the production of iodized salt and foods containing an additional amount of iodine, the development of a monitoring system to assess the effectiveness of interventions. In the Republic of Belarus at the level of government has also adopted a number of documents aimed at the elimination of iodine deficiency among the population, including by providing the population with iodized salt.

On the part of European territory, including in Belarus, there is a shortage in the soil such as the element selenium. Residents experiencing endemic selenium deficiency in food, resulting in a population marked cardiomyopathy, Keshin disease.

With a high content of selenium in the soil can be observed among residents of selenium toxicosis. The most common manifestation of which is the loss of nails and hair loss, yellowness, peeling epidermis, dermatitis, damage to tooth enamel, anemia, nervous disorders.

In countries with a deficit of this element taken a number of measures for the prevention of related diseases. Used as a tableted form of selenium, and food fortification. The most effective is selenium enriched yeast, which eliminates losses in its environment. Selenium-enriched yeast also have chemopreventive activity against the cancer of human diseases.

An effective way to prevent selenium deficiency states is the development and inclusion in the diet of the population selenium-enriched food products of mass consumption.

A prerequisite for effective implementation of the elimination of revenue deficit necessary for the body elements of the programs is the organization of an effective health monitoring their implementation.

The human body is constantly in need of entering various food substances that can only come from food. Food products are complex multi-component system, consisting of hundreds of chemical compounds.

Modern man consumes daily about 800 grams of food and about 2000 g of water. The daily ration of the world's population (5 billion.) Is more than 4 million. Tons of food.

Food should fully meet the physiological needs for nutrients and energy. Physiological needs — it is a necessary set of nutritional factors in order to maintain the dynamic equilibrium between man how to form during the evolution of biological species and the environment, aimed at ensuring life and reproduction of the species, as well as to maintain the adaptive capacity of the body. To satisfy this need and aims to foods or food products.

The food or food - it's all the objects of the environment and their products, which are used for human nutrition as sources of energy and nutrients. This concept includes food raw materials and food products directly to plant and animal origin. Nutrients or nutrients that make up the food — are chemical compounds that the body uses to build, update and fix their organs and tissues, as well as for energy, providing compensation for all types of energy expenditure.

One of the types of food contamination is an infection of food as a result of anthropogenic pollution. In addition, the products may be contaminated with a variety of alien chemicals (xenobiotic) have adverse effects on the human body.

A similar effect is given a number of toxic substances originally present in the plant and animal raw materials, or appear in it in the recycling process.

This so-called antinutritive substances, which include bioindicators of proteinosis antivitamin, demineralized factors. Alien compounds getting into the body, as a result of his response are subject to metabolism and detoxification. Central to these processes are the processes of formation of the active metabolite intermediate starting compound and foreign its interaction with biomolecules target cells.

All variety of xenobiotic metabolism can be divided into 2 phases:

— The first phase comprises all processes xenobiotic transformations accompanied by oxidation, reduction, hydrolysis or cleaving chemical groups of the molecules;

— The second phase conjugation processes are xenobiotic their metabolites molecules with endogenous substrates.

The metabolic processes play a critical role enzyme systems. Overall orientation metabolic processes aimed at their conversion into water-soluble compounds, which facilitates their removal from the body.

Pesticides

This collective name of protective chemical means for plants against harmful microorganisms, plants and animals. Pesticides (Ps) are jointed in 450 chemicals. In RB is applied more than 130 Ps. Ps are capable to cumulate in the environment and to be transferred into parts of food net.

The ultimate effects caused by pesticides:

- Cancerogenic effect; gonado-toxic action (damage of gonad gland structures at both sex persons) as consequence occurs infringement of reproductive function; teratogenic and embryotoxic action.

Heavy metals

Environmental contamination by metals, as a rule, is great near to large industrial complexes especial near chemical industry. As example of such territory is the Novopolotsk industrial region. Large industrial complexes are concentrated on rather small territory on the basis of oil pipeline "Friendship". In the given region there is an intensive metals accumulation: nickel, cobalt, vanadium, manganese, titan, lead, copper, etc. Are found out local sites where concentration of metals in

soil 10 times more their average maintenance in the earth's crust. The microcells unbalanced maintenance in a landscape is capable to cause various diseases in people. So nickel promotes occurrence cancer; cobalt increases erythrocytes quantity, causes the inflammation of a nose mucous membrane; copper — a liver cirrhosis; the titan and zirconium act on system of the top respiratory ways and can reduce hemoglobin quantity; mercury — on central nervous system.

Consequences of soil pollution

1. Process of soil formation is inhibited.
2. Soil productivity is considerably reduced, consumer qualities of plants are reduced.
3. Self-purification of soil, i.e. ability to decompose pollutants till assimilable by living organisms and substances involved in circulation are weakened. In such soil pathogenic microorganisms survive longer.
4. Pollutants accumulation in plants and further pass into human organism with throphic chain. Accumulation in plants is determined by factors:
 - a) in the speed of transition into plant (depends on a kind of a plant, physical and chemical pollutant properties, its concentration in soil, physical and chemical structure of soil);
 - b) decay rate in a plant is usual 3–5 times more slowly, than pollutant decomposition in soil.

Belarus occupies the area of 207,6 thousand km², average population density is equal 49 man on 1 km² that is rather low parameter according to European standards. 67 % of the population approximately lives in cities. A climate of Republic is soft continental. Belarus has significant reserves of potash and stone salts, peat, cement raw material, forming and glass sand, refractory clay, oil, dolomite, granite, sandy-gravel mixes, building materials, mineral waters.

The Republic specialized on labour-intensive sectors, including mechanical engineering, the textile industry, woodworking, manufacture of meat-and-milk production. Besides Belarus became the significant manufacturer of mineral fertilizers, basic chemical and petrochemical production.

In Republic there was an adverse ecological and sanitary-and-hygienic situation. To its development have resulted the negative phenomena which have collected for decades in environment, established consumer approach in use of natural resources, departmental interests at accommodation of established production capacities, accident with Chernobyl atomic electricity station.

High concentration of industrial and production potential has resulted to that on a share 11 from 210 cities (Minsk, the regional centers, Bobruisk, Orsha, Pinsk, Baranovichi, Borisov) has 70 % of an industrial output, 65 % of industrial and production potential, 62 % of city population and 39 % of all population of Republic. Therefore in some cities and areas of Republic difficult specific complexes of environmental problems were generated:

1. Zone of accident with radioactive pollution of area.

2. Area of Soligorsk industrial center.
3. Cities with a high level of industry concentration polluting the environment.
4. Area of Polissya lowland.
5. Areas of lakes Naroch, Osveiskoe, Chervonoe and Braslavskie lakes.
6. The locations of large cattle-breeding complexes.

Maintenance of the safe environment right of citizens is defined by the Constitution of Belarus, by socially oriented legislation at environmental problems basis of which is the Law of Belarus "About protection of the natural environment" with the combination to a complex of already accepted and accepting acts in the field of environment preservation and principles of nature management.

Main principles of the Concept of public policy in the field of preservation of the environment are:

1) a state ownership on all kinds of the natural resources, a providing opportunity of their transfer on the basis of the corresponding legislation in constant or temporary use to separate juridical and physical persons. Exception is the soil as a special kind of natural and economic resources which can be in state ownership and a private property;

2) preservation of the environment, objects of the living and lifeless nature in all territory of Republic in a combination with creation of system of especially protected natural territories, i.e. territories completely or partly derived from economic use in the nature protection purposes;

3) legislatively provided system of the state control of environmental condition financed from the state budget, protection and use of natural resources, quality of food stuffs, safety of industrial and agricultural production for environment and health of the population with obligatory division on all parts of system control and nature management functions;

4) legislatively provided system of multistage state ecological examination of the projected, builded and maintained economic objects, confirmed with the economic and legal liability at default its requirements or ignoring carrying out;

5) bringing to business of environment preservation and the condition control over its of the population, public organizations and movements; support at the state level of public organizations engaged in problems of environment preservation, human health, protection of the living and lifeless nature;

6) the economic mechanism of maintenance of the environment preservation include:

— Payment of the nature management for using all kinds of natural resources, dumps and emissions of polluting substances to environment and accommodation of waste products and allowing as except for free-of-charge using citizens some kinds of wild-growing vegetative resources (gathering of mushrooms, berries, etc.);

— Lax credit and the taxation of nature protection activity, construction of nature protection objects, including lax credit from off-budget funds of nature protection;

— State level support of the enterprises and the organizations of all patterns of ownership engaged in problems of natural resources economy, energy-saving, processing and utilization of industry and consumption waste products;

7) system of measures of the criminal and administrative responsibility for infringement of the nature protection legislation under condition of obligatory compensation of the damage to urban population health, to property of physical or juridical persons at the expense of the breaker;

8) perfection of legislative base, system of compensation of losses guilty of environmental contamination at municipal and interstate levels;

9) participation in the decision of global environmental problems, including:

— preservation of a biological diversity;

— protection of an ozone layer;

— prevention of anthropogenous climate change;

— protection of woods and forest regenerating ;

— development and perfection of system of protected natural territories of a various rank and purposes;

— regulations of trade by rare and are in the verge of destruction kinds of animals and plants.

Practical work

1. Calculate xenobiotic load due to nitrate in foods (vegetable) most commonly consumed by human.

It is necessary to calculate the actual amount consumed per day plant foods (vegetables, fruits) and the average content of nitrate according to laboratory tests (Table).

Table — The results of evaluation on the actual load person nitrates derived from vegetables consumed

Name of vegetable crops	The level of the total load at nitrate consumption 1 kg of product, mg / kg	Actual daily per capita consumption of food population, kg / day	The actual load on the human nitrates	
			mg / day	rank place
Potatoes	140			
Tomatoes	29			
Bulb onions	48			
Beet	1390			
Cabbage	289			
Carrot	194			
Cucumbers	111			

2. Rate these results.
3. Define your own need for essential nutrients and energy in accordance with the instruction 2.3.7 10-15-55-2005 "Standards of physiologic of nutrients and energy for different groups of population of Belarus".
4. List of own diet products containing basic food substances and specify which xenobiotic and biological agents they may contain.

