THEME 15

MAN AND THE ENVIRONMENT

Motivational statement of theme

Man is an integral part of the environment. A person from the standpoint of ecology has a dual role. On the one hand, a person is a biological species and its relationship with the biological environment is determined by biological laws (stability, variability, adaptation, etc.). On the other hand, a person is a powerful acting factor. To meet their ever-increasing needs, man changes natural ecosystems and even destroys them, and builds artificial anthropogenic ecosystems. As a result of human activity, significant changes occur in the environment. Knowledge about anthropogenic impacts on the environment and the environmental consequences of these impacts are necessary for the competent solution of environmental protection problems.

Objective:: to form an idea of the quality of the environment as an ecological factor that has been formed as a result of human activity and can have a negative impact on biological organisms, including human health; to get acquainted with the methods of assessing anthropogenic impact on the environment.

Questions for discussion

1. Anthropogenic impacts on the atmosphere: the main sources of pollution, the main pollutants.

2. Anthropogenic impacts on the hydrosphere: the main types of water pollution; the main sources of pollution of surface and groundwater.

3. Ecological consequences of pollution of the hydrosphere.

4. The main types of anthropogenic impact on the soil.

5. Anthropogenic impacts on plant communities; ecological consequences of human impact on the plant world.

6. Anthropogenic impacts on the animal world; ecological consequences of human impact on the animal world.

7. The impact of the state of the environment on human health.

8. The main indicators for assessing the quality of the environment.

Independent work of a student in the classroom

1. Watching the documentary film "Garbage". Regulated discussion is a discussion of the elements of environmental behavior in a person's daily life that will reduce environmental pollution by production and consumption waste.
2. Practical work:
2.1. Determination of anthropogenic pollutants entering the environment as a result of the operation of vehicles.
Materials and equipment are needed to perform the work: watches, pens, a notebook, a calculator.
Task:
2.1. Determine the number of vehicles passing along the selected section of the highway (100 m.) for 30 or 60 minutes. Enter the data in table 1.

Table 1

Average number of registered cars

Type of vehicle	In just 30 minutes	In just 1 hour
Passenger cars		
Trucks		
The buses		
Diesel trucks		

2.2. Determine the amount of emissions of harmful substances coming from vehicles into the atmosphere by the calculation method (Appendix 1).

1.Calculate the total distance traveled by a set number of cars of each type in 1 hour (La, km) using the formula: La = Na x L, where
-Na is the number of cars of each type;
-L is the length of the section, km;
-a is the designation of the type of car.
Common path:
2.3. Calculate the amount of fuel of different types (Qa) burned by the engines of cars, according to the formula: Qa = Ya x La , where
Y- is the specific fuel consumption (l/km); L is the length of the section, km; a is the designation of the type of car (appendix 1)
Enter the result in table 2.

Table 2

Total amount of fuel burned

Vehicle type	Qa	
	Gasoline	Diesel fuel
Passenger cars		
trucks		

the buses		
diesel trucks		
Total (ΣQ)		

2.4. Calculate the volume of pollutants released in liters for each type of fuel (multiplying the corresponding values of ΣQ and empirical coefficients K), enter the results in table 3.

Table 3

Volume of pollutants released

Types of fuel	Amount of harmful substances, l		
Gasoline	Carbon Monoxide	Hydrocarbons	Nitrogen dioxide
Diesel fuel			
Total (V)			

Calculate the mass of released harmful substances (m, g) by the formula:

m = V x M / 22.4, where

M is the molecular weight (for CO – 28, for NO2 – 46, the average molecular weight for hydrocarbons - 43).

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2.5. Determine the average daily concentration of harmful substances (Ccc, mg / m3) in the atmospheric air of the area, compare the data obtained with the MPCC for each of the harmful substances and make a conclusion (Appendix 1).Fill in table 4.

Table 4.

Types of fuel	Average daily concentration of harmful substances (Ccc, mg/m3)	Maximum permissible concentration of harmful substances (MPCC, mg/m3)
Carbon monoxide		
Hydrocarbons		
Nitrogen dioxide		

At the end of the work, formulate a general conclusion and write it down in the protocol of independent work.