TEST CONTROL

1. Biotic factors of soil:

- a) air permeability;
- b) a moisture capacity;
- c) worms.

2. Soil pollution reduce:

- a) to moisture capacity augmentation;
- b) to calorific capacity augmentation;
- c) to atmosphere pollution.

3. In the composition of soil air is not included:

- a) a carbon dioxide;
- b) methane;
- c) nitric oxide.

4. Soils contaminant of the chemical nature:

- a) a dust;
- b) radionuclides;
- c) hydrocarbons.

5. Factor of impurity of soil:

- a) sanitary number;
- b) porosity;
- c) a moisture capacity.

6. Acid precipitation are a condensation of an aerosol:

- a) sulfurous acid;
- b) phosphoric acid;
- c) silicic acid.

CHAPTER 8: «MEDICAL ASPECTS OF INFLUENCE OF THE INTERNAL ENVIRONMENT OF PREMISES ON THE HEALTH STATE OF POPULATION. NON-IONIZING ELECTROMAGNETIC RADIATION. MEDICAL ASPECTS OF INFLUENCE OF THE INTERNAL ENVIRONMENT OF PREMISES ON THE HEALTH STATE OF POPULATION»

The employment purposes:

1. To consider ecological and medical consequences of pollution of the internal environment of the closed premises, having paid attention to ecologically dangerous pollutants appearing as a result of activity of the person.
2. To study the eco-hygienic characteristic of the internal environment of the closed premises for the purpose of an estimation of influence of a condition of the air environment on an organism of people.
3. To consider the basic preventive actions and measures of protection from influence of adverse factors of the internal environment of premises.

Employment tasks:

1. Value of dwelling and the hygienic characteristic.
2. The Characteristic of factors of the air environment of the closed premises influencing health of people:
 - Tobacco smoke
 - Formaldehyde, etc. toxic substances
 - Biological factors
 - Natural gas and products of its combustion
 - Electromagnetic fields
3. Sources of pollution of the air environment of residential buildings.
4. Occupational diseases.
5. «A syndrome of sick buildings», the development reasons, clinical displays, preventive maintenance.

Practical skills:

1. To spend ecological inspection of inhabited apartment (hostel) under the scheme. To give the hygienic characteristic to the basic external and internal sources of low-frequency electromagnetic fields.
2. To study subjective reaction of an organism to low-frequency electromagnetic fields and influence on the central nervous and cardiovascular systems in actual practice residing.
3. To offer a complex of recommendations about optimization of conditions of residing on the basis of results of research.

Teaching material

Residents of cities, about 70 % of their lives indoors, and therefore, the internal environment of the premises of residential and public buildings should be the subject of attention of doctors.

The chemical composition of the ambient air

Ensuring complete comfort in modern indoors can be achieved provided that a microclimatic and air comfort. In connection with the development and implementation in a variety of sectors of the economy and, in particular, in civil engineering and the life of the new chemicals air environment of modern residential and public buildings it has a multi-chemical composition. The buildings form a special air environment, which is based on the state of air power and domestic sources of pollution, which primarily include the destruction of finishing products, polymeric materials, human life, the incomplete combustion of gas and others.

Indoor air quality in chemical composition largely depends on the quality of the surrounding air. Based on the study of the concentration of one of the most common air pollutants - dioxide sulfurs (SO_2), experts say the presence of a certain parallelism in the internal and external concentrations of this substance.

Concentrations of CO_2 inside the room is approximately 35 % of its content in the air. This difference can be explained by the sorption of substances on building envelope, interior space decoration items (wool carpets, wallpaper, paper, some kinds of paints, etc.).

A comparative study of internal and external concentrations of carbon monoxide (CO), which can manifest itself not only as a result of pollution of the atmosphere by motor transport, but also due to the formation inside the buildings, like a clear pattern was observed. In some cases, they swept aside higher concentrations indoors, in other CO indoors with the windows closed was 77 % from the outer. The concentration of nitrogen dioxide indoor was approximately 60 % of its content in the ambient air.

An interesting study of mutual influence of the internal environment of residential and public buildings and the environment. Mass spectrometric analysis revealed that residential and public buildings are the source of environmental contamination by substances such as ammonia, oxides of nitrogen monoxide and dioxide, carbohydrate, hydrogen sulfide, propyl amine, mercaptan, phenol, toluene, methanol, cresol and OE All these substances are either human waste products, or the products of degradation of polymeric materials.

Gasifying building versus track were more powerful sources release toxic substances (nitrogen oxides, carbon monoxide, sulfur compounds, ammonia, amine compounds).

Administrative buildings due to lack of garbage, washing processes, cooking and other emit 2.5 times less pollutant than residential.

Research has established that the concentration of certain chemicals in the indoor air levels exceed maximum permissible concentration (MPC) for the air,

even in the absence of an internal source of pollution. Inside their living space air pollution phenol, formaldehyde, acetone, nitrogen dioxide is higher than the outside air. This is especially evident at the level of the 1st floor. The vertical distribution of atmospheric pollution is not the same. Concentrations of formaldehyde, nitrogen dioxide and acetone are rising with increasing altitude; most celebrated at the 3rd floor.

In closed unpopulated residential areas found higher concentrations of sulfur dioxide than in outdoor air. This is due to the ability of sulfur dioxide to absorb and accumulate on the surface of finishing construction materials (plaster, paint, wallpaper, floor coverings). The greatest amount of sulfur dioxide adsorbed on polymeric coatings (synthetic carpets, linoleum, paint). Thus, the building does not protect residents from pollution contained in the air, and the chemical load on the person on the premises in some cases exceeds that which he feels outside.

One of the internal sources of chemical contamination of air tracks are indoor human waste produced during metabolism — anthropotoxins. Of particular importance for the formation of indoor air composition are carbon monoxide and carbon dioxide, aliphatic hydrocarbons, ammonia, amines, ketones, phenol, acetone, hydrogen sulphide, alcohols, fatty acids.

It was found that the air environment is deteriorating unventilated space proportional to the number of persons and time of stay in the room. At the same time it found that the unvented dimethylamine hydrogen sulfide exceeds MPC for air. MPC exceed or are at their level, and substances such as carbon dioxide and monoxide, ammonia.

In combustion gas particularly high concentration of carbon monoxide. At the hour of operation double stove plates indicated the concentration of carbon monoxide of 10–12 mg / m³, oxides of nitrogen — 0.11 mg / m³.

During combustion air kitchens gas is significantly polluted by carbon monoxide, the temperature rises and the relative humidity of the air, there is a decrease in the subjects of oxyhemoglobin in the blood and oxygen depletion of the reserves of the body (according to the functional test with physical activity); there has been some deterioration in the functional state of the central nervous system.

The modern model of gasified apartments with the same conditions of air (100 m³/ h) during the combustion of gas concentration of carbon monoxide, nitrogen oxides and formaldehyde exceed the maximum permissible concentration of air not only in the kitchen but also in living rooms.

One of the most powerful sources of air pollution are indoor building and finishing materials made from polymers.

Application of polymeric materials is extensive. Currently, only construction and nomenclature of polymer materials includes about 100 names. Building polymeric materials used for flooring, walls, outdoor roof insulation, waterproofing, sealing and wall mounted panels, manufacturing of window and door frames, volume elements of prefabricated houses.

The breadth of applications of polymeric materials and their appropriateness for use in the construction of residential and public buildings by a number of positive characteristics that facilitate their use, improving the quality of construction, reduces the cost of it. However, the results of numerous studies show, it's almost all polymer materials are the source of migration into the air of certain toxic chemicals harmful to human health. Thus, for example, polyvinyl chloride materials (polyvinyl chloride — one of the most common types of polymers used in the finishing of modern residential and public buildings) are sources of air discharge in the medium of benzene, toluene, ethylbenzene, cyclohexane, xylene, butyl alcohol and other hydrocarbons.

Particle board on the basis of phenol-formaldehyde pollute the air environment of residential and public buildings phenol, formaldehyde, ammonia. Carpets of man-made fibers emit styrene, isophene, sulfur dioxide in significant concentrations.

Fiberglass based on different mixtures used in the construction, sound and thermal insulation, is isolated in the air following significant amount of acetone, methacrylic acid, toluene, butanol, formaldehyde, phenol, styrene. Paints and containing adhesive substances are also sources of pollution air indoor tracks with the following. Toluene, butyl methacrylate, ethyl acetate, xylene, styrene, acetone, butanol, ethylene glycol, etc. (a list of some toxic materials listed in Appendix 1).

The intensity of emission of volatile substances depends on the operating conditions of polymeric materials — temperature, humidity, ventilation rate, operation time, saturation material. The amount of harmful substances in the room air environment increases depending on the "saturation" of its polymer material.

A significant disadvantage of polymer materials is the ability to accumulate large static electricity charges related to their dielectric properties. Prolonged exposure to static electricity is harmful to health. The presence of charges on the surface of the floor and protecting designs degrades a performance overhead tracks and complicates cleaning. Recommended permissible level of the electric field strength of static electricity — 150 V / cm.

There is a lot of data on the impact of air pollution on human health. Currently observed high incidence of toxic mists, each of which is accompanied by an increase in morbidity and mortality. In areas where air pollution was a higher incidence of respiratory diseases, conjunctivitis, skin, allergies and other diseases.

Morbidity in cities significantly higher than in rural areas. Urbanization determine the nature and frequency of many diseases of the nervous system. Since living conditions in the cities are connected and especially the spread of individual diseases. The dependence of the growth of acute respiratory diseases and influenza on the frequency of intra contacts. Special danger acquiring TB infection.

Practice shows that the most important role in the planning system plays a transformation of national measures aimed at improving productive forces, containment growth of large cities, air protection, water bodies and soil pollution.

On the improvement of living conditions of the targeted planning, technical, sanitary and technical and organizational measures.

Of great importance is the laboratory monitoring of atmospheric air, introduced instruments and automation control of environmental pollution.

The practical implementation of the system of automatic control and collection of information on air pollution to more closely study the impact of environmental factors on human health.

The quality of the human environment is governed by SNIP, SanRaN and near the sanitary and hygienic standards for specific environmental factors.

Hygienic requirements to housing include the creation of:

- 1) enabling spatial parameters of apartments (area for 1 person, the height of the room, utility room, open space);
- 2) optimal microclimate;
- 3) adequate natural and artificial lighting;
- 4) favorable state of ambient air in the room (the quantity of air cube for 1 person in the air anthropotoxins and new and toxic substances, microorganisms, dust);
- 5) favorable conditions for work, rest and sleep of people;
- 6) optimal conditions for domestic economic purposes, child-rearing;
- 7) conditions for the aesthetic design of the interior living and conductive.

In assessing the quality of the living environment should take into account the sum of risk factors in each object urbanized environment. Our experience allows research to advance the following conceptual framework to ensure healthy living conditions in this type of residential areas (see. Table 8.1).

Table 8.1 — Conceptual framework ensuring full and environmentally friendly hygienic living environment

Block number	Target setting	The principles and criteria indicators
1	Ensuring full implementation of social and human biological functions	1. A state of complete physical, mental and social well-being for all population groups
		2. Secure the human gene pool for longer stays
		3. High efficiency recovery processes and the possibility of complete relaxation and recreation in the home "in nature", to ensure the maintenance of the body's adaptive capabilities h The person
2	Secure outdoor living and ibside house of environment	1. The absence of negative factors in the residential area and the conditions for a healthy lifestyle
		2. Compliance with the quality of the land plot hygiene requirements
		3. Noise levels, infrasound, vibration, electric magnetic field, the content of radionuclides and radon is not more acceptable levels of risk

Block number	Target setting	The principles and criteria indicators
3	Monitoring the living environment as an ecosystem	1. Identify "absolutely causal factors" the risk in residential environment: asbestos, radon, radioactive nuclides, 3,4-benzo (a) pyrene, mercury, fungal spores, food migration of chemicals from building materials
		2. Establishment of the relative conditions that increase morbidity and definition modifying factors affecting the conditions of discomfort
		3. Establishing a correlation between the quality of the living environment and health of the population, depending on the allergenic factors
		4. Determination of the effectiveness of health and wellness activities to optimize the residential environment in the homes of various types
4	Control methods, indicators and mechanisms for protection	1. The classification of the quality of the living environment on the basis of ecological and hygienic approach
		2. Methods of examination and certification of building materials and technological means sound control Adding quality living environment
		3. Ecological and hygienic passport for residential and public buildings and residential areas
		4. Regulatory and methodological foundations of ecological and hygienic living environment monitoring
		5. Regulatory and legal support in the form of modern ecological and sanitary and building documents (SRN, SanNaR, State Standard)

The main element of the dwelling is an apartment consisting of:

- 1) accommodations (bedrooms, living room, office);
- 2) utility (kitchen, bathroom, toilet, shower room, corridor);
- 3) open (loggias, balconies, verandas).

Bedrooms should be oriented to the south, should not be designed communicating room. Living room can be focused on passing and any EPIRB.

Kitchen should be focused on the northern rumba. The minimum size of the kitchen about 7 m². In the case of canteen kitchens as its dimensions must be increased to 12 m².

The size of the front should not be less than 4.5 m², a bathroom - not less than 2.5 m² to 12 m²). The minimum area of toilet 1,5 m². Area pantries can range from 1.5 to 6 m².

Hygienic assessment of apartments includes not only a set of premises, but their plan: the aeration conditions, ventilation, heating, natural light.

From the hygienic point of view, the most favorable double-sided layout. This ensures cross-ventilation.

In contrast to the apartments to family homes and hostels are meant for lonely living workers, students of higher and secondary special educational institutions.

Residential houses or residential premises in its technical condition, composition, space, location and equipment should create favorable conditions for the health of residents.

When placing and design of residential buildings should take into account the level of radon and the possibility of man-made radioactive contamination at the site of construction.

Architectural planning and design solutions of residential buildings and premises should meet the requirements of the current SNB 3.02.04-03 "Residential buildings".

Redesigning of the house or use it for other purposes permitted premises in the presence of decisions of local executive and administrative bodies for the withdrawal of these facilities from the residential use of premises and only by agreement with the bodies and institutions of sanitary supervision in the accordance with the requirements of sanitary rules and norms. In the design and construction of houses should provide for measures ensuring access and conditions Wheelchair residence.

When designing the reconstruction and repair residential buildings and premises, depending on the specific circumstances, it should be possible to provide landscaping, equipment of cold and hot water supply, economic-faecal and drainage, heating, electricity, garbage disposal, elevator and other necessary utilities.

Do not be accommodated in the homes of objects of industrial activity, trade, cultural work, sports facilities, consumer services, health facilities, which are the source of release into the air of premises and air high concentrations of harmful substances, create excess of permissible levels various types of radiation, noise and vibration, as well as have a negative impact on the climate and other indicators of quality indoor environment, living conditions of the population, contribute to the spread of infectious diseases.

Home hygiene standards for dormitories: bedroom area per person of not less than 6 m², the height of not less than 2.7 m.

Additionally, in dormitories, intended for more than 300 people, provides a dining room catering, laundry and medical center.

Dwelling houses and premises shall, as a rule, equipped with cold and hot water supply, sewerage, heating, ventilation with the natural impulse, electricity, gas. Natural ventilation of residential and ancillary facilities necessary to carry out through the vents, skylights, special flaps, ventilation ducts. Exhaust vents holes are arranged in the lavatory (bath, toilet) and kitchen.

Heating and ventilation system, the building design must ensure hygienic standards of air quality, noise levels and vibration, as well as the climate in the living areas (Table 8.2).

Table 8.2 — Optimum climate indicators in a residential area

Indicators microclimate	Period of the year	
	cold and transition from word	warm
Air temperature (°C)	20–22	21–25
Relative humidity (%)	30–45	30–60
Air speed	0.1–0.15	Not more than 0,25
The temperature difference between the air temperature indoor and walls (°C)	not more than 6	
The temperature difference between the air temperature indoor air and floor (°C)	2	

Possible parameters of microclimate in a residential area in the heating season:

Air temperature +18 °C.

Relative humidity 30–65 %.

Air velocity of 0.25 m/sec.

The temperature difference between the air temperature of rooms and walls not more than 6 °C;

The temperature difference between the air temperature and space the floor no more than 2 °C.

Design solutions dwellings should provide a comfortable indoor environment, a favorable climate and plenty of natural light.

The heating system should provide warm air evenly throughout the entire heating season, to be comfortable to use and regulation.

In residential areas use water heating, which ensures a uniform convection air heating at a temperature not higher than the radiator 70 °C.

Surface heating based on heat transfer by radiation. The heating device is a panel (wall), ceiling or floor space. The most favorable is the temperature of the wall panels of 40–45 °C, the ceiling of 28–30 °C, floor 25–27 °C Number of air should be 1–1.5 per hour. In modern homes made a combined ventilation system, in the kitchen and sanitary unit organized artificial exhaust ventilation in the living room — supply.

The concentration of harmful substances and impurities in the air of residential premises shall not exceed the maximum permissible concentration (MPC) of pollutants in the ambient air of populated areas.

Noise levels, infrasound, vibration, ionizing radiation and electromagnetic fields from internal and external sources in residential areas or in the surrounding area should not exceed the values set out in the sanitary rules and norms.

Natural lighting is determined by the orientation of the building, number of floors, the size of the windows, the presence of balconies, etc. Light illumination factor (KEO) — 0.5 %, a light factor for living rooms 1:8. The most hygienic value has insolation. Continuous insolation in the northern regions should be at least 3 hours in the summer in the central areas of not less than 2.5 hours.

Artificial lighting should match the purpose of the premises, be sufficient, controlled and safe, not to provide glare and other adverse effects on humans and the indoor environment.

Average illumination of living rooms in apartments and dormitories, under the joint action of all fixtures must be 75 lux, and in the kitchen apartments and dormitories — 100 lux, lavatories — 30 lux.

Commissioning of residential houses and premises, completed construction, reconstructed, renovated, in the number of individual utilities residential buildings (water supply, sewerage, heating, ventilation), without entering into the territorial bodies and institutions State sanitary supervision is not allowed.

Commissioning of the completed construction of residential houses and premises or a separate step input utilities are allowed after receiving positive results of instrumental and laboratory tests, including drinking water quality, physical factors (in the presence of their sources inside the building), and, if necessary, microclimate .

Laboratory and instrumental investigations before commissioning completed construction, reconstruction and capital repairs of apartment houses and premises, as well as in their current operation, provides businesses, organizations, institutions and individuals in charge of the housing.

Characteristic factors air pollution indoors, affecting people's health

The most powerful component of the indoor pollutant — tobacco smoke. The combustion process of tobacco occurs around 600 different chemical compounds, which may have carcinogenic, toxic, allergenic and others. Act. These include carbon monoxide, nitrosamines, aldehydes, nicotine, benzpyrene, acrolein, and others. Smoking is responsible for about 3 million. Deaths worldwide every year. During the combustion of tobacco with atmosphere polluted by two mechanisms — basic and indirect. The main way of getting products of combustion associated with tightening tobacco smoke. An indirect source of air pollution is associated with the process of smoldering cigarettes, which lasts 8–10 minutes. Tobacco smoke is dangerous not only to active smokers but also passive. Second-hand smoke is especially dangerous for children, because children are more sensitive to tobacco smoke.