Appendix 1

Introduction

Internal combustion engines of cars are the main source of atmospheric pollution in cities and densely populated regions. In particular, on the scale of our country, the share of transport in total emissions of pollutants into the atmosphere from all sources reaches 45%, in greenhouse gas emissions - about 10%, in discharges of harmful substances with wastewater - about 3%.

The main harmful impurities contained in engine exhaust gases are: carbon monoxide, nitrogen oxides, various hydrocarbons, including carcinogenic 3,4-benz(a)pyrene, aldehydes, sulfur dioxide. Gasoline engines, in addition, emit products containing lead, chlorine, bromine, and sometimes phosphorus, and diesel engines - significant amounts of soot and soot particles of ultramicroscopic sizes. Each car with a gasoline engine that has traveled 15 thousand km consumes 4350 kg of oxygen and emits 530 kg of CO, 93 kg of hydrocarbons, 27 kg of nitrogen oxide. 75% of the lead contained in high-octane gasoline passes into the atmosphere, that is, each car annually emits up to 1 kg of lead into the air. In general, the exhaust gases of internal combustion engines contain more than 200 harmful substances and names.

The practical part :

On various sections of the highway (according to the teacher's instructions) with a length of about 100 m. determine the number of units of passing vehicles for 30 or 60 minutes. At the same time, take into account how many cars of a certain type (cars, trucks, buses, diesel trucks) drove through the selected section. In the event that the observation took 30 minutes, multiply the result by 2.

Calculate the average number of registered vehicles for each type of vehicle, depending on the number of selected sections of the route, (enter data in table 1 of the protocol).

The amount of emissions of harmful substances coming from vehicles into the atmosphere can be estimated by the calculation method. The initial data for calculating the amount of emissions are:

– the number of units of vehicles passing along a designated road section per unit of time;

– fuel consumption rates by motor transport.

The average fuel consumption rates when driving in urban conditions are shown in table 5.

Table 5

Average fuel consumption rates

Vehicle type	Average fuel consumption rates (liters per 100 km)	Specific fuel consumption Ya (l per 1 km)
Passenger cars	11-13	0.11-0.13
Trucks	29-33	0,29-0,33
Buses	41-44	0,41-0,44
Diesel trucks	31-34	0.31-0.34

The values of the empirical coefficients (K) determining the emission of pollutants from vehicles, depending on the type of fuel, are given in table 6.

Table 6

Values of empirical coefficients

Fuel types	Coefficient value (K)		
Gasoline	Carbon monoxide	Hydrocarbons	Nitrogen dioxide
Diesel fuel	0,6	0,1	0,4
	0,1	0,03	0,04

The coefficient K is numerically equal to the amount of harmful emissions of the corresponding component when the amount of fuel equal to the specific consumption (l/km) is burned in the car engine.

Processing of the results :

Calculate the total distance traveled by a set number of cars of each type in 1 hour (La, km) using the formula: La= Na x L, where
Na is the number of cars of each type; L is the length of the section, km; a is the designation of the type of car.
Calculate the amount of fuel of different types (Qa) burned at the same time by the engines of cars, according to the formula: Qa = Ya x La , where
Y is the specific fuel consumption (l/km); L is the length of the section, km; a is the designation of the type of car.
Determine the total amount of burned fuel of each type (enter the data in table 2 of the protocol).
Calculate the volume of pollutants released in liters for each type of fuel by multiplying the corresponding values of ΣQ and empirical coefficients K (enter the data in table 3 of the protocol).
Calculate the mass of released harmful substances (m, g) by the formula:
m = V x M / 22.4, where
M is the molecular weight (for CO – 28, for NO2 – 46, the average molecular weight for hydrocarbons - 43).

Determine the average daily concentration of harmful substances (Ccc, mg/ m3) in the atmospheric air of the area, taking into account that the volume of air used near a 100-meter-long road section is approximately 20,000 m3. It should also take into account the high intensity of traffic in the daytime.

REFERENCE MATERIAL

Environmental factors have different nature and specificity of action and are divided into abiotic (factors of inanimate nature); biotic and anthropogenic.