Natural gas and combustion products,

Gas — a multi-component system, consisting of dozens of different compounds. Natural gas in the home — a source of many different pollutants. Among them odorants — gaseous hydrocarbons, organometallic poisonous and radioactive radon, which are directly present in the gas; Incomplete combustion products (carbon monoxide, nitrogen dioxide, organic aerosol particles, polycyclic aromatic hydrocarbons). All of them can act as their own, or in combination with each other, having a synergistic effect. Odorants — organic sulfur-containing aromatic compounds (mercaptans, thioethers, etc.). They have a toxic effect on the human body, it is irritating to the eyes and skin. The combustion

gas leads to the formation of aerosols which contain carcinogenic organic compound and some volatile organic compounds, to which relates formaldehyde. These components may have allergic effects on the body.

The biological factors, polluting the air environment of premises include house dust mites, which have allergenic effects.

At present, the increased energy saturation of premises, houses, offices, through the use of electrical appliances, which are sources of electric and magnetic fields. The whole set of electromagnetic fields called electrosmog.

Electromagnetic pollution — a condition in which the population is exposed to low-frequency (LF) and midrange (MF) of the electromagnetic field (EMF), exceeding allowable levels by sanitary norms.

External sources of EMF LF and MF — LF and MF sources of EMF, which are located in residential areas and have an adverse effect on the health of the population of the territory in case of exceeding the permissible levels of sanitary standards.

Internal sources of LF and MF EMF — Sources of LF and MF (certain types of consumer goods), EMF, located directly in the housing or adjacent rooms, which have an adverse effect on the health of their populations in the event of exceeding the allowable levels of sanitary standards.

Terms of exposure LF and MF EMF on the population:

- Continuous and intermittent.
- General and local.
- Combined from multiple sources.
- Together with other unfavorable factors of the living environment. As a result of prolonged exposure to low-frequency EMFs on the human body are:

— Irritability, impatience, restlessness, impaired attention, memory, sleep, fatigue.

- Strain of humoral immunity and imbalance immune mechanisms.
- Change in the bioelectric activity of the brain.
- Reduction of adaptive reserves of the psyche.
- Deterioration of the psychophysiological state of a person.
- Changes in autonomic functions.
- Reduction of fertilization function in men.
- Vascular changes of the retina.
- The possibility of developing leukemia.

Features MF EMF exposure on the body. As a result of prolonged exposure Woofer EMF on the human body are:

- Fatigue, impaired attention, memory, sleep, irritability.
- Asthenic syndrome.
- Asthenovegetative syndrome.
- Hypothalamic syndrome.
- Exacerbation of chronic diseases.

— Deepening the flow of common diseases (diseases of the blood, hypertension, and others.).

The most sensitive to LF and MF EMF systems of the human body:

— Nervous (change of the blood-brain barrier function, the effect of EMI on glial brain tissue in the membrane of neurons, memory, on conditional reflex activity).

— Immune (decrease in the phagocytic function of neutrophils, a change in the complementary activity of blood serum, the development of autoimmunity).

— Endocrine (changes in the hypothalamic-pituitary-adrenal system).

— Sex (degeneration pycnosis cellular elements of seminiferous epithelium, changes in the ratio of cellular forms, cytochemical changes, hormonal disorders).

The unit of electric field component of the LF and MF range is the value of voltage per unit length: volts divided by the meter (V / m) or, respectively, of kilovolts per meter (kV / m).

The unit of measurement of the magnetic field component of the low and mid range is the value of voltage per unit length, ie amps divided by the meter (A / m) and magnetic induction - microtesla (mT) respectively nanoteslas (nT).

Sources LF EMI

1. Outside:

— Transmission lines of different voltage — source of energy radiation (electromagnetic energy field of industrial frequency 50 Hz) in the surrounding area are the wires.

Field strengths below the line depends on the voltage level (electric field), the load (the magnetic field), the height of the suspension, the distance between the wires under cover vegetable relief line. Levels of industrial frequency electric field is achieved in buildings 1,2–182 / m depending on the distance, which is much lower than the permissible level (in residential areas — 1000 V / m in a residential area — 500 V / m) and It leads to a significant increase in electromagnetic load on the population. Magnetic induction is reached at 250–560 nT buildings, exceeding the recommended safe level — 200 nT (Sweden). People living near power lines, exposed to EMF for 24 hours a day, so that the magnetic field of the load, which levels exceed the recommended level of 1.2–2.3 times, significant.

Zone adverse effect on LEP population can range from 20 to 200 m or more on either side of the outer wires (mainly due to the magnetic component of the field);

— Transformers and power substations, power plants, outdoor switchgear, electrical — these sources in the territories of cities and towns significantly (250–1000 m) away from residential buildings and residential areas, where they form the electric field strength of 1.0–3.0 V / m and magnetic induction levels —

40–80 nT, well below the established standards for the electrical component of the field (500 and 1000 V / m) and the recommended levels for the magnetic component of the field (200 nT, Sweden). In this regard, they do not significantly affect the electromagnetic background of these areas.

2. Internal sources:

— Power cables, cable lines, power distribution centers in residential buildings — exposed to high levels of low-frequency EMF exposed persons residing in the rooms adjacent to the data sources. The maximum electric field strength 180–280 V / m (RC 500 V / m) and magnetic induction field 800–2600 nT are recorded directly against the wall, behind which is a source of low frequency EMF, with the largest contribution from the general power cable (2600 nT) power distribution unit (1600 nT) and wire line (800 nT). the voltage level of the electric field, registered in the apartments of the data sources do not exceed the permissible level of 500 V / m, while the safe level (0.2 mT, Sweden), the magnetic field component in the apartments from the power cables, cable lines and power distribution points It is achieved at a distance of 3.0–3.5 m from the source. As a result, people living in the rooms adjacent to the data sources are exposed to high levels of magnetic induction (above the recommended safe level in Sweden, 4–13 times) around the clock; electrical household appliances — depending on the duration of use for the day.

These sources are divided into 3 groups:

1) products designed for round the clock operation, — refrigerators, freezers, fans, air conditioners, etc.;

2) products designed for continuous operation (from 1 to 6 hours a day), — washing and sewing machines, air cleaners for kitchens, PCs, video and audio equipment, televisions, etc.;

3) articles intended for short-term use (less than 1 hour a day), — vacuum cleaners, microwave oven, mincing machines, mixers, grinders, irons, hair dryers, and others.

On the overall level of electromagnetic pollution in residential areas affected by the work of the contact (mixer, iron, hair dryer, electric shaver, electric, etc.) and not in contact with a man (refrigerator, washing machine, TV, microwave oven, radio, kettle, toaster, etc. .d.) electrical products.

Levels of the electric field at the surface of these products are from 160 V / m to 420 V / m, not exceeding the hygienic standard 500 V / m. Levels of the magnetic field induction in these same products reach 0,12–11,6 mT, indicating a safe level excess (0.2 mT, Sweden) manufacturing 2-58 times. Recommended safe level for humans of 0.2 mT is achieved at distances from 0.8 to 1.0 meters of product.

According to the levels of the magnetic fields are the most unfavorable microwave oven, electric stove, electric heater, freezer, vacuum cleaner, refrigerator, fluorescent light (1,8–11,6 mT).

Thus, electrical products are a significant source of low frequency EMF, adverse effect on human health.

The basis for the prevention of adverse effects of electromagnetic emissions LF and MF range of public health is to ensure compliance with the hygiene regulations of this factor in residential areas and in a residential area, which is achieved by three main activities:

— The fight against electromagnetic emissions LF and MF band at source (introduction of modern technologies in the production, transmission and distribution of electromagnetic radiation).

— The fight against electromagnetic emissions LF and MF band in the path of (the method of isolation of the source of EMF, EMF absorption method, ie, EMI shielding to the spread of absorbing materials and structures; removal from the source to match the levels of EMF hygienic standards).

— Organizational measures (protection time method — reducing time source impact on the population, and others.).

Practical work

1. Ecogenetic Conduct a survey of residential apartments (hostel) in the scheme. Post a hygienic characteristics of the main external and internal sources of low-frequency electromagnetic fields.

2. To study subjective body's response to low-frequency electromagnetic fields and the effect on the central nervous and cardiovascular systems in real conditions of stay.

3. Propose a set of recommendations for optimizing the living conditions on the basis of research results.

The method was developed at the Department of General Hygiene, Ecology and Radiation Medicine GomSMU.

Exercise 1

The survey results bring to the table 8.3:

Table 8.3 — Criteria for assessing the impact of EMF

Criteria for assessing the impact of EMF	Specification	Results Surveys	Score
1. Place the passage of electrical power cables	The walls are not adjacent to the living rooms		
2. Location of power points	Should settle in areas bordering with ancillary facilities adjacent apartments		
3. Placing the power cables, cable lines and distribution points supply	At a distance no less 3.5 on the external walls of residential premises		
4. Availability of the total ground loop	Three-pole rose weave "phase" of "zero" and earthed neutral		

Criteria for assessing the impact of EMF	Specification	Results Surveys	Score
5. Placement of holiday destinations and frequent finding people (bed, chair, chairs, tables, etc.)	Away from the EMF sources, not less than 1.5 to 2 m		
6. Working with the electrical appliances during the day (blender, hair dryer, coffee grinder, harvester)	It should be smart shat time of contact with electrical devices during operation		
7. Placing a refrigerator, electric cookers, microwave oven, heater, washing machine, kettle, etc.).	Minimum distance finding people must be at least 1.5 to 2.5 m		
8. The co-location of electrical appliances (refrigerator to the microwave oven, etc.)	Prohibited		
9. Distance from TV sets	At least 1, 5–2,5 m from any surface of the TV receiver		
10. Turn off the power supply of the instrument after operation	Do not leave plugged in to the P mode In "Standby"		
11. Location jobs	At a distance of 20 to 35 cm from the outlet, hidden in the wall of wiring and cables		
12. If you have a computer running time for the monitor	Not more than 45 minutes.		
13. Time use of cellular communication iduring the day	Not more than 0.5 hours during the day, continuous use no more than 3 minutes.		

If the figure is correct, put 0 points if you do not fit, then 1 point. Evaluation of the results:

*Weak — 1–4 points, average — 5–8 points, high impact — 9–13 points.

Task 2

Respond to questions proposed to assess the effect of EMF on the human body.

Common symptoms are:

18. Whether you celebrate impaired concentration?

19. There are Do you have headaches?

20. Do you feel total weakness , loss of strength ?

21. There Do you have a decrease in performance?

22. Do you feel nagging fatigue?

23. Did you ever have dizzy spells?

24. There you got bad, superficial sleep?

- 25. Notes if you reduced potency?
- 26. Do you feel any state of inner devastation?
- 27. There Do you have unstable body temperature?
- 28. Do you suffer from allergies?

The symptoms of the nervous system:

29. Whether you are celebrating the functional disorders of the central and autonomic nervous system (anxiety, increased agitation, etc.)?

30. Do neurasthenic symptoms characteristic (irritability, aggressiveness, etc.)?

- 31. Whether you are celebrating a tendency to sweating?
- 32. Whether you are celebrating slight trembling fingers?

The symptoms of the cardiovascular system:

- 33. Whether you celebrate cardiac arrhythmia?
- 34. Whether you celebrate blood pressure instability?

18. Are There you fainting?

19. Have you ever had discomfort, pain in the heart?

20. Are there any changes in the ECG?

For each positive response put 1 point for each negative answer 0 points. If you scored 7 points, there is little impact of EMF, 8–14—the average severity of the impact, 15–20 — impact.

Make the necessary conclusions and suggestions.

TEST CONTROL

1. Technological measures designed to protect the environment include:

- a) the organisation of sanitary-protective zones;
- b) development of maximum concentration limit of contaminants;
- c) creation of manufacture without waste.

2. Arrangements for the protection of the environment include:

- a) emissions organization of enterprises in different time;
- b) development of maximum concentration limit of contaminants;
- c) clearing of emissions of harmful substances.

3. The basic sources of electromagnetic radiations in a city are:

- a) lines of electromagnetic transfers;
- b) radio;
- c) the industrial enterprises.

4. Superfluous entering of biogenic amines in a human body can cause:

- a) rising of arterial pressure;
- b) augmentation of secretion of a gastric juice;
- c) depression of secretion of a gastric juice.

5. Superfluous entering of strontium in a human body causes:

- a) goitrogenic effect;
- b) nephrotoxic effect;
- c) mutagenic effect.

6. Superfluous entering of iron in a human body causes:

- a) a liver and spleen siderosis;
- b) immunity disturbance;
- c) a lesion of the central nervous system.

7. Superfluous entering of aluminium in a human body causes:

- a) osteogenesis retardation;
- b) intensifying of a motility of a gastroenteric tract;
- c) depression of mental ability.

8. Phases of detoxication of xenobiotics:

- a) chemical modifications;
- b) physical modifications;
- c) excretion.

CHAPTER 9: «MONITORING OF THE ENVIRONMENT AND HEALTH STATE OF POPULATION»

The employment purposes:

1. Mastering by students of theoretical knowledge on: to structure of monitoring of environment and a population state of health; to regulatory legal acts on protection of biosphere and population health.

2. Mastering by students of practical skills: to the decision of situational problems; self-checking on test questions.

Employment tasks:

- 1. Monitoring, concept definition.
- 2. Monitoring Problems.
- 3. The Importance of the data of monitoring for practical activities of the doctor.
- 4. Biosphere (global) monitoring.
- 5. The International monitoring.
- 6. Regional monitoring.
- 7. National monitoring.
- 8. Local (local) monitoring.

9. Sanitary-and-hygienic monitoring.
10. Essence of medical and ecological information system, (MEIS).
11. The Organic law of Belarus, Constitution of RB.
12. The Law «About sanitary-epidemic well-being of the population». Essence and monitoring appointment.
13. Position About the Ministry of natural resources and preservations of the environment on preservation of cleanliness of biosphere and population health.

Practical skills:

1. To Familiarize with the sample of the decision of a problem, the formula of calculation of factor of correlation, its importance.
2. Independently to solve a problem with calculation of factor of correlation.
3. To state an ecological and hygienic estimation to the received results.
4. To Offer actions for improvement of a state of health of the population.

Teaching material

Monitoring (from the Latin *monitor* — resembling, supervising, checking) the environment (biosphere) is a state system of systematic observations of the physical state of the chemical, biological environmental factors. The main purpose of these observations in environmental medicine — identification and prevention of critical anthropogenic impacts on various ecosystems levels (local, regional, global) regions, entire continents. Anthropogenic contamination of different spheres of ecosystems unfavorable and dangerous to human life, health, living organisms and communities. Monitoring the changes in the biosphere is necessary to predict the adverse effects of social and hygienic, demographic, bioproductive, climatic.

Doctor needs knowledge of laws of nature, limiting factors, groups of ecological and health risks of infectious diseases to support a set of preventive measures to preserve public health, taking into account the impact of environmental factors.

Monitoring — a complex system of observations, evaluation and forecast changes in the state of the environment under the influence of anthropogenic factors. This term appeared before the UN Stockholm Conference on the environment, in addition to the concept of "*control*".

Allocate following **levels of monitoring**:

• **Local monitoring** — the sizes of supervision zone do not exceed tens kilometers. If objects of supervision are local sources of the raised danger, for example territories near to the radiochemical enterprises, places of a burial place of a radioactive waste, chemical plants etc. speak about *impact* monitoring (impact — influence).

• **Regional monitoring** is carried out within separate large areas. The sizes of supervision zone — to thousand square kilometers.

• **Global monitoring** is carried out on the basis of the international cooperation, tracking universal processes and the phenomena in biosphere of the Earth,

including all their ecological components. Often this monitoring is named *background or base*.

On components of investigated biosphere it is possible to allocate private kinds of monitoring of various environments — **monitoring of atmosphere, hydrosphere, lithosphere** etc., under influence factors — **ingredient monitoring**, which the control over polluting substances and agents (including electromagnetic radiation), thermal pollution, noise, toxic substances, etc. concerns.

Monitoring of sources of pollution includes tracking various types of sources of pollution: *dot stationary* (the factory pipes, the concentrated dumps of the industrial enterprises, cattle-breeding farms etc.), *dot mobile* (transport), *linear or vulgar* (a drain from agricultural fields, loss of an atmospheric precipitation, dispersion of fertilizers and their washout, etc.).

Biological monitoring defines abiota condition, its reaction to anthropogenous influence, and also function of a condition and a deviation of this function from normal natural at various levels — molecular, cellular, organism, population, at community level.

Biological monitoring — supervision for biogeocenosis by means of bioindicators. **Bioindicators** — organisms or their communities, which vital signs are closely connected with certain factors of environment.

Bioindication methods are:

Passive monitoring — at freely living organisms visible or physiological and biochemical damages or deviations from the norm, being signs of stressful influence are investigated.

Active monitoring — at the test organisms which are in investigated territory in standardised conditions, as the same changes in freely living organisms, try to find out.

The need for systems that collect information, analyze it and warn of possible danger to humans or human society originally began to emerge in hydrometeorology.

Such natural disasters such as hurricanes, earthquakes, volcanic eruptions have brought enormous destruction and casualties. It is necessary to create and develop a system of monitoring and forecasting, allowing the public to prepare for the upcoming test. Initially started to develop a monitoring system to observe changes in the natural environment, ie environmental monitoring. For such monitoring tasks defined as a complex system of monitoring of any objects and phenomena of the natural environment and prevent their occurrence, changes created critical situations, harmful or dangerous to human health, organisms, natural and man-made objects.

Global monitoring system, which was developed by Munnom and approved by the Intergovernmental Meeting on the UNEP (UN Environment Pro-

gramme) Monitoring, held in Nairobi in 1974, a program of the Global Environment Monitoring System was adopted environment, including 7 areas:

— Organization and expansion of the warning of the threat to human health.

— Assessment of the global atmospheric pollution and its impact on the climate.

— Assessment of the quantity and distribution of contaminants in biological fluids, especially in the food chain.

— Assessment of the critical issues arising from agriculture and land use.

— Assessment of terrestrial ecosystems reaction to environmental influences.

— Ocean pollution assessment and pollution effects on marine organisms.

— The creation of an improved warning system for natural disasters globally.

The main objectives of monitoring are: monitoring the state of the biosphere, assessment and forecast of the state of the environment, identification of factors and sources of anthropogenic impacts on the environment, which ultimately forms the informational support for decision-making in conservation and environmental safety solutions. The main procedures include the monitoring system:

◆ selection of the observed object;

◆ examination of the selected object of observation;

◆ preparation of the information model for the object of observation of;

◆ measurement planning;

◆ assessment of the object of observation and identification of its information model;

◆ forecasting changes in the state of the object of observation of;

◆ provision of information in usable form and bring it to the consumer.

The main objectives of environmental monitoring are to provide environmental management system and environmental safety-date and reliable information to enable:

◆ assess the performance status and functional integrity of ecosystems and human environment;

◆ identify the causes of changes in these indicators and to assess the implications of such changes, and to determine the corrective measures in cases where the targets of environmental conditions are not achieved;

◆ create the conditions for determining the corrective measures arising from negative situations before they will suffer damage.

In accordance with the basic objectives of its environmental monitoring functions are:

◆ monitoring of sources of anthropogenic impact;

◆ monitor the impact of anthropogenic factors;

◆ monitoring the state of the environment and the processes occurring in it under the influence of anthropogenic impact factors;

- ◆ assessment of the actual state of the environment;
- ◆ forecast changes in the natural environment under the influence of factors of human impact and assessment of the projected state of the environment.