Types of impact of environmental factors on organisms

Environmental factors have different kinds of effects on living organisms. They can be:

- stimuli that contribute to the appearance of adaptive (adaptive) physiological and biochemical changes (hibernation, photoperiodism);
- limiters that change the geographical distribution of organisms due to the impossibility of existence in these conditions;
- modifiers that cause morphological and anatomical changes in organisms;
- signals indicating changes in other environmental factors.

Environmental pollution is the introduction of components or structural changes that are not peculiar to the ecological system, interrupting the circulation of substances, their assimilation, the flow of energy, as a result of which this system is destroyed or its productivity decreases.

A pollutant is any physical agent, chemical substance and biological species entering the environment or arising in it in quantities beyond their usual concentration, the limit of natural fluctuations of the average natural background at the time under consideration.

Chemical pollution is a change in the natural chemical properties of the medium, as a result of which the average annual amount of any substances increases or decreases over the period under consideration, or the penetration into the medium of substances normally absent in it or in concentrations exceeding the MPC;

light pollution is a violation of the natural illumination of the area as a result of exposure to artificial light sources, leading to anomalies in the life of plants and animals;

noise pollution – is formed as a result of an increase in intensity and noise above the natural level;

electromagnetic pollution – appears as a result of changes in the properties of the environment (from power lines, radio, television, the operation of some industrial installations, etc.), leading to global and local geophysical anomalies and in subtle biological structures;

radioactive pollution – is associated with an increase in the natural level of radioactive substances in the environment.

The direct objects of pollution (acceptors of pollutants) are the main components of the ecotone: atmosphere, water, soil.

Indirect objects of pollution are components of the biocenosis – plants, animals, microorganisms.

Atmospheric air pollution is any change in composition and properties that has a negative impact on human and animal health, the condition of plants and ecosystems.

The degree of atmospheric air pollution depends on:

1. The capacity of industrial production.
2. The quality of the fuel being burned (for example, burning gas in a boiler room will produce less pollution than burning coal).
3. Availability and perfection of treatment facilities that delay the release of chemical pollutants into the atmosphere.
4. The location of the residential area in relation to the industrial enterprise (on the windward side).
5. Climatic and weather conditions.

There are weather and climatic conditions that contribute to the concentration of atmospheric pollution:

1. *Calm* - weather characterized by absolute calm, that is, when the air velocity is zero. In such weather, all substances released into the air are collected in the same place, reaching high concentrations.
2. *Foggy weather*, in which toxic fog is formed.

Fog is a high content of water vapor in the air (high humidity), which is formed by sudden fluctuations in temperature. When the air temperature decreases, small water droplets form. These small droplets of water adsorb on their surface all substances in a suspended state, which in such a situation do not disperse in space, but concentrate in large quantities.

3. *Temperature inversion*. According to the laws of physics, when climbing to a height, the air temperature decreases by an average of 0.65- 1 ° C for every 100 meters. The resulting vertical temperature difference in the air leads to its constant mixing. The chemical pollutants contained below rise up in air streams, and in general the air becomes cleaner. There are weather conditions in which, when climbing to a height, there is no decrease in air temperature, and, therefore, there is no mixing of it. In humid, windless weather, this gradient can change, then the warm air remains at on the surface of the earth, vertical convection air flows are weakening. Toxic emissions from enterprises are concentrated in the surface air layer.
4. *Photochemical fog or smog* - a type of critical weather is observed in the spring-summer period of the year, in places of heavy automobile traffic. As a result of fuel combustion, toxic substances are released into the air. As a result of the action of ultraviolet radiation on them, new chemicals are formed in the air, which are called photo-oxidants (ozone, organic peroxides, aldehydes, nitrogen and sulfur oxides, numerous organic compounds of peroxide nature, ketones and other chemicals). Photochemical smog occurs as a result of photochemical reactions under certain conditions: the presence in the atmosphere of a high concentration of nitrogen