Performing these functions allows the executive bodies to obtain the information necessary to:

- ◆ planning of measures to reduce pollution, highlight priority areas of activity, monitoring and evaluation of the effectiveness of conservation measures;
- ◆ development of measures to reduce pollution in the areas where it has reached dangerous levels;
- ◆ verify compliance with the norms and standards of quality natural object;
- ◆ obtain data for research, in particular, examine the effects of environmental factors on human health and the environment, the introduction of relevant legislation.

Monitoring the status, changes in natural and man-made ecosystems requires a widely ramified network of observations of objects: the global biosphere; Regional geosystem; local bioecological; sanitation; socio-demographic.

Biosphere monitoring of the atmosphere, hydrosphere, lithosphere includes the global characteristics of the cycle of matter; heat; water; CO₂; O₂; SO₂; NO₂; other contaminants in the form of aerosols, mists, smog, dust, Aeron.

International monitoring requires tracking of planetary processes and phenomena, including the impact of anthropogenic climate change.

Regional — tracking of the processes and phenomena within the region.

National — State system of environmental monitoring within a defined territory of the nation-state.

Local — contamination does not spread over long distances.

Socio-hygienic monitoring — a state system of monitoring, analysis, evaluation and forecast of the state of health of the population and the human environment.

Monitoring of environmental pollution in the Republic of Belarus

The main objective of environmental monitoring — monitoring of her condition and sources of harmful effects on the environment to ensure that government agencies and other legal entities and citizens of complete and reliable information in this area. Achieving this goal will ensure the functioning of the National Environmental Monitoring System (NEMS), established in 1993,

Ensuring continuous operation of NEMS is one of the main directions of state policy in the field of environmental protection. The country developed legal and regulatory framework, including regulatory legal acts governing the operation of NEMS as a whole and the individual types of monitoring, included in its composition.

Organization NEMS structure takes into account the distribution of spheres of competence of the central government bodies responsible for organizing and monitoring for each of his mind. As a single coordinating authority is the Ministry of Natural Resources and Environmental Protection. Provided functioning in-

terdepartmental coordinating council, set up the main information-analytical center of NEMS and information centers monitoring species.

NEMS includes 11 organizational independence, but functioning and cooperating on common types of monitoring of the principles of the environment (see table) and is based on an ordered system of collection, processing, analysis and evaluation of the information received in the science-based network of more than 3,500 observation stations included in the State Register NEMS observation points.

Radiation monitoring of the environment organized in Belarus after the Chernobyl accident allows to regularly assess the radiation situation in the areas affected by radioactive contamination.

Monitoring of radioactive contamination of water bodies, soil, air, refinement of the radiation situation in the territory of Belarusian sector of the 30-km zone of Chernobyl, contamination control of settlements and facilities to assess the living conditions and production activities in the territories affected by radioactive contamination as a result of the Chernobyl disaster, held units of the Ministry of natural resources and Environmental protection of the Republic of Belarus. The leading organization is a public institution "National Center for Radiation Control and Environmental Monitoring" (RCRCCEM) Hydrometeorology Department.

Given the specificity of radioactive contamination of some regions, their landscape-geochemical features in the country organized a permanent environmental monitoring networks comprising 121 benchmark stations and 19 landscape-geochemical polygons.

In order to complete and integrated use of information about the state of the environment and the factors influencing it NEMS interacts with the system of social and hygienic monitoring, system monitoring and forecasting of emergency situations of natural and technogenic character.

Ministry of Natural Resources and Environmental Protection

RU "RCRCCEM" Hydrometeorology Department	Monitoring of air
	Surface water monitoring
	Radiation monitoring
RUE "Bel NIC" "Ecology" SSPA "SPC NASB for Bioresources" Ministry of Forestry Ministry of Agriculture Poleski Berezinsky Biosphere Reserve National Parks	Monitoring of wildlife
RUE "Bel Nigro" RUE "Belgeologiya"	Groundwater monitoring
RUE "Bel NIC" Ecology "	Local monitoring
The National Academy of Sciences of Belarus	
SI "Center of Geophysical Monitoring NASB" SSI "Institute for Nature NASB"	Geophysical monitoring

SSI "Institute of Experimental Botany of the National Academy of Sciences" BSU	Monitoring of flora
Ministry of education	
CNRS MO BSU SSI "Institute of Physics, National Academy of Sciences"	Monitoring the ozone layer
Ministry of Forestry	
LRUP "Belgosles" PIP "Belgiproles" GU "Bellesozaschita"	Forest monitoring
Gousdarstvenny Property Committee	
RUE "IPA" NASB BSU GU "RCRCEM" Hydrometeorology Department	Land monitoring

The National Environmental Monitoring System (NEMS). based on the network of the regime observations.

When conducting monitoring of the following tasks:

- a) formation of the state information fund;
- b) identification of the causal relationships between the state of health of the population and the impact of environmental factors on human-based system analysis and risk assessment for human health;
- c) ensuring inter-agency coordination for monitoring the conduct of activities in order to ensure sanitary and epidemiological welfare of the population, development of proposals for decisions by the executive authorities.

These observations are used in the monitoring framework:

- a) the state of health of the population and the factors of the human environment, including biological (viral, bacterial, parasitic), chemical, physical (noise, vibration, ultrasound, heat, ionizing, non-ionizing and other radiation), social (nutrition, water conditions life, work and leisure) and other factors (being bodies and institutions of sanitary-epidemiological service);
- b) for natural and climatic factors, sources of human impact on the environment, including air, surface and ground water, soil (managed by the Ministry of Agriculture, Ministry of Natural Resources and subordinate organizations);
- c) for the human factors of the social environment (conducted by the State Statistics Committee, other interested executive bodies and subordinate organizations);
- g) the state of safety and working conditions of workers (conducted by the Ministry of Labour and Social Development, the State Statistics Committee, Ministry of Economic Development and Commerce and their subordinate organizations in the nationwide monitoring of social and labor sphere);

Monitoring Conduct provides:

- a) establish the factors that have a detrimental effect on the person and their assessment;

- b) prediction of the state of public health and the human environment;
- c) determining the immediate and long-term measures to prevent and eliminate harmful effects of environmental factors on human health;
- d) preparing the decisions on the implementation of measures aimed at protecting public health and the human environment;
- d) informing government authorities, local government bodies, organizations irrespective of their organizational-legal form, as well as citizens of the results obtained during the monitoring.

The basic principles of the organization and management of the environment and health

But social-hygienic monitoring (SHM) is a system of special observations, assessment and prediction of the state of health of the population due to changes in its environment and aimed at identifying adverse effects on populations of environment factors and human living conditions, developing a set of health and preventive measures for the prevention and elimination of harmful effects these factors on human health.

The basis of the SHM is targeted survey areas, objects and people to determine:

- environmental factors that have the most negative impact on public health;
- objects to the greatest extent determine the presence of selected factors on the territory of the district (area).

The basis of the methodology of SHM are:

- Evaluation and grouping objects, contingents of the population and environmental factors on the level, trends, etc. their characteristics;
- Ranking environmental factors, facilities and population groups according to the level of characterizing their performance.

Health information (on medical-demographic criteria) and the territory of the state supervision of objects (for sanitary and epidemiological criteria) enters the territorial paradise (mountain) SHM by departments and agencies in accordance with existing legislative instruments.

The resulting information is used in two ways:

1. Evaluation of sanitary-hygienic and epidemiological status of objects and territories in the order of the state sanitary inspection.
2. Updating the database and analysis to meet the challenges of social and hygienic monitoring.

The first direction is realized on the basis of the current sanitary legislation.

The second area is implemented for the ongoing analysis of the state of health of the population and its habitat in the district (city) on the basis of a special observation system, data of objective observation of the sanitary condition of the territory and objects, as well as data from other services and departments. At the regional level, the information base SHM updated data on the health sta-

tus of the population by regional health agencies, medical and demographic data from the organs and institutions of the state statistics and aggregated data on the state of the habitat of other departments.

Specialists of the regional department of the SHM level on the basis of the database analysis draws conclusions, conclusions, forecasts and prepare recommendations and proposed activities of the project, which are issued in the form of a draft regional environmental health bulletin. It provides a description of the territory (territories), the dynamic comparative analysis of indicators characterizing the medical and ecological situation in the region.

After the peer review of the document management group of major public health specialists and sanitary — epidemiological service, is formed of a draft conclusion on the results of monitoring and proposes a set of measures aimed at improving the health and environmental situation in the territory.

Designed document tabled created under the auspices of the Regional Executive Committee of the Advisory Council on the regional level of the number of physicians, sociologists, statistics agencies, economists, psychologists, ecologists and others.

The law of Belaruse On sanitary-epidemic well-being of the population

Chapter 1. General provisions.

Article 1. The basic terms applied in the present Law

In the present Law following basic terms are applied:

— Sanitary-epidemic well-being of the population — a population state of health at which there is no adverse influence on a human body of factors of environment of its dwelling and favorable conditions for ability to live of people are created;

— An inhabitancy of the person — the part of environment including its natural components (atmospheric air, water, soil), and also potable water, the food and industrial goods, working conditions, a life (dwelling, vacation spots, vehicles), training and education;

— The factor of an inhabitancy of the person — any chemical, physical or biological component of the environment of the natural or anthropogenous origin, capable to influence a human body;

— Socially-hygienic monitoring — system of special supervision, an estimation and forecasting of a state of health of the population depending on a condition of an inhabitancy of the person and conditions of its ability to live, including working out of a complex of improvingly-preventive actions for prevention and elimination of adverse influence on a human body of factors of environment of its dwelling.

Main principles and methodical approaches are developed for Gomel and the Gomel area on realisation of socially-hygienic monitoring on the basis of

Medical-ecological information system, MEIS. It is carried out centralised, information gathering goes in bodies and the establishments which are carrying out sanitary-epidemic supervision.

THE CONCEPTUAL SCHEME OF SOCIALLY-HYGIENIC MONITORING OF REGIONAL LEVEL

Basis — the data of a medical-ecological profile, bulletins.

With it is computer — the software.



«Reaction on changes the medical-ecological status of territory» — in dynamics under separate factors, gathering and information storage



«By factors differentiation of action state sanitary supervision » —

Operative actions



«Differentiation orientations the treatment-and-prophylactic population maintenance» — treatment, improvement



«Connection social hygienic monitoring with an existing state complex of protection of the population from adverse factors of an environment» — the information analysis in a complex, a databank

MONITORING ELEMENTS

The ministry of natural resources and preservation of the environment of Byelorussia in the activity is guided by the Constitution (organic law RB), other laws and standard documents.

Extraction from the Constitution of Belarus:

— Article 45. To citizens of Belarus the right to health protection, including free treatment in public health services official bodies is guaranteed.

The state creates conditions of health services accessible to all citizens.

The right of citizens of Byelorussia to health protection is provided also with physical training and sports development, measures on environment improvement, using possibility improving establishments, labour safety perfection.

— Article 46. Everyone has the right to favorable environment and on compensation of the harm caused by infringement of this right.

The state carries out the control over rational use of natural resources with a view of protection and improvement of living conditions, and also protection and environment restoration.

— Article 55. Environment protection — a debt of everyone.

Extraction from position about the Ministry of natural resources and preservations of the environment of Byelorussia:

— The ministry in the activity is guided by the Constitution of Belarus, other certificates of the legislation of republic Belarus and the present position.

— The main tasks of Ministry for Protection of the Environment and Natural Resources are:

- the state control in the field of preservation of the environment, including behind observance of norms of ecological safety, atmospheric air and an ozone layer, behind a condition and environmental contamination, sources of its pollution;

— Ministry for Protection of the Environment and Natural Resources according to the problems assigned to it:

- when due hereunder will organise national system of monitoring of environment; conducts the state climatic cadastre; conditions of atmospheric air;

- will organise and provides functioning of monitoring systems behind a condition and environmental contamination, sources of its pollution, a condition and climate change;

- considers materials of the preliminary coordination of places of placing of the enterprises and other objects of granting of the ground areas for state and social needs;

- takes part in acceptance in operation of the enterprises, constructions and other objects which work can have harmful influence on environment;

- in established by the legislation of Belaruse an order gives out, stops or cancels permissions on: emissions of polluting substances in atmospheric air; import on territory of Byelorussia or its export for limits ozone destroy substances and (or) production containing ozone destroy substances.

— Ministry for Protection of the Environment and Natural Resources has following powers:

- To make demands about compensation of the harm caused to environment as a result of infringement of the legislation of republic Belarus about preservation of the environment and rational use of natural resources;

- to involve when due hereunder persons in a liability of infringement of the legislation of Belarus about preservation of the environment and rational use of natural resources;

- to forbid, limit or stop when due hereunder work of the enterprises, separate shops, sites and other objects if their operation is carried out with infringement of the legislation of Byelorussia about preservation of the environment and rational use of natural resources, and also to limit, stop or forbid the economic activities connected with references by a waste and representing potential danger to environment and health of citizens;

- to give out obligatory instructions for execution about elimination of infringements of the legislation of Belarus about preservation of the environment and rational use of natural resources, the reasons of their fulfilment and conditions promoting them.

Laboratory Work

The task 1. To define the degree of air cleanliness of a city by the method of definition of the sum of phenolic connections in oak leaves.

The task 2. To state the estimation to the received results.

The task 3. To offer actions on decreasing of environment protection.

The task 4. To issue the report of laboratory work.

The equipment: mortars with pestles; scales; glasses on 100 cm³; water bath; evaporation cups on 800–1000 cm³ or glasses of the same volume; burets; flasks on 50 cm³; solution indicarmine (1 g of indicarmine dissolved in 50 cm³ of the concentrated sulfuric acid and lead up water to 1 dm³); 0,1 N KMnO₄ solution; the cleared water; the processed vegetative material (leaves of an oak, a maple), collected in different ecological conditions.

Work course:

a. Test 1–3 g of dry processed or 4–10 g of fresh pounded in a mortar with beaten glass of a vegetative material are heated up in glass on 100 cm³ with 40 cm³ of water cleared during 15 minutes on boiling water bath at intensive hashing.

b. The extract is cooled, filtered and lead up to a label on 50 cm³ in flask.

c. The part of the received extract (7,5 cm³) is transferred to porcelain cup or glass in volume 250 cm³, 1 cm³ of indicarmine solution is added.

d. The mixer is titrated with 0,1 N KMnO₄ solution (3,16 g KMnO₄ in 1 dm³ water) at vigorous hashing.

e. The titration termination is established on occurrence of a golden-yellow shade.

f. Result of titration is multiplied on factor (416) for transfer of milliliters of 0,1 N KMnO₄ in milligrams of the phenolic connections containing in 10 ml of extract taken for titration.

The estimation of degree of air cleanliness is spent by comparison of results with the control (*the sum of phenolic connections is equal 9,4 mg/g in the leaves of an oak collected in Berezinsky biospheric reserve*).

Accumulation of phenolic connections in oak leaves in city conditions defines content level in atmosphere of polluting substances: ammonia, formaldehyde, nitrogen dioxide.

Model situational task

Condition:

1. As a result of carrying out of monitoring of air pool of the city it was revealed, that in 2007 concentration of nitrogen dioxide in a point which settles down nearby from the enterprise of the chemical industry, has made 0,5 mg/m³, in 2008 — 0,9 mg/m³, in 2009 — 1,2 mg/m³. In 2010 enterprise expansion is planned. To state the estimation and the forecast of condition of environment. To offer actions for decrease air pollution.

Solution:

At an estimation of supervision the moderate degree of pollution of atmospheric air is revealed (in 2007 the maintenance of nitrogen dioxide has exceeded the maximum concentration limits in 5 times, in 2008 — in 9 times, in 2009 — in 12 times). By forecast working out it is established, that the outlined tendency to increase of level of air pollution has appeared authentic, and the forecast for immediate prospects adverse.

Increase concentration of nitrogen dioxide in the air environment can induce an inflammation of pulmonary system and reduction of a vital sign of a lung, to increase risk asthmatoïd signs, to lower resistance to bacterial diseases of lungs, to influence development of allergic reactions to other components, to strengthen allergic response to collateral allergens.

Legislative actions: working out of maximum permissible concentration for chemical substances; the **technological**: working out and creation of the closed technological processes, **technologies** without waste; **planning**: zoning of territory of a city, its gardening; the **sanitary-engineering**: clearing of garbage on soil by means of clearing devices, effective clearing of the occupied places of garbage, their gathering, removal, neutralisation and recycling.

Task 5. Calculation and evaluation of integrated medical and demographic indicators of well-being.

Sample solutions of typical problems

A task

Calculate the integral index of health demographic of well-being in the city of S. by the following data:

The overall incidence was during the year 1050 to 1000 people, the total mortality rate of 10.5 per 1,000 population, the infant mortality rate — 21.3 per 1,000 births, disability — 8.1; the birth rate of 21.0 per 1,000.

Rate these results. Explain the methodology for calculating the integral index.

Stages of solutions:

1. An integral component of medical and demographic well-being is defined in terms of total mortality, infant mortality, birth, disability, and general morbidity, taking into account the indicative qualitative assessment of the level of these indicators:

Table — Indicative qualitative assessment of the level of health indicators

The quality of health indicators*	The overall incidence of		Overall mortality		Infant mortality		Disability		childbirth	
	show	mark	show	mark	show	mark	show	mark	P Normal display	mark
Low	<900	1	8	1	up to 15	1	until 6	1	to 10	5
Below the average	900–1000	2	8–10	2	15–19	2	6–7	2	10–19	4

The quality of health indicators*	The overall incidence of		Overall mortality		Infant mortality		Disability		childbirth	
	show	mark	show	mark	show	mark	show	mark	P Normal display	mark
Average	1000–1100	3	11–12	3	20–24	3	7–8	3	20–24	3
Higher than the average of its	1100–1200	4	13–15	4	25–29	4	8–9	4	25–34	2
Tall	> 1200	5	16 and>	5	30 and>	5	9 and>	5	35 and>	1

*— Marchenko BI. health at the population level: statistical research methods (manual for physicians). Taganrog. Publisher "Sphynx", 1997.

Further, all assigned to the indicators scores are summed, and the indicator turns medico-demographic well-being (the higher the score, the lower the well-being):

The level of health well-being	Estimated to Qualitative level of health indicators (score)
Low	21
Below the average	18
Average	15
Higher than the average of its	12
Tall	9

In this case, the general index of the incidence (per 1000 population in 1050) according to the table "Indicative qualitative assessment of the level of health status" corresponds to 3 points, the indicator of total mortality (10.5 per 1,000) — 3 points, infant mortality rate (21.3 to 1000 born children) — 3 points, disability (8.2 per 1,000) — 4 points, the birth rate (21.3 per 1,000) — 3 points. points amounted to 16, the level of health well-being of the population average.

A task

Give the comparative characteristic of the health of the region's population, R., using medical and demographic indicators for 2011–2012. (Per 1000 population).

Childbirth		Overall mortality		Infant mortality		The overall incidence of		Disability	
2009	2010	2009	2010	2009	2010	2009	2010	2009	2010
10.8	10.7	10.5	11.0	6.6	3.9	1753.5	1490.3	30.7	30.4

Task 2. The decision of situational problems on "Environmental Monitoring and state of health of the population."

Sample solutions of typical problems

To investigate the link between the concentration of pollutants in the air and morbidity of the population in the city of Moscow for 2008–2010, using correlation analysis on the following data:

Years	The concentration of the pollutant, (X)	Morbidity, (Y)
2008	3.0	28
2009	2.0	18
2010	5.0	48

Stages of solutions:

1. According to available data (the concentration of a pollutant in the air and Morbidity) to calculate a correlation coefficient r .