oxides, hydrocarbons and other pollutants, intense solar radiation and windlessness or very weak air exchange in the surface layer.
Photo–oxidants have an irritating effect: they irritate the mucous membrane of the upper respiratory tract and eyes (eye pain, cough, sometimes pulmonary edema.
5. *The greenhouse effect* is an increase in the temperature of the lower layers of the planet's atmosphere compared to the effective temperature, that is, the temperature of the planet's thermal radiation observed from space. The main greenhouse gas is carbon dioxide: its contribution to the greenhouse effect, according to various sources, ranges from 50 to 65%. Other greenhouse gases include methane (about 20%), nitrogen oxides (about 5%), ozone, freons (chlorofluorocarbons) and other gases (about 10-25% of the greenhouse effect). In total, about 30 greenhouse gases are known, their warming effect depends not only on the amount in the atmosphere, but also on the relative activity of the action per molecule.
6. *Acid rain* - all types of meteorological precipitation — rain, snow, hail, fog, rain with snow, in which there is a decrease in the pH of precipitation due to air pollution with acid oxides (usually sulfur oxides, nitrogen oxides)
Pollution of reservoirs is a decrease in their biospheric functions and ecological significance as a result of the entry of harmful substances into them.

The main types of pollution of reservoirs:

Chemical pollution is the most widespread, persistent and far–reaching. This type of pollution can be organic (phenols, pesticides) and inorganic (salts, acids, alkalis), toxic (arsenic, mercury compounds, lead, etc.) and non-toxic. The most common: oil and petroleum products, synthetic surfactants, pesticides, heavy metals, dioxins.
Physical:
- *radioactive substances* (dangerous even at very low concentrations, the most harmful are "long-lived" radioactive elements), heat, etc.
-*thermal pollution* - an increase in water temperature as a result of mixing with more heated or technological waters. With an increase in temperature, the gas and chemical composition of the waters changes, which leads to the proliferation of anaerobic bacteria, an increase in the number of hydrobionts and the release of toxic gases (hydrogen sulfide, mtana), at the same time there is a "flowering" of water, accelerated development of microflora and microfauna.
Biological pollution is the introduction into ecosystems as a result of anthropogenic impact of uncharacteristic species of living organisms (bacteria, viruses) that worsen the conditions of existence of natural biological communities or negatively affect human health.
Mechanical contamination is the result of various mechanical impurities (sand, sludge, silt, etc.) entering the water. Mechanical impurities significantly impair the organoleptic properties of water.
The main types of anthropogenic impact on soils:
- *erosion*
- pollution

-secondary salinization and waterlogging,
- desertification
-alienation of land for industrial and municipal construction

The quality of the environment is the degree to which its characteristics meet the needs of people and technological requirements.

The principle of environmental quality regulation is the establishment of standards (indicators) of the maximum permissible human impacts on the environment.

The MPC of a chemical compound in the external environment is such a concentration, when exposed to the human body periodically or throughout life, directly or indirectly through ecological systems, as well as through possible environmental damage, there are no somatic or mental diseases or health changes that go beyond the adaptive physiological reactions detected by modern methods immediately or in the long term the life span of the present and subsequent generations (I.V. Sanotsky)

Maximum-one-time maximum permissible concentration (MPC M.R.)- such a concentration of a harmful substance in the air that should not cause reflex reactions in the human body when inhaling it for 30 minutes (a sense of smell, a change in the light sensitivity of the eyes, etc.)

The average daily maximum permissible concentration (MPC ss) is such a concentration of a harmful substance in the air that should not have a direct or indirect harmful effect on a person impacts with indefinitely long (years) exposure.

The maximum permissible concentration of a harmful substance in the soil (MPC, mg/kg) is the maximum concentration that cannot cause a direct or indirect impact on the environment, disrupt the self–cleaning ability of the soil and have a negative impact on human health.

The maximum permissible concentration of a harmful substance for the aquatic environment (MPC, mg/l) is such a concentration of substances in water above which it becomes unsuitable for one or more types of use.

MPCs of pollutants are set separately for drinking water and fishery reservoirs.

The maximum permissible level of radiation exposure to the environment is a level that does not pose a danger to human health, the condition of animals, plants, and their genetic fund.

The *maximum permissible levels of noise, vibration, magnetic fields* and other harmful physical effects have also been established.

The maximum permissible emission (MPV) or maximum permissible reset (PDS) is the maximum amount of pollutants that a given enterprise is allowed to emit into the atmosphere or dump into a reservoir per unit of time, without causing them to exceed the maximum permissible concentrations of pollutants or adverse environmental changes.