2. To evaluate the results obtained.

3. Propose measures to improve the health status of the population.

The formula for calculating the correlation coefficient (r):

where

x — the concentration of the pollutant;

y — disease of the population;

Σ — sum sign;

dx — the deviation from the mean value (M_x) concentration of the pollutant, $dx = x - M_x$;

dy — the deviation from the mean (M_y) morbidity, $dy = y - M_y$.

Next, a table of:

Years	Concentration of the pollutant, (x)	The incidence of, (y)	dx	dy	dx ²	dy ²	dx dy
2008	3.0	28	-0.33	-3.33	0.11	11.11	1.11
2009	2.0	18	-1.33	-13.33	1.78	177.78	17.78
2010	5.0	48	1.67	16.67	2.78	277.78	27.78
	$M_x = 3.3$	$M_y = 31.3$			$\Sigma 4,67$	$\Sigma 466,67$	$\Sigma 46,67$

Substituting the values in the formula we get:

Evaluation of the results:

connection direction:

1) if positive r_{xy} — correlation link straight (positive);

2) a negative value r_{xy} — correlation relationship inverse (negative).

The strength of the connection:

When correlation coefficient **0–0.3** connection between the phenomena of **poor** (almost absent);

0.31–0.7 — tightness of the relationship **average** (reasonable bond);

0.71–1.0 — bond **strong** (strongly expressed).

In this case, the correlation coefficient is turned one. Consequently, the level of morbidity of population is closely linked to the concentration of a pollutant in the air.

THE DECISION OF SITUATIONAL TASKS

2. In a city in 2007 excess of maximum concentration limit of formaldehyde in 2,1 times, in 2008 — in 2,4 times, in 2009 — in 2,9 times has been revealed. During 2007–2009 in a city the quantity of highways on which movement of cargo motor transport is authorised is increased. To state an estimation and the forecast of a condition of environment. To offer actions for decrease air pollution.

3. As a result of carrying out of monitoring of air pool of a city it was revealed, that in 2007 concentration of ammonia in a routeing point which settles down nearby from the enterprise for manufacture of nitric fertilizers, has made $2,4 \text{ mg/m}^3$, in 2008 — $2,9 \text{ mg/m}^3$, in 2009 — $3,2 \text{ mg/m}^3$. In 2010 opening of new industrial shops is planned. To state an estimation and the forecast of a condition of environment. To offer actions for decrease air pollution.

4. As a result of carrying out of monitoring of air pool of a city it was revealed, that in 2007 concentration dioxides sulfurs in the routeing point located in inhabited microdistrict near to energy station, has made $0,7 \text{ mg/m}^3$, in 2008 — $0,8 \text{ mg/m}^3$, in 2009 — $2,3 \text{ mg/m}^3$. The increase in capacity of thermal power station for the purpose of maintenance of an optimum temperature mode in heating systems is planned. To state an estimation and the forecast of a condition of environment. To offer actions for decrease air pollution.

5. The result of monitoring of air pool of a city in the routeing point located on distance of 150 m from the enterprise of the potash industry, has shown, that in 2007 concentration of ammonia has made $0,3 \text{ mg/m}^3$, in 2008 — $0,8 \text{ mg/m}^3$, in 2009 — $1,2 \text{ mg/m}^3$. In 2009 enterprise expansion was provided. To state an estimation and the forecast of a condition of environment. To offer actions for decrease air pollution.

6. As a result of carrying out of monitoring of sewage of the oil refining enterprise it was revealed, that in 2007 the maintenance in them of mineral oil exceeded maximum concentration limit in 2,4 times, in 2008 — in 2,9 times, in 2009 — in 3,8 times. The increase in capacity of the enterprise in 2010–2011 an estimation and the forecast of a condition of environment is planned to state. To offer actions for decrease hydrosphere pollution.

7. As a result of carrying out of monitoring of air pool of a city it was revealed, that in 2007 concentration of lead in the routeing point located in inhabited microdistrict on distance of 120 m from the enterprise of the chemical industry, there were $0,002 \text{ mg/m}^3$, in 2008 — $0,03 \text{ mg/m}^3$, in 2009 — $0,035 \text{ mg/m}^3$, emission of lead from operation by the enterprise of vehicles for 2007 has made 0,07 т, for 2008 — 0,076 т, for 2009 — 0,089 т. To state an estimation and the forecast of a condition of environment. To offer actions for decrease air pollution.

8. As a result of carrying out of monitoring of sewage of a laundry it was revealed, that in 2007 the maintenance in them of SAS has made $0,9 \text{ mg/m}^3$, in 2008 — $1,1 \text{ mg/m}^3$, in 2009 — $2,4 \text{ mg/m}^3$. The increase in capacity of a laundry

is planned. To state an estimation and the forecast of a condition of environment. To offer actions for decrease hydrosphere pollution.

9. As a result of monitoring of sewage of paint and varnish combine it was revealed, that in 2007 the maintenance in them of flying organic connections exceeded maximum concentration limit in 1,1 times, in 2008 — in 2,3 times, in 2009 — in 1,9 times. The increase in capacity of combine in 2009–2010 an estimation and the forecast of a condition of environment is planned to state. To offer actions for decrease hydrosphere pollution.

10. The result of monitoring of air pool of a city in the routeing point located on distance of 50 m from thermal power station, has shown, that in 2007 concentration of soot has made $0,9 \text{ mg/m}^3$, in 2008 — $0,95 \text{ mg/m}^3$, in 2009 — $1,15 \text{ mg/m}^3$. In 2009 the increase in capacity of thermal power station in 1,5 times is provided. To state an estimation and the forecast of a condition of environment. To offer actions for decrease air pollution.

11. As a result of carrying out of monitoring of air pool of a city it was revealed, that in 2007 concentration of carbonic oxide in a routeing point which settles down on distance of 10 m from a large highway, has made $4,2 \text{ mg/m}^3$, in 2008 — $4,5 \text{ mg/m}^3$, in 2009 — $6,3 \text{ mg/m}^3$. In 2009 the highway has been opened for movement of cargo motor transport. To state an estimation and the forecast of a condition of environment. To offer actions for decrease air pollution.

12. As a result of carrying out of monitoring of air pool of a city it was revealed, that in 2007 concentration oxide nitrogen in the routeing point which is nearby from the chemical enterprise, has made $0,3 \text{ mg/m}^3$, in 2008 — $0,7 \text{ mg/m}^3$, in 2009 — $2,2 \text{ mg/m}^3$. In 2010 introduction in action of new industrial shops is planned. To state an estimation and the forecast of a condition of environment. To offer actions for decrease air pollution.

13. As a result of carrying out of monitoring of air pool of a city it was revealed, that in 2007 concentration of a cement dust in the routeing point which is on distance of 100 m from the enterprise for manufacture of cement, has made $0,9 \text{ mg/m}^3$, in 2008 — $2,3 \text{ mg/m}^3$, in 2009 — $6,7 \text{ mg/m}^3$. In 2009 capacity of the enterprise has been increased in 2 times. To state an estimation and the forecast of a condition of environment. To offer actions for decrease air pollution.

14. As a result of carrying out of monitoring of soil of a city it was revealed, that in 2007 concentration of benzene in the routeing point which is on distance of 60 m from the chemical enterprise, has made $1,2 \text{ mg/kg}$, in 2008 — $1,7 \text{ mg/kg}$, in 2009 — $3,5 \text{ mg/kg}$. In 2010 the increase in capacity of the enterprise in 3 times is planned. To state an estimation and the forecast of a condition of environment. To offer actions for decrease air pollution.

TEST CONTROL

1. Environment monitoring is:

1) set of systems of supervision, estimations and the forecast of a condition of environments and the phenomena;

2) tracking universal processes and the phenomena in biosphere of the Earth;
3) biological responses to change of environment under the influence of natural and technogenic factors;

4) control over polluting substances and agents;
5) supervision behind sources of the raised danger.

2. Allocate following levels of monitoring:

1) ingredient;
2) local;
3) regional;
4) biological;
5) global.

3. On components of investigated biosphere it is possible to allocate monitoring:

1) atmosphere;
2) eczosphere;
3) endosphere;
4) hydrosphere;
5) lithosphere.

4. Under influence factors allocate following kinds of monitoring:

1) ingredient;
2) impact;
3) background;
4) volley;
5) local.

5. To ingredient monitoring control concerns:

1) climate change;
2) toxic substances;
3) electromagnetic radiation;
4) microorganisms;
5) noise.

6. On used methods monitoring is subdivided on:

1) land;
2) underland;
3) aviation;
4) space;
5) natur.

7. On methods of researches monitoring is subdivided on:

1) microbiological;
2) physiological;
3) chemical;
4) biological;
5) physical.

8. Local monitoring with reference to:

- 1) nature recreational resources;
- 2) separate objects which are subject to intensive anthropogenous influences more often;
- 3) natur improving resources;
- 4) most protected territories completely excluded from any economic activities;
- 5) territories where separate elements of a natural complex are protected.

9. Regional monitoring is a tracking for:

- 1) development of anthropogenous changes;
- 2) concentration of priority polluting substances of an anthropogenous origin;
- 3) processes and phenomena within considerable area on the area which differs from next on an environment;
- 4) recreational territories round cities;
- 5) condition of studied object prior to the beginning of anthropogenous influence.

10. Global monitoring is spent for the purpose of information reception about:

- 1) climate change;
- 2) background environmental contamination;
- 3) degree of influences of natural substances;
- 4) bioindicators;
- 5) condition of the ozone screen.

11. Land monitoring is carried out by means of definition methods:

- 1) physiological and biochemical damage or deviations from norm of live organisms;
- 2) biota reaction on anthropogenous influence;
- 3) sum of toxic substances in atmosphere;
- 4) limit degrees of radio emission;
- 5) physical or chemical parametres of a ground layer of air and soils, vegetation or waters.

12. Objects of biological monitoring are:

- 1) physiological and biological irritators;
- 2) bottom layer;
- 3) surfase waters;
- 4) industry and household drains;
- 5) radioactive radiations.

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(на английском языке)

Учебно-методическое пособие
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